Abstract

Nearly 4,000 potential hillforts exist throughout the Baltic region. Hillforts served multiple purposes, including defensive forts to protect against attack, wooden castles, and settlements. A ground penetrating radar (GPR) survey was conducted on a hillfort in the Šilalė district of western Lithuania. GPR is a non-invasive technology that sends high frequency pulses into the ground. A pulsed EKKO GPR system equipped with 500 MHz antennae was used to collect a 40m x 20m grid, with the Y-Lines extended when needed. Other tools such as a GVS and a laser lever were used to supplement the GPR data. The GPR data was processed using the software EKKO Project 5. The results of the grid contain: 1) two rectangular shaped structures with one being 5.2m x 11.5m in size, the second is 4.7m x 11.3m in size, both approximately 0.6m-1.4m in depth, 2) linear feature approximately 3.3m long at a depth of 0.75m-1.0m, and 3) two circular shaped objects, one is approximately 2.1m in diameter at 0.15m-0.4m in depth and the second approximately 3.9m in diameter at 1.1m-1.5m in depth. The results will help guide future archaeological excavations and aid in preserving cultural artifacts within the Bilioniai hillfort as well as help to further explain the history of hillforts.

Introduction

The Bilioniai hillfort is located in the Šilalė District of Western Lithuania (Figure 1). The hillfort is situated on top of an oval shaped mound 25m in height, approximately 55m x 37m in size (Baubonis et al. 2017). The hillfort was surrounded by 5 fortification lines or ramparts (Baubonis et al. 2017). The history of the Bilioniai Hillfort is mostly unknown, due to the results of the research often going unpublished (Vikūnas et al. 2017). Local archaeologists have put together two pieces of literature that help to identify the history and events at the hillfort (Bilioniai Hillfort). After examination of the texts the researchers identified that the main layout of many Baltic hillforts contain terracing on the sides which climb up to a high platform. At the peak height of the hillforts there was a place for a wooden castle or a fortifying structure (Baubonis et al. 2017). The terrace housing ramparts that were used for defenses against attacks (Baubonis et al. 2017). There were settlements at the bottom of the hillfort, where people gathered at markets and had items to either sell or trade. The Bilioniai hillfort is historically significant because of its role in founding the town of Bilionai, and to the context it has provided to the 34 other recognized hillforts in the Šilalė district (Vikūnas et al. 2017). A ground penetrating radar (GPR) survey was conducted on the highest platform of the Bilioniai hillfort to investigate where possible subsurface archaeological and geomorphic features might be located. GPR lines were also collected down the sides of the hillfort in three separate locations to look at the terracing of the mound (Figure 2).

Methods

A non-invasive archaeological tool called GPR was used to investigate the hillfort before archaeological excavations were conducted. This is done to concentrate the dig sites on the areas of higher interest after the GPR survey. GPR sends high frequency electromagnetic pulses into the ground from an antenna at the surface (Iol and Bratov 2003). The radiated electromagnetic energy is reflected back to the surface by any dielectric interface from subsurface materials and received by the sensor (Davis and Annan, 1989).

Topographical data was collected with a laser level to highlight any areas that would have a depression or a different elevation profile than the GPR grid data. Global positioning system (GPS) points were collected on the corners of the survey to reference the image to Google Earth or any other 3D point visualizer. After a discussion with Lithuanian archaeologist, Zabiela, a proposed grid location was selected to locate subsurface features. A proposed grid was placed on location to try to potentially locate the former gate into the hillfort and the associated subsurface anomalies. Subsurface features could include walls, artifacts, and human remains. The initial grid size was 40mx20m, with the Y-lines extended to the edge of the hillfort when needed. The grid was extended to the edge of the hillfort to highlight an area that could be interpreted as the gate to the hillfort.

Results

Above is a GPR slice image at a depth of around 0.45m. The upper right oval is highlighting an area of little to no reflection. This area can be seen in the image to the right at a lower depth. The area highlighted by the red box is an odd shaped feature of a half circle with a solid center circle within it. The left two ovals are circular features within the data. These were shown by either strong hyperbolic reflections or no hyperbolic reflections in the LineView module.

Another GPR depth slice is seen above, this one is at a depth of around 0.75m. The red ovals highlight many areas of significance. The top two ovals highlight areas of little to no reflection. The lower three ovals on the left highlight linear features and circular features. These red ovals are circular features within the data. These were shown by either strong hyperbolic reflections or no hyperbolic reflections in the LineView module. The longer oval above is an area of no to little reflectance as seen above at the end of the red line. This oval is highlighted by the red line above.

Lastly, a depth slice at 1.10m and has a long red oval that highlights individual ‘dot’ type features that are seen at almost every meter, consistently. The very top red oval highlights a feature that follows the extreme slope can for ramparts can be seen in the image to the right at a lower depth. The end of the red oval to the left in this line is highlighting the strong hyperbolic reflector seen above on the line. The longer oval above is an area of no to little reflectance as seen above at the end of the red line. This area is still significant even though there are hardly any reflectance. This just means that the soil here has a different dialectic property than the surrounding soil.

Conclusions

The GPR survey yielded promising results. There are many areas of high intensity reflections and hyperrbolic reflectors. The processed GPR data has many horizontal reflections which indicate the presence of a subsurface feature. There are some circular reflector features which are an indication of a feature that shows this shape, unnatural in nature. There are also areas of little to no reflectance throughout the grid, there are no matches the normal soil reflectance, which is an indication of "foreign" subsurface features. Many of these horizontal line features come together to form right angles and shapes that are unnatural in nature. Highlighting these subsurface features allows for archaeologists to see areas that are significant. These are shown by either strong hyperbolic reflectors or no hyperbolic reflectors within the data. These were shown by either strong hyperbolic reflections or no hyperbolic reflections in the LineView module. The longer oval above is an area of no to little reflectance as seen above at the end of the red line. This area is still significant even though there are hardly any reflectance. This just means that the soil here has a different dialectic property than the surrounding soil.

Future Work

The Bilioniai Hillfort has the potential for many more GPR surveys. Smaller GPR grids of higher frequencies could be conducted over areas of interest from the 500MHz survey completed in the summer of 2018. This could be done to get a more detailed view into the subsurface to highlight the areas that showed interesting features and confirm their importance. Other locations on the hillfort could be sites for future GPR surveys. There are terraces down the side of the hillfort which could be sites of potential grids. These grids would be in search of any remnants of the ramparts which are presently buried. More strategically placed GPR lines could be taken at different locations down the side of the hillfort to see the terracing within the subsurface. Other hillforts within the region of Lithuania could be future sites for surveys. If other hillforts have similar results they would verify the significance of the subsurface anomalies seen in the Bilioniai Hillfort survey. Archaeological excavations should be conducted on areas of significance within the Bilioniai Hillfort survey to confirm the results of the GPR survey. This can also help piece together the history of the Bilioniai Hillfort and find artifacts to preserve and put on display in local museums.

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