seagrass productivity

from genes to ecosystem management

Innovative aspects for European seagrass monitoring and management

Rui Santos – Action Chair

Aims of the Cost Action

To form a European-wide research coordination network that integrates expertise in physiological ecology, ecological genomics and proteomics and conservation/resource management in order to:

1. Provide the scientific basis for preserving the goods and services arising from the productivity of European seagrass ecosystems under anthropogenic pressure.

2. Develop comprehensive best practices for integrated seagrass habitat management.

Working groups

WG1. Ecophysiology: Drivers of seagrass plant productivity, vulnerability and resilience to anthropogenic driven change

Leader: Mats Björk (Sweden)

64 participants from 12 countries

Task 1. Development and application of innovative continuous measurement devices of productivity;

Task 2. Seagrass light requirements (availability and spectral quality);

Task 3. Understanding seagrass responses to globally changing temperature, CO_2 and pH (ocean acidification).

Working groups

WG2. Genetics: functional genetic and genomic tools to understand seagrass responses to environmental stressors

Leader: Gabriele Procaccini (Italy)

25 participants from 10 countries

Task 4. Understanding seagrass responses to globally changing temperature, CO_2 and pH (ocean acidification), in particular the genetic basis of ecological responses;

Task 5. Assessing levels of adaptive variation across environmental and geographical clines.

Working groups

WG3. Scientists-Managers Interface

Leader: Ragnhildur Sigurdardottir (Iceland)
57 participants from 14 countries

Task 6. Identify managers, agencies, plans and legislation for seagrass management in Europe in order to understand how to actually implement habitat protection

Working groups

WG4. Innovative approaches to seagrass monitoring and management in Europe

Leaders: Dorte Krause-Jensen (Denmark); Teresa Alcoverro (Spain); Nuria Marbá (Spain)

62 participants from 14 countries

Task 7. Parameters for monitoring seagrass meadows

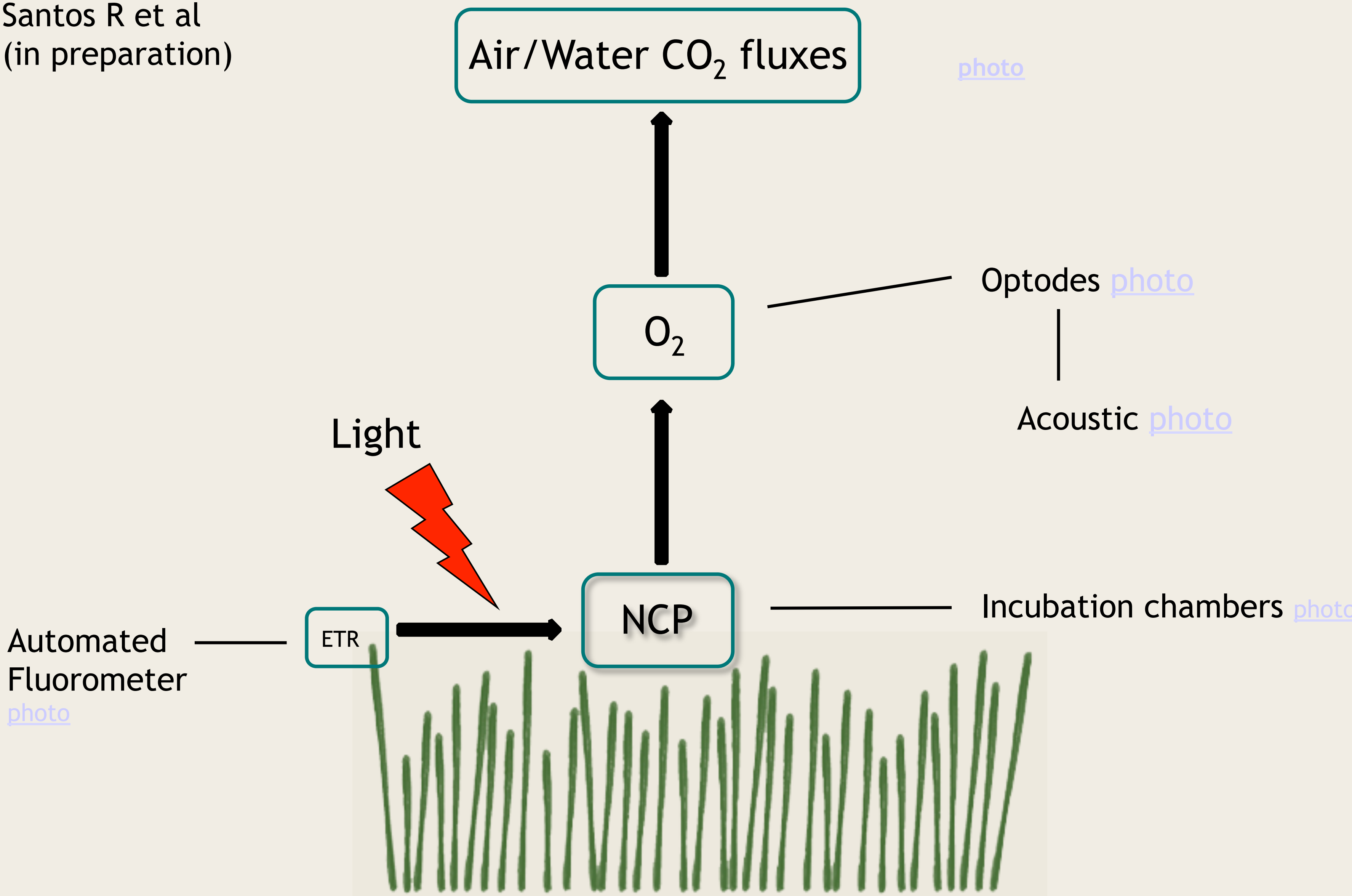
Task 8. Guidelines for seagrass ecosystem management across Europe.

COST Action ES0906

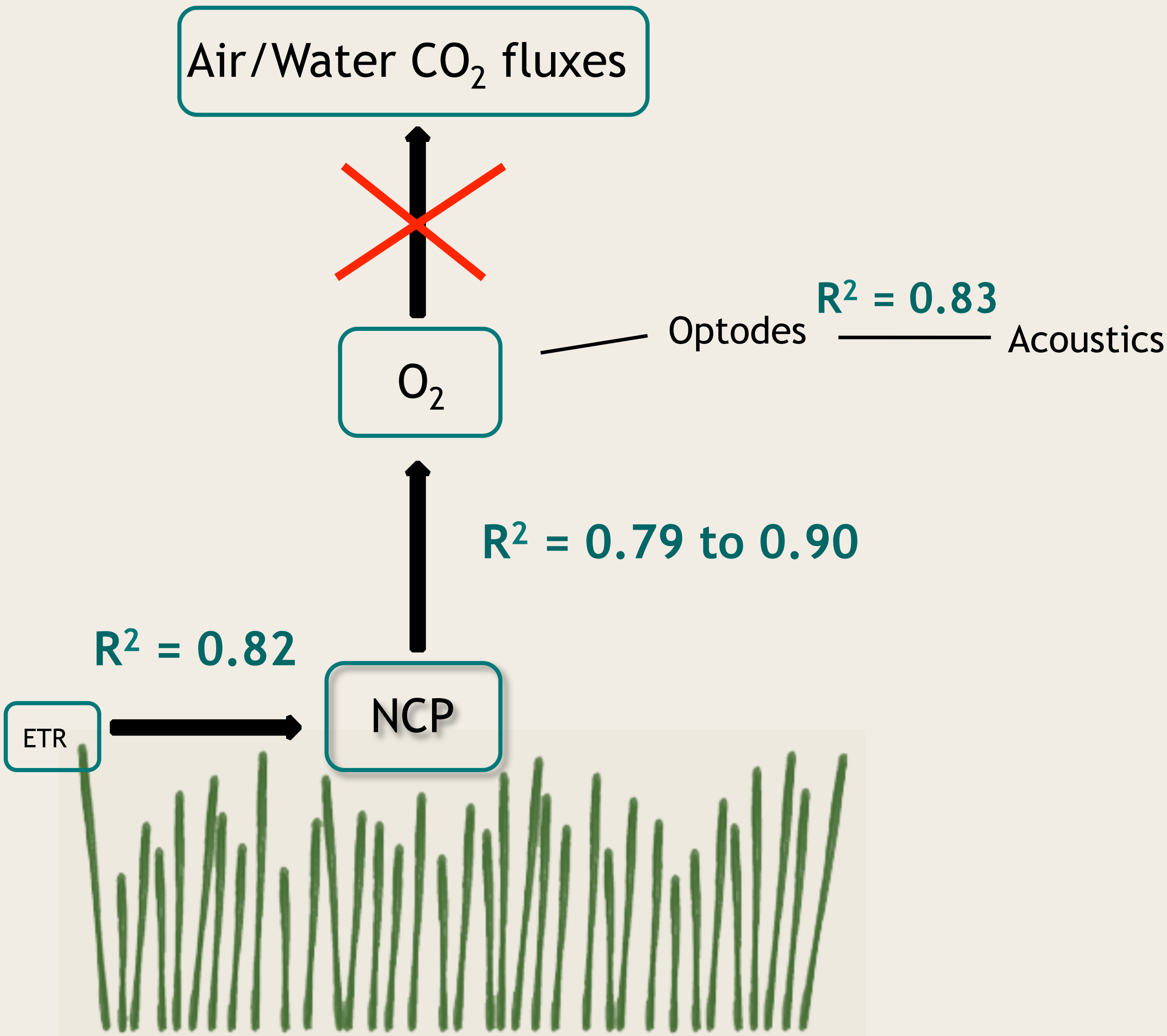
- Action will run from 2010 to 2014
- Web site: http://www.seagrassproductivity.com/
- 19 Cost countries participating; > 130 participants
- 2 non-COST institutions from Australia: University of Sydney and University of Technology (UTS)
- 10 papers published, 8 more in preparation

WG1. Seagrass production: linking individual, community and ecosystem carbon fluxes

Santos R et al
(in preparation)



Yes, we can!


Air/Water CO_2 fluxes
O_2
Optodes
$R^2 = 0.83$
Acoustics
$R^2 = 0.79$ to 0.90
$R^2 = 0.82$
ETR
NCP

Main Conclusions

- This work reveals how photosynthesis scale up to impact high order processes such as community-level and ecosystem-level metabolism, highlighting the importance of monitoring the environmental factors that affect the magnitude and variability of seagrass photosynthesis

- Continuous temporal measurements of ETR and water column O_2 concentration can be used as proxys for estimating NCP of *P. oceanica* meadows.

- Atenuation of the acoustic signal may be used to assess O_2 concentration in the water column (and ecosystem production), integrating both the spatial and temporal scales.

WG1/2. Linking ecophysiology and ecogenomics

Procaccini G, Beer S, Björk M, Olsen J, Mazzuca S and Santos R (2012). Seagrass ecophysiology meets ecological genomics: Are we ready? Marine Ecology, 33: 522–527.

- Are we ready to integrate the fields of seagrass ecophysiology and ecogenomics to provide inputs for management?

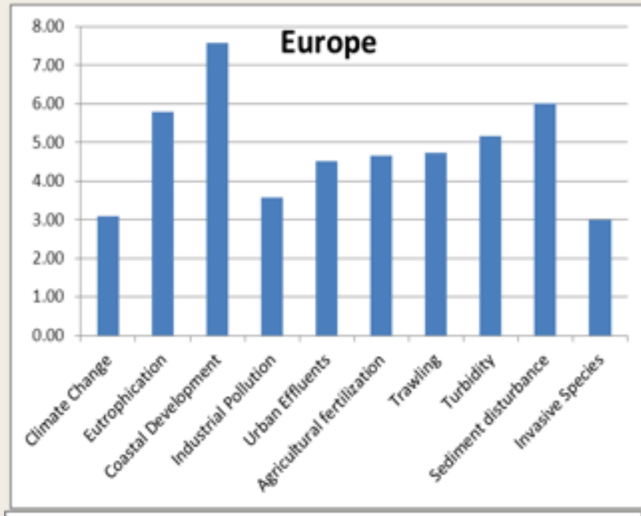
- **Short answer: not quite!**
  - Lack of knowledge on the biochemical pathways involved in carbon and nitrogen metabolisms of seagrasses
  - Genomic approaches have not been able to assign meaningful interpretations to more than a few genes expressed under differential stress

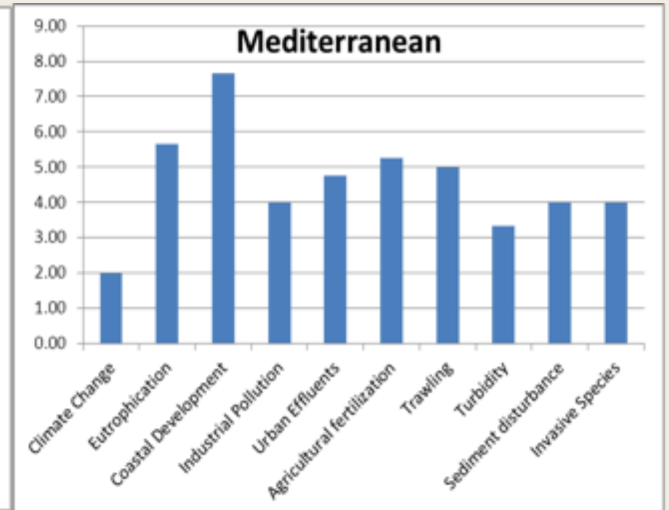
WG 3. Seagrass Management , Conservation and Policy in Europe

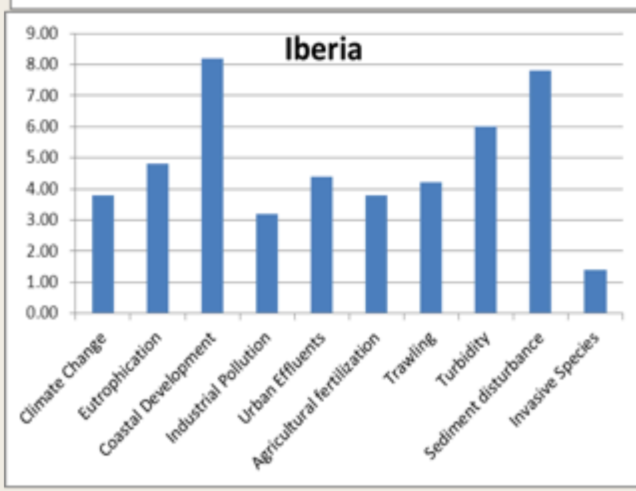
Sigurdardottir R and many authors (in preparation)

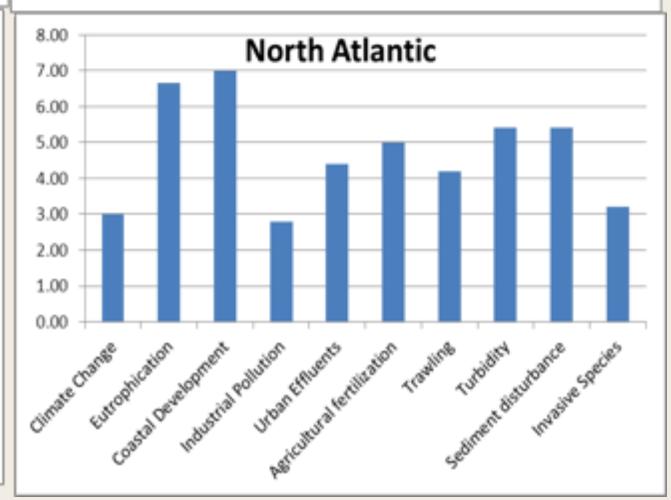
- How well do we know the distribution of seagrasses?
- What is the country-specific conservation status of seagrass habitats?
- What are the major threats to seagrass habitats in Europe?
- Are seagrass habitats being managed?
- Are there monitoring and restoration programs?
- What are the sources of funding for seagrass research and monitoring.
- What is the level of awareness of seagrass of the general public, of managers and of environmental policy makers ?
- Which European and the country-specific laws and regulations are in place for seagrass conservation?

WG 3. Causes of seagrass decline

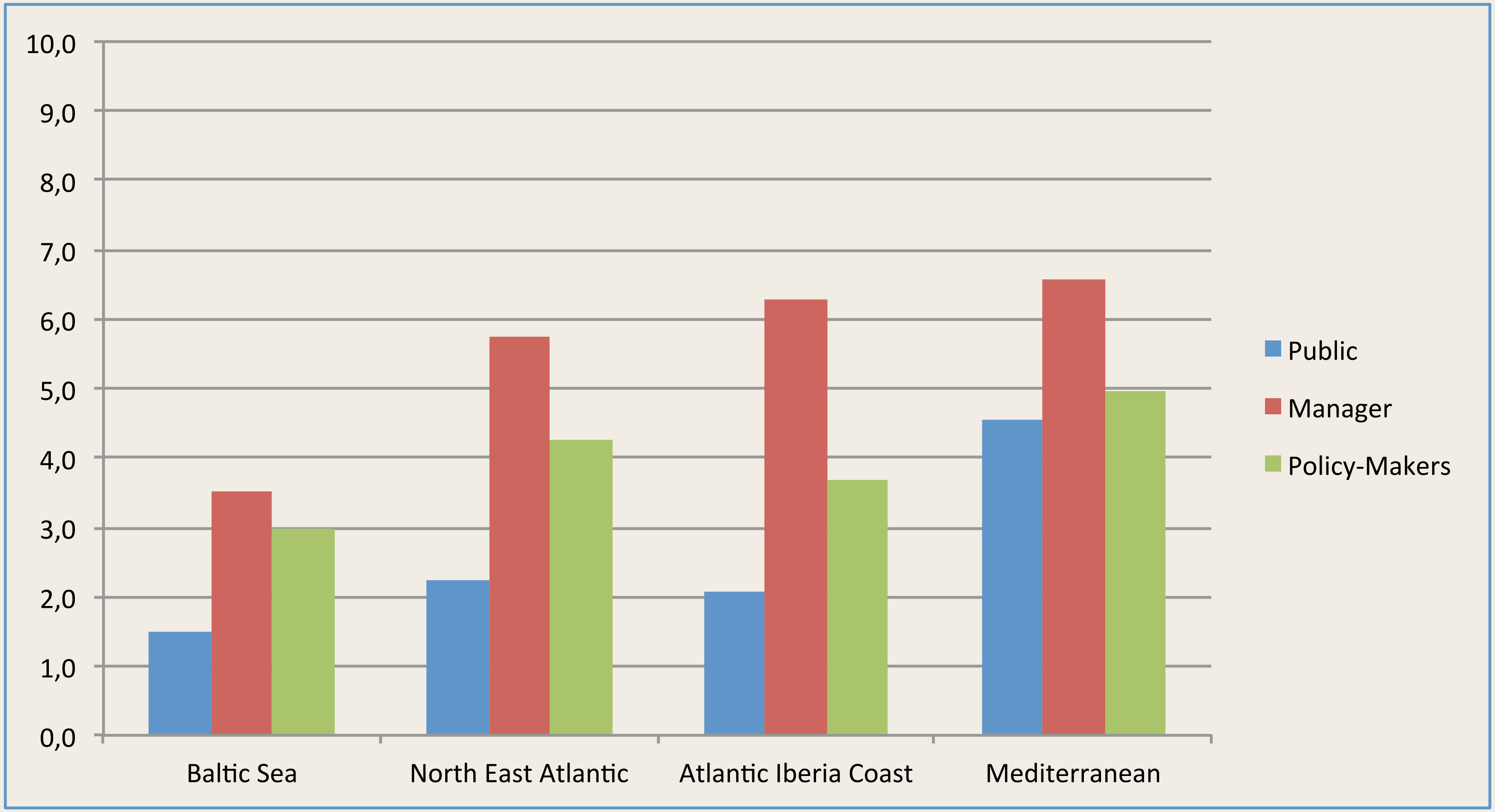




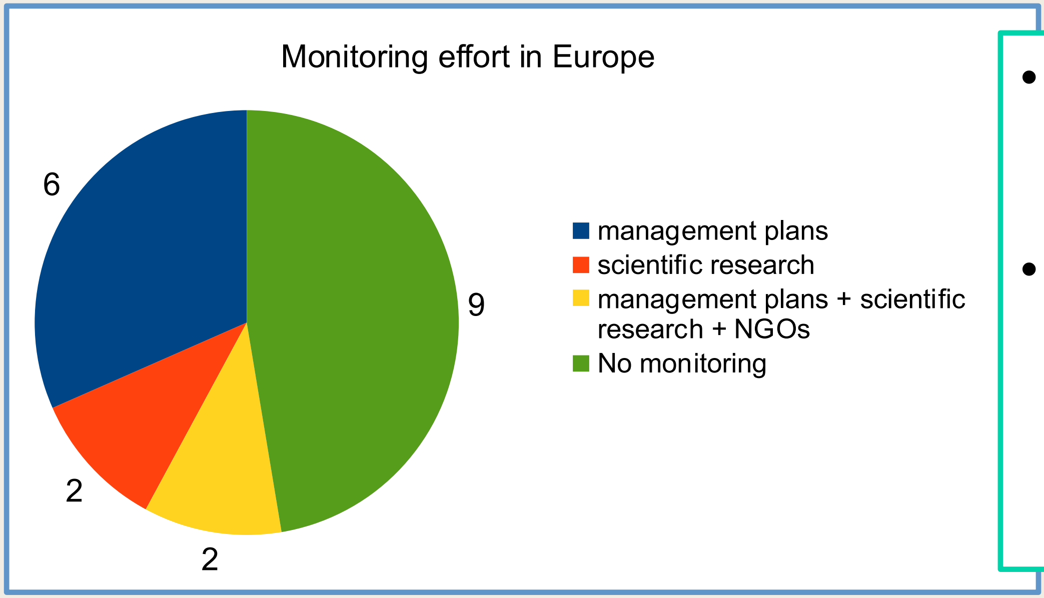




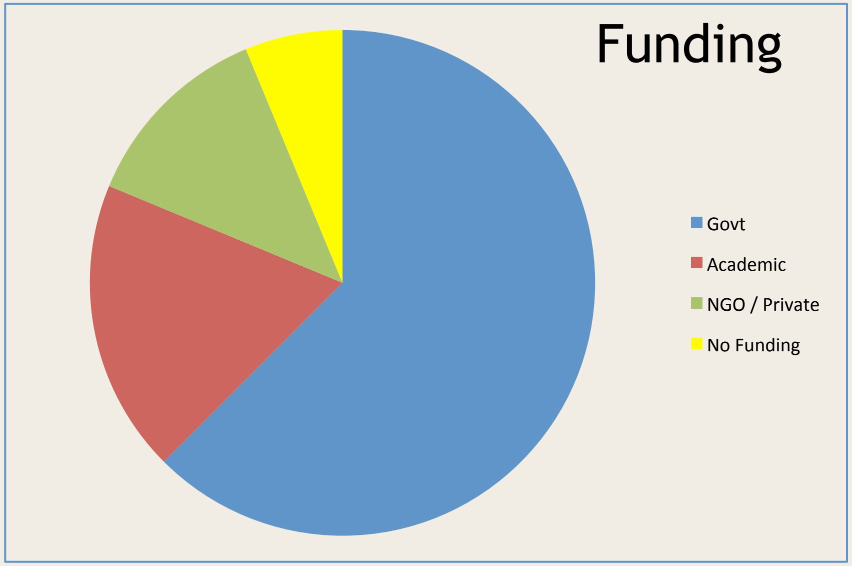
WG 3. Awareness of seagrass habitats



WG 3. Mapping and monitoring

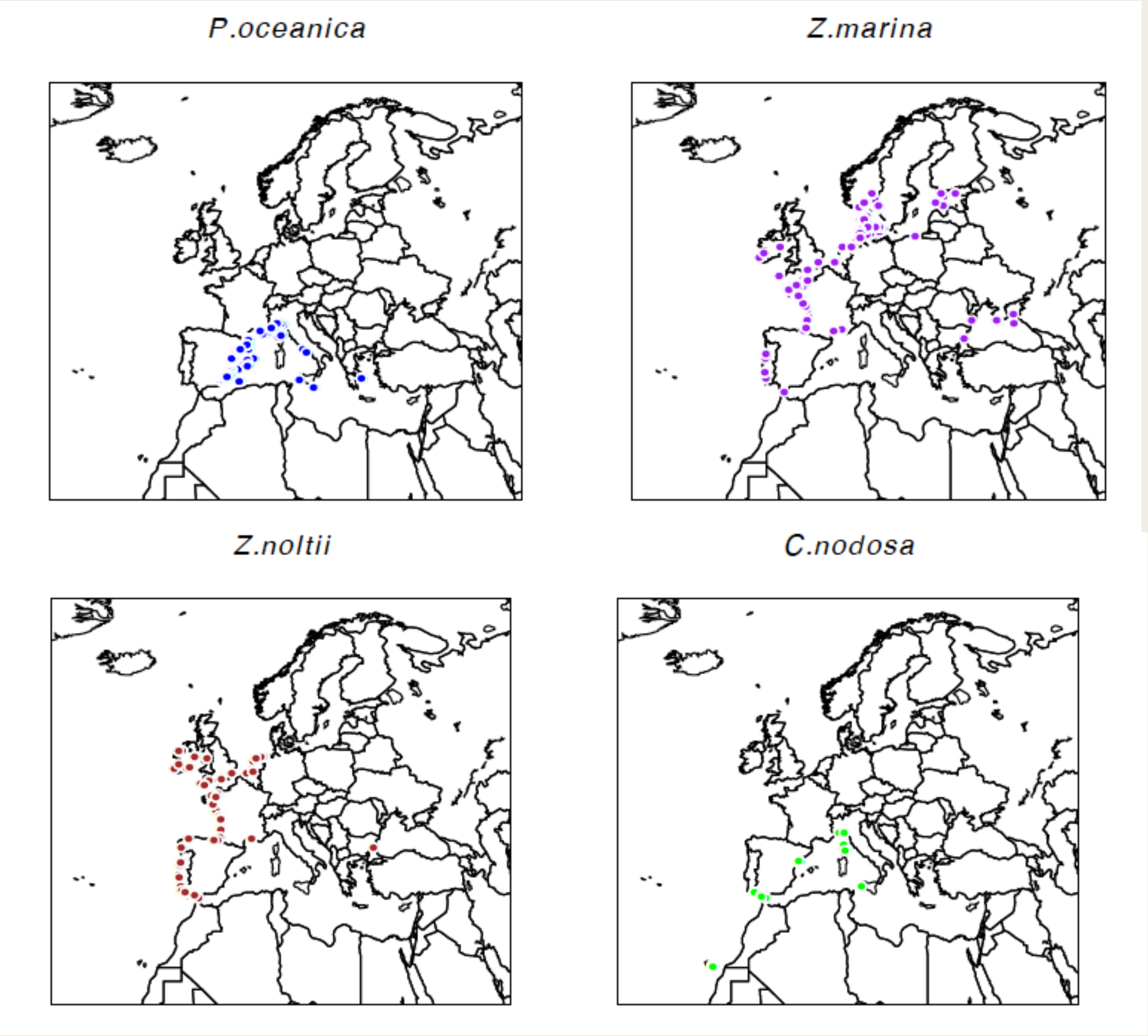


- Seagrass monitoring programmes are implemented in only 10 countries out of 19.
- Half of the countries with monitoring programmes stated that they are part of the Water Framework Directive and/or Habitat Directive.

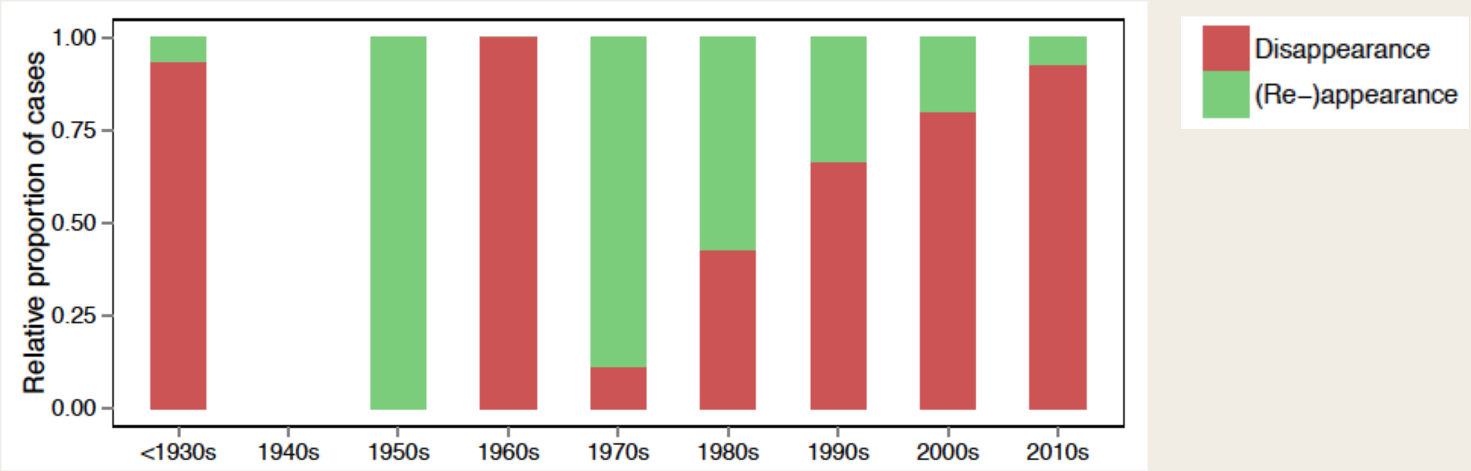


WG 3/4. Time trajectories of European seagrasses

Carmen Barrena and many authors (in preparation)



WG 3/4. Time trajectories of European seagrasses



Species	**Losses in area (ha)**	**Gains in area (ha)**	**Net changes (ha)**
C. nodosa	-391.25 (11)	526.37 (13)	135.12
P. oceanica	-7958.86 (4)	154.25 (33)	-7 804.61
Z. marina	-35448.91 (14)	2541.97 (37)	-32 906.94
Z. noltii	-5917.79 (21)	1950.88 (16)	-3 966.91
Total	-49716.81	5173.47	-44 543.34

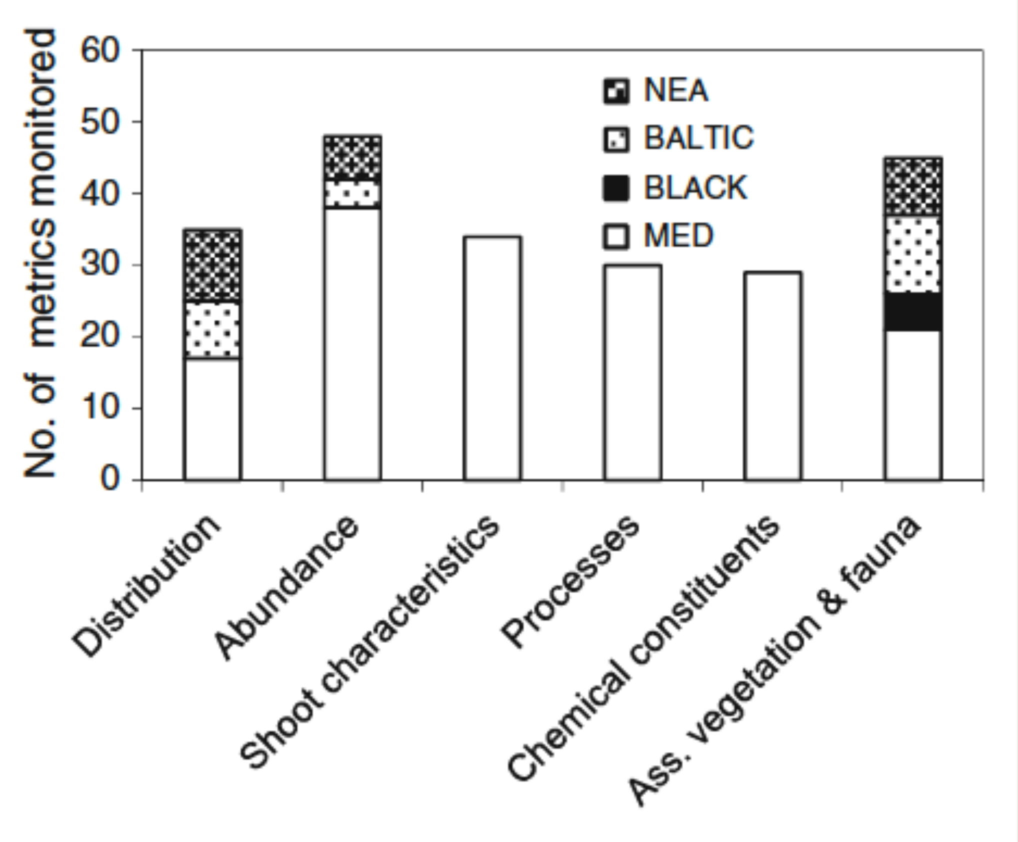
WG 4. Diversity of European seagrass indicators

Marbá et al (2013). Diversity of European seagrass indicators: patterns within and across regions. Hidrobiologia. DOI 10.1007/s10750-012-1403-7

51 metrics in 42 monitoring programs

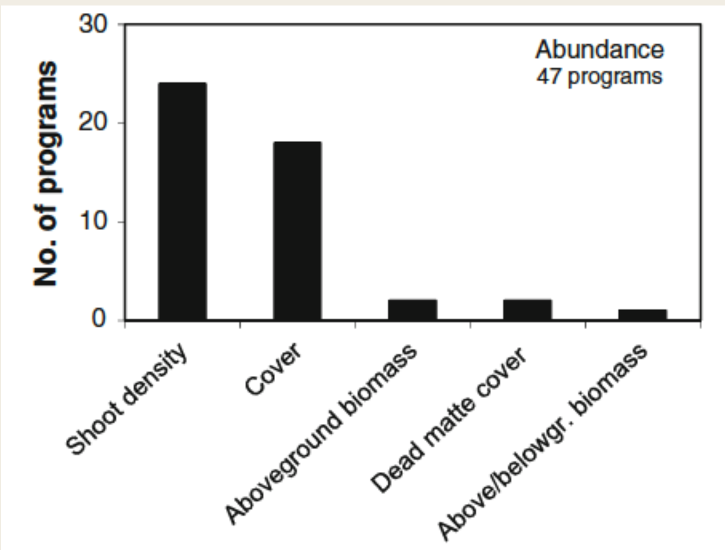
Too many, considering the possibility of providing pan-European assessments of seagrass status

A large set of indicators is used only in Mediterranean

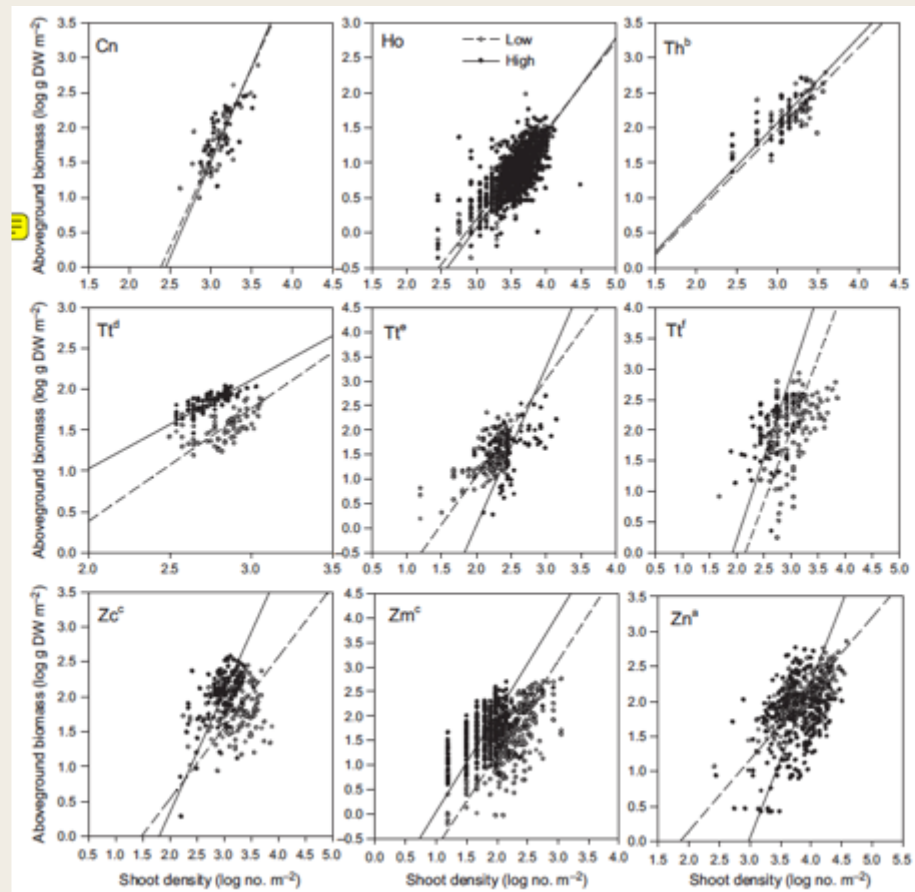


WG 4. Seagrass indicators: density and biomass

Marbá et al (2013)



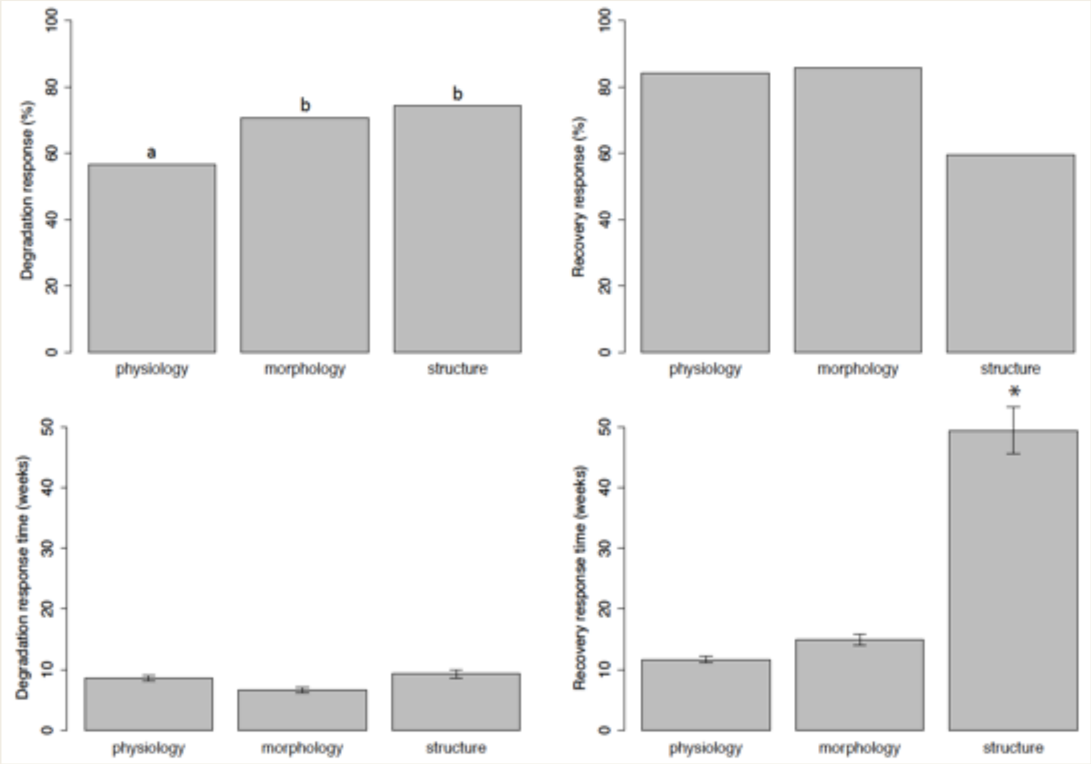
Cabaço et al (2013). Effects of nutrient enrichment on seagrass population dynamics: evidence and synthesis from the biomass-density relationships. Journal of Ecology. doi: 10.1111/1365-2745.12134



Biomass is not commonly monitored
However, B/D relationships reflect the nutrient load of systems

WG 4. Behaviour of indicators

Roca G and many authors (in preparation)



Structural indicators respond more in degradation phase
Physiological indicators respond more and faster in recovery phase

UICN

LIFE+
posidonia
andalucía

seagrass productivity

from genes to ecosystem management

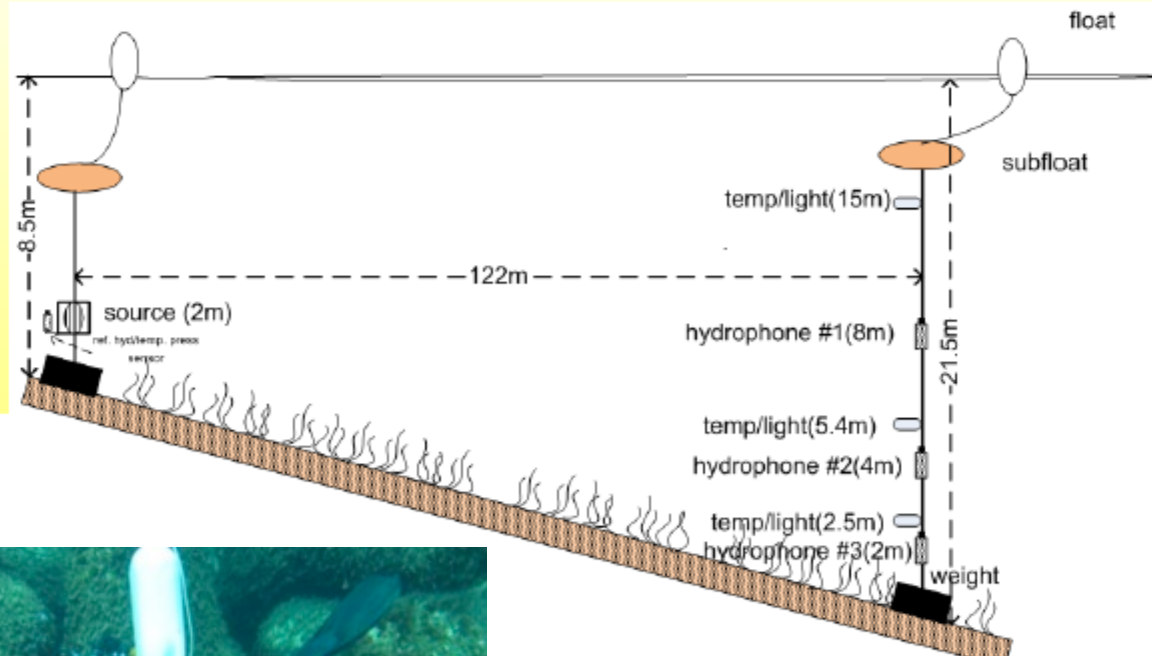
Gracias!

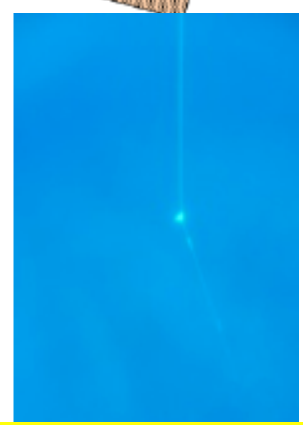
Rui Santos

cost

CCMAR

Measurement Setup





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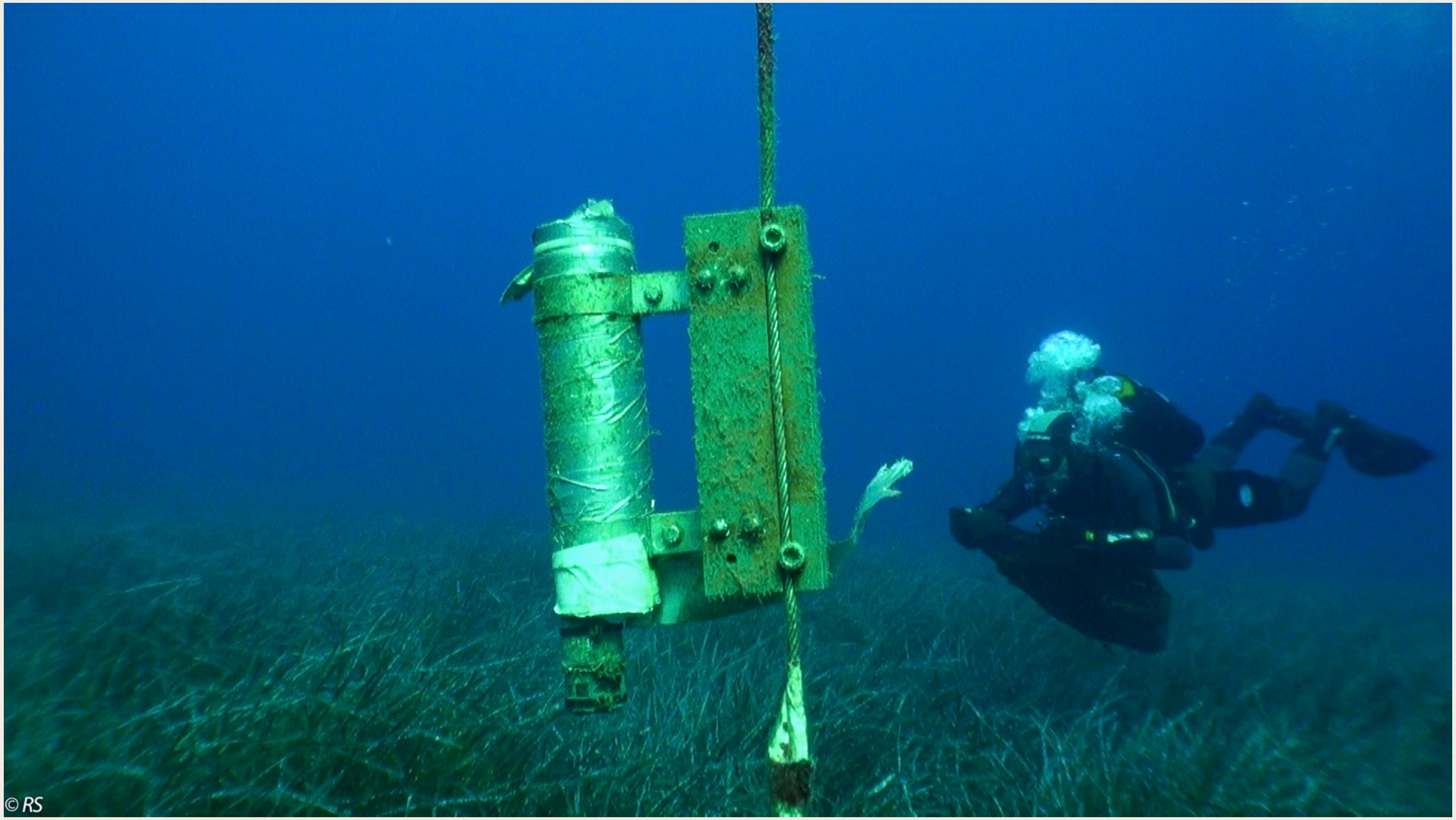
Optode over *P. oceanica* meadow



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NCP incubation chambers

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Floating equilibrator chamber

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Automated shutter fluorometer

Aquation, Australia

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