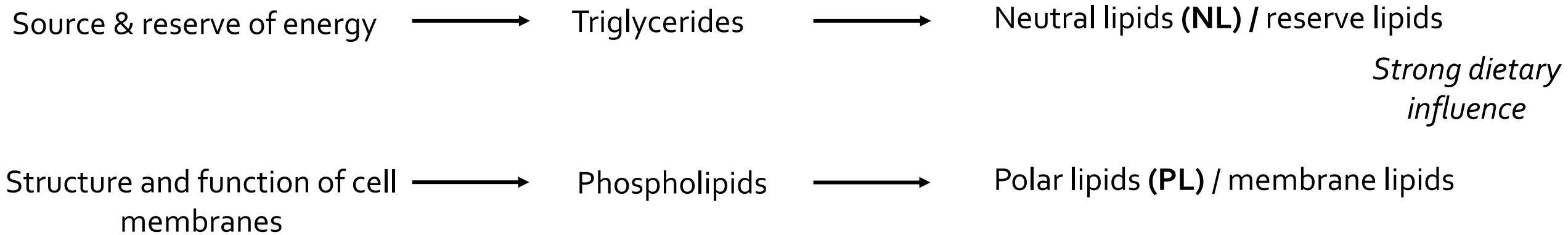


Effects of Dietary DHA Deficiency on  
Metabolic and Swimming  
Performance of Juvenile European  
Seabass (*Dicentrarchus labrax*) from  
the wild

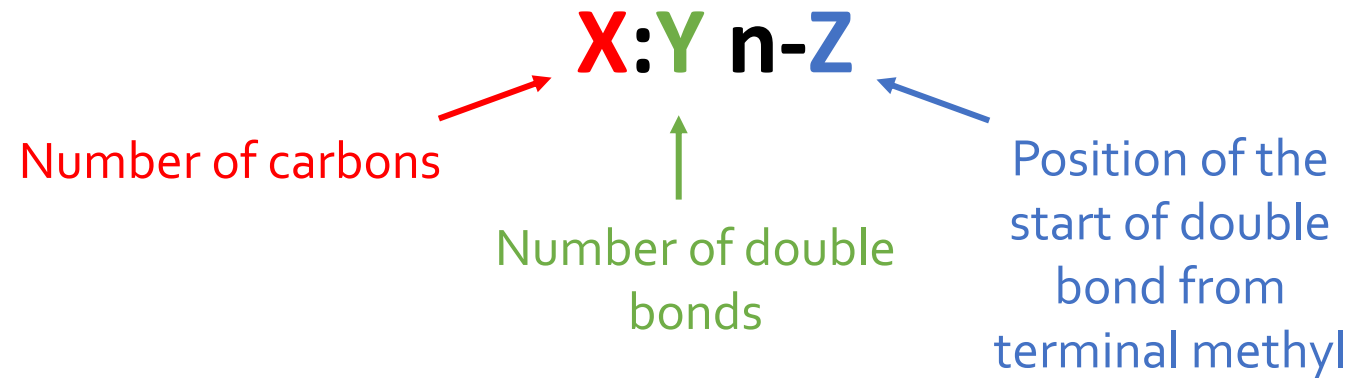
Mickaël Peron

F. Le Grand, P. Soudant, D. Mazurais, C. Lefrançois, V. Simon, M. Vagner

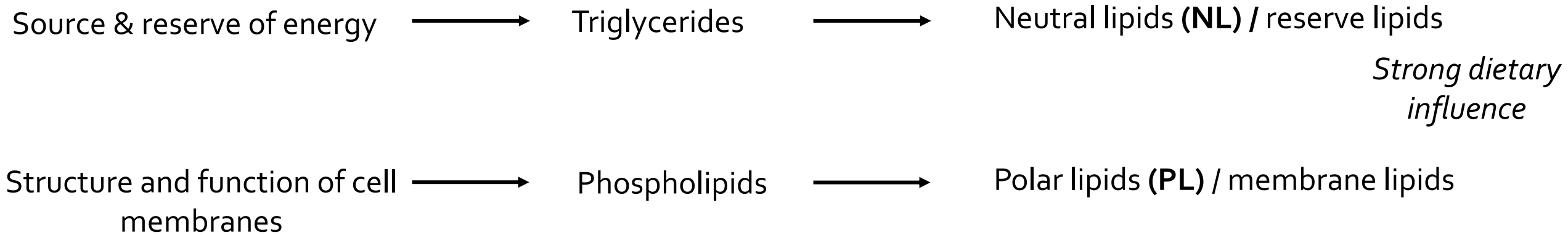
# Lipids



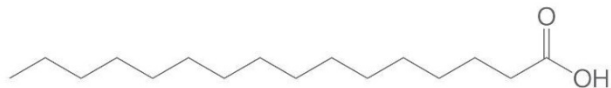
# Fatty acids



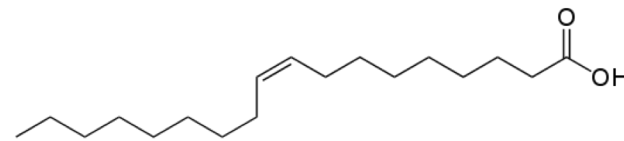
# Lipids



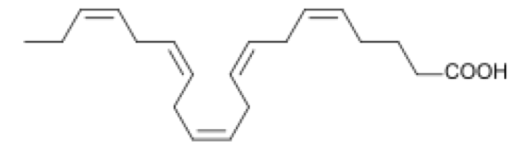
# Fatty acids



1 Saturated  
(e.g Palmitic acid ; 16:0)

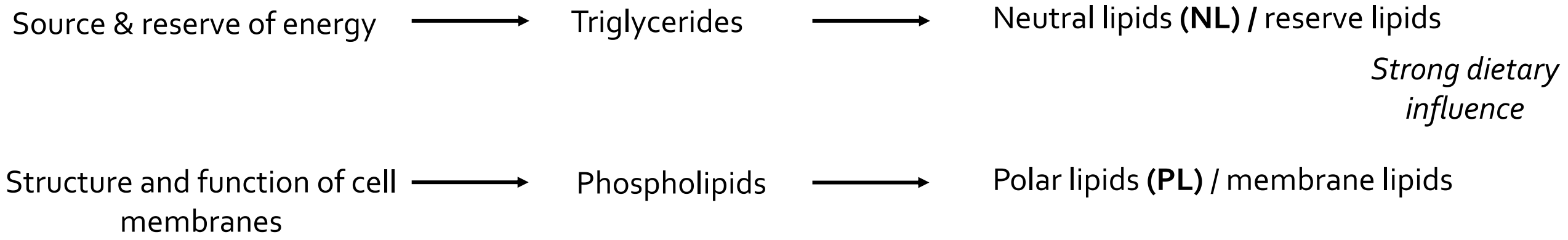


Mono unsaturated  
(e.g Oleic acid ; 18:1 n-9)

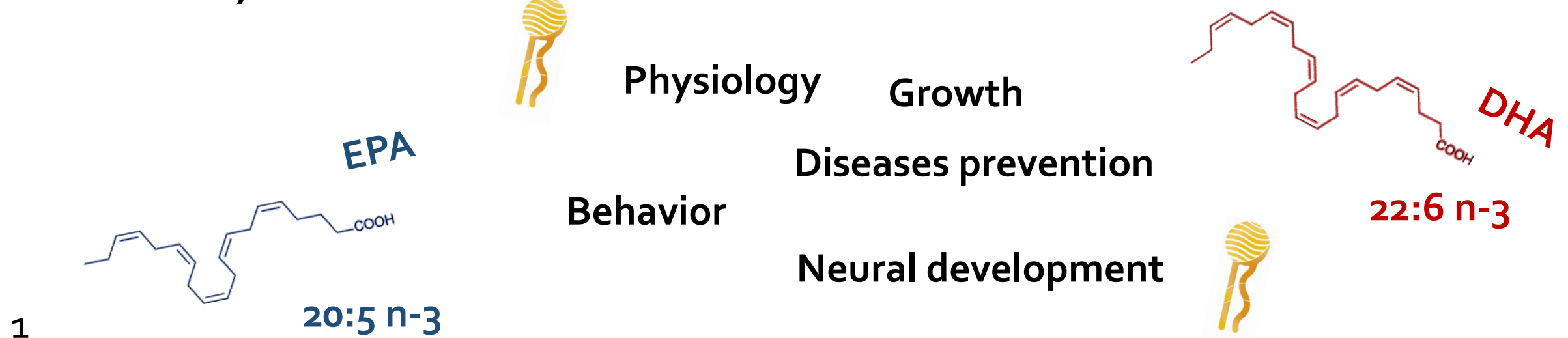


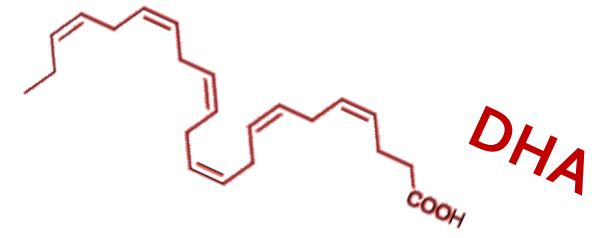
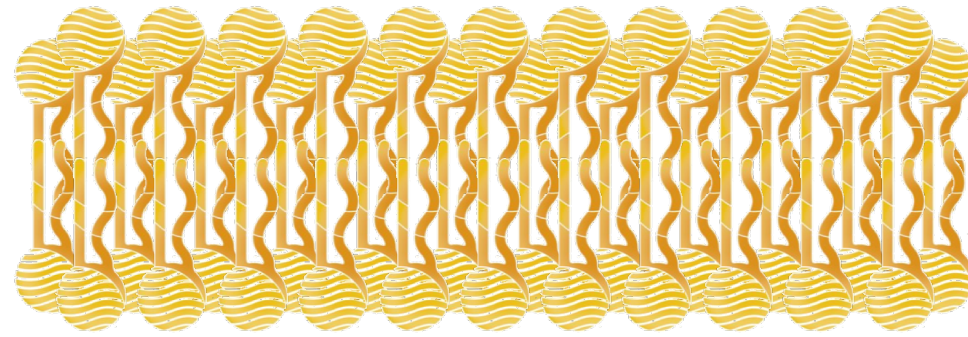
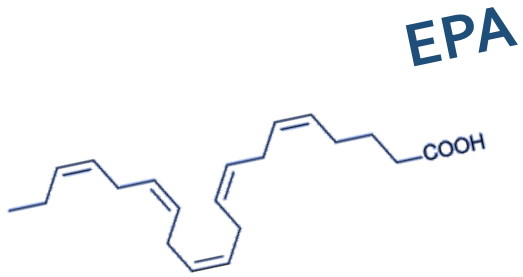
Poly unsaturated  
(e.g EPA ; 20:5 n-3)

# Lipids



## Essential fatty acids





**Membrane fluidity & permeability**



**Cell structure & function**

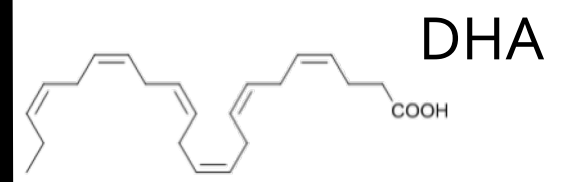
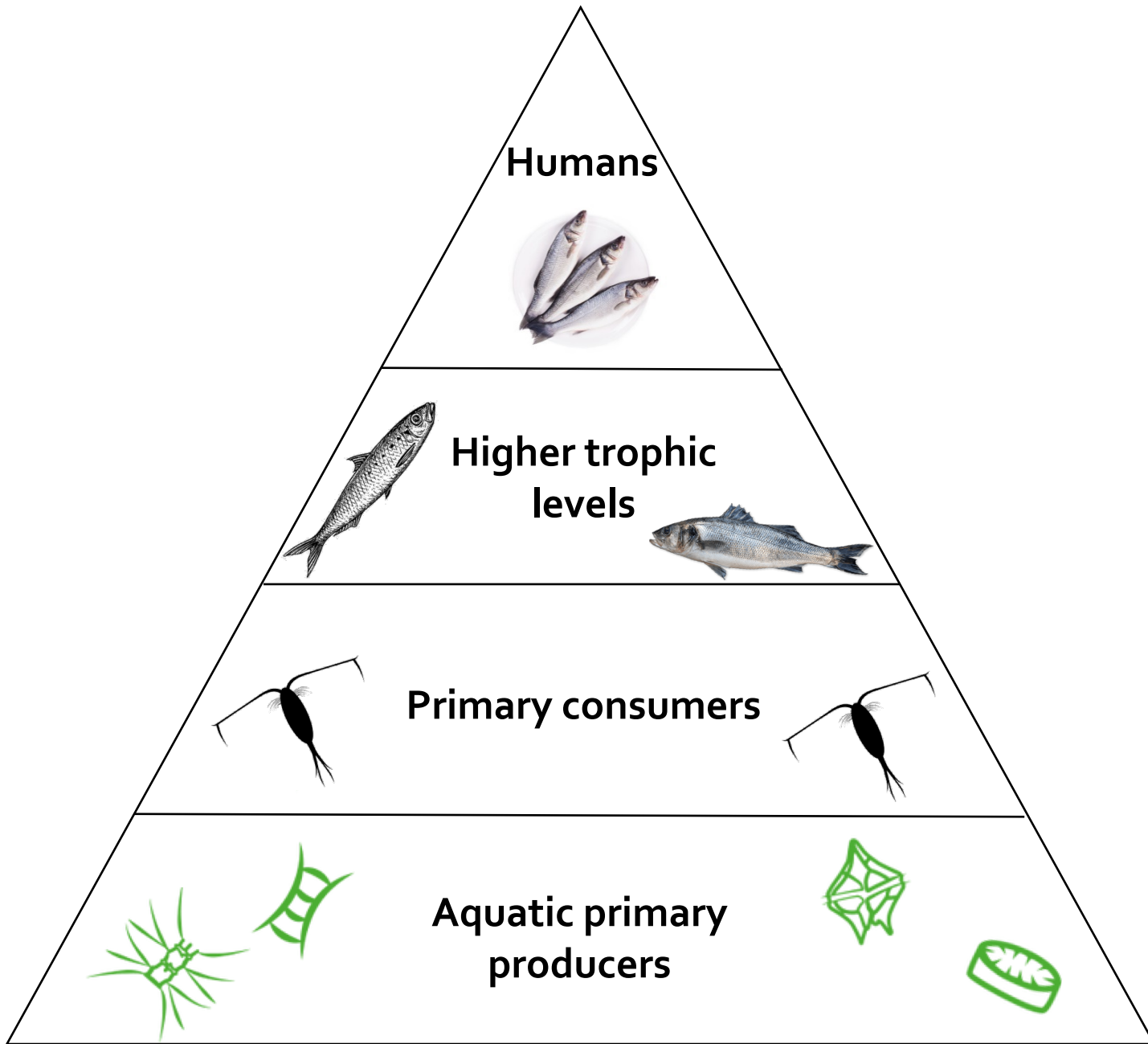


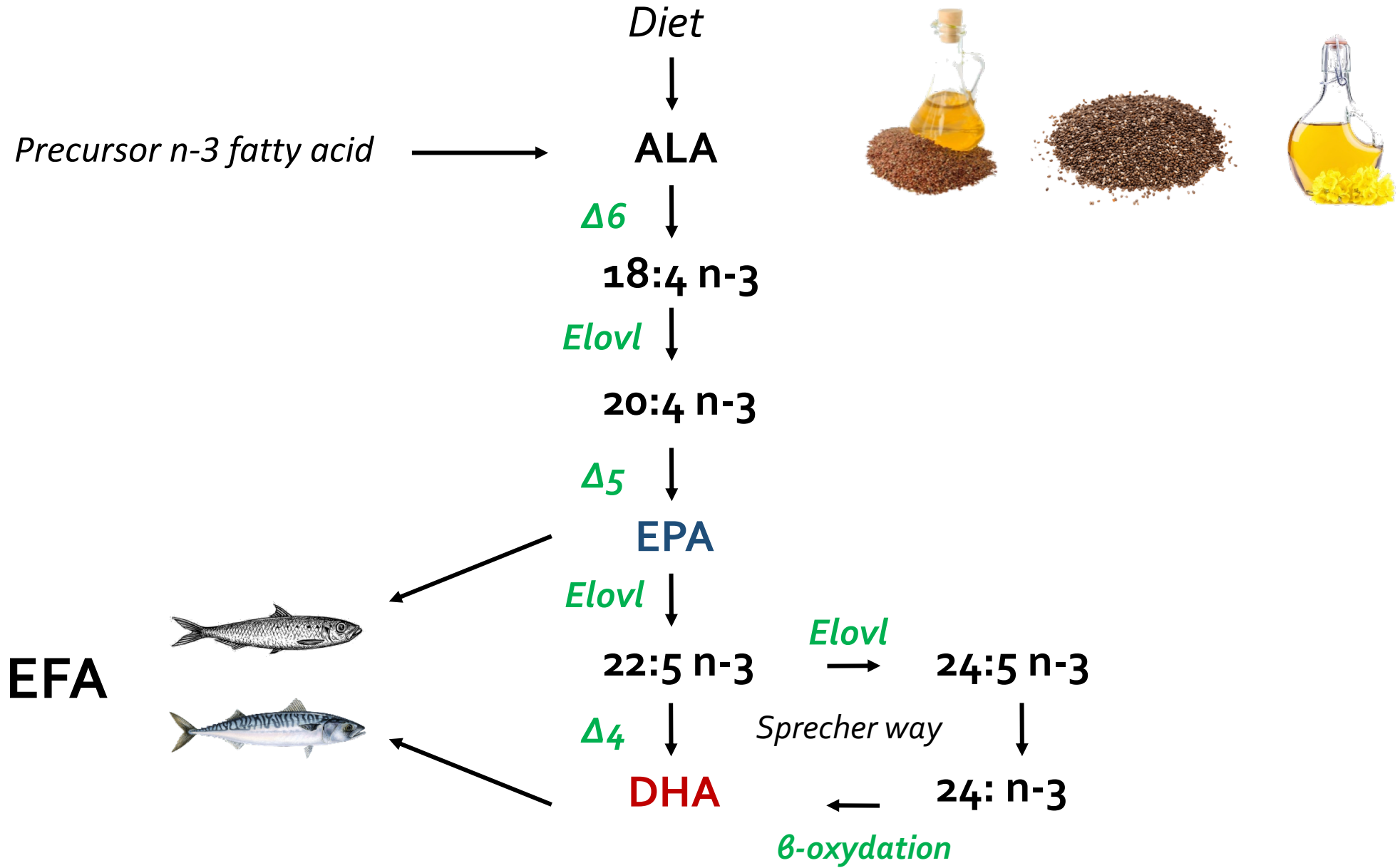
**Tissue development and performance**

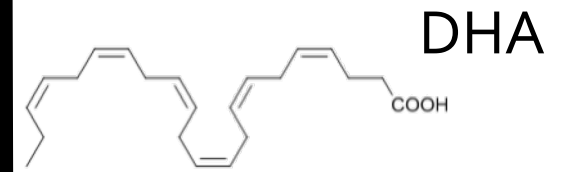
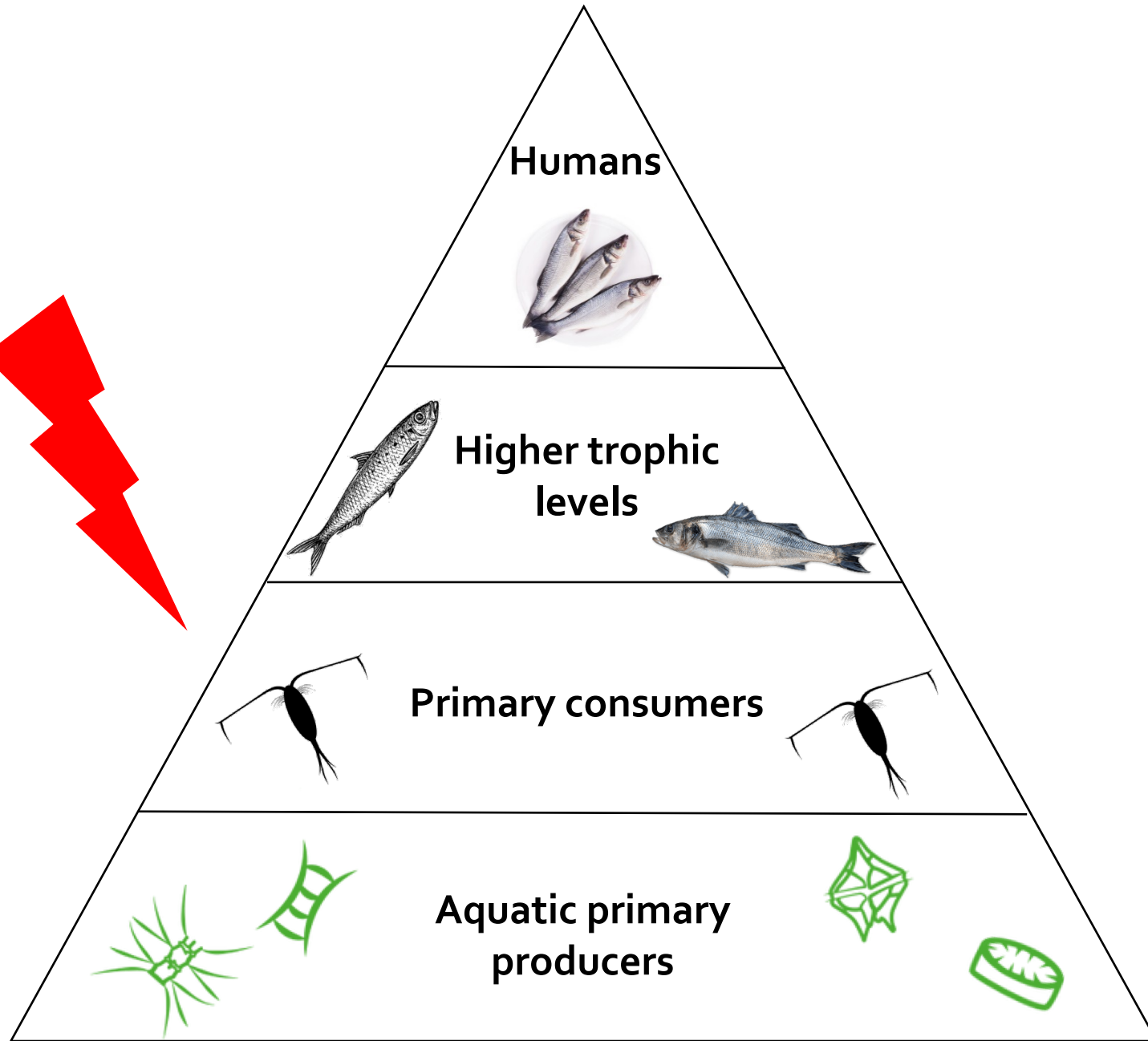


**Whole individual physiology  
(Growth, metabolism)**

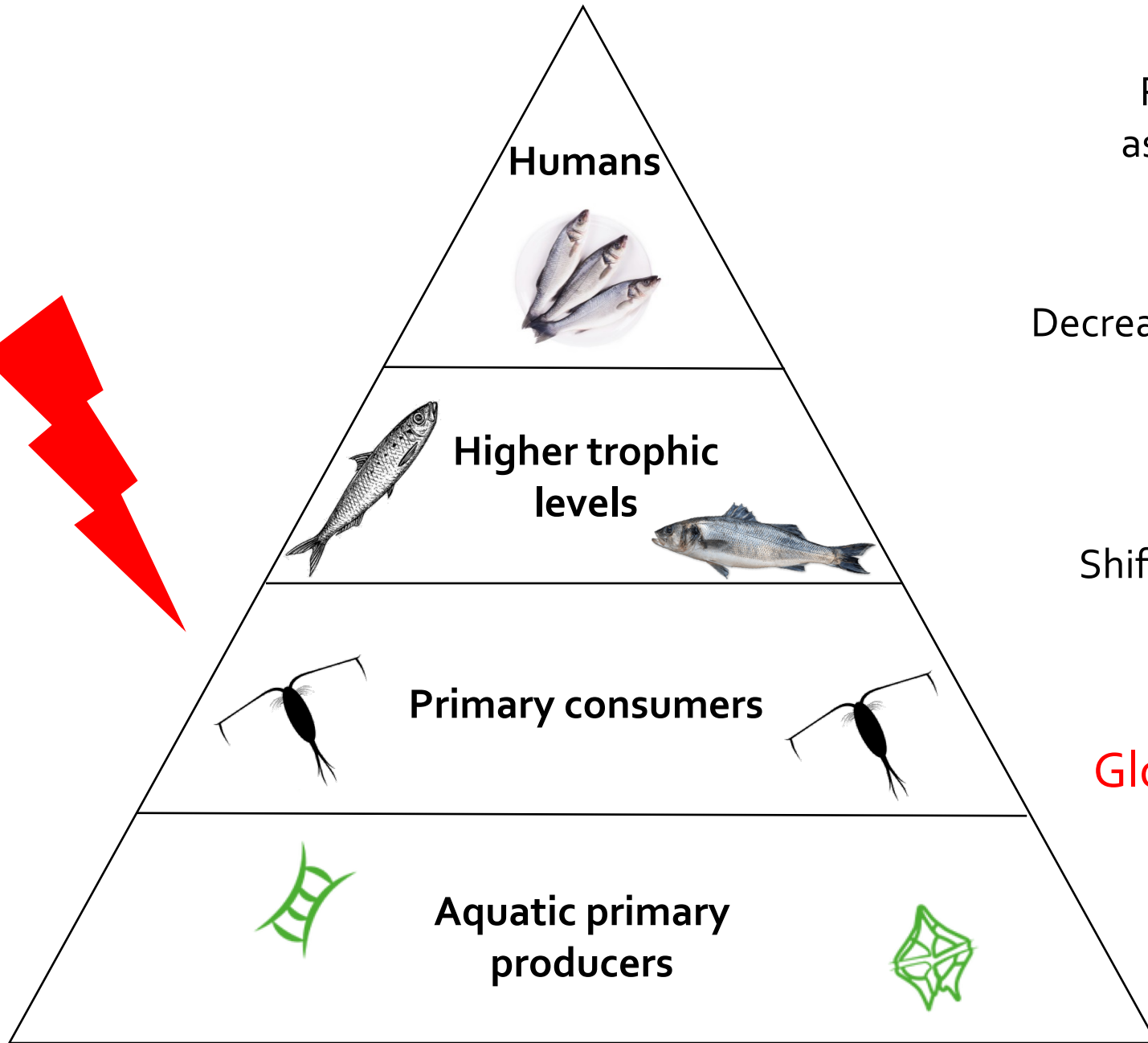
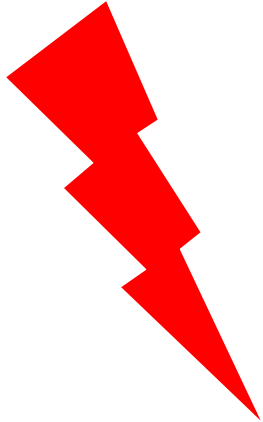












Physiology and species assemblage modification



Decrease in n-3 LC PUFA content of primary producers







Shift towards less productive communities

Global scale depletion ?





# Global scale depletion of LC- PUFA ?

**Projected declines in global DHA availability for human consumption as a result of global warming**

Stefanie M. Colombo , Timothy F. M. Rodgers , Miriam L. Diamond ,  
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Global Change Biology (2016) 22, 2744–2755, doi: 10.1111/gcb.13295

 Global Change Biology





## Climate warming is predicted to reduce omega-3, long-chain, polyunsaturated fatty acid production in phytoplankton

STEFANIE M. HIXSON and MICHAEL T. ARTS

Department of Chemistry and Biology, Ryerson University, 350 Victoria Street, Toronto, ON, Canada

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Progress in Lipid Research

journal homepage: [www.elsevier.com/locate/plipres](http://www.elsevier.com/locate/plipres)

Review

## Climate change and n-3 LC-PUFA availability

Karsoon Tan <sup>a,b,c,\*</sup>, Hongkuan Zhang <sup>a,b,c</sup>, Huaiping Zheng <sup>a,b,c,\*</sup>

<sup>a</sup> Key Laboratory of Marine Biotechnology of Guangdong Province, Marine Sciences Institute, Shantou University, Shantou 515063, China  
<sup>b</sup> Mariculture Research Center for Subtropical Shellfish & Algae of Guangdong Province, Shantou 515063, China  
<sup>c</sup> STU-UMT Joint Shellfish Research Laboratory, Shantou University, Shantou 515063, China

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Department of <sup>a</sup>

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Biotechnology Advances

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ELSEVIER

Research review paper

## Omega-3: A link between global climate change and human health





Jing X. Kang <sup>\*</sup>

Laboratory for Lipid Medicine and Technology, Massachusetts General Hospital and Harvard Medical School, Boston, MA 02114, United States

ia Street, Toronto, ON, Canada

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**Ocean warming combined with lower omega-3 nutritional availability impairs the cardio-respiratory function of a marine fish**

Marie Vagner<sup>1,\*.§</sup>, Eric Pante<sup>1</sup>, Amelia Viricel<sup>1</sup>, Thomas Lacoue-Labarthe<sup>1</sup>, Jose-Luis Zambonino-Infante<sup>2</sup>, Patrick Quazuguel<sup>2</sup>, Emmanuel Dubillot<sup>1</sup>, Valerie Huet<sup>1</sup>, Herve Le Delliou<sup>2</sup>, Christel Lefrançois<sup>1,‡</sup> and Nathalie Imbert-Auvray<sup>1,‡</sup>

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Marine Environmental Research

journal homepage: <http://www.elsevier.com/locate/marenvrev>

## The relationship between membrane fatty acid content and mitochondrial efficiency differs within- and between- omega-3 dietary treatments

[Karine Salin<sup>a,\\*</sup>](#), [Margaux Mathieu-Resuge<sup>b</sup>](#), [Nicolas Graziano<sup>a,c</sup>](#), [Emmanuel Dubillot<sup>c</sup>](#), [Fabienne Le Grand<sup>a</sup>](#), [Philippe Soudant<sup>a</sup>](#), [Marie Vagner<sup>a,c</sup>](#)

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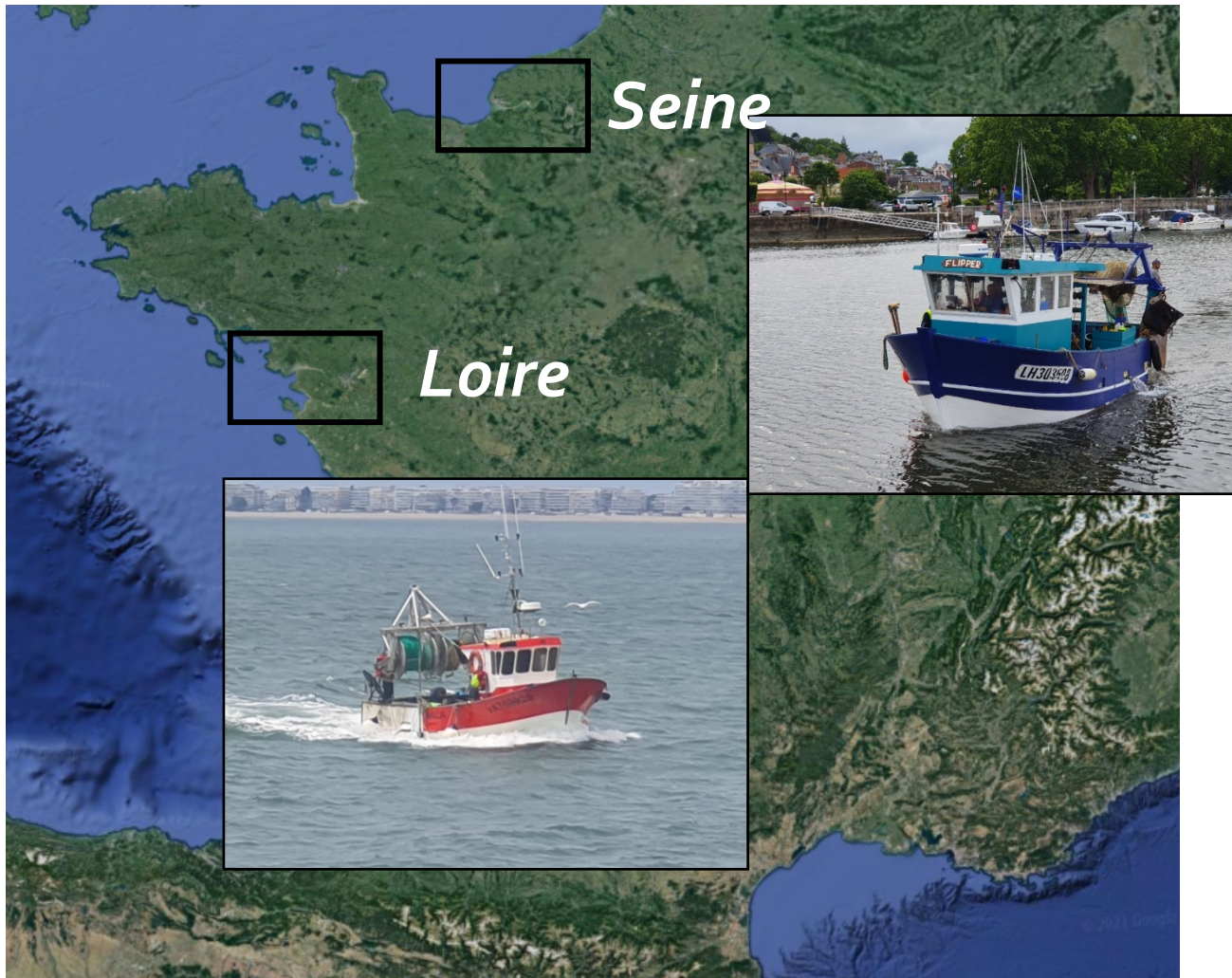
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## Depletion of Essential Fatty Acids in the Food Source Affects Aerobic Capacities of the Golden Grey Mullet *Liza aurata* in a Warming Seawater Context

Marie Vagner<sup>1,\*</sup>, Thomas Lacoue-Labarthe<sup>1</sup>, José-Luis Zambonino Infante<sup>2</sup>, David Mazurais<sup>2</sup>, Emmanuel Dubillot<sup>1</sup>, Hervé Le Delliou<sup>2</sup>, Patrick Quazuguel<sup>2</sup>, Christel Lefrançois<sup>1</sup>

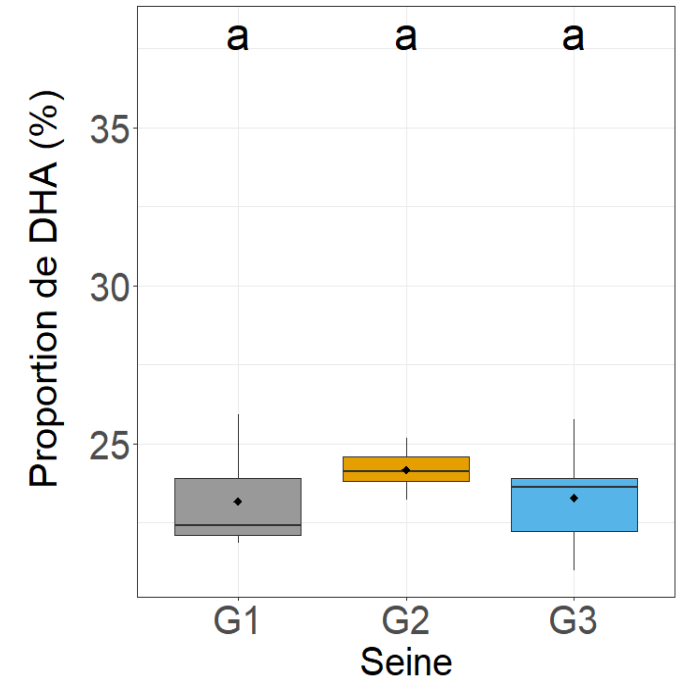
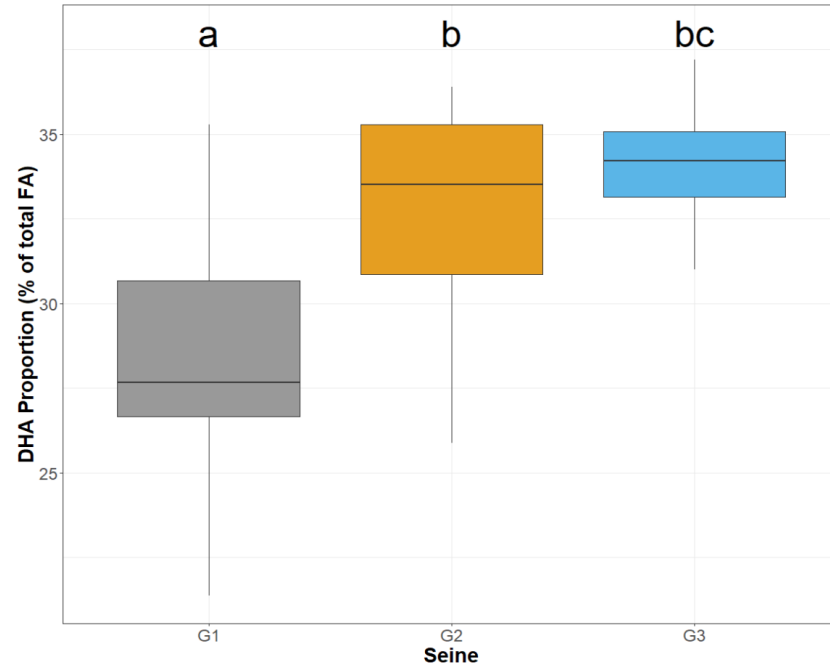
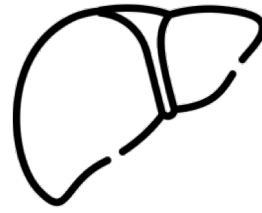
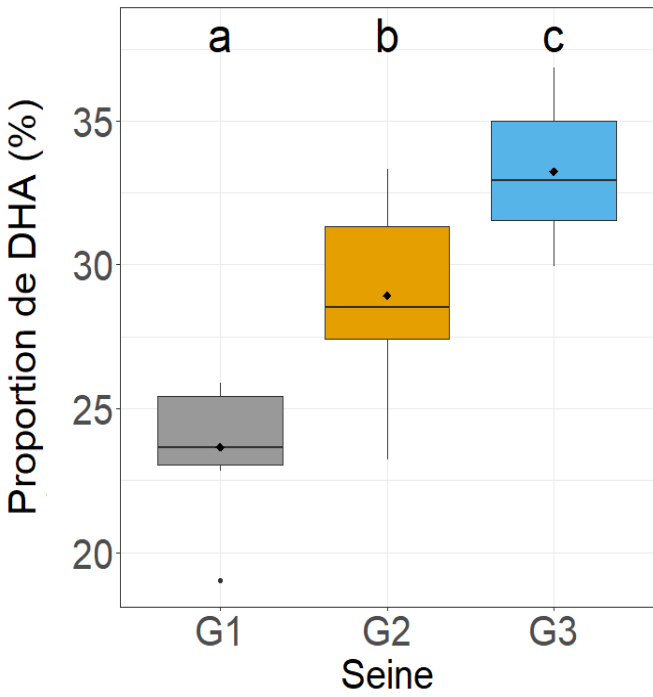
# Is the natural FA composition of juvenile sea bass impacted by its habitat and ontogenetic stage ?



**NourDem**

*Summer 2019 (July & August)*

Three different life stages : G1 / G2 / G3



N = 12 – G1



N = 10 – G2



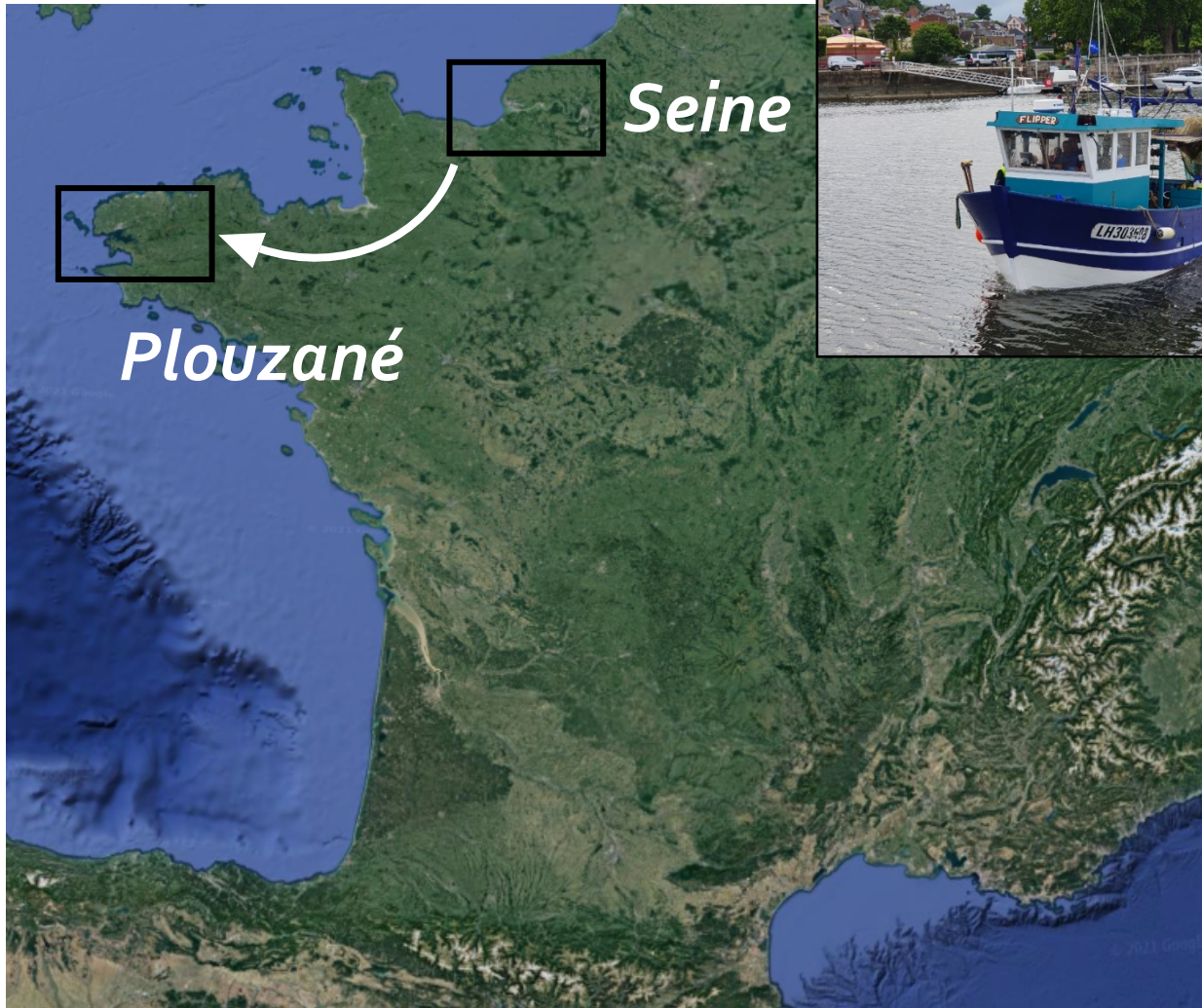
N = 12 – G3

## What are the physiological adjustments of juvenile European seabass from the Seine estuary when subjected to a DHA-depleted diet ?

- Considering the importance of DHA in fish development, the DHA depleted fish will have **reduced growth** and **metabolic performance**.
- Fish will try to compensate the lack of DHA by enhancing their biosynthesis availability



One target life stage : G<sub>1</sub>



**Fishing and  
transportation to  
rearing facilities**





Fishing and  
transportation



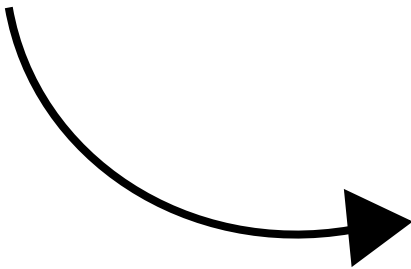
Quarantaine



Fishing and  
transportation



Quarantaine



**$18,7 \pm 1,5$  cm**  
 **$81,2 \pm 18,9$  g**

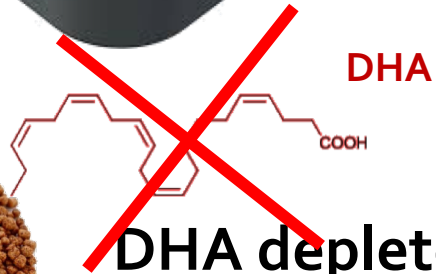
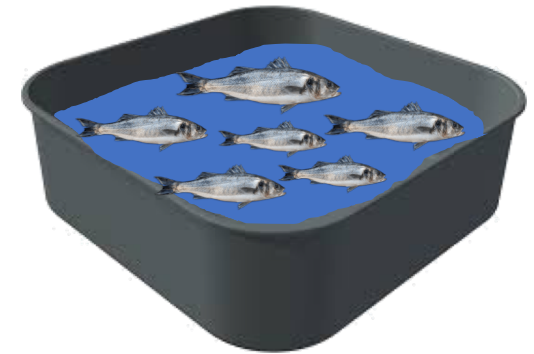
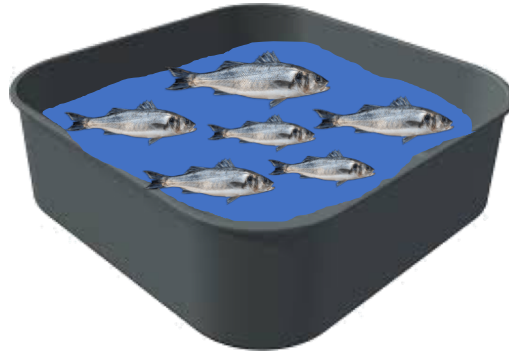
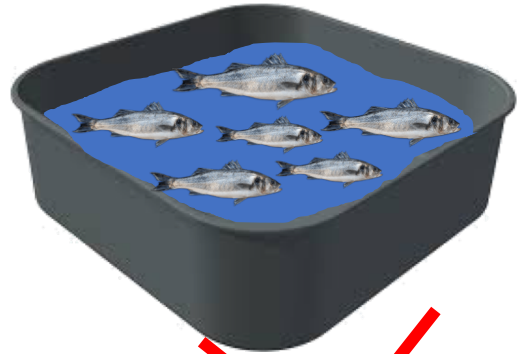
**5/6 months  
conditioning**



**Control pellet / 2-0,5% BM/day (T° dependant)**



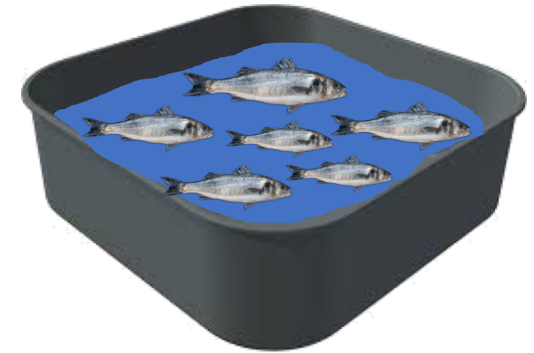
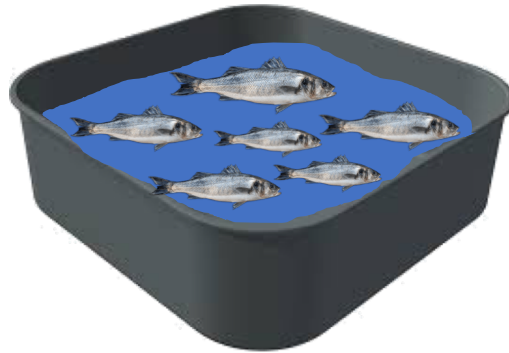
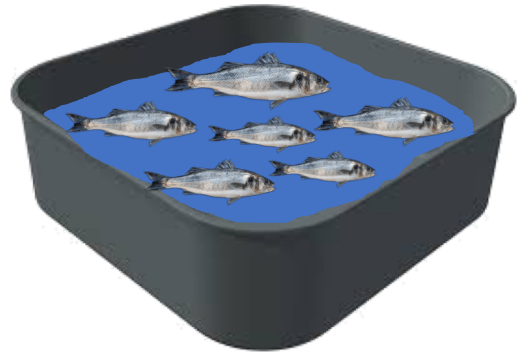
**N = 17/tank**



**DHA depleted pellet / 2-0,5% BM/day (T° dependant)**



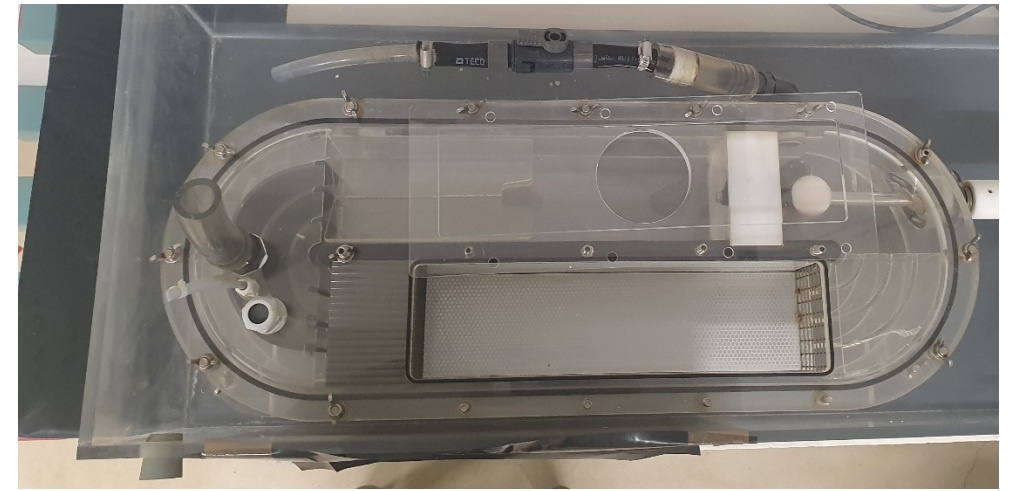
**N = 17/tank**





Fishing and  
transportation

$21,1 \pm 1,4$  cm  
 $111,6 \pm 24,5$  g



Quarantaine

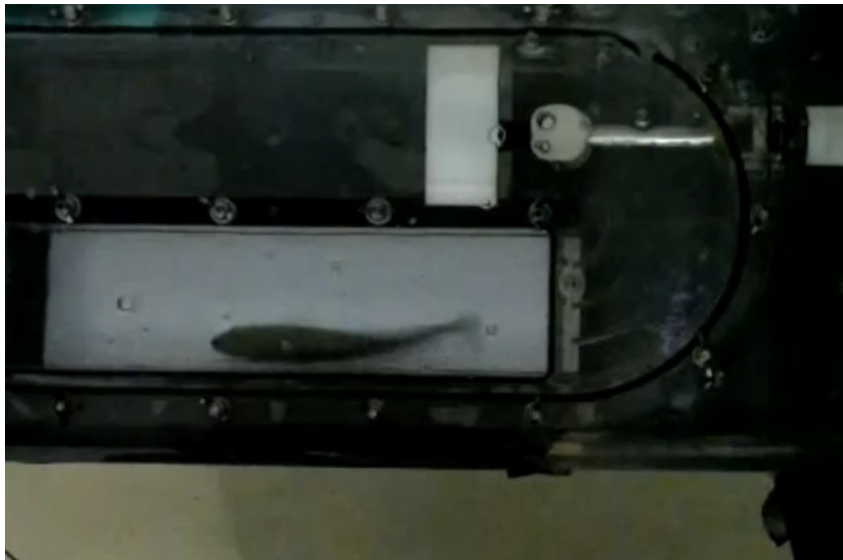
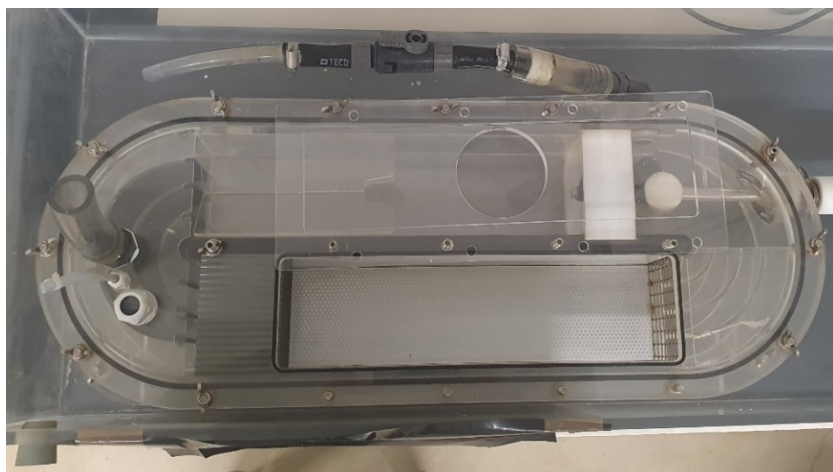
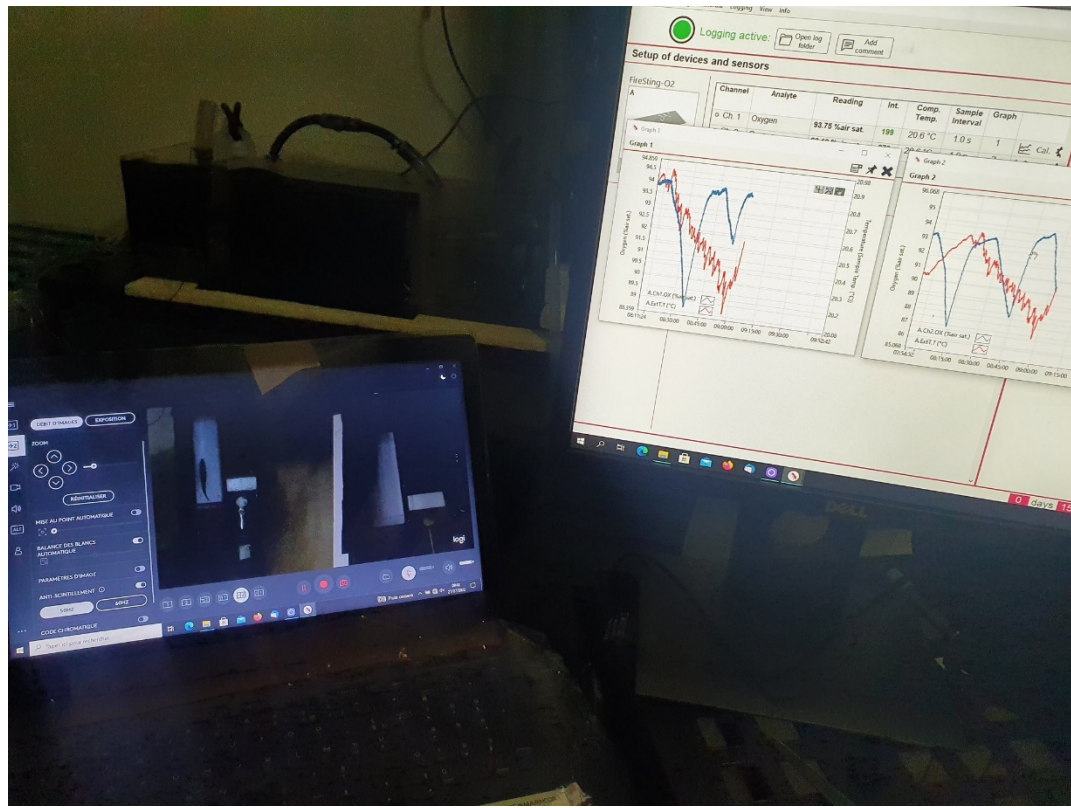
$18,7 \pm 1,5$  cm  
 $81,2 \pm 18,9$  g

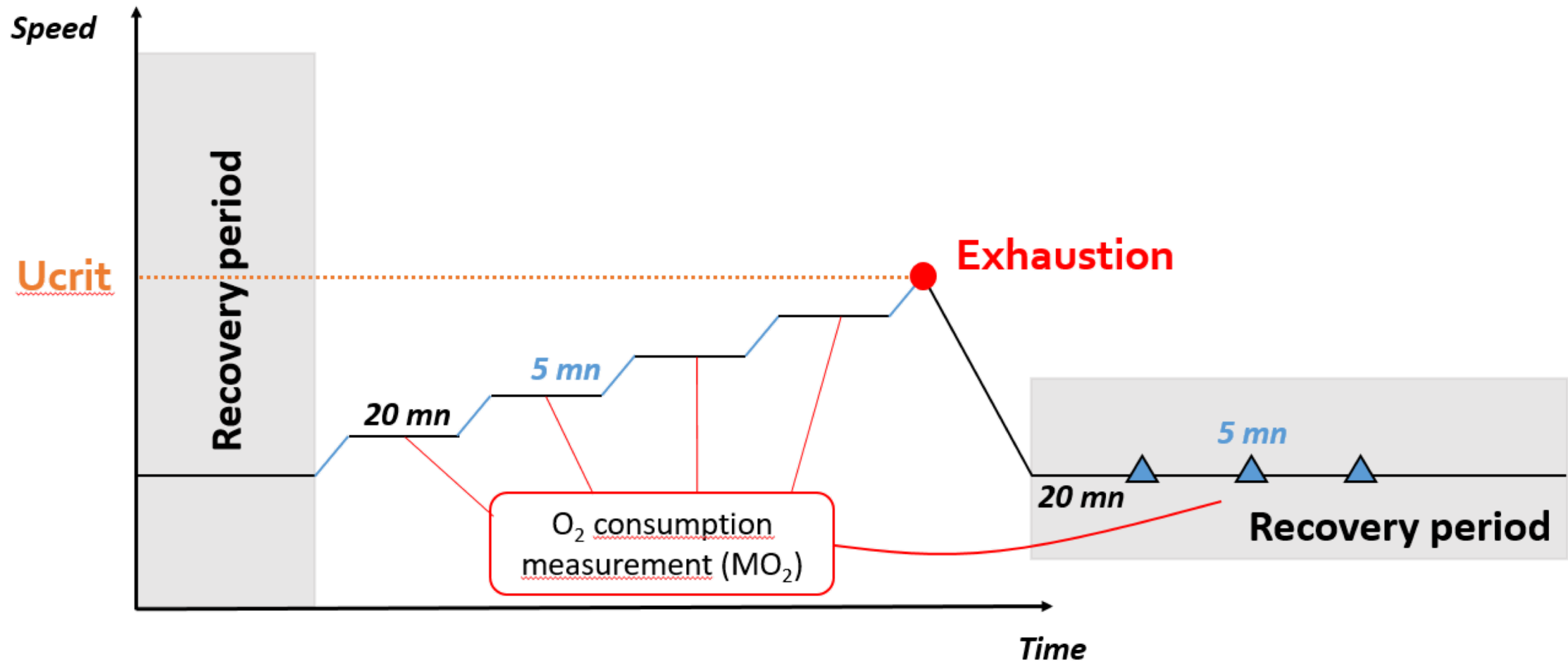


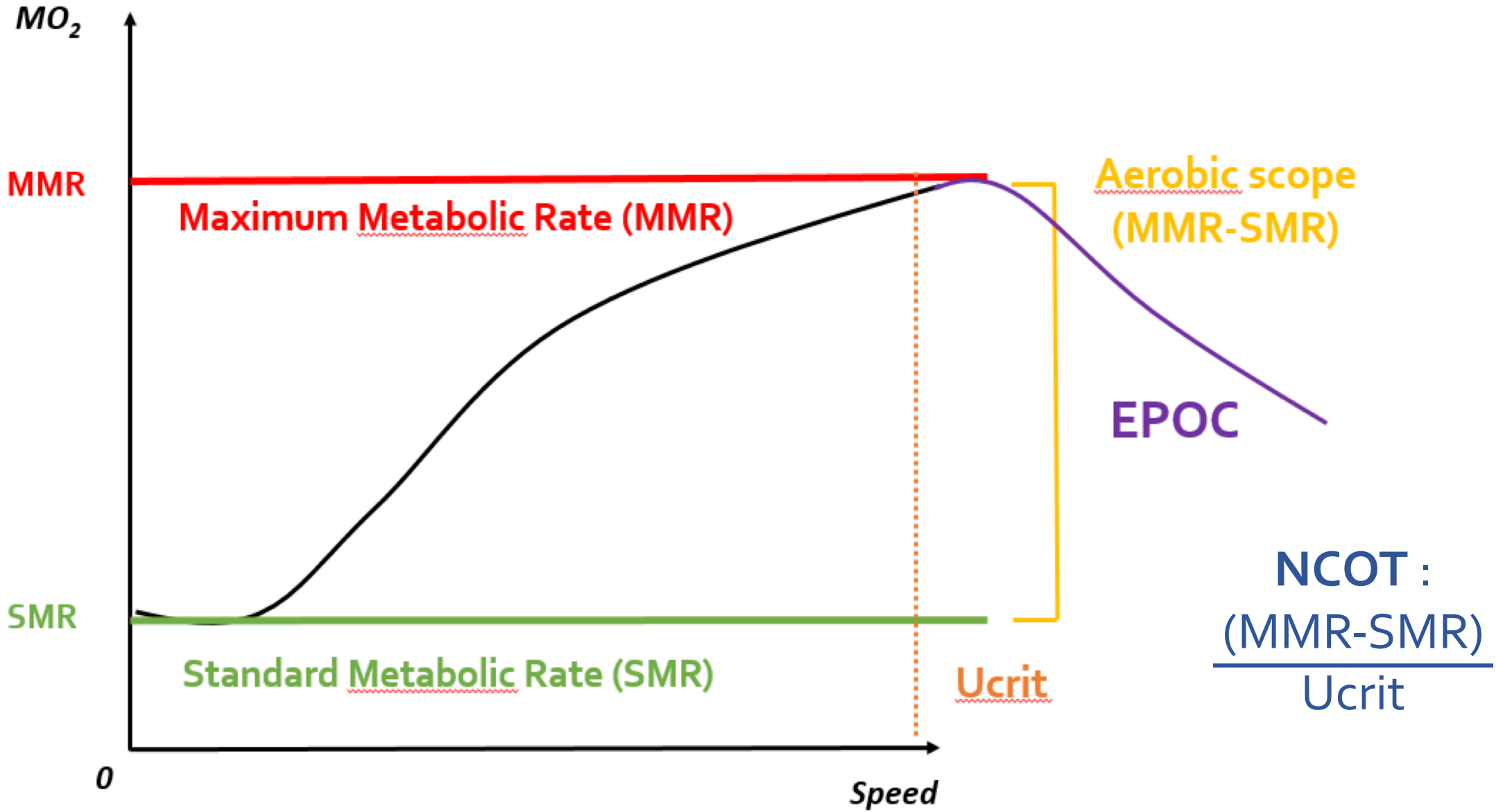
Respirometry  
& swimming  
challenge

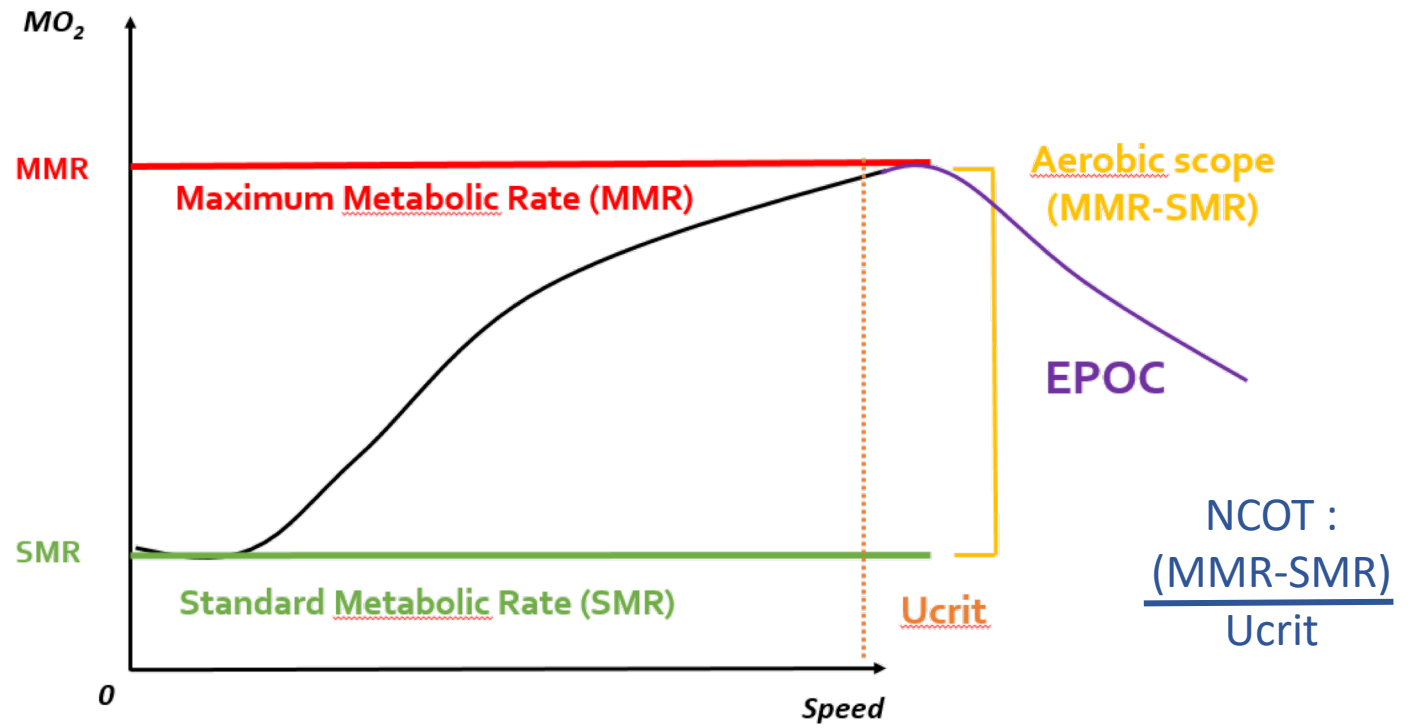
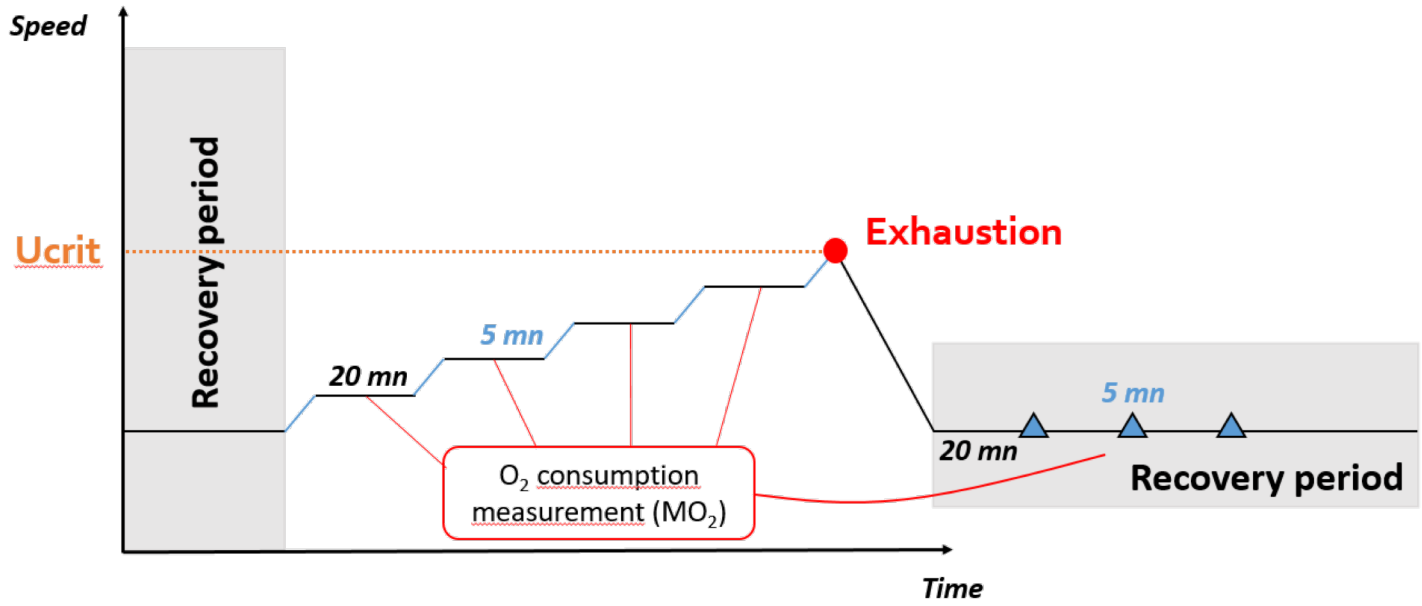


5/6 months  
conditioning

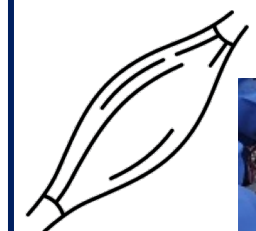
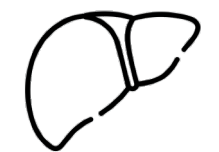






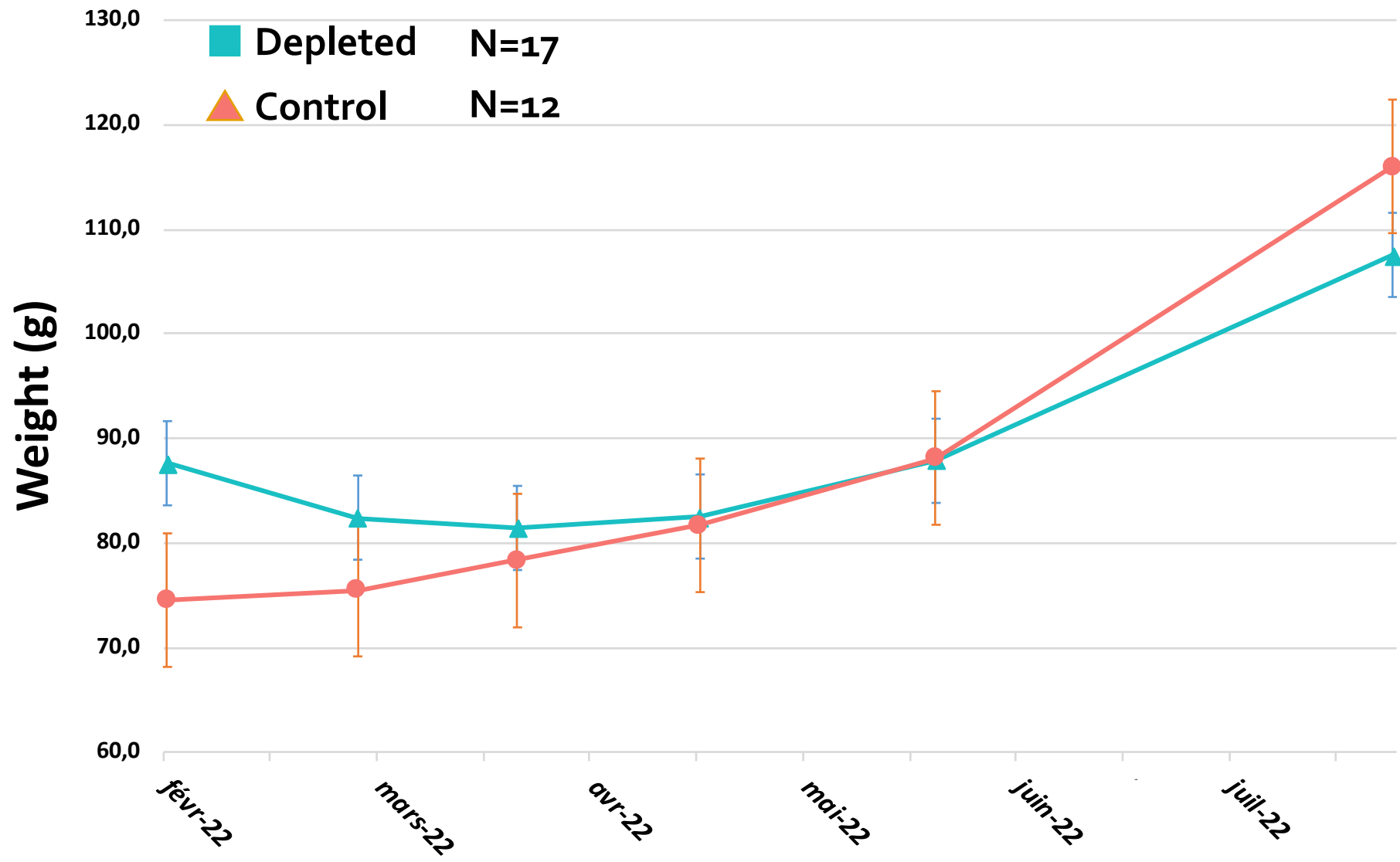


# Tissue sampling for FA analysis

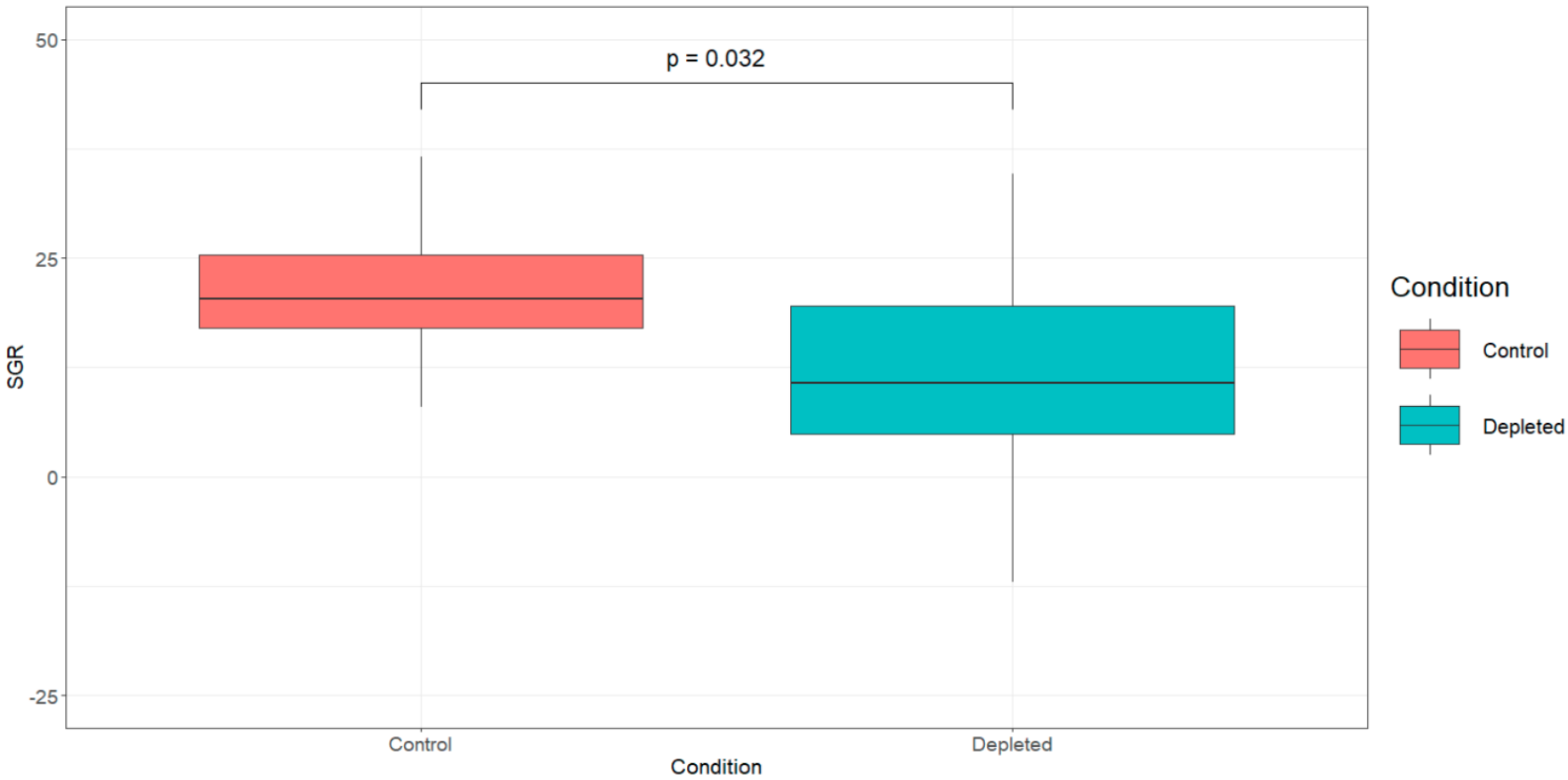




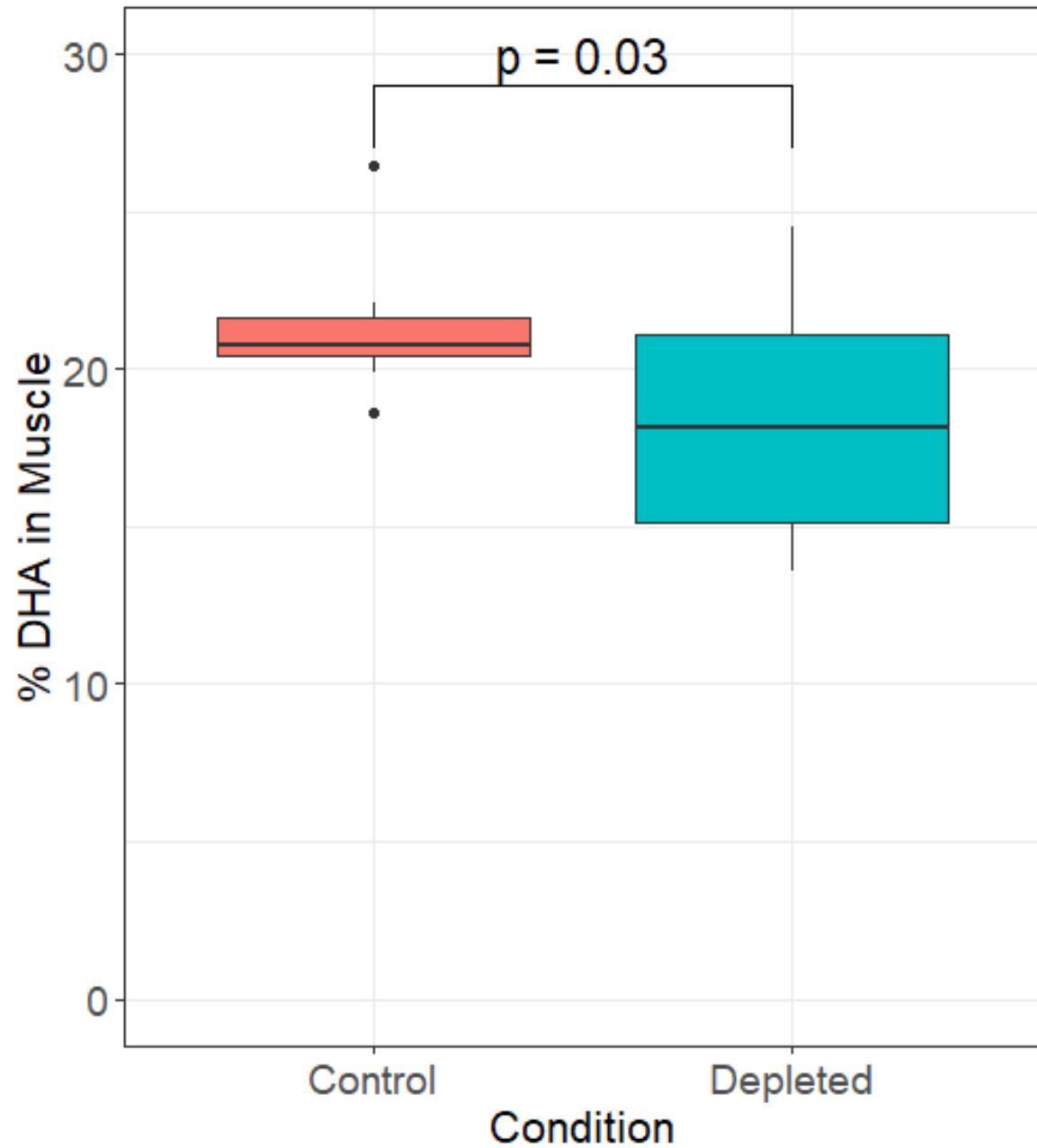
# Weight evolution



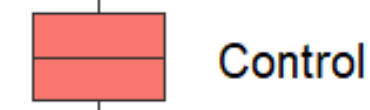
# Specific Growth Rate



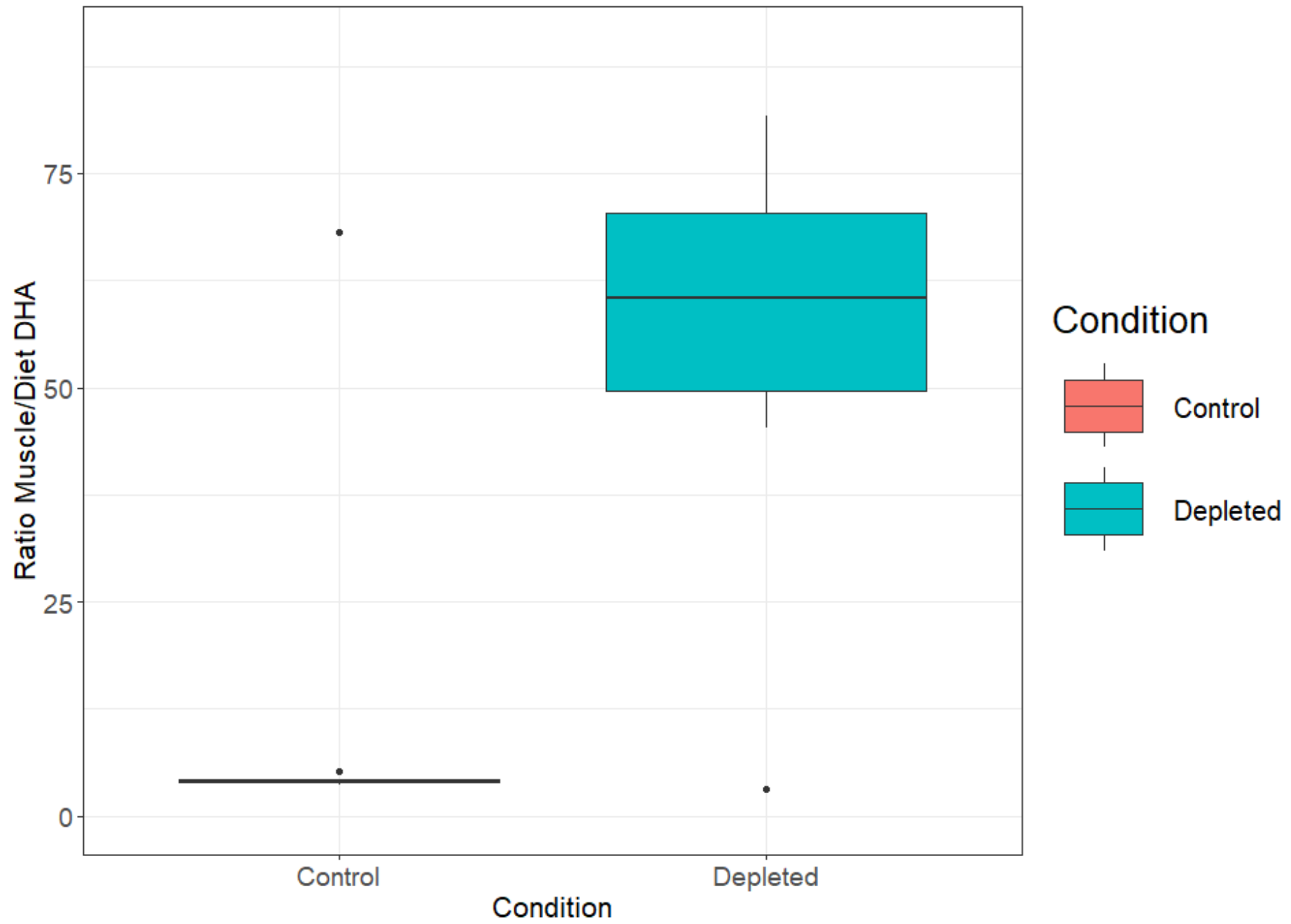
**SGR is significantly higher for control group**



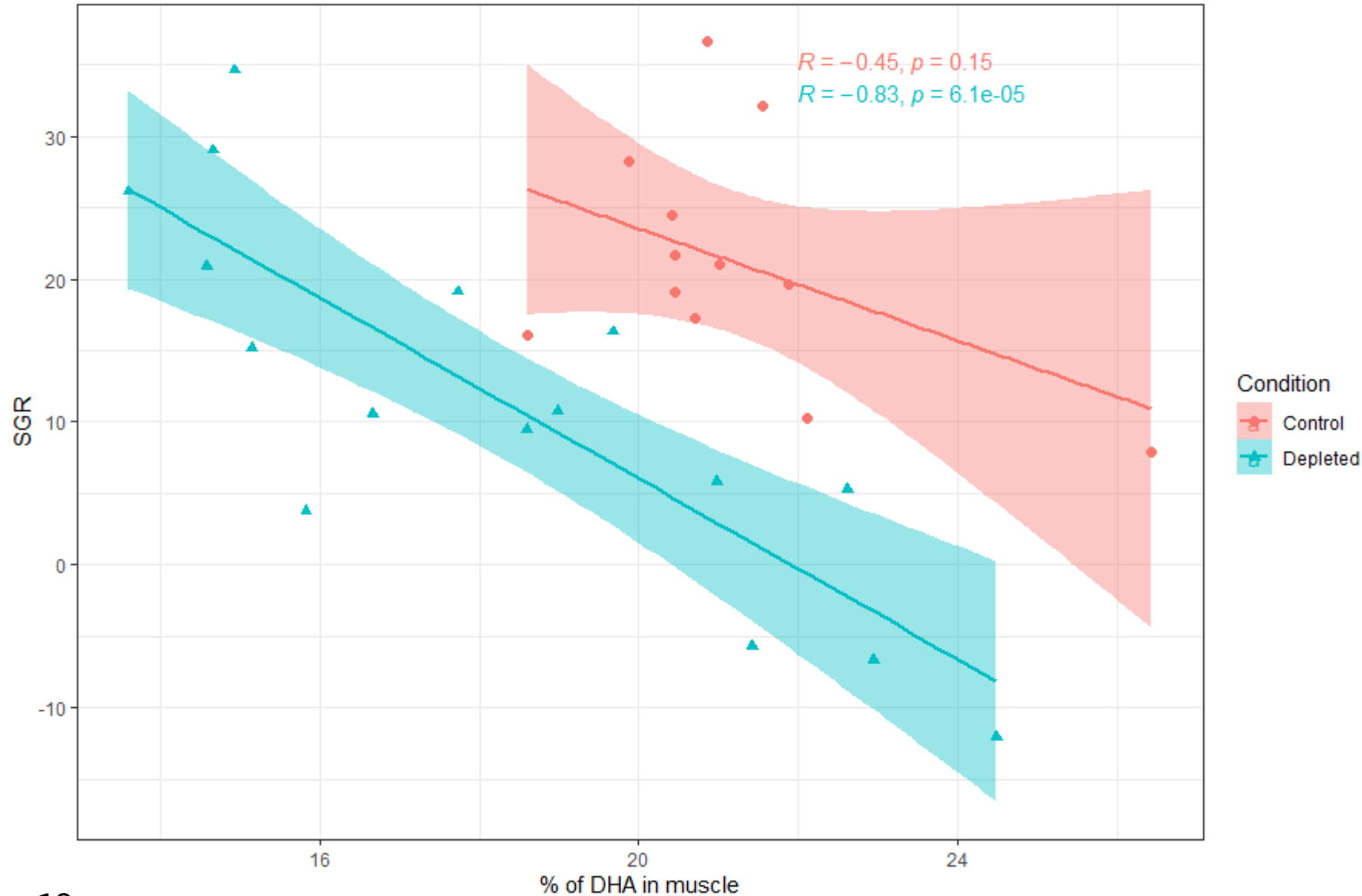
Condition



**DHA in muscle is lower in the depleted group ( $p=0,03$ )**



# Specific Growth Rate & DHA

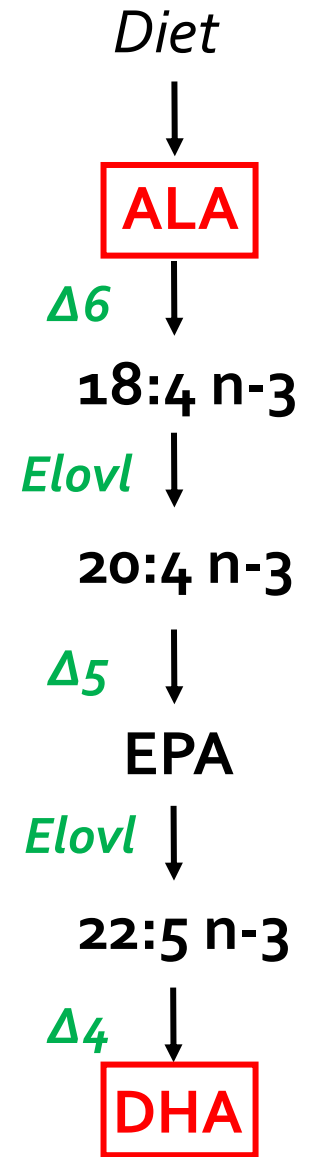
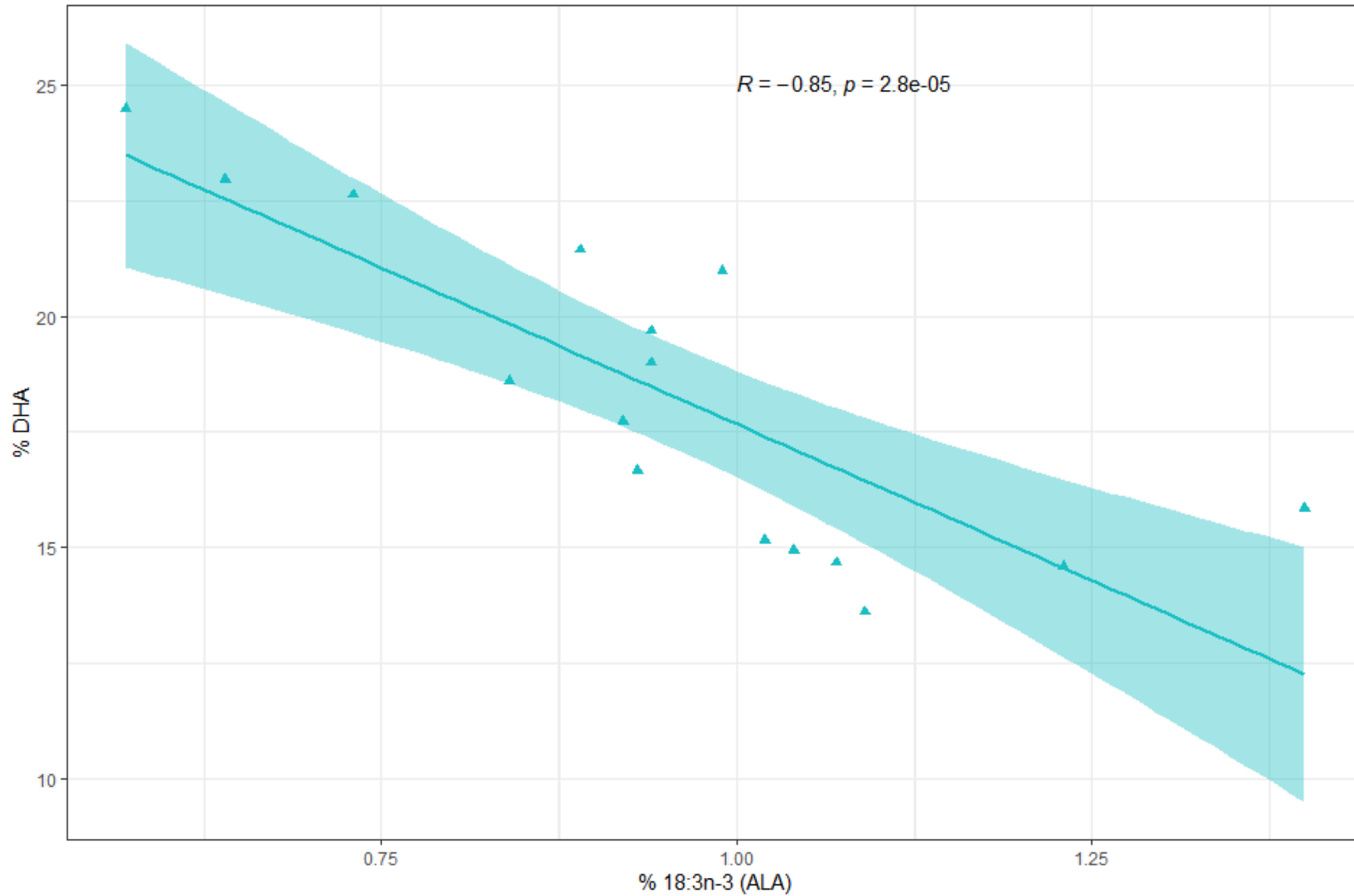


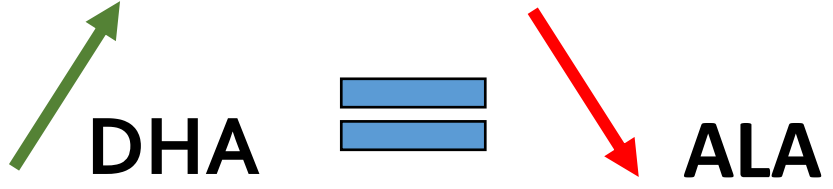
Significant relation  
in depleted group

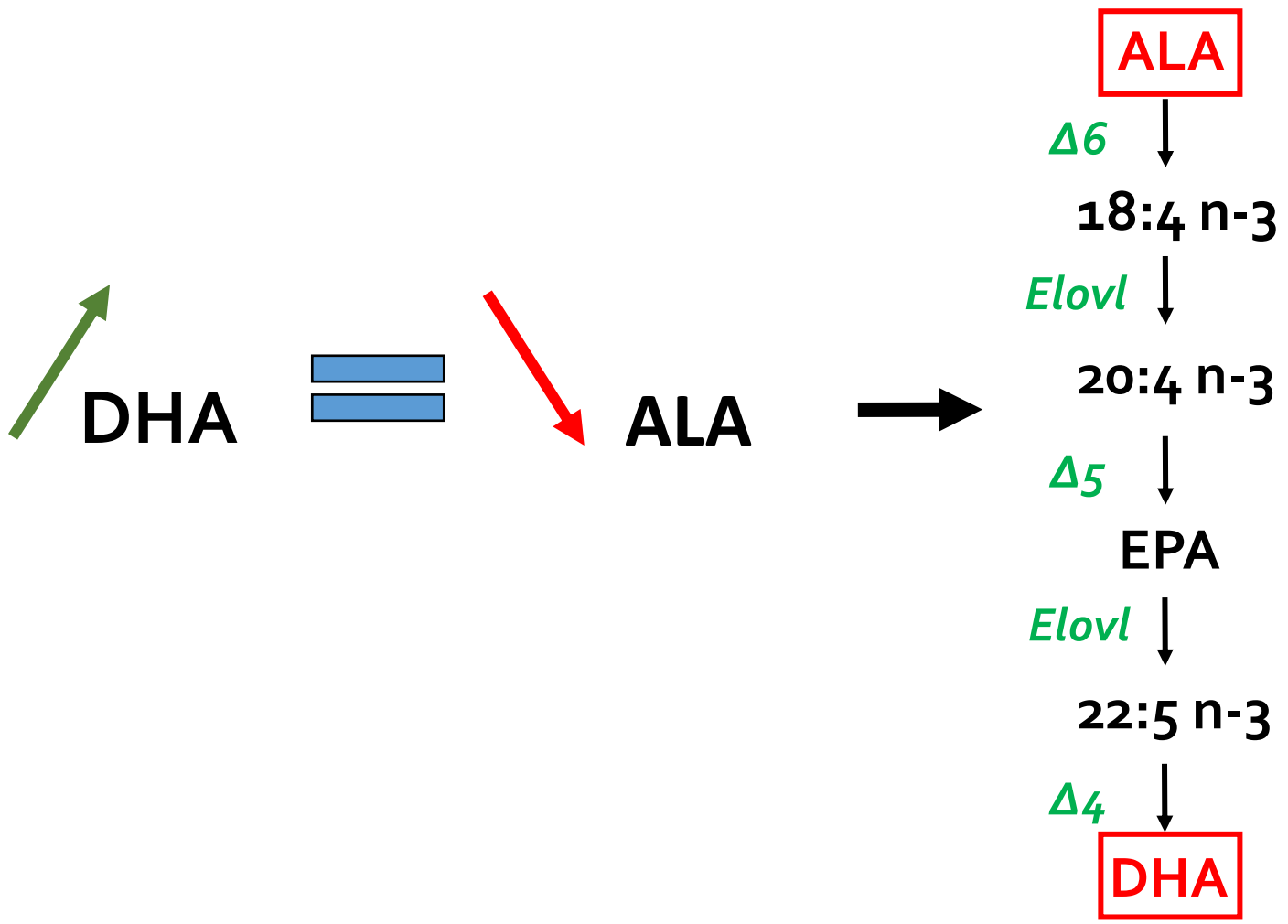
The more DHA,  
the less growth

????

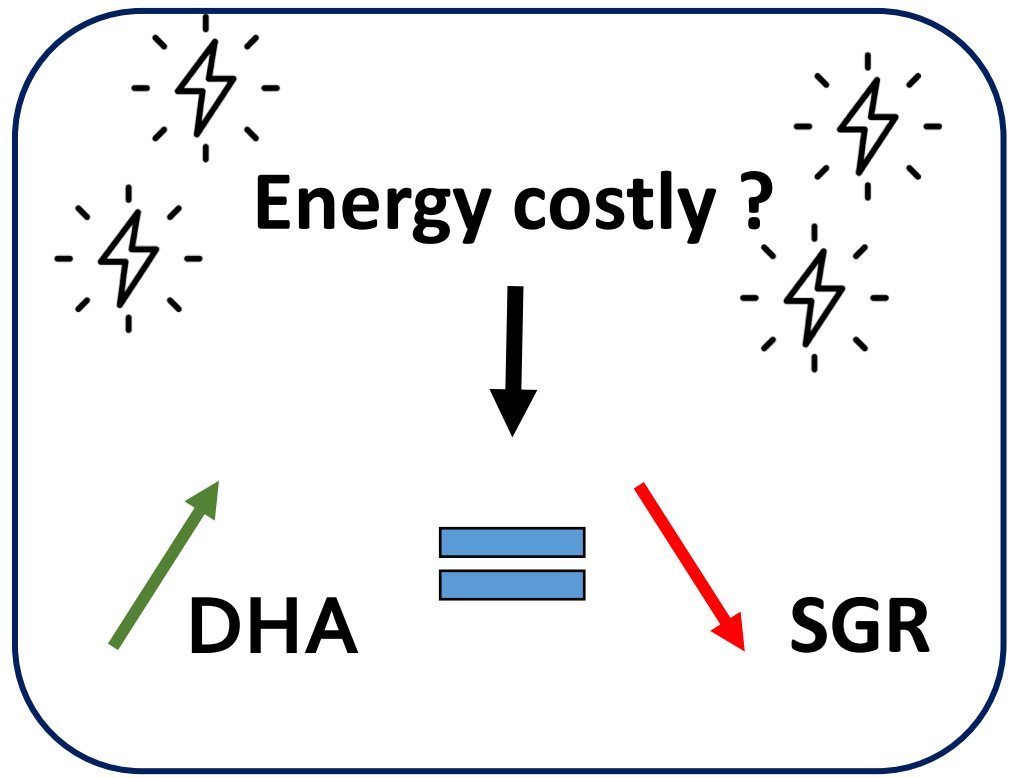
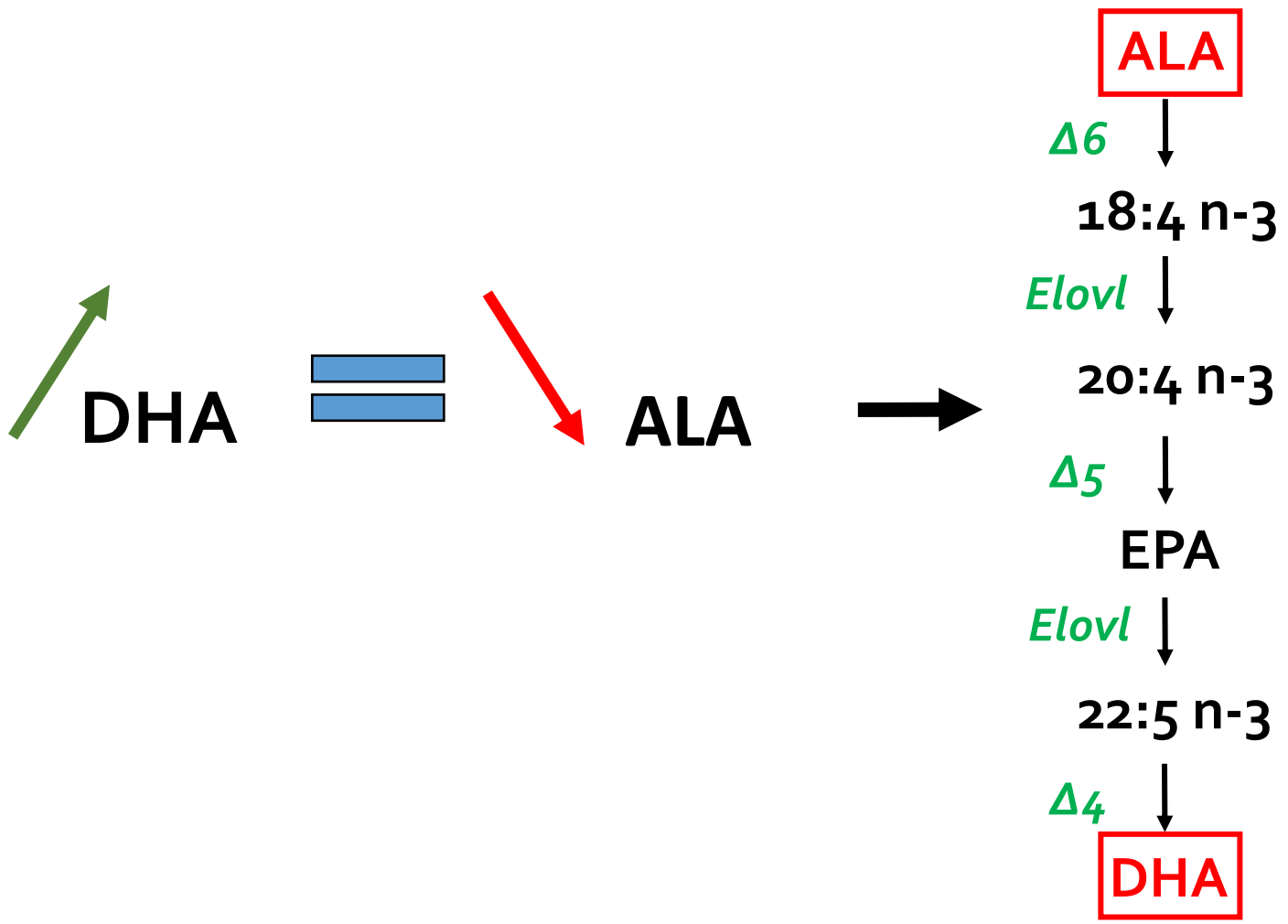
# DHA & ALA



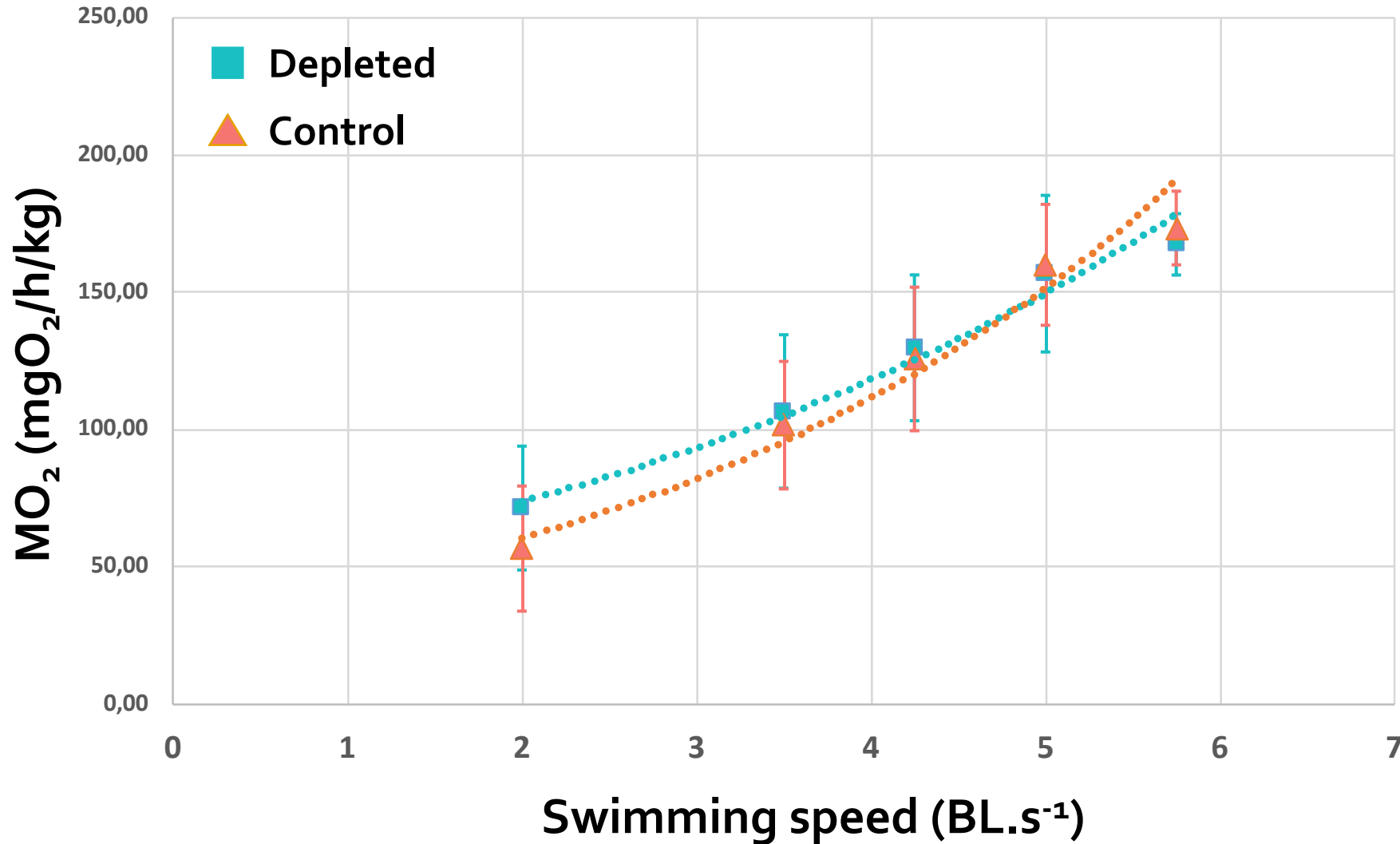




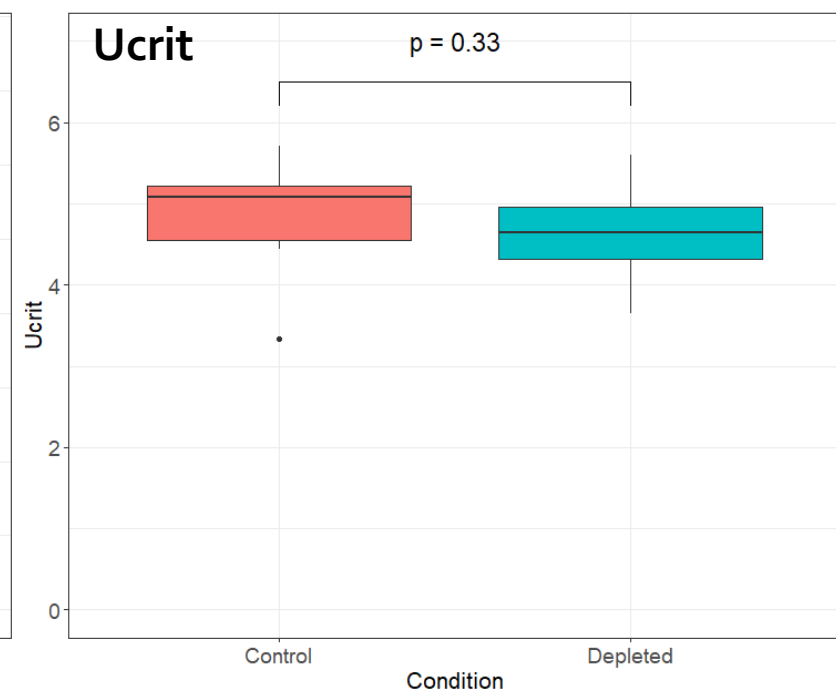
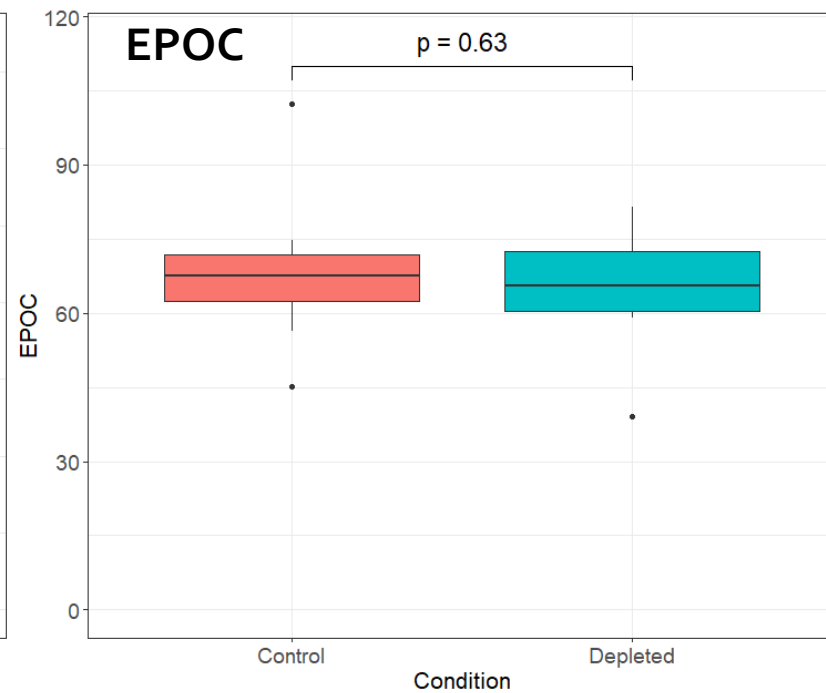
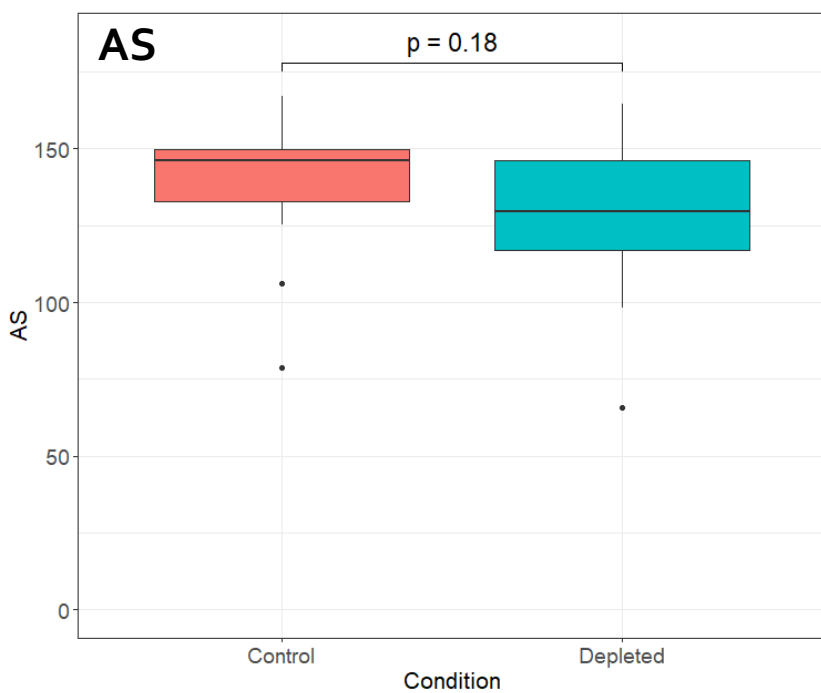
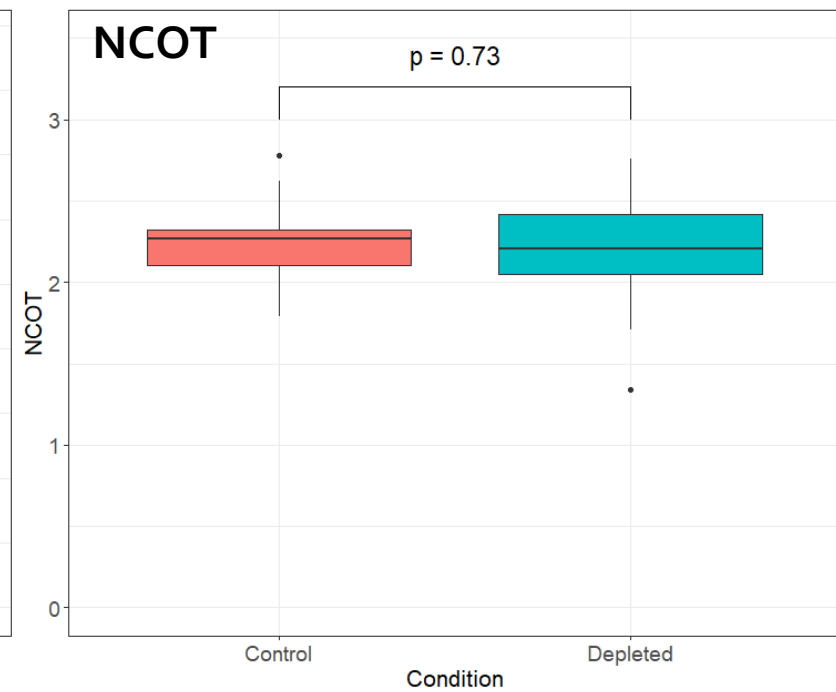
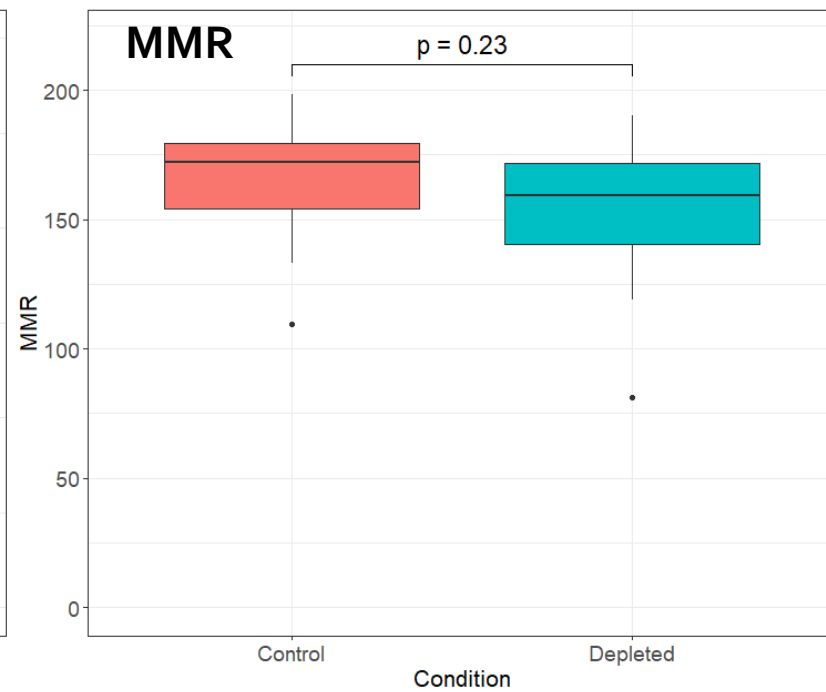
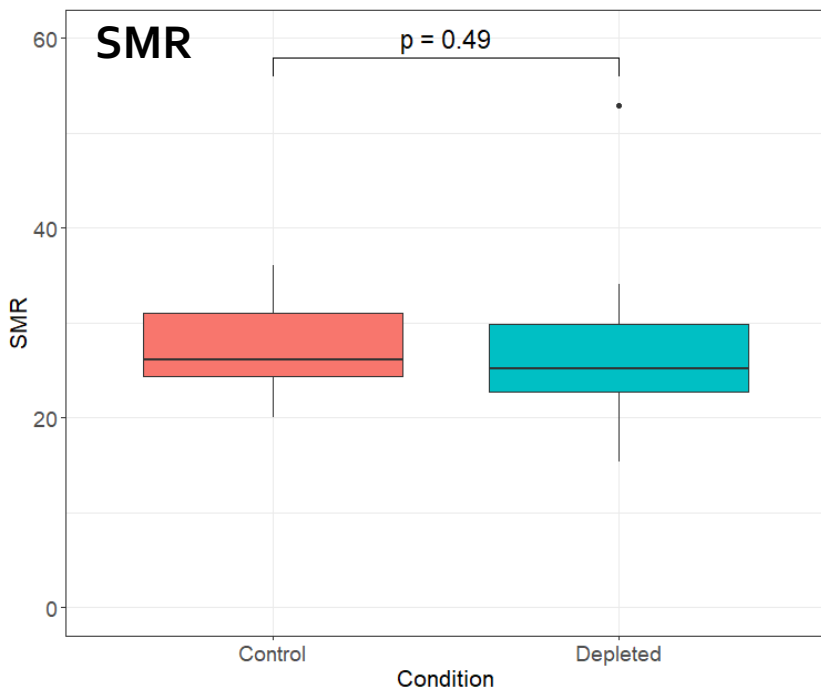


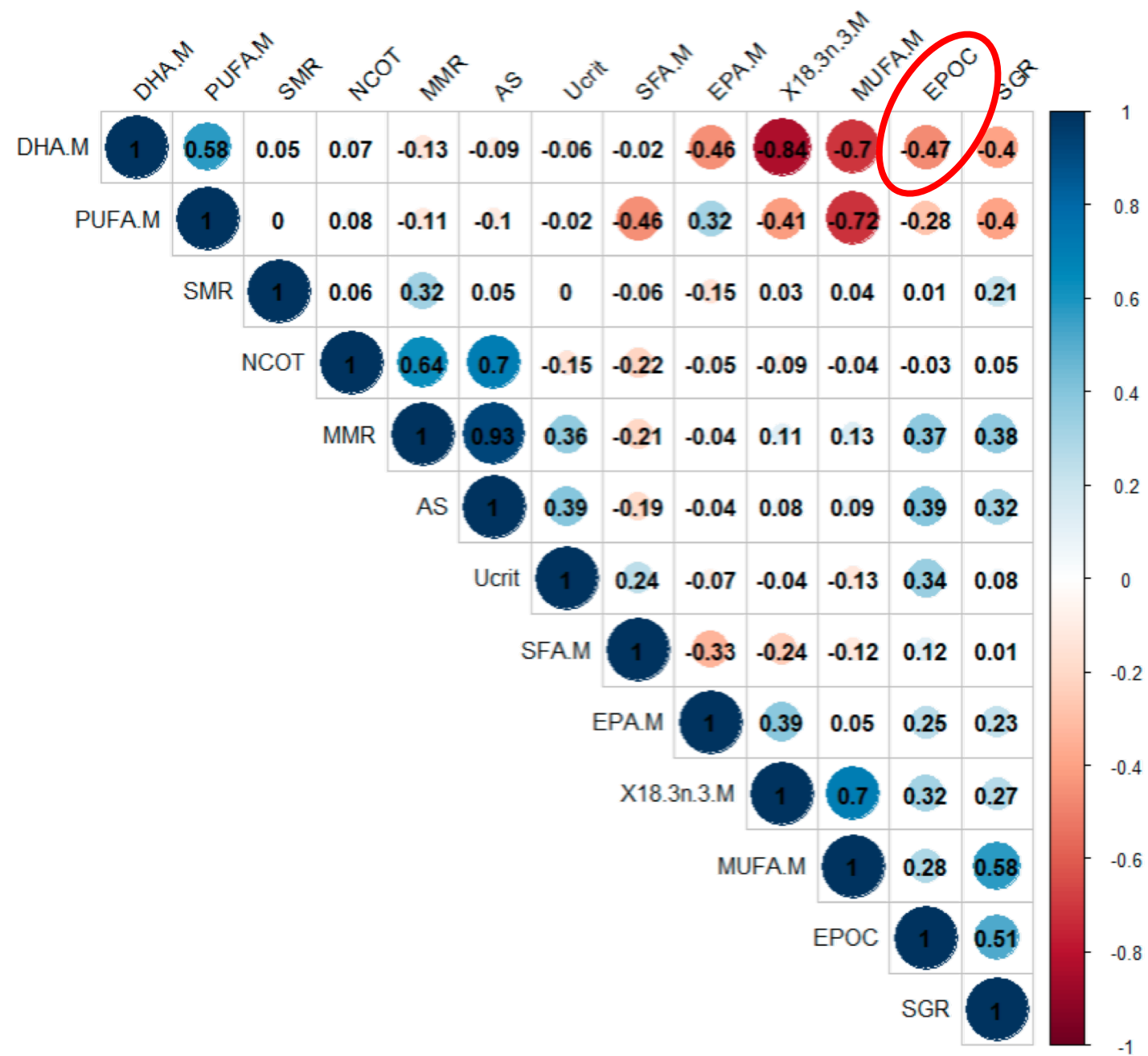


## MO<sub>2</sub> as a function of swimming speed (~19°C)



Expected exponential increase of MO<sub>2</sub> with swimming speed

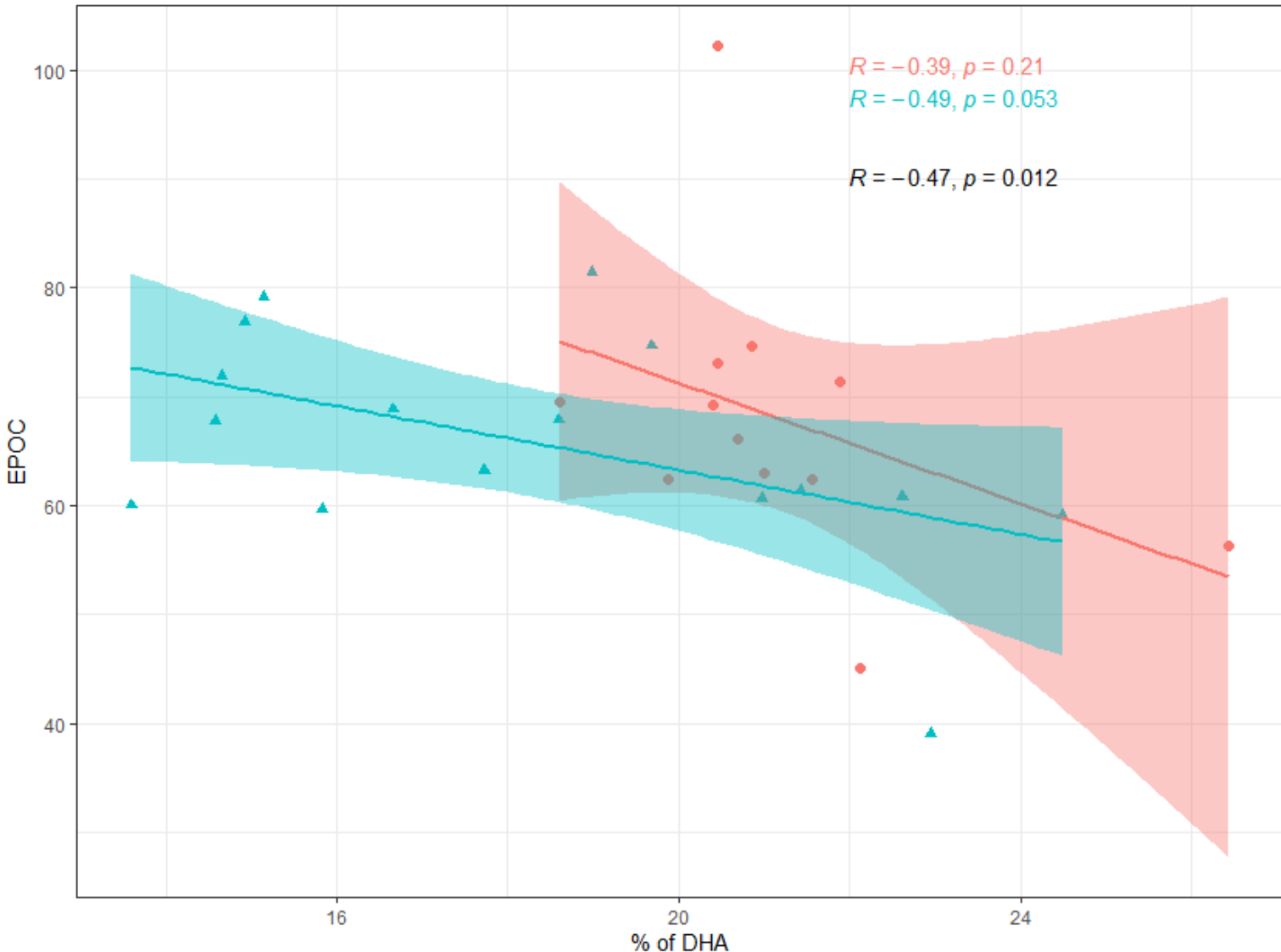




Negative correlation of Muscle DHA with EPOC

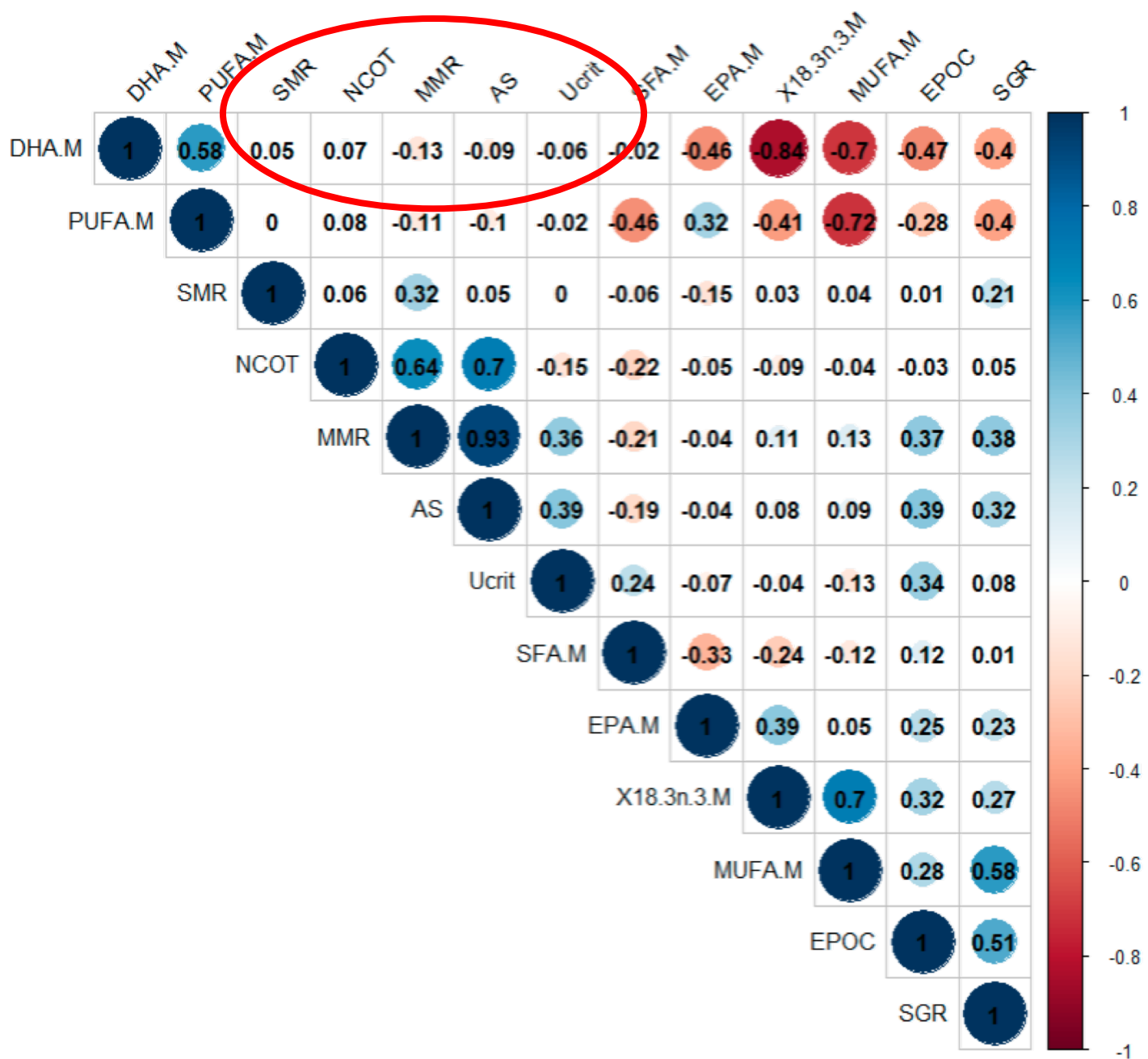
# DHA & EPOC

	DHA.M	PUFA.M	SMR	NCOT	MMR	AS	Ucrit	SFA.M	EPA.M	X18.3n.3.M	MUFAM	EPOC	SGR
DHA.M	1	0.58	0.05	0.07	-0.13	-0.09	-0.06	-0.02	-0.46	-0.84	-0.7	-0.47	-0.4



When separating the treatments, the trend is not significant (but  $p = 0,053\dots$ )

**Implications of DHA depletion ??**



No other metabolic variable with a Muscle DHA correlation

**Need for deeper investigation**

# Take home message

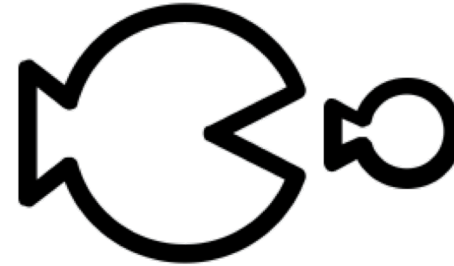
## Implications in a changing natural environment context :

- Reduced SGR in depleted group -> Energy trade off?
- Prey/predator interactions ? EPOC and **ability to catch preys**  
-> **Locomotion frequency**

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- DHA is also important in **behavior and vision.**

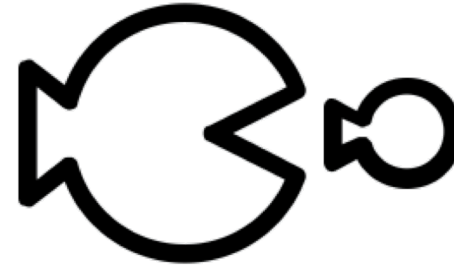




# Take home message


## Implications in a changing natural environment context :

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-> **Locomotion frequency**
- DHA is also important in **behavior and vision.**



One of the first studies with **wild caught** sea bass studying DHA deficiency


Careful when working with wild fish !

 **Mickaël Peron** @MickalPeron1 · Oct 13, 2022

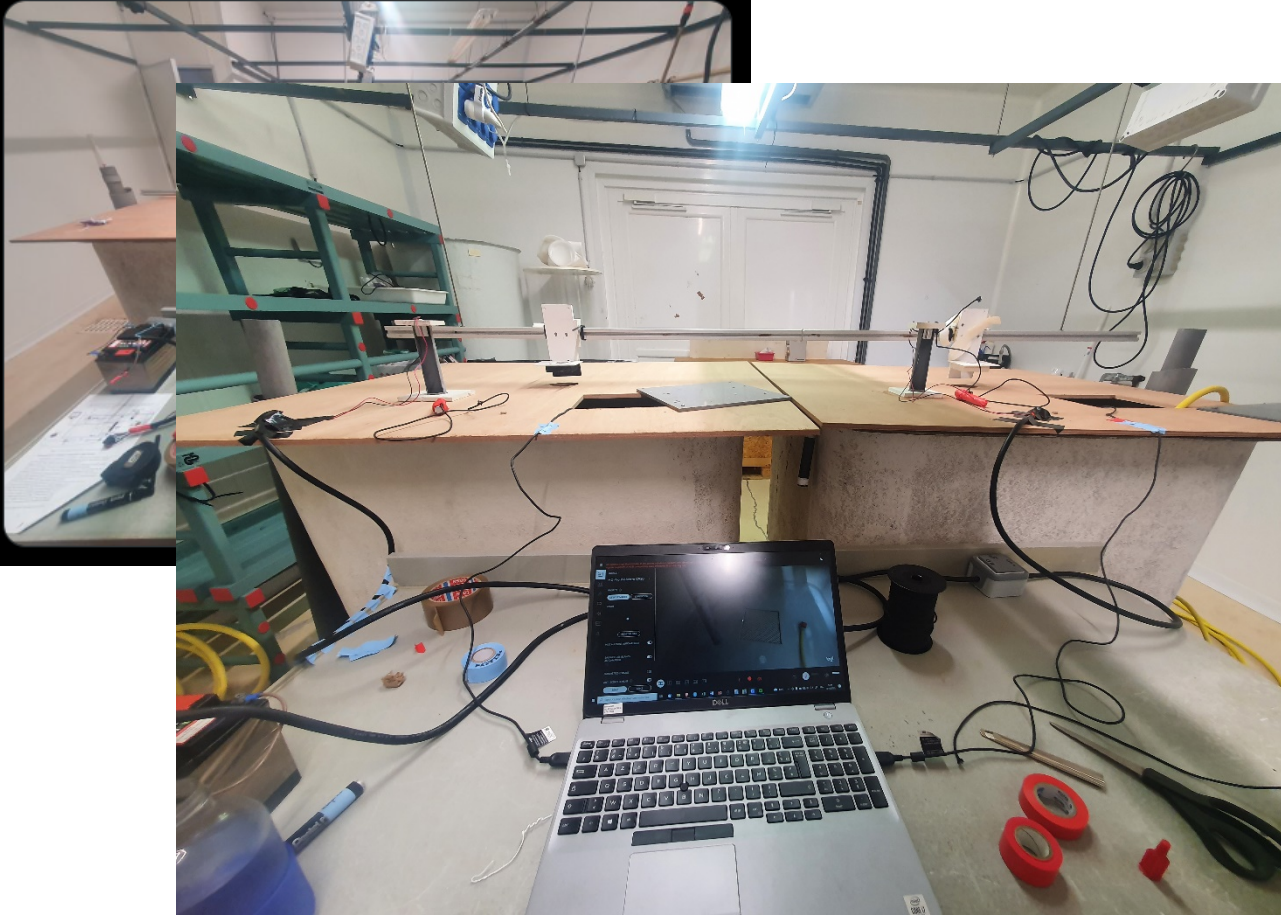
Setting up (more like trying to) our new experiment about fish escape response at @LemarLab! 🐟  
Really excited to start learning about 🐟 behavior !!




**STAY TUNED !**

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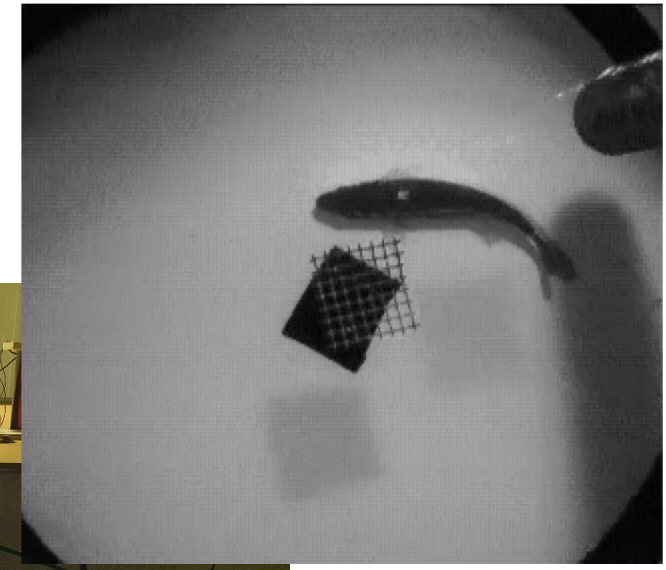
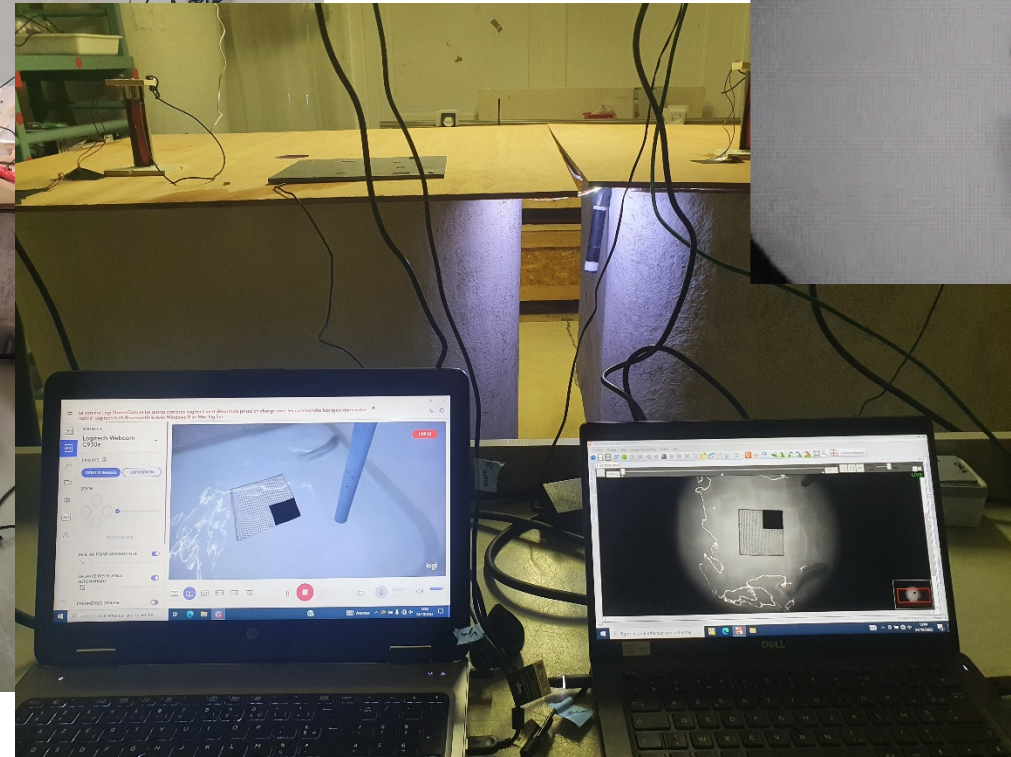
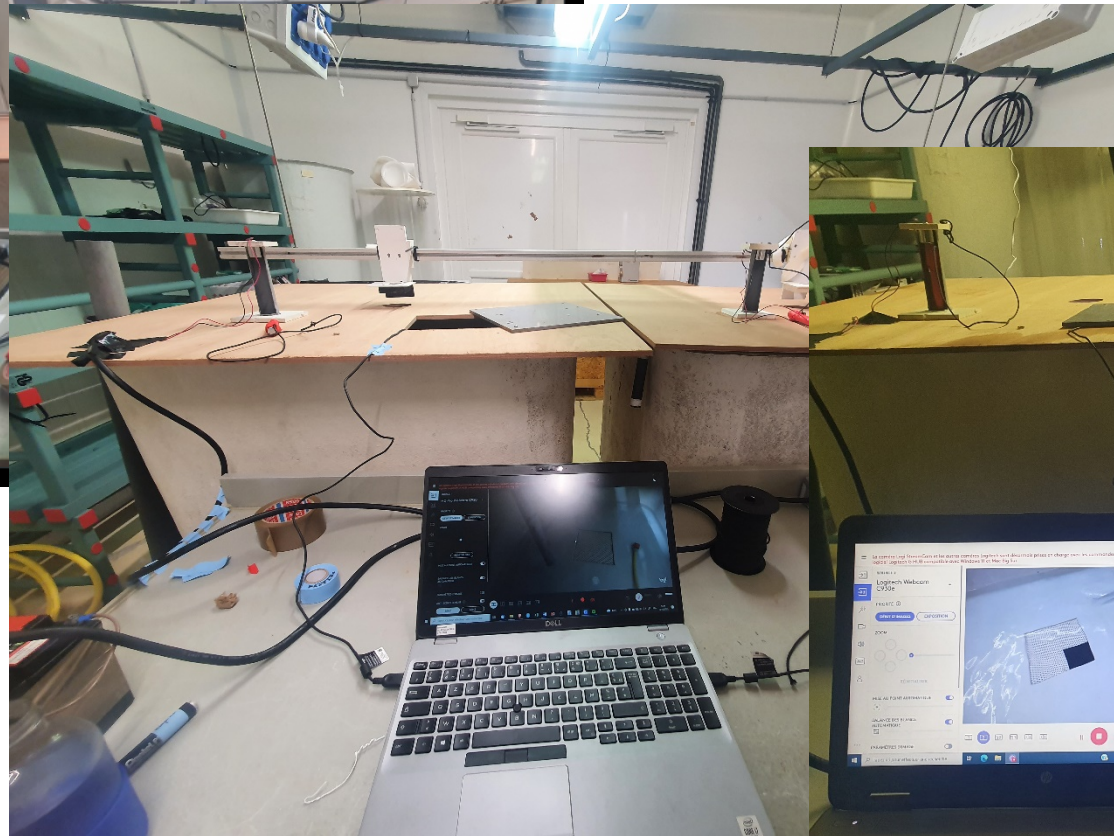
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# STAY TUNED !



# Acknowledgments

Fishing, transportation and help with the fish :

M. Drogou; S. Martin, L. Le Ru, C. Le Bigre  
PHYTNESS Unit



Helpful discussions and experiment setup :

E. Dubillot; T. Milinkovitch



Feed manufacturing :

F. Terrier



# Research & supervising team



@MickalPeron1