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# Anthropogenic degradation of mountainous raised bogs. Case study of the Polish Carpathians

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Publications on the human impact on peat bogs pay a lot of attention to peat erosion, peat burning and changes in the physical and chemical properties of peat deposits that indicate pollution in the environment, but a more detailed analysis of current changes in the peat bog relief as a result of peat deposit extraction and drying is omitted. Compared to other areas of the world, the level of knowledge on anthropogenic changes in the relief of peat bogs in some areas of Poland may be considered advanced. This applies not only to peat bogs in northern Poland but also southern Poland, where peat bogs in the Carpathians and the Sudetes are also found. The best analyzed peat bogs in southern Poland are the raised bogs in the Orawsko-Nowotarska Basin (Western Carpathians) and in valleys in the Bieszczady Mts. (Eastern Carpathians). Both areas are impacted by deep precipitation shadow. The purpose of this paper is: (1) to assess the rate of shrinkage in the surface area of peat domes in the mentioned areas, (2) to describe the rate of growth in the surface area of older and younger post-peat areas, (3) to explain current changes in peat bogs morphology, (4) to explain changes in water retention in peat deposit, (5) to separate phases in peat bogs relief changes. With that in mind, the direction and rate of change of landforms typical of younger post-peat areas, such as peat extraction scarps, post-extraction hollows, drainage systems including ditches and regulated stream channels, were analyzed. A special emphasis was placed on the period of time when the restoration of such areas has taken place. The paper is based on an analysis of maps produced over the last 230 years as well as on aerial photographs taken since 1965 and on LiDAR data. Fieldwork included the geomorphological and hydrographic mapping of specified landforms within peat bogs using GPS methods. In period prior to human activity peat domes were larger than today and were surrounded by lagg fens and were drained by meandering streams. In period prior to the end of peat extraction and drying the amount of area lost by the peat dome and former wetland fringe can be identified in terms of older and younger post-peat areas. Stream channels in the general area have been regulated and drainage ditches dug. Partial or full peat extraction taking place primarily in the domes' fringe zone has produced major changes in peat bog relief and has substantially reduced peat bog water content. The increased density of drainage ditches in the area surrounding the remnants of peat domes has led to further drying of the peat bogs. An unintended consequence of stream regulation are shallower and wider channels that evolve into braided channels with a local tendency to aggradate material. The current stage of peat bogs development is their restoration which started when peat extraction had been halted in most peat bogs and drainage ditch maintenance had been abandoned.