ABSTRACT

In context of catastrophic floods and extreme droughts in recent years there is an urgent need of solving of issues dealing with protection against hydrological extremes, not using just classical engineering methods but also untraditional practices. There is a new protection strategy focusing on gradual increase of river catchment retention capacity including its headwater regions. All of the issues related to various possibilities and measures leading to river headstream areas retention capacity increase should be discussed by experts in various fields taking into account objectives and priorities of a supra-regional, regional and local significance. Natural runoff process is affected by man already by its birth, thus in headwaters where numerous procedures related to runoff retardation and water retention increase in headstream areas could be realized.

Suitable conditions for the research realization at present is related to the Otava River headwaters (sw. Czechia) representing the core zone of a number of extreme runoff events and with high heterogeneity in the terms of physical-geographic and socio-economic aspects. To understand and clarify the runoff generation process and the effect of various physical-geographic factors on its dynamics, the detailed analyses of runoff regime in chosen experimental catchments began in 2005 by the establishment of unique network of automatic stations for the monitoring of hydro-meteorological features and physio-chemical parameters of surface water. In order to assess the retention potential in the Otava River headwaters catchment natural conditions need to be characterized and their effect on runoff formation including peat bogs hydrological function assessment needs to be done. With respect to the existence of this phenomenon in the Šumava Mts. core zone it is necessary to consider the evaluation of their retention capacity and of the hydraulic communication with draining water courses. Therefore continuous analyses of hydrological and meteorological time series were carried out, and especially analyses of runoff responses from peat land areas in relation to the duration, intensity and distribution of precipitation on experimental catchments by means of detailed analysis of its ascending and descending phases, were done.

Part of the research was focused on the evaluation of retention and hydrological conditions of the bog within the Rokytka (Weitfäller) Moors, located in the Vydra River headwaters. Special attention was paid to the assessment of their retention capacity and hydrological balance. The main attention was focused on findings of a runoff dynamics dependence on the ground water table in the peatland.

Present hydrology deals with a number of difficulties to sufficiently define the environment where hydrological processes take place. These are under-described secondary conditions and features that have a direct and indirect influence on the runoff formation. Modern experimental hydrology uses hydrochemical and geochemical approaches to explain the mechanisms which are related to water retention and runoff formation in headstream areas. Stable oxygen isotopes are the only natural, physically definable and tracable substances existing in the hydrosphere which can be balanced correctly. This geochemical approach was used to understand streamflow generation processes in the highly peaty catchment. Contribution of water from peat bog areas to the total surface runoff has been assessed using a hydrological time series as well as geochemical, hydrochemical and isotope-hydrological approaches for unit hydrogram separation by means of anion deficiency. On the basis of data from the whole hydrological year, the role of an existing peat bog in the runoff formation dynamics was determined and the hydrological cycle using stable $^{18}O/^{16}O$ isotopes was described and assessed.

On the base of acquired results, graphical outcomes and time series statistical analyses it could be stated that more distinct runoff variability is typical for streams draining catchments with the significant proportion of peat land. The fact that the existence of bogs has the negative effect on the runoff process, especially during

extreme hydrological situations such as floods and droughts, was confirmed by hydropedological, hydrochemical and geochemical approaches. It can be stated that bogs in the Otava River headwaters represent separate hydrological units with their own typical runoff regime, which does not contribute to the discharge curve balancing, and that their hydrological functions in this area is insignificant.

An important phenomenon of runoff formation in headwater areas of Czech streams is in total annual balance represented by seasonal snow cover which is a quite hardly quantifiable element. The character of its occurrence is characterized by a high time and spatial variability. Snow cover observations in experimental catchments confirmed the existence of a significant difference in the amount of accumulated snow not only in relation to altitude, but also to vegetation cover, especially between forest and open areas. It is a fact, which is difficult to capture using the results of measurements carried out routinely at meteorological stations. Optimalization of snow cover monitoring in the Šumava Mts. conditions is crucial for modelling the runoff from a snow cover and in terms of accuracy for hydroprognosis inputs.

In addition to considering dyking of former drainage channels, which is a part of Šumava Mts. National Park management at present, the evaluation of the usage effectiveness of retention spaces related to suitable relief configuration and former accumulation reservoirs, used for wood floating in the past, with their potential function as dry polders balancing the runoff, is in the process of evaluating. On the base of acquired data and partial results it could be stated that the effectiveness of such measures might not be far from negligible. Using complex system of suitable hydrological models the simulation of runoff process and the assessment of the effectiveness of these reservoirs could be made. Implementation of such unforceable measures, such as the use of potential accumulation and retention spaces in the catchment area, could contribute significantly to reduction of peak flows and to increase of water resources during eventual extreme droughts in future. The topicality of this subject is associated with recent climate change and the intensification of meteorological and hydrological extremes in Czech conditions.

Key words: hydrological extremes – runoff formation – retention potential – Otava River – automatic stations – experimental catchment – peat bogs hydrological function – oxygen isotopes – snow cover – retention and accumulation spaces – climate change