Amedee 26/03/2015

Life history trajectories of two small pelagic species from otolith microchemistry: European anchovy (*Engraulis encrasicolus*) and Sardine (*Sardina pilchardus*) of the Bay of Biscay

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2014 5TH INTERNATIONAL OTOLITH SYMPOSIUM

Ifremer

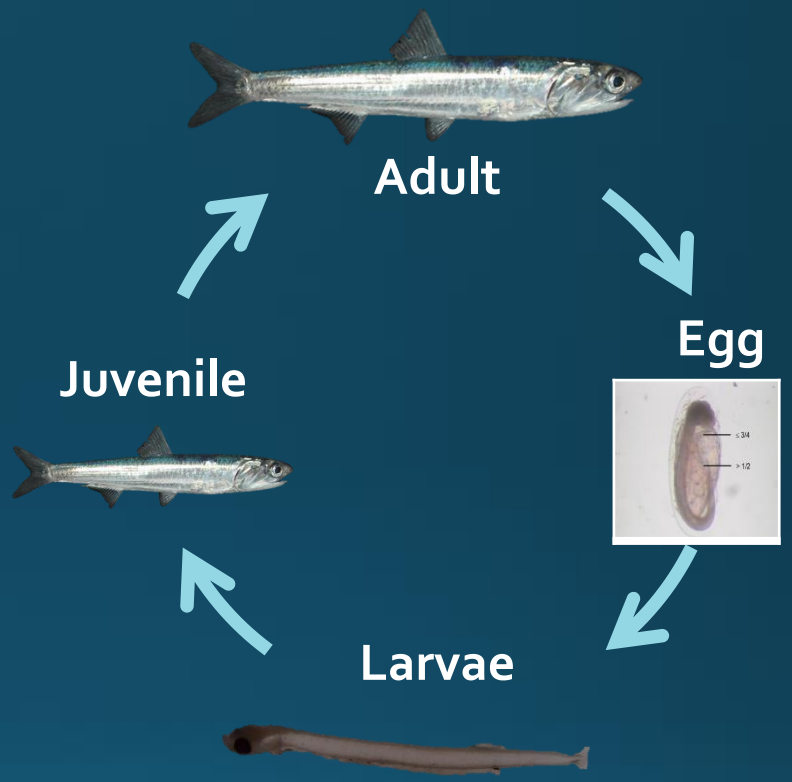
LEMAR laboratoire des sciences de l'environnement marin UMR CNRS/UBO/IRD/Ifremer

Pamal Femtosecond laser ablation

PHD project

Modelling the **whole life cycle** of anchovy & sardine in the **Bay of Biscay**

- Using **Individual Based Model** (IBM)
- In order to identify
  - **Essential habitats** for every life stage
  - **Connectivity patterns** between these habitats
  - Compare **life history traits** of both species



Life history : all processes (biotic & abiotic) affecting the fish during its whole life

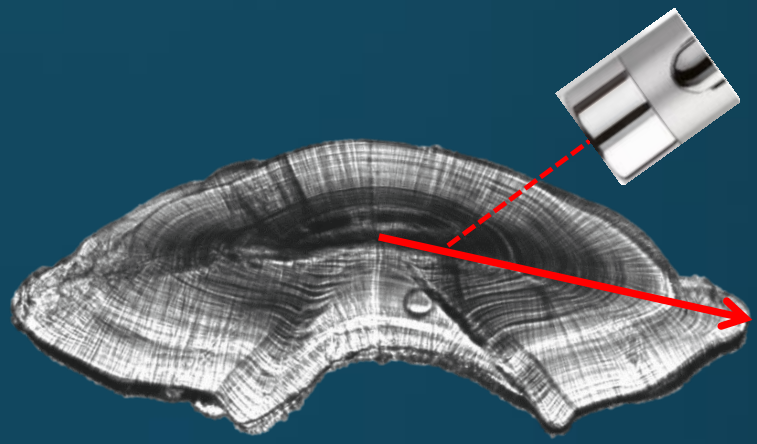
- Need of clues about potential **migration patterns / population structure / life history strategy….**

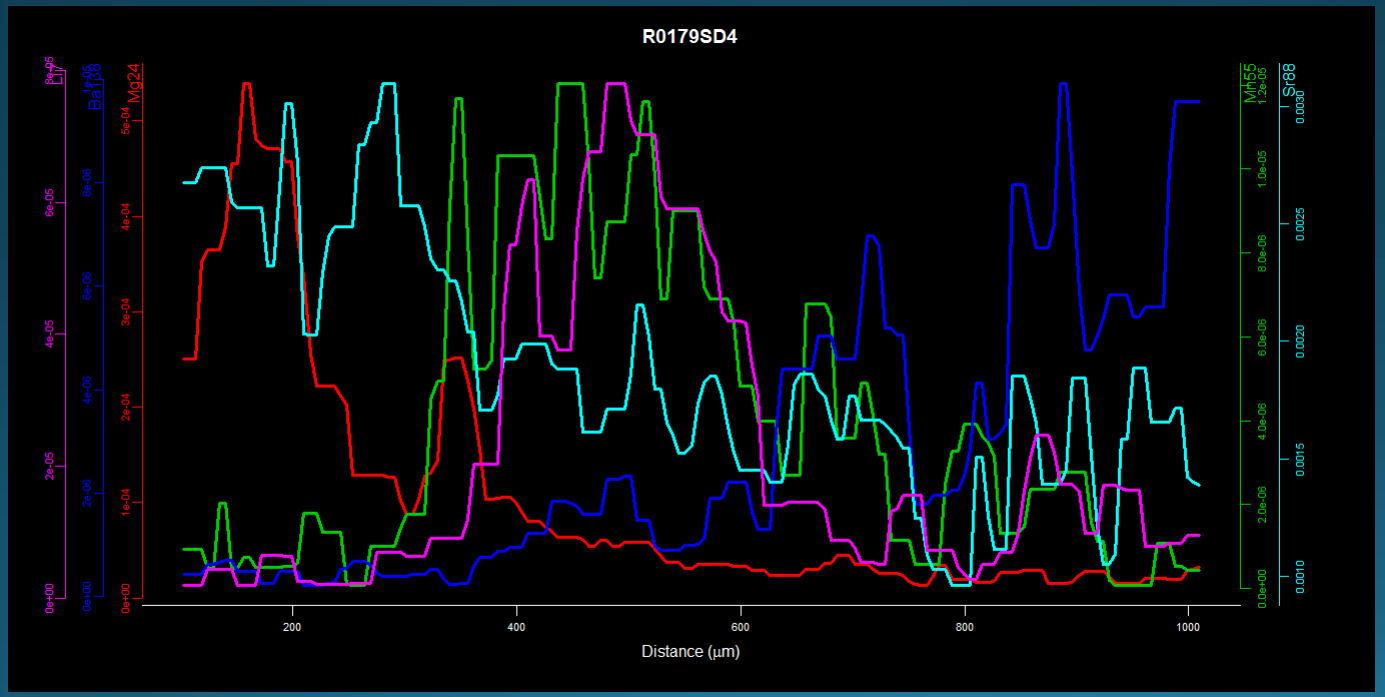
- The **otolith** hide in its crystal lattice informations about the **whole life history** of the fish, coded with **elemental signatures**, reflecting **a large variety of processes**

➔ **Otolith microchemistry** to investigate these issues

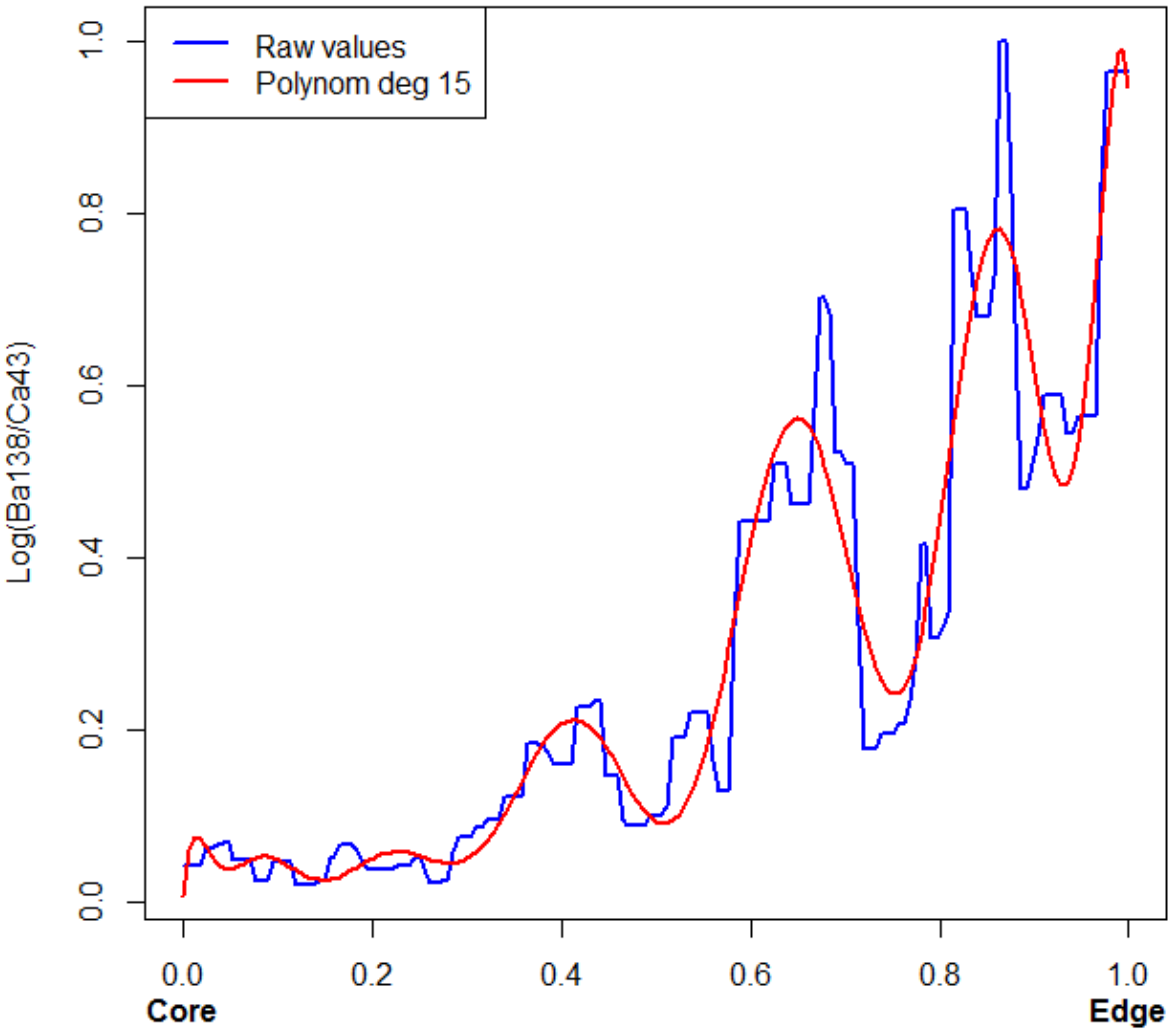
Assumption: *if several fishes display close elemental signatures they experienced similar life histories*

- LA-ICPMS
- Continuous laser transect
- Elements : Sr, Ba, Mn, Mg and Li





1.

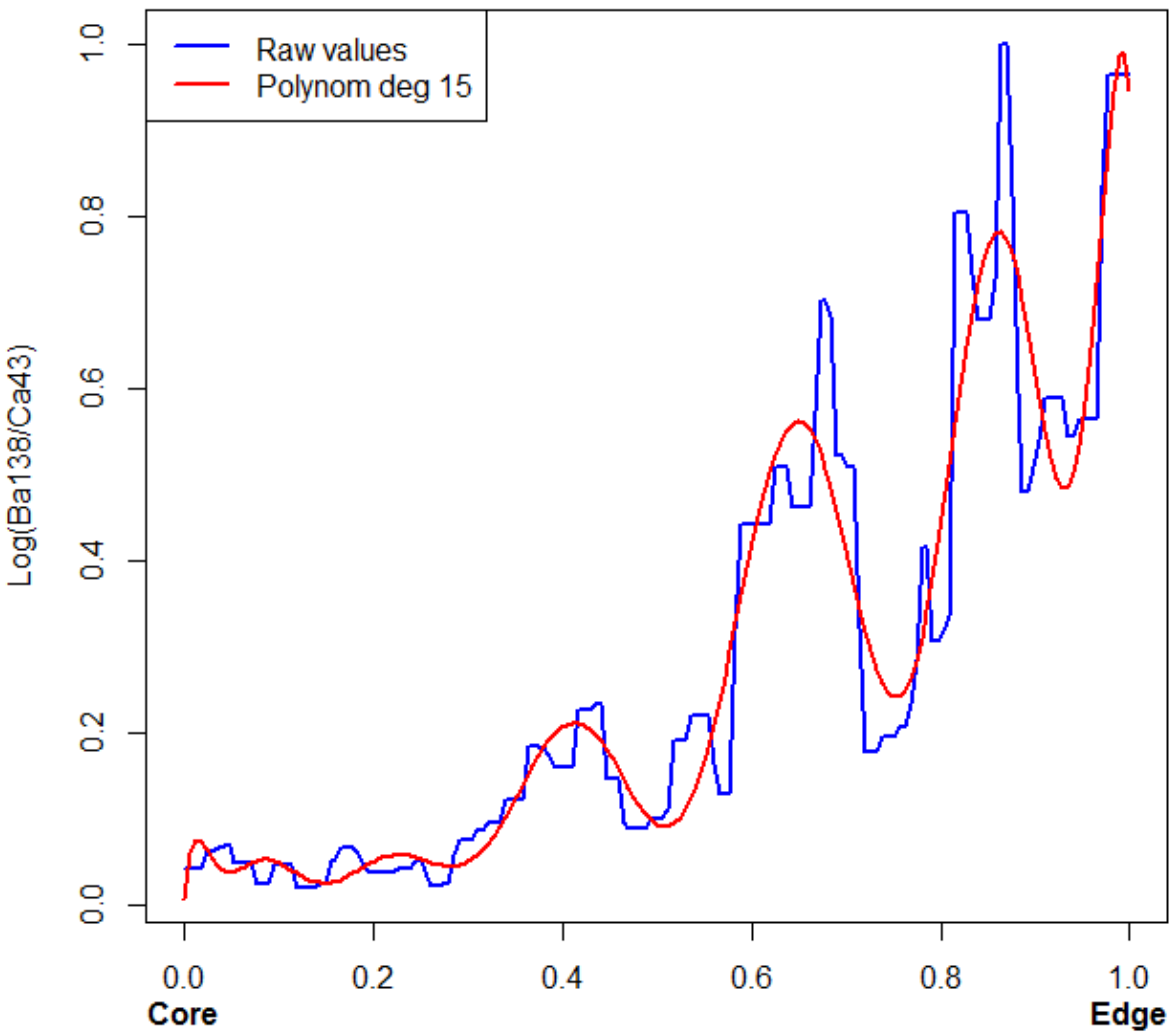

Fit Polynomial Curve
Raw values
Polynom deg 15
Log(Ba138/Ca43)
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.2
0.4
0.6
0.8
1.0
Core
Edge

Standardisation → $[0; 1]$

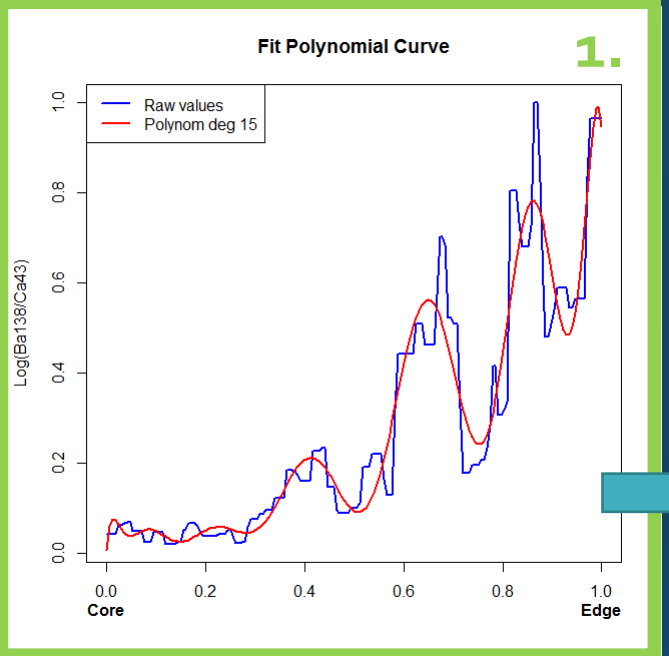
$$[x] = \frac{[x]}{[x_{max}]}$$

- For each element and fish
- Keep only trends
- Same weight for each element

1.



1.



2.

MFA

FACTOMINER

Mg

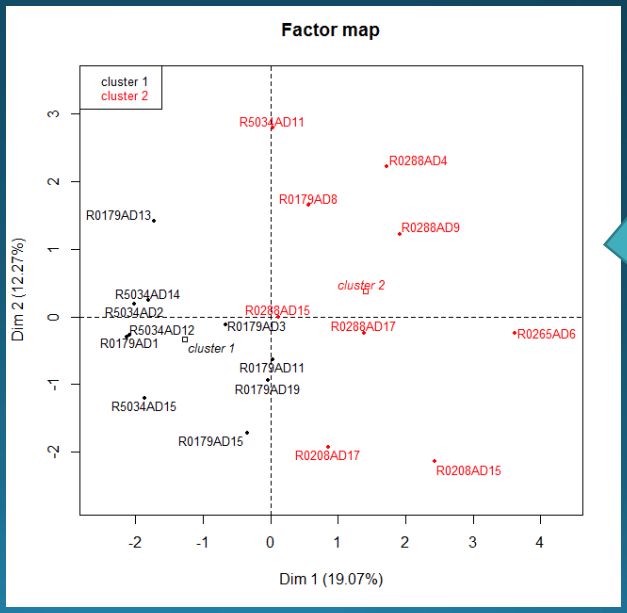
Mn

Ba

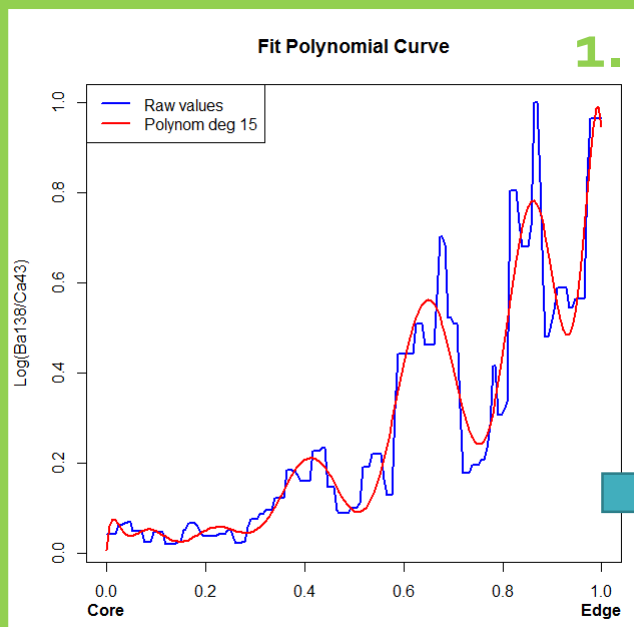
Li

Sr

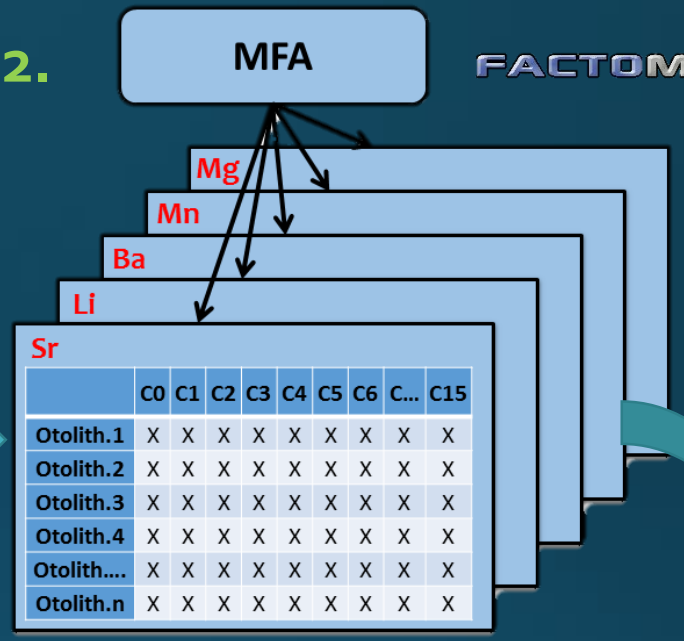
	C0	C1	C2	C3	C4	C5	C6	C...	C15
Otolith.1	X	X	X	X	X	X	X	X	X
Otolith.2	X	X	X	X	X	X	X	X	X
Otolith.3	X	X	X	X	X	X	X	X	X
Otolith.4	X	X	X	X	X	X	X	X	X
Otolith....	X	X	X	X	X	X	X	X	X
Otolith.n	X	X	X	X	X	X	X	X	X



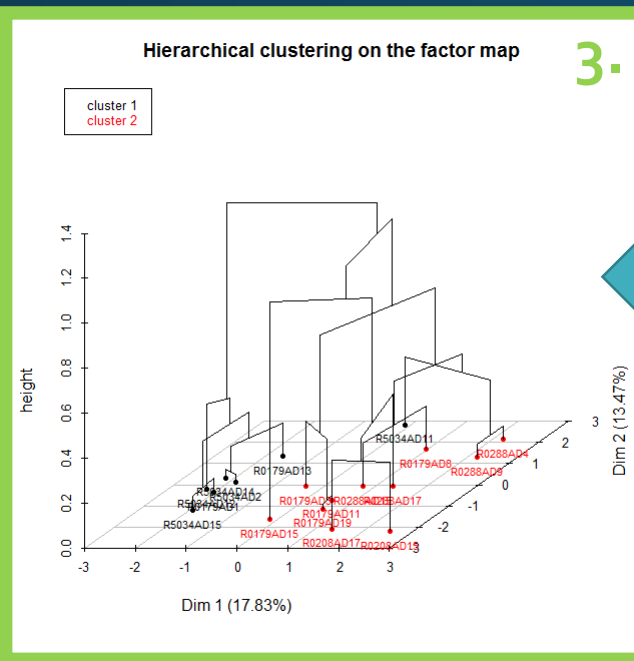
1.

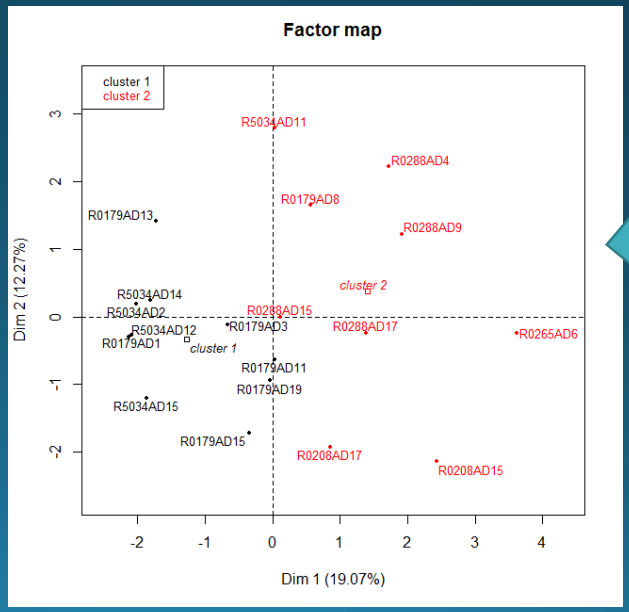

Fit Polynomial Curve
Raw values
Polynom deg 15
Log(Ba138/Ca43)
0.0
0.2
0.4
0.6
0.8
1.0
Core
Edge

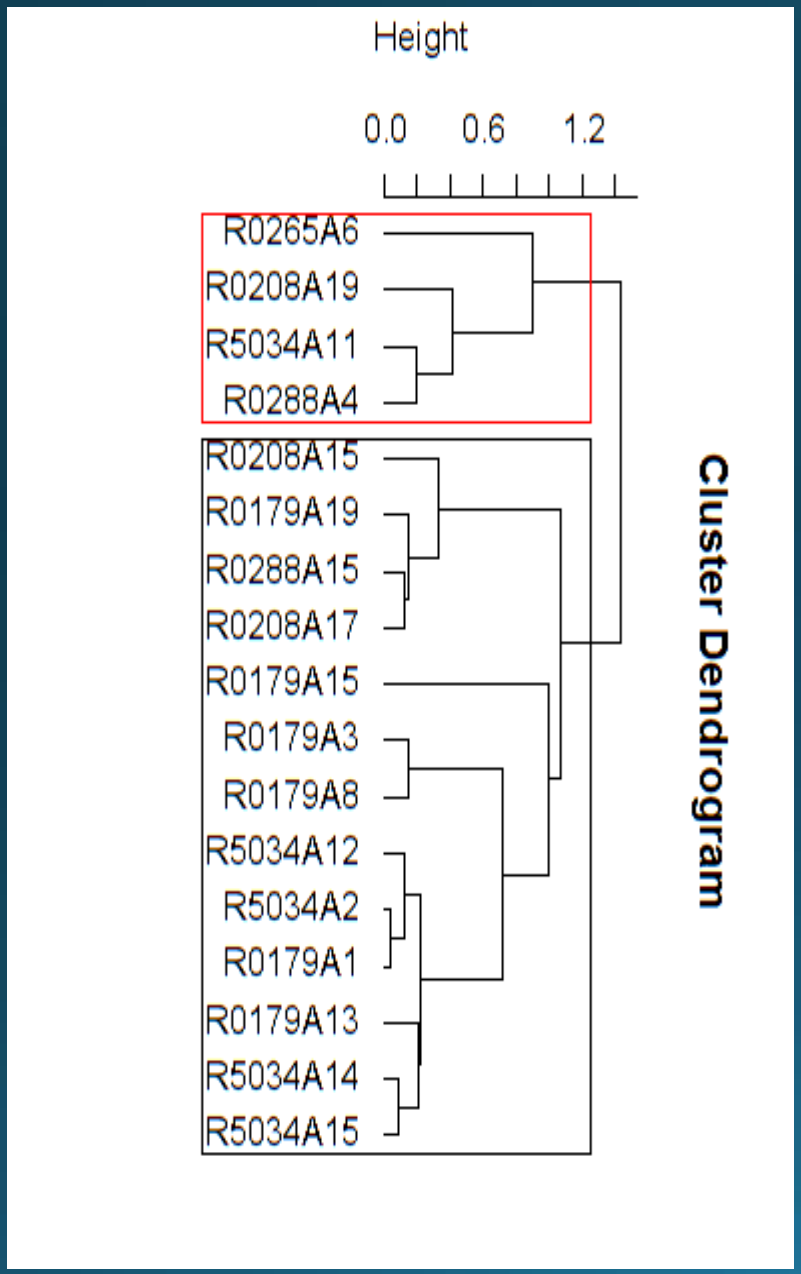
2.


MFA
FACTOMINER
Mg
Mn
Ba
Li
Sr
C0 C1 C2 C3 C4 C5 C6 C... C15
Otolith.1 X X X X X X X X X
Otolith.2 X X X X X X X X X
Otolith.3 X X X X X X X X X
Otolith.4 X X X X X X X X X
Otolith.... X X X X X X X X X
Otolith.n X X X X X X X X X

3.


Hierarchical clustering on the factor map
cluster 1
cluster 2
height
Dim 1 (17.83%)
Dim 2 (13.47%)


Factor map
cluster 1
cluster 2
Dim 2 (12.27%)
Dim 1 (19.07%)
R5034AD11
R0288AD4
R0179AD8
R0179AD13
R0288AD9
cluster 2
R5034AD14
R5034AD2
R0288AD15
R5034AD12
R0179AD3
R0288AD17
R0265AD6
R0179AD1
cluster 1
R0179AD11
R0179AD19
R5034AD15
R0179AD15
R0208AD17
R0208AD15


Height
0.0
0.6
1.2
R0265A6
R0208A19
R5034A11
R0288A4
R0208A15
R0179A19
R0288A15
R0208A17
R0179A15
R0179A3
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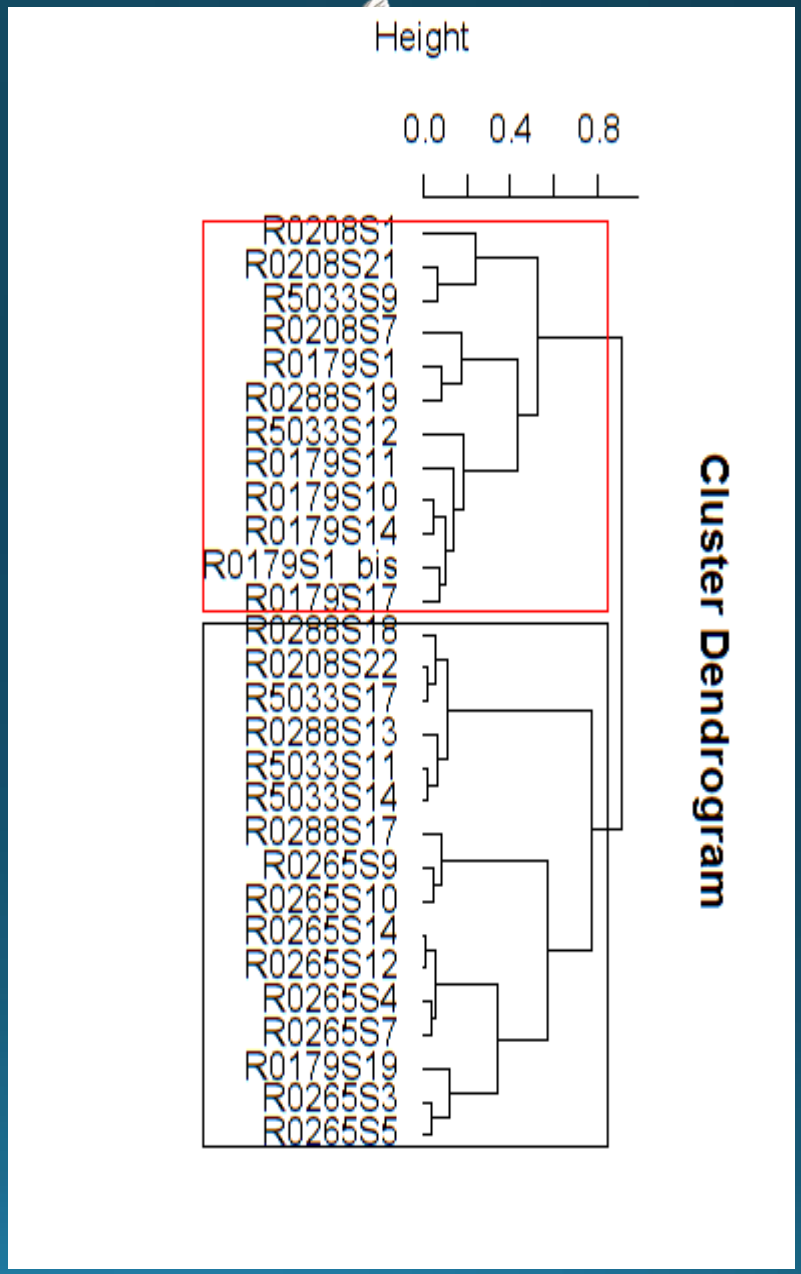
R5034A2
R0179A1
R0179A13
R5034A14
R5034A15
Cluster Dendrogram


Height
0.0
0.4
0.8
R0208S1
R0208S21
R5033S9
R0208S7
R0179S1
R0288S19
R5033S12
R0179S11
R0179S10
R0179S14
R0179S1_bis
R0179S17
R0288S18
R0208S22
R5033S17
R0288S13
R5033S11
R5033S14
R0288S17
R0265S9
R0265S10
R0265S14
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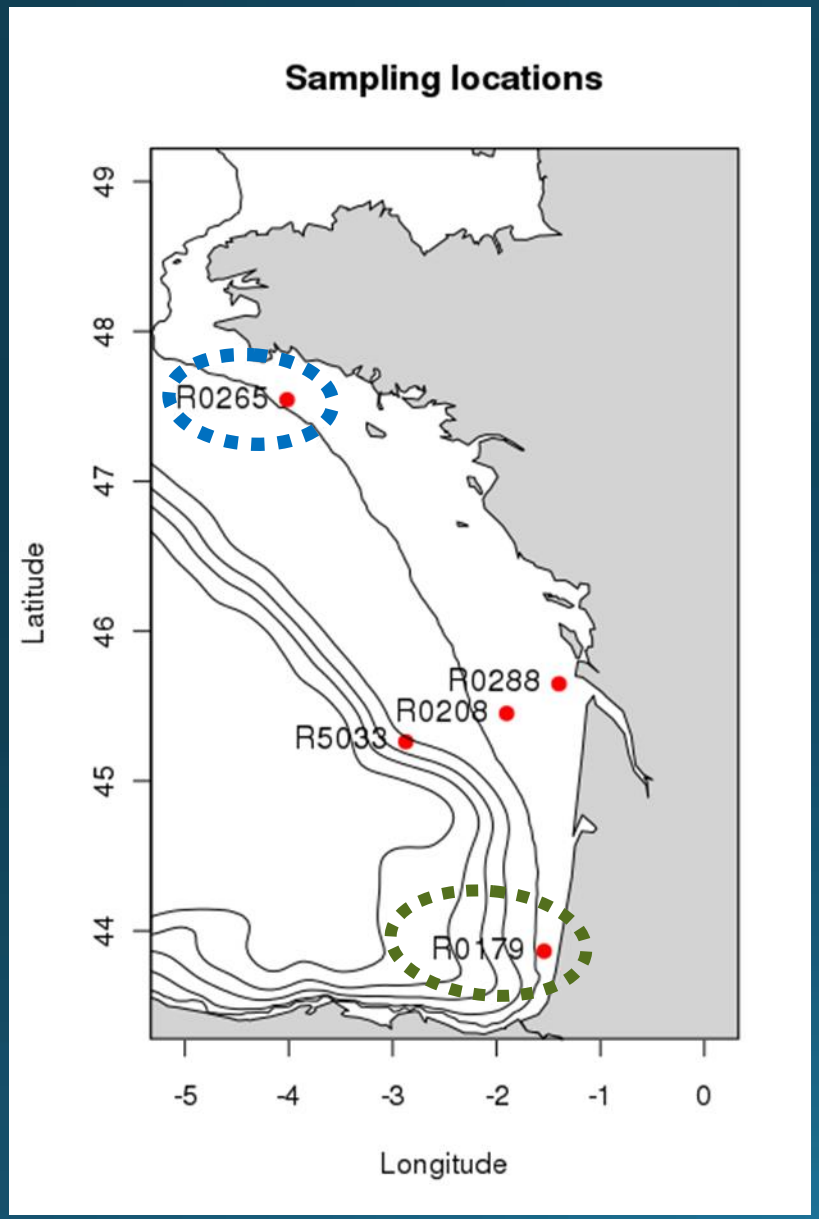
R0265S4
R0265S7
R0179S19
R0265S3
R0265S5
Cluster Dendrogram


Sampling locations
Latitude
Longitude
49
48
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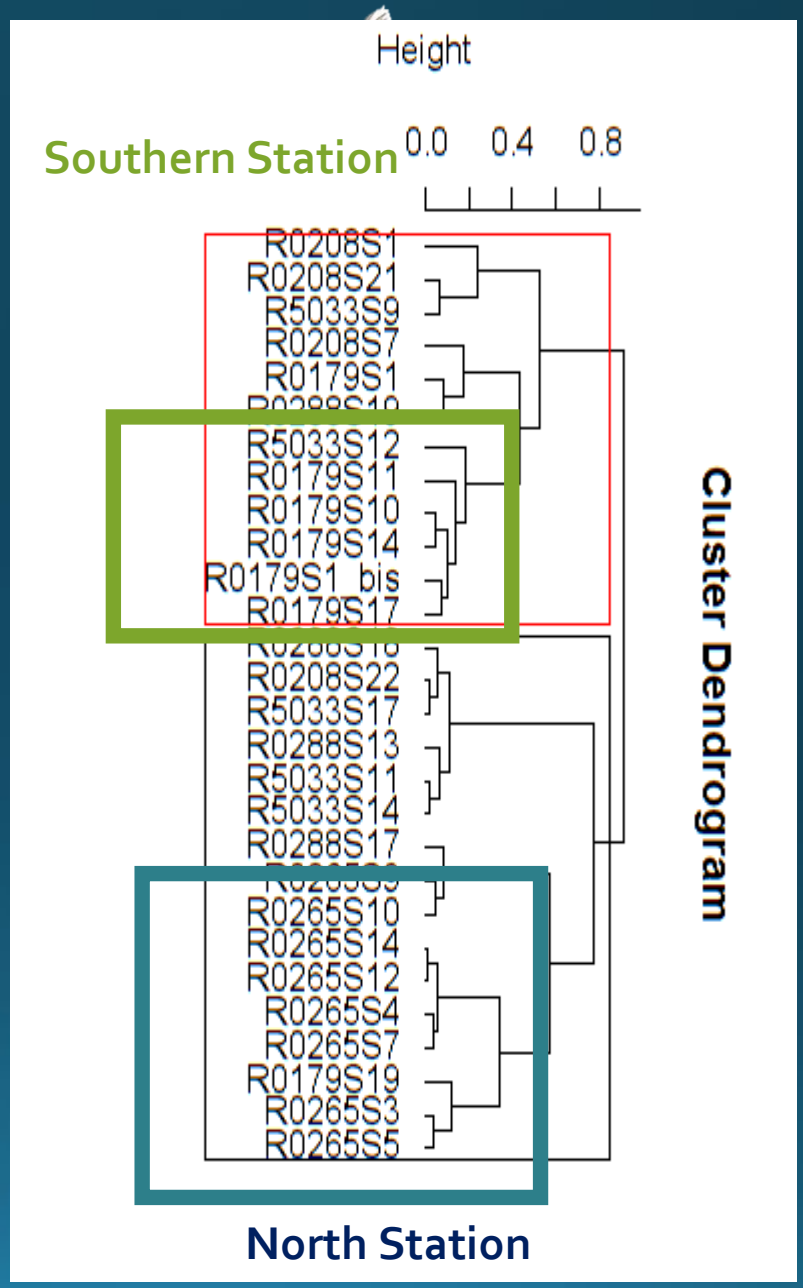
-5
-4
-3
-2
-1
0
R0265
R0288
R0208
R5033
R0179


Height
0.0
0.4
0.8
Southern Station
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R0208S21
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R0208S7
R0179S1
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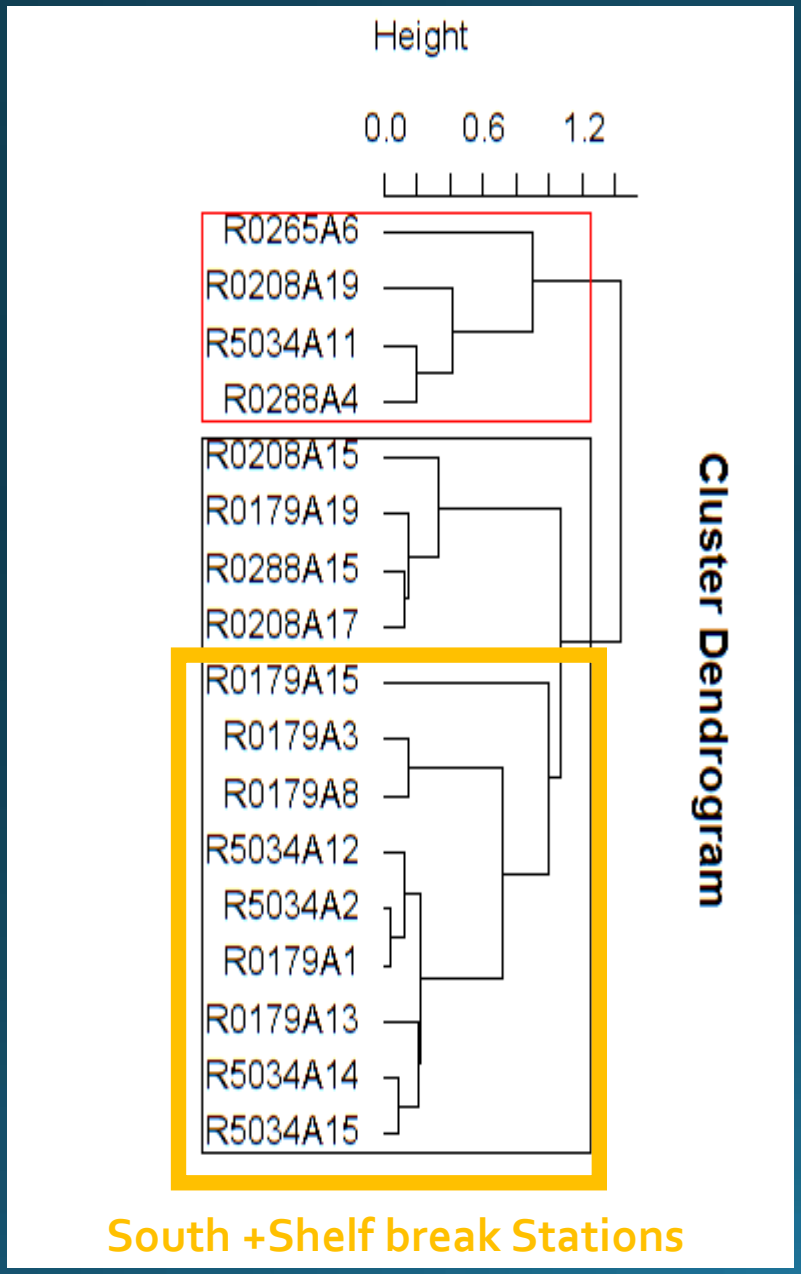
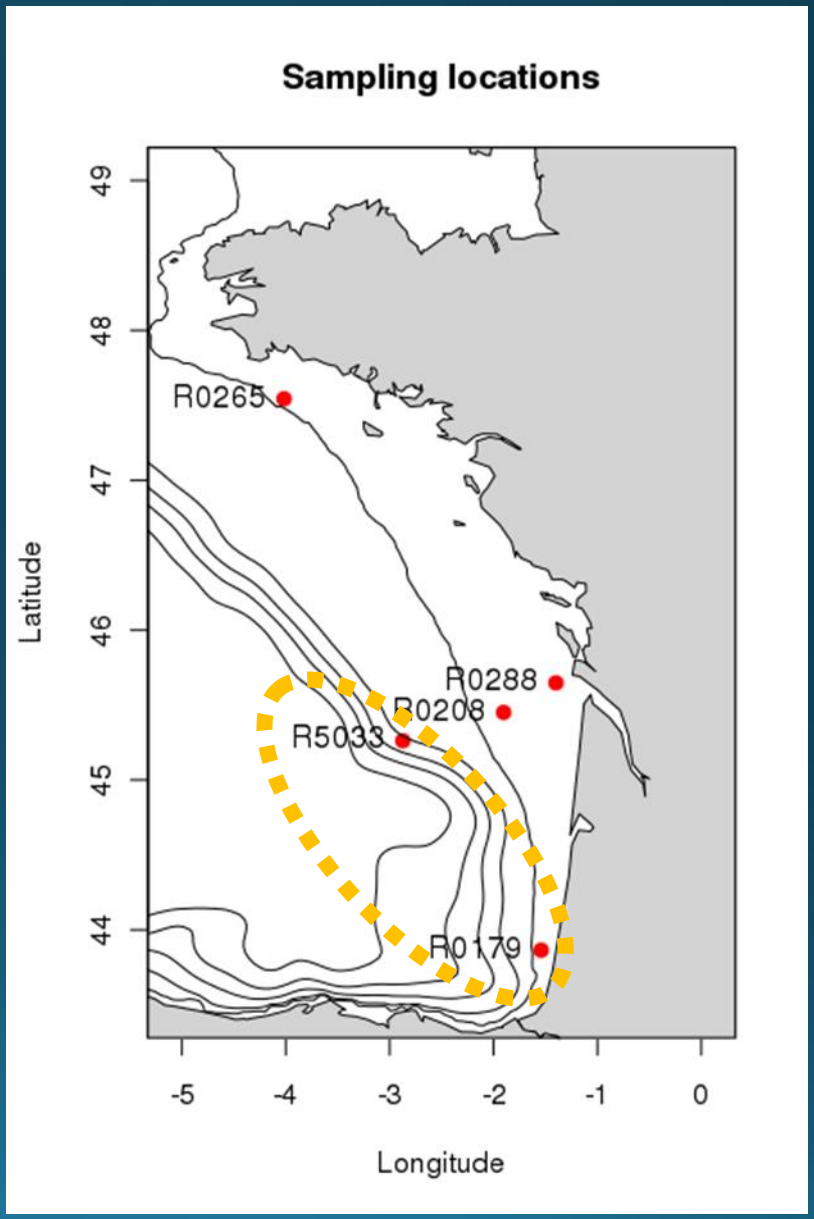
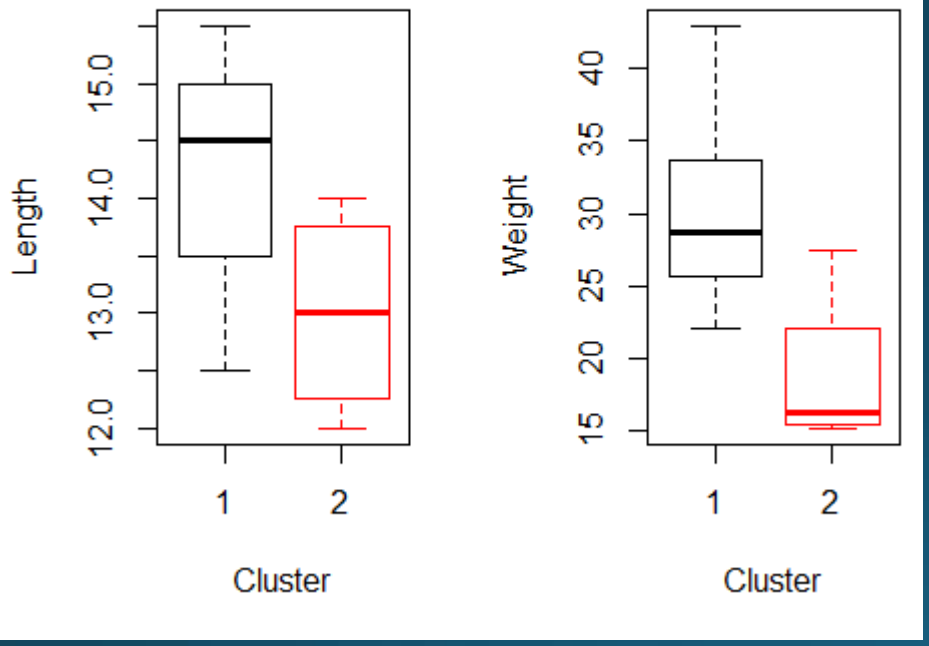
R0179S11
R0179S10
R0179S14
R0179S1_bis
R0179S17
R0208S22
R5033S17
R0288S13
R5033S11
R5033S14
R0288S17
R0265S10
R0265S14
R0265S12
R0265S4
R0265S7
R0179S19
R0265S3
R0265S5
Cluster Dendrogram
North Station

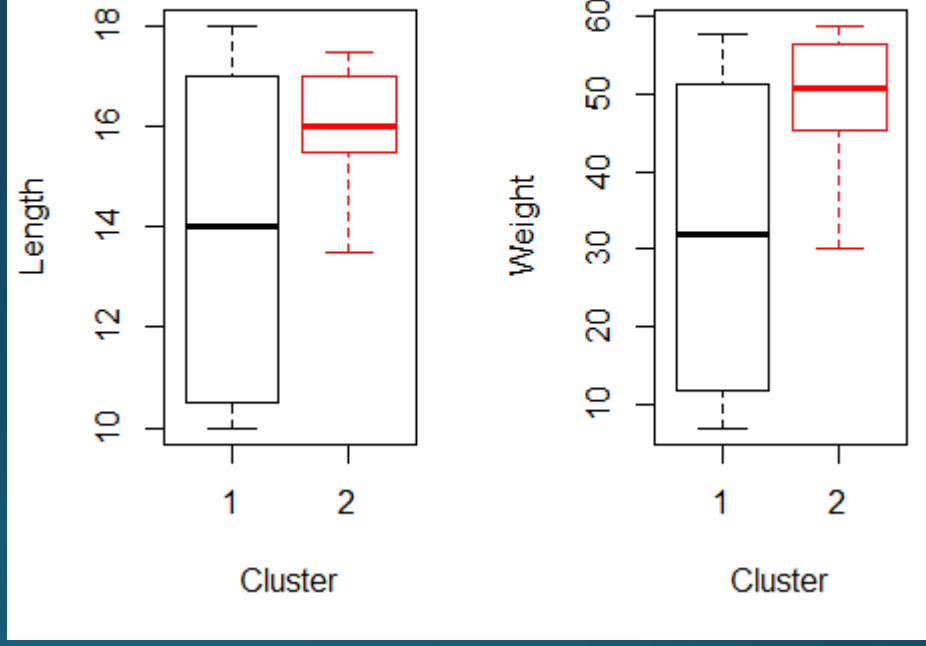


South +Shelf break Stations



p-value = 0.01515



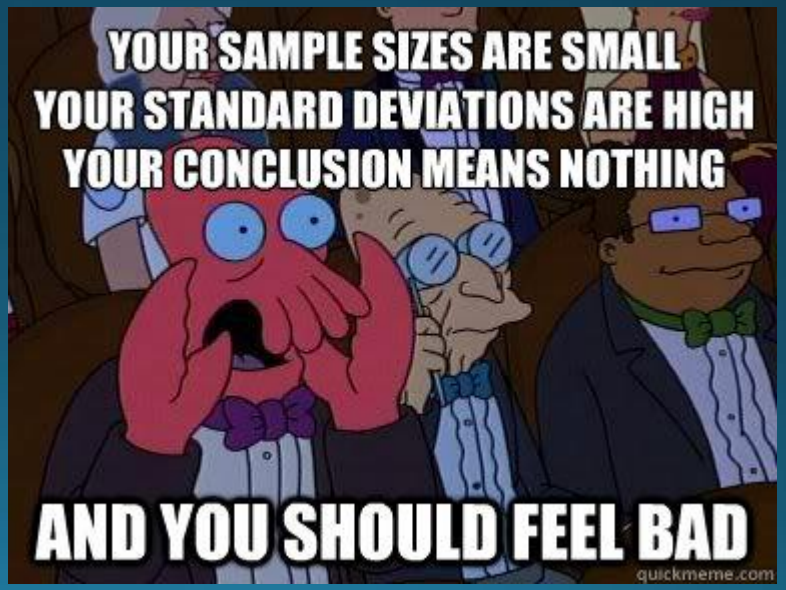


Significatve for weight, pval=1.15%

Significatve for weight, pval=3.3%

- Limited set of samples & sampling coverage

- Potential **groups**, displaying **different size & weight** at the same age
  - **Does microchemistry reflect fish condition ?**
  - **Several life history trajectories** ?
  - **Several populations** ?
    Sardine North/South ?
  - Several migration patterns ?



- Increase the **sampling coverage**
  - In space: the **Bay of Biscay** and in the **English Channel** for Sardine
  - In time: several years → robust interannual patterns ?

- ***TRY*** to interprete elemental signal

→ Correlate signals with age, climate, food

- Focussing on **core** signals
  - ➢ Different **spawning areas** ?
  - ➢ **Sub-populations** ?

- Using **heavy metals** (Cd, Cu, Pb…) as more effective geographical markers (river discharge, human activities…)

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- ~**40 anchovies** caught in the **English Channel** (EVOHE 14) ***M1 Masaya***

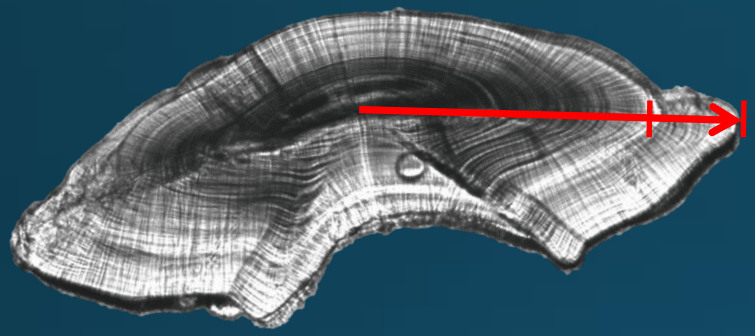
→ ***Unlikely to prepare other samples***

- Already tried → **not convincing**

- *Small set of data to be analysed …*

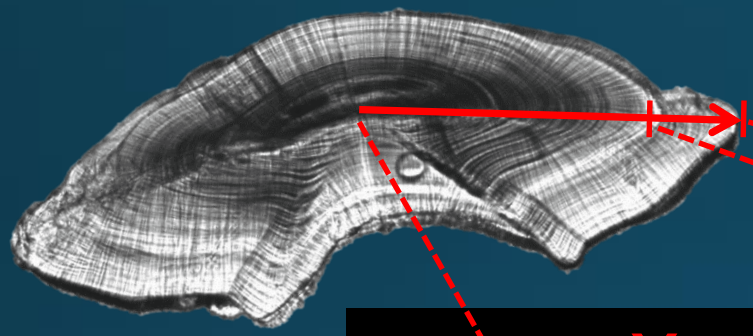
- Only a fraction of the whole dataset exploited
  → **35/100** (only age 2)

- Only a fraction of a the whole datasets exploited
- For one sample → **split elemental signals through years of life**



… by measuring otolith radius of each year of growth

- Only a fraction of a the whole dataset exploited
- For one sample → **split elemental signals through years of life**



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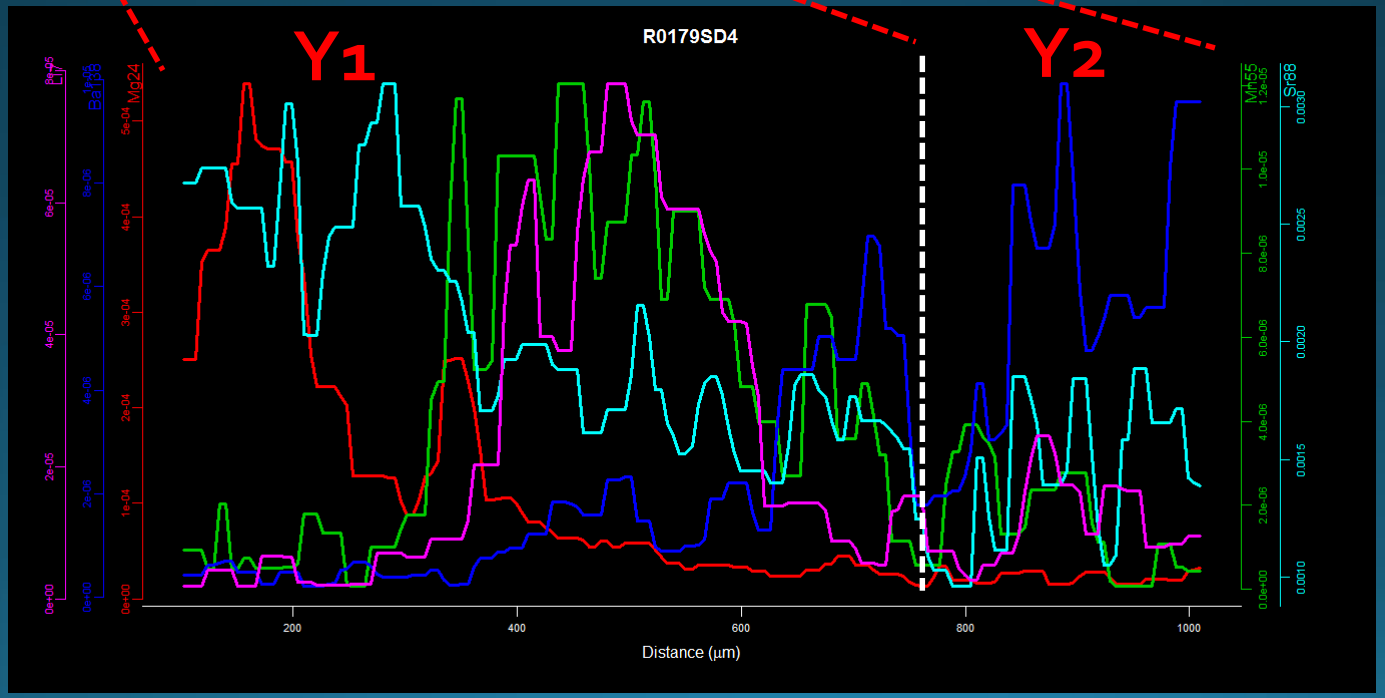
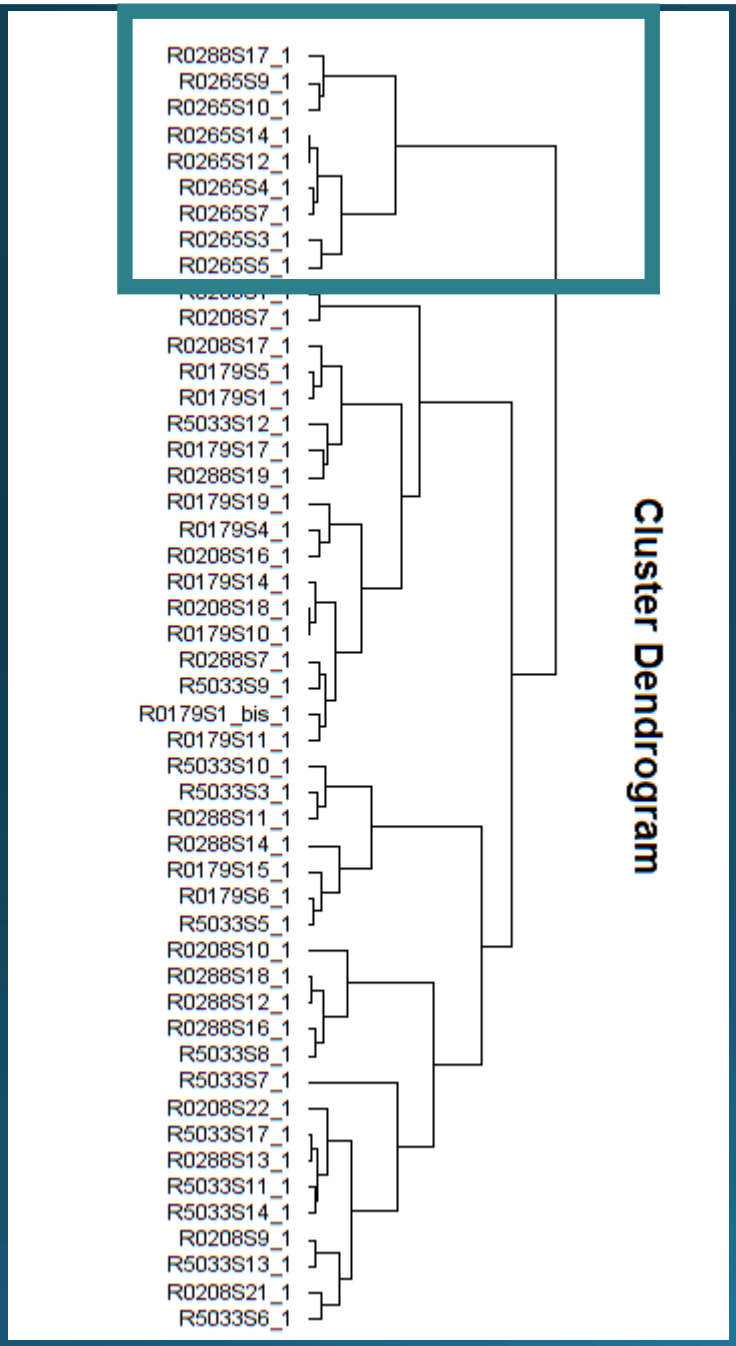


- Only a fraction of a the whole dataset exploited
- For one sample → **split elemental signals through years of life**

→ **Classify portions of each transects**

- ***Is the cluster pattern robust through years ?***
- ***Is the cluster pattern robust through cohorts ?***
- ***Do the fish experience the same history each year of its life ?***
- ***Is there some evidence of school mixing / splitting ?***


R0288S17_1
R0265S9_1
R0265S10_1
R0265S14_1
R0265S12_1
R0265S4_1
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R0265S5_1
R0208S7_1
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R0179S10_1
R0288S7_1
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R0179S1_bis_1
R0179S11_1
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R0288S13_1
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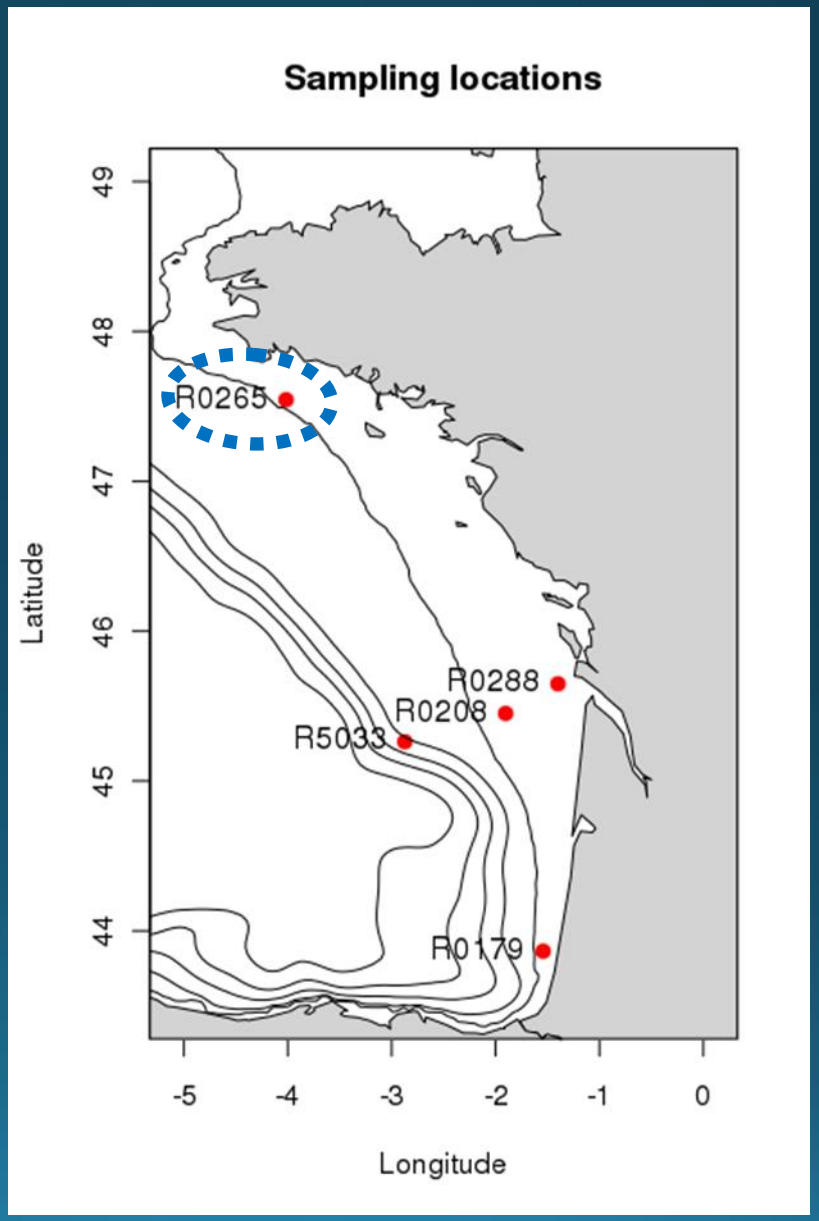
R0208S21_1
R5033S6_1
Cluster Dendrogram


Sampling locations
R0265
R0288
R0208
R5033
R0179
Latitude
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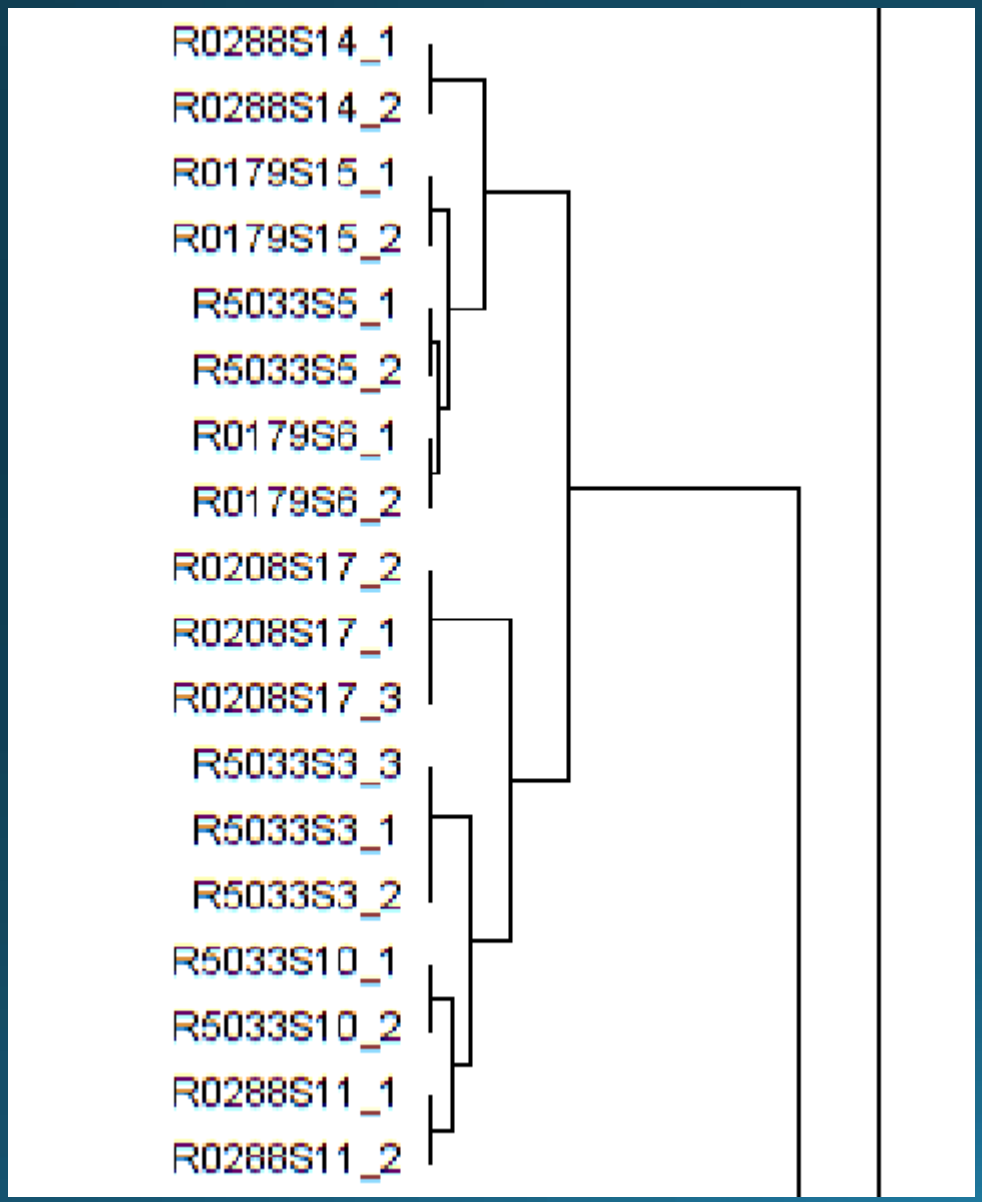

- Stabilité interannuelle des signaux ?
- Même histoire de vie ?
- Même pattern de migration ?

Aknowledgment

*I would like to thank all the technicians and engineers for providing technical and **moral** support, at every step of the protocol*

IRD, LEMAR: Eric DABAS, Jean-Marie Munaron, Maylis Labonne

Ifremer: Patrick GRELLIER

LCABIE (PAU University): Gaëlle BARBOTIN

Thank you for your attention

Up to now, our main certitude is their final destination…