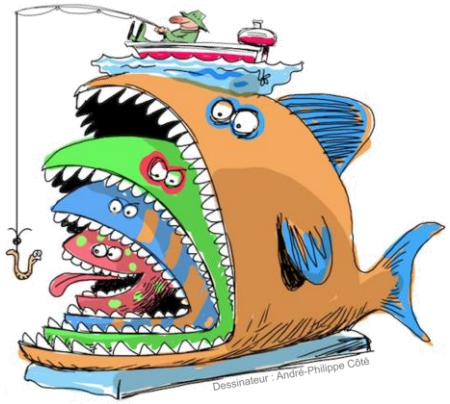
Marianne ROBERT
Dorothée KOPP

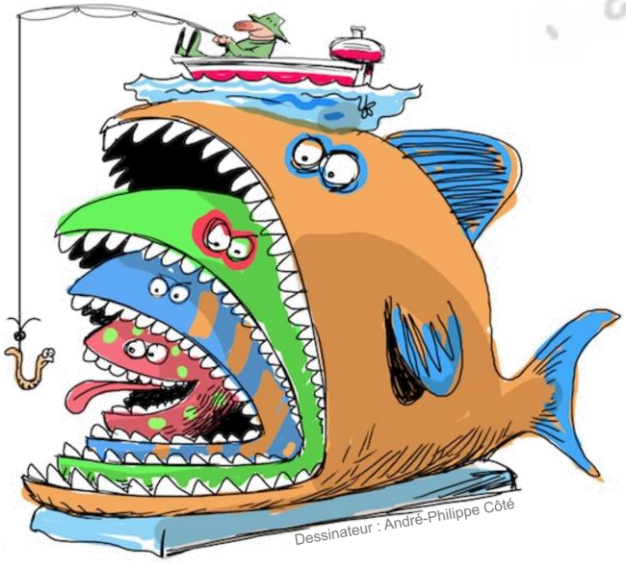
Didier GASCUEL

Fonctionnement trophique de l'écosystème mer Celtique : impact de la pêche et scénarios de gestion écosystémique



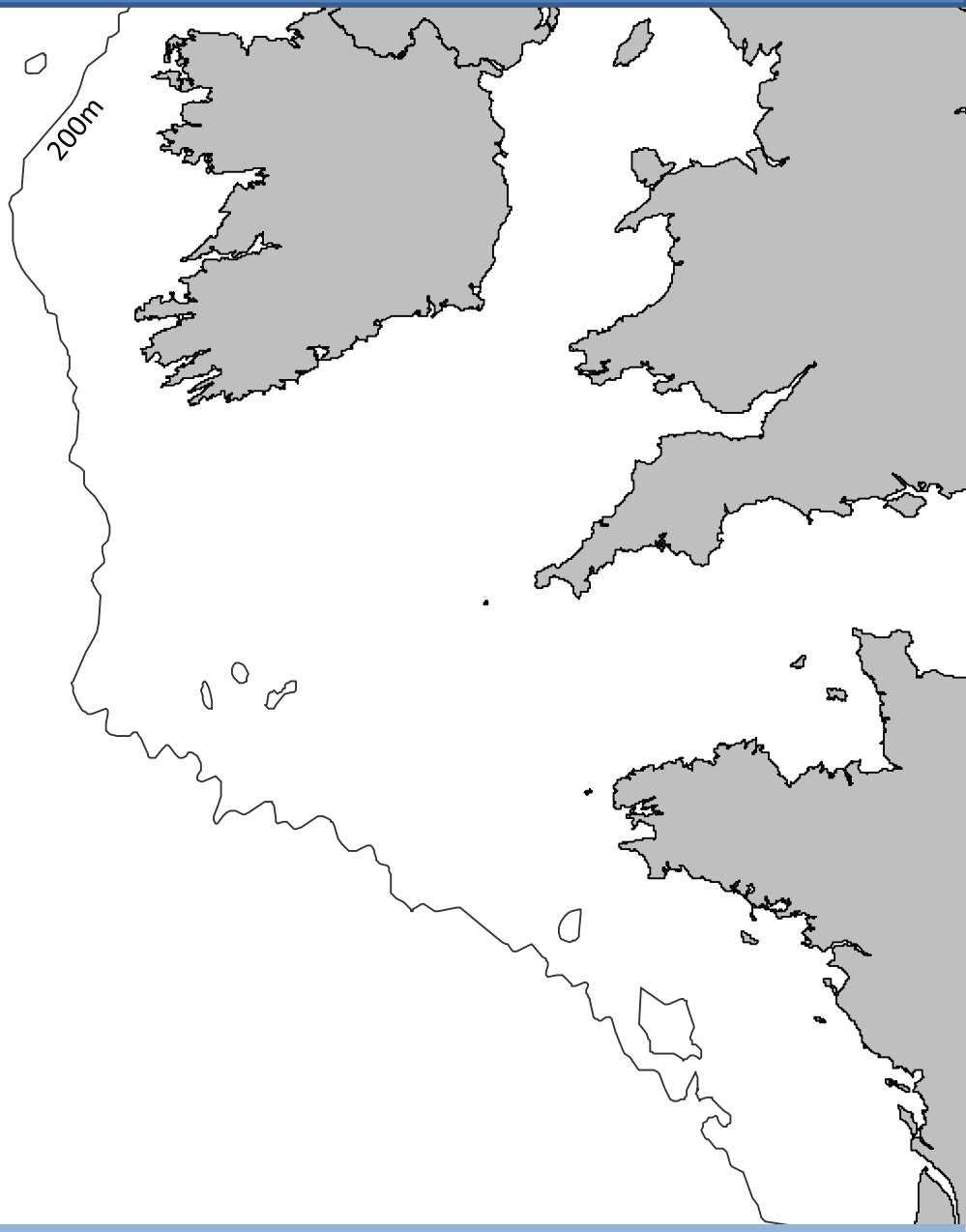
Pierre-Yves Hernvann

CONTEXTE



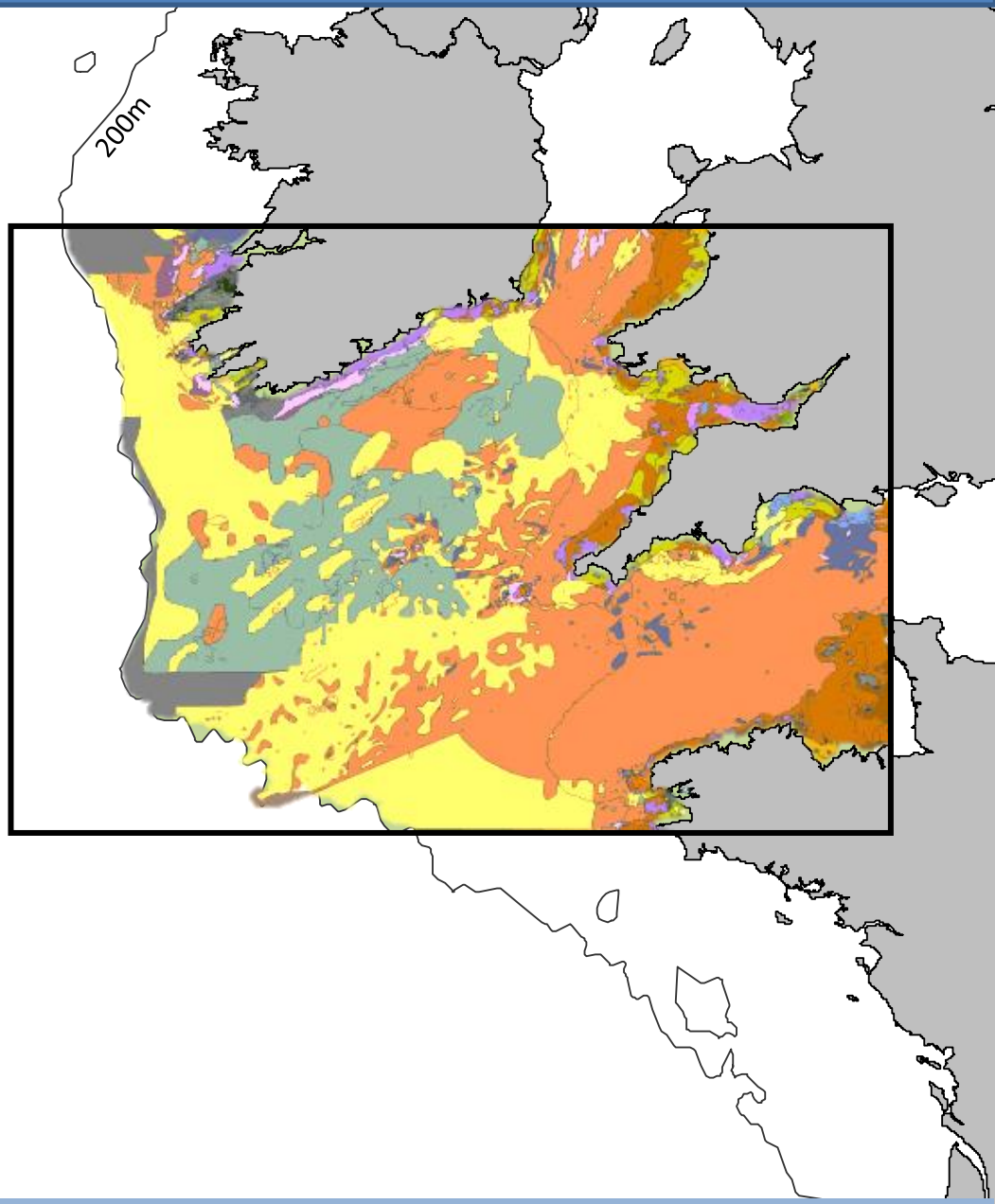
A CASE STUDY: THE CELTIC SEA

- North-West European ecosystem



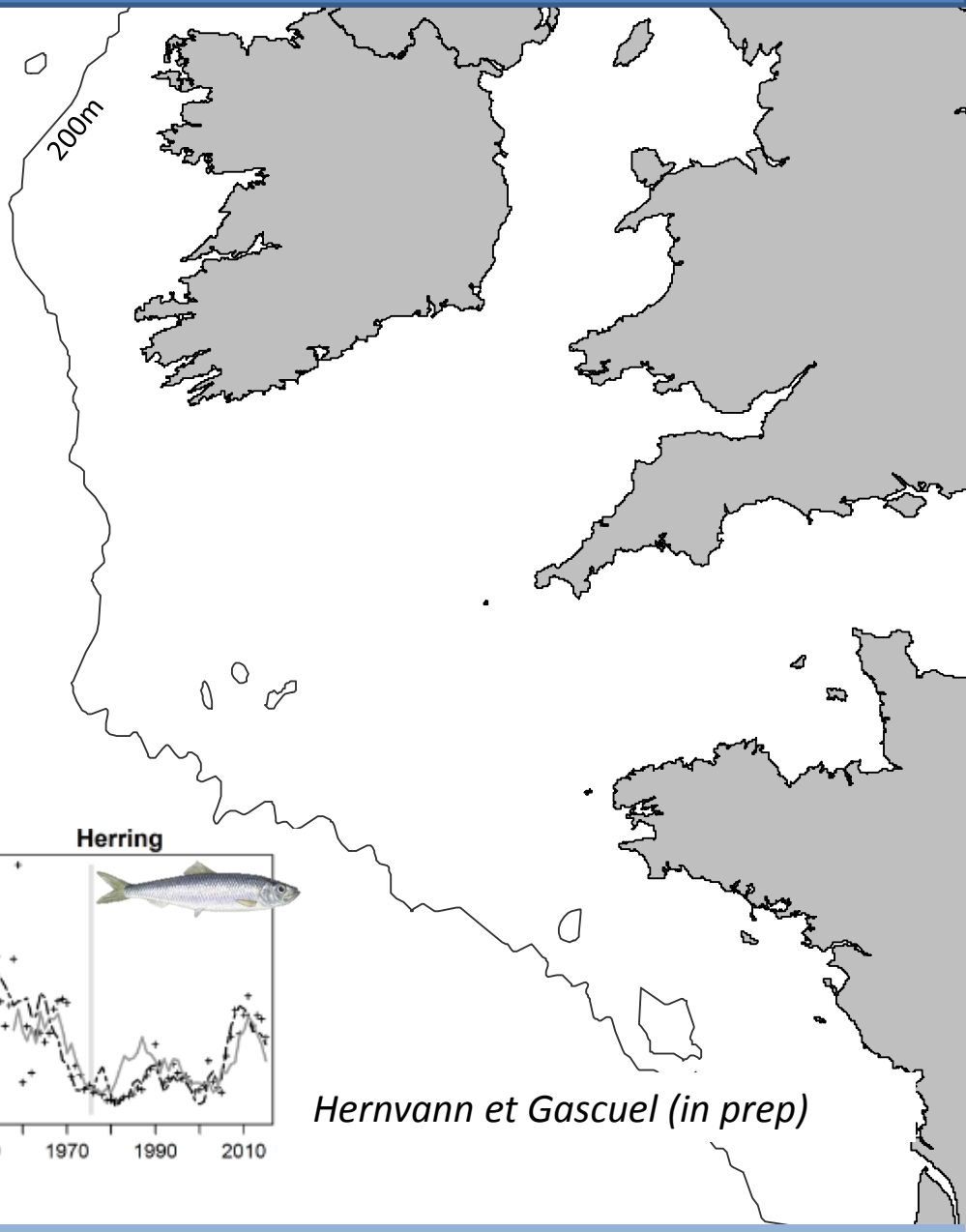
A CASE STUDY: THE CELTIC SEA

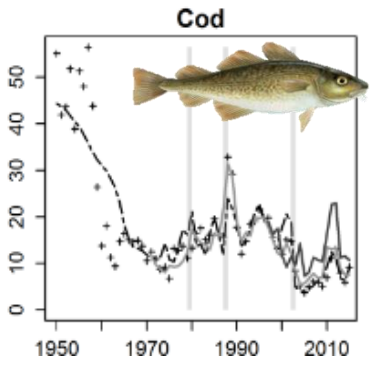
- North-West European ecosystem
- Great variety of habitats
  → diversity of species

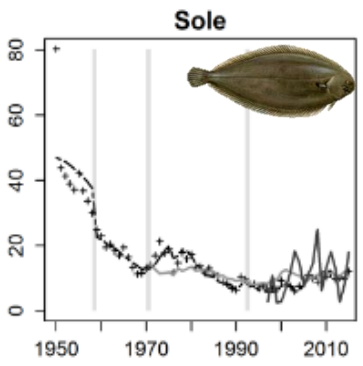


A CASE STUDY: THE CELTIC SEA

- North-West European ecosystem
- Great variety of habitats
  → diversity of species
- Intensive fishing since the XXth century and particularly after 1950
  → 75% reduction of main target species biomass in 1980







Hernvann et Gascuel (in prep)

A CASE STUDY: THE CELTIC SEA

- North-West European ecosystem
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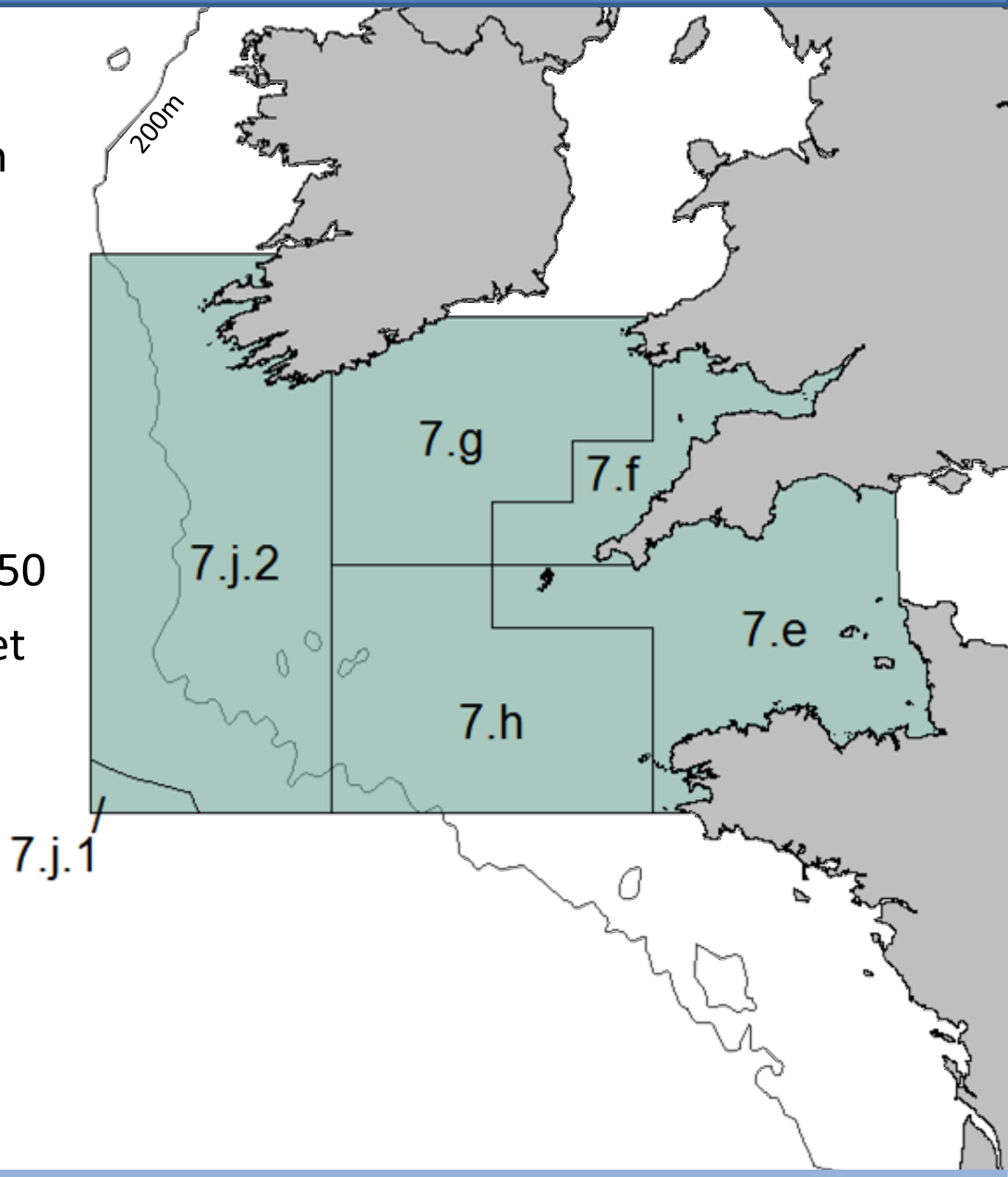
- Intensive fishing since the XXth century and particularly after 1950
  → 75% reduction of main target species biomass in 1980
- Strategic area for European fishing fleets

+ + = 340,000 t

13.5% French catch in FAO27



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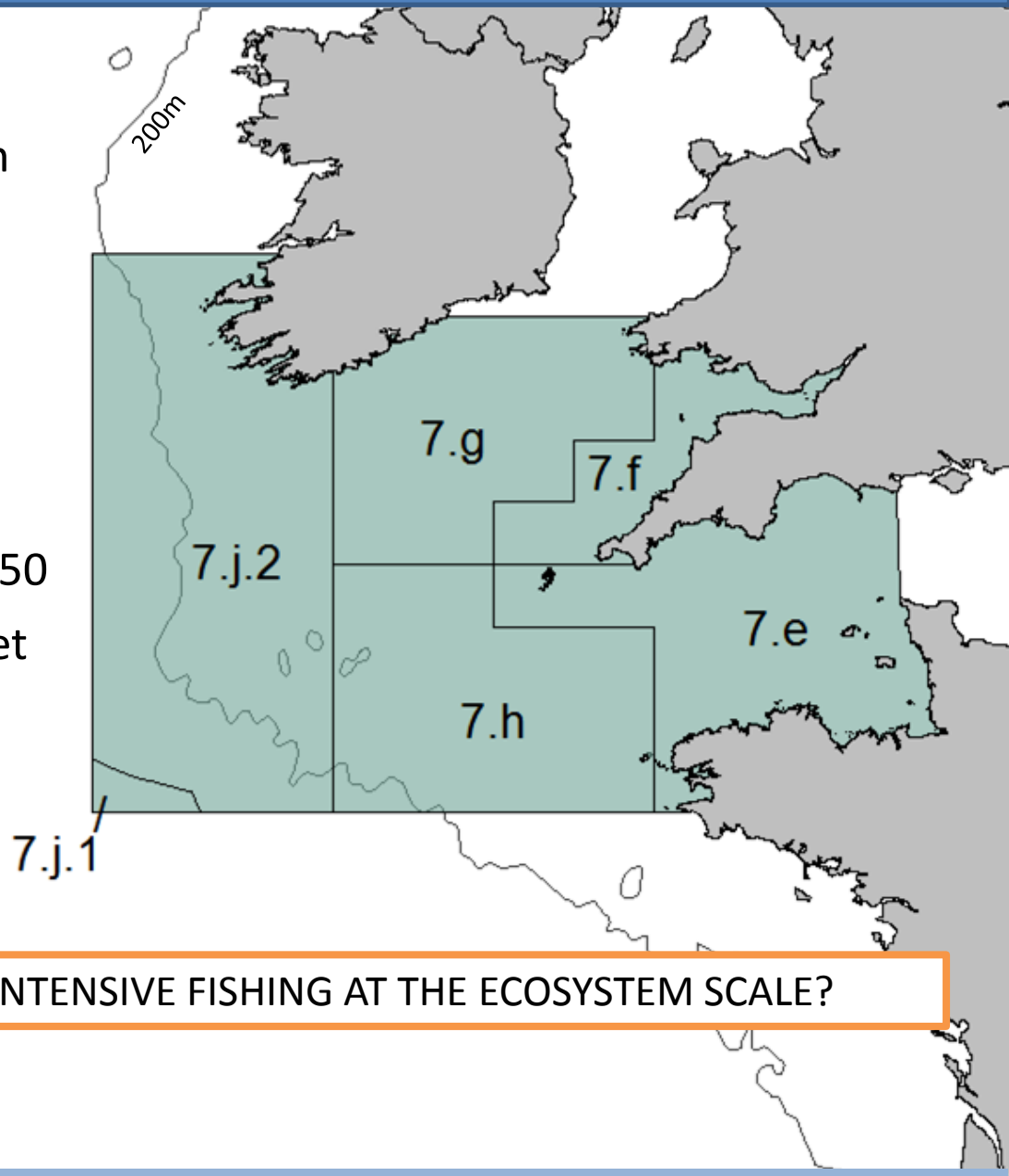
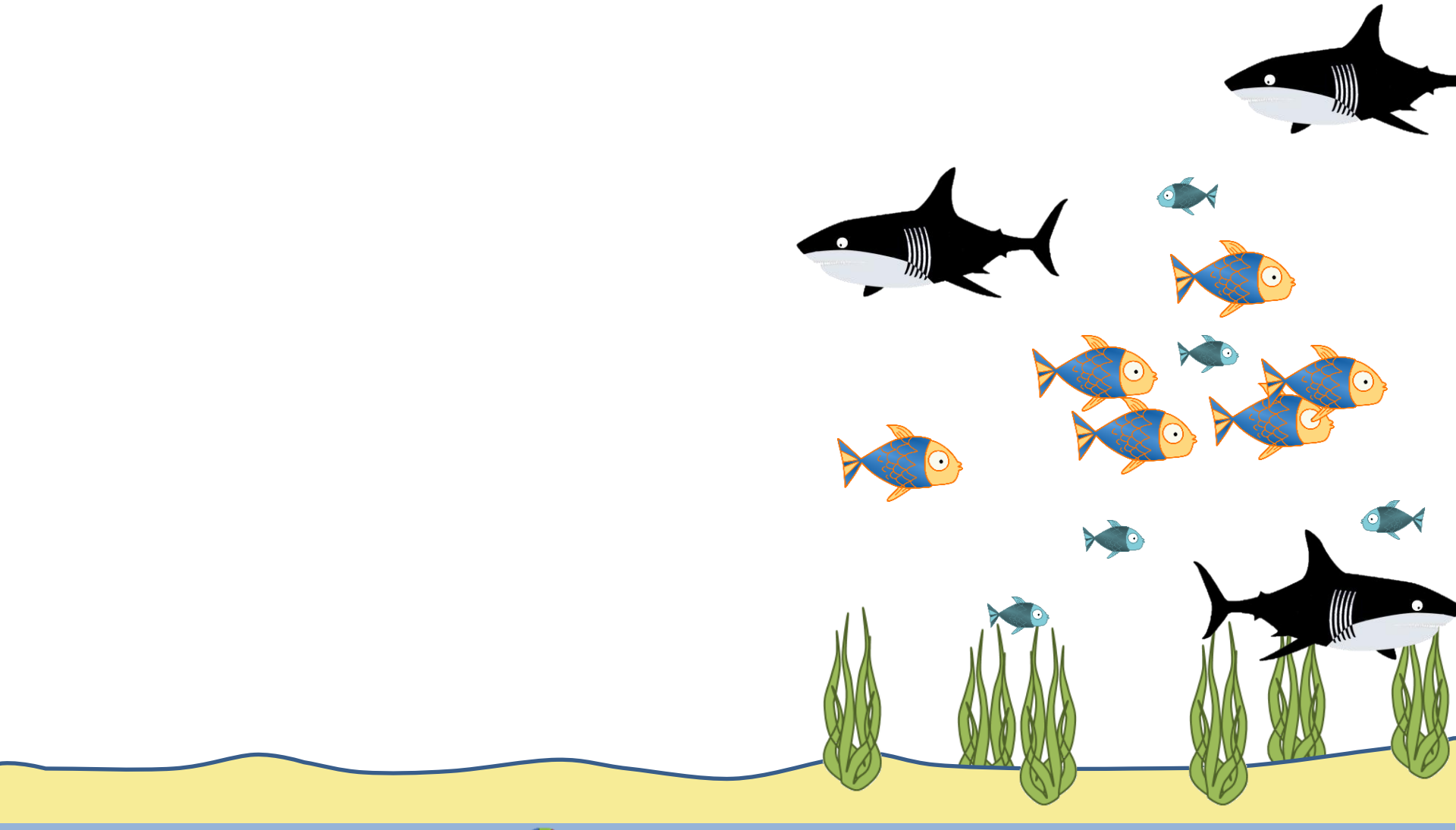


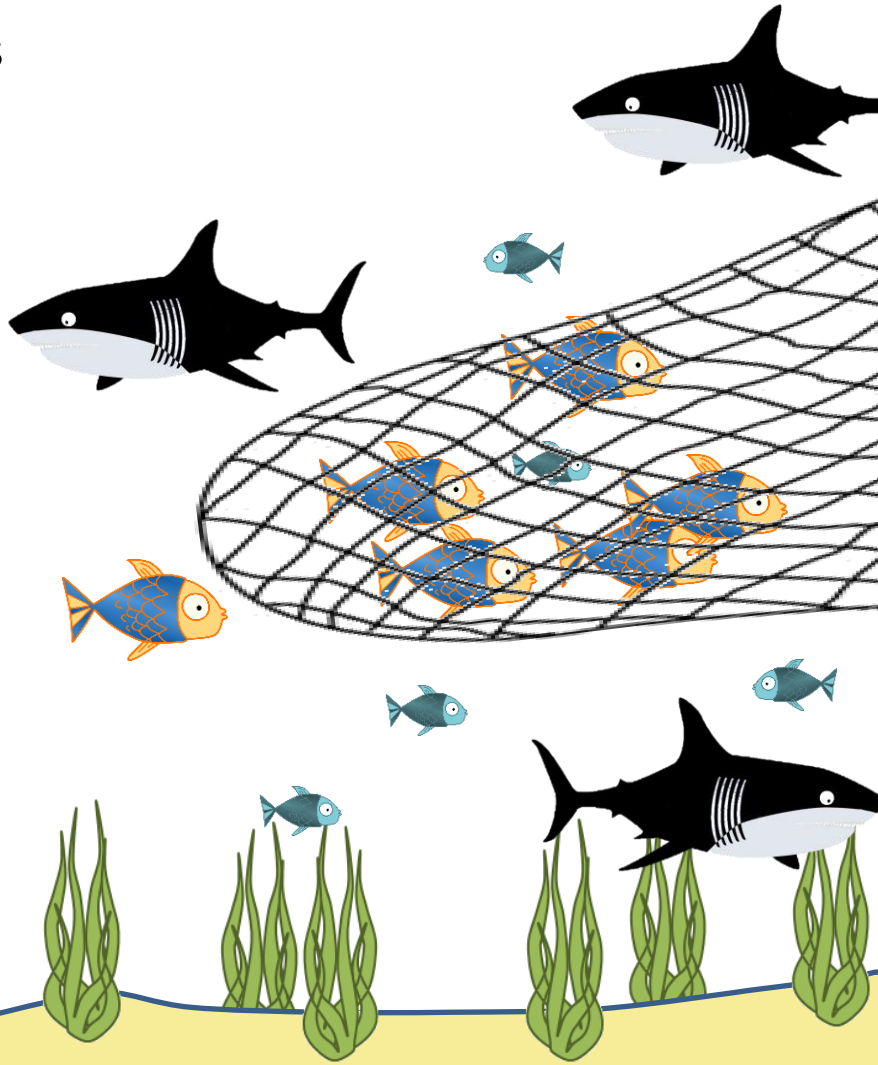
WHAT IS THE IMPACT OF SUCH INTENSIVE FISHING AT THE ECOSYSTEM SCALE?

FISHING IMPACT ON ECOSYSTEMS – The trophic side



FISHING IMPACT ON ECOSYSTEMS

- Biomass reduction of exploited stocks



FISHING IMPACT ON ECOSYSTEMS – The trophic side

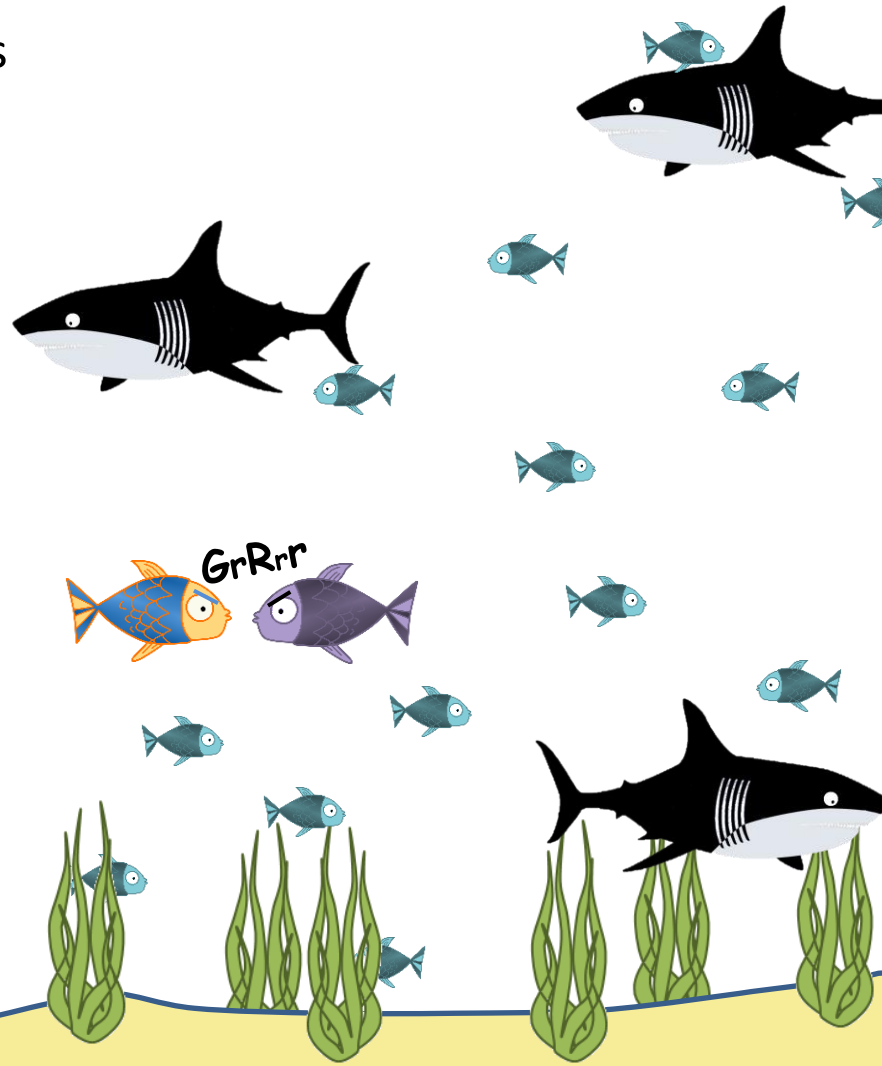
- Biomass reduction of exploited stocks

- Changes of species composition

  Predators

  Preys

  Competitors



FISHING IMPACT ON ECOSYSTEMS – A TROPHIC VIEW

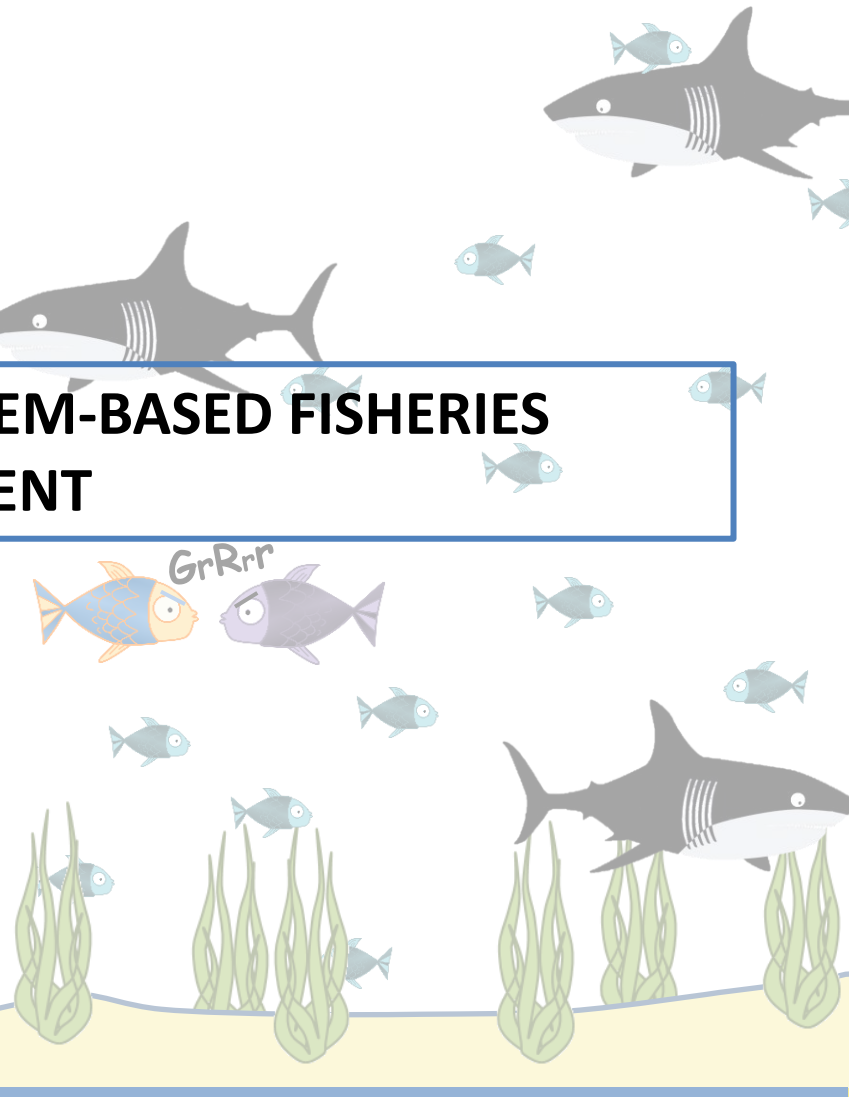
- Biomass reduction of exploited stocks
- Changes of species composition

MOVE TOWARD AN ECOSYSTEM-BASED FISHERIES MANAGEMENT

Predators

Preys

Competitors

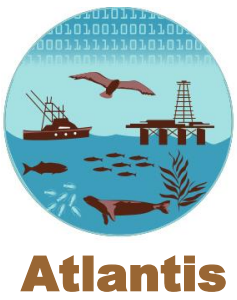


ABOUT ECOSYSTEM MODELLING

- Need of an ecosytem-based fisheries management (Pikitch et al., 2014; Garcia et al., 2003 …)

Scientific Community + Policy Makers (CFP)

- One tool to support an EBFM is ecosystem modeling, especially trophic modeling (Plaganyi, 2007)



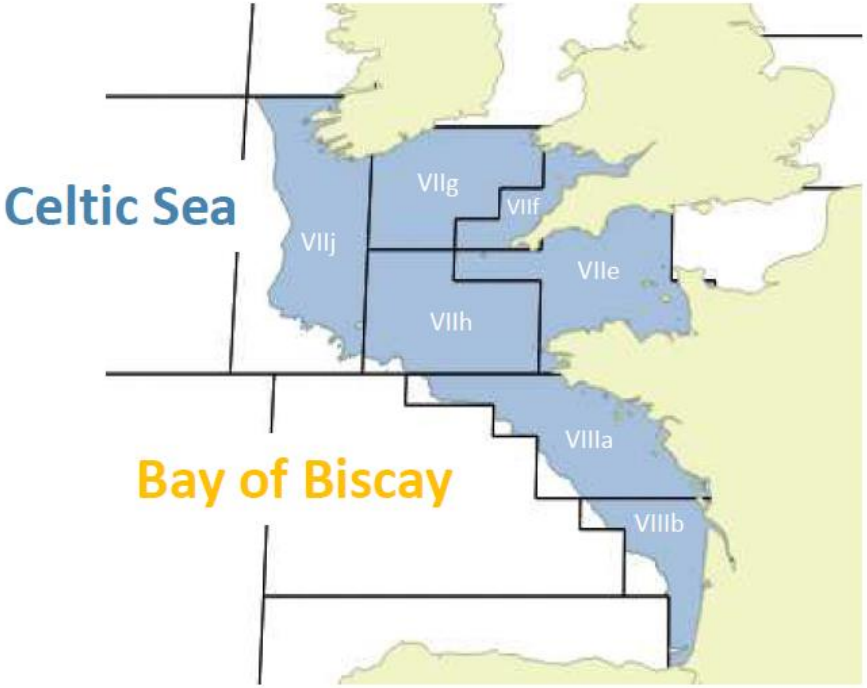
etc.

PRE-EXISTING MODELS

Guénette & Gascuel (2009) — 1

Bentorcha et al (2017) — 2

1980 - 2012



+ EBFM designed
+ Actualisation

PRE-EXISTING MODELS

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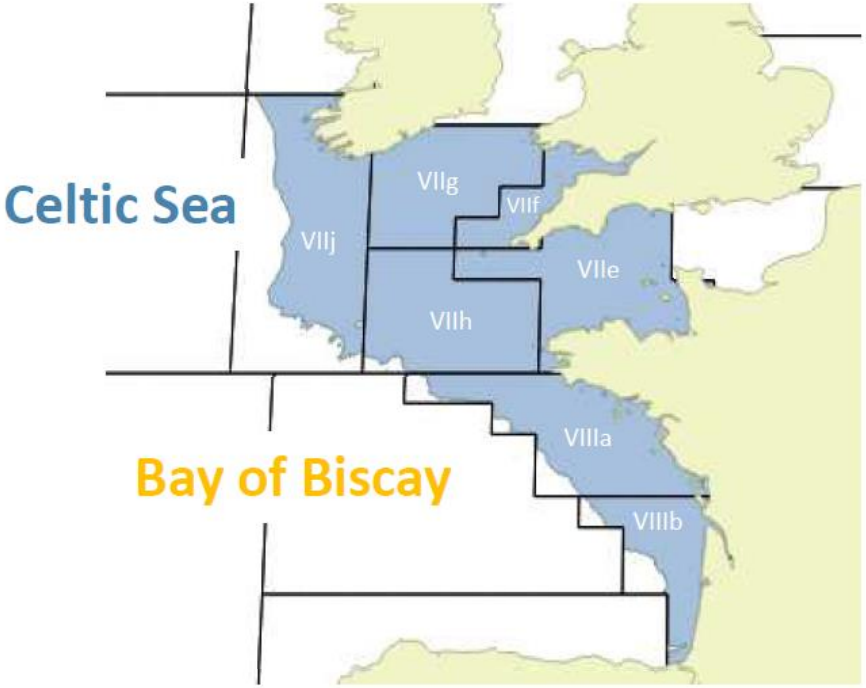

+ EBFM designed
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PRE-EXISTING MODELS – Celtic Sea model (Moullec et al. 2015)

PRE-EXISTING MODELS

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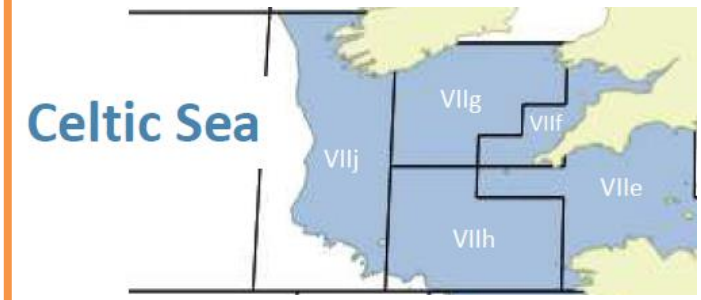
Moullec et al (2017) — 3

Me! — 4

1980 - 2013





AU MENU

- What are the fisheries and environmental determinants of the Celtic Sea ecosystem dynamics?
  What would be the impacts of various management measures and how can trophic models contribute to the identification of fisheries in order to minimize the impacts on ecosystems?

- In practical terms: Improve the predictive capacity of the Celtic model and Test realistic ecosystem-based fisheries management scenarios

- 3 main steps:

  1. Develop a generic method to estimate diet matrices in Ecopath models and apply the method to the Celtic Sea
  2. Spatialize the trophic model through Ecospace
  3. Test various fisheries management scenarios

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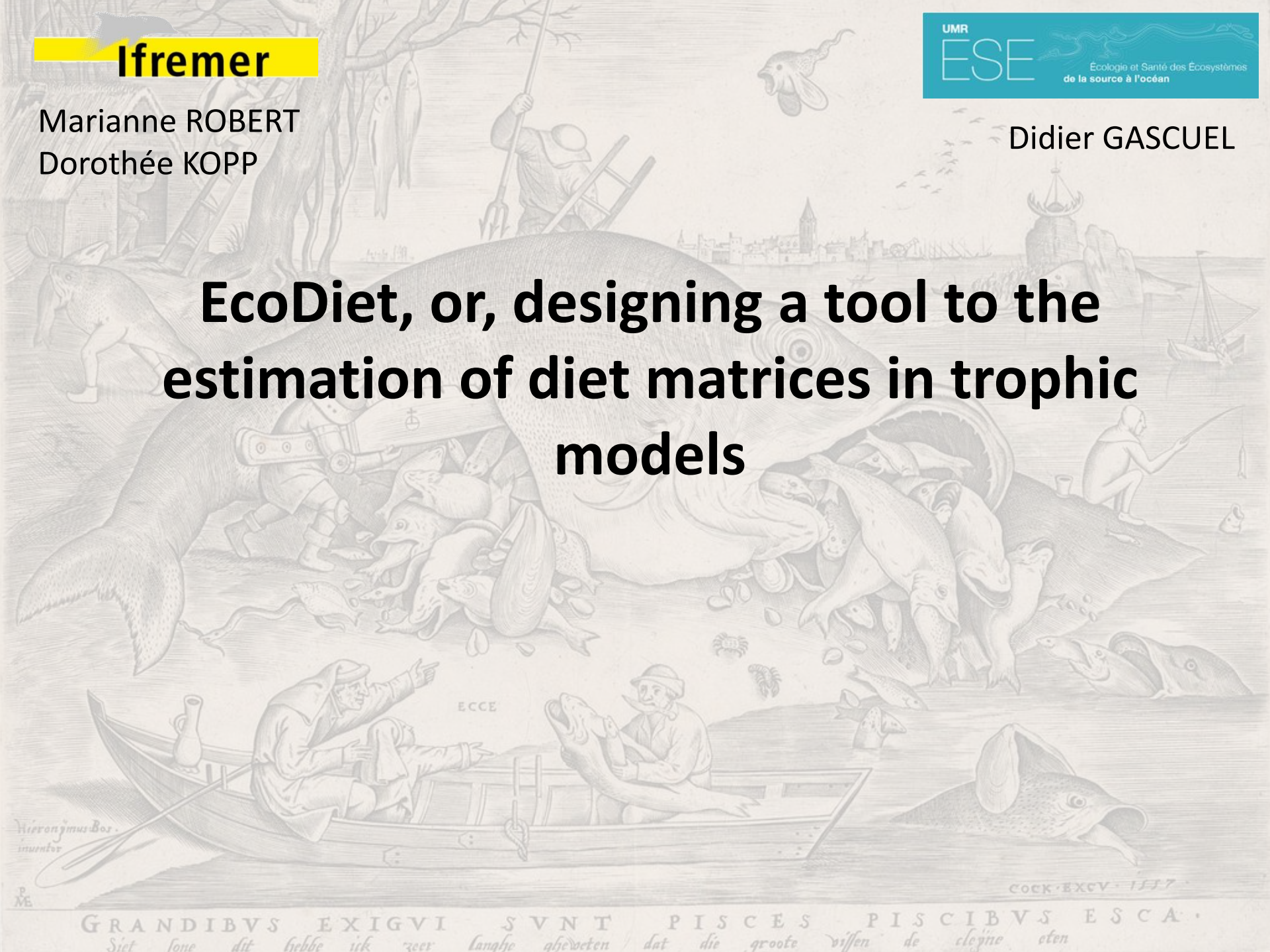
Ifremer

Marianne ROBERT
Dorothée KOPP

UMR ESE Écologie et Santé des Écosystèmes de la source à l'océan

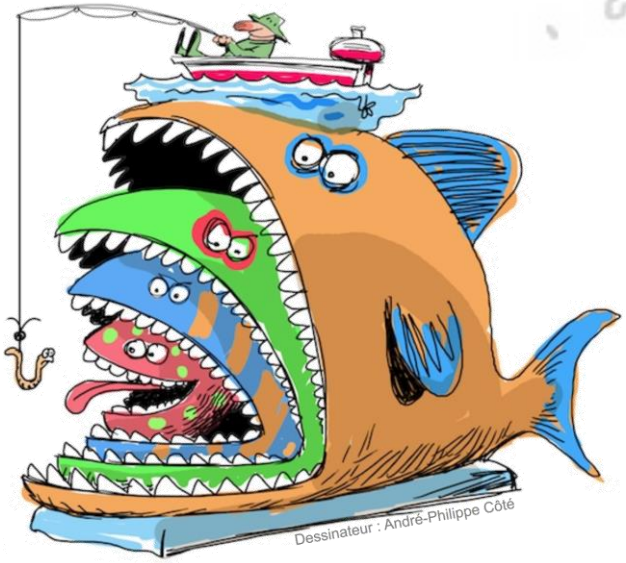
Didier GASCUEL

EcoDiet, or, designing a tool to the estimation of diet matrices in trophic models



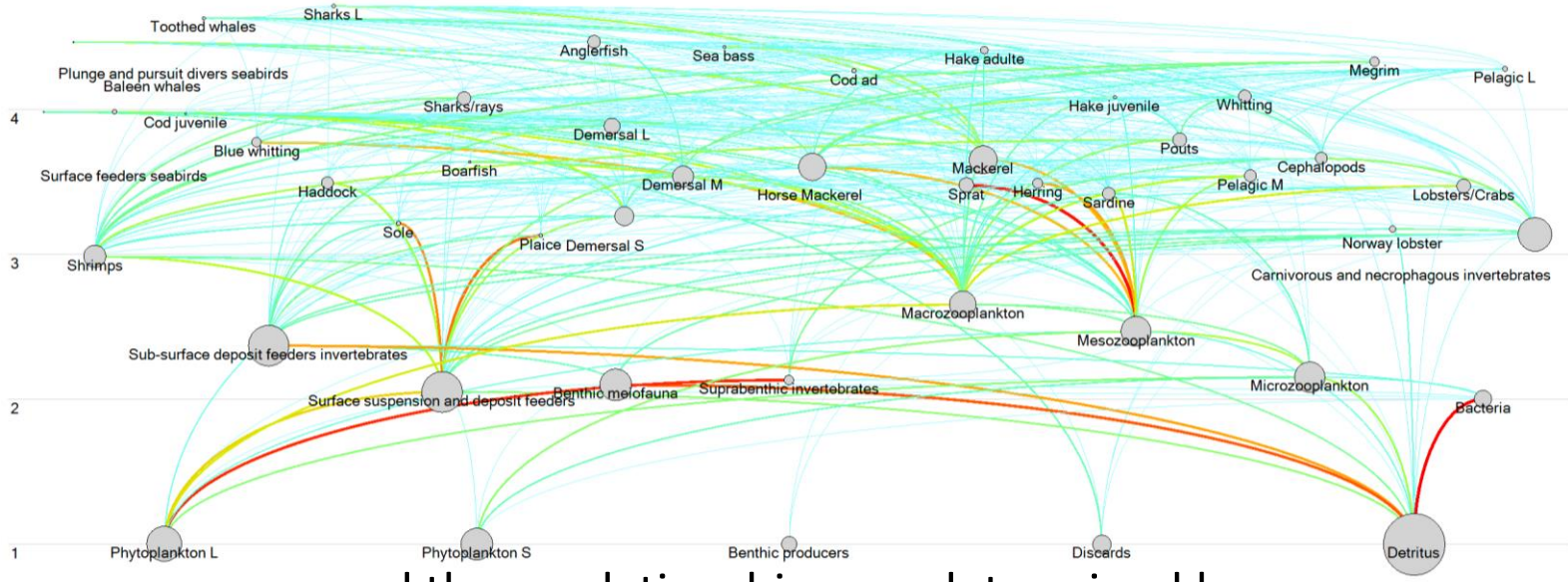
~~CONTEXTE~~

INTRO



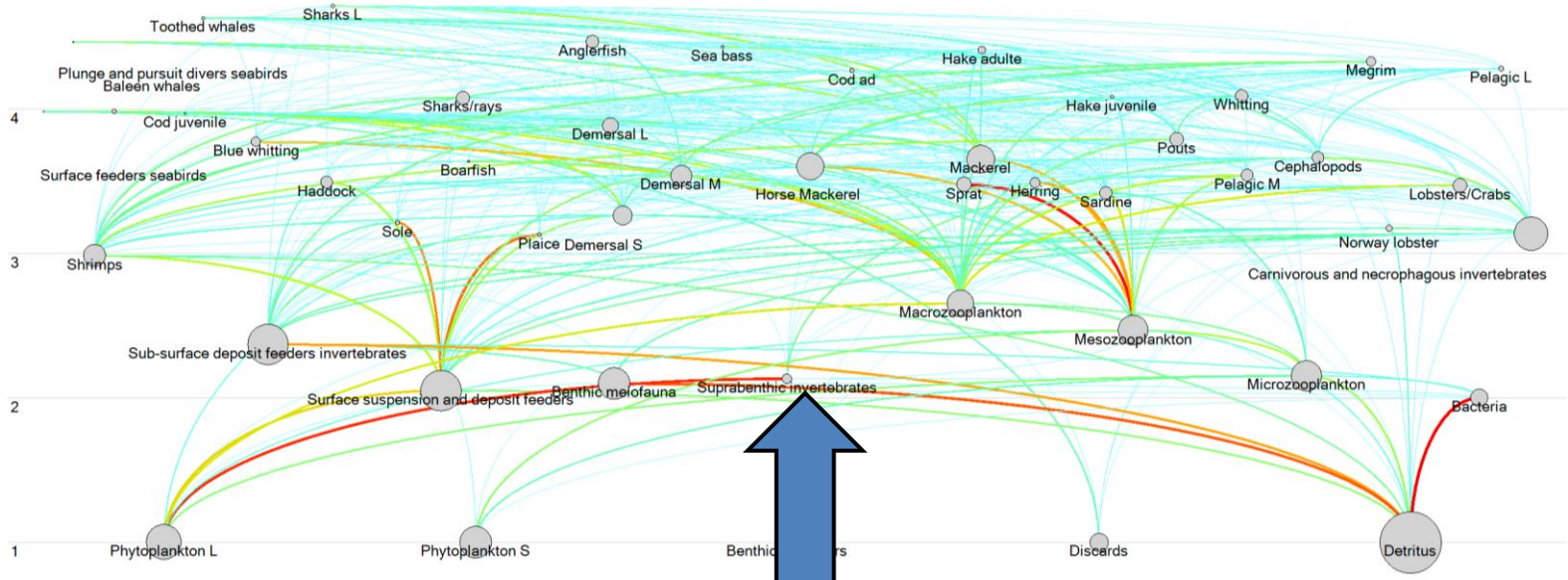
THE DIET MATRIX

Species or trophic connected together through predator/prey relationships



…and these relationships are determined by…

THE DIET MATRIX



Prey \ predator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 Plunge and pursuit divers seabirds																					
2 Surface feeders seabirds																					
3 Baleen whales																					
4 Toothed whales																					
5 Sharks L				0,00518	0,0137																
6 Sharks/rays				0,00518	0,0301	0,000259	0,0287		0,0425												
7 Anglerfish				0,0300	0,0200	0,00501			0,00400											0,00484	
8 Sea bass					0,00266		0,00202														
9 Cod ad				0,00351	0,00701		0,00200					0,00400								0,00499	
10 Cod juvenile						0,00230	0,00100		0,000528	0,00500		0,00403	0,000096							0,00140	
11 Blue whitting				0,0665	0,00137	0,00829	0,0101		0,0323		0,0104	0,00876	0,0163		0,0173						
12 Hake adulte				0,00324	0,0165	0,00204	0,0150					0,0252								0,00173	
13 Hake juvenile				0,00405		0,000973	0,00810			0,00792		0,0201	0,0179								
14 Haddock					0,00100	0,00501						0,0806			0,0200					0,00500	
15 Whitting				0,00445	0,00411	0,00404	0,0302	0,126	0,00300	0,000450		0,0705	0,00674							0,0245	
16 Megrim					0,00822	0,00829	0,00403		0,000222			0,000598								0,00835	
17 Sole				0,00351		0,00100	0,00100		0,00500			0,00806				0,00130				0,000870	
18 Boarfish							0,00100					0,00503									
19 Plaice				0,000498		0,000907	0,000609		0,0180			0,0201								0,00245	
20 Demersal L				0,00608	0,00753	0,00518	0,0356		0,00462	0,00989			0,00379		0,0116	0,0129				0,0269	
21 Demersal M	0,0594			0,0190	0,0120	0,0701	0,171		0,0500	0,0200	0,0100	0,0161	0,00300	0,0500	0,0210	0,254				0,0858	
22 Demersal S			0,0869	0,115	0,0572	0,0805	0,0828		0,115	0,424	0,126	0,00478	0,0227	0,103	0,0150	0,239				0,115	
23 Horse Mackerel	0,187	0,150		0,0407	0,0569	0,00801	0,0670	0,00499	0,0400			0,181	0,350		0,130						
24 Mackerel	0,454	0,307	0,160	0,205	0,365	0,0110	0,00288	0,390	0,0600			0,166			0,00900	0,0800					
25 Sprat		0,0300		0,0154	0,00411	0,0167	0,00230		0,00369	0,00759		0,0252		0,0516	0,0613	0,0257					
26 Herring	0,0511	0,0300	0,0400	0,0190		0,00404	0,0143	0,01000	0,00200			0,0302			0,00400						
27 Sardine	0,119	0,118		0,0495	0,00398	0,00975	0,00101	0,0890	0,00921			0,0234	0,0227	0,0416	0,00578					0,00858	
28 Pouts				0,0892	0,0100	0,00777	0,0504	0,00551	0,168	0,00708		0,0467	0,0278		0,231						
29 Pelagic L				0,01000	0,110	0,000829						0,00403									
30 Pelagic M	0,0831	0,0800	0,0483	0,0397	0,0103	0,00518		0,0341				0,000305	0,00676		0,0578					0,0116	
31 Cephalopods			0,0670	0,226	0,170	0,149	0,0310	0,0110	0,00646	0,00124		0,000359		0,0140	0,0347	0,0776				0,00407	
32 Norway lobster						0,00104	0,0345													0,00613	
33 Lobsters/Crabs					0,0100	0,0103	0,0504	0,0262	0,0397		0,0301									0,00613	
34 Shrimps					0,0501	0,272	0,0655	0,0366	0,212	0,1000	0,0971	0,0201	0,00758	0,0230		0,275	0,110	0,150		0,208	0,180
35 Carnivorous and necrophagous invertebrates					0,00701	0,0634	0,0300	0,121	0,0200		0,0171	0,0201	0,00758	0,00999	0,00115	0,0340		0,100		0,0123	0,0690

…the DIET MATRIX !

THE DIET MATRIX

Predators (=consumers)

Preys (=sources)

Producers

	Prey \ predator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	2
1	Plunge and pursuit divers seabirds																												
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17	Sole				0,00351		0,00100	0,00100		0,00500			0,00806				0,00130				0,000870								
18	Boarfish							0,00100					0,00503																
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20	Demersal L				0,00608	0,00753	0,00518	0,0356		0,00462	0,00989			0,00379		0,0116	0,0129				0,0269								
21	Demersal M	0,0594			0,0190	0,0120	0,0701	0,171		0,0500	0,0200	0,0100	0,0161	0,00300	0,0500	0,0210	0,254				0,0858								
22	Demersal S			0,0868	0,115	0,0572	0,0805	0,0828		0,115	0,424	0,126	0,00478	0,0227	0,103	0,0150	0,239				0,115		0,00158	0,0104	0,0200				0,0
23	Horse Mackerel	0,187	0,150		0,0407	0,0569	0,00801	0,0670	0,00499	0,0400			0,181	0,350		0,130													
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25	Sprat		0,0300		0,0154	0,00411	0,0167	0,00230		0,00369	0,00759		0,0252		0,0516	0,0613	0,0257							0,0259	0,0310				0,00
26	Herring	0,0511	0,0300	0,0400	0,0190		0,00404	0,0143	0,01000	0,00200			0,0302			0,00400									0,00500				0,00
27	Sardine	0,119	0,118		0,0495	0,00398	0,00975	0,00101	0,0890	0,00921			0,0234	0,0227	0,0416	0,00578					0,00858			0,0102	0,0110				
28	Pouts				0,0892	0,0100	0,00777	0,0504	0,00551	0,168	0,00708		0,0467	0,0278		0,231													
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32	Norway lobster						0,00104	0,0345													0,00613								
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34	Shrimps					0,0501	0,272	0,0655	0,0367	0,212	0,1000	0,0971	0,0201	0,0758	0,0230		0,275	0,110	0,150		0,208	0,180	0,160	0,0368			0,0500		0,1
35	Carnivorous and necrophagous invertebrates					0,00701	0,0634	0,0300	0,121	0,0200		0,0171	0,0201	0,00758	0,00999	0,00115	0,0340		0,100		0,0123	0,0690	0,0450	0,0100					0,1
36	Sub-surface deposit feeders invertebrates					0,0100		0,0101	0,0262	0,000073			0,0201	0,0197	0,140	0,0509		0,189	0,100	0,250	0,245	0,00900	0,0469	0,0102				0,0400	0,0
37	Surface suspension and deposit feeders						0,106			0,0700		0,0522			0,394	0,0289		0,701	0,100	0,750	0,0785	0,309	0,375	0,0307				0,0500	0,0
38	Benthic meiofauna																												
39	Suprabenthic invertebrates										0,00300		0,0199	0,0379													0,0200		
40	Macrozooplankton		0,0852	0,443	0,0180		0,0781	0,0560	0,0920	0,0530	0,203	0,587	0,134	0,230	0,0700	0,145				0,411	0,0880	0,335	0,0336	0,234	0,240	0,0500	0,184	0,210	0,1
41	Mesozooplankton			0,154			0,0591		0,0280	0,0400	0,211	0,0701	0,0403	0,136	0,0530	0,0700				0,139	0,0490	0,0982	0,193	0,601	0,604	0,950	0,650	0,500	0,0
42	Microzooplankton													0,0152		0,00462									0,0190		0,0960	0,200	
43	Bacteria																												
44	Phytoplankton L																						0,125						
45	Phytoplankton S																												
46	Benthic producers																												
47	Discards	0,0475	0,200																										
48	Detritus					0,000664	0,00402								0,0500	0,0810													
49	Import	0,000	0,000	0,000	0,0210	0,01000	0,000	0,191	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,0
50	Sum	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,0
51	(1 - Sum)	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,0

THE DIET MATRIX

Predators (=consumers)

Preys (=sources)

Producers

	Prey \ predator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	Plunge and pursuit divers seabirds																											
2	Surface feeders seabirds																											
3	Baleen whales																											
4	Toothed whales																											
5	Sharks L				0,00518	0,0137																						
6	Sharks/rays				0,00518	0,0301	0,000259	0,0287		0,0425																		
7	Anglerfish				0,0300	0,0200	0,00501			0,00400											0,00484							
8	Sea bass					0,00266		0,00202																				
9	Cod ad				0,00351	0,00701		0,00200					0,00400								0,00499							
10	Cod juvenile						0,00230	0,00100		0,000528	0,00500		0,00403	0,000096							0,00140							
11	Blue whitting				0,0665	0,00137	0,00829	0,0101		0,0323		0,0104	0,00876	0,0163		0,0173												
12	Hake adulte				0,00324	0,0165	0,00204	0,0150					0,0252								0,00173							
13	Hake juvenile				0,00405		0,000973	0,00810			0,00792		0,0201	0,0179														
14	Haddock					0,00100	0,00501						0,0806			0,0200					0,00500							
15	Whitting				0,00445	0,00411	0,00404	0,0302	0,12(	0,00300	),000450		0,0705	0,00674							0,0245							
16	Megrim					0,00822	0,00829	0,00403		0,000222			0,000598								0,00835							
17	Sole				0,00351		0,00100	0,00100		0,00500			0,00806				0,00130				0,000870							
18	Boarfish							0,00100					0,00503															
19	Plaice				0,000498		0,000907	0,000609		0,0180			0,0201								0,00245							0,00
20	Demersal L				0,00608	0,00753	0,00518	0,0356		0,00462	0,00989			0,00379		0,0116	0,0129				0,0269							
21	Demersal M	0,0594			0,0190	0,0120	0,0701	0,171		0,0500	0,0200	0,0100	0,0161	0,00300	0,0500	0,0210	0,254				0,0858							
22	Demersal S			0,0868	0,115	0,0572	0,0805	0,0828		0,115	0,424	0,126	0,00478	0,0227	0,103	0,0150	0,239				0,115		0,00158	0,0104	0,0200				0,0
23	Horse Mackerel	0,187	0,150		0,0407	0,0569	0,00801	0,0670	0,004	0,0400			0,181	0,350		0,130												
24	Mackerel	0,454	0,307	0,160	0,205	0,365	0,0110	0,00288	0,39(	0,0600			0,166			0,00900	0,0800											
25	Sprat		0,0300		0,0154	0,00411	0,0167	0,00230		0,00369	0,00759		0,0252		0,0516	0,0613	0,0257							0,0259	0,0310				0,00
26	Herring	0,0511	0,0300	0,0400	0,0190		0,00404	0,0143	0,010(	0,00200			0,0302			0,00400									0,00500				0,00
27	Sardine	0,119	0,118		0,0495	0,00398	0,00975	0,00101	0,089	0,00921			0,0234	0,0227	0,0416	0,00578					0,00858			0,0102	0,0110				
28	Pouts				0,0892	0,0100	0,00777	0,0504	0,005	0,168	0,00708		0,0467	0,0278		0,231												
29	Pelagic L				0,01000	0,110	0,000829						0,00403															
30	Pelagic M	0,0831	0,0800	0,0482	0,0397	0,0103	0,00518		0,034				0,000305	0,00676		0,0578					0,0116							
31	Cephalopods			0,0670	0,226	0,170	0,149	0,0310	0,011	0,00646	0,00124		0,000359		0,0140	0,0347	0,0776				0,00407			0,0204	0,0700				0,0
32	Norway lobster						0,00104	0,0345													0,00613							
33	Lobsters/Crabs					0,0100	0,0103	0,0504	0,026	0,0397		0,0301									0,00613		0,0200	0,0102					0,0
34	Shrimps					0,0501	0,272	0,0655	0,036	0,212	0,1000	0,0971	0,0201	0,0758	0,0230		0,275	0,110	0,150		0,208	0,180	0,160	0,0368			0,0500		0,1
35	Carnivorous and necrophagous invertebrates					0,00701	0,0634	0,0300	0,12	0,0200		0,0171	0,0201	0,00758	0,00999	0,00115	0,0340		0,100		0,0123	0,0690	0,0450	0,0100					0,1
36	Sub-surface deposit feeders invertebrates					0,0100		0,0101	0,026	0,000073			0,0201	0,0197	0,140	0,0509		0,189	0,100	0,250	0,245	0,00900	0,0469	0,0102				0,0400	0,0
37	Surface suspension and deposit feeders						0,106			0,0700		0,0522			0,394	0,0289		0,701	0,100	0,750	0,0785	0,309	0,375	0,0307				0,0500	0,0
38	Benthic meiofauna																											
39	Suprabenthic invertebrates										0,00300		0,0199	0,0379													0,0200	
40	Macrozooplankton		0,0852	0,443	0,0180		0,0781	0,0560	0,092	0,0530	0,203	0,587	0,134	0,230	0,0700	0,145				0,411	0,0880	0,335	0,0336	0,234	0,240	0,0500	0,184	0,210	0,1
41	Mesozooplankton			0,154			0,0591		0,028	0,0400	0,211	0,0701	0,0403	0,136	0,0530	0,0700				0,139	0,0490	0,0982	0,193	0,601	0,604	0,950	0,650	0,500	0,0
42	Microzooplankton													0,0152		0,00462									0,0190		0,0960	0,200	
43	Bacteria																											
44	Phytoplankton L																						0,125					
45	Phytoplankton S																											
46	Benthic producers																											
47	Discards	0,0475	0,200																									
48	Detritus					0,000664	0,00402								0,0500	0,0810												
49	Import	0,000	0,000	0,000	0,0210	0,01000	0,000	0,191	0,00(	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,0
50	Sum	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,00(	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,0
51	(1 - Sum)	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,00(	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,0

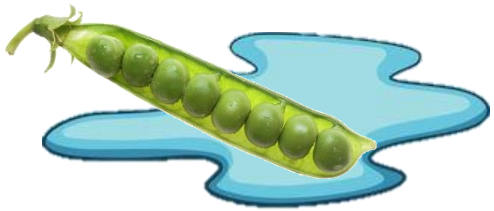
THE DIET MATRIX

	Cod
Sharks/rays	0,04
Blue whiting	0,03
Sole	0,01
Plaice	0,02
Demersal M	0,05
Demersal S	0,12
Horse mack.	0,04
Mackerel	0,06
Sardine	0,01
Pouts	0,17
Cephalopods	0,01
Lobsters/Crabs	0,04
Shrimps	0,21
Carn/necro	0,02
SSDF	0,07
Macrozoo	0,05
Mesozoo	0,04
Sum	1,00

The « cod case »

« je mange ***% de bidule,
***% de truc,
***% de machin ……. »

Unité =



THE DIET MATRIX

- Generally, diet matrix are based on information from the literature

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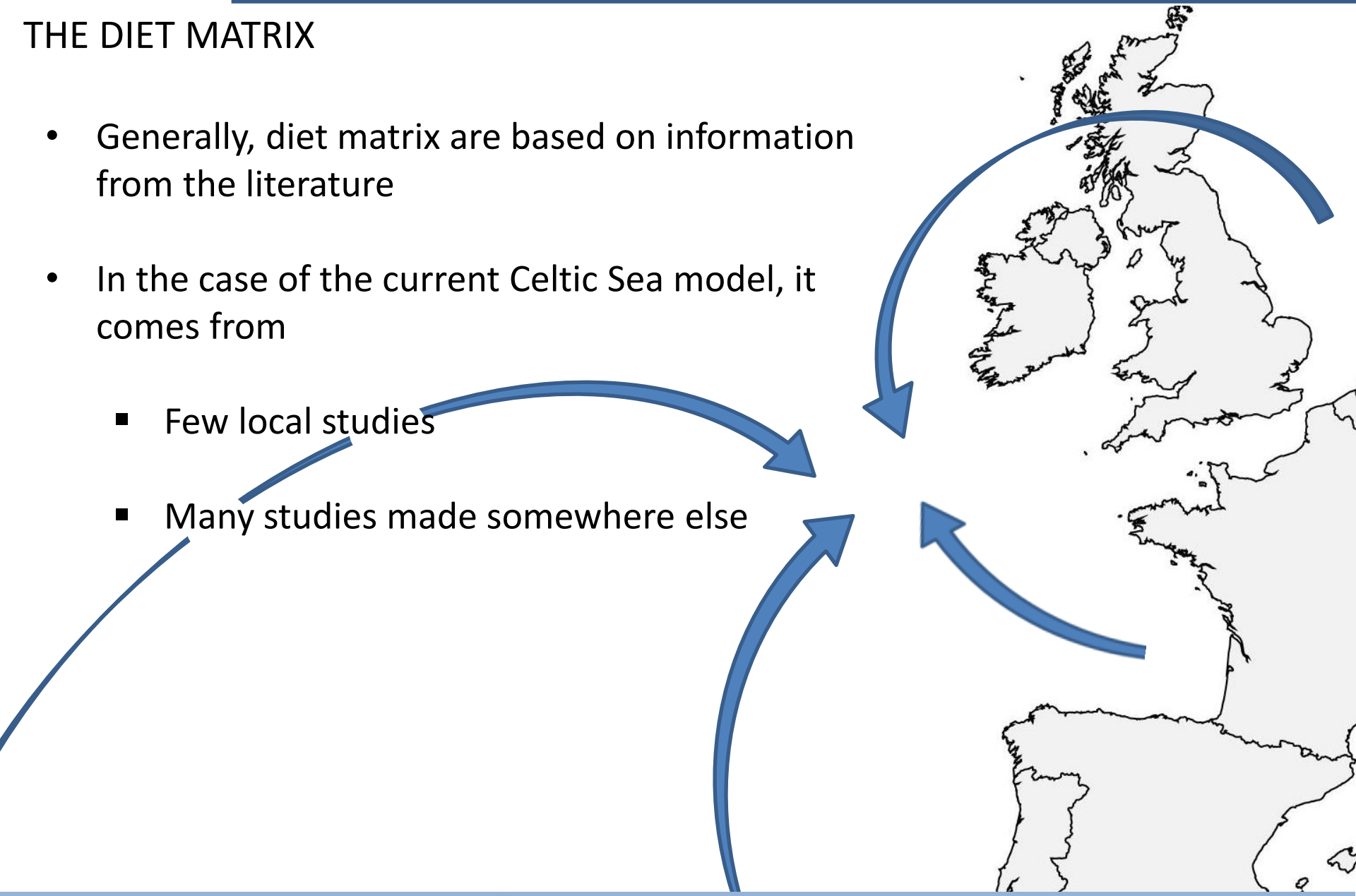
  - Few local studies

THE DIET MATRIX

- Generally, diet matrix are based on information from the literature
- In the case of the current Celtic Sea model, it comes from
  - Few local studies
  - Many studies made somewhere else



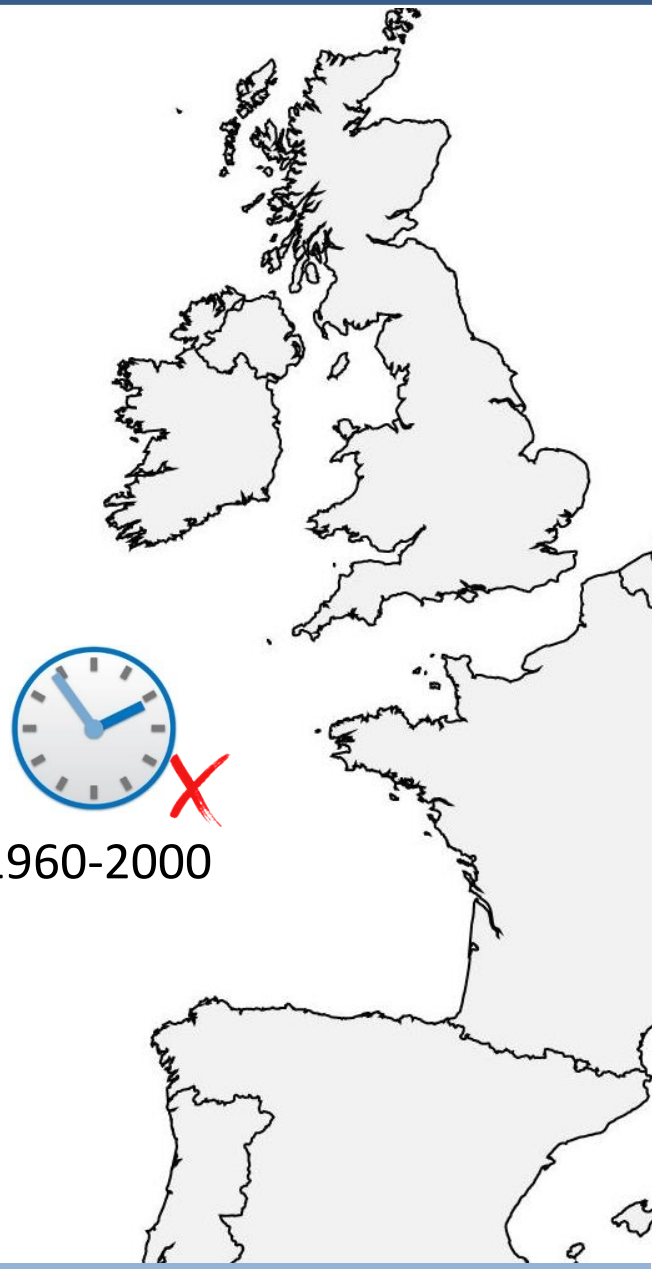
THE DIET MATRIX

- Generally, diet matrix are based on information from the literature
- In the case of the current Celtic Sea model, it comes from
  - Few local studies
  - Many studies made somewhere else
  - Some recent studies

> 2000

THE DIET MATRIX

- Generally, diet matrix are based on information from the literature
- In the case of the current Celtic Sea model, it comes from
  - Few local studies
  - Many studies made somewhere else
  - Some recent studies
  - Many old studies



1960-2000

THE DIET MATRIX

- Generally, diet matrix are based on information from the literature
- In the case of the current Celtic Sea model, it comes from
  - Few local studies
  - Many studies made somewhere else
  - Some recent studies
  - Many old studies

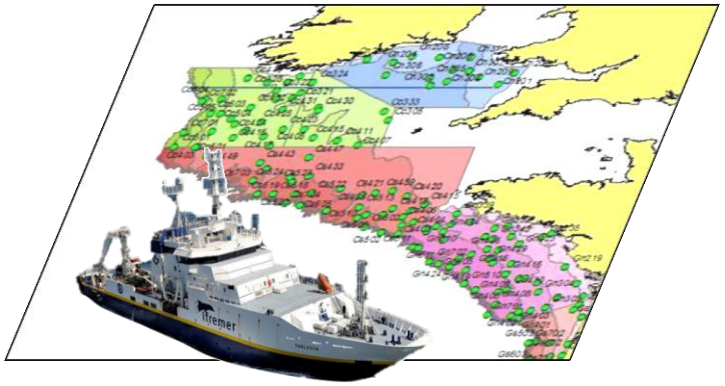
→ NEED OF BETTER INFORMATION
(local and relevant)
ON SPECIES INTERACTIONS

A GREAT OPPORTUNITY FOR TROPHIC MODELING IN THE CELTIC SEA

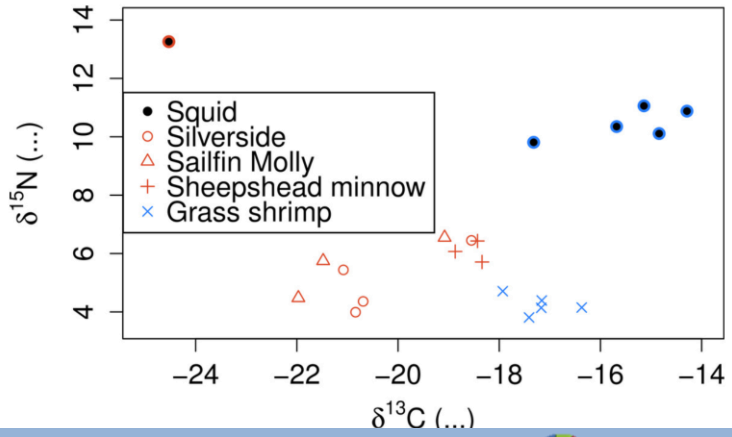
- EATME Project – IFREMER Lorient

- EVHOE survey 2014-2016 – Celtic Sea

- More than 2000 samples



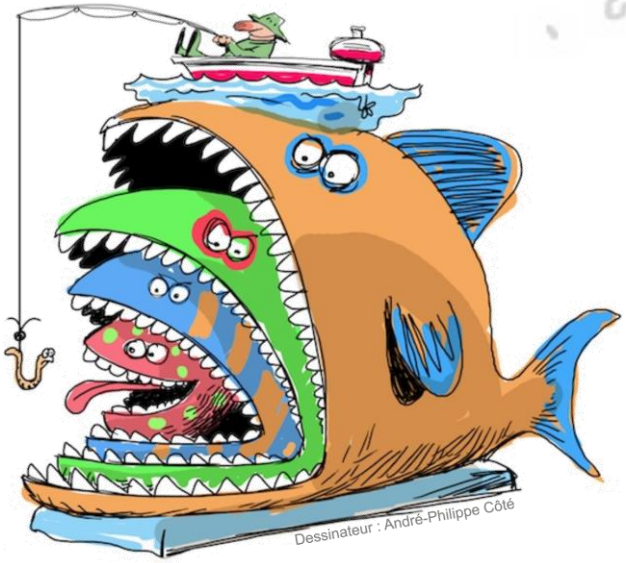
Stable isotops analysis (SIA)



+

Stomach contents analysis (SCA)

METHODS



CONSIDERATIONS ABOUT THE DATA:

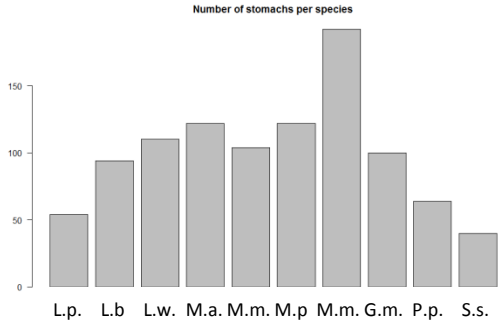
- HOW TO USE EACH TYPE OF DATA?
- EVENTUAL DATA PREPARATION

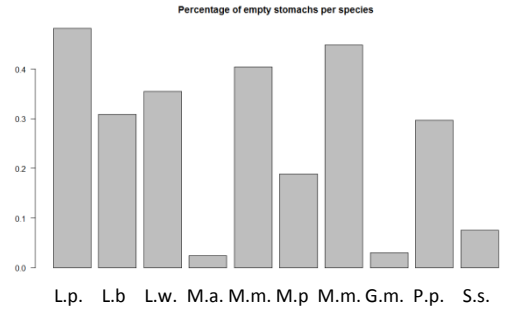
STOMACH CONTENT ANALYSIS

- 10 main commercial species

- > 1000 stomachs analyzed

  75 % of non empty





- Identification as precise as possible of taxa - 206 different taxa
- Occurrence, numerical, ~~gravimetric, volumetric~~ ()

STOMACH CONTENT ANALYSIS

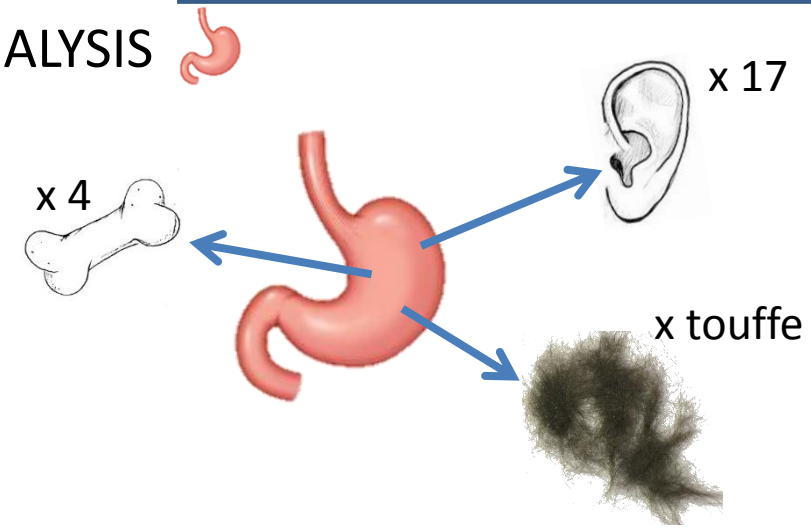
STOMACH CONTENT ANALYSIS

Consumer_id | Prey_id | detail | Nb_items | Finest taxon

campagn	station	Latitud	Longitu	taille	Nom.latin	code_ind	Mass	Masse	Masse	No	Pa	Code_Proie.	Prey_Phy	Prey_S	Prey_Su	Prey_Cla	Prey_Sub	Prey_Si	Prey_Or	Prey_Sul	Prey_In	Prey_Si	Prey_F	Prey_G	Prey_S	Prey_Nb	Remarks	Prey_Taxon	Prey_Ta
EVHOE	CC322	50.921	-9.6318	39	Gadus morhua	GM-Z1-1	25.11	19.77	5.34	1	0	GM-Z1-1-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	NA	NA	NA	NA	NA	NA	NA	A	1	1 paire d'yeu	Eumalacostra	
EVHOE	CC322	50.921	-9.6318	39	Gadus morhua	GM-Z1-1	25.11	19.77	5.34	1	0	GM-Z1-1-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	NA	NA	NA	NA	A	1	1 paire d'yeu	Brachyura	
EVHOE	CC323	51.039	-9.636	38	Gadus morhua	GM-Z1-10	30.37	18.63	11.74	1	0	GM-Z1-10-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	NA	NA	NA	NA	NA	NA	NA	A	3	3 paires d'ye	Eucarida	
EVHOE	CC323	51.039	-9.636	38	Gadus morhua	GM-Z1-10	30.37	18.63	11.74	1	0	GM-Z1-10-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	NA	NA	NA	NA	A	1	carapace san	Brachyura	
EVHOE	CC323	51.039	-9.636	38	Gadus morhua	GM-Z1-10	30.37	18.63	11.74	1	0	GM-Z1-10-3	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	Portun	Polybii	Liocarci	NA	A	1		Liocarcinus	
EVHOE	CC323	51.039	-9.636	39	Gadus morhua	GM-Z1-11	38.13	14.68	23.45	1	0	GM-Z1-11-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Caridea	Pandal	Pandal	NA	NA	A	3	3 queues, 3 t	Pandalidae	
EVHOE	CC323	51.039	-9.636	39	Gadus morhua	GM-Z1-11	38.13	14.68	23.45	1	0	GM-Z1-11-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	NA	NA	NA	NA	NA	NA	NA	NA	A	7	1 queue, 4 p	Eumalacostra	
EVHOE	CC323	51.039	-9.636	39	Gadus morhua	GM-Z1-11	38.13	14.68	23.45	1	0	GM-Z1-11-3	Echinode	Astero	NA	Ophiuro	NA	NA	Ophiuri	Ophiurir	Chiloph	NA	Ophiur	Ophiur	NA	A	1	1 disque san	Ophiura	
EVHOE	CC323	51.039	-9.636	39	Gadus morhua	GM-Z1-11	38.13	14.68	23.45	1	0	GM-Z1-11-4	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Anomur	NA	NA	NA	NA	A	2	3 P1 (2 gauch	Anomura	
EVHOE	CC323	51.039	-9.636	38	Gadus morhua	GM-Z1-12	21.7	16.02	5.68	1	1	GM-Z1-12-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Caridea	Process	Process	NA	NA	A	1	rostre tronqu	Processidae	
EVHOE	CC323	51.039	-9.636	51	Gadus morhua	GM-Z1-13	81.61	56.56	25.05	1	1	GM-Z1-13-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	NA	NA	NA	NA	A	1	péréiopodes	Brachyura	
EVHOE	CC323	51.039	-9.636	51	Gadus morhua	GM-Z1-13	81.61	56.56	25.05	1	1	GM-Z1-13-2	Chordata	Verteb	Gnatho	Actinopt	NA	NA	NA	NA	NA	NA	NA	NA	NA	A	1	chair, arêtes	Actinopteri	
EVHOE	CC323	51.039	-9.636	42	Gadus morhua	GM-Z1-14	26.89	24.49	2.4	0	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	
EVHOE	CC323	51.039	-9.636	41	Gadus morhua	GM-Z1-15	22.52	20.14	2.38	1	1	GM-Z1-15-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Caridea	Crango	Crango	Crango	Crang	A	1	entière	Crangon alln	
EVHOE	CC323	51.039	-9.636	41	Gadus morhua	GM-Z1-15	22.52	20.14	2.38	1	1	GM-Z1-15-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Caridea	Crango	NA	NA	NA	A	1	1 pince subcl	Crangonoide	
EVHOE	CC323	51.039	-9.636	37	Gadus morhua	GM-Z1-16	20.66	15.5	5.16	1	0	GM-Z1-16-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	NA	NA	NA	NA	NA	NA	NA	NA	A	21	5 têtes sans l	Eumalacostra	
EVHOE	CC323	51.039	-9.636	37	Gadus morhua	GM-Z1-16	20.66	15.5	5.16	1	0	GM-Z1-16-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	NA	NA	NA	NA	A	1	1 œil, 1 pinc	Brachyura	
EVHOE	CC323	51.039	-9.636	51	Gadus morhua	GM-Z1-17	67.62	56.88	10.74	1	1	GM-Z1-17-1	Mollusca	NA	NA	Bivalvia	Pteriomc	NA	Pectino	NA	NA	Pectinc	Pectini	Palliolu	Pallio	A	2	1 bivalve, 1 v	Palliolum tig	
EVHOE	CC323	51.039	-9.636	51	Gadus morhua	GM-Z1-17	67.62	56.88	10.74	1	1	GM-Z1-17-2	Chordata	Verteb	Gnatho	Actinopt	NA	NA	NA	NA	NA	NA	NA	NA	NA	A	1	arc branchial	Actinopteri	
EVHOE	CC323	51.039	-9.636	35	Gadus morhua	GM-Z1-18	26.97	15.83	11.14	1	0	GM-Z1-18-1	Mollusca	NA	NA	Bivalvia	Pteriomc	NA	Pectino	NA	NA	Pectinc	Pectini	Palliolu	Pallio	A	1	1 bivalve	Palliolum tig	
EVHOE	CC323	51.039	-9.636	35	Gadus morhua	GM-Z1-18	26.97	15.83	11.14	1	0	GM-Z1-18-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	NA	NA	NA	NA	NA	NA	NA	A	8	8 paires d'ye	Eucarida	
EVHOE	CC323	51.039	-9.636	35	Gadus morhua	GM-Z1-18	26.97	15.83	11.14	1	0	GM-Z1-18-3	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	NA	NA	NA	NA	A	1	1 paire d'yeu	Brachyura	
EVHOE	CC323	51.039	-9.636	35	Gadus morhua	GM-Z1-18	26.97	15.83	11.14	1	0	GM-Z1-18-4	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	Portun	Polybii	Liocarci	Liocar	A	2	2 pinces, 1 cc	Liocarcinus v	
EVHOE	CC323	51.039	-9.636	35	Gadus morhua	GM-Z1-18	26.97	15.83	11.14	1	0	GM-Z1-18-5	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	Xantho	Xanthi	NA	NA	A	1	1 corps entie	Xanthidae	
EVHOE	CC323	51.039	-9.636	35	Gadus morhua	GM-Z1-18	26.97	15.83	11.14	1	0	GM-Z1-18-6	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	Cancroi	Atelec	Atelec	Atele	A	1	1 corps entie	Atelecyclus r	
EVHOE	CC327	51.161	-9.9233	39	Gadus morhua	GM-Z1-19	34.65	17.63	17.02	1	0	GM-Z1-19-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	Portun	Polybii	Macrop	Macrc	A	1	entier	Macropipus	
EVHOE	CC327	51.161	-9.9233	39	Gadus morhua	GM-Z1-19	34.65	17.63	17.02	1	0	GM-Z1-19-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	NA	NA	NA	NA	A	5	1 chair carap	Brachyura	
EVHOE	CC327	51.161	-9.9233	39	Gadus morhua	GM-Z1-19	34.65	17.63	17.02	1	0	GM-Z1-19-3	Mollusca	NA	NA	Bivalvia	Heterodc	NA	Carditoi	NA	NA	Crassat	Astarti	Astarte	Astart	A	1	entière	Astarte sulca	
EVHOE	CC327	51.161	-9.9233	39	Gadus morhua	GM-Z1-19	34.65	17.63	17.02	1	0	GM-Z1-19-4	Echinode	Echino	NA	Echinoic	NA	NA	NA	NA	NA	NA	NA	NA	NA	A	1	fragments d	Echinoidea	
EVHOE	CC322	50.921	-9.6318	41	Gadus morhua	GM-Z1-2	31.58	24.28	7.3	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	
EVHOE	CC327	51.161	-9.9233	31	Gadus morhua	GM-Z1-20	10.58	8.4	2.18	1	0	GM-Z1-20-1	Annelida	NA	NA	Polychae	NA	NA	NA	NA	NA	NA	NA	NA	NA	A	1	tube membr	Polychaeta	
EVHOE	CC327	51.161	-9.9233	31	Gadus morhua	GM-Z1-20	10.58	8.4	2.18	1	0	GM-Z1-20-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Caridea	Pandal	Pandal	NA	NA	A	1	céphalo rost	Pandalidae	
EVHOE	CC327	51.161	-9.9233	31	Gadus morhua	GM-Z1-20	10.58	8.4	2.18	1	0	GM-Z1-20-3	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Anomur	NA	NA	NA	NA	A	1	tête sans ros	Anomura	
EVHOE	CC327	51.161	-9.9233	31	Gadus morhua	GM-Z1-20	10.58	8.4	2.18	1	0	GM-Z1-20-4	Mollusca	NA	NA	Gastropc	Caenogas	NA	Littorini	NA	NA	Naticoi	Naticid	NA	NA	A	1	columelle tr	Naticidae	
EVHOE	CC327	51.161	-9.9233	35	Gadus morhua	GM-Z1-21	15.27	10.6	4.67	1	0	GM-Z1-21-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	NA	NA	NA	NA	NA	NA	NA	NA	A	3	3 têtes	Eumalacostra	
EVHOE	CC327	51.161	-9.9233	35	Gadus morhua	GM-Z1-21	15.27	10.6	4.67	1	0	GM-Z1-21-2	Mollusca	NA	NA	Bivalvia	Pteriomc	NA	Pectino	NA	NA	Pectinc	Pectini	Palliolu	Pallio	A	1	1 bivalve	Palliolum tig	
EVHOE	CC327	51.161	-9.9233	35	Gadus morhua	GM-Z1-21	15.27	10.6	4.67	1	0	GM-Z1-21-3	Chordata	Verteb	Gnatho	Actinopt	NA	NA	NA	NA	NA	NA	NA	NA	NA	A	1	1 otolithe tr	Actinopteri	
EVHOE	CC327	51.161	-9.9233	48	Gadus morhua	GM-Z1-22	46.97	27.47	19.5	1	0	GM-Z1-22-1	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	Leucosi	Leucos	Ebalia	Ebalia	A	1	carapace ave	Ebalia tuber	
EVHOE	CC327	51.161	-9.9233	48	Gadus morhua	GM-Z1-22	46.97	27.47	19.5	1	0	GM-Z1-22-2	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Anomur	Paguro	Paguric	NA	NA	A	1	1 corps avec	Paguridae	
EVHOE	CC327	51.161	-9.9233	48	Gadus morhua	GM-Z1-22	46.97	27.47	19.5	1	0	GM-Z1-22-3	Arthropo	Crustac	Multicri	Malacos	Eumalacc	Eucarid	Decapo	Pleocym	Brachyu	NA	NA	NA	NA	A	2	1 pince	Brachyura	

STOMACH CONTENT ANALYSIS

Number of prey items per stomach



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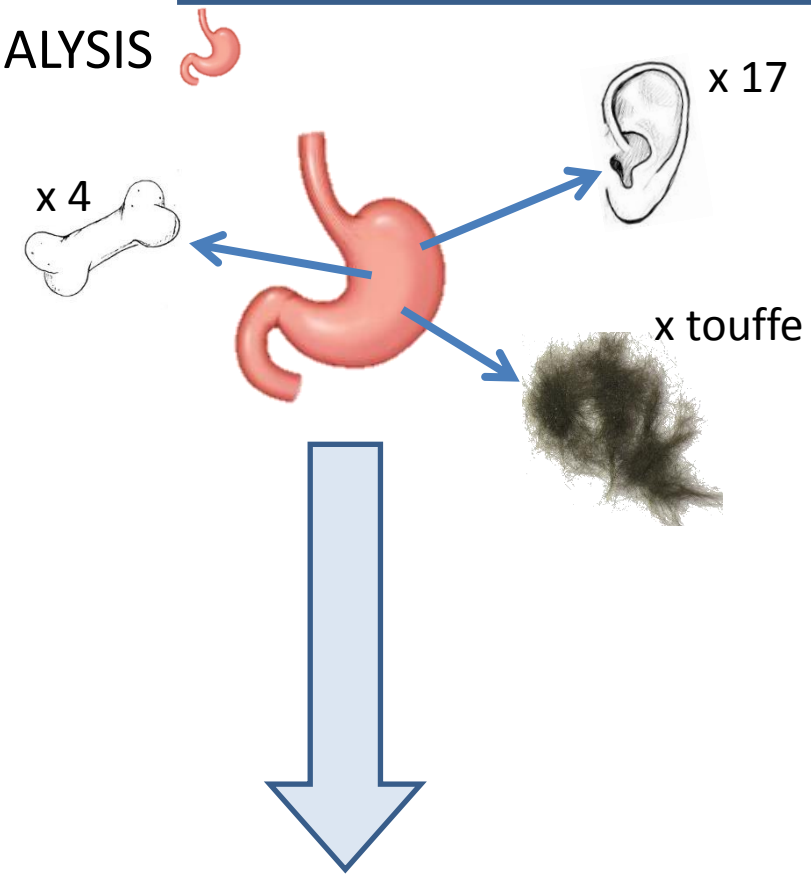

Eaten quantity of each prey type

STOMACH CONTENT ANALYSIS

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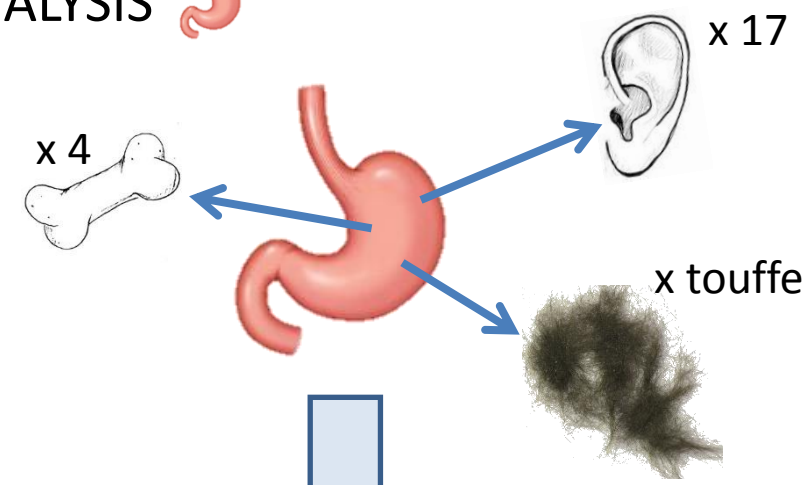
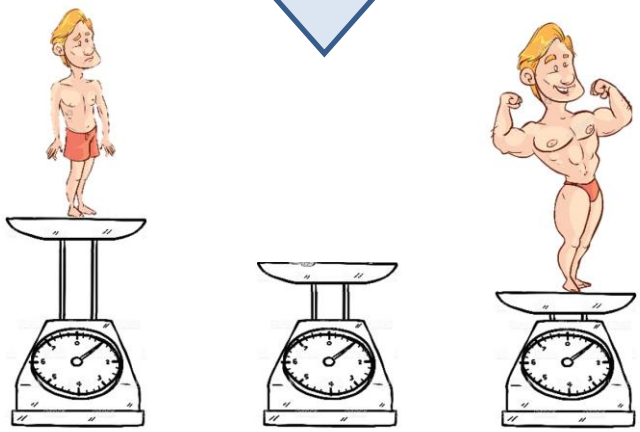


- Number → Weight?
- Question of digestibility

PREY ITEMS = ESTIMATORS OF MATTER FLOWS?

Eaten quantity of each prey type



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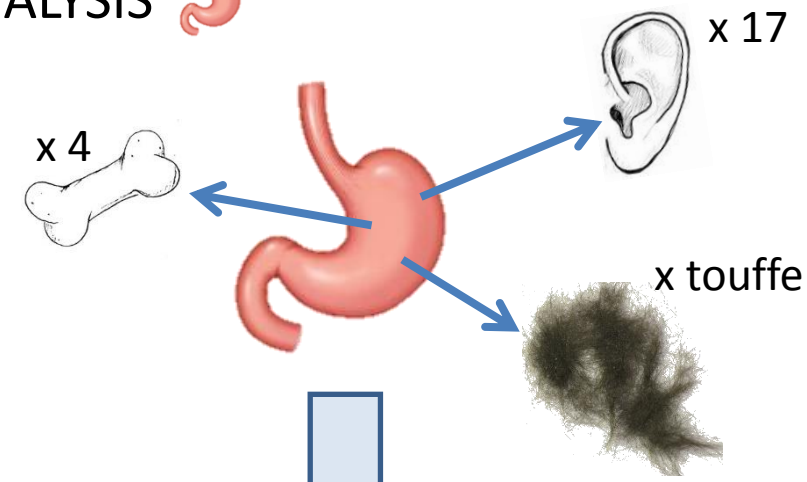
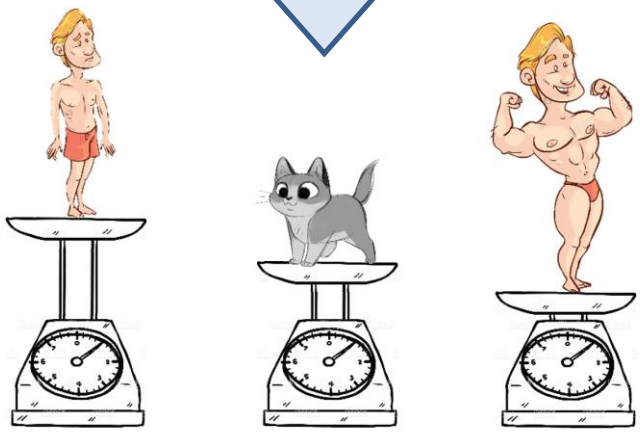


- Number → Weight?
- Question of digestibility
- Compare species…

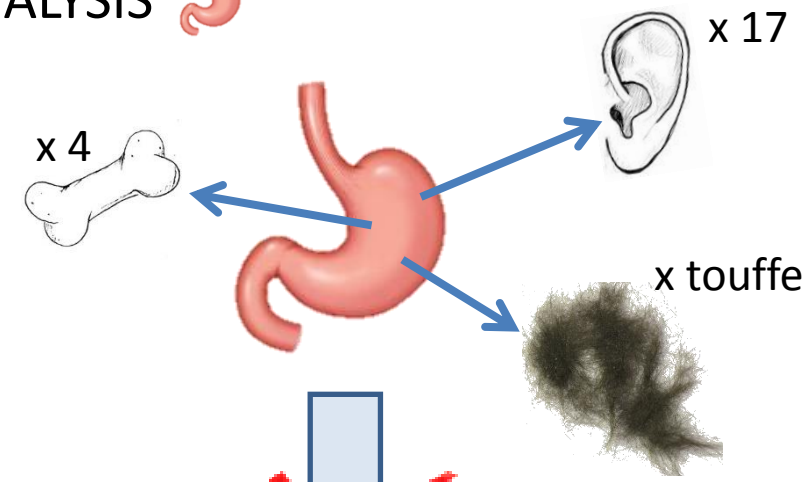
PREY ITEMS = ESTIMATORS OF MATTER FLOWS?

Eaten quantity of each prey type



STOMACH CONTENT ANALYSIS

Number of prey items per stomach



PREY ITEMS ESTIMATORS OF MATTER FLOWS?

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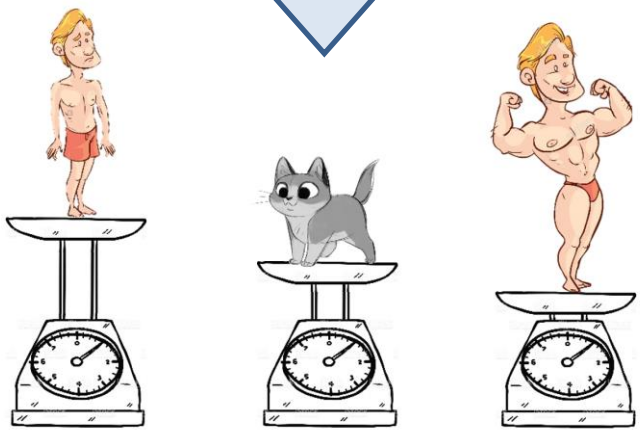

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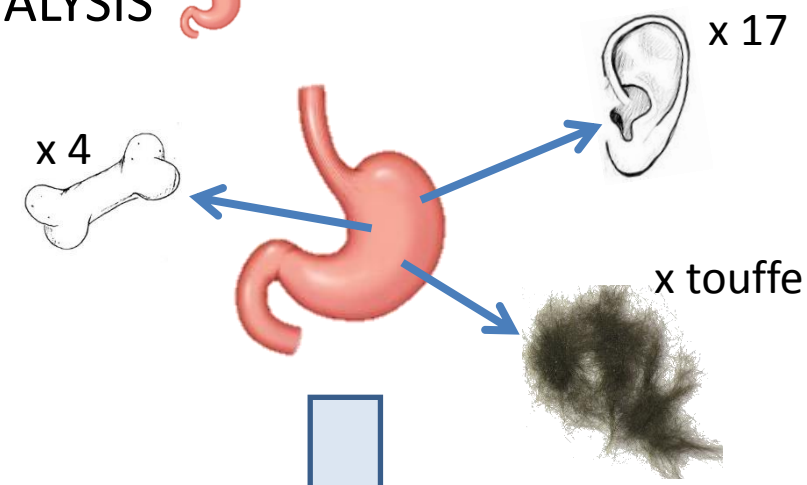
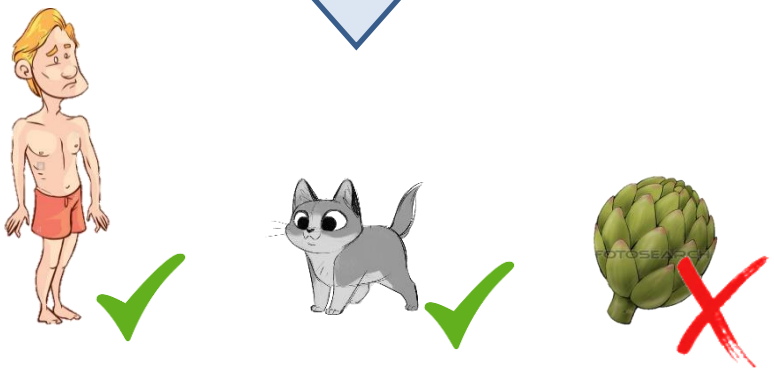


Frequencies of observation



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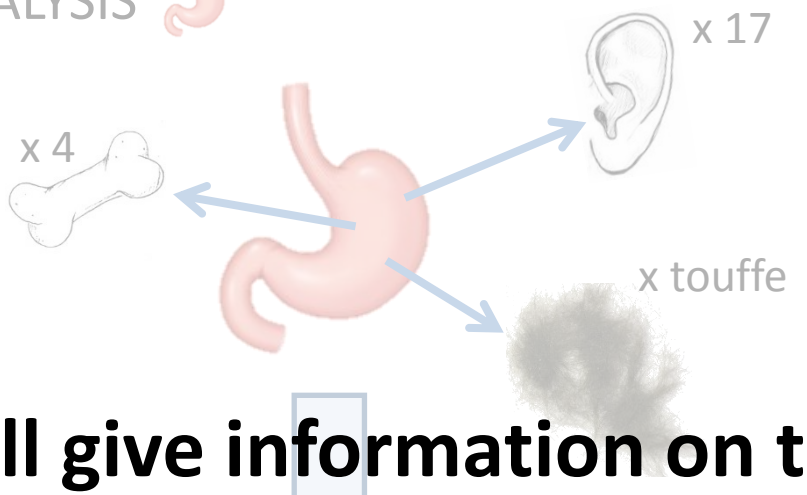


SCA will give information on the links to be considered in the diet matrix

→ Topological web

Frequencies of observation

STABLE ISOTOPES ANALYSIS

- ~ all functionnal groups in the ecosystem (the 10 commercial species and their potential preys)

- > 1000 samples

- Both carbon and nitrogen stable isotopes

$\delta^{13}C$	$\delta^{15}N$
Identification of the primary source	Identification of the trophic position

STABLE ISOTOPES ANALYSIS

TROPHIC ENRICHMENT CONCEPT

« You are what you eat »

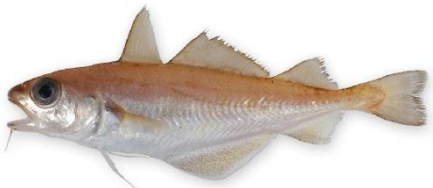
Fry 2006 etc

p shrimp-> cod = ***46 %***

p pout-> cod = ***19 %***

p small dem-> cod = ***35 %***

$\delta^{15}N$ shrimp



$\delta^{15}N$ pout

$\delta^{15}N$ small dem

TROPHIC ENRICHMENT CONCEPT

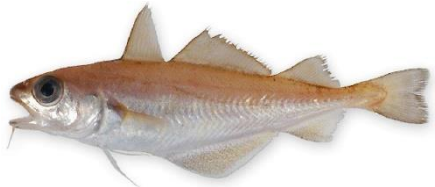
$$\delta^{15}N \text{ cod} = \frac{0.46 * q_{N,shrimp} * (\delta^{15}N \text{ shrimp} + \Delta) + 0.19 * q_{N,pout} * (\delta^{15}N \text{ pout} + \Delta) + 0.35 * q_{N,sm\ dem} * (\delta^{15}N \text{ small dem} + \Delta)}{0.46 * q_{N,shrimp} + 0.19 * q_{N,pout} + 0.35 * q_{N,sm\ dem}}$$

p shrimp-> cod = **46 %**

p pout-> cod = **19 %**

p small dem-> cod = **35 %**

$\delta^{15}N$ shrimp



$\delta^{15}N$ pout

$\delta^{15}N$ small dem

TROPHIC ENRICHMENT CONCEPT

$$\delta^{15}N_{\text{cod}} \sim \mathbf{0.46} * (\delta^{15}N_{\text{shrimp}} + \Delta) + \mathbf{0.19} * (\delta^{15}N_{\text{pout}} + \Delta) + \mathbf{0.35} * (\delta^{15}N_{\text{small dem}} + \Delta)$$

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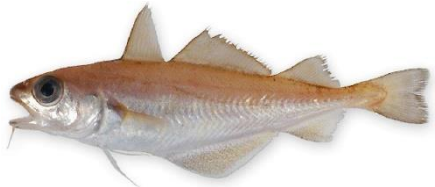


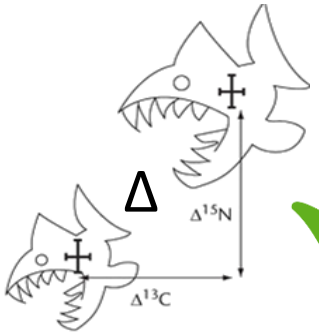
$\delta^{15}N$ pout

$\delta^{15}N$ small dem

TROPHIC ENRICHMENT CONCEPT

→ ISOTOPIC SIGNATURE of CONSUMER and SOURCES + TROPHIC ENRICHMENT

= DETERMINATION OF THE DIET



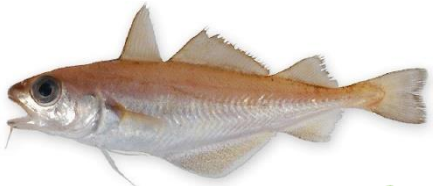
$\delta^{15}N$ cod

p shrimp-> cod = ? %

p pout-> cod = ? %

p small dem-> cod = ? %

$\delta^{15}N$ shrimp

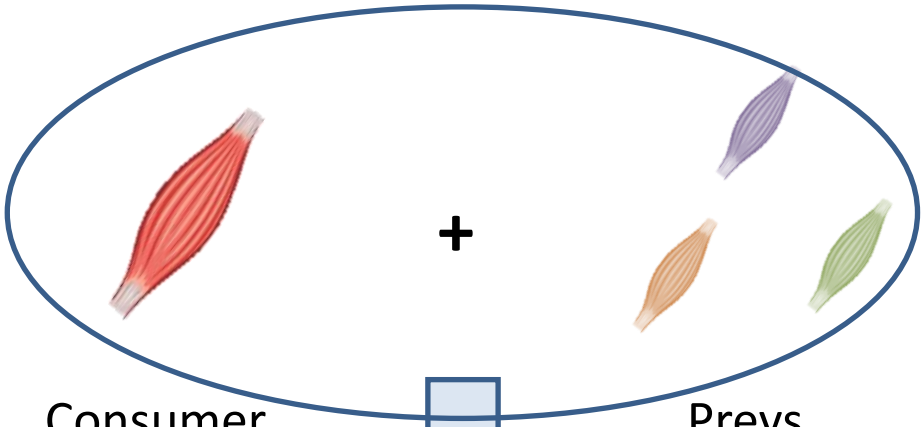


$\delta^{15}N$ pout

$\delta^{15}N$ small dem

STABLE ISOTOPES ANALYSIS

Stable isotopes concentrations

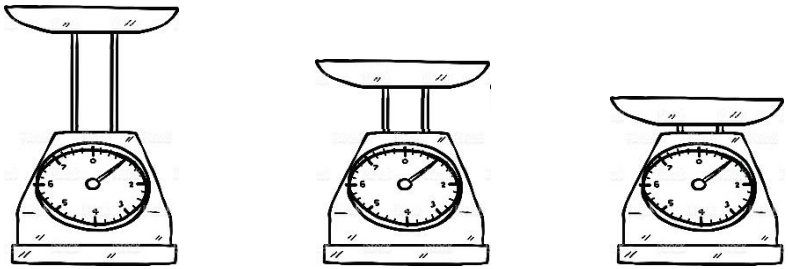


Consumer Preys

$\delta^{13}C$ & $\delta^{15}N$

TROPHIC ENRICHMENT

Eaten quantity of each prey type



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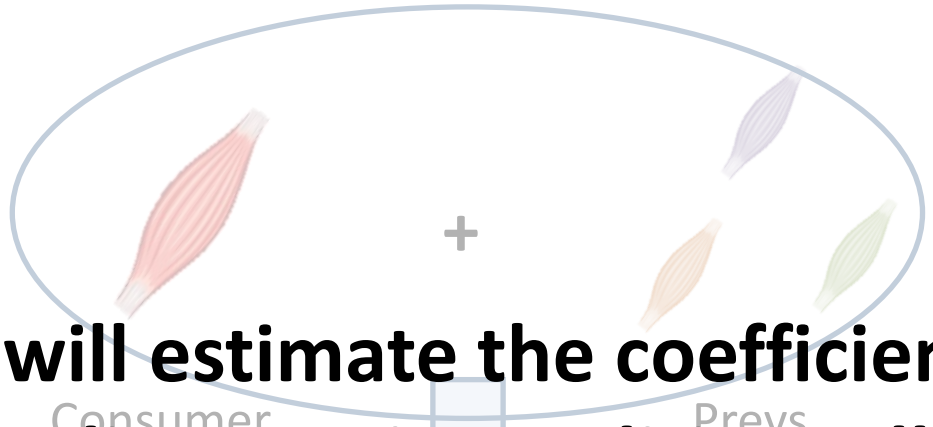


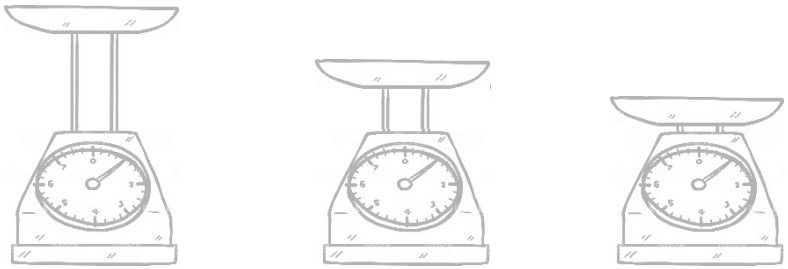
$\delta^{13}C$ & $\delta^{15}N$

Consumer

Preys

SIA will estimate the coefficients of the diet matrix conditionnally to the topological web

Eaten quantity of each prey type



LITERATURE…because it is still useful!

- Does the predator X eat the prey Y?
  - If we miss something!
  - Because of the temporal coverage of our SCA and SIA data
- Are there estimates of the contributions?

  Qualitative or Quantitative studies?
- What about data quality?
  - Local vs Foreign
  - Recent vs Old

LITERATURE…because it is still useful!

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Literature can inform on both topological web and contributions

OK, SO KNOW WE CAN START MODELLING:
Building EcoDiet

Diversity of data = SIA & SCA
to couple

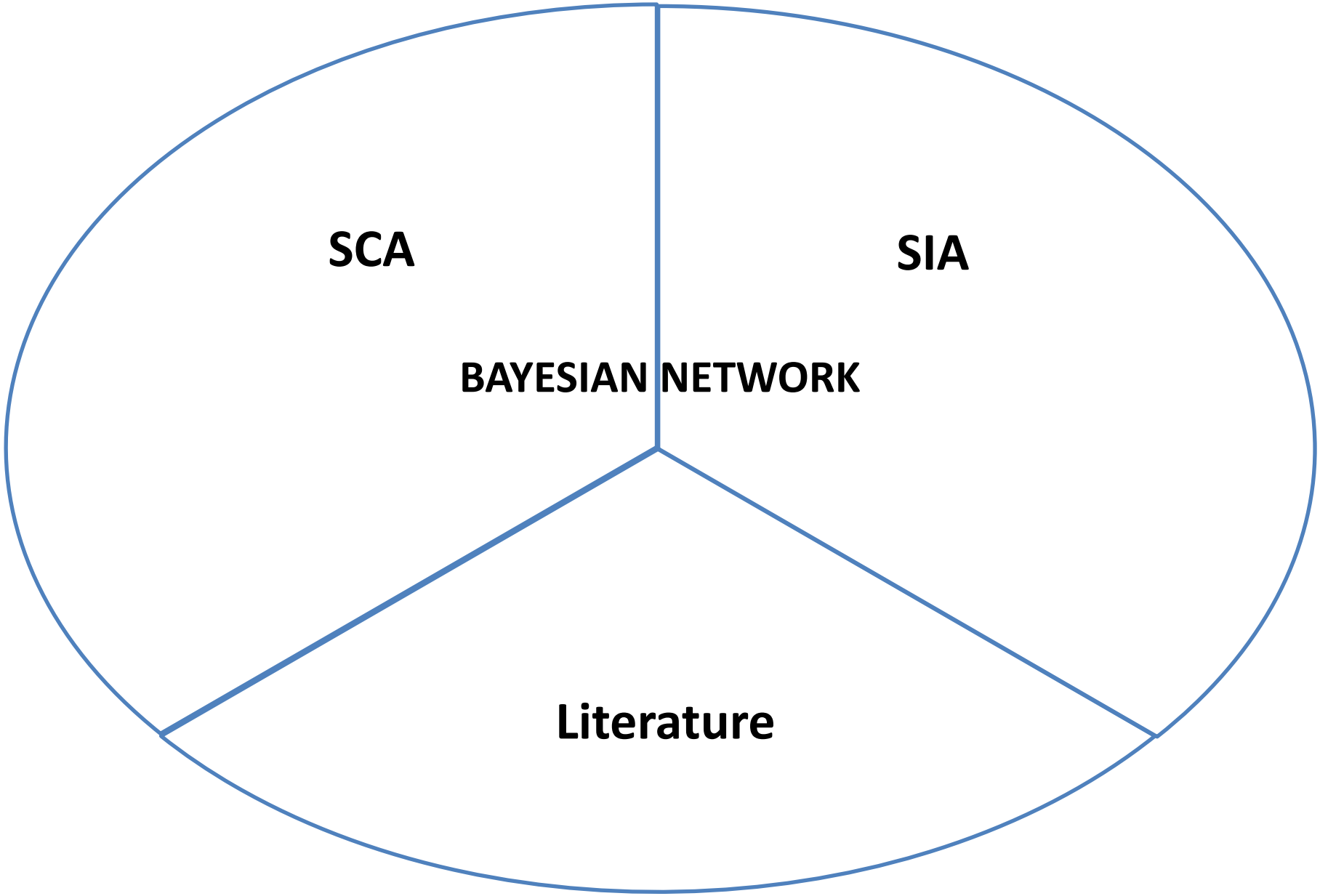
+

Integrate « a priori » knowledge from the literature

+

Need of taking into account uncertainty related to diet estimates

INTEGRATED BAYESIAN MODEL
=
EcoDiet


SCA
SIA
BAYESIAN NETWORK
Literature

STOMACH CONTENT ANALYSIS

For each consumer: Found vs Not found

N stomachs = N « trials »

Σ

1 0 1 1 0 … 1 1 = ?

= success

0 0 1 1 0 … 0 1 = ?

= fail

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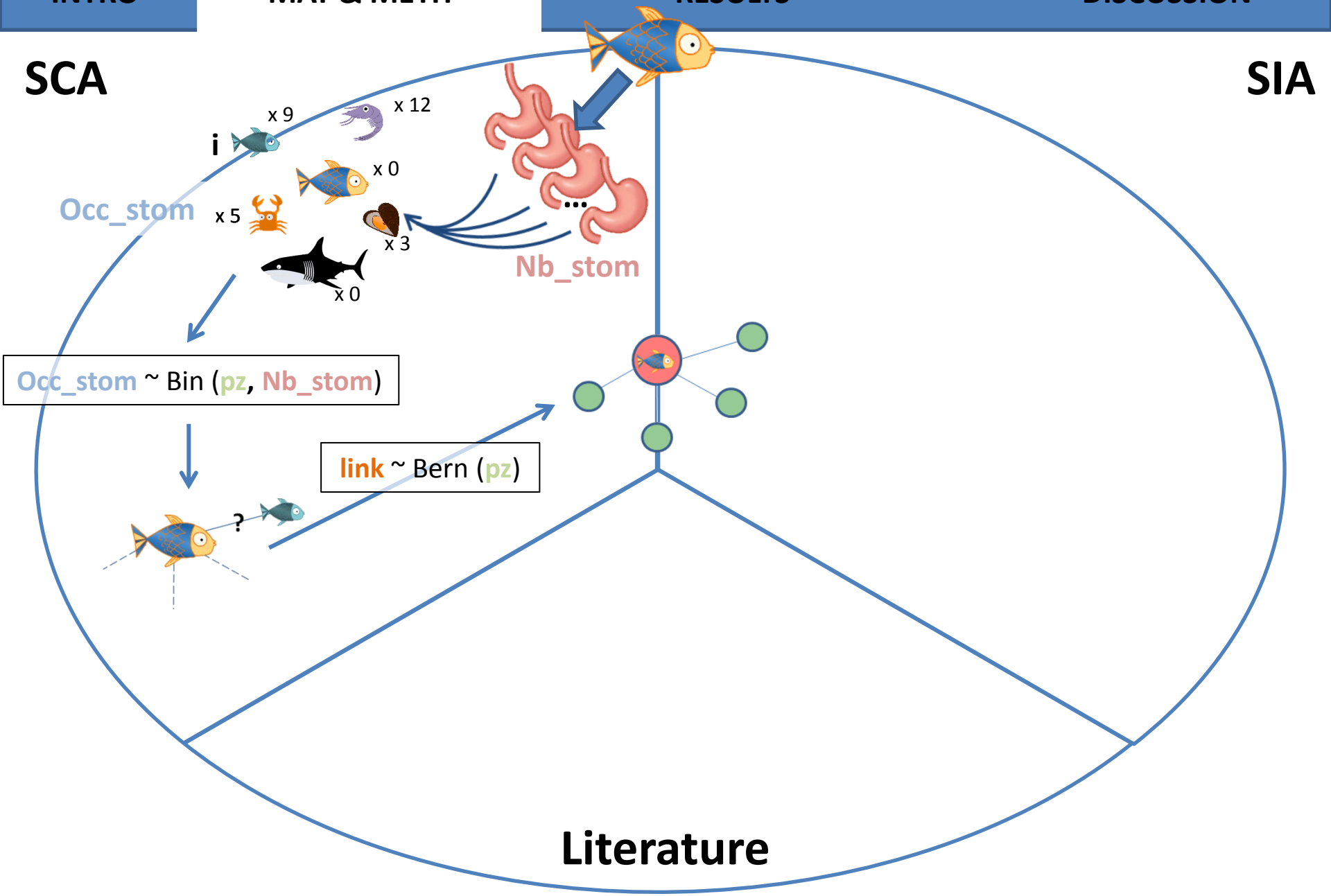
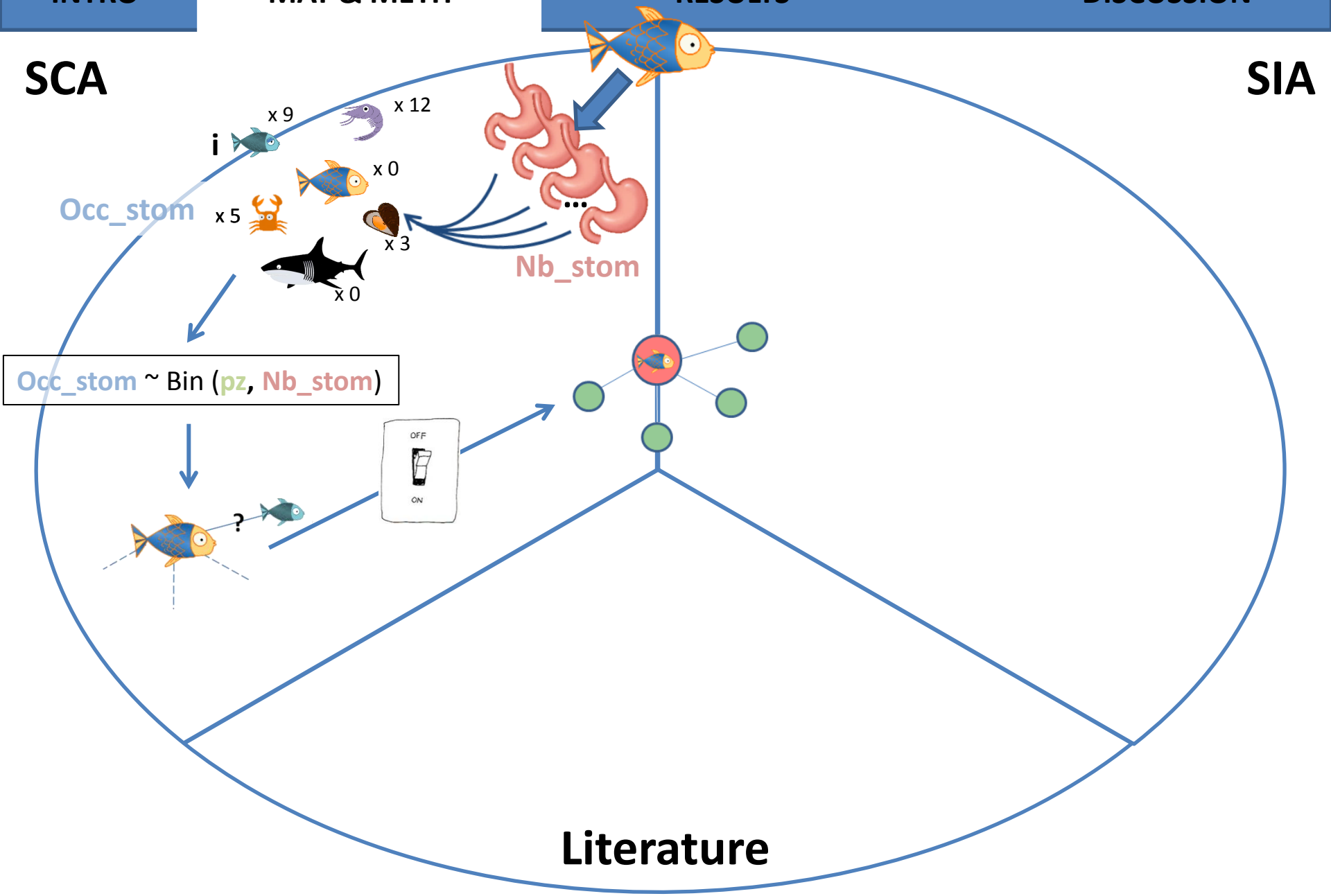

SCA
SIA
i
x 9
x 12
x 0
x 5
x 3
x 0
Occ_stom
Nb_stom
Occ_stom ~ Bin (pz, Nb_stom)
link ~ Bern (pz)
?
Literature


SCA
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x 9
x 12
i
x 0
Occ_stom
x 5
x 3
...
Nb_stom
x 0
Occ_stom ~ Bin (pz, Nb_stom)
OFF
ON
?
Literature

STABLE ISOTOPES ANALYSIS

- SIA module based on a pre-existing global mixing model

IsoWeb: A Bayesian Isotope Mixing Model for Diet Analysis of the Whole Food Web

Taku Kadoya, Yutaka Osada, Gaku Takimoto

PLOS ONE

- Main equations

$$X_{ij} \sim N\left(s_{ij},\ \sigma_{ij}^2\right)$$

$$c_{j\boldsymbol{k}_i[m]} \sim N\left(\Lambda_j,\ \tau^2_{j\boldsymbol{k}_i[m]}\right)$$

$$s_{ij} = \frac{\sum_{m=1}^{M_i} p_{i\boldsymbol{k}_i[m]} Q_{j\boldsymbol{k}_i[m]} \left(s_{j\boldsymbol{k}_i[m]} + c_{j\boldsymbol{k}_i[m]}\right)}{\sum_{m=1}^{M_i} p_{i\boldsymbol{k}_i[m]} Q_{j\boldsymbol{k}_i[m]}}$$

$$p_{i\boldsymbol{k}_i[1]}, \ldots, p_{i\boldsymbol{k}_i[M_i]} \sim Dirichlet\left(\alpha_{i1},\ \ldots,\ \alpha_{iM_i}\right)$$

Data:

X_{ij} = observed isotope ratio of element j in consumer i; normally distributed with mean s_{ij} and variance σ_{ij}^2.

$Q_{j\boldsymbol{k}_i[m]}$ = observed concentration of element j in resource $\boldsymbol{k}_i[m]$.

Estimated:

s_{ij} = mean of isotope ratio of element j in consumer i.

σ_{ij}^2 = residual variances of isotope ratio of element j in consumer i.

$c_{j\boldsymbol{k}_i[m]}$ = trophic enrichment factor of element j for the trophic link from resource $\boldsymbol{k}_i[m]$ to consumer i ($\boldsymbol{k}_i[m]$ is the mth resources of consumer i).

$p_{i\boldsymbol{k}_i[m]}$ = dietary proportion of resource $\boldsymbol{k}_i[m]$ of consumer i.

Priors:

Λ_j and $\tau^2_{j\boldsymbol{k}_i[m]}$ is the mean and variance of prior distribution

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s_{ij} = mean of isotope ratio of element j in consumer i.

σ_{ij}^2 = residual variances of isotope ratio of element j in consumer i.

$c_{j\boldsymbol{k_i}[m]}$ = trophic enrichment factor of element j for the trophic link from resource $\boldsymbol{k}_i[m]$ to consumer i ($\boldsymbol{k}_i[m]$ is the mth resources of consumer i).

$p_{i\boldsymbol{k_i}[m]}$ = dietary proportion of resource $\boldsymbol{k}_i[m]$ of consumer i.

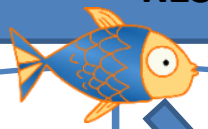
Priors:

Λ_j and $\tau^2_{j\boldsymbol{k_i}[m]}$ is the mean and variance of prior distribution

$\alpha_{i1} = \ldots = \alpha_{iM_i}$ are the parameters of a Dirichlet prior

SCA

SIA



$\delta^y X$

$\delta^y X$

...

$\delta^y X$

$\delta^y X$

$\delta^y X \sim \text{Norm}(s, \sigma^2)$

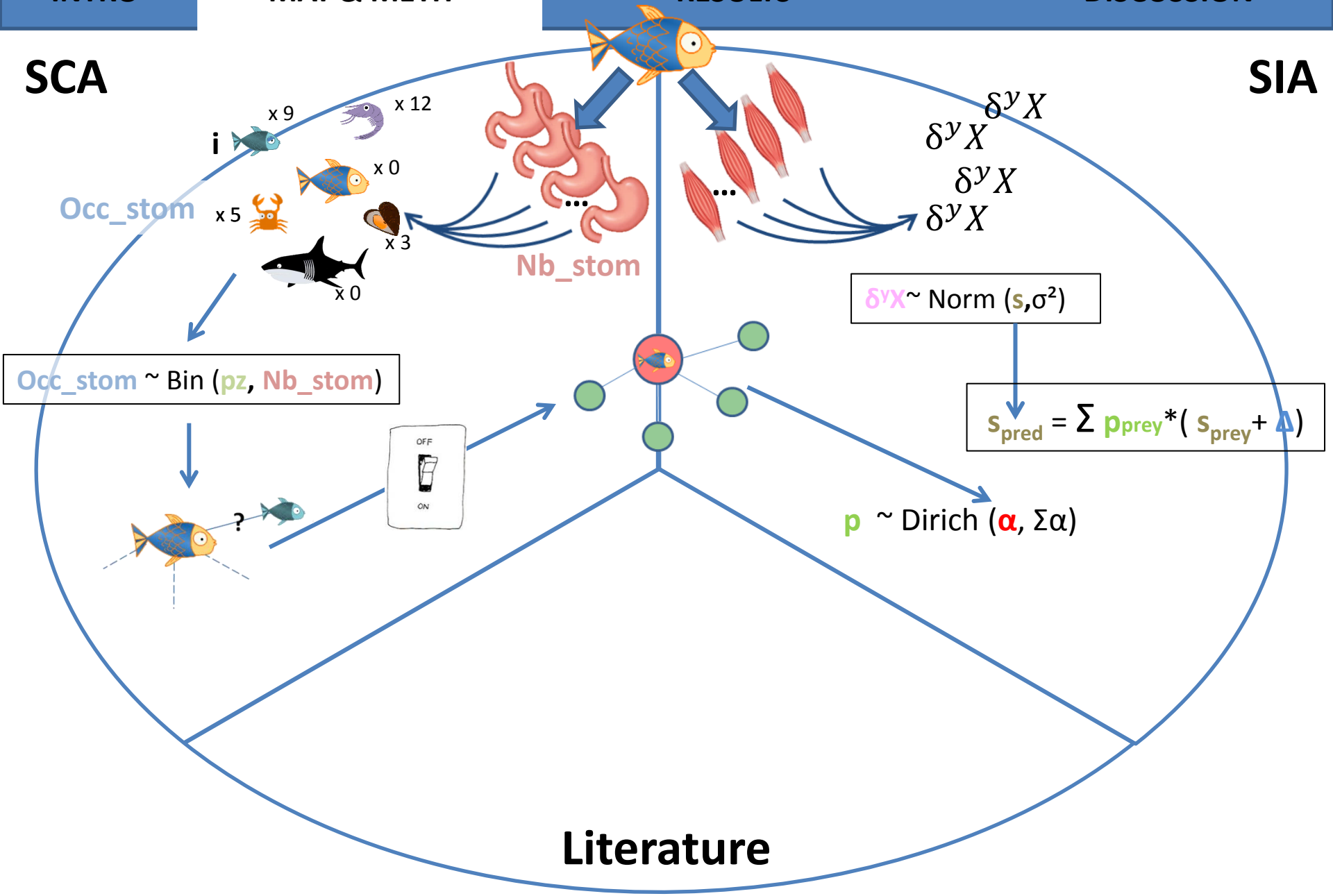
$s_{pred} = \Sigma\, p_{prey} * (s_{prey} + \Delta)$

$p \sim \text{Dirich}(\alpha, \Sigma\alpha)$

Literature

SCA

SIA


i
x 9
x 12
x 0
x 5
x 3
x 0
Occ_stom
Nb_stom
$\delta^y X$
$\delta^y X$
$\delta^y X$
$\delta^y X$
Occ_stom ~ Bin (pz, Nb_stom)
δʸX~ Norm (s,σ²)
$s_{pred} = \Sigma\ p_{prey} * (s_{prey} + \Delta)$
p ~ Dirich (α, Σα)
OFF
ON
?
Literature

LITERATURE - how to assess the quality of the data

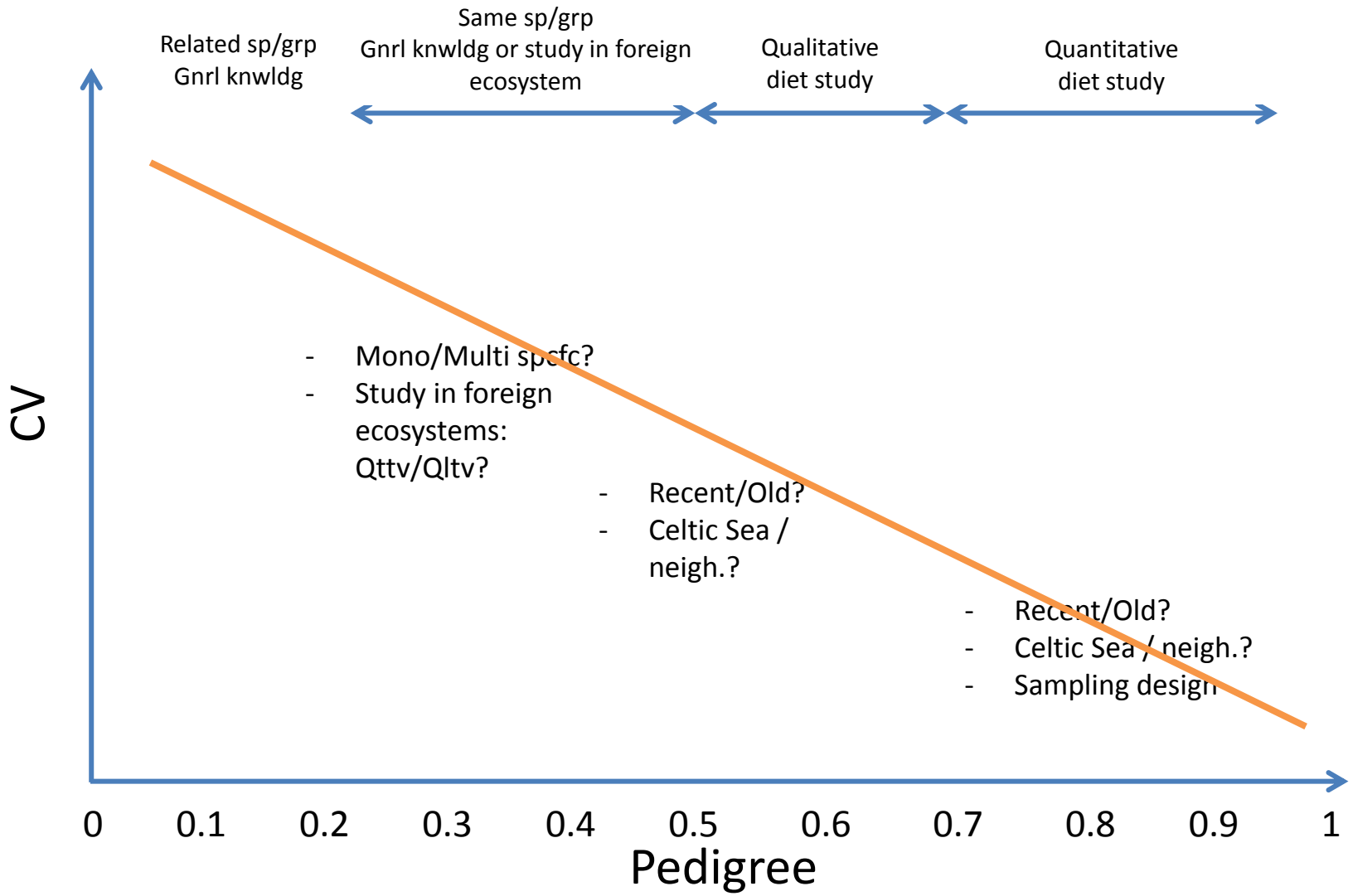
- Consistency with EwE approach: using the Pedigree scores
- = A mark (Є [0;1]) that decreases when the data becomes more uncertain

Parameter	Category	Description	Index	Default confidence interval (+/- %)
Biomass (*B*)	1	Missing parameter (estimated by Ecopath)	0.0	n.a.
	2	From other model	0.0	80
	3	Guesstimates	0.0	80
	4	Approximate or indirect method	0.4	50-80
	5	Sampling based, low precision	0.7	40
	6	Sampling based, high precision	1.0	10
P/B and *Q/B*	1	Missing parameter (estimated by Ecopath)	0.0	n.a.
	2	Guesstimates	0.1	90
	3	From other model	0.2	80
	4	Empirical relationships	0.5	50
	5	Similar group/species, similar system	0.6	40
	6	Similar group/species, same system	0.7	30
	7	Same group/species, similar system	0.8	20
	8	Same group/species, same system	1.0	10
Diets (*DC*)	1	General knowledge of related group/species	0.0	80
	2	From other model	0.0	80
	3	General knowledge for same group/species	0.2	80
	4	Qualitative diet composition study	0.5	50
	5	Quantitative but limited diet composition study	0.7	40
	6	Quantitative, detailed, diet composition study	1.0	30
Catches	1	Guesstimates	0.0	>80
	2	From other model	0.0	>80
	3	FAO statistics	0.2	80
	4	National statistics	0.5	50
	5	Local study, low precision/incomplete	0.7	30
	6	Local study, high precision/complete	1.0	10

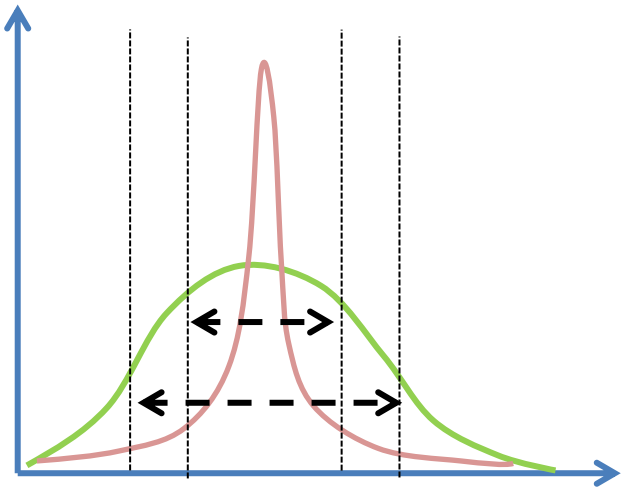
+ C.V.

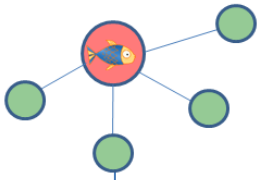
LITERATURE

- Pedigree → a target *C.V.* by consumer



LITERATURE - how to assess the quality of the data





Weight Lit vs Stom:

Pedigree = 1

⇔

 = 

⇔

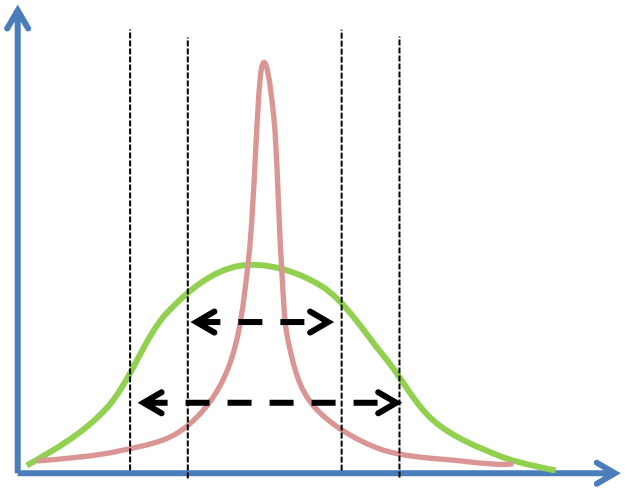
non informative prior :

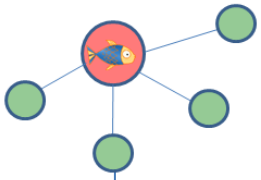
pz[i,j] ~ Beta(1,1)

$\sum$

$\sum \sim$ ***Sampling size of*** 

LITERATURE - how to assess the quality of the data





Weight Lit vs Stom:

Pedigree = 1

⇔

 = 

⇔

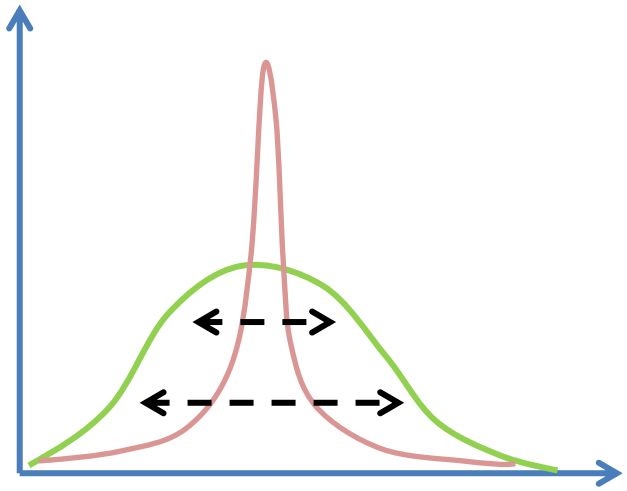
informative prior :

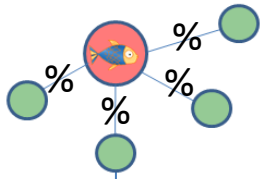
pz[i,j] ~ Beta(x,y)

$\sum$

$\sum \sim$ ***Sampling size of*** 

LITERATURE - how to assess the quality of the data





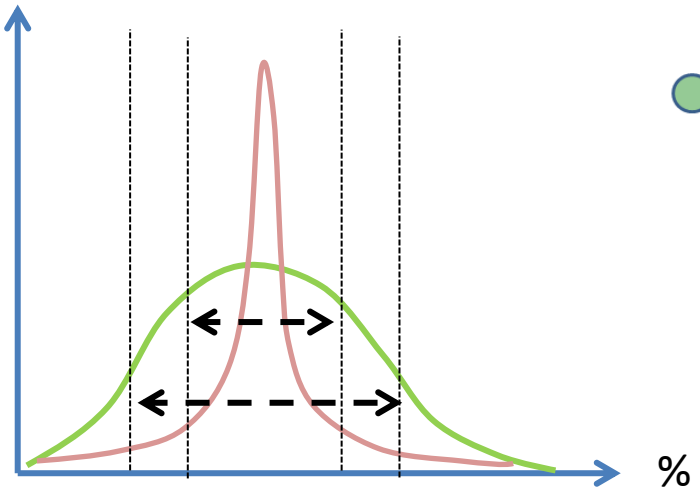
	LIT1	LIT2	LIT3	

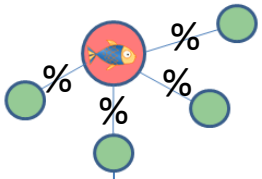
non informative prior :

$$p[i,j] \sim Beta(p_{lit}, 1)$$

$$\sum = \textbf{determined by } CV_{pedigree}$$

LITERATURE - how to assess the quality of the data





	LIT1	LIT2	LIT3	

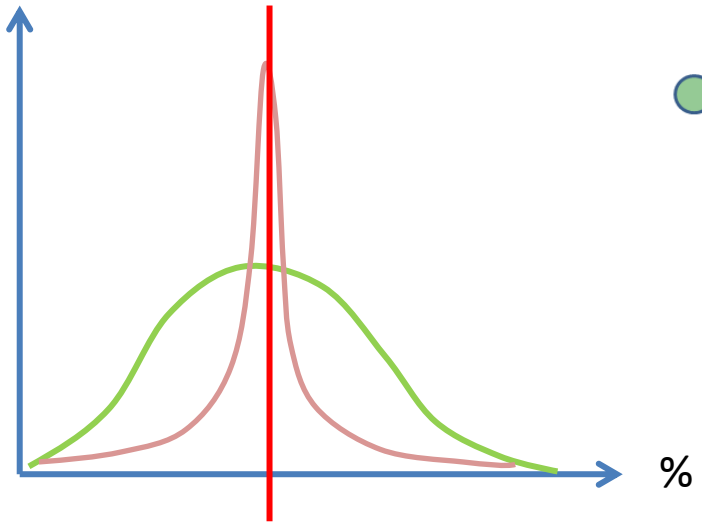
informative prior :

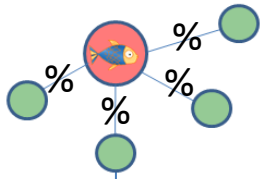
$$p[i,j] \sim \text{Dirich}(\alpha[i,j], \Sigma\, \alpha[i,],)$$

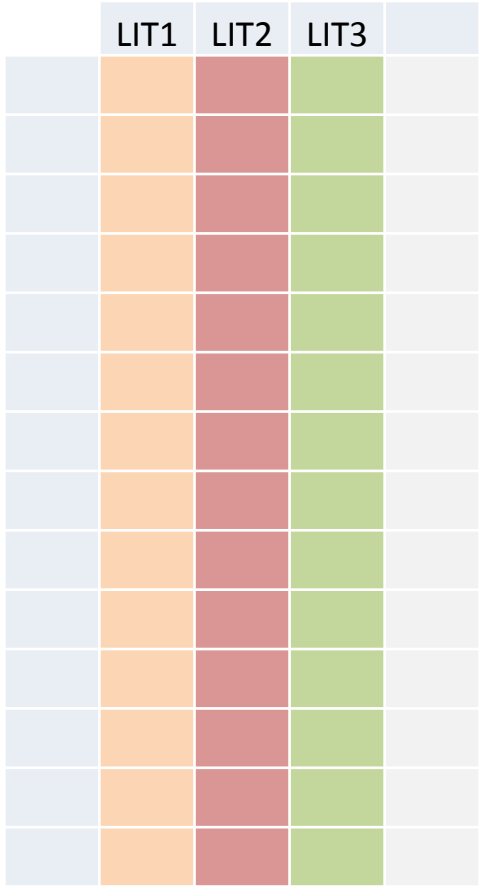
$$\sum$$

$$\sum = \textbf{determined by } CV_{pedigree}$$

LITERATURE - how to assess the quality of the data







informative prior :

$p[i,j] \sim Beta(\alpha[i,j], \Sigma\, \alpha[i,])$

$\alpha[i,j] / \Sigma\, \alpha[i,]$

$\sum = \textbf{determined by } CV_{pedigree}$

SCA

SIA

i

x 9

x 12

x 0

x 5

x 3

x 0

Occ_stom

Nb_stom

$\delta^y X$

$\delta^y X$

$\delta^y X$

$\delta^y X$

$\delta^y X \sim$ Norm (s, σ^2)

Occ_stom ~ Bin (pz, Nb_stom)

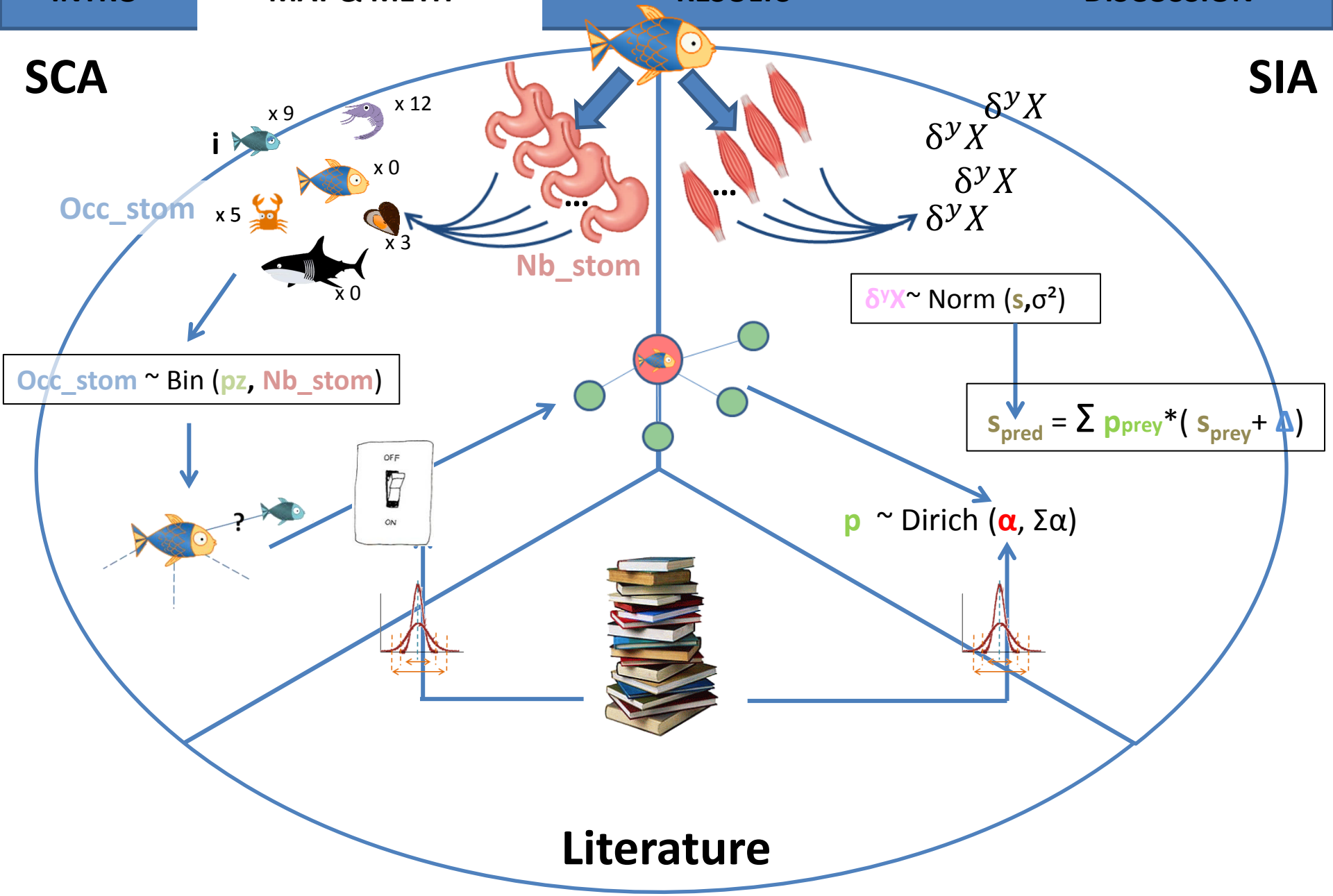
$s_{pred} = \Sigma\ p_{prey} * (s_{prey} + \Delta)$

p ~ Dirich (α, $\Sigma\alpha$)

Literature

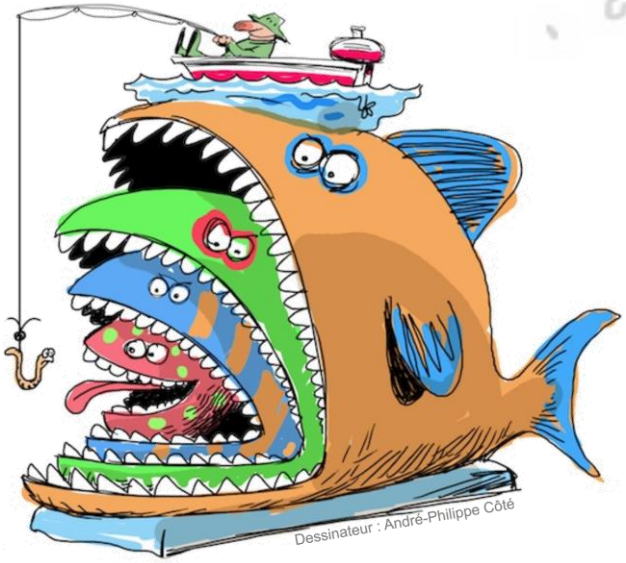
SCA

SIA


i
x 9
x 12
x 0
x 5
x 3
x 0
Occ_stom
Nb_stom
$\delta^y X$
$\delta^y X$
$\delta^y X$
$\delta^y X$
Occ_stom ~ Bin (pz, Nb_stom)
δʸX~ Norm (s,σ²)
$s_{pred} = \Sigma\ p_{prey} * (s_{prey} + \Delta)$
p ~ Dirich (α, Σα)
OFF
ON
?
Literature

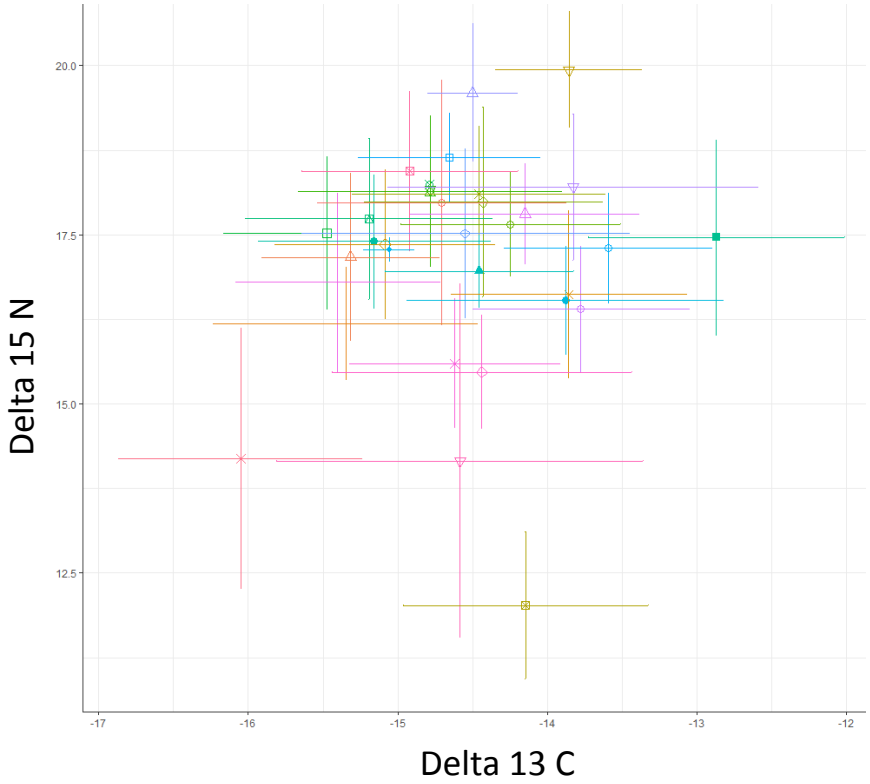
(first)

RESULTS



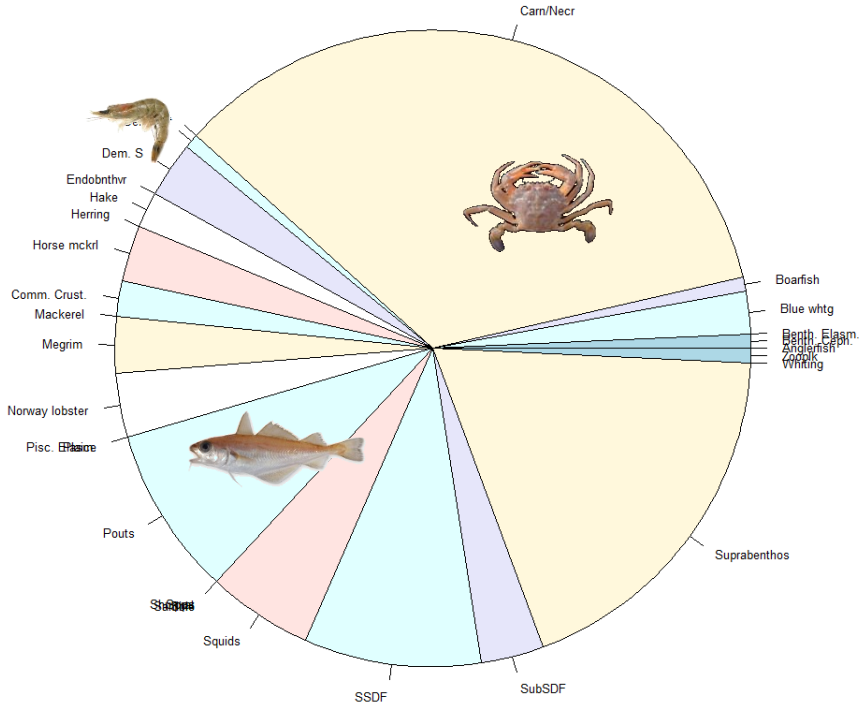
« EASY » RESULTS

SIA for all trophic groups



(Data prep.: baseline correction)

SCA for one species: cod

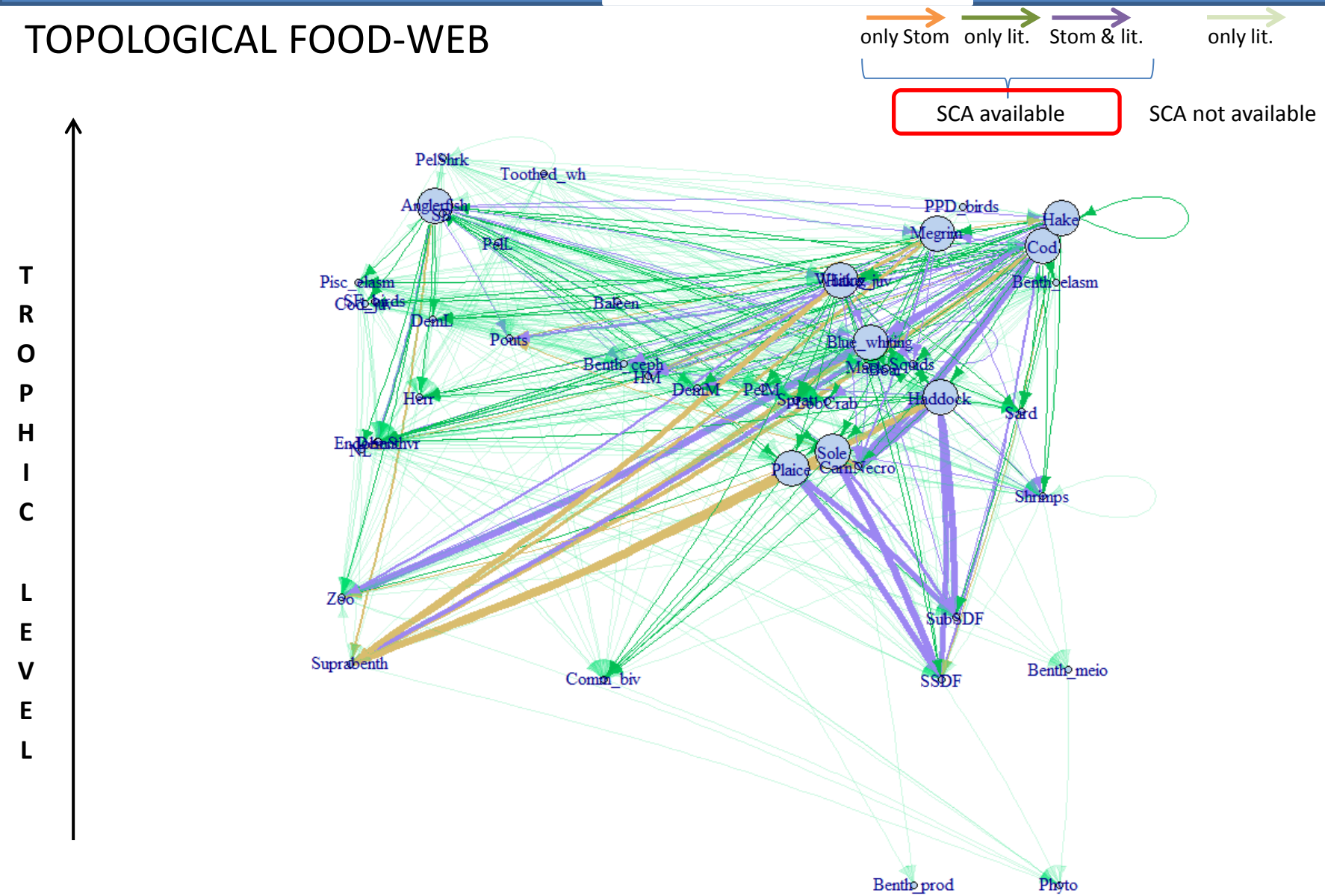


/!\ Occurrences of each prey in separated stomachs

(Data prep.: reassignation of undet. grp)

FIRST RUN OF EcoDiet ON BOTH SIA & SCA DATA IN THE CELTIC SEA

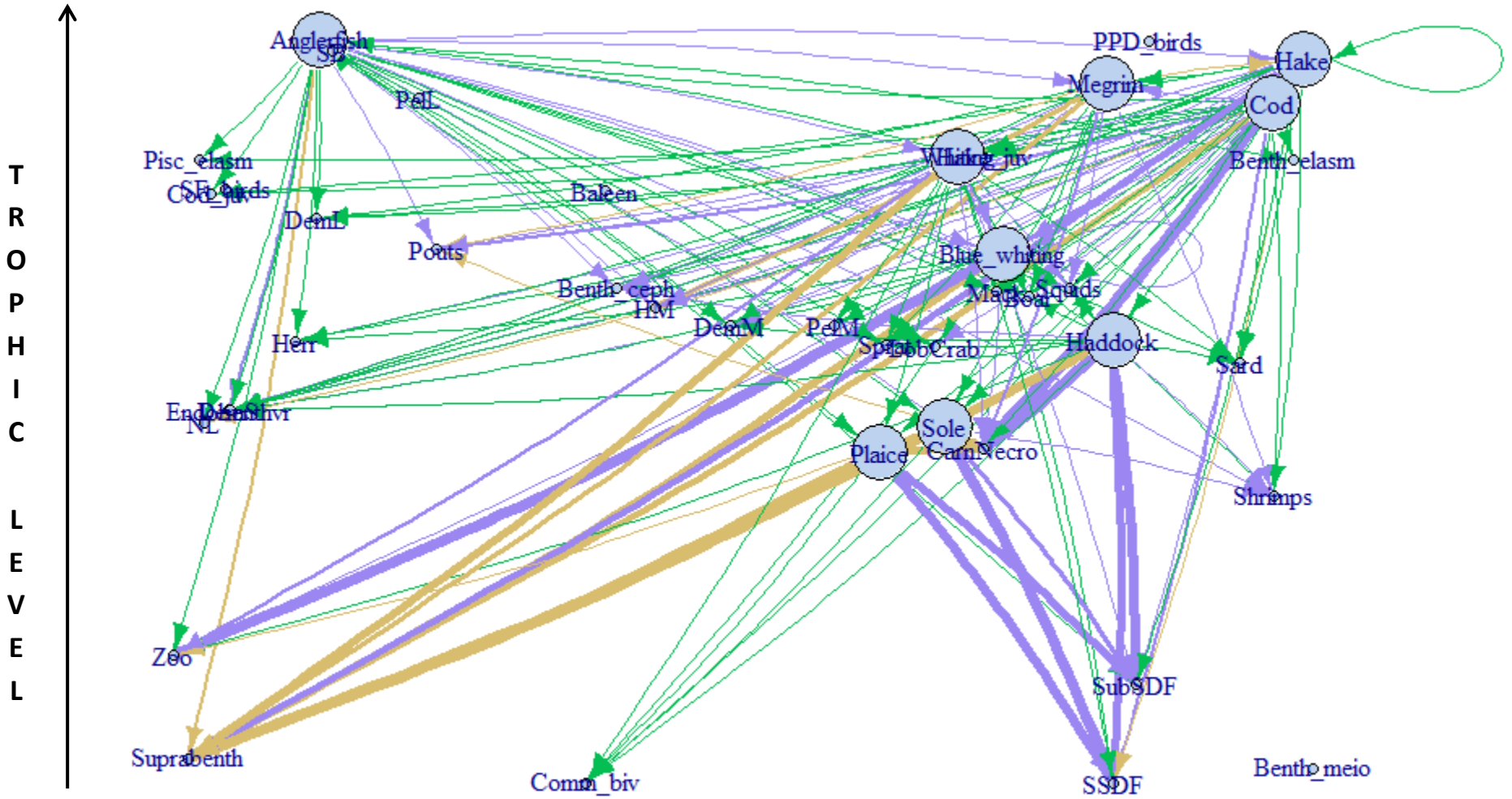
TOPOLOGICAL FOOD-WEB



(Width is proportional to the probability that a link exist between two groups)

TOPOLOGICAL FOOD-WEB deduced by SCA

only Stom | only lit. | Stom & lit.

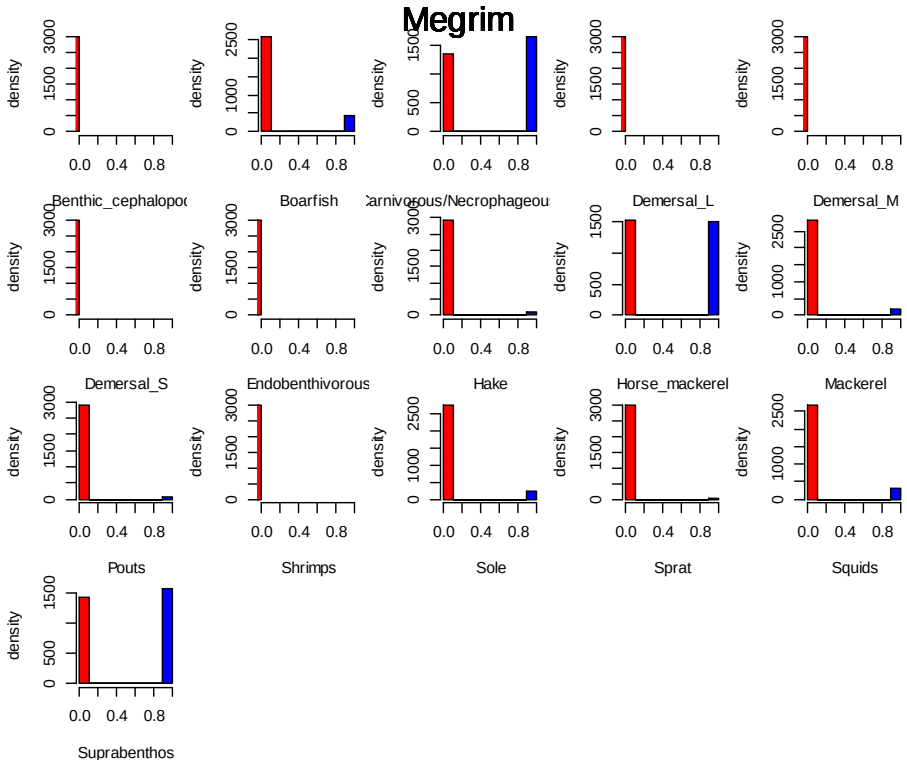


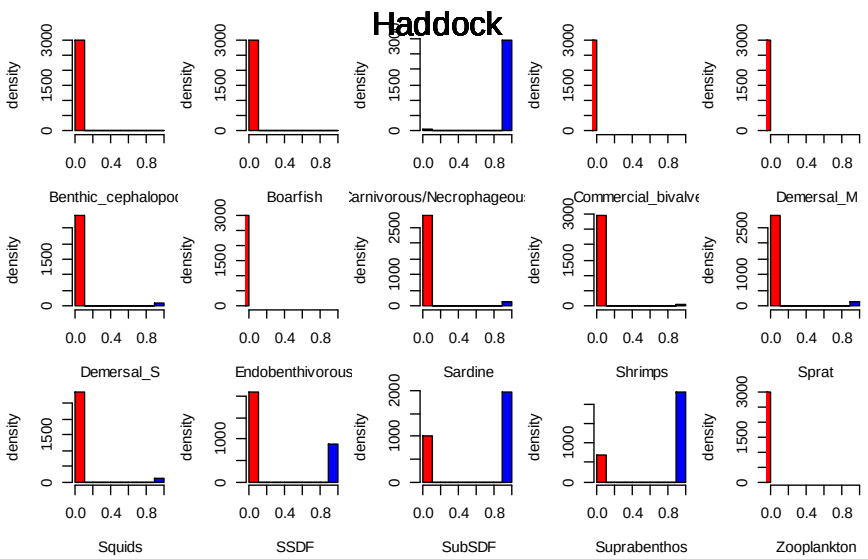
(Width is proportional to the probability that a link exist between two groups)

TOPOLOGICAL FOOD-WEB

Take back posteriors of the several parameters

« SWITCHER »

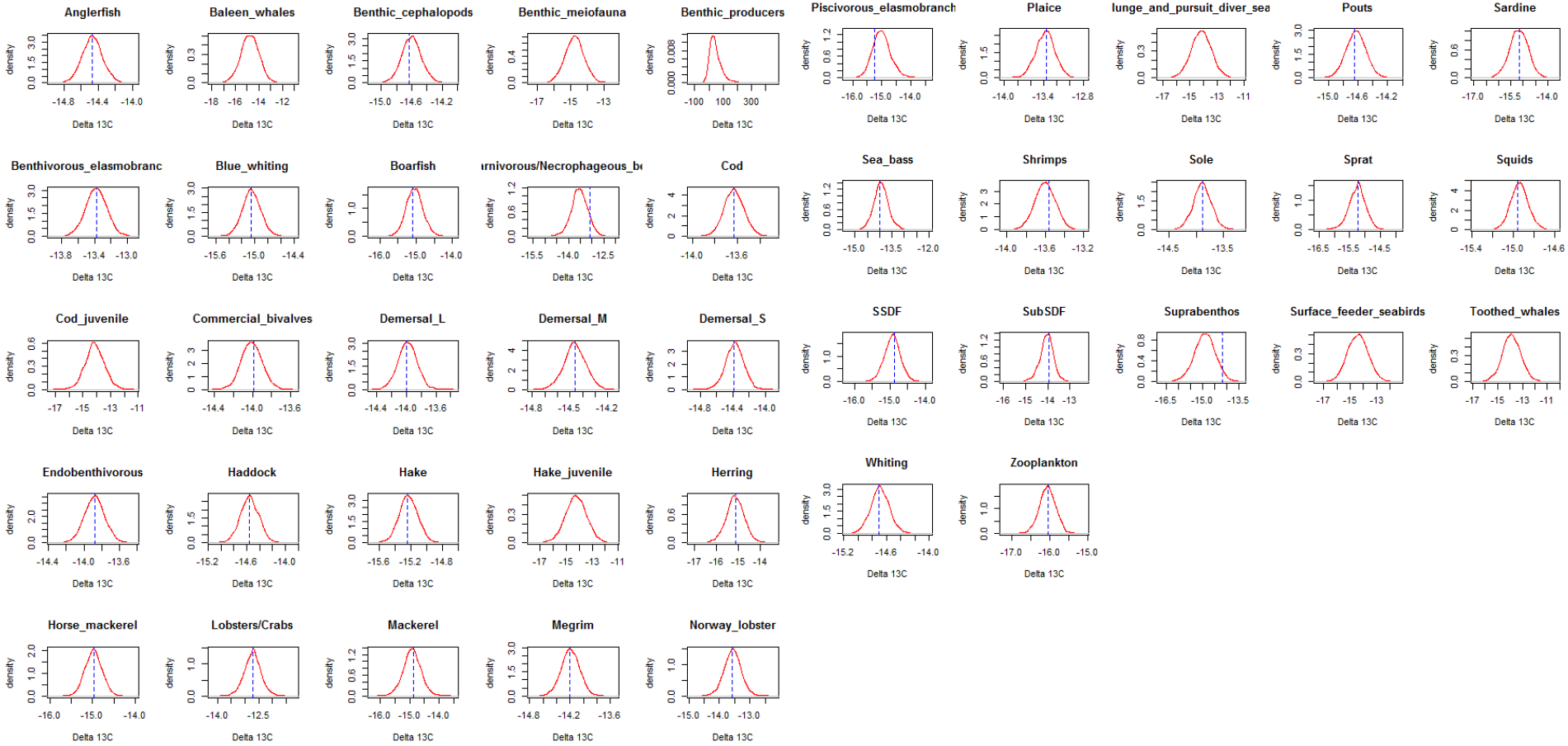




STABLE ISOTOPES MODULE

Take back posteriors of the several parameters

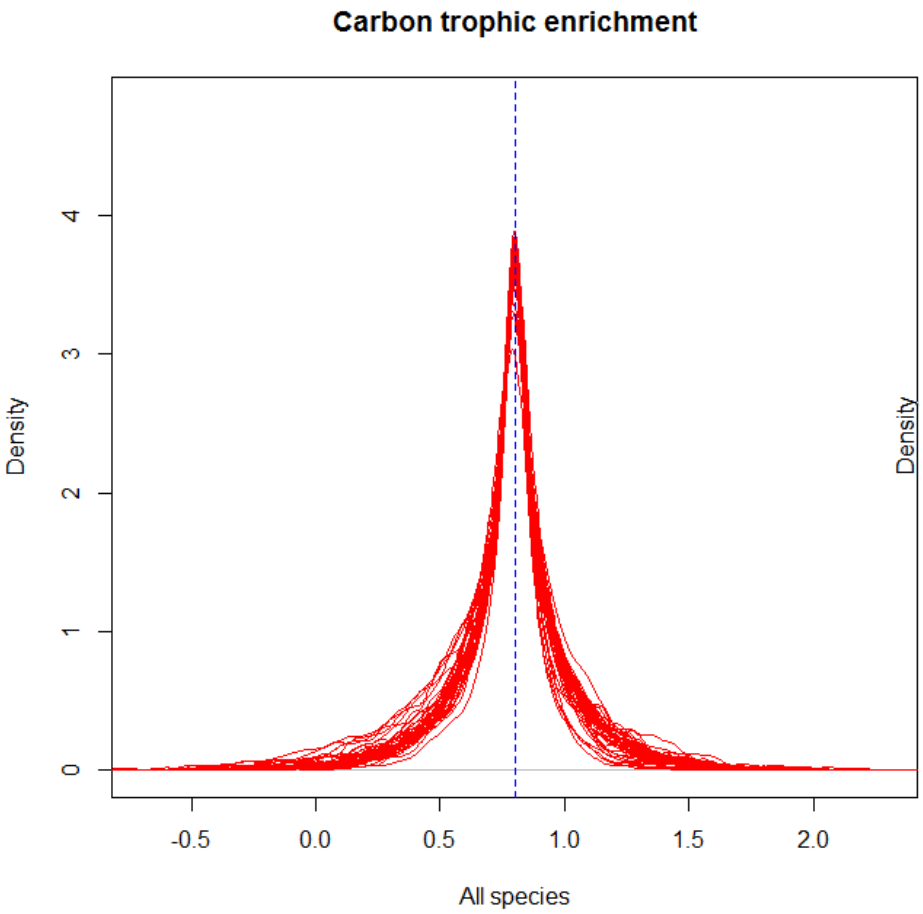
ISOTOPIC SIGNATURES

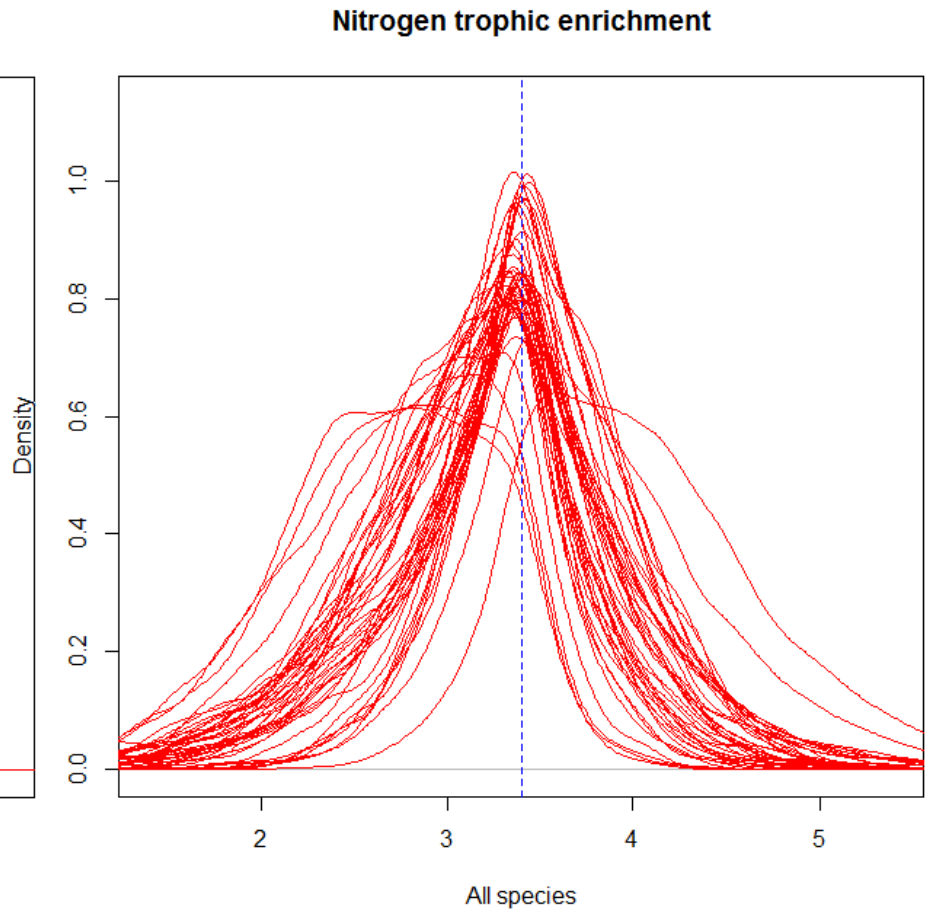


STABLE ISOTOPES MODULE

Take back posteriors of the several parameters

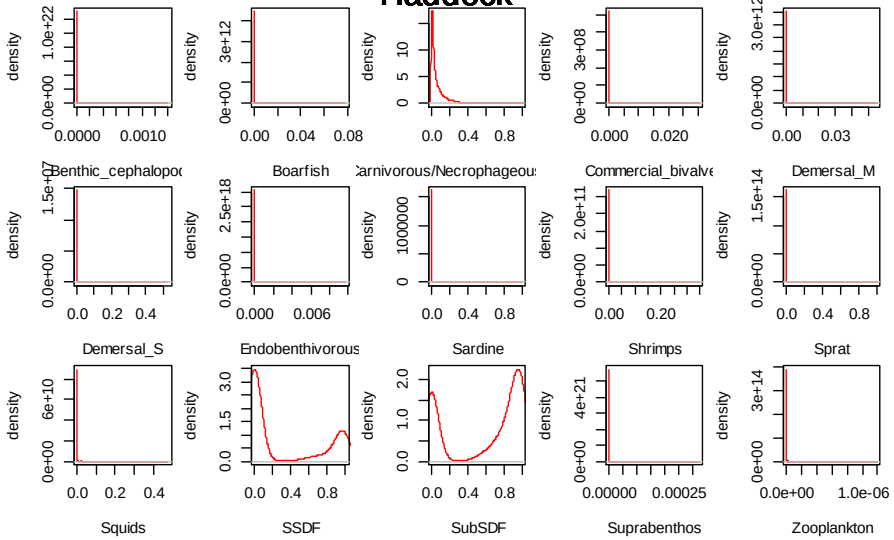
TROPHIC ENRICHMENT



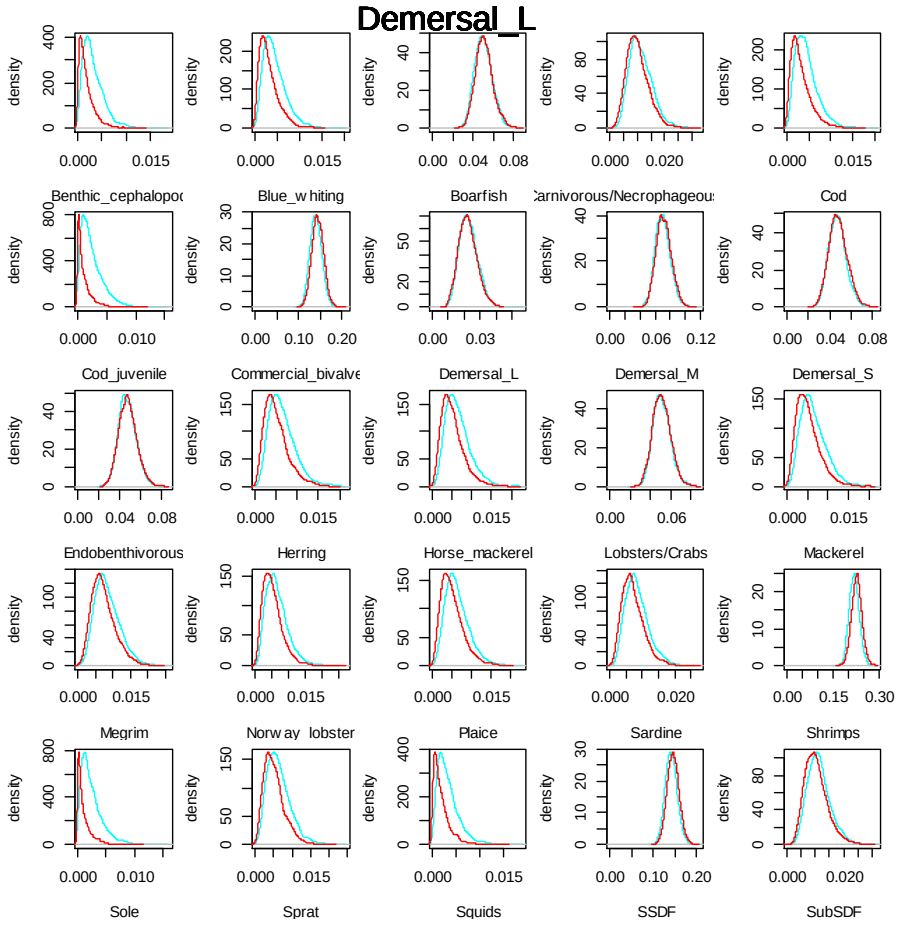


STABLE ISOTOPES MODULE

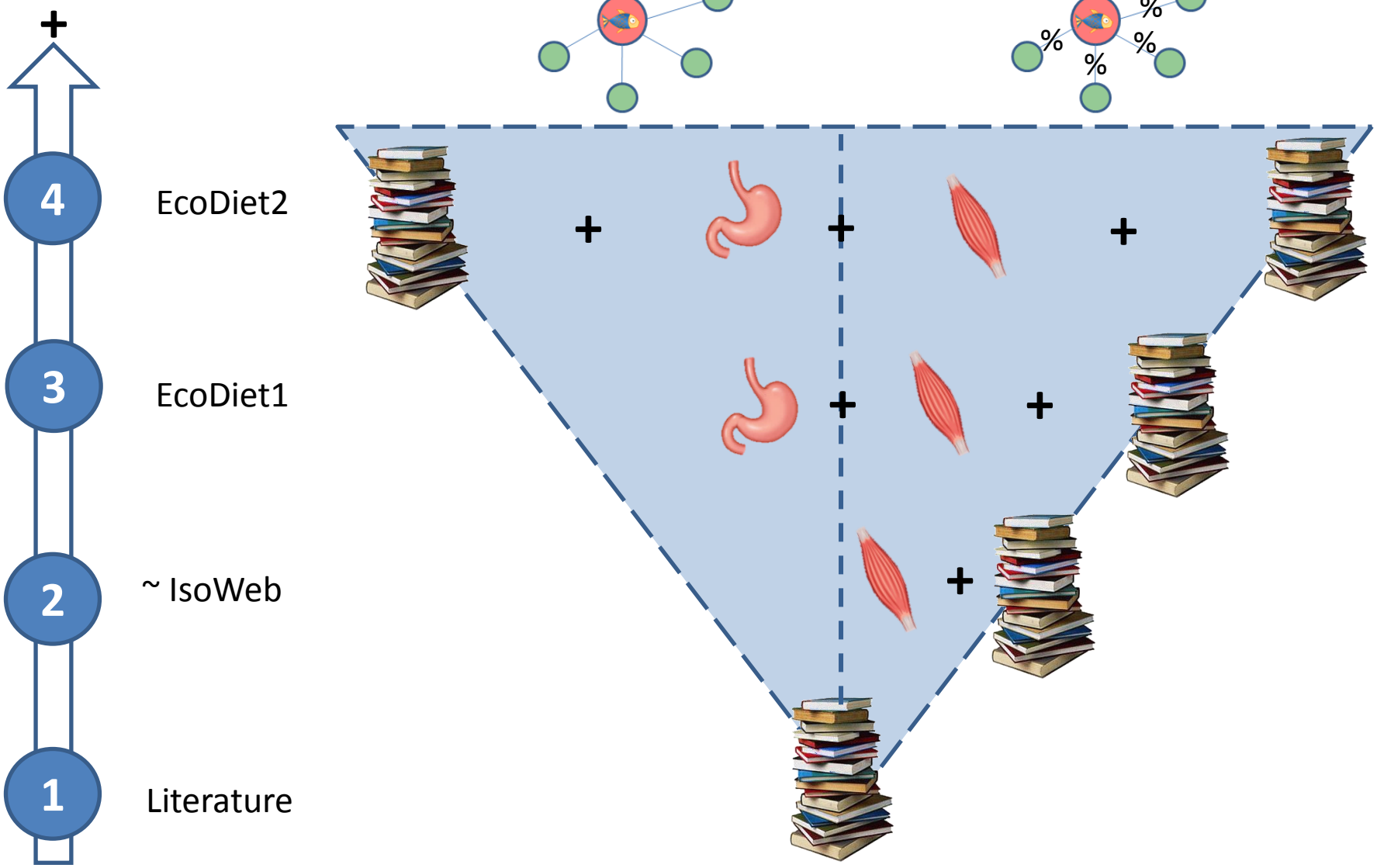
Take back posteriors of the several parameters



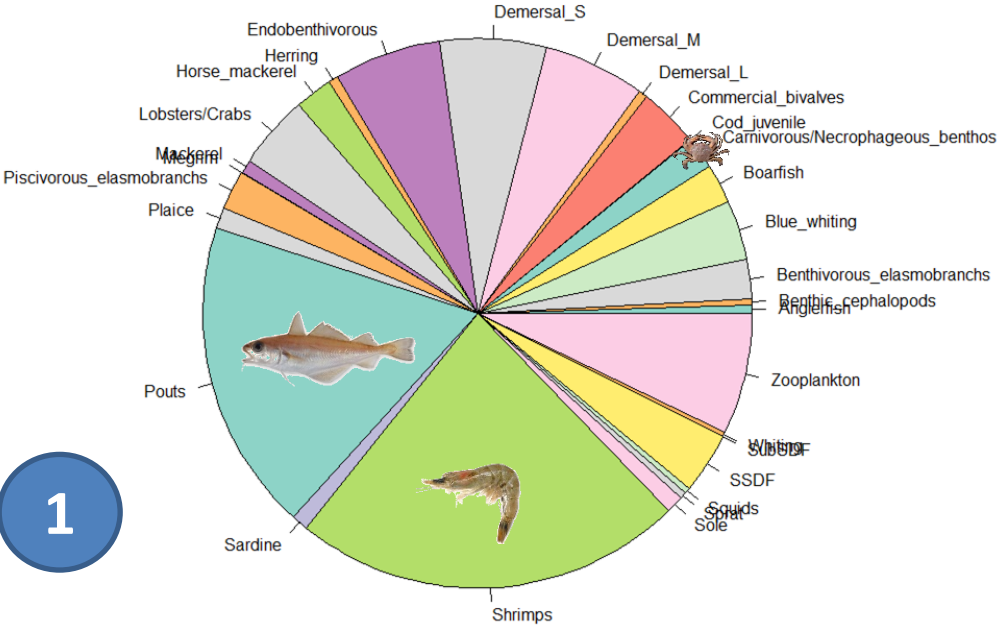
CONTRIBUTIONS



COMPARING THE RESULTS - Strategic design



A NEW VISION OF DIETS IN THE CELTIC SEA – the cod case



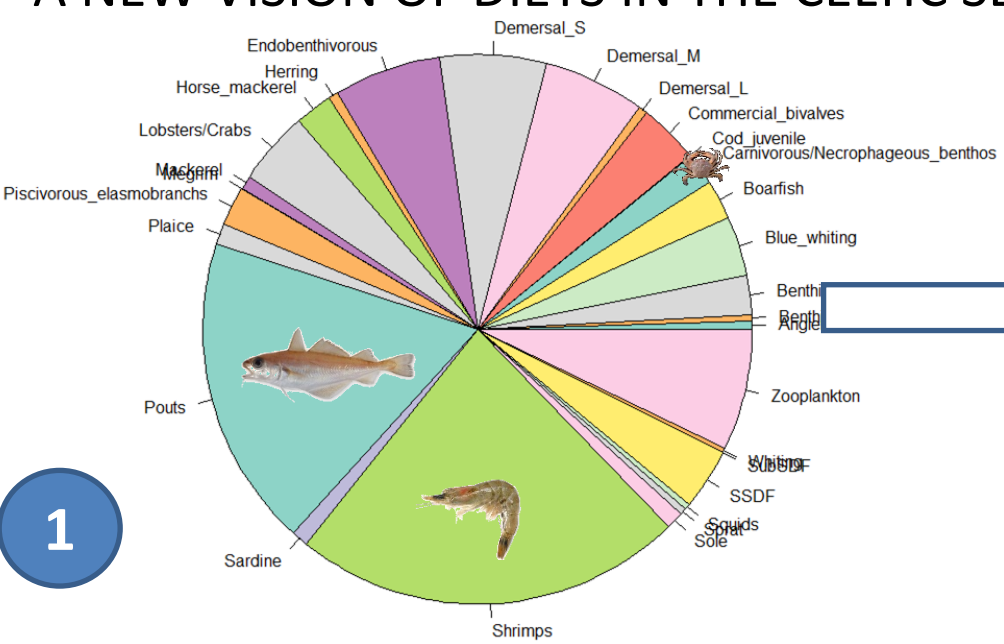
1

2

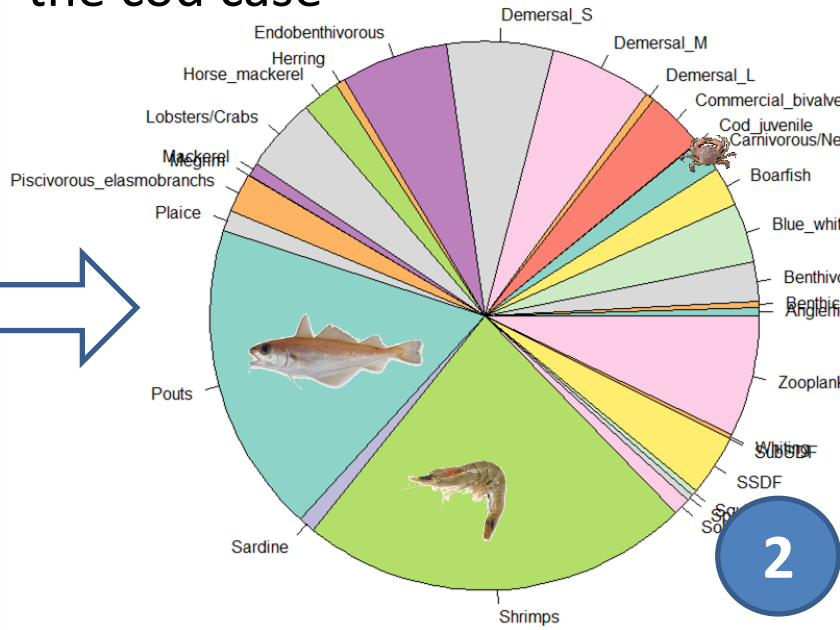
4

3

A NEW VISION OF DIETS IN THE CELTIC SEA – the cod case



1

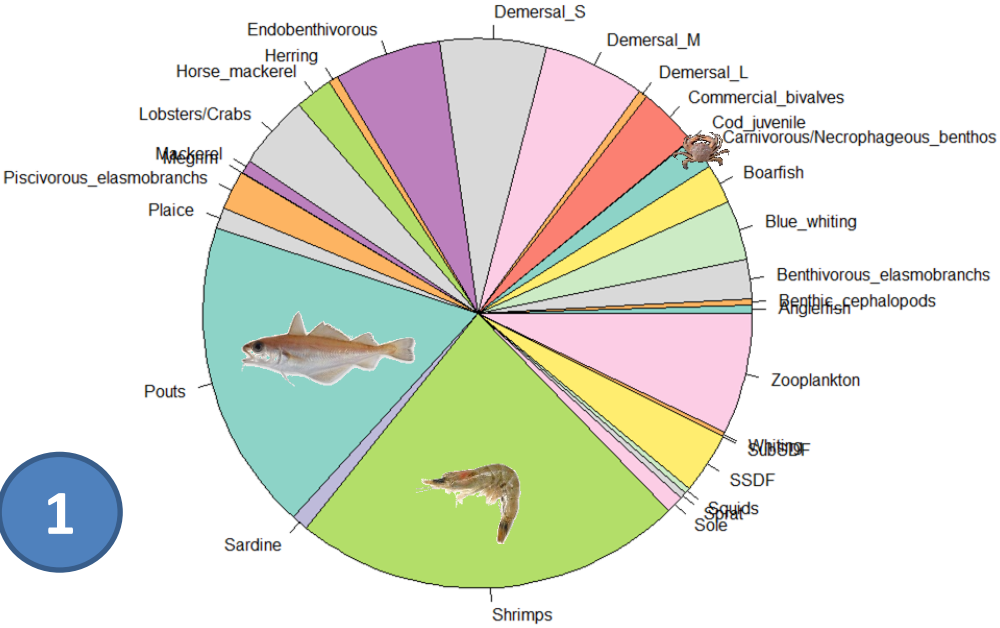


2

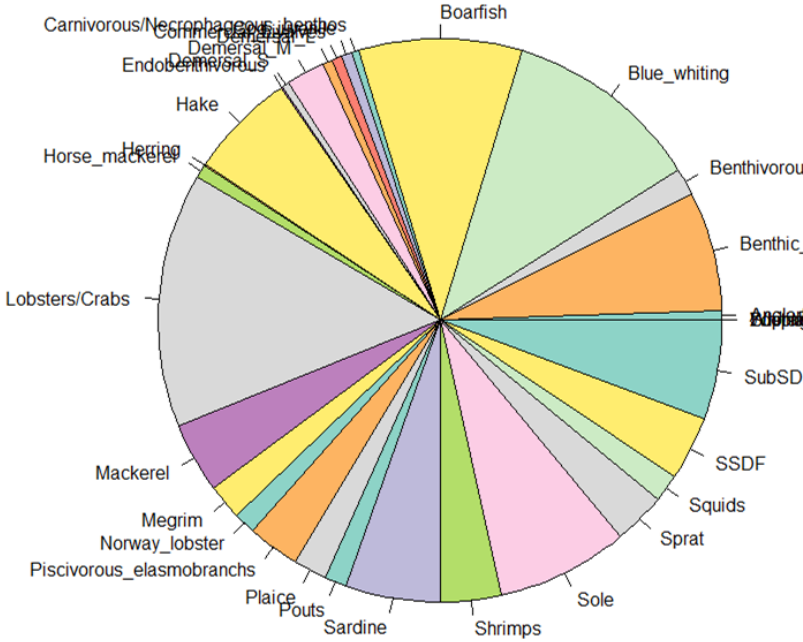
4

3

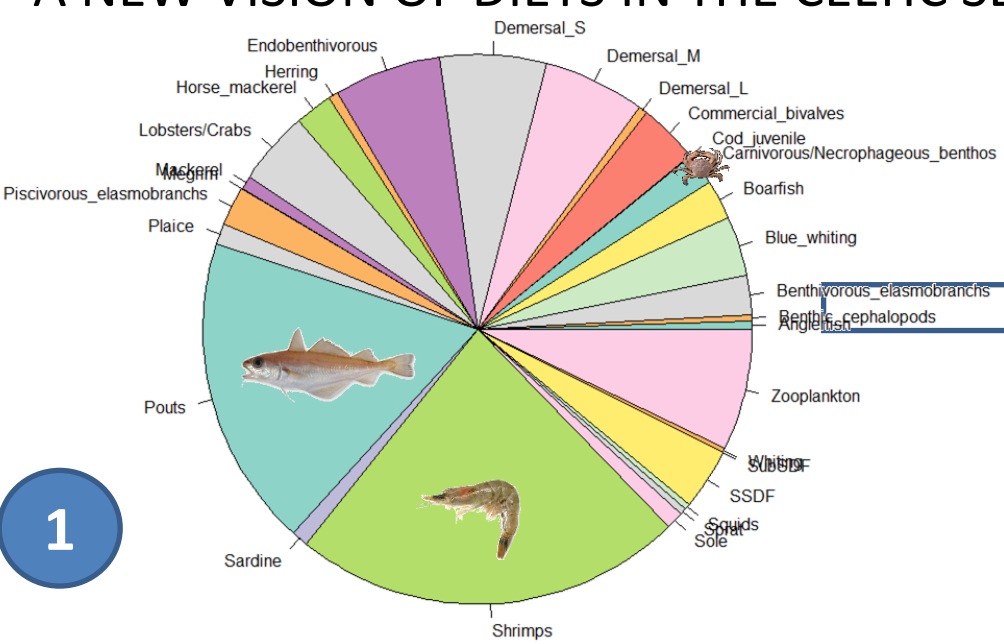
A NEW VISION OF DIETS IN THE CELTIC SEA – the cod case



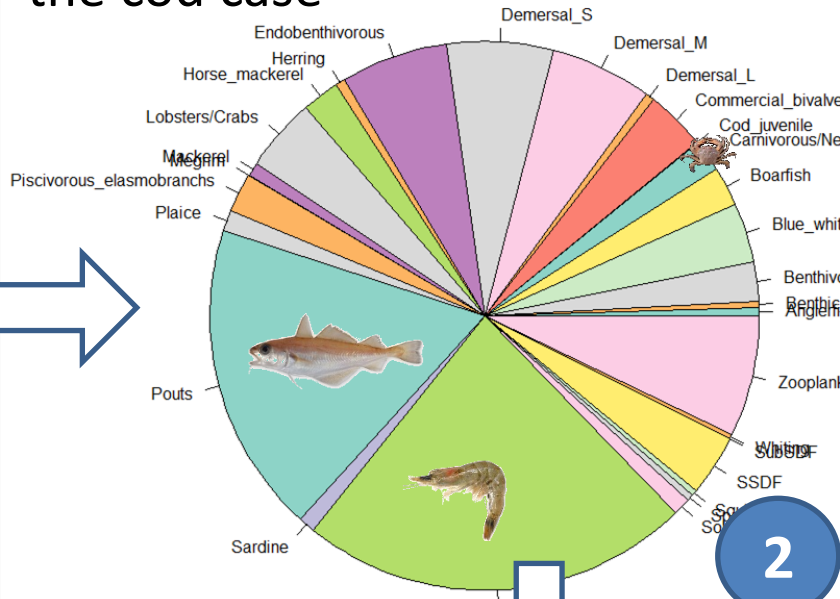
1



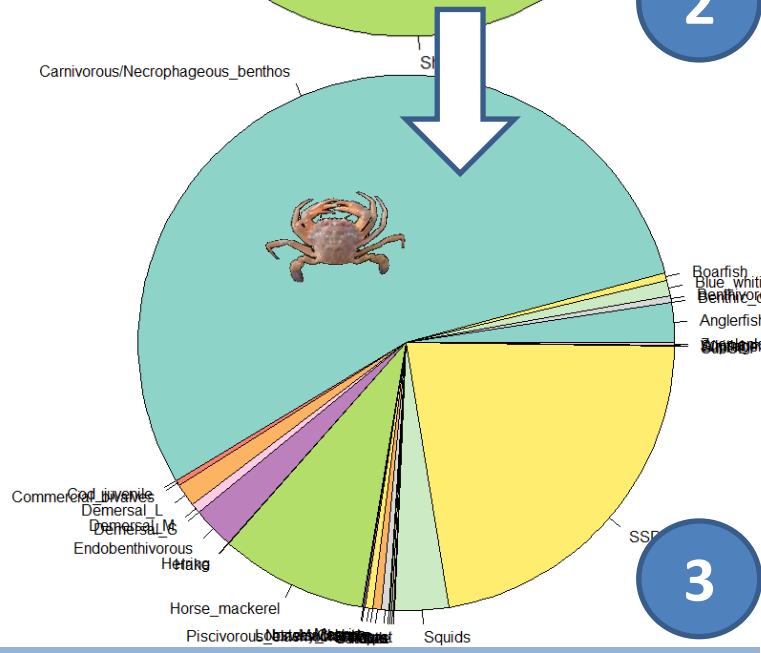
A NEW VISION OF DIETS IN THE CELTIC SEA – the cod case



1



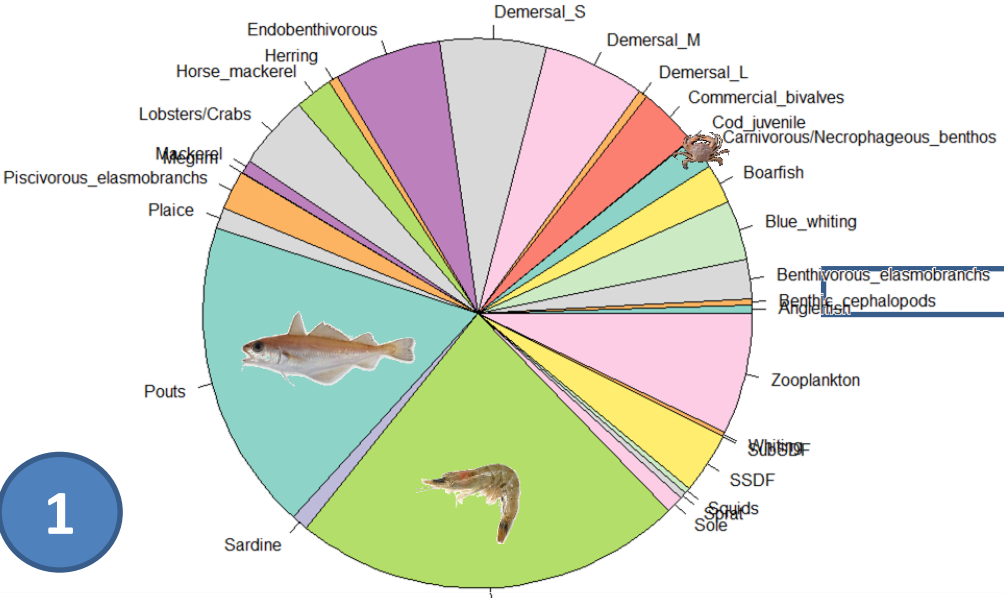
2

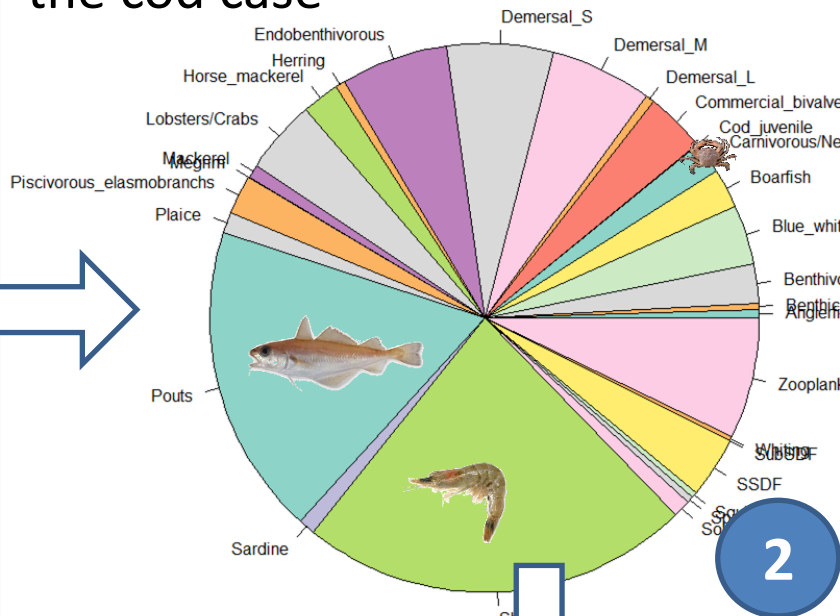


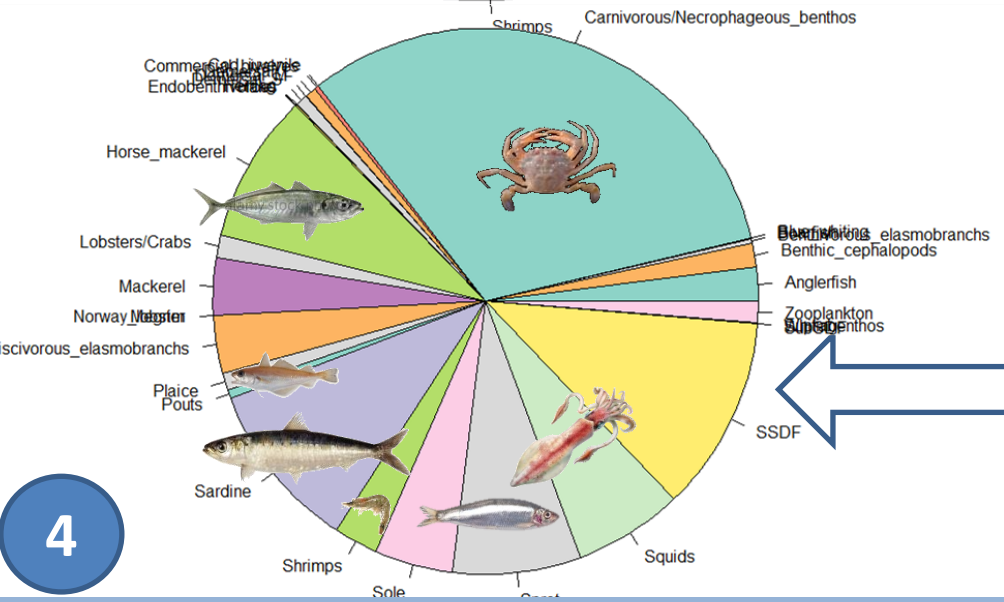
3

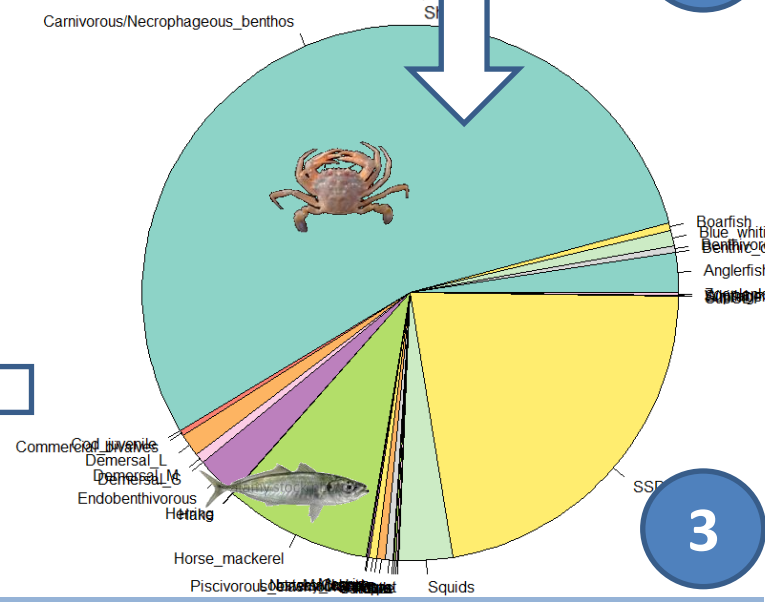
4

A NEW VISION OF DIETS IN THE CELTIC SEA – the cod case

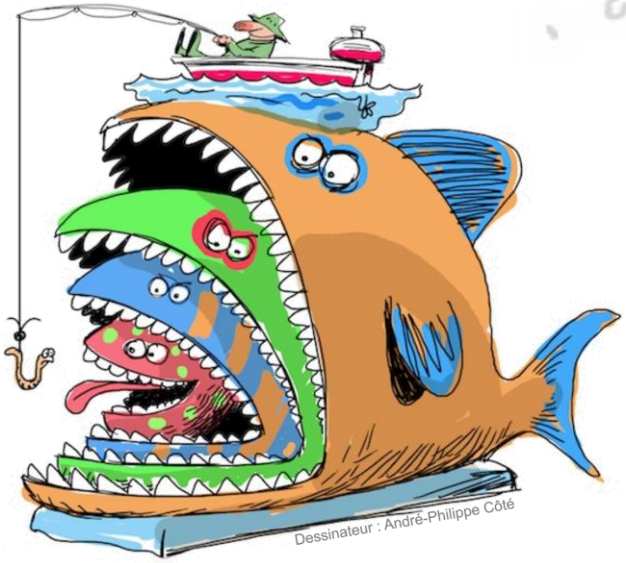








DISCUSSION



STILL TO DO

- Inclusion of final a « Pedigreed » diet matrix as prior
- Remove variation for the trophic enrichment factor
- Sensitivity analysis on data pretreatment of SIA & SCA

ABOUT EcoDiet

- EcoDiet: an innovative integrated model to couple both SCA and SIA…
  ….and literature data

- Main strengths:

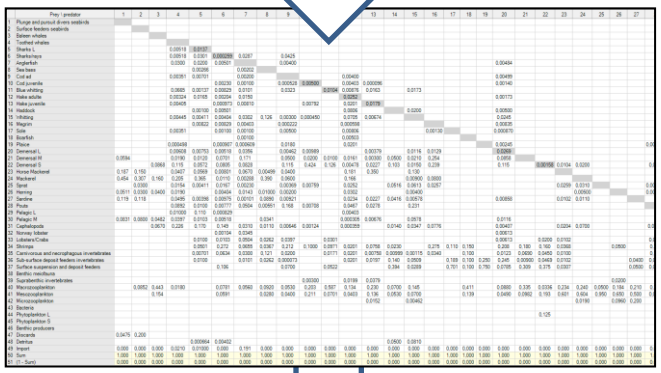
  - SCA as occurrences = less time-consuming

  - Distinction between preys with similar isotopic signatures

  - Better estimates of contributions since it artificially decrease the number of potential preys

- Promising results: new vision of trophic functionning in the Celtic Sea

Perspectives



???