

Working Group “DRAVA”

ArchaeoGates

Danube River Submerged Heritage

Scanning and Data-base

ABSTRACT

The objective of ArchaeoGates project is to identify the cultural sites submerged under the Danube, to collect and process the data to develop a database (Danube River Submerged Heritage D.A.R.S.H.), with the possibility to extend it to include other river basins and/or lakes. The equipment used in the implementation of the project are side-scan sonar, seismic radar, scuba diver recognitions. For a tangible perception of the discovered cultural patrimony on the bottom of the river, 3D models and projections will be created: these reconstructions of the submerged sites will add an immeasurable value to the area and to the whole Danube Region. The case study is focusing on the Iron Gates area. The recovery of previously unexplored submerged cultural heritage will foster knowledge on cultural heritage and history of Europe, with the goal of preserving and promoting the value of the sites on local, regional, national and international level.

KEYWORDS

River archaeology
Cultural heritage
Database
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Iron Gates

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1. CONTEXT

Cultural heritage as an evidence of the past is constantly threatened and in danger of complete destruction. The esteem of cultural heritage is one of the main tasks of the preservation of cultural identity of the Danube Region, as well as the sustainable use and development of this potential.

Nowadays, a remarkable amount of cultural sites of great importance are submerged under the water of the Danube, not only as a consequence of the change of the river-bed through the ages, but also as a result of human modifications (dams, levees, etc.).

Accordingly, the following project proposal will address the untapped potential of the Danube river basin area, focusing on the opportunities for sustainable growth addressing the research and innovation divide.

It addresses the Social Challenge Europe in a Changing World – Inclusive, Innovative and Reflective Societies; it will take into account most Horizon 2020 cross-cutting issues, primarily social sciences, promotion of Responsible Research and Innovation (RRI), SMEs and widening participation.

Also, the project will have a great impact on achieving the goals of the Danube Region strategy, especially impacting the socio-economic dimension; it aims at Priority Actions related to Competitiveness, People and skills and Knowledge society within the pillar Building prosperity and Culture and tourism, people to people of the Connecting the region pillar.

The use of different survey techniques will make it possible to have a clear idea of the submerged cultural sites; the 3D reconstruction of those sites will make this valuable heritage available for everyone, through the development of an international database of the Danube River Submerged Heritage (D.A.R.S.H.).

The method will be tested in a specific area of the Danube river, the Iron Gates region.

2. THE PROJECT

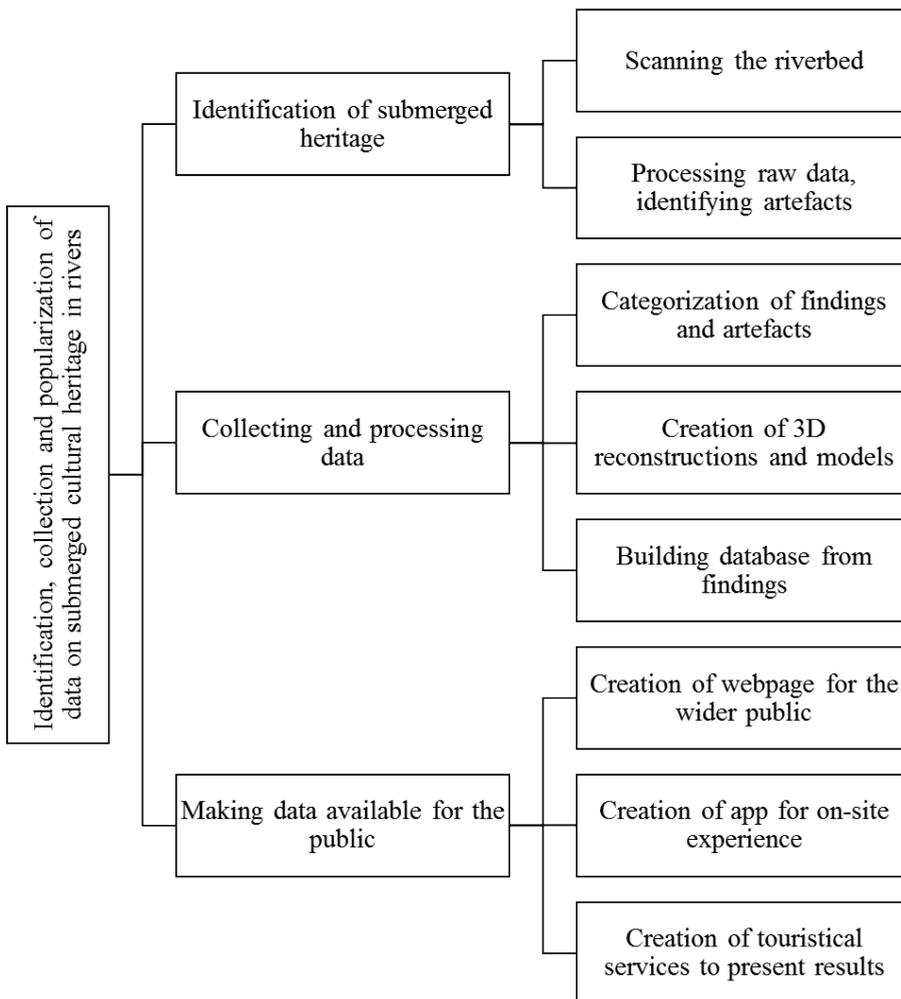
ArchaeoGates Project is proposing to develop a new database of the existing submerged sites and objects on the river beds. The new database, Danube River Submerged Heritage (Da.R.S.H.), will be accessible and available on the web for all interested public.

The equipment used in the implementation of the project is *side-scan sonar, seismic radar, scuba diver recognitions*. The gear will be used at the scanning of the riverbed and of the former shores. The collected information of

the submerged sites will be processed by specialists and researchers using different software products in order to create the complex database. For a tangible perception of the discovered cultural patrimony on the bottom of the river, 3D models and projections will be created: these reconstructions of the submerged sites will add an immeasurable value to the area and to the whole Danube Region.

The case study is focusing on the Iron Gates area in the Danube River Basin, but the method and the techniques can also be applied to the entire Danube Basin, other rivers and even lakes.

Figure 1 – Objective Tree



The main objective of the project, as the objective tree shows, is to identify the cultural artefacts and sites submerged under the Danube, to collect and process the data and to develop a publicly accessible database, with the future possibility to extend it and include other river basins and/or lakes as well. The first step is the identification of the flooded cultural, historical and archaeological sites and scanning them with different survey techniques. These, after analysing and processing raw data, will be uploaded to a free interactive database, available from a website, which can be utilized both by researchers in several scientific fields and for – among others – educational purposes as well. At a later stage it creates the possibility of touristic development as well.

In order to reach the general objectives described above, detailed surveys have to be performed. The previously identified sites have to be scanned and the raw data has to be analysed and processed, creating 3D reconstructions of the underwater complexes. This data then has to be organized and catalogued in a newly created database.

The results have to be made accessible to both professionals and the general public, which requires the creation of a website with an interactive, user-friendly design. In addition, in the long term, a multimedia application for mobile devices can be designed and touristic infrastructure can be developed to enhance the on-site experience.

This makes the utilization and exploitation of the potential of the underwater cultural heritage possible and enables it to act as a platform, to bring the submerged objects and structures accessible to different stakeholders. Researchers, especially in social sciences and humanities, will be able to use the survey methods and data for further research, SMEs will have the opportunity for creation of new cultural and touristic products, children and the general public will learn from the created products, etc.

3. METHODS AND APPROACH

With modern survey methodologies it is now possible to actually discover and display sites that are now under the water and under the sediment.

Through the scanning methods, we will obtain 3D reconstructions and other digital products, which show the real cultural prestige of the area and are used for various purposes, including cultural product creation, education etc.

The beginning of underwater archaeology dates back to the turn of the 19th-20th century, and became a real scientific discipline by the diffusion of autonomous diving equipment. However these researches focused on marine archaeology and even the UNESCO convention on Underwater Cultural Herit-

age (2001) concentrates only on marine archaeology. The reason is that the physical conditions of rivers are different from that of the sea: the visibility is usually close to zero and the current is stronger, which means that the methods and technologies of marine archaeology are not automatically applicable.

The role of new technologies in river archaeology is to reduce the handicap caused by the unfavourable environmental conditions.

The new high resolution side-scan sonar (900-1200 MHz) is usually applied to survey the morphology of the sea floor, it can also produce a realistic image of the riverbed and it will make detailed images of underwater objects. This system is based on the different backscattering given by various material and lithotype and records the backscattering data through a digital technology that gives back high resolution images, it identifies the different type of floor of the river, and the objects eventually dispersed on it. The trace recorded can go wide until 500m each side of the machine, and the system works until 1500m of depth. This sonar is a useful tool for detecting large areas during short time, in the case of "open" river bed, or to mapping already known composite sites (shipwreck, groups of ships, walls).

The other technology is seismic radar, which can penetrate into the sediment: echo sounds reflect the anomalies of sedimentation, so it is possible to detect covered objects. By the use of GPS methodologies it is possible to combine the sections made by the devices and create 3D images of river-bed.

The scuba-dive archaeological survey in the river will allow the identification and dating of the scanned sites. Those practical data are needed for the database, which will contain not only the geographical information, but also the archaeological and historical ones.

Raw data collected by sonar and radar mapping of the Danube riverbed will be processed at a local computer. Local computer processing will be used for image processing of gathered data by sonar and radar mapping. This image processing will be used for the removal of noise from the pictures and then for improving the picture quality. The data, processed at the local computer (at the site of measurement), will be used in special software solution (provided by University of Zagreb) in which virtual 3D model of the site (underwater artefacts) will be built and reconstructed with regard to data quality. The virtual 3D model of the site will be saved on a system cloud platform with dedicated virtual machine for archiving of 3D model data. This cloud platform can be used to remotely access the 3D data models by the developed ArchaeoGates web application from anywhere in the world.

4. PILOTING AREA

The Iron Gates is one of the most remarkable river gorges in Europe and it occupies the area from the village Vinci to the village Kostol on the right coast (Serbia), and from Moldova Veche to Drobeta Turnu Severin on the left coast (Romania). The length of this river segment is approximately 130 kilometres. The importance of this area is reflected in its favourable geo-traffic location since it is located on the international water route E-80 (the Pan-European corridor VII). The construction of the Djerdap (Iron Gate) Hydro-Electric Power Plant led to the flooding of many cultural sites of European importance. The Iron Gates is not only a unique natural environment with botanical, ornithological and environmental importance (Djerdap National Park in Serbia and Iron Gates Natural Park in Romania), but is also an area with historical monuments (Lepenski Vir, pillars of Trajans Bridge, Tabula Trajani, fortresses of Drobeta, Golubac, Fetislam, Decebal's statue etc.)

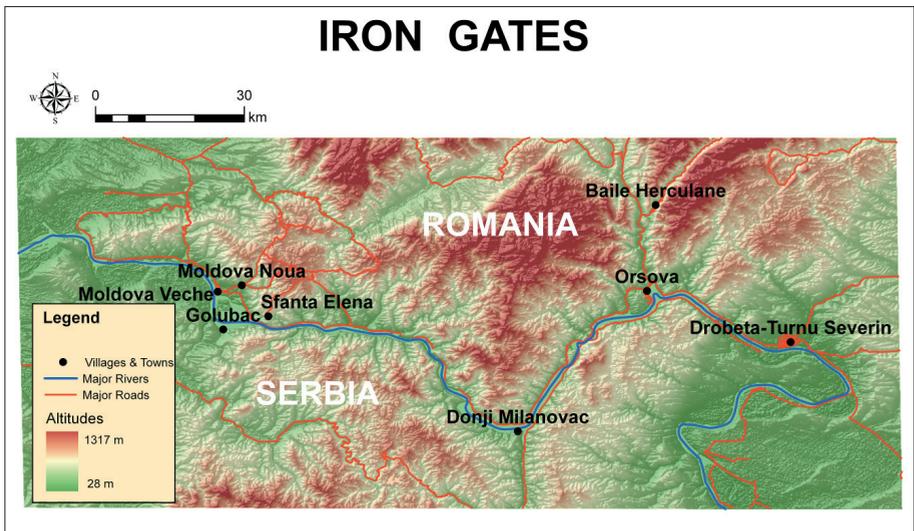
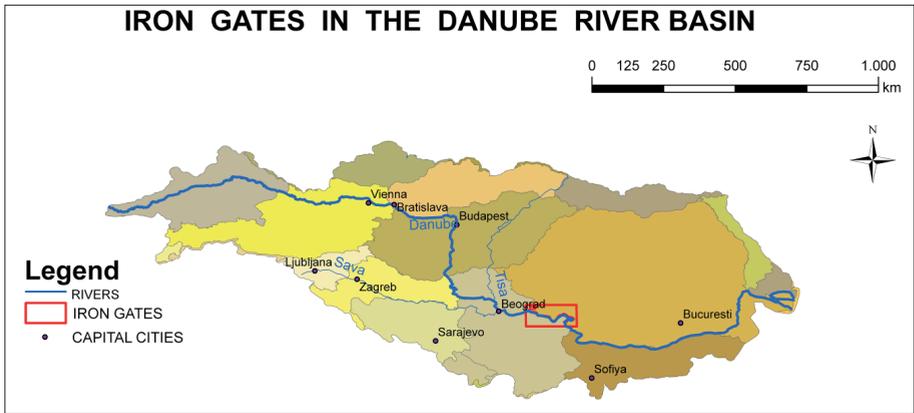
The construction of the Djerdap (Iron Gate) Hydro-Electric Power Plant led to the flooding of the Danube riversides. Therefore, below the surface, in the mud, lies a priceless cultural heritage, inaccessible to us as well as the future generations (Radojičić, Vasić, 2003). The flooded area has so far remained unexplored, which is why it is particularly important to perform underwater exploration of the flooded prehistoric, Roman, medieval and modern heritage.

The Iron Gates is not only a unique natural environment (it lies within Djerdap National Park in Serbia and Iron Gates Natural Park in Romania), but also a significant touristic target area rich in natural and cultural values with various monuments of the rich history of Lower Danube. This area has been the crossroads for many cultures for millennia, since the early prehistoric era until the present day. One of the most valuable sites of prehistory from the VI and the VII millennia BC can be seen at Lepenski Vir (Janićijević, 2005), along with numerous other museums and exhibitions.

As a consequence of the flooding of the Danube's floodplains following the installation of the Iron Gate's dams between 1972 and 1984, a lot of archaeological sites, historic artefacts and villages are currently underwater. Even if the villages and some sites are known, their potential is not actually exploited at all. As far as archaeology is concerned, some surveys have been made on both banks of the river between 1960 and 1980, but a lot of archaeological data has been lost: a massive part of the cultural heritage of that area is underwater.

Although it is an exceptionally valuable tourist area, according to data of the National Bureaus of Statistics of the Republic of Serbia and Romania, in the last decade the number of tourists has decreased and the domestic tourist demand is still dominant. Foreign tourists mostly visit the region within the

tourist cruises. In order to ensure mass tourist demand, it is necessary to improve the content of the aquatic and nautical route significantly, along with presenting the natural and the cultural values.



5. EXPECTED RESULTS AND VALUES

The implementation of the project will generate the Da.R.S.H. database and website, which will make the cultural heritage visible and accessible for the public. The recovery of previously unexplored submerged cultural heritage will

foster knowledge on cultural heritage and history of Europe, with the goal of preserving and promoting the value of the sites on local, regional, national and international level. Due to unpractical methods, gear and the hostile river environment, river archaeology has not presented much interest for the researchers. New survey techniques will make – through scanning and 3D projections – this heritage available for everyone. The modern techniques are not only applicable in the Danube basin, but also in other river basins and lakes. This will add cultural and historical value to all explored sites. The complex database will serve as support for archaeologists, anthropologists, botanists, historians, hydrologists, software developers, technicians and other researchers and will serve as an example for future procedures for other areas of interest.

An important achievement of the application of these methodologies is also the identification of the unexploded bombs, from World Wars and the recent Balkan Wars. This will enable the possibility to secure the area of the survey from this danger.

The Dissemination and Outreach Work Package (WP4) will be led by the University of Novi Sad, and developed in coordination with Babes- Bolyai University, in a transnational cooperation, which will make it possible to have a better coverage of the area of interest.

Furthermore, the project will improve awareness of cultural heritage on local, regional and international level, enhance touristic development and its economic impact on the local, national and international scale. In that way, the project will create, widen and maintain awareness about the heritage, culture, local and national identity and help to make the European cultural heritage visible and accessible for public. This project will ensure the new use of still unexplored cultural heritage. The recovery of the currently unknown submerged cultural heritage is one of the first steps towards the sustainable development of the region.

6. CONSORTIUM

LEAD PARTNER: UNIVERSITY OF TRIESTE (ITALY)

Other partners: Babes-Bolyai University (Romania), University of Novi Sad (Serbia), University of Zagreb (Croatia), University of Rijeka (Croatia), Corvinus University of Budapest (Hungary), International Commission for Protection of Danube River, Geographical Institute “Jovan Cvijić” of the Serbian Academy of Science and Arts, Belgrade (Serbia), Romanian Academy of Sciences (Romania), Hungarian Academy of Sciences – Centre for Ecological Research – Danube Research Institute (Hungary), University of Udine, Department of History

and Cultural Heritage (Italy), Public Company Djerdap National Park (Serbia), Iron Gates Natural Park (Romania).

University of Trieste will be the lead partner the project, since they are in possession of the seismic radar necessary for the survey. The Corvinus University of Budapest (Hungary) and the International Commission for Protection of Danube River will provide research and data on the landscape history of the region.

The Geographical Institute Jovan Cvijic (Serbia) and the Romanian Academy of Sciences (Romania) will develop the desk research on the state of art of already known submerged sites. University of Udine (Italy) will take care of the underwater archaeological survey.

Babes–Bolyai University (Romania) and University of Novi Sad (Serbia) are responsible for contact with local authorities and dissemination, with the help of Public Company Djerdap National Park (Serbia), Iron Gates Natural Park (Romania).

The University of Zagreb, Department of wireless communication (Croatia) will lead the digitalization of the data, the creation of the database and of the web-site, in partnership with the Danube Research Institute (Hungary).

The University of Rijeka (Croatia) will elaborate the sustainable management model for cultural assets in the Danube region.

7. WORK PACKAGES

WP 1. MANAGEMENT

Project management will be carried out by the University of Trieste.

Task 1.1 Responsibility for the overall administration and financial transactions management of the project.

Task 1.2 Coordination of the work among the project partners and implementing the contacts between them.

Task 1.3 Supervision and monitoring of the progresses.

WP 2. UNDERWATER RESEARCH

Underwater research part will be led by University of Trieste.

Task 2.1 Monitoring the desk research of archaeological sites in the Danube river, underwater, focusing on the Iron Gates area.

Task 2.2 Manage of survey of sites and objects available using the needed methodologies.

Task 2.3 Organization of scuba-diving survey, in cooperation with Department of History and Cultural Heritage of University of Udine.

WP 3. DIGITALIZATION

The University of Zagreb will manage the digitalization.

Task 3.1 Digitalization of the data obtained with the survey.

Task 3.2 Supervision of the creation of a GIS database of the existing sub-merged cultural heritage (Da. R. S. H.) at the Iron Gates area.

Task 3.3 Monitoring the creation of the web site.

WP 4. DISSEMINATION AND OUTREACH

University of Novi Sad will lead the dissemination part.

Task 4.1 Management of the diffusion of the existence of the project and of the knowledge acquired during the research.

Task 4.2 Organization of media coverage.

Task 4.3 Scientific community exchange.

Task 4.4. Community coverage with activities directed towards SMEs, NGOs and the general public

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LINKS

Djerdap National Park: <http://www.npdjerdap.org/en>

Horizon 2020 – The Framework Programme for Research and Innovation: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0808&from=EN>

Iron Gates Natural Parc: <http://www.pnportiledefier.ro/>

Romanian National Archeological Repertoire: <http://ran.cimec.ro/sel.asp>

Implementation of the EU Strategy for the Danube Region: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2011-0065+0+DOC+XML+V0//EN&language=EN>

International Commission for the Protection of Danube River: <http://www.icpdr.org/main/>

Iron Gates Natural Park: <http://www.pnportiledefier.ro/>

Romanian National Institute of Patrimony: <http://www.cimec.ro/arheologie.html>

Romanian National Institute of Statistics: <http://www.insse.ro/cms/>

Statistical Office of the Republic of Serbia: <http://webrzs.stat.gov.rs/>