# LOCATION OF EARLY MEDIEVAL HILLFORTS IN THE POLISH CARPATHIANS – PHYSIOGEOGRAPHIC ANALYSIS

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## ABSTRACT

The study area is located in southern Poland, in the Carpathians between Cieszyn in the west and Przemyśl in the east. Complex physiogeographic and geoarchaeological analyses are helpful, including: analysis of the Digital Elevation Model and derived maps based on EU-DEM, geological characteristics of the immediate vicinity of the central part of the hillfort (maidan) based on geological map (1:50 000) – litostratigraphy and tectonics of the surrounding area, relief and morphogenetic processes, a description of the mesoclimates of individual landscape elements around individual hillfort components based on hillfort plans (Marszałek 1993). The main methods include geoinformatics and geomorphological studies. The first of these was developed using modern ArcGIS Pro and QGiS software. Precise information from the National Geoportal (hillshading map) was also implemented.
There are approximately 44 archaeologically confirmed the Early Medieval strongholds in the Polish Carpathians, often with difficult-to-determine chronological order. There are mostly small, single-rampart structures, commonly found in forests within relatively low mountains and foothills. The strongholds' basement is usually hard and compact. They often occur near brown, lessive soils. Detailed field research will be carried out on selected strongholds in the future.

**Keywords:** Hillforts, Carpathians, Poland, Middle Ages, Geoarchaeology

## INTRODUCTION

Hillforts in the Polish Carpathians remain an underappreciated research topic among both domestic and international researchers. Over the past decade or so, there has been very little archaeological work in this area, which may be due to the lack of excavations and reliance on surface surveys. This significantly hampers the precise chronology of hillforts. Furthermore, almost all sites lack environmental context, revealing a clear research gap.
A hillfort is the remnant of a former hillfort, a possible settlement, most often defensive, surrounded by a rampart. In the territories of present-day Poland, Germany, the Czech Republic, and Slovakia, they were a characteristic feature of the lowland, upland, and mountain landscapes. In the south, Slavic settlements were less numerous, perhaps due to different geographic and cultural conditions. In this article, the Early Middle Ages is defined as the period from the beginning of hillfort construction in the mid-8th century until the 13th century [1], when the first proto-towns began to emerge. The Polish

Carpathians have long been a borderland, forcing the local population to adapt to geopolitical and cultural conditions. Two types of the Early Medieval hillfort remains exist today. The first is a hillfort covered in dense forest, e.g., Tyrawa Solna (Fig. 1), and the second is a site developed by a later castle, e.g., Manasterzec [2].

**Figure 1.** The hillfort in Tyrawa Solna on Diabla Góra (Devil's Hill) above the San River. An example of a hillfort on top of a forested hill (type: watershed IIIb). Photo by Cyryl Konstantinovski Puntos

## AIM AND METHODS

The main research goal was to create a comprehensive environmental database for the locations of 44 Early Medieval hillforts [3] in the Polish Carpathians, from Cieszyn to Przemyśl (Fig. 2), as well as to collect data characterizing the hillforts themselves—the number of ramparts and their surface area. This allowed, on the one hand, for an analysis of the "human-environment" relationship and the reconstruction of the realities and causes of the emergence of early Slavic hillforts in these locations. On the other hand, for the development of a hillfort typology based on their location.

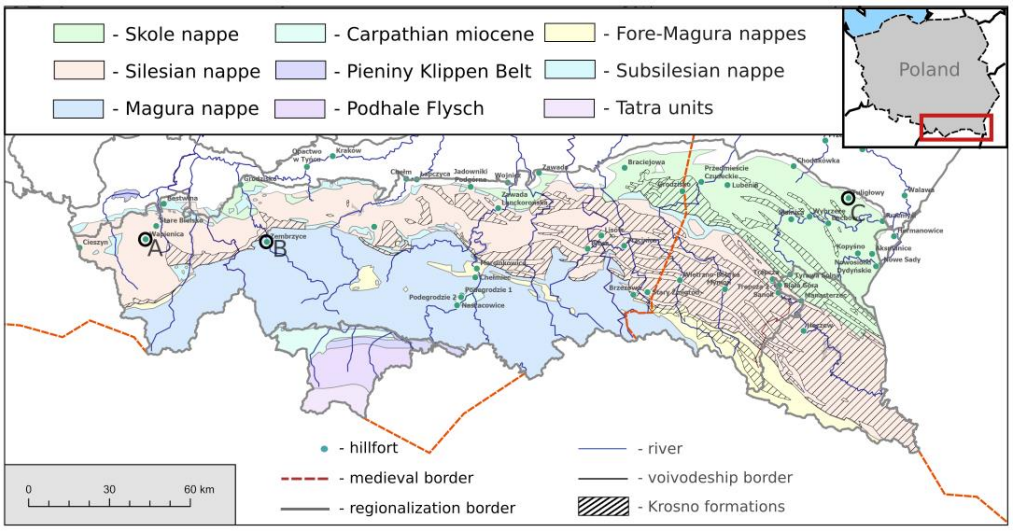


**Figure 2.** Area of the study. Carpathian hillforts [8, 9] on the background of the tectonic map [18]. Hillforts (see Fig. 4): A – Wapienica, B – Zembrzyce, C – Tuligłowy.

The developed database for hillforts consists of over twenty elements. Various literature and cartographic data were used to characterize them (Table 1).

**Table 1.** Schematic diagram of the table structure developed for this research.

| Name of the component | Classes or types | Sources and data |
|---|---|---|
| Regionalization | 16 regions where are hillforts | [4] |
| Tectonics | 3 main nappes and others | [13] |
| Stratigraphy and litology | Interpretation of geological map. Various classes | [13] |
| Quaternary deposits | Interpretation of geological map. Various classes | [13] |
| Relative height | m | [14] |
| Absolute height | m a.s.l | [14] |
| Relief typology | 3 classes | [6] |
| Landforms | 7 classes | [8], [11], [14] |
| Aspect | 0-360 degrees | [14] |
| Climate vertical zone | 2 classes | [14] |
| Mesoclimate | 3 classes | [7], [9] |
| River order | 3 classes (II., III., IV.) | [15] |
| Basin | Various names of the rivers | [15] |
| Soils | 5 main types and 1 combination | [13], [17] |
| Vegetation vertical zone | 2 classes | [14] |
| Potential vegetation | Various classes of vegetation | [5] |
| Area of hillfort | 8 classes | [10], [1], [12] |
| Rampart's count | 3 classes | [10], [12] |
| Typology | 7 classes | Author's typology |
| Chronology | 8th/9th-13th c. Various combination | [10], [1] |
| Preservation | 3 classes (good, medium, bad) | [12] |
| Landslides | 2 classes (Yes, No) | [13] |
| Comments | - | - |

Geoinformatics methods (arcgis pro and qgis) were used to process the data and analyze it. This involved working with raster data (digital elevation model) [11, 13] and vector data (including vectorization of the location points of the hillforts on the map). Some maps were calibrated (relief map, tectonic map) and then compared with a point layer of the locations of the early medieval hillforts. Obtained archaeological data regarding the chronology of hillforts and their morphometry were used. In many cases, data (such as geological data from the map 1:50,000 or soil science data) were implemented directly from the maps and saved in a spreadsheet. Some information was generated directly in the gis environment. Individual maps of each hillfort were also created using available rasters. Contour and slope maps were also created based on eu-dem. A preliminary field survey was conducted on selected hillforts, primarily in the eastern part of the carpathians.

## RESULTS

The distribution of hillforts in the Polish Carpathians is uneven, with more occurring in the eastern part than in the western part (Fig. 2). The Dunajec River Valley, along which

a distinct, linear concentration of hillforts is a distinct boundary between these two regions.
Carpathian hillforts were predominantly small, single-rampart structures (55%), located within predominantly low mountains [5, 10] (32%) and foothills (66%). This means that the majority, as many as 45% of hillforts, are located within the Silesian nappe, 32% within the Skole nappe, and only 7% within the Magura nappe. The basement is Mesozoic and Cenozoic flysch [13], which favors landslides. The Quaternary cover are most often composed of weathered rock, but 4 hillforts (9%) were built on loess.
The Dynów Foothills (approximately 11% of all hillforts in the Polish Carpathians) [4] contain the largest number of hillforts with three (or more) lines of defensive ramparts. In the Silesian Beskid, there is one hillfort with a single rampart, in the Wyspowy (Island) Beskid, one hillfort with a single rampart, and in the Low Beskid, there are two hillforts: one with a single rampart and one with three or more lines of defensive ramparts.
The hillforts occur between 200 and 688 meters a.s.l. They are located on various relief forms, 7 of them on the Tertiary, “foothill peneplain” with a relative elevation of approximately 150-200 meters above the valley floor. Approximately 20% of the hillforts are located within terraces, near their edge [8]. Climatically, the hillforts are located in a favorable, warm, and temperate location near relatively wide rivers [15]. 95% of the hillforts are located in the "moderately warm vertical climate zone" (average annual temperature from +6 to +8°C), and only 2 in the”moderately cool vertical climate zone” [16]. More than half of the hillforts (25 sites) are located within mesoclimate II (slopes and lower ridges; so-called "warm zone on slopes" with optimal mesoclimatic conditions) [4, 7], 14 hillforts are within mesoclimate Ic (valley sides, dryer and warmer at night), and 5 on terraces within mesoclimate Ib (central and lower parts of slopes).
Collectively exists 66% of the hillforts, which are located near valleys of II. river order, with a particular concentration in the Dunajec Valley. This is followed by 23% in IV. and 11% of the III. river order.
Hillforts often occur near areas with brown and lessive soils. The proximity of Cambisols (52%) and Retisols (34%) is the largest, according to the American classification WRB (The World Reference Base) [17].
On the potential vegetation map, most hillforts are located in forest habitats typical of oak-hornbeam, alder, and beech forests [5]. Currently, these areas are forested, but the species composition has been changed and created as a result of forest management in recent centuries.
Most hillforts have an area of less than 4 hectares (80%). More than half of the hillforts have only one line of defensive ramparts. Hillforts were constructed differently on hilltops (a defensive rampart surrounding the hilltop, usually at a single elevation) and on slopes and hillsides (the rampart can be built according to the relief, at varying heights). A typology based on the location of hillforts indicates that the majority of hillforts can be classified in the watershed (39%) and slope (36%) categories (Table 2, Fig. 3).
Hillforts are most often poorly preserved due to multidirectional anthropogenic impact. Their transformation or destruction by landslide processes, which are very common in the Polish Flysch Carpathians, is relatively rare. Approximately 23% of all hillforts are subject to landslide processes.

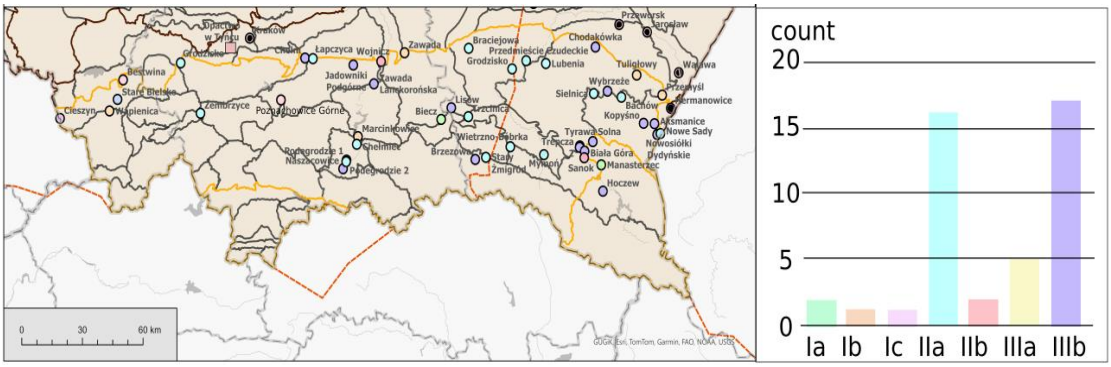


**Figure 3.** The typology of Polish Carpathians hillforts. Regionalisation (physicogeographical mesoregions-black line; physicogeographical subprovinces – orange line): [4], Medieval border of countries (red line) [1], Locations of hillforts [3]. Basemap Geography socio-economic: Esri

**Table 2.** Hillforts typology

| Types of hillforts | Characteristics | Count | Sample |
|---|---|---|---|
| Ia | Flat | 2 | Wojnicz |
| Ib | Flat – slope | 1 | Stare Bielsko |
| Ic | Flat- watershed | 1 | Cieszyn |
| IIa | Slope | 16 | Braciejowa |
| IIb | Slope - watershed | 2 | Biecz |
| IIIa | Watershed – slope | 5 | Zawada |
| IIIb | Watershed | 17 | Wybrzeże |

Three cases were selected for future detailed research. The site in Zembrzyce (type: slope IIa), where a hillfort was built in a side valley (III. river order) suspended above the Skawa valley (II. river order) on the Pleistocene alluvial fan (Fig. 4). For comparison, the hillfort was also compared with the site in Tuligłowy on Borusz Hill and its slope part (watershed-slope IIIa), located north of the Pleistocene valley near the Węgierka valley (IV. river order) and occupying the culmination of Wapienica Hill (type: watershed IIIb) above the Wapienica valley (III. river order), on hypsometric and slope maps.

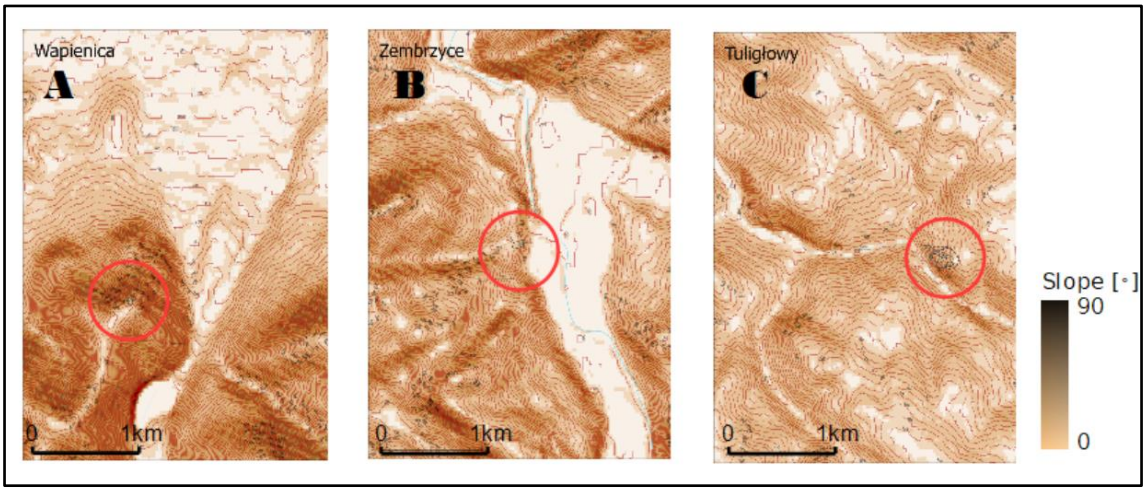


**Figure 4.** Examples of hillforts in the Polish Carpathians. Based on [12], [14], [15]. Hillforts are marked with a red circle on the map

## CONCLUSION

A database of environmental data for the locations of 44 hillforts in the Polish Flysch Carpathians can serve as a starting point for geographical, archaeological, and historical analyses.

This preliminary analysis allows us to hypothesize that geopolitical and strategic factors played a significant role in the location of the hillforts. Their small size, coupled with their greater number in the eastern part, suggests that their primary role was to protect the borderland from potential enemies. These are not primarily large refuges, such as Naszacowice near Nowy Sącz, but rather small watchtowers, such as Hoczew near Lesko. These small hillforts were constructed around the main hillfort in Przemyśl or Sanok. They also protected major trade routes, such as the Dunajec Valley, along which they are clearly concentrated.

The significantly smaller number of hillforts built on the Magura nappe may be a result of their location within the low mountains and foothills that formed on the flysch of the Silesian and Skole nappes. This conclusion is also supported by the geological structure of the Polish Outer Carpathians. In the eastern part, where the hillforts are most numerous, the Magura nappe occurs only in a very limited area and in the interior of the Beskidy Mountains.

The selection of sites for hillfort construction was largely determined by specific, favorable geomorphological conditions. Relatively "flat" areas were often chosen, such as Tertiary peneplain – the “foothill level”, which facilitated development. At the same time, these flatlands sloped downward on steep slopes formed during the Quaternary phases of erosion. This also applies to younger forms, such as the Pleistocene terraces and alluvial fans in side valleys, such as Zembrzyce (Fig. 4), suspended as a result of the early Pleniglacial and Holocene deep erosion in second-order valleys.

It appears that the location of hillforts was also related to knowledge of mesoclimatic conditions – the frequency of inversions, particularly in winter. This was all the more significant because they were built during the cooling period of the Late Antique Little Ice Age. A suitable temperature and climate were crucial for the population at that time, and hillforts were often temporary or permanent habitats for local communities.

The land around hillforts was certainly cleared to obtain timber for the construction of palisades and box ramparts, and for military reasons – to increase the field of observation and prevent undetected enemy approach.

In most cases, the specific location provides favorable viewing and defensive conditions. Only some of them were located in locations that do not fit this pattern, which may be related to their different function. Further, detailed analysis of the developed database should answer questions about the purpose and function of the Early Medieval hillforts in the Polish Outer Carpathians. Further detailed research, including paleogeographic and geoarchaeological fieldwork at selected sites, is planned for the future.

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