



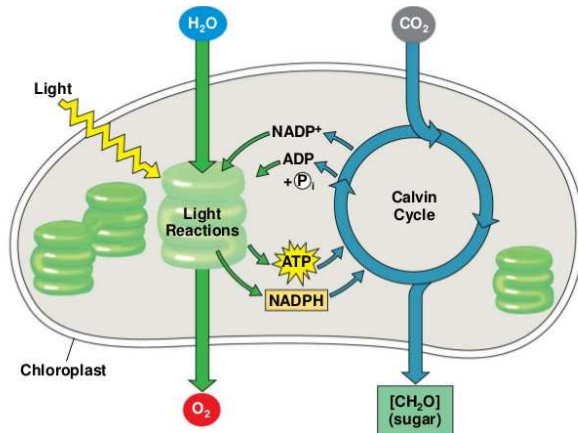
# Etude de la photosynthèse de *Posidonia oceanica* par fluorimétrie modulée

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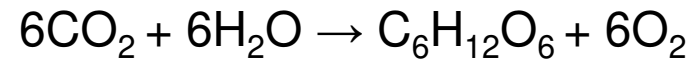
10-04-2018,  
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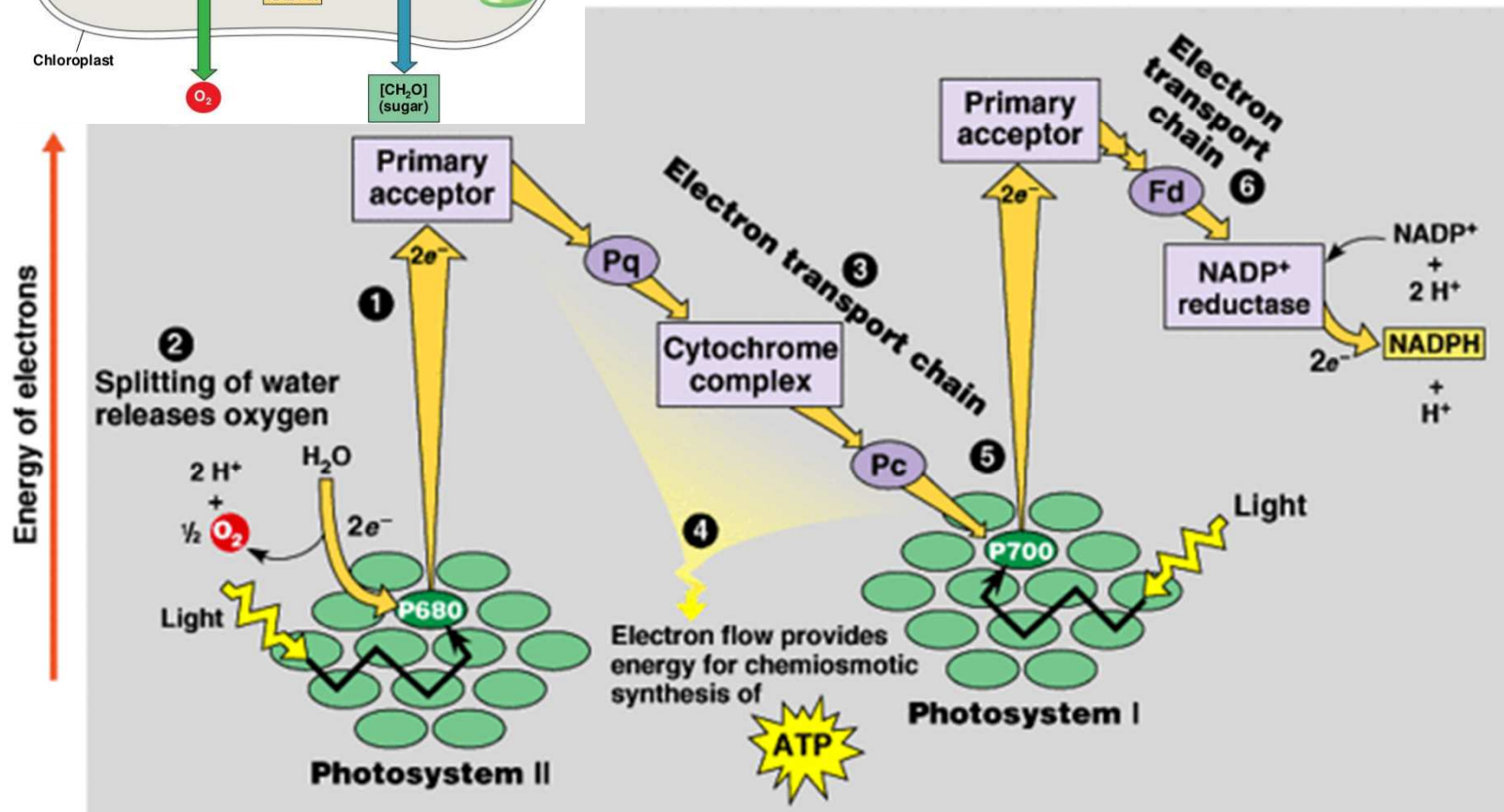
# The light reactions



Chemical equation of photosynthesis:

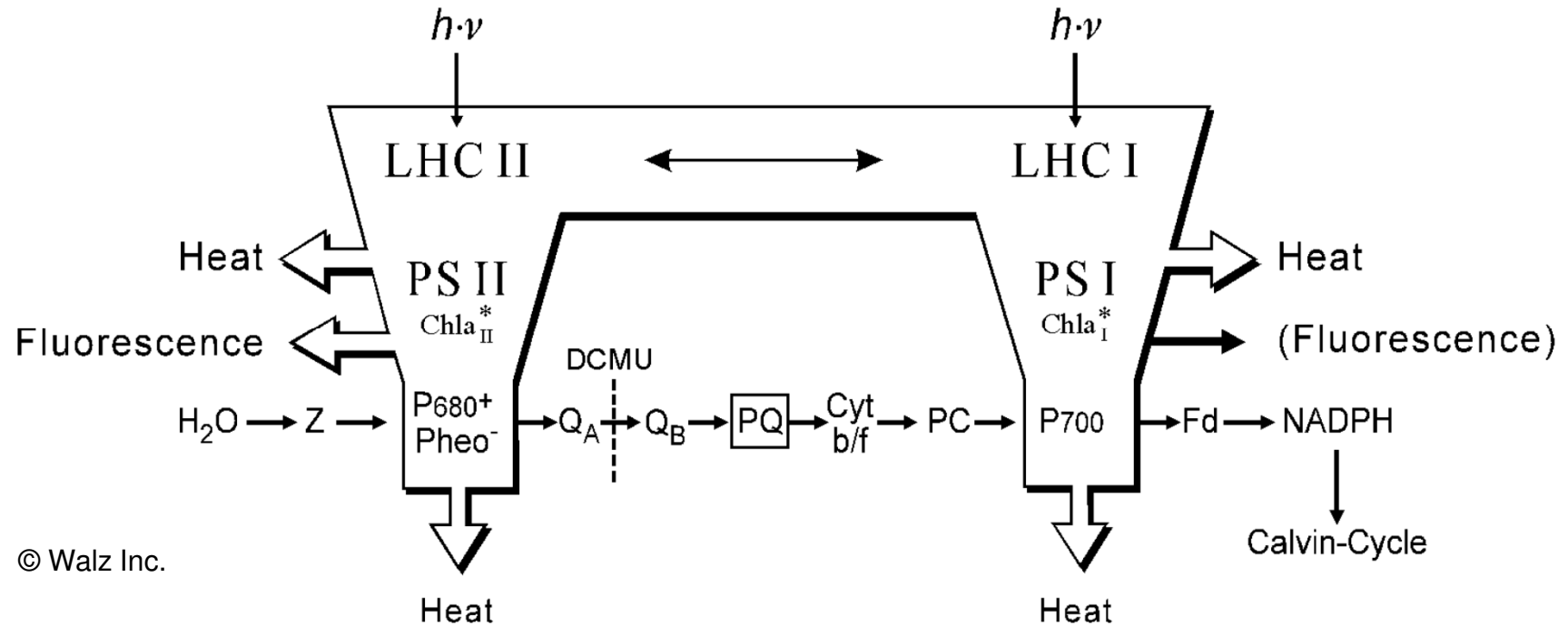


Light energy





# Fluorescence emission

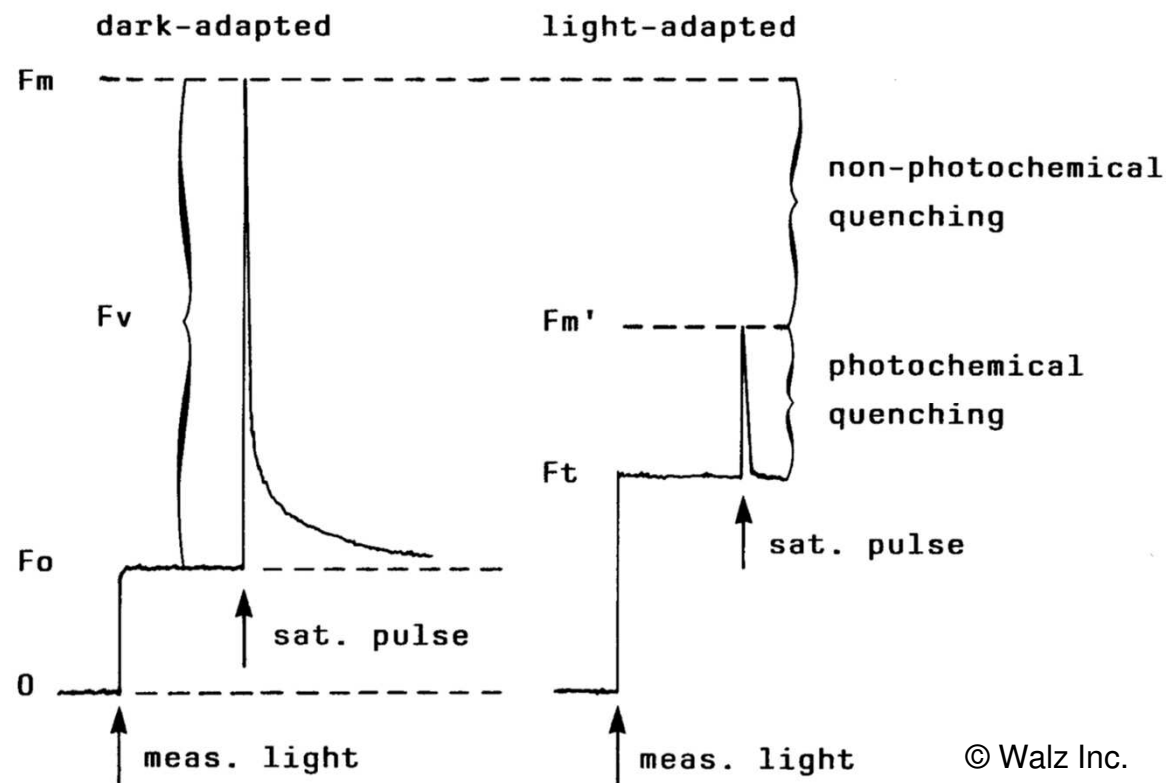


Fluorescence emission is complementary to the alternative pathways of de-excitation, which are photochemistry and heat dissipation.



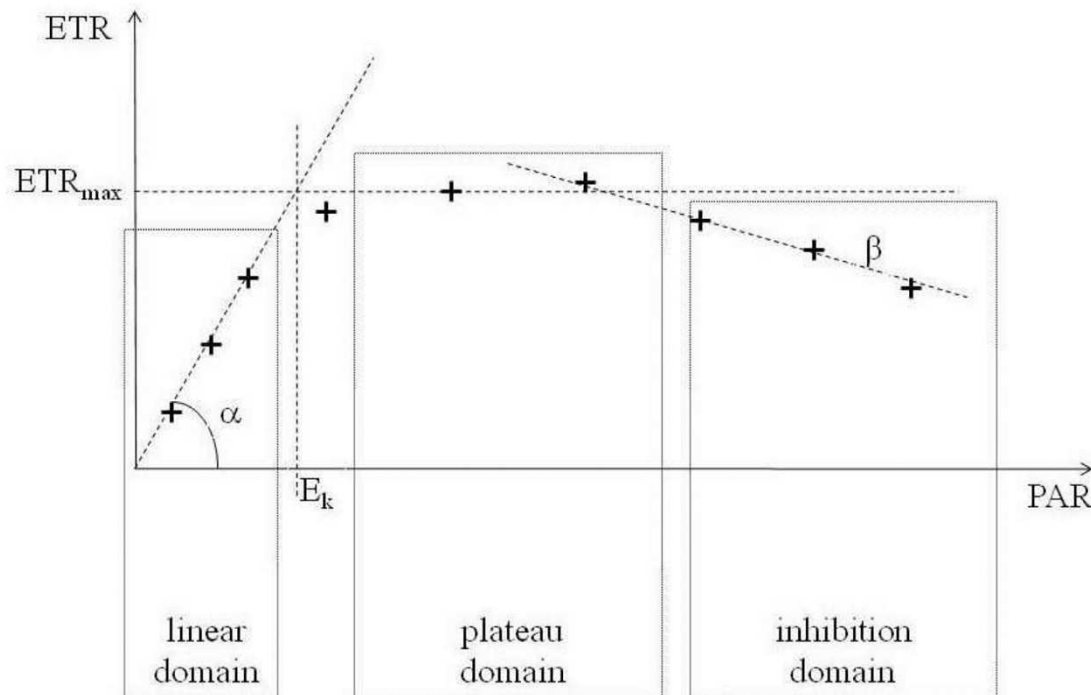
# Fluorescence measurement

- ❖ Dark adapted YIELD =  $(F_m - F_0) / F_m = F_v / F_m$ 
  - ➡ maximum photochemical efficiency
- ❖ Light adapted YIELD =  $(F_m' - F_m) / F_m' = \Delta F / F_m'$ 
  - ➡ effective photochemical efficiency



# ETR - RLC

- ❖ Relative Electron Transfert Rate :  
 $ETR = YIELD \times PAR \times 0.5 \times ETR\text{-factor}$
- ❖ Rapid Light Curve : photosynthetic flexibility with which a sample can adapt its photosynthetic aparatus to rapid changes of light intensity



$ETR_{max}$  = maximum electron transport rate

$E_k$  = compensation irradiance

(Lassauque, 2008)

## Diving-PAM

- ❖ Underwater study of *in situ* photosynthesis
- ❖ Optimized to determine the effective quantum yield of photosynthetic energy conversion,  $\Delta F/F_m'$



Julien Lassauque



## Objectives

*"With our present understanding of seagrass photosynthetic responses to anthropogenic stress, it would be ill advised to employ PAM as anything but a complementary tool to validate environmental stress derived with other, more robust methodologies."* (Gera et al., 2012)

➔ A **more in-depth knowledge** of the natural and stressful causes of variability **of *P. oceanica* photosynthetic responses** is a prerequisite to any surveys relying on that time and cost-effective method.

This work aimed to determine the **influence** of :

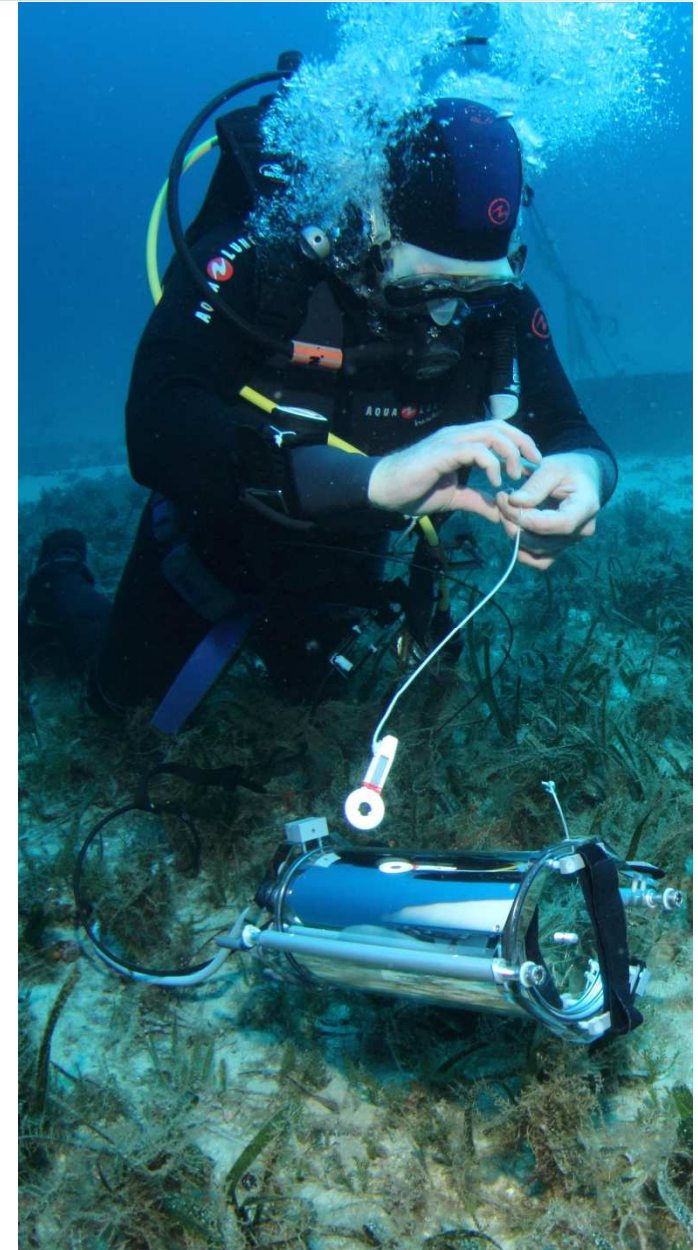
- ❖ **plant-ecophysiological characteristics**: pigments, carbohydrates, C/N/P, micronutrients, DMSP/DMSO,
- ❖ **environmental parameters**: light, temperature, nutrients,
- ❖ **stress-conditions** : metal toxicity, shading

.... on **photosynthetic responses** : Yield, ETR, RLC of *P. oceanica*.

## Preliminary work (2011-2012)

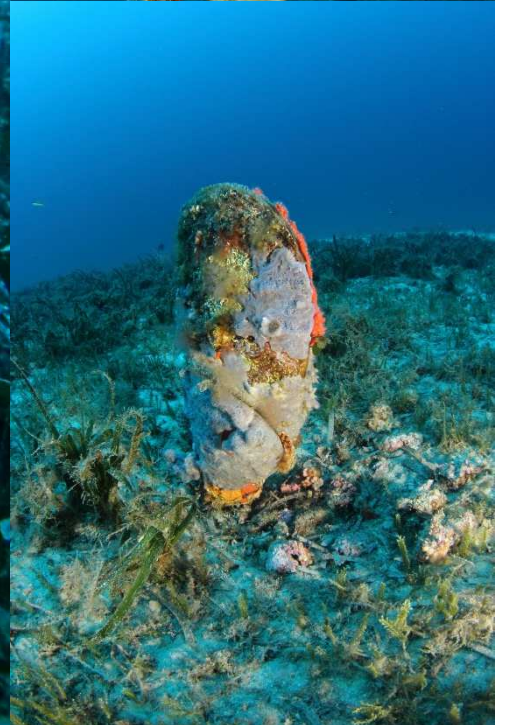
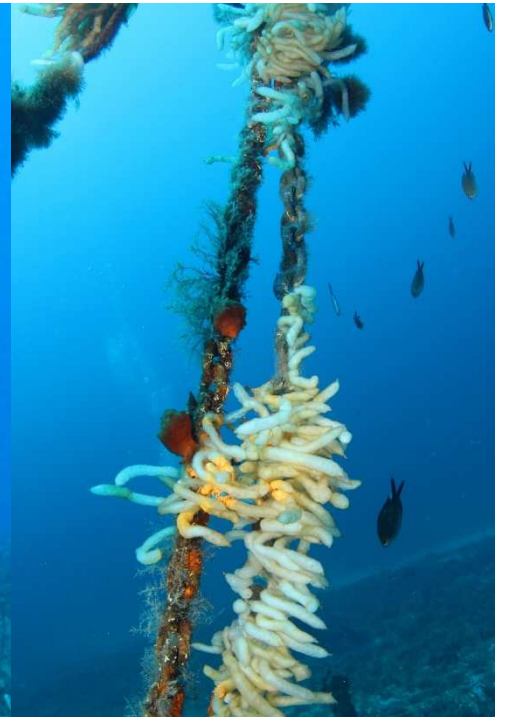
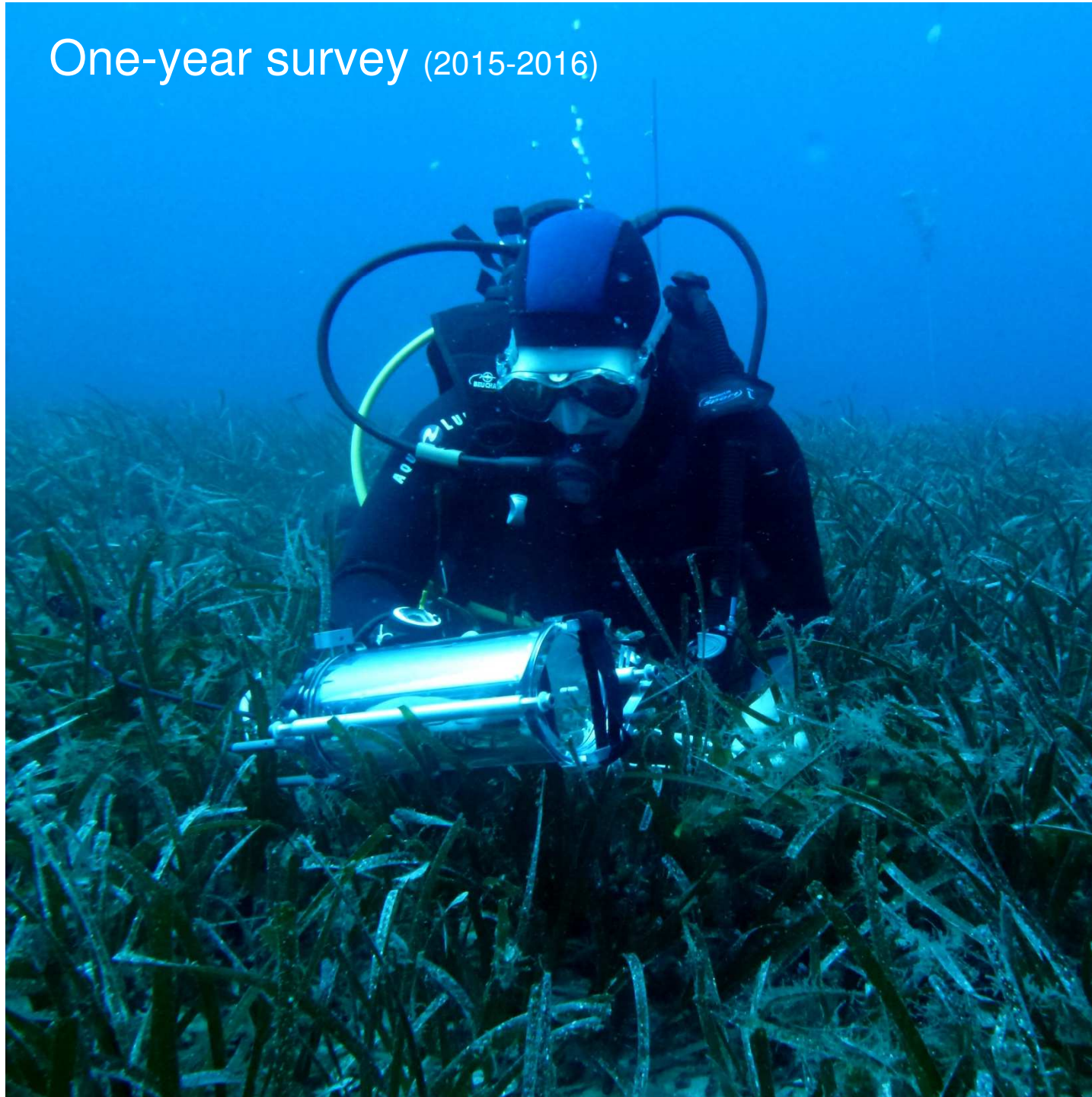
Essential to develop a consensual protocol to publish reliable and comparable results :

- ❖ to perform measurements at the zenith;
- ❖ at 10-15 m depth (and depth profile for physiological adaptation to reduced light conditions);
- ❖ on the middle part of the 3<sup>rd</sup> leaf, highly photosynthetic, little epiphyted.





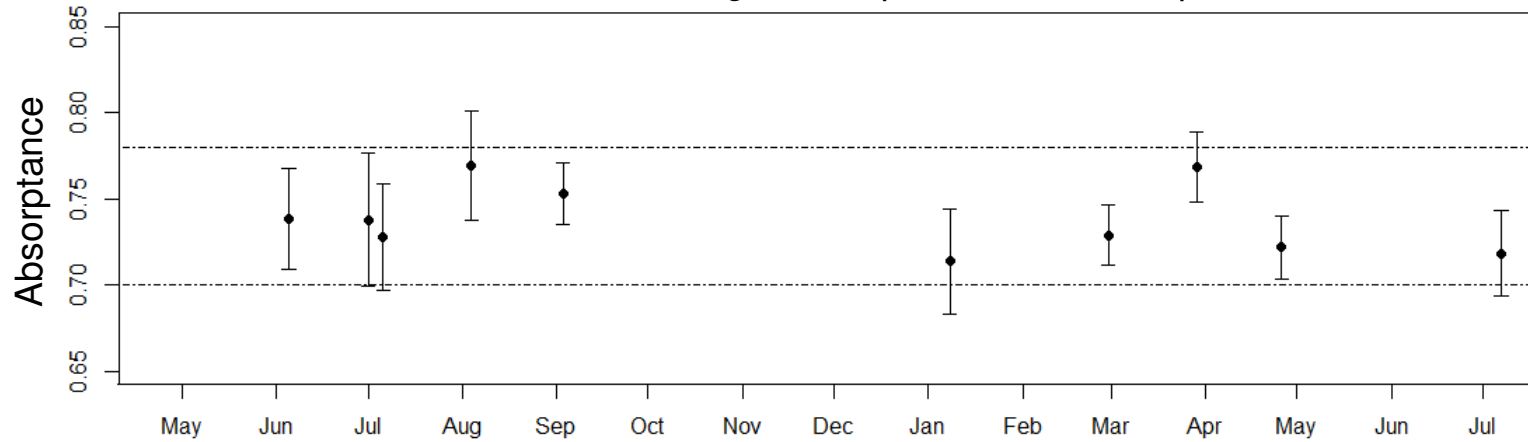
# One-year survey (2015-2016)



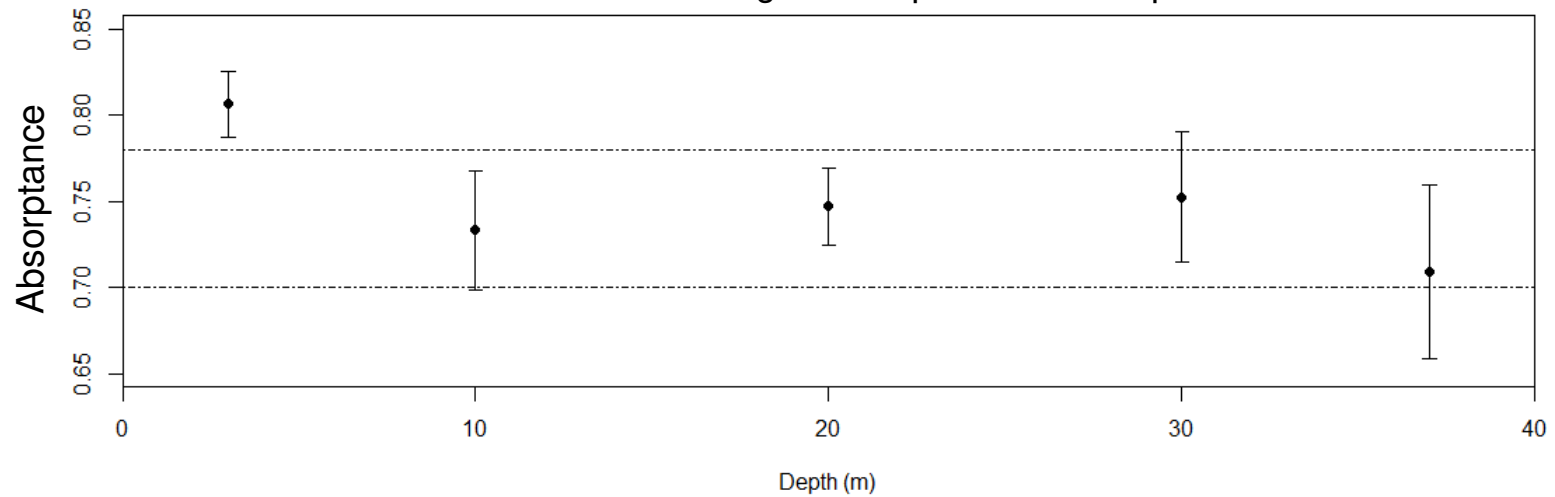


$$\text{ETR} = \text{YIELD} \times \text{PAR} \times 0.5 \times \text{ETR-factor}$$

Evolution of leaf light absorptance at 10 m depth

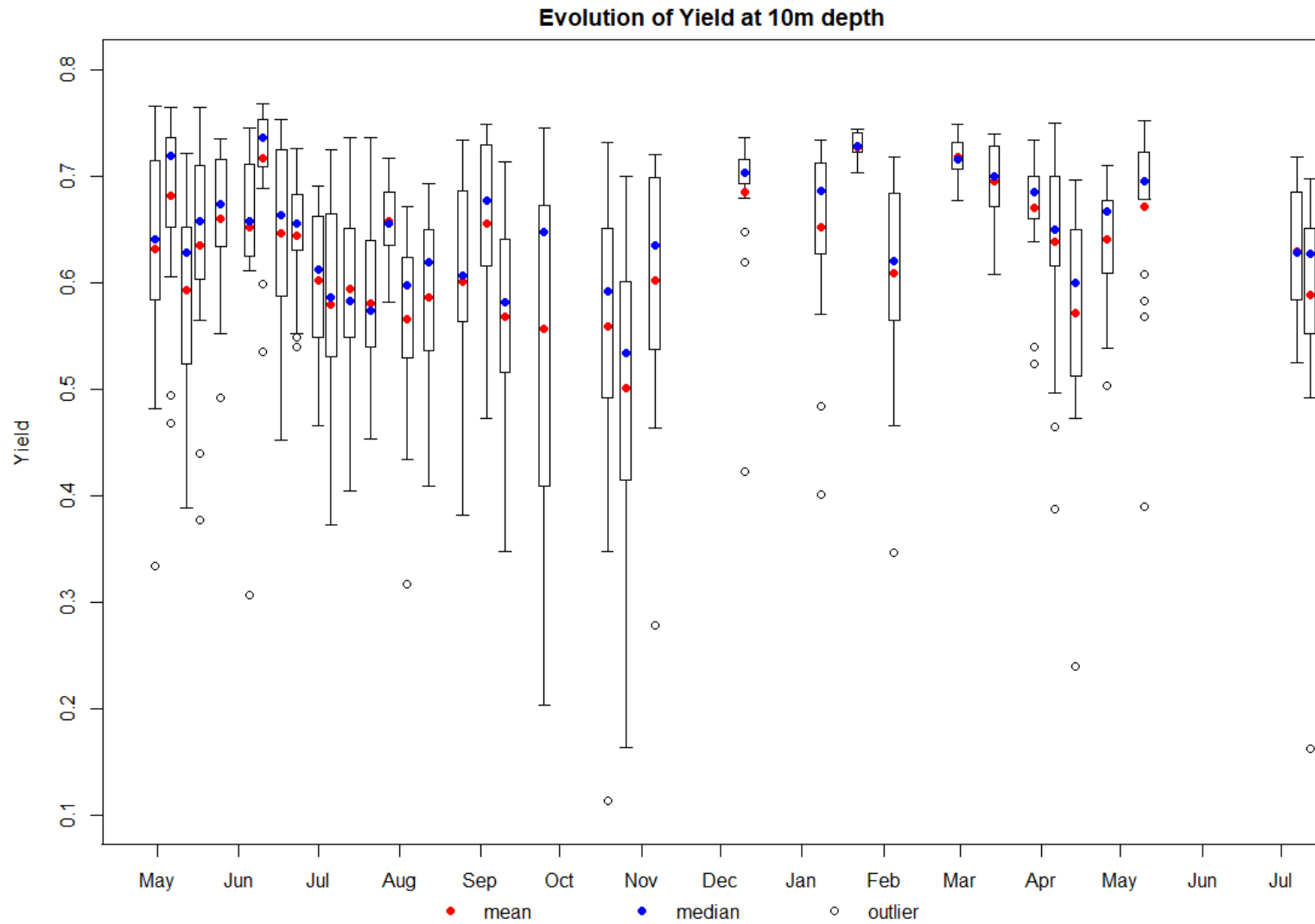


Evolution of leaf light absorptance with depth



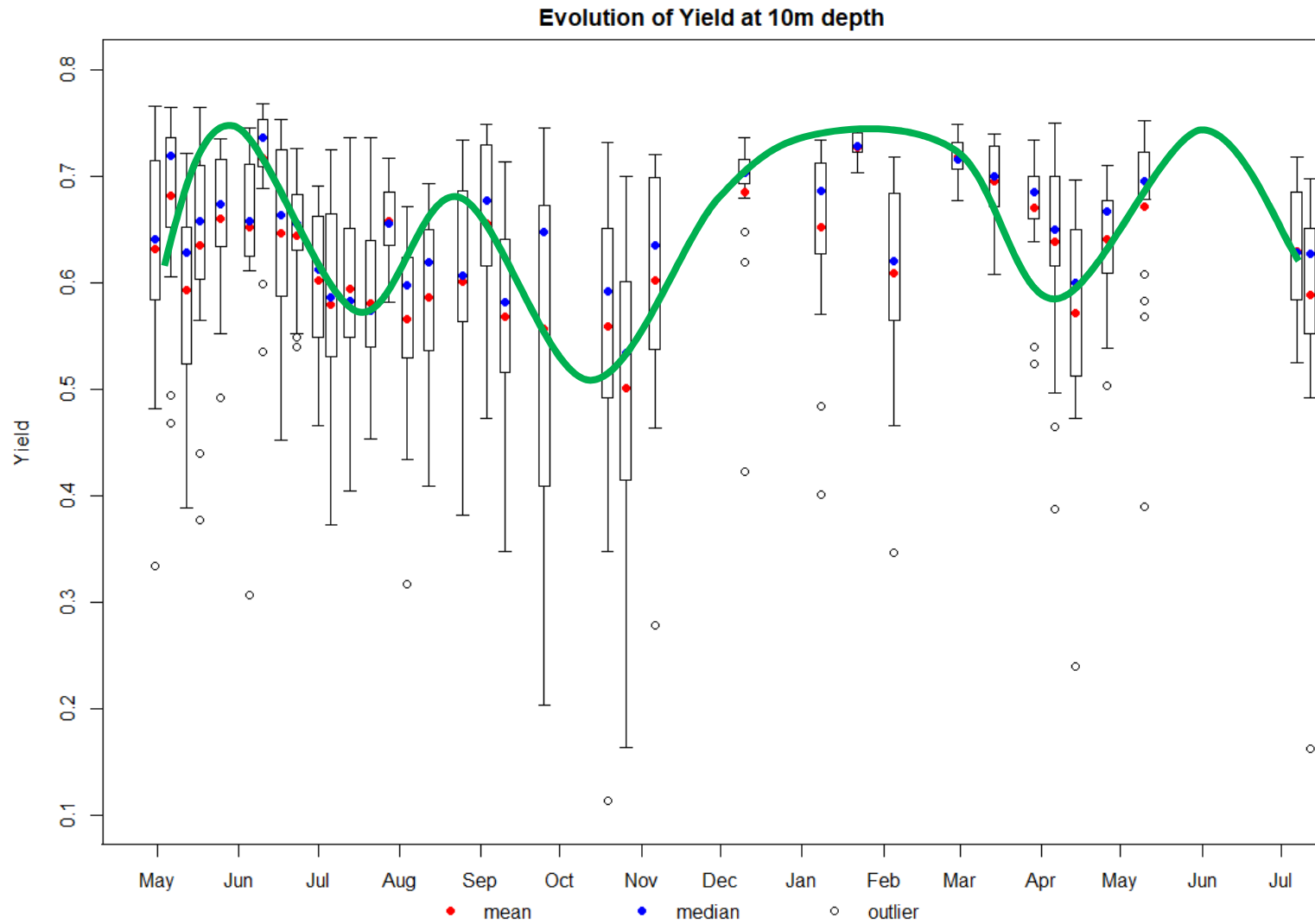


# Effective photochemical efficiency



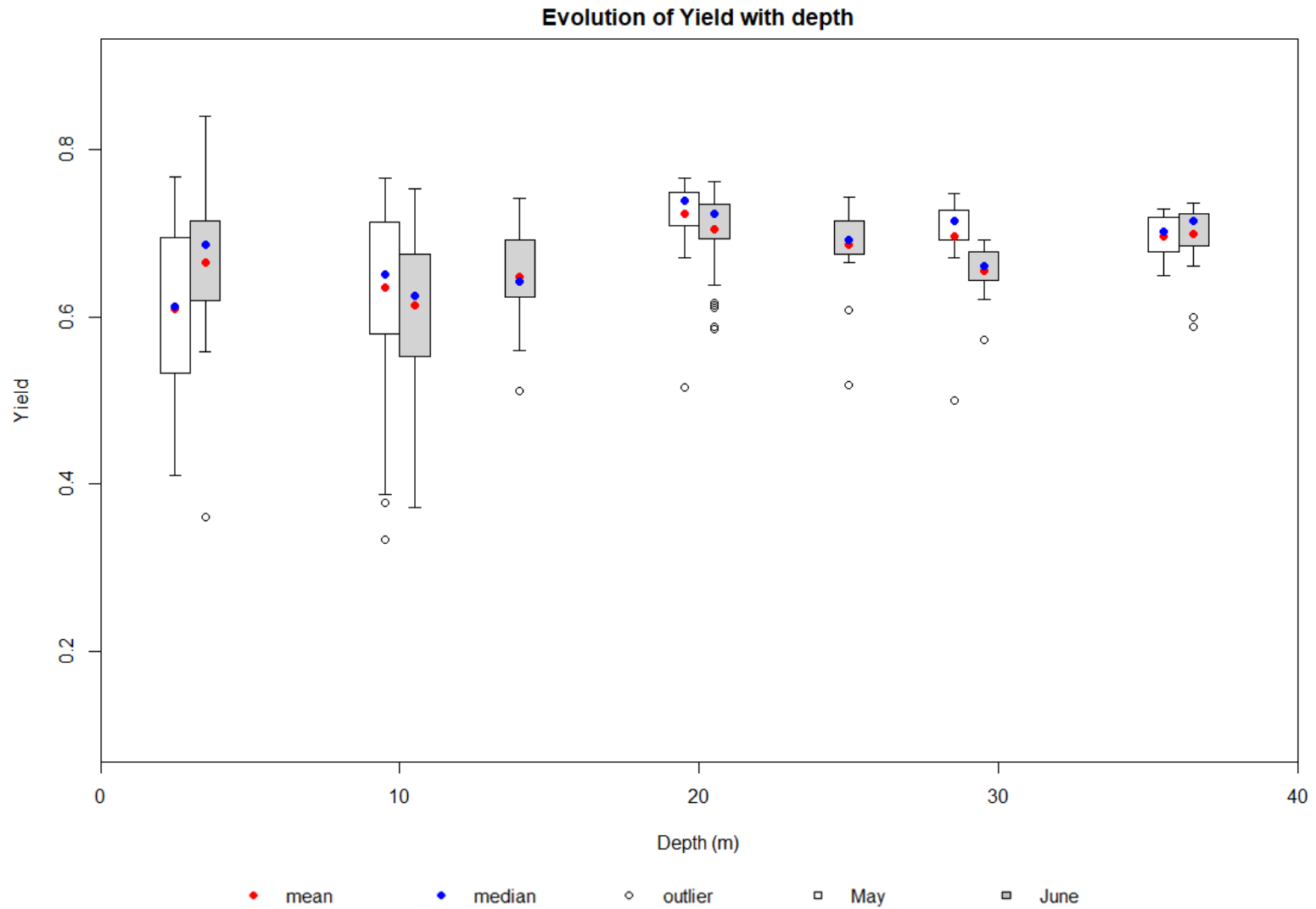


# Effective photochemical efficiency





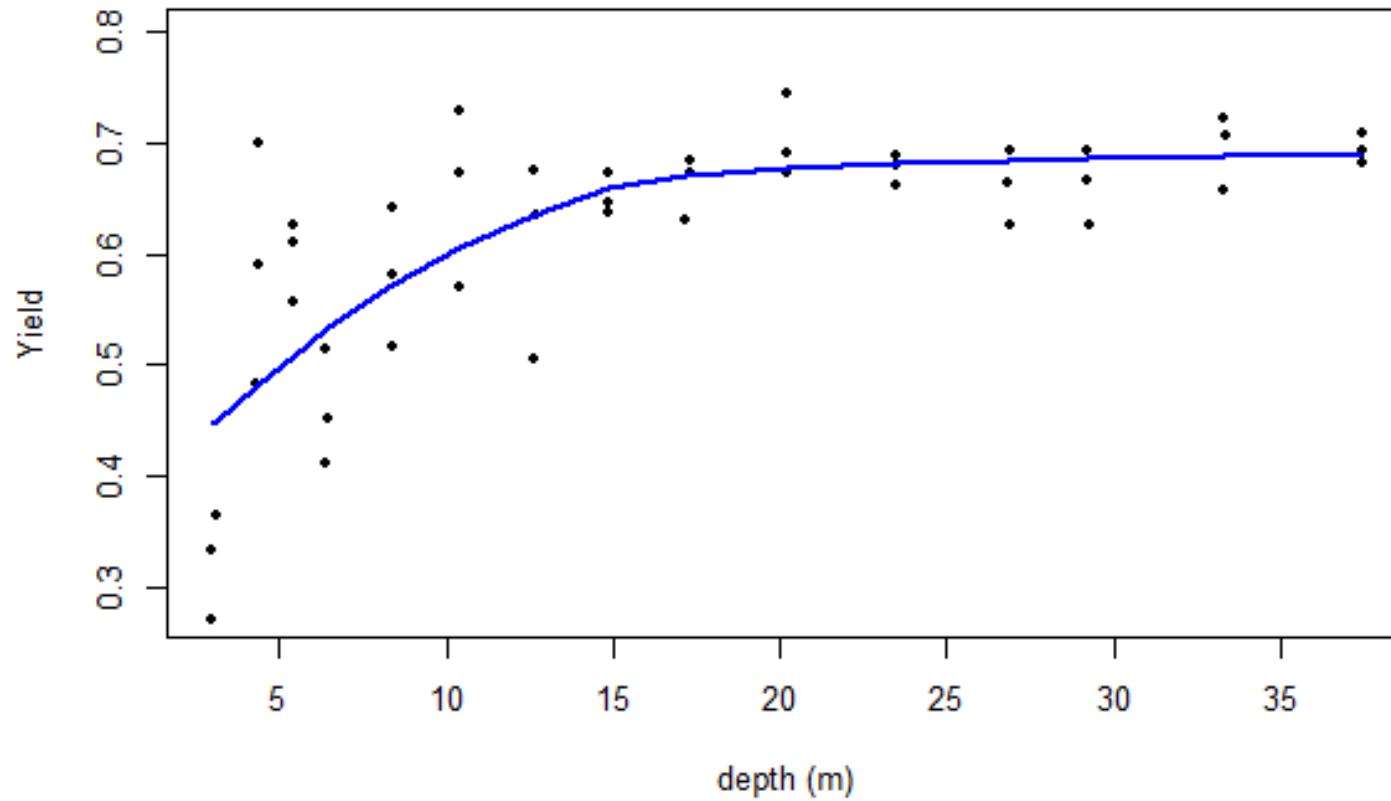
# Effective photochemical efficiency





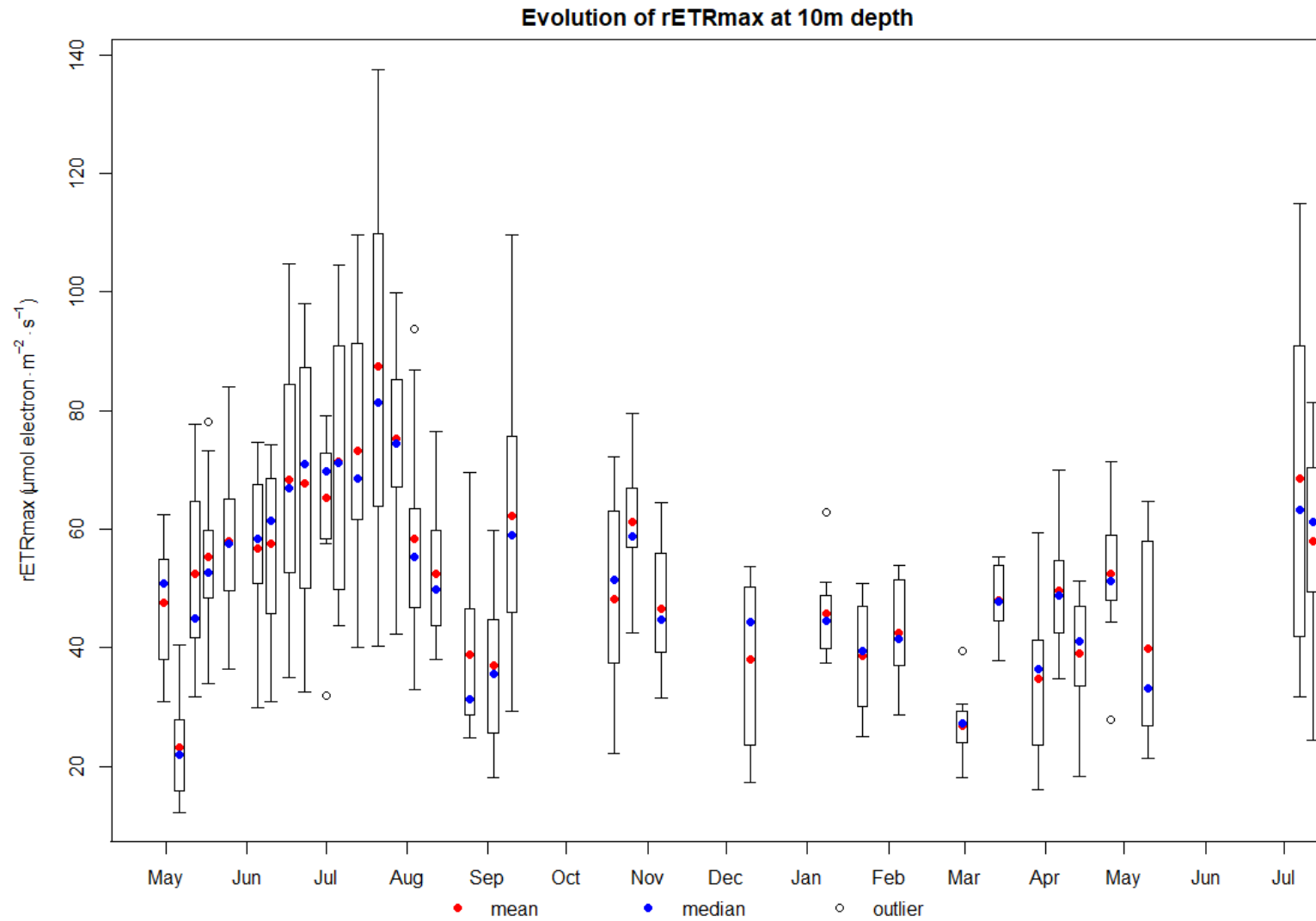
# Effective photochemical efficiency

*P. oceanica*, bathymetric profile, 2017-08-27 12:08:45 (mean time, GMT)

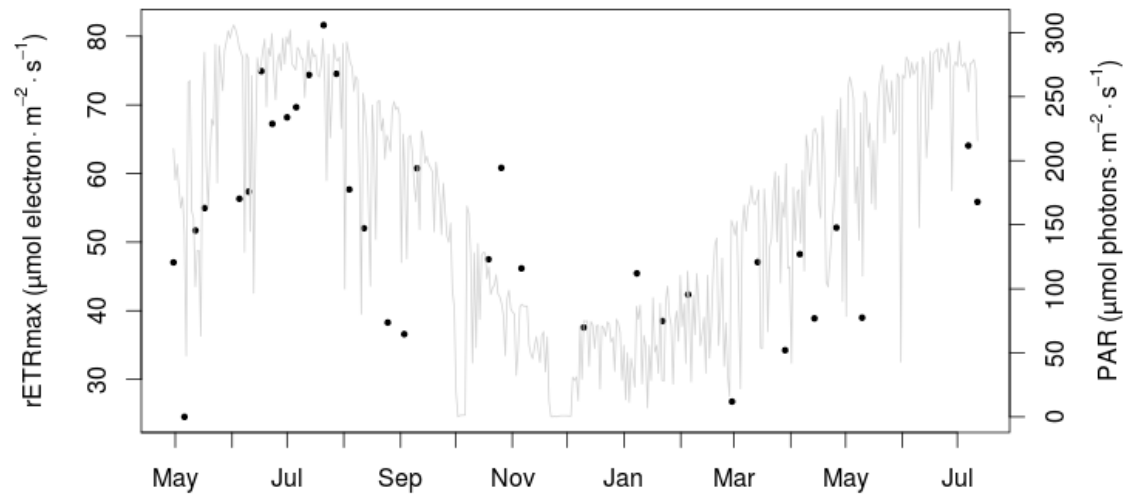




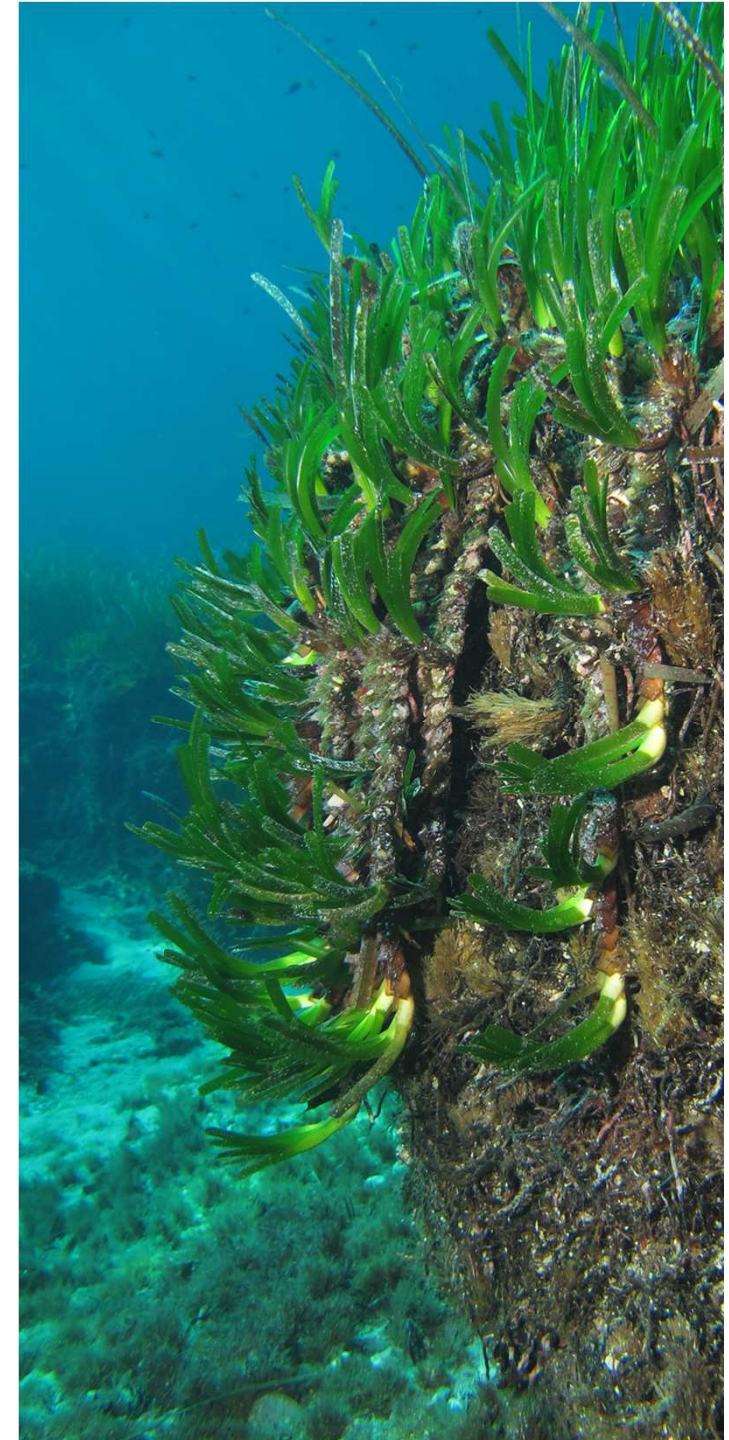
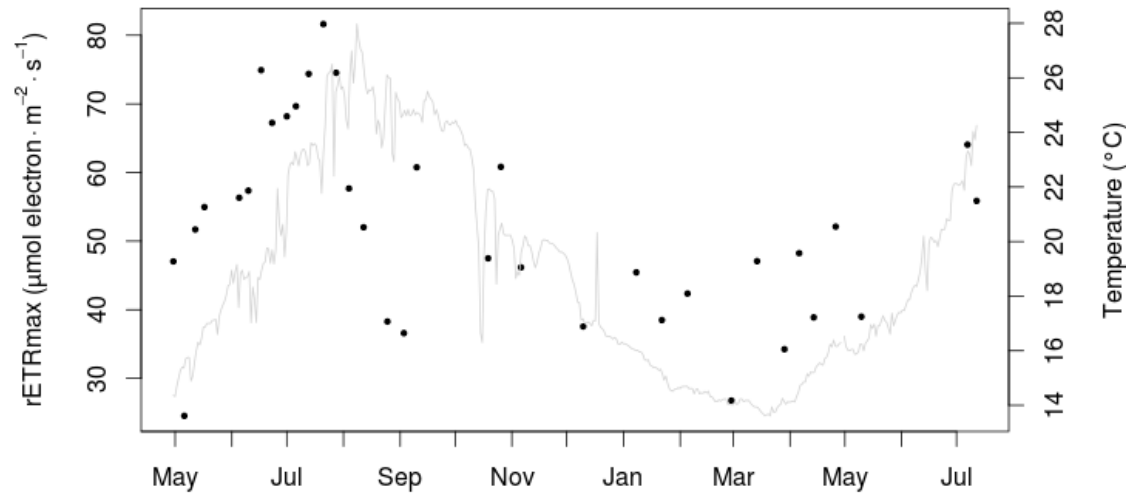
# Rapid Light Curve



## rETRmax vs PAR



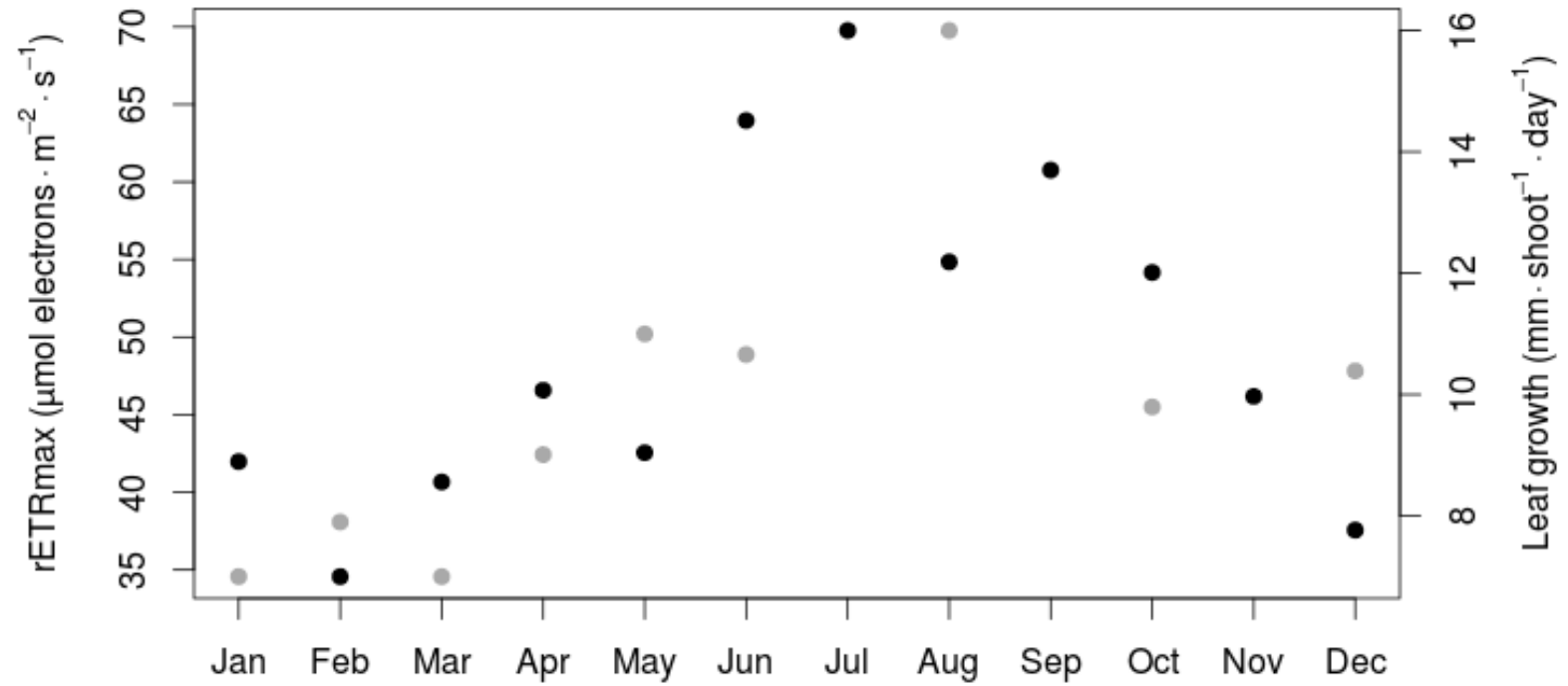
## rETRmax vs temperature







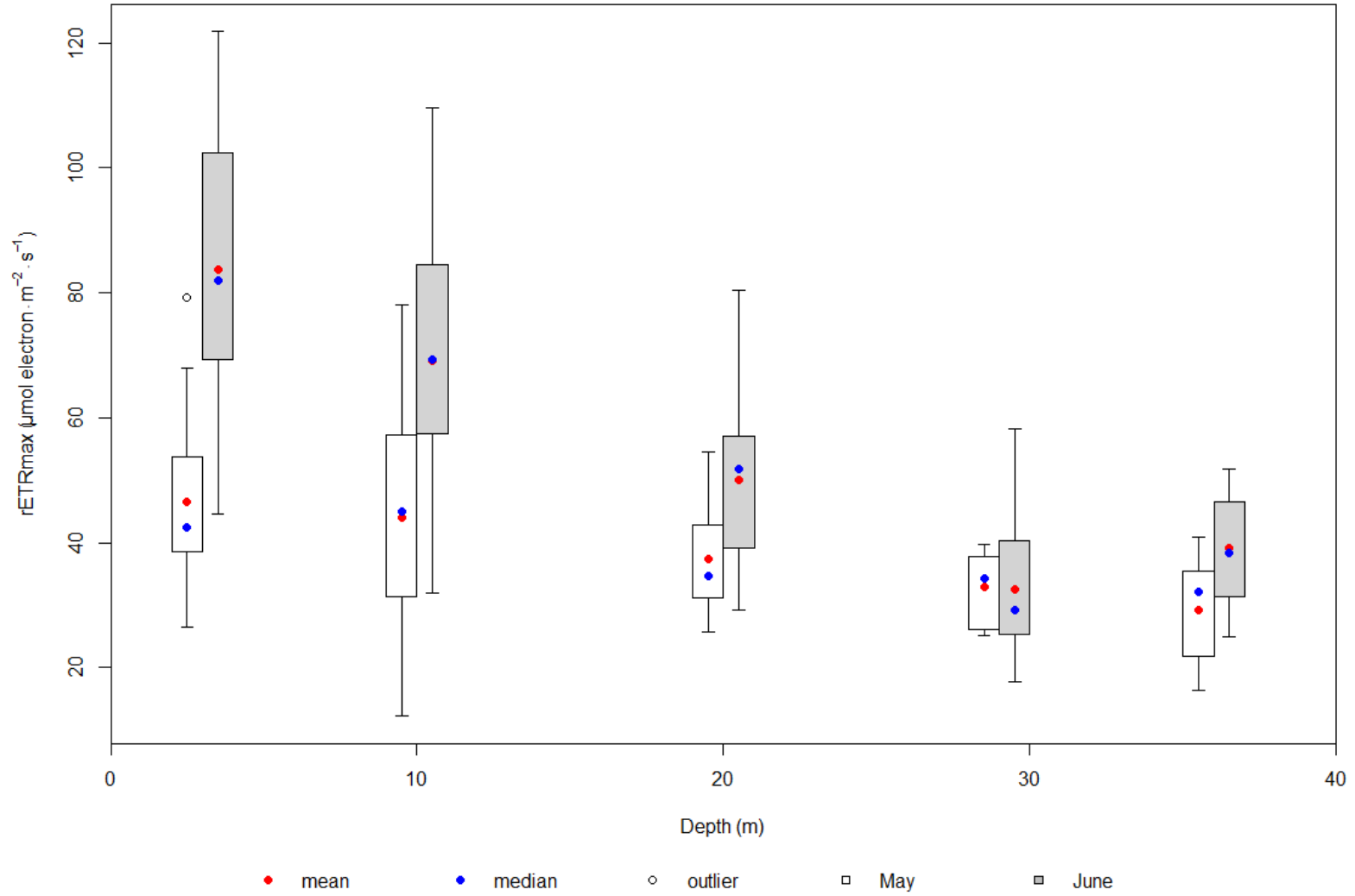
# rETRmax = leaf growth proxy ?





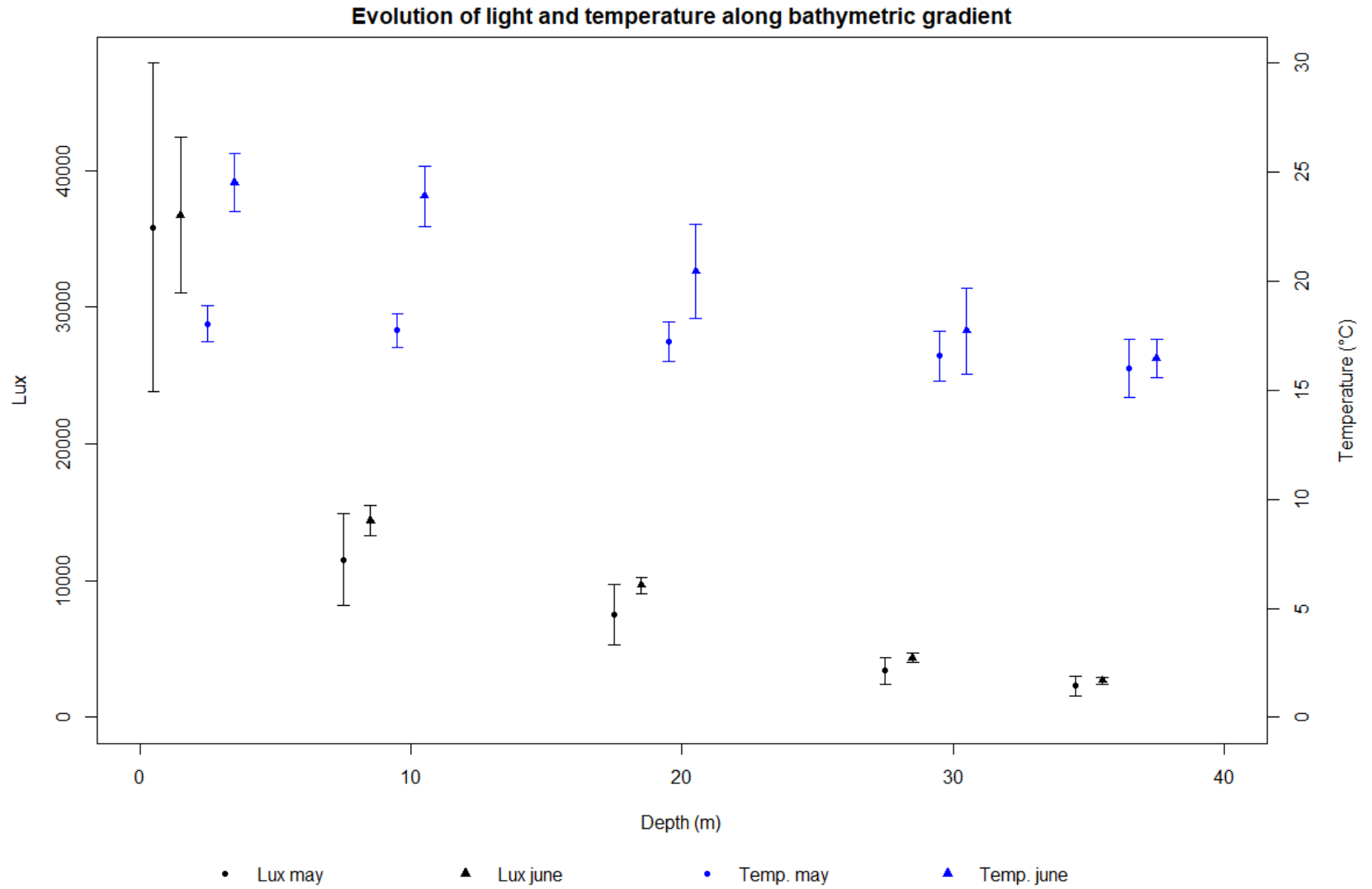
# Rapid Light Curve

Evolution of rETRmax with depth





# Light and Temperature





## Conclusion et perspectives

Etude de la photosynthèse de *Posidonia oceanica* par fluorimétrie modulée ...

➔ méthode rapide et peu couteuse pour :

- études écophysiologicals.
- études écotoxicologiques?

La suite:

- relations photosynthèse vs croissance foliaire,
- relations photosynthèse et PP (O<sub>2</sub>),
- biomarqueur de terrain.

