

Jan Kochanowski University in Kielce
Faculty of Natural Sciences
Institute of Geography and Environmental Sciences
Division of Environmental Research and Geoinformation

ABSTRACT

Impact of human pressure on selected geocosystem elements of small river catchments in the Świętokrzyskie Mountains

Author: *mgr Joanna Helena Przybylska*

Supervisor: *prof. UJK dr hab. Rafał Kozłowski*

Freshwater ecosystems, hosting substantial biodiversity, are among the most endangered by human pressure, due to deterioration of water quality, water abstraction, fragmentation of habitats and changes in river channel morphology. Therefore, there is an urgent need to assess the present state of river catchment geocosystems, characterise the mechanisms linking existing pressures and response of freshwater organisms, and finally – to propose measures enabling protection of rivers. The aim of the presented thesis was to assess the human impact in small river catchments of the northern part of the Świętokrzyskie Mountains (SE Poland) on hydromorphological state of river channels, physico-chemical parameters of water and bottom sediments, and – as a consequence – habitat quality of selected bioindicator – the Thick-shelled River Mussel *Unio crassus* Philipsson, 1788.

The first chapter introduces studied issues and describes the current state of knowledge of the functioning of the Świętokrzyskie Mountains' river catchments. The majority of hydrological and faunistic research has been devoted to urban and agricultural-forest catchments in the area of Kielce, as well as forest catchments in the Świętokrzyski National Park. Aims, theses and research methods used in the dissertation were described in this section as well. Physico-chemical properties and chemical composition of surface water were analysed once a month in hydrological years 2016-2018 in eight river profiles, where samples of bottom sediments and mussel shells were collected. On eleven sections hydromorphological assessment was performed with the use of River Habitat Survey method (RHS), and population of the bioindicator species was evaluated according to the method

developed for the State Environmental Monitoring. The following geo- and bio-indicators were analysed: water temperature, pH, conductivity, dissolved oxygen (EUTECH PCD650 meter), concentration of major ions in water (ion chromatograph DIONEX ICS-3000), acid neutralising capacity ANC_{aq} , concentration of selected heavy metals in water, bottom sediments and mussel shells (mass spectrometer ICP/MS-TOF Optimass), mussel populations' distribution, numbers, age and size structure, hydromorphological indices proposed for the RHS method (HQA, HMS, RHQ, RHM), as well as land cover structure and road network density in catchments and river valleys (analyses performed in ArcGis ESRI v. 9.3, based on Topographic Objects Database BDOT10k). Statistical analyses were conducted in Statistica v. 12.0 programme.

Systematic position, biology, ecology and conservation status of the thick-shelled river mussel were summarised in the second part of the dissertation. Research area was characterised in the third chapter, where localisation of river profiles, geology, relief, climate, hydrology, plant cover, protected areas and socio-economic conditions of the river catchments were presented.

The results of conducted research were analysed in the fourth chapter. Diversified share of highly modified forms of land cover in river catchments and river valleys, as well as different road network density, indicated rivers under high and low anthropogenic pressure. Hydromorphological assessment also showed that the modifications varied from highly natural to heavily modified river sections. Mussels were found in nine of the eleven studied river sections, although only in two of them conservation status of the species was assessed as favourable. Spatial and temporal changes in the analysed physico-chemical parameters and chemical composition of river water, resulting from geological structure and identified human impacts, were presented. Concentration of selected heavy metals in water, bottom sediments and mussels' shells indicated differences between the studied rivers. In the case of several metals, the age class of analysed specimens, as well as sample preparation procedure, was an important factor. Extreme events registered during field studies, affecting the geoecosystem functioning – acid mine drainage inflow to one of the rivers, were also presented in this chapter. The final point of the results discusses geoecosystems' reaction to human pressure and includes primary component analysis and correlations between the indices describing mussel's populations and ecological state of rivers.

In the fifth chapter, the results were confronted with the current knowledge of distribution and population status of the bioindicator species at the regional and country scale, its habitat preferences and conservation status. Factors limiting mussel's populations and

mechanisms determining its reaction to changes in hydromorphological and physico-chemical parameters, as well as chemical composition of river water, were discussed. Ecological state of analysed rivers was assessed in terms of applicable environmental standards and compared with other rivers under the State Environmental Monitoring. The factors resulting from human pressure, which affected studied geoeosystems, were indicated. Significant, negative impact of acid mine drainage on water quality and mussel's populations was underlined. Among other factors, the influence of arable lands, developed areas and road network was stressed.

To conclude, the analysed geoeosystems of the Świętokrzyskie Mountains are under human pressure which is diversified in temporal and spatial scale. Hydromorphological state of rivers is under a negative impact of intensive farming and road infrastructure. Chemical composition of water, determined by geological structure of catchments, is affected by point (acid mine drainage and sewage treatment plants), area (agricultural and developed areas) and line (roads) sources of pollution. Elevated concentrations of chloride and sodium, acidification of river water and high concentrations of copper, zinc and cobalt, are among the factors limiting populations of the thick-shelled river mussel. However, elevated concentrations of nitrates and ammonium, within the range set for the second class of water quality, do not affect the bioindicator. Therefore, the methods of species monitoring should include such habitat parameters as pH, concentration of hydrogen carbonates and calcium, indirectly showing ecosystem's resistance to acidification and high concentrations of heavy metals. Conservation status of the thick-shelled river mussel in the Świętokrzyskie Mountains is unfavourable, thus it is urgent to adopt all necessary measures to limit pollution of surface waters.

Joanna Przybylska