ASSESSMENT OF CHECK DAMS FILLING IN A MID-MOUNTAIN STREAM BASED ON TREE RING ANALYSES (THE EASTERN SUDETES MOUNTAINS)

Ireneusz Malik[1], Piotr Owczarek[2]

STUDY AREA

The study area is located in the upper part of the Cerny Potok catchment in the Eastern Sudetes Mountains called the Jeseniki Mountains (north eastern Czech Republic).
The Sudetes Mountains belong to a vast low mountain range that formed during the Hercynian Orogeny, an event which produced numerous mountain ranges and isolated massifs in Central and Western Europe. Study was located in Cervena Hora massif which was originally covered by beech and mixed forest, gradually giving way to spruce forests at higher elevations. This vegetation has been replaced by spruce monocultures; the highest trees being planted above the original timberline (1,250 – 1,300 m a.s.l.). The rainfall in the research area averages about 1,500 mm/year. The length of the section of the Cerny Potok stream analyzed is 2.2 km. The stream channel is mainly incised within alluvial deposits, but occasionally passes short sections of bedrock. The maximal incline of the channel is 19.5 %. Two parts can be distinguished in the Cerny Potok stream catchment. The upper part forms the sediment supply zone, where erosional processes dominate. In this part, debris flows during summers and snow avalanches in winter are observed. In the lower part of the analyzed catchment, depositional processes dominate. The fluvial deposit is captured by the system of five check dams, which are spread over a 400 m section of the stream channel.

METHODS

The 400 m of the Cerny Potok stream were surveyed by using a tape-measure, and a Frieberg 59 compass. The volume of sediments deposited upstream of the check dams was estimated based on the area and depth of accumulated material. The dendrochronological investigation was based on 2 methods of study. First, growth ring width reductions of 25 spruces, growing upstream the check dams of the Cerny Potok stream, were dated. These trees were burring with sediment and sometimes wounded by transported material and abrupt growth reduction resulted from this process. A local chronology was constructed from 15 living spruce trees growing on Cervena Hora massif to compare tree ring variation of burred and wounded trees and trees growing outside of depositional zone. Secondly exposure of 15 roots were dated. Roots of spruces growing upstream of the dams are exposed as a result of lateral erosion which occurred after reservoirs were entirely filled. Dating of growth reductions and root exposure allows detecting events when the dam reservoirs were filled.

1 University of Silesia, Faculty of Earth Sciences, Bedzinska 60, 41-200 Sosnowiec, Poland (Tel.: +48-032-380-9104; Fax: +48-032-380-9104; email: irekgeo@wp.pl)
2 Uiversity of Wroclaw, Institute of Geography and Regional Development, 50-138 Wroclaw, Poland (Tel.: +48-071-375-2233; Fax: +48-071-343-5184 email: piotr.owczarek@geogr.uni.wroc.pl)

RESULTS AND CONCUSIONS

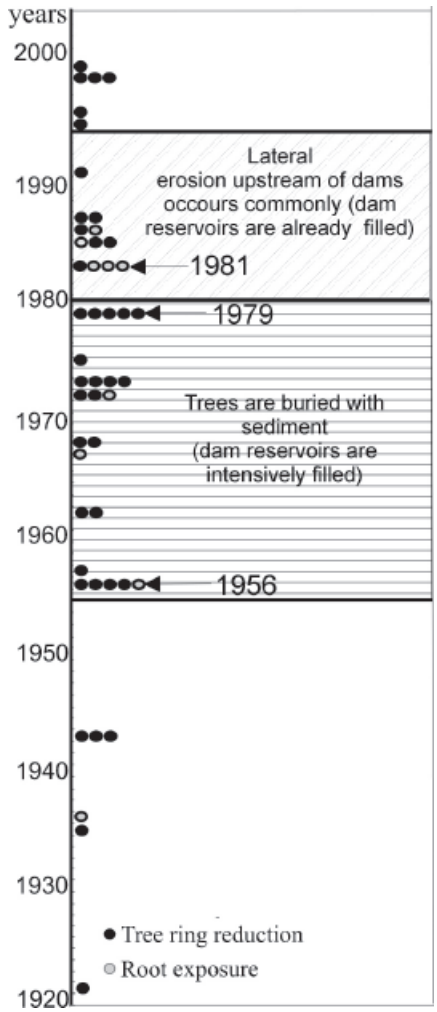

Fig. 1: Dendrochronological results derived from Cerny Potok stream

Check dams, which force deposition of mineral and organic material originated from the upper part of the catchment (as observed from the deposits of the debris flow), are located in the medial and lower section of the Cerny Potok stream channel. The system of 5 dams was built in the aftermath of catastrophic events, which occurred between 1920 and 1930, These events were comparable to the large floods observed at the end of the 19th and the beginning of the 20th century. The check dams (all < 6 m height) have induced the change of natural fluvial processes and the course of the Cerny Potok stream. Accumulation of sediment occurs upstream of the dams whereas intensive erosion is observed downstream. The dam reservoirs are almost completely filled with 198 to 387 m^3 of fluvial deposits. The dam reservoirs were filled in 1948, 1957, 1962, 1967/68, 1972/73, 1979, 1983, 1985/87 and 1997 (Fig. 1). Trees growing on the upper section are about 65 years old, trees in the lower section germinated earlier, in the first decade of 20th century. The trees in the upper part of the study area were probably killed during the extraordinary event of 1921. The oldest episodes were recorded in the lower part of the Cerny Potok stream in 1921 and 1935/36. No intensive morphological transformation episodes occurred between 1936 and 1955. Important events of the dams filling took place between 1956 and 1979 (Fig. 1). Dendrochronological analysis revealed that reservoirs above the check dams are filled within 50 to 60 years. Erosion started downstream after the dams had been built. Intensive lateral erosion occurred in the stream channel as soon as the reservoirs above the check dams were filled.

Keywords: Check dams, Sediment supply, Big floods, Mountain stream sedimentation, Dendrochronological methods.