First results of an epidemiological study on oyster (*Crassostrea gigas*) mortality events in France during summer 2008

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Introduction

French oyster production: between 110 000 and 130 000 tons/year

first production in Europe

Some characteristics of this production

✓ Multiple growing areas
✓ Spat production: mainly natural production
  (70% versus 30% from hatcheries)
✓ Lot of oyster movements for spat supply, yield optimisation and commercial purposes

Periodical mass mortality observed in France since the end of 70s due to multiple factors (T°C, physiological stress, aquaculture practices, pathogens, pollutants, phytoplanctonic toxins...)

1. Shellfish aquaculture in France

- **Oyster production**: 109,500 t
- **Oyster farms number**: 3,113
- **Lease surface**: 12,695 ha

Census data in 2001

Girard et al., 2005

**Shellfish aquaculture in France**

- **North Brittany**: 8.5% (175), 14%
- **South Brittany**: 20% (401), 27%
- **Pays de Loire**: 31% (1,190), 35%
- **Poitou Charentes**: 7% (374), 4%
- **Aquitaine**: 9% (367), 3%
- **Normandy**: 18% (251), 8%
- **Mediterranean sea**: 8.5%

**Regions**

- **Normandy**
- **Pays de Loire**
- **Poitou Charentes**
- **Aquitaine**
- **Mediterranean sea**
Context in 2008

Exceptional mass mortality affecting 6 to 18 month old juveniles of *Crassostrea gigas*, observed simultaneously in all French growing areas in June-July 2008

First analyses

☑ No notifiable pathogen detected

☑ OsHV-1 and *Vibrio species* frequently detected and together in some samples

☑ Suspected associated environmental parameters: mild winter, rainy spring, rapid temperatures increase in May, local toxic algal blooms for marine life
Aim of the epidemiological study:

Describe the phenomenon, identify associated factors and the cause (or causes) of these mortalities

An investigation in 2 parts

✓ A descriptive study

✓ An analytical study
Objective of this talk:

To present the results of the descriptive part of this investigation

Objectives of the descriptive epidemiological study

✓ To describe the pattern of mortalities in time and space

✓ To identify the affected population
Methods
1. Data collection

✓ Mortality notifications collected through the departmental Offices of Maritime Affairs (local competent authority) and the regional mollusc producer bodies between January and September 2008

✓ Data from regional surveys to evaluate farmers losses

✓ National and regional surveillance network data
  
  * REPAMO (Ifremer)
  * REMORA (Ifremer)
  * networks developed by local technical organisations of shellfish farmers in Marennes Oleron area and in Normandy

2. Database

1 notification = 1 site (lease) + dates (mortality observation, duration) + percentage of mortality + age + origin (spat) + zoo technical data
2. Database (following)

**Coded data:**

**Age**

1: Spat (≤ 12 months)
2: Juveniles (>12 – ≤ 24 months)
3: Adults (> 24 months)

**Temporal unit**

- Date of notification
- Mortality date
- Observation date
- Period of mortality

**Spat origin**

1: Natural spat
2: Hatchery spat

**Period = tidal cycle LT-HT**

(around 15 days)

**Spatial unit**

Oyster leases with geographic coordinates

3. Map-based analysis using Arcview 9.2 with lease coordinates
First results
### 2. Distribution of data according to the shellfish areas

A database with **7237 mortality data (notifications + networks)**

<table>
<thead>
<tr>
<th>Shellfish areas</th>
<th>Local competent authority data (Notifications)</th>
<th>Regional producer bodies</th>
<th>Other sources (national and regional surveillance networks)</th>
<th>Total</th>
<th>N oyster farms (2008 - CNC data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normandy</td>
<td>100</td>
<td>775</td>
<td>131</td>
<td>1006</td>
<td>353</td>
</tr>
<tr>
<td>North Brittany</td>
<td>125</td>
<td>642</td>
<td>3</td>
<td>770</td>
<td>468</td>
</tr>
<tr>
<td>South Brittany</td>
<td>161</td>
<td>351</td>
<td>33</td>
<td>545</td>
<td>714</td>
</tr>
<tr>
<td>Pays de Loire</td>
<td>77</td>
<td>36</td>
<td>63</td>
<td>176</td>
<td>405</td>
</tr>
<tr>
<td>Poitou Charentes</td>
<td>3612</td>
<td>0</td>
<td>105</td>
<td>3717</td>
<td>1273</td>
</tr>
<tr>
<td>Aquitaine</td>
<td>109</td>
<td>157</td>
<td>17</td>
<td>283</td>
<td>455</td>
</tr>
<tr>
<td>Mediterranean sea</td>
<td>723</td>
<td>0</td>
<td>17</td>
<td>740</td>
<td>494</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4907</strong></td>
<td><strong>1961</strong></td>
<td><strong>369</strong></td>
<td><strong>7237</strong></td>
<td><strong>4162</strong></td>
</tr>
</tbody>
</table>

**Hypothesis:** if **mortality notification** of Japanese oyster, there is **mortality**

**Case definition**: batch of oysters (**Crassostrea gigas**) growing in French territory and impacted by mass mortality between January and September 2008
3. Temporal dynamics of mortality events in 2008

Notification frequency according to period of time (n=7237)

9: 24 May - 8 June
11: 24 June – 8 July
12: 9 – 24 July
13: 25 July–7 August
3. Relationship with age (mortality rate)

Ages
1: Spat (≤ 12 months)
2: Juveniles (>12 – ≤24 months)
3: Adults (> 24 months)

All ages impacted but mainly spat
Higher mortality in spat
4. Relationship with origin (mortality rate)

No difference regarding the spat origin

1 : Natural spat
2 : Hatchery
5. Pattern of spat mortality in time and space (mortality rate>30%):

- 1st cases: End of April-May
- 1st peak: End of May-June
- 2nd peak: End of June-July
- 3rd peak: End of July

Locations:
- Normandy
- Arcachon
- Thau lagoon
- Leucate lagoon
- Hossegor
- Charente
- Bourgneuf
- North Brittany

Mortality rate:
- 0.32000 - 0.47000
- 0.47001 - 0.66000
- 0.66001 - 0.87000
- 0.67001 - 1.00000

1st cases in North Brittany
1st cases in Normandy
Discussion
Pattern of mortalities in time and space

- First cases occurred in April (Mediterranean sea and Atlantic coast)
- The first peak of mortality observed at the end of May-beginning of June
- The second peak, heavy and general, registered at the end of June (in Normandy, only the 2nd peak)
- Sporadic cases in August except in one area (Arcachon Bay)
- Few areas without loss (small areas with a limited number of oysters farmers, limited growing oysters and few movements of oysters)
Identification of the affected population

- All age classes are affected but mainly spat
- Higher level of mortality for spat
- Similar mortality rate between natural spat and hatchery spat
Limit and bias of the study

Study based on shellfish farmers notifications

- Underreporting of mortality events
- First cases:
  - linked or not with the 2008 event?
  - Underreporting of the first cases if mortality rate was low

Limited knowledge on the cultivated oysters population including associated cultural practices (density and transfers between shellfish growing areas)

- Natural spat production versus hatchery spat production
- Half growing oyster production
- Adult growing oyster production
Conclusions et perspectives
Conclusions

- First epidemiological study based on mortality notifications in France
- Results of the descriptive study are in accordance with observations in the field during summer 2008
- Needs of recording growing oysters production data including growing oysters density and movements for a better analyses of these data
Observational study

To estimate the quantitative effects of the various components causes that contribute to the occurrence of mortality

**Risk factors** *(cf Morest, 2007)*

<table>
<thead>
<tr>
<th>Environmental parameters</th>
<th>Pathogens</th>
<th>Cultural practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain</td>
<td>OsHV-1</td>
<td>transfers</td>
</tr>
<tr>
<td>Air T°C</td>
<td><em>Vibrio</em></td>
<td>Density</td>
</tr>
<tr>
<td>Water T°C, salinity</td>
<td></td>
<td>Oyster bags bathymetry</td>
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<tr>
<td>Toxic phytoplankton</td>
<td></td>
<td></td>
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<td>Currents</td>
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Acknowledgments

IFREMER laboratories situated along the coast

The departmental Offices of Maritime Affairs (local competent authority)

The regional mollusc producer bodies

Thank you for your attention