Lo studio dei popolamenti bentonici mediante analisi di immagine

Eva Salvati (SZN)

An image is worth a thousand words:

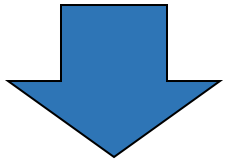
studying hard bottom benthic assemblages

I INTRODUCE MY SELF

Main areas of expertise are

- the ecology, taxonomy and distribution of zoo-benthic communities of rocky bottoms, with particular interest in cnidarian associations of the circalittoral and bathyal zone

- conservation of habitat and specie and biodiversity



acquisition and processing of image data from a remote platform starting from planning sampling to on-board data logging and the **analysis of images** using different software

WHY ARE IMAGES MORE IMPORTANT THAN 1000 WORDS?

- constitute the fundamental element of historical memory
- are free from subjective errors of interpretation
- can be analyzed with different techniques for different purposes
- are comparable in time and space and replicable
- allow us to observe details of great interest for the ecology of the species
- are unlimited thanks to digital photography

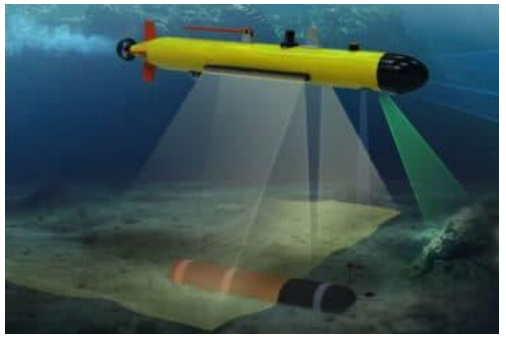
IMAGE ANALYSIS

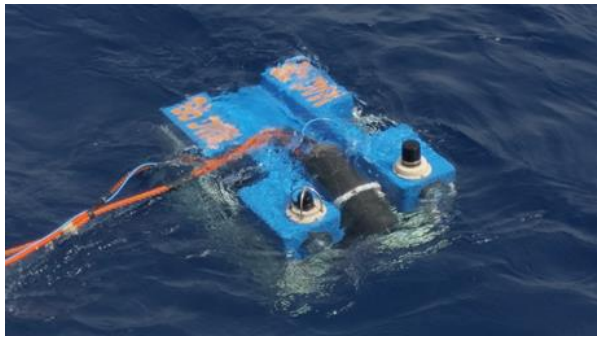
Data analysis starts with the design of the correct sampling plan up to the application of multiparametric indices to the numerical data extrapolated from the images

1. Planning of sampling activities
2. Data recording
3. Image Analysis (Kinowea, NIH-Image, CPCe Coral….)
4. Quali-quantitative data processing

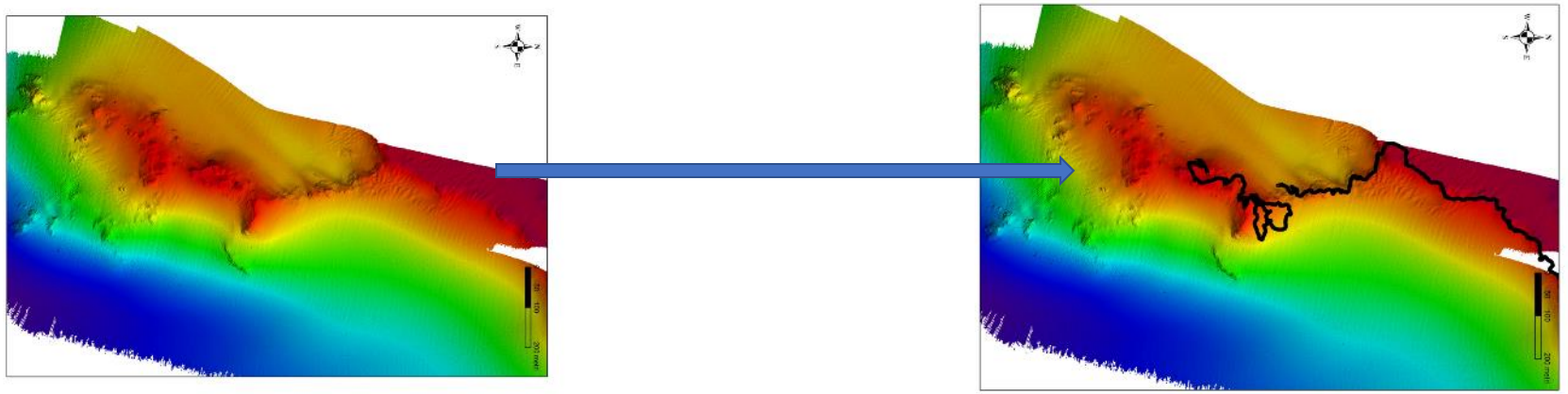
Planning of sampling activities

From remote platform (rov, auv, lander, wire towed camera)

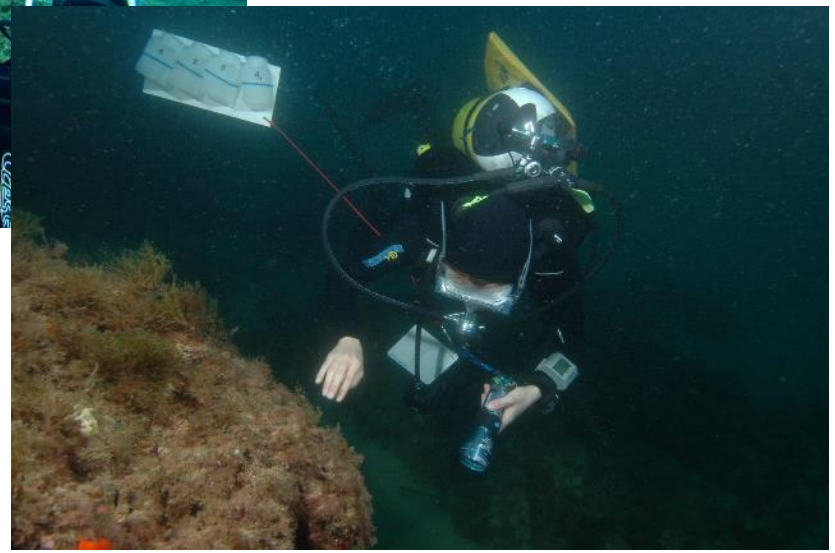




Considering that these are *blind* samplings it is essential to have a cartographic layer of good detail to choose the direction of the ROV and move towards the rocky outcrops.

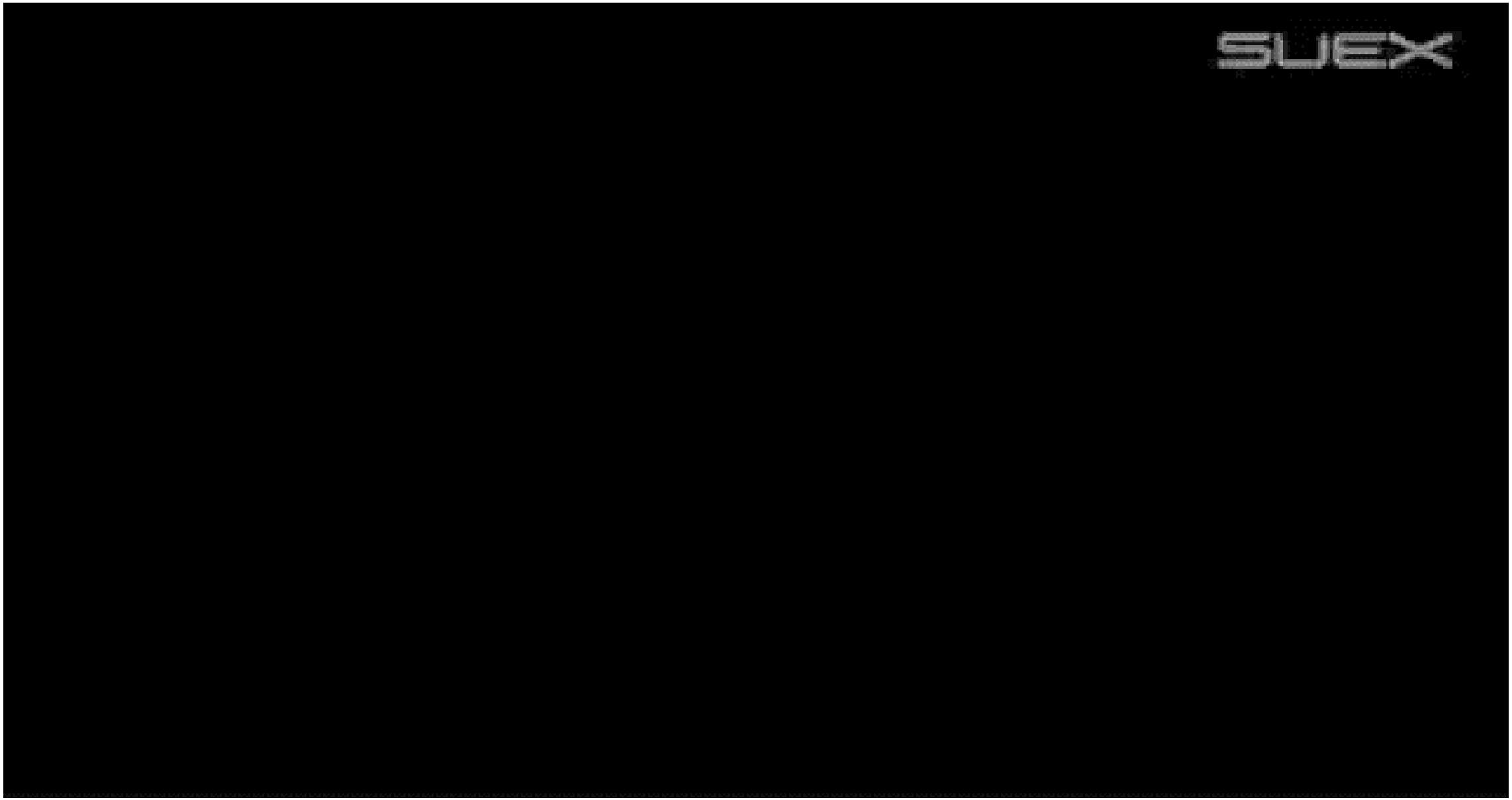


Data logging in situ by divers



- Better performance in sample collection/measurement
- Easy instrument positioning
- Costs of sampling reduced

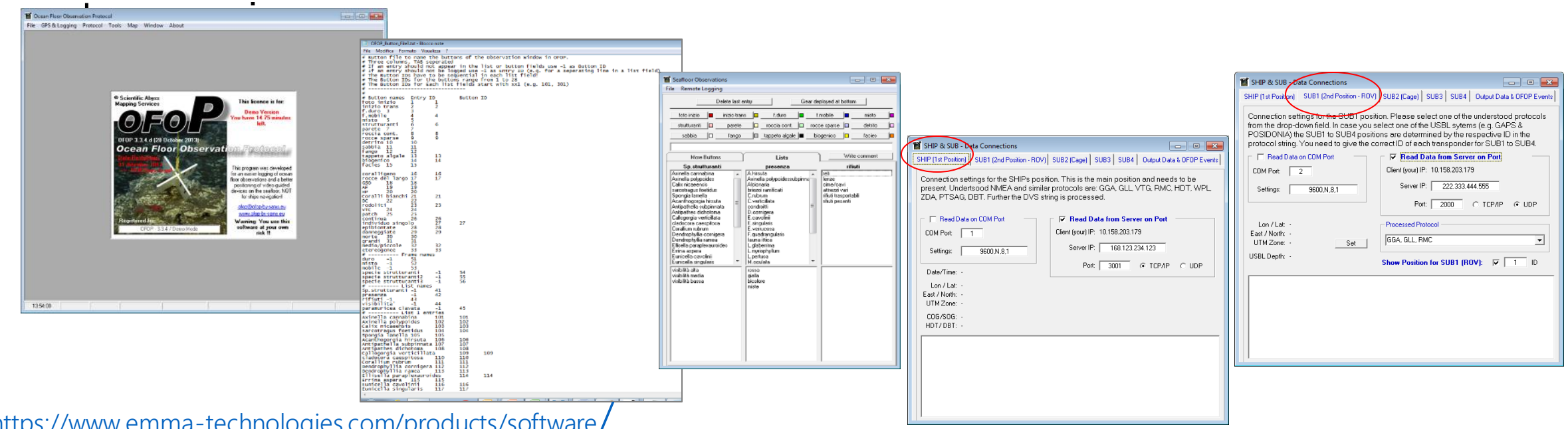
NAVIGATION AND MONITORING OF THE UNDERWATER DPV WITH ERON D–1


SUEX

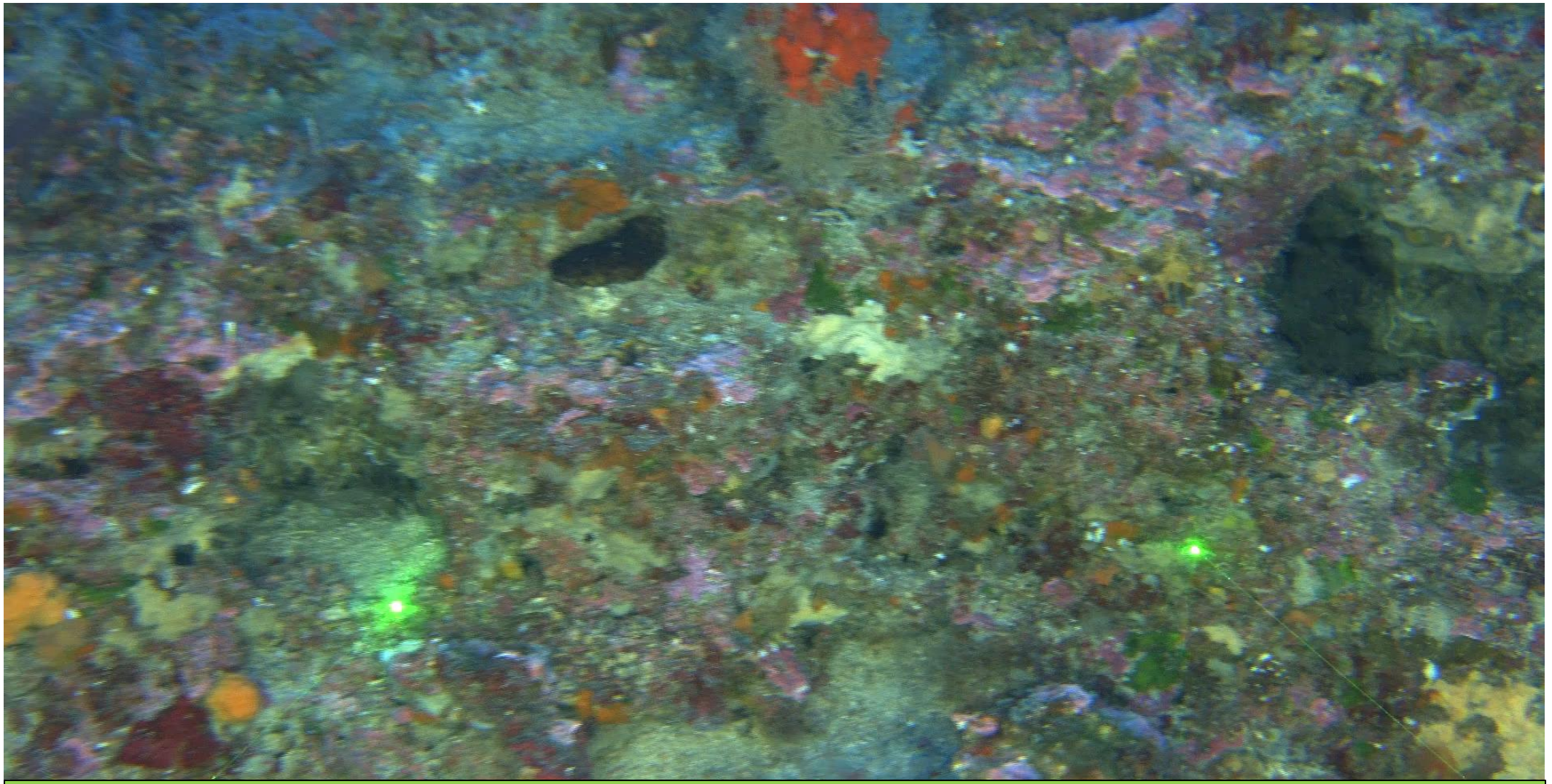
2 - Data logging on board (OFOP)

On-board data logging is essential for ordering and doing the data inventory.
An efficient on-board data logging significantly reduces the time required to sort and pre-process data

There are several choices (ADELIE -IFREMER, VARS –MBARI).
I have been using OFOP for a few years for georeferencing HD video in the data



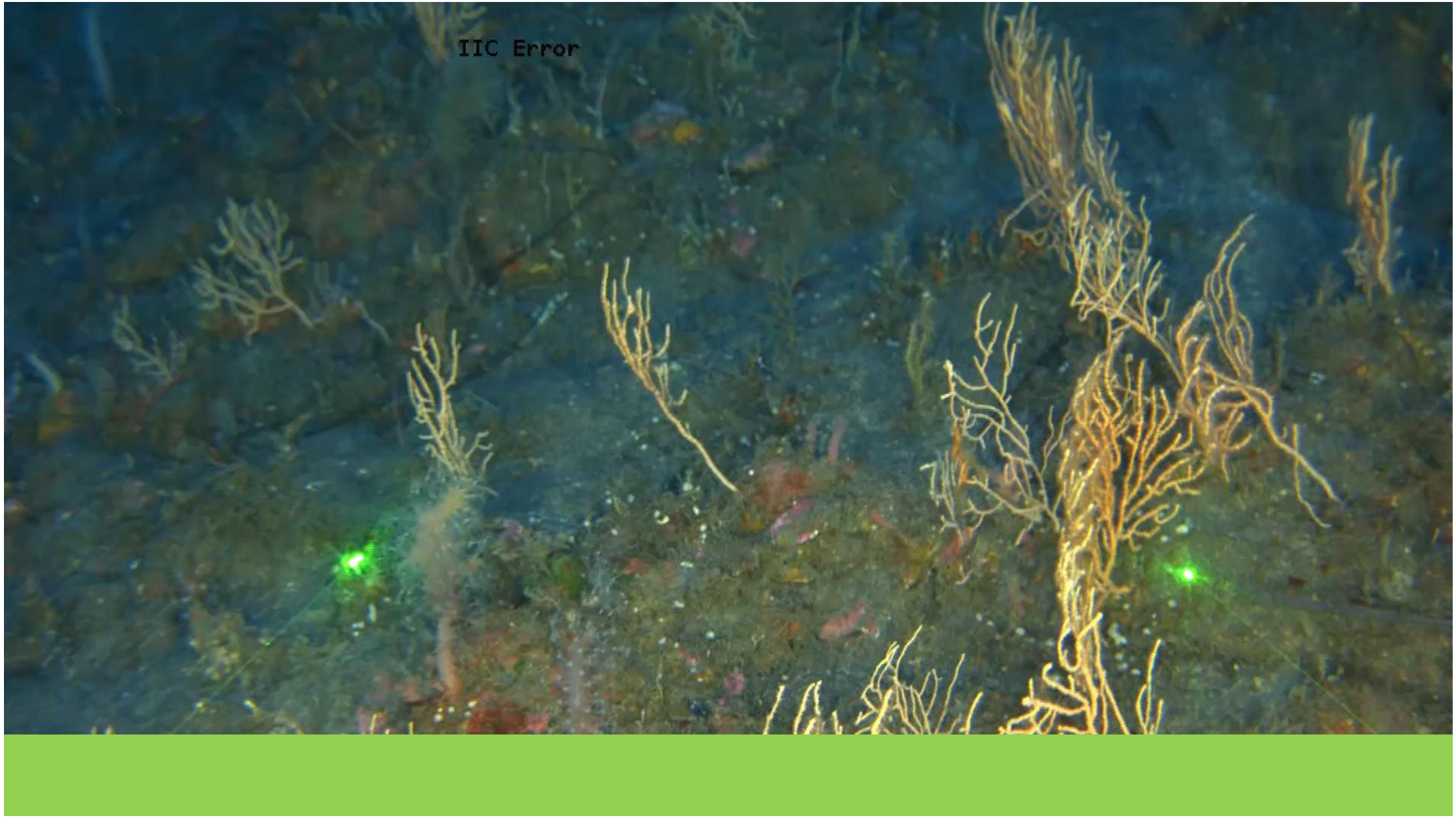
https://www.emma-technologies.com/products/software/



Whatever the project target, the same video can be analysed to give information on:

- Presence, distribution and habitat assessment
- Presence and distribution of protected, invasive or rare species
- Quantification and typology of marine litter
- Associated Fish fauna

Then …of great emotive impact are the unexpected events

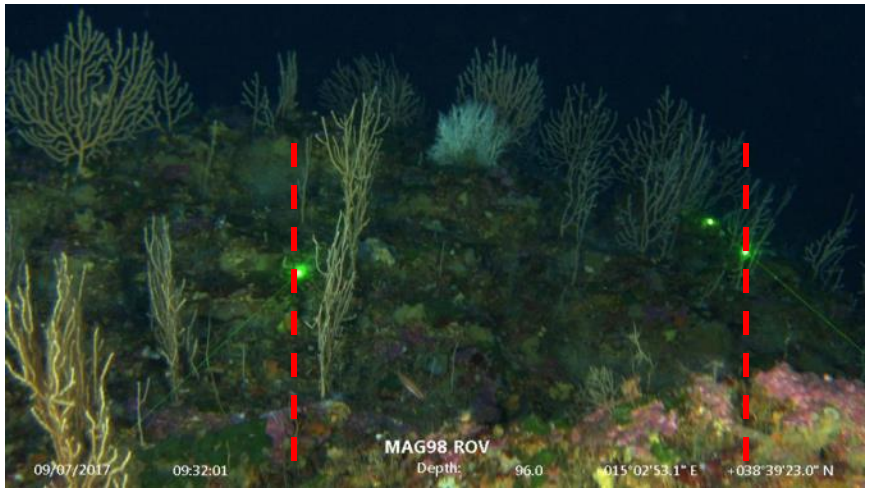

IIC Error

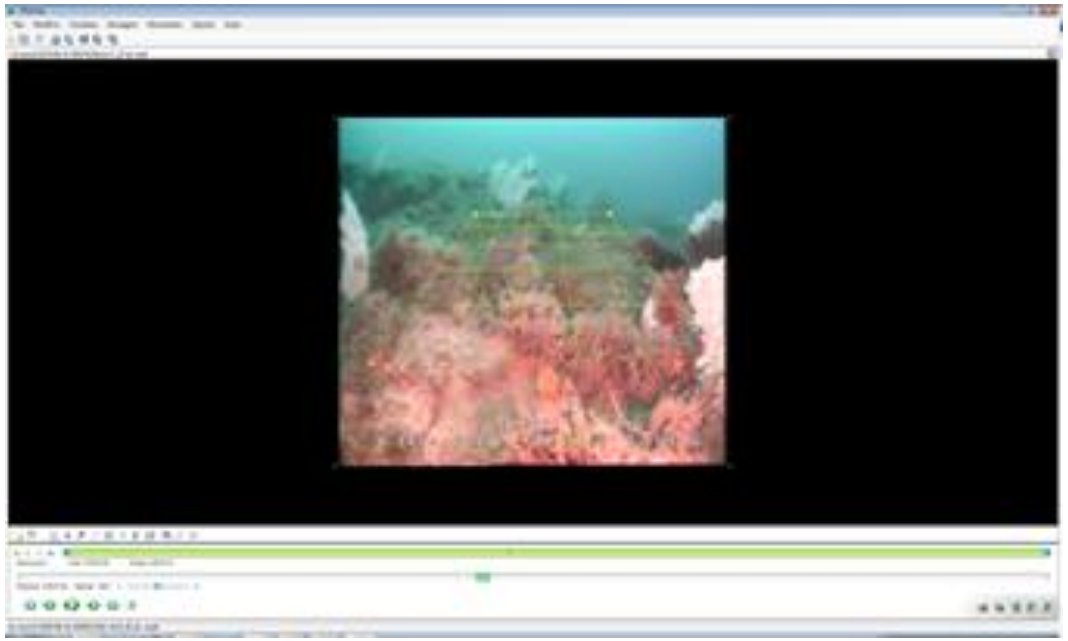
ROV sampling also allows the collection of samples.
Obviously the number of samples and the ease of collection is proportional to the ROV class.

Prélèvement d'une colonnie de gorgone *Placogorgia* sp.
(Janua, - 995 m).
Prelievo di una colonia della gorgonia *Placogorgia* sp.
(Janua, - 995 m).

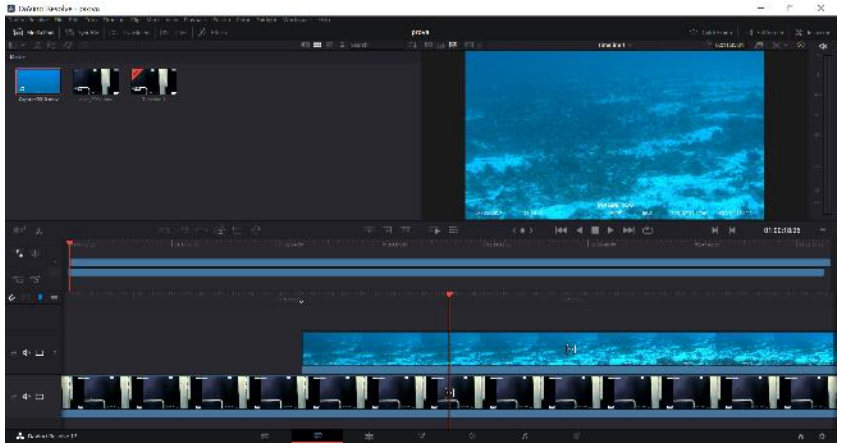
Image Analysis

continuous video vs still images



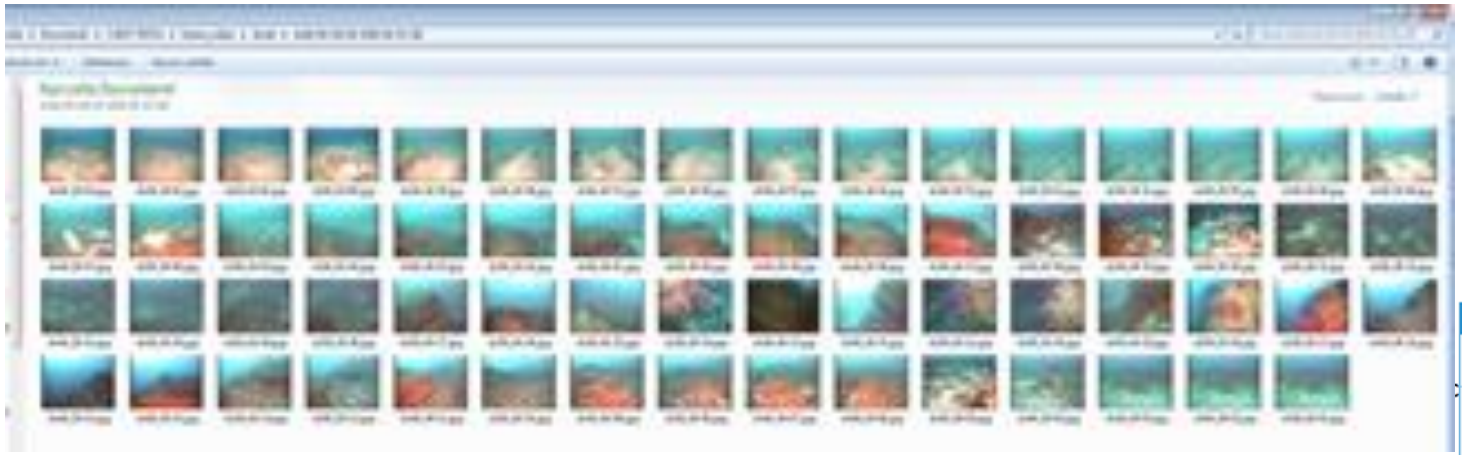


Kinovea

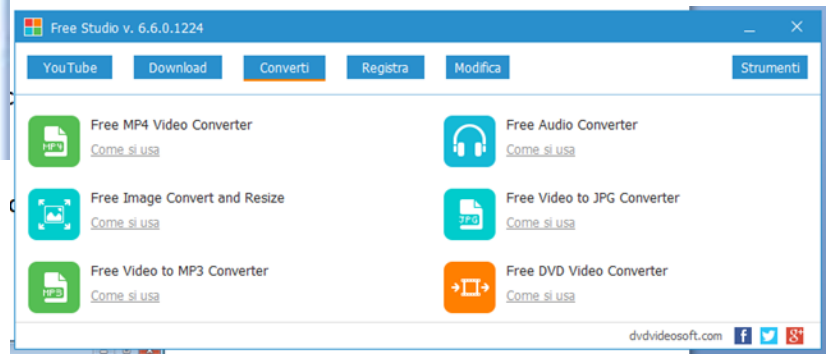


DaVinci Resolve

to extract still images

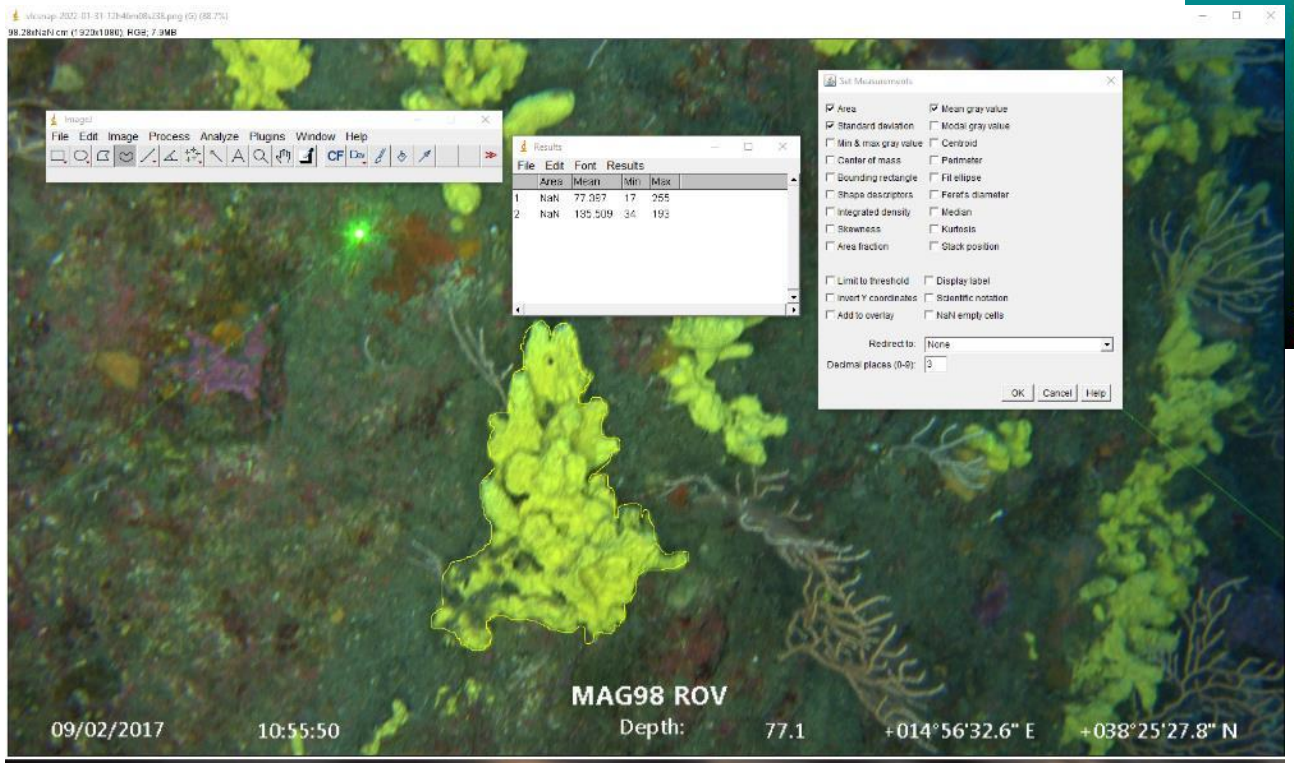


dvdvideosoft free studio

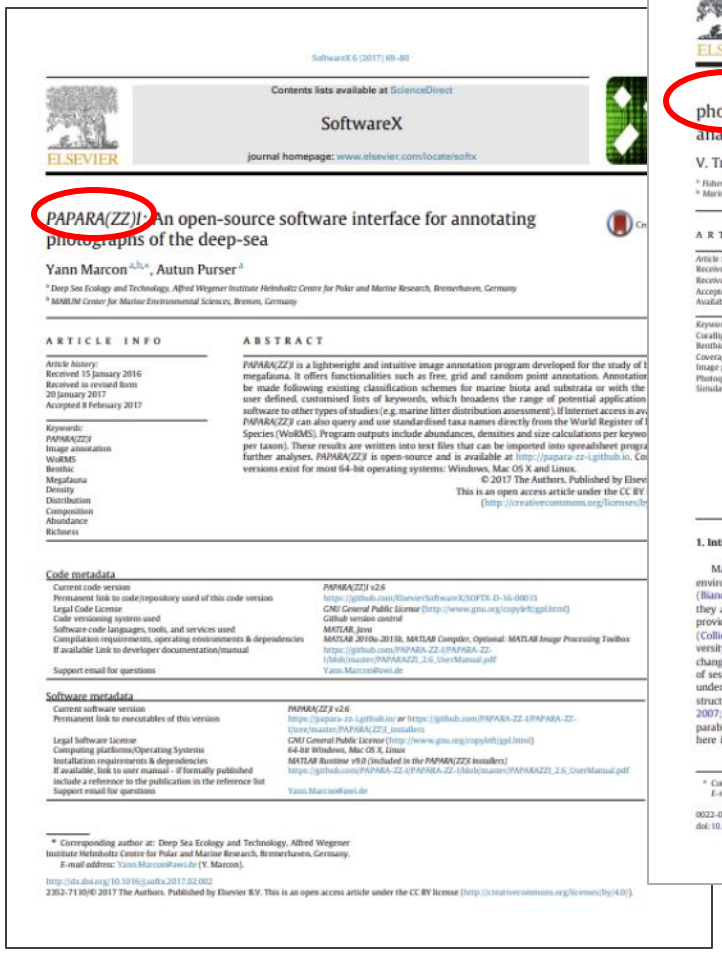


Still images analysis

CPCe coral



IMAGEJ or NIH Image



SoftwareX 6 (2017) 69–80

Contents lists available at ScienceDirect

SoftwareX

journal homepage: www.elsevier.com/locate/softx

PAPARA(ZZ)I: An open-source software interface for annotating photographs of the deep-sea

Yann Marcon [a,b,*], Autun Purser [a]

[a] Deep Sea Ecology and Technology, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

[b] MARUM Center for Marine Environmental Sciences, Bremen, Germany

ARTICLE INFO

Article history:
Received 15 January 2016
Received in revised form
20 January 2017
Accepted 8 February 2017

Keywords:
PAPARA(ZZ)I
Image annotation
WoRMS
Benthic
Megafauna
Density
Distribution
Composition
Abundance
Richness

ABSTRACT

PAPARA(ZZ)I is a lightweight and intuitive image annotation program developed for the study of l megafauna. It offers functionalities such as free, grid and random point annotation. Annotation be made following existing classification schemes for marine biota and substrata or with the user defined, customised lists of keywords, which broadens the range of potential application software to other types of studies (e.g. marine litter distribution assessment). If Internet access is av PAPARA(ZZ)I can also query and use standardised taxa names directly from the World Register of Species (WoRMS). Program outputs include abundances, densities and size calculations per keywo per taxon). These results are written into text files that can be imported into spreadsheet progra further analyses. PAPARA(ZZ)I is open-source and is available at http://papara-zz-i.github.io. Co versions exist for most 64-bit operating systems: Windows, Mac OS X and Linux.

Code metadata

Current code version	PAPARA(ZZ)I v2.6
Permanent link to code/repository used of this code version	https://github.com/ElsevierSoftwareX/SOFTX-D-16-00015
Legal Code License	GNU General Public License (http://www.gnu.org/copyleft/gpl.html)
Code versioning system used	Github version control
Software code languages, tools, and services used	MATLAB, Java
Compilation requirements, operating environments & dependencies	MATLAB 2010a-2015b, MATLAB Compiler, Optional: MATLAB Image Processing Toolbox
If available Link to developer documentation/manual	https://github.com/PAPARA-ZZ-I/PAPARA-ZZ-I/blob/master/PAPARAZZI_2.6_UserManual.pdf
Support email for questions	Yann.Marcon@awi.de

Software metadata

Current software version	PAPARA(ZZ)I v2.6
Permanent link to executables of this version	https://papara-zz-i.github.io/ or https://github.com/PAPARA-ZZ-I/PAPARA-ZZ-I/tree/master/PAPARA(ZZ)I_installers
Legal Software license	GNU General Public License (http://www.gnu.org/copyleft/gpl.html)
Computing platforms/Operating Systems	64-bit Windows, Mac OS X, Linux
Installation requirements & dependencies	MATLAB Runtime v9.0 (included in the PAPARA(ZZ)I installers)
If available, link to user manual - if formally published include a reference to the publication in the reference list	https://github.com/PAPARA-ZZ-I/PAPARA-ZZ-I/blob/master/PAPARAZZI_2.6_UserManual.pdf
Support email for questions	Yann.Marcon@awi.de

* Corresponding author at: Deep Sea Ecology and Technology, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany.
E-mail address: Yann.Marcon@awi.de (Y. Marcon).

http://dx.doi.org/10.1016/j.softx.2017.02.002

Journal of Experimental Marine Biology and Ecology 424–425 (2012) 99–108

Contents lists available at SciVerse ScienceDirect

Journal of Experimental Marine Biology and Ecology

journal homepage: www.elsevier.com/locate/jembe

photoQuad: A dedicated seabed image processing software, and a comparative error analysis of four photoquadrat methods

V. Trygonis [a,*], M. Sini [a,b]

[a] Fisheries Management & Fisheries Acoustics Laboratory, Department of Marine Sciences, University of the Aegean, Mytilene, 81100, Greece

[b] Marine Biodiversity & Coastal Management Laboratory, Department of Marine Sciences, University of the Aegean, Mytilene, 81100, Greece

ARTICLE INFO

Article history:
Received 5 January 2012
Received in revised form 6 April 2012
Accepted 30 April 2012
Available online 8 June 2012

Keywords:
Coralligenous
Benthic communities
Coverage measurement
Image processing software
Photoquadrat sampling
Simulation

ABSTRACT

Photographic quadrat sampling is commonly quadrat data handling is fragmented into serv tools that integrate all major analysis options of photographic samples, dedicated to ecolog extraction of species area, percentage covera (RP), grid cell counts (CL), freehand regions (neously functional in a layer-based environm image calibration, automatic quadrat bounda paper documents the main features of photo application of the RP, CL, FH, and SG method and coverage measurements. The simulated sity statistics are equivalent to three benthic The analysis indicated that measurement me to species size. Large patches were accurate RP provided high error variance, and their pe SG and FH methods provided the lowest erro tion process showed no statistically significan this result. Overall, photoQuad constitutes a clitating fast and comparable evaluation of t is freely available to download and use from

1. Introduction

Marine benthic habitats constitute an important part of the marine environment, with high ecological, scientific, and economic value (Bianchi and Morri, 2000; Dayton et al., 2000; Hughes et al., 2005); they are composed of a great diversity of sessile benthic species, and provide essential resources to fish and other motile invertebrates (Collie et al., 2000; Thrush and Dayton, 2002). Studies regarding biodiversity assessment, characterization of communities, and monitoring of changes over time commonly involve the estimation of area or coverage of sessile benthic species either through *in situ* observations or use of underwater photography and video (Bianchi et al., 2004). As the destruction and alteration of benthic habitats increases (Halpern et al., 2007; Pandolfi et al., 2003), so does the need for their accurate and comparable quantitative assessment. The photoQuad software presented here is an image processing tool created to address the need for fast, accurate, a in digital samples. Quadra sessile co 1983; Sut achieved t way. Wit used for t compositi et al., 200 2002), po the monit factors (G Inform includes individual solute are Among th the most

* Corresponding author. Tel.: +30 22510 36855; fax: +30 22510 36809.
E-mail address: vtrygonis@marine.aegean.gr (V. Trygonis).

0022-0981/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
doi:10.1016/j.jembe.2012.04.018

Vol. 431: 45–53, 2011 | MARINE ECOLOGY PROGRESS SERIES Mar Ecol Prog Ser | Published June 9

doi: 10.3354/meps09127

OPEN ACCESS

Hierarchical segmentation-based software for cover classification analyses of seabed images (Seascape)

Núria Teixidó[1,2,3,*], Anton Albajes-Eizagirre[4], Didier Bolbo[5], Emilie Le Hir[6], Montse Demestre[3], Joaquim Garrabou[3], Laurent Guigues[7], Josep-Maria Gili[2], Jaume Piera[8], Thomas Prelot[5], Aureli Soria-Frisch[4]

[1] Centre d'Estudis Avançats de Blanes (CEAB-CSIC), Accés Cala Sant Francesc 14, 17300 Blanes, Girona, Spain
[2] Institut Ciències del Mar (ICM-CSIC), Passeig Marítim de la Barceloneta 37–49, 08003 Barcelona, Spain
[3] Departament d'Ecologia, Facultat Biologia, Universitat Barcelona, Avda Diagonal 645, 08028 Barcelona, Spain
[4] Starlab, C. Teodor Roviralta n45, 08022 Barcelona, Spain
[5] Institut Géographique National IGN-Laboratoire MATIS, 2/4, av. Pasteur, 94165 Saint-Mandé, France
[6] Institut Géographique National, Parc Technologique du Canal, BP 42110, 6 av. de l'Europe, 31521 Ramonville Cedex, France
[7] CREATIS, UMR CNRS 5515, U 630 Inserm, INSA, 7 rue Jean Capelle, bat. Blaise Pascal, 69621 Villeurbanne Cedex, France
[8] Marine Technology Unit (UTM-CSIC), Passeig Marítim de la Barceloneta 37-49, 08003 Barcelona, Spain

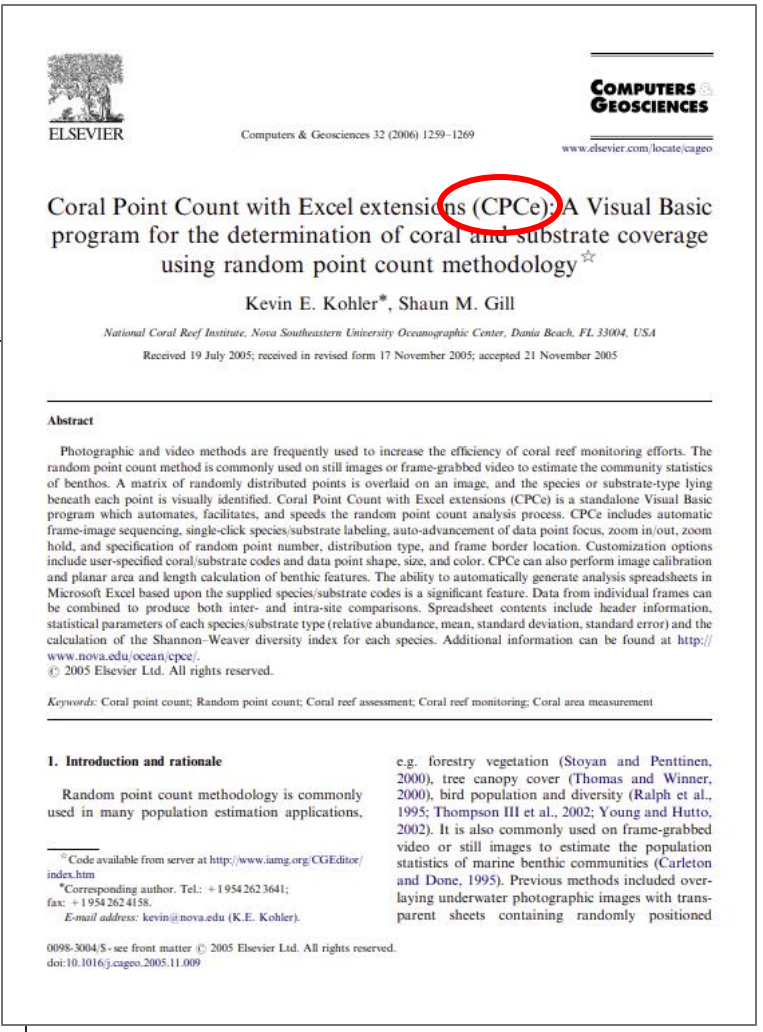
ABSTRACT: An important aspect of marine research is to quantify the areal coverage of benthic communities. It is technically feasible to efficiently obtain images of marine environments at different depths and benthic habitats over large spatial and temporal scales. Currently, there is a large and growing library of digital images to analyze, representing a valuable benthic ecological archive. Benthic coverage is the basis of studies on biodiversity, characterization of communities and evaluation of changes over temporal and spatial scales. However, there is still a lack of automatic or semi-automatic analytical methods for deriving ecologically relevant data from these images. We introduce a software program named Seascape to obtain semi-automatically segmented images (patch outlines) from underwater photographs of benthic communities, where each individual patch (species/categories) is routinely associated to its area cover and perimeter. Seascape is an analog to the classical and better known discipline of landscape ecology approach, which focuses on the concept that communities can be observed as a patch mosaic at any scale. The process starts with a hierarchical segmentation, using a color space criteria adapted to the problem of segmenting complex benthic images. As an endproduct, we obtain a set of images segmented into classified homogenous regions at different resolution levels (hierarchical segmentation). To illustrate the versatility and capacity of Seascape, we analyzed 4 digital images from different habitats and depths: coral reefs (Pacific Ocean), coralligenous communities (NW Mediterranean Sea), deep-water coral reefs (NW Mediterranean Sea) and the Antarctic continental shelf (Weddell Sea). The development of this semi-automatic outline tool and its use for classification constitute an important step forward in the analysis and processing time of underwater seabed images at any scale.

KEY WORDS: Area cover · Benthic communities · Digital photography · Image analysis · Hierarchical segmentation

INTRODUCTION

Characterizing and quantifying sessile marine species (macroalgae, seagrasses and invertebrates) that occupy benthic substrate is a fundamental aspect of marine benthic research from shallow sublittoral habitats to continental shelves and the deep sea (Hughes & Jackson 1985, Genin et al. 1986, Sebens 1986, Fossá et al. 2002). This essential information is the basis of studies on biodiversity, characterization of communities, evaluation of changes over spatial and temporal scales and benthic ecosystem health (e.g. Mergner & Schuh-

*Email: nteixido@icm.csic.es



ELSEVIER

Computers & Geosciences 32 (2006) 1259–1269

COMPUTERS & GEOSCIENCES

www.elsevier.com/locate/cageo

Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology ☆

Kevin E. Kohler*, Shaun M. Gill

National Coral Reef Institute, Nova Southeastern University Oceanographic Center, Dania Beach, FL 33004, USA

Received 19 July 2005; received in revised form 17 November 2005; accepted 21 November 2005

Abstract

Photographic and video methods are frequently used to increase the efficiency of coral reef monitoring efforts. The random point count method is commonly used on still images or frame-grabbed video to estimate the community statistics of benthos. A matrix of randomly distributed points is overlaid on an image, and the species or substrate-type lying beneath each point is visually identified. Coral Point Count with Excel extensions (CPCe) is a standalone Visual Basic program which automates, facilitates, and speeds the random point count analysis process. CPCe includes automatic frame-image sequencing, single-click species/substrate labeling, auto-advancement of data point focus, zoom in/out, zoom hold, and specification of random point number, distribution type, and frame border location. Customization options include user-specified coral/substrate codes and data point shape, size, and color. CPCe can also perform image calibration and planar area and length calculation of benthic features. The ability to automatically generate analysis spreadsheets in Microsoft Excel based upon the supplied species/substrate codes is a significant feature. Data from individual frames can be combined to produce both inter- and intra-site comparisons. Spreadsheet contents include header information, statistical parameters of each species/substrate type (relative abundance, mean, standard deviation, standard error) and the calculation of the Shannon–Weaver diversity index for each species. Additional information can be found at http://www.nova.edu/ocean/cpce/.

Keywords: Coral point count; Random point count; Coral reef assessment; Coral reef monitoring; Coral area measurement

1. Introduction and rationale

Random point count methodology is commonly used in many population estimation applications, e.g. forestry vegetation (Stoyan and Penttinen, 2000), tree canopy cover (Thomas and Winner, 2000), bird population and diversity (Ralph et al., 1995; Thompson III et al., 2002; Young and Hutto, 2002). It is also commonly used on frame-grabbed video or still images to estimate the population statistics of marine benthic communities (Carleton and Done, 1995). Previous methods included overlaying underwater photographic images with transparent sheets containing randomly positioned

☆ Code available from server at http://www.iamg.org/CGEditor/index.htm

*Corresponding author. Tel.: +1 954 262 3641; fax: +1 954 262 4158.
E-mail address: kevin@nova.edu (K.E. Kohler).

0098-3004/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.cageo.2005.11.009

SCUOLA ESTIVA DI GEOMORFOLOGIA, ECOLOGIA E BIOLOGIA IN AMBIENTE MARINO E INSULARE - TERZA EDIZIONE

PONZA 20-23.09.2022

ISPRA Istituto Superiore per la Protezione e la Ricerca Ambientale

Sistema Nazionale per la Protezione dell'Ambiente

UdA

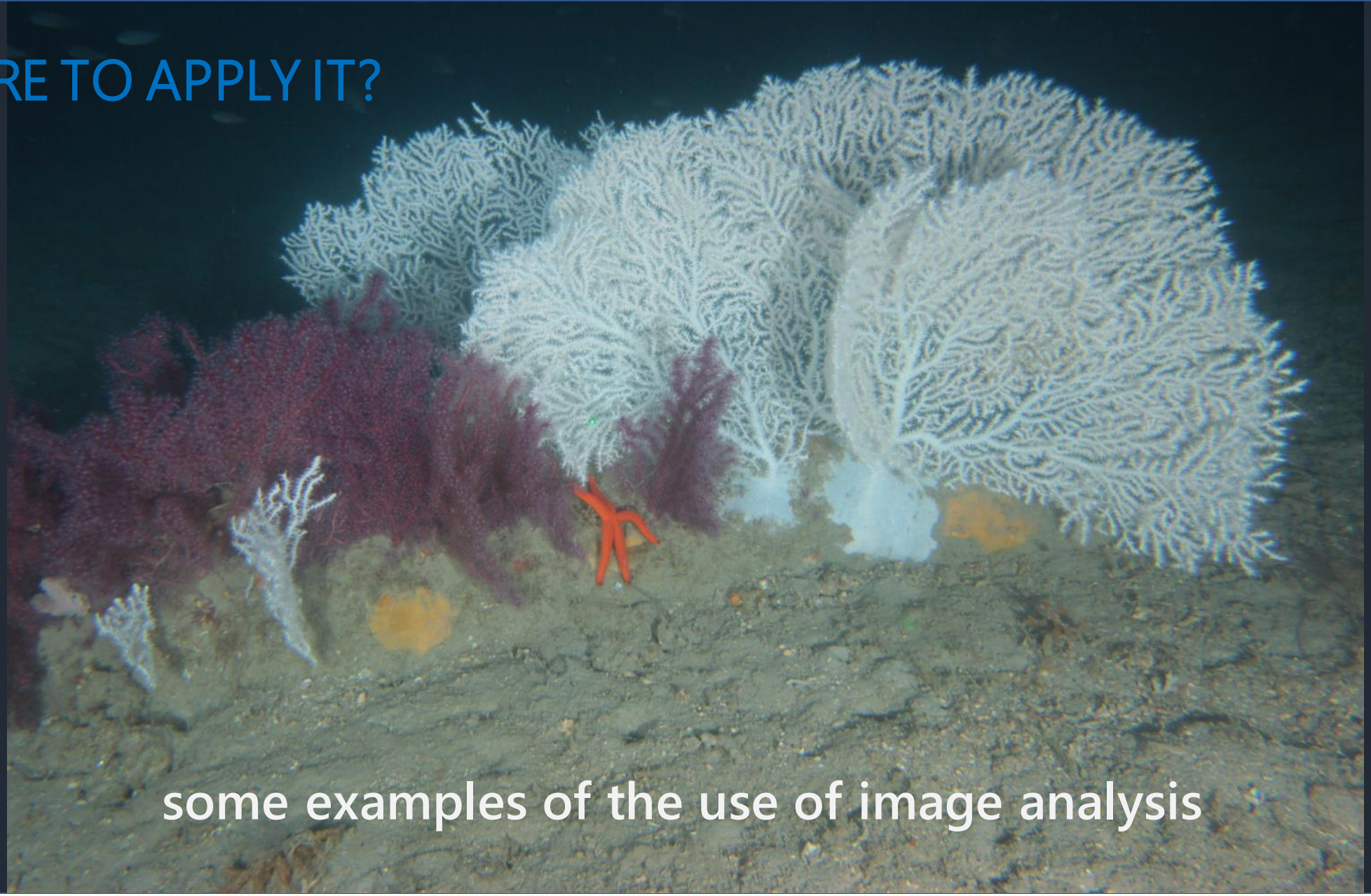
Data processing

Qualitative data are generally used for the characterization of habitats or for the restitution of large-scale thematic maps. When the resolution of the images is not optimal, morphological groups can be used.

Quantitative data (presence/absence, density) are used to describe site or compare sites in space and time.
For the study focused on target species, cover or other parameters can be estimated

Some software automatically calculates diversity indices, others give numerical values (abundance, area, frequency) which can then be processed by statistical analysis.

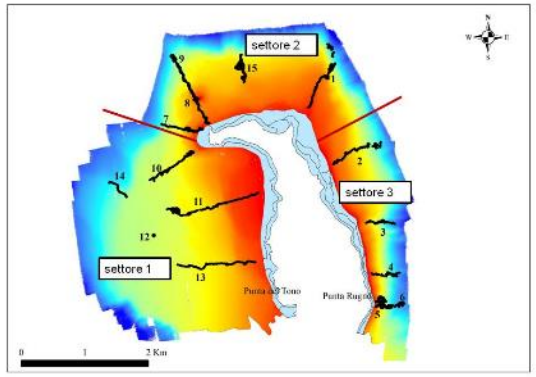
WHERE TO APPLY IT?

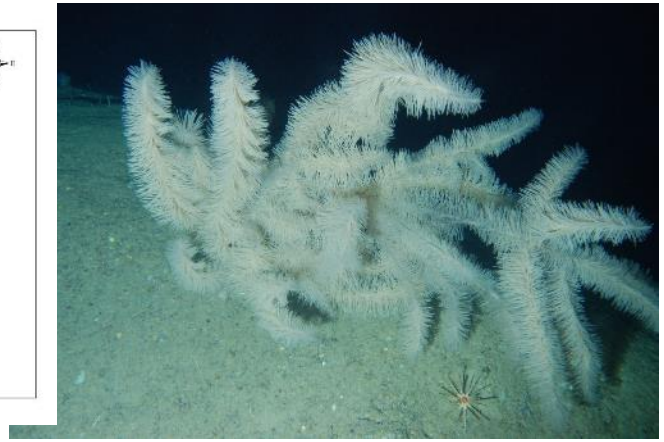


some examples of the use of image analysis

Description and distribution of habitats and species

Biocenotic, bionomic and thematic maps (MPAs establishment, Biodiversity hot-spot)





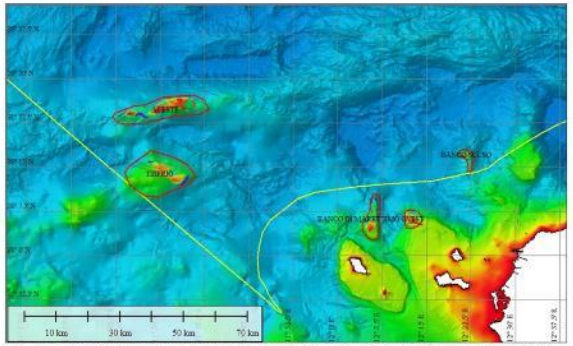
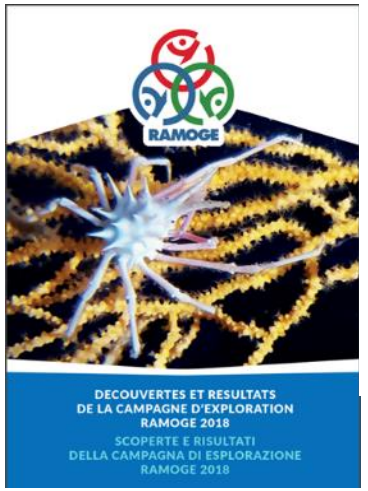
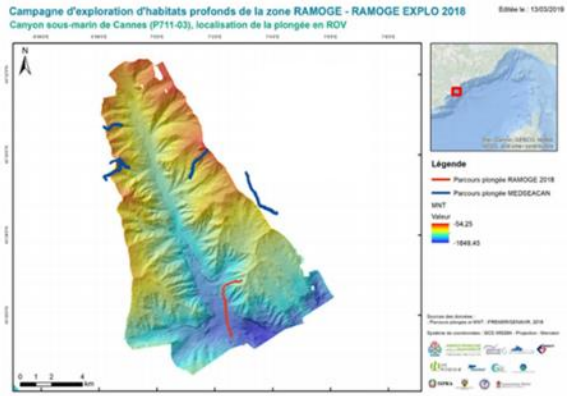
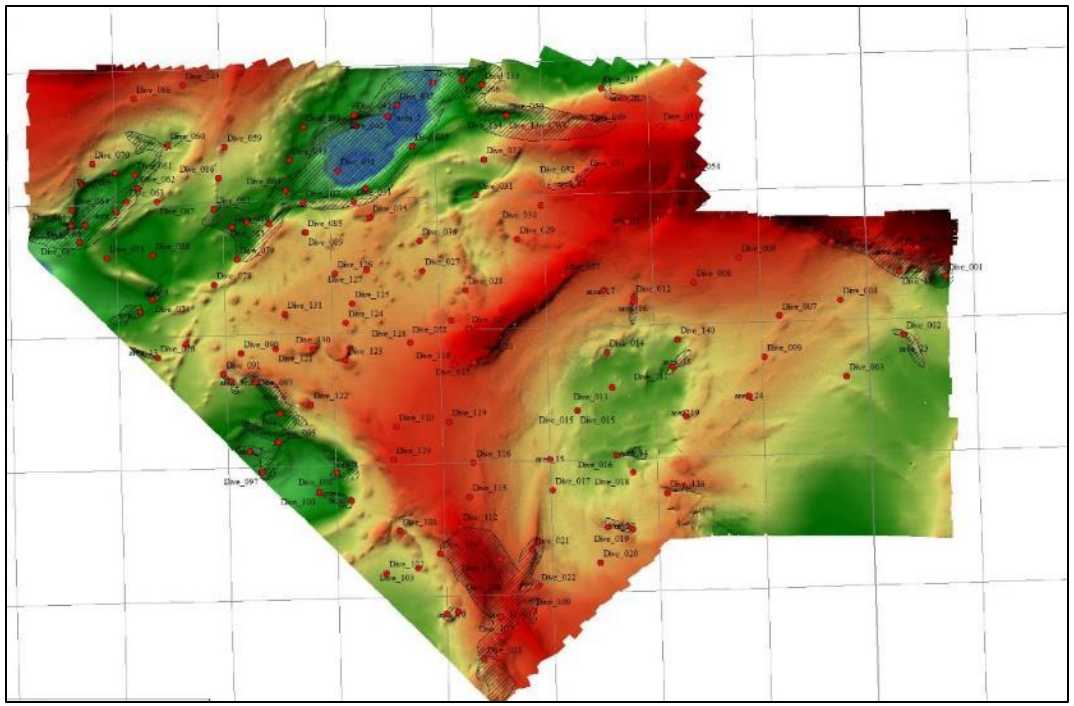


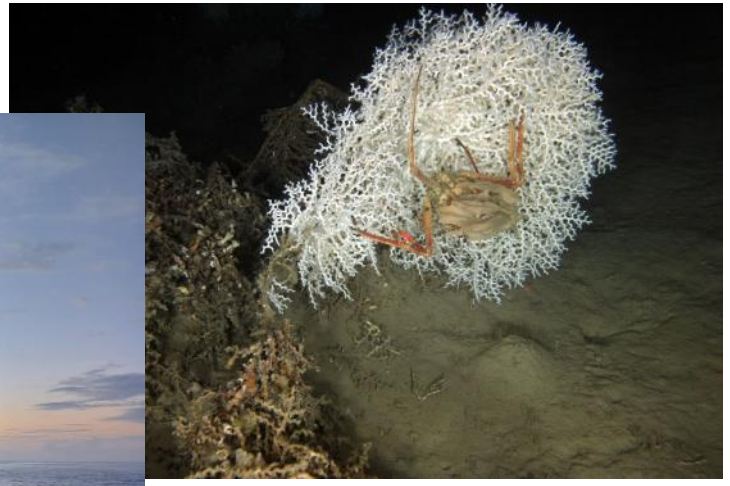
Figura 11: Visione d'insieme delle aree per le quali si ritiene sia importante prevedere l'istituzione di siti natura 2K e loro proposta di perimetrazione in rosso (visualizzate su base batimetrica EMODNET). La linea gialla rappresenta la delimitazione della ZPE Italiana (nella parte alta della figura - a Nord).

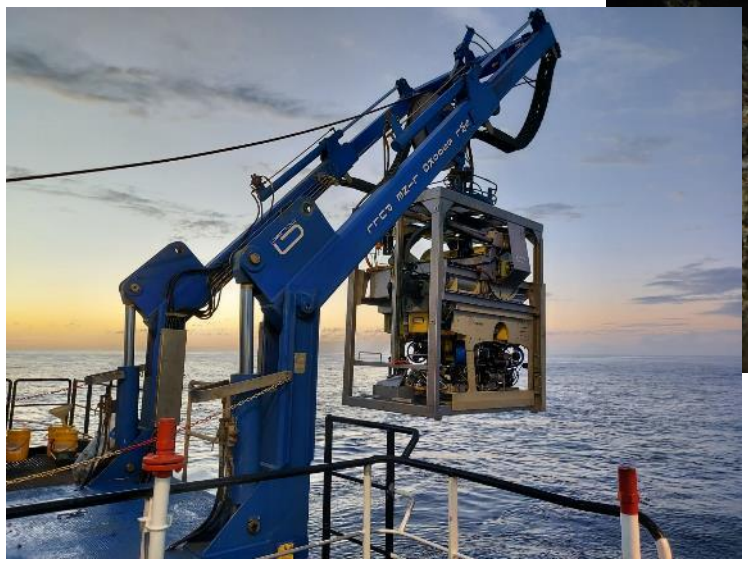




Feasibility study and environmental assessment







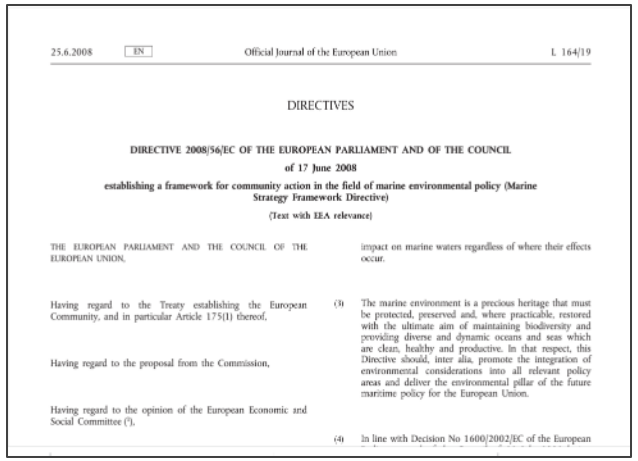
2000 km2 between 150 and 1200 m depth
140 tansects 1 km long

Habitat classification (EUNIS revision- EEA)

Identification of proxies for habitat assessment, quantification of pressures, and mitigation of impacts

Long-term monitoring

Environmental impact studies, directive implementations (MSFD, HABITAT)



25.6.2008 EN Official Journal of the European Union L 164/19

DIRECTIVES

DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 17 June 2008
establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)
(Text with EEA relevance)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 175(1) thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Economic and Social Committee (1),

impact on marine waters regardless of where their effects occur.

(3) The marine environment is a precious heritage that must be protected, preserved and, where practicable, restored with the ultimate aim of maintaining biodiversity and providing diverse and dynamic oceans and seas which are clean, healthy and productive. In that respect, this Directive should, inter alia, promote the integration of environmental considerations into all relevant policy areas and deliver the environmental pillar of the future maritime policy for the European Union.

(4) In line with Decision No 1600/2002/EC of the European

PHYLUM	SPECIE
Porifera	*Axinella cannabina*
Porifera	*Axinella polypoides*
Porifera	*Calyx nicaeensis*
Porifera	*Sarcotragus foetidus*
Porifera	*Spongia lamella*
Cnidaria	*Acanthogorgia hirsuta*
Cnidaria	*Antipathella subpinnata*
Cnidaria	*Antipathes dichotoma*
Cnidaria	*Callogorgia verticillata*
Cnidaria	*Cladocora caespitosa*
Cnidaria	*Corallium rubrum*
Cnidaria	*Dendrophyllia cornigera*
Cnidaria	*Dendrophyllia ramea*
Cnidaria	*Elisella paraplexauroides*
Cnidaria	*Errina aspera*
Cnidaria	*Eunicella cavolinii*
Cnidaria	*Eunicella singularis*
Cnidaria	*Eunicella verrucosa*
Cnidaria	*Leiopathes glaberrima*
Cnidaria	*Leptogorgia sarmentosa*
Cnidaria	*Paramuricea macrospina*
Cnidaria	*Paramuricea clavata*
Cnidaria	*Parantipathes larix*
Cnidaria	*Savalia savaglia*
Cnidaria	*Viminella flagellum*
Briozoa	*Myriapora truncata*
Briozoa	*Pentapora fascialis*

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Assessing the environmental status of temperate mesophotic reefs: A new, integrated methodological approach

Francesco Enrichetti, Marzia Bo, Carla Morri, Monica Montefalcone, Margherita Toma, Giorgio Bavestrello, Leonardo Tunesi, Simonepietro Canese, Michela Ghuttì, Eva Salvati, Rosa Maria Bertolotto, Carlo Nike Bianchi

Criteria for good environmental status relevant to the descriptors of Annex I to Directive 2008/56/EC

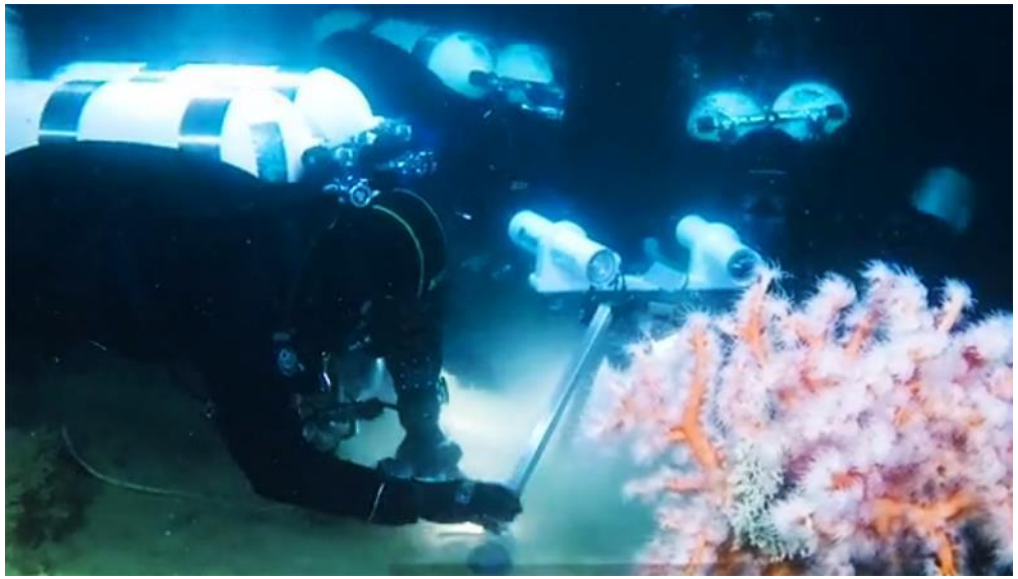
Descriptor 1: Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climate conditions.

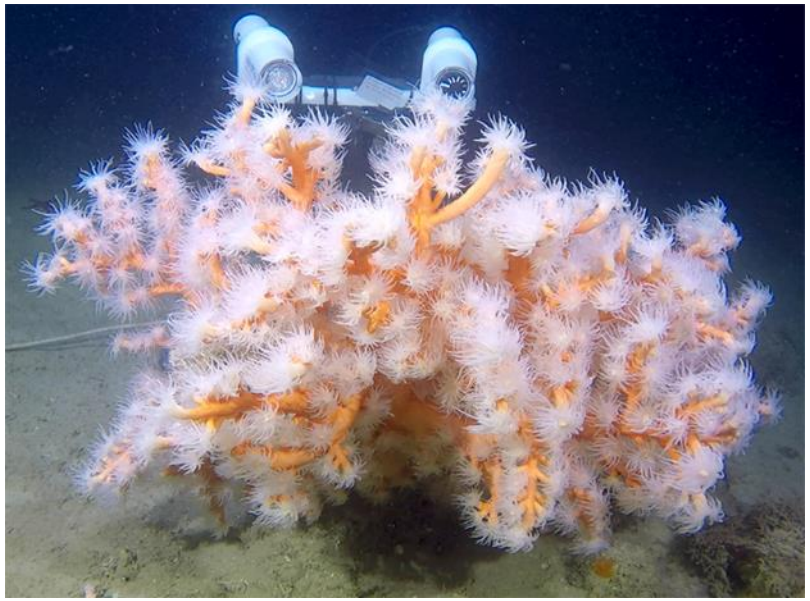
Descriptor 6: Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

Medium-term in situ observations of target species

The initial purpose of the project was to map the colonies within a known area and placing fixed sensors for recording environmental parameters thank to the operational support of tech divers

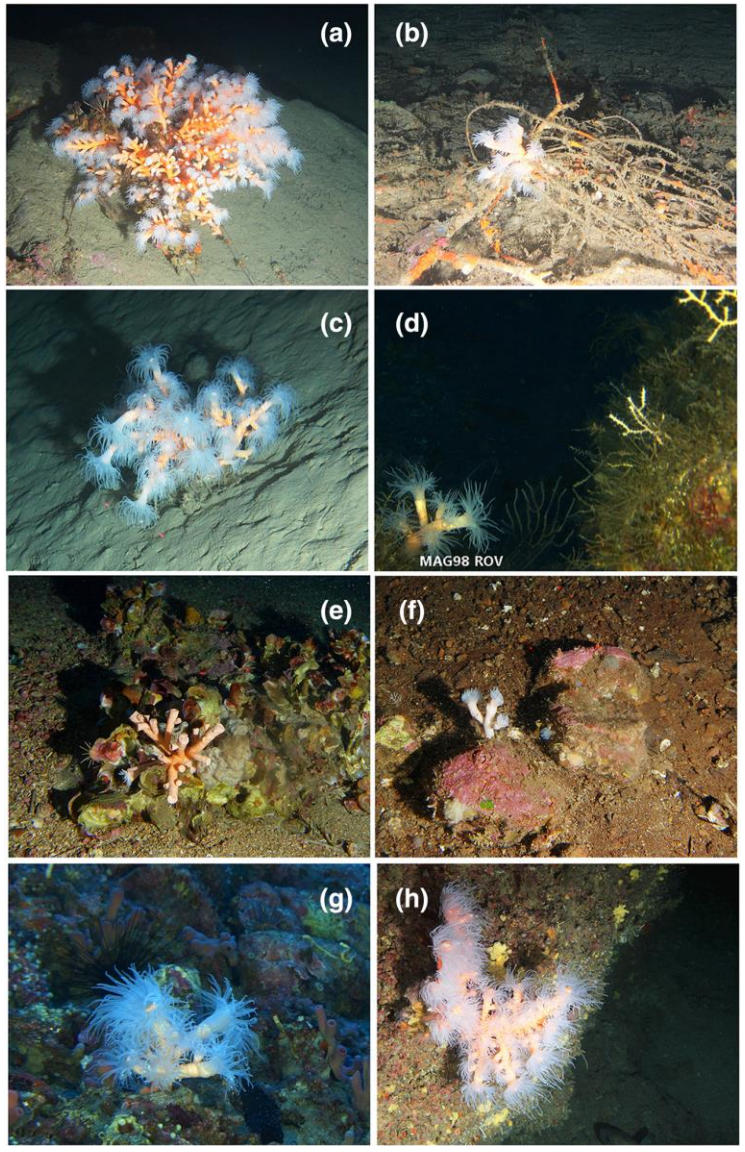
Instead of placing only the probes, using a solid structure, was also decided to collect image and video to better understand the ecology of the species.





programmed to collect a still image every 15' and to records a 5" video every hour.

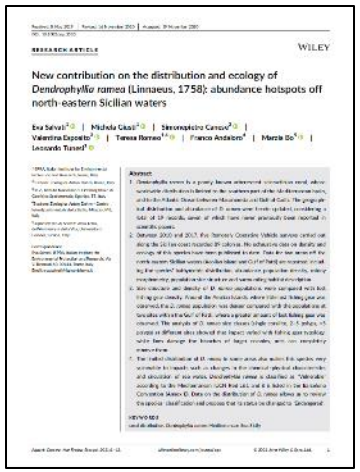
Ecology studies



SPONGE RESEARCH DEVELOPMENTS

Role of deep sponge grounds in the Mediterranean Sea: a case study in southern Italy

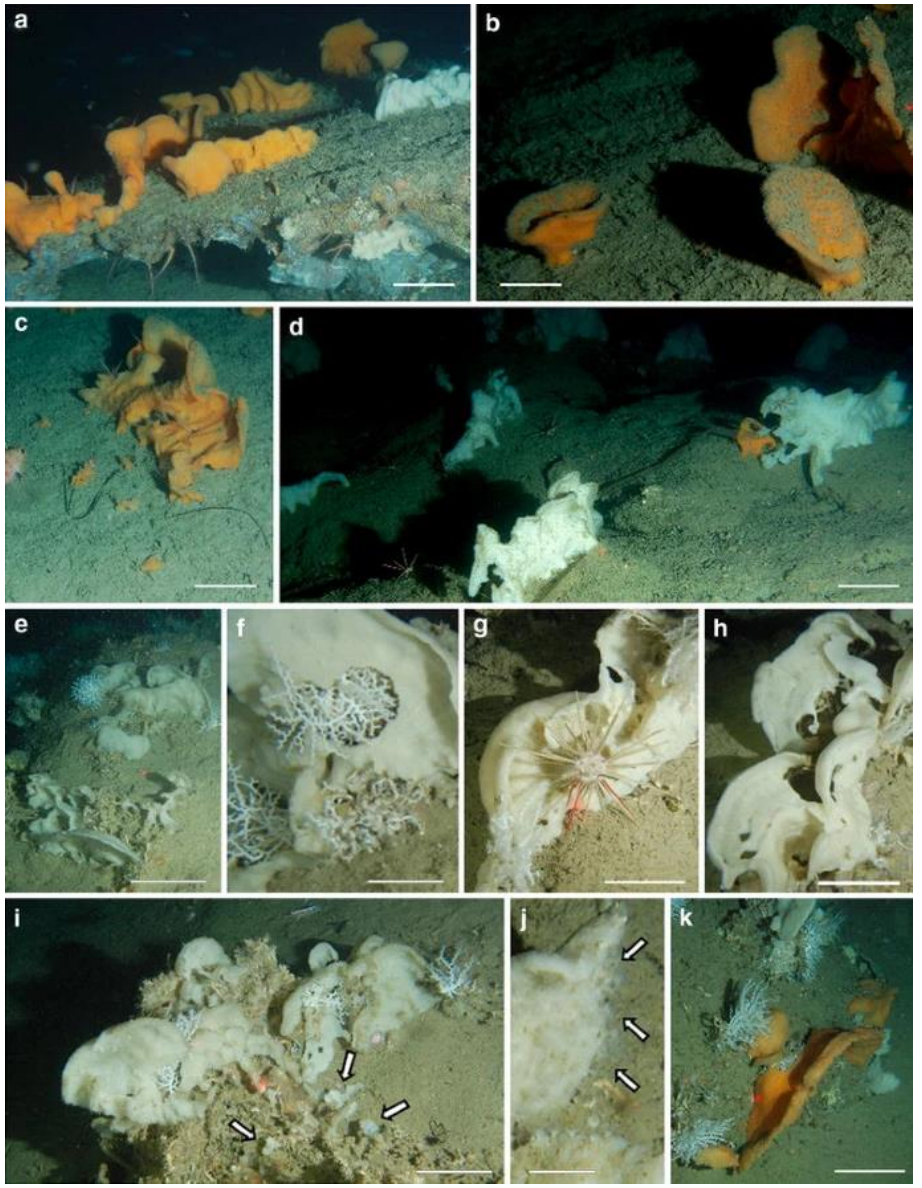
Marzia Bo · Marco Bertolino · Giorgio Bavestrello · Simonepietro Canese · Michela Giusti · Michela Angiolillo · Maurizio Pansini · Marco Taviani



RESEARCH ARTICLE

WILEY

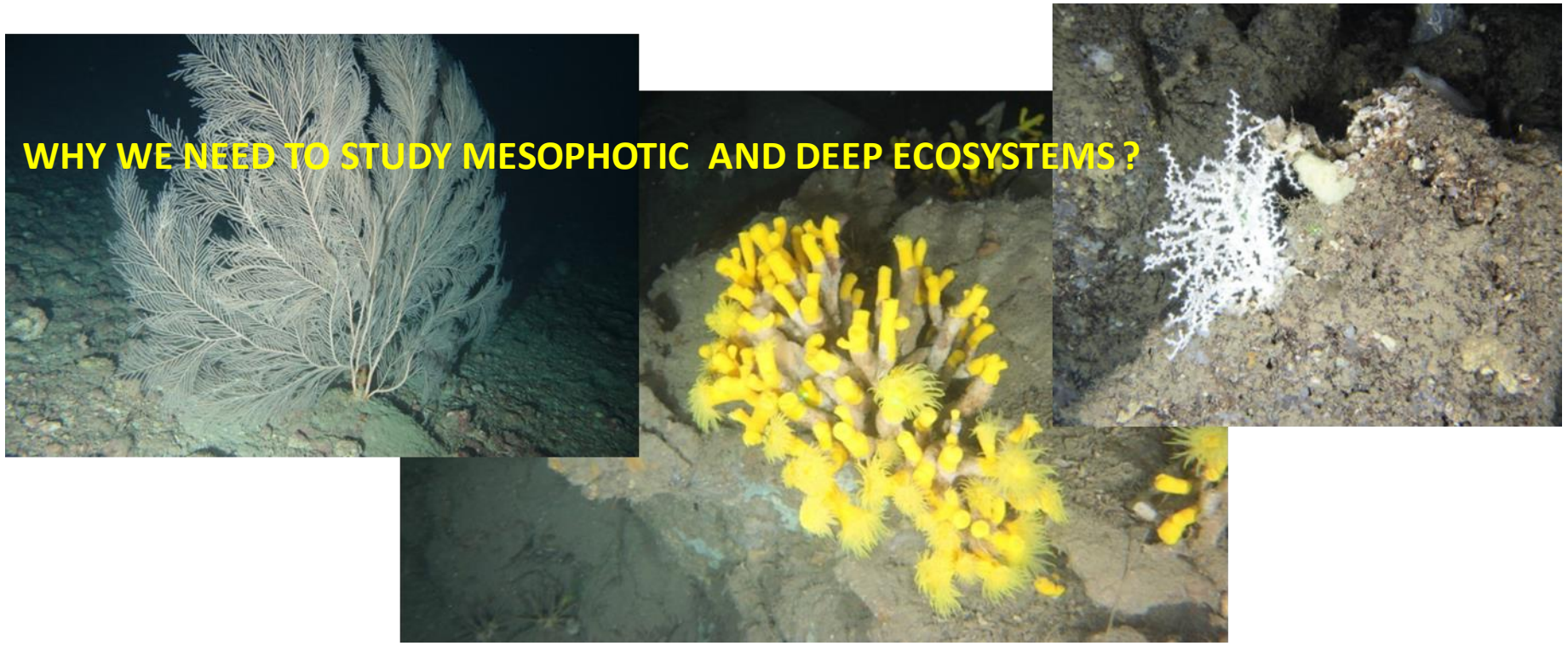
New contribution on the distribution and ecology of *Dendrophyllia ramea* (Linnaeus, 1758): abundance hotspots off north-eastern Sicilian waters



WHY WE NEED TO STUDY MESOPHOTIC AND DEEP ECOSYSTEMS ?

It hosts many relevant species :

- long-living species
- habitat forming species
- species of conservation and commercial interest many of which are little known.

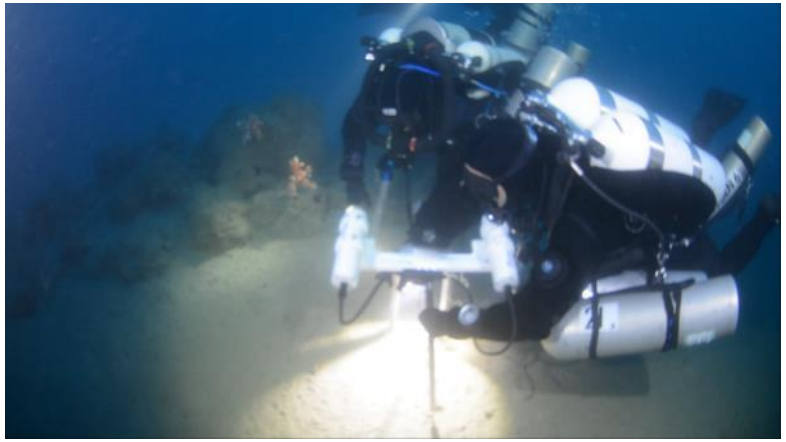


The mesophotic zone is characterized by more stable environmental factors respect to the shallower zones, moreover, anthropogenic pressure is, for the moment, reduced.
This provides "refuge habitats" where species are less affected by thermal anomalies (climate change) and which are a source of larvae to contribute to the resilience of shallower habitats.

However, it is scientific evidence that even the deepest habitats are subjected to growing stressors.

"Improving knowledge of mesophotic zone would benefit from combining different technologies to leverage the strengths of each". (*Mesophotic coral ecosystems*. Springer, 2019)

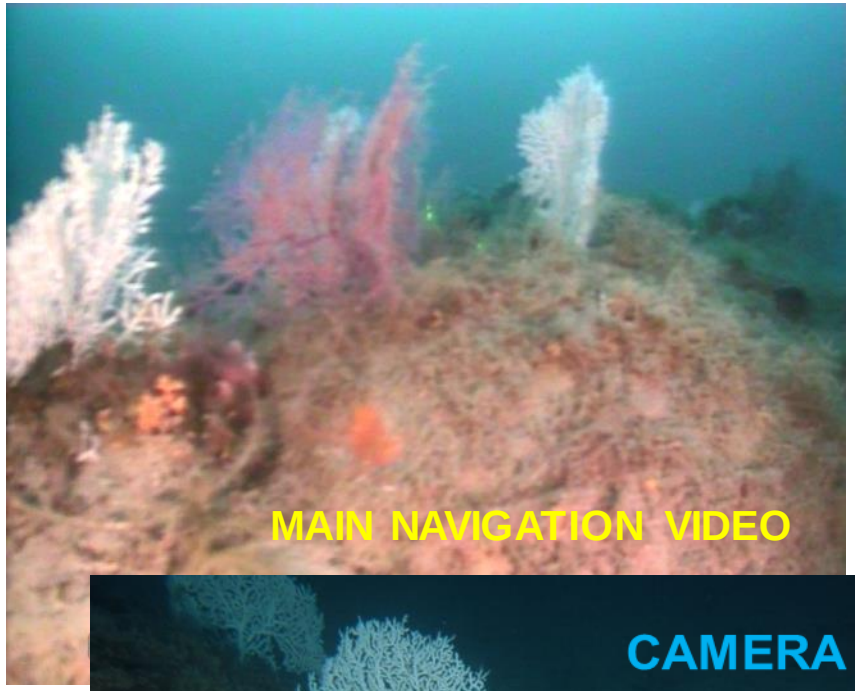
The upper part of the mesophotic zone is often accessible to technical divers who, with the use of ternary mixtures (trimix) or closed circuit (rebreather), can overcome the limits imposed on recreational or scientific diving.
The support of these divers is extremely useful in positioning equipment or collecting samples at reduced costs. However, it is necessary to keep in mind that, despite the enthusiasm shown by these excellent divers, the risk to safety is very high and the value of an instrument is not comparable to that of a human.

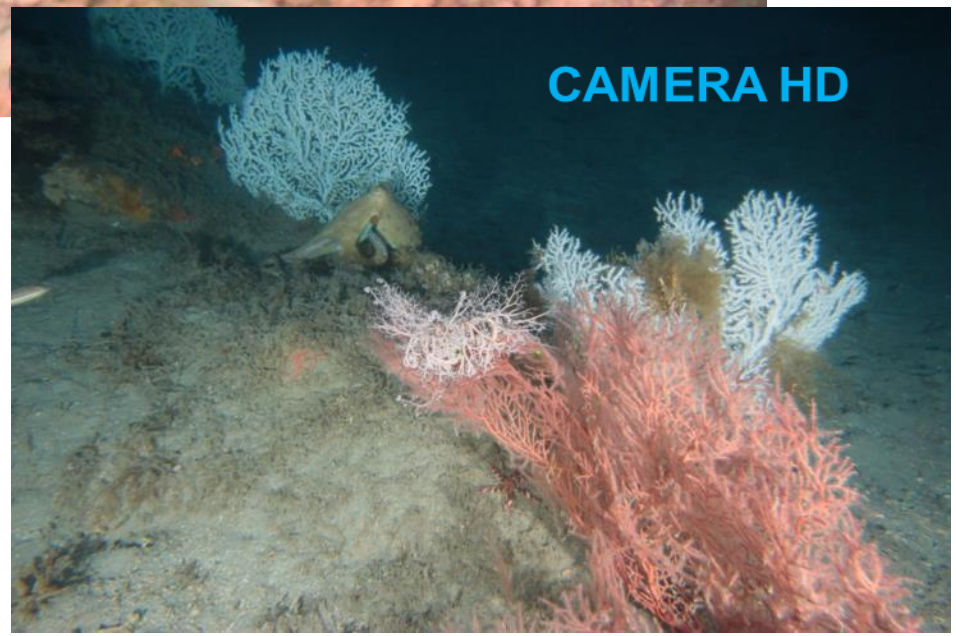


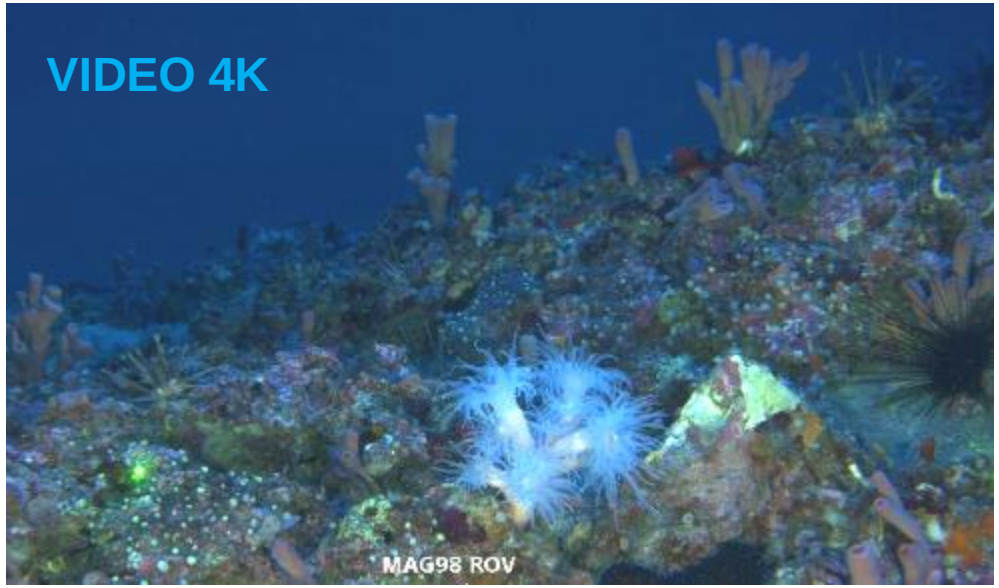
BBX divers during the positioning of fixed instruments

BBX divers during the sampling in the Sardinian caves

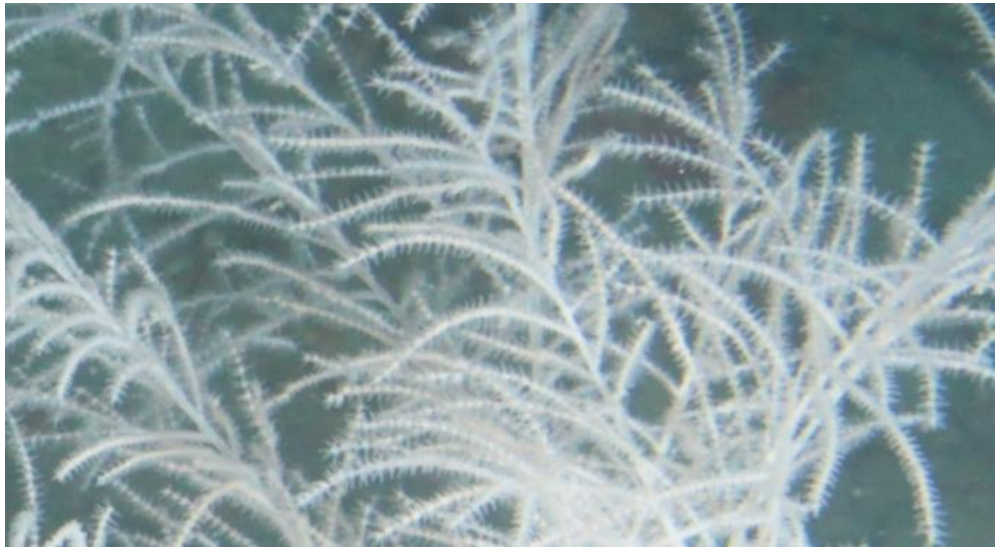
last but not least ….
the images resolution

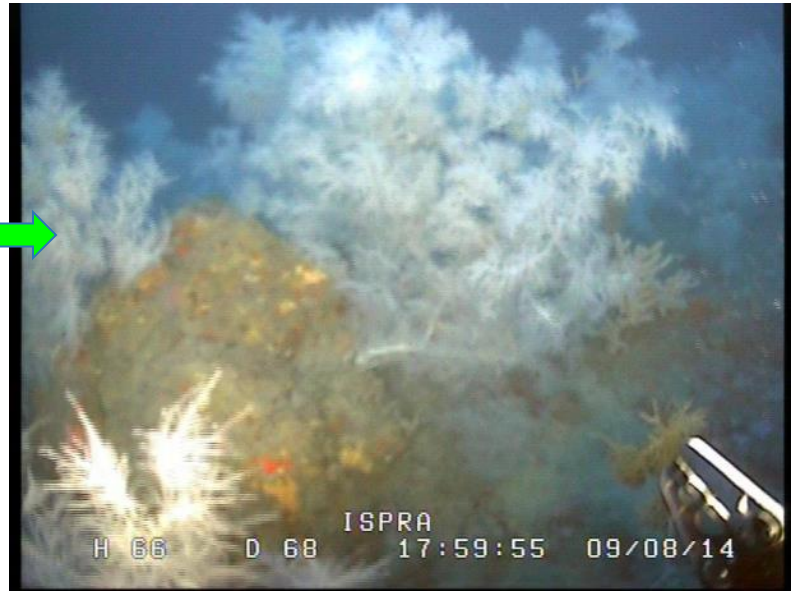




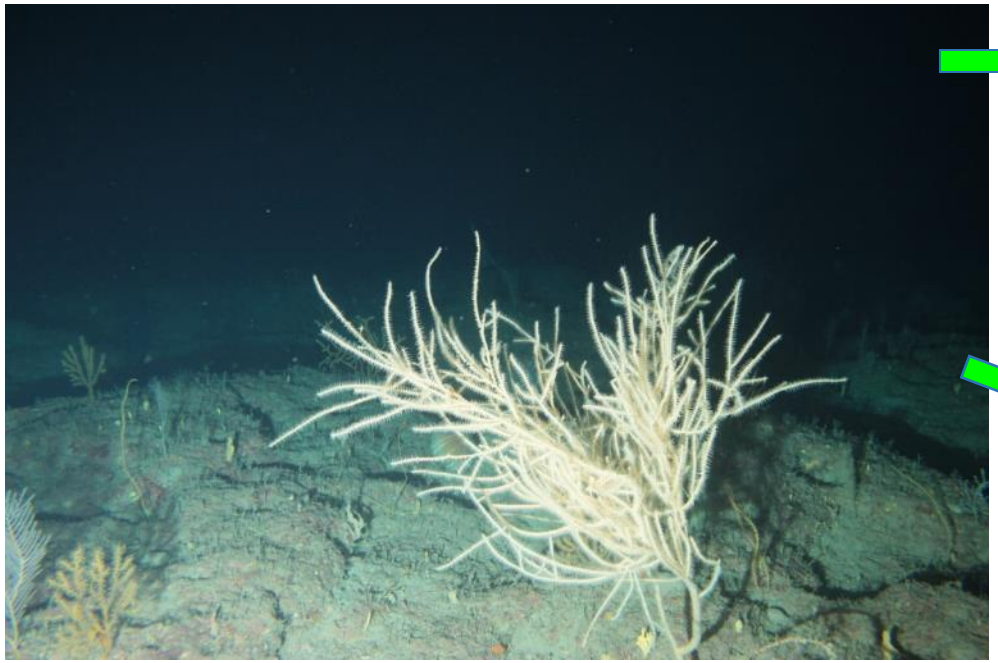


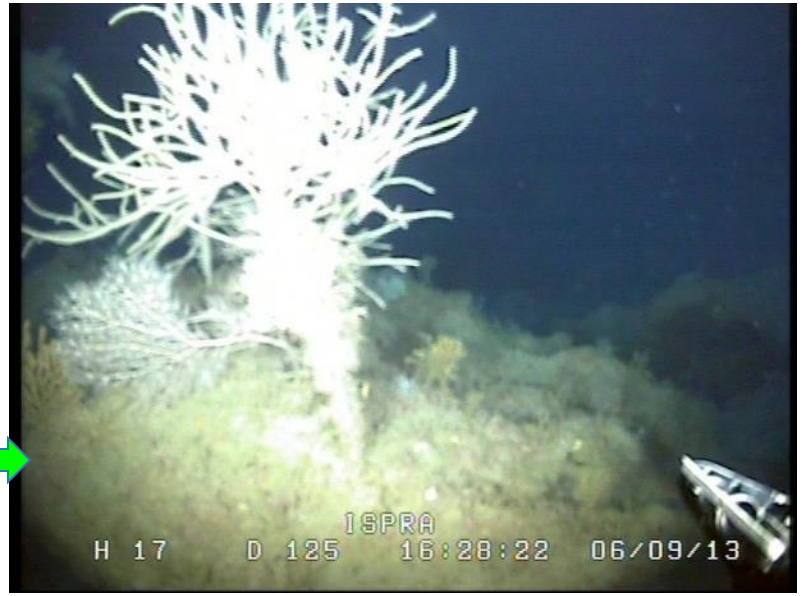
Antipathella subpinnata



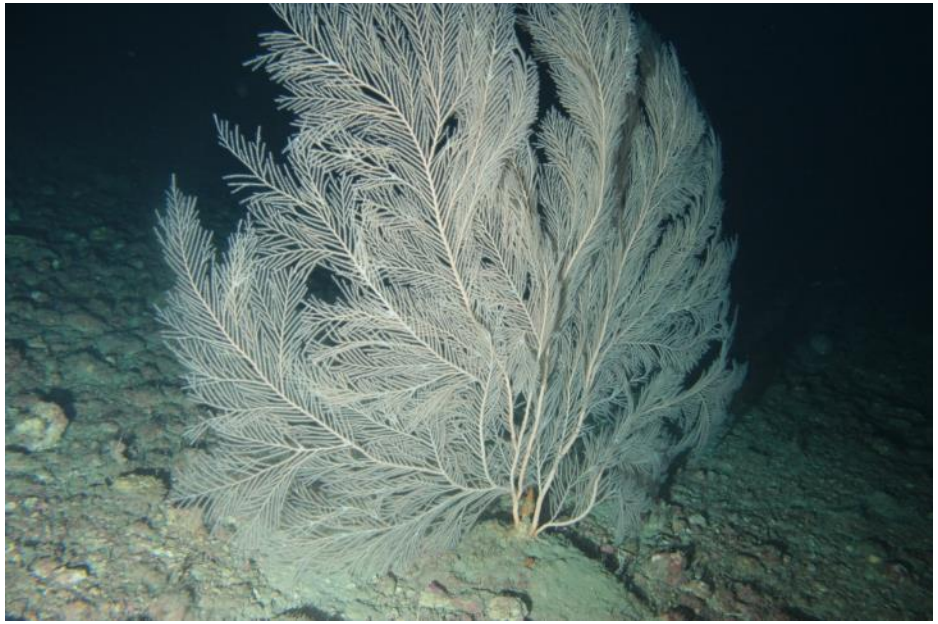


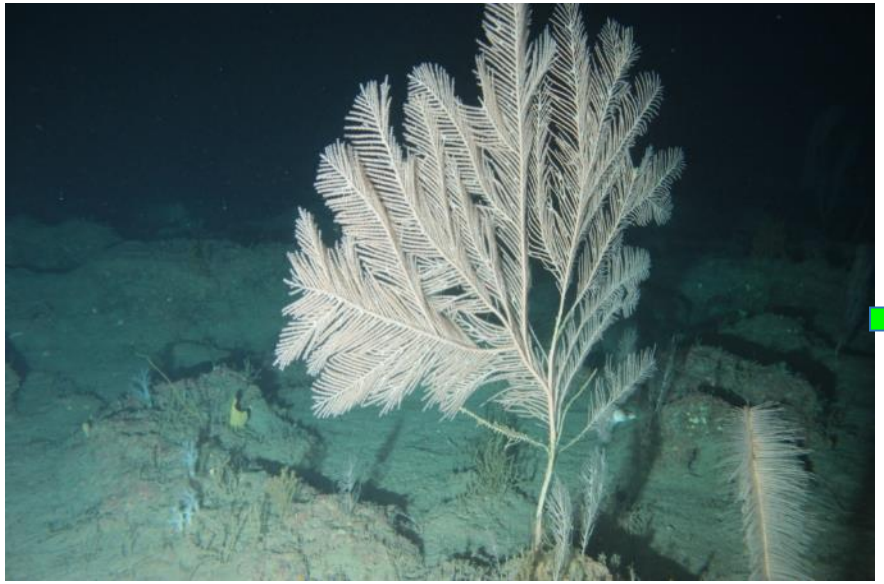
Antipathes dichotoma



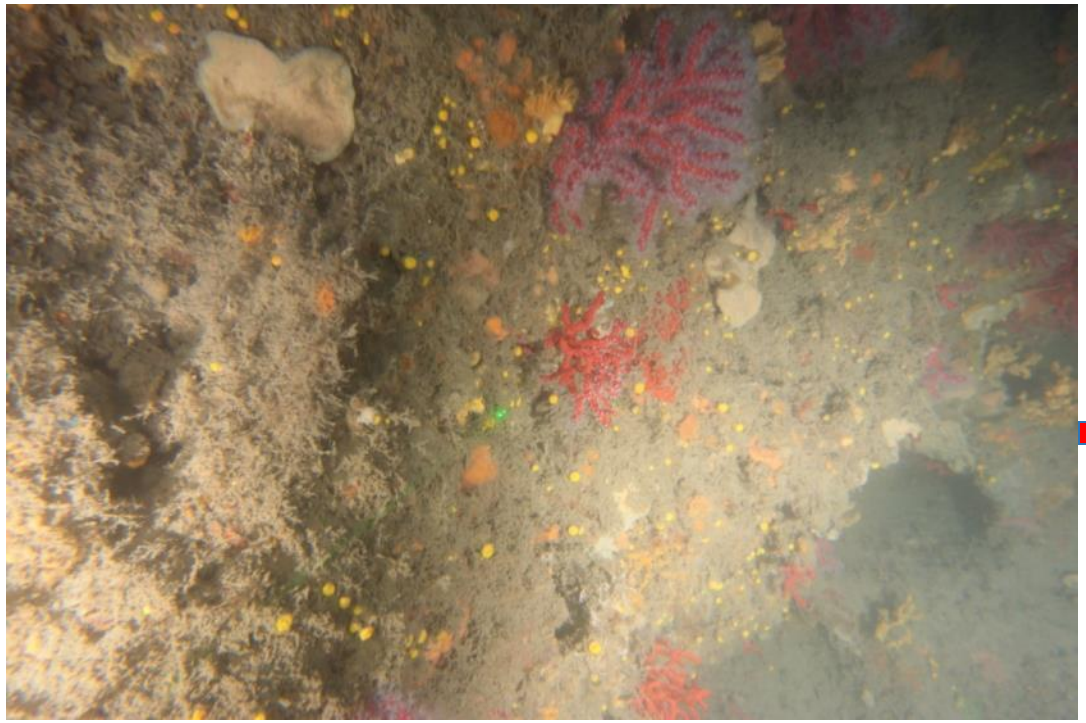


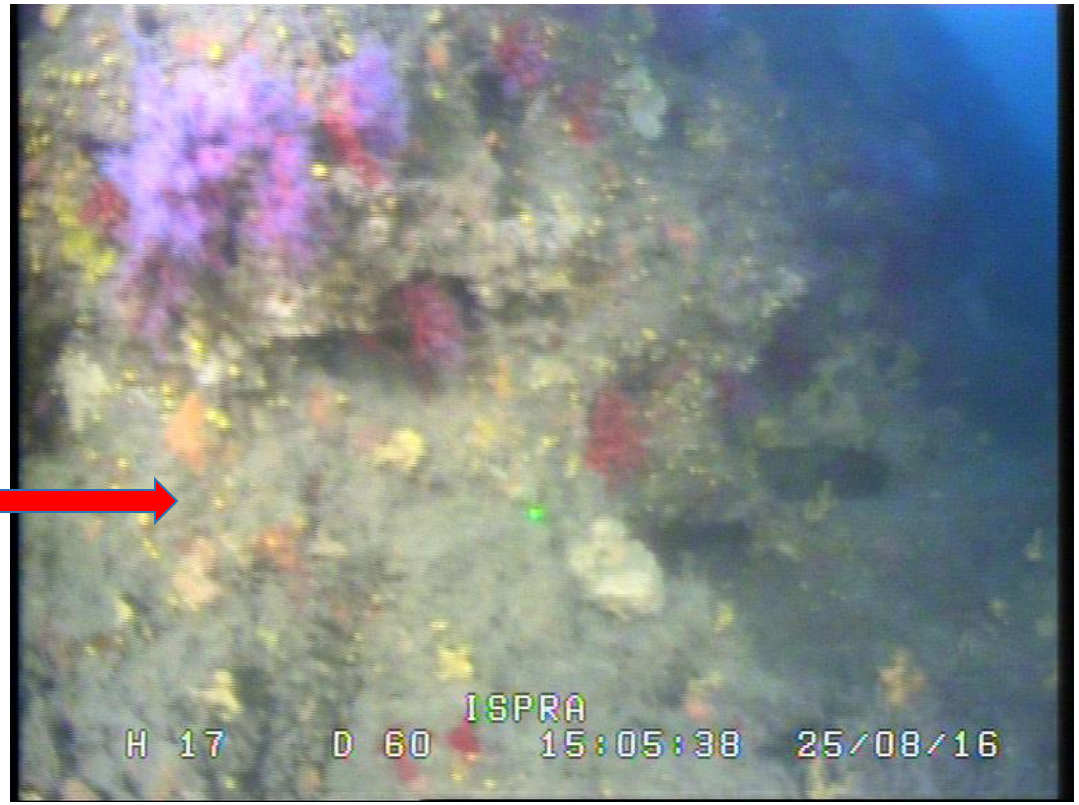
Callogorgia verticillata

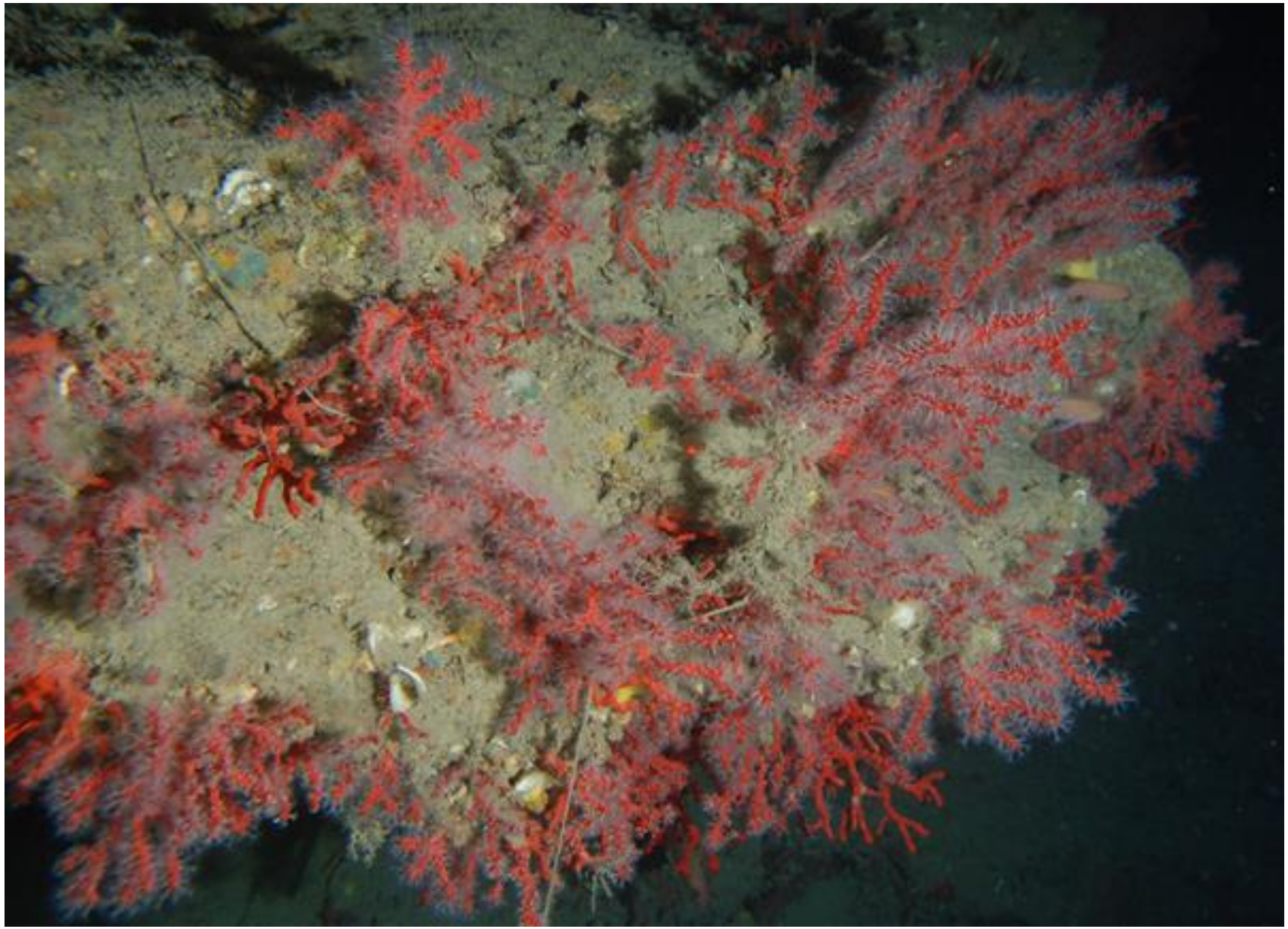




Corallium rubrum

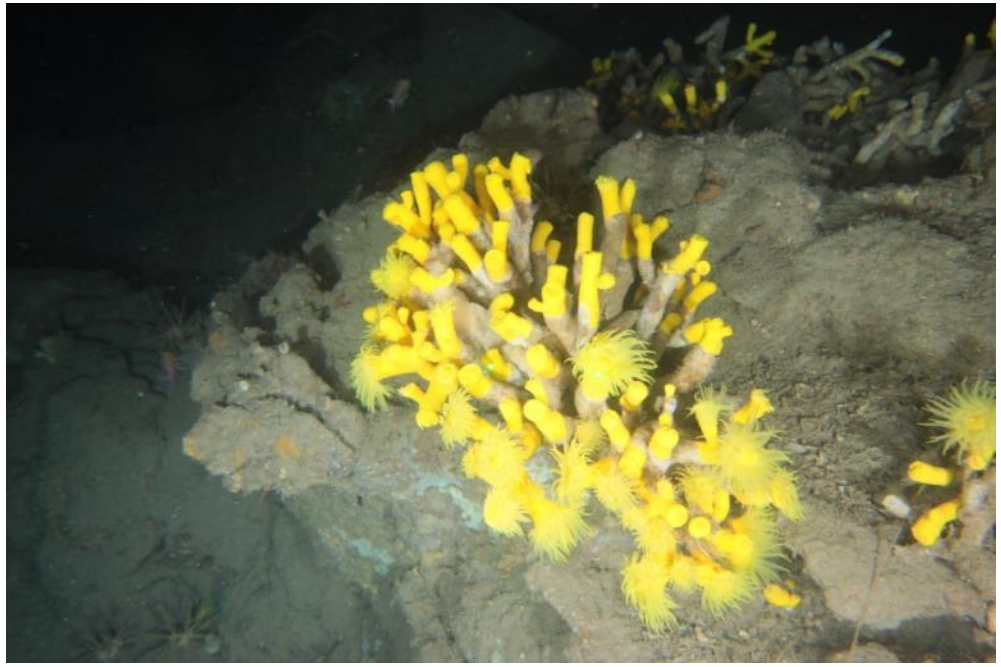


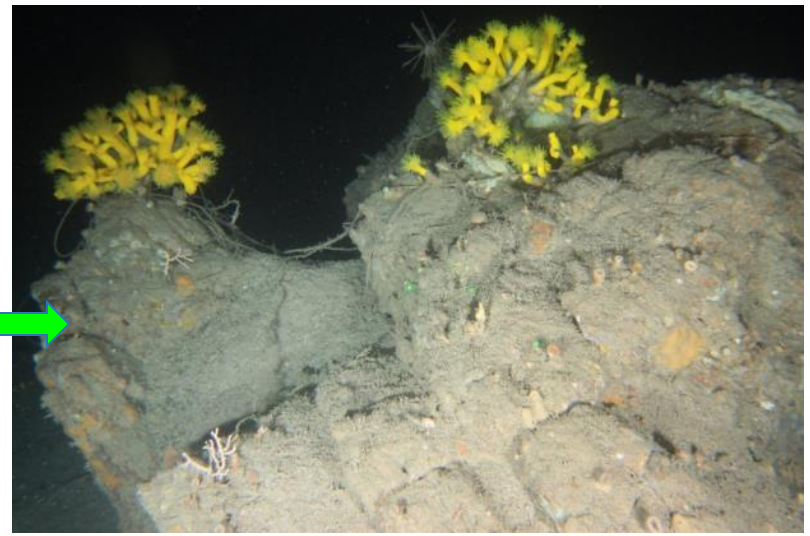




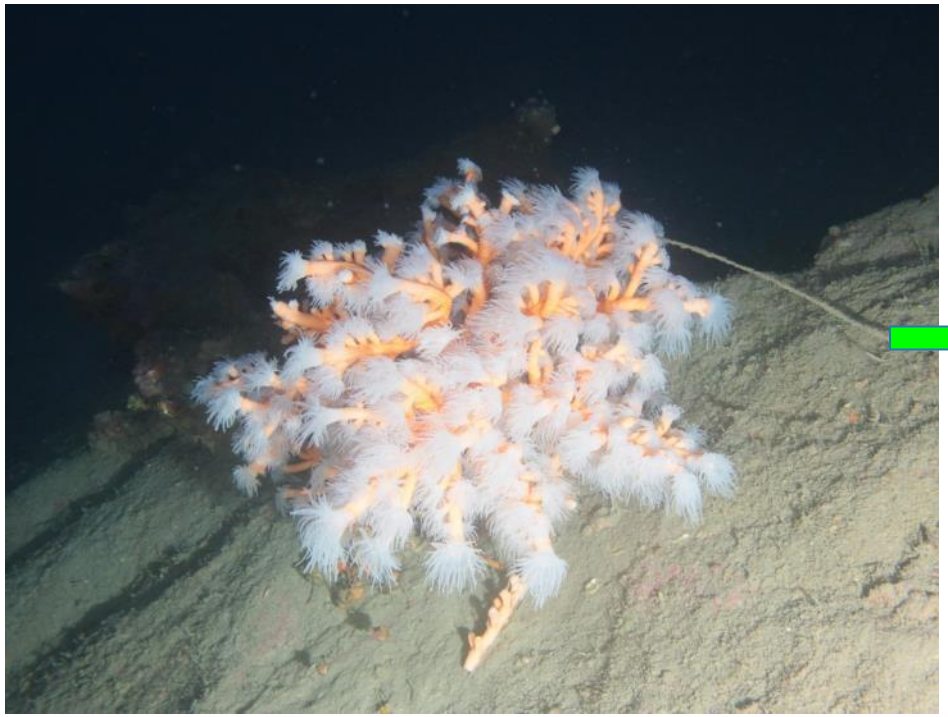
Acanthogorgia hirsuta

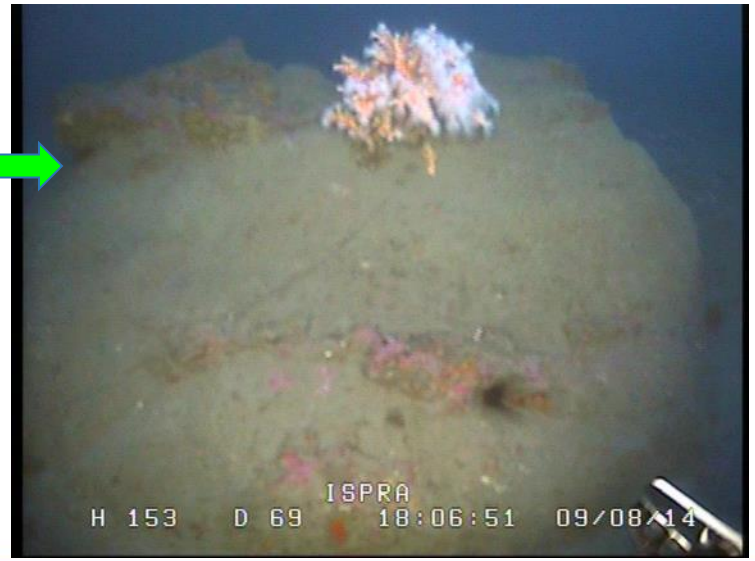
Dendrophyllia cornigera



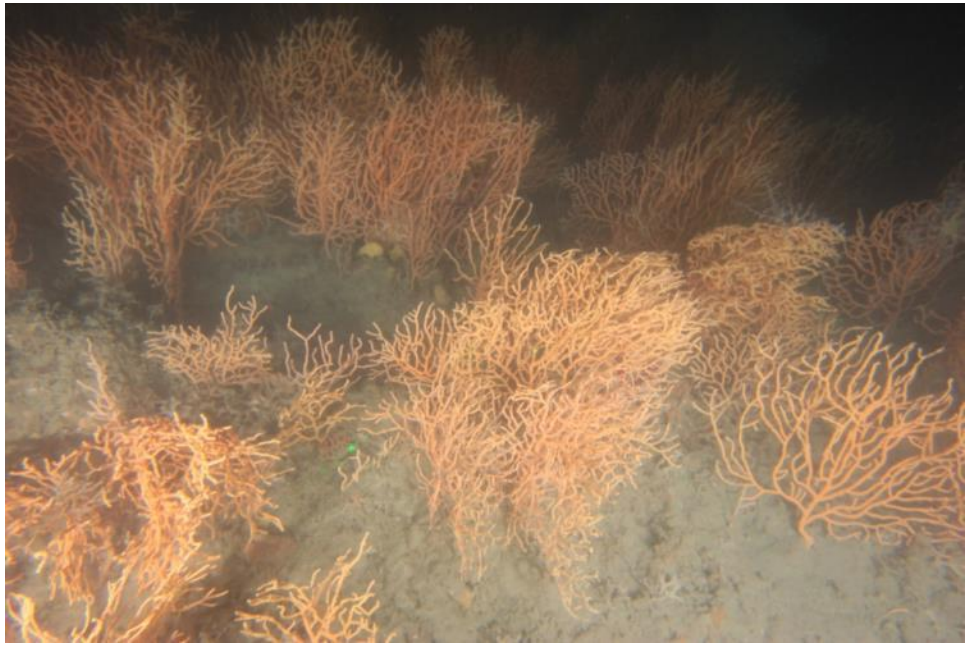


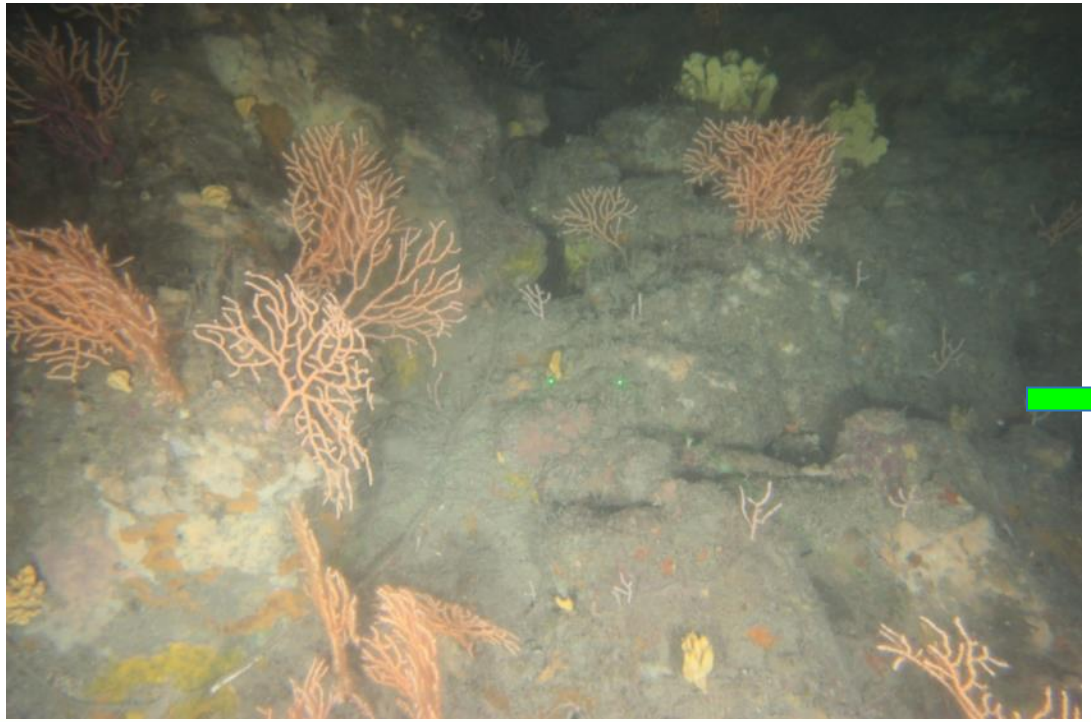
Dendrophyllia ramea



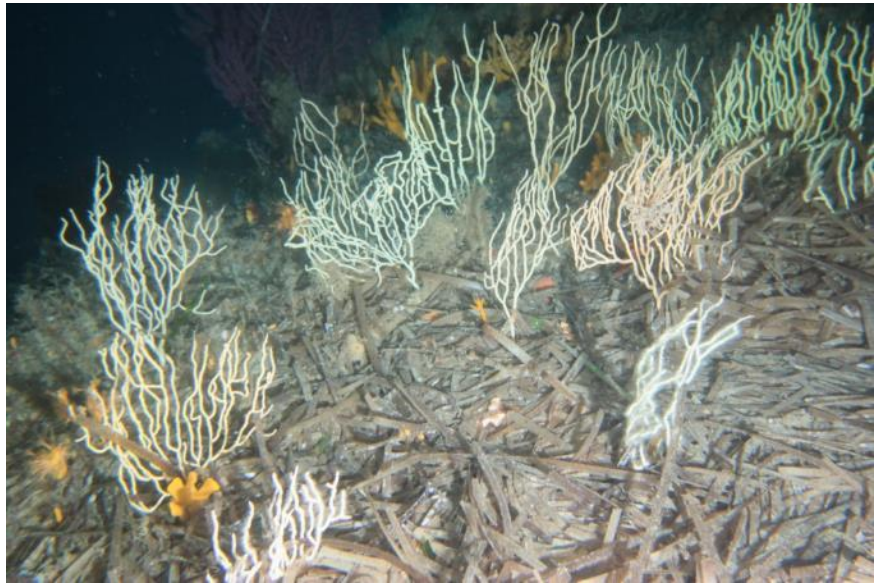


Eunicella cavolinii

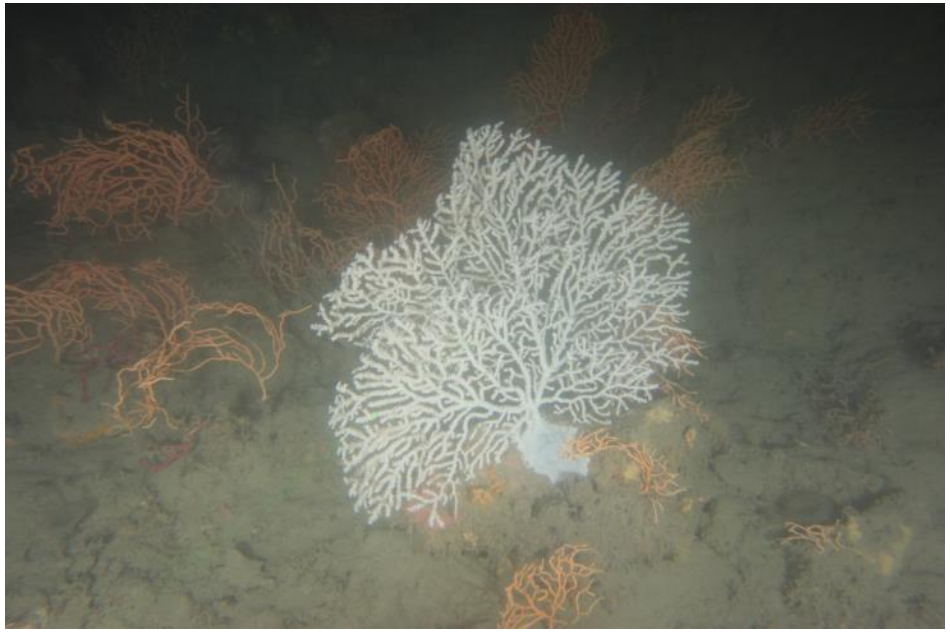


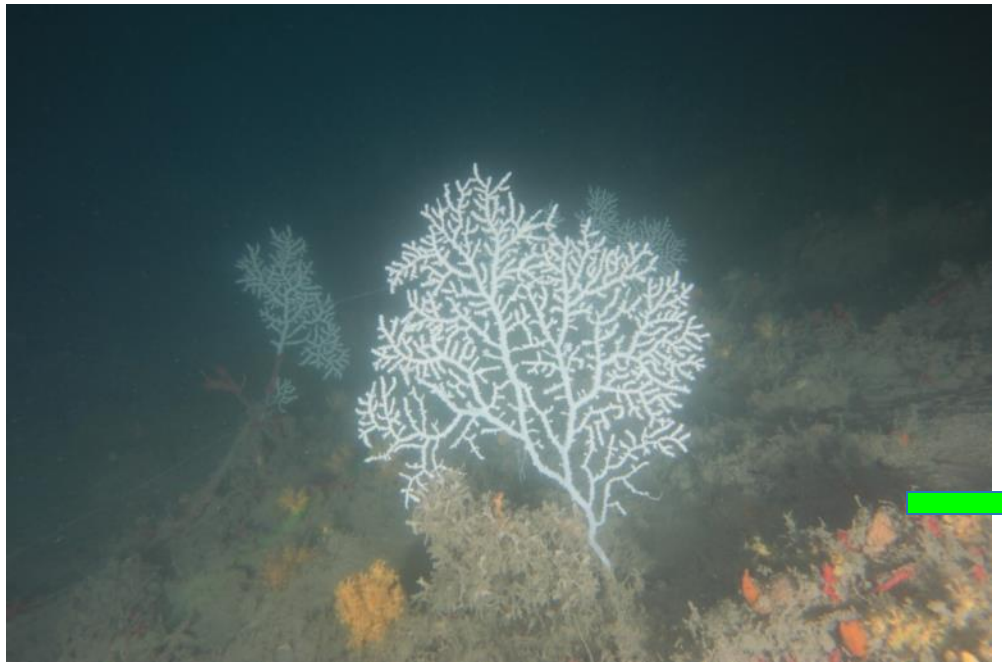


Eunicella singularis

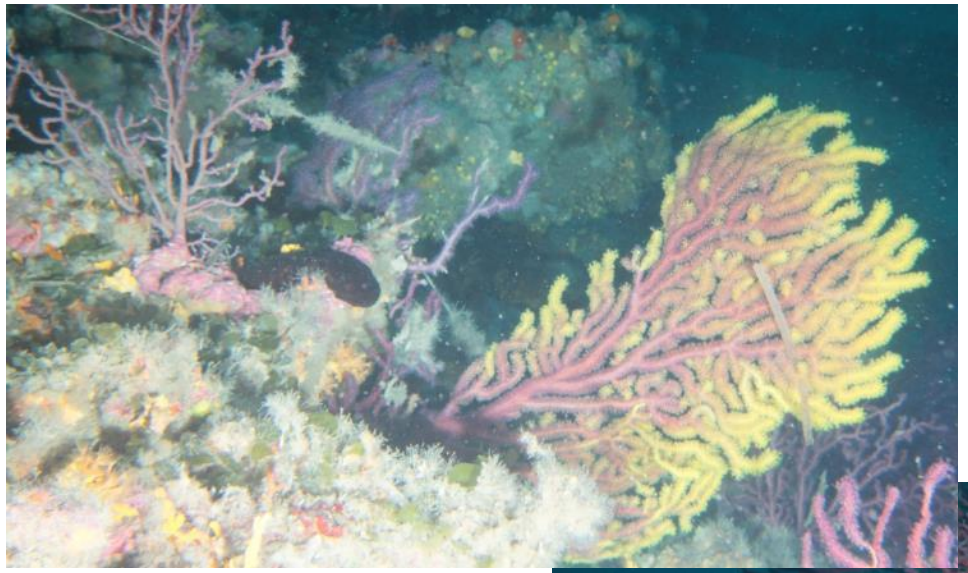


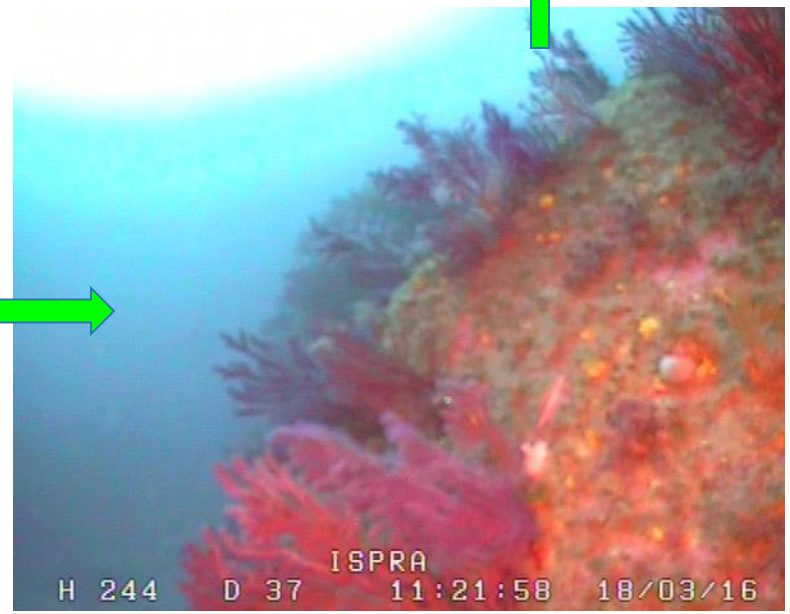
Eunicella verrucosa

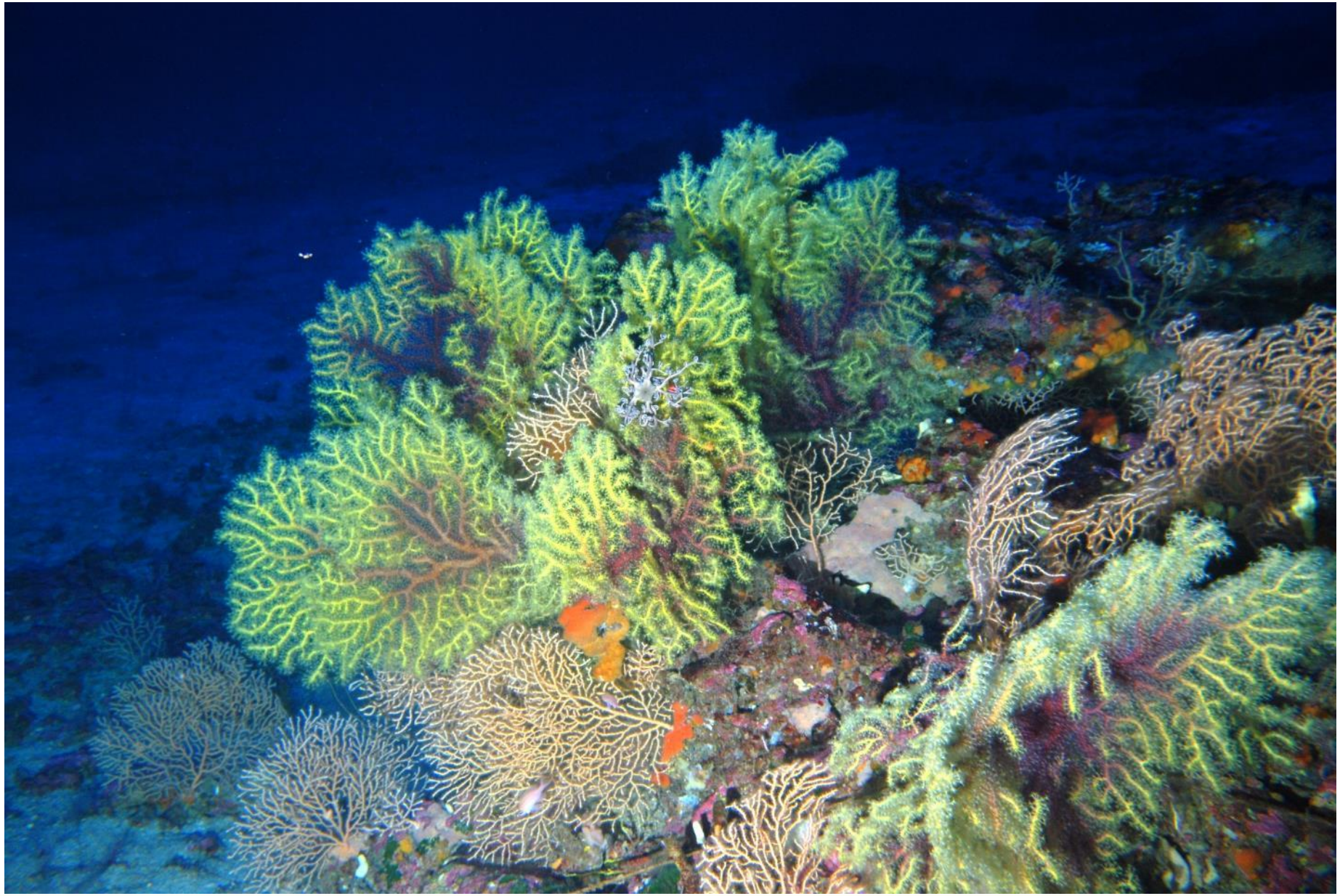




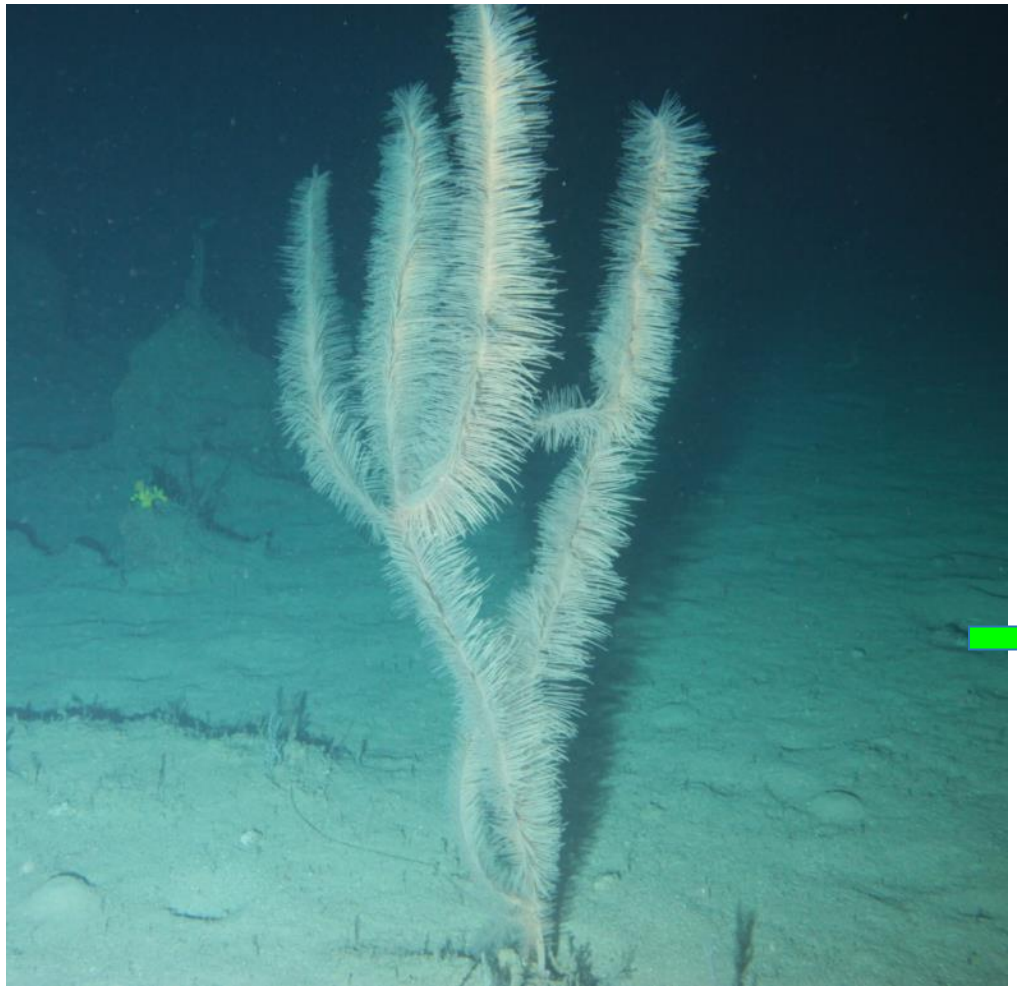
Paramuricea clavata



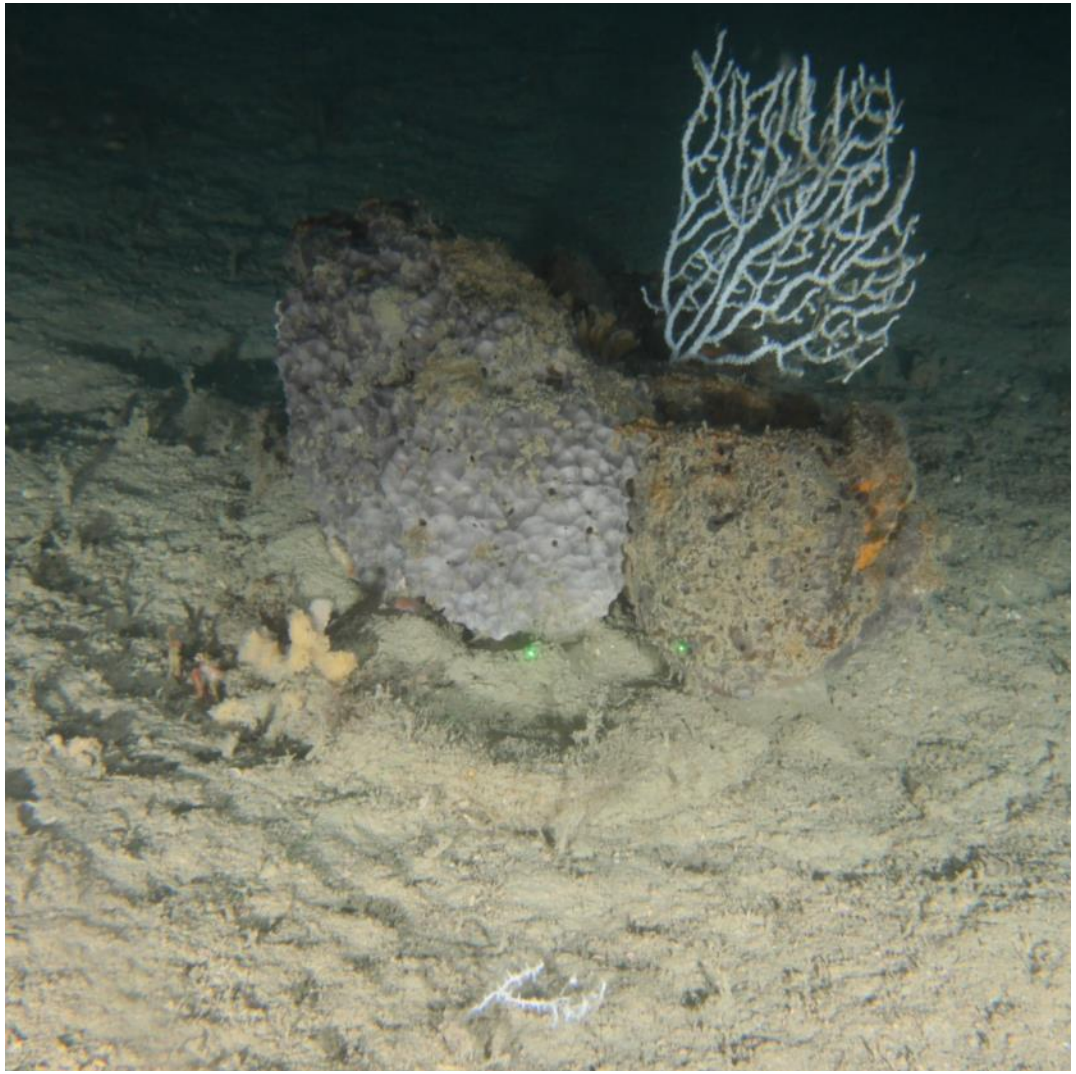




Parantipathes larix



Sarcotragus foetidus



Spongia lamella

eva.salvati@szn.it