KARST RESEARCH INSTITUTE
Scientific Research Centre
of the Slovenian Academy of Sciences and Arts

RESULTS OF AN INTERNATIONAL WORKSHOP ON

Long-Term Ecological Studies in Karst

Postojna, Slovenia. 2006

Cover photo
Malo Zagorsko jezero, December 2005. Courtesy of Janez Mulec.

Published by
Karst Research Institute, Scientific Research Centre of the Slovenian Academy of Sciences and Arts, Titov trg 2, SI-6230 Postojna, Slovenia

Organizer
Karst Research Institute, Scientific Research Centre of the Slovenian Academy of Sciences and Arts

Supported and sponsored by
Slovenian Research Agency
National Science Foundation
Scientific Research Centre of the Slovenian Academy of Sciences and Arts

Summary prepared by
David C. Culver
Tanja Pipan

Contents

Introduction

Karst Research Institute ZRC SAZU supported by the National Science Foundation, Slovenian Research Agency and Scientific Research Centre of the Slovenian Academy of Sciences and Arts sponsored an International Workshop on Long Term Ecological Studies in Karst on October 20 to 24, 2006.

Slovenia is the site of some of the most extensive and well developed karst landscapes in the world, landscapes formed by the dissolution rather than erosion of rock. Karst landscapes comprise between 10 and 20 percent of the earth's surface and 44 percent of the land surface of Slovenia. Slovenia holds a special place in karst studies as it was the birthplace of both biological and geological karst studies.

The workshop, held at the Karst Research Institute ZRC-SAZU in Postojna, Slovenia, brought together karst and ecosystem scientists from Slovenia and the U.S. to explore mutual interests in long term studies in the Slovenian karst, with a focus on the above ground and below ground components of karst. The Karst Research Institute ZRC SAZU is the only institute in the world that deals with the breadth and depth of karst phenomena. It is an international karst research and study center, and students are trained in a post-graduate program in karstology under the auspices of the University of Nova Gorica.

The discussions occurred within the framework of the International Long-Term Ecological Research (ILTER) Network. In 2003 Slovenia became one of the member countries of ILTER Network with seven participating institutions and LTER network sites in karst areas.

The main idea of this international workshop was to bring together a strong group of experts to present a comprehensive understanding of the patterns of karst ecosystems, the role of biodiversity in the structure and functioning of the karst ecosystems, and interactions at the interface level between managed and natural ecosystems. Integration between surface and subsurface studies, integration among hydrological, geochemical, biological, and ecological studies, and integration between Slovenian and American researchers were all areas of special interest.

The workshop was structured into three parts—short summaries of research interests by the participants; field trips to potential LTER karst sites (see Appendix 1), and group discussions. The results of the workshop are intended to serve as a framework and model for the study of karst ecosystem processes throughout the world.

Participants

Participants came from four more or less distinct intellectual traditions:

1. Speleobiologists (subterranean biologists)
2. Karst geoscientists
3. Karst biologists (surface biologists), especially botanists, limnologists, and vertebrate biologists
4. Ecosystem scientists

There were 16 participants from the United States and 21 from Slovenia. The names and addresses of participants are listed in Appendix 2.

The U.S. participants came from 15 institutions in 10 states:

- American University
- University of Maine
- University of Maryland
- University of Maryland Baltimore County
- Wittenberg University
- University of Massachusetts-Lowell
- University of Colorado
- Institute of Ecosystem Studies
- Louisiana State University
- University of Arkansas
- University of Missouri
- Virginia Tech
- University of Louisville
- University of Florida—St. Petersburg
- University of New Mexico

Slovenian participants came from three universities and four research institutions:

- University of Ljubljana
- University of Maribor
- University of Primorska
- National Institute of Biology
- Jovan Hadži Institute of Biology ZRC-SAZU
- Nortranjska Museum, Postojna
- Karst Research Institute ZRC-SAZU

The participating Slovenian scientists of course did not encompass the entire range of researchers interested in long-term ecological research. There are important ecological research areas with strong Slovenian research groups, such as marine biology and mammalogy, that were either not represented or only partially represented.

Overview of Research Interests of Participants

Brief biographies of all of the participants are given in Appendix 3. In the overview that follows, the breadth of research interests of the workshop participants is highlighted.

Among speleobiologists several research themes emerged. The first of these is the tracing of lineages of animals in a geographic context, typically using mtDNA sequences as a measure of similarity. The study of Verovnik et al. (2005) is an excellent example of the use of this technique to trace evolutionary history of the isopod *Asellus aquaticus* (Fig. 1). Note that their diagram shows the complex history in the Dinaric karst of Slovenia

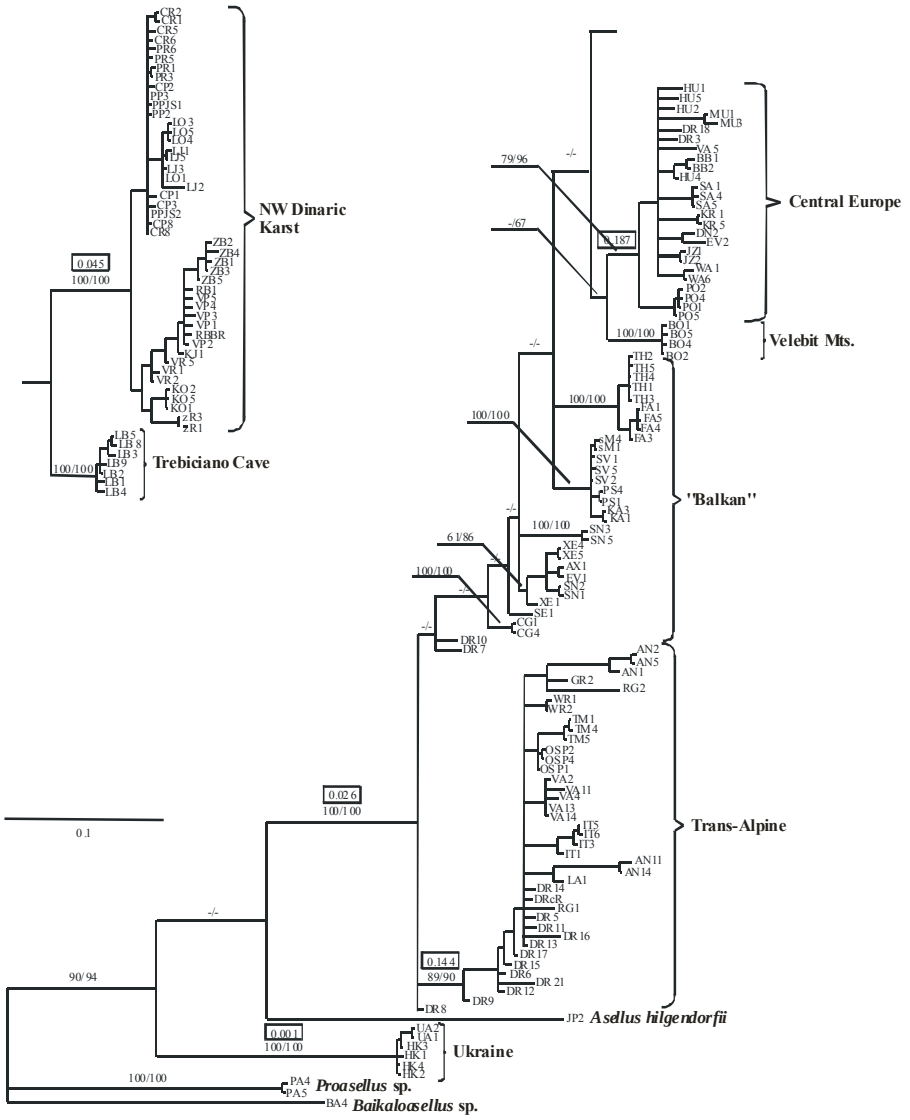
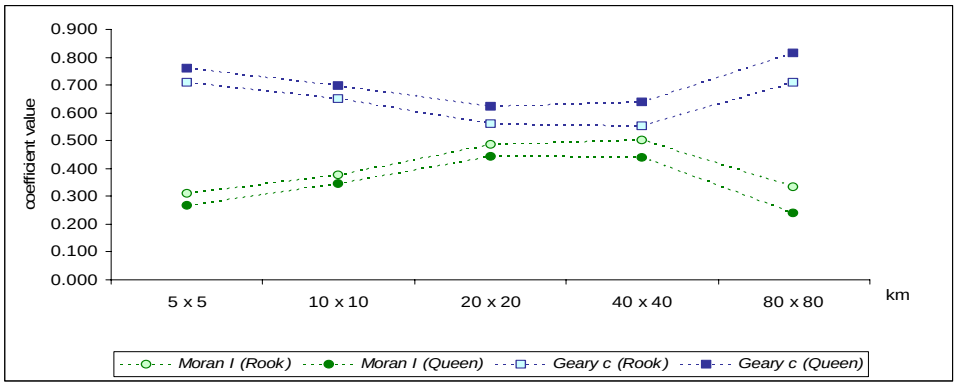


Fig. 1. mtDNA phylogeny of *Asellus aquaticus*. From Verovnik et al. (2005).

Porter, Trontelj, and Fong also provided research summaries along a similar vein.

A second research theme among speleobiologists is the mapping of biodiversity. An example of this kind of study is that of Zagmajster on determining the appropriate cell size for the analysis of distribution pattern of cave Leptodirinae beetles (Zagmajster et al. 2006).



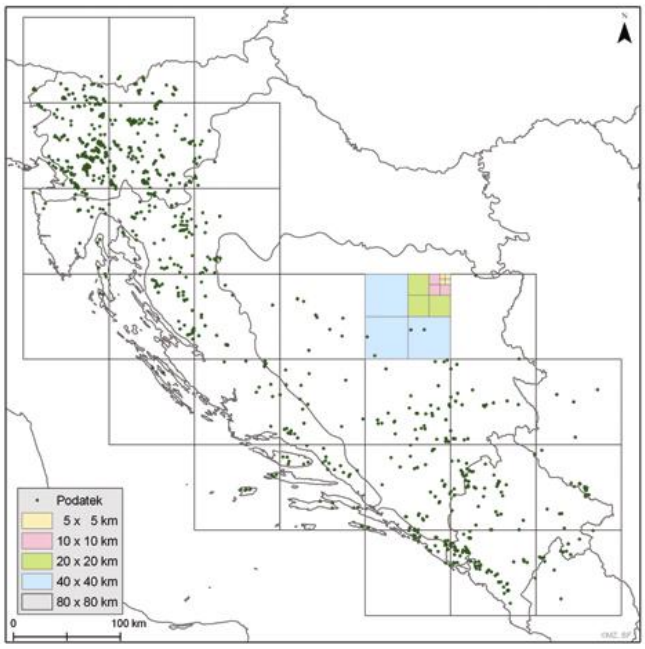


Fig. 2. Distribution and spatial correlation of number of species of Leptodirinae at different cell sizes. From Zagmajster et al. (2006).

Hobbs and Schneider also presented information on mapping biodiversity.

The discovery of biodiversity continues to be an important theme, as exemplified by the work of Pipan on epikarst copepods. She and her co-workers have found a remarkably treaure-trove of subterranean biodiversity in the epikarst (Fig. 3).

Harpacticoida from Epikarst of Six Slovenian Caves:

Nitocrella sp.
Attheyella crassa
Bryocamptus balcanicus
Bryocamptus borus
Bryocamptus dacicus
Bryocamptus pygmaeus
Bryocamptus pyrenaicus
Bryocamptus sp.
Bryocamptus typhlops
Bryocamptus zschokkei
Bryocamptus zschokkei caucasicus
Canthocamptus staphylinus
cf. Stygepactophanes sp.
Echinocamptus pilosus
Elaphoidella cvetkae
Elaphoidella franci
Elaphoidella kieferi
Elaphoidella millennii
Elaphoidella sp.
Elaphoidella stammeri
Epactophanes richardi
Maraenobiotus cf. brucei
Moraria poppei
Moraria sp. 1
Moraria sp. 2
Moraria stankovitchi
Moraria varica
Morariopsis dumonti
Morariopsis scotenophila
Paracamptus schmeili
Parastenocaris cf. andreji
Parastenocaris nolli alpina
Parastenocaris sp. 1
Parastenocaris sp. 2
Parastenocaris sp. 3
Phyllognathopus viguieri

Fig. 3. Harpacitoid copepod species found in epikarst habitats in six caves in western Slovenia. From Pipan (2005).

Other speleobiologists, including Sket, Mulec, Slay, Brancelj, Northup, and Novak also reported on the discovery of subterranean biodiversity.

Finally, Simon reported on the use of stable isotopes to determine food web structure in a cave stream community (Simon et al. 2003).

Karst geoscientists reported on a range of topics, from the way cobbles move in a stream (Wicks), to age of water in epikarst drips (Krest), to water tracing using phages (Bricelj), to pulse hydraulics in the Slovenian karst (Gabrovšek, see Fig. 4):

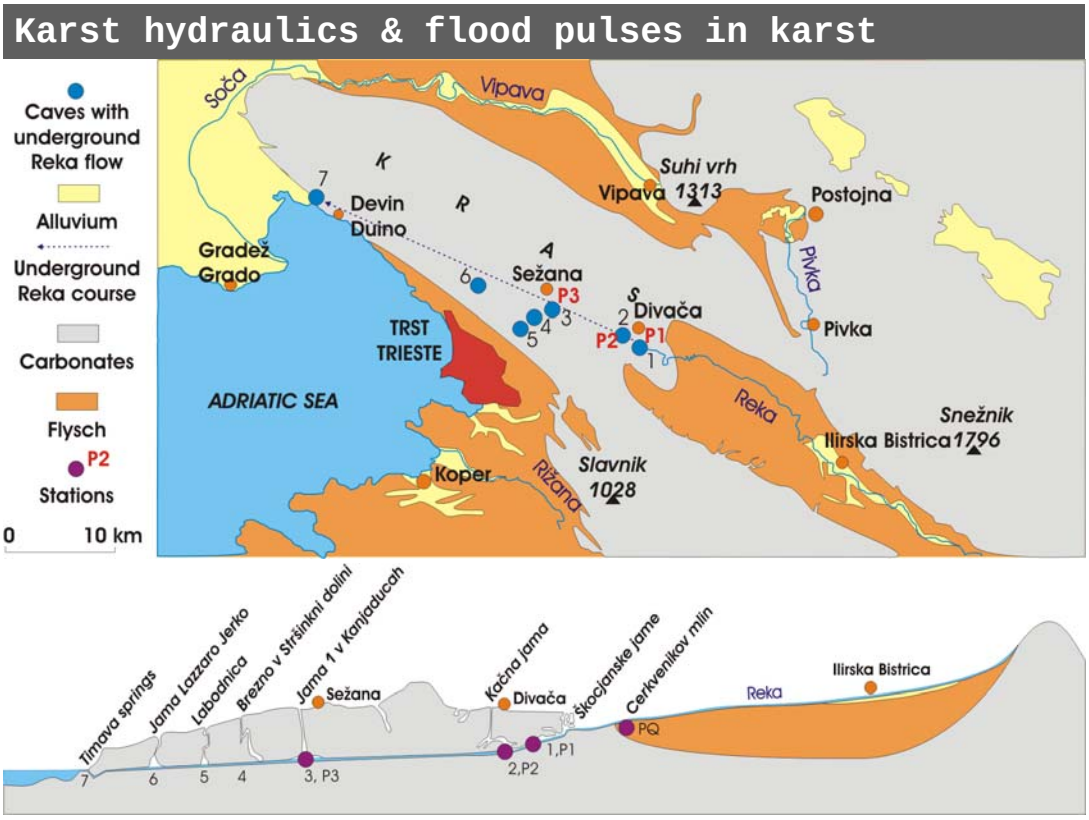


Fig. 4. Flood pulses in western Slovenian karst (Gabrovšek and Peric 2006).

Biologists studying animals on (rather than in) karst emphasized the themes of fragmentation and change. Krystufek reported on the temporal and spatial variability of the populations of the edible dormouse *Glis glis* inhabiting Slovenian karst areas (Fig. 5)

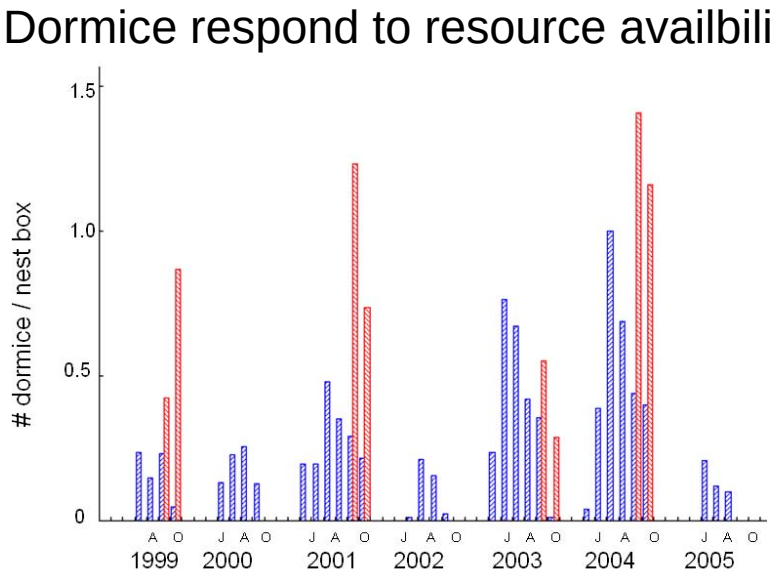


Fig. 5. Population variability of dormice as it relates to resource availability. Unpublished data of Boris Kryštufek.

Polak, Vrezec, and Kos also reported on change and heterogeneity among animal populations living on karst.

The rich tradition of phytosociology was represented at the workshop by the work of Vreš, Babij, and Surina. Surina (2005) provided a particularly interesting example of an inversion of the elevational gradient in a dolina in western Slovenia.

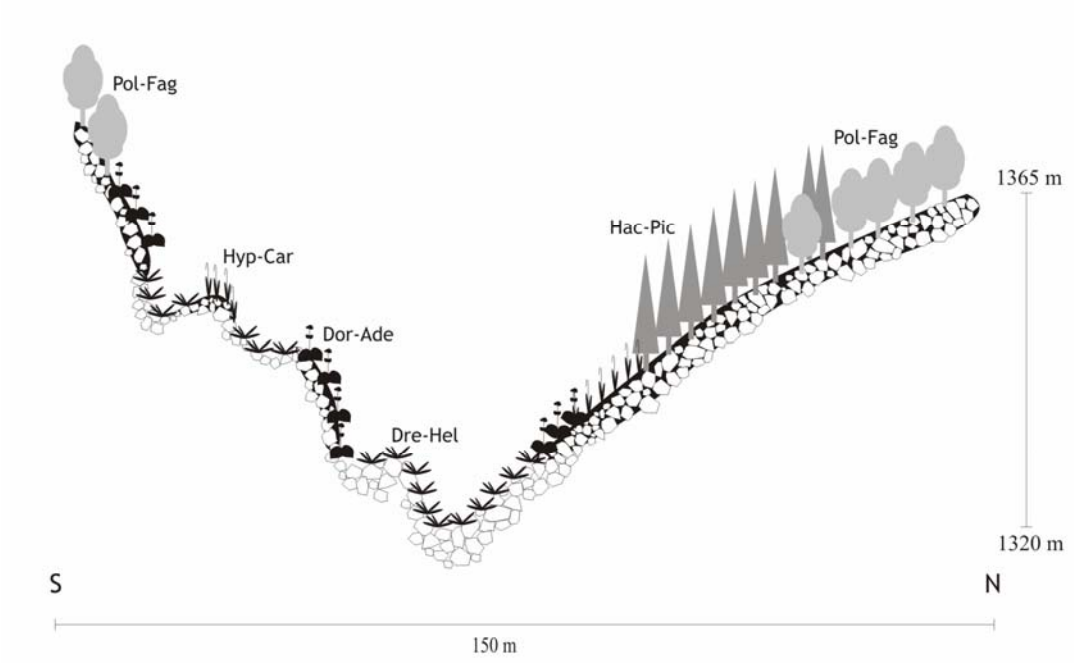


Fig. 6. Vegetation profile in Herbade dolina (Liburnian karst, Snežnik plateau).

A strong group of Slovenian scientists (Šraj-Kržič, Germ, and Gaberščik) reported on nutrient processing in intermittent lakes in the Slovenian karst. Gaberščik provided an important example of the effect of an amphibious habitat on ecosystem processing
(Fig. 7).

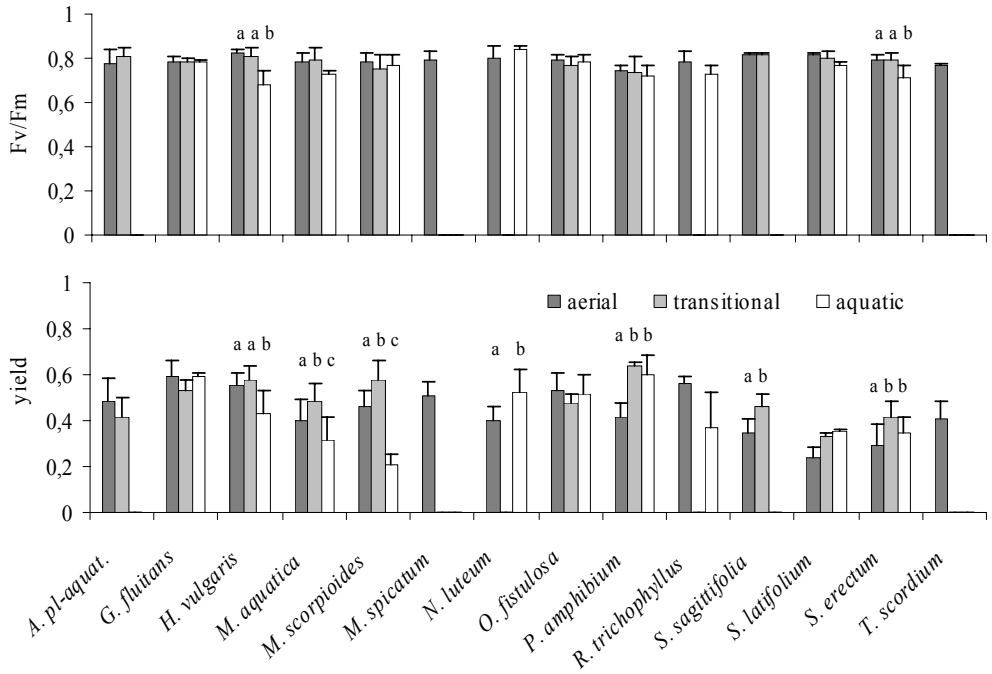


Fig. 7. The influence of change of media on photosynthetic efficiency. From Kržič and Gaberščik (2005).

Jack reported on similar habitats in the United States.

Mulec, Porter, and Northup discussed the role of microbes in the subsurface karst environment, and Summers Engel reported on the extensive role microbes play in nutrient processing.

The final group of participants were ecosystem scientists not working in karst, but rather with expertise in American LTER ecosystem projects. They provided insights in ecosystem science and its paradigms, including watershed-stream biota interactions (Benfield), mercury processing in rivers (Hines), landscape hotspots—hydro-bio-geo-chemically active edges (Groffman), and the role of dissolved organic carbon in stream ecosystems (McKnight). They also provided valuable insights into developing LTER projects.

Karst Research Institute ZRC-SAZU

The Karst Research Institute continues the long tradition of karst research in Slovenia. Founded in 1947, it is the only institute in the world that deals with the breadth of karst phenomena, including geology, biology, and engineering. They have extensive environmental monitoring data, especially for the Postojna-Planina Cave System, the world's most biologically diverse cave. It has a professional staff of 15 researchers, an extensive library of karst literature, an aquatic chemistry laboratory, a GIS facility, and maintains a registry of the nearly 9000 caves known in Slovenia. It has an extensive outreach program, ranging from frequent visits from school children to a post-graduate karstology program, funded by the European Union's Marie Curie program. The School of Karstology was established at the University of Nova Gorica by personnel of the Karst Research Instiute. The Karst Research Institute also publishes *Acta Carsologica*, an peer-reviewed international journal devoted to karst studies throughout the world. The Karst Research Institute is the permanent headquarters of the Union Internationale de Spéléologie (UIS).

LTER Sites in Slovenia

Three sites have been designated by the Slovenian Long Term Ecological Research Network:

1. Kras
2. Karst of Notranjska (karst in the Ljubljanica River basin)
3. Alpine karst

The location of these three sites is shown in Figure 8.

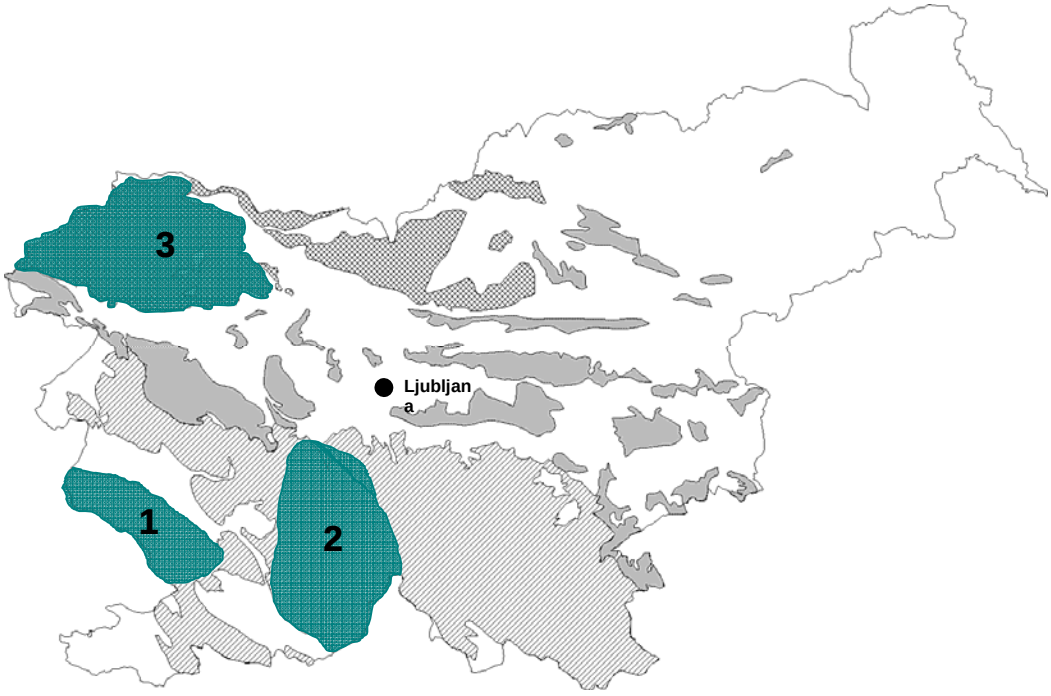


Fig. 8. The three LTER research sites in Slovenia. Numbering is as above.

Kras, a karst plateau, is in the northwestern part of the Dinaric karst. The limestone plateau, bordering Trieste Bay, is the site of the description of many karst features, such as poljes, dolinas, and even karst itself. The most significant caves in the region are the Škocjanske Jame, which are included as a UNESCO World Heritage site and a Ramsar wetland, the first subterranean wetland so designated.

Karst of Notranjska (karst in the Ljubljanica River basin) is an area with more than 1500 known caves. The most important cave system in the region is Postojna-Planina Cave System (PPCS), home to more cave-limited species than any other cave in the world and type locality for numerous species, including *Leptodirus hochenwartii.* The underground portion of the Pivka River is home to the Dinaric salamander *Proteus anguinus.* The Karst of Notranjska is famous world-side for its intermittent lakes, e.g., Cerkniško Jezero and Pivka lakes. These intermittent lakes have an especially rich flora and fauna, which also contains endemic species such at the fairy shrimp *Chirocephalus croaticus.*

Alpine karst of the Slovenian high mountain region is notable for its alpine vegetation and mountain lakes. This LTER site is less well known than the others, but may face more threats from increased human use of the area.

As a result of the discussions described in more detail below, the Karst of Notranjska was chosen as the likely site of the LTER project to be developed. There were several reasons for this but most prominent among them were:

1. A wide variety of both common and rare karst features, including ponors, poljes (Fig. 9), dolinas, springs, caves, intermittent lakes (Fig. 10), and unroofed caves.
2. A rich subterranean fauna and a rich surface biota
3. A largely intact forest
4. A long history of scientific investigation.

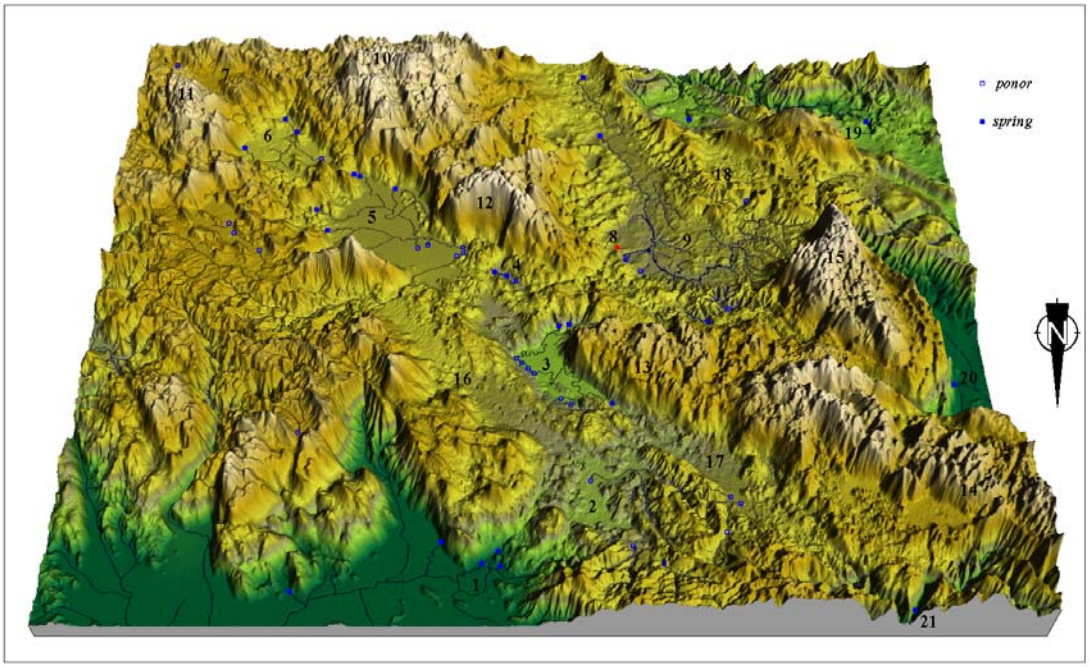


Fig. 9. 1. Springs of Ljubljanica at Vrhnika, 2. Logaško polje, 3. Planinsko polje, 4. Rakov Škocjan, 5. Cerkniško polje, 6. Loško polje, 7. Babno polje, 8. Postojna, 9. Pivka basin and polje. High karst plateaus: 10. Snežnik, 11. Racna gora, 12. Javorniki, 13. Hrušica, 14. Trnovski gozd, 15. Nanos. Karst levelled surfaces: 16 Logaški ravnik, 17. Hotenjski ravnik, 18. Slavenski ravnik; 19. Škocjanske jame cave - ponor of Reka river, 20. Vipava spring, 21.Divje jezero spring at Idrija.

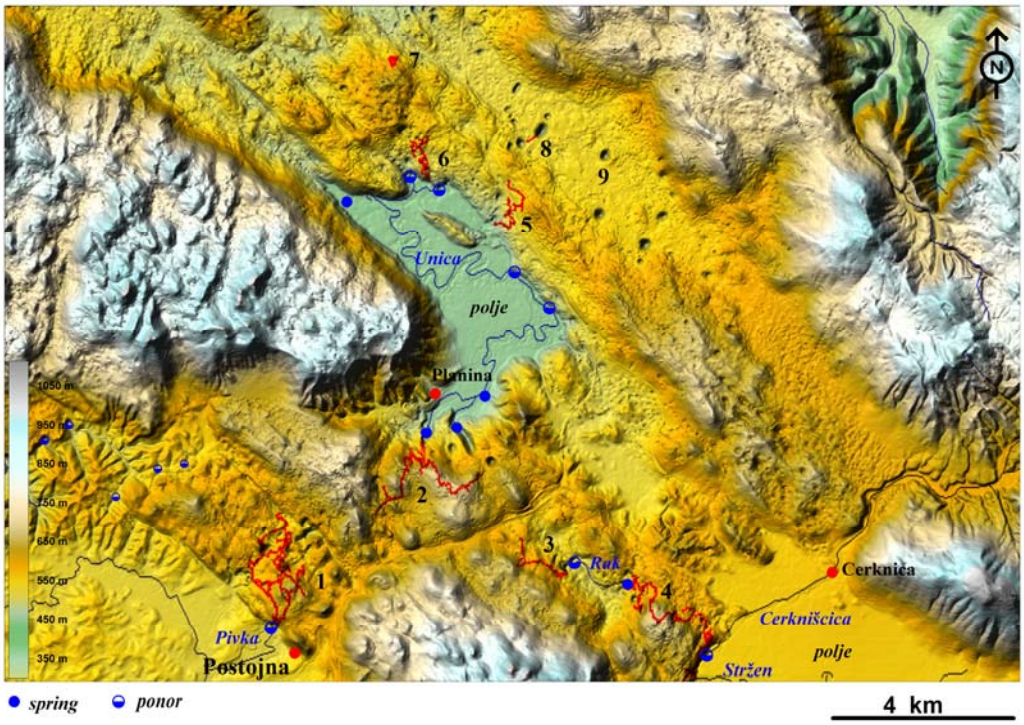


Fig. 10. Planinsko polje and important karst features around it. Legend: 1. Postojnska jama cave, 2. Planinska jama, 3. Tkalca jama, 4. Zelške jame–Karlovica cave, 5. Logarček, 6. Najdena jama, 7. Gradišnica, 8. Vetrovna jama, 9. large collapse doline

---

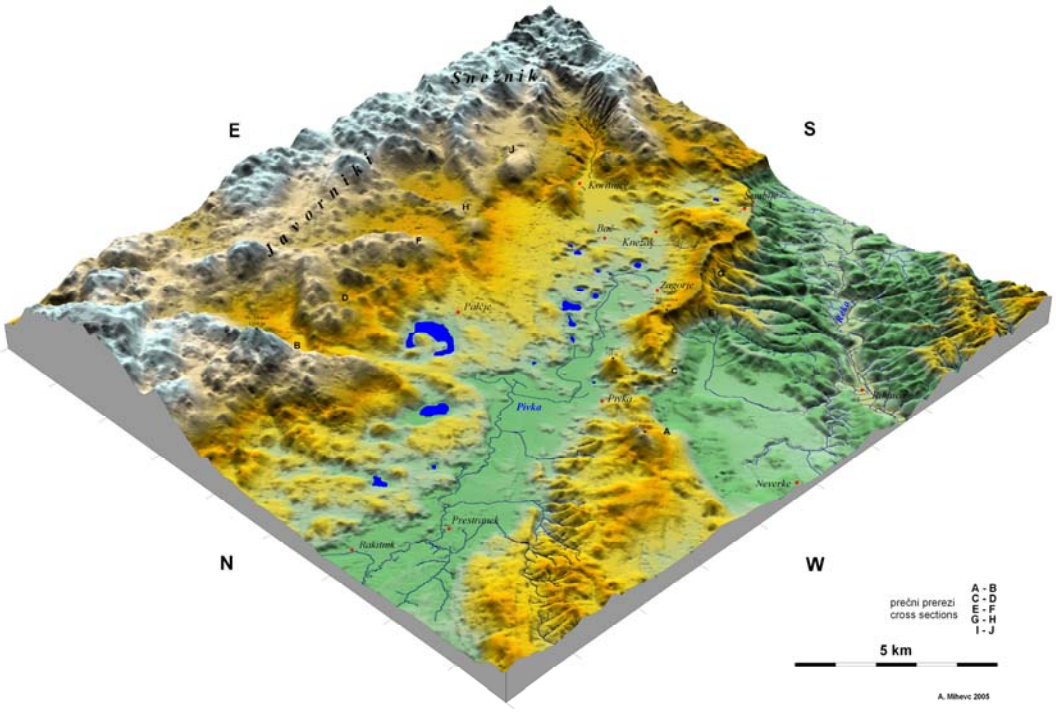


Fig. 11. Digital Elevational Model of the upper Pivka Basin.

The last point is worthy of some discussion. There is a remarkable number of books, monographs, and scientific papers written about the Ljubljanica River basin. Many of the articles are in *Acta Carsologica.* Listed below are only a few of the books and special issues of journals that highlight this history:

Aljančič, M. [ed.] 1993. **Naše Jame (Our Caves).** Vol. 35, No. 1.

Gaberščik, A. [ed.] 2003. **Jezero, ki izginja. Monografija o Cerkniškem jezeru.** Društvo Ekologov Slovenije. Ljubljana.

Gospodarič, R. and P. Habič [eds.] 1976. **Underground water tracing. Investigations in Slovenia 1972-1975.** Institute for Karst Research SAZU. Ljubljana.

Kranjc, A [ed.]. 1997. **Karst hydrogeological investigations in south-western Slovenia.** Acta Carsologica 26. Ljubljana.

Petrič, M. 2002. **Characterisics of recharge-discharge relation in karst aquifer**. Inštitut za raziskovanje krasa ZRC SAZU, Založba ZRC. Postojna-Ljubljana.

Pipan, T. 2005. **Epikarst—a promising habitat.** ZRC Publishing and Karst Research Institute at ZRC SAZU. Postojna-Ljubljana.

Shaw, T. 2000. **Foreign travellers in the Slovene karst 1537-1900.** ZRC Publishing and Karst Research Institute at ZRC SAZU. Ljubljana.

Šebela, S. 1998. **Tektonska zgradba sistema Postojnskih jam. Tectonic structure of Postojnska jama cave system.** Znanstvenoraziskovali center SAZU, Založba ZRC. Ljubljana.

Šebela, S. 2005. Postojna-Planina cave system, Slovenia, pp. 456-458. In D.C. Culver and W.B. White [eds.], **Encyclopedia of caves**. Elsevier. Amsterdam.

Summary of Successful LTER Core Areas Research Projects

Diane McKnight summarized the commonalities of successful American LTER projects in order to provide a framework for discussion. LTER's must include the following components:

1. Population studies
2. Movement of inorganic substances
3. Movement of organic substances
4. Disturbance Patterns
5. Primary Production

They have the following common features:

1. Designed with a century timescale in mind
2. Long-term manipulation experiments to be followed over time—be creative
3. Integrate geophysical understanding with biological and ecological understanding
4. Central themes or hypotheses evolve and are renewed

Other Requirements of LTERs

1. Database management-encourage to start with a relational database.
2. Integrate prior data into the new database
3. Project coordination among investigators
4. Outreach-community and school children
5. Training graduate students
6. Activity within LTER network-other ILTERs with common themes

Summary of Discussions on Research Directions

The discussion began with a series of questions being raised about karst ecosystems in general, and Slovenian karst ecosystems in particular. Comments are summarized after the question in order to give a sense of the directions the discussion took.

Are karst systems relevant to carbon sequestration? Are people thinking of pumping CO_2 into the subsurface? Several participants indicated that karst is a carbon sink but no one knew of any plans to pump CO_2 into the subsurface. Karst is also a large carbon reservoir in the form of calcium carbonate.

To study ecosystems, one needs to draw a boundary around it, and do a mass balance equation. Can this be done for karst ecosystems? A study by the French biologist Rouch in the 1970's made a case that the karst basin was the "natural" ecosystem, not a cave. Drawing of boundaries within the Notranjska Karst has not really been done but many dye tracing studies have been done over the past few decades.

What are the connections between surface and subsurface in karst? Primary productivity is on the surface and this links surface and subsurface. If surface biodiversity is high, then perhaps subsurface biodiversity may be high because of the links. Threats to subsurface life largely originate on the surface, especially water dripping into caves (epikarst). In Alpine areas the distinction between surface and subsurface fauna is less distinct. One can find troglobionts on the surface in Alpine areas. In general there are two links—percolating water (epikarst) and sinking streams (ponors)

What are the threats to karst ecosystems and changes are likely? In the U.S. land use change due to development is a major threat. Is that the case in Slovenia? There was disagreement on this point with some feeling that development change was unlikely and others that it was inevitable. Slovenian LTER sites may be heavily influence by population growth in lowland areas, by pollution, and by highway construction. Increased tourism may also be an important threat. On the other hand, industrial pollution has decreased. Climate change may also be important. It is possible to get long term climate change records in karst from isotope ratios in speleothems, but short term changes are harder to acquire.

What makes karst ecosystems unique? One reason is that water has shaped them. The linkages between surface and subsurface are driven by the flux of water. It is dynamic in time and will change with climate change. Intermittent lakes are unique, especially when they are drained and filled by estavelles. Such estevelle-controlled temporary lakes may be of special interest. Two things are unique to karst—(1) it is driven by carbon rather than by nutrients (especially N) as is the case in many other ecosystems, and (2) the coupling between surface and subsurface.

A summary by Groffman refined the answers to this question:

Movement of….

- **Organic Matter:**
  - **A highly unique aspect of karst in that the food chain is dominated by transfer of organic material from elsewhere.**
- **Inorganic matter (nutrients):**
  - **Karst is unique in that the residence time of water is much less than in other temperate ecosystems. Water yield is very high which should have a marked influence on inorganic nutrient dynamics and retention.**

Has anyone made a model for karst hydrologic systems? Will White (Penn State) and his students have conceptual models of linkages and movement of water and contaminants. They didn't grapple with the problem of carbon and energy in karst ecosystems. There hasn't been a lot of communication between ecosystem scientists and karst biologists. A box diagram of carbon movement would be very useful.

What are the potential sources of funding for a long-term ecosystem project? NSF isn't funding new LTER's at present, but there are other NSF opportunities such as Critical Zone Observatories. The Slovenian government has an initiative to fund long-term monitoring. It is useful in the context of U.S.-Slovenian cooperation, to identify systems and problems were participation by both Slovenians and Americans is important. It is important to look at a long enough time frame, especially since forecasting is a major part of ecosystem studies. A monitoring timeframe of at least 6 years is probably needed.

The discussion then moved to biodiversity, where a series of questions were also raised.

What is the importance of biological inventory and what is known? There has been some history of all taxa inventory in Slovenia. The Karst Research Institute has an amazing databank of information on caves which provides an important starting point for geographic analysis, including determining gaps in sampling. There is also a great deal of information on subterranean fauna distributions. It would be important to recollect in sites to compare data over time.

What would make a biodiversity study in Notranjska Karst interesting and fundable? One aspect would be endangered species, but we can't document the decline in subterranean species, if indeed it is occurring. On the other hand, karst systems, both surface and subsurface, have high degrees of endemism and this also makes them more generally interesting. *Proteus anguinus* is a charismatic species but there are no data to suggest that it is declining. There may be some local declines but this has not been systematically investigated.

What are the sampling problems in karst? Because of high levels of endemism, many species remain to be discovered even in relatively well sampled areas. Data from Schneider in West Virginia also bear this out. Very intensive sampling of a few caves may actually provide more information, based on several studies of the Slovenian cave fauna. Another problem is that one doesn't have access to most of the subterranean habitat. This is especially true for habitats like epikarst where sampling is indirect. Overall, one can find between 40 and 60 species of invertebrates in even small Slovenian caves although many of these are not limited to caves. Caves should also be sampled in different seasons because there are seasonal differences. There are also statistical approaches, many of which are available in the software package EstimateS, that allow estimation of total diversity based on incomplete information.

Based on these discussions, a consensus emerged on two basic research questions:

- *What is ecosystem function (e.g. the carbon cycle) in surface and subsurface karst habitats and what is the relationship between the two?*
- *What are the biodiversity patterns in surface and subsurface karst habitats, and what is the relationship between the two?*

In the next discussion session, participants split into two groups based on these two questions.

What is ecosystem function (e.g. the carbon cycle) in surface and subsurface karst habitats and what is the relationship between the two? The discussion focused on a both the conceptual (stoichiometry, linkage of biodiversity and function) and physical components (percolation water, subterranean streams, and intermittent lakes). In some cases the questions and comments were wide-ranging and the summary reflects the eclectic nature of the discussion. A model was put forward as the basis for discussion. There are two inputs—percolating water and sinking streams (ponors), and the output can include intermittent lakes with a repeated cycle of inputs and outputs within the basin.

Percolating water. How can the connection between organic matter produced aboveground and organic matter flux belowground be made? One could work at different scales (basin, cave) to get quantitative measures. For percolating water it is possible to get concentrations and one can estimate catchment area of drips in cave by estimating the area of the cave passages and finally estimate inputs by knowing rainfall. It may be possible to use radium isotopes to obtain dates of the age of the percolating water. There is a wealth of data about percolating water in Postojna Cave, including an artificial tunnel at Hubelj where all structures and fractures have been mapped.

Sinking streams Are ponors identified well enough to estimate all of the organic matter coming in? Overall, the Ljubljanica basin is too complex to do this but it can be done on a smaller scale. In most surface streams, sunlight is an important regulator; it breaks down organic matter. In underground streams and rivers dissolved organic matter (DOM) is a major input but there is no sunlight to break it down. One could hypothesize that there is less biological uptake of DOM per unit of stream if there is no sunlight. Perhaps a perturbation experiment with artificial illumination could be done.

Intermittent Lakes Poljes are intermittent; flooding has not been regular in the last 6 years. This affects primary production and inputs and will complicate models. Are intermittent lakes a hotspot of nitrogen processing? How will this change with climate change? There have been various engineering schemes to make poljes drier or wetter but in general they

haven't worked. Regular flooding may reduce the possibility of major perturbations to the biota.

Stoichiometry We don't know if these systems are carbon, nitrogen, or phosphorus limited. Nitrogen is generally important and much nitrogen is retained. In karst systems, the water goes through very fast, so does nitrogen go through fast too? This is also often connected to land use changes, and it would be interesting to do both nutrient addition and land use changes in the LTER. Considerable data about water chemistry are available. Nitrogen is a key question also because there may be important microbial involvement in cave streams.

Biodiversity link There may be several reasons why the Dinaric karst is a subterranean biological hotspot. One is, and this is especially true for the Ljubljanica basin, is that the density of cave habitat is higher than elsewhere. For the aquatic fauna, proximity to the Adriatic combined with the periodic salinity crises may be important. The third idea is directly linked to productivity. The highest terrestrial cave biodiversity is found in North Temperate areas of maximum actual evapotranspiration (and productivity). The Ljubljanica basin lies on this "ridge" of maximum biodiversity and productivity. This makes a nice hypothesis for the linking of ecosystem function and biodiversity. There is a regional context to diversity. High diversity areas are not isolated, but rather in regions of high cave density and productivity. Diversity may also be enhanced because water is coming from diverse sources and locations.

What are the biodiversity patterns in surface and subsurface karst habitats, and what is the relationship between the two? This too was a wide-ranging discussion and two themes emerged—scale of analysis and surface-subsurface biodiversity.

Scale of analysis For many biodiversity studies, emphasis on a single area such as Notranjska Karst is inappropriate and in many cases a much larger area, even the entire Balkans, may be needed. The study of endemism typically requires large areas. One can also first determine the LTER site and then decide upon appropriate questions after the location and size are known. There was some interest in manipulation experiments but this possibility was not pursued in any detail, and concern was raised about environmental impacts. There have been "natural" perturbation experiments, especially relating to land cover changes.

Surface-Subsurface biodiversity There should be a complete inventory of above and below ground biodiversity. Superficial subterranean habitats such as the *milieu souterrain superficiel* (MSS) and epikarst should get special attention, also at connection sites between surface and subsurface. An inventory by itself is insufficient and there need to be hypotheses. One hypothesis is that surface productivity and diversity determine subsurface diversity.

Synthesis

From these discussions emerged the beginnings of a synthesis and consensus on the direction of long-term ecological research in karst. Leaders of the discussion groups (Kevin Simon for ecosystem function and Daniel Fong for biodiversity) presented summaries of research questions, but there was no formal statement that was approved by the workshop. However, in the opinion of the co-organizers (Tanja Pipan and David Culver) some important areas of agreement emerged.

1. Karst ecosystems present some unique questions about ecosystem function, and it would be mutually beneficial to ecosystem science and karst science to have more interaction between the two.

2. Among the potentially unique features of karst ecosystems are (a) the intimate connection between surface and subsurface, (b) the dominance of energy transfer from elsewhere in subterranean food chains, (c) the rapid rate of movement of water and the material carried by water, (d) the likelihood that the system is carbon rather than nitrogen or phosphorus limited.

3. The Notranjska karst presents a nearly ideal site for ecosystem function studies, both because of the extensive background studies that have been done and because of the presence of many interesting unusual karst features, such as poljes and intermittent lakes, as well as well developed typical karst features such as caves, dolinas (sinkholes), and springs.

4. Given the nature of karst, a multidisciplinary approach involving biologists, geoscientists, and hydrologists is absolutely essential for a successful ecosystem study. In this respect, the Karst Research Institute ZRC SAZU, with its multidisciplinary staff, will play a key role in this endeavor.

5. Key questions to be studied are:
   a) How do different pathways (diffuse flow of percolating water versus sinking streams) of organic matter influence the structure and function of subsurface ecosystems?
   b) How does hydraulic residence time influence the structure and function of karst ecosystems? In particular, N, P, and C retention should be low as a result of low hydraulic residence times.
   c) Are intermittent lakes (including poljes) hotspots for N, P, and C processing
   d) What is the role of disturbance, and especially changing patterns of disturbance in the karst ecosystem
   e) Does a surface area with high diversity increase the number and size of fluxes to the subsurface, and does this result in a high biodiversity in the subsurface?

Future Directions

It was agreed that the possibility of longer-term ecological studies in the Notranjska karst is worth pursuing, and that more discussion between Slovenian and American colleagues is necessary. To this end David Culver and Tanja Pipan will continue to serve as coordinators and organizers of this effort. From each of the two discussion groups two colleagues agreed to help facilitate further discussions—Alenka Gaberščik and Kevin Simon for ecosystem function and Maja Zagmajster and Katie Schneider for biodiversity studies. Subject to funding availability, a follow-up workshop with about 10 to 12 participants will be convened in the United States in 12 to 18 months with the purpose of beginning to write and organize a multidisciplinary research proposal.

References Cited:

Gabrovšek, F., and B. Peric. 2006. Monitoring the flood pulses in the epiphreatic zone of karst quifers: the case of Reka River system, Karst Plateau, SW Slovenia. **Acta Carsologica** 35: 35-45.

Kržič, N., and A. Gaberščik. 2005. Photochemical efficiency of amphibious plants in an intermittent lake. **Aquatic Botany** 83:281-288.

Surina, B. 2005. Some novelties in the flora and vegetation of the Mt Snežnik (SW Slovenia, Liburnian karst). **Acta Botanica Croatica** 64: 341-356.

Verovnik R., Sket, B., and Trontelj P. 2005. The colonization of Europe by the freshwater crustacean *Asellus aquaticus* (Crustacea: Isopoda) proceeded from ancient refugia and was directed by habitat connectivity. **Molecular Ecology** 14: 4355-4369.

Zagmajster, M., B. Sket and T. Podobnikar. 2006. Choosing a grid network for spatial analysis of subterranean biodiversity. In: Perko, D., J. Nared, M. Čeh, D. Hladnik, M. Krevs and T. Podobnikar, eds. **Geographic Information Systems in Slovenia 2005 – 2006.** Monography of 8th Bienal Symposium. Ljubljana: ZRC SAZU Publishing: 261 – 269. [in Slovenian, with English abstract].

Appendix 1

Excursion Guides

WHOLE-DAY EXCURSION, 23 October 2006

Classical Karst

Andrej Mihevc
Karst Research Institute ZRC SAZU, Titov trg 2, SI-6230 Postojna, Slovenia

Classical Karst is a part of karst of Dinaric mountains. This karst has abundance of interesting karst phenomena like large sinking rivers and springs, intermittent lakes, numerous large caves and relief features like karren, dolines, collapsed dolines, uvalas, poljes and leveled surfaces and plateaus. But it was the exploration of the people that were driven first by curiosity and later by land use or water management issues and tourism that make the Kras famous. Well researched, described and mapped natural phenomena in 19th century made the area cradle of a new scientific discipline – karst studies.

Ljubljanica river system

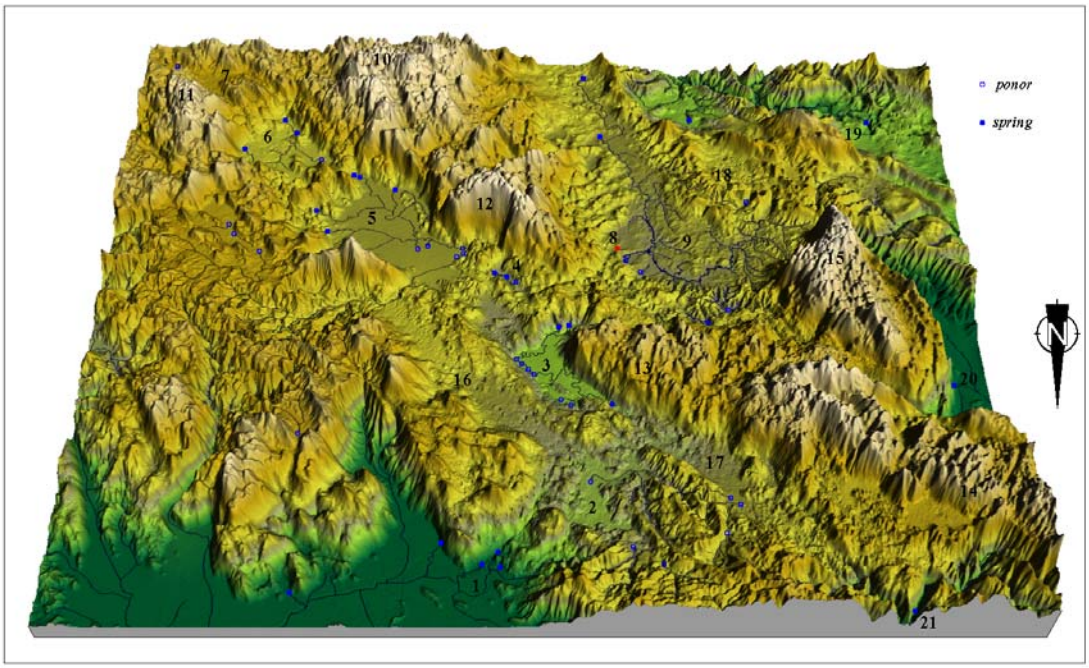


Fig. 1: Legend: 1. Springs of Ljubljanica at Vrhnika, 2. Logaško polje, 3. Planinsko polje, 4. Rakov Škocjan, 5. Cerkniško polje, 6. Loško polje, 7. Babno polje, 8. Postojna, 9. Pivka basin and polje. High karst plateaus: 10. Snežnik, 11. Racna gora, 12. Javorniki, 13. Hrušica, 14. Trnovski gozd, 15. Nanos. Karst levelled surfaces: 16 Logaški ravnik, 17. Hotenjski ravnik, 18. Slavenski ravnik; 19. Škocjanske jame cave - ponor of Reka river, 20. Vipava spring, 21.Divje jezero spring at Idrija.

Ljubljanica River collects the water from SW part of Dinaric karst in Slovenia and belongs as right Sava affluent to Danube and of Black Sea. The Ljubljanica water basin is about 1100-1200 km^2. Nearly all watershed of the river is in karst and therefore is not well defined. The

mean annual precipitation in the basin is 1300 - 3000 mm, during 100 to 150 rainy days. The one-day maximal amount to 100 mm, in extreme cases even 300 mm.

Most of the river basin is formed on the Mesozoic rocks, mostly limestone. On these rocks the precipitations infiltrate directly into the karst and there are no surface rivers. Triassic dolomite is important, allowing some surface flow, forming bottoms of some karst poljes or forming hydrologic barriers.

The highest parts of the basin are high karst plateaus Hrušica, Javorniki and Snežnik and Racna gora. On the poljes among them surface rivers appear only, but they have different names: Trbuhovica, Obrh, Stržen, Rak, Pivka, Unica and finally after the springs at Vrhnika the name Ljubljanica. The highest lying is the karst polje near Prezid (770 m), followed by Babno polje (750 m), Loško polje (580 m), Cerkniško polje (550 m), Rakov Škocjan and Unško polje (520 m), Planinsko polje (450m), Logaško polje (470 m) and finally by Ljubljansko Barje (300 m) where the Ljubljanica springs are at 300 m a.s.l. There are several large springs are dispersed along the edge of the Ljubljana Moor, which is connected with gradual tectonic subsidence of the area. Mean annual discharge of the Ljubljanica at springs is 38.6 m^3.

There are 1540 caves, accessible fragments of underground drainage system known in the catchment area of the Ljubljanica. The average length of the cave is 48 m and the depth 18 m. However, the largest caves are the ponor or spring caves; in them we can follow the 71 km of passages of the main rivers, tributaries of Ljubljanica.

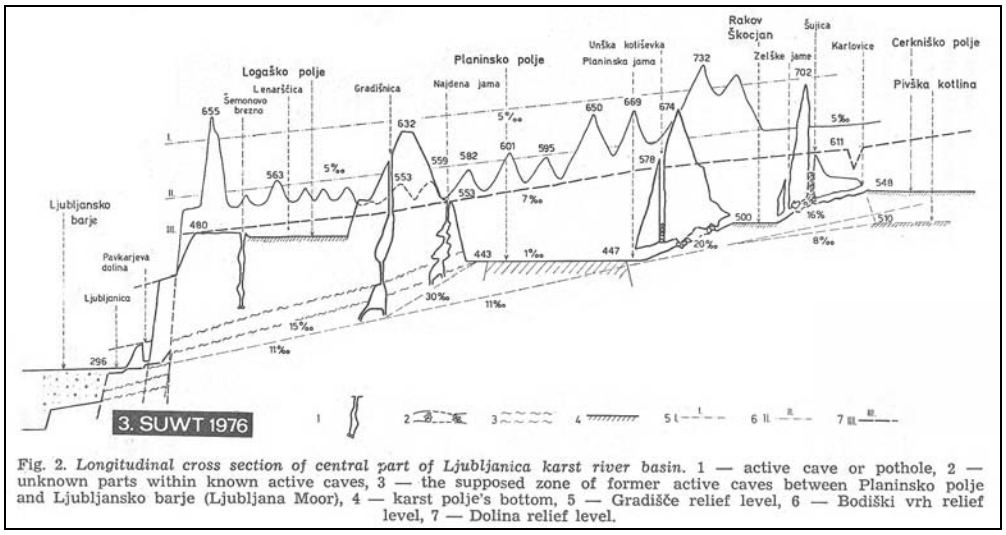


Fig. 2. *Longitudinal cross section of central part of Ljubljanica karst river basin.* 1 — active cave or pothole, 2 — unknown parts within known active caves, 3 — the supposed zone of former active caves between Planinsko polje and Ljubljansko barje (Ljubljana Moor), 4 — karst polje's bottom, 5 — Gradišče relief level, 6 — Bodiški vrh relief level, 7 — Dolina relief level.

Fig 2: Longitudinal cross section of Ljubljanica karst river basin (Gospodarič & Habič 1976).

Logaško polje

Logaško polje (polje of Logatec) is developed on the contact of dolomite and limestone between 470 and 480m a.s.l. A number of small streams flow onto in, the largest being the Logaščica, which collects run-off from a dolomite area of 19 km^2. The mean flow is 0.3m^3/s. Short lasting floods occur at the swallow-holes Jačka on the Logaško polje when the flow exceeds 30 m^3/s.

The ponor of the Logaščica river is in the centre of the town, and there is located also the central waist water treatment plant. The water from the plant is directly flowing into the stream just 50 m before it sinks. The station located near the school, church, kindergarten, cemetery and school playground and direct injection of often not enough treated water is interesting case of understanding of sustainable use of karst.

Planinsko polje

Planinsko polje is overflow polje, of rectangular shape, 6 km long, 2 km wide, with two narrow pocket valleys on SW part, 50 m deep, with 16 km^2 flat surface at height of 450 m. Its wider surrounding is built by Upper Triassic dolomite, Jurassic and Cretaceous limestone. The development of closed karst depression is result of accelerated corrosion, controlled by geological structures.

It presents the most important water confluence in the river basin of Ljubljanica. Tectonically crushed and less permeable dolomite barrier along the Idrija wrench fault zone, which crosses the polje, forces the karst waters to overflow from higher karstified limestone background to the surface and after crossing Planinsko polje toward NE they can sink into the underground again. The principal Unica springs, with mean annual discharge 24 m^3/s (min. 0.3 m^3/s, max. 100 m^3/s) are situated in the southern polje's part in Cretaceous limestone, where the confluence of waters from Cerknica, Javorniki Mt. and Pivka is located.

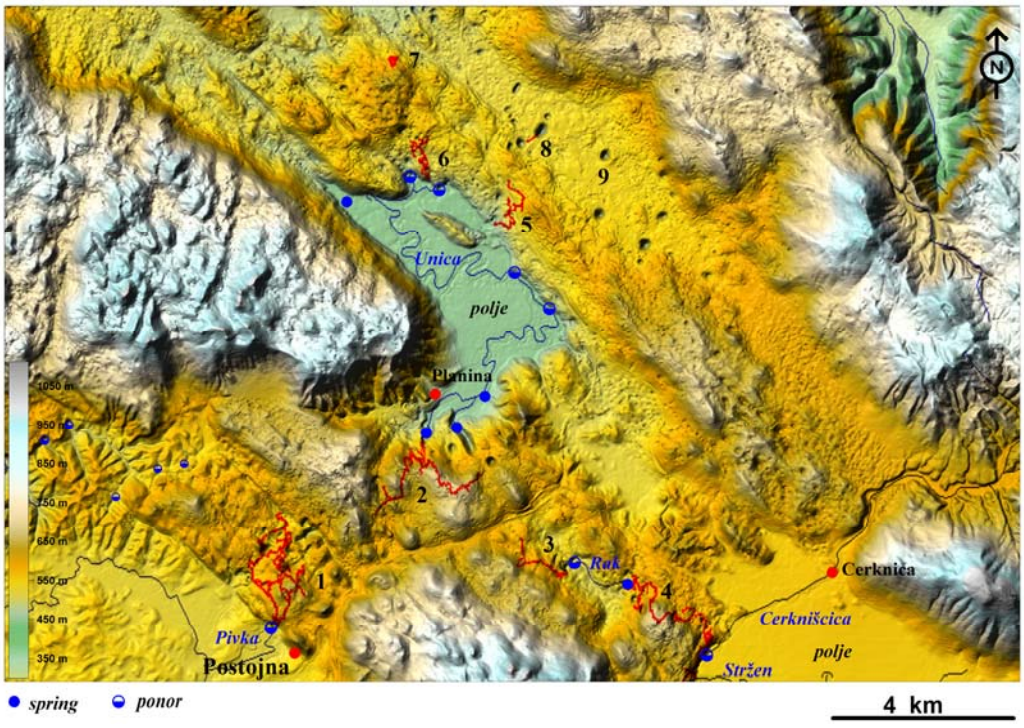


Fig. 3: Planinsko polje and important karst features around it. Legend: 1. Postojnska jama cave, 2. Planinska jama, 3. Tkalca jama, 4. Zelške jame–Karlovica cave, 5. Logarček, 6. Najdena jama, 7. Gradišnica, 8. Vetrovna jama, 9. large collapse doline.

The principal Unica swallow-holes are disposed at NE edge, where mostly medium and high waters are sinking. At low waters the whole Unica is disappearing in swallow-holes at eastern polje's border. The water is sinking directly from Unica bed through the polje's bottom across more than 150 swallow-holes and impassable fissure. Only at Dolenje Loke and in Škofji lom, up to 160 long ponor caves are known, but there are several horizontal caves in vicinity of the polje, where water oscillations can be observed. Larger caves behind the ponors are over 4987 m long Najdena jama cave and Logarček.

Planinsko polje is flooded several times in a year. The minimum inflow to the polje amounts to 1.5 m^3/s; mean 23 m^3/s, maximal was estimated to 100-120 m^3/s, the total ponor capacity is about 60 m^3/s. At floods, lasting 1-2 months, the water increases up to 10 m and up to 40 millions of m^3 of water inundate the polje.

Planinska jama

Planinska jama cave is 6656 m long cave, situated on the southern most part of Planinsko polje at 453 m a.s.l. The explorations of the cave started in 1849 and are still in progress, mostly on the far ends of the cave where divers explore in deep sumps.

The cave is formed in Cretaceous limestone. The entrance to the cave is in the pocket valley under 40 m meters high vertical wall. From it river Unica emerges. Most of the cave are large passages wider and higher than 15 m The cave consists of two branches which are named by the rivers that flow trough them. The eastern branch is named after Rak, river that comes from Rakov Škocjan and Cerkniško jezero. The southern branch is named after river Pivka which comes from Postojna cave.

The position on the rock above the pocket valley was used by a medieval castle; later in front of the cave the water was use to power the mills, and small power station. Between the two wars the tourist path was made deep in a cave. There is only small number of visitors entering cave since it is in a shadow of the better equipped Postojna cave.

Rakov Škocjan

Rakov Škocjan is a karst depression about 1.5 km long and 200 m wide. It is situated below the N side of Javorniki Mountain at elevation about 500 m between Planinsko and Cerkniško polje. Through the depression flows the permanent river Rak. The Rak springs from Zelške jame cave, bringing water from Cerkniško polje. Zelške jame are about 5 km long; the end of the cave is in huge collapse doline Velika Šujca, where from the other side the Karlovica cave system ends. In Karlovica system is the main outflow from Cerkniško polje. Numerous collapse dolines are situated around the entrance of Zelške jame. In one of them the Small natural bridge is present. Downstream the valley widens and several springs bring additional water to the Rak River. The valley is narrowed at the Great Natural Bridge and afterwards the Rak sinks into Tkalca jama cave from where the water flows towards cave Planinska jama at Planinsko polje. The connections of the Rak with water from Cerkniško polje and with the Unica springs at Planinsko polje were proved by water tracing.

Before World war I Rakov Škocjan was owned by the Windischgrätz family and was closed as their private park; between 1st and 2nd World war, the Italians also closed the area for the public. From 1949 Rakov Škocjan has been a Landscape Park.

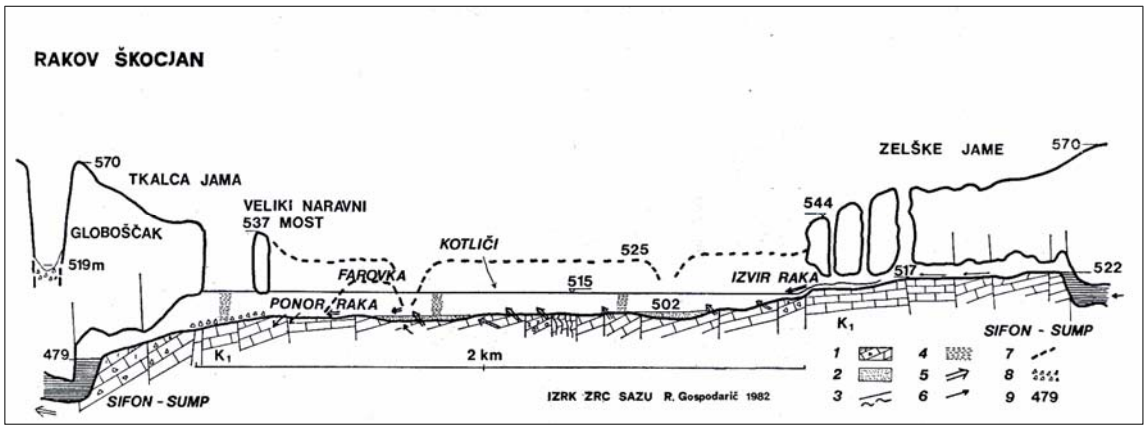


Fig.4: Cross-section along Rakov Škocjan karst depression between spring at Zelške jame and sink in Tkalca jama. Legend: 1 – rocky bottom, 2 – alluvia, 3- fault zone, 4 – flood in 1982, 5 – karst spring, 6 – water flow directions, 7 – terraces, 8 – boulder rocks, 9 – altitude (Gospodarič et al. 1983)

Cerkniško polje

Cerkniško polje (polje of Cerknica) is the largest karst polje in Slovenia. Often it is called just Cerkniško jezero (Lake of Cerknica), because of its regular floods, or intermittent lake. The intermittent lake covers 26 km^2 when is full; it is 10.5 km long and almost 5 km wide. Its hydrological properties caused that already in the beginning of New Age scholars from all round Europe were attracted to it. The lake becomes still more known through the Valvasor's description in 1689.

It is a karst polje developed in the important regional fault zone – Idrija fault. Idrija fault has "Dinaric" direction (NW-SE); in the same fault zone are developed: Planinsko polje, Loško polje and Babno polje. Bottom of Cerkniško polje covers 38 km^2 in elevation of about 550 m. Bottom is formed on Upper Triassic dolomite, which is presented also on the N, E and SE side of the polje, there are some Jurassic dolomites also presented. On W and NW the Cretaceous limestone are presented. Inflows are on E, S and partly on W sides of polje. The largest tributary to polje is Cerkniščica drained the dolomite catchments area. The important karst springs are Žerovnica, Šteberščica and Stržen. Stržen flows on the W side of polje towards the ponors in the middle of the polje, from where water flows directly to Ljubljanica springs, and towards NW side of polje, from where the water flows to Rakov Škocjan. From the foot of Javorniki mountain to the contact with dolomite in the polje bottom is 12 ponor caves. They are connected to Karlovica cave system to which also the highest waters from polje flows. It the system there is more the 7 km of passages. Passages are generally low, because they are filled by alluvia. Thickness of alluvia in Jamski zaliv, before the caves entrances, is about 8 –15 m.

During the last centuries a lot of plans for the change of polje hydrology have been made, but not any of them was realised. In 1965 was proposed to make Cerknica polje a permanent lake, in the years 1968 and 1969 entrances to the caves Velika and Mala Karlovica were closed by concrete walls and 30 m long tunnel was made to connect Karlovica with the surface, but small effect of retention in dry period and less moistened years were assessed.

The bottom of Cerkniško polje covers 38 km^2 in elevation of about 550 m. Inflows are on E, S, and partly on W polje's side. There are some small superficial tributaries to polje, the largest is Cerkniščica, with about 45 km^2 of hinterland mostly dolomite.

Flattened bottom of Cerkniško polje is regularly flooded for several months in autumn winter and spring time, at floods it alters to spacious karst lake. Lower waters are sinking mostly in marginal swallow holes and in numerous ground swallow holes and estavellas, which are disposed in central polje's bottom. Principal ponor caves and swallow holes are disposed at NW polje's border.

Next to the polje border, from the foot of the Javorniki to the contact with dolomite in the polje bottom is 12 ponor caves. They are all connected with the system of the Velika and Mala Karlovica cave. Most of caves are short; they get narrow or are blocked by breakdown

The highest waters run off through the caves Mala and Velika Karlovica, where more than 7 km of passable channels are known.

Outflow from the polje was not oriented to one channel, rather to a mesh of channels, which about 200 m from the edge of polje combine into a couple of larger galleries. They are generally low, because the bottoms are filled with sediments. The sediment fill is at 550 m a.s.l. in all the ponor caves, its thickness is possibly the same as a thickness of alluvia in Jamski zaliv, 8 - 15 m respectively.

Pivka basin

The bottom of the Pivka basin, an area of about 70 km^2, is of Eocene flysch rock. A river network has formed on the floor of the basin; the water flows into the boundary limestone rock going to different river basins (Habič, 1982; 1989).

Karstificated limestone surrounds the valley from all sides; at the contact on higher levels there is flysch. Along the 59 km long lithologic contact of flysch and limestone, 17 larger and a number of small rivers sink, transforming only 2.3 km^2 of karst.

The Pivka, with a mean flow of 6 m^3, is the largest sinking river in the basin. Most of its water flows from karst sources on the southern part of the basin, at the foot of the Javorniki, where a karst polje formed on limestone. For a large part of the year, the Pivka is dry; when waters are high, it floods the floor of the field. The main inflow into the Pivka from flysch rock is the Nanoščica, which flows from W; it collects water in the western part of the flysch basin.

The Pivka sinks into the 20 km long Postojnska jama cave about 511 m a.s.l. The cave has several levels, the main level being between 520 and 530 m a.s.l., and the lowest between the sink of the Pivka and the outflow sump at 477 m a.s.l. Between the sump in Postojna cave and Planinska jama there is still more than 1500 m of unexplored underground course of the underground Pivka.

Postojnska jama is formed in the Upper Cretaceous limestone. The difference of altitude between higher and lower levels is about 18.5 m. Several large collapses above the old galleries formed large collapse dolines like Vodni dol, Jeršanave doline and Stara apnenica.

The ceiling above the cave is between 60 m and 120 m thick. Intensive growth of sinter is due to high annual precipitation, about 1700 mm, and high mineralization of percolating water.

Postojna cave is one of the oldest and largest tourist caves of the world. Important tourist development of the cave started in 1818, although cave was known for visitors in 13. century already. Between the years 1818 and 2000 27.000.000 people visited it. Maximum was in the year 1990 when there were 989.084 visitors. In 1991 number of visitors decreased dramatically because of the war but now the number is increasing slowly and there is more than 500.000 visitors annually.

Kras

Kras is a low carbonate plateau between Divača, Sežana and Trieste. The name itself has a pre-Indo-European origin from word karra, which means rock – stone. The ancient word for "stone" gave the origin to the ancient name for the region (Carusadus, Carsus) and this word changed according to different languages into Kras (Slovene), Karst (German) and Carso (Italian) (Kranjc, 1997). From this toponym the international term – karst – for such type of landscape is derived. The name and some other terms from the area like dolina, polje, and ponor have entered to international scientific terminology from here.

Kras is a limestone plateau, lying above the Trieste bay at 200 - 500 m a.s.l., the northernmost part of the Adriatic Sea. The climate is Mediterranean in general: hot and dry summer, cold winter with most of precipitation and NE wind "burja " (bora = borealis). Because of different land use, pasturing, in past centuries, the Karst was bare, with rocky and grassy surface. Last decades the bushes and trees are overgrow the landscape.

Kras plateau is stretching in "Dinaric" direction (NW - SE); it is 40 km long and up to 13 km wide, covering about 440 km^2, sloping towards NW. The karstification of mostly Cretaceous limestone started after its uplift in Oligocene. There is about 300 m of vadoze zone accessible and there are caves formed in all elevations from the surface to the sea level and below. The central part of Kras is built by well permeable Cretaceous limestone and partly less permeable dolomite, which may play a role of a relative isolator. Cretaceous rocks pass into well permeable Paleocene limestone, and very low permeable Eocene Flysch that acts as an important impermeable dam surrounding the carbonate massif.

Average yearly precipitation on Kras varies from 1400 to 1650 mm, and average yearly evapotranspiration from 700 to 750 mm (Kolbezen & Pristov, 1998). There are no surface streams on the Kras area, but some rivers are sinking edge of it, largest of them is Reka.

There are about 3490 caves known on the Kras plateau. In seven of them we can reach 21 km of passages of the underground Reka which flows between 2000 and 300 m below the surface.

Divaški kras

Karst surface above Škocjanske jame, Divaški kras is a SE part of the Kras plateau between the sinks of Reka river and the village Divača. It is built mostly by Cretaceous and Paleogene limestone. The surface is levelled in elevations between 420 and 450 m a.s.l, inclined slightly

towards NW. The karst features here are exceptional; there are sinks of Reka river, 15 large collapse dolines and hundreds of dolines.

In the Divaški kras there are known 64 caves with the total passages length of 18,500 m. The largest caves of the area are Škocjanske jame, 5800 m long and 250 m deep cave. They were formed by the sinking river Reka that after sinking flows towards Kačna jama, Labodnica and then to springs of Timavo.

The largest collapse doline in the area is the Radvanj double collapse doline (volume 9 million m^3). It is followed by the 122 m Sekelak, the volume of which is 8.5 million m^3 and Lisični dol (6.2 million m^3). Then there are: Globočak (4.6 million m^3), Bukovnik (1.5 million m^3), Risnik (1.5 million m^3) and others. As rooms as big are not usual in the Karst, we must assume that collapse dolines this large could develop only with simultaneous rock removal. If this were not the case, the room would fill up with caved-in rock and only collapse dolines much smaller than the primary cave would appear on the surface.

Kačna jama is the longest cave system of Reka River in the continuation of Škocjanske jame. The entrance lies west from Divača 435 m a.s.l. The total length amounts to 12.500 m. In the lower level the actual underground flow of Reka is met at 195 m respectively.

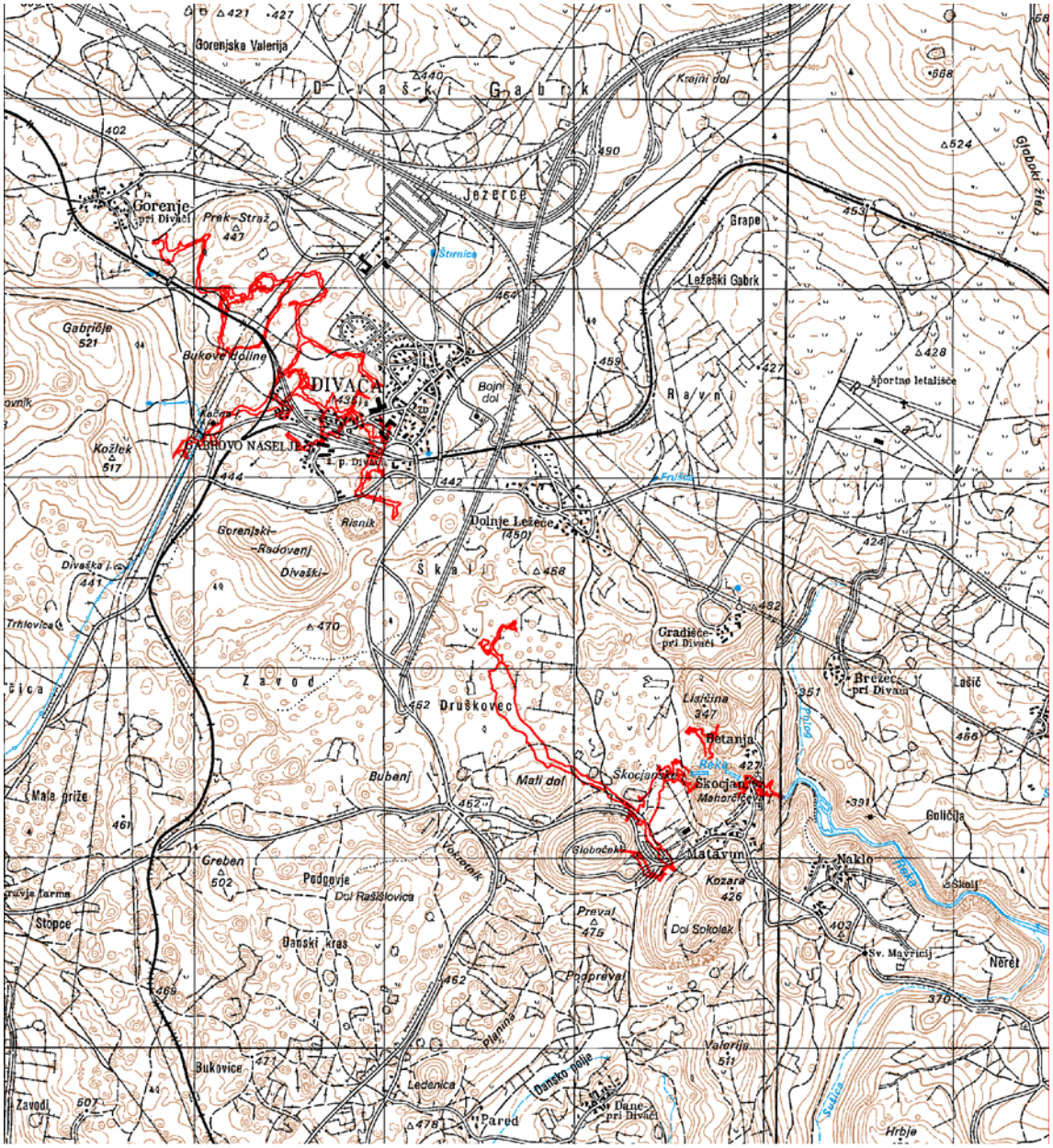


Fig. 5: Divača Karst with Škocjanske jame caves and Kačna jama cave (J. Hajna, 2002).

Reka river – Timavo

The Reka river is the main sinking river of the Kras. It gathers the water from the area of more than 350 km^2. Around 60 % of it is with surface drainage network on Eocene flysch. In the period 1961-1990 the minimal measured discharge of the Reka river was 0.18 m^3/s and the mean discharge 8.26 m^3/s. In the time of extremely high waters its discharge can reach up to more than 300 m^3/s. At such conditions the water is dammed in the underground and over 100 m high floods occur in Škocjanske and other caves.

After underground flow the Reka and rainwater from the Kras and inflows from the rivers Soča, Vipava and Raša reappear at springs as Timavo about 35 NW from Škocjanske jame.

Three main springs with mean discharge 30.2 m^3/s are on the coast are connected by a network of passages that reach a depth of about 80 m below the sea level (Civita, 1995).

Škocjanske jame

The Škocjanske jame caves are 5.8 km long. The Reka river, mean annual discharge 8,26 m^3/s enters the cave at an altitude of 317 m; in the Martelova dvorana room, it is 214 m above sea level (i.e. 103 m lower). The Reka can all sink before it enters the cave. Floods usually reach up to 30 m. The largest known flood in the previous century raised the water table level for 132 m.

Morphology and development of Škocjanske jame cave are described according to Mihevc (2001). Caves are developed in a contact area of cretaceous thick-bedded rudistic limestone and Palaeocene thin-bedded dark limestone (Gospodarič, 1983; Habič et al., 1983).

Škocjanske caves are composed of phreatic tunnels, and gravitational or paragenetic reshaped galleries. The proto-channels developed in phreatic conditions, formed along tectonised bedding-planes. The water flow demanded a high degree of phreatic rising and falling between individual bedding-planes which, in the area of the chambers Svetinova dvorana and Müllerjeva dvorana, are approximately 175 m. Large quantities of water could flow through all these tunnels, but meanwhile, rubble was transported through water table caves above them. Such a cave is unroofed cave in Lipove doline at an altitude of around 450 m. A long period followed when the piezometric water table was 340-300 m above sea level and the gradient was in a SW direction. The Reka formed new or adopt old passages by paragenesis and bypassing. The large galleries Mahorčičeva and Mariničeva jama, Tominčeva jama, Schmidlova dvorana in Tiha jama were formed.

In the further development of Škocjanske caves, potent entrenchment prevailed. Cutting occurred in inner parts of the cave, in Hankejev channel for about 80 m, much less about 10 m, in the eastern, entrance part of the cave.

First paths in the cave area were made in 1823, but construction of paths for exploration and for the visitors started in 1884. Cave exploration and construction of the pathways were done by cavers of DÖAV from Trieste. The most important explorer was Anton Hanke. In 1891 they reached the final sump in the cave.

The largest chambers are Martelova dvorana, with a volume of 2,100,000 m^3, and Šumeča jama (870,000 m^3). Some of big chambers collapsed forming the big collapse dolines like Velika and Mala dolina.

Because of their extraordinary significance for the world's natural heritage, in 1986 the Škocjanske jame were included in UNESCO's World Heritage List. The Republic of Slovenia pledged to ensure the protection of the Škocjanske jame area and therefore adopted the Škocjanske jame Regional Park Act.

Risnik collapse doline

Collapse dolines are, by definition, relief forms which occur when ceilings above underground caves collapse. Slovenian expert literature understands collapse dolines as those with exceptional dimensions, and steep or vertical walls. Smaller collapse forms are frequently left aside because of lack of signs of collapse processes.

Risnik is about 80 m deep collapse dolina situated south of Divača village on levelled karst surface. Its edges are on elevation about 440 m, and bottom at 366 m a.s.l. Most of the doline has vertical walls in upper parts and boulders and scree in lover part of doline.

About 50 m N an E of the doline there are galleries of Kačna jama cave where Reka flows at 190 m a.s.l. There are no signs of connection between the doline and the gallery, so we have to suppose, that the Risnik was formed above unknown passages above Kačna jama. Only 50 m W of Risnik is dolina much larger, 800 long and 450 m wide collapse dolina Radvanj. Volume of it is about 9.000.000 m³.

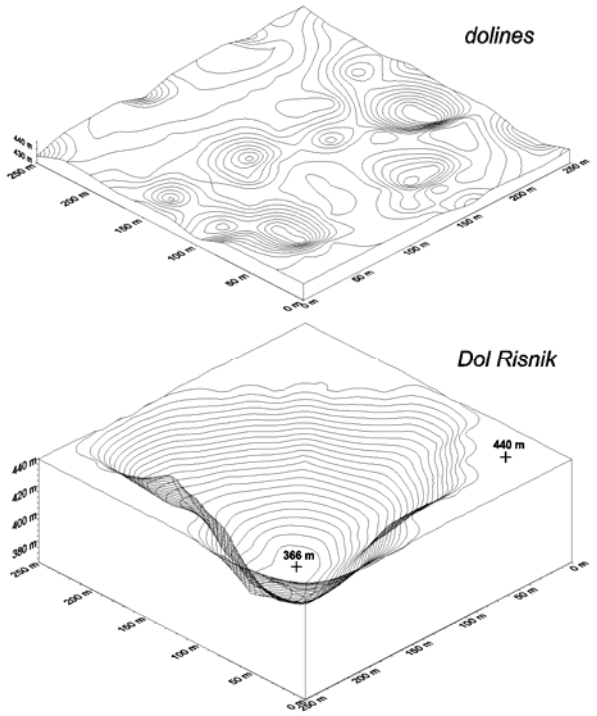


Fig. 6: The comparison between the surface with dolines and surface with a single collapse doline Risnik (Mihevc, 2001).

Unroofed cave at Lipove doline

Unroofed caves are an important part of the surface morphology of Divaški kras where 2,900 m of the unroofed caves was mapped (Mihevc, 2001).

They are caves exposed to the surface due to the surface denudation lowering which re-shapes them into the surface relief forms. In such features flowstone, allochtonous sediments and morphology are testifying their cave origin. Several unroofed caves were studied and sediments were analyzed (Mihevc & Zupan, 1996; Bosak P. et al., 1998); clastic sediments are dated to 1.6 - 1. 8 Ma or/and 3.8 to 5 Ma.

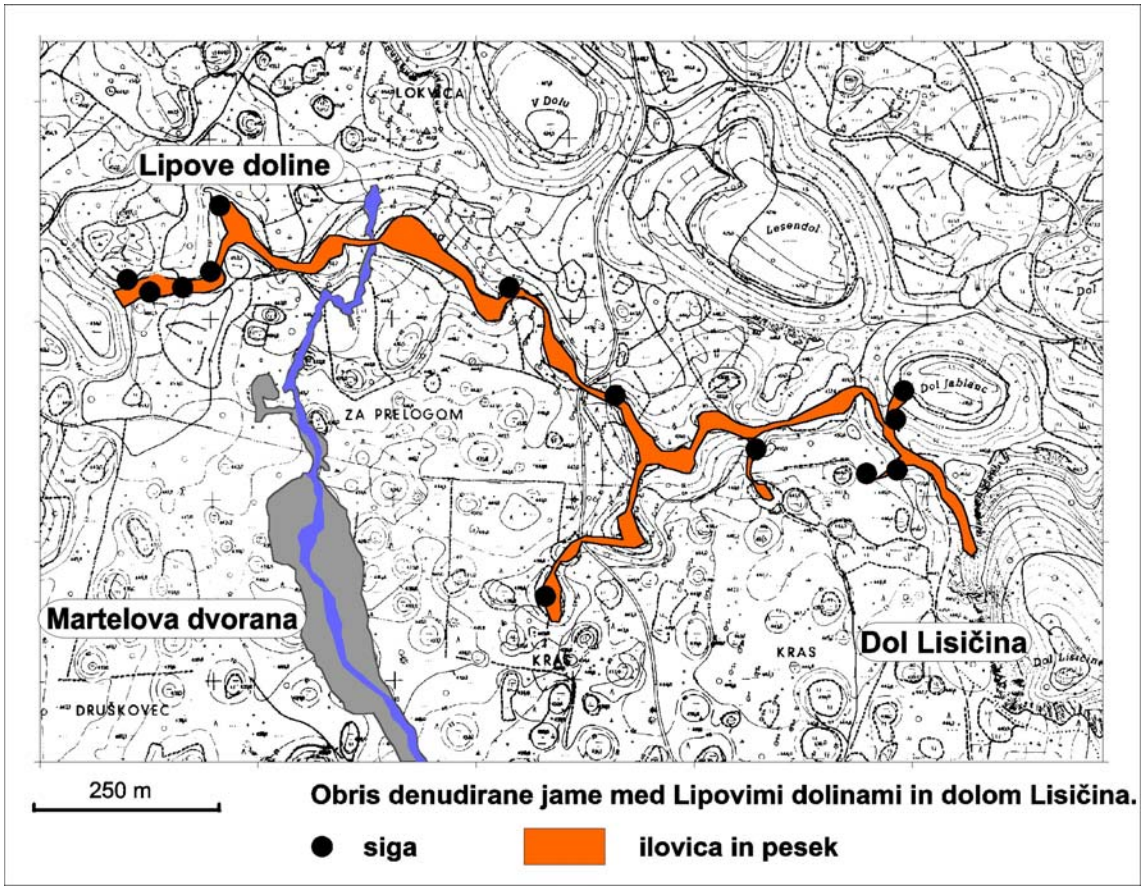


Fig. 7: Unroofed cave Lipove doline (Mihevc, 2001).

References

Shaw, T.R., 1992: History of Cave Science. The Sydney Speleological Society, NSW, 338 p. Sydney.

Bosak P., P. Pruner & Zupan Hajna N. 1998 - Paleomagnetic research of cave sediments in SW Slovenia. Acta Carsologica 27/2, 151-179, Ljubljana.

Civita, M. & F. Cucchi A.& Eusebio & S. Garavoglia & F. Maranzana & B. Vigna 1995: The Timavo Hydrogeologic System: An Important Reservoir Of Supplementary Water Resources To Be Reclaimed And Protected. Acta carsologica 24, 169-186, Ljubljana.

Gams, I. 2003: Kras v Sloveniji v prostoru in času. Ljubljana: Založba ZRC, ZRC SAZU, 516 p., Ljubljana.

Gospodarič, R., 1976: Razvoj jam med Pivško kotlino in Planinskim poljem, Acta carsologica, 7, 9-139, Ljubljana.

Gospodarič, R., & P. Habič, P., 1976: Underground water tracing. Third International Symposium of Underground Water Tracing (3. SUWT), 1-312, Ljubljana.

Gospodarič, R., 1983: O geologiji in speleogenezi Škocjanskih jam. Geološki zbornik, 4, 163-172. Ljubljana.

Habič, P.,1982: Kraški relief in tektonika. Acta carsologica, 4, 23-43, Ljubljana.

Habič, P., 1989: Kraška bifurkacija Pivke na jadransko črnomorskem razvodju. Acta carsologica, 18, 233-263, Ljubljana.

Kolbezen, M. & J. Pristov, 1998: Površinski vodotoki in vodna bilanca Slovenije. MOP-Hidrometeorološki zavod Republike Slovenije, 98 p, Ljubljana.

Kranjc, A, 1997: Kras: Slovene classical karst. Znanstvenoraziskovalni center SAZU, Založba ZRC: Inštitut za raziskovanje krasa ZRC SAZU, 1997. 254 p. Ljubljana.
Mihevc A., & N. Zupan, 1996: Clastic sediments from dolines and caves on the route of highway at Divača, Acta Carsologica 25, 169-191, Ljubljana.
Mihevc, A., 1996: Brezstropa jama pri Povirju. Naše jame, 38, 92-101, Ljubljana.
Mihevc, A., 2001: Speleogeneza Divaškega krasa. Založba ZRC, ZRC SAZU, 180 p. Ljubljana.

AFTERNOON EXCURSION, 24 October 2006

Karst intermittent lakes

Lake of Cerknica

Andrej Kranjc
Karst Research Institute ZRC SAZU, Titov trg 2, SI-6230 Postojna, Slovenia

Cerkniško polje is a typical karst feature – a polje. Because a great part of its bottom is practically regularly and for a longer time flooded, it is often called "jezero", which means a lake. It is polje – seasonal lake.

Maybe it is for the first time by mentioned a Roman geographer Strabo and since the 16th century this is the most frequently described and the most famous natural phenomenon of the former Carniola. In his well known work "Glory of the Duchy of Carniola …" (1689) Valvasor (by his "Letter" on the hydrography of Cerkniško Jezero he earned the membership at the Royal Society) cited about 40 authors describing or mentioning Cerkniško Jezero before him.

Cerkniško polje lies in the middle of Notranjsko (Inner Carniola), in the so called "Notranjsko Lowland" – about 50 km long and up to 7 km large depression formed along one of the main tectonic lines in Slovenia, the Idrija fault. There are other poljes up- and downstream of Cerkniško polje. This is a closed depression (Javorniki Mts. 1268 m on the SW, Slivnica Mt. 1114 m on the NE, treshold 640 m towards Loško polje on SE and 560 m towards Planinsko polje on the NW side) at 550 m above the sea level. The bottom of the polje covers about 38 km^2, little more than 27 km^2 of it can be under water during the extreme flood. At normal flood there is about 19 million m^3 of water stored in the lake, and about 87 million at extreme flood (water level at 553 m).

The region is formed by Mesozoic rocks. There is Cretaceous limestone on SW and Jurassic one towards SE. Part of the bottom itself is in limestone and part of it as well as NW and NE slopes in Triassic dolomite. The dolomite forms a hydrologic barrier which is very important both for the origin and evolution of the polje and its hydrology. The whole region belongs to the water basin of the Ljubljanica River. The basin of the Cerkniško polje covers 475 km^2. Except for the one surface stream flowing on the polje from the dolomite Bloke plateau at the East, all the tributaries are karst (underground) ones. They are flowing either from upper lying Loško polje (big karst springs Cemun and Obrh in the SR corner of Cerkniško polje) or from surrounding karst mountains and plateaus. The runoff from the polje is completely karst one, that is underground. On the part of the polje's bottom which lies on limestone, there is a lot of ponors – swallow holes in the alluvium. They are concentrated in the NW part of the polje, where besides holes in alluvium there are also ponors in limestone edge of the polje and big ponor caves.

Maximal inflow to Cerkniško polje can be 211 m^2/sec. (mean value about 20 m^3/sec.) while the outflow can reach 90 m^3 at the most. The difference, about 120 m^3/sec. is the reason for the "lake", that is for flooding. Yearly amount of the precipitation is between 1600 and 1800 mm. The Ljubljanica River as a whole has the pluvio-nival river regime with weak Mediterranean influence: primary maximum in November, secondary in March, while primary minimum is in August. In accordance with them is flooding or the stage of the lake.

In average the lake (not a very large one) persists 285 days per year, and for 80 days the polje's bottom is dry.

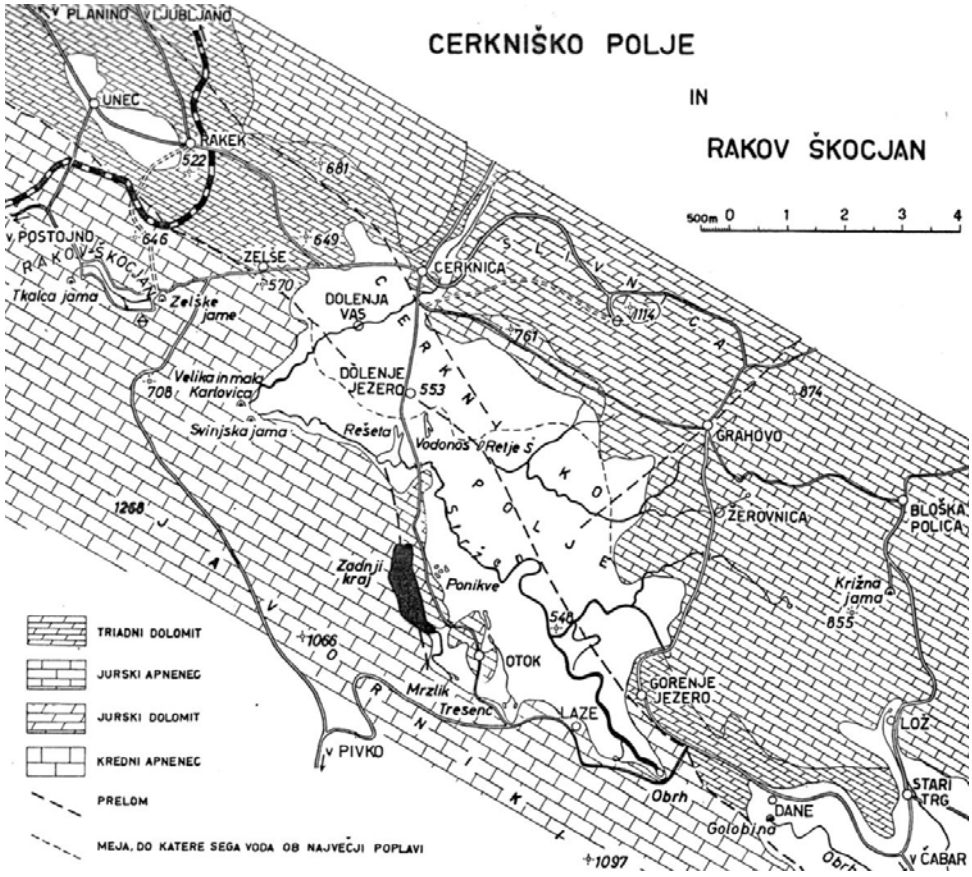
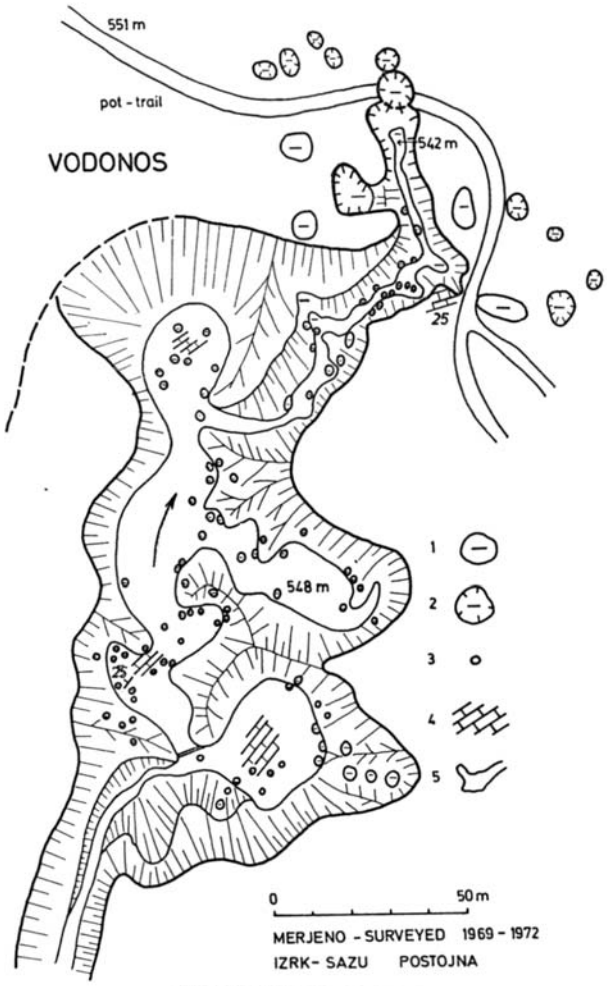


Fig. 1: Cerkniško polje (Legend: triadni dolomit = Triassic dolomite, jurski apnenec = Jurassic limestone, jurski dolomit = Jurassic dolomite, kredni apnenec = Cretaceous limestone, prelom = fault).

Older authors tried to explain the intermittence of the lake by different theories: A. Kircher (1665) by underground "hydrophilatia" by which water was "pumped" underground from the sea; J. V. Valvasor by a system of additional five underground lakes, connected with the surface lake by numerous siphons. The first who literally said that the cause of the flood is the surplus of inflow related to outflow was J. Nagel in 1748.

It is not surprising that such a large part of flat land with relatively thick soil and so well known in literature did not escape the eyes of more practical people. The first whom we know, a sympathizer of the physiocratic trend, was B. Hacquet who has made an "economic" travel in 1774 to find out how to drain the poljes of Notranjsko. Demand for the arable land was increasing and also the plans how to drain Cerkniško and other poljes of Notranjsko. These projects became more and more serious; Schaffenrath (Postojna district engineer) in the first, Witschel and Vicentini in the second part of the 19th century. To study the problem more comprehensively, "Société de spéléologie" (Verein für Höhlenkunde) was founded in 1879 on

the initiative of F. Kraus, geographer from Vienna, and few years later the "Karst-Comité". In 1886 Agriculture Ministry in Vienna decided to finance the observations of precipitation and the plan itself. W. Putick was charged to prepare it. The plan included drainage works at Loško, Cerkniško, Planinsko and Logaško polje. Some works have been done (channel and tunnel to the swallow hole and blasting some siphons at Loško polje, lowering and blasting siphons and ponors of Cerkniško polje, regulation of ponors (including the construction of two "kathavotrons") at Planinsko and Logaško polje. Then the works were stopped by provincial government due to fear that faster runoff from the poljes will increase the flooding of Ljubljana, the capital of the province.



Sl. 28. Morfologija Vodonosa
1 — stari ugrezi v okolici ponikve, 2 — sveži ugrezi v okolici ponikve, 3 — grezi v ponikvi, 4 — razkrita skalna podlaga, 5 — obod ponikve

Fig. 28. Morphology of Vodonos ponor
1 — old sinkholes in the ponor vicinity, 2 — recent sinkholes in the ponor vicinity, 3 — sinkholes in the ponor, 4 — exposed rocky bottom, 5 — ponor boundary

Fig. 2: Morphology of Vodonos ponor.

During the first half of the 20th century the energy was becoming more important than the agriculture. There were more proposals and plans not to dry Cerkniško polje but to retain the

water and use it as a source of energy. In 1954 "Water economy of Upper Ljubljanica" envisaged accumulation of Cerkniščica stream, tunnel from Loško to Cerkniško polje, hydroelectric power plant at Cerknica, tunnel to Planinsko polje, another plant at Planina, accumulation lake at Planinsko polje, tunnel to Vrhnika with the third power plant. The plan was abandoned but the idea of a permanent lake was kept in mind. 1969 – 1972 the project "Experimental permanent lake" was carried on: smaller ponors were closed (walled up), the largest one (Velika Karlovica) was half closed; a tunnel with sluice was made to allow the drainage of flood waters directly into inner parts of the swallow hole. It was included in a large scale tourism project "The Upper Adriatic" (the leader was a bureau from Paris), where 1000 tourist beds, hotels, marinas, floating swimming pools, etc. were foreseen. The conclusion of the project was that without huge technical works Cerkniško polje cannot be transformed into a permanent lake.

In the 80-ies and 90-ties of the last century "green" and ecological movements and parties became more important, plans and actions were turned towards the preservation of the lake and towards ideas of a natural park. Some of previous technical works were destroyed and people began to talk about "natural" or "primary" state, which of course is not a reality. Cerkniško Jezero was expected to be the core zone of future Natural Park or MAB (Man And Biosphere) region. For the moment, the part of the polje, which belongs to the Cerknica commune, is a part of "Notranjski regijski park" (Regional Park of Notranjsko), while the other parts are under different lower protection regimes.

References

Novak, D., 1965: Ljubljana – Cerknica – Postojna. In: Guide de l'excursion à travers le Karst Dinarique, 19-23, Ljubljana.

Gospodarič, R. & P. Habič, 1979: Kraški pojavi Cerkniškega polja. Acta carsologica, 8, 7-162, Ljubljana.

Lake Cerknica – an intermittent ecosystem

Alenka Gaberščik & Nina Šraj-Kržič

Department of Biology, Biotechnical faculty, Večna pot 111, SI-1000 Ljubljana, Slovenia

The intermittence in Lake Cerknica presents specific conditions that differ from flooded areas elsewhere (Martinčič, 2002). The through flow of energy and turnover of matter are gained by the exchange of wet and dry periods, which can either promote or suppress the decomposition, and growth and development of vegetation (Gaberščik et al., 2003).

The exchange of dry and wet periods influences the distribution, survival and development of organisms in the area (Gaberščik et al., 2003). Their survival is enabled by various strategies of overcoming drought. They either have mobile adult stage (dragonflies, water-beetles, mayflies…), desiccation resistant eggs (zooplankton, snails…) or migrate to other wetlands (birds). This is not the case with plants, which are rooted and need to overcome changes in water level. Their occurrence, reproduction, and distribution, and the structure of communities in intermittent habitats are determined by short term changes such as duration of inundation, water depth and water retention capacity (Barrat-Segretain et al., 1999; Riis & Haves, 2001; Capers, 2003; Warwick & Brock, 2003). Under extreme conditions amphibious plants have competitive advantage over truly aquatic and wetland plant species, which have a

low tolerance of variable water regime (Fernández-Aláez et al. 1999; Cronk & Fennessy, 2001).

The extent and duration of floods at the Cerkniško polje create a hydrologic gradient, which result the specific distribution and the diversity of plant species. Soil on the edges of the polje is wet or only occasionally flooded, therefore wet grassland communities prevail (*Molinietum caeruleae* and *Deschampsio-Plantaginetum altissimae*). These are regularly mown for forage. Small area Dujice is dominated by unusual group of plants, characteristic of transition bogs i.e. peat mosses. On areas, where water does not exceed 2 metres, wetland plant species grow. The largest part of the polje is covered by reed stands (*Phragmites australis*). The communities of different sedge species (*Carex* sp.) which are used for strewing are common as well. Truly aquatic plants are confined to the permanent water bodies, such as some deeper depressions and the Stržen stream with tributaries. In these water remains long enough to enable plants to complete their life cycle. The most common are stoneworts (*Characeae*) and pondweeds (*Potamogeton* sp.) (Martinčič, 2002). The alternation of floods and dry periods results in flora, dominated by plant species exhibiting amphibious character that enables their survival under varying water conditions (Warwick & Brock, 2003; Williams et al., 2003; Urbanc-Berčič et al., 2005). Morphological and biochemical features and reproduction strategies enable them continuous physiological functioning over the hydrologic gradient from water to dry land (Boulton & Brock, 2001; Šraj-Kržič & Gaberščik, 2005). When the water level in spring is high, tall amphibious plants prevail (*Senecio paludosus* and *Sium latifolium*), but at lower water levels shorter plants dominate (*Mentha aquatica*, *Gratiola officinalis*, *Rorippa amphibia*, *Teucrium scordium* and *Myosotis palustris*).

The Cerknica Lake acts as a buffer system, with primary producers reducing the effects of pollution. Nutrient loads from some tributaries are rather high, but in wet period they present an insignificant source of pollution for the lake. Nutrients released into the lake are incorporated into the biomass of primary producers, which increases the harvesting of solar radiation. The dense reed (*Phragmites australis*) and sedge stands (*Carex* spp) function as a sink for nutrients and contribute the most to the primary production of the ecosystem. At the beginning of dry period the decomposition of organic matter is accelerated due to better oxygen access, although further drying kills microorganisms and decreases mineralization. Before draining underground, the water gathers in the main stream Stržen. Its selfpurification efficiency is low and the concentrations of nutrients become higher due to reduced amounts of water. This situation presents a threat to aquatic organisms, as the main stream Stržen, and tributaries, become their refugees in the dry period (Boulton & Brock, 2001; Gaberščik et al., 2003).

References

Barrat-Segretain, M.H., Henry, C.P., Bornette, G., 1999. Regeneration and colonization of aquatic plant fragments in relation to the disturbance frequency of their habitats. Archiv für Hydrobiologie 145: 111-127.

Boulton, A.J., Brock, M.A., 2001. Australian freshwater ecology. Processes and management. Gleneagles Publishing. Glen Osmond, Australia, pp 149-167.

Capers, R.S., 2003. Six years of submerged plant community dynamics in a freshwater tidal wetland. Freshwater Biology 48: 1640–1651

Cronk, J.K., Fennessy, M.S., 2001. Wetland plants - biology and ecology. Lewis Publisher. London, pp 462.

Fernández-Aláez, C., Fernández-Aláez, M., Bécarez, E., 1999. Influence of water level fluctuation on the structure and composition of the macrophyte vegetation in two small temporary lakes in the northwest of Spain. Hydrobiologia 415: 155-162.

Gaberščik, A., Urbanc-Berčič, O., Kržič, N., Kosi, G., Brancelj, A., 2003. The intermittent lake Cerknica: Various faces of the same ecosystem. Lakes & Reservoirs: Research and Management 8: 159-168.

Martinčič, A., 2002. Pteridophytes and spermatophytes. In: Gaberščik, A. (Ed.), The vanishing lake - Monograph on Lake Cerknica (Slovenian with English summary). Društvo ekologov Slovenije, Ljubljana, pp 80-96.

Riis, T., Hawes, I., 2002. Relationships between water level fluctuations and vegetation diversity in shallow water of New Zeland lakes. Aquatic Botany 74: 133-148.

Šraj-Kržič, N., Gaberščik, A., 2005. Photochemical efficiency of amphibious plants in an intermittent lake. Aquatic Botany 83: 281-288.

Urbanc-Berčič. O., Kržič, N., Rudolf, M., Gaberščik, A., Germ, M., 2005. The effect of water level fluctuation on macrophyte occurrence and abundance in the intermittent Lake Cerknica. In: Vymazal, J. (Ed.), Natural and constructed wetlands: Nutrients, metals and management. Leiden, Backhuys Publishers, pp. 312-320.

Warwick, N.W.M., Brock, M.A., 2003. Plant reproduction in temporary wetlands: the effects of seasonal timing, depth, and duration of flooding. Aquatic Botany 77: 153-167.

Williams, P., Whitfield, M., Biggs, J., Bray, S., Fox, G., Nicolet, P., and Sear, D., 2003. Comparative biodiversity of rivers, streams, ditches and ponds in an agricultural landscape in Southern England. Biological Conservation 115: 329-341.

Pivka lakes

Janez Mulec & Tanja Pipan
Karst Research Institute ZRC SAZU, Titov trg 2, SI-6230 Postojna, Slovenia

Morphological characteristics of the Upper Pivka basin and lake depressions

The Pivka basin is a large depression among high karst plateaus of Nanos (1313 m), Hrušica (1264 m), Javorniki (1268), low plateau Slavenski ravnik (600 – 700 m), Snežnik (1796 m), and flysch hills that form a catchment area of the Reka river. The northern part of the basin was formed in noncarbonate flysch rocks with superficial drainage, while the southern part of the Upper Pivka basin was formed in limestone and has some characteristics of a karst polje.

The Upper Pivka basin is about 16 km long and 4 – 5 km wide part of the basin. The Pivka river, which is the largest in the basin, collects water from flysch and karst springs in the Upper Pivka basin and finally sinks into Postojnska jama cave on the NE part of the Pivka basin. The surface of the Upper Pivka basin can be divided into two distinctive morphological units: levelled bottom of the basin and higher rocky terrace along the Javorniki mountains. Depressions of the Pivka lakes are deepened into the terrace. The characteristic of the basin bottom is levelled ground along the Pivka river. It is completely levelled only in close proximity of the Pivka river; elsewhere it is slightly undulated and elevated several meters above the riverbed. Somewhere on this surface there are also low, about 10 meters high isolated hills. Rocky bottom of the surface is somewhere covered with a thin layer of clay and sandy sediments. There are no dolines in the bottom, but numerous springs and ponors, which are small and morphologically not very distinctive. The higher rocky terrace lies between the bottom of the basin and the Javorniki mountains (Mulec et al. 2005).

Most of the depressions of the Pivka lakes are doline-like, closed with large levelled bottoms and sharp transition from the bottom to the slope above it. The largest lakes are Palško jezero and Petelinjsko jezero with longer axis of the lake bottom larger than 1500 m. The other depressions have bottom diameter between 100 and 300 m. The depressions of the lakes are much larger than dolines which bottoms are not reached by the floods. Their rocky bottoms are covered by a layer of sediment and soil which in most cases is not thicker than 0.5 m. Transition from a levelled bottom to the steep slope is morphologically strict and distinctive. Slopes of the bottom basin to the higher terrace are similarly developed. The bottoms of the lake depressions are in that level that is still reached by the oscillations of the karst water table. When water in numerous channels rises it appears on the surfaces of these depressions and also in the bed of the Pivka river. The appearance of water on the surface enables stronger dissolution of limestone; mainly laterally what causes widening of the depression bottoms. Steep slopes indicate that the corrosion is especially strong on the edges of the lake depressions and that the process is nowadays still active (Figure 1). In the Pivka valley during high waters we can encounter several lakes from the north to the south: **Jeredovce, Krajnikov dol, Petelinjsko jezero**, **Palško jezero, Klenski dol, Radohovsko jezero, Parsko jezero, Malo Drskovško jezero, Veliko Drskovško jezero**, **Veliko Zagorsko jezero**, **Malo Zagorsko jezero, Kljunov ribnik, Veliki dol, Bačko jezero, Laneno jezero, Kalsko jezero** and **Šembijsko jezero** (Mulec et al. 2005).

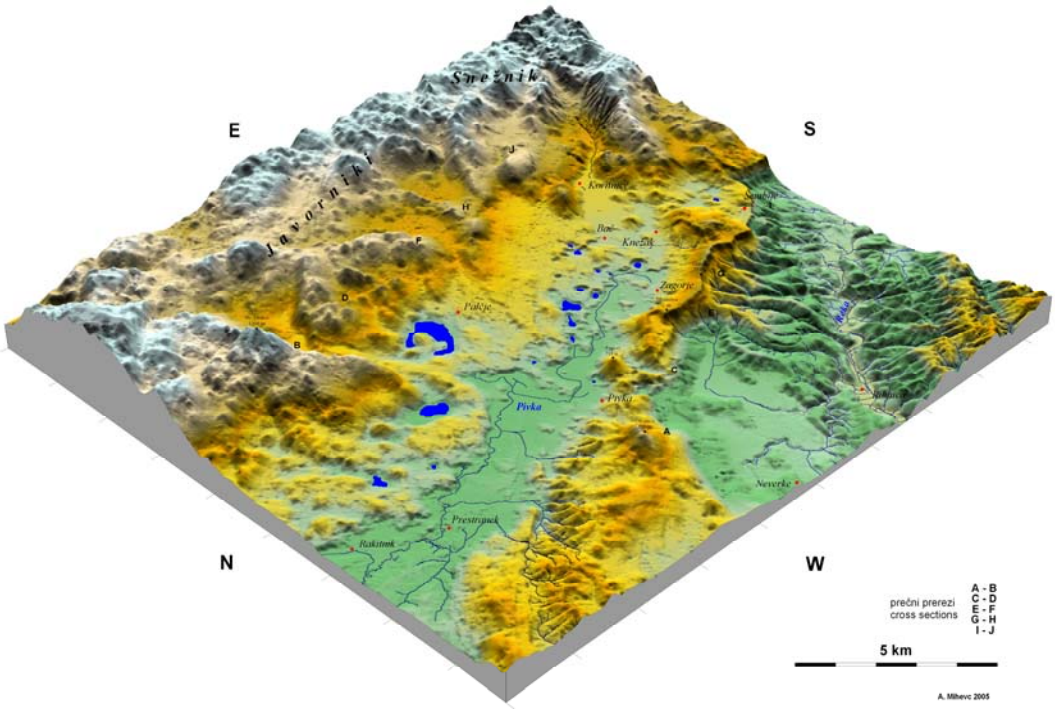


Figure 1: DEM of the Upper Pivka. View from NE.

Special water regime affects flora and fauna

The Pivka valley belongs to two phytogeographical areas, Submediterranean and Dinaric (Wraber 1969). A seasonal flooding of the Pivka lakes creates special growing conditions for some very interesting plant species as the floods last from some days to, in extreme circumstances, even to half a year. The plants cannot withdraw as the animals do but must confront the changes. For this reason they develop adaptations thus the water level changes do not disturb them too much as they can survive in water and on the surface. Some of them develop morphological and physiological adaptations to accept oxygen and carbon dioxide both from water or air (Gaberščik & Urbanc-Berčič 2003). The others can start their growth in water as true aquatic plants with submerged leaves and later continue on the surface as usual terrestrial species – yet by sight rather changed. For the flora and fauna of the Pivka lakes both open, meadow-like flooded areas and higher dry meadows at the margins of the lakes reaching to the edges of the forest vegetation are important (Tome 2000).

It is typical of the Pivka lakes that the soil at their banks is shallow or even rocky, becoming thicker towards lower lying parts due to soil wash off from the margins. This is why in central parts of the lakes the conditions are usually more favourable to develop the plant association typical of cultivated meadows (Lovka 2000). Such associations occur, for example on Veliko Zagorsko jezero, where a major part already resembles cultivated meadows. The structure of these associations heavily depends on the way of exploitation, how the land is fertilized and mowed. The central parts and those parts that are flooded for a longer period are places where overgrowing of grassland starts because of ceased mowing or pasturing. The overgrowing plants start with high stalks and later purple willow (*Salix purpurea*) and other bushes occur.

Inventory of flora and vegetation of the Pivka lakes established 182 species of higher plants (Lovka 2000). Although a major part of the lakes is floristically poorly examined, it is worth to stress out that:
- on the eastern part of Petelinjsko jezero there are small bunches of siberian iris (*Iris sibirica*), which habitat needs to be protected;
- mostly on Petelinjsko jezero there are vast associations of mouse garlic (*Allium angulosum*), an endangered species in Slovenia;

- on Veliko Drskovško jezero and on Malo Drskovško jezero and partly on Petelinjsko jezero there is an association of wild gladiolus and purple moor grass (*Gladiolo-Molinietum*), a very rare and endangered species;

- on Petelinjsko jezero grows a well-developed association of tufted hairgrass and tall plantain (*Deschampsio-Plantaginetum altissimae*), a rare and endangered species in Slovenia;

- in the area of the Pivka lakes there is a large group of dry, half-dry and seasonally flooded meadows giving living space to many plant species and due to intensive agricultural exploitation and other anthropogenic impacts they are more and more endangered;

- last but not least, on the Pivka lakes there are several plant species potentially endangered due to picking, collecting and digging: clustered bellflower (*Campanula glomerata*), mouse garlic (*Allium angulosum*), solitary clematis (*Clematis integrifolia*), meadow saffron (*Colchicum autumnale*), gentian (*Gentiana pneumonanthe*), great burnet (*Sanguisorba officinalis*), wild gladiolus (*Gladiolus illyricus*), garden spedwell (*Pseudolysimachion longifolium*), violet (*Viola elatior*).

In the area of the lakes besides 182 species of plants, also many other animal species were identified. Pivka lakes together with related caves harbour two species of fairy shrimps, three species of water fleas, nine species of copepods, one species of isopods and amphipods and

some taxa of ostracods. Pivka lakes are truly outstanding for four species, *i.e*., two speceis of fairy shrimps and two species of copepods. Petelinjsko jezero is populated by the endemic species of karstic fairy shrimp *Chirocephalus croaticus*. The population that was found in this intermittent lake is vital and appears each year (Brancelj & Gorjanc 1999). In total, three planktonic speceis of water fleas have been found in Pivka lakes: *Daphnia obtusa*, *Moina brachiata* and *Biapertura affinis*, the last one also from cave waters (Brancelj & Gorjanc 2000). According to the data known up to now there are nine copepod species found in the Pivka lakes, from which seven belong to a group of Cyclopoida and two are from a group of Calanoida (*Arctodiaptomus laticeps*, *Diaptomus cyaneus*). Species *A. laticeps* was discovered also in Cerkniško jezero (Brancelj 2003). Both lakes (Petelinjsko jezero and Cerkniško jezero) are among the southernmost sites for this species in Europe. The most outstanding in the group of Cyclopoida is the stygobiontic speceis *Diacyclops charon*, first discovered in Postojnska jama. The range of species extends from north Italy to Lika in Croatia on the east (Pipan 2005).

So far 20 mammal species and 127 bird species have been identified around the Pivka intermittent lakes (Polak 2005). Of the bird species, 75 also nest here. The nesting density of the barred warbler, skylark, red-backed shrike and corn bunting at the Pivka lakes is among the highest in the country. In the area of the Pivka lakes 8 reptile species and 9 amphibian species have been identified. Many specimens of *Proteus anguinus* are found not just in Matijeva jama, but also in the main Pivka spring in the Pivšce and also in the upper part of the Pivka riverbed when high karst waters eject them. The majority of these species are on the Red List of Threatened Animals. 106 butterfly species have been identified in the area, which amounts to 57% of all species of butterflies living in Slovenia. 210 species of beetles have been identified, but it is estimated that between 4000 and 6000 species of beetle live here. An analysis of animal species in land habitats and their ecological requirements indicates that many of the threatened species are connected with the marshy grasslands of the lakes themselves, and many of them are connected with the dry karst grasslands and barren rocky outcrops (Polak 2005).

References:

Brancelj, A., 2003: Škrgonožci, vodne bolhe ter ceponožci. In: Jezero, ki izginja. Monografija o Cerkniškem jezeru, Gaberščik, A. (ed).- Društvo ekologov Slovenije, 131-137, Ljubljana.

Brancelj, A. & N. Gorjanc, 1999: On teh presence of *Chirocephalus croaticus* (Steuer, 1899) in an intermittent lake in SW Slovenia.- Hydrobiologia, 412, 25-34.

Brancelj, A. & N. Gorjanc, 2000: Vodni nevretenčarji in jamska favna. In: Inventarizacija favne, flore in vegetacije Pivških jezer. Končno poročilo, Tome, D. (ed).- Nacionalni inštitut za biologijo, 16-19, Ljubljana.

Gaberščik, A. & O. Urbanc-Berčič, 2003: Ekosistem, ki ga ustvarja igra vode. In: Jezero, ki izginja. Monografija o Cerkniškem jezeru, Gaberščik, A. (ed).- Društvo ekologov Slovenije, 51-57, Ljubljana.

Lovka, M. 2000: Flora in vegetacija. In: Inventarizacija favne, flore in vegetacije Pivških jezer. Končno poročilo, Tome, D. (ed).- Nacionalni inštitut za biologijo, 8-15, Ljubljana.

Mulec, J., Mihevc, A. & T. Pipan, 2005: Intermittent lakes in the Pivka basin.- Acta carsologica, 34/3, 543-565.

Pipan, T., 2005: Fauna of the PIvka intermittent lakes.- Acta carsologica, 34/3, 650-659.

Polak, S., 2005: Fauna of the land habitats of the Pivka lakes.- Acta carsologica, 34/3, 660-690.

Tome, D., 2000: Inventarizacija favne, flore in vegetacije Pivških jezer. Končno poročilo.- Nacionalni inštitut za biologijo, 36 pp, Ljubljana.

Wraber, M., 1969: Pflanzengeographische Stellung und Gliederung Sloweniens.- Vegetatio, 17, 176-199, Den Haag.

Appendix 2

Addresses of Participants

Valerija Babij
Jovan Hadzi Institute of Biology
Novi Trg 5
1000 Ljubljana
Slovenia
valerija@zrc-sazu.si

E.F. Benfield
Department of Biological Sciences
Virginia Polytechnic Institute & State University
Blacksburg VA 24061
Benfield@vt.edu

Anton Brancelj
National Institute of Biology
Večna pot 111
1000 Ljubljana
Slovenia
anton.brancelj@nib.si

Mihael Bricelj
National Institute of Biology
Večna pot 111
1000 Ljubljana
Slovenia
mihael.bricelj@nib.si

David C. Culver
Department of Biology
American University
4400 Massachusetts Ave. NW
Washington DC 20016
dculver@american.edu

Annette Summers Engel
Department of Geology & Geophysics
Louisiana State University
Baton Rouge LA
aengel@geol.lsu.edu

Daniel W. Fong
Department of Biology
American University
4400 Massachusetts Ave. NW
Washington DC 20016
dfong@american.edu

Alenka Gaberščik
Department of Biology
University of Ljubljana
Večna pot 111
1000 Ljubljana
Slovenia
Alenka.gaberscik@bf.uni-lj.si

Franci Gabrovšek
Karst Research Institute ZRC-SAZU
Titov trg 2
SI-6230 Postojna
Slovenia
gabrovsek@zrc-sazu.si

Mateja Germ
National Institute of Biology
Večna pot 111
1000 Ljubljana
Slovenia
Mateja.germ@nib.si

Peter M. Groffman
Institute of Ecosystem Studies
Box AB
65 Sharon Turnpike
Millbrook NY 12545
groffmanp@ecostudies.org

Mark E. Hines
Department of Biological Sciences
University of Massachusetts Lowell
Lowell MA 01854
Mark_hines@uml.edu

Horton H. Hobbs III
Department of Biology
Wittenberg University
PO Box 720
Springfield OH 45501-0720
hhobbs@wittenberg.edu

Jeffrey Jack
Department of Biology
University of Louisville
Louisville KY 40292
Jeff.jack@louisville.edu

Ivan Kos
Department of Biology
University of Ljubljana
Večna pot 111
1000 Ljubljana
Slovenia
Ivan.kos@bf.uni-lj.si

James M. Krest
Department of Environmental Science
University of South Florida—St. Petersburg
St. Petersburg FL 33701
krest@stpt.usf.edu

Boris Kryštufek
University of Primorska
Science and Research Centre
SI-6000 Koper
Slovenia
Boris.krystufek@zrs-kp.si

Diane McKnight
Institute of Arctic and Alpine Research
1560 30th Street
Boulder CO 80309-0450
diane.mcknight@colorado.edu

Janez Mulec
Karst Research Institute ZRC-SAZU
Titov trg 2
SI-6230 Postojna
Slovenia
janez.mulec@guest.arnes.si

Diana E. Northup
Department of Biology
University of New Mexico
MSC03 2020
Albuquerque NM 87131
dnorthup@unm.edu

Tone Novak
Department of Biology
Faculty of Natural Sciences and Mathematics
University of Maribor
Koroska 160
SI 2000-Maribor
Slovenia
tone.novak@uni-mb.si

Tanja Pipan
Karst Research Institute ZRC-SAZU
Titov trg 2
SI-6230 Postojna
Slovenia
pipan@zrc-sazu.si

Slavko Polak
Nortranjska Museum, Postojna
Ljubljanska 10
SI-6230 Postojna
Slovenia
slavko.polak@guest.arnes.si

Megan L. Porter
Department of Biology
University of Maryland-Baltimore County
Baltimore MD 21250
porter@umbc.edu

Katie Schneider
Program in Behavior, Ecology, Evolution & Systematics
University of Maryland
College Park, MD 20742
katie2@umd.edu

Kevin S. Simon
Department of Biological Sciences
University of Maine
Orono ME 04469-5751
ksimon@maine.edu

Boris Sket
Department of Biology
University of Ljubljana
Večna pot 111
1000 Ljubljana
Slovenia
boris.sket@bf.uni-lj.si

Michael E. Slay
The Nature Conservancy
Ozark Highlands Office
675 N. Lollar Lane
Fayetteville AR 72701
mslay@tnc.org

Boštjan Surina
University of Primorska
Science and Research Centre of Koper
Garibaldijeva 1
6000 Koper
Slovenia
Bostjan.Surina@zrs-kp.si

Nina Šraj-Kržič
Department of Biology
University of Ljubljana
Večna pot 111
1000 Ljubljana
Slovenia
nina.krzic@bf.uni-lj.si

Peter Trontelj
Department of Biology
University of Ljubljana
Večna pot 111
1000 Ljubljana
Slovenia
peter.trontelj@bf.uni-lj.si

Rudi Verovnik
Department of Biology
University of Ljubljana
Večna pot 111
1000 Ljubljana
Slovenia
rudi.verovnik@bf.uni-lj.si

Branko Vreš
Jovan Hadzi Institute of Biology
Novi Trg 5
1000 Ljubljana
Slovenia
Brane.Vres@zrc-sazu.si

Al Vrezec
National Institute of Biology
Večna pot 111
1000 Ljubljana
Slovenia
al.vrezec@nib.si

Carol M. Wicks
Department of Geological Sciences
University of Missouri
Columbia MO 65211-1380
wicksc@missouri.edi

Maja Zagmajster
Department of Biology
University of Ljubljana
Večna pot 111
1000 Ljubljana
Slovenia
Maja.Zagmajster@bf.uni-lj.si

Appendix 3

Short Biographies of Participants

Valerija Babij received her Ph.D. in 2003 in Biology from the University of Ljubljana. She is currently Senior Research Assistant at the Jovan Hadži Institute of Biology, Scientific Research Centre of the Slovenian Academy of Sciences and Arts with research interests in botany, plant taxonomy, biodiversity, biogeography, habitat types and nature conservation. She has experience in mapping of flora, vegetation and habitats. Regarding karst studies she has been researching diversity of flora of karst ponds, trmporary lakes, grasslands, shrubs, forests and overgrown habitats. She has been active at the fallowing research projects dealing with karst: project Aquadapt (Strategic tools to support adaptive integrated water resource management under changing conditions at catchment scale: A co-evolutionary approach, 5th European Framework Programme), Kras - region biodiversity, successional stages and conservation significance (2004-2007), Mapping of nonforest habitat types – Pivka east (2004), Biodiversity of Posočje and nature conservation applications for Natura 2000 sites (2005-2008).

She is a member of Botanical Society of Slovenia and Biological Society of Slovenia, Ostalpin-Dinaric Society of Phytosociology, CLUSIUS – Internationale Forschunggesellschaft. V. Babij was a member of the editorial board of monograph *Water and life in a rocky landscape Kras* (2005), which contains results of Slovene part of abovementioned project Aquadapt. From 2006 is a member of editorial board of *Hacquetia* (published by Jovan Hadži Institute of Biology SRC SASA, Ljubljana).

Selected recent publications:

Babij, V., Seliškar, A., Vreš, B., Zelnik, I. 2005: Flora in vegetacija kalov in lokev na Krasu = Flora and vegetation of karstic ponds "kali and lokve" (Kras, Slovenia). - V: Mihevc, A. (ur.). **Kras : voda in življenje v kamniti pokrajini = water and life in a rocky landscape, (Projekt Aquadapt)**. Ljubljana: Založba ZRC, ZRC SAZU, str. 83-99.

Čelik, T., Zelnik, I., Babij, V., Vreš, B., Pirnat, A., Seliškar, A., Drovenik, B. 2005: Inventarizacija kalov in lokev na Krasu ter njihov pomen za biotsko raznovrstnost = Inventory of karstic ponds (kal and lokev) and their importance for biotic diversity. - V: Mihevc, A. (ur.). **Kras : voda in življenje v kamniti pokrajini = water and life in a rocky landscape, (Projekt Aquadapt)**. Ljubljana: Založba ZRC, ZRC SAZU, str. 72-82.

Babij, V. 2005: Naravne danosti Krasa : uvod = Natural environment of the Kras : introduction. - V: Mihevc, A. (ur.). **Kras : voda in življenje v kamniti pokrajini = water and life in a rocky landscape, (Projekt Aquadapt)**. Ljubljana: Založba ZRC, ZRC SAZU, 2005, str. 17-19.

Vreš, B., Seliškar, A., Babij V. (in print): **Flora and vegetation of man-made lakes in Slovenia and adjacent areas.**

E. F. (Fred) Benfield is Professor of Ecology and Associate Head in the Department of Biological Sciences at Virginia Polytechnic Institute & State University (Virginia Tech). He received his PhD in Zoology at Virginia Tech in 1971 and has been employed at Virginia Tech since earning the degree. His research specialty is in the area of ecosystem level responses of Appalachian Mountain streams to landscape disturbance. He is a CO-PI for the Coweeta Hydrologic Laboratory NSF LTER site in western N.C. His present research efforts include investigating long-term recovery of ecosystem function by a stream draining a watershed that was clear-cut in 1976. He is also studying population, community, and ecosystem level responses of headwater streams that drain watersheds that are being experimentally clear-cut but are left with riparian strips of different widths. He is also working on a new project involving ecosystems services provided by unionid mussel beds to streams. A continuing LTER regional project involves responses of streams to the conversion of historically agricultural land to residential/urban use.

He has served as Associate Editor for the American Midland Naturalist, Associate Editor for the Journal of the North American Benthological Society (two terms), Interim Managing Editor for JNABS, and the JNABS Editorial Board. He has held several positions of leadership in NABS including serving as President, Executive Committee Chair, Elections and Place Chair, Awards Chair, and Chair of the Board of Trustees for the NABS Endowment.

Selected Recent Publications:

Simon, K.S. , E.F. Benfield and S. A. Macko. 2003. Food web structure and the role of microbial films in cave streams. **Ecology** 84(9):2395-2406.

Benfield, E.F. 2006**.** Leaf breakdown in stream ecosystems. 2nd Edition**.**. In: F.R. Hauer and G.A. Lamberti (eds). **Methods in stream ecology**. Academic Press, San Diego, CA.

Hagan, E.M., J.R. Webster & E. F. Benfield. 2006. Are leaf breakdown rates appropriate for measureing stream integrity along an agricultural land-use gradient? **Journal of the North American Benthological Society** 25(2): 330-343.

Burcher, C.L. and E.F. Benfield. 2006. Stream physical and biotic responses to rural development in historically agricultural watersheds, **Journal of the North American Benthological Society** 25(2): 356-369.

Burcher, C.L., Benfield, E.F., and H.M. Valett. In Press The land cover cascade: disturbance propagation between landscapes and streams. **Ecology** 87.

Anton Brancelj received his Ph.D in 1991 in Ecology from the University of Ljubljana. He is currently a senior researcher at the National institute of biology in Ljubljana and head of Department for Freshwater and terrestrial ecosystems research. His main interests are ecology and paleolimnology of mountain lakes in Slovenia, speleobiology and taxonomy of Copepoda and Cladocera. He is also associated professor at the University of Nova Gorica where he gives lectures on Limnology and Ecology of karst.

Brancelj participate since 1996 on three EU projects on high-mountain lakes (AL:PE 2; MOLAR and EMERGE) and one EU project on groundwater (PASCALIS). He was editor of a book "High-mountain lakes in the Eastern part of the Julian Alps" where the results of EU as well as national projects are presented. He participated in several international expeditions in Mongolia, Russia and China where he collected interstitial fauna in the rivers and lakes. Currently he is a coordinator of national program "Communities, Relations and Communications in the Ecosystems" (a period 2004 – 2008) where he studies limnology of lake Bohinj and ecology /ecophysiology of cave animals.

Selected recent publications:

BRANCELJ, Anton. 2002. Microdistribution and high diversity of Copepoda (Crustacea) in a small cave in central Slovenia. **Hydrobiologia** (Den Haag), 477:59-72.

SIMČIČ, Tatjana, LUKANČIČ, Simon, BRANCELJ, Anton. 2005. Comparative study of electron transport system activity and oxygen consumptionof amphipods from caves and surface habitats. **Freshwater Biology** 50:494-501.

BRANCELJ, Anton. 2005. *Hadodiaptomus dumonti* n. gen., n. sp., a new freshwater stygobitic calanoid (Crustacea: Copepoda: Calanoida) from Vietnam (south Asia) and a new member of the subfamily Speodiaptominae Borutzky, 1962. **Hydrobiologia** (Den Haag) 534:57-70.

MORI, Nataša, BRANCELJ, Anton. 2006. Macroinvertebrate communities of karst springs of two river catchments in the Southern Limestone Alps (the Julian Alps, NW Slovenia). **Aquatic Ecology** 40:69-83.

SIMČIČ, Tatjana, BRANCELJ, Anton. 2006. Effects of pH on electron transport system (ETS) activity and oxygen consumption in *Gammarus fossarum, Asellus aquaticus* and *Niphargus sphagnicolus*. **Freshwater** Biology 51:686-694.

BRANCELJ, Anton (ed.). 2002. **Visokogorska jezera v vzhodnem delu Julijskih Alp = High-mountain lakes in the Eastern part of the Julian Alps.** Ljubljana: ZRC, ZRC SAZU: = ZRC Publishing: Nacionalni inštitut za biologijo: = National institute of Biology, 266 p. ISBN 961-6358-58-8.

Mihael Bricelj was born in Ljubljana in 1946. After primary and secondary school, he went to study at the Biological Department of Biotechnical Faculty of University of Ljubljana, where he finished studies for MS. He received his Ph.D in Genetics from the Biotehnical faculty of University of Ljubljana in 1994. He is currently a senior scientific researcher in the National Institute of Biology. He actually works in the field of ecological toxicology and toxinology and biological monitoring of fresh water systems, especially lakes and rivers. He is a specialist for tracing of underground waters with phages and fluorescent dies.

He is a member of the ATH (Association for Tracers in Hydrology) and participates with the lectures of biological impact of tracers on water organisms and tracing techniques with phages on Post Graduate Course on Groundwater Techniques, sponsored by Unesco and Austrian Republic, held at the Institute of Water Resources Management in Hydrology and Geophysics in Graz.

Selected recent publications:

HEATH, Ester, BRICELJ, Mihael, LESKOVŠEK, Hermina. Biodegradation studies of polyaromatic hydrocarbons in aqueous media. **J Appl Microbiol**, 1997, vol. 83, str. 561-568.

HEATH, Ester, BRICELJ, Mihael, LESKOVŠEK, Hermina. Degradation of fluoranthene by Pasteurella sp. IFA and Mycobacterium sp. PYR-1e : isolation and identification of metabolites. **J Appl Microbiol**, 1998, vol. 85, str. 746-754.

PLOHL, Karmen, LESKOVŠEK, Hermina, BRICELJ, Mihael. Biological degradation of motor oil in water. **Acta chim. slov**.. [Tiskana izd.], 2002, vol. 49, str. 279-289.

HEATH, Ester, BRICELJ, Mihael, LESKOVŠEK, Hermina. Toxicity of fluoranthene and its biodegradation metabolites to aquatic organisms. **Chemosphere (Oxford***)*. [Print ed.], 2003, vol. 52, str. 1125-113.

BRICELJ, Mihael. Microbial tracers in groundwater research. **RMZ-mater. geoenviron**., 2003, letn. 50, št. 1, str. 67-70.

BRICELJ, Mihael, ČENČUR CURK, Barbara. Simulation of microbiological pollution in the unsaturated zone of karstified limestone aquifers-tracing with bacteriophages. **RMZ-mater. geoenviron.,** 2005, letn. 52, str. 661-668.

David C. Culver received his Ph.D. in 1970 in Biology from Yale University. He is currently Professor of Biology at American University in Washington, DC, with broad research interests in subterranean biology, especially biodiversity, biogeography, and ecosystem function. He has active research projects on U.S. subterranean biodiversity databases (with Horton Hobbs III), spatial statistical patterns of obligate subterranean animals (with Mary Christman), the obligate subterranean animals in seeps in the Washington, DC area and Slovenia (with Tanja Pipan), diversity and biogeography of epikarst invertebrates in the Appalachians and Slovenia (with Tanja Pipan), organic carbon flux in caves (with Kevin Simon and Tanja Pipan), large scale subterranean biodiversity patterns (with Louis Deharveng and others), and regional scale subterranean biodiversity patterns and protection in West Virginia (with Daniel Fong and Horton Hobbs III).

Culver is Executive Vice President of the Karst Waters Institute, a member of the Board of the International Society of Subterranean Biology, a member of the Virginia Cave Board, and an Honorary Life Member of the National Speleological Society. He has organized or co-organized symposia and workshops on conservation and protection of karst (1997), mapping subterranean biodiversity (2001), epikarst (2003), and time in karst (2007). He is currently Associate Dean for Science at American University.

Selected recent publications:

D.C. Culver, L. Deharveng, J. Gibert, and I.D. Sasowsky [eds.]. 2001. **Mapping Subterrenean Biodiversity/Cartographie de la biodiversité souterraine.** Karst Waters Institute Special Publication 6, Charles Town, W.Va.

Culver, D.C., M.C. Christman, B. Sket, and P. Trontelj. 2004. Sampling adequacy in an extreme environment: species richness patterns in Slovenian caves. **Biodiversity and Conservation** 13:1209-1229.

Culver, D.C., and W.B. White [eds.]. 2005. **Encyclopedia of Caves**. Academic/Elsevier, Amsterdam.

Christman, M.C., D.C. Culver, M. Madden, and D. White. 2005. Patterns of endemism of the eastern North American cave fauna. **Journal of Biogeography** 32:1441-1452.

Culver, D.C., L. Deharveng, A. Bedos, J.J. Lewis, M. Madden, J.R. Reddell, B. Sket, P. Trontelj, and D. White. 2006. The mid-latitude biodiversity ridge in terrestrial cave fauna. **Ecography** 29:120-128.

Pipan T., Christman M.C. and Culver D.C. 2006. Dynamics of epikarst communities: microgeographic pattern and environmental determinants of epikarst copepods in Organ Cave, West Virginia. **American Midland Naturalist** 156:75-87.

Annette Summers Engel received her Ph.D. in 2004 in Geological Sciences from the University of Texas at Austin. She also received M.S. degrees in both Biological Sciences and Geology from the University of Cincinnati. She is currently an Assistant Professor of Geomicrobiology at Louisiana State University, Baton Rouge, LA, with a joint appointment in the Departments of Geology & Geophysics and Biological Sciences. Her interests in cave and karst science began when she was an undergraduate (at Wittenberg University, Ohio), and since then she has pursued various research avenues, from using caves to decipher landscape evolution to characterizing microbial roles in cave development. Her interdisciplinary research group uses geological, geochemical, genetic, and computational methods to explore the diversity, distribution, and ecology of microbes in various terrestrial environments. Engel and her students' current projects involve (1) describing the microbial diversity of sulfidic caves and karst aquifers, (2) examining regional to global spatial patterns of microbes in karst, (3) expanding and revising the taxonomy of microbial groups important to ecosystem processes, such as the *Epsilonproteobacteria*, (4) understanding microbial nutrient cycling and spiraling in karst, and (5) evaluating microbial adaptations to extreme conditions, such as acidity, anoxia, oligotrophy, high metal content (e.g., arsenic, antimony, chromium), or high temperatures.

Engel participated in the 2004 "Terra Microbiology" Okazaki Biology Workshop/Conference in Japan, and is on the planning committee for the Karst Waters Institute-sponsored workshop, "Future Directions in Karst Research." She has served on the Geobiology and Low Temperature Geochemistry panel for the National Science Foundation. She currently is on the board of directors for the Karst Waters Institute, and is an associate editor for the *Journal of Sedimentary Research*.

Selected recent publications:

Campbell, B.J.*, Engel, A.S.*, Porter, M.L., and Takai, K. 2006. The versatile *Epsilon-proteobacteria*: Key players in sulphidic habitats. **Nature Reviews Microbiology**. 4:458-468. (* shared contribution)

Phoenix, V.R., Bennett, P.C., Engel, A. S., Tyler, S.W., and Ferris F.G. 2006. Chilean high-altitude hot spring sinters: a model system for UV screening mechanisms by early Precambrian cyanobacteria. **Geobiology.** 4: 15-28.

Engel, A.S. 2005. Chemoautotrophy, in Culver, D. and W. White, (eds.) **Encyclopedia of Caves.** p. 90-102.

Engel, A.S.**,** Porter, M.L., Stern, L.A., Quinlan, S., Bennett, P.C. 2004. Bacterial diversity and ecosystem function of filamentous microbial mats from aphotic (cave) sulfidic springs dominated by chemolithoautotrophic "*Epsilonproteobacteria*". **FEMS Microbiology Ecology.** 51: 31-53.

Engel, A.S., Stern, L.A., and Bennett, P.C. 2004. Microbial contributions to cave formation: new insights into sulfuric acid speleogenesis. **Geology.** 32(5): 369-372.

Engel, A.S., Lee, N., Porter, M.L., Stern, L.A., Bennett, P.C., and Wagner, M. 2003. Filamentous "*Epsilonproteobacteria*" dominate microbial mats in sulfidic caves. **Applied and Environmental Microbiology.** 69(9): 5503-5511.

Daniel W. Fong received his Ph.D. in 1985 in Ecology and Evolutionary Biology from Northwestern University. He is currently Associate Professor of Biology at American University in Washington, D.C. He is interested in the evolutionary ecology of subterranean crustaceans. He has active research projects on the ecology and population genetics of the Madison Cave Isopod (with student Ben Hutchins), genetics and physiology of spring and cave crustaceans in the Virginias (with Dave Carlini and Steve MacAvoy), and diversity and protection of subterranean animals in West Virginia (with Dave Culver and Horton Hobbs III).

Fong is the treasurer and a former Board member of the Karst Waters Institute. He is a member of the Awards Committee and a Fellow of the National Speleological Society, and was newsletter editor of the Biology Section of the NSS. He also served on the Board of the Cave Conservancy of the Virginias.

Selected recent publications:

Fong, D.W., and D.C. Culver. 1994. Fine-scale biogeographic differences in the crustacean fauna of a cave system in West Virginia, USA. **Hydrobiologia** 287:29-37.

Jernigan, R.W., D.C. Culver, and D.W. Fong. 1994. A graphical analysis of genetic correlations as evidence for selection. **Evolution** 48:587-596.

Fong, D.W., T.C. Kane, and D.C. Culver. 1995. Evolution of vestigial and nonfunctional characters. **Annual Review of Ecology and Systematics** 26:249-268.

Fong, D.W. 1996. **Madison Cave Isopod (*Antrolana lira*) Recovery Plan**. U.S. Fish and Wildlife Service, Hadley, MA, 36pp.

Knapp, S., and D.W. Fong. 1999. Estimates of population size of the cave-dwelling amphipod *Stygobromus emarginatus* in Organ Cave, West Virginia. **Journal of Cave and Karst Studies** 61:3-6.

Fong, D.W. 2004. Intermittent pools at headwaters of subterranean drainage basins as sampling sites for epikarst fauna. **Proceedings of the International Symposium on the Epikarst.** Karst Waters Institute Special Publications 9: 114-118.

Alenka Gaberščik received her Ph.D in 1991 in Ecology from the University of Ljubljana. She is currently an associated professor on the Department of Biology, Biotechnical Faculty, University of Ljubljana giving lectures from Plant ecology, Ecosystems and Nature conservation and environment protection Her research is oriented to intermittent and aquatic ecosystems and plant ecology. For more than 15 years she has been researching structure and function of the intermittent lake Cerknica. Recently she is also studying karst watercourses. She is mainly interested in the survival strategies in plants in amphibious habitats as well as in the effects of other stresses like drought and UV-B radiation on different plant species. In the last several years she was involved in different projects and programs, i.e., the role of UV-B radiation on aquatic and terrestrial ecosystems: an experimental and functional analysis of the evolution of protective and adaptive mechanisms in plants (EU - Environment and Climate, PL 970637, 1998-2001), Plant Biology (P1-012, MŠZŠ, 2004-2008) and The "Multifunctional integrated Study Danube, Corridor and Catchment" (MIDCC) Austrian Ministry of Education, Science and Arts (2002-2005), LIFE – Lake Cerknica (EU – 2007-2009).

She is a member of different associations: International Association on Danube Research, Macrophyte Group, IAD-SIL, Association of Ecologists of Slovenia,. Association for Plant Physiology Slovenia and a president of Association of Biologists of Slovenia.

Selected recent publications:

GERM, Mateja, MAZEJ, Zdenka, GABERŠČIK, Alenka, TROŠT SEDEJ, Tadeja. 2006. The response of Ceratophyllum demersum L. and Myriophyllum spicatum L. to reduced, ambient, and enhanced ultraviolet-B radiation. **Hydrobiologia** in press.

KRŽIČ, Nina, GABERŠČIK, Alenka. 2005. Photochemical efficiency of amphibious plants in an intermittent lake. **Aquatic Botany** 83:281-288.

URBANC-BERČIČ, Olga, GABERŠČIK, Alenka. 2004. The relationship of the processes in the rhizosphere of common reed Phragmites australis, (Cav.) Trin. ex Steudel to water fluctuation. **Int. Rev. Hydrobiol**. 89:500-507

GERM, Mateja, SIMČIČ, Tatjana, GABERŠČIK, Alenka, BREZNIK, Barbara, HRASTEL, Milena. 2004. UV-B treated algae exhibiting different responses as a food source for Daphnia magna. **Journal of Plankton Research** 26:1219-1228.

GERM, Mateja, GABERŠČIK, Alenka. 2003. Comparison of aerial and submerged leaves in two amphibious species, *Myosotis scorpioides* and *Ranunculus trichophyllus*. **Photosyntetica** 41:91-96.

GABERŠČIK, Alenka [ed.] 2003. **Jezero, ki izginja : monografija o Cerkniškem jezeru.** The vanishing lake : Monograph on Lake Cerknica, Ljubljana: Društvo ekologov Slovenije.

Dr. Franci Gabrovšek graduated in Physics at the University in Ljubljana, Slovenia, in 1995. Since 1996 he is a researcher at the Karst Research Institute of SASA in Postojna, Slovenia. He finished his PhD at the Department of Physics of the University of Bremen, Germany, in 2000. For his PhD work on the evolution of early karst aquifer he was rewarded by the price of the University of Bremen. His research includes process modelling of speleogenesis and other karst processes. He is involved in the exploration and study of cave systems in Slovenia and abroad. His bibliography in karstology includes more than 90 units. He co-authored ten original papers in leading hydrological journals. He is an author and co-author of two books on karst modelling, an editor of the book »Evolution of karst: From prekarst to cessation«, co-editor of the journal Acta Carsologica and a member of an editorial board of the International Journal of Speleology. He is a lecturer at Nova Gorica Poytechnics and at the Faculty of Humanities in Koper.

Mateja Germ received her Ph.D. in 2000 in Biology from University of Ljubljana. She is currently researcher in the National Institute of Biology with research interest in the ecology, biology and physiology of macrophytes. She was involved in international project “The role of UV-B radiation on aquatic and terrestrial ecosystems: an experimental and functional analysis of the evolution of protective and adaptive mechanisms in plants” (Jelte Rozema), "MIDCC - Multifunctional Integrated Study Danube Corridor and Catchment" (with Georg Janauer), the bilateral project “Water regime in wetlands – a driving force of the processes in the rhizosphere“(Maria Dinka).

Germ is coordinator ob basic project financed by Slovenian Research Agency. She has traveled extensively in her study of macropytes, including Romania, France, Hungary, Slovakia, and Sicily.

Selected recent publications:

GERM, M., MAZEJ, Z., GABERŠČIK, A., HÄDER, D.P. 2002. The influence of enhanced UV-B radiation on *Batrachium trichophyllum* and *Potamogeton alpinus* - aquatic macrophytes with amphibious character. **J. photochem. photobiol. B Biol**., 66, 1: 37-46.

GERM, M., GABERŠČIK, A. 2003. Comparison of aerial and submersed leaves in two amphibious species, *Myosotis scorpioides* and *Ranunculus trichophyllus*. **Photosynthetica** 41, 1: 91-96.

GERM, M. 2004. UV-B radiation screen and respiratory potential in phytoplankton in mountain lakes. **Acta biol. slov**. 47, 2: 57-64.

KRŽIČ, N., GABERŠČIK, A., GERM, M. 2004. The phenotypic plasticity of *Glyceria fluitans* growing over the water/land gradient. **Acta biol. slov**. 47, 2: 65-73.

GERM, M. 2005. The response of green alga *Spirogyra* sp. to different levels of UV-B radiation. **Phyton (Horn)** 45, 2: 173-182.

Peter M. Groffman received his Ph.D in 1984 in Ecology from the University of Georgia. He currently a Scientist at the Institute of Ecosystem Studies in Millbrook, NY, with research interests in ecosystem, landscape and microbial ecology, with a focus on carbon and nitrogen dynamics. He has research active at two LTER sites; Hubbard Brook and Baltimore, as well as work at other sites on nitrate dynamics in riparian buffer zones and the effects of exotic earthworm invasion on soil nitrogen and carbon cycling. He is chair of the Scientific Coordinating Committee of the Hubbard Brook Committee of Scientists and is a member of the Governance Committee of the LTER Planning Grant process.

Groffman was/is a member of the Steering Committee for the Workshop on Advanced Approaches to Quantify Denitrification (NSF funded), the Hubbard Brook Research Foundation Nitrogen Scientific Working Group, the NOAA Gulf of Mexico Hypoxia Nutrient Reduction Workgroup, the Working Group on Aquatic Terrestrial Biogeochemistry at the National Center for Ecological Analysis and Synthesis (NCEAS), the Working Group on Trace Gas Fluxes at NCEAS, and the Expert Group on N_2O and CO_2 Emissions from Agricultural Soils, IPCC/Organization for Economic Cooperation and Development (OECD) Programme on National Greenhouse Gas Inventories. He was a lead author for the Second (Wetlands) and Third (North America) Assessment Reports of the Intergovernmental Program on Climate Change (IPCC). He currently serves on the editorial boards of *Ecology* and *Ecosystems*, and was chair of the Soil Ecology section of the Ecological Society of America from 1997 – 98 and the Wetland Soils Section of the Soil Science Society of America from 2002 - 2003.

Selected recent publications:

Groffman, P.M. J.S. Baron, T. Blett, A.J. Gold, I. Goodman, L.H. Gunderson, B.M. Levinson, M.A. Palmer, H.W. Paerl, G.D. Peterson, N. L. Poff, D.W. Rejeski, J.F. Reynolds, M.G. Turner, K.C. Weathers and J. Wiens. 2006. Ecological thresholds: The key to successful environmental management or an important concept with no practical application? **Ecosystems** 9:1-13.

Groffman, P.M., N.L. Law, K.T. Belt, L.E. Band and G.T. Fisher. 2004. Nitrogen fluxes and retention in urban watershed ecosystems. **Ecosystems** 7:393-403.

Groffman, P.M., D.J. Bain, L.E. Band, K. T. Belt, G.S. Brush, J.M. Grove, R. V. Pouyat, I.C. Yesilonis and W. C. Zipperer. 2003. Down by the riverside: Urban riparian ecology. **Frontiers in Ecology and Environment** 6:315-321.

Groffman, P.M., C.T. Driscoll, G.E. Likens, T.J. Fahey, R.T. Holmes, C. Eagar and J.D. Aber. 2004. Nor gloom of night: A new conceptual model for the Hubbard Brook ecosystem study. **BioScience** 54:139-148.

Groffman, P.M., C.T. Driscoll, T.J. Fahey, J.P. Hardy, R.D. Fitzhugh and G.L. Tierney. 2001. Colder soils in a warmer world: A snow manipulation study in a northern hardwood forest ecosystem. **Biogeochemistry** 56:135-150.

Mark E. Hines received his Ph.D. in Microbiology in 1981 from the University of New Hampshire. He is currently Professor of Biological Sciences at the University of Massachusetts Lowell with broad research interests in microbial biogeochemistry, with a focus on anaerobic metabolism and terminal degradation processes, and carbon, sulfur, and metal cycling. He has active research projects on methanogenesis and C-1 metabolism in high latitude peatlands (with Jeff Chanton), factors controlling the cycling of mercury in Adirondack (New York) lakes (with Tamar Barkay, Charley Driscoll and Stefan Grimberg), and the fate of mercury downstream of the Idrija Mercury Mine (Slovenia) including river, estuarine, and marine environments (with Tamar Barkay, Jadran Faganeli and Milena Horvat). Other ongoing projects include studies of salt marsh nitrogen fixation and effects of synthesized nanospheres on bacterial viability.

Hines is Head of the Department of Biological Sciences at UMass Lowell, and is/was a member of the Hydrologic Sciences Committee of the National Science Foundation, a member of the International Committee for the International Symposium for Environmental Biogeochemistry, a member of the Public Relations Committee of the Subglacial Antarctic Lakes Environments (SALE) Program, a member of the editorial board of *Applied and Environmental Microbiology*, and a guest editor of *Applied Geochemistry* and *RMZ Materials and Geoenvironment*. In 2001, he organized a symposium on mercury dynamics in western Slovenia and the northern Adriatic Sea.

Selected recent publications:

Hines, M.E., K.N. Duddleston, and R.P. Kiene. 2001. Carbon flow to acetate and C_1 compounds in northern wetlands. **Geophys. Res. Lett**. 28:4251-4254.

Duddleston, K.N., R.P. Kiene, M. Kinney, and M.E. Hines. 2002. Anaerobic microbial biogeochemistry in a northern bog: acetate as a dominant metabolic end product. **Global Biogeochem. Cycles.** 16:1063, doi:10.29/2001GB001402.

Megonigal, J.P., M.E. Hines, and P.T. Visscher. 2003. Anaerobic Metabolism: Linkages to Trace Gases and Aerobic Processes. In: H.D. Holland and K.K. Turekian (eds.), **Treatise on Geochemistry Vol. 8**, W.H. Schlesinger (volume editor), Biogeochemistry. Elsevier Pergamon. pp. 317-424.

Gray, J.E., M.E. Hines, P.L. Higueras, I. Adatto, and Lasorsa, B.K. 2004. Mercury speciation and microbial transformations in mine wastes, stream sediments, and surface waters at the Almadén Mining District, Spain. **Environ. Sci. Technol**. 38:4285-4292.

Chanton, J.P., D. Fields and M.E. Hines. In press. Controls on the hydrogen isotopic composition of biogenic methane from terrestrial wetlands: evidence from an Alaskan transect from 60 to 70^o North latitude**. J. Geophys, Res Biogeosciences**.

Hines, M.E., J. Faganeli, I Adatto, and M. Horvat. In press. Microbial mercury transformations in marine, estuarine and freshwater sediments downstream of the Idrija Mercury Mine, Slovenia. **Appl. Geochem.**

Horton H. Hobbs III received his Ph.D. in Zoology in 1973 from Indiana University. Currently he is Professor of Biology at Wittenberg University in Springfield, Ohio, with research interests in the ecology, evolution, and systematics of decapod crustaceans as well as the biodiversity, biogeography, and conservation of subterranean ecosystems. He has active research projects on U.S. subterranean biodiversity databases (with David C. Culver); regional scale subterranean biodiversity patterns and protection in West Virginia (with David C. Culver and Daniel Fong); ecology, biodiversity, and biogeography of cambarid crayfishes in the Ozarks; ecology of parthenogenetic populations of rhaphidophorid crickets (*Hadenoecus*) in northeastern Kentucky; and research on biodiversity and karst feature databases of Kentucky and Ohio.

Hobbs is Vice President of Education of the Karst Waters Institute, Vice-President of the American Cave Conservation Association, board member of the Cave Conservancy of the Virginias, is a Fellow of the Ohio Academy of Science, Fellow and Honorary Life Member of the National Speleological Society, and Director of the Ohio Cave Survey. He currently serves on the editorial boards of the *Journal of Cave and Karst Studies* and *Subterranean Biology.*

Selected recent publications:

Hobbs, Horton H. III. 2001. A new cave crayfish of the genus *Orconectes*, subgenus *Orconectes*, from southcentral Missouri, USA with a key to the stygobitic species of the genus (Decapoda: Cambaridae) **Crustaceana** 74(7):635-646.

Yoder, J. A., Horton H. Hobbs III, and Matthew C. Hazelton. 2002. Aggregate protection against dehydration in adult females of the cave cricket, *Hadenoecus cumberlandicus* (Orthoptera, Rhaphidophoridae). **Journal of Cave and Karst Studies** 64(2):140-144.

Culver, David C., Mary C. Christman, William R. Elliott, Horton H. Hobbs III, and James R. Reddell. 2003. The North American obligate cave fauna: regional patterns. **Biodiversity and Conservation** 12(3):441-468.

Jones, William K., Horton H. Hobbs III, Carol M. Wicks, Robert R. Currie, Louise D. Hose, Ronal C. Kerbo, James R. Goodbar, and Jerry Trout. 2003. Recommendations and guidelines for managing caves on protected lands. **Karst Waters Institute, Special Publication** 8:1-95.

Hobbs, Horton H. III. 2005. Diversity in the United States. In White, W. B. and D. C. Culver (eds.), **Encyclopedia of Caves**, Academic Press. pp.170-183.

Graening, G., D. Fenolio, H. Hobbs III, S. Hensley, S. Jones, M. Slay, S. McGinnis, and J. F. Stout. 2006. Range extension and status update of the Oklahoma Cave crayfish, *Cambarus tartarus* (Decapoda: Cambaridae), endemic to three cave streams in Oklahoma. **The Southwestern Naturalist** 51(1):94-99.

Jeffrey Jack received his Ph.D. from Dartmouth in 1993. He is the Wallace Chair of Conservation Biology in the Biology Department at the University of Louisville and a member of the Louisville Stream Institute. His laboratory is interested in the biotic and abiotic controls on the invertebrate fauna of ephemeral karst lakes ("poljes") and the effects of urbanizing landscapes on karst spring and spring brook communities. He and his students are also assessing the environmental stressors on unionid mussel assemblages and working with various government agencies on the development of protocols for rearing the larval stages of mussels in the laboratory to re-colonize habitats and to stabilize threatened populations. Along with his colleagues in the Stream Institute, his laboratory is studying the use of functional assessments and geomorphic measures as indicators of stream restoration "success." Jack serves/has served on numerous grant review panels and on program and symposia committees for national and international meetings. He is currently working with the Green River Bioreserve group to develop management strategies for this important karst river corridor.

Selected Recent Publications:

K. Acharya, P. A. Bukaveckas, J. D. Jack, M. Kyle and J. J. Elser. 2006. Consumer growth linked to diet and RNA – P stoichiometry: Response of *Bosmina* to variation in riverine food resources. **Limnology and Oceanography***,* in press.

Jack, J. D., R. Kelley, D. Stiles. 2006. Using Macroinvertebrates to Monitor Agricultural Best-Management Practices in a Confined Swine Operation. **Journal of American Water Resources** 42: 747-753.

Bukaveckas, P.A. , Sellers, T.W.**,** Jack, J.D**.,** Guelda, D. 2005. Carbon flux in the Ohio River. **Ecosystems**, 8: 825-840.

.Acharya, K., J. D. Jack and P. A. Bukaveckas. 2005. Dietary effects on life history traits of riverine *Bosmina.* **Freshwater Biology** 50: 965-975.

Tehrani, K.A. and J. D. Jack. 2002. The effects of phosphorus enrichment on the phytoplankton community of a karst lake. **Kentucky Academy of Science** 63:97-101.

Kelley, R.H. and J.D. Jack. 2002. Leaf litter decomposition in an ephemeral karst lake (Chaney Lake, USA). **Hydrobiologia** 482: 41-47.

Kelley, R. and J. D. Jack. 2000. A Survey of Physical Parameters and Nutrient Concentrations of an Ephemeral Karst Lake in the Lost River Groundwater Basin, Kentucky**. Aquatic Ecology** 34: 77-89

Vessels, Nicole and J. D. Jack. 2001 The impact of vertebrate predation on microinvertebrate communities in a temporary karst wetland. **Kentucky Academy of Science** 62: 52-59.

.

Ivan KOS received his PhD in 1995 in Biology from the University of Ljubljana. He is currently assistant professor on the Department of Biology, Biotechnical Faculty; University of Ljubljana. He has lectures of Animal Ecology, Ecosystems and part of Biogeography. He is leader of research group of Animal Ecology. The main topic of research is related to the Dinaric forest and other habitats in Dinaric region, particular to structure, role and function of biodiversity in ecosystems processes. In the last years he was involved in different project and research programs i.e.: Zoological and speleobiological research (P1-0184, leader prof. dr. Boris Sket); Karst – biodiversity, influence of overgrowing and important on nature conservation (L1-6587); Conservation genetics of brown bear, lynx and red deer in Slovenia (L1-6484).

He is a member of different Association as: SCALP – Status and Conservation of Alpine Lynx Population; Centre International de Myriapodology, Paris; Dinaricum - Society of research, promotion and sustainable development of Dinaricum; Speleological Society Ribnica; Slovenian Ecological Society; Slovenian Entomological Society,

Selected recent publications:

KOS, Ivan. Some characteristics of animal biodiversity of Slovene forest. **Zb. gozd. lesar**., 2000, vol. 63, 95-117

GOVEDIČ, Marijan, JANŽEKOVIČ, Franc, KOS, Ivan. The diet of great cormorants Phalacrocorax carbo on the Sava river between Ljubljana and Zagorje (Slovenia). **Acrocephalus**, 2002, vol. 23, no. 110/111, 5-20

POTOČNIK, Hubert, KLJUN, Franc, RAČNIK, Joško, SKRBINŠEK, Tomaž, ADAMIČ, Miha, KOS, Ivan. Experience obtained from box trapping and handling wildcats in Slovenia**.** ***Acta Theriol.***, 2002, vol. 47, no. 2, 211-219

GRGIČ, Tanja, KOS, Ivan. Centipede diversity in patches of different development phases in an unevenly-aged beech forest stand in Slovenia. **African invertebrates**, 2003, vol. 44, no. 1, 237-252

GRGIČ, Tanja, KOS, Ivan. Forest stand structure influences biodiversity. **Zb. gozd. lesar**., 2004, vol. 73, 105-121

KOS, Ivan. Stonoge - Myriapoda. In: SKET, Boris, GOGALA, Matija, KUŠTOR, Valerija. *Živalstvo Slovenije*. Ljubljana: **Tehniška založba Slovenije**, 2003, 225-234 (in Slovenian)

KOS, Ivan, POTOČNIK, Hubert, SKRBINŠEK, Tomaž, MAJIĆ SKRBINŠEK, Aleksandra, JONOZOVIČ, Marko, KROFEL, Miha. **The Lynx in Slovenia**.. Ljubljana: Biotehniška fakulteta, Oddelek za biologijo, 2004. 239 pp., ISBN 961-90262-1-7 (In Slovenian with English summary).

GRGIČ, Tanja and KOS, Ivan. Influence of forest development phase on centipede diversity in managed beech forests in Slovenia. **Biodivers. conserv**., 2005, vol 14, no. 8, 1841-1862.

James M. Krest received his Ph.D. in 1999 in Geological Sciences from the University of South Carolina. He is currently an Assistant Professor in Environmental Science at the University of South Florida – St. Petersburg, with research interests in geochemistry and hydrology, and with a focus on water mixing and geochemical transport processes. Most recently, he has been using radium isotope concentrations and distributions to estimate mixing rates and water mass ages. He has active research in the Everglades determining rates of groundwater recharge/discharge; in Tampa Bay, Florida, studying the effects of the phosphate industry on the estuary; and in the Appalachians in West Virginia (with David Culver and Tanja Pipin) where he is testing the feasibility of using radium isotopes to determine model ages of water in the epikarst.

Before returning to school for graduate studies, Krest worked as a sea-going analytical chemist at Oregon State University and later at the University of Southern Mississippi, participating in oceanographic cruises to the equatorial Pacific, the Weddell Sea, and the western Pacific. His graduate work focused predominately on the flux of chemicals to the coastal ocean via shallow aquifers. After receiving his Ph.D., Krest worked for 3 years with the U. S. Geological Survey as a Postdoctoral Associate of the National Academies of Science, studying interactions between surface water and ground water. Currently, Krest serves on the executive committee of the Center for Science & Policy Applications for the Coastal Environment (C-SPACE) at USF-St. Petersburg, which is currently funded through the US EPA.

Selected recent publications:

Smoak, J.M. and Krest, J.M., (2006). Source of radium in a groundwater-augmented Florida lake. **Journal of Environmental Radioactivity**, 89: 102-114.

Harvey, J.W, Krupa, Steven L. and Krest, J.M. (2004) Ground-water recharge and discharge in the central Everglades, **Ground Water**, special issue , 42 (7), 1090-1102.

W.S. Moore and J.M. Krest (2004) Distribution of ^{223}Ra and ^{224}Ra in the plumes of the Mississippi and Atchafalaya Rivers and the Gulf of Mexico. **Marine Chemistry** 86 (3-4), 105-119.

Krest, J. M. and J. W. Harvey (2003). Using natural distributions of short-lived radium isotopes to quantify groundwater discharge and recharge. **Limnology and Oceanography** 48 (1), 290-298.

Wei-Jun Cai, Y. Wang, J.M. Krest and W.S. Moore (2003), The geochemistry of dissolved inorganic carbon in a surficial groundwater aquifer in North Inlet, South Carolina, and the carbon fluxes to the coastal ocean. **Geochimica et Cosmochimica Acta**, 67 (4), 631–637.

Boris Kryštufek received his Ph.D in 1988 in Biology from the University of Ljubljana. He is currently a Scientist and a Professor at the University of Primorska, Koper, and a Senior Curator at the Slovenian Museum of Natural History, Ljubljana, Slovenia. He has broad research interest in mammalian biology, especially taxonomy, biogeography, phylogeography and conservation biology. He has active research projects in Slovenia (species richness along elevational gradients; population biology of the edible dormouse), across the Balkans (rodent endemics and small isolated populations), in southern Africa (small mammals in forest fragments; with Rod M. Baxter, Fort Hare University, Alice, Republic of South Africa), and worked intensively in Anatolia. He serves in editorial boards of three international zoological journals (Folia Zoologica, Bonner zoologische Beitraege, Acta zoologica Cracoviensia), in several IUCN/SSC Specialist Groups (Small Mammals, Bears, Caprinae, Bats), and is a consultant in two IUCN Global Mammal Assessment Groups (Europe, south-west Asia). Between 1992 and 1999 he coordinated mapping of mammals of the former Yugoslavia for the project "Atlas of European Mammals" which he also co-edited. In 2001 he co-organized (with Huw I. Griffiths, The University of Hull, UK) a meeting "Pattern and Process in Balkan Biodiversity", sponsored by the European Science Foundation.

Selected recent publications:

Kryštufek, B., Vohralik, V. 2005. **Mammals of Turkey and Cyprus. Rodentia I: Sciuridae, Dipodidae, Gliridae, Arvicolinae.** UP ZRS, Koper, 292 pp.

Kryštufek, B., Pistotnik, M., Sedmak Časar, K. 2005. Age determination and age structure in the edible dormouse *Glis glis* based on incremental bone lines. **Mammal Review** 35: 210-214.

Griffiths, H.I., Kryštufek, B., Reed, J.M. 2004 (eds.) **Balkan Biodiversity.Patterns and Process in the European Hotspot.** Kluwer Academic Publishers, Dordrecht, 357 pp.

Kryštufek, B., Flajšman, B., Griffiths, H.I. 2003 (eds.) **Living with Bears. A large European carnivore in a shrinking World**. Liberalna Akademija, Ljubljana, 365 pp.

Kryštufek, B., Hudoklin, A., Pavlin, D. 2003. Population biology of the edible dormouse *Glis glis* in a mixed montane forest in Central Slovenia over three years. Acta **Zoologica Hungarica** 49 (Suppl.): 85-97.

Kryštufek, B. 2002. Cranial variability in the Eastern hedgehog *Erinaceus concolor* (Mammalia: Insectivora). **Journal of Zoology**, London 258: 365-373.

Kryštufek, B., Griffiths, H.I. 2002. Species richness and rarity in European rodents. **Ecography** 25: 120-128.

Diane M. McKnight, professor

Institute of Arctic and Alpine Research
University of Colorado
1560 30th Street
Boulder, CO 80309-0450
Tel: (303) 492-4687
Fax: (303) 492-6388
email: diane.mcknight@colorado.edu

Education

1979, Ph.D.	Environmental Engineering	Massachusetts Institute of Technology
1978, M.S.	Civil Engineering	Massachusetts Institute of Technology
1975, B.S.	Mechanical Engineering	Massachusetts Institute of Technology

Professional experience:
Research hydrologist, National Research Program, U. S. Geological Survey, 1979-1996
Professor of Civil, Environmental and Architectural Engineering, University of Colorado, 1996-present; Fellow of INSTAAR, University of Colorado, 1996-present

Professional service (recent): ASLO: Steering committee for workshop on Emerging Issues in Limnology, member 2002-2003, NRC: Water, Science and Technology Board, member, 2000-2003, Committee to review Climate Change Science Plan, member, 2003-2004, Committee on salmon and water resources in the Columbia basin, member 2003-2004, NSF AC-ERE, member 2004-2006, Editor, JGR-Biogeosciences, 2004-present.

Scientific societies: American Society of Limnology and Oceanography- (Member of Board: 1992-1994, President- elect, President and Past-President-1995-2000); American Chemical Society; American Geophysical Union, Acting President of Biogeosciences Section (2000-2002); International Humic Substances Society; Phycological Society of America; North American Benthological Society.

Selected recent publications (of about 100 total):

Esposito, R. M. M., S. L. Horn, D. M. McKnight, M. J. Cox, M. C. Grant, S. A. Spaulding, P. T. Doran, and K. D. Cozzetto. 2006. Antarctic climate cooling and response of diatoms in glacial meltwater streams. **Geophys. Res. Lett**., 33, LXXXXX, doi:10.1029/2006GL025903.

Cozzetto, K., McKnight, D. M., Nylen, T. and Fountain, A G.**.** 2006. Experimental investigations into processes controlling stream and hyporheic temperatures, Fryxell Basin, Antarctica. **Advances in Water Resources** 29 (2): 130-153.

Cory, R. M, McKnight, D. M. 2005. Fluorescence spectroscopy reveals ubiquitous presence of oxidized and reduced quinones in dissolved organic matter. **Environmental Science & Technology**, 39 (21): 8142-8149.

Janez Mulec received his Ph.D. in 2005 in Biology at the University of Ljubljana. He is currently Postdoctoral Research Assistant at the Karst Research Institute at ZRC SAZU with research interests in microbiology, ecology of karst ecosystems and nature protection. Besides his main interest which concerns role and significance of microorganisms in karst processes he actively participates in different projects running at the Institute: promotion of science, organizing scientific meetings, COST 625 "3-D monitoring of active tectonic structures" and various projects connected with local community.

Mulec is member of Caving club Luka Čeč, Postojna, Karstological society Anthron, Slovene microbiological society, Nature science society of Slovenia, and SIBIOS - Société internationale de biospéologie.

Selected recent publications:

Mulec J, Zalar P, Zupan Hajna N, Rupnik M. 2002**.** Screening for culturable microorganisms from cave environments (Slovenia). **Acta carsologica** 31, 2: 177-187.]

Gerič B, Pipan T, Mulec J. 2004. Diversity of culturable bacteria and meiofauna in the epikarst of Škocjanske jame Caves (Slovenia). **Acta carsologica** 33, 1: 301-309

Mulec J. 2005. Alge v kraških jamah Slovenije : doktorska disertacija = **Algae in the karst caves of Slovenia : dissertation thesis.** Ljubljana 149 p.

Mulec J, Kosi G, Vrhovšek D. (in press) Algae promote growth of stalagmites and stalactites in karst caves (Škocjanske jame, Slovenia). **Carbonates and Evaporates**

Diana E. Northup received her Ph.D. in Biology with a specialization in Geomicrobiology in 2002 from the University of New Mexico. She is currently Professor Emerita (University Libraries) and Visiting Associate Professor (Biology) at the University of New Mexico. Her overarching research themes include (1) microbe-mineral interactions in caves in sulfur, manganese, iron and carbonate systems, (2) the biogeography of microbial species in caves, (3) the impact of humans on microbial communities in caves, (4) preservation of and access to cave and karst information. Previous research interests have included work on arthropod communities in caves. Currently, her active projects include: (1) bacterial and fungal transformations of manganese and iron compounds in ferromanganese deposits in caves and surface rock varnish (with Penny Boston, Mike Spilde, and others), (2) molecular phylogenetic characterization of microbial communities associated with ferromanganese deposits in Spider and Lechuguilla Caves, Carlsbad Caverns National Park (with Armand Dichosa and others) (3) microbial associations with pool precipitates in caves (with Leslie Melim, Penny Boston, and Mike Spilde), (4) characterization of microbial communities in Cueva de Villa Luz, Tabasco, Mexico (with Louise Hose, Penny Boston, Mike Spilde and others), (5) investigations into the nature and functions of microbial mat communities in lava tubes in El Malpais National Monument, NM, USA (with Mike Spilde), (6) examination of human indicator bacterial (HIB) presence in Carlsbad Cavern and Spider Cave, CCNP, NM, USA (with Kathy Lavoie), (7) colonization of an artificial chiroptorium, Texas, USA (with Kathy Lavoie), (8) an investigation of UV resistance of cave bacteria in comparison to surface bacteria (with Jessica Snider and Bob Miller), and (9) characterization of the microbial community present in the atmosphere of high and low human impact areas of Carlsbad Cavern, CCNP, NM, USA (with Dale Griffin and Mike Gray).

Northup's research (with Penny Boston, Carol Hill, Annette Summers Engel and others) was featured on the NOVA program, "Mysterious Life of Caves," and she was a guest editor for a special issue of **Geomicrobiology Journal.** She is the Secretary of the Karst Waters Institute (KWI) and sits of the boards of KWI and the National Cave and Karst Research Institute. Together with Bob Brinkmann, Todd Chavez, and Louise Hose, she is initiating a Karst Information Portal to gather, digitize, and make accessible karst information. She is a fellow of the National Speleological Society and Cave Research Foundation, and is the Science Award Subchair for the National Speleological Society Awards Committee.

Selected recent publications:

Spilde, M.N., Northup, D.E., Boston, P.J., Schelble, R.T., Dano, K.E., Crossey, L.J., and Dahm, C.N. 2005. Geomicrobiology of cave ferromanganese deposits. **Geomicrobiology Journal** 22:99-116.

Northup, D.E. and Lavoie, K.H. 2004. Microbiology in caves. pp.506-509 *In:* Gunn, John (ed.) **Encyclopedia of Cave and Karst Science**. New York: Fitzroy Dearborn Publishers.

Hunter, A.J., Northup, D.E., Dahm, C.N., and Boston, P.J. 2004. Persistent coliform contamination in Lechuguilla Cave pools. **Journal of Cave and Karst Studies** 66(3): 102-110.

Northup**,** D.E., Barns, S.M., Yu, Laura, E., Spilde, M.N., Schelble, R.T., Dano, K.E., Crossey, L.J., Connolly, C.A., Boston, P.J., and Dahm, C.N. 2003. Diverse microbial communities inhabiting ferromanganese deposits in Lechuguilla and Spider Caves. **Environmental Microbiology** 5(11): 1071-1086.

Northup, D.E. and Lavoie, K.H. 2001. Geomicrobiology of caves: A review. **Geomicrobiology Journal**, 18(3):199-222.

Northup, D.E., Davis Mobley, E., Ingham, K.L., and Mixon, W.W. 1998. **A Guide to Speleological Literature of the English Language : 1794-1996.** St. Louis: Cave Books. 539pp.

Tone Novak
Oddelek za biologijo / Department of Biology
Univerza v Mariboru / University of Maribor
Koroska 160
SI-2000 Maribor, Slovenia, EU

Interests: Ecology of terrestrial hypogean habitats
Opiliones

Speleobiology of terrestrial habitats are in both ecological and biodiversity sense the most interesting problems to me as far as I can remember. After starting my scientific investigations in 1975-80 at the Institute for Karst Research in Postojna, there was a 15-year gap when I was engaged as a college teacher, and municipal ecologist, respectively. At the moment, the cave entrance zone attract my special attention because of several reasons. In Slovenia, there are only 30-40 dominant terrestrial species in this zone, which deserve to be studied more in details. Consequently, the entrance communities are relatively simple. The entrance habitats (in fact, relatively short caves; up to ca. 100 m) are ideal to study the general characteristics of communities in the epigean/hypogean ecotone, selected cases of coexistence of ecologically similar species as well as selected problems in some species. This zone can provide evidence of how different adaptive mechanisms and strategies can take place in even closely related species within the same habitats. A few such studies are in progress.

Daddy long-legs: zoogeography, taxonomy, ecology of species living in Slovenia, Western and Middle Balkans and eastern Italy

Selected recent papers:

Lipovšek, S., Novak, T. , Janžekovič, F., Senčič, L. & Pabst, M.A. (2004) A contribution to the functional morphology of the midgut gland in phalangiid harvestmen *Gyas annulatus* and *G. titanus* during their life cycle. **Tissue and Cell** 36(4): 275–282.

Novak, T., Lipovšek, S., Senčič, L., Pabst, M.A. & Janžekovič, F. (2004) Adaptations in phalangiid harvestmen *Gyas annulatus* and *G. titanus* to their preferred water current adjacent habitats. **Acta Oecologica** 26: 45–53.

Novak, T. (2005) Terrestrial fauna from cavities in Northern and Central Slovenia, and a review of systematically ecologically investigated cavities. **Acta carsologica** 34(1): 169–210.

Tanja Pipan received her Ph.D. in 2003 in Biology from University of Ljubljana. She is currently Research Fellow at the Karst Research Institute ZRC-SAZU with research interests in the ecology, biology, and systematics of the subterranean copepod fauna, especially in the epikarst. She has active research projects on diversity and biogeography of epikarst invertebrates in Slovenia and the Appalachians (with David Culver), the obligate subterranean animals in seeps in Slovenia and in the Washington, DC area (with David Culver), diversity in epikarst in Romania (with Oana Moldovan) and China, organic carbon flux in caves (with Kevin Simon and David Culver), invertebrate fauna of temporary karst lakes (turloughs), and the systematics of Appalachian epikarst copepods (with Janet Reid).

Pipan is country coordinator for the Slovenian Long Term Ecological Research program, and Assistant Professor of Karstology at University of Koper. She received the 2004 award from the International Society for Subterranean Biology for best presentation at the meeting in Raipur, India and an award in 2005 for best paper at the International Association of Hydrogeology meeting in Kotar, Montenegro. She has traveled extensively in her study of epikarst and other subsurface habitats, including China, Vietnam, U.S., Romania, and Croatia.

Selected recent publications:

Brancelj A, and Pipan T. 2004. Diversity of Copepoda (Crustacea) in the unsaturated zone of karst caves in Slovenia. In: Griffiths HI, Krystufek B and Reed JM, eds. **Balkan biodiversity: pattern and process in the European hotspot**. Dordrecht, The Netherlands: Kluwer Academic. pp. 323-332.

Pipan T. 2005. **Epikarst - a promising habitat. Copepod fauna, its diversity and ecology: a case study from Slovenia (Europe).** ZRC Publishing, Karst Research Institute at ZRC SAZU, Ljubljana, Slovenia.

Pipan T, and Culver DC. 2005. Estimating biodiversity in the epikarstic zone of a West Virginia cave. **Journal of Cave and Karst Studies** 67: 103-109.

Pipan T, and Culver DC. 2005. Epikarst communities: biodiversity hotspots and potential water tracers. In: Stevanović Z and Milanović P, eds. **Water resources and environmental problems in karst.** Belgrade: International Association of Hydrogeologists. 823-830.

Pipan T, Blejec A, and Brancelj A. 2006. Multivariate analysis of copepod assemblages in epikarstic waters of some Slovenian caves. **Hydrobiologia** 559: 213-223.

Pipan T., Christman M.C. and Culver D.C. 2006. Dynamics of epikarst communities: microgeographic pattern and environmental determinants of epikarst copepods in Organ Cave, West Virginia. **American Midland Naturalist** 156:75-87.

Slavko Polak received his Master in 2004 in Natural Heritage Conservation Master Study of Ljubljana University. He is a biologist and Senior Curator of Notranjska Museum in Postojna, where he founded and lead the Biological department and collection. He works on inventarisation and popularization of fauna and flora of Notranjska region with broad research interest on different animal groups, mostly on vertebrates, beetles and butterflies of the region and subterranean beetles on wider Dinaric scale. He is preparing an Atlas on Subterranean beetles of Slovenia. Last year he is working on molecular phylogeny of Leptodirinae. As a curator he made couple of exhibitions but the opening of new Speleo-vivarium in 2004 in Postojna cave is his fundamental work.

Polak is member of most Slovene zoological societies (working on birds, bats, butterflies, dragonflies, entomology, herpetology, natural heritage conservation…) and some of International societies. In DOPPS - BirdLife Slovenia he was member of Board for 15 years, president last two years and founder of regional Notranjska group. He was included in projects working on proposals for site protection of Notranjska (Snežnik) Regional Park, Cerknica Ramsar site, Slovene IBA, SPA and Natura 2000 sites designation.

Selected recent publications:

Polak, S. 2000. Slovenia. In; Important Bird Areas in Europe: Priority sites for conservation (eds: M. F. Heath and M.I. Evans), 2: Southern Europe. Cambridge, UK, BirdLife International (**BirdLife Conservation Series No. 8**), p.p.503-513.

Polak, S. 2001. Description of nests, nestlings and breeding behavior of a Yemen Serin *Serinus menachensis* population in Tawi Attair Sinkhole, Sultanate of Oman. **Acrocephalus** 22 (104-105): 3-8.

Weygoldt, P., H. Pohl, and S. Polak. 2002. Arabian whip spiders: four new species of the genera *Charinus* and *Phrynichus* (Chelicerata: Amblypygi) from Oman and Socotra. **Fauna of Arabia,** 19: 289-309.

Polak, S. 2002. *Spelaeodromus sneznikensis* sp. nov. from Slovenia (Coleoptera: Cholevidae; Leptodirinae): **Acta entomologica Slovenica** 10 (1),

Polak, S., L. Kebe, and B. Koren. 2004. Thirteen years of the Corncrake *Crex crex* census at Lake Cerknica. Kongres ornitologov Slovenije ob 25. obletnici DOPPS, 19.02.2005 Grand Hotel Union, Ljubljana., **Acrocephalus** 25 (121): 59-70.

Polak, S. 2004. Cenoses and species phenology of Carabid beetles (Coleoptera: Carabidae) in three stages of vegetational succession on upper Pivka karst (SW Slovenia). XVII. SIEEC – Societas Inaternationalis Entomofaunistica Europae Centralis, Radenci – Slovenija, **Acta entomologica Slovenica,** 12. (1): 57-72.

Polak, S. 2005. Importance of discovery of the first cave beetle *Leptodirus hochenwartii* Schmidt, 1832. Centenario del descubrimiento de *Typhlociriolana moraguesi* en Coves del Drac. XIII Jornadas cientificas de la SEDECK, Mallorca, 10 – 12 spetember 2004. **Endins**, num. 28: 71-80.

Megan L. Porter received her Ph.D. in 2005 in Molecular Evolution from Brigham Young University, Utah, USA. She is currently a postdoctoral researcher at the University of Maryland Baltimore County with broad research interests in the molecular evolution, phylogeography, and phylogenetic systematics of cave faunas. She is active in research projects investigating the microbial community composition of sulfidic cave ecosystems (with A.S. Engel), the population genetics of epikarst copepods (with D. Culver, S. Iepure, O. Moldovan, and T. Pipan), the reduction and loss of visual system components in bat flies (with K. Dittmar de la Cruz), the biogeography of subterranean mysid fauna, and the age of cave-adapted lineages relative to karst age.

Porter has served as chair of the National Speleological Society (NSS) Biology Section since 2001. She has organized or co-organized symposia and workshops on *New Frontiers in Biospeleology* (NSS, 1998), *National Karst Databases Initiatives* (NSS, 2006), and *Estimating Age in Karst* (Karst Waters Institute, 2007). She received the NSS Mitchell Award in 1998 for the best presentation by someone younger than 25 and was named a Fellow of the NSS in 2003 for significant contributions to the society. She has traveled extensively in her study of cave fauna ecology and evolution, including Romania, Malaysia, Dominican Republic, Mexico, and Italy.

Selected Recent Publications:

Porter, M.L., K. Meland, and W. Price. in press. Global assessment of Mysida (Crustacea) from inland waters. **Hydrobiologia**.

Porter, M.L. in press. Molecular Perspectives on Subterranean Biogeography. **Journal of Cave and Karst Studies**.

Dittmar, K., M.L. Porter, S. Murray, and M.F. Whiting. 2006. Molecular phylogenetic analysis of nycteribiid and streblid bat flies (Diptera: Brachycera, Calyptratae): Implications for host associations and phylogeographic origins. **Molecular Phylogenetics and Evolution** 38:155-170.

Engel, A.S., M.L. Porter, L.A. Stern, S. Quinlan, and P.C. Bennett. 2004. Bacterial diversity and ecosystem function of filamentous microbial mats from aphotic (cave) sulfidic springs dominated by chemolithoautotrophic "*Epsilonproteobacteria*". **FEMS Microbiology Ecology** 51:31-53.

Porter, M.L. and K.A. Crandall. 2003. Lost along the way: The significance of evolution in reverse. **Trends in Ecology and Evolution** 18(10):541-547.

Katie Schneider's first interest in cave research was spurred by Dr. David Culver from American University. After I took one of his biogeography courses, I started to work as his research assistant, compiling data regarding the distribution of troglobionts and stygobionts east of the Mississippi River, USA. After a year of sorting through publications, writing information in cells of an Excel spreadsheet, and mispronouncing Latin names, I finally got the chance to see these animals in their natural environment. In 2001, I attended a workshop put on by the Karst Waters Institute and not only learned more about cave biodiversity through presentations by expert biospeleologists, but also went caving for the first time. Fascinated by caves and the spectacular species that reside therein, I was immediately hooked. On the drive back from the workshop, Dave and I talked about pursuing a master's degree in biology while I was at American, where he would be my advisor.

For my master's work, I investigated the distribution of troglobionts, focusing specifically on the importance of large scale sampling. As most of the caves that are investigated are large and easily accessible caves, I sampled the entire suite of caves in a high cave density area to determine how many species are missing if only a portion of those caves are sampled. The results of this study can be found in the publications listed below.

Now, as a fourth year Ph.D. student at the University of Maryland, I am continuing my research in cave ecology and the distribution of troglobionts, under the direction of Dr. William F. Fagan. For my dissertation work, I am studying how the availability of nutrients and energy influences the biodiversity of cave ecosystems. Specifically, I am interested in how the quantity and quality of allochthonous inputs into caves support the obligate cave species that depend on these resources. I am also interested in the stoichiometry of cave arthropods (that is, their chemical composition, namely C: N: P), and its relationship to cave adaptation. Many of the cave-adapted life history strategies may be correlated with changes in body stoichiometry, such as slow growth and thin cuticles (associated with low P and N, respectively). I am testing this hypothesis through experiments both in the field and in the laboratory, including a large scale resource manipulation experiment.

I am also continuing my research related to sampling questions and cave biodiversity through the use of repeated sampling of a large number of caves in a small (~20 km^2) area. In general, I hope to learn more about large scale patterns of cave biodiversity, as well as to investigate the potential for resource availability to structure cave communities and ultimately drive these patterns.

I have received several grants while working on this research, including support from the Cave Conservancy Foundation, the Cave Research Foundation, and the West Virginia Association of Cave Studies. Awards received include the Tom Kane Memorial Award for Interdisciplinary Research in Karst Science from the Cave Research Foundation (2006) and the James G. Mitchell Award for the best scientific paper by a young researcher at a National Speleological Society Convention (2003).

Selected Publications

Schneider, K. & D.C. Culver. 2004. Estimating subterranean species richness using intensive sampling and rarefaction curves in a high density cave region in West Virginia. **Journal of Cave and Karst Studies** 66 (2): 39-45.

Schneider, K. 2003. **The Biogeography of the Subterranean Invertebrate Fauna of West Virginia** [Thesis]. American University: Washington (DC). 82pp. Available from: UMI Microforms, Ann Arbor, MI; 1413637

Kevin S. Simon received his Ph.D. in 2000 in Biology from Virginia Tech. He is currently an Assistant Professor in the Biological Sciences Department at the University of Maine. His research deals primarily with ecosystem function (carbon and nitrogen cycling) and microbial ecology of cave and surface streams. His doctoral work focused on food web structure and organic matter dynamics in cave streams (with Fred Benfield at VT). As a postdoctoral fellow at the Univerisity of Otago, New Zealand he studied how invasive fish and agricultural landuse alter nitrogen cycling in streams. His current research dealing with karst systems includes organic carbon flux in caves (with Dave Culver and Tanja Pipan) and the response of microbial community structure and function to variation in quality of dissolved organic matter and the presence of grazing invertebrates.

Selected recent publications:

Simon, K.S., C. R. Townsend, B. J. F. Biggs, and W. B. Bowden. 2005. Seasonal patterns of N and P uptake in 2 New Zealand streams. **Journal of the North American Benthological Society** 24(1):1-18.

Simon, K.S., C. R. Townsend, B. J. F. Biggs, W. B. Bowden, and R.D. Frew. 2004. Habitat-specific nitrogen dynamics in New Zealand streams containing native or invasive fish. **Ecosystems** 7(8):777-792.

Simon, K.S., E.F. Benfield, and S.A. Macko. 2003. Food web structure and the role of epilithic biofilms in cave streams. **Ecology** 84(9):2395–2406.

Simon, K.S. and E.F. Benfield. 2002. Ammonium retention and whole-stream metabolism in cave streams. **Hydrobiologia** 482 (1-3):31-39.

Simon, K.S. and E.F. Benfield. 2001. Leaf and wood breakdown in cave streams. **Journal of the North American Benthological Society** 20(4):550-563.

Boris Sket received his Ph.D. in Biology from Ljubljana University, Slovenia, in 1961. He is currently Professor of Invertebrate Zoology and Speleobiology at the Biology Department, Biotechnical Faculty, University of Ljubljana. He is interested in fauna in general, but particularly in its subterranean components. In taxonomy, mainly freshwater Isopoda, Amphipoda, Hirudinea; biodiversity (with David Culver, Maja Zagmajster), conservational issues and biogeographical patterns in karst areas, origins of cave fauna. He did ecological investigations (probably the first ones) in anchihaline caves and studied consequences of pollution in cave waters. At the moment, he is particularly active in phylogenetic and taxonomical study of some invertebrate groups and of *Proteus* (with Peter Trontelj, Rudi Verovnik, Simona Prevorčnik, Cene Fišer, Valerija Zakšek, Špela Gorički), as well as in the evaluation and analysis of the subterranean biodiversity in the Western Balkans (with Maja Zagmajster and foreign colleagues).

Sket is the President of the International Society for Subterranean Biology; a Honorary Member of the former Speleological Union of Yugoslavia and prizeman of some state awards; member of some editorial and advisory boards. He was the Dean of the Biotechnical Faculty and the Rector of the ljubljana University, also the National coordinator for biology. Currently, he is the Head of the Research Group of Zoology and Speleobiology in his institution.

Selected publications:

Sket B., Velikonja M., 1986. Troglobitic freshwater sponges (Porifera, Spongillidae) found in Yugoslavia. **Stygologia**, 2(3): 254-266

Sket B., 1994. Distribution patterns of some subterranean Crustacea in the territory of the former Yugoslavia. **Hydrobiologia** 287: 65-75

Sket B., 1997. Distribution of Proteus (Amphibia: Urodela: Proteidae) and its possible explanation. **J. Biogeogr.,** 24: 263-280

Verovnik, R., Sket, B. & Trontelj, P., 2005. The colonization of Europe by the freshwater crustacean *Asellus aquaticus*(Crustacea: Isopoda) proceeded from ancient refugia and was directed by habitat connectivity. **Molecular Ecology**, 14: 4355-4369.

Sket B., 1977. Gegenseitige Beeinflussung der Wasserpollution und des Hohlenmilieus**. Proc. 6th Intern. Congr. Speleol., Olomouc** 1973, 5: 253-262

Sket B., 1986. Ecology of the mixohaline hypogean fauna along the Yugoslav coast. **Stygologia**, 2(4): 317-338

Sket B., 1996. The ecology of the anchihaline caves. **Trends Ecol. Evol**. 11(5): 221-225

Sket B. & Šapkarev J., 1992. Distribution of Hirudinea (Annelida) in the ancient Ohrid Lake region. **Arch. Hydrobiol**. 124(2): 225-237

Danielopol D. L., Gunatilaka, A., Notenboom, J., Griebler, C., Gibert, J., Sket, B., Hahn, H.J., Messana, G., Lüders, T., Griffoen, J., Liebich, J. & Albrechtsen, H.-J., 2006. Groundwater ecology as a necessary link to the EU Water Framework Directive. **European Groundwater Conference 2006**, Presentation abstracts Chapter 1.3.5: 94-99.

Sket B., 1992. Conservation of sites important for their hypogean aquatic fauna. A proposal. **Bull. Liais. Soc. Biospeol.** 19: 23-26

Sket B., 1999. The nature of biodiversity in hypogean waters and how it is endangered**. Biodiversity & Conservation**, 8(10): 1319-1338

Sket B., 1999. High biodiversity in hypogean waters and its endangerment – the situation in Slovenia, Dinaric karst, and Europe. **Crustaceana,** 72(8): 767-779.

Sket, B., K. Paragamian, and P. Trontelj, 2004. A census of the obligate subterranean fauna in the Balkan Peninsula. In: H.I. Griffiths & B. Krystufek (eds), Balkan Biodiversity. **Pattern and Process in Europe's Biodiversity Hotspot**. Kluwer Academic Publishers B.V., pp 309-322.

Zakšek, V., Sket, B. & Trontelj, P., 2006. Phylogeny of the cave shrimp Troglocaris: evidence of a young connection between Balkans and Caucasus. **Molecular Phylogenetics and Evolution**, doi:10.1016/j.ympev.2006.07.009

Michael E. Slay is pursuing his M.S. in Biology from University of Arkansas. He is currently employed as Karst Ecologist for The Nature Conservancy with research interests in biodiversity, ecology, and conservation of subterranean fauna. He has active research projects on the description, diversity, and monitoring of subterranean animals in the Ozarks and Great Basin area (Steve Taylor and others), the comparison of terrestrial communities and habitats in caves and abandoned limestone mines, the delineation of aquatic subterranean habitats (Tom Aley), flooding impacts to aquatic cave species relative to land use changes, and long term groundwater monitoring of endangered cave species habitats.

Slay is a member of the International Society of Subterranean Biology, member of the National Speleological Society, and member of the Entomological Society of America.

Selected publications:

Slay, M. E., W. R. Elliott, and R. Sluys. 2006. Cavernicolous Missouri Triclad (Platyhelminthes: Turbellaria) records. **Southwestern Naturalist** 51:251-252.

Graening, G.O., M.E. Slay, and J.R. Holsinger. 2006. Annotated checklist of Amphipoda of Arkansas with emphasis on groundwater habitats. **Journal of the Arkansas Academy of Science** 59:80-87.

Landolt, J.C., S.L. Stephenson, and M.E. Slay. 2006. Dictyostelid cellular slime molds from caves. **Journal of Cave and Karst Studies** 68:22-26.

Graening, G. O., M. E. Slay, A. V. Brown, and J. B. Koppelman. 2006. Status and distribution of the endangered Benton Cave Crayfish, *Cambarus aculabrum* (Decapoda: Cambaridae). **Southwestern Naturalist** 51:376-381.

Boštjan Surina received his Ph.D. in 2004 in Biology from University of Ljubljana. He is currently a postdoctoral Marie Curie fellow at the University of Vienna, Faculty of Life Sciences, Department of Biogeography (funding: European Community MEIF-CT-2005024315). His research interests are biodiversity, biogeography, phylogeny, systematics and phylogeography of SE flora with an emphasis on Balkan endemics. His active research projects are on focused on Dinaric-Balkan genera Edraianthus and Heliosperma (with Harald Niklfeld, Peter Schönswetter, and Gerald Schneeweiss), as well as Moehringia, Papaver and Saxifraga. He also provides research on high-alpine vegetation of SE Alps and Dinaric Mts.

Boštjan Surina is University Assistant at University of Koper. He received the Jesenko award of the Biotechnical faculty, University of Ljubljana for his research achievements in 2002. In his studies he conducted several botanical trips to the Balkans (Croatia, Bosnia and Hercegovina, Montenegro, Serbia, Bolgaria, Romania), Alps (Italy, Austria, Switzerland), Apennines, and Sicily.

Selected recent publications:

SURINA, B., I. DAKSKOBLER. 2005. Delimitation of the alliances Caricion firmae (Seslerietalia albicantis) and Seslerion juncifoliae (Seslerietalia juncifoliae) in the southeastern Alps and Dinaric mountains. **Plant Biosystems** 139: 399-410.

SURINA, B. 2005. Phytogeography and syntaxonomy of snow-bed vegetation on calcareous soils in the South-eastern Alps: a numerical approach. **Annales, Series historia naturalis** 15 (2): 10-19.

SURINA, B. 2005. Subalpine and alpine vegetation in the Krn area in the Julian Alps. **Scopolia** 57: 1-222.

SURINA, B. 2005. Some novelties in the flora and vegetation of the Mt Snežnik (SW Slovenia, Liburnian karst). **Acta Botanica Croatica** 64: 341-356.

SURINA, B. 2004. *Carex austroalpina* Becherer, a new South-eastern-Alpine species for the flora of Slovenia, and *Viola pyrenaica* Ramond ex DC., second recording for the flora of the Julian Alps. **Annales, Series historia naturalis** 14: 231-236.

SURINA, B. 2002. Phytogeographical differentiation in the Dinaric fir-beech forest (*Omphalodo-Fagetum* s. lat.) of the western part of the Illyrian floral province. **Acta Botanica Croatica** 61: 145-178.

KOVAČIĆ, S., B. SURINA 2006. *Campanula waldsteiniana* (Campanulaceae): a new species in the flora of Slovenia**. Razprave IV.razreda SAZU**, in press.

SURINA, B., B. VREŠ. 2004. Phytsociological characteristics of sites of *Heliosperma pusillum* (=*Silene pusilla*, Caryophyllaceae) in the freezing ravines on the Snežnik Plateau (SW Slovenia). **Razprave IV.razreda SAZU** 45: 147-183.

Nina Šraj-Kržič is a PhD student of Biology, Biology Faculty at the University of Ljubljana. She works as a young researcher in the group of Plant Ecology at the Department of Biology, BF, with research interests in the ecology and eco-physiology of plants, especially aquatic and wetland plants. In the framework of her doctoral thesis she is investigating the distribution of plant species in intermittent karstic watercourses (partly through the MIDCC project - Multifunctional Integrated Study Danube Corridor and Catchment), the influence of variable water regime on plant species diversity at the Cerknica Lake. She is studying the differences between submerged and emerged specimens of plants with amphibious character. She is also interested in mycorrhizal colonisation of plants from intermittent aquatic habitats.

Šraj-Kržič is actively participating in laboratory work and field work with students of Biology. In past two years she translated four booklets on ecology for children.

Selected recent publications:

Šraj-Kržič, N., Gaberščik, A., Germ, M. 2004. The phenotypic plasticity of Glyceria fluitans growing over the water/land gradient. **Acta Biologica Slovenica** 47 (2), 65-73.

Šraj-Kržič, N., Gaberščik, A. 2005. Photochemical efficiency of amphibious plants in an intermittent lake. **Aquatic Botany** 83, 281-288.

Šraj-Kržič, N., Pongrac, P., Klemenc, M., Kladnik, A., Regvar, M., Gaberščik, A. 2006. Mycorrhizal colonisation in plants from intermittent aquatic habitats. **Aquatic Botany** (in press)

Peter Trontelj received his PhD in 1997 in Biology from the University of Tübingen, Germany. He is currently associate professor of Zoology and Molecular evolution at the University of Ljubljana, Slovenia. He is a member of Boris Sket's team at the Department of Biology at the same university. His research interests in subterranean biology lie in biodiversity, systematics, evolution, and conservation biology. His methodological approaches are mainly molecular phylogenetics, phylogeography and population genetics. Recently, he has been involved in the study of cryptic diversity patterns of stygobiotic fauna within PASCALIS and other projects. He is also interested in comparative studies of diversification and speciation patterns of epigean freshwater fauna, especially in karst areas. He has been working with David Culver and others on the study of regional and larger-scale subterranean biodiversity patterns.

Trontelj has received no relevant awards or honors, neither has he been invited to participate at important boards or committees.

Selected recent publications:

TRONTELJ Peter, SOTLER Maruša, VEROVNIK Rudi. 2004: Genetic differentiation between two species of the medicinal leech, *Hirudo medicinalis* and the neglected *H. verbana*, based on random-amplified polymorphic DNA. **Parasitology Research** 94, 118-124.

VEROVNIK Rudi, SKET Boris, TRONTELJ Peter. 2004: Phylogeography of subterranean and surface populations of water lice *Asellus aquaticus* (Crustacea: Isopoda). **Molecular Ecology** 13, 1519-1532.

TRONTELJ Peter, MACHINO Yoichi, SKET Boris. 2005: Phylogenetic and phylogeographic relationships in the crayfish genus *Austropotamobius* inferred from mitochondrial COI gene sequences. **Molecular Phylogenetics and Evolution** 34, 212-226.

TRONTELJ Peter, UTEVSKY Y Serge. 2005: Celebrity with a neglected taxonomy: molecular systematics of the medicinal leech (genus *Hirudo*). **Molecular Phylogenetics and Evolution** 34, 616-624.

VEROVNIK Rudi, SKET Boris, TRONTELJ Peter. 2005: The colonization of Europe by the freshwater crustacean *Asellus aquaticus* (Crustacea: Isopoda) proceeded from ancient refugia and was directed by habitat connectivity. **Molecular Ecology** 14, 4355–4369.

LEFÉBURE T., DOUADY C.J., GOUY M., TRONTELJ P., BRIOLAY J., GIBERT J. 2006: Phylogeography of a subterranean amphipod reveals cryptic diversity and dynamic evolution in extreme environments. **Molecular Ecology** 15, 1797–1806.

ZAKŠEK Valerija, SKET Boris, TRONTELJ Peter. 2006: Phylogeny of the cave shrimp *Troglocaris*: evidence of a young connection between Balkans and Caucasus. **Molecular Phylogenetics and Evolution**, doi:10.1016/j.ympev.2006.07.009

Rudi Verovnik received his Ph.D. in 2003 in Biology from University of Ljubljana. He is currently assistant professor at the University of Ljubljana, Biotechnical faculty, Department of Biology with research interests in biodiversity, systematics and conservation of subterranean Isopoda and karstic grassland butterflies. His main fields of study are the phylogeography of aquatic crustaceans in Europe with special emphasis on cave invasions, the phylogenetic relationship within *Monolistra* (Crustacea: Isopoda) genus and biodiversity and conservation of butterflies (Lepidoptera: Rhopalocera) in Slovenia. He was a coworker on the PASCALIS (Protocols for the assessment and conservation of aquatic life in the subsurface) project. He has active research projects on diversity and biogeography of stygobiont invertebrates in Slovenia and Dinaric karst (with Boris Sket, Peter Trontelj), diversity of butterflies in military areas including two in karstic region (with Al Vrezec).

Verovnik is country coordinator for the Slovenian Atlas of butterflies and has extensive knowledge of the distribution and endangerment of butterflies in Slovenia. He has organized or being part of expeditions to SE Asia karstic regions and has actively participated at International Society for Subterranean Biology meetings in Makarska 1999 and Sao Paolo 2001.

Selected recent publications:

Verovnik R. 2004. The presence of *Plebeius pyrenaicus dardanus* (Feyer, 1845) (Lepidoptera: Lycaenidae) on Mt Čvrsnica in Bosnia and Herzegovina, with notes on the butterfly fauna of this mountain. **Entomologist gazette** 55: 29-34.

Verovnik R., Sket B., Trontelj P. 2004. Phylogeography of subterranean and surface populations of water lice *Asellus aquaticus* (Crustacea: Isopoda). **Molecular Ecology** 13: 1519-1532.

Trontelj P, Sotler M., and Verovnik R. 2004. Genetic differentiation between two species of the medicinal leech, *Hirudo medicinalis* and the neglected *H. verbana*, based on random-amplified polymorphic DNA. **Parasitology research** 94: 118-124.

Predovnik Ž., and Verovnik R. 2005. New records of rare pierids (Lepidoptera: Pieridae) in Slovenia. **Natura Sloveniae** 6: 39-47.

Čelik T., Verovnik R., Gomboc, S., and Lasan M. (ČELIK, Tatjana edt). 2005, **Natura 2000 in Slovenia, Butterflies, = Lepidoptera.** Ljubljana, Slovenia, ZRC Publishing.

Verovnik R., Sket, B., and Trontelj P. 2005. The colonization of Europe by the freshwater crustacean *Asellus aquaticus* (Crustacea: Isopoda) proceeded from ancient refugia and was directed by habitat connectivity. **Molecular Ecology** 14: 4355-4369.

Branko Vreš received his Ph.D. in 1996 in Biology from the University of Zagreb. He is currently Senior Research fellow at the Jovan Hadži Institute of Biology, Scientific Research Centre of the Slovenian Academy of Sciences and Arts (SRC SASA) with research interests in botany, plant taxonomy, biodiversity, biogeography, habitat types and nature conservation. He has experience in mapping of flora, vegetation and habitats. He has been active in development of biological database and information system (FloVegSi).

Regarding karst studies he has been researching diversity of flora of karst ponds, intermittent lakes, wet and dry grasslands, shrubs, forests and overgrown habitats. He has been active at the fallowing research projects dealing with karst: Flora, Vegetation and Fauna of the Kras Regional Park (1995), Research on the Flora, Fauna and Vegetation of the Škocjan Caves Regional Park (2001-2003), Spatial Indicators for European Nature Conservation (SPIN) 2002-2005, project Aquadapt (Strategic tools to support adaptive integrated water resource management under changing conditions at catchment scale: A co-evolutionary approach, 5th European Framework Programme), Kras - region biodiversity, successional stages and conservation significance (2004-2007), Mapping of nonforest habitat types – Pivka east (2004), Biodiversity of Posočje and nature conservation applications for Natura 2000 sites (2005-2008).

From 2003-2006 he was head of the Jovan Hadži Institute of Biology, SRC SASA. He is a member of Botanical Society of Slovenia and Biological Society of Slovenia, Ostalpin-Dinaric Society of Phytosociology, International Association for Vegetation Science, OPTIMA (Organization for the phyto-taxonomic investigation of the Mediterranean area), Natural History Society of Slovenia, a vicepresident of CLUSIUS - Internationale Forschunggesellschaft. From 1997 was a managing editor of *Acta Biologica Slovenica* (Ljubljana), from 2001-2003 a member of editorial board of *Herbika* (Ljubljana).

Selected recent publications:

Surina, B., Vreš, B. 2004: Fitocenološka oznaka rastišč vrste Heliosperma pusillum (=Silene pusilla, Caryophyllaceae) v mraziščih na Snežniku (JZ Slovenija) = Phytosociological characteristics of sites of Heliosperma pusillum (=Silene pusilla, Caryophyllaceae) in freezing ravines on the Snežnik plateau (SW Slovenia). **Razpr. - Slov. akad. znan. umet., Razr. naravosl. vede,** 45, 2, str. 147-183.

Gomboc, S., Seliškar, T., Seliškar, A., Vreš, B., Celar, F., Milevoj, L. 2003: Šifrant organizmov in njegova uporaba v informacijskih sistemih = Species list and its application in the information systems. V: Maček, J. (ur.). **Zbornik predavanj in referatov 6. slovenskega posvetovanja o varstvu rastlin, Zreče, 4.-6. marec 2003**. Ljubljana: Društvo za varstvo rastlin Slovenije: = Plant Protection Society of Slovenia, 2003, str. 398-401.

Vreš, B. 2004: Eleocharis carniolica W.D.J.Koch - kranjska sita. and Marsilea quadrifolia L. - štiriperesna marsiljka, marzilka. - V: Čušin, B. (ur.). **Natura 2000 v Sloveniji, Rastline.** Ljubljana: Založba ZRC, ZRC SAZU, str. 76-82, str. 120-124.

Babij, V., Seliškar, A., Vreš, B., Zelnik, I. 2005: Flora in vegetacija kalov in lokev na Krasu = Flora and vegetation of karstic ponds "kali and lokve" (Kras, Slovenia). - V: Mihevc, A. (ur.). **Kras : voda in življenje v kamniti pokrajini = water and life in a rocky landscape, (Projekt Aquadapt).** Ljubljana: Založba ZRC, ZRC SAZU, str. 83-99.

Čelik, T., Zelnik, I., Babij, V., Vreš, B., Pirnat, A., Seliškar, A., Drovenik, B. 2005: Inventarizacija kalov in lokev na Krasu ter njihov pomen za biotsko raznovrstnost = Inventory of karstic ponds (kal and lokev) and their importance for biotic diversity. - V: Mihevc, A. (ur.). **Kras : voda in življenje v kamniti pokrajini = water and life in a rocky landscape, (Projekt Aquadapt).** Ljubljana: Založba ZRC, ZRC SAZU, str. 72-82.

Trpin, D., Vreš, B., Kurtto, A. (ur.), Lampinen, R. (ur.), Junikka, L.(ur.) 2004: **Atlas florae europaeae : distribution of vascular plants in Europe. 13, Rosaceae (Spiraea to Fragaria, excl. Rubus).** Helsinki: The Committee for Mapping the Flora of Europe: Societas Biologica Fennica Vanamo, 320 str.

Dobravec, J., Seliškar, A., Tome, S., Vreš, B. 2001: **Biotopi Slovenije CORINE**. Ljubljana: Založba ZRC, ZRC SAZU, 110 str.

Seliškar, A., Vreš, B., Surina, B., Seliškar, T. 2001: Use of GIS in floristic and vegetation investigations in Slovenia. V: **Successione della vegetazione nelle aree marginali e utilizzo del telerilevamento e del GIS : workshop, 31 May - 2 June** . Trieste: Societa Estalpino-Dinarica di fitosociologia.

Al Vrezec received his Ph.D. in 2004 in Biology from University of Ljubljana. He is currently Research Assistant at National Institute of Biology, Ljubljana, with broad research interests in ecology of terrestrial ecosystems, surface as well as subterranean, and ecosystem function with special emphasis put on interaction studies, e.g. competition, predation, mutualism, and population dynamics patterns. Most of his studies he conducted on birds and beetles. He has active research projects on distribution, habitat selection and population size estimation of the Stag Beetle in NE Slovenia, biodiversity and conservation of the environment at military areas in Slovenia (with Olga Urbanc Berčič), and communities, relations and communications in the ecosystems (with Anton Brancelj).

Vrezec is Vice President of BirdLife Slovenia, former Editor-in-Chief of the international ornithological journal **Acrocephalus**, member of Raptor Research Foundation, and Research Associate at the Global Owl Project. He co-organized the First Slovenian Ornithologists Congress (2005), and actively participated at several international symposia and workshops in Slovenia, Austria, Switzerland, France, and Spain. He made several research trips to Montenegro, Croatia and Finland. For the best scientific ornthological paper in Slovenia he was awarded two times, in 2000 and 2004.

Selected recent publications:

A. Vrezec. 2001. Description of the new subspecies *Anophthalmus pretneri ceji* (Coleoptera: Carabidae: Trechinae) from Slovenia. **Acta entomologica slovenica** 9 (1): 5-12.

A. Vrezec. 2003. Breeding density and altitudinal distribution of the Ural, Tawny, and Boreal Owls in North Dinaric Alps (central Slovenia). **J. Raptor Res.** 37 (1): 55-62.

A. Vrezec, and V. Tutiš. 2003: Characteristics of North Dinaric Ural Owl (*Strix uralensis macroura*) population. In: O. Schwerdtfeger, and J. Schwerdtfeger [eds.]. **Internationales Symposium Dornbirn 2003: Ökologie und Schutz europäischer Eulen, Ecology and Conservation of European Owls**: 75.

A. Vrezec, and D. Tome. 2004. Altitudinal segregation between Ural Owl *Strix uralensis* and Tawny Owl *S. aluco*: evidence for competitive exclusion in raptorial birds. **Bird Study** 51: 264-269.

A. Vrezec, and D. Tome. 2004. Habitat selection and patterns of distribution in a hierarchic forest owl guild. **Ornis Fennica** 81: 109-118.

A. Vrezec, A. Kapla, A. Pirnat, and Š. Ambrožič. 2005. Relative activity abundances of the Dor Beetles (Coleoptera: Scarabaeoidea: Geotrupidae) in Slovenia: a large-scale aplication of the survey method using pitfall traps. **Acta entomologica slovenica** 13 (2): 145-164.

Carol M. Wicks received her PhD in 1992 in Environmental Sciences from the University of Virginia. She is currently a Professor in the Department of Geological Sciences at the University of Missouri – Columbia, with broad research interests in subterranean stream ecosystems, particularly habitat disturbance due to physical processes, and karst hydrology and contaminant transport. She has research active at numerous karstic basins in Missouri.

Wicks was a member of the National Research Council's "Science and the Greater Everglades Ecosystem Restoration: An Assessment of the Critical Ecosystem Studies Initiative" and of the National Science Foundation's "Environmental Geochemistry and Biogeochemistry" Panel. She has served on the editorial boards of *Water Resources Research and Ground Water*. She served on the Geological Society of America's Research Grant Committee and the Joint Technical Program Planning Committee for five years. She is President of the Karst Waters Institute.

Selected recent publications:

Wicks, C.M., Noltie, D.B., Dogwiler, T., Lerch, R.N., in review, Disturbance of the streambed habitat of the endemic pink planarian (Macrocotyla glandulosa Hyman). **Freshwater Biology**

Jenzen, E., and Wicks, C.M., in review, Rates of Infiltration through the Losing Reach of Bonne Femme Creek, Missouri: A Technical Report, **Journal of Cave and Karst Studies.**

Dogwiler, T., and Wicks, C.M., 2005, Thermal variations in the hyporheic zone of a karst stream, **Speleogenesis and Evolution of Karst Aquifers**, v. 3, no. 1, p. 1-11.

Lerch, R.N., Wicks, C.M., Moss, P.L. 2005, Hydrologic characterization of two karst recharge areas in Boone County, Missouri, **Journal of Cave and Karst Studies**, v. 67, no. 3, p. 158-173.

Peterson, E.W. and Wicks, C.M., 2005, Fluid and solute transport from a conduit to the matrix in a carbonate aquifer system: **Mathematical Geology**, v.37, no. 8, p. 851-868.

Peterson, E.W., Wicks, C.M., and Kelley, C.A., 2005, Persistence of 17 β-estradiol in waters and sediment-pore water from cave streams in Central Missouri: **Environmental and Engineering Geology**, v. XI, no. 3, p. 221-228.

Dogwiler, T.J. and Wicks, C.M., 2004, Sediment Entrainment and Transport in Fluviokarst Systems, **Journal of Hydrology**, doi:10.1016/j.jhydrol.2004.03.002.

Wicks, C.M., Kelley, C.A., and Peterson, E.W., 2004, Estrogen in a karstic aquifer, **Ground Water**, v. 42, p. 384-389.

Peterson, E. W. and Wicks, C. M., 2003, Characterization of the physical and hydraulic properties of the sediment in karst aquifers of the Springfield Plateau, Central Missouri, USA, **Hydrogeology Journal**, 11:357-367 DOI10.1007/s10040-003-0260-x.

Noltie, D.B., and Wicks, C.M., 2001, How hydrogeology has shaped the ecology of Missouri's Ozark cavefish, *Amblyopsis rosae,* and southern cavefish, *Typhlichthys subterraneus*, **Journal of the Environmental Biology of Fishes**, p. 171-194.

Maja Zagmajster is a PhD student at the University of Ljubljana, Biotechnical Faculty, Department of Biology, with broad research interests in the biology of subterranean fauna and bats (Chiroptera). Her main field of research is the biodiversity and biogeography of subterranean fauna in the Dinaric karst (Balkan Peninsula), with troglobiotic beetles (Coleoptera) chosen as the model study group. She was a coworker in the PASCALIS (Protocols for the assessment and conservation of aquatic life in the subsurface) project. She is conducting the study of bat fauna, as part of the cooperative project on biodiversity in military areas in Slovenia (with partners from National Institute of Biology and CKFF – Centre for Cartography of Fauna and Flora). She is the external coworker at the project Monitoring of populations of certain bat species in Slovenia (led by CKFF).

Zagmajster is one of the editors and authors of the Atlas of bats (Chiroptera) in Slovenia, publication in print, issued by CKFF in cooperation with SDPVN – Slovenian Association for Bat Research and Conservation. She is the president of SDPVN. On the subject of bats, she participated at many symposia, workshops and meetings also abroad. On the invitation of European Commission, she presented the Slovenian NGO's evaluations of the governmental list of proposed Sites of Community Interest (Natura 2000 sites under Habitats Directive of EU) at the two Biogeographical Seminars (Kranjska Gora, Slovenia in 2005; Darova, Check Republic in 2006). She actively participated at the international workshop Forum on Karst and World Heritage in Europe (Lipica, Slovenia, 2004) and at the 18th International Symposium of Biospeleology (Cluj, Romania, 2006). She took part in the research expeditions to China (Hainan, 2005), Bosnia and Herzegovina (Popovo polje, 2005) and Ukraine (Crimea, 2006).

Selected recent publications:

Presetnik, P., K. Koselj and M. Zagmajster. 2001. First records of *Pipistrellus pygmaeus* (Leach, 1825) in Slovenia. **Myotis**, 39: 31-34.

Zagmajster, M. 2003. Display song of parti-coloured bat *Vespertilio murinus* Linnaeus, 1758 (Chiroptera, Mammalia) in southern Slovenia and preliminary study of its variability. **Natura Sloveniae**, 5(1): 27-41.

Zagmajster, M., K. Koselj, N. Zupančič, A. Petrinjak and K. Jazbec. 2006. Bat Conservation in Slovenia. **Eurobats Publication series**, 1: 94 – 100.

Zagmajster, M. and L. Kováč. 2006. Survey of the distribution of palpigrades (Arachnida, Palpigradi) in Slovenia with a new record of *Eukoenenia austriaca* (Hansen, 1926). **Natura Sloveniae**, 8(1). (in print).

Zagmajster, M., B. Sket and T. Podobnikar. 2006. Choosing a grid network for spatial analysis of subterranean biodiversity. In: Perko, D., J. Nared, M. Čeh, D. Hladnik, M. Krevs and T. Podobnikar, eds. **Geographic Information Systems in Slovenia 2005 – 2006.** Monography of 8th Bienal Symposium. Ljubljana: ZRC SAZU Publishing: 261 – 269. [in Slovenian, with English abstract].