



# Genomic of adaptation of the Pacific cupped oyster, *Crassostrea gigas*, in the context of its geographic expansion

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# Context of the introduction of *Crassostrea gigas*

Native oyster in Europe : *Ostrea edulis*



*Bonamia ostreae*  
*Marteilia refringens*



Crash of *O. edulis* production

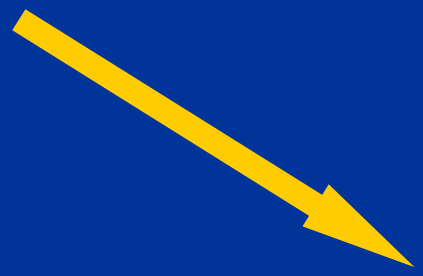
Cultivated oyster in Europe : *Crassostrea angulata*



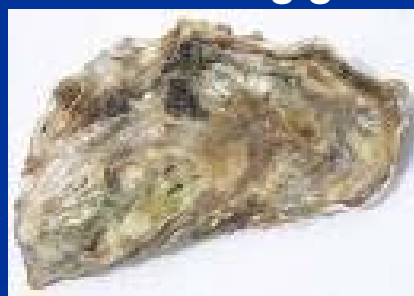
*Iridovirus*



Crash of *C. angulata* production



Introduction of *Crassostrea gigas* originated from Japan



# *Crassostrea gigas* way of life

## - Habitat -

### Native range

Estuarine and coastal marine waters of Japan and south-east Asia

Usually attach to rocks



### Europe

Estuarine and coastal intertidal marine waters

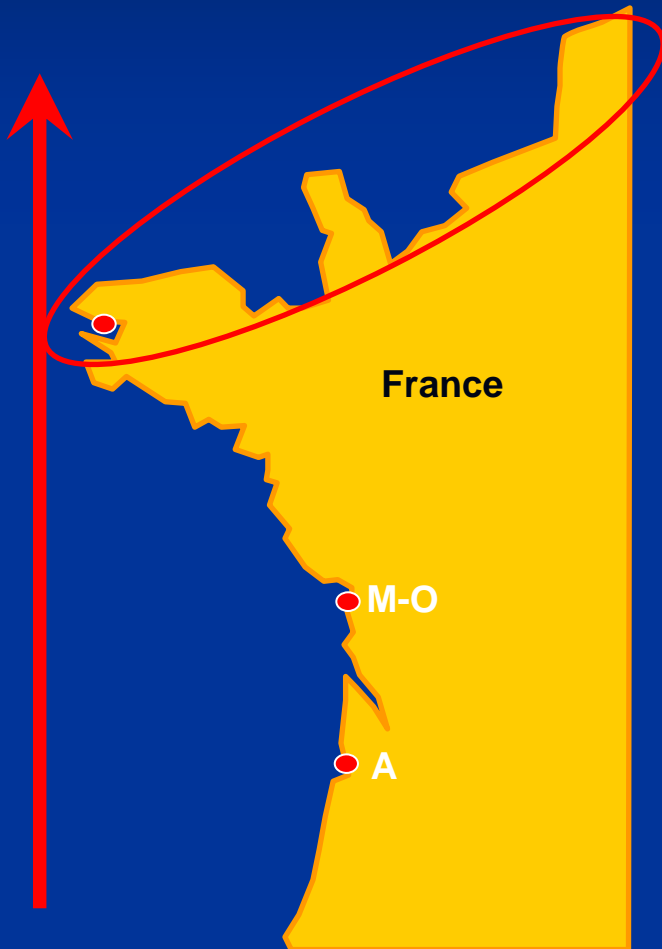
When hard surfaces are scarce :

- artificial hard substrate
- dead shell
- blue mussel beds ...



## Invasion history

### - France – ProGig program -



1970s introduced massively on Atlantic coast

1970-1980 : Natural populations in Marennnes-Oleron and Arcachon basins

1976 : Warm summer → reproduction in Brittany

1990-2006 : Natural populations in English Channel

# Invasion history

- First introduction : 1964 in Oosterschelde
- 1975-1976 : first natural settlement
- 1980 : colonization of other estuaries
- 1983 : found in Texel in the Wadden sea



1964  
1975  
1976

1980

1983  
Texel

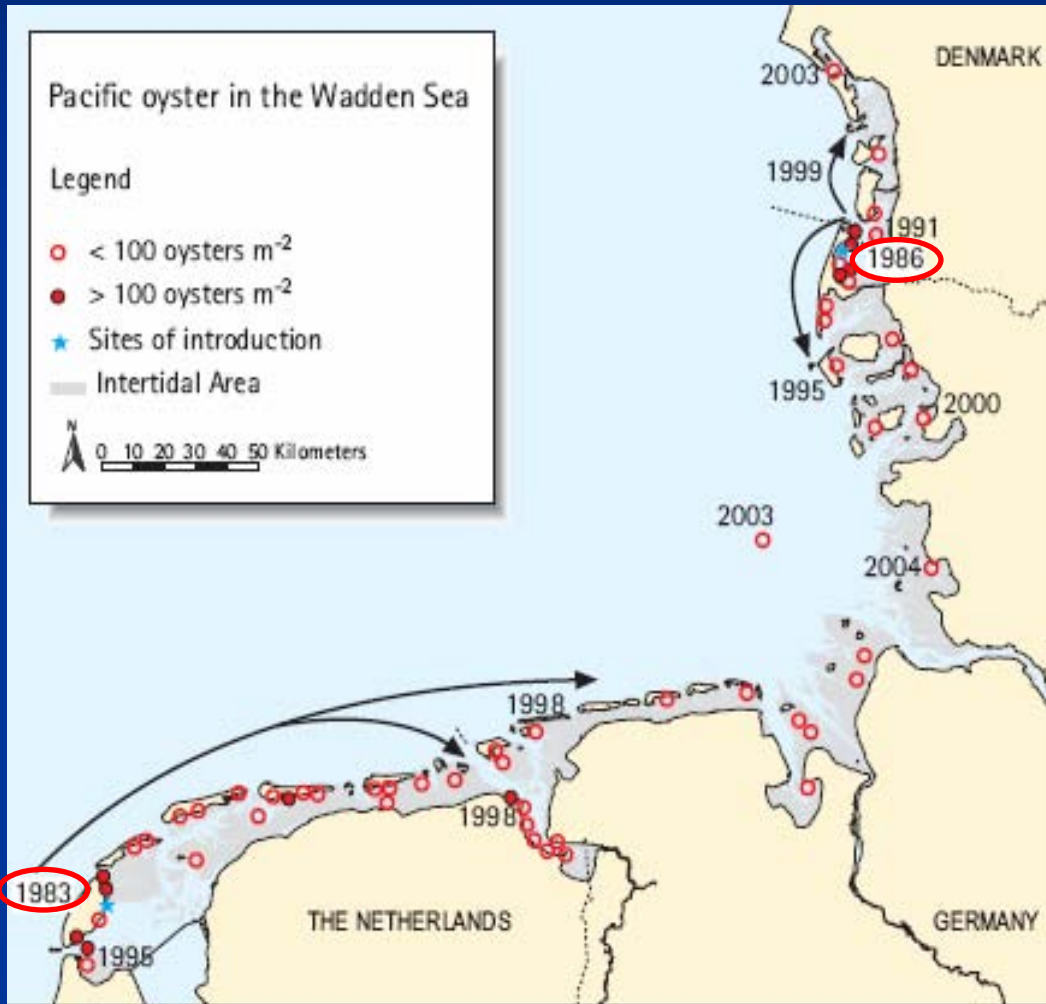
Dutch Delta region

Oosterschelde

Wadden sea

# Invasion history

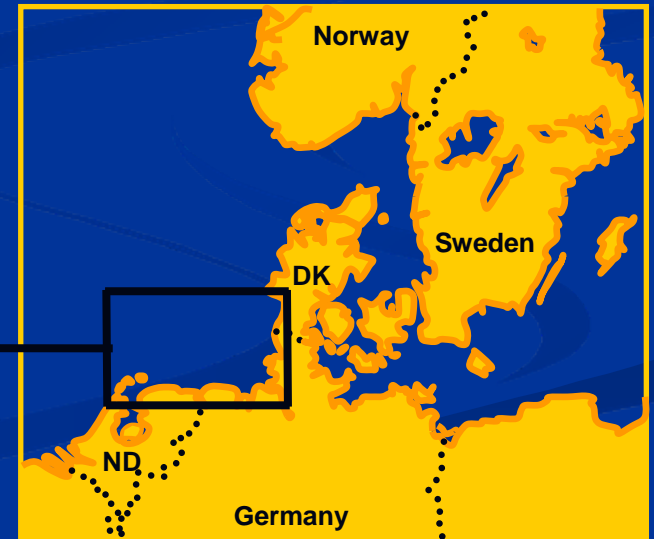
## - Wadden Sea -



1983 found in Texel

1986 commercial oyster farming in Sylt

1990s natural spread of larvae



## Invasion history

### Denmark

Several attempts of oyster farming ●

Since 1999 natural populations ●

Oyster reefs in the Wadden sea +  
western part of Limfjorden

### Sweden

Dense populations of recently  
settled oysters

### Norway

No aquaculture up to now

Hyp : larval dispersal ?  
Imported as food and released in  
the sea ?



# Only opportunity or adaptation ?

Objective : Quantifying adaptative part implied in *C. gigas* success

Tools : population genomics («genome scan») / AFLP

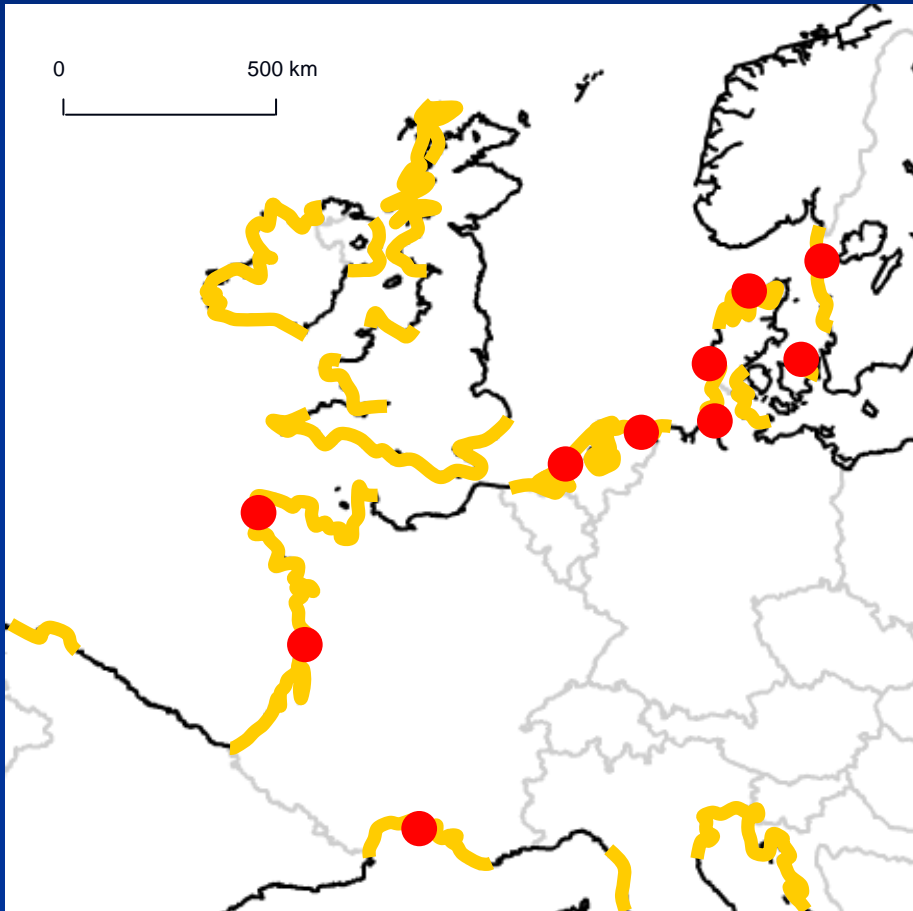
= “scan” of several loci trough the whole genome



**SELECTION ?**



## Sampling of natural populations



3 populations from France

2 populations from the Netherlands

1 population from Germany

3 populations from Denmark

1 population from Sweden

1 population from Japan

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11 populations ↔ 528 samples

## AFLP (amplified fragment length polymorphism)

### principle

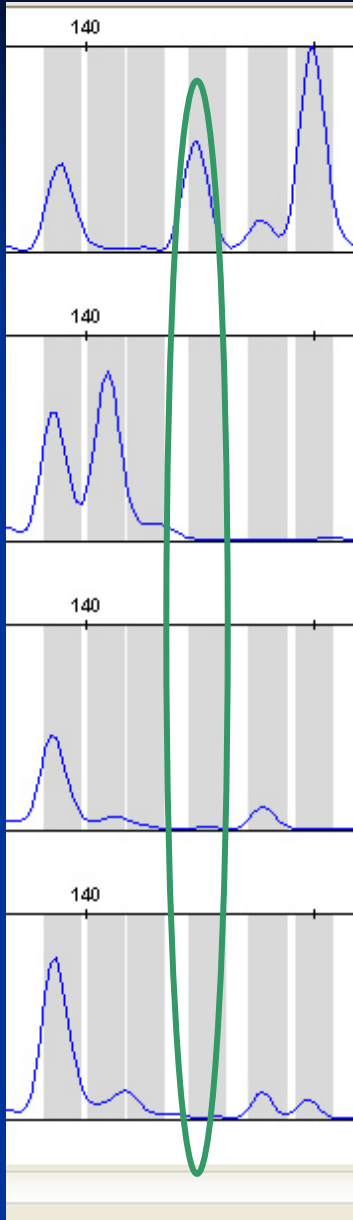
Enzyme digestion followed by successive PCR  
Polymorphism of “presence/absence”

### assets

Multilocus (>100 loci/primer pair)  
No prior knowledge on the genome  
Repeatability  
High genome cover

### disadvantages

Dominant marker  
Require high DNA quality and quantity



## The different markers

### AFLP

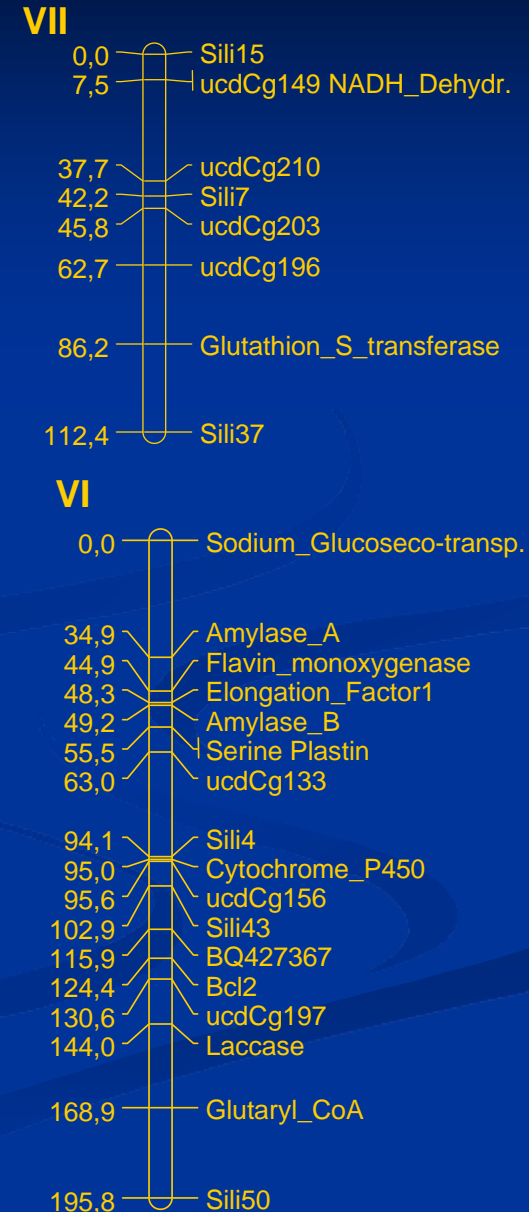
Test with AFLP : almost 30 primer pairs selected

528 samples genotyped with one primer pair  
→ almost 10 workable loci

### Other kind of markers available in the lab

SNP : all populations genotyped with 29 SNP  
and mapped on a linkage map

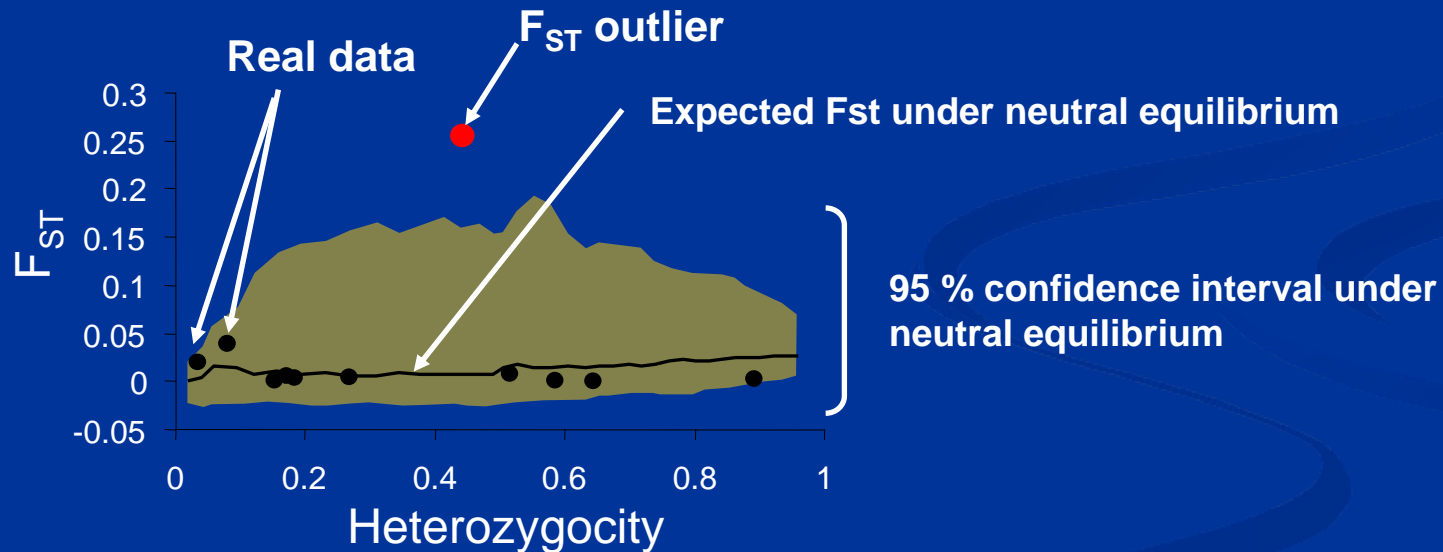
53 microsatellites already mapped on a linkage map



# Fst outlier

## - Beaumont and Nichols approach -

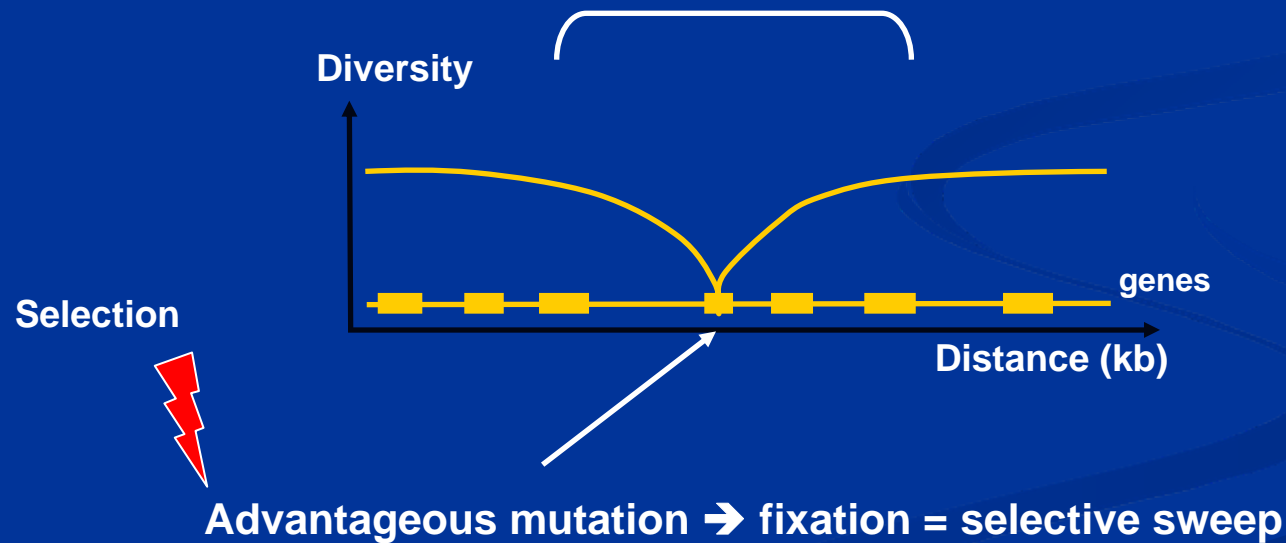
Based on simulated distributions of genetic differentiation estimators between population pairs



# Genome scan

## - Valley of diversity -

Drop in diversity by hitch-hiking  
in the neighbor of the mutation  
under selection



## Two scenarios



### Selection not found

No trace of selection in *C. gigas* genome ?

The tool we used were not enough powerfull ?



### Selection found, yes but...

Genome scan = blind anonymous scan



It would be interesting to get more information about the region under potential selection (gene, function, sequence...)

**To be continued...**

## Thanks to

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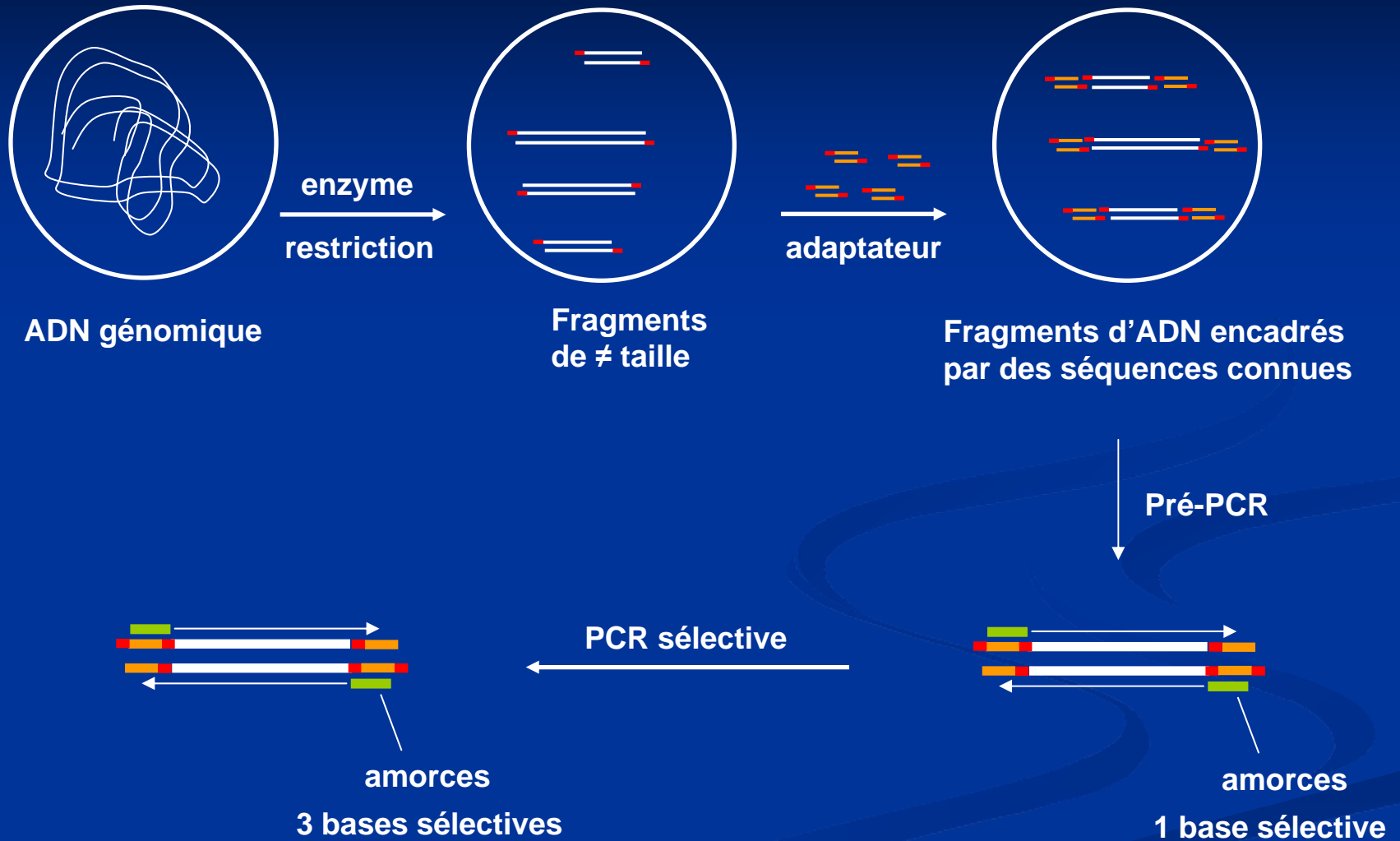
D. B. Toring,

M. S. Berggren

For samples



# Les AFLP



## *Crassostrea gigas* way of life

### Salinity

10 to 42 psu

Optimum for fertilization : 23 to 36 psu

### Temperature

4°C to 35°C

Temperature needed for reproduction > 20°C

Need sweet-tempered water during larval period (3-4weeks)

### Estimated life expectancy

30 years