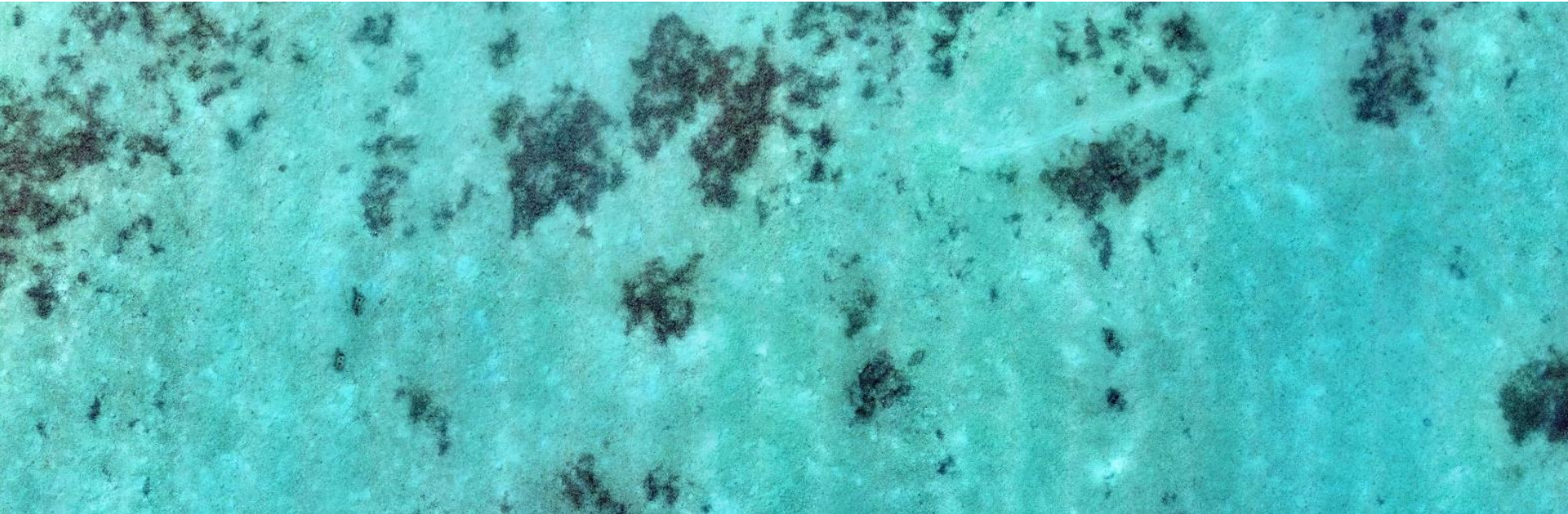


A novel approach to monitor the deep limits of *Posidonia oceanica* meadows: seascape analysis using high-resolution underwater orthomosaics

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¹Seagrass Ecology Group (IEO-CSIC), Spain. jose.martinez@ieo.csic.es ²Uware Robotics S.L, Spain. ³Department of Ecology and Hydrology, UM, Spain.

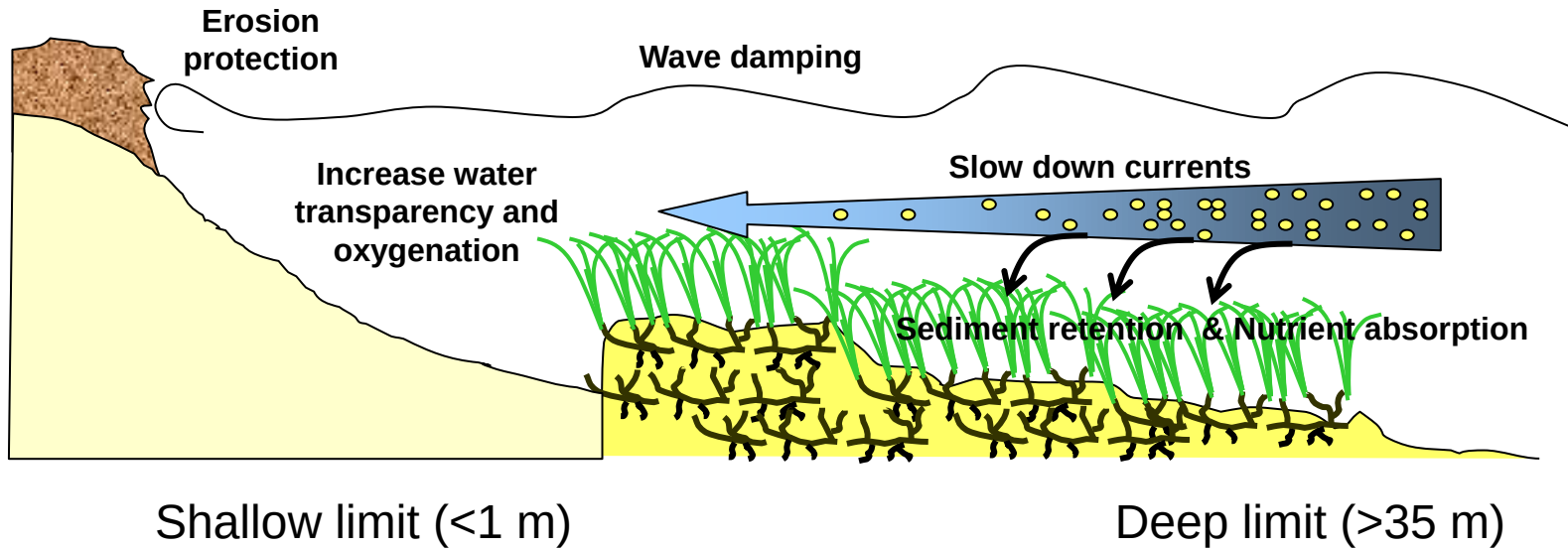


Introduction

Posidonia oceanica



Key mediterranean species



Introduction

Deep limits



***P. oceanica* close to its physiological threshold**

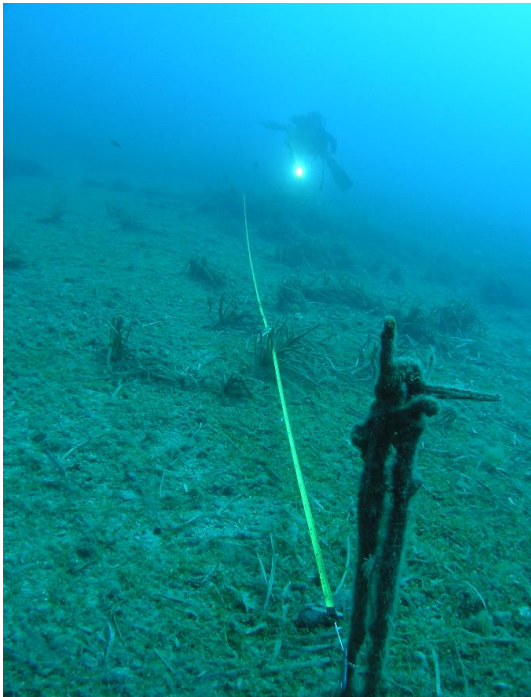
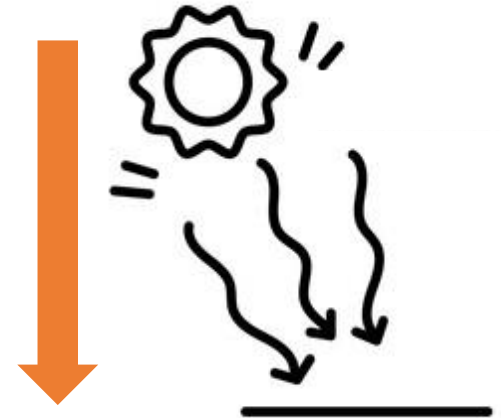


Introduction

Deep limits

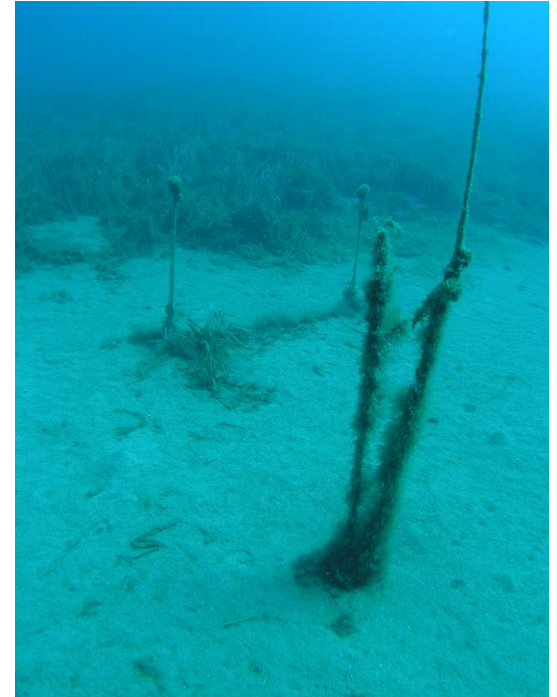


P. oceanica close to its physiological threshold



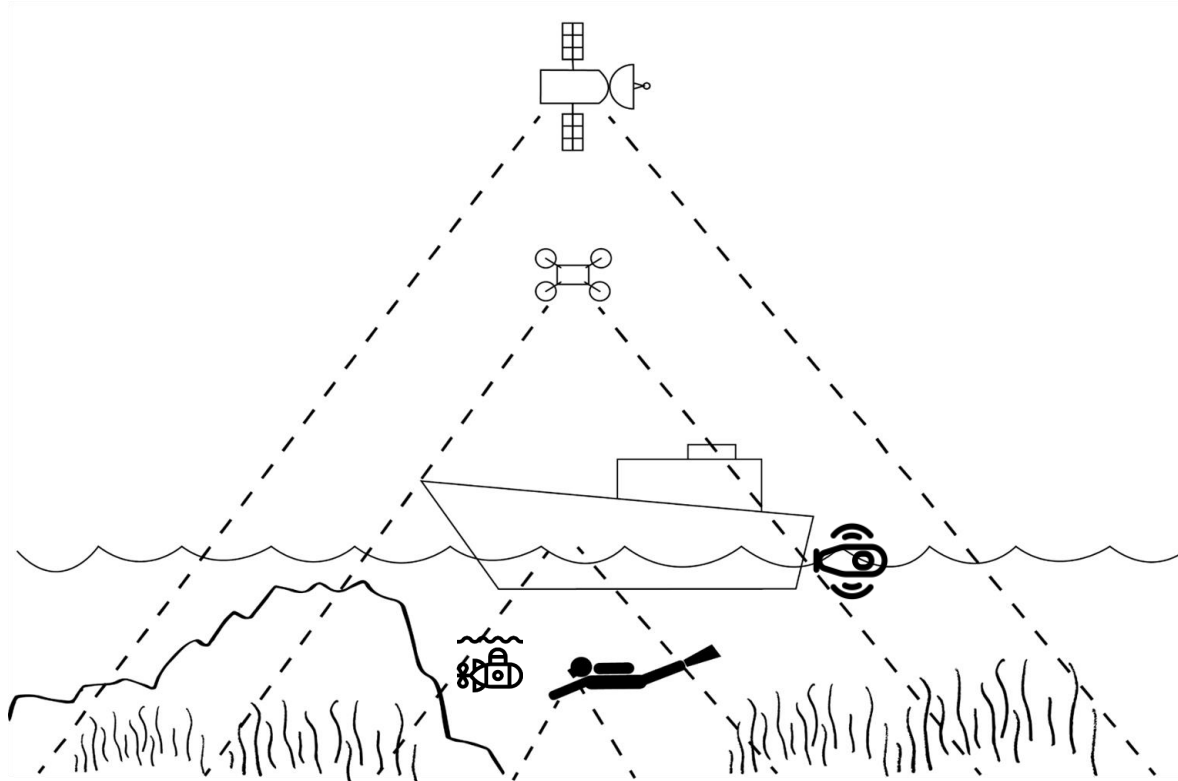
Meadows are **very sensitive** to climate and antropogenic pressures

Changes in the distribution of these limits are directly related to the health of meadows and could be used as **indicator** to assess the habitat status in the Habitat Directive and MSFD



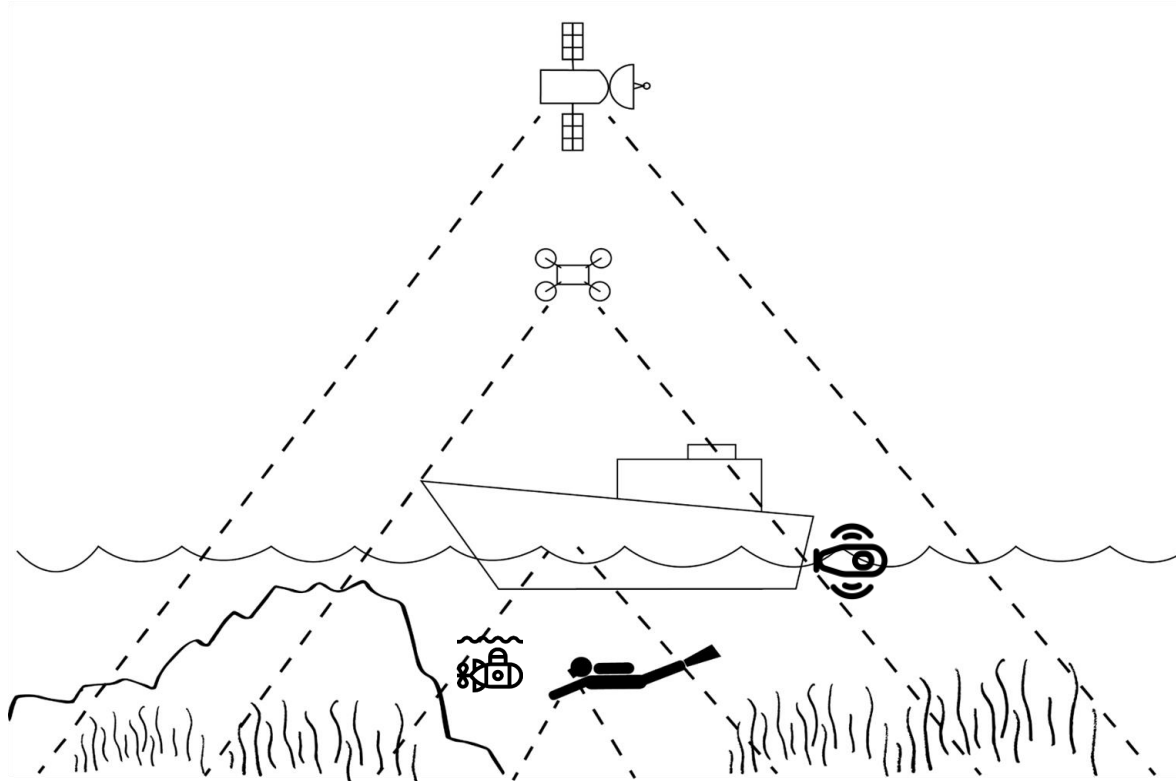
Introduction

Methods and challenges



Introduction

Methods and challenges



Satellite/ drone

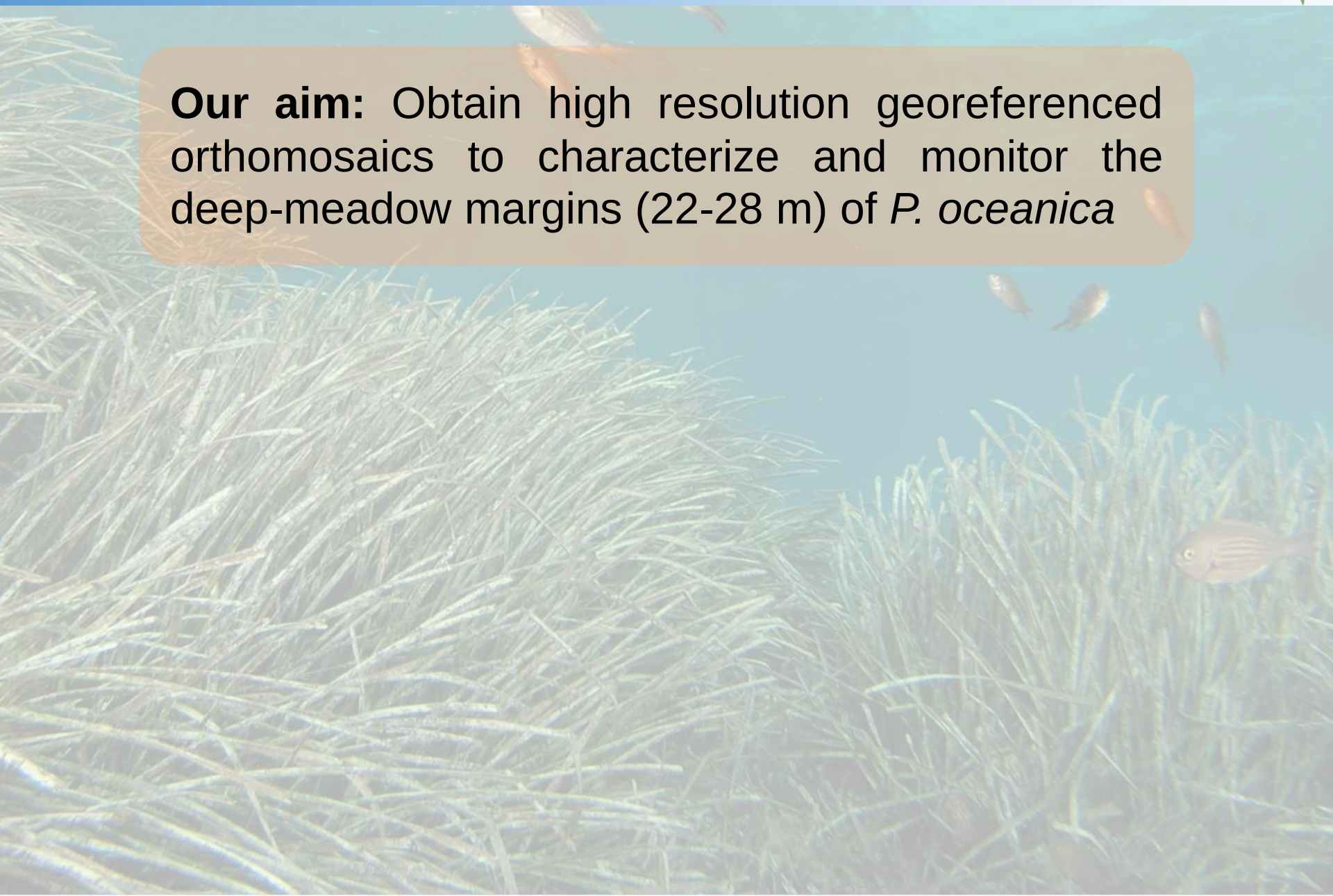
image **low**
penetration in
turbid waters

Diving studies
risky and **costly** at
high depths

Objectives



Our aim: Obtain high resolution georeferenced orthomosaics to characterize and monitor the deep-meadow margins (22-28 m) of *P. oceanica*



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1. Develop georeferenced orthomosaics with AUV



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1. Develop georeferenced orthomosaics with AUV
2. Classify the orthomosaics with Random Forest



Our aim: Obtain high resolution georeferenced orthomosaics to characterize and monitor the deep-meadow margins (22-28 m) of *P. oceanica*

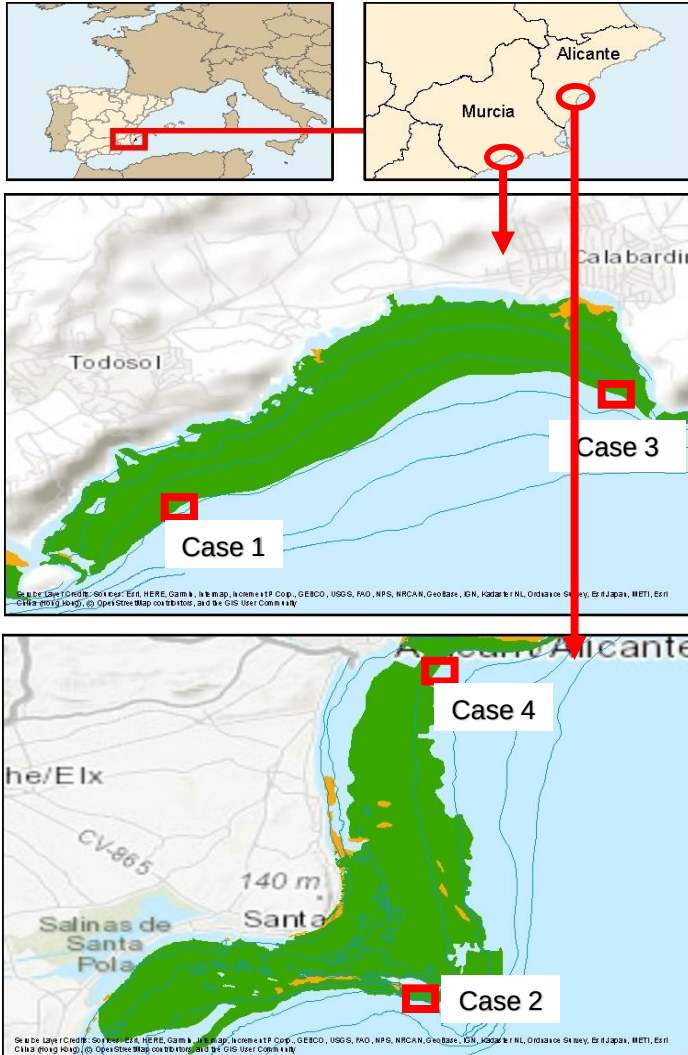
1. Develop georeferenced orthomosaics with AUV
2. Classify the orthomosaics with Random Forest
3. Validate the results with diving data

Methods

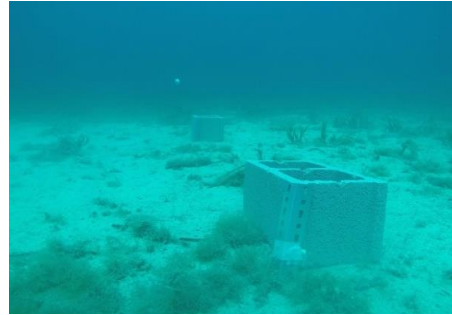
Study area



4 study cases



Fixed marks



Meadow cover (%)

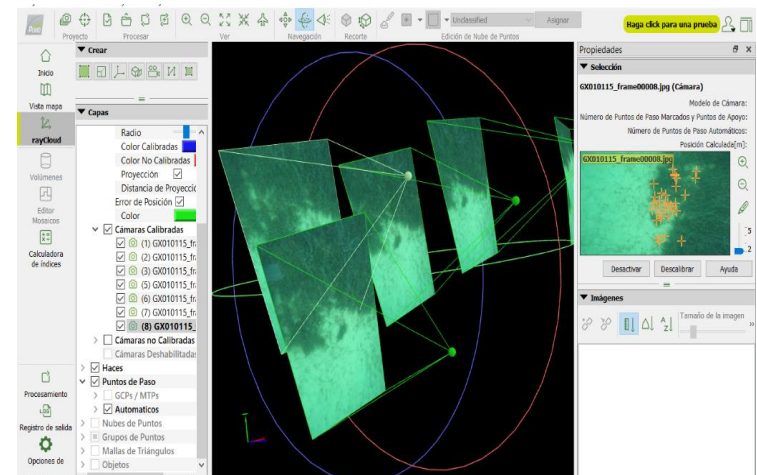
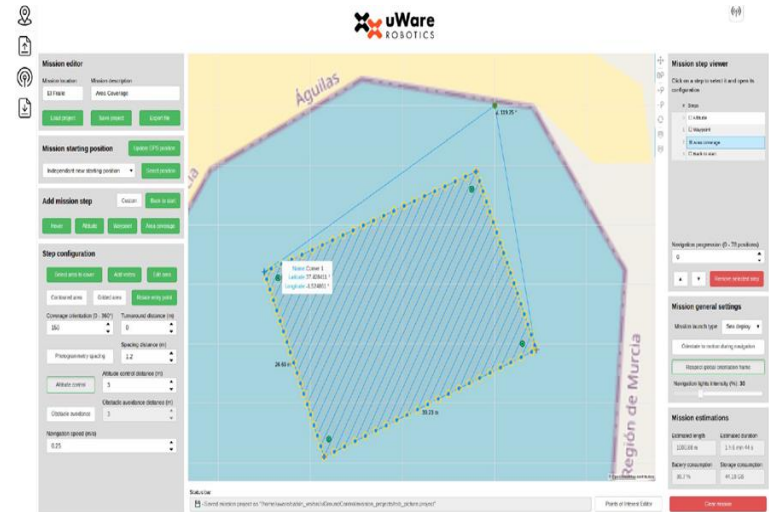


Methods

AUV



Autonomus Underwater Vehicule (AUV; uWARE Robotics)

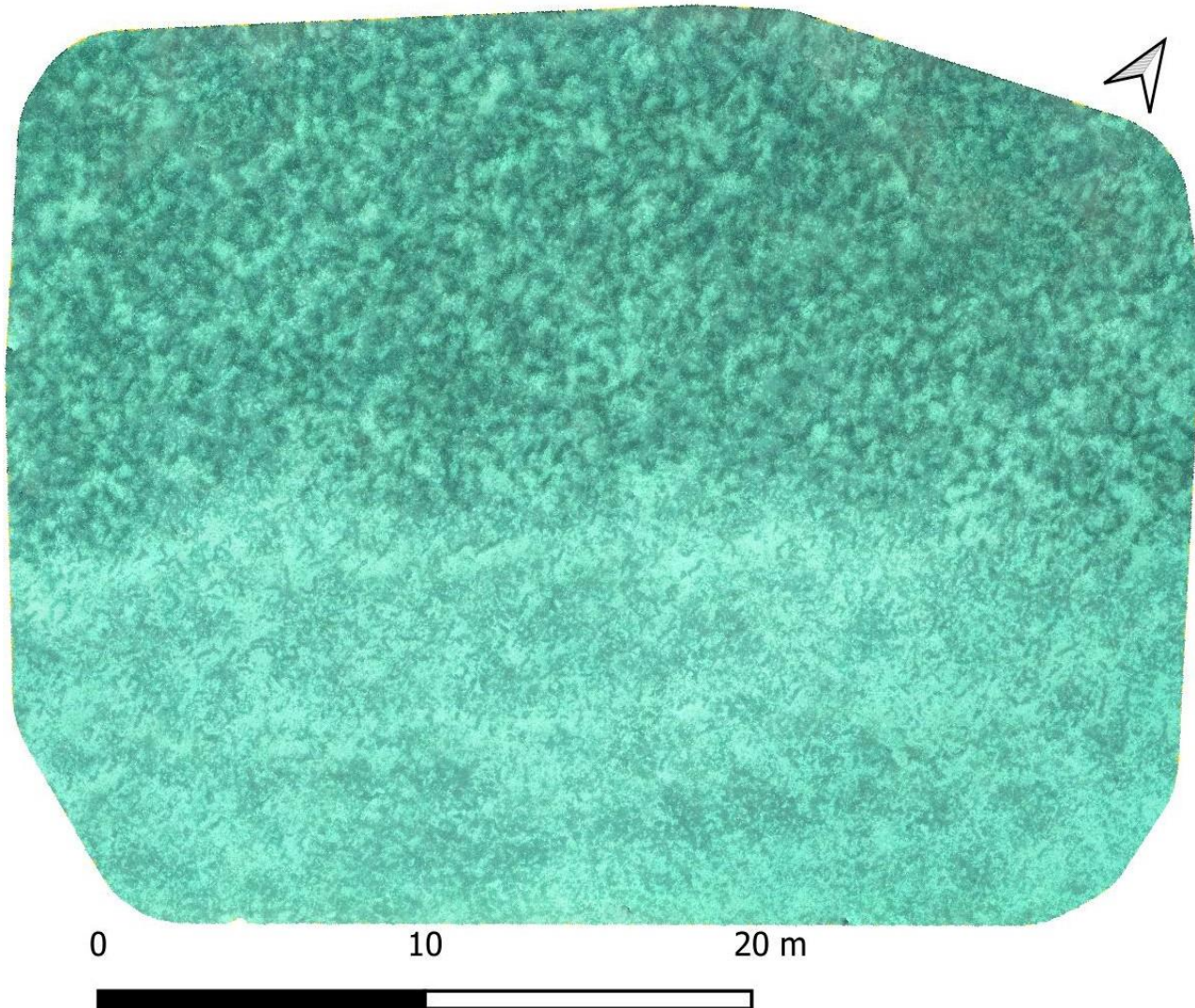


Results

Georeferenced orthomosaics



Case 1: Depth: 24 m. Area: 954 m²

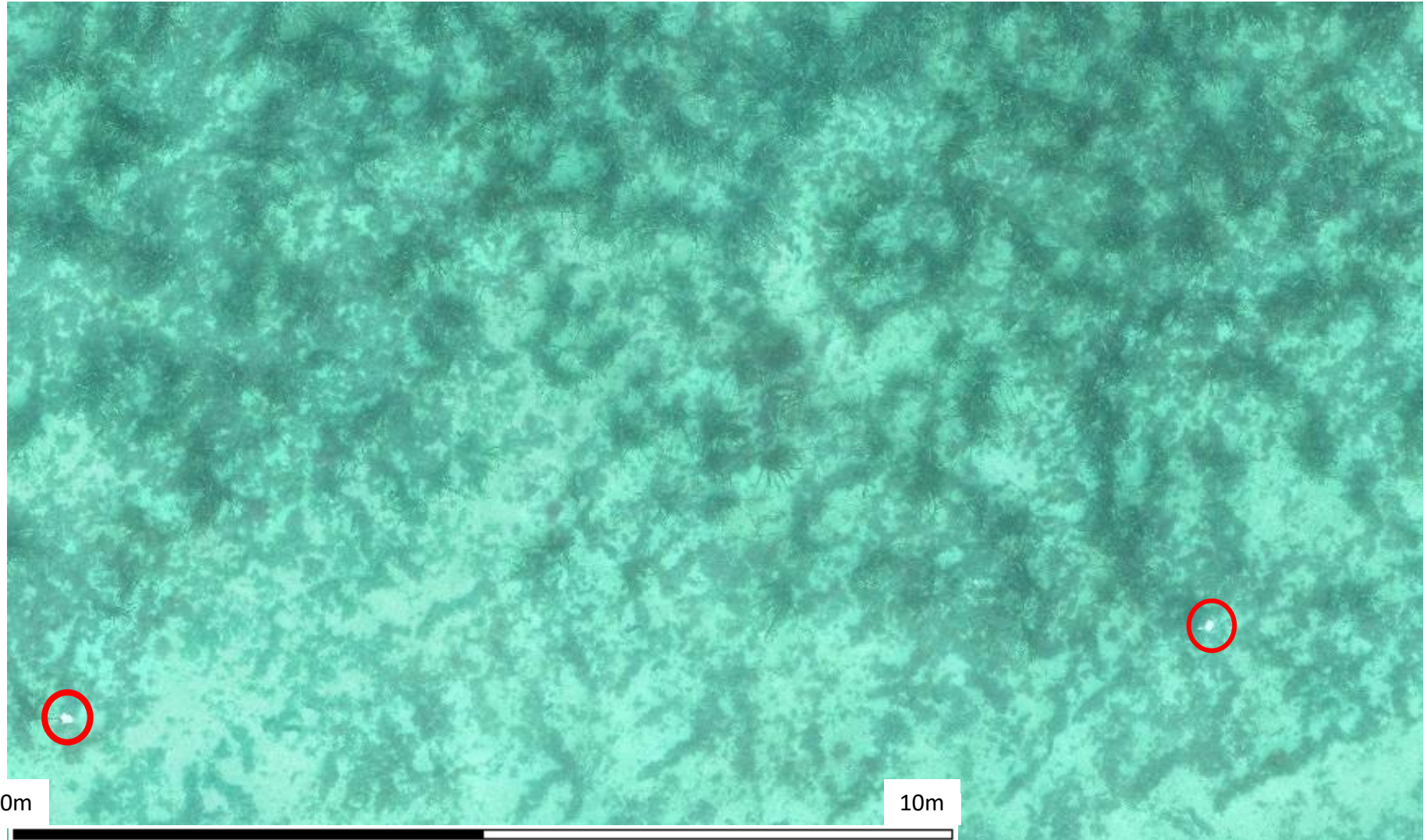


Results

Georeferenced orthomosaics



Case 1: Depth: 24 m. Area: 954 m²

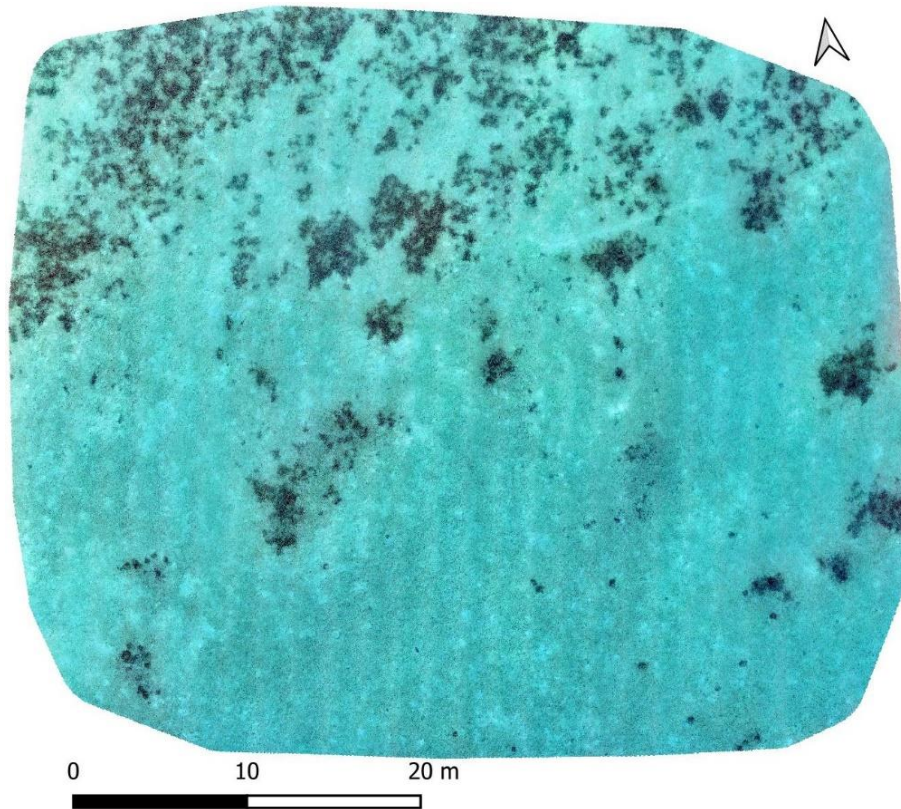


Results

Georeferenced orthomosaics



Case 2: Depth: 27 m. Area: 2037 m²

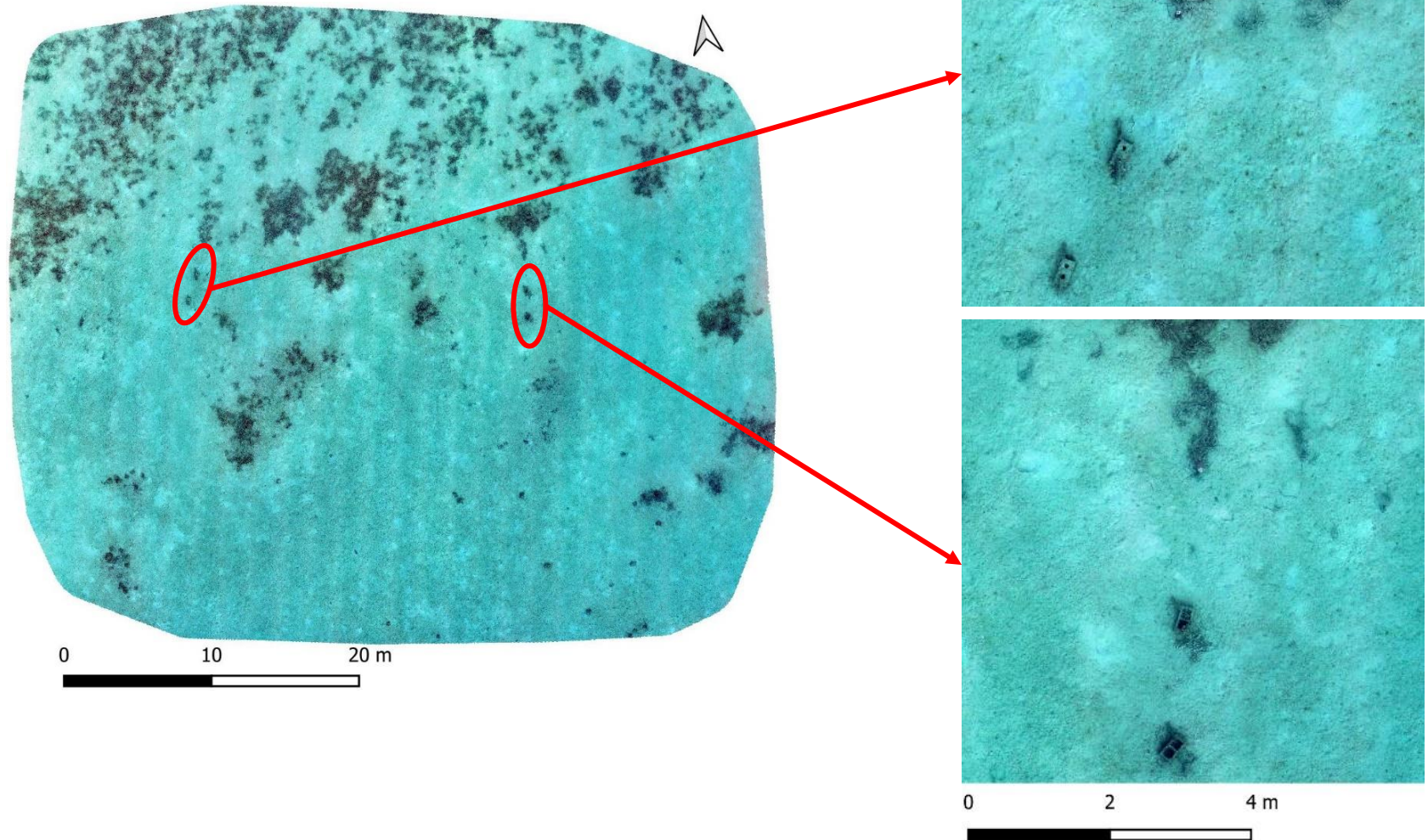


Results

Georeferenced orthomosaics



Case 2: Depth: 27 m. Area: 2037 m²

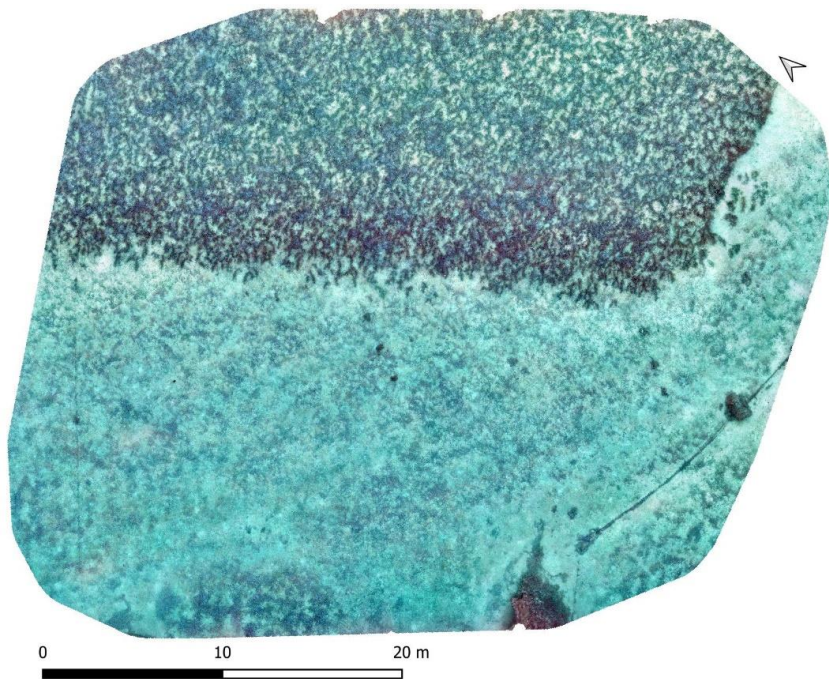


Results

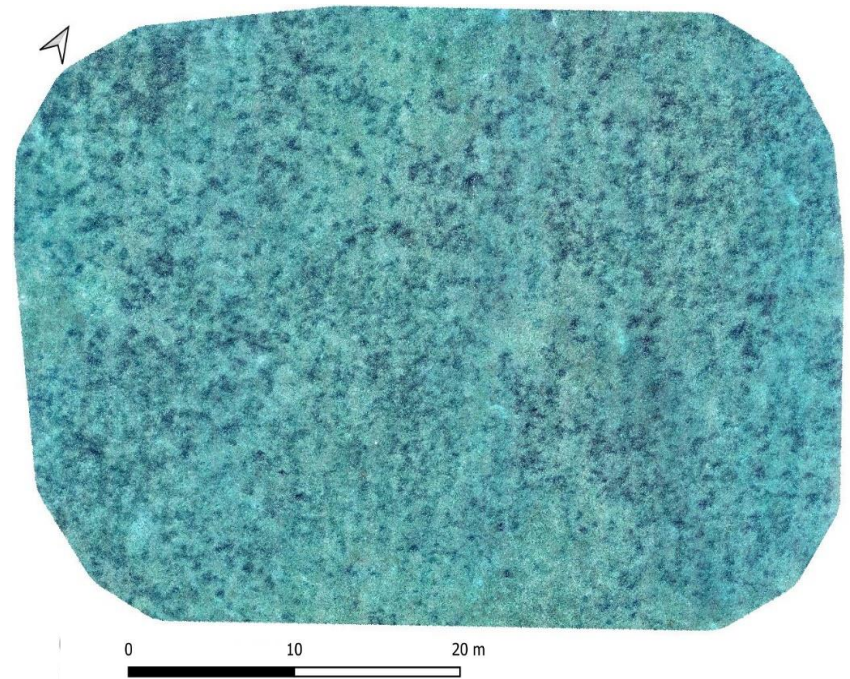
Georeferenced orthomosaics



Case 3: Depth: 24 m. Area: 1348 m²



Case 4: Depth: 22 m. Area: 1698 m²

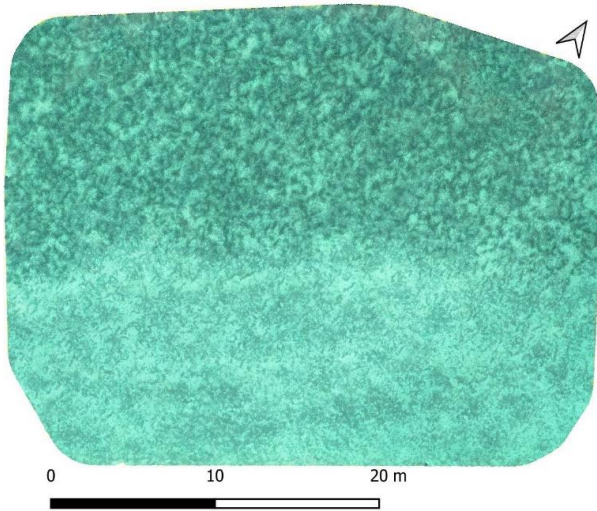


Results

Classification



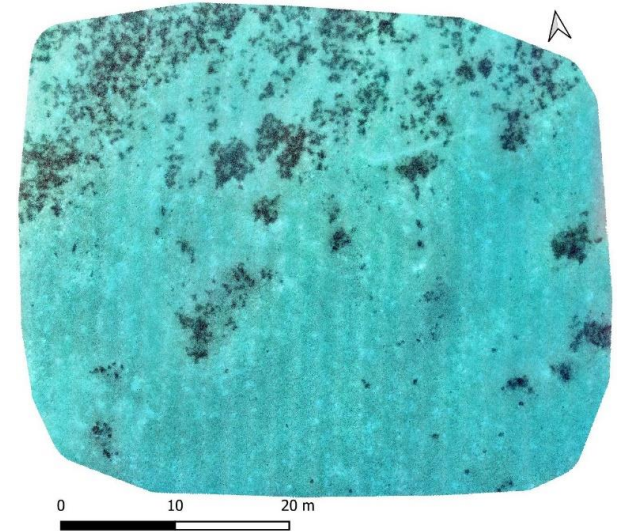
Case 1 - Accuracy: 94%



True label	Predicted label	
	Posidonia	Sand
Posidonia	21	4
Sand	2	76

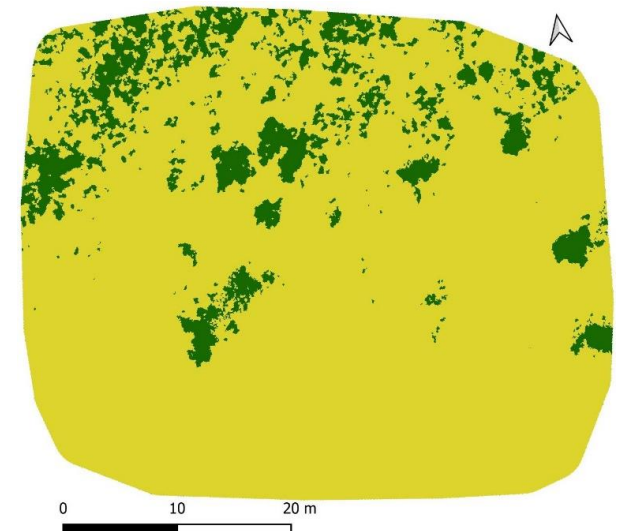
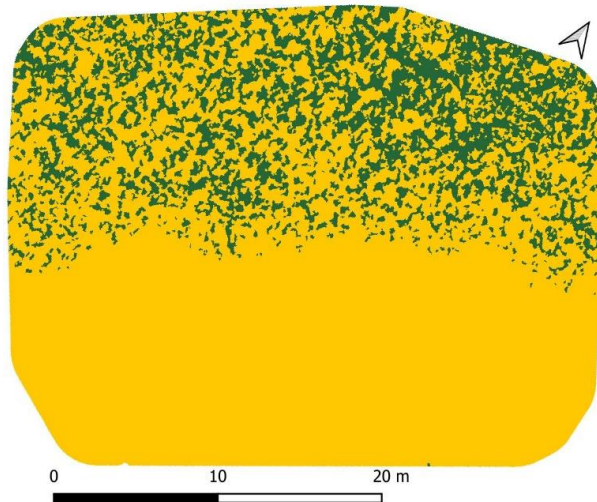
Accuracy: 94.17
Precision: 91.30
Sensitivity_recall: 84.00
F1-score: 87.50

Case 2 - Accuracy: 89%



True label	Predicted label	
	Posidonia	Sand
Posidonia	25	5
Sand	4	55

Accuracy: 89.11
Precision: 85.37
Sensitivity_recall: 87.50
F1-score: 86.42

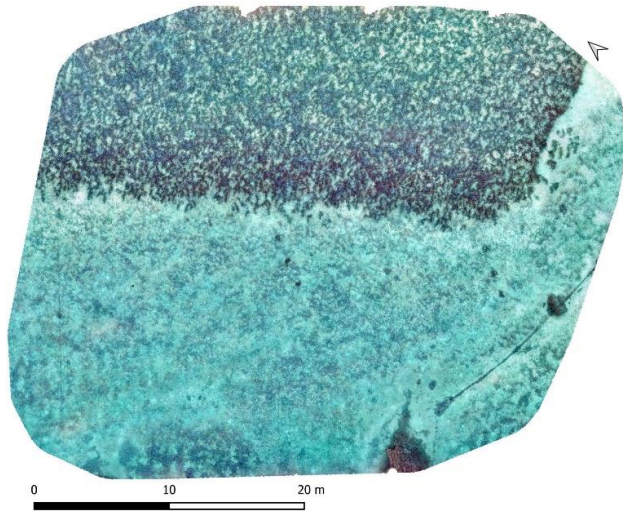


Results

Classification



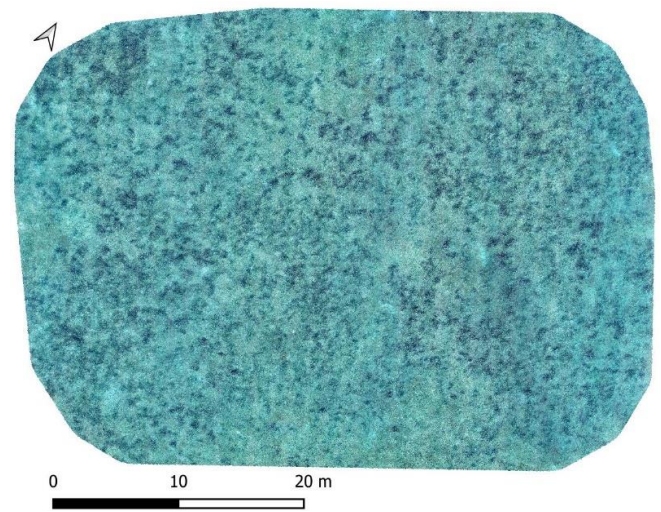
Case 3 - Accuracy: 92%



True label	Predicted label	
	Posidonia	Sand
Posidonia	24	7
Sand	1	68

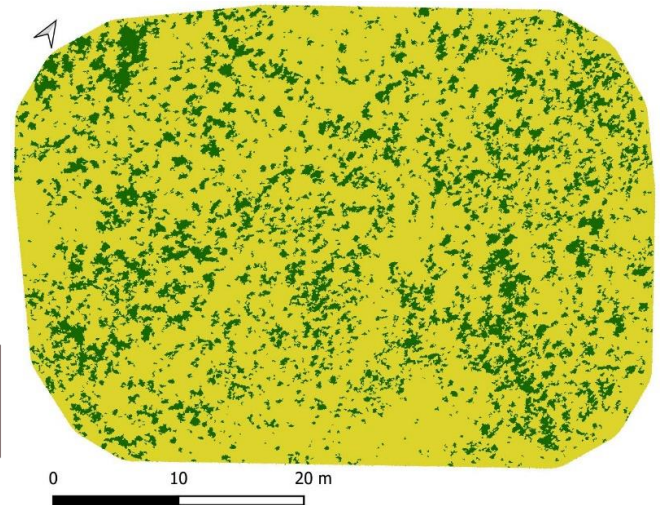
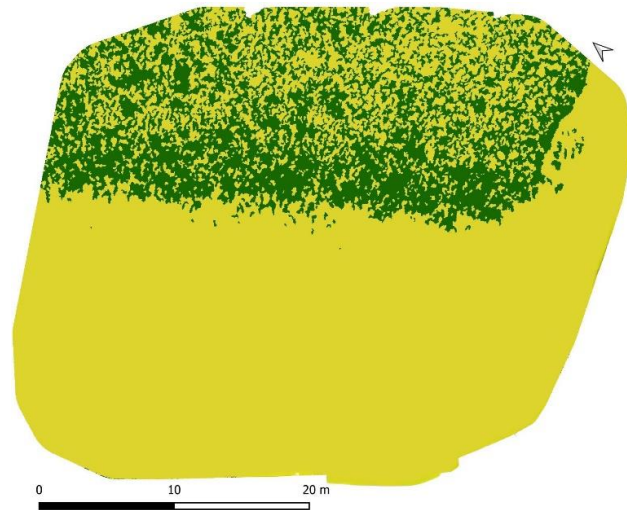
Accuracy: 92.00
Precision: 96.00
Sensitivity_recall: 77.42
F1-score: 85.71

Case 4 - Accuracy: 83%



True label	Predicted label	
	Posidonia	Sand
Posidonia	17	15
Sand	2	66

Accuracy: 83.00
Precision: 89.47
Sensitivity_recall: 53.12
F1-score: 66.67

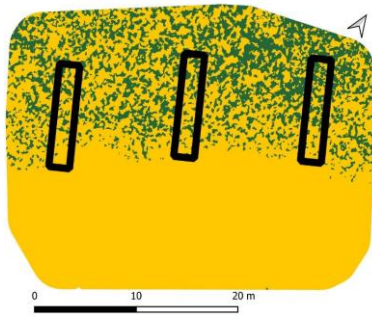


Results

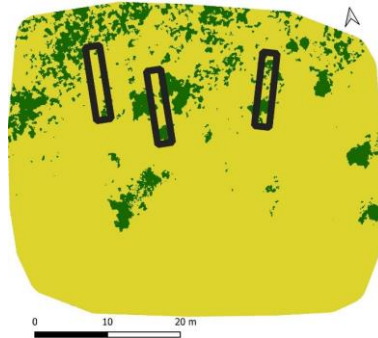
AUV vs Diving data



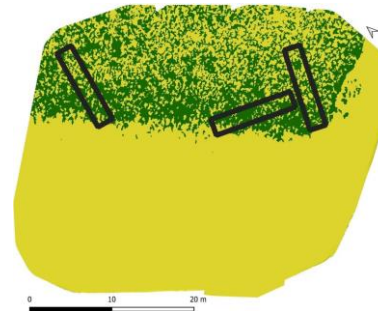
Case 1



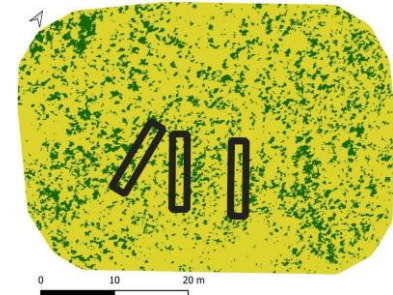
Case 2



Case 3



Case 4

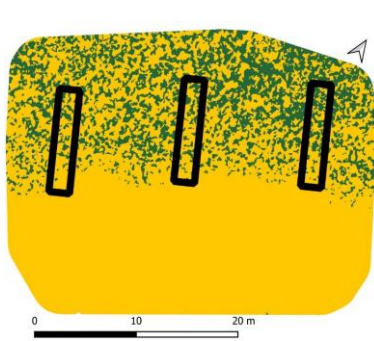


Results

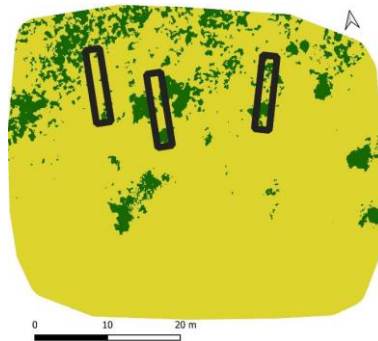
AUV vs Diving data



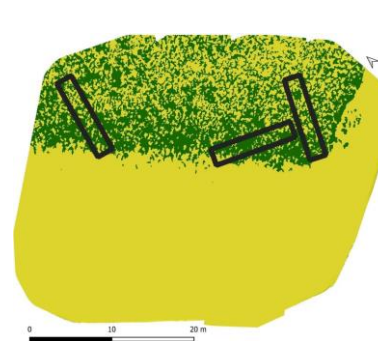
Case 1



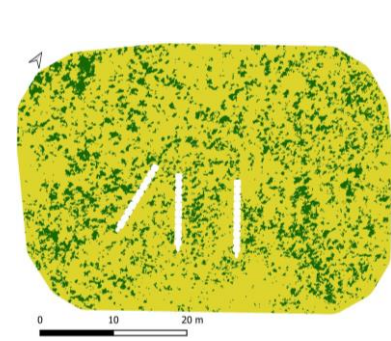
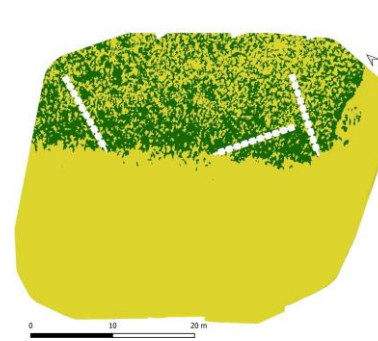
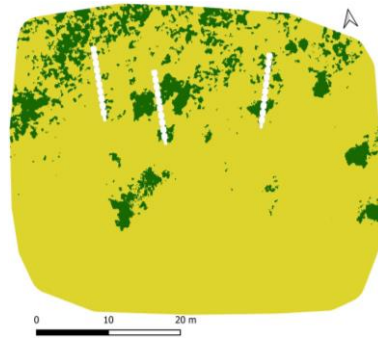
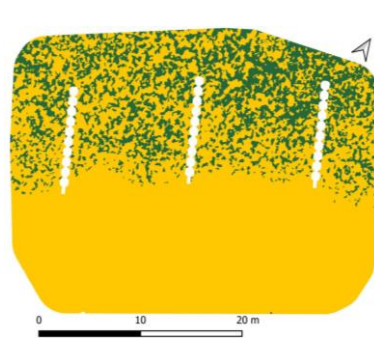
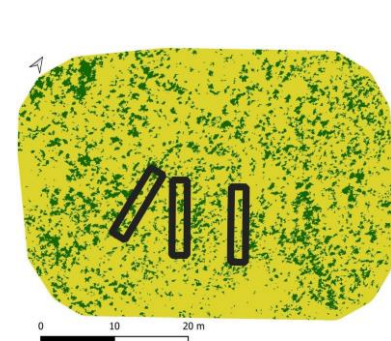
Case 2



Case 3

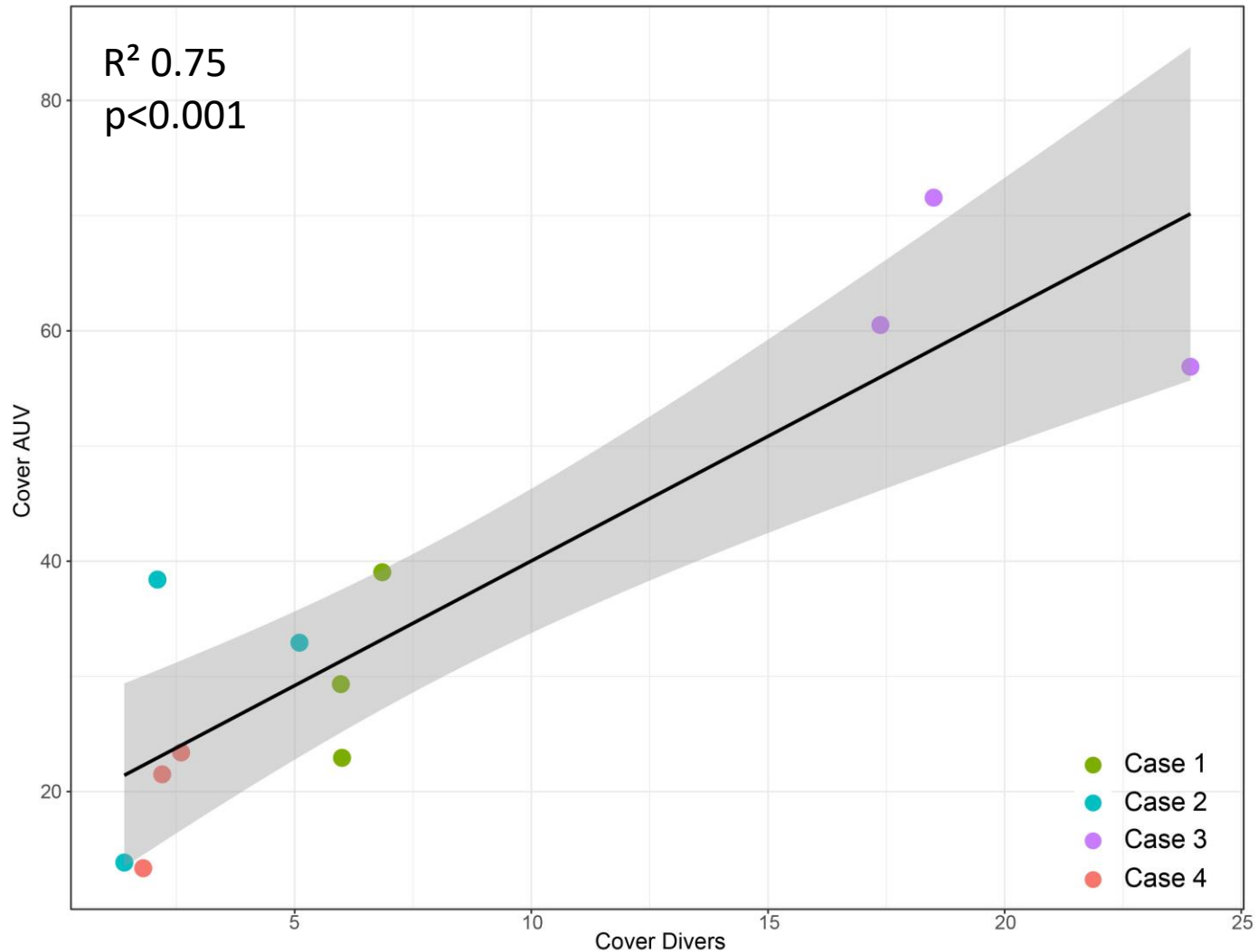


Case 4





Regression analysis

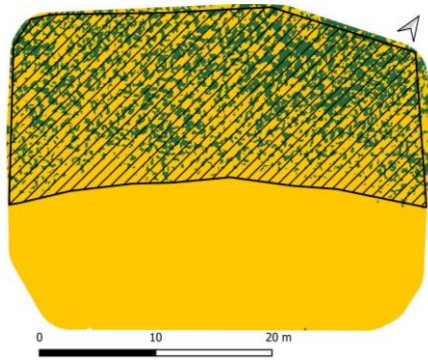


Results

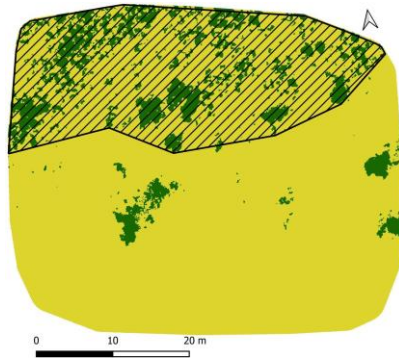
Seascape analyses



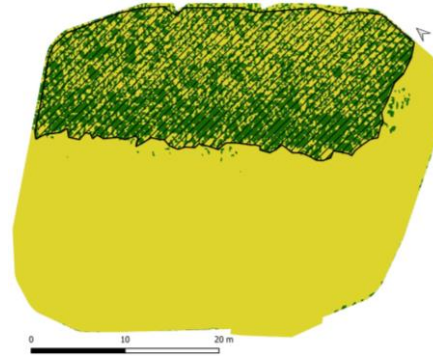
Case 1



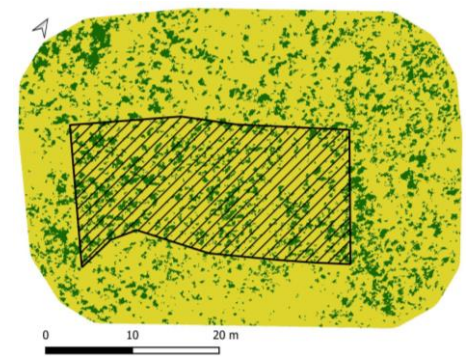
Case 2



Case 3



Case 4



Case	Area (m ²)	Cover (%)	# Patches	Perimeter (m)
Case 1	445	36,7	481	2502
Case 2	727	25,7	283	1454
Case 3	519	56,6	265	3066
Case 4	470	22,6	604	1901

Conclusions



- Accurately detect distribution changes and fragmentation processes in the same area over years.
- Apply new seascape analyses to the meadows.
- Detect early signs of meadows degradation.



***Thank you for your
attention!***



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