

Journée thématique sur les sargasses – Paris, 19 juin 2023



Study of holopelagic SArgassum responsible of massive beachings:
Valorization & Ecology on Caribbean coasts

Valérie STIGER-POUVREAU

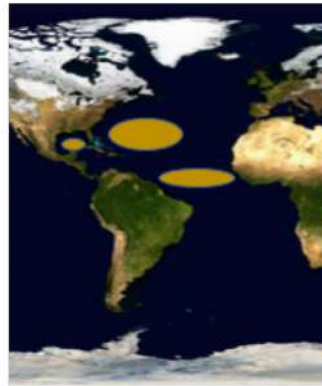
LEMAR UMR 6539 – IUEM-UBO (Brest)



Consortium : 14 partenaires



7 partners:
Caribbean areas



7 partners:
Metropolitan France



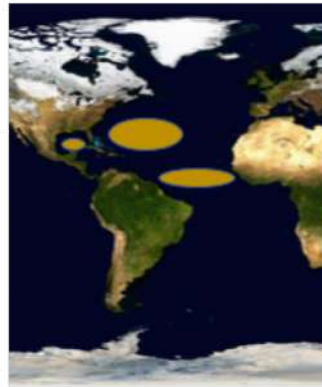
LEMAR-IUEM-UBO, Wikipedia, LEMAR-IUEM-UBO



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3 partenaires industriels
11 partenaires académiques

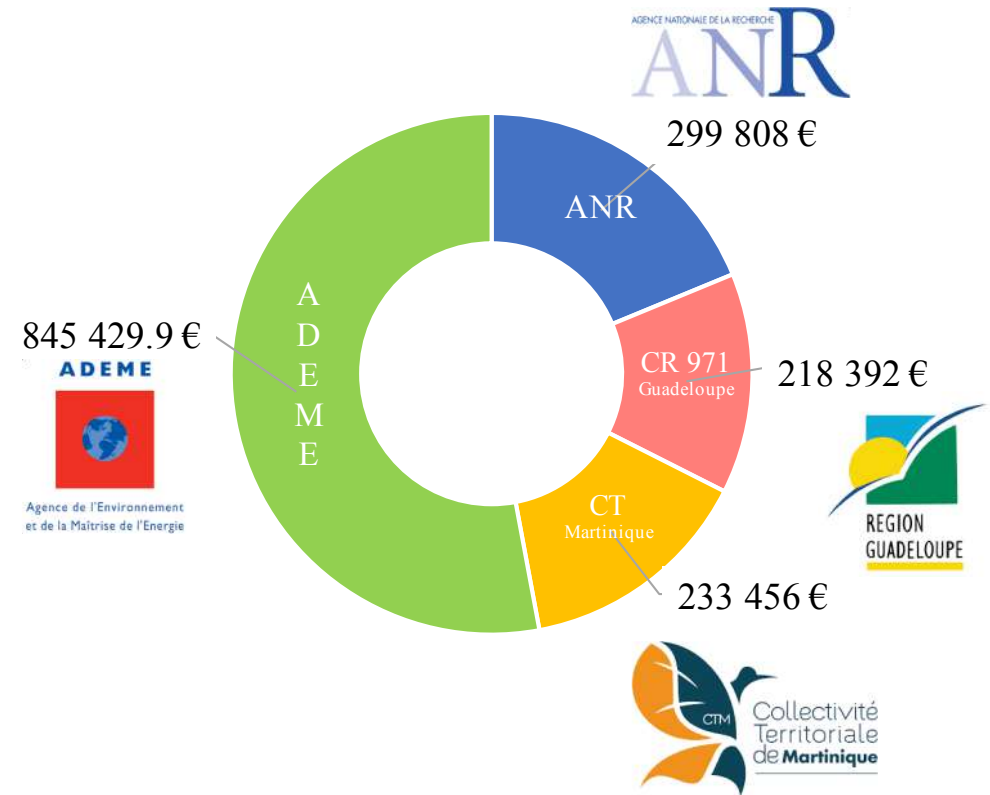
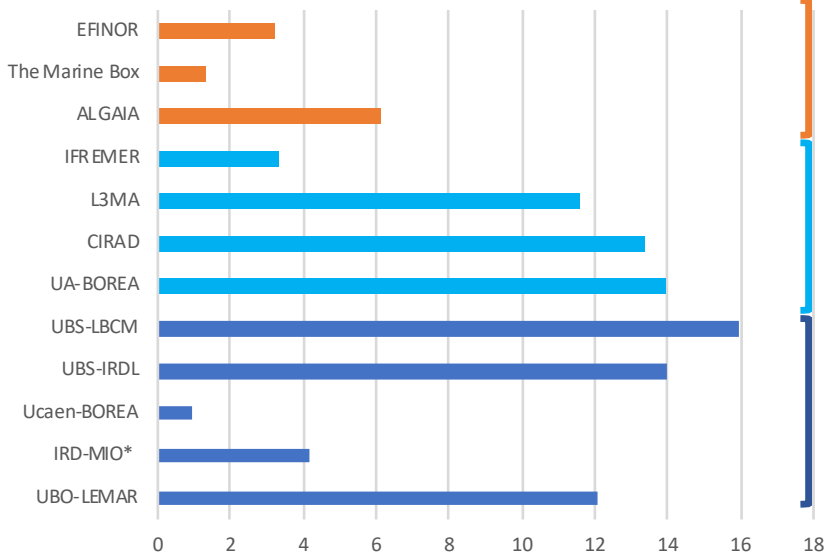
2 partenaires sur fonds propres
(CINVESTAV + UWI)

LEMAR-IUEM-UBO, Wikipedia, LEMAR-IUEM-UBO



Budget total obtenu : 1 567 100 €

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CINVESTAV + UWI → sur fonds propres

Main Objectives



1. The *Sargassum* raft is a remarkable and poorly known habitat

- to bring knowledge on which organisms live with *Sargassum* and how this diversity varies with time and space, how this diversity interact within raft ecosystem (**WP1,WP2**)
- The quality of the biomass to valorize depending of the physiology of *Sargassum*: what is its biochemical composition? Which environmental parameters influence the capacity of the alga to stay and develop rafts and mostly, to concentrate arsenic along rafting? (**WP3**)



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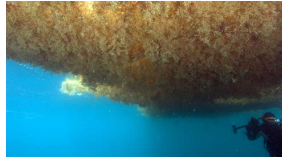


2. *Sargassum* rafts represent a biomass to be valorised

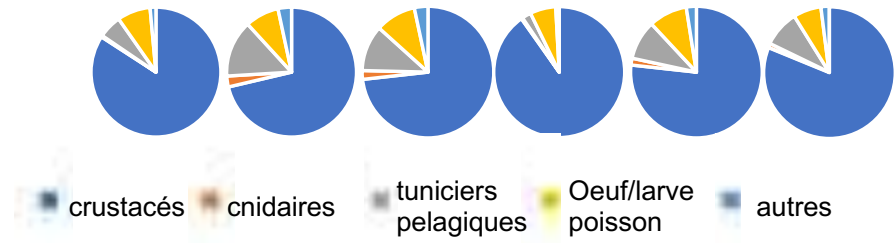
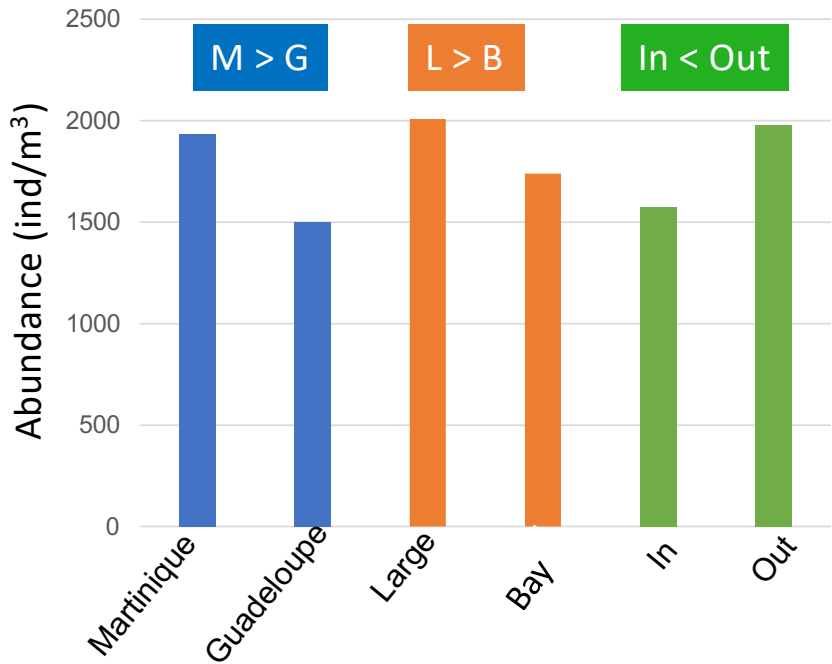
- How to collect and stabilize this biomass which degrades very quickly and is enriched with arsenic (**WP4**)
- How to find a value from this huge biomass of *Sargassum*? Two sectors are prospected with an innovative biorefinery model: agriculture and biomaterials (**WP5**)



Main Results WP1



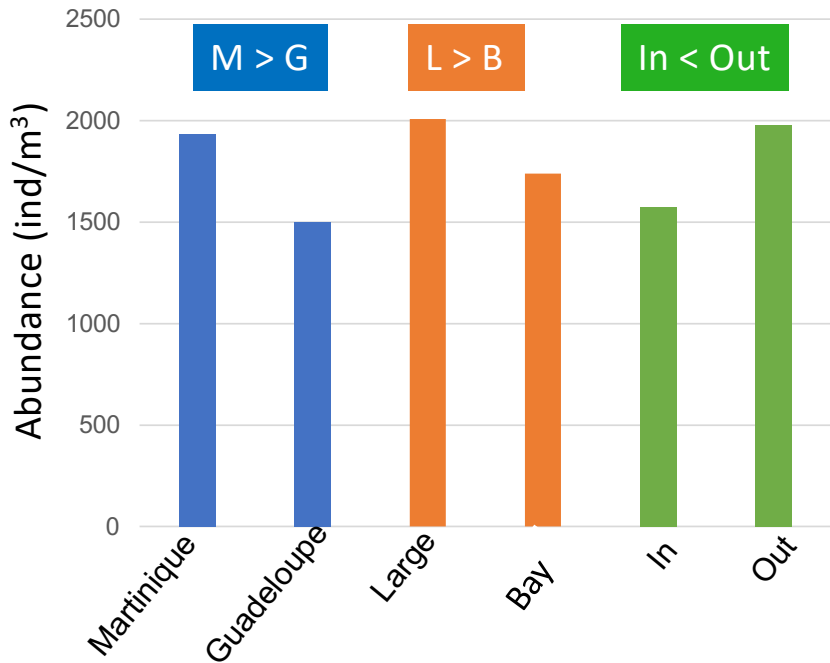
Zooplankton community



Main Results WP1



Zooplankton community



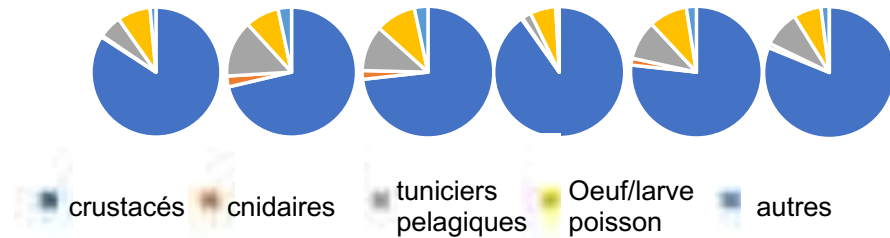
• Total abundance:

➔ Need to deepen the differences observed

• Community largely dominated by crustaceans (blue)

• Pelagic tunicates (grey) and fish eggs/larvae (yellow):

➔ second in terms of proportion

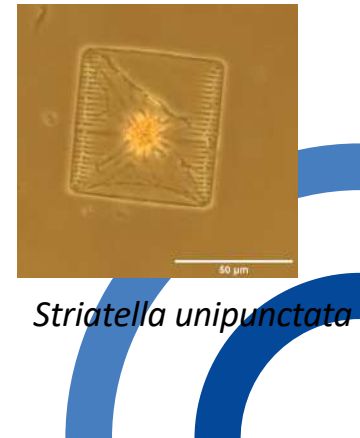
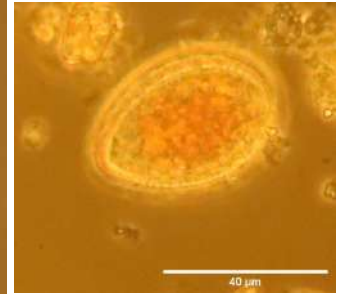
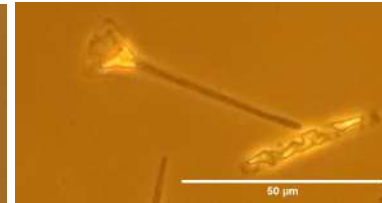
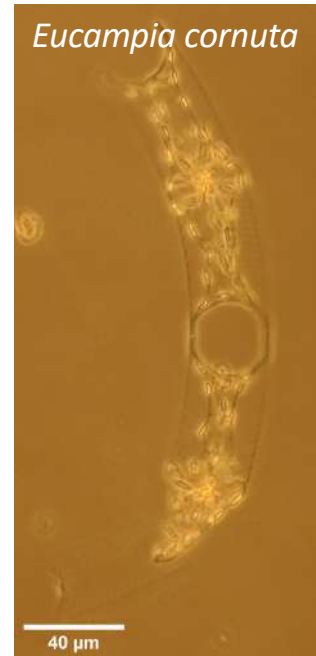
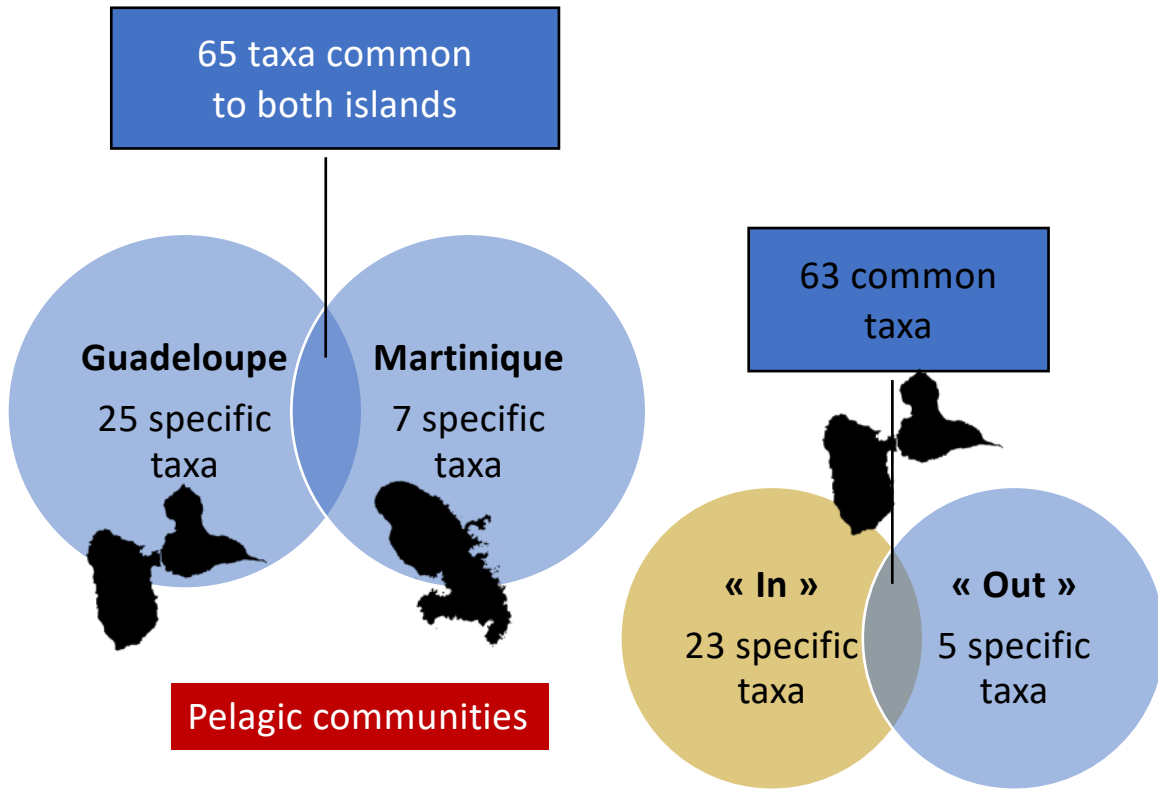


Main Results WP1



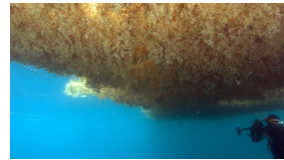
Phytoplankton community

M < G L > B In > Out



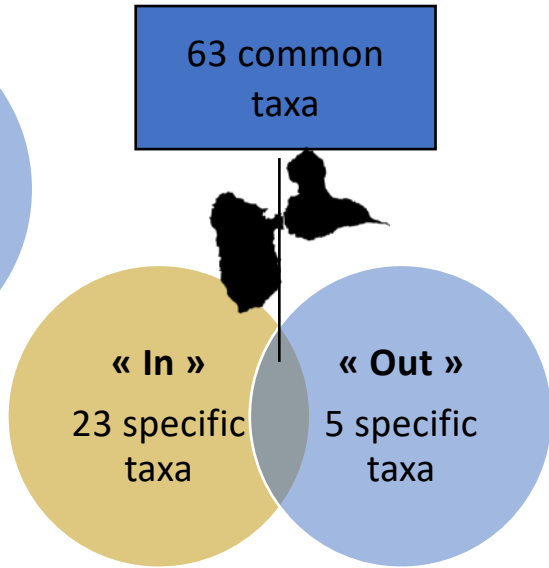
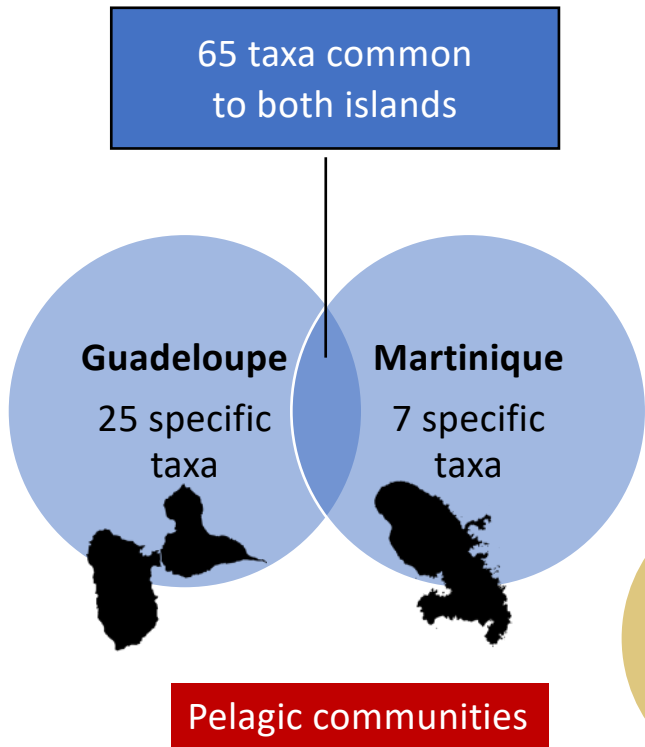
Raft specific taxa

Main Results WP1

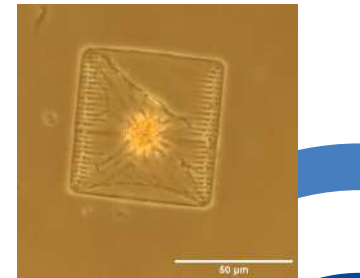
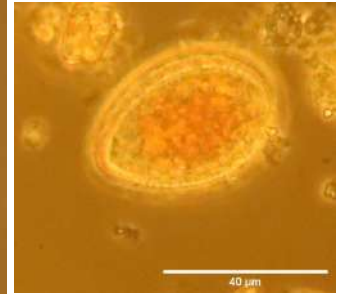
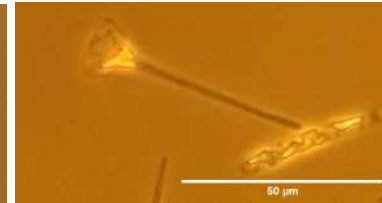
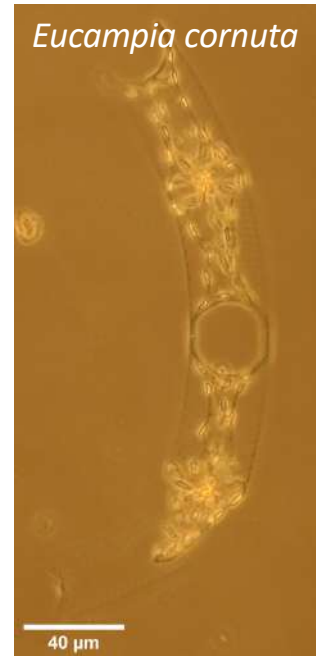


Phytoplankton community

M < G L > B In > Out

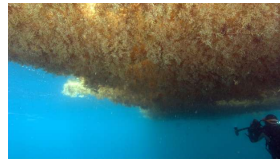


- **Total abundance:**
 - ➔ Need to deepen the differences observed
 - Pelagic community largely dominated by Diatoms & Chlorophyceae
 - Epiphytic community dominated by Diatoms & Dinoflagellates



Raft specific taxa

Main Results WP2



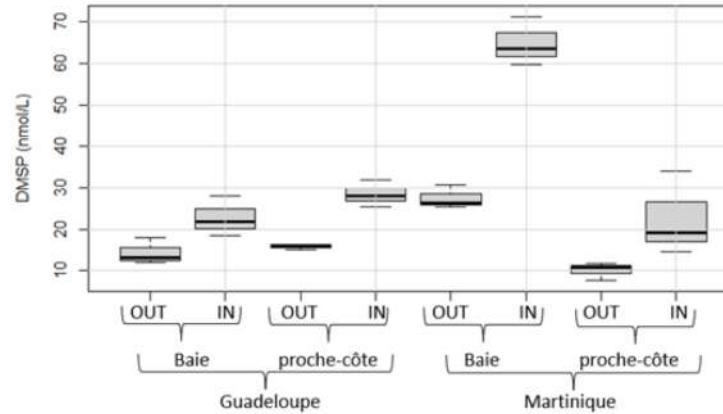
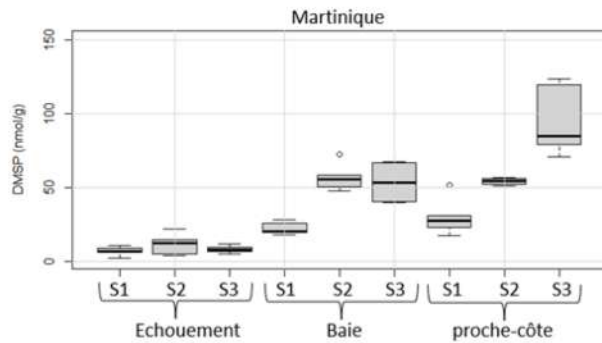
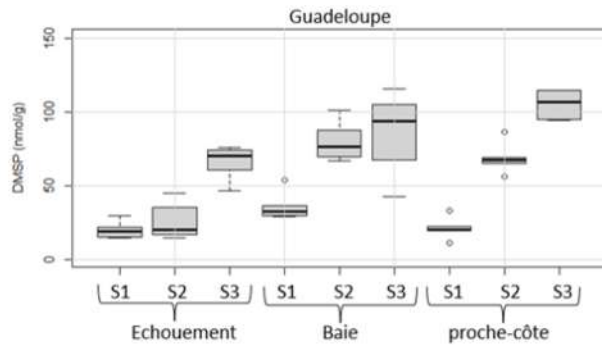
Chemical ecology of *Sargassum*: example of the DMSP contents

M < G

L > B

In < Out

DMSP contents are different:
S. fluitans III > *S. natans* I >> *S. natans* VIII



DMSP concentrations in seawater collected within the rafts are ~2- fold higher than outside the rafts

DMSP variations:
 Antioxidant? Defense mechanism? Chemoattractant?
 To be further investigated: pigments, phenolic compounds, planktonic community...

UBO
 Université de Bretagne Occidentale

LEMAR



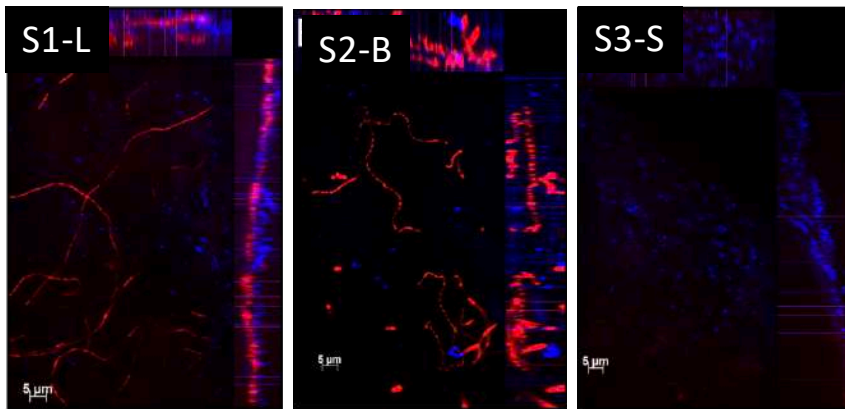
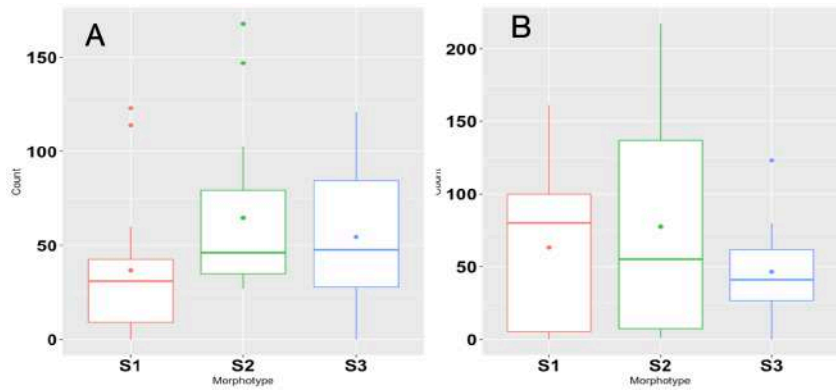
Main Results WP2



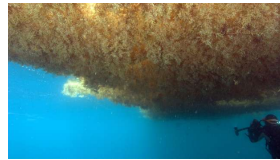
Microbiota associated to *Sargassum*: example of bacteria

Microscopic approach

Bacterial enumeration on fronds and floats



Main Results WP2

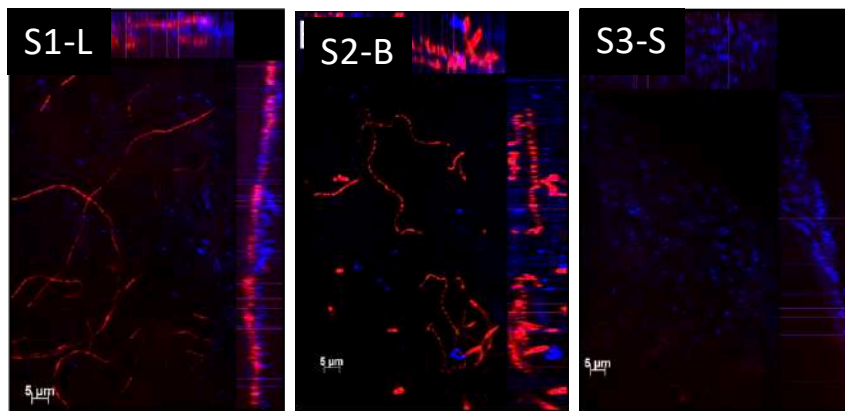
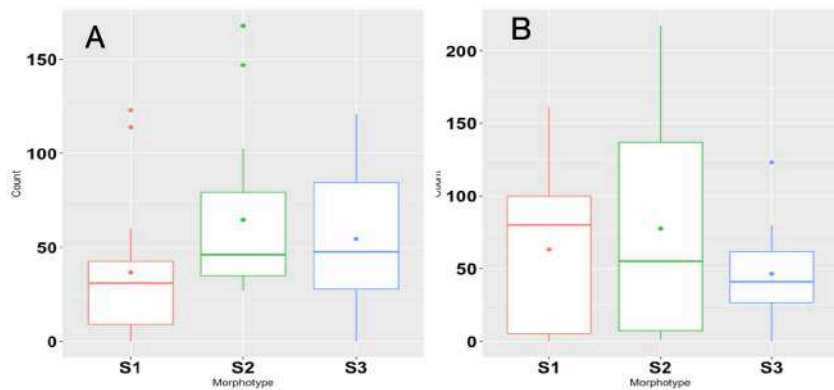


Microbiota associated to *Sargassum*: example of bacteria



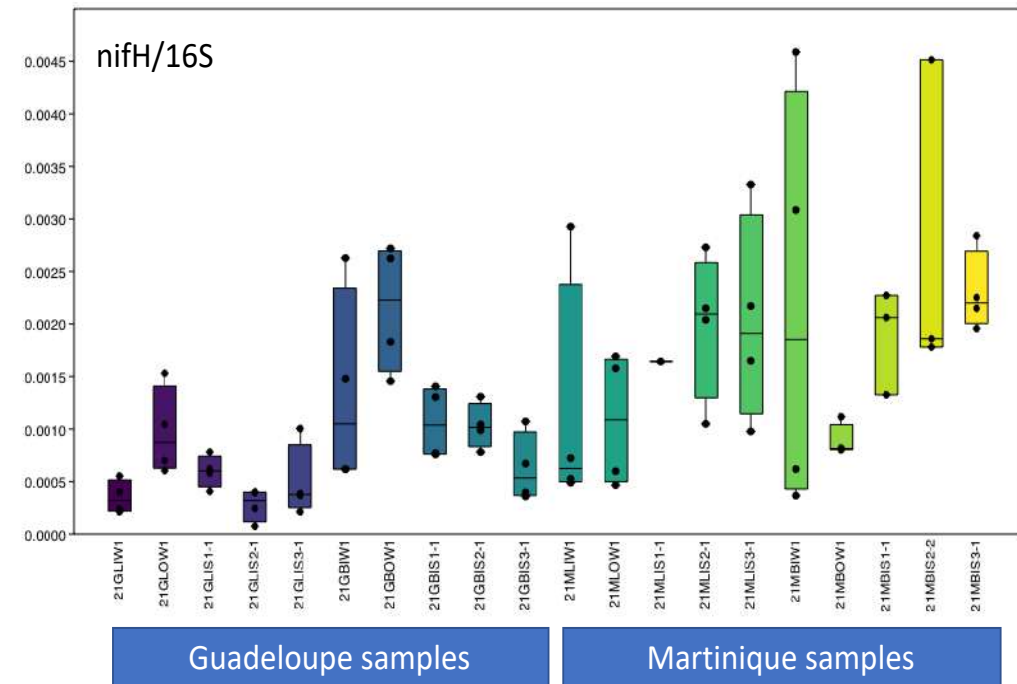
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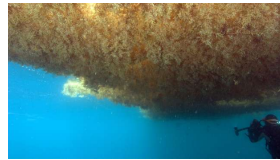


Molecular approach

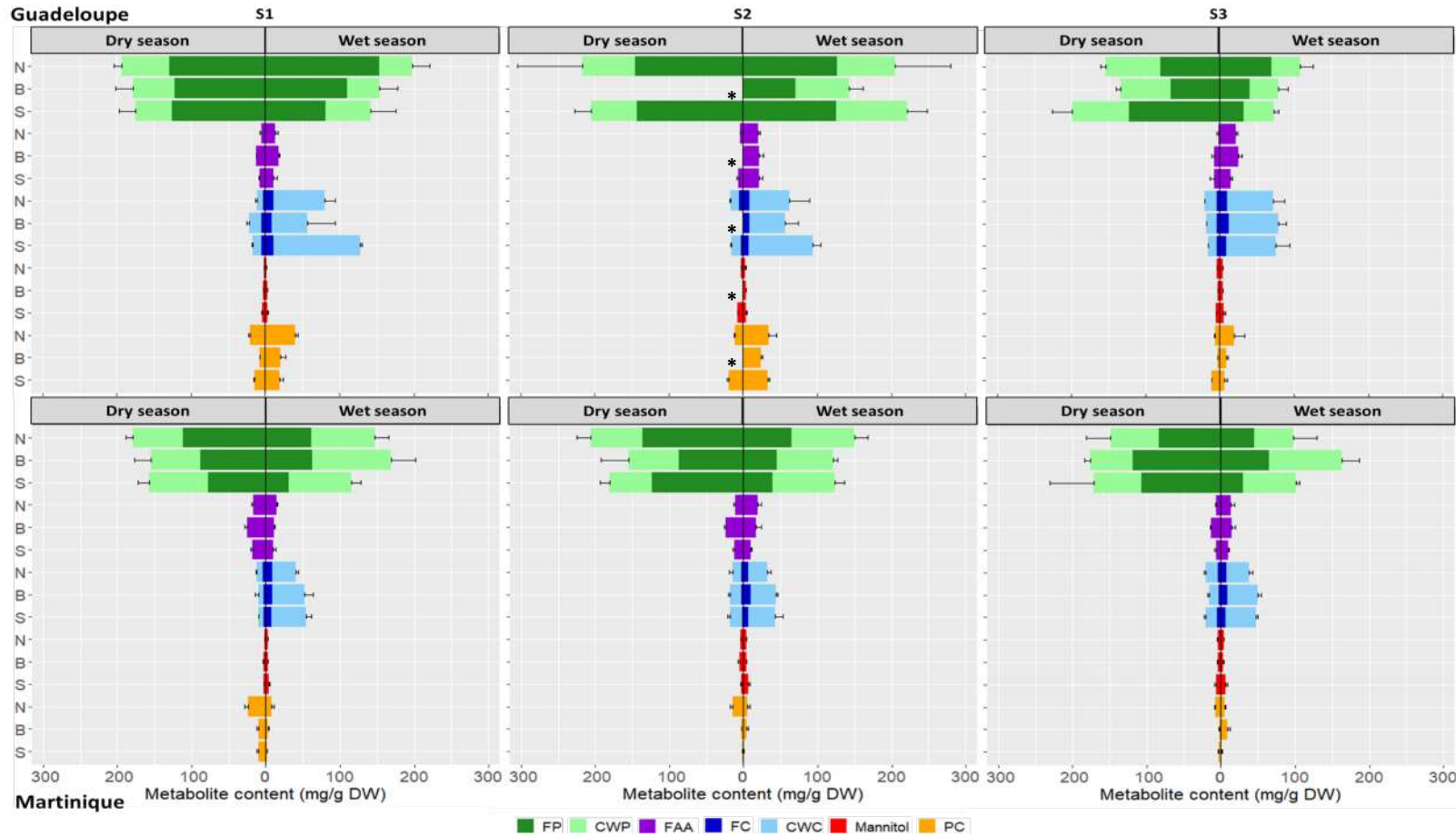
Quantification of different genes using qPCR targeting *nosZ* for denitrifying bacteria, *amoA* (Bacterial and Archeal) for nitrifiers, *nifH* for diazotroph (N_2 fixation)



Main Results WP3



Ecophysiology of *Sargassum*: variability with time and space of the biochemical composition

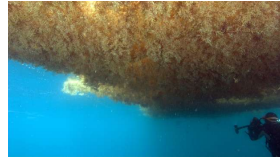


Understand the biochemical degradation of *Sargassum*:

- physiology
- valorization

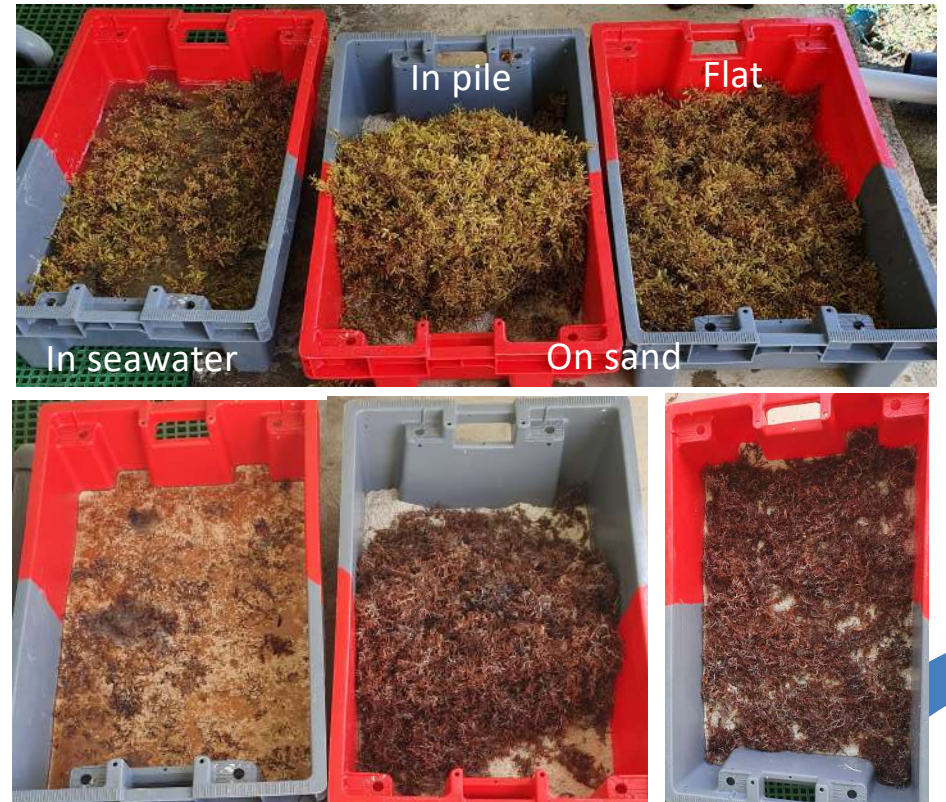


Main Results WP3



Ecophysiology of *Sargassum*: variability with time of SRM (*Sulfate Reducing Microorganisms*)

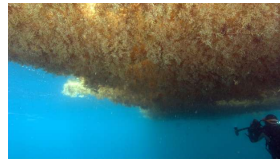
Shape of the stranded *Sargassum* : flat on sand (Plat) or in pile (Tas) on the surface of the pile or inside (Tas Ext or Tas int)



T1

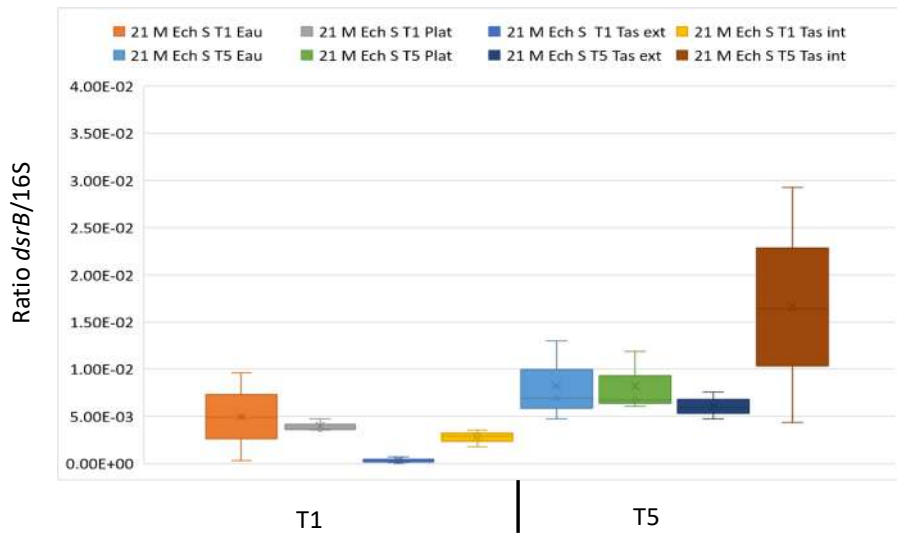
T5

Main Results WP3



Ecophysiology of *Sargassum*: variability with time of SRM (*Sulfate Reducing Microorganisms*)

Shape of the stranded *Sargassum* : flat on sand (Plat) or in pile (Tas) on the surface of the pile or inside (Tas Ext or Tas int)



The proportion of SRM increases in all *Sargassum* samples collected at T5 compared to T1, whatever the shape of the biomass

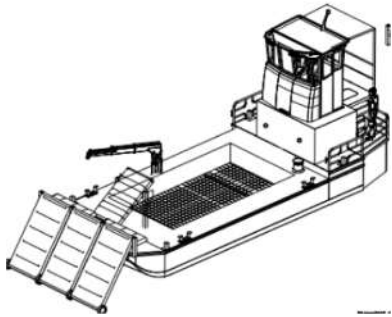
Increase related to the degradation of the *Sargassum* stranded on the beach

Main Results WP4



Valorization requires a good *Sargassum* collection strategy

Collection vessel in coastal waters



- Boat capable of collecting and preserving seaweed from degradation for recovery
- Critical path: transfer to land => efficient transfer means so as not to break the collection flow
- Storage of floating algae - continuous transfer during collection

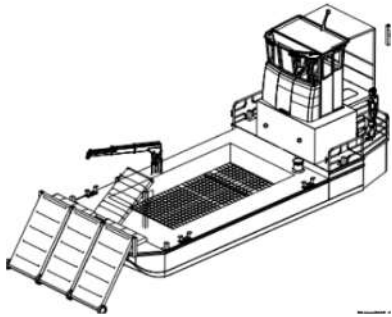


Main Results WP4



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Offshore collection vessel



- Boat capable of collecting in all sea conditions and capable of preserving the algae from degradation.
- Dynamic and continuous collection according to the currents
- Possibility of storing 45 tons of seaweed during collection => seaweed is pressed and compressed into 1m³ bales

1 le portail des Outre-mer

guadeloupe guyane martinique mayotte nouvelle-calédonie

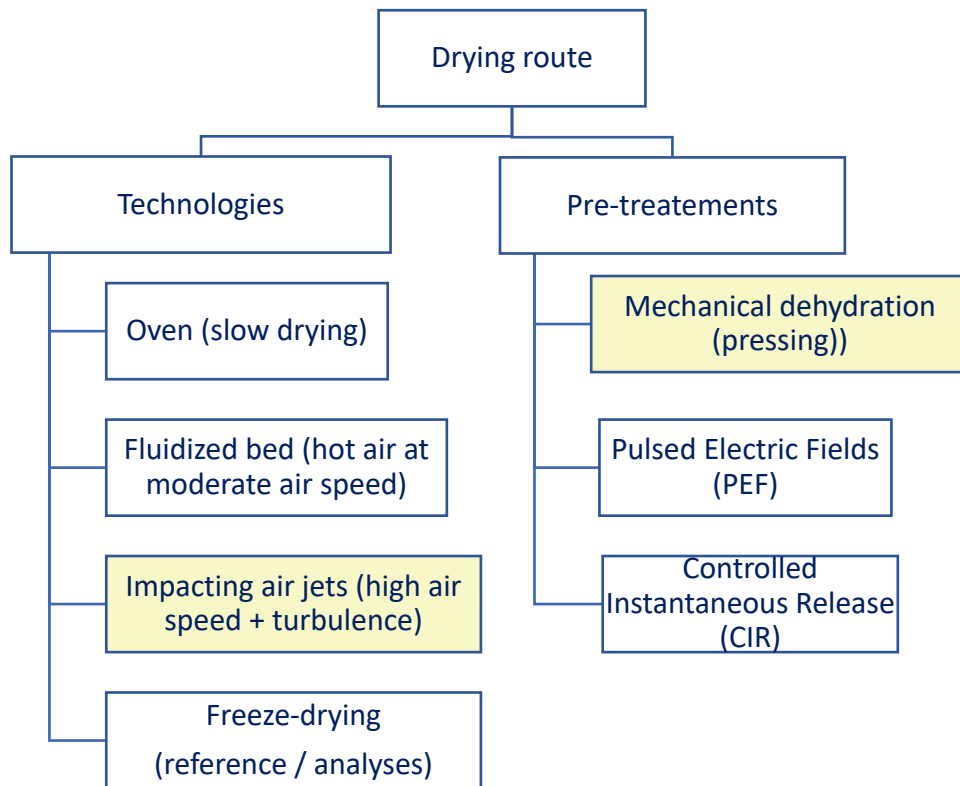
Antilles : une entreprise bretonne propose de décharger les sargasses depuis la mer

Realization of the plans of boat → possibility of construction for the Antilles)

Main Results WP4



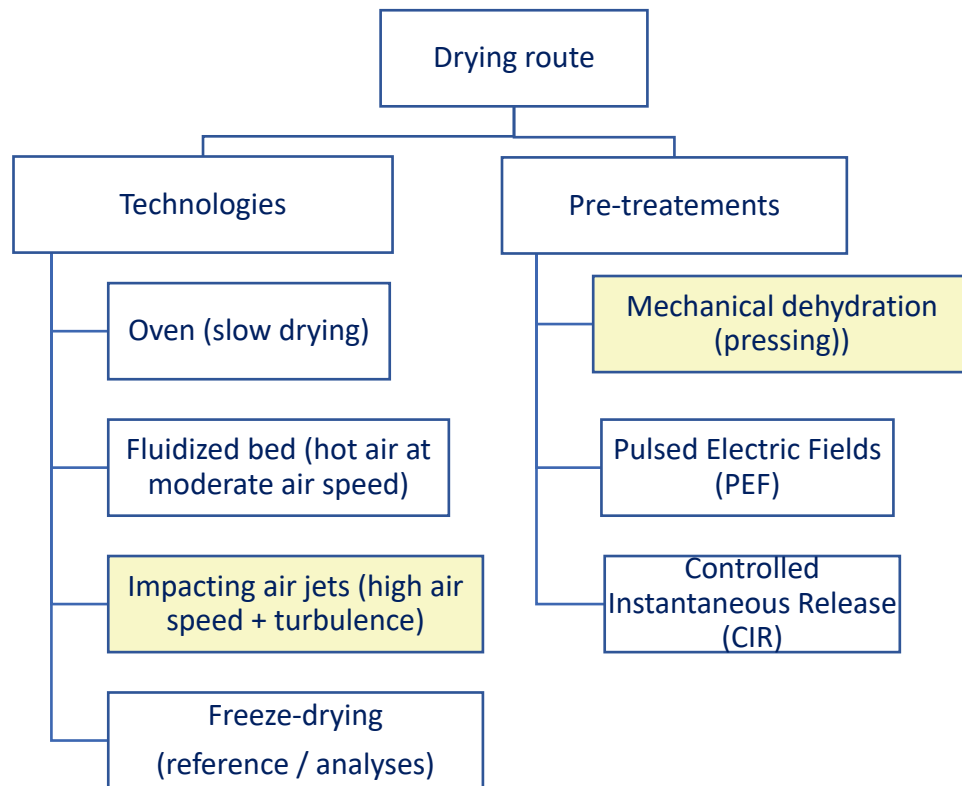
Valorization requires a good conservation of the biomass *Sargassum*



Main Results WP4



Valorization requires a good conservation of the biomass *Sargassum*



Pre-treatment:

Dehydration by mechanical pressing is highly recommended:

➔ Up to 50% of the water content can be removed very quickly



Technologies:

The rapid air jet drying technology is validated:

- For all species
- Thin layer or thick layer (4-5 cm) drying
- Little impact on the biochemical composition of the algae



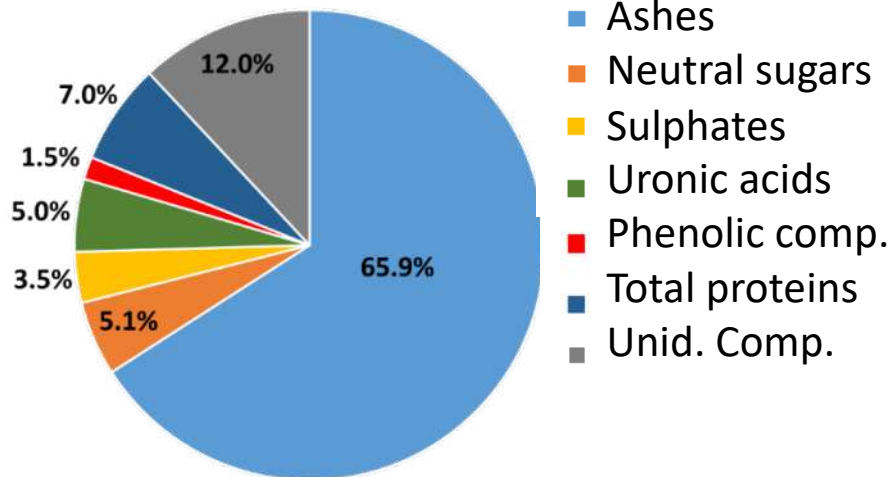
Main Results WP5



Green and sustainable processes for the production of bioactive-enriched extracts

Optimisation of a protocol for the preparation of a liquid biocontrol, adaptable to an in-line "aqueous maceration" pilot demonstrator

Example of extracts generated:



Ultrasound Assisted Extraction (UAE)

➔ **Experimentations in biocontrol:**
on tomatoes against the whitefly *Bemisia tabaci*



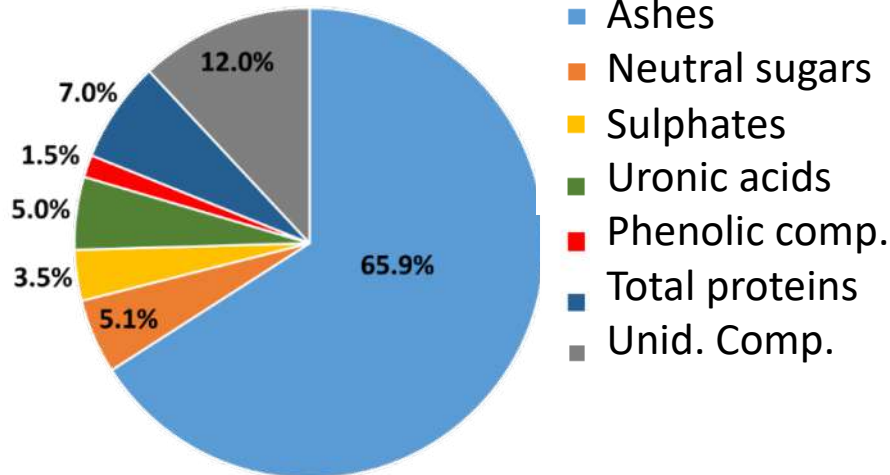
Main Results WP5



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Biocidal effect of *Sargassum* extracts on *B. tabaci*



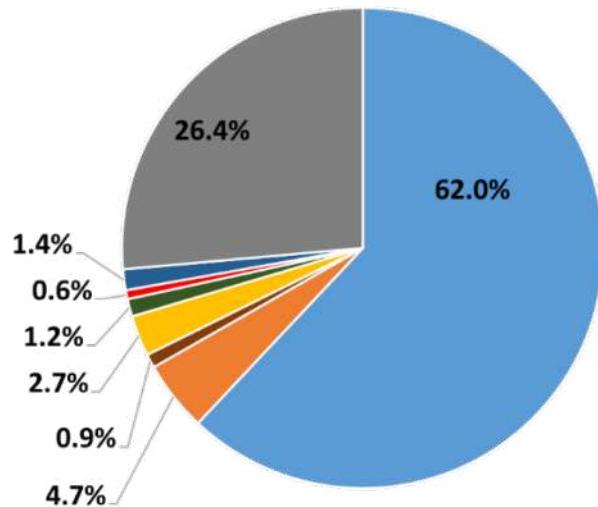
Main Results WP5



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Optimisation of a protocol for the preparation of a liquid biocontrol, adaptable to an in-line "aqueous maceration" pilot demonstrator

Example of extracts generated:



Extrait MS2-70-3 (E4)

➔ Experimentations in biostimulation



- Plant height
- Number of leaves
- Biomass



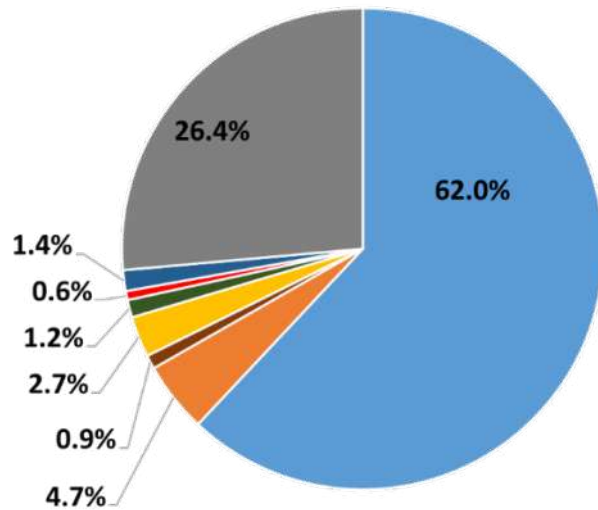
Main Results WP5



Green and sustainable processes for the production of bioactive-enriched extracts

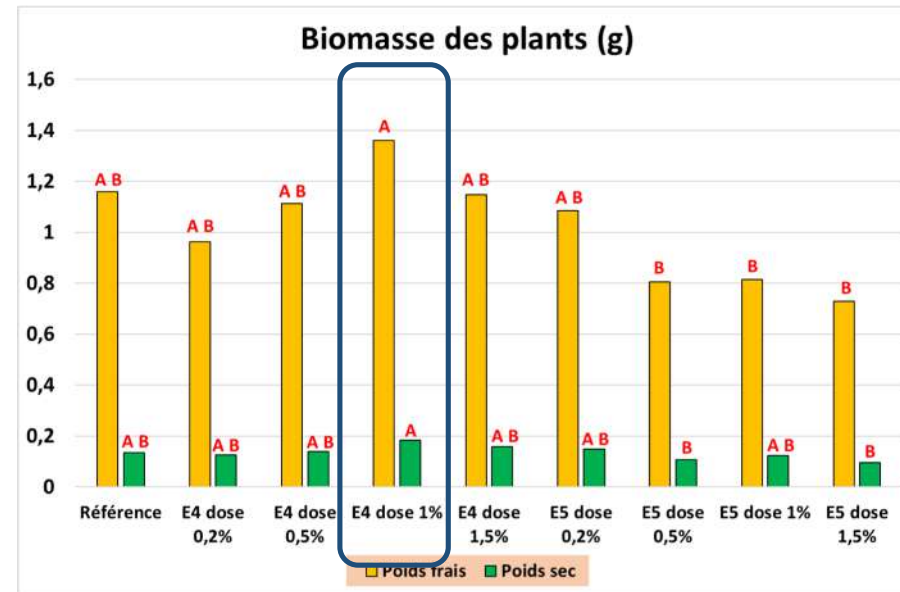
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Example of extracts generated:



Extrait MS2-70-3 (E4)

➔ Experimentations in biostimulation



Extract at a dose of 1% is the most promising biostimulant for plant growth

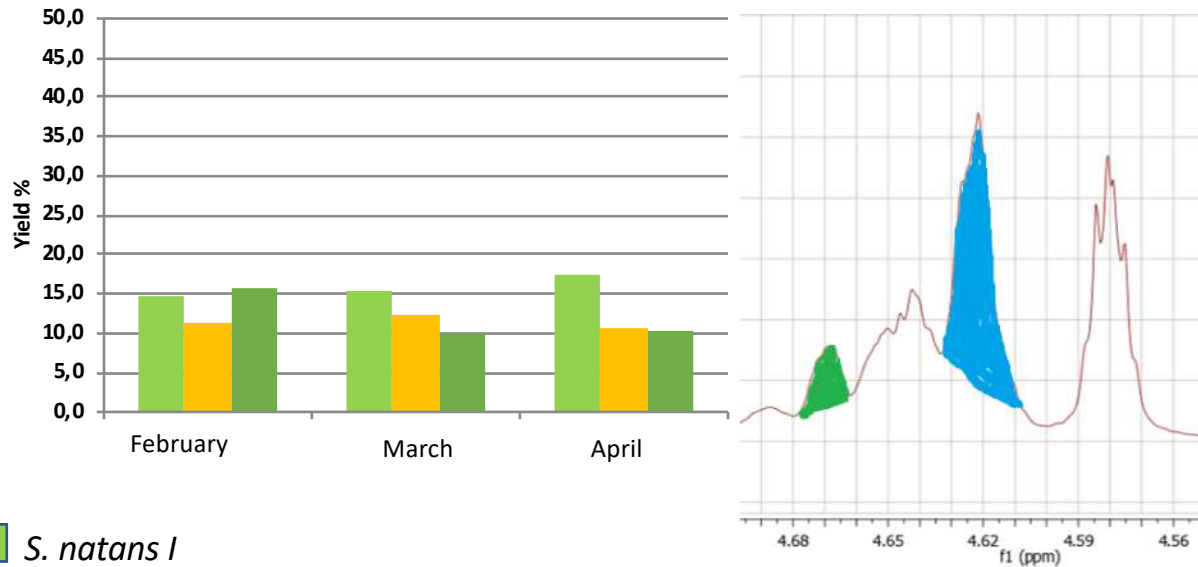


Main Results WP5



Green technologies: Bioactive-enriched extracts for materials design

Example of monthly monitoring of alginate levels



- *S. natans I*
- *S. fluitans III*
- *S. natans VIII*

M/G ratio by FT-IR



TMB to be operational in summer



Planning for the remaining months



May 2022, EFINOR and IRDL actors present their prototypes to the funders

February-April 2023: a PhD student at CINVESTAV to study arsenic in *Sargassum*

In general, all data are acquired or in the process of being acquired
==> data processing



Final meeting in Guadeloupe in December 2023