

EARTHWATCH INSTITUTE FIELD REPORT

Project Title: MOUNTAIN WATERS OF BOHEMIA

Principal Investigators: JOSEF KRECEK
Department of Hydrology
Czech Technical University

ZUZANA HORICKA
Faculty of Science
Charles University

RESEARCH SITE

The Jizera Mts. (North Bohemia, Czech Republic, altitude of 50°40' - 50°52', longitude of 15°08' - 15°24', area of 350 km²) is situated in the humid temperate zone of the Northern Hemisphere. The highest elevation is 1,124m, the area of about 200km² is formed as an upper plain above the elevation of 800m. The percentage of forests is 83% with dominant plantations of Norway spruce (*Picea abies*).

LOCAL MANAGEMENT STATUS

In 1967, the region of the Jizera Mountains was proclaimed a Protected Landscape Area (350km²) with 22 spots of State Nature Preserves (18 km²).

Additionally, in 1978, the Protected Headwater Area of the Jizera Mts. was proclaimed to control the recharge of water resources.

KEY RESEARCH OBJECTIVES

- 1) Monitoring of the acid atmospheric deposition in headwater catchments.
- 2) Detailed study of forest hydrology and biogeochemistry in two experimental basins (clear-cut of mature spruce stands and forestation, and a control study in mature beech stands).
- 3) Study of water quality in drinking water reservoirs in relation to the lake management, and the inventory of forest stands, vitality of trees, and forest practices in their watersheds.
- 4) Inventory of forest regeneration after the clear-cut.
- 5) Assessment of the environmental role of herbaceous vegetation at clear-cut sides.
- 6) Assessment of environmental impacts of alternative forestry practices.

Date this report was completed: 12th October 2006

DATA COLLECTION AND RESULTS

A) DATA COLLECTED

Atmospheric precipitation and bulk deposition

40 rain-gauges (open field, under the canopy, stem-flow) and 3 fog-drip collectors were checked after any significant rainfall to evaluate the volume of rain water, and to take samples for chemical analyses.

Stream water quality

30 stream profiles 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 quality in reservoirs

The water temperature, electric conductivity, pH and oxygen measured *in situ*, and water sampled in vertical profiles of 3 drinking water reservoirs.

Biota in reservoirs and their inlets

Zooplankton (rotifers and crustaceans) and phytoplankton (algae) sampled in vertical profiles of 3 reservoirs, and benthic organisms sampled in related inlets.

Herbaceous vegetation at clear-cut areas

Phytosociological relevés (4 x 4 m, Braun-Blanquet scale) were estimated, and above- and under-ground vegetation sampled at 20 points of selected transects three times during the field season (beginning, progress and culmination of the vegetation season).

Inventory of forest stands

Identification of tree species, stem diameter and height, and ground-vegetation in 10 different forested stands (area of 30x30 m). Health of trees was observed visually as well as by measuring the electric resistance in the conductive layer of stems.

DATA PROCESSED

Stream flow

In experimental catchments, the stream flow was calculated from the continuous observation of water level at the gauging stations instrumented by the V-notch weir. At the other sampled stream profiles the stream flow regime was evaluated from several field estimates and the correlation to instrumented profiles.

Water chemistry

The electric conductivity and pH of rain water samples were measured in the field laboratory (field camp in Bedrichov, the Jizera Mts.). Standard analyses of cations and anions (Ca, Mg, Na, K, Al, Fe, Zn, Mn, Cl, SO₄, N-NH₄, N-NO₃), and toxic fraction of Al were done in the laboratory in Prague.

Water biota

Samples of zooplankton, phytoplankton and benthos were analysed in the laboratory in Prague.

Forest canopy

The horizontal canopy density was estimated by the statistics of the sky versus canopy readings at the 5m-grid squares at the observed plots. The relative vertical canopy density was then evaluated from the percentage of the penetration of light and phytocologically active radiation to the ground.

Biomass of herbaceous vegetation

Samples of above- and under-ground vegetation analysed in the field laboratory (field camp in Bedřichov, the Jizera Mts.): the leaf area measured by the leaf area meter, both above and under-ground herbaceous vegetation was dried and the dry mass scaled.

B) RESEARCH PROGRESS

The field season of 2006 contributed to the long-term study on the acidification and restoration of mountain watersheds and lakes exposed to the acid atmospheric deposition in the Jizera Mts.

Acid atmospheric deposition

The open field load of sulphur corresponds to the decreasing trend observed already in the 1990s, and dropped now to cca 30% of the level of the late 1980s. However, inside the forest stands, particularly under the canopy of spruce plantations, the load of sulphur exceeds the open field deposit by 3-4 times. Contrary to sulphur, the stagnation or even a moderate increase in the atmospheric load of nitrogen was observed.

Stream and lake water quality

Chemistry of sampled surface waters confirmed the recent recovery of surface waters in the Jizera Mts. The population of brook char was successfully reintroduced into the headwater streams and lakes: the population is now stabilised and self-reproducing. However, brook char is still endangered by episodic acidification events (rapid snow-melt, summer rain-storms). On the contrary, the re-growth of spruce plantations and expected increase in the atmospheric load of nitrogen might still cause an adverse effect on the water quality in the near future. The experimental reintroduction of brown trout and minnow in waters of the upper plain of the mountains was not successful, but, downstream (with increasing pH of water), the brown trout mostly succeeds the competition with the brook trout.

Re-growth of forest stands

Immediately after the clear-cut of spruce plantations, the headwater catchments have been reforested again by seedling of Norway spruce, dwarf pine, or some resistant exotic conifers (Colorado blue spruce, black spruce). However, these stands contribute to the increase of the atmospheric load of sulphur under their canopy, and, thus, to the reverse trend in the recovery of water resources. Therefore, the trend is now to support the forest stands near the native composition by the introduction of deciduous species (common beech and mountain ash).

Role of herbaceous vegetation at cleared slopes

After the clear-cut of mature spruce plantations, the community of *Junco effusi-Calamagrostietum villosae* became dominant in the headwater catchments. The natural succession of herb layers particularly at the cleared slopes is an important factor in the protection of soil and water.

SIGNIFICANCE/ BENEFITS OF RESEARCH

a) Significance of research

Research results contribute to the local, national as well as the international level of the sustainable resource management and development.

Local

Contribution to the watershed management in the Jizera Mts.: to meet an effective control of local water resources. Contribution to the conservation of the environmental role of headwater wetlands.

National

Both water resources as well as headwater wetland (mostly peatbog) spots in the Jizera Mts. are of national importance. Supporting the National Education System: students of Charles University and Czech Technical University (both MSc and PhD) participate in the project.

International

Outcomes on the water resources control were submitted to EFC/FAO (European Forestry Commission, and Food Agriculture Organization of United Nations - Intergovernmental Panel) *Working Party on the Management of Mountain Watersheds* to revise the European watershed management guidelines.

Outcomes on the conservation of the environmental role of headwater wetlands were submitted to the NATO Advanced Research Workshop to increase environmental security in Europe.

b) Contribution to issues of sustainability

Research results in frame of the above mentioned levels contribute to sustainable water resource management as well as to sustainable development in the area of the Jizera Mts.

DISSEMINATION OF RESULTS

In 2005, the project results were published in scientific papers:

Krecek, J., 2006: Headwater wetlands in the Czech Republic. In: Krecek, J. and M.J. Haigh (eds.), *Environmental Role of Wetlands in Headwaters*. Springer, NATO Science Series.

Krecek, J. & Z. Horicka, 2006: Forests, air pollution and water quality: influencing health in the headwaters of Central Europe's "Black Triangle". *Unasylva*, FAO, Rome, 57/224, in press

Krecek, J. & Z. Horicka, 2006: Impacts of acid rain and forest practices on run-off genesis in the Jizera Mountains, Czech Republic. In: Kovar, K., Hrkal, Z. and J. Bruthans, HydroEco2006, Proceedings of the International Conference on Hydrology and Ecology, 14-16th September, Karlovy Vary (Czech Republic), Charles University in Prague, 73-76.

Novakova, J. & J. Krecek, 2006: Soil erosion and plant succession at clear-cut areas in the Jizera Mountains, Czech Republic. Ecology (Bratislava), 25: 146-153.

Puncochar, P., Krecek, J. & Y. Fukushima, 2006: Modelling baseflow in a small mountain catchment. In: Kovar, K., Hrkal, Z. and J. Bruthans, HydroEco2006, Proceedings of the International Conference on Hydrology and Ecology, 14-16th September, Karlovy Vary (Czech Republic), Charles University in Prague, 19-23.

Presented:

24th April, 2006: Czech National paper (J. Krecek) at the 25th Working Party on the Management of Mountain Watersheds, EFC/FAO: Intergovernmental Panel, Salzburg (Austria), 37 participants.

26th September, 2006: Report (Z. Horicka) at the „Gladocera 2006“ International Workshop in Prague, Charles University in Prague, 28 participants.

15th September 2006: Report (J. Krecek) at the International Conference of IAHS HydroEco2006, Karlovy Vary (Czech Republic), 156 participants.

Management plans and reports

Czech National Report on the Management of Mountain Watersheds submitted to the EFC/FAO Intergovernmental Panel.

Report on the Headwater Wetlands in the Czech Republic in frame of the NATO Advanced Research Activity to Secure the Environment in Europe.