

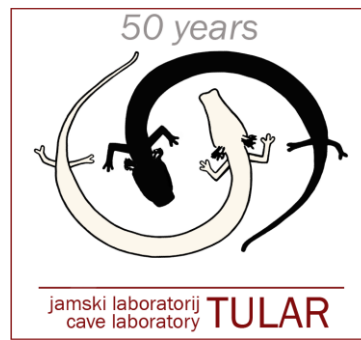
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**MONITORING OF
PROTEUS ANGUINUS
VIA INTERNET CONNECTION**

Final report



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MONITORING OF *PROTEUS ANGUINUS* VIA INTERNET CONNECTION

Résumé

L'installation de la connexion Internet à la grotte Tular est une étape importante dans la mission de plus de 50 années de la Grotte-Laboratoire Tular dans le domaine de la conservation du Protée et de la protection de son habitat souterrain. La mise en œuvre de ce projet - **Tular Virtual Lab** - va augmenter les chances de préserver dans le futur cet animal de grotte en danger. Aujourd'hui, grâce à ce projet, notre laboratoire est le bénéficiaire d'une connexion internet à haut vitesse (25 Mb/s). **Tular Virtual Lab** sera facilement accessible parmi les partenaires du monde entier. Notre objectif est de créer un outil pédagogique et scientifique innovant et attractif pour présenter le Protée comme l'un des plus importants symboles mondiaux du patrimoine naturel et de la biodiversité souterraine, avec un accent particulier sur sa vulnérabilité et des problèmes de conservation du Karst.

Abstract

The installation of the Internet connection to the Tular Cave is an important milestone in more than 50 years long mission of **Tular Cave Laboratory** in the field of conservation of *Proteus* and protection of its subterranean habitat. The implementation of this project - the **Tular Virtual Lab** - will rise the chance of preserving this endangered cave animal in future. Today, our laboratory is the beneficiary of a high speed internet connection (25 Mb/s). The Tular Virtual Lab will be easily accessed by partners around the world. Our aim is to create an innovative and attractive educational and scientific tool to present *Proteus* as one of the world's most important symbols of nature heritage and subterranean biodiversity, as well as by emphasizing its vulnerability and Karst conservation problems.

1. Introduction

The Project Monitoring of *Proteus anguinus* via Internet connection was successfully completed on December 16, 2011. This was achieved through a joint project of Tular Cave Laboratory, Iskra ISD, Carnium Caving Society of Kranj, Municipality of Kranj, Gymnasium of Kranj, and by the support of the European Speleological Federation. The project was awarded with the EuroSpeleo Protection Label 2011 by the European Cave Protection Commission at ESF.

The main result of this project - the installation of the Internet connection to the Tular Cave - is an important milestone in more than 50 years long mission of Tular Cave Laboratory in the field of conservation of *Proteus* and protection of its subterranean habitat. The implementation of this project will rise the chance of preserving this endangered cave animal in future, by widening our knowledge on *Proteus* (physiological and ecological conditions), as well as by reinforcing the *ex situ Proteus* captive breeding program in Tular.

Today, our laboratory is the beneficiary of a high speed internet connection (25 Mb/s). The Tular Virtual Lab will be easily accessed by partners around the world. This will open new opportunities in the field of science and education, especially in the respect of the conservation of cave fauna. Our aim is to create an innovative and attractive educational and scientific tool to present *Proteus* as one of the world's most important symbols of nature heritage and

subterranean biodiversity, as well as by emphasizing its vulnerability and Karst conservation problems.

2. Long-term integrated ecological sustainability

The project will have a direct benefit on the scientific progress of the laboratory (24/7 monitoring, advanced video management, minimizing our presence in the cave as a potential source of stress for animals, etc.) and an indirect impact on our conservation efforts to preserve *Proteus* in the nature (redefining ecological and physiological needs of the endangered species, etc.). The virtual mobility and the involvement of new partners (remote access to the Tular Virtual Lab) will also give us an attractive and noninvasive tool to bring *Proteus* and the vulnerability of its subterranean habitat closer to the public, from class rooms to universities, from caving clubs to institutes.

2. Technical description

The internet connection is provided by the [Iskra ISD factory](#). To build a connection we have extended the existing factory network. To link the factory and Tular Cave, we switched to a wireless transmission, using two Buffalo AirStation WHR-HP-G300N Modem Router devices. One is connected to the factory network, acting as a wireless distribution system, emitting the Wi-Fi standard protocol signal to the other device, installed at the entrance of the Tular Cave (Photos 1-2). Because of high humidity and dripping water, the routers and cameras are protected by a waterproof housing.

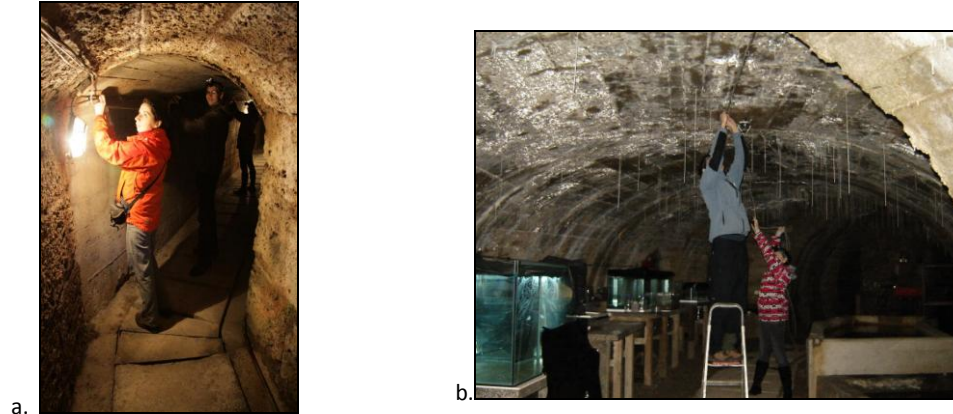


Photos 1a-b The Modem Router inside Iskra factory



Photos 2a-b: The Modem Router at the cave Tular entrance

From here on, the data passes to a wired network. For this purpose we have placed 250 m of a standard UTP cable along the corridor (double cable for back-up), all the way to the control room at the end of the laboratory. At this point, the network is split by a [network switch](#), from where the camera network leads separately to each IP camera ([Internet protocol camera](#)). The UTP cable was installed following the electricity network, in order to have a minimum impact on the cave morphology (Photo 3a-b).



Photos 3a-b: The UTP cables installing process

An IP camera is designed to autonomously send data (video or images). Currently, the laboratory operates with 2 high resolution infra red digital cameras ([Arecont Vision](#)). Gradually, extra cameras will be added above each pool.

The server computer is placed in the remote facility of the Carnium Caving Society of Kranj. It consists of a personal computer with high capacity hard drives to store monitoring data. Clients will remotely access the server computer.

4. Chronological implementation program

The implementing of the Internet infrastructure in Tular Cave was made in five steps, from July to December 2011.

1. *Preparing the laboratory chambers (September - October 2011)*

We have prepared a detailed plan of installation of the wired network in the cave, in order to have a minimal impact on the cave environment.

Further, the Tular Cave is in complete darkness; the monitored laboratory pool is therefore illuminated by IR LED reflectors of different intensity to equally expose the entire area. The main problem is the high absorption of IR light in the water; deeper parts of the pool require higher illumination. We have performed specific measurements to choose an optimal position of the IR camera and reflectors.

2. *Installing the wired network and devices (September - December 2011)*

The UTP cable was installed from the cave entrance through the tunnel and the laboratory chamber, in total length of 250 m. For a minimum impact to the cave, the cables are following the existing electrical installation.

The next task was to prepare the additional installation of the wired network in the Iskra ISD factory facilities.

3. *Setting IR video cameras (November 2011)*

The last part of implementing the internet infrastructure was to set the internet parameters and to connect the IR cameras to the server computer at the facilities of Iskra ISD and Carnium Caving Society of Kranj.

4. Testing the system (December 2011)

After the infrastructure was completed, the system steps into a testing phase, during which we have checked the integrity and performance characteristics of the system.

5. Public presentation (July - December 2011)

The project was first introduced to a specialized audience (cavers and speleobiologists). The public presentation started in November 2011, with an interview in one of the national newspapers (Nedeljski Dnevnik, November 27, 2011, p. 13).

5. Involvement of the local cavers and external partners

Several members of the caving society are specialists in IT and telecommunication. With their help we have installed the internet infrastructure (wired network in the Iskra ISD and Tular cave, wireless access points and server computer). The Carnium Caving Society of Kranj will keep and maintain the server computer which stores the monitoring data from the laboratory. Also, the Carnium Caving Society of Kranj server hosts the Internet web page of the Tular Cave Laboratory.

Pupils of the Gymnasium of Kranj were involved as volunteers, helping in different phases of the project (Photo 4a-b). This collaboration will continue further through the school year 2011/12.



a.



b.

Photos 4a-b: Pupils of the Gymnasium of Kranj helping on the cables installing process

6. Communication with media and public

As a result of this project, an agreement between Tular Cave Laboratory, Gymnasium of Kranj and the Municipality of Kranj has been reached, in order to fully develop the idea of the Tular Virtual Lab educational tool.

The project was already announced as a successful project (Bukovec, 2011). However, the main media campaign is planned in February 2012, when the main application of this project, the Tular Virtual Lab, will be ready for public presentation.

7. Financial report and work contributions

During the project, specific equipment and materials have been acquired to ensure a proper internet system.

Equipment/ Materials/ Works	No. of products	Price (Euro)
Buffalo AirStation WHR-HP-G300N Modem Router	2	119,66
Router waterproof housing	2	28,44
Camera waterproof housing	1	27,29
UTP Cable	300 m	327,00
Other el. material		294,18
Internet provider works		313,20
Total		1.009,77

Also, the project tasks were accomplished with the help of the laboratory members and volunteers (cavers and pupils).

Task	No. of volunteers	Time (hours)
Preparing the laboratory chambers	4	20
Cable installation in Tular	6	40
Cable installation in Iskra factory	4	48
Setting IR video cameras	3	30
Assembling routers, housing, etc.	5	60
Testing the system	4	40
Other tasks	7	30
Total		268

REFERENCES

Bukovec, T., 2011: Kranjski proteus svetovne veljave [Kranj's *Proteus* as a world treasure].
Nedeljski dnevnik, November 27, 2011: 13.