VULNERABLE HABITATS AND SPECIES IN THE DEEP-SEA EMILE BAUDOT ESCARPMENT (SOUTH BALEARIC ISLANDS) SURVEYED BY ROV

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Abstract
Geological features like seamounts and canyons are known to be potential biodiversity hotspots due to the variety of bathymetric ranges, substrata, habitats and species that they can host. Escarpments share these characteristics and new findings show they can be considered as important biological hotspots.
Remotely operated vehicle (ROV) dives between 100 and 1000 m depth carried out in the Emile Baudot Escarpment (Southern Balearic Islands) and the surrounding shelf-break have provided new data on the distribution of deep-sea habitats and species. The most important factor influencing species and habitats' presence is the nature of the substrate and the bathymetry. Although most of the area is heavily covered by sediment, rocky outcrops and overhangs show thanatocenoses of oysters and corals. Coral framework and oyster shells are colonized by other cnidarians, mollusks and sponges like Caryophyllia calveri, Spondylus gussonii or Tretodyctium tubulosum. Some Neopycnodonte zibrowii individuals can even still be found alive. Important aggregations and communities of the crinoid Leptometra phalangium and the brachiopod Gryphus vitreus occupy a wide area on the shelf-break and on top of the escarpment. Different researches and international fora (like UNEP or FAO) include these communities in the classification of vulnerable, sensitive or essential habitats and ecosystems.

Key-words: Deep-sea, vulnerable, Escarpment, Mediterranean Sea, Balearic Islands

Introduction
Emile Baudot is the largest escarpment in the Western Mediterranean, stretching up to 275 kilometers long. It is SW-NE oriented, with depths ranging from 200 m in the shallowest part to deeper than 2,000 m at its base (Acosta *et al.*, 2002). It splits the Western basin into two regions: the Balearic Sea in the North and the Algerian Basin in the South.
The Northeastern area of the escarpment has sharper gradients and is highly covered by sediments, while the Southwestern flank is dotted by different submarine elevations and the lower sediment deposition allows rocks to emerge. The escarpment concentrates a wide array of geomorphological features including guyots, seamounts, submarine canyons, underwater cliffs, volcanic pinnacles, etc. (Acosta *et al.*, 2001; 2004).
ROV dives have provided images of the biological communities present over soft and hard bottoms, giving a first overview of the species and habitats´ distribution range. The geodiversity in this deep-sea area allows the proper settlement of peculiar species and the occurrence of ecologically important habitats.

Material and methods
In 2013, Oceana carried out a total of 11 ROV dives in the southernmost area of the NE part of the escarpment, some 3 to 5 nautical miles to the S-SE off the Cabrera National Park (Fig. 1). The survey was performed between 114 m and 1,004 m depth, using a Saab

Seaeye Falcon DR ROV equipped with an HDV camera of 480 TVL with Minimum Scene Illumination 2.0 LUX (F1.4), Pick Up Device ½” CCD, Image Sensor, and spherical ½ of 3.8 mm and wide angle lens.

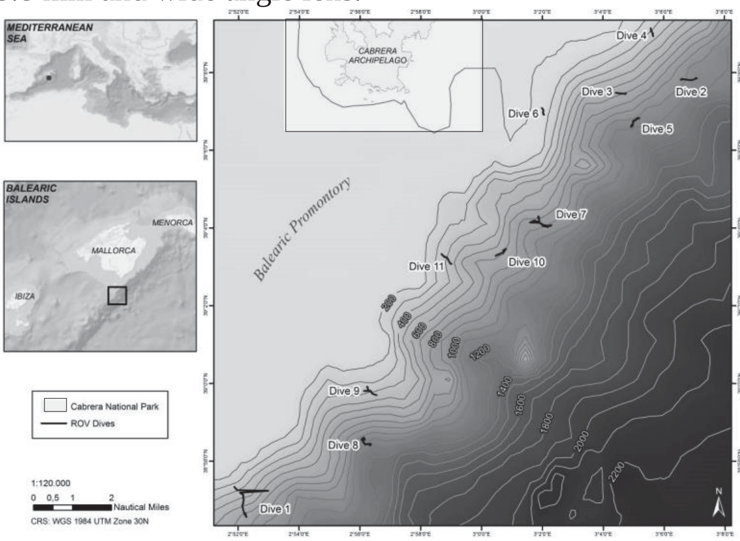

Fig. 1: Location map and deep-sea dives in the Emile Baudot escarpment.

The ROV footage was filmed both in HD and Low Res. Data on the position, depth, course and time was also recorded for the future examination of the images. The average sailing speed of the ROV was 0.2 knots.
Most of the taxonomic identifications were made by visual means, although several samples of key habitat-forming species were collected (with the ROV’s robotic arm and a dredge) for detailed analyses to confirm preliminary identifications. Every sighting was counted per individual – estimated when high aggregations (e.g. pandalids) – and taxa, and annotated together with the depth distribution.

Results

Considering the 11 dives undertaken, the ROV sailed across over 15.2 kilometers of seabed, covering an area of almost 228,000 square meters filmed and surveyed. The observation effort was of 20h09’27”, sighting an average of 13.48 individuals and 0.3 species per minute.
In total, close to 200 taxa were recorded in all transects, for a total of 16,218 individuals. Among the taxonomic groups found, chordate (46 species), cnidarian (35 species) and crustacean (29 species) were the groups with greater species representation (Fig. 2), and Echinodermata (4932 ind), Brachiopoda (4121 ind), Crustacea (2733 ind) and Cnidaria (2572 ind) were the dominant taxonomic groups in abundance.
The general trend observed reveals that the total number of species and individuals decreases with the depth (Fig. 3), so the vast majority of observations (50% species; 83% individuals) have been made in the shallower bottoms, from -100 down to -350 m (Fig. 3). Independently of this trend, a continuous species replacement in depth is also observed (Fig. 4). The results also show a significant decrease in species and abundance in the range of 600-750 m depth (0.14% individuals; 2.2% species) (Fig. 4), although it should be noted that such a breach coincides with the area where less observation effort was concentrated. Nevertheless, when taking into account the observation effort (Fig. 5), a strong abundance reduction trend in depth is confirmed, while the species reduction trend seems less pronounced if the less surveyed depth range is excluded.

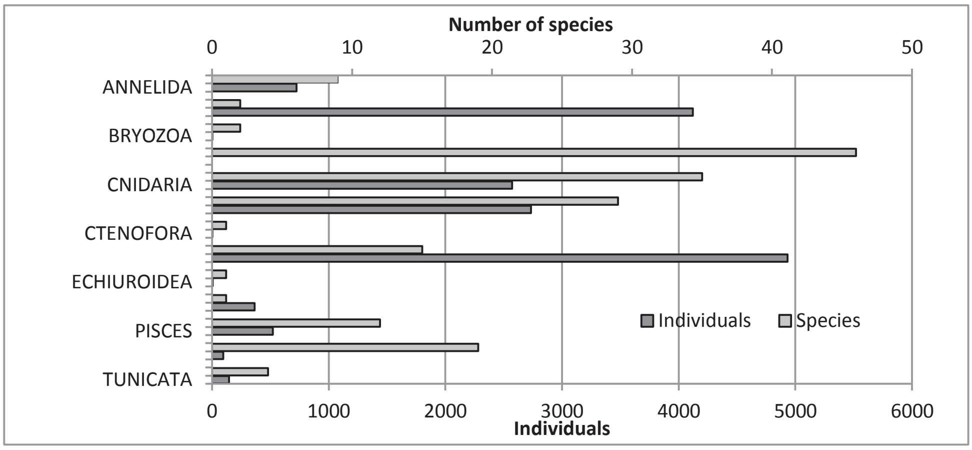

Fig. 2: Distribution of number of species and total abundance by taxonomic groups

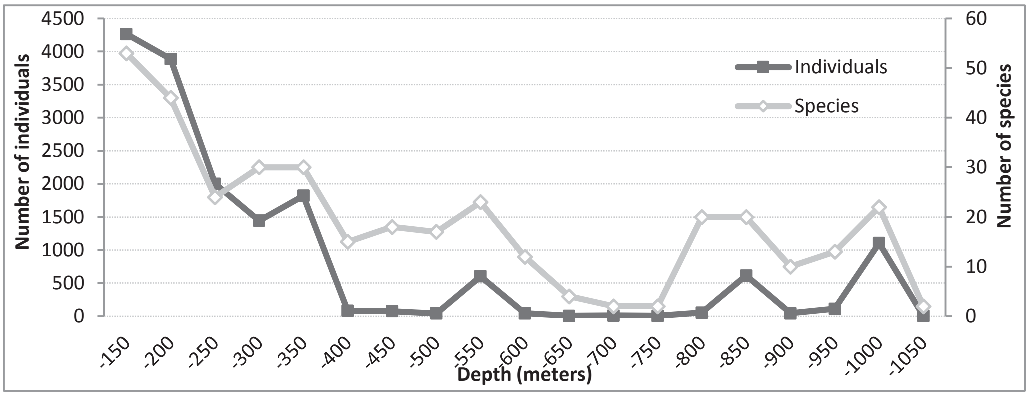

Fig. 3: Depth distribution of the number of individuals and species

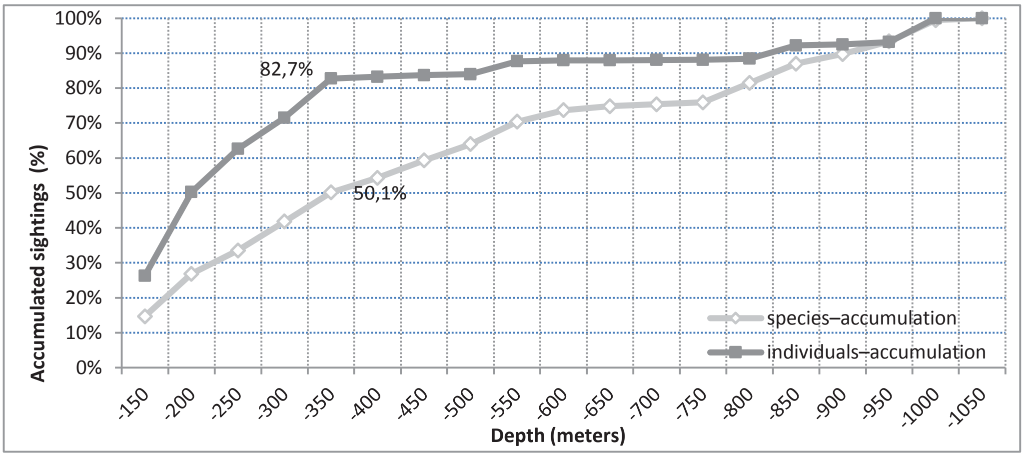

Fig. 4: Species and individuals accumulation

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Abundance peaks in the shelf and shelf break (150m and 250m) are the result of the large populations of *Leptometra phalangium*, *Megerlia truncata, Gryphus vitreus*, and *Lanice conchilega*. While in deep areas, it coincides with specific sightings of large populations of *Plesionika narval* (300m) and *P. edwardsii* (350m), and colonies of an unidentified epilithic zoanthid joined by stolons covering the rocks (550m, 850m and 1000m).

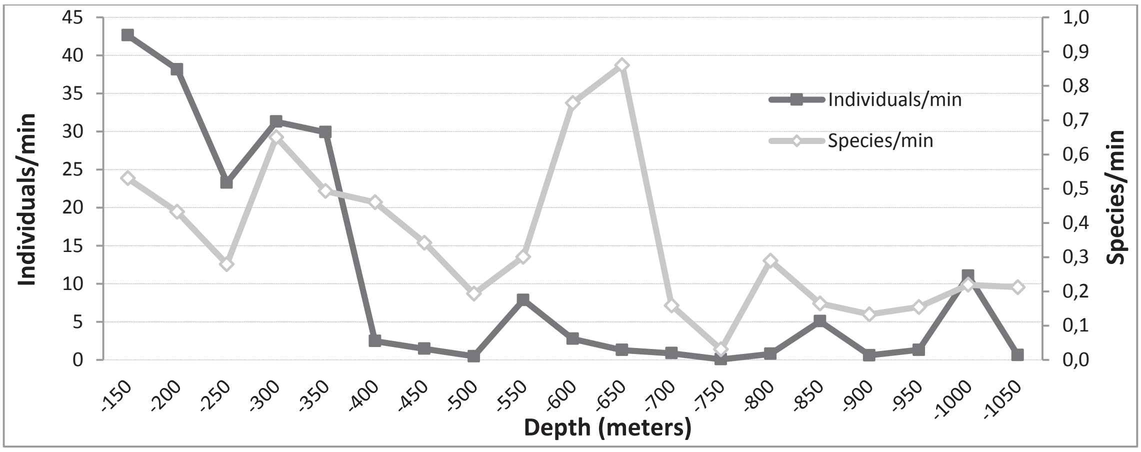

Fig. 5: Sightings per effort unit

Main facies and communitites observed:

1) *Gryphus vitreus* beds, mainly documented on detritic bottoms of the shelf-break before the escarpment, with estimated densities reaching up to 50-60 ind./m^2.
2) *Leptometra phalangium* beds, observed on sedimentary beds of the shelf, sometimes are mixed with *Gryphus vitreus* when closer to the escarpment. The highest estimated densities were of some 15-20 ind./m^2.
3) *Lanice conchilega* beds, occur in combination with *Gryphus vitreus* and *Leptometra* beds, but sometimes being the dominant species.
4) Ceriantharia beds, appear mainly at two different depth ranges, one on the shelf (150m) with *Arachnanthus* cf. *nocturnus* as the dominant species, and another on deeper areas (800m and 850m) with *Cerianthus* sp. and other Ceriantharia species.

With regards to the sea bottom typology and geomorphology:

5) Caves. Located on the shallowest part of the shelf down to approximately -170 m, the caves host an abundant and rich fauna, including several protected and/or regulated species (*Ranella olearia*, *Centrostephanus longispinus, Scyllarus arctus*, etc.).
6) Rocky overhangs with thanatocenoses of *Neopycnodonte zibrowii*. Dead giant oyster aggregations appear at around -300 m, but the densest ones are located in the deepest areas below -950 m providing substrate for other oysters (*Spondylus gussonii*), polychaetes and sponges´ settlement.
7) Rocky outcrops with coral framework. Have a very similar distribution to the oysters' thanatocenoses. Different sessile fauna attached to these beds includes live coral species such as *Caryophyllia* spp. and *Desmophyllum dianthus*.
8) Soft bottoms with burrowing megafauna. Widely distributed along the escarpment with higher bioturbation due to *Nephrops norvegicus* and other crustaceans' burrows below -450 m.

Discussion and conclusions

Seamounts and canyons, considered as potential biodiversity hotspots (Morato, 2003; Samadi *et al*., 2007; Abdulla *et al.*, 2009; de Juan & Lleonart, 2010; Morato *et al.*, 2010; Harris & Baker, 2012; Würtz, 2012), share characteristic escarpments which result in a wide diversity of substrates, habitats, communities and species (Drazen *et al*., 2003; Taviani *et al*., 2011; Van Rooij *et al.*, 2011).

Outcomes from ROV surveys presented in this document and others in different Mediterranean areas provide the evidence that escarpments and their overhangs host important Scleractinia and Ostreidae fossil assemblages (e.g. Strait of Sicily (Freiwald *et al.*, 2009); area between Malta and Syracuse (Taviani & Colantoni, 1984); Alboran Sea (Hebbeln *et al.*, 2009)). These communities in the Emile Baudot Escarpment still keep some remaining alive aggregations of oysters and small colonies of scleractinians which may have been strongly reduced from what they originally were in the past.

This research has shown that the shelf and shelf-break between the Cabrera National Park and the Emile Baudot Escarpment displays important areas for communities considered as Sensitive Habitats (Colloca *et al.*, 2004; Mangano *et al.*, 2010), such as *Leptometra phalangium* and *Gryphus vitreus* beds.

The area seems to be important for several vulnerable, threatened and protected species, like deep-sea sharks (*Centrophorus granulosus*), manta rays (*Mobula mobular*), hatpin urchins (*Centrostephanus longispinus*), wandering tritons (*Ranella oelaria*) or the anthozoans *Callogorgia verticillata* and *Savalia savaglia* that were also documented during this survey The escarpment has been already appointed as a feeding and, possible, breeding ground for sperm whales (*Physeter macrocephalus*) (Pirotta et al., 2011).

Further analyses are needed to estimate the impact on these communities and species of lost fishing gears, garbage and sedimentation rates observed in the escarpment.

Infralittoral caves have been studied in many Mediterranean areas and they are often recognized as reservoirs of unknown biodiversity and non-resilient communities (Harmelin *et al.*, 1985; UNEP/MAP, 2013). However information on deep-sea caves and cavities is pretty scarce. The area between the circalitoral and bathyal zones on the shelf break beside the Emile Baudot Escarpment host caves that are largely unexplored, but first images collected show important communities and species.

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