# MOUNTAIN WATERS OF BOHEMIA

## RECOVERY OF THE JIZERA MOUNTAINS ECOSYSTEM

© Josef Krecek

© Tim Hall

© Tim Hall

© Tim Hall

In the late 1980s, the Jizera Mountains in Czechoslovakia became ground zero for the widespread devastation wrought by acid rain and forest mismanagement. Coal-fed power stations in the Black Triangle, the border region between Czechoslovakia, Poland, and the former East Germany, burned lignite, an abundantly cheap, soft coal that generated less heat and four times the sulfur dioxide of hard coal. The resulting acid rain damaged two-thirds of the mountain forests and turned streams into toxic currents unable to support fish. Commercial strip-logging further contributed to the deforestation and also caused soil erosion. The pollution took a human toll as well—people living in the Black Triangle suffered higher rates of cancer and circulatory disease than anywhere else in the world.

The Jizera Mountains ecosystem spans 350 square kilometers, with forests covering 83 percent. Although forest stands of common beech (*Fagus silvatica*) and silver fir (*Abies alba*) dominated the region at the beginning of the 18th century, Norway spruce (*Picea abies*) prevailed during the 19th century. In the second half of the last century, Norway

© Josef Krecek

© Tim Hall

spruce grew to represent about 90 percent of the forest cover. Timber production figures prominently in the local economy. Watersheds of the Jizera Mountains supply a fifth of the Czech Republic, including Prague, with drinking water.

Dr. Josef Krecek, an environmental hydrologist at Czech Technical University, has been studying and restoring the Jizera Mountain ecosystems since the early 1980s. At that time, communist authorities censured his findings, forcing him to communicate information through an underground network. Since 1991, two years after the collapse of the Eastern Bloc, Krecek has shared his passion for rehabilitating the mountain waters of Bohemia with teams of volunteers.

© Josef Krecek

## ACID TRIPS

Initially the volunteers helped him document the scale of the problem. Because sulfur dioxide is converted in the atmosphere to sulfuric acid, which is then dispersed in precipitation or as particles in the air, the research team started by measuring acid levels. They collected rainfall samples in open fields, under the canopy in stands of beech and spruce, and under grass. They also measured fog volumes and precipitation by using fog-collection gauges located at elevations from 700 to 1,000 meters above sea level. This monitoring work continues today.

The researchers found that up to ten metric tons of acid per square kilometer per year coated the spruce trees, several times what the trees could tolerate. Precipitation had a **pH level**, which indicates acidity, of 4 and Jizera's streams registered 4.5, nearly 10 times what even the most acid-tolerant fish could withstand.

## ECOSYSTEM REHAB

Since the early 1990s, political and technological changes in the region have reduced sulfur dioxide emissions and brought some green to the Black Triangle. In 1993, Krecek and his team recorded a 40-percent drop in sulfur dioxide emissions and 25 percent less acid in the rain while mountain streams and lakes showed a 1.5-unit rise in pH level. In 1995, Krecek and his volunteers focused on reintroducing Brook char (*Salvelinus fontinalis*) to Jizera's waterways.

Another ongoing effort for Krecek and his team is assessing water quality in more than 35 streams and reservoirs that make up the Jizera Mountains watershed. The data they collect range from periodic readings of temperature, pH, electrical conductivity, and oxygen content to samples of plankton. They also monitor the levels of aluminium, a toxic metal in acid rain that threatens the survival of fish.

One way to neutralize acidic waters is to add powdered limestone, which is very alkaline. This process, called liming, is expensive, however, and its effects are only temporary. Krecek initiated a liming program for reservoirs with mixed results. Summertime liming affects only the epilimnium, or topmost layer of water,



© Josef Krecek


© Josef Krecek


© Josef Krecek


© Tim Hall


© Josef Krecek

increasing the levels of important phytoplanktons and zooplanktons (microscopic plants and animals). By fall, increased circulation from declining temperatures resets the entire reservoir to the pH of the hypolimnium, or bottommost layer, resulting in a short-term population explosion of planktons that causes problems for water-purification plants.

Documenting recovery is just as important as documenting devastation because it provides a clear link between cause and effect. Ironically, Krecek found that the drop in reservoir acidity was due to not only the closing of power stations but also clear-cutting of spruce stands, which reduced leaf area and allowed less air-born acid to accumulate. Certainly Krecek does not see clear-cutting and mechanized logging with heavy equipment as the solution for cleaning up Jizera's reservoirs because these activities increase soil erosion and reduce the watershed's capacity to hold water. Instead, he advocates that the timber industry rely on horse teams or cable cranes to harvest trees, replant what is harvested with the beech-fir stands that dominated 200 years ago or other mixtures of trees, and preserve existing peat bogs, which filter acid-tainted waters.

In addition to his continued monitoring efforts, Krecek's current research focuses on the following objectives:

- Evaluate and compare low-cost (ground-based) and high-cost (aerial) liming techniques
- Test two new reforestation strategies as an alternative to the traditional Norway spruce: stands of nonnative Colorado spruce (*Picea pungens*), which are fast-growing and acid-resistant, and a native mixture of common beech (*Fagus sylvaticus*), common fir (*Abies alba*), European mountain ash (*Sorbus aucuparia*), and Norway spruce.
- Evaluate how well the Jizera Mountains ecosystem functions as a watershed
- Assess the sustainability of the reintroduced fish populations.

## SHARING WITH SCIENTISTS AND POLICY MAKERS

In 1995 and 1997, Krecek's results were presented at conferences organized by the Food and Agricultural Organization (FAO) of the United Nations to debate the management of mountain watersheds in the Jizera Mountains. Krecek also forwards his findings to the Czech ministries of agriculture and environment as well as to the FAO, the European Forestry Commission, the European Observatory of Mountain Forests, and the International Association of Headwater Control. International interest in the project continues because successful watershed management schemes that benefit the Jizera Mountains, one of the most acidified areas of the world, can be applied in other parts of the world.

Krecek uses his work to educate and inspire the next generation of hydrologists who will take on the world's fossil fuel emissions. He has lectured about the rehabilitation of the Jizera Mountains in seminars and courses at Charles University, Czech Technical University, and the Czech Agricultural University. He also teaches an environmental hydrology course through the Socrates Program, the European Community's educational initiative to broaden its knowledge base.

## GLOSSARY

***acid rain:*** a phrase that often substitutes for the more accurate term "acid deposition," which covers both wet and dry deposition. Wet deposition involves rain, fog, and snow. Dry deposition involves acidic gases and particles. The acid being deposited comes from two air pollutants—sulfur dioxide and nitrogen oxide—emitted by burning fossil fuels and wood. These pollutants combine with gaseous water in clouds to form sulfuric acid and nitric acid.

***pH level:*** a measurement from a scale measuring acidity, called pH, a term pronounced by saying the two letters in order. The scale ranges from 0 to 14.0, with pH levels below 7.0 indicating acidity and pH levels above 7.0 indicating alkalinity. The pH level of 7.0 is neutral, neither acidic nor alkaline. Normal rain is slightly acidic with a pH of about 5.5 because carbon dioxide dissolves into it. For comparison, tomato juice has a pH of 4.0; oven cleaner has a pH of 13.0. Because the pH scale is logarithmic, a difference of one pH unit represents a factor of ten change. For example, the acidity of a sample with a pH of 5 is ten times greater than that of a sample with a pH of 6.

## FIND OUT MORE


Stutz, Bruce. 2005. Europe's Black Triangle Turns Green. OnEarth, Spring 2005. **www.nrdc.org/onearth/05spr/triangle1.asp**

Bird, Maryann. 2003. A Light In The Black Triangle. Time International. Volume 161, number 17, April 28, 2003. **www.time.com/time/europe/magazine/printout/0,13155,901030428-442027,00.html**

Steichen, Girard C. 1991. Years of Grime and Grunge Will Take Decades to Clean, *The Christian Science Monitor*, April 25, 1991.

Smith, Michael. 1989. Pollution in Eastern Europe; Industry Takes Priority at Expense of Public Health. *Financial Times*. March 23, 1989.


*Web Sites*

Acid Rain
**www.epa.gov/acidrain/index.html**

*Key Words*

acid deposition, acid rain, Black Triangle, Bohemia, Jizera Mountains, liming, sulfur dioxide emissions, sulfuric acid

Volunteers have joined this project through Earthwatch Institute. Read more about this study and other scientific field research at **www.earthwatch.org**.


EARTHWATCH INSTITUTE
FINDING SOLUTIONS FOR A SUSTAINABLE FUTURE

3 Clock Tower Place
Suite 100
Maynard, MA 01754-0075