Coast Bordeaux 2017

Complex response of aquaculture to Climate Change:
the case study of oyster farming in Arcachon bay

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GLOBAL CHANGE

Climate Change

Anthropogenic pressures

- The durability of an economical activity (such as oyster farming) depends on its ability to adapt to Climate Change
- Only if we understand all its subtle impacts on the provided Good (e.g. oyster) and its synergy with anthropogenic pressures

Oyster-farming in Arcachon Bay: the 'spat' crisis

- **Magallana gigas**, the Japanese oyster **introduced for farming** in 1970
- Oyster- farming is facing several 'crisis' ..due to its vulnerability to environment
- Arcachon bay: a **threaten spat producer** while oyster reproduction is better and better in others farming bays with Global Warming

Mondial oyster production
4th rank

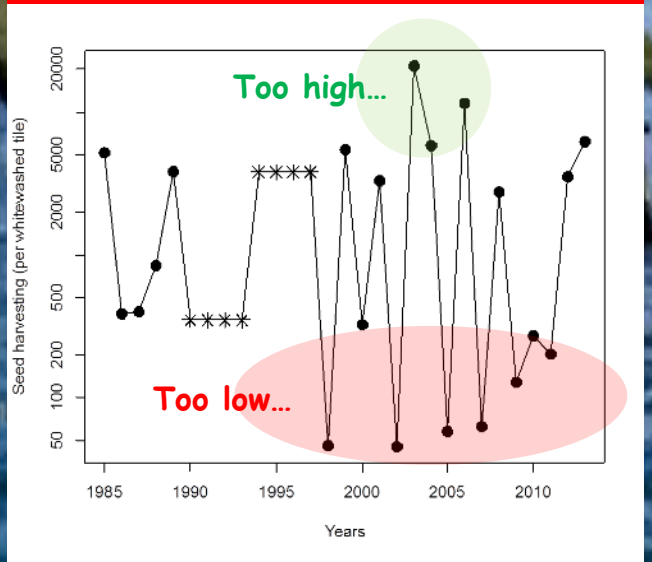
1st aquaculture activity
98% *C. gigas*

4th national producer
1st european spat producer

Wild oyster reefs

'Spat' collection

High fluctuations of spat harvest…



MAIN & TOOLS

- Understand the causes of these spat anomalies in Arcachon Bay using…
- all available data

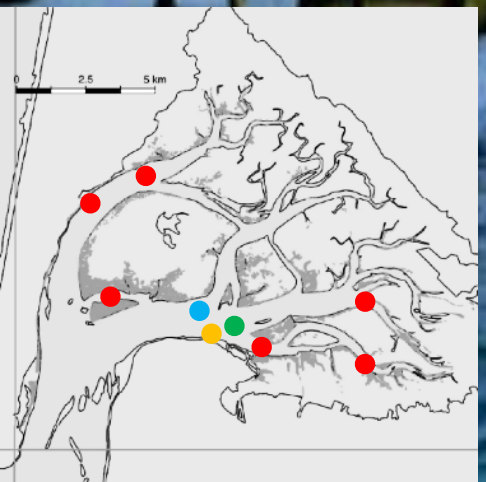
… several surveys since 1987

…Spatial assessment of fecundity (2013), seasonal survey on 2 stations (2014)

- several tools:

… Data analysis: Long-term series and multivariate analysis, DEB models, non linear regressions…

…Environmental / food pressure: health indices, stable isotopes and fatty acids biomarkers



Ifremer

National surveys

- Hydrology (**ARCHYD**)
- Daily water temperature
- Phytoplankton (**REPHY**)
- Larval sampling (**VELYGER**)

'Velyger' survey

✓ Annual laying dates

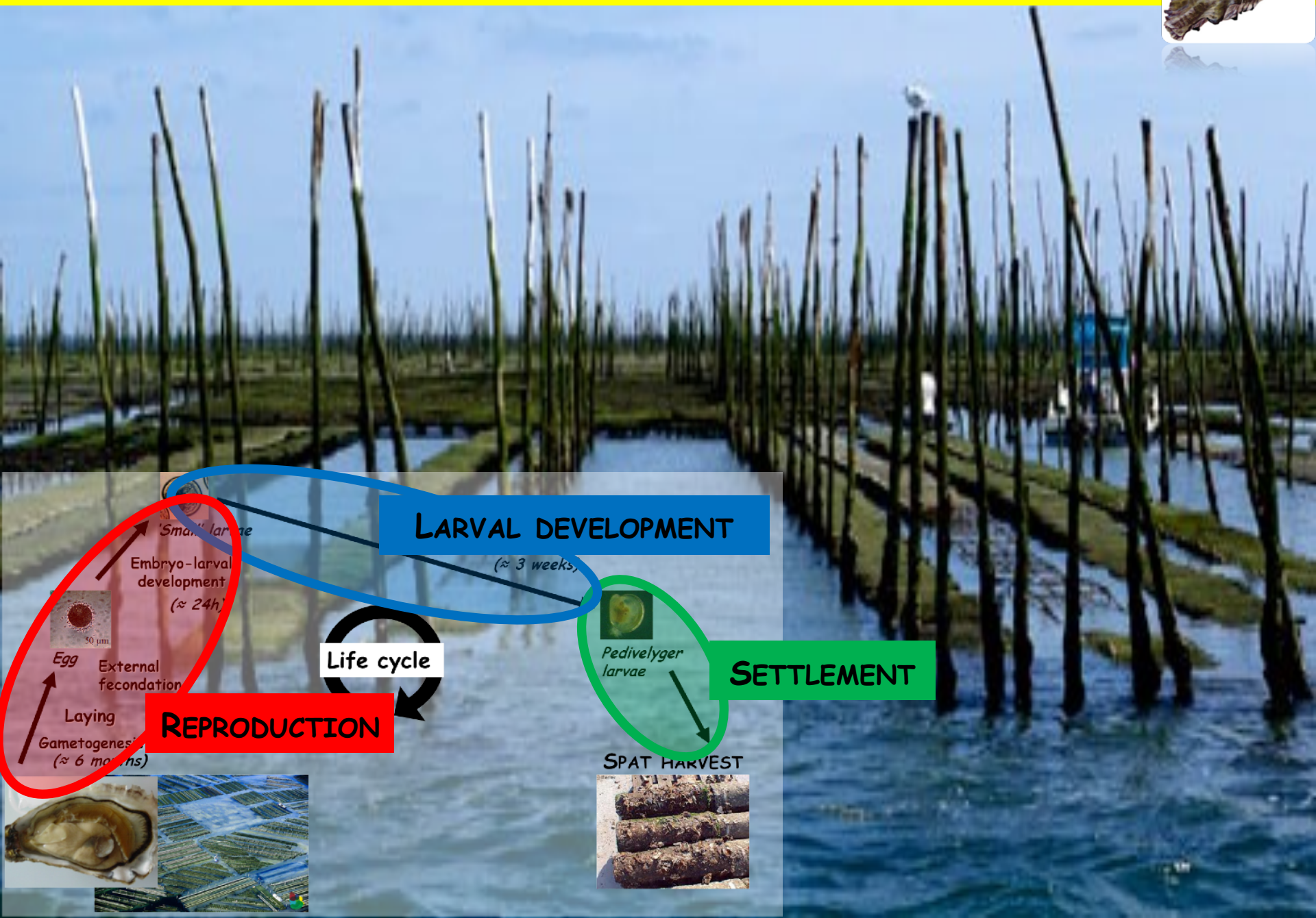
✓ Average abundances of small larvae / year and station

-Twice a week during summer

- Small larvae abundances

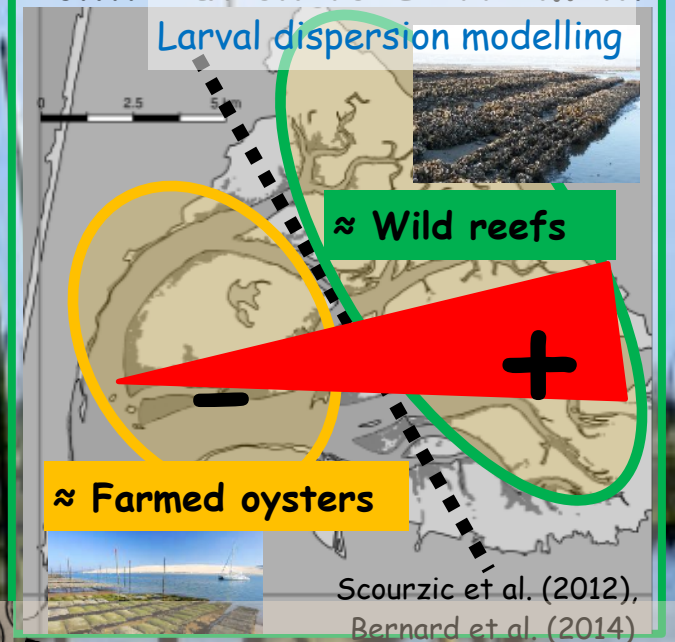
-Cohort analysis

Which phase(s) of the life cycle are impacted?



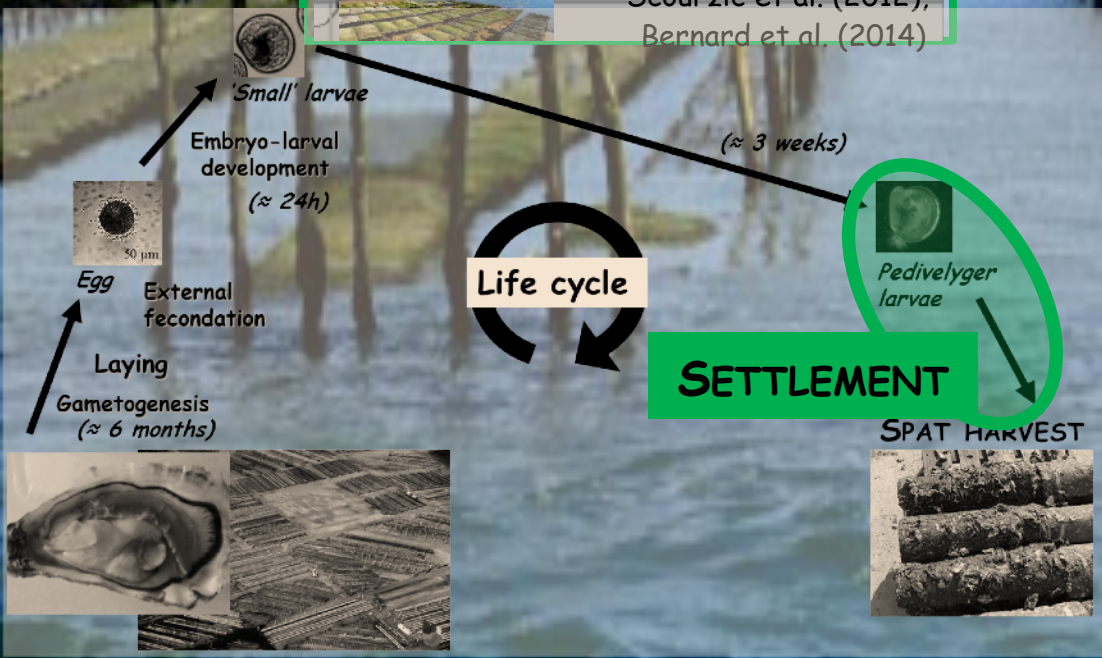
What about SETTLEMENT?

Contribution to Settlement



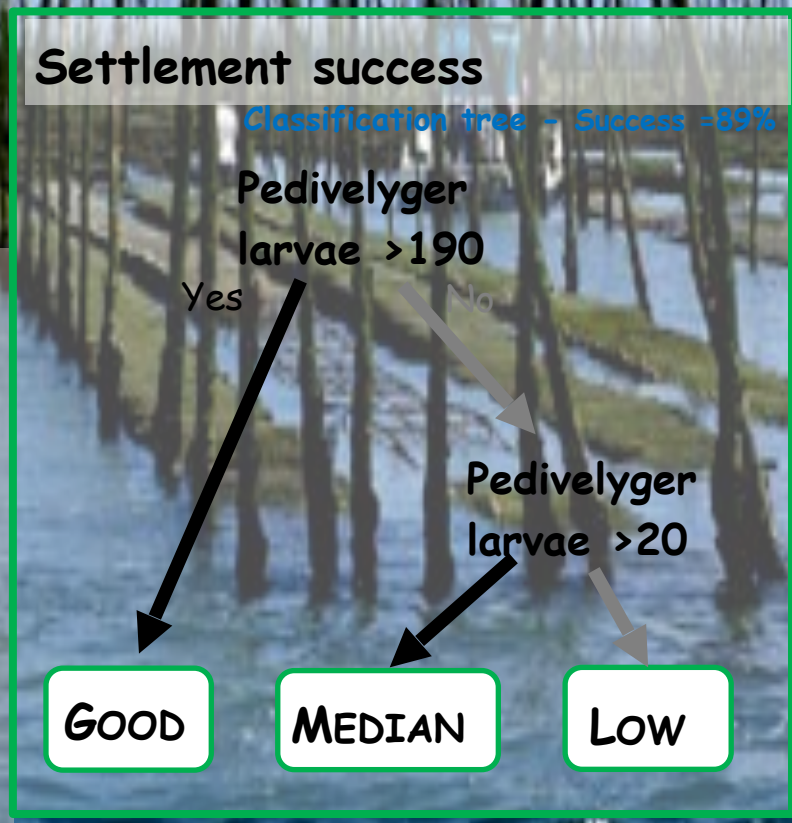
Scourzic et al. (2012), Bernard et al. (2014)

- Settlement depends on the **availability of large larvae**
- **Settlement is mainly guaranteed by the inner oyster stock,** ie Wild oysters,



Settlement success

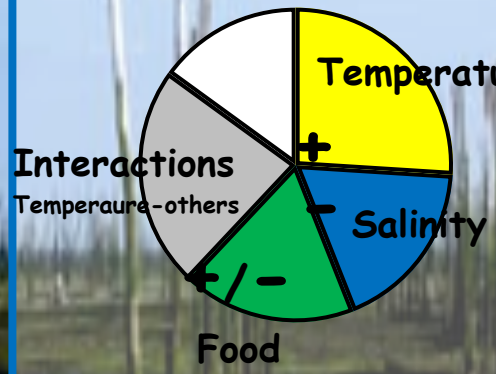
Classification tree - Success =89%



What about LARVAL DEVELOPMENT?

Factors contributing to larval survival

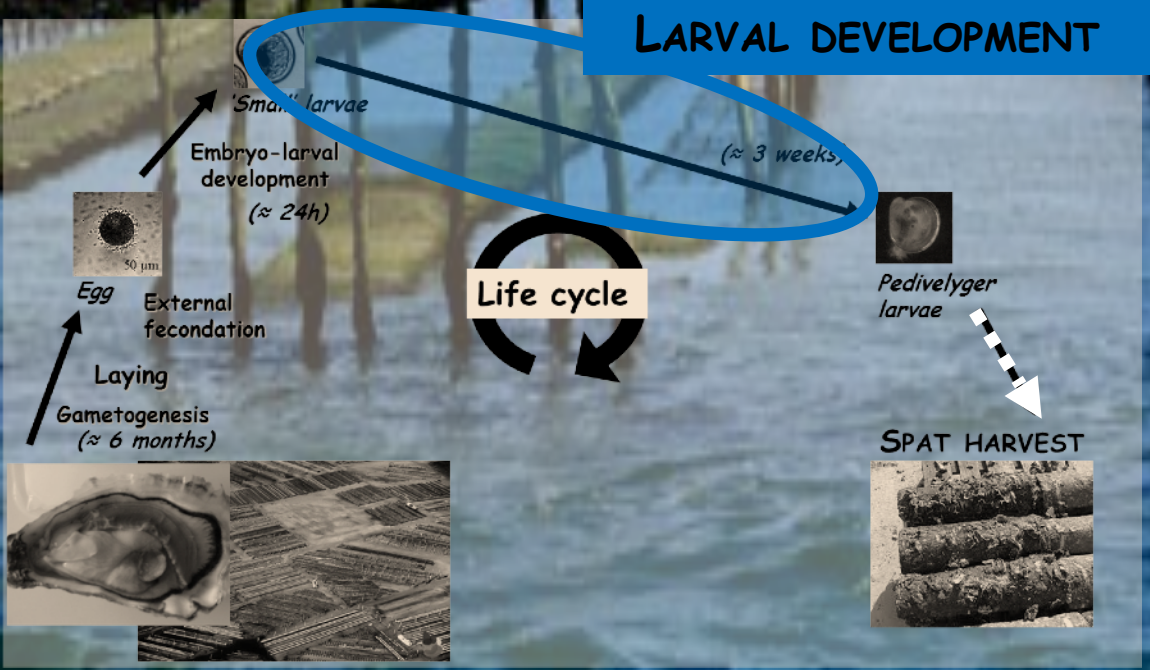
Multiple linear regression - Variance partitioning



R2 =0,85 (***)

Log (Survival)= 0,92 Temperature -0,81 Salinity -0,24 log(Aglacialis) +0,48log(Chaetoceros)

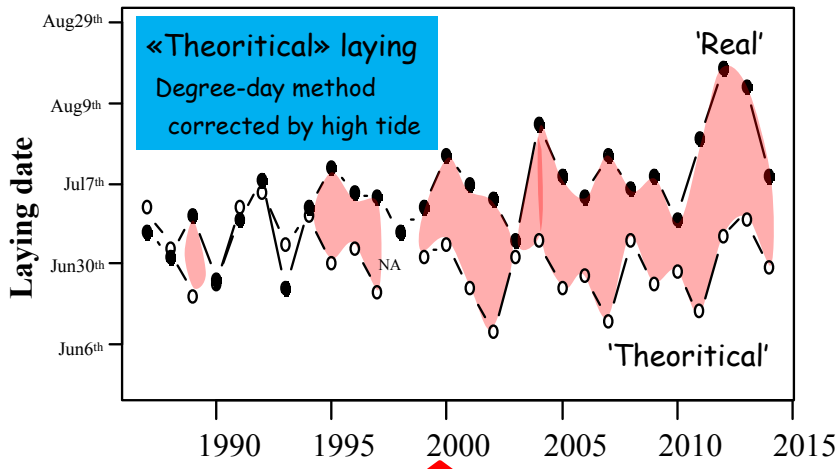
LARVAL DEVELOPMENT



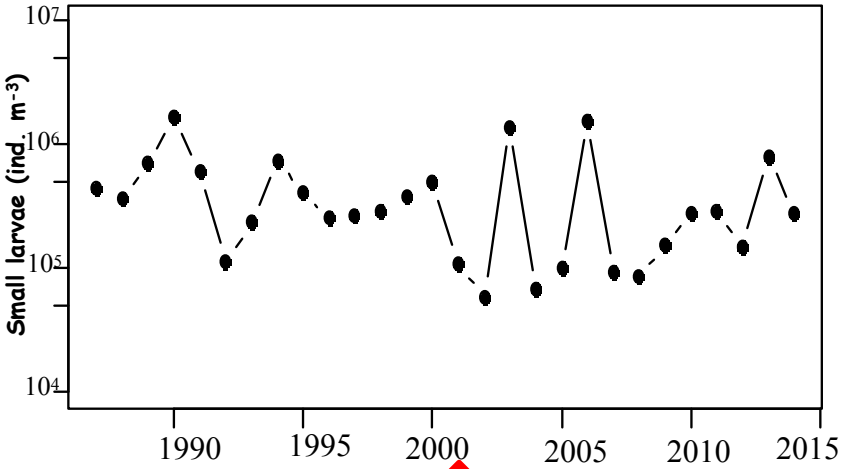
- Larval survival is mainly controlled by **temperature**
- **Salinity and food quality** may affect it negatively

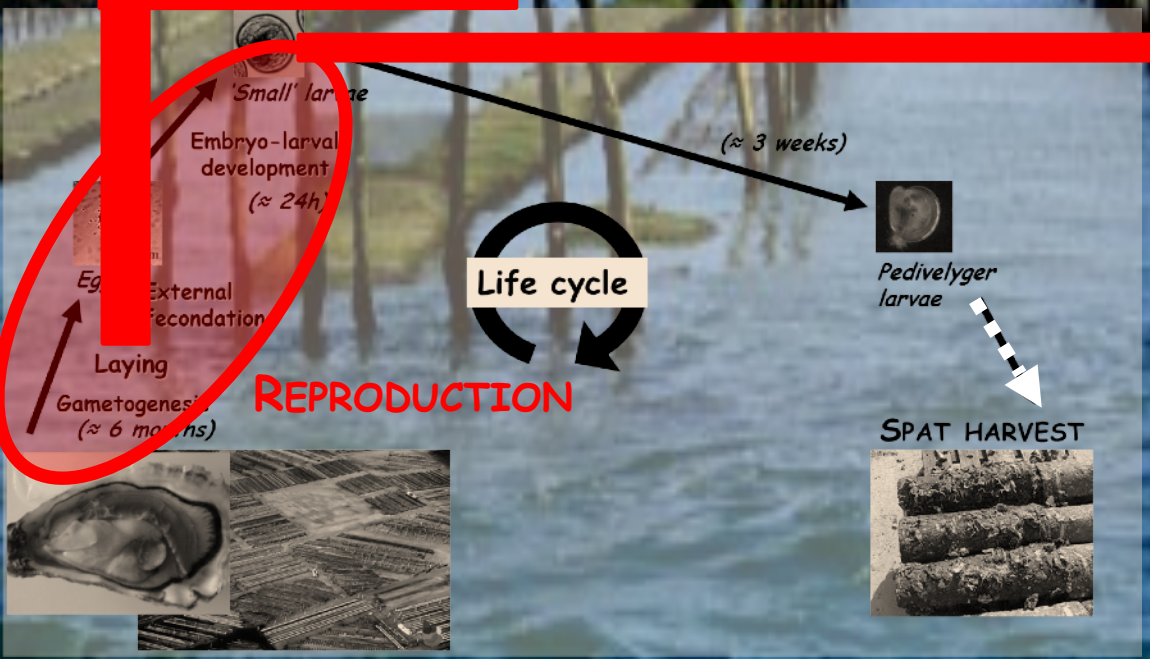
What about GENITOR REPRODUCTION?

Laying date and delay



Laying effort





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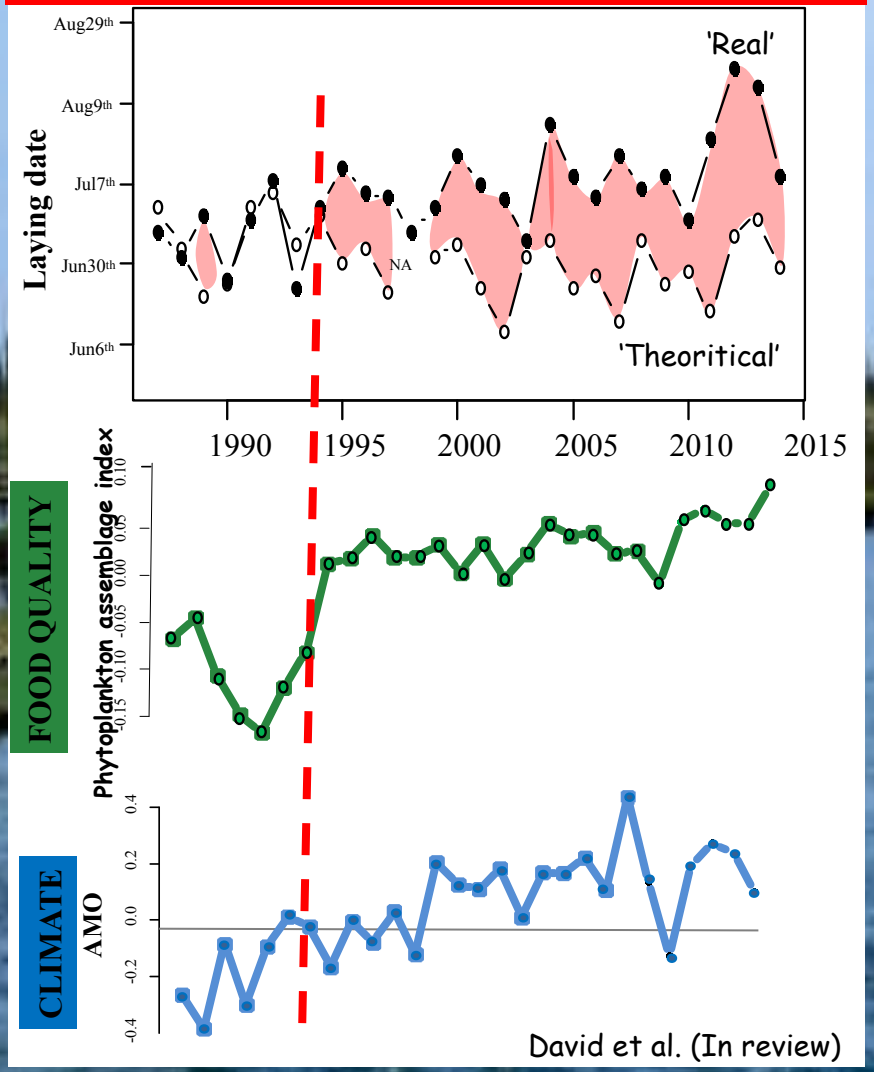
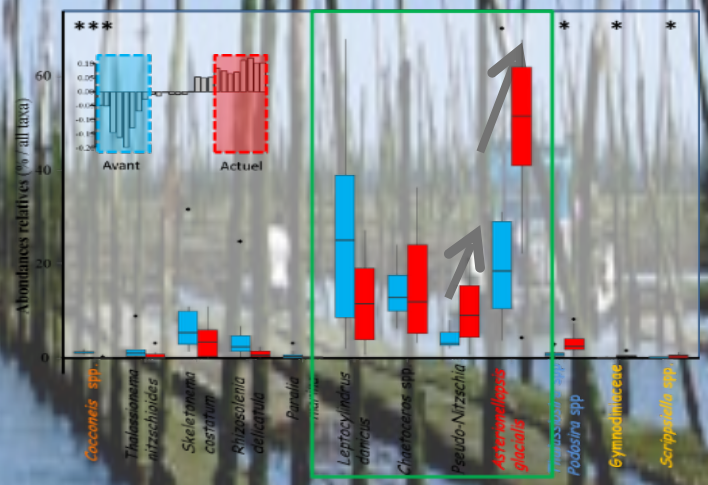


David et al. (In review)

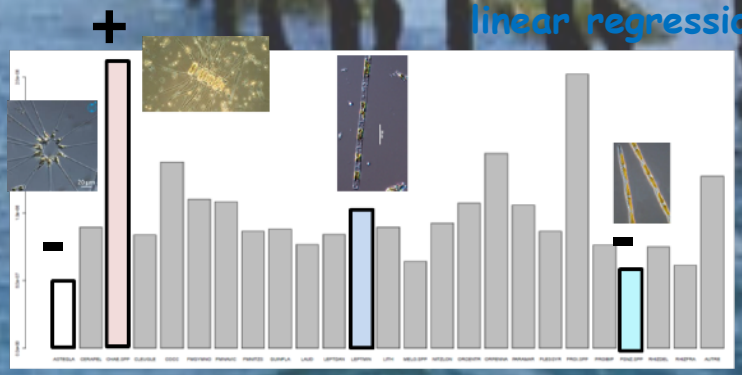
- Delays related to **Climate change** with a nowadays **limitation by food quality**

Change in phytoplankton assemblages



Species patability

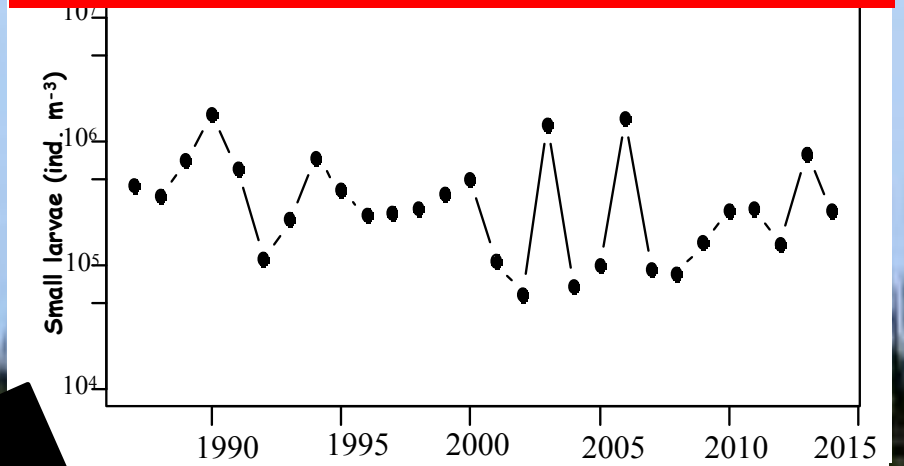
Inverse DEB model coupled with non linear regression

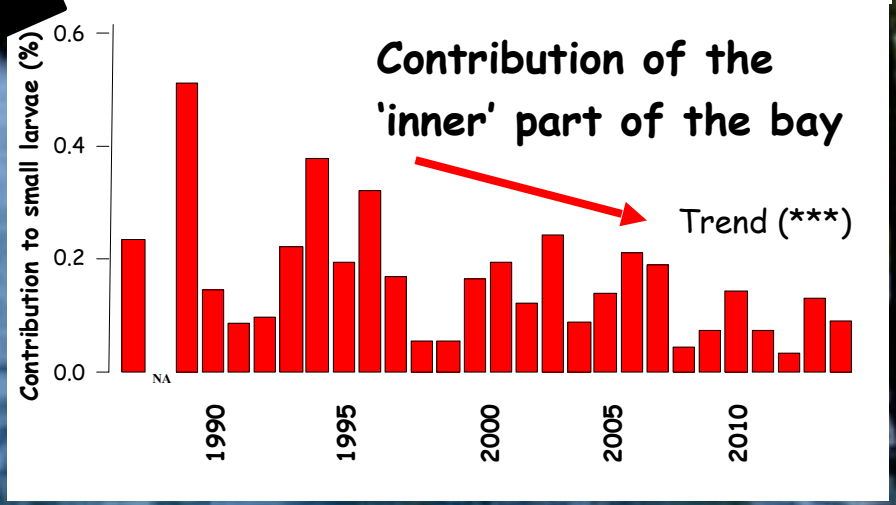


What about GENITOR REPRODUCTION?

- Fecundity is higher in the outer part of the bay
- Lesser and lesser contribution of the inner part of the bay

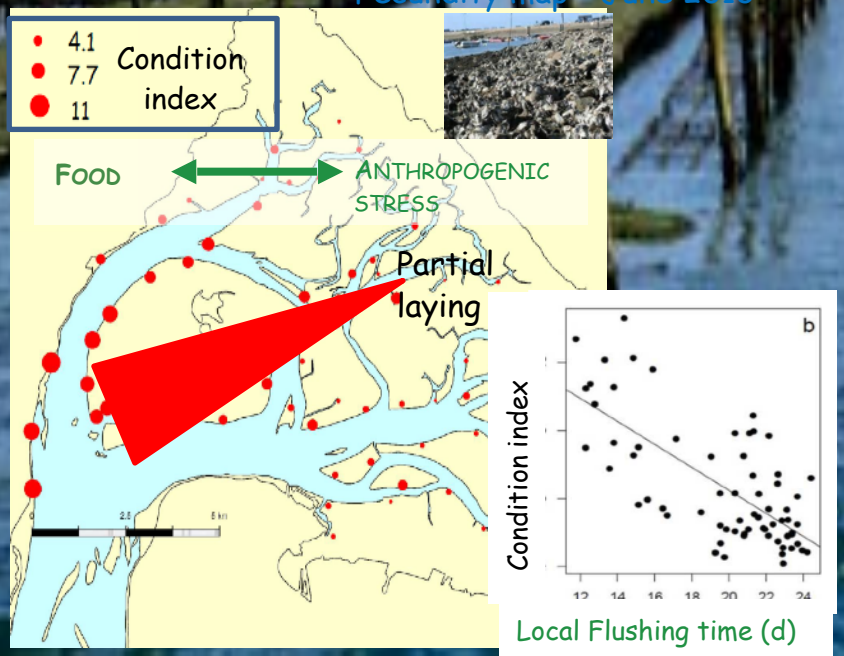
Laying effort





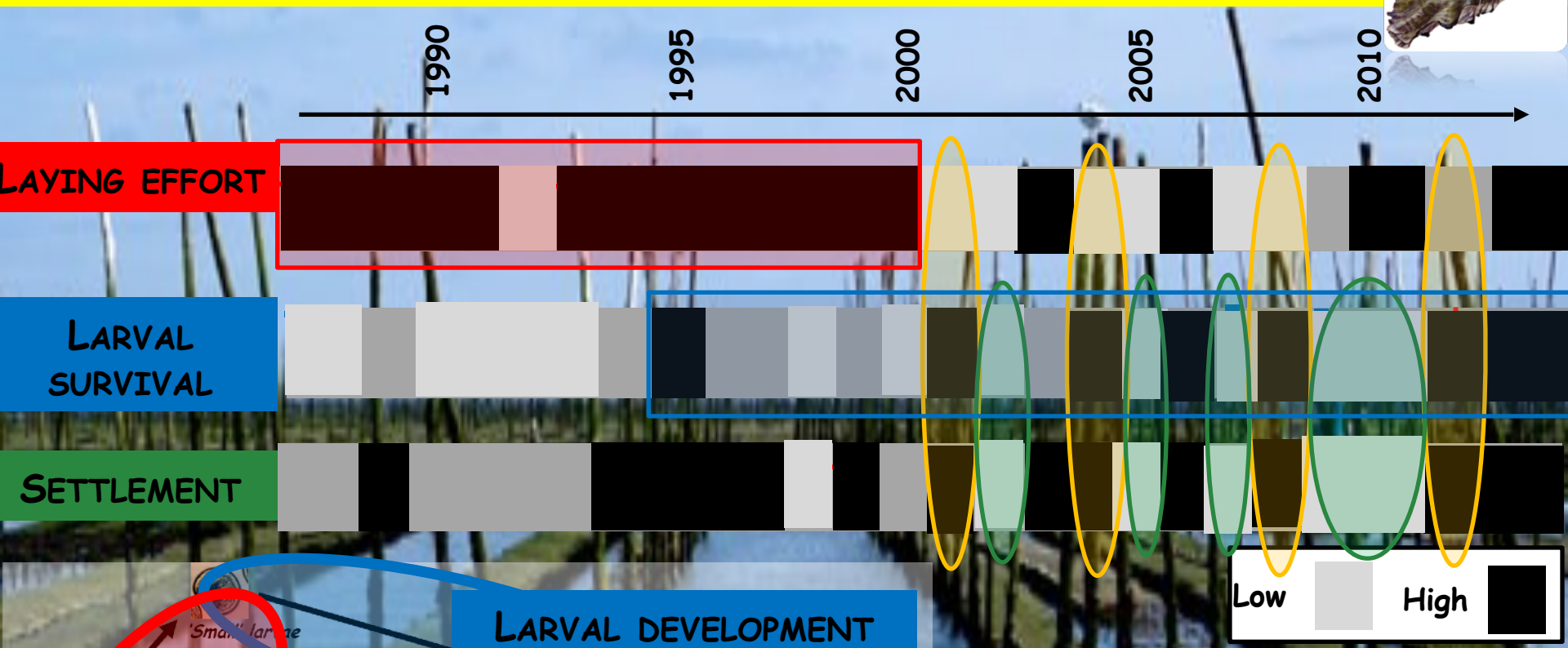
Spatial assessment of fecundity

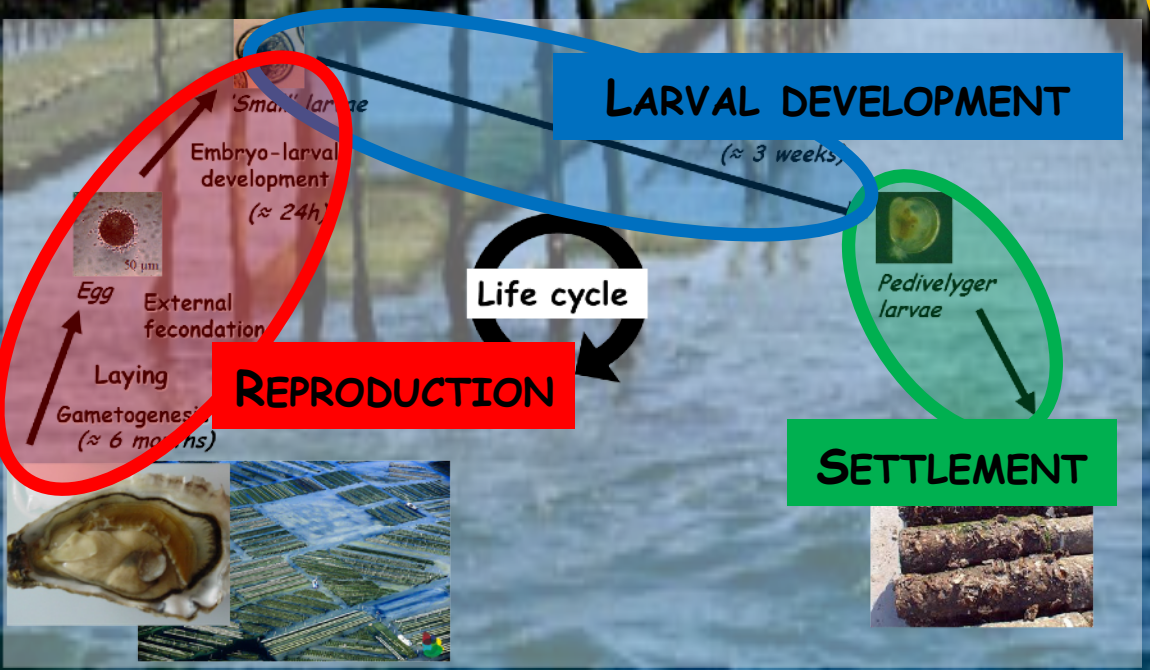
Fecundity map - June 2013



Synergy between anthropogenic pressures and climate change

An integrated response due to a complex life cycle…





- More constrated interannual response than before
- Good survival may compensate low laying effort
- Low survivals explain low recruitments

…A higher dependence to larval survival

Conclusions & Perspectives

Mesoscale Climate (AMO)

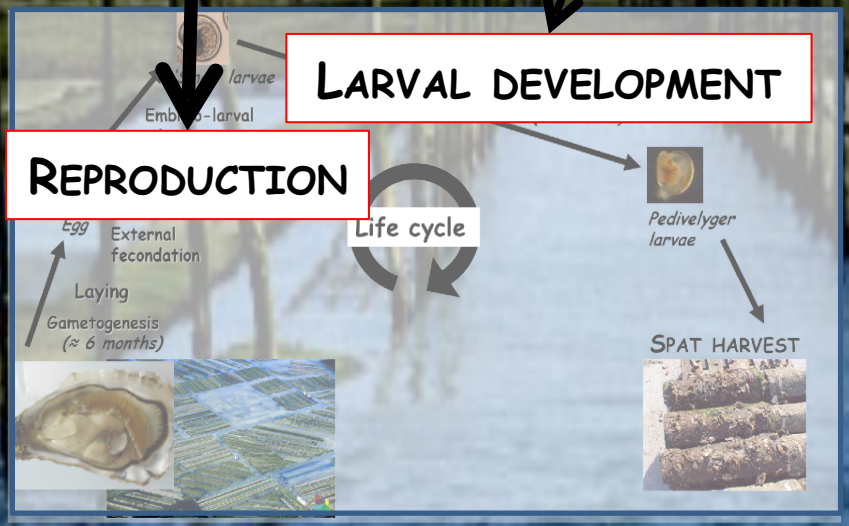
Local Climate (NAO weather regimes)

Hydrodynamic processes

Phytoplankton

Contaminant?

Temperature, salinity



LARVAL DEVELOPMENT

REPRODUCTION

=> Complex response to Climate Change

...probably in synergy with anthropogenic pressures

- Sensitivity/adaptability of oyster-farming entreprises?
- What about others oyster farming bays?