

SC -02 -06 [02]

2<sup>nd</sup> Meeting of the Southern Indian Ocean Fisheries Agreement (SIOFA) Scientific  
Committee

13-17 March 2017, Saint Denis, La Reunion

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Development of a photographic protocol for macrobenthos bycatch  
monitoring in the French fisheries of the Southern Ocean and first  
preliminary results obtained in the Kerguelen EEZ

*Relates to agenda item: 6.Vulnerable marine ecosystems*    Working paper ☒ info paper ☐

Delegation of France  
(France Territories)

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## Development of a photographic protocol for macrobenthos bycatch monitoring in the French fisheries of the Southern Ocean and first preliminary results obtained in the Kerguelen EEZ

by Alexis Martin, Marc Eléaume, Nadia Améziane, Patrice Pruvost, Guy Duhamel

From 2015 to 2016, a new protocol has been developed and tested to collect data about the macrobenthos by-catch specimens caught by the French fishing vessels in the Southern Ocean.

This approach is based on a standardized photographic protocol, implemented on board by the scientific observers. All the collected pictures of the benthic invertebrates have been sorted and registered in specific sets of data at the laboratory. A pipeline of treatment of the pictures, including taxonomic identification, allows to produce various analysis about species composition and community assemblages. Linked to the “Vulnerable Marine Ecosystems” conservation issue, the preliminary results obtained from the Kerguelen French EEZ highlight the spatial distribution of some sensible marine ecosystems/habitats.

All the data collected with this protocol is stored and managed within the global information system used for the Fisheries monitoring.

The developed approach aims to reply to specific feasibility constraints, especially the need of non time-consuming protocols on board and the difficulty of taxonomic identification for the benthos.

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## Recommendations *(working papers only)*

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Development of a photographic protocol for macrobenthos bycatch monitoring in  
the French fisheries of the Southern Ocean  
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by Alexis Martin\*, Marc Eléaume, Nadia Améziane, Patrice Pruvost, Guy Duhamel

alexis.martin@mnhn.fr

*Photos : Gwenael Bodiger*



**MUSÉUM**  
NATIONAL D'HISTOIRE NATURELLE



In 2014, the “Terres Australes et Antarctiques Françaises” administration (TAAF), in charge of ruling the fishing industry in the French Southern Ocean Exclusive Economic Zones (EEZ) decided to apply the CCAMLR rules for “Vulnerable Marine Ecosystems” (VME) conservation in the two French EEZ of Kerguelen and Crozet.

The “Conservation Measure 22-07” of the CCAMLR includes, for example, that fishing activity must be stopped if 10 liters per 1000 hooks of organisms belonging to indicator taxa of VME are caught during the hauling observation time (25 % of each longline).

A list of those taxa have been established by the CCAMLR (CCAMLR VME Taxa Classification Guide 2009). They are considered to be indicators of vulnerable marine benthic ecosystems which have to be protected. The taxa considered to be indicators are mostly colonial and/or builder and/or fixed animals. The list includes, for example, all the Porifera phylum and all the corals (Cnidaria phylum).

In 2015, the Muséum national d'Histoire Naturelle (MNHN) has developed a new evaluation protocol to follow the new rules of VME conservation. The new protocol aims to increase the knowledge on benthic ecosystems in the fishing areas and highlight the conservation issues for EEZ.

It is based on :

- the continuation of the opportunistic specimens collect,
- the weigh and photographic sampling of the bycatch.

The protocol is deployed in the EEZ of Kerguelen and Crozet, and also in the EEZ of Saint-Paul and Amsterdam and the CCAMLR and SIOFA areas. It is applied both for commercial cruises and for halieutic surveys.

## Opportunistic collect of specimens

All the specimens caught on the longlines can be collected by the observer.

He can contact the MNHN to get instructions if he observes unusual organisms.  
The MNHN can transmit priorities before the cruise or during the cruise, depending of the scientific objectives of the team, the national collection increase strategy, and requests of other teams we collaborate with.  
For example : crinoids for sytematics and population biology.

**In CCAMLR and SIOFA areas, we ask to collect all the benthos bycatch.**



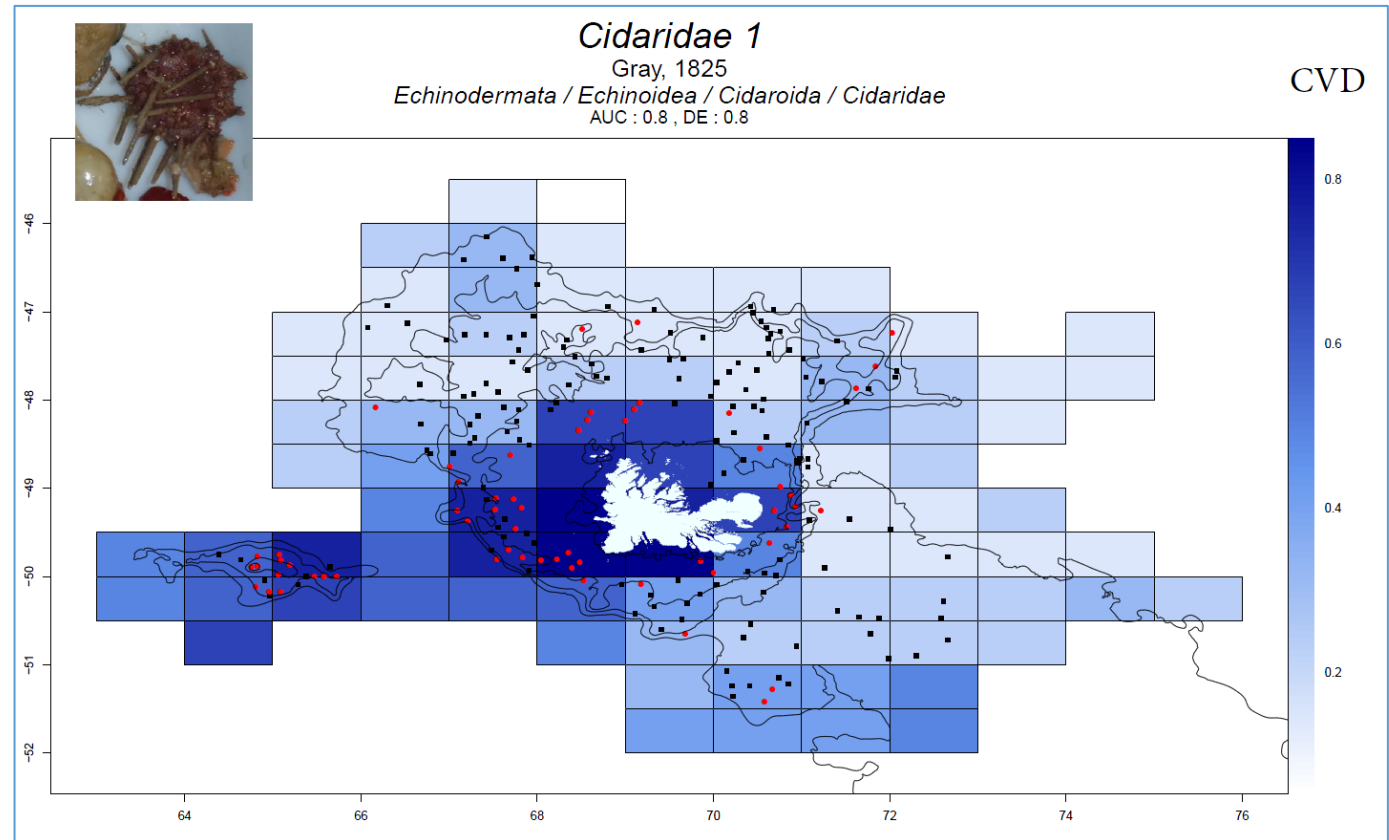
The Muséum's  
collections reserve



Photo : Corentin Matheron

The collect of specimens permitted us in 2016 to analyze conservation issues at taxonomic level in the Kerguelen EEZ, to help the TAAF for the MPA extension.

We built niche models (Boosted Regression Trees) and distribution predictions for 18 VME taxas, to highlight the areas to be protected and the useful bioindicators.



But the opportunistic collect of specimens doesn't allow :

- to analyze the composition of species assemblages,
- statistics on abundances,
- to analyze the conservation status of the species,
- to analyze the impact of fishing activity on benthic ecosystems.



We have developed a photographical sampling to collect more data and abundances. The photographic protocol have been developed regarding a series of constraints :

- very short time available for the observers to treat benthos bycatch (approx 30 minutes per day),
- no skills in identification : huge group of taxas, very difficult to identify (even difficult for specialists with time and lab facilities !),
- need to have a protocol not time consuming,
- need to transfer the identification action from the field to the lab.

**During the hauling observation, 25 % for each longline**

1) global weigh and picture of all the bycatch.

The weigh will allow biomasses evaluations.



2) the organisms are photographed separately with a scale :



*Photos : David Beaufils*

Individual pictures will allow taxas identification, abundances record and biometry.

The protocol can be difficult to apply, because of :

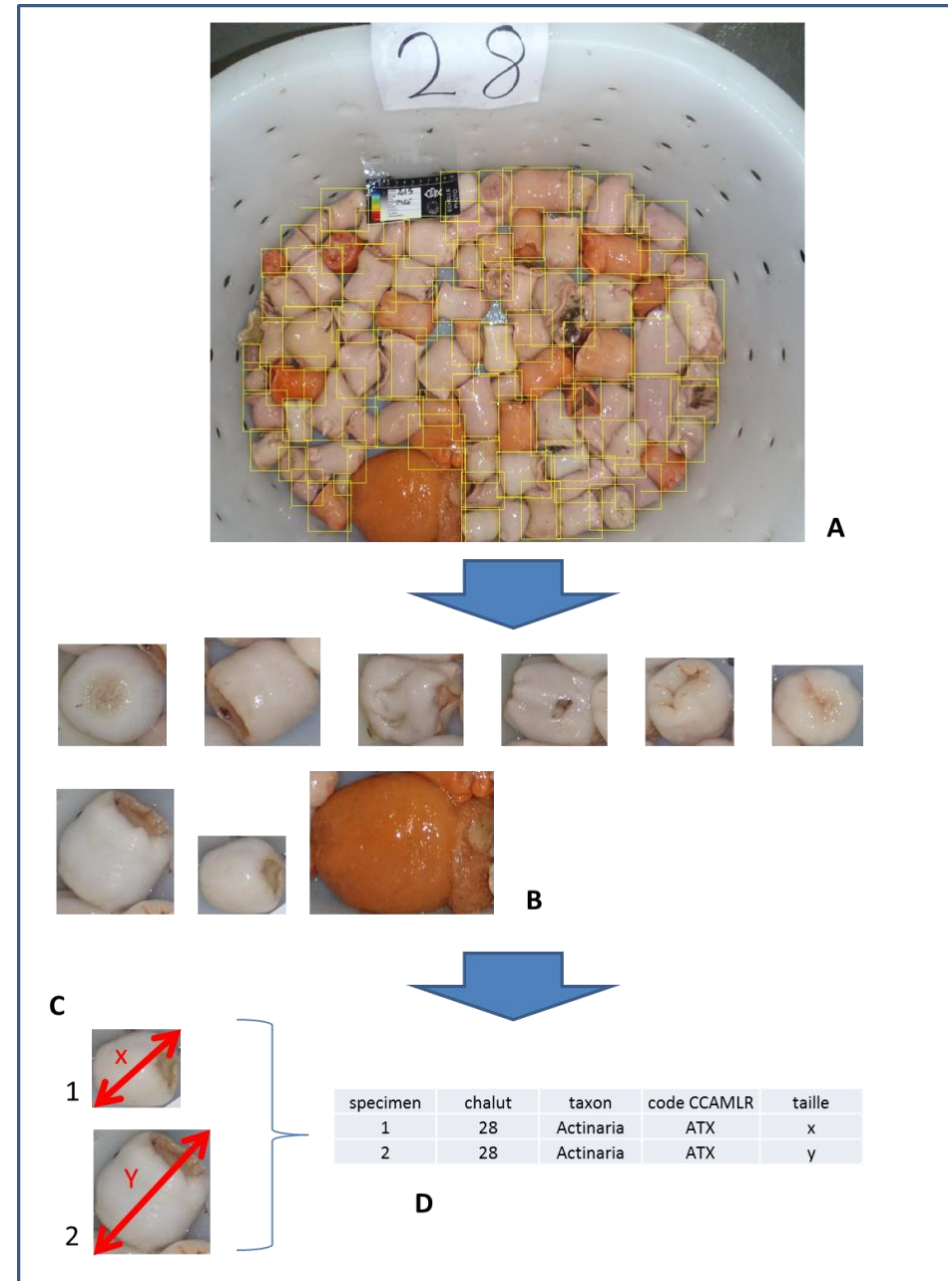
- huge amounts of caught organisms,
- organisms destructed on the longline during hauling,
- difficult to obtain fishers collaboration,
- security problems to collect the organisms on the longline during hauling,
- depredation.

In this case, we do sub-sampling and an estimation of the non-observed amount of organisms.



In lab, all the pictures are analysed and treated with through a pipline we developed :

- taxas identification
- organisms counting
- measurements



In year one of the new protocol (2015-2016), we obtained 4427 pictures from the commercial vessels, for single organisms or group of organisms.

90 % of the pictures are from the Kerguelen plateau, mostly from the shelf.

It represents approximately an acquisition capacity of pictures from 10000 organisms or colonies pictured per year.

*Photos : Jean-Luc Aubert*



The **PIGE** cruise in 2016, a stock assessment survey in two sectors of the Kerguelen Plateau : the Skiff bank and North-East sector of the Kerguelen plateau.

62 stations (trawl)

We applied the protocol for the benthos bycatch, and we obtained **7789 pictures of organisms or colonies**, allowing various analysis and species assemblages mapping.



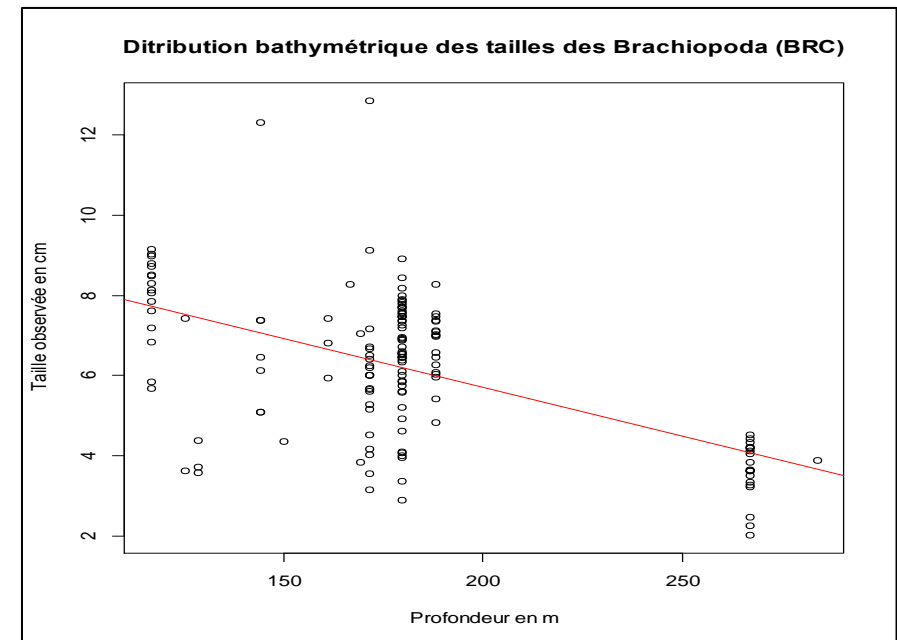
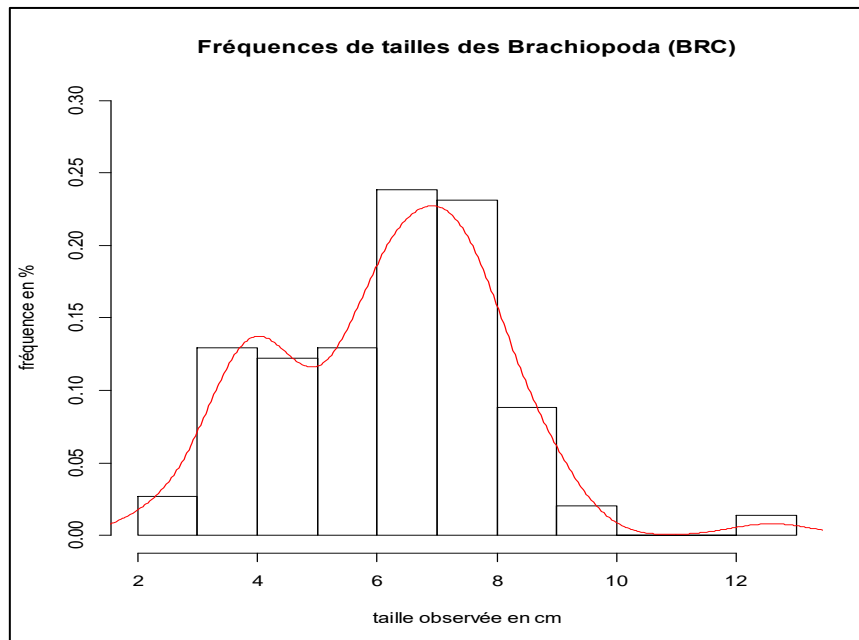




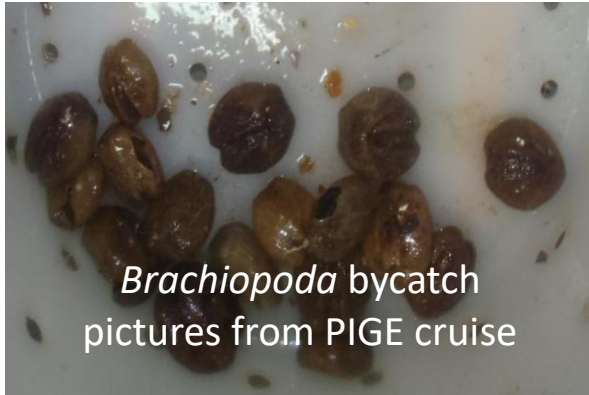
The example of *Brachiopoda*

VME taxa

Exploring data with biometry  
obtained from pictures

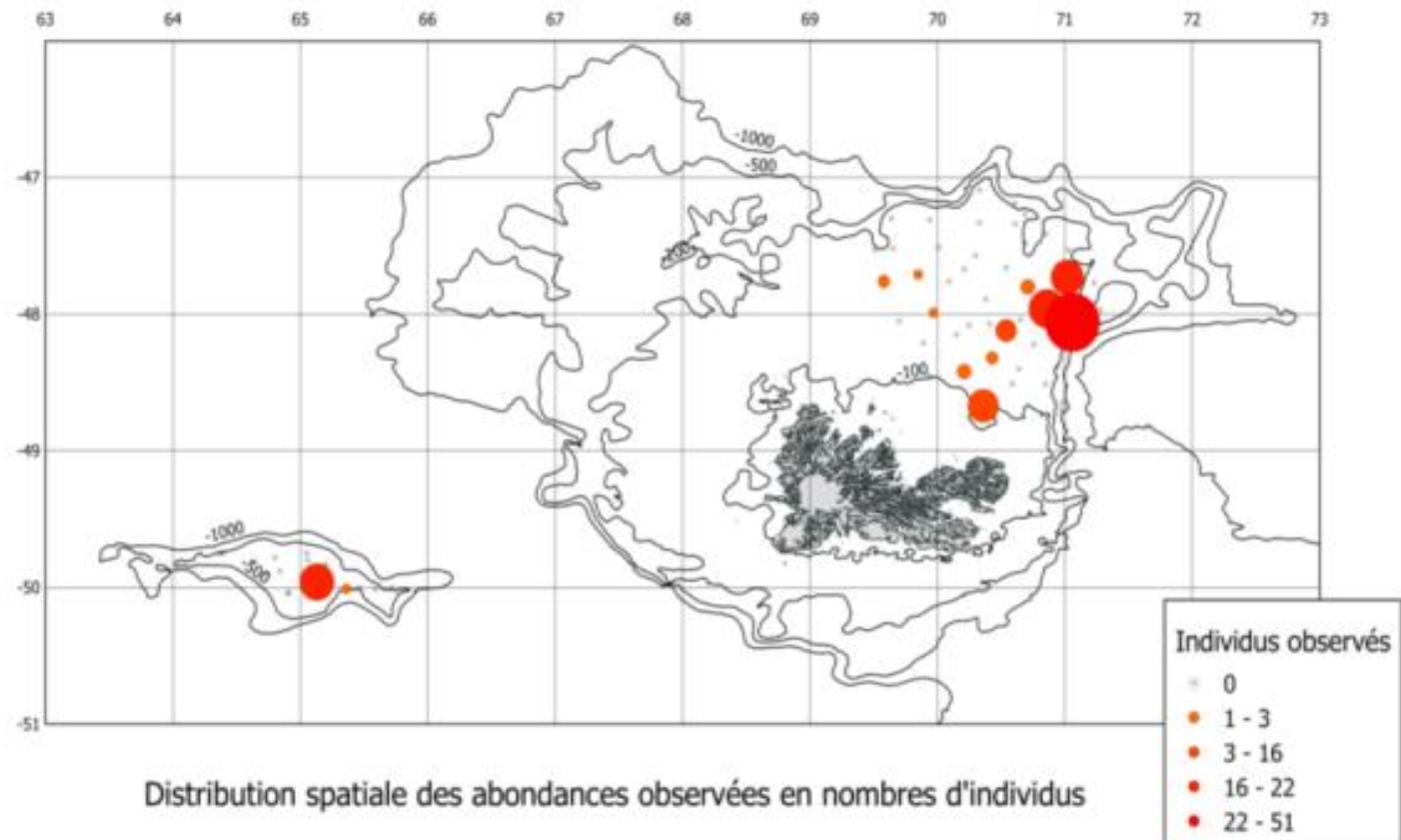






## Mapping abundances

### *Brachiopoda* (BRC)

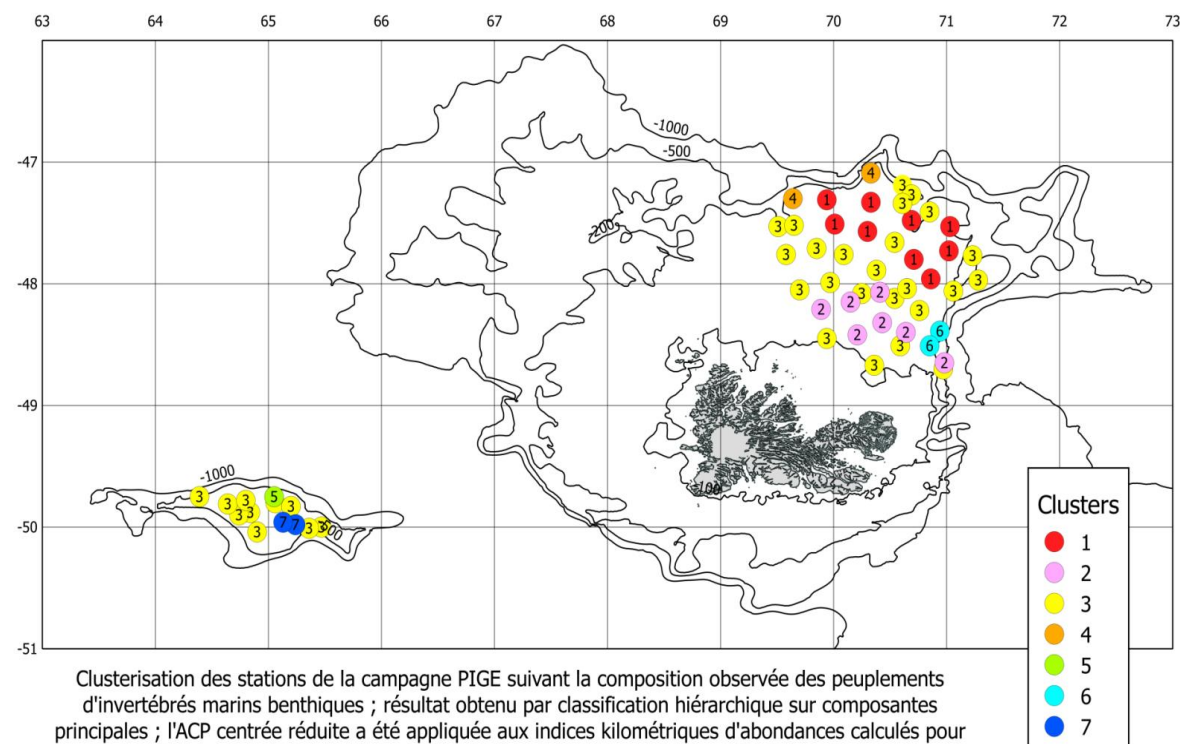


We have estimated benthos densities by calculating a Kilometric Abundance Index matrix for all the 62 stations and the 50 taxa we could identify.

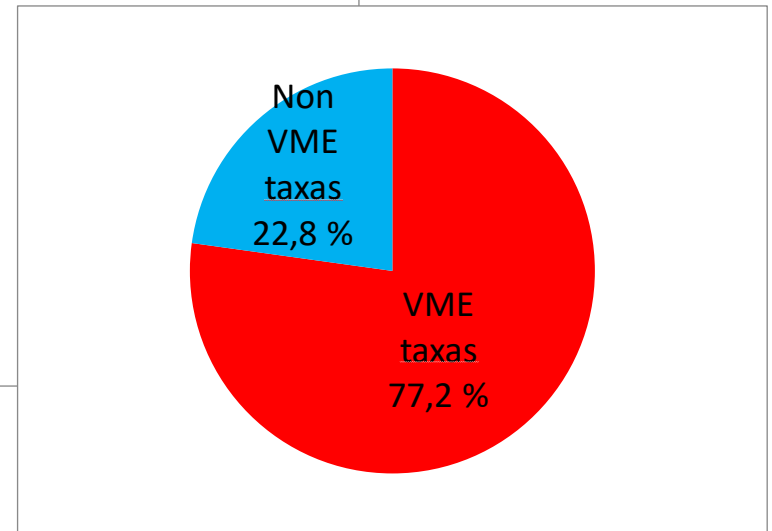
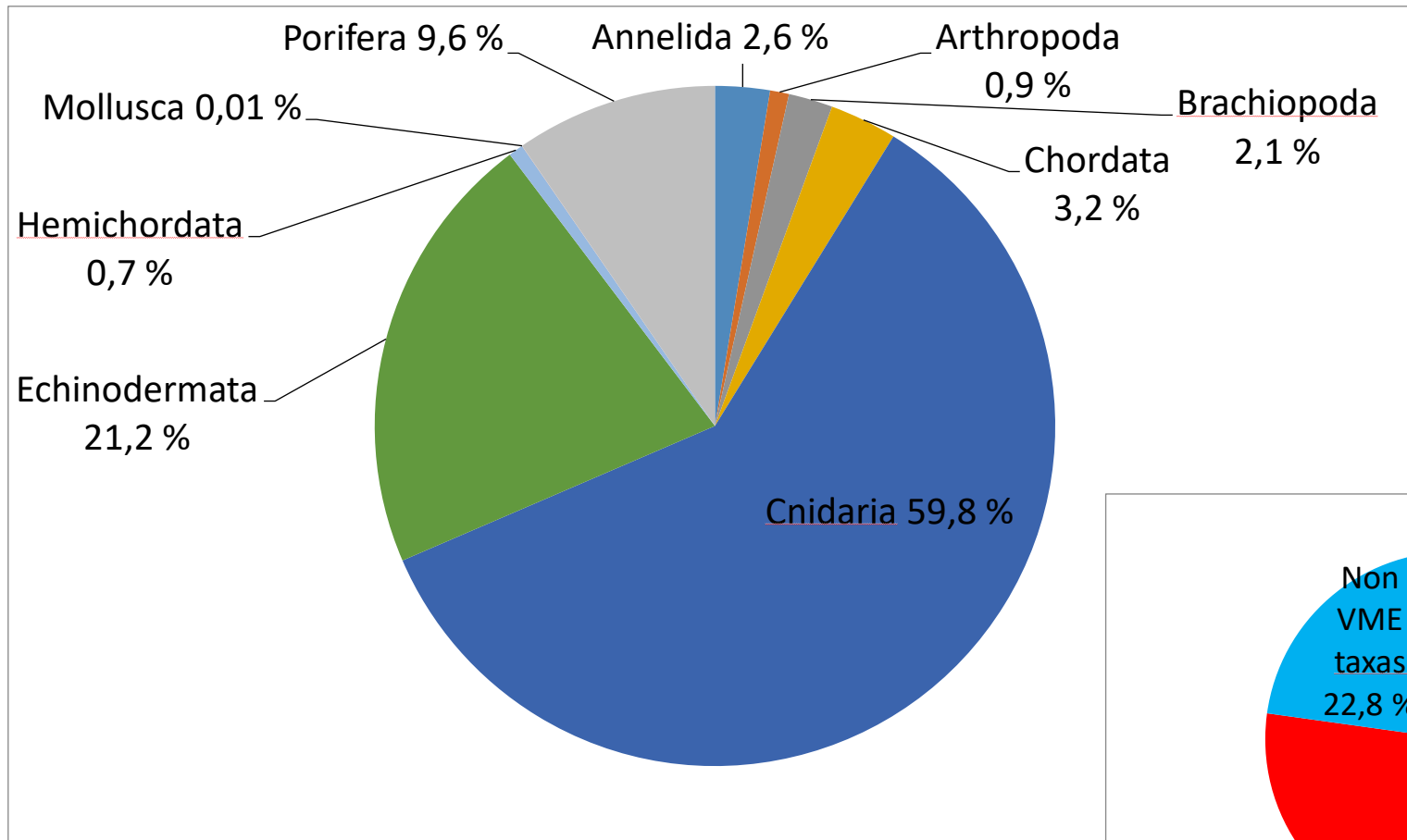
We used multivariate analysis with PCA and clustering applied on KAI matrix

We obtained 7 clusters, as a first result for mapping species and taxa assemblages.

## Clusterisation des stations



## Evaluation of taxas proportions in the pictures database based on the number of occurrences per group





An important limit of the approach :

The quality of the taxonomic data is strongly linked to the quality of the pictures.

Interests of the approach :

Little cost to produce raw data : pictures were taken by observers if they had time (secondary protocole).

Medium quality of taxonomic data but **huge amounts of occurrences, allowing statistic** and ecology studies.