Trophic diversity and potential role of detritivorous crustaceans in *Posidonia oceanica* litter

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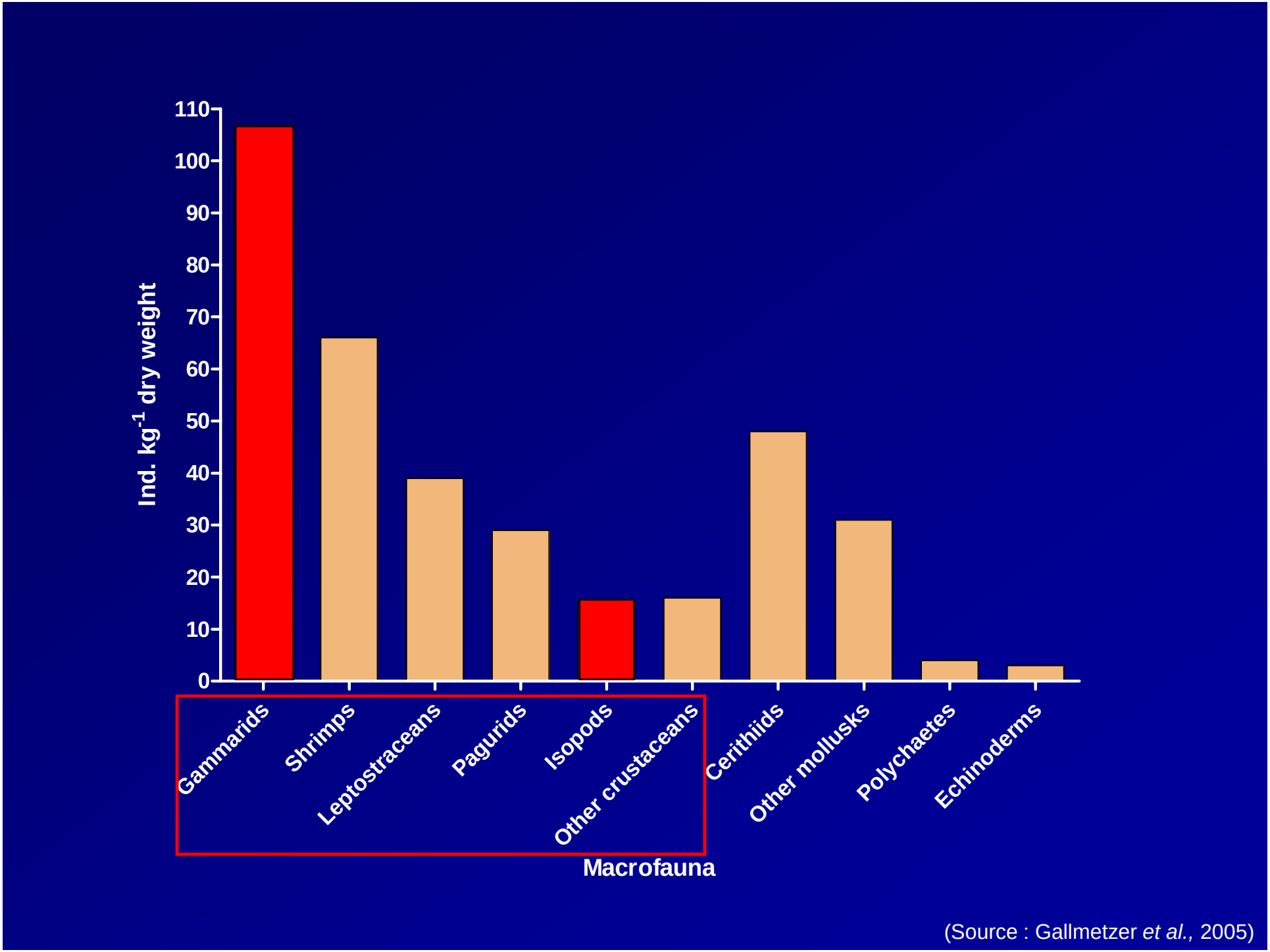
P. oceanica litter

- **Fragmented material**
  - **abscised dead leaves**
  - **degraded leaf fragments**
- **Uprooted shoots and drift macroalgae**

Photo : D. Vangeluwe

- **Food and shelter for an abundant animal community**



(Source : Gallmetzer *et al.*, 2005)

Problems

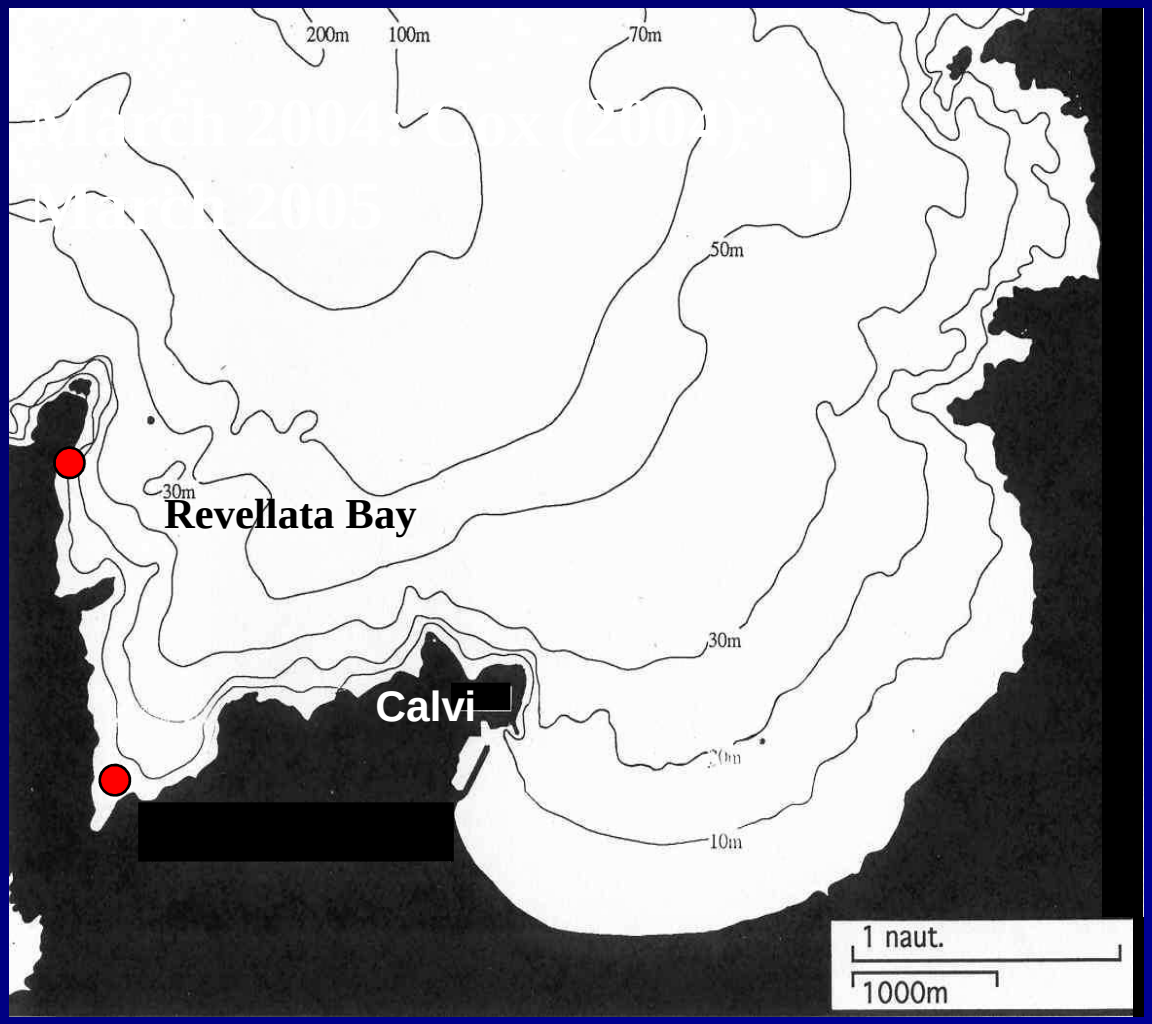
- How is coexistence possible between the detritivores living in *Posidonia* litter ?
  - What is the role of these species in the degradation of *Posidonia* litter ?
    - apparently homogeneous food sources
    - they use a variety of *Posidonia* leaf litter
- Are they a link between seagrass primary production and adjacent habitats ?

Objective

Determine the trophic diversity and potential role of amphipod and isopod living in *P. oceanica* litter

Material & Methods

Sampling and study area



Material & Methods
Diet analysis

2 methods

- **Gut content analysis**

  (ingested material)

- **Stable isotope analysis: carbon & nitrogen**

  (Assimilated material)

  - The isotope signature of an animal is a weighted mixture of the isotopic values of the food sources assimilated

Results and Discussion

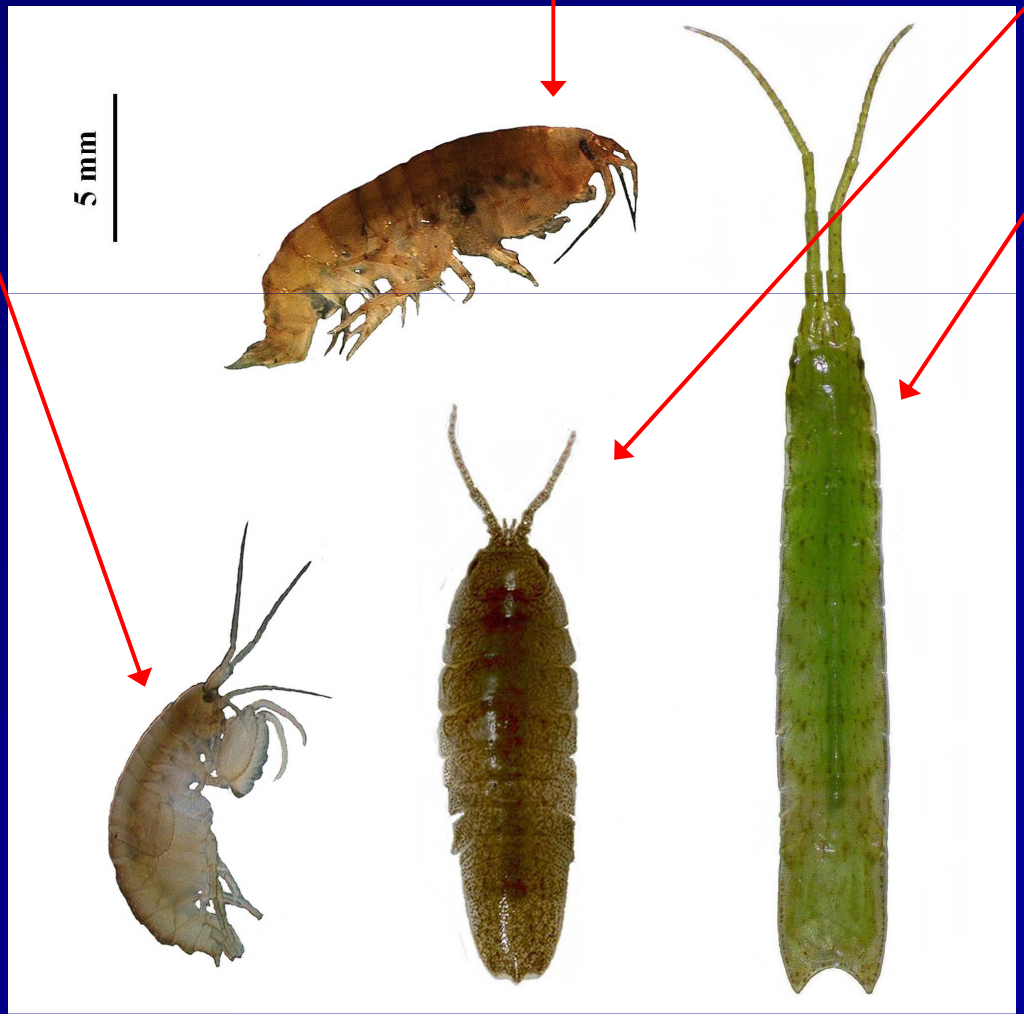
Target species

Gammarella fucicola

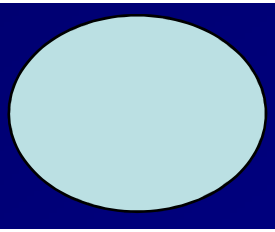
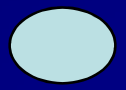
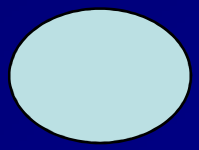
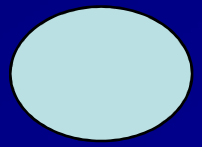
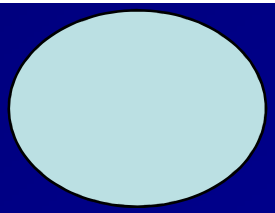
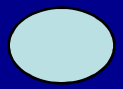
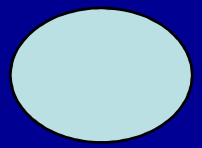
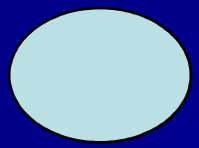
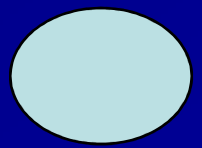
Gammarus aequicauda

Idotea baltica

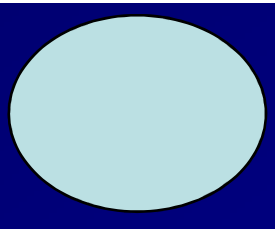
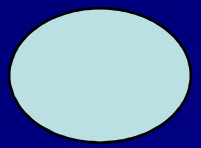
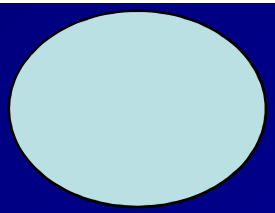
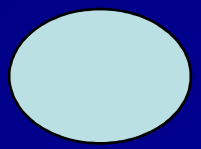
Idotea hectica



Gut contents
semi-quantitative estimation

	P. oceanica litter	Macroalgae (Drift & epiphytes)	Crustaceans	Microorganisms (Diatoms, Foraminifera)
G. aequicauda 				
G. fucicola 				
I. baltica 				
I. hectica 				

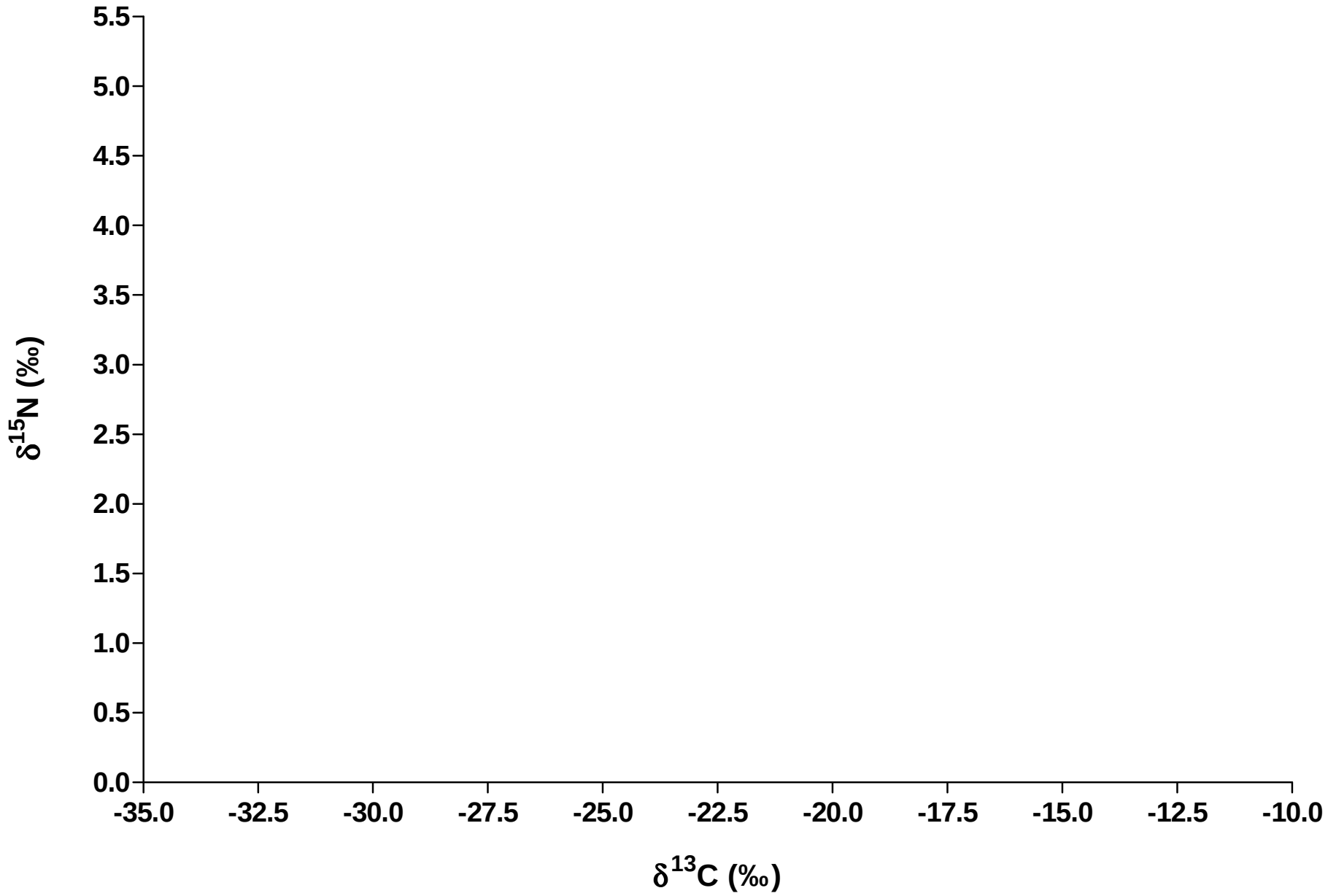
Frequency of occurrence in guts

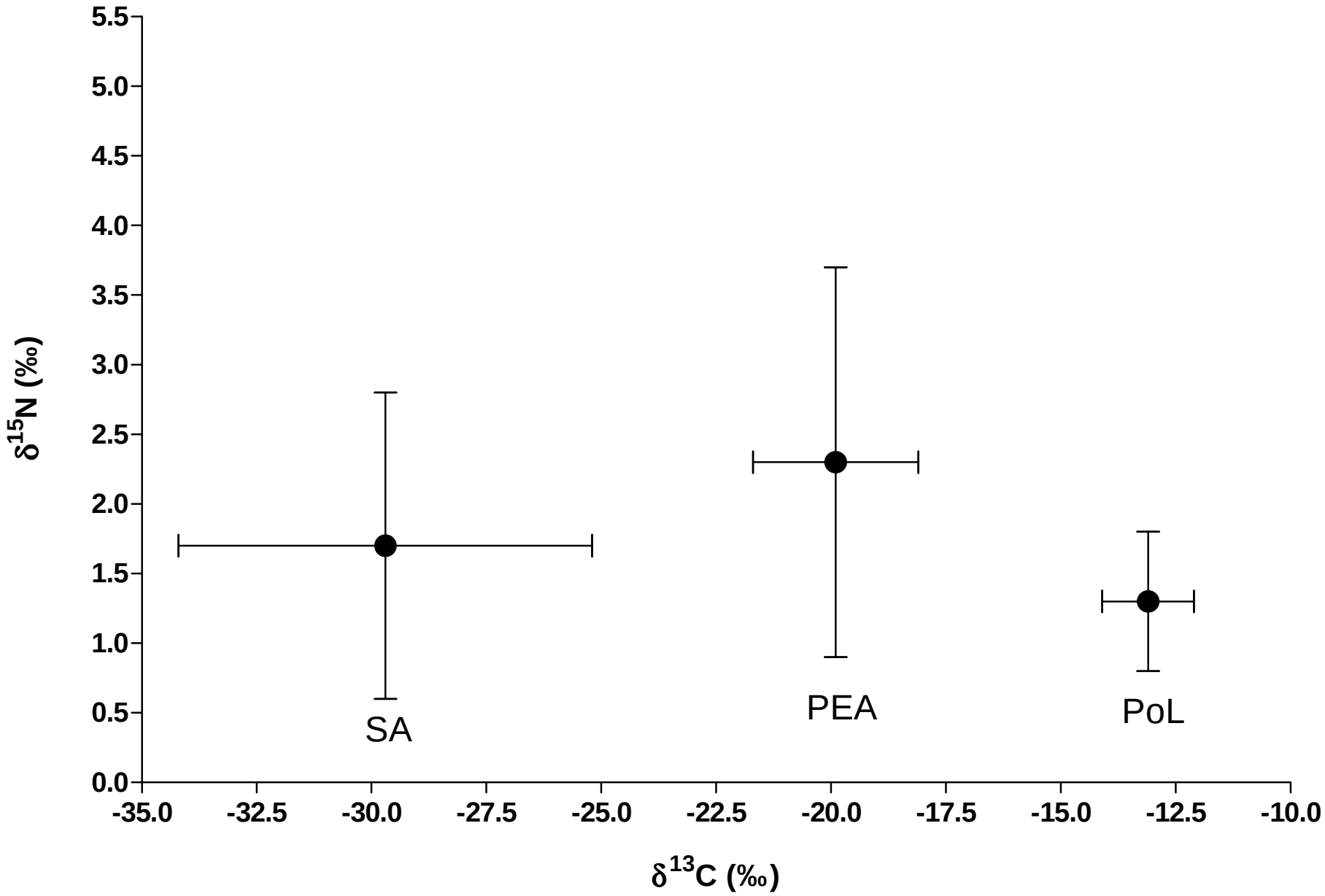
	P. oceanica litter	
G. aequicauda 		~ 100 %
G. fucicola 		~ 50 %
I. baltica 		~ 90 %
I. hectica 		~ 90 %

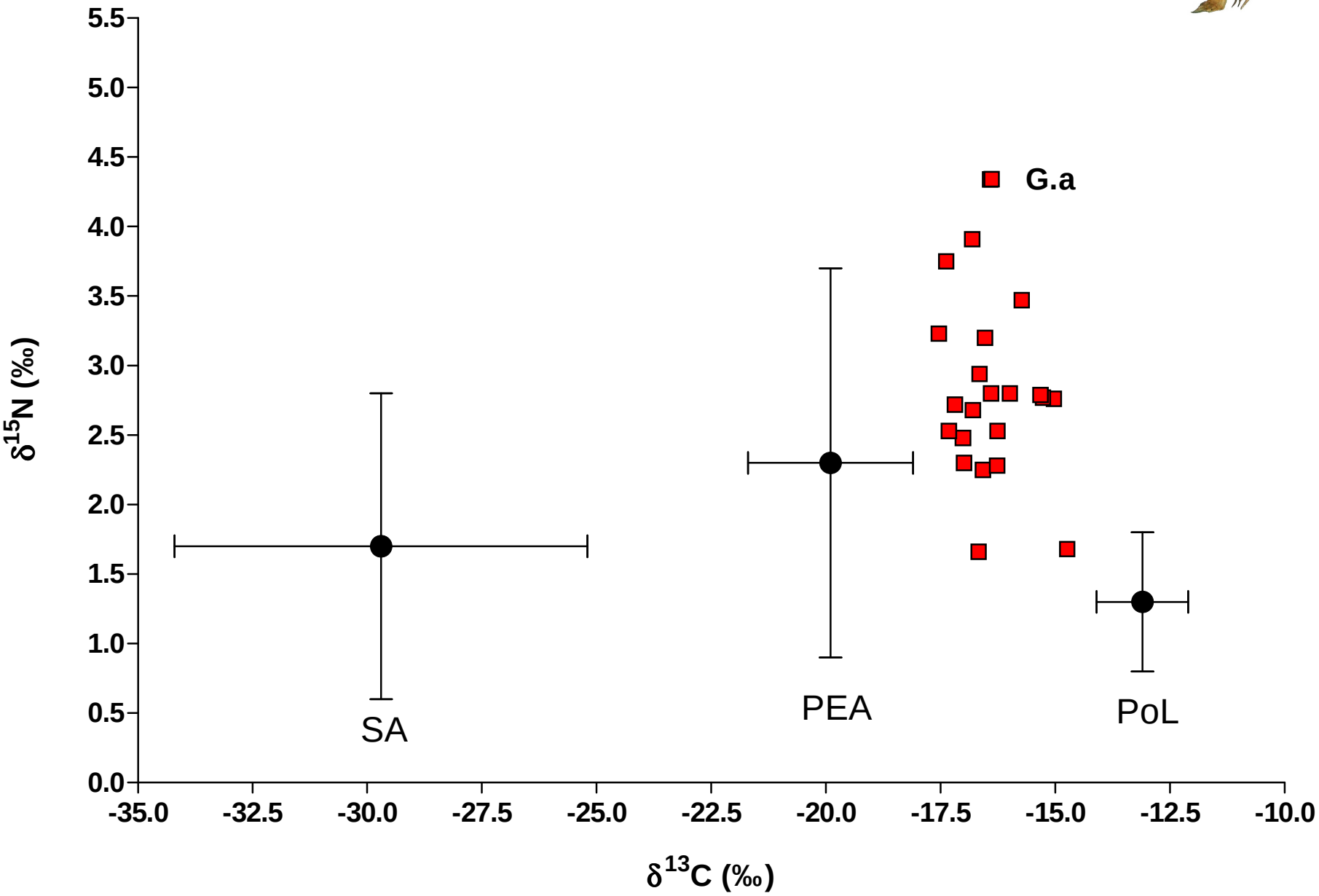
Ingested fragments of *P. oceanica* litter are small (5-100 cells)

- **Potentiel role of these species in the mechanical degradation of litter**

Results of isotopic ratios


5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
δ15N (‰)
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0
δ13C (‰)


5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
δ15N (‰)
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0
δ13C (‰)
SA
PEA
PoL


5.5
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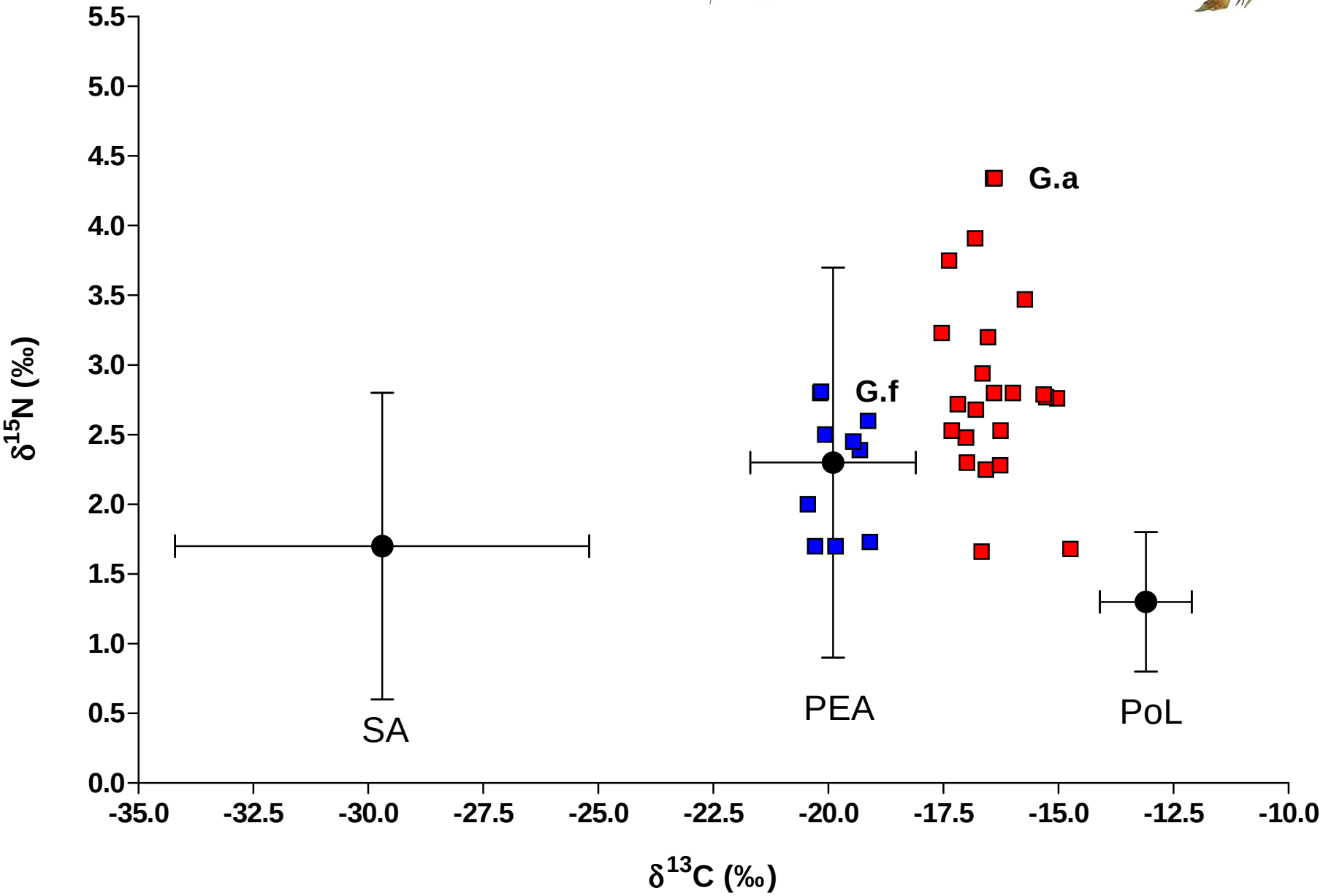
δ15N (‰)
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0
δ13C (‰)
G.a
SA
PEA
PoL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5.0
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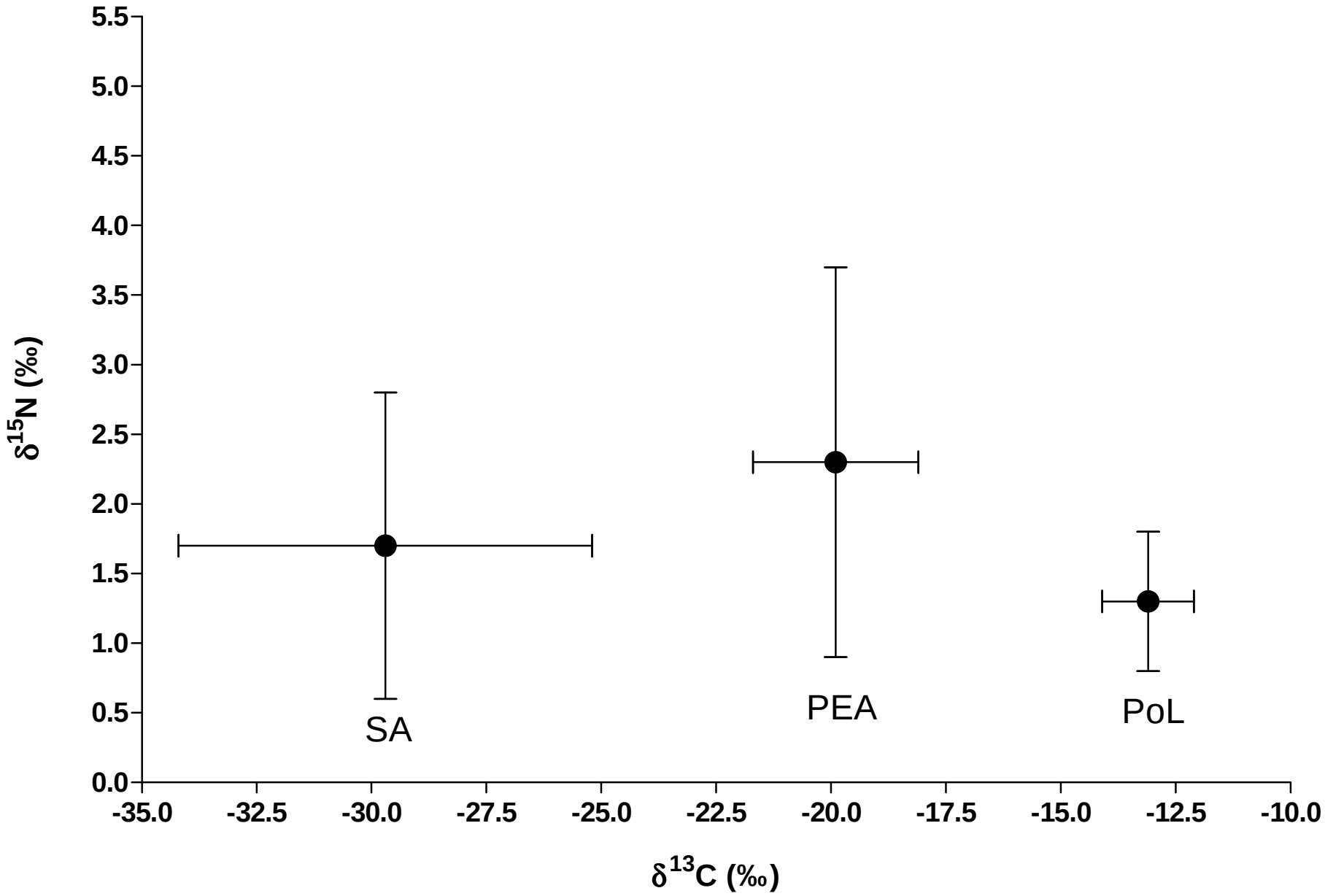
0.0
δ15N (‰)
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0
δ13C (‰)
G.a
G.f
SA
PEA
PoL


5.5
5.0
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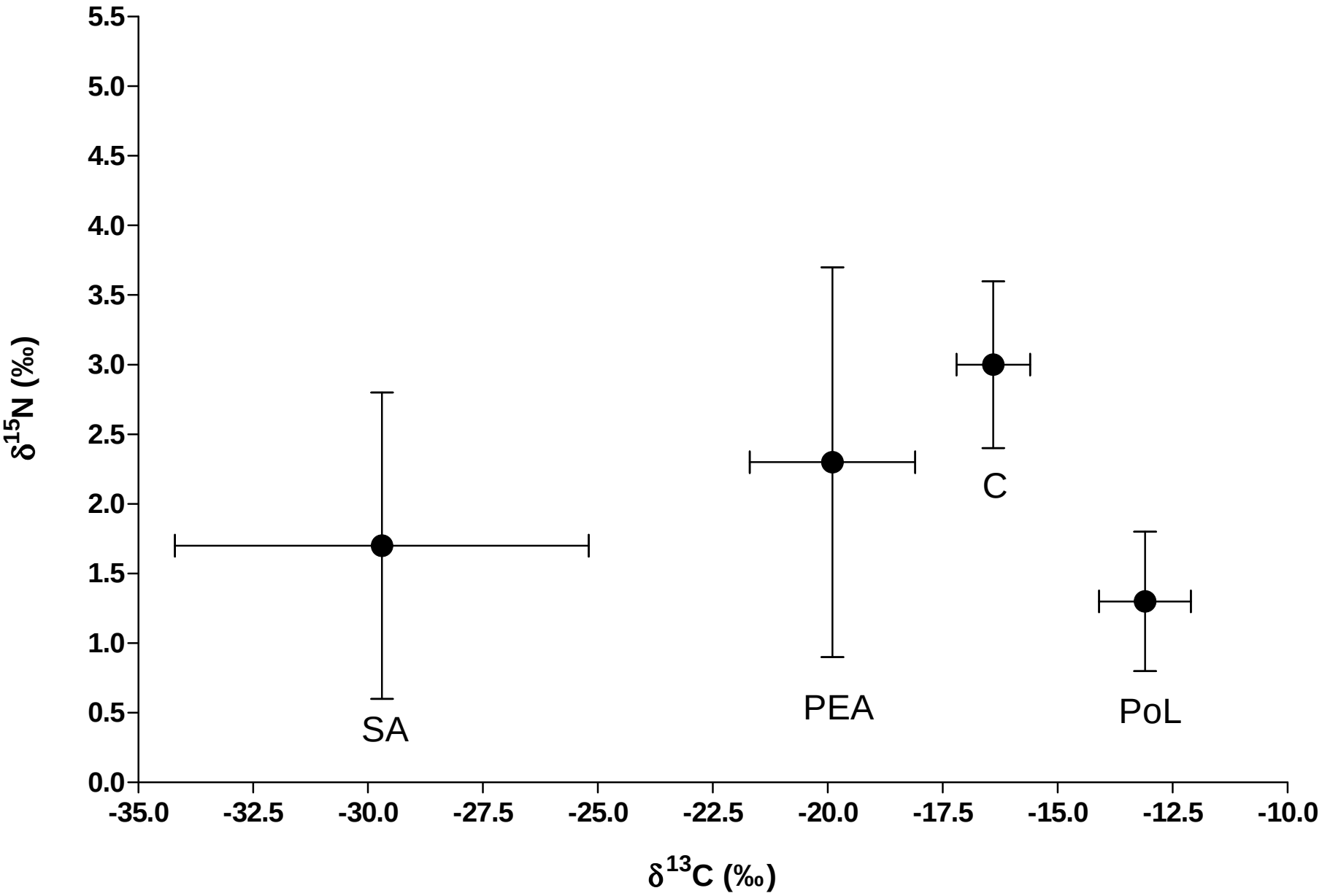
0.0
δ15N (‰)
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0
δ13C (‰)
SA
PEA
PoL


5.5
5.0
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4.0
3.5
3.0
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1.0
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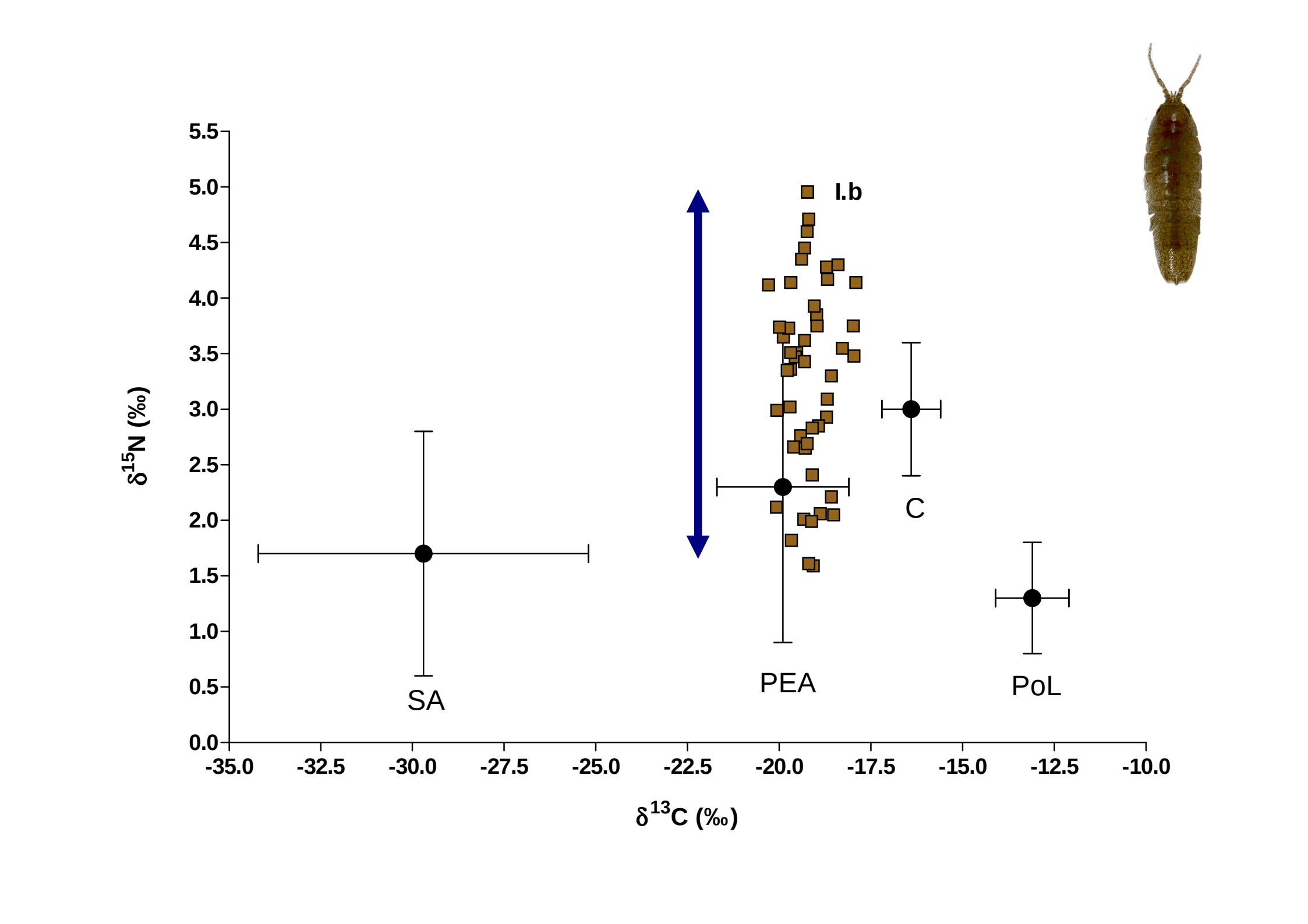
δ15N (‰)
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0
δ13C (‰)
SA
PEA
C
PoL


5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
δ15N (‰)
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0
δ13C (‰)
I.b
SA
PEA
C
PoL

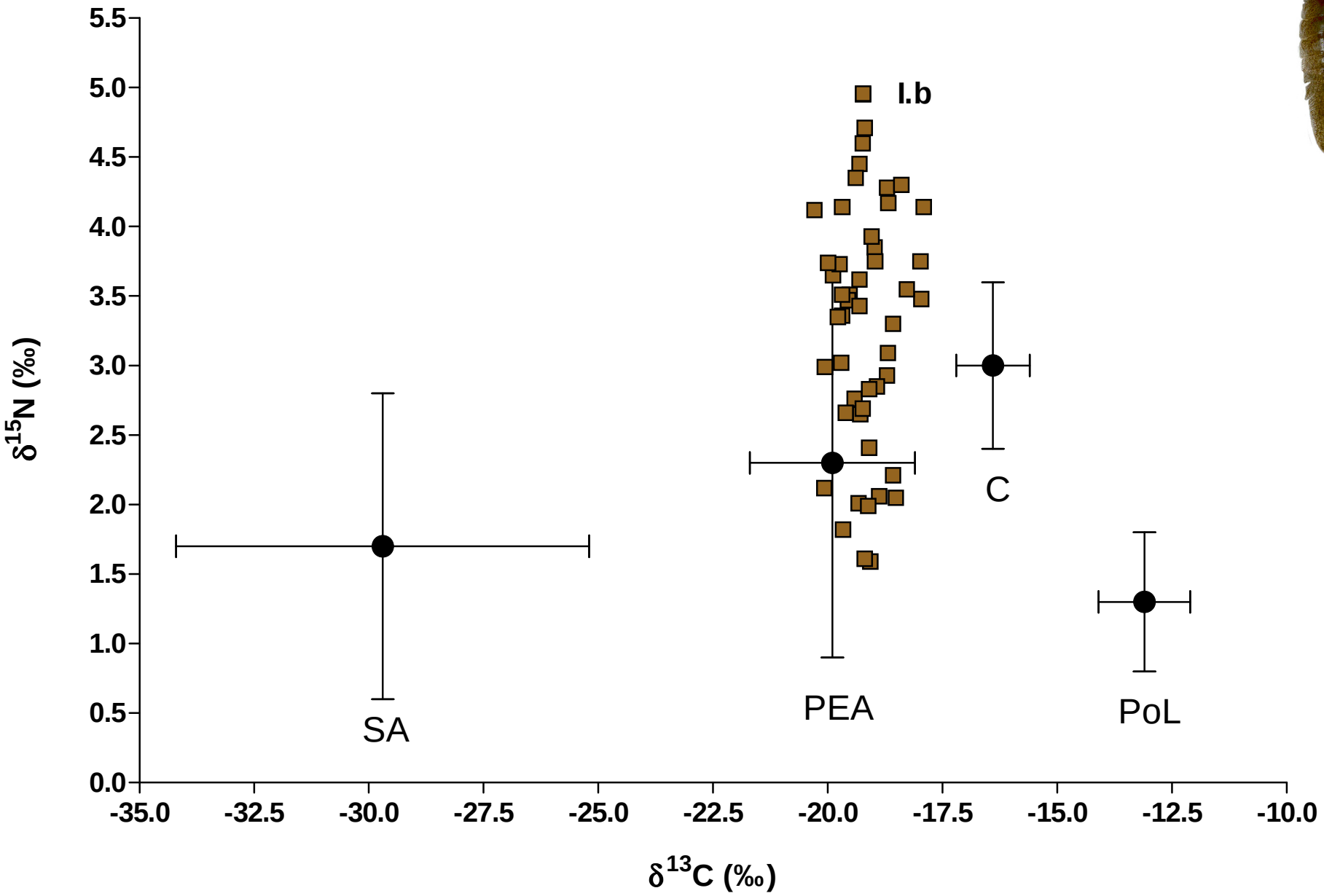
Hypothesis : Modification of the diet during growth of the animal → agrees with gut content results

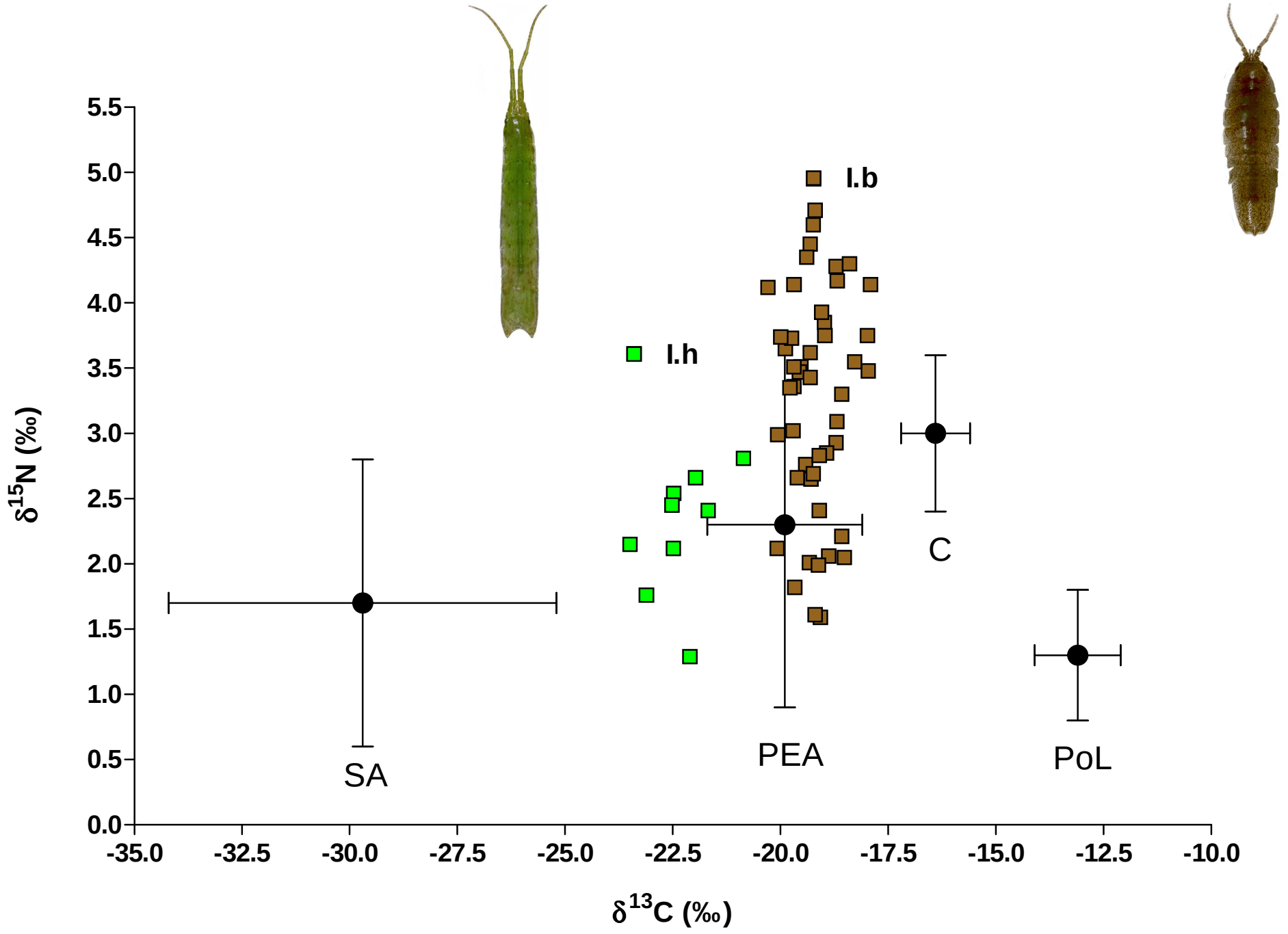
$\delta^{15}N$ (‰)

4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0

2 4 6 8 10 12 14 16 18 20 22 24 26 28

Lenght (mm)


l.b
SA
PEA
C
PoL
δ15N (‰)
δ13C (‰)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0


5.5
5.0
4.5
4.0
3.5
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2.0
1.5
1.0
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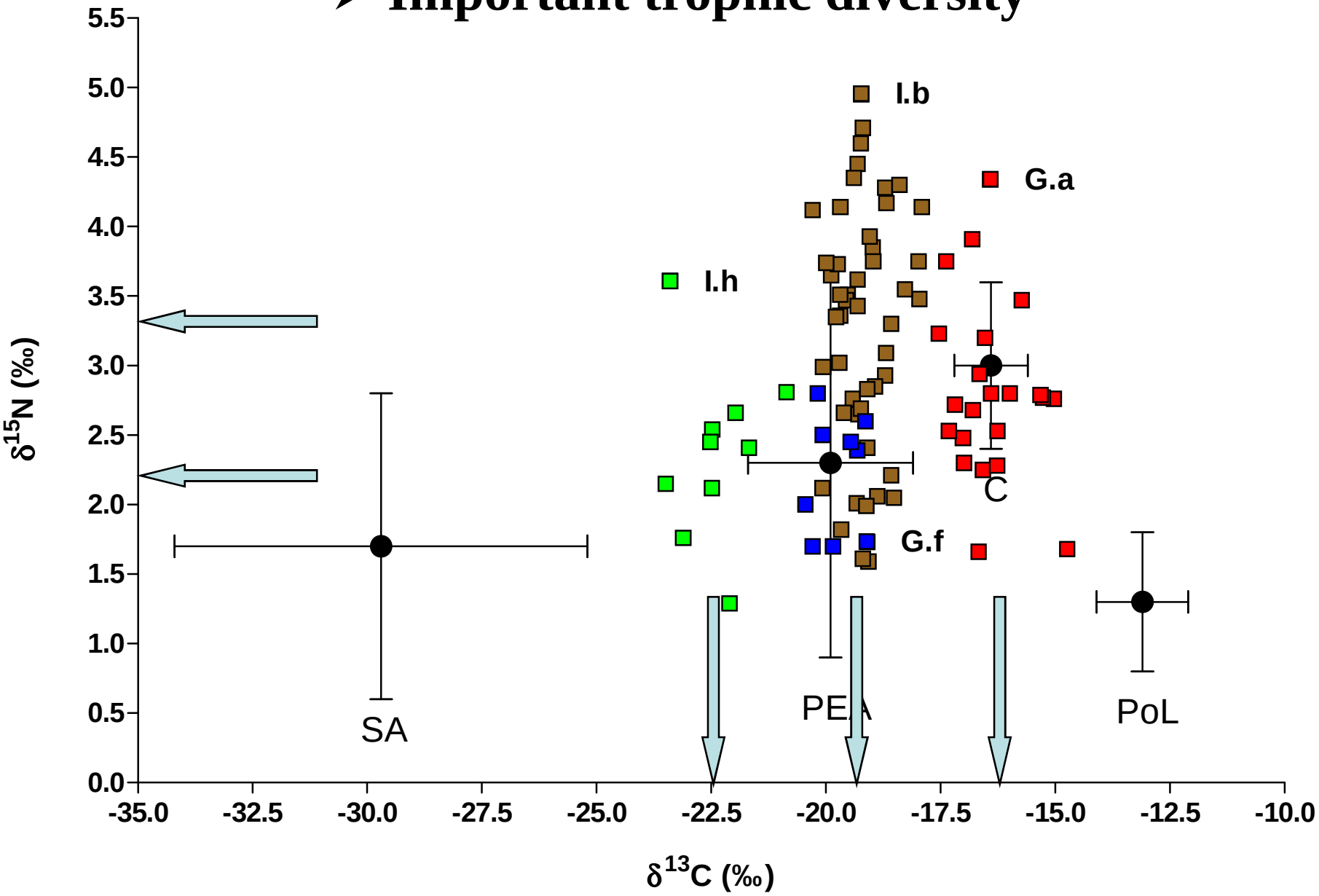
0.0
δ15N (‰)
-35.0
-32.5
-30.0
-27.5
-25.0
-22.5
-20.0
-17.5
-15.0
-12.5
-10.0
δ13C (‰)
I.b
I.h
SA
PEA
C
PoL

➢ Important trophic diversity



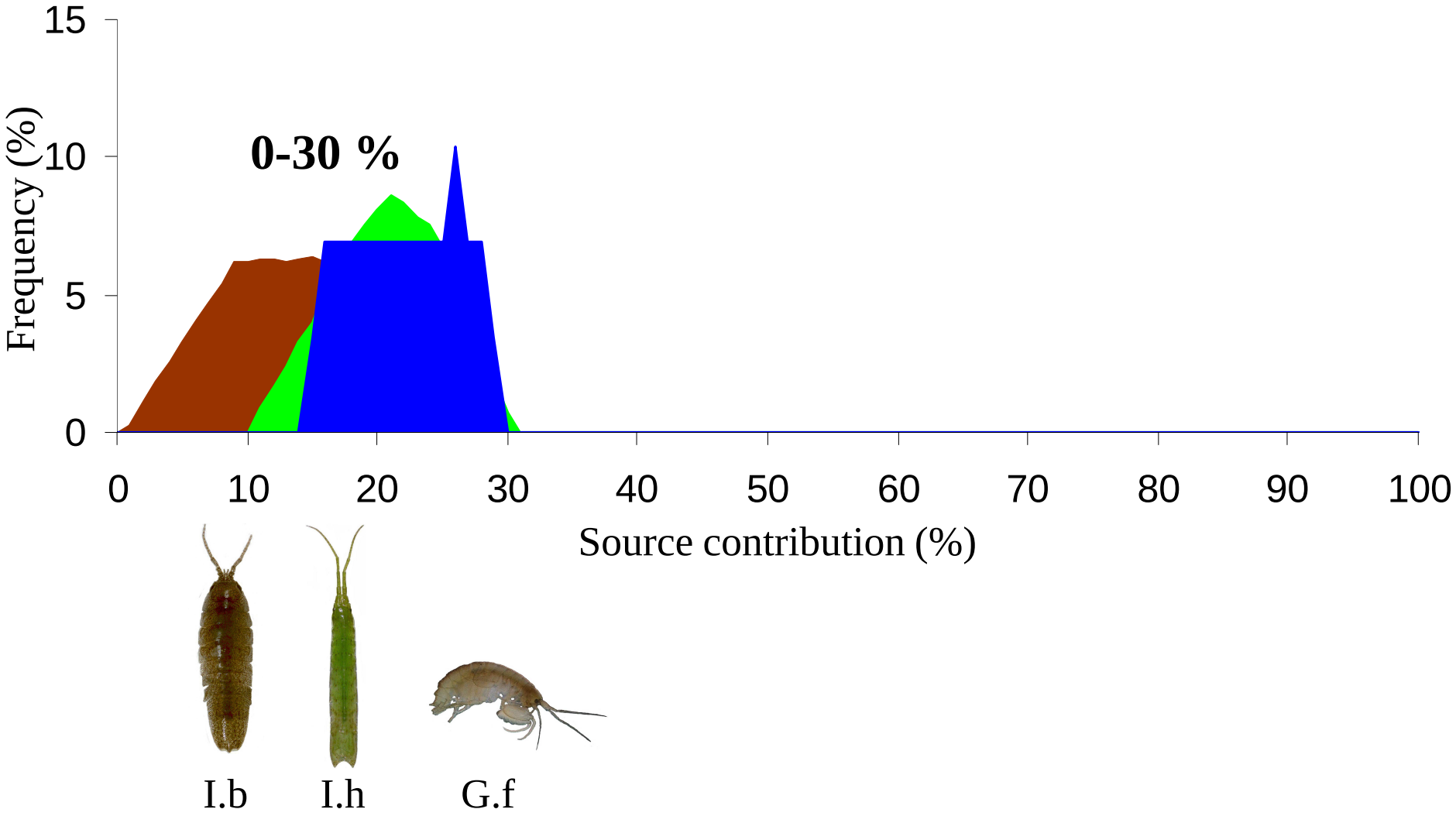
Mixing model

- **Mathematic model that can estimate relative contribution of different food sources**

- **Method :**
  - **Phillips & Gregg (2003)**
  - **Computer program (IsoSource) to perform calculations**

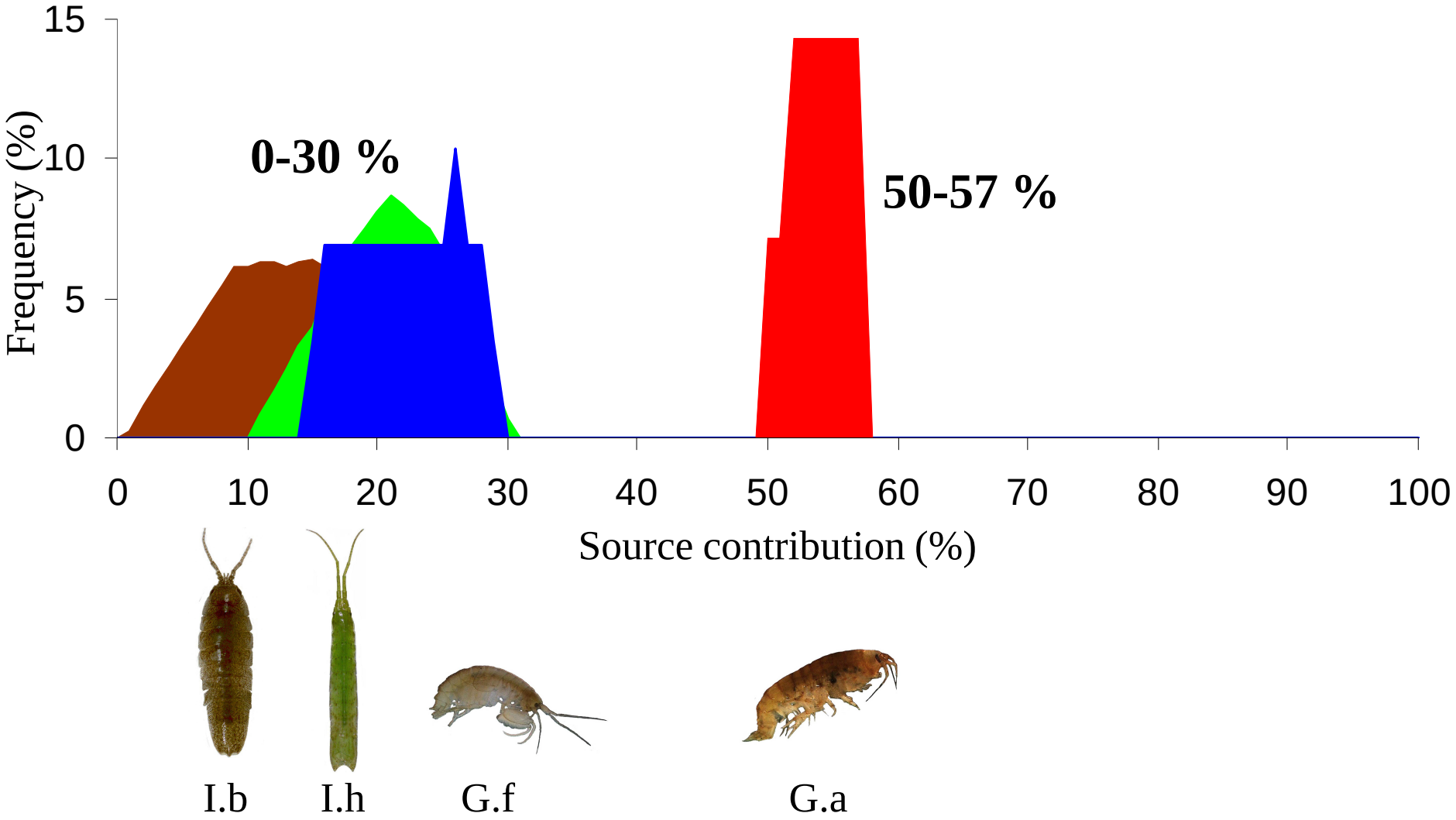
➢ **find a distribution of feasible solutions for the different food sources**

Posidonia litter

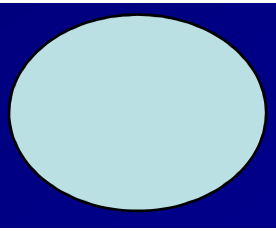
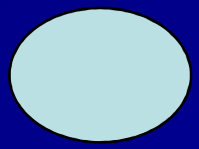
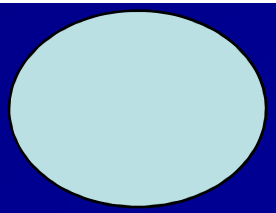
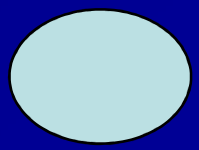


Posidonia litter

➢ **Difference with gut content results**

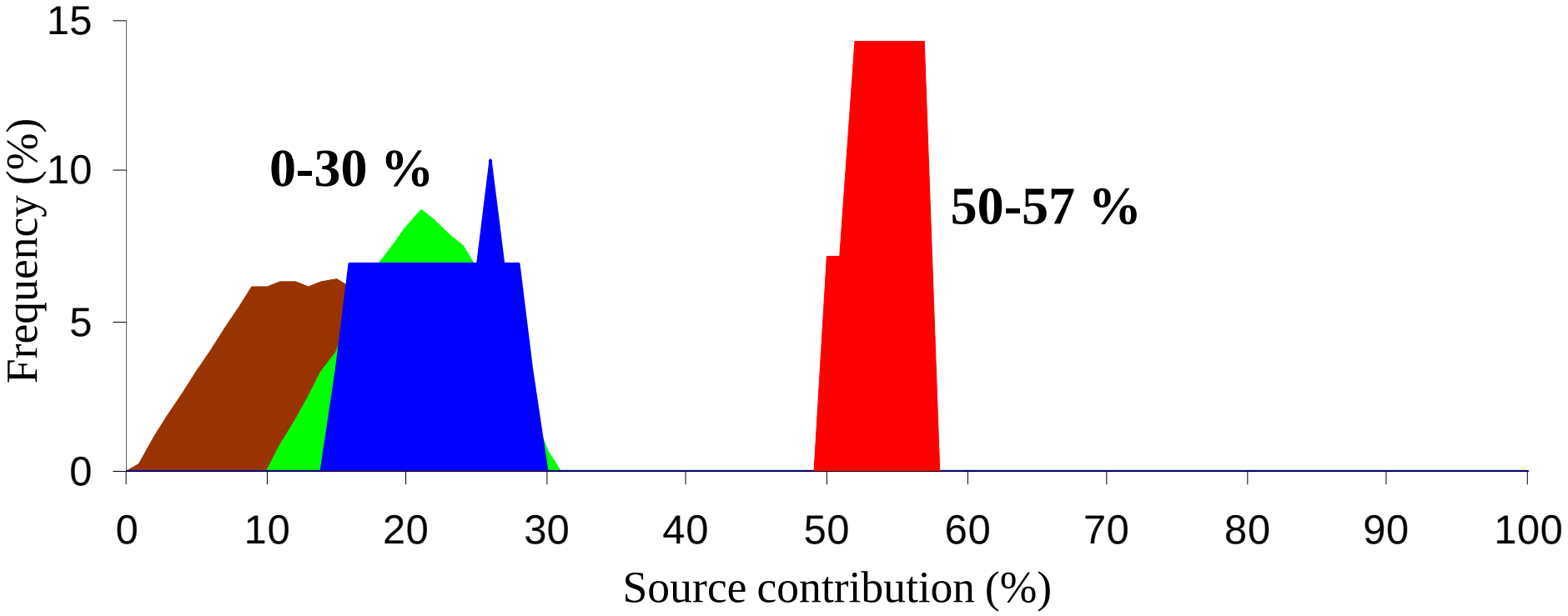


Gut contents
semi-quantitative estimation

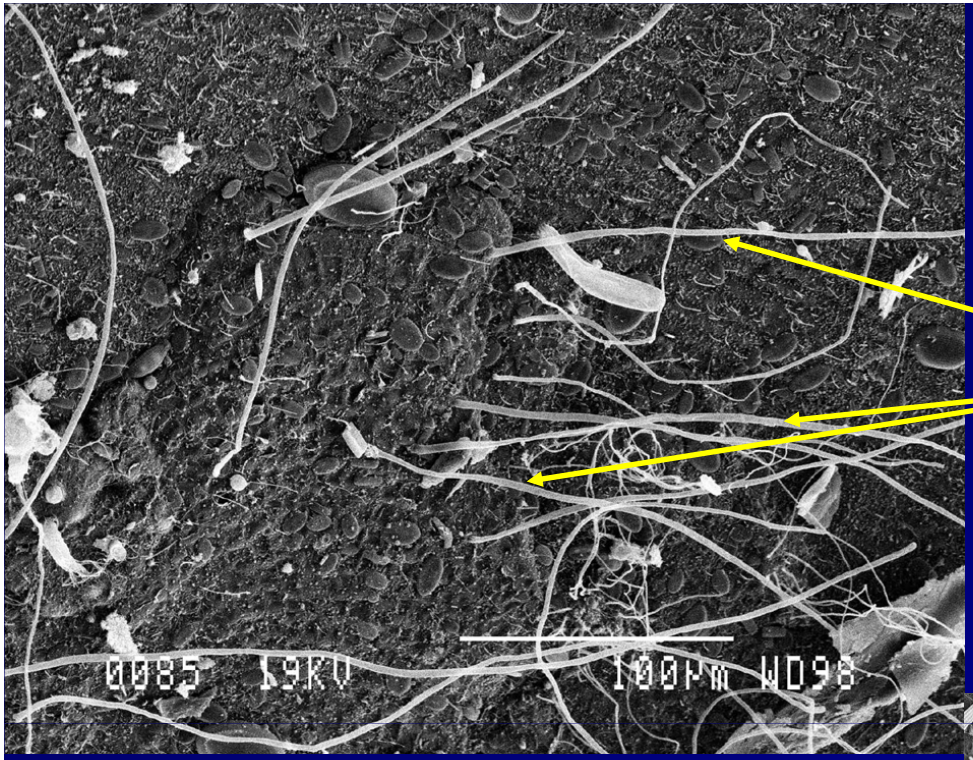
	P. oceanica litter
G. aequicauda 	
G. fucicola 	
I. baltica 	
I. hectica 	

Posidonia litter

➢ **Difference with gut content results**



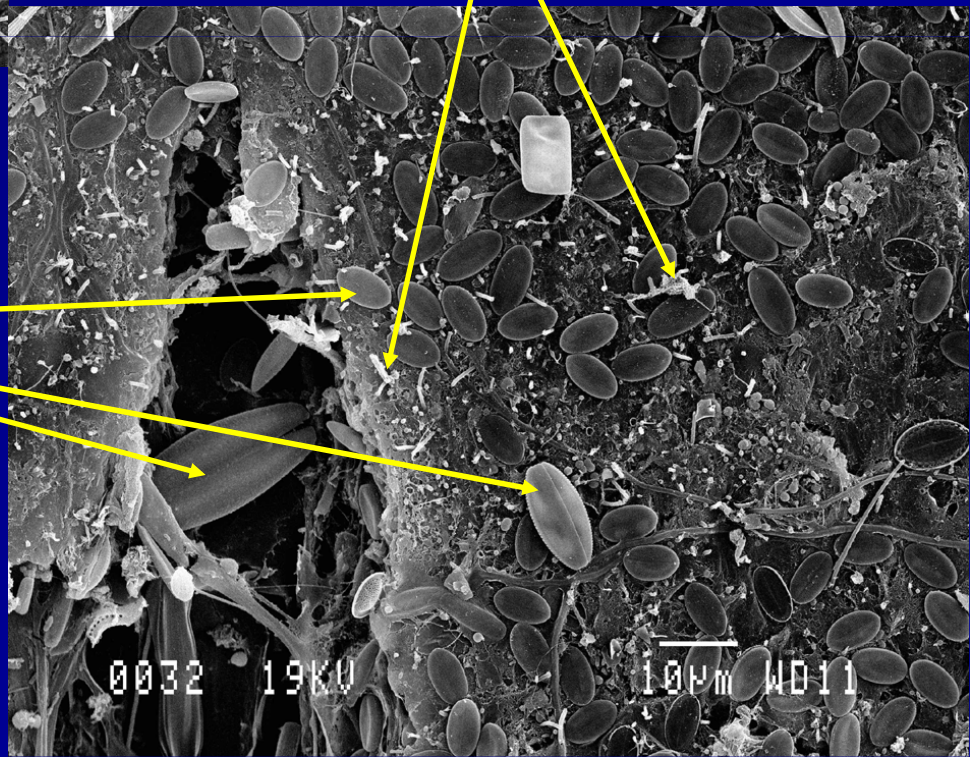
➢ **Micro-organisms colonising leaf litter may constitute an important food source for litter fauna**



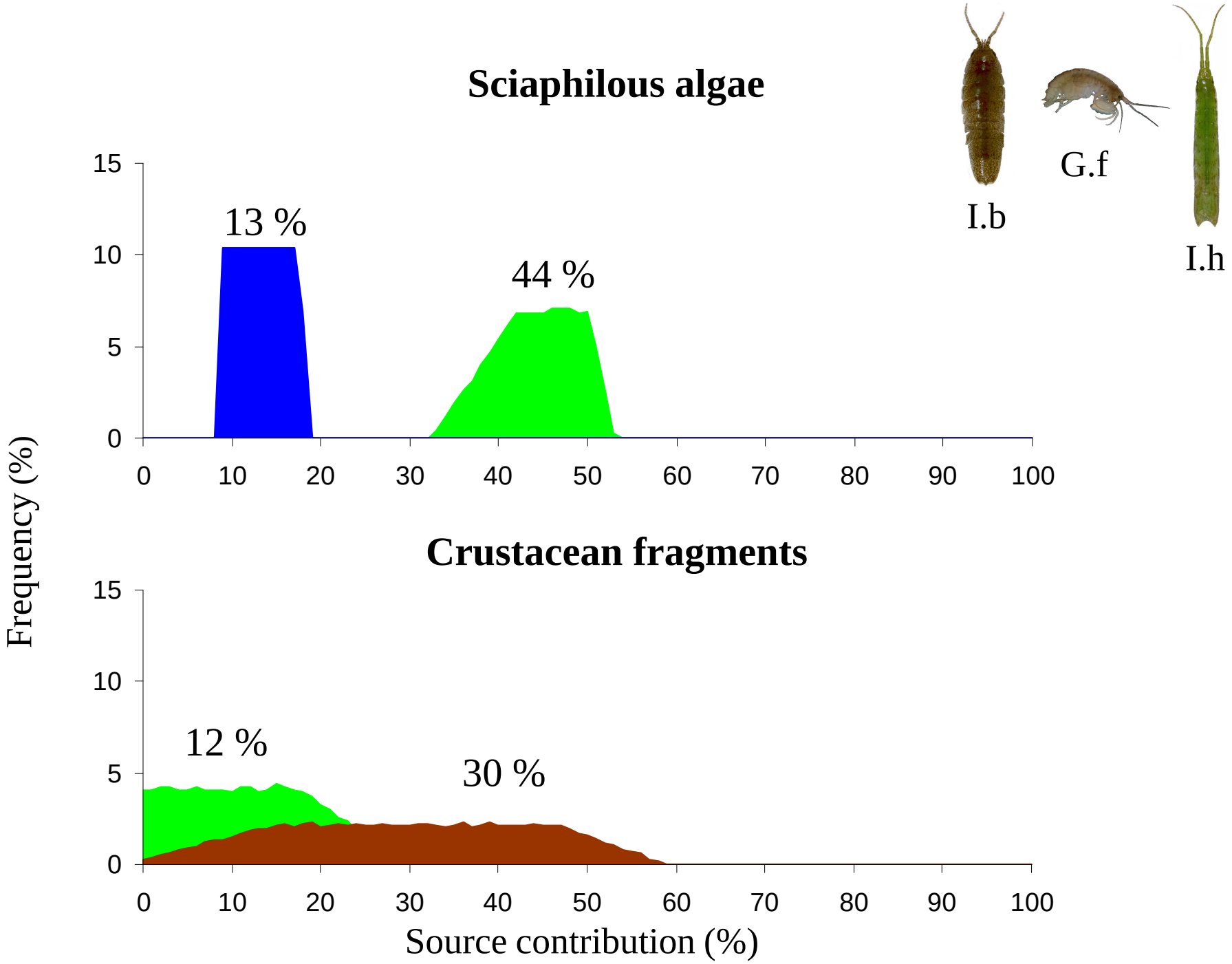
Fungi

Bacteria

Diatoms



Photos: Dr. Mathieu Poulicek


Sciaphilous algae
I.b
G.f
I.h
13 %
44 %
Crustacean fragments
12 %
30 %
Frequency (%)
Source contribution (%)
0
5
10
15
0
10
20
30
40
50
60
70
80
90
100

Summary of mixing model results

Species	Principal assimilated food sources
G. aequicauda 	*Posidonia* litter - PEA
G. fucicola 	PEA
I. baltica 	PEA - Crustacea
I. hectica 	SA - PEA

Conclusions

Our results demonstrate

- **The important trophic diversity existing between detritivorous crustaceans in *Posidonia* litter**
- **Importance of combined methods in diet studies (ingested material *vs* assimilated material):**

  ***Posidonia* leaf litter are ingested but a little assimilated (except for *G. aequicauda*)**

Conclusions

- **Role in the mechanical degradation**
- **The transfer to higher trophic level and the link between seagrass primary production and adjacent habitats**
  - ➢ **macrofauna of the litter is consumed by local shore fishes**

Acknowledgments

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