



# Le Krill: Un acteur trop souvent oublié en conservation et pourtant si important



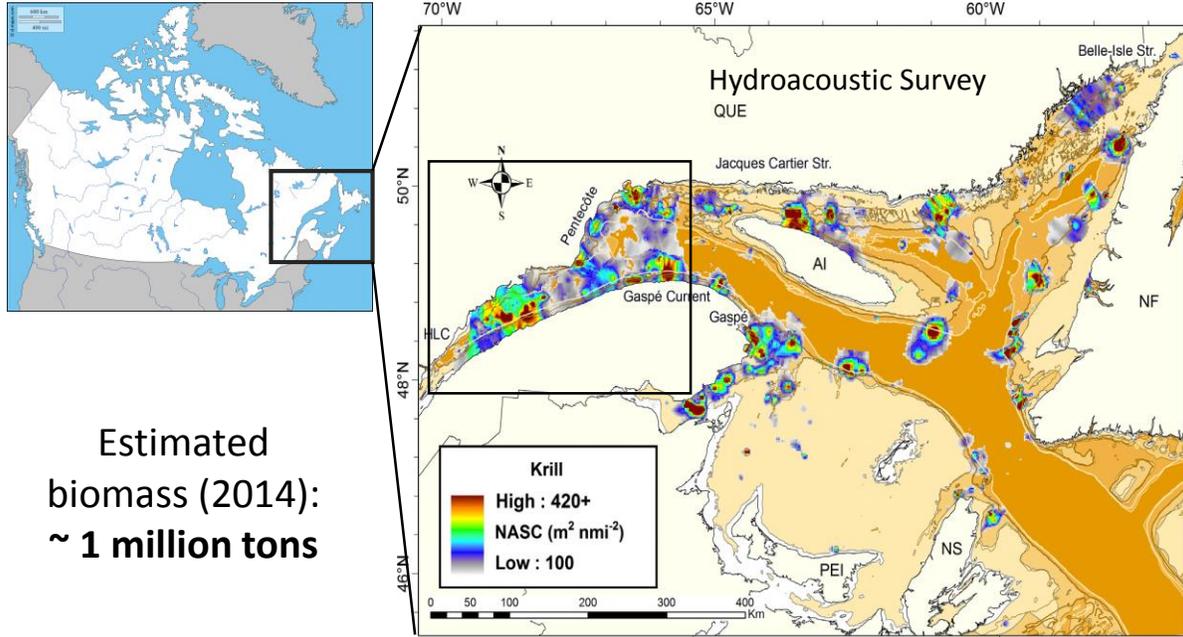
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# Ecological importance of northern krill species

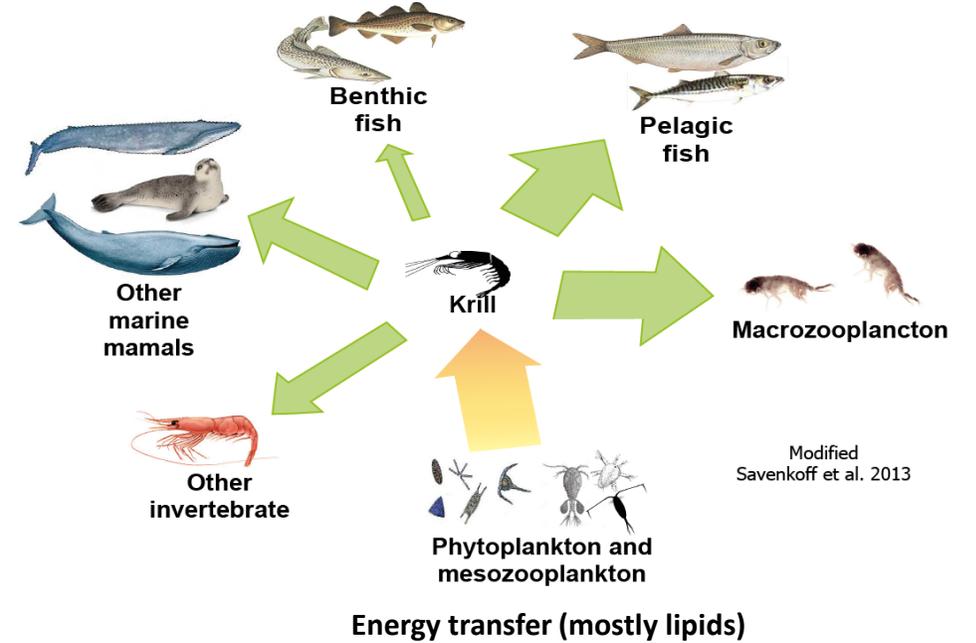
## Abundant species



McQuinn et al., 2015

Estimated biomass (2014):  
~ 1 million tons

## Keystone species in marine trophic food webs



Modified Savenkoff et al. 2013



*Meganyctiphanes norvegica*  
(temperate/boreal)

Warm adapted



*Thysanoessa inermis*  
(arctic/boreal)

Cold adapted

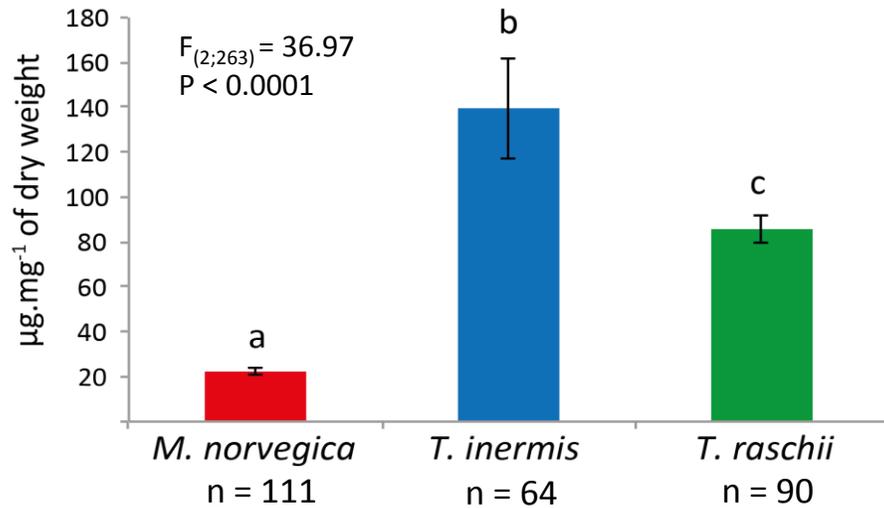


*Thysanoessa raschii*  
(boreal/arctic)

3 species  
coexist in sympatry

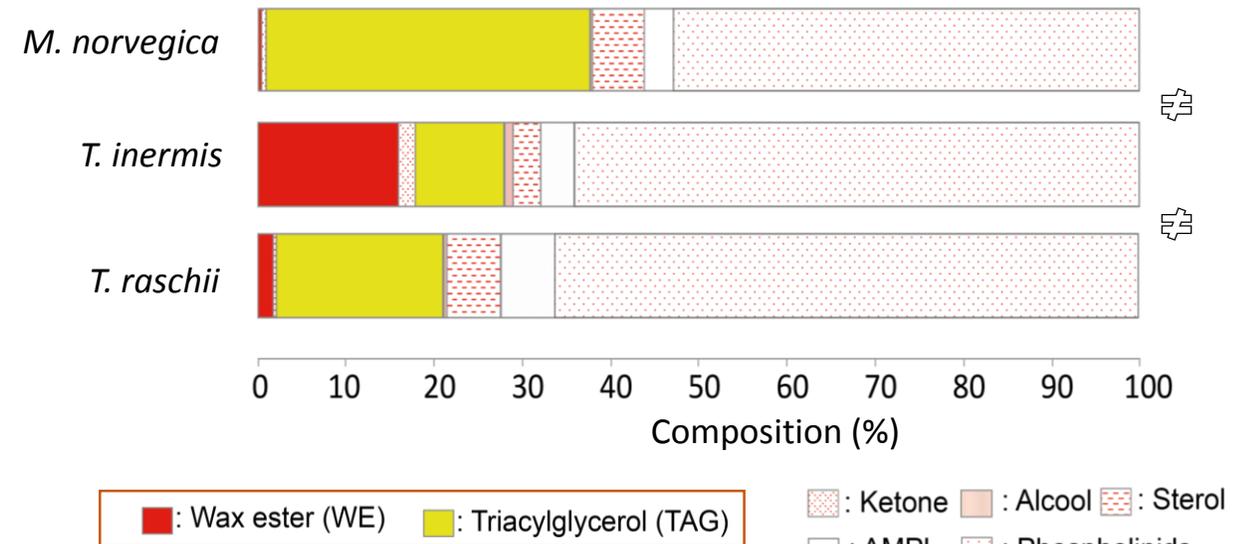
# Lipid content and composition differences among species

Mean annual lipid contents of krill



Cabrol et al, 2018

Mean annual lipid class composition of krill



Huenerlague et al. , 2014



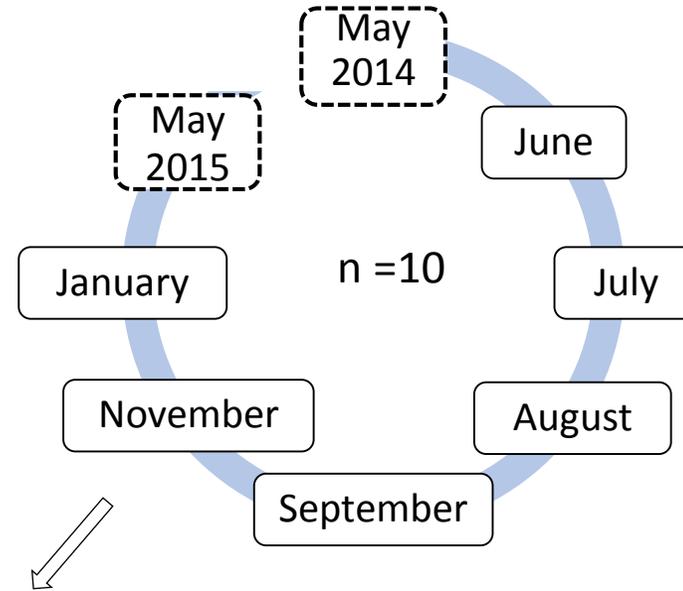
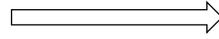
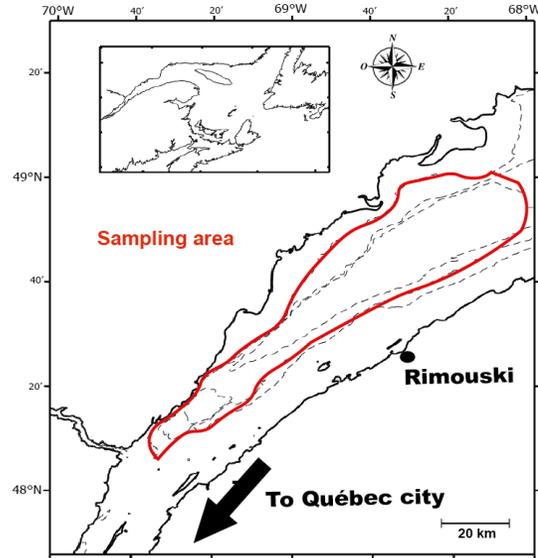
Limited knowledge on processes affecting the energy reserve content



## PhD Objective :

**To determine how the physiological condition and feeding behaviour differ among species and in relation spatio-temporal changes of environmental conditions in subarctic environments**

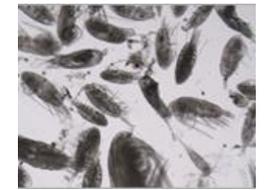
# Material and Methods : Seasonal survey



## By sampling cruise:

Krill

Potential food sources



Lipid content (IatroScan)

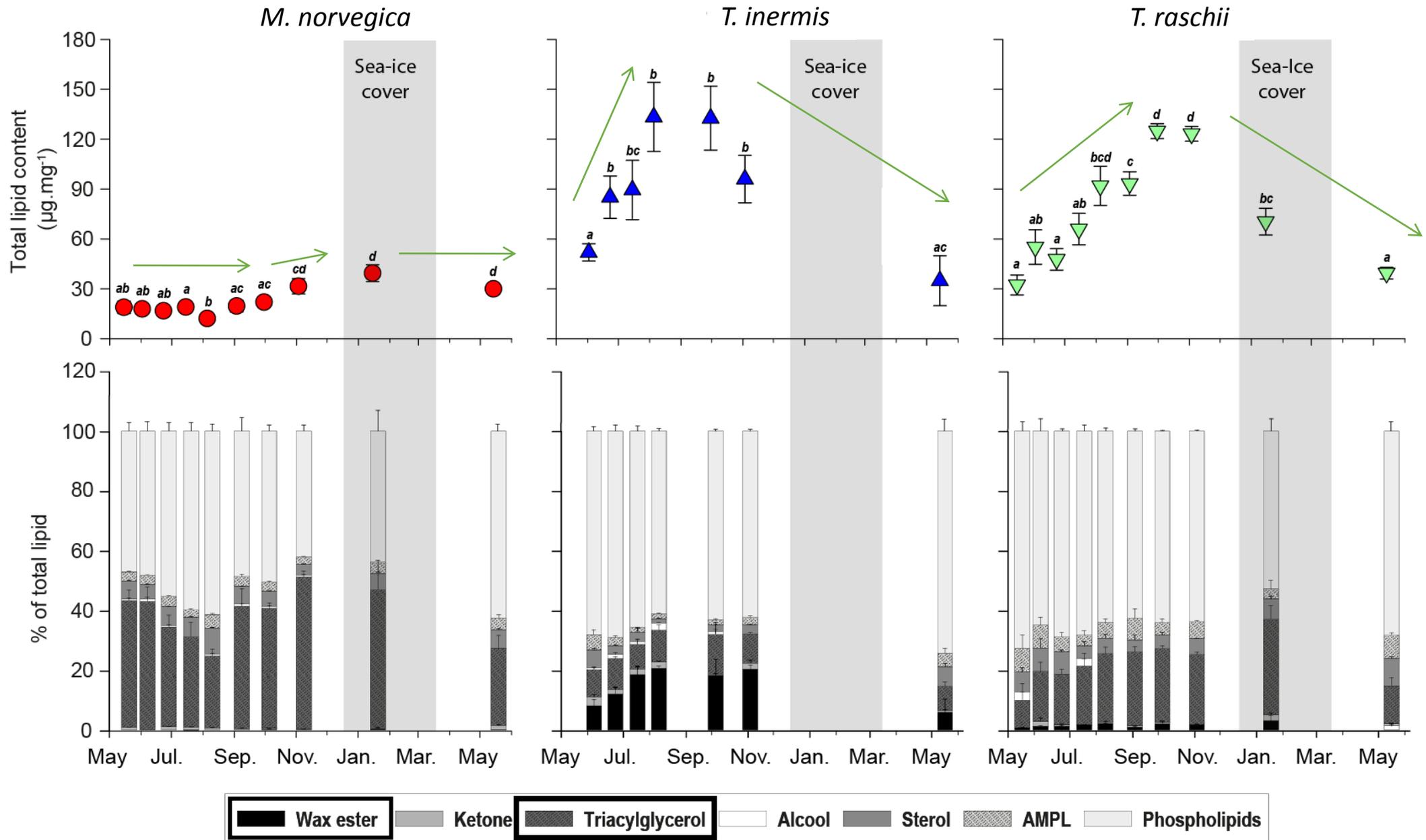
Phytoplankton

POM

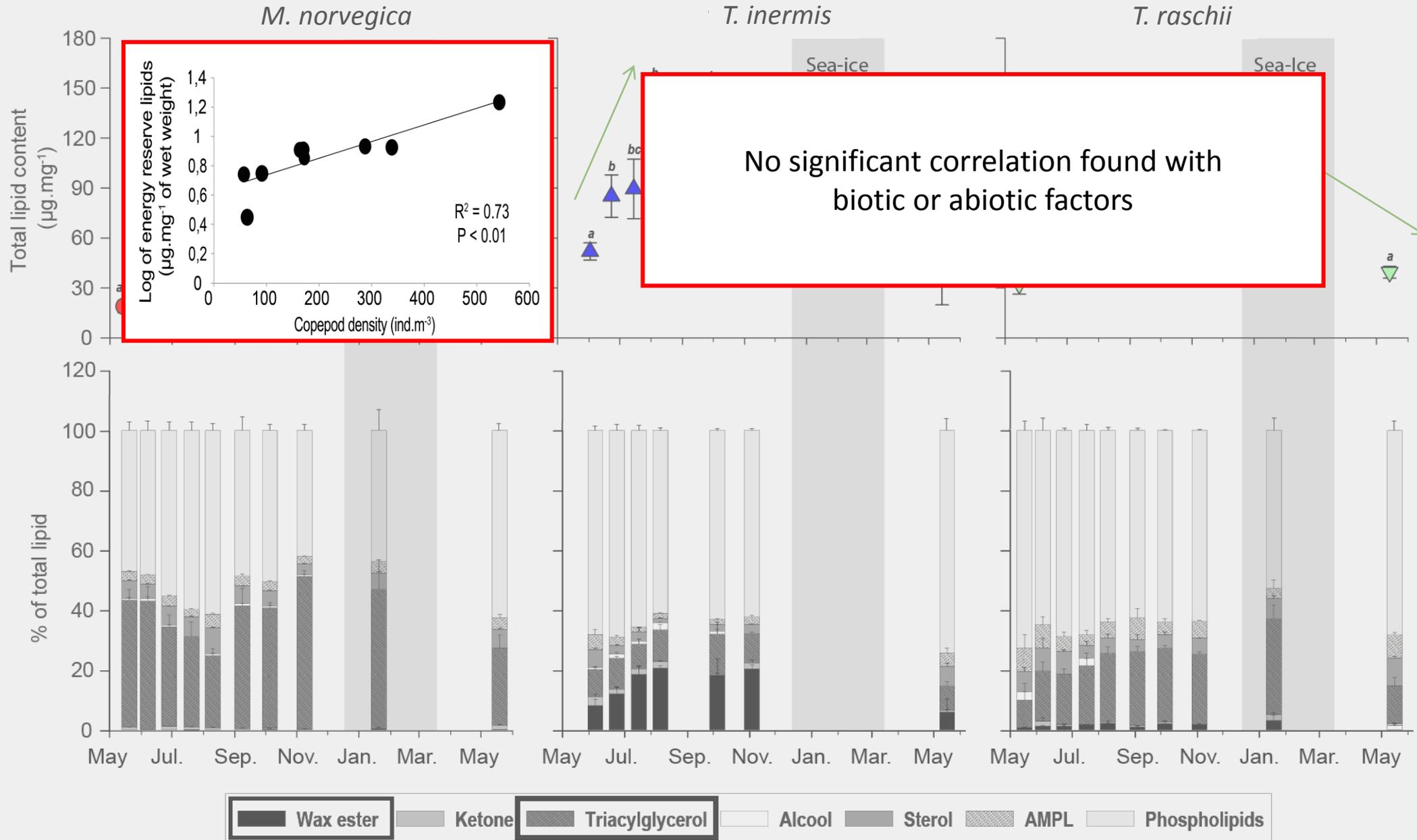
Zooplankton  
(18 species)

Fatty acids -> Neutral (krill) and Total (prey)  
Stable isotopes (IRMS) ->  $\delta^{15}\text{N}$  &  $\delta^{13}\text{C}$

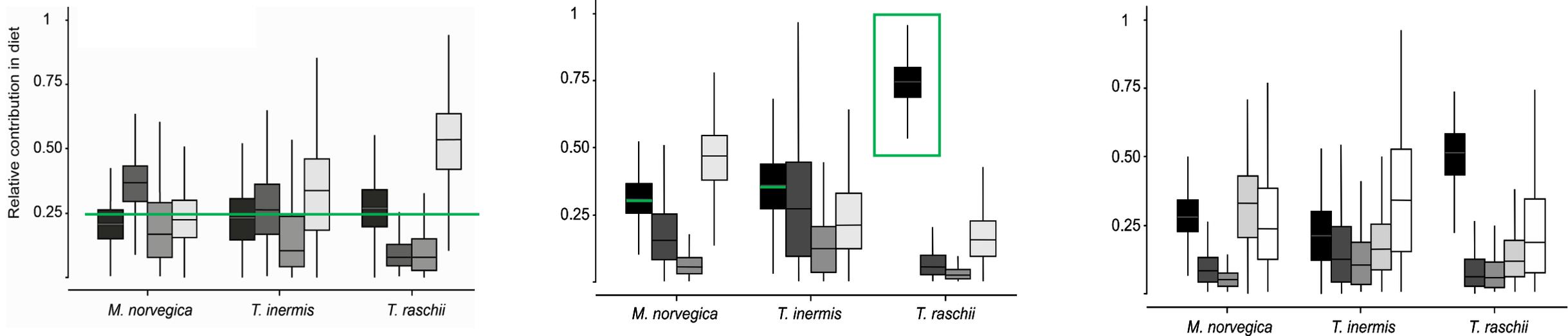
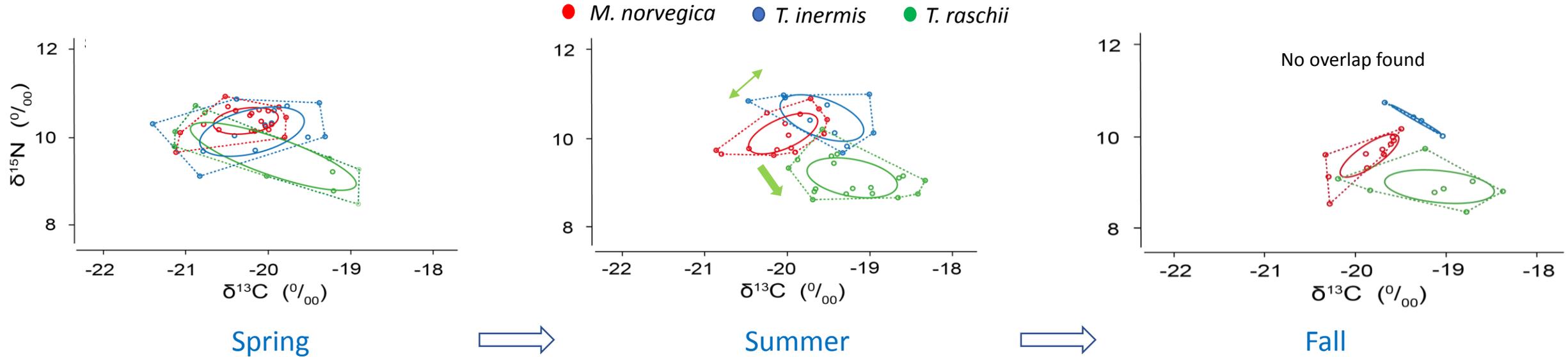
# Total lipid & lipid class composition dynamics over the year



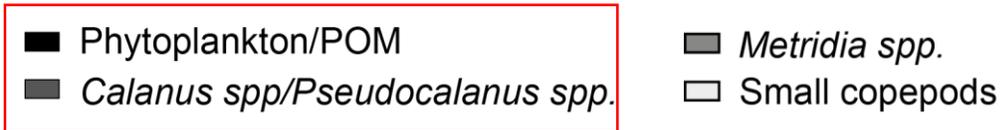
# Total lipid & lipid class composition dynamics over the year



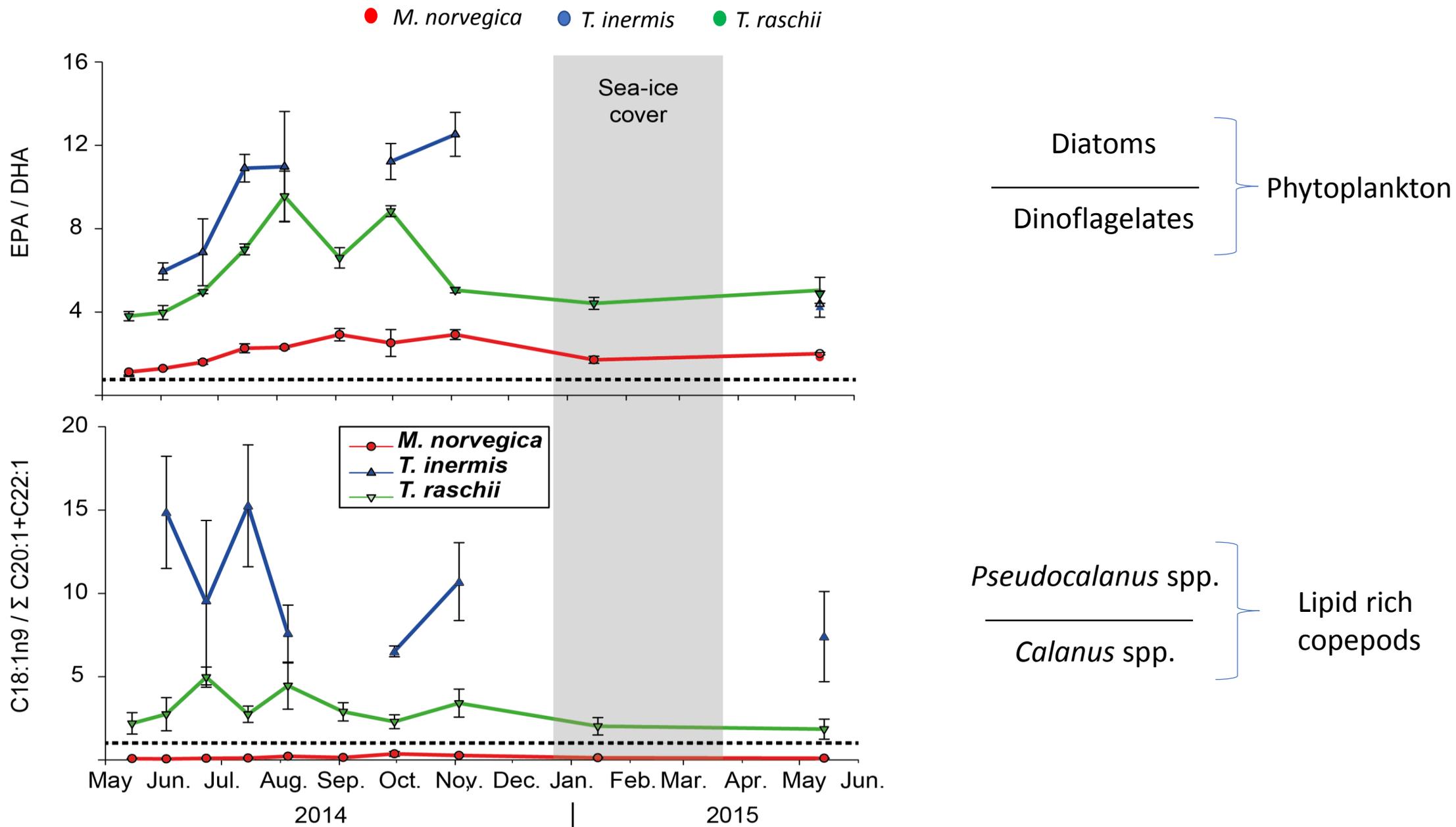
# Trophic niches overlap and diet composition estimates: SIAR



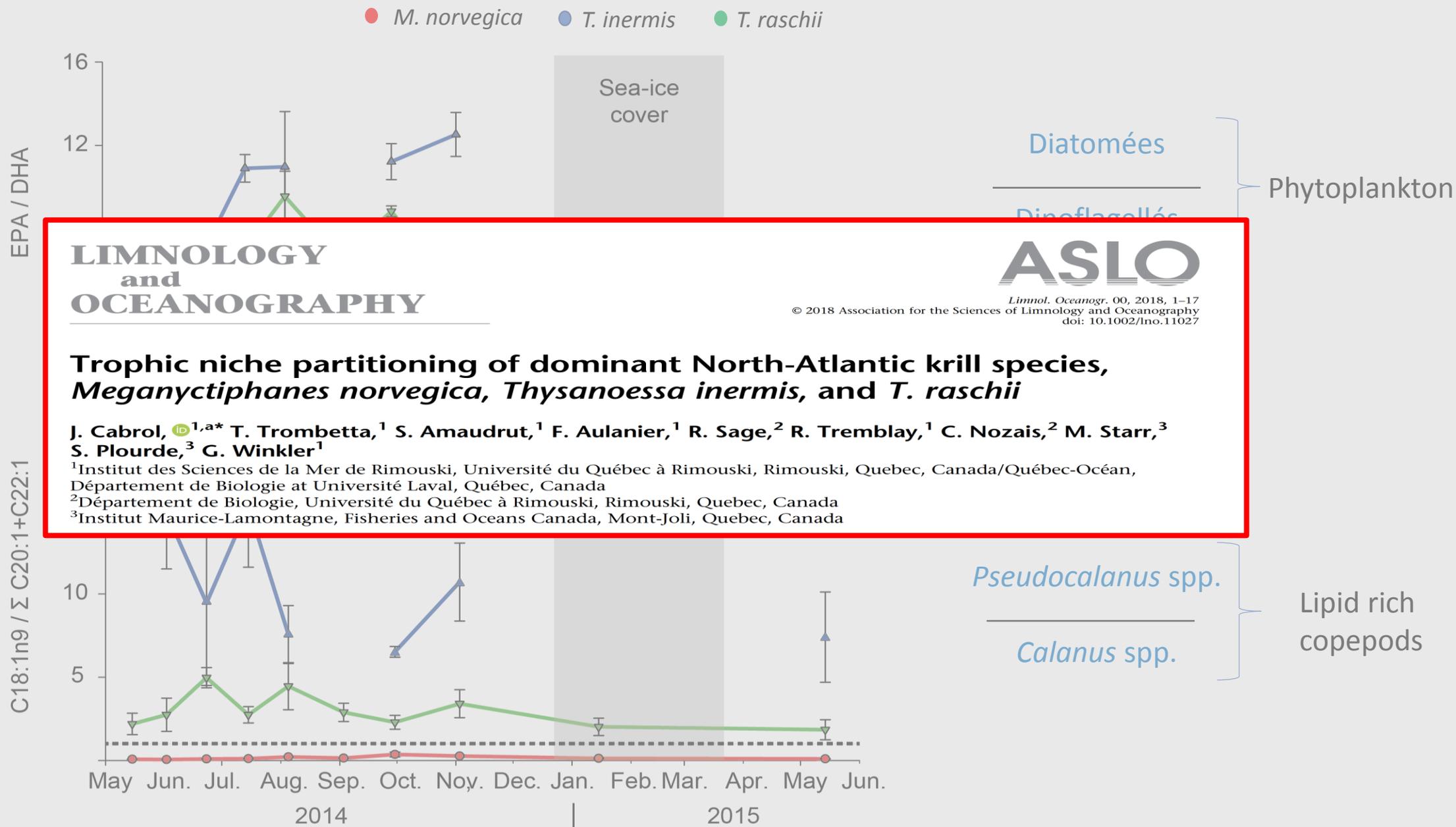
Low taxonomic resolution ←



# Selectivity differentiation based on fatty acid trophic marker ratios



# Selectivity differentiation based on fatty acid trophic marker ratios



# Material and Methods : Spatial survey

Fall 2014



NGCC Hudson

Spring 2015

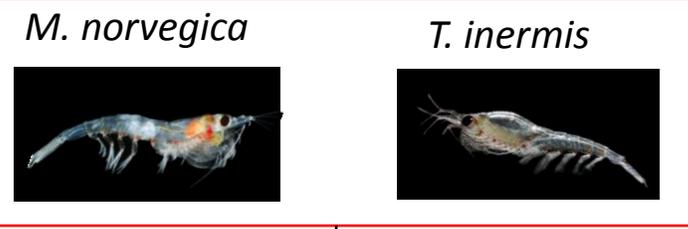
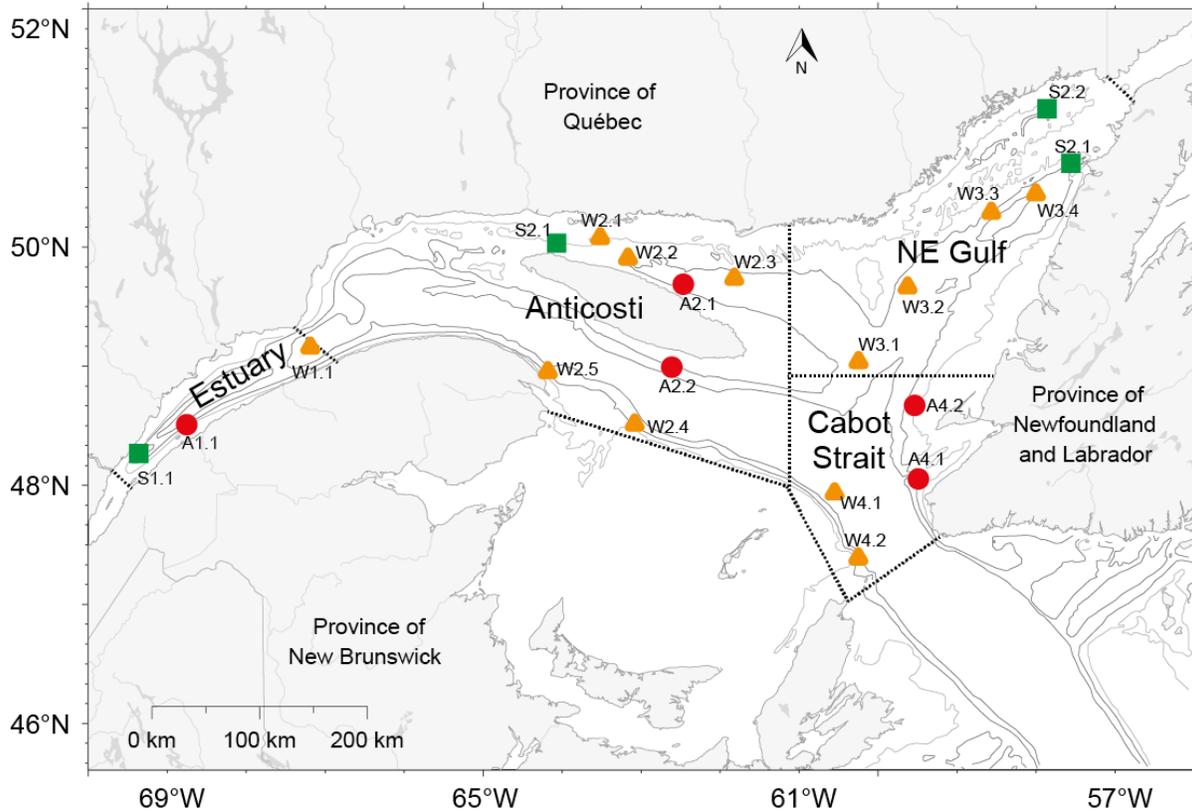


NGCC téléost

Winter 2016



NGCC Martha-Black



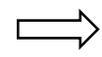
Neutral Fatty acids

(J.B Nadalini (UQAR/ISMER))

Total fatty acid  
used as proxy of energy  
content

(Cabrol et al. 2015; Fraser et al. 1989)

Trophic FAs  
Feeding selectivity



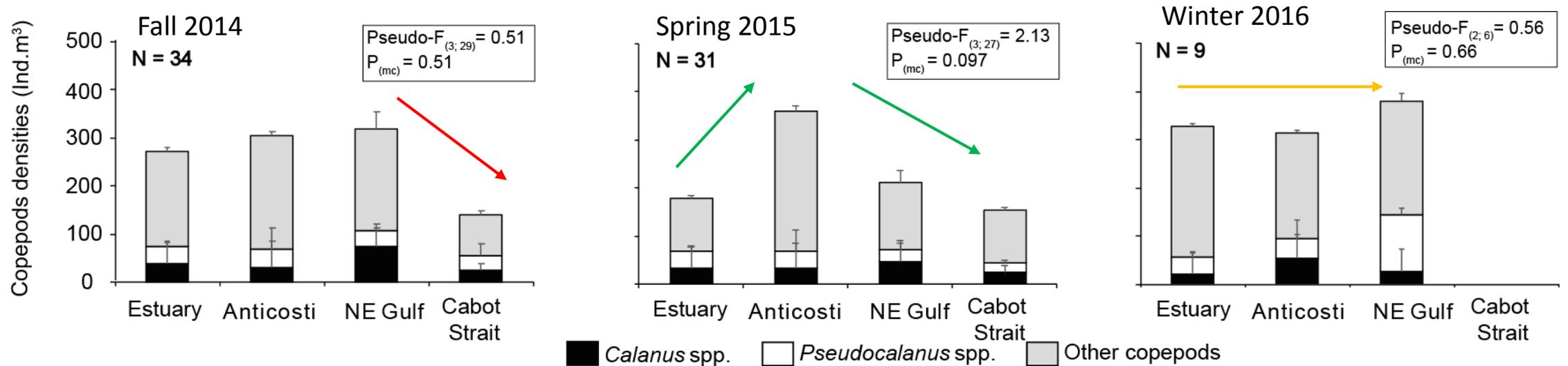
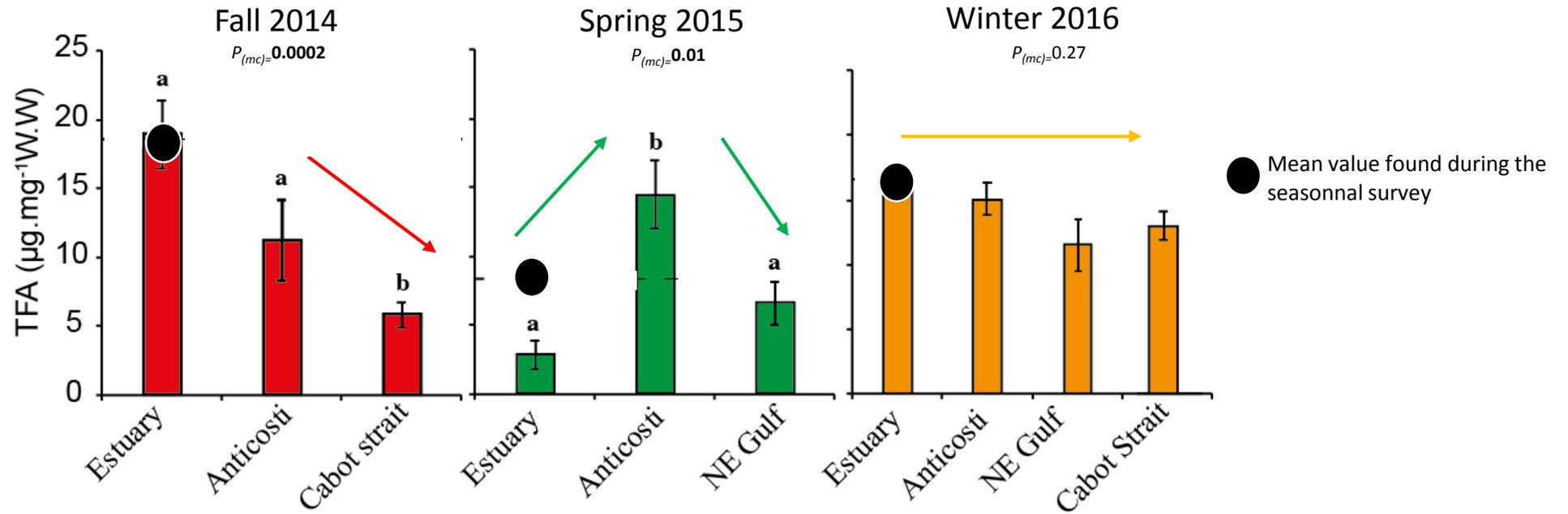
AZMP  
(CTD + phytoplankton + zooplankton)

Peter Galbraith (MPO) + Marjolaine Blais (MPO)

# Spatio-temporal variations of lipid contents of *M. norvegica*



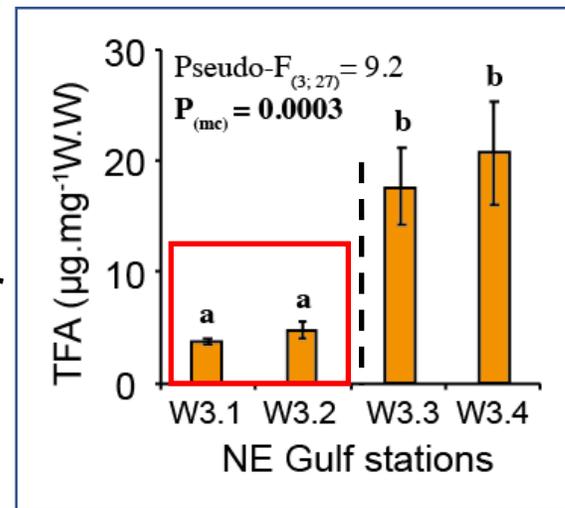
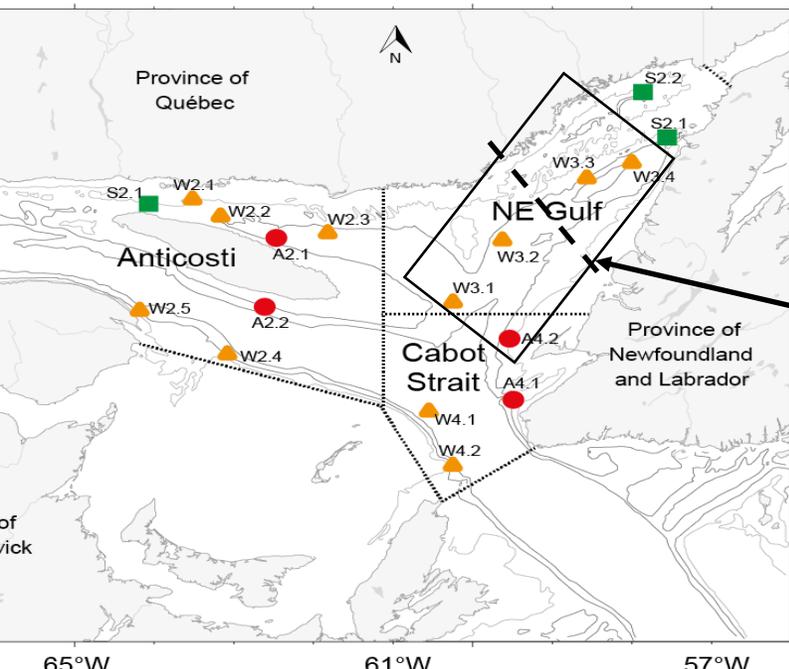
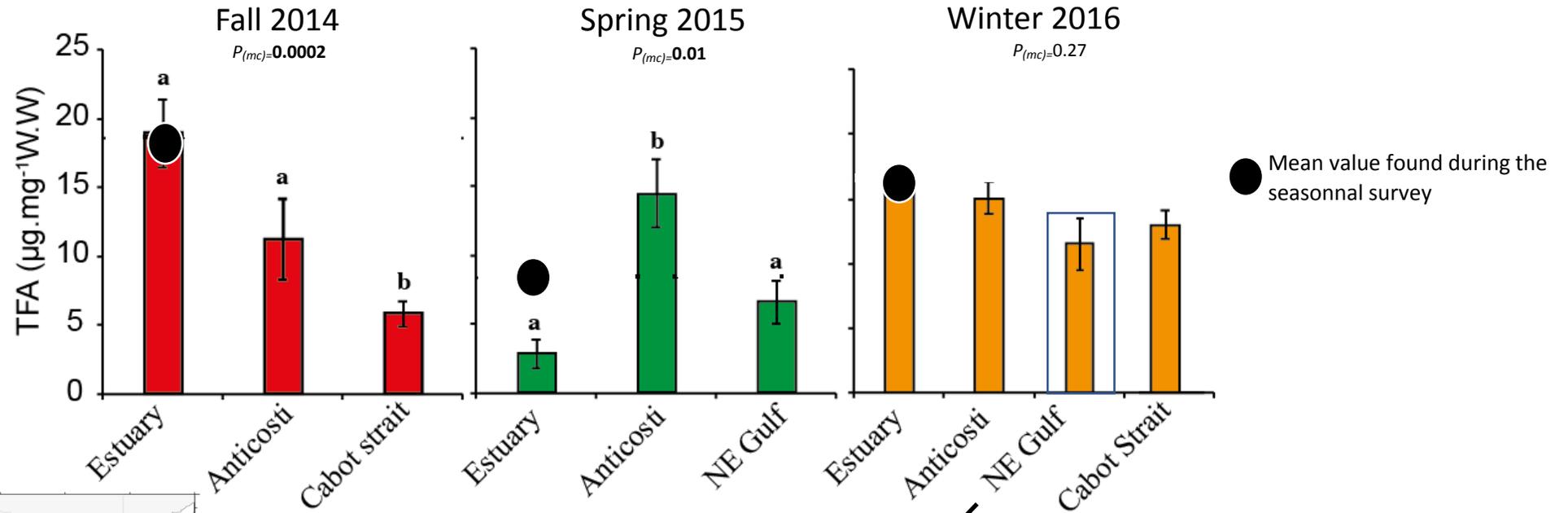
*M. norvegica*



# Spatio-temporal variations of lipid contents of *M. norvegica*



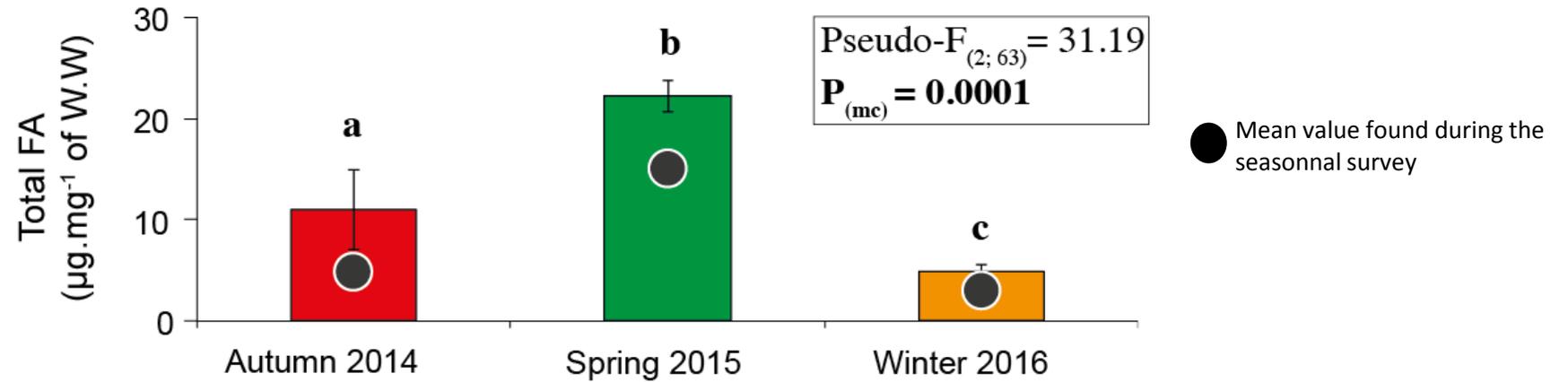
*M. norvegica*



# Spatio-temporal variations of lipid contents of *T. inermis*



*T. inermis*

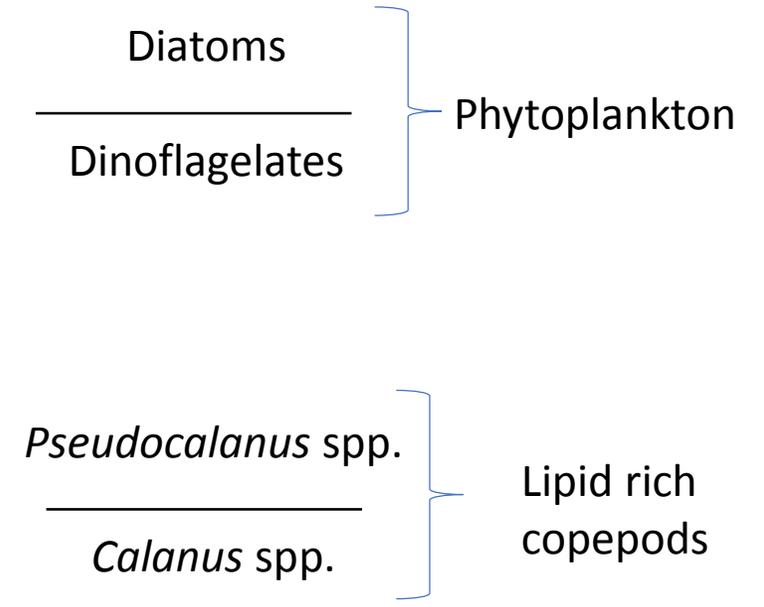
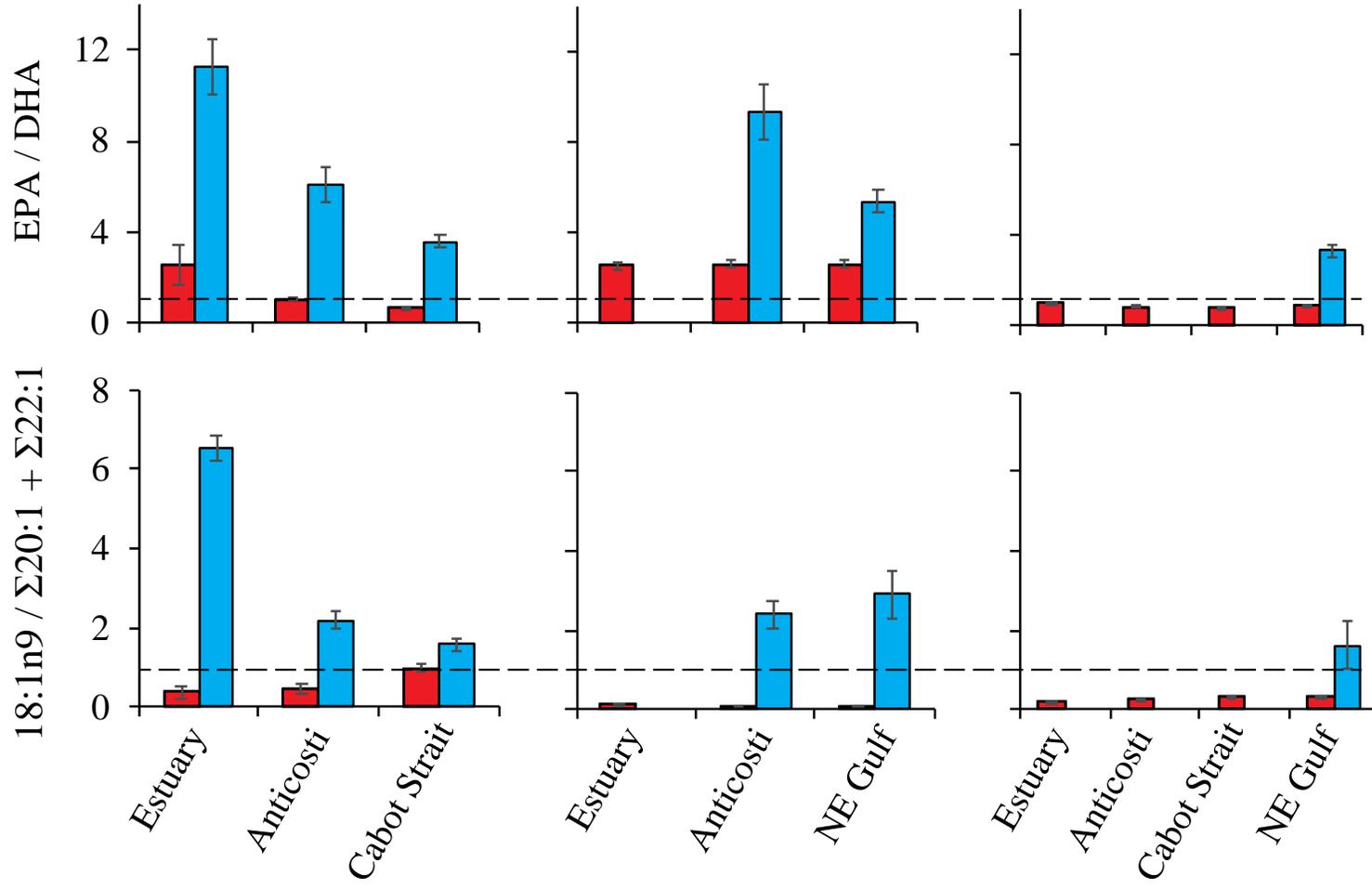


- No significant spatial variations found despite changes in food quality and quantity throughout the EGSL
- Lipid variations might be more related to the internal clock
- *M. norvegica* and *T. inermis* showed two contrasting patterns

# Confirmation of the trophic segregation based on fatty acid trophic marker ratios



■ *M. norvegica*
■ *T. inermis*



# Conclusion

- Total lipid content and lipid class composition varied among species over the year and across the EGSL.
- Two constrating spatial patterns → *M. norvegica* more affected by food supply than *T. inermis*
- Trophic segregation could help to maintain stable coexistence

## Selectivity on Phytoplankton

All species preferred diatoms but :

*T. inermis* > *T. raschii* > *M. norvegica*

## Selectivity differences on zooplankton

*M. norvegica* → *Calanus spp./small copepods*

*T. inermis* → *Pseudocalanus spp.*

*T. raschii* → Small copepods

**Changes at the base of the food web will have differential consequences on the three krill species and ultimatly on the energy transfer to upper trophic levels.**

## Take Home messages

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**« Think globally to act locally.... »**

# Remerciements

Gesche Winkler (ISMER)  
Christian Nozais (UQAR)  
Réjean tremblay (ISMER)  
Peter Glabraith (MPO)  
Stephane Plourde (MPO)  
Michel Starr (MPO)  
Gwenaelle Gremion (ISMER)  
Angélique Ollier (ISMER)  
Anne-Marie Trudel  
Caroline Lafleur (MPO)  
Claude Belzile (UQAR)  
Danaë Lemieux  
Félix St.-Pierre (MPO)  
Jean-François St.-Pierre (MPO)  
Joana Roma (ISMER)  
Lilliane St-Armand (MPO)  
Magalie Combes (ISMER)  
Marie Guilpin (ISMER)  
Mathieu Babin (ISMER)  
Mathilde St.-Pierre  
Pierre Joly (MPO)



Peter Galbraith (MPO)  
Jean-Bruno Nadalini (ISMER)  
Thomas trombetta (UM2)  
Roxane Sage  
Fanny Aulanier (ISMER)  
Sarah Amaudrut (UQAC)

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# Mean annual trophic levels of krill

*M. norvegica*



n = 53

*T. inermis*

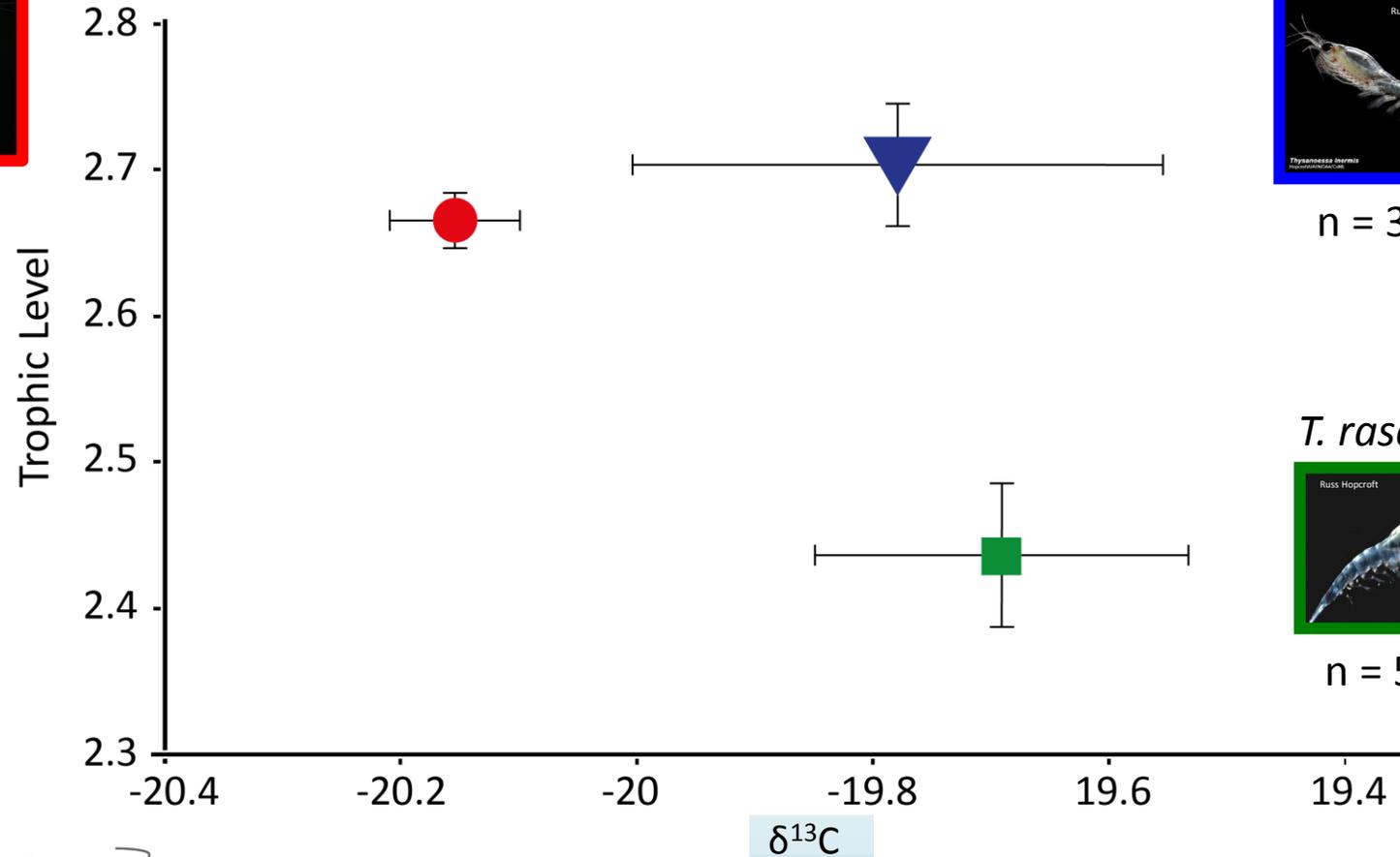


n = 31

*T. raschii*



n = 51



*M. norvegica*

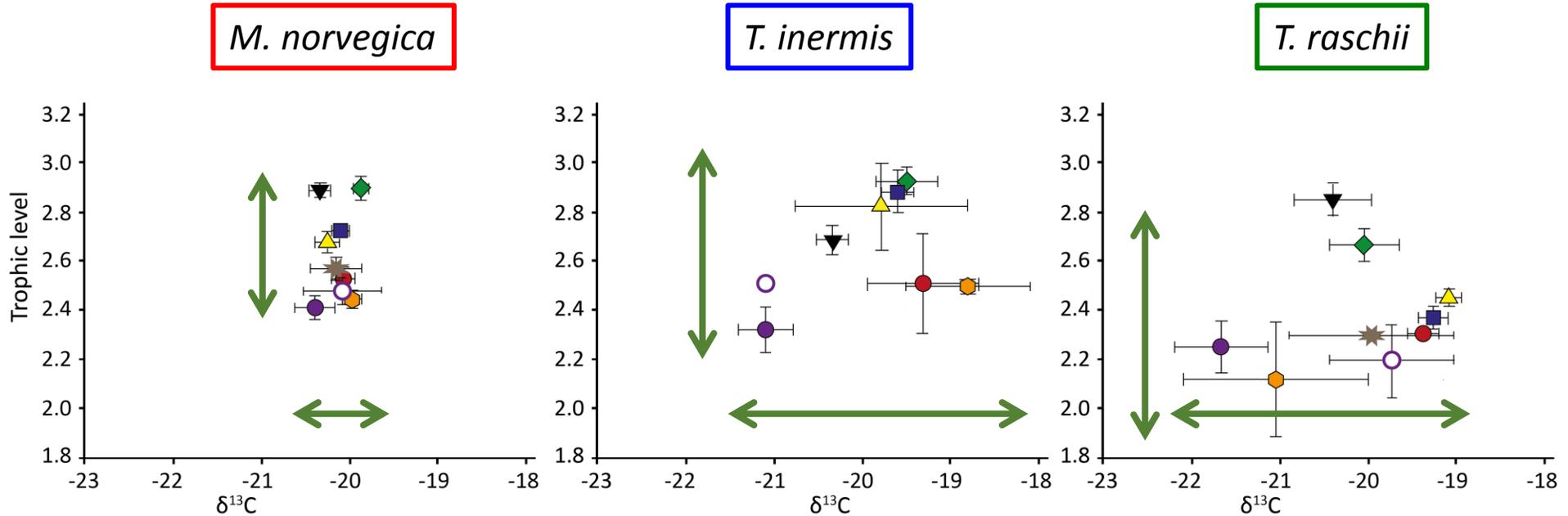
*T. inermis*

*T. raschii*

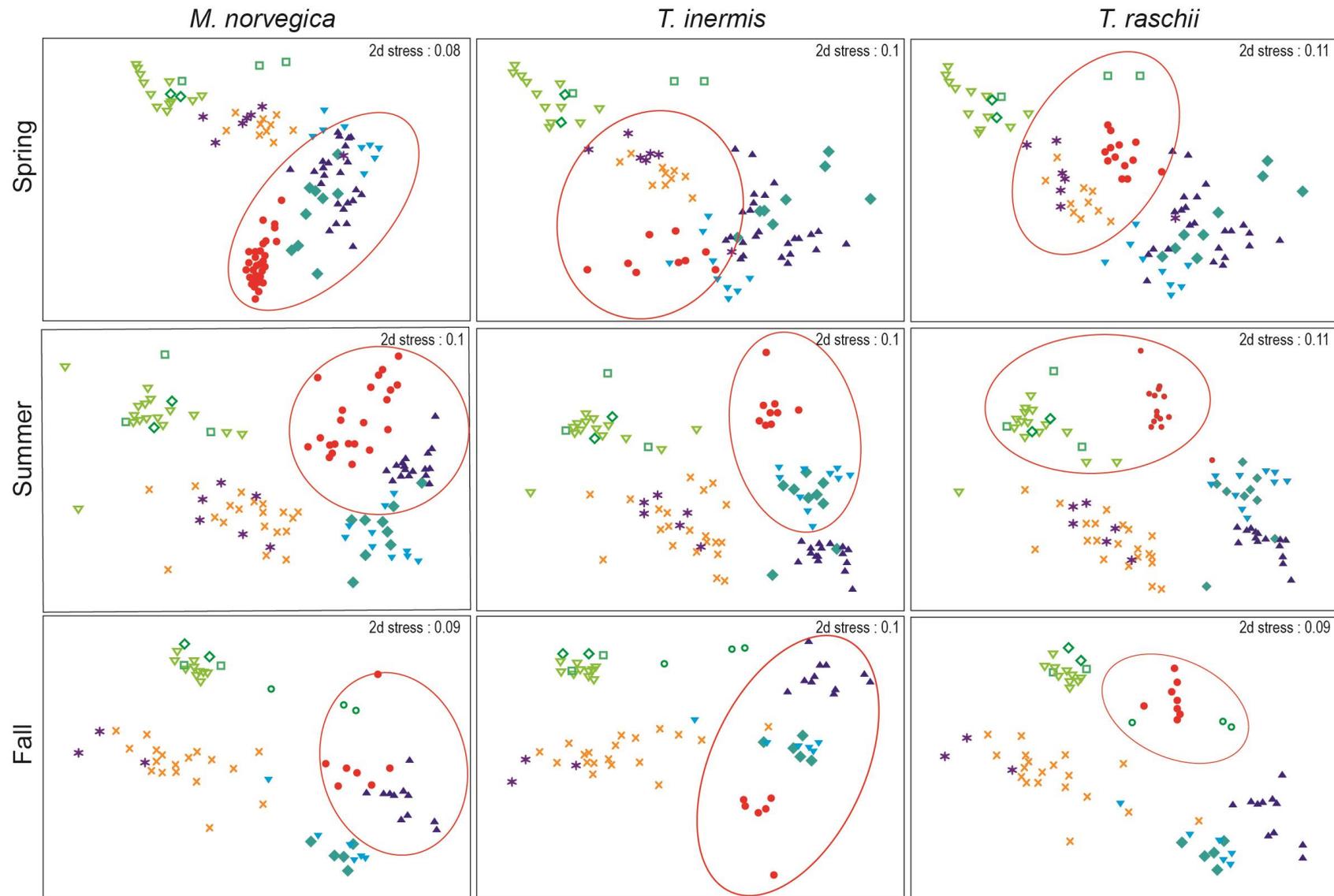
Omnivorous with a high proportion of zooplankton in their diet

Omnivorous with a herbivorous tendency

# Seasonal variations of the trophic space



# Seasonal variation of selectivity among krill species reveal by Fatty acids



Seston (TL)

● Phytoplankton    ◻ Surface POM    ◊ Surface POM (>20 $\mu$ m)    ▼ POM (water colum)

Zooplankton (TL)

× Small copepods    \* Nauplii    ▲ Calanus sp.    ◆ Metridia sp.    ▼ Pseudocalanus sp.

Predator (NL)

● Individual of Krill