VODOHOSPODÁŘSKÉ TECHNICKO-EKONOMICKÉ INFORMACE

(WATER MANAGEMENT TECHNICAL AND ECONOMIC INFORMATION)

VTEI / 2026 / 2

60 years ago in VTEI

The article below, *Flood Forecasting by Radar*, was published in *VTEI*, Issue 2, in 1966.

Ronald T. H. Collins, head of the Aerophysics Division at Stanford Research Institute, working with the United States Weather Bureau in Menlo Park, California, has developed an instrument that makes it possible to forecast floods during rainfall. This instrument is intended to enable timely implementation of protective measures against floods, particularly on streams draining uninhabited mountainous catchments, or on those where signs of flooding become apparent only through rising water levels in the lower reaches.

The instrument consists of two parts:

The first of these, the radar equipment, identifies precipitation activity in a manner customary in hydrometeorological practice. The backscatter of radar pulses from water droplets accumulated in the atmosphere indicates precipitation occurring within a certain radius of the radar. In this way, an area of approximately 30,000 square miles (77,500 km^2) can be monitored; this area is divided into 150 nodal points.

The recording of radar signals is continuous, providing an uninterrupted overview of where precipitation is occurring. This information, in the form of "yes" or "no", is transmitted by telephone or radio to the second part, a map model located in the hydrological forecasting centre.

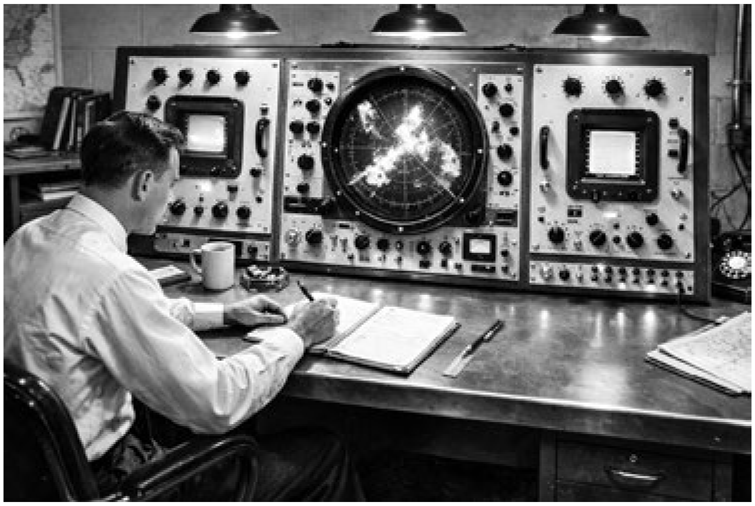
The map covers the same area as the radar equipment, and the coordinate arrangement of its points corresponds to the coordinate grid used by the radar monitors. Each point on the map is equipped with an electromechanical computer (similar to a distance counter on a car odometer) that receives the radar data. The radar system is designed to distinguish between different precipitation intensities. The data displayed on the map thus provide an immediate overview of whether the precipitation consists of light showers, moderate rainfall, or heavy downpours. In addition, the computers provide the total amount of rainfall recorded over a given time interval at any of the monitored points.

By setting all the computers to zero simultaneously and regularly reading the precipitation totals, the operational hydrologist obtains the volume of rainfall not only for the entire catchment but also for any of its sub-catchments. From a forecasting perspective, such quantitative information on the spatial distribution of rainfall is highly valuable.

This allows the hydrological forecasting service to monitor flood development from the early stages of runoff formation in the upper catchment. This enables the timely preparation of flood protection measures and the achievement of maximum flood control. At the same time, it allows for early warning of threatened locations, including in the upper reaches of watercourses.

(Adapted from Water and Water Engineering by Ing. J. Hladný, Central Hydrological Forecasting Service of the Hydrometeorological Institute – Prague)

From TGM WRI archives



Generated by artificial intelligence (ChatGPT)

Content

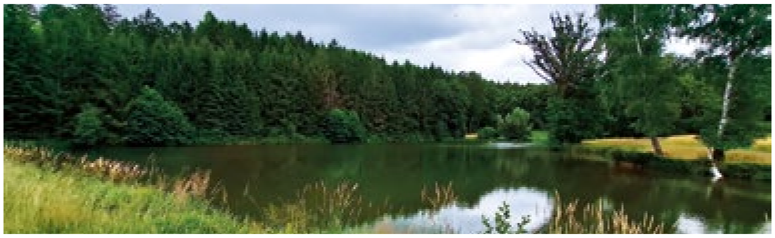


Photo J. Unucka

Dear Readers,

The April issue of VTEI is published at a time when water once again begins to “move” in the landscape – in the soil, in watercourses, in reservoirs, but also in our thinking about what we managed to prepare over the winter and what we postponed. It is also in spring that the importance of water storage and its wise management over time becomes fully apparent. In practice, this means not only major measures but also smaller steps and sound decisions in spatial planning, agriculture, forestry, and the management of reservoirs. At the same time, the debate reopens on how to combine technical solutions with nature-based approaches so that the result is not a one-off effect but a landscape that functions sustainably in the long term.

The second issue of our professional journal VTEI this year offers a diverse mosaic of topics that fit well within this broader framework – from historical contexts to hydrobiology and GIS tools to landscape transformations, as well as an interview that addresses the key issues of current water-management challenges.

We open the scientific section of the April issue of VTEI with the article “Historical water reservoirs – splash dams in the Low Tatras (Slovakia)”, which traces the development of historical splash dams (reservoirs associated with timber floating) in the Hron and Váh river basins, from the 19th century to the present. Based on the interpretation of historical maps, including those of the second military mapping, as well as field verification, the authors demonstrate a significant decline in historical water bodies while also noting that the remnants of these structures may serve as inspiration for present-day adaptation measures in mountain landscapes.

The second scientific article, “Fauna of water mites (*Acari*, *Hydrachnidia*) in the stony littoral of water supply reservoirs in the Czech Republic”, presents extensive findings from a survey of 45 reservoirs used for water supply. The results describe the species composition of water mites in the stony littoral, while also filling gaps in current knowledge – including the record of a species new to the fauna of the Czech Republic and the identification of species that had been found previously but had not yet been listed in the relevant databases.

The third contribution presents the very useful practical tool “Czech Land Use and CN Analyzer: an open tool for generating CN layers and calculating direct runoff from design rainfall in QGIS”. The article describes a plugin that automates the preparation of inputs for the SCS-CN method (land use, hydrologic soil groups, design rainfall) and the subsequent calculation of direct runoff, with an emphasis on the use of open data in the Czech Republic and on a consistent processing workflow. The tool is open, documented, and suitable for both practical applications and teaching.

The fourth scientific article, “Landscape changes in the upper part of the Výrovka basin from a water-management perspective”, examines landscape transformations through a comparison of historical maps, current map sources and orthophotomaps, followed by field verification. Among other findings, the article shows how the intensification of agricultural land use is linked to changes in the location of watercourses, their straightening, deepening, and the drainage of floodplains, and how these changes are reflected in the hydrological regime of the area.

As usual, the April issue includes an interview, this time with RNDr. Pavel Punčochář, CSc., who reflects on his professional path from hydrobiology on to his leadership of TGM WRI to his work in public administration. The central theme, however, is the question of why we will not manage the future without water storage. The interview offers both personal and professional perspectives and helps place the technical topics in a broader context of institutional changes, practical experience, and communication with the public.

The information section is complemented by the article “Boží Dar Peat Bog”, which takes readers to the Ore Mountains – a region of exceptional natural and cultural value that forms part of the historic landscape inscribed on the UNESCO World Heritage List. The article explains what sejpy are, what Blatná Water Ditch was used for, and which educational trails cross this national nature reserve.

This April issue also includes an invitation to the international conference Hydrology Days 2026, which will take place in Bratislava on June 16–18, 2026. An image supplement with further details can be found at the end of this issue.

We hope that the April issue will bring not only new insights but also useful inspiration for practice – whether you are engaged in hydrology, hydrobiology, GIS work, landscape conservation, or water management planning. We wish you inspiring reading and would welcome your suggestions, feedback, and ideas for topics that you believe deserve attention in one of the forthcoming issues of VTEI.

For the VTEI Editorial Team

Ing. Josef Nistler

Historical water reservoirs – splash dams in the Low Tatras (Slovakia)

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Keywords: splash dams – historical water reservoirs – timber floating – 2nd Military Mapping – GIS analysis – Low Tatras

ABSTRACT

The paper analyses the development of historical water reservoirs (splash dams) in the Low Tatras region based on the interpretation of maps from the mid-19th century to the present. In the past, splash dams served as part of the system for floating timber down the Hron and Váh rivers. They represented a key hydro-technical element that significantly influenced the hydrological regime of rivers and the formation of the mountain landscape. The identification of historical splash dams was based on the analysis of maps of the 2nd Military Mapping (1836–1852), which were compared with current map data (ZBGIS, Orthophotomap of the Slovak Republic) and verified by field research.

Fourteen splash dams were identified on historical maps. Their total historical area was 6.28 ha (2nd Military Mapping), of which only a small part has been preserved to this day, with an area of 2.19 ha (ZBGIS – current mapping). The results point to a significant decline in historical water areas, with some splash dams disappearing as a result of dam damage, sedimentation, succession, or land use changes, while others have been preserved only in the form of dam relics or have been transformed into new retention reservoirs. The article emphasizes the importance of historical splash dams not only from the perspective of historical-geographical research, but also in the context of current adaptation measures to climate change in mountainous regions.

INTRODUCTION

Natural lakes cover a negligible area in Slovakia and cannot be compared with the largest lakes in neighbouring countries, or in Europe and the world. Nevertheless, they perform an irreplaceable function within the ecosystem of the Western Carpathian landscape, while their economic use is almost zero. For this reason, humans have been constructing water reservoirs in Slovakia since the Middle Ages. From the 14th century onwards, fishponds were gradually established near monasteries; from the 15th century also in sub-castle areas, and subsequently, from the 16th century, the construction of *tajchy* in mining regions reached its greatest development, serving mining, metallurgical and other technical operations. For the purpose of timber floating from the highest mountain ranges of the Western Carpathians, splash dams were constructed from the 16th century onwards. From the Early Modern period, particularly in the 18th and 19th centuries, water reservoirs were also built as ornamental features in the gardens and parks of ecclesiastical and secular aristocratic residences as well as towns.

In Slovakia, the most significant water reservoirs (*tajchy*) in the past were constructed in the vicinity of Banská Štiavnica. In the 18th century, they ranked among the largest, and as many as five *tajchy* from the Banská Štiavnica area were even among the ten largest in Europe. Veľký Rychňavský ranked 4th, Rozgrund 5th, Veľký Kolpašský 6th, Počúvadlo 7th, Dolný Hodrušský 10th, Malý Rychňavský 11th, and Veľký Vindšachtský 12th; three others were also within the top fifty, with Uhorniansky tajch in Smolník ranking 49th. Until the Second World War, the *tajchy* of Banská Štiavnica accumulated as much as 98 % of the total water volume of all artificial water bodies in Slovakia [1]. On the basis of the uniqueness of these water reservoirs (54 of which have been preserved) and of the entire water management system, Banská Štiavnica and its surroundings were inscribed on the UNESCO World Heritage List of cultural and technical monuments in 1993. It is therefore logical that, across scientific disciplines, the study of other historical water reservoirs in Slovakia has been largely overlooked. A comprehensive interdisciplinary investigation of these features has not yet been carried out in this country. In the professional literature, this issue appears only marginally and is treated in a very general and fragmentary manner.

Historical water reservoirs (splash dams) represent a significant, yet so far largely forgotten, anthropogenic element of the mountain landscape of Slovakia. They were constructed in the headwaters of high-mountain valleys in order to accumulate water for timber floating. These reservoirs enabled the efficient use of episodic flows and significantly influenced the hydrological regime of the catchments.

Within Slovakia, they occurred primarily in the mountain ranges of the Western Carpathians, such as Slanské vrchy, Slovenský raj, Slovenské rudohorie, Veľká Fatra, Oravské Beskydy and Low Tatras. The beginnings of their construction are documented as early as the 16th century, particularly in the western part of Low Tatras, in connection with timber extraction for the needs of mining and metallurgy, as well as for society as a whole. Following the decline of these economic activities and the introduction of modern timber transport (forest railways) at the turn of the 19th and 20th centuries, splash dams lost their original function, which led to their gradual abandonment, infilling by sediments, or overgrowth through natural succession.

At present, these hydraulic engineering structures have been preserved only in the form of terrain relics, most commonly as remains of dams or depressions in the relief. Those that are water-filled have been reconstructed or rebuilt in their original profile. In Low Tatras, these include the Lacková and Malužiná splash dams, and in other mountain ranges also Hrončok and Biele Vody. In recent years, modern fire-protection reservoirs have been constructed in the original profiles of historical splash dams, for example in the Ľubochnianska dolina – Dolný tajch and below Babia hora in Boršucie.

The aim of this paper is to present a basic, pilot methodology that would enable the identification of historical water reservoirs (splash dams) and the analysis of their spatial extent in the area of Low Tatras on the basis of the interpretation of maps of the 2nd Military Mapping (1836–1852), or other historical maps, to verify the data through field research, and to compare them with other historical and contemporary maps.

Material and sources

For the research (identification) of historical water reservoirs, textual historical sources are largely absent. For this reason, it is possible to rely only on cartographic

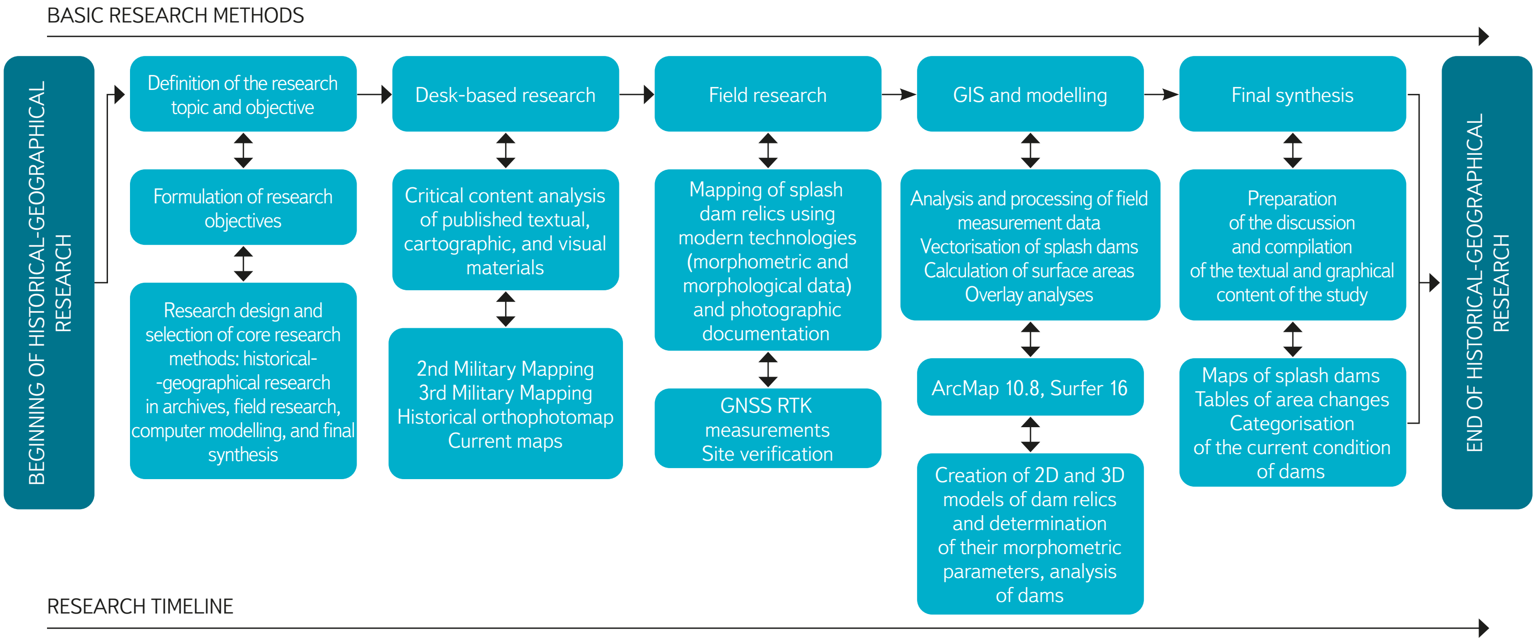

Fig. 1. Research workflow and data processing

sources; however, their availability is also considerably limited, primarily due to the small size of splash dams and the small scale of historical maps; therefore, they were usually not represented in the map content.

Therefore, maps of the 2nd Military Mapping were used as the primary source for detecting their occurrence. These maps are available for viewing on the National Geoportal, also as a WMTS service (or at https://maps.arcanum.com/sk/). They represent the oldest suitable cartographic source, created between 1837 and 1858 at an original scale of 1 : 28,800. They constitute the first relatively accurate set of maps depicting the landscape prior to extensive anthropogenic interventions (industrialisation). In comparison with the 1st Military Mapping, the accuracy of representation increased due to the implementation of military triangulation. Individual map sheets were georeferenced to a spatial resolution of 1 : 10,000 [2]. We can say that these maps represent the fundamental cartographic source for the identification of historical water reservoirs and for reconstructing the extent of their surface area in the mid-19th century.

Another cartographic source used was the 3rd Military Mapping from 1875–1884 at a scale of 1 : 28,800, from which a decimal scale of 1 : 25,000 was derived. The map sheets from this mapping were georeferenced to a spatial resolution of 1 : 10,000 [3].

As a supplementary source for the identification of disappeared splash dams, or their relics, a historical orthophotomap from the mid-20th century was used, providing information on an intermediate stage in landscape development. This orthophotomap is freely available on the portal of the Technical University in Zvolen [4].

For the depiction of the current state, the current Basic Topographic Map of the Slovak Republic at a scale of 1 : 10,000 (ZTM 10) and the current Orthophotomap of the Slovak Republic from 2024 were used. Both map products are available as a WMS service of the Geoportal of the Ministry of the Environment of the Slovak Republic [5, 6].

METHODOLOGICAL PROCEDURE FOR DATA PROCESSING

The research design, derived from the aim of the study, was, due to its interdisciplinary nature, based on several fundamental methodological approaches. These included a combination of cartographic and historical-geographical content analysis of historical maps, computer-based processing of current spatial data, and field verification of selected sites. The research presented in this study provides an initial and model methodological procedure (applied to the area of Low Tatras) for the forthcoming mapping and comprehensive investigation of historical water reservoirs (splash dams) in the Western Carpathians (within Slovakia).

Historical-geographical research

The historical-geographical research [7] focused on the content and spatial evaluation of selected historical maps, their georeferencing, the identification of the locations of original splash dams, and the calculation of the surface areas of water reservoirs in the mid-19th century. In the evaluation of historical maps, a historical-geographical critical spatial, content and comparative analysis was applied [8, 9].

Field research

In direct continuity with the findings obtained from the critical content analysis of cartographic sources, field research was carried out at 14 sites, focusing on the identification of preserved dams and their relics [10–12]. The fieldwork was conducted during the summer months of 2024–2025. During the field research, it was essential to identify, analyse and map the relics of splash dams and to obtain their morphological and, above all, morphometric characteristics.

Detailed field research was carried out using modern cartographic and computer-based equipment. Spatial data were collected through geodetic measurements using a GNSS device (Stonex S900) operating in DGPS mode. In this mode, when receiving differential corrections, the approximate horizontal positional accuracy was ~ 0.25 m RMS and the vertical (elevation) accuracy was ~0.45 m RMS. During the fieldwork, procedures followed methodological steps used for the location, morphological and morphometric mapping of landscape features related to historical anthropogenic lakes and their dams, based on the work of V. Pilous [13–15].

Computer-based data processing

In the computer-based data processing, we followed methodological procedures applied in similar studies on disappeared historical water reservoirs by J. Česák and M. Šobr [16], as well as by K. Weis [17, 18].

The map sheets of the 2nd Military Mapping were georeferenced in the ArcMap 10.8 environment to the S-JTSK (Krovak East North) coordinate system. Distinct and stable morphological and settlement features (stream confluences, roads, ridges and valleys) were used as reference points. After georeferencing, the sheets were mosaicked and linked to the current ZBGIS layer. Based on the interpretation of the maps of the 2nd Military Mapping, splash dam locations were manually digitised as point features into a new point *shapefile layer*; at the same time, polygon *shapefile layers* were also generated. Each object was assigned an identifier, name, catchment, historical period and preservation status (preserved, partially preserved – relics, or disappeared). For unclear locations, supplementary visual data from the historical orthophoto map of the Slovak Republic (1950–1960) and field observations were used. The surface areas of individual splash dams were calculated directly within the GIS environment using the *Calculate Geometry (Area)* function. The resulting values were exported to Microsoft Excel 2019 for the creation of summary tables.

The areas of present-day water reservoirs were obtained from the ZBGIS layer and compared with the records of the 2nd Military Mapping through a spatial analysis using the *Overlay (Intersect)* method. For each site, both graphical and numerical comparisons of the extent of historical and current surface areas were carried out. In cases where a reservoir had disappeared, the reason (negative driving force) was determined. The results were visualised using layers (preserved, partially preserved – relics, and disappeared).

Georeferencing of archival maps and the integration of current WMS or WMTS layers were carried out in the ArcGIS environment, specifically using ArcMap 10. 8. The identified splash dams were vectorised, making it possible to determine the degree of their preservation or disappearance. This was followed by the creation of polygon layers in.shp format. Each polygon was precisely defined by its identification number, period and surface area. The resulting values were exported to Microsoft Excel and subsequently visualised in tables and compared with current spatial data (orthophotomaps and ZBGIS).

The layer of catchments and sub-catchments was derived from a digital elevation model (DEM) with a resolution of 1 × 1 m using hydrological tools in the ArcMap 10.8 (ESRI) environment. The DEM was pre-processed using the *Fill* tool in order to eliminate local depressions and ensure the continuity of surface runoff. Subsequently, *flow direction* and *flow accumulation* were calculated, forming the basis for the identification of confluence points (catchment closing profiles; *Pour points*). Based on the defined confluence points (catchment closing profiles; *Pour points*), the boundaries of sub-catchments were derived using the *Watershed* tool. The resulting raster catchments were converted into polygon format and topologically verified. The areas of individual sub-catchments were calculated in the attribute table using the *Calculate Geometry (Area)* function and expressed in hectares. All spatial data were processed in the S-JTSK (EPSG:5514) coordinate reference system. The resulting layer of sub-catchments constituted the fundamental analytical dataset for assessing spatial relationships between historical water reservoirs and their hinterlands.

The entire methodological procedure, the sequence of individual research steps and the methods used are shown in *Fig. 1*.

BASIC GEOGRAPHICAL CHARACTERISTICS OF THE STUDY AREA

The splash dams investigated in this study are located within the geomorphological unit of the Low Tatras, which represents an important mountain range in the central part of the Western Carpathians. The Low Tatras are the second highest massif of the Carpathian arc, with the main ridge predominantly oriented in a west–east direction. The highest point of the range is Mt Ďumbier (2,043 m a.s.l.). Most of the investigated splash dams fall within the catchment of the Váh river, while a smaller proportion lies within the Hron catchment [19]. The analysed features are located at elevations of approximately 800–1,250 m a.s.l. [20], predominantly in the upper parts of valleys, where they originated as storage reservoirs capturing the waters of mountain streams. Based on the interpretation of maps of the 2nd Military Mapping, a total of fourteen historical splash dams were identified in the area of the Low Tatras, forming part of a water management system designed for timber floating (*Fig. 2*, *Tab. 1*). From the perspective of administrative division, the studied mountain range is located within the districts of Ružomberok, Banská Bystrica, Liptovský Mikuláš, Brezno and Poprad. The area of the geomorphological unit of the Low Tatras was divided into two parts: northern and southern, with the boundary formed by the main ridge of the Low Tatras, which also represents the watershed divide between the Hron and Váh catchments.

Tab. 1. Identified historical water reservoirs (splash dams) in the study area

Number	Name	Part	Basin	Municipality	Coordinates [°]		Status	Note
					WGS			
					Y	X		
1	Korytnica	northern	Váh	Liptovská Osada	48.89	19.27	relict	preserved dam
2	Magurka			Partizánska Ľupča	48.97	19.42	relict	preserved dam
3	Malužiná			Malužiná	48.93	19.84	transformed	water body
4	Svarín I.			Východná	48.97	19.89	non-existent	-
5	Svarín II.				48.95	19.90	non-existent	-
6	Hošková				48.93	19.91	non-existent	-
7	Lacková				48.94	19.95	transformed	water body
8	Medvedia				48.95	19.99	non-existent	-
9	Dikula				48.95	20.01	non-existent	-
10	Kremeniny			Liptovská Teplička	48.97	20.04	non-existent	-
11	Ždiar				48.94	20.09	non-existent	-
12	Sopotnica	southern	Hron	Brusno	48.88	19.35	non-existent	-
13	Pálenica			Dolná Lehota	48.92	19.56	relict	preserved dam
14	Bacúch			Bacúch	48.87	19.81	relict	preserved dam

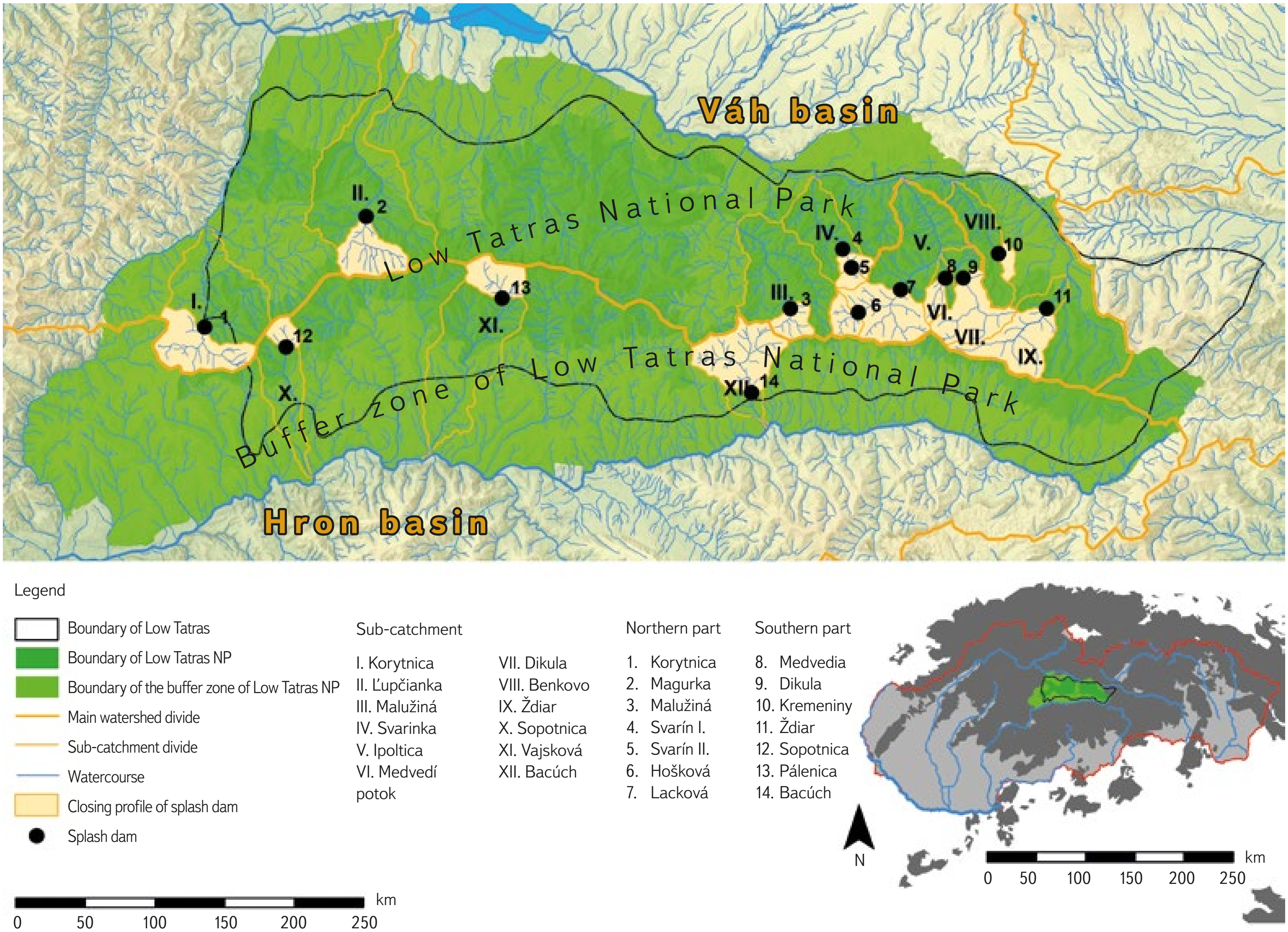

Fig. 2. Study area within the Low Tatras geomorphological unit, showing the location of identified splash dams on maps of the 2nd military mapping and verified in the field, with respect to sub-catchments

Brief geological, geomorphological and soil characteristics

The main ridge of the Low Tatras is formed by a crystalline core composed predominantly of intrusive igneous rocks, especially granodiorites. The entire area belongs to the Central Western Carpathians, where Palaeozoic and Mesozoic complexes of the Low Tatras dominate. From the perspective of tectonic division, the mountain range is situated within two tectonic units: the Tatra–Fatra unit and the Vepor unit. The studied area belongs to the zone of core mountains of the eastern group with a Tatric crystalline basement. The crystalline complex of the Tatricum consists of acidic plutonic rocks (granitoids) and medium- to high-grade metamorphosed volcano-sedimentary complexes (gneisses, paragneisses, amphibolites and migmatites). Above this crystalline core lie original (autochthonous) sedimentary formations composed of a diverse group of rocks such as shales, quartzites, limestones and dolomites [21]. From a geomorphological perspective, the Low Tatras unit belongs to the Fatra–Tatra area of the Inner Western Carpathians.

The splash dams are located in the geomorphological sub-units Ďumbierske Tatry and Kráľovohoľské Tatry, more precisely in the areas of Prašivá, Salatíny, Priehyba and Ďumbier. The area is characterised by the relief of pedimented uplands and hilly landscapes, with a predominance of highland foothill relief. In terms of morphological-morphometric relief types, high mountains, moderately high mountains and hilly terrains prevail. The soil cover reflects both geological conditions and elevation. In both the northern and southern parts, rendzinas on carbonate substrates and podzolic cambisols on gneisses and granitoids with loamy-sandy to loamy textures dominate [20]. At the highest elevations and on slopes with higher moisture, modal and humic-iron podzols occur [22]. These geological and geomorphological conditions significantly influenced the location of splash dams, which were situated primarily in narrow valleys with suitable morphological conditions for dam construction.

Basic hydrological and climatic characteristics

The hydrological conditions of the area are determined by the mountainous character of the relief, with a predominance of short watercourses exhibiting pronounced seasonal discharge dynamics. Splash dams were constructed on smaller streams, where they enabled the regulation of flows and their short-term increase during periods of timber floating. The Low Tatras belong to two main second-order catchments; the Hron and the Váh. Within the Hron catchment, splash dams occur in the valleys of Vajsková (Pálenica), Sopotnica, and Bacúch, while those belonging to the Váh catchment are located in the northern valleys of Korytnica, Ľupčianka, Malužiná, Svarinka, Ipoltica, Medvedia, Dikula, Benkovo, and Ždiar. Splash dams in the Váh catchment belong to the sub-catchments of Revúca, Boca and Ipoltica, which are left-bank tributaries of the Čierny Váh. Splash dams in the Hron catchment are situated on its right-bank tributaries. From a hydrological perspective, the area represents a mid-mountain region with a snow–rain runoff regime characterised by pronounced seasonal variability (*Tab. 2*) [19, 23].

The average specific runoff ranges between 20–30 $l \cdot s^{-1} \cdot km^{-2}$, with higher values typical of the northern part of the mountain range, where precipitation totals and snow accumulation are greater. Watercourses are short, steep and of a mountain character. The analysed splash dams are identified and located at river kilometres within the range of 1.8–17.6 km (with an average of 8.28 river km) (*Tab. 3*). At present, the hydrological regime of most of these watercourses remains natural, with only a small proportion of splash dams retaining their storage function [22].

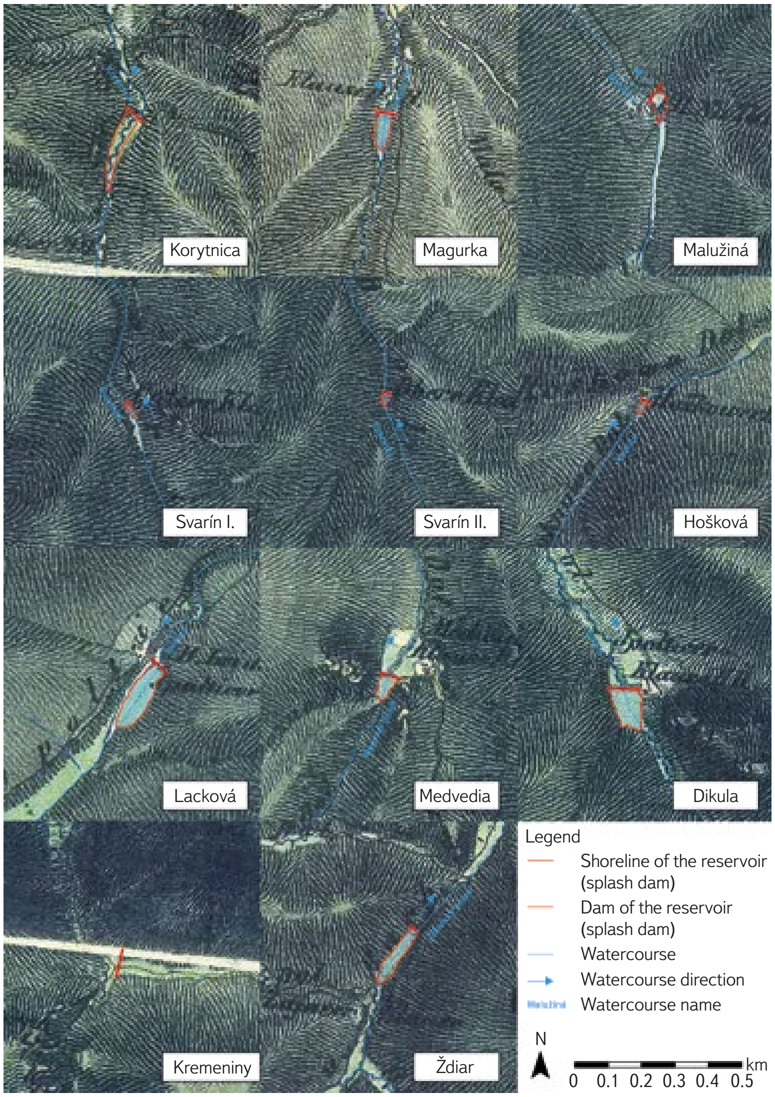

Fig. 3. Example of historical splash dams shown on the map of the 2nd Military Mapping in the Low Tatras region (northern part) (1 : 10,000)

The Low Tatras are situated in a cold mountain and moderately cold very humid climatic region. The mean annual air temperature ranges from −1 to 7 °C. The average annual precipitation reaches up to 1,500 mm at the highest elevations and around 800 mm at lower elevations. The average number of days with snow cover ranges from 60 to 100 days [24].

Protected areas and ecological context

Several sites (13) are located within Low Tatras National Park or in its buffer zone (1) [25, 26]. This creates specific conditions for their potential restoration, where environmental and landscape-hydrological significance takes precedence over economic use. Today, these water bodies can function as habitat islands with high diversity of wetland vegetation, amphibians and insects, thereby representing valuable microclimatic and retention features in the mountain environment.

RESULTS

Identification of historical splash dams based on maps of the 2nd Military Mapping

Georeferencing of maps and the determination of the “precise” location of splash dam embankments in maps also enables accurate location of their relics in the field. Through the analysis of map sheets of the 2nd Military Mapping, 13 historical water reservoirs were identified in the studied area of the Low Tatras (a 14th splash dam, Kremeniny, was verified on the basis of written sources), situated predominantly in the upper parts of mountain valleys on smaller watercourses. Their spatial distribution shows a clear association with areas of intensive historical timber extraction and favourable geomorphological conditions for damming watercourses (*Figs. 3, 4*).

The results of the processing of historical cartographic sources indicate that splash dams generally had a small to medium surface extent, with their size adapted to the short-term accumulation of water required for timber floating. Data on reservoir surface areas are, in many cases (given the absence of archival documents) the only available information, and can be verified only against data obtained from 3D modelling of disappeared splash dams. Input data for

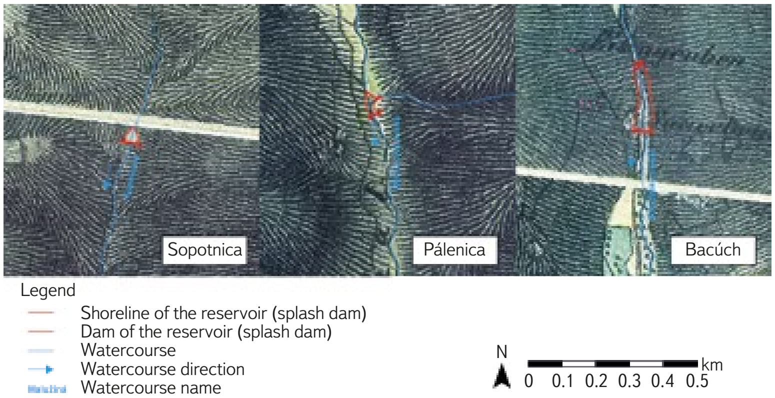

Fig. 4. Example of historical splash dams shown on the map of the 2nd Military Mapping in the Low Tatras (southern part) (1 : 10,000)

Tab. 2. Hydrological characteristics of the study area

Number	Name	Basin	Sub-basin	Watercourse/ Micro-catchment	rkm	FRT	R	Average specific runoff [in l · s^{-1}]
1	Korytnica	Čierny Váh	Revúca	Korytnica	8.06	snow-rain	mid-mountain	25–30
2	Magurka		-	Ľupčianka	17.56			
3	Malužiná		Boca	Malužiná	8.06			20–25
4	Svarín I.		-	Svarinka	6.63			
5	Svarín II.				8.18			
6	Hošková		Ipoltica	Ipoltica	14.84			
7	Lacková				10.94			
8	Medvedia			Medvedí potok	1.82			
9	Dikula			Dikula	2.70			
10	Kremeniny		-	Benkovský potok	6.57			
11	Ždiar			Ždiarsky potok	2.87			
12	Sopotnica	Hron	-	Sopotnica	10.78			25–30
13	Pálenica			Vajskovský potok	13.99			
14	Bacúch			Bacúšsky potok	2.90			20–25
Average					**8.28**			

Notes: FRT – Flow Regime Type, R – Hydrological region, rkm – River kilometre

Tab. 3. Area of the micro-catchment and the closing profile above the splash dams

Number	Name	Watercourse/ Micro-catchment	Area [ha]					Share
			Micro-catchments		Splash dam closing profile			
1	Korytnica	Korytnica	5,731.49		1,972.34	1,972.34		34 %
2	Magurka	Ľupčianka	7,942.16		1,452.58	1,452.58		18 %
3	Malužiná	Malužiná	4,465.90		585.12	585.12		13 %
4	Svarín I.	Svarinka	2,486.83		321.13	548.13		22 %
5	Svarín II.				227.00			
6	Hošková	Ipoltica	8,574.22	5,665.93	518.11	2,442.86	4,571.42	53 %
7	Lacková				1,924.75			
8	Medvedia	Medvedí potok		665.22	390.36	390.36		
9	Dikula	Dikula		2,243.07	1,738.20	1,738.20		
10	Kremeniny	Benkovský potok	2,019.04		234.78	234.78		12 %
11	Ždiar	Ždiarsky potok	2,482.86		1,967.36	1,967.36		79 %
12	Sopotnica	Sopotnica	2,355.75		392.32	392.32		17 %
13	Pálenica	Vajskovský potok	5,759.24		961.13	961.13		17 %
14	Bacúch	Bacúšsky potok	2,765.66		2,287.66	2,287.66		83 %
Total			**44,583.14**		**14,972.85**	**14,972.85**		-
Share of basin and closing profile								**33.58 %**

reconstructive 3D models can be obtained solely on the basis of field-based geodetic morphometric measurements (*Tabs. 3, 4*).

Most of the identified splash dam sites were depicted as individual water bodies with clearly distinguishable embankments. Thirteen splash dams were located in the upper reaches of individual valleys, as the accumulated water was used for timber floating from mountain areas to processing sites. In the Čierny Váh area, splash dams were also used to raise the water level of the river itself, along which semi-rafts were floated. Only the Bacúch splash dam was situated on the lower course, as it served exclusively to increase the water level of the Hron, enabling the floating of rafts even during dry summer months.

Comparison of the historical and current state of splash dams

The comparison of historical maps with current data from ZBGIS and the Orthophotomap of the Slovak Republic, together with their subsequent comprehensive comparison and verification using field research results, indicates significant changes in the morphological and morphometric extent of historical splash dams and their relics. In the first step, the main negative driving force responsible for their gradual disappearance was preliminarily identified. Where they were secondarily used as fishponds or for recreation, they have been preserved to the present day as water-filled relics. Where they were abandoned for economic reasons, they have gradually, under the influence of natural processes – particularly floods, weathering, water erosion, succession and sediment infilling – been preserved only in the form of larger or smaller relics, or have disappeared completely. Only in one case (the Korytnica splash dam) was destruction recorded as a result of anthropogenic driving forces (road construction).

According to their state of preservation, the individual splash dams were categorised (*Tab. 4*) as preserved (Malužiná, Lacková), partially preserved – relics (Korytnica, Magurka, Svarín I, Svarín II, Hošková, Medvedia, Dikula, Ždiar, Sopotnica, Pálenica, Bacúch), and disappeared (Kremeniny). The individual dams, or their relics, can also be classified according to construction technique into concrete–stone (Bacúch, Magurka), stone (Korytnica), stone–earth (Pálenica, Sopotnica, Medvedia, Dikula), embankment–earth, or rather stone–earth (Malužiná, Lacková, Hošková, Ždiar), and wooden (probably Svarín I, Svarín II and Kremeniny).

Out of the total of 14 identified historical water reservoirs, 8 sites (57.1 %) have disappeared and are preserved only in the form of relief relics, while a further 4 splash dams (28.6 %) have been preserved only as dam structures; only 2 splash dams (14.3 %) have been preserved as water bodies in a transformed form. Overall, 85.7 % of historical water reservoirs have lost their original storage function.

The comparison of the spatial extent of historical and present-day water reservoirs indicates a significant reduction in the storage capacity of splash dams. The current surface area represents only 34.9 % of the historical area recorded on maps of the 2nd Military Mapping and 19.2 % of the area recorded on maps of the 3rd Military Mapping, documenting a pronounced decline of these features in the landscape. The comparison of the historical and current state of selected splash dams illustrates different forms of their preservation within the landscape.

Characteristics of selected identified splash dam relics

Based on the comparison of the historical and present-day state, it can be stated that in the Low Tatras, lakes have been preserved at only two splash

Tab. 4. Parameters of the study splash dams

Number	**Name**	**Part**	**Basin**	**Area [ha]**			
				Historical		**Current ZBGIS**	**Computer- reconstructed**
				2nd M. M.	**3rd M. M.**		
1	Korytnica	northern	Váh	0	0.37	0	1.09
2	Magurka			0.72	1.87	0	1.07
3	Malužiná			0	1.93	0.44	0.24
4	Svarín I.			0.10	0.42	0	
5	Svarín II.			0.10	0.24	0	
6	Hošková			0.12	0	0	
7	Lacková			2.03	2.15	1.75	
8	Medvedia			0.48	0	0	
9	Dikula			1.48	1.81	0	
10	Kremeniny			0	0	0	
11	Ždiar			1.04	2.60	0	
12	Sopotnica	southern	Hron	0.21	0	0	
13	Pálenica			0	0	0	0.27
14	Bacúch			0	0	0	1.30
Total				**6.28**	**11.39**	**2.19**	**3.97**

dam sites. These are the Malužiná and Lacková splash dams; however, both have significantly modified embankments and no longer serve their original purpose. They represent important ecological sites within Low Tatras National Park. The majority of splash dams (10) have been preserved to the present day in the form of complete or partial dam relics. Wetlands are often found in the area of the former reservoir basins. The only splash dam that could not be identified in the field was Kremeniny (or its relic) (see *Tab. 1* for details).

Field verification of selected sites confirmed that the degree of preservation of historical splash dams varies considerably depending on their current use and the level of anthropogenic or natural disturbance.

With regard to the aim and scope of the study, a basic characterisation of two identified splash dams is presented. As representative examples, a partially preserved, still water-filled splash dam at Malužiná and the relic of a preserved dam at Magurka were selected, where a wetland is located within the former reservoir area.

The embankment of the **Malužiná splash dam** (*Figs. 5–9*) is located at river kilometre 8.06 of the Malužinský stream, in the headwaters of the valley of the same name on the northern slopes of the Low Tatras (cadastral area of Malužiná, Liptovský Mikuláš District). The Malužinský stream, which rises on the south-eastern slopes of Vrbovica (1,393.8 m a.s.l.) at an elevation of approximately 1,195 m a.s.l., is a fourth-order stream that flows into the Boca stream from the right at Malužiná at an elevation of approximately 738 m a.s.l. (the Boca stream flows from the left into the Váh river, which is a left-bank tributary of the Danube). The Malužinský stream has a snow–rain runoff regime and drains a catchment area of 4,465.9 ha.

During fieldwork, the precise mathematical position of the geometric centre of the dam crest was determined at 48º 93′ N latitude and 19º 84′ E longitude.

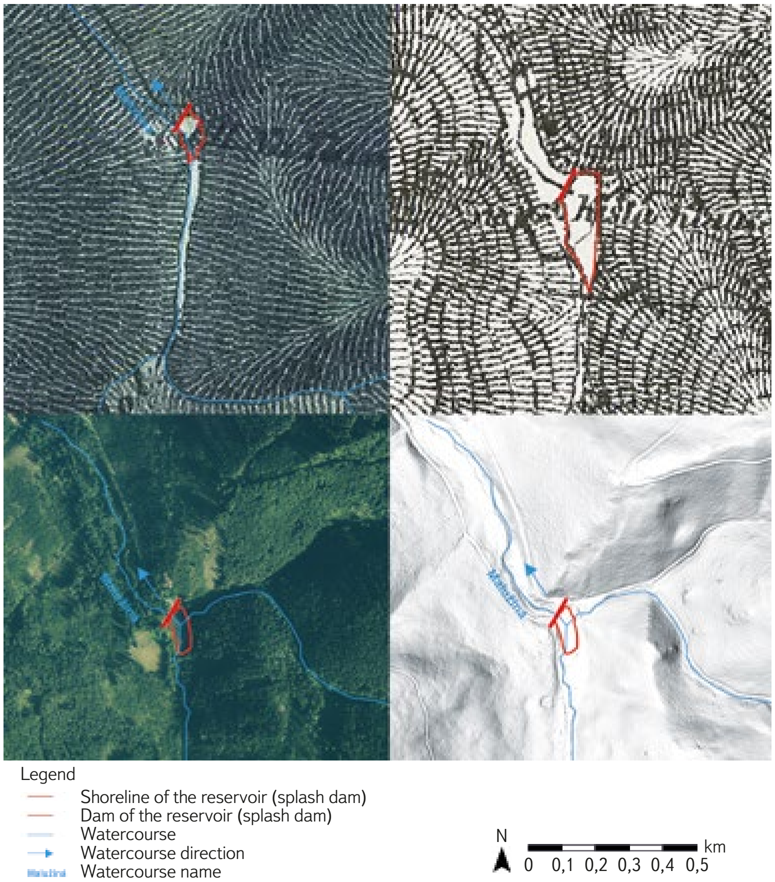

Fig. 5. Preserved water surface of the historical Malužiná splash dam in the northern Low Tatras (1 : 10,000)

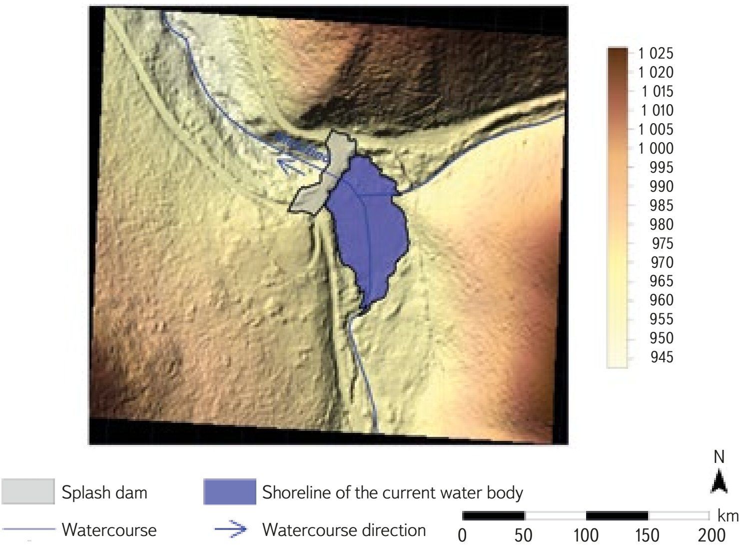

Fig. 6. Computer model of Malužiná splash dam based on field measurements

The elevation of the dam crest at the Pod Vrbicou site, located at the confluence of the Stratená stream (from the right) with the Malužinský stream, is 964 m a.s.l. The catchment area of the outlet profile of the splash dam, from which water was accumulated in the reservoir, is 585.12 ha, representing 13 % of the total catchment area of the Malužinský stream.

Based on additional field measurements and 3D modelling, the basic parameters of the relic of the original splash dam embankment are as follows. The width of the dam base is approximately 30 m, the maximum height reaches 8 m, and the crest length is 67.45 m. The volume of the reservoir could not be calculated due to its inundated state; its current surface area was estimated at approximately 0.25 ha, whereas according to the map of the 3rd Military Mapping, its area in the 1880s was 1.93 ha. The present surface area is determined by a temporary, rehabilitated spillway, as the original one is in a critical condition and non-functional. The original outlet adit, constructed in the centre of the earthfill dam from precisely worked travertine blocks and vaulted with a barrel vault, was approximately 22.5 m long (measurable part), 2.6 m wide and 2.5 m high.

At present, the surroundings of the splash dam are covered by spruce monoculture forests, although a large part has been subject to clear-cutting. On the left side of the splash dam, in a deforested area, there is a maintained hunting lodge, which is regularly rented out by Forests of the Slovak Republic to individual visitors for short-term stays for hunting, hiking, cycling or active recreation in the mountains. The site is accessible via an asphalt road (passable only with permission from the national park or state forests) leading through the Malužinská dolina from the village of Malužiná, which is approximately 8 km away. Two cycling routes run along this road. The first ends at the Pod Vrbicou site near the splash dam, while the second crosses the dam crest and continues further as a loop along forest roads back to Malužiná.

Given the absence of textual archival sources, historical maps (*Fig. 5*) represent the primary relevant source for reconstructing the history of the Malužiná splash dam. The earliest record, noted with a delay of more than 130 years in the chronicle of the village of Malužiná, states that the splash dam was constructed in 1801. It was a wooden log dam built of spruce timber, as also documented by sources held in the Forestry and Timber Museum in Zvolen. An already existing splash dam is depicted on a map stored in the Hungarian National Archives in Budapest (S 11 – No. 636) from 1804, where a blue-coloured reservoir with a dam is shown without a name. The map of the 2nd Military Mapping from 1839 depicts the splash dam reservoir in blue and labels the site as *Na Teichu*. On the map of the 3rd Military Mapping from 1876, the site is labelled as *Klause* and depicts a dam with a reservoir. It is highly probable that

Fig. 7. Malužiná splash dam (right) and reservoir (view from the east), November 2025

Fig. 8. Malužiná splash dam (left) and reservoir (view from the west), November 2025

Fig. 9. Portal of a disused outlet gallery preserved in the embankment of Malužiná splash dam, November 2025

the original wooden dam was rebuilt and maintained several times until 1923, when it was reconstructed into an earthfill stone–earth dam, the relic of which is present in the landscape today. The maximum volume of the reservoir of the new splash dam, prior to sediment infilling, was 45,000 m^3. The dam was constructed from material extracted in a quarry approximately 50 m in extent, opened directly near the dam crest on its right side. It ceased to serve its original purpose in 1930, when a forest railway was put into operation in the Malužinský stream valley.

The embankment of the **Magurka splash dam** (*Figs. 10–14*) is located at river kilometre 17.56 of the Ľupčianka stream, in the upper third of the valley of the same name (cadastral area of Partizánska Ľupča, Liptovský Mikuláš District), approximately 500 m south of the confluence of the Tlstý stream and Veľká Oružná with the Ľupčianka. It is situated about 500 m from the turn-off to the former mining settlement of Magurka, on the left-hand side of the road. The dam profile is positioned in a narrowed section of the valley between the ridges of Tajch on the right (eastern) side and Hlinisko on the left (western) side of the valley. The entire area is covered by spruce monoculture forests. The Ľupčianka is a third-order stream that rises in the Low Tatras (Ďumbierske Tatry), in the Ďurková massif (1,749.8 m a.s.l.), on the northern slopes below the Ďurková saddle at an elevation of approximately 1,605 m a.s.l. Originally, after 24 km it flowed into the Váh from the left near Bešeňová (at present into the Bešeňová reservoir) at an elevation of approximately 512 m a.s.l. The Ľupčianka has a snow–rain runoff regime and drains a catchment area of 7,942.16 ha.

During field measurements, the precise mathematical position of the geometric centre of the dam crest of the Magurka splash dam was

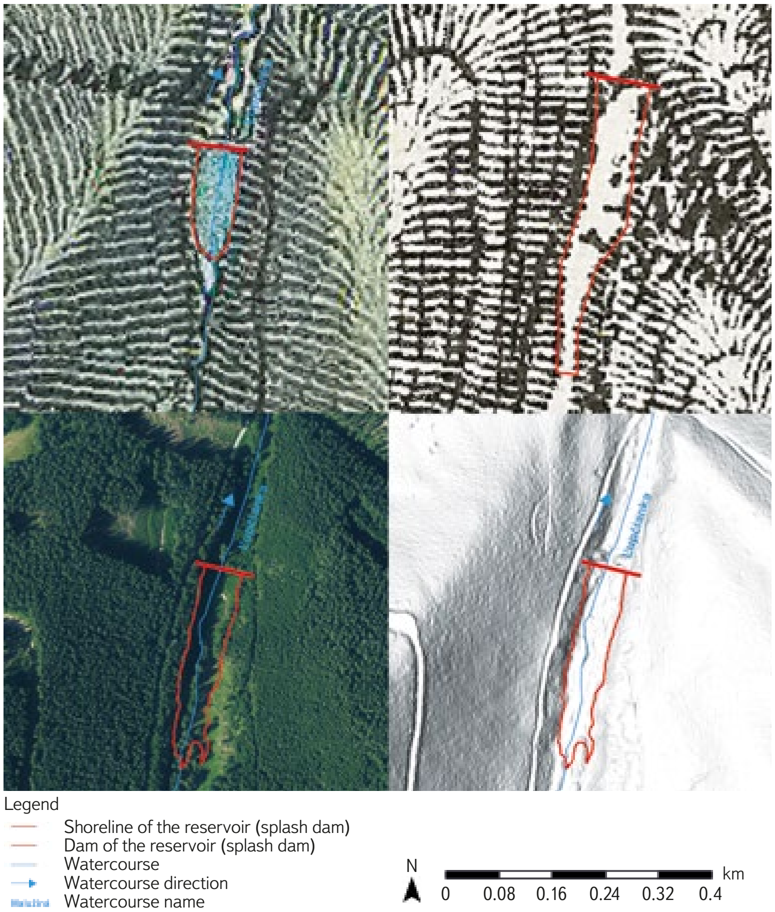

Fig. 10. Indications of the historical Magurka splash dam, still identifiable despite the disappearance of the reservoir (1 : 5,000)

determined at 48° 97′ N latitude and 19° 42′ E longitude. The elevation of the crest is 817.5 m a.s.l. The catchment area of the outlet profile of the splash dam, from which water was accumulated in the reservoir, is 1,452.58 ha, representing 18 % of the total catchment area of the Ľupčianka stream.

Based on field measurements and 3D modelling, the basic parameters of the relic of the dam and the original splash dam are as follows. The width of the dam base is 11.27 m, the height 9.9 m, and the length 54.3562 m. The volume of the reservoir was 38,833.3 m^3 and its surface area 10,743 m^2. According to the map of the 2nd Military Mapping from the mid-19th century, its area was 0.72 ha, and according to the map of the 3rd Military Mapping from the 1880s, 1.87 ha. The dam wall is constructed of quarry stone, with the crest reinforced by a concrete slab. In its lower central part, the dam contains two outlet openings vaulted with segmental arches, while in the central upper part there is a spillway. To prevent back erosion below the outlet openings, the stream bed is lined with wooden beams and its banks are reinforced with retaining walls over a length of approximately 30 m. In the centre of the dam, there was a wooden shelter housing the technical equipment used for opening the outlet gates.

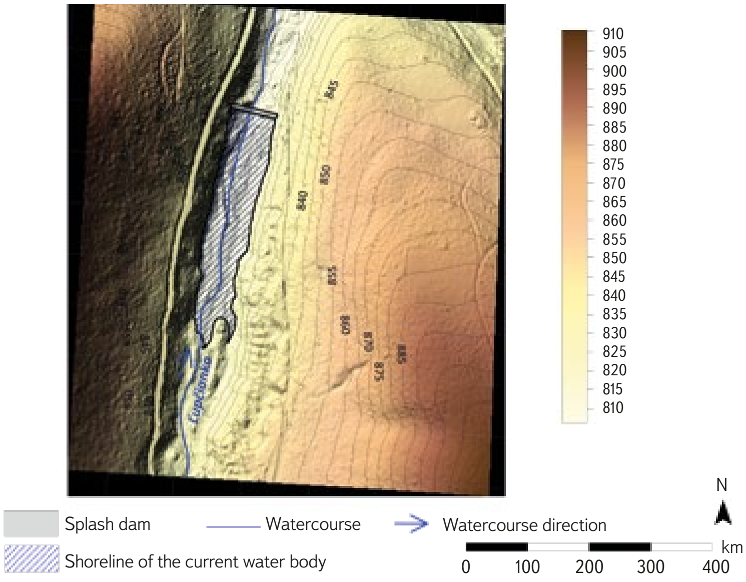

Fig. 11. Computer model of Magurka splash dam based on field measurements

Fig. 12. Downstream slope of Magurka splash dam, November 2025

Fig. 13. Upstream slope of Magurka splash dam, November 2025

Fig. 14. Relics of outlet galleries of Magurka splash dam, November 2025

Just like in the previous splash dam, the main historical sources for the study of the Magurka splash dam are historical maps. Written sources document the construction of a wooden–earth dam as late as 1819, intended for the annual floating of timber to Partizánska Ľupča. Relics have been preserved approximately 5 m below the existing stone dam on both sides of the wooden chute. The original log structure had a base thickness of approximately 20 m, a length of about 45 m, and its height can be estimated at around 8 m. This reservoir is first depicted on the analysed maps of the 2nd Military Mapping from 1845, where it is shown as a blue-coloured lake and labelled *Klause*. On the map of the 3rd Military Mapping from 1876, the site is depicted and labelled *Klause*, and the site in which it is situated is named *Na Teichu*. The splash dam was maintained and probably served its purpose until the beginning of the 20th century, as in 1911 the Forest Cooperative in Nemecká (now Partizánska) Ľupča constructed the present dam. By 1938, historical maps already depict the site without a reservoir and refer to it using *Tajch* Slovak nomenclature. That the splash dam was most likely no longer in operation at the turn of the 1930s and 1940s is also evidenced by a record in the municipal chronicle of Partizánska Ľupča, which states that timber from the Teich was already being transported by horse-drawn wagons. On maps produced after 1955, only the dam is shown, without a reservoir.

DISCUSSION

Based on the content analysis of historical maps, with particular emphasis on the 2nd Military Mapping from the second half of the 19th century, and on archival sources, a total of 14 splash dams were identified in the area of the Low Tatras, in most cases preserved only as dam relics. However, it is highly probable that in the past (since the 16th century), additional small water reservoirs were constructed in the headwaters of Low Tatras streams, which had already disappeared by the mid-19th century. This assumption is suggested by limited textual archival sources; however, these wooden, partly earth-built dams are now in such an advanced stage of naturalisation that their location in the field will most likely be impossible. The confirmation or refutation of these hypotheses will require more detailed historical-geographical research (partly making use of the methodology presented here).

According to the state of preservation of splash dams in the Low Tatras, or their embankments, the individual sites were classified (*Tab. 4*) as preserved, partially preserved – relics, and disappeared. In the studied area, preserved dam structures clearly dominate, not only as compact bodies but above all as remnants of specific forms of anthropogenic water-management relief. From the results of the research on splash dams in the Low Tatras, as well as on the basis of a preliminary survey of their location and condition in other mountain ranges of the Western Carpathians, it can be inferred that, upon completion of the overall research, a fourth category will likely be added, namely restored reservoirs in the profiles of former splash dams. These have been referred to in previous sections of the study.

Preserved splash dams (i.e. water-filled reservoirs with reconstructed embankments) represent a minor proportion of the analysed set, and their current function generally differs from their original purpose. In several cases, these features have been adapted to new uses, particularly as small retention reservoirs, fishponds, and water features for recreation. The results indicate a significant reduction in the spatial extent of historical water reservoirs, confirming a long-term trend of the disappearance of technical features associated with historical forest management.

Historical splash dams in the area of the Low Tatras underwent rapid degradation following the loss of their original function. In contrast to fishponds, which were often used continuously or adapted to new economic purposes, splash dams represented purpose-built and temporally limited hydraulic structures whose existence was closely tied to timber floating. After the cessation of this activity, they lost their practical significance, which led to their neglect and subsequent disappearance. A similar trend of splash dam decline has also been recorded in other areas of the Western Carpathians, where these features were associated with historical forest management. Their importance is currently increasing again in connection with climate change, which is manifested by a more frequent occurrence of extreme events – droughts, torrential rainfall and soil erosion. Their study is thus becoming not only a specialised historical-geographical topic, but increasingly also raises the possibility of their reconstruction within the landscape of Low Tatras National Park. Such efforts need not necessarily involve only the reconstruction of reservoirs but may also include the restoration of wetlands as unique habitats. At present, Forests of the Slovak Republic are considering the possibilities of restoring the Malužiná and Bacúch splash dams in the Low Tatras, as well as other splash dams in different mountain ranges.

As the main aim of the paper was to identify historical splash dams (and subsequently analyse their spatial extent) on the basis of historical maps, with particular emphasis on maps of the 2nd Military Mapping, it is also necessary to point out the limitations of these cartographic sources, which, however, can be reliably minimised through appropriate methodological procedures, experience and expertise. When interpreting historical maps, it is essential to take into account possible positional inaccuracies, which in the case of the 2nd Military Mapping may reach approximately 20 to 50 metres after georeferencing. In mountainous areas, particularly in valley headwaters, these inaccuracies tend to approach the upper limit. These inaccuracies, however, do not affect the identification of the existence of splash dams, as their location can be refined on the basis of the relief framework and the course of watercourses through comparison with current maps. A greater challenge arises in the precise geometric delineation of these features and in determining their morphometric characteristics. In some cases, it may be difficult to distinguish splash dams from other types of small water bodies, or, due to their small size, to identify them at all. These limitations were minimised through content analysis of additional cartographic (and textual) sources, mutual comparison of all available historical and contemporary materials, and detailed field verification. Maps of the 2nd Military Mapping provide sufficient thematic content and relatively good positional accuracy for the identification of historical water bodies and technical structures. For the purposes of this research, their primary value lay in their ability to reliably capture the existence and spatial distribution of splash dams, rather than their precise geometric parameters. The obtained surface areas, shape characteristics of the reservoirs and other morphometric parameters are therefore considered only supplementary, unless verified by other sources.

From all materials obtained through desk-based or field research, it is possible to derive new, far broader, higher-quality, more accurate and more comprehensive information by applying modern computational methods, digitisation, computer modelling and GIS. Within a computational environment, it is possible not only to create reconstructive 2D and 3D models, but also to obtain qualitatively new insights into disappeared splash dams that are not contained in any existing sources.

The results of our research show that as many as 85.7 % of splash dams in the area of the Low Tatras have disappeared or have been preserved only in the form of relics, while the current surface area of water reservoirs represents less than one fifth of the historical extent recorded at the end of the 19th century.

Our research also highlights the importance of historical cartographic sources as an irreplaceable source of information on disappeared landscape features. At the same time, it points to the potential of historical splash dams in current discussions on water retention in the landscape and sustainable water resource management in mountain areas.

CONCLUSION

The paper focused on the identification and analysis of the spatial development of historical water reservoirs (splash dams) in the area of the Low Tatras, based on a comparison of maps of the 2nd Military Mapping with current cartographic sources. The results indicate a significant decline in historical splash dams, with only a small proportion of these features preserved to the present day as water bodies or terrain relics.

The analysis confirmed that splash dams represented short-term, purpose-built hydraulic structures, the disappearance of which was closely linked to the cessation of timber floating. Most historical splash dams disappeared as a result of natural geomorphological processes and changes in land use. The proposed typology of splash dam preservation enables a systematic assessment of their current condition and provides a basis for further research into these anthropogenic relief features.

The marked decline of historical splash dams can also be interpreted in the context of the geomorphological and hydrological conditions of mountain environments. Steep slopes, high stream energy and intense erosion processes accelerated the infilling of reservoirs with sediments and the degradation of dam structures. Simultaneously, vegetation succession gradually eliminated the visible manifestations of these features in the landscape.

From the perspective of historical geography and landscape research, splash dams represent an important record of human technical adaptation to the mountain environment. Their spatial distribution reflects historical economic strategies and the ways in which natural resources were utilised in the Carpathians. In comparison with other regions of the Western Carpathians, it can be stated that the disappearance of splash dams is a general phenomenon, with local differences determined primarily by the degree of subsequent land use and interventions in the hydrological regime.

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Fauna of water mites (*Acari*, *Hydrachnidia*) in the stony littoral of water supply reservoirs in the Czech Republic

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Keywords: water mites (*Acari*, *Hydrachnidia*) — species occurrence— stony littoral — drinking water dam reservoirs

ABSTRACT

The article presents the results of a survey of the water mite fauna in 45 dam reservoirs in the Czech Republic that are sources of drinking water. In 37 reservoirs, the average seasonal concentration of chlorophyll *a* in water were lower than 20 µg/L, which indicates that most of these reservoirs have an oligotrophic to slightly mesotrophic character. Samples were taken with a hand plankton net in the stony littoral at a depth of 0.5–1.0 m at all localities; therefore, it is possible to compare findings from individual localities, although they do not represent quantitative data of water mites related to unit area or water volume. In total 1,356 water mites (849 adults, 507 nymphs) were caught and 34 species were recorded. Twelve species occurred in more than 15 % of the investigated reservoirs and accounted for 87.4 % of all individuals caught. These species show great locomotive activity, they are adapted for swimming/floating, and they commonly occur in the littoral fauna of European lakes. The most numerous species were *Brachypoda versicolor* (Mueller, 1776) and *Unionicola crassipes* (Mueller, 1776), which occurred at the largest number of localities (23 and 21) and totalled 357 individuals, which is 26.3 % of all recorded water mites. Fourteen species of water mites occurred only in one locality; these are common in standing waters, and their preferred habitat is littoral vegetation. On the other hand, species of the genus *Lebertia* Neumann, 1880, were not found in the monitored reservoirs: they form a stable component of water mite fauna in lakes, especially at greater depths. *Forelia longipalpis* Maglio, 1924 is a new species for the fauna of the Czech Republic; *Arrenurus albator* (Mueller, 1776) and *Hygrobates trigonicus* Koenike, 1895 have previously been recorded in the Czech Republic, but have not yet been listed in the species database of the Nature Conservation Agency of the Czech Republic (NCA). The results provide the first more extensive knowledge of the water mite fauna in reservoirs in the Czech Republic, as until now most hydrachnological studies in the Czech Republic have been focused on the water mites of ponds and watercourses.

The study was created with the support of the NCA for the implementation of the Species Occurrence Database under a contract for the development of the work *Diversity of water mites in water reservoirs of the Czech Republic* in 2025.

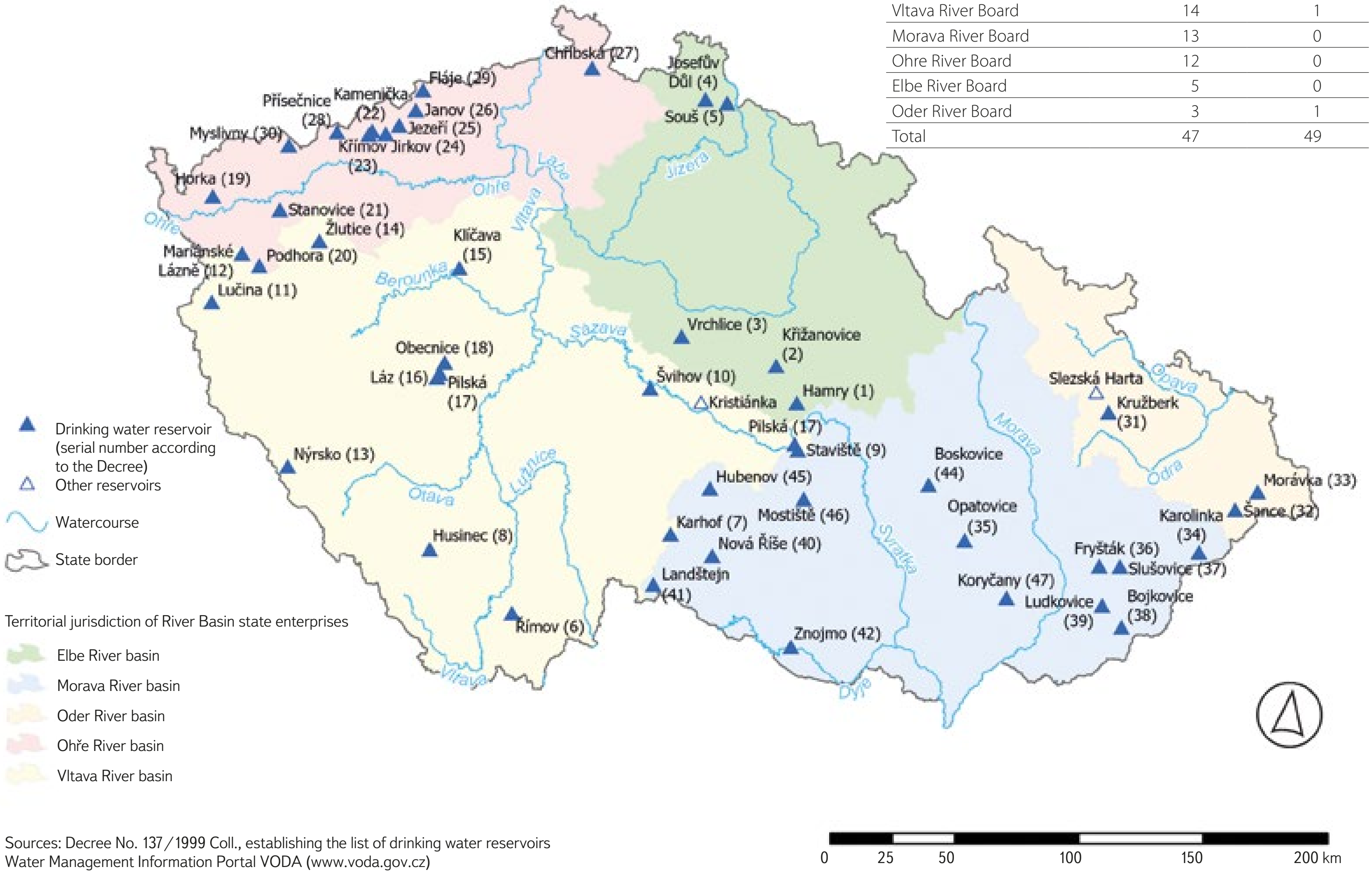
INTRODUCTION

Previous research on water mite fauna in the Czech Republic has focused mainly on ponds, running waters (especially streams), and springs; the occurrence of water mites in dam reservoirs has received little attention, although there are 165 significant dam reservoirs in the country. Of these, 47 are designated by Decree No. 137/1999 Coll. [1] for water-supply purposes and provide 50 % of the drinking water supply for the population of the Czech Republic. The management of these water reservoirs and land-use practices within their catchments are subject to protective regimes, not only to ensure a sufficient volume of stored water to meet supply demands, but above all to maintain the highest possible water quality. Protection zones of water-supply sources (see Act No. 254/2001 Coll., on waters and on amendments to certain laws, as amended [2]) and regulated agricultural management within catchments (in accordance with river basin management plans under the Water Framework Directive 60/2000/EC) strengthen the provision of high-quality raw water for water treatment. A total of 36 water reservoirs (*Tab. 1*) are located at elevations above 400 m a.s.l., and their inflows consist of upper (headwater) sections of watercourses, i.e. catchments without significant sources of pollution. For these reasons, water quality in water reservoirs is significantly higher than in multi-purpose reservoirs, ponds, and smaller standing waters. At the same time, biomanipulation is applied in these reservoirs through the support of so-called purpose-oriented fish stocking, with the aim of limiting phytoplankton development by influencing the structure of the food web within the reservoir biocoenosis. Increased stocking of predatory fish species affects the food chain by reducing the abundance of small fish species, which allows the development of larger zooplankton species (especially cladocera). Through their predatory activity on planktonic algae, these organisms can regulate phytoplankton biomass even under conditions of elevated nutrient concentrations.

To date, only a few isolated records exist on the occurrence of water mites in dam reservoirs in the Czech Republic, mostly obtained as part of hydrobiological research projects (e.g. [3]). Similarly, in other European countries, little attention has been paid to the water mite fauna of reservoirs; most information on standing waters comes from studies of lakes and ponds.

The aim of this survey was to obtain data on the water mite fauna in dam reservoirs in the Czech Republic, with a focus on their occurrence in the littoral zone over the stony surface of the dam embankment, i.e. in that part of the reservoir which is connected to the pelagic zone, is not overgrown with littoral vegetation, and has characteristics of certain lacustrine habitats, thus allowing comparison with findings of water mites from European lakes.

River Board, state enterprise	Reservoirs (number)	
	Drinking water	Other
Vltava River Board	14	1
Morava River Board	13	0
Ohre River Board	12	0
Elbe River Board	5	0
Oder River Board	3	1
Total	47	49



Sources: Decree No. 137 / 1999 Coll., establishing the list of drinking water reservoirs
Water Management Information Portal VODA (www.voda.gov.cz)

Fig. 1. Location of investigated reservoirs in the Czech Republic, indicating the responsibility of the river basin administrators (River Boards, state enterpises) that manage the reservoirs. (Source: Ministry of Agriculture, elaborated by Mgr. Monika Stadníková)

SAMPLING SITES

The distribution of water reservoirs in the Czech Republic is shown in the map in *Fig. 1*. A list of them is provided in *Tab. 2*, which contains basic information on the individual reservoirs from which water mite samples were collected in August and September 2024. The majority of water reservoirs (80 %) are located at elevations above 400 m a.s.l.

Of the total of 47 water reservoirs listed in Decree No. 137/1999 Coll. [1], sampling was not carried out at Znojmo reservoir (which is essentially a multipurpose reservoir with water-supply abstraction) or at Stavíště reservoir (access to the dam was closed and it was not possible to obtain a sample from a suitable location). Jezeří reservoir is also missing (it was drained in the given year), as is Myslivna reservoir, which, given its size, has more the character of a pond. On the other hand, sampling was carried out at Slezská Harta reservoir, which serves as a "pre-reservoir" for Kružberk reservoir, from which water is abstracted for supply purposes. A sample was also taken from Kristiánka water reservoir near Světlá nad Sázavou, which is a permanent source for a public water supply operated by Vodovody a kanalizace Havlíčkův Brod, a. s. In total, water mite fauna samples were collected from 45 reservoirs; the numerical designation of the sites/reservoirs follows their order in the cited Decree, with the two additional reservoirs assigned the numbers 48 and 49 in the list.

Sampling sites were located in the littoral zone immediately adjacent to the dam structures or over the stony bottom at the toe of the dams (geographical coordinates are given in *Tab. 1*); examples of several specific sites are shown in *Figs. 2–9*.

Tab. 2 contains data on chlorophyll *a* concentrations in the individual reservoirs, which allow comparison of their trophy, as the quantity of phytoplankton is an indicator of nutrient loading in water bodies. Mean values and ranges of chlorophyll *a* concentrations are presented, based on samples collected at weekly intervals from April to September 2024. Typically, 9 to 11 values were determined over the course of the season. *Tab. 2* includes data on water transparency, also measured at weekly intervals during the period from April to September. These data were provided by staff of the River Boards, state enterprises from ongoing long-term monitoring of water quality in all water reservoirs.

From water-level fluctuation data obtained from monitoring of the individual reservoirs (provided by the respective River Board, state enterprise), it was confirmed for each site that the sampling locations had been submerged for more than three months prior to sampling; thus, the water mite fauna samples

Tab. 1. List and characteristics of water reservoirs (in order according to Decree No. 137/1999 Coll. [1]) and date of water mites sampling in 2024

No.	Reservoir	Watercourse	Coordinates		Year of construction	Volume [mil. m^3]	Reservoir area [ha]	Dam height [m]	Altitude [m]	Date of sampling (2024)
			Latitude	Longitude						
1.	Hamry	Chrudimka	49.737976	15.914700	1912	3.6	66	17	590	11. 8.
2.	Křižanovice	Chrudimka	49.862636	15.775655	1954	2.04	31.8	31.7	404	11. 8.
3.	Vrchlice	Vrchlice	49.926630	15.226189	1970	9.8	102.8	40.8	325.8	11. 8.
4.	Josefův Důl	Kamenice	50.793835	15.195264	1982	22.6	138.1	44	735	31. 8.
5.	Souš	Černá Desná	50.790400	15.317972	1915	7.48	85.9	23	764	31. 8.
6.	Římov	Malše	48.850100	14.490481	1977	34.5	210	47.5	534	16. 8.
7.	Karhov	Studenský potok	49.209331	15.305234	1971	0.56	27.2	5	669	13. 8.
8.	Husinec	Blanice	49.038384	13.992757	1939	6.6	60.9	27.2	531.7	16. 8.
9.	Staviště	Staviště	--	--	1959	0.55	15.3	10.8	582.4	--
10.	Švihov	Želivka	49.722838	15.088437	1975	309	1602.6	58.3	392	7. 9.
11.	Lučina	Mže	49.806938	12.581830	1975	5.79	86.2	23.5	535	14. 8.
12.	Mariánské Lázně	Úšovický potok	49.997680	12.705938	1896	0.278	4.29	15.6	731.7	14. 8.
13.	Nýrsko	Úhlava	49.260407	13.143352	1965	20.75	148	36.2	665	8. 9.
14.	Žlutice	Střela	50.086955	13.126297	1968	15.61	167.4	26.2	510	14. 8.
15.	Klíčava	Klíčava	50.064200	13.932895	1955	10.4	71.4	37.2	294	31. 8.
16.	Láz	Litavka	49.659623	13.893948	1822	0.83	15.5	15.7	643	16. 8.
17.	Pilská	Pilský potok	49.587930	15.927363	1853	1.6	20.79	14	668	16. 8.
18.	Obecnice	Obecnický potok	49.717406	13.926984	1964	0.71	12	14	566	16. 8.
19.	Horka	Libocký potok	50.186642	12.490510	1969	21.35	130.2	40.7	507	14. 8.
20.	Podhora	Teplá	49.963779	12.813693	1956	3.03	95	10.28	693.5	14. 8.
21.	Stanovice	Lomnický potok	50.174810	12.877487	1978	27.8	142	57.5	519.5	14. 8.
22.	Kamenička	Kamenička	50.512157	13.331325	1904	0.714	6	32.9	597.1	28. 9.
23.	Křímov	Křímovský potok	50.498343	13.314142	1958	1.26	10.4	41.3	569	28. 9.
24.	Jirkov	Bílina	50.509916	13.409800	1965	2.51	16.4	50.8	454.8	28. 9.
25.	Jezeří	Vesnický potok	--	--	1904	0.05	0.64	17.54	471.7	--
26.	Janov	Loupnice	50.610601	13.558451	1914	1.67	10.1	44.5	493.5	28. 9.
27.	Chřibská	Chřibská Kamenice	50.852563	14.524592	1924	1.06	13.8	24.73	438.6	31. 8.
28.	Přísečnice	Přísečnice	50.489700	13.135506	1976	46.7	362	47.2	735.9	28. 9.
29.	Fláje	Flájský potok	50.686812	13.579553	1964	21.6	153	49.5	737.3	28. 9.
30.	Myslivny	Černá	--	--	1950	0.06	4.1	5.6	959.1	--
31.	Kružberk	Moravice	49.824270	17.662043	1955	35.5	280	34.5	428.5	25. 8.
32.	Šance	Ostravice	49.510751	18.415829	1969	61.8	337	65	507.8	25. 8.
33.	Morávka	Morávka	49.583322	18.535607	1967	0.5	79.5	39	791.1	25. 8.
34.	Karolinka	Stanovice	49.345127	18.234131	1987	7.4	50.5	35.5	522.7	24. 8.
35.	Opatovice	Malá Haná	49.308193	16.929371	1972	9.9	70.5	36.1	335.1	24. 8.
36.	Fryšták	Fryštácký potok	49.264247	17.691415	1939	2.95	62	13.7	249.2	24. 8.
37.	Slušovice	Dřevnice	49.271474	17.801005	1976	9.95	78.4	30	313	24. 8.
38.	Bojkovice	Kolelačský potok	49.050300	17.845050	1966	0.96	15.45	16	323.3	24. 8.
39.	Ludkovice	Ludkovický potok	49.122171	17.729111	1968	0.69	12.43	15.2	286	24. 8.
40.	Nová Říše	Řečice	49.151312	15.546533	1984	3.31	51	19.9	556.4	27. 9.
41.	Landštejn	Pstruhovec	49.020682	15.244270	1973	3.26	40.5	23.4	570	27. 9.
42.	Znojmo	Dyje	--	--	1966	4.29	45	17	228.5	--
43.	Vír I	Svratka	49.564015	16.311877	1958	56.19	223.5	76.5	470.4	11. 8.
44.	Boskovice	Bělá	49.495490	16.696949	1989	7.02	52	42.5	432.3	11. 8.
45.	Hubenov	Maršovský potok	49.391948	15.489894	1972	3.39	55	19	523.6	13. 8.
46.	Mostiště	Oslava	49.395663	16.011232	1961	11.93	93	41.7	459	11. 8.
47.	Koryčany	Kyjovka	49.116610	17.194012	1959–1963	2.56	35.15	20	308.25	24. 8.
48.	Slezská Harta	Moravice	49.888653	17.578802	1997	218.7	870	64.8	500	25. 8.
49.	Kristiánka	Žebrakovský potok	49.697750	15.381924	1986–1989	0.438	11.2	7.9	484.3	21. 9.

Tab. 2. List and additional characteristics of investigated water reservoirs (water transparency measured by Secchi disc, chlorophyll a concentration, water level fluctuations; data provided by colleagues of River Boards, state enterprises) and numbers of water mites found

No.	Reservoir	Secchi disc transparency [m] mean values (April–September 2024)	Chl. a [μg/L] ranges and mean values of April–September 2024	Level fluctuations compared to the long-term average (status 2 months before sampling)	Number of adults	Number of nymphs
1.	Hamry	0.5–1.25 1.0	4.1–61.3 21.0	slight drop in water level (by about 1.25 m)	30	17
2.	Křižanovice	0.1–2.0 1.4	3.8–147.4 54.0	level fluctuates by up to 2.2 m	36	2
3.	Vrchlice	1.6–2.4 2.3	4.1–24.9 13.3	level fluctuates and steadily decreases	41	13
4.	Josefův Důl	2.8–3.5 3.4	0.9–5.7 2.6	water level fluctuates by up to 2 m	0	0
5.	Souš	2.0–3.6 2.9	0.9–14.5 6.2	level fluctuates by up to 2.9 m	0	4
6.	Římov	1.4–3.6 2.4	4.2–42.0 20.9	slight permanent decrease (by about 2 m)	15	11
7.	Karhov	0.7–1.2 1.0	16.0–33.0 24.4	slight drop in water level	10	10
8.	Husinec	1.0–3.1 1.9	2.4–21.0 11.7	slight drop in water level (by 0.5 m)	46	51
9.	Staviště	-	-	-	-	-
10.	Švihov	4.0–5.6 4.8	1.0–8.7 4.0	slight drop in water level (by 0.5 m)	7	1
11.	Lučina	1.0–1.7 1.2	3.0–46.0 22.6	slight drop in water level (by 0.5 m)	12	8
12.	Mariánské Lázně	0.95–1.3 1.0	12.1–40.5 19.3	slight drop in water level	34	8
13.	Nýrsko	3.5–5.3 4.4	1.4–7.7 4.1	slight drop in water level (by 0.5 m)	22	47
14.	Žlutice	2.2–3.1 2.6	2.3–27.0 13.6	drop in water level (by about 1 m)	34	8
15.	Klíčava	4.1–6.0 4.7	3.3–10.0 4.4	drop in water level (by 1.5 m)	33	13
16.	Láz	-	1.9–5.9 4.1	drop in water level (by 1 m)	10	19
17.	Pilská	-	1.8–4.6 2.9	drop in water level (by 1.4 m)	12	22
18.	Obecnice	1.4–2.0	4.1–56 15.6	drop in water level (by 0.6 m)	2	15
19.	Horka	2.5–4.0 3.5	1.3–4.6 3.1	slight drop in water level	1	3
20.	Podhora	0.95–1.7 1.4	4.3–270.3 70.4	slightly rising water level	9	3
21.	Stanovice	1.7–2.8 2.45	4.7–14.2 10.4	water level rise (by about 0.4 m)	2	13
22.	Kamenička	3.2–6.2 4.2	2.7–8.6 4.6	water level rise (by 0.25 m)	5	5
23.	Křímov	2.0–6.3 3.9	2.9–23.9 11.5	water level rise (by 0.43 m)	7	0
24.	Jirkov	1.1–4.2 3.1	1.0–75.6 16.5	water level rise (by 0.7 m)	10	0
25.	Jezeří	-	-	-	-	-
26.	Janov	1.6–2.9 2.1	-	slight drop in water level (by 0.5 m)	19	3

No.	Reservoir	Secchi disc transparency [m] mean values (April–September 2024)	Chl. a [µg/L] ranges and mean values of April–September 2024	Level fluctuations compared to the long-term average (status 2 months before sampling)	Number of adults	Number of nymphs
27.	Chřibská	2.7–4.0 3.2	1.0–3.2 2.1	slight increase (by 0.3 m)	5	25
28.	Přísečnice	3.2–3.7 3.6	1.2–7.9 2.4	slight drop in water level (by 0.3 m)	8	1
29.	Fláje	1.9–2.8 2.3	1.0–3.3 2.4	slight increase of water level (by 0.3 m)	37	11
30.	Myslivny	-	-	-	-	-
31.	Kružberk	2.3–4.8 3.3	0.63–5.35 2.96	gradual decrease in water level (from spring by 0.9 m)	17	7
32.	Šance	1.0–3.4 2.85	1.2–8.4 2.5	gradual decrease in water level from January	4	24
33.	Morávka	0.4–4.5 3.0	0.28–5.49 2.25	gradual decrease in water level from January	11	11
34.	Karolinka	2.2–4.8 3.4	2.5–6.9 3.6	gradual decrease in water level (by about 2 m)	57	57
35.	Opatovice	1.8–3.2 2.7	3.1–29.2 9.7	does not fluctuate, steady state	4	4
36.	Fryšták	0.4–1.7 0.9	2.5–108 40.0	does not fluctuate, steady state	12	1
37.	Slušovice	2.4–4.2 3.6	2.5–9.0 3.1	slight increase in water level (by 0.5 m)	7	4
38.	Bojkovice	1.4–2.3 1.5	3.0–10.6 5.9	does not fluctuate, steady state	12	15
39.	Ludkovice	1.2–2.0 1.5	4.4–39.3 9.5	does not fluctuate, steady state	55	2
40.	Nová Říše	1.9–2.3 2.1	2.5–14.3 7.2	does not fluctuate, steady state	117	7
41.	Landštejn	2.0–2.8 2.5	2.5–20.0 7.1	does not fluctuate, steady state	11	10
42.	Znojmo	-	-	-	-	-
43.	Vír I	1.6–4.6 2.8	2.5–38.5 13.9	drop in water level (by about 0.5 m)	12	14
44.	Boskovice	1.3–3.6 2.6	2.5–25.5 14.8	drop in water level (by about 1 m)	20	3
45.	Hubenov	1.5–2.8 2.0	8.4–52.1 23.1	does not fluctuate, steady state	5	5
46.	Mostiště	1.1–2.8 1.9	3.7–304 16.1	slight drop in water level (by 0.25 m)	13	0
47.	Koryčany	1.2–3.3 2.4	2.5–16.5 7.4	oes not fluctuate, steady state	17	6
48.	Slezská Harta	2.3–4.1 3.0	1.5–10.4 4.2	gradual decrease in water level (by 2 m from January)	14	10
49.	Kristiánka	-	-	does not fluctuate, steady state	14	14

were collected from long-term submerged surfaces of the littoral zone. In cases of a gradual long-term decrease in water level by several metres, for example in Horka reservoir (site No. 19), changes in benthic community composition in the littoral zone cannot be ruled out.

METHODOLOGY

For sampling water mite fauna, a standard method was used involving the collection of organisms with a plankton net mounted on a pole; the diameter of the circular opening was 30 cm and the mesh size was 0.350 mm. Each sample was taken by sweeping the net along the dam face or over the stony riprap at the toe of the dam, with horizontal movement of approximately 1.5 m and at depths of 0.5–1.0 m below the water surface for a duration of two minutes. Sampling sites were selected so that the substrate (stony surfaces under the open water column) was largely free of vegetation and morphologically very similar (*Figs. 2–9*).

This methodological approach does not provide an absolute quantification of the number of individuals collected, i.e. in relation to water volume or surface area; however, it allows comparison of the number of water mites captured, the frequency of species present, and their occurrence within the same habitat (littoral over a stony substrate). It therefore represents a semi-quantitative method for assessing the occurrence of water mites at individual sites, making it possible to express the relative abundance of the recorded species.

The collected material, consisting of detritus with zooplankton, meiobenthos (including water mites), macrozoobenthos, and larger phytoplankton species, was transferred from the net into water in a plastic tray (30 × 50 cm). Water mites were picked out on site using a pipette and fixed in Koenike's solution (a mixture of glacial acetic acid, glycerine, and distilled water [4]). After the completion of sampling at the end of September 2024, the individual water mite samples were sorted under a stereomicroscope (at 10–50× magnification), and both adult specimens and nymphs were counted. From the adult specimens, already sorted to genus level, several individuals from each morphologically uniform group were selected for further preparation. After heating in potassium hydroxide (30 %), during which the chitinous body structures turn brown, the homogeneous body contents are expelled from the individual specimens under a stereomicroscope; after rinsing in water, the specimens are transferred to glycerine. Subsequently, on a microscope slide, the organs necessary for species identification are prepared (mouthparts are separated, and in some cases certain legs). After embedding in glycerine jelly and covering with a coverslip, permanent slides of adult specimens were prepared, suitable for microscopic identification to species level. These permanent preparations serve as reference material and allow the acquisition of photographic documentation. Glycerine jelly is a historically well-established medium for zoological microscopic preparations and is still used today for preserving voucher material of water mites, see [5].

Immature stages of water mites (nymphs) were, with few exceptions, not prepared, as their morphology generally does not allow reliable identification to species level.

Species identification of water mites was based primarily on literature published in the last 10–12 years [6–8]; however, older identification keys are also useful for certain more detailed information [4, 9].

RESULTS

Average chlorophyll *a* concentrations (*Tab. 2*) during the growing season were below 10 µg/L in 26 reservoirs, while in 11 reservoirs they ranged between 10 and 20 µg/L. Only six reservoirs exceeded 20 µg/L, in three cases very substantially. These data indicate that the sites are predominantly oligotrophic to slightly mesotrophic, which corresponds to the requirements for water quality of sources used for drinking water treatment. This is also reflected in the average values of water transparency during the summer (growing) period, which ranged between 2 and 3 m; only in a few cases were they less than 1 m.

A total of 1,356 water mites were recorded in 45 water reservoirs, of which 507 specimens (37.3 %) were immature stages (nymphs), for which identification to species level is uncertain (*Tab. 3*). The list of water mite species in *Tab. 3* is therefore based solely on the identification of 849 adult individuals, whose occurrence and abundance were found at the individual sites.

The numbers of water mites vary considerably among individual sites, as does the proportion of immature stages (nymphs). *Tab. 4* presents data from sites with more than 40 water mites (adults and nymphs), i.e. more than 3 % of the total number of collected water mites. The highest numbers of water mites were found in Nová Říše reservoir (site No. 40), Karolinka reservoir (site No. 34), and Husinec reservoir (site No. 8). By contrast, no water mites were found in Josefův Důl reservoir (site No. 4), and

Fig. 2. Hubenov reservoir (site No. 45), view from the dam to the sampling site

Fig. 3. Přísečnice reservoir (site No. 28), view of the dam and sampling site

Fig. 4. Horka reservoir (site No. 19), view of the dam and sampling site

Tab. 3. Number of adults and nymphs of individual water mite species found in investigated reservoirs

Species found	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	26	27	28	29	31	32	33	34	35	36	37	38	39	40	41	43	44	45	46	47	48	49	Total	Number of sites
Arrenurus albator **(Mueller, 1776)**	9	28				1	2	2			3	5	3	2										8			2	4		1	1					4	4			3						82	17
Arrenurus compactus Piersig, 1894																																					1									1	1
Arrenurus crassicaudatus Kramer, 1875	1							2					1																	1						1	1								2	9	7
Arrenurus falciger Viets, 1908			4												1							1																								6	3
Arrenurus sinuator (Mueller, 1776)	3							17						1														2							6		3		4			3	2		2	43	10
Atractides ovalis Koenike, 1883																									4													1								5	2
Brachypoda versicolor (Mueller, 1776)	1	6	3			3				1			3	1								2	9	10		7		3		1	7	2			3	1	9	7	4			8	7		4	102	23
Hydrodroma despiciens (Mueller, 1776)			23										8	20	2				5									4																7		69	7
Hydrochoreutes ungulatus (Koch, 1836)						7												1													1									1						10	4
Hydrochoreutes krameri Piersig, 1896											13																																			13	1
Hygrobates longipalpis (Hermann, 1804)		2	2					2		2												1		1		1			1	3							1									16	10
Hygrobates trigonicus **Koenike, 1895**																																											3			3	1
Forelia liliacea (Mueller, 1776)			1			1		3	1	7		3	2	5		2				1								1		2	14				1	14								4	1	63	17
Forelia longipalpis **Maglio, 1924**																																						1								1	1
Forelia variegator (Koch, 1837)																																					1									1	1
Limnesia koenikei Piersig, 1894																					2																									2	1
Limnesia maculata (Mueller, 1776)									2							6									1												1									10	4
Limnochares aquatica (Linnaeus, 1758)							3																																							3	1
Mideopsis orbicularis (Mueller, 1776)			3				1	1		2	3		9			3							1																							23	8
Neumania deltoides (Piersig, 1894)						1		2			9		3			1				1	2	1															9		3							32	10
Neumania imitata Koenike, 1908																						1																								1	1
Neumania limosa (Koch, 1836)	2		1					17				14			5		1					1						2			1	1	1		1			1		12					2	62	15
Neumania vernalis (Mueller, 1776)	1								3																			1	2	2								1							3	13	7
Neumania verrucosa (Koenike, 1895)											6			2			1																													9	3
Piona conglobata (Koch, 1836)			1																																											1	1
Piona discrepans (Koenike, 1895)			1																																											1	1
Piona laminata (Thor, 1900)																					1									1	1															3	3
Piona nodata (Mueller, 1776)															1																															1	1
Piona obturbans (Piersig, 1896)									1																																					1	1
Piona pusilla (Neuman, 1875)			1																												2															3	2
Piona rotundoides (Thor, 1897)			1																																											1	1
Piona stjordalensis (Thor, 1897)															1																													2		3	2
Unionicola crassipes (Mueller, 1776)	13					2	4						4	2					4								35		1		30	1	11	6	1	35	88		1	4	5	2	5	1		255	21
Vicinaxonopsis g. sp. zatím neurčeno																																		1												1	1
Celkem druhů	7	3	11	0	0	6	4	8	4	4	5	3	8	7	5	4	2	1	2	2	3	6	2	3	2	2	2	7	3	7	8	3	2	2	5	5	10	5	4	4	1	3	4	4	6		
Počet dospělých vodulí	30	36	41	0	0	15	10	46	7	12	34	22	33	33	10	12	2	1	9	2	5	7	10	19	5	8	37	17	4	11	57	4	12	7	12	55	118	11	12	20	5	13	17	14	14	849	
Počet nymf	17	2	13	0	4	11	10	51	1	8	8	47	8	13	19	22	15	3	3	13	5	0	0	3	25	1	11	7	24	11	57	4	1	4	15	2	7	10	14	3	5	0	6	10	14	507	
Celkem vodulí	47	38	54	0	4	26	20	97	8	20	42	69	41	47	29	34	17	4	12	15	10	7	10	22	30	9	48	24	28	22	114	8	13	11	27	57	125	21	26	23	10	13	23	24	28	1,356	

Tab. 4. Number of adults and nymphs of individual water mite species found in investigated reservoirs

Site No.	Reservoir	Total number of adults + nymphs (% of nymphs in brackets)
40	Nová Říše	125 (6)
34	Karolinka	114 (50)
8	Husinec	97 (49)
13	Nýrsko	69 (68)
39	Ludkovice	57 (4)
3	Vrchlice	54 (24)
29	Fláje	48 (23)
1	Hamry	47 (36)
15	Klíčava	47 (30)
14	Žlutice	41 (20)
12	Mariánské Lázně	42 (19)

only four nymphs were recorded in Souš reservoir (site No. 5) (only one was identified, belonging to the genus *Hydrochoreutes* Koch, 1837). The likely cause is the low pH values of the water in these reservoirs (see Discussion). Only a single water mite was also found in Horka reservoir (site No. 19); a probable reason may be the long-term gradual but substantial decrease in water level of approximately 6–8 m (as shown in *Fig. 4*), which may have significantly reduced the availability of organisms necessary for the development of water mite larvae. A total of 34 water mite species were recorded across all 45 studied reservoirs. Twelve species dominated in both occurrence and number of individuals, accounting for 87.4 % of all recorded adult water mites (*Tab. 5*). All these species possess numerous swimming setae on their legs, and *Unionicola crassipes* (Mueller, 1776) as well as species of the genus *Neumania* Lebert, 1879 are characterised by very long legs, as illustrated in *Microphotographs I–L*. The number of species recorded in individual reservoirs is given in *Tab. 3*; the highest numbers were found in Vrchlice reservoir (site No. 3) and Nová Říše reservoir (site No. 40), see *Tab 6*. Fourteen species occurred at only one site, while two to three species were recorded at three sites. These are species of the genera *Arrenurus* Dugès, 1834, *Limnesia* Koch, 1836, and *Piona* Koch, 1842, which otherwise commonly occur in large numbers in standing waters with macrophyte vegetation, especially in ponds.

Three recorded species expand the list of water mite species documented in the Czech Republic in the database of the Nature Conservation Agency of the Czech Republic. These are the following species:

- *Forelia longipalpis* Maglio, 1924 (*Microphotograph H*)
  The record of this species in Landštejn reservoir (site No. 41, see *Tab.* 3) also represents a species new to the fauna of the Czech Republic, as it has not previously been reported in published studies on water mites in Czech waters.
- *Arrenurus albator* (Mueller, 1776) (*Microphotographs F, G)*)
  This species has been recorded previously, and Láska [9] reports it as common throughout the Czech Republic. It is among the most frequently recorded species of the genus *Arrenurus* Dugès, 1834 in European water bodies, especially in large lakes [10, 11].
- *Hygrobates trigonicus* Koenike, 1895 (*Microphotographs A, B*)
  This species is not new to the fauna of the Czech Republic either; however, it is reported as a "relatively rare species" from submontane streams [9]. It was found in the studied reservoirs but is common in lakes [11, 12].
- The record of *Atractides ovalis* Koenike, 1883 is also noteworthy, as it is the only species of this genus that occurs in standing waters and is particularly common in lakes of northern Europe [10].

Fig. 5. Kružberk reservoir (site No. 31), view of the dam and sampling site

Fig. 6. Karolinka reservoir (site No. 34), view from the dam to the sampling site

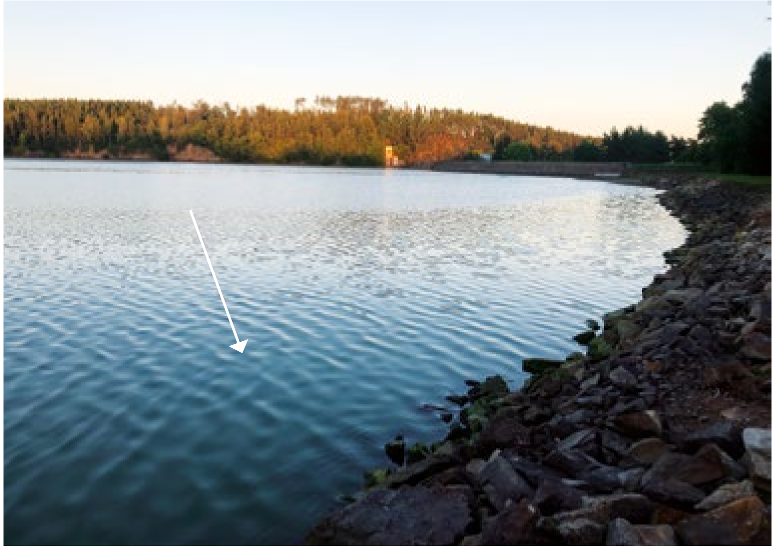


Fig. 7. Mostiště reservoir (site No. 46), view of the dam and sampling site

Tab. 5. Species of water mites with the highest abundance in all investigated reservoirs

Species	Number of sites	Frequency of species occurrence [%]
Brachypoda versicolor (Mueller, 1776)	23	51,1
Unionicola crassipes (Mueller, 1776)	21	46,6
Arrenurus albator (Mueller, 1776)	17	37,7
Forelia liliacea (Mueller, 1776)	17	37,7
Neumania limosa (Koch, 1836)	15	33,3
Neumania deltoides (Piersig, 1894)	10	22,2
Hygrobates longipalpis (Hermann, 1804)	10	22,2
Arrenurus sinuator (Mueller, 1776)	10	22,2
Mideopsis orbicularis (Mueller, 1776)	8	17,8
Arrenurus crassicaudatus Kramer, 1875	7	15,6
Hydrodroma despiciens (Mueller, 1776)	7	15,6
Neumania vernalis (Mueller, 1776)	7	15,6

- The identification of the water mite designated as "*Vicinaxonopsis* Cook, 1974" remains unresolved. It belongs to the subfamily *Axonopsinae*, Viets, 1929. The genus *Vicinaxonopsis* has so far been described only from Bulgaria and Sardinia [7]. Only a single specimen (*Microphotograph O*) was found in Slušovice reservoir (site No. 37, see *Tab.* 3), and further clarification of this record will therefore require repeated sampling at this site.

The article also includes microphotographs of water mite species that expand the existing list of species recorded in the Czech Republic by the Nature Conservation Agency, as well as species most frequently occurring in water reservoirs and species found only sporadically in the country *(Microphotographs A–O).*

DISCUSSION

Water mite fauna in dam reservoirs in the Czech Republic has not been studied in detail to date, and available knowledge is therefore only fragmentary.

Tab. 6. Reservoirs with the highest number of water mite species

Site No.	Reservoir	Number of species
3	Vrchlice	11
40	Nová Říše	10
14	Žlutice	8
15	Klíčava	7
31	Kružberk	7
33	Morávka	7
1	Hamry	7
6	Římov	6
23	Křímov	6
49	Kristiánka	6

The first data on the occurrence of water mites in a dam reservoir in the Czech Republic (then Czechoslovakia) were published in 1960 [3] as part of an extensive hydrobiological survey of Sedlice reservoir on the Želivka river. The study was conducted at nine sites at depths of 6–8 m using a trap placed just above the reservoir bottom. After a 24-hour exposure, several dozen water mites were captured at each site. A total of six species were recorded, differing markedly from the species composition of water mites in the water reservoirs presented in this study. Representatives of the genera *Unionicola* Haldeman, 1842 and *Neumania* Lebert, 1879 were absent, while the most abundant species were *Piona coccinea* (Koch, 1836) and *Hygrobates longipalpis* (Hermann, 1804). The occurrence of *Lebertia fimbriata* Thor, 1899 is noteworthy, as this species was not found in the studied water reservoirs. Additional species recorded from the genus *Piona* Koch, 1842 included *Piona rotunda* (Kramer, 1870), now *Piona rotundoides* (Thor, 1897), and *Piona fallax* (Thon, 1899). This species, described by Thon from Munický pond in Czechoslovakia [14], does not appear in current hydrachnological literature and is not listed among the synonyms of existing species of the genus *Piona* Koch, 1842. Láska [15] included *Piona fallax* (Thon, 1899) in his list of water mites recorded in the Czech Republic, but it has not appeared in any subsequent studies on the water mite fauna of the country. Viets [16] also mentions this species in his 1955 publication and reports its

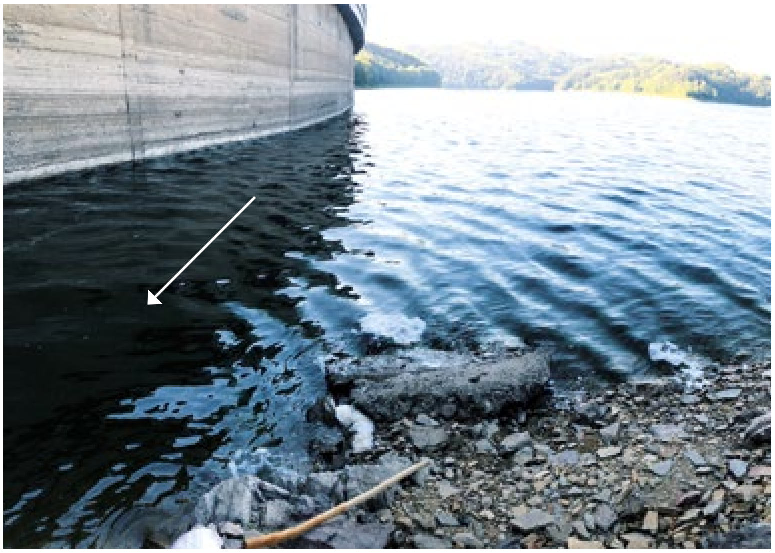


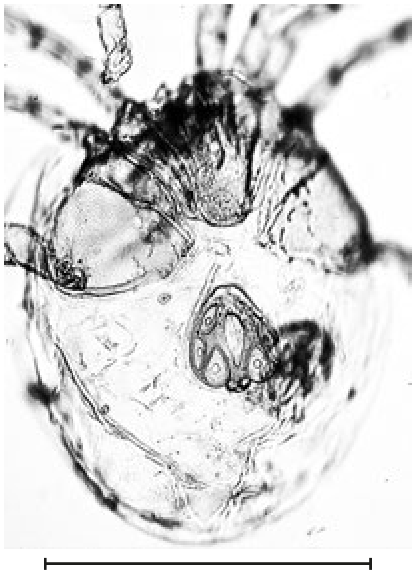
Fig. 8. Vír reservoir (site No. 43), view of the dam and sampling site

Fig. 9. Nová Říše reservoir (site No. 40), view of the sampling site

Tab. 7. The occurence of water mite species found in more than 10 % of samples in seven littoral biotops of the Rybinsk reservoir. Data taken from the publication Tuzovskij [13], who investigated the fauna of water mites in different littoral biotops of the Rybinsk reservoir in samples taken by a grab-sampler in 1970–1971 (total number of samples 802). A brief description of biotopes: Biotope I – The most flooded zone of the littoral with the predominance of Carex acuta L., Carex vesicaria L., Carex nigra (L.) Reich. Biotope II – Rorripa amhibia (L.) stands on areas of 30–40 m^2 they closely follow the previous Carex stands. Biotope III – Reed community (Phragmites communis Trin.) on a sandy bottom, with an insignificant occurrence of other plants. Biotope IV – Potamogeton heterophyllus Schreib. stands with a relatively significant admixture of Agrostis stolonifera L. and Eleocharis acicularis (L.) Roem. et Schult. Biotope V – Eleocharis palustris (L.) stands with admixture of Alisma plantago-aquatica L., Potamogeton heterophyllus Schreib., Eleocharis acicularis (L.) Roem. et Schult., and others. Biotope VI: Protected coast, gray clay bottom, no vegetation, depth up to 2.5 m. Biotope VII: Surf zone of the coast of Khokhotki Island, sandy bottom, no vegetation

	Water mite species occurring in more than 10 % of samples collected	**Habitat I**	**Habitat II**	**Habitat III**	**Habitat IV**	**Habitat V**	**Habitat VI**	**Habitat VII**
1	*Arrenurus globator*	30				20		
2	*Arrenurus crassicaudatus*						18.7	
3	*Arrenurus nobilis*							
4	*Eylais hamata*	20						
5	*Eylais extendens*	35	40	30.4	26.7	13.3		
6	*Eylai borkensis*	20		36.4		33.3		
7	*Eylais infundibulifera*							
8	*Forelia liliacea*			13.6			90.7	25.7
9	*Hydrachna conjecta*	15						
10	*Hydrodroma despiciens*		30		23.4	45.6	43.7	17.3
11	*Hydrochoreutes krameri*	20	45	36.4	20			
12	*Hydryphantes crassipalpis*	35						
13	*Hydryphantes placatonis*	20						
14	*Hydryphantes planus*	25						
15	*Hydryphantes ruber*	60						
16	*Hygrobates longipalpis*						47	51.5
17	*Hygrobates nigromaculatus*						62.5	40.5
18	*Hygrobates trigonicus*						34.2	
19	*Lebertia inaequalis*						40.7	11.4
20	*Lebertia schmidtii*						72	19.9
21	*Limnesia maculata*		20					
22	*Limnesia undulata*				50	36.7	78	48.5
23	*Mideopsis orbicularis*						90.7	31.4
24	*Neumania deltoides*						15.6	
25	*Neumania limosa*						28.2	
26	*Piona coccinea*	20	35	36.4				
27	*Piona conglobata*		10	13.6	10			
28	*Piona longipalpis*					56.7	93.7	57.2
29	*Piona nodata*	40		54.5	63.4	60	25	45.7
30	*Piona pusilla*	25	70		66.7	63.3	18.7	31.4
31	*Piona variabilis*	20	60	63.7		36.7		
32	*Tiphys ornatus*	25						
33	*Unionicola aculeata*						40.7	
34	*Unionicola crassipalpis*			23.7			37.5	
Number of species occurring in more than 10 % of samples		**13**	**8**	**9**	**7**	**9**	**17**	**11**
Total number of species found in the individual habitats		**25**	**16**	**17**	**15**	**18**	**21**	**14**

A



B

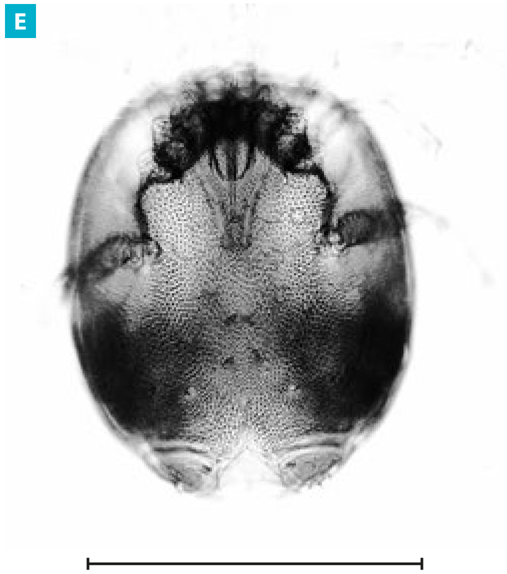
B

C

C

D

E

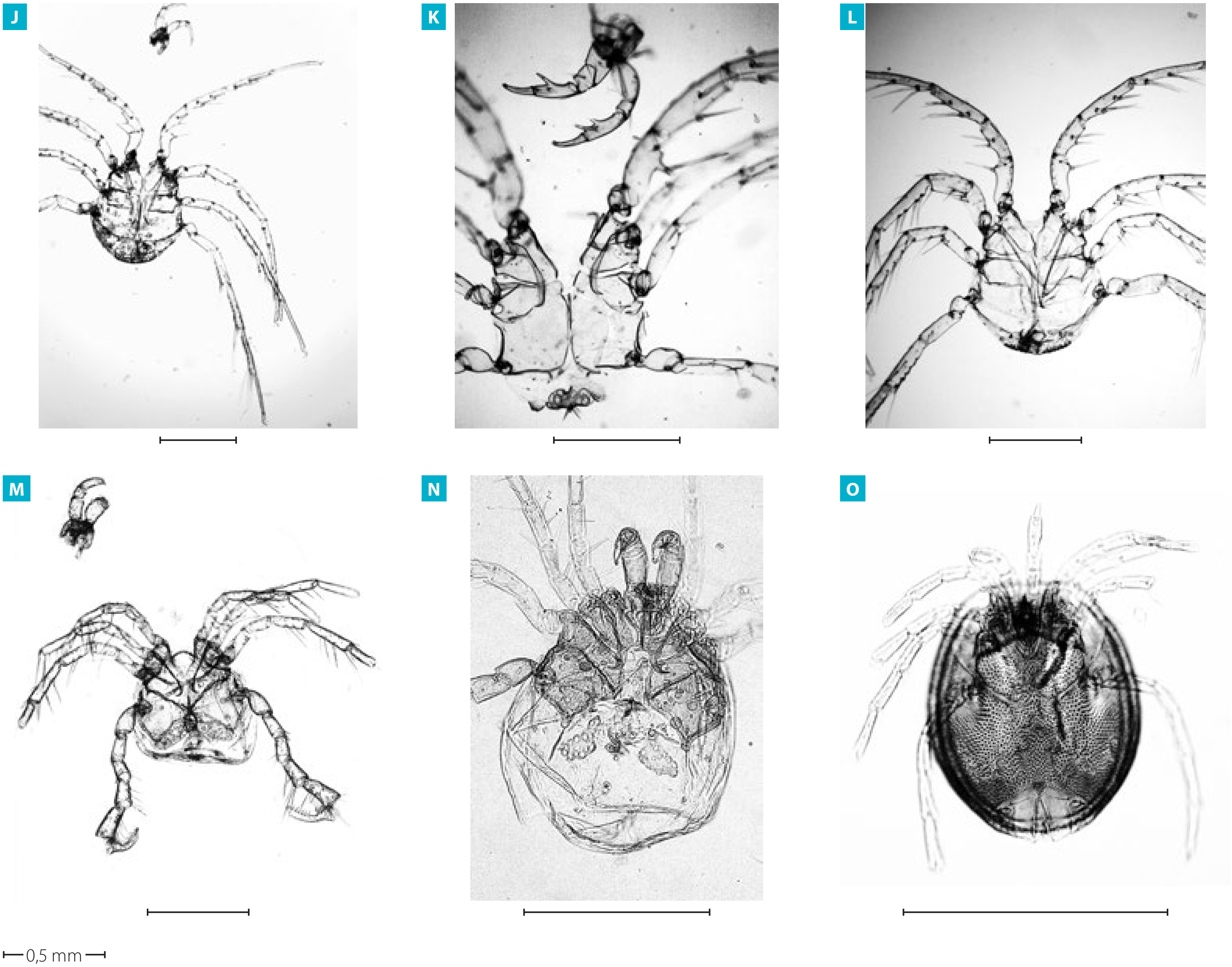


F

G

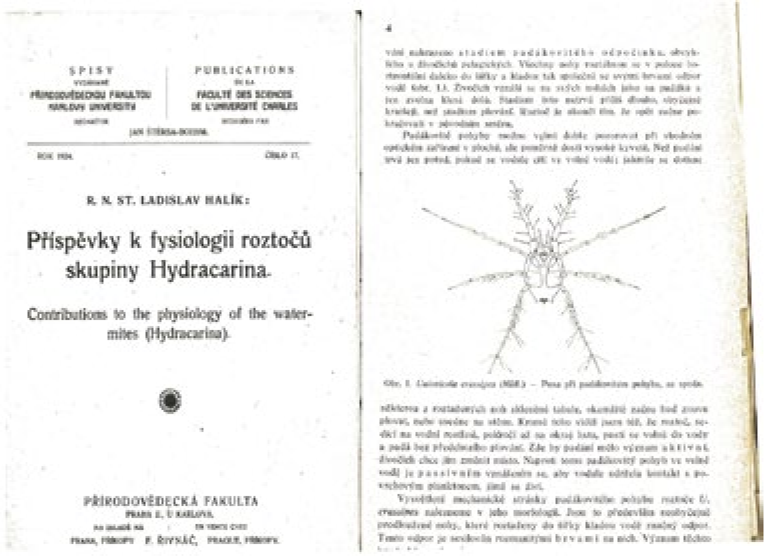
H

I



A, B – *Hygrobates trigonicus* (Koenike, 1895); [A] male; [B] female (preparation No. 41-2).
C, D, E – *Brachypoda versicolor* (Mueller, 1776); [C] male; [D] male, side view; [E] female; (preparations No. 2-1 and No. 15-3).
F, G – *Arrenurus albator* (Mueller, 1776); [F] male, [G] female (preparation No. 29-2).
H – *Forelia longipalpis* (Maglio, 1924); female (preparation No. 41-1).
I – *Unionicola crassipes* (Mueller, 1776); female (preparation No. 45-2).
J – *Neumania limosa* (Koch, 1836); male (preparation No. 35-2).
K – *Unionicola crassipes* (Mueller, 1776); female (preparation No. 7-2).
L – *Neumania limosa* (Koch, 1836); male (preparation No.16-4).
M, N – *Forelia liliacea* (Mueller, 1776); [M] male (preparation No. 3-4), [N] female (preparation No. 8-8).
O – *Vicinaxonopsis* (Cook, 1974); female, not determined to species level (preparation No. 37-4).

Microphotographs of several water mite species found in the investigated reservoirs. The first digit in the specimen designation is the locality number according to *Tab. 1* and *2*, the second digit is number of preparation prepared from this locality. All bars are 0.5 mm.



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R. N. ST. LADISLAV HALÍK:

Příspěvky k fysiologii roztočů skupiny Hydracarina.

Contributions to the physiology of the water-mites (Hydracarina).

PŘÍRODOVĚDECKÁ FAKULTA
PRAHA II, U KARLOVA
F. ŘIVNÁČ

Fig. 10. Example of a publication by Halík from 1924 [10] (title page and drawing of Unionicola crassipes (Mueller, 1776)); the text describes the locomotor activity of this water mite species in the water column: swimming alternately with parachute-like descent with the long legs with swimming setae extended

occurrence in Great Britain. Since the cited record from Sedlice reservoir, however, the species has not been recorded again; its existence therefore remains uncertain and cannot be verified, as the material from Sedlice reservoir is no longer available.

A second record of water mite occurrence from this region comes from Kníničky reservoir in Moravia, where Hrabě [17] studied the colonisation of the littoral zone and reservoir bottom. In samples collected with a plankton net at depths of up to 1.5 m at eight sites, he recorded eight species of water mites. The most abundant species was *Hygrobates longipalpis* (Hermann, 1804), but he also reported occasional occurrences of *Unionicola crassipes* (Mueller, 1776), *Neumania limosa* (Koch, 1836), and *Mideopsis orbicularis* (Mueller, 1776), which are among the species with the highest frequency of occurrence in the water reservoirs studied here.

A detailed study of water mite fauna was published by Punčochář and Hrbáček [18] from Hubenov reservoir in the Bohemian-Moravian Highlands, where they described the dominance of *Piona carnea* (Koch, 1836), which occurred in the plankton of the reservoir pelagic zone after the reservoir was filled in 1972. During the first few years, the fish stock consisted solely of brown trout (*Salmo trutta fario*), while large cladocerans of the genus *Daphnia* dominated the zooplankton and limited the development of phytoplankton biomass. Water transparency in the reservoir exceeded 9 m (the maximum depth of the reservoir is 16 m). In the water mite fauna in the years 1976–1978, *Piona carnea* (Koch, 1836) predominated (70–90 %); owing to the dense swimming setae on its legs, it was able to move within the pelagic zone. Complementary species included *Piona pusilla* (Neuman, 1875) and *Piona rotundoides* (Thor, 1897), which accounted for 5–17 % of the water mite fauna. A change in fish stock, when trout were replaced due to disease by an ichthyofauna dominated by non-predatory fish, was accompanied by a marked shift in the water mite assemblage: the originally "complementary species" subsequently became dominant, and the occurrence of additional species increased, including *Limnesia maculata* (Mueller, 1776) and *Unionicola crassipes* (Mueller, 1776). Monitoring of Hubenov reservoir is also included in the present study (site No. 45 – *Tab. 1* and *2*, *Fig. 2*). Its fish stock currently consists of a mixture of species [19], in which predatory fish do not predominate, and the water mite fauna is characterised by a clear dominance of *Unionicola crassipes* (Mueller, 1776), see *Tab. 3*. A similar, unusual dominance of the water mite *Piona limnetica* Biesiadka was described by Gliwicz and Biesiadka [20] in the plankton of a dam reservoir in Panama. As in the case of Hubenov reservoir, the main reason was the availability of planktonic cladocerans as a food source, together with suitable body morphology, as the legs of this species, with a specific arrangement of swimming setae, enable movement (swimming) in open water outside the littoral zone. Species of the genera *Neumania* Lebert, 1879 and *Unionicola* Haldeman, 1842 were present in lower numbers in this reservoir; their swimming setae also allow them to occur in the plankton.

Of the 34 water mite species recorded in the studied water-supply reservoirs, 12 species occurred at more than 10 % of sites (*Tab. 5*). These are species characterised by pronounced locomotory activity in the pelagic zone.

With regard to the occurrence and biology of *Unionicola crassipes* (Mueller, 1776), reference should be made to the publication by the Czech author Ladislav Halík from 1924 [21], in which he described the "parachute-like movement of individuals of this species", enabled by extremely long legs bearing numerous swimming setae. This was confirmed by later studies [20, 22]. A similar limb morphology is also characteristic of species of the genus *Neumania* (*Fig. 10*). Other abundant water mite species – *Brachypoda versicolor* (Mueller, 1776), *Arrenurus albator* (Mueller, 1776), *Forelia liliacea* (Mueller, 1776), and *Hygrobates longipalpis* (Hermann, 1804) – also possess dense swimming setae on their legs. They commonly occur in the littoral zone with vegetation in standing waters, although they do not reach such a high relative abundance there [40].

Unfortunately, in most studies of reservoir ecosystems, information on water mite fauna is only general [23] or their presence is referred to merely as a group of organisms [24]. A very similar composition of dominant water mite species in littoral habitats with and without macrophyte vegetation was reported from Rybinsk reservoir by Tuzovskij [13], as shown in *Tab. 7*. In habitats with macrophyte vegetation, he found a markedly different species composition of water mites, with a predominance of species of the genus *Piona* Koch, 1842 and others, which are also common in ponds [33, 40].

There is a substantial body of detailed publications on the fauna of water mites in lakes. A comparison of the results from drinking water reservoirs presented in this study with data from lakes is difficult and problematic, as the sampling methods used differ considerably. For monitoring the occurrence and composition of water mite fauna in lakes, various quantitative sampling methods have been employed, including traps [30], dredges [12, 13], and grabs for benthic sampling [25, 27]. At the same time, sampling sites were predominantly located in the littoral zone with macrophyte vegetation, i.e. in a habitat similar to that found in fishponds. In a quantitative study of water mites in 50 lakes in Schleswig-Holstein, Viets [27] reported 58 species of water mites in samples collected using a grab. Thirteen species occurring at more than 20 % of sites include seven species with the highest frequency of occurrence in the drinking water reservoirs studied – *Unionicola crassipes* (Mueller, 1776), *Hygrobates longipalpis* (Hermann, 1804), *Forelia liliacea* (Mueller, 1776), *Neumania deltoides* (Piersig, 1894), *Mideopsis orbicularis* (Mueller, 1776), *Arrenurus albator* (Mueller, 1776), and *Arrenurus crassicaudatus* Kramer, 1875 (*Tab. 5*). These water mite species also occur most frequently in Dutch lakes [26].

In the oligotrophic lakes of Stechlinsee [12] and Bodensee [25], in samples taken from the bottom using a benthic grab and dredge, the species *Brachypoda versicolor* (Mueller, 1776), *Unionicola crassipes* (Mueller, 1776), and *Hygrobates longipalpis* (Hermann, 1804), which dominate in drinking water reservoirs, were among the most frequent. By contrast, *Arrenurus albator* (Mueller, 1776) occurred only sporadically in Stechlinsee and was completely absent from Bodensee. In both lakes, however, species of the genus *Lebertia* Neumann, 1880 were present.

Biesiadka [28] compared the composition of water mite fauna from the littoral zone of Lake Kierskie in collections from the period 1930–1933 with results from 1969–1970. Although the composition of the water mite fauna changed slightly, the dominant species were the same as those in drinking water reservoirs, with the exception of a notable occurrence of *Lebertia insignis* Neumann, 1880.

The composition of water mite fauna from 21 oligotrophic reservoirs (with chlorophyll *a* concentrations ranging from 0.22 to 4.81 µg/L) was published by Pozojevič et al. [29]. The genus *Lebertia* Neumann, 1880 (frequency of occurrence 57 %) and the species *Arrenurus albator* (42 %), *Neumania deltoides* (47 %), and *Hydrochoreutes krameri* Piersig, 1896 (38 %) formed a common component of the water mite fauna. The authors do not report the occurrence of *Hygrobates longipalpis* (it may be included under the genus *Hygrobates* Koch, 1837, which they did not specify in more detail). The species *Brachypoda versicolor* (Mueller, 1776) was recorded at only two sites (9 %). A more detailed comparison of species composition with the results from the studied reservoirs is not possible, as the occurrence of the genera *Limnesia* Koch, 1836, *Neumania* Lebert, 1879, and *Hydrodroma* Koch, 1837 is likewise reported without species-level identification. By contrast, *Unionicola crassipes* (Mueller, 1776) was not recorded, which is surprising, as it commonly occurred in lakes (particularly oligotrophic ones) [12, 13, 22, 25–28, 30, 37]. Viets [27] states that an essential condition for the occurrence of this water mite species is the presence of bryozoans. Unfortunately, Pozojevič et al. [29] and most of the other cited references do not provide more detailed information on the fauna of the studied lakes. The occurrence of this species is probably strongly influenced by habitat conditions that allow individuals to move/swim (suspend) in the open water, which is, of course, limited by dense stands of macrophyte vegetation. In all the oligotrophic lakes mentioned, species of the genus *Lebertia* Neumann, 1880 were present, which Lundblad [10, 11] reported as a common component of the water mite fauna of Swedish lakes. Representatives of this genus were not found in any of the studied drinking water reservoirs, which represents the main fundamental difference from the species composition of water mite fauna in lakes.

The cited results from lakes [10, 11, 27] were obtained from benthic samples collected using a grab or dredge at depths greater than 2–4 m (in some cases even 10 m or more), where species of the genus *Lebertia* Neumann, 1880 commonly occurred. This is also confirmed by data from Sedlice reservoir [3], in which water mites of this genus were found just above the bottom (in a trap placed 5 cm above the sediment surface), in the sublittoral zone at depths of 6–8 m. Pieczynski [30], in his extensive study of water mites in the littoral zone of Polish lakes, sampled using traps placed in vegetated littoral habitats, and reported virtually the same species that dominated in drinking water reservoirs, but accompanied by additional water mite species typical of the littoral of standing waters. However, he only recorded representatives of the genus *Lebertia* Neumann, 1880 in a single lake, in a habitat influenced by the inflow of a watercourse. In the littoral zones of the other studied lakes, he did not report the occurrence of species of the genus *Lebertia*.

A probable reason for the absence of species of the genus *Lebertia* Neumann, 1880 in the studied drinking water reservoirs is the character of the habitats from which the samples were taken. The author of the study recorded water mites of the genus *Lebertia* Neumann in hand-net samples from the shallow littoral of the oligotrophic Lake Ohrid at depths of up to 1 m (unpublished data). Thus, the sampling method itself does not necessarily have a decisive influence on the occurrence of water mites of this genus, although species of this genus clearly show a preference for habitats at greater depths.

It is evident that not only the character of the habitat, but also the methods used for collecting water mites, have a significant influence on both the occurrence and abundance of individual species. In this study, the occurrence of individual water mite species is compared with published data without assessing the effect of the methods used, which differ considerably – from passive "traps" to quantitative sampling per unit area of the bottom (using corers, grabs, or dredges). The comparisons presented therefore rely on data on the most frequent occurrence of individual species in the littoral zones of different sites.

The abundance of water mites in individual drinking water reservoirs shows considerable variation (*Tab. 3*), with the highest numbers recorded in Nová Říše reservoir (site No. 40; see *Fig. 9*) and Vrchlice reservoir (site No. 3). This may be due to the short distance of the sampling sites from macrophyte stands in the littoral zones of both reservoirs, as aquatic vegetation provides a range of favourable conditions for water mite communities, as evidenced by data in [22, 30, 32]. In Josefův Důl reservoir (site No. 4), no water mites were recorded, while in Souš reservoir (site No. 5) only four nymphs were found (one of which could be identified as a representative of the genus *Hydrochoreutes* Koch, 1837). The reason is evidently the low pH of water in these reservoirs, which fluctuates considerably over the course of the year: outside the summer season, values drop to around 5.0–5.5, whereas in summer they reach 6.0–7.0, as documented by long-term water quality monitoring carried out by the Elbe River Board, state enterprise. The effect of low pH values on the absence of water mites was also described, for example, by Lundblad [10] in Swedish lakes.

The methodology used for studying water mite fauna does not provide absolute quantitative data; however, it allows comparisons of fauna from the same habitat across individual sites. The range of chlorophyll *a* concentrations recorded in the studied drinking water reservoirs is relatively narrow (indicating oligotrophic to slightly mesotrophic conditions), which limits the possibility of drawing conclusions about relationships with water mite diversity. Nevertheless, a comparison of water mite occurrence among reservoirs with different chlorophyll *a* concentrations suggests a tendency towards higher abundance and greater species richness in reservoirs with concentrations below 20 µg/L (Nos. 34 – Karolinka, 14 – Žlutice, 8 – Husinec) compared to reservoirs with concentrations above 20 µg/L (Nos. 2 – Křižanovice, 20 – Podhora, 36 – Fryšták).

Current literature emphasises the potential of water mites as indicators of the state of aquatic ecosystems [34], as, through their dependence on larval hosts and trophic interactions, they integrate the character of the biotic community. The relationship between water mite community diversity and water quality has been studied primarily in running waters [35, 36]. The occurrence of water mites in relation to reservoir trophic status has not yet been demonstrated [30, 37], since most available data on water mites from lakes originate from the littoral zone, which is a highly heterogeneous habitat where the abundance of organisms and the representation of different communities within the aquatic ecosystem are influenced by a range of additional factors.

The importance of littoral habitats in lakes for the occurrence of different water mite species is demonstrated by the cited study of Tuzovský [13] and the data presented therein, summarised in *Tab. 7*. Verification and evaluation of the influence of different littoral habitats in specific reservoirs would undoubtedly enhance our understanding of the indicative potential of water mite diversity in standing waters (both reservoirs and lakes).

The occurrence of water mites is influenced by a range of abiotic and biotic factors, with the presence of hosts for their developmental stages (larvae) being particularly important, as well as the availability of food [22, 38], the presence of predators, and the hydrochemical and hydromorphological characteristics of the water body. For this reason, the species composition of water mite fauna can be considered one of the key integrative indicators of the state of an aquatic ecosystem, although it may not always be clear which of these factors is dominant or decisive. The presented results and their comparison with data from the literature indicate that habitat plays a significant role, as it can enhance the representation of species better adapted to particular conditions, even though these species may be absent from sites with a different habitat within the same water body. Together with the relatively difficult identification of water mite species, this represents one of the main reasons for the still limited use of water mite fauna in the assessment of aquatic ecosystems.

CONCLUSION

In samples of water mite fauna collected from the stony littoral of 45 drinking water reservoirs in the Czech Republic in August and September 2024, a total of 1,356 water mites were recorded (849 adults and 507 nymphs). A total of 34 water mite species were identified, while one specimen (probably belonging to the genus *Vicinaxonopsis* Cook, 1974) has not yet been determined to species level. Twelve water mite species were recorded at more than 10 % of sites: *Brachypoda versicolor* (Mueller, 1776), *Unionicola crassipes* (Mueller, 1776), *Arrenurus albator* (Mueller, 1776), *Forelia liliacea* (Mueller, 1776), *Neumania limosa* (Koch, 1836), *Neumania deltoides* (Piersig, 1894), *Hygrobates longipalpis* (Hermann, 1804), *Arrenurus sinuator* (Mueller, 1776), *Mideopsis orbicularis* (Mueller, 1776), *Arrenurus crassicaudatus* Kramer, 1875, *Hydrodroma despiciens* (Mueller, 1776), and *Neumania vernalis* (Mueller, 1776). These species are characterised by high locomotory activity (swimming in open water), enabled by swimming setae on their legs. The representation of these species accounted for 87.4 % of all recorded individuals. Species of the genus *Neumania* Lebert, 1879 and especially *Unionicola* Haldeman, 1842 have very long legs and can therefore be considered typical inhabitants of the so-called "lacustrine zone" of reservoirs, i.e. the area in front of the dam, although their ontogenetic development and trophic relationships are linked to the morphology of the shoreline and bottom. These species also occur most frequently in lakes, where, however, representatives of the genus *Lebertia* Neumann, 1880 are also among the most common species, although they were not found in the studied drinking water reservoirs. The reason is probably the sampling methodology using a plankton net, which captures the occurrence of water mites above the stony bottom to a depth of 1.0 m, whereas data from lakes were obtained from benthic samples collected using a grab or dredge at depths greater than 1 m. Three recorded species – *Arrenurus albator* (Mueller, 1776), *Hygrobates trigonicus* Koenike, 1895, and *Forelia longipalpis* Maglio, 1924 – have extended the checklist of water mites of the Czech Republic maintained by the Nature Conservation Agency of the Czech Republic. *Forelia longipalpis* Maglio, 1924 represents a species new to the fauna of the Czech Republic, as its occurrence has not previously been reported in the literature.

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Czech Land Use and CN analyzer: an open tool for generating CN layers and calculating direct runoff from design rainfall in QGIS

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Keywords: SCS-CN — design rainfall — hyetogram — QGIS — open data — HSG — ZABAGED — LPIS — direct runoff — conservation measure

ABSTRACT

The SCS–CN method is one of the most widely used hydrological methods in the Czech Republic for estimating direct runoff from precipitation events in small catchments. Its practical application is sensitive to the quality and consistency of input data, in particular land use (LU), soil characteristics defined by the hydrological soil group (HSG), and appropriately specified design rainfall. The tool, designed to utilise open data in the Czech Republic as a plug-in for the QGIS GIS platform, automates the preparation of input data and the subsequent SCS–CN analysis. Land use is derived from ZABAGED data in combination with LPIS data. HSG and design rainfall are obtained via download services provided at rain.fsv.cvut.cz. CN values are derived based on the spatial intersection of LU and HSG layers.

The tool operates in three main steps. Within an area of up to 20 km^2, it automatically downloads and processes LU layers using a uniform priority hierarchy and classification scheme, and vectorises the downloaded HSG raster. It then performs geometric intersection of these layers and assigns unique CN2 values to each combination, also deriving CN3 values. For the specified design rainfall (for selected return periods or user-defined events), it calculates the depths and volumes of direct runoff. When using design rainfall from the rain.fsv.cvut.cz service, the tool weights the resulting volumes across six synthetic hyetographs and the probability of antecedent saturation (based on API), in accordance with the latest design rainfall characteristics.

The tool is published as open-source software, and its development is documented on GitHub platform. It is intended both for professional practice and for educational purposes. The tool does not include the calculation of peak discharges or hyetograph shapes, as deriving these requires additional expertise in hydrology, hydraulics, and GIS.

INTRODUCTION

The estimation of direct runoff using the SCS–CN method [1] is widely applied in the Czech Republic, particularly for determining hydrological response in small catchments, ungauged profiles, and in the design of water management measures in the landscape. The use of this method is accepted, for example, in the design of infiltration strips, swales, ditches, and other shared facilities within land consolidation projects, as well as in the preparation of spatial studies. The implementation of this method under Czech conditions has been presented in a number of standards and methodological guidelines prior to this publication. In particular, this includes the most recent methodology *Soil Erosion Protection* [2], preceded in the field of hydrology by the methodology *Short-term Rainfall for Hydrological Modelling and the Design of Small Water Management Structures in the Landscape* [3].

The conceptual approach of the SCS–CN method, which is widely used for its simplicity and clarity of methodological procedures, nevertheless has its limitations. The method itself was derived and developed for small catchments, typically a few km^2 in size. Its application to larger areas, additionally affected by uniform rainfall, is therefore debatable. The SCS–CN method is used to derive runoff depth, i.e. runoff volume, and does not account for changes in runoff conditions under different rainfall intensities. To obtain peak (design) discharges, it is necessary to combine this method with another approach (e.g. a unit hydrograph). A major limitation is the classification of soils into only four hydrological soil groups. This limitation can be overcome by physically based methods. An example is the Czech model SMODERP [4], which can operate with inputs similar to those used by the tool described here. However, due to their application demands, physically based models are currently used only to a limited extent and primarily in specific cases.

The SCS–CN method is implemented in a range of proprietary and open-source modelling tools, for example in the freely available HEC-HMS [5], the Czech-localised Atlas HYDROLOGY [6], and the HydroRAIN web service [7]. The tool described here is partially based on the latter. The SCS–CN method is also used by the Czech Hydrometeorological Institute (CHMI) as one of the approaches for deriving hydrological characteristics of surface waters in ungauged profiles (ČSN 75 1400).

Despite the simplicity of the method itself, its practical application is constrained by (1) the use of different data sources and their varying quality, (2) inconsistent assignment of CN values to land use (LU) classes, and (3) the need to correctly handle design rainfall and antecedent moisture conditions.

The aim of the tool developed and described here is to partially consolidate input data and derived outputs in the form of a plug-in (hereafter referred to as the "plugin") for the open-source geographic information system software QGIS [8]. The tool standardises and automates individual steps in the processing of geospatial data using open data sources in the Czech Republic, and provides direct outputs both as geospatial layers (CN layers, direct runoff volume layers) and as tabular outputs within the QGIS environment.

The tool has been designed to be:
- *practical* (minimal manual intervention, step-by-step guidance),
- *transparent* (documentation and open-source code),
- *verifiable* (automated tests and input validation),
- *adaptable* (parameter configuration via separate editable files and modular steps under user control).

MATERIALS AND METHODS

The SCS–CN method and selected parameters

The SCS–CN method is described in a number of available publications [1–3]. Only a very brief outline of the method is presented here. The direct runoff depth H_0 from total rainfall H_s is determined by the maximum potential retention A and the initial abstraction $I_a = \lambda A$ (with $\lambda = 0.2$ by default), according to the following equation:

$$H_0 = (H_s - I_a)^2 / (H_s - I_a + A)$$

The retention is determined by the curve number (CN) according to the following equation:

$$A = 25.4\left(\frac{1000}{\mathrm{CN}} - 10\right) \qquad (1)$$

The CN value itself is tabulated for combinations of land use (LU) and hydrological soil group (HSG) for three fixed antecedent moisture conditions, based on the antecedent precipitation index. In Czech practice, the scenarios of antecedent moisture CN2 (average conditions) and CN3 (increased antecedent moisture) are used, with CN3 derived from CN2 using a standard transformation. CN1 (dry conditions) is of marginal relevance in the Czech Republic and is practically not encountered. The method was originally derived empirically for the entire USA, including arid regions.

The antecedent precipitation index is applied in a five-day form (API_5), determined according to the following equation [3]:

$$API_5 = \sum_{n=1}^{5} R_n \cdot 0{,}93^n \qquad (2)$$

where:

R_n denotes the 24-hour rainfall total for the period beginning n days prior to the rainfall event. A 30-day antecedent precipitation index (API_{30}) is also used in some cases.

Technical solution

OGC web services for the automated acquisition of input vector data from open data sources use the OGC Web Feature Service (WFS) specification, which enables distributed access to spatial features, including their geometric and attribute characteristics. Within the developed tool, datasets provided under the open data framework in the Czech Republic (ZABAGED and LPIS) are retrieved using standard WFS operations. These two datasets form the primary information input for subsequent land use classification. HSG and design rainfall data are obtained via the OGC Web Processing Service (WPS) provided by the rain.fsv.cvut.cz project. To ensure smooth operation of the plugin user interface, communication with remote servers is handled asynchronously. This approach enables continuous updating of input data, a high degree of automation, and full reproducibility of the computational workflow.

QGIS processing tools

The computational workflow was implemented in the open-source QGIS environment using a combination of built-in analytical tools and functionality extended through a custom plugin. The core principle of the processing is the stepwise transformation of input vector layers representing land use (LU), hydrological soil groups (HSG), and rainfall characteristics into derived thematic layers used as inputs to the SCS–CN model. This process employs spatial overlay operations, attribute- and geometry-based joins, buffer generation, and raster vectorisation. These computational operations are carried out using standard QGIS tools executed via the Python interface PyQGIS, enabling their automated chaining and ensuring output consistency. The entire workflow is complemented by a system of input data validation and ongoing checks of computational steps, aimed at eliminating errors in the generation of CN layers and the subsequent calculation of direct runoff volumes. The objective of the technological solution is to ensure numerical stability and reproducibility of results.

Development of the custom plugin

The development of the plugin was conceived as a stepwise integration of individual analytical steps into the QGIS environment. The implementation was carried out in the Python programming language using the PyQGIS interface and the PyQt library for the development of the graphical user interface. Emphasis was placed on the modularity of the solution, the transparency of individual computational steps, and the possibility for user-defined adjustments of input parameters and layer prioritisation via configuration files in YAML format, thereby enhancing the flexibility and practical applicability of the resulting plugin.

DATA AND RESULTS

Description of the technical solution

The plugin is developed as open-source software under the GNU GPL licence and is available on the GitHub platform. Installation instructions and the user manual are available on the rain.fsv.cvut.cz website.

The workflow is divided into four consecutive steps. This allows the user to verify individual steps and use their own or modified data, thereby enabling the use of only selected parts of the workflow.

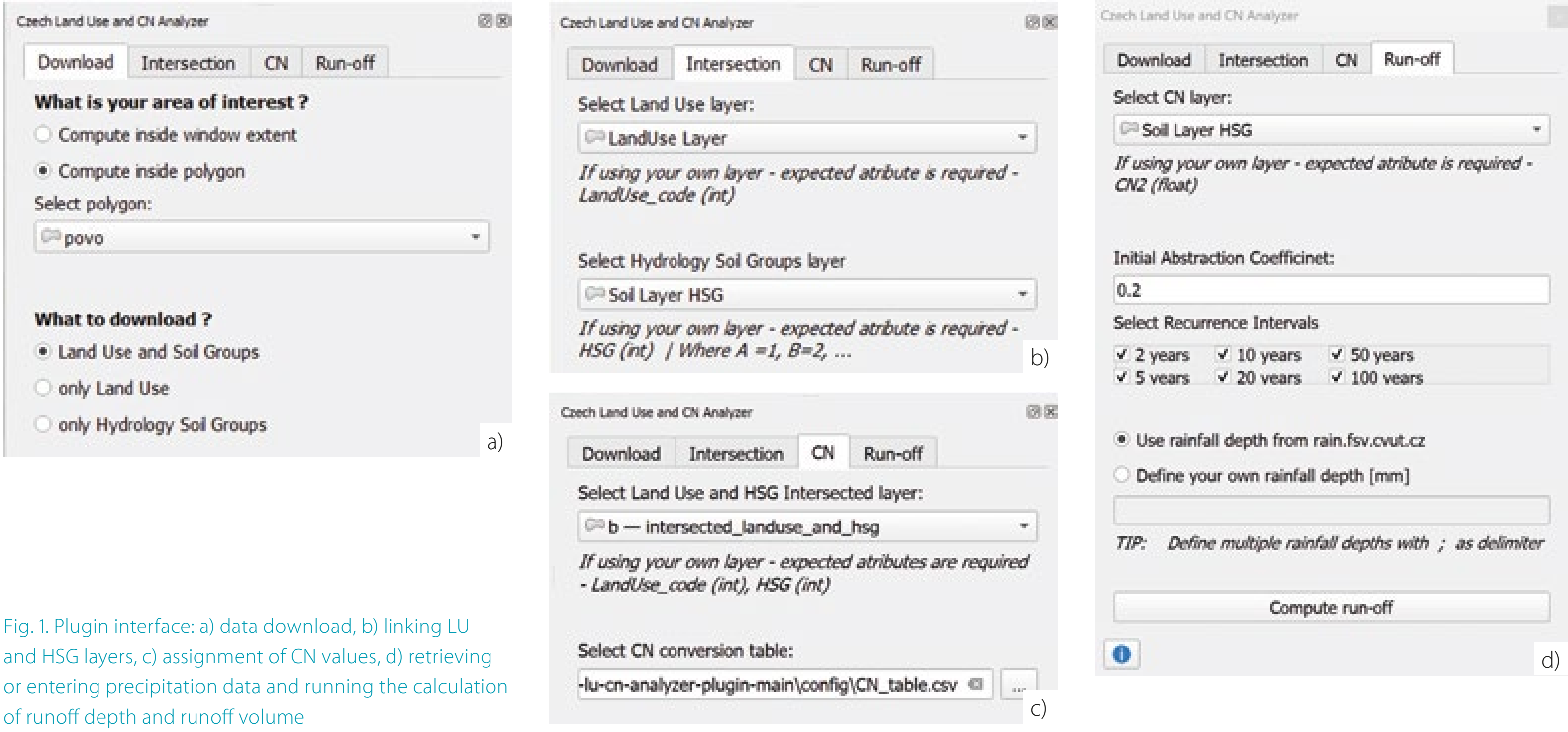
The tool validates input layers (specifically the existence and types of attributes defining land use (LU), hydrological soil groups (HSG), and CN2 values), parameter ranges (λ in the interval 0.1–0.3), the numerical format of user-defined rainfall inputs, and the structure of configuration files and CSV tables. It also includes a uniformly applied symbology for generated LU, CN, and direct runoff volume layers (using a quantile classification), comprehensive user documentation (CZ/EN, MkDocs), and a suite of automated tests implemented via GitHub Actions, verifying data retrieval, editing operations, CN value assignment, and the generation of direct runoff volume layers.

Input data and their basic processing

The model operates with national open data and other available data sources.

Land use

The derivation of land use (LU) is based on a combination of selected ZABAGED and LPIS layers with a defined priority hierarchy. Selected linear features are interpreted as polygon features using buffers defined by attribute values. The result is a topologically consistent layer without overlaps between input layers.



What is your area of interest ?

○ Compute inside window extent

● Compute inside polygon

Select polygon:

povo

What to download ?

● Land Use and Soil Groups

○ only Land Use

○ only Hydrology Soil Groups

Select Land Use layer:

LandUse Layer

If using your own layer - expected atribute is required - LandUse_code (int)

Select Hydrology Soil Groups layer

Soil Layer HSG

If using your own layer - expected atribute is required - HSG (int) | Where A =1, B=2, ...

Select Land Use and HSG Intersected layer:

b — intersected_landuse_and_hsg

If using your own layer - expected atributes are required - LandUse_code (int), HSG (int)

Select CN conversion table:

-lu-cn-analyzer-plugin-main\config\CN_table.csv

Select CN layer:

Soil Layer HSG

If using your own layer - expected atribute is required - CN2 (float)

Initial Abstraction Coefficinet:

0.2

Select Recurrence Intervals

☑ 2 years ☑ 10 years ☑ 50 years
☑ 5 years ☑ 20 years ☑ 100 years

● Use rainfall depth from rain.fsv.cvut.cz

○ Define your own rainfall depth [mm]

TIP: Define multiple rainfall depths with ; as delimiter

Compute run-off

Fig. 1. Plugin interface: a) data download, b) linking LU and HSG layers, c) assignment of CN values, d) retrieving or entering precipitation data and running the calculation of runoff depth and runoff volume

Hydrological soil groups

Hydrological soil groups (HSG) are obtained using the integrated WPS service *soil-texture-hsg* (https://rain.fsv.cvut.cz/webapp2/ogc-wps/#1-wps), operated on the rain.fsv.cvut.cz server and used to provide soil data. The HSG layer was created using digital soil mapping in combination with pedotransfer functions (PTFs) as part of the TA CR project No. TJ02000234. The derivation is described in two publications [9, 10]. The data are provided in raster format with a spatial resolution of 20 m. HSG are not derived in military training areas, where soil mapping is not available, in areas of surface mining, in the centres of large cities, or in water bodies. The raster data are subsequently vectorised without smoothing, and values are supplemented in water bodies to enable the assignment of CN = 99 for these areas.

Design rainfall, probability distribution of hyetograph shapes and initial conditions

The plugin primarily operates with six-hour design rainfall totals for return periods ranging from two to 100 years, which were derived for the purposes of hydrological modelling [11]. In addition to the design rainfall depth itself, the plugin, in accordance with current methodologies [2, 3], incorporates the probability distribution of hyetograph shapes [12] in combination with the probability of elevated (abnormal) initial saturation conditions. The user is also allowed to specify a custom rainfall total.

The characteristics of design rainfall (total depth, distribution of hyetograph shapes, and probability of initial saturation) for the selected return periods are retrieved via an integrated WPS service, d-*rain6h-timedist* (https://rain.fsv.cvut.cz/webapp2/ogc-wps/#1-wps), which is incorporated into the plugin.

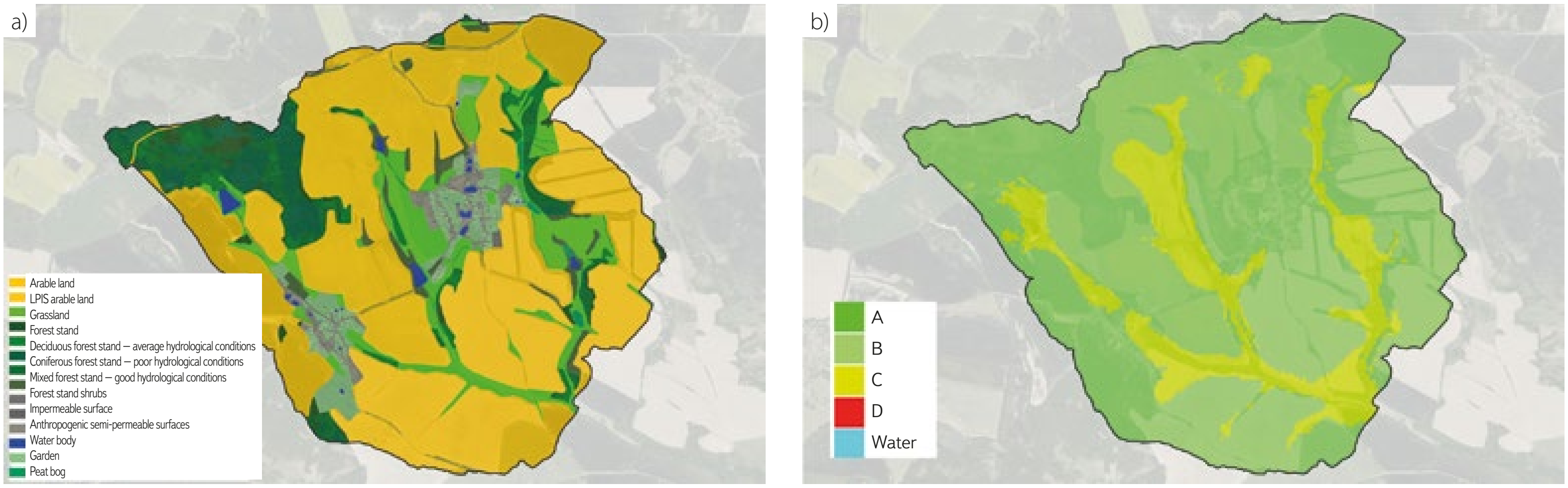
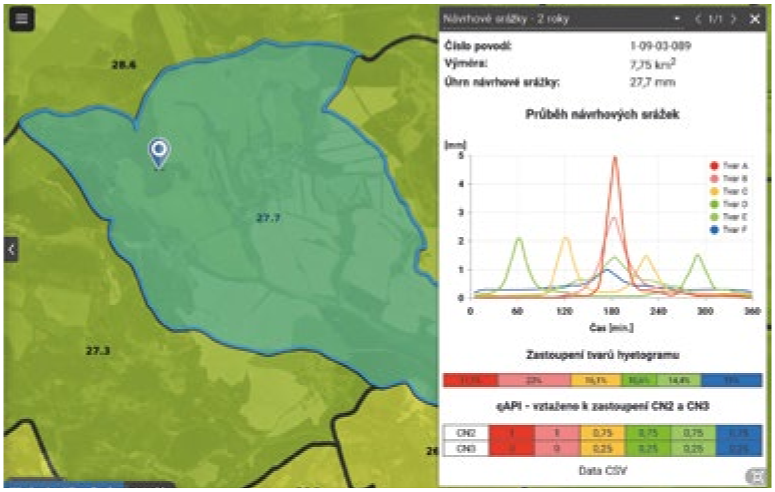


Fig. 2. Input data processed with the plugin for Třebešice and Býkovice (Benešov District): a) LU layer derived from ZABAGED and LPIS data, b) HSG



Číslo povodí: 1-09-03-089
Výměra: 7,75 km^2
Úhrn návrhové srážky: 27,7 mm

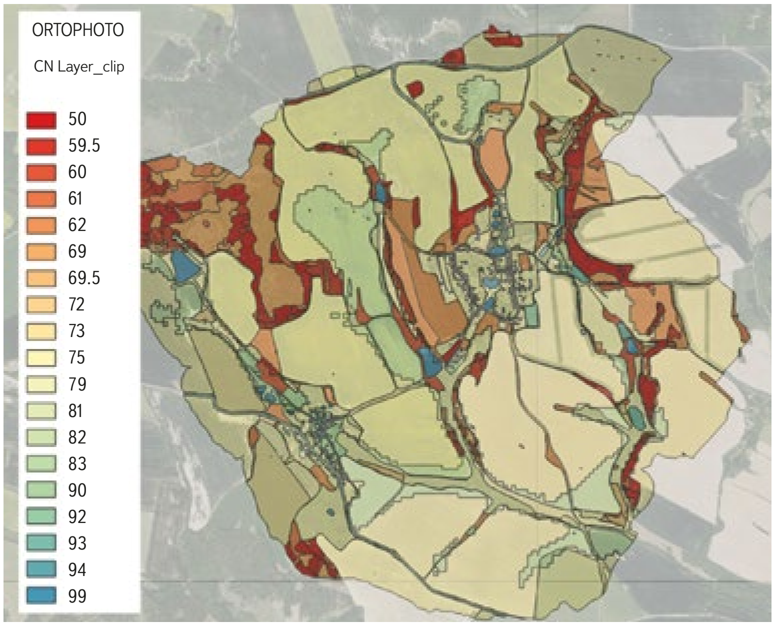
CN2	1	1	0,75	0,75	0,75	0,75
CN3	0	0	0,25	0,25	0,25	0,25

Fig. 3. Interface providing pre-prepared design rainfall data for fourth-order catchments (https://rain1.fsv.cvut.cz/); the plugin retrieves the data for the user-specified area

Assignment of CN values and calculation of runoff depth and volume

The assignment of CN values is carried out in two steps. In the first step, an overlay of the LU and HSP layers is performed. This allows the user to work directly with downloaded data, data refined to reflect actual conditions, user-defined datasets, or future scenarios/designs. This is followed by the assignment of the CN value itself based on the code designation of LU and HSP. The plugin includes an integrated CN table derived from the original United States Department of Agriculture (USDA) methodologies [1] and their interpretation for Czech conditions [2], published in more detail at https://rain.fsv.cvut.cz/scs-cn/scs-cn-met/ for average antecedent moisture conditions (CN2). For the determination of CN3, the tool applies a derivation from CN2 according to the following equation:

$$CN_3 = 23 \cdot CN_2 / (10 + 0{,}13\ CN_2) \tag{3}$$

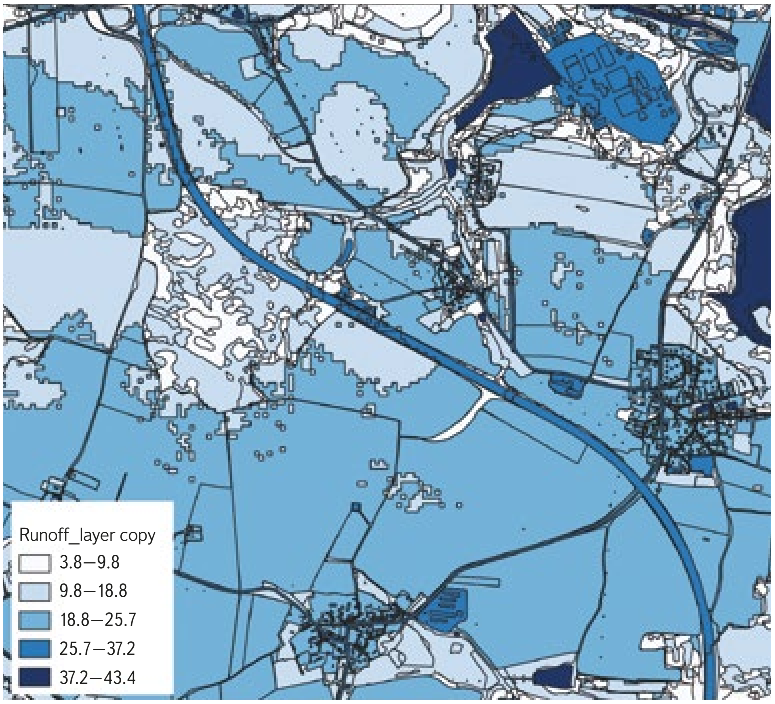


🟥	50
🟥	59.5
🟥	60
🟧	61
🟧	62
🟧	69
🟧	69.5
🟨	72
🟨	73
🟨	75
🟨	79
🟩	81
🟩	82
🟩	83
🟩	90
🟩	92
🟦	93
🟦	94
🟦	99

Fig. 4. Assigned CN values based on the intersection of LU and HSG layers

Calculation of runoff depth and volume

If the user employs design rainfall for *N*-year return periods from the rain.fsv.cvut.cz service, runoff volumes are calculated including the probability distribution of hyetograph shapes and the probability of occurrence of elevated saturation conditions. In the case of user-defined rainfall, these probabilities are not included, and the calculation is performed only for average antecedent moisture conditions (CN2).



☐	3.8–9.8
🟦	9.8–18.8
🟦	18.8–25.7
🟦	25.7–37.2
🟦	37.2–43.4

Fig. 5. Example of calculated runoff depth for individual polygons for a 30 mm precipitation event; the result illustrates which parts of the catchment generated higher direct runoff (dark blue)

The result consists of runoff depths or runoff volumes for individual polygons resulting from the overlay of LU and HSP layers. Further processing of these values and their possible aggregation is left to the GIS user. For the calculation of the average runoff depth, another QGIS plugin, *Area Weighted Average* may be used.

CONCLUSION

The presented plugin, "Czech Land Use and CN Analyzer" for QGIS, consolidates and significantly accelerates the practical application of the SCS-CN method for open data in the Czech Republic by automating key steps—namely, the acquisition and harmonisation of LU layers (a combination of ZABAGED and LPIS), the processing of hydrological soil groups, and their geometric integration into a unified data structure for the derivation of CN2/CN3. On this basis, the tool enables the direct calculation of direct runoff depths and volumes within the QGIS environment for both user-defined and design rainfall totals. When design rainfall from the rain.fsv.cvut.cz service is used, the tool also accounts for the distribution of synthetic hyetographs and the probability of elevated initial saturation, thereby facilitating the application of current methodological recommendations.

The detailed solution based on ZABAGED data enables the use of derived CN values not only for catchments but also for urbanised areas. These values can be applied in specialised hydrological models for urban areas, such as Storm Water Management Model (SWMM) [13]. The geometric accuracy and timeliness of land use data are determined by the accuracy and timeliness of the ZABAGED dataset.

The principal benefit of the tool lies in its transparency (open-source code), the reproducibility and verifiability of the entire workflow, and the use of consistent symbology for data layers. As a result, it is suitable both for design and applied practice (e.g. rapid identification of spatially dominant runoff sources and supporting data for the design of measures) and for education and methodological support for local authorities, where rapid orientation within a territory and a consistent methodological approach for users with differing professional backgrounds are often essential.

At the same time, it is necessary to emphasise that, within the limits of the SCS-CN method, the tool remains focused primarily on the volumes (runoff depth) of direct runoff, rather than on the estimation of peak discharges or the shape of the hydrograph, which require subsequent procedures and additional expert inputs and knowledge.

The limitations of the SCS-CN method lie primarily in the limited level of detail of soil data and in the treatment of the CN value as a static parameter. A significant source of uncertainty is the adoption of most CN values from original datasets developed in the USA. A systematic verification of CN values for the Czech Republic has not been carried out.

Another limitation of the tool is the maximum area of the processed territory, which is 20 km^2. The CN method itself was developed for small catchments; therefore, its results may be misleading when applied to larger areas. Further constraints arise from the web services used to obtain input data. Soil data are also provided for a maximum area of 20 km^2, and WFS services of the Czech Office for Surveying, Mapping and Cadastre are limited to 1,000 features per request.

The open-source code and the separation of parameters influencing the calculations into configuration files enable the straightforward implementation of new findings and further improvements. The authors welcome any comments and extensions.

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Landscape changes in the upper part of the Výrovka river basin from a water management perspective

PAVEL RICHTER

Keywords: archival maps — watercourses — floodplains — ponds — landscape changes

ABSTRACT

This article presents landscape changes in the upper part of the Výrovka river basin using a comparison of historical and current maps and orthophotomaps, including verification of the current state of the landscape. On the map of the 2nd Military Mapping, 22 water bodies (ponds) with a total area of 57.53 ha were mapped. On the current map, 71 water bodies with a total area of 42.48 ha were recorded. Furthermore, significant changes in the location of watercourses were recorded; they were deepened, straightened, and their floodplains were drained. It is clear from the comparison of the map documents that these changes mainly occurred due to the intensification of agricultural use of the landscape.

INTRODUCTION

The aim of this article is to provide information on the site that is being analysed within the framework of systematic research in Polabí lowland. One of the main objectives of this research was to map landscape changes at sites of current and disappeared ponds and wetlands, as well as changes in the location of watercourses in the catchments of the tributaries of the Elbe in Polabí lowland. The research was based on the interpretation of archival maps and their comparison with contemporary sources, including field surveys at the respective sites. Particular consideration was given to the possibility of restoring water retention features at suitable locations in this landscape. Specifically, this article describes changes in the location of watercourse channels and the development of the pond system on the Výrovka, i.e. in the intercatchment of the water body "Výrovka from the source to Ostašovský stream, inclusive". Polabí lowland is currently experiencing a significant groundwater deficit, and small watercourses are increasingly subject to seasonal drying, not only in summer but also in spring and autumn. In most cases, these are straightened, paved and deepened watercourses with degraded floodplains. In connection with the expected continued occurrence of extreme climatic events, it would be desirable to focus attention on the restoration of landscape elements with a positive influence on the water regime in the landscape, as well as on water management in the landscape as such.

SITE DESCRIPTION

Hydrology

The study area is defined by the intercatchment of the surface water body HSL_2620 Výrovka from the source to Ostašovský stream, inclusive, covering an area of 57.364 km^2. This water body, or rather its intercatchment, belongs to the third-order catchment 1-04-06 Výrovka and is located on the watershed of the sub-catchments of Upper and Middle Elbe and Lower Vltava within the international Elbe River Basin (*Fig. 1*). The Výrovka rises in Kochánov at an elevation of 492.5 m a. s. l. The total length of this watercourse is 61.9 km, and it is a left-bank tributary of the Elbe near the village of Písty in Nymburk district at an elevation of 181 m a.s.l. From the surface water body HSL_2620 Výrovka from the source to Ostašovský stream, inclusive, the stream flows into, or rather through, Vavřinecký pond at river kilometre 52.7, i.e. 19.2 km from the source. According to the Strahler stream order system, the river Výrovka is of the fifth order here [1–3].

Administrative divisions

From an administrative perspective, the intercatchment of the water body is located in Central Bohemian Region (*Fig. 1*) predominantly within Kutná Hora District (cadastral areas Bláto, Chmeliště, Janovická Lhota, Jindice, Kochánov u Mitrova, Křečovice u Onomyšle, Mančice u Rašovic, Miletín u Onomyšle, Mitrov u Uhlířských Janovic, Nepoměřice, Onomyšl, Opatovice II, Rašovice u Uhlířských Janovic, Rozkoš u Onomyšle, Staňkovice u Uhlířských Janovic, Sudějov, Uhlířské Janovice, Vavřinec, Žandov, Žíšov, and tiny parts of cadastral areas Smilovice u Staňkovic and Staré Nespeřice), and to a small extent in Kolín District (cadastral areas Církvice u Kolína, and Skvrňov) [2, 3]. The water body itself flows through cadastral areas Kochánov u Mitrova, Janovická Lhota, Uhlířské Janovice, Chmeliště, Žíšov, and Vavřinec (*Figs. 2* and *3*).

Geology and pedology

From a geological perspective, the entire area of this intercatchment belongs to the Bohemian Massif. The geological bedrock consists almost exclusively of paragneisses and migmatites of the Kutná Hora crystalline complex. In the northern part of the studied catchment above Vavřinecký pond, gravels, sands, conglomerates and sandstones occur [3].

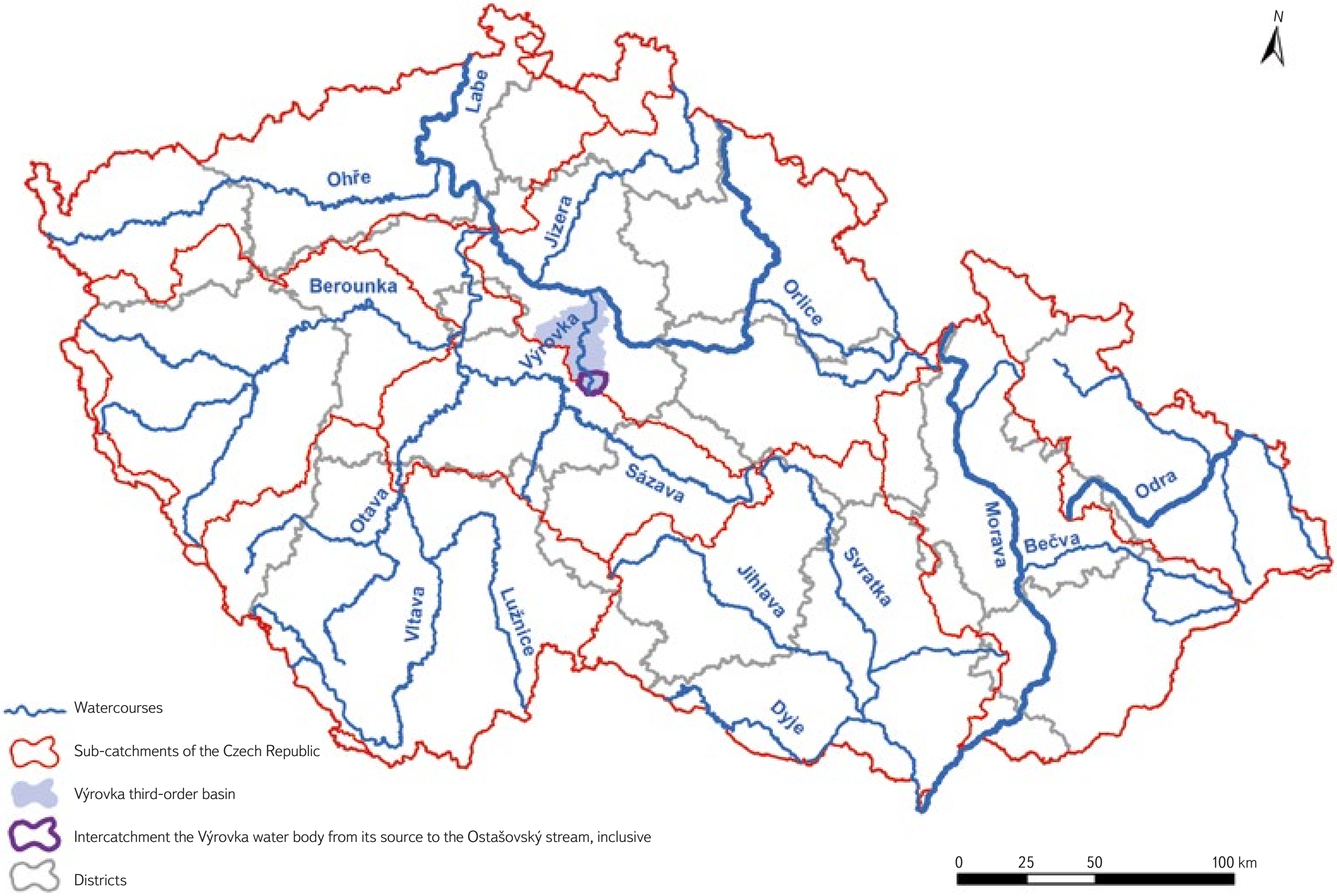

Fig. 1. The study area in the context of hydrological and administrative divisions

Soil conditions in the entire catchment are heterogeneous, with eight soil types occurring in the area (*Tab. 1*). In the immediate vicinity of watercourses, Gleyosols (with a pronounced redoximorphic features gleyic properties resulting from long-term saturation caused by a high groundwater table), Stagnosols (with a pronounced mottling and redoximorphic features caused by alternating waterlogging and drying of the soil profile), and Luvisols Stagnic or Haplic (soils with the presence of a luvic horizon with dark argillans) occur.

In the wider catchment area, these are mainly Cambisols (soils that develop predominantly under sloping conditions and are highly variable in their properties) and, to a lesser extent, Luvisols Chromic (soils with a profile differentiated by a slightly lightened eluvial horizon) [2–5].

Typology of the contemporary landscape of the Czech Republic

A total of four types according to the Typology of the contemporary landscape of the Czech Republic occur within the intercatchment. Two basic types of natural landscapes can be found here. The Výrovka source area belongs to the moderately cool landscape of uplands and highlands, while the remaining areas are located in the moderately warm landscape of basins and uplands. Two types of functional landscapes also occur. The Výrovka source area lies in a forest–agricultural landscape, while the remaining part of the intercatchment is situated in an agricultural landscape [6].

Tab. 1. Soil types in the intercatchment area

Soil type	**[km^2]**	**[%]**
Cambisol Dystric	13.107	22.85
Gleysol	11.603	20.23
Stagnosol	10.589	18.46
Luvisol Stagnic	9.595	16.73
Luvisol (Chromic)	5.421	9.45
Cambisol (Haplic)	3.023	5.27
Luvisol (Albic)	2.790	4.86
Luvisol (Stagnic)	1.236	2.15
∑	57.364	100

Land cover

From the perspective of land cover, a number of classifications with varying levels of precision or generalisation can be used. In this area, LPIS, CORINE Land Cover (CLC), and ZABAGED® are applied. In LPIS, only agriculturally used areas on which farming entities receive subsidies are recorded [7]. As a result, the LPIS register does not cover the entire area of the intercatchment. In this case, it covers 3,644.56 ha (63.53 %). Within LPIS, the clearly predominant land use category is standard arable land (86.25 %), while 10.62 % consists of permanent grassland; the remaining land cover categories recorded within LPIS are entirely negligible (*Fig. 2*).

According to the CLC classification, which is considerably more generalised compared with the classifications mentioned above [8], the dominant class is non-irrigated arable land, covering 64.36 % of the intercatchment area. Other classes with a more significant share are coniferous forests (18.09 %), land principally occupied by agriculture with significant areas of natural vegetation (8.22 %), and discontinuous urban fabric (4.29 % of the area). Other classes (pastures, transitional woodland–shrub, mixed forests, and industrial or commercial units) occupy only a very small proportion of the area. Water bodies occur on only 0.03 % of the intercatchment area and, due to the generalisation of this land cover type, only Vavřinecký pond is classified as a water body; however, it extends into the study area only by a very small part [3] (*Figs. 2* and *3*).

In the studied intercatchment, according to ZABAGED® [9], the dominant type is arable land and other areas – 3,390.48 ha (59.10 %). Other significant types include forest land with trees – 1,273.47 ha (22.20 %) and permanent grassland – 549.49 ha (9.58 %). A smaller share is formed by orchards and gardens – 234.83 ha (4.09 %) and settlement areas – 108.58 ha (1.90 %). Water bodies occupy only 0.81 % of this catchment. Shrub vegetation is represented only minimally (0.40 %), while marshes and swamps occurring on permanent grassland or forest land with trees are extremely rare (0.04 % and 0.05 %, respectively).

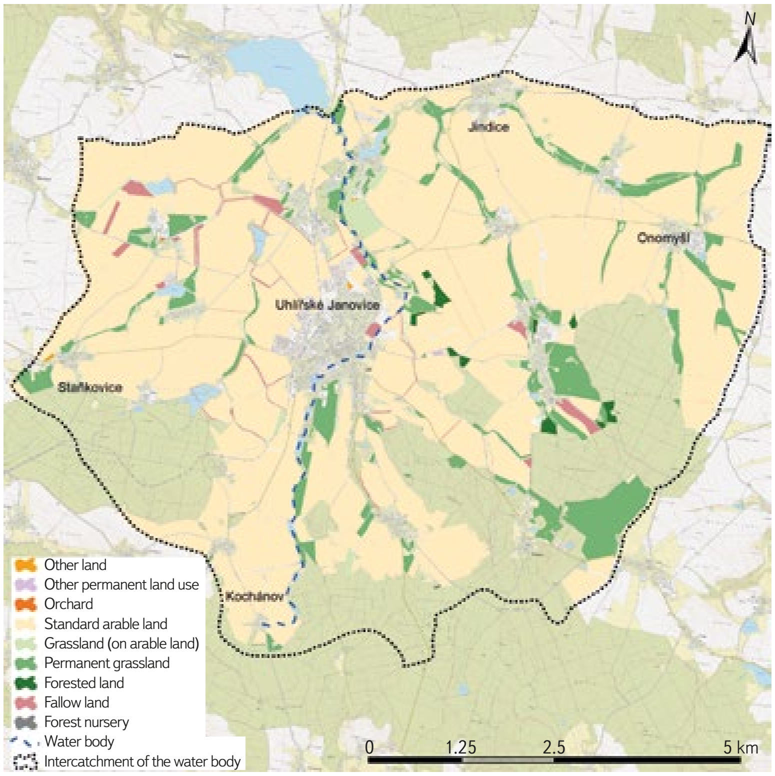

Fig. 2. Land use according to LPIS 2023 in the intercatchment of the Výrovka water body basin from the spring to the Ostašovský stream including in the context of BTM 10 (2024)

METHODOLOGY

The methodology used here is similar to that applied in other previously analysed sites in Polabí lowland and is described in greater detail, for example, in the article dealing with the development of the pond system on the Bečvárka [10]. The research was based on the selection and subsequent comparison of the present and historical state of ponds and watercourses in the intercatchment of this water body, based on the interpretation of contemporary and archival maps and orthophotomaps. This was followed by verification of the current landscape conditions through field surveys. The location of historical water bodies/ponds and watercourse floodplains was carried out using the map of the 2nd Military Mapping, which is available for viewing on the National INSPIRE Geoportal [11], as a WMTS service [12], and on the website of the Chartae antiquae project [13].

The current state of the landscape is recorded on the current Basic Topographic Map of the Czech Republic 1 : 10,000 (ZTM 10) and the current orthophotomap of the Czech Republic. These are available as WMS services from the Geoportal of ČÚZK [14]. For the subsequent analyses, only historical water reservoirs/ponds with a minimum area of 0.1 ha were considered. To refine the interpretation of landscape development between the situation shown on the map of the 2nd Military Mapping (which records the state of this site around 1852) and the present state, a historical orthophotomap from the 1950s was used. It can be viewed on the National INSPIRE Geoportal [11], where it is also available as a WMTS service [12]. In addition, archival orthophotomaps available as WMS services on the Geoportal of ČÚZK were used, currently covering the period 1998–2022 [14].

For a more detailed analysis of the landscape before the 2nd Military Mapping in selected sites, maps of the stable cadastre from 1839 were used. These can be viewed and ordered on the website of the Central Archive of Surveying and Cadastre [15]. To approximate the landscape conditions prior to the 2nd Military Mapping, particularly with regard to the historical occurrence of ponds and watercourse floodplains – though not their exact location – the map of the 1st Military Mapping from 1763–1768 was used. This map is available from the same source as the map of the 2nd Military Mapping [13].

RESULTS

Changes in the intercatchment of the surface water body HSL_2620 "Výrovka from the source to Ostašovský stream", inclusive, are substantial with regard to water bodies and watercourses and, apart from forested areas, have occurred across practically the entire area of this intercatchment. As regards changes in water bodies/ponds, the analysis primarily involved a comparison of the situation in the mid-nineteenth century with the present state. According to the applied methodology, 22 water bodies (ponds) with a total area of 57.53 ha were recorded on the map of the 2nd Military Mapping. Of these, eight ponds with a total area of 19.11 ha have disappeared, while 14 ponds have been preserved to the present day. Their combined historical area amounted to 38.42 ha; however, some of them have a smaller area today. On the current map, 71 water bodies with a total area of 42.48 ha were recorded. The area of Vavřinecký pond was included only in the part that lies within the study area, i.e. 3.72 ha of the historical pond area of 84.74 ha, or 1.72 ha of the current pond area of 77.94 ha. The reduction in the area of Vavřinecký pond occurred primarily due to the construction of the Kolín–Ledečko (Čerčany) railway line at the turn of the nineteenth and twentieth centuries. Other preserved ponds are Hořejší u Chmeliště (Oberchmelischter Teich), Panský pond, Kačíř (Kaczir), Škrobka (Skropka), Dolní Ostašov (Kohautek), Materna, Obora, Pančák (Hořeyssi), Napajedla, Dubinský rybník, Holoubek, Hořejší in Uhlířské Janovice, and the pond near the former Lucký mill. The largest historical ponds that have disappeared were Lawicker Teich near Chmeliště and Mleynsky near Jindice (*Fig. 3*, *Tab. 2*).

For a more detailed analysis in this article, we selected the source area of the Výrovka in Kochánov and the straightened and deepened section of the Výrovka, including the adjacent drained, agriculturally used areas near the former Lucký mill on the north-eastern edge of Uhlířské Janovice.

Tab. 2. Changes in the water bodies in the intercatchment between 1852 and 2024

Water bodies	**Disappeared**	**Continuous**	**New**
Area [ha]	19.11	38.42	42.48
Number of plots [pcs]	8	14	71
Minimum plot size [ha]	0.11	0.23	0.007
Maximum plot size [ha]	7.94	5.68	5.30
Average plot size [ha]	2.41	2.75	0.59

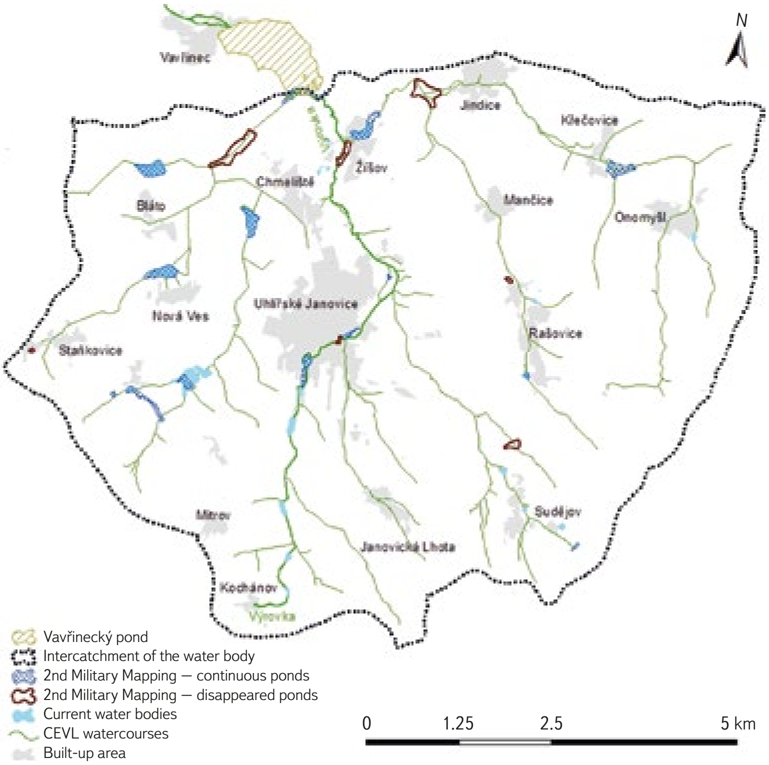

Fig. 3. Landscape changes from a water-management perspective in the intercatchment of the Výrovka water body basin (from the spring to the Ostašovský stream), from the 2nd Military Mapping (1852) to the present in the context of BTM 10 (2024)

Fig. 5a, b. Current state of the landscape in the Výrovka spring area (July 2025)

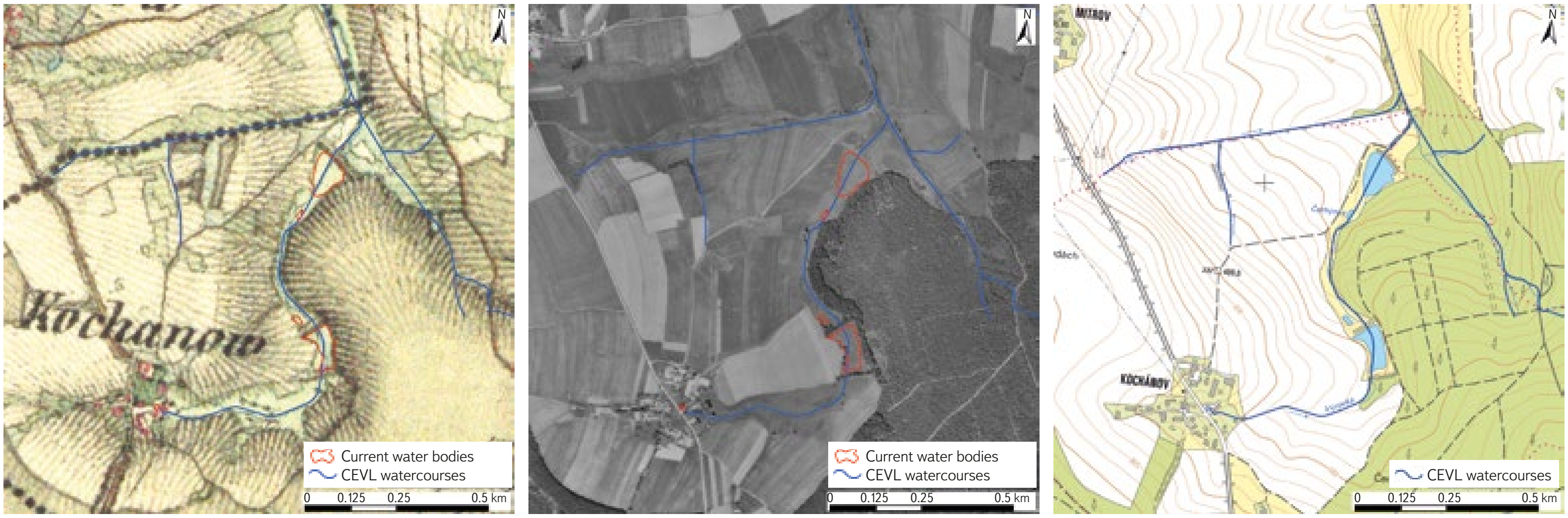

Fig. 4. Landscape changes in the Výrovka spring area, based on the 2nd Military Mapping (1852), historical orthophotomap from the 1950s, and BTM 10 (2024)

Fig. 4 shows the development of the landscape in the Výrovka source area from the mid-nineteenth century through the 1950s to the present. In the source area at Kochánov, a small water reservoir is currently designated as the source, from which the Výrovka flows out through a paved channel (*Fig. 5a, b*). The watercourse then continues in a straightened, overgrown channel through three smaller ponds (*Figs. 3* and *6*), the last of which (Bobr pond) has a dam located 2 km downstream from the Výrovka source. *Fig. 7* documents the current state of the landscape in this area.

Fig. 6. The first pond on the Výrovka (July 2025)

Fig. 7. Landscape in the Výrovka spring area up to Bobr (Beaver) pond (May 2025)

Over the next 4 km of the Výrovka, within the territory of Uhlířské Janovice, the following water bodies occur: Nový pond, the bathing pond, Hořejší pond, Holoubek pond, and the pond at the former Lucký mill (*Fig. 8*). The landscape around the former Lucký mill has undergone considerable changes from a water-management perspective. Extensive drainage of agriculturally used land has taken place, and the watercourses have been altered, including their straightening and deepening. The landscape development in this site from the mid-19th century through the 1950s to the present is shown in *Figs. 9* and *10*. These sources indicate that significant interventions in the watercourses have occurred: the location of the confluence of the Výrovka and Anenský stream has been changed, floodplain meadows have disappeared, and the landscape mosaic has become generally simplified. It should be emphasised that all these changes have taken place within the first 6 km of the Výrovka, and similar changes have also affected the tributaries of the Výrovka in this intercatchment. Combined with current climatic conditions, the above-mentioned changes in the landscape contribute to the periodic drying of the Výrovka channel and its small tributaries. The drying has a long-lasting character; initially it occurred only during summer, but in recent years it has begun as early as April and continues through September and usually also into October (*Fig. 11a, b*). In this site, the failure of drainage systems has led to the successional regeneration of a wetland headwater site on what is currently agricultural land (*Figs. 12–14*). However, this development is not the result of targeted management but rather of the inability to cultivate such waterlogged land using modern agricultural machinery.

Fig. 8. Pond at the former Lucký mill (July 2025)

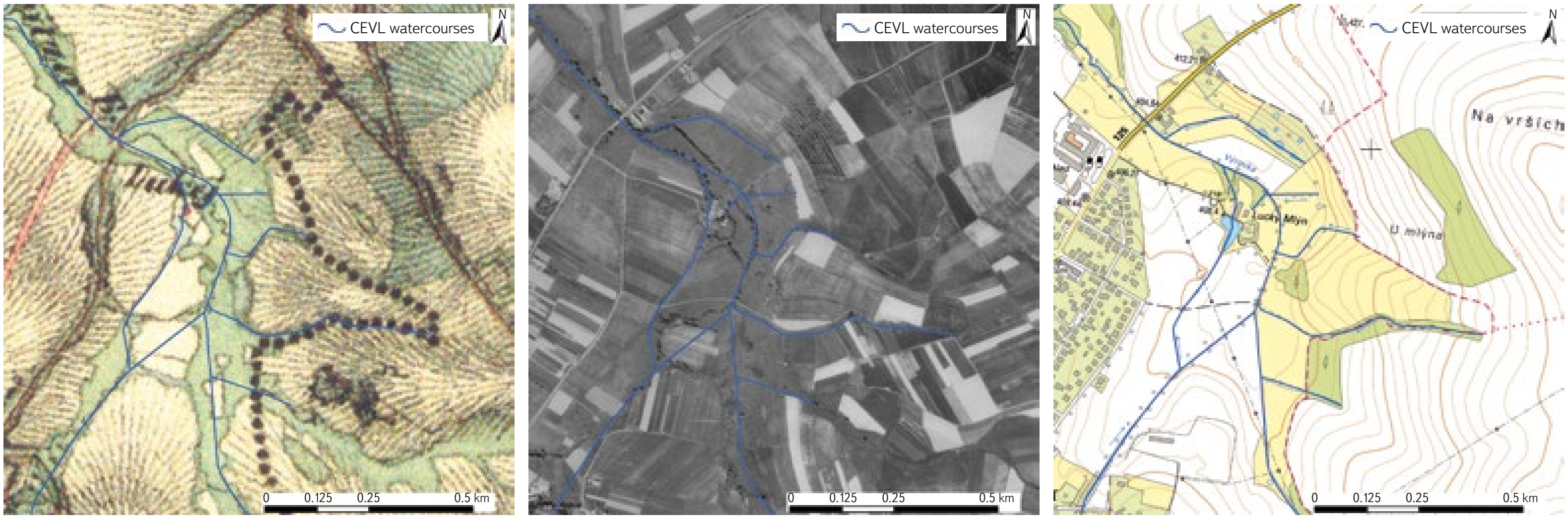

Fig. 9. Landscape changes in the area of the former Lucký mill shown based on the 2nd Military Mapping (1852), historical orthophotomap from the 1950s, and BTM 10 (2024)

Fig. 10. Landscape in the area of the former Lucký mill on Imperial Imprint of the Stable cadastre (1839)

Fig. 11a, b. Dried-up riverbed of the Výrovka at the confluence with Anenský stream (September 2025)

Fig. 12. Succession restoration of the drained site "U Stratinek" shown on the Stable cadastre (1839), historical orthophotomap from the 1950s, and archival orthophotomaps

Fig. 13. Site "U Stratinek" on a current orthophotomap (2023)

Fig. 14. Current state of the site "U Stratinek" (November 2025)

DISCUSSION AND CONCLUSION

In interpreting the development of water bodies, their specific use was not distinguished because definitions of a pond have differed between the past and the present. Today, there is a wide range of water body types in the landscape depending on their use, and there are also differences between the uses of water bodies that are designated as ponds. Historically, all artificially created water bodies provided with a dam or excavated by human activity were regarded as ponds. In the mid-19th century, the distinction between a reservoir (e.g. for fire protection, economic purposes, etc.) and a pond (a water body intended exclusively for fish farming) was not yet clearly defined. From this perspective, all water bodies shown on the maps of the 2nd Military Mapping and on the Imperial Imprints of the Stable cadastre can therefore be considered ponds [16, 17].

When interpreting the results in terms of the temporal stability of water bodies/ponds, it is necessary to take into account that the analysis compares only two reference states: the period of the 2nd Military Mapping and the present. Naturally, the extent of these areas has changed over time as a result of management; for example, a water body may have become silted up and later been restored. Thus, when historical water bodies/ponds are classified as disappeared or continuous, some of those considered may have disappeared in the interim and subsequently been restored. A continuous water body/pond is also a water body that is significantly smaller than it was in the past, but remains in its original location.

Under current climatic conditions, given the number of water reservoirs along the Výrovka, it is probably not possible to avoid the drying of stream channels; however, various landscape measures can increase water retention in the surrounding landscape. The restoration (revitalizion or renaturation) of watercourses appears to be necessary. In considering landscape changes in the headwaters, the historical locations of water-retention elements (wetlands, floodplain meadows, etc.) should also be considered, as their construction or restoration would be easier there and such elements would be more stable in the landscape. A general problem in the landscape is drainage infrastructure, both functioning and non-functioning, and it would be necessary to address this situation from a methodological or legislative point of view so that its function is beneficial for the water regime in the landscape. The current situation in the studied catchment, with a larger number of water bodies used for fish production and straightened sections of watercourses in the headwaters, is not particularly favourable for water retention in the landscape.

However, on the map of the 1st Military Mapping, ponds near Kochánov were located in similar places to those today (*Figs. 4* and *15*), but that time the watercourses meandered and were surrounded by floodplain meadows, and climatic conditions were also different from those today. The situation recorded on the 1st Military Mapping along the Výrovka in the area of Uhlířské Janovice shows more water bodies/ponds than the 2nd Military Mapping (*Figs. 3* and *16*). Here, near the former Lucký mill (if we can rely on the not entirely accurate depiction of the landscape), it appears that between the two military surveys, the watercourses within the floodplain at the confluence of the Výrovka and Anenský stream were modified (*Figs. 9, 10,* and *16*).

Based on the interpretation of archival maps, it would be appropriate not only to propose but also to implement restoration measures with a positive impact on the water regime of the landscape in suitable locations. In particular, this should involve the revitalisation or restoration of small watercourses, including the restoration of their floodplains, where possible. Such measures should also form part of the response to the challenges posed by ongoing climate change. The above-mentioned measures should primarily lead to increased water retention in the landscape. They would also contribute to greater landscape biodiversity. In particular, headwater areas and the upper parts of catchments (in their natural state, without straightened and deepened channels) play an important role in adaptation measures to ongoing climate change, by increasing the landscape's capacity to retain water and slow the onset of floods, and this role will probably become increasingly important in the future.

Fig. 15. Landscape in the Výrovka spring area on the 1st Military Mapping

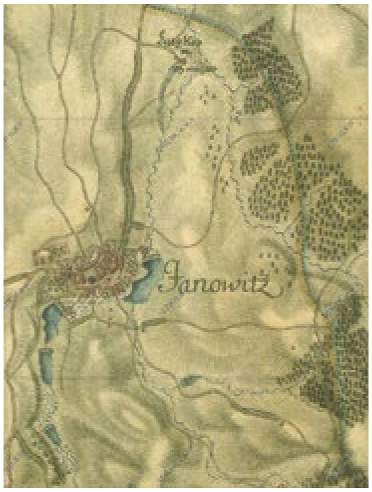

Fig. 16. Landscape in the area of Uhlířské Janovice village, including the former Lucký mill, on the 1st Military Mapping

These measures are consistent with the EU Biodiversity Strategy for 2030 [18], which is a valid long-term plan for nature conservation aimed at halting ecosystem degradation and restoring biodiversity in Europe. The strategy includes a commitment to place at least 30 % of land and inland waters under legal protection. It also calls for increased efforts to restore freshwater ecosystems and the natural functions of rivers, including the restoration of at least 25,000 km of free-flowing rivers compared with the situation in 2020, when the EU Biodiversity Strategy for 2030 was adopted. As part of this strategic plan, the first-ever EU legislative document for the long-term restoration of nature in both terrestrial and marine areas of the EU was proposed and adopted, establishing binding restoration targets for specific habitats and species. This is the Nature Restoration Law 2024/1991 [19], which represents the first Europe-wide legally binding framework for ecosystem restoration. It responds to the current situation in which Europe's nature is in alarming decline, with more than 80 % of natural habitats in poor condition. Its objective is to reverse the trend of biodiversity loss, increase landscape resilience, and strengthen ecosystems in order to support adaptation to climate change. In the area of wetland and freshwater ecosystems, it requires, among other measures, the restoration of at least 30 % of drained wetlands used for agriculture by 2030. Furthermore, each Member State is required to prepare its own National Nature Restoration Plan within two years of the regulation entering into force, specifying the timetable and scope of measures up to 2050 [19, 20].

In the Czech Republic, strategic objectives in the field of sustainable water management in the landscape are currently set out, for example, in the State Environmental Policy of the Czech Republic 2030 (with an outlook to 2050) [21]. Within Priority Axis No. 2, Protection of Natural Resources, emphasis is placed on improving the landscape's retention capacity, restoring the natural water balance, and implementing integrated river basin management. The document sets commitments to increase natural water retention by 10 % and to restore at least 500 km of watercourses with natural channels by 2030.

Another related document is the Strategy for Adaptation to Climate Change in the Conditions of the Czech Republic [22]. The main declared objective of this strategy is to maintain the availability of water resources, increase the landscape's retention capacity, and minimise the impacts of drought on ecosystems, the population, and the economy. Drought is identified as one of the main climate risks. This strategy is followed by the National Action Plan for Adaptation to Climate Change [23], which specifies measures for water retention in the landscape, the revitalisation of watercourses, the restoration of wetlands, increasing the share of permanent grasslands, and the introduction of soil-friendly land management practices.

The above-mentioned documents are largely theoretical in nature. They declare "useful and commendable" objectives, but without a direct translation into practice and without legal enforceability. An exception is the Nature Restoration Law of 2024, which represents the first Europe-wide legally binding framework for ecosystem restoration. In preparation for meeting the requirements of this European regulation on nature restoration (concerning free-flowing rivers and functional floodplains), the collection of background data began in advance within the project *Passportization of Watercourses* implemented from 1 May 2023 to 31 December 2025 and carried out by the Nature Conservation Agency of the Czech Republic. Its main objective was the field collection of hydromorphological characteristics of selected watercourses and the proposal of measures/management for watercourse sections to improve or protect their hydromorphological status. A total of 26,032 km of watercourses were selected for the passportisation, of which 23,665 km had been mapped by 31 October 2025. As of that date, the Výrovka is not included among the published outputs of the project, which are currently available through the Watercourses and Wetlands portal [24]. The main project output is a map and datasets relating to watercourse sections verified in the field. These sections are divided, with regard to their potential or need for revitalisation or restoration, satisfactory natural conditions, and limiting factors, into eight groups of "measures on watercourses". During the passportisation, permanently dry sections of watercourses were also detected.

A large amount of data is therefore available that is suitable as an ideal basis for proposing specific measures in watercourse channels or for supporting the restoration or revitalisation of watercourses in the coming years. It is therefore to be hoped that the results of this project will indeed be used in practice and that further projects with a practical impact on landscape restoration in terms of water retention will be implemented, such as the revitalisation or restoration of watercourses, including the restoration of their floodplains, or the restoration and establishment of wetland habitats at suitable locations.

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A graduate of the Faculty of Science at Charles University in Prague, where he obtained the RNDr. degree in 1969, and subsequently the CSc. degree at the Czechoslovak Academy of Sciences. He specialised in hydrobiology and aquatic microbiology at the Hydrobiological Laboratory of the Czechoslovak Academy of Sciences, at the Institute of Landscape Ecology, and from 1986 at the Water Research Institute, where he was appointed Director after 1990. Since 1998, he has worked at the Ministry of Agriculture; he is also a member of the "Senate Standing Commission WATER – DROUGHT" and served for 14 years as the Czech "Water Director" in negotiations with the European Commission. He has published more than 350 scientific papers in the Czech Republic and abroad. He lectures at the Czech University of Life Sciences Prague and also teaches at the Faculty of Fisheries and Protection of Waters of the University of South Bohemia in České Budějovice.

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Interview with RNDr. Pavel Punčochář, CSc., member of the Water Management Section of the Ministry of Agriculture of the Czech Republic

Life by the Sázava river, an enthusiasm for "living sticks" and the microworld of aquatic organisms; twenty years devoted to science, followed by a turning point: T. G. Masaryk Water Research Institute during the transformative 1990s, and subsequently the Ministry of Agriculture. In this interview, RNDr. Pavel Punčochář, CSc. recalls the people who shaped him, the moments when the very existence of our institution was at stake, and explains, why the public will have to learn to trust predictions and effective water management solutions.

Mr Punčochář, you come from the Bohemian–Moravian Highlands and are often described as a patriot. What has that region left in you?

I was born in Pelhřimov, but I spent my youth in Světlá nad Sázavou – just a few dozen metres from the Sázava river. That shaped me profoundly for the rest of my life. It was a time when the river was so clean that people would routinely rinse and bleach their laundry there – and I would go there with other children to sprinkle the linen while it was being whitened. In later years, I travelled every day to secondary school in Ledeč nad Sázavou on the Posázaví Pacific railway, running along the river and past Stvořidla Nature Reserve. Every day, I could see what was happening to the river.

All the men in our family were anglers – my brother, my father, my grandfather – so fishing rods and tackle were an ordinary part of our household equipment. It was a time when the river still teemed with many kinds of fish. It was a wonderful period and, I must say, it was precisely this that shaped my attitude towards rivers and water. When I walk along the Sázava today, only Stvořidla has essentially retained its original character. Everything else has changed.

When you went on to Charles University, did you already know that you wanted to work in the area of water?

It began as early as grammar school. I was fascinated by details, for example the "little red spheres" in the water. Later, I came to know that they were water mites. Or caddisfly larvae, which as boys we called "living sticks" – they build their cases from pine needles and small pieces of wood. Watching hydra on the surface of a pond, those were experiences that left a lasting impression. I was fortunate in my teachers as well. Our biology teacher at grammar school, Professor Louda, encouraged my interest. And at university I encountered lots of other people who helped to move me forward.

Who influenced you most at the beginning of your career?

I arrived in Prague at the age of seventeen as part of an "accelerated year" from the eleven-year secondary school and, within my first month, I made my way to the Department of Hydrobiology. I took the assistants somewhat by surprise, because when they asked what I wished to specialise in, I replied without hesitation: the self-purification process. I explained to them that I travelled along the Sázava every day and that the difference between the stretch upstream and downstream of Stvořidla was so striking that I wanted to understand everything that was happening in the river. When they later asked which group of organisms I wished to focus on, I chose water mites, which caused further surprise – at that time there was essentially only one specialist in water mites in the whole of Czechoslovakia, Dr Láska in Brno. Thanks to my teachers, especially Dr Lellák, I succeeded in establishing contact with him, and he then willingly introduced me to the study of water mites at the microscope in the Brno flat of the Láska family.

At the Faculty, I was strongly influenced by Dr Jan Lellák, Vladimír Kořínek (both later professors), and Jarka Horká (later Kořínková, who unfortunately died at a young age). They were true enthusiasts, willing to devote an enormous amount of time to science. Through them, I was also able to join the Hydrobiological Laboratory of the Czechoslovak Academy of Sciences in the Prague district Smíchov, where, from my fourth year onwards, I accompanied the laboratory staff on regular monitoring of water quality in reservoirs. I wrote my diploma thesis on the self-purification of the Botič between Průhonice village and Prague. Dr. Věra Straškrabová was a great help to me, and above all, Associate Professor Hrbáček. They devoted their time to me, provided literature and guidance, and thanks to their support I was able, after completing my studies, to continue seamlessly in the field within their team.

What did the scientific phase give you most – methodology, patience, the ability to question?

Methodology, certainly, but above all patience and diligence. Repetition, minor setbacks – one must not allow oneself to be discouraged. And, of course, to question results means returning to matters repeatedly and verifying them. At that time, statistical methods were becoming more firmly established. I attended courses in order to be able to apply statistical techniques in my work as a hydrobiologist. Later, this enabled me not only to use statistics, but even to explain it to colleagues and to lecture on it at seminars.

You moved into managerial positions relatively early in your career. What was the most difficult aspect?

I would not say that it was early – I had spent more than twenty years engaged in scientific work in basic research. The turning point came at a time when part of the Academy was to be relocated from Prague to České Budějovice. For me, this was both a personal and a family decision. We had our home in Radotín (which is now part of Prague), and my wife worked at the Faculty of Science in the Department of Algology. Leaving Prague was becoming unacceptable for me. It was one of the most difficult decisions of my life: to leave science and attempt to engage in practical, applied research. I applied for the post of Head of the Microbiological Laboratory at the T. G. Masaryk Water Research Institute, and in 1986 I was accepted and took up the position.

When did you first truly acknowledge that it would no longer be "only" about professional work, but primarily about leading people,

responsibility and decision-making – and what was the most difficult aspect of that change for you?

After the political and economic changes of 1989, I applied for the position of Director in 1990. I was strongly encouraged to do so by many Institute employees, and in particular by the heads of water management laboratories throughout the Czech Republic, both in the field of water supply and sewerage and within the state-owned River Basin enterprises, who sent a letter of recommendation to the then Ministry of Forestry and Water Management. I felt that I had a genuine chance of succeeding, yet at the same time I was aware that I did not know everything about water management practice. Therefore, several colleagues helped me prior to the selection procedure, to frame the full scope of what water management encompasses, as my focus until then had been primarily scientific.

I particularly value the support and advice of Ing. Václav Zeman, which were invaluable to me not only at that time but also later on.

What was your first day as Director of the Water Research Institute like?

The first day was marked by expectation and also by uncertainty. I had worked there for three years, I knew almost all the employees, and many of them expected that everything would change overnight. However, I immediately sensed the priorities: it was necessary to integrate the Institute, both spatially (having six workplaces at different locations across Prague was untenable) and in terms of working methods, so that teams would be formed to deliver comprehensive solutions rather than everyone pursuing their own agenda. At that time, there were many outstanding experts in individual disciplines and specialisations. The Ministry did not stand in the way of this arrangement, as it was satisfied with obtaining what it required for the governance of water management and left the remainder of the work largely to the discretion of the staff and their research reports. Yet it was precisely for this reason that specialists did not collaborate more closely on specific problems requiring multiple perspectives in order to achieve comprehensive solutions. My three main tasks were therefore as follows: to achieve spatial integration, to achieve professional integration, and to enhance the Institute's prestige through international cooperation; this was gradually and successfully developed with twelve institutes in six European countries.

However, I was taken aback at my very first meeting at the newly established Ministry of the Environment. I did not comply when I was advised whom I should appoint as my deputy – and the "punishment" came in the form of a reduction in part of the Institute's funding, which I then had to resolve through savings. At the same time, my superior there was Deputy Minister Benda, who was convinced that institutions of this kind were unnecessary and that the Institute itself was redundant. He intended to fundamentally restructure it and, in essence, almost abolish it altogether.

How did you cope with it?

The outcome was that I said: "No, no – I am convinced that institutions of this kind should be preserved. One need only look west of us, to countries that are economically advanced and democratic." I therefore took a strategic step and proposed that the matter be assessed by a group of respected foreign experts, preferably from the United Kingdom. With funding from the European Commission, a team of experts from England came to review the Institute, including its branches, and subsequently produced a report recommending that the Ministry should not dissolve the Institute but, on the contrary, develop it and give it the opportunity to generate additional income through practical projects. It was a strategic move that saved the Institute – first at that moment, and later once again.

At the same time, this marked the beginning of a period in which internal integration and the "hard" realities within the Institute also had to be addressed. Not everyone was able to accept that 620 employees was excessive and that not all were being used effectively. Reducing staff numbers was demanding and, on a human level, very unpleasant. I nevertheless tried to proceed in such a way that

In the Berounka river, approximately 150 metres from the author's residence (September 2018)

I would not appear as a ruthless director dismissing people indiscriminately. I studied their outputs, spoke with them, and pointed out concretely that, for example, there had been no discernible progress in their work over a period of three years. It was difficult because at that moment you hold up a mirror and show that, in effect, they had drifted along for three years without producing meaningful results. The reduction in staff numbers was also influenced by the privatisation enthusiasm of the time, when some employees left for the private sector; unfortunately, most of them were of high quality.

You mentioned Britain. How did you further develop one of your priorities, namely international cooperation?

Cooperation with Germany was particularly important because of the Elbe. The International Commission for the Protection of the Elbe River was established, and I wanted the Institute to be involved. One of the most intensive partnerships after 1990 was with GKSS Geesthacht. We carried out joint monitoring and sampling, and from this emerged the tradition of the Magdeburg Seminars, which continues to this day. It began almost humorously: a colleague from GKSS, Dr Wilken, needed to catch a train urgently and was looking for a taxi. I drove him to the main railway station myself, and on the way we agreed that we would turn our cooperation into regular seminars. And it has endured ever since.

We were also assisted by RIZA in the Netherlands. I took a group of senior staff there so that they could see how a comparable institute operates. Technical support from the Danish Hydraulic Institute was also important. At that time, they had developed a highly regarded innovation – the mathematical model MIKE 11. I went to see their director, who had founded the institute, and asked him directly whether the TGM WRI might obtain their widely acclaimed tool for modelling flows, floods and the testing of flood protection measures. After a longer discussion, he said to me: "Very well, I will give you MIKE." When I asked what they would expect in return, he replied: "Nothing." I still regard it as an exceptional moment – on my part, perhaps audacity; on his, remarkable generosity.

You moved from the Institute to the Ministry of Agriculture. Did the difference surprise you?

Indeed. It is a different kind of work – preparing documentation for decision-making, dealing with legislation, and navigating internal ministerial processes. Ing. Jan Plechatý was a great help to me; he quickly "trained" me and would occasionally place something on my desk that had to be prepared urgently for the Minister. In that environment, one acquires rapid practical skills. At the same time, I realised that if one wishes to promote substantively sound measures, one must be able to communicate effectively with politicians and senior officials within the state administration. And I did not always comply with the original brief if I was convinced that it was wrong.

Some of the confrontations were hard, and in retrospect I sometimes wonder how I managed to withstand them. It remains somewhat surprising to me that no minister removed me from the post of Director General, because I consistently sought to maintain a professional standpoint – to explain what was appropriate and important for water management and the administration of water resources, and, conversely, to reject initiatives that would have been detrimental to them.

You once described the drafting of the new Water Act as a milestone in your career.

It was an entirely new Act, as the one dating from the 1970s had truly become obsolete. The task had originally been assigned to the Ministry of the Environment, but as it was unable to bring it to completion, it was ultimately entrusted to the Ministry of Agriculture. We began working intensively on it at the turn of 1999 and 2000.

Here I must highlight my colleague, Ing. Mirek Král, who moved with me from the TGM WRI to the Ministry. Mr Král was a veritable repository of knowledge in administrative procedures and water management development. Together with other colleagues and legal experts from the state-owned River Basin enterprises, we gradually drafted the individual sections of the Act.

If you were to describe the greatest difference between drafting a sound legislative proposal and getting it implemented in practice, what would it be?

To be able to advance a well-formulated technical text politically. In this regard, I must mention the absolutely invaluable role of Ing. Karel Tureček, the then Deputy Minister of Agriculture. He essentially trained me not to be discouraged by the cries of politicians in the Chamber of Deputies and the Senate, but to persuade them gradually, through factual argument, that this is how it should be done, and it is the right approach.

At the same time, we were engaged in a fairly hard-fought struggle with the Ministry of the Environment, which was trying to modify a number of provisions according to its own ideas, while we resisted this and sought to ensure that the measures were technically feasible in practice and that they would genuinely work for the benefit of water in the Czech Republic.

I also remember some particularly tense moments: I attended meetings of the ministers, and I will never forget a very heated exchange of views between myself and the Minister of the Environment, Miloš Kužvart, when I was admonished that I was speaking to a minister and should stop. Fortunately, we had known each other for some time, and he then said: "no, we know each other and we have to talk this through", which I appreciated. In the end, the Act was passed; the main competences remained with the Ministry of Agriculture, and the competences of the other ministries were clearly defined in the Act as so-called shared competences of the central water authorities.

Apart from the construction of new reservoirs, which three measures do you think have moved water management forward?

If we are speaking about frameworks and principles, I consider the following to be important: the principle that the polluter pays and the user pays, the protection zones of water sources and their enforcement, and technical safety supervision – its importance is now increasing even for smaller reservoirs and fishponds because of the risks posed by torrential rainfall and the damage it can cause. A major advance has also been the development of information systems and modelling tools.

Today, many things are predictable and can be traced in databases. As for reservoirs, it has been and remains crucial to maintain territorial protection of sites where, in the future, water storage could be addressed through sufficiently large reservoir

Survey of water mites in Krkonoše National Park, sampling at the Malá Úpa site upstream of its confluence with the Úpa (July 2019)

Meeting of the Presidents of the International Commission for the Protection of the Elbe River on the 25th anniversary of its establishment (from left: moderator, Dr H. Wendenburg, Dr Ing. D. Ruchay, Ing. F. Pojer, Dr H. Bloech, Dr P. Punčochář and Dr F. Holzwart)

dams. A disappointment for me is how long it takes for some projects to be implemented; for example, Nové Heřminovy flood-control reservoir. Unfortunately, it often works in such a way that things only start to move after major events accompanied by damage and adverse consequences that wake both politicians and the public to the need for decisions.

If you were to look into the future, how do you see water management in fifteen to twenty years?

We will have to pay much greater attention to the consequences of rising air temperatures and the effect of evapotranspiration on water resources. And we will have to prioritise the accumulation of surface water, despite resistance from part of the public. Groundwater is not being replenished sufficiently because of the lack of snow and rapid runoff after intense rainfall. We have not yet succeeded in initiating measures to strengthen groundwater storage through infiltration-based approaches. Without water, none of this will work: quality of life, the economy, sustainability, the energy industry.

The public should stop listening to and believing simple claims that a change in land management alone will solve everything. Yes, it is important, but there are situations where even with good land management, a flood will occur because the soil profile is already saturated, or drought will arise due to prolonged high temperatures and the consumption of water by vegetation. I see the future in the need to convince the public that certain technical measures, such as water management structures, are necessary, even if they have local impacts on municipalities or on nature. Weather conditions often contribute to this as well, for example through abrupt changes that can negatively affect local residents. Nevertheless, the present abundance of water generally leads the public to forget very quickly.

If you were standing in front of first-year water management students, what would you say to them?

"You are in the right place, because life on Earth without water is not possible." I would recommend that they read the European Water Charter of 1968. And I would also tell them that water is a most faithful companion "most faithful mistress" – it gives great satisfaction when you succeed in improving it or increasing its reserves. However, it requires diligence, perseverance, and interdisciplinary knowledge. And do not rely blindly on modern information technologies: if a blackout occurs and everything fails, it will be you who must make decisions and manage with what you know.

What does your ideal day outside work look like?

When the time off lasts longer than three or four days, I become uneasy that I am neglecting something. An ideal day: I get up, make coffee, and go through the news on water management and the status of rivers. I follow this reporting every day and have it on my mobile phone as well. Then I would go fishing, perhaps to the Berounka or the beloved Sázava. To sit and gaze, recall memories, and do a little fishing. And if it were a longer break, I would go into the field: I would like to add to my collections and surveys of water mites in Šumava Mountains. In my home laboratory, the collected samples will wait. I think ahead: when one day I am no longer able to go out into the field, I want to have the material and devote myself to it in peace.

If I may, a few quick points to conclude:

- **For me, water represents:** the natural source that has captivated me.
- **The greatest professional lesson:** leaving research work and not going to České Budějovice to pursue a career in science.
- **The most difficult decision in my career:** probably the same as the greatest professional lesson, because I moved from basic research to applied research and subsequently into public administration.
- **One thing I wish the public understood about water:** that without water it is not possible to live, and that water resources must be safeguarded through water management and technical measures, not only by expecting nature-based measures to ensure them.
- **If I had not devoted myself to water, I would have been:** perhaps a physician – that would also have attracted me a great deal. Paradoxically, my family tried to dissuade me from it; when I was living in the student hostel with medical students, I thought to myself: "Anthropology seems really easy, I would certainly enjoy that!"

Mr Punčochář, thank you for the interview.

Ing. Josef Nistler

RNDr. Pavel Punčochář, CSc.

RNDr. Pavel Punčochář, CSc., was born on 20 March 1944 in Pelhřimov. He graduated from the Faculty of Science of Charles University in Prague, where he was awarded the degree of RNDr. in 1969, and subsequently obtained the degree of CSc. at the Czechoslovak Academy of Sciences (CAS). He specialised in hydrobiology and water microbiology at the Hydrobiological Laboratory of the CAS (1965–1984), at the Institute of Landscape Ecology (1985–1986), and, from 1986 onwards, at the Water Research Institute, where he was appointed Director (1990–1997). Since 1998 he has been employed at the Ministry of Agriculture, initially as Director of the Department of Water Policy and subsequently as Director General of the Water Management Section. He is also a member of the Senate's Standing Commission WATER–DROUGHT and, for fourteen years, served as the "Water Director of the Czech Republic" in negotiations with the European Commission. He has published more than 350 professional papers in the Czech Republic and abroad. He lectures at the Czech University of Life Sciences Prague and also teaches at the Faculty of Fisheries and Protection of Waters of the University of South Bohemia in České Budějovice. His personal interests include angling and research on water mites.

Boží Dar Peat Bog

The Ore Mountains triangle formed by the towns of Abertamy, Boží Dar, and Horní Blatná is not only a tourist and skiing paradise, but also part of the Erzgebirge/Krušnohoří Mining Region, inscribed on the UNESCO World Heritage List since 2019. It is located in western Bohemia in the Karlovy Vary District, near the state border with Saxony in Germany (see map in *Fig. 1*). The area consists essentially of three ore mining districts combined into a single region, characterised by a range of urban and landscape heritage features, led by the historic centres of all three towns (e.g., the Church of the Fourteen Holy Helpers in Abertamy from 1534, *Fig. 2*).

Nature reserve

A highly significant and inspiring part of this area is Boží Dar Peat Bog National Nature Reserve (*Fig. 3*). It is located west of Boží Dar on a plateau near Božídarský Špičák, the highest basalt dome in Central Europe (1,115 m a.s.l.; *Fig. 4*). Covering an area of approximately 930 ha, it is one of the important protected areas in the Czech Republic. Its value in terms of nature conservation is best demonstrated by the fact that in 2008 it was designated as a Wetland of International Importance under the Ramsar Convention. It is also part of Ore Mountains Plateau Site of Community Importance within the Natura 2000 network.

Among the watercourses, the most important for the peat bog are the Černá stream, which rises here at the northern edge, the Božídarský stream, and their small tributaries (*Fig. 5*). In the southern part lies Mrtvý pond, characteristic for its dark colour caused by the presence of peat. Since the 16th century, it served the needs of mining operations. Blatenský Water Ditch also originates in Boží Dar Peat Bog (*Fig. 6*). This is a unique technical structure built between 1540 and 1544, which supplied water to local tin and iron mines and also functioned as a navigation canal for timber transport. The ditch ran from the peat bog via Myslivny and Ryžovna to Bludná and around Blatenský hill to Horní Blatná, where it was piped and led into the Blatenský stream. Even after mining ceased in the 19th century, its use did not end – it became a source of water for local mills, sawmills, and paper mills, as well as for fire protection; indeed, it remains in operation to this day. It is approximately 12 km long and is accompanied by an educational trail of the same name with 23 stops. Blatenský Water Ditch is an excellent example of the high level of technical and logistical cooperation between the mining industry and water management in this Ore Mountains region as early as the 16th century. In 2017, it was designated a National Cultural Monument.

History of the area

Boží Dar (1,028 m a.s.l.), the highest town in the Czech Republic and in Central Europe, with a current population of around 260 inhabitants, was founded as early as 1533 by the Saxon Elector John Frederick I, who is still depicted in one of the town's symbols – the famous mountain Green Hotel (*Fig. 7*) from 1542 – in a wall painting.

The three ore mining districts mentioned above (Horní Blatná, Hřebečná, and Bludná), with their numerous surface and underground remains of mining activity, still provide exceptional evidence of various methods of extracting tin, as well as iron, copper, and other ores from steep greisen veins (*quartz veins in strongly metamorphosed granitic rock, typical of the Blatná granite massif; author's note*) over a period of more than 400 years, from the 16th to the 20th century. Illustrative examples include the former tin mines of Vlčí and Ledová jáma on Blatenský hill and Zuzana mine in the nearby Bludná district. Even larger is the collapse depression of Červená jáma mine between Bludná and Hřebečná. The well-preserved Mauritius mine in Hřebečná, now a National Cultural Monument, features the 400 m long Kryštof adit, which is open to the public and offers the opportunity to view traces of manual excavation using hammer and chisel, as well as rock fractured by heat from the fire-setting technique.

Of a completely different type is the Zlatý Kopec deposit (originally called Kaff), located on a steep slope above the Zlatý stream on the edge of Boží Dar. The largest mine in this district was Johannes mine from the 16th century, which was used to extract polymetallic ores of tin, iron, and copper from flat-lying skarn bodies (*formations metamorphosed at the contact of limestones and magma into silicate rocks, which are rich sources of these ores; author's note*). It operated for almost 400 years with only minor interruptions.

The extraction of tin ores was also linked to the establishment of the town of Horní Blatná, which is the only example of a mining town in the Ore Mountains that was deliberately founded in the 16th century on previously undeveloped land for the extraction of ores other than silver.

Sejpy — a unique feature of the mining landscape

Deep mining of tin ores in many parts of the Abertamy – Boží Dar – Horní Blatná mining landscape was preceded by the washing of cassiterite from alluvial deposits of watercourses, especially the Božídarský stream, the Černá stream, and its unnamed tributaries in the highest parts of the Ore Mountains. Hundreds of small mounds and depressions near Boží Dar and below Blatenský hill testify to the enormous extent of the washing of tin ore grains – cassiterite (tin dioxide, SnO$_2$). The main period of alluvial mining of tin dates to the 16th to 18th centuries; however, it certainly took place even earlier, before the founding of Boží Dar in 1533, as Mathesius's chronicle of Jáchymov from 1562 already describes some of the mining mounds as overgrown with tall trees (*information from the Boží Dar Peat Bog educational trail; author's note*).

These mining mounds, also known as *sejpy* (from the German *seifen* = to pan), are composed of sands and gravels and fragments of rocks from the surrounding area, mainly schists and phyllites, as well as rounded fragments of Tertiary volcanic rocks; irregular grains of quartz, mica, and feldspar are also ubiquitous. A distinctive feature of the Boží Dar *sejpy* is the presence of gold flakes, i.e. small particles of gold.

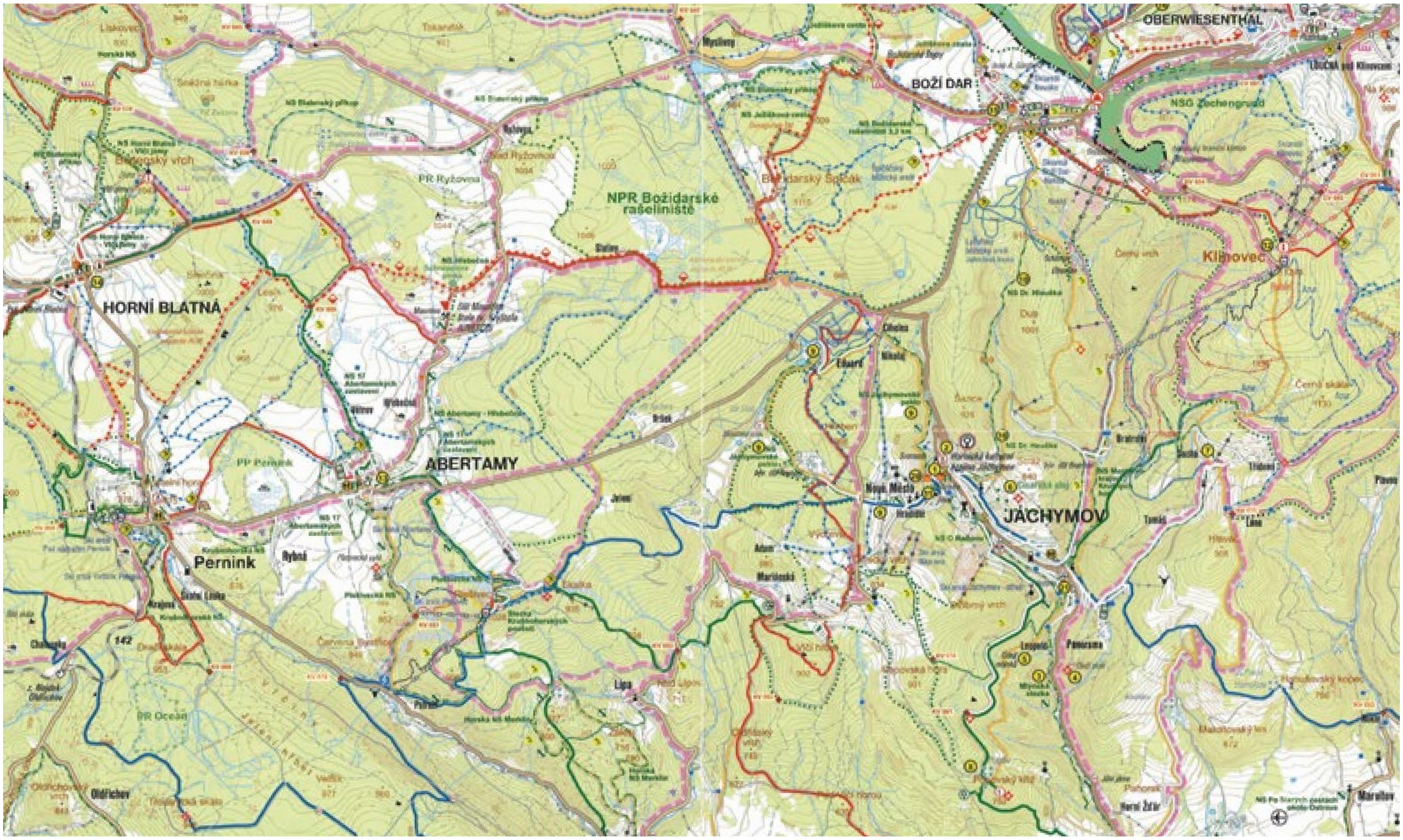

Fig. 1. Map of Boží Dar Peat Bog and its immediate surroundings

Fig. 2. Church of the Fourteen Holy Helpers in Abertamy

Fig. 3. Boží Dar Peat Bog

Fig. 4. The nature reserve is situated on a plateau

Although gold has never been mined in the Ore Mountains (unlike silver, tin, copper, cobalt, and iron ores) and no primary deposits are known, small and therefore non-economic quantities of gold flakes have always been found here during panning. Their occurrence has not yet been scientifically explained; they are probably already present in greisen veins and are subsequently concentrated in local alluvial deposits through transport and natural processes such as weathering and sedimentation.

Individual *sejpy* are typically rounded mounds five to ten metres in length, with heights at their crests exceeding two metres. The greatest concentration occurs around the Černá stream above the former Nový Mill, near the so-called Hubertky area, and along an unnamed stream at the eastern edge of Boží Dar Peat Bog. Numerous remains of former panning sites can also be found further downstream along the Černá near Myslivny, Ryžovna, and other locations. The total area covered by *sejpy* in the vicinity of Boží Dar exceeds 250,000 m^2, placing them among the largest in the Ore Mountains as well as in the Czech Republic as a whole (*for completeness, it should be noted that* sejpy *can also be found, for example, in the Šumava Mountains near Kvilda; there, however, they are associated with gold rather than tin panning; author's note*).

Since 2013, the historic *sejpy* near Boží Dar have been protected as a cultural monument of the Czech Republic.

Fig. 5. The landscape is interwoven with numerous small streams

Fig. 6. Blatenský Water Ditch with a newly repaired footbridge (June 2025)

Unique vegetation

The reason for the strict protection of this area is not only the wetland itself as a source of moisture for the landscape and its specific microclimate, but also the local flora and fauna. As the most fertile humus layer was washed away during panning, the *sejpy* are very poor in nutrients. They therefore differ markedly from surrounding sites in the vegetation that grows on them. A particularly interesting feature is that their individual elements – mounds and depressions – also differ from one another. While the mining mounds, with their distinctive vegetation, resemble northern flora, the depressions between them retain more moisture, allowing characteristic wetland plants to grow there, such as clubmosses and the carnivorous round-leaved sundew.

In terms of forest vegetation, the *sejpy* are characterised by stunted spruce stands and dwarf pine, as well as dwarf birch and mountain pine; among plants, there are communities of heather, cowberry, mountain everlasting, red fescue, and red campion (*Fig. 8*). Wild pansy also thrives here (*Fig. 9*). Among protected herbaceous plants, one can find mountain arnica, bog bilberry, crowberry, and others.

A characteristic species is also hare's-tail cottongrass (*Eriophorum vaginatum*) (*Fig. 10*), a member of the sedge family, for which the local acidic peat soils and higher elevation are well suited. After flowering, it is easily recognised by its white cotton-like tufts, which are carried across the landscape and readily dispersed. In the past, these white fluffy fibres were often used for making wadding and even paper. At the same time, hare's-tail cottongrass contributes to the formation of peat, which was once extensively extracted from Boží Dar Peat Bog for use in nearby spa facilities.

The local fauna is particularly rich in numerous species of insects and songbirds, but one may also encounter the common adder as well as various species of lizards and newts.

Educational trails

The landscape of Boží Dar Peat Bog is interwoven not only with numerous adits, mines, and collapse depressions, but also with several educational trails. These are mostly of an informative and educational nature. In addition to the above-mentioned trail along Blatenský Water Ditch, there is also, in the northern part, the Tin Trail (German *Zinnweg*) from Boží Dar to Ryžovna, bearing the logo "Ahoj sousede" (Hello neighbour), which was created as a symbol of cross-border cooperation between the Czech Republic and Saxony within the European Regional Development Fund. The main objective of this project was the preservation, protection, and development of natural and cultural heritage, as well as the improvement of tourist infrastructure in the Central Ore Mountains region.

AHOJ SOUSEDE.

HALLO NACHBAR.

A circular educational trail of the same name runs directly through Boží Dar Peat Bog. It was established as early as 1972 with the construction of a boardwalk leading through part of the peat bog. Between 2009 and 2011, the trail underwent a technically and financially demanding reconstruction, 85 % of which was co-financed by the European Union – namely the European Regional Development Fund. The trail is now 2.3 km long and features 12 numbered stops with well-prepared information on the history of the area, its flora and fauna, and many other points of interest (*Fig. 11*). The new boardwalk is built of solid oak timber and, compared to the original, has been widened for visitor safety. As the Boží Dar Peat Bog trail passes through its most valuable part, it is strictly forbidden to leave the boardwalk and enter the surrounding landscape.

Fig. 7. Zelený dům Hotel in Boží Dar

Fig. 8. Red campion

Fig. 9. Wild pansy

Fig. 10. Hare's-tail cottongrass is an important species for the peatland

Fig. 11. The educational trail provides much useful information about Boží Dar Peat Bog

Fig. 12. This wooden statue is a symbol of the Ježíšek Trail

Of a completely different character is the so-called Ježíšek Trail, which has two circuits (5.6 km and 12.9 km), with the longer route leading around the entire peat bog, allowing it to be joined from the Boží Dar Peat Bog trail. The Ježíšek Trail begins in the town of Boží Dar, and its stops in the field are easily recognisable thanks to small wooden figures (*the same symbol is also placed in front of the post office in Boží Dar, where the so-called Ježíšek Post Office operates; author's note;* see *Fig. 12*). This recreational trail is primarily intended for families with children, for whom maps and activity booklets with tasks can be obtained at the information centre in Boží Dar; children complete the tasks and record their answers at individual stations. In addition to its playful character, the trail also has an educational function, with an emphasis on nature conservation from an early age. The unique Boží Dar Peat Bog, with its rich history and rare vegetation, undoubtedly deserves protection and respect.

Sources and acknowledgements

All information used in this article, apart from personal observations and conversations with local residents, is derived primarily from maps, guidebooks, and booklets obtained from information centres and hotel receptions, as well as from the information panels of the individual educational trails that I visited during my travels in the Ore Mountains in August 2024 and June 2025. Special thanks are due to Mr Radovan Příklopil from the reception of the Radium Palace Hotel in Jáchymov, who kindly provided me with many useful maps and sources of information.

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The conference called Hydrological Days, organized alternately by the Slovak Committee for Hydrology and the Czech National Committee for Hydrology, has been held at 5-year intervals since 1980. In Slovakia, the conference was previously held in 1985 at Zemplínska Šírava, 1996 in Stará Lesná, and 2005 and 2015 in Bratislava. The most recent conference took place in 2021 in Brno. The conferences have always been organized in close cooperation with leading hydrological and water management institutions in Slovakia and the Czech Republic. The organizers believe that this year's joint scientific event will contribute to the tradition of serious, competent, and systematic approach to hydrology and its application in modern practice, which affects society as a whole

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FROZEN SPRING

This photograph, taken near Prague, aptly illustrates a situation in which photographic passion prevails over reason and one realises that we only live once. It was early April 2001, with spring in full progress. Overnight, however, snow fell and frost returned. I set out from home in the morning for a work meeting and, on the way, caught sight of spring flowers peeping out from beneath a light dusting of snow. I did not hesitate for long. I went back home, packed my photographic equipment, cancelled the meeting, and set off to take photographs. Nature is a powerful magician, however, it does not offer its miracles twice.
That morning, I returned home wet and frozen, yet content. Two frames from the three rolls of film turned out beautifully; from the slide, a violet greeting of the new spring smiled back at me, and I knew that it had been a meaningfully spent fragment of life. And that is precisely what macrophotography is about.

Text and photo by Milan Blšťák, www.macro4you.cz

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