

# COCKLES

Co-Operation for Restoring Cockle Shellfisheries  
and its Ecosystem-Services in the Atlantic Area

## Parasites: Good or not good ? – Part I:

### PARTNERS

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Presentation Xavier de Montaudouin, University of Bordeaux



**FINAL VIRTUAL CONFERENCE**

**March 2021**

# 1. Field survey

- Macroparasites
- Microparasites and Diseases

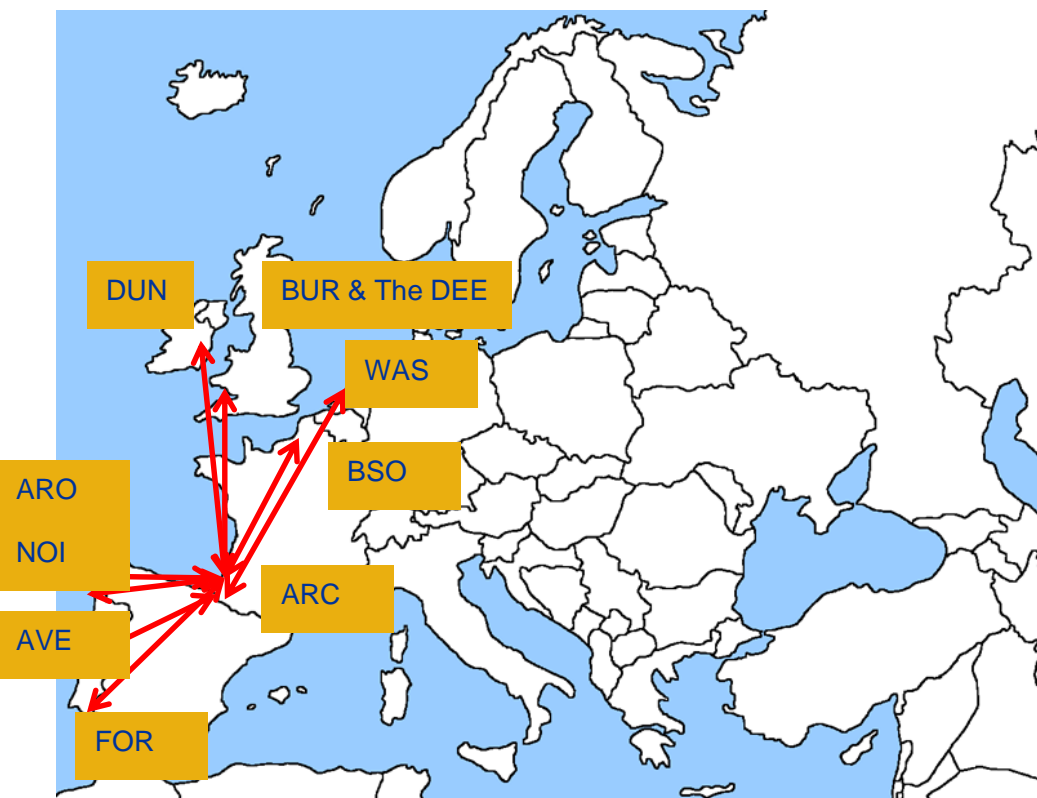
# 2. Specific actions

- Immune system (next talk) - CIMA
- Parasite and environmental interactions – UCC
- Parasite and metalloid interactions – UA
- Cockle cohort lifespan, growth and diseases – UBx



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## Where? When? What? Who?



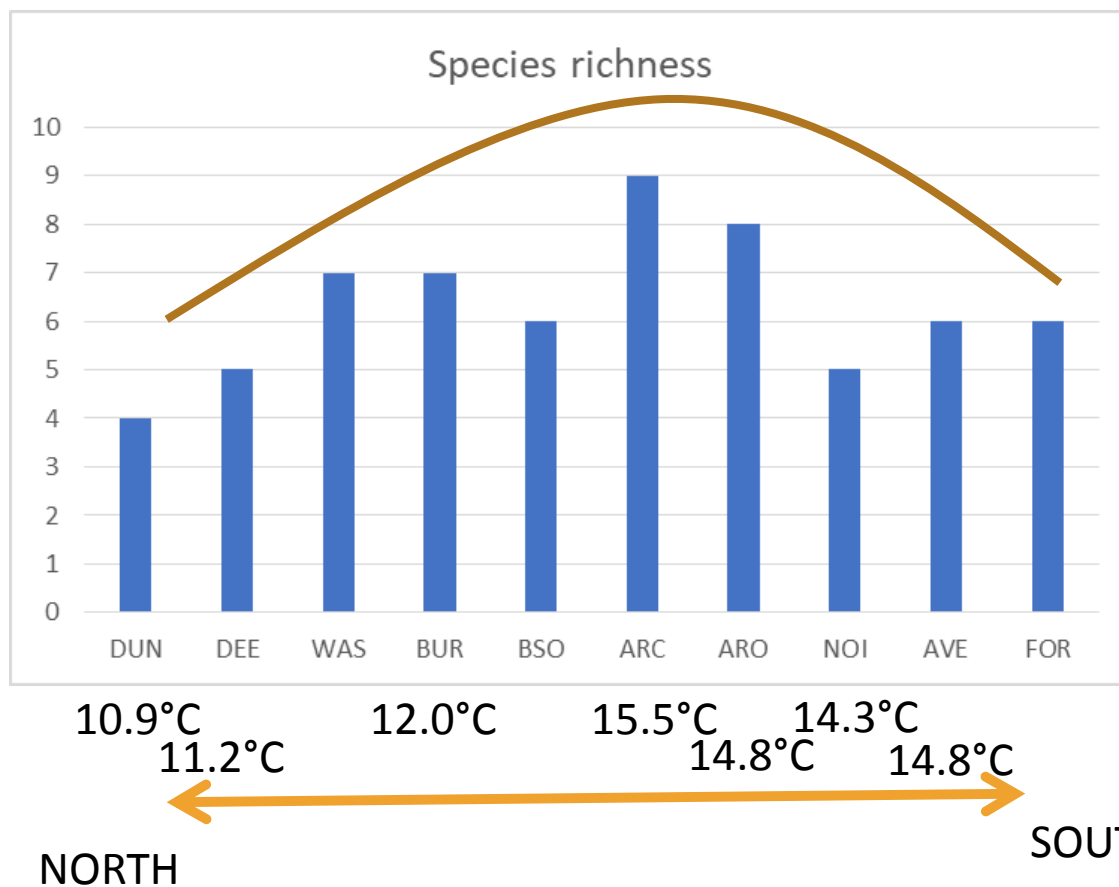
- 10 sites
- 2 seasons
  - Pre-spawning
  - Post-spawning
- 2 cohorts
- 10-30 cockles

- 38 taxons
- 3 diseases

- Anatomy
- Histology
- Molecular biology

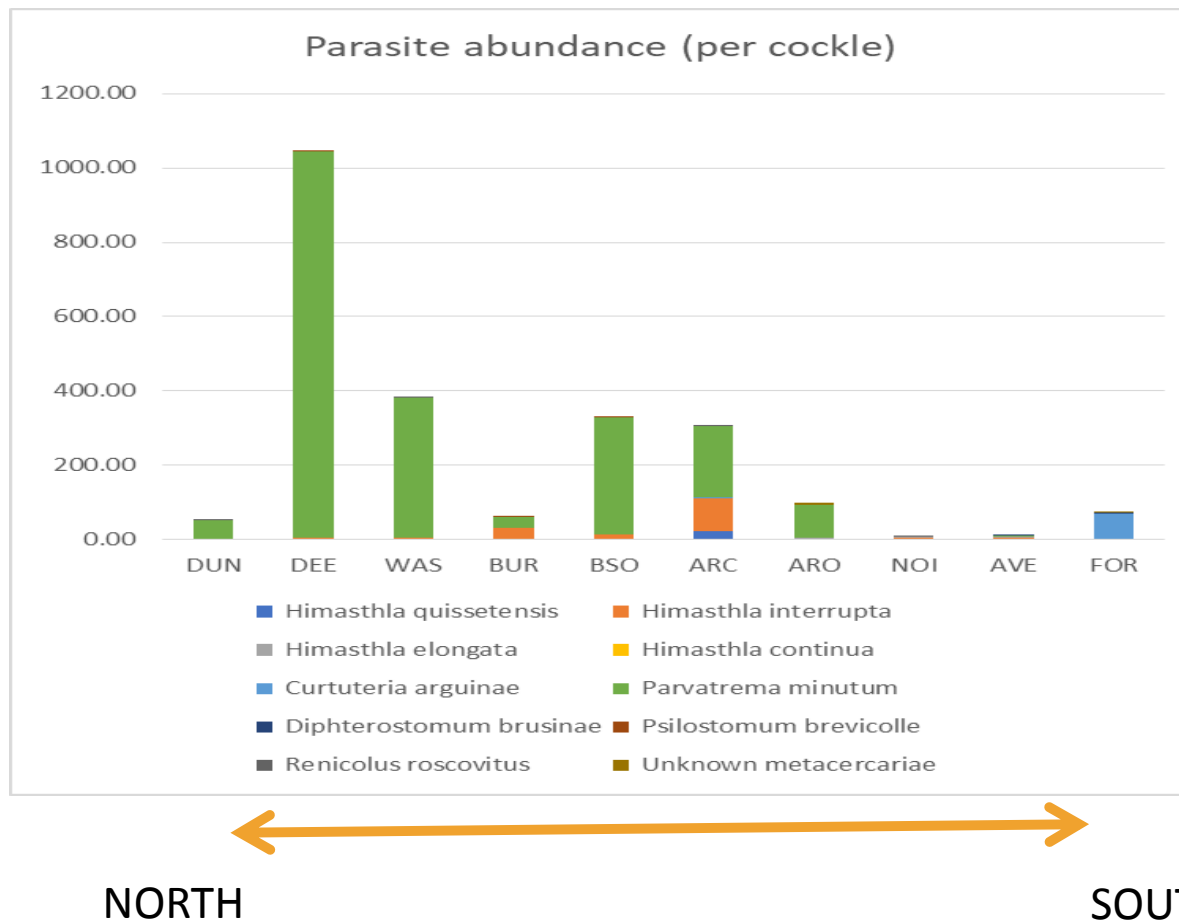
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## Trematodes



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## SURVEY OF PATHOLOGICAL CONDITIONS OF COCKLES AT THE EU SCALE

*Ifremer, UCC, Cima, IPMA, Bangor University*

### OBJECTIVES

Identification of major pathogens infecting cockle populations along the North-East Atlantic coast

Mapping the distribution of main cockle diseases at the EU level

Establishing a reference picture for future investigation



### SAMPLING STRATEGY

2 cohorts : 30 adults and 30 small cockles  
twice a year : before and after the spawning period

**METHOD** Histology



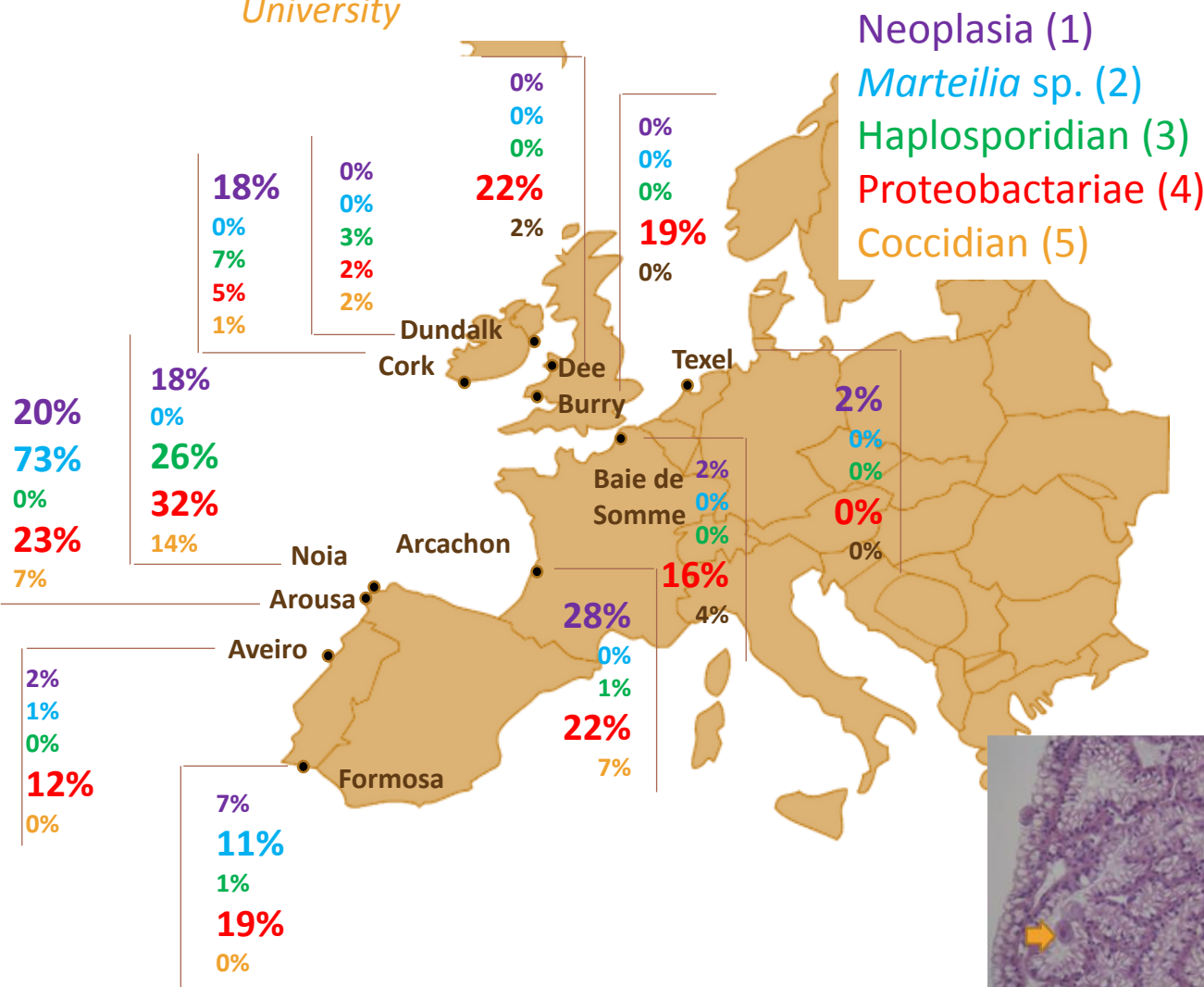
www.CipProject.info



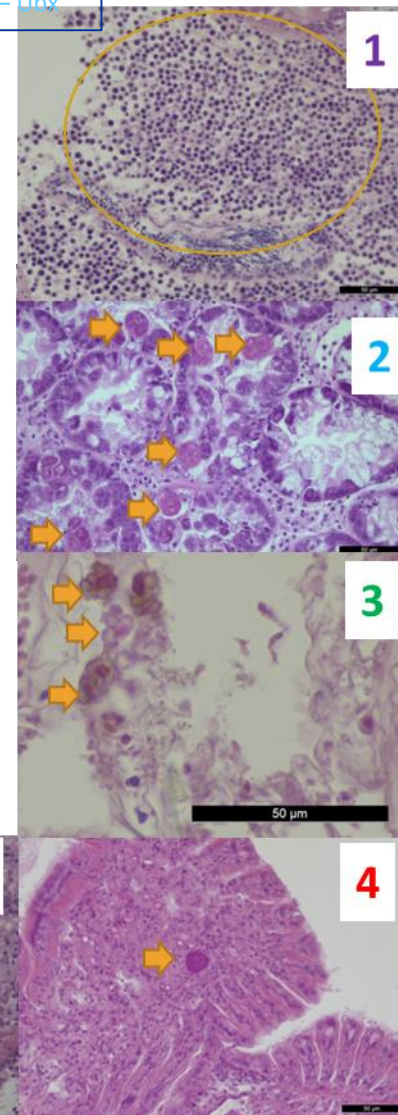
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Neoplasia (1)  
Marteilia sp. (2)  
Haplosporidian (3)  
Proteobactariae (4)  
Coccidian (5)



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ATLAS OF  
**PARASITES AND DISEASES  
OF THE COMMON COCKLE**  
*Cerastoderma edule*



CATÁLOGO DE  
**PARASITAS E PATOLOGIAS  
DO BERBIGÃO-VULGAR**  
*Cerastoderma edule*

**COME BACK ON WEDNESDAY!**



INVENTARIO DE  
**PARASITOS E ENFERMIDADES  
DO BERBERECHO**  
*CERASTODERMA EDULE*



ATLAS:  
**PARASITES ET MALADIES  
DE LA COQUE COMMUNE**  
*CERASTODERMA EDULE*

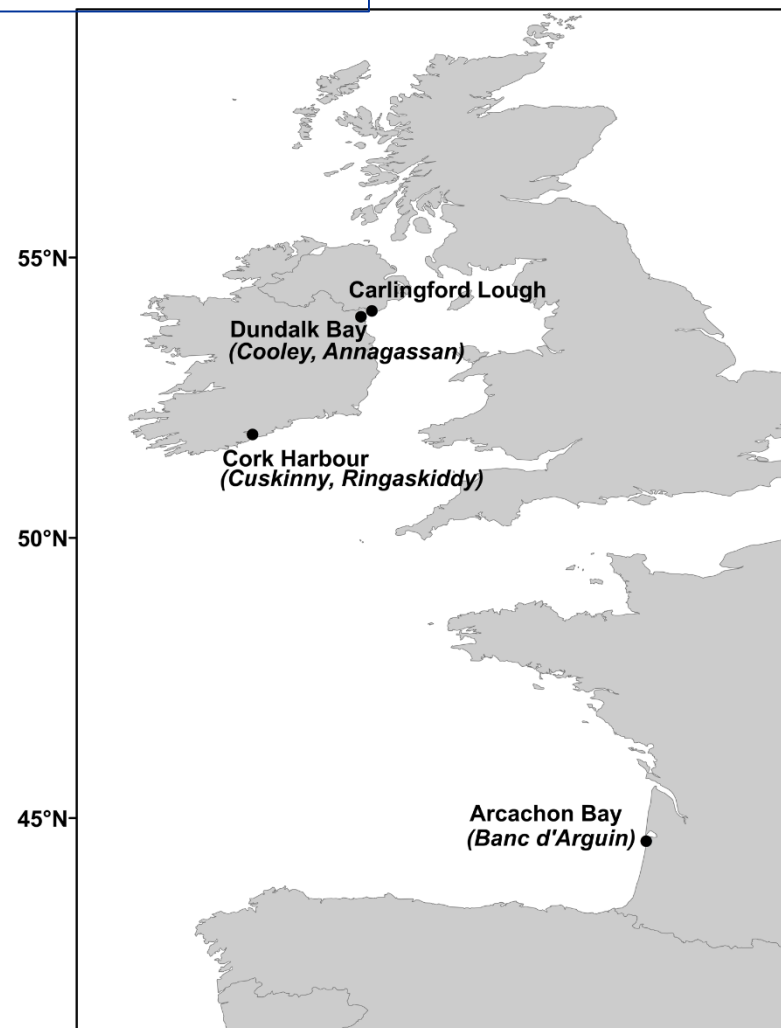


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# Macro and Microparasite Analy

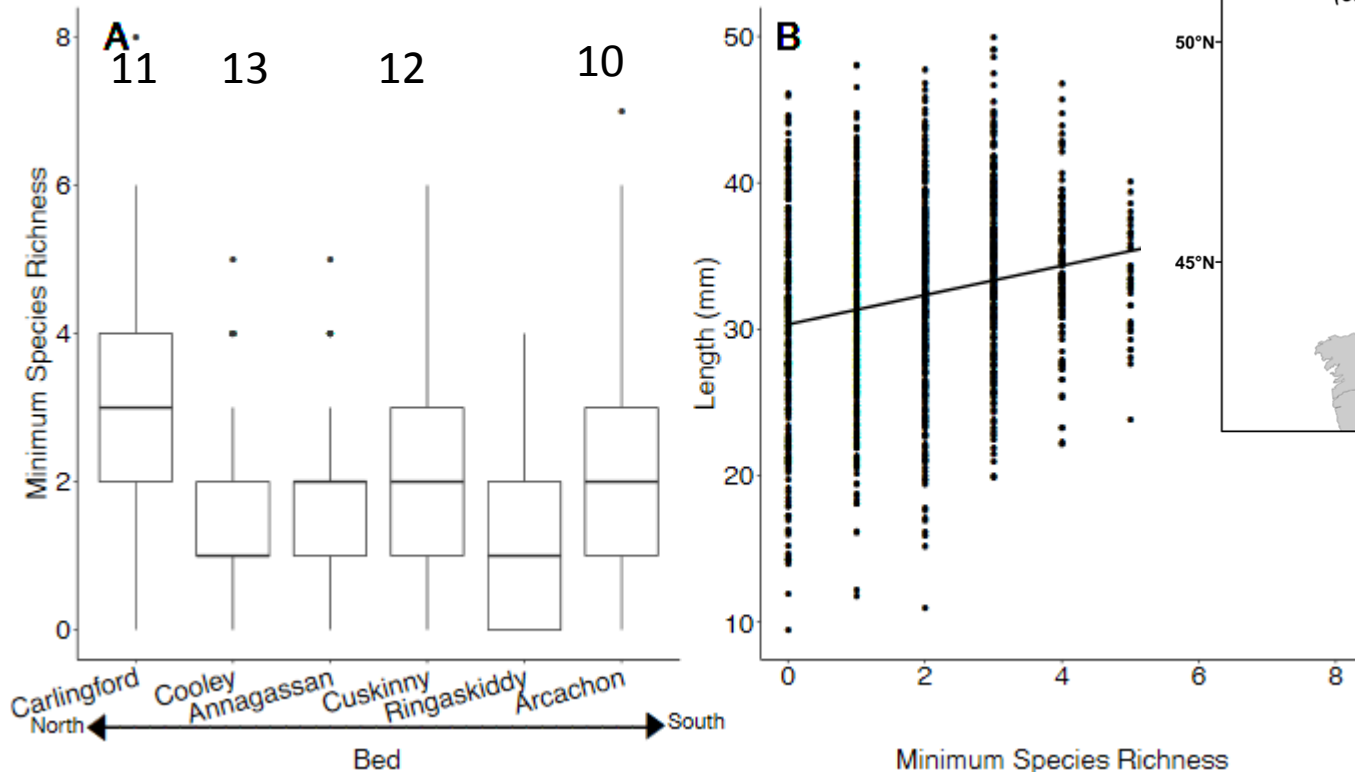
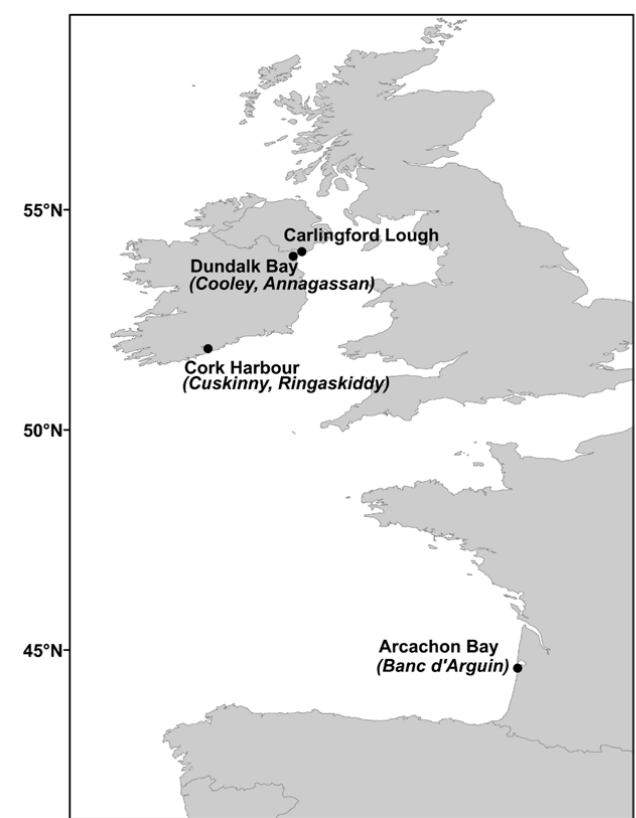
## Materials and Methods

- Sites from Ireland and France
  - Histology
- Species Richness of Parasites
- Associations between parasites
- Associations between parasites and their environment



*University College Cork (Mahony et al.)*

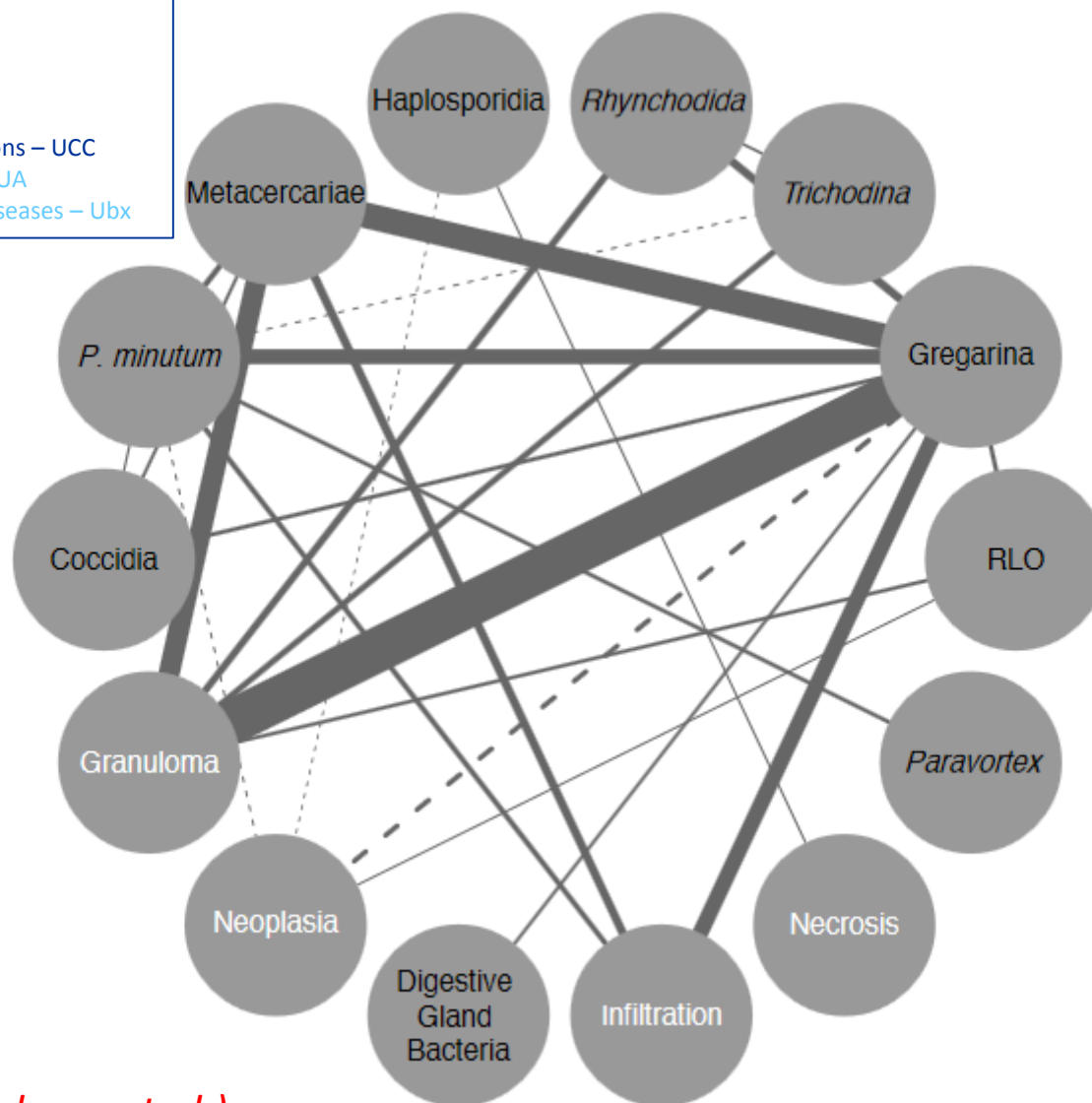
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## Species Richness

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## Species Associations



University College Cork (Mahony et al.)

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## Environmental Associations

Warmer water

*Rickettsiae* like  
*Trichodina*  
Sporocysts  
*Paravortex*

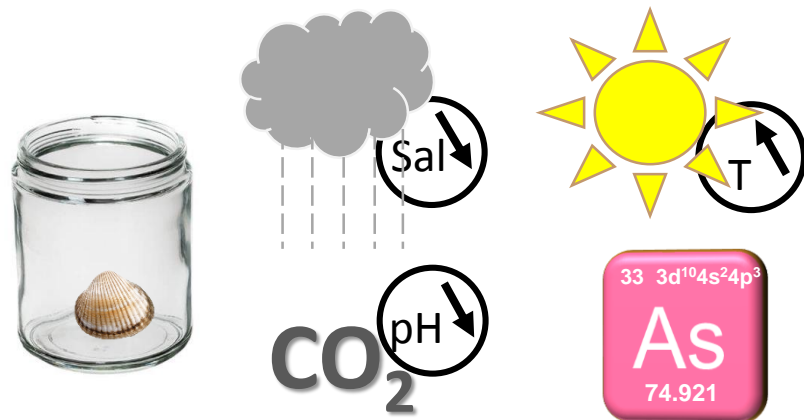


Low Salinity

Digestive gland bacteria  
Coccidia  
Metacercariae

# Parasite and biochemistry disorders: experimental approach

## 1. Exposure to different scenarios



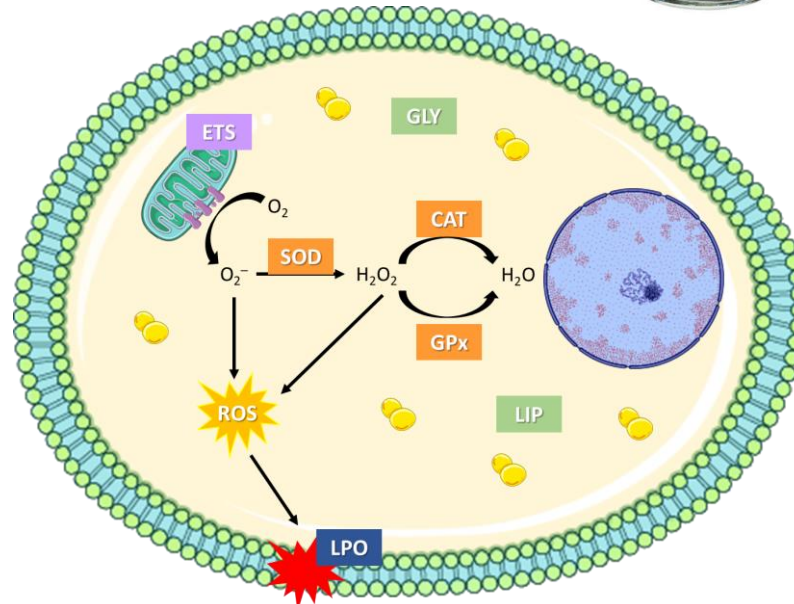
## 2. Parasite infestation

*Himasthla elongata*



## 3. Biochemical analysis

- Energy reserves
- Metabolic capacity
- Oxidative stress response
- Cellular damage





# Parasite and biochemistry disorders: experimental approach

## 1. Parasite infestation

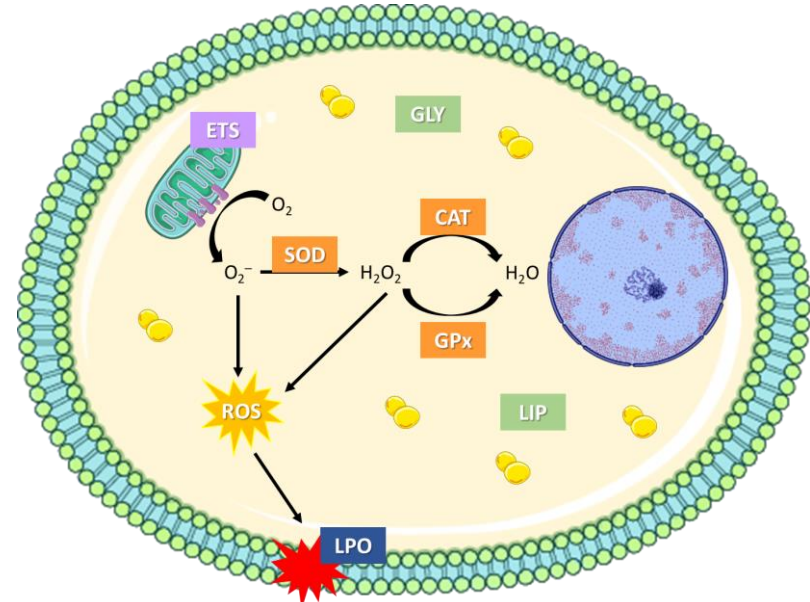


## 2. Physiological analysis



## 3. Biochemical analysis

- Energy reserves
- Metabolic capacity
- Oxidative stress response
- Cellular damage



# Parasite and biochemistry disorders: experimental approach

## Main findings

- Cockles exposed to lower salinity, higher temperature and lower pH presented **higher trematode infection**, modifying cockles' stress response to infection:
  - Lower antioxidant activity
  - Higher cellular damage
- Arsenic contamination did not influence infection success but modified cockles stress response to infection: interactive effects showed a surprising **antagonistic effect**:
  - Reduced host metabolism
  - Reduced cellular damage
- Infection success was different according to parasite species (higher for *H. elongata*) with different effects in the level of **oxygen consumption** and in the accumulation of **lipids and glycogen**

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# Parasite and biochemistry disorders: experimental approach

## Conclusions

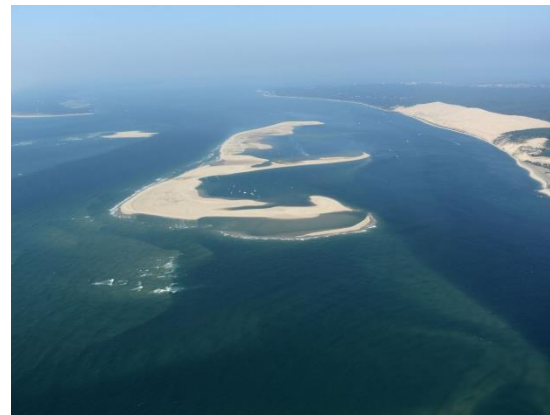
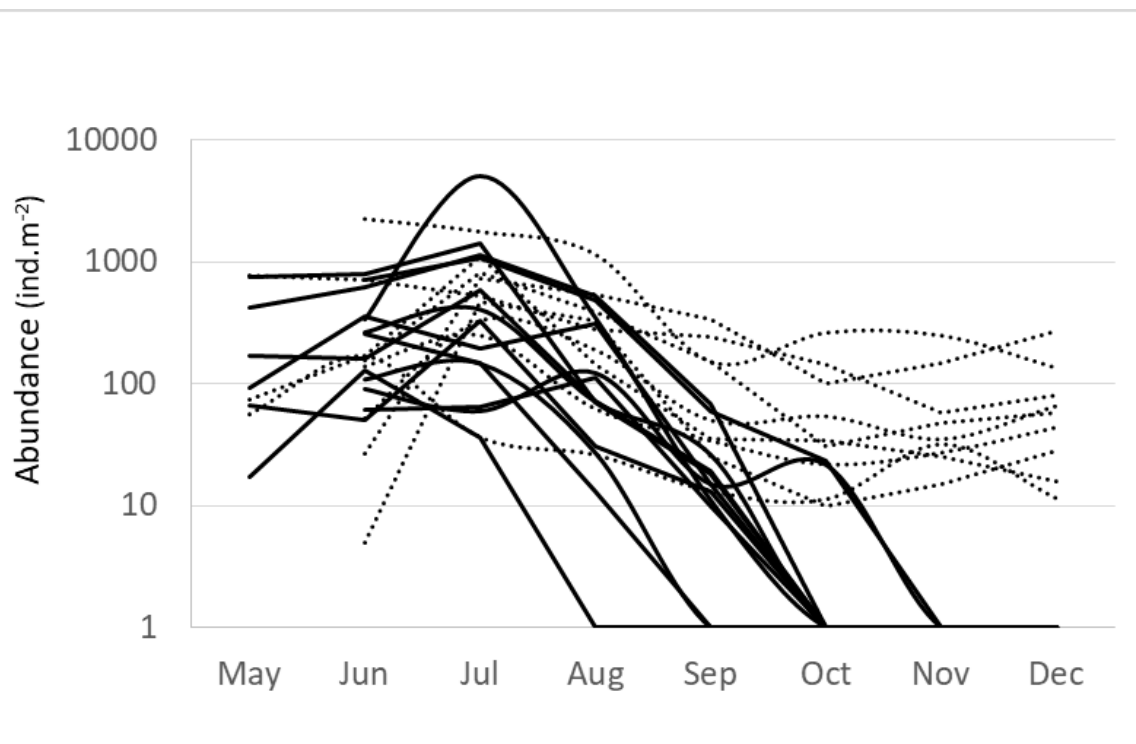
- According to sensibility to  $T^{\circ}$ , S, pH, climate change may promote the proliferation of the parasites infective stages in many ecosystems;
- Metacercariae, usually reported as having lower pathogenicity can also induce alterations on cockles regular biochemical performance;
- This negative impact seems to be trematode specific;
- In a contamination scenario, trematode infection may be beneficial to cockles, working as a protection for the pollutant accumulation in the organism.

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## Cockle cohort lifespan, growth and diseases

Data : Banc d'Arguin - 1998-2019 – Monthly sampling – Dynamics of PHS

### Cohort monitoring

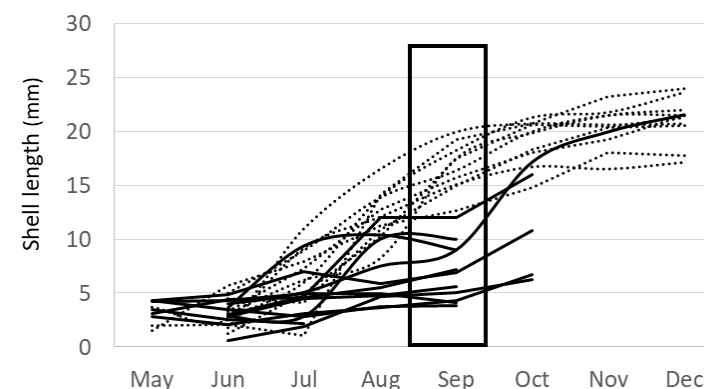


Parameter	Unit	Month	Mean (L vs. H)	F	p
Maximum cockle density ("0+ peak")	Ind.m <sup>-2</sup>		763<854	0.04	0.853
Date of "0+ peak"			12 Jun<5 Ju	5.50	0.029
Shell length	mm	Jun	3.2=3.2	0.00	0.984
		Jul	6.7>4.6	3.95	0.060
		Aug	12.9>6.3	29.1	<0.001
		Sep	16.6>7.3	34.0	<0.001
Shell growth rate	µm.d <sup>-1</sup>	Jun to Aug	24.7>11.4	7.95	0.011
		Jul to Sept	16.1>8.0	4.29	0.051
Recruitment date			15 May<20 May	0.41	0.530
Air temperature	°C	Jun	24.3>23.7	0.37	0.552
		Jul	25.0<25.9	1.50	0.235
		Aug	25.8=25.8	0.02	0.905
Water temperature	°C	Jun	17.6<17.9	0.46	0.505
		Jul	19.9<20.0	0.03	0.864
		Aug	21.0<20.8	0.17	0.685
Salinity		Jun	34.2>33.9	1.12	0.302
		Jul	34.5>34.3	1.04	0.321
		Aug	34.7>34.5	1.20	0.277
<u>Chla</u>	µg.L <sup>-1</sup>	Jun	1.76<1.82	0.11	0.740
		Jul	1.62<1.79	0.59	0.451
		Aug	1.58>1.51	0.15	0.701
Parasite abundance	Metacercariae.cockle <sup>-1</sup>	Jul	2.1>1.5	0.46	0.507
Predator abundance	Knots.mo <sup>-1</sup>	May	330>138	7.76	0.013
		Jun	73>12	5.70	0.030

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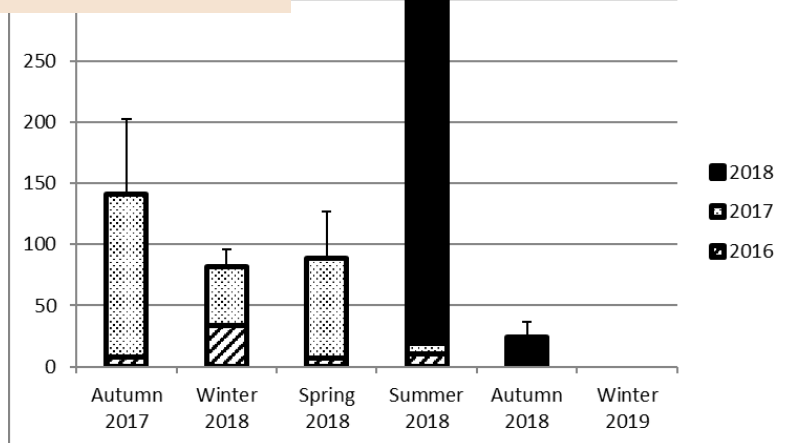


*University of Bordeaux (de Montaudouin et al.)*

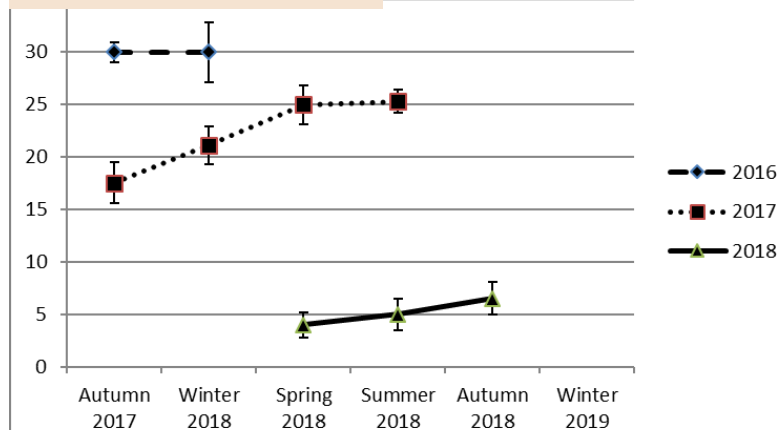


# Study case : collapse in Banc d'Arguin

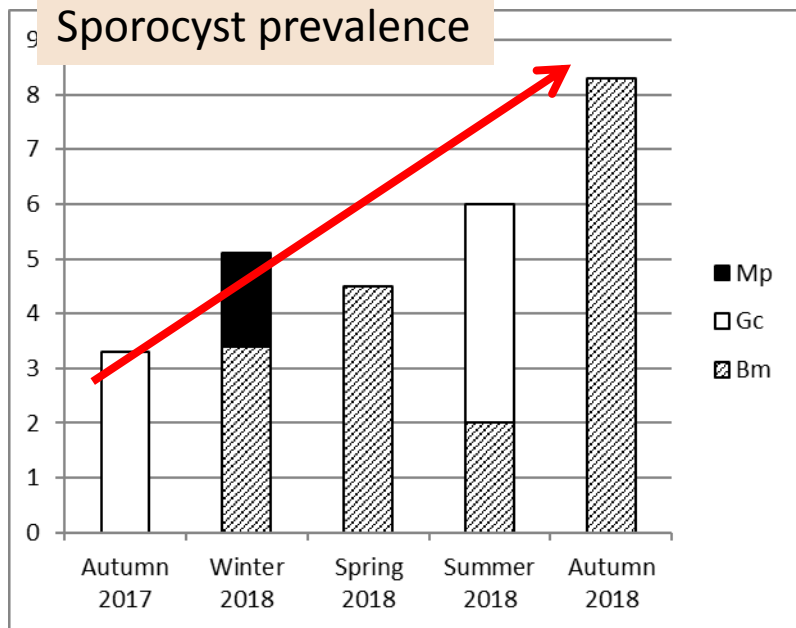
## Abundance/m<sup>2</sup>



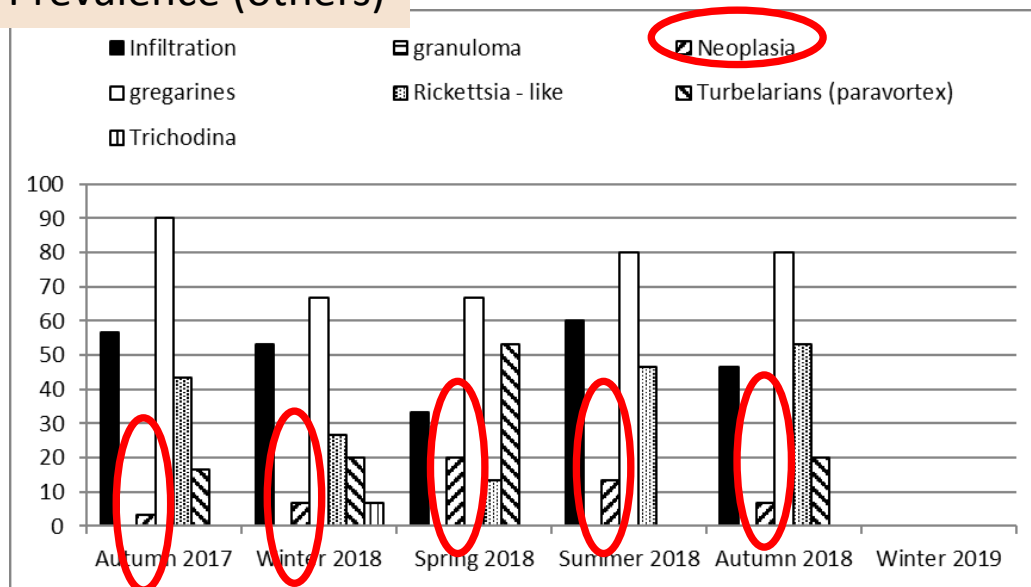
## Shell length mm<sup>2</sup>



## Sporocyst prevalence



## Prevalence (others)



University of Bordeaux, CNRS, Ifremer

## References

de Montaudouin, X, Grimault, S., Grandpierre, M., ., Garenne, A. (In Rev.) Juvenile growth deficit as an early alert of cockle (*Cerastoderma edule*) mortality, Marine Ecology Progress Series.

Magalhães L., de Montaudouin X., Figueira E., Freitas R. (2018) Trematode infection modulates cockles biochemical response to climate change. Science of the Total Environment, 637-638, 30-40, DOI: 10.1016/j.scitotenv.2018.04.432

Magalhães, L., de Montaudouin, X., Figueira, E., Freitas, R. (2018) Interactive effects of contamination and trematode infection in cockles biochemical performance. Environmental Pollution, 243, 1469-1478, DOI: 10.1016/j.envpol.2018.09.102

Magalhães, L., de Montaudouin, X., Freitas, R. (2020) How costly are metacercarial infections in a bivalve host? Effects of two trematode species on biochemical performance of cockles. Journal of Invertebrate Pathology, DOI: 10.1016/j.jip.2020.107479

Mahony, K.E., Lynch, S.A., de Montaudouin, X., Culloty, S.C. (In Rev.) Extrinsic and intrinsic drivers of parasite prevalence and parasite species richness in an ecosystem engineer, Ecology and Evolution.