From seascape genomics to community ecology: comparing the physical factors structuring genetic diversity within a bioengineer species of the coralligenous habitats with those structuring the species composition of the coralligenous community

Aurélien DE JODE , Romain DAVID , Caroline ROCHER , Marjorie SELVA , Anne Haguenauer , Stéphane SARTORETTO , Jean-Pierre FERAL , Anne CHENUIL

IMBE team Biodiversity Origin and Evolution

Coralligenous habitats

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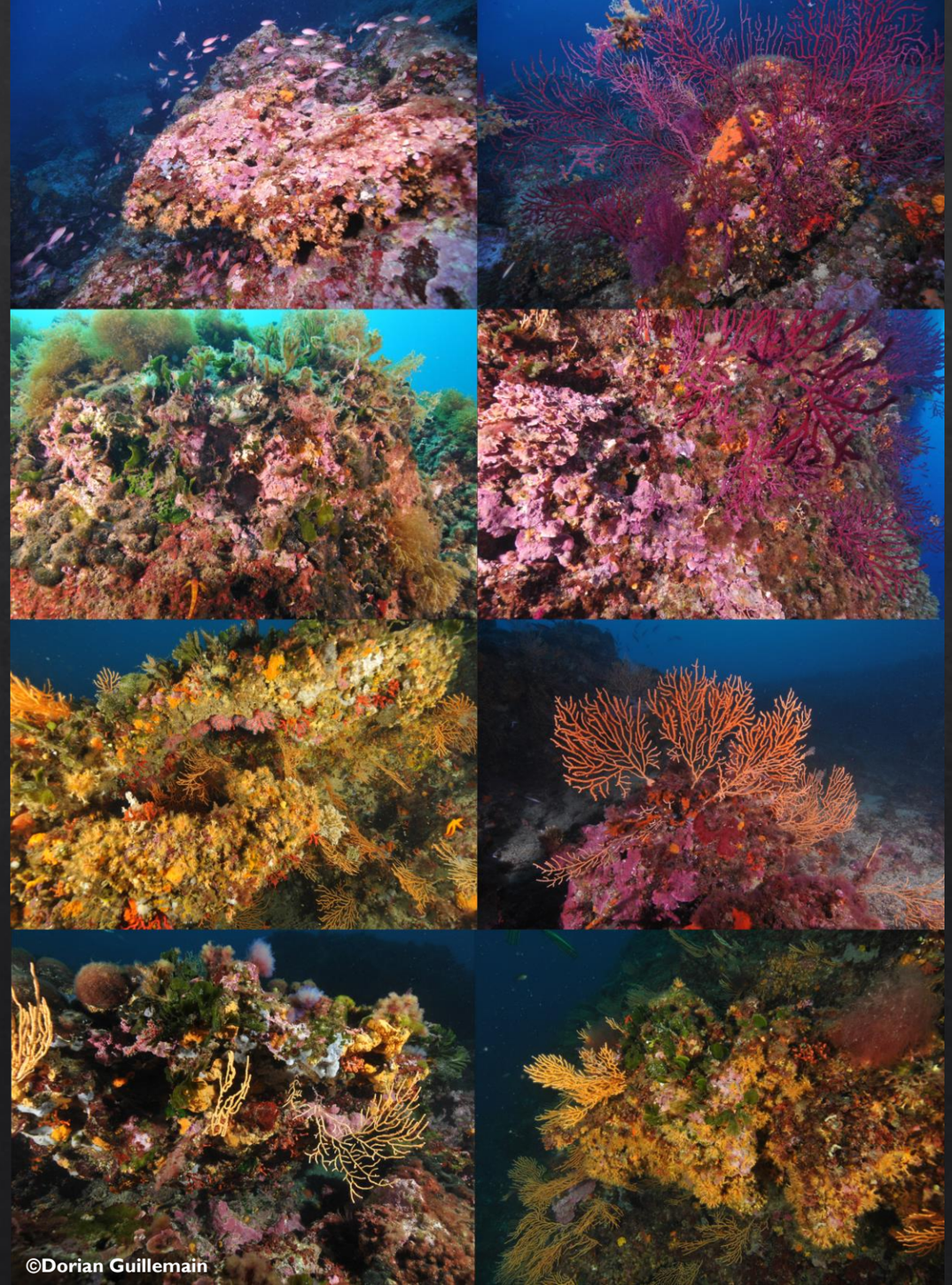
  - **Bio-concretion** of calcareous red algae (*Peyssonneliaceae* & *Corallinaceae*)
  - Dim light
  - Marine invertebrates



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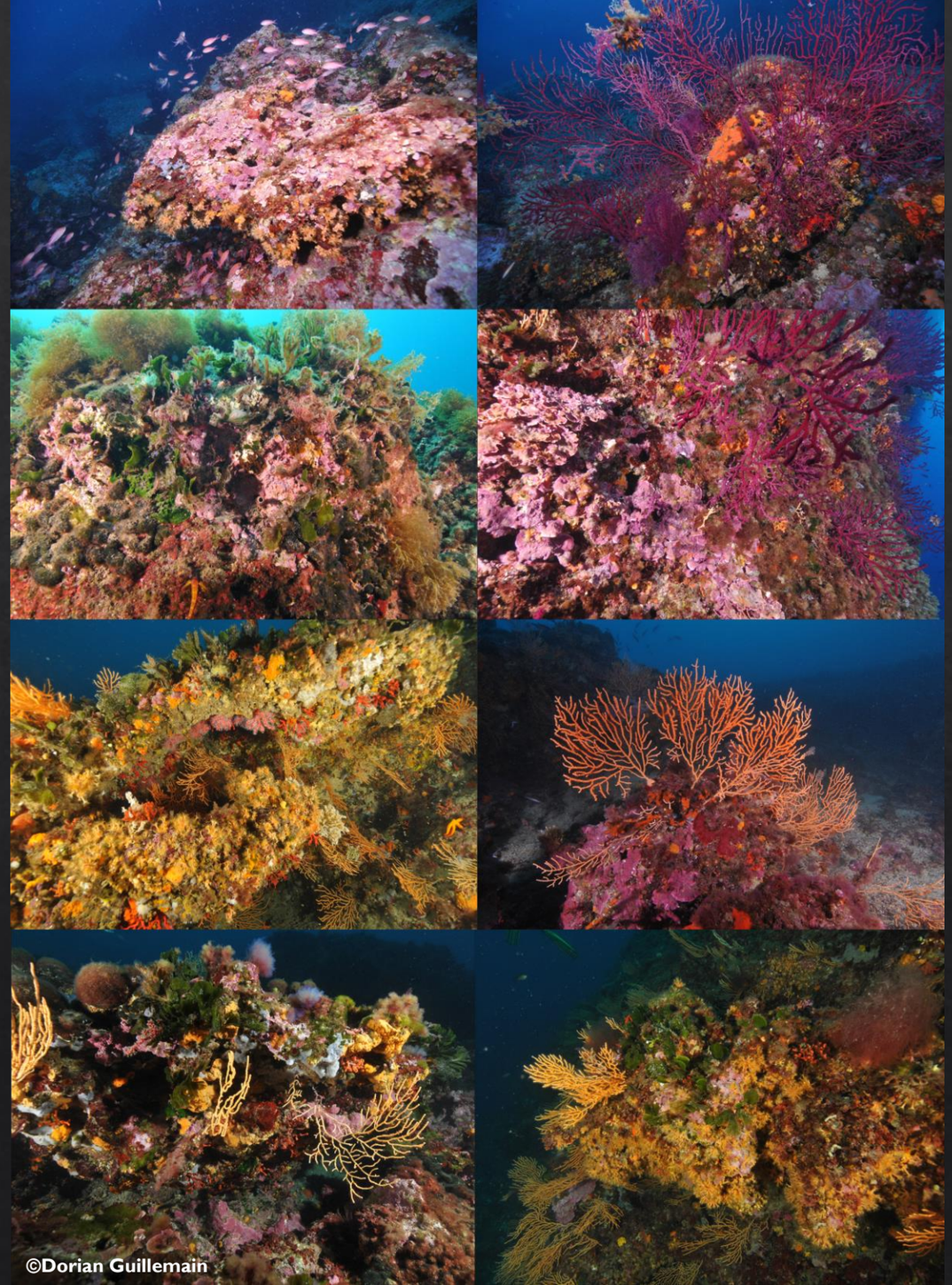

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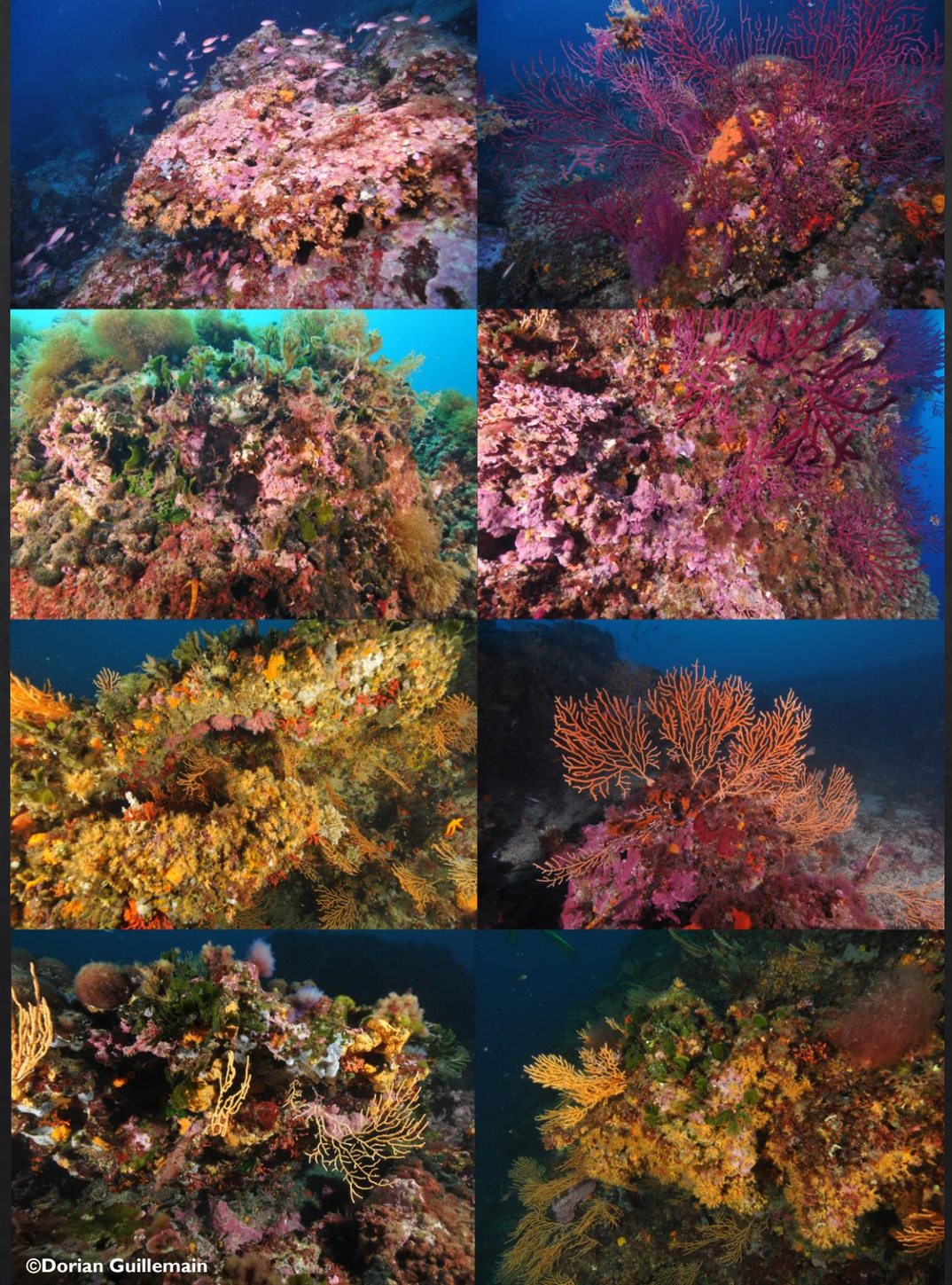

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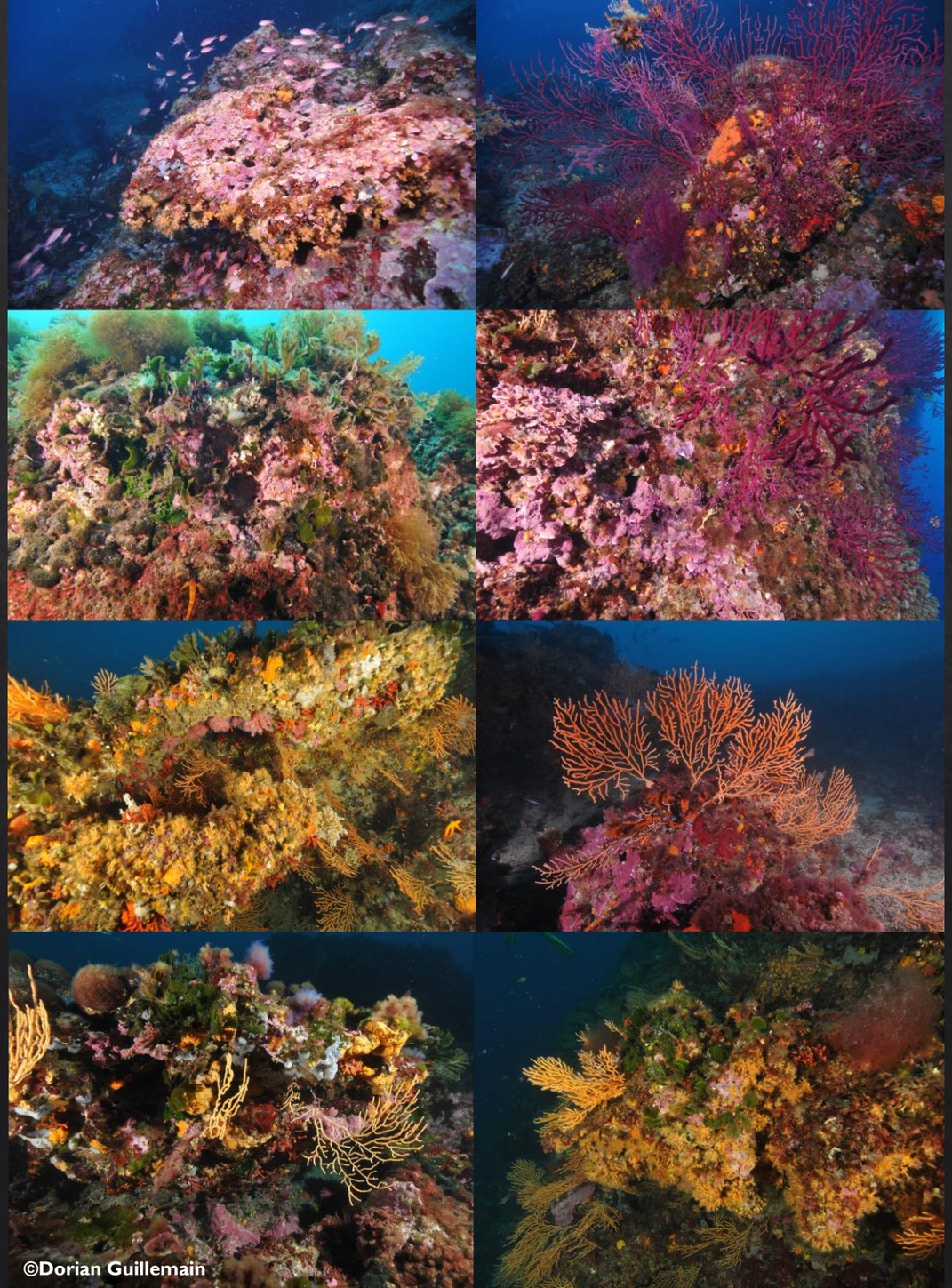

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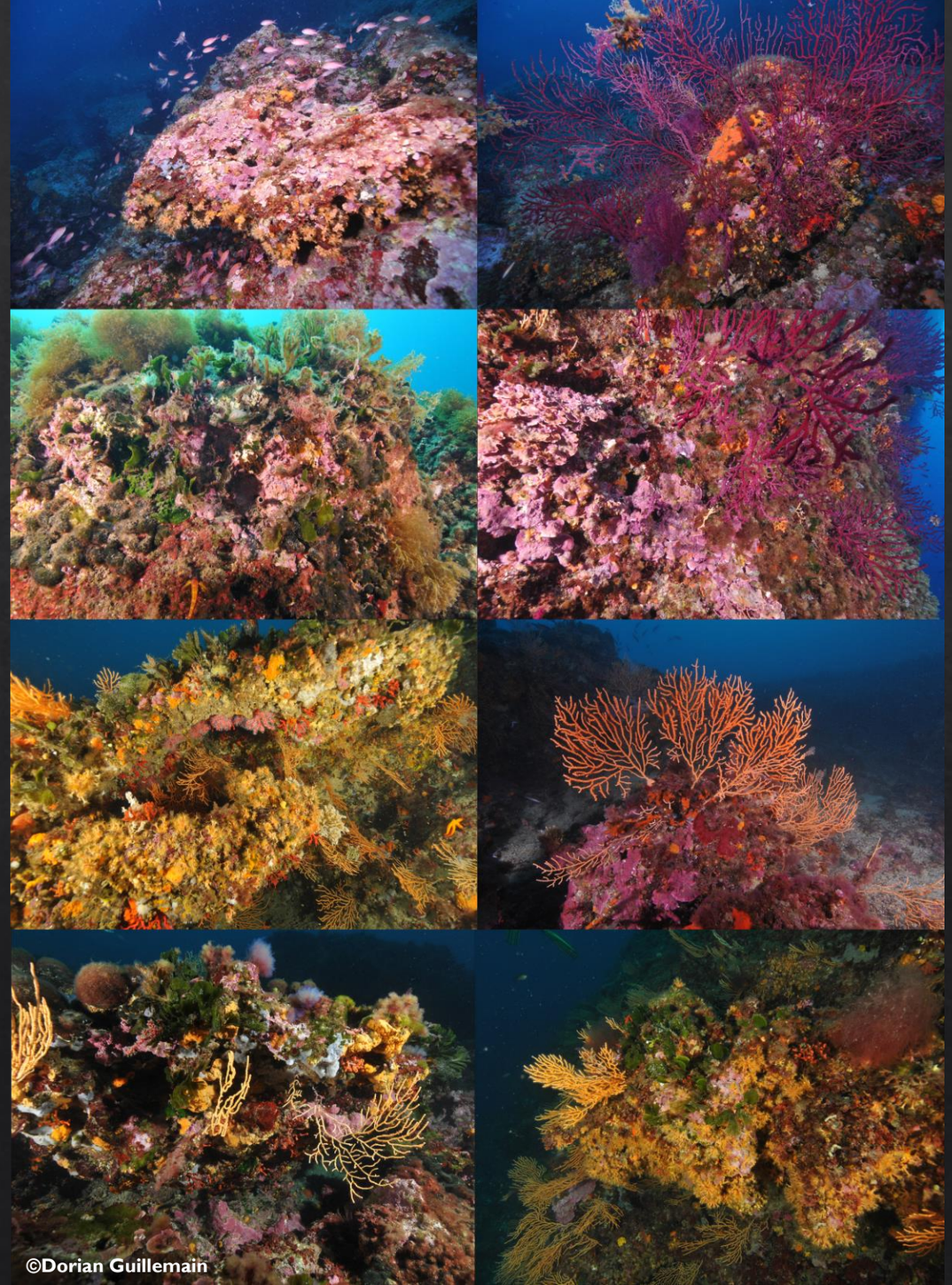

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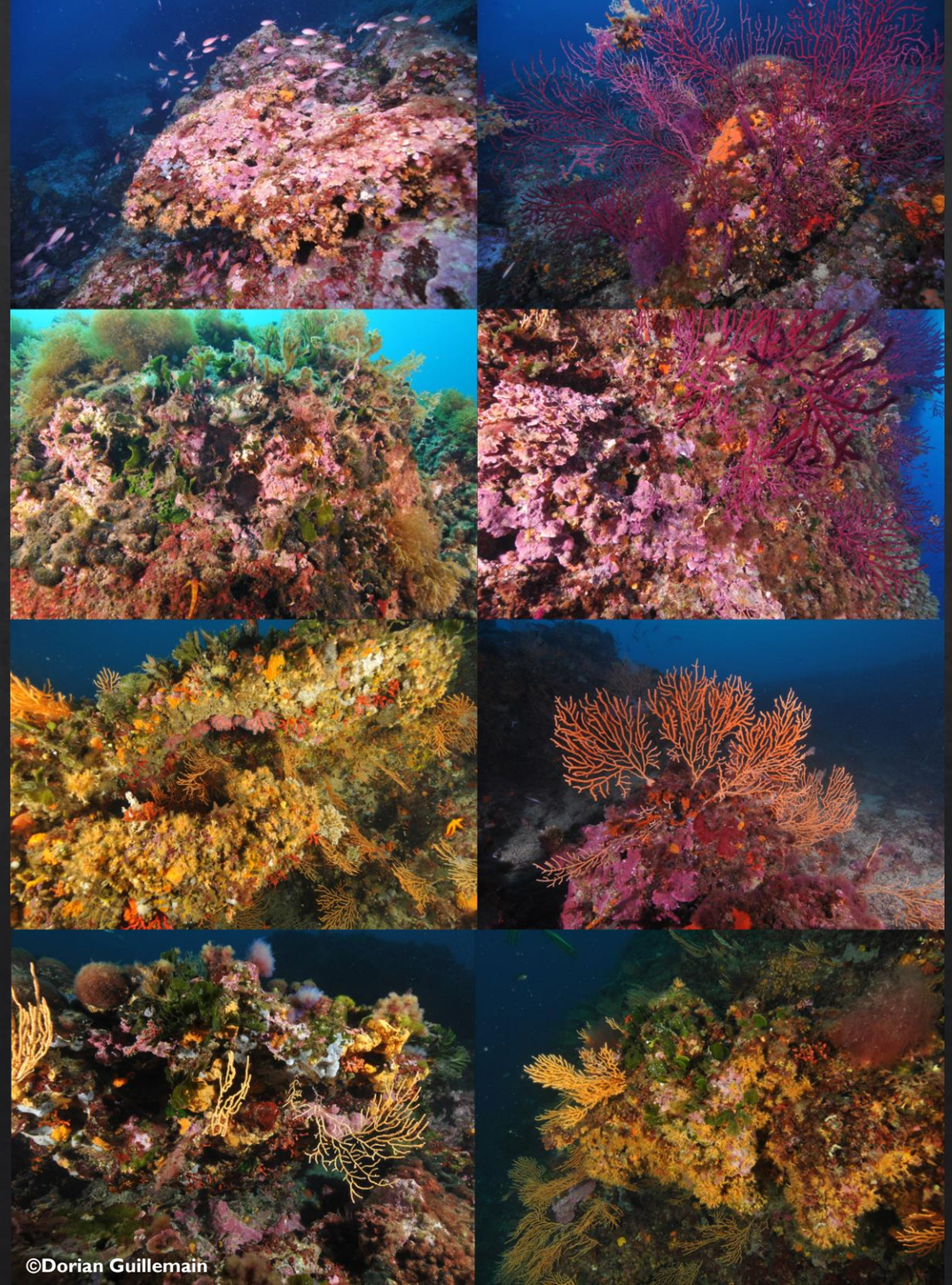

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➢ **Priority targets for conservation**

Major engineering species of coralligenous habitats : Calcareous Red Algae

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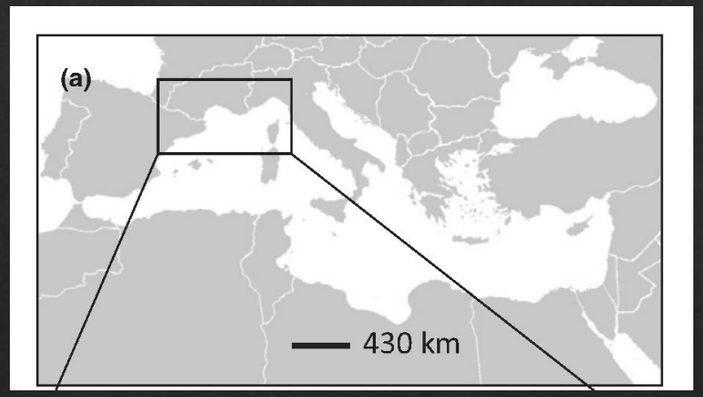
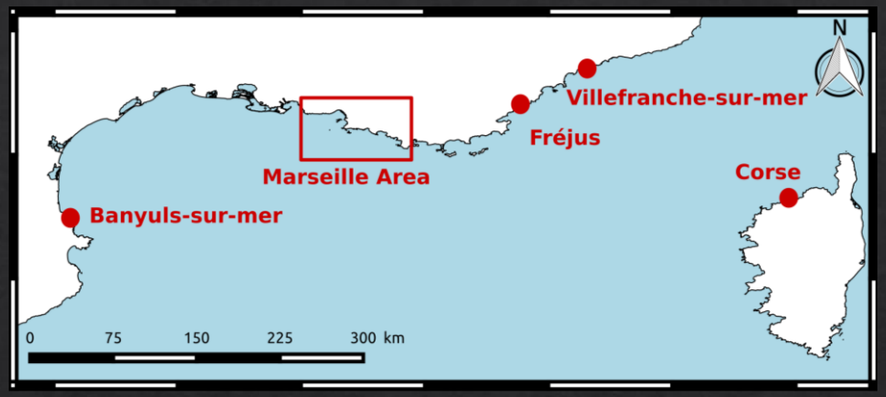
507 individuals on 13 sites





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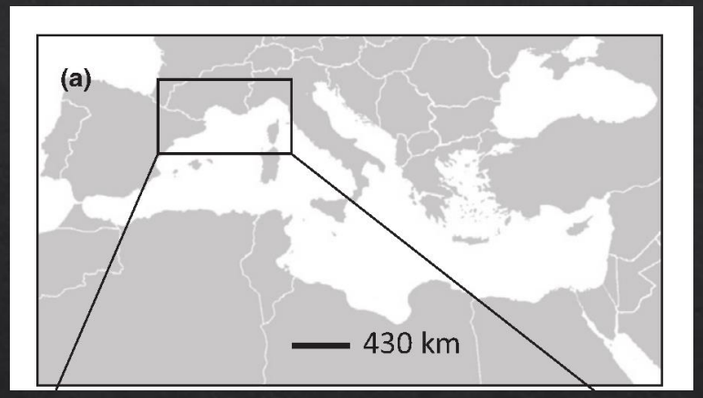

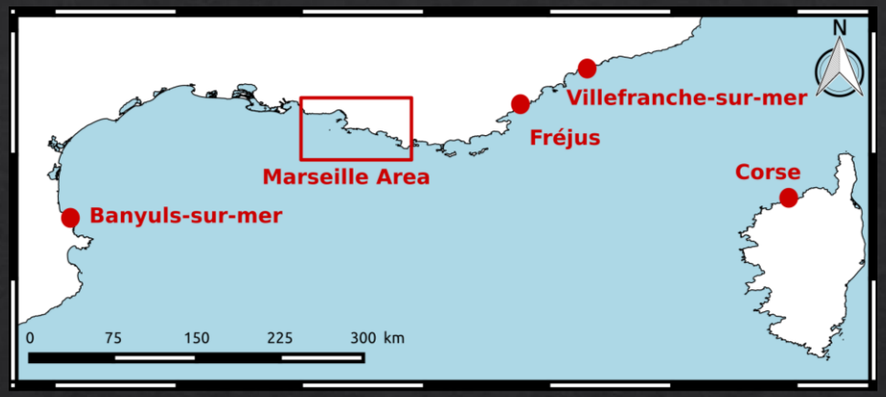

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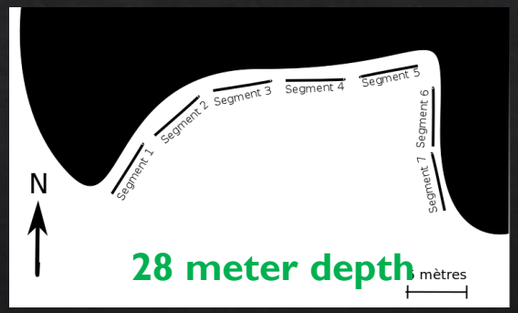

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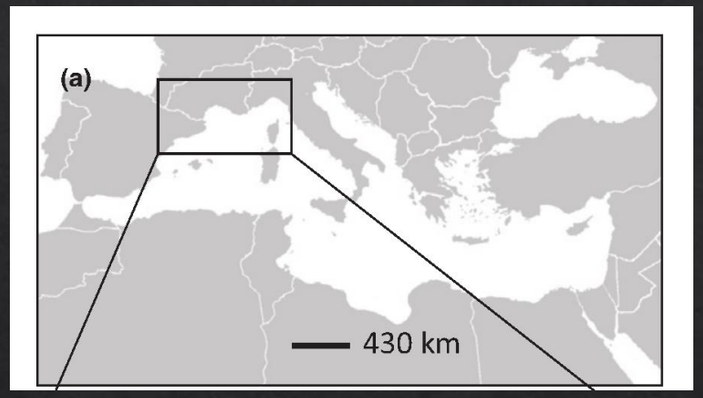

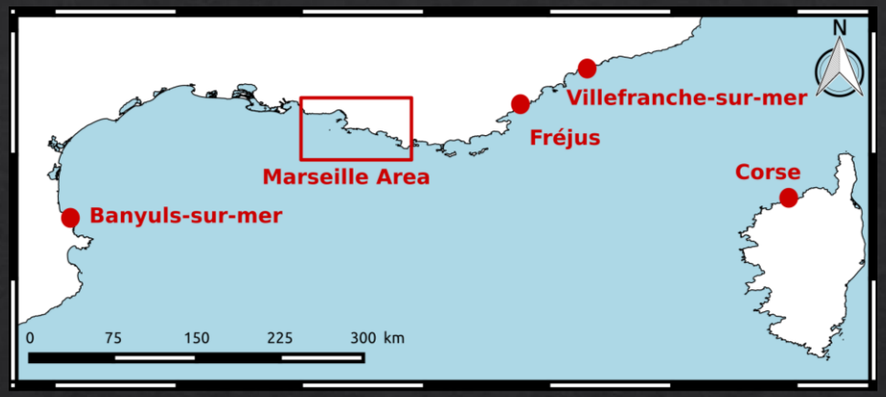

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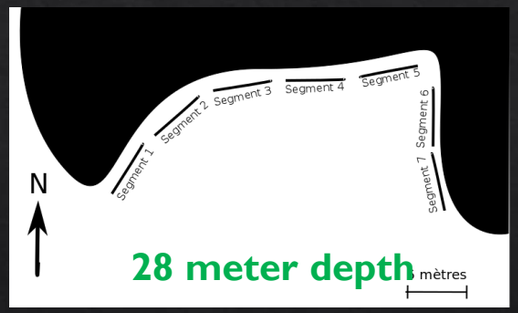

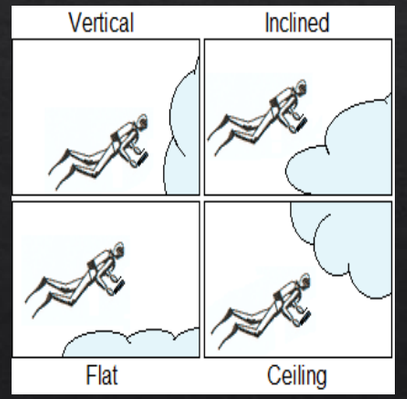

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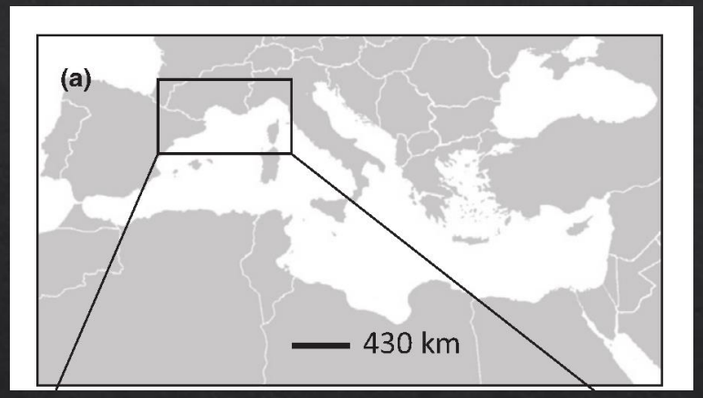

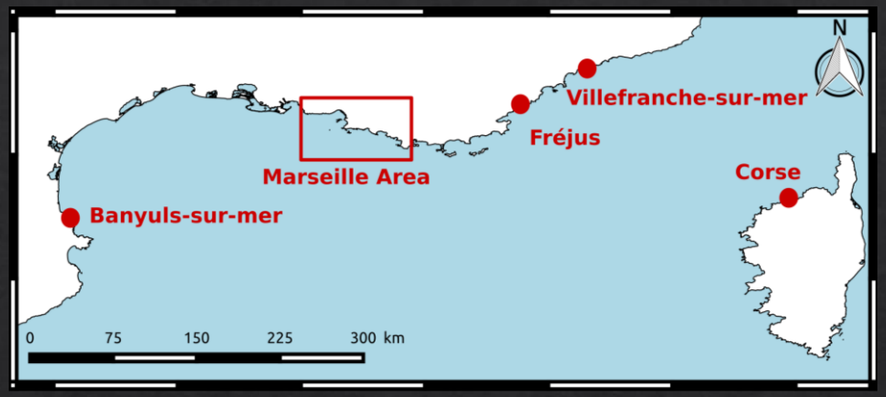

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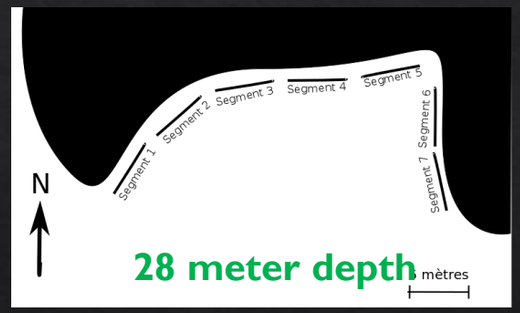

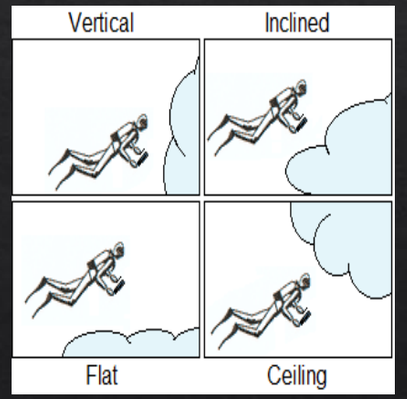

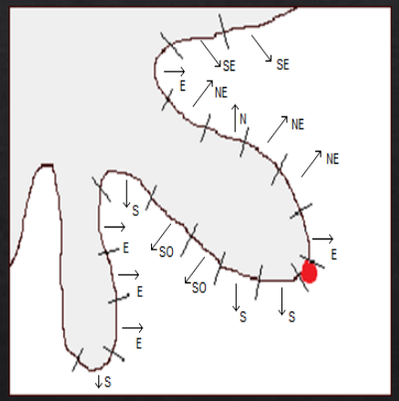

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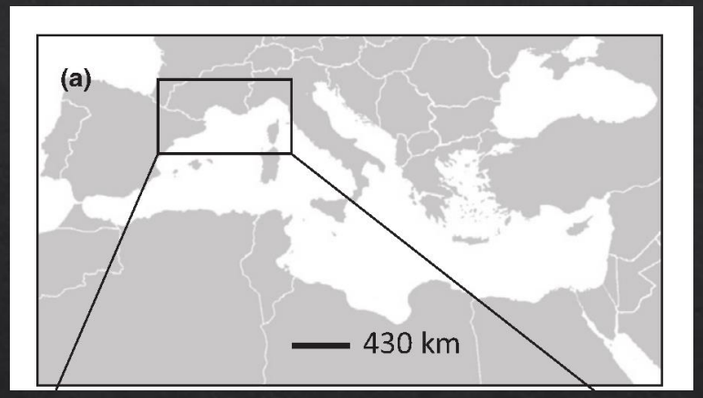

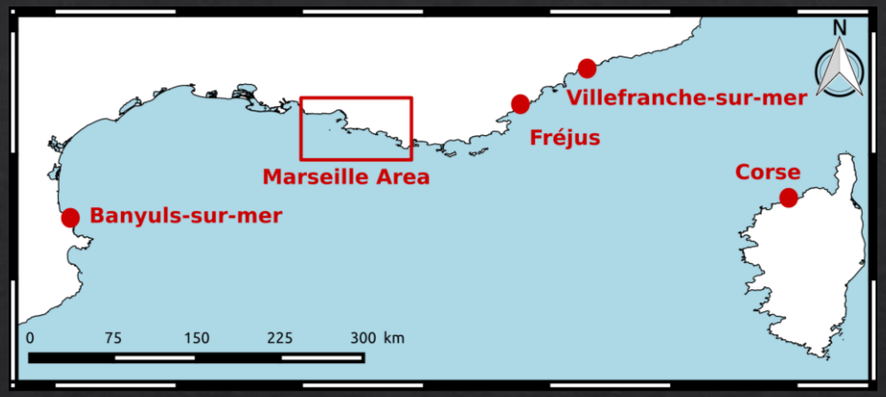

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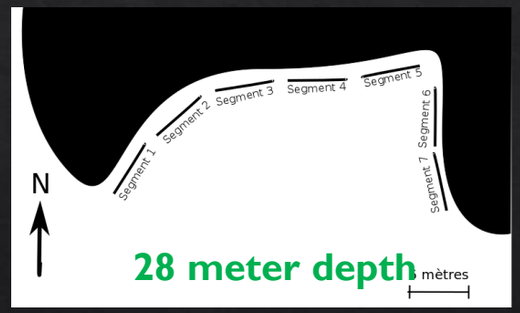

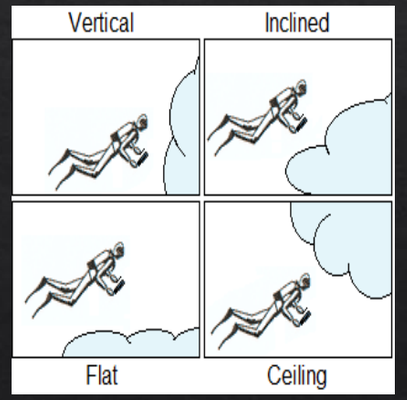

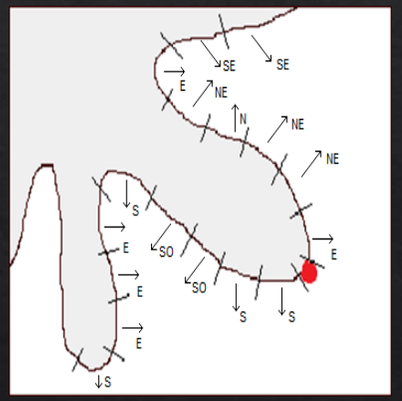

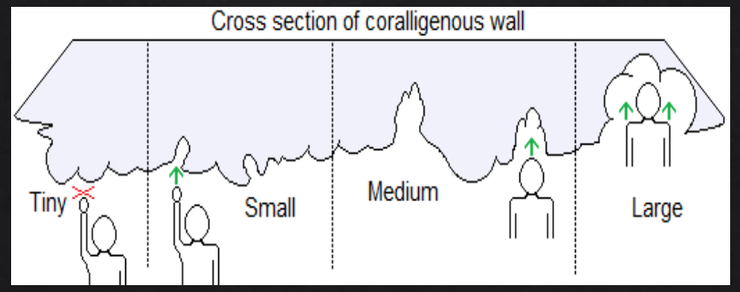

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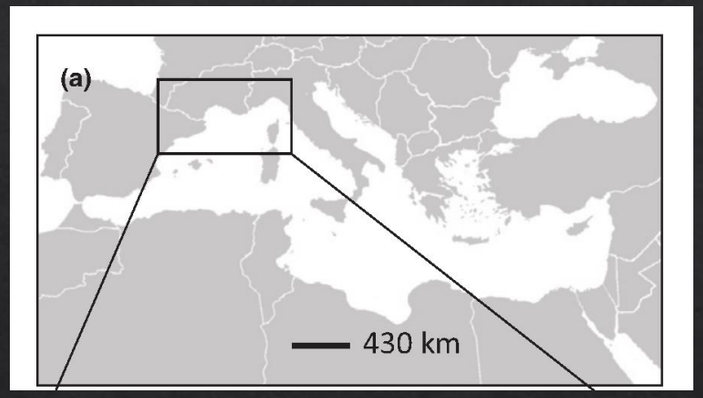

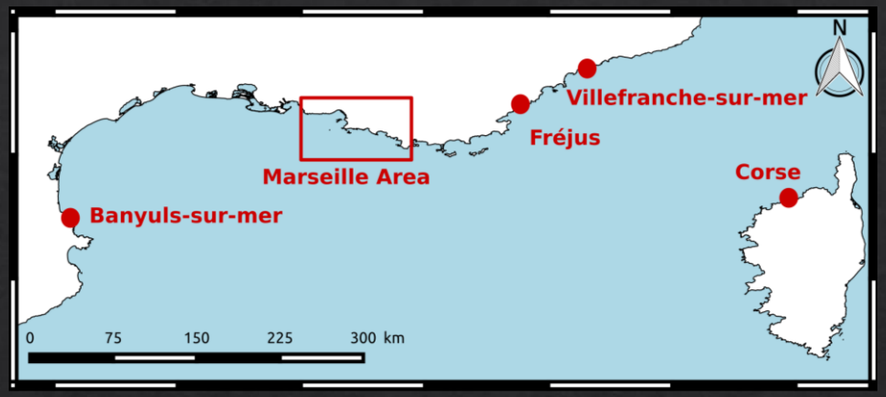

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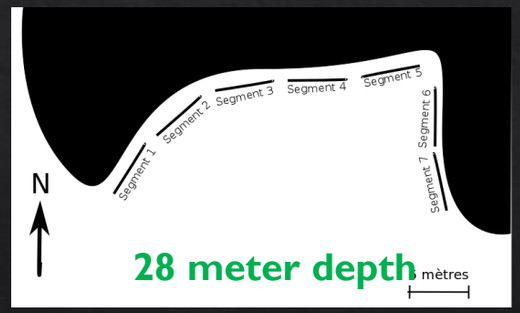

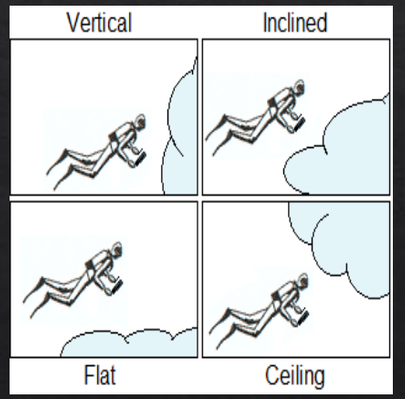

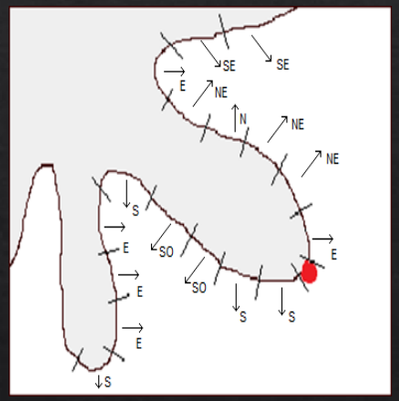

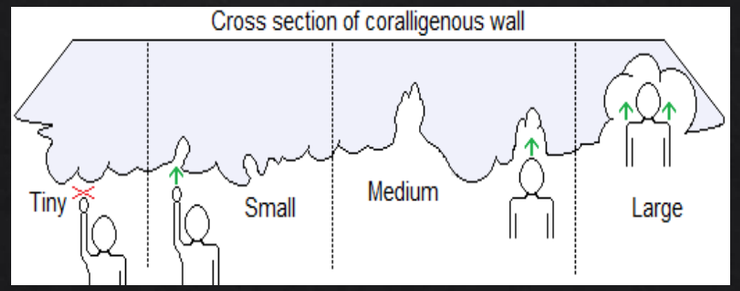

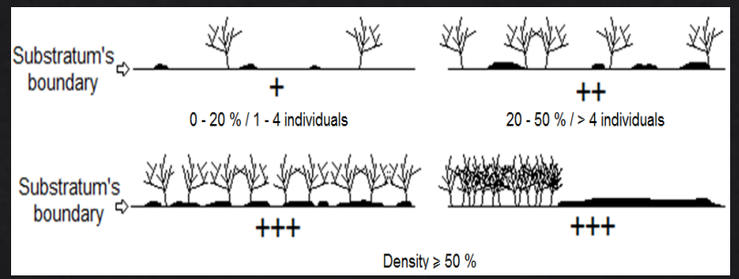

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DNA Extraction

PCR for each maker

Phylogenetic analyses

Intra specific diversity or cryptic species ?

Species identification of each individual

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- **Population genomics approach : Genotyping by capture sequencing**

RNA extraction, sequencing and assembling to build a reference transcriptome

Probe design based on the reference transcriptome

DNA extraction

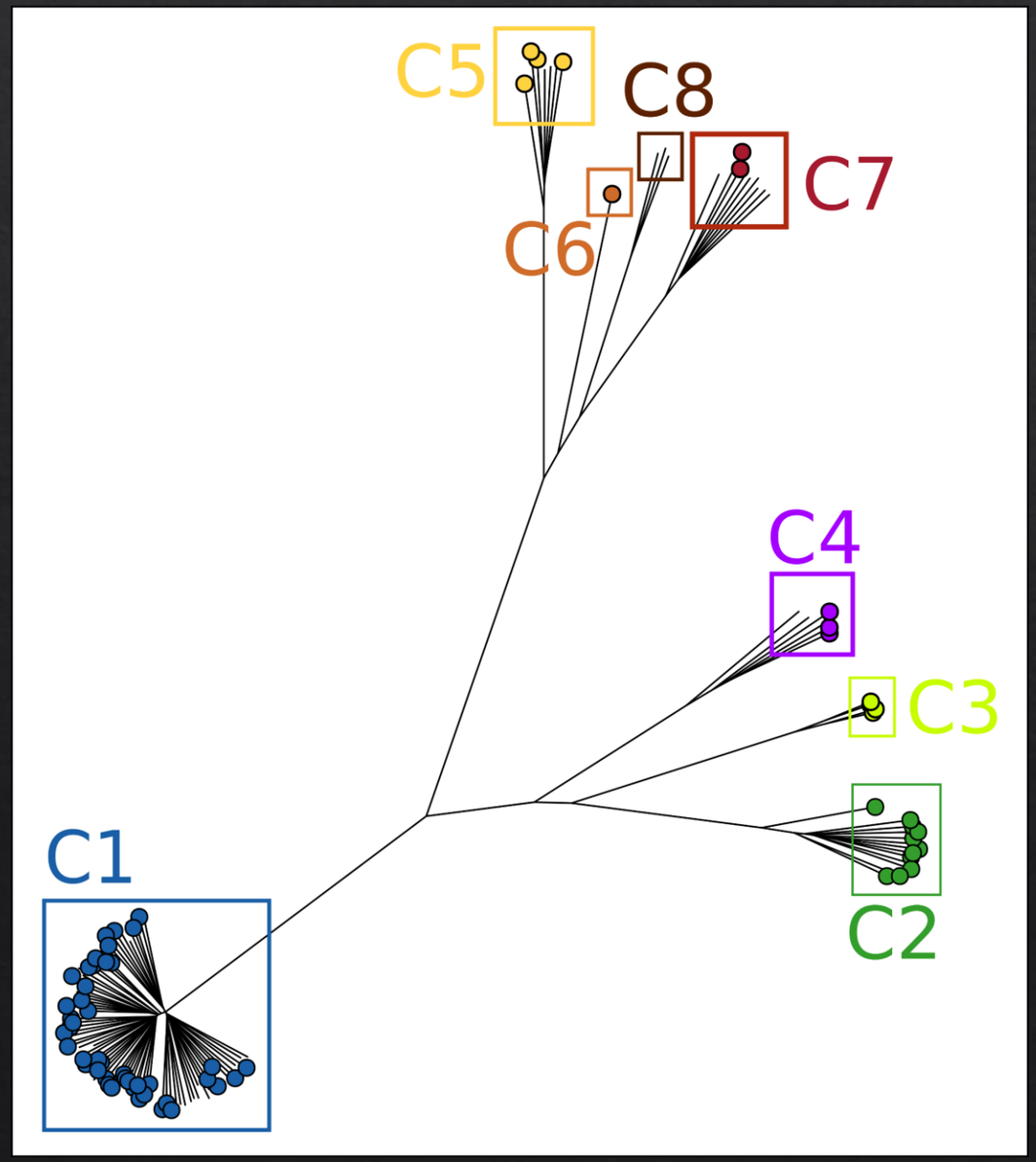
Capture reaction & sequencing

→ **Combine with the barcoding approach species delimitation**

Genetic diversity and connectivity

Local adaptation

Results : Lithophyllum stictaeforme/cabiochae cryptic species complex in coralligenous habitats



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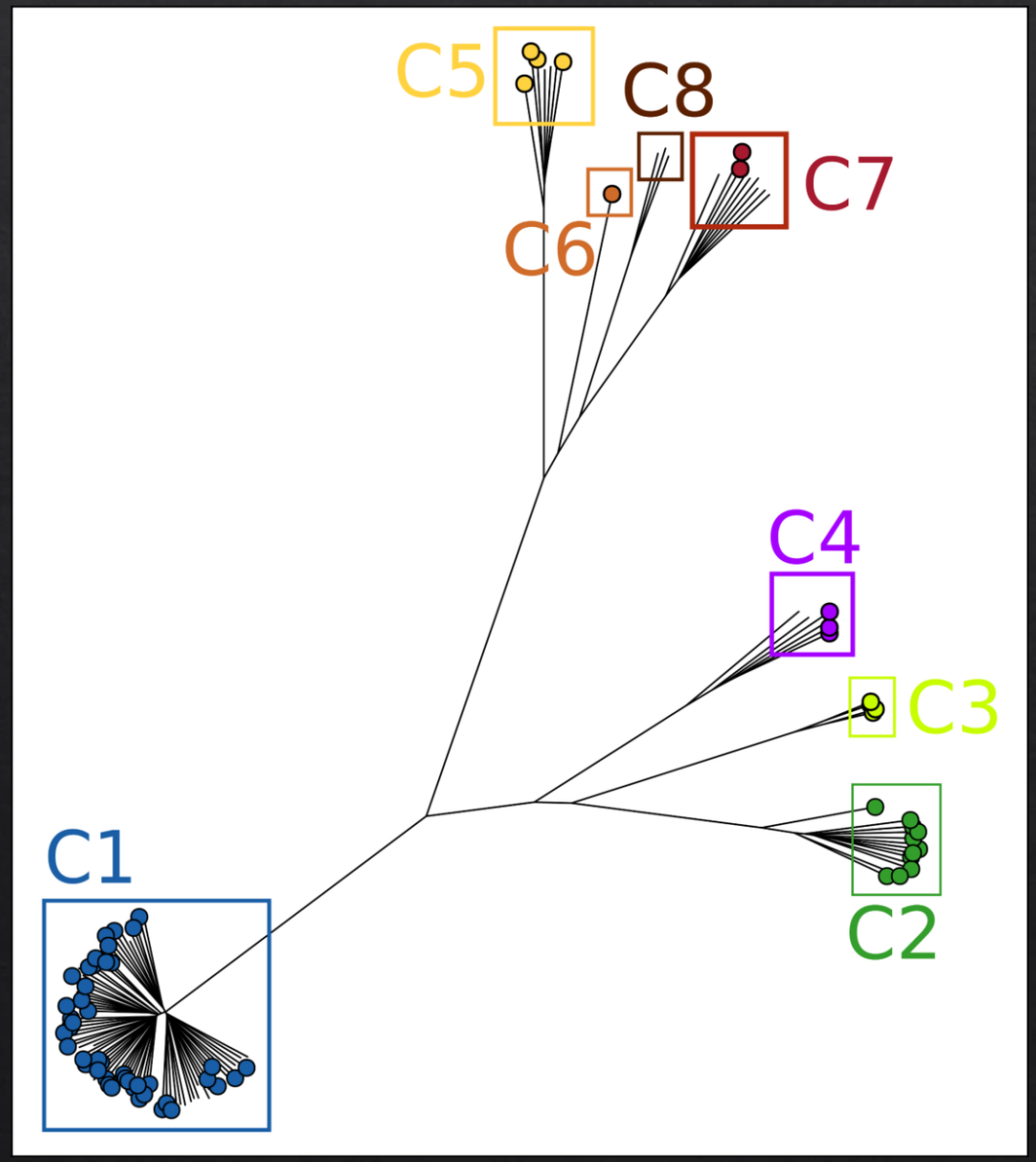

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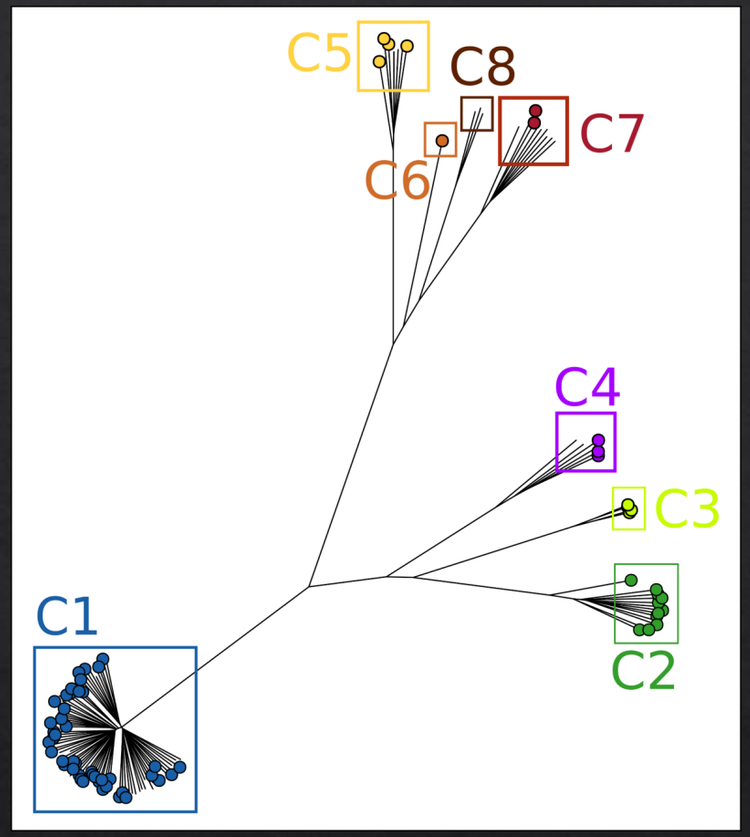

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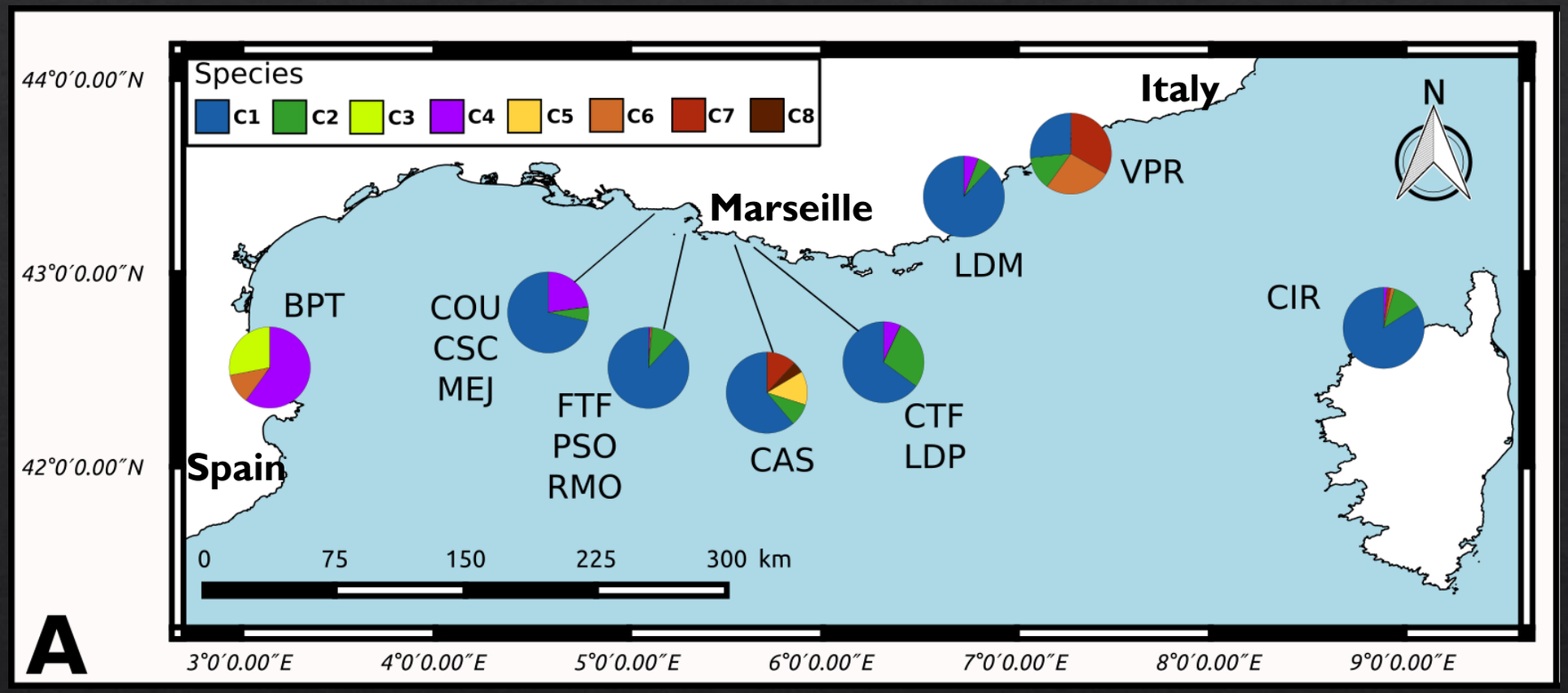
- **Distribution of these species along the French Mediterranean coastline ?**
- **Distribution along a depth gradient ?**
- **Ecological differentiation ?**

Distribution along the French Mediterranean coast

- 12 Sites from Banyuls to Corsica (3 sites with contrasted depths



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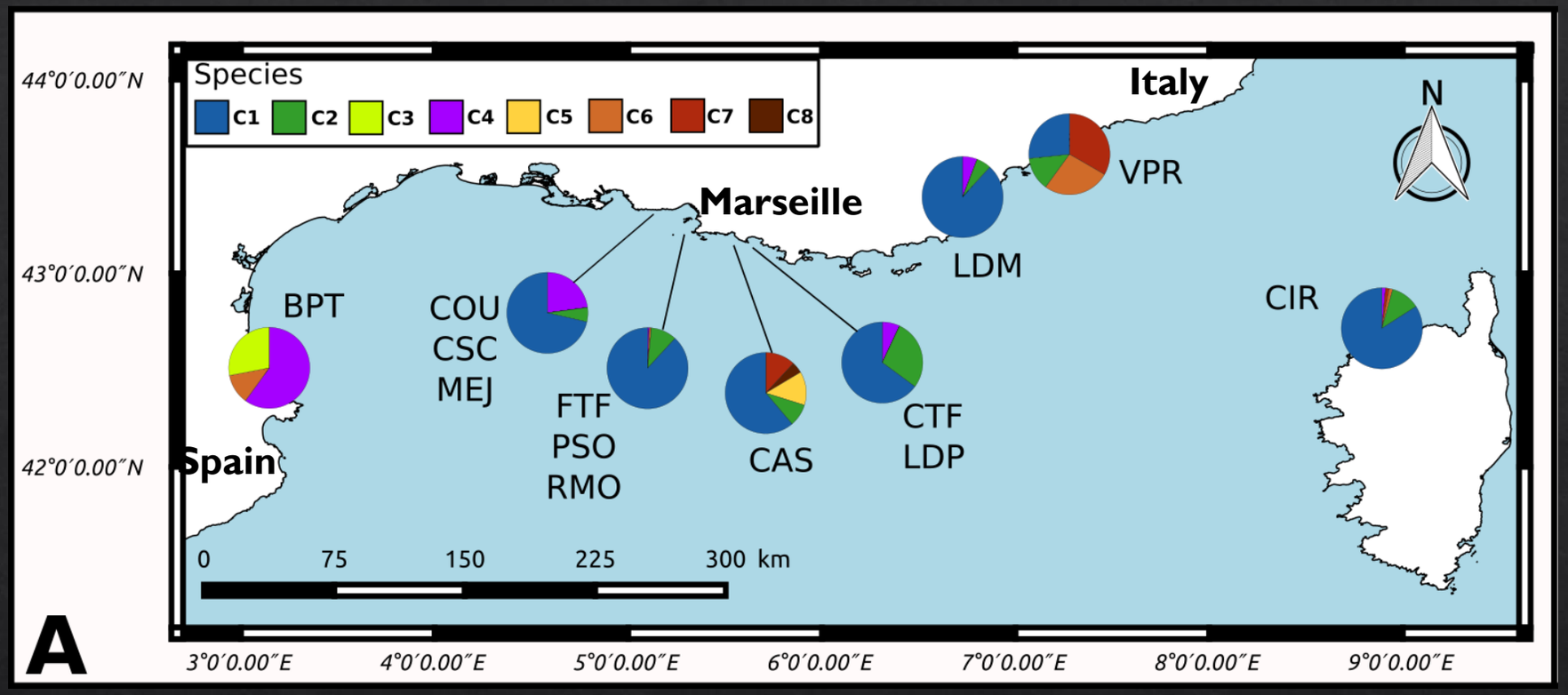

- Different communities in different sites
- C1 everywhere except in BPT
- C3 only found in BPT

- C6 & C7 very abundant in VPR
- C8 & C5 only found in CAS
- Community from Corsica are close from Marseille communities

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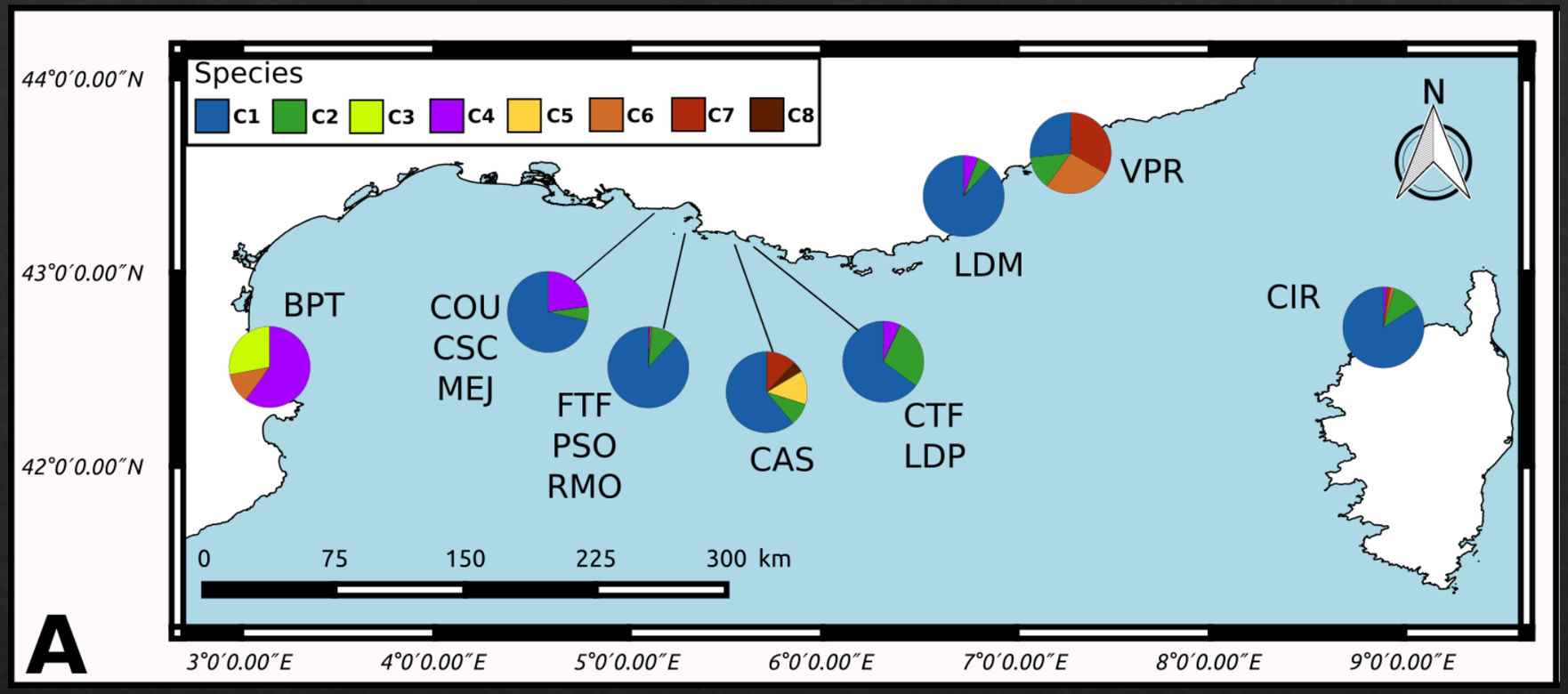

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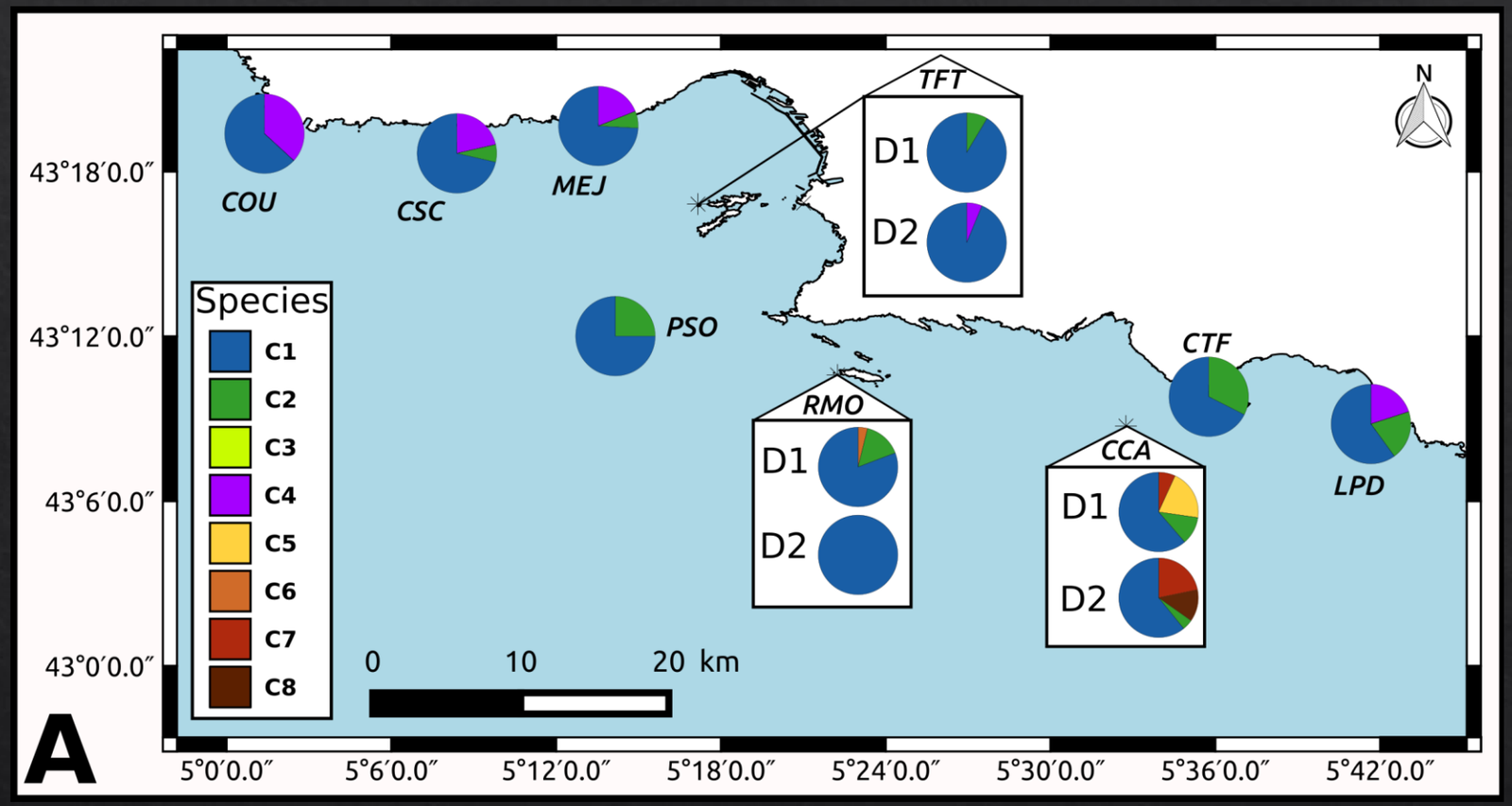
Environmental conditions different in different sites ?

Or/and connectivity breaks ?

Distribution in the Bay of Marseille



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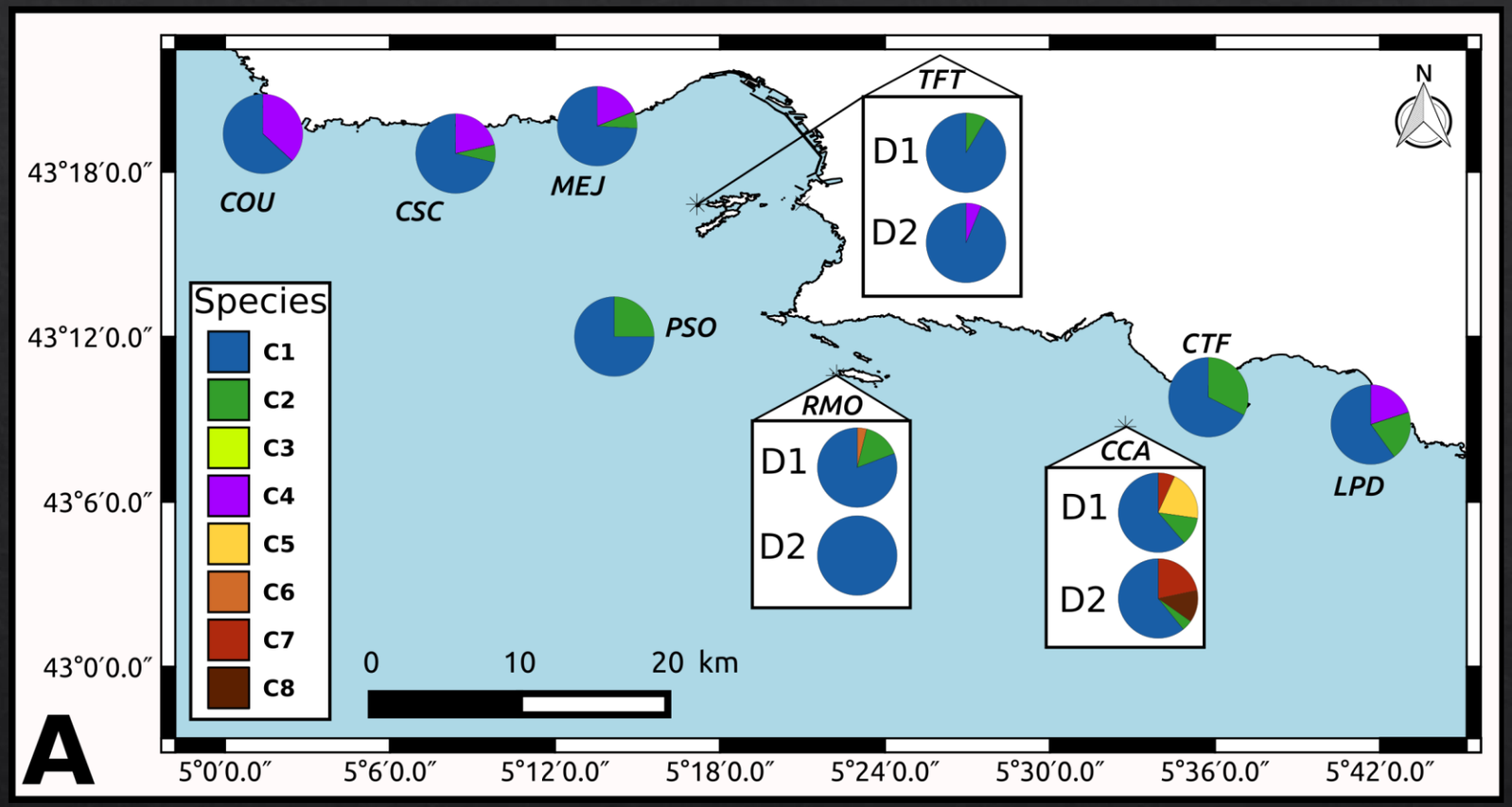

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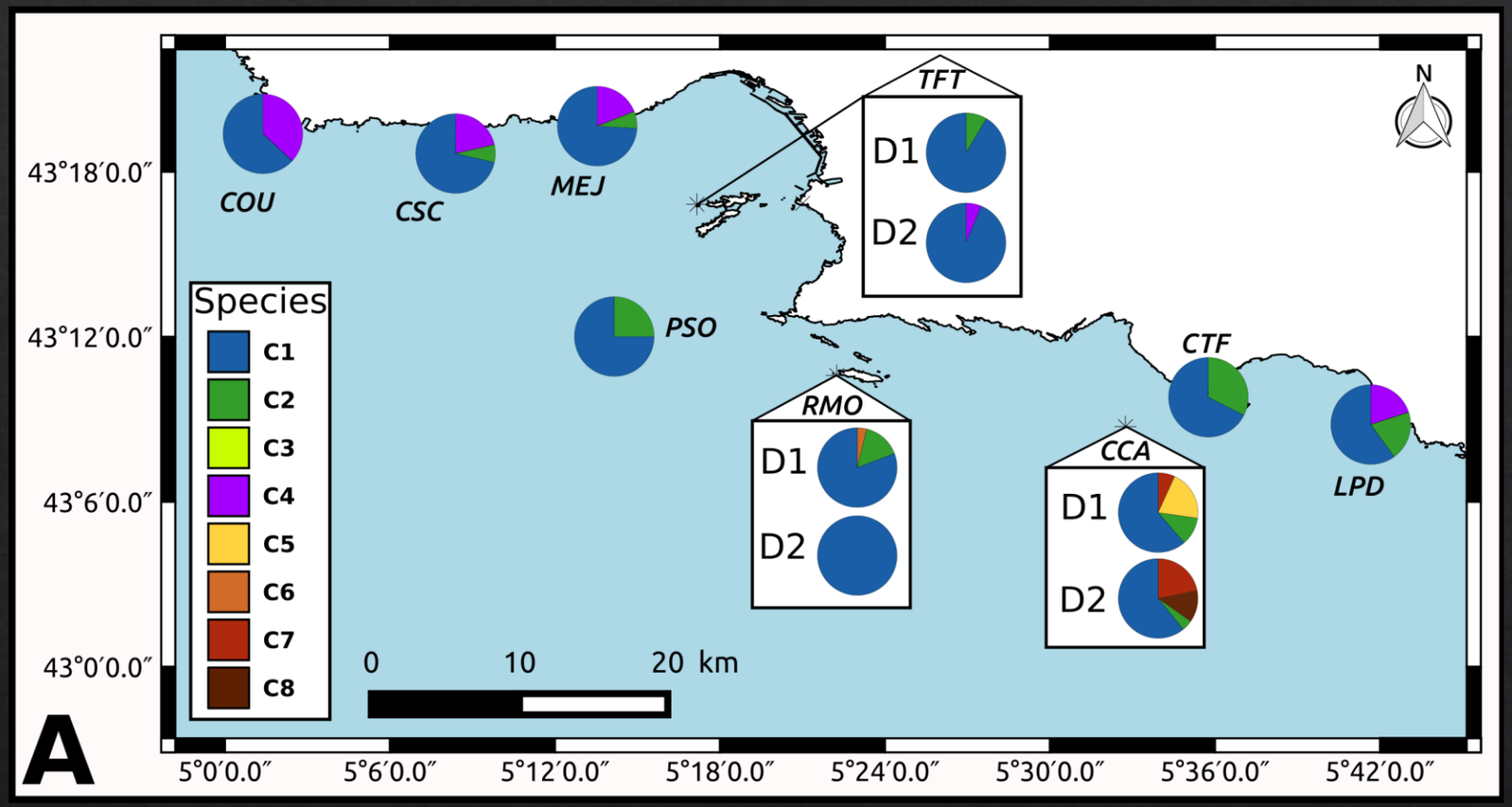
- Community differentiation among sites
- C4 only in Cote bleu and Les Lecques

Distribution in the Bay of Marseille



- D1 : 28 to 32 meters depth
- D2 : 40 to 45 meters depth

➢ Community differentiation among sites

➢ C4 only in Cote bleu and Les Lecques

➢ High diversity in CCA

➢ Different communities at different depths in CCA and RMO

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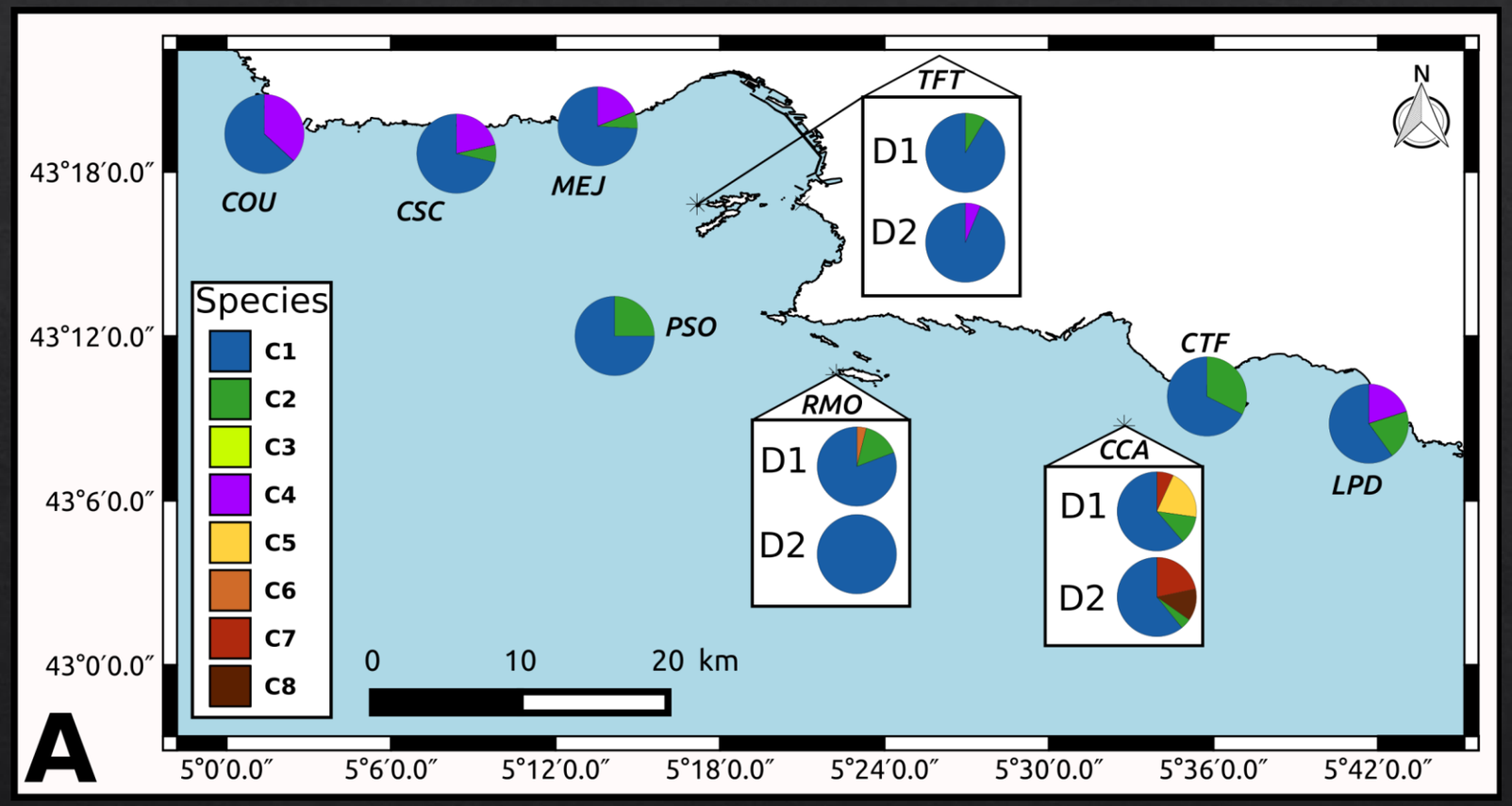

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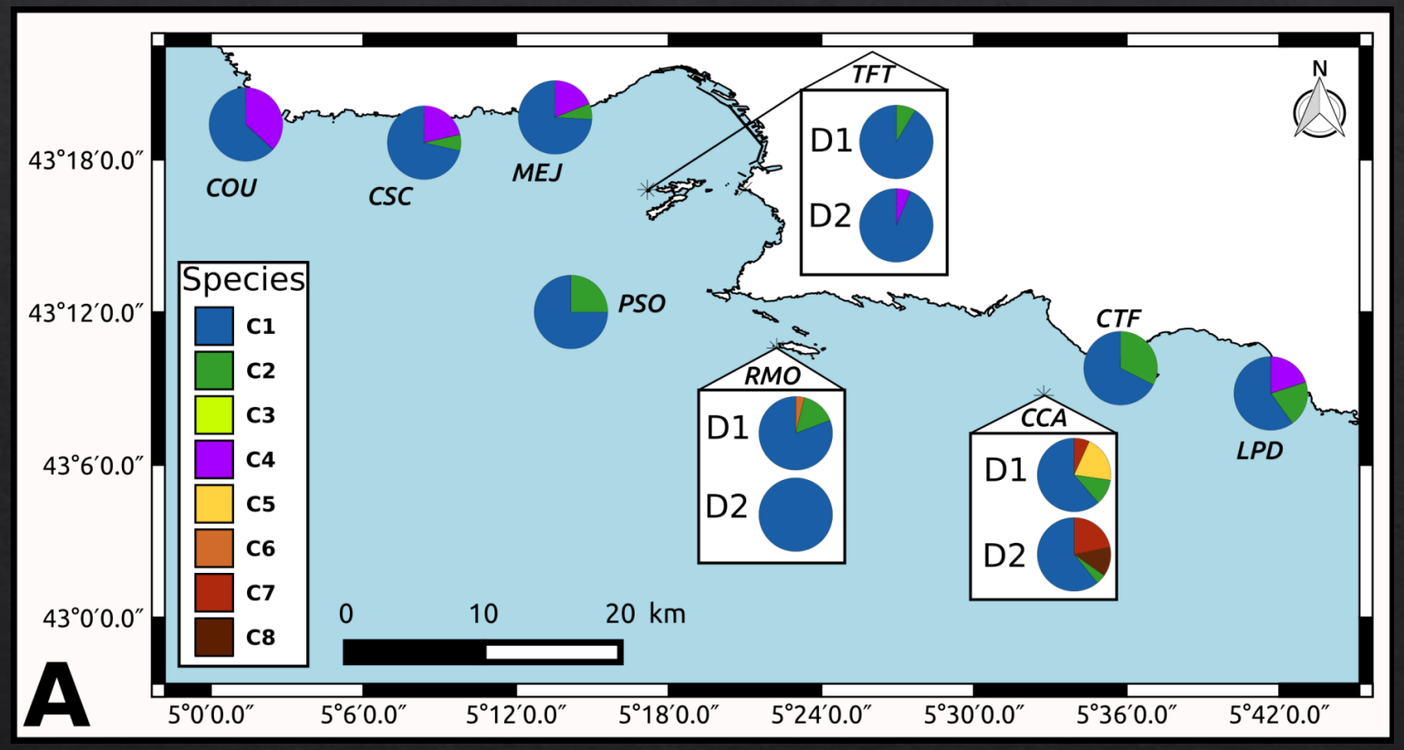
- Different communities in different sites
- C4 only in Cote bleu and Les Lecques

- High diversity in CCA
- Different communities at different depth in CCA and RMO

Is the community differentiation between the two depth due to a lack of migration ?

Genetic structure in the most abundant species



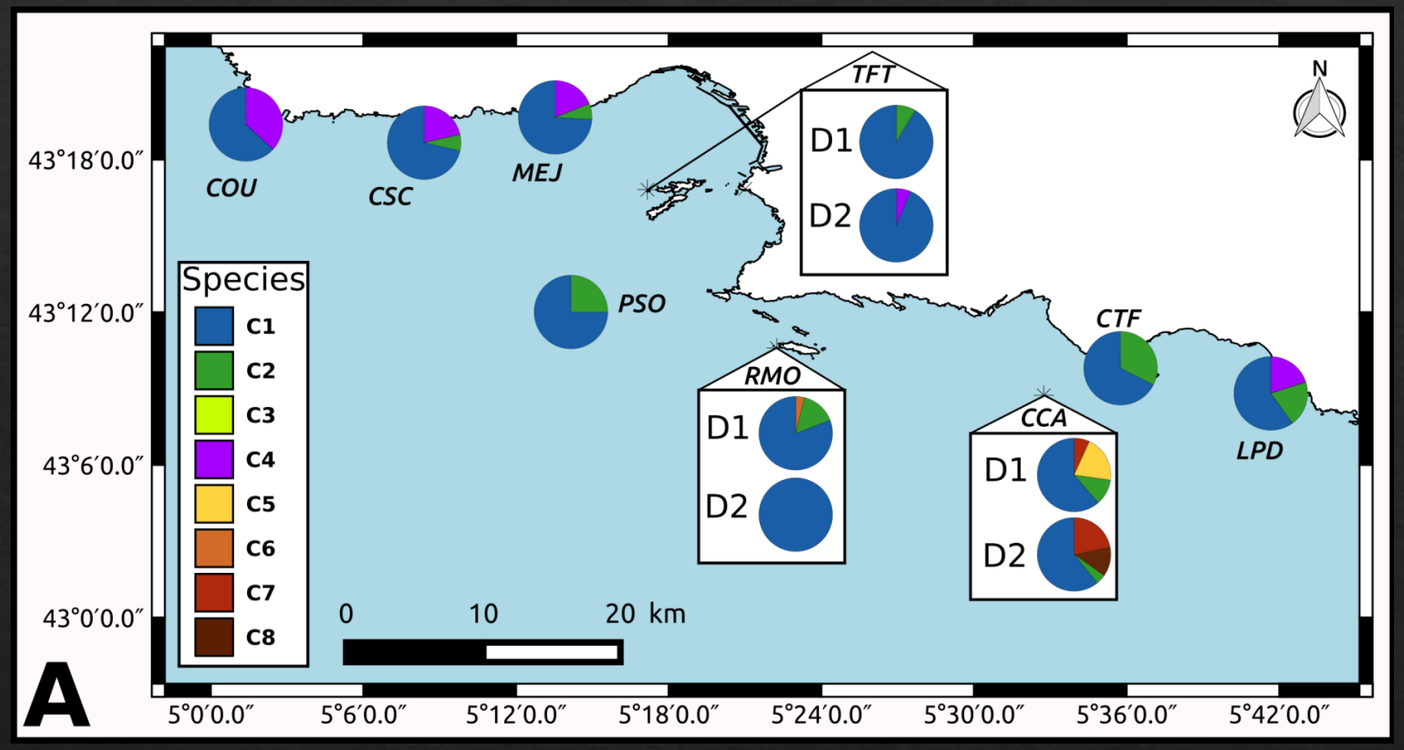
- ~3000 SNPs from capture sequencing

Pop D1
28 meters depth

$F_{ST}=0$

Pop D2
42 meters depth

Genetic structure in the most abundant species



- ~3000 SNPs from capture sequencing

Pop D1
28 meters depth

$F_{ST}=0$

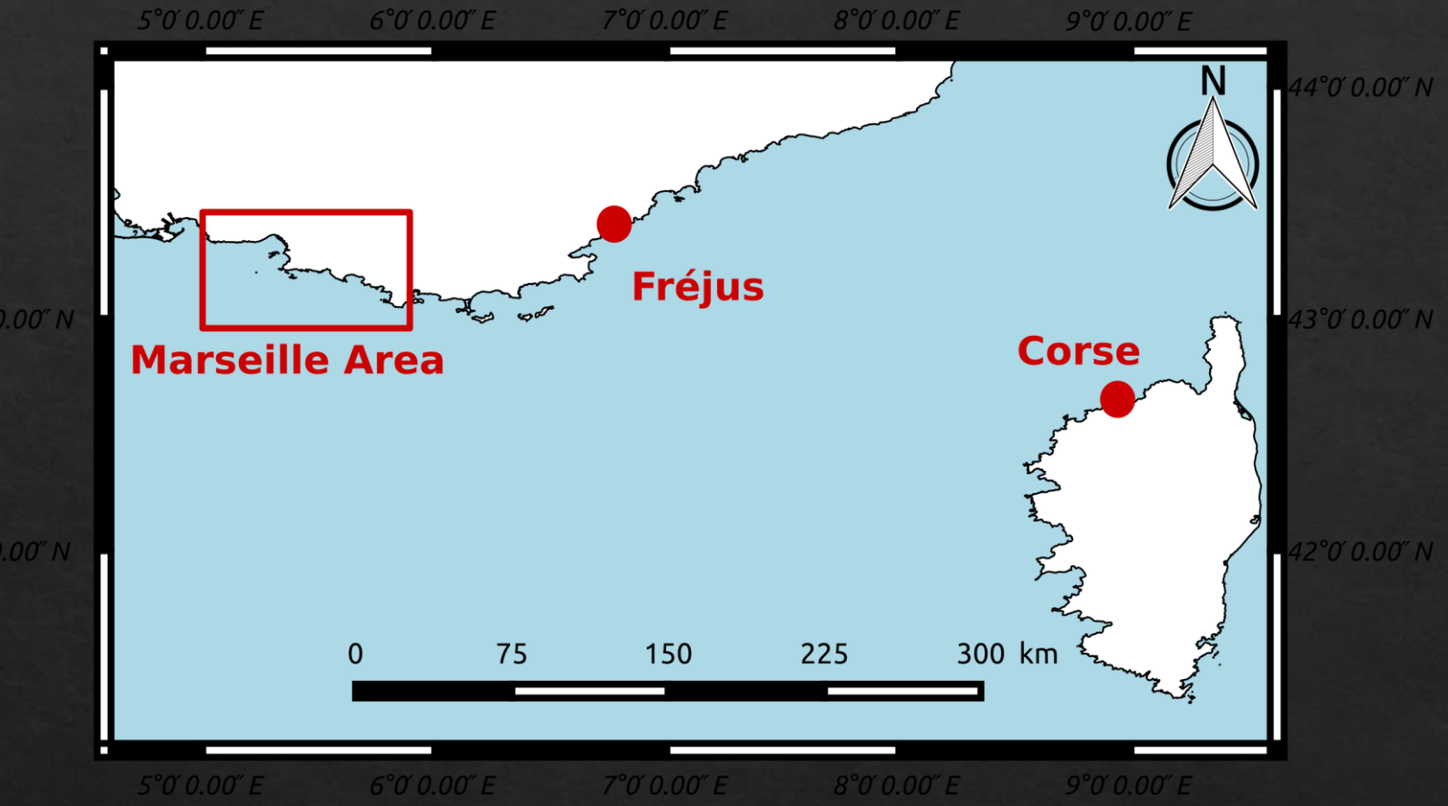
Pop D2
42 meters depth

- No genetic differentiation between population of different depth at the same
- Migration is possible between two depth at the same site

- Community differentiation probably due to a selective effect

What about genetic structure in the most abundant species ?

Genetic structure in the most abundant species



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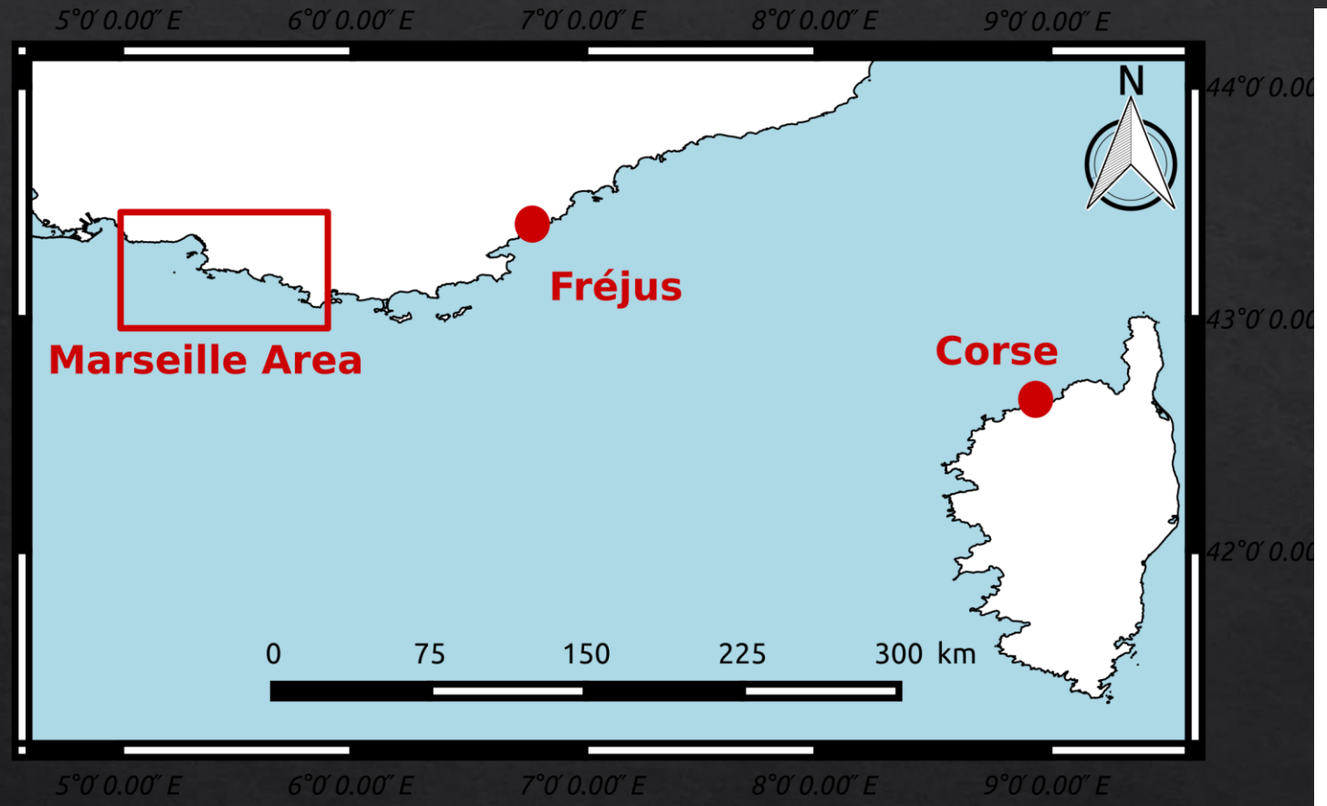
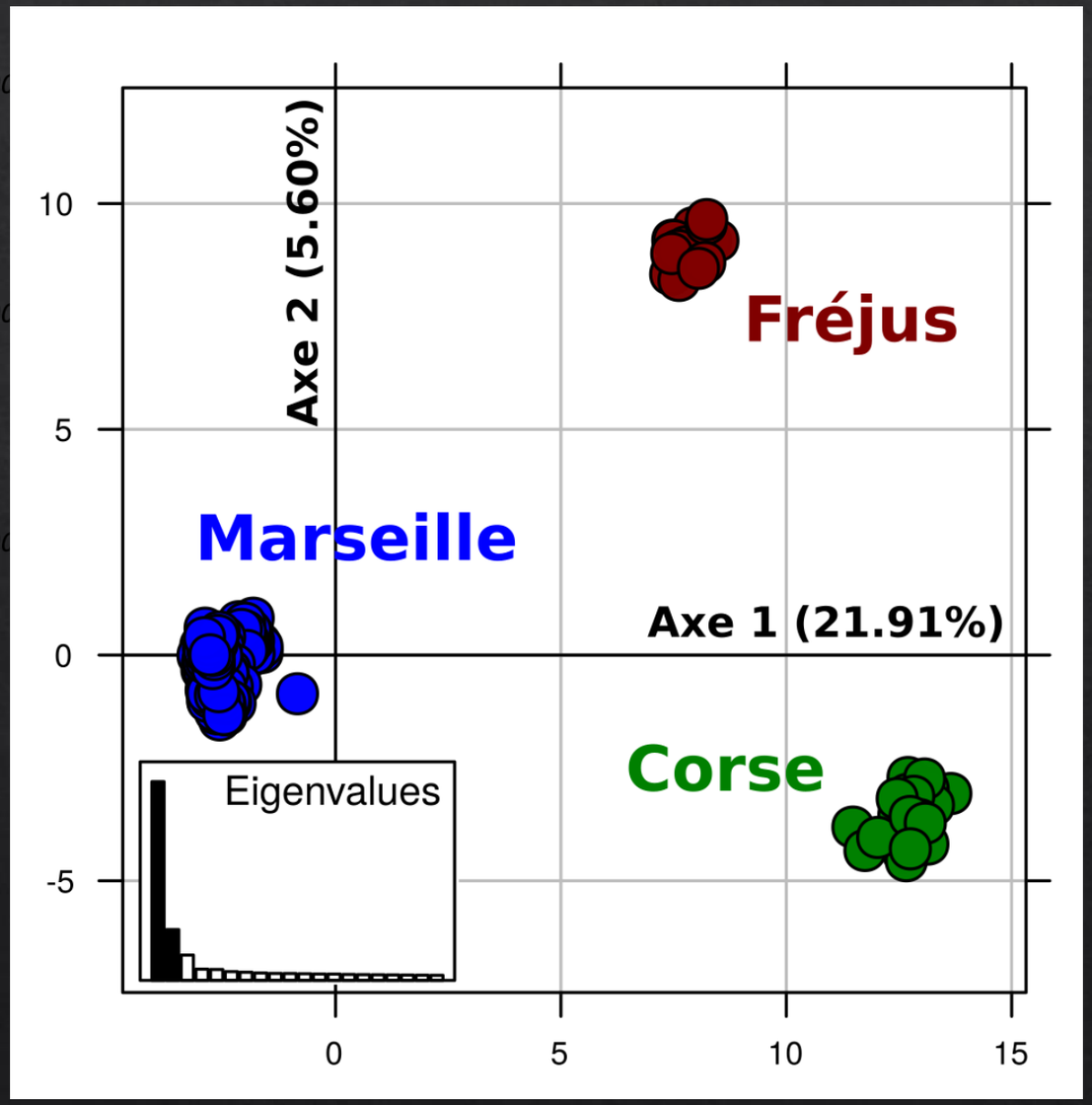
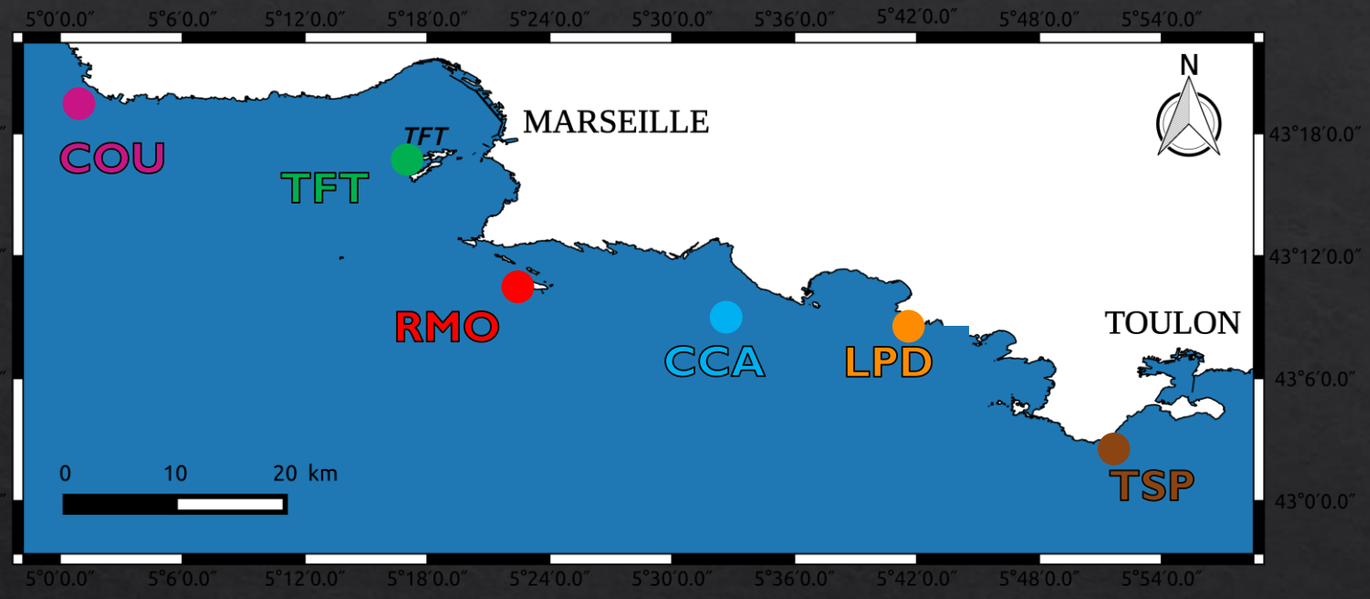


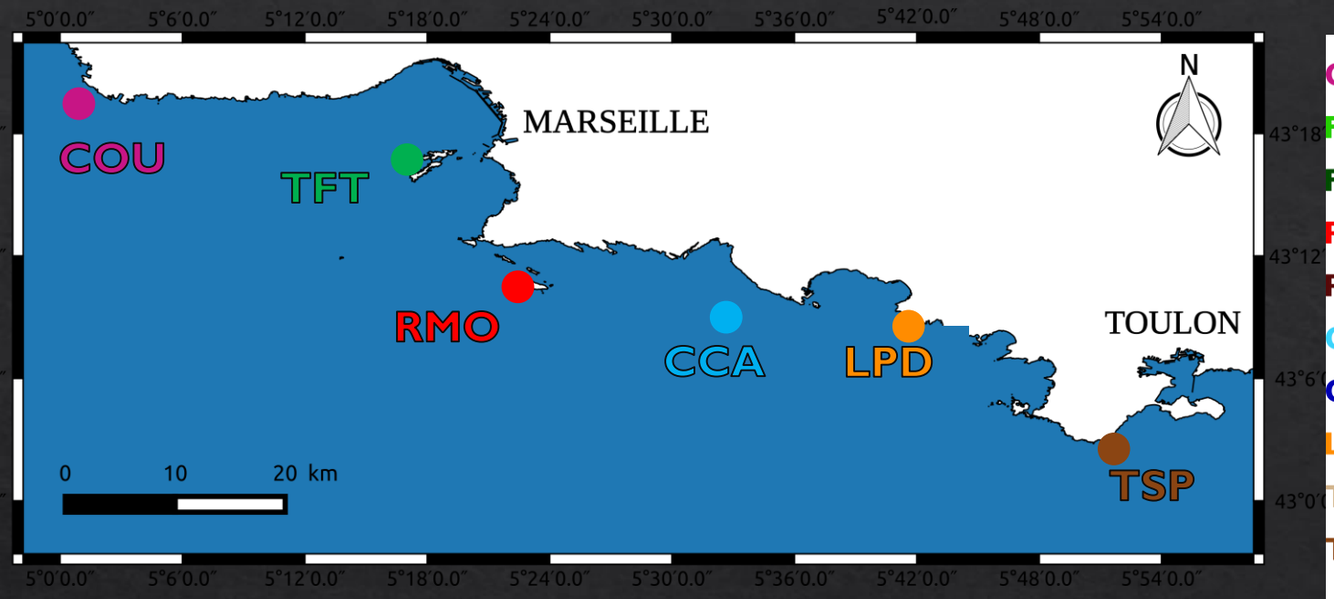


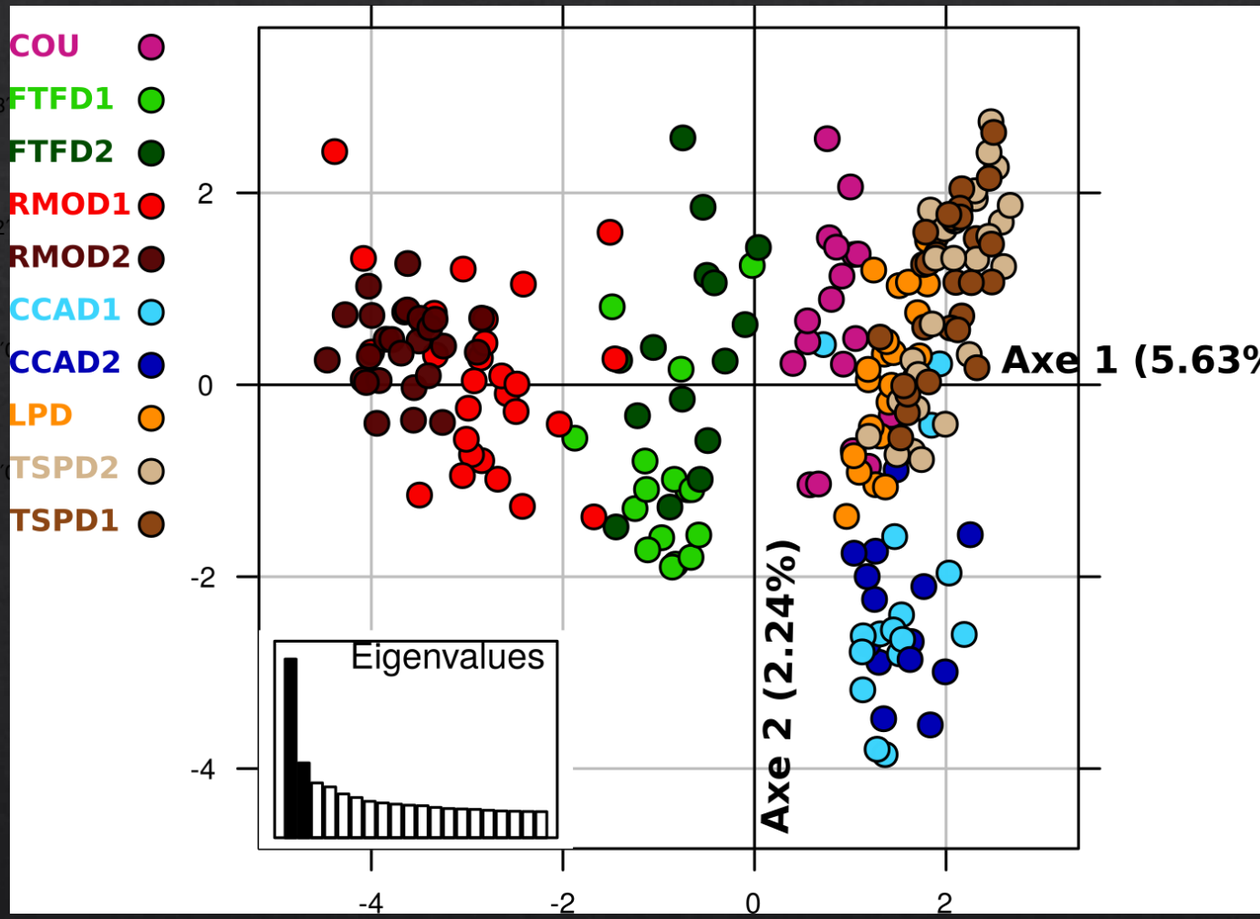
- **Strong genetic structure at large spatial scale**

Genetic structure in the most abundant species



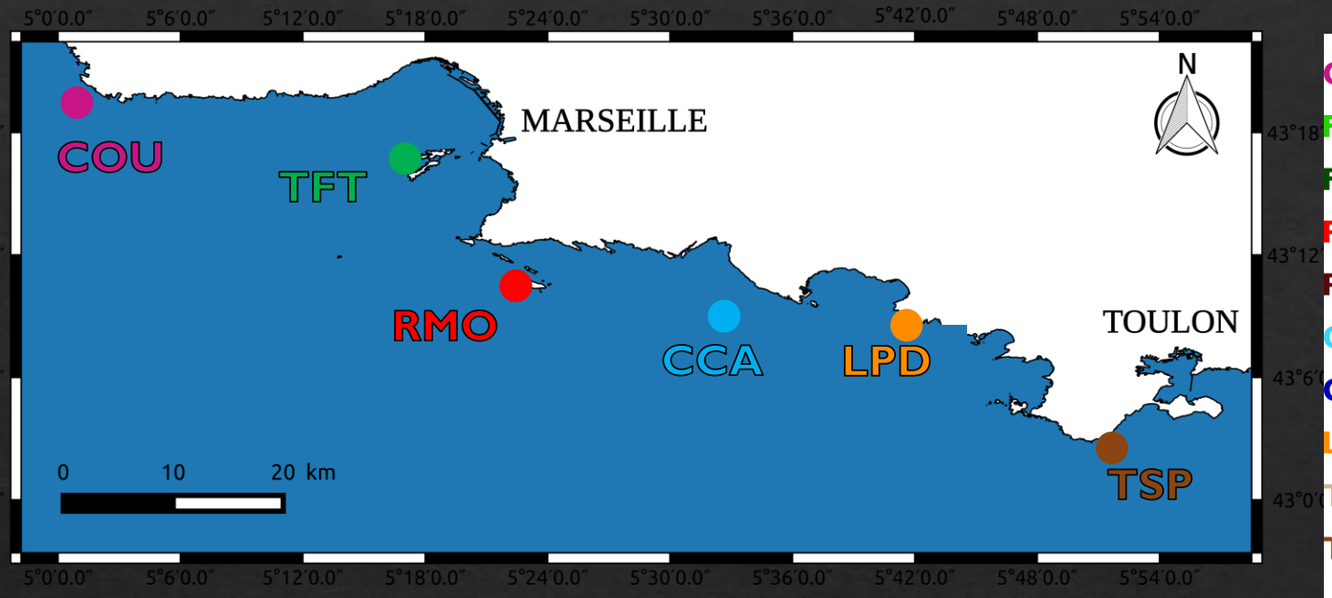
Genetic structure in the most abundant species

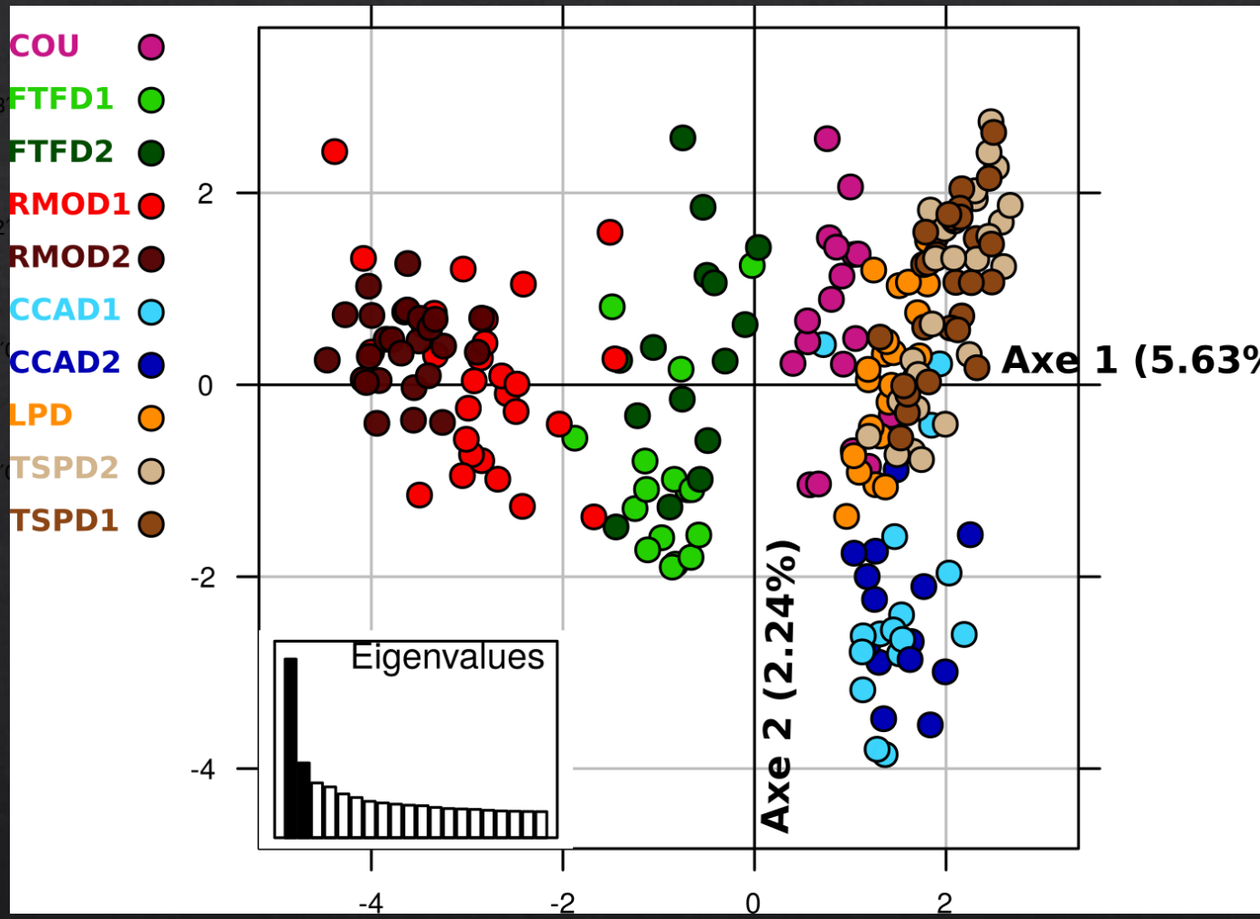




- Strong genetic structure even at small spatial scale
- Current in Marseille
- No differentiation between depth

Genetic structure in the most abundant species





- **Strong genetic structure even at small spatial scale**
- **Current in Marseille**
- **No differentiation between depth**

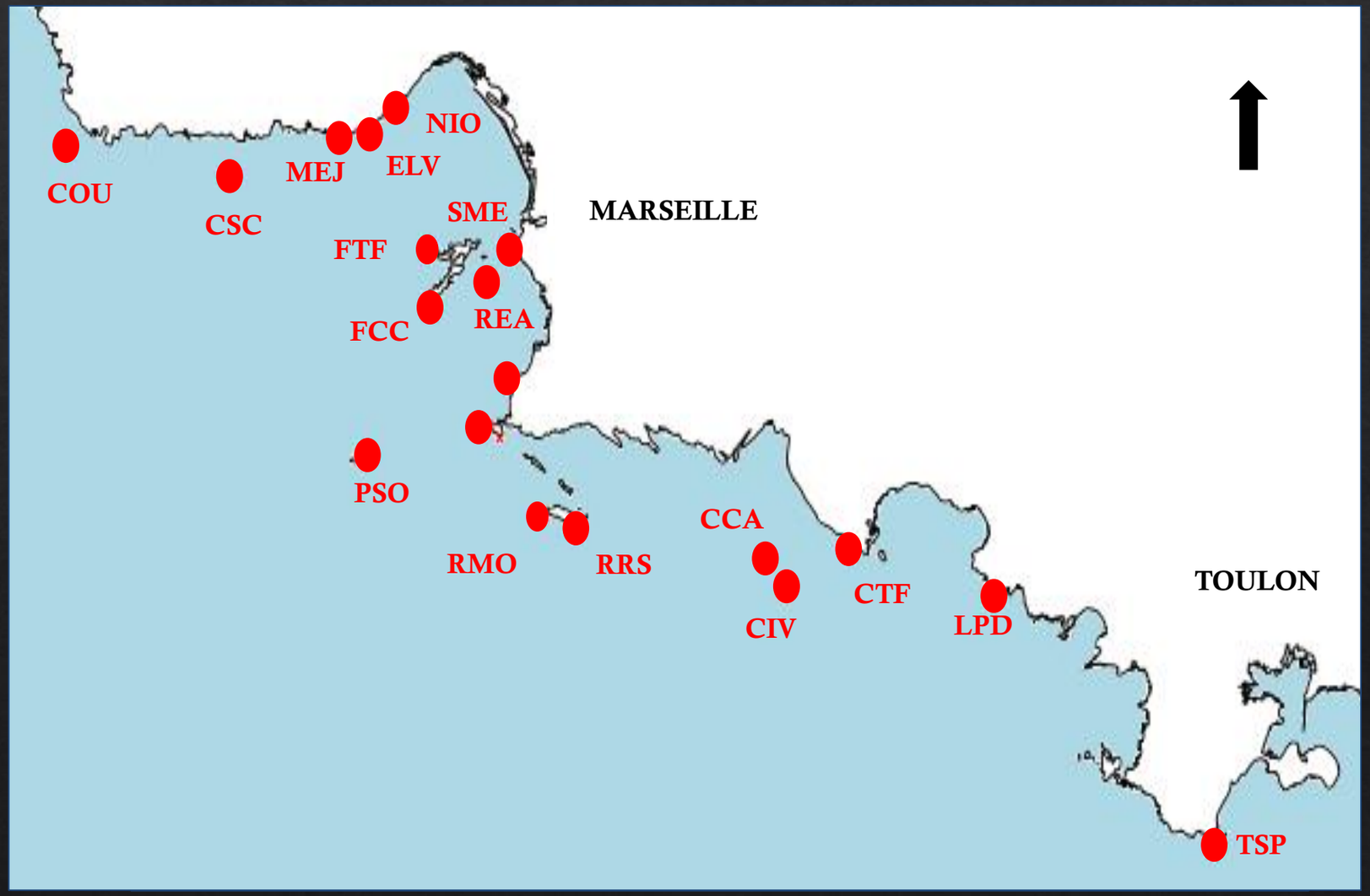
BUT

We found several loci « outliers » or correlated with depth indicating a potential local adaptation of these population to depth

What about coralligenous species communities ?

Coralligenous communities using a metabarcoding approach

- 240 samples from 20 sites

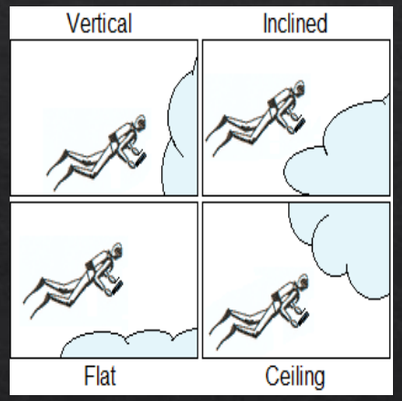


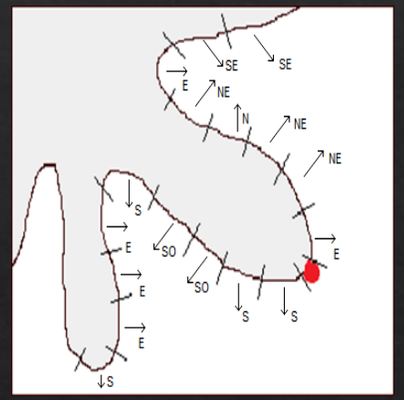
Sampling protocol

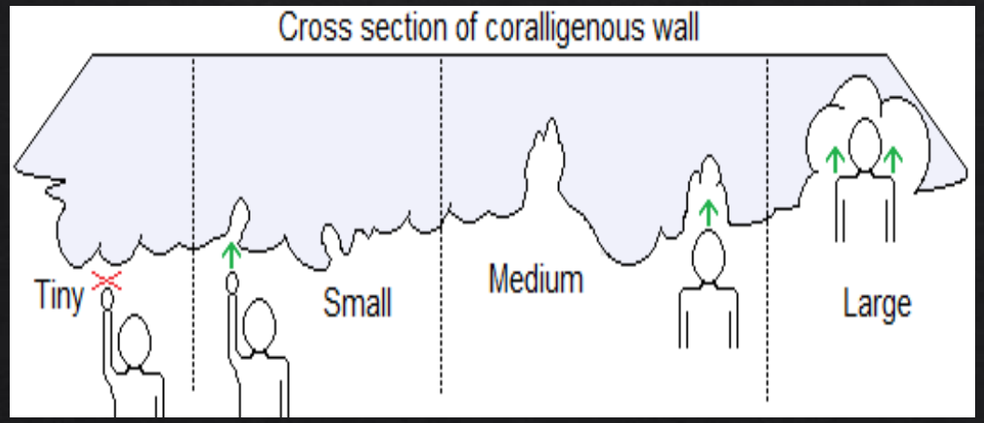
- **Succion sampler**
- **Surface square of 10cm**

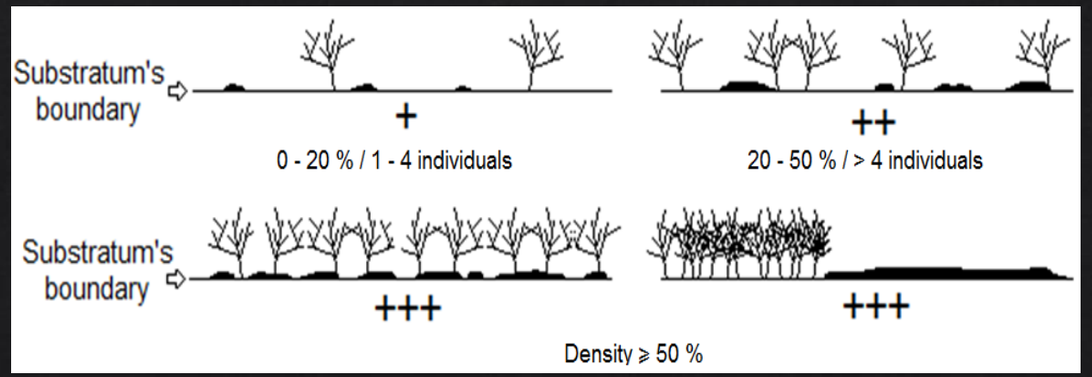
Sampling protocol

- **Succion sampler**
- Surface **square of 10cm**
- **Depth and topological** data were recorded on each segment
  - Inclination
  - Orientation
  - Rugosity
  - Most abundant species









Molecular biology and bioninformatics

Molecular biology and bioninformatics

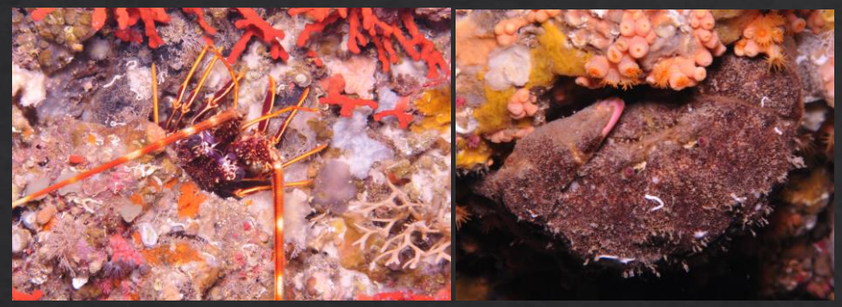
DNA Extraction

PCR COI fragment

Primers targeting metazoans

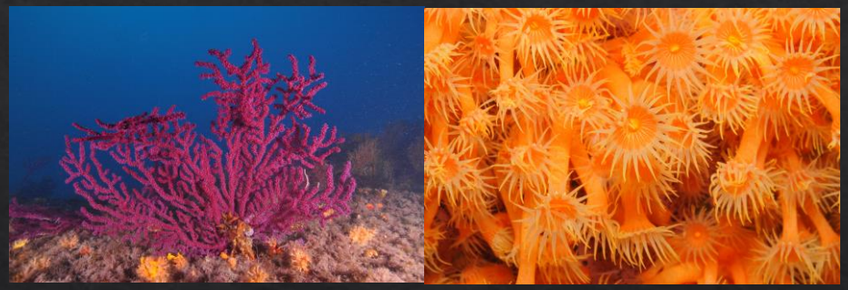
Bryozoa

Crustacea



Mollusca

Cnidaria



Annelida

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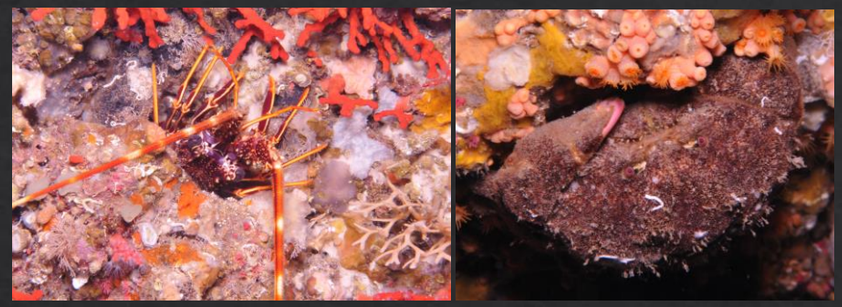

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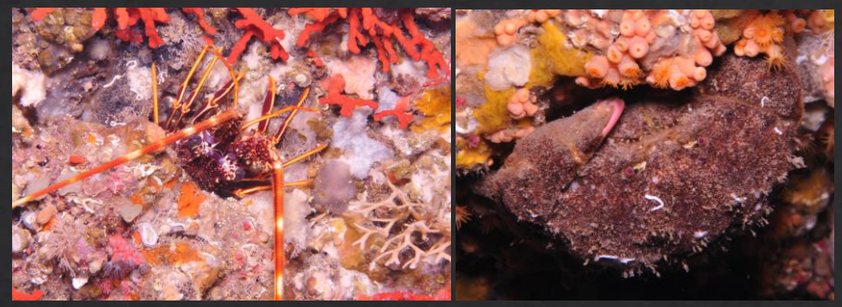

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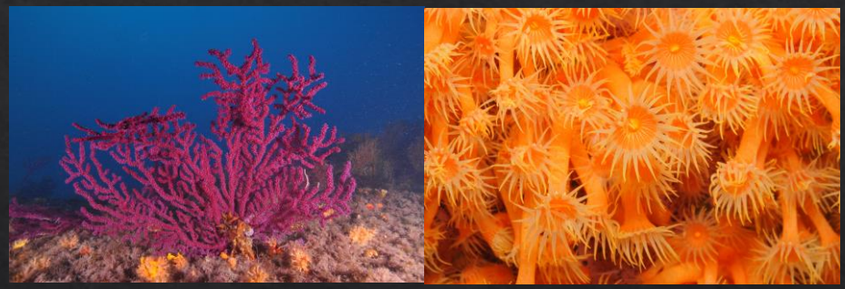

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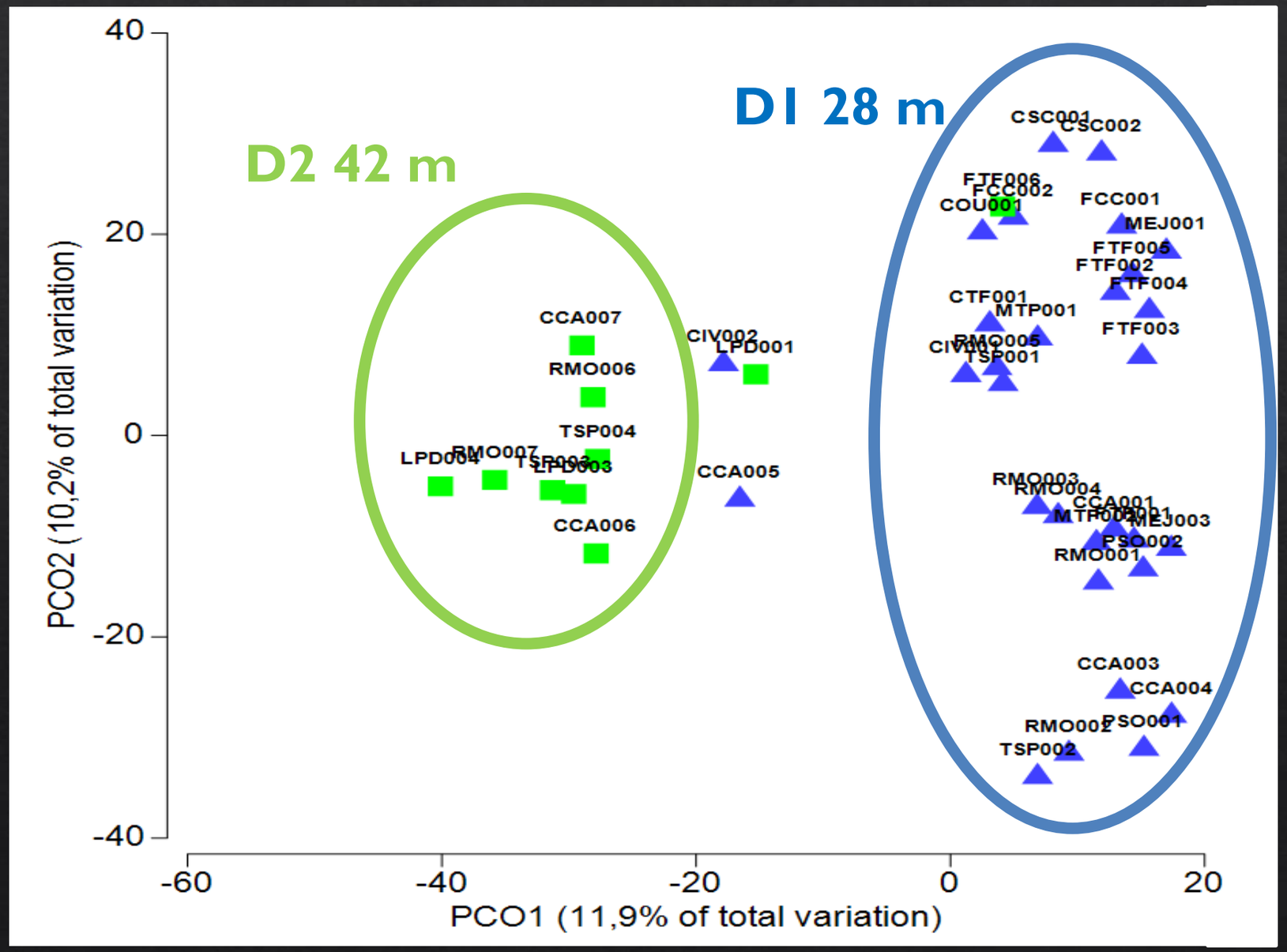
Communities in coralligenous habitats



- **3029 mOTUs**

➢ **Differences between sites**

➢ **No clear correlation with geographical position in the bay**

➢ **Correlations with environmental variables such as depth**

Conclusions & Perspectives

- Eight cryptic engineering species with varying abundances among sites and depth
  - Adaptative capacities of these different species in the context of climate change ?
  - Phenotypical differences between these cryptic species (photosynthesis, carbonate precipitation …) ?

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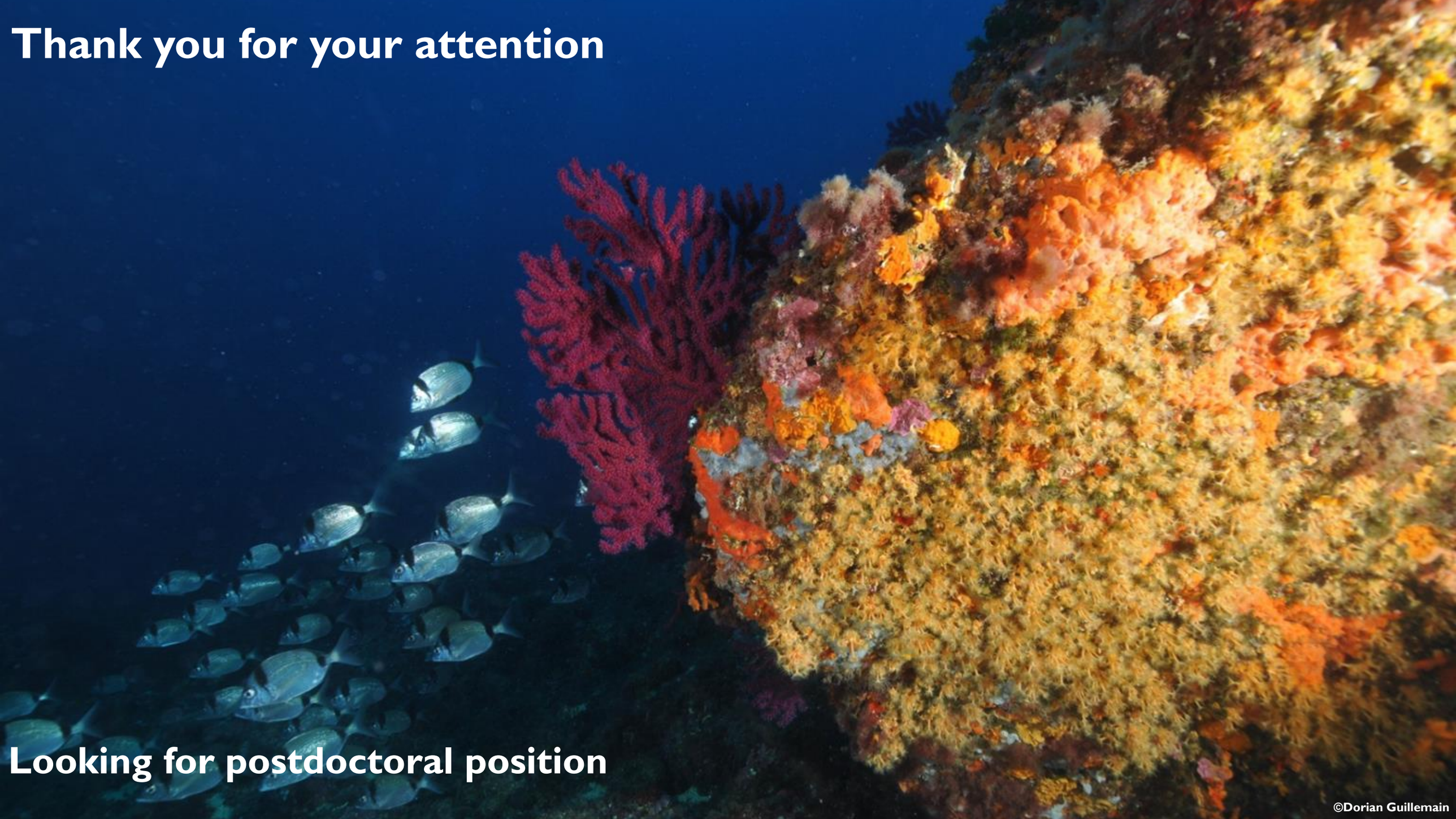
- The study of diversity structure at the species level and genetic level provides critical information to protect efficiently coralligenous habitats.

Thank you for your attention



Looking for postdoctoral position