

Marine caves in the area of future MPA PLATAMUNI (Montenegrin coast)

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ABSTRACT

Marine caves are an important and endangered habitat considered as an biodiversity reservoir of high representativeness and great scientific interest. In the area planed for future marine protected area Platamuni basic characteristics for 4 marine caves are presented. This data could be used for the urgently needed creation of a Montenegrin Cave's Register and also as a basis for future research and protection measures.

Keywords: marine caves, habitat, endangered, Adriatic Sea

INTRODUCTION

On the global scale, coastal zones are one of the most dynamic and rapidly changing environments, mainly caused by anthropogenic activities (industry, urbanization, tourism and food production) (Pikelj, Juračić 2013). The Montenegrin coast consists of a wider variety of rocks, including carbonates, flisch and volcanoclastites, while area planed as potential marine protected area (MPA) Platamuni is completely represented by carbonates (Radović 1964; Badalamenti et al., 2008).

Although the rocky coast is not rare the carbonates generate quite specific coastal forms and marine caves are considered as rare habitat (Williams, 2008). Furthermore, marine caves are an important and endangered habitat listed in Annex I of the EU Habitat Directive (92/43/EEC). This particular ecosystem in the Mediterranean Sea is

considered a biodiversity hotspot, appearing to be an important biodiversity reservoir of high representativeness and great scientific interest (sponges, plankton, etc.), deserving further detailed study and protection (Williams 2008).

There are few definitions for marine caves but in many documents there is no precise definition. In the Habitat directive, under the Natura 2000 code 8330, is a habitat name "Submerged or partially submerged caves" and description of this habitat is given as: "Caves situated under the sea or opened to it, at least at high tide, including partially submerged sea caves. Their bottom and sides harbour communities of marine invertebrates and algae." Here is missing definition of dimensions, so for the purpose of this paper definition of the cave will be taken from the national Law of nature protection (Sl. list br. 51/08) where cave is naturally formed hole in the rock longer than 5 metres where a person can enter. In the case of sea caves they could be completely or just partially submerged.

All these openings are mainly created by the waves' force or by freshwater running into cracks and eroding the rock in millions of years (Pikelj & Juračić, 2013). Sea caves are a particular ecosystem and their bottom and sides have specific communities of marine invertebrates and algae while in the water column inside the cave particular species of plankton different than the species in the open sea could be found (Bussotti et al., 2006). In sea caves, prevailing conditions differ from those of the open sea: the deeper they are the weaker becomes the waves' force allowing fragile organisms to settle. As sunlight becomes less and less intensive, algae different than those growing in the direct sunlight occupy the space, red algae in the majority. Deeper in the cave, where it is too dark even for red algae, more and more sessile animals such as colourful sponges, marine

worms residing in their calcareous tubes and bryozoans with their fragile skeletons occupy the walls (EU Interpretation Manual of European Union Habitats, 2013). Finally, in the very back of deep sea caves where there is no light at all life can hardly exist. The water's temperature inside the marine caves is usually lower and more stable than that in open sea in front the cave. These and other ecological factors in marine caves are similar to the conditions in deep sea waters, so sometimes we can find there organisms that generally occur in the deep sea (Pergern et al., 2002). Typical for all those organisms is the reduction of eyes and a less intensive pigmentation (Iliffe & Bishop, 2014)

Marine caves are also habitat for some species of endangered bats and they are also an important habitat for resting and reproduction of the endangered Mediterranean monk seal (*Monachus monachus*) (Panou et al., 1993).

In our national Law on nature protection (Sl. list no. 51/08) it is indicated that "speleological objects" should be protected. Unfortunately there are no adequate regulations neither a "Caves' Register" does exist. The preparation of these regulations is ongoing already for some time now, but in those draft regulations there are no details about marine caves. Aim of this paper is to present some characteristics of this valuable and endangered habitat and to help towards the improvement of existing documents and the creation of an appropriate Marine Caves' Register. Also this should be a starting point for further investigation, management and protection of the marine caves in the area of future MPA Platamuni and in Montenegrin coast in general.

MATERIAL AND METHODS

The survey of the coastline from Cape Platamuni to Cape Žukovac (ca. 10km) was performed in September 2013 (Figure 1). On all locations where a cave or a big hole was noted coordinates were taken by GPS Garmin 76 and notes were taken on maps. During the postprocessing of the data collected all locations were stored by Quantum GIS software. For all registered caves/holes the following basic data were noted and organized in tables: number, location name, geographic coordinates, approximate dimensions (in meters), exposition, morphological characteristics, typical living organisms, date of survey, typical living organisms in front of the cave. Where details were noted the orientation and position was always noted as looking from the sea at the cave.

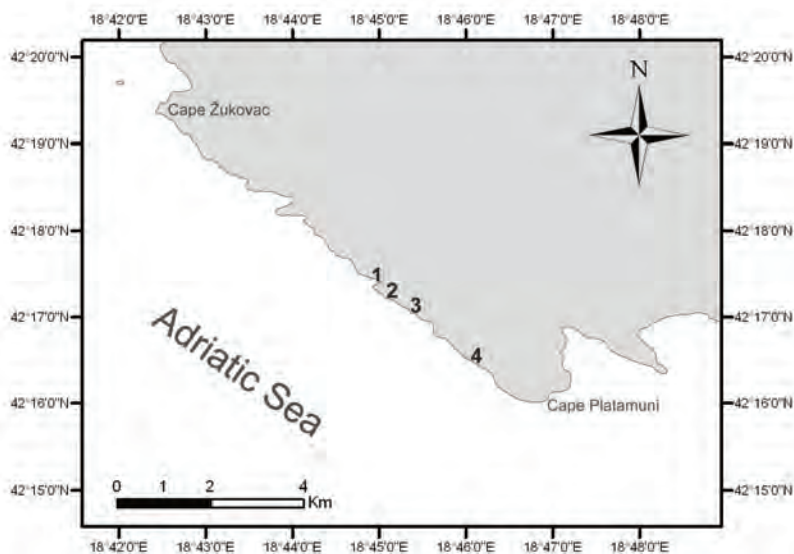


Figure 1. Distribution of marine caves in the area of future MPA Platamuni (1. inlet Velika Krekavica, 2. Saletova cave, 3. Krekavica, 4. close to St. Nikola)

RESULTS AND DISCUSSION

Distribution of 4 caves in the area of future MPA Platamuni is shown in Figure 1. Here are presented the data just for the caves (by definition in Law of nature Sl. list 51/08) while data for smaller holes here are not presented. Anyway, we should have in mind presence also of that small, specific habitats, because these are very important habitats for many protected and rare species.

Registered caves are concentrated at the central part of the surveyed area. One cave had the entrance under the water, while 3 were with the entrances on the sea level. All caves consists of a single passage or chamber and although very simple, they are also very different between each other.

Two smallest caves are situated in the bottom of the inlet Velika Krekavica (Figure 2). Entrances in these caves are exposed to the south, but regarding their position in the bottom of the inlet they are very protected. Entrances are small, 1m and 2m wide and 2m high continuing with simple channel, respectively 5m and 7m long. Booth channels are partially submerged and water dept in these channels are up to 1m. Furthermore channels have a air gaps mostly up to 1m high and on the end of one cave there is a small pebble beach. Beside this small beach in one of the caves we should underline that close to this 2 caves there are also small pebble beach few meters long and 1m wide on the one side, while on the other side there is a bigger pebble beach with dimensions approximately 7m long and 5m wide. This is important to note because represents combination of habitats, in general, under high anthropogenic pressures, which are here preserved in natural conditions.

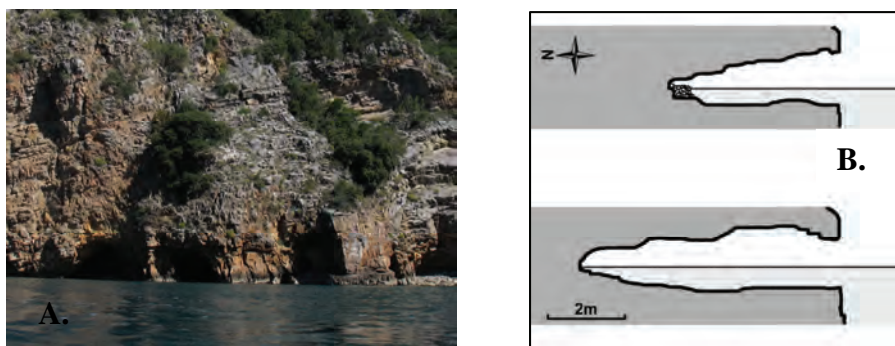


Figure 2. A. Two small caves situated in the bottom of the inlet Velika Krekavica; B. cross sections

This two small caves according to Pergent et al. (2002) belong to Biocenosis of mediolittoral caves (RAC SPA code: II.4.3) and correspond to EU habitat type code: 8330 and CORINE code: 1126. This habitat is located in the crevices or the entrances of caves at sea level and it is formed of very shadowy rocky surfaces subject to extremely great humectation. Because of the relatively small dimensions of this mediolittoral caves, just on the very end of the holes biocenosis could be defined also as biocenosis of semi-dark cave (RAC SPA code: IV.3.2.). Inflow of fresh water is evident and obviously influencing the quality and zonation of this habitat.

On the beginning of these two small caves there are some *Corallina elongata*, *Peyssonellia rubra*, incrusting red algae, *Patella* sp, few species of sponges and others, while in the deeper parts of the caves marine macro-organisms are almost absent.

This complex of two small caves and neighboring beaches is very important as potential habitat for monk seals and also a nursery area for fish, especially groupers. Within the entire area of the planned establishment of MPA Platamuni this is probably the most important location. It is also important to note that there is no road access to the small beach and anthropogenic touristic impact is very low. A problem might be

the planned setting of an electricity cable from Montenegro to Italy and ending of electrode in this area (Geoprojekt, 2013). On the other hand, the presence of the electrode may lead to a better control of the access to this area.

Saletova pećina is a relatively big cave with underwater triangular entrance, few meters high and wide, starting from the 8m depth (Figure 3). After passage cave is represented by a rounded chamber (25m in diameter). Submerged are several big blocks and boulders, while above the sea level there is also a big air chamber approximately 25m high. Inside the cave chamber, in the north direction, is a beach with a 40% slope, consisted of big, mostly sharp rocks. Close to the entrance in the cave and in some parts of the bottom there is very fine sand. Inflow of fresh water is very strong and water on the surface is very cold comparing to deeper parts.

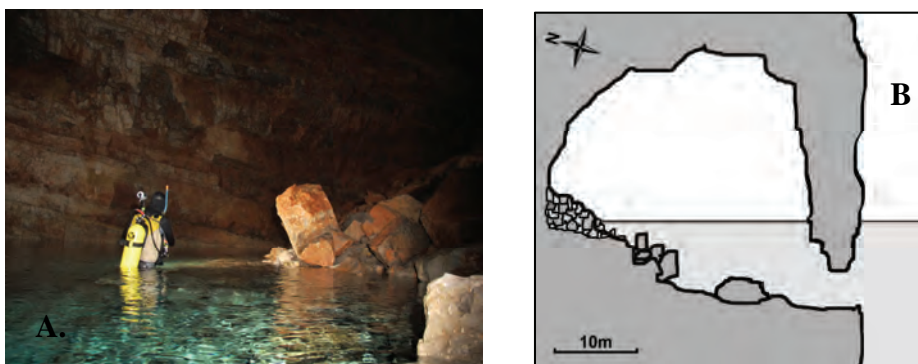


Figure 3. A. Saletova cave with underwater entrance; B. cross section

This cave belongs to Biocenosis of semi-dark and dark caves. The entrance and front part of the cave are represented with calcareous and sciaphilous algae with different animals (mostly passive filterers and no herbivores) and this is biocenosis of semi-dark caves (RAC SPA code: IV.3.2. compatible to the EU code: 8330 and CORINE code: 1126). In this cave light and water movement diminish rapidly after the entrance.

Because of that deeper parts of the cave are classified as caves in total darkness (RAC SPA code: V.3.2., compatible to EU code: 8330). Most abundant are Serpulid polychaetes with white calcified tubes. There are some anemones, fish *Apogon imberbis*, *Thorogobius ephippiatus*, plankton copepods and others but not too many.

The biggest cave in this area is Krekavica cave (Figure 4.) Entrance in this cave is very exposed to the south, very large and above the sea level it is 15m large and 8m high. Above the entrance and on the boat sides of the cave is very high vertical cliff. But characteristic of this cave is that submerged entrance is also very large and vertically is prolonged to the dept of 30m.

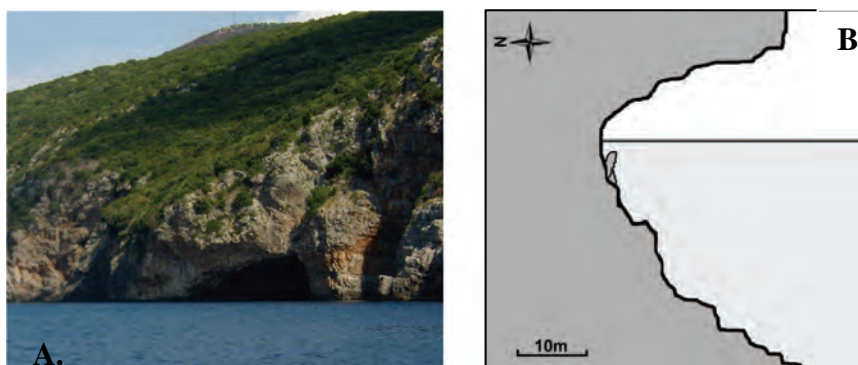


Figure 4. A. Krekavica cave; B. cross section

In larger area in front of the cave is rocky bottom, but in a small area in front of the entrance and inside the cave bottom is sandy. On the left upper 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 right 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 right side it is completely dark.

Vertical walls in this cave are overgrown by immense quantity and diversity of organisms and probably it is the richest cave in Montenegrin part of the Adriatic Sea. The most abundant organisms are various species of sponges and *Leptopsammia pruvoti*, but also many other polychaetes, bryozoans, crustaceans and others. It seems that on the west walls there are slightly higher biodiversity, but some further research should prove (or not) this theory. On the east side is part of the cave in complete darkness and here was recorded presence of crustacean *Stenopus spinosus*, fish *Apogon imberbis* and *Thorogobius ephippiatus*.

Next cave in this area is situated close to the small church of St. Nikola and looks like big slit in the rock, with opening very exposed to the west. Vertically entrance in this cave is about 14m and half of this is submerged. Cave is deep inside the rock 7m, while wide of the entrance on the level of the sea is 1m (Figure 5). This cave belongs to the biocenosis of mediolittoral and semi-dark caves. At the entrance there are massive assemblages of the red algae *Corallina elongata* and also small colonies of protected *Lithophyllum byssoides*. Unfortunately here, as well as on many other locations, rocky bottom is barren-degraded rocky biocenosis. Inside the cave some calcareous algae were very abundant, but more details about marine life were not collected.

During this research several protected species (Sl. list 76/06) were recorded and regarding that this area is planned for the future marine protected area this data are contributing to the general knowledge of their biology, underlining the ecological importance of this area. Those species are following:

(a) Algae and seagrass: *Lithophyllum byssoides*, *Cystoseira amentacea*, *Posidonia oceanica*

(b) Molluscs: *Pinna nobilis* and *Lithophaga lithophaga*

(c) Plants: *Euphorbia dendroides* and *Limonium angustifolium*

(e) Birds: *Ardeola ralloides*, *Alcedo atthis*, *Phalacrocorax aristotelis*, *Acciptier gentilis* and *Corvus corax*

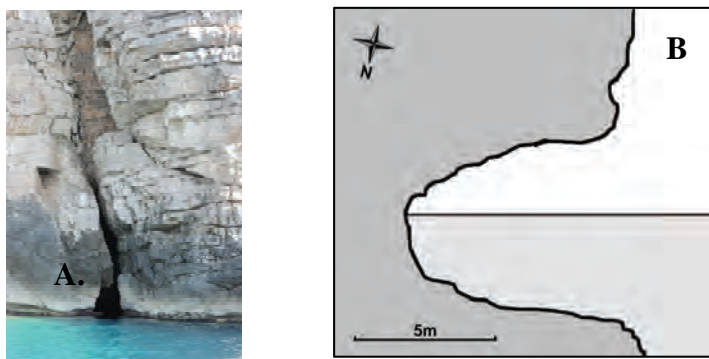


Figure 5. A. Small marine cave close to St. Nikola church; B. cross section

CONCLUSIONS

This data could be used for the urgently needed creation of a Cave's Register, but also as a basis for future research and protection measures. In parallel with creation of Marine Protected Area Platamuni we should work also on awareness programmes, to make marine caves better known, specially their vulnerability and the interest for conservation. These informations should be directed to decision-makers, users (e.g. divers, fishermen) and the wider public (environmental education) with scope of better understanding, management and conservation of these unique resources.

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