

Dear Earthwatcher,

2007 was the seventeenth year of this research programme focused on headwater catchments and reservoirs in the Jizera Mountains, Bohemia, Czech Republic, supported by the Earthwatch Institute. Twenty volunteers from eight countries participated in three two-week field expeditions. With your kind help, we completed many field tests and collected a lot of samples of water, soil and biota in both watersheds and water reservoirs.

The main message from our research is the progress made in the recovery of mountain waters from the extreme acidification which occurred in the 1980s. However, we also discovered some ominous aspects which might have negative impacts (increasing deposition of nitrogen, problems with new spruce plantations etc). Hopefully, you were interested by aspects of our field investigations, as well as related facts on the history, culture and socio-economy of the studied region.

Our special thanks are due to the volunteers and scientific colleagues who succeeded in field and laboratory data collection as well as data processing.

Yours faithfully,

Josef Krecek & Zuzana Horicka



MOUNTAIN WATERS OF BOHEMIA

EARTHWATCH INSTITUTE ANNUAL RESEARCH REPORT

Date completed: 15th February 2008

Completed by: **Josef Krecek**

Period covered by this report: 1st January 2007 to 31st December 2007

Progress on Objectives

1. **The long-term monitoring of the climate, water cycle, atmospheric deposition and quality of surface waters.**

1.1 Atmospheric load

The observation system included 4 different forest stands of 900 m² (mature semi-natural beech stand, three spruce plantations of different forestry characteristics): 40 rain-gauges (open field precipitation, through-fall under the canopy), 5 stem-flow collectors and 3 fog-drip collectors were checked systematically to evaluate the volume of precipitation, and to take samples for detailed chemical analyses.

Results:

In 2007, although the trend of sulphur emissions continued to decline, the problem of damage to forest stands is still significant. Namely, an increase of nitrogen emissions affected the acid atmospheric deposition. In the open field, the annual deposition of sulphur varied between 7 and 12 kg ha⁻¹ year⁻¹ (dry deposition 32%, wet deposition 68%) and the deposition of nitrogen between 10 and 16 kg ha⁻¹ year⁻¹ (dry deposition 65%, wet deposition 35%). Under the forest canopy, particularly, the deposition of sulphur increased to 11 – 28 kg ha⁻¹ year⁻¹ while the deposition of nitrogen only to 10 – 17 kg ha⁻¹ year⁻¹. The critical acid load (for spruce plantations: 1463 mol H⁺ ha⁻¹ year⁻¹) on investigated plots was exceeded (1500 – 2100 mol H⁺ ha⁻¹ year⁻¹).

1.2 Stream water quality

The observation included 30 stream profiles and 3 water reservoirs. Streams were checked in different hydrological situations (during and after the rainfall, dry periods), water temperature, conductivity and pH measured in situ, and water sampled for chemical analyses. Additionally, the discharge in stream profiles was estimated by measuring the cross section, slope, velocity and hydraulic roughness of the stream channels. Water reservoirs were checked seasonally.

Results:

In 2007, relatively higher pH values in the reservoirs Bedrihov and Josefuv Dul (5.0 – 6.6) were affected also by the extra mild winter of 2006/2007 with almost negligible snow-pack. In several prior years, the observed pH values were 4.6 – 6.1. In the Sous reservoir, the extremely high pH values (6.8 – 7.3) are results of liming applied on the lake surface in early May of 2007. Concentrations of aluminium in surface waters (0.1 – 0.3 mg/l) did not exceed the hygienic limit.

2. Studies on effects of forest practices on hydrology and bio-geo-chemistry in experimental basins.

The long-term observation of runoff genesis continued in two experimental basins (*Jizerka* – the site reforestation after clear-cut of spruce plantations, and *Oldrichov* - semi-native beech stands with only selective cut). The detailed inventory of the soil-vegetation system (basal area, height of trees, canopy density and health conditions) in both catchments was done during the summer field expeditions.

Results:

In the *Jizerka* basin, *Junco effusi-Calamagrostietum villosae* became a new dominant community after the clear-cut of spruce plantations (*Picea abies*) in 1984-1990. Reforestation has been complicated by a relatively high moisture status, competition of herb communities and a high mortality of spruce seedlings. In 2007, the average number of trees is 1237/ha (Norway spruce 53%, Colorado blue spruce 26 %, Dwarf pine 16 %, Silver birch 3 %, Mountain ash 2 %); the average horizontal canopy density is 21 % (2 – 44 %) and the height of trees 2.07 m (0.3 – 7.2 m). Herb communities (namely *Calamagrostis villosa*, *Deschampsia caespitosa*, *Molinia caerulea*) still dominate at the *Jizerka* basin. The average leaf area index in the basin is 2.8 (1.5 – 3.4).

In the *Oldrichov* basin, semi-native stands of Common beech (*Fagus sylvatica*) are dominant.

In 2007, the average number of trees is 1352/ha (Common beech 98 %, Norway spruce 2 %); the average horizontal canopy density is 99 %; the height of trees 38.2 m (3.4 – 42.6 m); and the mean standing volume is 642 m³/ha (462.3 – 708.4 m³/ha). The average leaf area index in the basin is 7.6 (4.7 – 9.2). The average increment of the stem diameter (1.6 mm/year) had been found to be stable since 1991 and corresponds to the progress in the environment. In the period of 1976 – 1988, the diameter increment was 1.05 mm/year.

During summer rainstorms, higher leaf area and deeper root system of semi-native beech forests increased the retention and deeper water circulation within the investigated basin. Thus, in 2007, in the *Oldrichov* basin, the base-flow component was 78 % while at the *Jizerka* catchment it was only 42 %. Both higher pH of soil solution and deeper water circulation at *Oldrichov* contributed to the effective control of pH and toxic metals in stream water.

3. The study of temporary (episodic) acidification in the streams and reservoirs of Bedrichov, Sous and Josefuv Dul.

In 2007, extremely low snow-pack did not allow us to evaluate the effects of episodic acidification during the snowmelt.

Results:

During six summer rainstorms (recurrence interval of 0.5 - 2 years), the level of toxic inorganic aluminium did not exceed the critical value for the survival of fish (300 µg/l). This reflects the progress in recovery of surface waters in the investigated watersheds.

4. The study of liming at the Sous reservoir.

In early May 2007, air-sprinkled fine crushed limestone (particle size of less 0.2 mm) was applied (12.0 g of calcite powder per 1 m³ of water volume) on the water surface of the reservoir.

Results:

In the *Sous* reservoir, pH of water increased to 7.5 and did not fall below 7.0 in the whole summer period. The fish individuals of brook trout (*Salvelinus fontinalis*) 3+ reached mean body lengths of 122 mm (first year of life), 196 mm (second year of life) and 253 mm (third year of life) in comparison to the corresponding lengths of 108, 162 and 208 found in the reservoirs of *Bedrichov* and *Josefuv Dul*.

5. The study of environmental effects of the herbaceous vegetation in acidified mountain watersheds.

In summer of 2007, detailed study of herbaceous vegetation was carried out in two parallel transects at the *Jizerka* basin.

Results:

The dominance of grasses is a temporary phenomenon which depends on the thickness of humus layers. With reduced humus layer, *C. villosa* spreads slowly and acidophilous species increase their cover (e.g. *Avenella flexuosa*), thus, the diversity of species is increasing. Particularly with spontaneous succession of tree species (*Picea abies* and *Pinus* sp.), *Calamagrostis villosa* is losing dominance. The plants of wet stands (*Calamagrostis villosa*, *Deschampsia caespitosa*, *Molinia caerulea*, *Juncus effuses*, *Carex nigra*, *Eriophorum vaginatum*, etc.) are spreading over the investigated transect. Considering the effects of topography, soil water content in the topsoil correlates most significantly with the slope-gradient in periods of 'moderate' soil moisture. However, under 'dry' and 'wet' conditions, the effect of slope-gradient was not significant. *Ellenberg's indicator F* values, calculated for particular stand, are decreasing with the altitude, and increasing with the time of plant succession. Considering sustainable soil processes, natural succession seems to be more effective than forestry interventions.

	Indicators (from section 7 of your last proposal)	Means of measuring the indicators (from section 7 of your last proposal)	Frequency of monitoring (from section 7 of your last proposal))	Has work started on this objective? (y/n) IF No – state expected start date	Provide report on this objective
Objective 1	Long-term monitoring	1) Atmospheric load 2) Stream water quality	Adequate	Yes	Described above
Objective 2	Effects of forest practices on hydrology and bio-geo-chemistry	1) Clear-cut regeneration 2) Near-native beech stand	Adequate	Yes	Described above
Objective 3	Episodically acidification in streams and reservoirs	Three reservoirs and their watersheds	Adequate	Yes	Described above
Objective 4	Effects of liming	The Sous reservoir	Adequate	Yes	Described above
Objective 5	Environmental effects of herbaceous vegetation	Two transects of the Jizerka basin	Adequate	Yes	Described above

Significance & Benefits of Research

1. Local (to the area of the research site)

- 1) Progress in watershed restoration.
- 2) Progress in water quality of local resources.
- 3) Restocking the fish in the upper plain of the Jizera Mountains.

2. National / Regional

- 1) Water Resources Control: Recharge of water resources and control of the water duality. Watershed restoration (activities of the *Watershed Authority of the Elbe River*).
- 2) Better understanding of the role of headwater peat spots.
- 3) High Education: both undergraduate and graduate courses of the Czech Technical University (*Hydrology and Climatology*), Charles University (*Hydrobiology, Ecology*) and the Czech Agricultural University (*Landscape Ecology, Botany*).
- 4) Thesis: BSc, MSc and PhD thesis at the Czech Technical University and Charles University in Prague:

Zuzana Horicka (finished PhD. thesis in 2007, Charles University in Prague),

Jiri Kremsa (finished BSc. thesis in 2007, Czech Technical University in Prague),

Petr Punciochar (preparing PhD. thesis, Czech Technical University in Prague),
Pavel Vesely (preparing PhD. thesis, Czech Technical University in Prague).

3. International

- 1) *EFC/FAO Working Party on the Management of Mountain Watersheds*: Discussion between researchers, university teachers and decision makers on developing the Planning Process in Mountain Watersheds of Central Europe.
- 2) *International Association on Headwater Control*: Project results used by the preparation of the Guidelines on Revitalization in Headwater Catchments.
- 3) High Education – MSc. thesis:

Ryan Scott (finished MSc. thesis in 2007, Oxford Brookes University, UK)

Communication of results

1. Printed communications

Krecek, J. and Z. Horicka (2007): Forests and water supply reservoirs of the Jizera Mts. In: Forest and Water, Publication of the Czech Ministry of Agriculture, ISBN 978-80-7084-634-6, 177-183

Krecek, J. (2007): Land-use and water phenomena in the Czech Republic. In: Proceedings of YRiS Joint Meeting (Kyoto, 15-16th November 2006), RIHN, Kyoto (Japan), 32-35.

Krecek, J. (2007): Sustainable agriculture and forestry in the Czech republic. In: Proceedings of the 3rd International Workshop on Yellow River Studies (Kyoto, 14-15th February 2007), RIHN, Kyoto (Japan), 111-114.

2. Visual communications

Poster "*Mountain Waters of Bohemia*" (Krecek, J. & Z. Horicka), presented at the "3rd International Workshop on Yellow River Studies", Kyoto (Japan), 14-15th February 2007)

3. Meetings and conferences

Presentation of the lecture "*Sustainable Agriculture and Forestry in the Czech republic*" At the "3rd International Workshop on Yellow River Studies" held in Kyoto (Japan), 14-15th February 2007.

Presentation of the invited lecture on "*Mountain Waters of Bohemia*" at the seminar of Earthwatch Japan, Tokyo, February 2007.

4. Educational resources: lesson plans; resource packs

Projects results have been used for lessons of both undergraduate and graduate courses of the Czech Technical University (*Hydrology and Climatology*), Charles University (*Hydrobiology, Ecology*) and the Czech Agricultural University (*Landscape Ecology, Botany*).

Data gathered during the field expeditions are used by practical seminars for students, and by the preparation of BSc, MSc and PhD thesis.

Educational Opportunities

1. Involvement of different groups

Local Communities

We are in contact with local people in respect of the process of public debate.

Students

Both undergraduate (2) and graduate students (3) participated in the field expeditions or in some additional field activities within the year 2007. Their PhD, MSc or BSc thesis are based on results gathered during the Earthwatch field expeditions.

PhD students:

Zuzana Horicka (Charles University) submitted PhD thesis in February 2007. Petr Punciochar (Czech Technical University) continued preparation of PhD thesis. Pavel Vesely (Czech Technical University) continued preparation of PhD thesis.

BSc students

Jiri Kremsa (Czech Technical University) submitted BSc thesis in June 2007.

Early career scientists

Dr. Jana Novakova (Czech Agricultural University) submitted the results of the project by the application procedure for the position of associate professor (June 2007)

2. Helping these groups better understand the conservation of a sustainable environment

Research results are also used by NGOs: "Foundation on Forests and Water" (Prague, Czech Republic) and "European Observatory of Mountain Forests" (Chambery, France) to better understanding of relationships between forest management and water phenomena.

3. Contribution to the completion of educational research

Student *Jiri Kremsa* (Czech Technical University) finished his BSc and is continuing his research activities in the Jizera Mts. in preparation for submission of his MSc thesis until December 2008.

Postscript

We are trying to evaluate the educational progress made through the contribution of the Earthwatch field expeditions and to publish it in the Journal of Geography in Higher Education (2008).

Acknowledgements

We would also like to acknowledge our thanks to the staff of the Earthwatch Institute, particularly to *Jen Alger* and *Natalie Rothwell* (Earthwatch Europe) for the assistance in managing our field research teams.