An integrated approach to characterize the canopy forming macroalgae of *Gelidium corneum* (Hudson) J.V.Lamouroux, 1813 on the French rocky Basque coast in 2022

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Introduction

The Basque coast in the Bay of Biscay offers particularly favorable ecological conditions for the development of the foundation species *Gelidium corneum*. This canopy-forming macroalgae is of a major importance functional value in maintaining the biodiversity of coastal communities, building large and productive biogenic habitats. In addition, this species constitutes an important economic resource. It is exploited for its biochemical properties (extraction of agar and new active molecules, particularly for cosmetics manufacture).

If a decline of the canopy-forming macroalgae of *Gelidium corneum* has been largely documented along the Basque coast of northern Spain in recent decades (Muguerza et al., 2022), very few studies have been done on the French part of the coast.

For the first time, from June to July 2022, a study of the characterisation, distribution, biochemichal properties and fisheries landings of the Gelidium resource was carried out on the French Basque coast.

Materials and methods

Characterizing Gelidium fields by diving and underwater imaging

- 2 divers , 15 transects, 2 depths : shallow (-3 m) and deep (-8 m) → **proxy for light**
- **5 random quadrats** for each transect and depth (149 quadrats, 1820 measurement of Gelidium feet)
- Descriptors : Frond **yellowing**, height and **abundance** of plant, percentage **cover**, **biomass**

- Underwater drone (Chasing M2)
- 10 transects, 20 videos, 648 pictures
- Descriptors: **Yellowing**, percentage **cover** of the **bottom types and *Gelidium sp*.**

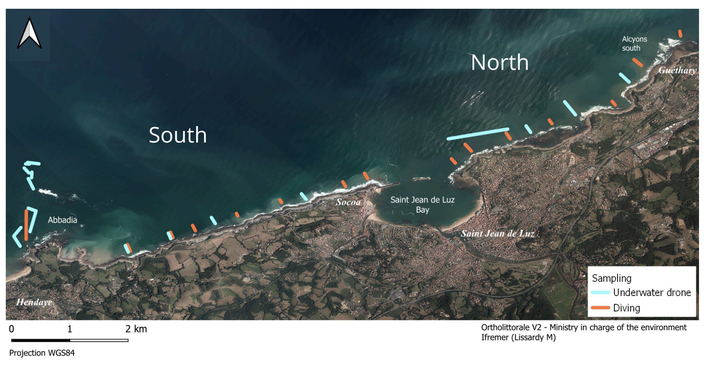


Figure 1: Sampling survey along the Basque coast in 2022.

Fisheries landings

- Bibliography and compilation of available statistics

Assessing Gelidium quality using a biochemical approach

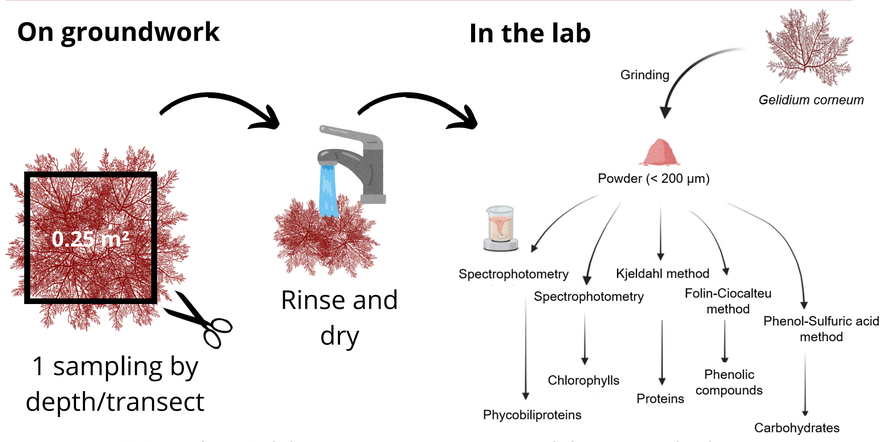


Figure 2: Sampling, *Gelidium corneum* extraction and dosage methods

Results

Ecological quality

	Total area	South	North	-3 m	- 8 m
	Mean (Min/Max)	Mean (+/- sd)	Mean (+/-sd)	Mean (+/- sd)	Mean (+/- sd)
Coverage (%)	64,9 (15/87,5)	66,1 (+/-23,4)	63,5 (+/-16,5)	72,9 (+/-16,8)	56,7 (+/-20,8)
Frond yellowing (%)	11,6 (0/50,7)	8,8 (+/-9)	14,9 (+/-10,8)	9,6 (+/-8,2)	13,7 (+/-11,7)
Feet height (cm)	24,4 (10,9/38,6)	24,8 (+/-5,5)	24 (+/-4,8)	23,4 (+/-4,3)	25,4 (+/-5,3)
Biomass (gr/m²) Dry weight	813,6 (140,8 to 1336,4)	882,8 (+/-297,2)	737,2 (+/-299,2)	956 (+/-299,2)	656 (+/-278,8)

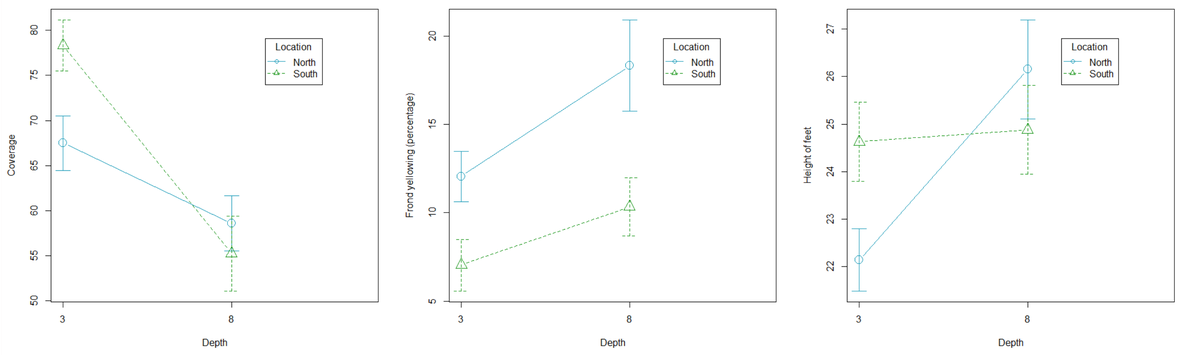


Table 1 & figure 3. Results from biological descriptors of canopy-forming *Gelidium sp*. according to location and bathymetry.

Diving results:

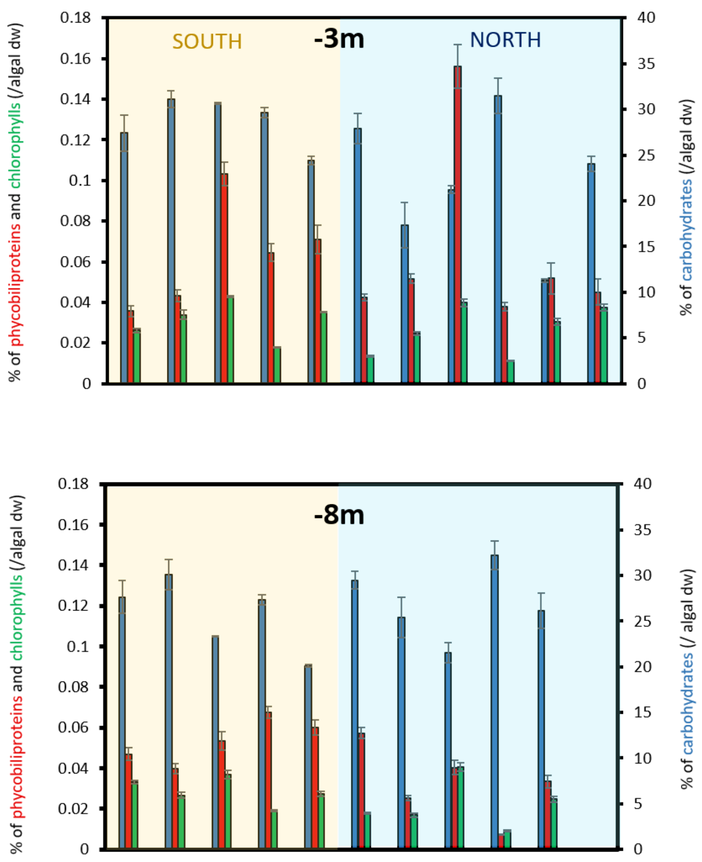
- Mean coverage greater than 65% and significant effect of bathymetry
- Mean yellowing of fronds less than 15% and effect of bathymetry and location (north/south)
- Feet height: effect of bathymetry

Drone results:

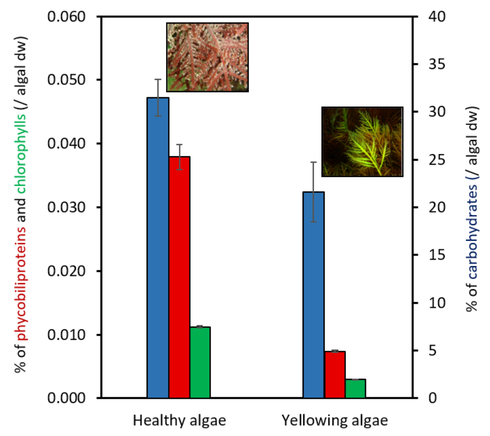
- Non-uniform Gelidium coverage
- Dense fields on rocky ridges and flysch substratum but sandy areas devoid of Gelidium
- Other algae attached to sandy rocks

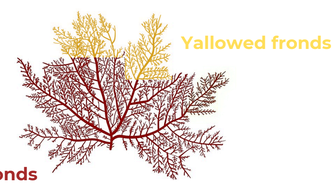
Biochemical composition

Impact of the distribution (location and bathymetry)



Impact of the yellowing





- Significant impact of yellowing on the concentrations of phycobiliproteins, chlorophylls and carbohydrates
- No significant influence of the bathymetry and location (north/south) on the biochemical composition

Figures 4 & 5: Effect of the location/bathymetry and of the yellowing on the biochemical composition of *Gelidium sp.*

Discussion & conclusion

- In the absence of similar previous data, it is not possible to discuss stock trends on the French part of the coast.
- **Underwater drone** is usefull to vizualise and monitor the **spatial coverage** of the Gelidium canopy (Bajjouk et al., 2019 ; Dulenin et al., 2022).
- Gelidium morphological differences in rocky shores could be explained by a sandier bottom in the North and a low variability in yellowing (<10%) may not be ecologically relevant.
- **Biochemical characteristics** of Gelidium are **homogeneous** across the Basque coast, however a **degradation** is observed on the **yellowish fronds**. Many environmental factors and pressure may be involved, but **temperature and irradiance** are considered as the relevant factors (Diez et al., 2012 ; Quintano et al, 2017).
- High demand from Spanish manufacturers (better stock and condition of the canopy of the northern Basque coast). Natural stock assessment of Gelidium can not be correlated to harvest wreck algae by fishing activity (exploitation depends on sea conditions).
- In a context of **stressful conditions**, this study shows the importance to **continue this monitoring** as well as the assessment of the global change impact which could cause a degradation of the biochemical properties of the algarophyte but also the decline of its exploitation.

Socio-economic characteristics

- Fishing authorized from September 15 to May 31, Monday to Friday, from 7 a.m. to 6 p.m. including in the 3 MN zone.
- In 2022-2023, **12 licenses** (out of 20 possible) but 6 ships do most of the harvest (wreck algae).
- Decrease of economic resources context since several years (CIDPMEM, 2023): In 2022-2023, the price has been set at **€0.47/kg** (wet weight). High economic losses since 2019-2020 (2009 t for k€ 1,058), 898 t in 2022-2023 for k€ 498 in turnover).

References: Diez et al., 2012: DOI: 10.1016/j.ecss.2011.12.027; Dulenin et al., 2022: DOI: 10.26428/1606-9919-2022-202-450-465; Muguerza et al., 2022: DOI:10.1007/s12526-022-01268-2; Quintano et al, 2017: https://doi.org/10.1016/j.seares.2017.02.008

To read more: de Casamajor MN., Sanchez F., Lissardy M., Marmion L., Caill-Milly N., Soulier L., de Matos Fernandes S., Adrien A., Guillaume E., Lalanne Y., Antajan E., Perriere-Rumebe M. (2023). Gelidium 64 - Caractérisation des champs de Gelidium à l'échelle de la côte basque en 2022. R.ODE/LITTORAL/LERAR/ 23-019. 70p. (DOI : 10.13155/98254)

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