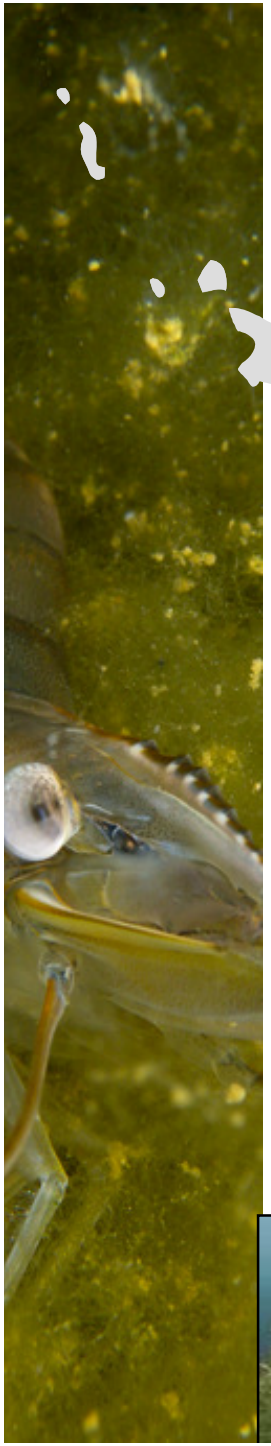


Orange gills in *Litopenaeus stylirostris*: a new phenomenon in caledonian shrimp ponds

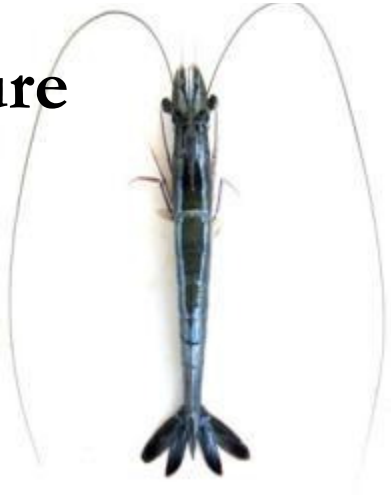
Wabete N.[1], Lemonnier H.[1], Barri K.[3], Pham D.[1], Boulo V.[1], Royer F. [1], Hubert M. [1], Laugier T. [1], Lignot J.H.[4], Pierrot T.[2], Blockmans B.[3], Tostin N.[3]

[1] Lagon, Ecosystème et Aquaculture Durable, IFREMER, Boulouparis, New Caledonia
[2] Centre Technique Aquacole, ADECAL/Technopole, New Caledonia
[3] Groupement des Fermes Aquacoles, New Caledonia
[4] Equipe Adaptation Ecophysiologique et Ontogenèse, UMR 5119, Ecosym, UM2, Montpellier, France

Aquaculture 2015, 20th-22th July , Brisbane



Characteristics of caledonian aquaculture



Alien species imported from Panama

Litopenaeus stylirostris

More than 55 generations of captive broodstock

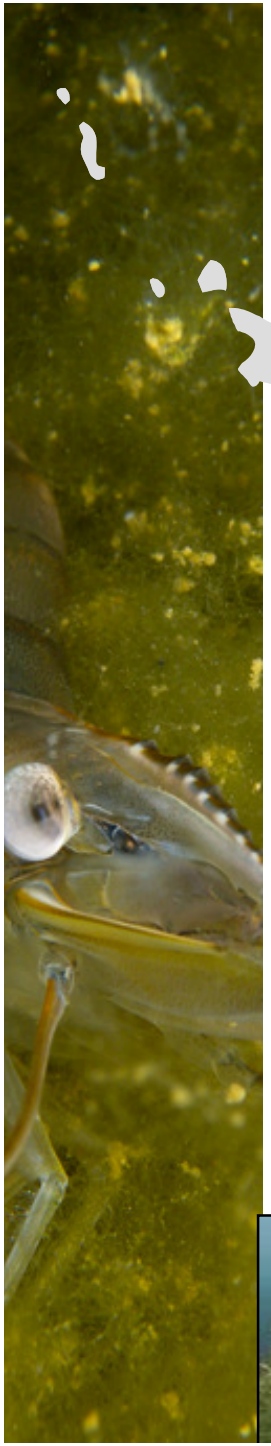
Less than **0,4% of shrimp world market**

→ 7.2 million metric tons

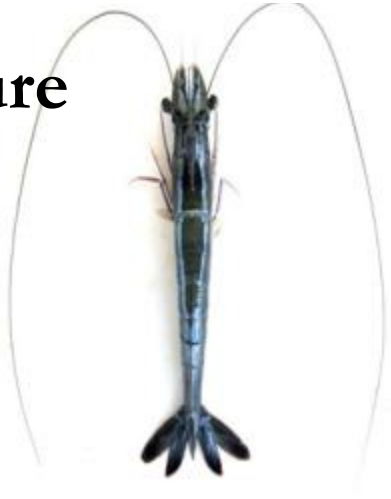
FAO data, 2014



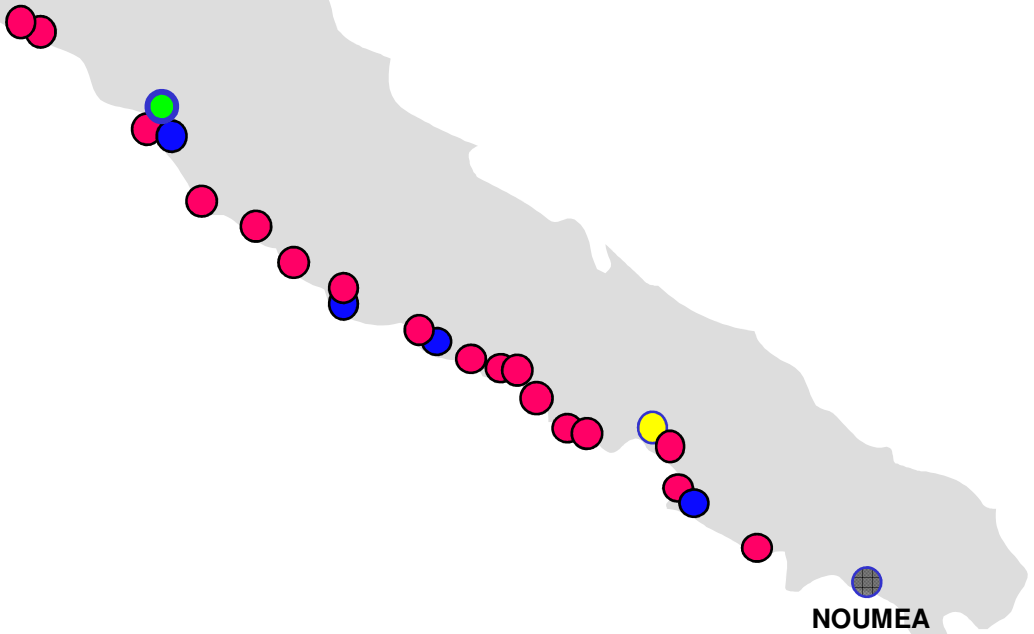
isbane



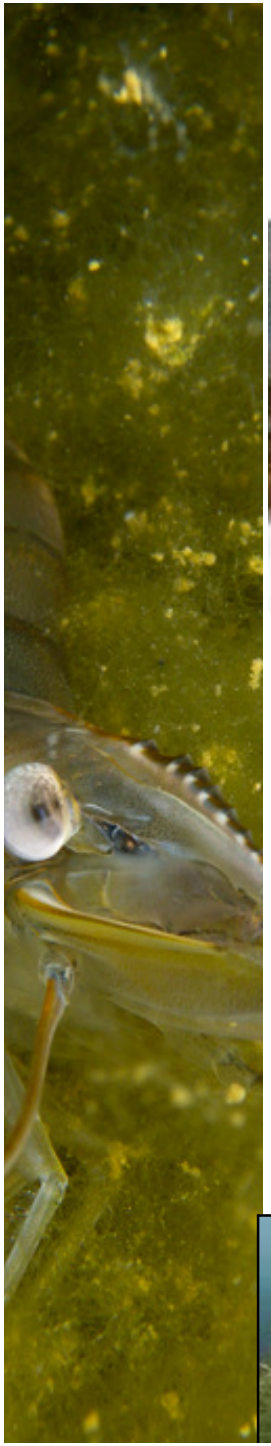
Characteristics of caledonian aquaculture



- 4 Hatcheries (200 M PL)
- 18 Farms (700Ha)
  - earthen pond (5-10Ha)
  - semi-intensive conditions (20 PL/m^2)

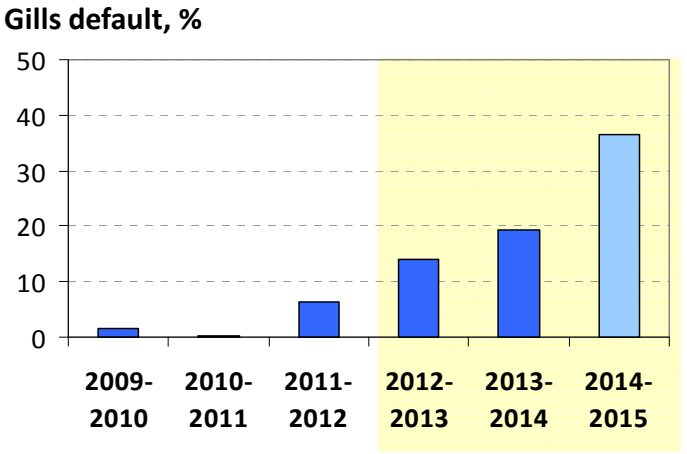




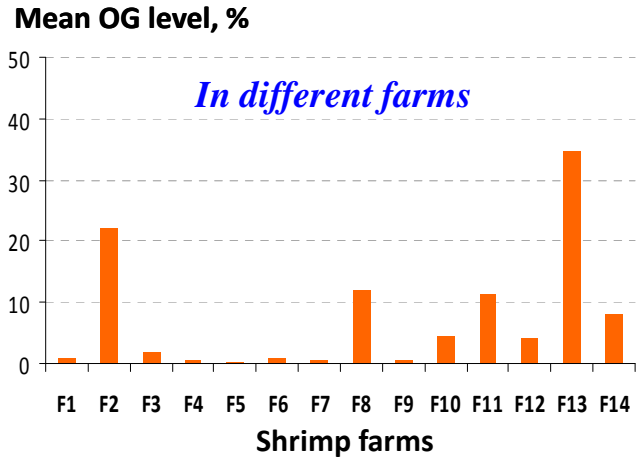


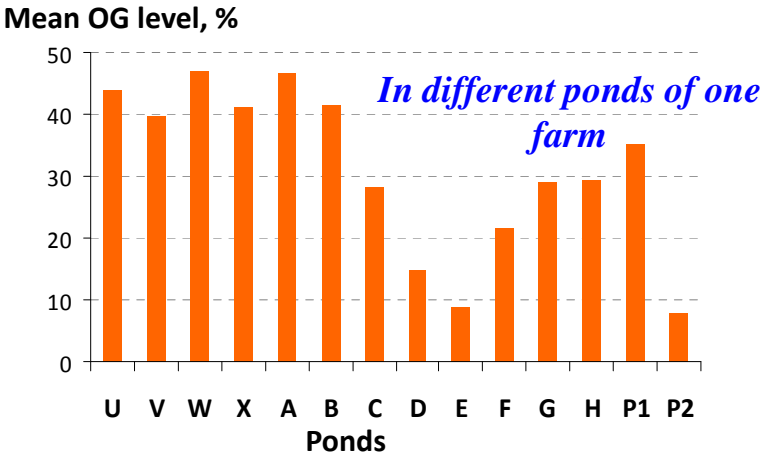
Orange Gills in shrimp ponds





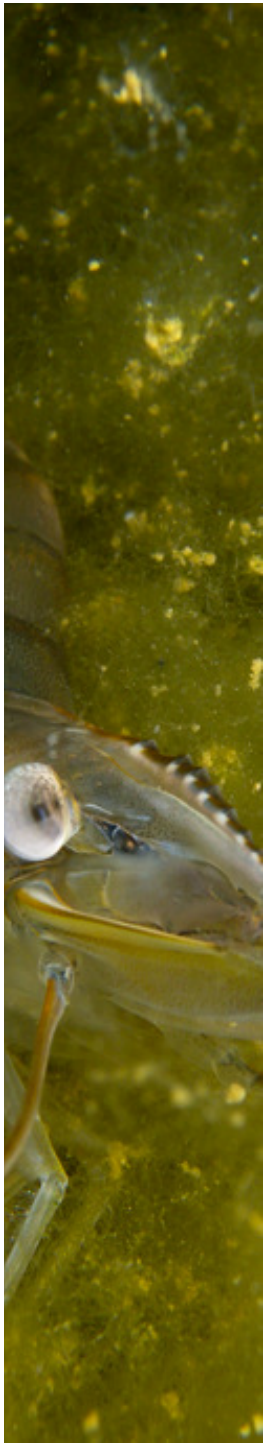
- Increase level of gills default since 2012
- Potential farm and/or pond effect





Can cause high economic impact for farmers





Caracterization of « Orange Gills » Phenomenon



Evaluation in shrimp Farm

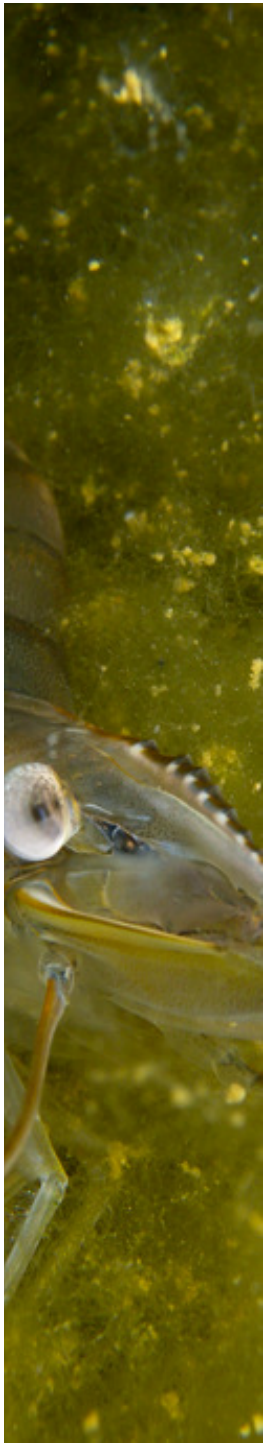
Moult cycle influence



Gills analysis



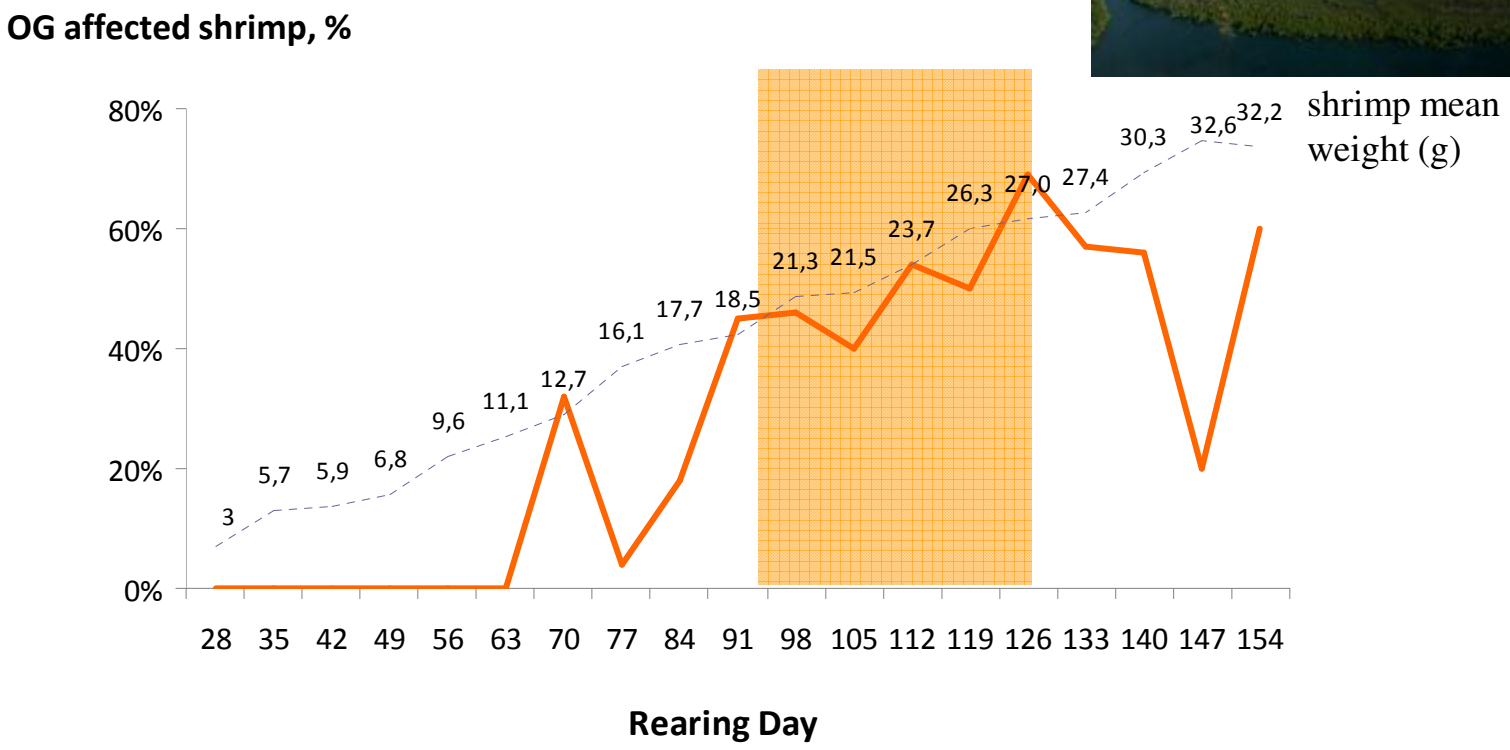
Environmental conditions



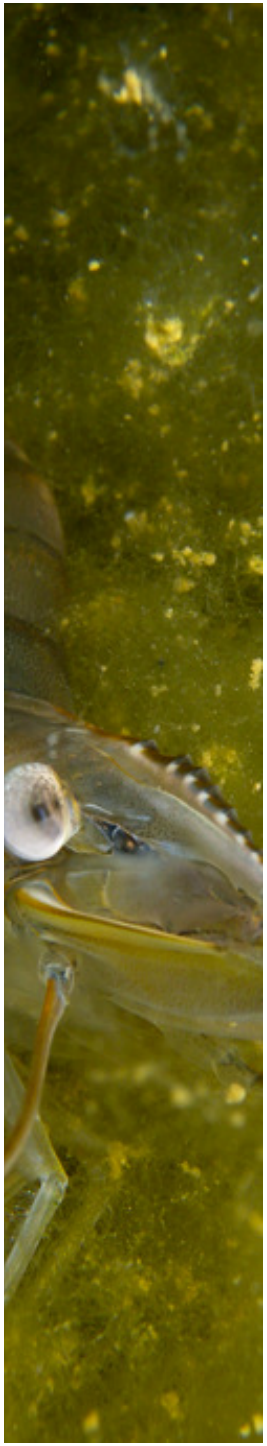
Orange Gills occurrence in shrimp ponds

One shrimp farm

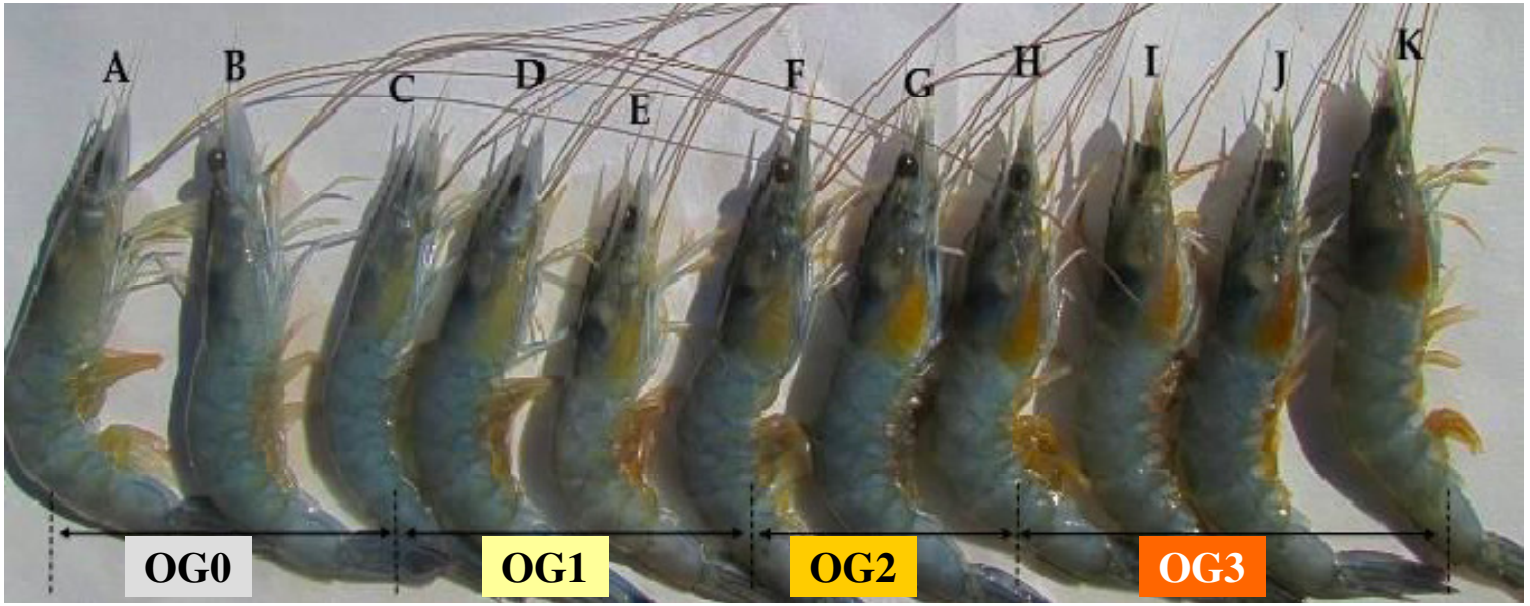


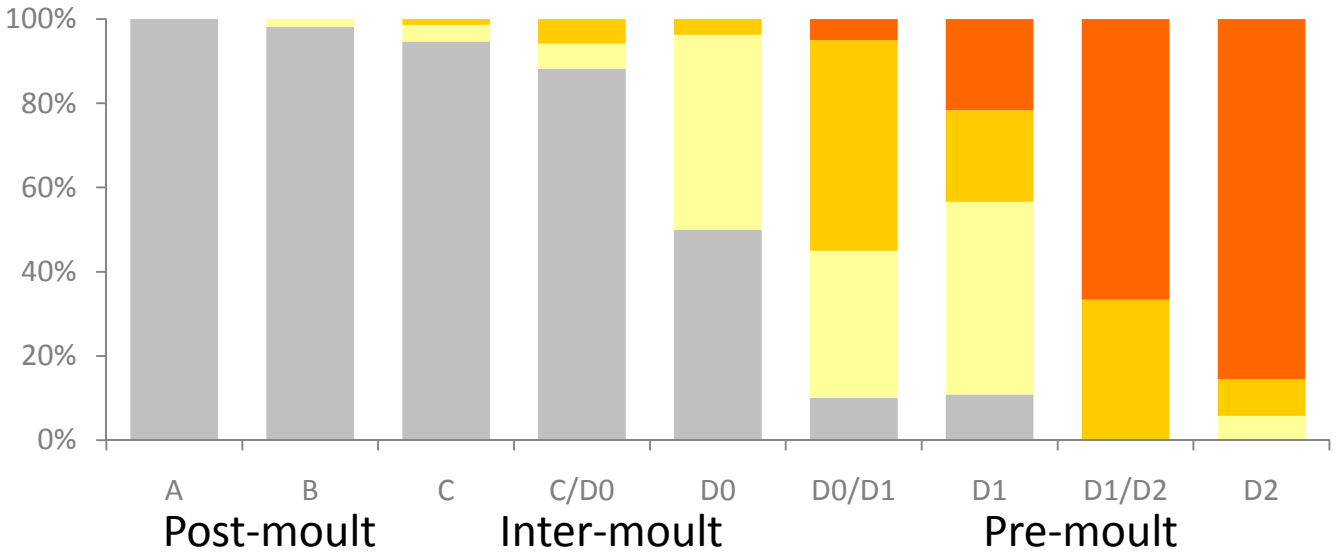


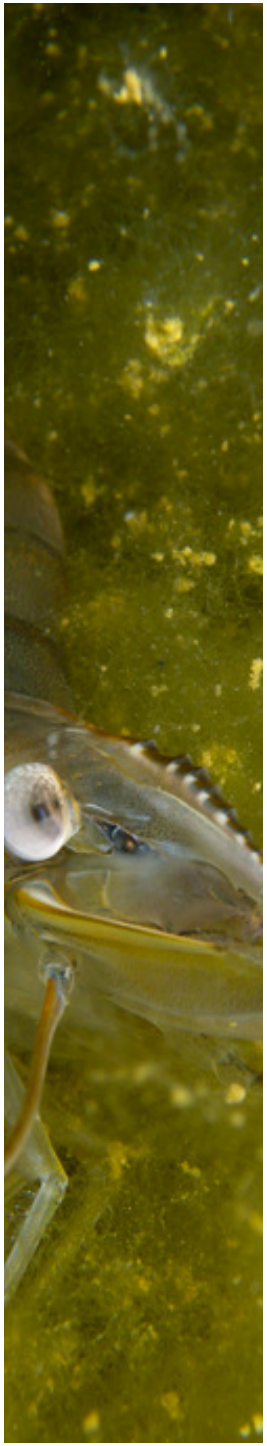
Occurence during rearing (after 70-80d) and increase (up to 75%)



Moulting cycle influence







Histological analysis

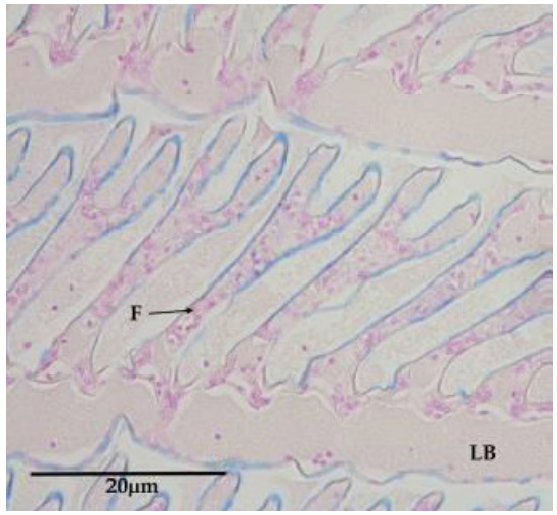
Control





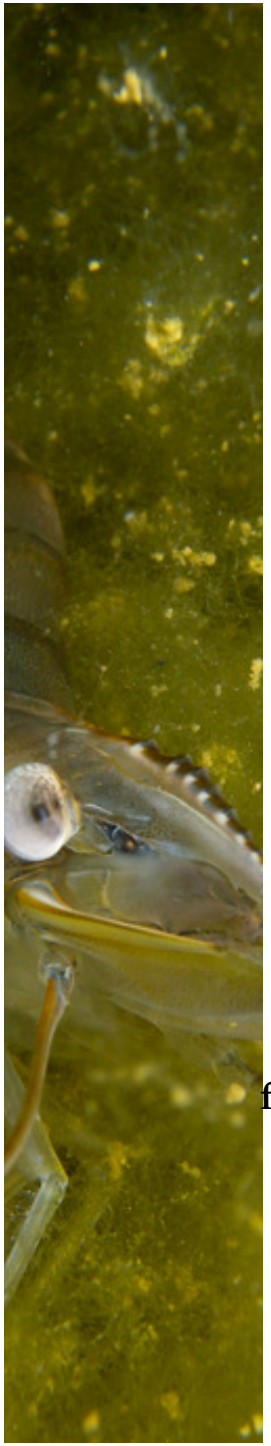
Orange Gills





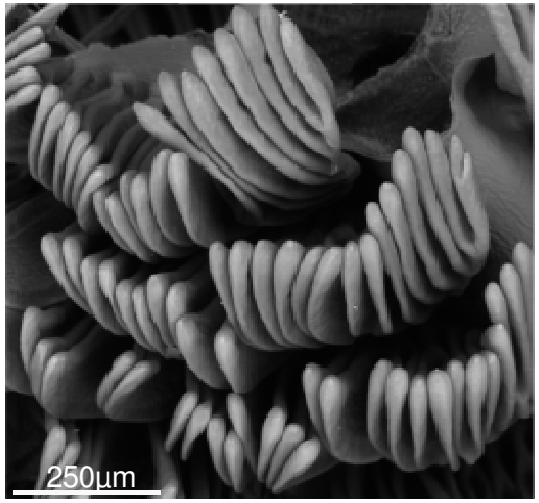
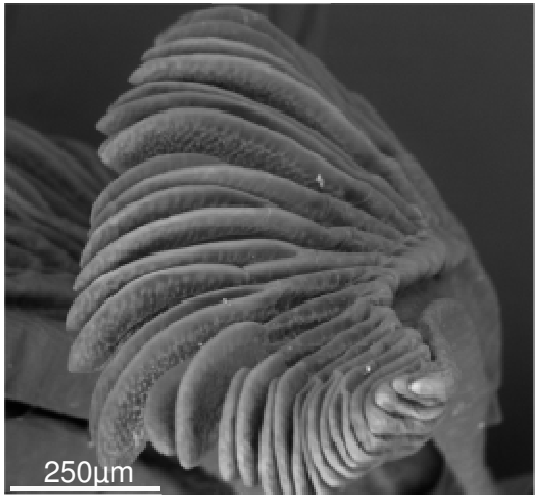
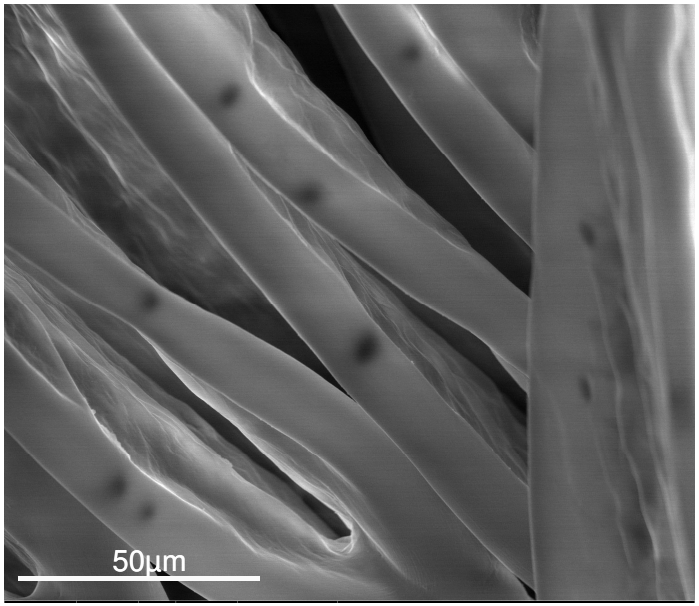
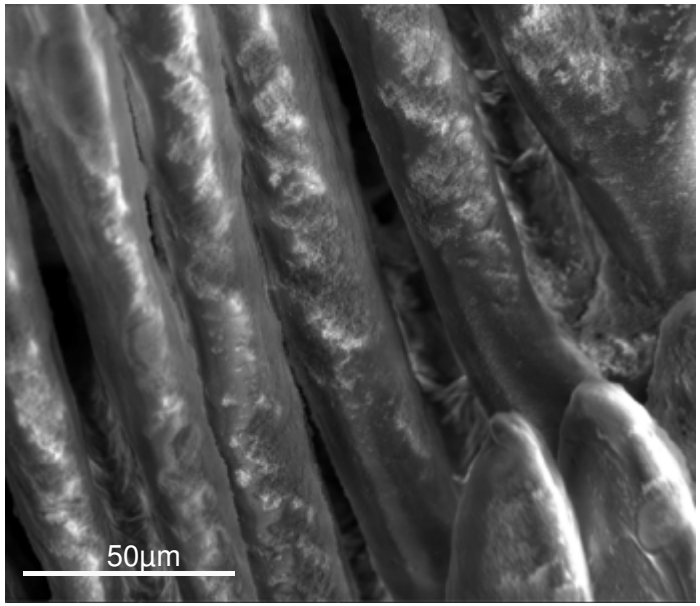
Orange colour located only upon gills in the branchial cavity

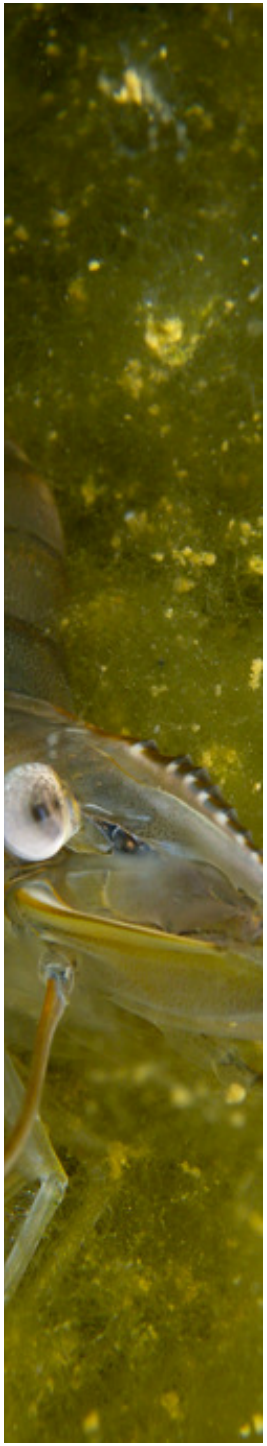
Perl's Iron Stain reveals the presence of IRON on gills (blue color)



Gills analysis : Topography and morphology

Scanning Electron Microscopy

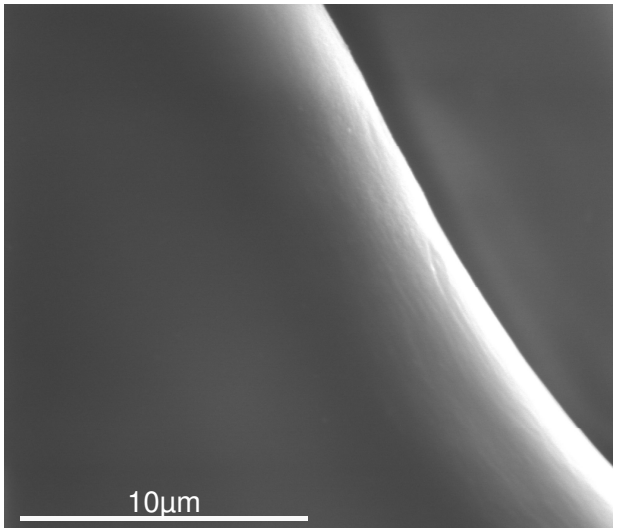
	Control	Orange Gills
Gills		
Gill filaments		

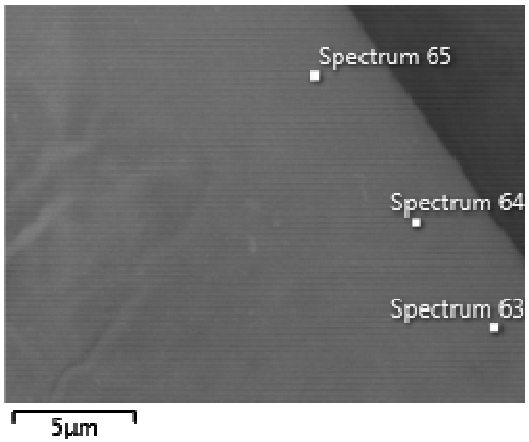


Gills analysis : Topography and morphology

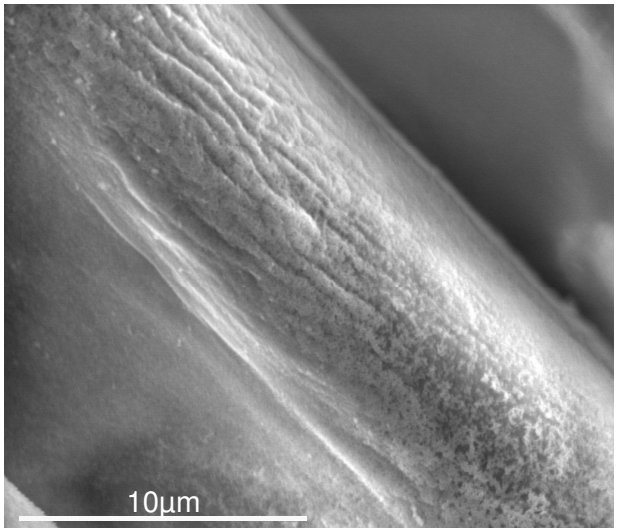
Scanning Electron Microscopy

Control



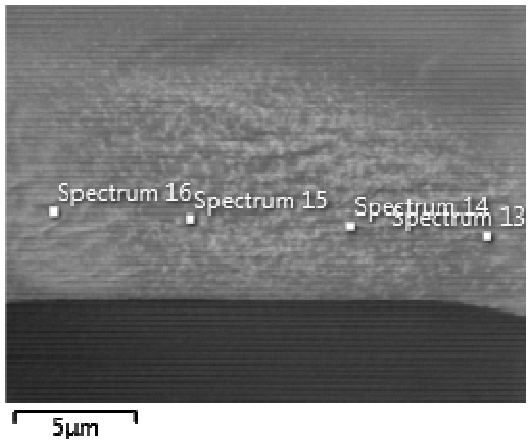


Orange Gills



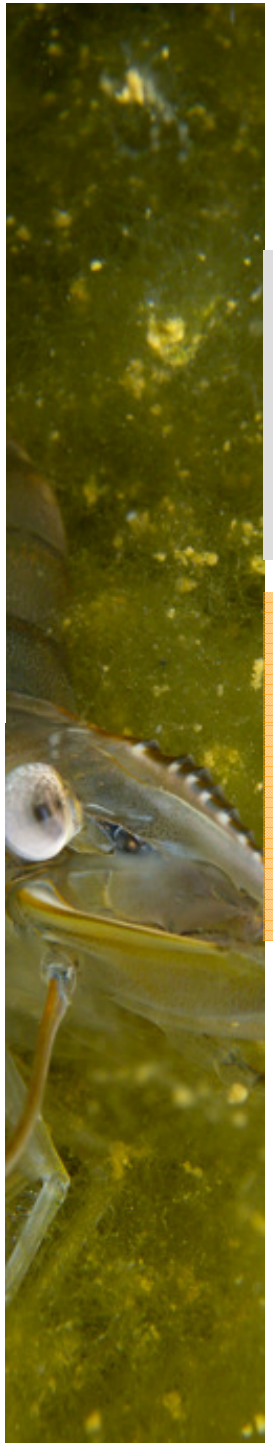
4 spots

of 3 areas

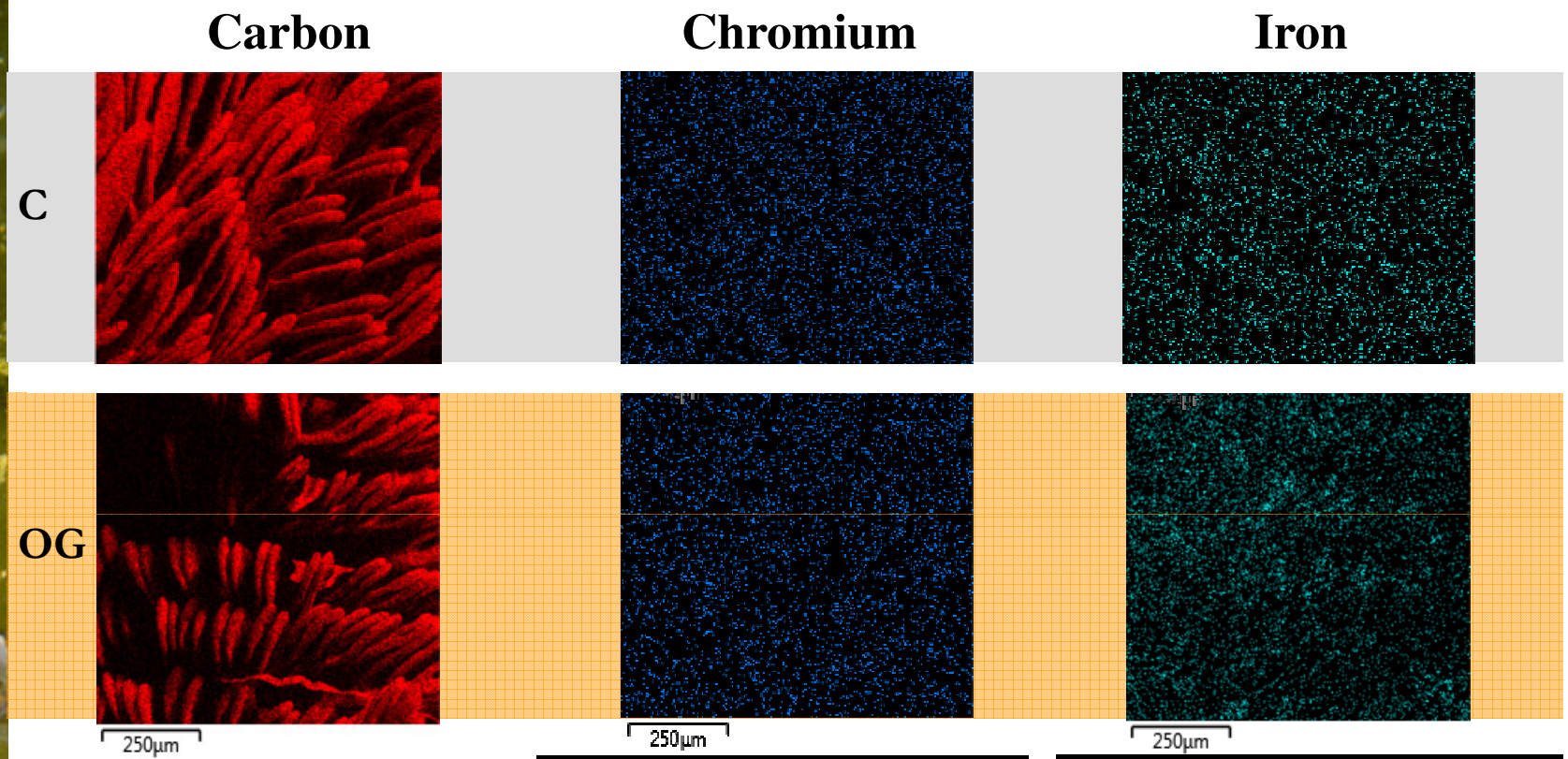


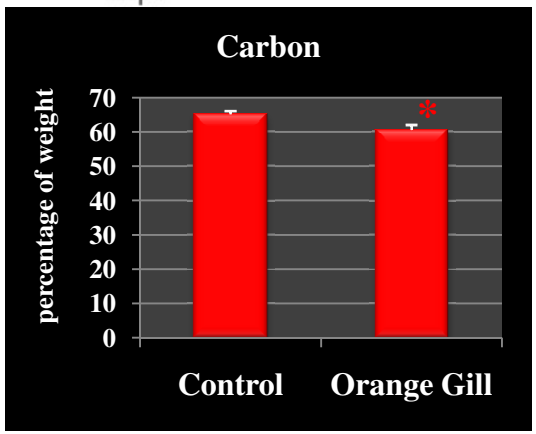
In 4 spots of 3 areas selected on gills sample of each case

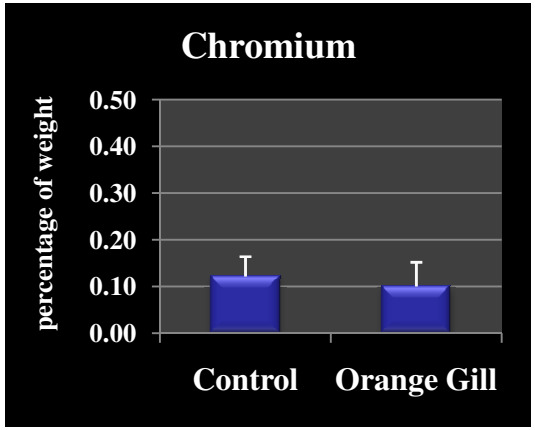
→ Micro-analysis of 17 chemical elements (ESEM)

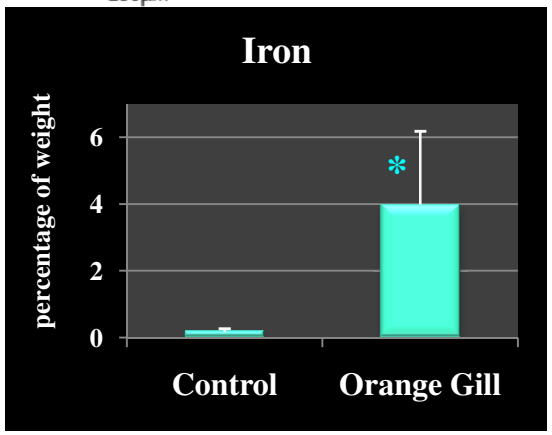


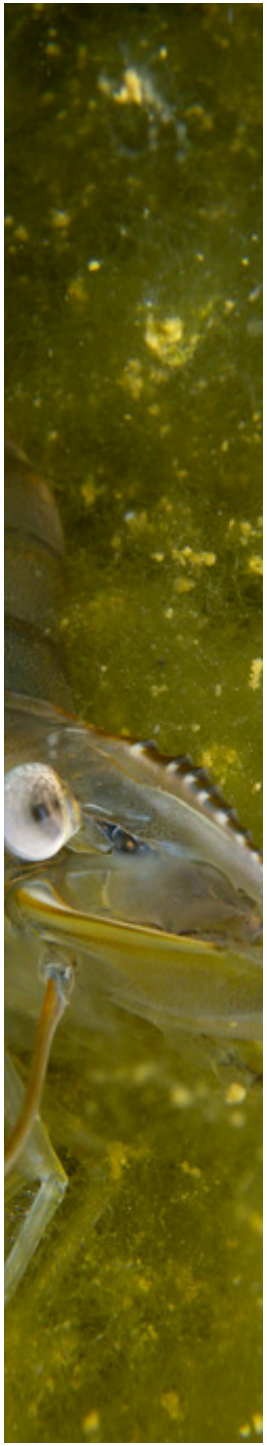
Chemical micro analysis (ESEM)





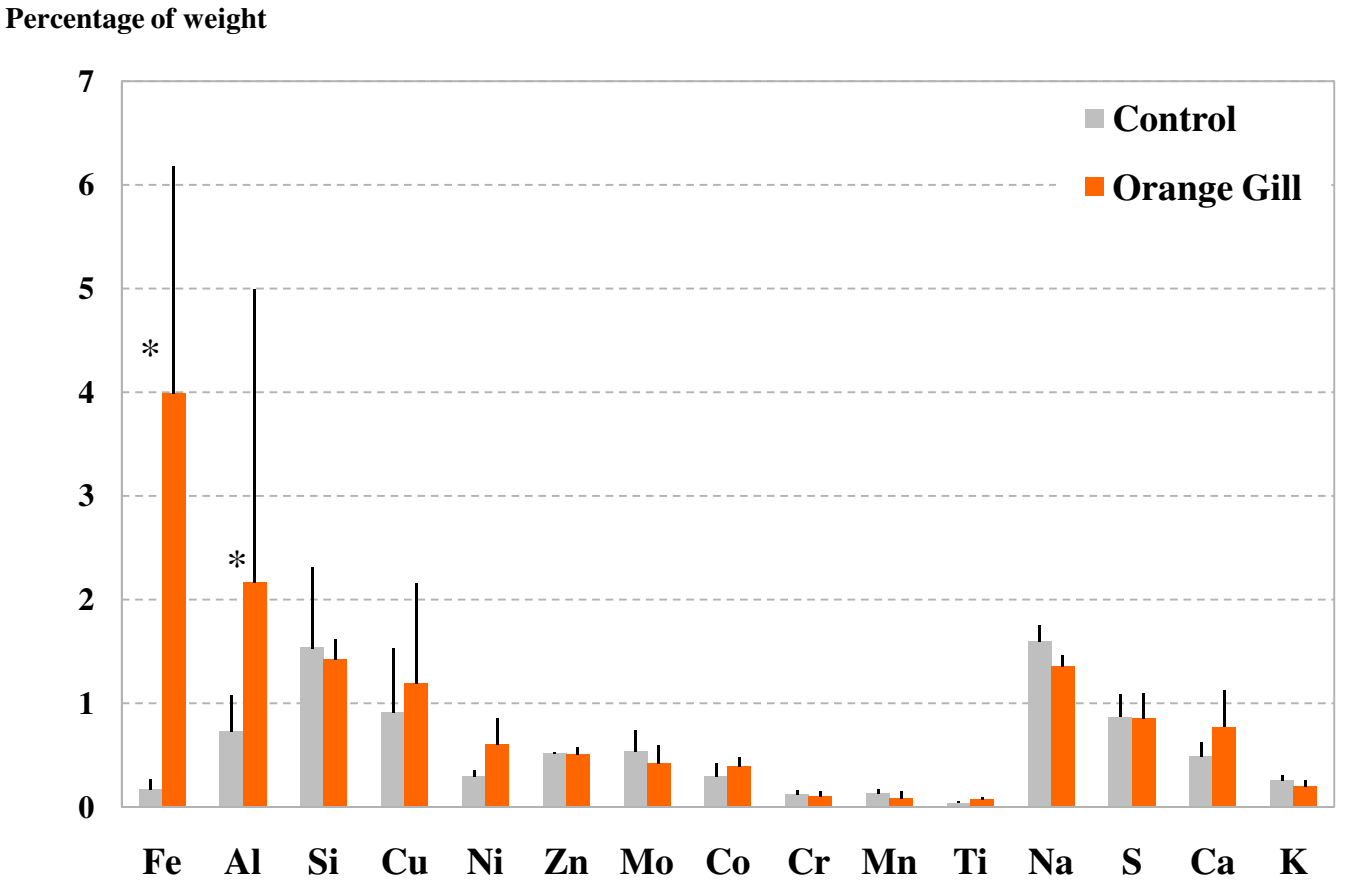




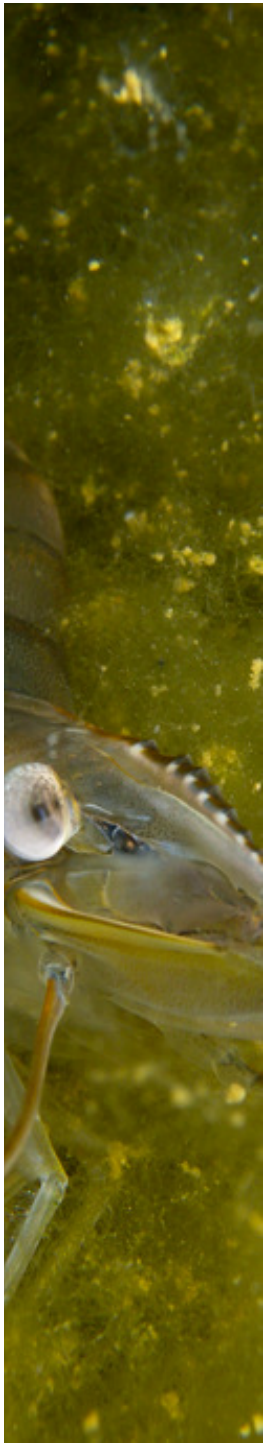


Chemical micro analysis (ESEM)

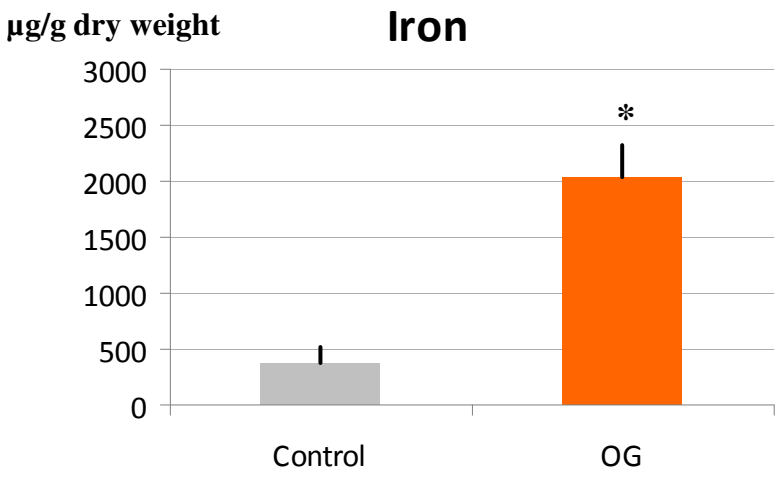
Relative rate of different elements analysed (except C & O)



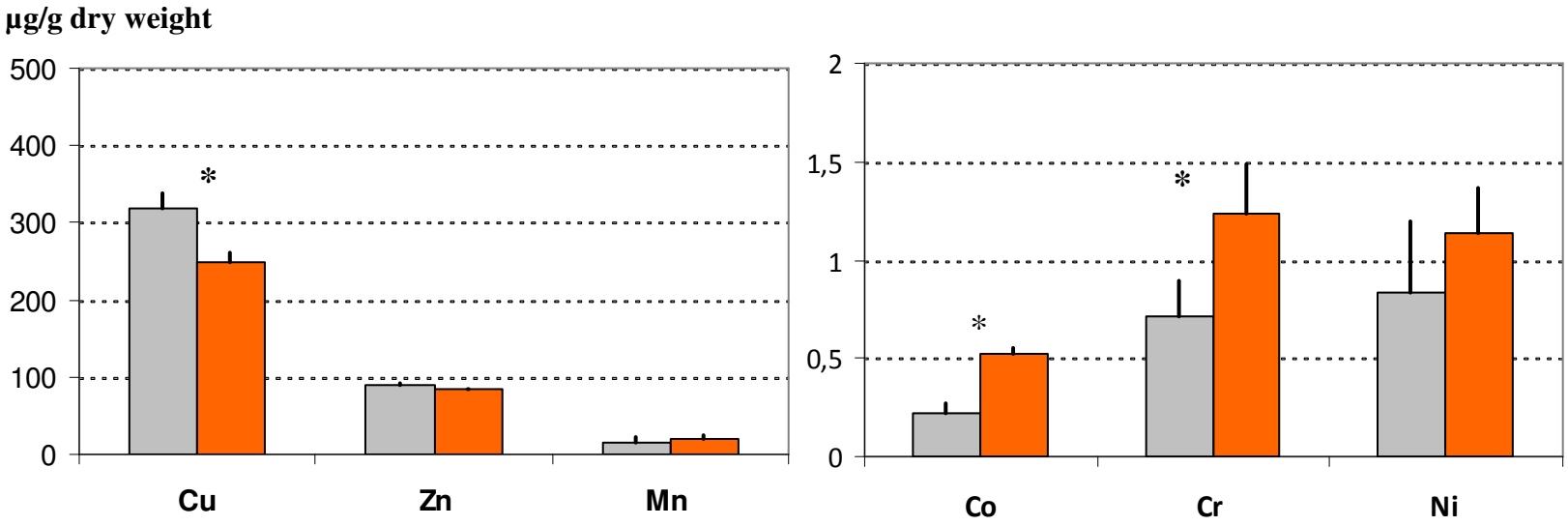
A significant difference in composition
They represent 14% in OG and 8.5 % in Control

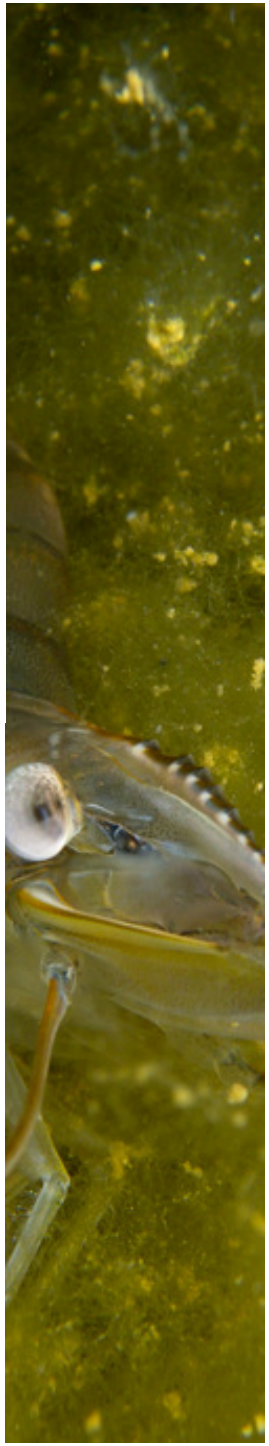


Chemical analysis in whole Gills



Iron level is **4 fold** higher than in control





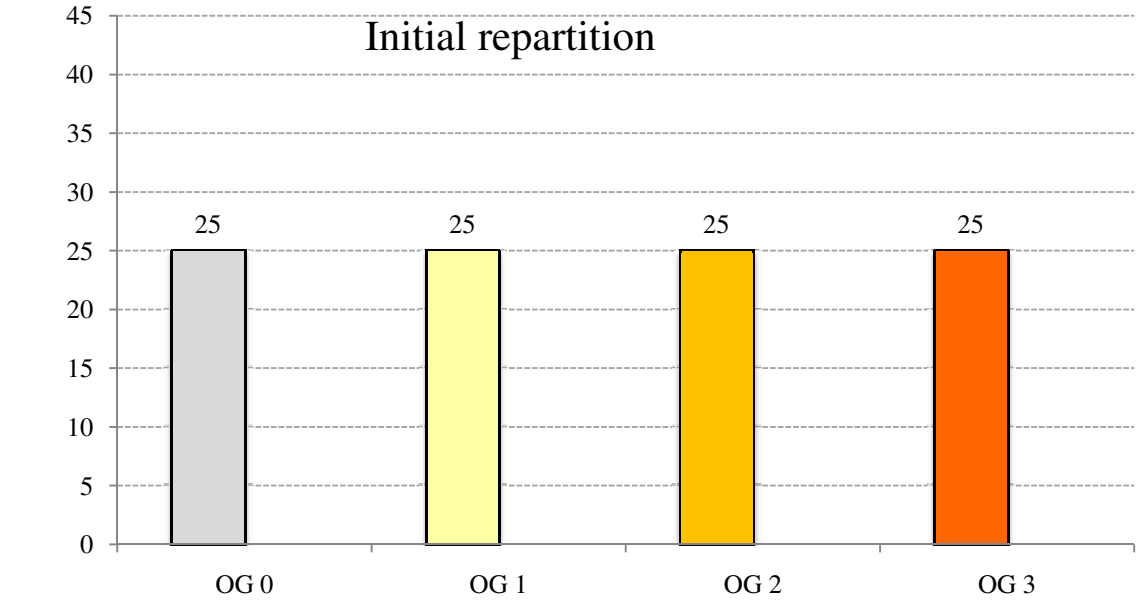
Iron origin : water or sediment

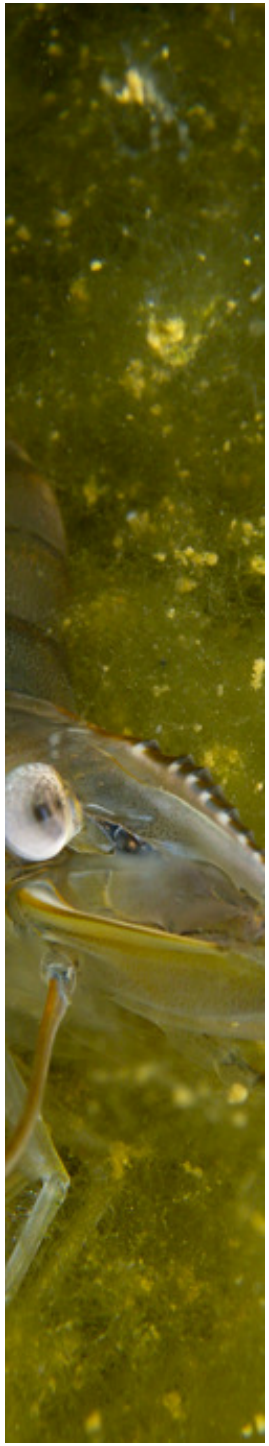
- Individual labelling according to gills colour
- Floating cage : no contact with pond bottom
- 3 weeks (moulting cycle)
- Same zoo-technical conditions than Pond











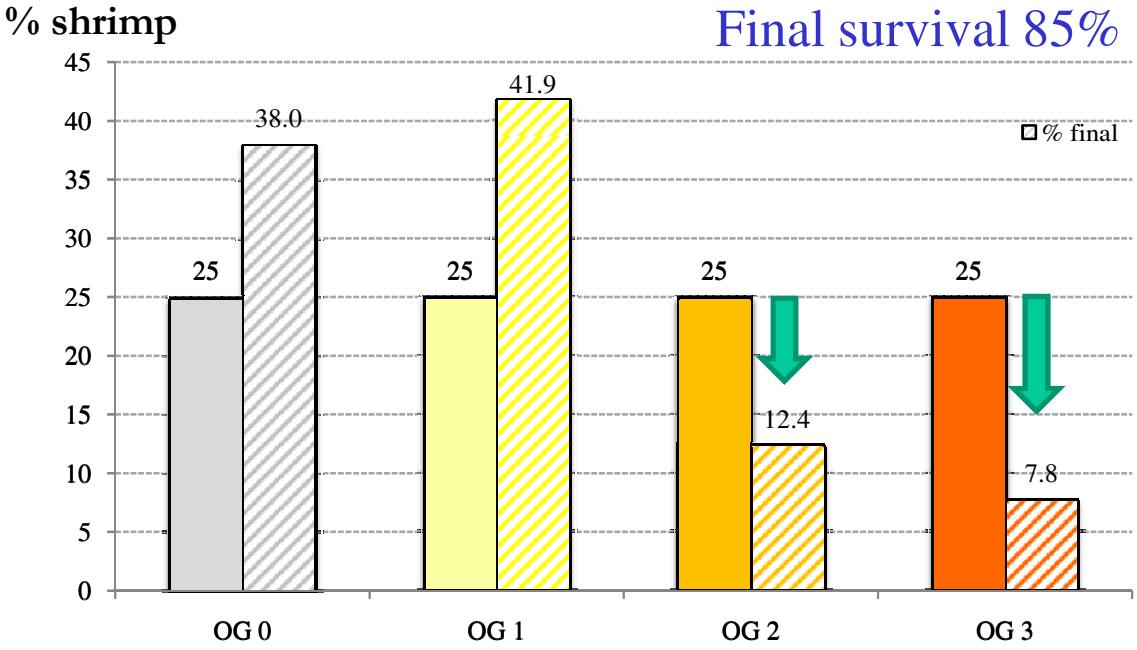
Iron origin : water or sediment

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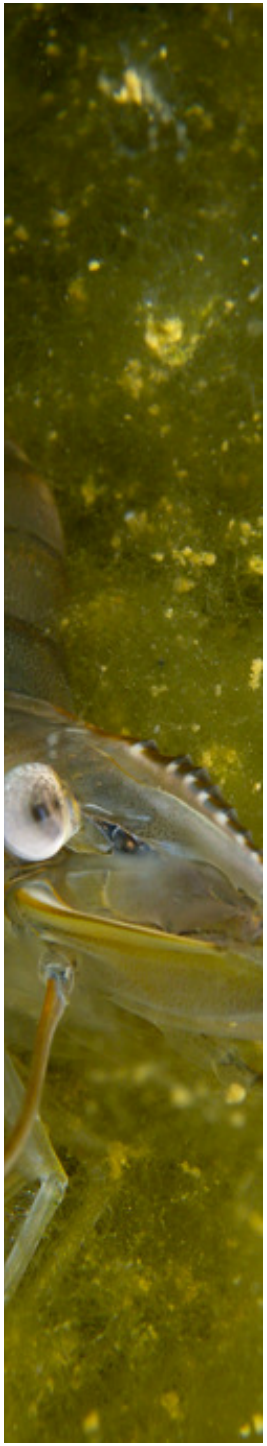






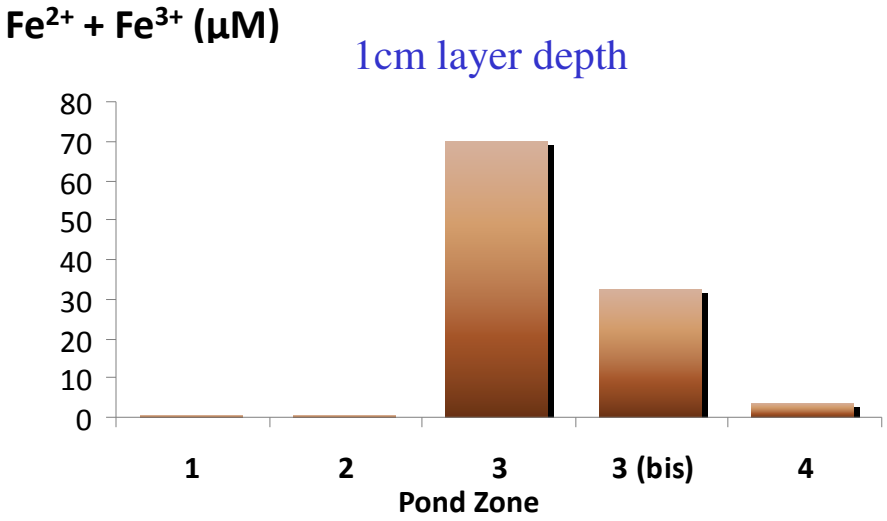


→ **Iron origin in sediment**

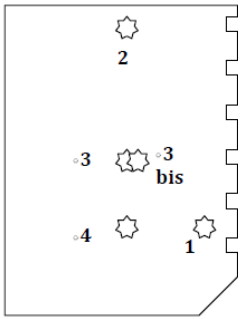


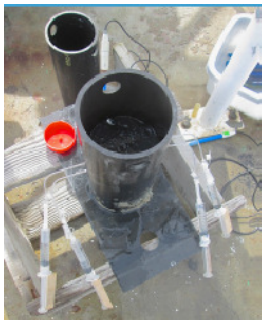
Dissolved iron : in sediment pore water

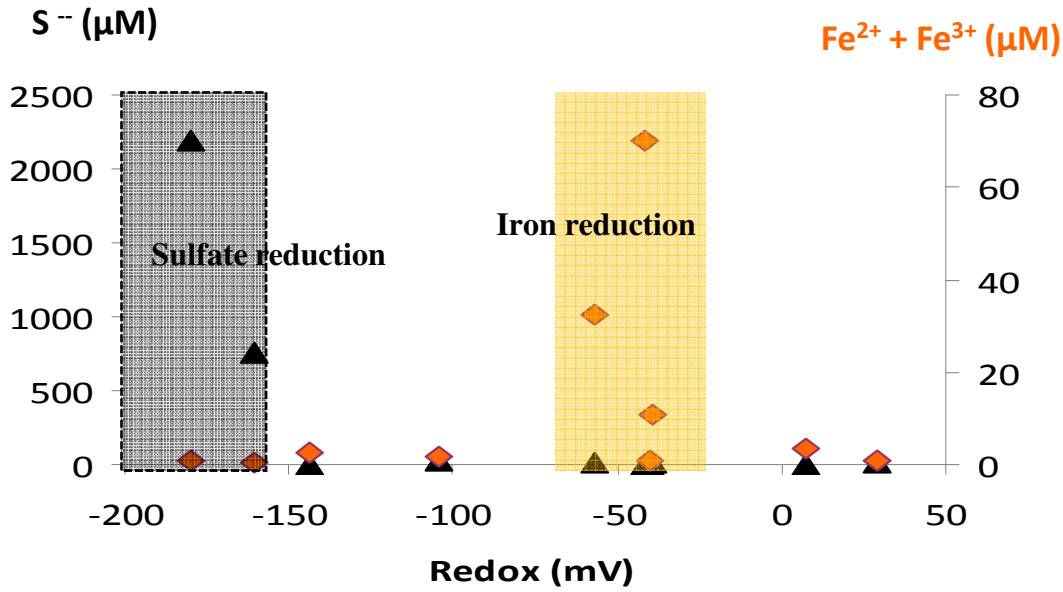


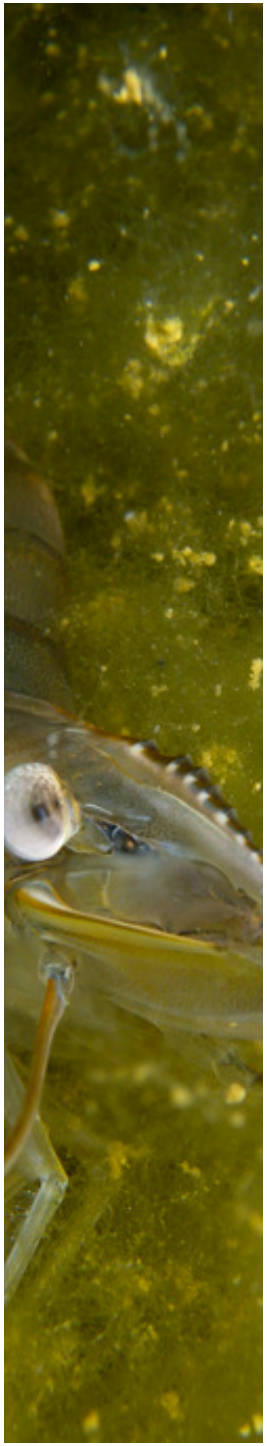


Spatial variability









Conclusions

Orange color of Gills = **Iron** deposit on gills

Elimination with Moulting process

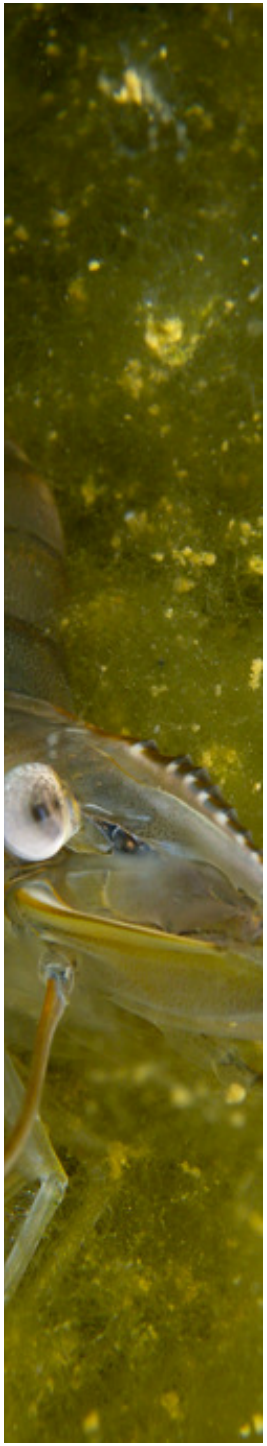
An **Hypothesis for Iron origin**:

Organic enrichment during shrimp rearing

OG occur after 70-80 days of rearing (eutrophication)

→ Decrease of Redox potential in sediments
Increase of iron and sulfate reduction

→ Increase of Fe^{2+} concentration in sediment



Perspectives

How does iron deposit upon the gills?

Abiotic process during water circulation in branchial cavity

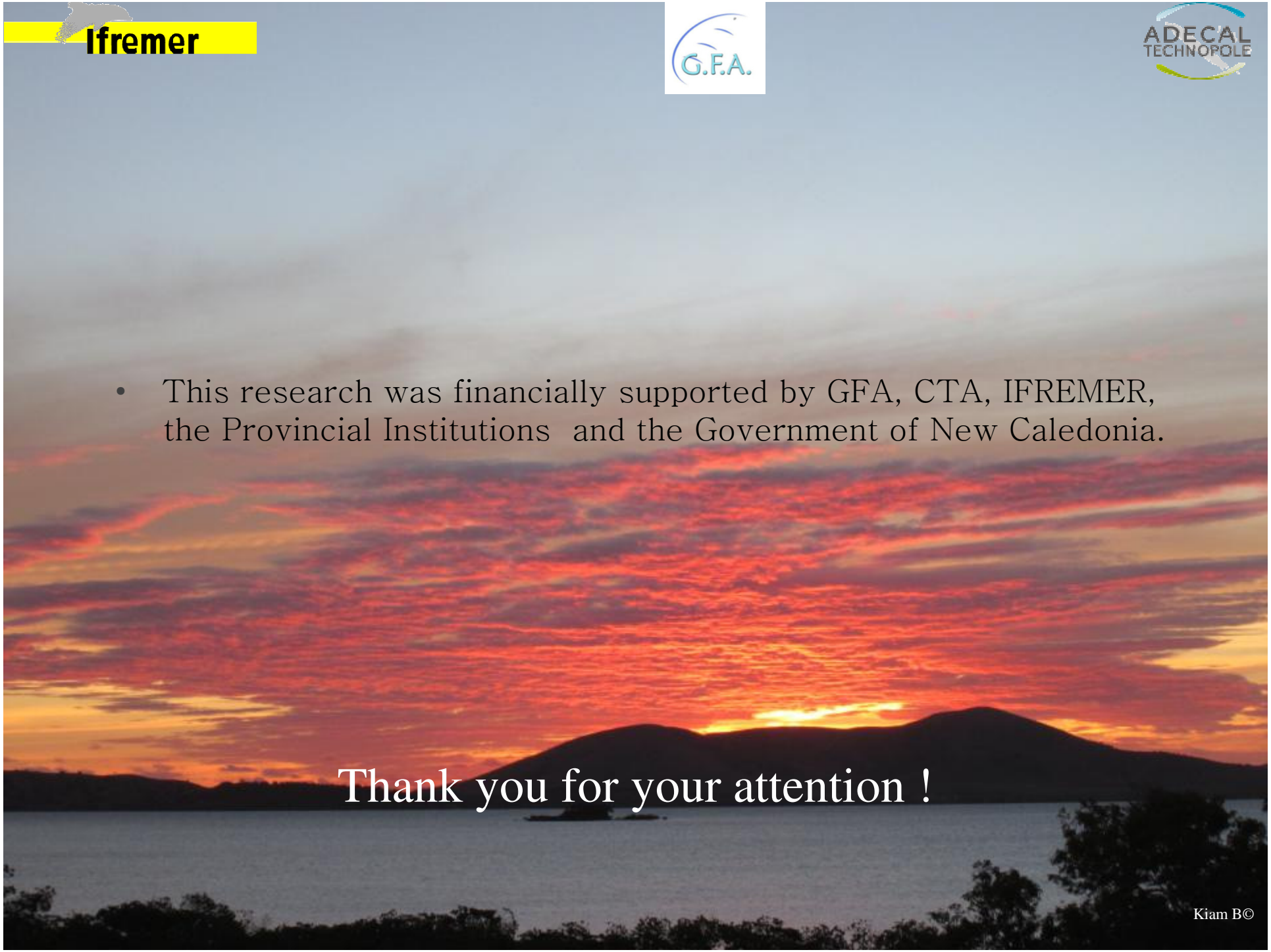
Biotic process implying bacteria

Identify Iron origin in sediment

Natural geological feature according to watersheds or accumulation through time?

Does Iron species depend in increasing organic load in pond?

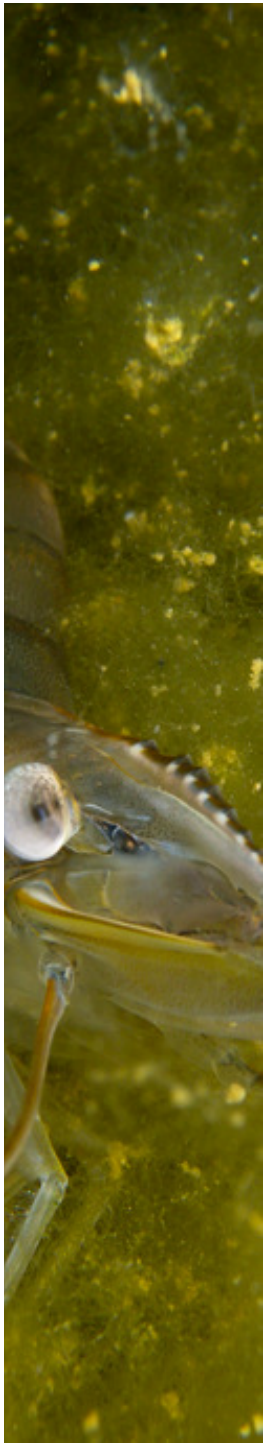
What is the impact on animal health and its ability to face stressful conditions?

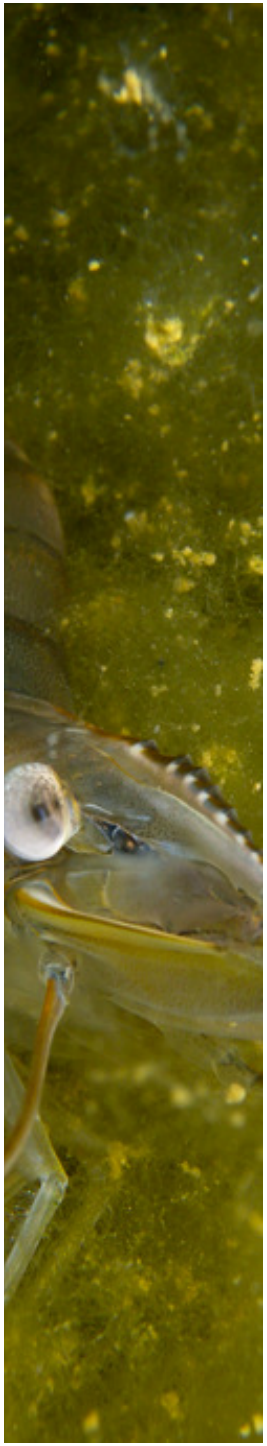


- This research was financially supported by GFA, CTA, IFREMER, the Provincial Institutions and the Government of New Caledonia.

Thank you for your attention !

Kiam B©





Dissolved iron: in sediment pore water

Shrimp ponds……Similar environnmental conditions than…. Hydrothermal vents



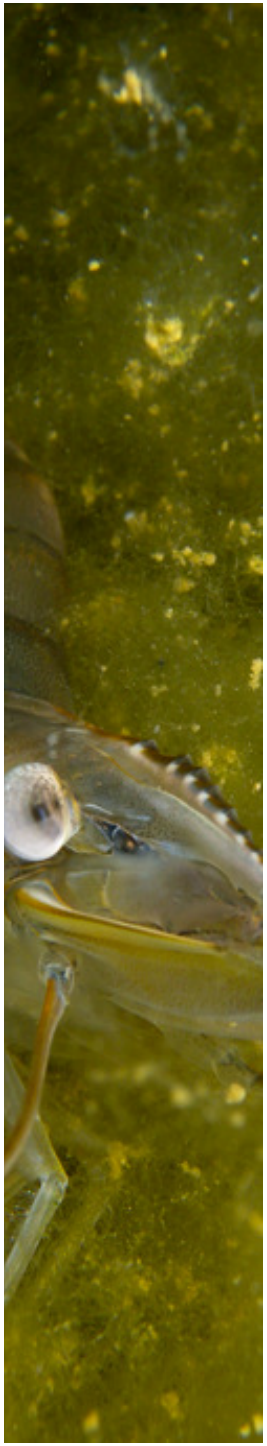


Zbinden et al., 2004

pH	6.7-7.1
O_2 µM	250
S^{-II} µM	0-2200
$Fe^{2,3+}$ µM	0-70

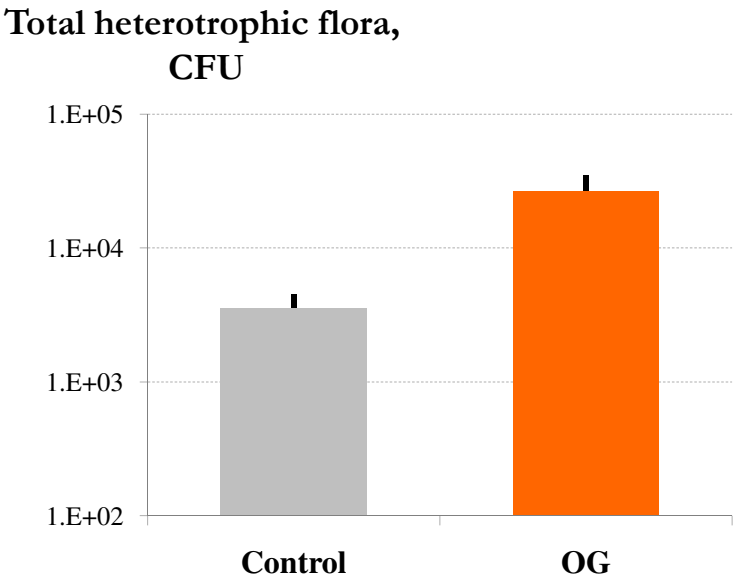
Table 2. pH (at 25°C, 1 atm), O_2, total sulphide (S^{-II}) and total iron ($Fe^{II} + Fe^{III}$) concentrations in discrete samples of ambient seawater and of fluid in vicinity of *Rimicaris exoculata* swarms, and at outlet of a black smoker. nd: no data

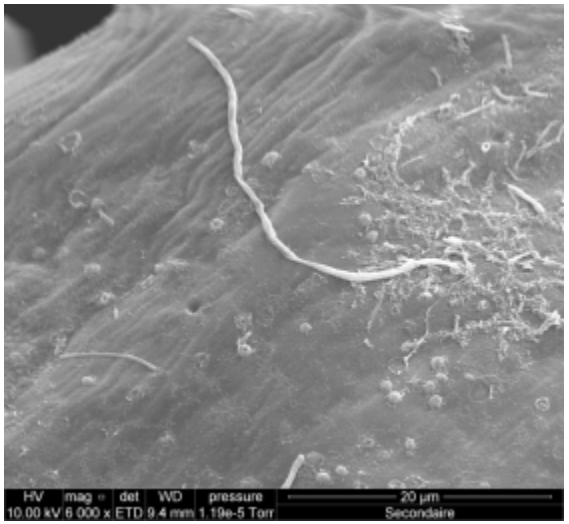
Sample	pH	O_2 µM	S^{-II} µM	$Fe^{II} + Fe^{III}$ µM
Ambient seawater	7.8 (n = 2)	242 (n = 2)	<0.1 (n = 2)	<0.5 (n = 2)
Shrimp swarms	7.0 6.8–7.3 (n = 4)	166 63–236 (n = 3)	– <0.1–2.7 (n = 4)	73 45–101 (n = 4)
Smoker output	5.6 5.3–6.1 (n = 3)	12.4 <0.1–37 (n = 3)	nd	5197 1620–8425 (n = 3)

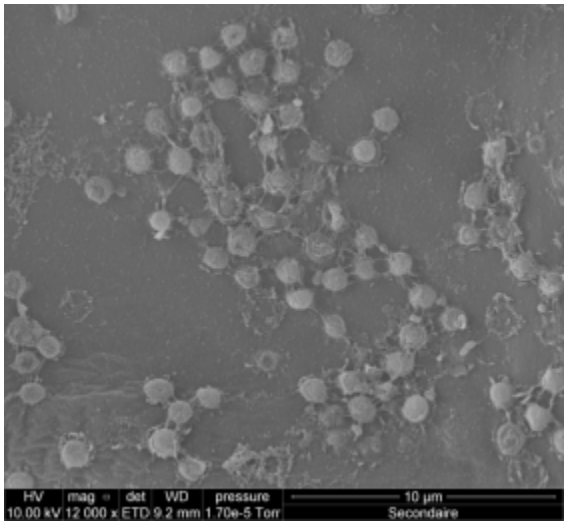


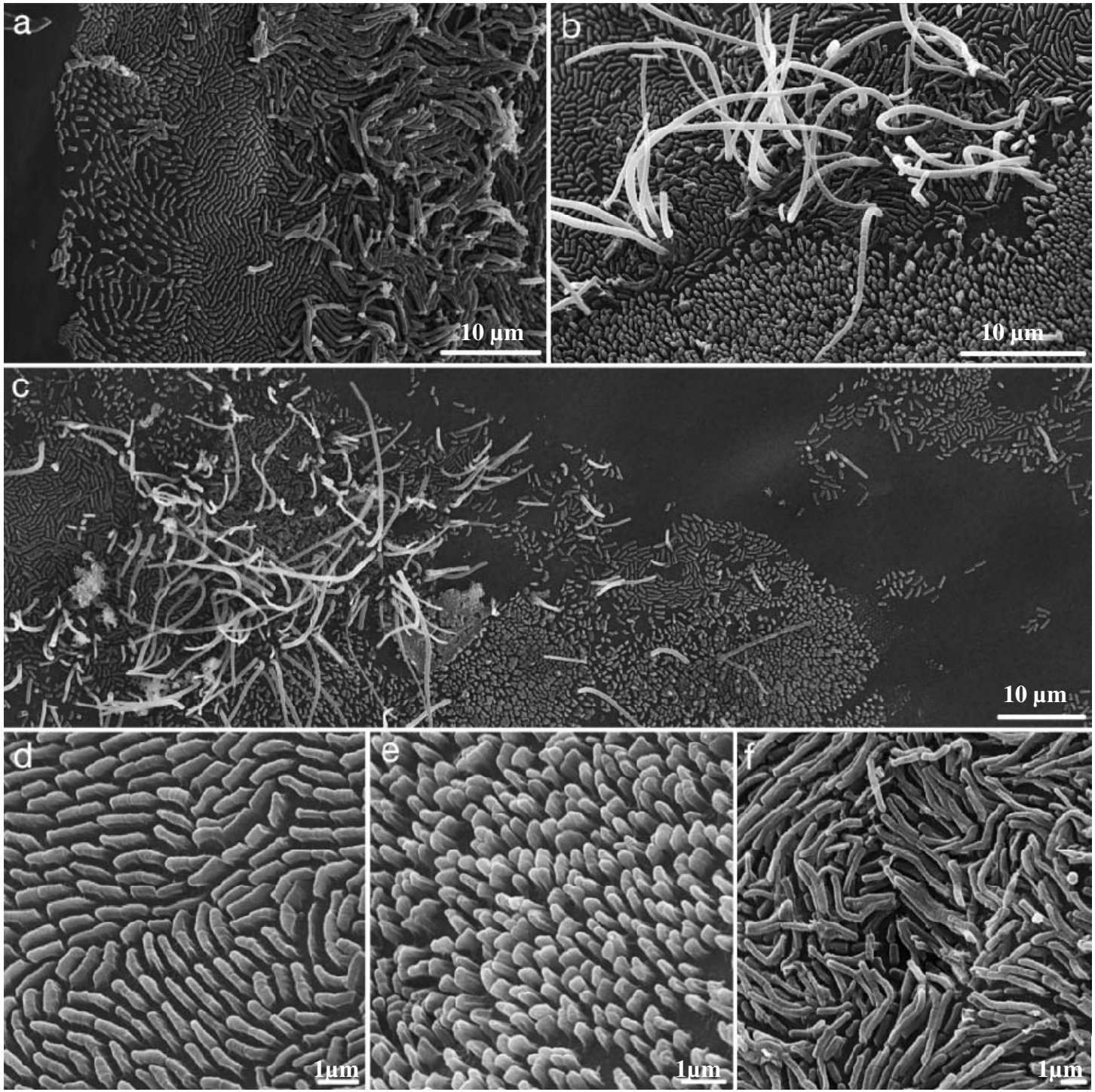
Bacterial analysis

Bacterial colonisation ?





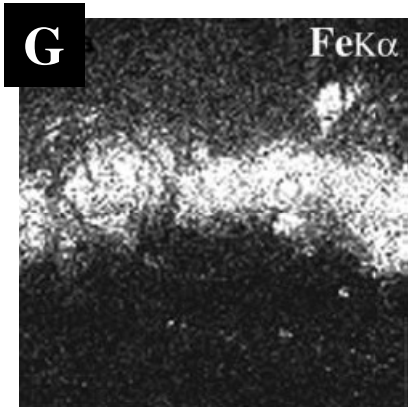






SEM analysis of Branchiostegite of *Rimicaris exoculata*

Important colonisation with bacterials implied in iron accumulation



Zbinden et al., 2004