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Typology of marine litter in „Papuča“ (Slipper) cave (Montenegro, South Adriatic Sea)

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ABSTRACT

Marine caves are endangered and protected habitat. Marine litter is a growing threat for biodiversity but unfortunately, until now there are only few data about litter in marine caves. Because of that aims of our work were to evaluate quantity and typology of the marine litter in one of the semi-submersed marine caves and to contribute to the awareness. As expected, huge majority of the litter was plastic (95.2%) while other 5 categories were present in less than 5 % (rubber 2.8%, glass 1.2%, cloths 0.6%, wood 0.2%, metal 0.1%). Peculiarity of the marine litter in this cave is a huge number of slippers, in number 76. We think that name of the cave “Papuča” (Slippers) as well as many pictures of marine litter collected from the cave could help us to better promote this cave cleaning activity and underline problems caused by marine litter.

Keywords: Marine litter, cave, clean-up, awareness, Adriatic Sea

INTRODUCTION

Marine caves are considered as a biodiversity hotspot and endangered habitat (EU Habitat directive, 1992; Gerovasileiou & Voultsiadou, 2012; UNEP/MAP, 2013; UNEP/MAP SPA/RAC, 2017). Because of that they are protected habitat and one of the priority habitats under the EU Habitat directive (1992). There are numerous studies of the marine caves biodiversity in the Western, Eastern and Central Mediterranean.

Furthermore, there are also many studies for the Croatian part of the Adriatic Sea, while there are only few studies for the Montenegrin and Albanian coast (Garašić, 1991; Belmonte *et al*., 2006; Mačić *et al*., 2015; Mačić et al., 2018). According to the recommendations of the Integrated Monitoring and Assessment Programme (IMAP), future monitoring schemes for marine caves should mainly consider common indicators related to biodiversity (EO1), while other indicators such as invasive species (EO2), destruction of the habitat (EO8), pollution (EO9) and marine litter (EO10) could be considered on a supplementary basis (UNEP/MAP SPA/RAC, 2017).

Marine litter is a growing threat and there were many initiatives for the development of the international methodologies for the monitoring of marine litter (Cheshire et al., 2009; MEDITS, 2013; JRC, 2013; CIESM, 2014; Vlachogianni *et al.*, 2017) as well as many initiatives for cleaning coastal areas, beaches and sea bottom, testifying to the increased problems, but also to the increased awareness. Still, education, information and training are extremely important and together with clean-up activities are listed as one of the first actions that everyone should develop (UNEP, 2005; Marcou *et al*., 2016). There are numerous examples of beach clean-up activities where volunteers and tourists are sensibilised about the issue of marine litter and some initiatives are becoming regional and even global. Unfortunately, there are only few data about litter in marine caves and because of that aims of this paper were to evaluate quantity and typology of the marine litter in one of the semi-submersed marine caves in south Montenegro and to contribute to the awareness.

MATERIALS AND METHODS

The Papuča (Slippers) cave (N 41º 54’ 02.28’’ E 19º 13’ 04.44’’) is oriented toward south, entrance is 1.8 m wide and 5.4 m high. The length of the cave is 36 m and on the back of the cave there is a pebble beach (Fig. 1A). Cleaning of this cave was performed on 1st June 2018 when all marine litter bigger than 2.5 cm was taken out of the cave, classified, photographed and deposited on the proper place. All collected items were classified according to the nature of the material into seven categories (plastic, metal, rubber, paper, clothing, glass and other) and according to the dimensions in 6 size range classes (A. < 5cm×5cm = 25cm^2; B. < 10cm×10cm = 100cm^2; C. < 20cm×20cm = 400cm^2; D. < 50cm×50cm = 2500cm^2; E. < 100cm×100cm = 10000cm^2 = 1m^2 and F. > 100cm×100cm = 10000cm^2 = 1m^2) (Fig. 1B) (Vlachogianni *et al*., 2017).

RESULTS AND DISCUSSION

As expected huge majority of the litter in Papuča (Slippers) cave was plastic (95,2%) while other 5 categories were present in less than 5 % (rubber 2.8%, glass 1.2%, cloths 0.6%, wood 0.2%, metal 0.1%). In our knowledge there are no similar reports on typology and quantities of marine litter in the semi-submeresed caves. However, our results are in accordance with other studies which showed plastics material as a main category of marine litter on the beaches (STAP-GEF, 2012; Peraš *et al*., 2017). All together 2654 pieces of plastic litter was collected and the most frequent item, were polystyrene items

and other plastic (1972 pieces), followed by plastic bags (398 pieces), than plastic cups and lids (203 pieces), rubber boots and slippers (76 pieces).

Fig. 1. A) The Papuča cave before and after cleaning; B) classification of marine litter from Papuča cave

As it is for plastic materials also for other types of litter, small size classes A (5 cm× 5 cm= 25 cm^2) and B (10 cm× 10 cm= 100 cm^2) were dominant (Fig. 2). We could speculate that wave action is provoking additional fragmentation and decomposition of marine litter and because of that cleaning activity was a very time consuming work. We should also have in mind that small pieces of marine litter are also more dangerous to the animals who mistake it for food and because of ingestion there are many reports of their mortality (STAP-GEF, 2012).

Peculiarity of the marine litter in this cave is a huge number of flippers or flip flops, in number 76. Actually that is the reason why in one of the previous surveys of the semi-submersed caves in Montenegro this cave was called Papuča (Slipper) (Mačić *et al*., 2015).

We think that this specific name of the cave as well as many pictures of marine litter collected from the cave could help us to better promote this cave cleaning activity and underline problems caused by marine litter. With that purpose all the results from the cleaning of this cave was published in local TV, newspapers, radio and social media.In our opinion this work was useful to investigate quantity and typology of the marine litter in one of the semi-submersed marine caves on the south of Montenegro. It will be interesting to continue monitoring and to perform same activity in this cave seasonally or at least after one year and to compare how much marine litter is accumulated during one year. Because of the narrow entrance to the cave and length of 36 m we suppose that marine litter once entered in the cave is very likely to stay there for a longer period, so in the next monitoring we expect less litter. In any case these results could be used for the awareness raising campaigns and explanations how marine litter is accumulated in some areas causing degradation of habitats.

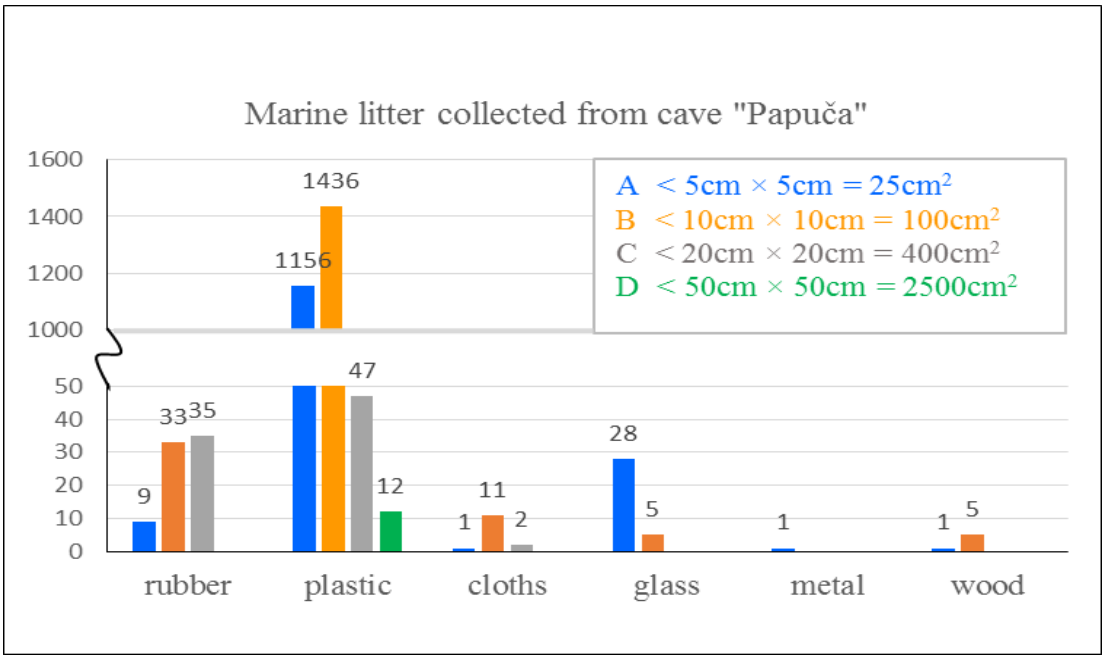

Fig. 2. Typology and quantity of marine litter collected from cave "Papuča"

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Tipologija čvrstog otpada iz mora u pećini „Papuča“ (Crna Gora, južni Jadran)

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SAŽETAK

Morske pećine su ugroženo i zaštićeno stanište. Čvrsti otpad iz mora je rastući problem za biodiverzitet ali nažalost do sada ima vrlo malo podataka o čvrstom otpadu iz mora u pećinama. Zbog svega toga cilj našeg rada je bio da procijenimo količinu i tipologiju čvrstog otpada iz mora u jednoj od polu-potopljenih pećina i da doprinesemo podizanju svijesti o tome. Prema očekivanjima, ogromna većina otpada je bila od plastike (95.2%) dok su ostalih 5 kategorija bile prisutne u manje od 5 % (guma 2.8%, staklo 1.2%, odjeća 0.6%, drvo 0.2%, metal 0.1%). Specifičnost čvrstog otpada iz mora u ovoj pećini je velika količina papuča, brojem 76. Smatramo da je naziv pećine “Papuča” kao i veći broj fotografija sakupljenog otpada iz pećine pomogao da bolje promovišemo ovu akciju čišćenja pećine i ukažemo na problem koje izaziva čvrsti otpad iz mora.

Ključne riječi: čvrsti otpad iz mora, pećina, čišćenje, podizanje svijesti, Jadransko more