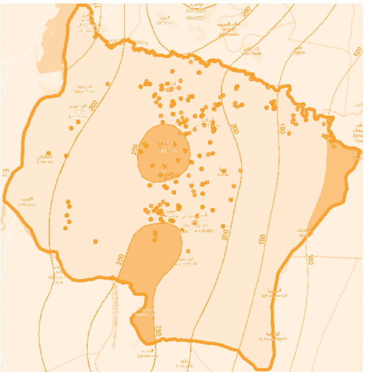
The Gobolitide (Al-Jibal) microregion: geography and settlement network evolution from Nabataean to Byzantine times



Abstract: A spatio-temporal analysis of the ancient settlement landscape of northeastern Edom (ancient Gobolitide, Islamic al-Jibal) from Nabataean to Byzantine times was performed based on surface survey data, taking into account various geographical factors (main morphological units, floristic regions, annual precipitation) and climatic fluctuations. The article presents preliminary conclusions concerning the distribution of settlements in the microregion, the determining factors behind the evolution of the settlement network and the temporal changes observed. The mapping of sites based on chronological and typological criteria indicated specific settlement clusters in the Edomite highlands and in episodic river valleys (wadis). The pattern is disturbed only by Wadi al-Hasa. Overall, climate change turns out to have the greatest impact on the change in the number of sites over time.

Keywords: Nabataean/Roman/Byzantine archaeology, Jordan, settlement landscape, spatial analysis

While the Roman Empire is probably one of the best-studied periods in human history (suffice it to see the number of books, articles, reviews etc. that were published on the subject in 2020 alone), not all regions once ruled by the Romans are subject to the same intensive research. The reasons are many: geographical, political

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Polish Archaeology in the Mediterranean 30/2
Kopij and Bała 2021: 181–201
https://doi.org/10.31338/uw.2083-537X.pam30.2.28

and social. Roman metropolises and military camps, both great and small, have always attracted the attention of researchers, archaeologists in particular. Indeed, a disproportionate amount of attention has been paid to large Roman and Hellenistic urban settlements, but not so the smaller ones, unless a specific chronological period is involved (for example, the transition between the Byzantine and early Islamic periods, which is one focus of researchers in the Levant). The province of *Arabia Petrea* (and its later mutations related to administrative changes in the empire) is a good example. Regions poor in magnificent Hellenistic cities, like the Gobolitide (al-Jibal) area, are therefore very poorly recognized archaeologically as far as settlements are concerned (Kołodziejczyk 2014). Several surveys of the area, which largely overlaps with the territory of the present governorate of al-Tafila with the addition of small parts of the governorates of Ma'an and Karak, have recorded more than 100 sites identified as settlements, but only sites like Rashadiah, Gharandal, Dharih and Feinan[1] have been excavated. A recently launched archaeological research

Fig. 1. The Gobolitide microregion in Jordan (Illustration made with the use of ESRI ArcGIS Pro)

1 All site names given after the MEGAJordan (MEGA-J) system: Rashadiah – JADIS: 2101019; MEGAJordan No. 9833; Gharandal/ancient Arindela – JADIS: 2101001; MEGAJordan No. 9821; see Walmsley 2000; Walmsley and Grey 2001; Dharih – JADIS: 2103134; MEGAJordan No. 9942; see Al-Muheisen and Villeneuve 1994; Villeneuve and Al Muheisen 2000; 2008; Al Muheisen and Piraud-Fournet 2013; Durand et al. 2018; Feinan/ancient Phaino – JADIS: 1900001; MEGAJordan No. 4032. See Barker et al. 1997; 1998; 1999.

project at Tuwaneh may expand the list of more thoroughly studied sites (Bodzek et al. 2019). In the meantime, there are the sites identified during the surveys, which can be more than mere dots on a map. They can provide data to trace general settlement trends over a longer time frame. The article analyzes settlement patterns in northeastern Edom from the Nabataean to the Byzantine period.

GEOGRAPHICAL STUDY AREA

Northeastern Edom corresponds to the area of ancient Gobolitide (Islamic al-Jibal) in central Jordan [*Fig. 1*]. The boundaries defined by François Villeneuve (1992: 277–278; see Gatier 2000) make it a relatively small territory with an area of 2403 km². It overlaps with four main morphological units: the Dead Sea Rift Valley, the Transjordan Plateau/Western Highlands, the western part of the Arabian Desert, and the southern extent of the Middle East steppe (see MacDonald 2015: 1–4). Its northern border is the Wadi al-Hasa; to the west is the Southern Ghors and further south Wadi ʻArabah (the two are separated by a 50-m-high escarpment, the Khanazir Fault) (Macumber 2001: 2; MacDonald 2015). To the north and west, the terrain is rugged, reaching some 1600 m above sea level, and cut through by deep valleys (the lowest point in the Dead Sea Rift Valley being approximately 400 m below sea level). The eastern border coincides more or less with the western border of the Arabian Desert. The southern boundary is somewhat less precisely defined topographically, although its western section follows the course of Wadi Ghuweir, Wadi Feinan and Wadi Fidan. The eastern section as defined by Villeneuve follows the modern Unayza–Shawbak road (Villeneuve 1992: 278). The central part of the study area corresponds to the northern part of the Edomite highlands, which are separated from the Wadi ʻArabah by rather steep slopes. The descent of the terrain eastward toward the desert is quite different, being gentler (Villeneuve 1992: 277–278; Besançon 2010: 23–24, Fig. 3; MacDonald 2015: 1–4) [*Fig. 2*].

DATA AND METHOD

The database and methodology should be discussed briefly in order to understand the limitations imposed on the conclusions. There are 764 records in the database (online: https://zenodo.org/record/5849856), based primarily on the MEGA-J (Middle Eastern Geodatabase for Antiquities-Jordan) on-line system,[2] supplemented with sites not yet included. Wherever possible, the information from the MEGA-J was verified with the literature, including above all the publication of the results of numerous surveys in the area, e.g., Tafila-Busayra Archaeological Survey (MacDonald et al. 2004), The Southern Ghors and Northeast Arabah Archaeological Survey (MacDonald 1992), Wadi al-Hasa Archaeological Survey (MacDon-

2 For more details on the system and its history see Drzewiecki 2015.

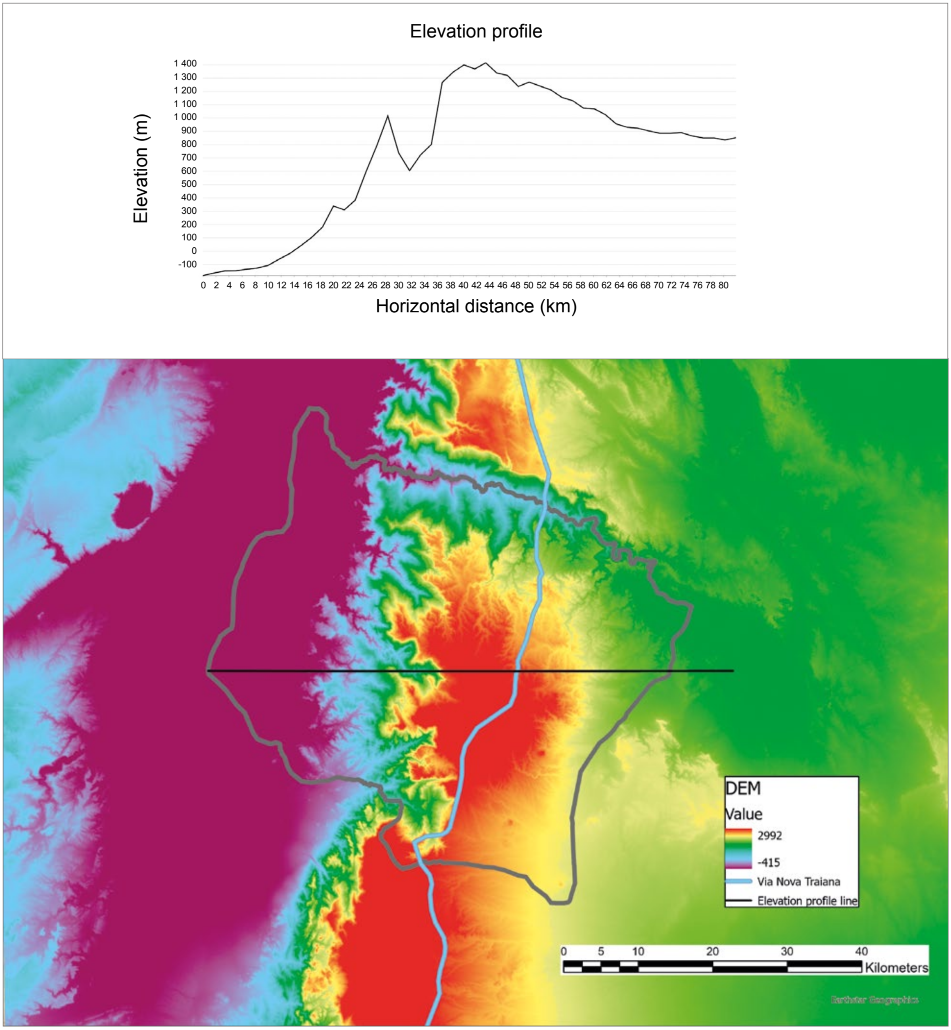

Fig. 2. Elevation profile (Illustration made with the use of ESRI ArcGIS Pro)

Table 1. Regional chronology according to different survey authors and the corresponding chronology adopted by K. Kopij and S. Bała in the present study

	332–63 BCE	63 BCE–324 CE	324– ~640 CE
G.A. Clark and others (1994)	Hellenistic	Roman and Nabataean	Byzantine
S.T. Parker (2006)	Hellenistic	Roman	Byzantine
B. MacDonald and others (2004); B. MacDonald (2015)	Hellenistic (and Nabataean)	Roman (and Nabataean)	Byzantine
K. Kopij and S. Bała (2021)	Nabataean	Roman	Byzantine

ald 1988), Wadi Hasa North Bank Survey (Clark et al. 1992; 1994), Limes Arabicus Project (Parker 2006), Archaeological Rescue Survey of the Tafileh-Ghor Feifeh Road (GFTS; Waheeb 1993), Tuwaneh Survey (Fiema 1993; 1997), The Jabal Hamrat Fidan Regional Archaeological Project (Levy et al. 2003), Wadi Feynan Survey (Barker et al. 1997; 1998; 1999), Wadi Dana Archaeological Survey (Finlayson et al. 2000), Da'janiya Survey (Rucker 2007), and the Survey of Byzantine and Islamic Sites in Jordan (King's Survey; King et al. 1987). The surveys covered almost the entire area of study, although the intensity of the investigations may have been lesser in some small parts of the province, especially in difficult mountainous terrain (Kołodziejczyk 2014).

Survey data is by its very nature not of the highest quality. Chronology is determined based on surface potsherd collections and in the case of multiphase sites, it is usually impossible to determine which phase is represented by the remains of architecture or agricultural activities.

Another problem is the lack of standardization regarding chronological attribution of the recorded sites. Different surveys have used different relative and absolute chronologies, requiring the data to be properly correlated [*Table 1*]. Some do not provide any absolute dates at all (King et al. 1987; Waheeb 1993; Levy et al. 2003; Rucker 2007). This problem was pointed out for Petra and its hinterland along with a proposition of how to deal with it (Kennedy and Hahn 2017). However, the lesser chronological spread between different surveys in the case of the Gobolitide study area, related rather to the nomenclature of individual periods, allowed a less sophisticated method of correlating chronological data to be applied here, namely, standardizing the names of individual periods.

The present analysis starts with the Nabataean period, examined already by Villeneuve (1992; border date is 106 CE) and includes the Roman and Byzantine periods. It corresponds closely with MacDonald's recent analysis of the Southern Transjordan Edomite Plateau and the Dead Sea Rift Valley (MacDonald 2015: 50–81, Figs 5–6), albeit based on a number of sites recorded in our database far exceeding the data at MacDonald's disposal.

GEOGRAPHICAL FACTORS

As said above, a total of 764 sites dating from the Nabataean to the Roman and Byzantine periods has so far been identified in the study area [*Fig. 3*]. Certain trends are evident here: for example, the course of the *via Nova Traiana* is clearly observed. Other trends become clearer once the mapping is contextualized in the elevation model of the microregion [*Fig. 4*]. Two large concentrations of sites can be seen: Wadi al-Hasa in the north and the plateau in the center.

The analysis presented here takes into consideration geographical and climatic variables that could have influenced the distribution of sites across space and time. The discussion concerns 105 sites described as settlements, towns and villages, and 64 isolated farms [*Fig. 5*]. Sites of a military character

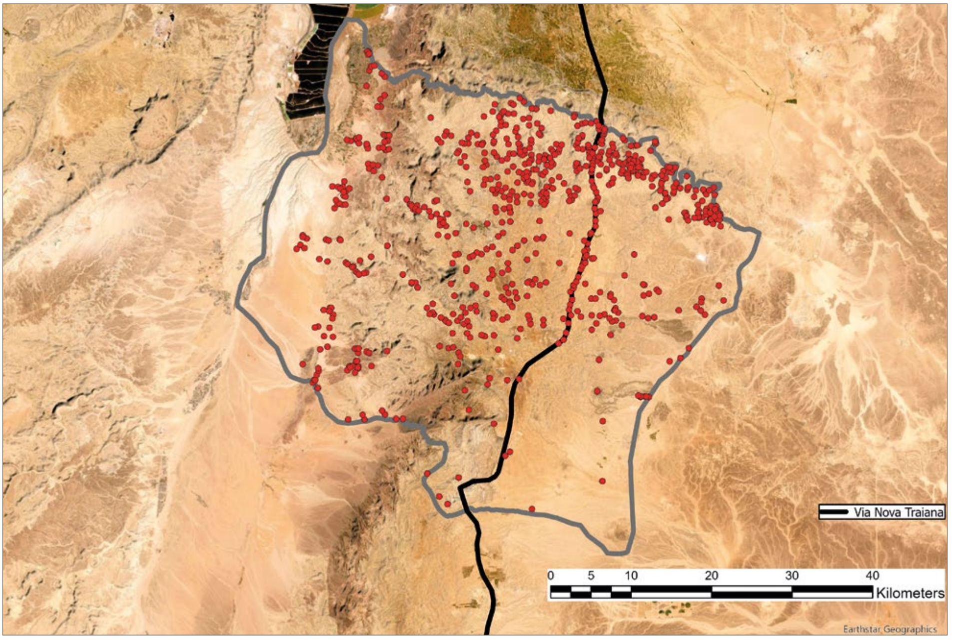

Fig. 3. Geographical distribution of all recorded sites from the Nabataean, Roman and Byzantine periods and the course of the *via Nova Traiana* (Illustration made with the use of ESRI ArcGIS Pro)

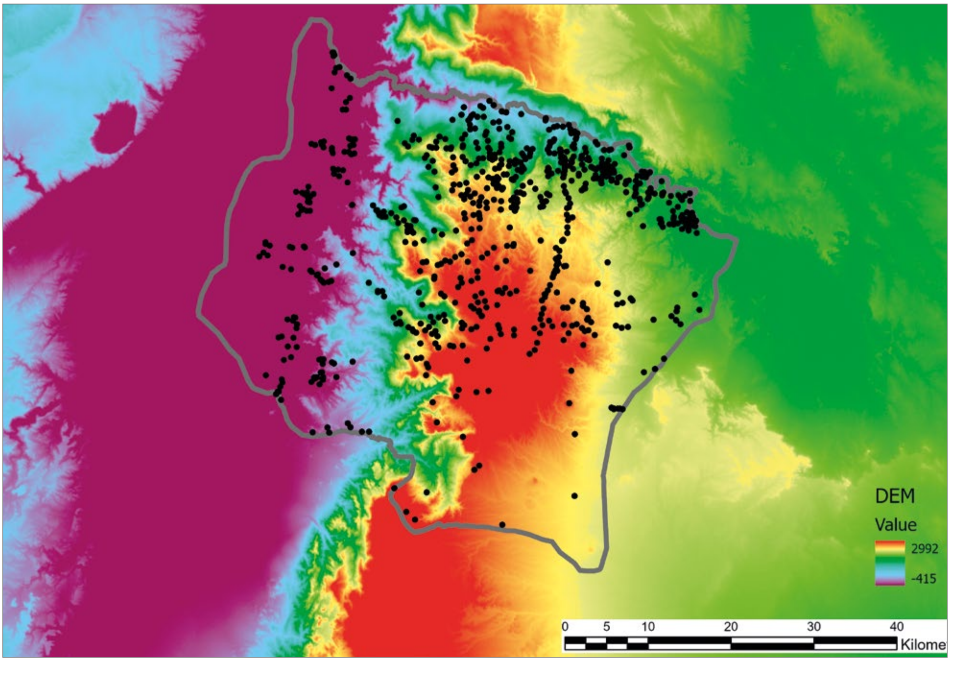

Fig. 4. Geographical distribution of all sites from the Nabataean, Roman and Byzantine periods in the database against a SRTM Digital Elevation Model (Illustration made with the use of ESRI ArcGIS Pro)

(forts and towers), of which there are 165 on record, and six that are of a religious nature (temples, monasteries and churches) will not be considered here, because their location was governed by other factors, even if at least some of them were important population centers.

The distribution of sites was first examined in relation to the main modern morphological units of the studied area [*Fig. 6:A*; *Table 2*]. The underrepresentation of settlement sites (and, in truth, also sites of a different nature) in the hostile Dead Sea Rift Valley environment is not surprising. Settlement sites within the desert area are concentrated only within the wadis, in the western part at the mouths of the wadis toward the lowland area, and in the eastern part within Wadi al-Hasa. The same is true of the sites in the Middle East steppe. They, too, are concentrated within Wadi al-Hasa and its tributaries. Two-thirds of the settlement sites within the Gobolitide microregion are located in

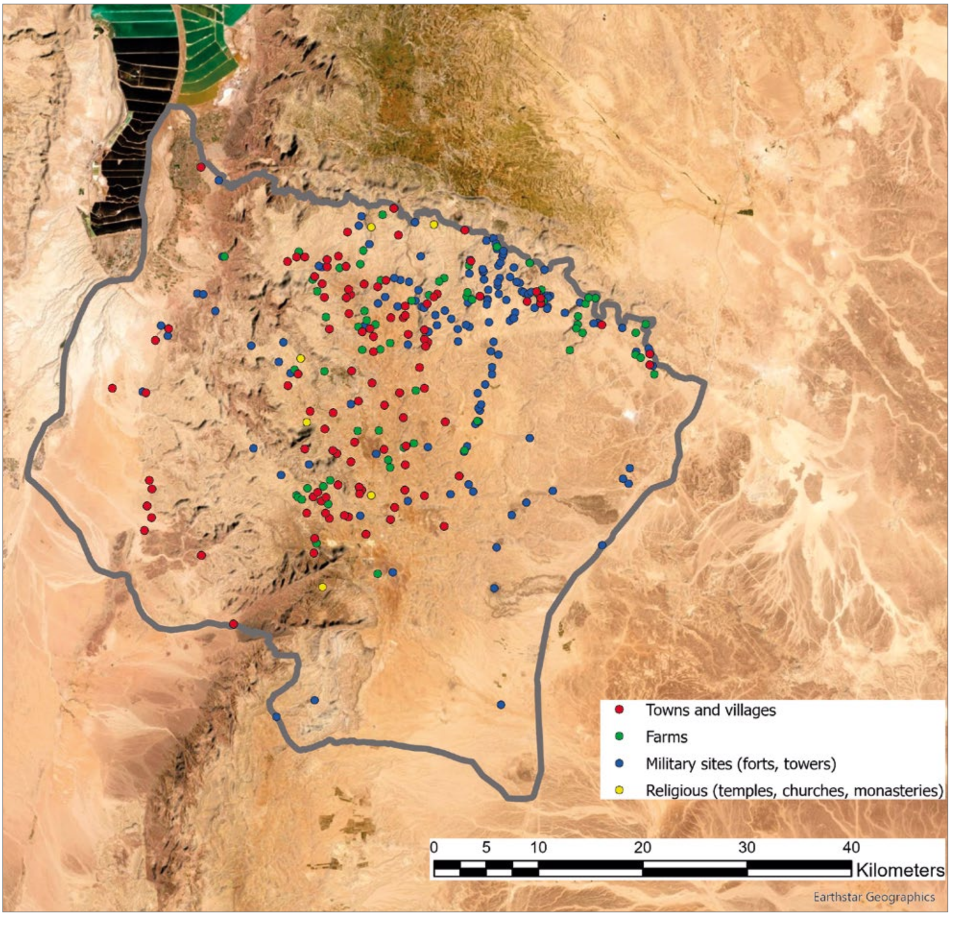

Fig. 5. Geographical distribution of settlements, farms, military and religious sites (Illustration made with the use of ESRI ArcGIS Pro)

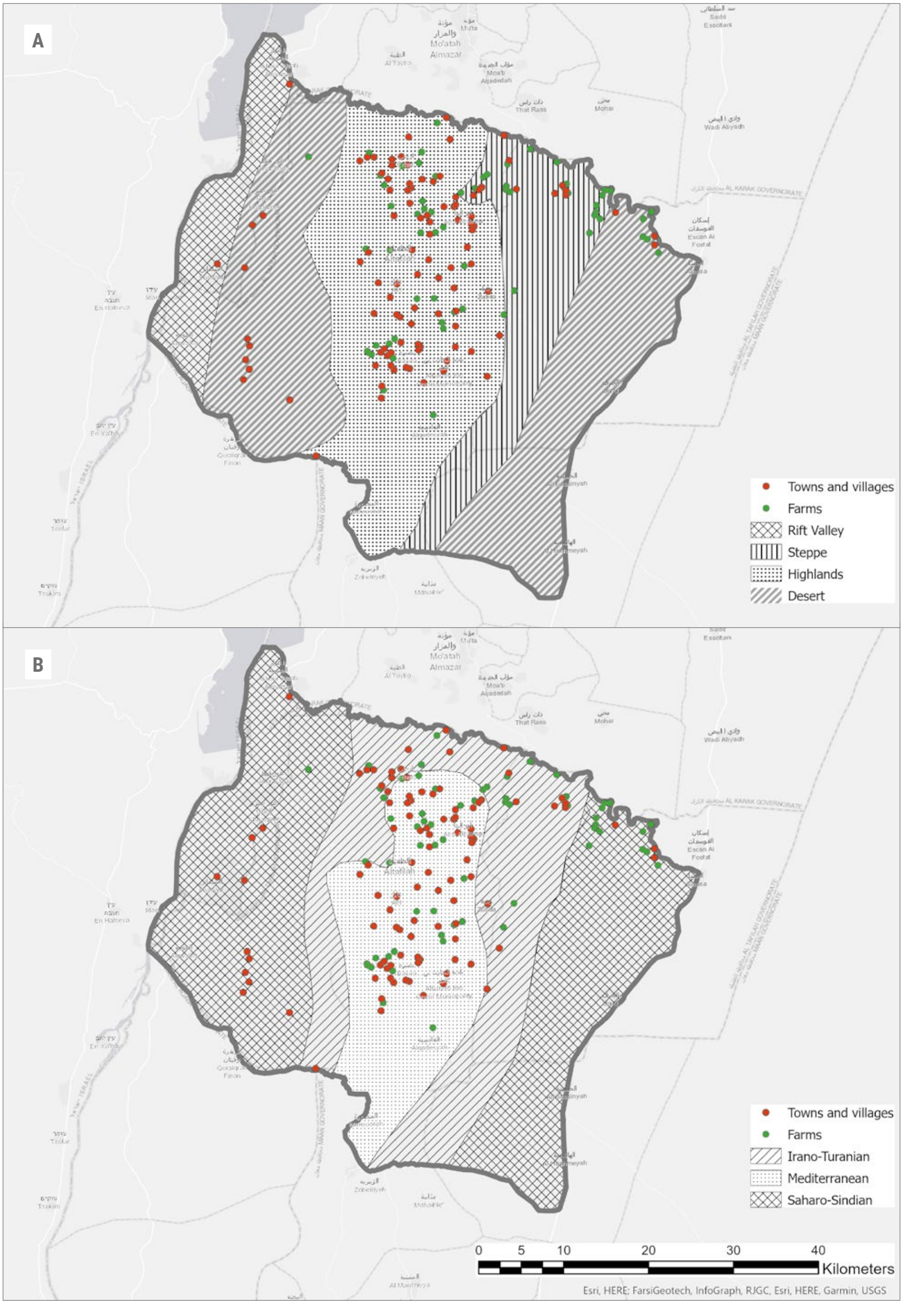

Fig. 6. Geographical distribution of settlements and farms against: A – main morphological units; B – phytogeographic regions (Illustration made with the use of ESRI ArcGIS Pro. Based on MacDonald 2015: 3, Fig. 1.2 and 5, Fig. 1.4)

the uplands, where their distribution is fairly even. The only exception is the highest and most undulating part of the terrain to the west and south (in the lattermost case, Wadi Dana and Wadi Feynan). However, it should be kept in mind that the surveys conducted by the HLC project have demonstrated that this mountainous, inaccessible terrain is the least investigated (Kołodziejczyk et al. 2018).

Table 2. Number of sites in the main morphological units and area in km² within the microregion

Morphological unit	No. of sites	Area (km²)	Density (sites per km²)
Dead Sea Rift Valley	2	214	0.009
Desert	23	939	0.024
Middle East steppe	34	386	0.088
Transjordan Plateau	122	864	0.141

Table 3. Number of sites in phytogeographic (floristic) regions and area in km² within the microregion

Floristic region	No. of sites	Area (km²)	Density (sites per km²)
Saharo-Sindian	33	1167	0.028
Irano-Turanian	44	666	0.066
Mediterranean	104	569	0.183

In the second step, the distribution of settlement sites was examined in context with the three modern phytogeographic regions, i.e., areas with specific flora: Saharo-Sindian, Irano-Turanian, and Mediterranean (Takhtajan 1986: 131–143; MacDonald 2015: 4–6) [*Fig. 6:B; Table 3*].[3]

Although the boundaries between these regions are not sharp, making it difficult to determine their size within the study area, the Saharo-Sindian region is the largest (over 1000 km²). The other two are about half as large, covering about 600–700 km² each. The differences in the density of settlement sites located within these regions are very clear [see *Table 3*]. Again, it is worth noting that the sites in the Saharo-Sindian region are located either within Wadi al-Hasa or to the west, where the wadis transition into the lowlands. Similarly, Wadi al-Hasa is the location of the bulk of the sites within the Irano-Turanian region. A notable exception to this is Tuwaneh, which, like the other sites outside Wadi al-Hasa, is located on the *via Nova Traiana*.

The correlation of the number of sites was then examined against modern annual precipitation [*Fig. 7; Table 4*]. The resolution of the available annual rainfall data is not high, hence it shows areas of precipitation varying by around 50 mm. It also means that small areas with annual precipitation reaching or even exceeding 300 mm are not included. This is because measuring stations are usually located in the settlements, avoiding, for example, the highest peaks in the Petra region (Besançon 2010: 27–29). Nevertheless, certain general trends can be discerned. Not sur-

3 For a more detailed discussion of the vegetation of the region for the Petra area and its hinterland see Besançon 2010: 33–34.

prisingly, the areas with the highest annual rainfall (>250 mm and 250–200 mm) also have the highest site densities (0.078 and 0.116 sites per km² respectively). This density decreases as annual precipitation decreases. In areas where annual rainfall is between 100 mm and 200 mm, site density decreases by about 67%. The results for the area with the lowest annual rainfall may be surprising, but this is due to the small area within the Gobolitide territory. Once

Table 4. Number of sites within areas of varying annual precipitation

Annual rainfall (mm)	No. of sites	Area (km²)	Density (sites per km²)
>250	16	205.27	0.078
250–200	136	1169.54	0.116
200–150	25	684.01	0.037
150–100	13	358.61	0.036
100–50	4	62.25	0.064

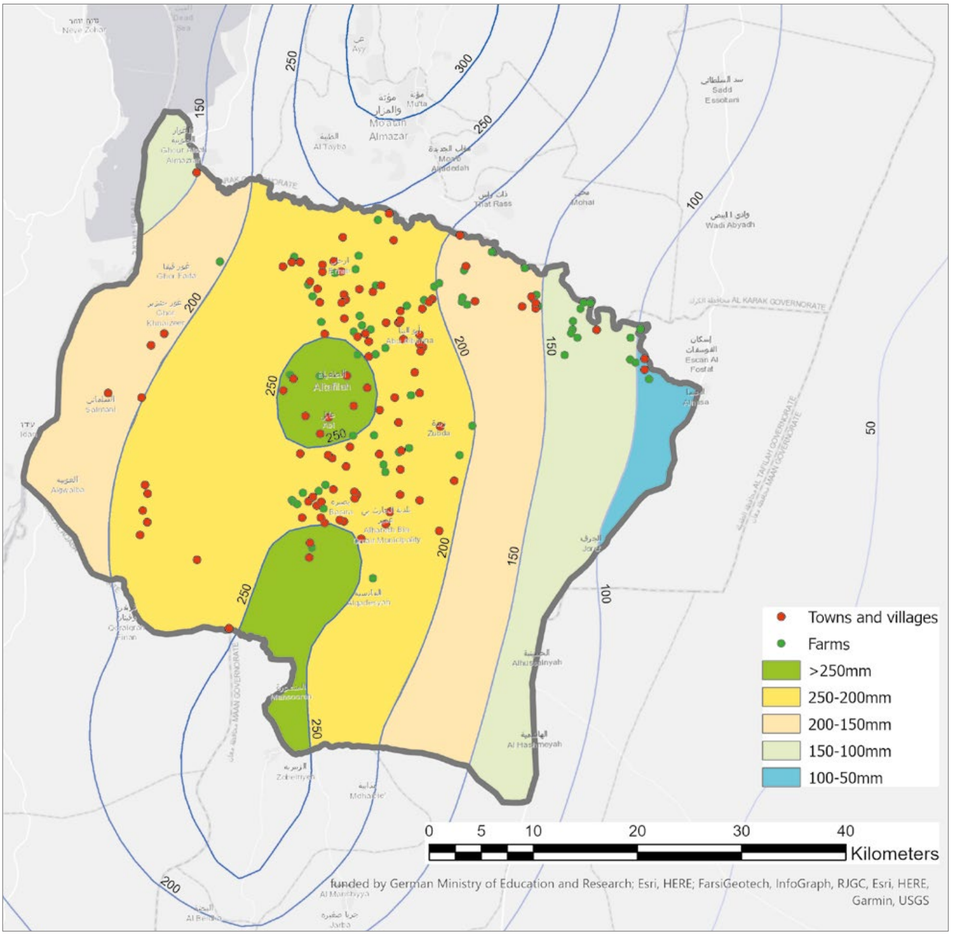

Fig. 7. Geographical distribution of settlements and farms against annual precipitation (Illustration made with the use of ESRI ArcGIS Pro and data from https://www.ufz.de/arcgis/rest/services/Middle_East/General_Climate/MapServer)

the study area is extended, a significant decrease in site density is observed; it is barely 10% of the site density in areas with the highest annual precipitation.[4]

It merits note that sites in areas with annual rainfall of less than 200 mm are concentrated almost exclusively within Wadi al-Hasa. This is not surprising considering that 200 mm per year is the lower limit for dry-farming cereals. Below this threshold, artificial irrigation is necessary (Decker 2009: 12–13).

WADI AL-HASA

In light of the results presented above, it is essential to understand why—despite the unfavorable climatic and geographical conditions—a settled population was concentrated at Wadi al-Hasa. The first explanation that comes to mind is easy water collection in terrain characterized by large differences in altitude. However, this is at best a partial explanation, related only to meeting water demands. The number of farms and villages in the wadi area indicates the need for further clarification. Geological and geoarchaeological studies of Wadi al-Hasa are of assistance here. In 1984, on the basis of the presence of interstratified marls, evaporites, and debris flow deposits along the valley walls, Clark (1984) hypothesized the existence of a Wadi al-Hasa paleolake of about 48 km^2 that existed as late as about 8000 BP.[5] The lacustrine nature of the sediments is sometimes questioned (Winer 2010), but whether lacustrine or fluvial, the sediments provide rich soil for agricultural cultivation. This in turn explains why Wadi al-Hasa was an attractive place to settle.[6]

Similar reasons were surely behind the location of several settlement sites at the mouth of different wadis opening into the Rift Valley. The accumulation of fluvial layers, although not as rich as in Wadi al-Hasa, made these sites relatively attractive for agriculture. Easy water storage was undoubtedly an additional factor.

PALEOCLIMATE AS A FACTOR

The collected data was analyzed also in a temporal perspective. The nature of the data allows only an analysis dividing the sites according to three distinct periods: Nabataean, Roman, and Byzantine.

Of the total of 166 settlement sites (excluding military installations), 95 sites can be dated to the Nabataean period, 80 to the Roman, and 126 to the Byzantine, many of which demonstrate continuity over two or even three periods [*Fig. 8*]. The sites were

4 In all three cases (morphological units, floristic regions, and annual precipitation), the size of each group is too small for statistical tests that would determine their significance.

5 For further research see Clark et al. 1992; Schuldenrein and Clark 2003; Schuldenrein 2007.

6 See similar conclusions regarding soil accumulation with greater thickness than the surrounding areas in the valleys at Jabal Shara (Besançon 2010: 34–35).

established in more or less the same area, only their density changes over time. The data can be visualized with the help of heat maps, which show that in the Nabataean-period sites were spread fairly evenly across Wadi al-Hasa and the Edomitic plateau, although the concentration in Wadi al-Hasa is more prominent [*Fig. 9:A*]. Although fewer sites have been dated to the Roman period, the distribution is somewhat different. Clear concentrations can be seen in the eastern part of Wadi al-Hasa and in the Bsaira area [*Fig. 9:B*]. In the Byzantine period, the number of sites in the eastern part of Wadi al-Hasa decreases. Instead, there is a new strong concentration in the area north of Tafilah Governorate [*Fig. 9:C*]. As a result, the settlement network appears to have shifted slightly to the west. This is interesting as the opposite trend is observed in Syria, i.e., an increase in the number of sites in the steppe zone during the late Roman and Byzantine periods, which was probably related to the expansion of irrigation systems inspired by the central authorities (Decker 2007). A similar eastward shift of settlement during the Byzantine period was observed at Jabal Shara near Petra (Tholbecq 2013), indicating that developments in the Gobolitide region were an exception to the rule in this respect.

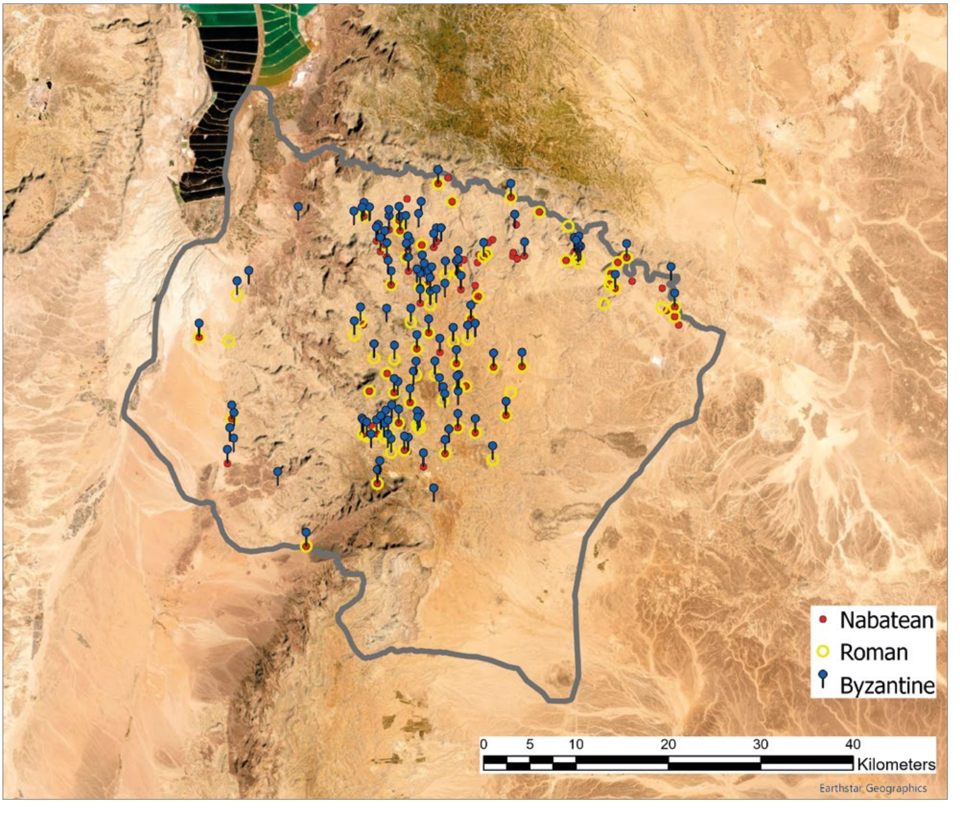

Fig. 8. Geographical distribution of sites by chronological periods (Illustration made with the use of ESRI ArcGIS Pro)

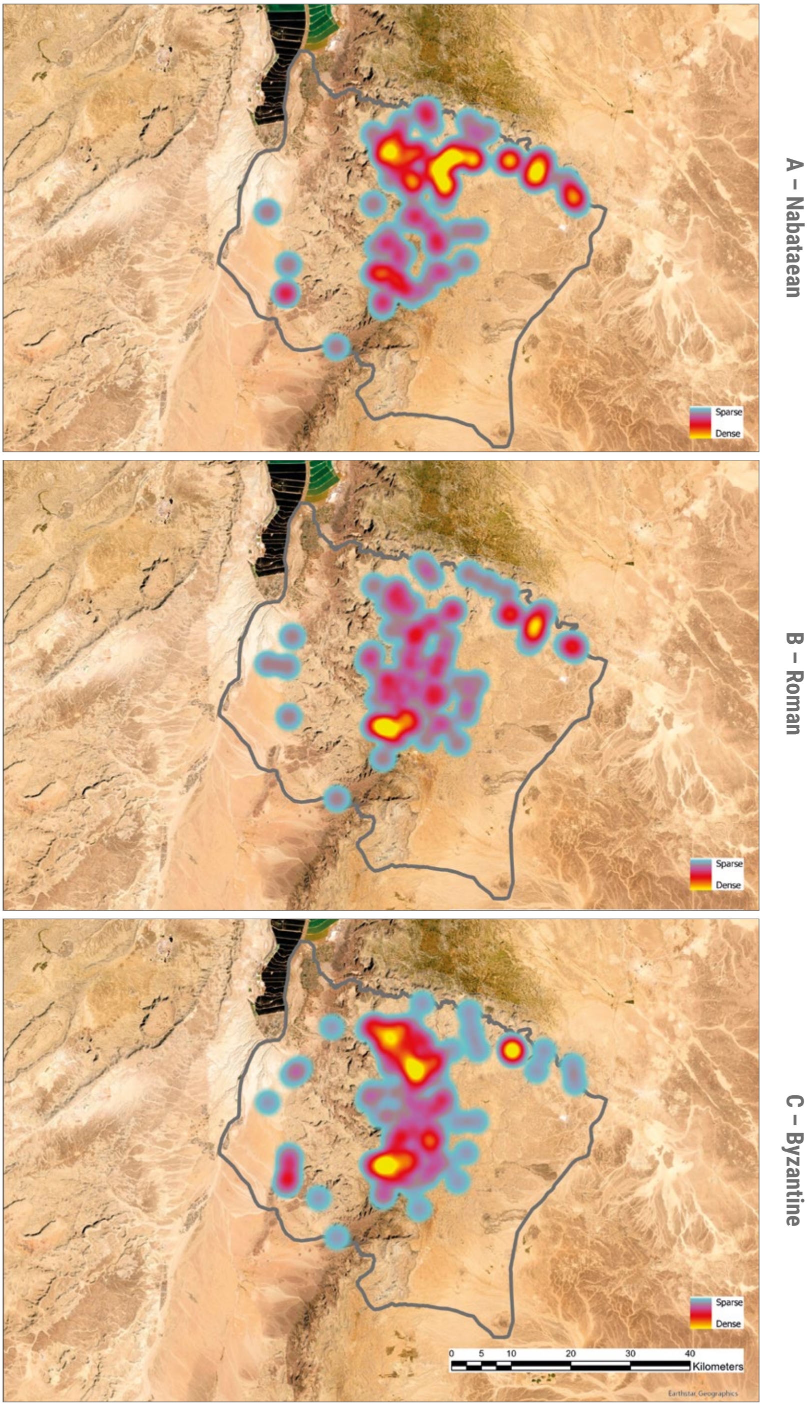

Fig. 9. Heat map of the distribution of sites dating to the chronological periods: A – Nabataean; B – Roman; C – Byzantine (Illustration made with the use of ESRI ArcGIS Pro)

The results were compared with the palaeoclimatic data for the area of interest, coming mainly from the Dead Sea and the Red Sea regions (Büntgen et al. 2011; McCormick et al. 2012; Izdebski et al. 2016). The study area is located in the middle between the two, so the macroregional data, which show how the climate has changed over time, cannot be uncritically translated to the microregion under study, because different geographical factors affect local climate change differently. Nevertheless, the geographical proximity means that they probably relate quite well to those data.

Palaeoclimatic data indicate that from about 200 BCE to about 150–200 CE (a period sometimes referred to as the Roman Climate Optimum; Harper 2017) the climate within the Mediterranean was stable, slightly warmer and wetter than today (McCormick et al. 2012: 174–191). Reconstruction of the level of the Dead Sea indicates that the wet period lasted through the last centuries BCE and ended at the turn of the era when the water level began to drop (Bookman et al. 2004: 565–566, Figs 7–8). This period largely coincides with the Nabataean period in our data. This means that for the most part of this period the conditions were optimal for the development of agriculture and, consequently, Nabataean settlement.

Later on, when the climate became more unstable, regional rather than macroregional patterns became much more important (McCormick et al. 2012: 185–191; Izdebski et al. 2016). A decrease in humidity (and presumably average temperature) is noted in the Levant from about 150–200 CE onwards. This period lasts for about 150 years. The beginning of the Byzantine period (4th century) was associated with a renewed increase in humidity (and probably temperature), evidenced by, among other things, a sharp rise in the level of the Dead Sea (Bookman et al. 2004: 566, Figs 7–8; Izdebski et al. 2016: 196–197). Periods of favorable climate, where droughts were shorter and rainfall increased, were particularly favorable in the 5th century (McCormick et al. 2012: 188). Some research indicates, however, that in the 6th

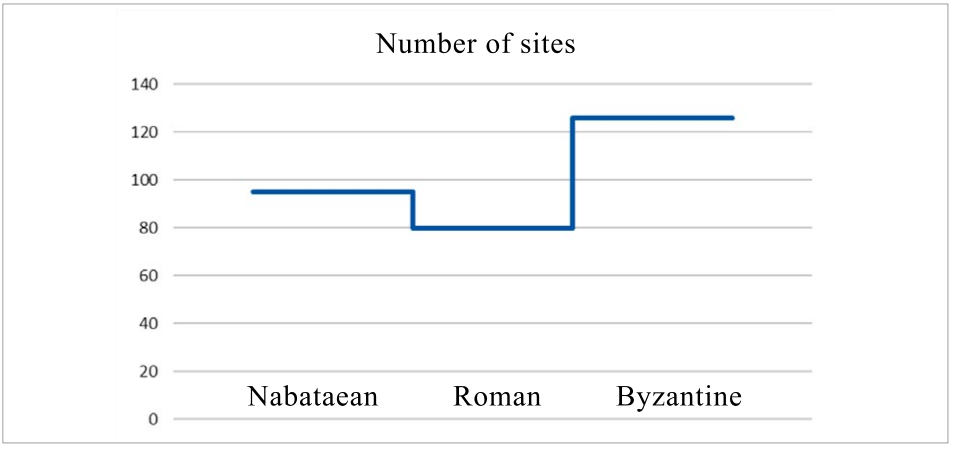

Fig. 10. Trends in the number of settlement sites over time

century the picture was probably more complicated (Büntgen et al. 2011; 2016; Fuks et al. 2017), especially as the water level in the Dead Sea seems to have started to fall at that time (Bookman et al. 2004: 566–567, Fig. 8). Severe droughts are documented (also in the written sources) between 523 and 538, in effect offsetting episodes of increased rainfall (McCormick et al. 2012: 197). A series of volcanic eruptions (in particular the event of 536 CE) appears to have had serious consequences for the local climate in the Middle East, with a decrease in solar irradiance causing a dramatic drop in temperature (especially between 536 and 545 CE) and a significant increase in precipitation (Büntgen et al. 2016: 233–234; Fuks et al. 2017). It is worth noting, however, that these changes may have had a mixed—rather than unambiguously adverse—impact on semiarid and desert areas. However, the nature of the data does not allow the settlement grid to be reconstructed at such a high temporal resolution. Overall, it appears that these changes are visible in the data as a decline in sites dating to the Roman period and a resurgence in sites dating to the Byzantine period.

The changes in the number of sites [*Fig. 10*], especially the increase in the number of sites during the Byzantine period, is consistent with the results of other studies of settlements in the Levant, which have focused on fewer but much better-researched sites (Izdebski 2011; Avni 2014: 204–207; Izdebski et al. 2016: Figs 1, 8; Pini 2019: 184–211). This shows that even poor quality data, as in this case, gives grounds for sound, even if not final, conclusions, especially since a similar increase in the number of sites (of all kinds, not just settlements) between the Roman and Byzantine periods has been observed in survey data from many surrounding areas.[7]

It is worth noting, however, that the trajectory of change within the Gobolitide microregion appears to be somewhat different from that of the sites on the other side of the Rift Valley, where an increase in the number of sites is evident as early as the Roman period and continues to grow during Byzantine times and in some cases even during the early Islamic period (Avni 2014: 204–207, 281–284). On the other hand, the trajectory of change is similar to that observed at the Jabal Shara near Petra (Tholbecq 2013).

CONCLUSIONS

Settlement in the Gobolitide microregion during the periods under discussion was concentrated mainly in the Wadi al-Hasa area and the Edomite plain. The dry climate of the Transjordan caused the settlement network in this microregion to be closely linked to access to water. Accordingly, outside the area with more than 200 mm of annual precipitation, settlements were concen-

7 These include: Jordan in general (Piccirillo 1985: 257–258); Golan (Ma'oz 1993: 536–538); Kerak Plateau (Miller 1991); Wadi al-Hasa (MacDonald 1988); Hesban (Ibach 1987: 174–187); Iraq al-Amir and Wadi al-Kafrayn (Ji 1998; Ji and Lee 1999); and Wadi al-Zarqa (Palumbo et al. 1996).

trated in the valleys of periodic rivers and on the margins of these valleys. The wadis themselves were also natural communication routes crossing the plateau reaching 1600 m above sea level, which ensured sufficient conditions for the development of a settlement network in an area with a meridional extension of approximately 40–50 km. In addition, Wadi al-Hasa was attractive for agriculture because of its fertile lacustrine or fluvial sediments.

It seems that chronological changes in the number of sites are related to climate change, with transitions between wet periods (increase in the number of sites) and dry periods (decrease in the number of sites). The increase in the number of sites between the Roman and Byzantine periods is consistent with the conclusions of other settlement studies in the Levant. More binding conclusions could follow from more detailed research, verifying and surveying the settlements in the region.

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How to cite this article: Kopij, K. and Bała, S. (2021). The Gobolitide (Al-Jibal) microregion: geography and settlement network evolution from Nabataean to Byzantine times. *Polish Archaeology in the Mediterranean* 30/2, 181–201. https://doi.org/10.31338/uw.2083-537X.pam30.2.28

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Supplementary material
Survey site database: https://zenodo.org/record/5849856

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