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ABSTRACT OF Ph.D. THESIS

„ Natural and historical changes of the Kamionka catchment (Suchedniów Platau) in Subatlantic"

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The transformation of river valleys under the influence of climate and human activity is one of the important research directions. The work carried out in many regions of the Polish and Central Europe by different timespan and methodical approach. Some of them also concerned the highly industrialized catchment. Kamionka catchment is located on a mountain and upland area of northern Mesozoic margin of the Holy Cross Mountains. Research on Late Glacial and Holocene changes of the Holy Cross floodplains have been or are carried out in the Lubrzanka, Belnianki, Czarna Nida, Kamienna, Nida, Wierna Rzeka and other valleys. This allows for comparison of study results of Kamionka catchment on the regional and timespan broad background.

Kamionka is a right tributary of the Kamienna river, a small watercourse having about 17 km length and a catchment area is about 107 km^2. This area lies within of the Old Polish and Central Industrial District, which resulted in a strong human pressure on the environment associated with a rapidly developing industry based on the mining and processing of iron ore.

The aim of the work is a case study - an analysis of geological, geomorphological, historical and cartographic of Holy Cross Mountains small river catchment in chronological and spatial determination, the state of the morphogenetic processes, both natural and anthropogenic and their role in the Subatlantic evolution, as well as an explanation, which factor was dominant in this period. The time frame has been limited to the Subatlantic period (from approx. 2400 BP), because the work focuses on the anthropogenic factor and its impact on changes in the Kamionka catchment.

The study used a number of interdisciplinary methods. In the field, performed geological mapping of the Quaternary sediments (profiles and drills), geomorphological (map

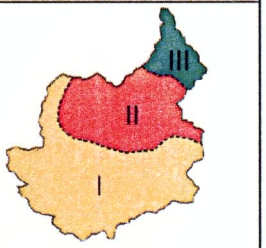
- est. 1) and geophysical GPR survey in the Suchedniów former pond located in the city park area. The laboratory analyzes were performed using sediment grain size sieve (gravel and sand) and laser diffraction (dust and clay), geochemical analysis (concentration of heavy metals) in the sediments of the floodplain and the old pounds. Dating of clastic sediments was performed using TL methods (the Pleistocene sediments), OSL (the Holocene sediments) in the Laboratory of Science and Teaching in IG UJK, while the organic material was dated by ^{14}C. As part of the chamber work, were collected and analyzed multi-topic, rich collection of archival materials (eg. geological, archaeological, photographic), historical and cartographic data among others based on a digital terrain model (DTM), a series of thematic maps, geological and hypsometric cross-sections of the Kamionka catchment. As a summary was developed the grading of anthropogenic changes that have occurred in three separate parts of the study area.

In the chapters of the documentation after discussing the development of the settlement and development of the area during the Prehistoric, Medieval and Modern times shows the natural and anthropogenic environmental changes of chronological and spatial in terms (separated three distinct regions within the basin). The summary of these considerations is the descriptive and tabular (bonitation) rating of the Subatlantic changes in natural and anthropogenic basin (Fig. 1-5). This allowed us to formulate conclusions of this work.

Conclusions

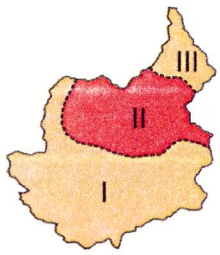
Geological, geomorphological, historical and cartographic analysis document very large changes of the environment in the small river basin, which is Kamionka in chronological and spatial terms.

The largest anthropogenic changes in the basin ranged from the seventeenth to the second half of the twentieth century, as a result of mining and industrial activities (forges, mills). Kamionka riverbed was regulated, especially in the middle and lower section - near Suchedniów, Ostojów and Rejow in more than 50% of its length. In the vicinity of larger towns in varying all landforms become anthropogenically changed.

Catchment part	Morphology																			
	Natural forms anthropogenically transformed											Anthropogenic forms							Summary
	Fluvial-denudation				Fluvioglacial		Fluvial				Aeolian	Accumulating		Erosion					Anthropogenic anastomoses	
	The slopes	Dry valleys	Landslides	Alluvial fans	Kems	Kem terraces	Pleistocene terraces	Floodplain	Makropaleomeanders	Paleochannels	Dunes	Alluvial fans	Embankments	Building cuts	Channels and sluice	Excavations	Holwegs	Trenches		
III – Lower	3	1	1	0	0	0	2	1	1	2	0	0	2	1	1	1	0	0	1	17
II – Middle	2	2	0	1	3	3	3	2	3	3	2	1	3	2	3	3	0	1	2	39
I – Upper	3	3	0	2	0	1	1	1	0	1	0	0	2	2	2	2	1	3	1	25

Dig. 1. Anthropogenic transformation of the terrain in the Kamionka catchment area (ed. P. Przepióra)
0 – lack, 1 – low, 2 – medium, 3 – high

Catchment part	Water relations						
	Riverbed renaturalisation	hydro-technical objects	Forges with infrastructure	Water mills with infrastructure	Reservoirs	River course changes	Summary
III – Lower	3	1	1	1	2	3	11
II – Middle	2	3	3	3	3	3	17
I – Upper	1	1	2	3	2	2	11



High: >13

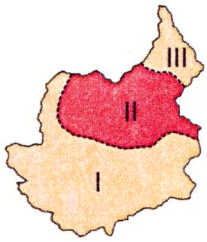
Average: 7 - 12

Low: 0 - 6

Dig. 2. Changes of water relations in the Kamionka catchment area (ed. P. Przepióra)

0 – lack, 1 – low, 2 – medium, 3 – high

Catchment part	Development											
	Forestry	Agriculture	Industrial objects	Old mine excavations	Modern mine excavations	Buildings	Asphalted surfaces	Sewers	Soils	Vegetation	Barrens	Summary
III – Lower	1	0	2	2	0	3	3	3	1	2	2	19
II – Middle	3	1	3	3	3	3	2	2	1	3	2	26
I – Upper	1	3	1	1	1	1	1	1	3	1	3	17



High: >23

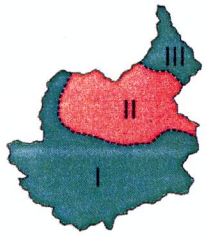
Average: 12 - 22

Low: 0 - 11

Dig. 3. Development changes in the Kamionka catchment area (ed. P. Przepióra)

0 – lack, 1 – low, 2 – medium, 3 – high

Catchment part	Intersections deposits				
	Slag	Charcoal	Heavy metal pollution	different ages ceramics	Summary
III – Lower	1	0	1	0	2
II – Middle	3	3	2	1	9
I – Upper	1	0	1	0	2



High: >8

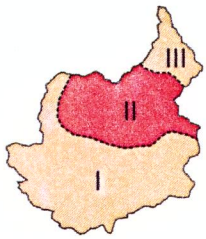
Average: 5 - 8

Low: 0 - 4

Dig. 4. Intersection deposits changes in the Kamionka catchment area (ed. P. Przepióra)

0 – lack, 1 – low, 2 – medium, 3 – high

Catchment part	Renaturalisation						
	Riverbed	Slopes	Concave forms	Convex forms	Reservoirs	Vegetation	Summary
III – Lower	1	1	2	2	1	1	8
II – Middle	3	1	3	3	2	1	13
I – Upper	2	2	1	2	1	1	9



High: >13

Average: 7 - 12

Low: 0 - 6

Dig. 5. Renaturalisation changes in the Kamionka catchment area (ed. P. Przepióra)

0 – lack, 1 – low, 2 – medium, 3 – high

The last centuries were decisive in terrain morphology and the accumulation of specific types of deposits in the Kamionka catchment. Those sediments are layers of charcoals (natural and anthropogenic) and slags. The occurrence of coal and slag in the lake sediments is connected with forges activities on the river. In the catchment area there are preserved many anthropogenic forms dating from the period of industrial activity and mining

(embankments, channels, abandoned test and mining shafts). In the upper part of the catchment agricultural activity on the western slopes led to the rejuvenation of the smaller, younger Holocene, dry valleys. Field roads transformed into holwegs. Anthropogenic factor is the dominant and decisive in the evolution of the Kamionka valley in historical times and today. However, it should be emphasized that with the decrease of the intensity of industrial human activity processes began renaturalisation of Kamionka basin.

No black oaks logs in the sediments of the Kamionka floodplain, in contrast to many subfossil logs found in the sediments of the nearby Kamienna and other major rivers of the Holy Cross Mountains, shows great planar stability of the riverbed, which could be associated with a number of anthropogenic anastomosing sections. In the Little Ice Age, the increased frequency of extreme events, inundating large floods in the entire valley floor did not occur, which documents the lack of cover overbank deposits with increased of heavy metals content on the floodplain. She contributed probably to this enhanced anthropogenic network of small retention (numerous ponds with forges and mills channels etc.) lowering the peak of the flood wave and prevent flooding of the valley floor. Indirect proof of this is local buildings at that time on the floodplain, as is documented archival photographs. Large role in modeling of the small retention of water and the development of river basins has already note by other authors in the 80s of the twentieth century.

However the human activity in the twentieth century has led to create in small mountain river a catastrophic flood that earlier in the Holocene were not recorded because it was not found sediments indicative of such events. They are associated with disaster construction - braking the dam and rapid drainage of the reservoir. An indirect confirmation of the hypothesis of anthropogenic causes of catastrophic events in the Kamionka catchment is the very thick inserts in the Holocene sediments.

Within the Kamionka catchment, in all watercourses the biggest impact have construction projects, especially large. They contribute to the silting of water reservoirs in Kamionka, filling them with material from embankments that was cut and transported by the river. It reduce reservoir retention capacity, and ultimately diminishes their anti-flood role. This leads to the occurrence of large floods. This is demonstrated by the event that took place in recent years, for example in 2010. Even some investments led to the disappearance of smaller streams, just like Pstrążnica for example.

Paweł Przepióra