

Verification and photogrammetric documentation of the archaeological site in Lake Boczna

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This project aims to verify the underwater position of the archaeological site as well as to confirm and expand obtained information using photogrammetric documentation along with a 3D model of the site.

The settlement is located in the western part of the Lake Boczna, about 300 meters south of Bogaczewo (in the Warmian-Masurian voivodeship) and 70 meters from the Lake's western shore. This settlement is only one of the few known of its kind that is also in such a good state of preservation in Poland.

The site was discovered by J. Hajdec in 1895. Due to low water levels, Hajdec was able to discover remains of the grate platform (13x9m) that consisted of five layers of beams. During his research, he also found fragments of ceramic vessels, animal bones and unidentified items destroyed by fire. The finds were dated to the 9th-7th century BC. While Hajdec's research of the site was very preliminary and cursory, and attempts to relocate the site in the 50s and 60s were unsuccessful. However, in 1993 it was possible to locate the site and document its state of preservation through drawing, but no photographic documentation was made. The position of the site was determined on a rectangle measuring 16x12m. The dimensions of the shorter sides were poorly visible due to the deepening of the lake's canal several years earlier. The settlement itself was on a platform made up of alternating beams stacked at an angle of 90 degrees. The remains of the rest of the settlement could not be found, but the poles in the central part of the platform suggest the possibility of walls. An attempt at detailed reconstruction was prevented by the chaotic arrangement of the stones and stains and the limestone deposits on the site. A breakwater was also located in the form of several poles positioned north-south, approximately 7 and 10 meters respectively from the settlement. Traces of the bridge were not found. Through inventory work of the ceramic and bioarchaeological material, it is evident that the site is being destroyed due to its location (near the bathing area, camp site and small

depth). The site has been dated to the first phase of the development of the western Baltic Kurgan culture, ie the end of the Hallstatt period D (620-450 BC).

The purpose of this year's research is to re-document the site and to investigate it using non-invasive (sonar) methods. From the time of the previous research, the site has been continuously exposed to destructive factors such as frequent boat anchorage within the site (Lake Boczna is one of the lakes where it is possible to sail in the Great Masurian Lake region). During the 7-day research, a thorough search of posts to verify the archaeological plans of previous studies is planned. Another objective is to determine the state of preservation of the site by applying photogrammetric techniques to analyze the changes without interfering with the position of the site itself. In addition, the entire area of the site and the area around will be scanned by a high-quality sonar, which will allow for the observation of structures and objects not visible on the lakebed.

In 2017, employees of the Department of Archeology of the University of Warsaw and members of the Association of Archeologists of Tomorrow together with the students of the Institute of Archeology carried out non-invasive studies of the water surface in the lake Boczny near Gیزیcko. The study was divided into two stages. During the first stage in April this year, a sonar mosaic was made (using EdgeTech 4125 Ultra High Resolution Sonar). Approximately 1km² of the bottom of the lake was located in the vicinity of the station and its vicinity. In the course of the work the exact location of the post was determined and the research area was selected for the next stage of work. The second stage of the project took place on 31 August and 3 September 2017. Its purpose was to execute a bathymetric site plan and its surroundings, documented using the SFM (Structure from Motion) photogrammetric technique, based on which a detailed residual settlement plan was developed, as well as digital terrain modeling along with

a 3D model. The bathymetric plan was made with the help of a side sonar Lowrance HDS-12 Gen2. The area of the sonar survey covered nearly 1300 m², which allowed for a very detailed bathymetric plan of this part of the lake (Fig1).

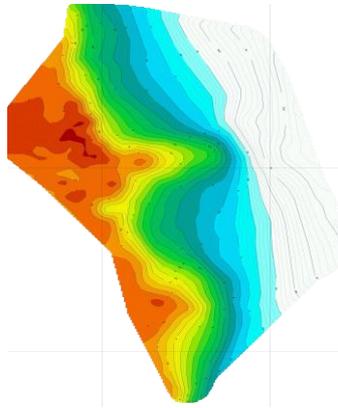


Fig.1 Bathymetric plan of the lake Boczne

It turned out, however, that the site selected for the study in the previous stage turned out to be quite tightly covered with a thick underwater species of the Earplug species, which completely prevented photogrammetric documentation. As a result, it was decided to limit the area of study to a rectangle measuring 10x15m, which was completely cleared of vegetation within two days. There was a stretched measuring tape around the study rectangle and the area was divided into ten lengths of 15 m and a width of 1 m. During this work, 30 Ground Control Points (GCPs) were determined, which were measured using the Total Station . This target was used to measure 3.65 meters long, spaced over each point on the tripod by two divers (Figure 2).

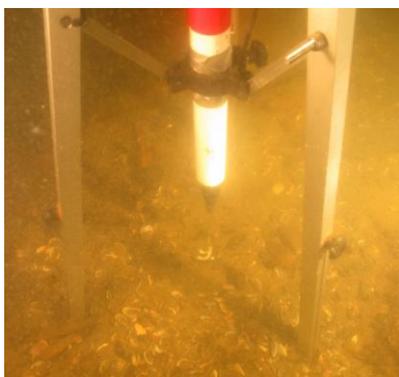


Fig.2 Measurement pole on tripod

The photogrammetric documentation of the position was prepared on the last day. For this purpose,

two GoPro 4 cameras were mounted on a common arm set 90 degrees from the bottom and the diver itself, due to the water's visibility of about 1-1.5m, floated above the bottom at a height of about 70cm, which made it possible to document the bottom belt approximately 1,2 m. A total of 140 minutes of films was recorded.

The next step was to get photos from films.7008 photos were acquired from the films that used to make the terrain model using Agisoft PhotoScan. MSI GE62 6QD Apache Pro with the following specifications: Processor Intel Core I7-4720HQ 2.6GHz GTX 960M graphics card 3072 MB, 32GB operating memory, Samsung EVO960 1TB SSD hard drive, the process of connecting pictures with HD resolution (1920x1080), took 8h37min. On this basis, more than 2 million common points were created between the images, which during the next 6h23minut created a point cloud composed of 53 million points. The next step was to create a 3D model, which was made in 53 minutes and consisted of 3.5 million polygons. The texture and orthophotomap process and the DEM map took another 2 hours. So total processing took about 18 hours. The result was a 3D model with a resolution of about 1cm, a DEM model with a resolution of 2.19mm / pixel and orthophotosomal resolution of 0.5mm / pixel. For example, the previous position paper, which took place in 1993, was made using traditional documentation methods such as a 1x1m mesh and a drawing of 10 days. However, it should be noted that the area was almost twice as large as the area examined by the authors). At the same time, however, the technique did not permit even one documentary photograph of the same transparency of water.

By comparing our method to the traditional drawing documentation method used on most underwater posts, it appears that we can accelerate around 10 times and the data itself can be collected even in very poor visibility (in this case it was about 1 to 1.5 m). Accelerating documentation methods significantly influences the safety of work in a specific water environment and the costs of such work. Additionally, the documentation obtained is incomparably more accurate, which translates into better understanding and development of the work.

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