

ZOOPLANKTON ABUNDANCE IN THE BAY OF BREST (FRANCE) : TESTING A CAPTURE-MARK-RECAPTURE METHOD.

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INTRODUCTION & OBJECTIVES

Plankton refers to all organisms unable to resist the current: plants (phytoplankton) and animals (zooplankton). The animal fraction includes **copepods**, crustaceans forming **one of the most abundant groups** of marine plankton.

In 2021, a new monitoring was set up in Lanvéoc (Fig. 1) to estimate the **seasonal variations in the composition of the zooplanktonic communities** in the bay of Brest, an area that has only known occasional studies on this subject. As zooplankton communities are composed of many taxa, often very abundant, the **exhaustive enumeration of a sample is often impossible**.

In this context, this study focused on the evaluation of the applicability of a **Capture-Mark-Recapture (CMR) method** to estimate the relative abundance of different taxa. Another objective was to **set up a temporal monitoring** of the zooplanktonic communities in the bay of Brest.

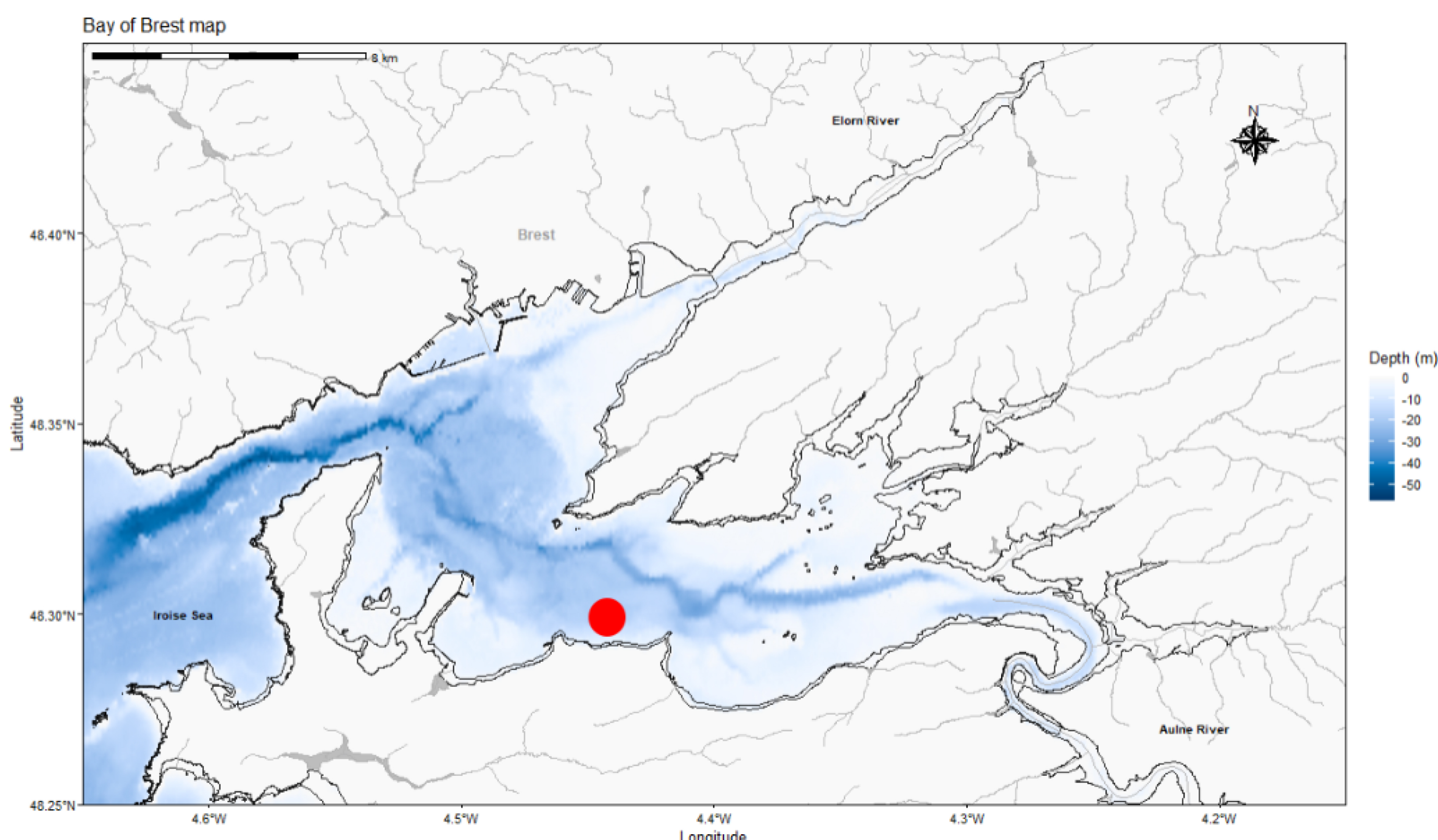


Figure 1: Map of the study area showing sampling location (red dot), produced using R software.

RESULTS & DISCUSSION

1) Validation of the method

The counting result of a sample confronted with the estimation using a **non-parametric Wilcoxon test**:

- **Non-significantly** different for the **abundant groups** (Tab. 1), with an <40% error.
- Error margins **varies a lot** for groups with **low abundances**, ranging from 0 to 140%.

The method is **not robust for the enumeration of rare taxa**, often absent from the recaptures, biasing the estimates. **Groupings** were then made, allowing to obtain stronger results for these rare taxa.

Taxa	Estimation (Ni)	Confidence interval	Count (N)
Copepods	3247	387	3230
Chaetognaths	9.5	3.8	19

Table 1: Comparison of the results, in number of individuals, of an abundant group (Copepods) and a group showing low abundances (Chaetognaths) from the totally counted sample.

2) Zooplanktonic abundances

Two peaks of total zooplankton abundance were observed, with **similar phenologies** between Lanvéoc and what is found in the literature, in Plymouth.

It appears that the **March peak** was mostly due to the abundance of **cirripedia nauplii**, which is supported by the literature since from March to April off Plymouth these larvae can represent **up to 42.5% of the total community**, following blooms.

The **September peak** corresponded mainly to **copepods**. The latter are present almost all year round and **dominate the majority of the year**, which is in agreement with the literature.

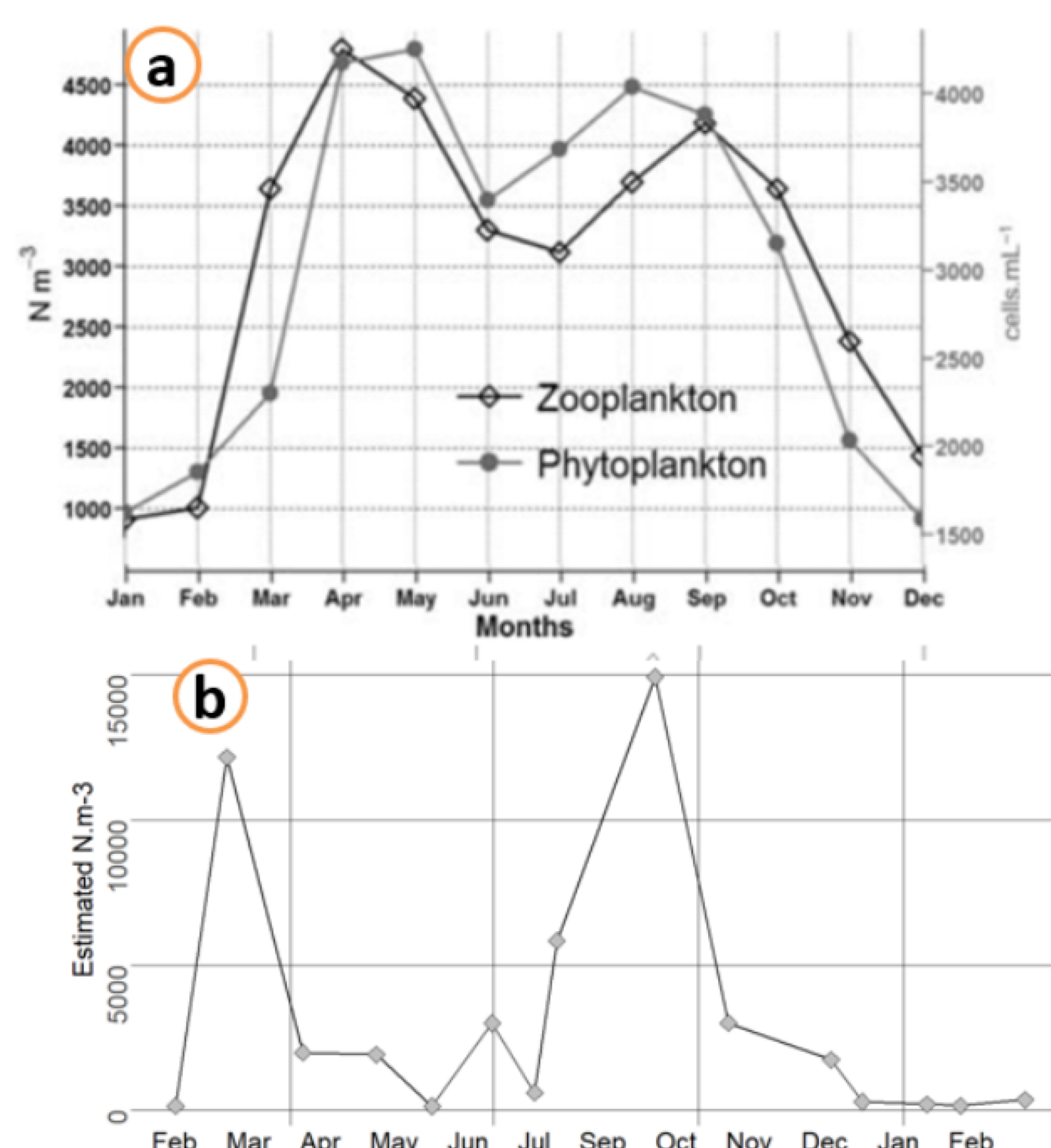


Figure 4: Variations in abundance of total zooplankton in (a) Plymouth for the period 1988-2007 (Eloire *et al.*, Journal of plankton research 2010) and (b) Lanvéoc during the study year (2021-2022).

METHODS

Samples are collected **every two weeks using a Bongo net** with a mesh size of 200 μm , which is equipped with a flowmeter and towed at the back of the vessel "Albert Lucas". Back to the laboratory, it is **fixed in 96° alcohol and preserved in 70% alcohol**.

It is then treated by a **CMR approach**, which, to our knowledge, has never been used to treat fixed zooplankton samples. The objective is to better **estimate the relative abundance N** of different taxa when an exhaustive enumeration is not possible (Fig. 2).

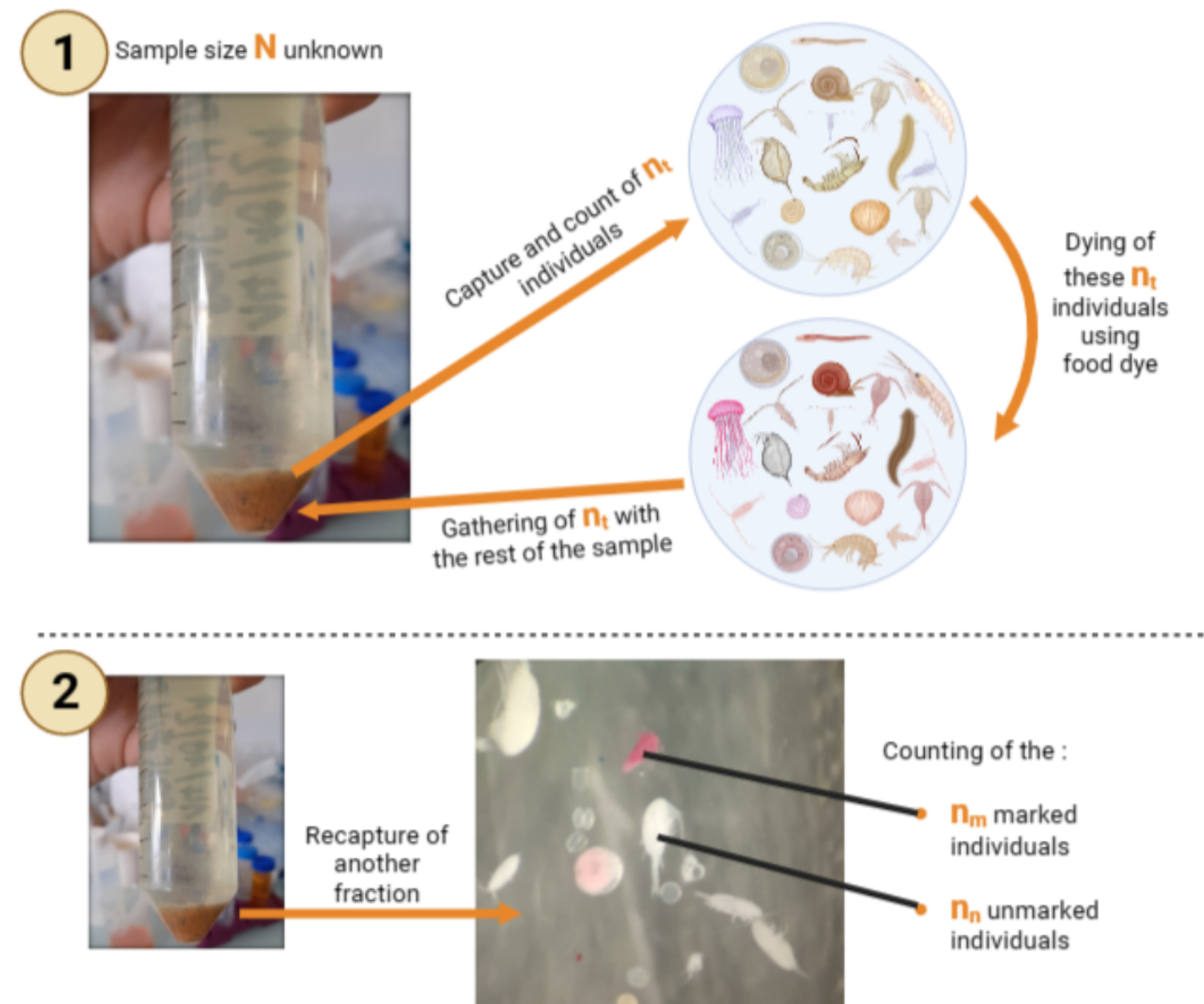


Figure 2: Overview of the CMR method used to estimate the abundances of the zooplankton taxa, made using biorender website.

The proportion of individuals **marked at the start** (n_t/N) is assumed to be equal to that of **marked and recaptured individuals** (n_m/n_m+n_n). The application of the **Lincoln-Petersen formula** (Fig. 3) thus allows to obtain estimates of the abundance of taxa (N_i). These estimates are corrected using the **unbiased Chapman estimator**. The results were then converted back to a **density** (number of organisms per m^3). To **validate** this method, a whole sample was counted and the **result compared with the estimation** obtained by the CMR method.

$$\hat{N}^i = \frac{n_t + 1 * (n_n + n_m + 1)}{n_m + 1} - 1$$

Figure 3: Lincoln-Petersen formula, combined with unbiased Chapman estimator, used to estimate the abundances.

CONCLUSION & PERSPECTIVES

This study **tested the applicability of a Capture-Mark-Recapture method to the study of zooplankton samples**. This work was a preliminary study of the seasonal variability of the taxonomic richness and abundance of zooplankton in the bay of Brest.

This temporal monitoring is continued with bi-monthly samples. Some improvements started since, such as the **acquisition of a vertical net** adapted to the sampling flowmeter. Moreover, the **recapture effort after marking was increased** for the continuation of the study, thus reducing the error margins on the density estimate.

REFERENCES

Eloire D., Somerfield P. J., Conway D. V. P. *et al.*, 2010. Temporal variability and community composition of zooplankton at Station L4 in the Western Channel: twenty years of sampling. J. Plankton Res. 32: 657-679.

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