

VISUALIZATION OF THE SOČA RIVER SECTION AND WATER FLOW MODELLING FOR KAYAKING

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ABSTRACT:

The Soča river is one of the most beautiful Alpine rivers. Its green colour, gorges and cascades and surrounding landscape attract many tourists and water sports enthusiasts. However, the use of the river for kayaking, rafting and similar activities depends mostly on water height and flow, which can change very quickly. In such cases it is essential to keep potential river users informed about the situation, about the possibility of activity in case of low water or about possible dangers in high water time. At the moment, the decision about activities on the river can be made only by observing the river level at some specific points and upon experiences. To enable more relevant information about the river status a 3D model of one of the most attractive sections of the river Sočawas prepared. The model is based on official topographic data (DEM, orthophoto) and field GPS measurements. It gives a very detailed presentation of the river basin, with all prominent rocks, cascades and river banks. Changing water levels in the model enable visual simulation of the situation. For the future the idea is to include real time water level measurement and to calculate hydraulic behaviour of the water in the river basin. Such simulation would enable almost real time predictions of the river situation. They can be used by river authorities to balance activities on the water.

Keywords: *Soča Valley, leisure activities, recreation, tourism, sustainable development, 3D model.*

1. INTRODUCTION

The Soča valley and the Soča river basin are located in the easternmost part of the Julian Alps in north-west Slovenia, bringing together three municipalities: Bovec, Kobarid and Tolmin.

They cover an area of 942 km². The Soča river is a quite short stream, as its length is only 136 km, of which 94 km run through the territory of Slovenia - the first 20 km of the stream in the Triglav National Park (Fig. 1).

In its last kilometres the Soča river runs through the territory of Italy, flowing under the name of Isonzo into the Gulf of Trieste in the Adriatic Sea. It has a large gradient



Fig. 1 Area of the Upper Soča Valley
(<http://www.damjanleban.com>)

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and highly changeable outflow. Depending on the amount of water it can become one of the most aqueous rivers in Slovenia. After heavy rainfall it may grow into a large steep mountain stream and its level can rise by more than one meter in less than one hour.

Water and waterbound space in the Soča Valley belong to landscapes that have preserved a high degree of originality. Consequently, this area is one of the most attractive areas for leisure and recreation activities in Slovenia (Fig. 2). The national legislation does not yet impose any mechanisms to limit the use of natural space in the sense of the number and types of users and in terms of time constraints.



Fig. 2 The Soča river valley and water activities (rafting) on the river

2. PROBLEMS IN THE USE OF THE SOČA RIVER BASIN

The use of the Soča river and other Slovenian water bodies, including waterbound area, is not subjected to any specific restrictions. Considering the specifics of water and waterbound areas, in the future the following will have to be defined:

- areas for leisure activities in natural environment;
- areas of protected values, where additional leisure activities should be both spatially and time limited according to the definition of critical limits of acceptability of the use of natural resources;
- regimes for the implementation of activities linked to water.

In Europe and worldwide natural water environment observed from the economic point of view has taken on what is called »added value« of rural economy. Thus, one of the main challenges of environmental protection has become environmental planning and management of rural tourism and recreation that would help establish the capacity of water environmental sensitivity and the degree of acceptability of tourism, while at the same time ensuring user safety and quality tourist services. Management of water and waterbound space is for several reasons subjected to the highest standards of society's responsibility for the environment and the future of mankind. Coordination between activities and environmental features is implemented in the process of planning that allows with its methods of work to include the effects of individual interventions and activities in the decision-making processes about land use and protection, which prevents environmental and economic damage.

The Soča River basin is most burdened by tourism in the summer months in a 9 km stretch from the access point of Log Čezsoški to the exit point of Trnovo ob Soči, presented

in **Fig. 3**. This section is the most frequented part of the river for kayaking and rafting with several access points to the river that are differently maintained. However, none of them is sufficiently equipped and none of them satisfies the needs of users.



Fig. 3 Slovenian part of the Soča valley with the most attractive part for water activities
(<http://www.dolina-soce.si/>)

Additionally, the records and analyses of the area under scrutiny have shown the following:

- sport activities are not properly organized, being the result of uncontrolled development and unplanned spatial use;
- the discussed area of the Soča river involves two town communities that lack commonly harmonized legislature in terms of the river and river-shore space;
- local inhabitants are poorly informed about the exceptional natural value of Soča that needs to be marketed and on the other hand protected;
- poorly controlled navigation and the use of improper equipment that directly and indirectly influence the safety of users.

3. ANALYSIS OF BURDENING THE SOČA VALLEY

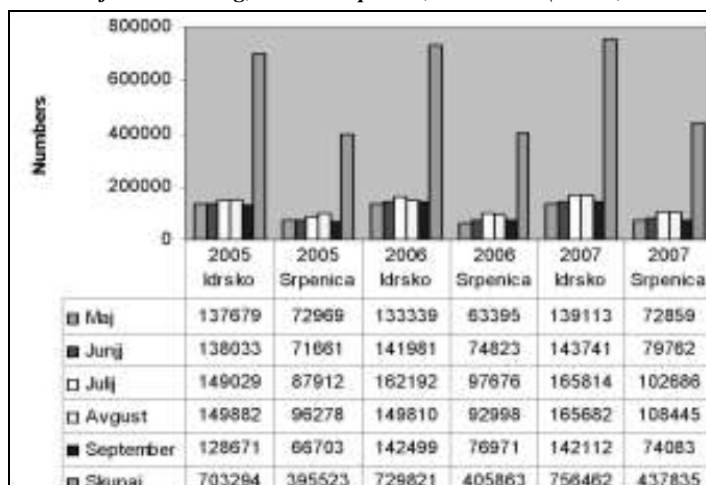
The methodology is based on an interdisciplinary relation among different types of expert knowledge from individual disciplines. The purpose of the research is to define the starting point for efficient management of the Soča Valley for leisure activities and tourism, as well as to create scenarios of spatial development in the Soča Valley and the detailed

arrangements for the use of the water and waterbound space of the Soča river. Definitions of the starting points of problems are based on knowledge about specifics of the issues related to space and environment, fieldwork, observation of users and mapping of the area, collected statistics, previously produced studies and other available material.

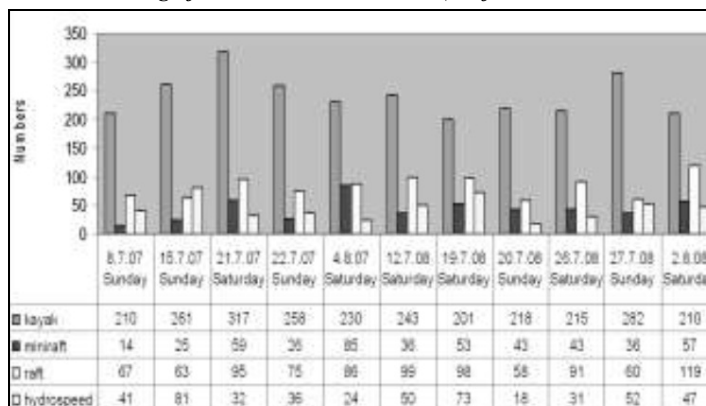
In the Soča Valley we have witnessed accelerated development of leisure activities and tourism, which largely relies just on the river and its affluents. Analysis of the narrow area reveals:

- Poor regulation of the basic conditions for the implementation of activities at and by the water, such as access roads, parking areas, sanitary facilities, walking paths, entry and exit points to the water areas, riparian buffer facilities, catering facilities or picnic areas;
- Negative impacts of leisure and tourist activities on the riparian relief, vegetation and animal world by and in the water, the conditions of use of adjacent properties, on the level of noise in the natural and living environment, on the pollution of water, soil and air, on the conflict among various activities;
- High traffic load in the Soča Valley between Bovec and Tolmin during the tourist season; Average annual daily traffic loads in two measured places for all vehicles in both directions during the summer season between 2005-2007: Srpenica – measuring point 96: August about 99,240 (DRSC, 2007); Idrsko – measuring point 679: July about 159,011 (DRSC, 2008).

Table 1. Traffic Monitoring, Idrsko -Srpenica, 2005-2007 (DRSC, 2003-2007)



- High load of the river with boats in the tourist season; (15/03. – 31/10.); Analysis of recreational navigation on the Soča river in the summer season between 2007 and 2008 was implemented in the nine kilometre section of the Soča river between Log Čezsoški as the point of entry and Trnovo ob Soči as the exit point (*Own monitoring, TIC 2008*). This is the most attractive part of the river for navigation, and therefore most exposed to stress during the season. The number of people coming to the river during weekends exceeded 1100 persons per day in 2007 and 1200 persons per day in 2008.

Table 2. Monitoring of River Boats, 2007-2008 (Golja, 2007, TIC Bovec, 2008)

• Analysis of occupancy of overnight capacities indicates the low degree of utilization of these facilities. Data for the period from 2000 to 2007 show: each year about 173,000 guests come to the Soča Valley, and they stay there on average 2.3 days (*SURS, 2007*). In correlation to the data on available overnight capacities this means 15% occupancy on an annual basis (*TIC, Bovec 2008*). One of possible solutions that could meet the spatial and environmental requirements of land-use planning of the Soča Valley is to exploit its potential for leisure activities and tourism by introducing various sectors with several core areas of tourism and navigation of the Soča river. The solution results from the Strategy of spatial development of Slovenia (*SPRS 2004*) as proposal for leisure activities and tourism. It summarizes the findings of the targeted expert bases that see Slovenia, in contrast to classical division of the country in tourist destinations, as a single tourist destination (*Simoneti et.al, 2002*). The authors suggest to prevent uncontrolled growth of the mass tourism infrastructure and to promote coordinated development of tourist and leisure activities in the core areas, which would expose the outstanding specifics of these locations and possibilities of experiences in the context of expectations, especially of modern tourists with high demands.

According to this proposal, the Soča Valley would be divided into four sections with selected core areas for the implementation of leisure activities and particularly for river navigation. The sections as extended areas of activities with the minimum necessary and extremely limited infrastructure and a core as the area of concentration for leisure and tourist infrastructure would present a great potential for the coherent development of the planned activities and for the preservation of natural values, and would also present an important tool for effective control of interventions into land and use of space.

4. 3D MODEL OF THE SOČA RIVER BASIN

To assist any planning activities in the area and to improve safety on the river for tourists and water sports enthusiasts' relevant spatial information about the river basin should be provided. Traditional 2D maps are quite limited since users who are not very familiar with relief reading cannot get the real impression of the steepness of the terrain. A three-dimensional model and a visualization of such model can be a very useful and informative way to overcome such limitations. Therefore, a 3D model of about 800 m long section of the Soča river and its riverbanks was made. The 3D model covers the section

near Trnovo village, where usually advance kayaking take place; the section is also used for white-water kayak and canoe World Cup. This section of the river is also quite easy to access; this helped us in field measurements.

The basic source of data for establishing 3D model was DEM with 5 m resolution (*Surveying and Mapping Authority*). The area has a rectangular shape, measuring 750×500 m (**Fig. 4**). Objects, rocks and other contents were captured from orthophoto with resolution 0.5 m (*Surveying and Mapping Authority*) and from terrain measurements, made by combined GPS – terrestrial measuring method. In addition, some pictures taken in the field were used for easier interpretation, too.

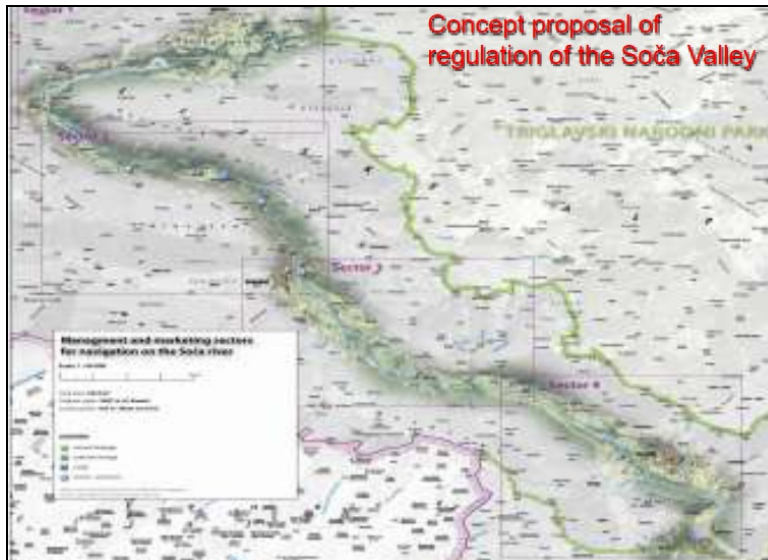


Fig. 4 Management and marketing sectors, area 342 km², highest point 2587m, lowest point 165m, with four sectors (*Source: Golja, 2005*)

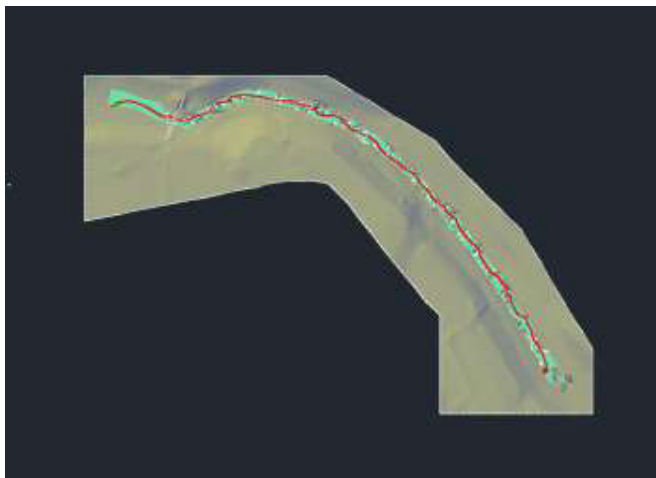


Fig. 5 The entire area of the 3D model

The contents of the 3D model were selected according to its primary use – planning and safety navigating along river Soča. The river flow is presented in quite detail, with all prominent and distinctive rocks, cascades, safe places (available for resting), dangerous spots with points where such spots can be observed and checked in the place before descend, access points and other prominent objects, such as bridge. The kayaking track, which shows the safest and less technically difficult water way is added, too. **Fig. 6** shows the orthophoto of the beginning part of the discussed area with access point Trnovo 1 and exit point Trnovo 2, while the other figure shows cartographically presented 3D model of the area with all the above mentioned contents.



Fig. 6 Orthophoto of section at access point Trnovo 1 and exit point Trnovo 2, visualization of 3D model.

The data show that this area is among the most attractive rural areas for spending leisure time in Slovenia. The research project focused on the problems of using natural values and measures to ensure coherent water spatial development, environmental protection and user safety. Our goal was to improving the maximum user safety on the river through better visualization of the terrain with a 3D map model. As a prototype of use, a few selected views (**Fig. 7**), a short animation, as well an export for Google environment were prepared.

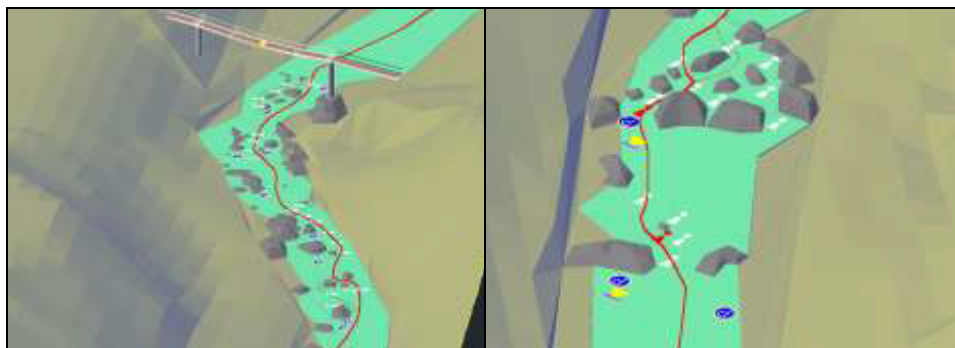


Fig. 6 Two examples of views to 3D model of the Soča river

5. CONCLUSION

Due to their geo-morphological features mountain water streams are even more vulnerable than other running waters. Like the Soča Valley, most of them are defined as natural value and are important because of their hydrological, geomorphological, botanical

and zoological features. For effective planning of development, particularly vulnerable areas, such as mountainous areas along the rivers, need specific development methods with detailed planning of spatial development in terms of permanent and temporary water use, thus providing further protection of the river as a source of development. The use of natural resources, such as running waters, without adequate additional regulations and regimes of use, has become due to the high interest for their use inadequate, in some places and occasionally even harmful. In the space and environment the damage is reflected in the selection of activities and in relations between people.

The effectiveness of development activities in the area depends on careful and detailed planning, timely integration of different stakeholders and complementary deployment of land-use regimes to ensure compliance with acceptable load of the most exposed resources, such as the River Soča in our case. Sustainable rural development for the needs of leisure and tourism requires in the long term compromises and the willingness of all parties involved, from local people, to property owners, investors and policy-makers, to cooperate with high degree of responsibility in the discussions about the future use of common goods.

The suggested proposal is based on sustainable development, which will take the advantages of the region and turn them into opportunities for the local inhabitants.

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