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Spatial and ontogenic variability of omega-3 fatty acid composition in European sea bass *Dicentrarchus labrax* from two French estuaries

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Spatial and ontogenetic variability of omega-3 fatty acid composition in European sea bass *Dicentrarchus labrax* from two French estuaries

Mickaël Péron, Antoine Bideau, Fabienne Le Grand, David Mazurais, Philippe Soudant, Marie Vagner

Lipids

Source & **reserve** of energy



Triglycerides



Neutral lipids (NL)

Dietary influence

Skalli et al, 2006

Lipids

Source & **reserve** of energy



Triglycerides



Neutral lipids (NL)

Dietary influence

Skalli et al, 2006

Structure & function of
membranes



Phospholipids



Polar lipids (PL)

Lipids

Source & **reserve** of energy



Triglycerides



Neutral lipids (NL)

Dietary influence

Skalli et al, 2006

Structure & function of
membranes

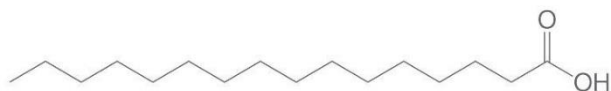


Phospholipids

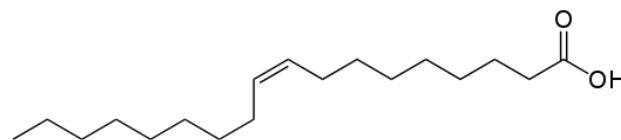


Polar lipids (PL)

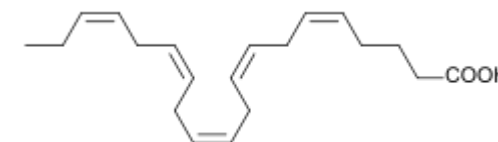
Fatty acids



Saturated
(e.g Palmitic acid)



Mono-unsaturated
(e.g Oleic acid)



Poly-unsaturated
(e.g Ecosapentaenoic acid)

Lipids

Source & reserve of energy



Triglycerides



Neutral lipids (NL)

Dietary influence

Skalli et al, 2006

Structure & function of
membranes



Phospholipids



Polar lipids (PL)

Fatty acids

**Long chain n-3
Poly-unsaturated**



Physiology

Growth

Disease preventing

Behavior

Neural development



Essential for
humans and
animals

Lipids

Source & **reserve** of energy



Triglycerides



Neutral lipids (NL)

Dietary influence

Skalli et al, 2006

Structure & function of
membranes

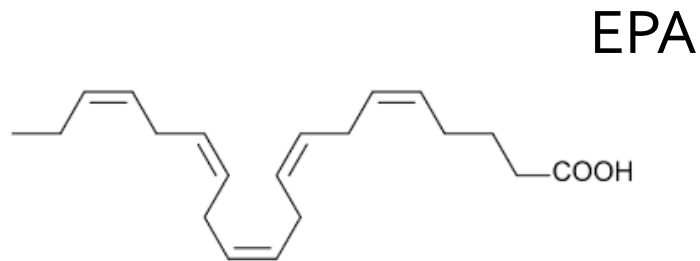


Phospholipids



Polar lipids (PL)

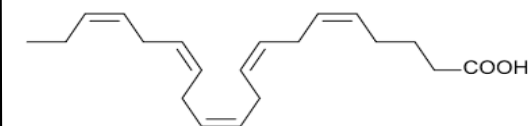
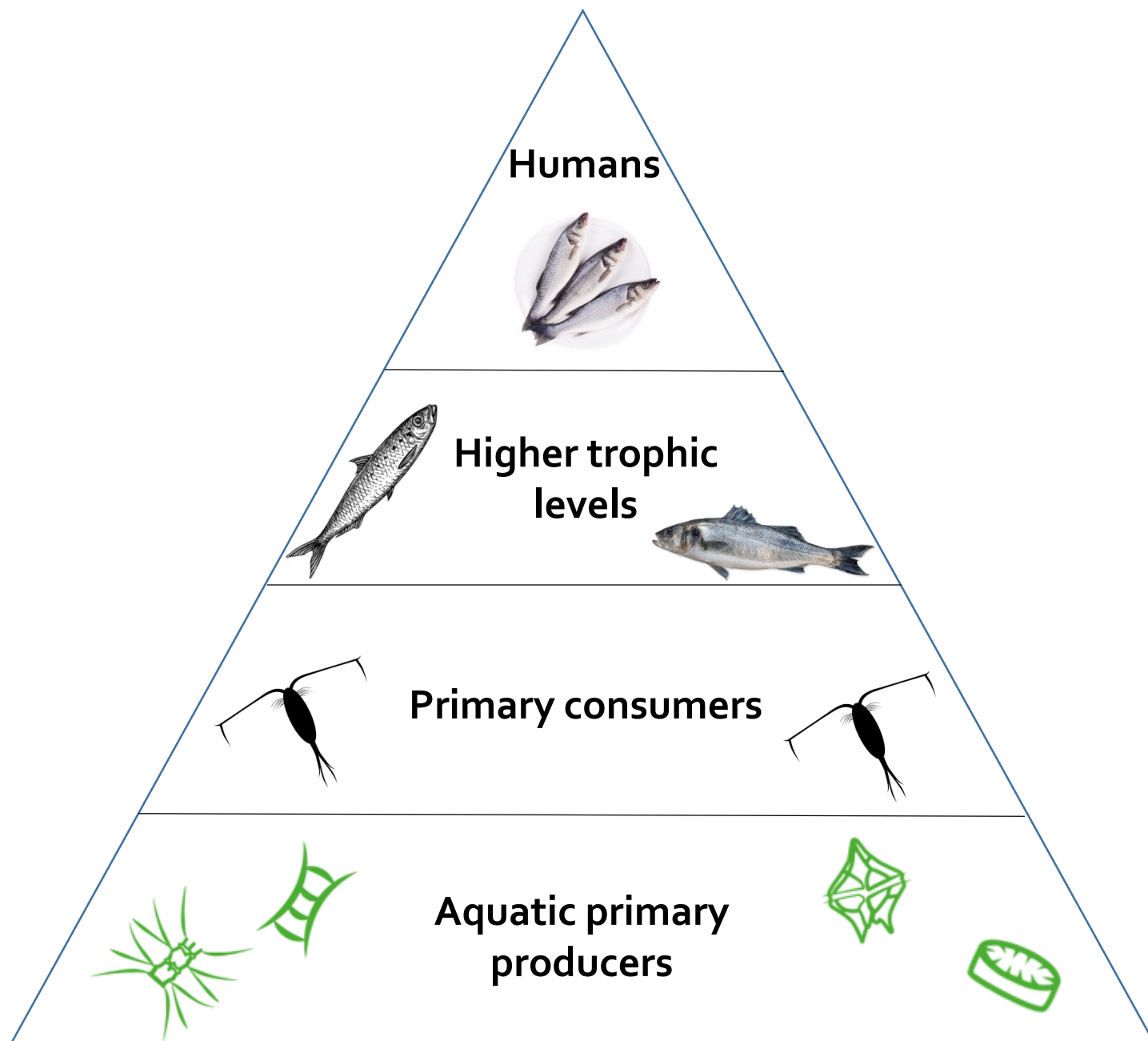
Fatty acids



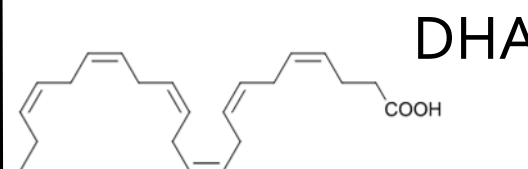
20:5 n-3



22:6 n-3



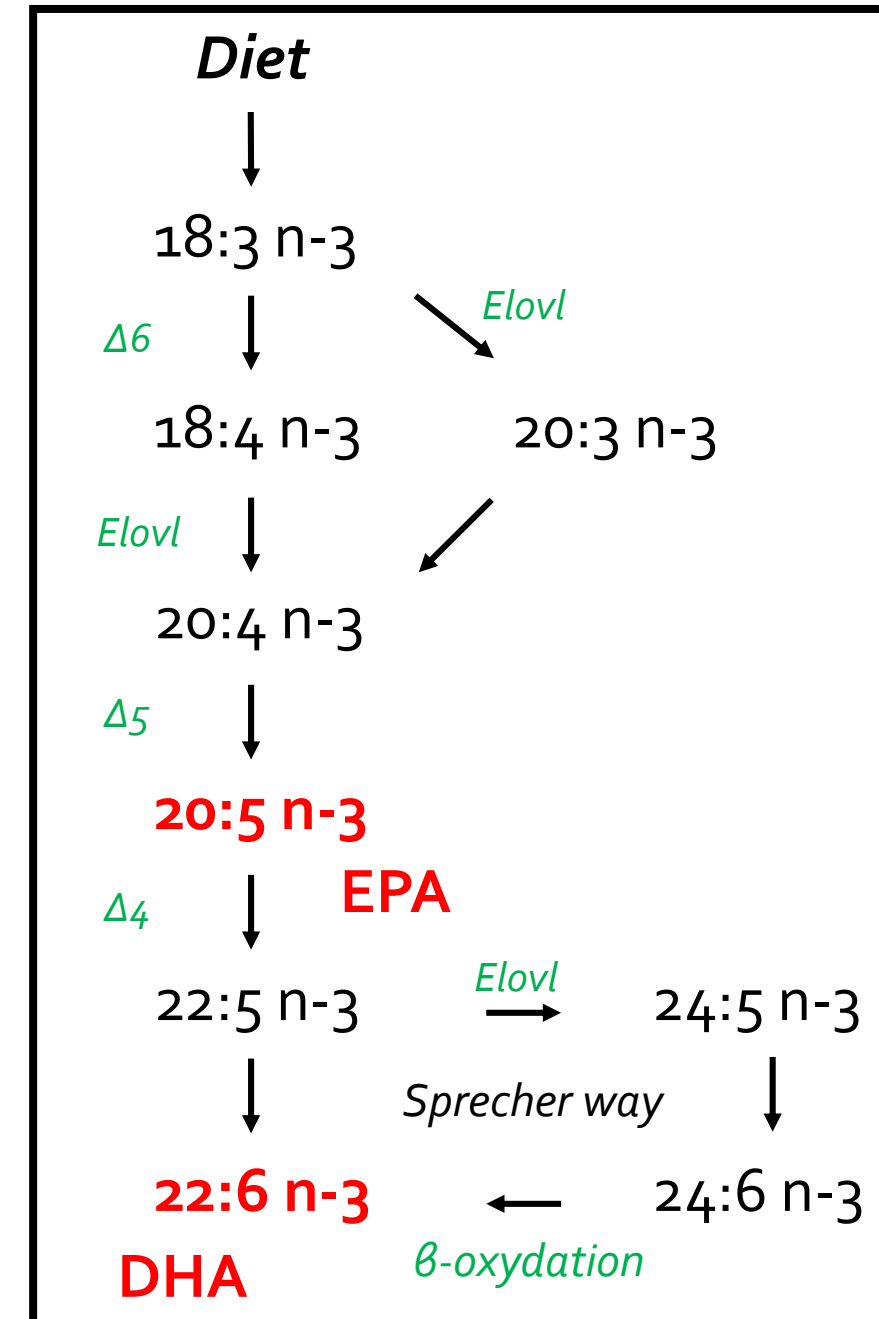
EPA



DHA

- Low / no ability to synthesize n-3 fatty acids for fish

-> Limited efficiency of enzymes (*elongases* & *desaturases*)

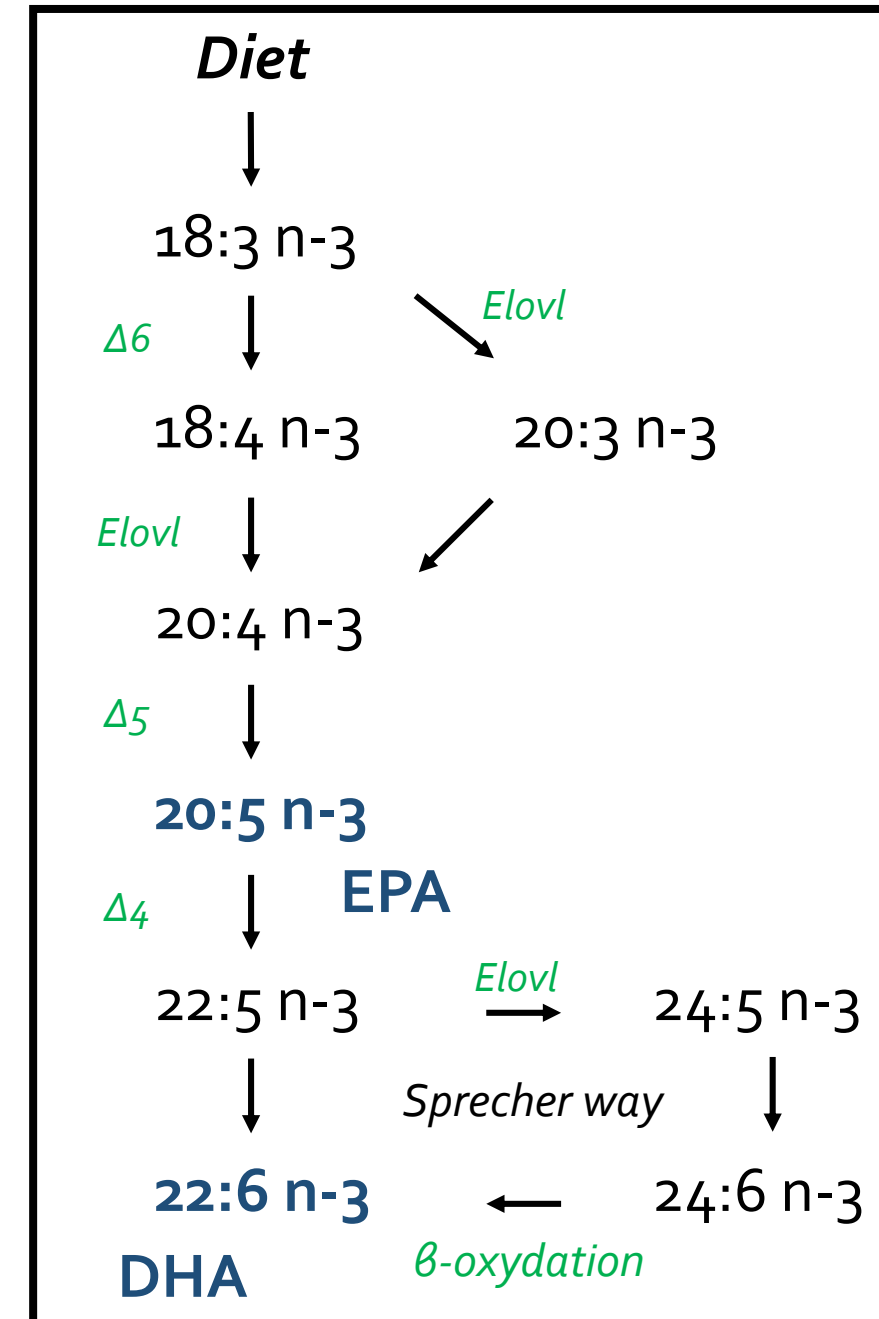


- Low / no ability to synthesize n-3 fatty acids for fish

-> *Limited efficiency of enzymes (elongases & **desaturases**)*

- Difference between marine and freshwater systems

-> *No selective pressure on highly abundant n-3 systems*



- Low / no ability to synthesize n-3 fatty acids for fish

-> Limited efficiency of enzymes (elongases & **desaturases**)

- Difference between marine and freshwater systems

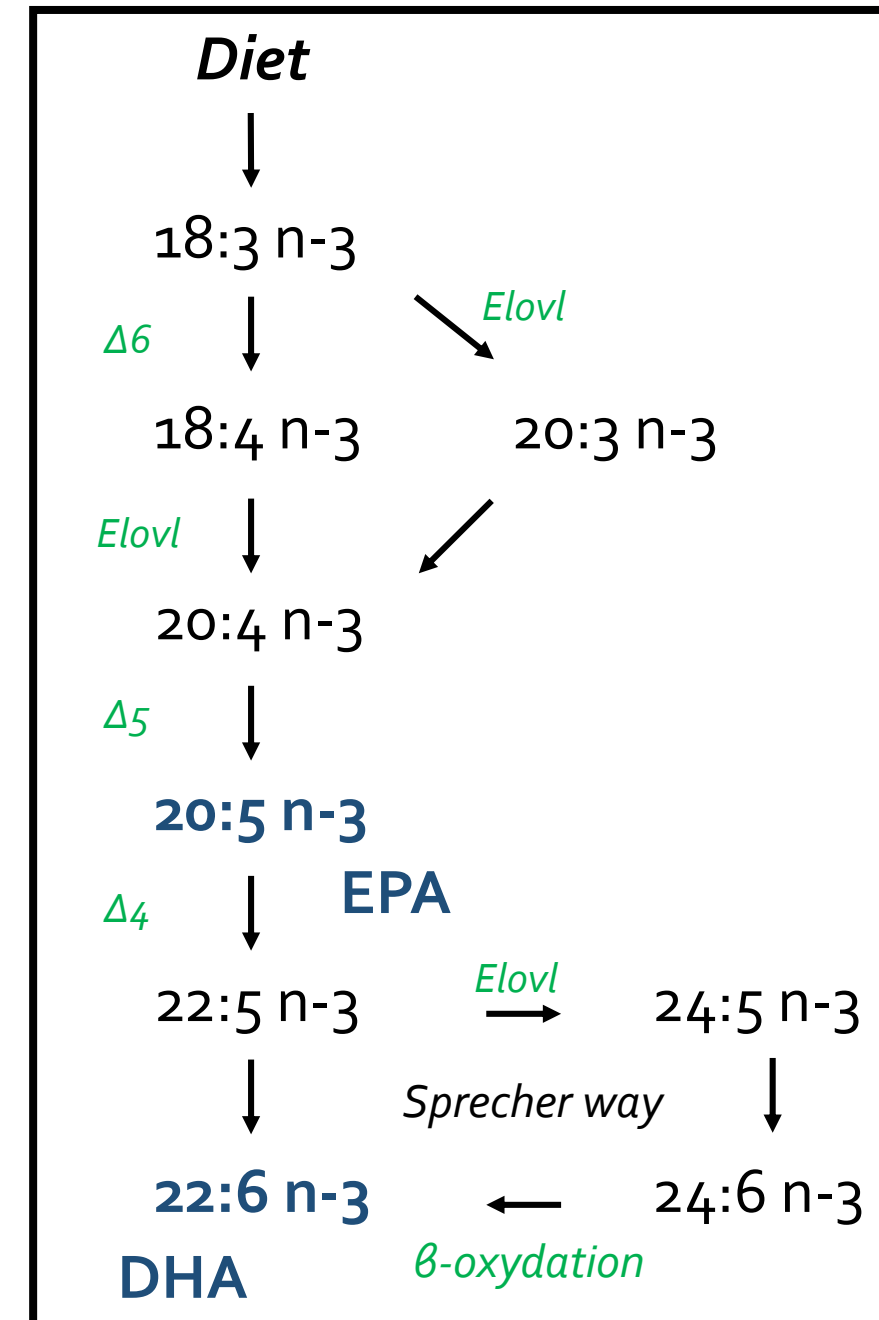
-> No selective pressure on highly abundant n-3 systems

What about euryhaline fish ?

European sea bass
Dicentrarchus labrax :
juvenile stages in estuaries

Habitat / life stage effect on n-3 tissue composition

Low in-natura information

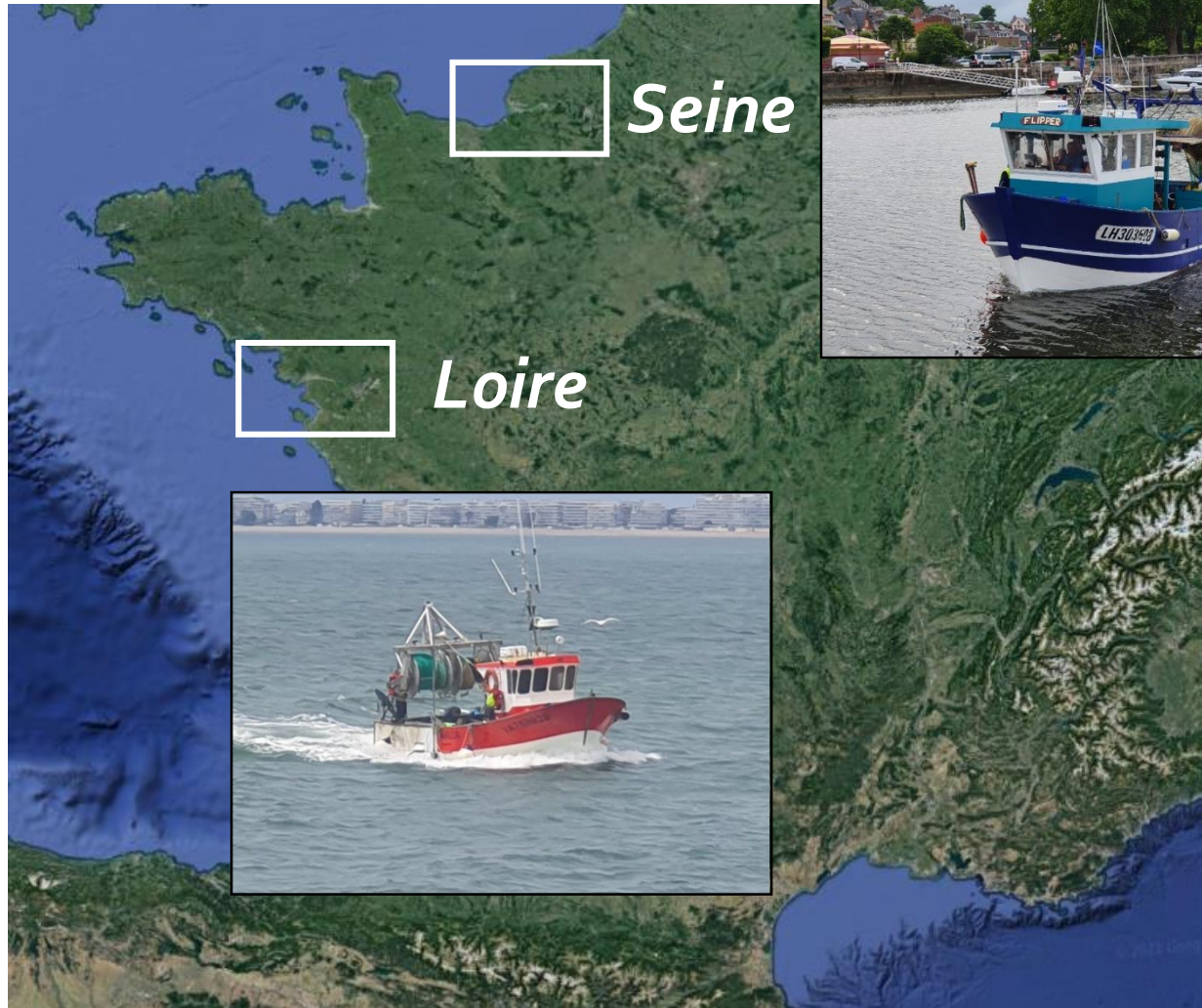


What about euryhaline fish ?

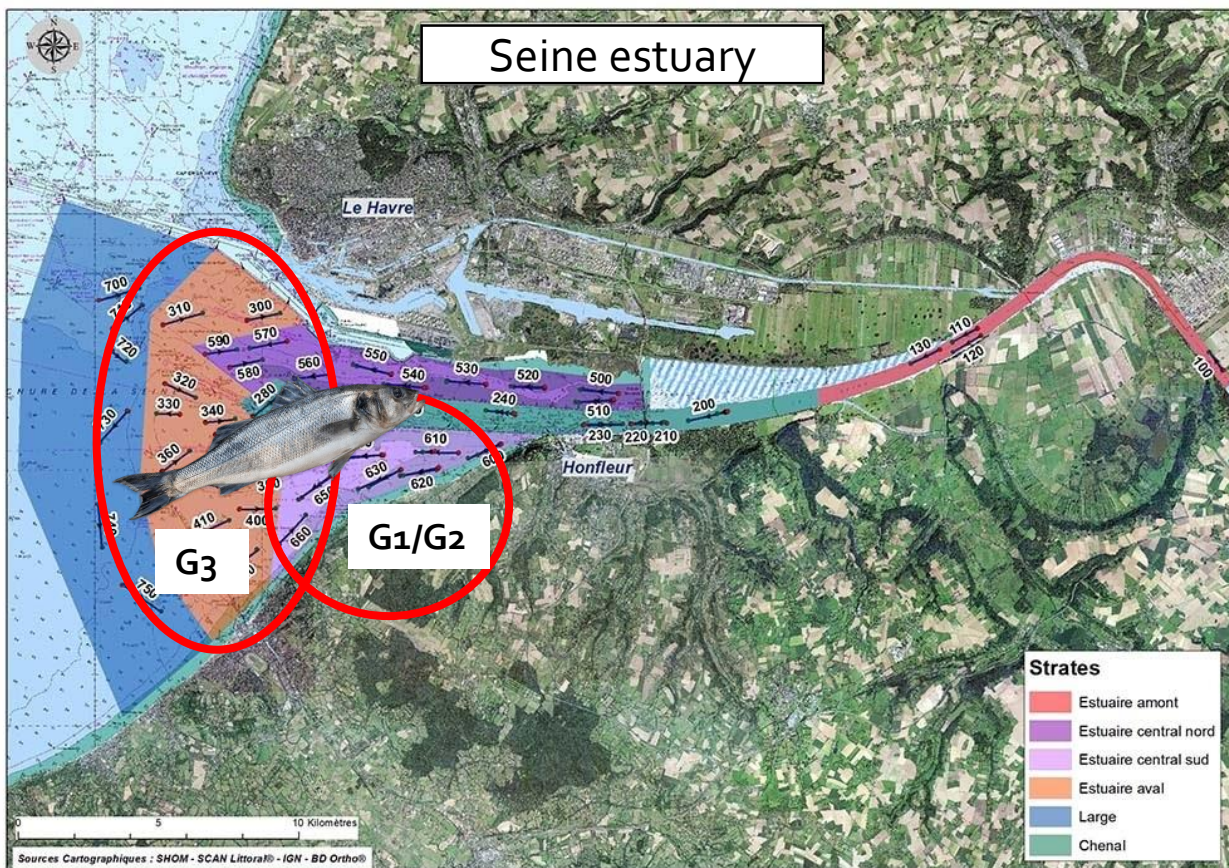


Dicentrarchus labrax

- How is the n-3 FA composition modulated ?
- How does it vary in natural habitat
- Does it depend on sampling site / life stage ?



Three different life stages : G1 / G2 / G3

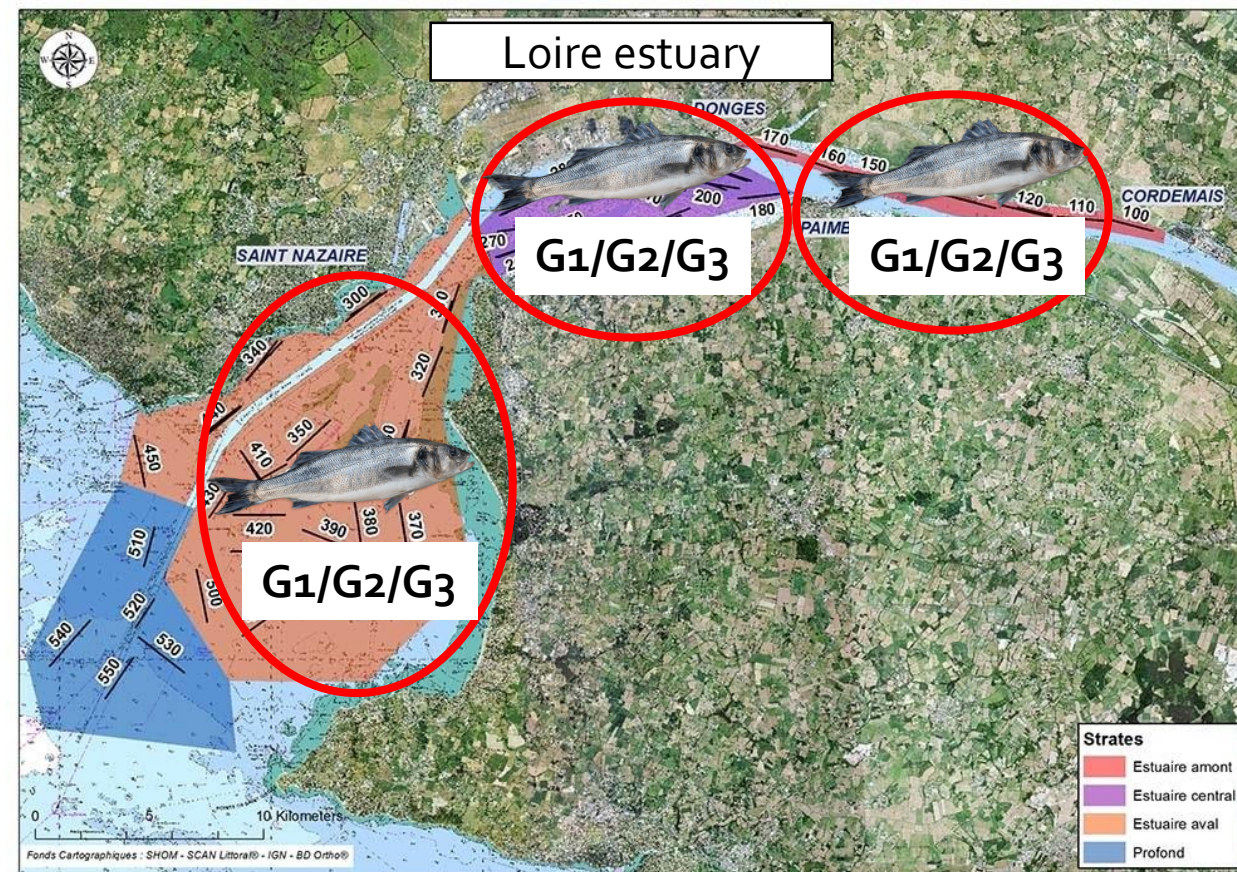


N = 12 – G1

N = 10 – G2

N = 12 – G3

76 juveniles



N = 18 – G1

N = 12 – G2

N = 12 – G3



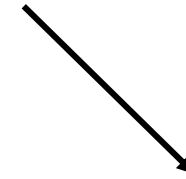
Liver = Highly influenced
by trophic differences

Caballero *et al*,
1999

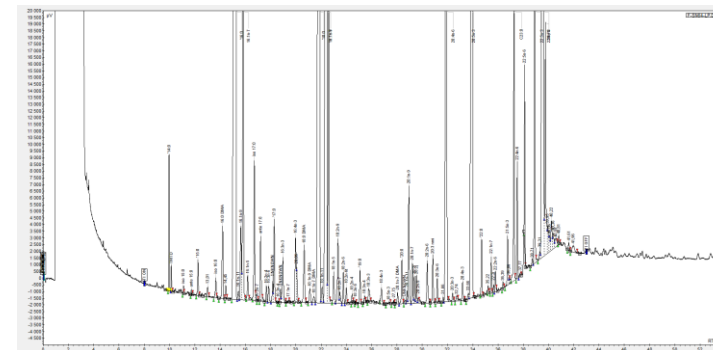


Lipid extraction and
separation

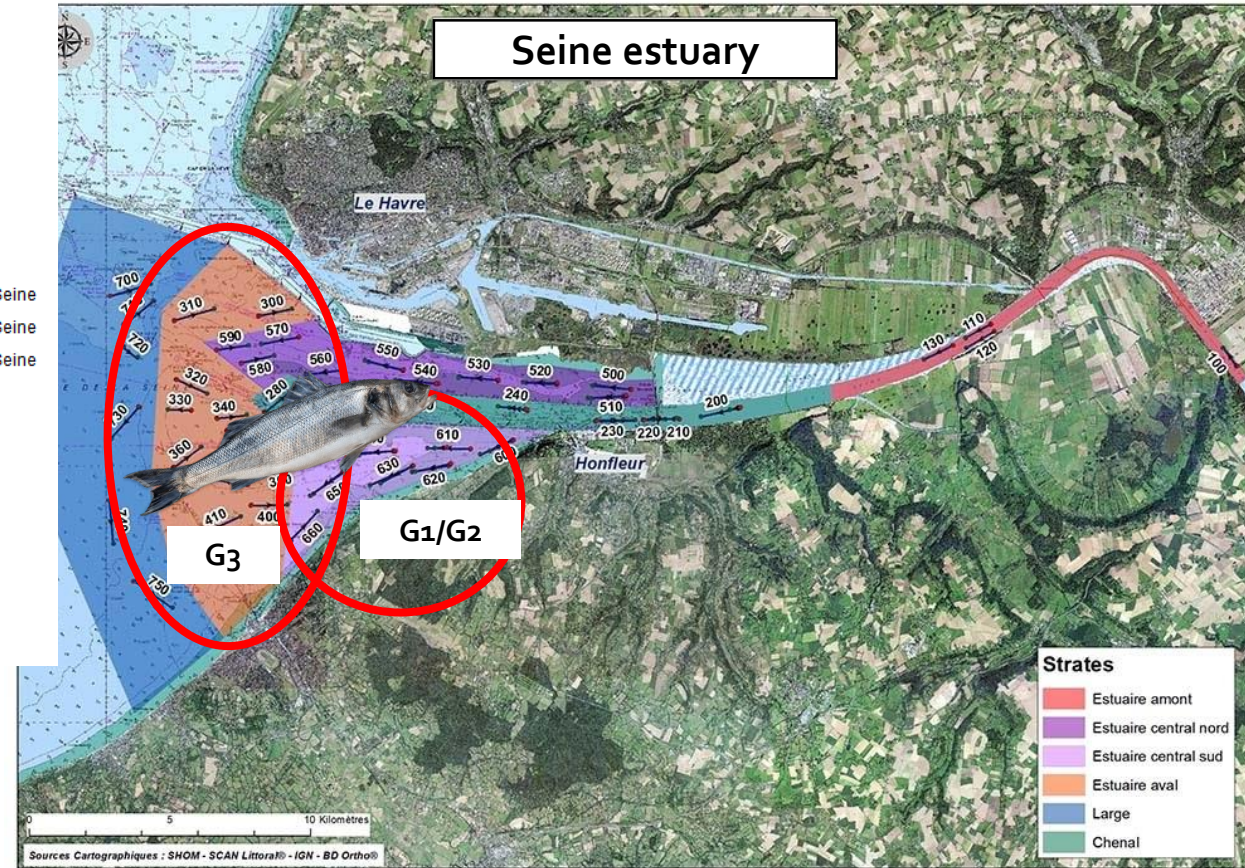
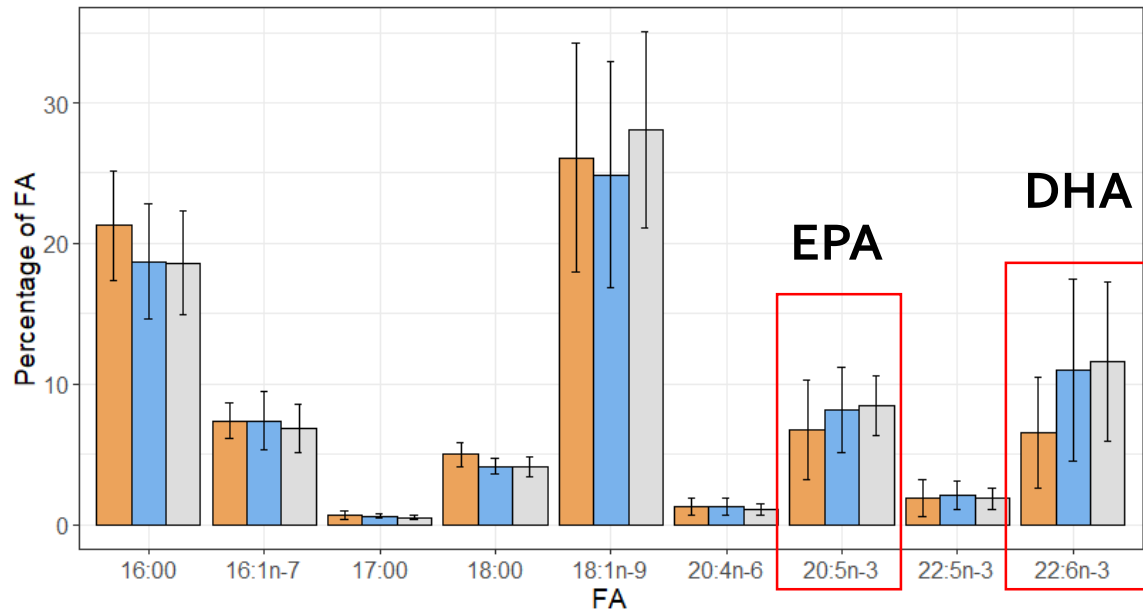
Reserve lipids (NL)
Membrane lipids (PL)



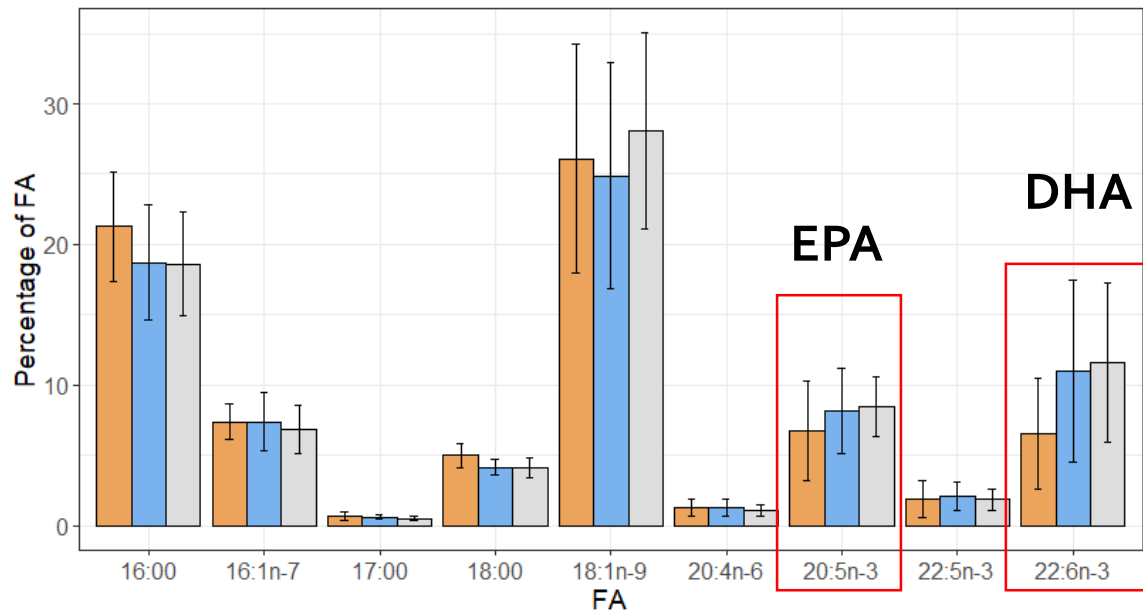
Fatty acid profiles with
GC-FID



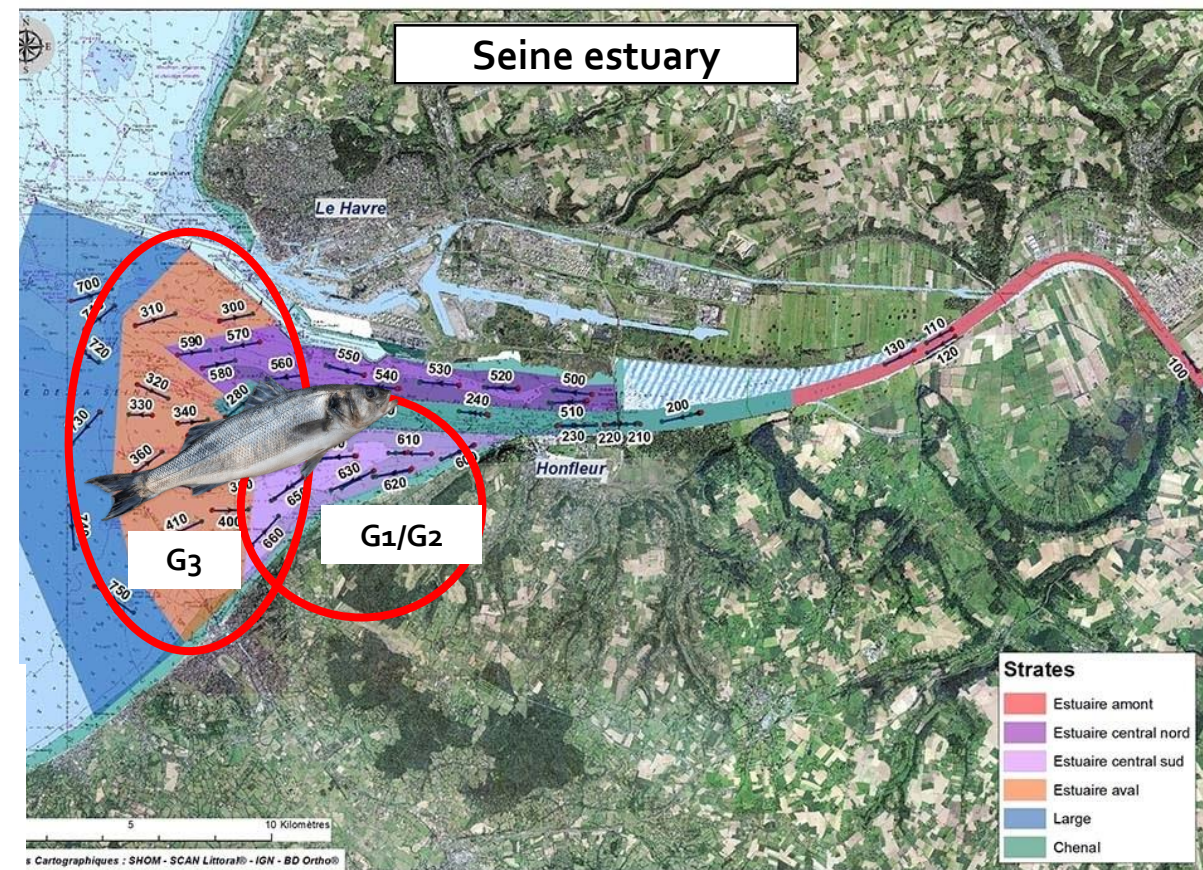
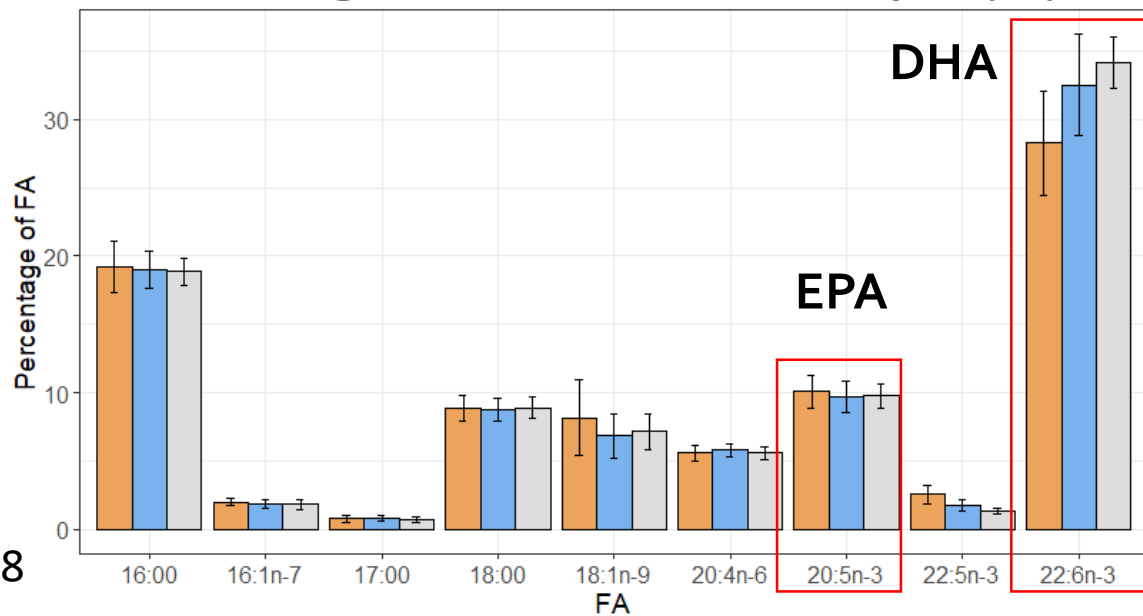
Percentage of main FA in reserve lipids (NL)



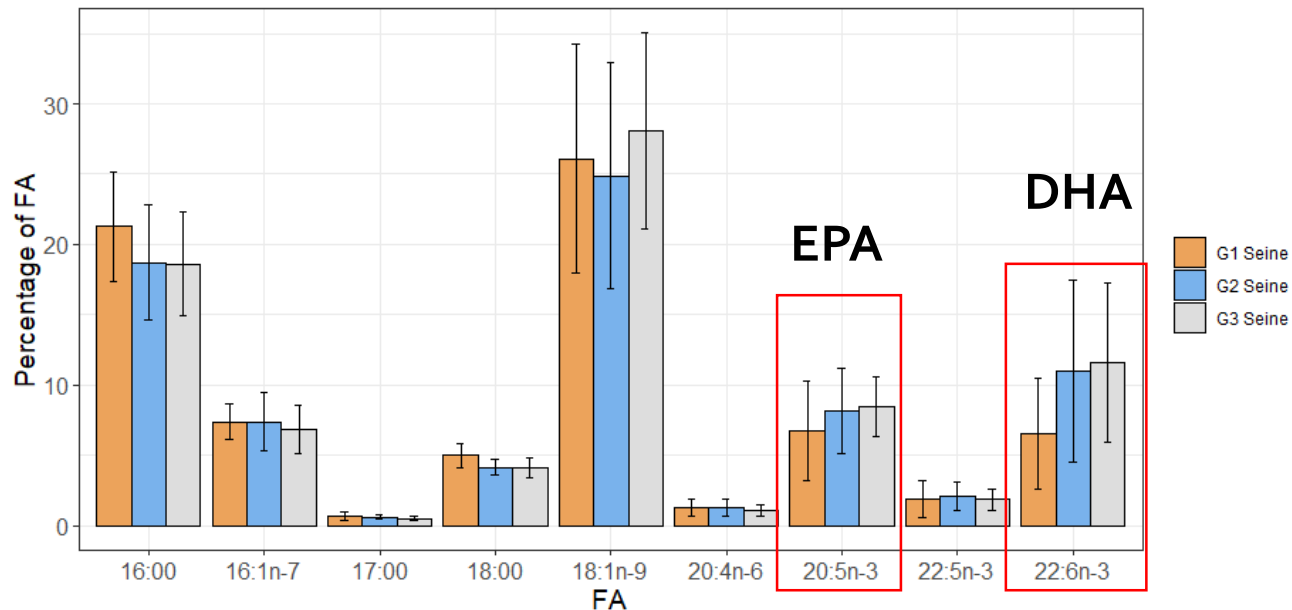
Percentage of main FA in reserve lipids (NL)



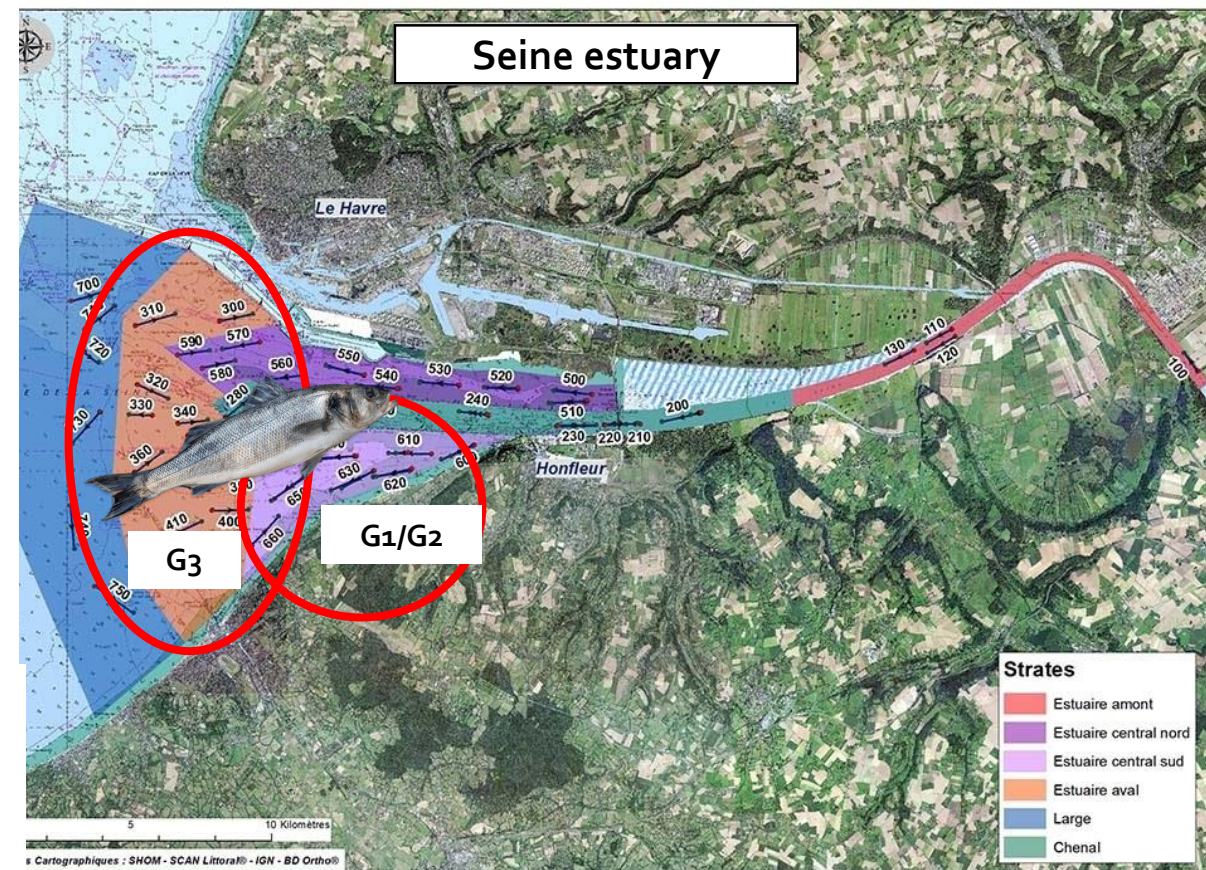
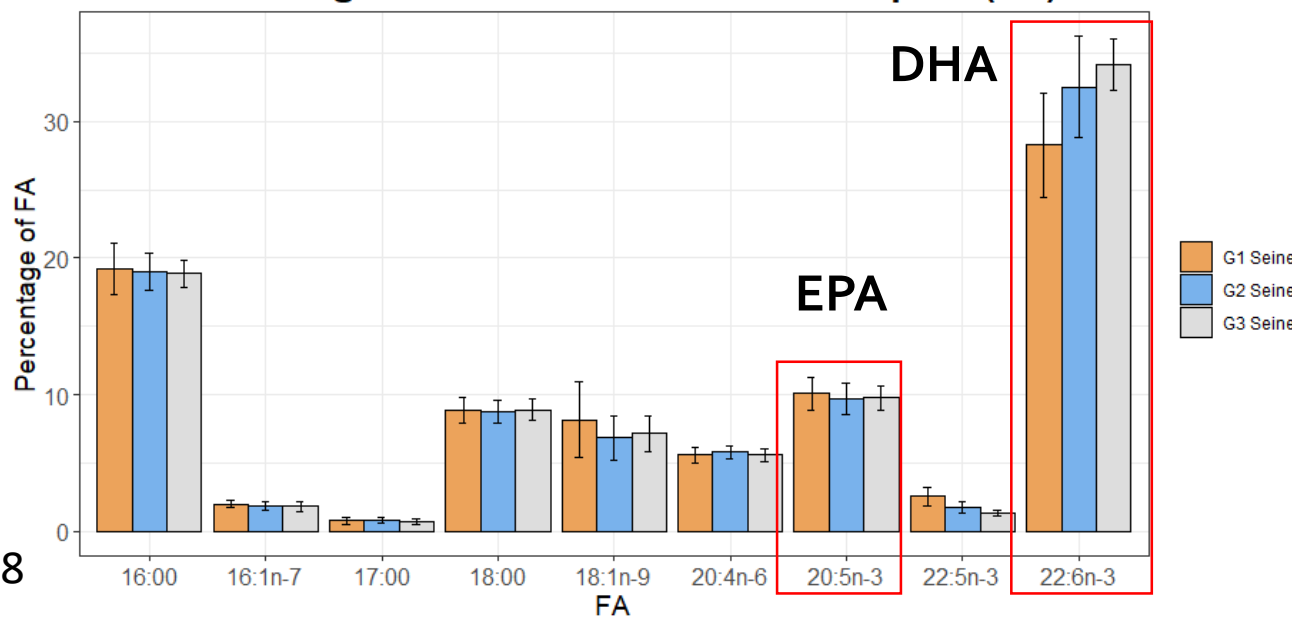
Percentage of main FA in membrane lipids (PL)



Percentage of main FA in reserve lipids (NL)

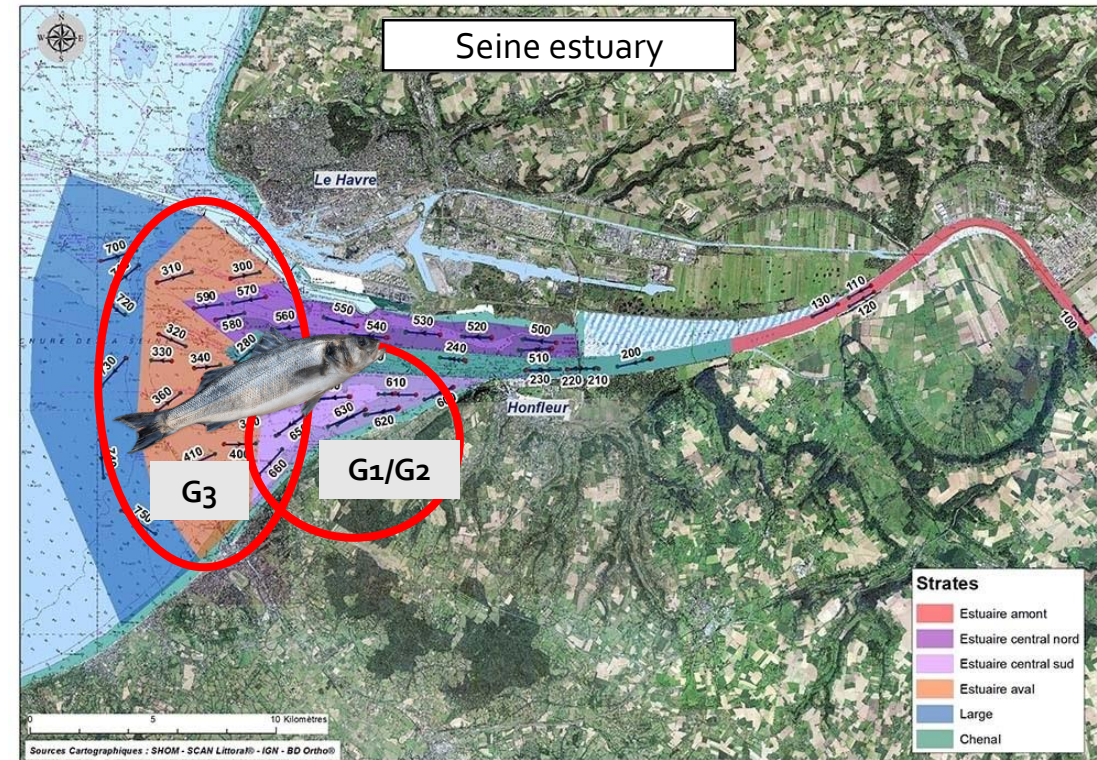
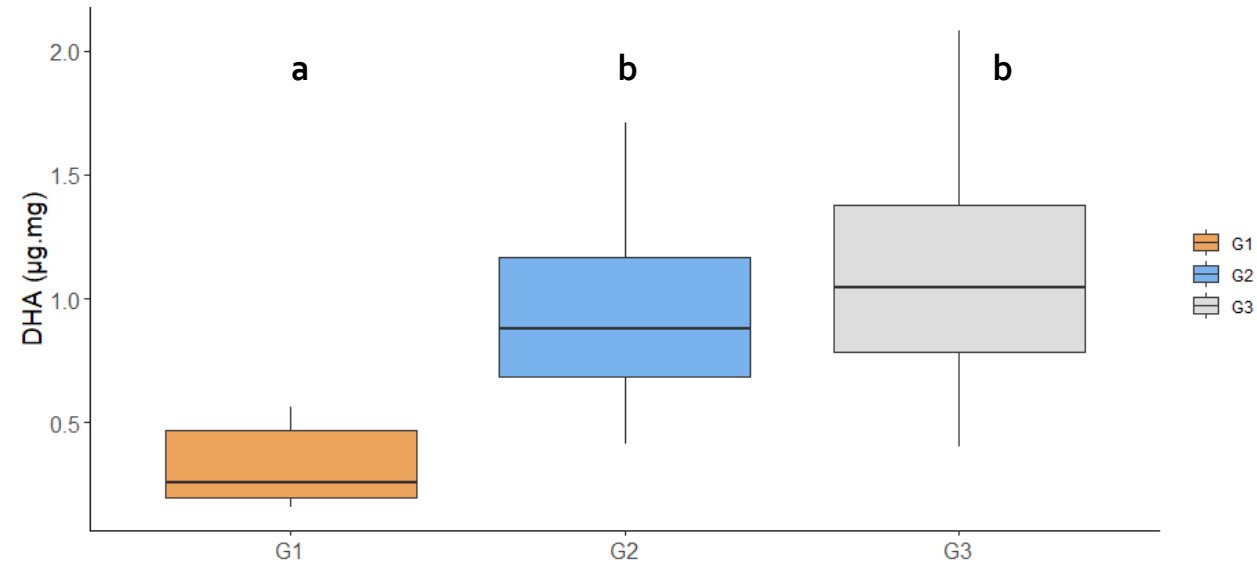


Percentage of main FA in membrane lipids (PL)

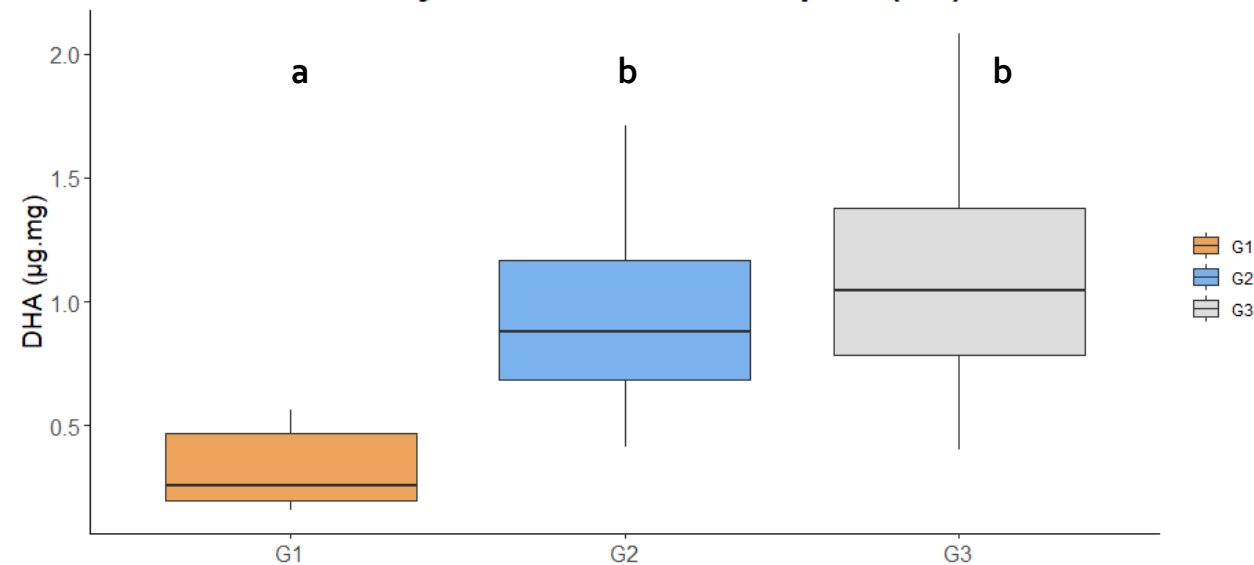


- High variations in reserve lipids -> Dietary influence
- DHA = main FA in membranes
- EPA / DHA ratio matching litterature (3x factor)

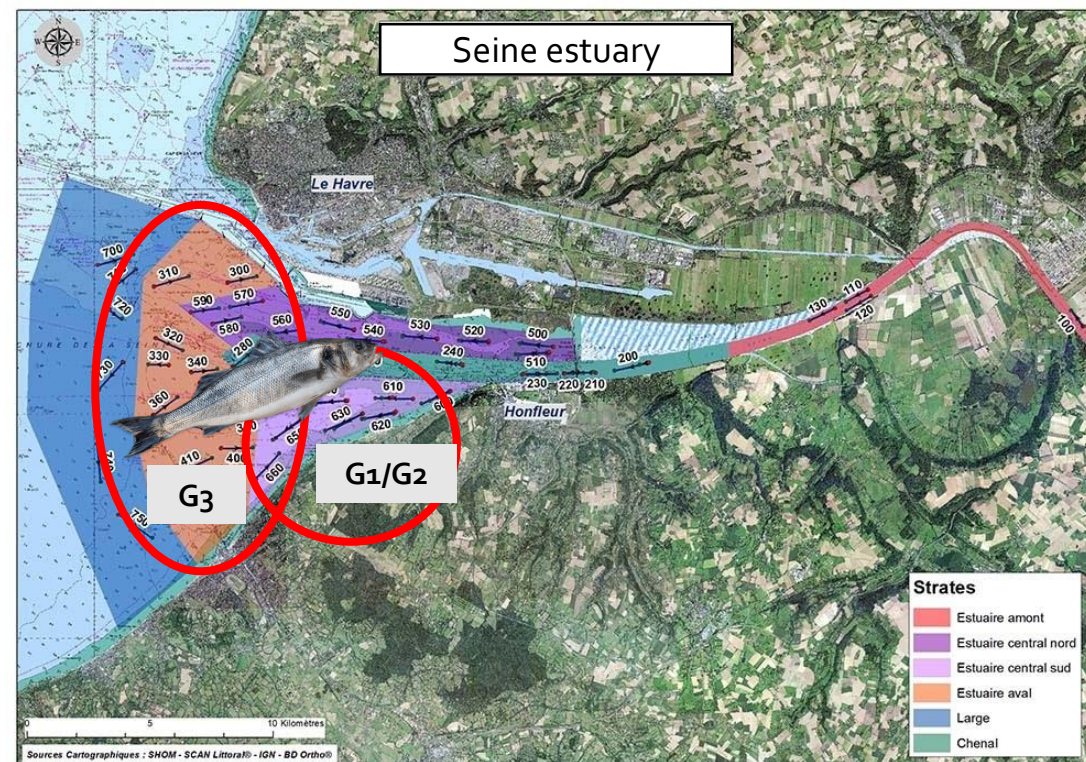
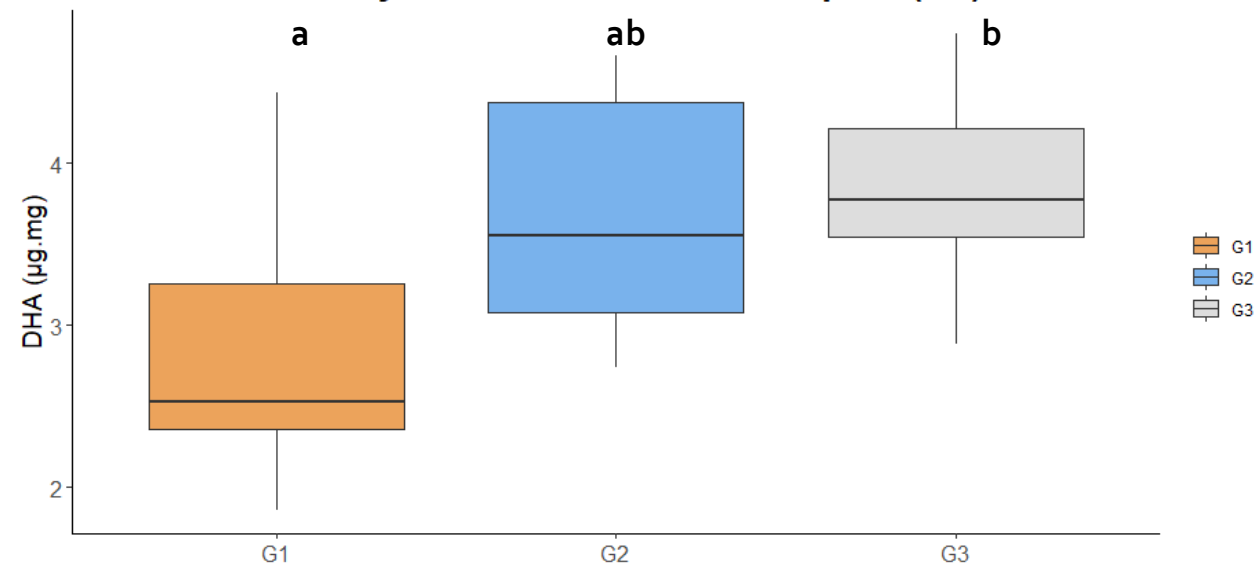
Quantity of DHA in reserve lipids (NL)



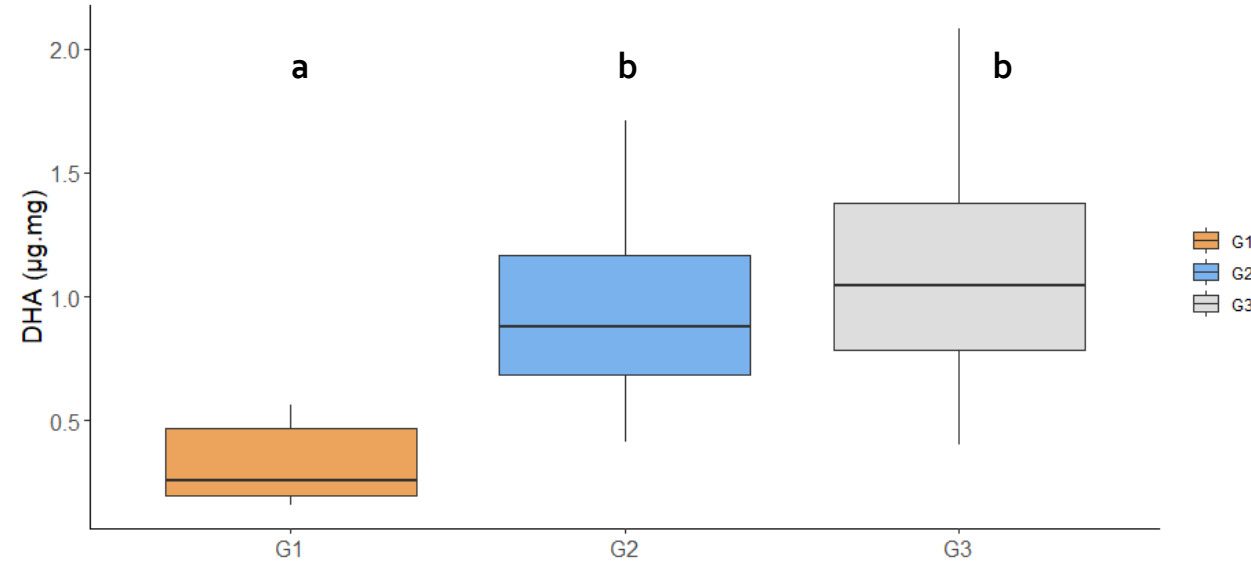
Quantity of DHA in reserve lipids (NL)



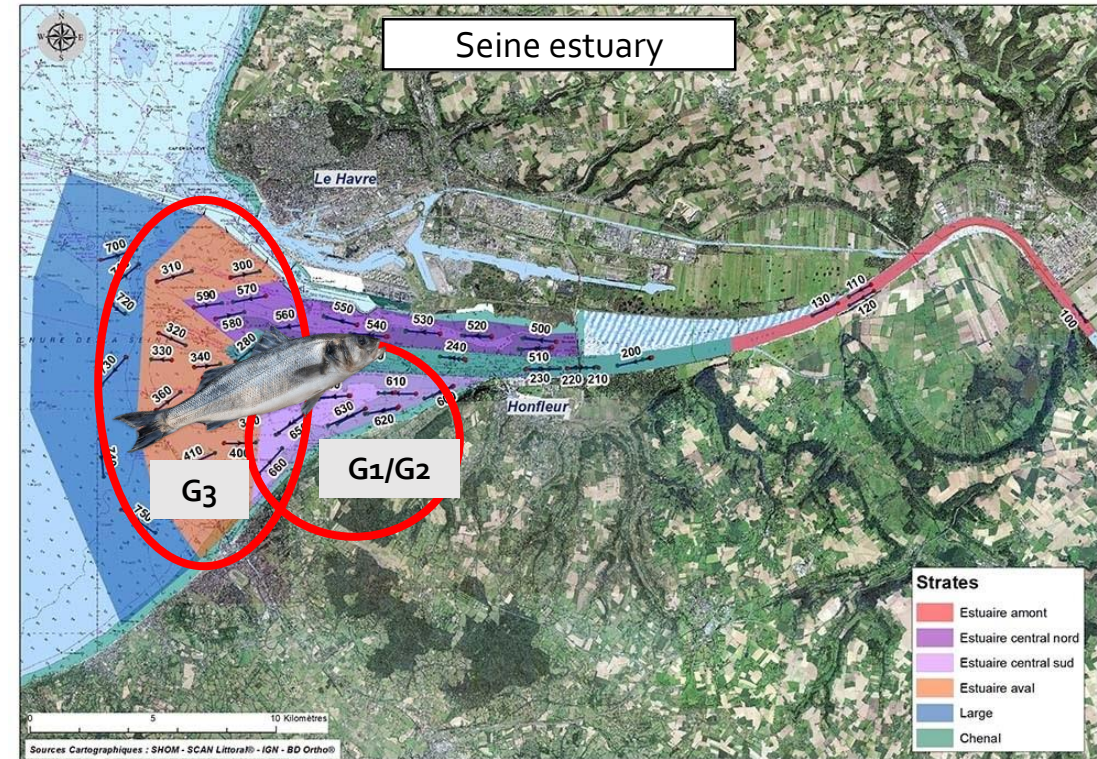
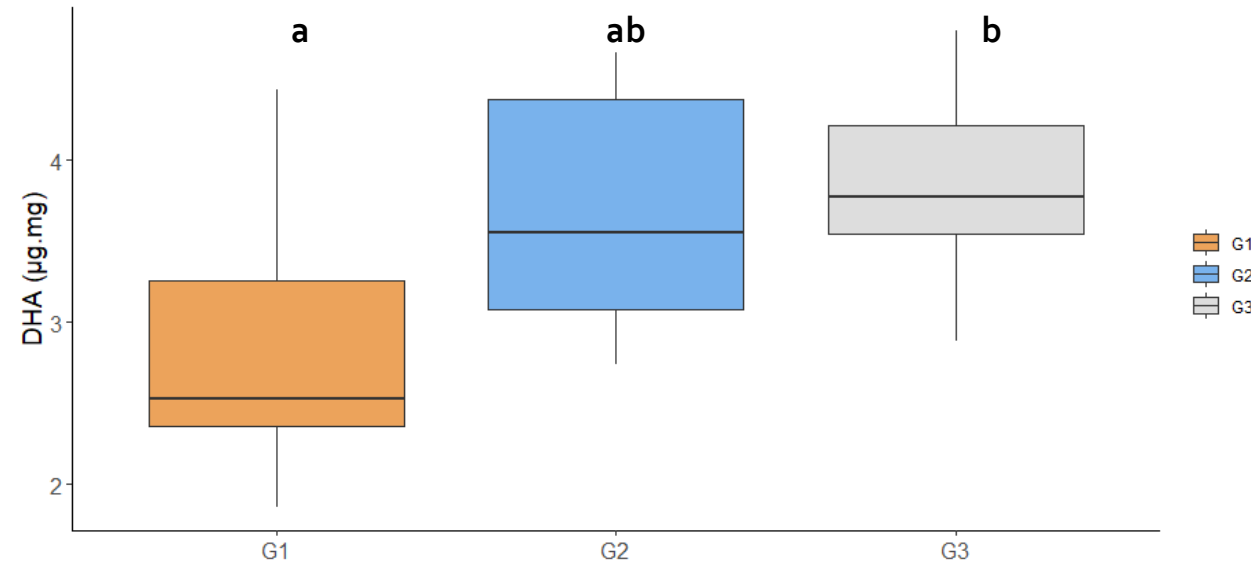
Quantity of DHA in membrane lipids (PL)



Quantity of DHA in reserve lipids (NL)

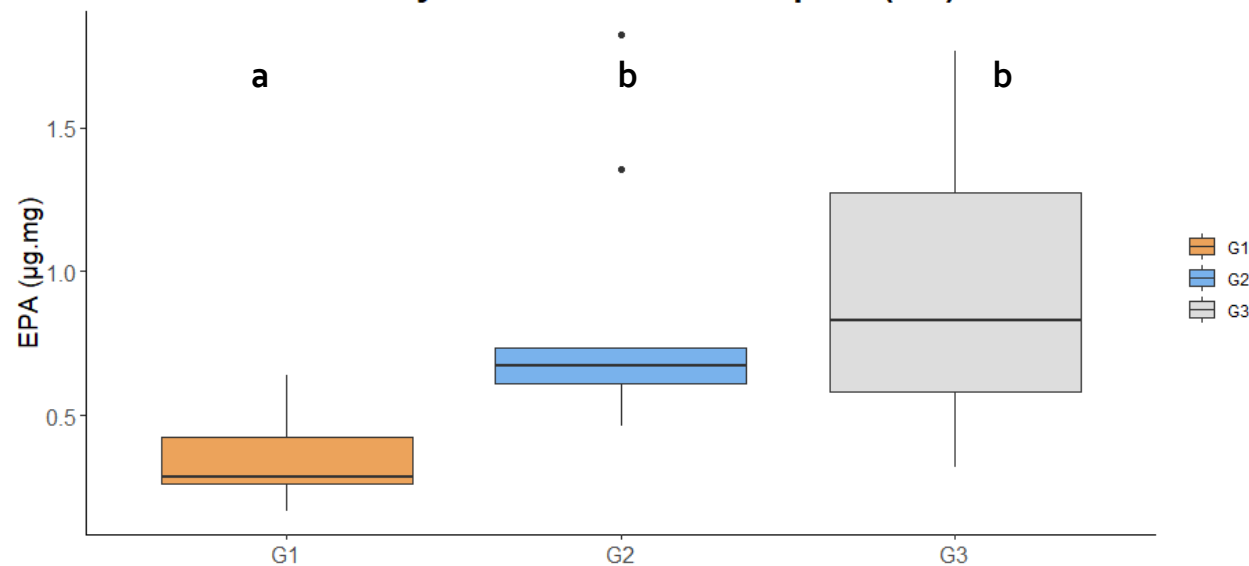


Quantity of DHA in membrane lipids (PL)

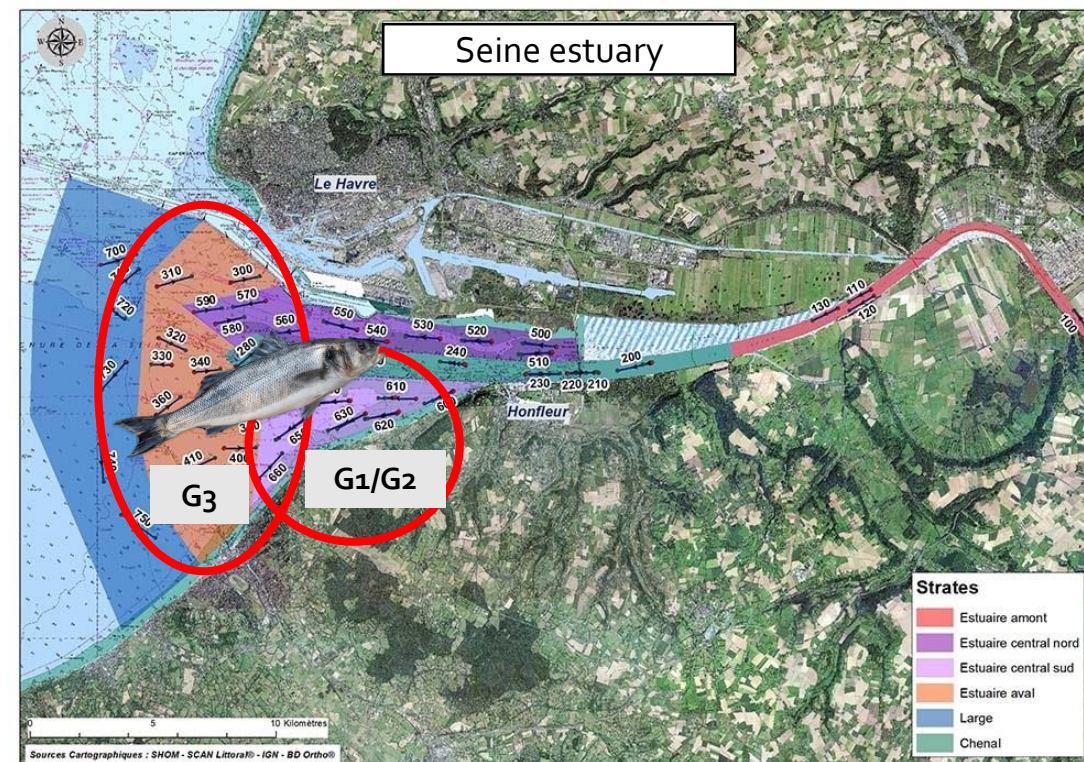


- Lower DHA quantity in G1
- Prey lipid composition influence ?
- DHA retention in tissue : PL > NL
- Retention / Synthesis plasticity :
Influence of environment / trophic level

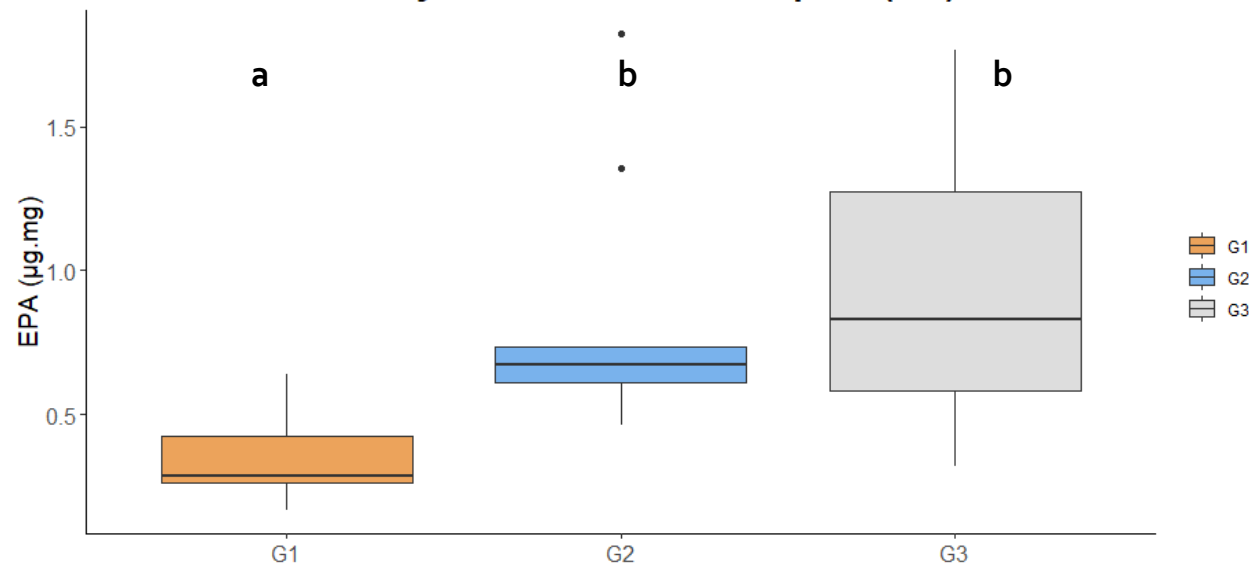
Quantity of EPA in reserve lipids (NL)



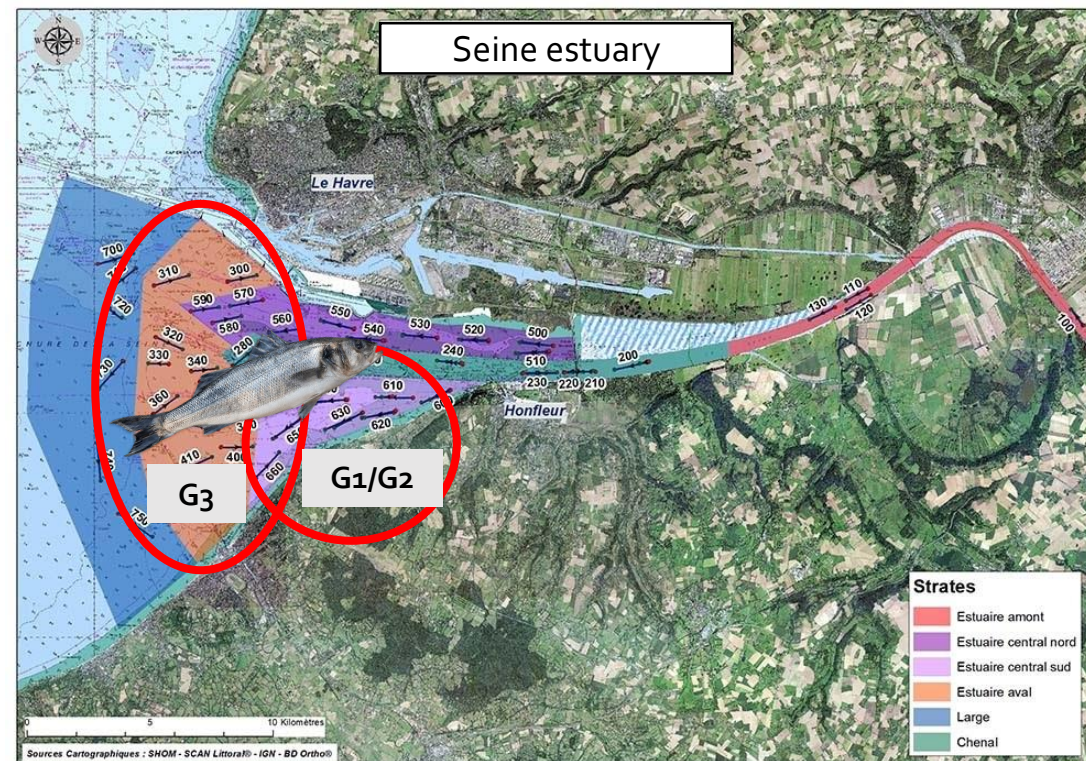
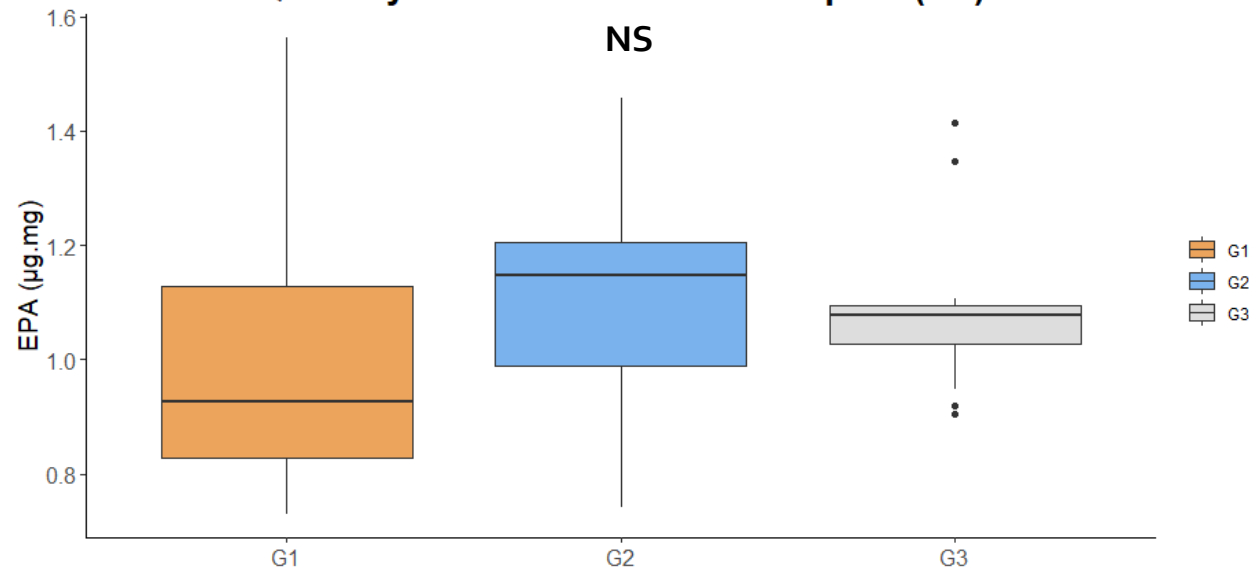
NS



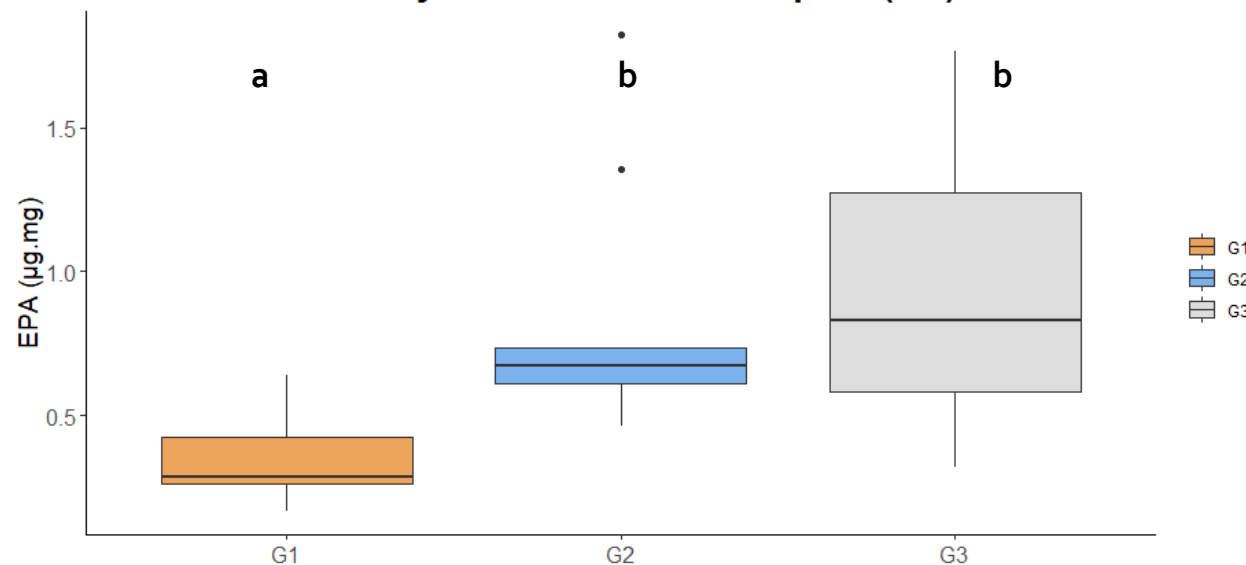
Quantity of EPA in reserve lipids (NL)



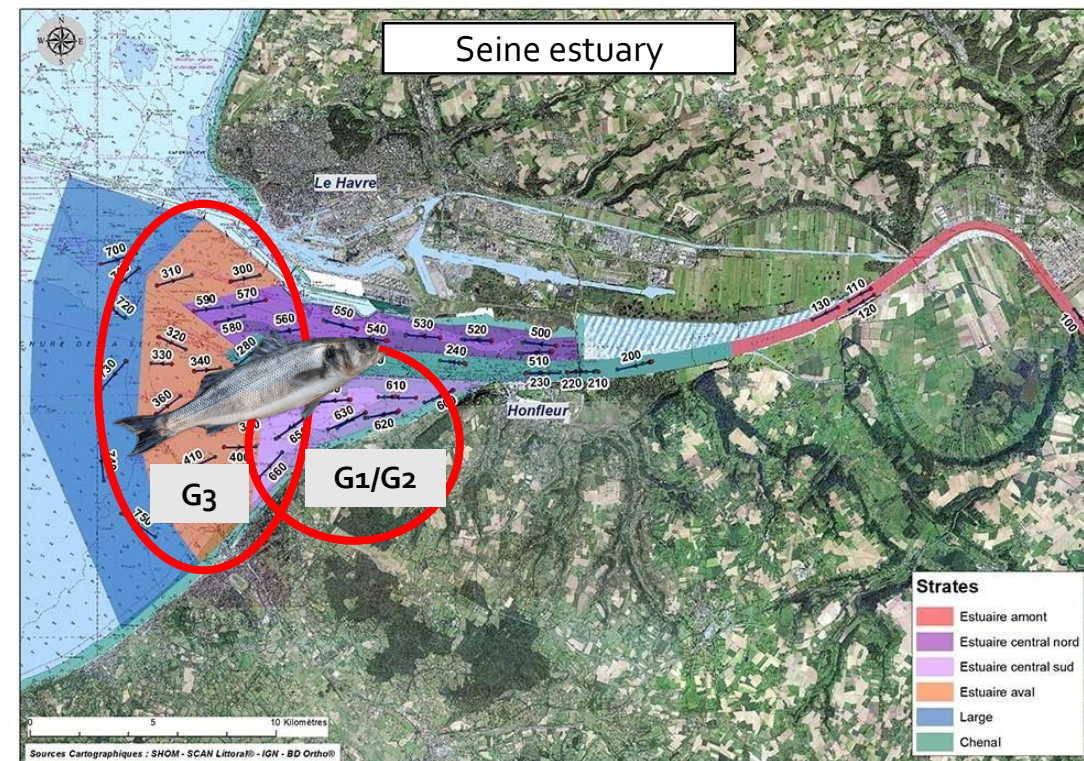
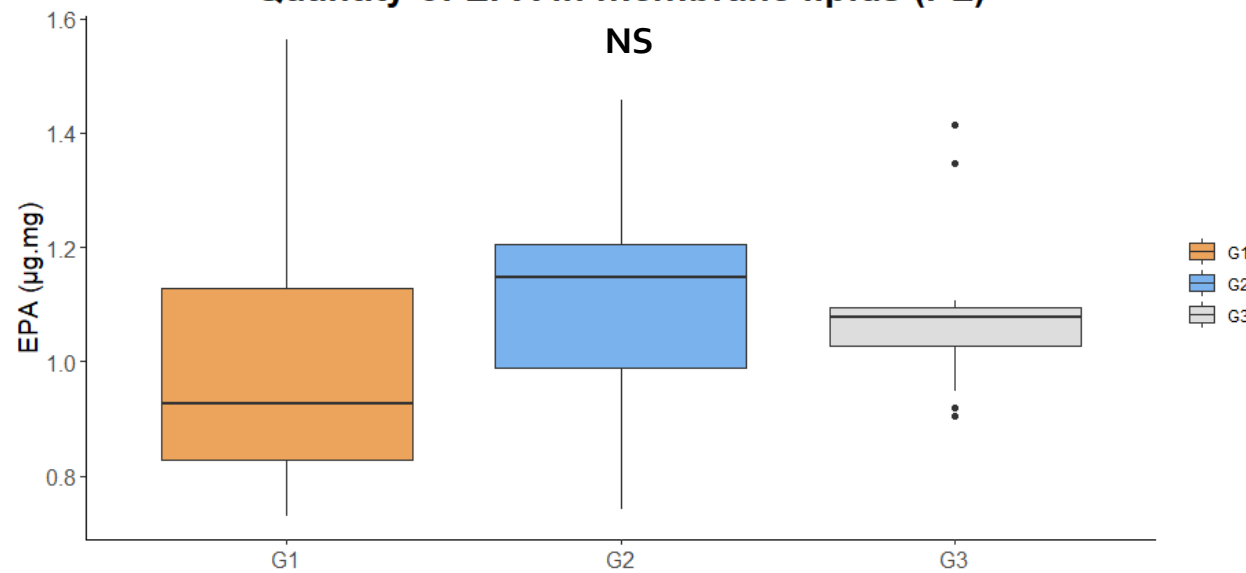
Quantity of EPA in membrane lipids (PL)



Quantity of EPA in reserve lipids (NL)

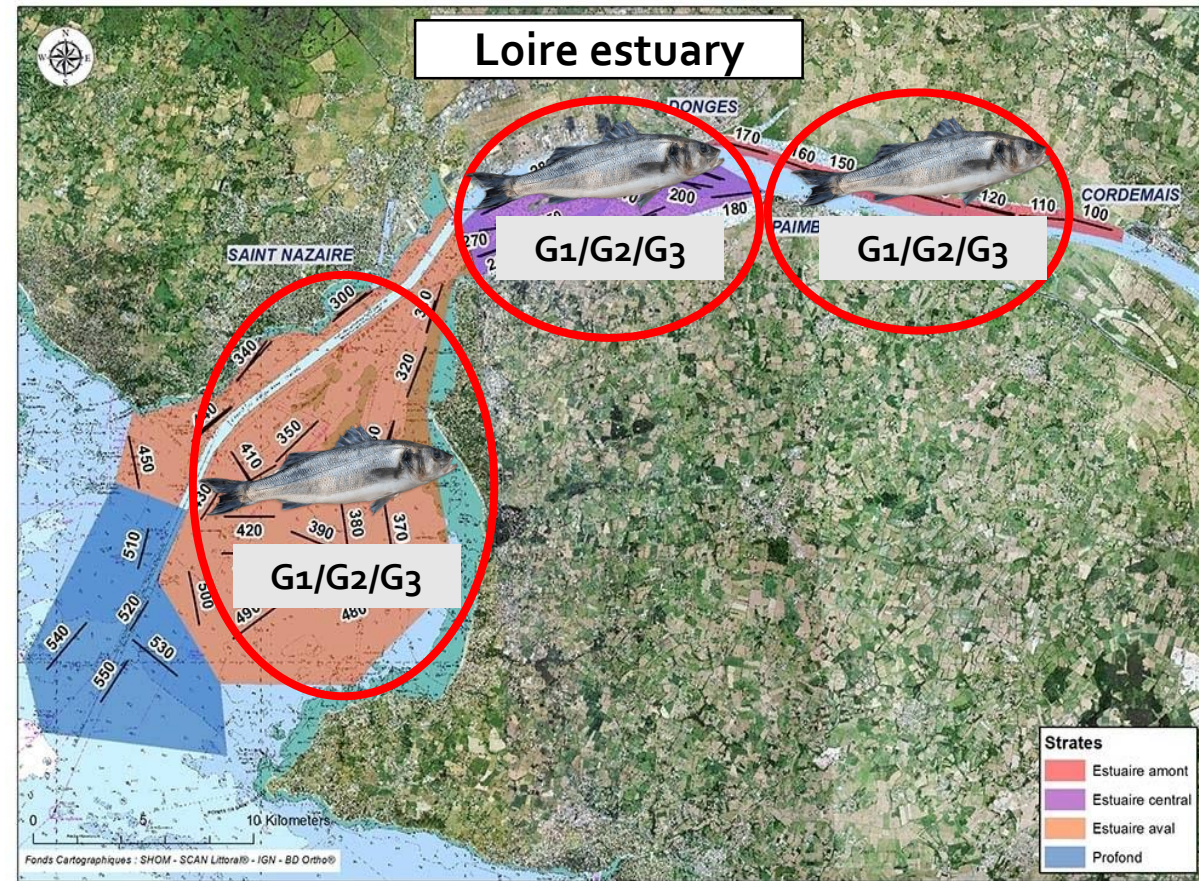
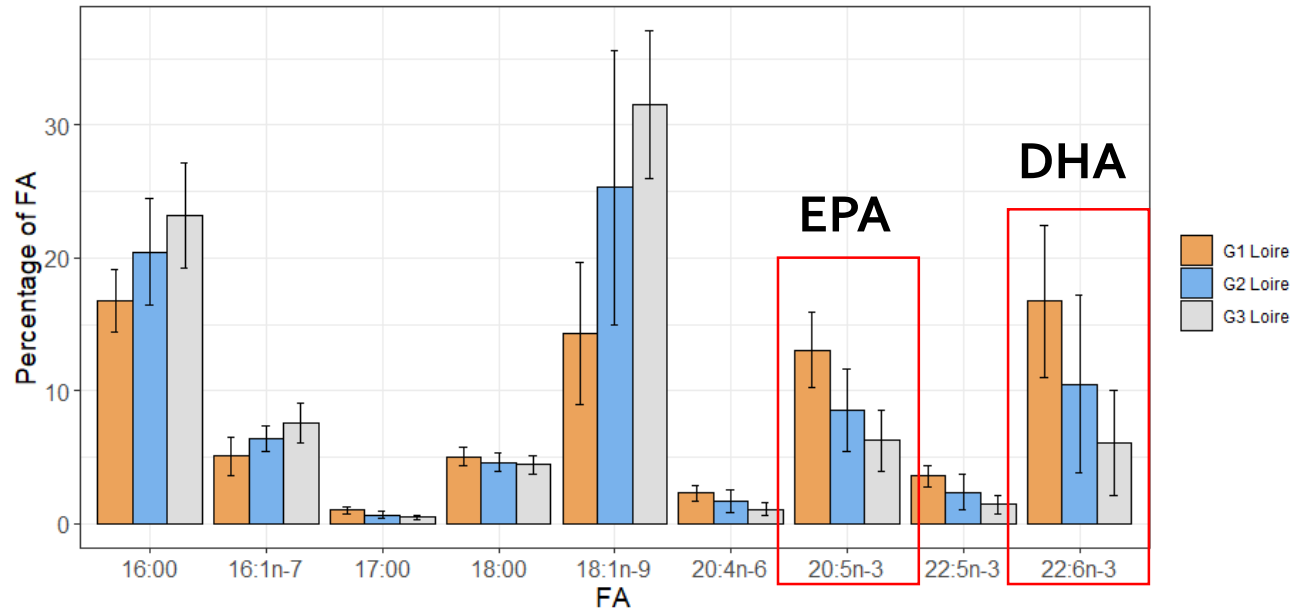


Quantity of EPA in membrane lipids (PL)

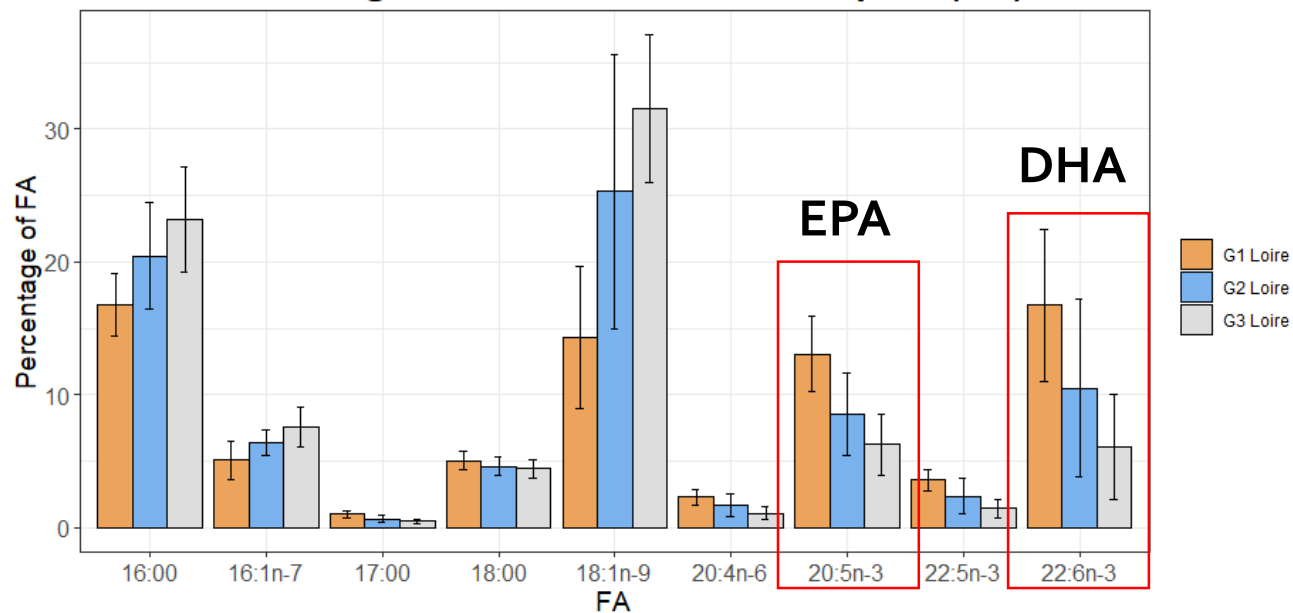


- Different profiles between reserve & membrane
DHA & EPA = different roles
Tocher, 2003
- Used for eicosanoids production ?
- Used to be converted into DHA?

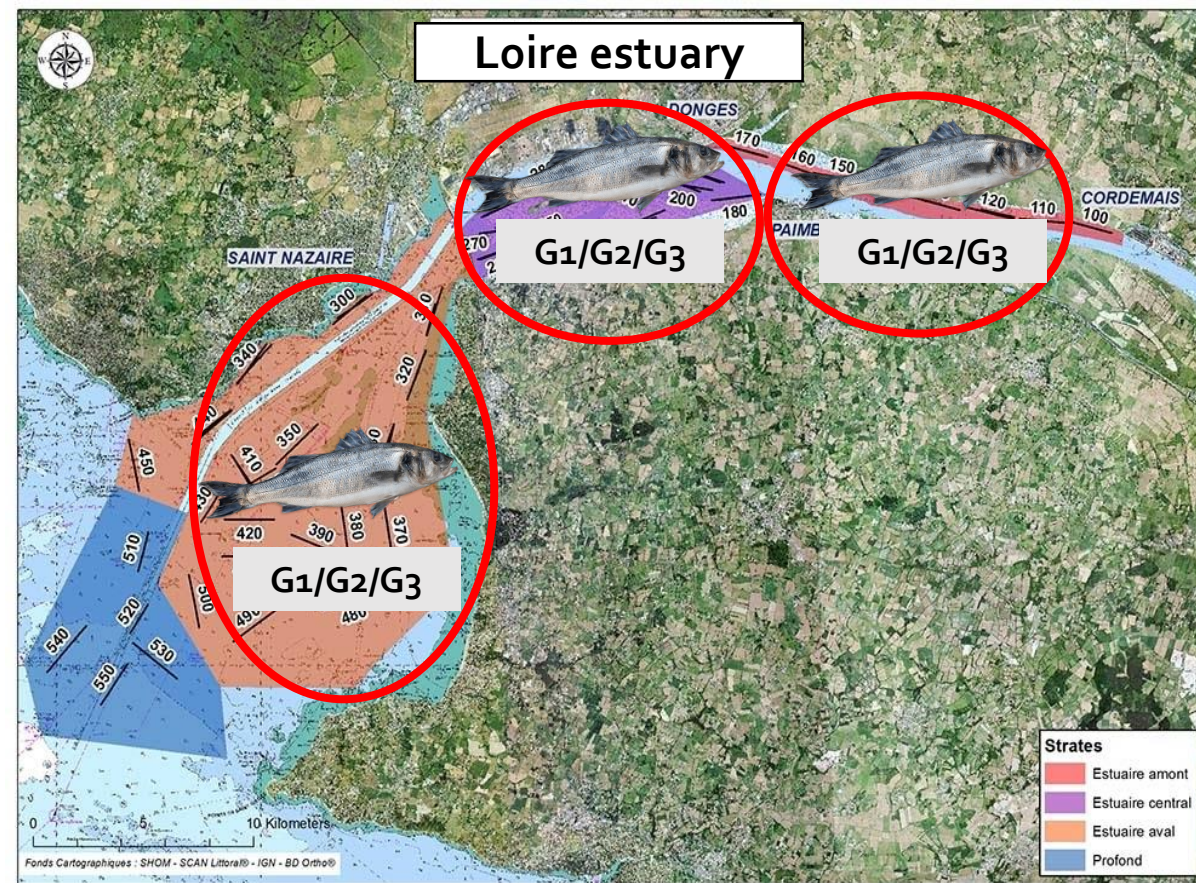
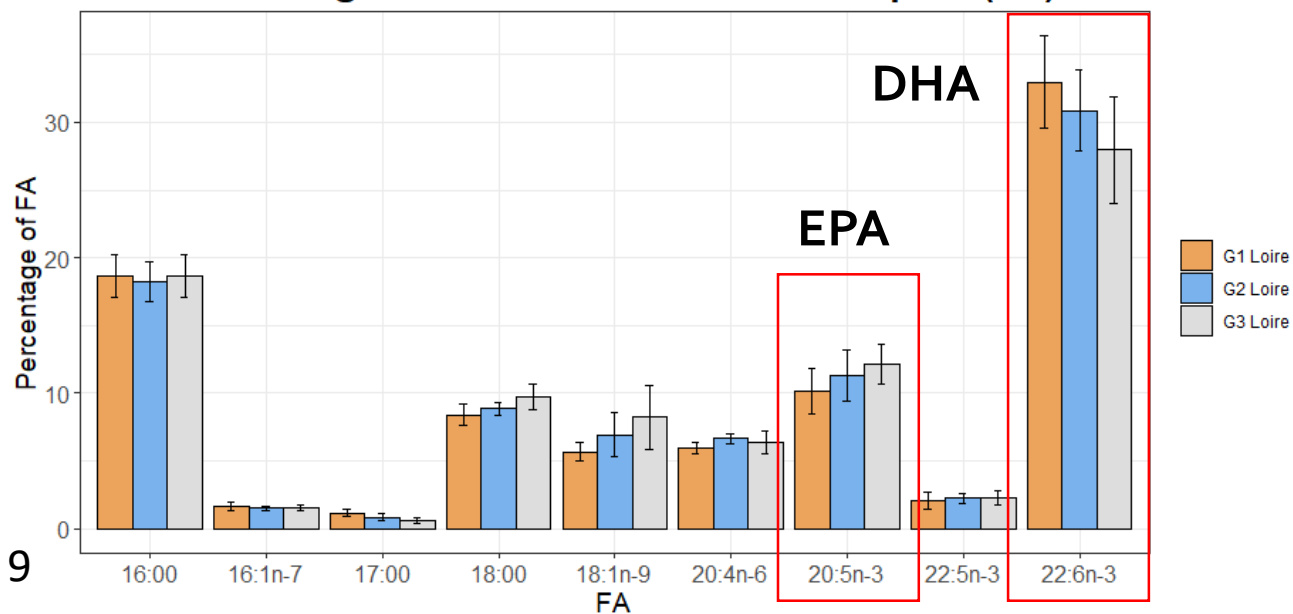
Percentage of main FA in reserve lipids (NL)



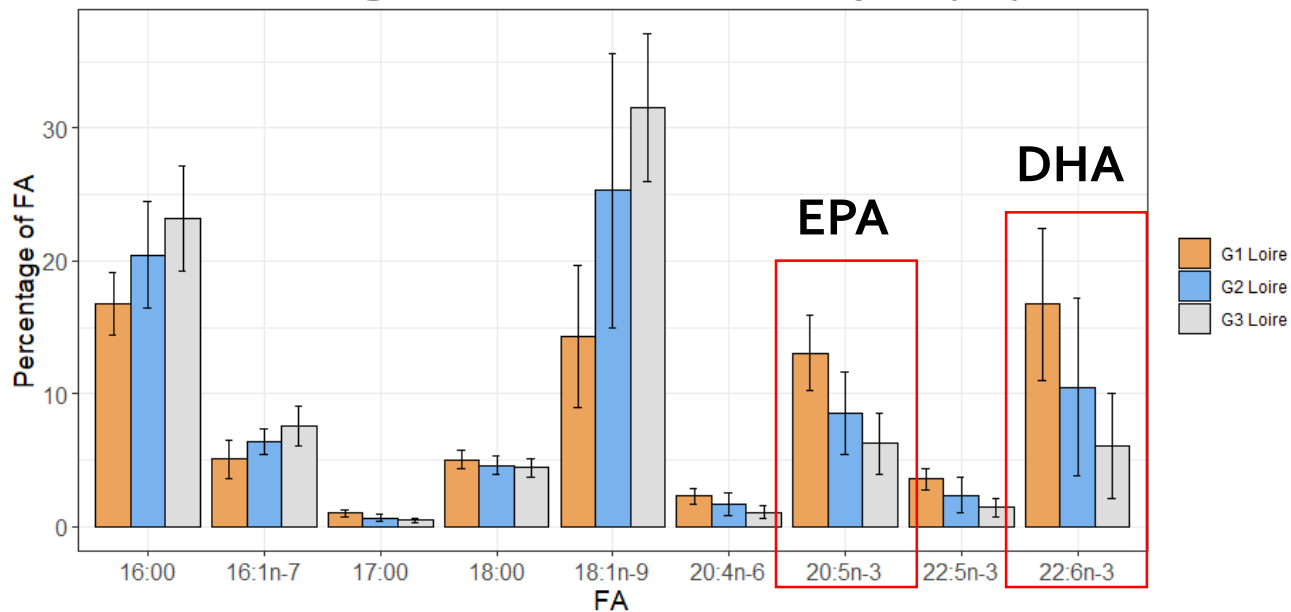
Percentage of main FA in reserve lipids (NL)



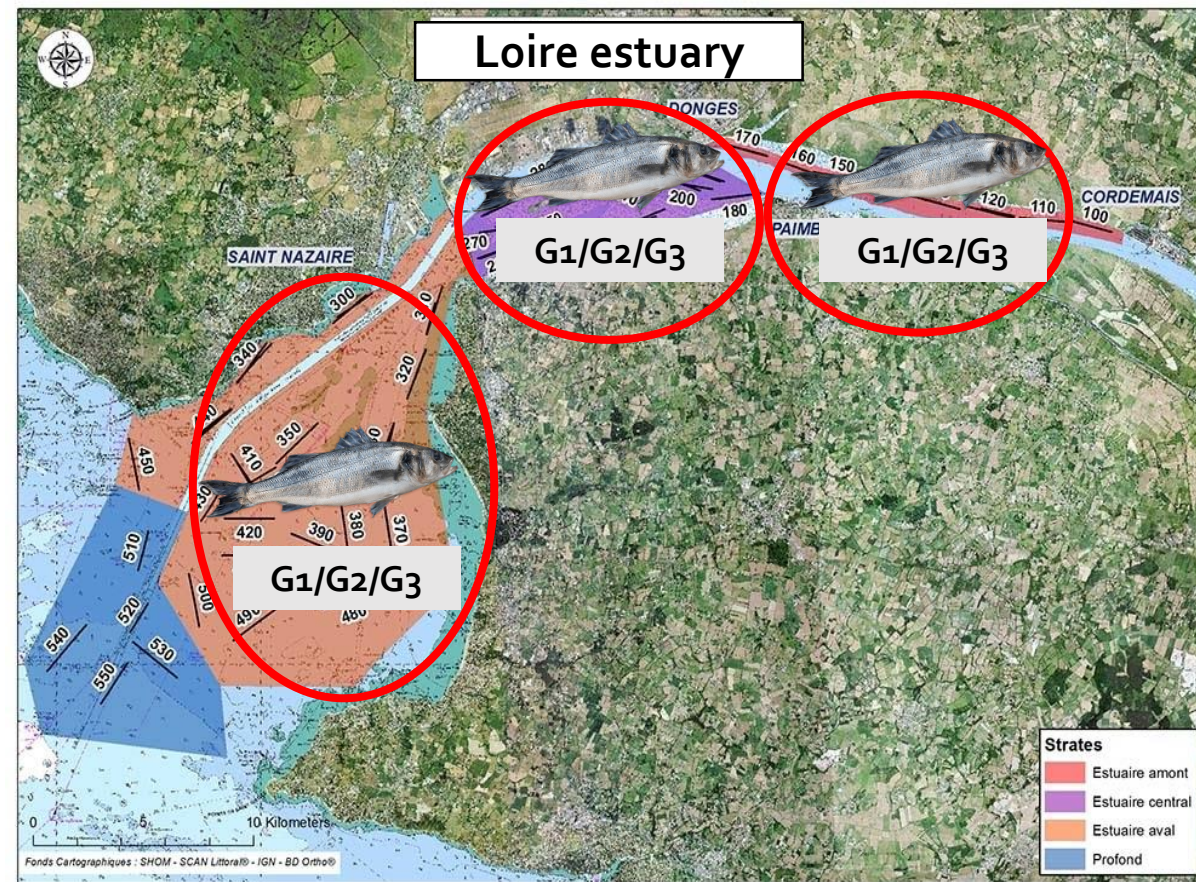
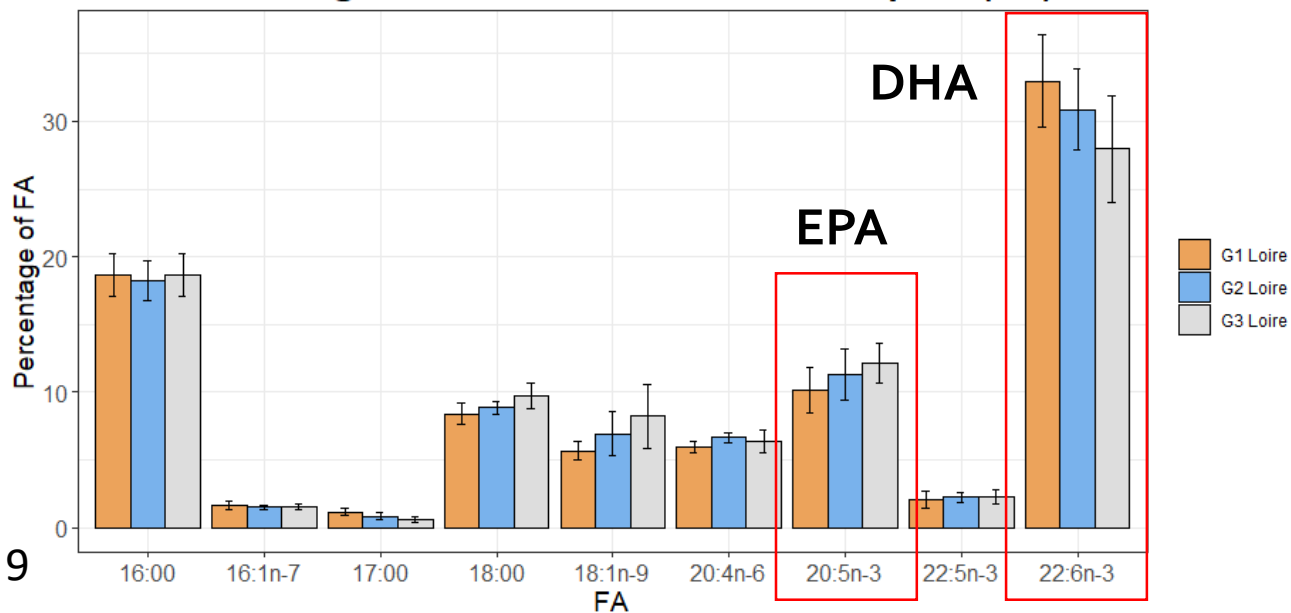
Percentage of main FA in membrane lipids (PL)



Percentage of main FA in reserve lipids (NL)

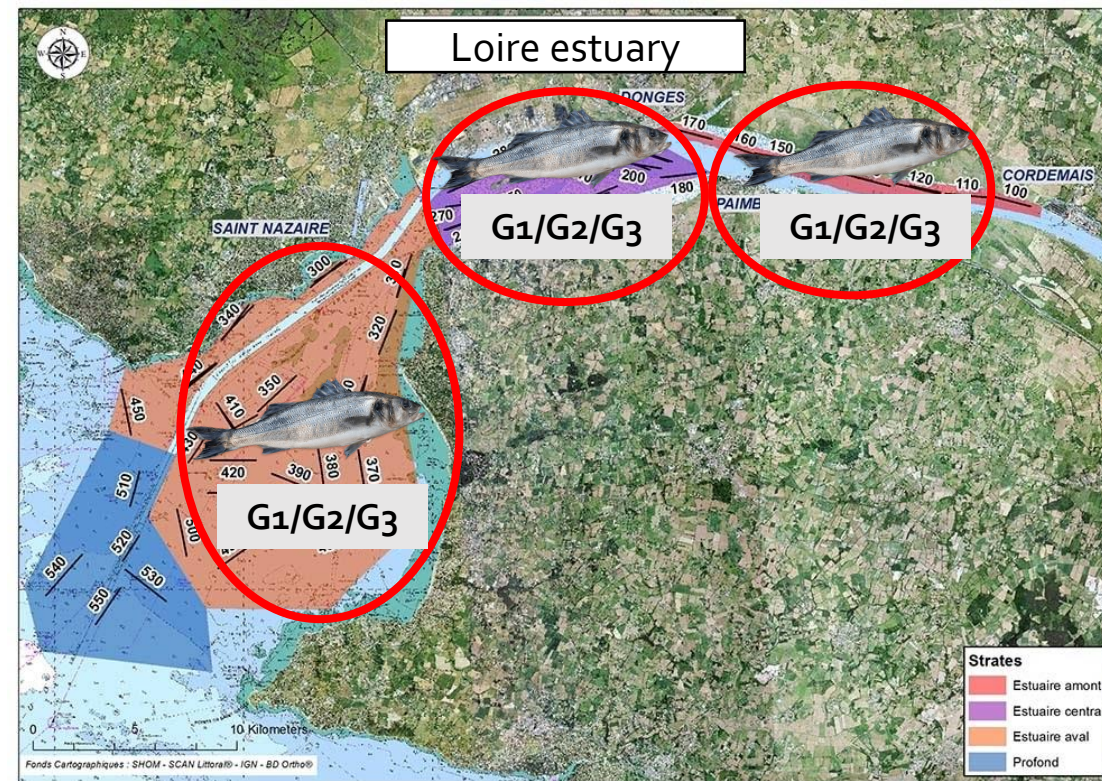
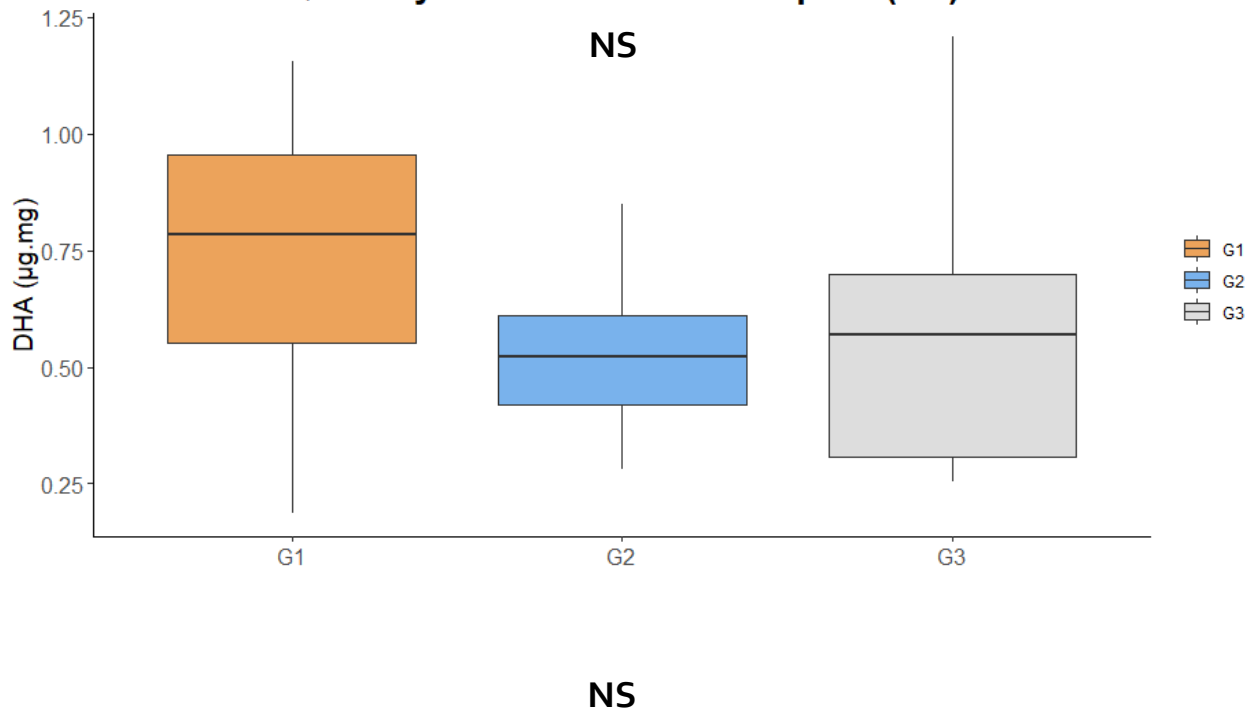


Percentage of main FA in membrane lipids (PL)

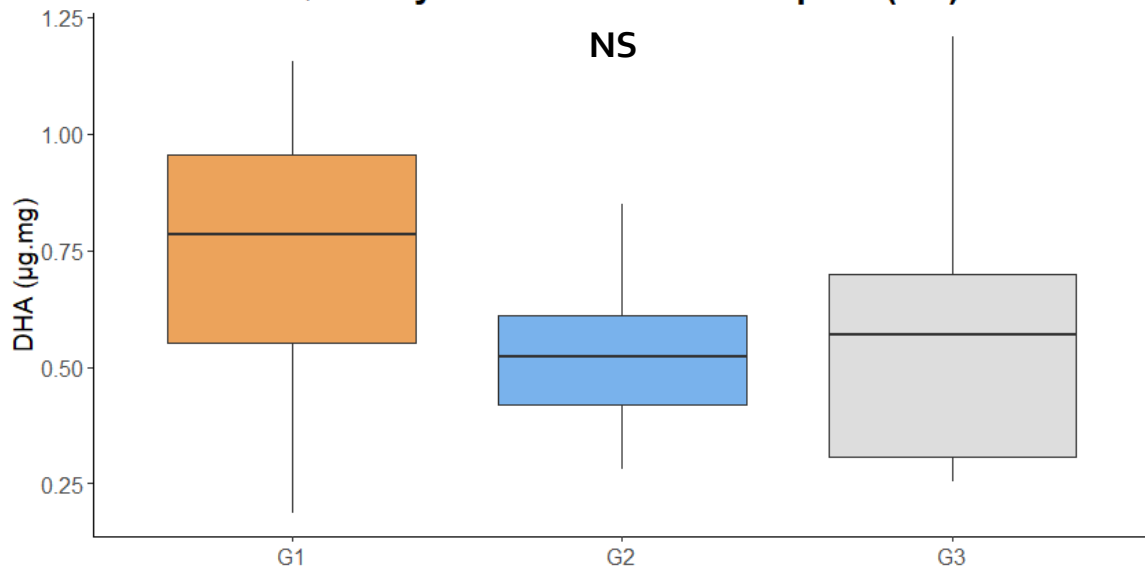


- EPA and DHA levels varying with age -> Different trophic dynamics ?
- EPA / DHA used as energy source ?

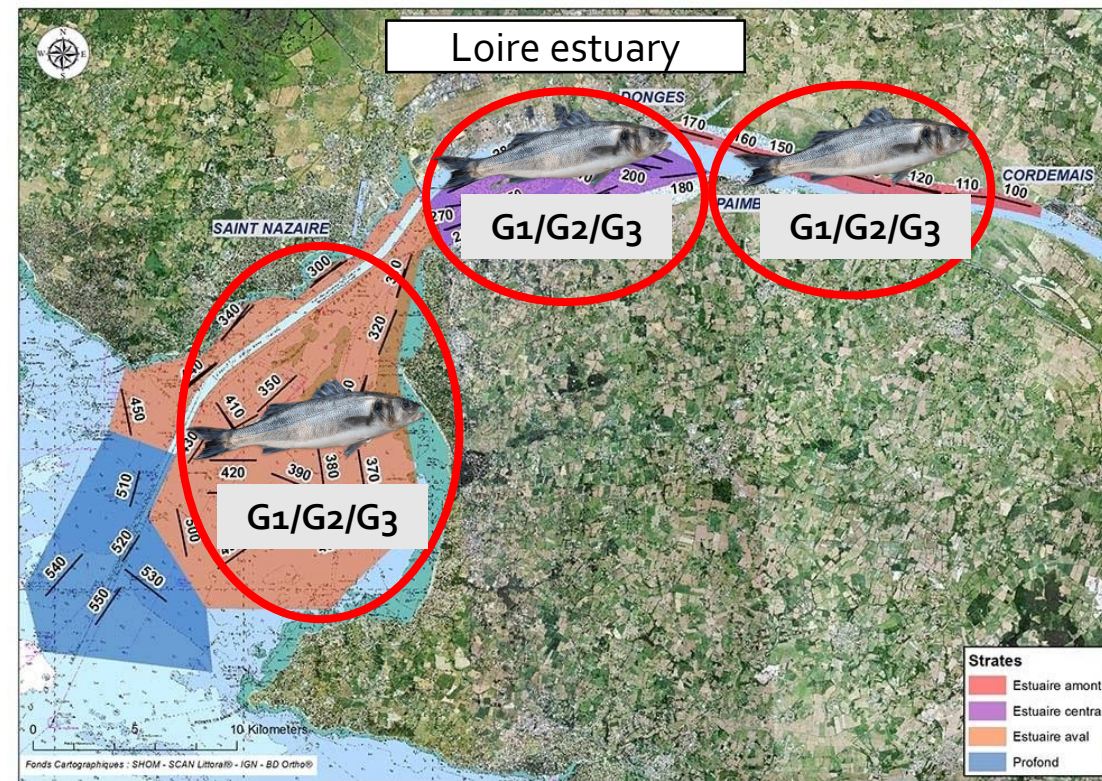
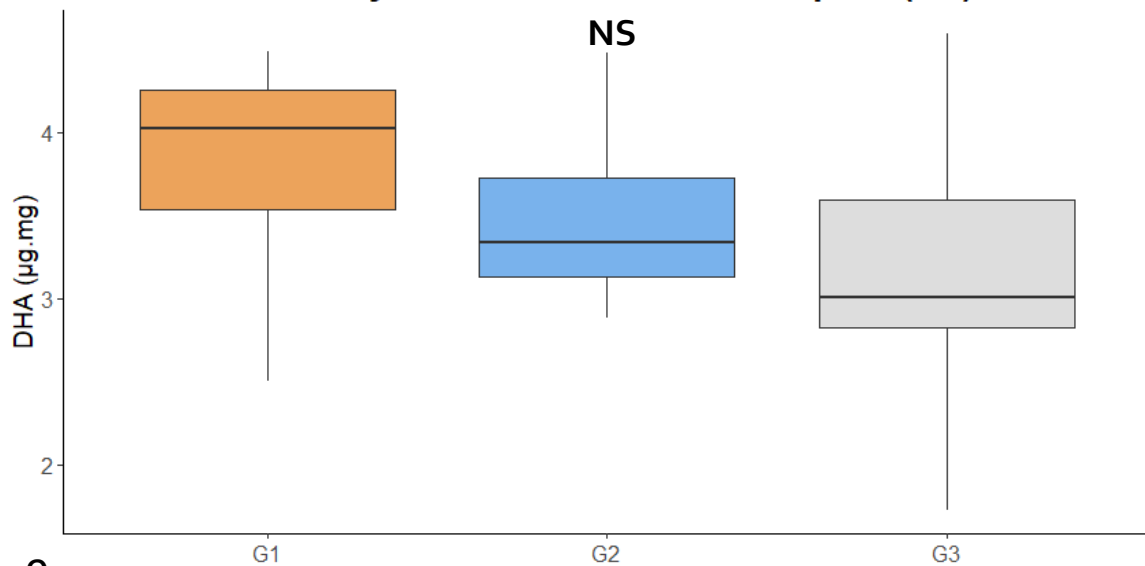
Quantity of DHA in reserve lipids (NL)



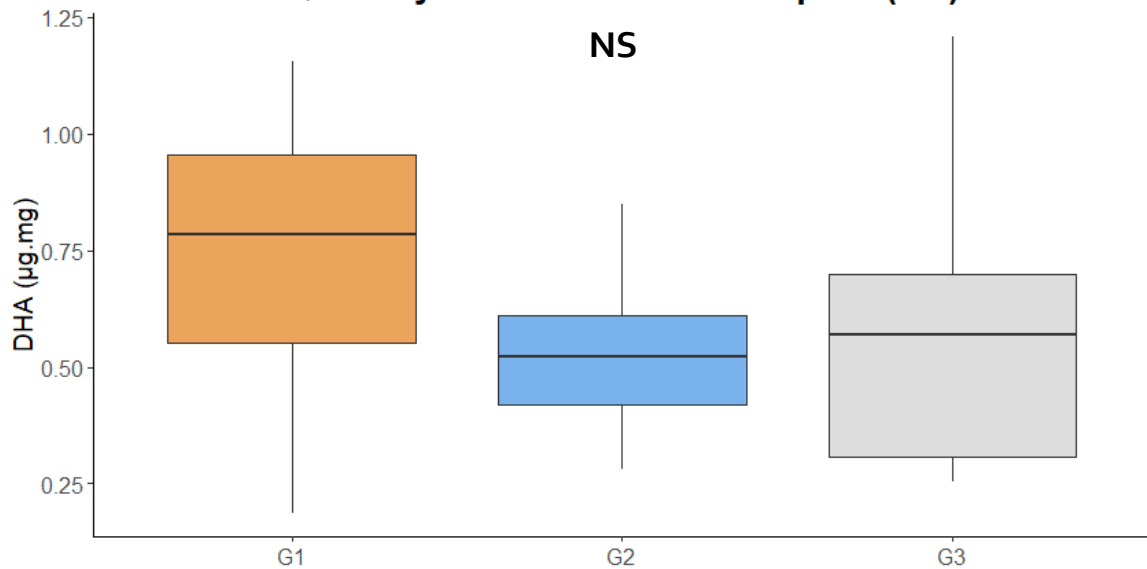
Quantity of DHA in reserve lipids (NL)



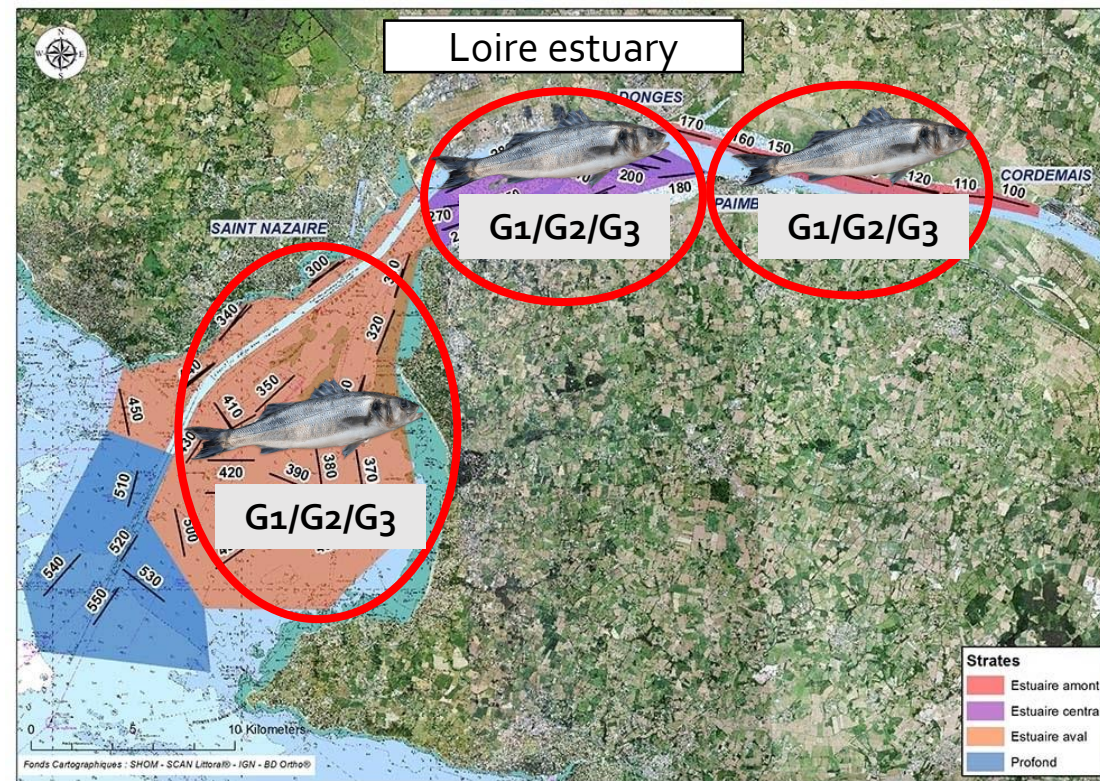
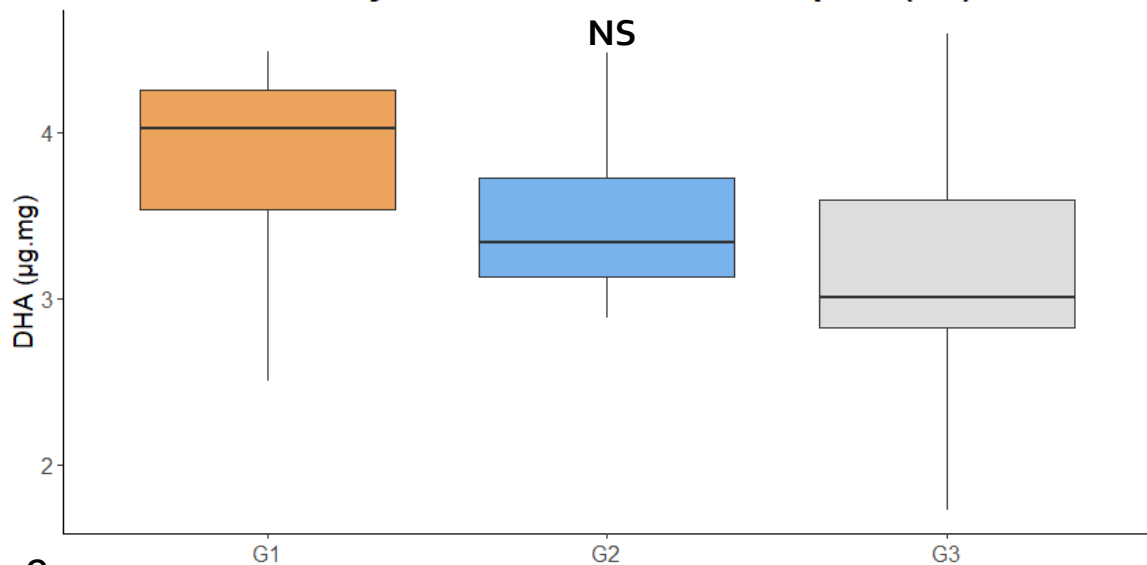
Quantity of DHA in membrane lipids (PL)



Quantity of DHA in reserve lipids (NL)



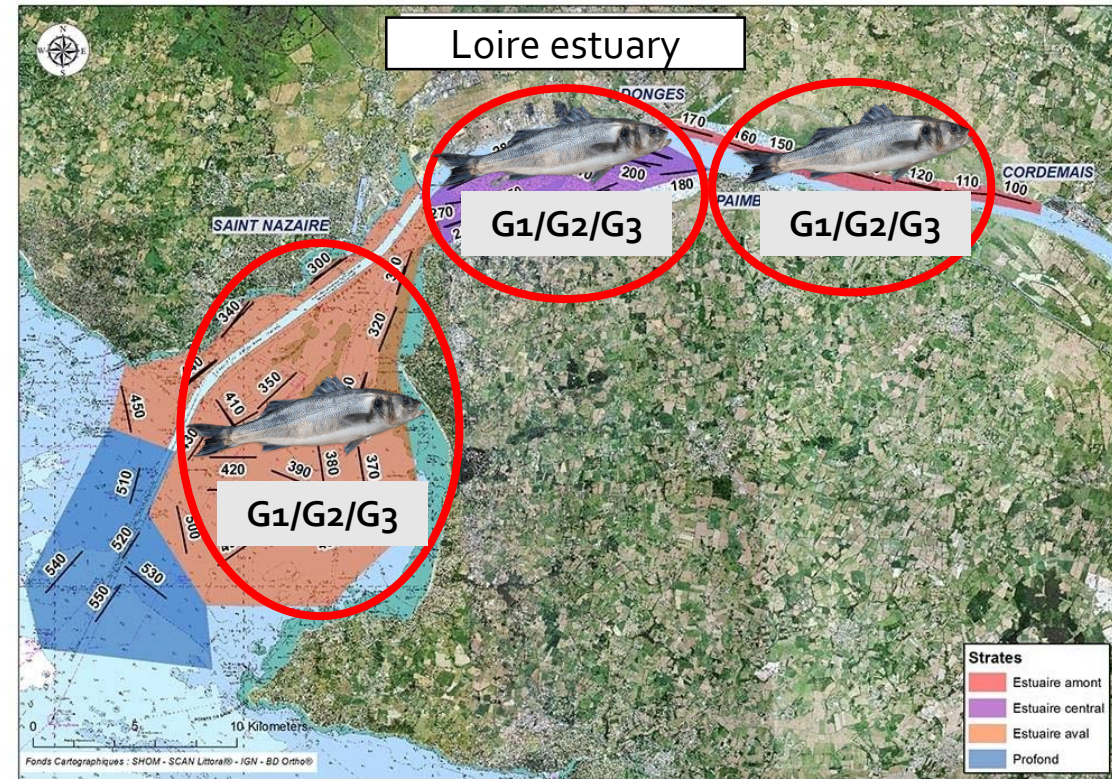
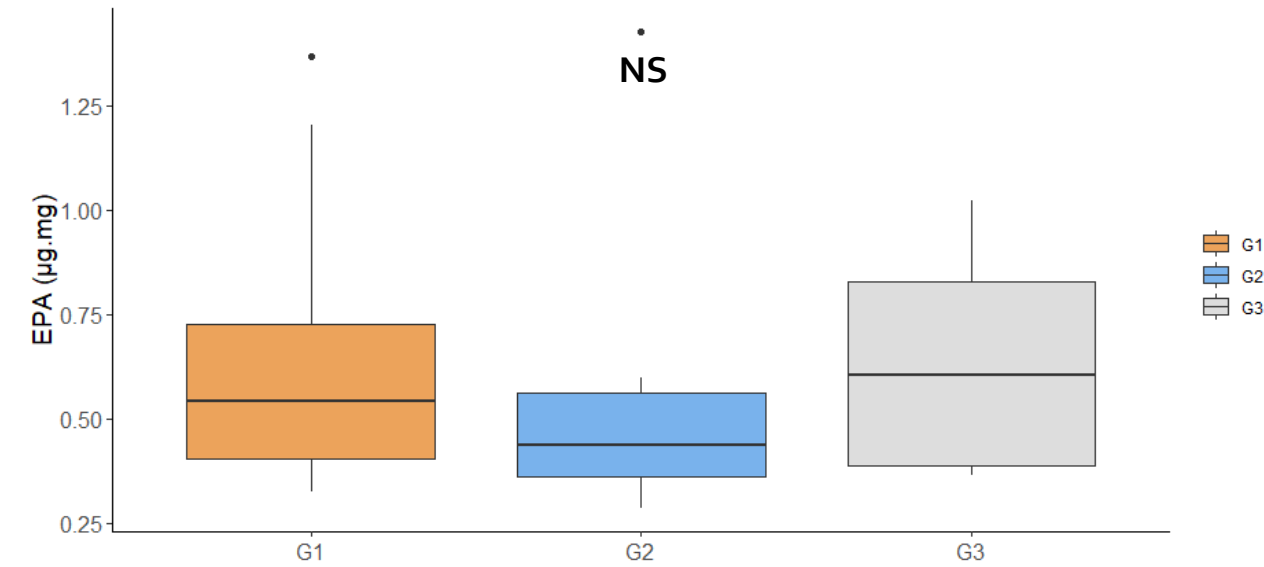
Quantity of DHA in membrane lipids (PL)



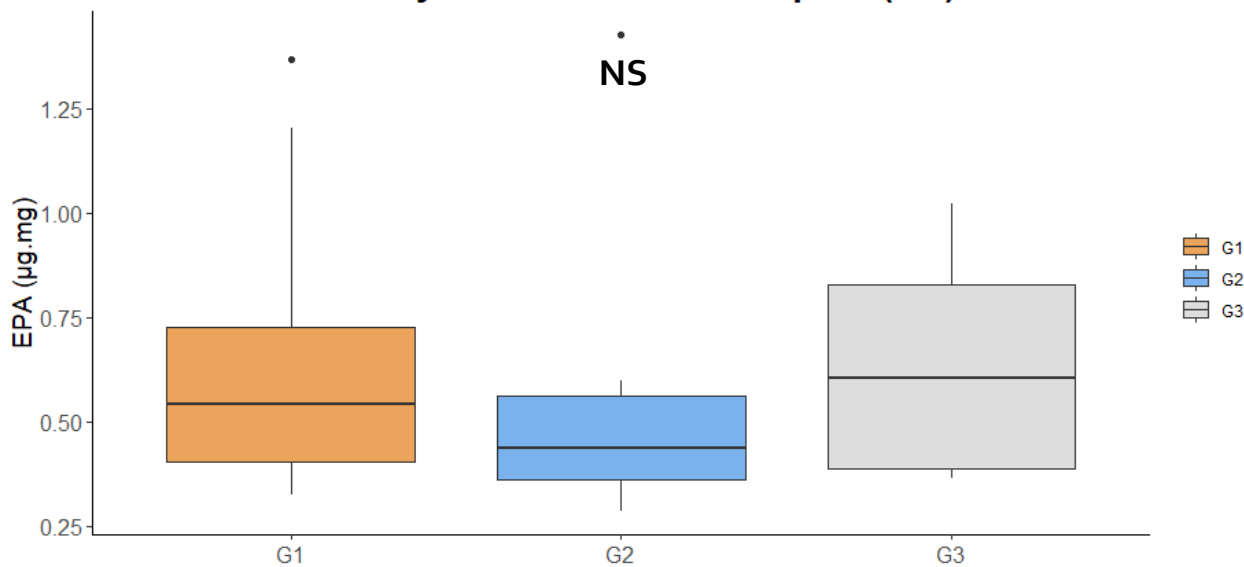
- No trophic differences or membrane differences -> Effect of sampling sites ?

Quantity of EPA in reserve lipids (NL)

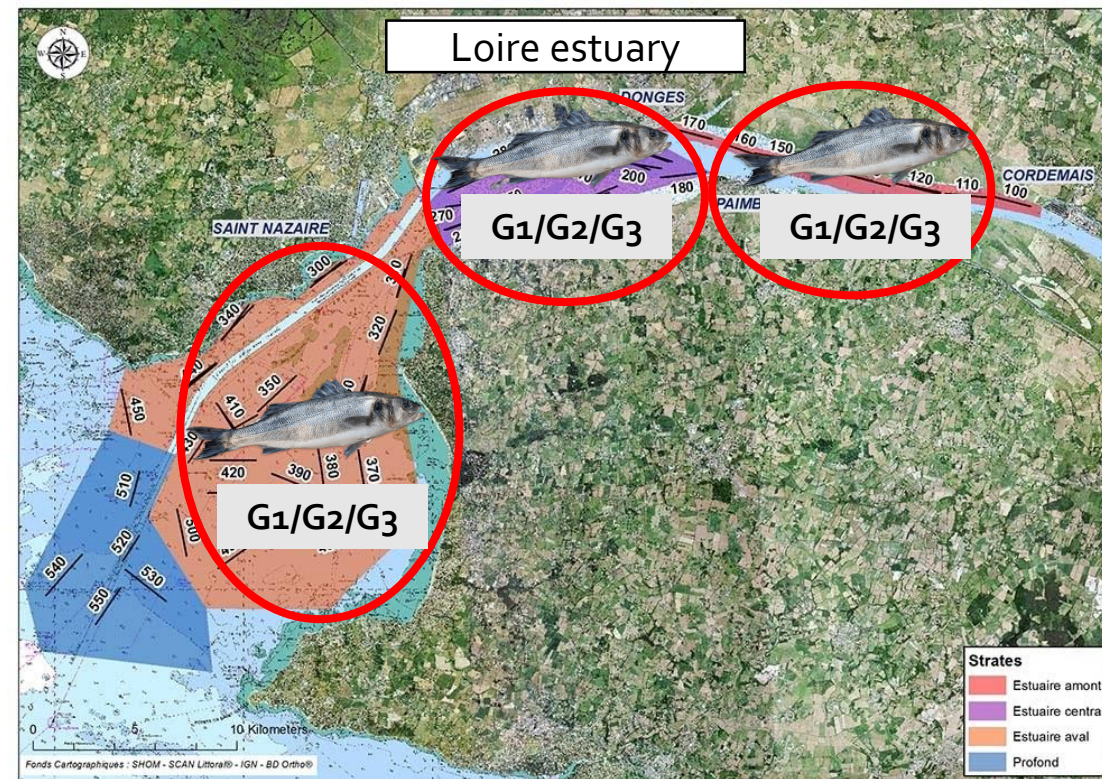
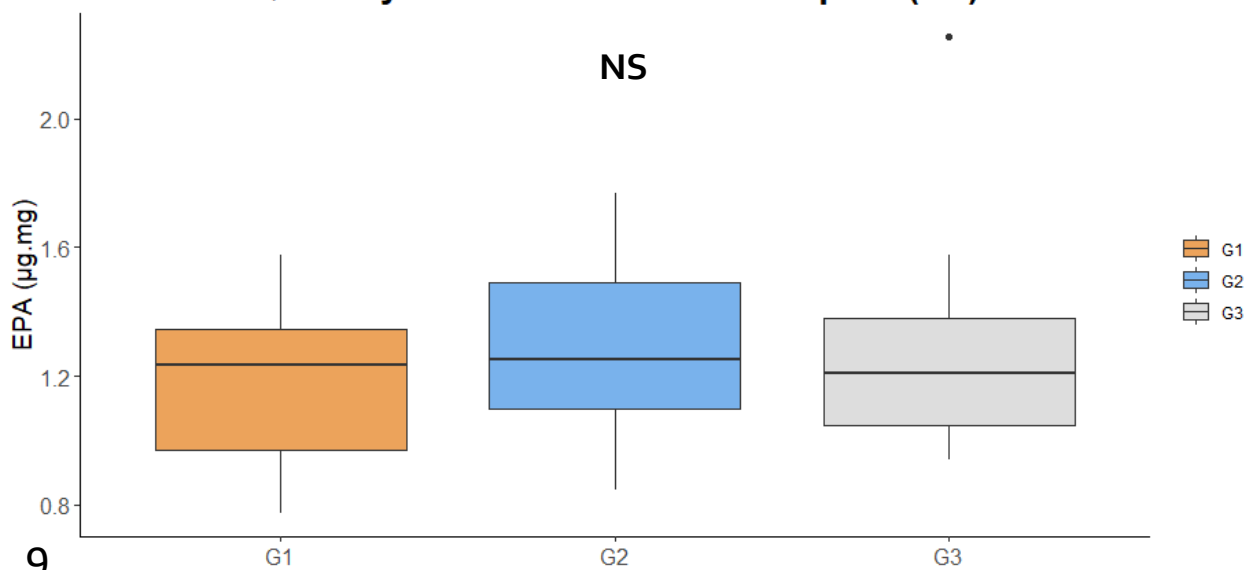
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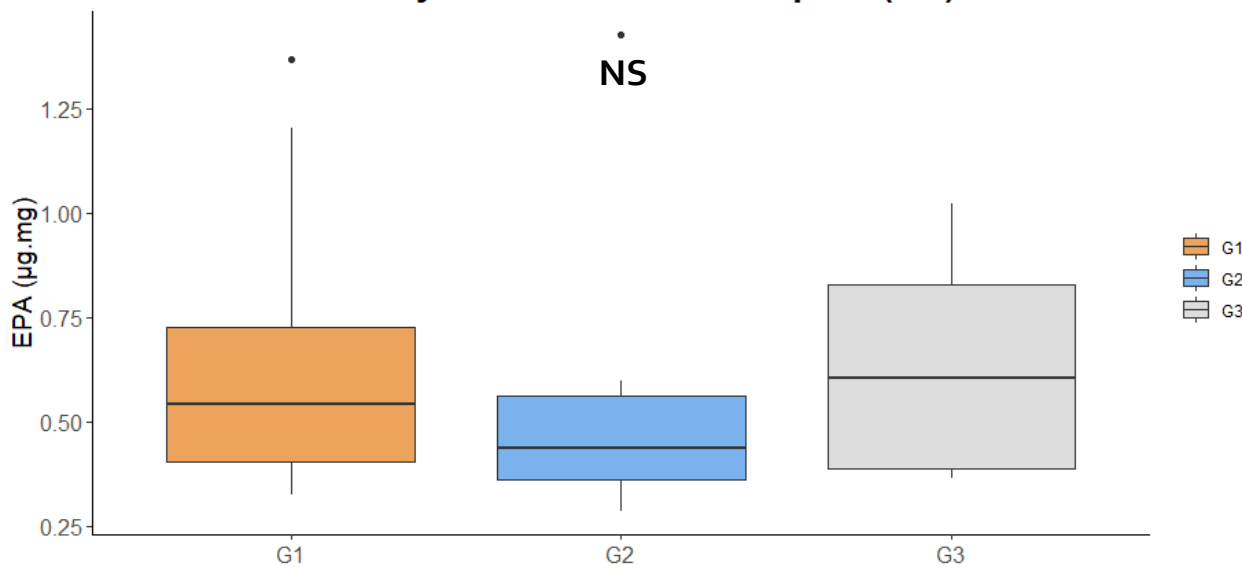
Quantity of EPA in reserve lipids (NL)



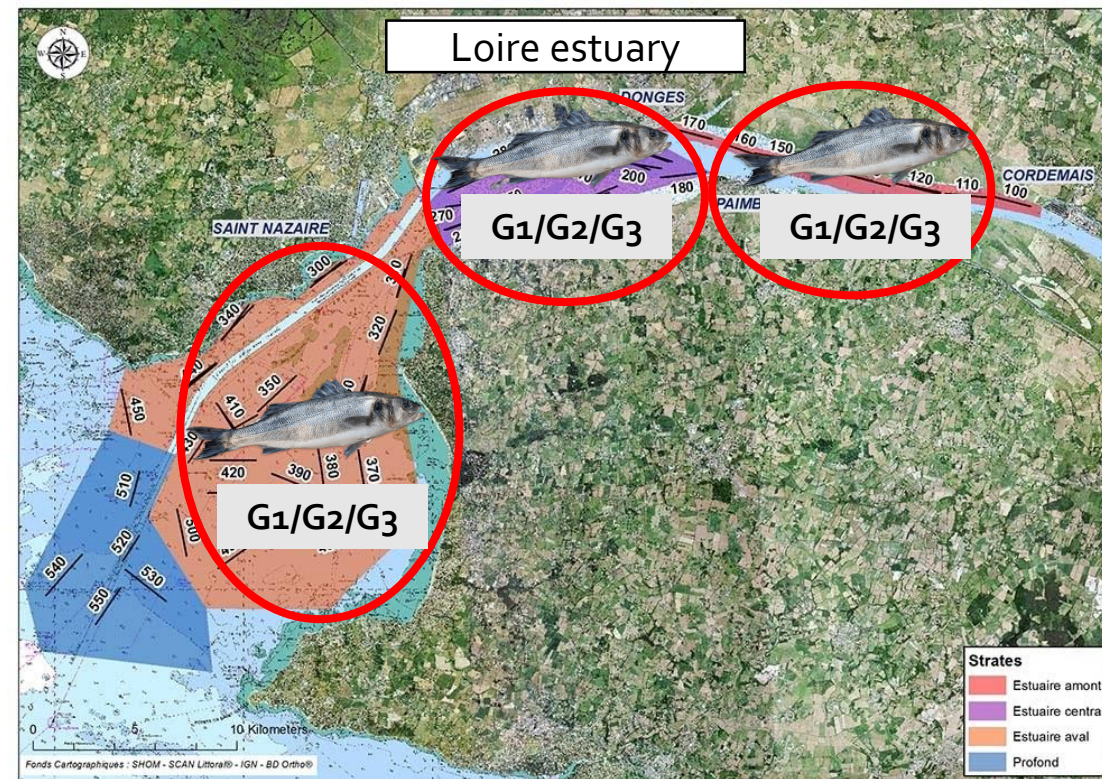
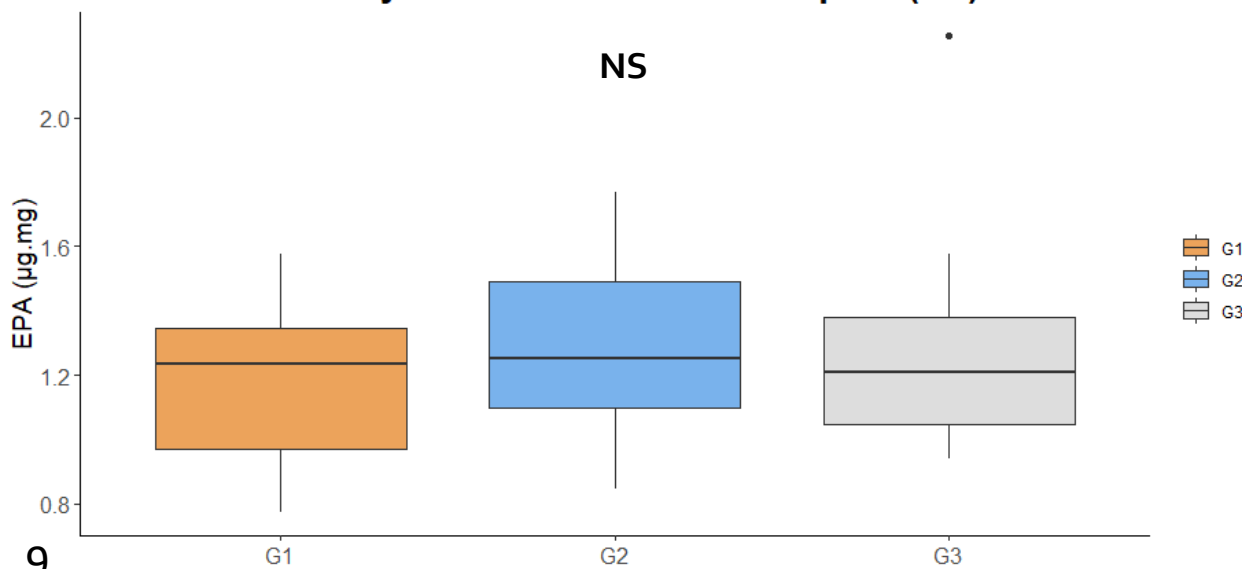
Quantity of EPA in membrane lipids (PL)



Quantity of EPA in reserve lipids (NL)



Quantity of EPA in membrane lipids (PL)



- No trophic differences or membrane differences -> Effect of sampling sites

What was observed *in natura* ?

Selective DHA retention in membrane lipids in
Loire & Seine

What was observed *in natura* ?

Selective DHA retention in membrane lipids in
Loire & Seine

Life stage effect on DHA composition in
Seine

What was observed *in natura* ?

Selective DHA retention in membrane lipids in Loire & Seine

Life stage effect on DHA composition in Seine

No differences for EPA quantities in membrane lipids

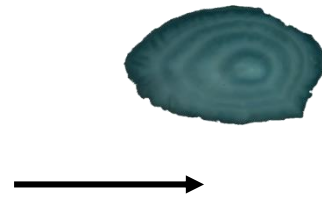
Many factors could influence the levels of EPA / DHA

- Habitat related factors :
 - Trophic chain length
 - Abundance of preys
 - Water parameters

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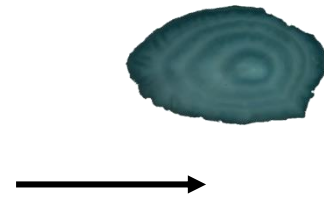


Otoliths micro-chemistry : elemental composition of water fish lived in : salinity, metals

Many factors could influence the levels of EPA / DHA

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Otoliths micro-chemistry : elemental composition of water fish lived in : salinity, metals

- Individuals related factors :

- Capacities of retention / synthesis



Transcriptomic data on n-3 PUFA metabolism genes :
elongases, desaturases

Many factors could influence the levels of EPA / DHA

- Habitat related factors :

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- Abundance of preys
- Water parameters



Otoliths micro-chemistry : elemental composition of water fish lived in : salinity, metals

- Individuals related factors :

- Capacities of retention / synthesis
- Type of tissue → Analyzing other tissues : Muscle, brain





*Thank you for
your attention*