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The Network(s) of Mithraism: Discussing the Role of the Roman Army in the Spread of Mithraism and the Question of Interregional Communication

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1. Introduction

Mithraism, also known as the Roman cult of Mithras, was one of the most successful cults of originally foreign deities adopted by the Romans from Hellenistic times onward. The first traces of Mithraism are attested in archaeological material from the last quarter of the 1st century CE.[1] The cult continued to thrive through the 2nd and 3rd centuries CE, but its vital-

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1 See the list and critical discussion of the earliest Mithraic evidence in Aleš Chalupa, "The Origins of the Roman Cult of Mithras in the Light of New Evidence and Interpretations: The Current State of Affairs", *Religio*: *Revue pro religionistiku* 24/1, 2016, 65-91: 77-89 and table 1 (p. 117).

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ity decreased throughout the 4th century and it finally became extinct at some point after 400 CE.[2] The origins of Mithraism are still disputed.[3] Although Mithras, the cult's central figure, is undoubtedly identical with an ancient Indo-European deity well known from different cultural areas, including India and Persia,[4] it is not easy to demonstrate a connection between Mithraism and previous forms of Mithras worship in the East.[5] Mithraism in its western form used some typical "structures" which are entirely unknown in the East, especially a tauroctony (a central iconographic motif depicting Mithras in the act of killing a bull)[6] and a mithraeum (a place where followers of Mithras gathered, dined together and performed other cultic activities).[7] Because of the extensive use of these typical structures, which are easily identifiable in archaeological evidence, we know a great deal about Mithraism's spatial distribution in the Roman

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2 The reasons for the disappearance of Mithraism are still discussed. The conventional narrative operating with the growing destructive pressure exercised by Christianity is seen less credible now than a few decades ago, although the targeted destruction of some Mithraic temples proves that this type of religious competition contributed, at least partially, to the cult's demise. For more detailed evidence of Christian attacks on Mithraism, see Eberhard Sauer, *The End of Paganism in the North-Western Provinces of the Roman Empire: The Example of the Mithras* Cult, (BAR International Series 634), Oxford: Tempus Reparatum 1996; id., *The Archaeology of Religious Hatred in the Roman and Early Medieval World*, Stroud: The History Press 2009. It seems that Mithraism was already in decline, at least in some regions, even before the start of the 4th century, and this internal crisis was brought about by the disastrous influence of various social, political, and demographic changes taking place in the Roman Empire from the middle of the 3rd century CE. For a more detailed account of this gradual decline and demise of Mithraism, see the recent monograph David Walsh, *The Cult of Mithras in Late Antiquity: Development, Decline and Demise ca. A.D. 270-430*, (Late Antiques Archaeology [Supplementary Series] 2), Leiden: E. J. Brill 2018. The decline and disappearance of Mithraism is part of a bigger question concerning the reasons for the demise of paganism generally, which has recently been opened again, in a very stimulating way, by Jan N. Bremmer, "How Do We Explain the Quiet Demise of Graeco-Roman Religion? An Essay", *Numen* 68/2-3, 2021, 230-271.

3 For the academic history of this question and the current consensus, see A. Chalupa, "The Origins of the Roman Cult of Mithras…", 67-75.

4 Adrian H. Bivar, *The Personalities of Mithra in Archaeology and Literature*, New York: Bibliotheca Persica Press 1998; Jaan Lahe, *Mithras – Miθra – Mitra: Der römische Gott Mithras aus der Perspektive der vegleichenden Religionsgeschichte*, (Kasion. Publikationen zur ostmediterranen Antike 3), Münster: Zaphon 2019.

5 For "classical" and still valid arguments defending the inconclusiveness of any historical ties between Mithraism as attested in the Roman Empire and previous Persian religious tradition(s), see Richard L. Gordon, "Franz Cumont and the Doctrine of Mithraism", in: John Hinnells (ed.), *Mithraic Studies* I, Manchester: Manchester University Press 1975, 215-248.

6 Manfred Clauss, *The Roman Cult of Mithras: The God and His Mysteries*, Edinburgh: Edinburgh University Press 2000, 78-90.

7 *Ibid.*, 42-61.

Empire.[8] But what was the reason behind this geographically impressive spread of Mithraism and its indisputable, albeit temporary, popularity? Were there some factors particularly pertinent for the dispersion of Mithraic communities in the Roman Empire? And what stands behind the relative uniformity of Mithraic iconography? It seems that Mithraists could transmit their core visual motives with a minimal number of significant deviances,[9] which is, considering the absence of any central authority controlling the fidelity of transmission, a unique example in the conditions of the Graeco-Roman World. Why did Mithraism succeed when other cults failed or needed to create power structures for policing, often unsuccessfully, the normativity of their religious ideas and imagery, as was the case of Christian orthodoxy? In this article, we discuss both these issues and contribute to the current debate with data collected by an innovative application of network analysis, which may help open new perspectives on these problems when used with care and restraint.

2. Setting the stage, defining the problem(s)

From the beginning of modern Mithraic studies, scholars speculated about the importance of the Roman army and its deployments for the successful transmission of Mithraism. Some scholars soon recognized that Mithraic communities were often situated in proximity to Roman legionary fortresses and that Roman soldiers made a large proportion of Mithraic dedications.[10] However, no systematic study of the Roman army's influence on Mithraism was conducted until the 1990s. A meticulous epigraphic analysis, performed by the German professor of ancient history Manfred Clauss, showed that in no Roman province (except for Britannia) did the proportion of identifiable dedicators from the Roman soldiery exceed

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  8 See Fig. 1 below.
  9 By talking about "the relative uniformity of Mithraic iconography" and "core visual motives with a minimal number of significant deviances", we mean that Mithraic imagery is generally recognizable across the Roman Empire, despite regional and cultural differences. We have no intention to argue that there are no regional traditions in the selection of motifs or the styles of their depiction, as is correctly observed by Kevin Stoba in the project "Mapping Mithraic Cults Across the Roman West" (University of Liverpool), also using the method of network analysis. For the annotation of this project see <https://www.liverpool.ac.uk/archaeology-classics-and-egyptology/research/phd-research/kevinstoba/> [16. 8. 2021].
 10 Franz Cumont, *Les mystères de Mithra*, Bruxelles: H. Lamertin [3]1913, 36-60; Charles M. Daniels, "The Role of the Roman Army in the Spread and Practice of Mithraism", in: John R. Hinnells (ed.), *Mithraic studies II*, Manchester: Manchester University Press 1975, 249-274.

20 %.[11] Clauss's analysis was later supplemented by a detailed evaluation of Mithraic evidence of military origin conducted by Richard Gordon, who reached similar conclusions.[12] According to Gordon, the occurrence of military dedications is unevenly distributed and is usually concentrated on the heavily militarized Britanno-Rhine-Danube frontier. Gordon was also able to demonstrate that the image of Mithraism as a "military cult" arose relatively late in the 19th century in Germany (where the quantity of military dedications is particularly high) and was subsequently perpetuated in future scholarship by Cumont's scenario seeing the Roman army as the main propagator of Mithraism in the West. These studies successfully debunked previous theories uncritically seeing Mithraism as a typical representative of Roman "military cults".

Nevertheless, the large quantity of Mithraic evidence found in border provinces with a strong military presence and the otherwise not easily explainable rapid and geographically impressive spread of Mithraism has led some scholars to conclude that, whatever the story Roman epigraphy might be telling, the "hijacking" of Roman military structures and communications still offers the best credible explanation for Mithraic success in terms of its wide geographic transmission.[13] In other words, Mithraism spread because the followers of Mithras were highly mobile and might not have included only soldiers but also military and civil personnel who provided essential services for the Roman army and catered for its needs. This possibility brings, in our opinion, the role of Roman military infrastructure in the spread of Mithraism back into play and requires further scrutiny.

In this paper, we use a transportation network model based on ORBIS (the Stanford Geospatial Network Model of the Roman World)[14] and a network analytical approach to uncover a possible relationship between the military network of Roman legionary fortresses and the network of

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11 Manfred Clauss, *Cultores Mithrae: Die Anhängerschaft des Mithras-Kultes*, (Heidelberger Althistorische Beiträge und Epigraphische Studien 10), Stuttgart: Franz Steiner 1992, 267-269.

12 Richard L. Gordon, "The Roman Army and the Cult of Mithras: A Critical View", in: Catherine Wolff – Yann Le Bohac (eds.), *L'Armée romaine et la religion sous le haut- -empire romain: Actes du quatrième Congrès de Lyon (26-28 octobre 2006)*, Lyon: De Boccard 2009, 379-450.

13 Christian Witschel, "Die Ursprünge des Mithras-Kults: Orientalischer Gott oder westliche Neu-schöpfung?", in: Claus Hattler (ed.), *Imperium der Götter: Isis, Mithras, Christus: Kulte und Religionen im Römischen Reich*, Stuttgart: Theiss 2013, 201-210; Luther H. Martin, "Cult Migration, Social Formation, and Religious Identity in Graeco-Roman Antiquity: The Curious Case of Roman Mithraism", in: id., *The Mind of Mithraists: Historical and Cognitive Studies in the Roman Cult of Mithras*, London: Bloomsbury 2015, 89-106, 139-143, 173-181.

14 Walter Scheidel – Elijah Meeks, Stanford Geospatial Network Model of the Roman World (ORBIS), accessible at <http://orbis.stanford.edu/>.

sites where the presence of Mithraism can be historically documented. The main hypotheses we intend to test are:

- **H1:** There is significant overlap in the locations of Mithraic evidence and of Roman legionary fortresses.
- **H2:** Military infrastructure and military deployments throughout the Roman Empire facilitated the spread of Mithraism. The sites of important nodes situated on the routes connecting Roman legionary fortresses correlate with the sites of documented Mithraic presence.

3. Materials and methods

This section is divided into five parts. In the first and the second part, we describe the coding of Mithraic evidence and Roman legionary fortresses. In the third part, we define the geographical area and its regional and provincial subdivisions that are used in the statistical analysis. In the fourth part, we explain in greater detail the methods used to detect a possible relationship between locations of attested Mithraic evidence and the places where Roman legionary fortresses were situated. In the final part, we describe the transportation network, the network analytical measures, and the ways of evaluating ties between military infrastructure and sites of documented Mithraic presence that were used in this research.

3.1 Mithraic evidence

In this dataset, we coded all sites where the presence of Mithraism can be attested either archaeologically (by the discovery of a mithraeum or other artefacts identified positively as Mithraic) or epigraphically (through preserved inscriptions mentioning dedications to Mithras or the building or reconstruction of a mithraeum, etc.). The coding was primarily based on the lists of Mithraic localities assigned to individual provinces of the Roman Empire in *Cultores Mithrae,* which registers all Mithraic sites known up to 1990.[15] Mithraic sites discovered after that year until the present were added on the basis of Clauss's supplement to *Cultores Mithrae*[16] and other archaeological reports and reviews of regional corpora of Mithraic material published since 1990.[17] Each Mithraic site was

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15 M. Clauss, *Cultores Mithrae…*

16 Manfred Clauss, *Mithras: Kult und Mysterium*, Mainz: Philipp von Zabern 2012.

17 See e. g. Innes Klenner, "Breaking News! Meldungen aus der Welt des Mithras", in: Patrick Jung – Nina Schücker (eds.), *Utere felix vivas: Festschrift für Jürgen Oldenstein*, Bonn: Rudolf Habelt 2012, 113-127; Barbara Rossi, *I mitrei della Britannia romana nelle testimonianze architettoniche, scultoree ed epigrafiche*, (BAR International Series 1253), Oxford: Hedges 2004; Gabriel Sicoe, *Die Mithräischen Steindenkmäler*

Fig. 1: The sites of Mithraic evidence (in black dots).

geolocated (for the visualization of Mithraic sites, see Fig. 1). To distinguish between sites of isolated Mithraic evidence and sites with strong Mithraic presence, each locality was evaluated and ranked from 1 to 6 (1 for sporadic Mithraic presence and 6 for particularly strong Mithraic presence).[18] Based on these steps, two variables were established. The

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aus Dakien, Cluj-Napoca: Mega Verlag 2014; Jaime Alvar, *El culto de Mitra en Hispania*, Madrid: Dykinson 2019; Valentin Bottez, "Mithras in Moesia Inferior: New Data and New Perspectives", *Acta Antiqua Academiae Scientiarum Hungaricae* 58, 2018, 243-262; Csaba Szabó, "The Material Evidence of the Roman Cult of Mithras in Dacia CIMRM Supplement of the Province", *Acta Antiqua Academiae Scientiarum Hungaricae* 58, 2018, 325-357, etc.

18 By the quantification of the relative strength of Mithraic presence in a particular locality we intended to distinguish, for the purpose of our analysis, between major Mithraic hubs (e. g. Rome, Ostia, Poetovio, Carnuntum, Nida etc.) and places from which only isolated finds have been recovered. The ranking 1-6 was based on the following criteria: 1 – a place of isolated evidence in the form of one Mithraic artefact; 2 – a place of limited Mithraic presence defined by the discovery of 2-5 Mithraic artefacts; 3 – a place of denser Mithraic presence defined by the discovery of 6-10 Mithraic artefacts; 4 – a place of strong Mithraic presence defined by the discovery of 11-30 Mithraic artifacts or mithraea, either detected archaeologically or attested epigraphically (each
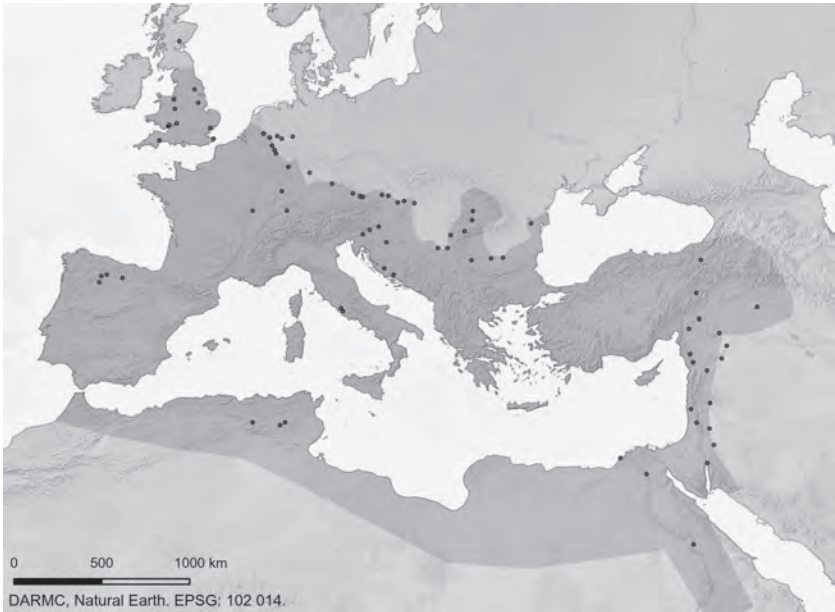
Fig. 2: The sites of the major Roman legionary fortresses
(in black dots) based on the *Handbook
to Roman Legionary Fortresses.*

variable *mithrea* gives the number of Mithraic sites in each region. The
variable *mithrea_av* then gives the average significance of Mithraic evi-

Mithraic temple counting as the equivalent of 20 Mithraic artefacts); 5 – a place of
substantial Mithraic presence defined by the discovery of 31-100 Mithraic artifacts and
mithraea; 6 – a major center of Mithraic activity defined by the discovery of more than
100 Mithraic artefacts and mithraea.

One of the anonymous reviewers of the first version of this article raised our attention
to the fact that our map of Mithraic evidence and its relative strength reflects, to a
great extent, modern research dynamics (influenced by the process of discovery and
publication, the intensity of archaeological surveys, and the durability or perishability
of material used by Mithraic communities etc.) more than ancient realities. This is
certainly a correct observation and we acknowledge this issue as highly relevant and
worthy of further discussion, especially in studies focusing on metatheoretical pro-
blems influencing our perception and study of ancient religions. However, we decided
to retain our former methodological decision and continue to work, in this quantitati-
vely oriented study, with the only evidence we have at our disposal and which is suit-
able for meaningful quantification, despite its possibly biased character.

dence in each region, based on the rank of Mithraic presence in individual sites belonging to this region.[19]

3.2 Locations of Roman legionary fortresses

In this dataset, we coded the most important Roman legionary fortresses whose GPS coordinates can be established from archaeological surveys or ancient literary sources. The list of legionary fortresses is based on the *Handbook to Roman Legionary Fortresses*.[20] Only those legionary fortresses which existed at the time when Mithraism originated (50-100 BCE)[21] or were founded later were taken into consideration in the subsequent analysis. Each legionary fortress was geolocated and assigned to a Roman province and region (for the visualization of sites of legionary fortresses see Fig. 2). The variable *forts* gives the number of legionary fortresses in each region. Our decision to include into our analysis only a relatively small number of major legionary fortresses and disregard hundreds, if not thousands, of smaller bases, fortresses, or strongholds we know about was motivated by our intention to neutralize (at least to some extent) the most acute chronological problems raised by the temporal aspects of our evidence. Mithraic artefacts coming from places of documented Mithraic presence were, for the purpose of our analysis, used undated. The reason why we decided to work with undated Mithraic evidence is that this evidence is, in most cases, datable only imprecisely on the basis of paleographic estimates (in the case of inscriptions) or artistic style (in case of Mithraic reliefs or sculptures) – usually within a span of many decades. Similar problems would materialize with the inclusion of smaller military bases, fortresses, and strongholds, which were often provisional, their existence and use temporary and dependent on the current military situation. Our choice to work only with large military fortresses mitigates these issues, at least partially, since these bases were seen as permanent installations and existed for many decades or even centuries. Furthermore, we see these major fortresses as important hubs of intensive military activity, from which smaller military units or individuals traveled to places of their immediate deployment and later returned to, typically in winter times or after their sentry duties ended and the current military situation dictated

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19 For more details see the section Geographical area of interest, transportation network, regions, and provinces below.

20 Mike C. Bishop, *Handbook to Roman Legionary Fortresses*, Barnsley: Pen and Sword 2012.

21 Roger Beck, "The Mysteries of Mithras: A New Account of Their Genesis", *Journal of Roman Studies* 88, 1998, 115-128: 117-118; A. Chalupa, "The Origins of the Roman Cult of Mithras…", 75-77.

their redeployment. We believe that these major military centers exercised a powerful and lasting influence not only in the immediate region where they were geographically situated but also in neighboring regions through which the roads connecting them with other military centers went, and that this influence will be recognizable in the distribution pattern of Mithraic evidence.

3.3 Geographical area of interest, transportation network, regions, and provinces

After the Roman legionary fortresses were coded, we used them to map the spatial trend of the intensity of military deployments and movements. The ORBIS project was used as the primary source of the ancient Roman transportation network since it offers, so far, the most complete data. The ORBIS model consists of a dataset of sites (major cities, towns, and settlements) and a dataset of routes which connect them.[22] In addition to the geographical representation, these datasets are supplemented with other attributes. For our study, the most important one was the price (in temporal units) which defined the costliness of travelling through specific routes.

To be able to address statistically the relationship between Mithraism and the Roman army, we decided to transform the continuous space of the Roman Empire into a set of distinct regions. By this transformation, each region aggregates data that lie inside a particular area. We used the *node* layer from the ORBIS network as the primary source for the creation of these regions. In the first step, we weeded out the *nodes* that had no name attribute or valid geometry or were of very low importance (e. g., *nodes* representing crossroads rather than regional population centers). We buffered the political extent of the Roman Empire in the year 117 CE with a 200 km value to define the limit for further analyses. Several *nodes* and three Mithraic sites situated in the Crimean Peninsula were removed because they lay outside these limits. In the second step, distinct regions were constructed from point *nodes* (represented by major cities, towns, and settlements used by the ORBIS project) through the method of Thiessen polygons. Each of the Thiessen polygons (also known as a Voronoi diagram) created in this manner is defined as the locus of all points that are closer to their own *node* than to any other *node*.[23] At the

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22 In network science terminology, the sites are called *nodes* and interconnecting routes *edges*.

23 Kurt E. Brassel – Douglas Reif, "A Procedure to Generate Thiessen Polygons", *Geographical Analysis* 11, 1979, 289-303. You can easily visualize this process by the animation accessible at <https://en.wikipedia.org/wiki/Voronoi_diagram#/media/File:Voronoi_growth_euclidean.gif>.

end of this process, each region was clipped with the layer of the sea. The result is displayed in Fig. 3. We decided to use this method of spatially regionalizing the Roman Empire because it enables the easy assignment of Mithraic evidence and legionary fortresses to geographically distinct regions (polygons) and thus an effective statistical analysis of their correlation.
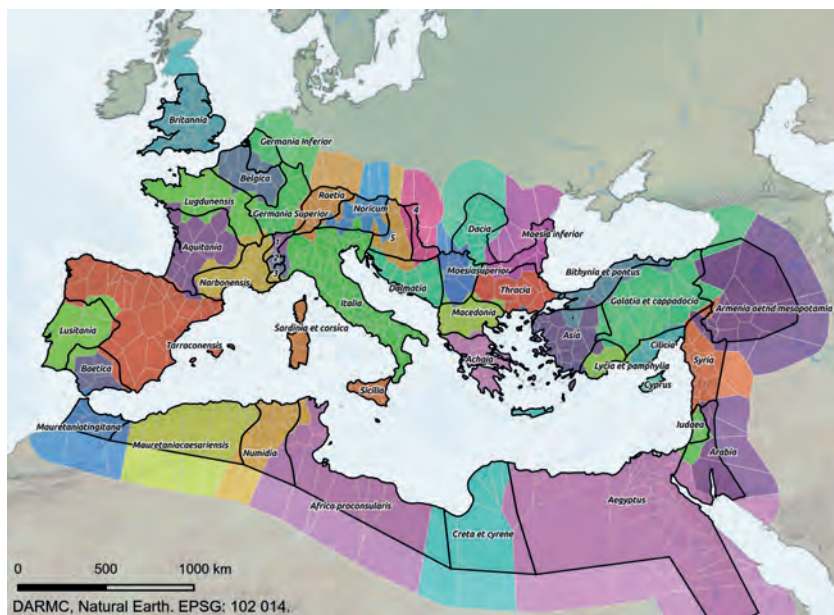

Fig. 3: *Nodes* (polygons) created around sites from the ORBIS network and provinces of the Roman Empire 117 CE [19].
The ORBIS sites are represented as points.
Provinces without label:
1 – Alpes Graiae et Poeninae, 2 – Alpes Cottiae, 3 – Alpes Maritimae,
4 – Pannonia Inferior, 5 – Pannonia Superior.

Using network analysis semantics, we will, from this moment onward, address these regions in the form of Thiessen polygons as *nodes* and the routes between them as *edges*. The input network is therefore weighted and oriented. For each *node*, we calculated the number of legionary fortresses that lay within its boundaries. The same was done with the dataset of Mithraic evidence, where we also summed the *mithrea_av* value as the average significance of Mithraic evidence found in each *node* (polygon).

The other attributes extracted for each *node* are as follows: *port* (binary variable) – the presence of a port (both river or maritime) in each polygon; *port river* (binary variable) – the presence of a river port in each polygon; *port sea* (binary variable) – the presence of a maritime port in each poly-

Node name	Alexandria	Carnuntum	Roma
node ID	17	99	316
longitude	29.91	16.92	12.49
latitude	31.20	48.12	41.89
node rank	100	80	100
forts	1	1	2
mithrea	1	4	6
mithrea_av	60	298.5	689
population	1	1	1
POP sum	500 000	12 000	1 000 000
port sea	1	0	0
port river	1	1	1
port	1	1	1
province	Aegyptus	Pannonia superior	Roma
province detail	Aegyptus	Pannonia superior	Roma
area	85 798	168 867	2 082

Table 1: An example of the dataset of regions and extracted attributes. *Node ID* is an arbitrary number; *node rank* originates from the ORBIS database; *forts* shows the number of legionary fortresses (garrisons) in a given *node*; *mithrea* gives the number of Mithraic sites attested in a given *node*, while *mithrea_av* includes also information about the magnitude and strength of Mithraic presence; *population* is the number of towns and larger settlements in a given *node* based on Wilson; and *POP sum* is the estimated number of inhabitants based again on Wilson; *port sea*, *port river*, and *port* are binary variables (1 for present, 0 for absent); *province* and *province detail* assign individual regions to Roman provinces and *area* in square kilometers represents the size of a region.

gon; *node rank* – the population size in each polygon obtained from the ORBIS model for each major city, town, and settlement; *POP sum* – the population size in each *node* (polygon) approximated from estimates in

Wilson's dataset;[24] *population* – the number of cities, towns and larger settlements in each *node* (polygon) extracted from Wilson's dataset.[25] An example of the dataset is shown in Table 1. For further analyses, we also decided to assign the name of the province from the dataset of the Roman Empire (117 CE) to each *node* according to the location of the original site (variables *province* and *province detail*).

It should be noted that the Thiessen polygons method used here is based on the unweighted Euclidean distance and does not respect the specificities of the local terrain or modes of transport. For this reason, a more complex distance analysis is planned in future research that could better define the regional impact of nodes based on a set of various geographical phenomena and constraints.

Number of *nodes*	613
Number of *nodes* with Mithraic evidence attested	209
Number of *nodes* with a fortress	66
Number of *nodes* with an overlap between Mithraic evidence and fortresses	44
Number of *nodes* with either Mithraic evidence or fortresses or both	231

Table 2: Quantification of Mithraic sites and Roman legionary fortresses in *nodes* (polygons).

3.4 Relationship between Mithraic sites and Roman legionary fortresses

To answer our main hypothesis (H1: There is significant overlap in locations of Mithraic evidence and of Roman legionary fortresses), we computed Spearman's correlations between the sites with Mithraic evidence and the locations of Roman legionary fortresses in each *node* (polygon). Only those *nodes* where either Mithraic evidence or Roman legionary fortresses or both were documented entered the statistical analysis. Further, we grouped the findings into a summed value for each province and computed Spearman's correlations at the level of the Roman provinces (as an aggregation of *nodes* lying within the borders of historical Roman provinces). Table 2 captures the main characteristics of these variables and Table 3 the characteristics of the used networks. Fig. 5 in the

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24 Andrew Wilson, "City Sizes and Urbanization in the Roman Empire", in: Alan Bowman – Andrew Wilson (eds.), *Settlement, Urbanization and Population*, Oxford: Oxford University Press 2012, 161-195.

25 *Ibid.*

Results section captures the distribution of Mithraic evidence across *nodes* and the localization of Roman legionary fortresses.

3.4.1 Subnetworks used by the Roman Army

The modeling of a military transportation network can help to confirm our second hypothesis (H2: Military infrastructure and military deployments throughout the Roman Empire facilitated the spread of Mithraism. The sites of important *nodes* situated on the routes connecting Roman legionary fortresses correlate with the sites of documented Mithraic presence). Since our main interest lies in studying the relationship between Mithraism and the Roman army, we limited the ORBIS network to a subnetwork of *edges* preferred for the deployments and movements of larger military units, not individual soldiers; in other words, only the types of *edges* realistically used by Roman legions and supporting personnel were considered. River and maritime routes were excluded from the network, because we know from historical sources that they were not routinely used for massive deployments of Roman legions.[26] However, there are two notable exceptions. We include these routes when: 1) we have reliable historical evidence that particular maritime/river routes were used by the Roman military (e. g., the maritime route between Sicily and Carthage, the crossing of the Bosporus, etc.), and 2) a *node* would otherwise become isolated (in this instance, we connected this *node* with the rest of the network via the least expensive route).

Further, we limited our military subnetwork according to the assumption that army units and supporting personnel usually did not travel throughout the entire area of the Roman Empire but only regionally in the areas around the place where they were permanently stationed. This means that a threshold had to be established. As mentioned earlier in the text, the weights on the *edges* represent the *cost of transport*, the higher the weight, the more expensive the transport. The shortest paths between *nodes* where Roman legionary fortresses were located were identified and the histogram of shortest path lengths was constructed, as shown in Fig. 4. Three drops (natural divisions in the cost of travel between the Roman legionary fortresses) were located and used in the follow-up analyses. These drops in the shortest path lengths were measured for cost values of 3, 8, and 16. In other words, the network was reduced to enable only travel between garrisons close to each other when the journey did not exceed costs of 3, 8 or 16, respectively.

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26 Jonathan P. Roth, *The Logistics of the Roman Army at War (264 B.C.-A.D. 235)*, Leiden: E. J. Brill 1999.

For the sake of the completeness of the results, the non-thresholded network was also analyzed as the network including only the shortest paths between Roman legionary fortresses and the city of Rome (going both ways). This served as a means of excluding a possible alternative hypothesis that the observed effect was the result of some other factors such as Rome's impact as the capital of the Roman Empire in the network.
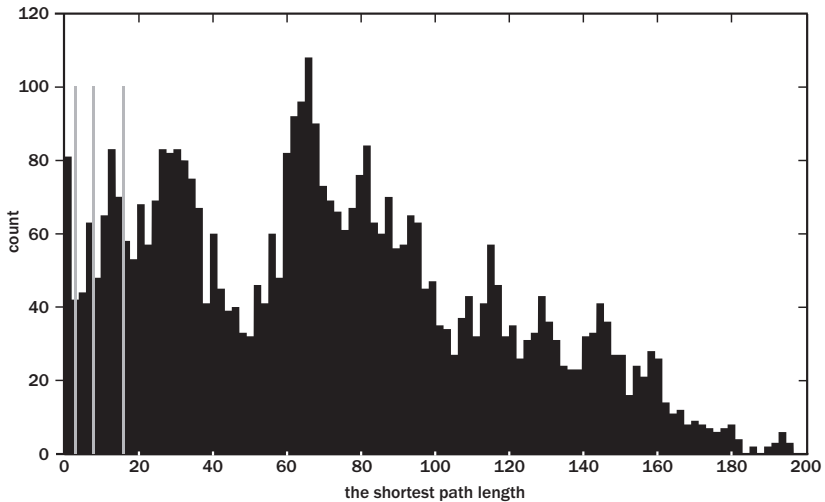

Fig. 4: Histogram of costs of the shortest paths between Roman legionary fortresses. The gray lines (for the shortest path lengths of 3, 8 and 16) show three thresholds used to restrict the network.

3.5 Importance of *Nodes*

As the next step, the importance of *nodes* on the thresholded network was evaluated by their betweenness centrality. Betweenness centrality measures the ratio of the number of the shortest paths traversing through a given *node* to the number of all possible shortest paths. In this case, this measurement was modified and limited to the paths between the *nodes* (polygons) with the presence of a Roman legionary fortress. To check whether the *nodes* with the presence of a Roman legionary fortress were more or less connected to Mithraism than other *nodes*, the importance of *nodes* was further weighted by the addition or subtraction of an arbitrary

weight in the range of [-100, 100] to increase or decrease the importance of *nodes* with the presence of a Roman legionary fortress. This weight range reached up to a maximum of 10 % of the computed betweenness centralities. The addition of weight was based on the assumption that *nodes* with a Roman legionary fortress were more inclined to have Mithraic presence. In contrast, the subtraction of weight was based on the assumption that Mithraic evidence was found in *nodes* other than those with a Roman army garrison because soldiers or other personnel could have left Mithraic artefacts on the roads connecting fortress *nodes* to other *nodes* important for military infrastructure – for example, places where smaller strongholds were situated or where craftsmen, traders, billeting officers, and administrative personnel were active; in other words, at places that were located in *nodes* neighboring the major Roman legionary fortresses.

The computed modified betweenness centralities of *nodes* were correlated (Spearman's correlations) with variables of Mithraic evidence, and relationships were established for each *node* (polygon) as well as for each Roman province after the summation of data belonging to separate provinces. The centralities were computed and the relationships to Mithraic evidence evaluated for the non-thresholded network, thresholded networks, and the network of routes between Roman legionary fortresses and Rome. Table 3 captures the basic characteristics of these networks.

A network	Number of *nodes*	Number of *edges*	Density [%]
ORBIS	608	1551	0.42
military (no thr)	395	861	0.55
military (thr = 3)	325	584	0.55
military (thr = 8)	329	598	0.55
military (thr = 16)	335	618	0.55
fortresses – Rome	234	463	0.85

Table 3: The characteristics of used networks. The ORBIS network is shown for comparison. Thresholded military subnetworks are listed here by the value of the threshold (*thr*; cost) in parentheses.

4. Results

4.1 Relationship between the sites of Mithraic evidence and Roman legionary fortresses

At the level of the whole Roman Empire, *we did not find* any statistically significant relationship between the distribution of Mithraic evidence and the locations of Roman legionary fortresses when studied for each *node* (polygon) separately. With this result, we did not reject the null hypothesis to our H1 (H0: There is no relationship between the locations of Roman legionary fortresses and the sites of Mithraic evidence). The relationships are visualized in Figure 5.
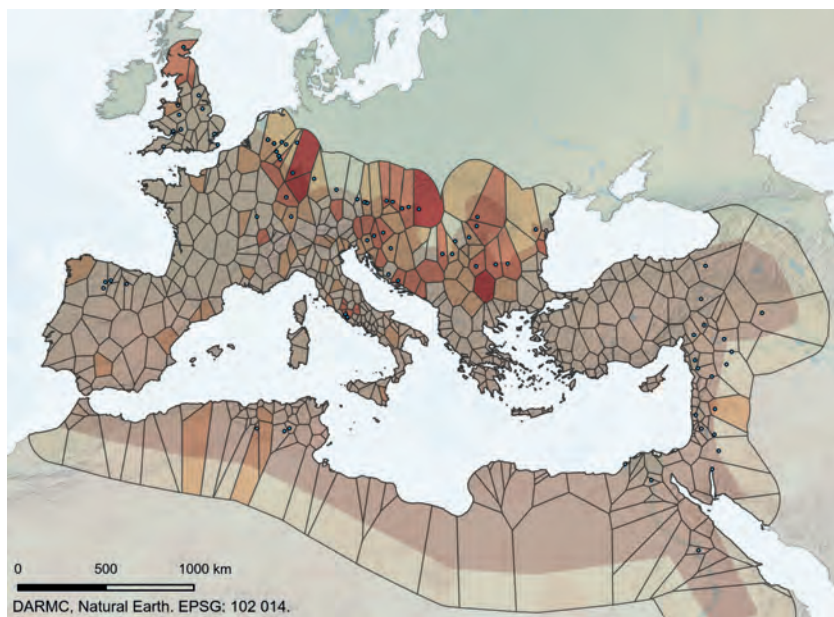

Fig. 5: The distribution of Mithraic sites (*mithrea*) within the constructed *nodes* (polygons) and the locations of Roman legionary fortresses.
The color hue represents the density of Mithraic evidence in each *node* (polygon); dots show the locations of Roman legionary fortresses.

However, when ascribing the *nodes* to individual provinces (and computing the correlations for each province separately), we uncovered both positive and negative relationships in some provinces of the Roman Empire. Detailed results are shown in Table 4.

Province	*mithrea* x *forts*	*mithrea_av* x *forts*
Britannia (0.05 < p < 0.10)	r = -0.50†	r = -0.53†
Italia (0.05 < p < 0.10)	r = 0.27*	–
Moesia inferior (p < 0.05)	r = 0.75*	–
Moesia superior (0.05 < p < 0.10)	–	r = 0.79*
Hispania Tarraconensis (p < 0.05)	r = -0.91†	r = -0.87†

Table 4: Relationship between Mithraism and Roman legionary fortresses at the level of the provinces of the Roman Empire. Only significant results (p < 0.05) and trends (0.05 < p < 0.10) are shown. Values with asterisks show significant positive correlations, values with crosses negative ones.

4.2 The relationship between sites of Mithraic evidence and other regional characteristics

Considering the other measured variables, significant correlations were further detected between sites of Mithraic evidence and the presence of river ports (r = 0.20) and maritime ports (r = -0.15). No relationship between Mithraic evidence and population size was found. These results are captured in Table 6. To provide a full description of the dataset, correlations were also computed between the locations of Roman legionary fortresses and regional characteristics. The number of legionary fortresses significantly correlated with the presence of river ports (r = 0.17) and maritime ports (r = -0.22).

4.2.1 Relationship between locations of Mithraic evidence and the importance of *nodes* in military subnetworks

The modified betweenness centrality of *nodes* on the shortest paths between Roman legionary fortresses was computed on military subnetworks with *nodes* with the presence of a Roman legionary fortress con-

nected only when such *nodes* were closer than a cost of 3, 8 or 16, respectively. Also, different weights for *nodes* with Roman legionary fortresses were considered. The results are summarized in Table 5, with a visualization for the threshold of the cost equal to 3 shown in Fig. 6.
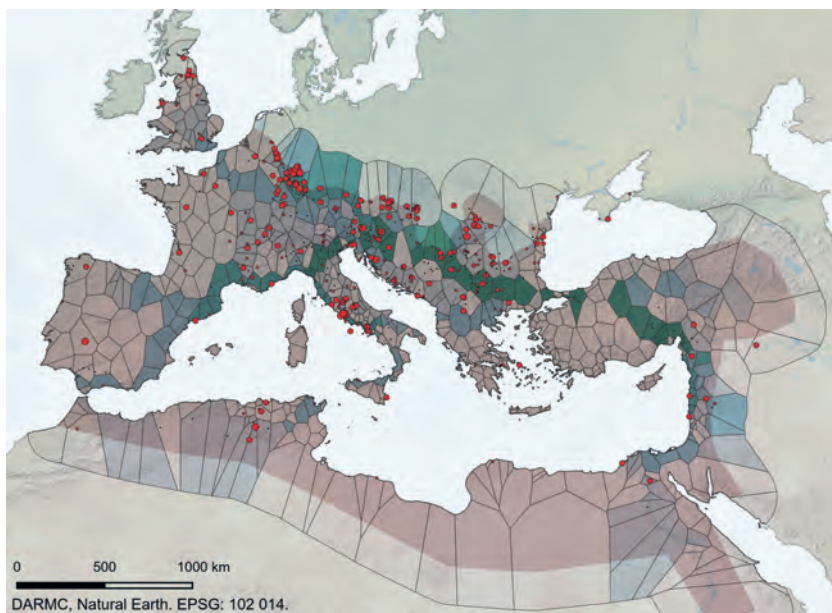

Fig. 6: Relationship of Mithraic evidence and the importance of *nodes* in the military subnetwork (thresholded for cost = 3). The color of each region corresponds to its betweenness centrality (without weight for the presence of a legionary fortress); points show locations of Mithraic evidence, the size of each dot corresponding with its significance.

No relationship between the sites of Mithraic evidence and the importance of *nodes* on the non-thresholded military network or on the network connecting Rome with the locations of the Roman legionary fortresses was detected. However, statistically significant positive correlations were detected when the importance of *nodes* was computed on the thresholded subnetworks (for all three thresholds). When the weight of the regions with Roman legionary fortress was added, significant results were measured for negative weights rather than positive ones. In other words, positive correlations were detected in *nodes* important on the thresholded military sub-

networks that did not have a legionary fortress located within their borders. Table 5 illustrates these findings. Table 6 shows correlations between the sites of Mithraic evidence and other regional characteristics.

	mithrea		*mithrea_av*	
	p-value	**r-value**	**p-value**	**r-value**
forts (no thr)	0.526	–	0.966	–
BC (no thr, w = -100)	0.115	–	0.120	–
BC (no thr, w = 0)	0.265	–	0.231	–
BC (no thr, w = 100)	0.350	–	0.288	–
BC (g-Rome, w = -100)	0.681	–	0,599	–
BC (g-Rome, w = 0)	0.790	–	0.529	–
BC (g-Rome, w = 100)	0.971	–	0.570	–
BC (thr = 3, w = -100)	0.027*	0.144*	0.117	–
BC (thr = 3, w = 0)	0.058*	0.124*	0.145	–
BC (thr = 3, w = 100)	0.173	–	0.251	–
BC (thr = 8, w = -100)	0.025*	0.147*	0.113	–
BC (thr = 8, w = 0)	0.047*	0.130*	0.128	–
BC (thr = 8, w = 100)	0.158	–	0.238	–
BC (thr = 16, w = -100)	0.006*	0.179*	0.021*	0,151*
BC (thr = 16, w = 0)	0.021*	0.151*	0.042*	0,133*
BC (thr = 16, w = 100)	0.087*	0.112*	0.116	–

Table 5: Spearman's correlations between the sites of Mithraic evidence and the metrics of military networks and other regional characteristics. Both variables describing the quantity of Mithraic evidence (*mithrea* and *mithrea_av*) are shown. Values with asterisk show statistically significant positive results. R-values are displayed only for significant results (p < 0.05) or trends (0.05 < p < 0.10). *BC* stands for betweenness centrality; threshold levels (as *thr*) and weights (as *w*) are specified in parentheses. Centralities computed on the network of paths between Roman legionary fortresses and Rome are marked as *BC (g-Rome)*.

As was the case when testing the first hypothesis (H1) about the relationship between the locations of Mithraic evidence and Roman legionary fortresses, here, in the case of *nodes* important in military infrastructure, we also divided the space into provinces and computed Spearman's correlations for each province separately. This way, we were able to detect differences in the relationship between Mithraism and the Roman army across space. Results for the variable *mithrea* are shown in Table 5. The variable *mithrea_av* provided very similar, however, less significant results.

	mithrea		*mithrea_av*	
	p-value	**r-value**	**p-value**	**r-value**
port	0.082*	0.114*	0.044*	0.132*
port river	0.002*	0.203*	0.003*	0.195*
port sea	0.019†	-0.153†	0.135	–
node rank	0.289	–	0.827	–
POP sum	0.643	–	0.196	–
population	0.615	–	0.409	–

Table 6: Spearman's correlations between the sites
of Mithraic evidence and other regional characteristics.
Both variables describing the quantity of Mithraic evidence
(*mithrea* and *mithrea_av*) are shown.
Values with asterisks show significant positive correlations,
values with crosses negative ones.
R-values are displayed only for significant results ($p < 0.05$)
or trends ($0.05 < p < 0.10$).

5. Discussion

The results of our analysis suggest that the relationship between Mithraism and the Roman army was, in all probability, more complex than how it has been presented in previous scholarship. We were not able to find, at the level of the Roman Empire, sufficient support for our H1 (There is significant overlap in locations of Mithraic evidence and of Roman legionary fortresses) and these results justify the revisionist claim downplaying the importance of the Roman army for Mithraism and its daily operations. It is evident that Mithraism must have also appealed to

various other social groups, not only to the Roman soldiery, and spread, from very early on, to regions where the Roman army was either absent or its immediate presence rather sporadic. In Hispania and Italia, we can find mithraea installed in large private agricultural villas, where they catered for the religious needs of their owners and their extended families including freedmen and slaves.[27] In Gallia, mithraea are often situated in temple precincts associated with the cult of waters and healing springs.[28] In some other places, mithraea were built on the outskirts of existing settlements in zones of industrial production – for example, close to kilns and ceramic factories.[29] We can argue, with a sufficient level of certainty, that the personnel that frequented these mithraea was typically nonmilitary.

On the other hand, the statistically significant presence of Mithraic evidence in the *nodes* important on all three thresholded military subnetworks provides some support for our H2 (Military infrastructure and military deployments throughout the Roman Empire facilitated the spread of Mithraism. The sites of important nodes situated on the routes connecting Roman legionary fortresses correlate with the sites of documented Mithraic presence). These results are consistent with more nuanced views seeing the impressive geographical spread of Mithraism within the borders of the Roman Empire as a byproduct of Roman military and logistical infrastructure. In this scenario, the Roman army is no longer seen as a pri-

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27 E. g. mithraeum of Spoleto (ant. Spoletium): *CIMRM* 673; Giovanna Bastianelli Moscati, "Il mitreo di Spoleto", *Bolletino della Deputazione di Storia Patria per l'Umbria* 104/1, 2007, 27-53; mithraeum of Taquinia (ant. Tarquinii): Attilio Mastrocinque, "Mithras in Tarquinia", in: Matthew M. McCarthy – Mariana Egri (eds.), *The Archaeology of Mithraism: New Finds and Approaches to Mithras-Worship*, (BABESCH Supplement 39), Leuven: Peeters 2020, 87-92; Attilio Mastrocinque – Fiammetta Soriano – Chiara Maria Merchetti (eds.), *La domus del Mitreo a Tarquinia I: Ricerche archeologiche dell'Università di Verona*, (BAR International 2986), Oxford: British Archaeological Reports 2020; mithraeum of Els Munts: Francesc Tarrats Bou – Joseph Anton Remolà Vallverdú – Jacinto Sánchez Gil de Montes, "La vil•la romana dels Munts (Altafulla, Tarragonès) i Tarraco", *Tribuna d'Arqueologia* 2005-2006, 213-227; Jaime Alvar, *El culto de Mitra en Hispania*, Madrid: Dykinson S. L. 2018, 163-169.

28 E. g. mithraeum at Septeuil: Marie-Agnès Gaidon-Bunuel, "Les mithraea de Septeuil et de Bordeaux", *Revue du Nord* [thematic issue *Archéologie*] 73/292, 1991, 49-58; mithraeum at Les Bolards: *CIMRM* 1917; Émile Thévenot, "La station antique des Bolards à Nuits-Saint-Georges (Côte-d'Or)", *Gallia* 6/2, 1948, 289-347.

29 E. g. mithraeum at Tienen: Marleen Martens, "The Mithraeum in Tienen (Belgium): Small Finds and What They Can Tell Us", in: Marleen Martens – Guy De Boe (eds.), *Roman Mithraism: The Evidence of the Small Finds*, Brussel: Museum Het Toreke 2004, 25-56; mithraeum at Kempraten: Regula Ackermann et al., "Spotlighting leftovers. The mithraeum at Kempraten (Rapperswil-Jona, Switzerland)", in: Matthew M. McCarthy – Mariana Egri (eds.), *The Archaeology of Mithraism: New Finds and Approaches to Mithras-Worship*, (BABESCH Supplement 39), Leuven: Peeters 2020, 47-63.

mary source of Mithras followers and Mithraism as a typical "military cult". Instead, the Roman army is seen as a facilitator which gave rise, by the construction and maintenance of a dense web of fortresses, strongholds, roads, and personnel (military and civil),[30] to conditions conducive to the spread of Mithraism as a cult based primarily on the interpersonal bonds among followers of Mithras.[31] Mithraic communities may have been situated in settlements lying on roads often frequented by the followers of Mithras, such communities providing social support for followers in situations in which they had to leave their previous communities and move to a new place for occupational reasons.

It is very unlikely that this statistically significant presence of Mithraism on thresholded military subnetworks is coincidental because we did not find any significant correlations with other, potentially confounding, variables, such as the population density; furthermore, the strength of this significance is lost on the non-thresholded military subnetwork. There is also no significant correlation between the sites of Mithraic evidence and *nodes* important on the routes connecting Rome with the locations of Roman legionary fortresses. This result shows that Rome as the capital of the Roman Empire and a major population center had no comparably significant influence on the distribution of Mithraic evidence across the military subnetwork. This fact seems to problematize the theory which situates the origins of Mithraism in Rome.[32] The influence of Rome was indeed significant, but, as it seems, only at the level of Italian regions.

The situation was, however, more complex at the regional level. We do not want to argue that the existence of military networks and infrastructure was the only factor which contributed to the spread of Mithraism and can explain the distribution pattern of Mithraic evidence in all provinces of the Roman Empire. It is very likely that other social networks played an important role as well and future research must pay attention to their possible influence. For example, our analysis detected a strong positive correlation between settlements with river ports and the presence of Mithraism, and a negative correlation between maritime ports and the presence of Mithraism (Table 6). While the latter result was anticipated, since it is generally ac-

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30 Ben Kolbeck, "A Foot in Both Camps: The Civilian Suppliers of the Army in Roman Britain", *Theoretical Roman Archaeology Journal* 1/1, 2018, article no. 8 (s. 1-19), doi: https://doi.org/10.16995/traj.355, accessible at <https://traj.openlibhums.org/article/id/4002/>.

31 David E. Aune, "Expansion and Recruitment among Hellenistic Religions: The Case of Mithraism", in: Peder Borgen – Vernon K. Robbins – David B. Gowler (eds.), *Recruitment, Conquest, and Conflict: Strategies in Judaism, Early Christianity, and the Greco-Roman World*, Atlanta: Ga. Scholars Press 1998, 39-53.

32 M. Clauss, *The Roman Cult of Mithras*…, 7-8; id., *Cultores Mithrae*…, 253-255; id., *Mithras*…, 14-18.

cepted that Mithraism did not depend on maritime routes as, for example, the cult of Isis and other Egyptian deities,[33] the former came as a surprise. There are two possible explanations for this situation. The first claims that these results are heavily influenced by the strength of the Roman *limes* and the fact that, in regions with the strongest Mithraic presence, the Roman frontiers consisted of two large rivers (the Rhine and the Danube). Further research verifying whether this positive correlation continues even if we differentiate between ports on the Roman frontiers and ports within the Roman Empire could help to clarify the picture. The second explanation argues that another factor must have come into play, e. g. a network operated by a social group other than the Roman army, such as officials of the Roman customs offices (*portorium*) often situated at ports and river crossings.[34] This is also an avenue for further research. Yet another social group which might have contributed to the spread of various cults was Roman army veterans. After the termination of their military service, they were, very often in large groups, resettled in *coloniae* established by the Roman state and awarded plots of land for agriculture.[35] According to a recent study, Roman veterans played a role in the spread of the Bona Dea cult[36] and the possibility that the same situation applied in the case of Mithraism cannot be excluded.

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33 Françoise Dunand, *Le culte d'Isis dans le bassin oriental de la Méditerranée I-III*, Leiden: E. J. Brill 1973.

34 The most detailed study of this topic is still Per Beskow, "Portorium and the Mysteries of Mithras", *Journal of Mithraic Studies* 3, 1980, 1-18.

35 Gabriele Wesch-Klein, "Recruits and Veterans", in: Paul Erdkamp (ed.), *A Companion to the Roman Army*, Oxford: Blackwell 2007, 435-450.

36 Leonardo Ambasciano, "The Goddess Who Failed? Competitive Networks (or the Lack Thereof), Gender Politics, and the Diffusion of the Roman Cult of Bona Dea", *Religio: Revue pro religionistiku* 24, 2016, 111-165.

Summary

The Network(s) of Mithraism: Discussing the Role of the Roman Army in the Spread of Mithraism and the Question of Interregional Communication

The cause of the rapid and geographically impressive spread of Mithraism in the Roman Empire from the last quarter of the 1st century CE onward is still only partially explained. Scholars had speculated about the influence of the Roman army and the popularity of Mithraism among Roman soldiers; however, a meticulously conducted demographical study of the known followers of Mithras based on Roman epigraphical data problematized this view. This paper uses a transportation network model based on ORBIS (the Stanford Geospatial Network Model of the Roman World) and a network analytical approach to uncover the possible relationship between the network of Roman legionary fortresses and sites where the presence of Mithraism can be historically documented. To demonstrate the possible impacts of Roman military infrastructure on the spread of Mithraism in the Roman Empire, we coded all sites of documented Mithraic presence and the locations of the major Roman legionary fortresses, positioned them on the transportation network, and used statistical analysis to detect possible relationships between these datasets, both at the level of the whole Roman Empire and regionally. Although we were not able to find, at the level of the Roman Empire, a statistically significant overlap between the locations of Roman legionary fortresses and Mithraic sites, we discovered the statistically significant presence of Mithraic evidence in nodes important on thresholded military subnetworks connecting Roman legionary fortresses. These results support the view that the Roman army and supporting civil personnel responsible for supplying and maintaining Roman military infrastructure contributed to the spread of Mithraism and can partially explain the geographical distribution of archaeologically attested Mithraic evidence in the Roman Empire.

Keywords: Mithraism; diffusion of religions; Roman army; network analysis; transportation network

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