

The relationship environment/life trajectory/physiological performance examined through the example of marine fish

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Adaptation, Reproduction et Nutrition des Poissons



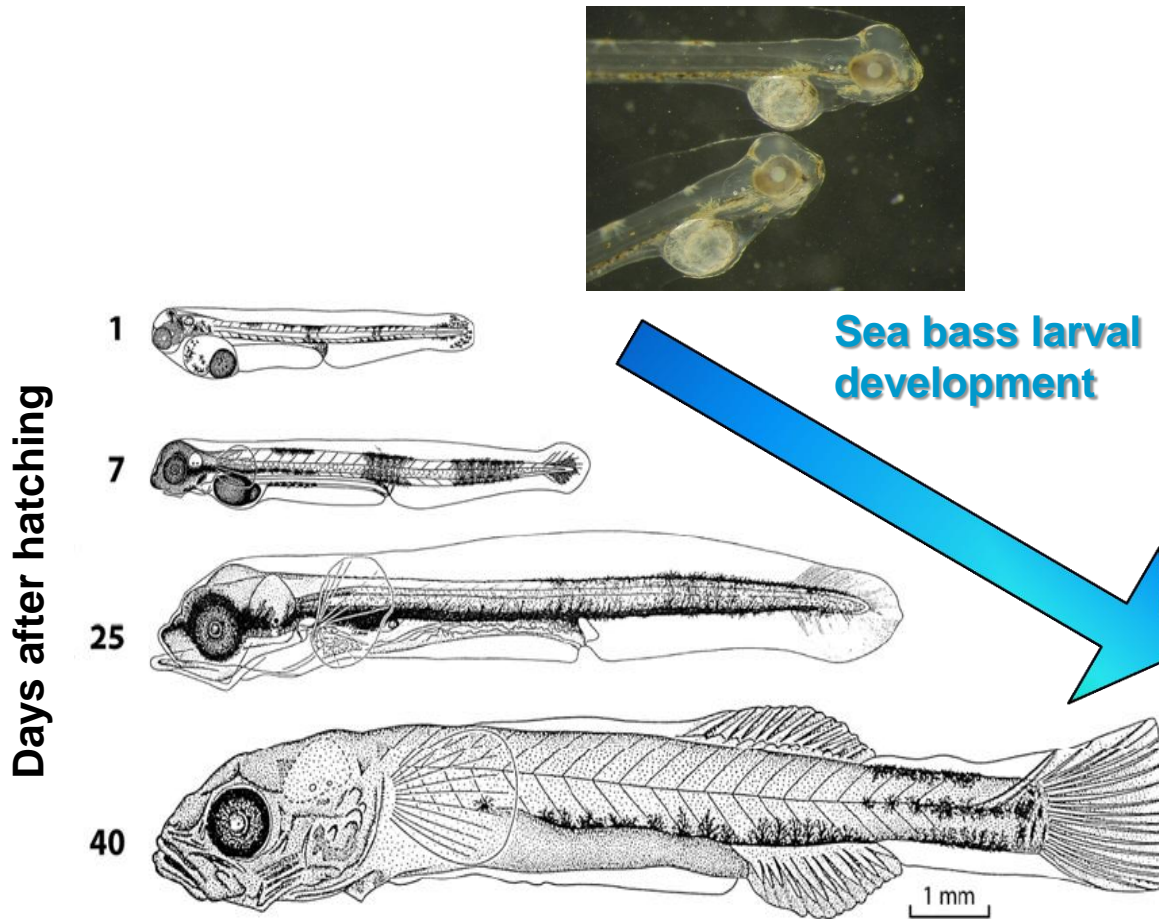
Equipe 1:

Réponses des organismes aux changements globaux : approche intégrative

How do we tackle this relationship?

- Study of the physiological basis of the relationships between fish and environment (natural or aquaculture)
- Environment determine life-trajectories of fish: early-stage effects
- Analytical expertise at different organisational levels (from gene to population)
- Assessment of physiological effects during challenges . Multidisciplinary collaborations

What is a larva?



Sea bass larval development

It is a developing organism...such as a mammal embryo

This development occurs in coastal areas (nurseries) and could be influenced by the environmental parameters of these zones...

Environmental conditioning

Do environment (including contaminants and counteracting measures) affect fish early life stages, and determine the physiological performance of the future juveniles?



What future in the context of an increasing anthropogenic impact upon marine ecosystems?

Phenotype 1

Phenotype 2

Phenotype n

-
-
-

Different developmental trajectories

Environmental parameters... such as T°, pH, O₂, food, contaminants

Ontogenic effects



Egg, larvae...

Integrative approach

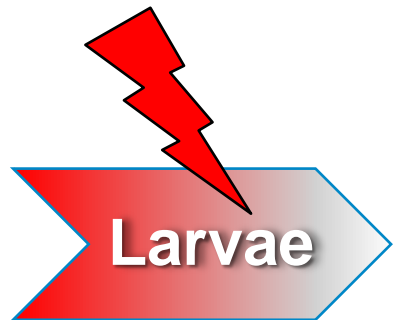
Environmental adaptation capacity

**Physiological regulations
(from molecular to individual level)**

Study strategy

Based on predicted scenarios of the fate of marine ecosystems,

Effects



Evaluation of long-term effects



Temperature

Hypoxia

Acidification

food

Pollutants



...up to one year later

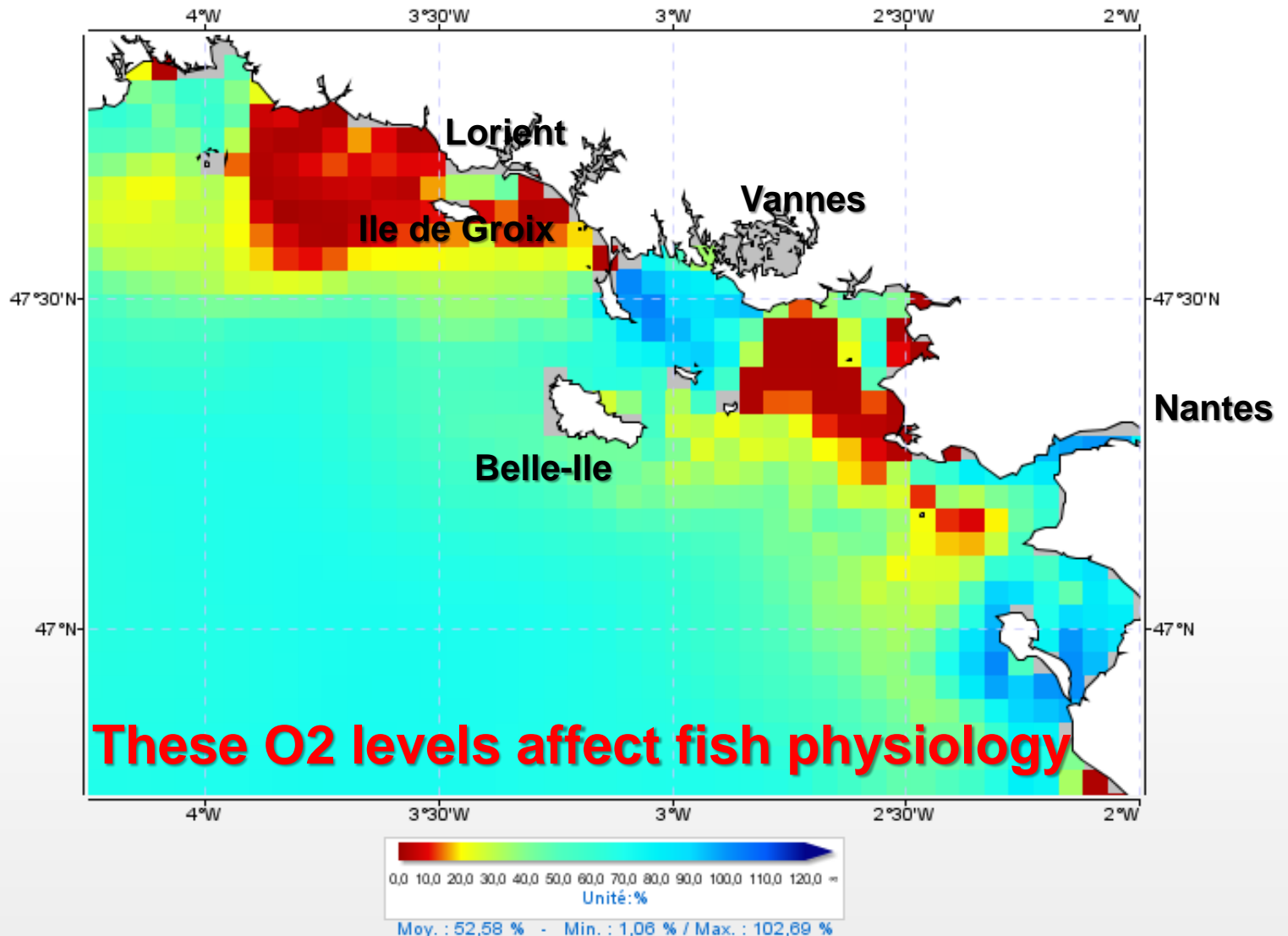
Effect of an exposure to a moderate hypoxia during larval stages

Comparison of two species: sea bass and common sole

PhD thesis of G. Vanderplancke

Frequent hypoxia episodes in South Brittany...

Pourcentage de saturation en oxygène (O2) au fond
le 08/07/2014 (heure légale) mise à jour du 08/07/2014 19h00



Experimental protocol

8 days of moderate hypoxia (40% oxygen) during the larval period



bar

More than 50000 larvae...



sole

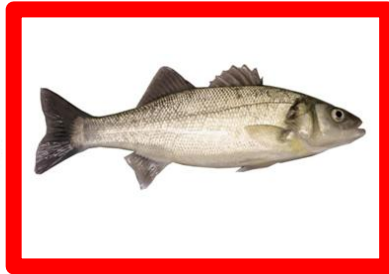
Assessment of potential effects nearly one year later...



Several hundred of fish...



Observed effects

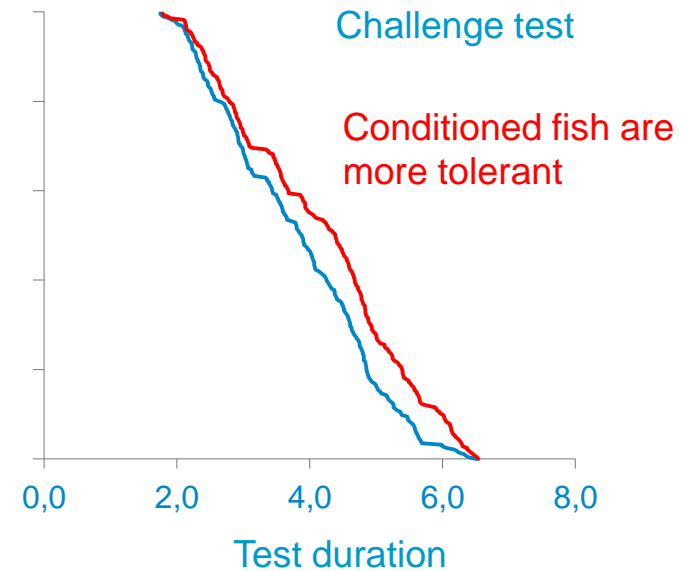
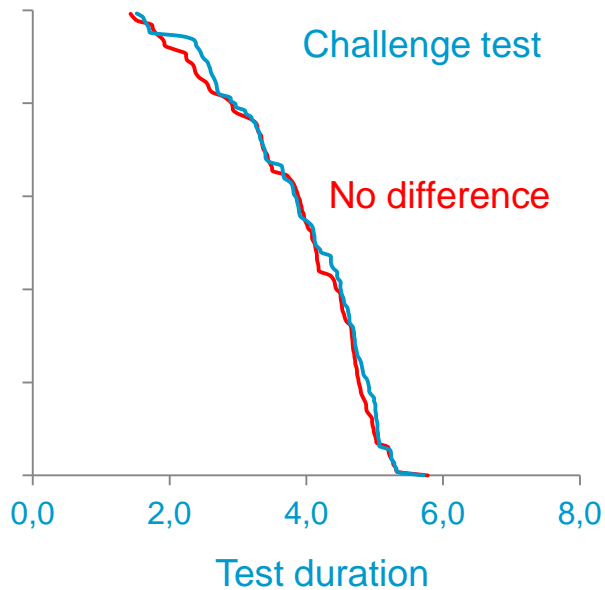


Conditioned fish are smaller

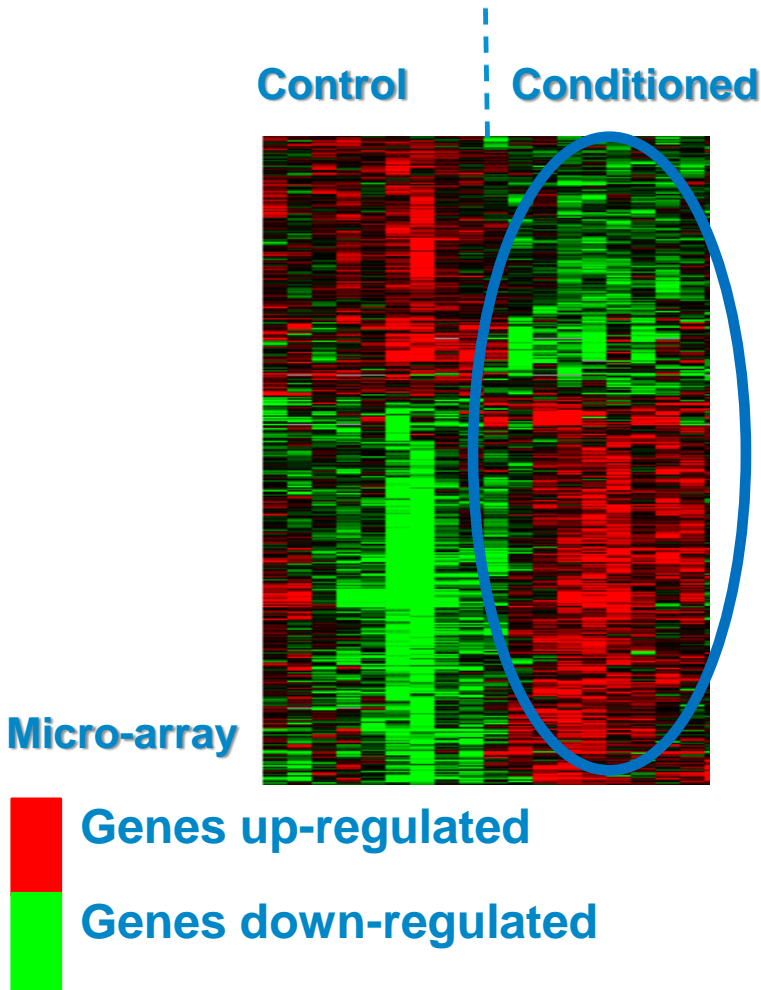


Conditioned fish are bigger

although they have the same feed ingestion



Transcriptome of conditioned sea bass is permanently imprinted by early hypoxia



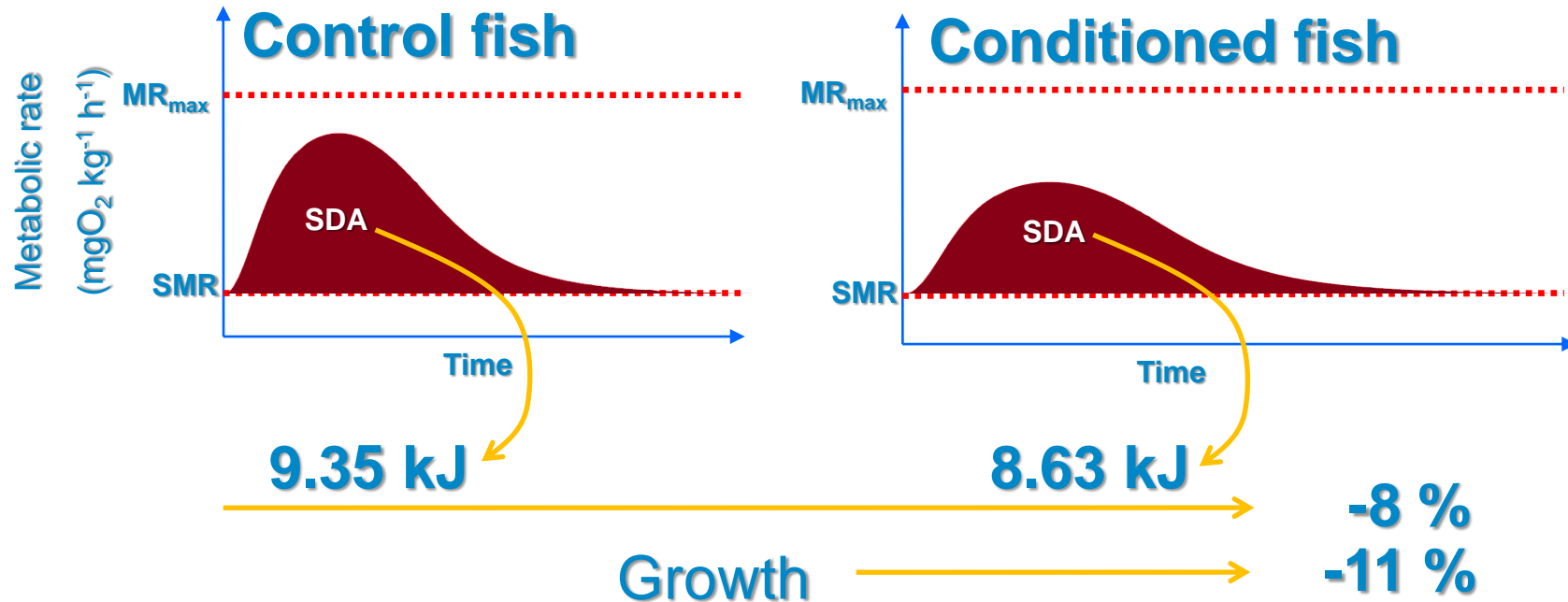
Down-regulation of ATP-consuming processes in conditioned fish

- Signature of hypoxia
- Fish that have been conditioned during the larval period seem to exhibit a « metabolic brake »



Metabolic expenditure following ingestion & assimilation of food in sea bass

Same amount of food ingested (gavage)

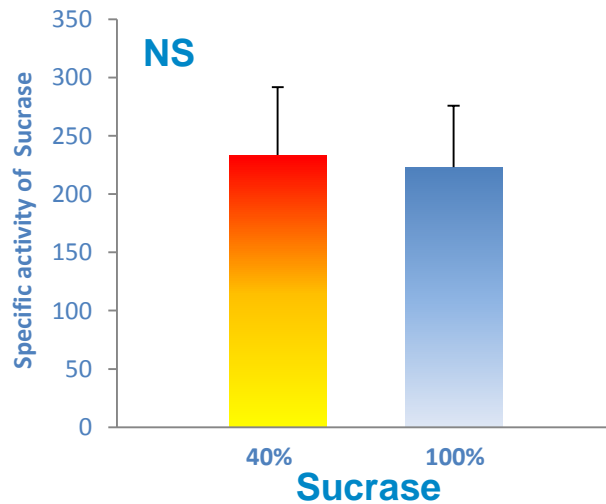
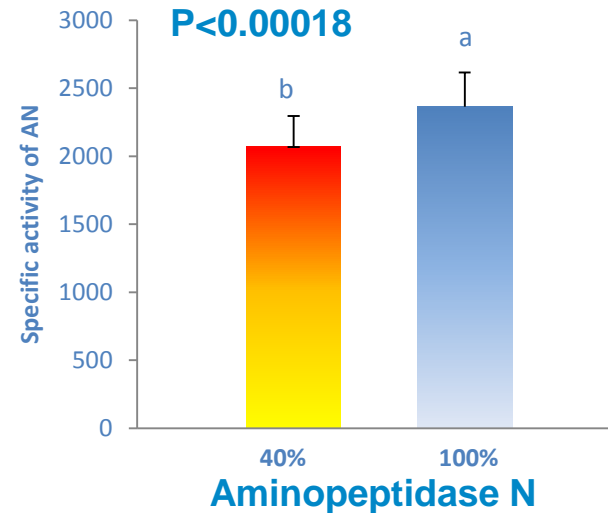
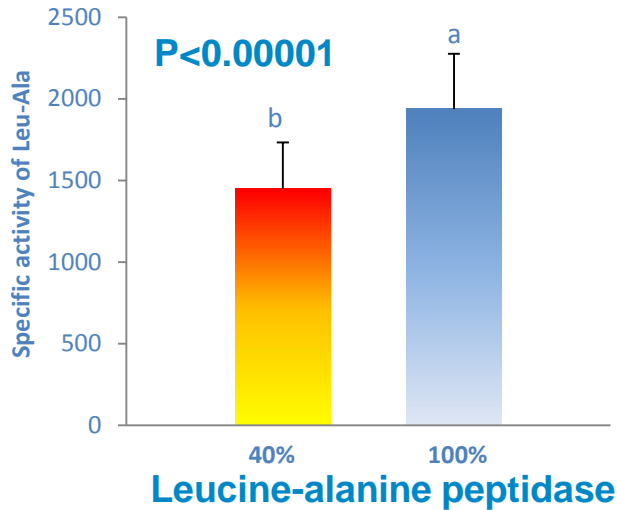


MR_{max} & SMR were similar in the two groups

SDA: 8% lower in conditioned group

Conditioned fish have lost 8% energy in feces...

Activities of some digestive enzymes in sea bass intestine



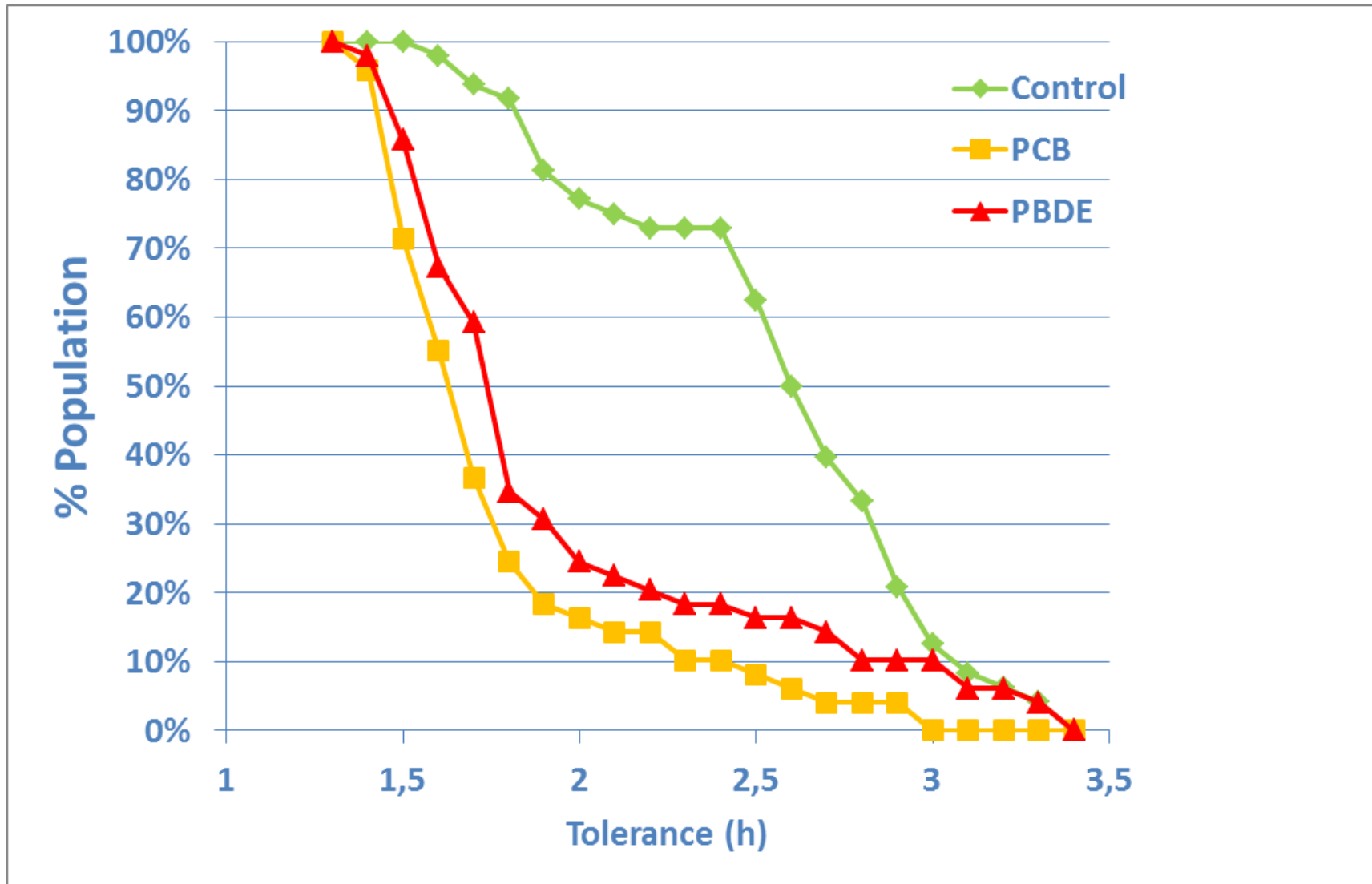
Protein digestion was impacted in conditioned fish

Long-term effect of POP on sole offsprings

PCB and PBDE transfer from the females to the progeny

On-going ANR Project: Fish'N'POPs

The physiology of the off-spring has been imprinted by the contamination of the breeders



Conclusions

- A short and moderate hypoxia during sea bass larval stage significantly impaired the growth of the ensuing phenotype
- This could be in part explained by an hypoxic imprinting of the transcriptome, which has led to an impairment of ATP-dependent processes, with visible repercussions on digestive processes.
- Linking epigenetic to fitness?

General considerations

- Environment during larval period strongly influences the adult phenotype
- Phenotypes are easier revealed during challenges
- Physiological studies examining biological effects of environmental parameters need to take into account life history of animals.
- Studies based on life-history trajectories should take into account combined effects of environment and pollutants
- Necessary to have long-term monitoring of individual performances in natural (or semi-natural) conditions (with a pooling of different expertise)

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