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ANCIENT HISTORY

ARCGIS FOR MAPPING VETERAN SETTLEMENTS IN THE PROVINCE OF UPPER MOESIA

Abstract: This article is about mapping the veterans' inscriptions from Upper Moesia using ArcGIS software. How can this be done and toward what aims? By applying GIS algorithms to these datasets, we can make various maps and queries that allow us to discuss distribution and spatiality from many different angles. Such an experiment provided us the possibility of a better visualization of data in geographic context and allowed us to identify the specific locations of inscriptions and thus draw conclusions about veteran's settlement.
Keywords: *Upper Moesia, veterans, GIS, mapping, origin, establishment.*

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This article represents the results obtained after the implementation of the project „ArcGIS for mapping veteran's mobility in the province of Upper Moesia", financed during September - November 2022 within the Digital Humanities Center of Babeș-Bolyai University. The project aimed to develop transdisciplinary research which would allow the investigation of the ancient world with the help of modern digital technologies, namely application of GIS technology in spatial analysis of inscriptions attesting veterans (legionaries and auxiliaries) settled in the province of Upper Moesia.

A geographic information system (GIS) is a system that creates, manages, analyses, and maps all types of data. GIS connects data to a map, integrating location data (where things are) with all types of descriptive information.[1] Burrough gave one of the first definitions of GIS: "a set of powerful tools for acquiring, storing, processing and visualization of spatial data for a certain purpose".[2] Simply stated, GIS technology provides a foundation for mapping and analysing data in a geographical context. This allows a better visualization of data in a unique format that leads to discoveries regarding patterns and relationships about and between the data itself. GIS technology is increasingly employed in the field of archaeology, but it has not yet been extensively applied to epigraphic datasets. Rebecca Benefiel's study of wall inscriptions from Pompeii offers an excellent demonstration of the potential of this technology in answering historical questions.[3]

We believe that GIS technology can be applied with great benefit also to the study of the veterans' inscriptions from Upper Moesia. The province of Upper Moesia was selected as an area of interest for quantitative GIS exploration because it had a significant military presence, therefore a representative number of inscriptions, which can be used as indicators for

[1] https://www.esri.com/en-us/what-is-gis/overview, accessed 18.12.2022.
[2] BURROUGH 1986, 6.
[3] BENEFIEL 2010, 45-75.

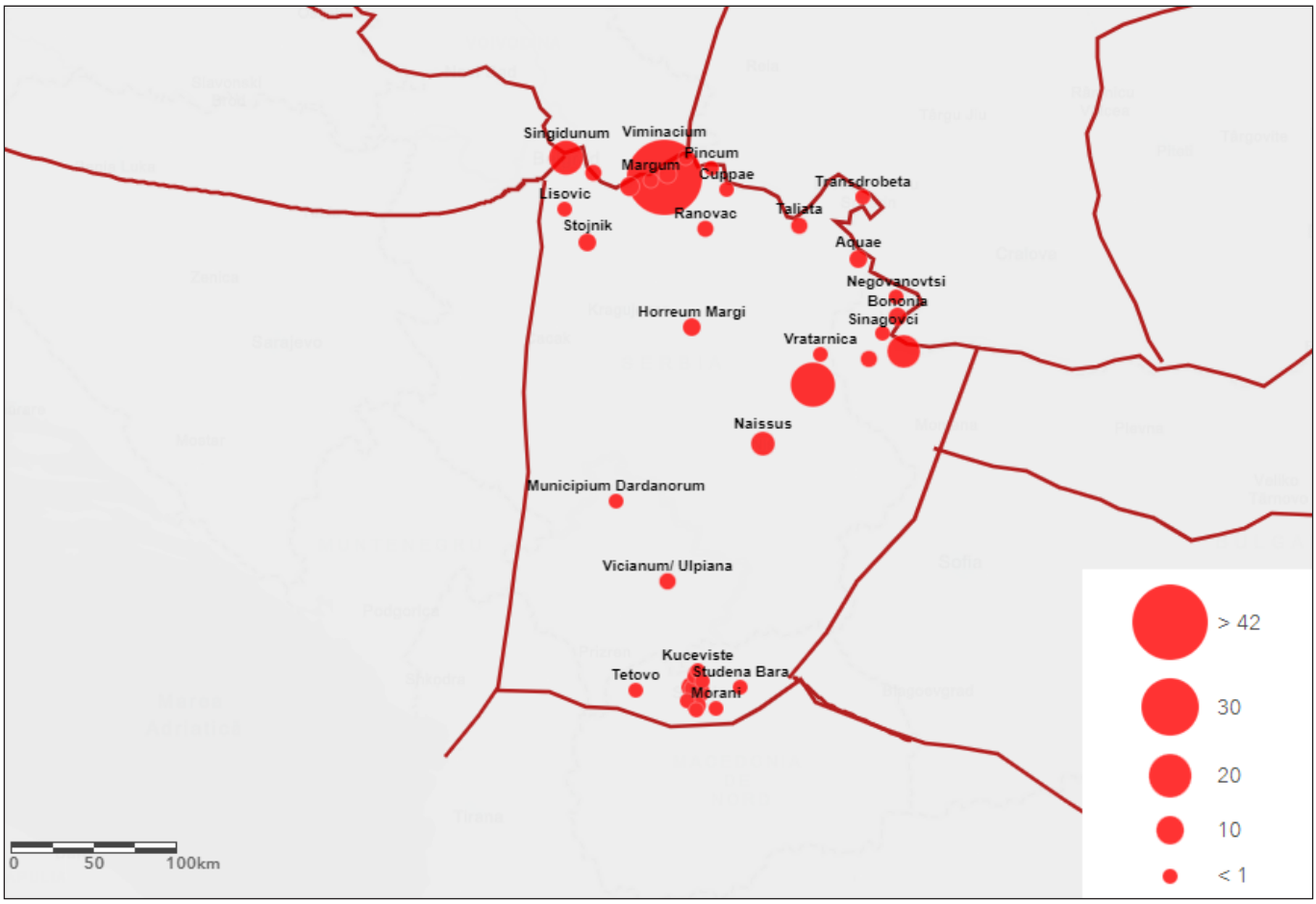

Fig. 1. The settlement of veterans in the province of Upper Moesia.

the three measured variables: Roman veterans, their origin and place of establishment. Veterans' settlement was the subject of a number of studies. We would like to mention papers published in the volume *Heer und Integrationspolitik*, edited by W. Eck and H. Wolff, and Margaret Roxan's long-term project investigating settlement of veterans during the first centuries AD.[4] Although there are some studies that deal with the settlement of veterans in Upper Moesia, for example those of S. Ferjančić[5] or K. Stoev, they do not cover all categories of ex-soldiers, such as auxiliary veterans, and they are devoid of geospatial analysis. Creating a digital database that could be keyed to a geo-referenced map would greatly facilitate research involving inscriptions and spatial analysis. Our study has two goals. The first is to demonstrate the usefulness of the application of GIS to a database containing a considerable epigraphic *corpus* and the second aim is to identify the specific locations of inscriptions (the parameters being interval versus topographical location) and to draw conclusions about veterans' settlements. The database and a map of Upper Moesia were synchronized uzing ArcGIS software so that the spatial distribution of inscriptions in the province could be further explored.

We will offer here some case-studies to illustrate the potential benefits of combining the technology of GIS with epigraphy. For this purpose, we began by selecting the veterans' inscriptions to create our database. More than one hundred inscriptions from across the geographic expanse of the ancient province have been recorded (the dataset was

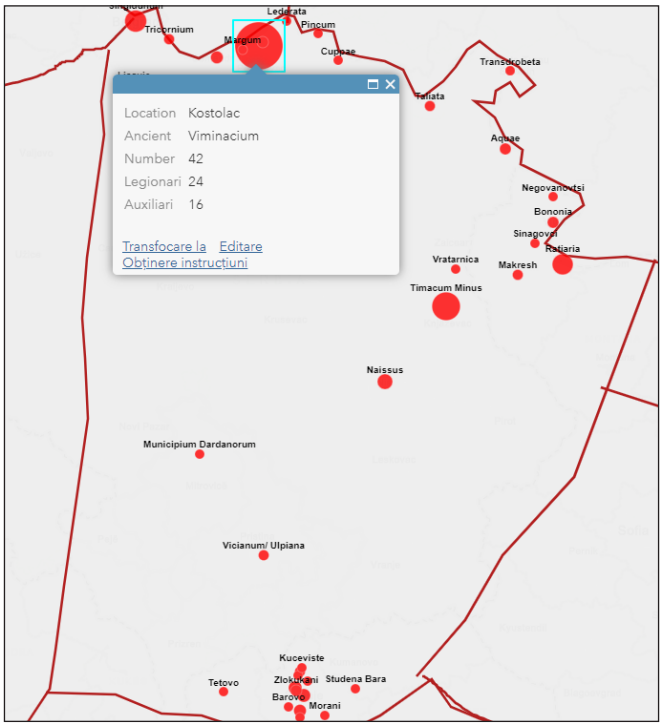

Fig. 1.2. Data visualization in ArcGIS on line.

[4] ECK/WOLFF 1986; ROXAN 1995, 483-491; ROXAN 2000, 307-320.
[5] FERJANČIĆ 2002; STOEV 2007.

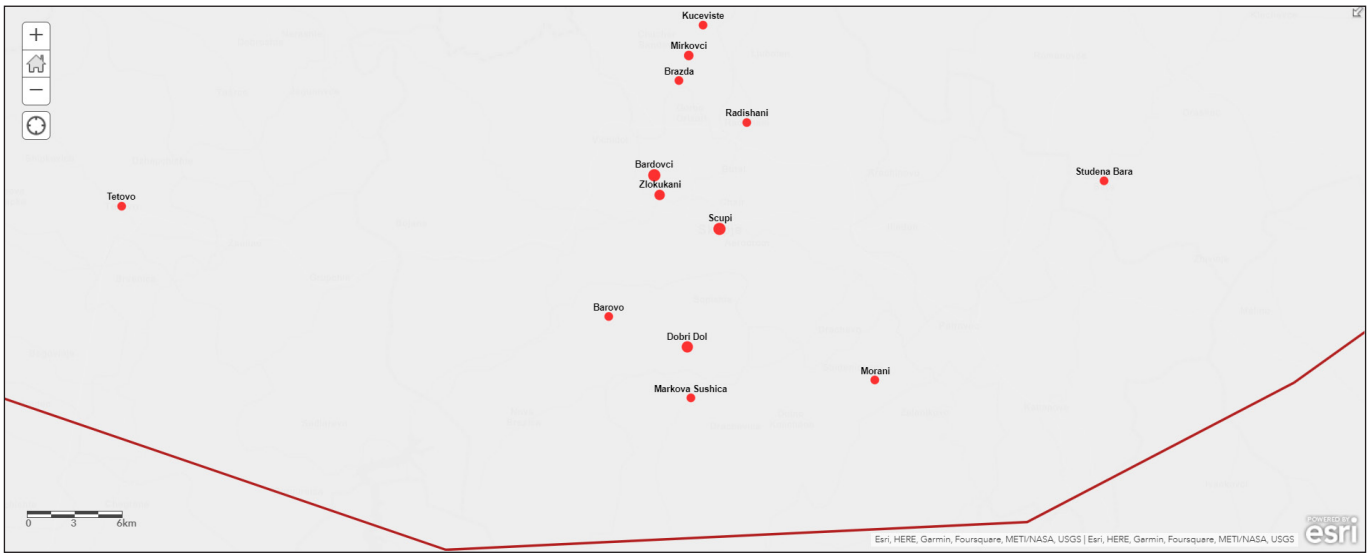

Fig. 2. Veterans settled in the rural territory of Scupi.

comprised of 164 inscriptions, collected from epigraphic *corpora* or online epigraphic databases).[6] Creating the database requires not insignificant effort, but once available it provides a powerful and flexible mechanism for advanced searches to explore the spatial distribution of inscriptions. The number of fields with a variety of information to be included in the database is theoretically unlimited, but to facilitate the analysis, we preferred to divide it into two subgroups (legionary and auxiliary veterans). We generated a number of maps for these inscriptions, which consisted of several layers, including: topographical location, kind of space (rural/urban), and various sets of information that we wanted to examine (e.g. category of veterans, origin).

1. MAPPING VETERANS' INSCRIPTIONS IN ARCGIS

Fig.1 displays the location of all veterans (legionaries and auxiliaries) in the province. Distribution of veteran settlements in Upper Moesia presents an expansive, complex spatial arrangement. Our 164 inscriptions attesting veterans are distributed in 40 settlements, 17 of which are ancient

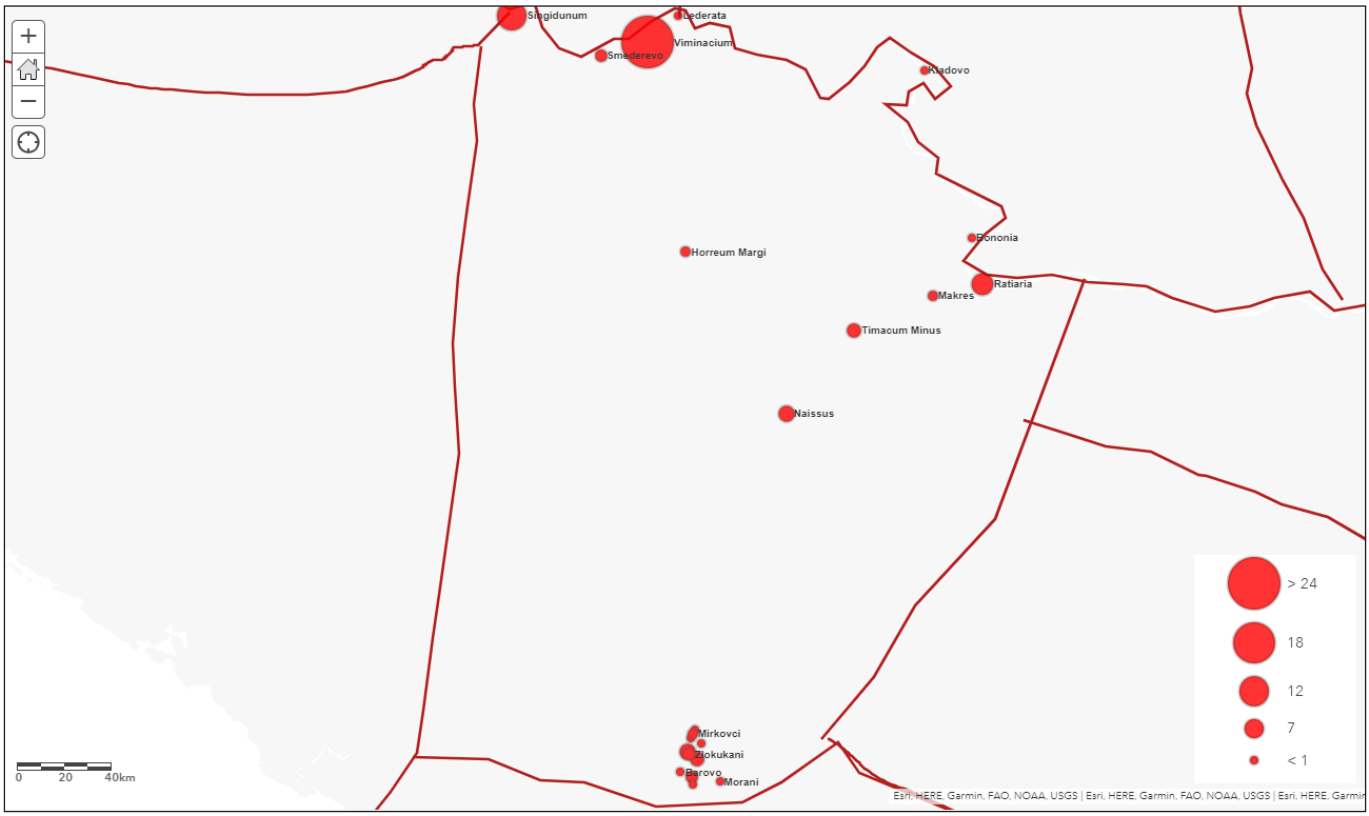

Fig. 3. Location of legionary veterans.

[6] *IMS* I, II, III/2, IV, VI; Epigraphik-Datenbank Clauss, Romans1by1.

Fig. 3.1. Location of legionary veterans.

settlements.[7] Most veterans settled at Viminacium (**Fig.1.2**), following Scupi with the colonial territory – 26 inscriptions, and Timacum Minus – 21 inscriptions (including 12 auxiliary veterans). There is also a concentration of veterans around the legionary camps – for example 14 veterans settled in Singidunum. At Ratiaria, a *colonia* from the time of Trajan,[8] 13 veterans settled. Probably the *vexillationes* of the legions *VII Claudia* and *IIII Flavia* were also placed here.[9] We can draw a first general conclusion – the preferred areas are the northern, southern and north eastern provincial borders, cities with colonial status (Scupi,[10] Ratiaria) or municipal status[11] (Singidunum,[12] Horreum Margi, Naissus, Ulpiana), the "provincial capital" (Viminacium),[13] legionary and auxiliary camps (like Singidunum and Timacum Minus),[14] *castella* (for example Bononia),[15] but also settlements with economic potential. Thirty veterans settled in the rural territory: 24 in Scupi (**Fig. 2**) through *missio agraria*; two at Cajir and four at Smederevo, in the territory of Viminacium.

The following maps pin-point the locations of legionary (**Fig 3, 3.1**) and auxiliary veterans (**Fig. 4**). Regarding the categories of veterans attested by inscriptions, the situation is as follows: 90 legionaries, 57 auxiliaries, 17 unidentified. It can be stated that the use of ArcGIS maps and a specific database clearly helps map separate categories of inscriptions. The settlements of legionary and auxiliary veterans are immediately apparent on this map. Not only the high concentration of inscriptions has a big visual impact, but so does their spread as well, because no part of the territory is empty. This could not be created without digital aid, and the maps illustrate how the topographical distribution of texts can be analyzed in greater detail to provide a multi-layered picture of veterans. Here our aim

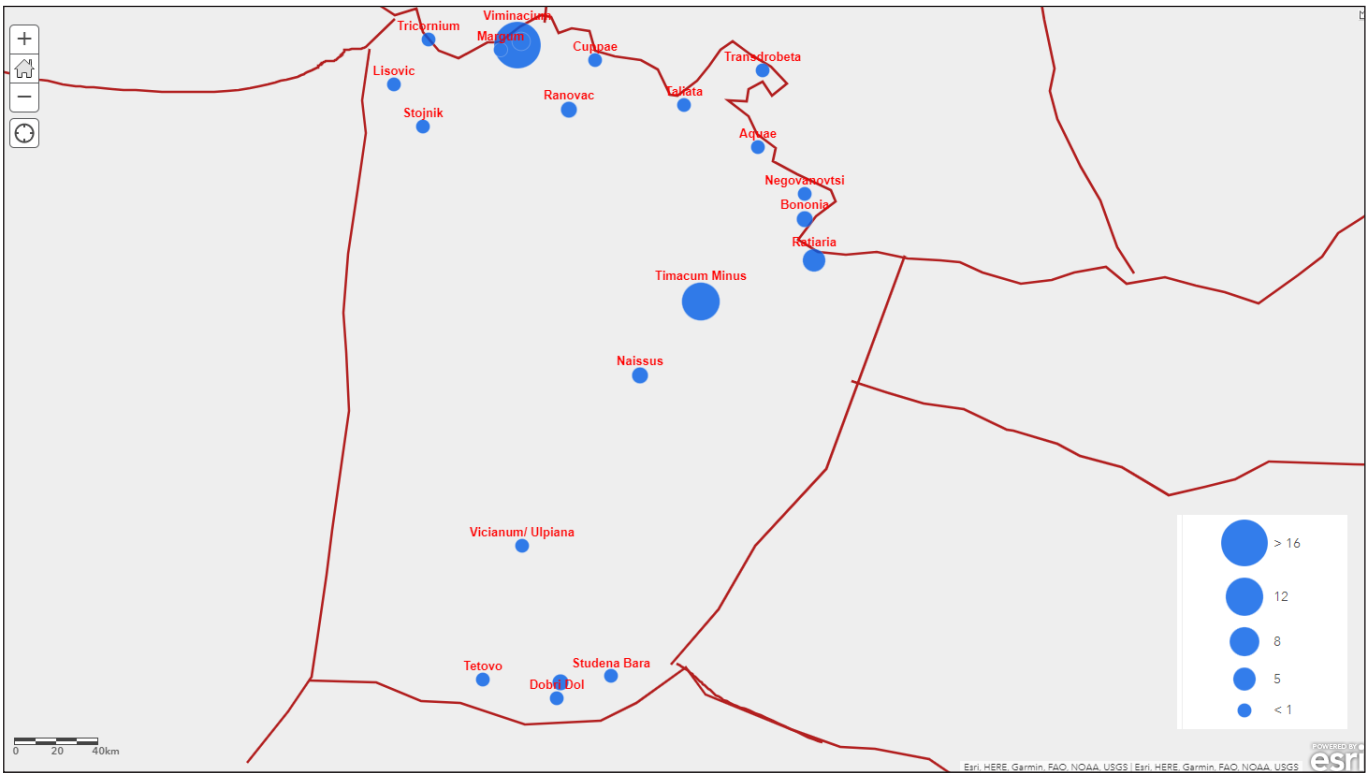

Fig. 4. Location of auxiliary veterans.

[7] MÓCSY 1970; MÓCSY 2014.
[8] BENEA 2011, 13.
[9] DIMITROV 2015-2016, 56.
[10] *IMS* VI, 25-26.
[11] Viminacium and Singidunum obtain colonial status only in the 3rd century (BENEA 2011, 13), *IMS* I, 20, certifies the status.
[12] *IMS* I, 47.
[13] *Municipium* from the reign of Hadrian: *Municipium Aelium Viminacium* (*IMS* II, 3, 22, 26, 56, 72-79).
[14] PETROVIC/FILIPOVIC 2007, 31.
[15] With the exception of the road station and the military structure (*castellum*), a port on the Danube was also located here, which had important military-strategic functions (DIMITROV 2015-2016, 52).

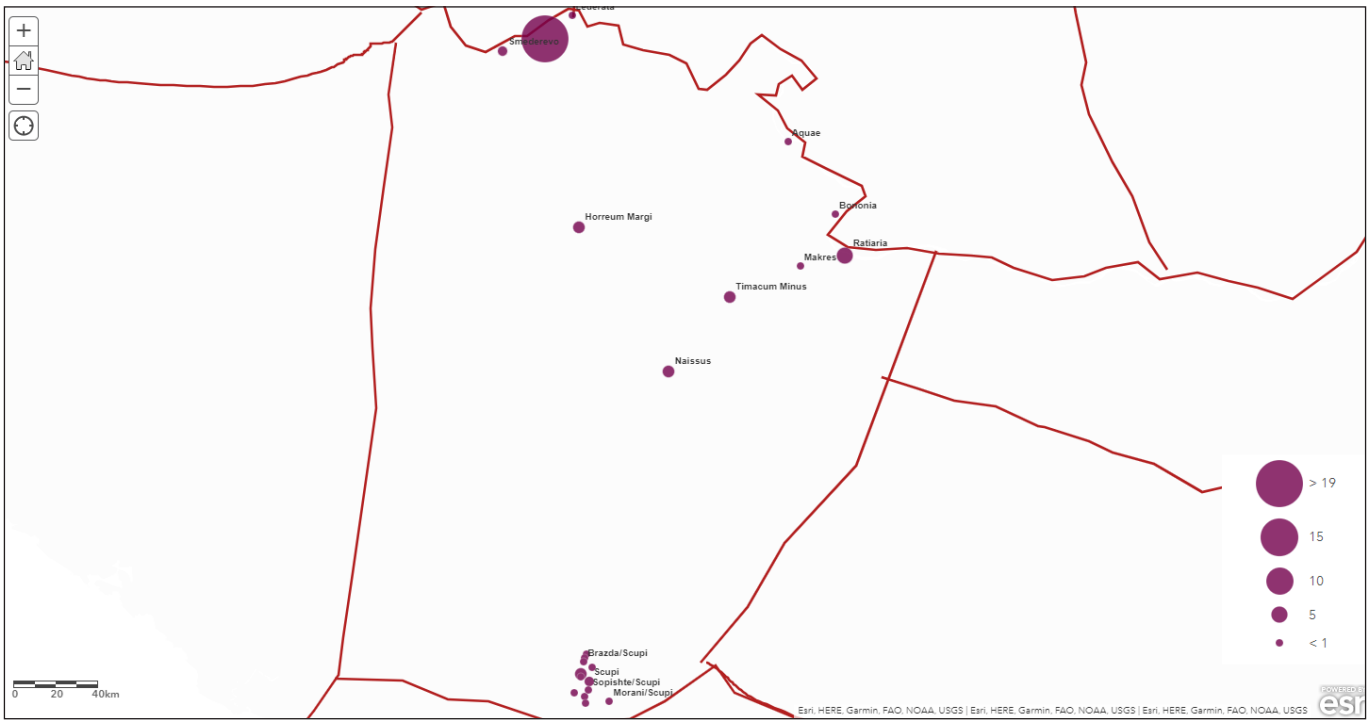

Fig. 5. Veterans of legio VII Claudia.

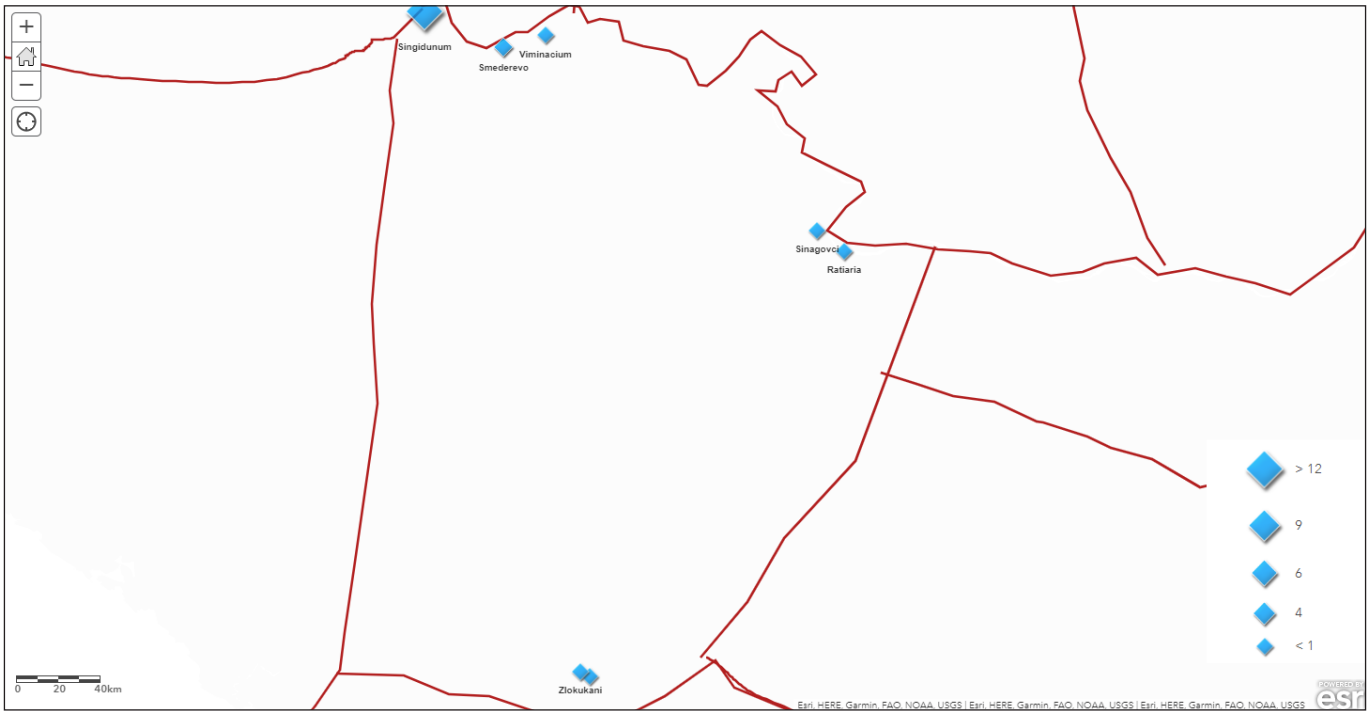

Fig. 6. Veterans of legio IIII Flavia.

was to analyze different subsets of this group (especially the dating of the inscriptions and the enlistment of legions or auxiliary units) in order to determine where and when a particular group of veterans was established, and what this tells us about veterans' preferences for the place of establishment. 10 legions have been stationed in the province of Upper Moesia over time,[16] but veterans from the province come from 6 of them (*VII Claudia, IIII Flavia, I Italica, V Macedonica, V Alaude, XIII Gemina*). We also note that only one veteran comes from a legion that was not in the province (*XIIII Gemina*). Most veterans come from the *legio VII Claudia*, stationed at Viminacium, and *legio IIII Flavia* located at *Singidunum*.[17] ArcGIS maps (**Fig. 5** and **Fig. 6**) show that there is a visible clustering: the dispersion of the legionary veterans from *legio VII Claudia* and *IIII Flavia Felix* being present in the north and south of the province. Most

[16] MIRKOVIĆ 1968.

[17] BENEA 1983.

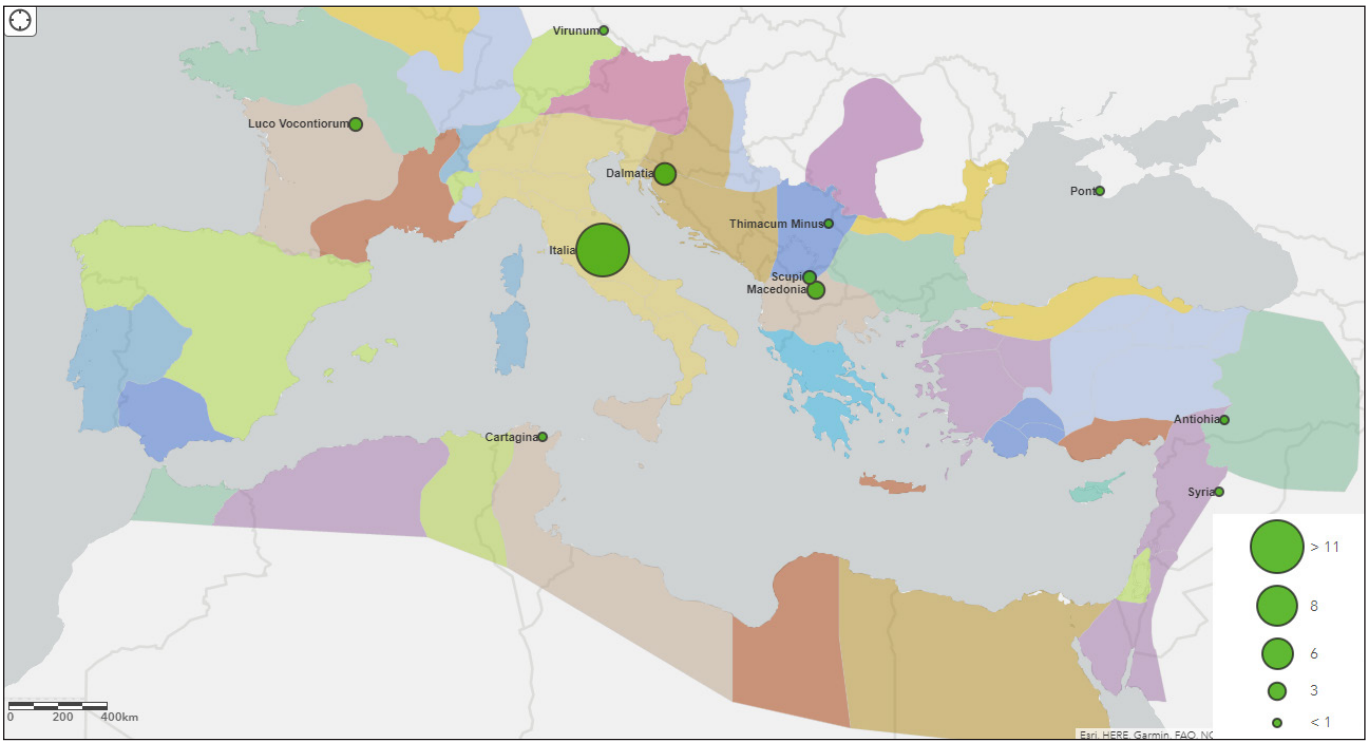

Fig. 7. Origin of legionary veterans.

auxiliary veterans settle in the place where they performed their military service: the inscriptions preserved the names of 20 military units, of which 17 were stationed in the province.[18] For example, the veterans stationed at Timacum Minus come from the *cohors II Aurelia Dardanorum* and *I Thracum Syriaca* stationed here over time. A classic example of this phenomenon at a local level comes from Intercisa, in Pannonia. Twenty-three inscriptions recording veterans of the *cohors I Hemesenorum* were found at this site, close to their former camp.[19] The decision to stay rather than move away is described as a classic Militärgesellschaft.[20] Comparing the find spot of a diploma with the province where the veteran undertook his military service, it has been concluded that 70% of the diploma recipients stayed in the province where they completed their service. Some settled near military camps and some moved to cities and rural areas, while only around 10% of the attested veterans returned to their home country.[21]

Fig. 7 and **8** map the origin of veterans established in Upper Moesia. We should mention that the database included the inscriptions that preserved *ad literam* the origin of the veterans. Most legionary veterans who mention their origin are mostly Italians who settled at Scupi[22] and in the colonial territory. Auxiliary veterans come from cities such as Hierabytna, Hierapolis, Bassianae and Noviodunum, and they settled in large numbers at Viminacium, Timacum Minus, Naissus and Ranovac.

[18] MATEI-POPESCU/ȚENTEA 2018.
[19] HAYNES 2001, 75.
[20] HAYNES 2001, 75, note 52.
[21] IULEVA 2015, 437.
[22] HONCU 2022.

2. SPATIAL ANALYSIS

Spatial analysis is the process of manipulating spatial information to extract new information and meaning from the original data. Within GIS, several methods of spatial analysis can be applied, of which a few have been selected to give a synthetic picture of the possibilities offered by it. By these methods we can make analytical queries about What? Where? How? When? and we can propose solutions to the pursued problems. GIS layers are created to explain the phenomenon of point of view of geographical distribution.[23]

a. Summarizing the data

This tool will count and summarize any points that fall within the area we choose. We have the option of adding statistics that will calculate the sum, mean, minimum, maximum, or standard deviation of the points within the area. The result is a new layer with polygons (grid/area) representing the number of point and statistics of the points that fall within the specified areas. In our analysis, it calculated how many points (locations of veterans) fit into each surface and the total number of inscriptions from the grid/area (**Fig. 9**). We selected a distance of 40 km for each polygon.

So, we can see that we have two clusters – the north and the south of the province. In area C-9, the total number of settlements of veterans is 7 (count of points – Bardovci, Zlokukani, Scupi, Barovo, Dobri Dol, Markova Sushica, Morani), and the total number of inscriptions is 20 (**Fig. 9.1**). Comparing the data with surface C-1 (5 count of points – Margum, Viminacium, Cai, Lederata, Pincum and 48 inscriptions) (**Fig. 9.2**), we can observe that in the south of the province there is a greater concentration of settlements with veterans, but the number of inscriptions is bigger in the north.

[23] CLARKE 2003.

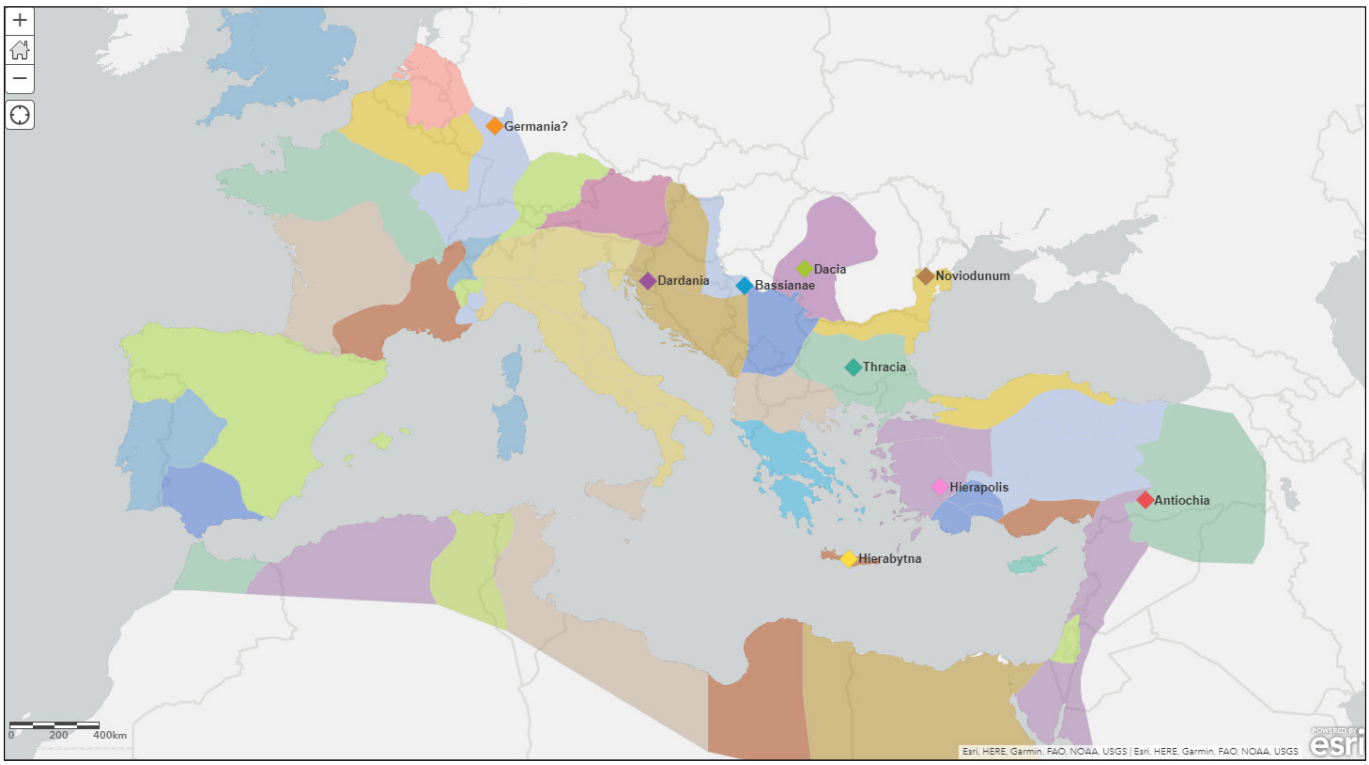

Fig. 8. Origin of auxiliary veterans.

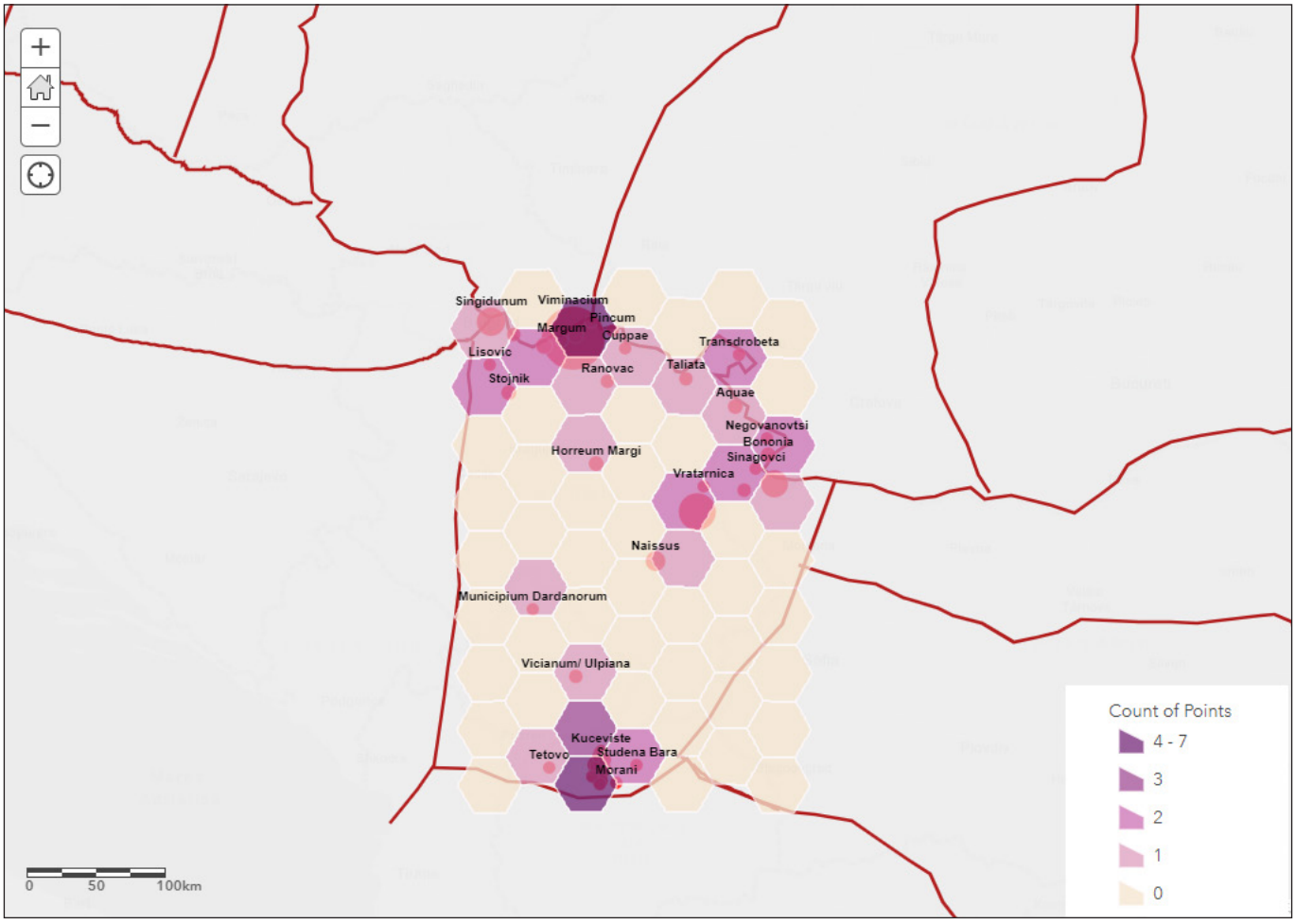

Fig. 9. Summarizing data tool in ArcGIS.

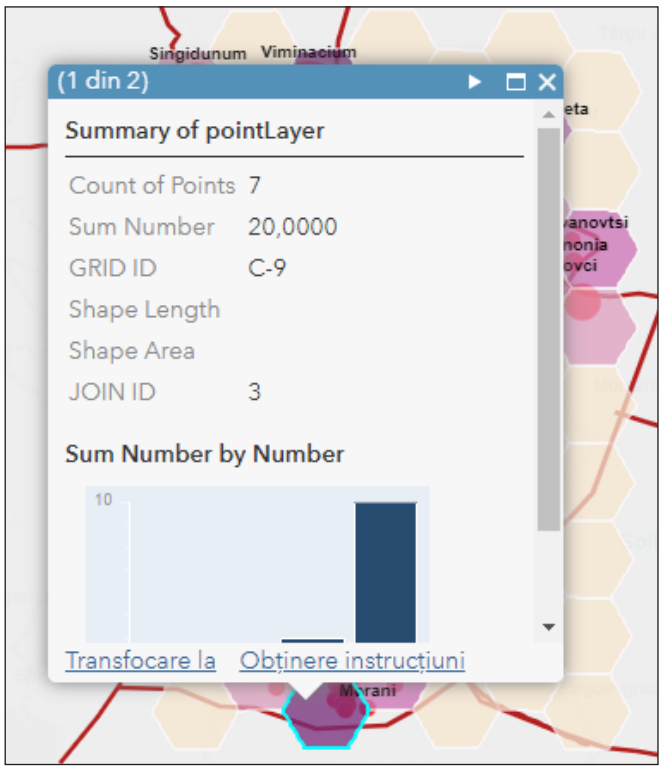

Fig. 9.1. Detail with Grid C-9.

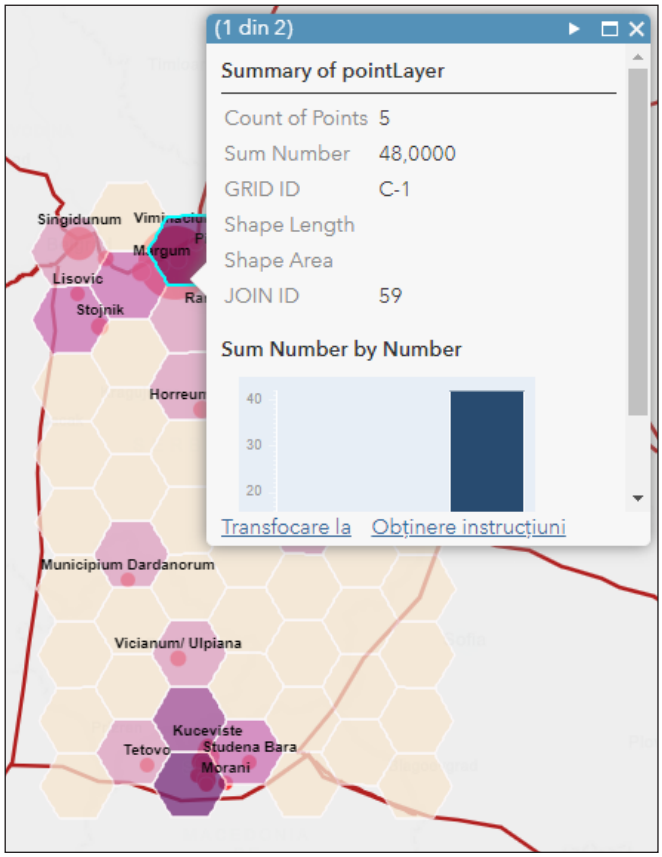

Fig. 9.2. Detail with Grid C-1.

It is useful to remember H. Kellner's opinion in order to draw conclusions about settlement of veterans in the frontier zones. He observed that a majority of veterans settled near the frontier rather than in the hinterland, which determines him to support the hypothesis that a high proportion of families living in settlements on the peripheries of the Empire had military ties.[24] J. Mann thinks it is a natural decision for men who were often themselves born in the frontier zone – there was little inducement to settle anywhere else.[25]

S. Dušanič suggests a relation between the mines and military property in metalliferous provinces like Upper Moesia.[26] Starting from the example of the veteran T. Aurelius Atticus, who probably took care of the *vectigalia* situated in the neighborhood of Singidunum (mines of Avala), he supports an implicit connection between veterans' settlements and the *res metallica*.[27] This hypothesis is plausible, taking into account the existence of *metalla Tricornesia* in the north and *metalla Dardanica* in the south of the province.[28]

To conclude, the higher density of settlements in the south is due as mentioned, to the properties owned by the veterans established by *deductio agraria* in location from colonial territory of Scupi. In the north, the proximity to the legion camps and the mines constituted favorable premises for the establishment of veterans.

b. Find locations

This tool identifies existing features that meet a series of criteria we specify. These criteria can be spatial queries (for example, legionary veterans established at a certain distance from the military camp; legionaries intersect with the auxiliaries). We obtained two layers on a map: legionaries established at a distance of 200 km from the camps (**Fig. 10**), and locations where legionaries intersect with the auxiliaries (**Fig. 11**). Studying the results of the analysis, we obtain some effective conclusions. Veterans who settled at a distance bigger than 200 km from the legionary camps are those from the *regio Scupinorum*. In 10 locations out of the 40 (Stojnik, Tricornium, Pincum, Taliata, Aquae, Timacum Minus, Naissus, Scupi, Viminacium and Dobri Dol), both auxiliary and legionary veterans are certified.

It is clear that the veterans settled 200 km from the camp were the ones who had been settled by *deductio* in a veterans' colony, like Scupi. The other inscriptions, mostly dated after Hadrian (from the beginning of his reign veterans ceased to be deducted to colonies), clearly show ex-soldiers seated *viritim*, close to the place where they undertook the military service or for other reasons. After a legion or an auxiliary unit had been stationed on a particular site even for a short period of time, it produced a greater or smaller extra-mural community of both civilians and veterans.[29]

c. Connect Origins to Destinations

The *Connect Origins to Destinations* tool measures the travel time or distance between pairs of points using either straight lines or network-based travel modes.[30] Now,

[24] KELLNER 1986, 243.
[25] MANN 1953, 82.
[26] DUŠANIČ 1990, 589.
[27] DUŠANIČ 1990, 591.
[28] DUŠANIČ 2000, 361
[29] MANN 1956, 345.
[30] https://doc.arcgis.com/en/arcgis-online/analyze/connect-origins-to-destinations.htm, accessed 24.01.2023.

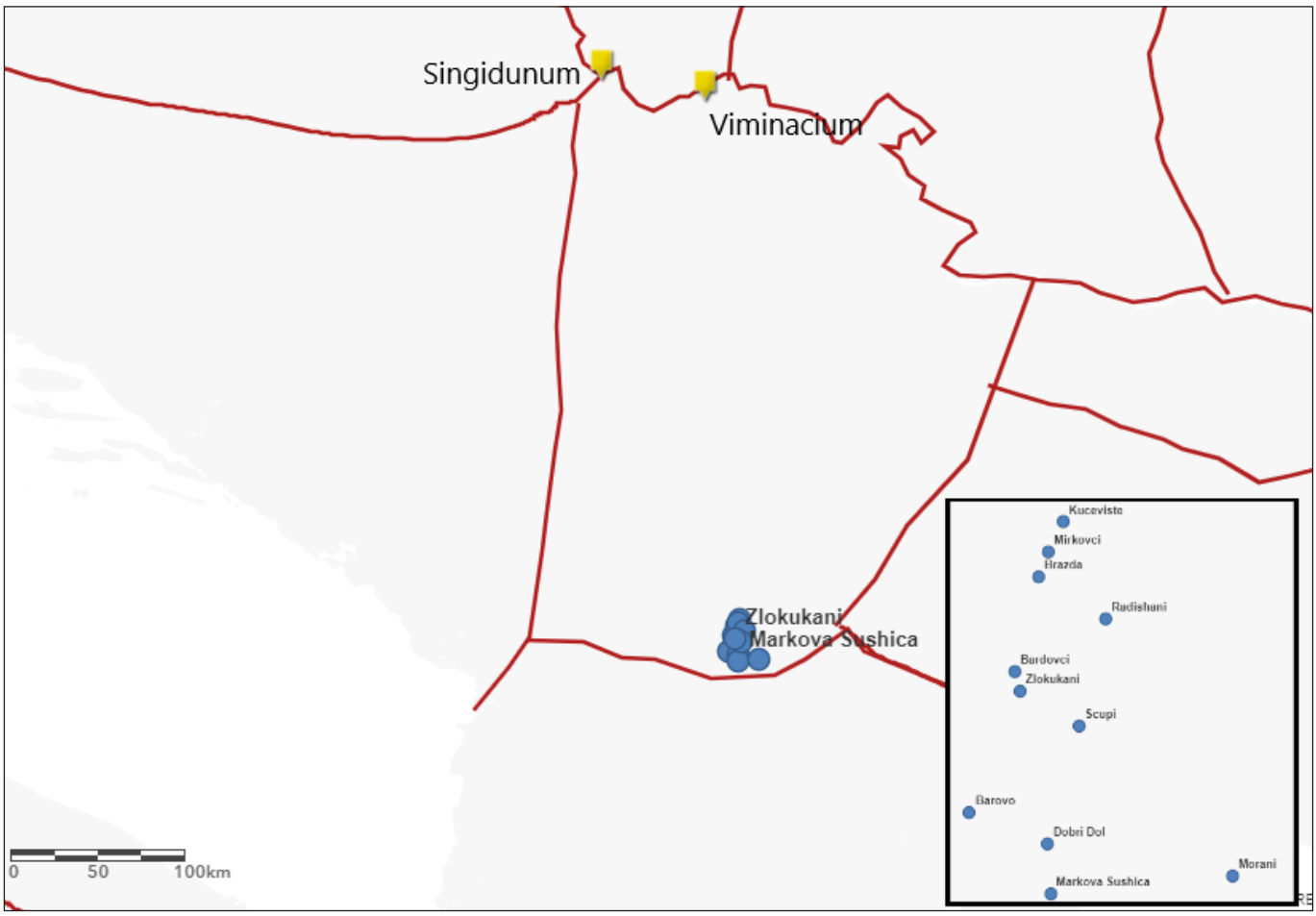

Fig. 10. Find location tool. Veterans established at a distance of 200 km from the military camp.

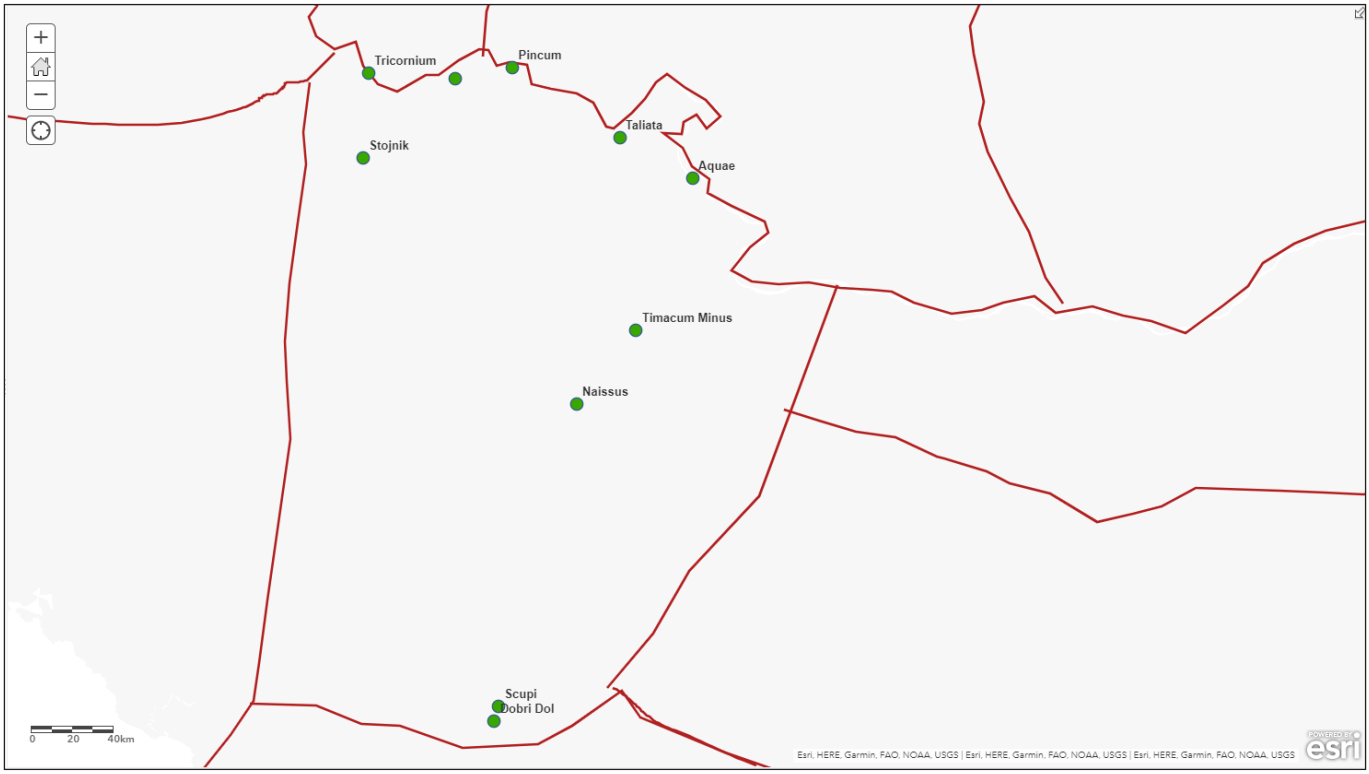

Fig. 11. Find location tool. Locations with legionary and auxiliary veterans.

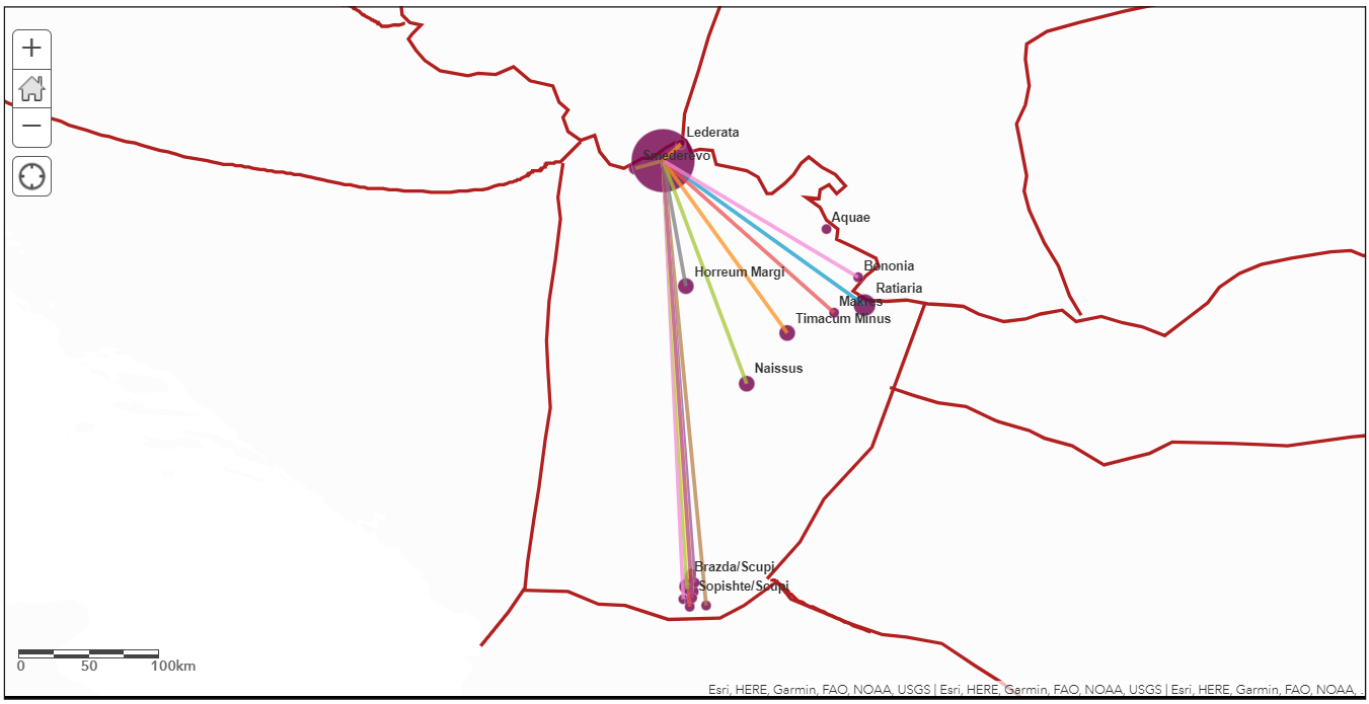

Fig. 12. Connect origins to destinations tool. Routes that connect military camp of legio VII Claudia with veterans' settlements.

we have a good visual representation of the relationship between military camp and veterans' settlements. The lines are beneficial for identifying potential answers, or at least ask why veterans choose to relocate farther. However, this method of analysis has a disadvantage, because the straight-line distance between any origin-destination pair cannot exceed 27 miles (43.45 kilometers) when the travel mode is *Walking Time* or *Walking Distance*. Twenty-two routes were identified that connected the camp of *Legio VII Claudia* with the legionary veterans' destination (**Fig. 12**). The shortest route is Viminacium-Lederata, 26.78 km; and the longest – Viminacium – Markova Sushica, of 406 km. These data are a clear proof of the veterans' ways of establishment: *deductio* or voluntarily chosen certain territories. In the second case, the process of the colonial settlement was conditioned by the assignment of land and determined the veterans to move to a greater distance (406 km from military camp in this case). The shortest route shows the preference to settle near the legionary fortress, when possible.

FINAL REMARKS

Viewing results on an interactive map makes it easy to adjust and adapt analysis until we find the answers we need. Interactive maps create immersive experiences that transform maps from a static view into an opportunity for users to explore.

The establishment of veterans in the province of Upper Moesia was determined by several premises. In the first century, some veterans were settled by the government at Scupi. From the beginning of Hadrian's reign, veterans ceased to be deducted to colonies, and the choice to return to their homeland or to stay near their place of service was left to themselves. The inscriptions show that most veterans preferred to end their days in the vicinity of the fortresses in which they had served. Our study presented the distribution of veterans' settlements in the province of Upper Moesia and highlighted the preferred areas: northern, southern and north eastern provincial borders, cities with colonial status, *municipia*, legionary and auxiliary *vici* and adjacent settlements, but also places with economic potential. Thirty veterans were settled in the rural territory of Scupi by *missio agraria*. Spatial analysis applied to our information explained the phenomena from the point of view of geographical distribution. *The summarizing data* tool shows a bigger concentration of veterans in the north of the province, but a greater accumulation of sites in the south, due to the granting of land to veterans. *Find location* analysis selected the locations based on several parameters: Stojnik, Tricornium, Pincum, Taliata, Aquae, Timacum Minus, Naissus, Scupi, Viminacium and Dobri Dol are locations preferred by both legionary veterans and auxiliaries. *Connect origins to destinations* tool drew the distances from the legionary camp of *legio VII Claudia* to the place of establishment of the veterans. It is visible that only the locations of the veterans established by the *missio agraria* are at the greatest distances from the camp.

Nonetheless, it is important to be aware of the limitations involved in this type of analysis, such as incomplete historical data, where some of the material evidence is either not known or cataloged, or has been completely destroyed over time. For these reasons, the statistical results from this research cannot be considered indestructible scientific statistical evidence, but rather should be perceived as arguments that indicate a very likely trend on the settlement of veterans in a distinct area. The developed methodological model (database storage, geographic analysis), given its complexity, will also serve as a basis for future research which will imply: extending the geographical area, the possibility to do more complex

research on the veterans (such as *social network analyses*), applying the same methodology, as a 'golden standard', to other social groups from the Roman provinces.

The results demonstrate the potential of the GIS approach in testing the hypotheses produced by the traditional epigraphic studies. Our study demonstrates that the process of combining established methodologies with formal approaches is fruitful and has significant potential. Including topographic information for the study of inscriptions enriches existing practices in digitization of data, making it accessible to a wide audience. In this mode, the inscriptions are connected with great accuracy to their geographic background. Briefly, ArcGIS contributes to the management of epigraphic studies with a more precise information about inscriptions and their context: it can offer a quick comparison between different types of epigraphic data; it allows merging of archaeological, historical and epigraphic information and establishment of a scientific predictive model by means of spatial analysis. The possibility to display data on a map made possible the connection of textual and geographical information and to achieve different types of investigations, such as number of veterans in a specific area, which are the areas where auxiliary and legionary veterans intersect, which zone is not populated with veterans, how far from the camps did the veterans sit. Not least, ArcGIS allows us to create different databases queries from spatial criteria (proximity, inclusion, buffer zone, etc.).

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