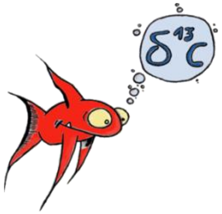
MSW’15 – 4th Mediterranean Seagrass Workshop – 20/05/2015 - Oristano

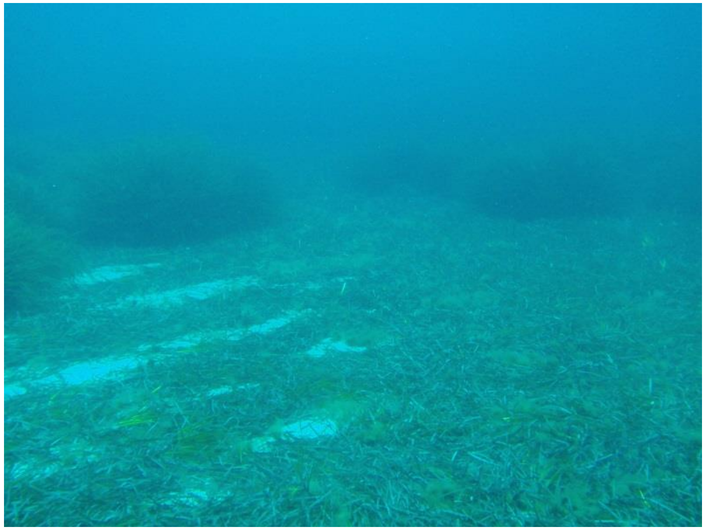
Changes of macrofauna stable isotope compositions in a very inconstant seagrass detritic habitat: actual diet modification or baseline shift?

François REMY, Thibaud Mascart, Patrick Dauby, Sylvie Gobert, Gilles Lepoint

FREEDOM TO RESEARCH



*Contact: francois.remy@ulg.ac.be

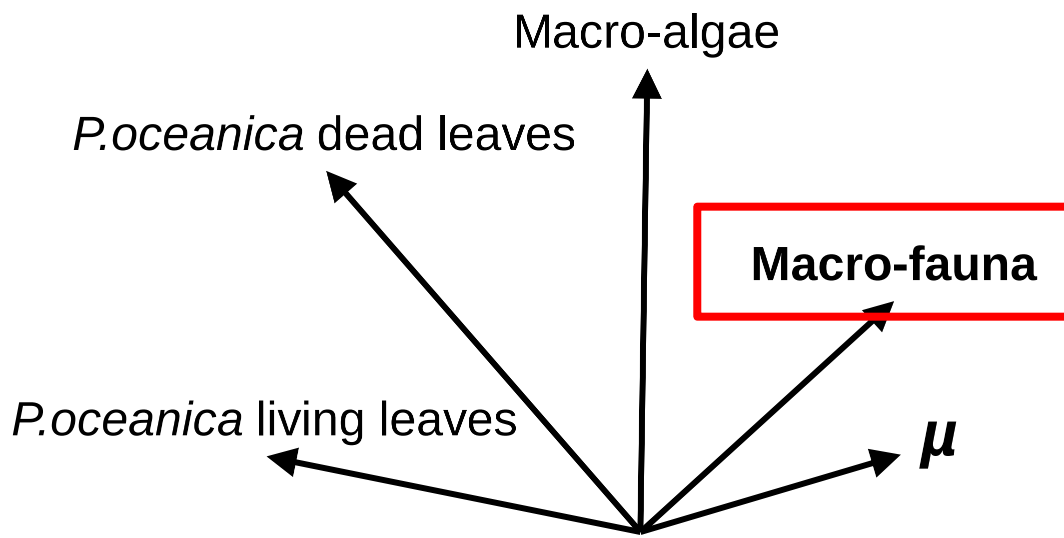


Seagrass detritus

What is « seagrass detritic habitat »?

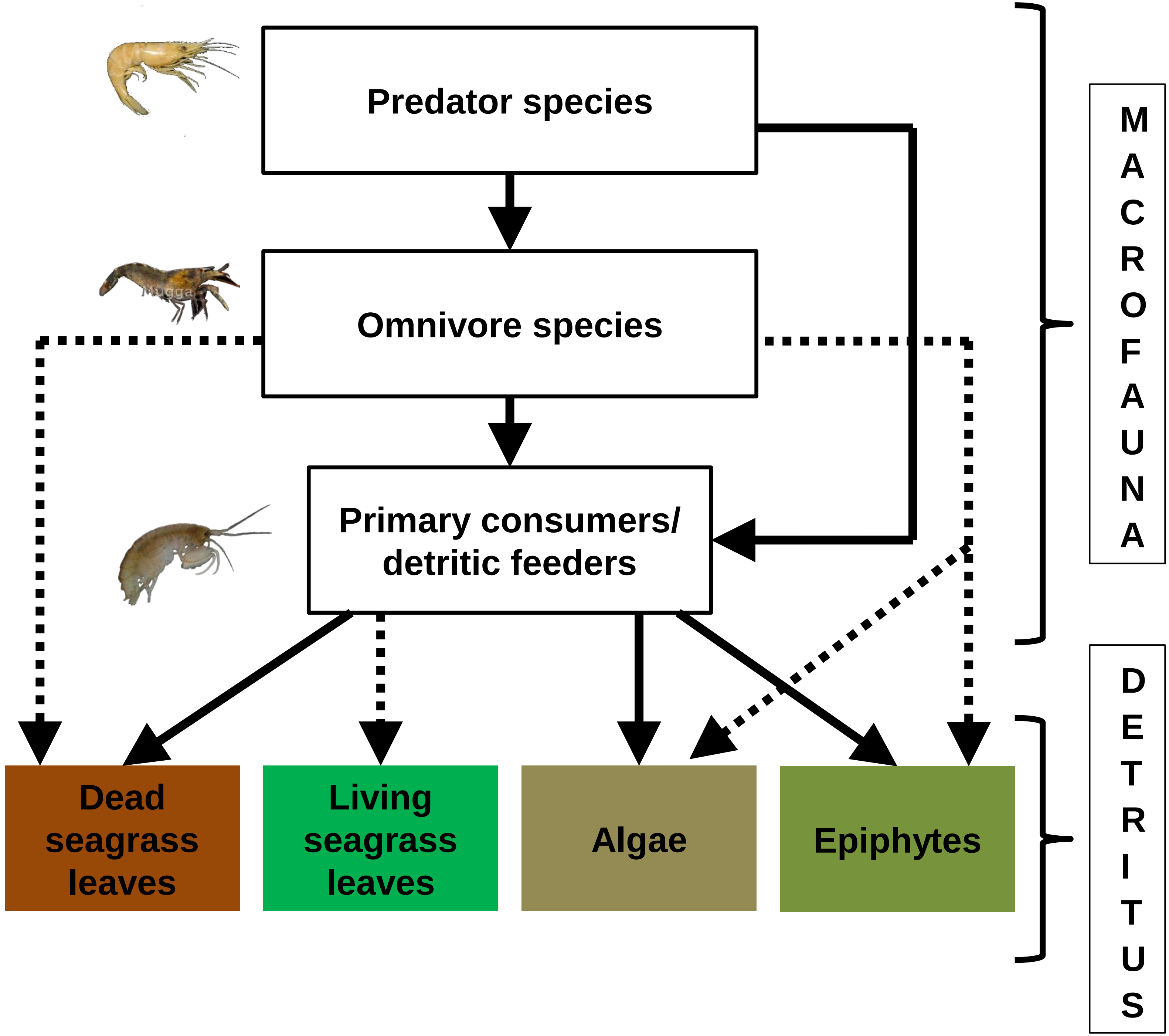
Posidonia oceanica

seagrass



« Dead leaves litter »

50-90 %
exported



Mugga
Predator species
Omnivore species
Primary consumers/
detritic feeders
Dead
seagrass
leaves
Living
seagrass
leaves
Algae
Epiphytes
MACROFAUNA
DETRITUS

Exported litter patches are inconstant places!

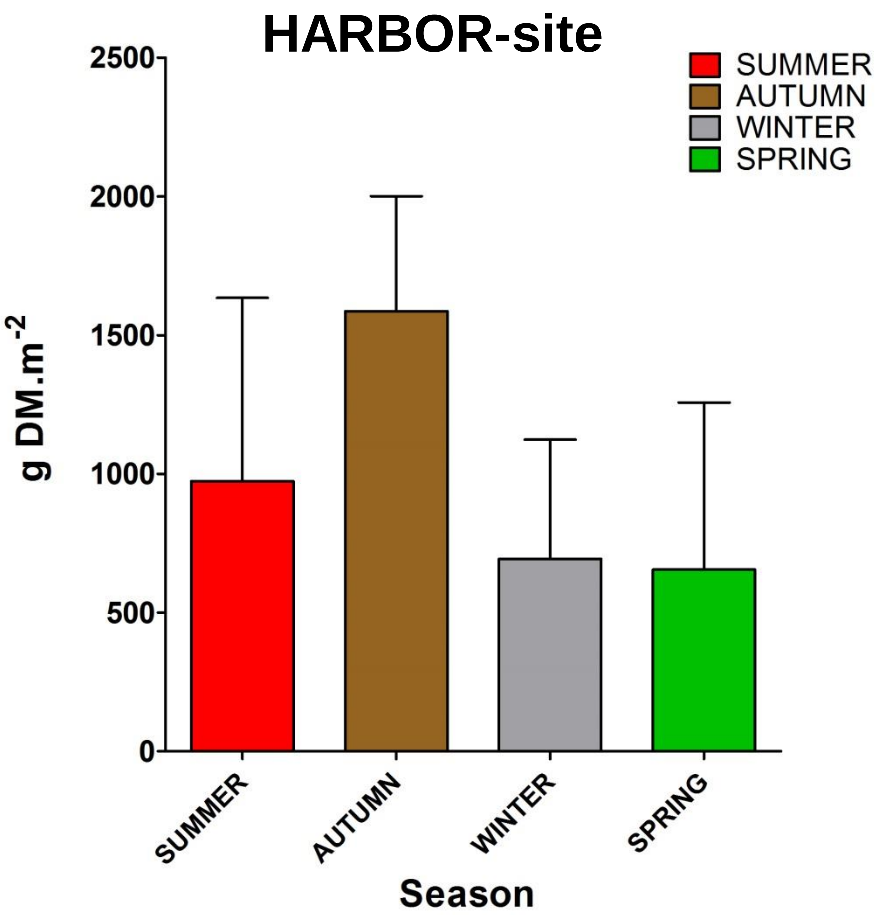
STORM

31/10/12 – 16:00h → 01/11/12- 10:00h

Mean thickness: 53,4 cm
Cover : 100%

Mean thickness: 1,8 cm
Cover : < 5%

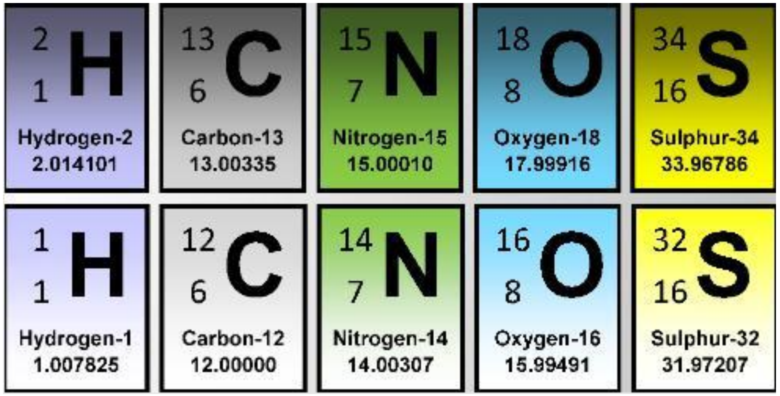
Exported litter patches are inconstant places!



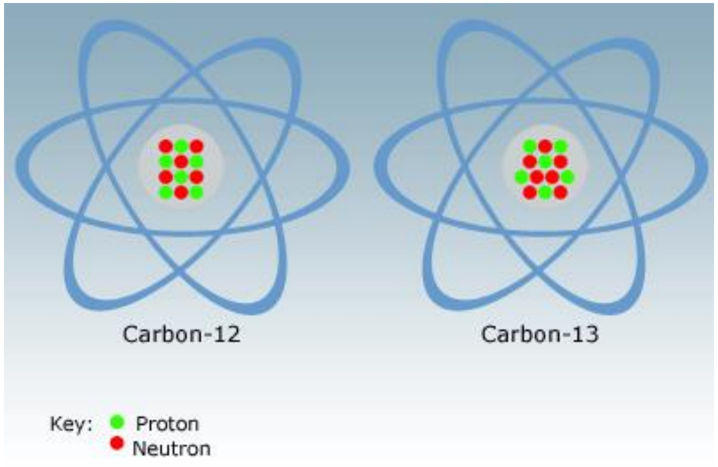
➔ **Day-level variations**

Seasonal variations

➔ Potential effect on food availability/composition !!



Stable isotopes



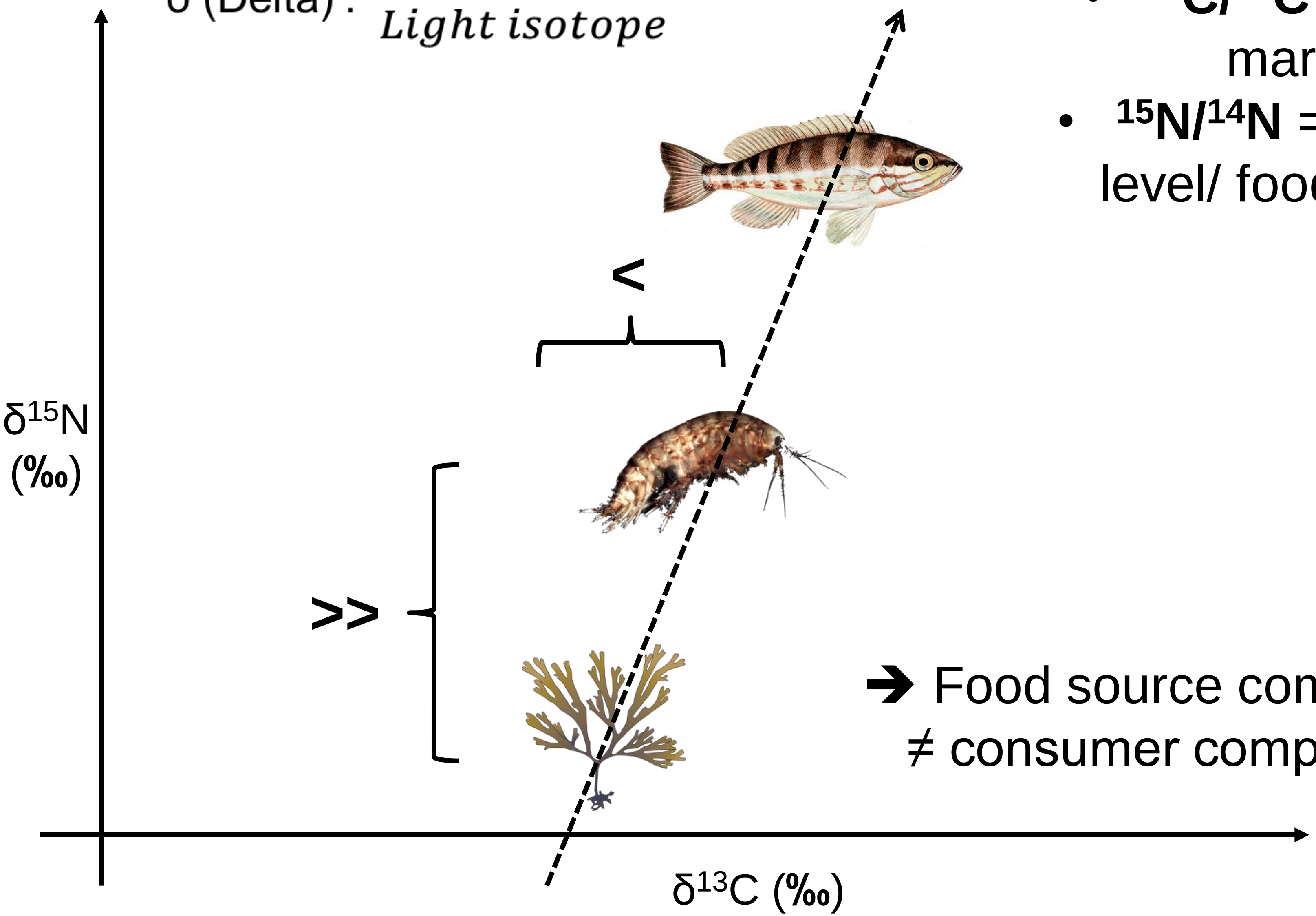
Why use N and C "stable isotopes"?

→ Main rule in isotopic ecology :

"You are what you eat, plus (or minus) a few permill…" (DeNiro & Epstein 1976)

Why use N and C “stable isotopes”?

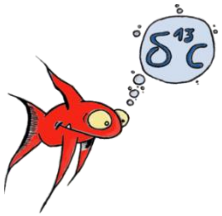
δ (Delta) : $\frac{\textit{Heavy isotope}}{\textit{Light isotope}}$



- **^{13}C/^{12}C** = food marker
- **^{15}N/^{14}N** = trophic level/ food marker

➔ Food source composition ≠ consumer composition

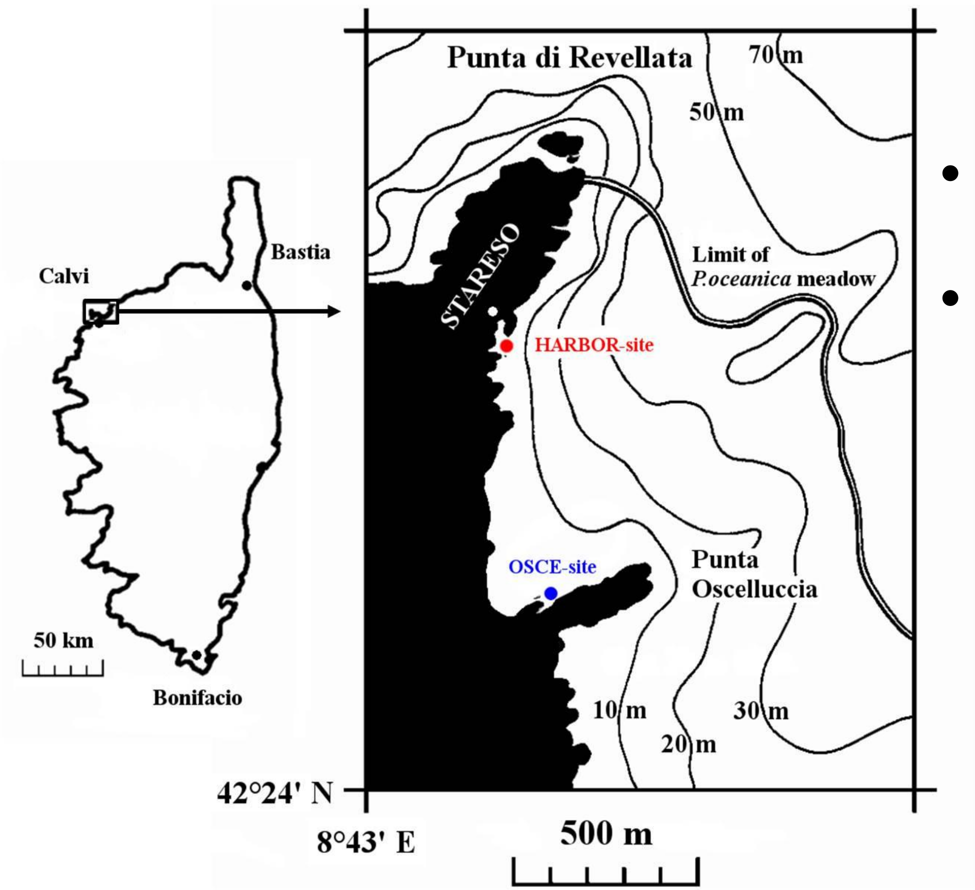
Aim?



Aim of the study :

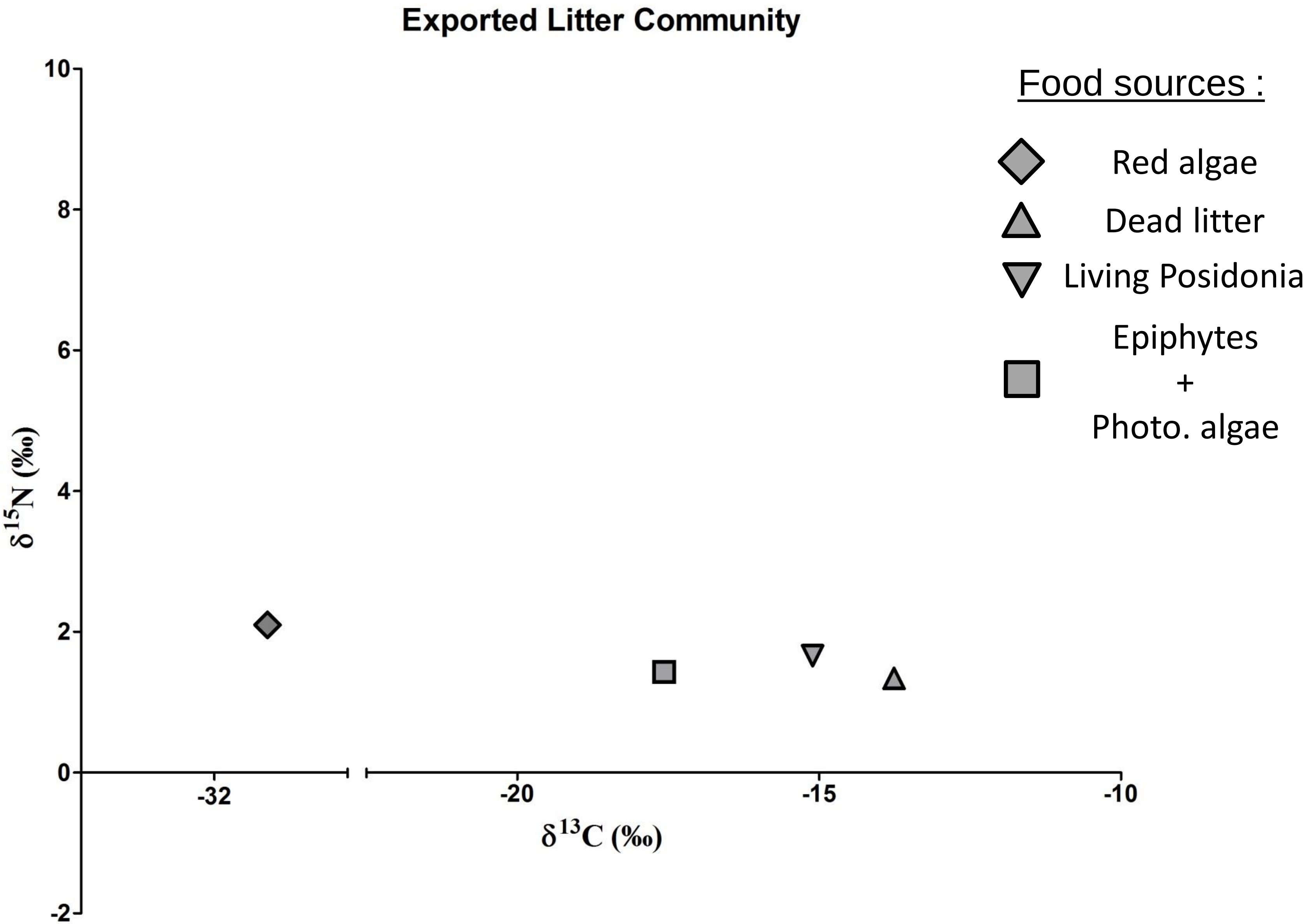
- Determine if the vagile macrofauna community experiences spatio-temporal changes of its isotopic composition
- Determine whether these variations are due to real diet modifications, or only due to isotopic baseline shifts of sources.

Sampling techniques

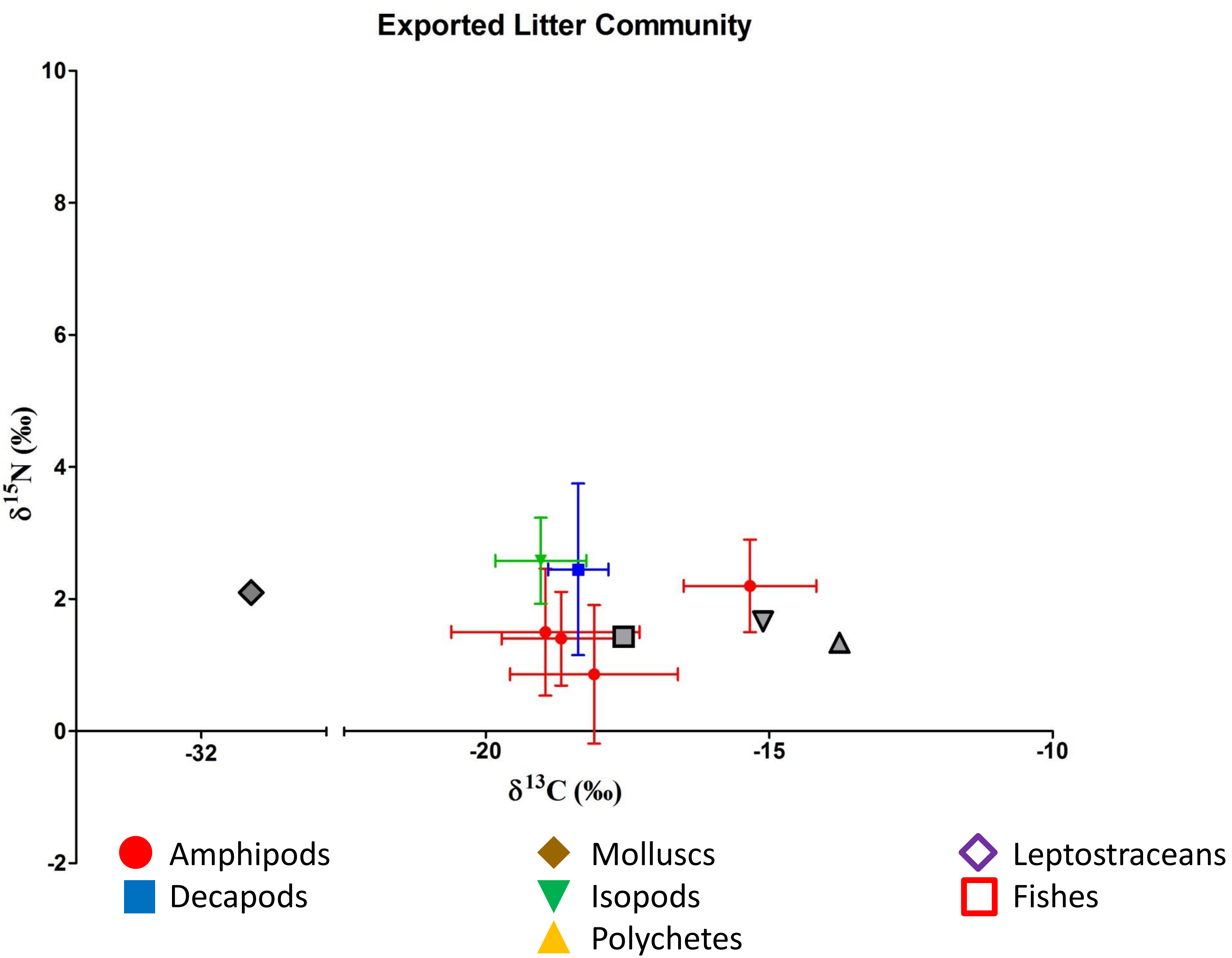


- Sampling in August 11, November 11, March 12 and June 12
- 2 sites (7-10m depth)
- Food sources + macrofauna

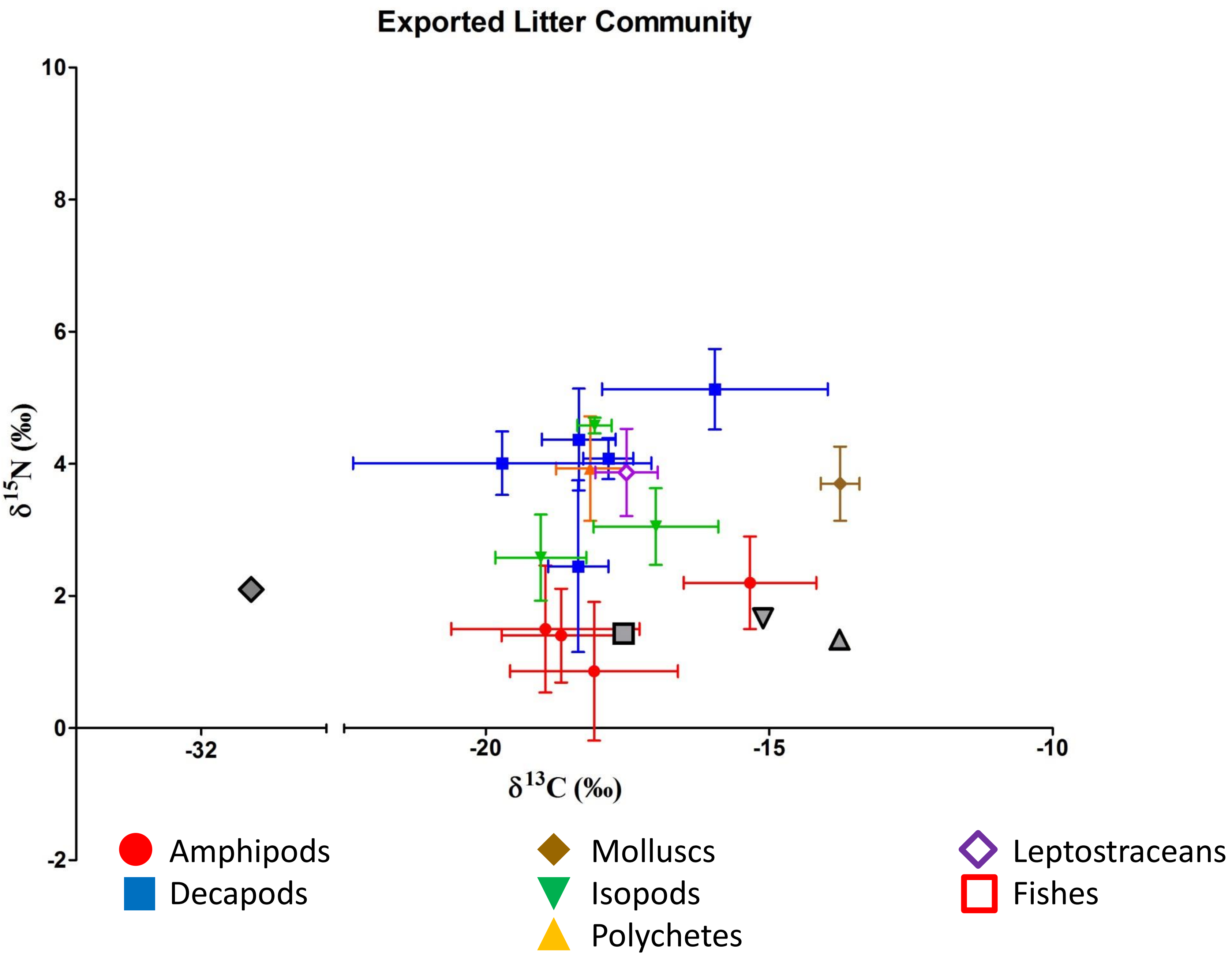
Results : the global community



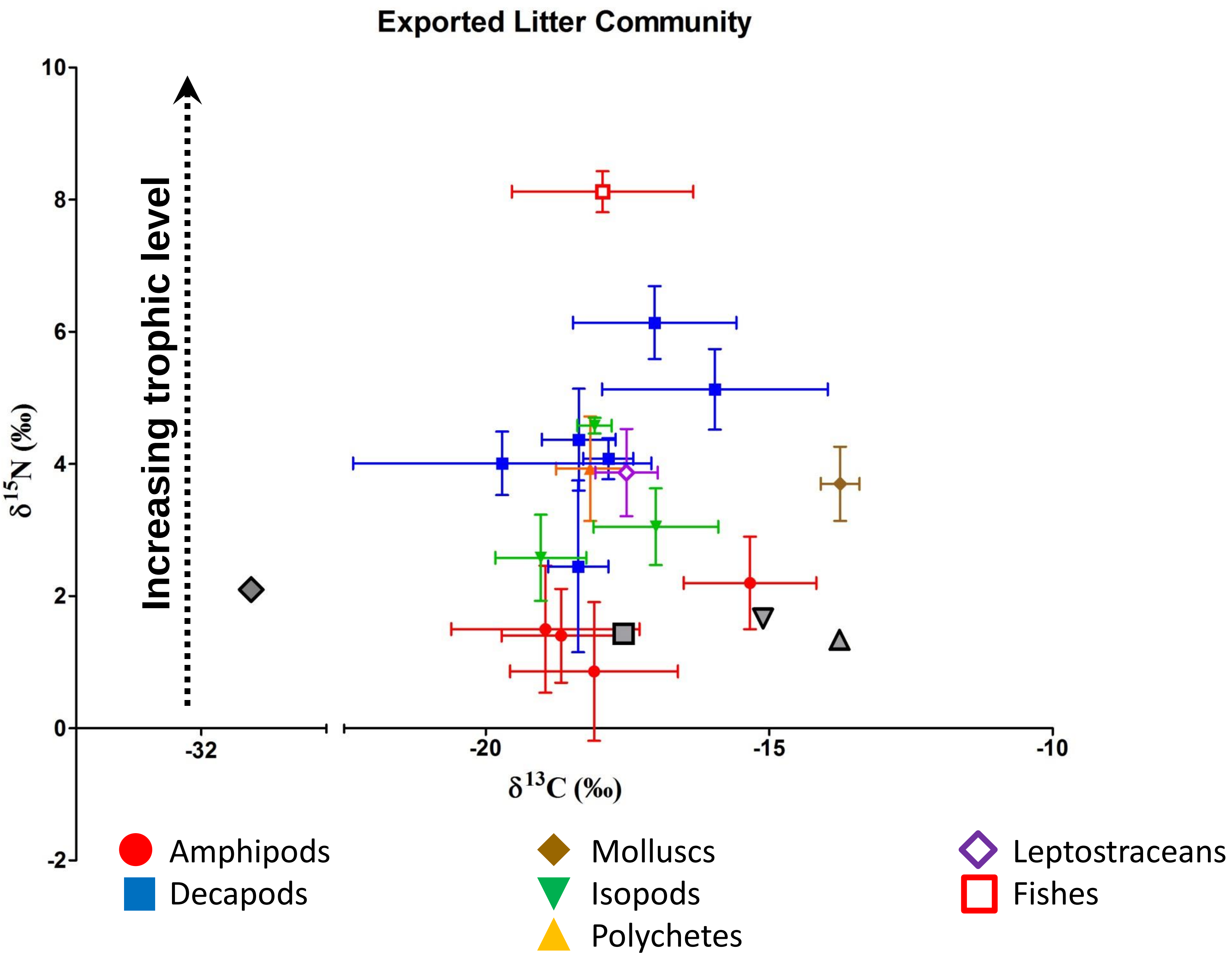
Results : the global community



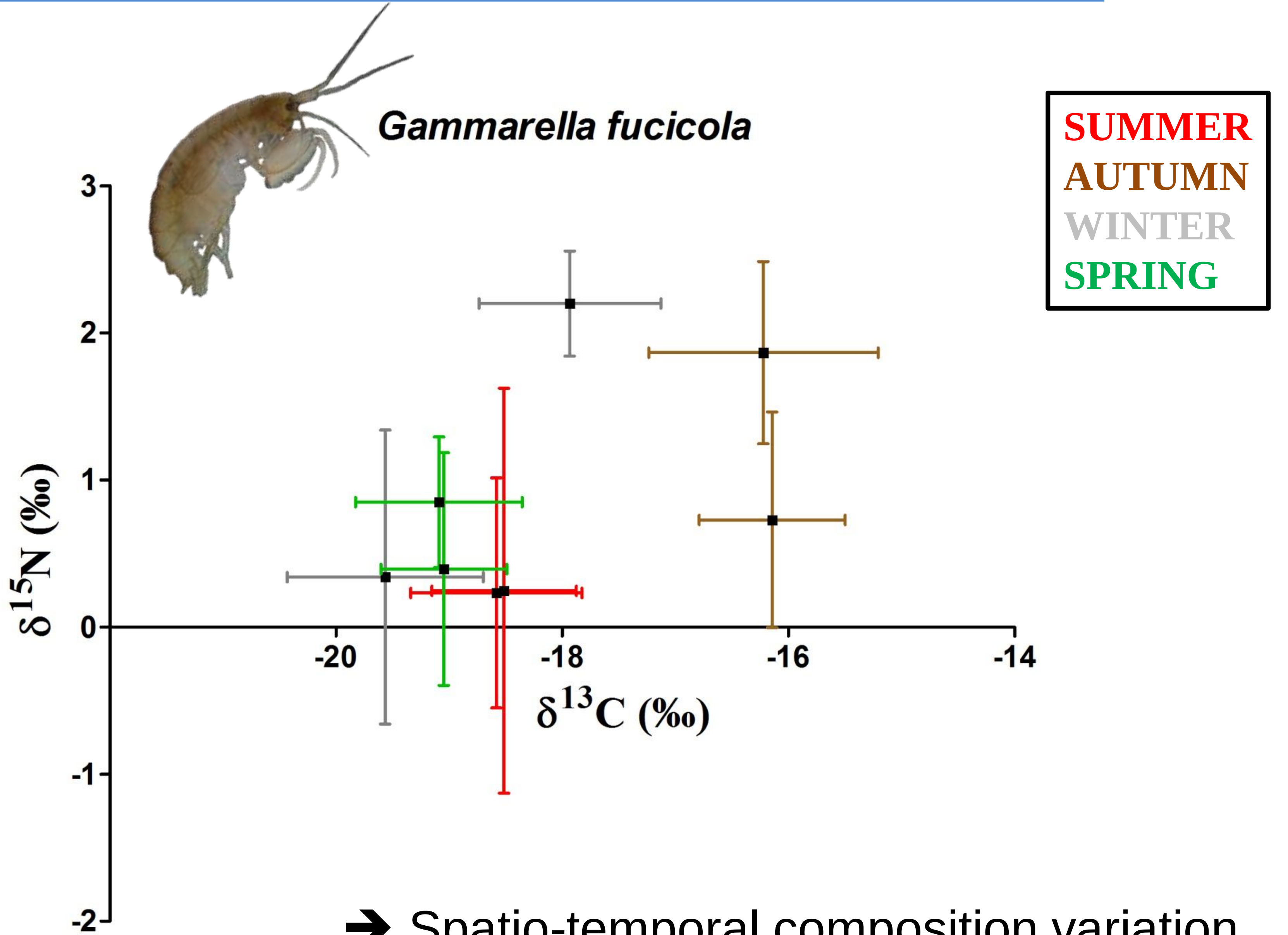
Results : the global community



Results : the global community



Results : zoom on the most abundant species



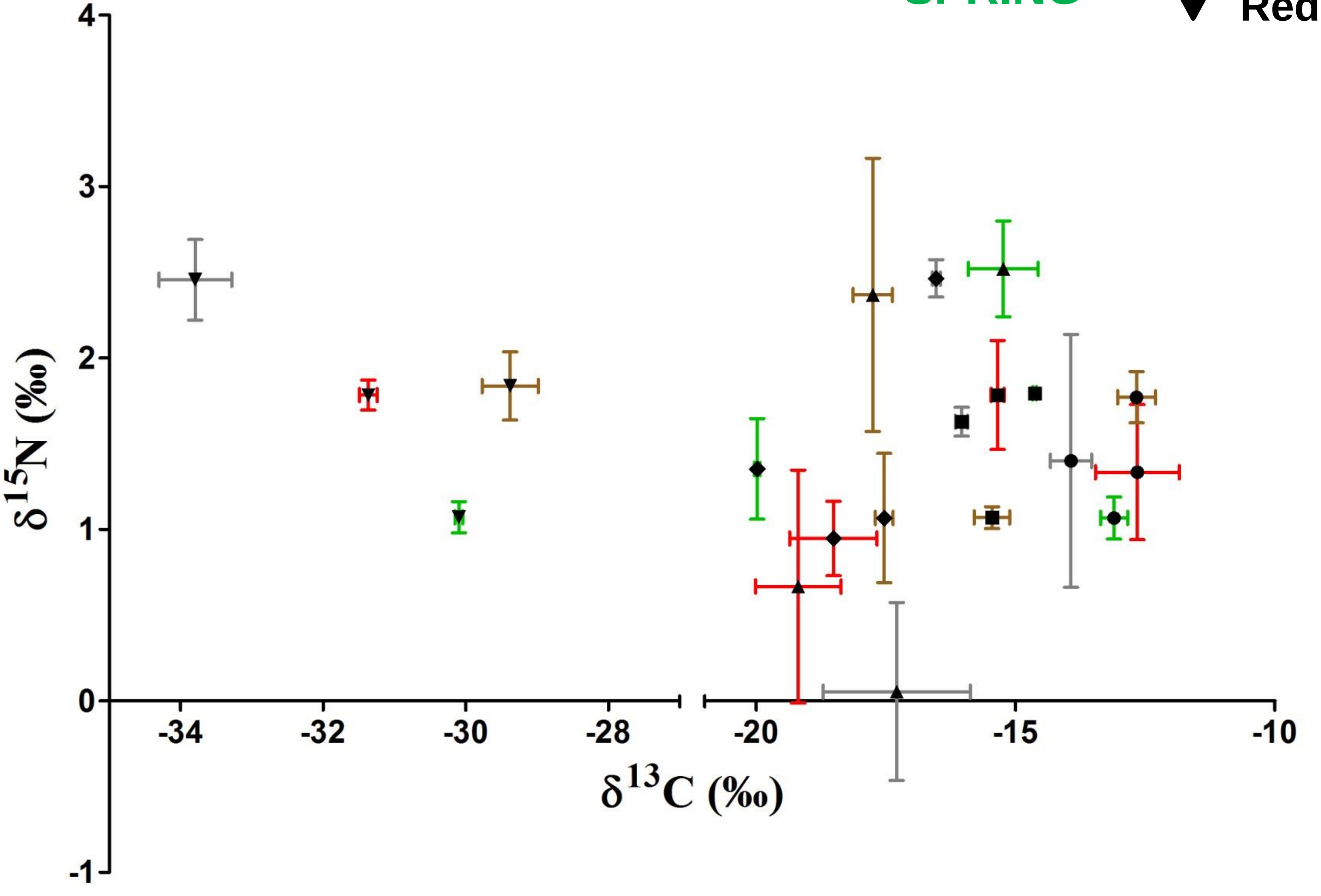
➔ Spatio-temporal composition variation

Results : basal sources variations

HARBOR-site

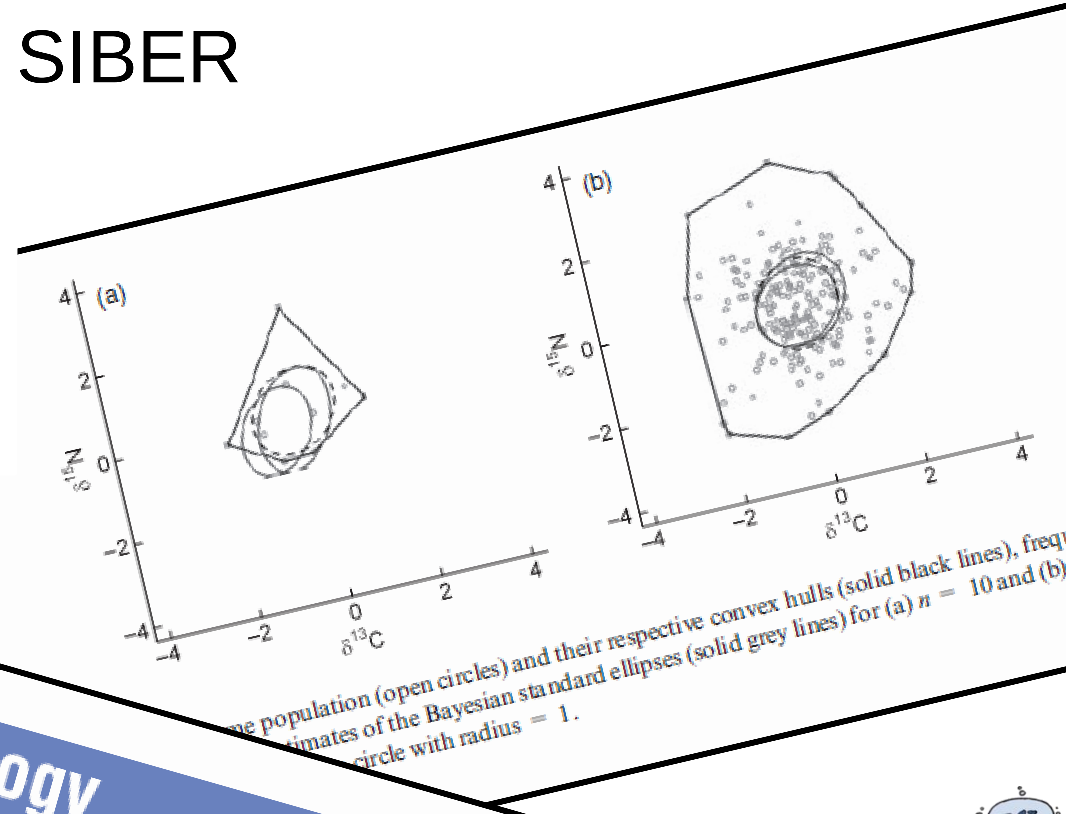
SUMMER
AUTUMN
WINTER
SPRING

● Litter
■ Living leaves
▲ Epiphytes
◆ Photophilous algae
▼ Red algae

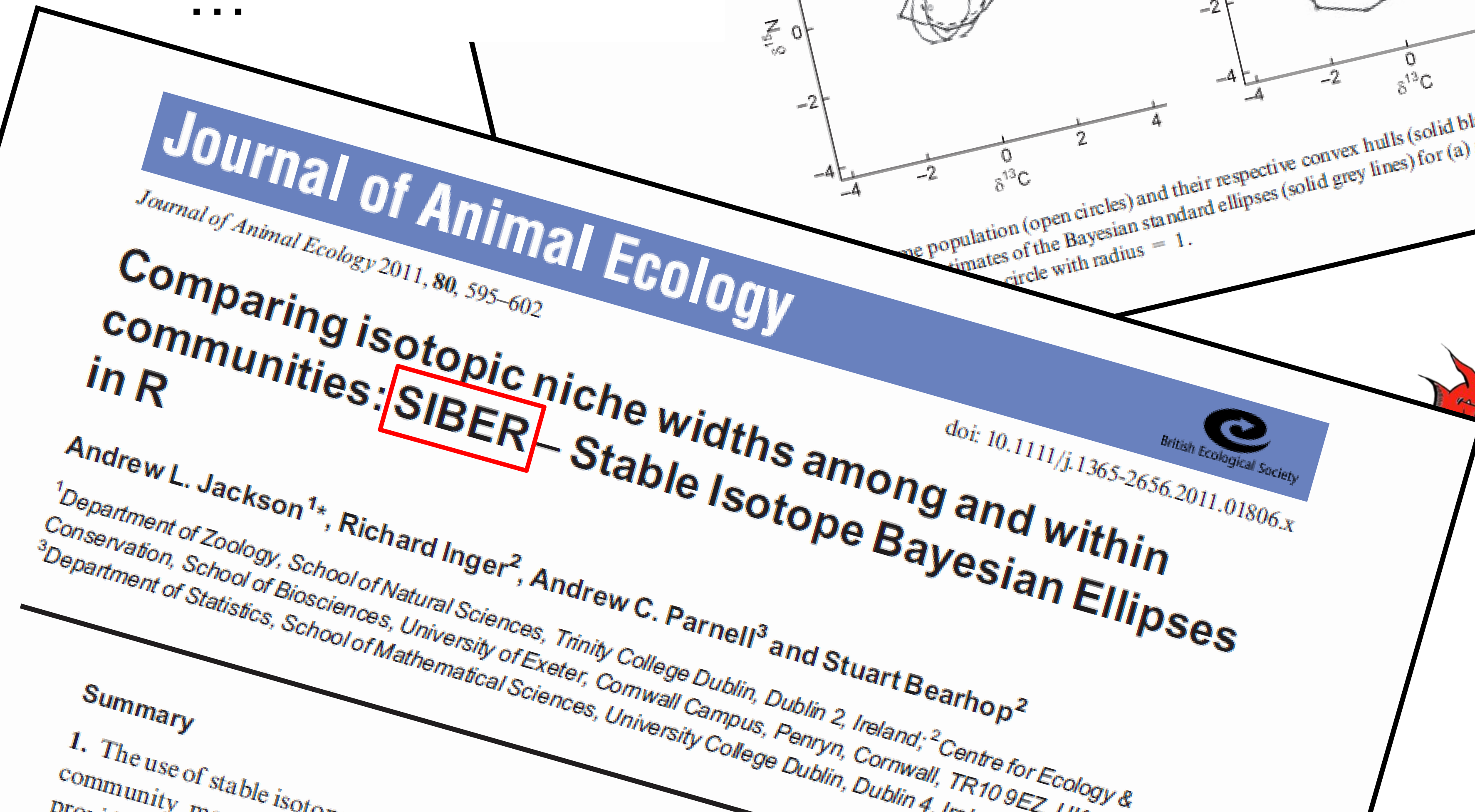


For more information ➔ SIBER

« Isotopic niches »
Ellipses metrics
…



…e population (open circles) and their respective convex hulls (solid black lines), freq…
…timates of the Bayesian standard ellipses (solid grey lines) for (a) n = 10 and (b)…
…circle with radius = 1.



Journal of Animal Ecology

Journal of Animal Ecology 2011, **80**, 595–602

doi: 10.1111/j.1365-2656.2011.01806.x

British Ecological Society

Comparing isotopic niche widths among and within communities: SIBER – Stable Isotope Bayesian Ellipses in R

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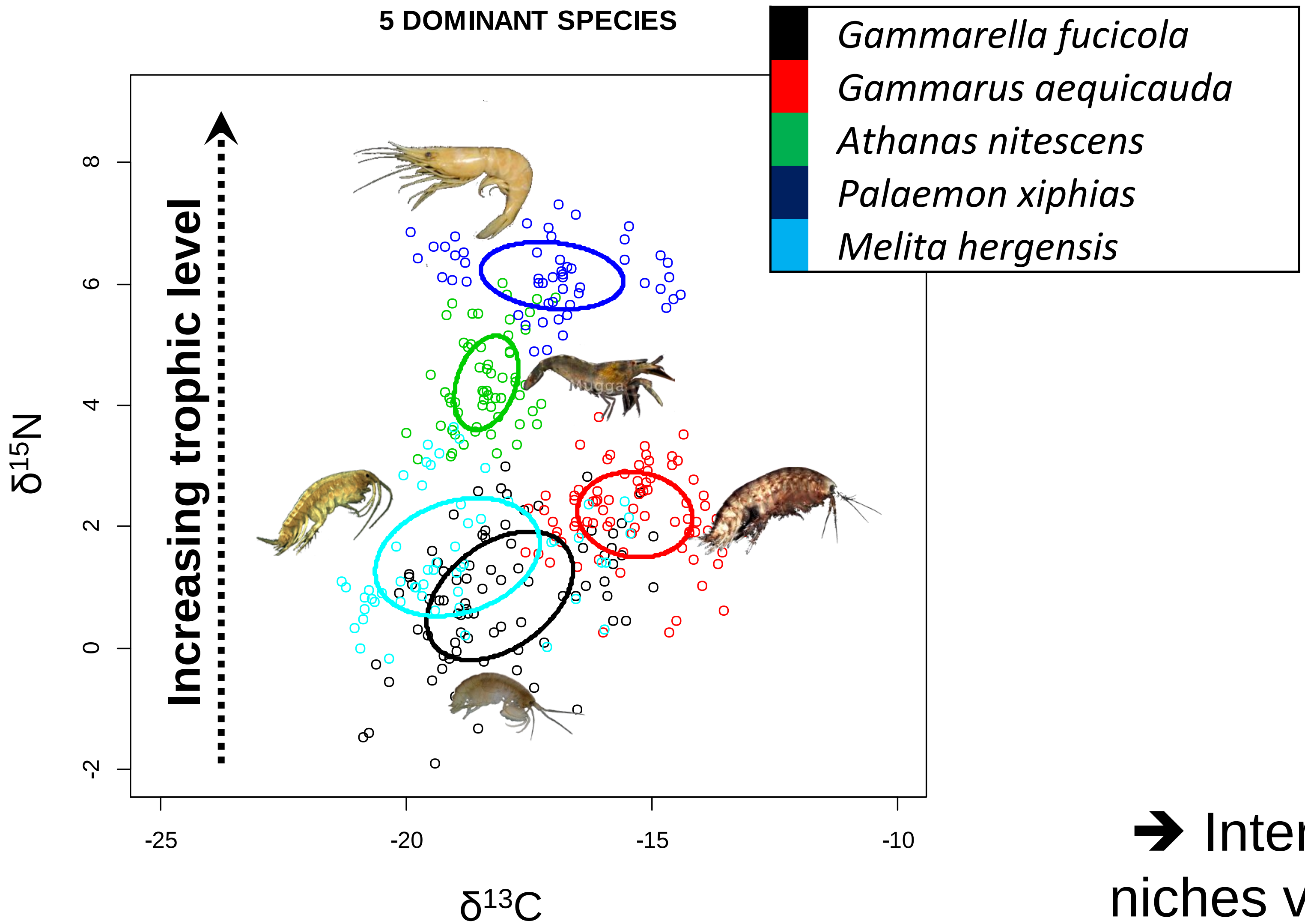
Summary

1. The use of stable isotop…
community…
provi…

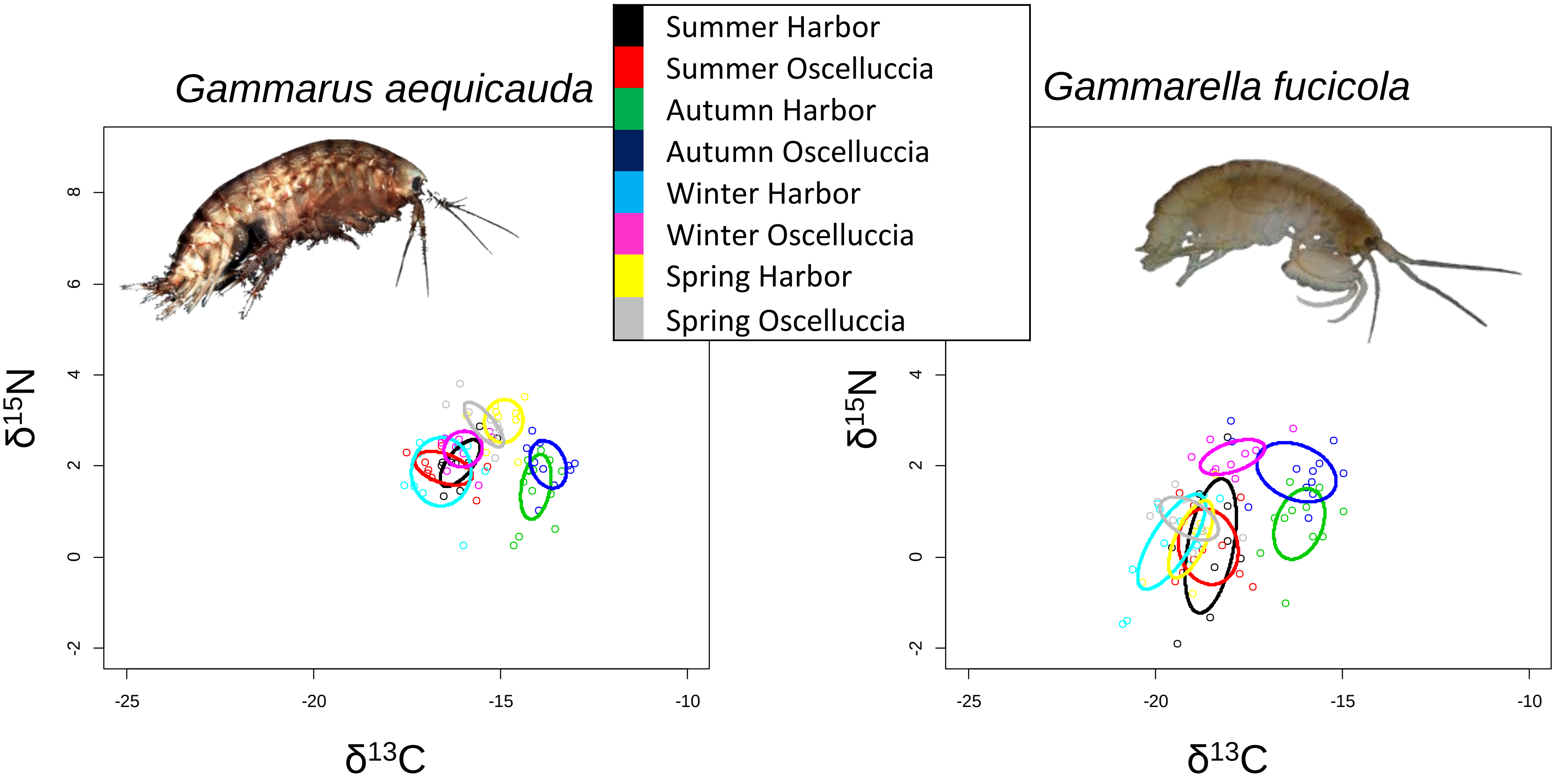
Results : SIBER run



➔ Interspecific niches variations

Results : SIBER run

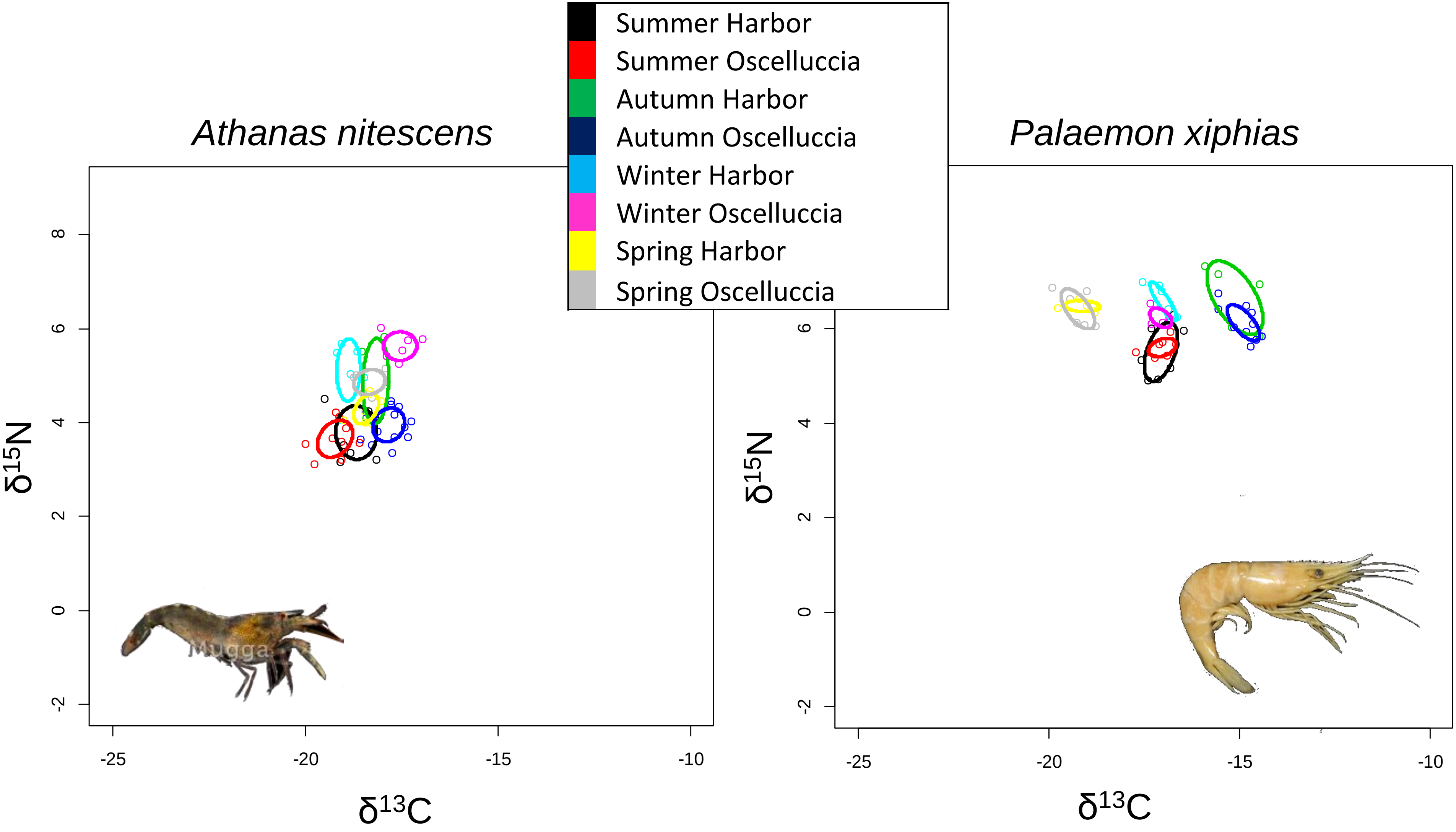
Primary consumers



➔ Spatio-temporal intraspecific level niche variations

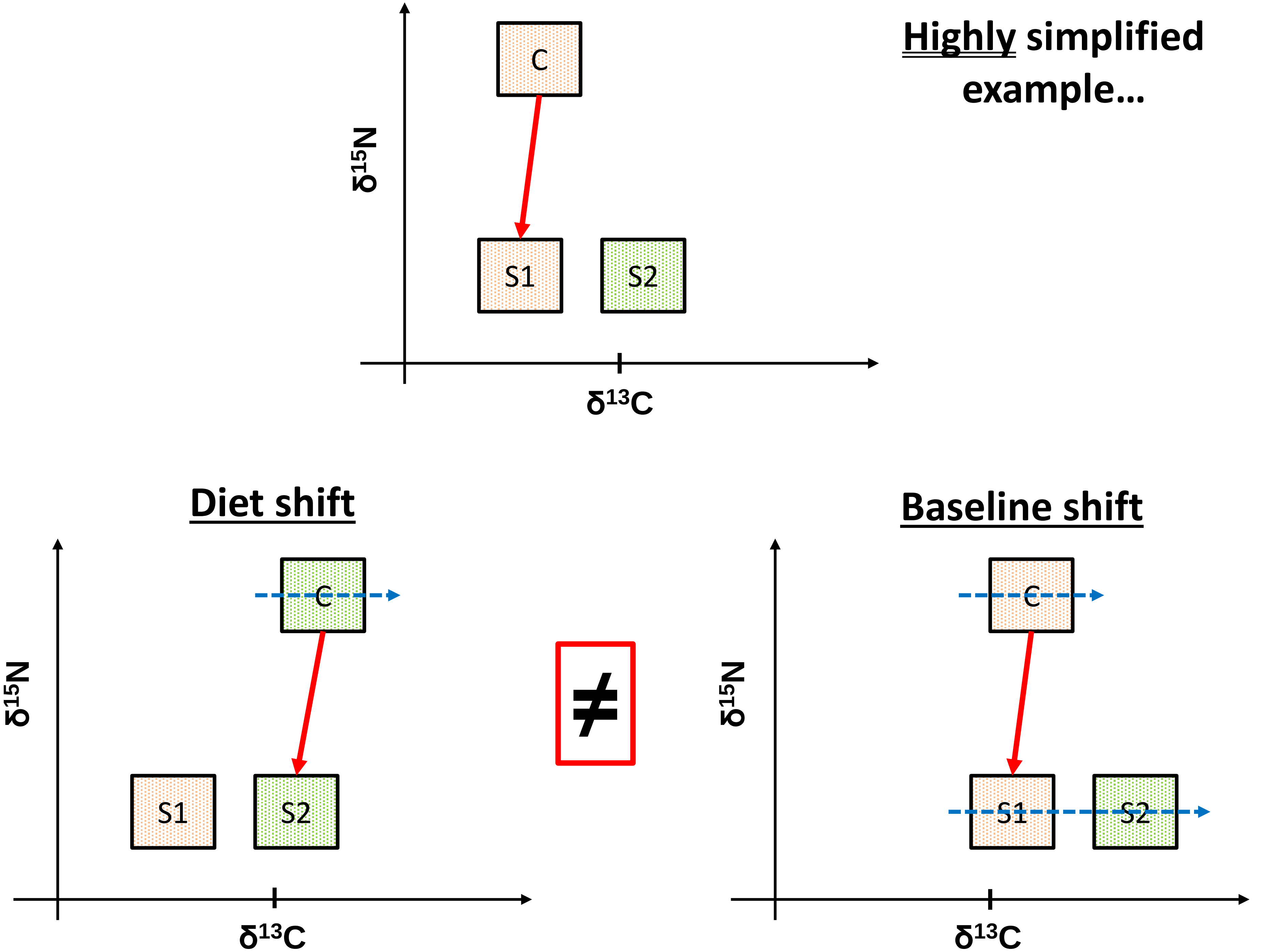
Results : SIBER run

Also true for omnivores and predators…

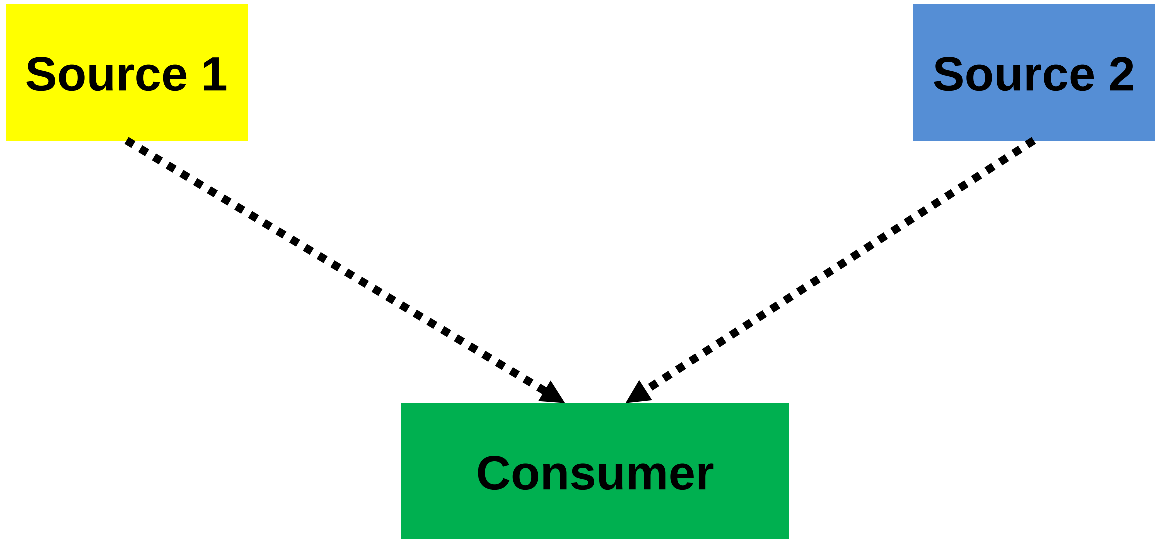


Okay BUT…

But… are these differences reflecting a diet change, or only a food sources baseline shift?


Highly simplified example…
C
S1
S2
δ15N
δ13C
Diet shift
C
S1
S2
δ15N
δ13C
≠
Baseline shift
C
S1
S2
δ15N
δ13C

Mixing model



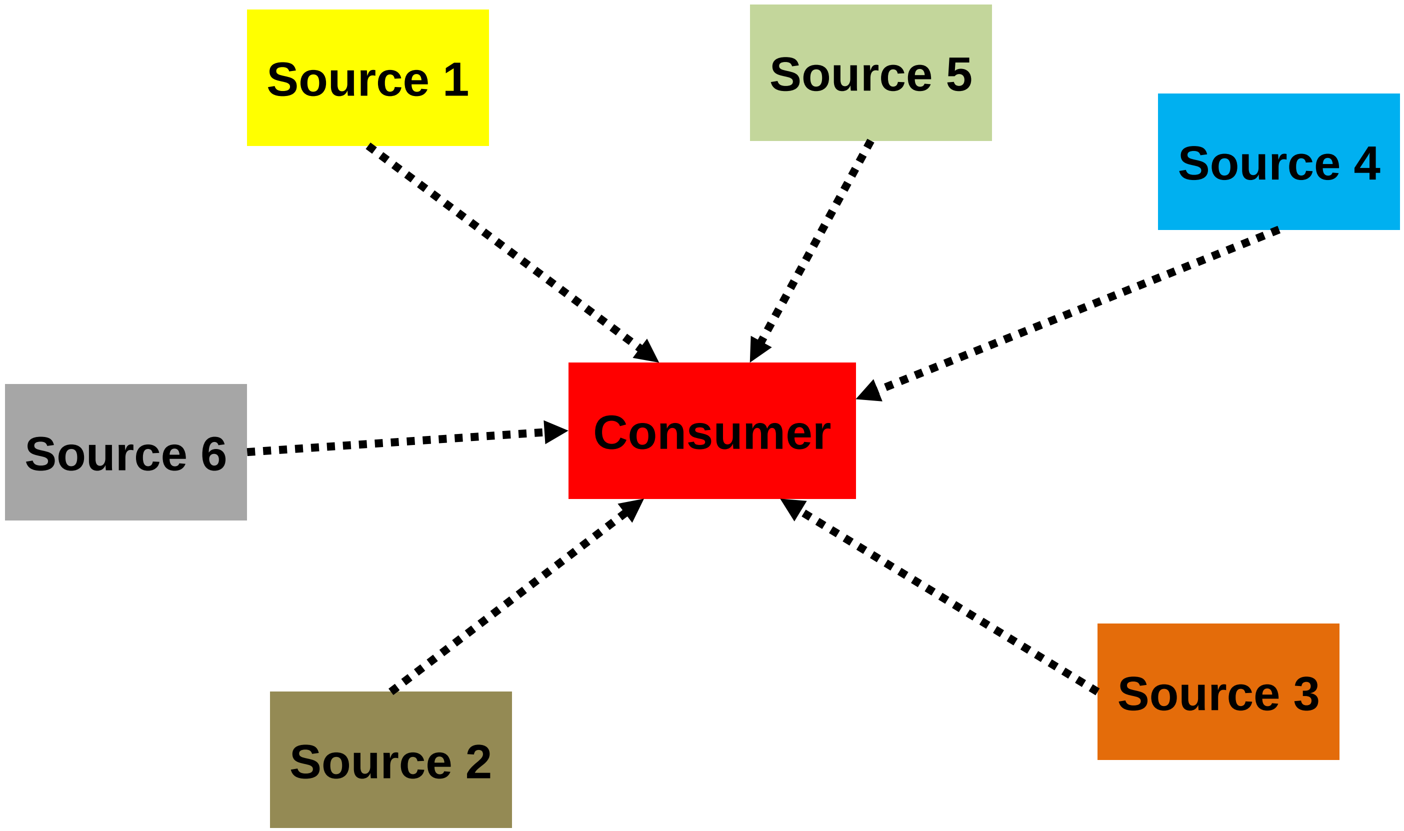
Mixing equation

$$\delta_m = (fa\delta_a + fb\delta_b)$$

$$fa\delta_a + fb\delta_b = 1$$

The model gives the proportions of each food source

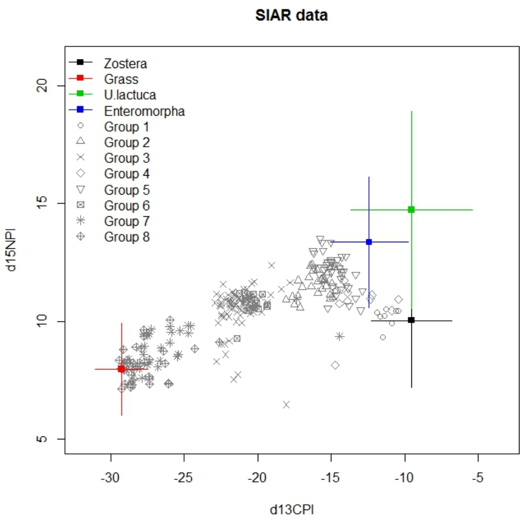
Mixing model

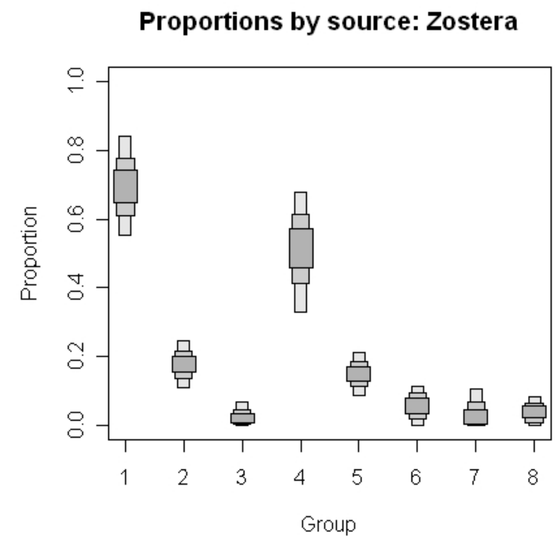


<u>Mixing equation</u>

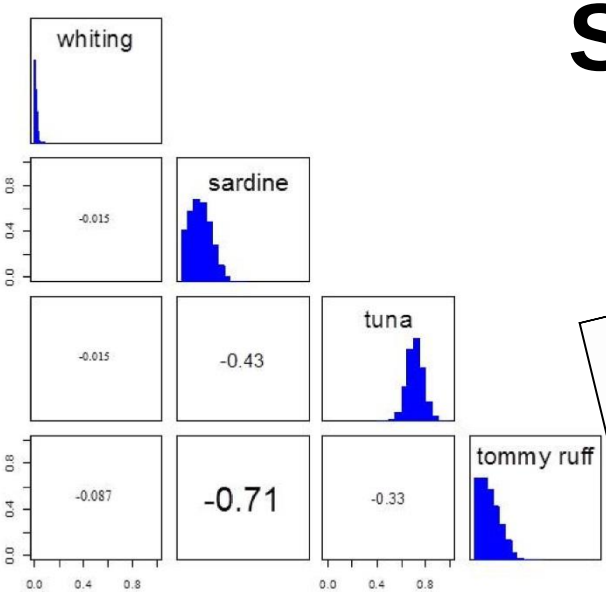
$$\delta_m = (fa\delta_a + fb\delta_b + fb\delta_c + fb\delta_d + fb\delta_e + fb\delta_f)$$

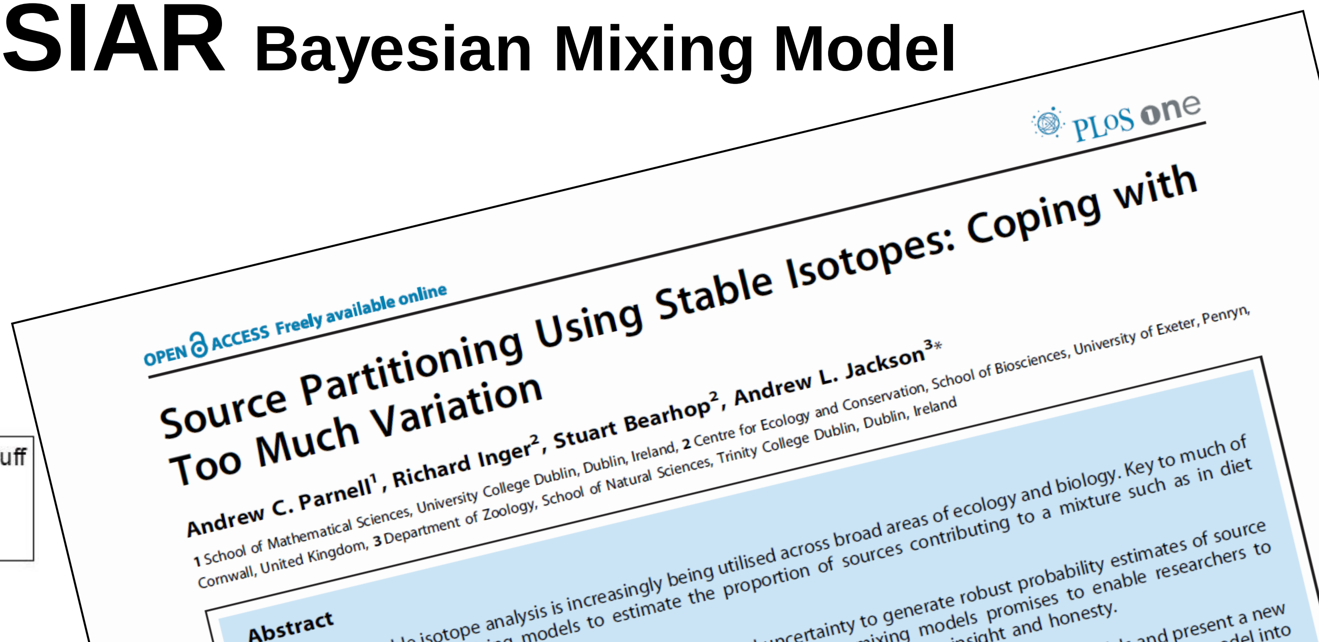
$$fa\delta_a + fb\delta_b + fb\delta_c + fb\delta_d + fb\delta_e + fb\delta_f = 1$$





SIAR Bayesian Mixing Model




PLoS one

OPEN ACCESS Freely available online

Source Partitioning Using Stable Isotopes: Coping with Too Much Variation

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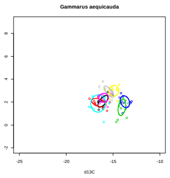
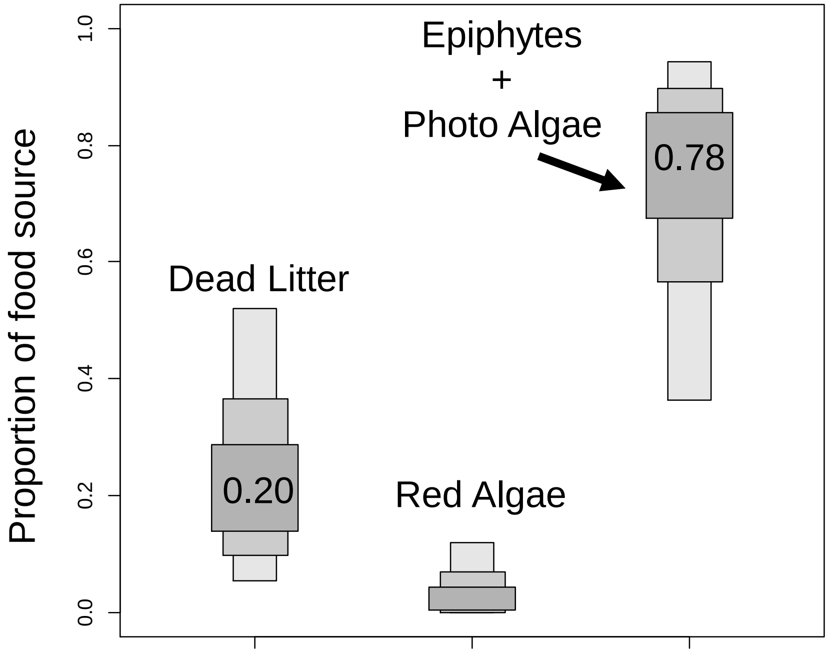
Abstract

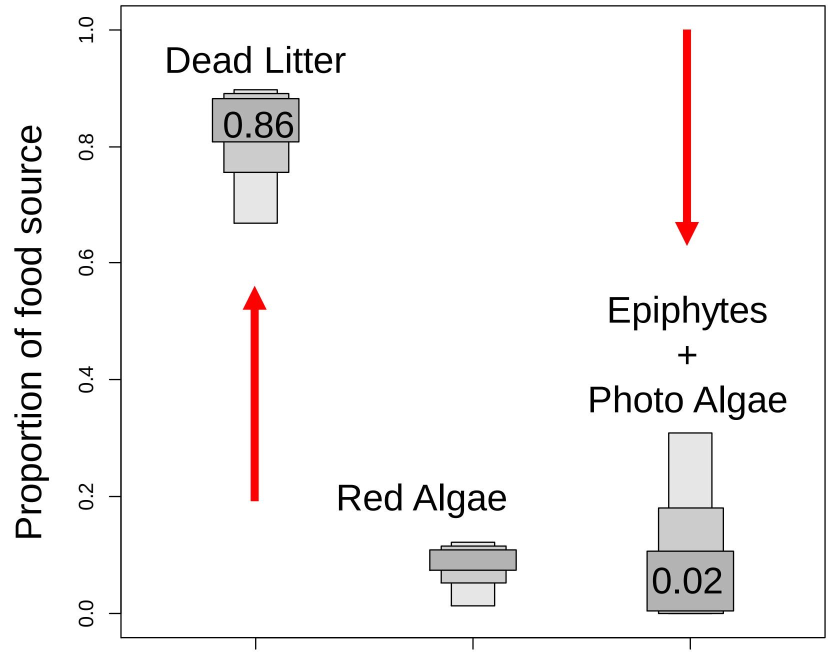
SIAR mixing model run



Gammarus aequicauda, **summer**, HARBOR



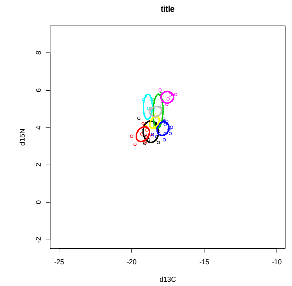
Gammarus aequicauda, **autumn**, HARBOR



➔ Drastic changes even if the model takes baseline variations into account

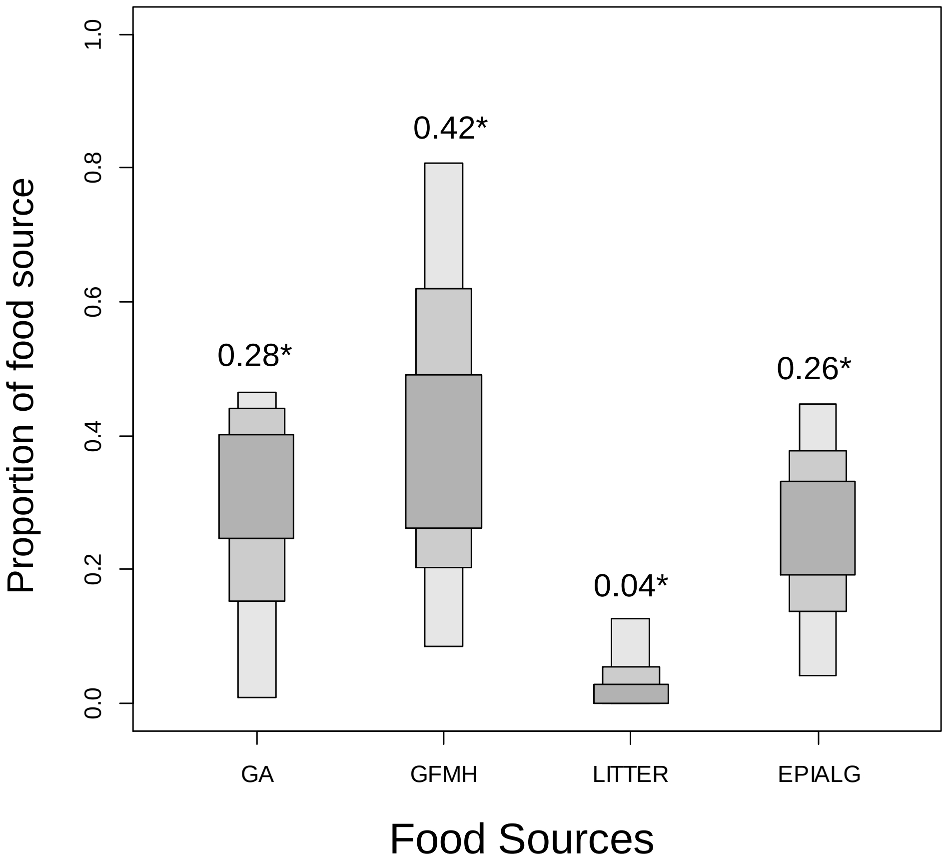
Real diet change independently of food sources isotopic composition!

SIAR mixing model run

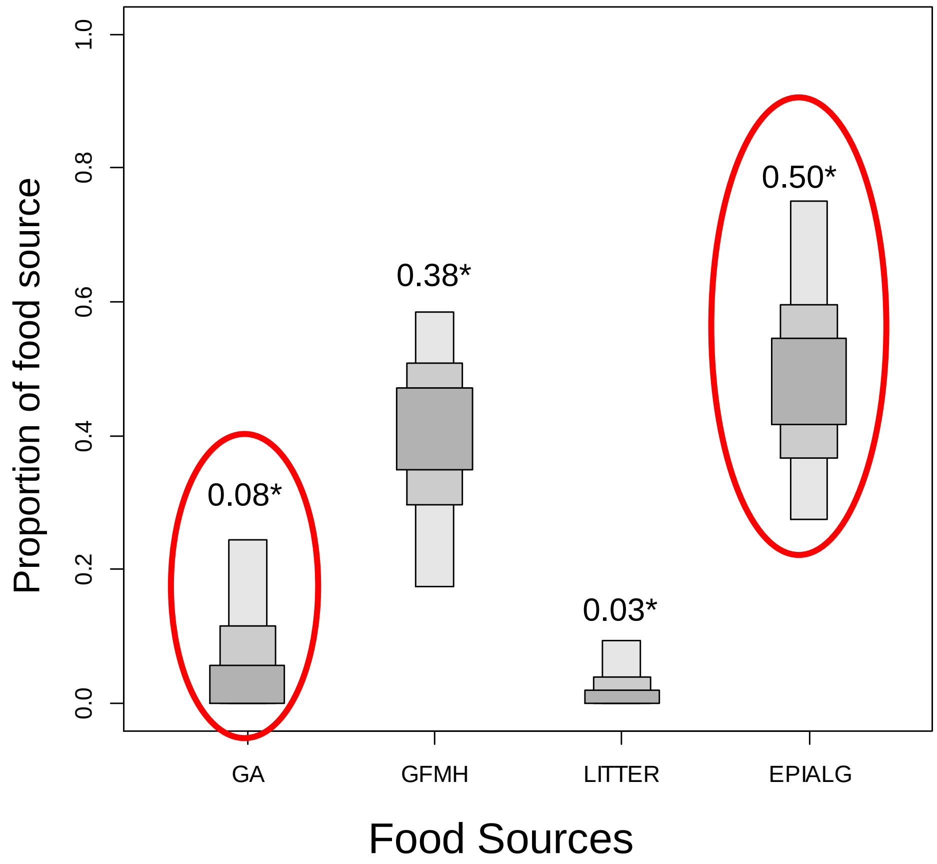


Changes also for "omnivorous" species…

Athanas nitescens, **summer**, HARBOR



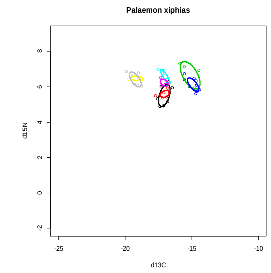
Athanas nitescens, **autumn**, HARBOR



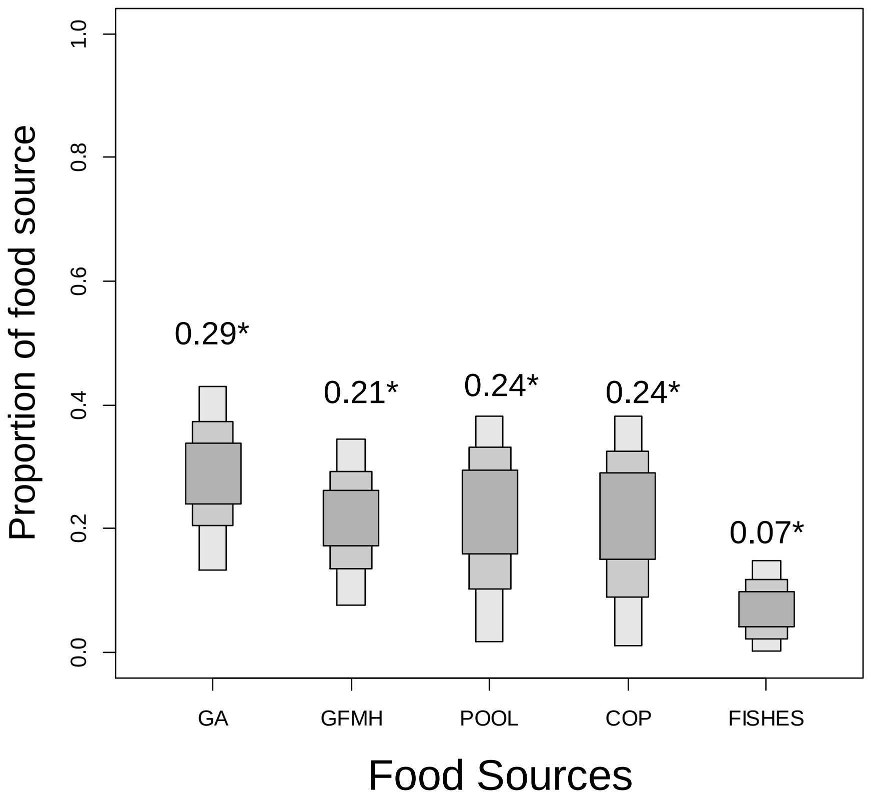
* Median proportion values

SIAR mixing model run

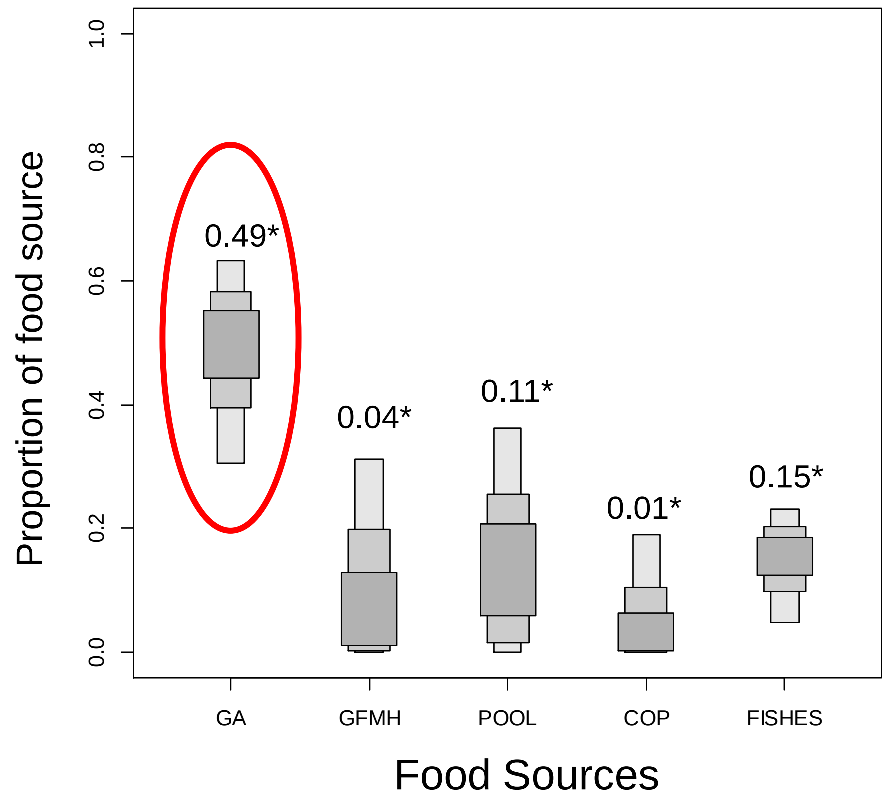
Changes at the “top” of the food web…



Palaemon xiphias, **summer**, HARBOR



Palaemon xiphias, **autumn**, HARBOR



***** Median proportion values

Take home message

- **SIBER** and mixing models like **SIAR** are powerful tools for trophic ecology to identify isotopic niches spatio-temporal variations and explain these modifications.

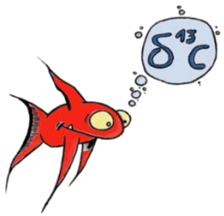
BUT…

- Need to work at a more precise taxonomic level
- Sampling all potential food sources

- **Various** trophic preferences

- **Litter signal** can sometimes be detected at the **top** of the trophic chain

➔ Importance of dead leaves



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Thank you for your attention !