



Extension of monitoring of the sea bathing water quality in Croatia (EU directive 2006/7/EC) Importance of beach sediment characteristics

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Abstract:

The Republic of Croatia monitors water quality on over 900 official sea bathing areas for the last 9 years. Monitoring is regulated by national and EU directives. This regulation sets out standards for microbiological parameters and other characteristics of the sea. Also, the bathing area profile is determined for each monitored site, containing information about its general characteristics, such as physical properties and bathing area facilities. For the purpose of collecting, validating, managing and public presentation of this data, the Institute of Oceanography and Fisheries developed a web application. This paper presents the extension of the monitoring program and web application in form of additional categories related to beach sediment characteristics. These new elements should provide a base for better coastal management and spatial planning in the future.

Keywords:

Sea bathing water quality, Sea beaches, Bathing water profile, Coastal geomorphology.

1. Introduction

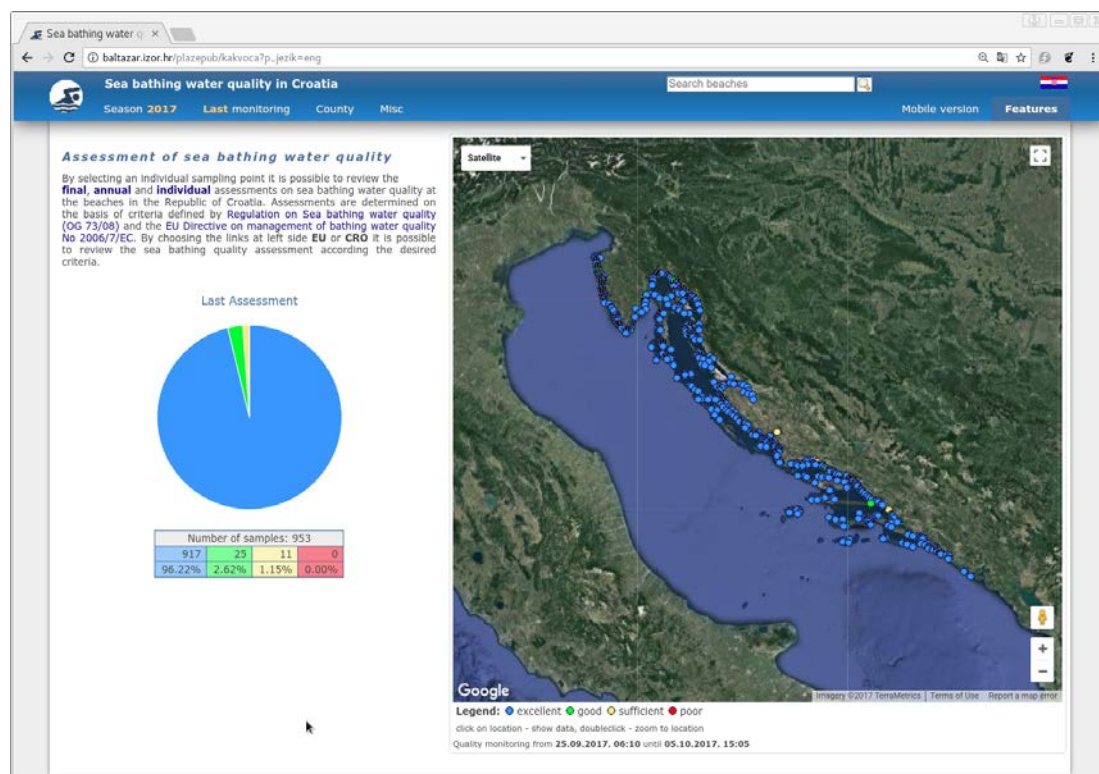
Over 900 official sea bathing areas in the Republic of Croatia were monitored for bathing water quality for the last 9 years. Monitoring is regulated with national “Regulation on Sea Bathing Water Quality” (OFFICIAL GAZETTE, 2008) and EU directive 2006/7/EC (OJEU, 2006). This Regulation sets out standards for microbiological parameters and other characteristics of the sea. Obtained water quality data are entered in the national database, developed by the Institute of Oceanography and Fisheries and the previous Croatian environmental agency. In addition, for the purpose of collecting, validating, managing and public presentation of this data, the Institute of Oceanography and Fisheries developed a web application, used for the first time from tourist season 2009, (IVANKOVIĆ *et al.*, 2010). Beside the water quality data, general characteristics are provided in form of the bathing water profile for each

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monitored location. Profiles were created in 2011 with some non-systematic updates during next 5 years.

Being the main national touristic resource and the growing touristic market, Croatian coast is facing with fast and expanding construction, greatly incompatible with natural heritage. Since being enlarged by nourishment, natural beaches are endangered in the first place, as well as parts of the natural rocky coast, along which artificial beaches are being constructed. To prevent the deterioration of the coastal scene and to maintain natural and artificial beaches in the future, sustainable beach management is urgently needed. Understanding of physical functioning of particular beach environment is essential for its usage. Bearing in mind the general lack of the knowledge about the physical aspects (geological and geomorphological) of bathing areas in Croatia, especially beaches (PIKELJ & JURAIĆ, 2013), an update and extension of the database in terms of the efficient collection of information of physical processes have been considered and presented here.



*Figure 1. Web application with all locations for season 2017,
(<http://www.izor.hr/bathing>).*

2. The monitoring and the bathing water profiles

Water samples are collected (10 times from middle May until end of September) and analysed every two weeks by eight authorized Public health institutes from seven Croatian coastal counties. Obtained data are entered into the national database (using

web application). Once entered, data are instantly presented on the Internet, in the public application part (figure 1). There are two public web addresses, one in Croatian at <http://www.izor.hr/kakvoća> and other in English at <http://www.izor.hr/bathing>. All data on the public presentation pages are organized by counties and cities and available by city, location name or description search. Click on the map showing locations is another way to find desired data. Google Maps are used for presentation of locations, color-coded depending on last measured water quality. Web pages with sea bathing water quality are available in many European countries; they usually publish data at the end of bathing season or within two weeks or more after sampling. In Croatia average amount of time between sampling and publishing results is 3 days.

To identify possible sources of pollution EU directive 2006/7/EC required establishing of bathing water profile. Bathing water profiles had to be established for the first time on 24 March 2011 and should be updated at least every four years. The profile is defined in ANNEX III of EU directive (OJEU, 2006). Definition sets general goals which should be achieved by creating profile, and according to these goals concrete profile elements are created.

Publicly available part of the profile is shown in figure 2. Existing profiles include information about bathing area surface type, dimensions, slopes, accessibility, vegetation, seawater temperature and salinity, wind exposure, occupancy, a distance from the settlements, beach facilities etc. Such profiles partially overlap with BARE guidelines for determining bathing area type proposed by WILLIAMS & MICALLEF (2009). This methodology was already used in the pilot analysis of the UNDP COAST project implemented for 32 selected beaches along the Croatian coast (<http://beach-management.com/projekt>). Ideally, each of 956 monitored bathing areas along the Croatian coast might be fully evaluated according to BARE guidelines for the management purposes in the future. However, beaches are ones among bathing areas considered to be most threatened by the natural and anthropogenic impacts in terms of potential sediment disturbance and sediment loss. Knowing and understanding of beach characteristics and beach sediment dynamics is the basis of the beach management. In this regard, we propose an update of all monitored bathing water profiles and the bathing profile extension for beaches.

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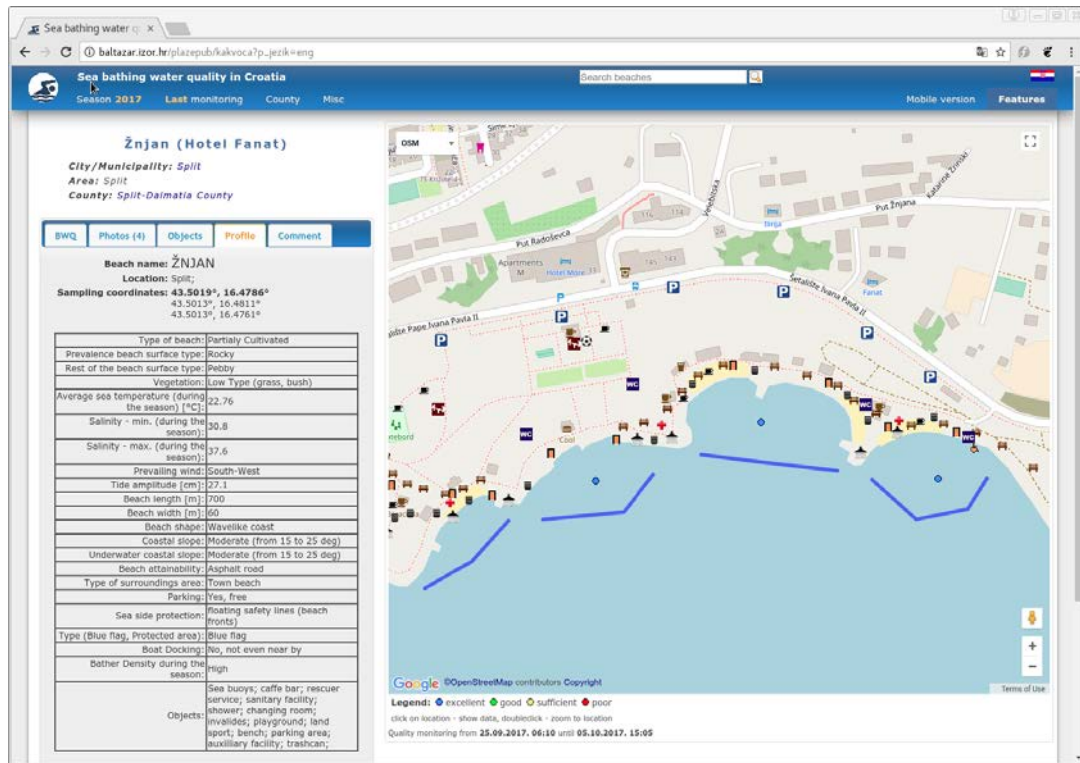


Figure 2. The example of the public part of bathing water profile from the web application.

3. The bathing water profile update and extension

In order to use the collected data for management purposes, the first step is a mandatory update of the all monitored bathing area profiles. If directed toward coastal management and spatial planning, it should adopt the terminology according to the BARE guidelines (WILLIAMS & MICALLEF, 2009) and be in line with EU directive 2006/7/EC at the same time.

The extension of the bathing water profiles includes more detailed information regarding beach sediment characteristics, beach erosion and deposition. Categories to be added to the profile should include:

- rough estimation of coverage of the beach sediment according to the grain size: sand %, pebble % and cobble % coverage,
- sediment changes during the monitoring period (yes/no); if yes, description of change (natural/artificial), the scope of change (small, intermediate, large), sediment grain size change (e.g. pebble to sand) are needed,
- rough estimation of the nearshore sea floor sediment coverage: sand %, pebble % and cobble % coverage,

d) obvious signs of erosion/deposition (yes/no); if yes, additional field for description will be provided.

Upload of beach photography is the part of the beach profile. Extension of the profile in case of grain size requires photography of beach sediment grain size with appropriate scale. In addition, panoramic view of the beach at the beginning and the end of the bathing season may be added, together with photography of beach surface in macro mode to record notable changes. Special attention in terms of beach sediment changes needs to be paid to the artificial and nourished beaches. The nourishment along the Croatian coast usually takes place during the springtime and replenished sediment sometimes might be the source of bathing water pollution.

As previously, monitoring, profile update, and creation are performed by a legal person in charge for monitoring activities in the field of environmental protection pursuant to the Environmental Protection Act and it is founded by counties.

Extension of the profile was already discussed at the yearly meeting of responsible authorities (Ministry of Environment and Energy, Spatial planning departments and Public health institutes of coastal counties) held in May 2017. It is concluded that the extension of profile does not require large additional funds and that expert analysis of gathered seasonal and annual changes may help to detect potentially problematic coastal environments and provide a frame for further legal regulations.

The update and extension of profiles have been planned for the tourist season 2018, as a first step. As far as profile extension concerned, the appropriate methodology needs to be developed in such a way as to be feasible during monitoring area (tourist season). Furthermore, technical capacities of all Public health institutes involved needs to be ensured. To apply the methodology, an education of staff in charge of monitoring activities is needed. To achieve this, additional funds will be sought within national or EU projects. Eventually, added elements can be officially recognized in amendments of national regulations what will ensure permanent funding.

Considering the huge length of the Croatian coast and the fact that over 900 bathing areas are already being monitored, the benefit of the proposed extension is seen as an initial tool to recognize potential erosional hot spots. Once identified, special attention should be paid to these coastal environments in terms of erosion management.

4. Conclusions

In order to maintain the good water quality and to protect public health, monitoring of sea bathing water quality in Croatia is regulated by the national and EU directives.

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Update of bathing water profiles is mandatory on a 4-year basis and could be made in accordance with BARE guidelines to provide information for coastal management purposes in the future. The extension of profiles in terms of additional monitoring of beach sediment characteristics was found to be useful as well, not only to recognize a potential source of water pollution but also to indicate potentially endangered coastal areas. Detection of threatened coastal environments is a first step to establish official coastal monitoring, greatly lacking in Croatia. The extension of profiles in already well-established and organized monitoring is a cost-effective way to gather additional knowledge about changes in coastal areas and of great benefit for coastal and beach management in the future.

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