

# Characterization of the migratory light response of microphytobenthos using biomass vs. light curves

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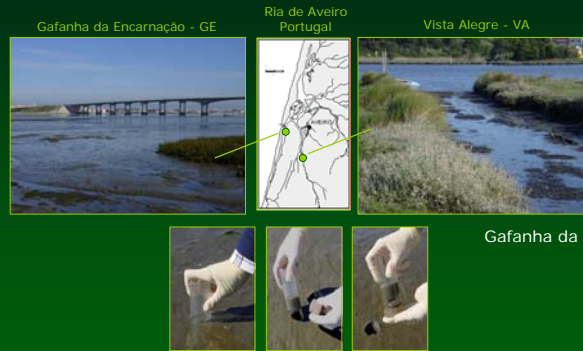
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## 1. RESEARCH QUESTIONS

This work aims the characterization of the phototactic response of natural microphytobenthos (MPB), by measuring the variation in MPB biomass as a response to changes in incident irradiance and addressing the following questions:

- Are PAM Chlorophyll Fluorescence (parameter  $F_0$ ) and Reflectance Spectral Analysis (Index NDVI) effective non-invasive methods for measuring the biomass of microphytobenthos (MPB) biofilms?
- Can  $F_0$  and NDVI be used to characterise the phototactic response of MPB, by means of Biomass vs Light curves (BLC)?
- How does the phototactic response of MPB biofilms vary with incident irradiance?
- Do MPB biofilms from sediments with different granulometry display different migratory photoreponse?

## 2. SAMPLING SITES



Undisturbed MPB samples were collected using plastic cores on Ria de Aveiro (central west coast of Portugal), in two intertidal sites with different granulometry:

Gafanha da Encarnação (GE) - sandy mud  
Vista Alegre (VA) - fine mud

## 3. EXPERIMENTAL SETUP

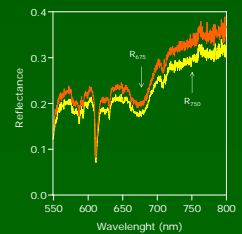


- $F_0$  and NDVI were measured on undisturbed sediment samples simultaneously exposed to 7 different irradiance levels during low tide periods: 0, 50, 100, 250, 500, 1000, and 1500  $\mu\text{mol m}^{-2} \text{s}^{-1}$ , using cold light sources

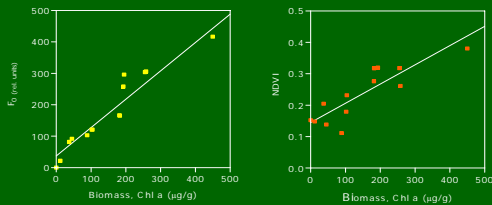
- Samples were pre-exposed to 150  $\mu\text{mol m}^{-2} \text{s}^{-1}$  for 1 hr

- $F_0$  was measured after 2 min of dark-adaptation

- Normalized Difference Vegetation Index (NDVI) was calculated by: 
$$\text{NDVI} = \frac{R_{750} - R_{675}}{R_{750} + R_{675}}$$

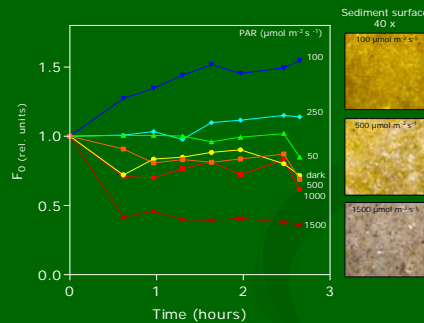


## 4. RELATIONSHIP $F_0$ vs Chl a AND NDVI vs Chl a



- Highly significant relationship between  $F_0$  and Chl a ( $r^2=0.932$ ,  $P<0.001$ ) and NDVI and Chl a ( $r^2=0.837$ ,  $P<0.001$ )
- Both methods enable the non-invasive estimation of MPB biomass

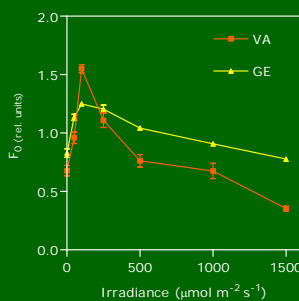
## 5a. PHOTOTACTIC RESPONSE



Typical phototactic response was bi-phasic, with upward migration under low light and downward migration under high light:

- Largest upward migration at  $E = 100 \mu\text{mol m}^{-2} \text{s}^{-1}$
- Rapid and large downward migration for  $E > 250 \mu\text{mol m}^{-2} \text{s}^{-1}$
- Darkness induced significant downward migration
- Effects of migration can be easily confirmed by changes in the colour of sediment surface after 1 hr

## 6. COMPARISON OF BIOFILMS



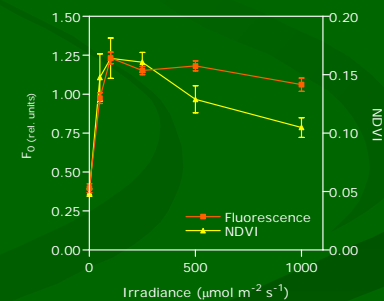
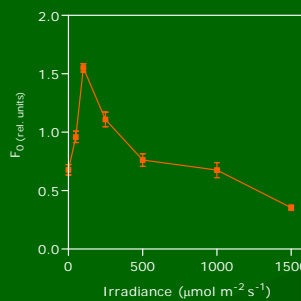
The same general phototactic response pattern was observed in biofilms from both types of sediments:

VA – Fine mud, dominated by epipellic diatoms

GE – Sandy mud, epipsammic diatoms abundant

Nevertheless, significant differences were found between the two types of samples, with biofilms from GE exhibiting a smaller amplitude of the phototactic response

## 5b. BIOMASS vs LIGHT CURVE (BLC)



The phototactic response can be characterized by constructing **Biomass vs Light Curves** (BLC), relating the surface biomass and the incident irradiance

Typical BLC determined after 1h30 of light treatment showed positive phototaxis under low light, with surface biomass reaching a maximum under 100  $\mu\text{mol m}^{-2} \text{s}^{-1}$ , and a negative phototaxis (photophobic) under higher light levels

Similar results were obtained with the two methodologies ( $F_0$  and NDVI)

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