Isolation or Integration?
A Spatial Analytical Approach to the Local Impact of the Roman Army on the Northern Frontier

By

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Abstract

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This dissertation analyzes changing rural settlement patterns in the Lower Danubian Plain from the Late Iron Age through Late Antiquity in order to elucidate the role played by garrison settlements in the economic strategies of peasants living near the Roman frontier. The military cordon on the northern frontier has been seen both as a stimulus to provincial economic development and as an oppressive burden preventing growth in its vicinity with no consensus forthcoming. I approach the question from the perspective of the rural producers, using the landscapes in which they chose to live as evidence for common goals and conditions. In order to isolate the role of garrison settlements from other features in the landscape, I employ a novel method of comparative multivariate logistic regression analysis. This allows me to test different hypothesized relationships against known settlement patterns while controlling for other influences on location. The result is a quantitative measure of how well each hypothesis fits empirical data.

The first chapter reviews the state of the question on Roman peasant economies, frontier economies and the military community. Having concluded that current interpretations based on documentary and artifactual evidence have failed to settle the issue of military-rural relations, I propose the quantitative analysis of archaeological landscapes as a promising way forward. Here, landscape refers to the embodied perception of a meaningful environment. Each settlement anchors the movements of the people who live there, so the locations of ancient settlements, combined with modern topographic and climatological data provide a foundation for the reconstruction of landscapes as experienced by their ancient inhabitants. I finish the chapter by describing a method of comparative modeling using logistic regression analysis for hypothesis testing. The goal of most locational analysis of this sort is a single mathematical model that predicts or explains settlement location using environmental variables. I suggest that multiple models be created using variables that have been constructed according to competing hypotheses and the goodness of fit between each model and known data be compared to the others. The model with the closest fit contains the variable that best reflects ancient reality. In this way, it is possible to assess the empirical support for each hypothesis and to select the best one.

The second chapter discusses the Lower Danubian Plain in modern Bulgaria, ancient Moesia Inferior. This frontier zone has not figured prominently in discussions of Roman frontier society. This is unfortunate because the area has a unique history of conquest that sets it apart

from other, better-known frontiers: unlike the frontier in Western Europe, it was not heavily garrisoned until relatively late and, after the beginning of the fourth century, it was quite close to the imperial capital at Constantinople. In this chapter, I describe the natural environment of the study area in the middle of the Danubian Plain and the local economy prior to Roman conquest before discussing the history of the area from first century BCE through the sixth century CE. I show that the pre-Roman population of the area, though sparse, was well suited to integration with the Roman military community. I then describe the history of violence in the area and the ways in which different violent episodes impacted the countryside. Next I trace the construction and maintenance of the physical infrastructure of Roman power—forts, cities, and roads—from conquest to collapse before investigating the changing origins of the resident population. I conclude the chapter with an examination of the evidence for the economic status of garrison settlements in Moesia Inferior.

In the third chapter, I describe the process of systematizing the diverse and varied record of archaeological research in the study area. The result is a database that includes ancient places of various functions grouped into chronological phases stretching from Pre-Roman to Late Antique. I also describe how I reconstructed archaeological landscapes for each settlement and how these landscapes, grouped chronologically, were analyzed. First, the immediate territories around settlements are compared to territories around random locations to determine if there are factors that are more or less abundant in one group than the other. Then, the accessibility of traffic routes and possible market centers is compared. As a result of this, I show that Roman settlements are located in very different landscapes than either Pre-Roman or Late Antique settlements. There is little consistency in Pre-Roman landscapes, but Roman landscapes are ideal for intensive agricultural production, and Late Antique landscapes offer greater defensive capabilities. I then use logistic regression analysis to create baseline models of settlement location to which I add Market Potential variables to test the various hypotheses on which they were constructed. The primary result is that settlements from the Middle Roman period (second to third centuries CE), avoid forts and cluster around non-military centers.

In the final chapter, I discuss the strengths and weaknesses of quantitative landscape analysis and comparative modeling before assessing the impact of these results on our understanding of the local economy and the role of garrison settlements in both central Moesia Inferior and the Empire in general. I end by outlining next steps, both for improving the methodology and expanding the scope of investigation.

This dissertation reaches the following main conclusions: 1) Settlement-centered landscapes contain valuable evidence for the behavior of people who are not well-represented by traditional archaeological and historical evidence. 2) While no clear tendencies emerge from the Pre-Roman settlement pattern, Roman settlements show a strong preference for landscapes best suited to intensive agricultural production. In contrast, after the late fourth century, rural settlements prefer locations with access to defensible refuges, demonstrating the value of the security previously provided by the Empire. 3) The rural economy of central Moesia Inferior flourished during the Roman period so military demand did not depress the local economy. 4) At the same time, peasants in this particular frontier zone were not using garrison

settlements as frequent markets for their produce. They may have supplied the frontier indirectly or infrequently, but most would have had few opportunities to visit the army bases themselves. This means that peasants were not in a position to exploit soldiers' demand for local produce to supplement their rations. 5) Nothing in the material or literary record would have suggested that the military communities were isolated in this way, so further investigation along these lines in other frontier zones is warranted.

Optimis parentibus

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Chapter 1: Introduction

1.1 Introduction

This project is an attempt to better understand the impact of the Roman Empire on the lives of ordinary people. The vast majority of the population of the Roman world lived in the countryside and subsisted primarily on food they had produced within their household. The two basic instruments of Roman imperial power were the standing army and the city. The expansion of the Empire brought both into areas which had previously been too sparsely populated to support either. These institutions transformed the lands and peoples subject to Rome profoundly. The spread of urbanism has generally been seen as a positive development indicative of growing per-capita production and consumption (Morley 2011; Wilson 2011). The impact of the army has been more controversial. Some see army bases and their attendant settlements as similar to towns in stimulating economic growth in their hinterlands while others see them as parasitic instruments of oppression that impoverished those unlucky enough to live nearby. This formulation of the issue invests all agency with the military communities. While it is true that the soldiers and their followers were privileged in having access to imperial resources and coercive power, we should not forget that the people who lived in the frontier zone had the ability to interact strategically with these people to further their own ends. I prefer, therefore, to formulate the question as follows: "What role did the garrison settlements play in the economic strategies of peasants in the frontier zone?"

The question is difficult to answer. Peasants leave little trace and the evidence that historians normally rely on is not well suited to answering questions about the mundane aspects of rural life. A way forward may be found, however, by focusing not on the things that might have been exchanged between town or fort and countryside like coins and imported pottery, but on the landscapes in which that exchange might have taken place. Landscapes facilitate and constrain a person's options, which a person can then manipulate by changing the landscape or by moving to a different place. The landscapes around the places where people chose to live, therefore, reflect their priorities, strategies, and options. By reconstructing these landscapes and examining the place of Roman frontier garrison settlements within them, we can learn how people in the countryside saw Roman military communities.

Using this approach, I investigated military – rural relations in central Moesia Inferior within the context of long term, rural settlement dynamics. In the process, I found that a desire to maximize agricultural production pervaded the countryside in the Roman period but, after the end of the fourth century, fear drove people to prefer landscapes of refuge at the expense of production. As for Roman army bases, they played little part in the lives of most country-dwellers. While the regional economy was fundamentally structured by the presence of the army, in the household economies of Roman peasants, the important markets were non-military centers. Indeed, for reasons that can be speculated upon but not proven, most peasants seem to have actively avoided living near Roman forts. Despite cultural similarities

and a strong veteran element in the rural population, the garrison settlements in the central Lower Danube were isolated.

This dissertation is divided into four chapters. The second is devoted to the history of central Moesia from the first century BCE through the sixth century CE. The third describes the construction of the archaeological database, the reconstruction of settlement landscapes, and the results of both univariate analyses of landscape characteristics and the multivariate, comparative modeling that isolates the influence of army bases. The fourth chapter discusses the implications of the new methodology for future research and how the results generated here affect our understanding of Roman frontier society in general.

In this first chapter, I discuss in abstract terms the economic strategies of peasants operating within the context of Roman urbanism, the economic context of the Roman frontier, and military communities, concluding that the archaeological, documentary and literary evidence alone is not sufficient to determine the nature of the relationship between the forts and the countryside. The rest of the chapter is dedicated to explaining the use of landscapes as evidence. I discuss the theoretical background of landscape archaeology and the value of representing landscapes quantitatively within a Geographic Information System (GIS). I end by describing a process of comparative modeling that allows competing hypotheses to be tested simultaneously.

1.2 The economic strategies of peasants

The creation and maintenance of the Roman Empire required the spread of institutions of control, especially the Roman military and Roman urban-based system of administration. In addition to securing the power of the imperial center, both of these institutions created legal, social, cultural, and economic entities: armies with their constituent units, headquarters and military communities on the one hand and cities on the other. The appearance of cities and armies in places where nothing comparable had existed in the past must have affected the ways in which people made a living for themselves, but the details of that influence are often difficult to understand.

1.2.1 Roman urbanism

Because the Roman Empire originated in a series of asymmetric alliances of city-states in Italy and the Mediterranean, the city became the basic administrative node in the network of relations of control.[1] These geographically stable interfaces between imperial and local power

[1] Eich and Eich describe the emergence of the Roman Empire through war and the establishment of alliances with cities in Italy as a particularly successful instance of a generalizable model of state-building (Eich and Eich 2005). After Augustus, the Roman Empire was a network of relations of control centered on the figure of the emperor, but embodied by various individuals who acted under the assumed (legitimately or not) under the authority of the Roman state (e.g. provincial governors, soldiers, members of the imperial household, and government contractors) and practices (e.g. the payment of taxes and the celebration of the imperial cult) (Adams 2007c discusses the role of the army in provincial administration and society; Ando 2000 emphasizes the active participation of the ruled in the construction of empire through the ritual declaration of loyalty; Ando 2006 describes administrative structures and personnel; Edmondson 2015 describes the mechanisms through which the emperor interacted with local communities; Lendon 1997, 201–222 describes the interactions between imperial officials and subjects; for empire as relationships of control see D. J. Mattingly 2011, 6; Millar 1977 is the classic account of the activities of the

relations became sites of elite investment. Following the example of the emperor, local elites built public and private monumental architecture, staged spectacles, and consumed agricultural surpluses in ways designed to advance their social standing (Brunt 1990, 267–281; Lendon 1997; Noreña 2011; Woolf 1998, 24–47).

Although a minority of people lived permanently in cities, the influence of urbanism penetrated deep into the countryside. Any increase in the non-food producing portion of the population requires an increase in surplus production. How this surplus was transferred to the non-food producers determines whether and how much the producers actually benefit from their increased production. Roman cities derived most of the basic sustenance through redistributive mechanisms: urban elites owned land from which they extracted rents and taxes which supported those living in the town (Erdkamp 2001).[2] Thus, while per-capita production rose, those living outside the cities did not necessarily profit proportionally.

The Roman city, however, was much more than a concentration of non-food producers.[3] The crystallization of elite consumption and administrative functions in a stable location led to demographic concentration in these centers—artisans and merchants who catered to the resident elites—which in turn led to more consumption and the emergence of service industries that depend on large consumer bases (Erdkamp 2001; Morley 2011; Wilson 2011). In this way, the political and social functions of Roman cities which induced aristocrats to live in close proximity underpinned their economic functions (Wickham 2005, 594–595). The concentration of consumption and the crystallization of social functions allowed cities to become nodes in long-distance exchange networks.[4] The aggregate demand of the urban populace and the Roman custom of commercial exchange (section 1.3.1) made exotic goods available to anyone who had the money to buy them, including residents of the countryside. Roman cities were commercial hubs integrating peasants, local urbanites, distant cities, and ultimately, distant peasants.

Roman emperor; Shaw 2005, 362–373 discusses the importance of citizenship and cities for the social and political cohesion of the Empire). This network was exceptionally widespread and durable because it successfully united the interests of local and imperial elites (Noreña 2010; Noreña 2011).

[2] This model is known as the "consumer city" model, a characterization which emphasizes the difference with medieval, "producer cities" which relied on the exchange of urban goods for rural produce to survive (for a cogent acocount of the history behind these models and the intellectual contexts whence they originate, see Morley 2004, 1–30). While useful in highlighting a dynamic that was fundamental to the existence of ancient cities but unfamiliar to modern city-dwellers, most modern scholars no longer find it useful for generating new questions (Erdkamp 2001; Whittaker 1995; Horden and Purcell 2000, 89–122)

[3] Indeed, the link between geography and food production, which places agriculturalists in the countryside and consumers in the city should not be taken for granted (Bairoch 1989, 263–266 compiles examples from pre-modern contexts of urban peasants and rural artisans). Concentrated populations can farm their surroundings and produce their own food while dispersed populations can rely on the production of others. Economic discussions of the "consumer city" are best applied not to the geographic entities of city and countryside or even to the human entities of agriculturalist and consumer, for the same person can play both roles at different times, but to sectors of the economy. Nevertheless, Roman cities, like most pre-modern cities in history, do seem to have been net food consumers (Bairoch 1989, 265–266; Garnsey 1979).

[4] Urban centers were not the only nodes in this network. Large-scale landowners in Italy were able to create their own networks of transportation and exchange that bypassed cities (Morley 1996).

Peasants are rarely mentioned in literary sources, but enough references exist to begin to form a picture of peasant marketing activities in some of the most densely urbanized parts of the Empire at least (Bekker-Nielsen 1989; de Ligt 1990; de Ligt 1993; Erdkamp 2005; Garnsey and Scheidel 1998, 91–150 for the position of the peasant within Roman society; Morley 1996). For peasants living near a Roman city, however, access to exotic produce was probably of secondary importance. The opportunities at the urban market for converting their surplus produce and labor to other forms of wealth were much more relevant.[5] This is illustrated most vividly by Apuleius' description of man who buys a donkey in order to transport vegetables to sell to a merchant in a nearby town. He buys nothing but returns home riding the donkey with cash and spends the rest of the day working in his garden (Apuleius *Metamorphoses*, 9.32). The account is echoed in the pseudo-Virgilian poem *Moretum* in which a poor man cultivates certain vegetables exclusively for market. For these men, the town is important because it provides access to money, not because of the availability of imported goods.

It is significant that in both cases, the poor man sells vegetables rather than grain. Grain is more profitable for the wealthy agriculturalist because it is harvested once a year, at which time there is a surplus and only someone who has the capital to invest in storage and who does not need cash immediately can wait for market conditions to improve (Erdkamp 2005, 151–153). The annual grain harvest also requires a large labor force working in concert to reap, bind, sheave, and transport the ripe grain before it can be eaten by animals or destroyed by the weather (Shaw 2013, 11–33). A peasant household would be able to harvest what it needed for its own subsistence using only internal labor, but external labor was necessary to harvest a surplus (Halstead 2014, 102–105). This could be obtained through reciprocal relationships with other peasants or by hiring seasonal labor. A peasant's ability to harvest surplus grain was restricted by their social contacts while the aristocrat was limited only by the supply of seasonal labor and by the ability to pay the workers. Prior to the industrialization of agriculture, armies of migrating harvesters could be found in all large-scale, agricultural societies (Shaw 2013, 1–23). Furthermore, an experienced harvester, as most migrant laborers would have been, can cut about two-thirds more grain in a day than a novice (Palladius, 7.2), so the wealthy have access not only to more labor, but to better labor as well. In this context, surplus grain production is not a good strategy for a peasant household.

Vegetables, on the other hand, are perfectly suited to peasant economies. The cultivation of vegetables requires little land and no expensive equipment, but it does require a great deal of the peasant's chief asset: labor. Apuleius even makes a point of emphasizing the contrast between the hard working market gardener and his lazy donkey. Vegetables are also harvested throughout the growing season, spreading the demand for labor. Finally, vegetables cannot be stored, removing an important competitive advantage of the well-to-do. The deduction that small-holders would have been better off cultivation gardens than fields for

[5] This in itself integrates the peasant into the larger economy through participation in the Roman monetary system. I do not mean to suggest that cities' integrative roles were of secondary importance to historians, merely that the peasants visiting cities were probably more concerned with local affairs than their position within a larger economic and political network.

market is borne out by the literary evidence: whenever peasants appear selling goods in town they sell vegetables (Erdkamp 2005, 134–137).

1.2.2 The means and ends of peasant households

Peasant households are defined by their goals and the means at their disposal for achieving those goals. Unlike capitalist firms, the goal of the peasant household is not material gain but biological and social well-being. This does not imply that peasants did not seek out profits, merely that material acquisition was put to use for social and biological ends (Erdkamp 2005, 95–105; Grey 2011; Polanyi 1944, 45–58; Wickham 2005, 535–539). Unlike elites, who may share the goal of biological and social well-being (Finley 1999, 108–110; Kehoe 1989), the peasant household relies on the labor of its members to support to achieve its goals. Peasants usually employ that labor in the cultivation of crops and animals under their own direction (Wickham 2005, 259–261, 386; cf. Erdkamp 2005, 61–79 who is less concerned than Wickham about who makes decisions about cultivation; Horden and Purcell 2000, 270–278 critique both the notion of "subsistence" and the degree of self-determination usually attributed to peasants). Peasants may own or rent the land they work and may be engaged in production for market or wage labor to a variable extent, but the most important resource they control is their own labor. Large-scale landowners' most important resource is capital in the form of land, equipment (including animals, slaves and employees), and money; their labor is invested in managing that capital.[6] Of course, the lines between the peasant household, the elite household, and the capitalist firm may blur in practice, but for a theoretical reconstruction of economic strategies it is essential to define a category by the ends and means available. This also serves to distinguish the peasant household from more familiar units of analysis: the firm of classical economic theory and the elite household at the center of the ancient literary tradition.

In order to achieve the primary goal of biological and social subsistence, the household must consume goods. Secondary goals of the household, then, will be to maintain or increase the security of the households' access to the required goods as well as the quantity and quality of those goods. The goal of securing consistent access to goods generally took precedence over increasing the quantity and quality of consumed goods and a great deal of—if not most—ancient economic practices can be explained as a response to the constant risk of food shortage (Garnsey 1988; Horden and Purcell 2000, 175–230; Kehoe 1989). Horden and Purcell famously summarized the three basic responses to risk as "diversify, store, redistribute" (Horden and Purcell 2000, 175).

Money based market exchange is one mode of redistribution that is particularly flexible in that goods are easily converted into other types of goods or services. This allows for specialization, more efficient use of labor, and increased per-capita production. For this reason, market engagement has been associated with economic development and increased standards of living. It has even been argued recently that market integration may have allowed the Roman

[6] The wealth of the elites could serve as a buffer against shortfall, potentially allowing them to take greater risks than peasants. This certainly occurred, but there were cultural taboos that discouraged speculative investment. As my focus is on non-elites, I will not enter into a discussion about the actual effect of these taboos (Vivenza 2012 provides a recent overview with literature).

economy to escape the Malthusian "low-equilibrium trap" (Erdkamp 2015). The link between market engagement, economic growth, and well-being, however, has been challenged as a product of neo-liberalism (Hobson 2014). It is important, therefore, to think carefully about the nature and consequences of peasant market engagement.

For a peasant household with very little land, the existence of a market might allow investment in producing labor-intensive, high-value food that could be converted to staples. Conversely, the conversion of staples to luxuries would allow a peasant household to improve its social standing through consumption or redistribution. Peasants could also sell their labor during slack periods. The money acquired through market exchange of goods or labor could be used to acquire needed goods or services, to discharge social obligations (paying rents or taxes) or as a store of wealth. This store can help to buffer against the risk of production failures and can also be accumulated over time for large scale expenses. Markets that are integrated into long-distance trade networks provide access to a wide range of goods produced elsewhere.

The risks of market engagement increase with the degree of dependence on the market. Because exchange is based on mutual utility rather than social obligations, the availability of goods is dependent not only on their successful production, but on the willingness of the producer to exchange them for something the consumer has. A shortage of required goods is disastrous in any redistributive situation, but in a market situation, a glut can be equally disastrous. Market exchange can also lead to relations of domination. A single, large-scale consumer who buys from many producers has a great deal of power in setting the terms of exchange, especially when those producers are dependent on the exchange for their livelihood. This is equally true when there is a single, powerful producer and many, dependent consumers. Market engagement, then, cannot be automatically assumed to be beneficial. The market conditions and the balance of power are crucial considerations.

In the face of unfavorable market conditions, a producer can either sell and suffer, invest in storage and wait for conditions to improve, or invest in transportation and seek out better conditions elsewhere. Storage is not always an option: the required infrastructure may be too expensive, the produce may be perishable, or the need of the seller may be immediate. In regions where market places are widely dispersed, transport may be equally difficult. Where market places are more densely clustered, however, a peasant who does not have the capital to invest in storage facilities might have the time and labor to invest in transportation. The geography of a market system, then, significantly influences the power dynamics and the opportunities available to small-scale rural agriculturalists (Bekker-Nielsen 1989).

Modern economic geographers have devised several models that relate the spatial distribution of settlement to overarching economic processes (Haggett 1966; Smith 1976). These models are based on modern settlement patterns which are known to be complete, and so can only be applied to archaeological settlement patterns with caution, but much of the underlying logic is valuable. Cities that compete with one another for territory (administrative or economic) and are roughly equal in power will tend to be spaced regularly across the landscape. The most efficient pattern is a hexagonal lattice, with cities roughly a day's journey apart. This is because the people in their hinterlands will try not to spend the night away from

home, a prospect both risky and potentially expensive. Thus, the most distant part of a city's territory will be half-a-day's journey away. If the people in the countryside travel exclusively to one city, more of them will live close to that city. If, on the other hand, the rural inhabitants travel to multiple cities regularly they will tend to live near the territorial borders, all other things being equal.

On the Roman frontier, however, forts and their associated *vici* and *canabae* could have fulfilled the marketing function normally associated with cities. Unlike an urban agglomeration that emerges spontaneously, the location of a fort is not the result of long-term competition, but of a single event in which a representative of the Roman state decided the location. The reasons for this decision will have been tactical as well as economic (Karavas 2005; Sommer 2009). The spacing of forts, then, could be much closer than expected from ordinary cities. Under normal conditions of urbanization, someone wishing to do business in multiple cities would have to live about a half-day's travel from any one city. The zone in which such a person could live would be relatively narrow. On the frontier, on the other hand, if the forts were packed more closely together the zone with access to multiple centers would be significantly wider. Therefore, the Roman frontier could have offered greater economic opportunity to people in the countryside than a mature urban system. If it did we would expect to find rural settlements in locations that maximize access to military communities.

1.3 Roman Frontiers and Roman Economies: Scales and Modalities of exchange

1.3.1 Roman Economies

The scale and nature of the ancient economy has exercised historians for well over a century, but the debate has recently entered a new phase (Hobson 2014 criticizes the terms of the current debate; a detailed history of the debate is provided by Morris and Manning 2010; Saller 2002; Scheidel, Morris, and Saller 2007 is a recent overview of the ancient Mediterranean; Scheidel 2012 is a recent overview of the Roman economy specifically). The current tendency is to reject the validity of universalizing paradigms and to adopt a more inductive approach that is guided by economic theory, particularly by the New Institutional Economics (NIE) (this is the strategy behind the Oxford Roman Economy Project as described in the introduction to A. K. Bowman and Wilson 2009; Jongman 2014 discusses how economic theory shapes the questions that we ask; Evers 2011 has applied this approach with great profit to the Vindolanda tablets; Morris, Saller, and Scheidel 2007; Temin 2013, x). With greater attention being paid to the constituent parts of the economy, some new ways to think about the economy as a whole have also emerged.

David Mattingly has recently proposed a three-tiered model of the Roman economy (D. J. Mattingly 2011, 138–40). He identifies an imperial economy that embraces all the extraction and redistribution of resources overseen by the imperial state. Taxation, military salaries, and official military supplies would fall into this category. Mattingly's second tier is the extraprovincial economy, which includes market driven interregional traffic across customs zones. The distribution of terra sigillata and other table wares, wine, and olive oil, when not directed by the state, fall into this category. Distinguishing the imperial economy from the extraprovincial economy is sometimes difficult for modern historians, but the laws giving tax

immunity to goods transported under state contract prove it was possible in Antiquity—the laws punishing shippers who abused these exemptions prove it was difficult in practice (D. J. Mattingly 2011, 139).[7] Mattingly's final category, the provincial economy, consists of the network of local markets within a customs zone "even where these were in part at least a response to the pressures/demands of the imperial economy"(D. J. Mattingly 2011, 140). Though Mattingly does not discuss it, the distinction between imperial and provincial economy is blurred because state-controlled redistribution of goods often occurred within provincial boundaries. Indeed, Mattingly's model is somewhat confused because the first category, the imperial economy, is defined by the nature of exchange (state-controlled redistribution) while the other two categories are defined by the distance over which the exchange takes place.

Kasper Grønlund Evers has recently proposed a more satisfying model. Evers also identifies three different spatial scales (or "levels," in his terminology): imperial (extraprovincial in Mattingly's terms), intra-provincial (provincial to Mattingly), and local (Evers 2011, 44–45). In addition, however, he sees these as intersecting with Polanyi's three modes (or "layers") of economic activity: market exchange, redistribution, and reciprocity (Evers 2011, 42–44). Distinguishing the spatial scale of economic activity from the modality of exchange allows for greater analytical clarity. The prevalence of monetized market exchange is now recognized as a distinctive characteristic of the Roman economy (Erdkamp 2005; Harris 2006; Howgego 1992; Howgego 2013; Jongman 2007; P. Kay 2014; Kehoe 2007; Lo Cascio 2007b; Morley 2007; Scheidel, Morris, and Saller 2007, 8; Temin 2001; Temin 2013; von Reden 2012). Market exchange is distinguished from other types of exchange by its social ephemerality; ideally, neither party to the exchange incurs a social obligation to the other. This can be simultaneously liberating and destabilizing (Aarts 2005; Morgan 2010; Sillitoe 2006). The fascinating result of Evers' analysis of the Vindolanda tablets is to show how intertwined the different modalities of exchange were in practice. State redistribution relied on market exchange not only to transport goods but also to convert state-owned goods to cash and cash to the required supplies (Evers 2011, 25–33).

For a peasant households, cities and small towns were places where the different scales of the Roman economy intersected. In the local economy, these centers were places where rural produce was transferred to a second party, whether through redistribution or market exchange (Bintliff 2002, 218–224). Simultaneoulsy, they acted as nodes in intraprovincial and, for the cities, interprovincial exchange networks. The goods that travelled along these networks entered local economies in the same places where local goods entered the intra- and interprovincial economies: small towns and cities (Bintliff 2002 synthesizes twentieth century scholarship on the economics of Greek and Roman urban networks; see Hohenberg and Lees 1995, 45–73 for different models of pre-modern urban systems and the roles of central places at different spatial scales; Morley 1996 for the urban network of central Italy centered on Rome).

[7] The debate about the distribution mechanism for Baetican olive oil can be understood as a question of the categorization of this traffic as part of the imperial or extraprovincial economy (Remesal Rodríguez 1986; Remesal Rodriguez 2002; Funari 2002; Lo Cascio 2007a).

1.3.2 Frontier Economies

The most important mechanism by which the imperial network of relations was brought into being and maintained was the Roman army. The threat and performance of acts of spectacular destruction discouraged organized resistance and irregular acts of small-scale brutality inflicted by soldiers on civilians served to reinforce Roman dominance (Campbell 2002; Isaac 2002; MacMullen 1990b). Simultaneously, the opportunities for social and material advancement offered to elites encouraged collaboration (for the role of the army in suppressing local unrest see Isaac 1990, 101–160). The army also served as an avenue of social and material advancement for non-elites through the opportunity of enlistment (Haynes 2013). Roman soldiers earned a salary and, at the end of a long period of service, a discharge bonus and the legal benefits of citizenship (Greene 2015 suggests the rewards granted upon retirement should be seen as a primary reason for enlistment).

Roman frontiers were heavily garrisoned, creating a massive source of demand which the imperial government undertook to meet, at least in part. Military demand can be divided between official demand—the basic rations and equipment that the government undertook to supply—and unofficial demand—that of soldiers for supplements to their rations and the demand of all those who were not entitled to state support. The official demand would have been most efficiently met by a relatively small number of large-scale transactions while unofficial demand would have to be met by many small-scale transactions. In order to understand the impact of these different types of demand on the local population it would be helpful to know the scale of the demand, how much was met from production by the military community, how the remainder was collected, and from whom.

1.3.2.1 Scale of demand

There have been numerous attempts to estimate the scale of official military demand for food and equipment (Cherry 2007, 728–729 reviews several estimates; as does Kehne 2007; Kooistra et al. 2013 and; Marieke van Dinter et al. 2014 are the most recent attempt; Rathbone 2007 doubts the utility of quantitative estimates; Roth 1999 is the most detailed analysis of the problem). For the present purposes, it is enough to say that the scale of demand was large, but the distribution of troops in military bases smaller than a legion distributed the demand. Whether imports from outside the region were necessary depended on the agricultural quality of the land in the frontier zone and the ability of the population to cultivate it. A recent model suggests that even in the lower Rhine, where the agricultural conditions are poor and the importation of grain has been demonstrated archaeologically, the local population could have produced about half the grain needed for the region's military community (Kooistra et al. 2013; Marieke van Dinter et al. 2014).[8] The 480 soldiers of a full-strength auxiliary cohort could have

[8] This model assumes that 200 kg of grain sown over one hectare would yield 1000 kilograms (Marieke van Dinter et al. 2014, 45). Roman agronomists generally recommend sowing 200 modii per iugerum, or 135 kilograms per hectare (Goodchild 2013, 69). Retaining the seed to crop ration of 1:5, which may have been low for ancient Italy (Erdkamp 2005, 34–54; Kron 2008), reduces the harvest from 1000 kilograms per hectare to only 675. Indeed, Kehoe estimates that only Egypt attained average yields of 1000 kilograms per hectare and that a more representative figure would be 500 kilograms per hectare (Kehoe 2007, 551). That having been said, average wheat yield in Bulgaria at the beginning of the twentieth century, when the most common type of plow was made of wood and the vast majority of grain was harvested by hand with a sickle, was approximately 1000 kilograms per

consumed the entire grain surplus of sixteen to twenty-three peasant households in a year or fewer if external labor is brought in for the harvest.[9] The official demand for grain, then, was significant but not impossibly high (Kreuz 1999, 91–94 reaches a similar conclusion for the Wetterau in Germany). To this must be added the other items in a soldier's ration as well as the fodder required for the unit's animals. These would compete with grain for land but not for labor as they would be harvested at different times.[10] It is conceivable, then, that most of a unit's official demand was met by a small number of households. If a household had access to external labor at harvest time, it could supply even more of the unit's grain. Just as in the grain supply of towns, supplying grain to the military would be most profitable to large landowners.

The scale of private demand is impossible to model because we have no standard ration figures, but at a broader level, the scale should be determined by the size of the non-soldier population and the amount of disposable income available to the soldiers. Carl Sebastian Sommer has suggested that the population of the vicus was slightly smaller than that of the unit to which it was attached (Sommer 1984, 32–33), or had a population density of around 100 people per hectare (Sommer 1988, 621–622). Carrington has estimated the population of the legionary canabae at Chester using a variety of methods which seem to indicate that the non-combatant population slightly outnumbered the soldiers (Carrington 2012, 373–376) in the area around the fortress. The model estimating the sustainability of the lower Rhine frontier assumes that most forts were not accompanied by a settlement in the earliest phase, but that

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hectare (Timoshenko 1930, 221–223, 230 gives the figure 15.7 bushels per acre, which equals 1056 kilograms per hectare).

The model also assumes that a grown man could harvest 0.25 hectares per day and that the harvest had to be completed in two weeks (Marieke van Dinter et al. 2014, 23, 49). Drawing on the Roman agronomists and harvest contracts from Egypt, Shaw estimates that an expert harvester could reap between 0.167 and 0.188 hectares per day (Shaw 2013, 14–15). Elderly Greek farmers report that, prior to mechanized agriculture, an adult could harvest only about 0.1 hectares per day (Halstead 2014, 102–103). The lower Rhine model, then, may be underestimating labor requirements of harvest by a factor of two. At the same time, the Mediterranean harvest season lasts from four to six weeks, rather than the two assumed in the model (Halstead 2014, 103–104; Shaw 2013, 24).

[9] This model assumes that labor at harvest time is the limiting factor. The relevant figures are as follows: a rural settlement contained on average 3.66 adults who could harvest a maximum of 12.8 hectares, of which 3.3 hectares was required to feed the settlement. The remaining 9.5 hectares probably produced 9,500 kilograms of grain per year. 2,650 kilograms would have been stored for seed leaving 6,850 kg. Each kilogram of grain provides 3,100 kilo-cals of energy and each soldier required about 2,000 kilo-cals of energy from grain each day. Each soldier, then eats 730,000 kilo-Cal = 235.5 kg of grain each year. Thus, each settlement unit could supply grain for almost 30 soldiers per year. An Auxiliary unit of 480 soldiers, then, would require the entire grain surplus of sixteen households. Of course, the actual number of soldiers drawing rations would probably be less than 480, but the actual yield of each household would be uncertain, so some cushion would probably have been required.

Put another way, if an adult man can harvest 3.5 hectares of grain in one season he will produce 3,500 kg of grain, of which 700 kg is required for seed leaving 2,800 kg of grain. This would be enough to feed eleven soldiers and himself, if he consumed only 209.5 kg of grain per year.

This consumption figure for grain, however, does not match official rations recorded in Polybius (6.39.13) of four modii per month = 323.5 kg per year. The production figures given above, then a single man could harvest enough grain to feed eight soldiers if he only consumed 212 kg of grain himself. A household with the equivalent of 3.66 adults could feed 21 soldiers and a cohort of 480 soldiers would require the surplus of 23 households.

These figures make no allowance for spoilage or crop failure and do not include the consumption needs of horses and non-combatants. They represent, therefore, an absolute minimum.

[10] Columella says that the grain harvest follows hay making (2.18.3).

in later phases it was similar to the unit in size (Kooistra et al. 2013; Marieke van Dinter et al. 2014). Thus, the population of a military community can be estimated as approximately twice the size of the unit around which it is based. Actual consumption rates will have been lower, however, as the non-combatant portion of the population will have included more women, children and elderly people.

The amount of disposable income available to soldiers depended on their salaries and the amount that was withheld for official supplies. The amount soldiers were paid in principle is relatively well established (Alston 1994; Speidel 1992; Speidel 2014). Compared to other laborers and the attested subsistence level in Italy, a soldiers' salary was comfortable, but not extravagant (Alston 1995, 105–108; Jongman 2007). Less well known are the more subtle changes to the military system of remuneration. In this respect the most helpful evidence comes from two records of soldiers' accounts: *RMR* 68 (=*P.Gen.Lat.* 1) and *RMR* 70 (=*ChLA* 410), dating to 81 CE and 192 CE respectively. Both happen to record payments soon before a pay-raise. Both documents contain multiple soldiers' accounts and the earlier contains accounts for an entire year.

The soldiers recorded in *RMR* 68 received 247.5 drachmas three times a year. Out of this, they suffered significant deductions of pay and deposited what was left with the bank. In every pay period they were docked for hay (10 drachmas), food (80 drachmas), and boots and foot-wraps (or strappy boots? *Caligas fascias*) (12 drachmas). During the first pay period they were also charged 20 drachmas for the Saturnalia, in the second they were charged 4 drachmas *ad signa*, and in the third they were charged 145 ½ drachmas for clothing. The third paycheck, then, all went back to the unit.[11] In addition, the first pay period contains an unknown charge for one soldier of 60 denarii and for the second soldier a charge of 100 denarii for clothes. At the end of the year the first soldier had made only 207 denarii, or 27.6% of the promised income (assuming he was an auxiliary paid 750 denarii/year). The second made only 167 denarii, or 22.3%. This does not sound like very much, but we must remember that this is all net profit above basic living expenses. If soldiers were frugal, they could save a significant amount of money over their careers. More important for the local economy is the fact that they left their surplus pay on deposit with the camp, so none of this money would exit the imperial economy through private spending. Soon after this account was drawn up, Domitian raised the soldiers' pay and limited the amount of money that could be held in a unit's bank, which must have forced soldiers to take more of their pay in cash (Suetonius *Domitian* 7.3).

RMR 70 was written 111 years after *RMR* 68, so comparisons can only indicate changes at a coarse scale. Soldiers serving in the late second century took most of their salary in cash, the only regular deduction being a *collatio* of four denarii, 22 ½ obols (= 19 ¾ HS). It seems that all soldiers were required to keep 175 denarii on deposit, 75 *in viatico* and 100 *lorictitis*. Apparently, by the end of the second century, soldiers were responsible for supplying themselves with clothes, food, shoes, and other basic supplies. The army may still have produced these things for sale to the soldiers, but the soldiers now had the option of buying them from civilian producers or acquiring them through non-commercial means. Beginning in

[11] 10 + 80 + 12 + 145.5 = 247.5.

the early second century we start to see letters of soldiers asking their family to send supplies like food, clothes, footwear and even weapons, the kinds of things that were supplied to the soldiers in *RMR* 68 in return for reduced pay (Speidel 1992, 97–98; Wierschowski 1984, 112–121). Carol Van-Driel Murray has noticed that, in the second century in Britain, distinctively military shoes disappear, replaced by civilian shoes on military sites. The army, apparently, stopped supplying shoes of its own production and instead made soldiers buy them on their own (van Driel-Murray 1985). A sailor in early first century Alexandria asks his father to send shoes with leather soles (*caligas cori subtalare<s>*) because the shoes he currently uses (*caligae nucleatae*) wear out so fast (*P.Mich.* 468). The letters suggest that this changed in the early second century and we may have oblique reference to it in *HA Hadr.* 10.3 (…ordinatis et officiis et impendiis").

The shift from controlled supply need not have been universal to cause a major shift in the army's economic importance to local producers and craftsmen. As long as the unit arranged for supplies, producers or middlemen who could control large quantities of these supplies were at a distinct advantage through lower transaction costs. When soldiers arranged for their own supplies individually, this advantage disappeared. Transactions with individual soldiers would have been smaller in scale and much more frequent, potentially allowing smaller-scale producers to compete more effectively.

1.3.2.2 Military production

Some of the demand of the military community was met by production from within that community. Evidence for craft production, especially metal working, in and around military forts is ubiquitous (Allison 2013, 289–294). Supplying the crafts and services to the army was a basic function of military *vici* and *canabae* (Carrington 2012, 345; Hanel 2007; Sommer 1997; Sommer 1988, 585–598; Sommer 1984, 34–36) Even within the official redistributive system, however, supply and demand were not always perfectly matched. The Vindolanda tablets record both the sale of surplus boot nails by the army and, at a different time, the purchase of boot nails from a private supplier (Evers 2011, 32). Even things that the army produced might need to be bought. Furthermore, people living near a military base could benefit from military surplus production.

The military community also produced some of its own food, but it is very unlikely that it was self-sufficient. Units owned land that could be used for pasture (Bohec 1994, 219–220; Carrington 2012, 344; Kehne 2007, 329). Soldiers and others in the military communities cultivated gardens, but probably not grain (Allison 2013, 290–291 records a significant number of agricultural tools at Vetera I, but these were found in a workshop, suggesting the army was involved in repair or production of tools but not cultivation; MacMullen 1963, 1–22 collected evidence for soldiers acting as farmers, but only gardening and animal husbandry are attested; Sommer 1988, 598–603 argues that military vici were only engaged in small-scale animal husbandry and gardening). The best evidence for large-scale agriculture in the military community comes from field systems in low-land Britain that may have Roman origins and that may take their orientation from the street grid of a nearby military settlement (Sommer 1984, 36–38; J. L. Davies 2002, 193 notes a few other places in Britain where agriculture might be attested around military bases).

1.3.2.3 Modalities of acquisition

How the state acquired the resources necessary to meet this demand, whether by taxation and requisition, forced purchase at a fixed price, or voluntary purchase at a negotiated price, is the subject of much debate (Adams 1999; Breeze 2000; Erdkamp 2002; Lo Cascio 2007a; Roth 1999; Papi and Bonifay 2007; Whittaker 2004, 14–15). Evers' analysis of the Vindolanda tablets has led him to conclude that the supplies obtained by the government could be acquired through one of two systems: one in which military personnel are completely responsible for acquiring supplies through unknown means and the other in which the military provides money and information about demand and entrepreneurs arrange for the supply through market channels (Evers 2011, 32). It would be valuable, however, to understand which was more common and how the military dominated system acquired goods, since the way in which the demands of the army and its soldiers were satisfied determines the nature of the impact on the people who produced the required goods and services. If supplies were purchased at a price set according to market principles, producers had the opportunity to profit significantly from the presence of the army, whether the purchaser is a soldier or an entrepreneur. If the price was set according to other mechanisms, the profit to the producer is less certain, but still possible. If, on the other hand, supplies were acquired through requisition—either legal or illegal—the producer will not have profited at all and may have suffered.

It is very difficult to reconstruct a "normal" system of supply because the evidence reveals remarkable fluidity and flexibility. Finding clear evidence that tax grain was used to supply the army in peacetime is surprisingly difficult.[12] We have evidence (contra Whittaker 2004, 14) that grain was collected as tax (Josephus *AJ* 14.202-6, Tacitus *Ann.* 4.6, Tacitus *Agr.* 31.2, *AE* 1948, 109, Ps. Hyginus *Constitutio Limitum* L 205-6), that grain was collected by imperial officials through unspecified mechanisms (Pliny *Ep*. 10.27, Tacitus *Agr.* 19.4), and that officials were supposed to deliver grain to troops (Dio 60.24.5, Tac. *Hist* 3.8.2). Some of the grain came from imperial estates (*P.Dur* 64 = *RMR* 91, *P. Oxy* IV 735 = *RMR* 81), but we also have evidence of officials buying grain and other supplies, probably through forced sale (*Dig.* 39.4.4.1 under Hadrian, *Speidel* 1981b = Campbell no. 238 in second or third century, *P. Amh* 107 = Campbell no. 235 in 185 CE, *P.Lond* 482 = *RMR* no. 80 in 130, *Sel Pap 2* no. 395 = Campbell no. 239 in 138).[13] The best evidence that soldiers ate grain from in-kind taxation is an

[12] Colin Adams has argued, based on Egyptian papyri, that the supply of grain was organized through centralized taxation (Adams 1999). He illustrates the model using a receipt addressed to the strategos of the Hermopolite nome and issued by a *duplicarius* of an *ala* confirming that a certain village had produced their allotted portion of the grain ordered by the Egyptian prefect. The exact clause that modifies the total amount of grain is "which was ordered by the illustrious prefect Longaius Rufus *to be bought up* out of the produce…" (P.Ahm. 107 = Hunt and Edgar 1934 II, no. 387). Adams renders the Italicized portion as "to be brought up" (Adams 1999, 120), but the verb is *συνωνηθῆναι* clearly indicates a purchase (Liddell et al. 1996 s.v. "συνωνέομαι"). The verb is translated correctly in *Select Papyri* II (Hunt and Edgar 1934 II, no. 387) and in Brian Campbell's source book on the Roman army (Campbell 1994 no. 235). Although there is no mention of money changing hands in this document, the transaction is part of a monetary transaction. Adams' arguments about the involvement of the provincial bureaucracy stand, but this document cannot be used as evidence for the use of grain from in-kind taxation to feed the troops.

[13] It may be significant that none of these documents refer specifically to wheat. *Dig.* 39.4.4.1 is not specific, Campbell no. 238 concerns wooden spears, no. 235 concerns barley, *RMR* no. 80 is issued to hay contractors, and Campbell no. 239 concerns clothes.

ostracon dating from second quarter of the first century CE (*O. Petr.* 245) on which a soldier acknowledged receipt of one load of "public wheat" from a private transportation contractor (Adams 1995).[14] Even here there is uncertainty about the mode of acquisition as the phrase "*πυροῦ δημοσίου*" specifies the owner of the grain but not how it was acquired. It has been interpreted as payment in kind for the lease of public land (Adams 1995, 121) but there is no way to be sure. For the purposes of the people issuing the receipts on which so much of our evidence is based, the means by which the state acquired its grain was inconsequential. For the producers, the difference between tax and rent may have mattered little, but the difference between getting paid, even if it was below market price, and getting nothing must have been important.

The line between forced purchase and taxation or requisition without payment was sometimes blurred, but it always existed in theory. In Pliny's panegyric to Trajan he says "*emit fiscus quidquid videtur emere,*" which means that the fisc actually bought what it appeared to buy. This passage has been taken as evidence that forced purchase was little different from unrecompensed requisition in practice (Erdkamp 2002), but the second half of the sentence suggests that purchase was the norm; a "bad emperor" may commandeer goods for the army, but he had to do so under the guise of purchase. Recompense, then, was normal and outright confiscation was a transgression. These were not free market exchanges, for Pliny goes on to specify that, under Trajan, seller and buyer agreed on a price (*de qua inter licentem vendentemque conveniat*). Confiscation was possible, forced purchase was normal, and consensual purchase was remarkable, the mark of an exceptional emperor. While some authors assume the prices paid during forced purchase were unfair (Erdkamp 2002; Garnsey and Saller 1987; Alston 1995; Kehne 2007), others argue that they were generally in line with market prices and could even exceed them (Rathbone 2007; Breeze 1984).

Even if military demand was met through requisition, there is no good reason to think that people living close to military bases would have felt the burden of imperial taxation more keenly than others. First, basic supplies could come from very long distances, as in *P.Amh* 107, where a soldier from a unit in Coptos collects grain from a village in the Hermopolite nome 300 kilometers away (Adams 1999). The papyrus known as "Hunt's *pridianum*" records the absence of soldiers from a unit in Moesia who are in Gaul collecting clothes and grain (*RMR* no. 63). The closest sources were not necessarily the first to be tapped.

Furthermore, the tax burden experienced by individuals had as much to do with local social status as with centrally determined tax rates. Walter Scheidel has recently estimated

[14] There is much clearer evidence that soldiers ate tax-grain in the Late Roman period. *CTh* 11.1.11 (365 CE): "The payments of taxes in kind shall be conveyed to the frontier in accordance with the situation and proximity of the landholdings. This order takes effect without difficulty, if the registrars through fear of ever-present torture may be kept from their customary fraudulent practices." An example of these practices can be found in *CTh 11.1.22* (386): "Inland municipalities were formerly burdened with the tax payments of maritime municipalities, and maritime municipalities with the tax payments of inland municipalities so that the transportation caused more expense than the payment of taxes. By this law We prohibit such practice, not only for the present but also for the future, so that those persons who commit this misdeed shall know that they will be punished with the extreme penalty." (tr. Pharr 1952). The manipulation of collection points for profit is known even in the late Republic and early Empire (Cicero, *In Verrem* 3.190; Tacitus, *Agricola* 19.4).

Roman state expenditure, revenue from direct taxes, and revenue from indirect taxes and found that, even allowing for the imprecision of the figures, much more was assessed than was spent. At the same time, to judge from the extraordinary measures taken in times of increased expenditure, there was very little slack in the system. He concludes that only a modest portion of the direct taxes collected reached the central government and that indirect taxes furnished a larger portion of total state revenue than hitherto appreciated (Scheidel 2015). Official rates of direct taxation gave tax payers a way to defend themselves from extortionate collectors and gave the government a general idea of how much revenue to expect. This imprecision allowed ample opportunity for tax payers and collectors alike to manipulate the system (MacMullen 1987).

To understand how Rome's various subjects experienced taxation, a brief description of the processes of assessment and collection is necessary. During the principate, direct taxes were assessed through irregular provincial censuses overseen by a governor but probably carried out by municipal magistrates or liturgists (Brunt 1990, 329–335). After the third century, the imperial state became more and more involved in all aspects of the process, but many features of the system, including the ultimate devolution of responsibility onto local elites, remained the same.[15] The opportunities for local elites to under-assess their own and their friends' properties and making up the deficit through over-assessment of others were obviously enormous. When the imperial government became more involved in taxation, laws were passed to address the problem making it visible to historians.[16]

Based on this assessment, the governor calculated a payment for each municipality in the province. Local civic officials were responsible for collecting taxes from their citizens and they did this either through liturgies or by contracting with *publicani*. In either case, the tax collector was held responsible for the debt regardless of how much they actually collected (Brunt 1990, 339–343, 354–432). Both liturgist and publican would have had a very strong incentive to maximize the amount they extracted from tax payers, to take bribes from those who could afford them and, for the liturgists at least, to distribute favors in the form of lax collection (Brunt 1990, 342–343; Corbier 2005, 370–373; MacMullen 1987). Tax payers, in turn,

[15] The literature on Late Roman taxation is vast (e.g. Corbier 2005; Goffart 1974; Grey 2007; Grey 2011, 189–197; A. H. M. Jones 1964, 411–469). While there were significant changes under Diocletian and his successors, the legal evidence that resulted from these can be useful in understanding the experience of paying and collecting taxes in the Principate. In this regard, MacMullen notes "Over some period before the *incipit* of the Theodosian Code…the deflection of tax pressure from intended groups and levels of taxpayer had thus become a noticeable political problem…" (MacMullen 1987, 747). It is possible that, prior to the fourth century, euergetically minded elites were shouldering their fair share of the burden, but I think it is much more likely that the deflection of tax pressure was not the state's problem until it took over tax-collection.

[16] E.g. *CTh* 13.10.1, issued 313 CE: "Since the registrars of the municipalities through collusion are transferring the burden of the taxes of the more powerful men to persons of inferior status, We command that if any person should prove that he has been thus oppressed, he shall assume only his original tax declaration." Also *CTh* 11.16.3 (325 CE: "Whenever it is necessary for a tax assessment to be made, the assessment of each municipality shall be made in accordance with the plans and regulation of the governor, so that the multitude of lower classes may not be subjected to the wantonness and subordinated to the interests of the more powerful and thus suffer the infliction of grave and iniquitous outrages." (tr. Pharr 1952). *CTh* 13.10.8 (383 CE) sentences registrars caught granting fraudulent tax exemptions to be burned to death.

avoided payment by bribing the tax collector,[17] defying him if they were powerful enough,[18] and by seeking the protection of a patron[19] or simply fleeing[20] if they were poor. The amount a person paid in taxes, then, depended heavily on their wealth, social status, ability to enlist the services of a patron, and relationship to the tax collector.

Peasants living near forts could have had the opportunity to cultivate officers as patrons. Libanius complains bitterly about villages which purchase the protection of the soldiers billeted therein and take advantage of their patrons' status to abuse neighboring villages and refuse to pay taxes (*Or.* 47, 3-12). In this way, peasants living near forts who cultivated good relations with the local soldiers and officers, could have experienced a lighter tax burden than people living far from the frontier. The key is the successful integration of soldiers into local life.

The acquisition of basic military supplies, primarily grain, took place in a number of ways. While much of the grain eaten by the troops must have been acquired through redistributive mechanisms—whether as rent from imperial estates or taxes—there are numerous instances of producers being paid as well. Even when the grain was extracted through taxation, however, there is no reason to think that the people living in the frontier zone suffered disproportionately. Indeed, some could have been relatively immune from tax collections because of the patronage of the local garrison. While only a single instance of this relationship is attested, we must entertain the possibility that it existed elsewhere and so cannot assume that people living near soldiers were victimized by them.

1.3.2.4 Suppliers

The number and the social context of producers is as important as the modality of acquisition. If a few people produced large surpluses to meet military demand then they would profit or suffer hugely while everyone else would be little affected. If the demand were spread more evenly, the impacts would be less intensely but more extensively felt. These impacts, both positive and negative, would also spread through social networks to influence the people with whom the producers interacted. The economic impact of the army could have been very intense, but limited in scope to people who were intimately connected to the institution, either

[17] *CTh* 11.11.1 (368, 370 or 373 CE) establishes penalties for both bureaucrats who accept bribes and tax payers who give them.

[18] *CTh* 11.7.16 (401 CE) responds to the problem of high ranking tax payers defying the authority of low ranking collectors: "We also come to the assistance of the judges and their office staffs to the extent that they shall have the right to exercise their authority against contumacious delinquent taxpayers of whatsoever high rank they may be." Almost twenty year earlier, the emperors had tried to solve the problem making the statuses of collector and payer more equal with *CTh* 11.7.12 (383 CE): "The office of the governor of the province must collect the taxes of the houses of the more powerful landholders, but decurions shall demand payment of decurions; more-over, the defenders of the municipalities, with approved fidelity, shall compel the smaller landholders to make payment of their fiscal dues." (tr. Pharr 1952). The former edict, giving authority to collectors over people of higher rank, is a concerted effort to raise tax revenue quickly while avoiding the use of the soldiers to collect it.

[19] *CTh* 11.24.1-6 (issued 360 – 415 CE), headed "*De Patrociniis Vicorum*" establishes penalties for people of high rank who take individual farmers or even whole villages under their protection. While the state is concerned with the loss of tax revenue, the farmers and patrons had much more complex reasons for entering in to this type of relationship (Grey 2011, 160–161, 206–213). If the purpose of this patron-client relationship was not actually to evade taxes then there is no reason to think that it was an innovation of the fourth century.

[20] Flight is attested throughout antiquity (Grey 2011, 217–218 n. 69 for literature).

as soldiers and their families or as merchants and craftsmen who traded almost exclusively with others in the military community. In this case there must have existed a large number of people for whom the presence of the army was of little importance.

Unfortunately, it is much easier to find evidence for middle-men who connected military demand to supply than it is to find evidence for the producers (Whittaker 2004, 15–16). The geographic distribution of epitaphs and toponyms in the Vindolanda tablets show that these *negotiatores* operated at a provincial and inter-provincial scale, it is not clear whether they acted at a local scale as well (Verboeven 2007, 304; Evers 2011, 42–46). The extent to which their livelihoods depended on military contracts is also unclear. Most of the scholarship on long-distance army supplies has focused on the involvement of the state in directing it (Funari 2002; Remesal Rodríguez 1986; Remesal Rodriguez 2002; Whittaker 1994; Lo Cascio 2007a). For our present purposes, it is enough that these supply-routes existed and that the military communities were not entirely dependent on locals.

The source of supplies for the military communities is surprisingly difficult to establish with certainty. In general, frontier provinces seem to have prospered during the principate (Cherry 2007; Bender and Wolff 1994). More detailed examination of specific frontier zones, however, reveals a more inconsistent picture. The best studied western frontier zones are those of Britain, the Rhine and North Africa and each paints a different picture. In Britain, indicators of prosperity are concentrated in the southeast while the frontier zones seem impoverished (D. Mattingly and Orejas 2009; D. J. Mattingly 2006, 174–175, 494–499). Agricultural production in Roman North Africa expanded greatly, but this could have been due to demand from Rome rather than the frontier army (Cherry 1998, 148–150). It is easier to argue for economic stimulus on the Rhine frontier. Intensive excavations of rural settlement in the Netherlands has demonstrated increased surplus production of both crops and animals that was very likely, but not certainly stimulated by the presence of the army (Maaike Groot 2008; M. Groot et al. 2009). In the area between the upper Rhine and the upper Danube, the advance of the frontier was followed by a rapid growth of rural settlement which was probably engaged in supplying the army (Kreuz 1999; Sommer 1999b; Sommer 1999a; Sommer 2011; Sommer 2013). In short, the suppliers of the British army lived far from the frontier, the suppliers of the Rhine army lived closer to the frontier, and the suppliers of the African army did so almost as a by-product of their export-oriented production.

1.4 Military communities

The idea that military communities contained not only soldiers but their slaves, families and other traders and craftspeople who made their living off the soldiers' salaries is well established (Allison 2013, 12–32 summarizes the literature; Goldsworthy and Haynes 1999; D. J. Mattingly 2006, 87–254). The soldiers were closely integrated with non-combatants to such an extent that even the spatial divisions between intra- and extra-mural are losing significance (Allison 2013, 31). The terms "garrison settlement" (D. J. Mattingly 2006, 171) and "military base" (S. James 2011, 171–172) capture the unity of this type settlement much better than "fort and vicus" or "fortress and canabae." The distinction between soldier and civilian was important (Eck 2014; Potter 2011; Speidel 2012), but these labels are inadequate to describe the various social groups that existed on the frontier. The military community included soldiers,

their dependents, and all those who depended on the army for their livelihood. It is the nature of the relationship between the military community and outsiders, not the relationship between soldiers and civilians, which is the object of this investigation.

In many ways, military bases resembled ancient towns: each had a concentrated population of diverse specialists and the social processes of market exchange, craft production, administration and adjudication of disputes all occurred inside them.[21] The parallel between urban-based garrisons in the East and garrison settlements in the West that look like cities has led to the conclusion that these garrison communities operated as cities in regional and imperial contexts (Adams 2007c, 230; Mladenović 2012, 53). It is not at all obvious, though, that garrison settlements were "urban" in the same way as the old cities that existed prior to Roman conquest. What has been termed "the ancient city" is characterized by a legal and traditional relationship between urban core and rural periphery (Finley 1981; Rich and Wallace-Hadrill 1992; Whittaker 1995; see section 1.2.1 for the role of urban centers in local economies). Garrison settlements had no traditional relationship to their surroundings. They existed because of the army, their inhabitants relied on soldiers and traders attracted by the soldiers' salaries for their livelihood. Every army base was part of a massive, far-flung network through which goods, money, information, and people flowed, both with and without imperial sanction. The non-combatant inhabitants could also tap into this system to satisfy some of the needs normally provided to urbanites by nearby peasants. In this way Roman army bases may have been important nodes in interprovincial and intraprovincial economies without necessarily interacting with local economies.[22]

Investigations into the local integration of military communities have yielded mixed results. The best evidence that a garrison settlement was integrated into the local economy is its survival after the departure of the soldiers. In lowland Britain, the abandonment of a fort was usually followed by the emergence of a town, but in the northern highlands and in Wales, this almost never happened (Sommer 1984, 50–51; J. L. Davies 2002, 190–192; rates of coin loss in the canabae at Chester, however, show that the economic fortunes of the non-combatants was not entirely dependent on the size of the resident garrison Carrington 2012). In Germania Superior and Raetia, around half of the garrison settlements survived after the troops had left (Sommer 1988, 627–637). Integration may also be demonstrated by the clustering of rural habitation around garrison settlements. This pattern has been observed around legionary bases at Chester (Carrington 2012) and Novae (Conrad 2006) and around auxiliary bases in Dacia (Oltean 2007, 177), but this type of spatial approach is unfortunately rare. Much more common

[21] Craft production and marketing, whether in a market place or in strip houses, have been attested at canabae and vici wherever troops were not stationed in cities including North Africa (D. J. Mattingly 1994, 218–222) Britain (Carrington 2012; J. L. Davies 2002; Sommer 1984), the Germania Inferior (Enckevort 2004; Willems 1986; Vos 2009), the Germania Superior and Raetia (Sommer 1988, 589–598), Noricum (Flynt 2005), Pannonia (Fitz 1980; Mócsy 1974), Moesia Superior (Mladenović 2012; Mócsy 1974), and Dacia (Benea 1995; Oltean 2007, 155–164). The evidence from Moesia Inferior will be discussed below (section 2.8). For administration and justice, the best evidence is documentary, most of which comes from Egypt (Alston 1995).

[22] The parallel breaks down inside the settlement as well. While soldier and civilian were closely integrated in garrison settlements, Pollard has demonstrated that the urban garrisons in Syria were generally isolated from the civilian population (Pollard 2000, 111–167).

is a comparison of the material culture assemblages from rural and military sites. In most of Britain, the comparison shows that rural and military sites were isolated (D. J. Mattingly 2006, 174–175, 494–499; D. Mattingly and Orejas 2009; Higham 1989; J. Taylor 2013, 427), but around Chester, the assemblages from rural sites are more similar to that from the garrison settlement (Carrington 2012). Interestingly, the architecture of these sites is not Roman at all. This combination of Roman material culture and native architecture is also observed in the Batavian area of the Lower Rhine (Heeren 2014; cf. Bloemers 1983), demonstrating the inadequacy of architecture alone as a cultural marker.

The actual social networks of soldiers can be partially revealed through documentary evidence. Saller and Shaw used epitaphs to argue that in contrast to civilians, soldiers were more likely to be commemorated by a comrade than a family member, though the pattern was more pronounced in Rome, Britain and the German provinces than in Noricum, the Pannonias, Spain and Africa (Saller and Shaw 1984). The marriage of soldiers and veterans indicates integration with non-combatants, but it is not clear that it indicates integration with the non-military community as defined above. David Cherry's study of the African evidence showed that soldiers in frontier zones very rarely had wives with non-Roman names, suggesting institutional endogamy within the military community (Cherry 1998, 119–134). Elizabeth Greene has recently examined marriage patterns as attested in the ever increasing corpus of military diplomas and come to similar conclusions: soldiers generally married the relatives of other soldiers or women from their own tribe. When they did marry someone from the region where they served, she usually joined the military community rather than bringing her husband into the local community (Greene 2015; Phang 2001 is the standard work on Roman soldiers' marriages).

Richard Alston has used personal archives from the Fayyum to show that many of the friends and families of soldiers bore Egyptian names (Alston 1999). He takes this to be evidence for the close integration of military and non-military communities in Roman Egypt. The archives on which he draws, however, come overwhelmingly from the northeastern corner of the Fayyum, a region with an exceptionally high concentration of soldiers and veterans (Alston 1995, 39). Rather than demonstrating the integration of military and non-military communities, then, Alston's evidence could indicate the existence of a military community in a place that did not have a garrison. In order to establish the boundedness of this community it would be necessary to reconstruct social networks of many villages in the Fayyum, not just those that have evidence for military ties.

If the villages in the northeastern part of the Fayyum had a tradition of sending sons to the army who maintained social ties with their home while other villages did not, then the former should be seen as part of an extended military community. The Batavians represent the best-known such community. Their tradition of entering the army began as a treaty relationship, but even after the revolt of 69 CE negated that treaty, Batavians continued to supply recruits to "their" units (van Driel-Murray 2003; van Driel-Murray 2009). The Batavian tradition of military service profoundly shaped the structure of their society (van Driel-Murray 2008). Similar communities may have existed in Thrace, considering the large number of Thracian auxiliary units and Thracian soldiers known epigraphically (Zahariade 2009). For

recruits from these groups, enlistment may have felt more like a rite of passage or a change of status than assimilation into a new community.

If one includes not only those who lived in garrison settlements, but also families or groups with a strong tradition of military service and merchants who relied on military contracts for their livelihood, the military community becomes quite large and geographically dispersed. The integration with non-military communities, then, becomes a question of the social relations between people who have various roles in the military community—soldier, nuclear family, garrison settler, extended military community member, army merchant—and people who do not. It would be interesting to know how important the relationship to the army was for the identity of people in the extended military community and how that shape their relationships, but such an investigation is beyond the scope of this project, which seeks to understand the relationships between the inhabitants of the garrison settlements and their neighbors.

It is possible, however, to investigate the interactions between soldiers and civilians outside the military community as they are portrayed in literary and documentary evidence. These consist for the most part of complaints about soldiers abusing their right to requisition transportation and lodging,[23] "shake-downs" for money,[24] and wanton violence.[25] Complaints about the abuse of the *cursus publicus* are common and concern not only soldiers but anyone on imperial business (Mitchell 1976). The most famous example is an inscription from the village of Scaptopara (*CIL* III, 12336) in which the villages complain that their village is at risk because it has the advantage of hot springs and lies between two camps. They specify that the people demanding hospitality are "people who stay for fifteen days in the place of the festival … soldiers sent elsewhere leaving their proper route … [and] the governors of the province and your procurators." In addition to soldiers, imperial officials and even private citizens attending a nearby market prey upon the village. It is not soldiers per se, but rather travelers of high status who are dangerous (for an exhaustive treatment of this inscriptions, see Hauken 1998, 74–139).

Soldiers demanded bribes, but they were not alone. A second century papyrus listing the expenses of a private Egyptian includes several entries that we would consider extortion (Campbell 1994 no. 297). Interestingly, the owner distinguishes the 2,200 drachmae for extortion (*διασεισμός*) from two payments of 100 drachmas that go to "two police agents" and "Hermias, police agent", and also from the 500 and 400 drachmas which were given "to the soldier at his demand". The *stationarius*, a soldier on guard duty, only received 2 drachmae, 1 obol, which seems too small to be a bribe. The biggest payment for "extortion" is not further specified and though it might be earmarked for soldiers, it could also be intended to bribe a variety of other powerful people. As with requisitions, soldiers were just one of the groups that took bribes.

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[23] E.g. Columella, 1.5.6-7; Pliny, *Ep.* 10.77-78; Epictetus, *Disc.* 4.1.79; *Sel. Pap.* 2, 221 (=Campbell 1994 no. 293); *OGIS* 609 (=Campbell 1994 no. 299); Apuleius, *Met.* 9.39-42; *CIL* III, 12336; Ulpian *Dig.* 1.18.5-6.

[24] E.g. *Luke* 3.14; Tacitus, *Agr.* 19.4; *CIL* III, 14191; *SB* 9207 (=Campbell 1994 no. 297); *P. Oxy* 1.240 (=Campbell 1994 no. 296)

[25] *P. Oxy* 19.2234 (=Campbell 1994 no. 286); Juvenal, *Sat.* 16

The literary record attests to casual brutality by soldiers, but they are not the only culprits. People of superior status could abuse lower-status individuals with relative impunity and the penalty for assault depended heavily on the relative status of the people involved (Isaac 2002; MacMullen 1990a, 190–197, 204–217). Common soldiers had a slightly higher status than non-citizens, but what made their power particularly galling was that they were tried in military court, so they could get away with abusing people who felt themselves to be more honorable (Juvenal, *Sat.* 16). In general, the army gave influence to people outside the traditional aristocracy which naturally led to conflict with the people who created the literary record (Alston 1999, 190–192; Ando 2007). None of this is to deny the violence and abuse that soldiers were capable of inflicting upon civilians. The point is that such violence and abuse was endemic to ancient society, not a unique feature of the places where soldiers were stationed.[26]

Military communities included soldiers, but also many others. Marriage patterns suggest a certain degree of institutional endogamy, but the archaeological evidence demonstrates that, while some garrison settlements were isolated from their surroundings, others were integrated. Around this core of soldiers and garrison settlers there may have existed a penumbra of merchants who relied on the army for their livelihood and groups with a strong tradition of military service, but it is very difficult to ascertain the extent of this secondary community and their exact relationship to the army. Military communities were, perhaps unsurprisingly, complex.

Given this complexity, it would be foolish to predict how peasants in a certain frontier zone interacted with the garrison settlements without further investigation. Unfortunately, even where evidence is abundant, some questions remain unanswered: the inhabitants of the lower Rhine increased their surplus production, probably in response to military demand, but what were the terms of the transaction? The rural inhabitants of northern and western Britain did not consume the same type of material culture as those in the garrison settlements, but does this mean that they did not interact at all with the military community or that their interactions took forms invisible in the archaeological record?[27] In most frontier zones, of course, the evidence is not abundant. Aerial photography holds great promise for discovering

[26] I have intentionally avoided discussing Petronius, *Satyricon* 82 where Encolpius is accosted by a soldier who relieves him of his sword. When Encolpius sees the soldier, he immediately assumes he is either a fraud (*planus*) or a hooligan (*grassator*) despite the fact that it is Encolpius who is wild with rage and impersonates a soldier. When the real soldier sees through this, he demands the sword and lets Encolpius go with a warning (*ponere me iussit arma et malo cavere*). Encolpius claims to be *despoliatus*, but in reality, Petronius depicts the soldier as quite benign. This reversal of the normal trope may contribute to the humor of the scene.

[27] The term "archaeological record" is often used synonymously with "archaeological remains" to denote the surviving physical traces of ancient behavior. This is how Brian Schiffer used the term for most of his book *Formation processes of the archaeological record* (Schiffer 1987). Toward the end, however, he devotes an entire chapter to the influence of archaeology itself, writing, "The archaeological record is, finally, the documents that describe what was recovered and analyzed and what procedures were used" (Schiffer 1987, 339). As this project relies entirely on such documents, it seems appropriate to use "archaeological record" to refer to archaeological data rather than archaeological remains. These data consist of interpretations by experts of archaeological remains. The diversity of experts interpreting remains over more than a century under wildly divergent circumstances introduces a degree of heterogeneity into the data that must be accounted for before they can be interpreted as evidence for ancient behavior (see section 3.2 with subsections below).

rural settlements and establishing their architectural plans, but as the example of the Batavi shows, architecture is not a simple indication of cultural interaction. For many sites, not even a basic plan is known; the surface scatter is the most common type of archaeological site by far.

There is a way to wring information from even this meager evidence if one takes the landscape, rather than the site or the artifact, as the object of analysis. By reconstructing the ancient landscape as seen from the perspective of an ancient peasant in a specific location, it becomes possible to understand the constraints and opportunities that that peasant faced. Settlement location is a choice, so the landscape as experienced from that location is an artifact of human behavior. By combining a large number of these landscapes, one can identify trends—features that were more or less accessible than would be predicted by random chance, and by examining how settlement location, and therefore landscapes, change over time one can begin to comprehend the history of people who left behind nothing but a scatter of sherds.

1.5 A new approach to studying rural economies in a frontier zone

In the remainder of this chapter, I outline my theoretical and methodological approach to investigating the role of garrison settlements in the rural economy of the frontier zone. Inspired by landscape archaeology, I focus on the relationships between the people who dwelt within rural settlements and their natural and social environments rather than on artifacts or sites. A GIS-based locational analysis allows these relationships to be reconstructed, compared, and analyzed. By employing logistic regression analysis – a statistical procedure that quantifies the relative impact of different variables on site location – I create a series of models that each use different sets of variables that influence productive potential and access to communication routes. Then a "market potential" variable is added which is a quantitative measure of the accessibility of potential customers from any point in the landscape (section 3.3.3.4). To understand whether these customers included military communities I create different versions of the market potential variable: one consisting of only civilian communities, one consisting of civilian and military communities, and – to test the possibility that military communities were a danger to rural settlers – one in which civilian communities exert a positive influence but military communities exert a negative influence. By comparing the goodness-of-fit of the different models, it is possible to draw conclusions about the relative influence of the different variables and the role of military communities in the rural economy. After explaining this novel approach to location analysis, I discuss the selection of factors used in these models. Detailed discussion of the process by which these factors were transformed into measurable variables can be found in chapter three.

1.6 The theoretical background

1.6.1 Landscape Archaeology

To find evidence for the relationship between military and civilian communities in the West, scholars have looked in two places: military settlements and the countryside.[28] They equate these places with the people who reside there and study the changing characteristics of

[28] In the East, soldiers were stationed in pre-existing cities but in the West they were almost always stationed in rural areas (Pollard 2000).

these places in an attempt to infer the types of relationships that existed between the residents of each place. Similarities in material culture assemblages from each place are taken to indicate close relationships between the people who lived there.[29]

A landscape approach, on the other hand, embarks from the assumption that people do not live their lives in a single place, but rather are constantly in motion over a wide area as they perform the tasks that make up mundane existence (Ingold 1993). The landscape is the surrounding environment that is experienced, constituted by, and partly constitutive of the people moving through it. Within the landscape there are places, meaningful entities with specific locations. These places are bound together in a network of movement by the paths that are traveled between them. [30] While traditional archaeological approaches oblige us to understand relationships by understanding the places involved, landscape archaeology directs our attention not to places, but to the connections between them.[31]

These connections are forged by physical movement. Even in cases where only information is conveyed, the information must take physical form in order to reach its intended audience, usually as a letter or a messenger. More often, goods are also carried between places by animals and people, and because the resource over which peasants have the most control is their own labor, I will focus on pedestrian movement.[32] Movement of any type is constrained by distance. Distance, as opposed to space, is the accessibility of something *as experienced by someone*. Unlike space, distance changes depending on the traveler. I will measure distance in terms of the energy required for a person to walk between two places.[33] The method of calculating distance adopted here will be described in the next chapter.

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[29] See, e.g. "Roman Urbanism: The View from the Countryside" (J. Taylor 2013).

[30] My thinking on landscapes is heavily influenced by Tim Ingold's work collected in *The Perception of the Environment* (Ingold 2000), especially chapters 1, "Culture, nature, environment: steps to an ecology of life"; 3, "Hunting and gathering as ways of perceiving the environment"; 9, "Culture, perception and cognition"; 10, "Building, dwelling, living: how animals and people make themselves at home in the world"; 11, "the temporality of the landscape" (= Ingold 1993); and 13, "To journey along a way of life: maps, wayfinding and navigation".

[31] This description makes the landscape seem like a collection of points and lines, but this is a simplification. In actuality, the paths themselves are places and places can be points, lines, areas, or volumes. It may be more accurate to think of the landscape as a quilt of continuous and overlapping places across which paths are embroidered. As the landscape exists in the relationship between a person and their surroundings, two people in the same location will have different quilts, but because the surroundings are the same there is a limit to the differences. Neustupny's "community area theory" is a conception of landscape that emphasizes continuous areas rather than networks (Farinetti 2011a; Kuna 1991; Kuna and Dreslerová 2009; Neustupný 1991).

[32] Movement using pack animals, drawn vehicles and water-borne transport were, of course, also important. Pack animals, though, would have been led by a human walking and so routing decisions would have been the same as in purely pedestrian transport. Carts and boats are especially useful for moving large quantities and heavy things reducing transportation costs most for people engaged in large-scale transactions. They also require an investment of capital and so were probably used more by wealthier people.

[33] Ideally one would measure distance in terms of travel time because this is more readily interpreted, is universally limiting and is easily comparable with other tasks. Unfortunately, the formula most commonly used to model pedestrian travel time is based on empirically weak foundations. Energy is a more consistent and better studied basis for measuring distance and still allows for meaningful comparison of different distances even if it is not immediately intuitive (section 3.3.3.2).

Just as artifacts can be used to learn about the people who made and used them, the landscape can be used to learn about the people who inhabited it (Kuna 1991, 332). As people go about their daily lives they shape the landscape around them, but are in turn shaped by their surroundings. Tasks are given physical form in the landscape and the present landscape is a palimpsest of all traces of prior activity. At the same time, it offers certain opportunities and constraints to the people dwelling therein, and thus can help predict the future. Landscapes both manifest past behavior and shape future actions.

1.6.2 The settlement as a place

The term "settlement" is generally understood and rarely requires definition. From the landscape perspective outlined above, according to which people live their lives moving between various places, the definition of "settlement" becomes problematic. To understand the nature of a settlement we must ask what set it apart from all the other places in the experienced landscape. In other words, if places are "nodes in a matrix of movement" (Ingold 2000, 219), what type of movement through a place defines it as a settlement?

To answer this question it will be helpful to adopt Tim Ingold's notion of the taskscape. Ingold defines "task" as "any practical operation, carried out by a skilled agent in an environment, as part of his or her normal business of life. In other words, tasks are the constitutive acts of dwelling." Tasks are all the things that people do. By analogy with landscape, he coined the word "taskscape" to describe the range of tasks performed and their mutual interrelationships (Ingold 1993, 158). Taskcapes are all the tasks performed and, just as importantly if not more so, the relationships between task performances. [34]

The landscape is made up of many different places, but these places are not undifferentiated. Each place is unique, in that it has a history specific to it, and also typical, in that multiple places can have similar meanings to the same or different people. The most important place in the landscape for most people is the one they call "home." This is the place where they feel secure enough to sleep, an activity which leaves them vulnerable to predators, malicious humans, and prolonged exposure to the elements. In agrarian societies, people generally sleep in the same place night after night. This means that they begin and end their day at the same place, so all of the tasks they perform throughout the day have to be scheduled and distributed (spatio-temporally arranged) in such a way that they can get back home.[35] This provides an anchor in space, a focus around which all other activities are centered.

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[34] Ingold considers the landscape as the embodiment of the taskscape (Ingold 1993, 162), but in this I think he is only partially correct. According to his definition, tasks are only carried out by skilled agents. The landscape, though, is the entire world as experienced by an agent. This includes many embodiments of tasks carried out by skilled agents, both human and non-human, but it also includes the physical manifestations of inanimate processes. An earthquake is not a task, but the landscape is physically changed by it and thus embodies it as well. Thus, while the landscape embodies the taskscape, it is not an embodiment of the taskscape alone.

[35] In comparing human houses to the nests made of tree branches that great apes weave around themselves every night in order to sleep, Ingold expresses a similar idea: "The human 'nest', if we may call it that, is a fixed point for the movements of its several occupants, and a place to which they regularly return" (Ingold 2000, 182).

By extension, a settlement is a place with at least one home that is relatively fixed in space.[36] It is the reference point for the people who inhabit it, the place from which every other place is distant and different. It is usually, also, the place where a major portion of the taskscape is performed, including tasks necessary for both biological and social reproduction. The settlement is central to the lives of its inhabitants, both spatially (all movement radiates from it), and temporally (days begin and end in it). Therefore, even though we can never fully reconstruct past landscapes or taskscapes, by identifying settlements we can limit the possibilities imaginable.[37]

1.6.3 Studying settlements, settlement, and settlement patterns

I wish to distinguish the study of settlement from the study of settlements themselves. Study of settlements takes the individual settlement as the unit of analysis and focuses on characteristics such as architectural morphology, size, density, material culture, and their temporal trajectories.[38] The study of settlement, on the other hand, takes regions as the unit of analysis and observes the character of settlement within it: the number of settlements, their dates, the range of settlement types, the relative sizes of settlements, and settlement patterns,[39] a term refers specifically to the spatial distribution of settlements within a region. Observed variables include density and the relationship of densities to landscape features, the dispersion or concentration of settlements relative to each other, and the spatial relationships between different types of settlements.[40] Obviously one cannot study settlement patterns without studying settlement and settlements, but it is possible to study settlements without regard to settlement, and settlement without regard to settlement patterns if one focuses on the fluctuation of numbers through time, typologies and hierarchy while ignoring the spatial distribution of settlement.

Studying settlement and settlement patterns requires a broadening of focus from sites to regions. While most archaeological data are restricted in space to the find spot, settlement patterns exist across a wide area. Rather than learning about the habits of people in a single place, which may or may not be representative of other places, settlement studies explicitly

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[36] The word "settlement" is usually understood to imply multiple homesteads, but from the landscape perspective outlined above, it is residency rather than the number and social organization of residents that define a settlement. In any case, it is very difficult to distinguish sites that represent villages from those that represent a single, large homestead without intensive archaeological research.

[37] This idea was first formally expressed by Torsten Hägerstrand who coined the term "Time-Geography." It has since become influential in human geography, but has rarely been explicitly applied in archaeology (Hägerstrand 1970; Hägerstrand 1973; Hägerstrand 1975; Pred 1990; Pred 1977; Mlekuz 2013 for an archaeological application).

[38] An excellent, recent example is Diederick Habermehl's *Settling in a Changing World: Villa development in the northern provinces of the Roman empire* (Habermehl 2013).

[39] Ioana Oltean, in Dacia: Landscape, colonisation and Romanisation (Oltean 2007) studies settlement in southwestern Transylvania to learn about the processes and consequences of territorial conquest and provincial incorporation in the Roman empire.

[40] Classical settlement patterns have been investigated most explicitly in Greece, particularly Boeotia. Emeri Farinetti makes good use of the spatial relationships between settlements in *Boeotian Landscapes: A GIS-based study for the reconstruction and interpretation of the archaeological datasets of ancient Boeotia* (Farinetti 2011a). John Bintliff has examined the process of polis-formation and urbanization using settlement pattern theories developed by modern economic geographers in "Going to market in antiquity" (Bintliff 2002).

search for generalities that hold true in many places. Settlement patterns also provide a wider time frame than other streams of evidence. Documentary evidence is vivid, but restricted to a single point in time; evidence from archaeological excavation is limited to the occupation history of the site; settlement evidence is limited to the occupation history of the entire region, which is almost always longer than any one site in the region.

Studying settlement also directs our gaze to the whole socio-economic hierarchy. Indeed, a common goal of settlement research is to gain some impression of the complexity and hierarchical nature of a society. In contrast, most of our other evidence from the ancient world comes from a narrow segment of society, usually the elite: literature, fine art, and the most durable and impressive architecture are all the products of the wealthiest section of society. Epigraphy comes from a broader base, but it still requires money and the inclination to display one's accomplishments or identity in a permanent form. Papyri often concern humble people, but most of the information they yield concerns official bureaucracy or the operations of large estates. We sometimes catch glimpses of the lower classes in well-preserved cities like Pompeii or Dura Europos, but urban residence itself gives people social advantages over the masses of people in the countryside. Peasants simply do not leave very many traces that survive in the historical or archaeological record.[41] When they do leave traces, they are usually so slight as to be recoverable only when they have accumulated over time. That is to say, the actions of peasants that are visible to us are the ones they performed frequently in the same place for a long time. We can examine, then, how the mundane taskscapes of peasants changed over the medium and long term, but short term change will generally elude us.

The rural archaeological record also over-represents the wealthier sections of society, but to a smaller degree. Those who can invest in stone architecture and tiled roofs are more likely to be noticed by archaeologists than those who rely on timber and thatch. Nevertheless, in places where pottery was common and cheap – as was the case for most of the Roman Empire – surface survey can identify places where broken ceramics have accumulated, and most of these places will represent settlements for the simple fact that pottery was most often used, and therefore broken, in settlements.[42] Even if the concentration of pottery represents a rubbish pit, it will indicate the presence of a settlement nearby. Some specialty sites will also produce large amounts of broken pottery, such as kilns and places where amphorae were loaded or unloaded, but these are usually identifiable by examining the range of pottery found.

1.6.4 Settlement patterns and economic systems

Settlement patterns are linked to the strategies by which people acquire the necessities of biological and social life through the friction of distance. Time is a limited resource and any time spent traveling is time that could be spent doing something else. In addition, travel requires energy and, if carrying a bulky load, technology. All of these costs are included in

[41] As one advisor put it to me in my first year of graduate school, "you don't get much from them."

[42] This is especially true when the archaeological record has been constructed through extensive and non-systematic survey. Without total survey there is little chance of detecting the smallest and briefly occupied settlements, but there is also little chance of detecting other, non-residential places that might be mistaken for a settlement.

transportation costs that people generally try to minimize. This includes not only carrying goods to market, but also the time they spend commuting between their home and the various activity areas in their landscape (on the importance time management in household economics, see De Vries 2008, 25–27; de Vries relies primarily on Becker 1965; Hägerstrand's Time Geography, summarized in Pred 1977 has also been influential; (Hägerstrand 1970; Hägerstrand 1973; Hägerstrand 1975); Zipf 1949, esp. 347–415 is seminal on the principal of least effort and its implications for human geography). In agricultural societies, this means that people will usually live near the fields they cultivate, especially those that they cultivate intensively (Chisholm 1979, 33–62).

The scarcity of time is also attested in ancient sources (Erdkamp 2005, 136–137). On the few occasions when peasants are depicted bringing produce to town in literature, they sell their goods quickly in order to return to work in the fields. Plato argues that urban retailers are a necessary evil so that farmers do not have to take time away from their work waiting for customers (*Rep.* 2.371c); Plato's advice was later codified into law (*Dig.* 50.11.2). Apuleius depicts a market-gardener traveling to town in the morning to sell vegetables and returning to work in his garden for the rest of the day (*Met.* 9.32). Libanius supplies a vivid account of the importance of time to peasants when he complains that they are being forced to carry rubble from Antioch. He reports that there is such a struggle to pick up the required load quickly that some even pay for the privilege of avoiding delay. Those who cannot pay are forced to wait, sometimes until after dark, to collect their burden and leave the city, exposing them to the dangers of traveling by night. Most tellingly, Libanius says that the peasants would normally have been home before midday (*Or.* 50.25-26). Time is precious, not only because there are a limited number of daylight hours in which to work, but because the sequence and scheduling of agricultural tasks is crucially important. As Cato says, "If you do one thing late, you do all jobs late" (5.7).

Of course, transportation costs are not the only factor influencing the locations of settlements. For peasants, who operate around the level of subsistence, the mitigation of risk is also important (Horden and Purcell 2000, 175–230). This is why farmers often work several dispersed fields instead of a single consolidated field. In this case, the extra time spent traveling between fields is offset by the mitigation of the risk of crop loss due to local events. Scattered holdings are generally associated with settlement in villages, which also reduces the cost of coordinating projects with neighbors. On the other hand, farmers who live amongst their fields have more labor time to invest in cultivation. The nucleation or dispersion of settlement, then, has important economic and social implications.

Social factors or history may have an even greater influence on settlement location. Settlements, especially large ones, rarely move. Immovable infrastructure represents an investment that is costly to abandon, so the advantages of moving would have to be significant to make it worthwhile. People are also, often, emotionally attached to their homes and reluctant to leave them even when it would be economically advantageous. If farmers do decide to move, their choices of location will be restricted by the claims that other people have

on land, not to mention political forces that may prevent them from owning land in the territory of another polity.

Certain topographic features may make certain places attractive or repellent as well. If the area is hilly, the direction a farm faces will influence the amount and timing of sunlight it receives. This is important for the cultivation of plants, but also for the comfort of the residence. The presence of manageable running water is advantageous, but standing water can drown crops and breed pests. If the rural settlement is important in maintaining social status, highly visible locations will be attractive, but if strong winds are problematic farmers will opt for more sheltered locales.

There are a multitude of factors influencing settlement location and we cannot hope to account for all of them, but we can guess which were most important in any given context and investigate their relative influences through multivariate analysis (section 1.7.2). Further, each person, and therefore each settlement, will have slightly different priorities and will react to the same situation in slightly different ways. It is not my intention to document the unique suite of factors and reactions that applied to any given settlement, but rather to document the similarities in factors and reactions that are shared by most settlements of a given type. That is to say, I am studying settlement, not settlements.

The initial decision to place a settlement in a given location is only half of the story. Once placed, a settlement's location shapes the constraints and opportunities open to its inhabitants. For example, if a new market place springs up near an older settlement, the inhabitants will have easy access to marketing, even though that was not a factor in the initial placement of the settlement. The proximity to market is likely to lead to greater commercialization regardless of the non-commercial intent of the original founders.

Alternatively, the adoption of a new technology might turn a constraint into an opportunity. The ard, or scratch plow, is well-suited to the thin soils of the Mediterranean, but is insufficient to work the heavier soils of temperate Europe, even though they are often more fertile. The introduction of the heavy plow could turn marginal land into prime real estate to the benefit of the previously disadvantaged, if they have the means and inclination to capitalize on the new opportunity. These examples demonstrate the inadequacy of a static conception of landscape resources. Gibson's concept of "affordances" is better suited to an approach that emphasizes the relationship between the observer and the landscape. Affordances are features in the landscape as they are perceived by the inhabitants (Chemero 2003; Gibson 1979; K. Jones 2003; for the applicaion of the idea in an archaeological context see Gillings 2012).[43]

A theory of affordances does not deny the importance of the physical reality of the environment. Rather, it directs us to consider both those realities and the social context, goals and abilities of the inhabitants of the landscape. In this case we are investigating whether the

[43] The precise nature of affordances has been a matter of intense debate since Gibson proposed the idea. Gillings 2012 offers a cogent overview from the perspective of GIS based archaeology. For a recent attempt to broaden the concept see (Rietveld and Kiverstein 2014).

creation of the Roman frontier led to intensified agricultural production and/or frequent, small-scale, commercial transactions between military and rural communities. We are fortunate to have the writings of Roman agronomists which identify characteristics of the landscape that are conducive to increasing agricultural production using ancient technologies. Economic geography and ethnographic data have shown that there is a threshold distance beyond which the cost of travel rapidly diminishes the return on increased labor investment. If intensive agricultural production was a common goal, then ancient agriculturalists should have maximized the amount of agriculturally productive land within the radius of profitability. Similarly, the ability to carry out frequent commercial transactions is constrained by the distance between a settlement and the point(s) of exchange. If this was a common goal, ancient agriculturalists should settled in locations that minimized transportation costs to the most profitable markets.[44] The location of ancient settlements, then, is indirect evidence for the goals of the settlers and for the affordances open to them.

1.7 Methodology

1.7.1 In defense of quantitative location analysis

In order to understand ancient peoples' interactions with the landscape and its affordances, patterns in the differential accessibility of those affordances must be identified. This is difficult because the landscape is composed of a multitude of affordances with differing influences. The use of GIS to integrate archaeological and environmental data is well established, but the analysis of those data and their use in historical interpretation is not uncontroversial.[45] Quantitative, statistical analysis can be used not only to detect patterns, but to judge how meaningful those patterns are (Wheatley and Gillings 2002, 125). This is done by comparing the accessibility of different affordances from settlements to the accessibility of those affordances from randomly distributed locations in the study area. This mitigates the risk of recognizing patterns that are not actually present (e.g. seeing the man in the moon) and the

[44] Such a location could be found either next to a single, rich market or between multiple markets.

[45] The history of location analysis (or "spatial analysis") in archaeology is long. Interest in quantitative location analysis peaked during the era of processualism (Clarke 1977; Hodder and Orton 1976) but waned when post-processualist critiques of scientism and quantification became dominant in the 1990s. At the same time the development of computerized Geographic Information Systems (GIS) made quantitative location analysis more efficient and effective so interest never disappeared entirely. Its use was bolstered by a commitment in North America and Europe to preserve archaeological resources in the face of increasing development ("heritage management" in Europe, "cultural resource management" in the U.S.). Predictive modeling through location analysis promised to be a cost-effective decision making tool for developers and governments in assessing the risk posed by a project to archaeological remains and the risk that finding archaeological remains posed to the success of a project. Predictive modeling's success in this field is debated but it continues to be a popular tool especially in the U.S. and the Netherlands (For an early overview of predictive modeling in the U.S. see Judge and Sebastian 1988; for more recent overviews of American predictive modeling see Mehrer and Wescott 2006; and Wescott 2000; For recent overviews of predictive modeling in the Netherlands see Kamermans, van Leusen, and Verhagen 2009; van Leusen and Kamermans 2005; Verhagen 2007; For a critique of predictive modeling see Wheatley 2004). Predictive modeling and location analysis share many of the same techniques but they differ in their goals: predictive modeling quantifies the likelihood of finding unknown sites in a given place while location analysis aims to understand the processes that led to the distribution of known sites. Models normally used for prediction can be valuable in this endeavor but unless the researcher uses them to generate a prediction they should not be termed "predictive models" (Verhagen 2007, 17; Verhagen and Whitley 2012, 52–53).

risk of identifying patterns as meaningful with no behavioral correlate (e.g. arguing, based on the fact that 80% of settlements are found on a certain type of soil, that ancient settlers preferred that soil when in fact that soil simply covers 80% of the study area).

This type of correlative analysis has been attacked as de-humanizing and narrowly focused, ignoring important factors that influenced past behavior because they cannot be readily mapped and quantified (Wheatley 2004). While it is true that not every aspect of human experience can be quantified, and so the models generated through purely quantitative analysis will not be complete, this is not a reason to reject quantification altogether. Many important elements that shape human behavior – things like the slope of the terrain, exposure to wind and sun, and distance to other places – are quantifiable and can be profitably investigated using statistical analysis. The results of this analysis can then be interpreted in combination with other types of data in any given theoretical framework the researcher chooses. As always, no single stream of evidence is sufficient to represent every aspect of ancient behavior and this should not be used as an excuse to ignore potentially valuable information.

This project uses spatial analysis of settlement landscapes to test specific hypothesized economic relationships between military communities and rural settlements that are sensitive to transportation costs, and therefore can be expected to have influenced the spatial distribution of settlements. Other economic and non-economic relationships that are less constrained by transportation costs would not have had the same identifiable repercussions and these are not under investigation, though they will be considered in the final interpretation. Marcos Llobera has described targeted analysis of the type performed here as "scaffolding models and/or methods." As he puts it, "their construction can be seen as an attempt to shorten the gap that often exists between empirical information and narratives" (Llobera 2012, 503–504).

The proximity of a settlement to a theorized affordance does not guarantee that that affordance was actually exploited from that site, but it does increase the probability of exploitation and, perhaps, the frequency of its exploitation. Put more concretely, for a person living very far away from a city, the probability of traveling to that city on a given day is very small; this is not to say that the person never travels to the city and it is even possible that she travels to the city frequently, but the difficulty of the journey makes this unlikely. This type of probabilistic reasoning is not particularly rewarding when applied to a single person or a single settlement, but when trends are observed in larger datasets, the probabilities multiply. In this way, powerful arguments can be supported even with uncertain data.

1.7.2 Comparative modeling for hypothesis testing

One exciting consequence of the recent exponential growth in computing power is the ability to quickly generate and compare multiple models. When GIS-based predictive modeling first became popular in archaeology, the processualist approach was still dominant and so the potential for hypothesis testing using statistical analysis was quickly grasped (Kvamme 1988a, 386).[46] Later, in response to charges of environmental determinism, Martijn van Leusen

[46] "Finally, the methods of statistical hypothesis testing are particularly well suited as a means of verifying (or refuting) hypotheses."

defended the use of GIS by invoking the ability to test hypotheses (Gaffney and van Leusen 1995, 370).[47] More recently, Philip Verhagen and Thomas G. Whitley have advocated for the comparison of multiple models rather than testing a single model (Verhagen and Whitley 2012, 83).[48] Despite this, most model building continues to seek a single, best model. Different models may be compared in the process, but these are rarely constructed to reflect explicit hypotheses, and the failure of a model to fit the data is rarely considered informative. In the following sections, I will describe a method of comparative modeling for hypothesis testing that takes advantage of one of the more prosaic steps in the model building process: the construction of measurable variables.

1.7.2.1 The standard modeling process

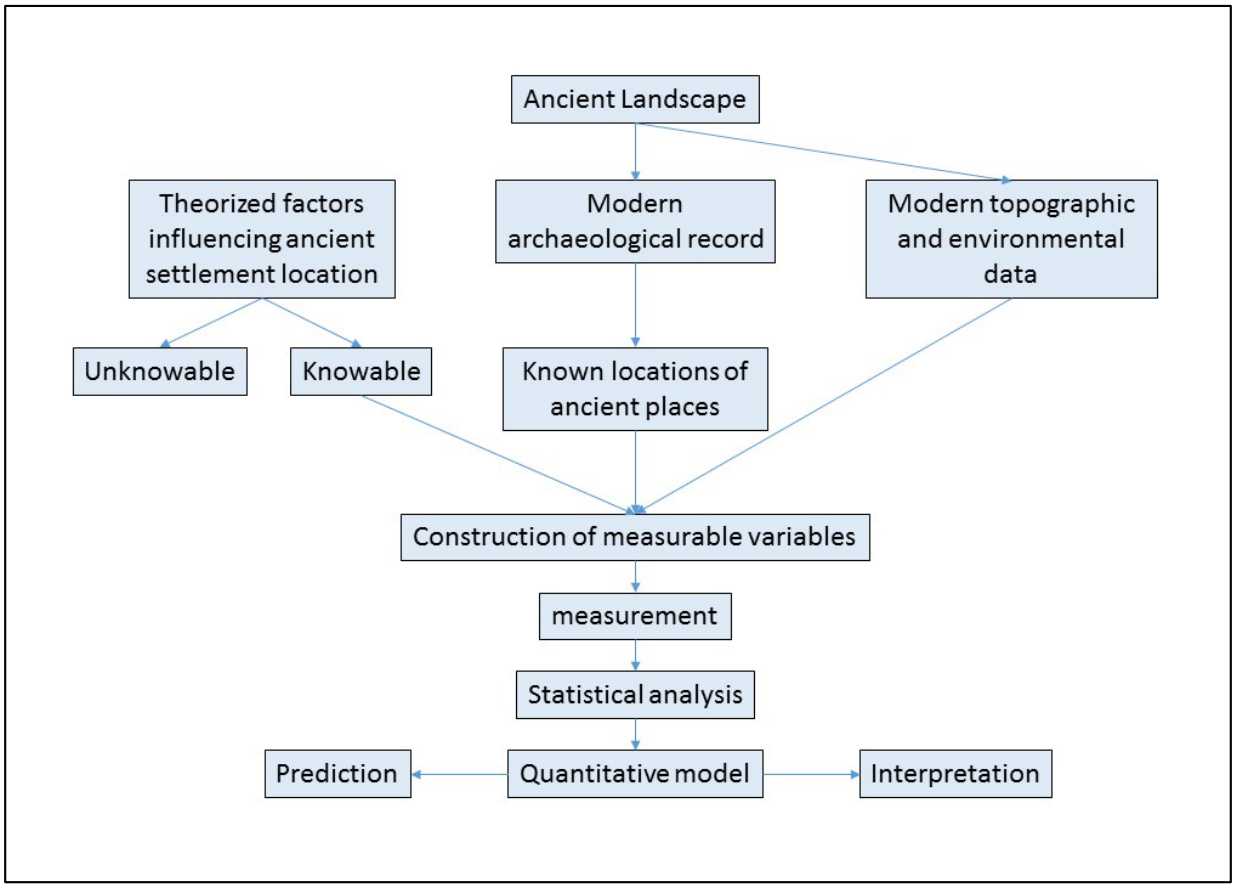


Figure 1: The standard modeling process.

Settlement patterns are shaped by a multitude of factors. The task of the modeler is to identify as many of the most influential factors as possible and to elucidate the behaviors that link those factors to the observed distribution of settlements. This can be done inductively or deductively (Kohler and Parker 1986). In the inductive approach, the researcher tests the

[47] "…even if some cultural variables prove to be unmappable, hypotheses about cultural behavior can still be tested in a GIS if they have spatial consequences"

[48] "By specifying more than one option and looking at the issue from multiple perspectives, we might be able to come up not so much with the final answer but at least with the most probable one (or a few probable ones)"

correlation of site locations with various factors, selects the significant ones, and combines them into a model.[49] In the deductive approach, the researcher specifies a combination of factors that are believed to be influential and tests this combination against the locations of settlements.[50] In truth, the two approaches are not clearly distinct as the initial selection of variables in inductive approaches is necessarily theory-laden and deductive approaches may calibrate the weights of the variables in response to empirical evidence (Kvamme 2006). The landscape perspective outlined above, in which the features of the landscape become meaningful only in relation to historically contingent human beings, is not compatible with an approach that assumes a priori understanding of the priorities and perceptions of ancient people. The approach adopted here, therefore, is inductive in that it derives the weights of variables from the data, but the recognition that the initial selection of factors is theory-laden requires that theory to be made explicit. This will be done below (sections 1.7.2.3 and 3.3.2).

After the initial selection of factors has been made, these must be transformed into measurable variables before they can be correlated with settlement locations. Factors may be characteristics of the precise location of the settlement, quantities of features in a neighborhood around the settlement, or distances from the settlement to certain features (Kohler and Parker 1986). For this project, I consider the latter two types of factors only as the locational uncertainty of the available data makes it very difficult to calculate characteristics of precise site location. When measuring quantities of features within a neighborhood, the size of the neighborhood must first be specified. For categorically measured features, like soil type, it is relatively straightforward to measure the portion of the neighborhood falling within each category, but for features that are continuous in nature, like slope, one must construct categories. For distances, it is important to specify the nature of distance – whether Euclidean or experiential – and the method by which it is measured.

Decisions about how variables are to be constructed must take into consideration the state of the archaeological record and the available topographic and climatic data. The formation process of the archaeological record will be considered below (section 3.2.4), but the formation of modern topography must also be considered. No paleo environmental reconstructions are currently available for the study area. Nevertheless, there is good reason to

[49] The selection of variables chosen for screening in inductive approaches is rarely defended as it is assumed that the relevant variables emerge from the screening process. Any variables not chosen for initial screening are assumed to be unimportant or unmeasurable. Predictive modeling was first developed to investigate "primitive" societies at a time when it was assumed that economic considerations were preeminent and that the most important economic transactions were between humans and their environment. Early practitioners of predictive modeling acknowledged this as a limitation, but it was generally felt to be acceptable (Kohler and Parker 1986, 400). That changed with the advent of post-processual archaeology and with the rise of phenomenological approaches to landscape and attempts to integrate "cultural" variables into GIS models (Gaffney and van Leusen 1995; Gaffney, Stančič, and Watson 1996; Llobera 1996; Lock 2000; Lock and Harris 1996; Lock and Harris 2006; Verhagen 2007, 203–210; Verhagen and Whitley 2012; Verhagen et al. 2013). The value of this approach has recently been questioned as it assumes that the "cultural" can be easily separated from the "environmental" (Llobera 2012, 496–7; Pauknerová, Salisbury, and Bamanová 2013). The method adopted here employs variables that would be considered "environmental" and "cultural," but no distinction is made between these categories.
[50] Land evaluation, or suitability analysis, is a common deductive approach (Goodchild 2007; Hans Kamermans 2000; Kooistra et al. 2013; Kooistra et al. 2014; van Joolen 2003).

believe that the modern landscape is a fair approximation of the ancient one and places where there has been significant change can be identified.

The most dynamic parts of the landscape are the river banks where alluviation and landslides can occur. Recent landslides occur primarily near the Danube and in the hilly, southeast corner of the study area, while the majority of the study area is stable (Dobrev et al. 2013; Bruchev et al. 2007; Berov et al. 2002). The other significant change to the landscape is hydrological. In the early twentieth century most of the floodplains and wetlands in the area were drained (K. Stoyanov and Gachev 2012, 404). Russian military maps at a scale of 1:126,000 compiled for the Russo-Turkish war in 1877-1878 show numerous patches of inundated land around the Yantra and its western tributaries (Map 6) (Russian Military Topographic Directorate 1877). This has not been incorporated formally into the modeling process, but will be considered when interpreting model results.

Once all the measurements have been taken, the standard procedure is to use some sort of multivariate statistical tool to test the ability of these variables to accurately predict which locations contain ancient settlements. The method employed here, logistic regression analysis, has been a popular choice for its ability to predict binary outcomes (settlement presence or absence) and to incorporate both categorical and numerical data (Kohler and Parker 1986; Kvamme 1988a; Warren 1990; Warren and Asch 2000; Woodman 2000; Woodman and Woodward 2002). The model is then validated, either through comparison with the data used to construct the model or a different set of data, and then used for prediction or historical interpretation. In either case, the result is a single, best model.

1.7.2.2 The modeling process modified for comparative hypothesis testing

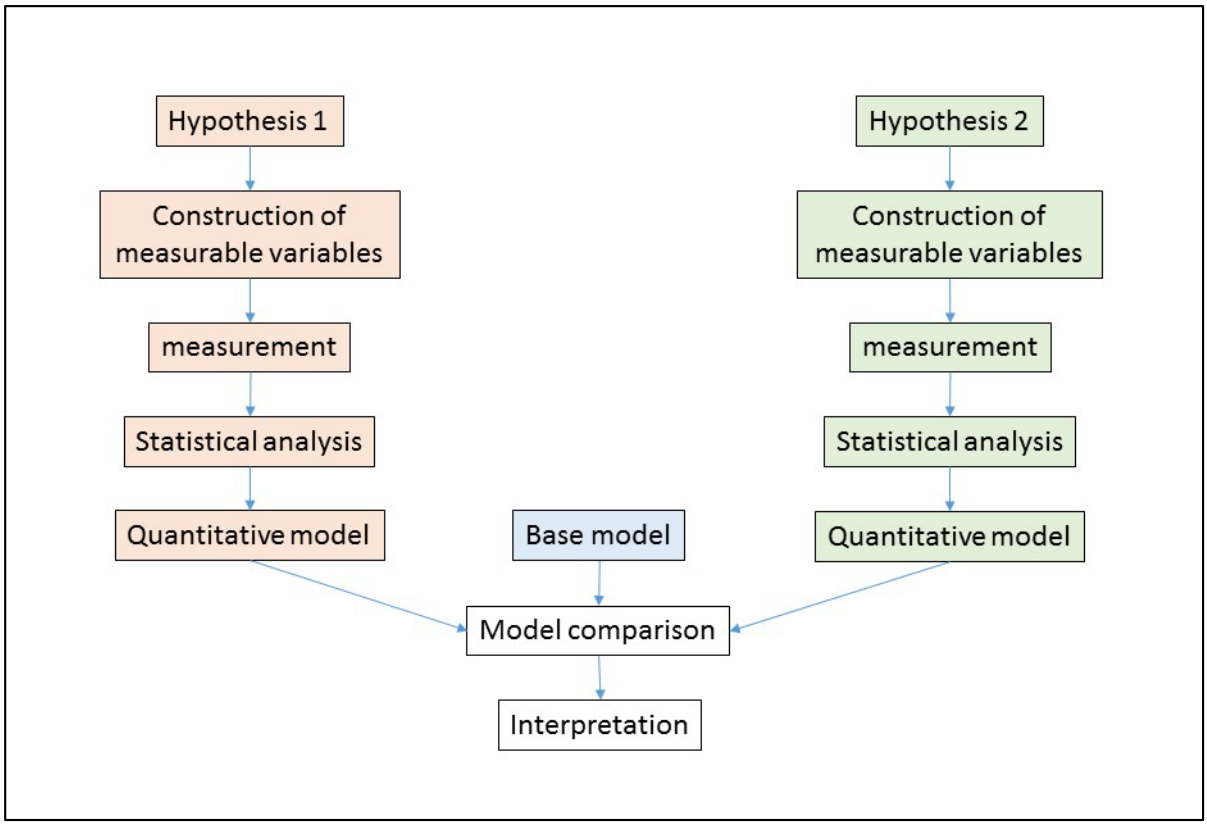


Figure 2: The process of comparative modeling for hypothesis testing.

The process followed here differs from the standard one in that the goal is not a single, best model, but the comparison of several models that correspond to competing hypotheses about the possible role of military bases as market places for rural produce. The first step is to create a quantitative model that includes factors relevant to agricultural production and access to traffic routes following the standard procedure. This is the baseline model. How well it fits the data is quantified using leave-one-out cross-validation (G. James et al. 2014, 178–181). Next, five different versions of a market potential variable are constructed corresponding to different hypotheses (see section 3.3.3.4 for the calculation of this variable). New models are then built by adding each of these variables to the suite of variables used in the baseline model and the goodness-of-fit of each model is calculated, again using cross validation. An improvement in the goodness of fit is taken as evidence in support of the hypothesis used to construct the relevant market potential variable.

1.7.2.3 The selection of factors for screening.

The factor of primary interest in this study is the accessibility of market opportunities for small-scale rural producers of the type described in Chapter one. I assume, however, that ancient farmers were more concerned with production, be it for auto consumption or sale. Before one can bring goods to market, the social and physical subsistence requirements of the household must be met and the surplus produced and transported. The productivity of the land around the farm, then, and its access to transportation routes must be considered first.

We are fortunate to have written evidence about how some ancient authors perceived the landscape as it relates to agricultural production. I have used the writings of Cato, Varro, Columella and Palladius, with occasional reference to Pliny the Elder and Theophrastus, to select factors that might have influenced the locations of Roman period farms. Although these authors were elites living in central Italy, it is preferable to use their testimony to that of modern agricultural science because the technology and economic context of the ancient world differ radically from the modern world. That is to say, the same landscape elements provide different affordances to ancient cultivators than to modern ones. By the same token, caution must be taken in applying the opinions of the Roman agronomists, all of whom were aristocrats with large estates in the center of the empire, to the world of the small holder on its edge.

There are good reasons to think that the writings of the agronomists may provide insight into the expectations of ancient small holders in general for the productivity of different landscape features. First, the agronomists were writing for an aristocratic audience which held property throughout the Empire, so their advice was intended to be applicable beyond Italy.[51] Second, the medium and large estates envisioned by the agricultural writers are not as different from small holdings as might at first be assumed. True, large land owners cultivated one or more cash crops intended for sale in bulk, but this was only part of their operation; they also cultivated staple crops to feed themselves and their laborers (Erdkamp 2005, 114–118; Morley 2000, 216–218). While they may emphasize cash crops such as vines and olives, they also discuss more humble crops like grain and legumes (Cato 6.1, 34-37; Varro 6.3, 9, 23; Columella 2; Palladius 1.6). Furthermore, the agricultural writers sought to maximize profit through maximization of production and minimization of expenditure (Erdkamp 2005, 109–114; Purcell 1995). They were, therefore, sensitive to the productive capacity of the landscape for different types of crops. For all of these reasons, the Roman agricultural writers are a valuable source for understanding the environmental factors that influenced agricultural productivity.

Based on the Roman agronomical texts, I have identified the following factors as influential for the agricultural productivity of an ancient farm: slope, landform, aspect, sun exposure, soil, and water supply. These texts also discuss access to traffic routes and access to markets. I will discuss the portrayal of these factors in ancient texts and the way I transformed them into measurable variables in chapter three, where I also discuss the results of analyzing the data from the Lower Danube. Now, I turn to the difficulties of working with archaeological settlement patterns.

1.7.2.4 Recovering settlement patterns and constructing non-sites – the dependent variables

It is not easy to reconstruct settlement patterns from archaeological data alone, and indeed it is impossible to recover a complete settlement pattern at any one moment in time. The first problem is with the notion "site." An archaeological site cannot be assumed to represent a settlement. The archaeological site exists in the present as a location with interesting archaeological remains. These remains may be architectural, whether standing or detected through crop marks or geophysical prospection, or artefactual, usually concentrations

[51] See, e.g., Columella's comparison of soils in Africa, Numidia, Asia and Mysia (Praef. 24) and Palladius' description of a Gallic reaping machine (7.2.2-4). Cf. Columella's disapproval of owning distant estates (1.1.20).

of pottery.[52] The latter are the most problematic. This is because the datasets on which regional settlement analysis relies are often generated through surface survey, so a concentration of artifacts is the most numerous type of site. Distinguishing a site from off-site scatter is difficult if the surface pottery forms a more or less continuous carpet (Dunnell 1992; Fentress 2000; D. J. Mattingly 2000; Terrenato 2004; Wandsnider 2004). The process by which sherds came to be concentrated is also problematic. Ideally they are concentrated because they entered the archaeological record all in the same place, thus reflecting ancient behavior. Theoretically, though, it is also possible for post-depositional processes to concentrate artifacts: sherds can be transported down a hill through erosion or plowing and deflation (aeolian erosion) can artificially increase sherd density in places exposed to wind. If one knows about general climatic conditions, the topography and geology of the landscape, and recent land use patterns, these post-depositional processes can be accounted for. To do so over a region as large as a study area would require a model that would automatically calculate the geomorphological processes that shaped the current landscape. Unfortunately, no such model is currently available.

If it can be established that depositional, rather than post-depositional processes, caused the concentration of artifacts, the interpretation of the site is still problematic. The concentration might be the result of numerous people living in close proximity relative to other places, but extended duration of occupation and increased consumption of pottery can also result in increased sherd density (Wandsnider 2004). The differential consumption of pottery is a particularly vexing problem when making diachronic comparisons because ceramics were more plentiful in some periods than others. Also, the durability of ceramics, and thus the rate at which they survive in the present, also vary greatly across time and place (Bintliff, Howard, and Snodgrass 1999; Pettegrew 2010; Witcher 2012). It is necessary, therefore, to understand the dynamics of pottery supply and consumption through excavation. The chronological resolution of typological sequences is rarely as fine as we would like, but this too can be accounted for by weighting finds according to their relative time-spans.

Relating archaeological sites to past landscape features is also problematic. Roman archaeologists are lucky in that we have textual evidence showing that there were people who lived on farms. We can distinguish settlements from other places by the functional range of pottery recovered. This does not, however, address the problem of changing function. A farm may be perennially occupied for a while, and then only seasonally; alternatively a household could move from a house into a barn, turning a specialized building into a settlement (Wandsnider 2004). This is not as big a problem as it may seem, though, for both barn and house represent settlements.

Contemporaneity of small settlements is very difficult, usually impossible, to prove. This does not make the data useless, but it does condition the kinds of techniques we can use to understand them. We cannot reconstruct exclusive territories with Thiessen polygons or path distance tessellation, and we cannot use nearest-neighbor analysis to demonstrate the

[52] To this list could be added alterations of the natural landscape, like rock art or patches of soil with high concentrations of phosphate, and non-architectural constructions, like statues.

dispersion or clustering of settlements at this scale. We can, however, use locational analysis to determine which features made these places suitable for habitation.

The problem of contemporaneity is simply a version of a more pervasive problem: we will never recover a complete record of all the rural settlements that existed at a given time. This is for two reasons. First, geomorphological dynamics such as erosion and alluviation destroy or conceal potential sites; second, some settlements will not leave detectable traces after they have been abandoned (Pettegrew 2001). The first of these can be addressed through the careful selection of non-sites.

Logistic regression analysis requires a binary dependent variable, both locations where there was an ancient settlement and locations where there was not. In the absence of systematic field survey, the traditional strategy for choosing locations where ancient settlement was absent has been to create a set of random points and assume that there are no undiscovered archaeological sites at those points (Kvamme 1988b; Warren and Asch 2000).[53] This is reasonable when archaeological sites are rare in the landscape, but there is still a risk of labeling an occupied location as unoccupied when a site exists but has not been discovered. This risk can be mitigated by taking into account the formation processes of the archaeological record. The influence of these processes can be identified by careful study of the history of research that created the archaeological record and through comparing the distribution of sites to modern landscape features that can be expected to have preferential exposed or concealed archaeological remains (Schiffer 1987; J. Taylor 2000; Terrenato 2000; van Leusen 2002).

1.8 Conclusion

I have described in general terms my approach to investigating the economic relationships between military and rural communities on the northern Roman frontier. Landscape archaeology has encouraged me to examine the spatial distribution of rural settlements relative to various natural and social affordances. Likely candidates for affordances can be identified in this case because the Roman agricultural writers provide insight into the possible meanings of landscape features for ancient farmers. Univariate and multivariate statistical analysis—the latter in the form of logistic regression analysis—are the tools best suited to identifying significant patterns in the location of settlements relative to those affordances. Thus far, the procedure is not significantly different from previous projects which taken a landscape-based approach to settlement pattern analysis with the goal of understanding ancient economies and societies.[54] These projects seek to arrive at a general

[53] Known as the "case control" method, the results of the predictive modeling must be interpreted as relative rather than absolute probabilities. That is, one cannot say that there is a certain probability of finding a site at a given location, only that the probability of finding a site at that location is twice as high or low as at another location (Conolly and Lake 2006, 181; Woodman 2000; Woodman and Woodward 2002).

[54] This is a diverse group, and the projects discussed here are by no means exhaustive. Vita-Finzi and Higgs coined the term "site catchment analysis" for the analysis of the characteristics of settlement territories to learn about the past (Vita-Finzi and Higgs 1970), which is similar in many ways to "community area theory" (Neustupný 1991; Kuna 1991; see Farinetti 2011b, 3–14 for an overview of both). Andrew Bevan and others with the Kythera Island Project have explored the potential of GIS examining the landscapes of neopalatial Kythera (Bevan 2002; Bevan and Conolly 2002)The Archaeomedes project, carried out in France in the 1990s, was a massive effort to

understanding of the most important factors influencing settlement location. I, on the other hand, aim to understand the influence of different versions of one, specific variable on settlement location. As far as I am aware, no other project has used multivariate location analysis to investigate a single variable. I am also unaware of any other project that systematically substitutes different versions of a variable to investigate its constituent parts as I do here. If my results are found to be convincing, the same strategy can be applied anywhere to investigate any phenomenon that can be expected to have had geographic consequences. Before applying this method in chapter three, I will describe my area of interest in the middle of the Lower Danubian Plain.

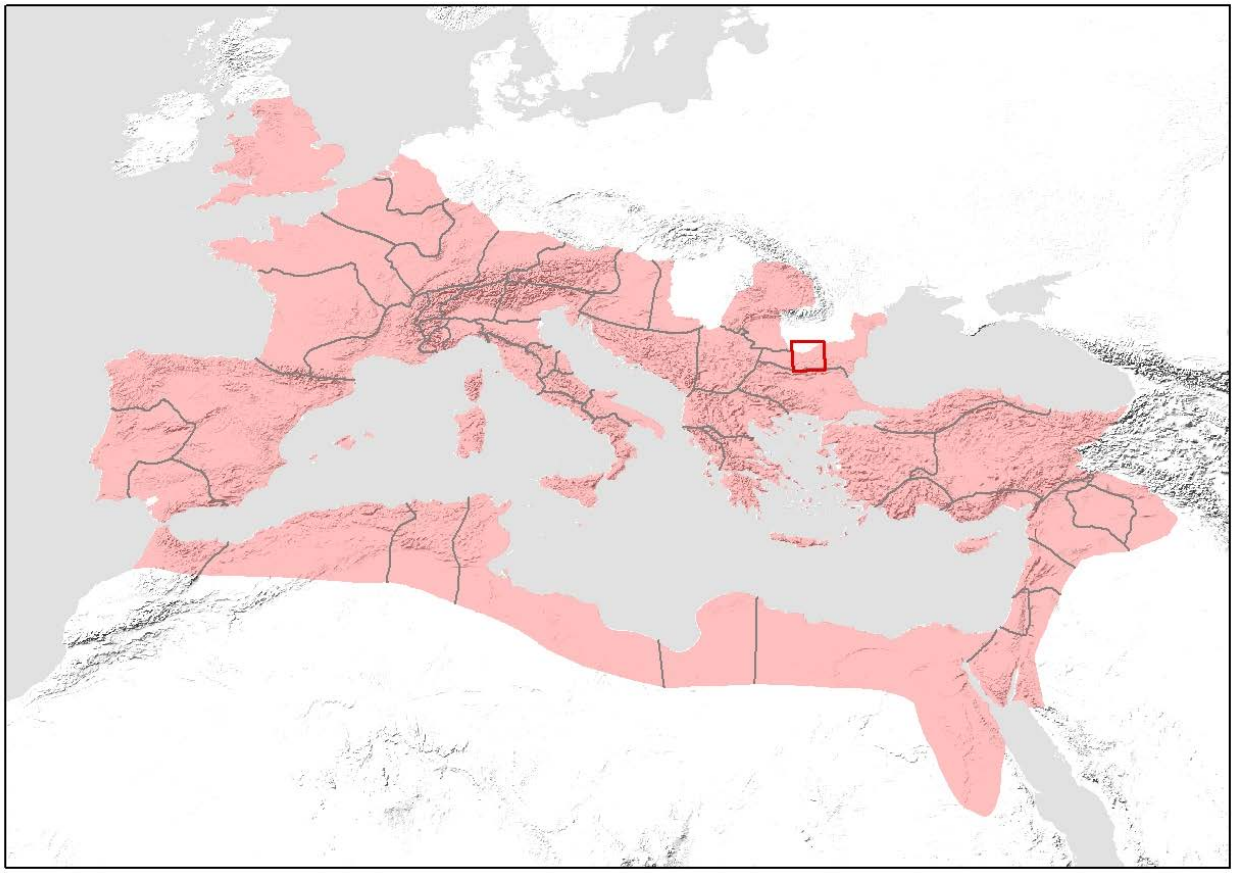
understand land degradation as a product of both natural and socio-cultural processes (Van der Leeuw 1998). As part of this effort, the Roman colonization of the lower Rhone valley and the subsequent contraction of rural settlement were examined to determine what in the landscape, if anything, influenced settlement location and survival (Van der Leeuw 1998, 201–208; Van der Leeuw and Team 2005). They did this through statistical analysis of the characteristics of settlement territories, as I do here, but they use principle component analysis and factor analysis. Both of these methods focus attention on the most influential factors in determining settlement location. Since I expect that the variable in which I am most interested is not the most influential variable in settlement location, these procedures are inappropriate for my purposes. Logistic regression analysis, on the other hand, retains variables with small influences. Helen Goodchild has investigated the environmental and social setting of farms and villas in the Tiber valley using a combination of univariate analysis and deductive, multivariate analysis (Goodchild 2007; Goodchild 2013). Like me, she relies on Roman agronomists to inform her choice of landscape factors and then tests the correlation between each factor and ancient settlements. She then combines the significant factors into suitability surfaces using manually weighting each factor according to its suitability for a specific purpose like wheat production. I, in contrast, rely on the creation of the logistic regression model to define variable weights. Stephen Kay and Robert Witcher have developed a predictive model for settlement in southern Etruria using an ArcGIS extension known as Weights of Evidence. Like logistic regression analysis, the weight of each factor is derived from the correlation of that factor to settlement presence (S. J. Kay and Witcher 2009). The interpretation of their model, however, is hampered by the difficulty in distinguishing taphonomic and behavioral causes for patterning.

Chapter 2: Roman rule in the central Danubian Plain

2.1 Introduction

The Danubian Plain (Map 1) has not played a central role in the investigation of Roman frontier society. Overviews of the social and economic aspects of the frontiers rarely discuss the Lower Danube (Cherry 2007; Whittaker 1994). This is understandable. The regional debates on which these overviews rely have focused on the relatively abundant archaeological and documentary records from North Africa (Cherry 1998; Fentress 1983; D. J. Mattingly 1994; Shaw 1983), Egypt (Alston 1995), Syria (Pollard 2000), the Rhineland (Kooistra 1996; Sommer 1988; Sommer 1999b; Strobel 2007b; Willems 1986) and Britain (Blagg and King 1984; A. K. Bowman 1994; Evers 2011; D. J. Mattingly 2006; Millett 1990). In contrast, the Lower Danube lay behind the Iron Curtain for most of the twentieth century so primary sources were difficult to access and there were few syntheses published in Western European languages (e.g. Gren 1941 for the Lower Danube; Mócsy 1974 for the Middle Danube; Lengyel and Radan 1980 for Pannonia). This is unfortunate as the history of the Lower Danube frontier sets it apart from other areas of the Empire. The area was not densely fortified until the end of the first and beginning of the second century, but in the third century it experienced intense military conflict and in the fourth century, the shift of the capital from Rome to Constantinople brought it from the periphery to the center of the Empire.[55] It is not yet known how this dynamic relationship with the imperial center influenced the nature of the frontier society that emerged on the Lower Danube.

[55] Orbis estimates that, at a fast military march, it would take just under 17 days to travel from Rome to Novae in the summer and over 23 days in winter ("ORBIS: The Stanford Geospatial Network Model of the Roman World" 2016 accessed April, 2016). In contrast, a similar journey from Constantinople would take over 10 days in both summer and winter as no sea travel is required. This would be a very significant difference for an emperor concerned with people crossing the frozen Danube. If a horse relay were dispatched from Novae to Constantinople at the first sign of trouble in January, it would take 3.3 days to make the journey and the message would arrive in capital on the fourth day. If soldiers left on the fifth day, they would spend 10.3 days traveling and arrive at Novae on the sixteenth day if they did not encounter the invaders before. A messenger going to Rome in January would not even arrive until the seventh day of the journey. By the same token, Constantinople is much more vulnerable to incursions across the Lower Danube than is Rome.



Map 1: The central Danubian Plain within the Roman Empire, ca. 200 CE.

2.2 The State of the Question on the Army's impact in Moesia Inferior

It is generally agreed that the military presence on the Danube fundamentally shaped society on the Danubian Plain in the Roman period. The simple presence of so many people who were not producing their own food stimulated increased agricultural production (Duch 2015, 236–237 estimates that, in addition to the fleet, around 20,000 soldiers were stationed in Moesia Inferior from the late first to mid second century, falling to around 18,000 in the second half of the second century). The military population demanded new types of pottery (Dimitrova-Milcheva 2008). The presence of the army created long-distance trade connections with both the eastern and western halves of the empire (Żmudziński 1998). The Roman government transferred wealth to the area in the form of soldiers' salaries, which in turn allowed for the growth of large urban centers around military bases (R. Ivanov 2004; Poulter 1983; Tomas 2012). While most of the military population lived near the major legionary fortresses, veterans and their families made up a sizeable minority of the rural population as well (section 2.7.3.3).[56] The army built roads and other transportation infrastructure that

[56] Duch estimates that soldiers made up between three and eight percent of the total population of Moesia Inferior in the first to third centuries (Duch 2015, 239–240). The figures seem plausible, but should be treated with caution as Duch estimates total population from hypothetical average population densities which do not take into account the unknown and shifting extent of forests. Furthermore, the population of Moesia Inferior was

lowered the cost of moving bulky cargo over land (Madžarov 2009; Panaite 2012). The imperial interest in the safety of traveling officials and in orderly tax-collection led the army to take steps against banditry. All of this created the conditions for the expansion of rural settlement in the Roman period that is detectable in the archaeological record (Conrad 2006).

The importance of the military in the history of Moesia Inferior is apparent, but some important questions remain unresolved. Did everyone benefit from the increased number of food consumers in the region? By what mechanisms were the military communities' various demands met? Could people outside the military *vici* take advantage of the soldiers' salaries? Did the influx of wealth change the pre-existing culture of exchange? Did the presence of immigrants change the food ways that had been practiced in the area? Was there a significant cultural divide between the military and local communities?

2.3 The "Natural" Environment

This section describes what, for convenience, might be called "the natural environment" of the Lower Danubian Plain (Map 2). This terminology is misleading as, already in antiquity, humans were shaping this environment.[57] It might be better to think of this as the structure within which each individual acted and which was very difficult if not impossible for him or her, as an individual, to change.[58] Among these structural features must be included the large-scale movements of people, wars, and the consequences of inclusion within empires.[59] Some particular events which instantiate these factors – the Roman conquest, the immigrations of Goths and others from beyond the Danube – are described in detail elsewhere. Here I will focus on the climate, topography, soil, hydrology, and vegetation of the area.

While these factors cannot be considered deterministic for the behavior of ancient people, they would have been influential. The "natural" environment provides opportunities and constraints which affect the ease and likelihood of success of different subsistence strategies. To understand how people actually behaved given this structure is the goal of this project.

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concentrated in the Greek cities along the Black Sea Coast, so any figure based on a uniform density is highly misleading. Historians have only recently begun to study systematically the demography of Moesia Inferior (Mihăilescu-Bîrliba and Curcă 2010).

[57] The literature on the environment in antiquity is vast and growing rapidly as climate scientists seek to better understand modern climate change. An excellent overview can be found in William Harris' edited volume, *The Ancient Mediterranean Environment between Science and History* (Harris 2013b) but, as the authors emphasize, the data are quickly changing and some of the specific conclusions will have to be updated.

[58] This is not to say that these structures were immutable, but rather that directed change could be brought about only through the collective action of many individuals. Such action could occur gradually over time or suddenly if many people worked in concert. Only individuals with significant social power could bring about the latter type of change intentionally.

[59] In a recent monograph, Roger Batty has persuasively argued that large-scale movements of people across the Eurasian steppes and the machinations of empires based in the Mediterranean should be seen as structural factors of this area.

2.3.1 Climate[60]

The Danubian Plain has a continental climate, meaning it has cold winters and hot, humid summers. Bulgarian climatologists have identified several different climatic regions within the Danubian Plain, of which the northern and middle regions intersect our study area. Most of the study area falls within the northern region, but the southern and southeastern parts fall into the middle region (Stanev, Kyuchukova, and Lingova 1991, 56 fig. 1.4). Average January temperatures for both regions are around -3° C, with lows from -14 to - 20° C. Average precipitation in the three winter months (December, January, and February) is between 115 and 140 millimeters, with more precipitation in the south. In this same period, there are around 50 days of snow cover. For farmers of winter wheat, this is enough to protect the plant from freezing, but not so much as to suffocate it (Spurr 1986, 21). Winter is also the season of the harshest winds, which blow from the west and northwest, and will desiccate plants not protected by the snow (Peterson 1965, 53–54). Winter conditions in the Danubian Plain also favor pastoral transhumance from the Balkans. The mountains experience more precipitation than the plain, but the biggest difference is in the number of days with snow cover: 80-100 in some places and over 200 in others (Figure 3). While there is somewhat more precipitation in the mountains, the decisive factor is the low temperature which keeps the snow from melting (Stanev, Kyuchukova, and Lingova 1991, 70–71).

Spring comes relatively early and quickly to the plain with temperatures rising permanently above 5° C by the middle of March. This is due to the rapidly lengthening days and air currents flowing unimpeded from the Black Sea. Spring winds are still predominantly westerly and northwesterly, but the frequency of northeasterly winds increases. Although the rapid onset of warm temperatures allows for a long growing season, there is a significant danger of spring frosts until mid-April. Total precipitation for the spring months (March, April, and May) ranges from 125 to 190 millimeters with more rain in May than March and with more precipitation in the south than in the north. The rain tends to come in downpours: of the 89 days in spring, only about 20 see more than 1 millimeter of precipitation. This is true both in the northern and middle climatic zones, so the deleterious effects of heavy showers on crops are more severe in the southern part of the Danubian Plain than in the north. For growers of winter wheat, the early onset of spring is advantageous, but there are serious risks from frost and storms. In this context, a spring-sown crop like spring wheat or millet will have been vital.

The summer months (June, July, and August) are hot. Average July temperatures are around 23° C with highs ranging from 35 – 36.5° C. June is the rainiest month of the year but August is relatively dry. Total summer rainfall is between 150 and 250 millimeters, with more in the south than the north. Despite the increased total, the number of rainy days is slightly less than in the spring, so brief, intense downpours are even more common. On the Danubian Plain, winter wheat ripens in late June and early July. In the early twentieth century it was harvested, then left in the fields to dry before being threshed in the second half of July and August (Timoshenko 1930). In this context, June storms are very dangerous as they can flatten a standing crop or leave it wet and liable to rust. On the other hand, the dryness of August and

[60] This section draws heavily from *Klimatat na Balgariya* (Stanev, Kyuchukova, and Lingova 1991).

September provides excellent conditions for threshing. Unlike in a Mediterranean climate, there is no summer drought, so livestock can graze the Danubian Plain all year.

The temperature drops quickly in October and the first frost arrives toward the end of the month, or sometimes in the beginning of November. September, like August, is very dry but October and November are rainier. Total fall precipitation is 120-150 millimeters spread across 17-19 days with more than 1 millimeter. This means the soil is damp but not water-logged and well-suited for plowing sowing.

In general, the climate is good for arable agriculture, but there are significant risks in the spring and summer, so summer crops are an important risk mitigation strategy. The other major risk is interannual variation in rainfall, which can be severe (Timoshenko 1930, 196, 231). This is reflected in Bulgarian wheat yield data for the period 1905-1914, over which time the average was 1,040 kilograms per hectare, but in 1907 it was only 660 kilograms per hectare and in 1913 it was 1,600 kilograms per hectare (FAO Regional Office for Europe. and International Institute of Agriculture. 1915, 28–29). For the sake of comparison, however, it should be noted that over the same time period, Italy's wheat yield was only 970 kilograms per hectare and fell behind Bulgaria's in every year but two.

The climate is also good for animal husbandry. Livestock fodder in the form of grass and wetland vegetation is plentiful, and snow covers the ground for less than two months out of the year. Even the dry months, July and August, immediately follow the wettest, which replenishes rivers and their adjacent wetlands. When fodder is scarce, pasture can be found in the higher lands to the south which receive more precipitation and enjoy numerous natural springs. Until the beginning of the 20th century, Bulgaria's agricultural production was focused much more on livestock, particularly sheep and cattle, than on grain production. It was only after the improvement of navigation on the Danube and the expansion of western European grain markets that grain began to be cultivated on a large scale (Timoshenko 1930, 212–215).

2.3.2 Topography, Hydrology and Soil

The southern bank of the Danube is steep (Map 3). In contrast to the northern bank, which is generally flat and prone to flooding, the bluffs on the south side provide numerous opportunities for surveillance and defense (Figure 11). The bank is interrupted periodically by the Danube's tributaries, most notably the Yantra and the Rusenski Lom. The Yantra river valley is broad for most of its course through the plain, but as it nears the Danube it cuts a deep gorge through the limestone bedrock (Figure 4). The mouth of the Yantra near the late Roman fortress of Iatrus formed a large wetland before it was drained in the mid-20th century (Figure 5). The mouth of the Rusenski Lom, near the Roman fort of Sexaginta Prista, is much narrower. Downstream from this junction, the bluffs become more gradual, gradually curving away from the Danube. Safe anchorages are provided by the mouths of these and other, smaller tributaries, as well as by several large islands in the middle of the river.

The Yantra divides the entire Danubian Plain into two geomorphological subzones (K. Stoyanov and Gachev 2012). The western subzone of the Danubian Plain is lower than the eastern subzone and has much gentler terrain. The plain immediately to the west of the Yantra contains long, straight ridges of hills with triangular cross-sections, forming broad, open valleys

with very gentle slopes (Figure 6). This area is drained by several small streams and the large Rositsa River in the south (Figure 7). The Rositsa flows from west to east through a very broad valley before joining the Yantra (Figure 8). Its left bank is higher than the right, and provided the platform on which the city of Nicopolis ad Istrum was built. Russian military topographic maps from the late 1877-78 show numerous wetlands bordering these streams, but they have since been drained (Map 6).

To the east of the Yantra, the elevation is higher. The uplifting of the terrain is strikingly illustrated by the line of hills that hug the right bank of the river through most of its journey to the Danube (Figure 9). The hills here undulate irregularly and the rivers of the Lom tributary network carve deep gorges into the limestone (Figure 10). These canyons meander in tight loops, providing a wealth of defensible positions, but also hamper overland travel (Figure 12). In the plateaus between the river valleys, groundwater is scarce due to the karstic geology which leads water through the limestone bedrock away from the surface.

On the south side of the plain, the Balkan foothills rise gradually (Figure 13). The land becomes rougher, but the number of springs increases and even here large rivers like the Stara form broad river valleys (Figure 14). There is a particularly broad plateau around the modern city of Strazhitsa where the Baniski Lom has its source (Figure 15). The steepness of the terrain restricts the area available for arable cultivation, but the river valleys and the abundant springs make the land that is available very fertile.

The Danubian Plain enjoys very fertile soils developed from Pleistocene deposits of loess (Map 7).[61] Chernozems and Phaeozems predominate, while the rivers deposit Fluvisols along their banks. All of these soils are high in organic content making them highly productive. Phaeozems, which are more intensely leached than Chernozems are more prominent east of the Yantra. Both the Phaeozems and the Luvisols which become more prevalent toward the mountains have clayey subsurface horizons, which may serve to retain water close to the surface.[62] The Chernozems closest to the Danube have a medium texture which becomes fine farther from the river. The Fluvisols, Phaeozems, and Luvisols all have medium-fine texture.[63] While this is heavier than most soils in Italy, and therefore more difficult to work with an ard, it is not heavier than the fertile loess regions of north-western Europe which are seen as extraordinarily productive in antiquity (Bakels 2009, 167–199).

2.3.3 Land Cover

A systematic investigation of the paleo vegetation in the study area has not been published. Nevertheless, there is enough information to give a general description. The presence of Chernozems, Gray-Brown Forest Soils, and Cinnamonic Forest soils indicates that at some point in the past the Danubian Plain was covered by steppe and deciduous forests (Shishkov and Kolev 2014, 28, 50–51, 105). Modern land use data show that most of the area is

[61] Whether this loess is aeolian or alluvial in origin is debated (Evlogiev 2007; Jipa 2013).

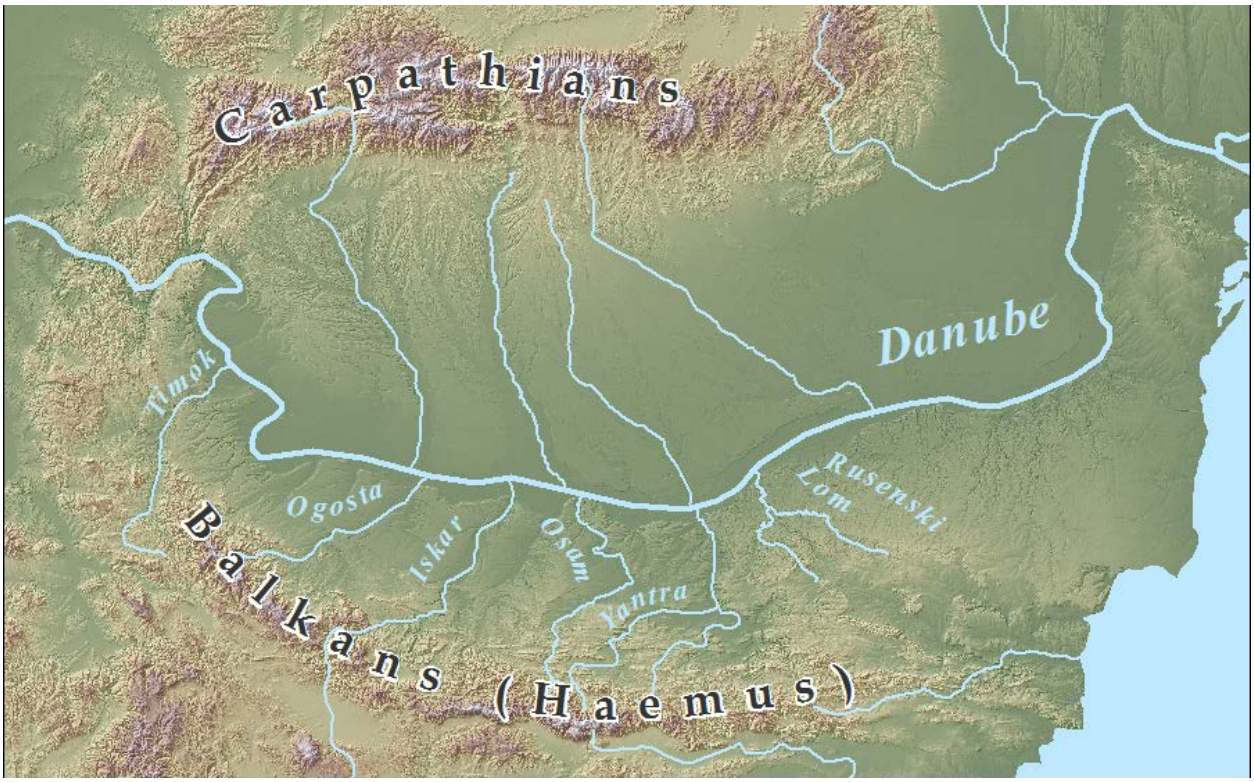
[62] These Phaeozems and the haplic Luvisols are referred to as Gray-Brown Forest Soils in the standard Bulgarian soil classification scheme. Chromic Luvisols are equivalent to leached Cinnamonic Forest Soils (Shishkov and Kolev 2014).

[63] For the definitions of texture descriptions see chapter 4. The soil classification system used here is the World Reference Base. For descriptions of these soils see *The Soil Atlas of Europe* (*Soil Atlas of Europe* 2005, 24–33).

under arable cultivation with patches of pasture land (Map 8). Pine and mixed oak-beech forests are common in the foothills and to the east of the Yantra, and palynological analysis in Lake Srebarna in northeastern Bulgaria has demonstrated that the area was covered in mixed oak forests 7000 years ago (Lazarova and Bozilova 2001). This has led some to the conclusion that the land to the east of the Yantra was entirely covered in impenetrable forests (T. Stoyanov 2000, 57), but this is not warranted. The same pollen cores show that deforestation due to climate change and the spread of agriculture began as early as the second millennium BCE and increased dramatically in the early Iron Age (Lazarova and Bozilova 2001, 93–4; Popova 2010; see Harris 2013a for a recent overview of the question of Mediterranean deforestation in antiquity).

There has been limited palynological investigation inside the study area. Nineteen pollen cores have been published from the late Roman fort of Iatrus, of which only one reached a pre-Roman level, but this showed a preponderance of non-arboreal pollen, including many anthropogenic indicators suggesting an open environment (Lazarova 2007). Three other pollen cores have been taken, but not yet published in full. Raiko Krauss, however, published some of the results in his examination of prehistoric settlement in the lower Yantra (Krauß 2006, 41–42). Two of these were taken from the area west of the Yantra and one was taken just barely east of the river, south of the site of Iatrus. These show dramatic forest contraction in favor of steppe grasslands during the Sub-Boreal period (mid-fourth to mid-first millennium BCE), with only modest forest recovery beginning in the Sub-Atlantic (mid-first millennium BCE to present). The Sub-Atlantic is also the period when anthropogenic indicators suggest major human impacts on the natural vegetation.

Botanical and faunal remains from the Roman period indicate that wooded areas continued to exist in the context of a generally open landscape. Bones from woodland mammals such as red deer and wild boar were recovered at Nicopolis ad Istrum, but they belonged to animals that would have been hunted for sport and did not constitute a large portion of the faunal assemblage (Beech 2007). Similar results were obtained from Novae (Makowiecki and Makowiecka 2002), Sexaginta Prista (Ninov 2013), Iatrus (Benecke 2007a), and Dobri Dyal (Poulter 2013a, 370). It should be noted that the game animals associated with forests can also survive in grasslands, so their bones are not a secure indication of wooded areas near the sites in which they were found. Further weakening the case for extensive forest cover is the fact that the Balkan Mountains were not deforested until quite recently. Even people living on the frontier could have made a long hunting excursion into the mountains and returned to deposit the bones of their quarry next to the Danube. The possibility of wooded areas in the plain cannot, of course, be discounted, but there is no reason to think that Danubian Plain to the east or west of the Yantra was extensively and thickly forested.



Map 2: The Lower Danubian Plain.

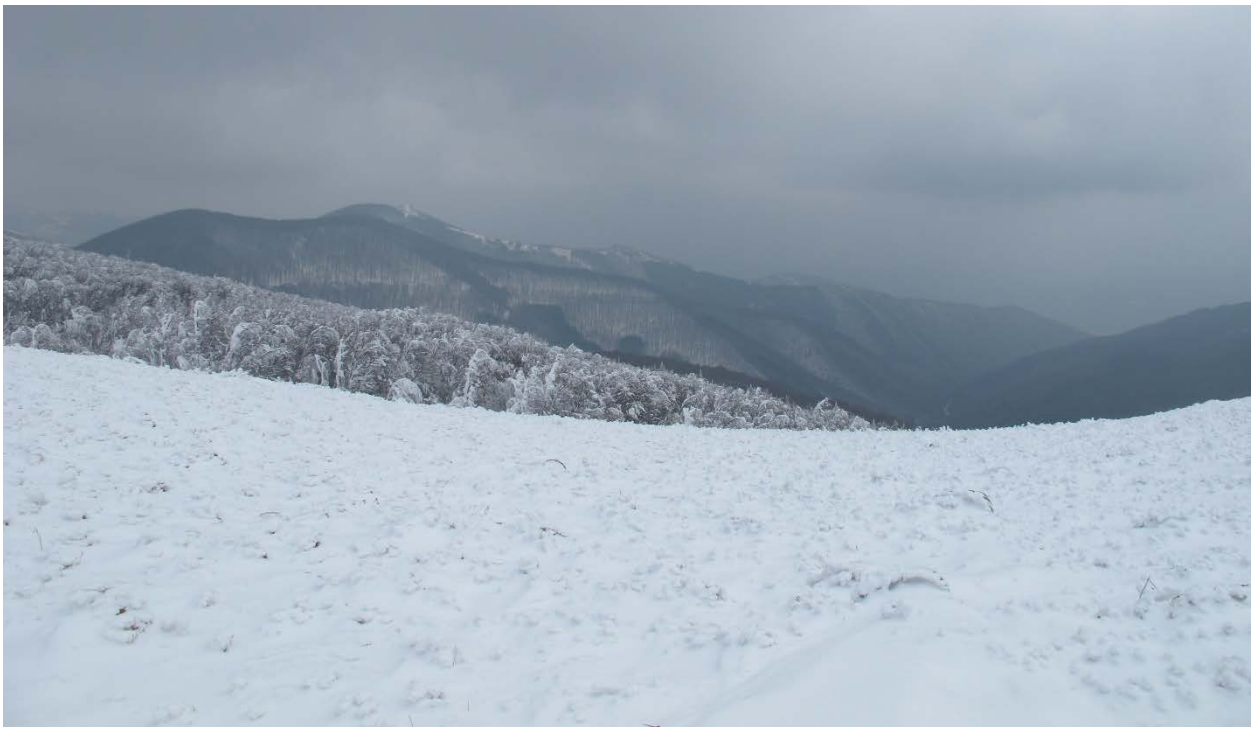
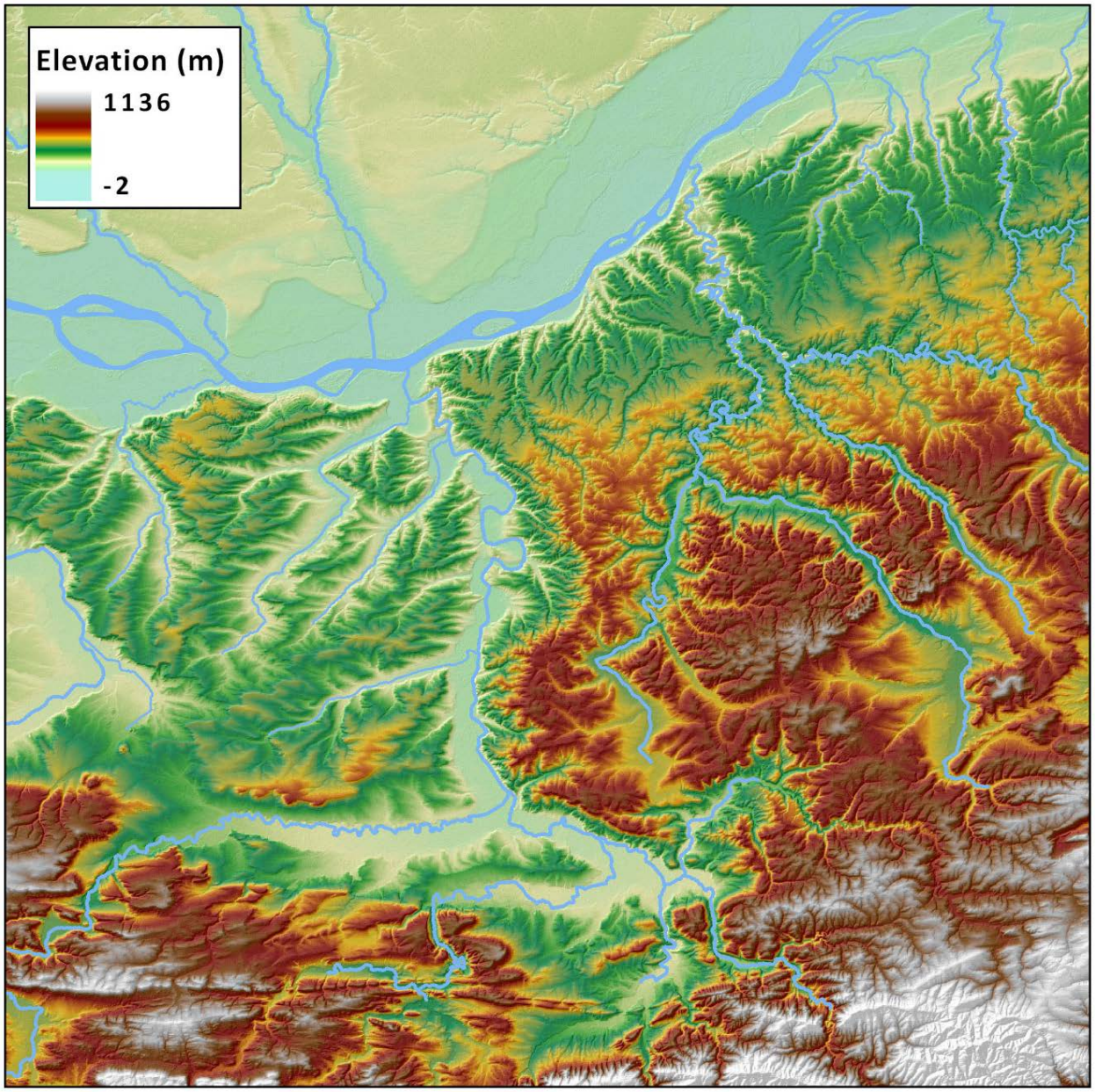
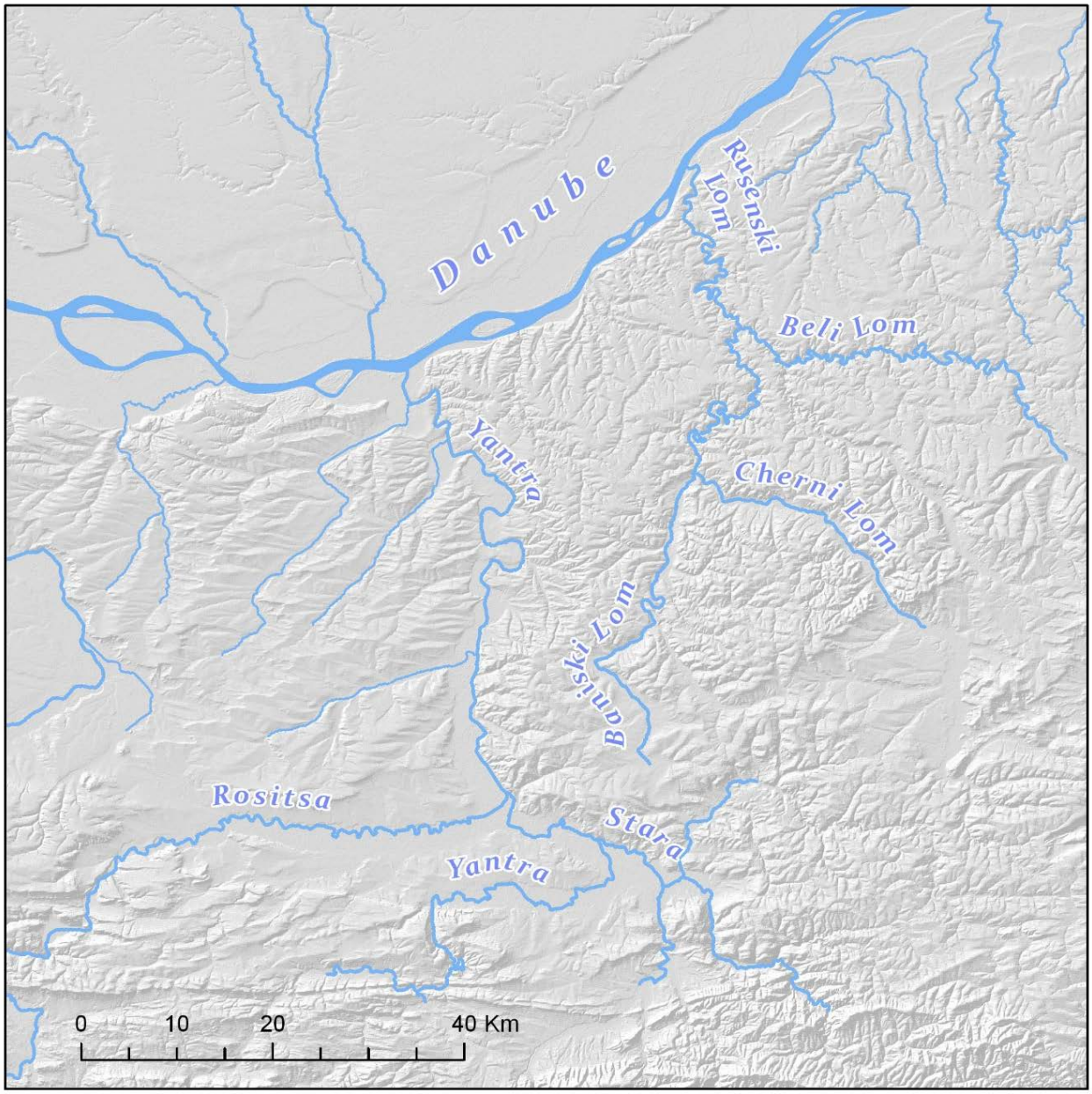


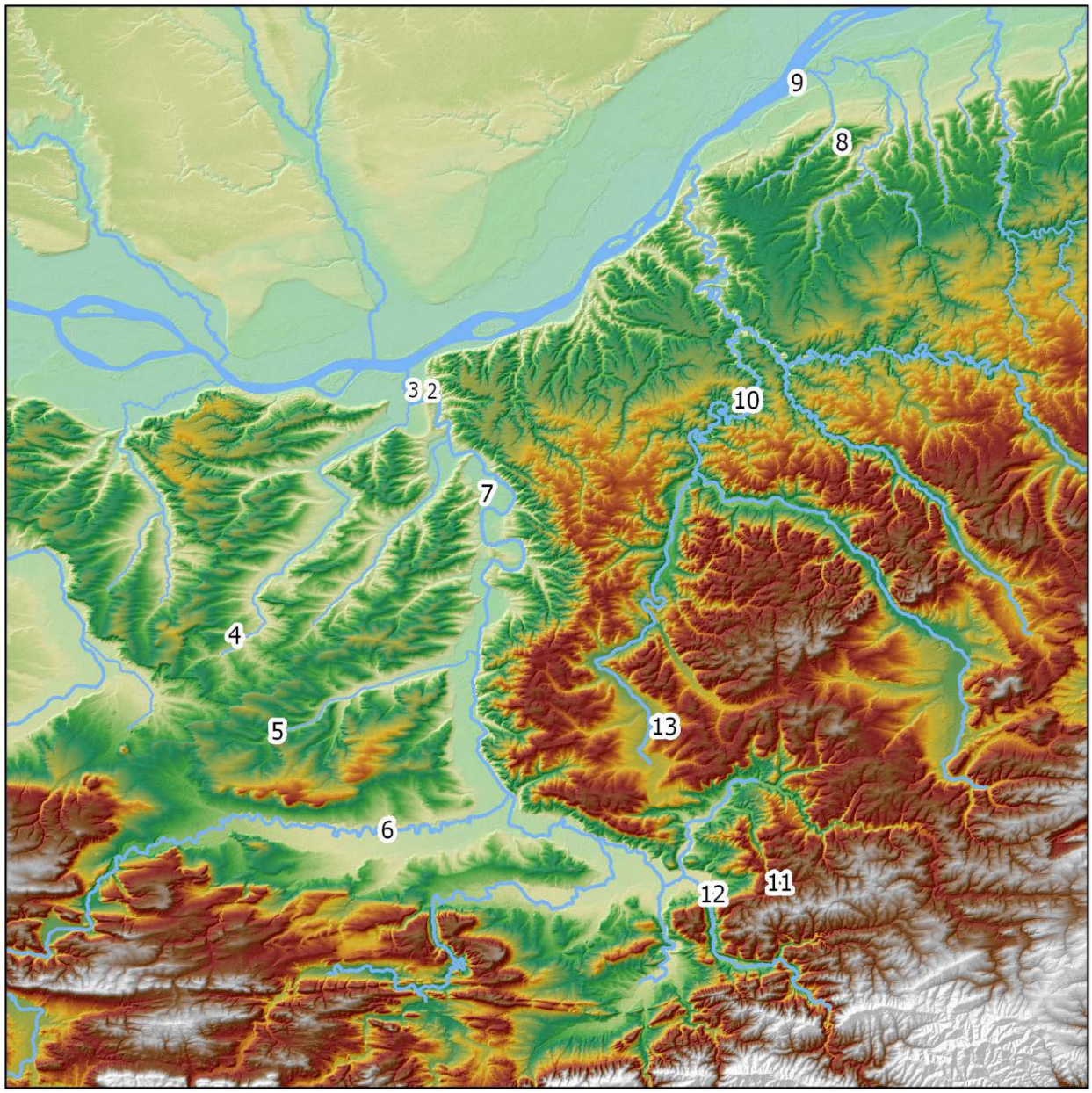
Figure 3: The Balkan Mountains covered in snow on March 13th, 2015.



Map 3: Topography of the study area.



Map 4: The major rivers of the central Danubian Plain.



Map 5: Locations of figures.

Figure 4: A gorge of the Yantra River before it reaches the Danube.

Figure 5: They Yantra River flowing through former wetlands near the Late Roman fortress of Iatrus.

Figure 6: A valley west of the Yantra.

Figure 7: A minor tributary of the Yantra on its western side.

Figure 8: The Rositsa River.

Map 6: Wetlands around the Rositsa and Yantra Rivers as depicted on a Russian military topographic map from 1877-78.

Figure 9: Looking across the Yantra River valley at the uplifted terrain to the east.

Figure 10: Irregularly undulating hills to the east of the Yantra.

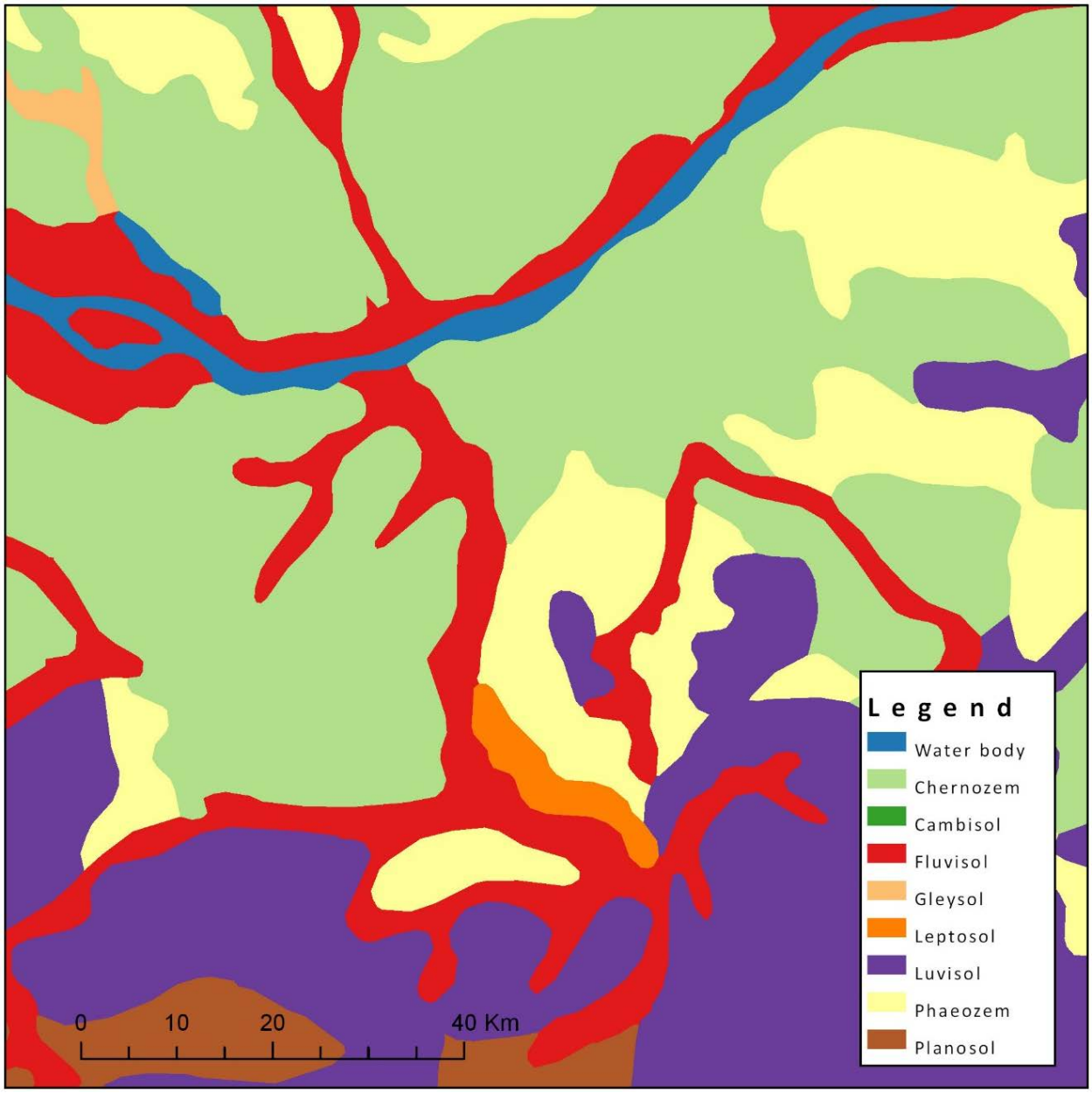
Figure 11: The view of the Danube from the Late Roman fort of

Figure 12: The Late Antique and Medieval fortress of Cherven located on a bend in the Cherni Lom River.

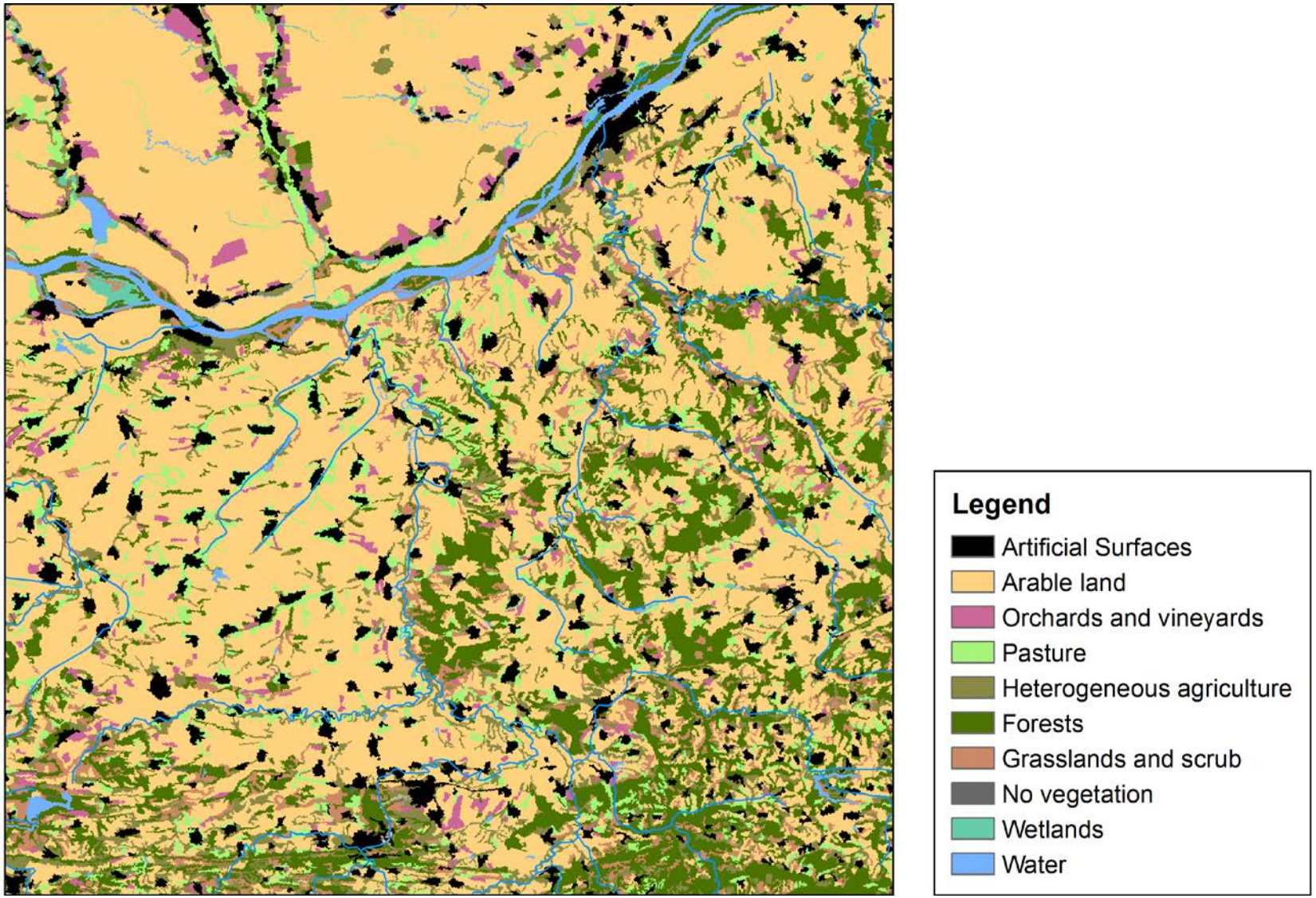
Figure 13: The foothills of the Balkan Mountains.

Figure 14: The Stara River.

Figure 15: The Strazhitsa plateau.



Map 7: Major soil classes of the study area. Data from the European Soil Database (European Commission and the European Soil Bureau Network 2004).



Map 8: Modern (1990) land cover. Data from the European Environmental Agency's Corine Land Cover inventory (Büttner et al. 2004).

2.4 Before the Roman conquest

The nature of the relationship that developed between the military and rural communities would have been shaped in part by the capabilities, dispositions and habits of the rural population. A portion of that population was made up of immigrants who arrived soon after the military communities, but many of inhabitants of the countryside would have been descended from people who lived in the area before the Roman conquest. The established economic habits of the indigenous population would have been particularly influential in the earliest stages of occupation. The ease of establishing Mediterranean style urban-rural relationships would have depended on the existence of a surplus production that could have been diverted toward the army, the desirability of that surplus for the army, the existing culture of economic exchange, and the density of the population able to produce that surplus.

2.4.1 Pre-Roman agricultural surplus production.

Detecting surplus production in the archaeological record is difficult. It requires evidence of population dynamics, storage capacities, crop specialization, and scales of production (Bakels 1996; Maaike Groot and Lentjes 2013). Little such evidence exists for the pre-Roman Danubian Plain. For this region the best available evidence consists of the indirect consequences of agricultural surplus production like specialized craft production, demographic concentration, and imports.

Specialist craft production and demographic concentration can be demonstrated at Sboryanovo[64] in the late fourth and early third century (T. Stoyanov 2003; T. Stoyanov 2000; T. Stoyanov 1999) but nowhere else.[65] This city, located to the east of the study area, was a political capital, founded around 340 BCE and destroyed by an earthquake around 250 BCE, after which it was abandoned. At its peak, the population may have exceeded 3,000 people, many of whom were engaged in metallurgy, to judge from the abundance of tools, products, and waste material. The sudden development and equally rapid disappearance of the city, however, show that it was created and maintained by the will of the Getic kings, not by the broader structure of Getic society (Hristov Popov 2002). Therefore, Sboryanovo attests to surplus production motivated by political elites rather than a large, stable group of non-food producers.

Other political and commercial centers have been identified in the Danubian Plain on the basis of amphora stamps, coin hoards and tumular necropoleis, but no settlement comparable to Sboryanovo has been uncovered. Some sort of political center existed in the region around Borovo, to judge from the tumular necropoleis, the coin hoards and the famous "Borovo treasure" (Stanchev 2002). Fortifications have been discovered at Byala, Svishtov and Zimnicea (Conrad 2006) and a settlement with a necropolis has been identified at the latter (Stefan 2009). A pit sanctuary near a settlement has been excavated under the Roman fort at Ruse (Varbanov 2013c). Finally, Tsarevets hill in Veliko Tarnovo has yielded Thracian layers (Tsarov 2007; Lilova 2005; Lilova 2002; Doulmova 2002; Ilcheva 2002; Ovcharov 2001; Chokoev

[64] See Map 9 for the places mentioned in this section.

[65] Stoyanov has identified the city at Sboryanovo with the city of Helis to which Dromichaetes brought the captured Lysimachus (Diodorus Siculus, 21.12).

and Stancheva 1999). Unfortunately, the current state of research does not allow any conclusions about the populations of these centers.

Evidence for imported goods implies the export of some sort of surplus. Some Italic luxury imports have been found to the west of the study area (Antonov and Torbov 2005), but in the central Danubian Plain, most of the published imports are amphorae from the Black Sea and the Eastern Mediterranean (Bozhkova 2008). Concentrations of amphora stamps on Tsarevets hill in Veliko Tarnovo, at Gorna Oryahovitsa nearby, and at the pit sanctuary in Ruse demonstrate significant consumption of imports in both Ruse and Veliko Tarnovo from the third through the early first century BCE (Bozhkova 2008; Bozhkova 2007; Bozhkova 2008; Madzharov 2013; Tsarov 2007). Unstamped, imported amphorae dating to the first century BCE to first century CE have also been found (Varbanov 2013b, 265).[66] Compared to the early Hellenistic period, however, the evidence for imported goods is weak.

The amphora stamps, along with coins, are helpful in determining the chronological scope of imports. The earliest stamp on Tsarevets hill is dated to the mid fourth century but the rest date from the second half of the third century to the first half of the second century. The stamps from Gorna Oryahovitsa have a broader range, with two dating from the late fourth to early third century and five dating from the late second to early first century (Tsarov 2007). In Ruse, the amphora stamps range from the early third century to the late second century (Madzharov 2013). These data must be handled with caution as we are dealing with a very small number of stamps (15 from Tsaravets hill, 17 from Gorna Oryahovitsa and 27 from Ruse) and the practice of stamping amphorae changed through time. This is especially apparent in Ruse, where the amphora stamps end in the second century BCE, but the majority of the pits in the complex date from the first century BCE to the first century CE.

The pre-Roman inhabitants of the Danubian Plain were capable of producing surpluses that supported an elite class and could be exchanged for imported goods. The evidence of Sboryanovo, hoards and tumuli all seem to indicate a relative economic peak from approximately the fourth to the second century, but this could be a result of the nature of the evidence—specifically the reliance of amphora stamps. While surplus production occurred, it seems to have been primarily driven by elites rather than a division of labor between food producers and specialists.

2.4.2 Pre-Roman and Roman food ways

It is important to know both what was being produced prior to Roman occupation and what the military communities demanded. A great deal of work has been done on the latter question drawing primarily on written sources and archaeological evidence from the northwest provinces (e.g. R. W. Davies 1971; Kooistra et al. 2013; Stallibrass and Thomas 2008a). The basic diet was heavily dependent on grain, meat, legumes, and wine. The types of grains and meat vary, but several forms of wheat – usually including bread wheat – along with barley and varying proportions of beef, mutton and pork seem fairly common.

[66] At Ruse, the vast majority of the pottery is locally produced and the imports are almost exclusively amphorae (Varbanov 2013b, 261).

Data on the food ways of the inhabitants of the lower Danube are uneven for both the pre-Roman and Roman periods. The best pre-Roman evidence comes from the pit sanctuary at Ruse underneath the Roman fort of Sexaginta Prista. This site produced a fairly large faunal assemblage but a very small botanical assemblage (Ninov 2013; Popova 2013). For the imperial period, faunal assemblages from the legionary fortress of Novae (Laszczak 2003; Makowiecki 1999; Makowiecki and Makowiecka 2002; Makowiecki and Schramm 1995; Ninov 2003) and the city of Nicopolis ad Istrum (Beech 2007; Beech and Irving 2007; Boev and Beech 2007) have been published along with botanical assemblages from Nicopolis ad Istrum (Buysse 2007; Popova 2002). Botanical remains from the Roman fort at Abritus have also been published, but only as a summary of all remains from the first through sixth centuries (Popova and Marinova 2000).[67]

2.4.2.1 Meat

The pattern of meat consumption in the pre-Roman period is best attested by the faunal remains from the pit sanctuary under the Roman fort of Sexaginta Prista (Ninov 2013). 115 pits dating from the second half of the second century BCE to the second half of the first century CE have been excavated (Varbanov 2013c). Almost no complete skeletons were found. Most of the bones are from cattle, sheep/goat and pigs, but horse, donkey, chicken, dog and cat are also present. In addition there is a small number of bones from wild animals including hare, red deer, roe deer, aurochs, wild boar, and hare. Fish bones and mussel shells are also common. The numbers of cows, sheep/goats, and pigs is roughly even in most pits, but one stands out as exceptional: pit 32 contained the remains of at least 42 pigs, but only three cows. The pigs were overwhelmingly juveniles and exclusively female or gelded. This pit also produced the latest datable artifact of the entire complex: a "Langton-Down" type fibula typical of the second half of the first century CE and found mainly in the northwest provinces (Hawthorne, Varbanov, and Dragoev 2011, 73; Varbanov 2013c, 82). It is possible, then that this assemblage is not reflective of normal, local practice. Pits 3 and 31, which overlap and are the largest pits in the complex, contain five cows, six sheep/goat and nine pigs. While the inhabitants of the lower Danube relied heavily on domesticated mammals for meat, they consumed beef, pork and mutton/goat in roughly equal quantities.

The faunal remains from Novae offer an interesting comparison. A deep pit in the southeastern corner of the mithraeum dating from the end of the first century to the beginning of the second century CE contained bones from three cows, two sheep/goats and five pigs, in addition to a dog and a red deer (Ninov 2003). Osteological remains from the second to third century in the *scamnum tribunorum* and the baths next to the principia show a similar species distribution with pig being most numerous followed by cattle and then sheep/goat.[68] Fish bones also make up a significant portion of these assemblages (Makowiecki 1999; Makowiecki and Makowiecka 2002). This stands in sharp contrast to the third to fourth century material

[67] The situation is better for Late Antiquity as the records from Nicopolis ad Istrum and Novae are joined by the published botanical and faunal remains from the Late Roman fort of Iatrus (Bartosiewicz and Choyke 1995; Benecke 2007b; Hajnalová 1982; Hajnalová 1991; Neef 2007), the botanical remains from the Late Roman fort at Dichin (Grinter 2007b; Grinter 2007a; Popova 2002; Popova 2009). These will be discussed below (section 2.7.2).
[68] These baths underlie the late Roman basilica and bishop's residence (Biernacki 2003). It should be noted that this material is quantified by number of identified bones rather than minimum number of individuals.

from sector IV, a residential and industrial neighborhood.[69] Here cattle dominate the assemblage overwhelmingly, distantly followed by horse, pig, and sheep/goat (Laszczak 2003). This is not a chronological shift as pig continues to dominate the other dated assemblages until the fifth to sixth century (Makowiecki and Makowiecka 2002). Other osteological assemblages from Novae have not been closely dated, but cattle prevail in all of them (Makowiecki 1999). Pork appears to be prevalent in the more socially prestigious areas of the camp while beef is prevalent elsewhere.

Osteological material from Nicopolis ad Istrum was collected by the British-Bulgarian team working in the area to the south of the city walls (Beech 2007). In the first period (100-175 CE) there were roughly equal numbers of cattle (25%), pig (27.7%), and sheep/goat (33.3%).[70] From the late second to mid third century, pigs begin to dominate the assemblage and the portion of cattle declines. The trend becomes particularly pronounced in the period from the mid-third to the mid-fifth century, when pigs constitute over 45% of the assemblage, and continues until the destruction of the city at the beginning of the seventh century. The Slavic layers, dating from the ninth and tenth century, are dominated by cattle.

The earliest osteological remains from Iatrus are dated to the third and perhaps the second half of the second century CE, the period known as "-A" (Vagalinski 2003). A third of the bones were identified as cattle, less than a quarter were pig, and 13% were from sheep/goat (Benecke 2007b). In the first half of the fourth century, cattle bones only made up 25% of the assemblage, while pig bones made up 28% and in the fourth to fifth century the proportions of cattle and pig were about even. The fortress was abandoned for a time in the later fifth century and when it was reoccupied in the sixth century half of all the bones were identified as cattle and only 14% were pig.[71]

Animal husbandry was already well developed in the late Hellenistic period before the Roman occupation. Pork, often seen as characteristically "Roman," was already being consumed regularly (cf. Stallibrass and Thomas 2008b for the situation in the northwestern provinces). Its significance may have increased in some contexts after Roman occupation, but this happened gradually. Chicken was also present prior to Roman occupation. In general, it seems that a fairly balanced mix of beef, pork and mutton persisted from first century into the second century. In the late second and third centuries, assemblages begin to be dominated by either cattle or pig depending, it seems, on social status. The shift that is most apparent in the archaeological record comes not with the Roman conquest but in Late Antiquity. Pork declines in importance in the fifth to sixth century at Novae and at Iatrus it is completely superseded by beef in the sixth century.

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[69] This is the site of the famous valetudinarium, but the hospital went out of use in the early third century (Dyczek 2003). Again, this material is quantified by number of identified bones.

[70] Quantified by minimum number of individuals.

[71] This pattern is different from the one identified by earlier osteological investigations which were heavily dominated by cattle bones (Bartosiewicz and Choyke 1995). This, in turn, increased the apparent contrast with the osteological remains from Nicopolis ad Istrum (Beech 2007).

2.4.2.4 Grains, Legumes and Fruits

There are very few published botanical assemblages from pre-Roman northern Bulgaria. At Sexaginta Prista, only one pit, dating from the first century BCE to the first century CE contained botanical remains other than wood and even this assemblage is very sparse. Nevertheless, it does demonstrate the presence of naked barley, wheat (either bread wheat or durum wheat), millet and cultivated grape (Popova 2013). The cultivation of vines in the Danubian Plain in the Hellenistic period is confirmed by the finds of grape pips and charred vine wood in a monumental tomb from the fourth to third century BCE near Sboryanovo (Popova 2005).

The scale of wine production and consumption in this area is illustrated by the spread of locally produced pottery associated with wine production, storage and consumption. In southern Romania, locally produced amphorae with anepigraphic stamps, billhooks and assemblages of vessels resembling Greek symposium equipment are commonly found in sites dating from the second century BCE to the first century CE (Sirbu 2003). The functional and qualitative range of these artifacts suggests that elites were consuming wine according to Mediterranean practices (Măndescu 2014). There is also evidence that at this time the consumption of wine became common at all levels of society. In the fifth to third centuries BCE wine drinking vessels were always made in precious metals and found in princely tombs, but beginning in the second century these types of finds become increasingly rare. Simultaneously, there is an explosion in the number and variety of clay drinking vessels that are modeled on Greek forms but have very distinctive anthropomorphic and zoomorphic decorations. These vessels are never found in public sanctuaries or tombs, but only in homes and pits (Sirbu 2003). The poverty of material and the contexts of deposition indicate a shift in the social meanings of wine consumptions and its commonality.[72]

Less research has been carried out on Late Hellenistic sites in northern Bulgaria, but recent excavations are beginning to show that there were production centers here as well. One of the commonly encountered wine-drinking vessels found in Romania is the relief-decorated bowl. To date, fragments of 50 of these bowls have been found in Bulgaria, of which 31 were found in Ruse. Considering the limited scope of excavations, this is a very large number. Furthermore, while some of these bowls were imported from known production centers in Romania, others are unique suggesting that the bowls were probably being produced here as well (Varbanov 2012b). The pit sanctuary at Ruse has also produced six anepigraphic amphora stamps of which three have no known parallel (Varbanov 2013a). Isolated examples of both relief-decorated bowls and anepigraphic amphora stamps have been found in other sites as

[72] This may explain a passage in Diodorus Siculus (21.12.5) in which the Thracian King Dromichaites, having captured Lysimachus, presents a banquet, serving the Macedonian captives rich food on precious-metal plates and vessels and serving his own men plain food in poor dishes. Despite the obvious theatricality of the scene, Diodorus specifically says that it was the custom for the Getae to drink wine from cups of horn or wood. The treasures from the late fourth and early third century amply demonstrate that the Getae drank wine from precious metal vessels at the time in which the story was set, but by the time Diodorus was writing in the first century BCE, it really does seem to have been the custom of the Getae to drink wine from vessels of poorer quality. To say that Diodorus was simply wrong (Măndescu 2014), or that he was taking artistic license (Sirbu 2003), ignores the historical context of the composition of the text.

well in the Bulgarian Danubian Plain, but nowhere in such concentrations as at Ruse (Varbanov 2012b; Varbanov 2011). When the Roman military communities arrived in the area in the first century CE they would have found a well-established tradition of wine production.

The most detailed archaeobotanical evidence relating to grain production published so far comes from the British-Bulgarian excavations at Nicopolis ad Istrum (Buysse 2007). Samples from the mid second century contain large amounts of bread wheat and millet. In the later second to mid third century, barley becomes more common as does, to a lesser extent, rye. Also present are lentils and bitter vetch, walnut, grape and blackberry. Rye continues to gain prominence in the third to fourth and fourth to fifth century samples, but it is never a dominant grain. Wheat, millet, barley, and rye continue to dominate the botanical samples until the destruction of the city. Broad bean (*Vicia faba*) appears for the first time in the fourth to mid fifth century. Prior to the fifth century, barley and rye are always found together and may have been grown as a maslin. In the mid fifth to early seventh century samples, millet always appears in combination with legumes.

Botanical remains from the Bulgarian excavations inside the city have only been published in summary form (Popova 2002). The samples date from the second to the fourth century, but too few were taken to establish diachronic change. Wheat, millet and barley are the dominant cereals while legumes are represented by lentils and bitter vetch. Rye is also present in every sample but never in large numbers.[73]

Botanical remains from Abritus have also been published in summary form and without chronological distinction. Bread wheat and/or durum wheat was by far the most common cereal followed by barley. The pulses consisted almost entirely of lentils but broad beans formed a significant minority (Popova and Marinova 2000). The low quantity of millet at Abritus distinguishes it from Nicopolis ad Istrum. It is interesting to note, however, that the most common cereal in both Roman sites and in the pre-Roman site at Sexaginta Prista was bread wheat.

What sparse evidence exists for food production in the pre-Roman period suggests that the rural inhabitants would have had little trouble producing the foods desired by the immigrant military communities. Pork beef and mutton, bread wheat, barley and even wine were all being produced prior to Roman conquest. The only Mediterranean staple missing is the olive, which does not grow in this climate. As far as it is possible to tell from the archaeological record, the people living in the Danubian Plain would have been able to produce almost all of the foods demanded by the military community without introducing new crops or animals.

[73] Intriguingly, two grains of Sorghum were also identified. This plant is found most commonly in Africa and India and is not considered to have been cultivated in the Mediterranean basin, let alone Europe during antiquity (Zohary, Hopf, and Weiss 2012, 73). Nevertheless, it has also been identified at the Roman fortress of Abritus (Popova and Marinova 2000), the late Roman fortress at Dichin (Dinchev et al. 2009), and the pre-Roman dynastic capital at Sboryanovo (Popova 2006), always in small numbers. Lest too much significance be attached to this, it should be noted that today Bulgaria is a major producer of brooms made from sorghum, so the possibility of contamination cannot be dismissed (Dahlberg et al. 2011).

2.4.3 The pre-Roman culture of economic exchange

Several coin hoards dating to the first century BCE and first century CE have been found in the central lower Danube (Paunov 2014; Paunov and Prokopov 2002). Coins, however, can be used in a different types of exchange and their presence alone does not indicate a culture of commercial exchange and the habit of monetized thought characteristic of the Roman economy (Aarts 2005 with responses; Howgego 2013; von Reden 2012; Wigg-Wolf 2011). The numismatic record can demonstrate the use of coins in commercial exchange in three ways: the widespread use of imitations; the presence of small change; and wear patterns. Imitations are the least secure indication. The minter of imitation coins is, by definition, hidden and therefore cannot acquire prestige through the production of coinage, but can acquire prestige through the acquisition and distribution of coinage (von Reden 2010 suggests that imitations may have bestowed prestige on the distributor by communicating their access to the outside world). Small change is a more secure indication of commercial transactions as the low value makes it less likely (though not impossible) that they were used in prestige-sphere exchanges. Wear patterns are the most reliable indication of commercial transaction as they result from frequent handling of a coin (Duncan-Jones 1994, 180–192).

Imitations are not uncommon in the numismatic record of northern Bulgaria. Already in the late fourth to early third century, imitations of Histrian coins were being minted in Sboryanovo (T. Stoyanov 2000). Among the imitations was found one cast coin weighing almost as much as a Histrian quarter drachm. The production of imitation small change at a standard weight is a strong argument for commercial transactions in the city.

Later imitations continue to be produced in this area. Recently a matrix for producing dies for “Sattelkopfpferd” (also known as “Vireju-Bukaresti”) type coins has been published (Draganov 2008). This type, dated to the second and first centuries BCE, is an imitation of drachmas and tetradrachms of Philip II. The matrix is in a private collection and so has no precise provenance, but it comes from somewhere in the Ruse district. The coins themselves are found primarily in south-central Romania and the Ruse region, so it is quite likely that they were produced here.

Imitations of Roman Republican denarii are rare in Bulgaria, but they are not unknown (Davis and Paunov 2012). They are similar to the “Dacian” imitations commonly found in Romania. Their primary zone of circulation included the Ruse district and areas farther east, but most extant specimens come from the Vratsa and Pleven districts along the Danube. They are generally found in combination with official denarii and so were probably not minted here.

Small change from the pre-Roman period is less common, but several hoards with bronzes of Philip II and Alexander, both genuine and imitation, have been found in north-central Bulgaria (Dimitrov 2005). The values of the coins range from one half to four drachmas and the distribution of the coins suggests they entered northern Bulgaria from the Macedonia through private, small scale transactions. Three of the hoards, deposited in the late fourth century, were found between Ruse and Veliko Tarnovo not far from Borovo and one contains a hybrid imitation (Philip II on the obverse, Alexander the Great on the reverse) that may have been minted in the area. These bronzes pre-date the Roman conquest by several centuries and

so prove only that commercial exchange had been practiced prior to Roman conquest, not that it was in practice at the moment of conquest.

Wear on a coin is an indication of a great deal of use. Often these coins have been in circulation for a long time, so the actual frequency of handling is hard to say, but no matter how old a coin is, it cannot be worn out unless it is handled (Duncan-Jones 1994, 180–192). The wear on imitations of Roman Republican denarii demonstrate that they circulated and so were used in commerce (Davis and Paunov 2012, 399). Paunov and Prokopov published an inventory of Roman Republican coins and hoards in Bulgaria in 2002 and an examination of the specimens from north-central Bulgaria reveals wear on several of them.[74] A large hoard from Popovo (no. 3) with a closing date of 12 BCE (though it could have contained coins all they down to Galba which have now been dispersed) contained worn denarii from 138 and 14-12 BCE; a hoard from Ruse (no. 58) closing in 49 BCE contained worn denarii from 127, 123 and 90 BCE; a hoard from Belene (no. 73) closing in 17 CE contained worn coins; a hoard from Batin (no. 100) closing in 54 BCE consisted entirely of slightly worn coins; and a worn denarius of 104 BCE was found alone in Butovo (no. 136). The hoard from Batin is particularly interesting because all the coins, not just a few old issues, were worn. They must have been used in commercial transactions.

Taken together – the imitations, the small change and the worn coins – the numismatic evidence suggests that the people living in north-central Bulgaria were familiar with commercial exchange in the last centuries BCE. This should not be particularly surprising as their neighbors, the Macedonians and Thracians to the south and the Greek colonies on the Black Sea coast to the east, all had monetary economies. Furthermore, the Getae frequently served as mercenaries in the armies of Hellenistic kings and Roman dynasts. Indeed, a Getic king had promised Marc Antony a large force for the battle of Actium, but never appeared (Plutarch, *Antony* 63.4; Cassius Dio 51.22; c.f. Appian, *Makedonikes* 18 for Perseus' attempt to hire Getic mercenaries). When the Roman soldiers arrived they would have found the locals well acquainted with commerce.

2.4.4 Demography

Accurate calculations of population are difficult even with the best evidentiary basis and in the Lower Danube the record of pre-Roman settlement is far from complete. On a very general level, it seems that occupation was probably sparser in the pre-Roman period than in the Roman period. A recent survey in the area identified 178 sites dated between the sixth and first centuries BCE, 136 from the first three centuries CE, and 203 from the fourth and first half of the fifth centuries CE. These figures amount to less than 30 sites per century for the pre-Roman period, over 45 sites per century for the Roman period and over 135 sites per century for the Late Roman period (Conrad 2006, 313 fig. 2). Within this general framework, the archaeological and historical evidence suggest some more detailed geographical and chronological trends.

The geographic distribution of pre-Roman settlement is illustrated by the survey mentioned above (Conrad 2006; Conrad 2008; Conrad and Stančev 2002). The identified sites

[74] The relevant hoards and finds are numbers 2, 3, 17, 18, 58, 59, 73, 86, 90, 92, 98, 100, 107, 112, 118, 125, 136, 138, 147, and 152 (see Paunov and Prokopov 2002 map 1).

seem to be concentrated in the river valleys of the Yantra and the tributaries of the Rusenski Lom (Conrad 2006; Zdravkova 2008). The karst geological basement would have limited the supply of water at the surface away from the river valleys (T. Stoyanov 2000), but the river valleys have also seen more intense archaeological prospection (Krauß 2006, 146). The area to the west of the Yantra seems to have been sparsely populated. Conrad notes that the settlements south of Svishtov yield very little material culture, perhaps an indication of brief occupation periods (Conrad 2006, 313–314).

It is very difficult to prove diachronic change in demography in the late Hellenistic period. One recent overview of settlements in ancient Thrace has argued that there was a dense, differentiated settlement system in the area of the Rusenski Lom from the second half of the fourth century BCE that continued at least until the second century CE (Hristo Popov 2015; T. Stoyanov 2000). The apparent lack of settlements in the second and first centuries BCE, however, might be a product of the datable material available.

Amphora stamps have been widely used to identify centers that were integrated into eastern Mediterranean and Pontic commercial networks (Bozhkova 2007; Bozhkova 2008; Tsarov 2007) and therefore were, perhaps, population centers, but the sources of these stamps stop producing them in the second century BCE. Hordes of precious metals and concentrations of tumuli have suggested the presence of a political center in the Borovo-Byala area to the east of the Yantra in the fourth to third centuries BCE (Stanchev 2002; T. Stoyanov 2000; Zdravkova 2008). Coin hoards in the immediate vicinity suggest the area flourished from the fifth to the second century BCE (Stanchev 2002). At the same time, the distribution of Late Hellenistic coinage, particularly Celtic coinage, shows that the areas around Veliko Tarnovo, the mouth of the Yantra, and the Rusenski Lom river remained important political and economic centers in the second and first centuries BCE (Paunov 2014, 186–190). A matrix for the production of obverse dies of Celtic coins was found somewhere in the Ruse region, further confirming the existence of a political center in the area (Draganov 2008). Distribution maps of hoards with the most commonly found Late Hellenistic coin types – Thasian and Macedonian – show a concentration in the area east of the Osam river and in the foothills of the Balkans, but there is a distinct gap in the area just west of the Yantra and south of the Danube (Paunov 2014, 138–148).

If there really was demographic contraction in the Late Hellenistic period, it could be explained by the immigrations and wars attested in the historical record (Batty 2007, 189–296). The Autariatae crossed the area in the late fourth century BCE, the Celts arrived in the early third century BCE, the Bastarnae probably appeared in the mid to late third century BCE, the Sarmatians are noticed south of the Danube in the first century BCE. Only slightly earlier in 341 BCE the historical sources identify a Getic king who made a treaty with Philip II which ensured his dominion of territory north of the Haemus mountains (Delev 2008). This was the first of a series of entanglements between local elites Macedonian kings (T. Stoyanov 1999; Theodossiev 2011). Even the campaigns that took place south of the mountains may have caused refugees to flee to the other side of the Haemus. Employment as mercenaries in the armies of Hellenistic kings and diplomatic gifts would also have enriched the area (Paunov 2015). In the first century BCE, Burebista was active in the area, though his impact is difficult to discern (Dimitrova 2007).

The Roman conquest of the area is described in greater detail below (section 2.5.1), but the fact that it consisted of multiple campaigns over almost a century means that the impact on local society must have been profound (Batty 2007, 400–404; Zahariade 2009, 39–58).

Unfortunately, without a wealth of closely dated settlements it is difficult to establish demographic dynamics in this period securely. Nevertheless, it is probable that the immigrants who arrived under the auspices of the Roman Empire found a landscape that was sparsely populated but not empty.

Map 9: Places mentioned in the text.

2.5 A history of violence: The process of Roman conquest, control, and collapse

In reviewing the sequence of violent episodes that shook the middle Danubian basin from the first century BCE to the sixth century CE, it is necessary to distinguish between two types of violence. Low-level violence is often termed "brigandage" or "banditry" and involves small groups of people acting independently. A peasant who fears brigands fears that he may be beaten or killed, that his donkey may be stolen. If the bandits come in a large group they may burn his house down. For an individual and a household, this is a tragedy, but with the help of social support networks it is possible for a household to recover. For a community and a society, no individual act of banditry is an existential threat.[75] The danger of brigandage was always present, but there is evidence that the Roman state took measures to mitigate that risk

[75] See, however, Strabo 3.3.5 for a description of the erosive effects of banditry over time.

especially to travelers. The primary focus of this section, however, is on the second type of violence.

High level violence is described by terms like "invasion" or "conquest." It involves much larger groups committing a series of violent acts. A peasant who fears invaders fears not only for himself and his household, but for his entire village and extended family. Entire flocks can be stolen and communities killed or enslaved. Invasions destroy the networks of social support that help individuals recover from tragedy. A community can recover from an invasion, but it requires the assistance of larger, possibly more fragile support networks. They may have to appeal to an external power who may demand concessions in return for assistance. They may have to migrate away from their homes. Both levels of violence are tragic, but the tragedy of low-level violence is experienced at an individual and household level while the tragedy of high-level violence is experienced at a societal level as well.[76] The military history of the region that follows should be read as a sequence of tragedies, the intensity and frequency of which had powerful impacts on local society.

2.5.1 Conquest

The first Roman campaigns in the territory that would become Moesia Inferior took place in the late 70's BCE. C. Scribonius Curio, in the process of subduing the Dardanians, is said to have reached the Danube, probably by way of the Timok river and thus to the west of our area of interest (Papazoglu 1978, 409–410. For a detailed account of the Dardanian wars see pp. 179-183). Soon after, M. Terentius Varo Lucullus campaigned in the Thracian plain, the Haemus Mountains, and along the coast of the Black Sea. His primary aim seems to have been the submission of the Greek cities allied to Mithridates so it is unlikely that his campaigns reached the central Danubian Plain (Papazoglu 1978, 410–414; Zahariade 2009, 49–50). Nevertheless, Roman campaigns can be expected to displace people who may have fled to our area.

The area around the Yantra may have been affected by the wars of Burebista in the middle of the century. Burebista's empire stretched from the Pontic coast to the future province of Pannonia and Strabo says that he would cross the Danube to plunder Thrace (7.3.11). A decree from Dionysopolis, however, says that Burebista had gained possession of land on both sides of the river (*IGBulg* I^2 13) – presumably referring to the Danube – so many put the borders of his kingdom and the Haemus mountains (Crișan 1978; Dimitrova 2007; Papazoglu 1978, 332–337; Zahariade 2009, 28–29, 51–52). Of course, the area around the Yantra may have been plundered and then incorporated into Burebista's kingdom. Whatever the case, the mid first century BCE was a period of unrest and probably violence. When Burebista died in 44 or 43 BCE his kingdom was split into several, unstable parts (Strabo, 7.3.12. For the date see Crișan 1978, 241–245).

[76] It is probably impossible to define criteria to neatly divide episodes of violence into low-level and high-level categories. Liminal cases can certainly be found. Nevertheless, distinguishing two poles on a spectrum of violence is useful for understanding how people respond to specific episodes. It may also be illuminating to interpret certain behaviors as anticipatory of different types of violence.

The first Roman campaigns to take place in our area were those of Crassus in 29 and 28 BCE.[77] They were sparked by an incursion of the Bastarnae south of the Haemus Mountains, but Cassius Dio says that they had already crossed the Danube and subdued the plain. The Bastarnae must have taken advantage of the political uncertainty following Burebista's death to expand their territory.[78] When they crossed the mountains and attacked a Roman ally, the governor of Macedonia took the opportunity to win glory by subduing the peoples living in and north of the Balkans. The details of the campaigns are less important than their effect on the area. Crassus conquered the peoples from what is now northwestern Bulgaria all the way to the Dobrudzha through a combination of war and terror (for the geographic extent of the campaigns see Papazoglu 1978, 414–428). He attacked groups who had never injured Roman allies and when he was harassed by groups who had previously submitted, he punished them by conquering them again and then cutting off the hands of the captives (Cassius Dio, 51.25.4). Some groups, like the Odrysae and the king Roles, benefitted from Crassus' wars, but for the most part, Dio's account describes a trail of slaughter.

Roman campaigns in Thrace after those of Crassus seem concentrated in the Thracian plain and the Haemus mountains, though there is a brief mention (Cassius Dio 54.20.3) of Sarmatians being driven across the Danube (Kirov 2007; Wilkes 1996; Zahariade 2009, 55–58). The area north of the Haemus was entrusted to the Thracian client kingdom until its annexation in 46 CE, at which point the legionary fortress at Novae was established.[79] The circumstances surrounding the Thracian annexation are rather obscure. Roman officials had been deeply involved in the administration of the kingdom for decades when the last king was assassinated (Danov 1979, 130–147). The only hints of violence are the establishment of the legionary fortress at this time and a mention of a "recent Thracian and Bosporan war" in Tacitus (*Annales* 12.63). The sources record no violent episodes in the area until the Sarmatian attacks in the late 60s CE. It is impossible to rule out the possibility that there were invasions that have gone unrecorded due to the political marginality of the area. As far as it is possible to discern, however, the region around the Yantra River did not suffer high-level violence for nearly a century after Crassus' bloody conquest.

The 60s appear to be a decade of turmoil in the areas to the north of the Danube. An inscription describing the career of Ti. Plautius Silvanus Aelianus describes a flurry of diplomatic activity involving previously unknown groups (*ILS* 986 = *CIL* 14.3608).[80] Tacitus records Sarmatian incursions into Moesia in the winters of 67/68 and in 68/69 (Tacitus, *Annals* 1.79). They not only plundered the province, but won significant victories against Roman armies, destroying two cohorts in 67/68. Dacians then attacked in the winter of 69/70. Tacitus says they

[77] Cassius Dio provides a relatively lengthy description of Crassus' activities at 51.23.2-27.3. Papazoglu offers the most thorough discussion of this campaign (Papazoglu 1978, 414–428).

[78] That this was a migration and not a raid is indicated by the presence of wagons and families mentioned at 51.24.4. (Batty 2007, 23–24, 400–401).

[79] The bank of the Danube East of Dimum was a military prefecture called the *ripa Thracica*. It is debated whether the area east of the Yantra was incorporated into the province of Moesia at this time or only later under the Flavians (Lica 2000, 146–149; Tacheva 2004; Zahariade 2009, 34).

[80] The inscription has long been known and debated. Pippidi is usually cited as the definitive source, but Wheeler cites other sources as well (Pippidi 1967, 287–348; Wheeler 2011, 203–205 n. 139).

stormed auxiliary bases and were about to destroy a legionary base when they were defeated by Mucianus bringing troops from the east (Tacitus, *Annals* 4.46). Later in 70, the Sarmatians attacked again and won a significant victory, which in turn prompted a strong major retaliation and strengthening of the fortifications along the river (Josephus, *Bellum Judaicum* 7.90-99). Tacitus never specifies the precise theater of operations, but he describes these incursions as extensive, and there is a thick, burned layer on the eastern wall of Novae dating to this period, suggesting that the violence probably affected the study area (Paunov and Doncheva 2013; Press and Sarnowski 1990, 228; Syme 1984, 1001).

Domitian's Dacian wars are poorly served by the historical record because of his later "*damnatio memoriae*," but there are attestations of plundering in Moesia occurring in the 80s. More certain is the fighting that took place in the area during Trajan's Dacian wars in 101-102 and 105-106 CE. Trajan won a major victory near the Yantra which he celebrated with the foundation of a city (Wheeler 2010, 1207). While there was probably some fighting in this area, the war was launched from Moesia Superior and most of the violence occurred to the north of the River. The most significant impact of the Dacian wars was probably psychological: Trajan's conquest of the kingdom of Decebalus removed a major threat to the lands south of the Danube. The chain of military bases probably made local populations feel safer from plundering Sarmatians. They might have been at risk of abuse from the soldiers and other Roman officials, but this type of violence would have been more akin to low-level brigandage than invasion. After forty years of semi-frequent episodes of intense violence, the inhabitants of the region may have felt cautiously optimistic at the beginning of the second century.

2.5.2 Control

That optimism was not seriously challenged for seventy years.[81] In 170 or 171 several groups including the Costoboci invaded Moesia Inferior and penetrated as far south as Greece (*H.A. Marcus Aurelius*, 22.1-2, Pausanias 10.34.5). The Costoboci were probably in search of land after having been driven from their own territory by the Astingi, but this migration was not peaceful (Cassius Dio 72.12.1-2; Batty 2007, 374–376, 482 seeks to downplay the violence of the episode). The evidence of coin hoards and closely dated destruction layers at Novae, Nicopolis ad Istrum and a villa near Pavlikeni all attest to an episode of significant violence in the central Danubian Plain that could easily be associated with the Costoboci (Gerov 1977, 118–123; R. Ivanov 1999, 109; Varbanov 2007; Vladkova 2009). In the mid 170's, the city of Nicopolis ad Istrum received a monumental curtain wall similar to other cities in the region (Poulter, Falkner, and Shepherd 1999, 15; Poulter 2007d, 58–61). This could be seen as an attempt by the imperial government to reassure people in the provinces that they would be secure in the

[81] The author of the *Life of Hadrian* in the *Historia Augusta* mentions a rebellion of Sarmatians and Roxolani that lasted from 117-119 after the death of Trajan (*HA Hadrian,* 5.2, 6.6-8, 7.3), but there is little evidence that this seriously affected the area under investigation. (Găzdac 2012; Gerov 1977, 116–117; Mócsy 1974, 99–101). Similarly, there are hints of two wars against Dacians in the reign of Antoninus Pius (r. 138 – 161 CE) but these were primarily fought north of the Danube (Varbanov 2007).

event of another invasion.[82] Judging from the quick recovery of the villa near Pavlikeni and at Nicopolis ad Istrum, these efforts were successful.

Again, the relative peace was broken after about seventy years, but the invasions of the mid third century were much more devastating than those of the Costoboci. Given the state of the evidence, it is difficult to compare the destructiveness of different episodes of violence, but in the middle of the third century, the Danubian Plain suffered a sequence of invasions in the years 238, 245-7, 248 and 250/251 (Varbanov 2012a).[83] The most damaging was the last. According to Jordanes (*Getica* 18 [101-103]), a newly appointed Gothic king name Cniva led 70,000 soldiers to ravage Moesia knowing that it was defenseless because of the negligence of the emperors (Boteva 2001 defends the historical accuracy of Jordanes' account of these invasions). He first attacked Novae but was driven off, at which point he made for Nicopolis ad Istrum. When the Emperor Dacius approached, Cniva crossed the Haemus Mountains and laid siege to Philippopolis. The Imperial army then followed the Goths across the mountains, but Cniva's soldiers caught them off guard and Decius was forced to flee back to Novae where the "*dux limitis*" was mustering troops.[84] Cniva, meanwhile, took Philippopolis after a long siege and allied himself with the general in the city. There followed a period of conflict culminating in Decius' defeat and death near Abritus (R. Ivanov 1999, 111–112).

The region around the Yantra, then, was the theater of war both before and after Cniva's capture of Philippopolis (Potter 2004, 245–246 gives an abbreviated account of this episode in which most of the action takes place to the east of this area, but he takes into account neither Jordanes' testimony nor the numismatic evidence mentioned above). Given that the imperial army was headquartered in Novae and the final battle occurred near Abritus, it seems unlikely that Decius should have crossed the mountains to fight Cniva near Philippopolis and then re-crossed them for the battle near Abritus. It is much more likely that the Goths turned north again after Philippopolis, especially as Jordanes says Cniva forged an alliance with the commander in the city in order to fight Decius (*Getica* 18 [103]). This means that the central Danubian Plain was occupied by one and sometimes two major armies for at

[82] The standard interpretation is that it was part of a second line of defense which meant to secure the passes through the Haemus—in this case, the Shipka pass (Wilkes 2005b, 159–160; Zahariade and Gudea 1997, 37–40). The two interpretations are not mutually exclusive.

[83] Invasions continued to afflict the lower Danube until the reign of Diocletian, but there is no evidence for their direct impact on the area under investigation (Drinkwater 2005 gives a narrative account from the imperial perspective). The literary record for the third century is notoriously unreliable and scattered. Archaeologists have sought to define the chronological and territorial extent of different invasions using destruction layers, but these traces are rarely dated precisely enough to be securely correlated with the literary record. Coin hoards have been seen as a more promising avenue of research because the coins themselves can be precisely dated and it was long assumed that the most common reason for the non-recovery of buried wealth was the death of the owner. Boris Gerov wrote the authoritative account of invasions in the East Balkans on the basis of hoard data and his conclusions have been repeated by numerous subsequent scholars (Gerov 1977). The "threat theory" that underpins Gerov's reconstructions has been challenged, forcing researchers to develop more rigorous methodologies in interpreting hoard data (Varbanov 2012a, 289–298 with literature). Further, the number of published coin hoards has increased dramatically since Gerov wrote. Younger scholars have synthesized this data, challenging and refining many of Gerov's conclusions, but reaffirming the general impression of widespread instability in the middle of the third century (Găzdac 2012; Varbanov 2012a)

[84] The title is anachronistic.

least one season. For people living in the countryside, the presence of a Roman army was probably preferable to the presence of a Gothic one, but neither would have been welcomed. Both armies would have taken supplies from the locals (see Adams 2007a for the impact of irregular levies on local economies). Soldiers collecting supplies, whether it is called "foraging" or "pillaging," can cause serious property damage. Farmers must have preferred to collect and deliver the supplies themselves in order to keep armed men away from their property. Whether this was labeled "requisition without remuneration" (about which Cassius Dio complains bitterly, 78.9.3) or "extortion," the producer maintains a greater degree of control in this case. As far as military supply is concerned, one cannot assume that the Goths were worse than the Romans.

This does not mean there was no difference between the two. After all, the Goths were operating in hostile territory, trying to acquire wealth through the application of violence. Their attacks on Novae and Nicopolis ad Istrum probably involved a general ravaging of the countryside in order to compel the defenders of the cities to come to terms. The Romans, on the other hand, were not trying to coerce local property owners and therefore would have had no reason—beyond the greed of the soldiers—for indiscriminate destruction. The arrival of any army will place a burden on locals, but a hostile army will inflict significant damage over and above what is necessary for its sustenance.

After an episode of high-level violence like this, farmers would have to repair what damage they could and replace what had been taken. But this process takes time and in the middle of the third century, these episodes followed each other after only a few years. Each invasion would have hampered recovery from the previous episode, compounding the damage. Further, the inhabitants of the empire would have lost their confidence in the ability of the Empire to provide security, making them unlikely to invest effort and capital in the land. The long-term impact of an invasion, therefore, is determined by its aftermath: if the survivors are able and willing to invest in recovery efforts, the impact could be minor, but if not, the invasion could be devastating. This seems to be what happened in the Danubian Plain in the third century.

The lower Danubian frontier continued to be a conflict zone until the Tetrarchy managed to reassert Roman power in the late third century, but none of the invasions following Cniva's can be definitively associated with the area around the Yantra. Nevertheless, the area would have been vulnerable to raids[85] and upheavals caused by refugees fleeing violence elsewhere.[86] The same is true of the disturbances attested between Constantine's accession in 306 and the peace treaty he made with the Goths in 332 (Kulikowski 2006, 357–361). This peace lasted for over forty years, for Valens' Gothic war of 367-369 was a Roman invasion of

[85] The settlement that preceded the fortress at Iatrus contains two burnt layers dated to 270-292/2 and after 291/2 which could be, but are not necessarily evidence of hostilities.

[86] The evacuation of Dacia created a large refugee population for whom Aurelian created new Dacian provinces between the two Moesias (Eutropius, *Breviarium* 9.15). The central Danubian plain remained a part of Moesia Inferior (now Moesia Secunda), but the demographic displacement caused by the loss of Dacia may have had indirect impacts here.

Gothic territory (Lenski 2002, 127–137).[87] It was not until the Gothic immigration and uprising of 376 that the Danubian Plain became a war zone again.

2.5.3 Collapse

The collapse of Roman control of the Danubian Plain was fitful and only recognizable as a collapse in hindsight. Between the late fourth century and the end of the sixth century, the empire lost and regained military supremacy of this area several times before losing it permanently at the beginning of the seventh century.[88]

The Gothic war that began with the immigration of the Tervingi in 376 was a monumental catastrophe. For the imperial state, the catastrophe came in 378 when the eastern Roman army was destroyed at the battle of Adrianople, but for the Danubian Plain, disaster struck in 377. After the initial uprising at Marcianopolis and the subsequent revolt of previously admitted Goths at Adrianople, the Goths plundered all over Thrace (Ammianus Marcellinus, 31.6). The imperial response was to drive the Goths north of the Balkan Mountains (Ammianus Marcellinus, 31.7.3). After an inconclusive battle, the army blockaded the passes through the mountains. Because the Goths could not take walled towns or forts, all the supplies were gathered in to the towns and the Goths were left to starve (Ammianus Marcellinus, 31.8).

From the imperial perspective, the goths were surrounded, but the people living in the Danubian Plain were essentially abandoned to the predation of armed and starving hoards with only their walls to protect them. Anything that could not be moved would have been lost. To make matters worse, Ammianus reports that this happened in the autumn. The late summer harvest was probably complete, but if the Goths prevented the plowing and sowing of fields with winter wheat and barley, the population would have been at risk of famine the following year.

After the Goths broke through the mountain passes, the war continued for five more years until, in 382, they agreed to a treaty with Theodosius according to which the Goths were given land in exchange for peace and military service. The location of this land is never specified, but it is very likely that much of it was in the Danubian Plain (Heather 1991, 159). They lived as a semi-autonomous group, culturally and legally distinct from the Roman citizens in the area. The Goths were not unified, however, and conflicts are attested in the late 380 and 390s both between Gothic factions and between the imperial army and deserters (Heather 1991, 158–165, 181–192). After Theodosius' death in 395, Alaric led a large band of Goths to Constantinople, and thence to Macedonia, Thessaly and Greece. Some form of agreement was reached in 397 which gave Alaric an important position in the imperial military administration. It is not known whether his soldiers returned to the lands they had acquired in 382 or if they moved somewhere else. In any case, most of the fighting seems to have taken place well away from the Danubian Plain (Heather 1991, 199–208). The same is probably true of Alaric's

[87] This is not to say there was no violence and no tensions between Goths and Romans. Small scale raiding seems to have continued throughout the fourth century, but this was low-level violence (Lenski 2002, 124–125).

[88] The literature regarding this period is extensive. Peter Heather's monograph focused on the Goths is seminal and conveniently summarized in the *Cambridge Ancient History* XIII and in *The Transition to Late Antiquity* with particular focus on the Balkans (Heather 1991; Heather 1998; Heather 2007).

expeditions beginning in 401 and 408, the latter of which returned the Danubian Plain to imperial administration (Heather 2007, 167–173). At this point the Roman state took pains to reestablish military control over the frontier.

The war and settlement of the late fourth century have been correctly described as a cataclysm (Poulter 2004). Late fourth century destruction layers have been identified at Novae and Nicopolis ad Istrum, but in both cases they are isolated to a single building (Poulter 2007d, 69; Poulter 2014, 50). More telling is the evidence from the countryside, where no villas survive the end of the fourth century (Poulter 2004). The only excavated villa in the study area was abandoned at some point after the reign of Constantius II (Vladkova 2011, 48). Elsewhere in the Danubian Plain, some villas survived into the last decade of the fourth century, but none were inhabited in the early fifth century (Poulter 2014, 64 lists the villas that survived the wars of 376-382 CE).

During the early 5th century, the Danubian Plain was unsettled and threatened by raids. The state exerted significant effort to strengthen its military control in the area, but it was tenuous. Sozomen reports incursions by Huns in 404/5 and 408 CE, though the latter can be placed to the west of the area of interest (8.25.1; 9.5.2-7). The burgus at Svalenik was reused at this time as a temporary refuge by the local population (Dragoev, Velikova, and Todorova 2012). The level of violence in the first four decades of the fifth century was probably comparable to, or perhaps slightly worse than that experienced in the mid fourth century.

In 447 CE, the Huns, led by Attila, devastated all of Thrace. Unlike the Goths in the 370s and 380s, the Huns were adept at siege warfare and sacked almost all the cities in the Diocese. The destruction they wrought in the central Danubian Plain is easily identifiable: Nicopolis ad Istrum was razed (Poulter 2007d, 69–71); Discoduraterae was abandoned (Boyanov 2014); the principia at Novae was burned and never reoccupied (Sarnowski 1999, 63); Iatrus was abandoned, burned and not reoccupied for several decades (Bülow 2007, 468–470); Trimammium was abandoned (Torbatov 2012b). The small fort at Dobri Dyal was abandoned, but may have been systematically demolished rather than sacked (Poulter 2013a, 380). Dichin survived, but was burned probably in the later in the century (Dinchev et al. 2009, 20). The ravages of the Huns were so devastating that in 448 the emperor Theodosius II bought peace with a massive amount of money and an agreement to evacuate a swath of land south of the Danube between Pannonia and Novae (Maenchen-Helfen 1973, 124).

Despite the collapse of the Hunnic kingdom after Attila's death in 453, the region was not left in peace. Attila's sons were active in Moesia Inferior for just over a decade before they were finally defeated (Maenchen-Helfen 1973, 143–168). Even then, the area was occupied by two competing groups of Goths for most of the rest of the century (Heather 1991, 240–308). Both groups were competing to be formally recognized as allies of Rome and for the substantial financial rewards that the status brought. Ironically, the primary method of convincing the imperial government to recognize them as allies was to plunder Roman centers of power (Heather 2007, 185). In the mid-470s, Theoderic based himself in Novae and soon afterward united the two competing groups. He remained at Novae until 488/9 when he decamped for Italy (Heather 2007, 183–186).

At the end of the fifth and beginning of the sixth century, the Roman state regained control of the Danubian Plain and the emperor Anastasius embarked on a rebuilding program which was continued and expanded by Justinian (J. H. W. G. Liebeschuetz 2007, 105–108). Nevertheless, the sixth century was far from settled. The literary record includes numerous examples of raids by various groups into Thrace and Greece (Curta 2001, 113–119; R. Ivanov 1999, 143–146; J. H. W. G. Liebeschuetz 2007, 110–114). The geographic scope of these episodes is rarely specified, but Marcellinus Comes does mention one successful battle against the Bulgars near Iatrus in 535 (Marcellinus Comes, 535.3). The level of violence associated with these raids is difficult to specify, but it was probably fairly high as a *magister militum* took the field against some Bulgars and was killed in 538 CE (Theophanes, *AM* 6031, John Malalas, 18.21). The excavators at Iatrus have discovered a thick and wide-spread destruction layer containing coins of Justin I (r. 518-527) which they dated to the 520's, though it has been argued that this should be associated with the conflict in 535 CE (Bülow 1995a; Vagalinski 2003, 69). The fortification projects of Anastasius and Justinian provided places of refuge, but they did not bring security to the countryside (J. H. W. G. Liebeschuetz 2007, 106).

In the last quarter of the sixth century, the Avars had become a powerful military and political force. Like so many groups before them, the Roman emperors paid them to fight other non-Romans instead of Romans. This inherently unstable relationship collapsed in the 580's when the Avars swept across the Danubian Plain and Thrace, sacking cities and forts along the way. Imperial forces were able to retaliate with some success in the 590's, but in 602 those same forces mutinied against the emperor, proclaimed one of their officers emperor, and marched to Constantinople (A. H. M. Jones 1964, 314–315; J. H. W. G. Liebeschuetz 2007, 114–132; Madgearu 1997).

It is difficult to assign exact dates of abandonment even in the case of well excavated sites. The latest coins found at Iatrus were minted in 577/8 CE, but Theophylact Simocatta mentions Iatrus in a campaign of 600 CE. The fort must have been destroyed shortly after (Theophylact Symocatta, 7.13.8; Bülow 1995b, 66). The situation is similar at Nicopolis ad Istrum, where the latest coin was issued by Tiberius II (r. 578-582) (Poulter, Falkner, and Shepherd 1999, 24–25). Both sites were burned, but at Nicopolis this may have been intentional, as metal fixtures were removed. Dichin's latest coins were also minted by Tiberius II (Dinchev et al. 2009, 25). The burgus at Svalenik survived at least into the first decade of the seventh century, as a coin of Phocas (r. 602-610) was recovered (Dragoev, Velikova, and Todorova 2012). Occupation at Novae lasted at least into the second decade, as coins of Heraclius (r. 610-641) have been found. Whatever the precise date of the abandonment at these sites, the early seventh century was another period of great violence, one from which these sites did not recover.

2.6 The infrastructure of control

The Roman imperial state invested heavily in the physical infrastructure of the lower Danube. The goal of this investment was military, administrative, and ideological control (see Purcell 1990 for the latter), but it also would have had important economic and social implications. What follows is a survey of building activities that can be associated, either directly or indirectly, with the Roman governmental apparatus. For convenience, I have

assembled the approximate foundation dates of the forts on the Danube in the following table. Ending dates are obscure in most cases.

Army base	Foundation date (CE)
Dimum	70-98
Novae	45/46
Iatrus	310-320
Scaidava	101-106
Mediolana	300-375
Trimammium	70-98
Sexaginta Prista	70-98
Appiaria	before 76

Table 1: Roman army bases on the Danube from Dimum to Appiaria.

2.6.1 The Julio-Claudians

The construction of forts in the area of interest began in 45/6 CE when Claudius annexed the kingdom of Thracia and the province of Moesia was extended eastward to the mouth of the Yantra river (Zahariade and Gudea 1997; R. Ivanov 1999).[89] The territory east of the Yantra and north of the new province of Thracia was the *ripa Thraciae* under the control of a military prefecture. Defense in this zone was the responsibility of the Moesian fleet and it has been suggested that naval bases may have been built at Dimum and Sexaginta Prista already in the mid first century (Torbatov 2012a).

The earliest archaeological evidence comes from the legionary fortress at Novae which was founded at this time.[90] The lowest levels are not well understood, but there are two phases of earth and wood construction. In the second phase, which may have ended during Domitian's Dacian wars, the fortress covered around 17 ha (Matei-Popescu 2010a).

Elsewhere in Moesia, inscriptions mentioning the construction of *tabernae* and *praetoria* along military roads have been dated to 61 CE and it has been hypothesized that a road linking Novae to Cabyle on the Thracian plain was built as early as Nero (Poulter and Blagg 1995, 10). This road would have passed the location of Nicopolis ad Istrum and it is possible that the earliest levels of that city predate its foundation under Trajan, but this cannot be proven (Vladkova 2002).

2.6.2 The Flavians

Major fortification work took place under the Flavians. The *ripa Thraciae* was incorporated into the province of Moesia under Vespasian and this is generally seen as the beginning of permanent military occupation east of the Yantra river (Torbatov 2012b, 439; R. Ivanov 1999). Josephus writes that, after repulsing barbarian invasions at the time of the civil

[89] The borders of the earliest province of Moesia are controversial. For a brief summary of the range of opinions see (Boteva 2012).

[90] Novae is the most researched place on the Danube Limes in Moesia Inferior. For a summary of the research and results see the entry in TIR K35/2 (R. Ivanov 2012a). For a complete bibliography on Novae see the first volume in the series *Novae* (Derda, Dyczek, and Kolendo 2008).

war, Rubrius Gallus "*πλείοσι γὰρ καὶ μείζοσι φυλακαῖς τὸν τόπον διέλαβεν*" (Josephus, *Bellum Judaicum* 7.4.3). The epigraphic record indicates a large influx of troops to Moesia at this time, but as yet there is little archaeological evidence for their presence in the area of interest (Matei-Popescu 2010b, 226). The only secure evidence for Roman forces east of the Yantra in the 70's CE is an inscription from Appiaria (modern Ryahovo, Ruse district) which names two cohort commanders and is dated to 76 CE (AE 1957, 307). It is likely that the earliest occupation layers at many forts were destroyed by subsequent rebuilding.

In general, the construction of forts along the Danube in Moesia Inferior coincided with the construction of the *via militaris* connecting them (Panaite 2012). If this is true it would imply that the Danube road was in place at the latest by the 70's CE to link Novae and Appiaria. Recent work in the Netherlands, however, has demonstrated that the forts along the lower Rhine predated the construction of the road by several decades (M. van Dinter 2013). It is possible, then, that the Danube road was not built until Hadrian as the earliest milestone in the study area dates to 144 CE (AE 1916, 65).[91]

Several forts have construction phases dating to the Flavian era and it is impossible to tell whether they were built under Vespasian or Domitian. The Dacian wars of Domitian and his division of Moesia in 86 CE would be a logical event to spur greater fortification, but the war effort was primarily based in Moesia Superior, with Moesia inferior playing a supporting role only (Zahariade and Gudea 1997, 33–35) The *castra* at Dimum to the west of Novae is Flavian (Dragoev 2012a; R. Ivanov 2012c) and, in an inscription from 100 CE, a "*canabae Dimensis*" is named as the westernmost border of a tax zone (*SEG* 1, 329), so Dimum must have been occupied from the Flavian period, if not before. Trimammium was probably built under the Flavians, but the earliest archaeological evidence comes from the second century. The fort covers only 1.7 ha (Torbatov 2012b). Interestingly, Ptolemy puts Trimammium under the heading "*πόλεις*" (*Geogr.* III 10.5). Sexaginta Prista is also generally dated to the Flavian period if not before (Dragoev 2012d; Torbatov 2012a). While the earliest Roman fortification found so far dates to the 3rd century, strong evidence for earlier Roman occupation comes from an inscription dating from 100/101 CE which mentions *"cives Roman[I consistentes] Sexsaginta Pri[st(is)*" (AE 1966, 356).

2.6.3 The Antonines

Trajan's Dacian wars provide the historical context for the further fortification of the Danube. Unlike under Domitian, Moesia Inferior saw major battles and was the base for offensive operations (Zahariade and Gudea 1997, 26). The bridgehead at Pietrosani was founded at this time (Zahariade and Gudea 1997, 34), which implies that Scaidava, opposite, was as well. Novae was rebuilt in stone under Trajan, or Domitian (R. Ivanov 2012a; R. Ivanov 2012c).

Trajan's most important foundation in the central Danubian Plain was the city of Nicopolis ad Istrum, founded to commemorate a victory over the Dacians (Ammianus

[91] It should be noted that a milestone from Sacidava (modern Aliman, Romania), much farther east on the Danube, has been dated to 103 CE (AE1981, 745). This need not indicate the existence of the Danube road, however, as a road from Tomis (modern Constanta, Romania) is also possible.

Marcellinus, 31.5.16; Jordanes, *Getica* 18.101). Although the foundation has been dated to 110 CE, the earliest datable construction phases have been dated to the reign of Hadrian (Poulter and Blagg 1995, 10–12). The foundation of Nicopolis ad Istrum probably coincided with the construction of the major East-West road linking Naissus to Odessus (Panaite 2012, 135)

All the forts along the Danube were rebuilt in stone at the latest under Hadrian (Torbatov 2012b; R. Ivanov 2012c; R. Ivanov 1999; Zahariade and Gudea 1997, 57). His evacuation of the Wallachian plain in 118 brought the frontier back to the Danube and he strengthened the fortifications accordingly (Karavas 2001, 145–149; Zahariade and Gudea 1997, 55–6). By 118 CE, the fortification system along the Lower Danube had assumed the shape it would retain until Late Antiquity.

The next major stage in the construction of forts does not come until the late third and early fourth century, but there was also work done during the second and early third century. There is a series of small forts in the interior of the province and in the Haemus mountains that probably date to this period, though the chronology of most of them is unclear (for the area of interest see Zahariade and Gudea 1997 nos. 116-130). Several inscriptions attest to the construction of fortifications in the territories of major towns in Moesia Inferior between 152 and 155 (Zahariade and Gudea 1997, 39) and under Marcus Aurelius many cities, including Nicopolis ad Istrum, received fortification walls (Poulter and Blagg 1995, 12 n. 38).

2.6.4 The Severans and the mid-third century

Under Septimius Severus the border between Moesia Inferior and Thrace was shifted southward to include the peaks of the Haemus Mountains and Nicopolis ad Istrum in the province of Moesia Inferior. There is some evidence of rebuilding efforts under the Severans in Novae (R. Ivanov 2012a) and Trimammium (Torbatov 2012b), though not as much as might be expected considering the Severans' reputation for investing in soldiers.

2.6.5 The Tetrarchy and Constantine

Fortifications throughout Moesia Inferior were seriously damaged in the mid third century by invasions from across the Danube. This was followed by massive reconstruction efforts during which a group of similar looking fortifications was built, including Iatrus. There is some debate as to whether this occurred under Diocletian or Constantine. In support of a Diocletianic date are three inscriptions dating to 298/9 found at Durostorum, Transmarisca and Sexaginta Prista with identical texts attesting to fortification efforts (Poulter 2007b). On the other hand, the fortifications at Iatrus are similar to those of Tropaeum Traiani which are dated by a building inscription to the reigns of Constantine and Licinius (Bülow 2007). In any case, the fortifications of the Danube were extensively overhauled between the end of the third century and the early fourth century.

In the central Danubian Plain, away from the frontier, the emporium of Discoduraterae was fortified (Boyanov 2014), the burgus at Dolap Boaz near Svalenik was built (Dragoev 2009) and the fortified road station at Kovachevsko Kale was constructed (Rusev 2007). On the frontier, extensive renovations from this time are attested at Dimum (Dragoev 2012a), Novae (R. Ivanov 2012a) Trimammium (Torbatov 2012b) and Sexaginta Prista (Dragoev 2012d), but the most radical change is the foundation of the fort at Iatrus in the second decade of the fourth

century (Dragoev 2012b; Bülow 2007; Vagalinski 2003). There is a settlement that predates the fort and in the past it was assumed that there must have been an earlier fort at the confluence of the Yantra and the Danube rivers but decades of excavation have not located one (Dragoev 2012b; Bülow 2007; Vagalinski 2003; Conrad and Stančev 2002).

The structure of the army after the third century was different than it had been before. During the turmoil troops were taken from the bases in which they had been permanently garrisoned and travelled with their commanders across the empire fighting rivals and invaders leading to the emergence of mobile field armies (to be known later as "*comitatenses*") distinct from the static frontier troops ("*limitanei*") (W. Liebeschuetz 2007; Strobel 2007a; Whitby 2007; Campbell 2005). The sizes of the units also changed. Under the principate a legion had over 5,000 soldiers while auxiliary units had 1,000 or 500, but in the later Roman Empire a legion had only 1,000 soldiers (Southern and Dixon 1996, 30–32). Vexillations also became more permanent (Strobel 2007a). The troops on the frontier, then, were more evenly spread over a larger number of fortified points in fourth century than in the second.

Of the forts under consideration, this shift should have had the greatest impact on Novae. The buildings in the fort may have left less room for soldiers than they had in the past, but at the same time the extension known as "Novae II" was built, increasing the total fortified area to 28 ha (R. Ivanov 2012a; R. Ivanov 1999; Poulter 2007b). This extension was probably meant to protect the *canabae*, so the actual impact on the military capacity of the fortress is hard to discern. It should be noted, though, that even under the principate, the legion headquartered at Novae was widely dispersed in vexillations across the province, leaving perhaps 3,000 soldiers at Novae itself (Zahariade and Gudea 1997, 43–48).

2.6.6 Valens

Under Valens in the late 360s significant construction work happened at a number of sites, as attested at Novae (R. Ivanov 2012a), Trimammium (Torbatov 2012b) and Sexaginta Prista (Dragoev 2012d). At Iatrus, the beginning of the second construction phase (Period "B/C") has been dated to the 350's or 360's, although it may have begun as late as the turn of the century (Poulter 2013b, 71; Poulter 2014, 59). This phase of renovations is identifiable through brick stamps of Flavius Rumoridus, *dux* of Moesia Secunda (Torbatov 2012b, 444 with references).

Rumoridus' tiles have also been found at a site near Pirgovo identified as Mediolana (Dragoev 2012c; Conrad and Stančev 2002). It is unclear whether this was newly built or merely repaired under Rumoridus. Mediolana is identified in the *Notitia Dignitatum* (*Or.* XL, 21) as the headquarters of the *milites Dacisci*, but it is absent the *Tabula Peutingeriana* and the *Itinerarium Antonini*. The *Notitia* is usually dated to the end of the fourth or beginning of the fifth century, but Andrew Poulter argues that the description of the Danube frontier better fits a date before Adrianople (Poulter 2007b, 33). If the *Tabula Peutingeriana* dates to the Tetrarchic period, as Talbert suggests (Talbert 2010), then Mediolana must have been founded at some point in the first three quarters of the fourth century.

2.6.7 Arcadius and Theodosius II

After the imperial state regained control of the area in early fifth century, the emperors and their subordinates invested considerable effort in rebuilding the frontier infrastructure. This is attested both by the legal tradition (*C.Th.* 7.17.1; 11.17.4; *Nov. Theod*. 24.5) and the archaeological record. The fortifications of Nicopolis ad Istrum were strengthened for the first time since their construction in the late second century (Poulter 2007d, 69). In addition, at least two small forts were built near the modern villages of Dichin (Dinchev et al. 2009; Poulter 2000; Poulter 2007d) and Dobri Dyal (Poulter 2013a). Neither has any of the internal buildings traditionally associated with Roman army bases. The discovery of a large granary at Dichin suggests that these were used to secure agricultural produce either for military supply or simply against depredation (Grinter 2007b; Grinter 2007a). The latest discernable construction period at Sexaginta Prista is dated to the late fourth or early fifth century at which point the *principia* went out of use. If Poulter's argument about the dating of period B/C in Iatrus is correct, then both *principiae* went out of use simultaneously. In contrast, the *principia* at Novae continues in use until the middle of the fifth century.

2.6.8 Anastasius and Justinian

At the end of the fifth century and in the sixth century the state re-established control and construction took place at many fortified sites, though it is often difficult to date with precision. Procopius' *De Aedificiis* gives the impression that Justinian was responsible for a massive construction campaign, but archaeological evidence indicates that Anastasius may be responsible for a good portion of it (Poulter 2007b). Sixth century construction has been identified at Novae (R. Ivanov 2012a), Iatrus (Bülow 1995a; Bülow 2007), Trimammium (Torbatov 2012b), Svalenik (Dragoev, Velikova, and Todorova 2012), and is likely at Sexaginta Prista (Dragoev 2012d). It is unclear when the new, much smaller fortifications at Nicopolis ad Istrum were built. They certainly existed by the beginning of the sixth century, but they may have been constructed as early as the 450's (Poulter 2007d, 71–72). Procopius also says that Justinian founded a new city called Theodoroupolis (*De Aedificiis* IV, 7.6, 131.21), which has been identified with late Roman fortifications in modern Svishtov that cover 5-6 ha (M. Ivanov 2012). While the fortifications at these sites are well built, the internal structures are light and made of timber (Bülow 2007). They are less impressive even than the fifth century building phases, let alone grand constructions of the principate.

2.7 The population during the Roman period

The population of the area during the Roman period was constantly shifting. It included people whose ancestors lived in the area prior to the Roman conquest as well as immigrants. The latter came from north of the Danube and from all over the empire. Many immigrants came because of Roman military activity. This includes active soldiers, veterans, their families, and the merchants and craftsmen who made their living from military salaries.

2.7.1 Evidence for Continuity

The best evidence we have for continuity of population from the pre-Roman period comes from cult sites. The pit sanctuary at Ruse contains a double pit that is much larger than all others and must have served as the focal point of the complex (Hawthorne, Varbanov, and Dragoev 2011; Varbanov 2013c). The complex went out of use in the second half of the first

century CE, but in the second half of the second century, a temple to Apollo was built and the central altar placed exactly above the central pit feature (Hawthorne, Varbanov, and Dragoev 2011, 81). Although the cult practices had changed, the memory of that location as a sacred place survived for a century. The temple itself yielded numerous fragments of votive plaques bearing the image of the Thracian Rider deposited in shallow pits (Hawthorne, Varbanov, and Dragoev 2011, 76–81). This figure is closely tied to a Thracian identity and may have served as an intermediary between the dedicant and the divine (Boteva 2011; Dana 2015, 255).

A second example of religious continuity comes from the Vodna cave near Tabachka (Torbatov 2007). This cult site contains hand-made and wheel-made pottery dating from the second century BCE to the first century CE and Roman pottery from the second century CE to the fourth century CE. In addition there are eighteen graffiti, dated on paleographic grounds to the second half of the second century to the mid-third century CE, recording the names of dedicators and numerals which presumably indicate the value of their offering. Ten of the inscriptions are in Greek and eight in Latin. The names are also Greek and Latin in roughly equal numbers, but there are also two Thracian names and one Thracian cognomen with a Roman gentilicium, though most of the dedicators have only one name. In several cases the dedicators identify themselves as veterans.

Unlike the pit complex at Sexaginta Prista, which is located on a hill next to the Danube, the Vodna cave is very difficult to access. It is located in a sheer cliff face high above the Cherni Lom River. The only approach is a narrow path that starts from the hill behind the cliff, meaning that the cave itself is invisible until the traveler has almost arrived. It is impossible to find without a guide who already knows the way.[92] It is very unlikely, therefore, that the cave would have been used in the Roman period if the memory of its location had not survived from the pre-Roman period.[93]

Evidence for continuity of population can also be found in pottery. Bogdan Sultov's work on pottery production centers near Pavlikeni, Butovo and Hotnitsa has demonstrated that potters were producing ceramics on a potter's wheel that imitated the forms of pre-Roman, hand-made vessels. These included not only cooking and storage vessels, but drinking vessels as well (Sultov 1985, 82–89). The earliest levels of Nicopolis ad Istrum have also produced Thracian forms. Interestingly, some of these forms are produced in two different wares: 30/31 and 1, the latter of which is the most common local ware throughout the life of the city (Poulter, Falkner, and Shepherd 1999, 65–6). This clearly demonstrates a continuous tradition of pottery production.

[92] I would never have found this site without the guidance of Varbin Varbanov of the Regional History Museum at Ruse, who informed me that while excavating in the cave, the archaeological team had to mark the path with flags so that they would not get lost.

[93] Examples of continuity in the location of changing cult practices in the Late Iron Age to Early Roman period are common in Gaul (Derks 1998, 168–185).

Figure 16: A votive plaque bearing the image of the Thracian Horseman found in the temple to Apollo in Ruse. Now in the Regional History Museum at Ruse.

Figure 17: Two graffiti from the Vodna cave near Tabachka. The graffito on the left reads "Διονυσισ/στρα" while the one on the right reads "Bitus vet/ж к И."

2.7.2 Evidence for immigration

Immigration into the southern Danubian Plain, especially from across the river, may have been a common occurrence in the history of the region (Batty 2007), but the Roman conquest of the area altered the dynamics of that immigration. Indeed, the argument has been made that the purpose of the conquest itself was to control the movements of populations into and through the region (Batty 2007, 400–404, 424–428). Crassus' campaign was sparked by the Bastarnae's crossing of the Haemus Mountains into the territory people under Roman protection. Other, less well documented campaigns of the first century BCE are similarly motivated by a desire to check the southward movement of peoples, though the line of demarcation shifts north to the Danube (Batty 2007, 401–403). In general, immigration causes political instability as groups compete for resources so it is in the interest of the state to curb such movements. The zeal with which Roman officials served the interest of the state can be explained by a desire for social prestige. Both are on display in the monument of Plautius Silvanus Aelianus, a governor of Moesia who boasts of admitting more than 100,000 Transdanubians and in the next sentence of suppressing the movement of Sarmatians (*CIL* 14.3608 = *ILS* 986).[94]

Twice in the first century CE, Roman officials supervised – or at least tolerated – the movement of large groups of people from the northern side of the Danube to the southern side.[95] We hear from Strabo that Aelius Catus transferred 50,000 Getae into Thrace and that these people were, at the time Strabo was writing, called "Moesi" (7.3.10). The precise date of this event is uncertain, but it certainly happened in the early first century CE (Syme 1934, 126–128). The precise location where these people settled is less well known. Strabo's testimony encourages authors to seek the territory of the Moesians in the early first century, which has been identified with the area around Ratiaria based on the evidence of Ptolemy's *Geography* (3.9.2-3), though others have suggested they settled as far east as the Yantra (Mrozewicz 1999; Mrozewicz 2013 with citations). As Papazoglu has shown, however, the territories inhabited in the early first century by groups identified as Moesians stretched across the entire Danubian Plain as far east as Dobrudzha (Papazoglu 1978, 431–437), making it impossible to be certain.[96]

The second immigration event dates to the reign of Nero and is attested on the *elogium* inscription of Tiberius Plautius Silvanus Aelianus found in Tibur (*CIL* 14.3608 = *ILS* 986). As propraetor of Moesia, he transferred over 100,000 Transdanubians with their wives, children, princes and kings for the purpose of ensuring tribute. Again, the precise location is unclear but the fact that, a few lines later, a "*ripam, quam tuebatur"* is mentioned has put scholars in mind of the *ripa Thraciae*, which was located in Dobrudzha at this time (Mrozewicz 2013; Avram

[94] "Motum orientem Sarmatarum compressit" can mean either to hold back a movement or to quell an uprising. Given the nomadic nature of people labeled "Sarmatian" in Roman texts, it is likely that uprisings were accompanied by mass movements.

[95] Batty discusses the possibility that the Roman officials were claiming credit for events outside their control (Batty 2007, 404–410). Batty's conclusion is criticized by Wheeler (Wheeler 2011, 201–205)

[96] A recent attempt to link this specific immigration event with a newly discovered *strategia* near Axiopolis is not convincing (Avram 2015). This, however, does not seriously detract from that author's larger point about the settlement of people from north of the Danube in eastern Moesia Inferior.

2015). The case is strengthened by the prevalence of toponyms ending with the Dacian suffix "-dava" and the epigraphic attestation of "*principes (locorum)*" in this area (Avram 2015).

These two events hint at a larger pattern of immigration from north to south across the Danube. We only know of the first because Strabo was making a point about the name "Moesi" and we know of the second from a single inscription found in Italy. Not only is small scale immigration likely, it is entirely possible that we are ignorant of other mass population movements that took place under the direction of Roman officials. Dacian names, especially on military diplomas, are commonly found in the area around Nicopolis ad Istrum (Dana 2013, 161). The *Itinerarium Antonini* mentions a place called "Scaidava" between Novae and Trimammium (222), possibly indicating a population from the north of the river.

It is unclear whether we should consider people from north of the Danube to be foreign immigrants to our area. In searching for the identities of groups in this area we are primarily dependent on ancient authors, who are not themselves local, and on archaeological material. It is unclear what actual meaning and reality the ethnic labels used by ancient authors had for the people to whom they were applied (for a recent discussion of ethnicity as it pertains to the area in question see Batty 2007, 25–30). Even if these terms did have meaning for the inhabitants of the area, it is not at all clear that the Danube formed a boundary between different groups. Many of the ethnic groups identified by Strabo lived on both sides of the Danube (e.g. 7.3.2) and he says that there is constant movement across the river (7.3.13).[97] Onomastic and toponymical evidence for the settlement of transdanubians in the lands south of the Danube relies on the idea that these territories are linguistically distinct, but that idea is not universally accepted (e.g. Boyadzhiev 2000; T. Taylor 1987). Furthermore, the inhabitants of the area were probably less sedentary than the polis-based cultures of the Mediterranean (Batty 2007, 269–278). If the Roman authorities were transferring people from just across the river, this may have been experienced more as a shift in land use patterns than an incursion by masses of foreigners.

The most significant shift in immigration dynamics wrought by the Roman Empire was the introduction of new sources of immigrants. The clearest example is the settlement of veterans in the area north of the Rositsa River in the Flavian period (Conrad 2004, 107; Gerov 1988, 45–46). These veterans came from Italy and western provinces, but also from the Greek-speaking eastern provinces of the empire (Boyanov 2008; Conrad 2002; Conrad 2004, 106). In fact, there was a strong element of immigrants from Asia Minor in the population of Nicopolis detectible in inscriptions (Conrad 2002; Conrad 2004, 105; Poulter 1992) and in their influence on local pottery production (Poulter, Falkner, and Shepherd 1999, 110–111; Sultov 1985, 102). The elites of the city, however, were predominantly of Italian origin (Ruscu 2007b). To judge from the funerary inscriptions, there was little friction between Greek and Latin speaking immigrants, and by the end of the second and beginning of the third century, some people with Thracian names had also adopted the funerary epigraphic habit (e.g. Conrad 2002, 108 n. 47 Cat. 24 = Conrad 2004 cat. 324 is a Greek stele with Latin inscription erected by a man with a

[97] Strabo and other sources often use the Danube to demarcate the territories of different groups, but the evidence for frequent movement across the river and inconsistency as to which groups dwelt on which side should make us suspicious.

Roman name for his Greek wife). This influx of people from Mediterranean, urbanized parts of the empire altered the culture of the area much more profoundly than the immigrants from north of the Danube.

Historical sources attest numerous cases of emperors settling "Barbarians" on Roman soil (collected in Batty 2007, 411–412 Table 7.2; see also Boatwright 2015; Mrozewicz 2013). In every case the ultimate destination is vaguely specified, but when it is described as "Moesia," "Lower Moesia," or "Thrace," there is a good chance that some immigrants came to our area.[98] Cassius Dio reports that many Barbarians, either as clans or nations (*hoi de men kata gene hoi de kai kata ethne*), sent embassies to Marcus Aurelius with offers to surrender and that some of these received land in Moesia (72.11.4). Between the late 260s and the early 280s, Claudius and Probus are both said to have settled Barbarians in Thrace (*HA Claudius*, 9.4-5; *HA Probus*, 18) and in the late 280s, Diocletian apparently moved people to Thrace from Asia (*Pan. Lat.* 8.21). Constantine settled Sarmatians in various places including Thrace in the 330s (*Anon. Vales.*, 6.32) and in the 340s Constantius II apparently settled Goths fleeing religious persecution throughout Moesia (Philostorgius *Eccl. Hist.*, 5). Jordanes says that even in his day (i.e. the mid-sixth century) these refugees formed a distinct group living in the territory of Nicopolis ad Istrum next to the base of the Haemus Mountains (*Getica* 51). The fourth-century inhabitants of the Danubian Plain, then, were a combination of people whose ancestors inhabited the area prior to Roman conquest, people whose ancestors had arrived after conquest from other parts of the empire, and people who had arrived from outside the empire.

In 376, yet another group petitioned the emperor Valens for land within the empire. This time, however, the balance of power was different. They had not surrendered and in fact they had recently fought this very same emperor to a negotiated and potentially humiliating truce (Ammianus Marcellinus, 27.5). While the emperor agreed to receive only half of those seeking admission there were not enough troops to both control those admitted and repel the rest. Such coercion might not have been necessary had the Roman officers not exploited the refugees so appallingly. As it was, these immigrants sparked an uprising that was joined both by other coherent groups of Goths[99] and by disaffected locals (Ammianus Marcellinus, 31.6). For the next six years imperial armies fought the Goths and other groups crossed the Danube to join them (Heather 1991, 147).[100] A treaty struck in 382 granted land for the Goths to farm and stipulated that they be available as for military duty when called upon. It also seems that they were responsible for the defense of the frontier, though what this means in terms of personnel is unclear (Heather 1991, 158–165). In 395 the Goths rebelled again, seeking to renegotiate the

[98] Lower Moesia was part of the Diocese of Thrace after the Tetrarchic reorganization.

[99] Ammianus describes two Gothic aristocrats (*Gothorum optimates*) who long ago had been received with their peoples (*cum populis*) as receiving orders from the emperor to move their followers to the Hellespont. They request food and money for the journey and a delay of two days to prepare. Clearly these are cohesive groups with their own political leaders living inside the Empire and negotiating with the emperor. The Tervingi, then, were not the first to be admitted with their tribal loyalties and political leadership left intact (contra Heather 1991).

[100] A detailed account of events from the expulsion of the Goths by the Huns to the battle of Adrianople in 378 is given by Ammianus (31.3-31.13). Peter Heather has written a comprehensive modern history of the Goths in Late Antiquity (Heather 1991). See also his chapter in *The Cambridge Ancient History* XIII (Heather 1998) and in *The Transition to Late Antiquity* (Heather 2007).

terms of the treaty, but the division of power between West and East made a lasting solution difficult. When Alaric set out for Italy in 401, some of the people who immigrated between 376 and 382 must have remained behind on their farms.

A fresh influx of Goths, this time from Pannonia, is attested in the 420s (Heather 2007, 174). These immigrants seem to have maintained tribal cohesion and served alongside Roman units in various campaigns for fifty years (Heather 2007, 174–5). As *foederati* they were given money and food by the imperial government. In 471, however, their leader and, as *magister militum*, representative in the government was assassinated and they revolted. Just two years later a second group of Goths entered the Balkans seeking the status and remuneration of *foederati*. These groups vied with each other and with Constantinople for ten years until the two Gothic factions united under Theodoric the Amal. This Theodoric established his base of power at the former legionary fortress of Novae from the mid-470s to the late 480s when he led his followers to Italy (Heather 2007, 180–186).

For over one hundred years, then, the Balkans were home to large groups of people who were, at best, provisionally under the control of the Roman state. After the destruction of the eastern Roman army at Adrianople, most of the military might in the Balkans was commanded by Gothic leaders. Even when they were employed by Constantinople, the institutional relationship between these soldiers and their neighbors was very different than the relationship that had existed with Roman soldiers. Previously, when Roman soldiers abused the inhabitants, there was the possibility of appeal to a governor or an emperor for redress (e.g. the Scaptopara inscription). This was not the case with the Gothic *foederati*.

It is very tempting, but difficult, to identify these *foederati* in the archaeological record (Poulter 2007e; Poulter 2013b). Forts come to resemble more and more fortified settlements rather than military bases in the late fourth and early fifth century (Bülow 2007; Dinchev 2007; J. H. W. G. Liebeschuetz 2007; Poulter 2007a).[101] In addition, a new type of pottery appears in the region at some point in the second half of the fourth century that is often called *foederati* ware. The technology of its manufacture suggests immigrant potters, but the forms of the vessels are both traditional Roman and new (Poulter, Falkner, and Shepherd 1999, 73–74, 111–112; Swan 2007; Vagalinski 2002; Vagalinski 2005). This pottery, then, is evidence for the influx of new potters as well as the spread of new tastes in pottery. This means that quantity of *foederati* ware at a given site cannot be assumed to represent the quantity of Gothic immigrants resident in the area.

Gothic presence at Novae is attested in the literary record (*Anon. Vales.*, 9.42) and also, perhaps, by the presence of jewelry associated with Goths uncovered in a late fifth century necropolis (Vladkova 2012a). Similarly, a recently excavated necropolis next to the Roman fort of Tigra has been taken as evidence for a resident population Goths in the fifth century (Dragoev 2014). There has also been speculation as to a Gothic presence at Nicopolis ad Istrum, Dichin and Iatrus based on the presence of *foederati* ware, but in my opinion, only the

[101] The chronology for this shift at Iatrus is disputed. The excavators argue that it took place in the mid fourth century (Bülow 2007, 466; Vagalinski 2003, 46–47) but their reasoning has been challenged by Andrew Poulter who prefers a date in the late fourth or early fifth century (Poulter 2013b, 71 n. 55).

assemblage from Iatrus indicates the predominance of a Gothic element in the population. This conclusion is based in large part on the botanical remains recovered from the site which show a preponderance of rye over other cereals.

The botanical remains from Nicopolis ad Istrum were presented above (section 2.4.2.4). Wheat, millet and barley were the most important grains throughout the occupation of the city. Rye is found more commonly in samples from the mid-third to mid-fourth century and is even more common in samples from the mid-fourth to mid-fifth century, but it is never found in the same quantities as wheat, millet, or barley (Buysse 2007).

The Late Roman fortification of Dichin is rich in botanical remains. The site may have been a collection point for local produce and two areas have revealed large quantities of stored grain dating from both the fifth and the sixth century (Grinter 2007b; Popova 2009). The archaeobotanical remains from three fifth century granaries have been published in summary (Grinter 2007b; Grinter 2007a). Twenty samples were taken from three structures. Most of the samples were composed almost exclusively of a single crop, suggesting segregated storage of different crops within the buildings. Main crops included barley (seven samples), wheat (five samples), lentil (four samples), millet (two samples), rye (one sample), and bitter vetch (one sample). There are two additional areas where millet is present as a significant minority in several samples, so the importance of millet is probably higher than the above list would suggest. The most important crops stored in the fifth century granaries of Dichin, then were barley, wheat, millet and lentils.

In the second area, samples were collected from buildings interpreted as family residences (Dinchev 2009). These have been published in greater detail (Popova 2009). Two buildings from the fifth century were sampled, each one producing one sample from the middle of the century and one from the end. There was greater consistency between samples from the same building than from the same time period. Two other buildings from sixth century, a phase which follows a period of disuse, were each sampled once. The samples from Building FII were composed of predominantly millet, followed by barley and, in the first phase, wheat. Rye, lentil and wheat were present in small numbers in both phases, grass pea and broad bean were present only in the first phase. The samples from building FIII were composed mostly of wheat, followed by rye and barley in the first period and by barley only in the second period. This late fifth century sample also contained millet and small amounts of rye and chickpea. The most important crops in the fifth century homes at Dichin, then, were millet, wheat and barley. One of the sixth century samples contained roughly equal amounts of wheat, barley, millet and rye, followed by broad bean and grass pea. The other contained almost entirely millet with wheat, barley, rye and oats also present.

The importance of millet, wheat and barley at Dichin is consistent across time periods and storage contexts. Lentil appears in significant quantities in the fifth century granaries and rye appears in significant quantities in one sixth century home. This agrees well with the patterns observed at Nicopolis ad Istrum and Abritus.

The last site where detailed botanical remains have been published is the late Roman fortress of Iatrus (Hajnalová 1982; Hajnalová 1991; Neef 2007). This material, most of which

comes from the mid fourth to mid fifth century, provides and interesting contrast to that from Nicopolis and Dichin. In Iatrus, rye is by far the most commonly encountered cereal. Barley and millet are also common as is, to a lesser extent, wheat. Bitter vetch is the most commonly encountered legume, but pea, broad bean, lentil, and grass pea were also present. Although rye is present in both Nicopolis ad Istrum and Dichin, nowhere else is it nearly as dominant as at Iatrus.

This distinction calls for explanation. The simplest hypothesis is that the inhabitants of Iatrus at this time, in contrast to those at Dichin and Nicopolis ad Istrum, consumed primarily rye. Alternatively, the preponderance of rye could indicate local specialization in its production or storage, implying a complex network through which food was supplied. Finally, the stores of rye could represent fodder rather than food for humans.

In support of the last hypothesis is the fact that the Notitia Dignitatum identifies the garrison of Iatrus as a *cuneus equitum scutarium* (*Notitia Dignitatum* XL). Furthermore, numerous cow bells attest to the importance of animal husbandry at this time (Gomolka-Fuchs 2007). However, the recovered botanical remains were extremely well cleaned, making their use as fodder unlikely (Neef 2007, 418 n. 18).

The existence of a complex supply network operating at this time is demonstrated by the recent excavations at Dichin (Poulter 2007d; Bülow 2007), but it is very unlikely that Iatrus' role in this network would be the production or storage of rye. Rye grows well in poor, sandy soils and is resistant to drought (Behre 1992), but Iatrus is surrounded by rich Chernozems and bordered a wetland. Furthermore, if the rye were being exported rather than consumed on site it would be stored in a centralized granary, but the wide distribution of botanical finds in Iatrus suggests a pattern of decentralized storage in the late fourth and early fifth century (Neef 2007, 428).

It is most likely, therefore, that the inhabitants of Iatrus were in fact consuming rye much more than their neighbors in Nicopolis ad Istrum and Dichin. This would set them at odds with the elite Roman dietary practices. Rye does not grow well in a Mediterranean climate, though it was known. Pliny the Elder describes rye as a very poor food only consumed to ward off starvation (18.141). Galen describes seeing rye in Thrace and Macedon, but had a very low opinion of it (*De Alimentorum Facultatibus,* 514). Nevertheless, rye was cultivated and consumed as the dominant grain in the Roman period in parts of the Netherlands, Germany and Poland (Behre 1992). Rye has also been found in significant quantities in Late Iron Age and Roman sites in Hungary, though never as the dominant cereal (Gyulai 2014a). Rye cultivation, then, was known in the Roman period, but it did not become widespread until the early Medieval period (Behre 1992; Gyulai 2014b).

Rye cultivation is widespread enough that it cannot be securely linked with a single historically attested ethnicity or archaeologically attested culture. Nevertheless many of the earliest examples of cultivated rye come from early Iron Age sites in the north Pontic region

(Behre 1992).[102] If rye was commonly preferred in these regions, its dominance at Iatrus could be explained by the presence of immigrants from the Eurasian steppes. East Germanic military equipment and objects of personal adornment have been found in significant enough quantities to suggest the actual presence of immigrants in the late fourth and early fifth century (Gomolka-Fuchs 2007). The burnished pottery known as "federati ware" has been found in Iatrus, Nicopolis ad Istrum and Dichin, but at the latter two sites in constitutes less than 2% of the ceramic assemblage (Swan 2007), while at Iatrus it constitutes closer to 4% (Conrad 2007). The presence of Goths at Dichin has been hypothesized based on the presence of this pottery, but the small finds of metal and bone do not support the argument (Dinchev 2009, 334). The situation at Nicopolis ad Istrum is similar: the presence of "federati ware" is not accompanied by distinctly non-Roman finds in other materials. The presence of this pottery, which differs from local pottery in manufacturing technology, probably does indicate the presence of immigrants in the region, but in itself it does not indicate a significant immigrant population in a given settlement (Swan 2007). The combination of pottery, military equipment and items of personal adornment does, however suggest a significant immigrant population (Conrad 2007, 236). The very un-Roman dominance of rye at Iatrus fits well with this conclusion.

After the departure of Theodoric at the end of the fifth century there are only sporadic references to centrally directed settlements that might have affected the study area (Batty 2007, 412 Table 7.2). The population must have consisted of a mixture similar to the one described in the fourth century but presumably with a larger portion of immigrants from across the Danube.

2.7.3 Military populations

Soldiers, by dint of their profession, have power over non-soldiers. The way soldiers treated people outside the military community will have depended in part on regulations governing their actions but much more on the social pressures they experienced. If their social relationships were confined to the military community they would likely face little censure for abusing an outsider, but if they had relationships with people living in the countryside they may have had more sympathy or, at least, may have feared the repercussions of their actions. Relationships between military and local communities could have been shaped by ethnic identities. Shared ethnicity could have helped to bridge a military – nonmilitary divide, while differing identities could have exacerbated it.

2.7.3.1 The ethnic origins of soldiers

In the Julio-Claudian period, auxiliary units were generally stationed in the area that they were raised unless they rebelled, in which case they were moved elsewhere. The Pannonian, Thracian and Batavian revolts are classic instances of this pattern. Units were also transferred when they were needed for major campaigns. The question of how these units were maintained, whether by recruiting in the area of origin or in the area in which they were stationed has been long debated (Haynes 2013; Cheesman 1914). There is a general consensus

[102] Recent pollen cores from the Alföld plain in Hungary and the Thracian plain south of the Balkans in Bulgaria, however reveal significant quantities of rye pollen in the Late Bronze Age and Early Iron Age here too (Chapman, Magyari, and Gaydarska 2009).

that there was a shift toward local recruitment in the second century that applied to the auxiliary units and to the legions.

That consensus is being challenged on several fronts. Haynes has reevaluated the epigraphic evidence from Africa on which the argument was originally based and finds it no longer supports the argument. Instead, he argues, recruits came from the "nearest convenient source", which was often, but not always, the area around the forts themselves (Haynes 2013, 134). Some regions, including Thrace, provided a disproportionate share of recruits who could then be stationed all over the empire (Haynes 2013, 103–121). Carol van Driel-Murray has recently argued that ethnic recruitment of, *inter alia*, Batavians continued throughout the second century (van Driel-Murray 2009). All scholars agree that the Roman military was cosmopolitan and none argue that there was no local recruitment, but significant questions remain about the level of local recruitment in any given place.

Direct evidence about the ethnicity of individual soldiers in the study area is difficult to come by. Due to the ubiquity of imperial gentilicia, onomastics are unreliable and when a soldier gives an *origo* on an inscription it could be because it is exceptional and should not be taken as representative of others in his unit (Haynes 2013, 121–134; Alexandrov 2012a; van Driel-Murray 2009) Recent work on the religious practices of military personnel in Moesia Inferior and Thrace, however, has shed some light on the issue (Alexandrov 2012a; Alexandrov 2012b). The assumption is that religious activity is related to ethnicity. When one finds dedications to native gods using specific epithets it is probable that the dedicant was indigenous. This assumption is not without problems as one can always imagine someone adopting local customs, but for our current purposes it will suffice.[103] Participation in local religious culture indicates connections outside the military community, whether pre-date or post-date enlistment.

The vast majority of dedications by military personnel date between the mid-second and mid-third century. While the officers made dedications primarily in official settings, common soldiers often made unofficial dedications. The nature of these dedications show that, at least from the mid second century on, there was a major contingent of locals serving in the Moesian army. The distribution of inscriptions suggests that they came from the rural population living north of the Haemus Mountains. At the same time, foreign soldiers never disappear (Alexandrov 2012a; Alexandrov 2012b).

The epigraphy left behind by veterans tells a similar story (Boyanov 2008). Under the Julio-Claudians, legionary veterans from both western and eastern provinces are attested, but Thracians are absent. Under the Flavians and Trajan there were still very few Thracians in the legions, though there were more in the auxiliaries. Only under Hadrian did local recruitment become widespread and, by the third century, almost the entire army consisted of Thracians.[104]

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[103] This line of argument is not unproblematic. Legionary veterans from northern Italy who settled in Gaul worshipped local *matrones*. Indeed, these *matrones* are only represented in the archaeological record because of the Roman practice of erecting inscribed stones in fulfilment of a vow (Derks 1998, 127–130, 234–239).

[104] It is unclear what role Hadrian had in the changing geography of recruitment. Le Bohec sees the transition to local recruitment taking place gradually (Bohec 1994, 80). Ian Haynes emphasizes the importance of Hadrian's military reforms in general, but the Emperor barely figures in his discussion of recruitment (Haynes 2013, 121–

Based on the stated *origines* and the distribution of diplomas, they came mostly from the garrison communities themselves and from the countryside rather than the cities.

After the end of the third century, the military diplomas and tombstones that provide evidence for ethnic origins cease. The only shred of evidence that might pertain to fourth century soldiers is the *Notitia Dignitatum*, which places *milites Dacisci* at Mediolana (*Or.* 40; see section 2.6.6 above for the date of the *Notitia Dignitatum* and Mediolana). After the late fourth century, it becomes less and less meaningful to speak of a distinct military population (section 2.8.2).

2.7.3.2 Movements of units

If military and local communities were integrated, the transfer of a unit to a new base would have caused significant disruption to local society. This is especially true if, as Sommer argues, the non-combatants generally followed their units even when the fort was immediately reoccupied by another unit (Sommer 1988, 627–629). In this case, the fort and vicus would remain, but the community occupying them would be different. Anyone living outside the base who wanted to do business with its inhabitants would have to forge entirely new social ties.

The best data about the distribution of troops comes from military diplomas issued to auxiliary soldiers upon completion of their term of service. These list all the auxiliary units in a province from which soldiers were discharged, allowing us to trace the movements of units across the empire. Unfortunately, this means that movements of troops between within a province are not recorded.

In the area of interest there was one legionary base, so a complete discussion of the legions in Moesia Inferior is unnecessary. In 46 CE the legion VIII Augusta was stationed at Novae (IGBulg 300=CIL 11.1835). It would remain there until 70 CE when it was replaced by the legion I Italica, a legion raised in Italy that fought for Vitellius in the civil war. This legion would remain at Novae until the fourth century.

Since we don't have similarly precise information for the auxiliaries we must consider the general picture of auxiliary units in Moesia Inferior. Some must have arrived with legion VIII Augusta, but we have no information on specific units. During the civil wars, large numbers of troops marched across the empire in support of their favored candidate including a major portion of the garrison of Moesia (R. Ivanov 1999, 99–102). After Vespasian won the throne he redistributed troops, sending some of Vitellius' supporters to the lower Danube. At the same time, major military operations were undertaken against groups from across the frontier who had taken advantage of the civil wars to raid Moesia (Tacitus *Histories* 1.79, 3.46; Josephus *Bellum Judaicum* 7.4.3). The epigraphic record supports the literary sources with a significant number of units attested in Moesia Inferior for the first time under Vespasian, even allowing for the fact that military diplomas were introduced at this time (Matei-Popescu 2010b).

134). Anthony Birley does not discuss recruitment, but his analysis of the evidence for Hadrian's army reforms demonstrates that they were recognized as consequential in antiquity and that they are poorly understood in the present (Birley 1997, 113–120).

Domitian's Dacian wars in the mid-80s brought more troops, but these were mostly stationed in Moesia Superior. Only two cohorts were added to Moesia Inferior. Similarly, Trajan launched his Dacian wars from Moesia Superior and only added two cohorts to Moesia Inferior's garrison (Matei-Popescu 2010a, 239–244). Between the beginning of Vespasian's reign and the Dacian wars there were nine alae and 22 cohorts stationed in the territory of Moesia Inferior. After the Dacian wars, the new province's garrison primarily came from Moesia Superior (Knight 1991). The territory of Moesia Inferior was extended north of the Danube until Hadrian evacuated part of it and organized the rest as Dacia Inferior. three alae and nine cohorts were transferred to Dacia Inferior, but they had probably been stationed in the territory already after the Dacian wars (Knight 1991). The garrison of Moesia Inferior continued to fluctuate until Hadrian's reorganization was completed in the 120's (Matei-Popescu 2010a, 241–2). After this there were minor changes in the garrison of the province, but these involved moving individual units, not the large swaths of the army.

After the initial garrisoning of Roman troops, the time between the civil wars and the reign of Hadrian was a long period of troop fluctuations, with the greatest changes occurring in the 70's and the first two decades of the second century. After this the garrison was relatively stable until the third century.

Based on recent archaeological investigations we have more detailed histories of the garrisons at Sexaginta Prista and Trimammium. Recent excavations at Trimammium have turned up evidence for the third century occupants of the fort in the form of brick stamps bearing the legend CORTISIBRA.[105] This has been identified as *cohors I Bracarorum civium Romanorum.* This unit first appears in Moesia Inferior in 120 having been transferred from Mauretania Tingitana. In the second half of the second century, a vacillation from this unit was present in the Tauric Chersonese (ILS III, 9160). A grave stele mentioning the unit and dating to the second half of the third century has been found in the Montana region, leading to the conclusion that the unit was stationed there, but this is weak evidence compared to the brick stamps from Trimammium. The only other information we have on this unit comes from an inscription found at Trimammium referring to a cohort with the epithet "Severiana". Unfortunately the name of the cohort is lost, but the name of the governor dates the inscription to 224 CE so, in light of the brick stamps, it should be the *I Bracarorum*. The rank of the commander, a prefect, suggests the cohort was quingenary. A fourth century inscription in Histria records a member of the *vexillatio XII catagractariorum* "[q?]ua[e? e]s(t?) T[ri]mamio" (Popescu 1976 no. 110) and in the *Notitia Dignitatum*, Trimammium is the headquarters of the *milites Constantini* (*Or.* 40). Unfortunately it is impossible to reconstruct when in the fourth century the garrison at Trimammium changed.

Sexaginta Prista was a naval base in the Flavian period (Torbatov 2012a). A building inscription at a nearby temple from the Trajanic period mentions the *cohors VII Gallorum equitata*, though this cohort also appears on a tombstone at Tomis (for the building, AE 1954, 35, inscription see Velkov 1980, 56. The tombstone is CIL III, 7548). It first appears in Moesia Inferior in a diploma of 75 CE and seems to have been transferred to Syria under Hadrian

[105] This paragraph is based on a synthesis of recent rescue excavations at Trimammium (Torbatov 2012b, 446–454)

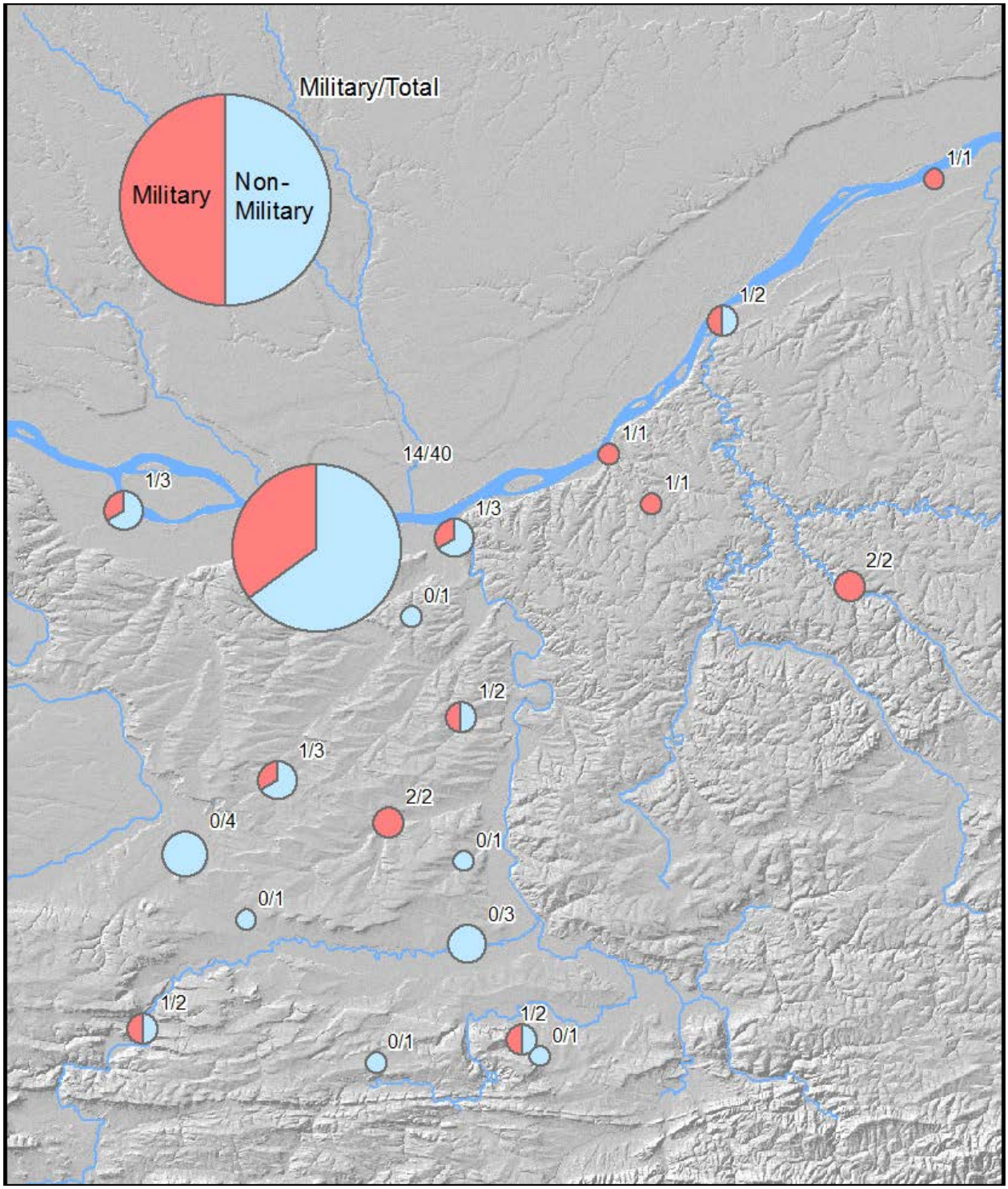
(Matei-Popescu 2010a, 212–213). The *cohors II Mattiacorum equitata* is attested at Sexaginta Prista by brick stamps and milestones from 144 CE (AE 1900, 18 = CIL III, 762 and AE 1916, 65), but soon after it appears in an inscription at Sostra (AE 2001, 1747). It was probably stationed at Sexaginta Prista early in the reign of Hadrian (Matei-Popescu 2010a, 223). The *cohors II Flavia Brittonum equitata* appears at Sexaginta Prista in milestones dated 162-164 and in building inscriptions from 184-192, 230 and 273-275 (the milestones are AE 1915, 137, 138; the building inscriptions are AE 2008, 1188; CIL III, 7473; AE 1915, 139). The unit appears in a military diploma already in 99 CE and may have been stationed at Durostorum in the first part of the second century (Matei-Popescu 2010a, 199). All three units stationed at Sexaginta Prista during the principate were quingenary cohorts. In late antiquity, Sexaginta Prista appears in the *Notitia Dignitatum* as a second base of *legio I Italica* and as a base of the *cuneus equitum armigerorum* (*Or.* 40).

Sexaginta Prista, then, has four garrison shifts that can be reconstructed: At some point under the Flavians or Trajan the *cohors VII Gallorum* was stationed there, turning a naval base into an auxiliary fort; under Hadrian the *cohors II Mattiacorum* replaced the *VII Gallorum*; under Antoninus Pius the *cohors II Mattiacorum* was replaced by the *cohors II Flavia Brittonum*; after the late antique reorganization of the army it contained a part of the *legio I Italica* and the *cuneus equitum armigerorum*. In every case, the unit that moved in to Sexaginta Prista had been in the province before, so none of these shifts are apparent in the record of military diplomas. The change of garrison under Antoninus Pius is particularly interesting as it comes at a time when the provincial organization of troops was stable. It also comes at a time when more of the soldiers are local recruits (section 2.7.3.1), potentially exacerbating the disruption to local society.

2.7.3.3 Veterans

Veterans formed a significant portion of the rural population, but they were not evenly distributed across the landscape. The earliest epigraphic attestations of veterans comes, not surprisingly, from the area around the legionary base at Novae (Boyanov 2008, 88–98), but already under the Flavians, veterans appear scattered around what would become the territory of Nicopolis ad Istrum. This has been interpreted as planned veteran settlement in which veterans were allotted land (Gerov 1988, 45), but the interpretation has recently been challenged on the basis that the veterans come from different units (Boyanov 2008, 147–148). Veterans certainly settled in the greater Yantra river valley, but no colony was planted there.

To understand the role of veterans in the rural population it is insufficient to examine only evidence relating to veterans while ignoring evidence that does not. Funerary monuments are helpful in this regard as these were erected by both veterans and civilians. Sven Conrad has published a monograph on the funerary stele in Moesia Inferior which collects this evidence (Conrad 2004). His catalog groups the stele according to the nearest village or ancient find spot, allowing them to be mapped in a very rough way. On the following map, every village in the area of interest with grave stele has been marked with a pie chart showing the portion of inscriptions which mention a veteran or active soldier compared to those that do not. The size of the pie chart is proportional to the total number of grave stones found in or near each place.



Map 10: Funerary monuments attesting to the presence of veterans and soldiers.

Conrad lists 76 funerary monuments in the area, of which 28 (37%) mention a soldier or veteran and 48 (64%) do not. By far the most grave stones were found at the legionary fortress of Novae, but even here, only 35% mentioned an active or retired soldier. Aside from the forts on the Danube, twelve places to the west of the Yantra have produced grave stones and of

these soldiers are present in five. Fewer gravestones have been found to the east of the Yantra, but almost all mention soldiers or veterans. This suggests that there were more epigraphically inclined people to the west of the Yantra, of whom soldiers and veterans were a significant minority. To the east of the Yantra, almost all of the epigraphically inclined people were soldiers or veterans. The epigraphic record probably over-represents the wealthy and "Romanized," so it is likely that significantly less than one-third of the people living in the area served in the military. This is still a significant portion, but it is a distinct minority.

2.8 Military bases and the economic landscape of Moesia Inferior

2.8.1 Second to third centuries

Military bases were centers of production, but they were not the only, or even the most important centers. Indeed, craft production seems to have been widely dispersed. A production center under the modern village of Butovo produced pottery and stone objects from the second through the fourth century (Sultov 1962; Sultov 1985). A villa complex west of the city of Pavlikeni also produced pottery during the second and third century as well as producing metal items on a small scale (Vladkova 2011). There was a major quarry near the village of Hotnitsa which supplied stone to both Nicopolis ad Istrum and Novae, but stone was also quarried at a smaller scale from numerous other places (Petrova and Ivanov 2008). Next to the quarry, a large settlement of stone workers existed from the second through the fourth century and a few kilometers away there was a large pottery manufacturing center (Ilcheva 2006; Sultov 1985). Farther to the east, a small Roman village near Kamen produced evidence for pottery production and metallurgy (Tsarov 1997). Bone working, metallurgy and pottery production have also been established at the city of Nicopolis ad Istrum (Poulter and Blagg 1995, 25, 28–29; Poulter, Falkner, and Shepherd 1999; Roberts 2007). Lime kilns and pottery kilns, along with evidence for black-smithing have also been found in the pre-fortress levels at Iatrus (Vagalinski 2003; Vagalinski 2011).

In comparison, the evidence for craft production at Novae during the principate seems rather meager: there was at least one bone and horn workshop (Vladkova 2012b) and several pottery kilns (Tomas 2003, 134–136). This may not be representative, however, as most of the excavation at military sites has occurred within with the walls and has targeted public buildings. The extramural settlements, where second and third century production is most likely to have occurred, are largely unknown. Thus, while military bases may have been production centers, there were also numerous other production centers in the central Danubian Plain and there is no reason to think that military bases were particularly important in this regard.

It has recently been suggested, based on the provenance of known agricultural tools, that military communities may have been engaged in agricultural production (Cholakov 2010; Cholakov 2012). For the area of the central Danubian Plain, the evidence is very sparse. Several plow shares and many cowbells have been found at Iatrus, but these all date to the periods after the *principia* was abandoned when the site was a fortified settlement or to the medieval period (Gomolka-Fuchs 1986; Gomolka-Fuchs 1991; Gomolka-Fuchs 2007). At the same time, pollen samples from Iatrus show that when the fortress was an army base, grain was being

cultivated in the immediate vicinity (Lazarova 2007). The question of agricultural production at the military bases in the study area remains unresolved.

Military bases were undoubtedly population and consumption centers. Indeed, the legionary fortress at Novae was the largest settlement in the region with an inhabited area between 70 and 80 hectares, as compared to the *municipium* of Nicopolis ad Istrum at around 25 hectares (Conrad and Stančev 2002, 674; Poulter 2007d; Tomas 2012). Both of these places held thousands of people. A second, large settlement has been identified 2.5 kilometers east of Novae at a place called Ostrite Mogile which covers an area of 15 hectares (Tomas 2014). The populations of other settlements can only be guessed at. Even the size of the fortified area of most army bases is only roughly known, but most were between one and five hectares, making them appropriate for an auxiliary cohort of 500 men (Hanel 2007, 407–408). Extramural settlement has been confirmed archaeologically at Trimammium (Torbatov 2012b) and epigraphically at Sexaginta Prista (AE 1966, 356). So little work has been done on these forts that civilian settlements cannot be ruled out for any of them. Even so, the populations of these centers was probably never much higher than 1,000 people. Nevertheless, in contrast to other settlements, most of these people were not farming and therefore consumed the produce of others. Their economic impact, therefore, is not simply proportionate to their population.

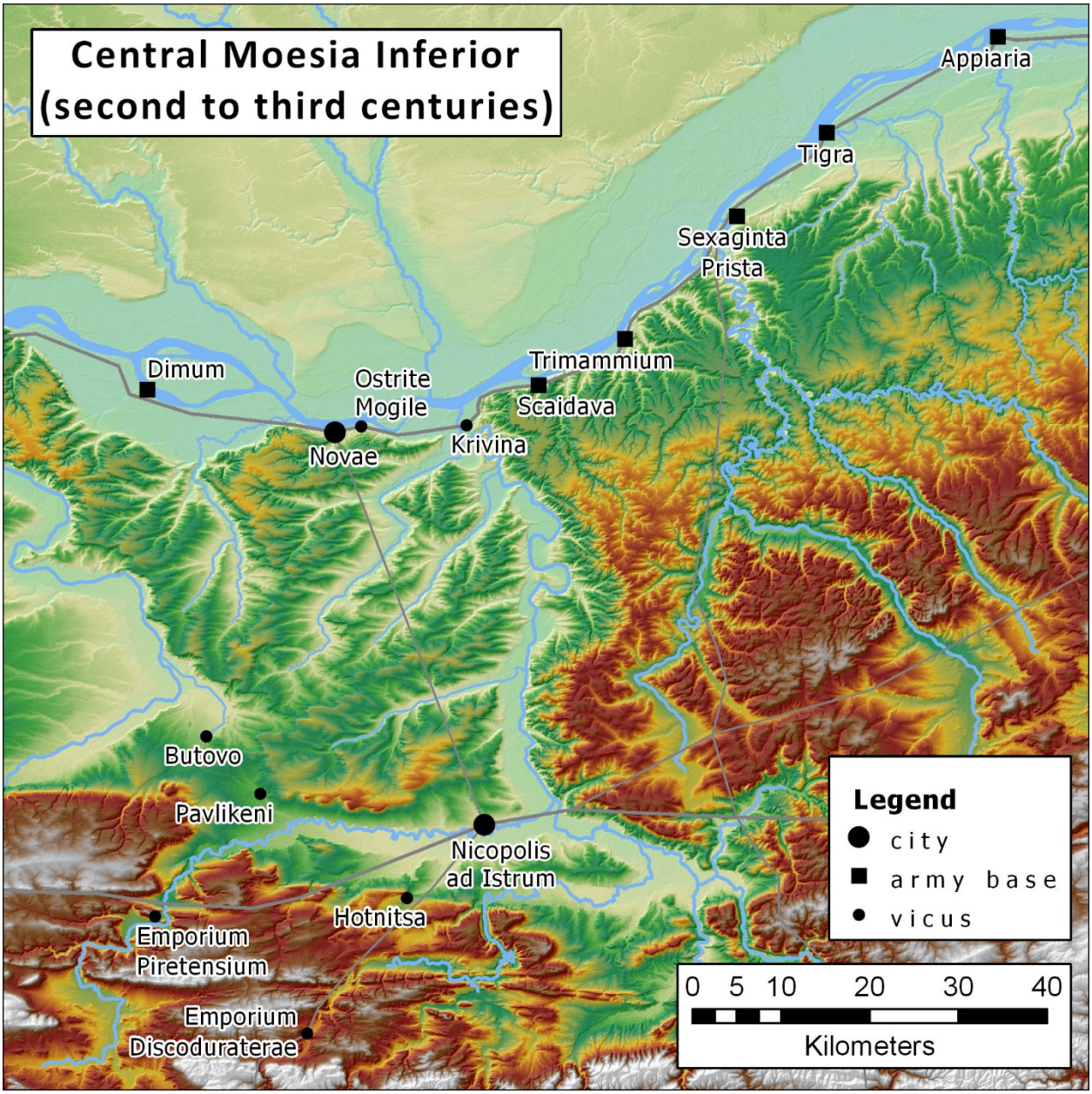
The Roman army, and by extension the entire military community, was well integrated into long-distance trade networks. The Danube and its tributaries facilitated shipping from the Black sea to Germany. Relatively short overland routes joined the riverine network to the Adriatic and the Rhine. This connectivity is reflected in the archaeological material from Novae. Imported table ware and lamps from Italy and the western provinces dominate the assemblage until the third century despite the establishment of local pottery production in the second century (Żmudziński 1998).[106] Wine, oil and fish sauce were imported in amphorae which came predominantly from the western empire in the first century but from the eastern empire in the second and third century. Local amphorae are rare, but it is possible that local wine was transported in barrels (Dyczek 1997). This stands in contrast to Nicopolis ad Istrum, which was supplied with table ware from local sources already in the early second century and consumed very little Gallic sigillata (Poulter, Falkner, and Shepherd 1999, 28). Local potters may have faced less competition from imported goods in a non-military market but someone wanting to buy imports would probably find better prices at a garrison settlement.

2.8.1.1 The status of Novae

Novae was a legionary headquarters from the middle of the first to the middle of the fifth century CE, but it was also a major urban center for most that time and at least a century after. At some point in the late second or early third century, Novae was recognized as a municipium (Tomas 2006), but even in the second century, it was the largest center in the region (Conrad and Stančev 2002; Tomas 2012; Dinchev 2015, 582 expresses doubts about the extent of the settled area). Indeed, surface survey has revealed a dense, possibly planned penumbra of rural settlements extending beyond the canabae (Conrad 2006, 321–324). This could be due to demand from soldiers and the military administration, but it could also be due

[106] The hospital is an exception. Here, table ware from Butovo and Pavlikeni is most prevalent (Dyczek 2002).

to the demand and productive activity of the non-combatant portion of the military community. Setting aside the soldiers' salaries, the sheer number of people living at Novae would have made it an attractive market for rural producers. Once it gained municipal status, its administrative functions would only have increased its appeal. Even though Novae was an army base, it was also a city. In order to clarify the role of the military in the local economy, Novae will only be considered a city.



Map 11: Economic centers in central Moesia Inferior.

2.8.2 Fourth to fifth centuries

Military communities always contained both soldiers and civilians, but changes in the architecture of forts at the end of the 3rd to beginning of 4th century and again at the end of the

4th to early 5th century indicate an increased civilian presence inside the fortification walls (Bülow 2007; Dinchev 2007; J. H. W. G. Liebeschuetz 2007, 108–110). These changes are most visible in Novae and in Iatrus due to the long history of excavation at these two sites, though the chronology of the latter is disputed.

In the late third to early fourth century, the fortification walls of Novae are renovated and an extension is added, presumably to enclose the civilian settlement. More striking is the architectural transformation of the intramural area: The principia continued to function, but the other military buildings do not: the site of the hospital is occupied by buildings that appear to be elite urban residences and workshops; the *scamnum tribunorum* is occupied by a large, public building with *tabernae* flanking the street; the baths continue to be used, but on a reduced scale (Dyczek, Kolendo, and Sarnowski 2008; R. Ivanov 2012a; Milčeva and Genčeva 1998). Novae continued in its role as a regional military center, but its role as an urban center was gaining architectural prominence.

In contrast, the architecture of the newly built fort at Iatrus is entirely military in character (Döhle 1995). That began to change in the second half of the fourth century. The *praetorium* was built early in the century on a Roman peristyle plan, but at some point in the second half of the century, a wall that snaked between the columns of the peristyle was built and the surrounding rooms were used for industrial and domestic purposes (Stanchev and Conrad 2007). Workshops began to appear in the barracks (Döhle 2007). At the same time, the *principia* maintained its public functions until the early fifth century when iron working begins (Dinchev 1999b, 166). In general, none of Iatrus' public buildings retain an official character after the first decade of the fifth century (Bülow 2007; Dinchev 1999b). By the time it was destroyed by the Huns in the middle of the fifth century, Iatrus looked much more like a fortified settlement than a military base.

In the fourth century, the residential buildings that housed Roman officials, like the barracks and the *praetorium* at Iatrus and the *scamnum tribunorum* at Novae lose that function. In Novae they are replaced by public buildings, in Iatrus, by production. At the same time, however, the *principiae*, the headquarters where military business occurs, continues to function. Presumably, the officials and soldiers now elsewhere in accommodations that were not as architecturally distinct. Perhaps the extension of the fortifications at Novae was deemed necessary because the officers were now residing outside the old walls. Within the military community there is a move toward greater integration between soldier and non-combatant that finds architectural expression earlier at Novae, where workshops began to occupy public buildings already in the second half of the third century, than at Iatrus. Nevertheless, both places retain their headquarters building until the early fifth century, after which there are no more distinctly military places that are archaeologically identifiable. This does not mean that military administration ceased. Three statue bases dating to the 430s and honoring *primipilarii*, officials responsible for the *annona*, have been discovered at Novae, suggesting it remained an important distribution center for military supplies (Poulter 2007b with references).

Novae and Iatrus both appear to be thriving cities with an important military function that becomes less distinct over the course of the fourth century. The impression from the archaeological excavations is of a drastic increase in productive functions, but we should be

wary of comparisons with earlier periods. Almost all of the excavation at both sites has occurred within the fortification walls, so earlier, extramural workshops are systematically excluded from the sample. It is unclear, then, if the increased evidence for production is evidence for a real increase or simply a shift in location. In general, a lack of evidence about second and third century garrison settlements hampers comparison with their fourth and fifth century successors. A shift toward the spatial integration of non-soldiers into military spaces is detectable, but there is no way of knowing how this would have changed the function of the settlement in the larger, local economy.

2.9 Conclusion

It is undeniable that the presence of the army on the Danube had a major impact on life in Moesia Inferior. What remains unclear is the precise nature of the relationship between the people who lived in and around military bases and those who did not. There are many reasons to think the relationship would have been amicable and mutually beneficial. Ethnically, both populations included strong immigrant elements, but also, especially from the late second century, strong local elements as well. Even before Roman conquest, locals were engaged in commercial exchange and consuming many of the staple elements of the Roman diet—bread wheat, wine, pork, and beef. The military communities may or may not have produced goods that they could offer in exchange of food, but they certainly had money. All of these factors should have worked to integrate the military and rural communities.

At the same time, there are reasons to be cautious. Many of the things that would have served to integrate the forts with the countryside were also true of non-military centers like Nicopolis ad Istrum. Unlike the army bases, these centers did not benefit from state-subsidized and directed supply mechanisms and the residents did not have the social privileges enjoyed by soldiers. These factors must be balanced against the soldiers' salaries and assessing how lucrative these different markets really were. Unfortunately, it is not possible to come to a conclusion based on the evidence presented above. In order to understand the relationship between military and rural communities, new sources of evidence must be sought.

Chapter 3: Data, Analysis and Results

3.1 Introduction

This chapter presents the data – their method of collection, processing and analysis – and the results used to investigate the relationship between the communities living in and around Roman army bases and the people living in the countryside in the lower Danubian frontier zone. First the database of ancient places and the method of its construction is described. Then the settlements from each chronological period are analyzed in terms of the agricultural affordances available in their immediate territories and their locations within the regional social landscape. This analysis is performed for each variable individually, but the final section combines the variables into predictive models. Several models are constructed and compared in order to clarify the spatial and social relationships between army bases and rural settlements.

3.2 Database Construction

3.2.1 Introduction

The empirical core of this dissertation is the database of ancient places which integrates and systematizes archaeological information from a variety of published and semi-published sources.[107] Both the level of investigation and the level of publication are highly uneven, which limits the areas that can be profitably included in a sample of rural settlements and the types of analysis that can be performed. This chapter will describe the sources of the information included in the database, with particular emphasis on the Archaeological Map of Bulgaria; the process by which those data were systematized; and finally, the structure of the database itself.

3.2.2 Sources of information

The first step in constructing the database of ancient places was to compile a list of all known archaeological sites with material from relevant historical periods. To do this I relied on the digital database known as the Archaeological Map of Bulgaria (AMB or AKB for *Arheologicheska Karta na Balgariya*), and *The Tabula Imperii Romani K 35/2 Philippopolis* (R. Ivanov 2012b). These two global overviews provided precise locational and chronological data respectively and form the foundation of the database. For further details and the most recent sites I consulted reports in the series *Arheologicheski Otkritiya i Razkopki*, regional archaeological overviews – especially the contributions of Karl Shkorpil and Stoyan Stefanov to the series Materials for an Archaeological Map of Bulgaria (Shkorpil 1914; Stefanov 1956) and an overview of archaeological monuments in the province of Ruse (Dremsizova-Nelchinova and Ivanov 1983) – and more detailed publications of individual sites. Only a small fraction of the archaeological sites has been published in detail. Most are known only from extensive survey and are published in very general terms.

[107] See chapter 1 for the definition of "place" as used here.

It is worth mentioning here two large-scale survey projects that were carried out in the late 1990's and early 2000's. The first is part of the Bulgarian-British research program, "The Transition to Late Antiquity," which followed a program of excavations at Nicopolis ad Istrum and sought to clarify the economic changes in the countryside around that city in the Late Roman and Early Byzantine periods. In addition to excavating a late Roman fortress near the village of Dichin, a series of intensive surface surveys and geophysical prospection was carried out at previously identified sites. The main results have been published in a series of preliminary reports and in a comparative volume, but the full publication is still forthcoming (Poulter 2000; Poulter 2004; Poulter 2007a; Poulter 2007c; Dinchev et al. 2009).[108] The second is the Bulgarian-German project "Archaeological Survey on the Lower Danube" which sought to understand the relationships between the fortresses of Novae and Iatrus and their respective hinterlands. Again, the primary results have been published in preliminary reports, but a detailed publication of the project has not yet appeared (Conrad and Stančev 2002; Conrad 2006; Conrad 2008).[109]

3.2.2.1 The Archaeological Map of Bulgaria

The majority of the sites used in this project are recorded in the Archaeological Map of Bulgaria.[110] The basic unit of the AMB is the card, which contains information about an archaeological site. A wealth of information can be included, expressed in a standardized, hierarchical vocabulary (For the vocabulary and the hierarchy of specificity see "Arheologicheska Karta Na Balgariya" 1989). Unfortunately, with the exception of

[108] I would like to express my gratitude to Andrew Poulter for allowing me to consult with him about several sites and for sharing with me unpublished maps of a site near Ivancha.

[109] One dissertation, focusing on prehistoric settlement patterns, has been published from this project (Krauß 2006). It contains a detailed description of the methodology, as well as a catalog of prehistoric sites discovered during the survey.

[110] Access to the AMB is usually restricted to Bulgarian Archaeologists. I would like to express my gratitude to the director of the National Archaeological Institute with Museum, Professor Lyudmil Vagalinski and to the national administrators of the AMB, Professor Georgi Nekhrizof and Doctor Ivo Cholakov for granting me access. The idea for a national map of Bulgaria's archaeological heritage dates back to the early 20th century when participants in the National Conference of Archaeological Societies formally decided to formulate consistent methods of data collection for the eventual formation of such a map. The above-mentioned monograph series "Materials for an Archaeological Map of Bulgaria", published from 1914 to 1963, is the most notable result. The modern AMB is a result of increased interest in field survey among Bulgarian archaeologists following a Bulgarian-Polish survey project carried out between 1978 and 1982. In 1988 a Working Party on "An Archaeological Map of Bulgaria" was formed within the National Institute of Archaeology – Bulgarian Academy of Sciences with the stated aims of creating a uniform method of field survey, training archaeologists in their application, and creating a computer database of national archaeological heritage (Domaradzki 2005; Tzvetkova, Nekhrizov, and Kecheva 2012). The fall of communism in 1990 and the consequent financial difficulties threatened to halt the project, but the Working Party appealed to regional and historical museums for funds and was able to continue their work. In 1991 a law was passed to privatize state agricultural land, threatening archaeological sites by removing the legal control the state had hitherto enjoyed. As a result, the commission on the implementation of this law contributed significantly to the completion of the AMB, which would now become a fundamental tool for the protection of archaeological heritage (Domaradzki 1994). Work on the AMB continued at a slower pace in the 1990s and 2000s, but new sites were added and the software continued to develop (Nekhrizov 2005). In 2000, the AMB software was rewritten to be compatible with Windows and in 2010 it was put online at www.naim-bas.com/akb (Tsonev and Nekhrizov 2012; Tzvetkova, Nekhrizov, and Kecheva 2012; Kecheva 2014).

geomorphological terminology, no definitions of the vocabulary have been published (For detailed definitions of geomorphological terms see Pernicheva 1992).

The general location of the site is given in terms of village, municipality, and province as well as a local toponym. The precise location is given as distance and compass bearing from the village, or rarely, from other prominent landmarks. In the past, the origin point of the distance and azimuth was the village square, but recently it has been decided that the geometric center of the village should be used. There is also space for a map, but as of this writing, most of these maps were not online. The most recently added cards generally contain maps as well as GPS coordinates.

Topographical details, such as geomorphology (e.g. “river terrace,”, “hill top,” “valley slope” etc.), watershed, and elevation (usually given as a 100 m range) as well as a description of the surface (slope, visibility, accessibility, etc.) follow. Next are fields describing the available sources of information such as archives, museums and publications.

A description of the site is given in terms of area (in decares), features, finds, concentration and grouping of finds and other specifics, along with a place for a detailed plot of the site. Like the maps, though, most of these plots are not yet online. An unlimited number of types and chronological periods can be described within a single site. Examples of types are fortifications, cult facilities, aqueducts and canals, isolated building, necropolis, hamlet (a settlement covering less than five decares), and kome/pagus, etc. (a settlement covering more than five decares). These last two terms, along with their more general variant “village”, are the most commonly applied typological terms aside from “tumulus”.

The periodization is also general, with “early Roman”, “late Roman”, and “late Antique” being the most specific options, but “Roman” or “Thracian” is much more common. There are also fields for the relevant archaeological complex (e.g. a necropolis might be related to the fortress at Trimammium), system (e.g. “Lower Danube Limes”) and culture (e.g. “Provincial Roman”). The lack of published definitions is particularly problematic for chronological periods. Some contributors, for example, consider the terms “late Roman” and “late Antique” to be synonymous (Pavlina Vladkova, personal communication), but others disagree, defining separate late Roman and late Antique phases at the same site.

A brief history of research is also included. Finally, information on the current legal status, security, and socialization efforts are described. Each card also has an author, a date of creation and a date of the most recent modification. Most of the cards I examined were created between 1991 and 1993 and have not been modified since they entered the online database in 2010.

The data in the AMB are not an exhaustive account of the archaeological remains in Bulgaria. The information comes primarily from legacy data held in museum archives and surveys carried out as part of its construction, but it also includes data from more recent scientifically motivated and rescue excavations and surveys. The majority of the registered sites are the result of extensive survey, local knowledge, and site-based systematic surface survey (Kecheva 2014). As a result, many of the smallest sites are not included. The geographical

coverage is also inconsistent. In the survey area of the Bulgarian-German program, 92 settlements, fortifications and necropolises were registered in the AMB before the survey began. In the course of the project 289 more were identified (Conrad 2006). For reasons explained below (section 3.2.3.1), I believe this reflects local variations in the completeness of the AMB's data and is not reflective of the AMB as a whole.

3.2.2.2 The Tabula Imperii Romani K-35/2-Philippopolis

The Tabula Imperii Romani is the second major source of data for this project. The series of which it is a part is an attempt, dating back to the 1920s, to map the entire Roman Empire at a scale of 1:1,000,000. Much like the AMB, it is not a map per se, but rather a list of sites with basic information on chronology, location, and archaeological finds. The relevant volume was published in 2012 and represents an up-to-date synthesis of known archaeological sites dating to the Roman and Late Antique periods (R. Ivanov 2012b, ix–xi).[111] Data are presented in a textual format supplemented by small-scale maps of all sites in a given province. The level of detail varies greatly. Major, well researched sites are treated to a full description of the archaeological remains and history of investigation (Nicopolis ad Istrum, for example, has 15 full columns of text), while minor sites that have been less well studied can receive as little as one sentence noting its existence. Unlike the AMB, which uses a controlled vocabulary, this format allows the authors to present information in its most precise available form. This proved especially important in refining the chronology presented in the AMB. The locational data, on the other hand, are vague, usually consisting of a distance in kilometers and intercardinal direction (e.g. one kilometer, northwest) from a village. The TIR and the AMB thus complement each other nicely with the AMB providing precise locational data and the TIR providing precise chronological data.

3.2.3 The Process of Systematization

3.2.3.1 Defining the sample area

The goals of the project drove the choice of the area from which rural settlement data were collected. The purpose of the database is to understand which features of the landscape were attractive, repellent, and inconsequential to ancient peasants and into which of these categories garrison settlements fell. This requires a sample of rural settlements from an area that is extensive enough to register influences that operate at a distance of dozens of kilometers. This means the sample area should be several thousand square kilometers. The sample area should contain multiple market places, both military and non-military and these should be far enough apart that a preference in settlement location can be discerned. Similarly, the sample area should extend far enough south of the river to allow for the possibility that settlements avoided the frontier zone.

The sample area does not have to contain a unified urban system. Many methods of settlement pattern analysis require that a relatively bounded system of interacting centers be defined before the analysis is performed.[112] This is critical when one wants to use some

[111] The coverage of *TIR K-35/2-Philippopolis* extends from 40° to 44° N and from 24° to 30° E, which includes the Roman provinces of Thrace, Moesia Inferior, and the eastern part of Moesia Superior.

[112] Rank Size analysis is particularly sensitive to this problem (De Vries 1990; Horden and Purcell 2000, 103–104).

characteristic of the system as evidence for the way the system functioned and came to be. In this project, there is no question of identifying a bounded system because garrison settlements are incorporated into Empire-wide military network. There is also no question of establishing a unified network *a priori,* since the unity of the Danubian Plain is the question under investigation. Finally, the project is concerned with a long enough time scale that historically meaningful boundaries between systems shifted. There is no way to make the sample area correspond to a historically meaningful behavioral region.

Nor is there any need to since my evidentiary basis is not the character of the settlement system as a whole, but the behavior of rural settlements with respect to landscape features, of which the marketing system is one part. Horizontal interactions between rural settlements are intentionally excluded from consideration because of the impossibility of establishing contemporaneity. This means that the exclusion of some of a system's rural settlements can be left out without affecting the others. In contrast, Rank Size analysis, an outgrowth of Central Place Theory, uses two pieces of information about every settlement in a system: its size and its rank. Removing one settlement changes the ranks of all the settlements below it, thereby changing the shape of the graph on which interpretations are based (Hohenberg and Lees 1995; Smith 1990).

My methodology bases interpretations on the average values of numerous variables describing each rural settlements' location relative to other features in the landscape as compared to randomly distributed locations within the sample area. These landscape features include the terrain in the settlement's immediate vicinity, traffic routes, and markets, but not other rural settlements. The averages of these values do depend on other rural settlements, but so long as the comparison data are drawn from the same area as the settlements, deviations from the comparison average will accurately reflect locational tendencies. Crucially, the sample area does not limit settlements' reconstructed landscapes. Environmental and archaeological data were collected from a larger area of interest. Therefore, the edge of the sample area does not affect the measurement of variables.

For this project, regional research bias is a much more serious threat to the integrity of the results than the precise boundaries of the sample area. I want to compare the locations where people settled to all of the locations where they could have settled and to the locations where no one settled.[113] This entails taking the absence of evidence for evidence of absence, a proverbially dangerous gambit. However, with sufficient attention paid to the formation processes of the archaeological record, it is possible to lessen the risk that the absence of evidence reflects post-depositional transformation processes or deficiencies in research. Transformation processes will be discussed below (section 3.2.4). Because of the organization of Bulgarian archaeology, research bias is best dealt with through the definition of the sample area and so is discussed here.

The area of interest is in the middle of the Danubian Plain around the Yantra River and the Rusenski Lom River system. As the administration of the AMB is divided according to modern political boundaries, each archaeologist being responsible for collecting and entering

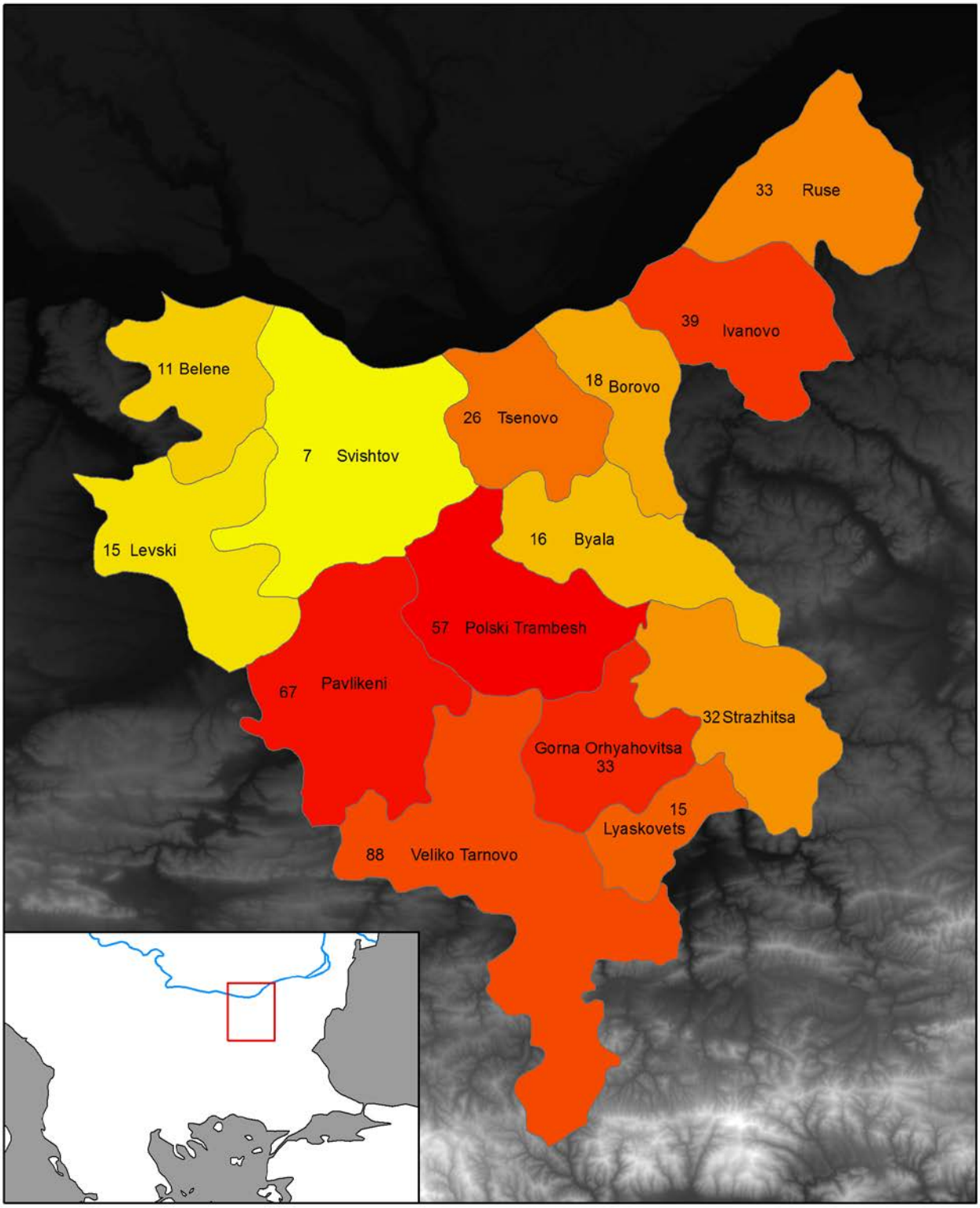
[113] As I clarify below, these are not the same thing (section 3.4.1).

the data from one or two municipalities. Therefore, it was necessary to define the precise borders of the study area along these lines to minimize variations in research intensity. It was also necessary to choose only those municipalities that seemed to have similarly complete representation in the AMB.

I searched the AMB for cards from the following municipalities: Belene (Pleven province), Levski (Pleven province), Svishtov (Veliko Tarnovo province), Pavlikeni (Veliko Tarnovo province), Polski Trambesh (Veliko Tarnovo province), Strazhitsa (Veliko Tarnovo province), Gorna Oryahovitsa (Veliko Tarnovo province), Lyaskovets (Veliko Tarnovo province), Veliko Tarnovo (Veliko Tarnovo province), Byala (Ruse province), Tsenovo (Ruse province), Borovo (Ruse province), Ivanovo (Ruse province) and Ruse (Ruse province). From these I selected those with chronological periods labeled "Antiquity," "Thracian,"[114] "Iron Age," "Late Iron Age," "Hellenistic," "Roman," "Early Roman," "Late Roman," and "Late Antique."[115] Comparing the number of cards in each municipality with the size of the municipality revealed underrepresented areas in the AMB (Map 12). Belene, Levski and Svishtov all had remarkably few cards, especially considering the density of cards from the neighboring municipalities of Pavlikeni and Polski Trambesh. This is most likely a result of uneven data coverage rather than a reflection of historical reality. The Bulgarian-German survey mentioned above included the majority of Svishtov and found a large number of sites that were not included in the AMB (Conrad 2006, 311–312 and fig. 3). It was decided, therefore, to exclude these municipalities from further analysis.

The municipality of Svishtov contains one of the most important urban centers on the lower Danube: the legionary fortress and Late Roman city of Novae. The influence of Novae on its immediate hinterland has been demonstrated by the Bulgarian-German survey which revealed a large number of rural settlements clustered around the center. By excluding Svishtov from this analysis I do not mean to minimize the importance of this center but rather to focus my attention on the roles played by smaller centers. The influence of Novae beyond the borders of Svishtov will be taken into account but the behavior of the rural settlements around Novae is not the object of this investigation.

[114] "Thracian is not officially sanctioned as a chronological period by the designers of the AMB ("Arheologicheska Karta Na Balgariya" 1989), but is commonly used nevertheless.
[115] Burial mounds from pre-Roman periods were excluded.

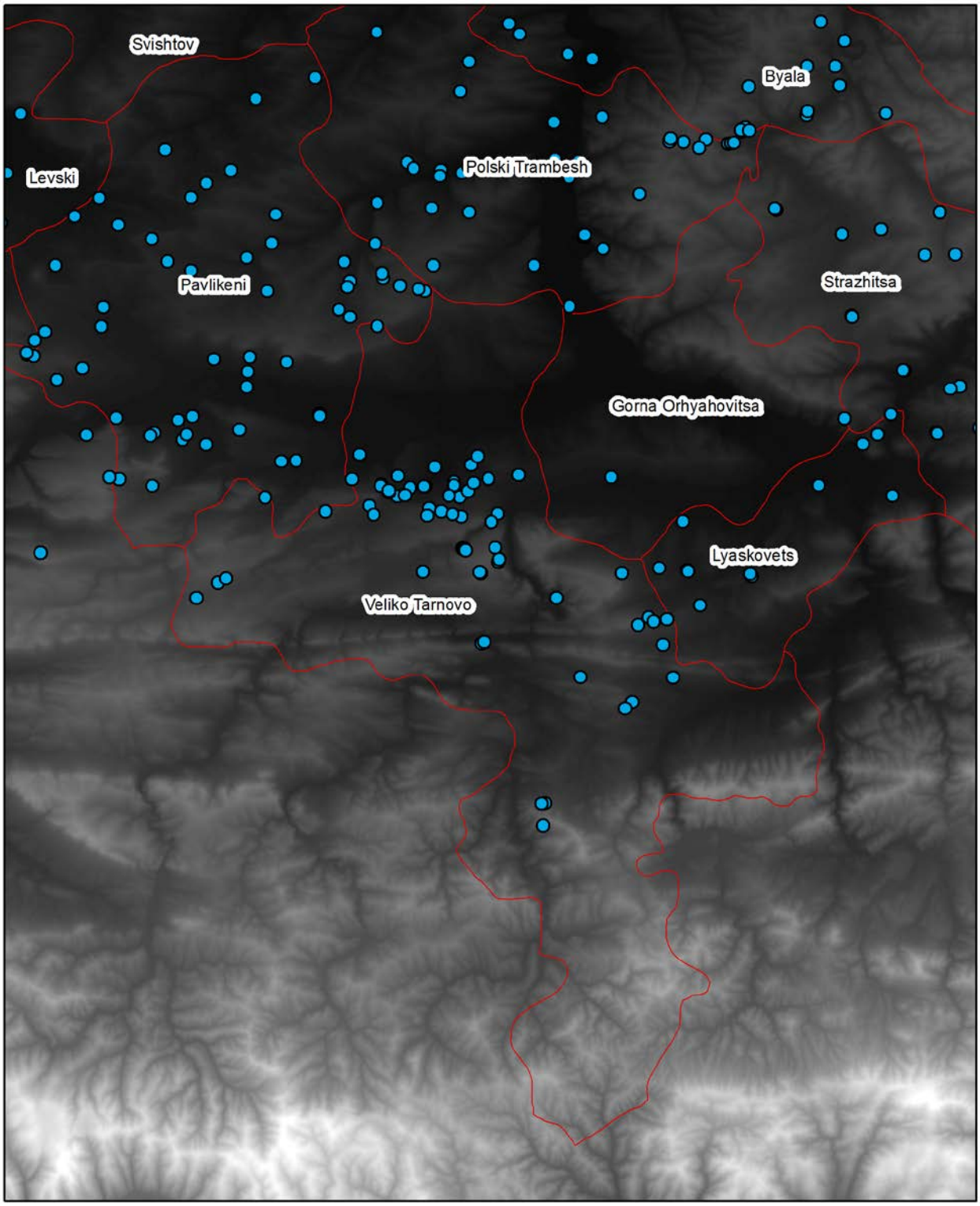


Map 12: Municipalities with the number of relevant AMB cards and colored to reflect the density of cards.

In the process of mapping the locations of AMB cards (described below, section 3.2.3.3), further deficiencies in the data became apparent. The municipality of Gorna Oryahovitsa,

although it has 33 cards, had to be excluded because the locational data in the AMB are unusable: the compass bearings consistently contradict the verbal indication of direction. For example, card 0740031 describes a location as “5040 m northwest 69°” of Draganovo. Measuring clockwise from north, as is usual, 69° is northeast. It is possible that the author measured counterclockwise from north, but that would not account for card 0740022 which describes a location “4000 m northwest 105°” of Dolna Oryahovitsa. All attempts to reconstruct a consistent method of measurement for the cards in Gorna Oryahovitsa failed and I was forced to exclude this municipality from my analysis.

Veliko Tarnovo also had to be excluded. In this case the problem was not with the locational data or the number of cards, but with the distribution of those cards (Map 13). The vast majority of cards from Veliko Tarnovo are concentrated in a small band south of the Rositsa river valley. This could reflect a historical response to the natural landscape or the burial of archaeological remains under alluvium, but in Pavlikeni there are several cards indicating sites in the same river valley. The situation in Veliko Tarnovo, therefore, is most likely the result of uneven research.



Map 13: The locations of AMB cards in Veliko Tarnovo and surrounding municipalities.

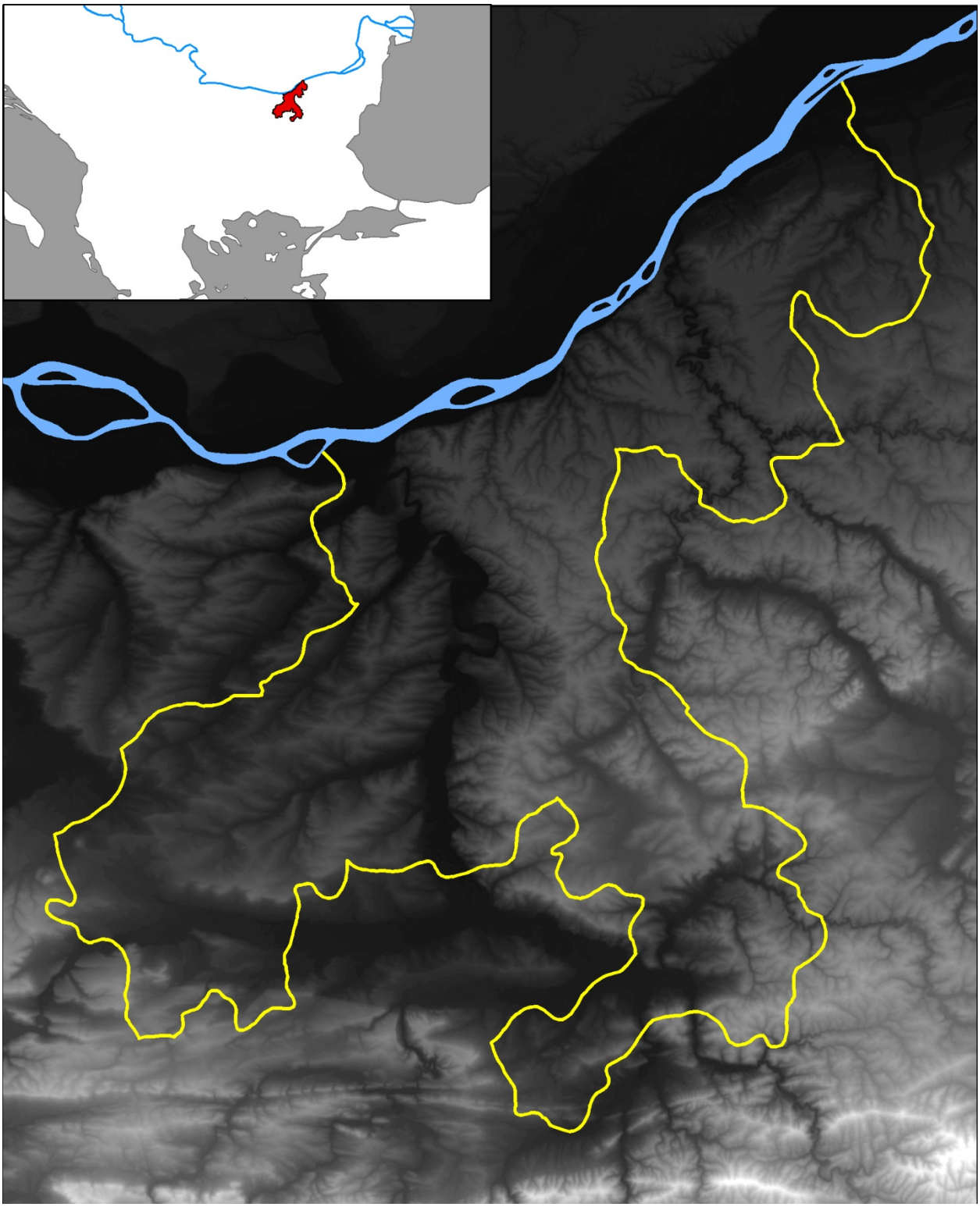
The city of Nicopolis ad Istrum lies in Veliko Tarnovo municipality near Gorna Oryahovitsa. Its relationship to the countryside has been examined by the Bulgarian British research program described above. As with Novae in Svishtov, the exclusion of Veliko Tarnovo

is not meant to minimize the importance of Nicopolis ad Istrum and its influence will be taken into account.

This sample area delimits the territory in which rural settlement will be analyzed, but there are several central places outside the study area which must be taken into account as their zones of influence could intersect with the delimited territory. Nicopolis ad Istrum and Novae have already been discussed. In addition, the epigraphically attested *emporia* of Discoduraterae (Boyanov 2014) and Piretensium (Tsarov 2006; Tsarov 2005), along with Novae's military vicus at Ostrite Mogile (Tomas 2006), the auxiliary fortress of Appiaria (Zahariade and Gudea 1997, 75 no. 22), the late Roman road station at Kovachevsko Kale (Rusev 2007), and the late Roman fort at Dichin should all be considered. While most of these are semi-urban places and potential markets, the fort at Dichin was most probably a collection point for agricultural produce destined to supply the army (Dinchev et al. 2009; Poulter 2007d).

In the end, the sample area includes the municipalities of Pavlikeni, Polski Trambesh, Strazhitsa and Lyaskovets from the province of Veliko Tarnovo and the municipalities of Byala, Tsenovo, Borovo, Ivanovo and Ruse from the province of Ruse, covering an area of 3,488 square kilometers (Map 14). It includes 70 kilometers of southern bank of the Danube (from kilometer marker 474 to 573) and its southernmost edge is 70 kilometers from that bank.[116] It is, therefore, large enough to register influences operating at a regional scale, includes multiple military and non-military centers, and includes areas both near to and at a distance from the frontier. Most importantly, the level of research that has occurred is fairly consistent across the whole sample.

[116] There are 310 relevant AMB cards and the authors responsible for these data are Volodya Popov (Byala), Petar Stanev (Pavlikeni and Polski Trambesh), Dimitar Stanchev (Borovo and Tsenovo), Sonya Sultova (Strazhitsa), Ivan Tsarov (Polski Trambesh), Hitko Vachev (Lyaskovets), Pavlina Vladkova (Pavlikeni), and Stoyan Yordanov (Ivanovo and Ruse).



Map 14: The sample area.

3.2.3.2 Creating places

The basic unit of the database is the ancient place, a location in the landscape where tasks were performed in a certain historical period. Ancient places are identified through, but distinct from archaeological sites. An archaeological site is a location where traces of ancient activity have been identified in the present (section 1.7.2.4). Where finds from a variety of periods have been found a single site represents several ancient places. At the same time, several archaeological sites, when in close proximity to each other, can represent a single ancient place. This project operates at a regional scale and is primarily interested in settlements. It makes little sense, therefore, to consider the constituent households of a village as separate places or to divide a settlement from its associated necropolis even if these have been investigated as different archaeological sites.

The first step in the process of creating places was to enter data from the AMB into a spreadsheet so that they could be quickly accessed and organized.[117] The next step was to compare these data with those from the TIR, also entered into a spread sheet. By comparing the two it was possible to match most of the records in the AMB with sites described in the TIR. In most cases this was a simple matter of matching the locational data, though there were cases in which the TIR and AMB described the same place with reference to different villages. This was only detectable through close examination of topographic maps. There were 54 sites in the TIR for which I could not identify a corresponding AMB card and 48 Roman or Late Roman sites in the AMB for which I could not find a corresponding entry in the TIR.

The next step was to split multi-phase sites and combine sites in close proximity that shared a chronological classification (section 3.2.3.4). There is no concrete rule defining how close sites must be to be considered a single place. In his investigation of Roman villas, for example, Dinchev found that the distance between adjacent structures in a single complex did not exceed 250 meters, but that the size of the villa complex itself could be much larger (Dinchev 1997a, 15). This was confirmed by the Bulgarian-British surveys of rural sites in the territory of Nicopolis ad Istrum. At the villa complex of Mramora, near Gorna Lipnitsa, houses from a dependent settlement were generally found between 150 and 700 meters from the main building, though one was over a kilometer away (Poulter 2007a, 372). Similarly, one of the necropolises of the late Roman fort Iatrus was 650 meters from the principia (AMB card 0820131). Ancient villages are also loosely structured. In his investigation of Roman villages in Bulgaria, Dinchev found that the most common type was a village in which each house was surrounded by a plot of land several times the size of the house itself and lacking any common spatial orientation (Dinchev 2000a). As a result of this tendency toward loosely clustered settlements, I joined contemporary sites into a single place when they were located around 500 meters apart or less.

This process resulted in a database of 462 places, including 20 places that fall outside the study area, in 322 distinct locations. The distribution of places and locations within modern municipalities and provinces is presented below, excluding places outside the study area.

[117] For regular users of the AMB it is possible to automatically export data, but I did not have permission to do this.

Province	Municipality	Places	Sites	Place Density (Per Km^2)	Site Density (Per Km^2)
Ruse	Borovo	28	21	0.11	0.08
Ruse	Byala	40	27	0.10	0.07
Ruse	Ivanovo	70	42	0.18	0.11
Ruse	Ruse	51	31	0.12	0.07
Ruse	Tsenovo	29	23	0.10	0.08
Veliko Tarnovo	Lyaskovets	24	20	0.14	0.11
Veliko Tarnovo	Pavlikeni	103	72	0.17	0.12
Veliko Tarnovo	Polski Trambesh	62	45	0.13	0.10
Veliko Tarnovo	Strazhitsa	35	32	0.08	0.07
Ruse Total		218	144	0.12	0.08
Veliko Tarnovo Total		224	169	0.13	0.10
Study Area Total		442	313	0.13	0.09

Table 2: Places and sites according to modern administrative units.

Both the places and the sites, the locations of ancient places, are fairly evenly distributed both between provinces and municipalities, though Ivanovo in Ruse and Pavlikeni in Veliko Tarnovo have a slightly higher place density than the other municipalities. This suggests that the research intensity that generated this record is evenly distributed within the study area.

3.2.3.3 Locating places

The locations of the places in the database were discerned through a variety of means, each with a corresponding level of confidence, which is reflected in the database through a code. I was able to visit and take GPS coordinates at a few of the places and these are given a code of A1 indicating the highest level of confidence in the precision of the location.[118] For other places a detailed map was available which I could use to find the location of the place on satellite imagery or a topographic map. These places have a code of A2, indicating a very high level of confidence and the source of the map has been noted. Sites for which geographic coordinates were available were also given a code of A2 and the source of the coordinates is noted.

The majority of the places were located through data in the AMB using a process described here. These places are given a code of B1. In a few cases, the AMB locational data were problematic, usually when the textual description of the direction did not match the compass bearing. In most cases it was possible to determine, through comparison with other sources describing the same site, whether the compass bearing or the verbal direction was in error. These places are given a code of B2 to indicate slightly greater uncertainty.

The locations of some places were determined through detailed verbal descriptions of features which could be identified on topographic maps or satellite imagery. These places were

[118] I used the GPS device in my smartphone, a Samsung Galaxy Note 3 with the free apps GPS Status 4.4.86 and Locus Free 2.20.2. The margin of error ranged from 3 to 35 meters, insignificant at the landscape scale.

given a code of C1. Their position in the hierarchy of locational confidence is below that of the places located through AMB data to reflect the possibility of misinterpreting the description, but when the description is correctly interpreted, the precision of these locations may be greater than those derived from AMB data for reasons which will become clear below. Places whose location is described in vague terms, such as those used in the TIR, are given a code of C2, indicating very low confidence in their precision. A very few places were described in even vaguer terms, such as "Slivite district, Byala Cherkva" (place 223). These places were located in the center of the village and given a code of C3, indicating a complete lack of precision. The results are summarized in the table below.

Location Certainty	Locations	Places
A1	13	35
A2	94	137
B1	160	217
B2	11	14
C1	9	13
C2	33	43
C3	2	2

Table 3: Certainty of locations in the database

In order to map the locations in the AMB it was first necessary to map all the villages named as points of reference. This was done by georeferencing Soviet topographic maps at a scale of 1:50000, finding the villages on the maps, and then accessing satellite imagery to identify the village center. In most cases this was obvious as it was the largest paved area in the village. In ambiguous cases, Google Earth's street view or Panoramio pictures were helpful in identifying the local administrative building that marked the village center.

Because the location data included a compass bearing calculated from a map, it was necessary to determine which map projection was used. Although the maps themselves were not online, in most cases the authors of the AMB cards noted the map scale they used, usually 1:25000, but in some cases 1:40000. The Bulgarian topographic map series at 1:25000 was produced by the military and uses a Gauss-Kruger transverse Mercator projection, while the 1:40000 scale maps were based on Russian topographic maps made during the Russo-Turkish war of 1877-78 using a polyhedral projection (Böhme and Anson 2013; Weber 2010; Mugnier 2002). Because the central meridian of the 1:40000 maps is unknown it was decided to compromise between these two projections by using a transverse Mercator projection with a central meridian of 25.5°, which falls inside the inside the study area.[119] Once the appropriate projection was determined it was a simple matter, using ArcGIS, to calculate the coordinates of each village. The coordinates of sites were obtained using simple trigonometric functions in an excel document.[120]

[119] Comparing the locations of sites calculated using this meridian to locations calculated using the central meridian of Gauss-Kruger zone 9 revealed differences of around 50 meters, an acceptable margin of error at this scale of analysis.

[120] TargetX = OriginX + SIN(RADIANS(Azimuth))*Distance; TargetY = OriginY + COS(RADIANS(Azimuth))*Distance.

In order to assess the accuracy of the AMB locations I measured the distance between locations of places with an A1 or A2 confidence level and the location calculated from the AMB distance and compass bearing. There were 65 such locations. Of these, five were over 4 kilometers from the location calculated using AMB data. All five of these AMB cards had contradictory location data and would have been given a confidence rating of B2. For the remaining cards, the error ranged from less than 200 meters to 3.7 kilometers. The average error is 1.06 km and the median error is 0.8 km, an acceptable range given the analytical techniques and scale of this project. 56 cards (93%) had an error lower than 3 km, 51 cards (85%) had an error lower than 2 km and 35 (58%) had an error lower than 1 km. Table 1 shows average error for each municipality.

Municipality	Mean Error (Km)	Count
Tsenovo	1.60	5
Ivanovo	1.23	13
Byala	1.17	3
Pavlikeni	1.07	7
Lyaskovets	1.01	14
Borovo	1.00	6
Polski Trambesh	0.93	6
Ruse	0.53	4
Strazhitsa	0.44	2
All	1.06	60

Table 4: Error in AMB location data

The locations recorded in the AMB are those of archaeological sites whereas the focus of this investigation is the ancient inhabited landscape. The location of a site, even when known with perfect accuracy, is only a rough indication of the portion of the landscape exploited by ancient people. The object of this analysis is that area of the landscape that was probably accessible from the settlements that produced the archaeological sites. Even if the ancient settlement is at a different location than the one recorded in this database most of its potentially accessible territory will overlap with that constructed from the archaeological record. Expanding the focus from the site to the landscape, therefore, mitigates the effect of uncertain data.

3.2.3.4 Dating places

The published chronological data about most of the places in the database are vague. This is because most of the places in the database have only been studied through non-systematic surface survey. Even when sites have been more thoroughly studied, they are often published only in abstract form, either as part of regional overviews or in the annual series *Arheologicheski Otkritiya i Razkopki*, so the published data are not as precise as they could be. One often encounters statements like “pottery characteristic of the second to fourth centuries was found” and it is never made clear if the recovered pottery was only dated to that range or if it was dated to several points within that range. In addition, the various sources of information employ different chronological vocabularies and rarely define their terms

precisely.[121] Finally, many sites were studied and published before detailed pottery typologies in the region had been published, further limiting the precision of the data.[122]

The problem is not just disagreement about historical periodization or lack of publications, but also the lack of chronologically diagnostic pottery from the fourth century. While the second to third century pottery from the area is fairly well understood, there is, at present, no way to distinguish pottery used in the fourth century from that used in the third century (Sultov 1985; Poulter, Falkner, and Shepherd 1999). An identifiable shift comes, instead, in the late fourth and early fifth century. Red-slipped fine ware, common from the second through the fourth century, is completely absent in the fifth century fort at Dichin (Dinchev et al. 2009; Poulter 2000). The introduction of a new, gray micaceous ware (the so-called "foederati ware") has also been dated to the fourth century (Poulter, Falkner, and Shepherd 1999, 73–74, 102–104, 111–112). Another change in pottery consumption dated to the Late Roman period is the (re)introduction of burnished pottery, but this occurs in the second half of the third century. This Late Antique burnished pottery has been divided into three periods dating from the second half of the third to the middle of the fourth century, the mid-fourth through the mid-fifth century, and the mid-fifth to the sixth century with the second group being the largest and most varied (Vagalinski 2002; Vagalinski 2005). Despite these changes, it must be noted that the most common fabric, a local gray ware, remains prevalent from the second century all the way through the sixth century (Poulter, Falkner, and Shepherd

[121] For the AMB, a hierarchy of terms was published and a more detailed hierarchy is established in the unpublished handbook for filling out the registration cards, kindly provided to me by Pavlina Vladkova, establishing which periods are included in the broader periods, but nowhere are the precise chronological boundaries of the periods stated ("Arheologicheska Karta Na Balgariya" 1989; Baltakov et al. 1990). One AMB contributor said that the terms "Late Roman" and "Late Antique" were synonymous and referred to the fourth and fifth centuries while another said that the "Late Roman" period covers the third and fourth centuries while the "Late Antique" period covers the fifth and sixth centuries (Pavlina Vladkova and Ivan Tsarov, personal communication). Most of the AMB authors included in this study use both "Late Roman" and "Late Antique", sometimes on the same card, so it is assumed here that they are not synonymous in practice. When interpreting AMB data I have followed the suggestion of Professor Tsarov: the Early Roman period covers the first and second centuries, the Late Roman period covers the third and fourth centuries, and Late Antiquity includes the fifth and sixth centuries. It follows from the hierarchy of terms that the Roman period includes the first four centuries and Antiquity includes the first six centuries CE.
The TIR defines its chronological terms in the introduction: The Roman period is equivalent to the Principate, which I take to mean the first three centuries CE, the Late Roman period stretches from Diocletian to Theodosius I, essentially the fourth century, Late Antiquity covers the fourth to the sixth century, and Early Byzantium is anything after the beginning of the seventh century.
Neither Stefanov (Stefanov 1956) nor Dremsizova-Nelchinova and Ivanov (Dremsizova-Nelchinova and Ivanov 1983) define their terms, but their meanings can be reconstructed from the text. For Dremsizova-Nelchinova and Ivanov, the terms "Late Antique" and "Late Roman" seem to be synonymous, as, for example, on page 27, no. 13. Stefanov never uses the term "Late Antique" but frequently mentions "Late Roman" pottery. By this he seems to usually mean pottery from the fourth century, as on pages 61-2, no. 47 he says there are "sherds from early and late Roman vessels, even to the V, VI c. …" (Stefanov 1956, 62).

[122] For example, the archaeological overviews of Ruse province and the lower Yantra basin were both published before Sultov's analysis of the pottery from Butovo, Pavlikeni and Hotnitsa and Falkner's analysis of the pottery from Nicopolis ad Istrum were available (Dremsizova-Nelchinova and Ivanov 1983; Stefanov 1956; Sultov 1985; Poulter, Falkner, and Shepherd 1999).

1999, 66–72 and table 5.1). It is simply impossible, in most cases, to distinguish the third century from the fourth century on the basis of pottery.

In order to integrate the various types of chronological data into a single system, there are columns in the database for every century from the fourth century BCE through the sixth century CE with numbers indicating the type of data that exist for habitation at a given site in that particular century. A 1 indicates that something closely datable to that century, usually a coin, has been found. A 2 indicates that the century is included in the range of possible dates for pottery or other archaeological material. A 3 indicates that the century is included in a named period.[123] This information was then used to fit each place into my own periodization scheme.

This scheme is an attempt to define historically meaningful eras that will be recognizable in the archaeological record. The Pre-Roman phase is an attempt to understand how people inhabited the landscape before the Roman occupation. The Early Roman phase attempts to capture the very beginning of Roman occupation. The Middle Roman phase attempts to understand the situation after Trajan's Dacian wars secured the area from the threat of raids by transdanubian peoples and the foundation of Nicopolis ad Istrum. The Late Roman period seeks to capture the situation after the reorganization of the Roman army and the frontier building program of Diocletian and Constantine. The Late Antique phase is an attempt to understand settlement in the period after the Gothic wars of the late fourth century when imperial control over the region was lost and reestablished several times before finally collapsing at the beginning of the seventh century (J. H. W. G. Liebeschuetz 2007).[124] In terms of centuries, the Early Roman period covers the first century CE, the Middle Roman period the second and third centuries, the Late Roman period covers the fourth century and the Late Antique period covers the fifth and sixth centuries. The broader categories of "Roman" and "Ancient" encompass the first four and the first six centuries CE respectively.

In classifying the places into periods, some compromises had to be made. Sites with pottery characteristic of the third to fourth centuries were classified as Late Roman places, as were sites with pottery characteristic of the third to fifth centuries. Sites with pottery characteristic of the second to fourth centuries were classified as Roman places unless there was also more closely datable material that could refine the classification. Pottery characteristic of the fourth to fifth centuries led to a Late Antique classification, as did pottery characteristic of the fourth to sixth centuries. Sites with pottery characteristic of the second to sixth centuries were classified as both Roman and Late Antique places. The fortification program of Valens at the end of the Late Roman period left brick stamps at various sites. When these are found in

[123] For the AMB I used the periods suggested by Ivan Tsarov, i.e. first and second century for the Early Roman, third and fourth for the Late Roman, and fifth and sixth for the Late Antique period. By extension, the Roman period covers the first four centuries CE and the Ancient period covers the first six centuries CE. For the TIR I used the periodization established in the introduction, i.e. first to third centuries for the Roman, fourth century for the Late Roman and fourth to sixth centuries for the Late Antique period.

[124] Although the terms "Late Roman" and "Late Antique" are often used synonymously I follow the example of the TIR in distinguishing them here. This convention is particularly appropriate to the lower Danube region where the influence of the Roman imperial state fluctuated in the in the fifth and sixth centuries.

conjunction with earlier material, the site is classified as Late Roman, but when found in conjunction with later material, Late Antique. When a site is described as "Early Roman" but no closely datable material has been published I consider it to be a Middle Roman place because in general finds from the second century are much more common in this region than finds from the first century. The results of this process are summarized in the table below. The column on the right gives the number of places for which the period on the left is the most precise possible dating. Thus, there are only seven places with clear evidence for occupation in the Early Roman period and there are 93 places for which the most precise chronological evidence available is "Roman." The seven Early Roman places are not included in the 93 Roman places. The periodization of sites with Roman material is more precise than that of sites with Pre-Roman material, so to compare these two epochs, I have also counted the number of sites with material from any Roman period.[125]

Period		Places	Approximate dates ranges
Ancient		13	1st – 6th c. CE
Pre-Roman		112	5th (?) c. BCE – mid 1st c. CE
All Roman		164	Mid 1st – late 4th c. CE
	Roman	93	Mid 1st – late 4th c. CE
	Early Roman	7	Second half 1st c. CE
	Middle Roman	79	2nd – late 3rd c. CE
	Late Roman	93	Late 3rd – late 4th c. CE
Late Antique		65	Late 4th – beginning 7th c. CE

Table 5: Places by period.

Because of the compromises discussed above and the incomplete state of research, any notion of continuity between periods must be considered highly tentative. Nevertheless, a comparison of total numbers of places, "births" and "deaths" by period provides a general sense of stability or disruption.

Period	Total	Births[126]	Deaths[127]
Pre-Roman	112	NA	70 (63%)
Early Roman	7	5 (71%)	0 (0%)
Middle Roman	79	53 (67%)	36 (46%)
Late Roman	93	50 (54%)	74 (80%)
Late Antique	65	38 (58%)	NA

Table 6: Continuity of occupation.

[125] The sum of Roman, Early Roman, Middle Roman and Late Roman places is 272, but 108 of these have material from more than one sub-period. 164 is the total number of archaeological sites which attest to the existence of at least one Roman place.

[126] Percent of sites with material from the given period but lacking material from the preceding period. Because the Early Roman period is so elusive, the pre-Roman period is also considered to be the predecessor to the Middle Roman period. Both the Late Roman period and the vaguely defined Roman period are considered predecessors of Late Antiquity.

[127] Percent of sites with material from the given period but lacking material from the succeeding period. Successors to the Pre-Roman period include the Roman, Early Roman and Middle Roman periods.

The Pre-Roman period has the most places but also covers a much broader span of time than any of the others. Over half of the sites with Pre-Roman material do not have material that could have come from the Early or Middle Roman period, but many of these places must have been abandoned even before the Roman conquest.

About two-thirds of the 79 places occupied in the Middle Roman period seem to have been new foundations, indicating a major, but not total transformation of the settlement system: one-third of the places had been in use in the Pre-Roman period, though not necessarily continuously.

In the Late Roman period, the total number of places climbs to 93, an impressive number considering the brief span of this period. The Late Roman settlement system was, however, not simply an expansion of the Middle Roman one: almost half of all Middle Roman places do not survive into this period and over half of the Late Roman places lack Middle Roman predecessors. This seems to be a period of great activity following the destruction of the third century.

The Late Antique period contains 65 places, but this number is deceptively high: most places in this period had fortification walls which survive well and draw the attention of modern researchers. Places from this period, then, are overrepresented in the archaeological record. This period follows on the destruction of the Late Roman settlement system: 80% of Late Roman places do not survive into Late Antiquity. People at this time did not, however, simply cling to the remnants of the system. Over half of the Late Antique places were new and these new foundations include not only fortifications but unfortified settlements as well. Like the Middle and Late Roman periods, this was a time of new construction, but the massive destruction at the end of the Late Roman period suggests that something was different this time.

3.2.3.5 Types of places

The typology of places has been constructed to achieve two goals without overstepping the limits of the evidence. Because of the uneven research and publication of sites in the database, the typology has been kept as simple as possible. The first purpose of the typology is to distinguish places which produced agricultural surpluses from places where that surplus was consumed and exchanged. These categories are not, of course, pure or mutually exclusive. Peasants consumed the surplus of others and people in cities and market places produced some of their own food, but the categories are still valid at a general scale. For the most part these are all settlements, but sanctuaries could also have been sites of exchange, as is well documented in other parts of the empire (de Ligt 1993 appendix 2). The second purpose of the typology is to distinguish places of exchange and consumption according to their institutional and economic characteristics. Places dominated economically and socially by the army must be separated from non-military places, but at the same time, places operating at the

interprovincial and intraprovincial scales must be separated from those operating only at a local scale.[128]

The settlement hierarchy is divided into three categories: cities, semi-urban vici, and settlements. Army bases are included as a subset of semi-urban vici. Settlements are assumed to be agricultural producers, semi-urban vici are assumed to be places where that produce was exchanged and to some extent consumed, while cities are places where the produce was exchanged and consumed to a large extent. Cities were also directly integrated into local, intraprovincial, and interprovincial exchange networks while semi-urban vici, along with sanctuaries, were only economic centers at a local scale.

Cities are distinguished by their population and consumption activities. Monumental architecture is the most durable result of high levels of consumption but this must be combined with evidence for demographic concentration to warrant labeling a settlement a city. The legionary fortress and canabae at Novae, covering 70 to 80 hectares, is the clearest example of a settlement that fulfills these requirements (Conrad and Stančev 2002, 674; Tomas 2012). Nicopolis ad Istrum was a *municipium* and its late second-century walls enclosed 21.55 ha with an extra-mural settlement to the south extending to around 5.75 hectares (Poulter 2007d). If one applies the usual multipliers for Roman urban population density of 100 to 400 people per hectare (Wilson 2011) the population of Nicopolis ad Istrum ranged from under 3,000 to over 10,000. In the fourth century, though, the intramural area was dominated by a few large town houses suggesting a population of only a few hundred people. At the same time, the extramural area to the south shows signs of intensive settlement with agricultural and industrial production (Poulter, Falkner, and Shepherd 1999, 17–20; Poulter 2007d, 67–69). Although the population may have been low, the wealth of the inhabitants inside the walls combined with the activities of the extramural settlement is sufficient justification to maintain Nicopolis ad Istrum's urban status in the fourth century. In the fifth century the city was destroyed and only the southern, extramural portion was reoccupied and defended with a fortification wall. At only 5.75 ha it is better considered a semi-urban vicus (Dinchev 1999a, 48–49; Dinchev 2000b, 68). At around the same time the city of Zikideva appears on Tsaravets hill in modern Veliko Tarnovo with a defended area of around 15 ha implying a population of 1,500 to 6,000 – a small size consistent with other Late Antique cities in the Balkans. Only its elaborate architecture justifies its urban classification (Dinchev 1997b; Dinchev 1999a; Dinchev 2000b).

The term "semi-urban vicus" is taken from Ventsislav Dinchev's classification of ancient settlements in modern Bulgaria (Dinchev 2000a; Dinchev 1996). For Dinchev, a semi-urban vicus was larger than a rural village and had a more complex spatial scheme implying some sort of street network. He included in this category settlements with specific functions such as road stations, markets, or spa resorts (Dinchev 1996). Unfortunately, it is not always easy to distinguish a semi-urban settlement from a large, wealthy village (or even a villa) without significant archaeological research. In this category are included two epigraphically attested *emporia* (*emporium Discoduraterae* (Boyanov 2014)and *emporium Piretensium* (Tsarov 2006;

[128] Novae and Nicopolis ad Istrum are both economic and administrative centers at the intraprovincial scale with lesser economic importance at the interprovincial scale (Dinchev 2015). It is more difficult to tell if the scales of administrative and economic functions coincided at smaller centers as well.

Tsarov 2005)), settlements with evidence for non-agricultural production at a scale which implies a significant specialist population (Butovo (Sultov 1962; Sultov 1985) and Hotnitsa (Ilcheva 2006)), the secondary vicus of Novae at Ostrite Mogile (Tomas 2006), and road stations (Pavlikeni (Vladkova 2011), Kovachevsko Kale (Doncheva 2002; Rusev 2007), and middle Roman Krivina (Vagalinski 2003)).

Also considered as semi-urban vici are Late Antique fortifications covering more than 2.5 hectares, a threshold based on the observed sizes of fortifications in the study area (below). In Late Antiquity, fortified settlements became the most typical form of settlement in the Balkans (Dinchev 2002; Dinchev 2006; Dinchev 2007). Because fortifications seem to be a necessity for settled life in the Balkans in Late Antiquity, the size of the fortified area is a decent approximation of the size of the population (Dinchev 1999a makes this argument for cities, but his logic holds for smaller settlements as well). Dinchev classifies fortifications enclosing less than one hectare as villages and those enclosing more than one hectare as semi-urban settlements without giving specific arguments for the validity of that particular cut-off point. The data gathered for this project, though, suggest that 2.5 hectares is a better dividing line between village and semi-urban settlement.

In choosing a dividing line between these two groups one should seek to minimize variation within the groups and to minimize the number of marginal cases. The graph below plots the sizes of Late Antique fortifications in the study area in order from smallest to largest, excluding the outlier fortifications at Tigra (100 decares), Zikideva (150 decares), Mediolana (200 decares), Novae (240 decares), and the fortification of unknown size at Sexaginta Prista.[129] The sizes increase gradually from 0.75 decares through 20 decares with no less than six places falling on Dinchev's dividing line of 10 decares. After two places at 20 decares, the sizes jump to 30 decares and increase quickly, but still steadily, to 57 decares. There are no places between 20 and 30 decares. This, along with the different rates of size increase, suggests that the places between 0 and 20 decares form one group and the larger places form a second. These groups are labeled as settlements and semi-urban vici respectively.

[129] Note that sizes are given in decares. 1 da = 10 ha.

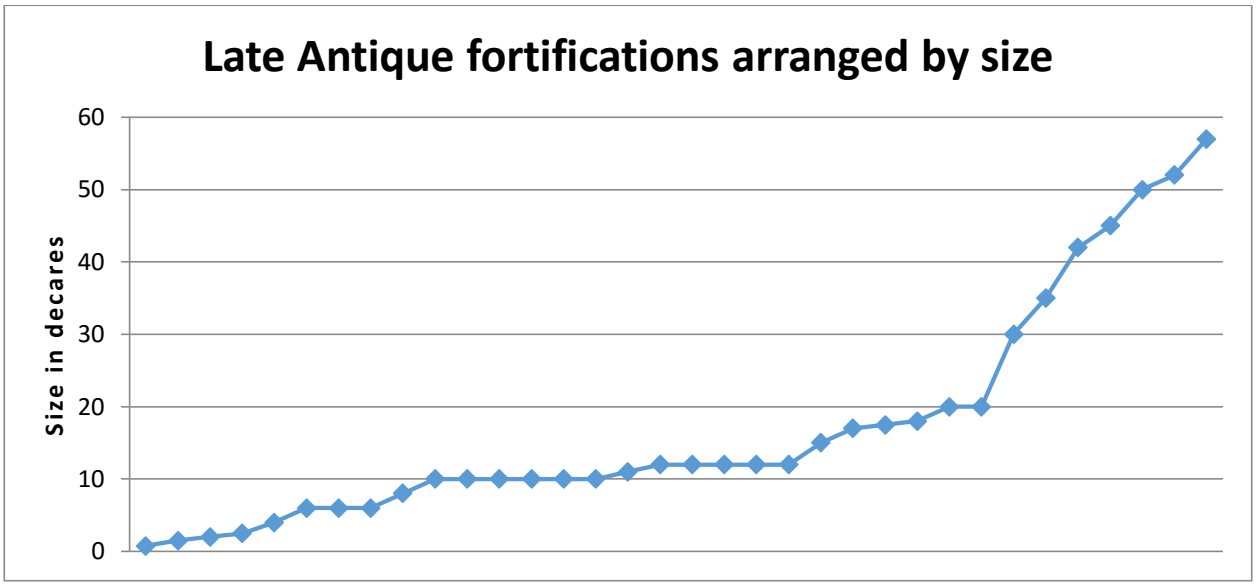


Chart 1: The sizes of Late Antique fortifications.

These labels imply that fortifications enclosing an area larger than 2.5 hectares were places where farmers exchanged their produce, while fortifications enclosing a smaller area acted as refuges or settlements, but not exchange centers. These assumptions seem justified regardless of whether the centrality of the larger fortified places was administrative, economic, or both. Unfortunately, the smaller fortified places cannot be accommodated in the following statistical analysis because it cannot be assumed that they anchored the daily movement of agricultural producers. They may have been refuges, rarely visited except in times of emergency. At the same time, even if it could be shown that they were permanently inhabited, their obviously defensive function undercuts any interpretation of their location that privileges agricultural productivity. Late Antique "settlements," therefore, consist only of unfortified settlements.

Army bases are a specific type of semi-urban vicus defined by the presence of hundreds of soldiers and the reliance on resources channeled through the imperial economy, especially soldiers' salaries. These are the headquarters of auxiliary units. Their names and relative locations are recorded in the *Itinerarium Antonini*, the *Tabula Peutingeriana* and the *Notitia Dignitatum*. All of the bases recorded in the ancient sources in this area have been identified with fortifications using epigraphic data and the distances between the forts (Biernacka-Lubanska 1982; R. Ivanov 1999; Zahariade and Gudea 1997).

Those settlements not identified as cities or semi-urban vici are simply labeled as "settlements". Further distinctions between villas and villages and between different types of villas and villages requires a level of investigation and publication that most places in the database do not enjoy (Dinchev 1997a; Dinchev 2000a). In addition, the very concept of "villa" is highly problematic. It is probable that the villa never existed as a homogeneous and bounded settlement category (Habermehl 2013; Marzano 2007, 2–5; Percival 1976, 15; Witcher 2012; Woolf 1998, 148–149). Rather than attempt a locally meaningful classification based on inadequate evidence, all rural settlements have been grouped together. The logic for doing so

rests on the presumed dominance of food production among the economic activities carried out in and around these places. Although non-agricultural production is attested at several of these settlements, most famously the production of ritual ceramics at the villa in Varbovski Livadi near Pavlikeni (Sultov 1985; Vladkova 2011), there is no indication that a significant population of specialists consuming the surplus production of others existed at any of these sites.

It is theoretically possible that some of the archaeological sites labeled here as settlements were not, in fact, places of habitation. Recent work in Italy has shown that some of the smallest sites identified through surface survey are not residential (Ghisleni et al. 2011; Vaccaro et al. 2013). This is unlikely to be the case for most of the sites included in this database as they are the result of extensive, rather than intensive survey. It is very unlikely that small sites, such as the pressing facility at Case Nuove originally thought to have been a small settlement, have been identified in the study area because very little off-site survey has been undertaken.[130]

Other types of places have also been identified and included in the database. Sanctuaries are recognized by the presence of cult paraphernalia, especially votive tablets. Necropolises include not only cemeteries, but also places where only one burial has been recognized. In most cases these were located near settlements and, where that settlement is known, they have not been recorded as separate places. The only necropolises recorded as such in the database are those that could not be connected to a known settlement. There is also one place recorded as a production center. In most cases, production took place in settlements, but recently a series of lime kilns from the late first century CE have been discovered in Chichov Elak near Krivina (Vagalinski 2011). A cheek piece from a helmet and two fragments of brick stamps suggest that the site was operated by the military, but there are no traces of settlement nearby. Indeed, it is possible that the kilns were only in operation for a matter of months (Vagalinski 2011, 56 n. 41). Late Antique fortifications have been identified as settlement as discussed above, but earlier fortifications that could not be identified with army bases also exist. These are small military outposts and were probably not settlement centers in the same way that army bases were. It is, however, possible that they functioned as places of exchange or collection points for taxes.

	Ancient	**Pre-Roman**	**Roman**	**Early Roman**	**Middle Roman**	**Late Roman**	**Late Antique**
City					2	2	2
Semi-urban vicus					6	4	10
Army Base				4	5	6	
Fortification	1	2	1		4	10	27
Sanctuary		4	1		5	2	

[130] This is a commonly accepted assumption about extensively collected data (Mladenović 2012, 8) which has been verified by the German-Bulgarian "Archaeological Survey on the Lower Danube" (Krauß 2006, 210–212).

Production center				1			
Settlement	11	103	72	2	54	68	24
Necropolis	1		15		2	1	
Unknown		3	4		1		2
Grand Total	**13**	**112**	**93**	**7**	**79**	**93**	**65**

Table 7: Places by Type and Chronology.

3.2.4 Detecting bias in the archaeological record

The archaeological record on which this analysis rests is the result of a long history of ancient behavior leading to deposition of artifacts and features, post-depositional processes that modified those remains, modern discovery and recording of information. The issues of modern discovery and recording are partly dealt with through the definition of the study area: only those municipalities which seem to have a substantial and well distributed collection of recorded archaeological sites have been included (section 3.2.3.1). Within these municipalities, though, it may be suspected that accessibility and visibility influence recovery rates. Accessibility is related to the movements and activity of modern humans. Places far from modern population centers will be rarely visited and therefore archaeological remains may not be discovered even if they are visible on the surface. Visibility is related to the preservation of ancient surfaces and the exposure of those surfaces to humans. Sediment accumulation, especially in river valleys, buries sites while erosion destroys them. Forests obscure the surface and any remains on them while arable cultivation not only clears the surface but brings shallow buried remains to light. Pasture and grass land is an intermediate category where the surface is relatively visible, but lack of disturbance leaves shallow remains obscured.

In order to assess the actual effect of these factors on the archaeological record I compared the location of archaeological sites in the study area to modern land cover, soil class, and distance from villages. To deal with the locational uncertainty of many of the sites I performed these calculations on three different datasets derived from the record of archaeological sites. One dataset contains the point locations of all sites with A1, A2 or B1 location confidence (236 out of 291 sites). Another contains the point locations of sites with A1 or A2 location confidence (94 sites). The third dataset is a surface of 100 x 100 m cells the value of which reflects the likelihood that the actual location of a known site is in that cell.[131] This surface was calculated by creating buffers around each site, giving each buffer a value, converting those buffers from vector to raster data and adding all the rasters together. Sites with A1 or A2 location confidence received a buffer of 300 m which, when converted to a raster with 100 m resolution, equals approximately 32 cells.[132] It is certain that the actual location of the site is within one of these cells so each cell received a value of 1/32=0.03125. Sites with B1 accuracy required a more complex procedure. The locational accuracy of these sites was judged by comparing the locations of 60 sites as derived from detailed maps or personal observations with the locations calculated from the distance/azimuth data provided in the AMB. It was discovered that the error for 58.33% of sites was less than 1 km, for 85% it was less than 2 km,

[131] The cell size was chosen to match the Corine Land Cover data.
[132] Depending on the location of the point within the central cell the actual total may be slightly less.

for 93.33% it was less than 3 km and for 100 % it was less than 4 km. To create a probability surface reflecting this error I created buffers at 1, 2, 3 and 4 kilometers around every B1 site. The likelihood of the actual location of site falling within the 1 km circle is 58.33% so, dividing the probability by the area of the circle, each cell receives a valued of 0.0018568077. The likelihood of the actual location of the site falling between 1 and 2 km from the given location is 85-58.33=26.67% so, dividing the probability by the area of the ring, each cell is given a value of 0.0002829421. The cells in the 2 to 3 km ring have a value of 0.0000530516 and those in the 3 to 4 km ring have a value of 0.0000303152.[133]

To understand the influence of modern land cover on the archaeological record the three datasets were compared to Corine Land Cover data from 1990. These data come in the form of a raster with 100 m cell size. The raster was reclassified to simplify the land classification as follows:

CLC grid codes	New grid code	Land Cover	Portion of study area
1-11	1	Artificial Surfaces	6.85%
12-14	2	Arable	56.23%
15-17	3	Permanent Crops	2.47%
18	4	Pasture	6.39%
19-22	5	Heterogeneous Agriculture	7.74%
23-25	6	Forests	13.09%
26-29	7	Grasslands and Scrub	4.91%
30-34	8	Little or no vegetation	0.19%
35-39	9	Wetlands	0.04%
40-41	10	Water	2.09%

Table 8: Transformation of Corine land cover values.

Chi-square tests for goodness of fit were performed to judge the distribution of site frequencies across these land cover classes. In short, the sum of sites (or the sum of site probability) falling within each class was compared to what one would expect given the area of each class (Aron and Aron 2008, 362–365). The results are as follows:

[133] In detail the GIS procedure is as follows. I separated out the B1 sites using a “select by attributes” query and created a shapefile with only those sites. I then created a model (“MultiringBuffers”) that iterated through those features and ran the Multiple Ring Buffer tool on each one with dissolve option ALL in order to output rings rather than overlapping disks. The rings were named for their distance from the site and stored in a geodatabase called “MultiBuffOut.gdb.” I then created a table with a distance field and a cell probability field. This was joined to the multiring buffer features through another model that iterated through all the feature classes in MultiBuffOut.gdb adding the cell probability field that matched the distance field in the buffer feature. Another model (“PlygontoRaster”) iterated through these features and converted them to rasters snapped to the Corine Land Cover raster and with the same size. It was necessary to set the processing extent of this model to match the Corine Land Cover raster so that each resulting raster would have identical extents. Before the rasters could be added together it was necessary to convert the NoData cells to 0. This was accomplished with a model that iterated through the rasters in MultiBuffOut.gdb and used the raster calculator tool with the expression Con(IsNull("%Rings5100m%"),0,"%Rings5100m%"). The rasters were combined using the “Weighted Overlay” tool with each raster receiving an identical weight of 1.

	A1, A2 and B1 sites		A1 and A2 sites		Site Probability	
Land Class	*Observed*	*Expected*	*Observed*	*Expected*	*Observed*	*Expected*
Artificial Surfaces	22	16.17	8	6.44	18.22	15.04
Arable	116	132.70	40	52.86	115.87	123.39
Permanent Crops	6	5.82	2	2.32	4.76	5.41
Pasture	20	15.08	10	6.01	17.44	14.03
Heterogeneous Agriculture	30	18.27	14	7.28	21.76	16.99
Forests	17	30.89	6	12.30	21.75	28.73
Grasslands and Scrub	23	11.59	13	4.62	17.17	10.78
Little or no vegetation	2	0.45	1	0.18	0.87	0.42
Wetlands	0	0.09	0	0.03	0.01	0.08
Water	0	4.93	0	1.96	1.58	4.59
Chi-Square	41.19271		36.63343		11.38029	

Table 9: Chi-square tables of site frequency according to land cover.

The datasets containing point locations of sites varied significantly from the expected distribution ($p<.01$) while the probability surface did not. It was hypothesized above that cultivation would enhance archaeological visibility but in fact, arable land has slightly fewer sites than expected in all three datasets, though the difference is small. This is by far the largest land cover class in the study area so this slight deviation is probably not significant. The vague category "heterogeneous agriculture", on the other hand, has more sites than expected in all three datasets and the difference is larger, although it covers less than 8% of the study area. Strangely, the largest deviation from expected values is in grassland and scrub. Although it covers only 5% of the study area it has 9.7% of all A1, A2 and B1 sites, 13.8% of all A1 and A2 sites and 7.8% of all site probability. There is no reason to think that this land cover is particularly conducive to site discovery. Instead, the reason for its overrepresentation is probably that these areas tend to cluster on the banks of rivers and rivers may have been attractive for ancient settlements. Pasture land is overrepresented in all three datasets but only slightly. The only land cover class that appears to bias the archaeological record is forest. Forests cover over 13% of the study area but contain only 7% of A1, A2 and B1 sites, only 6% of A1 and A2 sites and 9.9% of site probability. It seems that forests do obscure sites by a factor of approximately two, but arable land does not expose them to an extent that biases the archaeological record.

The effect of sediment deposition is assessed using data from the soil geo-database of Europe. The soil cover of the study area is summarized in the table below:

Soil Type	Portion of Study Area
Water	2.79%
Chernozem	45.37%
Fluvisol	14.77%
Leptosol	1.29%

Luvisol	16.88%
Phaeozem	18.91%

Table 10: Distribution of soils in the study area.

Alluvial deposition is represented here by Fluvisols covering 14.77% of the total area. The results of the Chi-square test are summarized in this table:

	A1, A2 and B1 sites		**A1 and A2 sites**		**Site Probability**	
Soil Type	*Observed*	*Expected*	*Observed*	*Expected*	*Observed*	*Expected*
Water	3	6.10	3	2.62	2.81	6.10
Chernozem	102	99.23	43	42.65	97.81	99.21
Fluvisol	45	32.30	21	13.88	38.33	32.29
Leptosol	3	2.82	3	1.21	2.74	2.80
Luvisol	35	36.91	8	15.86	32.42	36.92
Phaeozem	48	41.35	16	17.77	44.60	41.39
Chi-Square	7.824995		10.43048		3.722231	

Table 11: Chi-square tables of site frequency according to soils.

Across all three datasets, fluvisols have more sites than expected given their area, not less. This again hints at the attractiveness of rivers for ancient settlement. It does not indicate that sediment accumulation is biasing the archaeological record by burying significant numbers of sites.

Accessibility is another factor that may bias the archaeological record. If an ancient site is in a place rarely visited and difficult to reach the chances of it being known are small. To test this the distance from sites to the nearest modern village or town was compared to the study area as a whole. Because distance is a continuous variable, a Kolmogorov-Smirnov test was used instead of a chi-square test. The dataset consisting of A1, A2 and B1 sites differed significantly from the background terrain, but the dataset containing only A1 and A2 sites did not ($p<.01$). B1 sites tend to be closer to modern villages than would be predicted by chance.

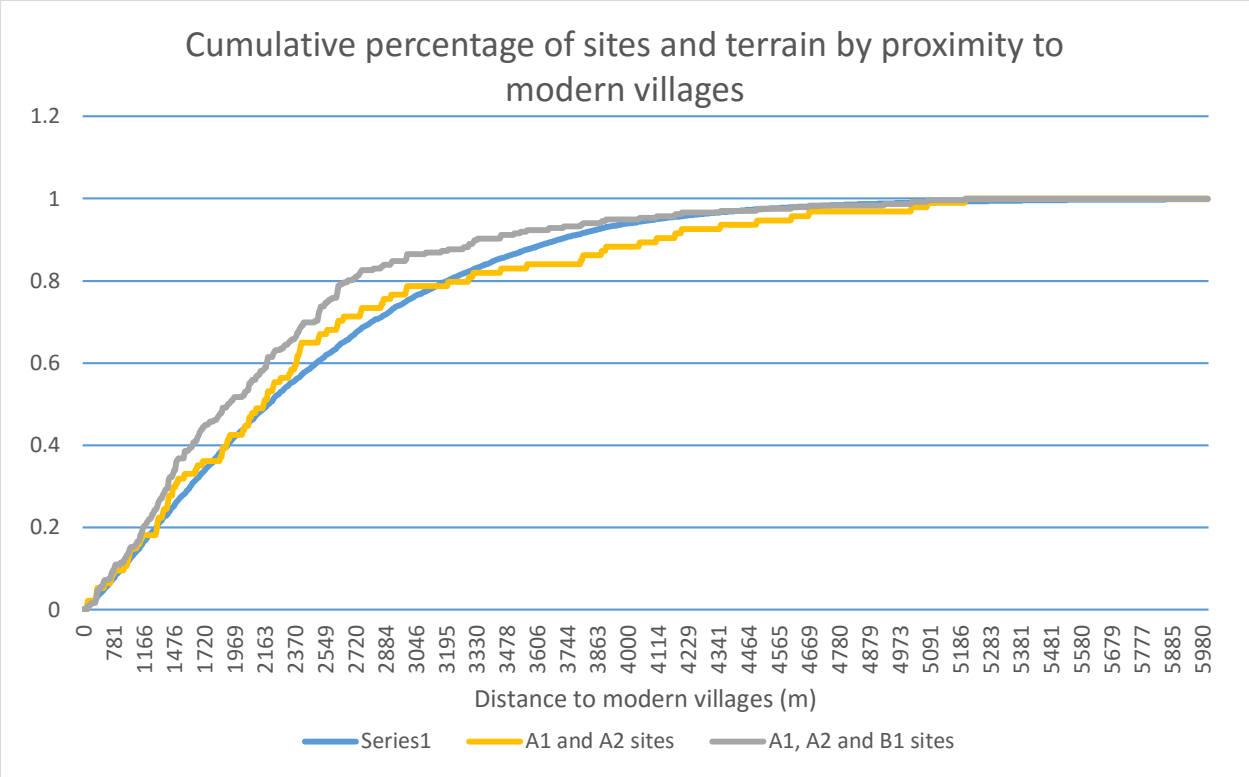


Figure 18: Cumulative percentage of archaeological sites according to proximity to modern villages.

Examining the data in classes of 500 meters reveals more details.

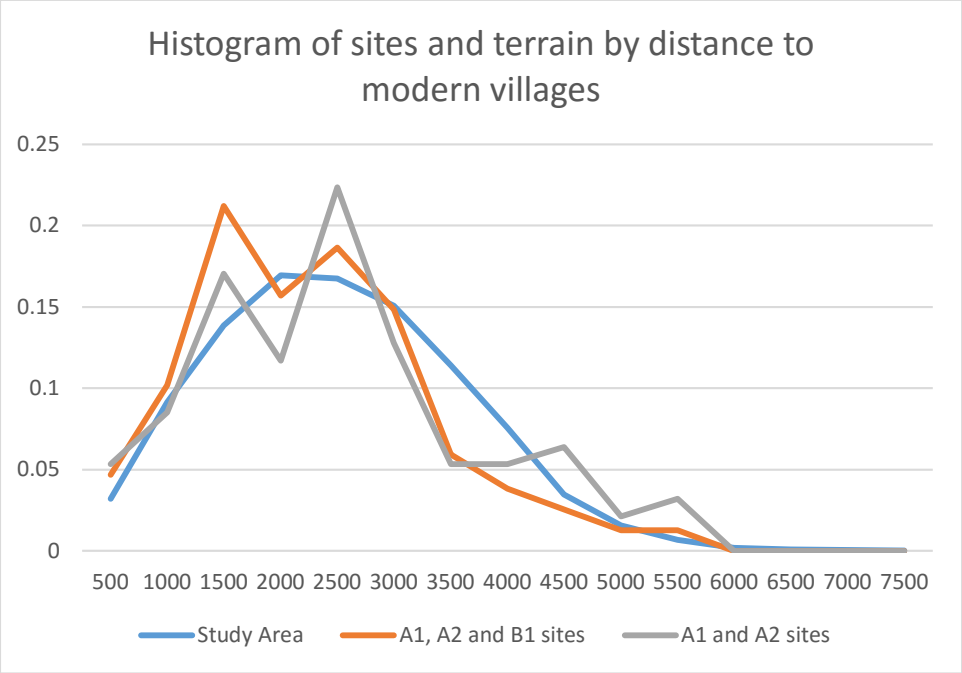


Figure 19: Percentage of archaeological sites according to proximity to modern villages.

There are more sites at 1.5 and 2.5 km from modern villages than expected but not at 2 km. The most consistent difference is at 3.5 km where both datasets show significantly fewer sites than expected. The amount of land beyond this distance from a modern village is small and the few sites that are found are roughly proportional. It seems that accessibility biases the archaeological record most strongly at a distance of 3 to 4 km where the proportion of sites is about half the proportion of the terrain.

Combining these findings allows us to produce a simple bias surface. An ancient settlement in a location that is now covered by forest is half as likely to become a known archaeological site as a settlement in a non-forested location. Similarly, a settlement in a location that is now 3 to 4 km from a village is half as likely to become a site as a settlement nearer or farther from modern villages. Rasters were created in which forested cells are given a value of 0.5 and non-forested cells a value of 1 and similarly cells between 3 and 4 km from a village are given a value of 0.5 while other cells are given a value of 1. These rasters were then multiplied together to create a surface with cells that have a values reflecting the likelihood that an ancient settlement in that place would become a modern archaeological site: 0.25 (forested and 3 to 4 km from a village), 0.5 (forested or 3 to 4 km from a village but not both) and 1 (neither forested nor 3 to 4 km from a village). Within the sample area, 71% of the cells have a value of 1, 25% a value of 0.5 and only 4% have a value of 0.25, indicating a generally low level of bias.

3.3 Univariate Analysis of Settlement Locations

3.3.1 Introduction

Rural settlements represent the basic units of the local economy: households and villages. They are the periphery against which central places are defined. Their locations relative to different centers and traffic routes reflects, in part, the ways in which surplus was transferred from producers to distributers and consumers in the local economy (as defined in section 1.3.1). At the same time, the locations of these settlements relative to the territory that can be exploited easily and frequently due to its proximity might reflect the ways in which that surplus was produced (Chisholm 1979, 95 uses the term “local” to describe the latter scale of economic activity, but following the scheme outlined above in section 1.3.1, productive activities within a household are sub-local).[134] Intensive agriculture is particularly sensitive to the potential of the immediate territory because farmers can maximize the amount of time spent cultivating their fields by minimizing the time spent traveling to them. I will first analyze the conditions of the immediate territory and then the position of rural settlements in the larger network.

3.3.2 Settlement Territories

It is impossible to reconstruct the territory actually exploited from any given settlement. The use of Thiessen polygons, which divide a territory such that every location is assigned to the nearest settlement, is inappropriate because there are certainly ancient settlements that existed which are not included in the archaeological record, and because it is not certain

[134] Similarly, Varro divides his discussion of the farm into the conditions of the estate itself and the conditions surrounding the farm (Varro, *RR* 1. 6, 16).

whether all settlements in a given time period actually existed simultaneously.[135] Instead, a standard radius was employed to create potential territories around each site that could have been regularly and intensively exploited by the inhabitants of a settlement. The result is a collection of circular territories that regularly overlap. No attempt has been made to assign this overlapping portion to one or another settlement as it is possible that people from both settlements used the area at different times.

The radius that defines these territories is 1.5 km. This distance is derived from Chisholm's work synthesizing multiple cross-cultural investigations of pre-mechanized farming, which found that intensive cultivation usually took place within 1 to 2 km of a settlement and more extensive cultivation usually extended to around 5 km (Chisholm 1979, 33–62, 94–105). Thus, the character of the landscape within 1.5 km will have a profound impact on the success of intensive agriculture. For settlers engaged in primarily pastoral production or extensive agriculture, the character of the landscape in this immediate territory will be less important. Trends in the character of this immediate settlement territory, then, can be interpreted as evidence for the prevalence of intensive agriculture.[136]

The characteristics analyzed here, drawn from an examination of Roman agricultural writers, are slope, land form, aspect, solar radiation, soil and water supply.[137] Each characteristic is broken into several classes and the percent of each territory falling into each class is then calculated. This means that the variable that is subjected to statistical analysis is not the characteristic (e.g. slope), but rather the portion of the territory in a given characteristic class (e.g. flat land).[138] This operation is performed for settlements dated to the Pre-Roman period, the Roman period broadly, the Middle Roman period, the Late Roman period and the Late Antique period. The Roman settlements include all sites with evidence for Early, Middle or Late Roman settlements as well as settlements that could not be dated more specifically than "Roman." There were not enough settlements dated to the Early Roman period to perform statistical analysis.

For comparison, 1000 randomly located points were generated and the characteristics of these points' territories were also calculated.[139] Two statistical methods of comparison were used: the distribution of means and the Kolmogorov-Smirnov test. The former compares the mean of a sample to the distribution of means of samples of the same size drawn from a population. Using the standard deviation of the distribution of means calculated from the population of 1000 points, the mean of each variable in each chronological period can be

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[135] The same logic applies to the use of path-distance allocation, which assigns locations to the nearest point using travel time rather than Euclidean distance.

[136] This is a form of site catchment analysis (Farinetti 2011b; Goodchild 2013; Vita-Finzi and Higgs 1970).

[137] Slope, landform, aspect and solar radiation have all been modeled from the digital elevation model produced by the Shuttle Radar Topography Mission (SRTM) at a resolution of 1 arc-second. At this latitude, the DEM has a cell size of approximately 26 meters square.

[138] The Archaeomedes project uses a similar procedure (Favory and Van der Leeuw 1998; Van der Leeuw 1998).

[139] These points are truly randomly distributed rather than distributed in accordance with the bias surface described above. A set of 1000 pseudo-random points was generated and slope class values were calculated, but these did not differ significantly from the truly random points. For the sake of simplicity, it was decided to use the truly random points as the basis of comparison for the univariate analyses.

expressed as a Z score – a standardized quantification of deviation from the mean of the 1000 random points.[140] In a normal distribution, around 95% of a population will fall within two standard deviations of the mean so Z scores greater than 2 are considered high and Z scores less than -2 are considered low. This makes it possible to quantify the relative preponderance or dearth of each variable in the territories of settlements in each chronological period.

The interpretation of the Z scores for each variable depends on the assumption that the population is normally distributed. This is often not the case, so a second, non-parametric test is needed to determine whether the differences detected are statistically significant. The Kolmogorov-Smirnov (K-S) two-sample test calculates the maximum difference between the cumulative percentages of two different samples to determine the probability that they came from the same population (the p-value). It does not require normally distributed data and can compare samples of radically different sizes, making it the perfect tool for comparing the settlements in each time period to the 1000 random points (Wheatley and Gillings 2002, 136–142). Unlike the distribution of means, it cannot express whether one sample has more or less of a variable than another sample, only whether or not they are different. The two analyses are thus complementary.

3.3.2.1 Slope Class

Roman agronomists recommend gently sloping terrain for grain crops, while hills can be planted with vines or olives (Columella 1.2.2-5). Extreme slopes are difficult to plow; they can be cultivated by hand, but this is less efficient (Varro 1.18.4, Pliny 18.178).[141] For the modern reader, used to hearing about the fertility of the great plains, it is perhaps surprising to come across frequent warnings against overly flat land which can cause problems with drainage. Cato recommends that the entire labor force of the estate be mobilized to drain water from the fields when the rains begin and that no standing water be left anywhere during the growing season (155.1-2). Varro considers drainage to be of prime importance for farms located in plains (1.6.6; similarly Columella 2.2.1). When describing how to bring new land into cultivation, Columella gives detailed instructions on constructing ditches to drain damp soil (2.2.11). Palladius, when describing ideal farming terrain, begins by saying, “The lay of the land should neither be so flat that the soil is stagnant nor so steep that it washes away” (1.5.5).[142] This is not to say that flat land could not have been cultivated, but to do so would have required building and maintaining a network of drains.[143]

Slope was derived from the Shuttle Radar Topography Mission (SRTM) 1 arc-second digital elevation model, and was then divided into classes. This is standard practice, but the

[140] The mean of the distribution of means is the same as the mean of the population but the standard deviation is much smaller than the standard deviation of the population. Standard deviation is calculated as the square root of the variance and the variance of the distribution of means is the variance of the population divided by the sample size (Aron and Aron 2008, 172–188).

[141] Ethnographic work in the Mediterranean confirms the possibility and extreme difficulty of cultivating steep slopes using hoes and mattocks (Halstead 2014, 19–21).

[142] Interestingly, this is one of the only times an agronomist expresses concern about erosion.

[143] Helen Goodchild, examining the locations of Roman farms in the middle Tiber valley, found that they tended to avoid the flattest areas, in contrast to modern farms (Goodchild 2007, 129–132).

exact classes vary.[144] The choice of a classification scheme must simultaneously maintain meaningful distinctions, while avoiding an abundance of classes with little distinction between them. This project employed the following six classifications:

Slope Range (%)	Description
0 – 3	Flat
3 – 9	Gently sloping
9 – 15	Moderately sloping
15 - 30	Strongly sloping
30 – 60	Steep
>60	Very steep

Table 12: Slope Classification.

The table below shows the Z scores of the average portion of territory in each slope class in each chronological period. Scores higher than two and less than negative two have been highlighted in red. This indicates that the average portion of land within 1.5 km of each settlement belonging to a given slope class is more than two standard deviations away from the mean of a random sample of the same number of points taken from the 1000 random points representing the environment. The figures for "Very Steep" land should be considered skeptically as the comparison mean is almost zero and there are many settlements and random points with no steep terrain at all in their immediate surroundings. The same concerns apply to "Steep" land but to a lesser extent.

	Flat	Gently Sloping	Moderately Sloping	Strongly Sloping	Steep	Very Steep	N
Pre-Roman	0.04411	-0.14648	-0.42825	0.012434	1.15383	3.657005	103
All Roman	0.607927	4.607485	-2.59222	-3.21749	-1.47265	0.773506	164
Mid-Roman	1.246551	3.198789	-1.77571	-3.00355	-2.09901	-1.42956	54
Late Roman	1.302055	4.071363	-1.89379	-3.77898	-2.58771	-1.27511	68
Late Antique	-0.23889	-2.08256	0.57789	1.05599	3.099695	4.433121	24
Random Average	20.49%	41.06%	20.98%	15.26%	2.12%	0.08%	1000

Table 13: Z scores of average portion of immediate territory in each slope class.

Considering only the well-represented slope classes, the land in the immediate vicinity of Pre-Roman settlements very closely resembles the land within the immediate vicinity of randomly located points. Settlements broadly dated as Roman, on the other hand, have more extreme Z scores. These settlements have more gently sloping land in their territory and less moderately and steeply sloping land. Middle Roman settlements alone also have significantly more instances of gently sloping land in their immediate territory than random locations and significantly fewer instances of strongly sloping land, but the average amount of moderately

[144] Goodchild, working in central Italy, uses classes of 3% up to 60% (Goodchild 2007, 130). Jeneson, working in north-west Europe, uses 0-2%, 2-4%, 4-8% and >8% (Jeneson 2013, 191). Verhagen et al., working in France, use these same classes but with 8-15% and >15%. The FAO soil classification guide uses 10 classes ranging from 0-0.2% ("Flat") to >60% ("Very Steep") (Food and Agriculture Organization of the United Nations 2006, 12).

sloping land is closer to that of random points. This trend intensifies for Late Roman settlements. Late Antique settlements, on the other hand, have fewer instances of gently sloping land than random points.

As noted above, the interpretation of Z scores depends on the assumption of normality which is often violated, so the K-S test is used to assess the significance of the Z scores. The table below shows the p-values (the chances that the settlement sample comes from the same population as the random sample) for each slope class in each chronological period. Values lower than 0.05 have been highlighted in red.

	Flat	Gently Sloping	Moderately Sloping	Strongly Sloping	Steep	Very Steep	N
Pre-Roman	0.54177	0.98270	0.16457	0.30315	0.02280	0.62346	103
All Roman	0.059571	0.000525	0.045607	0.039596	0.015857	0.988356	164
Mid-Roman	0.21952	0.01247	0.36037	0.00851	0.13194	0.79384	54
Late Roman	0.02717	0.00083	0.13159	0.00002	0.00048	0.39854	68
Late Antique	0.24913	0.00058	0.25591	0.03707	0.01909	0.01928	24

Table 14: P-values from Kolmogorov-Smirnov tests comparing the slopes of territories of settlements and random points.

This test confirms the general similarity of Pre-Roman settlements to the random points, which shows either that the people who built Pre-Roman settlements did not care about the slope of the land in their immediate vicinity or that there were several responses to sloping land. If slope was unimportant, this could be related to a mobile, pastoral economy in which slope is not a limiting factor and the real territory of the settlement is much larger than 1.5 km. The test also reveals that the Roman preference for gently sloping land and avoidance of moderately sloping and strongly sloping land is real. Settlers in this period apparently did care about the slope of the land around their settlements and agreed on the desirability of gentle slopes.

The K-S test suggests that there are also significant differences in the amount of flat land in the vicinity of Late Roman settlements. The average amount of flat land within 1.5 km of Late Roman settlements is 23.09%, a difference of only 1.30 standard deviations from the 20.49% average of the random points, but the data are skewed – 614 out of 1000 random points have less than 20.49% flat land within 1.5 km. The fact that Late Roman settlements have more flat land is, as the K-S test shows, unlikely to be due to random sampling error. In the fourth century, settlements continued to avoid strongly sloping land and favor gently sloping land, but they also began to favor flat land.

Late Antique settlements, on the other hand, have significantly more strongly sloping land in their territories and significantly less gently sloping land. The few unfortified settlements that we know of from the fifth and sixth centuries had opposite tendencies to second, third and fourth century settlements: they avoided gently sloping land and favored strongly sloping land. Late Antique settlements also have more steep and very steep land in their neighborhoods, but the statistical significance of this is difficult to assess. Steeper land may have been sought for defensive purposes, but changing cultivation practices that favor steep slopes cannot be ruled out.

3.3.2.2 Landform

Landform, closely related to slope, refers to the general shape of the ground surface. Examples of land forms are valleys, lower slopes, upper slopes, and ridges. Valleys and hollows were considered unhealthy on account of their lack of air circulation and humidity (Varro1.12.1-3; Columella 1.4.10; Palladius 1.3; 1.5.5; 1.16). Columella, followed by Palladius, balances his advice against valleys with a warning against ridges as being overly exposed to storms (Columella 1.4.10; Palladius 1.5.5). This advice relates to the setting of the farm house; later Columella says that grain thrives best on "open" ground (2.9.3), advice which echoes Cato's prescription for "high, open ground" (35.2) and is repeated by Palladius (1.6.15). The reason for this can be traced back to Theophrastus, who says crops planted in places that are elevated and exposed to the wind are less susceptible to rust (*Enquiry into Plants* 8.10.2).

In general, the agronomists recommend that the farm should have diverse landforms. Cato says that, if possible, the ideal farm should be at the foot of a mountain (1.3). Varro agrees, adding that it should be next to a plain (1.13). Columella says the best farm has both level and hilly areas (2.2.2). This reflects the assumption that the audience of these books will be operating a mixed farm, but also valorization of moderation (see especially Palladius 1.5.5).

Landform is a way to classify terrain into more meaningful units by considering the overall shape of the ground surface. The terrain was automatically classified into seven land forms: flat areas, valleys, lower slopes, gentle slopes, steep slopes, upper slopes and ridges. This was done using the "Difference from Mean Elevation" method (De Reu et al. 2011; Tagil and Jenness 2008), which calculates the difference between the elevation at a certain location and the average elevation in the surrounding neighborhood to create a "Topographic Position Index" (TPI). Large positive values represent peaks, smaller positive values represent upper slopes, negative values represent lower slopes and large negative values represent valleys. A TPI near zero can either represent a flat area or the middle of a slope, so slope values are used to classify these locations as flat, gentle slopes or steep slopes. The neighborhood used to calculate the average elevation can be adjusted to examine topographic position at different scales. The specific slope and TPI cut-off values can also be adjusted. Appropriate parameters, summarized in the following table, were determined through experimentation.

Calculation radius	20 cells = 536 meters
Valleys	TPI < -20
Lower Slopes	-20 < TPI < -10
Flat	-10 < TPI < 10 and Slope < 3%
Gentle Slopes	-10 < TPI < 10 and 3% < Slope < 15%
Steep Slopes	-10 < TPI < 10 and Slope > 15%
Upper Slopes	10 < TPI < 20
Ridges	TPI > 20

Table 15: Parameters used in land form classification.

The results of the analysis are presented in the following tables:

	Flat	Valleys	Lower Slopes	Gentle Slopes	Steep Slopes	Upper Slopes	Ridges
Pre-Roman	-0.25702	0.98405	0.03635	-0.55567	0.38148	0.54107	0.29477
All Roman	0.76640	-2.77548	-2.00593	3.99532	-2.79334	-2.95707	-2.36587
Mid-Roman	1.36771	-2.69658	-2.08559	3.45652	-2.90387	-3.12102	-2.36774
Late Roman	1.37434	-3.63505	-1.85695	4.04570	-3.63477	-2.91240	-2.95434
Late Antique	-0.52220	3.86623	-0.25400	-2.82057	1.55279	2.11575	1.93097
Random Average	17.05%	4.41%	10.47%	44.35%	8.23%	11.75%	3.73%

Table 16: Z scores of average portion of each territory according to land form.

	Flat	Valleys	Lower Slopes	Gentle Slopes	Steep Slopes	Upper Slopes	Ridges
Pre-Roman	0.45347	0.62346	0.64445	0.49844	0.23609	0.79308	0.61371
All Roman	0.06050	0.00115	0.05036	0.00022	0.01010	0.00229	0.19199
Mid-Roman	0.15444	0.00384	0.05163	0.00346	0.01461	0.02190	0.00714
Late Roman	0.00867	0.000200	0.06510	0.00026	0.00007	0.01014	0.00843
Late Antique	0.25081	0.00204	0.89963	0.00529	0.01222	0.03848	0.00124

Table 17: P-values of K-S tests on land form.

Again, the territory around Pre-Roman settlements strongly resembles the territory surrounding random points. Roman settlements avoid valleys and lower slopes, favor mid-slopes that are gentle, but avoid mid slopes that are steep as well as upper slopes and ridges. The K-S test shows that the statistical significance of the avoidance of lower slopes is slightly less than other slope classes, but the pattern is probably still real. Middle Roman settlements have the same tendencies as Roman settlements in general. Late Roman settlements follow a slightly different pattern. Gentle slopes are still favored and steep slopes, upper slopes and ridges are still avoided, but the aversion to lower slopes is somewhat weaker than it was in the middle Roman period and flat land begins to be favored.[145] The avoidance of valleys recalls Palladius' advice against placing one's farm in a valley bottom because of the health risks they pose (1.16.1). It is all the more striking, then, that Late Antique settlements prefer valleys, steep slopes, upper slopes, and ridges while avoiding gentle slopes. In sum, these results mirror those

[145] Although the average amount of flat land is roughly the same as for the Middle Roman settlements, there are fewer Late Roman settlements with less than 5% of flat land in their territories than Middle Roman settlements

of the slope class analysis; Pre-Roman settlements resemble a random distribution of points, Middle Roman and Late Roman settlement show strong preferences for gentle slopes, and Late Antique settlements show the opposite tendencies.

3.3.2.3 Aspect

The agronomists consider aspect, the direction a slope faces, to influence both the amount of sunlight received – especially in winter – and its exposure to different winds. The actual relationship between aspect, sun exposure, and wind exposure is not as straightforward as has sometimes been assumed (e.g. Goodchild 2007, 133; Jeneson 2013, 197). Cato recommends that the farm be placed at the foot of a mountain and face south (1.3). Although he does not say why, this would maximize sun exposure during the winter. Varro, however, in a passage that is almost an exact quotation of the Cato passage just cited, says the farmstead should face east because it will be shaded in the summer and sunny in the winter (1.12). In Columella's version of the same passage, he declines to commit to one or the other, saying only that the hills should have either southern or eastern slopes (1.2.2), advice echoed by Palladius who says that houses in cold climates should face south or east, but in hot climates, north (1.7.3).

Equally important, when considering the aspect of slopes, is the exposure to different winds.[146] Cato says that olive orchards should face the west wind, but also be exposed to the sun (6.2). Vines are particularly susceptible to damage by high winds (Palladius, 2.13.2). Columella advises that vineyards should be oriented so that the sun exposure will moderate the climate, unless this would expose them to destructive winds (3.12.6; echoed by Palladius, 2.13.6).[147] Theophrastus' observation that grain planted in windy, elevated places are less liable to rust has already been mentioned, but in the same paragraph he says that wind will destroy wheat and barley when they are flowering or have just dropped their flowers.

In general, it must be remembered that aspect is a fairly crude indicator for both sun and wind exposure, which are affected significantly by local topography. With modern GIS software it is possible to calculate local sun exposure in detail, but this is not yet possible for wind exposure. Both solar insolation and duration of direct sunlight were calculated for the study area and, surprisingly, it was found that neither measure correlated well with aspect. Therefore, aspect will be interpreted in relation to wind exposure only.[148]

Data collected throughout the twentieth century provide a good understanding of the annual and geographical distribution of prevailing winds (Stanev, Kyuchukova, and Lingova 1991, 297–329). In northern Bulgaria, the wind blows predominantly from the west and northwest. The consistency of these winds is greatest in the western part of the Danubian Plain

[146] For an account of the nature of Mediterranean winds see Pliny 18.326-339.

[147] The proper aspect for vineyards was a topic of much debate among the agricultural writers who considered both sun and wind exposure (Pliny 17.19-24; Columella 3.12.5-6).

[148] There is very little correlation between aspect and average length of direct sunlight exposure in May (for the significance of which, see section 3.3.2.4 below) in the study area. This is probably because the terrain is, for the most part, fairly gentle. Surprisingly, the average length of direct sunlight exposure for north-facing slopes is 14.1 hours while for south-facing slopes it is 13.9 hours. The shadow cast by the Balkan mountains to the south may account for this unexpected result.

and decreases gradually as one moves east, so that in the study area the wind blows from these directions 30 – 50 percent of the time. At the end of spring and in the fall, northern and northeastern winds are also common. The strongest winds are experienced in the winter and these come from the west and northwest.

Wind patterns in the study area vary from east to west because air masses flowing from the north around the east and west sides of the Carpathians meet here. The combination of sophisticated climate modeling and local meteorological data have been used to calculate micro regional climate conditions. Wind roses for Pavlikeni, representing the southwest part of the study area, and Ruse, representing the northeast portion, are shown below. The length of each spoke represents the total duration of time that the wind blows from each direction in a year. The colors of the spoke represent the speed of the wind. In both places, westerly winds predominate, but in northeasterly winds are much more common in Ruse than in Pavlikeni.

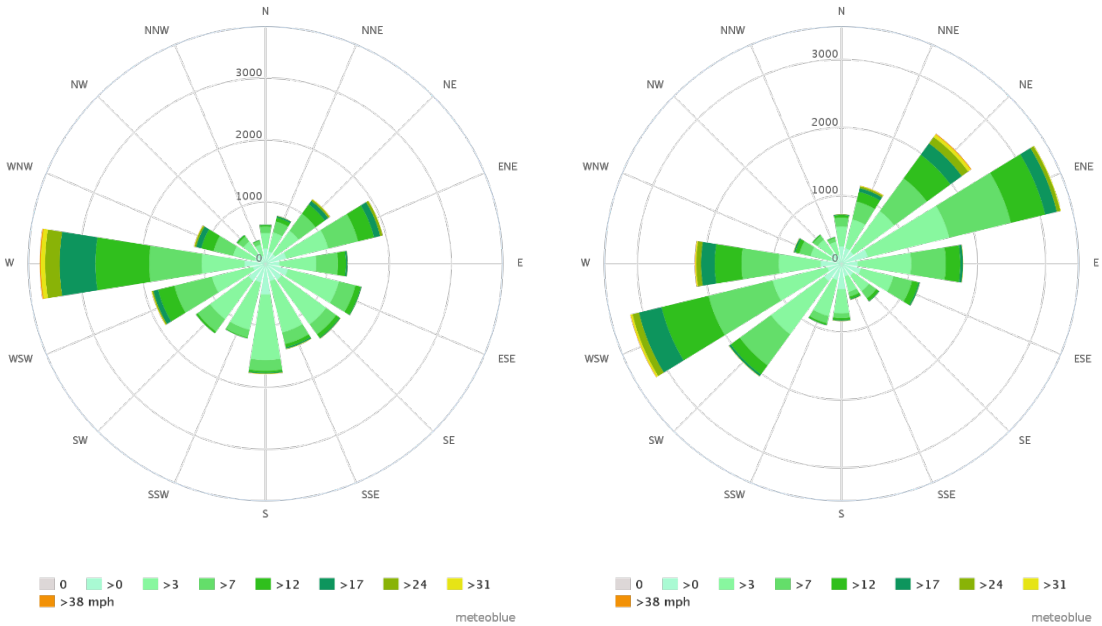

Figure 20: Wind roses for Pavlikeni (left) and Ruse (right) representing annual distribution of wind direction and speed based averaged over the past 30 years. Source: meteoblue.com, downloaded November 15, 2015.

The tables on the following page show the average portion of territory facing each cardinal and inter-cardinal direction:

	North	North-east	East	South -east	South	South-west	West	North-west
Pre-Roman	1.037	1.521	0.537	-0.694	-2.171	-0.500	0.805	0.889
All Roman	2.586	4.799	2.800	2.062	-1.901	-2.984	-4.572	-3.091
Mid-Roman	2.941	2.759	0.397	0.317	-1.349	-1.824	-2.928	-1.284
Late Roman	1.931	1.776	0.678	1.760	0.345	-1.903	-3.733	-2.723
Late Antique	-1.491	-1.277	0.130	0.443	0.617	0.900	1.133	0.065
Random Average	20.8%	11.8%	7.7%	10.9%	17.0%	10.8%	8.2%	12.9%

Table 18: Z scores of average portion of territories in each aspect class.

	North	North-east	East	South-east	South	South-west	West	North-west
Pre-Roman	0.307	0.170	0.709	0.947	0.227	0.906	0.549	0.625
All Roman	0.0319	0.001	0.007	0.031	0.029	0.002	0.000	0.001
Mid-Roman	0.072	0.187	0.713	0.396	0.182	0.021	0.037	0.108
Late Roman	0.105	0.191	0.308	0.099	0.161	0.015	0.000	0.004
Late Antique	0.037	0.102	0.957	0.374	0.748	0.556	0.184	0.376

Table 19: P-values of K-S tests on aspect class.

Again, Pre-Roman settlements look very similar to randomly distributed points. The average amount of south-facing land in the territory of Pre-Roman settlements is less than for random points, but the K-S test shows that this is probably not significant.

Roman settlements, on the other hand, differ significantly from random locations in every direction. They have more north-, northeast-, east- and southeast-facing land than random points and less south-, southwest-, west-, and northwest- facing land. The K-S tests show that all these differences are significant, even the amount of land facing south, which is less than two standard deviations from the random average. The territories in these settlements would have been relatively protected from the predominating westerly and northwesterly winds and relatively exposed to the secondary northeasterly winds.

Isolating the settlements that can be dated to the middle Roman period, the preference for northern and northeastern aspects remains, but the K-S tests show that the differences are less significant. The preference for east- and southeast-facing land disappears entirely and the aversion to south-facing slopes is weaker and less significant, as is the aversion to northwest-facing slopes. The aversion to southwest-and west-facing slopes is also weaker, but remains significant. Considering both Z scores of means and K-S significance values, the strongest tendency among Middle Roman settlements is the avoidance of western aspects, again suggesting that the prevailing winds were seen as a negative influence.

Isolating Late Roman settlements further decreases the degree and significance of the preference for north-and north-east facing slopes. There is no evident preference for east-facing land, but there may be a slight preference for southeast-facing land, though the difference is less and the statistical significance lower than when all Roman settlements are considered together. The avoidance of south-facing land disappears altogether, but the avoidance of southwest-facing land is stronger than in the Middle Roman period. Again, the avoidance of west-facing land is the most pronounced and statistically significant tendency but northwest-facing land is shunned as well. Again, these settlements were relatively sheltered from the prevailing western and northwestern winds, but somewhat exposed to northern and northeastern winds.

Late Antique settlements seem not to have been as sensitive to aspect. The moderate avoidance of north-facing land is significant and the slighter avoidance of northeast-facing land might also be significant, but no other types of land show major deviation from random points.

This is in direct contrast to earlier settlements which showed preference for those types of land.

The pattern of slope aspect in the territories of Roman settlements stands in sharp contrast to that observed in pre-Roman and Late Antique settlement territories. All three groups of Roman settlement showed some preference for north-, northeast- and, to a lesser extent, east-facing slopes, while they avoided southwest-, west- and northwest-facing slopes. The avoidance of west-facing slopes is consistently strong and significant. Pre-Roman settlements show very slight preferences for north- and northeast- facing slopes, but they also show very slight preferences for west- and northwest-facing slopes (though probably insignificant, p = 55% and 62% respectively). Late Antique settlements positively avoid north-facing slopes and, to a lesser extent, northeast-facing slopes. The only other difference between Late Antique settlements and random points is in west-facing slopes, which they slightly prefer, though there is an 18% chance that this is insignificant. Again, the three types of Roman settlements differ from Pre-Roman and Late Antique settlements.

3.3.2.4 Sun Exposure

Sunlight is obviously critical to photosynthesis, but different types of plants have different sunlight requirements. The Roman agronomists concur in recommending that wheat and barley be planted in a sunny place (Cato, 34.2-35.1; Columella 2.9.3; Palladius 1.6.15). Cato specifically mentions the duration of sun exposure, which may be related to the timing of wheat development. It has been observed that wheat flowers more quickly when the days are longer, so a location that received long hours of direct sunlight while the plant was developing would produce a harvestable crop earlier than shadier places (Acevedo, Silva, and Silva 2002). As the period right before harvest is also the period when stored grain would be running low, farmers must have been eager to harvest their grain as soon as they could. Places that received the longest hours of direct sunlight in April and May – the period when winter wheat develops and begins to flower – would have been attractive to ancient farmers.

Currently, winter wheat grown in northern Bulgaria flowers in early May (Boyadzhieva 2001). An important determinant of wheat production, then, will be the duration of direct sunlight experienced by a given location in the months of April and May.[149] The terrain and latitude of the study area is such that most places receive an average of 12 to 14 hours of sunlight in April. In May, however, there is more differentiation with some places receiving over 14 hours of sunlight in an average day. The percentage of land within the territories of settlements receiving different amounts of sunlight in May is therefore a useful quantification of sunniness. The tables below show the Z scores of the average portion of territory in each sunniness class for each time period as compared with the random points and the p-values of the K-S tests.

[149] This was calculated using the Solar Radiation tool in ArcGIS. The resulting rasters represented the cumulative hours of direct sunlight received by each location over the course of each month in the year. These were divided by the number of days in each month to obtain an average length of direct sunlight per day. These were then reclassified into two hour bins to aid in analysis. In April, the minimum length of direct sunlight is 3.9 hours and the maximum is 13.1. In May the minimum is 8.1 hours and the maximum is 14.5.

	% 10 hrs	% 12 hrs	% 14 hrs	% 16 hrs
Pre-Roman	3.736691965	1.577705	0.311735	-0.43531
All Roman	0.573819919	-0.73611	-1.91805	1.915228
Mid-Roman	-1.24984551	-1.85962	-2.32301	2.400266
Late Roman	-1.213426	-2.20997	-2.07598	2.187868
Late Antique	1.898898251	2.85827	1.857715	-2.02854
Random Average	0.01%	0.66%	43.84%	55.49%

Table 20: Z scores of average portion of immediate territory in each sunniness class.

	% 10 hrs	% 12 hrs	% 14 hrs	% 16 hrs
Pre-Roman	0.705853581	0.200961	0.962957	0.962957
All Roman	1	0.014207	0.071801	0.082136
Mid-Roman	0.956815956	0.019122	0.003614	0.004439
Late Roman	0.974784004	8.86E-05	0.028647	0.021469
Late Antique	0.021540383	0.015392	0.088904	0.089644

Table 21: P-values of K-S tests on sunniness.

Very little land received less than 10 hours of sunlight in May. Thus, although Pre-Roman settlements have more of this class of land in their territories than the random points, the K-S test shows that this difference is not statistically significant. The greater average of Late Antique settlements with this type of land, though smaller than the Pre-Roman difference, is statistically signficant. It is unlikely that people at any time period would seek to avoid the sun in this continental climate and the apparent Late Antique preference for land that receives less direct sunlight is probably a result of the previously observed preference for steep slopes and valleys which would have been shaded.

Slightly more land in the study area gets between 10 and 12 hours of sunlight in May. Pre-Roman settlements have somewhat more land in this class compared to random points, but the K-S test shows that this is probably not significant (p = 20%). Roman settlements, in constrast, have only slightly less land in this class than random points, but the K-S test shows that this difference is significant. Isolating Middle Roman and Late Roman settlements increases both the difference and statistical significance, suggesting that the settlements that are only broadly datable to the Roman period actually have more of this type of land in their territories than random points. This inconsistency, combined with the scarcity of land in this category, makes it dangerous to draw conclusions about Roman settlers' views on shady land, but it is interesting to note that Late Antique settlers have significantly more of this land in their territories than the random points. Again, the contrast with Roman settlements is striking.

The vast majority of the land in the study area receives either 12-14 or 14-16 hours of sunlight in May. Pre-Roman settlements had about the same amount of land in these categories as the random points, but Roman settlements had less of the land that receives less than 14 hours and more of the sunniest land in their territories. The K-S test shows that these differences are not as significant as some of the other differences observed. Isolating the Middle Roman settlements increases both the difference and the significance, suggesting that

Middle Roman settlers actively sought the sunniest land. The Late Roman settlements maintain the pattern, but the differences and significance values are not as great. Either the duration of direct sunlight was less important in the fourth century or the sunniest land was less available.

Late Antique settlements, in contrast to Roman settlements, avoided the sunniest land (though there is a 9% chance that this difference is due to sampling bias), they may have slightly favored the less sunny 12-14 hour land, and they definitely favored land that received only 10-12 hours of sunlight in May. This must have had an adverse effect on cereal production in the immediate vicinity of Late Antique settlements, though it is possible that cereal production ocurred farther from the settlements at this time.

3.3.2.5 Soil

The quality of the soil is, perhaps, the most important factor affecting the fertility of the land (Cato, 1.2; Varro, 1.7.5; Columella 1.2.3; Palladius 1.5.1). The agronomists recognized a great variety of soils and that different plants responded differently to them (White 1970, 86–109).[150] Varro attempts to classify soils according to their dominant substance, the relative preponderance of that substance compared to soils' other components, and their water content, but because his list of substances contains minerals (e.g. chalk), particle sizes (e.g. sand and gravel and unknown substances (*carbunculus*), his system is impossible to put into practice (1.9). Columella's system is simpler, but also difficult to operationalize. He measures soils on three axes defined by opposites: fertility (*pinguis/macer*), density (*solutus/spissus*) and water content (*umidus/siccus*) (Columella 2.2.2). These categories do not correspond well with categories used in modern soil science.

Fertility depends on the presence of nutrients in the soil as a result of mineral and organic contents and the availability of those nutrients to plants, which can be affected factors such as leaching in free draining soils and pH (Ellis and Mellor 1995, 187–192). The density of the soil depends on the soil's texture – the sizes of the particles – on its structure – the way those particles are aggregated – and on its pore space (Ellis and Mellor 1995, 26–36). The moisture content of a soil depends on the presence of water, the texture and structure of the soil, the depth of the soil, slope of the terrain, and position on that slope (Ellis and Mellor 1995, 189–192). Even if one were to map all these variables, the relationship of modern soil characteristics to ancient ones is uncertain. The nutrient content of soils is especially susceptible to rapid changes from modern agriculture (Shiel 1999).[151] Soil texture, on the other hand, is more stable, though erosion and deposition may alter it (Ellis and Mellor 1995, 200). Because soil properties are closely related to the parent material from which they derive, this may be a more reliable indication of ancient soil quality (Goodchild 2007, 141). For this project, soil texture and parent material are both considered indicative of the properties of ancient soil.

Soil data were derived from the Soil Geographic Database of Europe (SGDBE), but some additional processing was required to make them usable for this study. The smallest unit in the SGDBE is the "Soil Mapping Unit" (SMU) which is a combination of several Soil Typological Units

[150] See Pliny, *Natural Histories* 17.24 – 41 for the variety of types of soils and their diverse qualities relative to various crops.
[151] See Columella 2.1 for differing understandings of fertility changes in antiquity.

(STU) which have a certain texture and parent material. It is therefore necessary to summarize the relevant characteristics of the STUs that form an SMU and calculate the percentage of the SMU with those characteristics. Most of the SMUs in the area of interest were composed of STUs that shared a parent material, so summarizing this variable was straightforward. Texture class varied more. Soil texture is expressed as an integer which corresponds to one of seven classes:

Soil Class	Description
0	No Information
1	Coarse (18% < clay and > 65% sand)
2	Medium (18% < clay < 35% and >= 15% sand, or 18% < clay and 15% < sand < 65%)
3	Medium fine (< 35% clay and < 15% sand)
4	Fine (35% < clay < 60%)
5	Very fine (clay > 60 %)
9	No mineral texture (Peat soils)

Table 22: Soil Texture Classes in the SGDBE.

To arrive at a soil texture for an SMU I multiplied the soil texture code of each STU by the percentage of the SMU it occupied and summed the results producing fractional values that can be interpreted as approaching the above classes. ArcGIS, however, requires integer values in its area calculations. In order to preserve some of the fractional data I multiplied the SMU texture codes by two before rounding to the nearest integer. The results are summarized in the following table:

Soil Class	Description
4	Medium
5	Medium to Medium-Fine
6	Medium-Fine
7	Medium-Fine to Fine
8	Fine

Table 23: Calculated SMU soil texture classes.

As it turns out, there was very little “Medium to medium-fine” soil and “Fine” soils are completely absent from the territories of settlements and almost completely absent from the territories of random settlements. The results for the remaining textural classes are presented in the two tables below:

	No Information	Medium	Medium-Fine	Medium-Fine to Fine
Pre-Roman	-0.85451	-0.84314	0.922938	0.012056

All Roman	-2.25446	-2.31166	1.757859	0.885668
Mid-Roman	-0.96896	-1.38798	-0.18048	1.812479
Late Roman	-1.55674	-1.31715	0.151401	1.569324
Late Antique	-0.20232	3.010318	-1.76036	-0.68371
Random Averages	2.97%	20.73%	49.65%	26.65%

Table 24: Z scores for average amount of territory in each texture class.

	No Information	Medium	Medium-Fine	Medium-Fine to Fine
Pre-Roman	0.99993	0.464657	0.698066	0.830154
All Roman	0.955418	0.135671	0.187183	0.842341
Mid-Roman	0.999999	0.73075	0.69011	0.21796
Late Roman	0.998938	0.579674	0.905842	0.250271
Late Antique	1	0.016209	0.058965	0.931012

Table 25: P-values of K-S tests on percent of territory in each texture class.

Again, Pre-Roman settlements resemble random locations. Roman settlements appear to avoid soils with no textural information and medium soils but the K-S test shows that neither of these results are significant. Middle Roman and Late Roman settlements show no significant differences from random locations.

The parent materials represented in the territories of settlements and random locations are little differentiated. The most common parent materials are described in the SGDBE as "Loess," "Loamy Loess," "Residual Loam" and "Fluvial Clays, Silts and Loams." "No information" and "Calcareous Rocks" account for the remainder. The results are presented in the two tables below:

	No Information	**Loess**	**Loamy Loess**	**Residual Loam**	**Fluvial Clays, Silts and Loams**	**Calcareous Rocks**
Pre-Roman	-0.85422	0.011775	1.224229	-1.00879	-0.37989	0.631908
All Roman	-2.25434	0.885328	1.005081	-2.50479	1.311068	0.670081
Mid-Roman	-0.96882	1.812308	-0.63216	-1.52371	0.676849	0.482801
Late Roman	-1.55668	1.569123	-1.44499	-1.40803	2.46207	0.303831
Late Antique	-0.20213	-0.68386	-2.23001	3.213177	0.563919	-0.67465
Random Averages	2.97%	26.65%	35.25%	19.48%	14.40%	1.25%

Table 26: Z scores of averages of the amount of territory in each parent material class.

	No Information	Loess	Loamy Loess	Residual Loam	Fluvial Clays, Silts and Loams	Calcareous Rocks
Pre-Roman	0.999606	0.965887	0.965887	0.999606	0.694745	1
All Roman	0.955418	0.842341	0.406295	0.133478	0.592664	1
Mid-Roman	0.999999	0.155194	0.892592	0.706501	0.963435	1
Late Roman	1	0.250271	0.370609	0.624373	0.138467	1
Late Antique	1	0.931012	0.064929	0.007251	0.998391	1

Table 27: P-values of K-S tests on amount of territory in each parent material class.

There are several differences in the average amount of each parent material in the different settlement territories, but the only ones that are statistically significant are the Late Antique preference for residual loam and avoidance of loamy loess ($p < 1\%$ and $p = 6\%$, respectively). These parent materials are similar so the opposite tendencies seen here probably have less to do with the soil and more to do with the general distribution of settlement in Late Antiquity.

The soil data are difficult to interpret not only because there is little variation in parent material and texture, but also because the Soil Geographic Database of Europe was built at a continental scale and is too generalized to to really be useful for this project. Unfortunately, no more detailed soil data are available in digital form.

3.3.2.6 Water Supply

Water is a crucial and complex variable as it is both necessary and dangerous (Cato 1.3; Varro 1.11.2; Columella 1.2.3; 1.3.4-5; Palladius 1.2) to humans, animals and plants. The agronomists devote most of their attention to the water supply of the *villa* itself (Varro 1.11.2; Columella 1.5.2-4; Palladius 1.12-17). This was intended to provide convenient drinking water and to feed the baths and fountains that made the *villa* comfortable, but also to provide water for livestock. The technology of water management also contributed to the prestige of the owner (Purcell 1995, 176–177).[152]

Because of its importance to the life and comfort of the *villa* residents, water could also pose significant dangers. The primary danger of water is to health. Varro advises against building a farm house next to a river or near a swamp as it will be cold in winter and unhealthy in summer and the swamp will breed animalculae which will cause disease (1.12.1-2; Columella 1.5.4-6 offers similar advice). Palladius also advises that water should not be drawn from pools, marshes, or mines (1.4.1). Columella considers rainwater to be the healthiest, followed by water flowing from a mountain, and then well water from a hillside or valley, though not the

[152] Agnieszka Tomas has recently published a brief overview of Roman water-supply infrastructure in Moesia Inferior (Tomas 2011).

lowest part; slow flowing or standing water is poisonous (1.5.2-3). Although it is agreed to be healthiest, rainwater requires the construction of cisterns and pipes which could be prohibitively expensive, so Columella and Palladius recommend this only in the absence of springs or wells. Floods may also threaten the *villa*, but the agronomists do not dwell on this as much as on health risks (Varro 1.12.4; Columella 1.4.10).

Outside the villa, sources of ground and surface water are less important. In Columella's ideal farm, streams running down from the hills irrigate gardens, meadows, and willow groves but arable land, orchards, and vineyards are assumed to be fed by rain (Columella 1.2.4). Moisture content is one axis along which Columella classifies soils, but it is less important than fertility and density: more plants thrive in fertile soil than less fertile soil, and everything grows better in loose soil than dense soil, but the number of plants that prefer wet soil is matched by the plants that prefer dry soil. He goes on to say that the best soil is rich and loose, the second best is rich and dense, and the third best is well-watered (2.2.3-6). Indeed, the agronomists seem more concerned with the prospect of excess water than inadequate water.

Even places with excess water, though, can be highly productive. When ranking different uses for land, Cato places a vineyard of high quality and large yield first, but follows that with an irrigated garden and a willow grove (1.7). Varro says that gardens could be especially profitable near cities where there was a market for vegetables and flowers (1.16.3). Willow groves and reed beds supplied necessary material for other agricultural activities (Varro 1.23.4-5).[153] Meadows were valuable sources of fodder for animals including draft oxen (Columella 2.16).[154] Wetlands could even support certain types of grape (Pliny 17.31). In ground that was only moderately wet, emmer could be planted, but In general the agronomists recommend dry land for grain, especially barley (Cato 34.2; Varro 1.9.4; 1.23.5; Columella 2.6.4; 2.9.3; Palladius 1.6.16).[155] A distinction must be made, then, between different types of ground water sources. Springs and small streams must be analyzed separately from rivers and wetlands.

In the Danubian Plain, there is sufficient rainfall for cereal cultivation without the need of irrigation. This mirrors the situation in Italy with which the Roman agronomists were familiar. They assume that ground water is necessary for feeding baths, consumption by humans, irrigating gardens and willow groves, creating ponds for watering livestock in the farmyard and processing plant materials such as willow and flax. Aside from human consumption and sanitation, these are all requirements of intensive agricultural production. Extensive production of cereal and vines, as well as more transhument animal husbandry, do not require as much ground water near a settlement.

[153] Willows were used for a great variety of purposes including vine ties and basketry while reeds were often used for roofing thatch, vine props and trellises (White 1975, 235–237).
[154] For the food requirements of draft oxen which were especially high during the plowing season, see (Halstead 2014, 50–53).
[155] In older scholarship, *far/adoreum* was identified as spelt but emmer is much more probable (Nesbitt and Samuel 1996, 85–86).

The first analysis determined how many settlements had any type of ground water within their immediate territory and how many had a spring or small stream.[156]

	Any Water Source	Streams or Springs
Random	82.20%	75.10%
Pre-Roman	81.55%	75.73%
All Roman	90.85%	84.76%
Mid-Roman	90.74%	87.04%
Late Roman	88.24%	82.35%
Late Antique	91.67%	62.50%

Table 28: Percentage of territories with at least one water source.

As can be seen by the large portion of random points that have water sources within 1.5 km, the study area in general is fairly well-watered. Pre-Roman settlements have almost exactly the same portion of territories with water sources as the random points, while for all other time periods a larger portion of settlement territories have a water source. The portion of Roman settlements with a water source in their territory is 9% greater than random locations and the proportion of settlements for which that source is a spring or small stream is 10% greater than random locations. The set of only Middle Roman settlements also has 9% more territories with a water source and 12% more territories with a spring or stream. The differences are smaller for Late Roman settlements. The Late Antique settlement system, uniquely, has a smaller portion of settlement territories with streams or springs than random points, a difference of around 13%. This is especially striking as the portion of settlement territories with any water source is over 9% greater than the random points. There are seven settlements (out of 24 total) that are within 1.5 km of a river but not a small stream or spring. Since the rivers in this area often incise deep gullies and are surrounded by sheer cliffs, this could indicate a preference for defensible positions.

[156] Data on springs were gathered from Soviet topographic maps at a scale of 1:50,000 compiled in the 1980s. All spring icons, as well as water source icons with names that indicated natural occurence rather than artificial pumping or collection, were digitized as points (Headquarters, Department of the Amy 1958). These topographic maps were not suitable for gathering data on running water, however, as the Danubian plain has experienced extensive river management in the late nineteenth and twentieth centuries (see above); stream data is better modeled using a digital elevation model (as recommende by Kvamme 1988b). For this I relied on the European Environment Agency's Catchments and Rivers Network System (ECRINS). This is a digital database of all the rivers and streams in Europe generated using a digital elevation model with cell size of 100 x 100 m (European Environment Agency 2012). This is obviously coarser than would be ideal for a study on a regional scale, but it has the advantage of ensuring that all streams are perennial as they derive from a relatively large catchment. The open availability of the data and the wealth of included information also make this a valuable resource for environmental modeling. Each stream segment was classified according to its upstream area to divide small streams from rivers. An appropriate threshold was determined through the comparison of photographs taken by the author at a particularly wet part of the year (early April, 2015) and upstream areas as recorded in the ECRINS data. Stream segments with an upstream catchment of less than 500 ha were designated small streams, while those with an upstream catchment of more than 500 ha were designated rivers. I also separated out the Danube as a special case because of its continental watershed.

The second analysis examined the amount of water in each territory by counting the number of springs and the total length of stream segments within the territory of each settlement and comparing these to the territories of the 1000 random points.

	Length of small streams	Length of rivers	Length of Danube	Total stream length	Number of springs
Pre-Roman	0.197486	3.302749	0.134343	2.073151	0.689936
All Roman	2.777351	0.937731	-2.37749	2.375749	1.736837
Mid-Roman	0.52944	-0.24675	-0.87797	0.099291	1.451807
Late Roman	1.43978	0.69037	-1.7988	1.194779	0.463568
Late Antique	-1.73015	7.615001	0.351357	2.835624	-0.81746
Random Average	1854 m	466 m	126 m	2446 m	0.469

Table 29: Z scores of average stream lengths and numbers of springs.

	Length of small streams	Length of rivers	Length of Danube	Total stream length	Number of springs
Pre-Roman	0.972897	0.264413	1	0.055133	1
All Roman	0.034923	0.998784	0.944187	0.006632	0.388793
Mid-Roman	0.823573	0.999995	1	0.894831	0.53
Late Roman	0.416083	0.999941	0.996572	0.235138	1
Late Antique	0.164056	0.008373	1	0.044621	0.94

Table 30: P-values of K-S tests on length of streams and number of springs.

While there is no significant difference between the number of springs in settlement territories from any chronological period and the number of springs in randomly located territories, there are some interesting differences in the lengths of different classes of stream. The length of rivers in Pre-Roman settlement territories is larger than in those of random locations, but the K-S test shows that there is a 26% chance that this is due to random sampling bias. At the same time, the total stream length in the territories of Pre-Roman settlements is also larger than in the random territories and there is less than a 6% chance that this is due to sampling bias. The very small differences in the average length of small streams and the Danube make this somewhat puzzling and calls for further investigation.

Roman settlements have more small streams in their territories than random points and the K-S test shows that this is statistically significant. The difference in small streams accounts for the difference in total stream length between Roman settlements and random points. Middle Roman and Late Roman settlements do not show any significant differences in the lengths of any stream class as compared to random points.

The most pronounced deviation from random points is in the length of rivers in the territory of Late Antique settlements. While randomly located territories had an average of 466 meters of river, Late Antique territories had 1,172 meters on average. At the same time they

had shorter lengths of small streams and about the same length of Danube in their territories. This again points to a need for defensible positions close to Late Antique settlements.

The large difference in the average length of river in the territory of Pre-Roman settlements, combined with the large p-value from the K-S test on the same data, could be a result of the large number of territories with no rivers at all, as the K-S test is based on differences in cumulative percentage. To test this, all analyses were performed excluding zero values. First, the percent of territories in each chronological period with any length of each river class are presented, then the Z scores of the averages for each chronological period and the p-values of the K-S tests:

	Small Streams	Rivers	Danube	All Streams
Random	67.30%	16.90%	5.00%	75.80%
Pre-Roman	70.87%	24.27%	4.85%	80.58%
All Roman	77.44%	18.29%	0.61%	84.76%
Mid-Roman	75.93%	14.81%	1.85%	79.63%
Late Roman	76.47%	20.59%	0.00%	83.82%
Late Antique	58.33%	41.67%	8.33%	87.50%

Table 31: Percent of territories with any streams.

	Length of small streams	Length of rivers	Length of Danube	Total stream length
Pre-Roman	-0.41956	2.539295	0.651549	1.701445
All Roman	1.160581	0.970924	0.696652	0.813869
Mid-Roman	-0.47491	0.203008	0.696653	-0.40829
Late Roman	0.455741	0.002216	N/A	0.254555
Late Antique	-1.59513	5.866097	-0.90309	2.397643

Table 32: Z scores of average stream lengths excluding zeros.

	Length of small streams	Length of rivers	Length of Danube	Total stream length
Pre-Roman	0.630261	0.007962	0.919911	0.051867
All Roman	0.151195	0.585609	N/A	0.071139
Mid-Roman	0.397581	0.430178	N/A	0.8511
Late Roman	0.80484	0.993136	N/A	0.468728
Late Antique	0.241514	0.000332	0.109365	0.049557

Table 33: P-values of K-S tests on length of streams excluding zeros.

There are too few territories of any kind that include the Danube to make statistical processing worthwhile. For Pre-Roman settlements, excluding the territories with no rivers at all makes the difference with random settlements statistically significant. It is also significant, perhaps, that 24% of Pre-Roman settlements have such a river in their territory while less than 17% of random points do. This portion is exceeded only by Late Antique settlements, of which almost 42% are within 1.5 km of a river. This confirms what was observed in the first round of analysis which included zero values.

An interesting change is in the Roman settlements' small stream preference: if the territories with no small streams are excluded, there is no significant difference in the length of small streams in Roman territories as compared to random territories. Apparently, the presence of the stream rather than its length was important for these settlements, whereas for Pre-Roman and Late Antique settlements the length of the river, and not just its presence in the territory, was important. Again, this points to defense rather than easy access to riverine shipping as the prime affordance sought by Pre-Roman and Late Antique settlers.

3.3.2.7 Discussion

Taken together, the analysis of these various factors across time reveal a remarkably consistent picture: Pre-Roman settlements resemble random locations, Middle Roman and Late Roman settlements are distinct from random locations and resemble each other, while Late Antique settlements are distinct from random locations and from Middle and Late Roman settlements.

The resemblance of Pre-Roman settlements to random locations could indicate several things. The characteristics of the immediate territory may not have been important to the people deciding where Pre-Roman settlements were located. This would make sense if intensive agriculture was not particularly important, suggesting an emphasis on more extensive agriculture or pastoralism. Alternatively, this set of locations could include places with very different functions, and therefore different requirements of the immediate landscape. This could be a combination of different seasonal settlements, settlements from different time periods with different relationships to the environment, or even contemporaneous settlements with different subsistence strategies. Combining these different tendencies could produce the illusion of random distribution. The analysis of water sources in the territories of Pre-Roman settlements supports the suggestion that this is a heterogeneous group. Over three-quarters of Pre-Roman settlements were not within 1.5 km of a river, but those that were had significantly longer stretches of river in their territories than random points within 1.5 km of a river. For some settlements, then, rivers (or their banks) were a valuable feature of the landscape, while for other settlements they were not. Further subdivision of Pre-Roman settlements according to territorial characteristics like this might clarify their diverse relationships to the environment.

Middle Roman and Roman settlements seem to favor agriculturally productive areas. They favor gentle slopes, avoid valleys and ridges, favor land that is sheltered from western winds and receives long hours of direct sunlight in May. In short, Middle Roman and Late Roman settlements were located in places where the producers could intensively cultivate land that is well-suited to intensive cultivation. It is not clear whether sources of ground water were actively sought out as part of this. While broadly dated Roman settlements do show preference for small streams, as the agronomists suggest, more closely dated Middle Roman and Late Roman settlements do not. This could be the result of shifts in the location of small streams between antiquity and the present or the ECRINS data may not include even smaller streams that Middle and Late Roman settlements exploited. If, however, the tendency is not a result of insufficient data, it suggests that water was relatively plentiful in this area and that Middle and Late Roman settlements did not need to maximize their access to it.

Late Antique settlements' territories show opposite tendencies to those of Roman, Middle Roman, and Late Roman settlements. They avoid the types of places that Middle Roman and Late Roman settlements favor: gentle slopes, north-facing land and long daylight exposure. Instead, they favor steeper slopes, valleys, and ridges, as well as long stretches of river. These are characteristics that contribute to defensibility, so it appears that Late Antique settlers were more concerned with security than agricultural productivity.

These findings are significant for two reasons: first, it demonstrates that a change in the exploitation of the landscape did take place when Rome secured the Danubian frontier in the early second century C.E., and second, it demonstrates that the collapse of that frontier in the late fourth century and the tenuousness of subsequent Roman imperial control had major repercussions for people living in the countryside. It has recently been argued by Roger Batty that grain production remained secondary to pastoral production in the Pontic-Danubian realm in the Roman Empire (Batty 2007, 465-470). Whether or not this is correct for the wider region, it seems it cannot be true of the current study area.

Conversely, Boris Gerov has argued that Pre-Roman aristocrats in Thrace and Moesia derived a significant portion of their income from agriculture as well as animal husbandry, downplaying the cultural differences between these people and their Greek and Roman counterparts (Gerov 1988, 1–12). Close examination of settlement territories in this area, however, has revealed that there was a significant shift in exploitation under Roman rule. If there were intensive agricultural estates here before the Roman occupation, they are hidden among all the other forms of settlement. When Rome secured the frontier in the Dacian wars the people who lived in the countryside and the immigrants who moved into the countryside felt safe enough to settle primarily in the most agriculturally productive territories. Even after the raids of the Costoboci in the 170s, and the numerous incursions and civil wars of the mid-third century, the rural inhabitants prioritized agricultural potential over defensibility in choosing their settlement locations.

When Roman control of this area collapsed in the late fourth century the change was dramatic. People in the countryside were threatened with violence to such an extent that settlement shifted from the agriculturally fertile areas to defensible locations. Although Roman control was reestablished and both Anastasius and Justinian invested heavily in the defensive infrastructure of the region, the inhabitants of the countryside never again felt safe living far from a refuge. This fear forced them to live in places with lower agricultural potential, which in turn reduced the local surplus available to cities and troops. The data presented here thus reinforce the picture of economic hardship detected by other scholars in the reduced sizes of cities, the disappearance of elaborate rural architecture, and the construction of fortifications dedicated to the collection and storage of agricultural produce (Dinchev 1997a; Dinchev 2000b; Poulter 2004; Poulter 2007d; Poulter 2013b). Life in the countryside did not end after the fourth century, but it did become much more dangerous.

3.3.3 Locations within the Local Economic Network

3.3.3.1 Introduction

In the previous section I examined the physical characteristics of the lands that could have formed the immediate territories of ancient settlements in order to elucidate changing trends in the exploitation of the land. This section explores patterns in the locations of settlements within their broader social and economic networks. While ancient people probably cultivated land beyond the immediate territory of their home, the amount of labor they could have profitably invested in this land decreases significantly with distance. Simultaneously, the certainty with which the modern researcher can say a particular location was cultivated similarly decreases as the distance from a known settlement increases. For both of these reasons, this section focuses not on production but on the accessibility of traffic routes and exchange centers.

This analysis calculates values at a single point rather than a territory as before. This is a problem for places with uncertain locations. When summarizing measurements within a territory, small errors in the location of the center of that territory made little difference. Measurements taken at a point, on the other hand, could be severely affected by small errors. Settlements with A1, A2 and C1 certainties are considered to be unproblematic. For settlements with B1 certainty, the average of all measurements within a radius of 2 km is recorded. Settlements with B2, C2 and C3 levels of certainty are excluded. The number of settlements in each chronological period are presented below according to locational certainty.

	A1	**A2**	**B1**	**C1**	**Total**
Pre-Roman	1	27	62	4	94
All Roman	4	45	88	2	139
Mid-Roman	1	15	26	1	43
Late Roman	1	16	40	0	57
Late Antique	0	9	11	1	21

Table 34: Settlement datasets used in the following analyses.

3.3.3.2 Modeling accessibility

The potential for frequent interaction, or accessibility, between two places is strongly constrained by distance. Distance, however, is not to be understood as a measure of Euclidian space, but the experienced cost of moving from one place to another. This has always been recognized, but it is only since the advent and proliferation of GIS that researchers have been able to incorporate this fact into geographical analysis. The experienced cost can be measured in terms of time or energy and depends on a multitude of factors including transportation technology, load, the slope and surface character of the land, and topographical features. In the interest of simplicity only pedestrian travel is considered here, though the ease of riverine shipping is also accounted for.

One popular way of modeling this in archaeology is through the use of Tobler's Hiking function (Tobler 1993; see Gorenflo and Gale 1990 for its introduction to Archaeology). This equation is useful because it expresses distance in terms of pedestrian travel time while accounting for slope and, to a limited extent, ground surface conditions. By measuring distance

in terms of time the archaeologist can use approaches from time geography which relate geographical location to task scheduling and diurnal rhythms (Mlekuz 2013).

Convenient as it is, however, the empirical basis for Tobler's hiking function is weak. The function is derived from data published by Eduard Imhof (Imhof 1950), but recent criticism has shown that it does not actually fit those data particularly well (Herzog 2013a). Kondo and Seino have recently tried to modify Tobler's hiking function on the basis of data gathered from two, inexperienced hikers (Kondo and Seino 2010). They found that it was necessary to create two separate functions for walking on grades greater than -7% and less than -7% in order to achieve a reasonable fit to the observed data. They remain committed, however, to the basic form of Tobler's hiking function which produces smooth curves across different slopes. This is contradicted by physiological research into human locomotion, which shows that gait characteristics shift at certain critical slopes (A E Minetti, Ardigò, and Saibene 1993; A. E. Minetti 1995). This type of research, performed by experts who are able to precisely measure energy expenditure under different conditions, is a better basis for constructing cost functions.

The function that underlies this analysis – constructed by Irmela Herzog – calculates the cost of movement in joules per kilogram of walker per meter as a function of slope (Herzog 2013a; Herzog 2014).[157] This function is derived from data collected by Minnetti et al., who measured the energy expended by ten runners walking and running at various speeds on a treadmill at different slopes.[158] Although Herzog's function fits the data quite well, it is more difficult to interpret energetic cost than time. Unfortunately, the published results – a total of 13 data points – only relate minimum energy expenditure to slope without systematically reporting speed. This is, perhaps, because the relationship between speed an energy expenditure is imprecise.

It has been empirically demonstrated that energy costs have a U shaped relationship to walking speed and that the most efficient speed of travel on firm, level ground is around 1.3 meters per second regardless of load carried (Bastien et al. 2005).[159] Furthermore, humans seem to naturally select speeds which minimize energy expenditure (Alexander 2002).[160] When an experimenter asked 73 adults (aged 20-59) to walk at a "normal" pace, they walked, on average, at 1.33 meters per second, with a standard deviation of 0.17 m/s (Waters et al. 1988; Entin et al. 2010 found similar results; but cf. Wall-Scheffler 2015 who found preferred walking speeds to be slightly slower than optimum).[161] That standard deviation seems small, but translates to a speed of 0.6 km/hr, so that the distance covered in an hour varies between 4.2

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[157] The equation is $Cost(s) = 1337.8\, s^6 + 278.19\, s^5 - 517.39\, s^4 - 78.199\, s^3 + 93.419\, s^2 + 19.825\, s + 1.64$, where s is the mathematical slope (rise over run) and Cost is the kilo-joules expended for each kilogram of the walker covering 1 meter. According to this formula, the cost of travelling 1 km on flat terrain is 1,640 kj/kg.

[158] Cw and Cr, both in Joules per Kilogram per meter.

[159] Although carrying a load increases the total cost of locomotion, if the load is well centered on the body, the speed at which maximum energy efficiency is attained does not change.

[160] Interestingly, a recent study has compared the rates at which men and women choose to walk on different slopes to the most efficient walking speed and found that the difference between preferred speed and optimal speed is greater for women than for men (Wall-Scheffler 2015).

[161] No significant differences were found between women and men in speed or oxygen consumption, but women's heart rates were higher than men's.

to 5.4 kilometers. Assuming the observed speeds followed a normal curve, this still leaves almost 32% of the subjects who would cover either more or less ground in an hour. The problem is that when walking on a level or downhill, there is a broad range of speeds within which energy expenditure is practically unchanged (Margaria 1976, 71–73). In addition, optimal speed is heavily dependent on body morphology, particularly tibia length (Wall-Scheffler 2012). Humans tend to optimize energy expenditure while walking but this does not result in a consistently applicable walking speed.

Numerous studies have shown that energy costs increase as slope increases (Kramer 2010; Margaria 1976; A. E. Minetti 1995; Alberto E. Minetti et al. 2002). It has also been shown that energy expenditure increases when walkers carry heavy loads (Bastien et al. 2005; Gomeñuka et al. 2014; Kramer 2010; Santee et al. 2001). Only a few studies have investigated the energy expenditure of carrying loads at different slopes (Gomeñuka et al. 2014; Kramer 2010; Pal et al. 2014; Santee et al. 2001). The increase in energy expenditure of loaded over unloaded walking is greater at steep inclines than on level ground, but these results come from experiments in which subjects were forced to maintain a consistent walking speed across all gradients (Pal et al. 2014; Santee et al. 2001). When subjects walked at different speeds, it was found that the optimal walking speed on slopes was lower than on level ground and was unaffected by load. The difference in energy consumption at optimal walking speed of loaded over unloaded travel was still greater on slopes than on level ground, but the difference is less extreme than when walkers maintain a constant pace regardless of slope (Gomeñuka et al. 2014). Unfortunately, this difference has never been systematically quantified and so cannot be integrated into the current model.

The formula adopted here is generated from trained athletes walking at their optimal speeds, unloaded over different slopes. It therefore represents a best case scenario. We can assume that it underestimates the amount of energy needed to travel up steep slopes because travelers would normally have been carrying goods. Nevertheless, it is a useful tool for establishing the limits of accessibility.

When classifying terrain, as in the previous section, we generally see slope as an inherent characteristic of the terrain. For someone traversing that terrain, however, the slope of the path they take depends on the direction of travel. This is known as “effective slope” and is calculated as part of the Path Distance tool in ArcGIS Pro (For details on how this tool calculates distance see ESRI 2015c; ESRI 2015b; ESRI 2015a). This is the key difference between Path Distance and Cost Distance, which calculates the cost of movement without reference to the direction of travel. Some GIS programs only calculate Cost Distance, forcing researchers to create elaborate work flows to account for the variety of possible slopes in a given location or to ignore the problem altogether (For overviews of these approaches see Herzog 2013b; Herzog 2014). Neither approach is satisfactory. Although Esri’s Path Distance tool only allows for movement from cell to cell in eight directions, the integrated calculation of effective slope makes this the best tool currently available for modeling accessibility (For the consequences of calculating movement in only eight directions see Herzog 2013b).

No attempt has been made to account for differences in surface texture as this is nearly impossible to reconstruct for an ancient landscape. Furthermore, there is evidence from the

medieval period that pedestrians preferred the softer turf beside old Roman roads to the hard, paved surface (Hindle 2002, 34–35; Herzog 2013b). In addition, surface firmness changes rapidly with the weather and more slowly as traditional paths are slowly packed down. These considerations, in combination with the uncertainty of the precise locations of Roman roads, means that any multiplier that seeks to account for differences in the firmness of the ancient terrain would be meaningless.

Many studies with the goal of reconstructing ancient traffic routes consider visibility to a significant determinant of route selection (e.g. Bell and Lock 2000; Fovet and Zakšek 2014). This study, however, seeks to establish the limits of accessibility, not the location of routes, so visibility was not considered.

Rivers act simultaneously as barriers to those who wish to cross them and as corridors to those travelling on them. When calculating the accessibility of transportation routes these implications were ignored as they are functions of the transportation routes themselves. When calculating the accessibility of different centers, however, they must be taken into account. To model these effects I follow Wheatley and Gillings who suggest depicting rivers as a corridor of low-cost cells surrounded by barriers of high-cost cells (Wheatley and Gillings 2002, 157–158). As before, only streams with an upstream catchment area of greater than 500 ha were considered navigable. The ECRINS data were converted to a raster and navigable streams were given a value of 0.5, meaning it costs half as much to move along one of these streams than to move across land. The cells on either side of the navigable rivers were given a cost factor of 5, so that the cost of crossing the river is 10 times the cost of traversing the equivalent area on dry land. Streams that were not large enough to ease transportation would also have been difficult to cross, but less so, so these are represented as a single line of cells with a cost factor of 5. All other cells have a cost factor of 1, meaning they do not affect the cost of travel as calculated based on slope. These values are at the low end of the range suggested by Irmela Herzog (Herzog 2014).

3.3.3.3 Access to traffic routes.

Access to major traffic routes could be both a blessing and a curse. Cato, Varro, and Columella all agree on the desirability of having adequate rivers and roads for both importing and exporting goods from the farm (Cato, 1.3; Varro, 1.16, Columella, 1.2.3; 1.3.3-4). However, Columella also mentions that a highway can bring travelers who, by reason of their position within the imperial system, can demand food and lodging. Columella thus recommends a location neither on, nor far removed from a major road (1.5.7).[162] Travelers are not seen as potential customers by these elite writers. Transportation was seen simply as a source of expenditure and inconvenience to be minimized (Erdkamp 2005, 112).

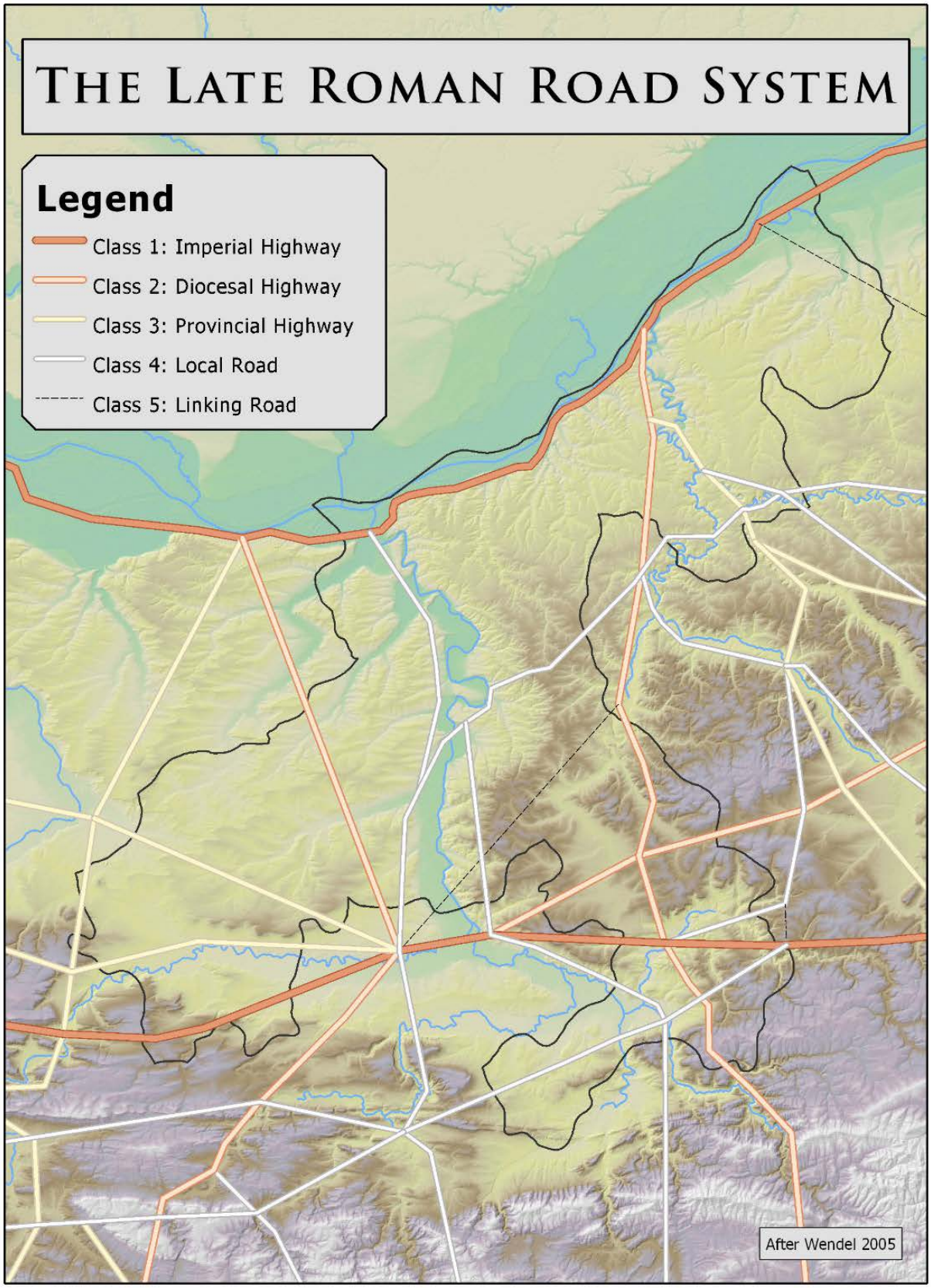
It is very difficult to predict the navigability of rivers because this depends not only on the type of craft used and the amount of water, but also the conditions of the river bed. On the other hand, it is possible to guess with a fair degree of confidence which rivers would not have

[162] Columella says that the farm should not be "iunctam militarem viam" (*RR* 1.5.6), but does not specify that the travelers who plague the estate are soldiers. Although many certainly were, other state officials would also have used military roads and would also have had the right to demand hospitality.

been navigable due to a lack of water by measuring their upstream catchment areas. As above, the data used here come from ECRINS and the threshold for navigability has been set at 500 ha.

The general positions of Roman roads can be reconstructed from itineraries and archaeological knowledge of road stations, nodes and, occasionally, the roads themselves. The precise locations of the roads, however, are usually impossible to reconstruct with any certainty. Michael Wendel has recently published an exhaustive account of the Late Roman and Early Byzantine road network in the Diocese of Thrace reconstructed on the basis of this type of evidence and his work underlies the data used in this project (Wendel 2005). Wendel classifies roads into five categories according to the importance of the places that they connect: class 1 represents the most important roads described in written sources, class 2 represents roads that connect major cities across provinces, class 3 represents roads connecting major intra-provincial centers, class 4 represents roads that connect the more important roads, mountain passes and trade centers, and class 5 represents connections between class 3 and 4 roads (Wendel 2005, 13–14).

The two largest roads in the study area both run east – west, one along the Danube and another to the south running through Nicopolis ad Istrum. The next largest roads generally run north – south connecting these two major routes. The smaller roads linked these larger routes.



Map 15: Transportation routes.

The chronology of the resulting network is impossible to establish with certainty, but as the road network is inextricably tied to the settlement network and the settlement network was largely established in the Roman period, the more important roads should approximate fairly well the situation in the periods under investigation. The eastern portion of the study area is the most suspect in this regard as it was relatively sparsely populated in the Middle and Late Roman periods, but more densely populated in Late Antiquity.

In order to test whether distance to transportation routes influenced settlement location path distance surfaces were calculated from navigable rivers, roads grouped according to class, and all transportation routes. Because the unit is energy required to reach a transportation routes, negative values are close to transportation routes and positive values are far from routes.

	Rivers	**Roads class 1**	**Roads classes 1-2**	**Roads classes 1-3**	**Roads classes 1-4**	**Any Route**
Pre-Roman	-1.968944	-0.736318	1.758065	0.909917	0.408228	0.199770
All Roman	-0.891352	0.856219	3.315288	0.638579	-1.989163	-1.948793
Mid-Roman	1.234927	0.173420	0.333563	-0.835249	0.214478	0.255414
Late Roman	-0.878723	1.369082	2.533102	0.889355	-1.981428	-1.899752
Late Antique	-3.100045	-0.635505	1.115848	0.568164	-1.270228	-1.553246
Random average (m)	13,366	22,585	13,221	10,358	6,697	6,274

Table 35: Z scores of average distance to traffic routes.

	Rivers	**Roads class 1**	**Roads classes 1-2**	**Roads classes 1-3**	**Roads classes 1-4**	**Any Route**
Pre-Roman	0.054661	0.704732	0.172049	0.482304	0.567554	0.183922
All Roman	0.190347	0.179349	0.008909	0.375715	0.046092	0.059060
Mid-Roman	0.613750	0.801626	0.991407	0.757256	0.642504	0.484126
Late Roman	0.656905	0.086516	0.005181	0.491104	0.048987	0.075649
Late Antique	0.010770	0.812733	0.339481	0.315148	0.258409	0.161065

Table 36: P-values of K-S tests on distances to traffic routes.

Pre-Roman settlements show no significant deviation from random points in the accessibility of roads and transportation routes as a whole. This is not surprising as the roads date from the Roman period. One would only expect to see some sort of relationship of pre-Roman settlements to roads if both the Roman roads closely traced pre-Roman traffic routes and those traffic routes influenced pre-Roman settlement locations. Pre-Roman settlements do seem to be attracted to rivers. The Z score of the average distance from settlements to rivers is almost two standard deviations below the average for random points and the K-S test shows that there is a less than 6% chance that these distances come from the same population. This reinforces the conclusions drawn from the analysis of settlement territories above in which it was seen that more pre-Roman settlements were within 1.5 km of a river than random sites and that the length of rivers in those settlement territories with a river were significantly longer

than in random territories with a river. Of all the landscape affordances so far analyzed, rivers are the only ones with a detectable relationship to pre-Roman settlements.

Roman settlements are located farther away from the largest two classes of road, but closer to the smallest roads than random points. Though both differences are statistically significant, the aversion to large roads appears more pronounced than the attraction to small roads. This latter effect, however, includes the former as distance to all roads is considered, so the attraction to smaller roads is strong enough to overwhelm the aversion to large roads. The Middle Roman settlements do not differ significantly from the random points, so the Late Roman settlements account for the trends observed in all Roman settlements. One could interpret this finding in light of Columella's fear of depredation by travelers along military highways referred to above.

Late Antique settlements are very close to rivers, but seem to be indifferent to the presence of roads. This is surprising as the paths of the roads are based on settlement patterns from this period and later. It must be remembered, though, that only non-fortified settlements are included in this category. People living behind fortification walls would have been closer to roads.

Minimizing distance to navigable rivers seems to have been important in the pre-Roman period and in the fifth and sixth centuries. Access to small roads may have been attractive in the fourth century but the larger roads, if anything, seem to have repelled settlers. Firm conclusions are difficult to draw, however, because the locations of the roads is so imprecise. The most that can be said is that the current evidence does not support the hypothesis that rural settlers favored proximity to major traffic routes.

3.3.3.4 Access to possible markets: the market potential variable

The Roman agronomists are famously reticent about the sale of farm produce (Erdkamp 2005, 109–120; Morley 1996, 159–166; Morley 2000). Cato says that a farm should be near a flourishing town, but lists the sea and a navigable river as alternatives, indicating that he has connectivity rather than marketing opportunities in mind (1.3). Cities were, nevertheless, places where buying and selling took place. Cato provides a list of the best cities to acquire various manufactured goods and tools (135). Columella says that an overseer ought not to be acquainted with a city or any periodic markets except for the purpose of buying and selling things relevant to his duties (1.8.6).

Access to markets influences the profitability of certain crops, but it is never suggested that difficulty of access to a market would render an entire farm unprofitable. Cato says that a suburban farm should have an *arbustum* for firewood and rods, grapes for eating and drying, various kinds of fruits, and a garden planted with various vegetables and flowers for garlands (1.7.1-8.2). Varro says that large gardens of violets and roses and other things required by a city can be profitable near a city, but not far from a city (1.16.3). Similarly, Columella says that it is not profitable to grow table grapes unless the plot is so close to the city that they can be sold to merchants "like orchard-fruit" (3.2.1).[163] To the elite agronomists, the largest cash crops would

[163] For the high prices of orchard-fruits in Rome see Pliny 17.1.

have been grain, wine, and olive oil and there is very little concern demonstrated to minimize the transportation costs of these goods, probably because they were shifted as much as possible on to merchants (Erdkamp 2005, 109–134; Morley 1996, 159–166; Morley 2000).

Estates devoted to cash crops could have had low market accessibility if the cost of moving products to market were relatively low. This could be achieved partially through selling produce on the estate and forcing the merchants to bear the transportation costs, but there is a limit to this strategy as the merchants must profit as well. Transportation costs could be lowered further through economies of scale in production and the use of transportation technologies—roads, wagons and barges, for example—that allow the efficient carriage of bulky cargoes.[164]

For peasants, on the other hand, the most profitable cash crop would have been labor-intensive fruits and vegetables, as discussed above (section 1.2.2). These ripen at different times throughout the growing season and spoil quickly, requiring frequent trips to market. Small-scale, market-oriented agriculturalists, in contrast to large landowners, would have been very sensitive to transportation costs. If settlements had relatively easy access to markets compared to random locations, it would suggest both that rural households were market-oriented and that transportation costs constrained their behavior; if, on the other hand, settlements had similar access to markets as random points, it could indicate *either* that they were not engaged in those markets *or* that they could overcome the constraints of distance.

In order to quantify access to marketing opportunities, it is not enough to measure the distance between a rural settlement and its closest market. First, just as access is determined primarily by distance, so marketing opportunities are determined primarily by the scale of demand present at the market place. In default of robust demographic and economic information, we are forced to assign weights to different types of market that capture the relative scale of demand at each. Second, peasants could have exchanged their surplus in more than one place, so distances must be measured to all markets in a system. Dividing the weight of a market by its distance from a certain location generates a quantitative representation of the market's potential for a producer in that location. Adding together the results of this calculation for all markets in a system generates a universal market potential score for that location.[165] Places with relatively high scores have easier access to more customers than places with relatively low scores.

Market potential scores depend heavily on the places included as markets and their assigned weights. This allows the researcher to test different hypothesized market systems. If market accessibility influenced settlement location and if the places and weights used to calculate market potential are a good representation of the historical market system, then the market potential scores of settlements will be much higher than those of random points. If the hypothesized market system is not a good representation of the actual system, the settlements' market potential scores will be closer to those of random points. Settlement scores and random

[164] See section 4.1.2.2 for further discussion of the socio-economic aspects of transportation.

[165] Market potential = (weight of market 1 / distance to market 1) + ... + (weight of market n / distance to market n).

scores will also be similar if the settlements were not market-oriented. Here, the goal is to test the influence of army bases, so only those weights will vary.

The central Danubian Plain contains four different types of places that could have been locations of market exchange: cities, semi-urban vici, sanctuaries, and army bases. Each chronological period has a unique set of possible market places and not all types are represented in every period. The pre-Roman period, for example, has only semi-urban vici and sanctuaries while the Late Antique period has only cities and semi-urban vici.[166] Each type of possible market was assigned a weight based on its presumed collective purchasing power. Sanctuaries, which could have been sites of periodic, rural markets were given a weight of 1; semi-urban vici, which may have contained a small but stable population of net food consumers, were given a weight of 3; cities, with a large population of net food consumers, were given a weight of 9.

I varied the weight assigned to army bases to test different hypotheses about their patterns of local consumption. As a result, the Roman, Middle Roman and Late Roman periods each have five different market potential surfaces: one surface, corresponding to the hypothesis that military communities were isolated from their rural neighbors, excludes the bases entirely; two surfaces correspond to the hypothesis that the military communities consumed rural produce acquired through market mechanisms and include army bases with weights of 3, making army bases equivalent to semi-urban vici, and 6, putting army bases between semi-urban vici and cities in terms of purchasing power. Two other surfaces correspond to the hypothesis that military communities were abusive to their rural neighbors to such an extent that people actually avoided settling near them and include army bases with weights of -3 and -6.

The various market potential scores for settlements were compared to those for random points using Z scores of means and Kolmogorov-Smirnov tests. The results are presented in the tables below.

	Army Bases -6	**Army Bases -3**	**Army Bases 0**	**Army Bases +3**	**Army Bases +6**
Pre-Roman	NA	NA	-0.324612	NA	NA
All Roman	4.713720	5.264575	4.232647	0.488912	-1.155513
Mid-Roman	2.528885	2.801699	2.394592	0.512004	-0.465230
Late Roman	2.978375	3.650327	4.106421	0.231022	-0.853151
Late Antique	NA	NA	2.567177	NA	NA

Table 37: Z scores of average market potential scores.

	Army Bases -6	**Army Bases -3**	**Army Bases 0**	**Army Bases +3**	**Army Bases +6**
Pre-Roman	NA	NA	0.909301	NA	NA
All Roman	0.000000	0.000000	0.000008	0.014354	0.214709

[166] In both the pre-Roman and Late Antique periods, the semi-urban vici are fortifications that enclose a large area. See above.

Mid-Roman	0.003079	0.002606	0.001902	0.198298	0.430663
Late Roman	0.000001	0.000001	0.000000	0.003699	0.012125
Late Antique	NA	NA	0.000002	NA	NA

Table 38: P-values of K-S tests on market potential.

Again, pre-Roman settlements show no significant difference in market potential scores from random points. Roman settlements have significantly higher market potential scores than random points when forts are considered to be repellent and isolated. More closely dated Middle Roman and Late Roman settlements show similar results. Late Antique settlements have significantly higher market potential scores on average than random points.

The greatest differences between settlements and random points are generated using market potential surfaces that either exclude army bases or consider them repellent. The market potential surface that produces the biggest difference between Roman settlements and random points includes army bases with a weight of -3, followed by the surface in which they have a weight of -6 and then the surface from which they are excluded. The pattern is the same for Middle Roman settlements, but the differences are smaller. Late Roman settlements show the greatest difference with random points when army bases are excluded, followed by the surfaces in which they have weights of -3 and -6.[167]

In general, these results are very easy to interpret: army bases were not attractive markets for rural settlers, but sanctuaries, semi-urban vici, and cities were. Detailed interpretation is more difficult. Because we know that the market system changed between the middle and late Roman periods, the scores of all Roman settlements put together in this manner are not terribly meaningful. The Z score for Middle Roman settlements' market potential is higher when army bases are considered repellent than when they are ignored, but the opposite is true of Late Roman settlements. Giving army bases a negative weight influences the scores of places nearby much more than those far away. In the Middle Roman period, random points' market potential scores must have fallen more than settlements' scores, suggesting that there were many fewer settlements near army bases than random points. In the Late Roman period, conversely, there must have been more settlements near army bases than random points as the averages are closer together than they are when army bases are excluded entirely. This does not mean that Late Roman settlements were attracted to army bases, just not as repelled by them as their Middle Roman predecessors.

3.4 Multivariate Analysis of Settlement Locations

The above analyses are all restricted to a single variable which is itself a subset of an environmental factor, but it is unrealistic to imagine that anyone chose the location of a settlement using only one criterion. Logistic regression analysis allows for the simultaneous consideration of the influence of multiple variables on an outcome—in this case whether or not

[167] Strangely, the K-S test shows significant differences from random points in the market potential scores of Roman settlements when army bases are considered somewhat attractive despite the closeness of their average scores. Similarly, Late Roman settlements have different scores than random settlements when bases are considered somewhat and very attractive despite close average scores. In each case this is because there are more random points with high market potential scores than settlements.

a certain location was chosen for settlement. Logistic regression classifies observations into mutually exclusive categories. This means that we cannot compare sites to random points representing the environment as was done above, because those the environment includes both settled and non-settled locations. Instead, we need to generate non-sites, locations where settlements were absent. While it very difficult to prove absence—many settlements must have existed that are not represented in the current archaeological record—it is possible to identify the conditions that make archaeological attestation of ancient settlements likely. Where such conditions exist and no evidence of settlement has been found, the absence of an ancient settlement is likely. Here I will describe how I constructed non-sites and how I processed the data before presenting the results of comparative modeling.

3.4.1 Constructing Non-Sites

Each chronological period required a unique set of non-sites that contained a number of locations approximately similar to the number of known settlements from that period. These non-sites should be located in places where an absence of evidence is most likely to be evidence of absence. I created a bias surface that quantified the likelihood of ancient settlements becoming archaeological sites using the distribution of modern villages and forest cover (section 3.2.4). This formed the foundation for the creation of period specific bias surfaces that determined the likelihood of a cell containing a non-site. This is not to say that cells with a value of 1 are automatically assigned a point but that all cells with a value of 1 have an equal chance of receiving a point while cells with a value of 0.5 are half as likely to receive a point and cells with a value of 0.25 are a quarter as likely.

It is also important to keep non-sites at a distance from settlements because the environmental characteristics that will become variables in the logistic regression analysis are measured in a neighborhood around each site. This is because the site most likely represents an ancient settlement surrounded by an exploited territory. This method also mitigates the problem of locational uncertainty in the data. Recent work on rural settlement around Nicopolis ad Istrum suggests that the Rositsa valley was the most densely occupied part of the study area and may even have been formally allotted to settlers. Roman villas are located approximately 2.5 km apart (Poulter 2007a). Using this as a guide it was decided that no non-sites should be placed within 2.5 km of a known site.[168] This, in turn, requires the creation of separate non-sites for each time period. The sites occupied during each time period were buffered at 2.5 km and the resulting polygon was converted to a raster which was then reclassified such that all cells within 2.5 km of a site were given a value of 0 and other cells a value of 1. This raster was then multiplied by the bias raster to create non-site probability rasters for each period.

Using these surfaces, a unique set of non-sites was created for each time period that roughly corresponded in size to the number of rural settlements known in that period: 150 pre-Roman, 200 All Roman, 100 Middle Roman, 100 Late Roman, and 100 Late Antique settlements. All of the measurements taken for settlements were also taken for non-sites using the same

[168] This also mitigates the risk of placing a non-site at the location of a known site whose precise location is uncertain. Only 8.33% of sites for which an error rate is calculable are beyond 2.5 km from the location indicated in the AMB.

methodology. These datasets were then merged and a field indicating whether the location was a settlement or a non-site was added. In total, 52 variables were defined for each location, including its status as a settlement.

3.4.2 Data Processing

Next the data were processed to prepare them for logistic regression analysis. Because the goal of this study is comparative modeling to elucidate the influence of one particular variable, the procedure employed differed slightly from that normally used in predictive modeling. In the latter case, the goal is to create a model that will accurately estimate the likelihood of site presence in an unexplored area. It is important that the model not be fitted too closely to the training data as this will produce an inflexible model (G. James et al. 2014, 33–36). This is not a concern for the present study. When logistic regression analysis is used to reconstruct the total suite of factors influencing settlement location it is critical that all confounding and interacting variables be identified as these relationships are crucial to a proper understanding of the coefficients associated with each variable in the model (Woodman 2000; Woodman and Woodward 2002). In this case, however, the important result is not the model itself or even how well the model fits the data, but rather how that fit changes with the introduction of the different market potential variables. In effect, this is a way of holding other variables constant to clarify the impact of one particular variable.

First, correlated variables were identified and removed.[169] This is more than a matter of convenience as correlated variables in a predictive model will take on undue predictive power, overwhelming the influence of other variables. Most of these correlations were consistent across time periods and are not surprising: the flat slope category is highly correlated to the flat landform category and certain soil textures and parent classes are highly correlated with each other. In addition, because many of the variables consist of percentages, it was necessary to ensure that at least one variable from each category was removed; a south-facing aspect is not correlated with any other single variable, but knowing the values of all other aspect variables determines the last, as they all add up to one. Finally, variables that were overly distinct between sites and non-sites were removed. Specifically, much less of the territory of settlements fell into the “Lower Slope” landform category than non-sites and much more fell into the “Gently sloping, mid slope” category. These two variables alone could be used to predict whether a location was a settlement or a non-site and so obscured any influence from other variables.

3.4.3 Logistic Regression Analysis

After the data had been processed a logistic regression curve was fit considering all remaining variables except for market potential to create a baseline model. Then curves were fit to the data with different versions of the market potential variables included. Using leave one out cross-validation, the error of each curve was calculated. To quantify the impact of each market potential variables, the error of each of these curves was subtracted from the error of the baseline curve and the difference divided by the error of the baseline curve. The result is

[169] All analysis described below was performed using R.

the percentage improvement resulting from the inclusion of each market potential variable.[170] Positive values indicate that the models containing the market potential variable improved on the baseline model (i.e. had less error), and negative values indicate that the market potential variable had an adverse effect on the goodness-of-fit on the baseline model.

	Baseline error	Impact of including market potential variable on model fit				
		Army Bases -6	Army Bases -3	Army Bases 0	Army Bases +3	Army Bases +6
Pre-Roman	0.084	NA	NA	0.93%	NA	NA
All Roman	0.082	-4.99%	-4.46%	-2.91%	-2.79%	-1.39%
Mid-Roman	0.056	22.44%	9.01%	7.34%	-2.49%	-12.08%
Late Roman	0.145	-16.63%	-24.32%	-6.26%	-6.03%	-10.45%
Late Antique	0.109	NA	NA	4.92%	NA	NA

Table 39: Mean squared error of logistic regression models and the influences of market potential variables.

The fit of the pre-Roman model improved very slightly when possible markets were included. Given the poor state of our knowledge about the settlement system at this time, the marginal difference is probably not meaningful. The inclusion of the market potential variable improves the fit of the Late Antique model by more, but not, perhaps, as much as one might expect given the results of the univariate analysis of these settlements.

More interesting is the fact that, when all Roman settlements and possible markets were grouped together, the baseline model performed better than any of the models that include market potential variables. This is in stark contrast to the results of the univariate analysis which showed that Roman settlements had significantly different market potential scores than random locations.

The baseline model of Middle Roman settlement location fits the data quite well and when the market potential variable in which forts are given extreme negative values are included, the fit improves significantly. The fit also improves for models with market potential variables that consider the forts to be slightly negative and neutral, but decreases when forts are given positive values. Taken together, these results indicate that, in the second and third century, settlements tended to be found in locations far away from army bases and not in locations nearby.

In the Late Roman period, the baseline model outperforms all models that include market potential variables. This could suggest that the effort of walking from a settlement to a market was not an important consideration for Late Roman settlers; either they were isolated from markets or transportation was not a limiting factor. Alternatively, it could indicate that settlement in the Late Roman period had expanded to marginal areas: locations that the model predicts to be unfavorable for settlement were inhabited because of land pressure. The fact

[170] Percent improvement = (baseline error – market potential error)/baseline error.

that the baseline model fits the data less closely in the Late Roman period than any other might support this conclusion.

3.5 Conclusion

This chapter has described the evidentiary basis of this investigation, the quantitative methods used and the results of both univariate and multivariate spatial analyses. This analysis has yielded important results concerning the changing nature of agricultural exploitation and the relationships between military and rural communities.

The data which form the foundation of this project come from a region in north-central Bulgaria and are the product of more than a century of scholarship. They vary widely in intensity of investigation and publication and in their chronological and locational precision. Despite these obstacles they have been integrated into a single database that stores information about each archaeological site and also the quality of that information. The nature of the data has shaped the types of analysis that can be profitably carried out: the focus on relative site location, chosen for theoretical reasons, allows sites for which minimal archaeological evidence has been published to be included; grouping settlements into broad chronological periods and nesting narrower periods within them also maximizes the number of sites that can be considered; analysis of settlement territories mitigates the problem of location imprecision, but when point measurements were taken some data had to be excluded and others could only be included as local averages. While better data is always desired it has been possible to choose appropriate scales and techniques of investigation to transform these data into evidence.

Univariate analysis of settlement territories has shown that Roman settlements, both as a whole and when split into Middle and Late Roman periods, were located to maximize the agricultural potential of their immediate hinterlands. This is in contrast to Late Antique settlements, which maximized defensive potential at the expense of agriculture. Pre-Roman settlements, as currently understood, reveal no dominant pattern in the character of their hinterlands and this could be because the immediate hinterland was less important to these people than their successors or because the state of our knowledge is insufficient to distinguish different types of settlements with different priorities.

Univariate analysis of access to transportation routes has shown that major roads were not particularly attractive to rural settlement in any period, and may even have been repellent in the Late Roman period, though proximity to smaller roads does seem to have been favored. Late Antique, unfortified settlements appear indifferent to roads, but do favor access to large rivers. Apparently, travelers on the largest highways were not considered resources to be exploited, but dangers to be avoided.

The analysis of market potential variables, both in univariate and multivariate contexts, has yielded very interesting results that have significant consequences for our understanding of the place of military communities in rural landscapes. There is no evidence at all that people living in the countryside favored locations that would provide easy access to Roman army bases. If army bases were analogous to small towns, we would expect to see rural settlement clustering around these wealthy markets, but we do not. Instead, the clearest pattern to

emerge is that rural settlements, at least in the middle Roman period, were avoiding military bases: a market potential variable that considers cities, semi-urban vici and sanctuaries attractive but army bases repellent increases the performance of the logistic regression model by over twenty-two percent. In the Late Roman period, all market potential variables decrease the fit of the baseline model, but that fit is also worse to begin with. It is possible that Late Roman settlements were forced to use less favorable land. Whatever the case, the evidence generated by this analysis does not support the hypothesis that military communities were integrated into the rural landscape as markets but rather supports the hypothesis that, in the Middle Roman period, they were isolated from their rural neighbors.

Chapter 4: Discussion and Conclusion

4.1 Discussion

I set out to investigate the impact of the Roman garrison settlements on rural frontier inhabitants. Specifically, I wanted to know if these settlements should be counted as urban centers that provided an opportunity for rural producers of modest means to engage in commercial exchange. In order to answer this question I developed a novel method that combines quantitative analysis of landscapes with comparative locational modeling to reconstruct the relationships between ancient settlers and different elements of their environment in general and to isolate the influence of garrison settlements on settlement location in particular. This chapter will lay out the strengths and weaknesses of this methodology before moving on to a discussion of the historical implications of the results.

4.1.1 Methodological implications

With this dissertation, I have proposed that the examination of landscapes using statistical methods can reveal patterns of behavior that are undetectable from material culture and documentary evidence alone. This section will discuss the advantages and limitations of the landscape as an object of investigation, and of the new modeling approach I have used in its analysis.

4.1.1.1 Landscapes as evidence

Historians and archaeologists search for evidence of past behavior in the traces that ancient people left behind in the course of their lives. Traditionally, the traces that have attracted attention are texts, artifacts, and architecture. While these approaches are valuable, they are incapable of answering all the questions we would like to ask. Assemblages of material culture will reveal only those interactions that led to the movement of archaeologically visible artifacts from one place to another. Documentary evidence, when and where it can be found, only attests to interactions that required the medium of writing. Many important exchange relationships fulfill none of these criteria for preservation in the archaeological and documentary record (section 1.6.3).

Apuleius has provided a vignette of a relationship that leaves no documentary and little artefactual trace: a market gardener grows vegetables, loads them on a donkey to take to town, sells them to a merchant, and returns to his home riding on the donkey with coins in his pocket (*Metamorphoses* 9.32). Neither the merchandise nor the containers in which it was transported would survive. The coins might survive, but it is equally likely that the gardener will spend those coins in the same town in which he sold his vegetables, use them to pay rent or taxes, lend them to someone, or dispose of them in some other way. The coins will only enter the archaeological record if they are lost or intentionally buried and not recovered. The town is central to this man's livelihood, but unless he chooses to spend his money on some object that

is both durable and only available in the town (imported pottery, for example), there will be no artefactual record of his dependence on it.[171]

There is only one element of this urban-rural exchange depicted by Apuleius that is amenable to archaeological investigation: the journey between the home and the town. As the place where a small number of people perform many tasks, the peasants' home is the behavioral trace most likely to survive in the archaeological record. As a place where many people perform a varying number of tasks, the town is similarly likely to leave a trace. Knowing the limitations imposed by ancient technology, human biology, terrain and distance, it is possible to estimate the arduousness of the journey between the two places. The nature of the journey, in turn, influences how likely it was to be carried out. Of course, the town is only one of the many destinations to which the farmer might travel. These destinations, the paths between them, and their meanings constitute the gardener's "landscape" (sections 1.6.1, 1.6.2).

In this study, I have attempted to show that landscapes can be profitably interrogated as traces of human behavior. First, "landscape" must be conceptualized as an experience of being in the world emerging from the relationship between a strategic, subjective agent with specific capabilities, memories, and *habitus* and its surroundings. These landscapes are artifacts of human behavior not because humans altered the terrain but because they chose the terrain in which to dwell. The fact of living in a certain place influences a person's experienced landscape profoundly. Days begin and end there, shaping the possible paths they may take, the tasks they might perform, and the schedule in which they do them. By dwelling in a certain location, humans create landscapes from the environment.

The landscape has two components: the surroundings and the agent. Because of this, the character of the landscape can change very quickly. The surroundings can change, as in a land-slide, but so can the agent, as when a traumatic experience creates new memories transforming a refuge into a place of fear. Just as each individual is unique, complex and constantly changing, so is each landscape. Dynamic complexity is not chaos. Common strategies, capabilities, memories and *habitus* combined with common surroundings will lead to some common behaviors. Variations exist as well, of course, but behavioral trends are real, historically significant, and often detectable. When they are detected, and when something relevant about the surroundings of the agents is known, then there is a chance that the shared strategies, capabilities, memories, and *habitus* of those agents can be reconstructed. Landscape archaeology finds evidence for shared human perceptions and experiences by putting the physical surroundings in dialogue with traces of ancient behavior.

Because settlements anchor movement, the surroundings experienced from a settlement can be taken as a static representation of the dynamic landscapes experienced by the people who inhabited it. This static representation, however, is still incredibly complex as it

[171] Even if imported pottery were found in this man's home he could have acquired it through an itinerant peddler or other means. If the architectural style of the town were distinct from that of the countryside and the gardener chose to build his home using "urban" style, this could also indicate interaction, but there is no reason to think that the urban-rural relationship is dependent on rural peasants adopting urban architecture.

encompasses every feature of a world experienced by the humans who lived there. The landscape must be simplified by concentrating on features that are relevant to the experiences and perceptions under investigation.

In seeking evidence for the perceptions and experiences of the people living in the countryside in the frontier zone, I have put the traces of settlement behavior from the Yantra valley in the Danubian Plain in dialogue with the surrounding topography (slope and landform), climate (wind exposure and sun exposure), natural resources (soils and water sources), traffic network (roads and navigable rivers), and settlement network (market potential). I have sought evidence for rural settlers' experiences of military communities. Certain experiences, if widely shared, would manifest in settlement behavior. If most peasants saw garrison communities as destinations to which transportation costs should be minimized, they would settle closer to the garrisons. Most peasants, however, also have other destinations to which they would like to minimize transportation costs and must compromise between these goals. Simultaneously, the peasant must respect any limitations that may restrict the availability of certain options. The choice of settlement location, just like its consequences, is highly complex. Luckily there are statistical tools to help deal with this complexity.

Taking landscapes as the object of analysis in this way has advantages and disadvantages over other streams of evidence. First, it interrogates the structural framework within which action took place rather than artifacts which may or may not have been involved in the behavior under investigation. Second, it allows the researcher to adopt a bottom-up perspective and investigate the behavior of people who left little archaeological trace. A landscape approach requires only that people leave behind a settlement that can be identified and dated. Finally, and relatedly, it is less susceptible to the vicissitudes of archaeological preservation and research. In order to be included in a landscape investigation an archaeological site need only be known and identified as a settlement from a certain time period. Thorough excavation and survey contribute greater nuance, but they are not strictly necessary. This allows the researcher to collect large sample sizes even in areas that have not been the intensively studied. Given both the regional diversity of the Roman Empire and the extreme unevenness of archaeological research, the ability to learn something about less well-known regions is a major advantage to the historian.

There are limitations to studying landscapes. First, like any other method, it still depends on the quality of the data available. Because it can encompass sites where very little is known, it runs the risk of including sites with improper functional or chronological classifications. A methodology that requires thorough excavation may have a restricted sample size, but the data are of higher quality. The landscape-based methodology can be applied to datasets of varying quality, but results from the analysis of low-quality data will necessarily be less certain than those that come from high-quality data. This applies to the environmental record as well. In dynamic environments like the lower Rhine, massive investments in paleo-environmental reconstruction will be necessary to perform landscape analysis. More stable environments require less investment, but there is always a risk that the modeled environment does not match the actual, historical environment. Nevertheless, uncertain results are better than no results at all.

Second, the method is very good at detecting global trends that hold true for a majority of the observations within a dataset; it less able to detect sub-groups within a dataset. As seen when investigating the pre-Roman settlement pattern, a lack of correlation between a feature of the landscape and settlement locations can indicate either that the feature was unimportant or that the feature was important to different people in different ways. This is a result of the probabilistic nature of the evidence. Proximity proves nothing in any individual case, but it does determine probabilities. Conclusions can only be drawn when the probabilities are multiplied across many cases. This means that idiosyncrasies will be lost and competing trends will cancel each other out. Only overwhelming trends can be detected. On the other hand, this also means that it is almost impossible to mistake an idiosyncrasy for a trend. That is to say, a result will only emerge if it is generalizable to most of the data.

Third, the method relies on proximity to establish the probability of interaction, assuming that transportation costs limit exchange. Exchanges in which transportation costs are low relative to other costs will be difficult to detect. Grain and wine, though bulky, are also easily stored if one has the capital to invest in the necessary infrastructure. A person with a few, large cargoes to dispose of can reduce transportation costs by combining them into a few, large trips made at a time when the price of transport is low and/or the prices of the goods are high. Such a person, by virtue of their wealth, may also be able to shift the transportation costs on to others, be they merchants or consumers. The Roman army sometimes, though not always, paid for the transportation of necessary supplies (e.g. Fink 1971 no. 80, but cf. Tacitus, Agricola 19.4 where farmers bear the cost of transportation). In these cases, proximity to the places of consumption will have little influence on the location of production.

Despite these limitations, a landscape-based approach, which takes the spatial relationship between a settlement and its surroundings as evidence for human behavior, has much to contribute to our understanding of the ancient world. Most importantly, the object of analysis—the spatial relationship of settlements to landscape features—is closely tied to the object of investigation—the socio-economic relationships of rural settlers to their “natural” and social surroundings. The spatial relationship influences the social relationship, even if that influence is not always simple. In addition, it opens up to investigation people and places that are not well represented in the archaeological record. It allows historians to expand their gaze to the poorer members of ancient societies and to regions where, in modern times, the resources necessary for intensive archaeological study have not been available. Finally, the results achieved from investigation are, by their nature, generalizable at least to the data from which they emerge. There is no risk, indeed no possibility, of mistaking the exceptional for the normal. Studying landscapes is an excellent way to learn about the structures and processes that had the broadest influence on ancient societies.

4.1.1.2 The study area and the data

The data used in this project have several shortcomings, but there are also significant strengths. Of the latter, the most important are their quantity and their broad geographic extent. I have excluded nothing from the database, which therefore represents a comprehensive collection of ancient places for which archaeological evidence exists. Not every place is included in every analysis, but by including every archaeologically attested place I have

generated samples of ancient rural settlement that are large enough that statistical analysis produces robust results.

The geographic extent of the data also strengthens the results of statistical analysis by ensuring variation in landscape characteristics. In a study area less than ten kilometers across, the proximity of settlements to a market will differ too little to influence ancient behavior. My study area, on the other hand, has a maximum breadth of over 100 kilometers,[172] it stretches from the edge of the Danube to lands 70 kilometers away from the river, and it covers almost 3,500 square kilometers. This extensive sample captures variations in landscape at a scale that would have been meaningful for ancient people. Variation and consistency can both be attributed to behavior rather than a restricted research area.

In order to assemble a large, comprehensive, geographically extensive dataset, certain compromises were necessary. Generating new data through surface survey was beyond the scope of this project and the siteless surface survey that has become the norm in Mediterranean archaeology would be impossible for even the most ambitious projects.[173] Any investigation at this scale must rely on the published and semi-published results of numerous older studies. The problems encountered in systematizing these data have been described above (section 3.2.3). Here, I will only highlight the most problematic aspects: chronology and location.

In order to assign places to a chronological period I had to rely on the interpretations of previous scholars. These are usually presented in vague terms and sometimes predate the publication of secure pottery sequences from the area resulting in a great deal of uncertainty. Contemporaneity and direct continuity are impossible to establish in all but a few cases. I have attempted to balance the availability of chronological data with the need to put settlement patterns into a historically meaningful context, so some important historical events could not be taken in to account. In most cases, it is impossible to tell if a Late Antique place was occupied before or after the Hunnic invasions of the mid-fifth century so the impact of this event on rural settlement patterns cannot be assessed until more detailed chronology becomes available for a large number of sites.

Even the most up-to-date pottery sequence, however, is sometimes insufficient. Most problematically, there are no forms that date exclusively to the fourth century so, although my "Late Roman" period is intended to represent the period from the Tetrarchy to the Gothic wars of the late fourth century, I may have inadvertently included earlier and later sites. Earlier periods are also problematic. Places can only be identified as "Roman" if they contain coins or pottery that is distinct from pre-Roman pottery. I cannot rule out the possibility that some of my "pre-Roman" sites were actually occupied in the Roman period by people who used predominantly traditional vessels. If this were true then the consistency of Middle Roman

[172] Measured diagonally from the southwest corner to the northeast corner

[173] For Mediterranean surface survey see (Alcock and Cherry 2004; Attema and Schörner 2012; Francovich, Patterson, and Barker 2000). For criticisms of siteless survey as too small to generate historically meaningful results see (Fentress 2000; Kowalewski 2008, 250–251; Terrenato 2004). Recent surveys in the study area have been site-based (Conrad 2006; Poulter 2007a).

settlement preference for agriculturally optimal landscapes could be restricted to a subset of the rural population. Some places, then, might be misdated, but the sample size is large enough that a few mistakes will not significantly alter the results of the analysis. The historical interpretation, in turn, rest on the congruent results of multiple statistical analyses. While the data's limitations introduce some uncertainty, their strengths—comprehensiveness, large sample sizes, and broad geographic distribution—and the multiplicity of analytical procedures provide a strong foundation for the conclusions presented here.

The locational problem is simpler. Most of the locational data come from the Archaeological Map of Bulgaria, which may be inaccurate by a kilometer or more (section 3.2.3.3). When characterizing these places' settlement territories, the impact of the error is mitigated—but not erased—by the fact that the modeled settlement territory will overlap the actual settlement territory to a great extent. When characterizing access to other places, however, this error can make a major difference because relatively small elements like rivers and cliffs can have a huge impact on the energy required for pedestrian travel. For these variables it was necessary to use the average of the area around the place, which means that some trends may have been obscured. This uncertainty also means that some potentially significant variables, like the view from a residential building, could not be considered. These limitations must be borne in mind when interpreting the results of analysis.

The necessity of relying on previously generated data also forced compromises in establishing the area from which the sample of rural settlements could be drawn. While the area of interest includes the entire central-Danubian Plain, the sample of rural settlements had to be drawn from only nine municipalities. The result is a highly irregular sample area that does not follow any natural boundaries. This is neither a physiographic nor a behavioral region (*sensu* Kowalewski 2008, 226). This is why it has been necessary to include possible market centers that fall outside the sample region. Specifying a sample area that corresponds to a meaningful behavioral region is important when studying urban systems which are, by definition, integrated to some extent. Certain tools like rank size analysis require that every element in a system be included for the results to reflect historical processes. This study, however, focuses not on the system as a whole but on the behavior of individuals that made up a part of that system and their relationships to other parts of the system. My analysis quantifies the relationships between rural settlements and their landscapes, not the relationships between rural settlements and each other. Neither the character of a settlement's territory nor its proximity to traffic routes and possible markets is influenced by the inclusion of other rural settlements in this analysis. The irregularity of the sample area, then, does not vitiate the analysis.

It should be noted that physiographic sub-regions can be identified within the sample area. As a result, one might be tempted to divide the area based on watersheds (the Yantra River versus the Rusenski Lom river), but for someone inhabiting the landscape, the Yantra itself, especially since its right bank is so precipitous in many areas, may represent a more meaningful boundary. Elevation and ruggedness might also be used to distinguish physiographic regions, but the boundaries would be arbitrary. One could also divide the study area into zones that are near and far from the Danube, establishing a certain distance (Euclidian

or otherwise) as a threshold which may have shaped ancient settlement behavior. This, however, would be to beg the question of the frontier's influence on settlements. In the future it may prove helpful to experiment with different sub-divisions of the sample area, but for the present it seems better to consider the area as whole.

The final difficulty is in knowing precisely what kind of settlements are represented by the known archaeological sites. Because the data are the result of unsystematic discovery and extensive survey, it seems likely that the lower levels of the rural settlement hierarchy—poor farmsteads, seasonal settlements, etc.—are at least partially missing. While this makes it unlikely that non-residential places have been mistaken for settlements, it also means that the results of this analysis can be safely applied only to those settlements that are most visible to modern archaeologists. Theoretically, areas that appear devoid of settlement might have been teeming with people whose settlements have not yet been recovered. The risk of this should not be overstated, however, as the pottery, tile, and stone foundations that serve to mark the locations of ancient settlement were ubiquitous in the region during antiquity. Limestone suitable for construction is widely available from river gorges and a flourishing local pottery industry made ceramic vessels and tiles relatively cheap (Poulter 2007a, 372 for the ubiquity of stone foundations in the Roman period). It is impossible to reject completely the possibility of a "hidden landscape," but there is also no reason to think that a large number of settlements, whose existence would radically alter the current picture, await discovery.

As is always the case in the study of ancient history, the data are not all that we would wish them to be. I have acknowledged and attempted to take the limitations of the data into account in my analysis. The publication of the two recent survey projects mentioned above (section 3.2.2) would go a long way to improving the evidentiary basis of this project, as would the ability to gather more accurate locational data for sites recorded in the AMB. Nevertheless, the data will never be perfect. If we are to make progress in the study of ancient history we must develop ways to use imperfect data to the fullest extent possible. I have attempted to do this by including measures of locational and chronological confidence, creating comparanda subject to the same influences that bias the archaeological record, and taking measurements from a neighborhood around each site when the location is uncertain. Without methods that make imperfect data usable, it would be impossible to study much of the Roman Empire. Most of the territory of the Empire is currently occupied by states which do not have the resources or inclination to invest in the decades of archaeological field work that have made Britain, France, Germany and Italy, for example, such fertile areas for research. Whether or not my current attempts are judged successful, historians must adopt and develop methods that can find evidence in uncertain data.

4.1.1.3 Quantitative comparative modeling for hypothesis testing

There currently exist multiple, competing conceptual models[174] for nature of the relationship between military and non-military communities. These were outlined in chapter

[174] Previously I have used the term "model" in reference to mathematical algorithms. Here I use the term in its broader sense of any explanatory simplification of reality. The use of models in the study of history is still somewhat controversial. As Neville Morley writes, "It remains in part a matter of taste: what sort of knowledge do we want of the past, a grand explanatory framework or isolated pieces of information?" (Morley 2004, 25). It is a

one above (section 1.4) and will not be repeated here, but it is important to note that these are all models and therefore ought to be evaluated as such. A model is a simplification of reality that emphasizes the typical (Morley 2004, 17). Models cannot be disproved by isolated contradictory observations as these can always be labeled "exceptions" to the general trends with which the model is concerned (e.g. Finley 1999, 181–182, 194–196; Hopkins 2002, 195). Instead, models must be judged against other models in terms of how well the account for the available data. The persuasiveness of a model rests on its logical consistency and its ability to account for more observations of reality than other models. This is true of conceptual, historical models as well as mathematical models. Assuming the models are logically coherent, how can we tell which model best fits the available data? Fortunately, statisticians have devised many tools for creating and evaluating models.

Unfortunately, the conceptual models are not easy to compare using statistical tools because ancient historians rely on evidence that varies widely in its nature, ranging from stories in literature to financial accounts to artifact assemblages. In addition to being incomparable, it is unclear how typical or exceptional each observation is.[175] Someone may write down a story because is exceptional or they may misrepresent the exceptional as typical. Documentary evidence may record the typical, but its survival is exceptional so it is unclear whether the identifiable trends apply outside the regional and chronological framework for which documentary evidence exists. Archaeological remains can be mobilized on a larger scale, but this requires the survival, recovery and publication of those remains. Even then, the interpretation of the archaeological remains in terms of ancient behavior is not straightforward. To compare conceptual models, then, the evidentiary basis of comparison must be consistent and it must reflect typical human behavior.

For reasons discussed above, I have chosen to focus on the spatial relationships between settlements and their landscapes (section 1.6.4). I have used several different statistical procedures to distinguish the typical from the exceptional. Of course, typical and exceptional both imply some sort of basis of comparison. An observation may be typical when compared to other similar observations, but that group of observations may be exceptional when compared to a different group. In this project, I have shown that the group of settlements from the Roman period are exceptional when compared to the sample area as a whole in having territories with higher than average agricultural potential. That is to say, Roman settlement territories typically have exceptional agricultural potential. Typicality and exceptionality depend on the comparandum.

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worthwhile endeavor to explore and record the rich variety of human experience, especially in a democratic, individualistic society like the modern United States. Examples of the exceptional have the power to liberate people from the strictures of tradition and to inspire innovation. However, that is not my purpose here. Instead, I seek to discover what was typical in the ancient world in order to choose which model best describes it.

[175] A related question in identifying typicality and exceptionality is the geographic scale of comparison. A certain form of interaction may be typical for a region, but exceptional for the Empire as a whole. The same is true for any spatial scale: within a region, garrison settlements may be exceptional and within a garrison settlement an individual may be exceptional. Similarly, the Roman Empire may be typical or exceptional of other Empires and societies in which military and non-military communities existed. At each scale it is also possible that the diversity of relationships was too great to identify a single "typical" form.

My first comparandum was the region as a whole. That is, I compared the area that was available for settlement[176] to the area that was chosen for settlement. The latter is a subset of the former, or in statistical terms, the area as a whole is the population from which a sample, the area chosen for settlement, has been drawn. I assessed the typicality or exceptionality of this sample in terms of a sequence of variables. No attempt was made to identify typical or exceptional cases within this sample.

This produced interesting results that shed light on the attitudes of ancient people to different landscape features, but it was not sufficient for testing hypothesized relationships between garrison and rural settlements. This is because settlement location is the result of multiple interacting influences. A peasant might reduce transportation costs to military markets only so far as this does not increase other costs. This would not be detectible in univariate analysis, but various methods of multivariate analysis are available for just such a situation. I chose logistic regression analysis for reasons explained above (section 1.7.2.1).

This required a different comparandum. Logistic regression analysis attempts to classify observations into one of two groups based on their attributes. In order to do this, the attributes should vary more between the groups than within the groups. The comparandum for univariate analysis was a set of points meant to represent the region as a whole, so the variance of attributes within this set is similar to the maximum variance of attributes within the environment. This cannot be used for logistic regression analysis. Instead, a comparandum that does not include the comparans as a subset must be defined (Rose and Altschul 1988, 207). In this case the groups are locations where people chose to settle and locations where they did not.[177] For this reason I created a set of non-sites for each chronological period according to the procedure outlined above (section 3.4.1).

Assuming that most people living in the countryside depended primarily on their own produce for subsistence but were not wholly autarkic, I began with a model that assumed that the only things that were important to rural settlers were the suitability of the land immediately surrounding their home and how easy it was to transport things into and out of the farm.[178] I calculated this model's goodness of fit using leave-one-out-cross-validation. This provided a baseline against which I could compare other models. By adding a market potential variable I tested the hypothesis that, in addition to the suitability of the land and ease of transportation, rural settlement location was also affected by a desire to minimize transportation costs to markets. If the hypothesis is true, the new model should have a lower error than the baseline. If not, the error should remain the same or even increase if there is more variation in market potential within than between the groups.

[176] Given the simplifying assumption that there were no constraints on settlement location choice at any period.
[177] Technically, the categories are locations where archaeological evidence indicative of settlement is present and locations where the absence of such evidence likely indicates the absence of settlement. The latter are distinct from locations where the absence of archaeological evidence is likely the result of post-depositional formation processes.
[178] It would be interesting to compare with this a model that did not include the transportation factor. This, however, is beyond the scope of the current project.

The market potential of a given location is defined as the weight of each market in the system divided by its distance to that location. This allows the researcher a great deal of flexibility in choosing markets and defining weights. I have taken advantage of that flexibility to create market potential variables that reflect the competing visions of the garrison settlements' role in the local economy. Creating models that include each variable in addition to the variables in the baseline model, I test the hypothesis that, in addition to the baseline factors, peasants minimized transportation cost to markets and that the market system consisted of a certain set of places with a certain set of weights. Again, a reduction of error compared to the baseline model supports the hypothesis. If multiple market potential variables reduce the error, the one that reduces the error more is a closer approximation of the actual system.

This methodology involves a great number of decisions concerning how to transform conceptual models into mathematical models that are susceptible to comparison, how to collect and calculate the data and variables that the models are expected to account for, and how to calculate the goodness of fit between model and data. At each step in the process I have tried to be explicit about the decisions I made and my reasons for making them. Others may make different choices and it would be valuable to see if different choices lead to different outcomes. That, however, is beyond the scope of this project. While these choices may affect the validity of the results obtained, they do not affect the explanatory potential of the methodology itself.

The evidence for the ancient world is sparse and the evidence for ancient peasants is sparser still. Keith Hopkins famously wrote that, "historians are forced to impose plausible and simplifying fictions on a complex and largely irrecoverable past" and, "[O]ne of the persistent problems in each generation is how to choose between competing fictions." (Hopkins 1978, 215, x). I have attempted to show that by reconstructing the landscapes that were experienced from ancient settlements we can recover a little more of the past and that by analyzing them using comparative, multivariate statistical modeling, we can choose more wisely between competing "fictions."

4.1.2 Historical implications

This project has been an attempt, as Marcos Llobera puts it, to "shorten the gap…between empirical information and narratives" (Llobera 2012, 503–504). Having acquired new information through the statistical analysis of rural landscapes in the central Danubian Plain we are now in a position to modify historical narratives about production, distribution, military supply, and the role of garrison settlements in that region. It is difficult to compare this region to others because of the novelty of the approach. There are many reasons why the relationship between military and rural communities might be different in other frontier zones, including the pre-Roman culture of the area, the nature and timing of conquest and the history of occupation. Without applying this method in other areas it is impossible to tell whether the social dynamics of central Moesia Inferior can be taken as a model for dynamics elsewhere. Clearly, further investigation in other parts of the empire is warranted.

4.1.2.1 Production

Our understanding of productive activities in the pre-Roman period is sketchy and location analysis has done little to clarify the matter. For most of the variables analyzed, pre-

Roman settlement territories strongly resemble randomly distributed territories. The only exceptions are a slight preference for steep slopes and rivers.[179] What this means is difficult to say because the temporal span of the pre-Roman period is so long and most of the settlements are not well understood. It is possible that trends would emerge if the data were subdivided into different groups. The most obvious grouping would be chronological, but the possibility for functional and perhaps even cultural subdivisions should be investigated as well.[180]

The analysis of stream lengths within territories hints at the possibility of functional differentiation. Three-quarters of pre-Roman settlements are not located within 1.5 kilometers of a navigable river. The remaining quarter, however, have more meters of river in their territory than random locations within 1.5 kilometers of a river. For these settlements, the river bank was a resource worth maximizing. The rivers in this region, especially in its eastern half where most of the pre-Roman settlement is located, meander through steep, gorges, creating tongues of land surrounded almost entirely by cliffs. Many of these places were fortified in later periods and it is impossible to know, in most cases, whether they were also fortified in the pre-Roman period. Some of them surely were. These could have served as temporary refuges or centers of power for local elites. It would be interesting to remove pre-Roman "settlements" in defensible locations to see if the remainder exhibit identifiable locational trends. Such an exercise, however, is beyond the scope of this project.

If the results are not a product of insufficient data, they would indicate that the character of the landscape within 1.5 kilometers of a settlement was not terribly important to most people in the pre-Roman period; the agricultural potential of the land was not a major consideration in deciding where to live at a local level. Perhaps the entire region was fertile enough to satisfy their needs and other considerations, not accounted for in this analysis, drove settlement decisions. Perhaps they practiced extensive agriculture or pastoralism and their productive territories extended far beyond 1.5 kilometers from their settlements.[181] The only thing that can be said with certainty is that there is no evidence of wide-spread intensive agriculture in the pre-Roman period.

The picture is very different in the Middle Roman period. Second and third century peasants settled in places which afforded easy access to good agricultural land. Univariate analyses showed that their immediate surroundings had more gently sloping land, less west-facing land, and more land with long exposure to direct sunlight than randomly chosen locations. This type of land would drain easily, be sheltered from the harshest winds, and be bathed in sunlight during spring, all of which serves to promote plant growth.[182] Environments that became settlement territories had significantly higher agricultural potential than environments that were not settlement territories. This result shows that most of the people who established these settlements intended to practice intensive agriculture. This may be

[179] The two variables are not correlated. Pearson's correlation coefficient is -0.08.
[180] Cluster analysis of landscape variables may help to identify some of these subgroups.
[181] This hypothesis could be tested using larger settlement territories.
[182] The baseline logistic regression model confirms the importance of these factors for people living in the second and third centuries: the mean squared error of the Middle Roman model was 0.055, lower than for any other period.

evidence for the agricultural ideology of early Roman immigrants and its lasting influence on the settlement pattern.

In Germany, paleo-botanical remains have shown that the Roman period saw the introduction of labor-intensive garden crops, indicating a shift in the way people thought about agricultural production and consumption (Kreuz 1999). The paleo-botanical evidence from the lower Danube is too sparse to draw the same conclusions, but the locational evidence suggests a similar process. The inhabitants of the Roman countryside chose to live in places surrounded by intensely cultivable—and presumably cultivated—landscapes. The valorization of intensive agriculture and the productive landscape is well established for Roman elites and Italian villas (Marzano 2007, 81–101; Purcell 1995). Quantitative analysis of settlement territories demonstrates the prevalence of a similar ideology in the second and third centuries next to the Danube. This could be because the earliest Roman settlers in the area were veterans from the I Italica, raised by Nero in Italy (section 2.7.2). These men were raised with the same appreciation of intense production that we see in the central Roman elites.

After the crisis of the third century—during which almost half of existing settlements were abandoned—the rural settlement system was reestablished along similar, but not identical lines. The preference for gently sloping land is even stronger in the Late Roman period than it is in the Middle Roman period, as is the avoidance of strongly sloping land. Middle Roman settlements show a slight preference for flat land, but it is not very significant, while in the Late Roman period the preference for flat land and its statistical significance have grown. Late Roman settlements do not favor north and northeast facing slopes to the same degree as Middle Roman settlements, but they avoid southwest, west, and northwest facing slopes even more strongly. The Late Roman relationship to sun exposure is also similar, but more extreme than the Middle Roman. The people who cultivated the land in the fourth century saw it in much the same terms as their immediate predecessors from the second and third century. This cannot be ascribed to path dependence because over half of the Late Roman settlements have no known Middle Roman predecessor.[183] The higher number of settlements raises the possibility of land pressure, but if this were at work one would expect to see Late Roman settlements compromising and occupying territories more similar to random locations, not less similar.

Late Roman settlements' greater preference for flat land and lesser avoidance of lower slopes may suggest that changes occurred in the landscape that made these areas less unfavorable between the third and fourth centuries. Candidates include drainage operations and the introduction of plow technology better able to cope with heavier, wetter soils. The former would require an increase in labor investment, but the growth in settlement numbers suggests that this may not have been a problem.[184] Ivo Cholakov has recently collected evidence for ancient iron tools in Bulgaria and concludes that the coulter—a blade mounted before the share on a plow which cuts the earth and allows for deeper tillage of heavier soils—appears at some point in the fourth to seventh century. This is also the period when the long

[183] Though further study could reveal earlier levels at many of these places.

[184] One wonders where these people came from. The evacuation of the province of Dacia provides a likely explanation, but this cannot be proven.

scythe, allowing for more efficient harvesting of hay and grain cut close to the ground, appears (modern data show that reaping with a scythe can be over twice as efficient as reaping with a sickle. Shaw 2013, 15). The more developed forms of billhooks and axes also appear sometime in the fourth to seventh centuries (Cholakov 2010, 196–197). Cholakov acknowledges the difficulty of dating tools and divides his assemblage into only two periods: first to third centuries and fourth to seventh centuries. More tools date to the latter half than the earlier, so it is possible that the greater diversity of types is a product of uneven recovery. Like the settlement and landscape data, the shifts in technology are based on uncertain data and therefore tentative, but it is suggestive that all of these changes are in the direction of greater agricultural intensification. In the fourth century, the countryside of the Danubian Plain was booming.

By the late fifth century, the boom was over. Four-fifths of the Late Roman settlements had been abandoned. New settlements were built, but they were not located in the same type of "productive landscape" as their predecessors. Where Middle and Late Roman settlements preferred gently sloping hills and avoided steep terrain, Late Antique settlements did the opposite. While Middle and Late Roman settlements, in agreement with Roman agricultural writers, shunned valley bottoms, upper slopes and ridges, Late Antique settlements gravitated toward these landforms. The westerly winds which drove Middle and Late Roman settlers away from west-facing slopes did not deter Late Antique settlements, which seem to have sought out the shadiest, rather than the sunniest terrain. Roman settlers seem not have cared how long the river in their territory was, but Late Antique settlers cared a lot, favoring territories with long river banks even more than Pre-Roman settlements. While Middle and Late Roman settlers surrounded themselves in landscapes of production, Late Antique settlers surrounded themselves in landscapes of defense.

4.1.2.2 Distribution

The contradiction between landscape data for the relationship between settlements and traffic routes, on the one hand, and consumption and exchange centers, on the other, is puzzling. Pre-Roman settlements are closer to rivers than to random points, but preference for territories with long stretches of river bank suggests this may have more to do with defense than transportation. Of course, the two are not mutually exclusive and rivers must surely have played a role in the distribution of bulky goods, but it is impossible to tell how important easy access to riverine transportation was to pre-Roman settlers. Proximity to higher order centers appears to have had little impact, but this could be a result of incomplete data.

The addition of roads in the Roman period only serves to confuse the matter. There is no evidence that Middle Roman settlements were intentionally located near roads or navigable rivers, suggesting that minimizing the cost of transporting bulky loads was not a very high priority. At the same time, Middle Roman settlements did minimize the cost of walking to non-military markets like sanctuaries, small towns and cities. With the exception of Nicopolis ad Istrum, there are no firm foundation dates for these places so it is impossible to tell if peasants chose to settle near markets or if markets emerged amidst concentrations of rural settlement. Whichever came first, the statistical significance of market potential indicates that the cost of traveling between rural settlements and markets was important enough to minimize. People

were traveling across the landscape but proximity to traffic routes seems unimportant to settlement location. The reconstruction of the road network used here might be flawed, but this would not account for the fact that Middle Roman settlements did not cluster around navigable rivers.[185]

This settlement pattern suggests that the people living in the countryside did not depend on roads and rivers to fulfill their transportation needs. This is not as paradoxical as it may initially sound as the relative advantages of travel by river and well-built road depend on the cargo and the technology of transportation. Riverine travel is efficient because water eliminates friction. The only limit to the size of cargo is the boat and the nature of the river itself. Downstream travel also requires no energy from humans or animals, but upstream travel requires quite a lot in the form of rowing or towing. Rivers are most advantageous, then, to people wishing to transport very large cargoes.

Wagons also excel at carrying large cargoes. A first century inscription from Sagalassos defining the city's transportation obligations equates a single wagon with three mules and six donkeys (Mitchell 1976).[186] In Diocletian's Price Edict, a wagon-load of firewood was estimated at 1,200 Roman pounds, a mule-load at 300 Roman pounds and a donkey load at 200 Roman pounds, giving a ratio of 1:4:6 (16.8, 10, 11).[187] In comparison, Vegetius says that recruits should be trained to carry loads up to 60 pounds and feels the need to defend such a great weight (1.19). A single wagon could carry twenty times this much. Other estimates of ancient carrying capacity have been offered (e.g. Adams 2007b, 70–83; Roth 1999, 202–211), but the fact always remains that wagons could carry much more than pack animals or humans.

The problem with wagons is that they require a firm, smooth surface to be effective. Roman roads, with a reinforced bed and gravel or stone pavement, can accommodate wagons carrying very heavy cargoes (Laurence 1999, 58–67), but if the road is damaged it quickly becomes impassable to wheeled transport (e.g. *Tab Vind* 2.343.20-21). Pack-animals and humans also benefit from roads in that they provide a firm, obvious path clear of obstacles, but they are not dependent on them.

Wagons and river barges are expensive pieces of equipment. Pack animals are expensive as well, but they are also more versatile, providing traction, manure, and other secondary products in addition to carriage (reliable prices for pack animals are rare, but Rathbone 1997, 207–210 has collected the prices of donkeys in Egypt). Most of the cost of maintaining pack animals goes toward feed, which could be very expensive in places like Egypt where fodder crops compete for land with wheat and where pasture has to be rented (Adams 2007b, 83–90).

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[185] Alternative road network reconstructions agree on the main roads running east-west along the Danube and along the foot of the Balkans, but differ as to the routes of the connecting roads (Panaite 2012; Panaite 2015; Talbert and Bagnall 2000)

[186] The Latin word is "carrum," which Roth defines as a four-wheeled, mule drawn freight wagon (Roth 1999, 208).

[187] The apparent discrepancy between the ratios of mules to wagons (3:1 in Sagalassos, 4:1 in the price edict) is a product of English translation. The word "mule" simply refers to the offspring of a horse and a donkey, while the Latin "mulus," used in the Sagalassos inscription, refers specifically to the offspring of a female horse and a male donkey and "burdo," used in the Price Edict, refers to the offspring of a male horse and a female donkey.

In the Danubian Plain, however arable and pasture land are much more abundant, so animal husbandry would have been much cheaper.

Roads and rivers are necessary to transport very large and bulky loads, but for loads of a moderate size, up to 400 Roman pounds, a pack animal is more efficient. If most of a household's transportation needs were fulfilled this way, there would be no particular advantage to living near a road or a river. These traffic routes are only important for large landowners who anticipate the need to frequently move very heavy loads to and from the farm. The position of Middle Roman settlements relative to roads and markets suggests that the inhabitants of the countryside were sensitive to transportation costs to markets—and so were integrated into regional exchange networks—but were not carrying such large loads that they would have required expensive transport equipment and infrastructure. These were comfortable, but not wealthy peasants.

While Middle Roman settlements show some indifference to roads and rivers, Late Roman settlements avoid the largest roads and cluster around the smallest.[188] Like the Middle Roman settlements, they cluster in areas close to non-military markets. If roads were attractive, Late Roman farmers must have been using wagons and transporting larger cargoes than Middle Roman settlers. The fact that they avoid the largest roads is telling. Apparently the construction of local roads was sturdy enough to transport agricultural products. Any advantages that the imperial roads enjoyed in this regard were outweighed by the danger of the people traveling along them. This included individual soldiers and imperial officials who were allowed to demand transport and hospitality as well as passing armies of various loyalties who all demanded supplies. One is reminded of Columella's advice that a farm should not be located next to a military highway, but should still have access to transportation (1.5.6-7).

The fourth century inhabitants of the Danubian Plain seem to have been just as focused as their predecessors on intensive agriculture, but they were wealthier than them: their territories had more flat land and lower slopes, suggesting they had the resources to implement drainage works, and they had access to better tools including coulters and long scythes. They needed roads to transport their goods, suggesting that they were transporting larger quantities of produce than their predecessors and had access to the wagons and draft animals needed to move these cargoes. Again, the fourth century countryside appears to be bustling and booming.

In Late Antiquity, settlements did not cluster around roads of any size. They were much closer to rivers, but just as was the case with Pre-Roman settlement, this probably had more to do with defense than transportation. The problem of defense also bedevils attempts to interpret the proximity of settlements to market centers, as these centers were invariably fortified. Surplus production, transportation and exchange must have continued in Late Antiquity, but all of this economic activity took place within the constraints imposed by structural insecurity.

[188] They are also cluster near rivers, but this is not statistically significant.

4.1.2.3 The value of security

Late Antique settlers were afraid in a way their Roman predecessors had not been. On the basis of the archaeology alone it is difficult to tell if this change was gradual or sudden and if it can be tied to a specific historic event. As research continues, new data will clarify and alter these conclusions, but on the basis of present evidence, I would suggest that people in the countryside lost faith in the ability or willingness of the imperial government to protect them and their property during the Gothic revolt of 377/8 – 382.

After the invasions of the third century, the Tetrarchy, followed by Constantine, invested heavily in restoring and strengthening the frontier defenses and campaigning beyond the river. Tetrarchic building inscriptions emphasize the peace and security that these efforts were supposed to bring. Modern scholars rightly see this as evidence that the sense of security afforded by the frontier had been compromised, but they go too far when they conclude, based on the later collapse of the frontiers, that these efforts were ineffectual (e.g. Wilkes 2005a, 264–268). Zosimus faults Constantine for weakening the frontiers that Diocletian strengthened, but Zosimus is by no means impartial (2.34). Constantine and Constantius both campaigned north of the river. By 332, Constantine had won a major victory and imposed a treaty on the Goths. Immigrants were allowed to settle south of the Danube and the frontier was permeable, but the abundance of rural settlement in undefended locations shows that it was effective in maintaining the general security of the countryside.

Valens, who was not a member of the Constantinian dynasty, campaigned against the Goths in the late 360s and ordered the strengthening of frontier infrastructure. The relationship between the Goths and the Constantinian emperors had kept the plain relatively safe and prosperous, but with the end of the dynasty, the relationship, and Rome's dominance, had to be reestablished. Valens' campaigns amounted to little, but the act of campaigning and building fortifications may have convinced the rural inhabitants of the frontier zone that the Empire was strong enough to repel invaders. After all, it had been over a century since the last major invasion and almost forty years since Constantine's treaty.

I imagine landowners who relied on the Roman state to ensure their property rights must have felt concerned when the Emperor allowed a large mass of Goths into the Empire in 376. When these immigrants revolted against the government, they must have been worried, probably frightened. When they learned, in the summer of 377, that the Emperor had ordered all the food to be removed behind walls and that that the Emperor's forces were busy blockading the mountain passes instead of driving the Goths back across the frontier, they must have been terrified. They also must have felt deeply betrayed. Walls could protect their households and some of their movable property, but their most valuable asset, the land itself, was abandoned to the depredations of foreigners. Even if the Yantra valley saw little violence after 378—and it is by no means certain that this is the case—the sense of insecurity would have remained. The war stretched on until 382, at which point Goths were granted land on which to settle and asked to guard the frontiers. The reaction of our imagined landowners, if any survived, must have been skeptical at best.

After the Gothic revolt, no one living in the Danubian Plain could reasonably believe that the state would keep them safe from invasion, let alone low-level brigandage and raids. Now,

everyone lived in fear of violence, ready to flee to a refuge. Regardless of how often they actually used the refuge, the fear that made it necessary forced them to move away from the best agricultural land. We cannot know how intensively they cultivated their fields and gardens in the fifth and sixth century, but even if intensive agriculture continued it would not have been as profitable simply because the conditions were not as favorable.

4.1.2.4 Military supply

The study of rural landscapes has shed interesting light on the question of military supply in the Middle Roman period. It is generally assumed that the local population would have had some role in supplying the military with basic food needs and there is nothing in this analysis to suggest otherwise. The fact that rural settlements did not cluster around garrison settlements does not prove that nothing was transported from the farm to the fort, merely that this traffic did not influence settlement location. This could be because the traffic was infrequent, indirect, posed no cost to the farmers, or posed a cost that was outweighed by other considerations.

Based on the proximity of settlements to non-military markets, it seems that the most likely scenario is indirect transfer of surplus to the garrison settlements. In this scenario, the grain would be gathered together at some point away from the frontier and then shipped either directly to a specific unit or to a central military depot from which it would be distributed. It is not clear who was responsible for covering the cost of transportation at each stage in the journey and it is equally unclear whether the producers were paid. Given that rural settlement expanded in the Middle and Late Roman periods and that the army was probably a major consumer of rural produce, it would be difficult to argue that military supply was a drain on the local economy. Either it was profitable or it was benign and supplying non-military demand was profitable. In either case, the presence of the frontier did not depress the economy.

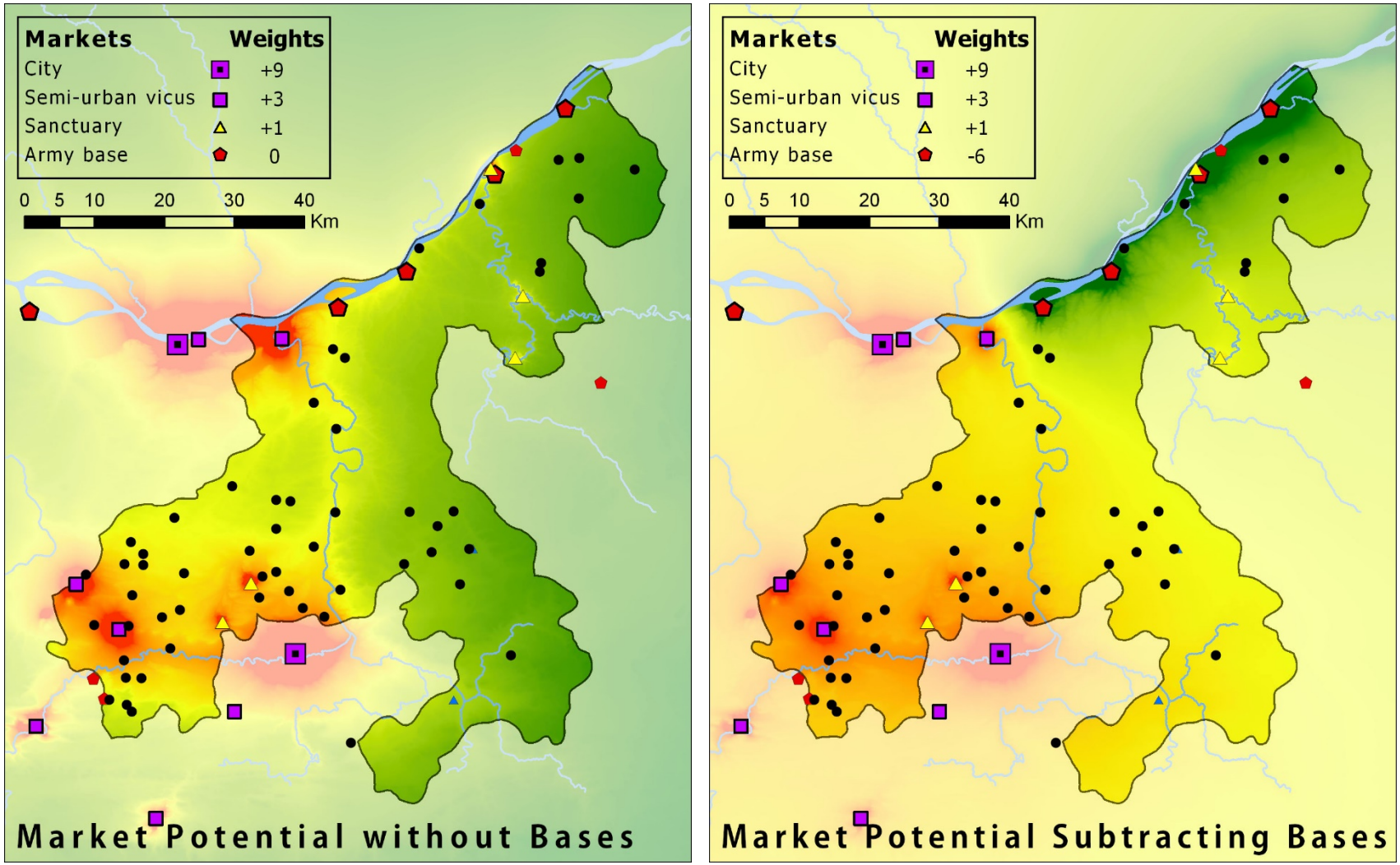
4.1.2.5 The role of garrison settlements in the economic strategies of peasants: integration or isolation?

How do the results of the comparative modeling process change our understanding of the impact of the Roman army on the Lower Danubian frontier and elsewhere? First, I must emphasize that the influence of legionary fortresses is not in question. Novae was simultaneously the headquarters of the legion I Italica and a major, regional, urban center. At some point, probably in the late second or early third century, its urban status was enshrined in Roman law (Tomas 2006). Surveys in the immediate surroundings have revealed numerous, densely packed rural settlements (Conrad 2006). It goes without saying, then, that the society of the Danubian Plain was profoundly influenced by the presence of the army.

But we can no longer assume that auxiliary forts operated similarly but on a smaller scale. The apparent similarity between military and urban communities suggests that, if the biggest forts acted like cities then, accordingly, the smaller forts should act like small towns. In 2007, Colin Adams wrote, “The pattern seems to be of a spread of urban centers based on military forts, which provided markets, distribution centers and even administrative centers located at intervals through the province. These settlements were thus central to the development of the urban landscapes of Roman provinces” (Adams 2007c, 231). Adams’ bases

this statement on C.S. Sommer's work in Germania Superior, but he applies the conclusions to the whole Western Empire. It is becoming increasingly clear that the populations of both legionary and auxiliary garrison settlements were diverse and that soldiers and non-combatants of various type intermingled extensively in both forts and extramural settlements, making them appear similar to towns (Allison 2013). The Vindolanda tablets show local produce on sale at Vindolanda (A. K. Bowman 1994; Whittaker 2002). Naturally enough, all of this suggests that auxiliary forts functioned like small towns within the local economy (For the economic functions of small towns in Roman Britain see Burnham and Wacher 1990, 43–50; Poulter 1987 discusses Roman towns in general while emphasizing garrison settlements; For the functions of small towns in Gaul see Rorison 2001, 51–63). Now we know that, at least in the central Lower Danube, this was not the case.

Middle Roman settlers not only minimized the cost of accessing cities and non-military semi-urban vici, most of them maximized the cost of accessing army bases. If they had simply ignored the garrison communities, the market potential variable that excluded them would have improved the model more than the variable that considered them repellent. To understand this result, it is helpful to map the Middle Roman settlement system along with the different market potential variables.



Map 16: Comparison of two Middle Roman Market Potential variables.

The map on the right shows the market potential variable that improved baseline model performance by over 20% while the variable shown on the left improved model performance by only 7%. The area to the east of the Yantra but well south of the Danube contains a cluster of settlements which have relatively low values when the army bases are excluded, but come close to the overall average when the forts are given a negative influence. Giving the forts a negative weight means that there are a few settlements with very low market potential in the northeast corner of the sample area, but most of the settlements have average and above average market potential scores.[189] When forts are ignored it is difficult to explain why the area east of the Yantra in the south should have more settlements than areas farther north. When forts are considered repellent, the answer seems obvious.

The settlements in this cluster seem to have intentionally maximized the distance between themselves and the military communities living along the frontier. The traditional explanation for this behavior would be to avoid the clutches of rapacious tax collectors and thuggish soldiers. This could be true, but what of the settlements that are found near the frontier? There are eight settlements in the northeast corner of the sample area near Sexaginta Prista and Tigra where the only markets available were army bases and sanctuaries. Perhaps these were inhabited by members of an extended military community who were therefore immune from the soldiers' depredation. The distribution of military and non-military funerary monuments showed an overwhelming preponderance of military tombs in this area, while the stones in the southwest part of the study area are much more mixed (map 7).

I cannot prove that the great distance between most rural sites auxiliary forts on the lower Danube is due to military mistreatment of peasants since other explanations are possible, but the results of both univariate and multivariate analyses are at least consistent with that interpretation. At the same time, the countryside at a distance from the frontier flourished and it seems perverse to deny the role of military demand in this. That distance, however, is important to notice. On Map 16, one can detect a line running approximately east-west to the south of which settlement density is much greater than to the north. That line is roughly a day's journey from the nearest army base.[190] Anyone living within a day's journey of an army base

[189] Compared to the market potential of the 1000 randomly distributed points used above. When garrison settlements are excluded there are 12 settlements with a market potential score farther than half a standard deviation below the mean, 14 within half a standard deviation, and 29 more than half a standard deviation above the mean (including two outliers over three standard deviations above the mean). When garrison settlements are given a value of negative six, there are only five settlements with market potential scores farther than half a standard deviation below the mean, 16 within half a standard deviation, and 22 more than half a standard deviation above the mean.

[190] Distance, as before, has been measured in terms of the energy required for pedestrian travel. This can be rendered more comprehensible by expressing it in the form of "flat kilometer equivalents" (fKme), which is the kilojoules per kilogram required to walk one kilometer on flat land, or 1,640 kj/kg. Of the 54 Middle Roman Settlements, only 12 live less than 21 fKme from an auxiliary base. The remaining 42 live more than 29 fKme from an auxiliary base. The inclusion of Novae does not alter this pattern. The fact that there are no settlements between 21 and 29 fKme while there are six between 16 and 21 and five between 29 and 36 fKme suggests there may be something significant about this distance. It is remarkably close to the 30 kilometers generally assumed to be a day's journey.

risked being forced to provide hospitality to soldiers and officials traveling to and from that base; living beyond a day's journey from the frontier would have lessened the risk.

Another possible explanation for the avoidance of the frontier's hinterland is that the territory was administered differently from the lands farther south. Perhaps it was owned by the army and rented to those with military ties or reserved for pasture. Unfortunately, very little is known about the extent of military territory in this area. Alternatively, we may be detecting the influence of the second century provincial border between Thrace and Lower Moesia, which would have coincided with the northern limit of the territory of Nicopolis ad Istrum. The course of this border is controversial.[191] A number of inscribed stones defining the border between Moesia and Thrace were erected in 136 CE. Six of these have been found in the Yantra River basin, but the find spots do not form an easily intelligible line. Some of the known stones have been moved and one may never have left the quarry. According to one reconstruction, the path of the border would roughly correspond with the northern edge of the densely settled region identified here. However, since that path was proposed another stone has been found significantly to the south of it. Very little evidence for the course of the provincial border east of the Yantra has been found. An administrative explanation cannot be ruled out, but neither can it be confirmed. The only thing that is certain is that most people avoided living in the immediate vicinity of auxiliary forts.

This is not to say that military communities were not consuming the surpluses produced by these people. The source of the Baniski Lom River lies amidst the southeastern cluster of settlements. It is not a large river today, but if it were larger in the past, a small boat could take supplies downstream all the way to Sexaginta Prista.[192] Even if these people were sending their produce to the frontier, they would only have traveled there occasionally. To the west of the Danube, the most likely route by which surplus produce would reach the frontier is through Nicopolis ad Istrum. Harvests could have been collected and combined into large loads to be shipped down the Rositsa to the Yantra, meeting the Danube at the place that would become Iatrus. The farmers who supplied the army, then, would have had little contact with the people living in the garrison settlements.

The picture that emerges, then, is of two distinct rural communities: a few who lived close to the frontier and who were probably integrated into the communities living in and around the army bases, and a separate majority who lived farther south and who spent most of their time interacting with people in the cities and small non-military small towns. This latter community included many veterans and there were probably soldiers present, but it was not dominated by the army in the way that garrison settlements and their hinterlands were. This community probably would not have existed without military demand, but the garrison settlements did not figure prominently in these peoples' daily lives. They were not lucrative markets for garden produce. In order to profit from military demand, one would need to

[191] Two recent articles provide overviews of the debate while arguing for different conclusions (Ruscu 2007a; Tomas 2007). In 193 CE, under Pertinax, the border between Moesia Inferior and Thrace was shifted south to the peaks of the Haemus mountains (Boteva 1997).

[192] Currently, the river flows through a ditch cut into a fairly level, broad valley so it is possible that it was wider in the past.

control large quantities of staples that could be efficiently shipped to the frontier, meaning large landowners and merchants who collected the surplus of small landowners. Small landowners could make money supplying the cities and small towns. These people felt the benefits of military demand indirectly at best. Whether the army claimed the land surrounding its bases or simply made it unattractive through rapacity, small landowners probably felt the ill effects of military presence more acutely than the benefits.

This is not to say that the benefits provided by the military cordon were not real. Roman conquest and occupation removed the threat of high-level violence against rural communities. This allowed people to intensively exploit the most productive locales without fear of invaders burning their buildings and stealing their harvest. Soldiers and imperial officials may have stolen animals and some equipment, but they generally did not destroy the means of production. As long as one avoided interacting with them directly, the presence of Roman soldiers on the Danube was advantageous for people living in the countryside.

4.1.2.6 Implications for frontiers beyond the Lower Danube

The social dynamics between military and rural communities identified on the Lower Danube frontier could be similar to those in other frontier zones, but that is yet to be proven. At the very least, the disconnect between traditional archaeological evidence and the evidence derived from spatial analysis should make us cautious about assuming anything. Based on the evidence typically adduced to judge the economic impact of the army bases, the central Lower Danube appears to be a model for the stimulative effects of the frontier. Prior to Roman conquest, the inhabitants of the area were already producing wine, growing bread wheat, and using coins in commercial transactions, so many of the cultural barriers that distinguished "Roman" and "Native" in the northwest provinces were absent. After conquest, settlement numbers increase and a local pottery industry develops that appears to have roots in both local and imported traditions. By the late second and early third century, many of the soldiers were local recruits and veterans are well attested in the countryside. In short, there is no *a priori* reason to think that garrison settlements would be isolated from people in the countryside.

None of the auxiliary forts in this area have been completely excavated, but extra-mural settlements are attested epigraphically at Dimum and Sexaginta Prista and archaeologically at Trimammium. Given the urban appearance of auxiliary garrison settlements elsewhere and the cultural similarities between military sites and the countryside in this region, these garrison settlements should have functioned as towns, providing local markets for rural produce. The distances between the settlements—around ten kilometers between Scaidava and Trimammium, twenty between Trimammium and Sexaginta Prista, and ten between Sexaginta Prista and Tigra—are small enough that much of the area would have had access to multiple markets. The military cordon, then, created excellent conditions for market gardening. If one ignored the locations of rural settlements, it would be very easy to argue that the string of army bases on the lower Danube provided favorable marketing conditions for peasants without a great deal of capital, allowing them to amass wealth and participate in long-distance exchange networks. The only evidence that runs counter to this optimistic reconstruction is the spatial relationship between rural and garrison settlements. Without similar analysis in other frontier

zones we should be wary of assuming that cultural similarities between military and rural sites imply frequent interaction between the two communities.

We should also be wary of ascribing too great a role to soldiers' salaries in the monetization of frontier regions. The army has long been seen as a prime motor of monetization, but recently, scholars have begun to argue that the role of urbanization and merchants may have been as (if not more) important (Howgego 2013, 35–45; von Reden 2012, 268–269). Constantina Katsari has compared the numbers of coins found at urban, military and mixed urban and military sites in several provinces along the Danube and found that the urban and mixed sites contained more coins than the purely military sites (Katsari 2008).[193] The results presented here support these conclusions. The salaries paid to auxiliary soldiers were out of reach for most of the people living in the central Danubian Plain. What money flowed from the army to the countryside did so by way of other urban and semi-urban centers. These centers probably would not have existed without the presence of the troops on the frontier, but the fact remains that peasants looking to acquire coins to pay their rent or their taxes did so at non-military markets.

This project has focused on garrison settlements based on auxiliary units. Most discussions of the economic impact of the army make little of the distinction between legionaries and auxiliaries, assuming that the latter are simply a smaller version of the former. This is because there is little observable difference between the civilian settlements that surround them (Sommer 1997). In addition, the social status of auxiliaries seems to have risen from the time of the republic to be similar to that of legionaries. Ian Haynes, however, has recently argued that distinctions between auxiliaries and legionaries remained important into the late second century at least (Haynes 2013, 80–84). I have assumed that the legionary fortress of Novae performed the economic function of a city because recent surface surveys show that rural settlements clustered around it. I have now shown that the auxiliary bases did not perform the economic functions of small towns. If both of these characterizations are true, there was a real, qualitative difference between legionary fortresses and auxiliary forts. Perhaps the sheer size of the community centered on the legion made it attractive despite the fact that it was a military market. Another possibility is that administrative functions were performed at legionary bases that were not performed at auxiliary forts. In this case the qualitative difference would be due not to the size of the settlement but to the institutional structure of the Roman army. The two possibilities are not mutually exclusive.

[193] I have certain reservations about Katsari's analysis. First, as she acknowledges, she could not control for the extent of excavation or survey at different sites (249). More problematic, however, is her classification. She does not define "City-Fort" and it is unclear on what basis she distinguished these from "Military" and "Urban" sites. In Pannonia Inferior, for example, Aquincum is considered "Urban" despite the presence of a legionary fortress while Intercisa is described as a "City-Fortress" despite the fact that it was an auxiliary garrison settlement that never achieved municipal status. Katsari's data from Moesia Inferior is very sparse, including only three cities and two military sites. The cities (Axiopolis, Histria and Callatis) are all Greek cities from the eastern part of the province. Of the two military sites, one is Iatrus, which did not become a fort until the early fourth century, too late to be involved in the "Monetization" of this frontier province.

4.2 Conclusion: Next steps

4.2.1 Methodological refinements

While the methodology presented above has been successful in elucidating changes in the relationships between rural settlers and their surroundings and in clarifying the role of garrison settlements in peasants' strategies, there are areas where improvements could be made. These pertain particularly to the ways in which the different comparisons have been constructed and to the potential for greater subdivision of groups of ancient places.

This project has relied heavily on constructed datasets of random locations and non-sites to establish a base of comparison for the ancient places detected in the archaeological record. For the univariate analysis of settlements' relationship to individual landscape factors, I relied on a set of 1000 locations randomly distributed throughout the sample area. Using GIS, it would have been possible to distribute these points in such a way that took account of archaeological formation processes, placing fewer in areas where archaeological sites are more likely to be missed. Instead of representing the entire landscape as it currently stands, this set of points would represent the archaeological sites that would have resulted from a random distribution of ancient places. From a theoretical standpoint, this is a much better basis for comparison, but in practice, little difference was observed between the truly random set of points and the pseudo-random set. In other places, however, there could be a significant difference, so in the future, pseudo-random distributions should be used.

For multivariate analysis, it was necessary to create sets of non-points that were distributed in a way that took account of archaeological formation processes and avoided placing non-sites near settlements. The number of non-sites in each set was roughly similar to the number of settlements in the corresponding chronological period, between 100 and 200 non-sites. Because of their relatively small size, these sets may not be an accurate representation of all the places ancient people chose not to settle, but logistic regression analysis works best when the two categories have roughly similar numbers of observations. One way around this problem would be to perform the analysis hundreds of times with different sets of non-sites and then average the changes in error.

The baseline model is the point of comparison that allows the influence of the different market potential variables to be isolated. In this project, I selected the variables for inclusion in the baseline model in an informal way. This is appropriate so long as the same variables are used in both models, but it does limit the interpretative possibilities of the models. The coefficients of model variables may hold important information about settlement location decisions. In order to mine this information, however, a more rigorous variable selection method must be employed. One possibility would be to perform a principle components analysis (PCA), which combines variables into a smaller number of "components." The disadvantage is that these components are difficult to interpret, but in this case, we could run PCA on the variables within each factor. This would produce one or two components for each landscape factor which would be represent the relationship of ancient settlements to that factor as a whole. That is to say, rather than knowing that Roman settlements preferred territories with gentle slopes we could define a certain combination of slope classes that was

particularly desirable.[194] Once the number of variables has been reduced, it would be possible to examine the coefficients of the variables in the baseline model to better understand how each factor influenced settlement location in concert with all the other factors.

The method used for comparing the performance of models could also be improved. I used leave-one-out-cross-validation, a procedure meant to estimate how well the model will perform on data not used in its creation. This is done by creating a model using all of the observations except one and then trying to predict that observation and measuring the error. This is done for every observation in the dataset and the average of all the errors represents the model's performance. While generally a robust measure of model performance, LOOCV has led to some difficulties in this case. Most notably, it is difficult to interpret the meaning of an increase in model error after a market potential variable is added. This happens because models with many variables can fit the data used to construct them so closely that they fail to fit anything else. An alternative measure of model performance would be the Root Mean Square Error (RMSE). This is calculated by measuring the error for each observation in the model, squaring it, summing the results and taking the square root. The result is a measure of how well the model fits the training data rather than an estimate of how well the model will fit new data.

It would also be informative to experiment with different subdivisions of the sample area. The regional possibilities were mentioned above (section 4.1.1.2) and include dividing the areas east and west of the Yantra from each other, dividing the watershed of the Yantra from that of the Rusenski Lom, or dividing the area within a day's journey from the frontier from areas beyond this limit. It would also be possible to divide the settlements based on their landscape attributes. To do this, one would perform cluster analysis to see if there were distinct groups of settlements that consistently had similar landscapes. As noted above, this would be particularly helpful in the case of Pre-Roman settlements.

Finally, one could subdivide the market system in other ways. It would be helpful to distinguish the relative importance of cities, non-military semi-urban vici, and sanctuaries. This would be a simple matter of creating more versions of the market potential variable and testing them against the baseline model.

The methodology used in this project is susceptible to improvement, but the historical conclusions at which I have arrived based on it are unlikely to change substantially. Most of the suggested refinements promise to provide further information about ancient settlement patterns or to improve our confidence in the results of the analysis. While the precise results—the Z values, p values and measures of model error—may change, the overall conclusions are likely to be robust because they have been drawn from the results of many different analyses. This is especially true of the conclusions drawn from univariate analysis. The general picture of Roman settlements favoring productive landscapes and Late Antique settlements favoring defensive landscapes can only be proved wrong by demonstrating that the numerous results on which it rests are all biased in a consistent way. The conclusions drawn from the results of

[194] The Archaeomedes project used a similar procedure for understanding settlement location, but they did not restrict their analyses to discrete factors as I propose here (Favory and Van der Leeuw 1998; Van der Leeuw 1998).

multivariate analyses, based as they are on fewer data points, are somewhat less robust. Even here, though, the conclusion that Middle Roman settlements avoided contact with garrison settlements is likely to survive simply based on the greater density of settlements in the southern part of the sample area. What the multivariate analysis showed was that this cannot be ascribed to differences in agricultural potential and connectivity to traffic routes. For the conclusion to be overturned, then, one would have to demonstrate that the variables used in the baseline model do not capture agricultural potential or connectivity accurately and that a more accurate representation of these accounts for the distribution of Roman settlements. This is possible. If it were done, however, it would serve to refute only my approximation of agricultural potential and connectivity. It would not undermine the promise of quantitative spatial analysis of landscapes and comparative modeling for historical research.

4.2.2 Investigative possibilities

Thanks to quantitative landscape analysis and comparative modeling, we now have a much more nuanced picture of how people in the countryside south of the lower Danube interacted with the auxiliary military communities that lined the river. Unfortunately, it is impossible to say how this compares with the area to the north of the Danube and with other frontier zones. Similar analyses on settlement patterns from southern Romania would reveal how people on the other side of the river experienced the frontier. The Romanian Danubian Plain was briefly incorporated into the province of Moesia Inferior, but for most of the Roman period, this was a *Vorlimes* zone, a region into which the Empire projected power and influence, but did not undertake to govern directly. How much did this matter to the people living in the area? Was the experience of the rural settlers of the *Vorlimes* similar to that of the *Hinterlimes* zone? At stake here is the meaning of the linear frontier, whether it was a border that demarcated two different ways of life or the center of a broad, frontier zone with a coherent way of life that was distinct from more distant areas on both sides of the frontier (Whittaker 1994, 127–130). If a distinctive frontier zone can be identified, how for did it stretch to the north of the Danube and what determined this distance?[195]

Of course, the Lower Danube is only one frontier. To really understand the local economic impact of the Roman army it will be necessary to carry out this type of analysis on other frontier zones. It would be especially interesting to study areas where more is known about both military communities and rural settlements. It has long been known, for example, that some garrison settlements in Germany survive after the departure of the garrison (section 1.4). Did rural settlements cluster around these sites? Did the relationship with rural settlements change after the troops departed? Analyzing better known frontier zones could also reveal whether all garrison settlements were treated in the same way or if some were seen as markets while others were not. Were the headquarters of *alae* different types of places than the headquarters of *cohortes*? As our understanding of rural-military relations grows it is likely that regional differences will emerge, at which point we can begin to ask what accounts for different types of relationship.

[195] Here I have argued that the area within a day's journey of the frontier has different settlement characteristics to the area beyond this distance, but other proposed internal frontier zones are much larger (e.g. Bartel 1980, 21–22 for Moesia Superior).

Finally, the method could profitably be employed away from frontiers as well to test how important urban and semi-urban marketing was to peasants in different parts of the Roman world. Was Apuleius' market gardener a common figure across the Empire, common only in certain parts, or a fiction? This, in turn, will shed light on the nature of Roman urbanism itself. Did Roman cities bring about economic growth and the spread of commercialization in the countryside? How were the economic functions of cities related to their administrative and cultural functions? How did Rome's preference for city-based administration change the rural landscapes of its provinces?

Our understanding of military communities has improved immensely in the last two decades.[196] No longer viewed as a monastic enclave of soldiers, military communities are now known to have contained people of diverse ages, genders, and occupations. This social diversity, coupled with the obvious occupational specialization of the soldiers, the layout of the settlements and the expressions of civic identity sometimes found in them make these settlements look very much like small towns, leading some to consider garrison settlements as semi-urban nodes in ancient settlement systems (Poulter 1987 is an unusually early example; more recently, see Adams 2007c, 231; J. L. Davies 2002; Oltean 2007, 218–220). This is sometimes justified, but too often garrison settlements are categorized as "urban" based on the evidence of internal social dynamics while the external dynamics that constitute ancient urbanism—the relations with the countryside—are simply assumed to have been present as well. The spatial analysis performed here demonstrates that this assumption is very dangerous. If we are to understand the economic impact of the army, it is not enough to observe that garrison settlements look like towns from the inside. We must examine these places, and indeed all settlement agglomerations, from the outside. After all, the vast majority of people living in the ancient world experienced Roman urbanism from the countryside.

[196] The recent advances are vividly illustrated by comparing the programmatic statements made by Simon James in 2001 with recent scholarship, especially that focused on the roles of women in military communities (Allison 2013; Greene 2015; S. James 2001).

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