3rd MEDITERRANEAN SYMPOSIUM ON THE CONSERVATION OF THE DARK HABITATS

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Monitoring the complex benthic habitat on semi-dark underwater marine caves using photogrammetry-based 3D reconstructions

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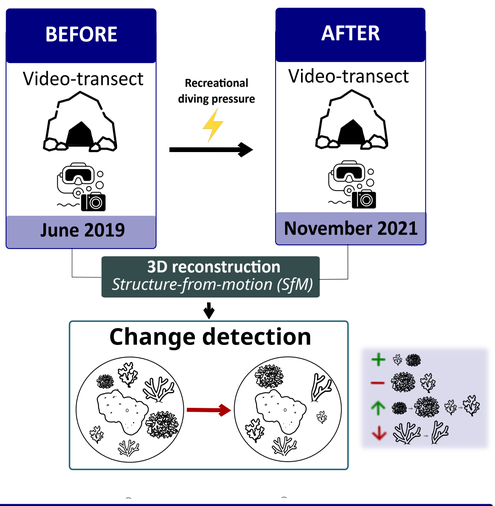
Introduction

Marine caves are dark environments considered a priority habitat for conservation included in the EU Habitats Directive (H8330). They harbor fragile benthic communities and represent a major reservoir of marine biodiversity [1]. However, there is a lack of knowledge of these habitats due to the difficulties of creating detailed benthic maps and characterizing the biodiversity, structure, and dynamics of their communities. This study aims to build a monitoring framework to characterize the structure and temporal dynamics of marine caves using Structure-from-motion (SfM) photogrammetry. SfM is a novel, non-invasive technique that relies on images acquired by video footage to build fine-scaled 3D digital models of the substrate using overlapping imagery [2].



Method

→ We carried out two surveys by scuba diving in **June 2019** and **November 2021** in a marine cave **highly frequented by divers**, located in Illa de l'Aire (Balearic Islands, Spain).

1 Permanent transect installation

To create a **reference network** defined by several well identifiable points to unequivocally **identify the transect area** in successive samplings.

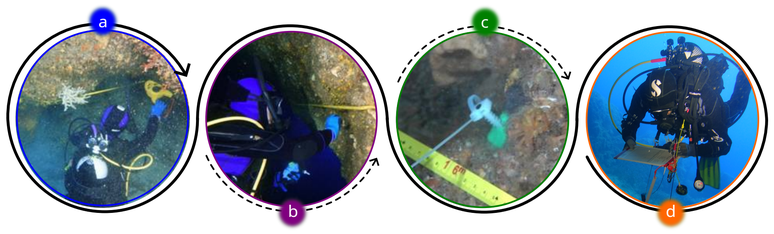


Figure 1. Steps to install permanent transects. a) Tape measure placing; b) Polyamide screw fixation; c) Fixed screw detail; d) Screw location recording.

2 Image acquisition

A **guideline** is placed for a visual reference, and **three-dimensional scales** are placed for scaling.

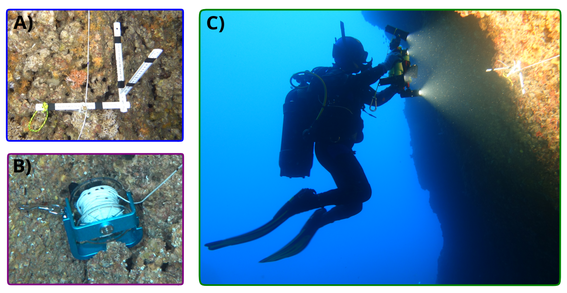


Figure 2. (A) Three-dimensional scale; (B) Guideline reel; (C) In situ permanent transect recording.

3 Image processing

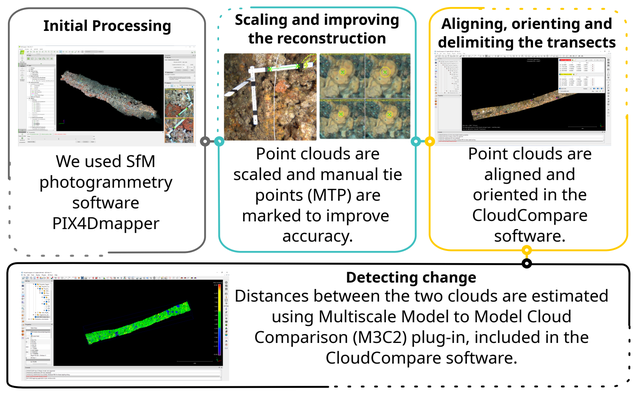


Figure 3. Schematic workflow of image processing for change detection using 3D SfM reconstructions.

Results

→ We found a **loss of 12 colonies of erect bryozoans** with fragile skeletons and **5 individual sponges with globose morphotypes.**

→ For the main structural species, the bryozoan **S. serratimargo**, we were able to observe the **settlement of 7 new colonies** and the **increase** in diameter and height of **30 colonies.**

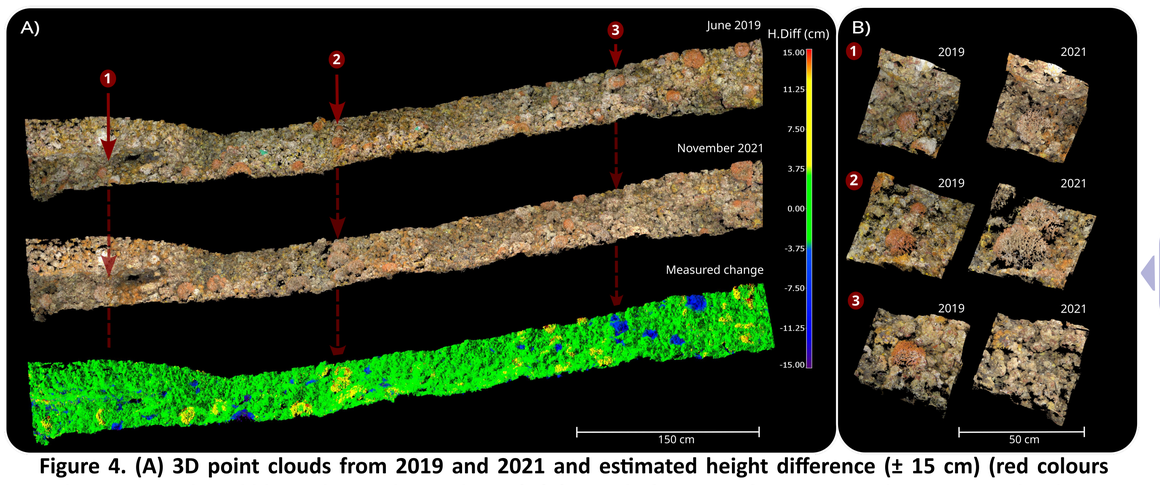


Figure 4. (A) 3D point clouds from 2019 and 2021 and estimated height difference (± 15 cm) (red colours indicates growth and blue colour indicates losses); (B) Detail of sections from 2019 and 2021 point clouds.

View transect reconstruction

Conclusions and future perspectives

- Our results indicate that this methodology produces a detailed 3D reconstruction of the marine cave surface, that allows us to easily visualize and identify changes in benthic organisms over time.
- This technique enables an efficient monitoring of benthic communities in underwater caves, that lead to a better understanding of their dynamics and, therefore, to the development of the necessary management measures.
- This method should be tested to determine the accuracy and precision of measurements in obtaining automatic values of change in size structure and biomass.

Acknowledgements

This work was carried out in the framework of the LIFE IP INTEMARES project (LIFE15 IPE/ES/000012), and the support of the Estació d'Investigació Jaume Ferrer – La Mola.

References

[1] GEROVASILEIOU, V. , VOULTSIADOU, E. (2012). PLoS One, 7: e39873
[2] FONSTAD, M. A., et al. (2013). Earth surface processes and Landforms, 38: 421-430.16

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Organized by UN environment programme | Mediterranean Action Plan Barcelona Convention | SPA/RAC

In partnership with ISPRA | Università di Genova | DISTAV | S.I.B.M.

With the financial support of MAVA Fondation pour la Nature | Co-funded by the European Union