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This issue is dedicated to the 80th anniversary of birth doc. JUDr. Stanislava Šprincová, CSc., Prof. RNDr. Jiří Machyček, CSc., a doc. RNDr. Ladislav Zapletal, CSc.

THE STUDY OF RECENT DESTRUCTIVE PROCESSES IN THE MORAVIAN KARST CAVES (CZECH REPUBLIC)

J. Faimon[1], J. Zimák[2], P. Zajíček[3], M. Schwarzová[1], J. Štelcl[1]

[1]Institute of Geological Sciences, Faculty of Sciences, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic – faimon@sci.muni.cz, stelcl@sci.muni.cz , 13255@mail.muni.cz
[2]Department of Geology, Natural Science Faculty, Palacký University, Svobody 26, 779 00 Olomouc, Czech Republic – zimak@prfnw.upol.cz
[3]Agency for Nature Conservation and Landscape Protection of the Czech Republic, Caves Administration of the Moravian Karst, Svitavská 11-13; 678 01 Blansko, Czech Republic - zajicek@cavemk.cz

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Abstract

This work tried to decide whether an occasionally observed falling of straw stalactites in the Moravian Karst caves is caused by a hypothetical chemical corrosion. The straw stalactite wall was found to be formed by three calcite layers. The middle layer (a stalactite skeleton) was typically cracked in agreement with calcite cleavage. Some impact of chemical corrosion was positively identified on the outer side of straw stalactite walls. Any corrosion of the inner wall of stalactite channel was not explicitly proved. This is consistent with the supersaturation of the majority of monitored dripping waters with respect to calcite (SI=0.2 to 1.2). However, the finding of unsaturated dripping water in the Punkevní Caves (SI=-0.8 to -0.3) did not allow to exclude the chemical corrosion definitively. The seasonal increase of cave CO_2-concentrations (up to 1 vol. %) was consistent with increasing number of visitors (up to 28 000 per month in the Punkevní Caves) and with the CO_2-production in the soils above caves (up to 1 vol. % in soil atmosphere in Summer). The drop of the cave CO_2-concentrations in Fall and Winter roughly corresponds to the decrease of the soil CO_2-concentration, visitor number, and probably also to change in cave ventilation. Enhanced concentrations of NO_3^- in the Amatérská Cave (up to 1.2×10^{-3} mol/l) indicate anthropogenic pollution.

KEY WORDS: cave, CO_2, corrosion, destruction, dripping water, fissures, straw stalactite, supersaturation

1. INTRODUCTION

The Moravian Karst is the biggest and the most important karst area of the Bohemian Massif. It is located north of Brno, making part of the Drahany Highlands area. Its rocks crop out on the area of 94 km^2 as a belt 3-5 km wide and 25 km long. The Moravian Karst is formed mainly by Middle and Upper Devonian limestones, which are divided into two formations – the Macocha Fmt. (Vavřinec Lmst., Josefov Lmst., Lažánky Lmst. and Vilémovice Lmst.) and the Líšeň Fmt. (Křtiny Lmst., Hády-Říčka Lmst.). Total thickness of the carbonate rocks has been estimated as 500–1000 m. The overwhelming majority of caves were formed in the Vilémovice Lmst. The largest cave system in the Moravian Karst is the system called the Amatérská Cave (over 15 km of corridors). At present four caves in the Moravian Karst are open to the public – the Punkevní Caves, Sloupsko-Šošůvské Caves, Kateřinská Cave and Balcarka Cave. With their unique dripstone decoration, they belong to the most impressive caves in the Central Europe. Recently, however, some destruction processes, in which a falling of straw stalactites dominates, are observed in all caves of the Moravian Karst. A hypothesis is suggested that some chemical corrosion reduces the stalactite wall at “a stalactite neck”, which leads to stalactite destabilization and consequent falling. The goal of this work was to decide whether such corrosion really operates in the caves.

2. METHODS

The straw stalactites collected from the floors of the Punkevní Caves, Amatérská Cave, Kateřinská Cave and Balcarka Cave and their longitudinal and transverse thin sections were studied under using of binocular microscope and standard polarization microscope, respectively. Selected straw stalactites were corroded in laboratory by 0.1 mol l^{-1} HCl flowing continuously through the stalactite channel and consecutively studied by former methods.

Dripping waters in the Punkevní Caves, Balcarka Cave, and Amatérská Cave were studied during year 2003. pH (combined glass electrode, pH-meter WTW pH 330i), calcium (complexometric microtitration, 0.01 mol l^{-1} EDTA, 10 % KOH, calcein), and alkalinity (potenciometric

microtitration by 0.005 mol l^{-1} HCl) were determined in cave environment. Sodium, potassium (AAS), chlorides, sulfates (ITP), nitrate, nitrite (spectrophotometry) were determined in laboratory. Speciation was calculated by the computer code PHREEQC (Parkhurst and Appelo, 1999).
The results of the speciation calculation were verified experimentally. Evolution of the *calcite-water-CO_2* system was monitored in stirred batch reactors (polyethylene, volume of 1 liter, magnetic stirrer, and Teflon stirring bar) in the Punkevní Caves. Calcite was represented by grains of 1.25-2.0 mm in diameter prepared from a cave floor stone (the Kateřinská Cave). The calcite sample was fixed vertically in the reactor, in thin layer between two polyester screens. The dripping water from speleothem the Angel (the Punkevní Caves) was used as an experimental supersaturated solution. The dripping water from the Tunnel corridor (the Punkevní Caves) was used as an undersaturated solution. pH and Ca of the solutions were continuously monitored in reactors (see the methods above). In addition to the experiments, the sampled dripping waters were tested for stability in cave environment. In stirred reactor, evolution of water-atmosphere system without of any contact with calcite was monitored.

Carbon dioxide was monitored (IR-spectrometer FT A600-CO2H linked with Almemo 2290-4 meter, both Ahlborn) in the Balcarka Cave (the Big Dome), Punkevní Caves (the Masaryk Dome) and Amatérská Cave (the Za štolou Cave, Rázstoka Cave, Rozlehlá Cave) during year 2003. Probes, 60 cm deep and 15 cm in diameter, were hollowed out in the soil profiles over the Punkevní Caves (coniferous wood, deciduous wood), Balcarka Cave (meadow) and Amatérská Cave (agrarian field edge). The probe walls were reinforced by perforated plastic tubes and covered by plastic plates. In both the caves and probes, CO_2 was monitored with two-week frequency.

3. RESULTS

3.1. Straw stalactite morphology and mineralogy

The wall of straw stalactite was found to consist of three layers:

(1) Outside layer, about 0.1 mm thick is constituted of fine-grained calcite aggregate. It is developed irregularly and it is missing on some parts of the wall.
(2) Middle layer, up to 1 mm thick is constituted of relatively small number of calcite mono-crystals. A local reduction of the layer was related to augmentation of opposite wall; i.e. it was a consequence of off-centered stalactite channel. Middle layer is typically disrupted by fissures leading in the direction of calcite cleavage. The microscopic fissures largely permeated across the wall and the macroscopic ones permeated the wall longitudinally on the distance up to few centimeters.
(3) Inner layer consists of aggregates of calcite crystals (0.1-0.3 mm in diameter) of different orientation. Thickness of the layer is up to 1 mm. The layer is not formed along the whole wall; it is locally missing or it is represented by single calcite crystals. In some straw stalactite from the Balcarka Cave, this layer was observed also on outer side of the wall.
An impact of chemical corrosion was sporadically identified on the outer side of stalactite walls. The corrosion of inner channel, on the other hand, was not positively proved. The only phase in the stalactite wall was identified as calcite.

3.2. Karst waters

The flow rates of dripping waters largely depended on season and locality. The rate of stable drippings was determined to be between tens and hundreds milliliters per hour. The rates of other drippings seasonally decrease to zero. Extremely low rates of all drippings were found in the Balcarka Cave.

pH of all waters typically varied between 7.6 and 8.2. Extremely, the low pH-value about 6.8 was measured in the Tunnel corridor (the Punkevní Caves). Most high pH-value, about 8.3, was found in the Masarykův Dome (the Punkevní Caves).

Table 3.1. Composition of dripping waters

Concentration [mol l^{-1}]							
Ca	Na	K	Mg	alkalinity*	SO_4	Cl	NO_3
2 - 5x10^{-3}	5 - 9x10^{-5}	1 - 2x10^{-5}	4x10^{-5}-1x10^{-4}	4x10^{-3} - 1x10^{-2}	2 - 5x10^{-4}	5 - 9x10^{-5}	2 - 9x10^{-5}

*[equivalents per liter]

Ca dominated in all waters. Na, K, and Mg concentrations were minor (see Table 3.1.). The concentration of other metals was under the limit of determination. From anions, ion HCO_3^- dominated, as indicated by carbonate alkalinity between 4.10^{-3} and 1.10^{-2} eq/l. Anions as SO_4^{2-}, Cl^-, NO_3^- were minor. The concentrations of other components (NO_2^-, PO_4^{3-}, NH_4^+) were under the limit of determination. Apart from this composition, some dripping waters in the Amatérská Cave showed enhanced concentrations of NO_3^- (up to $1.2x10^{-3}$ mol/l).

3.3. Cave experiments

(1) Supersaturated waters

During 200 hours of the *calcite-water* interaction in batch reactor, Ca-concentration decreased from the initial $2.82x10^{-3}$ to the limit value of $9.2x10^{-4}$ mol l^{-1}. pH-value firstly decreased from the initial 8.13 to 7.90 and then gradually increased to the limit value about 8.01.

(2) Unsaturated waters

Ca-concentration increased from the initial $1.4x10^{-3}$ to $1.66x10^{-3}$ mol/l during 240 hours of experiment. pH-value increased from initial 8.01 to 8.20.

(3) Test of a stability of sampled dripping water

The evolution of *dripping water-atmosphere* system in stirred reactor was stagnant during 430 hours of experiment. Ca-concentration, pH, and saturation index SI varied in very tight range of $2.42\text{-}2.40x10^{-3}$ mol l^{-1}, 8.11-8.13, and 1.27-1.26, respectively.

3.4. Carbon dioxide

In the cave opened to public, CO_2-concentration increased from 0.06-0.09 vol. % in the Spring (April) to 0.21 vol. % (the Balcarka Cave) and 0.41 vol. % (the Punkevní Caves) in August. In soils, the measured maxims of CO_2-concenbtrations were 0.53 vol. % (meadow above the Balcarka Cave), 0.45 vol. % (coniferous wood above the Punkevní Caves) and 1.06 vol. % (deciduous wood above the Punkevní Caves) in June. The cave CO_2-concentrations quickly decreased to 0.08-0.05 vol. % (the Balcarka Cave) and 0.04-0.05 vol. % (the Punkevní Caves) between October 15 and December 17. These values were somewhat higher than the outer CO_2-concentrations (~ 0.04 vol. %), but they were significantly lower than the instantaneous concentrations in soils, 0.23-0.19 vol. % (meadow above the Balcarka Cave), 0.26-0.19 vol. % (coniferous wood above the Punkevní Caves), and 0.33-0.46 vol. % (deciduous wood above the Punkevní Caves) during the same season.

The proportion of the CO_2 breathed out by visitor in the total cave CO_2-concentration was tested in the Nagel Dome (the Císařská Cave) at a speleotherapy. 27 persons at enhanced physical activity increased the CO_2-concentration in speleo-atmosphere from initial 0.07 vol. % to 0.12 vol. % during four hours. This concentration decreased to 0.08 vol. % of CO_2 during 17 hours without human presence.

In comparison with the caves opened to public, higher seasonal increase in CO_2-concentrations was registered in the caves closed to public (the Amatérská Cave). In the Rázstoka Dome (the Amatérská Cave), CO_2-concentration increased from 0.22 vol. % in April to 1.04 vol. % in October. From the maximum, the concentration decreased to 0.28 vol. % on December. The maximums in other parts of the Amatérská Cave were 0.55 vol. % (the Za štolou Cave) and 0.54 vol. % (the Rozlehlá Cave) in September. Maximal CO_2-concentration in the soil profile above the Amatérská Cave was lower (0.57 vol. %) and was reached already in April. From the date, CO_2-concentrations systematically decreased to 0.05 vol. % in December.

4. DISCUSSION

The outer layer of the straw stalactite wall is probably the results of speleo-aerosol deposition, as is indicated by the extremely fine aggregate structure. This layer does not influence the stalactite firmness. The middle layer of the straw stalactite wall, a main stalactite skeleton, is the result of the slow calcite growth from the water drop on the end of stalactite straw. This water becomes supersaturated as soon as the dissolved CO_2 degasses into speleo-atmosphere. The inner layer was probably formed additionally, from episodically supersaturated waters. This is indicated by the large number of chaotically oriented crystals. The analogous layers sporadically observed on the outer walls of stalactites in the Balcarka Cave were probably formed from water flowing along outer walls of the stalactites.

The fissures in stalactite walls were probably formed by a mechanical stress at stalactite falling and stroking cave floor. Due to extremely high calcite wall fragility, however, we cannot exclude the cracking caused by tectonic moves or vibrations resulting from traffic. In fact, some fissures could be predisposed already in the deep past, e.g., at constructional works or at cave discovering. Such fissures could potentially influence stalactite stability and could be responsible for the present stalactite destruction and falling.

The mechanism of the corrosion of outer side of stalactite wall is not known. However, we speculate that this corrosion could be a result of an attack of (1) „acid aerosols" (Faimon and Štelcl, 2001, Faimon et al., 2001) and/or (2) condensed steam (Dublyansky and Dublyansky, 1998). Both aerosols and supersaturated steam could be sucked into cave from outdoor atmosphere at so called "cave breathing" (Hakl et al., 1997). Any corrosion of stalactite inner wall was not positively proved. In fact, it was very difficult to distinguish the corrosion impact of the wall from other phenomena (e.g., growth irregularities). Some corrosion impact could cause an enlargement of some fissures, occasionally observed on both natural and artificially corroded straw stalactites. Main result of laboratory corrosion, however, was uniform reducing of wall thickness without any etched pits or other irregularities.

All studied dripping waters were of Ca-HCO_3 type. Calcium largely comes from dissolved limestone; part of carbonate ions comes from outdoor/soil atmosphere. Other components come from other limestone/soil phases and rain water. Enhanced concentrations of NO_3^- (up to $1.2x10^{-3}$ mol/l) in the dripping waters of the Amatérská Cave indicate anthropogenic pollution. Speciation calculation indicated that all dripping waters had been slightly supersaturated with respect to calcite. Saturation index SI, (e.g., Nordstrom and Munoz, 1994), varied from 0.5 to 1.2. Lower supersaturation, SI = 0.2-0.4, showed the single dripping water in the Amatérská Cave. The supersaturation is probably the result of water degassing in unsaturated zone above caves. The number of supersaturated dripping water questions the straw stalactites falling as the result of wall thinning by chemical corrosion. However, the finding of the single unsaturated dripping water (SI = -0.8 to -0.3) in the Tunelová corridor (the Punkevní Caves) does not allow to exclude this hypothesis definitively. Any correlation was not found between the flow rate and supersaturation of dripping waters.

The experiments in cave environment confirmed the results of modeling:
(1) The decrease of Ca-concentrations from initial $2.82x10^{-3}$ to $9.2x10^{-4}$ mol/l was consistent with decrease of saturation index from 0.94 to 0.0-0.03 and confirmed dripping water supersaturation and calcite precipitation.
(2) The increase of Ca-concentrations from $1.4x10^{-3}$ to $1.66x10^{-3}$ mol/l, on the other hand, was consistent with the increase of initial saturation index from -0.65 to zero and confirmed dripping water undersaturation and calcite dissolution. In addition, other experiments confirmed the stability of sampled dripping water in the cave environment.

The increase of CO_2-concentrations in caves in Spring and Summer was in agreement with increasing number of visitors. The study in the Nagel Dome confirmed the significant anthropogenic CO_2-fluxes, $8x10^{-4}$ vol. % per hour and person. However, the increasing CO_2-concentration in caves was also consistent with the CO_2-production in the soils above caves. The large seasonal increase of CO_2-concentrations in the cave closed to public suggests significant CO_2-fluxes from soils. In Fall and Winter, the cave CO_2-concentrations quickly decrease to the CO_2-concentrations of outdoor atmosphere. This was roughly consistent with the CO_2-concentration decrease in soils and, in addition, with low number of visitors. For example, the relaxation rate of the Nagel Dome without visitors was minus 0.0021 vol. % per hour. In addition, the drop of outdoor temperature below cave temperature could largely enhance cave ventilation (Bourges et al., 2001).

5. CONCLUSIONS

Amounts of fissures were observed in stalactite walls. They were probably formed by a mechanical stress at stalactite falling and stroking cave floor, however, they could come from (1) tectonic moves, (2) some vibrations resulting from traffic, and (3) constructional works and cave discovering in the past. Such fissures can destabilize straw stalactites and can be responsible for their falling.

The chemical corrosion was positively identified only on the outer side of straw stalactite wall. It is hypothesized to be a product of an attack of (1) „acid aerosols" and/or (2) condensed steam sucked into cave at „cave breathing". Any corrosion of inner wall of stalactite channel was not explicitly proved except of a widening of some fissures.

All dripping waters were slightly supersaturated with respect to calcite, which questions the hypothesis about straw stalactites falling as the result of chemical corrosion. The finding of the one unsaturated dripping water, however, does not allow to exclude this hypothesis definitively. The cave experiments confirmed speciation calculations and the stability of sampled dripping water in the cave environment. Enhanced concentrations of NO_3^- in the Amatérská Cave indicate anthropogenic pollution.

The seasonal increase of CO_2-concentrations in caves was consistent with (1) increasing number of visitors and (2) the CO_2-production in the soils above caves. The quick decrease of cave CO_2-concentrations in Fall and Winter was consistent with (1) the CO_2-concentration decrease in soils (2) low number of visitors and, perhaps, (3) with an enhanced cave ventilation at drop of outdoor temperature under cave temperature.

6. SOUHRN

SOUČASNÉ DESTRUKTIVNÍ PROCESY V JESKYNÍCH MORAVSKÉHO KRASU

Stěny studovaných brček byly běžně narušeny množstvím puklin ve směru štěpných ploch kalcitu. Tyto pukliny zřejmě vznikly mechanickým rázem při dopadu brčka na podlahu jeskyně, avšak mohly vzniknout i při (1) tektonických pohybech, (2) vibracích pocházejících z letecké a automobilové dopravy a (3) stavebních pracích při zpřístupňování a objevování jeskyní v minulosti, a mohou být tak hlavním důvodem současného padání brček.

Projevy chemické koroze byly nalezeny pouze na vnější stěně brčka. Lze spekulovat, že tato koroze je důsledkem působení (1) kyselých aerosolů a/nebo (2) zkondenzované vodní páry migrující do jeskyně při tzv. „dýchání jeskyně“. Koroze vnitřní stěny brčka nebyla jednoznačně prokázána. Jistou indicií by mohly být rozšířené štěpné trhliny, které byly nalezeny především ve stěnách uměle korodovaných brček.

Všechny skapové vody byly lehce přesycené vzhledem ke kalcitu. To zpochybňuje hypotézu o chemické korozi. Nález jednoho nenasyceného skapu v Tunelové chodbě (Punkevní jeskyně) však nedovoluje tuto hypotézu zcela vyloučit. Správnost výsledků modelování byla potvrzena experimenty v míchaných vsádkových reaktorech přímo v jeskynním prostředí. Zvýšené koncentrace dusičnanů v některých skapech Amatérské jeskyně naznačují antropogenní znečištění. Sezónní nárůst koncentrací CO_2 v jeskyních byl v souladu se (1) vzrůstajícím počtem návštěvníků, ale také (2) s rostoucí produkcí CO_2 v půdách nadloží. Vliv návštěvníků není zcela vyjasněn díky faktu, že v uzavřených jeskyních (Amatérská jeskyně) nárůst CO_2 dokonce převýšil nárůst v navštěvovaných jeskyních. Rychlý pokles koncentrací CO_2 v jeskyních v podzimních a zimních měsících pravděpodobně souvisí (1) s poklesem koncentrací CO_2 v půdách, (2) s poklesem počtu návštěvníků mimo sezónu a pravděpodobně také (3) se zvýšenou ventilací jeskyně při poklesu venkovní teploty pod teplotu v jeskyni.

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© Doc. RNDr. Jiří Zimák, CSc. (et al.)
Palacky University of Olomouc
Natural Science Faculty, Dpt. of Geology
Svobody 26
77146 Olomouc
Czech Republic
zimak@prfnw.upol.cz

Reviewed:
Ondřej Šráček, Ph.D.

THE IMPERIAL COUNCIL ELECTIONS IN 1907: GERRYMANDERING IN BOHEMIA?

M. Fňukal[1]

[1] Department of Geography, Natural Science Faculty, Palacký university, Olomouc, Svobody 26, 771 46 Olomouc, Czech Republic - fnukal@prfnw.upol.cz
Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

The paper deals with the electoral system used in Bohemia in 1907 for the House of Deputies of the Imperial Council. The aim of this study is to determine whether gerrymandering or malapportionment was intentionally used in defining the constituencies, and, if so, how it influenced the results of the elections (especially results of Czech social democracy).

KEY WORDS: gerrymandering, malapportionment, Bohemia, 1907 elections, Austrian Parliament

1. GERRYMANDERING AND MALAPPORTIONMENT

Election results can be – in addition to other factors – influenced by the method of defining constituencies BUTLER - CAIN (1992), KOSTELECKÝ (2000). Generally, there are two types of manipulations of constituencies leading to deformations of the voters' will: malapportionment and gerrymandering. In the Czech literature, both manipulation methods are generally labelled as electoral geometry („volební geometrie“, KREJČÍ (1994).

Malapportionment is the intentional influence of election results by an unequal size of constituencies. With malapportionment there is discrimination against voters in larger constituencies, as a higher number of votes is necessary for winning the seat than in smaller constituencies. Malapportionment often appears together with a majority electoral system, where it is easy to identify it, but it can also be found in systems of proportional representation. It can be used for discrimination against a certain political party or ideology. It is considered legitimate only in those cases when it helps to align the representation of members of federations or unions[1], or ensures the representation of minorities[2].

Gerrymandering does not refer to a manipulation of the constituency size, but of its borders. Gerrymandering means that the borders of a constituency are delineated in such a way that one party is discriminated against in favour of another party when calculated as votes per seat. Gerrymandering can be largely used in the majority electoral system with one-seat electoral constituencies, where it can essentially influence the number of elected representatives of particular parties. With the increase of the proportional elements of the electoral system, the possibility of affecting the election results by the territorial delineation of constituencies is significantly reduced, but not entirely eliminated. Gerrymandering is motivated by the effort to privilege one political party/group against another either with the goal of maximizing its representation and simultaneously minimizing the representation of the opposition in the elected body, or of ensuring the representation of groups that would not have any chance to get elected unless gerrymandering were used (American “affirmative racial gerrymandering”, see Fig. 1).

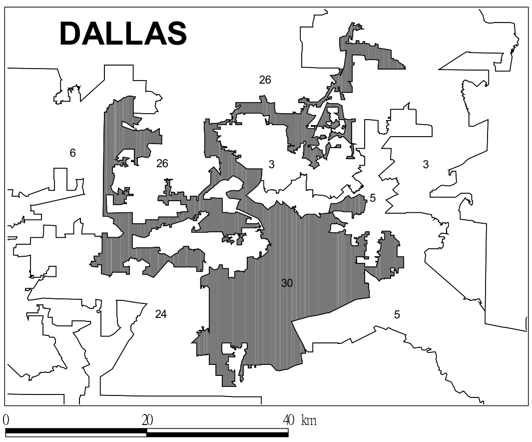

Figure 1. Affirmative racial gerrymandering (Afro-American 30th Congress District of Texas, 1992, data source: U.S. Census Bureau)

According to POWEL (2004), main techniques of gerrymandering are:

1) Stuffing most of one party's voters into as few districts as possible (“packing”)

2) Dispersing blocs of one party's voters into several districts so that they become a harmless minority ("cracking")

3) Drawing district lines so that two incumbents from the same party must now run against each other ("kidnapping").

The first two classical techniques of gerrymandering are practically described in every work dealing with this issue. "Kidnapping" is a complementary technique used in the U.S.A., where the relationship between deputies and their constituency is very strong. The basic methods of gerrymandering are presented in Fig. 2.

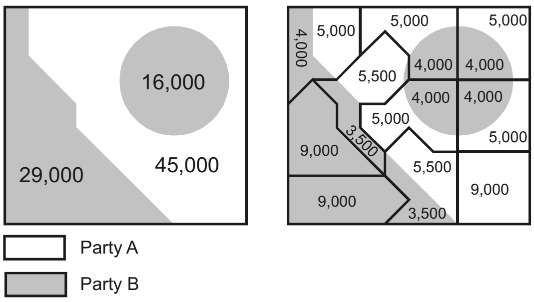

Figure 2. The basic techniques of gerrymandering (own instructive material)

Voters are evenly distributed within the area, but the supporters of parties A and B are territorially separated. The total number of voters is 90,000; the numbers of voters of party A and B are balanced. All constituencies have the same number of voters, party A has absolute majority in 8 constituencies, party B in 2. "Packing" was used to eliminate the southwest concentration of voters of party B; "cracking" eliminated the northwest concentration of voters.

Gerrymandering is possible only if the following two conditions are simultaneously met: one of the parties must, unlike the others, have control over the delineation of constituencies and the voters of particular parties must be unevenly distributed within the given territory (failing that, the election result does not depend on the distribution of constituencies).

"Invented" at the beginning of the 19th century, gerrymandering has a long-term tradition, especially in the U.S.A. The attempts to find mechanisms to stop it arose only a couple of years later. There are two possible methods for the regulation of gerrymandering: to eliminate the delineation of constituencies from the powers of executive branch (i.e. from the influence of the parties presently in power), or to set exact and controllable regulations for defining the constituencies in order to prevent any manipulations (KOSTELECKÝ (2000)). The former method was applied, for example, in the United Kingdom[3], the latter, with disputable success, was adopted by the United States.

The issue of regulating the delineation of constituencies in the United States is analyzed below; a failure to maintain the regulations can be a symptom (but obviously not evidence) of gerrymandering. The regulations are not embodied in a law, but they have gradually developed according to decisions of the Supreme Court in particular controversial cases. KOSTELECKÝ (2000) divides them into three categories: constitutional, political-geographic and political criteria.

The constitutional criteria of the delineation of constituencies (in accordance with the U.S. Constitution) – include the requirement of *equal population size of constituencies* (malapportionment is prohibited), i.e. the requirement of, if possible, a balanced number of inhabitants within individual constituencies. In elections for the U.S. Congress, the permissible deviation from the average within one state is 2%. Similar regulations are common in other countries, permissible deviations are higher: e.g. in the United Kingdom, the maximum ratio of number of voters in the largest constituency and the smallest constituency is 1.25: 1 (KOSTELECKÝ (1993)), in the Czech Republic (Senate) the maximum permissible deviation of the number of inhabitants of the constituency from the average is 15%[4] (i.e. the ratio of the largest constituency and the smallest constituency is 1.35: 1). Another constitutional criterion applied in the U. S. is the rather controversial requirement of *equal probability of representation for various racial or language minorities* that is practically applied only in the case of disadvantaged minorities.

The political-geographical criteria of delineation call for the application of *the principle of representation of political units*. For better voter awareness concerning the constituency, the constituencies should, at the maximum extent, correspond with the existing political units (counties, states) and for logistic reasons, the constituencies' delineation should to the maximum possible extent *respect the borders of the existing administrative unit*.
Political criteria of delineation especially include the recommendation *not to make changes to the constituency borders too often*, and if changes are necessary, they should not be too radical. It is not recommended to establish too many constituencies with equal chances for various political parties. Political criteria should help to avoid undue unpredictability of election results and the dependence of the results on small fluctuations in electoral support.

2. THE IMPERIAL COUNCIL ELECTIONS IN 1907

The elections to the House of Deputies of the Imperial Council that were held in May 1907 were the first elections to the Austrian Parliament conducted on the basis of the universal suffrage. The issue of the electoral system was one of the thorny problems for the country at the beginning of the 20th century. The existing electoral system to the Central Parliament as well as to the provincial assemblies had been based on unequal and limited suffrage, reflecting the idea that the individual political interests should be represented in accordance with the weight of the contribution that is brought by the representatives of these interests for maintaining and development of the state (KREJČÍ (1994)). The central Austrian Parliament consisted of two chambers: the House of Deputies (Abgeordnetenhaus / Poslanecká sněmovna) and the Upper House (Herrenhaus / Panská sněmovna). The Upper House consisted of major princes of the Imperial House, hereditary members from the upper aristocratic classes and members appointed by the Emperor, the number of members was not stable. The House of Deputies consisted of 425 members and it was elected in accordance with the estate principle. The landowners elected 85 deputies, municipalities and industrial centers elected 118 deputies, villages had 129 deputies, the commerce and trade chamber elected 21 deputies, and the remaining 72 deputies were elected by all adult men older than 24 years (so called *general electoral curia*). The suffrage was plural (citizens can belong to several estates) and unequal.

At the end of 1905, the Austrian Council of Ministers (Cabinet) decided to accept the growing demands for the introduction of equal, universal suffrage. At its session on 23rd November 1905, it settled on the basic principles of the reform, including the majority electoral system. Balanced (not equal) representation of particular nations in the Parliament should have been ensured by small constituencies delineated with respect to national borders. In allocating the seats, the tax yield and cultural importance should have been taken into account instead of the number inhabitants in order to „reinforce the national structures“ (TOBOLKA (1936)).

On 23rd February 1906, the Cabinet submitted the particular bills in the Parliament. The proposal was negotiated by the Parliamentary Committee, which worked from 23rd March 1906 until 29th October 1906. Discussion of political parties naturally focused on proportional representation of individual nations in the Parliament. Another point of controversy was the issue of the possible division of constituencies into rural and urban. This division had a long tradition in Austria and political parties focused on rural populations (agrarians, clericals) had a strong position in policy and were afraid of the urban population gaining a majority. Therefore they demanded a political compromise that divided constituencies into rural and urban. Furthermore, the issue of the election law was intentionally linked with other political problems concerning the Czechs, for example with the internal official language in Bohemia, a Czech university in Moravia, etc.

The major point of the controversy was obviously the issue of allocating the seats. The inability to find a feasible solution caused a demission of the Cabinet in two cases (Paul Freiherr Gautsch von Frankenthurn – 30th April 1906, Konrad Prinz von Hohenlohe-Waldenburg-Schillingsfürst – 28th May 1906); the final success of negotiations was achieved by the Cabinet of Max Wladimir Freiherr von Beck.

Table 1. Proposals of dividing seats of the House of Deputies

	Proposals of dividing seats of the House of Deputies		
	Feb. 1906 (Gautsch)	May 1906 (Hohenlohe)	Jun 1906 (Beck)
total	455	495	516
Bohemia	118	122	130
Czech : German ratio	70 : 48	72 : 50	75 : 55

Source: TOBOLKA (1936)

The proposals negotiated in the Parliament, despite the strong protests of the Czech political parties, gradually decreased the ratio of the Czech seats in Bohemia (from 59.3% to 59.0% and finally to 57.7% - see Tab. 1), although the „furthest acceptable“ limit acceptable by the Young Czechs (mladočeši / Jungčechen, leading Czech political party) was 60% (i.e. 78 Czech seats), and the Czech National Socialistic Party required even 62.5% (TOBOLKA (1936)).

The turning point of the negotiations came on 21st July 1906, when the Parliamentary Committee adopted dividing the Czech seats between the Czechs and Germans in a ratio of 75:55. It was not a compromise – both the representatives of the Czech political parties and Czech Germans voted against it – the proposal was adopted due to the votes of other countries. The Czechs did not agree with the disproportional representation of individual nations that did not correspond with the ratio of their populations determined by the census. Germans unsuccessfully attempted to gain German seats for Prague, Budějovice / Budweis and Plzeň /

Pilsen. On the same day, 21st July 1906, the division of constituencies between urban and rural was adopted and the Czech parties settled an agreement concerning their number (33 urban and 42 rural Czech constituencies in Bohemia). After 21st July rather technical issues were negotiated, and on 1st December 1906, the electoral law was adopted in the House of Deputies (194 yes votes / 63 no votes). The final version of the law did not meet general acceptance. However, the majority of Czech deputies voted for the law, as stated by TOBOLKA (1936): „neither of the Czech parties had wished the electoral amendment to come to naught, as they were aware of the fact that this electoral remedy would bring them more political powers." The procedure for the vote of approval continued in the Upper House and was crowned by the approval of the Emperor Franz Joseph I on 26th January 1907. The laws came into force by the day of the dissolution of the Parliament on 31st January 1907 as follows:

1. Law no. 15/1907[5] increased the total number of members of the House of Deputies to 516 and allocated the seats among the countries and also extended the active equal suffrage to all Austrian male citizens older than 24 years (with the condition of having stayed in the municipality where the election took place for at least for one year), passive from 30 years of age (with the condition of having had Austrian citizenship for at least three years);

2. Law no. 16/1907[6] established so called numerus clausus in the Upper House (number of appointed members could not exceed 170 nor drop below 150),

3. Law No. 17/1907[7] contained the electoral regulations themselves including the delineation of the constituencies and regulations excluding some people from the elections (professional soldiers, insane people, people under public assistance or convicted for criminal activities),

4. Law No. 18/1907[8] established a criminal sanction for the obstruction of the free course of elections.

After the Reform, the House of Deputies had 516 members from 480 constituencies elected by the majority system. One deputy was elected in 444 constituencies; two deputies were elected in 36 constituencies. In one-seat constituencies, it was necessary to win the absolute majority of collected, valid votes. If none of candidates managed to gain an absolute majority, the two most successful candidates in the first round of elections qualified for a second round where the candidate with the highest number of votes was elected. In two-seat constituencies, the two most successful candidates were elected in the first round provided the first won more than 50% of the vote and the second at least 25% of vote. Otherwise the elections continued to the second round where various procedures were applied in accordance with the ratio of votes for the first two candidates.

The constituencies were primarily delineated according to the language of the inhabitants, but there were three different practical approaches for individual countries:

1) in the majority of countries, the constituencies were delineated in accordance with the national borders and typically the individual constituencies were nationally homogenous,

2) in Moravia, this model of elections to the Provincial Assembly (see MALÍŘ (1906)) was adopted: voters were divided into electoral groups according to their nationality and the whole territory of Moravia was divided into separate constituencies for each nationality (each municipality belonged to one Czech constituency and to another German constituency)

3) In Galicia, the rural constituencies were comprised of two seats; the nationality of the elected deputies partially reflected the national conditions of the particular constituency (2 Poles, a Pole and a Ukrainian, 2 Ukrainians)

3. BOHEMIA: MALAPPORTIONMENT?

As mentioned above, Bohemia was divided into 130 constituencies of which 75 were comprised of Czech majority and 55 of German majority[9]. The delineation of borders between Czech and German constituencies was carried out at the municipal level. For the first time in Czech history, the designated „Czech / German political dependency" (thus HAVLÍČEK (1910)) in Bohemia, or Czech Bohemia (České Čechy / Tschechischböhmen) and German Bohemia (Německé Čechy / Deutschböhmen)[10] were precisely defined as far as territory was concerned. For simplification, we will denote the territory of the Czech constituencies as Bohemia A, and the territory of the German constituencies as Bohemia B. Naturally, their border in 1907 was very similar to other attempts at a national division of the country that have appeared since 1880 (the effort to divide Bohemia into nationally homogenous regions in 1918, attempts of German provinces to split when Czechoslovakia was established, etc.).

The borders of Bohemia A and Bohemia B were delineated in a very tactful way, individual municipalities were ranked according to the nationality of the majority (unless otherwise stated, all population data in this paper refer to the census of 1900, data on voters refers to the elections of 1907). However, some exceptions appeared: on the whole, 70 villages and towns became parts of constituencies with the opposite national character[12]. These municipalities included small settlements of mixed villages (in this case, the goal of maintaining „national propriety" was subordinated to the principle of not dividing municipalities), other cases included 19 municipalities with a slight Czech majority where the local authorities were probably under German control. This case mostly involved rapidly growing industrial centers in the region of Most (5 municipalities, but 19,517 inhabitants on the whole, i.e. 63,24 % of the inhabitants of „incorrectly ranked" Czech settlements)[13]. The failure to respect the national majority in dozens of settlements slightly privileged the German side, but it did not cause the difference between the theoretical ratio of seats converted in accordance with the number of Austrian citizens living in Bohemia A and Bohemia B (81:49) and the ratio of Czechs and Germans within Bohemia's population (82:48). Even if the national structure of municipalities and settlements were consistently respected, the first ratio would not have been changed. The difference of one seat was caused by smaller national homogeneity of Bohemia B, which was continually gradually decreasing (see Tab. 2).

Table 2. The development of the national structure of Bohemia A and Bohemia B (1900 – 1921)

census	area	Number: citizens*)	therefrom: Czechs	therefrom: Germans	therefrom: other	%: Czechs	%: Germans	%: other	theoretical division of 130 seats, ratio: Bohemia A / Bohemia B	theoretical division of 130 seats, ratio: Czechs / Germans
1900	Bohemia A	3,918,669	3,828,118	87,715	2,836	97.69	2.24	0.07	81:49	82:48
	Bohemia B	2,352,336	101,975	2,249,294	1,067	4.33	95.62	0.05		
	Bohemia	6,271,005	3,930,093	2,337,009	3,903	62.67	37.27	0.06		
1910	Bohemia A	4,194,208	4,097,270	94,617	2,321	97.69	2.25	0.06	81:49	82:48
	Bohemia B	2,518,566	144,648	2,372,937	981	5.74	94.22	0.04		
	Bohemia	6,712,774	4,241,918	2,467,554	3,302	63.19	36.76	0.05		
1921	Bohemia A	4,172,005	4,086,380	70,344	15,281	97.95	1.69	0.36	83:47	87:43
	Bohemia B	2,395,592	289,603	2,100,492	5,497	12.09	87.68	0.23		
	other**)	9,228	6,805	2,403	20	73.74	26.04	0.22	-	-
	Bohemia	6,576,825	4,382,788	2,173,239	20,798	65.70	32.58	1.72	-	-

*) 1900, 1910: Austrian citizens, 1921: Czechoslovak citizens
**) small corner of the Upper Austrian district of Gmünd that was ceded to post-1919 Czechoslovakia
own research[11]

While the delineation of the Czech-German border was basically correct and it did not cause any substantial discrimination against Czech voters, the division of 130 seats between Bohemia A and Bohemia B in the ratio 75:55, which was a result of political decision that did not correspond with the real number of Czechs and Germans (82:48), not even with the ratio of the number of inhabitants (81:49), the number of Austrian citizens (81:49), or the number of voters in 1907 (80: 50). If the Czechs were to win 82 seats in accordance with the number of inhabitants, then 1 seat was lost due to the applied election system, and 1 seat was lost due to the lower ratio of voters (different age structure and probably a higher ratio of people excluded from the suffrage), and another 5 seats were lost due to the political decision.

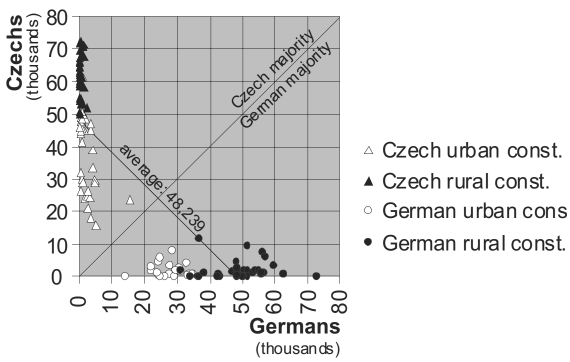

Figure 3. National composition of constituencies (Bohemia, 1907 elections, 1900 census[14])

Naturally, the political manipulation influenced the size of the Czech and German constituencies. In average, 48,239 citizens were apportioned to one seat, the average German constituency was 18.14% smaller than the average Czech constituency. The differences in size of rural and urban constituencies were even greater: smaller urban constituencies were weaker in population than rural constituencies by 35.18% in Bohemia A and by 42.30% in Bohemia B (see Tab. 3, Fig. 3). Naturally, these two cases of inequality influenced the election results in favour of the German parties at the expense of the Czech parties (the above mentioned shift of 5 seats) and even more substantially privileged urban areas against rural (a shift of 8 seats in Bohemia A, and 7 in Bohemia B).

The large range of the size of the constituencies arouses suspicion that malapportionment was applied not only in the proportion of nationality (Czech-German) and estate (urban-rural) – with all the subsequent deformations of the election results, but also of political parties (some political parties within the same nationality and estate group were disadvantaged in favour of others). Considering the fact that we do not have detailed demographic statistics of constituencies for the period in question, we can only analyze the election results. We will restrict ourselves to Czech constituencies (limited area and less complicated political spectrum).

Table 3. The differences in size of constituencies[15]

area	area (km^2)	citizens (1900)	voters (1907)	seats	citizens per seat
Bohemia A – urban	2,065	1,313,648	287,747	33	39,808
Bohemia A – rural	30,395	2,605,021	561,466	42	62,024
Bohemia B – urban	1,314	618,087	135,948	21	29,433
Bohemia B – rural	18,173	1,734,249	390,664	34	51,007
Bohemia A	32,460	3,918,669	849,213	75	42,770
Bohemia B	19,487	2,352,336	526,612	55	52,249
Bohemia	51,927	6,271,005	1,375,825	130	48,239

The extent of privilege for individual political parties can be calculated by a comparison of the number of votes won with the number of votes that would have been sufficient for the party for the same result even if the malapportionment had not been applied[16], as follows:

$$A_i^{/} = \frac{X}{n} \cdot \sum_{j=1}^{n} \frac{A_{ij}}{X_j}$$

where A_{ij} is the number of votes for party A_i in the j^{th} constituency, X_j is the total number of votes in the j^{th} constituency, and n is number of constituencies. By comparing the actual number of votes won by A_i with $A_i^{/}$ we can determine the extent of privilege / discrimination of the party as a result of malapportionment. The calculated results are stated in Table 4 – and they are not very conclusive. If we set aside parties that nominated their candidates in only a few constituencies, we can observe a slight discrimination of social democracy (in urban constituencies). The values are much higher if we use the same procedure for quantification of the estate malapportionment (urban-rural) – however, the results reflect the ratio of urban and rural voters of a particular party: the privilege of the electoral coalition of Young Czechs and Old Czechs (Staročeši / Altčechen) and Czech state democracy (the majority of urban voters), the disadvantage of agrarians and clericals (clear superiority among rural voters), the neutral position of social democracy (practically equal support in both urban and rural constituencies).

4. BOHEMIA: GERRYMANDERING?

Unlike malapportionment, gerrymandering is difficult to prove. As the results of elections in municipalities are missing, we can only examine the election results in constituencies or use indirect methods („suspicious“ forms of constituencies, „suspicious“ neighbourhoods). This method allows us to rule out gerrymandering (if the adverse effects did not appear), but not to prove it (coincident characteristics can appear accidentally – or due to other factors). As in our examination of malapportionment, we will restrict ourselves to Czech constituencies.

The basic consequence of gerrymandering is the disadvantage of a party. Social democracy is mentioned in literature in this context. The idea of discrimination against social democracy by the electoral regulations (TOBOLKA (1936): „the electoral regulations were developed in order to face the social democratic flood“) is probably based on the relatively significant difference between the ratio of votes in the first round of elections (in Bohemia A 38.68%) and the number of seats won (17, i.e. 22.67%), which is particularly obvious in comparison with the coalition between Young Czechs and Old Czechs (the same number of seats for one third of the votes) and agrarians (more seats, but half the number of votes).

If we concede gerrymandering within the social democracy, the following partial list of effects should occur:

1) within the distribution of electoral support, there should be a several constituencies with a significantly above-average ratio of votes (consequence of

"packing"), and, on the other hand, the number of constituencies with the result slightly lower than 50 % should be also suspiciously high (consequence of "cracking"). However, this effect is not easy to detect – see Fig. 4.

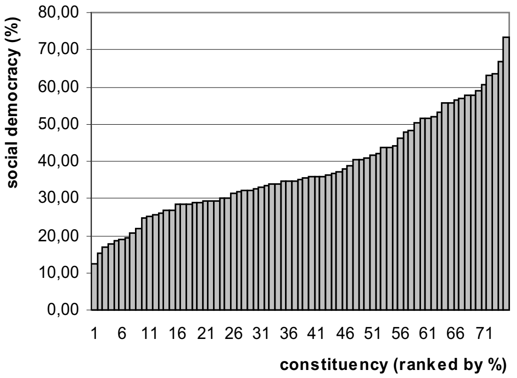

Figure 4. Social democracy: 1907 Election results by constituency (Bohemia A, 1st round) [17]

2) constituencies with an „unusual form" should correspond to the group of constituencies mentioned in paragraph 1. It is a fact that a number of constituencies are „suspicious" considering their form, some constituencies are assembled from several non-contiguous territories (see Fig. 5), some constituencies have a very curious shape, but these cases appear exclusively in the area along the border of Bohemia A and Bohemia B (the reason for the unnatural shapes of the constituencies' borders is obvious) and urban constituencies.

3) the theoretical relationship between the total number of votes garnered by a political party and the number of seats gained should not reflect the reality.

KOSTELECKÝ (2000) states that results of elections under the majority election system can be considered natural and undistorted if the relationship between the total number of votes garnered by a political party and the number of seats gained is ruled by the cube law, i.e.:

$$\frac{a_1}{a_2} = \frac{A_1^3}{A_2^3}$$

where a is the number of seats won by party A (the number of first places won in the first round in majority systems with an absolute majority), A is the total number of votes won by party A etc. The cube law relatively precisely reflects the situation in the United Kingdom, but it is obvious that the extent of „majority effect" must also depend on the distribution of support for political parties within the area. If only two parties took place in elections and their supporters were distributed absolutely equally, the victorious party could win all seats. On the contrary, if they were clearly separated and the constituencies' borders would respect this fact, the ratio of seats would be the same as that of votes. Then, the cube law is a practical interpretation of the relationship:

$$\frac{a_1}{a_2} = \frac{A_1^\gamma}{A_2^\gamma}$$

where $\gamma \geq 1$, while $\gamma = 1$ in the case when voters are territorially separated and their concentration in the area is decreasing with the rising ratio. Then, the ideal number of seats of a particular party is:

$$a_i = \frac{A_i^\gamma}{\sum_{i=1}^{p} A_i^\gamma} \cdot n$$

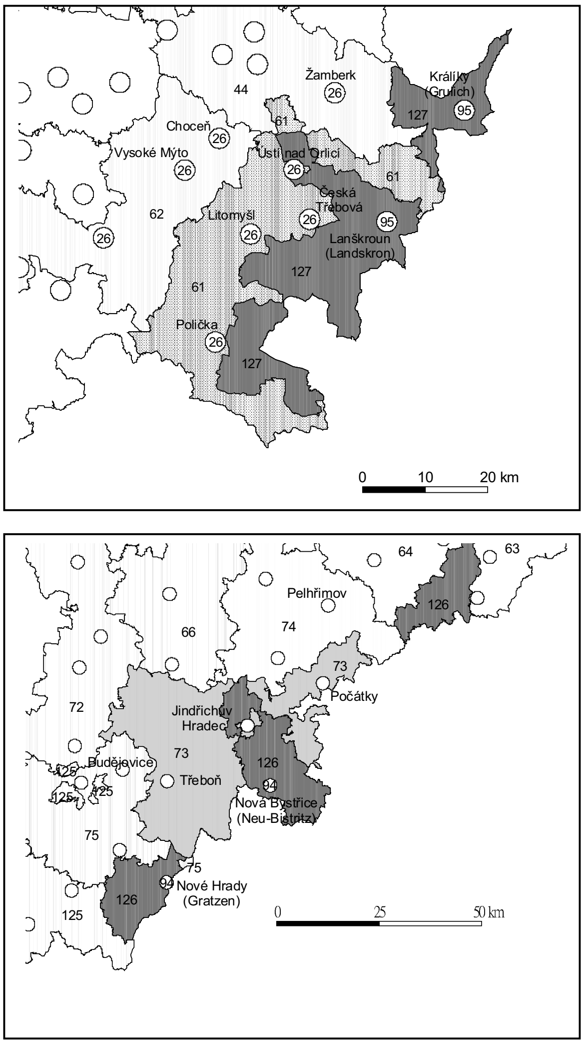

Figure 5. Constituencies No. 61, 73, 126, and 127 (1907 elections)[18]

where n is the number of seats and p is the number of political parties that took part in the elections. As the result would be deformed by massive malapportionment, we will apply this pattern not on the real number of votes for individual political parties (A_i), but instead on the votes adjusted for the influence of malapportionment ($A_i^{/}$):

$$a_i^{/} = \frac{A_i^{/\gamma}}{\sum_{i=1}^{p} A_i^{/\gamma}} \cdot n$$

For our calculations, we let $\gamma = 1.5$ (as the value that experimentally brought the most expected results and without the effort of discussing the issue of theoretical substantiation – which has been extensively carried out, for example by MALONEY – PEARSON – PICKERING (2001)). The results of the calculations are presented in Table 4. Theoretical numbers of first positions in the first round correspond with the real results so closely (correlation in urban constituencies is +0.9968, in rural +0.9761) that we can state that (regarding paragraphs 1 and 2) gerrymandering was not used in the delineation of constituencies. The substantial disproportion between the number of seats and the electoral support of social democracy would not have occurred if the elections had been organized in a one-round system. In the first round, social democrats won in 32 constituencies – in 17 with an absolute majority. In 38 constituencies they advanced to the second round but failed to win any seats. In these 38 constituencies they won 132,094 votes in the first round. In the second round, they slightly increased their electoral gains to 141,149 votes. The poor ratio of votes won in the first round and the final number of seats was not caused by an unfair election system (the irony is that this system was least advantageous for the victorious agrarian party), but by the plain fact that the program of social democracy was not acceptable for the majority of voters. The results of calculations of $a_i^{/}$ may indicate a slight gerrymandering effect in the division of constituencies into rural and urban. However, this result is logical: social democrats have different rivals in rural and urban areas. Under normal conditions,

Table 4. Malapportionment in Bohemia (1907 elections)

patry / group	Ai	candidates	won seats	$Ai^{/}$	Effect of malapportionment		ai	$ai^{/}$
					$Ai^{/}$ - Ai	%		
Constituencies No. 1 – 33 (urban, Czech):								
social democracy	91,731	33	7	87,109	-4,622	-5.04	14	14.8
agrarians	0	0	0	0	0	0.00	0	0.0
Young Czechs + Old Czechs	64,960	31	17	67,864	2,904	4.47	11	10.2
Czech state democracy	54,827	33	8	53,174	-1,653	-3.02	7	7.0
clericals	5,646	20	0	6,116	470	8.32	0	0.3
realists	3,406	4	1	2,947	-459	-13.48	0	0.1
independent candidates	3,174	5	0	3,417	243	7.64	0	0.1
German candidates	6,192	16	0	9,191	2,999	48.43	1	0.5
write-in candidates	1,043	-		1,162	119	11.43	0	0.0
in total	230,979		33	230,979	0	0	33	33
Constituencies No. 34 – 75 (rural, Czech):								
social democracy	186,382	42	10	184,822	-1,560	-0.84	18	19.2
agrarians	154,331	43	23	155,827	1,496	0.97	13	14.9
Young Czechs + Old Czechs	23,651	29	0	23,989	338	1.43	0	0.9
Czech state democracy	34,724	26	1	33,642	-1,082	-3.12	1	1.5
clericals	77,873	35	7	78,619	746	0.96	9	5.3
realists	2,727	5	0	2,527	-200	-7.33	1	0.1
independent candidates	5,898	3	1	6,154	256	4.35	0	0.0
German candidates	286	3	0	256	-30	-10.53	0	0.0
write-in candidates	2,161	-		2,198	37	1.70	0	0.0
in total	488,033		42	488,033	0	0	42	42
Constituencies No. 1 – 75 (Czech):								
social democracy	278,113	75	17	271,796	-6,317	-2.27	32	37.9
agrarians	154,331	43	23	128,563	-25,768	-16.70	13	12.3
Young Czechs + Old Czechs	88,611	60	17	112,742	24,131	27.23	11	10.1
Czech state democracy	89,551	59	9	100,587	11,036	12.32	8	8.5
clericals	83,519	55	7	73,241	-10,278	-12.31	9	5.3
realists	9,072	8	1	9,757	685	7.55	1	0.3
independent candidates	6,133	9	1	6,121	-12	-0.19	0	0.1
German candidates	6,478	19	0	12,799	6,321	97.58	1	0.4
write-in candidates	3,204	-	0	3,405	201	6.27	0	0.1
in total	719,012	0	75	719,012	0	0	75	75

own research[18]

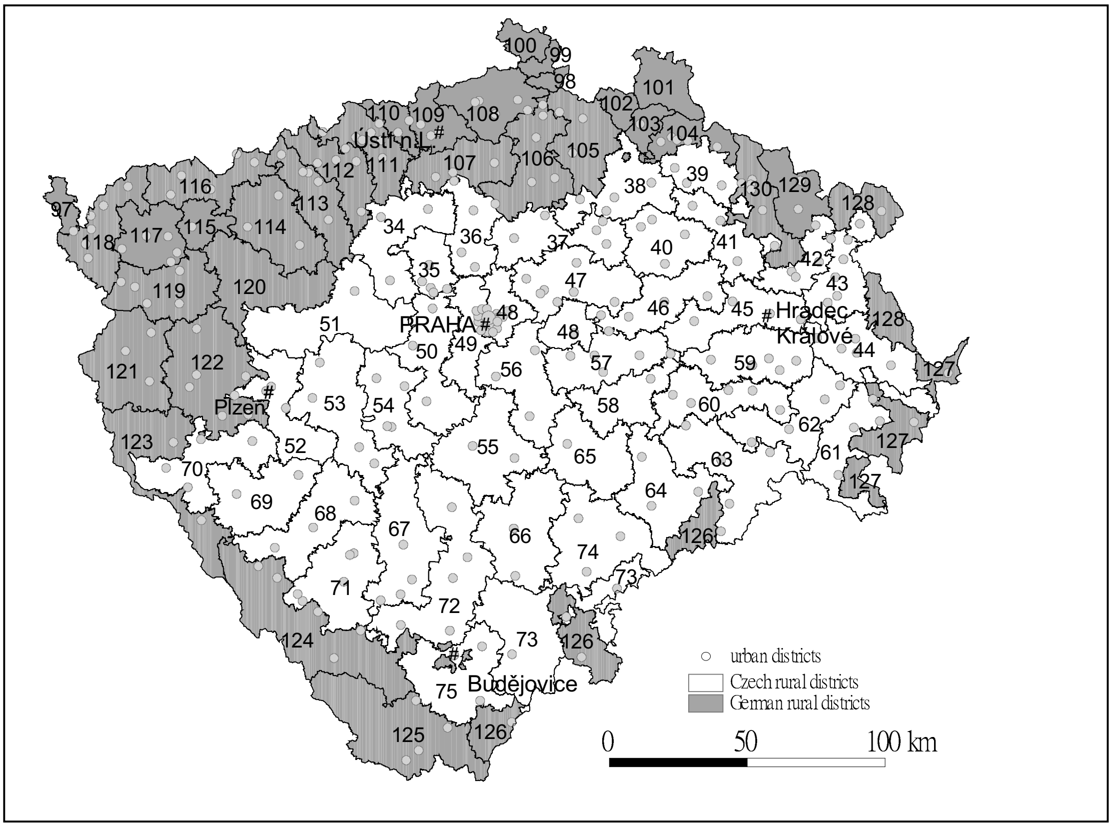

Figure 6 Rural constituencies in Bohemia (1907)[18]

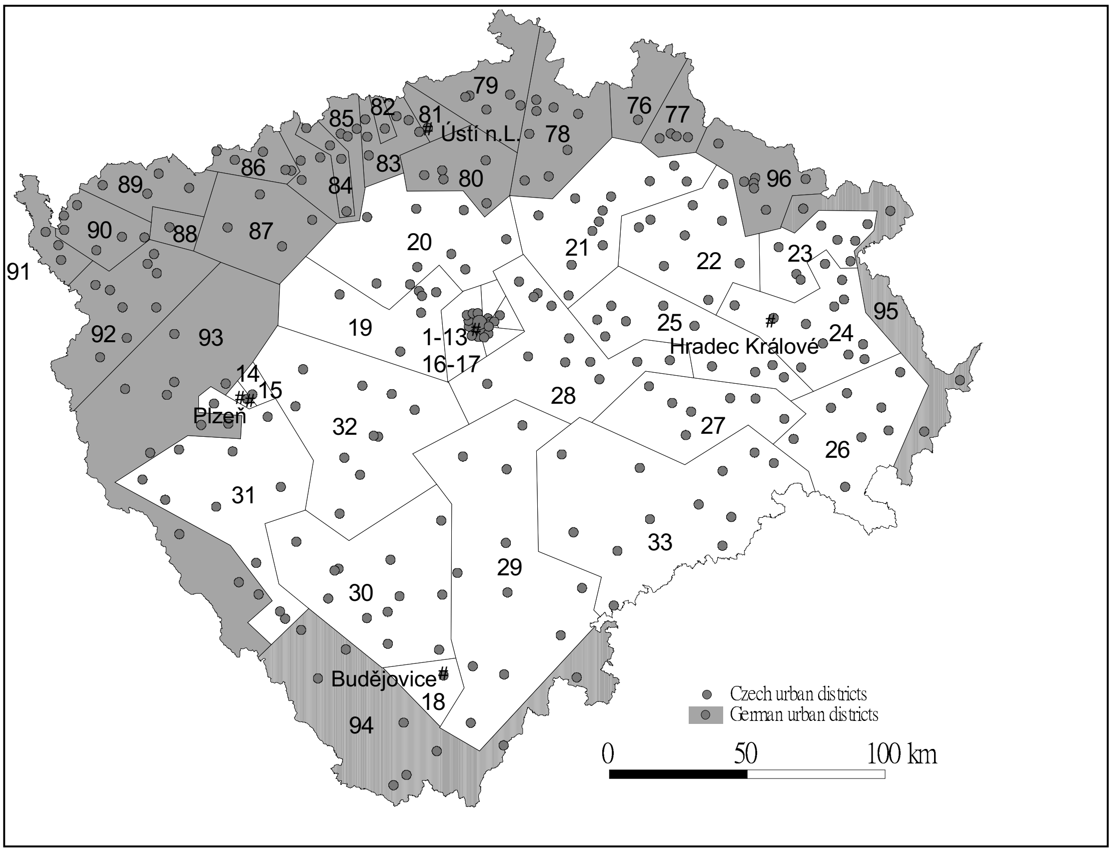

Figure 7 Urban constituencies in Bohemia (1907) [18]

these rivals would have competed which each other, which could have increased the chances of social democracy to win in the first round, but in the second round this effect would probably have lost its importance and any increasing in the number of seats is not probable.

5. CONCLUSION

In conclusion, we can state that, in the elections in 1907, malapportionment was extensively used in favour of urban inhabitants and, to a lesser extent, in favour of Germans. This privileged the German parties and parties with better support in urban areas, however no malapportionment or gerrymandering was applied in favour of a particular political party. This helped to fulfill the original intention of lawmakers, which was to reinforce the „national structures“ – these elements were identified with the German nation and urban inhabitants, not with a particular political party or ideology.

6. SOUHRN

VOLBY ŘÍŠSKÉ RADY V ROCE 1907: GERRYMANDERING V ČECHÁCH?

Při volbách v roce 1907 byl celkem masivně použit malapportionment ve prospěch městského obyvatelstva a v menší míře ve prospěch Němců. To objektivně zvýhodnilo německé strany a strany mající větší podporu ve městech, nebyl však uplatněn malapportionment či gerrymandering ve prospěch nějaké konkrétní politické strany. Tím byl vlastně naplněn původní záměr zákonodárců preferovat „složky udržující stát“ – tyto složky byly identifikovány s německým národem a městským obyvatelstvem, ne ale s konkrétní politickou stranou nebo ideologií.

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8. NOTES

[1] United States Senate, European Parliament, etc.
[2] Slovenian National Assembly, Croatian Parliament (Sabor), etc.
[3] Delineation of constituencies is in the hands of "advisory non-departmental public bodies funded by Office of the Deputy Prime Minister" (Boundary Commission for England, Boundary Commission for Scotland, Boundary Commission for Wales / Comisiwn Ffiniau i Gymru, Boundary Commission for Northern Ireland) that must observe a number of rules that should minimize all, including even potential, possibilities of manipulation - *Rules for Redistribution of Seats,* Newsletter No.1 of 2000 Issued 22 February 2000, Boundary Commission for England [online]. 2000, last revision 1 January 2001 [cit. 2004-03-02]. <http://www.statistics.gov.uk/pbc/bcnews1a-00.asp>
[4] § 59 article 2, Zákon č. 247/1995 Sb., o volbách do Parlamentu České republiky a o změně a doplnění některých dalších zákonů. Sbírka zákonů, č. 65, 1995, str. 3529
[5] Gesetz vom 26. Jänner 1907, wodurch die §§ 1, 6, 7, 12 und 18 des Grundgesetzes über die Reichsvertretung vom 21. Dezember 1867, R. G. Bl. Nr, 141, beziehungsweife die Gesetze vom 2. April 1873, R. G. Bl. Nr. 40, vom 12. November 1886, R. G. Bl. Nr. 162, und vom 14. Juni 1896, R. G. Bl. Nr. 168. Reichsgesetzblatt für die im Reichsrate vertretenen Königreiche und Länder, Jahrgang 1907, IX. Stück (30. Jänner 1907), p. 57
[6] Gesetz vom 26. Jänner 1907, wodurch der § 5 des Grundgesetzes über die Reichsvertretung vom 21. Dezember 1867 abgeändert wird. Reichsgesetzblatt für die im Reichsrate vertretenen Königreiche und Länder, Jahrgang 1907, IX. Stück (30. Jänner 1907), p. 59
[7] Gesetz vom 26. Jänner 1907, betreffend die Wahl der Mitglieder des Abgeordnetenhauses des Reichsrates. Reichsgesetzblatt für die im Reichsrate vertretenen Königreiche und Länder, Jahrgang 1907, IX. Stück (30. Jänner 1907), p. 59
[8] Gesetz vom 26. Jänner 1907, betreffend strafrechtliche Bestimmungen zum Schutze der Wahl- und Versammlungsfreiheit. Reichsgesetzblatt für die im Reichsrate vertretenen Königreiche und Länder, Jahrgang 1907, X. Stück (30. Jänner 1907), p. 109
[9] in the election law: „Die Wahlbezirke mit überwiegend böhmischer / deutscher Bevölkerung" - Gesetz vom 26. Jänner 1907, betreffend die Wahl der Mitglieder des Abgeordnetenhauses des Reichsrates. Reichsgesetzblatt für die im Reichsrate vertretenen Königreiche und Länder, Jahrgang 1907, IX. Stück (30. Jänner 1907), p. 59
[10] thus Dringliche Interpellation der Senatoren Jelinek, Dr. Spiegel, Dr. Naegle, Zuleger, Dr. Mayr Harting und Fahrner an die Regierung betreffend des der Friedenskonferenz im Jahre 1919 überreichte Memoire über das Problem der Deutschen in Böhmen, Prag, am 9. November 1920. Senát Národního shromáždění R. Č., r. 1920, I. volební období, 2. zasedání, Tisk 211.
[11] data sources: Gemeindelexikon der im Reichsrate vertretenen Königreiche und Länder bearbeitet auf Grund der Ergebnisse der Volkszählung vom 31. Dezember 1900, Podrobný seznam míst zemí rakouských zpracován na základě výsledků sčítání lidu ze dne 31. prosince 1910. IX. Podrobný seznam míst pro Čechy. C. k. statistická ústřední komise, Vídeň, 1916. Statistický lexikon obcí v Čechách, Státní úřad statistický, Praha, 1924, 598 p.,
[12] In Bohemia A 25 villages, in total 3,291 inhabitants, of which 2,419 were Germans, in Bohemia B 45 towns and villages, in total 30,861 inhabitants, of which 19,696 were Czechs (census in 1900)
[13] For example, the towns of Bruch (from 1920 Lom u Mostu, 7,654 inhabitants, 57.77% Czechs, the Czech candidate won 53,30% of votes in the first round of elections in 1907), Kopisty / Kopitz (4,044 inhabitants, 68,97% Czechs) and Čouš / Tschausch (from 1920 Souš, 3,803 inhabitants, 69,55 % Czechs) were ranked within the German constituency
[14] own research, data source: Gemeindelexikon der im Reichsrate vertretenen Königreiche und Länder bearbeitet auf Grund der Ergebnisse der Volkszählung vom 31. Dezember 1900
[15] own research, data source: Gemeindelexikon der im Reichsrate vertretenen Königreiche und Länder bearbeitet auf Grund der Ergebnisse der Volkszählung vom 31. Dezember 1900, Die Ergebnisse der Reichsratswahlen in der Im Reichsrate vertretenen Königreichen und Ländern im Jahre 1907.
[16] Generally, it is the conversion of votes of a particular party so that the total sum of votes of all parties is preserved and the balance of the individual constituencies is equaled.
[17] own research, data source: Die Ergebnisse der Reichsratswahlen in der Im Reichsrate vertretenen Königreichen und Ländern im Jahre 1907.
[18] own research, data source: Gesetz vom 26. Jänner 1907, betreffend die Wahl der Mitglieder des Abgeordnetenhauses des Reichsrates. Reichsgesetzblatt für die im Reichsrate vertretenen Königreiche und Länder, Jahrgang 1907, IX. Stück (30. Jänner 1907), p. 59

© RNDr. Miloš Fňukal, Ph.D.
Palacký University, Olomouc,
Natural Science Faculty
Department of Geography
Svobody 26
771 46 Olomouc
Czech republic

Reviewed:
doc. RNDr. Stanislav Řehák, CSc.

THE MAPPING OF SPRINGS IN MODRÝ DŮL, KRKONOŠE

R. Chmelová [1], T. Švecová [1]

[1] Department of Geography, Natural Science Faculty, Palacký University Olomouc, Svobody 26, 779 00 Olomouc, Czech Republic - chmelova@prfnw.upol.cz

Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

In this article the authors summarise recent hydrological data on the Modrý potok watershed, the Eastern Krkonoše. The authors also include data on those springs which have been monitored for two years which were characterised by a completely different set of climatic conditions: 2002 which had extreme floodings and 2003 which was characterised by a long-term drought during the vegetation season in the Czech Republic. The springs were located by GPS; spring water temperature and pH were also monitored.

KEY WORDS: springs, Modrý potok, water temperature, pH, snow cover, watershed water retention

1. INTRODUCTION

The extreme slope characteristics in the area of the Krkonoše Mountains, together with extreme climatic (especially precipitation) features promote some events which from a human perspective, negatively affect the landscape water regime. Such events include flood waves triggered by either occasional precipitation or a fast spring melt. Soil erosion is another example. As a result of slope processes ravines appear during extreme precipitation on both mountain and non-mountain slopes. Such ravines can penetrate deep into the mountain grade. To both understand and forecast these events hydrological knowledge of spring areas and small watersheds in mountainous regions, are needed the knowledge of both the input and output components of the water cycle in such sites.

The small enclosed watershed of Modrý potok represents a unique site for such studies. In the past this particular site drew attention (Vrba, 1964, Spusta, Kociánová, 1998). The reason for which may be found in its exclusive snow condition. The site is well known for its avalanche slope (Photo 1), geomorphologic, climatic, pedologic, and biotic conditions. Recently this site has drawn the attention of experts focused on the arctic-alpine tundra of the Eastern Krkonoše (Harčarik, 2002, Dvořák, Treml, Kociánová, Hejcman, 2004), spring areas (Tesař, Šír, Dvořák, 2000) and the impact of vegetation change on the soil water regime (Tesař, Šír, Dvořák, 2004).

Photo 1. The view of Modrý důl, Autumm 2003 (photo 1: Švecová , 2003)

This article summarises the hydrological data on the Modrý potok watershed collected in 2002 and 2003 and contributes data on springs to it. By spring we understand a concentrated natural water outflow on the ground. Springs can be classified according to various criteria, such as, efficiency, outflow permanency, direction of ground water movement, and their geologic, topographic and also their chemical water characteristics, and water temperature (Šilar et al. 1992).

Due to its position and geomorphology Modrý důl is connected to the direction of prevailing surface air streams and exhibits an anemo-orographic system (Jeník 1959, Vrba 1964, Vulterin 1969). As a consequence, a large amount of snow accumulates in Modrý důl creating a significant snowfield and avalanche scar with a snow layer multiply exceeding standard conditions. The avalanche scar in Modrý důl (a side valley of the larges the Eastern Krkonoše valley – Obří důl) has a significant position among Krkonoše avalanche slopes. It is situated on a south-oriented slope below the long and shallow Modré sedlo connecting Mounts Luční (1.555 m asl.) and Studniční (1.554 m asl.). The snowfield, the biggest one among all in the Krkonoše Mountains, unambigously defines the critical point where the avalanches are triggered in early summer. This snowfield usually lasts the longest and at a certain stage of melt its shape resembles the borderline of our state, giving it the name "The Map of the Republic".

2. RESEARCH AREA CHARACTERISTIC

Modrý důl´s area is almost identical with that of the watershed of Modrý potok. It is situated in the Eastern Krkonoše, in the cadastral area of Pec pod Sněžkou. The highest point is Mount Studniční (1.554 m asl.), with a range of altitudes from 1,010 to 1,554 m asl.

The entire area is situated within Krkonoše National Park (KRNAP). Rocks of the Krkonošsko-jizerské Crystallinicum represent the geological bedrock: from mica shist to phyllits of the velkoúpské group, gneiss, amphibolites, local quartzites. On the southern slope of Mount Studniční there are vast stone seas and debris fields consisting mainly of grey muscovite mica shist or phyllite, locally occurring with quartzite. Along Modrý potok watercourse and in some other places along its influxes, fluvial or fluvo-deluvial sediments can be found. These also occur smaller extent to a peat bogs. Soils are mountain humus or humus-ferrous podsols and immature soils with a very shallow humus layer. In the lower part, in the vicinity of Modrý potok, the soils are deeper (c. 60 cm). The vegetation cover of the watershed is 62 % forest and 38 % grass growths. The hydrological number of Modrý potok, running through the area of interest, is 1-01-02-001, and the watershed area is 2.62 km^2. The climatic condition of Modrý důl corresponds with Quitt's cold region CH4 (1971).

General climatic characteristics:

Average annual air temperature:	2.9 ºC
Average air temperature in January:	-5.9 ºC
Average air temperature in July:	12.1 ºC
Average annual total precipitation:	1261 mm
Average annual number of days of snow cover:	196

3. THE MAPPING AND RESULTS OF SPRING MONITORING

The spring was monitored and measurements taken in Modrý důl, which is situated within in the 1 st zone of KRNAP, during the spring, summer and autumn months in 2002 and 2003. Winter observation was made in possible because of the large amount of snow and the possible danger of avalanches. All measurements were executed in very difficult mountain terrain with an altitudinal gradient of 550 m asl. In addition, the field research was complicated by the growth of dwarf pine located below mountain ridge.

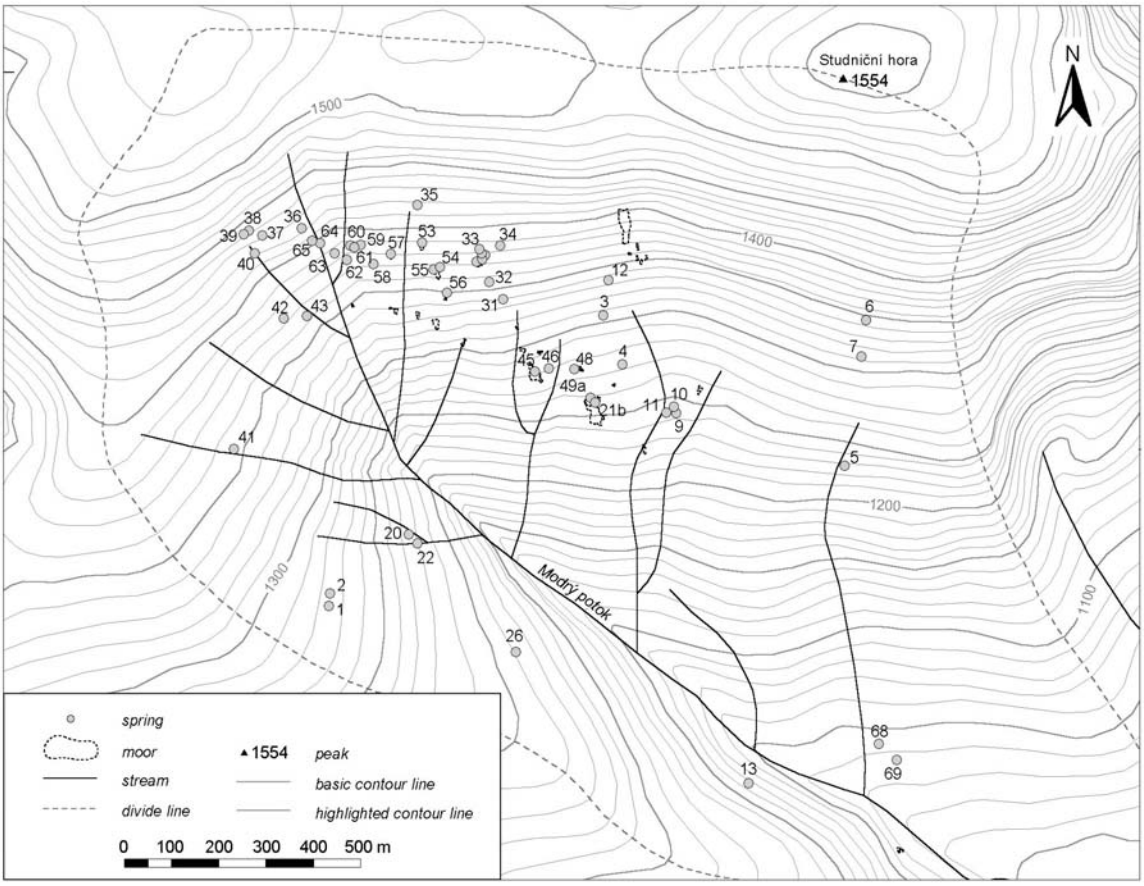
During the first year, 2002, monitoring focused only on the observation of individual springs; the presence of springs during the season was monitored. The monitoring took place in May, July and September. In May, 70 springs were discovered. In July, 23 springs out of the original 70 were dried-out, however by September 2 of the 23 dry springs had reappeared.

In 2003, both the water temperature and pH were measured along with the monitoring of extant springs. Temperature was measured using a laboratory thermometer directly in the spring's outflow. In May, the temperature varied from 3°C to 12°C. Nine springs from 2002 were not found again in 2003. Spring No. 2 , the one with the highest water temperature, was not re-measured because it dried out. We can conclude that the melting snow was water source. In July, only 33 springs were monitored. In the case of 12 other springs no value was measured due to technical difficulties, and 24 springs were obviously dry. The water temperature in those springs monitored varied from 3.3 to 10.2 °C, the average air temperature was 9 °C. 48 springs were monitored in September. No values were measured in the case of 4 springs, and 17 springs were dry. Total precipitation, counted back for 10 days preceding the measurement was 5.7 mm.

The water temperature of spring Nos. 45, 46, 47 and 49 reached values around 10°C through one the three season measurements, and all these springs were situated near moorland. Nevertheless, spring No. 48, situated also in the vicinity of this group of springs, showed water temperatures ranging from 4.4 to 4.5 °C.

Water samples were collected for pH measurement. To accurately maesure this parameter water samples were taken during the entire season. The pH measurement was executed using a field pH-meter in a temporary laboratory in a mountain cottage called Děvín. PH values ranged from 4.3 to 6.3. All springs were located using GPS Trimble Pathfinder ProXR (reference data for post processing are measured at the Czech Technical Institute in Prague). The results of the mapping are shown in Figure 1.

Figure 1. Location of springs in Modrý potok watershed in 2003.



4. HYDROLOGICAL CHARACTERISTICS OF THE RESEARCH AREA

Data used in the tables and graphs were obtained from the Administration of the Krkonoše National Park in Vrchlabí, and from the Institute of Hydrodynamics of the Czech Academy of Science. Automatic monitoring stations are installed in the Modrý potok watershed at 4 sites in different growths: in grass growth above the tree limit, in dwarf pine growth, in forest (no data available) and on a meadow in the floodplain (the site is called U Švejky). The altitudinal gradient among stations is 270 m. The stream flow in closure profile of the watershed is continualyy measured. On Mount Studniční, the peak of the watershed, there is an automatic meteorological station. Data from this station were used for temperature characteristics for 2002 and 2003. Temperature characteristics from individual stations are given in Tables 1, 2 and 3.

Data on temperature covering the time interval from June 21 to September 30 were processed in 2002. Total precipitation for the given time interval was 450 mm. With respect to 2003, available data on temperature covers the time interval from June 11 to September 29. Total precipitation was 346 mm. Average annual precipitation for the area (data from Mount Sněžka) is 1.261 mm for the last 10 years. The annual total precipitation in Modrý důl was 2.235 mm for the hydrological year 2002, and 928 mm for 2003.

The stream flow values in the closure profile of Modrý potok cover entire hydrological year for the last two years. Total runoff from the watershed was 5,266,512 m^3 in 2002, and 2,712,096 m^3 in 2003. The specific runoff from the watershed was significantly higher in 2002 (63.7 $l \cdot s^{-1} \cdot km^{-2}$) compared to that in 2003 (32.8 $l \cdot s^{-1} \cdot km^{-2}$). These characteristics are, to a large extent, influenced by the amount of snow in the winter season of that particular year. In 2002, the maximum height of snow cover in "the Map of the Republic" was 13.4 m (in May 2002), while the following winter (hydrological 2003) the maximum height of the snow cover was only 7.6 m (in April 2003). Considering these data on snow cover thickness the extreme difference in total precipitation between the two years is evident.

Other interesting results, as well as comparisons between the years 2002 and 2003 in other watershed runoff characteristics, can be seen in Table 4. In 2003, the evapotranspiration height (total evaporation) was negative, meaning that total runoff exceeded total precipitation in the watershed. Also the φ value (runoff coefficient expressing the percentage of total precipitation which flows out of a

Table 1 Monthly average temperature (°C) , the station Modrý důl – Švejka

Modrý důl - Švejka

	May	June	July	August	September
2002		13.1	14.6	15.6	8.6
2003	11.1	17.4	17.2	19.1	11.8

Table 2 Monthly average temperature (°C), the climatological station Modrý důl dwarf pine and meadow

Modrý důl - dwarf pine

	June	July	August	September
2002	11.4*	13.0	14.1	6.8
2003	12.4**	14.5	16.9	9.3

Modrý důl - meadow

	June	July	August	September
2002	11.1*	12.8	13.9	6.7
2003		15.2	17.7	10.7

* counted back for 10 days ** counted back for 20 days

Table 3 Monthly average temperature (°C) , the climatological station Modrý důl – Studniční hora

Modrý důl - Studniční hora

	January	February	March	April	May	June
2002	-5.5		-2.9	-1.5	8.7	11.1
2003	-6.6	-9.4	-4.3	-2.2	8.2	12.2
	July	**August**	**Sempember**	**October**	**November**	**December**
2002	13.2*	15.4	5.9	0.4		-8.5
2003	11.7	13.6	7.6	-3.1	0.3	

* counted back for 16 days

watershed) confirms this fact. Its value was 112% in 2003. An explanation for this phenomenon in the case of Modrý důl is uncertain. A correct interpretation would demand the analyses of the data collected within an efficient time interval. One of the possible causes is the anemo-orographic. This system is responsible for snow transported by wind (prevailing NW to NE airflow) into the watershed from the vast deflation area surrounding Luční bouda.

Table 4. Hydrological characteristis of Modrý potok watershed (mm)

	Hs	Ho	He	φ
2002	2235	2010	225	90%
2003	928	1035	-107	112%

Hs – precipitation height, Ho – runoff hight He – evapotranspiration height φ - runoff coefficient

And an extreme total precipitation of 129 mm was recorded between August 10th and 14th in 2002. This particular month was extremely rich in precipitation (Table 5). The highest total precipitation of 101 mm was recorded on August 13th 2002. The average daily water flow was 1.17 $m^3 . s^{-1}$ on that day (an average monthly water flow in August 2002 was 0.142 $m^3 . s^{-1}$). This extreme situation is also visible in the graph depicting water flow dynamics (Figure 2). August 2003 was dry. The maximum total precipitation for August 2003 was recorded between August 18th and 19th. The highest value of daily total precipitation was 27 mm an August 18, 2003. Daily water flow on August 19, 2003 was 0.080 $m^3 . s^{-1}$. Average monthly water flow in August 2003 was 0.020 $m^3 . s^{-1}$.

Research into soil water regime in Modrý potok watershed has been conducted since from 2000. Soil moisture is monitored together with those features mentioned above. Total watershed retention is defined as the difference between cumulative precipitation and cumulative runoff through the watercourse closure profile (Czelis et al. 2003). Monthly total precipitation for 2002 and 2003 for the area of Modrý důl are given in Table 6. The difference in total precipitation in August of a particular year can also be seen in Table 6. The difference between the two years is 101 mm.

The maximum retention capacity of the Modrý potok watershed was estimated at 70 mm during the extreme August precipitation episode of 2002. 20 mm out of a total of 70 mm is the retention capacity of soil covered by vegetation. At the moment of maximum retention the precipitation reached 129 mm leading to surface runoff caused by the soil retention capacity having been highly

Table 5. Monthly average discharge (m^3/s) in Modrý potok

Modrý důl	**January**	**February**	**March**	**April**	**May**	**June**
2002	0.030	0.119	0.088	0.344	0.690	0.116
2003	0.037	0.015	0.060	0.250	0.236	0.036
	July	**August**	**Sempember**	**October**	**November**	**December**
2002	0.054	0.142	0.142	0.197	0.066	0.035
2003	0.027	0.020	0.020	0.089	0.175	0.065

Table 6. Monthly rainfall (mm), the climatological station Modrý důl

Modrý důl	**January**	**February**	**March**	**April**	**May**	**June**
2002	128	244	227	116	13	36
2003	139	38	32	59	82	54
	July	**August**	**Sempember**	**October**	**November**	**December**
2002	106	272	115	218	231	529
2003	120	71	57	131	95	50

exceeded. In 2003, during the precipitation episode of August 18-19, the maximum total retention was 50 mm while the total precipitation reached 60 mm. But surface runoff probablly did not take place. The exceeding 10 mm were probably infiltrated by the soil into the bedrock, and participated in the runoff wave in the watercourse. Thus, the retention capacity of the soil covered by vegetation was not used. The precipitation value of 60 mm is the maximum value not resulting in surface runoff (Tesař, Šír, Dvořák 2004).

Another interesting phenomenon of mountain watercourses is stream flow fluctuation dependency on the temporal dynamics of snow melting. This phenomenon can be noticed in May of both years where the snow in Modrý důl melts (Fig. 2). The difference in snow cover height between 2002 and 2003 is obvious from the intensity of the water flow in April and May.

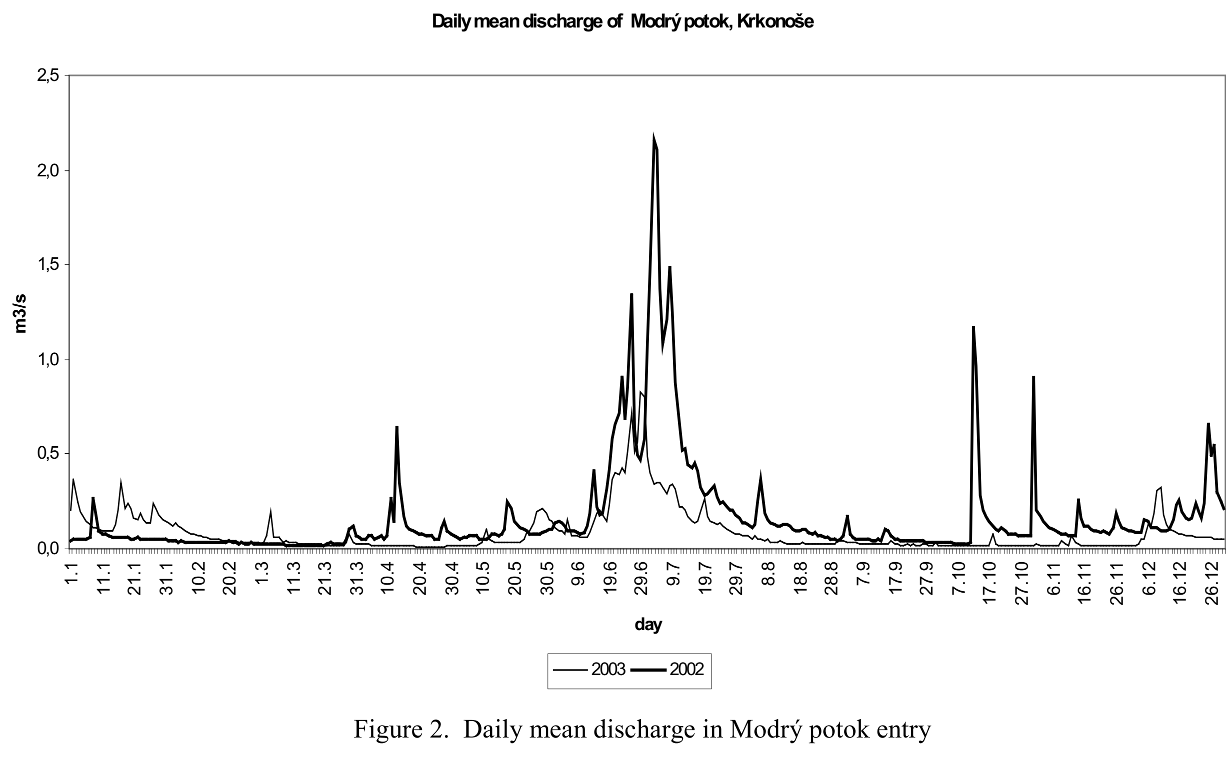


Figure 2. Daily mean discharge in Modrý potok entry

5. CONCLUSION

The mountain watershed Modrý důl is a site deserving of more profound interest and multidisciplinary research. It is a watershed with a significant altitude gradient, a watershed interfering with both forest and floodplain ecoystems (lower parts of the watershed), and tundra ecosystems (ridge parts of the watershed). Moreover, the course of forest limit is interrupted by avalanche scar No. 8 of the avalanche cadastre (Spusta, Kociánová 1998). The watershed is enriched by the depression known as "The Map of the Republic" and the interconnected procesess of snow accumulation and melt. Thus, a substantial input of solid precipitation in winter is assured from the vast deflation area around Luční bouda. This transport is connected with the prevailing NW – NE air flow. The monitoring of the elementary characteristics of the watershed, such as total precipitation, water outflow and water chemistry was later accompanied by the monitorig of other features: water dynamics in the soil in unsaturated zone, the influence of particular vegetation type on soil retention, the influence of both the accumulation and thickness of snow cover on the total watershed balance of water.

Moreover, the monitoring of springs and spring areas in the watershed and their dynamics, temperature and pH has begun. Also, the monitoring those found springs and spring areas will continue in order to find out whether the springs are permanent or temporar, dependant on snow melt or precipitation as their water source.

The last two years, characterised by extreme precipitation, show the necessity for long-term monitoring of the watershed as a unit. It is especially important to cover all areas of monitored features for a better understanding of all the processes engaged in the creation and maintenance of the natural environment of sensitive mountain ecosystems, from forest to meadow to tundra.

6. SOUHRN

MAPOVÁNÍ PRAMENŮ V MODRÉM DOLE V KRKONOŠÍCH

Horské povodí Modrý důl je lokalitou, která by si zasloužila hlubší zájem a multidisciplinární studium území. Je to povodí s velkým výškovým gradientem, do kterého zasahují ekosystémy lesní a nivní (části povodí s nižší nadmořskou výškou) a ekosystémy tundrové (hřebenové partie povodí). Průběh horní hranice lesa je navíc přerušen lavinovou dráhou č. 8 v lavinovém katastru (Spusta, Kociánová 1998). Prostředí povodí je obohaceno o nivační depresi Mapa republiky a s ní související procesy ukládání sněhu a jeho odtávání. Dochází tak, hlavně v zimním období, k velkému přísunu pevných srážek z rozsáhlé deflační oblasti okolí Luční boudy při převažujícím SZ až SV proudění. Sledování základních charakteristik povodí, tedy srážkové úhrny a odtoky společně se sledováním chemismu vod v povodí bylo postupně rozšiřováno o sledování dynamiky vody půd v nenasycené zóně, sledování vlivu typu vegetace na retenci půd, zjišťování vlivu ukládání a mocnosti sněhové pokrývky na celkové bilanci povodí.

V neposlední řadě bylo zahájeno sledování pramenů a pramenišť v povodí a jejich dynamika, teplota a pH. Předpokládá se pokračování ve sledování nalezených pramenů a pramenišť i v budoucnu, aby se zjistilo, zda se jedná o prameny stálé či občasné, závislé na tajícím sněhu nebo na srážkách jako zdroji napájení.

Na příkladu dvou extrémních let z pohledu množství srážek se ukazuje nutnost dlouhodobého sledování povodí jako celku. Především doplnění sledovaných jevů tak, aby došlo obecně k lepšímu pochopení všech procesů, které se podílí na utváření a udržování přirozeného prostředí citlivých horských ekosystémů od lesních, lučních až po ekosystémy tundrové.

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© RNDr. Renata Chmelová
Department of Geography
Natural Science Faculty
Palacký University
Svobody 26
771 46 Olomouc
Czech republic

Reviewed:
prof. RNDr. Ing. Ladislav Kříž, DrSc.

CZECH LAW IN AIR QUALITY PROTECTION IN THE CONTEXT OF THE NEW CLEAN AIR ACT No. 86/2002 Coll.

M. Jurek[1]

[1] Department of Geography, Natural Science Faculty, Palacký University of Olomouc, Svobody 26, 771 46 Olomouc, Czech Republic – geogr@prfnw.upol.cz

Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

The paper deals with the basic trends of Czech law in air quality protection, drawn by accession of the Czech Republic to the European Union. The Clean Air Act No. 86/2002 Coll., together with the consequent Regulations, is compared to former legislative tools, focusing on changes in air pollution limits and introduction of national emission ceilings.

KEY WORDS: air quality protection, law, Czech Republic, European Union, air pollution limits, emission ceilings

1. INTRODUCTION

Ambient air quality has undergone significant changes due to increasing industrial production, motorised transportation and growing population. Individual economic interests do not usually lead by themselves to reduction in air pollution, but vice versa. Thus, air quality protection must be anchored in the state legislation.

Most developed countries passed the first laws regulating air pollution in the latter half of the twentieth century. The oldest *Clean Air Act* in Great Britain dated back to 1956. It was widely understood as a reaction to disastrous smog situations in London. The Swedish *Environmental Protection Act* was passed in 1969, and the federal *Clean Air Act* originated in the U.S.A. in 1970. The member states of the European Communities started harmonising law in air quality control by means of introducing a set of directives into their national legislation. Accession of the Czech Republic to the European Union brought Czech law to the same task.

2. CZECH LAW IN AIR QUALITY PROTECTION IN THE PERIOD 1966–2003

2.1. Methods and data

The Clean Air Act No. 86/2002 Coll. was compared to Czech law on air quality control formerly in force. A more detailed analysis focuses on the differences between the current Act and the set of law regulations passed in the 1990s.

Most changes incorporated into the new Act originated in the directives on air quality control passed by the member states of the European Union. Therefore, individual parts of the Czech Clean Air Act and the consequent Regulations were compared to relevant Directives of the Commission.

Table 2.3. (On national emission ceilings) was elaborated using data taken over from the Treaty on Accession of the ten new member states to the European Union (2003). Supplementary data were required in order to derive values indexed by area and population. Areas of the involved states were taken from Velký atlas světa (Kartografie, 2002), population numbers from the CIA World Factbook (2003).

The bar graphs showing annual emissions of SO_2 and NO_x were created using data from the Register of emissions and air pollution sources, published in Czech statistical yearbooks in the years 1994–2003.

2.2. Evolution of Czech law in air quality protection in the period 1966–2001

The first, yet only a brief claim on the creation and protection of healthy living conditions by means of air quality control appeared in the *Act No. 20/1966 Coll. on the Care of the People's Health*. A separate law aiming to fit the claim was passed as the *Act No. 35/1967 Coll. on Measures against Air Pollution*. It was a restrictive tool, setting obligatory fees to be paid by large polluters for certain amounts of emissions. However, the fees were set too low. In many cases, companies decided to pay rather than reduce emissions, since it was economical to involve the fees into operational costs. The law did not result in any significant decrease in air pollution.

The Act No. 35/1967 Coll. was repealed by the *Act No. 309/1991 Coll. on the Protection of Ambient Air from Pollutants (the Clean Air Act)*. It was complemented by the *Act No. 389/1991 Coll. on the State Administration in Air Quality Control and Fees for Polluting Ambient Air*. Both acts were reviewed and amended during the 1990s, reflecting an ongoing progress of Czech legislation towards more strict claims on air quality and protection of the environment.
Ozone depletion became a global problem, inducing international conventions. The Czech Republic joined the effort at ozone layer conservation by passing the *Act No. 211/1993 Coll. on Prohibition of Production, Import and Use of Substances and Products Containing Substances Depleting the Earth's Ozone Layer*. Two years later it was replaced by the *Act No. 86/1995 Coll. on the Protection of the Earth's Ozone Layer*.

A Decree of October 1, 1991 to Act No. 309/1991 passed by the Federal Committee for the Environment (published in Volume 84/1991 Coll.) contained a particular list of observed pollutants, categorisation of emission sources, emission limits and air pollution limits. It also contained recommended specific air pollution limits for announcing air quality regulations.

The Act No. 309/1991 Coll. defined categories of emission sources based on the structure of the Register of Emissions and Air Pollution Sources (Czech abbr. REZZO). The Register had been created during the 1970s. Since the beginning of 1980s it has been collecting spatially organised data on emissions from air pollution sources, sorted into four categories according to their nominal output. Additive information represents data on fuels and technologies used.

The Act No. 309/1991 also defined terminology of air pollution limits and ordered to proclaim concrete limit values by regulations of the Ministry of the Environment. Duties of operators of air pollution sources were specified; authorisation and duties of air quality control bodies were named. Rules were ordered to be set for smog regulation and warning systems in order to avoid serious pollution of ambient air.

The Act No. 211/1993 Coll. and its follow-on No. 86/1995 Coll. on the Protection of the Earth's Ozone Layer set general conditions concerning production, import and sale of substances that deplete or imperil the Earth's ozone layer. A concrete list of prohibited substances was included in both of the acts. Thus the Czech Republic redeemed its pledge given by signing the Vienna Convention for the Protection of the Ozone Layer (1985) and the Montreal Protocol on Substances that Deplete the Ozone Layer (1987).

In 1998, negotiations on the accession of the Czech Republic to the European Union began, and Czech law started to accept the legislation of the EU (the so-called *acquis communautaire*). A new Clean Air Act was needed at once.

2.3. The Clean Air Act No. 86/2002 Coll. and the consequent Regulations in brief

The Act No. 86/2002 Coll. on Air Quality Protection and on Amendments to the Related Legislation (the Clean Air Act) was passed on February 14, 2002. Its main feature is the integration of the legislative tools formerly in force into one consistent act. The generally designed tools are given their definite shape by a set of five Government Decrees and four Regulations of the Ministry of the Environment, containing particular lists of pollutants, limit values and other air quality control tools. These consequent rules may be updated without amending the Act itself, which serves as a framework tool.

The Clean Air Act No. 86/2002 Coll. is more comprehensive and detailed than the former Act No. 309/1991. The new law not only sets regulations to avoid air pollution, but it also includes legislative tools for the reduction of emissions of substances that affect the Earth's climatic system. Furthermore, a claim for reduction of pollution of the atmosphere by artificial light is added, though the law does not specify this claim into particular methods or tools.

Among the **basic definitions** (Head I), a new term *emission ceiling* is introduced as the highest allowable total emission of a pollutant, expressed in units of mass per one year from all air pollution sources within a given area. Another new term, *margin of tolerance*, is defined as the percentage or fraction of the limit value by which this value may be exceeded. Also defined are the terms like *odorous substance*, *volatile organic compound*, *the best available technology* or *light pollution*.

Head II deals with comprehensive specifications of legislative tools for air quality protection. At first, **sources of air pollution** are divided into two groups: stationary and mobile. The stationary sources are then classified into combustion sources, waste incineration plants and other stationary sources. Within the class of combustion sources, the categories according to the Register of Emissions and Air Pollution Sources are preserved. In the category of large air pollution sources (REZZO 1), a new additional subcategory of "very large combustion sources" is defined, containing sources with nominal input of 50 MW or higher, regardless of what the nominal output is. Other combustion sources with nominal output exceeding 5 MW are called as "large combustion sources" again. The new additional subcategory is intended to recognise very large sources for application of certain EU directives (e. g. the Council Directive 88/609/EEC on the limitation of emissions of certain pollutants into the air from large combustion plants).

The allowable level of polluting the ambient air is defined by *emission limits*, which are given as 'general' and 'specific' for the stationary sources. *Emission ceilings* must be set, and *reduction objectives* are intended to meet the emission ceilings before a specified date. *Emission reduction programmes* are required for implementation on national, regional and local level.

The allowable level of air pollution is determined by *air pollution limits* for the individual pollutants, together with the *margins of tolerance* and the *maximum number of exceedances*. It is required for the air pollution limit not to be exceeded by more than the margin of tolerance and not in more cases than permitted. For ground-level ozone, *target limit values* and *long term objectives* are required to be set.

The Act requires that **regions with lowered air quality** are delimited and that programmes for the improvement of air quality are elaborated for these regions. Similarly to the Act No. 309/1991, the term **smog situation** is defined. It is also required that a *smog warning and regulation system* is prepared for each region with lowered air quality. The new Clean Air Act also requires that a Regulation is issued on the allowable level of odour nuisance, including given methods of odour nuisance assessment.

The following paragraphs of Head II specify the duties of operators of air pollution sources, conditions for the authorisation of persons to measurement of emissions, air pollution levels, combustion source efficiency, operation of waste incineration plants, and elaborating dispersion studies and expertises. Finally, conditions of waste incineration are given and obligatory payments for polluting the air are set.

Head III is a follow up of the former Act No. 86/1995 Coll., setting measures for the protection of the Earth's ozone layer.

Head IV, concerning the protection of the Earth's climatic system, requires a *national programme on the moderation of climate change* to be elaborated, setting emission ceilings and reduction objectives for the appropriate substances.

The following parts of the Clean Air Act set a legislative framework for the public access on information about air quality, the rules of remedies and sanctions, and execution of state administration by individual authorities and bodies.

The Act No. 86/2002 Coll. is conceptually derived from Czech laws on air quality control passed during the 1990s. Most of the new elements were transposed from EU directives now in force, especially from the framework *Council Directive 96/62/EC on Ambient Air Quality Assessment and Management*. Four daughter directives on specified pollutants follow this framework directive. In a similar way, the new Czech Clean Air Act is put into particular shape by the following measures:

Government Decree No. **350/2002** Coll., fixing air pollution limits and the terms and conditions for the monitoring, assessment, evaluation and control of air quality;

Government Decree No. **351/2002** Coll., fixing mandatory emission ceilings for certain air pollutants and manner of preparation and execution of emission inventory and emission projections (later amended by the Government Decree No. 417/2003 Coll.)

Government Decree No. **352/2002** Coll., fixing emission limits and other terms and conditions for the operation of combustion stationary sources of air pollution;

Government Decree No. **353/2002** Coll., fixing emission limits and other terms and conditions for the operation of other stationary sources of air pollution;

Government Decree No. **354/2002** Coll., fixing emission limits and other terms and conditions for the incineration of waste;

Regulation of the Ministry of the Environment No. **355/2002** Coll., fixing emission limits and other terms and conditions for the operation of other stationary air pollution sources emitting volatile organic compounds from processes applying organic solvents and from the storage and distribution of petrol;

Regulation of the Ministry of the Environment No. **356/2002** Coll., appointing a list of pollutants, general emission limits, the method used to forward messages and information, the method used to establish quantities of pollutants discharged, the darkness of smoke, permissible levels of odour nuisance and intensity, terms and conditions for the authorisation of persons, requirements regarding the keeping of operating records on air pollution sources, and conditions for the application of thereof;

Regulation of the Ministry of the Environment No. **357/2002** Coll., establishing requirements and standards for the fuels quality in order to protect the air quality;

Regulation of the Ministry of the Environment No. **358/2002** Coll., establishing conditions for the protection of the ozone layer of the Earth.

2.4. Air pollution limits

Tables 2.1 and 2.2 show air pollution limits fixed by the Government Decree No. 350/2002 Coll. in comparison with the former limit values that were set by the Decree of October 1, 1991 to Act No. 309/1991, passed by the Federal Committee for the Environment.

A closer look at the limit values and additional conditions reveals that the new measures are generally more strict. Air pollution limits are newly established for ammonia, benzene, benzo(a)pyrene, arsenic, nickel and mercury. The observation period for short-term concentration limits has changed from 30 minutes to 1 hour. Suspended particulate matter is observed as PM_{10} instead of the former SPM measurement and the new Decree no longer appoints a combined limit value for sulphur dioxide and particulate matter.

It is not required to fit the new limit values immediately. A step by step process of reduction in air pollution is implied instead, using the method of a linear decrease of the so-called margins of tolerance. The idea was transposed straight from EU directives. The margins of tolerance decrease annually by a certain constant fraction, finally reaching zero until a specified date. For most pollutants the limit values must be met until January 1, 2005. For nitrogen dioxide, benzene, arsenic, nickel, benzo(a)pyrene and ozone the limit values shall be attained by January 1, 2010.

Besides air pollution limits fixed in order to protect human health, another group of limit values is established for the protection of vegetation and ecosystems. These limit values must be kept within areas of national parks and protected landscape regions, in all territories higher than 800 m a. s. l. and also in other selected areas of natural forests, listed annually in the Bulletin of the Ministry of the Environment.

A separate limit value for the deposition of particulate matter has been fixed in order to protect human health. It is equal to a total of 12,5 g m^{-2} per month.

2.5. Emission ceilings

The Government Decree No. 351/2002 Coll. establishes mandatory emission ceilings for sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia. The ceilings for the whole territory of the Czech Republic must be attained in 2010 at latest. The national emission ceilings are further specified into recommended values of regional emission ceilings (for the 14 regions matching NUTS 3).

The Czech Republic had pledged to attain the emission ceilings by ratifying the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone in 1999. Meeting specified emission ceilings is also required by the Council Directive 2001/81/EC, amended by the Treaty on Accession to the European Union (Athens; April 14, 2003) so as to involve the ten new member states. By signing this Treaty, the Czech Republic agreed to attain lower emission ceilings for sulphur dioxide and ammonia than originally fixed in the Decree No. 351/2002 Coll. This change was transposed into the Czech legislation by passing an amendment through the Government Decree No. 417/2003 Coll. The emission ceiling for SO_2 was shifted from 283 kilotons per year down to 265 kilotons per year, the emission ceiling for ammonia changed from 101 kt/yr to 80 kt/yr. Regional emission ceilings were rearranged consequently.

In spite of this reduction, the national emission ceilings for the Czech Republic have been set relatively high in comparison with the West European states. Table 2.3 shows the national emission ceilings according to the Treaty on Accession to the EU, and two types of relative indices are included as national emission ceilings per unit of area (1 sq km) and national emission ceilings per Capita. Population of each state was put as the mid-year population in 2003 (CIA World Factbook), thus the index compares current obligations of the states to control emissions in the future within certain levels.

Table 2.1 Air pollution limits according to the Decree of the Federal Committee for the Environment (1991) and air pollution limits according to the Government Decree No. 350/2002 Coll.

Pollutant	Sampling Interval	Limit Value [μg m^{-3}]		Margin of Tolerance [μg m^{-3}]			Permitted Exceedance Within a Calendar Year	
		1991	**2002**	2002	2003	2004	1991	**2002**
SO_2	year	60	**50**	0	0	0	–	**0**
	24 hours	150	**125**	0	0	0	< 5 %	**3**
	1 hour	–	**350**	90	60	30	–	**24**
	30 min	500	–	–	–	–	< 5 %	**–**
SO_2 + SPM	24 hours	250	–	–	–	–	–	**–**
SPM	year	60	–	–	–	–	–	**–**
	24 hours	150	–	–	–	–	< 5 %	**–**
	30 min	500	–	–	–	–	< 5 %	**–**
PM_{10}	year	–	**40**	4.8	3.2	1.6	–	**0**
	24 hours	–	**50**	15	10	5	–	**35**
NO_2	year	80	**40**	16	14	12	–	**0**
	24 hours	100	**–**	–	–	–	< 5 %	**–**
	1 hour	–	**200**	80	70	60	–	**18**
	30 min	200	**–**	–	–	–	< 5 %	**–**
CO	24 hours	5 000	**–**	–	–	–	< 5 %	**–**
	30 min	10 000	**–**	–	–	–	< 5 %	**–**
	8-hr run.	–	**10 000**	6 000	3 300	1 700	–	**0**
O_3	8-hr run.	160	**120**	0	0	0	–	**25**
Pb	year	0.5	**0.5**	0.3	0.2	0.1	–	**0**
Cd	year	0.01	**0.005**	0.003	0.002	0.001	–	**0**
Benzene	year	–	**5**	5	4.375	3.75	–	**0**
NH_3	year	–	**100**	60	40	20	–	**0**
As	year	–	**0.006**	0.006	0.00525	0.0045	–	**0**
Ni	year	–	**0.02**	0.016	0.014	0.012	–	**0**
Hg	year	–	**0.05**	0	0	0	–	**0**
Benzo(a)pyrene	year	–	**0.001**	0.008	0.007	0.006	–	**0**

Explanations: ***margin of tolerance*** – a fraction of limit value, by which the limit value may be exceeded (decreases linearly in consequent years, by a specified date reaches zero); the sampling interval of a ***year*** – one calendar year; the sampling interval of ***8-hr run.*** – the maximum of eight-hour running averages updated each hour during the day; ***permitted exceedance 1991*** (< 5 %) – concentrations must not exceed the limit value in more than 5 % of all measurements; ***permitted exceedance 2002*** – maximum number of exceedances within one calendar year (for ozone, the number of exceedances within a year is derived as a 3-year average)

Table 2.2 Air pollution limit values for the protection of vegetation and ecosystems according to the Government Decree No. 350/2002 Coll.

Pollutant	**Sampling Interval**	**Limit Value**	**Margin of Tolerance**	**Maximum Number of Exceedances Allowed within a Calendar Year**
SO_2	calendar year and the winter season (Oct 1 – March 31)	20 μg m^{-3}	–	0
NO_x	calendar year	30 μg m^{-3}	–	0
O_3	AOT40 in May–July, five-year average	18 000 μg m^{-3} hrs	–	0

Explanations: AOT40 is the sum of the difference between hourly concentrations greater than 80 μg/m^3 (= 40 parts per billion) and 80 μg/m^3 over a given period using only the 1 hour values measured between 8:00 and 20:00 Central European Time each day.
Notice: the Decree of the Federal Committee for the Environment (1991) did not establish any limit values of air pollution for the protection of vegetation and ecosystems.

Table 2.3 National emission ceilings for SO_2, NO_x, VOC and NH_3 to be attained in the member states of the EU by the year 2010 (including the ten new member states, accessing to the EU in 2004)

country	SO_2			NO_x			VOC			NH_3		
	A	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*
Austria	**39**	0.47	4.76	**103**	1.23	12.58	**159**	1.90	19.42	**66**	0.79	8.06
Belgium	**99**	3.24	9.62	**176**	5.77	17.11	**139**	4.55	13.51	**74**	2.42	7.19
Cyprus	**39**	4.22	50.54	**23**	2.49	29.81	**14**	1.51	18.14	**09**	0.97	11.66
Czech Republic	**265**	3.36	25.86	**286**	3.63	27.90	**220**	2.79	21.47	**80**	1.01	7.81
Denmark	**55**	1.28	10.21	**127**	2.95	23.59	**85**	1.97	15.79	**69**	1.60	12.81
Estonia	**100**	2.21	70.99	**60**	1.33	42.60	**49**	1.08	34.79	**29**	0.64	20.59
Finland	**110**	0.33	21.19	**170**	0.50	32.75	**130**	0.38	25.04	**31**	0.09	5.97
France	**375**	0.69	6.23	**810**	1.49	13.46	**1050**	1.93	17.45	**780**	1.43	12.96
Germany	**520**	1.46	6.31	**1051**	2.94	12.76	**995**	2.79	12.08	**550**	1.54	6.67
Greece	**523**	3.96	49.03	**344**	2.61	32.25	**261**	1.98	24.47	**73**	0.55	6.84
Hungary	**500**	5.37	49.77	**198**	2.13	19.71	**137**	1.47	13.64	**90**	0.97	8.96
Ireland	**42**	0.60	10.70	**65**	0.92	16.56	**55**	0.78	14.02	**116**	1.65	29.56
Italy	**475**	1.58	8.19	**990**	3.29	17.07	**1159**	3.85	19.98	**419**	1.39	7.22
Latvia	**101**	1.56	43.00	**61**	0.94	25.97	**136**	2.10	57.90	**44**	0.68	18.73
Lithuania	**145**	2.22	40.36	**110**	1.68	30.62	**92**	1.41	25.61	**84**	1.29	23.38
Luxembourg	**4**	1.55	8.81	**11**	4.25	24.22	**9**	3.48	19.82	**7**	2.71	15.41
Malta	**9**	28.48	22.48	**8**	25.32	19.98	**12**	37.97	29.97	**3**	9.49	7.49
Netherlands	**50**	1.20	3.10	**260**	6.26	16.10	**185**	4.46	11.45	**128**	3.08	7.93
Poland	**1397**	4.47	36.17	**879**	2.81	22.76	**800**	2.56	20.71	**468**	1.50	12.12
Portugal	**160**	1.74	15.84	**250**	2.72	24.75	**180**	1.96	17.82	**90**	0.98	8.91
Slovakia	**110**	2.24	20.26	**130**	2.65	23.94	**140**	2.86	25.78	**39**	0.80	7.18
Slovenia	**27**	1.33	13.95	**45**	2.22	23.25	**40**	1.97	20.66	**20**	0.99	10.33
Spain	**746**	1.47	18.55	**847**	1.67	21.06	**662**	1.31	16.46	**353**	0.70	8.78
Sweden	**67**	0.15	7.55	**148**	0.33	16.67	**241**	0.54	27.15	**57**	0.13	6.42
United Kingdom	**585**	2.40	9.73	**1167**	4.78	19.42	**1200**	4.92	19.97	**297**	1.22	4.94
EU 25	**6543**	1.65	14.38	**8319**	2.09	18.29	**8150**	2.05	17.92	**3976**	1.00	8.74

Explanations: ***A*** – national emission ceiling (in kilotons per year); ***B*** – national emission ceiling per unit area (in tons per 1 sq km per year); ***C*** – national emission ceiling per Capita (in kilograms per person per year; mid-year population 2003)

Figure 2.1 Total SO_2 emission from sources REZZO 1–4 in the Czech Republic in the period 1990–2001 and the emission ceiling established by the Government Decree No. 417/2003 Coll.

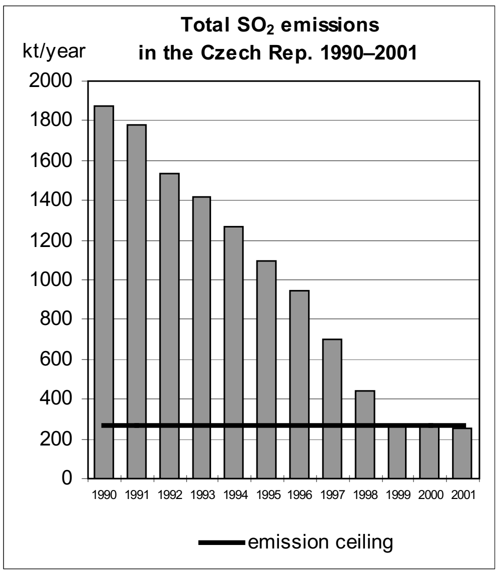
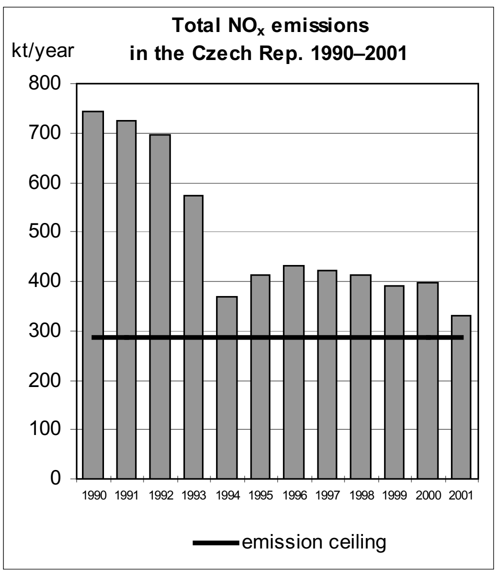


Figure 2.2 Total NO_x emission from sources REZZO 1–4 in the Czech Republic in the period 1990–2001 and the emission ceiling established by the Government Decree No. 417/2003 Coll.



When looking at the national emission ceilings and at the related indices, it is obvious that the Czech Republic is bound to attain quite generous levels of emission ceilings. As Figure 2.1 illustrates, the total emission of sulphur dioxide decreased during the 1990s from alarming amounts of pollution down to levels that are lower than the emission ceiling after reduction (265 kt/yr). However, the emission ceiling per unit area is one of the highest, overtaken by the values for Cyprus, Greece, Hungary, Malta and Poland only. In case of the NO_x emission ceilings, the difference between the Czech Republic and the Western European states is not so significant, on the other hand recent levels still exceed the mandatory ceiling of 286 kt/yr.

2.5. Emission limits

Limit values for the emission of pollutants have been established by three separate Government Decrees, each of them concerning stationary combustion sources, waste incineration plants and other stationary sources respectively.

Regulation of the Ministry of the Environment No. 355/2002 Coll. deals with emissions of volatile organic compounds.

Regulation of the Ministry of the Environment No. 356/2002 Coll. contains a list of the pollutants observed, appoints the general emission limits, the method of forwarding information about air pollution, the method used to establish quantities of pollutants discharged and the authorisation of persons. The allowable darkness of smoke is set, using two distinct assessment methods. The Ringelmann chart serves for a visual comparison of plume to six levels of gray (from white to black). The Bacharach scale compares the darkness of spots resulting on a filter paper after percolating a given amount of fumes.
The ways of *odour nuisance assessment* are broadened by a method derived from the definition of the European odour unit (OUER), used in the olfactometric analysis of odour. Other methods can still be applied according to the particular situation, among then a questionnaire on odour nuissance (statistical query and assessment), odour trail measurement or statistical survey of complaints.

3. CONCLUSIONS

The Clean Air Act No. 86/2002 Coll. has integrated Czech legislation tools on air quality protection into one consistent framework. Since the Act has come into force, the current Czech law corresponds with the recent approach to air quality management in the European Union, which the Czech Republic decided to access on May 1, 2004. It is convenient that the Act has transposed the concept of continuous air quality improvement, applying the process of an ongoing reduction in emissions, but not defining some lasting and fixed target levels. Certain emission limits and emission ceilings have been established by a set of Decrees and Regulations. They may be set as stricter in the future without necessarily amending the Act. Some of the reduction is already set, coming into force after 2005 and 2010. The Czech Republic as a member of the European Union is obliged to transpose future amendments and possible new EU directives on air quality management. A trend towards more significant reduction of the total emissions shall be expected and the national emission ceilings will almost certainly be fixed lower in the forthcoming years. Also, more substances will probably be enlisted among the observed pollutants.

4. SOUHRN

ČESKÁ PRÁVNÍ ÚPRAVA OCHRANY OVZDUŠÍ V KONTEXTU ZÁKONA Č. 86/2002 SB.

Zákon č. 86/2002 Sb. o ochraně ovzduší soustředil českou legislativu v ochraně ovzduší do jednoho souhrnného rámce a uvedl ji v soulad s aktuálním stavem právní úpravy ochrany ovzduší v Evropské unii, jejímž členem se Česká republika stává ke dni 1. května 2004. Pozitivní stránkou zákona je koncepce neustálého zlepšování kvality ovzduší, neboť hovoří o postupném snižování emisí, aniž by striktně vymezoval neměnné cílové hodnoty. Konkrétní emisní limity a emisní stropy uvedené v navazujících nařízeních a vyhláškách mohou v budoucnu podléhat zpřísnění. Některá z těchto zpřísnění po roce 2005 a 2010 jsou už dokonce naznačena. Členství v Evropské unii zavazuje Českou republiku k přejímání dalších úprav v oblasti ochrany životního prostředí, které budou orgány EU přijaty. Zejména lze v budoucnu očekávat tlak na další snižování celkových emisí zpřísňováním emisních stropů a také případné rozšíření seznamu sledovaných znečišťujících látek.

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© Mgr. Martin Jurek
Department of Geography
Natural Science Faculty
Palacký University of Olomouc
Svobody 26
771 46 Olomouc
Czech Republic
jurekm@prfnw.upol.cz

Reviewed:
Zora Koukalová
Head of Department of Air Quality Protection
Bureau of the Environment
The Municipal Authority of Olomouc

A CURRENT CONDITION OF THE LANDSCAPE AND THE SELECTED SITES OF THE NEOVOLCANIC FORMATIONS IN THE CENTRAL PART OF THE NÍZKÝ JESENÍK MOUNTAINS

L. Navrátil

Department of Geography, Natural Science Faculty, Palacký University of Olomouc, Svobody 26, 779 00 Olomouc, Czech Republic – geogr@prfnw.upol.cz
Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

A contribution presents a view about the current landscape of the central part of the Nízký Jeseník Mountains. This region was afflicted not only by the activity of volcanoes, but also by the activity of human. The construction of the Slezská Harta Water Reservoir was the last huge change in the landscape.

KEY WORDS: neovolcanic formation, Nízký Jeseník Mountains, Slezská Harta Water Reservoir, geomorphology and landscape

1. INTRODUCTION

The region of interest nearby the town of Bruntál is a part of geomorphological unit Nízký Jeseník (Fig. 1.1). Its geological structure is represented by formations of Culm Development from Carboniferous and Devonian periods (claystones, siltstones, greywackes). An axis of the land in SW-NE direction is formed by Devonian formations of šternbersko-hornobenešovský band. The young volcanic formations (Uhlířský Hill, Venus's Volcano, Malý and Velký Roudný Volcanoes) are situated to a Bělský Fault (Zapletal, 1966), only Zlatá Lípa by Stará Libavá site lies apart from the main volcanic centres. The most of the sites were involved by mining in the past, there is building stone exploited up to this day in the Lava Flow of Chřibský Les. Recent construction and a filling of Slezská Harta Water Reservoir (completion of the construction in the year 1997, filling 1998) also affected volcanic products. The Moravice River represents a hydrological axis. I attend mainly to a current condition of some neovolcanic formation sites in connection with current geomorphology of the landscape.

2. THE CURRENT GEOMORPHOLOGY OF THE LANDSCAPE

Volcanoes form rather major dominant points in the landscape of the central part of the Nízký Jeseník Mountains. Typical examples are the Velký and Malý Roudný Stratovolcanoes with their regular cones (Fig. 2.1.). Especially Velký Roudný and its products changed nearby surroundings considerably (Fig. 2.2.). We can unambiguously read from the map that the river network was affected considerably by the activity of the volcano and its present form developed when the volcanic activity had been over.

Fig. 2.1. This is a general view from the north of the cones of Velký Roudný (on the left) and Malý Roudný Volcanoes.

The Lesná Stream, which springs in the gap between the Velký and Malý Roudný Stratovolcanoes, runs tightly around lava flows of the Velký Roudný Volcano. The flow of Moravice River itself was dramatically affected by the activity of the Velký Roudný Volcano. The original river basin is buried under the bed of basalt more then 50 m strong, which builds up the Chřibský Les Lava Flow (Barth, 1977). The Mlýn Roudná Lava Flow also was the barrier for the Moravice River, however its run was principally affected up to Chřibský Les Lava Flow. This flow filled the basin of the river in all its width. Because of that fact the flow of Moravice River was put off in the NE direction. A new valley of the river is thin in many places and deeply cut in to surrounding formations in the space of the present dam especially.

There are samples of inversions of the topography in some places of the region as well. We can document this phenomenon graphically with an example of the Uhlířský Hill's lava flow. This flew

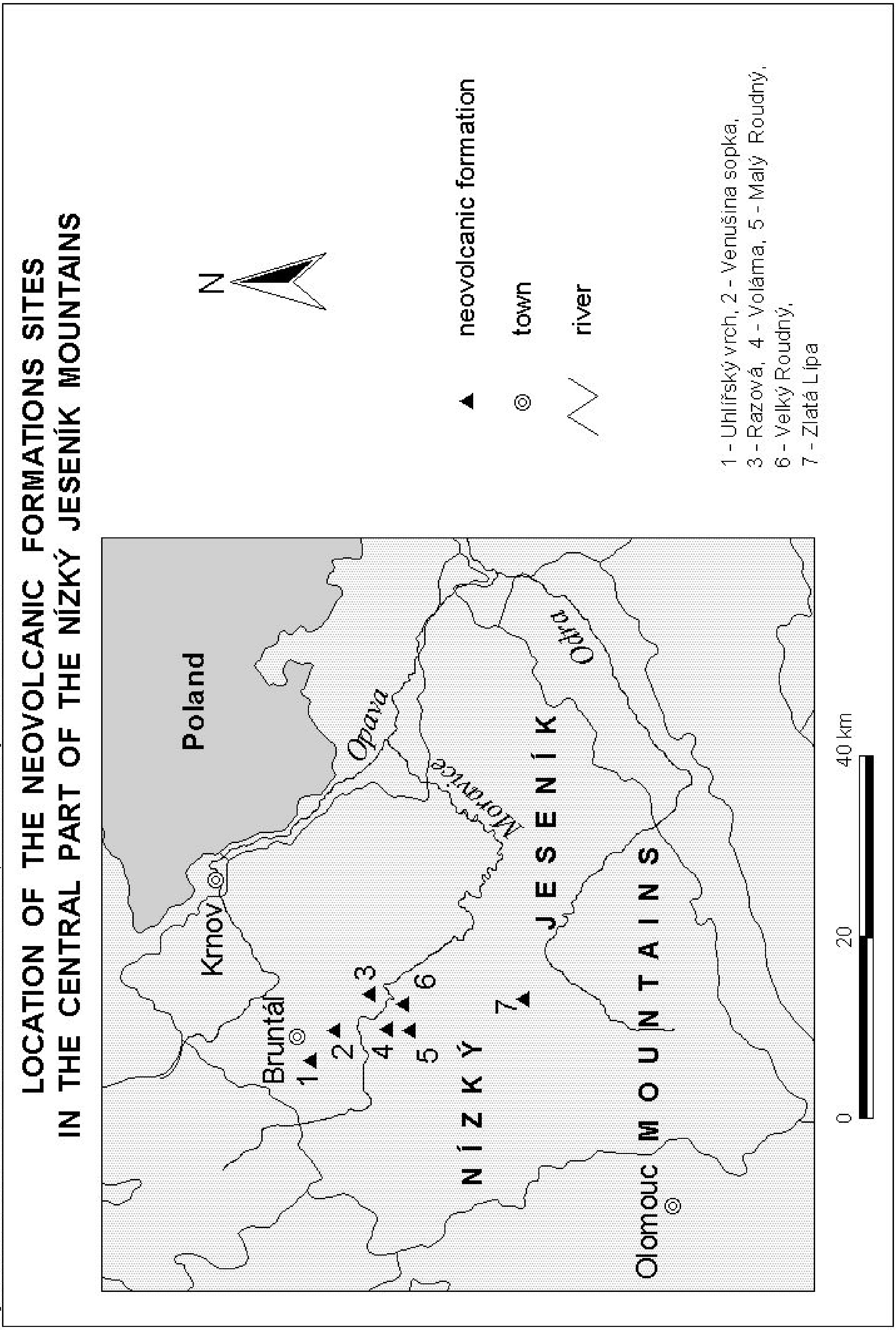

Fig. 1.1. Sites of the neovolcanic formations in the central part of the Nízký Jeseník Mountains

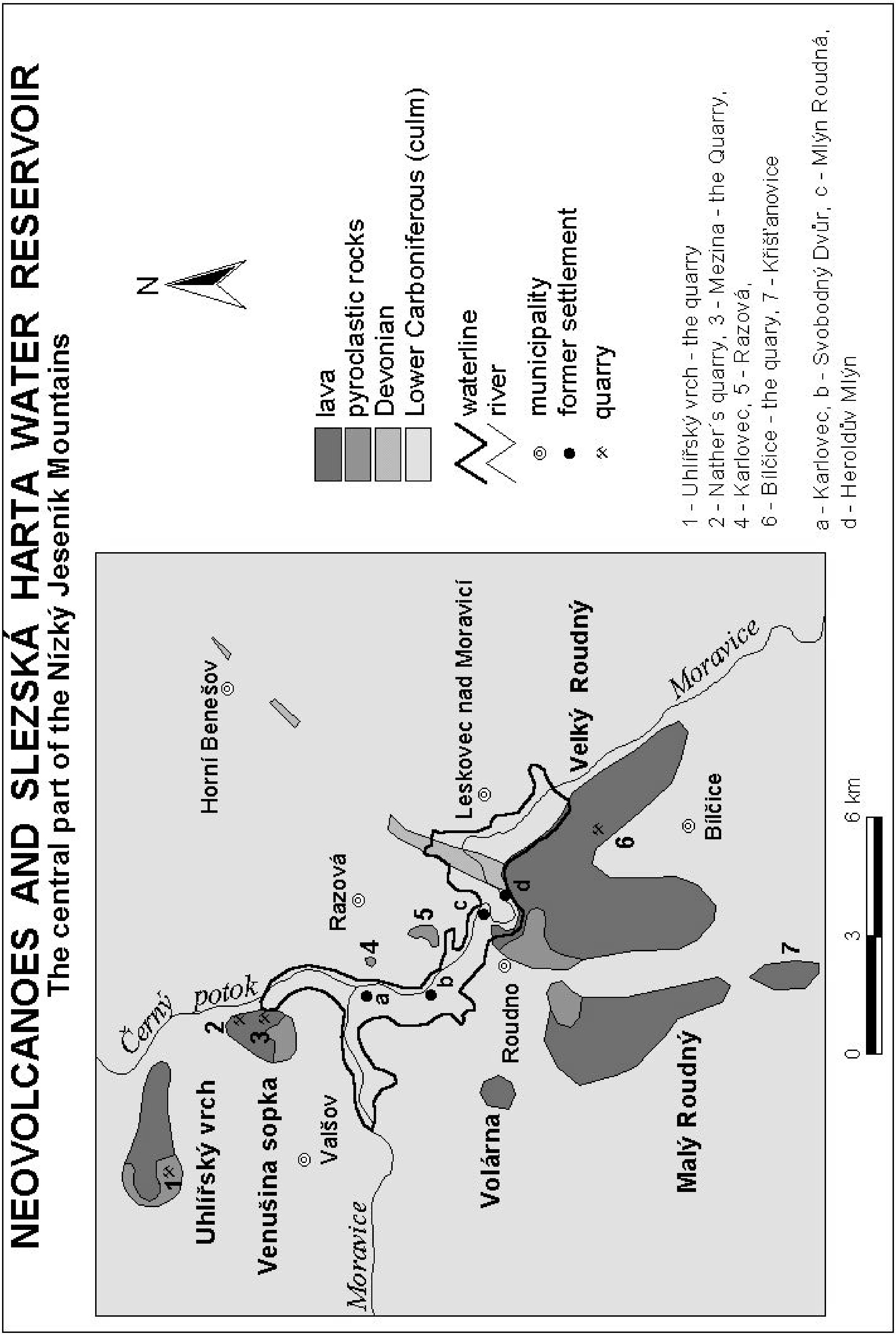

Fig. 2.2. Impacts of neovolcanoes and The Slezská Harta Water Reservoir in the landscape of the central part of The Nízký Jeseník Mountains

off the shallow depression probably (Barth 1966 in Barth 1970). However, basalt as a rock is more resistant to a weathering then Culm material in the surroundings and it makes the positive topography up. Also the Chřibský Les Lava Flow went down the wide depression before - the River Moravice's basin, that's why it has a similar topography.

The last big change in the landscape, in this case antropogenetic one, was the construction of Slezská Harta Water Reservoir, as mentioned above. The water reservoir with its dam forms today another dominant point in the region (Fig. 2.3.). However, a Moravice's deep valley with several meanders vanished under the water level, several settlements were flooded too. The process of filling period was accelerated with extensive floods, which reached a large part of Moravia, Silesia and eastern Bohemia in the year 1997. Because of that fact the Slezská Harta Water Reservoir was filled sooner than it originally had been expected.

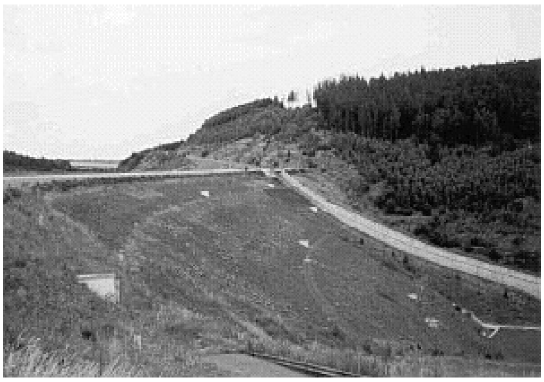

Fig. 2.3. The rock fill dam of the Slezská Harta Water Reservoir.

The construction was built originally in order to beef up the source of water supply Kružberk. But it fulfils more functions at present: for example it makes possible the water diversion for the industry and utilises waterpower for the electricity produce. It is the rock fill dam with a skew central puddle and its total capacity is 2,528 thousands square metres. The total dam crest length is 540 m and the maximum height of the dam is 64,8 m. The reservoir capacity makes up 219 millions cubic metres almost, the reservoir area-depth is about 870 ha. The Moravice's River valley is flooded in the total length of 13 km and likewise the valley of the Černý Brook in the length of 3,5 km.

The construction of water reservoir itself requested large changes into surrounding landscape. All the forests had to be chopped down under the reservoir borderline; some settlements were afflicted also. The water level reaches 497 m above sea level in the reservoir. Those buildings had to by removed from the landscape that occurred under the level 497 m a. s. l. Karlovec (Karlova Pláň before) vanished totally, the little settlement by the confluence of the Moravice river and Černý Brook. Local late-baroque castle was demolished also. The only building, which was conserved, is Jan Nepomucký Parochial Church from the years 1727-1728 (Lihanová, 2001). This stays on the bank of spacious water level today. The most low-lying parts of the villages of Razová and Roudno were flooded too. The Mlýn Roudná, Heroldův Mlýn and Svobodný Dvůr settlements vanished totally, because they occurred straight in an alluvial plain of Moravice River (Fig. 2.2.). The settlement of Nová Pláň was flooded almost the all. Leskovec nad Moravicí was changed considerably too, about one third of an area of the original village was flooded. Furthermore 15 km of roads approximately vanished under the water connecting single villages in the region before. It was necessary to build a new road for saving connection between Leskovec and Bílčice. This road utilises the Slezská Harta's dam to span the Moravice River.

Several important geological sites dissolved with the filling of the reservoir. Leskovec's Devonian was afflicted especially. Exposures in the valley of the Moravice River, which were mined intensely in the 19th century, haven't already existed as well as the great exposures on the right bank of the river along the former road Leskovec nad Moravicí-Roudno. There is about 10 to 15-m deep water in this space. There were also springs of mineral waters and of carbon dioxide in the Moravice River's alluvium. Directly on the left bank of the Moravice River by the village of Razová occurred a small spring of the carbon dioxide water, but it lacked practical usage (Květ, Kačura, 1978). The spring dissolved at the moment of the filling Slezská Harta Water Reservoir as well as a small spring of CO_2 by the village of Karlovec.

The only products among the young volcanoes affected by the swollen of the level of the Moravice River were those of Velký Roudný. Only a north-western side of the Chřibský Les Lava Flow is flooded. It dives under the level of water reservoir by the dam. A northern side of the Heroldův Mlýn Lava Flow is also under the water partly. The new sites were uncovered by the dam in connection with the modification of the terrain during a construction of the dam itself. One of them occurred by the dam on the right bank of the Moravice River, where is evident a prismatic jointing. The other neovolcanic formations weren't changed by the construction of the water reservoir.

3. A CURRENT CONDITION OF THE SELECTED SITES OF THE NEOVOLCANIC FORMATIONS (TO THE DATE OF 1ST AUGUST 2002)

All sites practically are an important testimony documenting young volcanic activity. Some of these are protected by the law, it means they are very important, the others won't get such a chance in the forthcoming time probably. On the base of the law No. 114/1992 Sb. about the Protection of the Nature and the Landscape it can be noted that there are four sites of neovolcanic formations in the centre of the Nízký Jeseník Mountains, which were recorded to the list of special protected areas. It's a National Natural Monument in one case (Velký Roudný Volcano); the others were filed in a class Natural Monument (Uhlířský Hill, Mezina – the Quarry and Razovské Tuffites). There is also vegetation cover protected at the Uhlířský Hill and Velký Roudný Volcano sites.

3.1. Uhlířský Hill (Uhlířský vrch)

The Uhlířský Hill Natural Monument (672 m a. s. l.) was declared in the year 1966 (Vencálek et al., 1998). There is an information panel by the entrance into the site. This shows visitors briefly an issue of the neovolcanic activity. A text is accompanied with coloured pictures generally, with a map and layouts. There are similar information panels by the all protected sites of volcanic formations in the region. In spite of the fact that Uhlířský Hill is an geological formation protected by the law, several small illegal dumps occur over there. According to the employees of Department of the Environment at the former District Office in town of Bruntál it is difficult to stop such shames, because it's not possible to ensure regular patrols in the landscape.

There is a pyroclastic material uncovered in a wall of the quarry at the Uhlířský Hill site. As late as sixties of the 20th century it was minded intensely. The mining itself endangered also the baroque church at the peak of the volcano. This was built in the years 1755-1758 and is visited in plenty today. Because of immense importance of this site the mining was stopped speedily and the Uhlířský Hill was recorded among sites protected by the law. The exploitation brought the only positive fact, there were uncovered an inner structure of this volcano at the Uhlířský Hill site.

There are uncovered also the extrusive products partly in the cutting of the track Olomouc-Bruntál. This intersects terminal part of the lava flow of the Uhlířský Hill Volcano. It is the only site probably suitable for sampling of basalt. The lava flow filled the shallow depression of the eastward direction (Barth, 1970).

3.2. Venus's Volcano (Venušina sopka)

There were mined two quarries in the past in the lava flow of Venus's Volcano lying in the valley of the Černý Brook (Barth, 1977).

3.2.1. Mezina – the Quarry

The first site named Mezina - the Quarry is a Natural Monument from the year 1997 (Vencálek et al., 1998). There is uncovered a frontal part of the lava flow at the quarry with a typical prismatic jointing of the basalt (Fig. 3.2.1.1.). The prisms are several meters high and are evolved very well. This place is along the terry road available, which terminates in the middle of the quarry.

Fig. 3.2.1.1. This shows the Natural Monument Mezina – the Quarry with a typical prismatic jointing of basalt.

3.2.2. Nather's Quarry

There is a second occurrence, named Nather's Quarry, east by north the quarry in the lava flow by the village of Mezina. Nather's Quarry is divided in two small parts, which are about 100 m apart from each other. The quarries both occur in the wood on the right side of the road connecting Mezina and Razová. They are named Nather's Quarry I (it lies in the north and it's bigger) and Nather's Quarry II (it lies in the south). There are cavities up to 30 m long saved in the Nather's Quarry I (Fig. 3.2.2.1). According to Barth (1977) these are lava tunnels either, which came into being by flowing out of lava after the perforation of the lava flow forehead or shapes originated by flooding up of the loose material by the ground water. Such a cavities are called "lava caves" sometimes. Human interventions in basalt can be seen at the entrance, they are remainders probably of an effort to enlarge the cavity artificially. The gravel terrace was found in the base of the basalt that lays about 12 m above the present level of the brook. According to Barth (1977) lava overlaid probably the part of the brook's old basin. The quarry is used as a campground in plenty.

There is Nather's Quarry II in the steep slope to the south of the Nather's quarry I, but it's hidden in compact vegetation. The quarry itself is vegetation-covered also. There is an extrusive body of the basalt with a distinct prismatic jointing in several places of the quarry. There can be observed two flat caverns in the wall of the quarry. It's a contact of two different basalt formations in all probability. These caverns penetrating perpendicular to prisms of basalt are the most likely products of the weathering. Barth (1977) according to Waters (1960) and Macdonald (1972) presents that thicker lava flows are formed of two to three positions with a prismatic jointing. On the base of this fact it can be adjudicated that joint planes arose just on a mutual contact of these planes and subsequent erosion caused their progressive propagation. This also can be observed that there are basalt's prisms thicker in the lower part of the lava flow then in the upper part.

Fig. 3.2.2.1. The underground cavity in the wall of the Nather's Quarry I.

The peak of the Venus's Volcano (665 m a. s. l.) itself is also changed by the mining. There were a pyroclastic material exploited before in this place. There are several mines and vegetation-hidden volcanic bombs in here. The part of this space is young forest-covered. The peak of the volcano can be reached going the blue pathway from the village of Mezina; it is about 500 m to the east of the village.

3.3. Pyroclastic complex by the village of Razová
There are two remnants of denudation in the middle of the Nízký Jeseník Mountains making up of tuffs, tuffites and conglomerates of tuffites (Barth, Zapletal, 1978). Razovské Tuffites Natural Monument was declared in the year 1997 (Vencálek et al., 1998). The only part of the pyroclastic complex is protected; the remnant of denudation by Karlovec hasn't been the subject of conservation.

As a source of pyroclastic material it can be considered Velký and Malý Roudný Volcanoes (Marek, 1973). Barth and Zapletal (1978) confirmed former research findings of several scientists the sedimentation of pyroclastic complex proceeded in the temporary lake, which arose by rising the level of the Moravice River. More or less all of the authors present a fact the products of Velký Roudný Volcano allowed the origin of the lake. But a dissension predominated in opinions, which of those products might have really become the barrier of the Moravice River. The tough barriers indeed arose as late as during the effusion period. The Heroldův Mlýn Lava Flow was the first, but not until the Chřibský Les Lava Flow had a needful thickness. This was such a massive barrier of Moravice River that its level rose up to altitude about 545 a. s. l. This maximum level reaches also a remnant by Kalovec and so it can be expected the level of water sedimentation environment reached up to this boundary.

3.3.1. Remnant of denudation by Razová
This remnant of pyroclastic material lies to the west of south end of the village of Razová. There are numerous natural exposures as well as many forsaken quarries with vertical walls in the southern part of the relict. Rocks are typical with its regular stratification (Barth – Zapletal, 1978), it can mean that the sedimentation was located in deeper and more stable environment of the lake. The thickness of this remnant is averaged at about 10 to 15 m. Lower Carboniferous graywackes were documented as its underlying rocks. Barth, Zapletal, 1978 assume furthermore that the pyroclastic material filled the depression, which the inflow of Moravice River passed through.

3.3.2. Karlovec's remnant of denudation
The relict is much smaller in comparison with the Razovský one, but it's rather good uncovered. Its thickness is averaged at about 8 to 10 m (Barth, Zapletal, 1978). This lies 2 km to the west of village of Razová in the grove with a bushy coppice. There is distinct cross bedding in several places. A dying out of beds occurs in the right part of the quarry. There is clearly evolved also a horizontal bedding here and there, where a position of silkier material interchanges with a positions of the rougher material. There can be seen quite distinctly positions of water non-dressed and sharp-crested clastics of a culm mixed with a pyroclastic material in the wall of the quarry. Clastics of the culm were scoured with a pyroclastic material together into the lake. It

can be read rather well from the quarry walls 3 to 4 m high, which environment sediments settled in. From the order of rock material arises obviously that the sedimentation was located in a very non-stable environment with the most probability not too far from the waterline, where both an impact of an undulation, and activity of an influent water is great. These impacts are recorded in the sedimentary structures of rocks in the wall of the quarry very well. The huge problem also is a fact that the quarry is used as a waste pit. The remnant of denudation by Karlovec is very important because of its high quality of volcanological and sedimentological records. And just because of importance of this site and a fact that is not protected, it is necessary for its saving to change this situation.

3.4. Velký Roudný Volcano

Velký Roudný National Natural Monument was declared in the year 1966 (Vencálek et al., 1998). This volcano (780 m a. s. l.) is a distinctive dominant point in the region (Fig. 2.1.). There can be seen also agrarian anthropogenetic formations in the picture, which are subjects of conservation as well. The peak of the Velký Roudný Volcano is reachable at present from the village of Roudno going the green pathway. There is a huge stone quarry active in the Lava Flow of Chřibský Les. This site lies about 1 km to the southwest of the Slezská Harta's dam by a road connecting Leskovec nad Moravicí and Bílčice. There is a typical prismatic jointing evident along the all length of the quarry's wall. It is evident that there are products of two extrusive phases of the Velký Roudný Volcano in here. A new exposure in the Chřibský Les Lava Flow nearby the dam of the Slezská Harta Water Reservoir is mentioned above.

3.5. Malý Roudný Volcano

Malý Roudný (771 a. s. l.) is also an important geological site, but its products are uncovered only a little. The situation is similar in the case of Křišťanovice exposure, which is detached from the products of Malý Roudný Volcano apart. The last larger research utilises knowledge detected through the boreholes (Barth, Kočandrle, 1979). On the basis of considerable petrographical concordance these authors assume the fact that both elements originally were the only one formation. Not until the denudation divided this formation in two parts. On the contrary the Volárna site is according to Barth (1977) a separate volcano, considered by some prior authors as the part of Malý Roudný Volcano.

Fig. 3.6.1 This figure shows spheroidal jointing of basalt in the quarry of Zlatá Lípa by Stará Libavá.

3.6. Zlatá Lípa by Stará Libavá

Zlatá Lípa by Stará Libavá is the further site. The volcano is placed rather off-centre because of the other exposures (sites), but it's a unique sample of a spheroidal jointing in the region (Fig. 3.6.1.). And that is the reason, why this should be recorded in the list of special protected areas. This former quarry lies about 2 km by the beeline to the east of the village of Stará Libavá and there is the Červená Mountain (749 a. s. l.) 1 km to the east of the quarry. This is reachable the best from the road connecting Horní Guntramovice and Stará Libavá along a cartway or along a blue pathway from the village of Horní Guntramovice. The site occurs on the border of a wood; trees and shrubs, especially the lower storey, cover the space of the quarry.

3.7. The age of the volcanoes

Neovolcanic formations, which are mentioned above, are typical with reverse magnetisation and on the basis of detected values of the age are sorted in the Matuyama Epoch. They are more then 0,7 MA older. The Velký Roudný Volcano is the oldest one probably; its age is about 3,4 MA. It means that this volcano belongs to the Gilbert Reverse Epoch (according to Teledyne Isotopes Laboratories in New Jersey, Šibrava, Havlíček, 1980). The Venus's Volcano is the youngest obviously, the age of the basalt of its lava flow is estimated 1,9 MA. The question of the age of volcanoes is not answered unambiguously, because different institutions and authors, who had been engaged in this issue, came to rather diverse results.

5. CONCLUSION

A description of changes and of a current condition of selected neovolcanic formation sites in the central part of the Nízký Jeseník Mountains were the goal of this contribution. This article is based on diploma work named "Geologie neovulkanitů ve střední části Nízkého Jeseníku", which is aimed at an environment of mentioned region partly. There are four neovolcanic formations being the subjects of the conservation in the Nízký Jeseník Mountains. The Velký Round Volcano is the National Natural Monument and three sites are sorted among Natural Monuments: Uhlířský Hill, Mezina – the Quarry and Razovské Tuffites. Uhlířský Hill is a little polluted for example in spite of the fact this site is protected by the law. Pollution is a topical problem of the most of sites (not only of those protected by the law). Also the construction of Slezská Harta Water Reservoir changed the landscape considerably. This is a new wide water surface with own impacts on the surrounding (mainly the deep river's valley were flooded due to the construction of the dam). This afflicts also a microclimate of the region probably, so it could be a subject of a further research.

SUMMARY

This contribution is specialised in some sites of neovolcanic formations in the central part of the Nízký Jeseník Mountains and gives notice of the fact that the volcanoes themselves represent distinct dominant points in the landscape east by south of the town of Bruntál. Neovolcanic formations provide rather good fancy about processes, which took place in relatively recent epoch here, on the border of Pliocene and Pleistocene (Šibrava, Havlíček, 1980). The law No. 114/1992 Sb. about the Conservation of the Nature and the Landscape protects some sites, but the other ones, in my opinion the important ones, are not protected, but they could be. The contribution judges also changes, which were caused by rather extensive effusion of lava and discusses a new regional element, Water Reservoir Slezská Harta. Its construction was the last radical change in the landscape for the present. So the whole region is a typical example of the land, which appearance was affected considerably by the volcanic activity and later the activity of people.

SOUHRN

SOUČASNÝ STAV KRAJINY A VYBRANÝCH LOKALIT NEOVULKANITŮ VE STŘEDNÍ ČÁSTI NÍZKÉHO JESENÍKU

Tento příspěvek je zaměřen na lokality neovulkanitů ve střední části Nízkého Jeseníku a upozorňuje na skutečnost, že samotné vulkány představují v krajině jihovýchodně od Bruntálu nepřehlédnutelné dominanty. Neovulkanity poskytují poměrně dobrou představu o procesech, které se zde odehrávaly v relativně nedávné době - na přelomu pliocénu a pleistocénu (Šibrava, Havlíček, 1980). Některé lokality jsou chráněny zákonem č. 114/1992 Sb. o ochraně přírody a krajiny, jiné, ovšem neméně zajímavé, takovou ochranu zatím postrádají. Příspěvek také posuzuje změny, které byly způsobeny poměrně rozsáhlými výlevy láv a upozorňuje i na nový krajinný prvek – vodní nádrž Slezskou Hartu, jejíž výstavba byla zatím posledním radikálním zásahem do místní krajiny. Celý region je tedy názornou ukázkou území, jehož vzhled byl značně pozměněn sopečnou činností a následně i činností lidí.

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© Mgr. Lubor Navrátil
Department of Geography
Natural Science Faculty
Palacký University in Olomouc
Svobody 26
771 46 Olomouc
Czech Republic
navratil.lubor@seznam.cz

Reviewed:
prof. RNDr. Jan Zapletal, CSc.

CHANGES IN SOCIO-SPATIAL STRUCTURE IN OLOMOUC, CZECH REPUBLIC DURING THE TRANSFORMATION PERIOD AFTER 1989

P. Ptáček[1]

[1] Department of Geography, Natural Science Faculty, Palacký University of Olomouc, Svobody 26, 771 46 Olomouc, Czech Republic - ptacekp@prfnw.upol.cz
Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

This article is dealing with the main changes in the internal socio-spatial structure in the city of Olomouc occurring after 1989. After introducing of general concepts of the post-communist cities transformation there are described main changes based on comparison of data from 1991 and 2001 census. Analysing changes in 68 basic territorial units within the city of Olomouc can be stated that main tendencies within the city follow the general pattern of post-communist cities as described by many authors. Next to the usual processes like commercialisation, deindustrialisation and suburbanisation is for Olomouc specific process of demilitarisation. Because of specific vertical and horizontal position of the city within the settlement system of the Czech Republic all these changes occurred with lower intensity than in other bigger cities, especially in Prague.

KEY WORDS: post-communist city, socio-spatial structure, Olomouc, Czech Republic

1. INTRODUCTION

Current development in post-communist cities is characterised by very quick changes in physical, social and functional spatial structure as an expression of general transformation of post-communist society. However these changes are still ongoing and relatively unfinished. One of the most important distinctions between communist and post-communist city is the growing extent of socio-spatial differences. Communist city was more homogenous with a lower extend of segregation then post-communist one.

The major aim of this article is to describe and try to explain the most important changes in socio-spatial structure in the city of Olomouc which occurred during 1990s as a result of transformation of the city (and whole the country) to market economy. Main source for the description of changes in the internal socio-spatial structure will be the comparison of results of 1991 and 2001 census. Observed changes in socio-spatial structure will be then explained by using general (whole state or whole post-communist world) principles and mechanisms and also paying special attention to specific transformation way of the city of Olomouc.

Using the combination of inductive and deductive methods of research (Sýkora, 2000b) we should start first with description of major processes in post-communist cities and classify them. Then we can deduce the most important processes and areas of change and use appropriate statistical indicators for their measurement and evaluation.

2. DEVELOPMENT OF POST-COMMUNIST CITIES – MAIN PROCESSES AND TENDENCIES

Current discussions about post-communist cities and their transformation are extensive and have brought forward many novel theoretical approaches along with some practical examples (Sýkora, 2000a, Matlovič et al, 2001, Weclawowicz, 2000). While the authors very often stress the uniqueness of these processes for particular cities, on the other hand they agree on general trends. The timing of these processes depends on:

1. the vertical position of the city (size of the city);
2. horizontal position (location within the national and international settlement system network, location to main urban centres and axes); and
3. the stage of economic transformation achieved by the particular country.

The following table presents a theoretical framework of the main processes taking place in post-communist towns and cities. It shows that the transformation of the internal spatial structure of the city is a very complicated and complex process.

Table 2.1. Basic transformation processes of a city's internal spatial structure in post-communism

	Type of structure in the inner city		
	morphological	functional	socio-demographical
Transformation processes	suburbanisation gentrification revitalisation intensification urban decay	suburbanisation commercialisation de-industrialisation demilitarisation sacralisation functional fragmentation	suburbanisation gentrification segregation separation socio-economic decay

Source: Matlovič et al. 2001

These processes begin earlier and are more intensive in larger towns or cities. This is especially true of capital cities which very often serve as "gate cities" for an entire country. Thus, the post-communist transformation taking place in Olomouc should be less intensive than that of either Prague or Bratislava (Matlovič et al. 2001). Compared to the two capitals the most significant changes to have taken place in Olomouc are the restoration and commercialisation of the historical centre and suburbanisation. Although, the intensity of the processes at work may lag behind that of both Prague and Bratislava (Matlovič et al. 2001) substantial changes can be observed that are in keeping with the general trends elucidated by Häussermann (1996) and Szelenyi (1996).

2.1. The comparison of socio-spatial patterns of communist and post-communist city

The transition from communist city is unique process which does not necessary lead to establishing of capitalist city, but it could create a new evolutionary urban type (Sýkora 2001b). The post-communist city is a temporary phenomenon therefore "its research must focus on studying the processes of change rather than on the sole description of static spatial patterns" (Sýkora 2001b).

All post-communist cities with the pre-communist past include also pre-communist socio-spatial patterns. These patterns has not been changed even during the communist period and survived until post-1989. From spatial point of view they are included in pre-communist inner city zones which mostly keep their significance despite many efforts and arrangements to change their social and partially physical structure. Examples can be subdivision and redistribution of large apartments, nationalisation of rental houses or confiscation of houses as a result of World War II. But for instance single family houses has never been nationalised, so dwellings in residential areas with better quality of housing and higher social strata could not been redistributed to for example working class households (Sýkora 1999). It means that also communist city has not been fully socially homogenous space. Certainly communist society was more homogenous than post-communist one and the same we can say about the communist and post-communist city. But even communist society produced residential differentiation despite official proclamations of the leading communist party. Majority of newly constructed prefabricated blocks of flats was built for "communist middle class". Upper class - communist elite and limited number of well-off households - concentrated in small residential areas of villas and single family houses. Poorer households remained or moved into the inner city areas or remained on the urban outskirts.

Very good overview and critical remarks to socio spatial differentiation research in communist cities is described by Steinführer (2003). The author states that the research of communist cities are too much based on theoretical concepts and do not have sufficient empirical base. Studies are isolated within national context and there is lack of systematic connection between social and spatial structure and lack of qualitative research. Moreover most of analysis is focused just on capital cities Steinführer (2003).

Comparing socio-economic, demographic and ethnic characteristics between communist and capitalist city we can see following differences and similarities:
Declining socio-economic status from the city centre to the outskirts (on the macro-scale) is similar to Western Europe and reverse to the USA. On the mezo and micro level there were socially stronger and weaker sectors.

From demographic point of view were communist cities characterised by ageing population and decreasing of their sizes from the outskirts to the centre. This was determinated by massive new housing construction on the outskirts of the city, settled usually by young families with children. This is important distinction from capitalist cities.

The cities in communist countries were ethnically more homogenous and there was no international migration like that which influenced ethnical differentiation of Western cities, especially in the USA and after World War II also in Western Europe. The exception could be found in the cities of the federal communist states like in the former Yugoslavia and the former Soviet Union where there was existing "institutionally directed internal migration" from other parts of the country.

Several papers present a more complex view of the post-communist city (Weclawowicz 2000; Sýkora 2000a; Sýkora 2000b; Sýkora 2001a,b). These authors deal with theoretical and methodological problems. Others, namely Häussermann (1996), Pickvance (1996) and Szelenyi (1996) derive general trends and present them using case studies of particular cities in Central and Eastern Europe.

2.2. Main processes contributing to changes in the internal socio-spacial structure in post-communist cities and example of Olomouc

Processes in the internal socio-spatial structure of post-communist cities react on the institutional changes with different pace. In general settlement systems change more slowly than institutional setting. Socio-economic status of the population is the characteristic that is changing most rapidly. Now we try to describe the most important processes of internal spatial pattern transformation and differentiation.

The major factors which contribute to uneven distribution of population in urban areas according to socio-economic status are socially differentiated population and consequently differentiated demand for housing and also differentiated housing stock according to its size, quality, price and location (various segments of the housing are unevenly distributed in the urban space). Processes connected with increasing of the social inequalities are connected with the economic reform starting at the beginning of 1990s. For the more detailed description of impacts of economic transformation on social inequalities within the Czech society and their spatial distribution look for example at Sýkora (1999). One of examples could be the position of Olomouc region and district within the Czech Republic according to month salaries. As described in table 2.2.1., this region belongs to the poorest in the Czech Republic and the gap between the national average is not narrowing. Also other indicators like unemployment rate show the region as the region with stably the 3rd highest unemployment rate among the regions. Also the City of Olomouc is lying above the national average. All these indicators show that there are substantially different conditions for rising socio spatial inequalities than especially in Prague but also in other more wealthy cities in the Czech Republic of similar population size.

Table 2.2.1. Comparison of the average month salary (in CZK) in Olomouc area and in the Czech Republic

Area	2000	2001	2002	2003
Czech Republic	13 484	14 633	15 657	16 253
Olomoucký region	11 892	12 800	13 302	13 787
Olomouc district	12 423	13 483	14 191	14 623

Source: Úřad práce (Employment Office) Olomouc, in companies with 20 and more employees

Transformation of the housing system is also very important for socio-spatial differentiation. The transformation has been shaped by privatisation, rent deregulation and a withdrawal of the state from direct housing provision. Rent policy divided the housing market into two different segments. Rent is regulated in the case of unlimited leases signed during communism in private and public housing. Market rent can be charged only for newly built housing, for leases for foreigners and for newly signed leases. Since the early 1990s, there also has been a duality between regulated rent in housing sector and deregulated rent for non-residential spaces. This unbalance leads to commercialisation of attractive parts of cities and is pushing out housing function and also to gentrification, i.e. the replacement of original population by high income people, especially foreigners. Gentrification is substantially changing the social character of a neighbourhood. The withdrawal of the state from the direct housing financing is replaced by subsidising of mortgages and of municipal housing. Municipalities allocate newly constructed, renovated or vacated municipal dwellings to households, which offer the highest rent in a competition.

2.2.1. Changes in the land and real estate ownership, privatisation, restitution in Olomouc

The biggest impact on the changes in the ownership structure had the restitution act and delimitation of the houses from the state to the municipality and than their privatisation.

Restitution act from 1990 and its impact on ownership structure was the most important in the city centre and in the inner part of the city. But in comparison to other cities the share of restituted houses in these part of the city was substantially lower. The reason is that these parts of the city were until 1945 mostly settled by population groups which do not fulfil the conditions of the act (mostly Germans) or which did not survived the war (mostly rich Jewish families). These estates were delimited to the municipality and step-by-step privatised.

Privatisation of municipal flats was the most significant change in the flat ownership after 1989. From 37981 of permanent living flats were 16578 until 1991 owned by state and in this year (1991) have been transfered into municipal ownership.

Table 2.2.2 Structure of flats ownership by 1991:

Entire number of flats	37 981	100 %
Flats owned by the city	16578	44 %
Cooperative flats	10 252	27 %
People´s flats cooperative	800	2 %
Other (family houses, etc.)	10250	27 %

Source: City hall office Olomouc, Dep. of housing

The privatization of municipal flats started in 1991 and annually were sold 400-1600 flats. By the end of 2001 (31.12.) remained in the ownership of the city 5 684 flats. The privatization should be finished in 2004 and the city plans to keep in its ownership 5 426 flats. Primarily were sold houses in worse physical condition. There is quite high interest to buy municipal flats because the prices are substantially lower than in case of cooperative flats. The money from privatization is mostly invested into new construction or reconstruction.

Except that the city builds communal flats. Since 1996 the state offers for municipal housing construction subsidies – 280 thous. Kc per housing unit and 50-80 thous Kc for technical infrastructure per flat. The city is usually the main investor and offers construction works for private housing construction companies. Than are these flats either rented or sold to customers under particular conditions. These conditions say that a tenant will pay directly some part of the price of the flat and within 20 years will pay the rest of the value to the city in form of a rent and after this time the flat will be in his private ownership. By this method were in the 2nd half of 1990s constructed 2 500 new flats in different localities. Except that in 1994-2000 there was a program of construction of new loft flats (400 flats). Despite that by 31.12. 2002 there was 2 800 of applications for allocation of municipal flat.

2.3. The most important processes of socio-spatial differentiation in post-communist cities

As an expression of above mentioned mechanisms we can observe the main processes which contribute to the socio-spatial differentiation. These are (Sýkora, 1999):

1) social mobility of households fixed in their residential locations;
2) internal migration within the existing housing stock;
3) immigration to newly constructed residential areas.

The first contributes to the growth of disparities but does not change the spatial distribution, the other ones reshape the socio-spatial pattern of cities.

Social mobility of households fixed in their residential locations leads to rising social polarisation. In areas with a high proportion of well educated people employed in the tertiary sector upward mobility will prevail, opposite can be expected in localities of manual workers and lower education. Migration within the existing housing stock will lead to rising segregation and most important processes will be commercialisation and gentrification in case of social upgrading and ghetoisation in case of social downgrading. Immigration to newly constructed residential areas can be divided into suburbanisation, i.e. mostly construction of single family houses for the rich people and construction of apartments for sale in condominiums, which are constructed mostly in the inner (compact) city in the existing built environment. Both are available only for households with very high incomes.

The most important changes in the socio-spatial structure of the post-communist city can be observed in the city centres and in suburban areas. In case of Olomouc they were described by special studies (Ptáček at al, 2003, Ptáček, Szczyrba, 2001). Other parts of the city keep or reinforce their previous social status. There can be some exceptions, but they must be caused by strong outer impulses like demilitarisation or deindustrialisation of certain areas and their transformation to housing areas.

3. CHANGES IN THE INTERNAL SOCIO-SPATIAL STRUCTURE OF OLOMOUC BETWEEN 1991 AND 2001

To demonstrate expected changes in the internal socio-spatial structure of Olomouc on empirical material we can use statistical data from 1991 and 2001 census. These data were used for basic territorial units in Olomouc where live over 50 people, which means all together 51 basic territorial units. There were selected 15 different variables describing social and demographical structure of the population. According to the mechanisms of socio-spatial differentiation can be stated that level of education and economic sector of the employment (tertiary sector) represent the most important variables of social differentiation. The other variables are also included in the evaluation but because of lack of space they are not included in figures.

3.1. Population change

For understanding of changes in socio-spatial structure it is important first to have a look at population change between 2001 and 1991. The city as a whole territorial unit lost between 1991 and 2001 only 179 inhabitants. But the changes within the city were substantial (see Figure 1). Unfortunately we cannot observe internal migration streams within the city (internal city migration is not the part of statistical data collection). The biggest population loses can be observed in the historical core and in the inner city, especially in the blocks of flats constructed from 1960s in the western, south western and southern sector of the city. This is caused by ageing of the population. The construction of these housing estates started in the western sector and continued to the southern sector, where the last estates were finished in 1993. Good indicator for that is the share of people over 60, which has substantially risen in these "old" high rises estates from 1960s and 1970s.

On the other hand there are several territorial units with substantial population growth between 1991 and 2001. These units can be divided into two groups. In the first group there are territorial units at the margin of the compact city. Here were finished last state subsidised housing estates in 1993 (the housing estate Nové Sady – jih) and also important was the process of demilitarisation – housing estates Černá cesta and parts of Nový Svět. These estates were originally used by Soviet army, which had its main base in Czechoslovakia in Olomouc. After reconstruction these estates were offered by the city hall to new residents. These flats were distributed mostly to people subscribed on the official waiting list of the city hall. New tenants (and after privatisation also new owners) were mostly young, middle class families with children and with higher level of education, mostly working in tertiary sector.

Other segment is represented by suburban localities with prevailing new constructions of new family houses (Chomoutov, Neředín and small enclaves near the city centre) and also construction of new condominiums either subsidised by the municipality or constructed by private sector. These localities are mostly concentrated on the margin of current compact city (Slavonín, Tabulový vrch).

3.2. Share of economically active people working in tertiary sector

As a good indicator of the social structure and its change can be seen the share of people working in tertiary sector. In 1991 (see Figure 3) these units were mostly concentrated into the western part of the inner city (so-called "clerk´s quarter") which keeps its status since the beginning of the 20^{th} century. Also the "old" housing estates from 1960s in the western sector (Neředín) had relatively high share of people employed in tertiary sector. In 2001 (see Figure 2) the situation is similar – we can observe clear divide of the city into "West end" and "East end" (industrial zone east and south east of the railwaystation) with substantially lower share of people employed in tertiary sector. From the suburban units has the higher share of people employed in tertiary only Svatý Kopeček in north eastern sector. This is very attractive suburban area especially because of attractive environment and countryside.

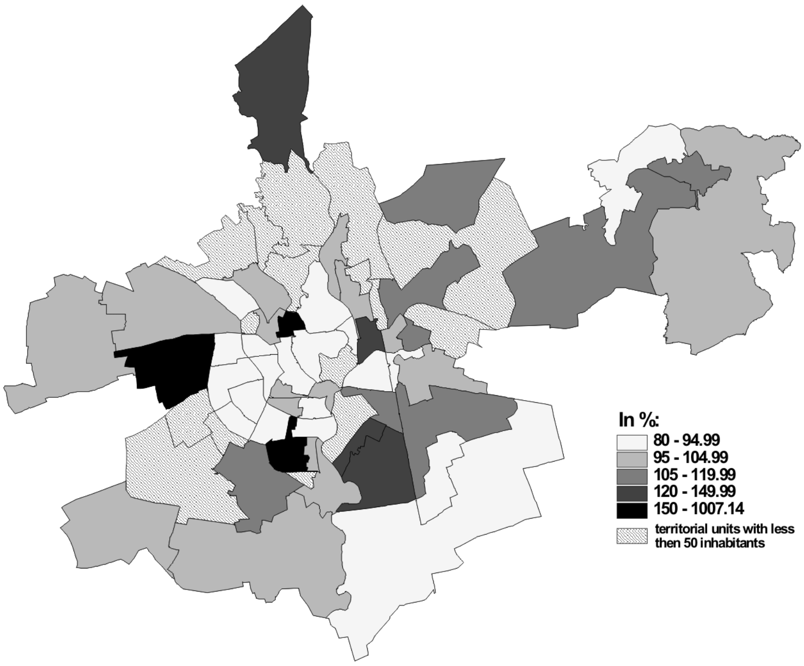

Figure 1. Population change between 2001 and 1991

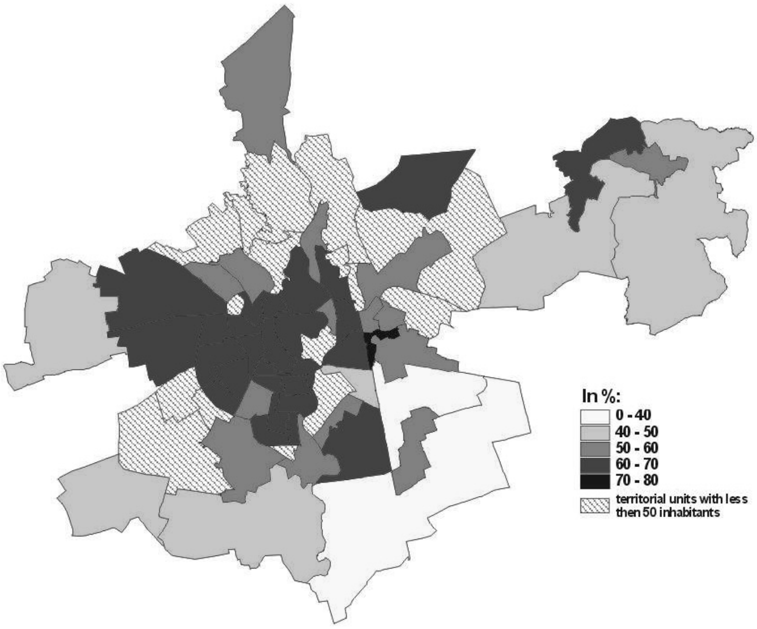

Figure 2. Share of economically active people in tertiary sector in 2001

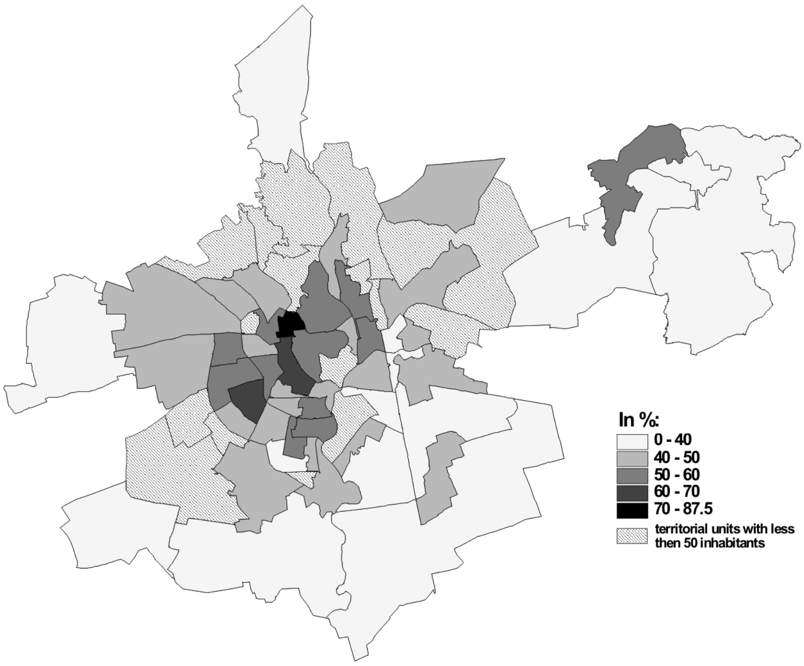

Figure 3. Share of economically active people in tertiary sector in 1991

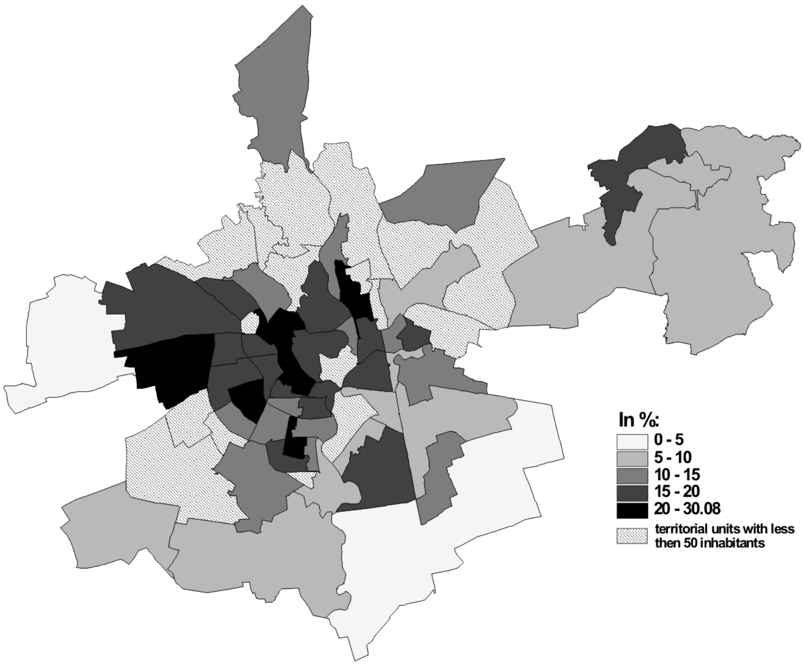

Figure 4. Share of university educated people in 2001

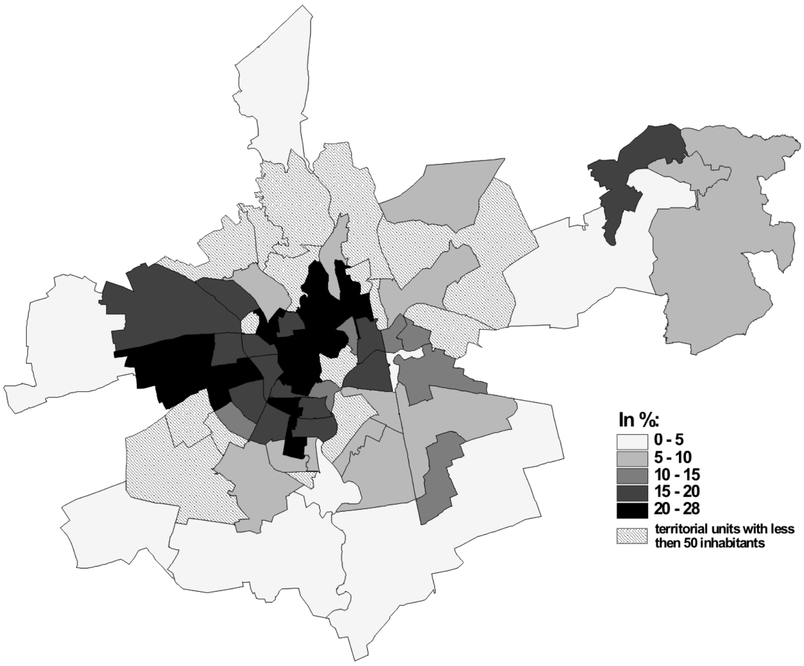

Figure 5. Share of university educated people in 1991

3.3. Share of university educated people and people with basic education

Very similar spatial pattern is visible also by using other variable – the share of university educated people in 2001 and in 1991 (see Figure 4 and 5). The territorial units with the high share of university educated people and that of economically active in tertiary sector are almost the same. Also the changes between 1991 and 2001 show high level of inertia and reinforcing of concentration into the western and south western sector. From the suburban units show especially high share of university educated people Svatý Kopeček and the neighbouring village of Samotišky, which is not the part of Olomouc but offers similar environment and is closer to Olomouc than Svatý Kopeček.

3.4. Share of people born and still living in Olomouc

Complementary variable showing the stability of local population is the share of people born in the same municipality and living there whole their life. The highest share of people living in the same municipality is situated in rural settlements of the suburban zone of the city. This pattern has not change between 1991 and 2001. It can show very high stability of population in rural parts of the city. But it can also hide the ongoing suburbanisation process, because people moving to these suburban localities from the compact city also mostly were born in Olomouc.

3.5. Share of atheists

Share of atheists has substantially increased between 1991 and 2001 in whole the territory of the Czech Republic. This is also the case of Olomouc. Despite the fact that Olomouc is an important religious city in the Czech Republic, the share of atheists is here in both two censuses around the national average. However, the spatial pattern of this variable is varying substantially within the city. The lowest share of atheists we can find in the rural settlements out of the compact city and also in the historical core. This is specific for Olomouc because the city is the seat of Moravian archbishop and also many religious orders are located in the historical core. The most atheist part of the city is situated in the housing estates, especially Neředín and Nové Sady and is higher than in industrial suburbs in the south eastern sector of the city.

3.6. Ethnical homogeneity of the city

The Czech Republic is still ethnically very homogenous country. The highest share of the other ethnic groups is concentrated especially into Prague, which attracts both highly skilled workers and also new immigrants from the third world countries and refugees. The share of non-Czech and non-Slovak population in Olomouc is in both censuses very low, around 4,5 %. It means that during 1990s the ethnical composition of the city has almost not changed. Also the spatial distribution within the city is very equal. The most important ethnical minority, Gypsies declared themselves in the both censuses as Czechs or Slovaks so we cannot observe any concentration of this specific ethnic group in the city. Next to Gypsies there is rising Asian minority, especially of Vietnamese and Chinese, which dominate specific businesses and services in the city. Thanks to the increasing foreign direct investment in the whole region during 1990s we can observe also the rising number of highly skilled foreigners living in the city. The example of internationalisation of the city can be the opening of the international grammar school in 2000.

4. CONCLUSIONS

This article was dealing with the main processes and tendencies of development of the socio-spatial structure of post-communist cities. After discussion of theoretical concepts it has focused on the changes in the socio-spatial structure of Olomouc based on comparison of selected variables based on the 1991 and 2001 census. Looking on the general trends and mechanisms described above we can say that the city of Olomouc is lying far behind the intensity of changes occurring especially in Prague. The most visible changes in the city are connected with the process of commercialisation of the centre, partly upgrading of the social status of the historical core connected with its physical rehabilitation. Specific process occurring in the city is connected with demilitarisation. In 100 thousand city there was until 1991 present the biggest Soviet army base in the former Czechoslovakia, which numbered more than 20 thousand soldiers and their families. Both suburbanisation and segregation has not influenced the socio-spatial structure of the city yet and show high level of inertia. With ongoing processes of internationalisation, globalisation and other transformational processes we can expect in the next decennium more intensive changes than that which occurred in the 1990s, in the beginning of social transformation.

5. SOUHRN

ZMĚNY V SOCIÁLNĚ PROSTOROVÉ STRUKTUŘE OLOMOUCE, ČESKÁ REPUBLIKA, V DOBĚ TRANSFORMACE PO ROCE 1989

Článek se zabývá problematikou sociálně prostorové transformace postkomunistických měst. V prvních dvou částech jsou diskutovány obecné procesy a mechanismy vedoucí ke změnám ve městech. V další části je potom proveden pokus o aplikaci těchto změn na konkrétní situaci města Olomouce. Na základě srovnání výsledků sčítání lidu, domů a bytů za roky 1991 a 2001 je proveden popis prostorového rozložení a změn nejdůležitějších sociálně prostorových indikátorů jako je podíl ekonomicky aktivních lidí v terciéru, úroveň vzdělanosti obyvatelstva, podíl rodáků, ateistů a etnická homogenita. Vzhledem k omezenému rozsahu článku byly vybrány podle názoru autora nejzajímavější kartogramy vyjadřující prostorovou diferenciaci těchto změn. Celkově se dá říci, že nejdůležitější procesy, segregace a suburbanizace, zatím výrazně nezměnily sociálně prostorový charakter města. Do budoucna se ale vzhledem k rostoucí integraci země a města do globální ekonomiky dá očekávat zrychlení procesu těchto změn.

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© RNDr. Pavel Ptáček
Department of Geography
Natural Science Faculty
Palacký University
Svobody 26
771 46 Olomouc
ptacekp@prfnw.upol.cz

Reviewed: RNDr. Petr Rumpel, Ph.D.

THE HISTORY AND THE PRESENT OF NATURE PROTECTION IN THE CZECH REPUBLIC

Lukáš Slouka

Gymnázium Ostrava – Hrabůvka, Fr. Hajdy 34, 700 30 Ostrava, Czech Republic – slouka@ghrabuvka.cz

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Abstract

The Czech Republic is expecting the culmination of its efforts in accession of the country to the European Union this year. Nature protection also represents one of the important areas whose legislation must become united with the European one. Nature protection has several-hundred-year-old tradition in the area of the Czech Republic, dating back to the reign of Charles IV, who concentrated especially on forests and game protection. Žofínský Virgin Forest (Žofínský prales) in the Novohradské Mountains (Novohradské hory), established in 1838, may be considered as the first really protected area in Bohemia. It is, at the same time, one of the oldest protected areas in Europe. Massive development of land protection could be seen only after World War II, when the protected areas' size was extending very quickly, and so, e.g. the large-scale protected areas' proportion to the state area is almost 15% today. The aim of this article is to document the history, the present and the future trends of nature and landscape protection not only in the Czech Republic itself, but also within the bounds of all-European trends.

KEY WORDS: specially protected areas, large-scale protected areas, small-scale protected areas, Ecological Net, NATURA 2000

1. INTRODUCTION

The Czech Republic is a landlocked country situated in Central Europe. Its position, as well as geomorphological structure, have formed a varied landscape; its nature is very rich in plant and animal species and it deserves considerable protection. This fact was already realized by the people living in the area in the past. The extent of nature protection and its ways have undergone a long development and the process has not been finished yet.

2. NATURE PROTECTION UNTIL THE FORMATION OF CZECHOSLOVAKIA

The development of nature protection in the Czech Lands was determined either by general political situation or it depended on particular rulers' and governments' approaches. Periods of different attitudes to nature alternated.

The first historically documented attempts to protect nature date back to the 14th century, to the reign of Charles IV. Then it referred first of all to preservation of game and forests. It was incorporated into the document *Maiestas Carolina,* dating back to 1355. This provision is considered to be the first forest act in our country and one of the first ones in Europe.

The next document determining forest protection came into effect in 1436 during the reign of Zikmund of Luxemburg. The only aim of this document was the protection of royal property from the poor, dishonest bailiffs and huntings, not the nature protection itself. Other regulations gradually came into effect in the whole country as well as in individual demesnes. For example Schwarzenbergs' measures concerning protection of bears in the Bohemian Forest (Šumava) and Český Krumlov area are well-known.

Žofínský Virgin Forest (Žofínský prales) in the Novohradské Mountains (Novohradské hory) is the first really protected area in Bohemia. It was established on 28 August, 1838 by earl Jiří Buquoy and now it belongs to the category of national nature reserves. The virgin forest land protection was motivated by Enlightenment Romanticism. The centuries-old forest was regarded as a monument (Čeřovský, in print). Other protected areas founded on private pieces of land followed. The national reserve Boubín Virgin Forest was founded in 1858. Its proclamation was preceded by the detailed exploration of woodlands. It can be regarded as pioneers of protected areas, as 'open-air laboratories' (Řehák, 1958). Buky u Vysokého Chvojna and Barrand's Rock (Barrandova skála) were proclaimed in 1894.

At the beginning of the 20th century, a net of areas protected up to the present was founded on Lichtenštejns' estate in Moravia. These areas represent very valuable woodlands comprising the centres of several present-day national nature reserves, e.g. Šerák-Keprník in the Jeseníky Mountains, Vrapač in Litovelské Pomoraví, Javořina in the White Carpathians (Bílé Karpaty) or Milovický Forest (Milovický les) in Pálava.

During the Austrian-Hungarian period, important documents emerged, most of them valid until World War II. Among them, there were especially 'Prügelpatent' from 1854 used to declare natural monuments, the Agriculturally Useful Birds Protection Law (Zákon o ochraně ptactva zemědělsky užitečného) from 1870, and the Natural and Landscape Monuments Protection Bill (návrh zákona na ochranu přírodních a krajinných památek) from 1908. The Austro-Hungarian forest act was of good quality too. In the Czech Lands, only individual decrees were successfully pushed through until 1918, e.g. birds protection, forests protection, natural monuments protection and listing.

3. NATURE PROTECTION IN PREWAR CZECHOSLOVAKIA

After World War I, the real national nature protection started. The important figure of our national nature protection in that period was Rudolf Maximovič (he worked in Ministry of Education and Culture from 1922 to 1938), who submitted several proposals of nature protection law (The Nature and Landscape Protection Agency of the Czech Republic – verbal information). The most famous scientist investigating the problems of nature and landscape protection was Professor Zlatník, who has laid the foundations of conception and theories used in nature and landscape protection up to the present.

There was a tendency to establish primarily small--scale protected areas. The size of the reserves and distribution of property represented problems. In 1938, according to data of R. Maximovič, the number of (private) nature reserves on the area of today's Czech Republic was 142 (113 in Bohemia, 29 in Moravia and Silesia). Unfortunately, on account of economic interests and political situation in the country no large-scale protected areas were established during the whole interwar period even though František Schustler's proposal to proclaim 'The Giant Mountains National Park' (Národní park krkonošský) already existed in 1923 (Čeřovský, in print).

4. THE PERIOD OF 1945–1989

In the postwar period, nature protection in the Czech Republic tends from mere care for natural monuments to more up-to-date conception corresponding to 'sustainable exploiting of natural sources in the first place of biodiversity'.

Already in 1947, Jan Šmarda worked out a complex proposal of Moravian-Silesian natural reserves. A great part was put into practice (about 50%). The next proposal was Alois Zlatník's net of Moravian-Silesian forest reserves. It was not, however, carried out (Čeřovský, in print).

Nature protection follows the national nature protection law No.40/1956 Coll., which enabled the existing protected areas to be splitted up into categories differentiated in form, practice, and aims of protection. Since that time (with the exceptions of PLA Český ráj and PLA Moravský kras proclaimed already in 1955) there have been protected landscape areas as well as national parks in our country. (The first national park, The Giant Mountains National Park – Krkonošský národní park was proclaimed in 1963).

In 1950s, reserves undergone an inspection, which should have confirm their right to exist. It arised from the state authorities' fear of protected areas' expansion, which reduced the possibilities of economic land use. Some reserves were really cancelled, but many new ones were established, e.g. in Central Bohemia, their number as well as their area increased (Čeřovský, 1963)!

Since 1960s, the environment in the Czech Republic had been changing substantially. An expanding industry and intensive agricultural activities led to landscape changes. Large industrial firms building, surface mining, field merging, amelioration gradually led to smaller landscape diversity. Nature protection was upstaged. However, in the 1960s four protected landscape areas and one national park were proclaimed and by the end of 1989 there had been 21 large-scale protected areas in our country (Kopecká, Vasilová, 2003).

In 1970s, protected areas' management started, which should have guided not only outside influence in the areas but also internal ecosystems' development. Admittance to the areas was regulated and they were used for educational purpose.

More people were interested in nature protection problems, not only professionals, whose number was about 500 in 1989 (Čeřovský, in print). Those who were interested in these problems were united into voluntary organizations, e.g. TIS, Brontosaurus Movement (Hnutí Brontosaurus) or Czech Environmentalists' Association (Český svaz ochránců přírody).

The foundations for international cooperation in nature protection were laid. Nature protection department of the State Institute for Preservation of Monuments and Nature Protection (Státní ústav památkové péče a ochrany přírody) entered the World Nature Protection Association (Světový svaz ochrany přírody); international cooperation especially in the area of České Švýcarsko and the Šumava Mountains was developing. However, international institutions could be joined completely only after the change of political regime in November 1989.

5. THE PRESENT STATE OF NATURE PROTECTION IN THE CZECH REPUBLIC

There are several levels of specially protected areas differentiated in the Czech Republic. According to their size, there are large-scale protected areas divided into national parks and protected landscape areas, and small-scale protected areas comprising

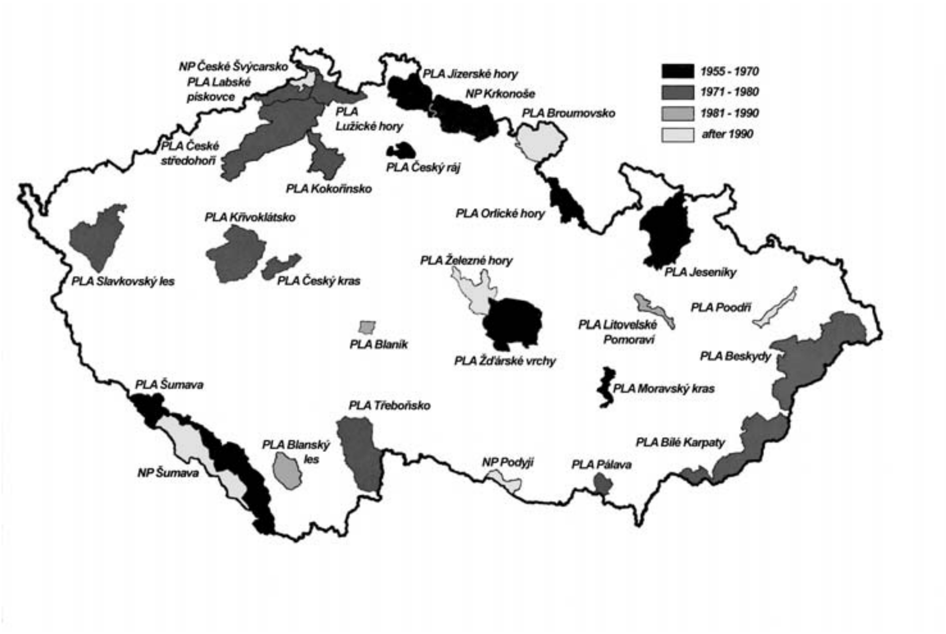

Figure 1: Large-scale protected areas' proclamations (Sedláčková, Slouka 1999)

national nature reserves, national natural monuments, nature reserves and natural monuments.
Some of the large-scale protected areas have been included into UNESCO biospheric reserves.
According to Act No. 114/92 Coll., nature protection is provided by the nature protection authorities (Ministry of the Environment of the Czech Republic, Czech Inspection of the Environment, national park's and protected landscape area's administrations, Nature and Landscape Protection Agency's regional centres, state administration – regional authorities, municipalities…).

5.1. Large-scale Areas (LA)

5.1.1. National Parks (NP)
National parks are areas with large-scale preserved natural environment unique on a national or international scale and their long-term aim is a dynamic environment protection or gradual regeneration in parts where it is missing.
The considerable part of the area is occupied by natural ecosystems or ecosystems only negligibly influenced by human activities. Plants, animals, as well as inanimate nature of these systems are of great scientific and educational importance. National parks can be used only on condition that natural situation is preserved or improved and all utilization is in accordance with the aims followed by national parks' proclamation. National parks are proclaimed by the Parliament and ensured by legislative acts.
National parks are internationally most valuable and the most strictly protected category of large--scale protected areas, therefore they should be proclaimed only provided that all legal requirements and guarentees can be followed.
Until 1989, there had been only one national park in the area of the Czech Republic, the Giant Mountains National Park (Krkonošský NP). Only with the change of political situation, after 1989, three new national parks could have been proclaimed: NP Bohemian Forest (Šumava), NP Podyjí (both in 1991), NP Bohemian Switzerland (NP České Švýcarsko) (in 2000). Therefore, national parks' area increased from 547 sq km before 1989 to the present-day 1190.2 sq km. National parks represent approximately 1.51% of the total state area (Kopecká, Vasilová 2003).
The methods and the ways of national parks' protection are graded according to the national parks areas' zoning usually into three zones of nature protection specified considering their natural values. The strictest rules are established in the first zone. The detailed zones' characterization and regime follow a generally binding legal regulation used to proclaim a national park (Law No.114/1992 Coll.). The following zones' definitions represent the synthesis of characterizations comprised in individual national parks' proclamations.
Zone I: It particularly consists of natural forest and wetland ecosystems, and subalpine grassy uplands only minimally transformed by people. The aim is to keep the ecosystems developing naturally and spontaneously. Human interventions are allowed only as an exception.

Table 5.1.1. Large-scale protected areas (Kopecká, Vasilová 2003)

SPA's name	Year of proclamation	Area (sq km)
NP Krkonoše	1963	363
NP Podyjí	1991	63
NP Šumava	1991	685.20
NP České Švýcarsko	2000	79
PLA Beskydy	1973	1 160
PLA Bílé Karpaty	1980	715
PLA Blaník	1981	40
PLA Blanský les	1989	212.35
PLA Broumovsko	1991	410
PLA České středohoří	1976	1 070
PLA Český kras	1972	132
PLA Český ráj	1955	181.52
PLA Jeseníky	1969	740
PLA Jizerské hory	1967	350
PLA Kokořínsko	1976	270
PLA Křivoklátsko	1978	630
PLA Labské pískovce	1972	300
PLA Litovelské Pomoraví	1990	96
PLA Lužické hory	1975	350
PLA Moravský kras	1955	92
PLA Orlické hory	1969	200
PLA Pálava	1976	70
PLA Poodří	1991	81.50
PLA Slavkovský les	1974	640
PLA Šumava	1963	944.80
PLA Třeboňsko	1979	700
PLA Žďárské vrchy	1970	715
PLA Železné hory	1991	380

Zone II: It encompasses especially forests with substantially modified generic and spatial structure in comparison with a natural state, and generically varied grassland communities dependent on human management. The aim is to preserve generic grassland variety and grow forests capable of development and regeneration with the minimum of human intervention. The forests should be gradually incorporated into the first zone. The meadows and forests are managed expediently to support natural generic and spatial diversity.

Zone III: It includes meadows and pastures with scattered housing and predominantly monocultural forests. The purpose is diversification of a natural generic and spatial forest structure, and preservation of approximate extent of meadows, pastures, and scattered housing on the edge of national parks, used for tourist purpose and functioning as a landscape maintenance area. Usual nonintensive management forms are practised on meadows, pastures and in forests preferring a natural regeneration and proportional increase of natural land-improvement and stabilizational woody plants. Scattered housing´s maintenance on the edge of national parks and its possible regeneration must not devalue the landscape character.

There is a tendency to increase the proportion of the first zone areas of national parks.

5.1.2. Protected Landscape Areas (PLA)

Protected landscape areas are huge areas encompassing harmoniously shaped primarily cultural landscape, characteristically formed relief, significant proportion of natural forest ecosystems and permanent grassland, numerous representation of woody plants, or perhaps preserved historic buildings. The long-term aim is to guarantee territorially differentiated and ecologically optimal land use, having respect for preserved environment and landscape character. Protected landscape area is proclaimed by the Czech Republic government.

The landscape management depends on graded protection zones, so that their natural state can preserve and improve and optimal ecological functions of these areas can be created and stay unchanged. Recreation use is allowed on condition that it does not damage natural values of the PLA. In accordance with the Nature and Landscape Protection Law, PLAs are divided into four zones and their percentual representation in 1996 was as follows: the first zone (zone I) – 11%, the second zone (zone II) – 37%, the third zone (zone III) – 41%, and the fourth zone (zone IV) – 11% (Sedláčková, Slouka 1999). There are only 16 PLAs containing the fourth zone.

It is difficult to characterize the individual zones in general. According to ing. Petr Moucha (Machátová 1997) the PLAs' zoning in the Czech Republic is the following:

Zone I (natural core) areas include natural and half-natural forest associations transformed very little by people, the most valuable generically varied wetland and steppe meadows and subalpine grassy uplands. The purpose is to preserve their naturalness and wealth of species. The care is concentrated on the most delicate forms of forest management and expedient grassland management. In the legitimate cases, selected parts of the forests can be left to develop spontaneously.

Zone II (half-natural, protective) areas encompass especially forest vegetation with substantially modified generic structure and forest associations close to nature, as well as growths of grass rich in species. The aim is to create and preserve spatially and genericly varied forest and rich grassland

associations, which serve, at the same time, as a protection first zone belt. The most delicate forms of forest management are carried out, small-scale natural regeneration is given preference together with the increase of natural generic variety. Greenlands should not be managed intensively.
Zone III (culturally landscape) areas consist of monocultural forests, meadows, fields, pastures, areas with scattered housing and small seats, and many woody plants growing out of forests. The aim is to preserve and complete the scenic landscape character. Forests, meadows, pastures and fields are commonly managed. Landscaping and completion of ecological stability system, as well as scattered housing maintenance should be carried on respecting the landscape character.
Zone IV (periphery settlement) encompasses more coherent urban area with a land reserve or intensively cultivated arable land without any ecological stability elements. It is possible to locate suitable housing there. It should respect the landscape character and enable business activities and living opportunities to develop. Intensive ecologically stabilized agricultural activities are also possible on condition that ecological landscape stability system is gradually being restored.
It is assumed that the proportion of the third and the fourth zones will increase in the future and the proportion of the second zone will reduce to 20–30% of the total PLAs' size.
Currently, there are 24 protected landscape areas in the Czech Republic with the total area of 10,180 sq km (13% of the total area of the republic) (Kopecká, Vasilová 2003). PLA Český Ráj and PLA Pálava are going to become extended (The Nature and Landscape Protection Agency, verbal information).

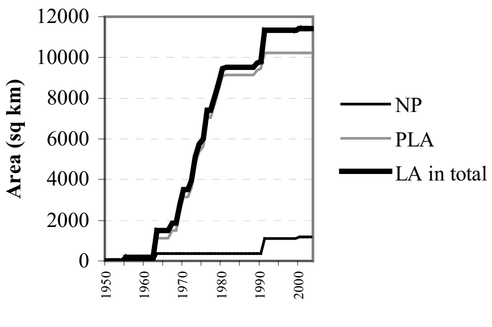

Figure 2: Large-scale protected area's area development (2002)
(Kopecká, Vasilová 2003)

5.2. Small-scale Protected Areas (SPA)
Small-scale protected areas form an extensive net in the whole republic. On December 16, 2003 they encompassed aproximately 1.17% of the total state area and their number was 2,130 (The Nature and Landscape Protection Agency, internal report). Small-scale protected areas are divided according to their importance. Altogether 211 most important ones (110 reserves and 101 monuments) are called 'national'.

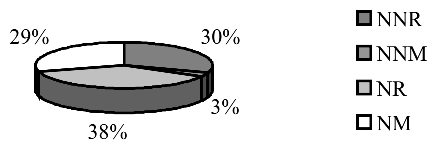

Figure 3: The proportion of individual small-scale protected areas' categories to the total area
(December 16, 2003)
(internal report, the Nature and Landscape Protection Agency of the Czech Republic)

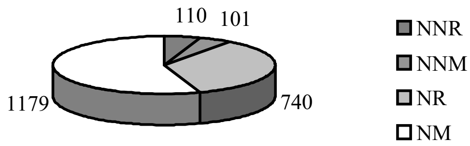

Figure 4: Small-scale protected areas' individual cathegories' proportional representation within the bounds of small-scale protected areas' total number
(December 16, 2003)
(internal report, the Nature and Landscape Protection Agency of the Czech Republic)

5.2.1. National Nature Reserves (NNR)
NNRs are extremely valuable smaller areas, in which a natural relief with a typical geological structure binds ecosystems of national or international importance. National nature reserves can be exploited on condition that it preserves or improves the existing state of the environment.
A national nature reserve is proclaimed by the Ministry of the Environment of the Czech Republic and according to the internal report of the Nature and Landscape Protection Agency of the Czech Republic (NLPA CR) 110 NNRs with the total area of 279 sq km have been registered in the Central List of Nature Protection (December 16, 2003). The same source was also used to characterize the remaining SPAs.

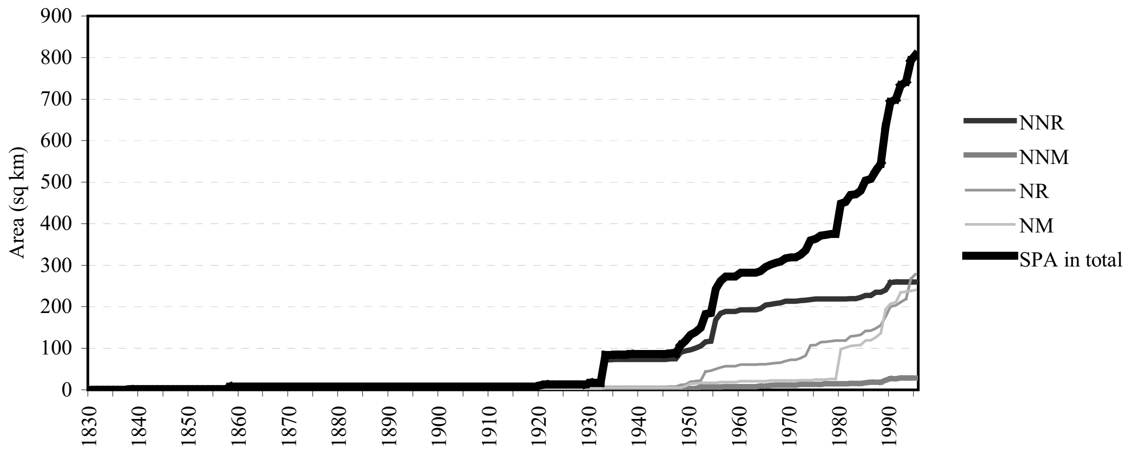

Figure 5. Small-scale protected areas' area development (December 16, 2003)
(internal report, the Nature and Landscape Protection Agency of the Czech Republic)

5.2.2. National Natural Monument (NNM)

It is a natural geological or geomorphological formation of a smaller size, a mineral deposit, or an endangered or rare species' site in fragments of ecosystems of national or international ecological, scientific or aesthetic importance. It can also be the result of human activities.

NNM is proclaimed by the Ministry of the Environment of the Czech Republic. There are 101 NNPs covering the total area of 27 sq km (December 16, 2003).

5.2.3. Nature Reserves (NR)

A nature reserve is a smaller naturally valuable area encompassing ecosystems which are typical and of great importantance to a particular geographic area. Nature reserves cover the area of 345 sq km and their number is 740 (December 16, 2003). Nature reserves' proclamation right has been transfered from the competence of the dismissed district authorities to regional council's competence.

5.2.4. Natural Monument (NM)

It is a smaller-sized natural formation, especially a geological or geomorphological formation, a precious mineral deposit or rare species′ site in fragments of ecosystems of regional ecological, scientific or aesthetic importance. It can also be the result of human activities. Natural Monuments are also proclaimed by regional councils and nowadays there are 1,179 NMs registered with the total area of 271.5 sq km (December 16, 2003).

5.3. Biospheric Reserves

Biospheric reserves are areas registered by UNESCO, which are of great importance for the preservation of biodiversity of species. They present representative examples of the main biom characteristic for the certain area but also examples of remarkable or unique ecosystems. Within the bounds of the programme MAB – Man and the Biosphere there are six biospheric reserves registered in the Czech Republic currently. All of them are either national parks or protected landscape areas at the same time.

The oldest biospheric reserves have been Křivoklátsko and Třeboňsko since 1977. In 1986 Pálava came after, followed by the Bohemian Forest (Šumava, 1990), the Giant Mountains (Krkonoše, 1992) and the White Carpathians (Bílé Karpaty, 1996).

6. ECOLOGICAL NET IN THE CZECH REPUBLIC

It was not only a need to proclaim new specially protected areas which arose in 1990s, but also a necessity to connect them to make an optimal, functioning ecological stability system. Therefore, a conception of a territorial system of ecological stability (TSES) ensured by Act No. 114/92 Coll. developed.

TSES' aim is to guarantee a variety of conditions and forms of life in the landscape by means of spatial structures of interconnected ecosystems, their component parts and elements. Its conception is based on two basic operations: making the frame of ecological landscape stability (a collection of ecologically stable landscape elements important from the point of biodiversity) and a TSES' proposal as a system of existing and purposefully spatially interconnected landscape elements (Buček, 2003).

The result is that as far as a design preparation is concerned, the whole area of the Czech Republic is covered by TSES proposals of all levels (supraregional, regional, local) and TSES is being adopted in practice. It is also important that the Czech conception of the ecological net is fully compatible with the European Ecological Net (EECONET) conception, which is gradually being developed. In order to be successful, this conception must become a part of landscape and territorial plans (Buček, 2003).

7. THE CZECH REPUBLIC AND NATURA 2000

In May 2004, the Czech Republic is becoming the member of the European Union. After accession, areas of European importance must be added into the system of specially protected areas (NATURA 2000). This newly built system is ensured by two EU guidelines:

a) the Wild Birds Protection Guideline No.79/409/EEC

b) the Wildlife Habitat, Wild Animals and Wild Plants Protection Guideline No.92/43/EEC

On these areas, the chosen kinds of biotopes and species of plants and animals will be protected by means of controlled care and careful management. The Nature and Landscape Protection Agency of the Czech Republic, which has been charged by the Ministry of the Environment, is currently mapping out these areas. The result will create conditions for preparation of a quality proposal of a national list for negotiation with European Commission.

NATURA 2000 differs from the ecological net conception in the fact that it comprises specially protected landscape structures which are not interconnected functionally. Thus, it could seem to be a backward step in comparison with TSES. Nevertheless, it is very important because it makes a homogeneous European system of protected areas of great European Union importance.

SUMMARY

The Czech Republic is expecting the culmination of its efforts in accession of the country to the European Union this year. Nature protection also represents one of the important areas whose legislation must become united with the European one. Nature protection has several-hundred-year-old tradition in the area of the Czech Republic, dating back to the reign of Charles IV, who concentrated especially on forests and game protection. Žofínský Virgin Forest (Žofínský prales) in the Novohradské Mountains (Novohradské hory), established in 1838, may be considered as the first really protected area in Bohemia. It is, at the same time, one of the oldest protected areas in Europe. Massive development of land protection could be seen only after World War II, when the protected areas' size was extending very quickly, and so, e.g. the large-scale protected areas' proportion to the state area is almost 15% today.

At the present time, the system is quite carefully worked-out and connected with the international systems of nature protection. The present systém's disadvantage is its institutionalization, when the citizens consider nature and lanscape protection to be the matter for experts and state administration. This situation should change together with the adoption of the project NATURA 2000, when nature protection should become the matter for the whole society.

SHRNUTÍ

HISTORIE A SOUČASNOST OCHRANY PŘÍRODY V ČR

Českou republiku čeká v letošním roce završení snah o vstup do Evropské unie. Jednou z důležitých oblastí, kterou musí sjednotit s evropskou legislativou, je i ochrana přírody. Ta má na našem území několikasetletou tradici, sahající až ke Karlu IV., který se zaměřil především na ochranu lesů a lesní zvěře. Za první skutečné chráněné území je pak možné považovat Žofínský prales v Novohradských horách, které bylo zřízeno v roce 1838. Je zároveň i jedním z nejstarších chráněných území v Evropě. Mohutný rozvoj územní ochrany přírody byl v České republice zaznamenán až po druhé světové válce, kdy rozloha chráněných území narůstala značným tempem, takže dnes například představuje podíl velkoplošných chráněných území na rozloze státu téměř 15%. V současnosti je systém poměrně dobře propracovaný, napojený na systémy mezinárodní ochrany. Nevýhodou současného systému je jeho institucionalizace, kdy občané chápou ochranu přírody a krajiny jako záležitost odborníků a státní správy. Tento stav by se měl změnit zavedením projektu NATURA 2000, kdy by se ochrana přírody měla stát skutečně veřejnou záležitostí.

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© Mgr. Lukáš Slouka
Gymnázium Ostrava – Hrabůvka
Fr. Hajdy 34
Ostrava – Jih
Czech Republic
slouka@ghrabuvka.cz

Reviewed:
Mgr. Andrea Petrová, Ph.D.

ANTHROPOGENIC RELIEF TRANSFORMATIONS AS A CONSEQUENCE OF EXTRACTION OF MINERALS IN THE ORLICKA TABULE PLATEAU (NORTH-EAST BOHEMIA)

I. Smolová[1]

[1] Department of Geography, Natural Science Faculty, Palacký university of Olomouc, Svobody 26, 771 46 Olomouc, Czech Republic – smolova@prfnw.upol.cz

Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

The paper deals with changes of relief that appear due to the extraction of minerals in the area of the Orlická tabule plateau. The extraction area of Světlá nad Orlicí, due to the rising volume of extraction of gravel sand and its concentration within the southern part of the Orlická tabule plateau (the confluence area of Tichá Orlice and Divoká Orlice Rivers), is a good illustrative example as shown at the end of this paper.

KEY WORDS: anthropogenic relief transformation, Orlická tabule plateau

1. INTRODUCTION

Anthropogenic relief transformation is a transformation of the natural landscape (relief created by natural geomorphologic processes) into the cultural landscape (anthropogenic relief). The stage, extent and velocity of transformation is reflected in the landscape's ability in various stage of anthropogenic influence of natural response and the possibility of return to the original natural regime. Some of the interventions are of such character that the return to the natural functions of the landscape is not possible and the destruction of the natural landscape is permanent. The issue of anthropogenic forms of relief (their morphometric analysis, the origin and development of the forms) and anthropogenic transformation of relief in various natural conditions often appears in general geomorphologic literature, for example in works by M. Havrlant (1980), J. Duda (1981), J. Loučková (1981), M. Hrádek (1997), K. Kirchner et al. (2000, 2001), M. Konečný (1983), J. Škvor (1984), A. Ivan (1988), A. A. Belousov et al. (2000). Quantitative evaluations of anthropogenic relief transformations were carried out for example by L. Zapletal (1968, 1976), K. Kirchner (1985, 1988) – in the model area of Žďárské vrchy Landscape Protected Area, Teplicko or Podyjí National Park, or P. Červinka (2001).

2. THE ORLICKÁ TABULE PLATEAU ZONE OF INTEREST

The zone of interest is located in the eastern part of the Česká tabule plateau that geologically belongs to the Česká křídová tabule plateau.

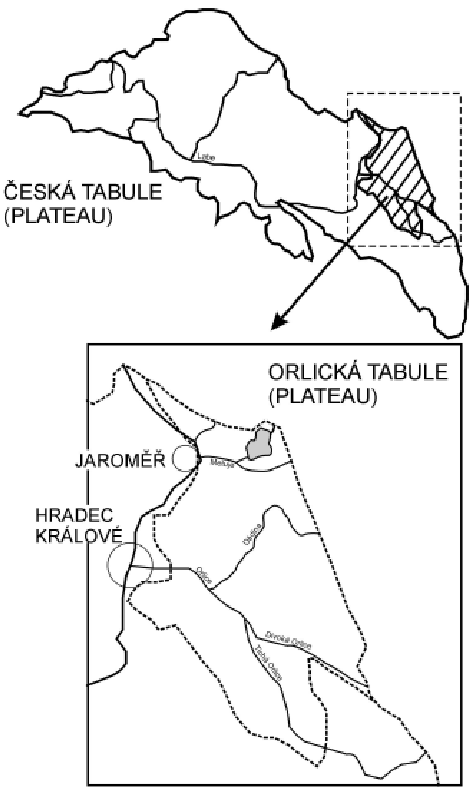

Fig. 1: Location of the Orlická tabule plateau

The Orlická tabule plateau is characterized as flat hilly area mostly in the catchment of Orlice, Úpa and Metuje Rivers with dominating accumulative relief. According to J. Demek et al. (1987), this area is characterized by mildly divided erosive-denudational and accumulative relief with structurally denudational plateaus and flat dividing ridges.

As for the morphological structure, the area is relatively homogenous (homogenous, comparable, natural landscape and potential) and enables analyses of influence of the extraction activities on the relief in a relatively large area. Considering the new geological, hydro-geological and geophysical findings on the structure and development of the Česká křídová tabule plateau (for example F. Herčík et al., 1999; J. Čurda, 1997), the issue of their interpretation at analyses of morphostructural characteristics and relief development in this area, which can contribute to harmonic use of the natural environment and its resources. With respect to the substantial natural potential of the area, namely its important accumulative areas of ground water, the issue of protection of the natural environment and its use in accordance with the sustainable development theory seems to be crucial. Nevertheless, this area has been often affected with considerable human interventions both in the past and at present, that damaged the natural landscape (namely water engineering adjustments) and often accelerated the geomorphologic processes.

3. LEGISLATIVE RESTRICTIONS

The mineral sources in the Czech Republic are owned by the state. They consist of deposits of selected minerals ("exclusive deposits"). Additionally, the protected deposit area is established for exclusive deposits of mineral resources, in accordance with the Mining Law no. 44/1988 Coll., that has already been amended ten times until now (the last amendment no. 320/2002 Coll.), where construction activities unrelated to the extraction of the exclusive deposit are limited.

Nowadays, in the area of the Orlická tabule plateau, there are 14 extraction areas of the total area of 13,9 km^2 (1,4 % of the total area of the territory) established in accordance with the Law no. 44/1988 Coll., The delimitation of the allotment is only the beginning of a procedure that will end with permission granted for mining entailing the beginning of the anthropogenic transformation of the relief. The ways of extraction and its limits are controlled by the Mining Law (no 44/1988 Coll.).

Extraction activities are also governed by the Nature and Landscape Protection Law (no. 114/1992 Coll.) and Water Law no. 254/2001 Coll.) that, as stated in § 28 of this Law, in the areas designated by the Government as Protected Zones of Natural Water Accumulation (CHOPAV), forbids extraction of pest fuel, dewatering of agricultural lands, reducing of forest lands and opencast extraction of minerals or other ground works that would result in the uncovering of the ground water table.

4. EXTRACTION POTENTIAL OF THE AREA

The area of the Orlická tabule plateau has a large natural potential. During the Great Ice Age, the Upper Cretaceous relief was affected with a vast fluvial erosion caused by the change of climate and covered with a discontinuous layer of sediments of fluvial and locally eolic origin. Eolic sediments originated by wafting out from the surface of the older terraces and their occurrence relates to them. In fluvial accumulations of Pleistocene, seven main terraces were established in the Orlická tabule plateau. The thickness of gravel sand varies from several metres to maximum 20 meters, which makes them potential sources of gravel sand of average thickness of 8 meters.

In the category of minerals, the area's greatest potential is in the quality deposits of gravel sands and brick clay and, in its peripheries and in limited extent, also in building materials (namely marlstone). The gravel sand deposits are represented by diluvial terrace accumulations of Rivers of Metuje and Orlice and its tributaries. The deposits of brick materials are located in the area of accumulation of loess loam of Pleistocene that is usable for production of thick-walled building elements. Marlstone was extracted especially at the end of the 19th century and in the first half of the 20th century, when they were used for local needs (building of houses, material for tiling works).

The extraction of minerals in the Orlická tabule plateau continued until the end of 1960s, mainly for local consumption, relatively evenly spread within the whole territory. Small sandpits and gravel-pits were opened in a majority of villages. In accordance with the archive documents and surveys of pits taken in the 1950s (for example in works by A. Polák, 1951), many of them were disused at that time, some of them were reclaimed others used for other purposes. Totally, 247 mining anthropogenic forms were identified within the territory of the Orlická tabule plateau. Nearly half of them were shelf pits used for extraction of Turonian marlstone (sandy marl). Pit quarries represent about one fifth of the total number and the rest are sandpits and other pits and extraction territories, mostly of smaller areas (up to 500 m^2). The development of large-area mining begins in the 1960s (see Figure 2), and reaches its peak after 1989 (namely gravel sands). Unfortunately, the most serious damages of natural environment are caused by extraction of gravel sand.

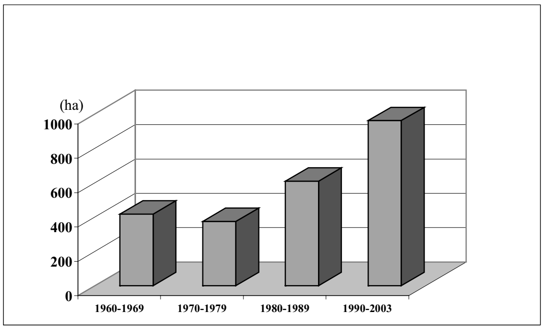

Fig. 2: The development of extracting areas in Orlická tabule plateau in the period 1960 – 2003 (designated total area of extracting territories in a particular period)

At present, the extraction of gravel send concentrates in the confluence area of Tichá Orlice and Divoká Orlice Rivers (Fig. 4), where the largest extraction territories are Běleč nad Orlicí (333.8 ha), Světlá nad Orlicí (393.8 ha) and Lípa nad Orlicí – Rašovice (324.0 ha). The extraction activities damaged mostly the 6th and 5th terrace accumulations in the catchment of Orlice River (see B. Balatka, J. Sládek, 1966). The terrace accumulation of the 6th terrace reaches the largest thickness in the neighbourhood of Choceň (CHLÚ Újezd u Chocně), where the terrace was created as a consequence of sudden change of the rate of grade of Orlice River when leaving the Potštejn cretaceous anticline and in the confluence area of Tichá and Divoká Orlice Rivers (DP Světlá nad Orlicí). The extraction of gravel sand in these extraction territories is carried out by the dry-getting method (the higher levels of terraces over the aquifers are mined), while non-exclusive deposits (small sandpits and gravel-pits) are extracted from the alluvial plain with following origin of water areas in inundation zones.

Their existence has an adverse effect especially at inundation situations, when the infiltration area of alluvial plain is substantially reduced.

5. ORIGIN OF NEW FORMS AND ANTHROPOGENIC-CONDITIONED PROCESSES

The extraction activities within the area of the Orlická tabule plateau gave origin to new forms of relief that can be divided into five principal groups:

- shelf pits – originated by the extraction of building materials (marlstones in the Orlická tabule plateau)
- pit quarries
- extraction shafts (sandpits, gravel-pits)
- bench sandpits – originated by vast mining within the extraction territory
- clay pits – extraction territories of clay materials

Shelf pits in the Orlická tabule plateau were created by the extraction of marlstones. Shelf pits and pit quarries are concentrated within peripheral territories of the plateau and at the feet of anticlines (Opočno, Potštejn and Libřice). The anthropogenic transformation of relief is caused by the very origin of the extraction form, which accelerates the slope development process. At the place of the pit's shelf, the slope makes way for the extraction activities, which is under natural geomorphologic processes most often caused by fluvial erosion when washing out the valley side. When the shelf pit is left (majority of them have not been used since the 1950s), the quarrying at the place of the pit's shelf is accelerated by frost-shattering processes or, in the case of calciferous content, also by karsting processes. Acceleration is caused by the large angle

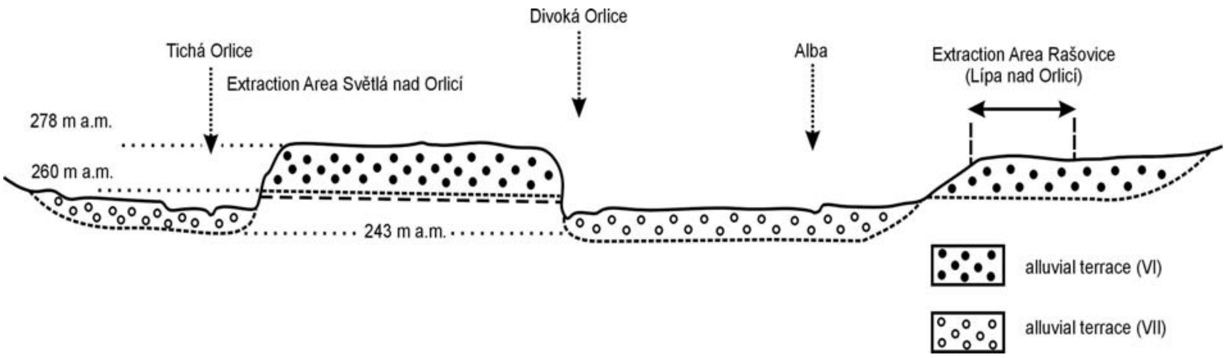

Fig. 3: Profile of the extraction area Světlá nad Orlicí and Lípa nad Orlicí

Tab. 1: Designated protected deposit areas and extracting areas in Orlická tabule plateau (by the 31. 12. 2003)

Protected deposit area		**Mining space (claim)**		**raw material**
locality	**area (ha)** [1)]	**locality**	**area (ha)** [2)]	**(extracted mineral)**
Běleč nad Orlicí	375.3	Běleč nad Orlicí I	309.5	gravel sand
		Běleč nad Orlicí II	24.3	gravel sand
Vlkov u Jaroměře	118.1	Vlkov	97.6	gravel sand
Pulice	36.8	Pulice	13.4	brick raw materials
Kostelec nad Orlicí	82,2	Kostelec nad Orlicí	43.5	brick raw materials
Kostelec nad Orlicí	149.1	Zdelov	98.1	gravel sand
Borohrádek	22.9	Borohrádek	11.4	gravel sand
Světlá nad Orlicí [3)]	402.6	Žďár nad Orlicí	393.8	gravel sand
Rašovice [3)]	348.6	Lípa nad Orlicí II	21.8	gravel sand
		Lípa nad Orlicí III	294.5	gravel sand
Kostelecké Horky	53.2	Kostelecké Horky	41.2	gravel sand
Ledce	262.2	Ledce	45.6	gravel sand
Běstovice	26.2	Běstovice	12.4	gravel sand
Újezd u Chocně	389.6	Újezd u Chocně	21.0	gravel sand

1) Total area of protected deposit areas
2) Total area of claims
3) As yet unspecified

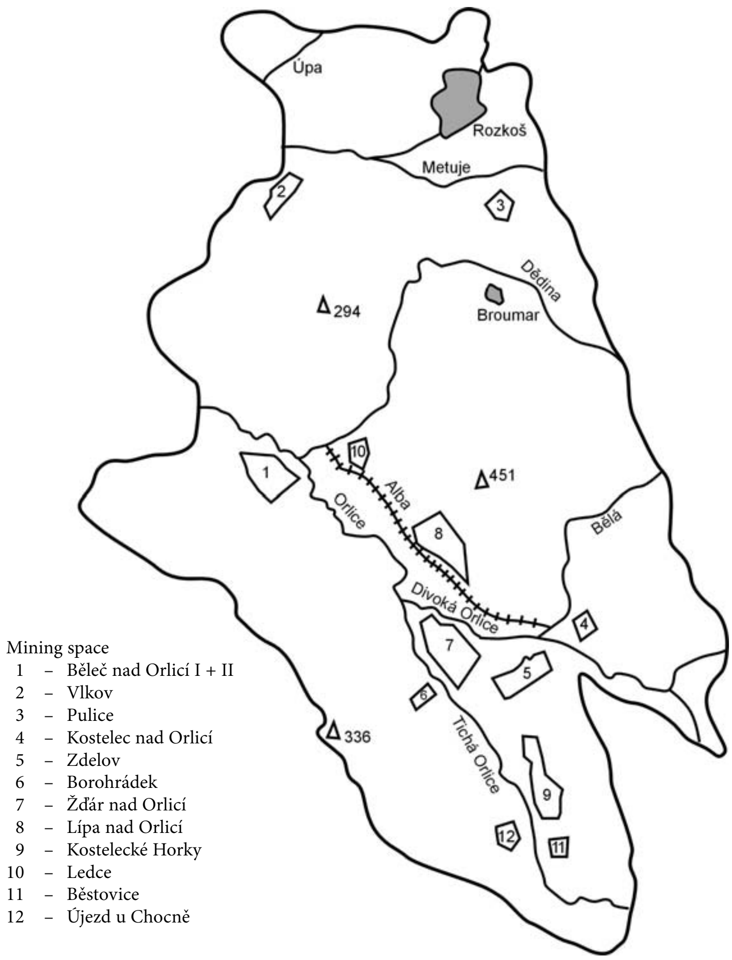

Fig. 4: Extracting areas (mining space) in Orlická tabule plateau (by the 31. 12. 2003)

of slope of newly originated mining shelves and the absence of the soil overlay in the area uncover by extraction and thus exposed to the influence of exogenous agents. In the case of the **pit quarries,** the rainfall water concentrates on the bottom of the pit, penetrates through cracks into the subsoil and enlarges the cracks when changing its state of matter.

Extraction shafts (sandpits, gravel-pits) are depressions of oval plan mostly originated by extraction from the alluvial plains (at the level of the lowest terrace). Extraction in the alluvial plain reaches the level of the groundwater table (infiltrating from the riverbed) and results in creation of new water areas. The origin of the inundated depression does not change the relief division. The anthropogenic-conditioned processes occur in the extraction area within the course of the extraction as well as after its termination. Abrasive processes wash out the sides and cause landslides in the banks' areas. The origin of some new landscape elements caused by smaller extraction forms can be evaluated as positive. Especially if, after the extraction activities, the specific condition of the pits (e.g. watered bottom, insolated slopes of the extraction shelves) enables development of azonal vegetation, which increases the biodiversity of the territory.

Fig. 5: Extracting gravel sand in the alluvial valley of Tichá Orlice River - locality Borohrádek (Photo I. Smolová, 2003)

Bench sandpits origin by vast extraction within the extraction territory on higher river terraces. If the extraction basis does not reach the level of the ground water, it is so-called "dry-getting" that is typical for the southern area of the Orlická tabule plateau. The bench sandpits cause the origin of very unstable slopes. The instability is caused by material (gravel sand) and steep slopes. The sandpits slopes without vegetation cover quickly submit to destructive effects of exogenous agents. The newly originated forms have not a long term of existence (transient forms). For example erosive gullies, ravines, and sliding blocks. The deepest ravines in the extraction area Světlá are 5 meters deep.

Fig. 6: Bench sandpit in the extracting area Světlá nad Orlicí (Photo I. Smolová, 2003)

Clay pits are mostly extraction areas of "pit quarry" or "shelf pit" character, in the Orlická tabule plateau they do not reach a large size. The extraction areas often include a plant processing the extracted mineral (brickworks). The largest extraction area in this territory is Kostelec nad Orlicí (Kinský brickworks) with clay of a very mixed quality, where the extraction formed a shelf of 15 meters of height. Different resistance and permeability of the individual extracted layers cause selective erosion and the slopes are often affected with landslides.

5. 1. Extraction Area Světlá (Cadastral District Žďár nad Orlicí)

The deposit of gravel sand lies on the cretaceous subsoil that rises above the level of the alluvial plains of Tichá Orlice and Divoká Orlice Rivers in their confluence area. The cretaceous subsoil has a roughly triangular shape and the genesis of the salient is conditioned by the erosive activities of both Orlice Rivers that flow around it. In the rock cover above the cretaceous sandstones, there are clays and claystones whose surface dip at the same angle as the watercourses. Directly on them, there is the level of the 6^{th} terrace.

The terrace base height is 258,7 metres above the sea level, i.e. the relative height o 6 meters above the present valley bottom. The original surface with the relative height of about 25 meters above the river is preserved only in the central section of the terrace, at the borders, in the area not affected by the extraction so far, there are deeply eroded cross valleys (see profile (Fig. 3, Fig. 7)). The terrace accumulation has two different levels. On the cretaceous subsoil mouldered to various extend, there is the lower terrace made of sterny or even bouldery gravel of maximum thickness of 4.4 m (E. Mališ, 1974). The deposit of the upper terrace has a better quality as for extracting activities and maximum thickness 16 meters. The analyses prove that the bottom and upper accumulations have different source areas. Material at the basis of the terrace was brought mostly by Divoká Orlice River, while the composition of the upper terrace corresponds with the source area of Tichá Orlice River.

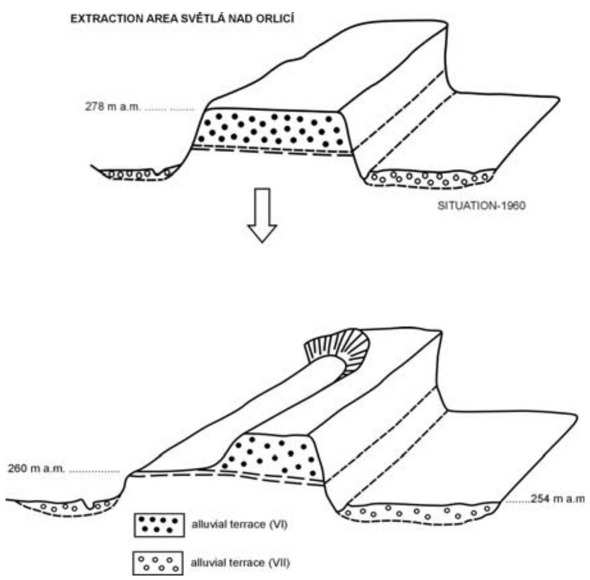

Fig. 7: Transformation of relief caused by extracting activities (1960 – 2003)

The extracting activities lead to substantial changes of relief. The extraction damages the terrace system of Orlice that brings evidence of the development of the fluvial activities in the territory in Pleistocene. The absolute level of the area decreases by 15 meters with the negative consequence of decreasing surface of the infiltration area (determined permeability of the 6th terrace accumulation is 1 – 10 cm/s). In the damaged terrace accumulation, the infiltrated water accumulated on the non-permeable clay subsoil at its border is drained to lower terrace of Orlice River, in the south-east section, it is drained by the Brodec brook. Thanks to the decline of the terrace subsoil, the dip between the terrace ends reaches 6,5 meters. Considering the fact that the extracted terrace level is dry and the ground water accumulates at the non-permeable clay subsoil on the terrace basis, drawing the terrace level brings a substantial reduction of the infiltrative area.

6. CONCLUSION

The extraction of minerals in the Orlická tabule plateau continued until the end of 1960s, mainly for local consumption, relatively evenly spread within the whole territory. Totally, 247 mining anthropogenic forms were identified within the territory of the Orlická tabule plateau. Nearly half of them were shelf pits used for extraction of Turonian marlstone (sandy marl). Pit quarries represent about one fifth of the total number and the rest are sandpits and other pits and extraction territories, mostly of smaller areas (up to 500 m^2). The development of large-area mining begins in the 1960s, and reaches its peak after 1989 (namely gravel sands). The extraction activities within the area of the Orlická tabule plateau gave origin to new forms of relief that can be divided into five principal groups: shelf pits – originated by the extraction of building materials (marlstones in the Orlická tabule plateau); pit quarries; extraction shafts (sandpits, gravel-pits); bench sandpits – originated by vast mining within the extraction territory and clay pits – extraction territories of clay materials. From the geomorphologic point of view, the extraction activities damage the unique terrace fluvial system of Orlice and Metuje Rivers. It is also very questionable to locate the large extraction territories in the close proximity of alluvial plains of Rivers. For example, the alluvial plain of Divoká Orlice ranks among the bio-corridors of European importance.

SUMMARY

Generally, the mineral deposits are a potential source of conflict of interests not only during the original surveying and the extraction itself, but also within the procedures of development plans, urban general plans or waste economy planning studies, in areas with quality land fund or housing development and dense communication network. Local extracting activities carried out mostly by farm cooperatives (extraction of natural materials of melioration for reclamation of light sandy soils) do not bring substantial problems in the territory of the Orlická tabule plateau. On the other hand, the large-area opencast extracting of sand and gravel sand concentrated in the southern part of the Orlická tabule plateau (catchment of Tichá and Divoká Orlice Rivers - Borohrádek, Světlá nad Orlicí, Lípa nad Orlicí and Běleč) represent substantial intervention into the landscape. The biggest problem is the danger of contamination of surface water and ground water resulted from extracting activities in the territories with substantial accumulation of ground water.

The large-area extractions cause a reduction of land fund and a decrease of forest percentage. The

extraction activity itself brings local network traffic loads as the building materials (with the exception of the brick clay) are not processed on the spot and must be transported in large volumes. Another adverse effect is a large anthropogenic relief transformation that leads to overall reduction of relative altitudinal division, which, together with reduction of the infiltrative horizon, has a negative effect on the surface detention rate.

From the geomorphologic point of view, the extraction activities damage the unique terrace fluvial system of Orlice and Metuje Rivers. It is also very questionable to locate the large extraction territories in the close proximity of alluvial plains of Rivers. For example, the alluvial plain of Divoká Orlice ranks among the bio-corridors of European importance. Next to the extracting area Běleč nad Orlicí, there is a Poorlicko biocentre of the total area of 110 km^2. Thanks to its uniquely preserved natural non-regulated section of the Orlice River with numerous meanders and crescentic lakes with designated small-area reserves, this region gains a European importance. Besides, the area along the Orlice River was designated the Nature Reserve and on the fluvial terraces, that are the most often objects of extracting, there are numerous occurrences of azonal communities on sands, moors or swamps.

SOUHRN

ANTROPOGENNÍ TRANSFORMACE RELIÉFU V DŮSLEDKU TĚŽBY NEROSTNÝCH SUROVIN V ORLICKÉ TABULI (SV ČECHY)

Svrchnokřídový reliéf Orlické tabule byl v průběhu starších čtvrtohor v důsledku změn klimatu postižen rozsáhlou fluviální erozí a nesouvisle překryt sedimenty fluviálního a lokálně eolického původu. Mocnosti štěrkopísků se pohybují od několika metrů po maximálně 20 metrů, což z nich činí potenciální zdroj štěrků a písků o průměrné mocnosti přibližně 8 metrů. V místech, kde vystupují na povrch předkvarterní struktury, jsou předmětem těžby zejména turonské pískovce a slínovce. Z historického hlediska probíhala těžba surovin v Orlické tabuli do konce 60. let 20. století, převážně pro místní spotřebu, relativně rovnoměrně na celém území. Ve většině obcí byly otevřeny malé lomy, pískovny a štěrkovny. Podle archivních materiálů a soupisů lomů pořizovaných v 50. letech jich řada byla opuštěna již v tomto období, některé z nich byly rekultivovány, jiné následně využity. Celkem bylo v zájmovém území Orlické tabule zmapováno 247 těžebních antropogenních tvarů. Téměř polovinu z nich tvoří stěnové lomy využívané pro těžbu turonských slínovců (opuk), pětinu jámové lomy a zbývající část pískovny a ostatní lomy a těžební prostory. Většinou se jedná o malé lomy a pískovny (řádově do 500 m^2), které jsou již neaktivní. K rozvoji velkoplošné těžby došlo počátkem 60. let a největší intenzity nabývá těžba po roce 1989 (zejména štěrkopísky). Koncentruje se do jižní části Orlické tabule, kde je těžební činností nejvíce narušena VI. a V. terasová akumulace v povodí Orlice. Společným znakem těžby štěrkopísků ve stanovených velkých dobývacích prostorech je suchý způsob těžby (těží se vyšší terasové úrovně nad zvodnělými vrstvami). V menších těžebních prostorech nevýhradních ložisek (malé pískovny a štěrkovny) probíhá těžba z údolní nivy s následným vznikem vodních ploch v inundačním území. Jejich existence se negativně projevuje zejména za povodňových situací, kdy se v nivě výrazně snižuje infiltrační prostor.

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© RNDr. Irena Smolová, Ph.D.
Department of Geography
Natural Science Faculty
Palacky University of Olomouc
Třída Svodbody 26
771 46 Olomouc
Czech Republic
smolova@prfnw.upol.cz

Reviewed:
RNDr. Karel Kirchner, CSc.

ENVIRONMENTAL REFUGEES – INTRODUCTION

Robert Stojanov

Department of Geography, Natural Science Faculty, Palacký University, Olomouc, Svobody 26, Czech Republic - iguana@prfnw.upol.cz
Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

This paper provides a short report about subject environmental refugees as a significant group of migrants and gives essential information for understanding this topic. Main reasons for fleeing the people from their houses and homelands and their situation in the field of international law are another topics of this article together with predicting number of environmental refugees and principal motivations for researching the phenomenon.

KEY WORDS: environmental refugees, global issues, climate changes, environment

1. PREFACE

According to annual report of United Nations Populations Fund „migration is a barometer of changing social, economic and political circumstances, at the national and international levels“ (UNFPA, 15). But report does not refer to environmental conditions which contribute to migration. In the news we can see people sitting on the roofs of their houses trying to escape rising water; people beside ruins their houses after an earthquake; people who had to leave their houses and fields due to deficiency of water or nuclear disaster. They are refugees too, but not accepted by international law.

The debate about issue of "environmental refugees (migrants)" is becoming more frequent in scientific as well as humanitarian field. Many articles and studies have emerged since 1990s and first years of this century, including studies for principal organizations and agencies which are responsible for matters of migration or refugees or prestigious scientific institutions and workplaces of universities.[1]

2. DEFINITIONS

The term "environmental refugees" was popularized first time by Lester Brown from the Worldwatch Institute in the 1970s, but first, who most paid attention on the subject were Essam El-Hinnawi and Jodi Jacobson (Black, 2001, 1). El-Hinnawi defines the concept of environmental refugees in 1985 in the report for United Nations Environment Program and calls these refugees as people "who have been forced to leave their traditional habitat, temporarily or permanently, because of a marked environmental disruption (natural and/or triggered by people) that jeopardized their existence and/or seriously affected the quality of their life. By ´environmental disruption´ is meant any physical, chemical and/or biological changes in ecosystem (or the resources base) that render it temporarily or permanently, unsuitable to support human life" (LiSER).

According to Norman Myers (1994, 2001) environmental refugees are people who can no longer gain a secure livelihood in their homelands because of drought, soil erosion, desertification and other environmental problems, together with the associated problems of population pressures and profound poverty. In their desperation, these people feel they have no alternative but to seek sanctuary elsewhere, however hazardous the attempt. Not all of them have fled their countries, many being ´internally displaced´. But all have abandoned their homelands with little hope of foreseeable return.

LiSER Foundation, which is specialized on this issue, simply defines environmental refugees on their web sides like a "people getting in trouble because their livelihoods have been damaged due to natural or human causes" (LiSER).

3. MAIN REASONS OF DISPLACEMENTS

There is a typology of the most frequently mentioned reasons for worsening environment because of the people become (or would become) refugees (compare with Lonergan, 1998; Rábelová, 2000; Blaikie, 2001).

1. Natural Disasters
   a) floods
   b) earthquakes

[1] Comparing results of advanced searching by Google (23.2.2004) we can find 8,180 references in English and only 2 references in Czech for exact phrase "environmental refugees – environmentální uprchlíci"; 320 references in English and 13 references in Czech for the exact phrase "environmental migration – environmentální migrace".

c) volcanic eruptions
d) landslides
e) severe coastal storms (include tropical cyclones)

They are usually characterized by a rapid onset, and their devastating effect is a function of the number of vulnerable people in the region rather than the severity of the disaster. “Poor people in developing countries are the most affected because they are the most vulnerable” (Lonergan, 1998, 50)

2. <u>Cumulative (Slow-Onset) Changes</u>
   a) desertification
   b) soil degradation and erosion
   c) droughts and deficiency of safe water
   d) climate changes (global warming)
   e) sea-level rise
   f) famine

Cumulative changes are, in general, natural processes existing at a slower rate which are interacted and advanced by human activities. Lonergan (1998, 50-52) claim that “human induced soil degradation is one factor which directly affects economic sufficiency in rural areas to water availability is another factor that may affect sustainable livelihoods… Do factors like water scarcity and human-induced soil degradation in and of themselves cause population displacement? The linkage is much more indirect; in most cases, one or more of rapid population growth, economic decline, inequitable distribution of resources, lack of institutional support and political repression are also present“. But in the event of validity of the theory human impacts on climate changes we are not capable to precisely recognize what is the clear natural causality (except, of course, volcanic eruptions and earthquakes[2]) and what is natural hazards or disasters influenced by humans (such as floods, drought, hurricanes due to global warming, etc). There are combinations of human and natural factors very often.

3. <u>Involuntarily Cause Accidents and Industrial Accidents</u>
   a) nuclear accidents
   b) disasters of industrial (e.g. chemical) factories
   c) environmental pollution

This category includes chemical factories, transport, nuclear reactor accidents and environmental pollution (air, land, water). The two most obvious examples are the nuclear accident at Chernobyl, in Ukraine (former USSR) in 1986, and the Union Carbide accident in Bhopal, India, in 1987. „Between 1986 and 1992, there were more than 75 major chemical accidents which killed almost 4,000 persons worldwide, injured another 62,000, and displaced more than 2 million. Most of the displacements, however, were temporary. In the case of the accident at Bhopal, despite the death of 2,800 people and illnesses to 200,000 more, there was virtually no mass movement of population out of the region” (Lonergan, 1998, 52).

4. <u>"Development” Projects</u>
   a) construction of river dams
   b) irrigation canals
   c) mining (extracting) natural resources

It has been estimated that development projects in India forced over 20 million persons to leave their habitats in the past three decades. The Three Gorges Dam project in China—expected to displace 1 million persons probably (Lonergan, 1998, 52).

5. <u>Conflicts and warfare</u>
   a) biological warfare
   b) destruction of environment
   c) wars due to natural resources

Environmental degradation is considered by many authors to cause and effect of armed conflict, the evidence of wars being fought over the environment are conflicts over land and natural resources. Lonergan (1998, 53-58) claims that “there is an increasing use of the environment as a “weapon” of war or strategic tool”. He states examples the threat by Turkey to restrict the flow of the Euphrates to Syria and Iraq in order to pressure Syria to discontinue its support of Kurdish separatists in Turkey, the purposeful discharge of oil into the Persian Gulf during the Gulf War (1990-1991) and the destruction of irrigation systems during conflicts in Somalia. Such activities have similar consequences as the slow-onset changes noted above. “But in these cases, it seems clear that the “environment” is merely a symptom of a larger conflict, and the root cause of any population movement is the conflict itself, and the reasons behind it” (Lonergan, 1998, 53-55).

In a similar way report of CIA “Global Trends 2015” (CIA, 2000, 28) estimates that “nearly one-half of the world's land surface consists of river basins shared by more than one country, and more than 30 nations receive more than one-third of their water from outside their borders”. And as soon as countries reach the highest limits of available water resources, the possibility of conflict will increase.

4. TYPOLOGY

El-Hinnawi and Jacobson created typology of environmental refugees to three sub-categories (Black. 2001, 2; see LiSER).

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[2] For human impacts on earthquakes see BUZEK, Ladislav (1997): *Základy geoekologie.* Ostravská univerzita, Ostrava, p.22-23.

a) Temporary displacement people
After the disasters like floods, earthquakes, volcanic eruptions people can return to their habitats and start rehabilitation livelihoods and reconstruction their houses. These events can happen periodically. For instance alone hurricane Mitch displaced 1,2 million people in Central America, floods in Peru (in 1998) and in Mexico (in 1999) displaced in both countries 500,000 people (McGirk, 2000).

b) Permanent displacement people
Permanent displacement created by the disasters like an effect of "development projects" (e.g. large dams, industrial events, mining etc). Potentially the refugees affected by rise of sea-level due to climate changes will belong to this group in the future.

The World Commission on Dams (WCD) published in 2000 report in which evaluated impacts of building the large dams in the second part of 20th century. The displacement is reported from 68 of the 123 dams (56 per cent), mainly in Asia, Africa and Latin America large dams like one of the form of displacement forced to leave from 40 – 80 million people from their livelihoods and homes, for example 10,2 million in China between 1950 and 1990 (34 per cent all development-related displacement including that due to urban constructions) according to official statistics. "But independent sources estimate that the actual number of dam-displaced people in China is much higher than the official figure" (WCD, 2000, 102-104). Large dams in India forced to leave 16-38 million people. But these numbers "do not include the millions displaced due to other aspects of the projects such as canals, powerhouses, project infrastructure …" (WCD, 2000, 104). Unfortunately, "resettlement programmes have predominantly focused on the process of physical relocation rather than the economic and social development of the displaced and other negatively affected people. The result has been the impoverishment of a majority of resettlers …" (WCD, 2000, 103).

c) Temporary or permanent displacement people
Sometimes – for instance after a period of drought – the displaced people indeed can go back to their original habits, but with uncertain future. For instance on September 2002 New Scientist on their web side (Pearce, 2002) published report written by team of geographers from Britain, Sweden and Denmark who had re-examined archive satellite images taken across the Sahel and found out that "vegetation seems to have increased significantly" in the past 15 years, with major regrowth across swathe of land stretching from southern Mauritania, northern Burkina, north-western Niger, central Chad, much of Sudan and parts of Eritrea, 6000 kilometres long. "Survey among farmers showed a 70 per cent increase in yields of local cereals (sorghum, millet) in one province in recent years", confirmed Chris Reij from the Free University, Amsterdam (Pearce, 2002). His colleague Kjeld Rasmussen from the University of Copenhagen "believes the main reason is increased rainfall since the great droughts of early 1970s and 1980s. But farmers have also been adopting better methods of keeping soil and water on their land." (Pearce, 2002)

5. THE RULE OF INTERNATIONAL LAW

The international refugee legislation likewise the main organization responsible for refugees on the world level – United Nations Commissioner for Refugees (UNHCR) – both were established more than fifty years ago and originally were meant for the huge number of displacement people after World War II. The Treaty of Geneva from 1951 calls refugees "as persons forced to flee across an international border because of a well-founded fear of persecution based on race, religion, nationality, political opinion or membership of particular social group". (UNHCR 1951; UNHCR, 2002) "The main conditions are that a person finds himself in a foreign country and does not have legal protection in the country of his nationality... people are on the move for other reasons then just war or violence" (LiSER).

Many critics argue that times have changed during the last few decades. There are, at least, two reasons for changing – categories persons called "internally displaced peoples" and "environmental refugees (migrants)" because of that at this moment the international law does not recognize them as refugees and they can not count with any material or juridical support of institutions like the UNHCR or government agencies (compare with Black, 2001, 1; LiSER; UNHCR, 2002;). There is one of the reasons why we have not enough information about exact numbers of environmental refugees.
And there is another (ethical) question, "is it right that while some states are far more responsible for creating problems like climate change, all states should bear equal responsibility for dealing with its displaced people?" (UNHCR, 2002).

6. ENVIRONMENTAL MIGRATION AS A GLOBAL PROBLEM

Some authors declare that number of incidents, that cause people to leave their houses from environmental problems, is increasing rapidly and they perceive this as a global serious issue, mainly for the future. Norman Myers is ranked among people interested in this phenomenon and he confided that "environmental refugees could become one of the foremost human crises of our times" (Myers, 1994). Myers (1993, 1994) presented first reports about numbers of environmental refugees ten years ago, he estimated there was more than 25 million environmental refugees (10 million recognized, 15 million unrecognized) and it is greater than 18 million officially recognized refugees (political, religious, ethnic). "We can fairly assume, moreover, that the total is likely to swell rapidly as burgeoning numbers of impoverished people press ever harder on over-loaded environments." (Myers, 1994)

Myers (1993, 1994) conservative estimate for 2050 is between 150 million and 200 million environmental refugees equates 1,5 per cent (respective 2 percent) of 2050´s predicted global human population (10 billion people) due to sea-level rise and agricultural distribution caused by global warming and climate changes mainly. He counts with 50 million globally displaced people due to climate change-induced famine. "Detailed analysis of the impact of climate change on agriculture suggests that by the year 2060 global warming may decrease cereal production in developing countries by 9-11 per cent" (Myers, 1993).

Egypt would lose 12-15 percent of its arable land and "given Egypt's predicted population for 2050 it is realistic anticipate that sea-level rise may displace more than 14 million people", as well as region of Shanghai, where government of China calculates that "30 million people may be displaced due to global warming impacts". Sea-level rise coupled with increase of inland floods (from melting Himalayan glaciers) would affect estimating 142 million inhabitants of India's coast living of flood zones and people from Bangladesh (see Table No.1). His "conservative" approximation is 30 million environmental refugees for India and 15 million for Bangladesh (see Figure: *Sea-level rise in Bangladesh*). Brown (2004) presents that "only" one meter rise in sea-level would inundate half of Bangladesh's riceland and forcing the relocation of easily 40 million people. "Other delta areas at risk include Indonesia, Thailand, Pakistan, Mozambique, Gambia, Senegal and Suriname" (together 10 million estimated environmental refugees) as well as number of islands, such as Maldives, Kiribati, Tuvalu, the Marshalls and some small islands in the Caribbean (1 million). He also warns of safe water problems caused by pollution of sea salt water which would encourage mass migration (Myers, 1993, compare with Novák, 2004). And Brown is asked, how many countries would accept even one million of Bangladesh's 40 million? (Brown, 2004)

Myers (2001b, 611) modified in May 2001 his own forecasts about total numbers of people at risk of sea-level rise (not environmental refugees, you can see the change of style), "in Bangladesh could be 26million, in Egypt 12 million, in China 73 million,

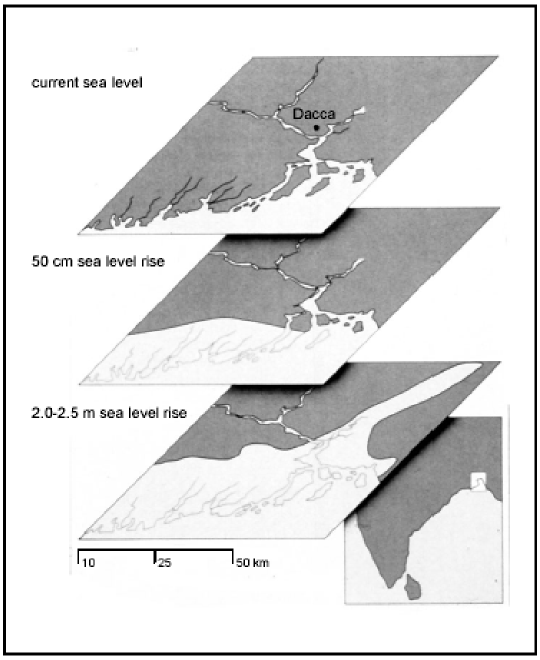

Figure: *Model of sea-level rise in Bangladesh*
Source: Myers (2001a)

in India 20 million and elsewhere, including small island states, 31 million, making of total of 162 million. At the same time, at least 50 million people could be at severe risk through increased droughts and other climate dislocations". But when you have lecture in Japan at occasion of his laureate of the Blue Planet Prize by The Asahi Glass Foundation at the same year he presented a little bit different numbers (Myers, 2001a). You can see Table: *People at risk in a globally-warmed world*. There is evidence of not clarify the definitions of names or methodology for determining of numbers.

Table: *People at risk in a globally-warmed world*

PEOPLE AT RISK IN A GLOBALLY-WARMED WORLD

Country/Region	Millions at risk
China	77
Bangladesh	28
India	23
Egypt	15
Island States	1
Drought areas	60
Total	204

Source: Myers (2001a)

Lester R. Brown presents "some 400 to 600 Mexicans leave rural areas every day, abandoning plots of land too small or too eroded to make a living. They either head for Mexican cities or try to cross illegally into the United States. Many perish in the punishing heat of the Arizona desert. Another flow of environmental refugees comes from Haiti, a widely recognized ecological disaster" (Brown, 2004). And he provides that in China, where the Gobi Desert is growing by 10,400 square kilometers a year the refugee stream is swelling. "Asian Development Bank preliminary assessment of desertification in Gansu province has identified 4,000 villages that face abandonment". (Brown, 2004).

Environmental degradation, nuclear disaster, building of irrigations canals and about 700,000 environmental refugees, there are the reasons of policy of soviet leaders and one of the clearest examples of environmental migration (UNHCR, 1996; UNHCR 1997, Box 1.2). According the report of UNHCR (1997, Box 1.2) "much of the Central Asia is affected by problems such as soil degradation and desertification by decades of agricultural exploitation, industrial pollution and overgrazing. During the Soviet years, irrigations schemes were introduced throughout the region (Aral Sea area), so that cotton could be cultivated on an intensive and continuous basis. Poorly designed and badly managed these irrigations schemes (mainly on rivers Amu Darya and Syr Darya) led to the large-scale wastage of scares water resources and the degradation of the land as a result of salinization". Using massive amounts of chemicals makes contamination of water, land and food. Around 270,000 people in the region were displaced for such reason (UNHCR, 1997). More than 45,000 people have moved from the Semipalatinsk in Kazakstan to safer areas in the country since independence. Semipalatinsk was hosted one of the Soviet largest nuclear missile testing-sites (UNHCR, 1996).

The Chernobyl nuclear power plant explosion took place in 1986 and there are as many as 9 million people living in Ukraine, Belarus and the Russian Federation may have been directly or indirectly affected. "At least 375,000 people (150,000 million in both Ukraine and Belarus; 75,000 in Russian Federation) had to leave their homes in the immediate aftermath of the accident." (UNHCR, 1996)

Miroslav Vaněk (1996, 48) presents in his study, with typical name "*Nedalo se tady dýchat" (The Breathing was impossible here),* that the North Bohemia region have left 50,000 people due to environmental pollution in 1960s. Communist functionaries were trying to prevent another flights by guarding of information about condition of pollution air, increasing of wages and social benefits and also because of decision by government of Czech Socialist Republic[3] in 1984 there was prohibited employing of medics from North Bohemia outside this region (Vaněk, 1996, 63). Author characterized this situation like a "modern thralldom". At the same time because of escalated mining of coals was induced destroying 116 villages in the previously described region (Vaněk, 1996, 60) – known as "Black Triangle", together with parts from Poland and former German Democratic Republic.

7. CURRENT DISCUSSION

Is the issue of environmental refugees (migrants) new or old phenomenon? What does it indicate for present time?

Richard Black (2001, 6) argue (on the base of study by Glazovsky a Shestakov) that migration away from desertification areas "is not new, including as ´desertification-induced migration´ such a movement as the migration of Mongolia tribe northwards in the second century B.C. due to drought…"

Norman Myers (1994) claims that people have migrated in large numbers and proportions in the past mainly due to deficits of natural resources (e.g. land, famines). "But the present area is altogether different and environmental problems ahead could swiftly match all those of previous centuries combined. Countries such as Philipines, Ivory Coast and Mexico can lose bulk of their forests within half a human lifetime. Countries such as Ethiopia, Nepal and El Salvador can lose much if not most of their farmland topsoil within just a few decades. Countries such as Jordan, Egypt and Pakistan can find themselves suddenly suffering acute deficits of water … Whole regions can find their protective ozone layer is critically depleted within a single generation. The entire Earth seems set to experience the rigours of global warming in what is, comparatively speaking, super-short order. Any of these environmental debacles can generate refugees in exceptionally large numbers." (Myers, 1994)

Lester Brown (2004) adds that among the "new refugees" are people being forced to move because of aquifer depletion and wells running dry. Thus far the evacuations have been of villages, but eventually whole cities might have to be relocated, such as Sana'a, the capital of Yemen, where the water table is falling by 6 meters a year according the experts from World Bank; or Quetta, the capital

[3] Czechoslovakia was federal state with federal government and was divided into two parts – Czech Republic and Slovak Republic – under communist rule obligatory named as "Socialist". Each of these republics had own regional government.

of Pakistan Baluchistan province, which was originally designed for 50,000 people and now has 1 million inhabitants and may have enough water for the rest of this decade like a Sana'a.

Richard Black (2001, 1) permits the environmental degradation and catastrophe may be important factors in the decision to migrate, but the "conceptualization as a primary cause of forced displacement is unhelpful and unsound intellectually, and unnecessary in practical terms". Similarly Homer-Dixon (1993) believes the term "environmental refugees" is misleading because "it implies that environmental scarcity will be the direct and sole cause of refugee flows. Usually it will be only one of large number of interacting physical and social factors that may together force people from their homelands. The term also does not distinguish between people who are fleeing due to genuine disaster or acute hardship and those who are migrants for a variety of less urgent reasons." (Homer-Dixon, 1993, 40-41) He suggests to use the term environmental refugees "only when there is a sudden and large environmental change" and presents example of "population displacement rising from environmental scarcity. Over the last three decades … land scarcity has been a key factor causing the large-scale movement of people from Bangladesh to the Indian state Assam" (Homer-Dixon, 1993, 41-42).

Myers is aware of difficulties in making difference between refugees driven by environmental factors and those forced by economic problems but "people who migrate because they suffer outright poverty are frequently driven by root factors of environmental degradation". (Myers, 1994). At least environment conditions and natural resources are one of the most important direct factors determined economic development or impoverished.

Richard Black (2001) has just critical opinion for ways of presentation of numbers of environmental refugees, "the latter's estimate of 10 million environmental refugees has been repeated by numerous authors, albeit without independent verification of its accuracy" (2001, 1). "Despite the breadth of examples provided in literature, the strength of the academic case put forward is often depressingly weak." (Black, 2001, 2)

He also questioned desertification as one from the most frequently mentioned reasons of displacement, when he talks about "myths" of desertification. "Even if there is no secular trend of declining vegetation cover and land productivity in Sahel, … it is possible that stress migration might result from a temporary decline in the productivity of agricultural and grazing land during drought periods. Yet, for such migrants to be termed "environmental refugees", it seems reasonable that environmental decline should represent the main (if not only) reason for their flight" (Black, 2001, 4). And also the study by Sally Findley (Black, 2001, 7) about "emigration from the Senegal River Valley in Mali shows that during the drought of the mid-1980s, migration actually declined rather than increased". According Black (2001, 6) the situation appears similar in other semi-arid regions of the world allegedly prone to desertification and related migration.

8. CONCLUSIONS

For Lester Brown (2004) "the rising flow of environmental refugees is yet another indicator that our modern civilization is out of sync with the earth's natural support systems". Lonergan (1998, X-XI) and his team recommend implementing follows measures for reducing biophysical and social vulnerability to environmental changes having also significant impact on environmental migration:

1) Increase assistance in the field of family planning in developing countries where the population growth is a threat to the environment and to the economic livelihood of many people.
2) There must be greater focus on agricultural activities in developing countries. This should focus on reducing erosion and deforestation, and increasing the sustainability of small farms in marginal areas.
3) Greater effort should be made to improve education and awareness with respect to the environment. This includes care for the environment and sustainable resource use.
4) Sufficiency of freshwater is crucial. It is also imperative that treated water be recycled to agricultural uses. Inefficient use of water, water loss must be preventing.
5) Encourage of greater capacity building in the administration of environmental programs.

However, it is apparent that environmental degradation and resource depletion may play a contributing role in affecting population movement, often filtered through contexts of poverty and inequity. To develop a more concise policy agenda, it is imperative that further attention be given to the links among environment, population and poverty; to those groups that are most vulnerable to environmental change; and to identifying vulnerable regions and future "hot spots" of insecurity and potential migration/refugee pressure (Lonergan 1998, XI).

We can agree with Rábelová (2000, 7) that prognosis of scope for environmental migration are based on estimates more than significant evidences, in spite of this is essential do not underrate the impacts of environmental changes and depletion of natural resources on movement of populations from the view of international security.

Partnership in projects covering research of indicators for building of warning systems before consequences of environmental stresses should be very important for Czech Republic from pragmatic and also ethical reasons. These indicators would be usable as a background for political decision-making as well as for deciding about directions for the best efficiency of Czech sustainable development assistance.

SOUHRN

ENVIRONMENTÁLNÍ UPCHLÍCI – ÚVOD DO PROBLEMATIKY

Role, kterou hraje životní prostředí v lidských dějinách a osudech, je nesmírně komplikovaná a téma migrace a uprchlictví je jednou z nich. Tato práce se omezuje jen na vymezení problematiky environmentálního uprchlictví (migrace) jako významné skupiny uprchlíků a podání základních informací o současné diskusi na toto téma.

Environmentálními uprchlíky jsou nazýváni lidé opouštějící své domovy kvůli tomu, že byli zbaveni svých způsobů obživy nebo byly zničeny jejich domovy či jsou ohroženi na svém zdraví nebo životech z důvodu náhlého či postupného zhoršení životného prostředí způsobeného přírodními či antropogenními faktory. Jejich situace je navíc komplikovaná nemožností získat azyl legálním způsobem v jiných zemích, včetně institucionální pomoci ze strany UNHCR vzhledem k zastaralé definici uprchlíka z roku 1951.

Ve většině případů je těžké odlišit environmentální uprchlíky od lidí, které z jejich domovů vyhnaly hospodářské či jiné důvody. Je ovšem nesporné, že změny životního prostředí ovlivňují socioekonomické podmínky, jejichž zhoršení může vyvolat migraci z postiženého území. Původní příčinou chudoby tak často bývají právě environmentální problémy, obvykle v kombinaci s dalšími socioekonomickými a politickými faktory. Vzhledem ke složitosti problematiky nemůže být hledání cest k prevenci a řešení environmentální migrace (potažmo environmentálních problémů) pouze věcí environmentální politiky, ale i politiky rozvojové a bezpečnostní, směřující ke snižování chudoby, posilování rovnoprávnosti jednotlivých společenských skupin, k demokratizaci.

Česká republika by měla mít z mnoha pragmatických i etických důvodů zájem účastnit se na projektech zkoumajících indikátory vytvářející systémy včasného varování před negativními důsledky environmentálních stresů. Tyto indikátory by mohly být použitelné jako přímý podklad pro politické rozhodování, případně pro rozhodování při směrování české efektivní dlouhodobě udržitelné rozvojové pomoci.

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© Mgr. Robert Stojanov
Palacký University, Olomouc,
Natural Science Faculty
Department of Geography
Svobody 26
771 46 Olomouc
Czech republic

Reviewed:
doc. RNDr. Tadeusz Siwek, CSc.

GLOBALIZED RETAIL STRUCTURES IN THE CITY OF OLOMOUC (SELECTED ISSUES OF BRANCH, REGIONAL AND SOCIAL ORGANIZATION)

Z. Szczyrba[1]

[1] Department of Geography, Natural Science Faculty, Palacký university of Olomouc, Svobody 26, 779 00 Olomouc, Czech Republic - geogr@prfnw.upol.cz
Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

The article deals with the development of the retail network in Olomouc after 1989. It emphasizes the influence of new forms of store business, namely supermarkets, hypermarkets etc. on the newly establishing functional relationships within the municipal retail system, on the background of globalized Czech economy.

KEY WORDS: globalization, store chains, retail network, hypermarket, municipal retail system, suburbanization

1. INTRODUCTION

The transformation of the store business from the original local scale to the present global dimensions can be seen in the period 1960 – 1970 (Pražská, Jindra, 1997). It was the period of spatial expansion of the stores. The store companies first focused only on regional markets, then their activities moved up to national and international level. The period of 1990s was characterized by the internationalization and globalization when several big supranational companies (SNC) began to dictate the further development of the whole branch.

The globalization of stores business is characterized with several features. According to Jindra (2000) the basic features include: concentration of trade structures, concentration of sales outlets, internationalization, diversification, domination, competition of companies, struggle for the customer and development of new forms of sale outside the stores (especially electronic sales). The last mentioned phenomenon, so-called "e-commerce", is one of the most dynamically developing areas of store business of the last couple of years (Birkin, Clarke, G., Clarke, M., 2002, Dicken, 2003). Sales and purchasing via the Internet becomes a new dimension of the world trade, as well as the introducing of new information technologies within the system of goods movement control outside and inside the store. Although the electronic stores undoubtedly deepen the tendencies to globalization, according to Jindra (2000), they would not threaten the dominant position of the standard forms of sales.

2. GLOBALIZATION TRENDS IN THE CZECH RETAIL

Globalization in the Czech retail has been started by social and economic changes after 1989. The whole process can be divided into two basic periods. In the first period (1st half of 1990s) the international store chains only „familiarized" themselves with the Czech retail background and mapped the possibilities of their expansion. In the 2nd half of 1990s, they actively entered the market and started extended development of a chain of hypermarkets and other large-area stores (*period of internationalization*, Szczyrba, 2001, 2003).

Among the most active SNC operating at the Czech market, we find the German companies *Globus*, *Metro*, *Tengelmann*, *Rewe* and *Schwarz*. However, nearly all important European retail concerns are present, for example *Ahold* – Netherlands, *Delhaize le Lion* – Belgium, *Tesco Stores* – Great Britain, *Carrefour* – France, *Julius Meinl, Spar*, *bauMax* – Austria, *IKEA* – Sweden. There was even one American SNC: *Kmart,* but it was operating here only for a short time, until 1996, when it was acquired by Tesco.

After the initial expansion wave, the process was slowed down in 2003. The market was stabilized and now it is in the period of preparation for the second expansion wave. This wave should extend, besides the well-established concepts of hypermarkets and large-area shopping centers; especially the segment of discount markets located more within smaller places. Globalization of the Czech retail comes to lower floors of the urban units structure. The expansion goals of SNC will become bigger in relationship with the Czech Republic entrance to the European Union.

The development of the Czech retail after 1989 is observed by a large number of specialists and professional institutions, as Department of Industry and Trade of the Czech Republic and commercial advisory companies working to order of SNC, inter alia to support their expansion goals (Incoma

Research, GfK Praha, AISA). Recently, the expansion of the international store chains into the Czech retail market was widely discussed issue considering the urbanistic, economic and sociologic relationships (for example Drtina, 1998, Körner, 1998) and also from the perspectives of geographers, for example in Prague (Sýkora, 2001, Kupková, 2003), Brno (Kolibová, 1999, Vaishar, 2000, Mulíček, Olšová, 2001) or Olomouc (Szczyrba, 1998, 2000, 2001, 2002). Another approach is represented by studies of behavioral geography dealing with the issues of the new model of the Czech consumers' purchasing behavior in relationship with the phenomenon of the shopping centers (Spilková, 2003).

2.1. Significant Features

The most significant features of the globalization process of the Czech retail include changes within the structure of TOP 10 of the largest shopping companies, where the above-mentioned international companies have been dominating for the last couple of years. The Czech companies have left their positions and being under the pressure of SNC, modify their business activities with the objective to reach competitiveness, for example founding the business co-operations (alliances). The store chains of the TOP 10 concentrate more than 60 % of foodstuff retail turnover.

Retail globalization brings also a change of the model of people's purchasing habits. Advisory companies carry out long-term surveys of shopping behavior of the Czech population and create customers profiles based on detailed monitoring. Their conclusions are used by the store chains for optimization of their business plans and philosophy of enterprising. Nowadays, the Czech populations choose hypermarkets as the most often shops for the foodstuff shopping (see Table 1). In long-term perspective, the preferences of smaller stores decrease and the small stores become to the shade of the SNC influence.

The segment of electronic shopping via the Internet also comes through tangible changes. The interest in shopping goods via the Internet shows increasing tendency especially since 2001. In absolute numbers, 1,5 millions of people were joined to the Internet from their homes (penetration of 15 %) at the end of 2002. In comparison with the states of Western Europe, where more than a half of population has home access to the Internet (in Sweden even 85 %, in Netherlands 73 %), the penetration in the Czech Republic is very low. The Czech e-shops' market has a large growth potential.

Table 1: Development of the Czech consumer's population preferences by particular type of store (the major location where foodstuff is bought in % of shoppers)*

store type	1999	2000	2001	2002	2003
hypermarket	10	23	25	33	39
supermarket	27	26	25	24	19
discount market	15	15	15	16	19
smaller store	46	34	33	25	22

Source: SUPERMARKET 2003 Study (Incoma Research + GfK Praha) Hospodářské noviny, 1.10.2003
** Other people prefer different shopping places; data were collected in May of a particular year.*

3. GLOBALIZED RETAIL SHOPPING IN OLOMOUC

Until 1997, the retail network of the city of Olomouc has been atomized with a low share of large-area shopping network or SNC. The retail network consisted of the „shopping relicts“ of the pre-transformation period, especially the Prior shopping center in the historical heart of Olomouc and some units put in operation in early 1990s - Senimo department store (1993) or bauMax hobby market (1996). In the atomized retail network of the city, the first stores of the international store chains started to appear (Droxi drugstore or Benetton). Considering the production line and the size, these shops were established in the downtown like other specialized non-food stores in the following years: Rossmann, DM markt or Kenvelo.

The first commercial suburban locality in Olomouc was Horní lán at the southeast periphery of Olomouc (exit Prostějov-Brno), where the first Olomouc hypermarket (Terno) was opened in 1997. Later on, other stores of international chains were opened in this location (see Table 2). Since 1997, the municipal retail system has undergone an essential transformation and restructuralization, including spatial reorganization of retail stores and shopping behavior of the Olomouc inhabitants.

When evaluating the position of Olomouc within the urban system of the Czech Republic and considering the trends in the Czech retail system, in comparison with cities of the same population (Liberec, Hradec Králové or České Budějovice), Olomouc is about two or three years behind in its development. Therefore, the last period is a logical result of the increased investment activities of SNC accommodating the existing disproportions in the structure of relevant shopping offer at the Czech Republic market.

At present, there are four hypermarkets (Terno, Globus, Kaufland, Carrefour), two hobby markets (OBI, bauMax) and many supermarkets and discount markets in Olomouc. In the first period of atomization of the retail network, the Dutch concern Ahold established supermarket Mana (later on Albert, downtown) at the place of former supermarket „Hanačka“. The same store chain opened its second supermarket in the area of Olomouc, at the housing estate Nové Sady (1999) and together with another supermarket Billa (Big Billa format, 2001) of the German Rewe store chain, it helped to develop the so far subdimensioned level of the civic amenities in this neighborhood at the south suburb of Olomouc. Other supermarkets are located in the center of city (Delvita, Billa) while the discount markets are on the borders of the downtown of Olomouc (Plus discount, Lidl).

Table 2: Development of large-area stores (over 3000 m^2) in the area of Olomouc and around Olomouc (period of internationalization)

Year	**Location**	**Situation**	**Store/Company (country)**	**Store type**
1996	Holická	downtown	bauMax / bauMax (A)	hobbymarket
1997	Horní lán	periphery	Terno / Jednota (CZ)	hypermarket
1999	Horní lán	periphery	OBI / Tengelmann (D)	hobbymarket
1999	Velká Bystřice	nearby village	Makro / Metro (D)	cash & carry market
2000	Pražská	periphery	Globus / Globus (D)	hypermarket
2001	Hálková	downtown	Kaufland / Schwarz (D)	hypermarket
2002	Horní lán	periphery	Carrefour / Carrefour (F)	hypermarket

Figure 1: Hypermarket Carrefour (Haná shopping center) - suburban location Horní lán

Since 2002, Olomouc belongs to the group of large Czech cities with functioning conception of regional shopping center. The Haná shopping center at the location Horní lán in Olomouc periphery consists of Carrefour hypermarket and tens of specialized stores. The total selling area of the center is 11,500 m^2. In 2004, the Olympia regional shopping center will be opened at the area of the nearby village Velký Týnec. With the final selling area of 30,000 m^2, it will be the largest shopping center in Central Moravia. The central hypermarket in this area will be also operated by the international store chain (Ahold - Hypernova). Prospectively, another large hypermarket should be opened in the Olomouc suburban location of Horní lán (Tesco?).

3.1. Shopping Behavior

The development of large-area stores in the area of Olomouc has brought an essential turn of the shopping behavior of the inhabitants of Olomouc and its surrounding, which has been confirmed with the last consumers' survey that took place in April 2003. In a set of 336 respondents who were asked about the level of the store's offer, expenses or frequency of shopping in Olomouc supermarkets, the answers assessing positively the existence of the store chains in Olomouc were in clear majority.

Nowadays, the most of respondents do shopping in some type store of SNC (discount market, supermarket or hypermarket), while shopping in small shops is less frequent, which correlates with the Czech republic overall data (see Table 1). In the respondents' answers, we can see a decline from formerly preferred small shops. Shopping activities move outside the traditional shopping zones, mostly to suburban locations.

The survey also determined which of Olomouc large-area stores (hypermarkets) the respondents use often or at least from time to time. Only a small part of them has no practical experience with this kind of shopping (13,7 %). Many of them mentioned several hypermarkets within their active information field. As supported by the survey results, the most popular of the Olomouc stores is Globus hypermarket that is regularly visited by more then half of respondents (53,3 %). About one third of respondents mentioned Kaufland and Carrefour hypermarkets .

3.2. Spatial Changes

Globalization of the retail structure in the city causes numerous reactions including the spatial-functional reorganization of the existing structure of the retail system, i.e. not only the distribution of relevant business offer and changes of shopping streams, but also the new hierarchy of the system. Under the condition of post-communist city, these changes are much faster than in the environment where they organically arose (Western Europe).

The model of spatial-functional relationships within the retail network of Olomouc was significantly influenced by the presence of large store chains in the area of the city as documented in Figures 2a, 2b. The model was build in accordance with empiric data continuously collected by the Department of Geography at the Faculty of Science of Palacký University in Olomouc (empiric surveys from 1996, 1998, 2001 + continual monitoring). Methodically, it is based on the experience that the retail network is hierarchically organized system where the basic features of the spatial structure are the individual centers of retail civic amenities (Berry, 1967, Ryšavý, 1970, 1980, Cimler, 1994). This model of Olomouc was firstly built in 1998, following the detail survey of retail network (Szczyrba, 2001). For better arrangement of the model, the segmentation on higher levels was based on the level of achieved services in the centers, relations of the spatial shopping mobility of population and analysis of the public transport network. The model identifies 14 urban subcenters with elementary features of hierarchic structure of retail civic amenities (breaking down to the level of neighborhood centers).

In comparison with the situation in the retail network of Olomouc in 1998, the retail globalization caused a significant change of quality of the retail offer, which is expressed by the shift of some centers to the hierarchically higher level. Namely, the „Horní lán“ center (subcenter 13), thanks to concentration and completeness of the retail offer, is gradually transforming to a hierarchically higher level of sector center. At the moment, it still fulfills the function of a large neighborhood center in the southwest housing estate of the city. At present, this location concentrates more than 20,000 m^2 of shopping capacities of the city and it has significantly contributed to decentralization of shopping functions in Olomouc. The same transformation can be seen in the case of urban center „Sídliště první pětiletky“ (subcenter 14) caused by opening a large Globus hypermarket (15,000 m^2). In other cases, the level of civic amenities of the majority of housing estate sectors has been improved (e.g. subcenter 11), other centers have kept their positions.

The existing monocentric model of the municipal retail network is gradually transformed in a polycentric layout. This change is significantly supported by SNC that represent a third of the total shopping area in the city of Olomouc.

3.3. Olomouc – SNC Logistic Center

Following the initial period of erection of hypermarkets, Olomouc has become an important logistic center of the Czech Republic. The large SNC establish their distribution stores in Olomouc and its surroundings for fluent supply of their stores throughout Moravia and East Bohemia. The central position of Olomouc within Moravia seems to be the most important location factor for international investments in the area of construction of regional and supraregional distribution centers (Viturka, 2000).

At the periphery of Olomouc, near the newly finished by-pass road, a new Ahold logistic center serving more than 100 Albert supermarkets and 22 Hypernova hypermarkets of this company. Distribution center employs 350 employees and has the storing capacity of more than 60,000 m^2. Other distribution stores are built by the German company Schwarz in the east periphery of Olomouc to supply a part of the retail network of Kaufland and Lidl in the Czech Republic.

About twenty kilometers from Olomouc (Lipník nad Bečvou) another logistic center was established by the German company Rewe in 2002 to supply goods to its discount market chain Penny Market.

4. CONCLUSION

Globalization is not a new phenomenon but an intensive continuance of the so-far development that used to be labeled as internationalization. While internationalization means the international trade with goods, in the case of globalization, the state borders surrounding the process of production and consumption do not constitute any barriers in business (Dicken, 2003, Giddens, 1998, Sýkora, 2000, Mezřický, 2003 etc.). Globalization of retail that is the most visible part of the whole process for majority of people is only the proverbial tip of the iceberg.

Globalization changes the existing ways of business that thanks to new information technologies moves to the sphere of virtual reality. Shopping acquires a new dimension. The role of „B2B“ (business-to-business) and „B2C“ (business-to-consumer) models of e-commerce is gradually increasing.

SUMMARY

Globalization in the Czech retail has been started by social and economic changes after 1989. The whole process can be divided into two basic periods. In the first period (1st half of 1990s) the international store chains only „familiarized“

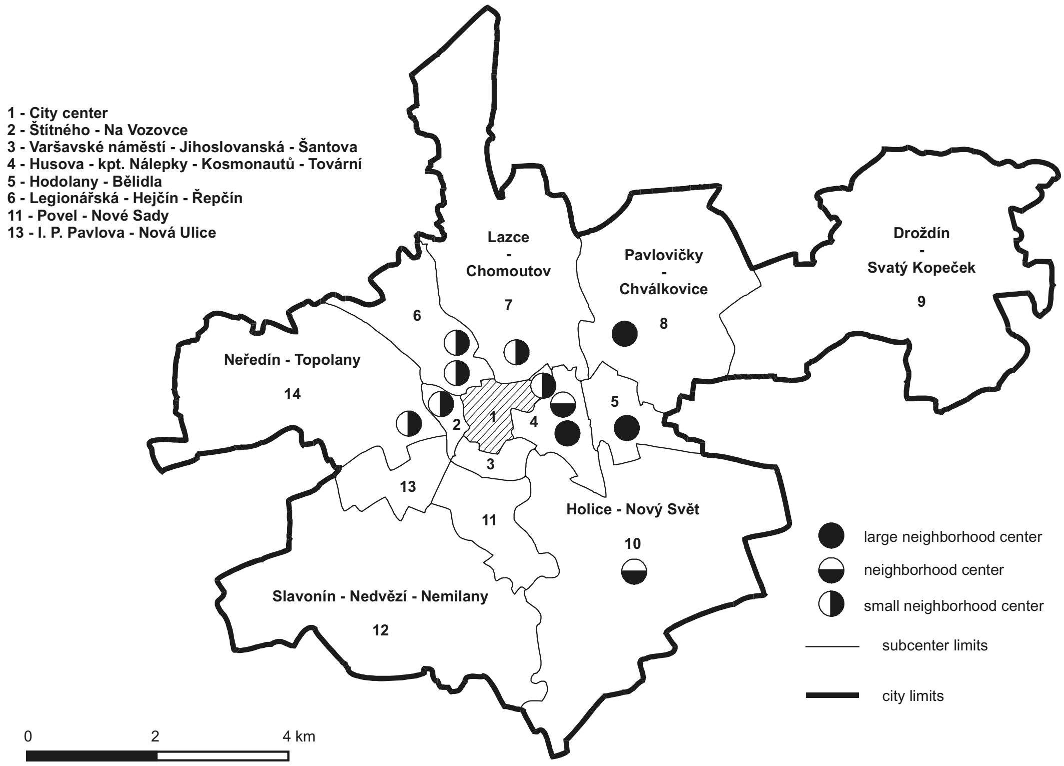

Figure 2a: Internal differentiation of the retail civic amenities of the city of Olomouc - 1998 (civic amenity centers within the structure of municipal subcenters)

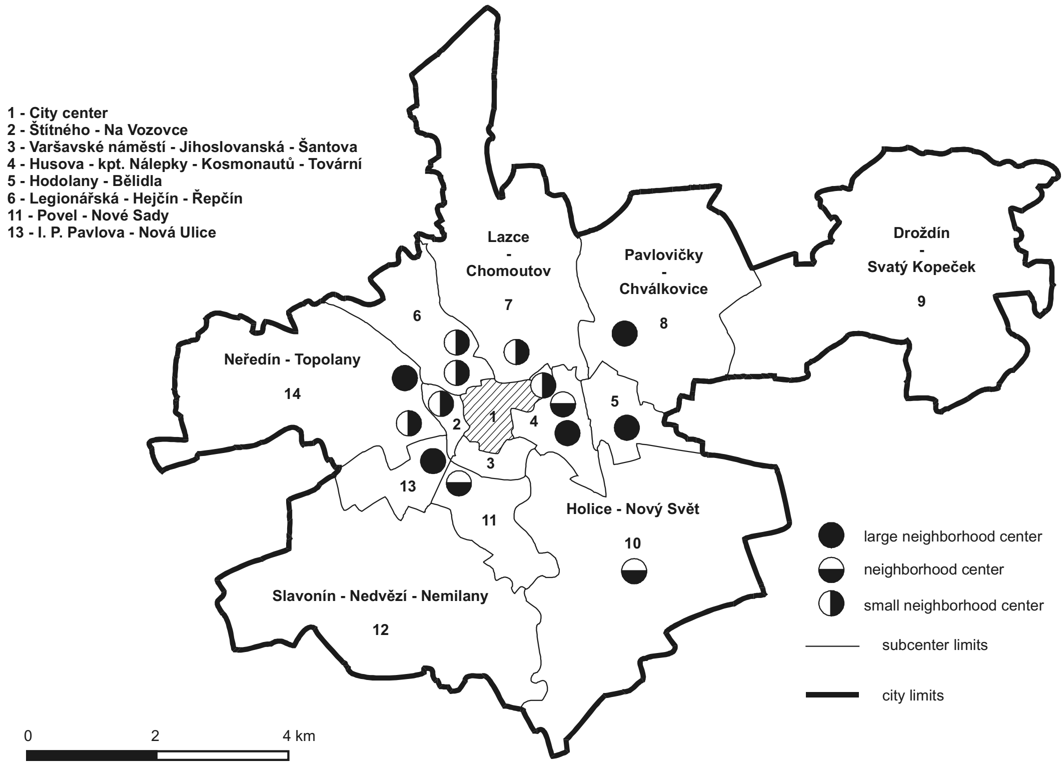

Figure 2b: Internal differentiation of the retail civic amenities of the city of Olomouc - 2002 (civic amenity centers within the structure of municipal subcenters)

themselves with the Czech retail background and mapped the possibilities of their expansion. In the 2nd half of 1990s, they actively entered the market and started extended development of a chain of hypermarkets and other large-area stores (*period of internationalization*). After the initial expansion wave, the process was slowed down in 2003.

When evaluating the position of Olomouc within the urban system of the Czech Republic and considering the trends in the Czech retail system, in comparison with cities of the same population, Olomouc is about two or three years behind in its development. Therefore, the last period is a logical result of the increased investment activities of SNC accommodating the existing disproportions in the structure of relevant shopping offer at the Czech Republic market.

At present, there are four hypermarkets, two hobby markets and many supermarkets and discount markets in Olomouc. Since 2002, Olomouc belongs to the group of large Czech cities with functioning conception of regional shopping center (the Haná shopping center).

Globalization of the retail structure in the city causes numerous reactions including the spatial-functional reorganization of the existing structure of the retail system. The monocentric model of the municipal retail network is gradually transformed in a polycentric layout. This change is significantly supported by SNC that represent a third of the total selling area in the city of Olomouc.

SOUHRN

GLOBALIZUJÍCÍ SE MALOOBCHODNÍ PROSTŘEDÍ MĚSTA OLOMOUCE (VYBRANÉ OTÁZKY ODVĚTVOVÉ, ÚZEMNÍ A SPOLEČENSKÉ ORGANIZACE)

Globalizace v českém obchodě byla odstartována společenskými a ekonomickými změnami po roce 1989. Celý proces lze s ohledem na jeho charakter rozdělit na dvě základní etapy. V první (1. polovina 90. let 20. století) se zahraniční obchodní řetězce teprve „seznamovaly“ s českým obchodním prostředím a mapovaly možností své expanze. Aktivně vstoupily do území teprve ve 2. polovině 90. let, když započaly s masivní výstavbou sítě hypermarketů a jiných velkoplošných prodejen (*etapa internacionalizace*). Po úvodní vlně expanze nastalo v roce 2003 zpomalení procesu.

Hodnotíme-li pozici Olomouce v sídelním systému ČR s ohledem na probíhající trendy v tuzemském maloobchodě, pak město ve srovnání s populačně stejně velkými městy zaostalo ve svém vývoji zhruba dva až tři roky. Poslední období je proto logickým vyústěním zvýšené investiční aktivity NNS, vyrovnávající existující disproporce v rozložení relevantní obchodní nabídky na trhu ČR.

V současné době jsou v Olomouci v provozu čtyři hypermarkety, dva hobbymarkety a mnohé supermarkety a diskontní prodejny. Od roku 2002 patří Olomouc do skupiny velkých českých měst, na jejichž území funguje koncept regionálního nákupního centra (obchodní centrum Haná).

Globalizace obchodního prostředí ve městě vyvolává četné reakce. Patří mezi ně také prostorově-funkční reorganizace dosavadního uspořádání maloobchodního systému. Monocentrický model maloobchodní sítě města se postupně transformuje v polycentrické uspořádání. Výrazně se na této změně podílí zahraniční obchodní řetězce, které kontrolují třetinu prodejní plochy ve městě.

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© RNDr. Zdeněk Szczyrba, Ph.D.
Department of Geography
Natural Science Faculty
Palacký University of Olomouc
Svobody 26
779 00 Olomouc
Czech Republic
szczyrba@prfnw.upol.cz

Reviewed:

RNDr. Václav Toušek, CSc.

AIR TEMPERATURE IN THE CITY OF OLOMOUC (1991–2000)

[1] M. Vysoudil, [2] M. Jurek

[1] Department of Geography, Natural Science Faculty, Palacký University of Olomouc, Svobody 26, 771 46 Olomouc, Czech Republic - vysoudil@prfnw.upol.cz
[2] Department of Geography, Natural Science Faculty, Palacký University of Olomouc, Svobody 26, 771 46 Olomouc, Czech Republic - jurekm@prfnw.upol.cz
Head of Department: Ass. Prof. Dr. Miroslav Vysoudil

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Abstract

The paper deals with elementary characteristics of air temperature in the city of Olomouc (Central Moravia, Czech Republic) in the decade 1991–2000. The data represent a current continuation to existing studies, describing periods 1910–1950 and 1961–1990. The annual course of temperature is described in detail; notice is given both to temperature at climatological times of observation as well as extreme temperatures.

KEY WORDS: air temperature, annual course, monthly course, Olomouc, decade 1991–2000

1. INTRODUCTION

A contemporary national climatological atlas of the Czech Republic is still missing. Thus, obsolete climatological characteristics (period 1901–1950) only are available for most sites of the Czech Republic (Climatological Atlas of the Czech Republic, 1957; or Climate of the Czech Republic – Tables, 1960). Such data must unfortunately be considered out of date. Basic climatological characteristics for the city of Olomouc had been elaborated earlier by Vysoudil for the period 1961 to 1990. In 2003, data were processed for the period 1991–2000.

The main goal of this article is to present basic temperature characteristics for the city of Olomouc in the period 1991–2000. The structure of the data is convenient both for a fundamental description of temperature conditions and for a successive, more detailed analysis. Due to the short time span of the data set, trends and variability were not researched. On the other hand, the previously processed decades 1961–1970, 1971–1980, 1981–1990, together with the period 1991–2000, allow us to define a climatic normal and to perform a detailed analysis of temperature conditions in the city of Olomouc for the period 1960–2000 and 1901–2000 respectively.

2. METHODS AND DATA

The authors treated meteorological records in the city of Olomouc in the decade 1991–2000. Even during such a short period of time observation at the meteorological station was either interrupted or ended up as described below.

Olomouc-Slavonín (garden/nursery) 225 m a.s.l.
Period of observation: Jan 1st, 1961–Feb 28th, 1993
Geographical location: 49º34′00″ N, 17º14′00″ E

Olomouc-Slavonín (observatory) 259 m a.s.l.
Period of observation: Mar 1st, 1993–Feb 14th, 2000
Geographical location: 49º34′10″ N, 17º13′01″ E

Olomouc-Holice (grounds of the Faculty of Science, Palacky University) 210 m a.s.l.
Period of observation: Feb 15th, 2000 – up today
Geographical location: 49º34′31″ N, 17º17′05″ E

A homogenous data base was available, containing temperatures at climatological times of observation and temperature extremes. It was used to derive mean daily temperatures, averages of extreme temperatures, temperature amplitudes and other basic climatological characteristics.

All computations, tables and graphs were made using Microsoft Excel tools.

3. AIR TEMPERATURE

Description of temperature conditions is derived from mean daily temperatures. In the Czech Republic (and Czechoslovakia formerly), mean daily temperature of air is computed using three temperature records within a day, performed at climatological times of observation (07:00, 14:00 and 21:00 of local mean time). Basic statistical parameters were consequently derived.

3.1. Annual Course

January
Average monthly temperature in the period 1991 to 2000 was –1.5°C. The highest average temperature occurred in the year 1998 (1.9°C), the lowest in 1997 (–5.2°C). This means that the amplitude of average January temperature was 7.1°C.

February
Average February temperature in the decade 1991 to 2000 was –0.1°C. The maximum value occurred in 1995 (3.4°C), minimum in 1996 (–4.8°C). The amplitude of average temperature reached 8.2°C.

March
Average monthly temperature for the period 1991 to 2000 was 3.6°C. The highest value occurred in 1994 (5.9°C), the lowest in 1996 (–0.5°C), which resulted in the amplitude of 6.4°C.

April
In April the average monthly temperature in the decade 1991–2000 was 9.5°C. The highest monthly average occurred in 2000 (12.8°C), the lowest in 1997 (5.9°C). The amplitude of average temperature was 6.9°C.

May
Average monthly temperature in May was 14.5°C during the decade 1991–2000. The highest monthly average was reached in 1993 (16.9°C), the lowest in 1991 (11.2°C). The amplitude of average temperature was 5.7°C.

June
In June the average monthly temperature in the period 1991–2000 was 17.5°C. The highest monthly average occurred in 1992 (19.5°C), the lowest in 1991 (16.2°C). The amplitude of average temperature was 3.3°C.

July
Average monthly temperature in July was 19.5°C during the period 1991–2000. The highest monthly average was reached in 1994 (22.5°C), the lowest in 2000 (16.9°C). The amplitude of average temperature was 5.6°C.

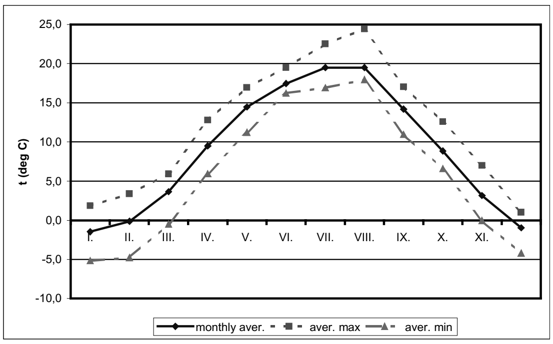

Figure 3.1.1. Annual course of air temperature (°C) Olomouc 1991–2000

August
The August average of monthly temperature in the period 1991–2000 was the same as in July, reaching 19.5°C. The highest monthly average occurred in 1992 (24.4°C), the lowest in 1999 (17.9°C), therefore the amplitude of average temperature was larger than in July, reaching 6.5°C.

September
Average monthly temperature in Septembers of the period 1991–2000 was 14.2°C. The highest monthly average came in 1999 (17.0°C), the lowest in 1996 (11.0°C). The amplitude of average temperature reached 6.0°C.

October
Average monthly temperature in October during the decade 1991–2000 was 8.8°C. The highest monthly average occurred in 2000 (12.6°C), the lowest in 1997 (6.6°C). The amplitude of average temperature reached 6.0°C.

November
In November the average temperature in the decade 1991–2000 was 3.2°C. The highest monthly average was reached in 2000 (7.0°C), the lowest in 1998 (–0.1°C). The amplitude of average temperature was 7.1°C.

December
In December the average monthly temperature in the period 1991–2000 was –1.0°C. The highest monthly average occurred in 1993 and also in 1997 (1.0°C), the lowest one came in 1996 (–4.2°C). The amplitude of average temperature was 5.2°C.

Period 1991–2000
Average annual air temperature in the decade 1991 to 2000 was 9.0°C. The highest annual average was reached in 1992 (10.4°C), the lowest occurred in 1996 (7.4°C). The amplitude of average annual temperature was 3.0°C.
The lowest mean daily temperature occurred on December 29th, 1996 (–18.6°C), the highest one was reached on August 10th, 1992 (30.7°C).
The amplitude of mean daily temperature during the whole decade 1991–2000 was as large as 49.3°C.

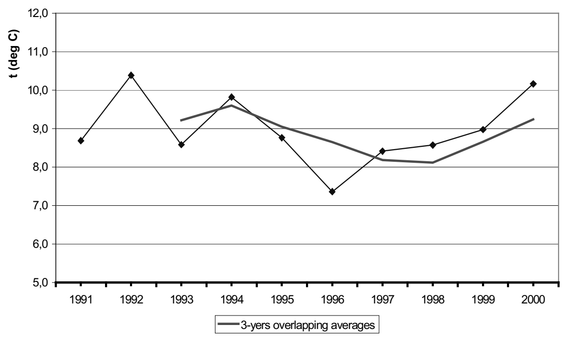

Figure 3.1.2. Annual air temperature (°C) Olomouc 1991–2000

Table 3.1.1. Average air temperature (°C) Olomouc 1991–2000

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	III–V	VI–VIII	IX–XI	XII–II
1991	–0.1	–4.0	5.6	8.4	11.2	16.5	20.9	19.1	16.2	8.2	4.0	–1.8	8.7	8.4	18.8	9.5	–2.0
1992	0.0	2.2	4.6	9.8	15.8	19.5	21.8	24.4	15.3	7.9	4.0	–0.6	10.4	10.0	21.9	9.1	0.5
1993	–1.0	–1.4	1.8	10.2	16.9	16.6	17.8	18.5	13.3	9.0	0.3	1.0	8.6	9.7	17.6	7.5	–0.5
1994	1.9	–0.4	5.9	9.4	13.8	17.4	22.5	20.2	15.4	7.0	4.4	0.5	9.8	9.7	20.0	8.9	0.6
1995	–1.3	3.4	2.8	9.0	13.3	16.2	21.3	18.3	12.9	10.4	1.1	–2.2	8.8	8.4	18.6	8.1	0.0
1996	–4.6	–4.8	–0.5	9.0	14.9	17.5	17.0	18.2	11.0	9.7	5.2	–4.2	7.4	7.8	17.6	8.6	–4.5
1997	–5.2	0.8	4.0	5.9	14.3	17.8	17.8	20.0	14.2	6.6	3.6	1.0	8.4	8.1	18.6	8.1	–1.1
1998	0.2	2.1	2.6	10.4	14.0	17.6	18.9	18.5	13.4	8.3	–0.1	–3.1	8.6	9.0	18.3	7.2	–0.3
1999	–1.4	–1.4	5.0	10.2	14.2	16.6	20.0	17.9	17.0	8.8	2.0	–1.2	9.0	9.8	18.2	9.3	–1.3
2000	–3.3	2.3	4.5	12.8	16.2	18.8	16.9	20.0	13.2	12.6	7.0	0.9	10.2	11.2	18.6	10.9	0.0
Aver.	**–1.5**	**–0.1**	**3.6**	**9.5**	**14.5**	**17.5**	**19.5**	**19.5**	**14.2**	**8.8**	**3.2**	**–1.0**	**9.0**	**9.2**	**18.8**	**8.7**	**–0.9**
Max.	**1.9**	**3.4**	**5.9**	**12.8**	**16.9**	**19.5**	**22.5**	**24.4**	**17.0**	**12.6**	**7.0**	**1.0**	**10.4**	**11.2**	**21.9**	**10.9**	**2.3**
Min.	**–5.2**	**–4.8**	**–0.5**	**5.9**	**11.2**	**16.2**	**16.9**	**17.9**	**11.0**	**6.6**	**–0.1**	**–4.2**	**7.4**	**7.8**	**17.6**	**7.2**	**–1.2**
St. dev.	**2.2**	**2.8**	**2.0**	**1.7**	**1.6**	**1.1**	**2.1**	**1.9**	**1.8**	**1.7**	**2.3**	**1.8**	**0.9**	**1.1**	**1.3**	**1.1**	**1.5**

3.2. Air Temperature at Climatological Times of Observation

Data of ambient air temperature measured at climatological times of observation (7 a.m., 2 p.m. and 9 p.m. of local mean time) are used as input values when deriving mean daily temperature. They are also used to obtain a variety of other temperature characteristics.

Air temperature at 7 a.m.

The annual average air temperature measured at 7 a.m. in the period 1991–2000 was 6.7°C. In 2000, the annual average was the highest (7.9°C), while the lowest one occurred in 1996 (5.3°C). The amplitude of annual average temperature at 7 a.m. in the decade 1991–2000 was 2.6°C.

The maximum of average monthly temperature observed at 7 a.m. occurred in July 1994 (19.6°C.) and the minimum fell on February 1996 (–7.4°C). The amplitude of the extreme monthly averages was 27.0°C.

The absolute maximum temperature at 7 a.m. was recorded on August 10th, 1992 (25.5°C), while the minimum was taken on December 29th, 1996 (–21.5°C).

Air temperature at 2 p.m.

The annual average air temperature measured at 2 p.m. in the period 1991–2000 was 12.3°C. The highest annual average of air temperature observed at 2 p.m. occurred in 2000 (13.8°C), while the lowest one occurred in 1996 (10.5°C). The amplitude of annual average temperature at 2 p. m. in the decade 1991–2000 was only 3.3°C.

The maximum of average monthly temperature observed at 2 p.m. occurred in August 1992 (28.9°C) and the minimum in January 1997 (–3.8°C). The amplitude of the extreme monthly averages was as large as 32.7°C.

The absolute maximum temperature at 2 p.m. was recorded on July 30th, 1994 (35.3°C) while the minimum was taken on December 29th, 1996 (–15.8°C).

Air temperature at 9 p.m.

The annual average of air temperature measured at 9 p.m. in the period 1991–2000 was 8.4°C. The highest annual average of air temperature observed at 9 p.m. occurred in 1992 (10.2°C), while the lowest one occurred in 1996 (6.8°C). The amplitude of annual average temperature at 9 p.m. in the decade 1991–2000 was 3.4°C.

The maximum of average monthly temperature observed at 9 p.m. occurred in August 1992 (24.7°C) and the minimum came in January 1997 (–5.4°C). The amplitude of the extreme monthly averages was 30.1°C.

The absolute maximum temperature at 9 p.m. was recorded on August 10th, 1992 (31.4°C), while the minimum was taken on December 29th, 1996 (–18.6°C).

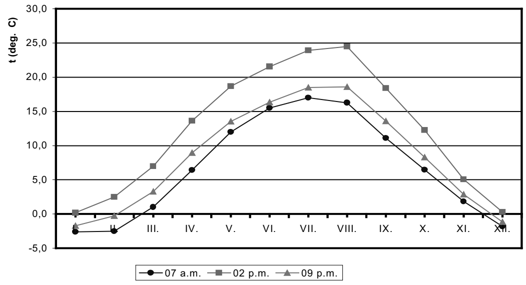

Figure 3.2.1. Course of air temperature (°C) at climatological times of observation Olomouc 1991–2000

Table 3.2.1. Average air temperature (°C) at 7 a.m., Olomouc 1991–2000

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	III–V	VI–VIII	IX–XI	XII–II
1991	–1.7	–6.9	3.0	5.3	8.9	14.1	18.1	16.2	12.1	5.4	2.6	–2.5	6.2	5.7	16.1	6.7	–3.7
1992	–1.6	0.4	1.5	6.6	12.8	17.9	18.0	19.3	11.3	5.9	2.6	–1.4	7.8	7.0	18.4	6.6	–0.9
1993	–2.8	–3.7	–0.6	6.6	14.0	14.9	15.8	15.4	10.6	7.1	–0.8	0.3	6.4	6.7	15.3	5.6	–2.1
1994	0.8	–2.9	3.6	6.7	11.7	15.2	19.6	17.1	12.5	4.8	3.2	–0.3	7.7	7.3	17.3	6.8	–0.8
1995	–2.4	1.3	0.6	6.6	11.1	14.4	19.1	16.2	10.5	7.3	0.3	–2.8	6.9	6.1	16.6	6.0	–1.3
1996	–5.4	–7.4	–2.7	5.6	12.8	15.6	14.6	15.5	9.2	7.7	3.6	–5.4	5.3	5.2	15.2	6.8	–6.1
1997	–6.1	–1.7	0.7	3.7	12.0	16.0	16.0	16.7	10.7	3.9	2.2	0.5	6.2	5.5	16.2	5.6	–2.4
1998	–0.7	–1.4	–0.3	7.2	11.6	15.7	16.1	14.9	11.2	6.9	–1.1	–4.1	6.3	6.2	15.6	5.7	–2.0
1999	–2.1	–3.1	1.8	6.7	11.3	14.8	17.6	14.4	13.2	6.1	0.5	–2.9	6.5	6.6	15.6	6.6	–2.7
2000	–4.2	0.4	2.5	9.2	13.8	16.3	15.0	16.9	9.9	9.7	5.4	0.3	7.9	8.5	16.1	8.3	–1.2
Aver.	**–2.6**	**–2.5**	**1.0**	**6.4**	**12.0**	**15.5**	**17.0**	**16.3**	**11.1**	**6.5**	**1.8**	**–1.8**	**6.7**	**6.5**	**16.3**	**6.5**	**–2.3**

Table 3.2.2. Average air temperature (°C) at 2 p.m., Olomouc 1991–2000

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	III–V	VI–VIII	IX–XI	XII–II
1991	2.2	–0.7	8.8	11.8	13.8	20.3	25.3	23.4	20.5	12.3	5.7	–0.2	11.9	11.5	23.0	12.8	0.4
1992	1.9	4.8	8.3	12.9	19.5	22.7	25.3	28.9	19.3	10.6	5.5	0.6	13.4	13.6	25.6	11.8	2.4
1993	1.4	1.2	5.0	15.1	21.8	20.5	22.0	23.7	17.6	11.6	1.8	2.1	12.0	13.9	22.0	10.3	1.6
1994	3.3	2.6	9.1	13.4	17.7	21.9	28.0	25.4	19.4	10.4	6.5	1.5	13.3	13.4	25.1	12.1	2.4
1995	0.1	5.5	6.5	12.3	17.5	20.6	26.6	22.8	16.6	14.7	2.5	–1.4	12.0	12.1	23.3	11.2	1.4
1996	–3.3	–2.0	2.3	13.7	18.5	22.2	21.4	22.4	13.8	12.7	7.2	–3.0	10.5	11.5	22.0	11.2	–2.8
1997	–3.8	3.4	7.8	9.9	18.9	22.0	21.4	25.2	19.5	10.8	5.6	2.2	11.9	12.2	22.9	11.9	0.6
1998	1.9	5.3	6.3	14.7	18.7	21.2	23.6	24.0	16.8	10.9	2.0	–1.8	12.0	13.3	22.9	9.9	1.8
1999	–0.2	–0.0	8.9	14.7	19.3	20.6	24.9	23.9	22.3	12.4	4.0	0.7	12.6	14.3	23.1	12.9	0.2
2000	–1.7	4.8	6.9	17.8	21.2	23.7	20.4	25.4	18.4	16.5	9.9	2.4	13.8	15.3	23.1	15.0	1.8
Aver.	**0.2**	**2.5**	**7.0**	**13.6**	**18.7**	**21.6**	**23.9**	**24.5**	**18.4**	**12.3**	**5.1**	**0.3**	**12.3**	**13.1**	**23.3**	**11.9**	**1.0**

Table 3.2.3. Average air temperature (°C) at 9 p.m., Olomouc 1991–2000

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	III–V	VI–VIII	IX–XI	XII–II
1991	–0.4	–4.3	5.4	8.1	11.1	15.7	20.2	18.4	16.0	7.6	3.8	–2.2	8.3	8.2	18.1	9.1	–2.3
1992	–0.2	1.8	4.3	9.8	15.3	18.7	21.9	24.7	15.3	7.5	3.9	–0.7	10.2	9.8	21.7	8.9	0.3
1993	–1.4	–1.6	1.4	9.6	16.0	15.5	16.6	17.4	12.5	8.6	0.1	0.7	8.0	9.0	16.5	7.1	–0.7
1994	1.6	–0.7	5.5	8.6	12.8	16.2	21.1	19.0	14.8	6.4	3.9	0.4	9.1	9.0	18.8	8.4	0.4
1995	–1.3	3.3	2.1	8.5	12.3	14.9	19.6	17.0	12.2	9.7	0.9	–2.2	8.1	7.6	17.2	7.6	–0.1
1996	–4.8	–4.9	–0.8	8.4	14.0	16.2	15.9	17.3	10.4	9.2	5.0	–4.2	6.8	7.2	16.4	8.2	–4.6
1997	–5.4	0.7	3.7	5.1	13.2	16.6	16.9	19.1	13.2	5.8	3.4	0.7	7.8	7.3	17.5	7.5	–1.3
1998	–0.1	2.1	2.3	9.8	12.8	16.7	17.9	17.5	12.8	7.7	–0.5	–3.2	8.0	8.3	17.4	6.6	–0.4
1999	–1.5	–1.4	4.7	9.6	13.0	15.5	18.7	16.7	16.3	8.3	1.8	–1.3	8.4	9.1	17.0	8.8	–1.4
2000	–3.6	2.0	4.3	12.0	14.9	17.6	16.1	18.9	12.2	12.0	6.3	0.4	9.4	10.4	17.5	10.2	–0.4
Aver.	**–1.7**	**–0.3**	**3.3**	**8.9**	**13.5**	**16.4**	**18.5**	**18.6**	**13.6**	**8.3**	**2.9**	**–1.2**	**8.4**	**8.4**	**17.8**	**8.0**	**–1.1**

3.3. Air Temperature Extremes

Maximum air temperature

Period 1991–2000
The average of maximum monthly temperature of air in the decade 1991–2000 was 13.6°C. The highest average of maximum monthly temperature occurred in the year 2000 (15.0°C), while the lowest average came in 1996 (11.7°C). The amplitude of average maximum monthly temperature in the period 1991 to 2000 was 3.3°C.

The highest monthly average of daily maximum temperature in the decade 1991–2000 occurred in August 1992 (30.6°C), while the lowest monthly average belonged to January 1997 (–2.8°C). The corresponding amplitude reached 33.4°C.

The absolute maximum temperature was recorded on August 1st, 1994, reaching 36.3°C.

Minimum air temperature

Period 1991–2000
The average of minimum monthly temperature of air in the decade 1991–2000 was 4.5°C. The highest average of minimum monthly temperature occurred in the year 1994 (5.6°C), while the lowest average came in 1991 (3.3°C). The amplitude of average minimum monthly temperature in the period 1991 to 2000 was 2.3°C.

The highest monthly average of daily minimum temperature in the decade 1991–2000 occurred in July 1994 (15.2°C), while the lowest monthly average belonged to February 1991 (–8.9°C). The corresponding amplitude reached 24.1°C.

The absolute minimum temperature was recorded on December 29th, 1996 at –22.0°C.

Table 3.3.1. Monthly average of daily maximum temperature of air (°C) Olomouc 1991–2000

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	III–V	VI–VIII	IX–XI	XII–II
1991	2.8	0.1	9.7	13.3	15.5	21.8	26.4	24.5	21.5	13.2	6.5	0.6	13.0	12.8	24.2	13.7	1.2
1992	2.9	5.6	9.6	14.3	20.7	24.3	27.4	30.6	20.9	11.4	6.6	1.5	14.6	14.8	27.5	13.0	3.3
1993	2.8	2.5	6.0	16.3	23.8	21.8	23.9	25.2	19.3	12.8	2.9	3.3	13.4	15.4	23.6	11.7	2.9
1994	4.5	3.6	10.2	15.0	19.2	23.3	29.5	26.1	20.8	11.5	7.6	2.7	14.5	14.8	26.3	13.3	3.6
1995	1.2	6.7	7.4	14.1	19.1	21.9	28.0	24.4	18.0	15.5	3.5	–0.3	13.3	13.5	24.8	12.3	2.5
1996	–2.3	–1.1	3.3	15.0	20.1	23.4	22.8	23.7	14.9	13.7	8.3	–1.8	11.7	12.8	23.3	12.3	–1.8
1997	–2.8	4.5	9.1	11.6	20.3	23.5	23.0	26.5	20.9	11.8	6.6	3.2	13.2	13.7	24.4	13.1	1.6
1998	2.7	6.6	7.4	16.0	20.4	23.6	24.9	25.5	18.2	11.9	2.7	–0.8	13.3	14.6	24.7	10.9	2.8
1999	0.6	1.2	9.9	16.2	20.7	22.7	26.6	25.4	23.7	13.7	4.7	1.8	13.9	15.6	24.9	14.0	1.2
2000	–0.7	5.7	8.6	18.9	22.6	25.3	22.4	26.7	19.4	17.2	10.8	2.9	15.0	16.7	24.8	15.8	2.7
Aver.	**1.2**	**3.5**	**8.1**	**15.1**	**20.2**	**23.2**	**25.5**	**25.9**	**19.8**	**13.3**	**6.0**	**1.3**	**13.6**	**14.5**	**24.8**	**13.0**	**2.0**

Table 3.3.2. Monthly average of daily minimum temperature of air (°C) Olomouc 1991–2000

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	III–V	VI–VIII	IX–XI	XII–II
1991	–3.6	–8.9	1.3	2.1	5.5	9.4	14.1	12.3	8.7	3.3	0.6	–5.1	3.3	3.0	12.0	4.2	–5.9
1992	–3.4	–1.5	–0.5	3.4	8.0	11.9	12.7	15.0	9.1	4.0	1.5	–2.7	4.8	3.6	13.2	4.9	–2.5
1993	–4.5	–4.9	–2.2	3.1	9.1	10.4	11.2	12.0	8.9	6.0	–2.1	–1.4	3.8	3.4	11.2	4.2	–3.6
1994	–0.6	–3.7	2.2	4.2	8.5	11.7	15.2	14.8	11.3	3.5	2.1	–1.4	5.6	5.0	13.9	5.6	–1.9
1995	–3.2	0.5	–0.6	4.6	8.1	11.8	14.8	13.5	9.4	6.5	–0.9	–3.8	5.0	4.0	13.4	5.0	–2.2
1996	–6.5	–8.6	–3.4	3.8	10.3	12.2	12.1	13.2	8.2	6.8	2.6	–6.7	3.6	3.6	12.5	5.8	–7.3
1997	–8.0	–2.9	–0.2	0.9	9.0	12.2	13.4	13.6	8.9	2.9	1.1	–0.6	4.2	3.2	13.1	4.3	–3.8
1998	–2.5	–2.8	–1.9	5.2	8.0	12.4	13.4	12.5	9.9	5.7	–2.4	–5.5	4.3	3.8	12.8	4.4	–3.6
1999	–3.1	–4.0	1.0	4.6	8.1	11.4	14.1	12.1	11.6	5.1	–0.3	–4.3	4.7	4.6	12.5	5.5	–3.8
2000	–6.7	–0.8	0.6	5.6	8.9	10.9	12.2	13.5	7.9	8.5	3.4	–1.3	5.2	5.0	12.2	6.6	–3.0
Aver.	**–4.2**	**–3.8**	**–0.4**	**3.8**	**8.3**	**11.4**	**13.3**	**13.3**	**9.4**	**5.2**	**0.6**	**–3.3**	**4.5**	**3.9**	**12.7**	**5.0**	**–3.8**

4. CONCLUSIONS

The analysis of time series data of temperature measurements in the city of Olomouc in the period 1991–2000 as presented in this paper broadens information about climatological features of the city. An assumption was made for a consequent study of a one-hundred-year long time series of air temperature measurements. A detailed comparison of all decades within the period 1961–2000 is now possible. Such a study would establish the grounds for describing short-term fluctuations of climate in the city of Olomouc and/or verify occurrence of certain climatic singularities.

5. SOUHRN

TEPLOTA VZDUCHU V OLOMOUCI V OBDOBÍ 1991–2000

Předložená analýza teplotní řady meteorologických pozorování v Olomouci v období let 1991–2000 rozšiřuje poznatky o charakteru klimatu v Olomouci o další dekádu. Tím byl vytvořen předpoklad pro další případné analýzy již stoleté pozorovací řady. Nabízí se vzájemné srovnání všech dekád v období 1961–2000. Byl by vytvořen předpoklad pro popis možného krátkodobého kolísání podnebí v Olomouci či ověření projevů některých singularit.

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© doc. RNDr. Miroslav Vysoudil,CSc.
Department of Geography
Natural Science Faculty
Palacky University Olomouc
Svobody 26
771 46 Olomouc
Czech Republic
vysoudil@prfnw.upol.cz

© Mgr. Martin Jurek
Department of Geography
Natural Science Faculty
Palacky University Olomouc
Svobody 26
771 46 Olomouc
Czech Republic
jurekm@prfnw.upol.cz

Reviewed:
doc. RNDr. Milan Trizna, Ph.D.

ŽIVOTNÍM JUBILEUM - DOC. JUDr. STANISLAVA ŠPRINCOVÁ, CSc.

Ke konci letošních prázdnin oslaví své významné životní jubileum docentka socioekonomické geografie na přírodovědecké fakultě Univerzity Palackého dr. Stanislava Šprincová.

Doc. Šprincová pochází z Olomouce, kde také absolvovala reálné gymnázium. Po skončení druhé světové války vystudovala a graduovala na právnické fakultě brněnské univerzity. Po ukončení vysokoškolských studií pracovala jako asistentka v Ústavu pro studium plánování Univerzity Palackého v Olomouci. Je třeba dodat, že od roku 1945 se podílela jako jednatelka Akčního výboru vysokoškolského studentstva na přípravných akcích, které vedly k obnovení olomoucké univerzity.

Interní aspirantská studia už v ekonomické geografii vykonala pod vedením prof. dr. M. Blažka na Vysoké škole ekonomické v Praze. V roce 1959 úspěšně obhájila svoji kandidátskou disertaci na téma „Hospodářská geografie severní Moravy a severozápadního Slezska". V tomtéž roce začala přednášet na katedře geografie přírodovědecké fakulty v Olomouci, kde působí dodnes. V roce 1966 se dr. Stanislava Šprincová habilitovala prací „Geografie cestovního ruchu (na příkladu rekreační oblasti Jeseníků)" a získala vědeckopedagogickou hodnost docenta ekonomické geografie.

Ve své pedagogické práci se jubilantka věnovala zejména přednáškám a cvičením z obecné socioekonomické geografie. Vychovala dlouhou řadu geografů – učitelů i odborných pracovníků. Vedla desítky diplomových i dalších studentských prací. Doc. Šprincová též působila i jako oponentka při kandidátských obhajobách na jiných vysokých školách.

Vědeckovýzkumná práce doc. Šprincové byla zaměřena zvláště na geografii cestovního ruchu a rekreace. Patří mezi první autory v bývalém Československu, kteří se touto problematikou v poválečném období začali zabývat. O pracovitosti jubilantky svědčí i bibliografie publikovaných prací, která čítá na 130 položek.

Doc. dr. S. Šprincová uskutečnila řadu zahraničních cest. Absolvovala studijní pobyt ve Francii na univerzitě v Aix-en-Provence v Centre des études du tourisme. O výsledcích svých prací referovala na mezinárodních geografických kongresech v Londýně, Montrealu, Moskvě, Tokiu, Paříži a na regionální konferenci v Budapešti. Z její iniciativy vznikla v r. 1972 pracovní skupina pro geografii cestovního ruchu při Mezinárodní geografické unii (IGU). Tato skupina je od roku 1980 komisí a doc. Šprincová se významně podílela na její činnosti. Přitom mohla uplatňovat své znalosti světových jazyků.

Stanislava Šprincová patřila mezi autory, kteří u nás začali prosazovat prostorové projevy cestovního ruchu do systému geografických věd. Jako první vypracovala terminologii pro tento obor. Ta posloužila jako základ pro oficiální rajonizaci cestovního ruchu v Československu vydanou v 60. letech Státním ústavem pro rajonové plánování v Praze. Některé publikace Stanislavy Šprincové jsou hodnoceny jako průkopnické a dodnes jsou citovány v geografických pracích.

Podle ustanovení vysokoškolského zákona odešla Stanislava Šprincová v r. 1989 do důchodu. O dění v geografickém světě však neztratila zájem, zůstává členkou ČGS a sleduje a zůstává v kontaktu s katedrou geografie i Univerzitou Palackého.

Za dlouholetou obětavou pedagogickou a výchovnou práci mezi studenty, za výsledky vědeckovýzkumné činnosti a reprezentaci přírodovědecké fakulty u nás i v zahraničí získala stříbrnou medaili UP a řadu ocenění. U příležitosti oslav 50. výročí přírodovědecké fakulty jí byla udělena na slavnostním zasedání pamětní medaile rektorky UP. Při příležitosti jubileí obnovy univerzity získala několikrát čestná uznání za aktivní účast při úsilí studentů v roce 1945 za obnovu olomouckého vysokého učení.

RNDr. Pavel Ptáček

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