

Study of the organic matter degradation in Guyana mangroves through the analysis of photosynthetic pigments

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Abstract: In Europe, the European Water Framework Directive enjoin European Union member states to achieve good qualitative and quantitative status of their water bodies by 2015. In that context, France is characterised by several thousands kilometers of coast in oversea territories, which are colonised by mangroves forests. In order to respect this directive and to develop a bio-indicator of the ecological status, a characterisation of sediment organic matter degradation in Guyana mangroves has been performed (trough the use of litter bag experiments composed of Avicenia sp. mangrove leaves). For this project, 3 sampling sites have been characterised : S1 is a pollution impacted station, S2 is an intermediate station and S3 is a reference site. Several parameters have been measured (such as bacterial diversity, environmental parameters, ...). In the present study, we will focus on the photosynthetic pigments composition in the litter bags during the decomposition process. This study shows differences between stations mainly explained by the differential degradation of mangrove leaves. This project is still in progress and it remains additional parameters to study to answer the objectives of the WFD.

The context

Within the context of the European Water Framework Directive (WFD), a study of biological functioning of Guyana mangroves sediments was realized. [1] Several biotic and abiotic parameters were measured. The aim of the present study is to use photosynthetic pigment composition to characterize the organic matter degradation in order to develop a bioindicator of the water pollution.

Materials and Methods

3 sites of coastal mangrove in Guyana have been selected and characterized for this study in 2017 :

- A pollution impacted site (S1) : Crique Fouillée
- An intermediate site (S2) : Confluence -
- A reference site (S3) : Petite Cayenne -







Discussion



The height of the tides (meters) have been measured by a probe every 8 min.

The presence of many degradation pigments on the site S2 can be explained by the height of the tides. This site is submerged 5h more than the other sites. This parameter likely influences the diversity and degradation activities of microbial communities between the stations.



Conclusion

These results show different degradation rates between the sites as show by pheopigment concentrations.

Litter bags are new tools to understand the degradation of organic matter in mangrove sediments. In order to develop a water pollution bioindicator, litter bags seem to be relevant.







20 litter bags of Avicenna sp on each site have been deposited at the sediment surface during 5 (T1), 10 (T2), 20 (T3) and 30 (T4) days.

After extraction and purification, photosynthetic pigments were identified and quantified by High-Performance Liquid Chromatography (HPLC) using the Brotas & Plante-Cuny method [2].





For each sample, two

chromatograms are obtained :

- one at 470nm : Chlorophyll-b, Chlorophyll-c and Carotenoids (Carotenes and
- Xanthophylls)
 - one at 665nm : Chlorophyll-a,
- Pheophytins and Pheophorbides

The identification of each peak is allowed by comparison of their light



In order to characterize the study sites, pH, redox potential and temperature have been measured. (Kruskal Wallis followed by pairwise Wilcoxon-Mann-Whitney with Bonferroni correction)

The pH at S1 is significantly more acid than S2 and S3 probably due to anthropic pressure. The potential redox that is significantly negative at S2 indicates :

- A reduced sediment which is consistent with a higher degradation activity
- Potential development of a specific bacterial communities as a result of tides amplitude for this site.

The temperature is not significantly different according to the sites.



Each site is characterized by specific biotic and abiotic parameters which influence the degradation of leaves and therefore pigment composition.



The first boxplot shows the degradation pigments according to the stations and time. Chl-b/Chl-a and Lutein/Chl-a ratio show

the variability between the stations and highlight the degradation state of mangrove leaves.

Pigments must be coupled to other biomarkers to develop an indicator for the WFD. Preliminary results obtained combining fatty acids and pigment composition are very promising.

In addition, other studies are currently in progress such as DNA sequencing to identify the structures of microbial communities and to put the studied parameters in common.



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Analysis of the repartition of photosynthetic pigments according to the qualitative variables stations (*S*1;*S*2;*S*3) and degradation time (*T*1;*T*2;*T*3:*T*4).

The intermediate site S2 differs from other sites according to a degradation axis. Moreover, S1 and S3 are still different in term of pigment compositions. Effectively, S3 mangroves leaves seems more degraded than S1 ones. There is also variability of pigment composition with time within each station.

Statistical analysis :

ANalysis Of SIMilarity (ANOSIM) according to the Bray-Curtis index with 999 permutations.

The pigment composition is significantly different between stations (statistic R = 0,6992) but not between the times.



Concentration (%) of identified pigments are represented by boxplots. Chlorophyll-a, Chlorophyll-b, Lutein and Pheophytin-a are the dominant pigments in every station and at anytime

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