UNDERSTANDING ECOLOGICAL FUNCTIONING OF CORALLIGENOUS HABITATS, AND BUILDING NEW INDICATORS BASED ON GENETIC TOOLS TO ASSESS THEIR GES (GOOD ENVIRONMENTAL STATUS).

WP 2 IMPACT OF CLIMATE AND ANTHROPOGENIC CHANGES ON MEDITERRANEAN ECOSYSTEMS AND SERVICES THEY PROVIDE

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IMBE team Interaction Diversity Evolution and Adaptation

What are Coralligenous habitats ?

- **Coralligenous habitats** = bioconcretions of corallines red algae that grows at dim light conditions. Corallines are the main builders, but some marine invertebrates, directly contribute to the framework of the habitats because they build their own calcareous skeleton.

- **Complex 3D structure** = eroders vs bioconstructors

- **Emblematic/Endemic** habitats of the Mediterranean sea

- **Biodiversity hotspot** → 1600 species

- **Poorly studied**

Photos : Frédéric Zubérer

Coralligenous habitats : Ecosystems services and threats

- Services :
  - Entertainement
  - Food production
  - Harvesting of red coral
  - Carbon sink

Photo : Frédéric Zubérer

Photo : Frédéric Zubérer

- Threats :
  - Mecanical degradation (divers, anchoring)
  - Global warming (mass mortality events)
  - Acidification
  - Pollution (turbidity, chemicals)
  - Invasive species
 - Harvesting and fishing

Rodolpho-Metalpa et al. 2009
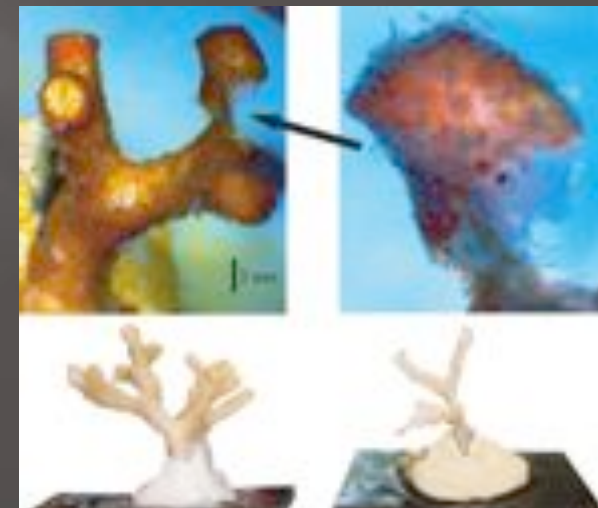
Aim of the project : Creation of new GES indicators

- Improve our understanding of the functioning and resilience capacity of coralligenous habitats, and establish **biodiversity** and **connectivity patterns** among localities and ecological profiles.

- To reach this goal, a multidisciplinary approach will be used, combining **population genetics**, **community ecology**, and **physical oceanography**.

- This requests four tasks, partly using the same data, but different analysis methods :

  - **1-** Species delimitation for two selected builders of the habitats a red alga *Lithophyllum spp.* and a bryozoan *Myriapora truncata*

  - **2-** Establishment of the species composition using metabarcoding (together with traditional taxonomy and photo quadrate validation for some samples)

  - **3-** Establishment population structure of the two selected taxa, on the CIGESMED sampling network.

  - **4-** Synthesis and Comparisons: Propose new GES (good environmental status) indicators for the coralligenous and biodiversity management rules

I- Species delimitation for the builders species using molecular barcodes

Myriapora truncata
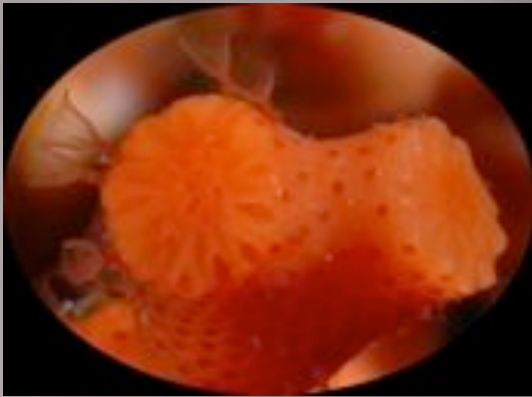
Lithophyllum spp.

▫ We found 4 different genetic entities all along the Mediterranean Sea

Still need to confirm if they are cryptic species or differentiated populations of the same species.
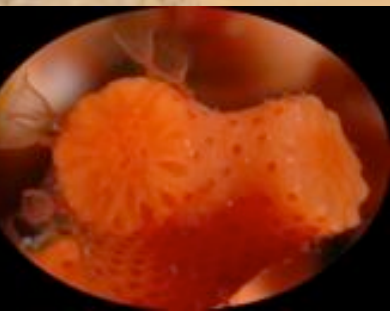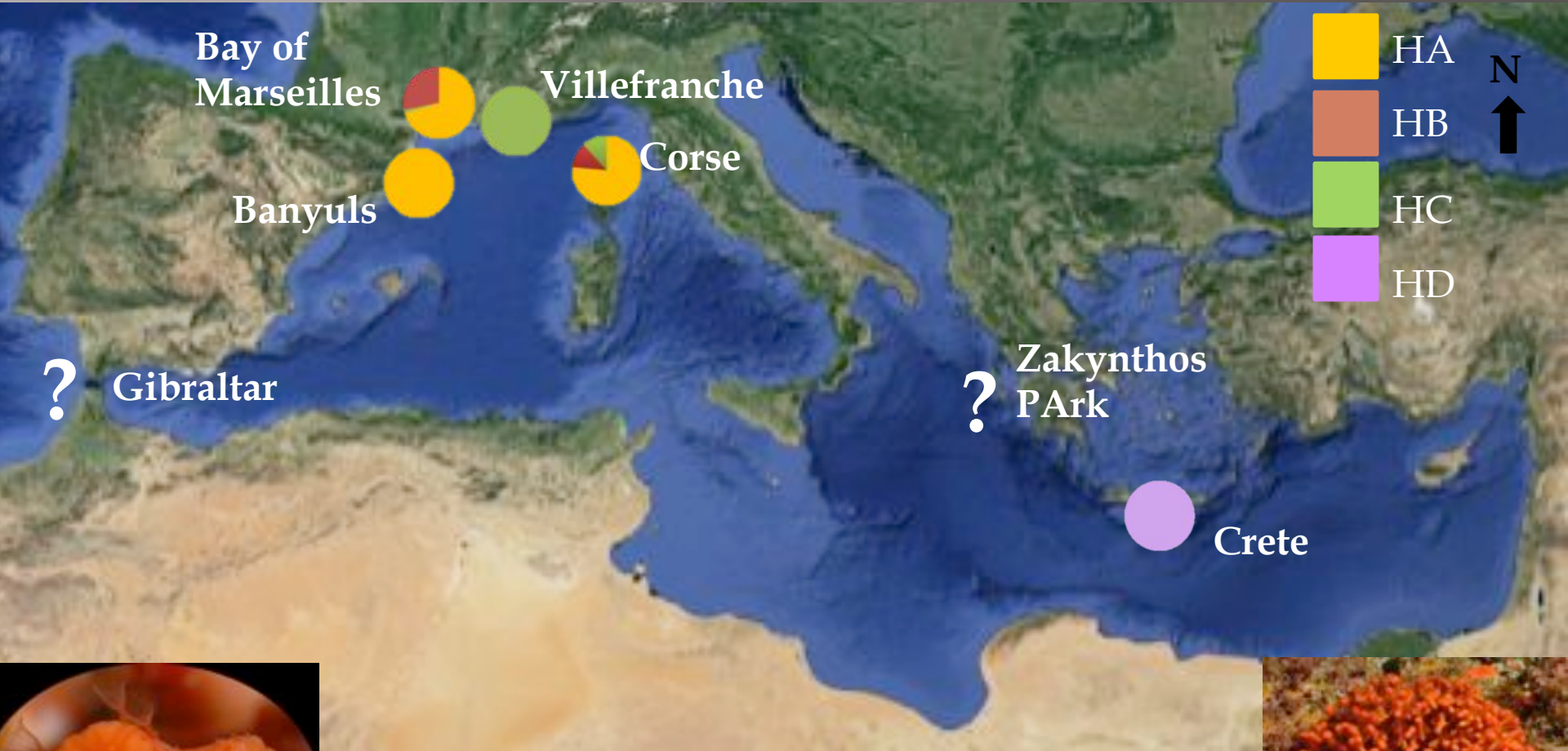
▫ We found 4 cryptic species in the Bay of Marseille.

▫ Collaboration with Marc Verlaque to study morphological traits.

Currently analysing if there is a link between ecological factors and species distribution.

Photos : Frédéric Zubérer

Distribution of the different haplotypes of the Bryzoan *Myriapora truncata* in the Mediterranean Sea.

Bay of Marseilles

Villefranche

Corse

Banyuls

Gibraltar

Zakynthos PArk

Crete

HA
HB
HC
HD

N

We just received new samples from Gibraltar detroit and Greece.

Photos : Frédéric Zubérer

Distribution of the different genetic entities of the Bryzoan *Myriapora truncata* in the Bay of Marseilles

Photos : Frédéric Zubérer

Distribution of the cryptic species of the species complex Lithophyllum spp. in the Bay of Marseilles

Clade 1
Clade 2
Clade 3
Clade 4

Couronne
Sec de Carry
Méjean
Frioul
Planier
Moyade
Figuerolles
Cassidaigne
Les Lecques

Photos : Frédéric Zubérer

- Biodiversity at the level of species
- All samples are available : 240 samples in total corresponding to 60 ecological conditions in 19 sites in the Bay of Marseilles.

± 10 cm environ

x 240
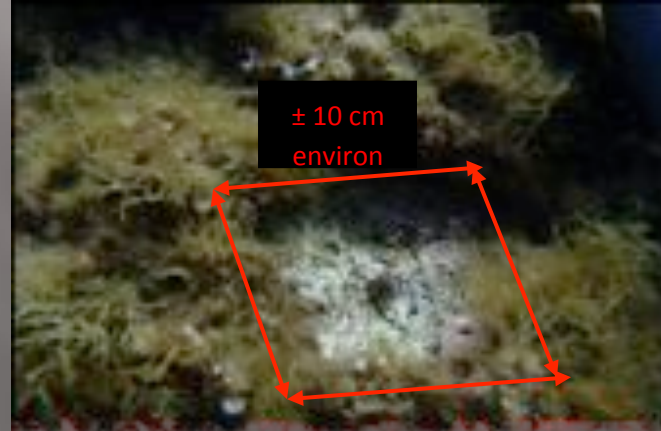
> Molecular biology protocols are ready

> First run of DNA sequencing at the end of January

Myriapora truncata

Lithophyllum spp.

▫ Biodiversity at the level of the gene

▫ Currently developping genetic markers

| Choose sequences of interest based on all genes of a few individuals | ➤ | Use these sequences to define genetic markers | ➤ | Sequence all these markers for many individuals |

➢ Fine genetic structure inside our clades/species

➢ Indirect connectivity between sites

➢ Correlation of genetic structure with environmental variables

Photos : Frédéric Zubérer

4- Synthesis and Comparisons: Propose new GES indicators for the coralligenous and biodiversity management rules

Community ecology (metabarcoding)
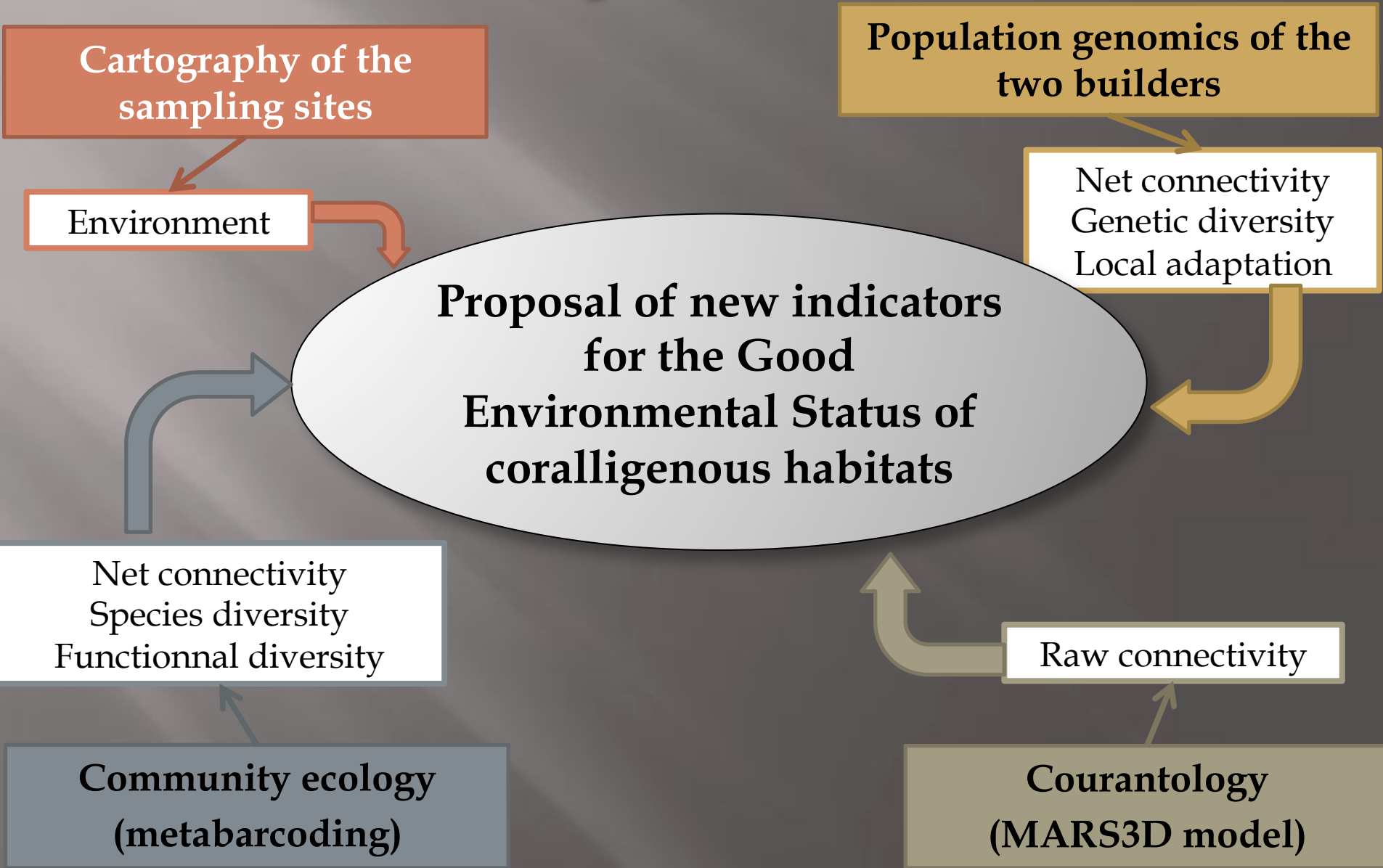**Species diversity**

Population genomics of the two builders
Genetic diversity

Comparing results for the two levels of biodiversity

What are the main factors controlling biodiversity ?
- Connectivity
- Environment

4- Synthesis and Comparisons: Propose new GES indicators for the coralligenous and biodiversity management rules

Cartography of the sampling sites

Environment

Population genomics of the two builders

Net connectivity
Genetic diversity
Local adaptation

Proposal of new indicators for the Good Environmental Status of coralligenous habitats

Net connectivity
Species diversity
Functionnal diversity

Raw connectivity

Community ecology (metabarcoding)

Courantology (MARS3D model)

Aknowledgement

- Divers team in Marseille (Romain David, Frédéric Zuberer, Anne Haguenauer, Dorian Guillemain, Jacky Dubar….).

- CIGESMED collaborators in Greece and Turkey for providing samples.

- Volunteers for sampling and laboratory work.

Thank you for you attention

Photo : Frédéric Zubérer