This project has received funding from the European Union's Horizon 2020 Research and innovation programme under grant agreement N° 678589

WP5: FATE

Consequences of oyster mortality episodes on benthic-pelagic coupling in Thau lagoon (France)



UMR MARBEC, Sète : Richard, Le Gall, Mortreux, Ouisse, Lagarde, Fiandrino, Fortune, Munaron, Messiaen, Oheix, Derolez, Belamy, Foucault, Devique, Roque d'Orbcastel
Montpellier: Bec, Mostajir, Hatey, McKenzie
Palavas: Callier
UMR IHPE: Montagnani, Rolland
UMS MEDIMEER: Mas, Parin
LDV34: Keck, Dedet, Singevin
Students: Bourreau, Vanhuysse, Chantalat, Degut, Neveu, Bourguoin
ShellFish farmers: Fournier, Navarro, Zecchinon, Tarbouriech, Galavielle, Avila, Chastel, Anthony

Context

The Thau lagoon is exploited by shellfish cultures

Oyster *Crassostrea gigas*

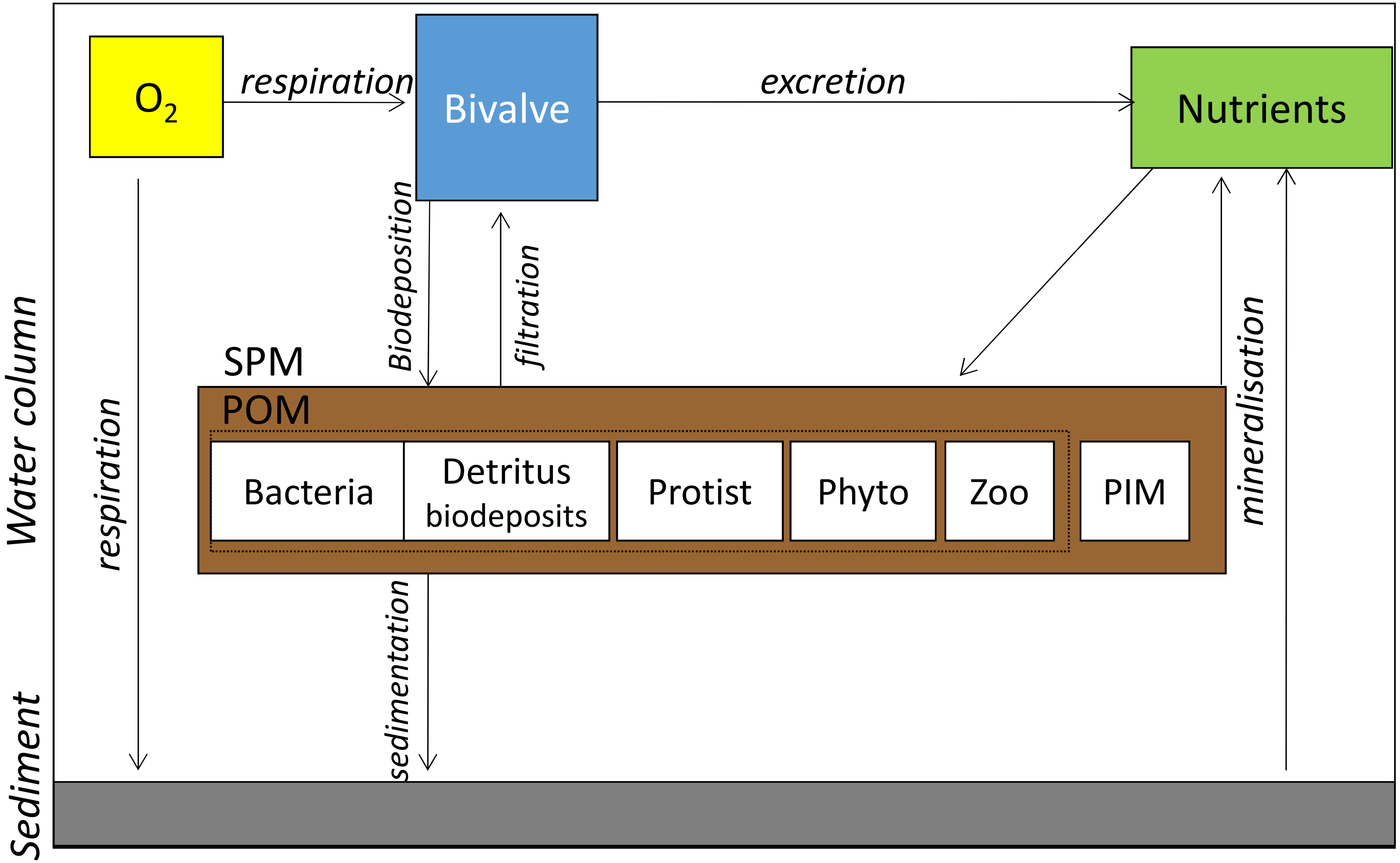
Pre-growing of oyster juveniles into suspended lanterns

Growing of oysters on ropes

Context

For **sustainable development of shellfish culture:**

→ **Necessity to study Aquaculture/Environment interactions**



Influence on ecosystem function

Context

2008 : Mortality of oyster juveniles (40-100%)
Period: April-May
Pathogen: Virus Herpes Os-HV1 µ var

→ Impact on production
Thau : 2001 : 10 -15 000 T → 2017: 7 000

2014-2015: Mortality of commercial-sized oysters (40-50%)
Period: June-July
Pathogen: Vibrio aestuarianus

→ Impact on summer sales

Context and General objectives

- sick organisms **are not separated** from conspecifics
- **Dead organisms are kept in the environment** until the total disappearance of their flesh.

Context and General objectives

- sick organisms **are not separated** from conspecifics
- **Dead organisms are kept in the environment** until the total disappearance of their flesh.

What are the consequences of this practice on (ii) dissolved and particulate fluxes, (ii) planktonic components, (iii) pathogen transfers into the benthic-pelagic coupling of the Thau Lagoon?

Oyster juveniles

MORTAFLUX
(2015-2016, Ifremer DS, EC2CO)
VIVALDI WP5 Fate, juvenile (2017, H2020)

Commercial-sized oysters

VIVALDI WP5 FATE, adult
(2016-2018, H2020)

Approaches

scales

Rearing unit

Individual

Lantern

Rope

Bag

Table

ex situ

Metabolic

in situ

Pelagic

Benthic chambers

Conception & Realisation
(UMR MARBEC + UMS MEDIMEER)

Approaches

scales

Rearing unit

Individual

Lantern

Rope

Bag

Table

ex situ

Metabolic

in situ

Pelagic

Benthic chambers

Conception & Realisation
(UMR MARBEC + UMS MEDIMEER)

First Results

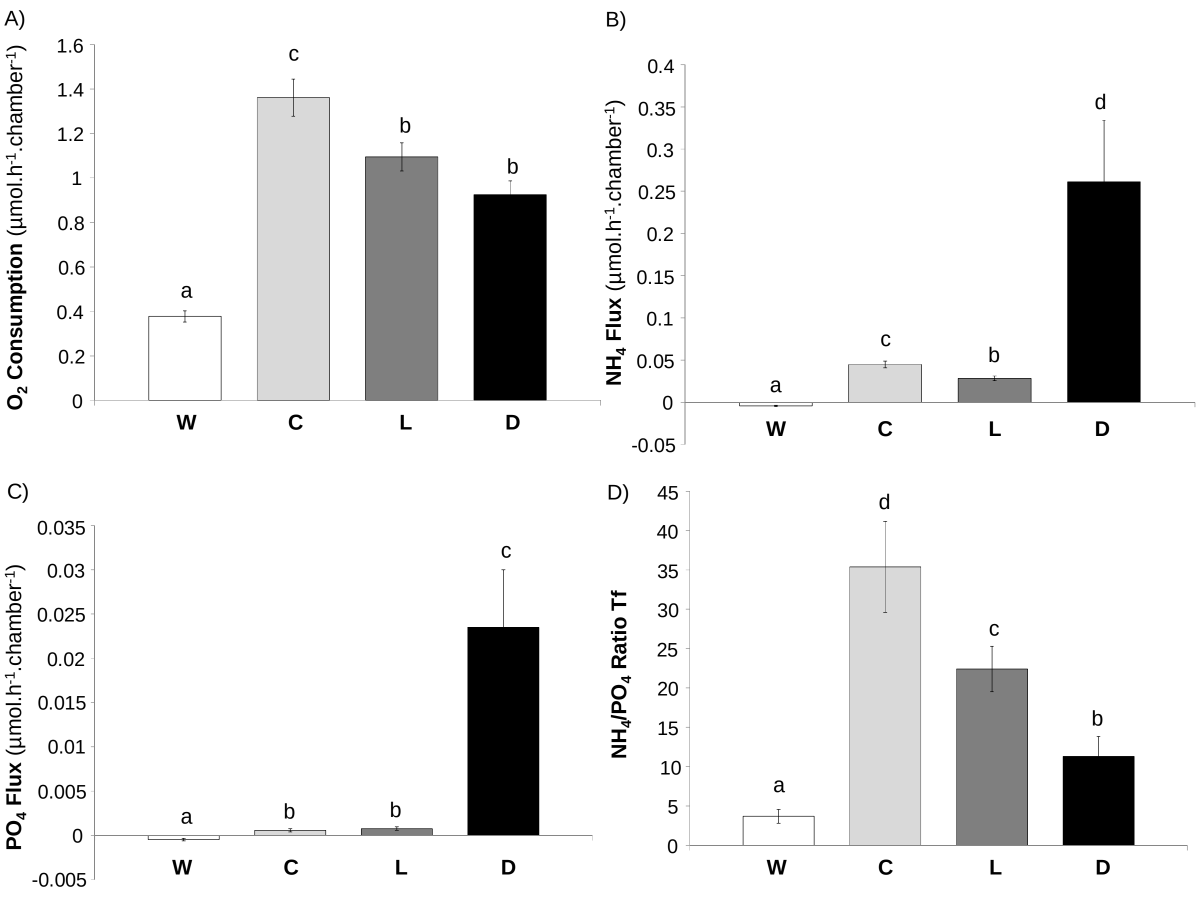
Contents lists available at ScienceDirect

Aquaculture

journal homepage: www.elsevier.com/locate/aquaculture

Influence of OSHV-1 oyster mortality episode on dissolved inorganic fluxes: An *ex situ* experiment at the individual scale

M. Richard [a,*], J. Bourreau [a], C. Montagnani [b], V. Ouisse [a], P. Le Gall [a], M. Fortune [a], D. Munaron [a], G. Messiaen [a], M.D. Callier [c], E. Roque d'Orbcastel [a]



- OsHV-1 **infection** (L):
decrease oxygen consumption and ammonium excretion of oyster juveniles.

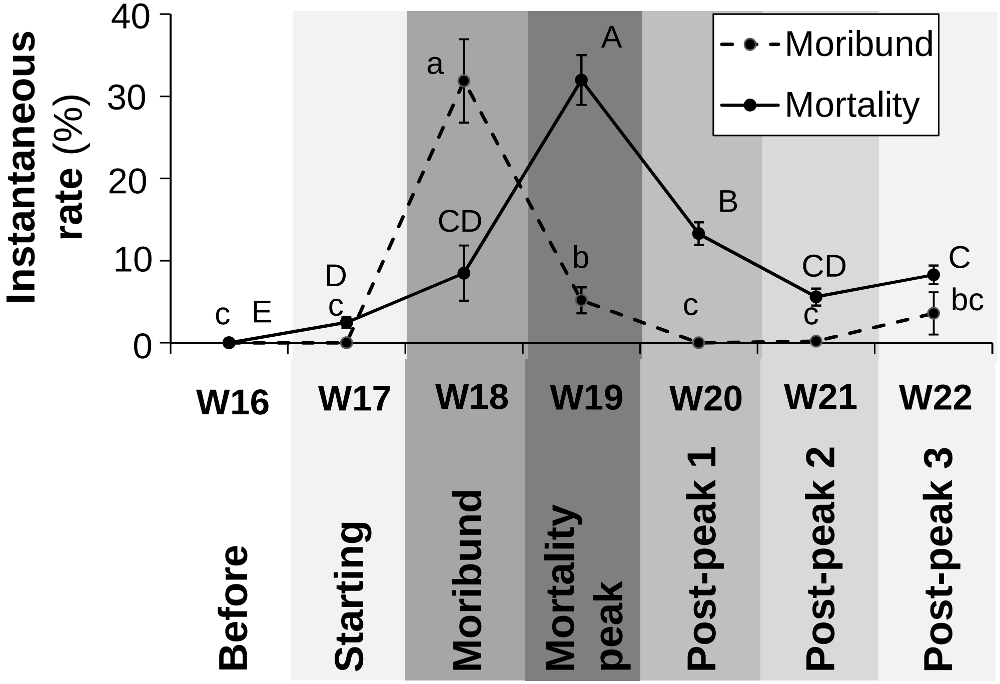
- **Mineralisation of the flesh of dead oysters** (D) :
Induce an increase of ammonium and phosphate fluxes and a decrease in the N/P ratio

with potential incidence on planktonic communities…

Richard et al. 2017 Aquaculture 475 40-51.

First Results

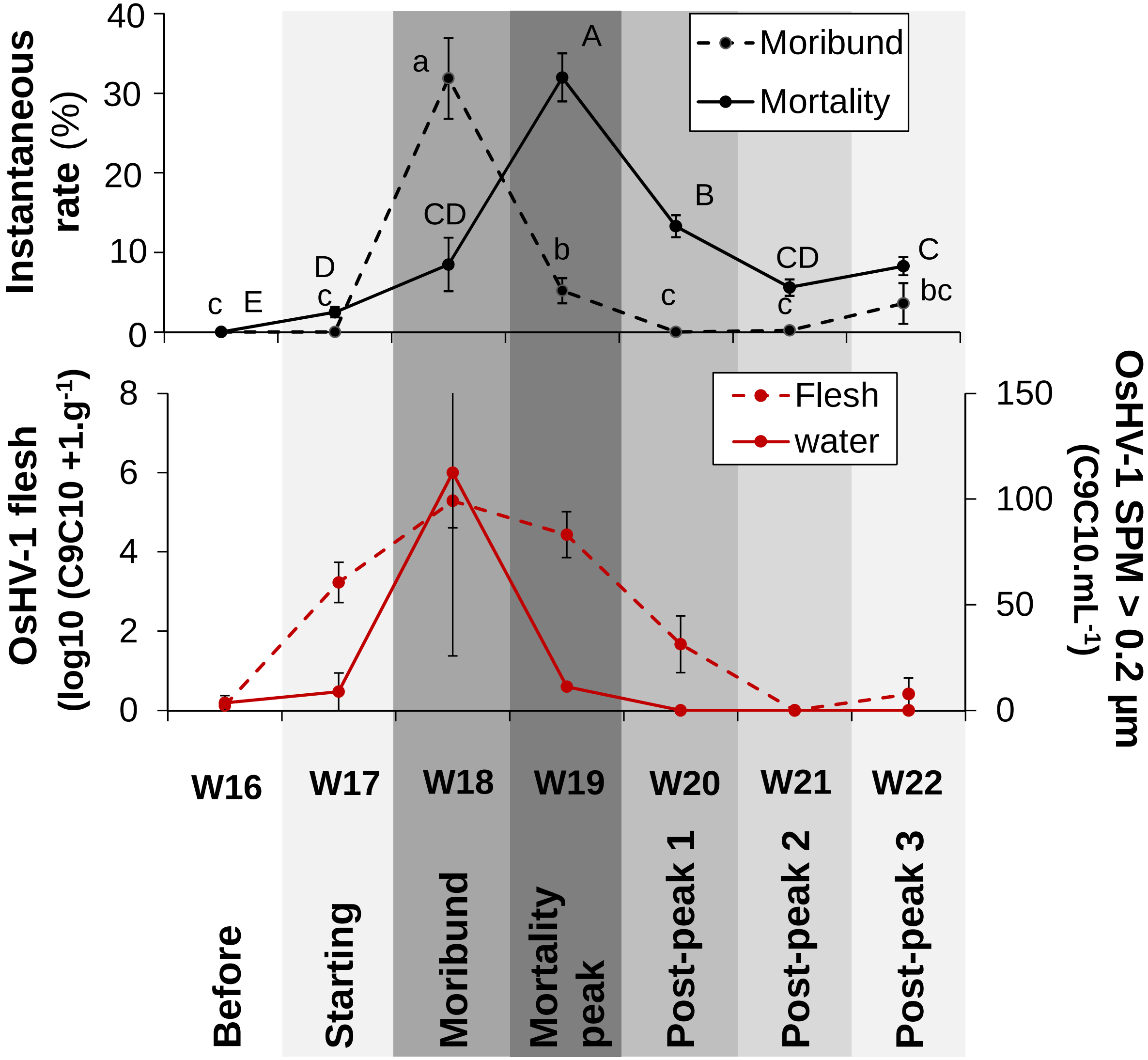
Moribund and mortality rate dynamics



Higher moribund rate was observed **one week before the mortality peak**

First Results

DNA OsHV-1 dynamics in oyster flesh and water column



-Quantification of **OsHV-1 in flesh one week** (W17) **before moribund period** (W18)

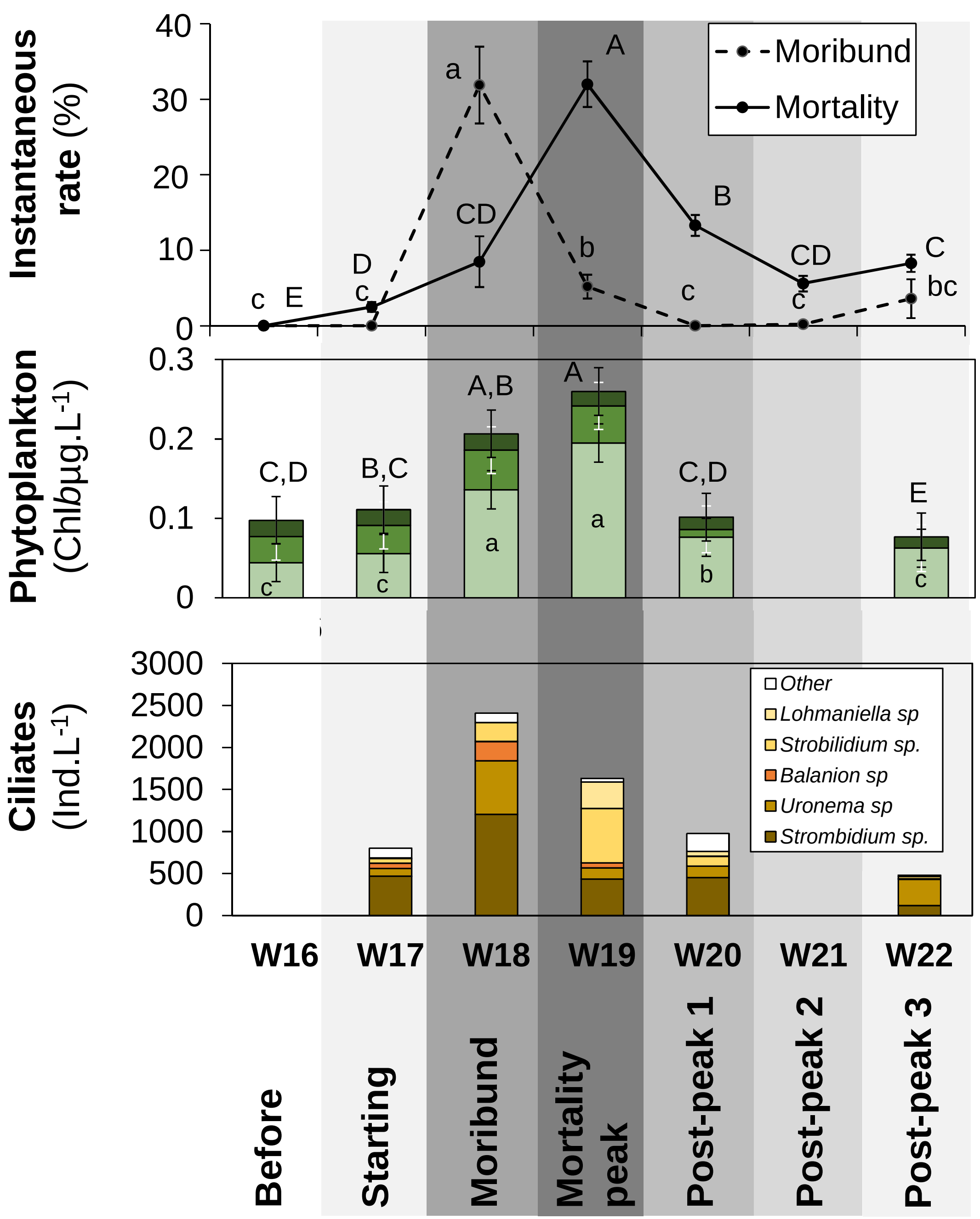
-No quantification of OsHV-1 as free form, ie. in < 0.2µm-filtered-water

-Presence of **OsHV1 in water column** as **associated form to suspended matter > 0.2µm**

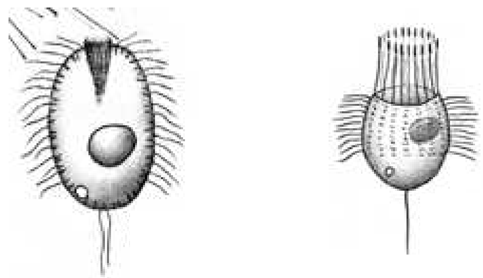
Highest OsHV-1 concentration in water column during moribund period (W18)

First Results

Planktonic microbial component dynamics



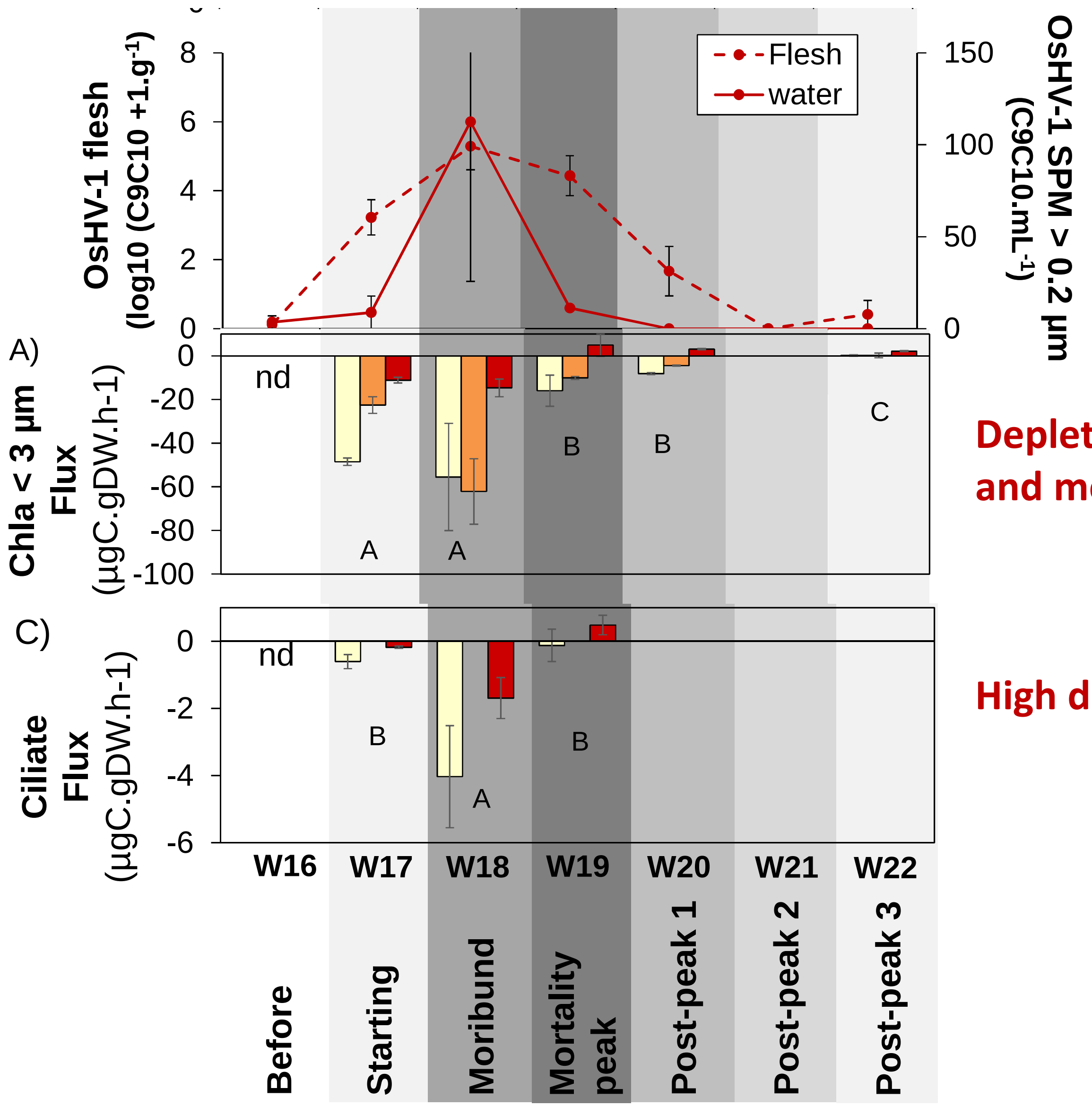
During **moribund and mortality** periods:
Increase of picophytoplankton and ciliate abundances



Uronema sp. & *Balanion* sp.

First Results

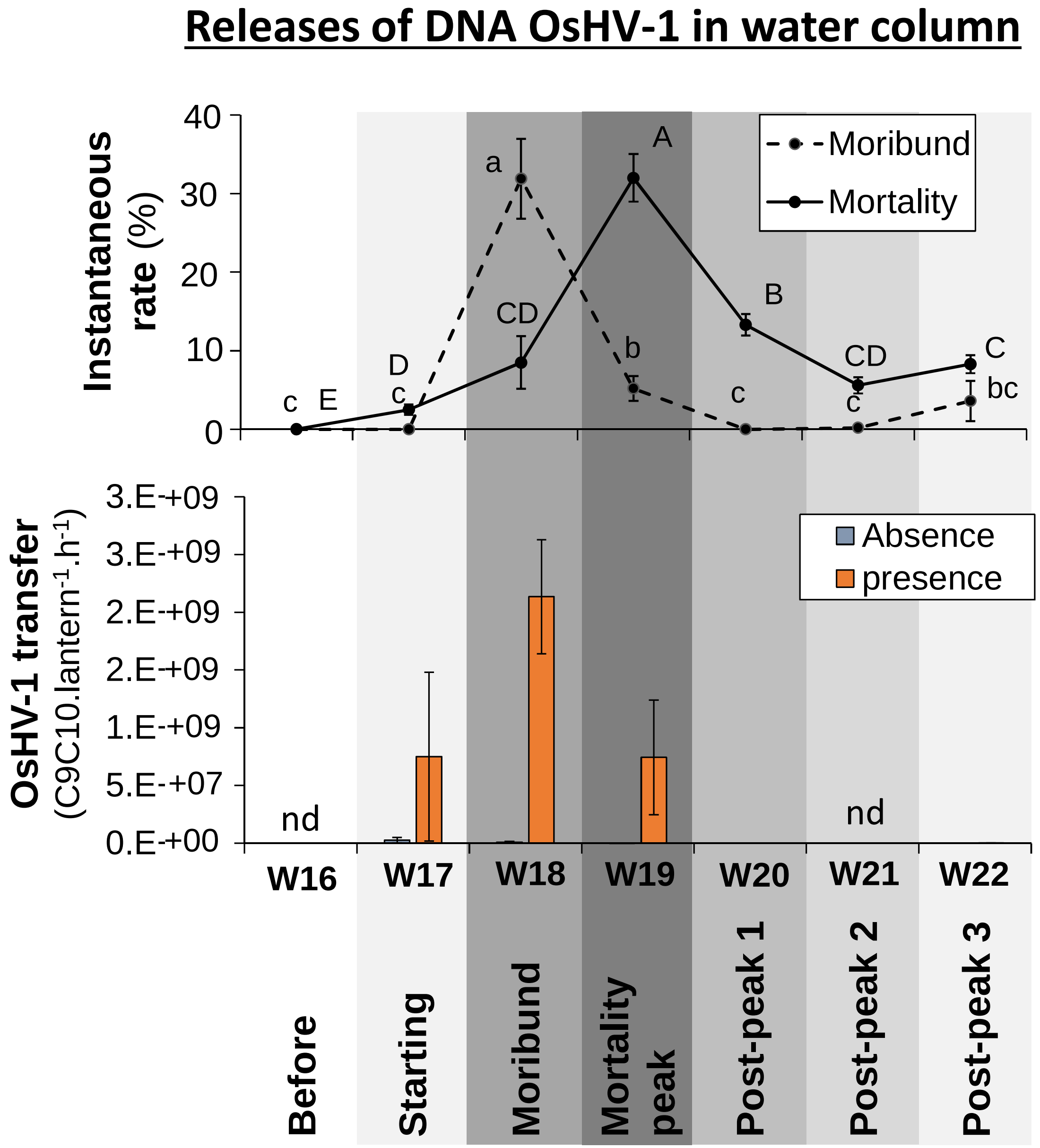
Depletion of Planktonic microbial components



Depletion of small (< 3 µm) phytoplankton at starting and moribond periods

High depletion of ciliates within moribund period

First Results

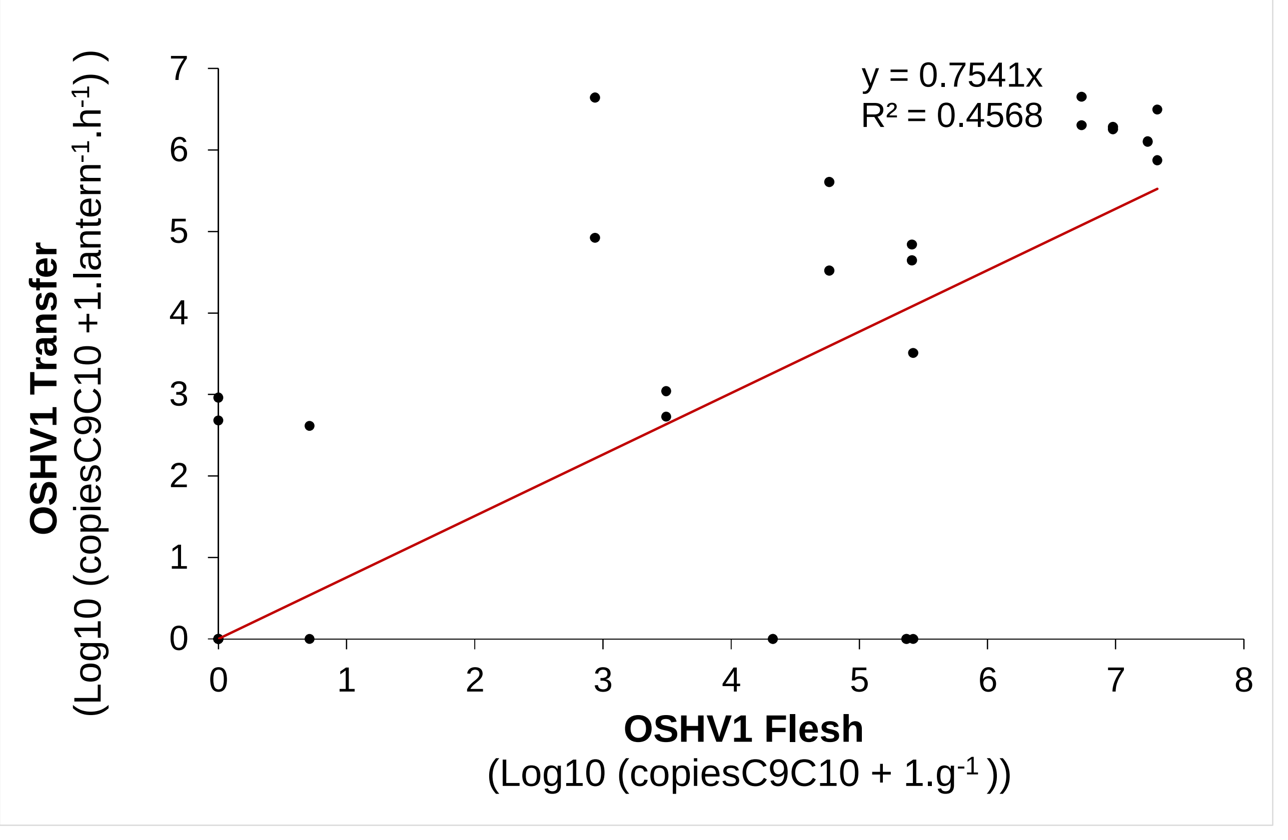



Significant DNA OsHV-1 releases in water column in presence of oyster juveniles

Highest releases were observed **in moribund period (W18)** and **begun one week before (W17)**

First Results

Relation between OsHV-1 releases and flesh concentrations

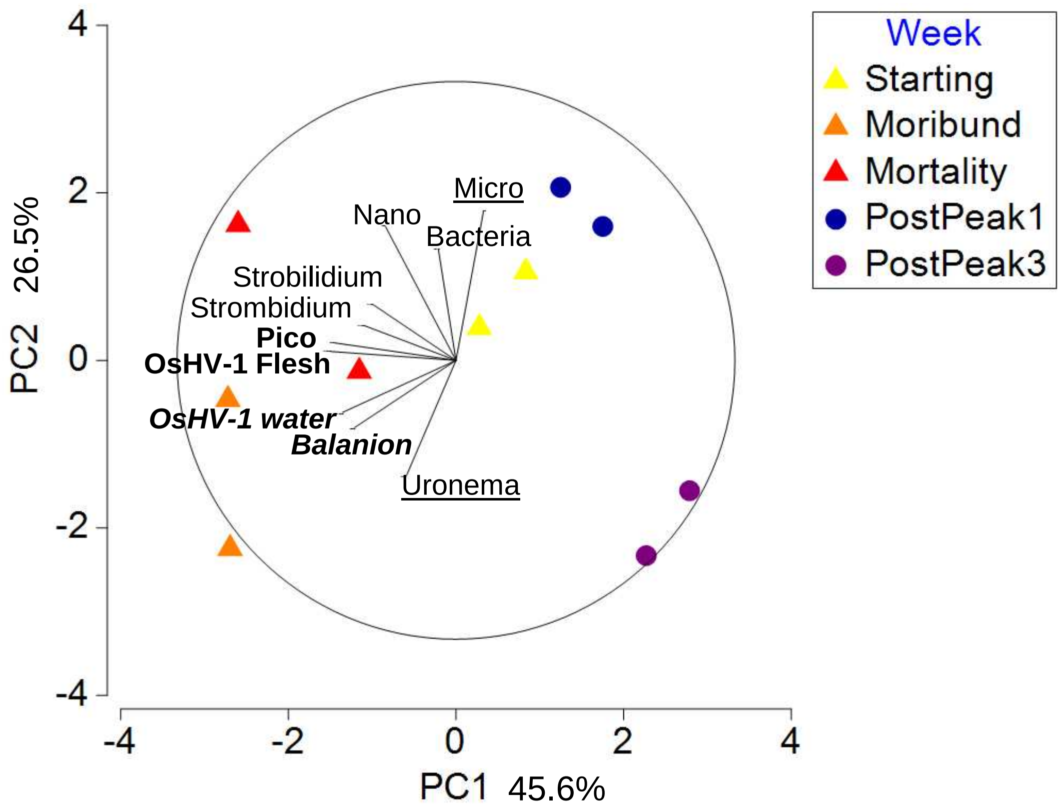


Significant correlation between OsHV-1 releases in water column and OsHV1 concentration in oyster flesh

→OsHV-1 releases may be associated to decaying flesh

First Results

Relation between OsHV-1 & microbial components



Significant correlation between :

[OsHV-1] flesh and picoplankton (0-3 µm)

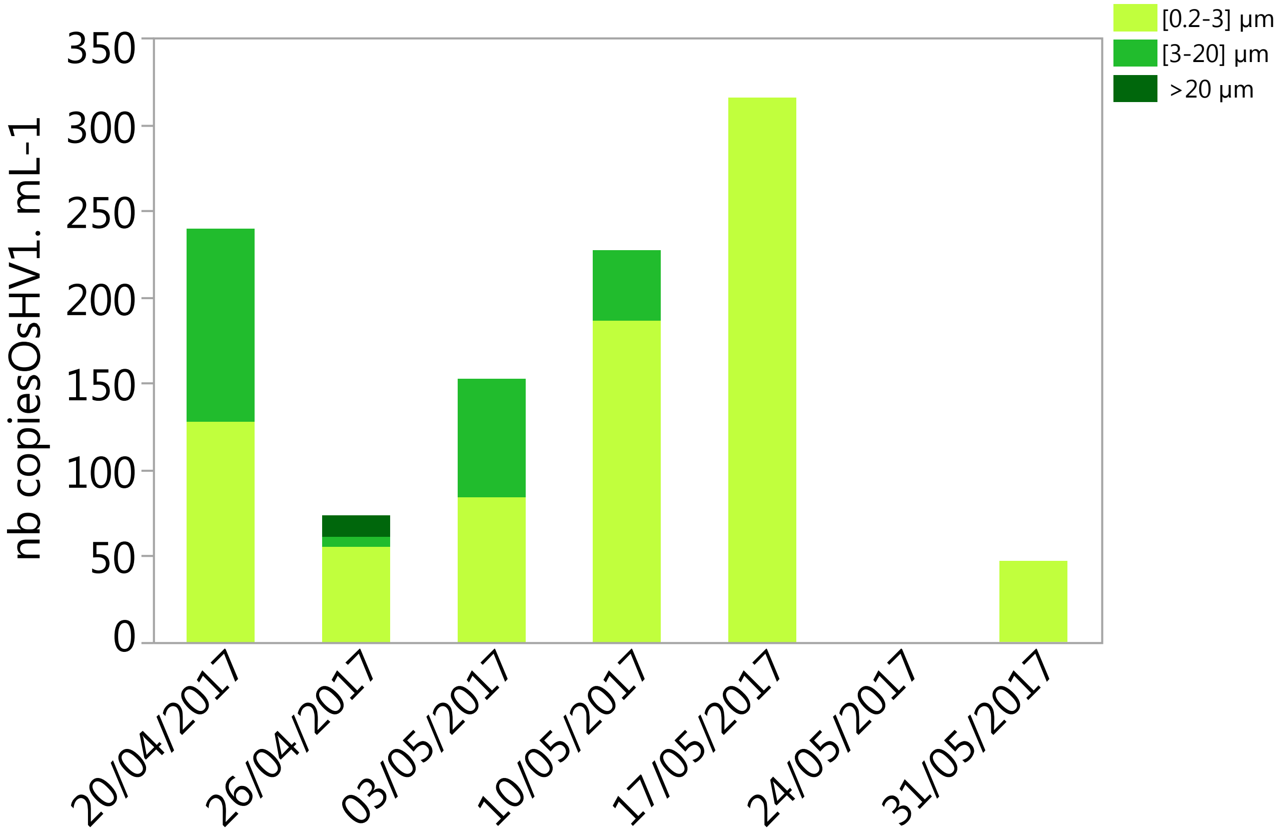
[OsHV-1] in water column and biomass of the ciliate Balanion sp.

Ciliates are known to be saprophyte and to grow on bacteria and picoplankton.
Depletion of picoplankton and ciliate have been observed in presence of oysters before and within moribund period.

→ Flesh in decomposition, Picoplankton and ciliates may be implicated in OsHV-1 transmission via filtration activity

First Results

Relation between OsHV-1 & suspended matter according to fraction size



OsHV-1 was **NOT observed outside farms**

Inside farm, OsHV-1 was **mainly associated to 0-3 µm fraction** but also with **3-20 µm fraction** with **different temporal dynamics**

Conclusions

<u>1) Mortality episode of oyster juveniles in the Thau lagoon induced:</u>

- Increase of NH_4 and PO_4 concentrations, decrease of N/P
- Bloom of picophytoplankton and ciliates (*Uronema, Balanion*)

during moribund period in relation to leaching and decomposition of decaying oyster flesh.

- OsHV-1 releases, two weeks before mortality peak with highest mean observed during moribund period
(2.5 x 10^9 OsHV-1.lantern^{-1}.h^{-1} or 3000 x 10^9 OsHV-1.h^{-1} at table scale)

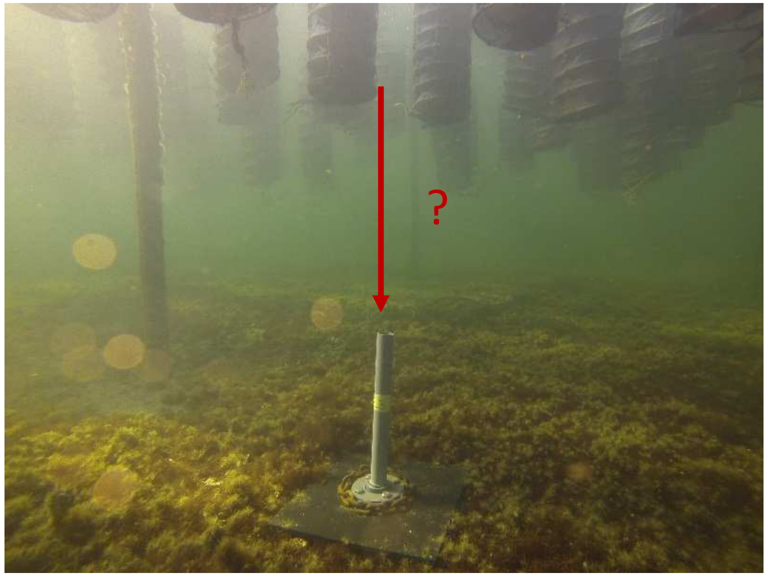
<u>2) OsHV-1 was associated to suspended matter, mainly with (0.2-3 µm) and (3-20 µm) fractions.</u> [OsHV-1] was correlated to flesh [OsHV-1], picoplankton and ciliates.

.

→ **releases of OsHV-1, depletion of decaying flesh, picoplankton and ciliates** may be **involved in spread of the disease.**

Perspectives

<u>Further analysis:</u>



1) **Ecological niche** of pathogens?

2) Consequences of mortality on **benthic system?**

OsHV-1 sedimentation via biodeposition?

3) **Effect of commercial-sized oyster mortality**?

Adult > Juvenile

(100g, 15 Kg.m^{-2}) (1g, 2.4 Kg.m-2)

Recommendations

- Do pathogen analysis and/or temperature challenge before to introduce oysters into environment.
- Do not introduce oyster juveniles during the risk period (17°C-24°C)
- Do not introduce infectious and moribund organisms.
- If mortality phenomena occurs, exclude moribunds as much as possible. Nevertheless, exclusion would not be a sufficient solution to limit the spread of the disease.

OsHV-1 being mainly associated to 0.2-3µm fraction, solution could be to develop **polyculture systems integrating oysters and other suspension-feeders which efficiently retain 0-3 µm particles, which will act as biofilters**.

To open the debate: Since OsHV-1 induces mortality of other species at larval stage (clam, pecten…), what are the consequences of oyster mortality episodes on marine biodiversity and specially on other key species?

This project has received funding from
the European Union's Horizon 2020 Research and innovation programme
under grant agreement N° 678589

Thank you for your attention!



Marion Richard PhD, marion.richard@ifremer.fr