Credits : Nicolas Job 2014

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# Optimisation of an imagery analysis method to characterise the epibenthic communities of submarine power cables

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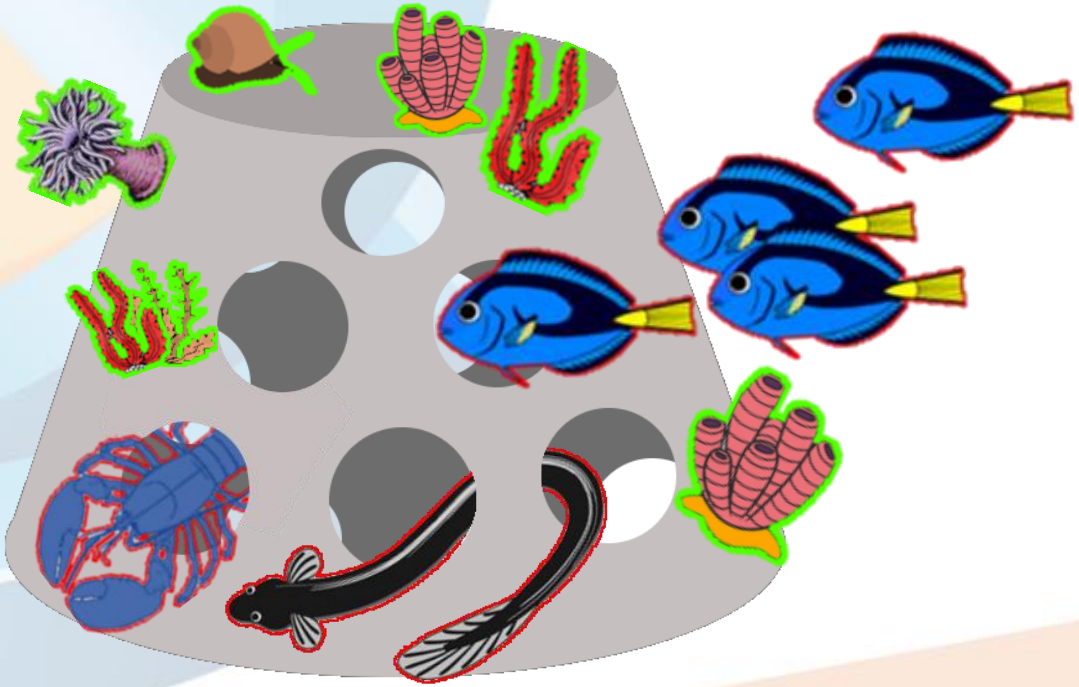
# Artificial reef

"An artificial reef is a manmade structure that may mimic some of the characteristics of a natural reef" → **The reef effect**



Colonised by **hard-substrate benthic species** (**epibenthic community** ~ *biofouling*) and also attract **mobile megafauna** with important economic value (decapods, fishes…)

# Artificial reef

"An artificial reef is a manmade structure that may mimic some of the characteristics of a natural reef" → **The reef effect**

Accidental reef
(ex : shipwreck)

SMS Seydlitz anchor – Scapa Flow
Credits: Lawson Wood

"Primary" reef
(ex : fisheries enhancement, surfing reef…)

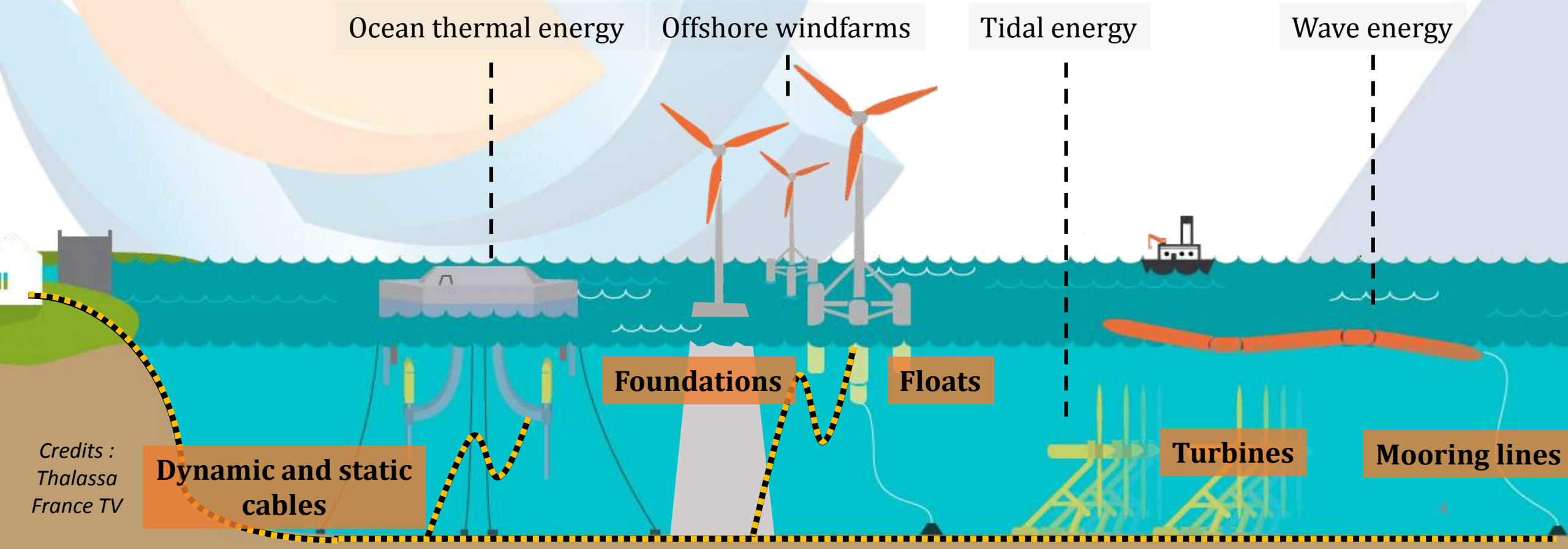
Australian artificial reef
Credits: Department of Fisheries Western Australia

"Secondary" reef
(ex : petroleum rigs, marine renewable energy…)

Rigs-to-Reefs in California
Credits: Caine Delacy

# Reef effect and MRE

All submerged parts of the different MRE installations are concerned




*Credits : Thalassa France TV*

# Reef effect and MRE

All submerged parts of the different MRE installations are concerned

"Positive effect" (↗ habitat heterogeneity / ⇆ "reserve effect")
Highly dependent on the nature of the structure, the location and characteristics of the native populations *(see Langhamer 2012 review)*

**→ It's important to describe and characterise this reef effect**

**How is this done in this particular context?**

# Underwater imagery

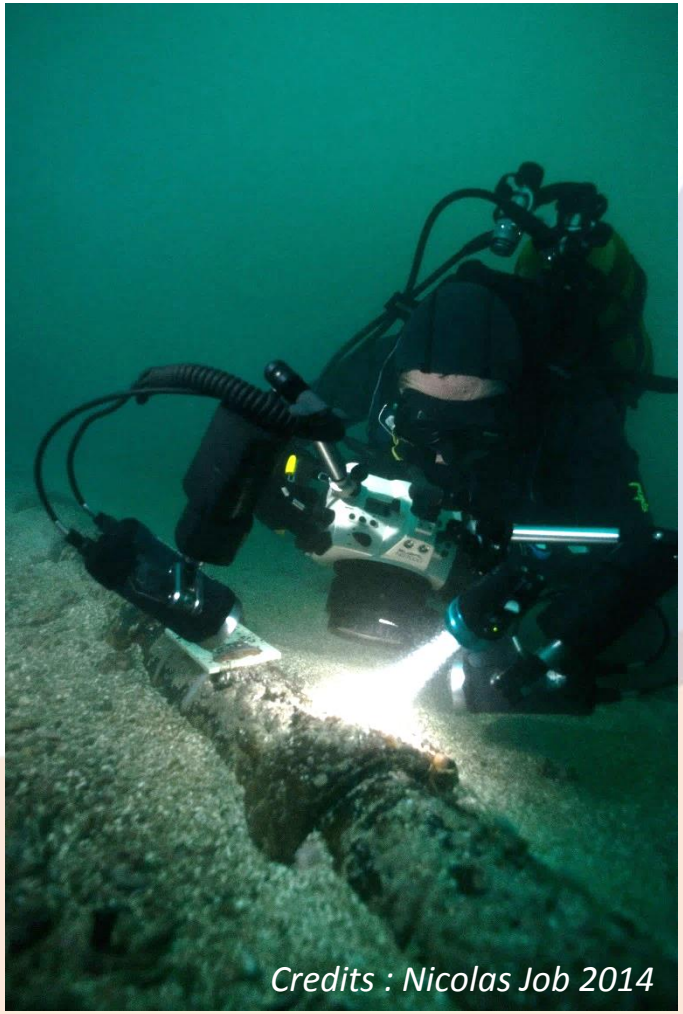
**Particularly adequate to study the reef effect**

+ Non-destructive
+ Relevant to study hard substrates
+ Rapid collection of data over large areas
+ Adequate for sites difficult to access

**But**

- Lots of images to analyse *a posteriori*
=Time consuming ⌛

**An adequate and optimised image analysis protocol is unavoidable to efficiently assess biodiversity data**

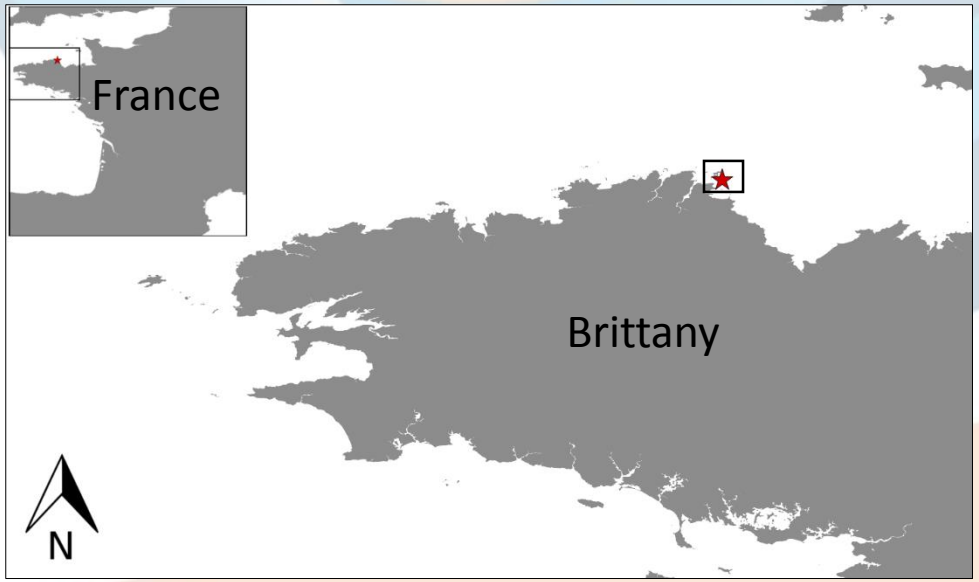


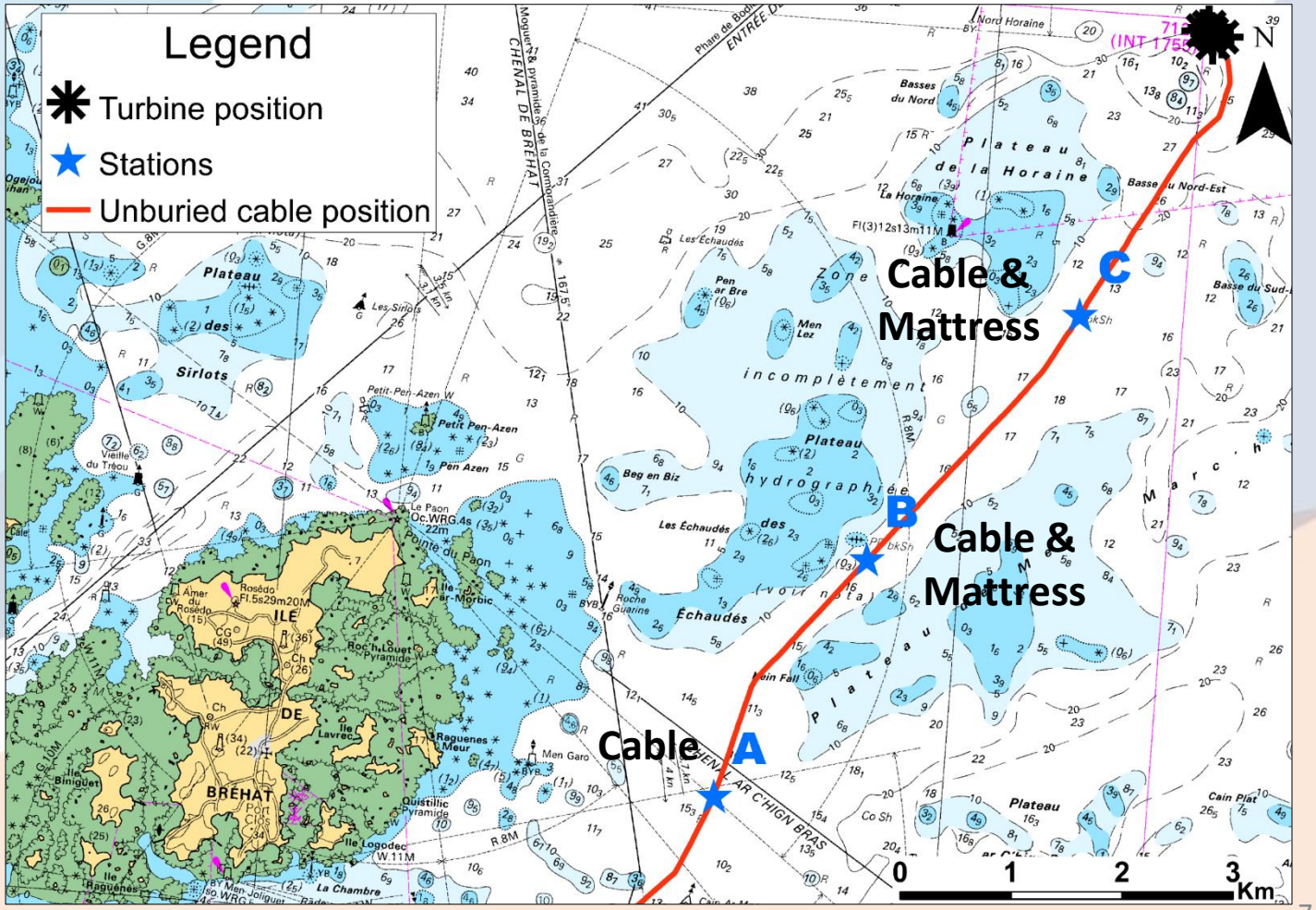
*Credits : Nicolas Job 2014*


# Study site

## Paimpol-Bréhat tidal test site cable


Tidal test-site coordinated by **EDF-EN** with an export cable (10 kVDC) installed in 2012, for 2 Openhydro turbines



# Image survey

**3 different sites and 3 different substrates:**

- **Cable → ~40 photos/site**
- **Mattress → ~16 photos/site**
- **Natural → ~30 photos/site**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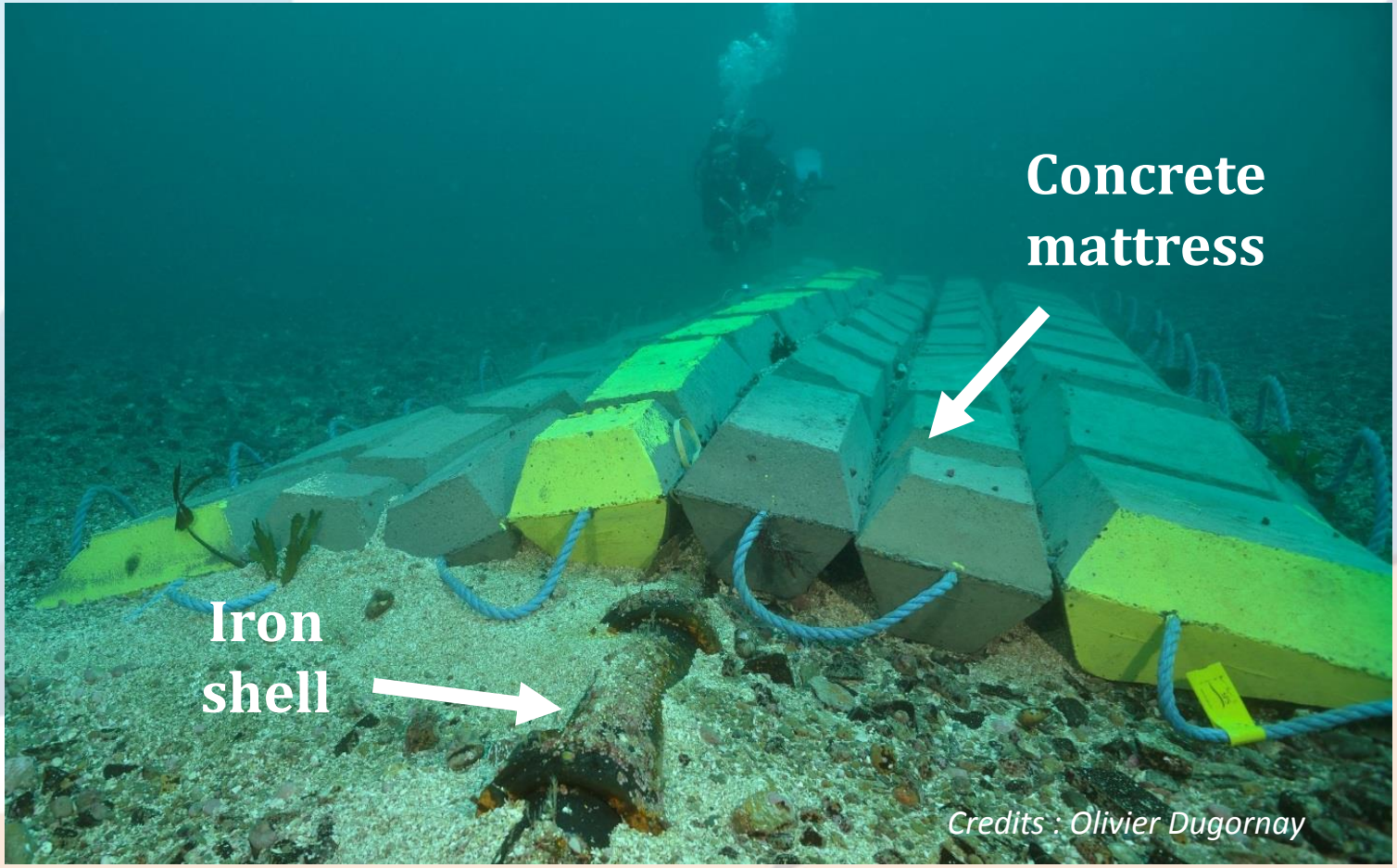
# Goals

**① Optimisation of an image analysis protocol**

**② Study the epibenthic communities on the three substrates**

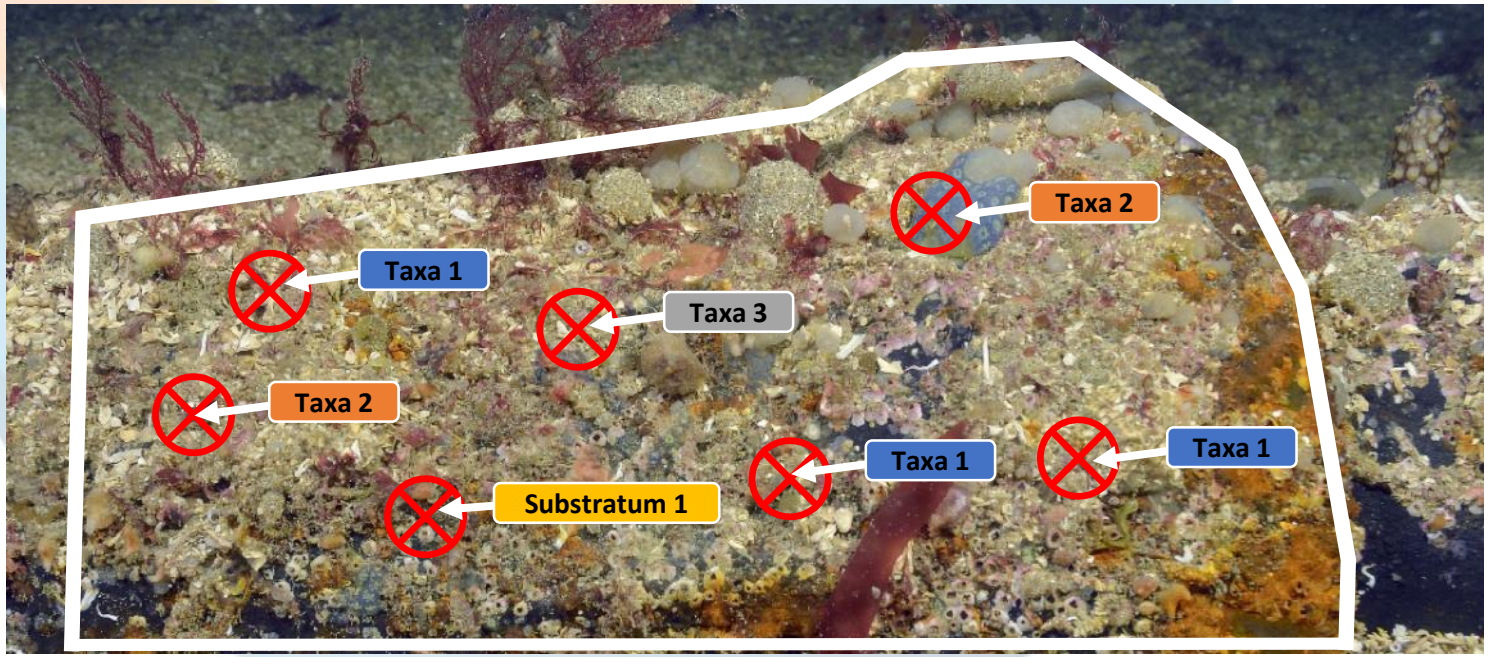
**1.** Protective cast iron shell
**2.** Stabilising concrete mattress
**3.** Surrounding natural substrate

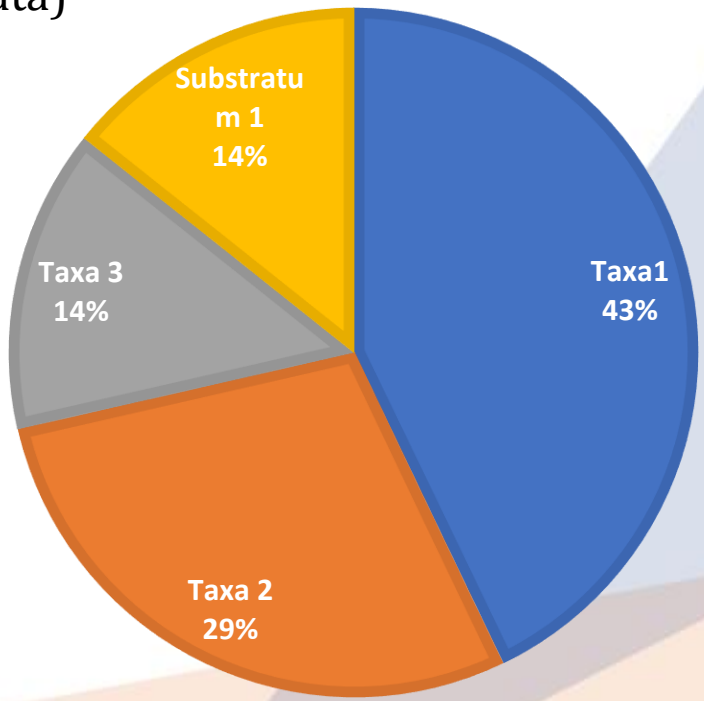
**③ Study the epibenthic communities before and after connection (Electromagnetic field effect)?**



# Random Point Count

Randomly assign points on the picture, and then manually assign each of them to a **category** (taxa or substrata)




**+ Rapid to process**

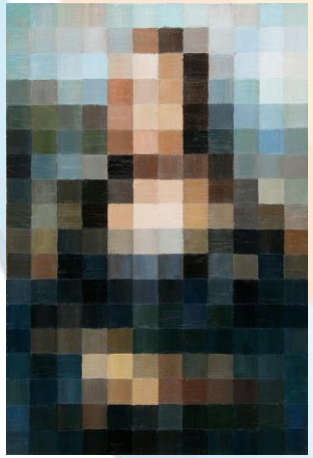
**+ Quantitative data (coverage)**

**But how many points ?**

# Random Point Count

**How many points ?**

**Low number of points**



**High number of points**

**Resolution**

**Time**

**Necessary resolution → good description of categories > 5% coverage = Which sampling effort ?**

# Methods

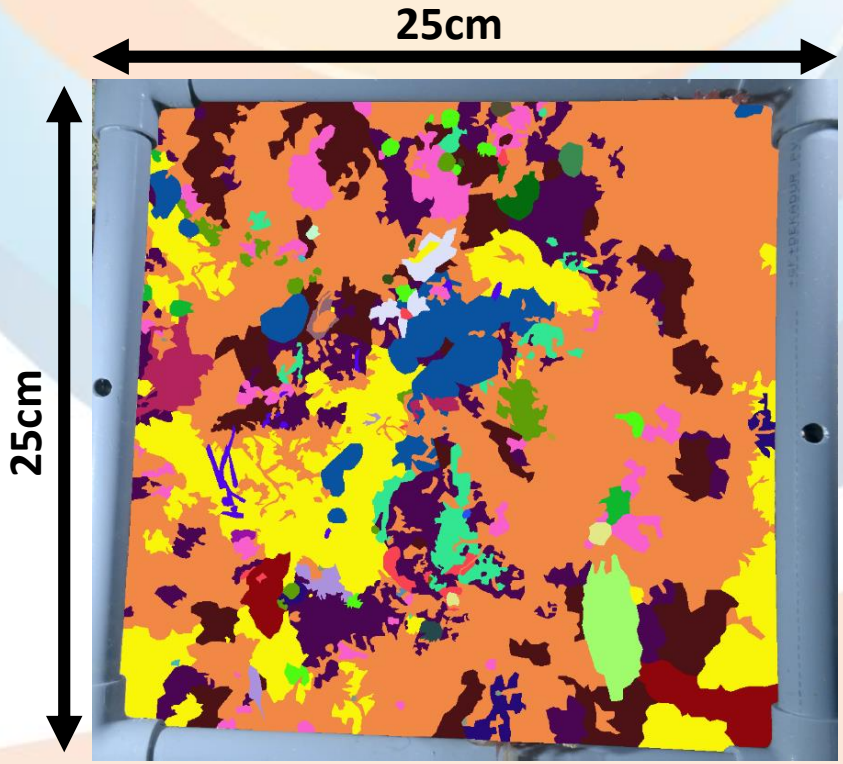
## Number of points for a good description of a 5% coverage category

**1st step:**

Exhaustively describe a small number of pictures

**(3 pictures/substrate =9)**

Yields **reference pictures (100% described)**




**2nd step:**

Simulate results obtained with **random point count**

**-100 point density (5,10, 15… to 500/picture)**

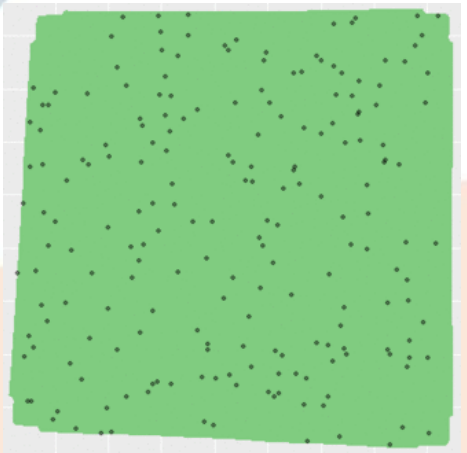
**-2 point distribution methods (full & stratified random)**

**↳ 1 000 simulations for each combination**

**Example : Simulation with number of points = 200**

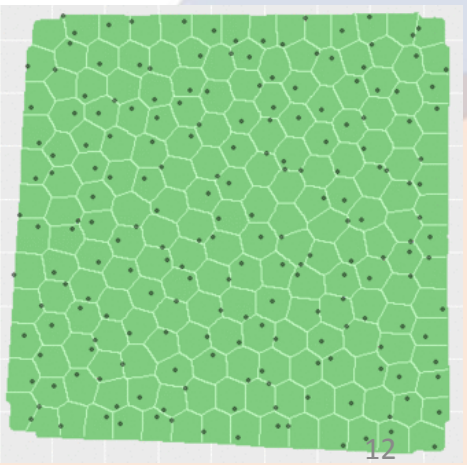
**Full Random**

**X 1000**



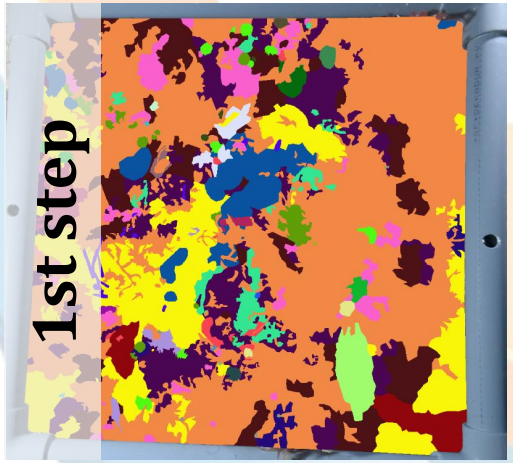
**Stratified Random**

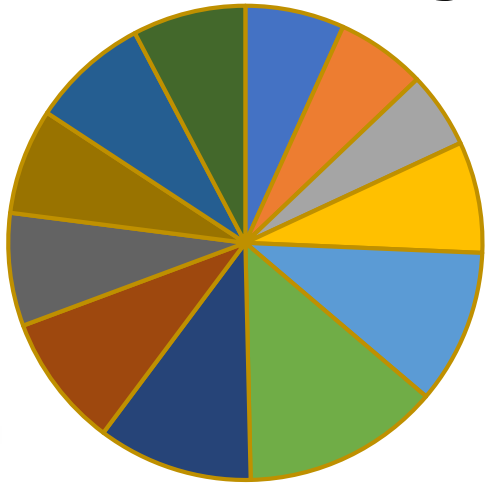
**X 1000**



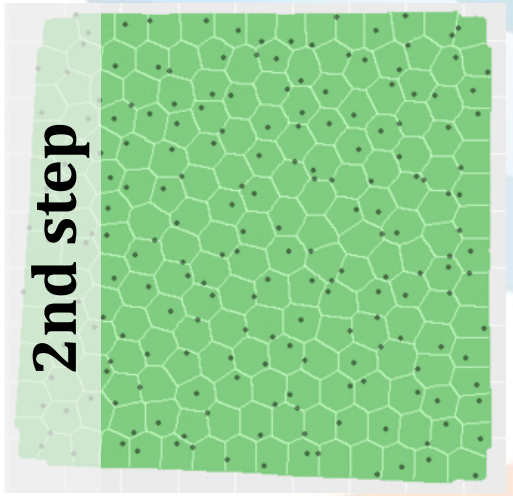
# Methods

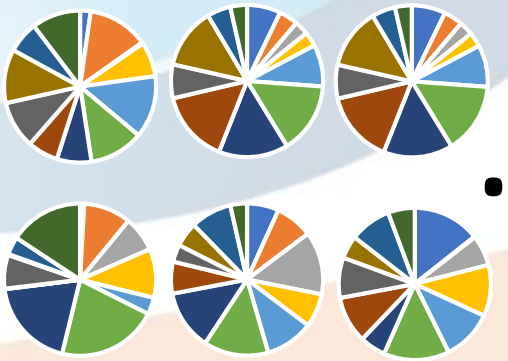
**Number of points for a good description of a 5% coverage category**



Gives the reference coverage of each category



Gives for each combination, 1000 coverage estimations of each category

$$CV_{cat_n} = \frac{\sigma_{cat_n}}{\bar{X}_{cat_n}}$$

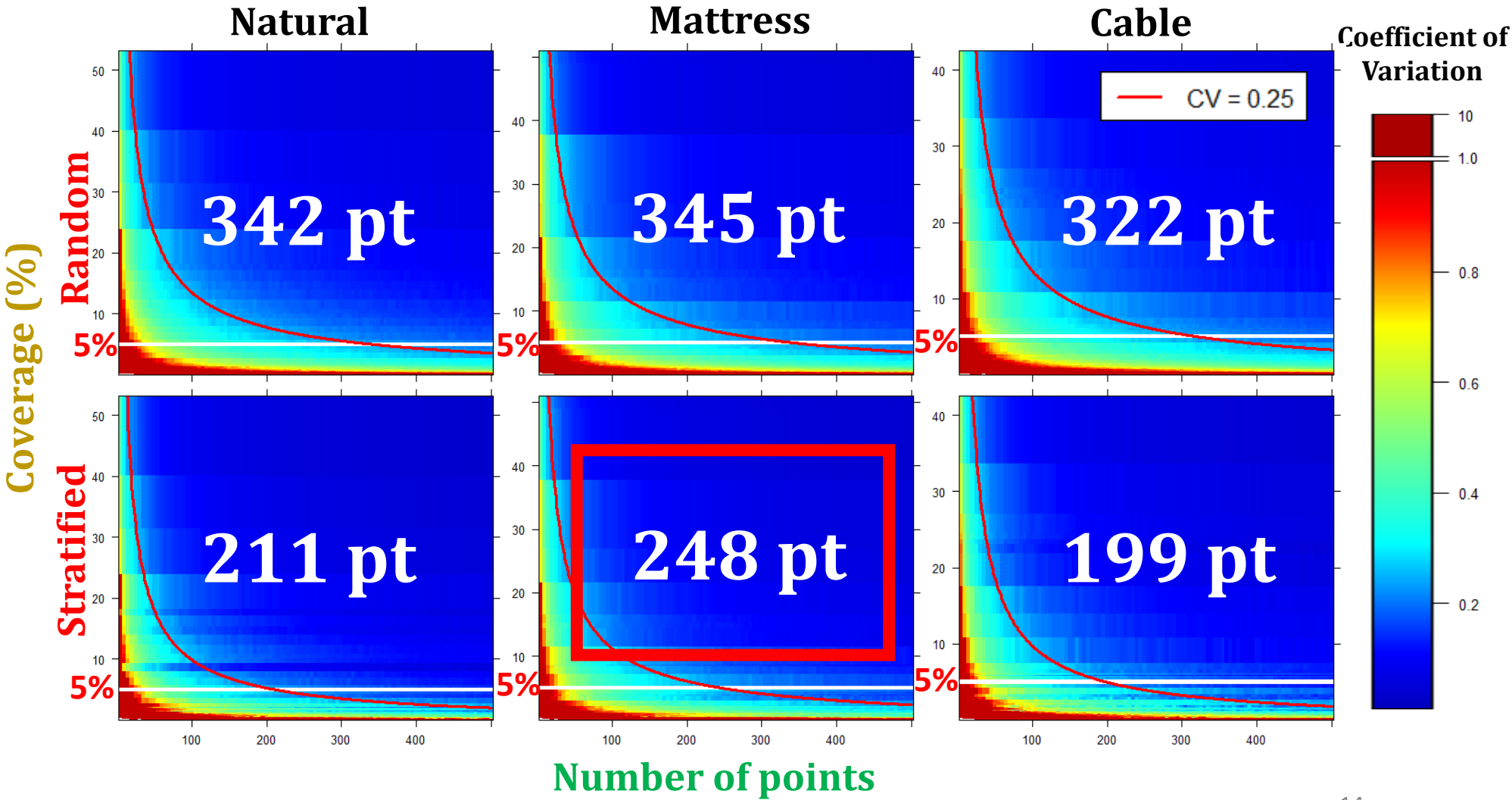
Standard error / Mean

# Results

$$CV_{cat_n} = \frac{\sigma_{cat_n}}{\bar{X}_{cat_n}}$$

**At which number of points, a 5% coverage category will have a coefficient of variation =0.25 ?**

**250 pt & Stratified**

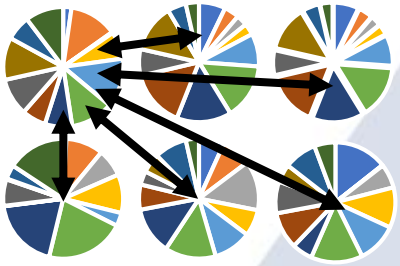


# Results

**Robustness of random point count with 250pt & Stratified distribution**

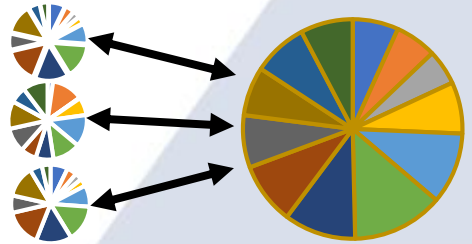
**Autosimilarity**

- **Bray-Curtis mean similarity between the 1000 simulations = 0.89**
  - **= Good repeatability**



**Similarity with reference**

- **Bray-Curtis mean similarity between the 1000 simulations and the reference = 0.91**
  - **= Almost the same results as the reference photos**



**Diversity**

- **62 % of total specific richness**
- **93 % of total Shannon-Wiener richness**
- **99 % of total Simpson richness**

→ **Poor sampling of rare species (<5% coverage)**

**Time**

- **Approximately 40 minutes/picture**
  - **= Reasonable, given the resolution**

# Perspectives

**250 points & Stratified → Good method for the description of a given picture**

**Other points for the optimisation :**

- How many pictures/substrate do we need to analyse ?
- Which minimum taxonomical level do we need ?

**Exemple :**

**Cnidaria : True Anemone** =

*Capnea sanguinea*
***Actinothoe sphyrodeta***
*Cereus pedunculatus*
*Sagartiidae*
*Urticina felina*
Undetermined anemone


?

**And <u>then</u>, look at the scientific questions.**

**Also, survey of megafauna populations with video imagery**


# Thanks !

*Credits : Olivier Dugornay*