CONTRIBUTION TO THE KNOWLEDGE OF RARE AND ENDANGERED HABITATS - MARINE CAVES (MONTENEGRO, SOUTH EAST ADRIATIC COAST)

Vesna Mačić,[1] Aliki Panou,[2] Luigi Bundone,[2,3] Dušan Varda[4]

(1) Institute for Marine Biology, 85330 Kotor, University of Montenegro (IBMK)
(2) Archipelagos - environment and development (NGO), Strofiliou str. 26, GR-145 61 Kifissia/Athens, Greece
(3) Università Ca' Foscari, Dipartimento di Scienze Ambientali Informatica e Statistica, Dorsoduro 2137, 30123 Venice, Italy
(4) Mediterranean Center for Environmental Monitoring (NGO), I. Milutinovića 7, Sutomore, Montenegro

1st Mediterranean Symposium on the conservation of the dark habitats (Portorož, Slovenia, 31 October 2014)

INTRODUCTION

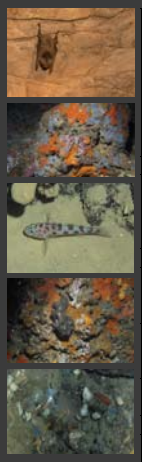
Marine caves are an important and endangered habitat listed in Annex I of the EU Habitat Directive (1992). They are also protected by the Montenegrin law on nature protection (Sl. list, 2013). Over two-thirds of the territory of Montenegro belongs to the karst formation of the south-eastern Dinarides with various and specific rocky forms including numerous caves. Data on marine caves in Montenegro are very scarce and, at present, there is no Marine Caves' Register (although it is planned by law). For all above reasons we surveyed the marine caves in the northern coast of Montenegro in order to:
(a) contribute to the knowledge of this important, but poorly studied habitat,
(b) to create the basis for the urgently needed Cave Register and
(c) to ensure a better management of this rare, endangered and protected habitat.

MATERIAL AND METHODS

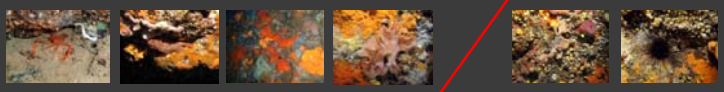
We surveyed the area from cape Arza (peninsula of Luštica) down to cape Platamuni (peninsula of Donji Grbalj) (ca. 40km), in September 2013. Special attention was given to the area planned for the future MPA Platamuni (from cape Žukovac to cape Platamuni). For all registered caves (longer than 5m) and holes (less than 5m) the following basic data were noted: location name, geographic coordinates, dimensions (in meters), exposition, morphological characteristics, date of survey, and typical living organisms in the cave and in front of it. During the postprocessing of the collected data all locations were mapped by Quantum GIS software (2013).

RESULTS AND RECOMMENDATIONS

In the surveyed area we registered 20 marine caves one of which had an underwater entrance. Only few marine caves had a relatively deep submerged area (up to 30m depth below the sea level), while most of them were only a few meters deep. In some caves there was a small pebble or sandy beach and in others cave rock formations were found. Some beaches inside the caves were registered as potential habitats for the endangered Mediterranean monk seal, *Monachus monachus*.



No. 8	Location: **Plava špilja**   Foto: Aliki Panou
Coordinates	N 42º 22' 26.36" E 18º 35' 48.34"
Dimensions	Two entrances partially submerged. The bigger entrance is 9m wide x 6m high, while smaller entrance is 4m wide x 2m high. Cave is 60m long x 46m wide (depth of water 6m; height above the sea level is cc 25m).
Exposition	West (and east for the smaller entrance)
Morpho-characteristics	The cave has two entrances. A part of the cave floor is sandy but mostly it is rocky. There is a inflow of fresh water and some cave rock formations on the walls.
Living organisms	Close to the entrances there are many algae and sponges, deeper in the cave assemblages vary and are not very rich. Occasionally there are bats on the cave's walls.
Notes	Anthropogenic pressure from touristic boats in summer months is intensive.
Date of survey	18. 09. 2013.
In front of the cave	Rocks, boulders, barren area, *Padina pavonica*, *Cystoseira amentacea*, *Posidonia oceanica*, *Pinna nobilis*, little sandy areas, few *Lithophyllum byssoides* colonies.



No. 40	Location: **Krekavica cave**  Foto: Aliki Panou  Foto: Dušan Varda
Coordinates	N 42º 17' 02.59" E 18º 45' 24.77"
Dimensions	15m wide x 8m high x 15m long (depth of water 30m; height above the sea level is 4m)
Exposition	South
Morpho-characteristics	The cave is widely open to the south and the walls inside the cave in the water are vertical down to 30m depth. On the bottom and in a small area in front of the entrance there is sand. On the west side of the cave there is a cubical boulder creating almost an underwater bridge. Further inside the cave there is no air gap. On the east side, a part of the vertical rock divides the space so that one can enter the cave also from the smaller hole. Behind this part on the east side it is completely dark.
Living organisms	High biodiversity. The most abundant organisms are various species of sponges but also many other polychaetes, bryozoans, crustaceans and others.
Notes	This is the location with the richest cave biodiversity observed so far.
Date of survey	21. 09. 2013.
In front of the cave	Above the cave there are high vertical cliffs where some endemic plants were observed. For example, *Euphorbia dendroides* is very abundant. Also the area is suitable for some protected bird species.

Besides the marine caves we also registered 24 holes less than 5m long, but still important as potential habitat for some rare or endangered species. In the surveyed area, the following 7 marine protected species (Sl. list 2006) were registered inside or around the caves: *Lithophyllum byssoides*, *Cystoseira amentacea, Posidonia oceanica, Cymodocea nodosa, Pinna nobilis, Cladocora caespitosa* and *Lithophaga lithophaga*. Additionnally, 2 species of protected terrestrial plants were noted, namely *Euphorbia dendroides* and *Limonium angustifolium,* 5 species of protected birds, namely *Ardeola ralloides, Alcedo athis, Phalacrocorax aristotelis, Acciptier gentilis* and *Corvus corax,* and one protected bat species (*Miniopterus schreibersii*). Furthermore, in few locations, in front of the caves we registered nursery areas for some key species (e.g. *Epinephelus costae, Epinephelus marginatus)*.

CONCLUSIONS

Our data on marine caves in Montenegro will be used for the urgently needed creation of a Caves' Register and will substantially contribute to implement more efficient protection measures of this fragile and endangered habitat and the marine environment in general.

Bibliography
EU HABITAT DIRECTIVE (92/43/EEC) - Available at: Council Directive on the conservation of natural habitats and of wild fauna and flora. Available at: ftp://www.central2013.eu/fileadmin/user_upload/Downloads/Document_Centre/OP_Resources/HABITAT_DIRECTIVE_92-43-EEC.pdf
SLUŽBENI LIST BR.76/06 (2006) - Rješenje o stavljanju pod zaštitu pojedinih biljnih i životinjskih vrsta. Sl. list RCG br. 76/06, od 12. decembra 2006. godine
SLUŽBENI LIST BR. 62/13 (2013) - Zakon o zaštiti prirode. Sl. list RCG od 31.12.2013. g.

Acknowledgements: The authors wish to thank Jugopetrol AD Kotor, Montenegro who financed this project. The University of Venice "Ca' Foscari", Dipartimento di Scienze Ambientali Informatica e Statistica financed the travel of Archipelagos' volunteer and PhD student Luigi Bundone.