



Society and Environment in the East Mediterranean ca 300–1800 CE. Problems of Resilience, Adaptation and Transformation. Introductory Essay

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Abstract

This introductory article sets out some issues associated with the concept and theorization of ‘resilience’. We describe some historical contexts in which theories of societal resilience can be usefully deployed; we offer some challenges to critiques of the validity and usefulness of Formal Resilience Theory (Theory of Adaptive Change). Resilience, adaptation, and transformation are complex issues, and while we cannot tell the whole story through the lens of environmental change, we can integrate the various categories of evidence to attempt to focus in on where and how climate change might impact an imperial system. Using an example from Byzantine Anatolia we examine the most vulnerable segments, such as subsistence systems, with respect to the agency of elite managers and the role of religious identity. Thus we can throw light on how interconnected environmental and social factors might exert pressure on other sub-systems and thus the system as a whole.

Keywords Resilience · Causality · Adaptation · Sustainability · Society · Transformation Anatolia, East Mediterranean

Introduction

The aims of the contributions in this Special Issue are to cast light on the causal relationships between specific, historically-identifiable societal changes and developments on the one hand, and environmental change and stresses, on the other, in the East Mediterranean and Balkan region from ca. 300 to ca. 1800 CE. In the process we highlight methodological issues with respect to scale, data analysis and interpretation, as well as the compatibility of different types of data (social scientific and natural scientific); and we comment on the predictive value of modeling these relationships for understanding past societal and cultural change and for re-assessing the ways in which we interpret our different types of data. We approach these questions from the point of view of a group of social scientists and natural scientists – historians and archaeologists, and specialists in a range of environmental and palaeoclimate sciences - with a

shared set of interests. Our common agenda derives from three years of discussions aimed at establishing a shared vocabulary that will facilitate cross-disciplinary appreciation of the methodological issues faced by both groups, and contribute to a holistic understanding and explanation of a range of societal responses to environmental and other stressors.

Over the last twenty or so years increasing numbers of climate scientists have become interested in questions of broad societal transformation associated with climate and environmental change (Büntgen *et al.* 2011). This is a result of a number of convergent factors, including more sophisticated modes of analyzing a greater quantity of proxy data, an increasing sense of alarm over the effects of current accelerated global warming on human economic and political structures, and the recently articulated awareness of transformations associated with the Anthropocene epoch. This is an association that has concerned historians, geographers, and archaeologists since the early twentieth century (e.g., Huntington 1915), but until recently the resolution and scale of proxy data required to address the issues it raises in a balanced and empirically grounded way has hardly been available. Reliance on documents, written records, and archaeological remains of material culture alone can only take us so far. And while recent work addresses the transformed situation, it demonstrates at the same time some of the

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key methodological issues historians, archaeologists and climate scientists face in such joint enterprises (e.g., De Vries 1981; Kaniewski *et al.* 2010). Questions of scale need to be resolved from the start. For instance, at what scale are the climatic and environmental events observed, and how does this relate to the societal changes in question? (Rogers *et al.* 2012; also McMichael 2012). Moreover, there are difficulties in relating three very different evidential spheres. Differentiating between the various effects of the structural dynamics of a set of inter-connected or overlapping socio-economic or cultural systems – let us call them the dialectics of the system – is complex enough in itself, even before we begin to build the impact of environmental stressors into our explanation. Determining the causal value – the level of impact - of the complex interactions between climate, environment and society likewise poses a series of difficulties: some environmental or climatic shifts may have more or less significance, depending on historical context and cultural habit, for example (Rosen and Rosen 2001).

While positing a relationship between climate/environment and society is entirely reasonable, indicating or even demonstrating a clear and consistent parallel between the two does not in itself explain why or how social change occurs. More importantly for historians and social scientists, it does not explain why it occurs with the results that it had in terms of observable historical outcomes. We all recognize that simplistic one-to-one determinisms are inadequate: human social organization is extraordinarily complex, and societal reaction to change can rarely – if ever – be understood from a monocausal perspective. Even in the most dramatic and catastrophic circumstances – total inundations, for example, or the impact of major pandemic events – societal flexibility has often been such as to permit relatively rapid recovery, as the discussion below will demonstrate (Rosen 2007). Of course the articulation and configuration of social and political structures will have been impacted in a number of ways, with substantial implications for consequent developmental pathways (think of the very different medium-term outcomes of the Black Death in England and France in respect of social-political and economic organisation) (Borsch 2005: 55–66; Herlihy 1997).

One good reason for a historical perspective, therefore, is to determine how different categories of socio-political system respond to different levels of stress, with the aim of showing that such knowledge can contribute to contemporary policy and future planning. If we do not actually understand these complex causal associations over the course of a deep-time perspective, we are unlikely to generate effective answers to how and why some societal systems are more resilient or flexible than others (Tainter and Crumley 2007).

Enabling a grounded and productive working collaboration between historians, archaeologists and environmental scientists presents several difficulties. From the point of view of empirical evidence and proxy data, there must be a continuous

process of querying analytical results, modeling by trial-and-error to generate the best fit between the various types of data and the known or observable outcomes. For the historian, the task is one of interrogating the documentary and archaeological record in the context of environmental data in order to locate, as far as the evidence allows, the contours and mechanisms of societal responses to change. At the same time, both parties need to keep each other informed of their working hypotheses and methodologies, in particular to avoid the dangers inherent in trying to evaluate and make use of the outcomes of research in very different fields of scientific endeavor.

From the point of view of the historian, a key aspect of this interdisciplinary collaboration is how to deploy understanding of the cultural milieu of the society or societies in question in order to determine how people responded to environmental shocks or changes within the framework set by the culturally available options at their disposal. What sort of technological knowledge inhered within the culture, for example, and what were the ideological constraints that limited responses and action? Societies do not always respond with the ‘right’ answer to crises, and the reasons for their failure are more often than not to be sought in the constitution and contents of the dominant belief-system and its inner logic (a criticism that can be leveled at the approach in Diamond 2005). Our rationality may not be theirs, even in the most unsustainable and existentially threatening circumstances. For example, this may be the case in localities which show more resources devoted to accelerated temple-building in times of rainfall uncertainty, rather than water-management systems, such as proposed for the end of the Early Bronze Age in the Southern Levant (EB III) (Rosen 2007).

Of course, we may not have the data to reveal causal mechanisms in detail. We may also be faced - as for the early expansion of Islam, for example - with major problems with respect to the reliability of the earliest historical documentation, on the one hand, and an overlay of religious ideological exegesis and re-writing of the documentary record, on the other, requiring particular attention to causal associations. But where enough archaeology and historical documentation is present, deployed in association with the proxy data generated by environmental scientists, and within a robust conceptual interpretive framework, we should be able to begin building sophisticated, causally-complex interpretations to help construct plausible hypotheses about those areas for which historical evidence is less readily available and to serve as pointers for future work.

The complexities of interpreting numerous proxies for climate and culture change as they occur over multiple scales of space and time require a well-defined and socially explanatory conceptual framework that accommodates interactions between diverse variables. Three key concepts have come to the fore in recent discussions about societal collapse or

survival: resilience, adaptability, and transformation. There is a vast literature now available on the topic of resilience, including the history and use of the concept in different debates, its value as a descriptive analytical term that can help us understand societal change, and its use in policy design and effectiveness in terms of contemporary concerns in environmental and ecological planning (for example Olsson et al. 2015, Alexander 2013). Resilience has, on the face of it, a relatively straightforward range of meanings having to do with flexibility, elasticity and resistance to stress, or at least returning to a previous state after experiencing stress. But it has also been deployed with some very specific conceptual values. Most recently the concept of resilience has been a focus for a review of work on collapse and adaptation in complex socio-cultural or natural systems, and a unifying social–ecological framework proposed that attempts to redefine some of the terms of the debate. This line of thought further argues that since the basic structural dynamics of a societal system contributes to the types of collapse to which it may be subject, systematic theories of collapse that unite structure and process are the best way forward in applying historical examples to contemporary planning initiatives with respect to environmental problems (Cumming and Petersen 2017). This systematic approach is a helpful conceptual construct, especially when allowances are made for individual human agency.

Resilience and Complexity

Formal Resilience Theory, or the Theory of Adaptive Change has as its basic unit the Adaptive Cycle, in which a Social-Ecological-System (SES) moves through stages. These stages are of increasing complexity, connectedness and conservatism (growth, or r-Phase) until the system reaches a stage in which networks are over-connected (stability, K-Phase), limiting the system's ability to respond effectively to exogenous or endogenous points of stress. The resulting Ω -Phase (of catastrophic shift) constitutes a 'release', opening the system to many possible responses, new and/or traditional. The Ω -Phase passes rapidly into an α -Phase which is highly resilient and loosely structured, resulting in reorganization of the system and leading to a new equilibrium with different key characteristics from those previously dominant.

Adaptive cycles link up in nested multi-scalar systems known as 'Panarchy', in which a series of small, fast SES cycles intersect with larger, slower ones (Gunderson et al. 2002; Holling 2001). But catastrophic system-wide change at the higher level can only take place when there is a coincidence in the level of vulnerability or fragility among all or most of the different adaptive cycles from which the system as a whole is composed. Without such a convergence there can be no breakdown or collapse, and it is precisely because different adaptive cycles operate at different scales that

Panarchy is neither a deterministic nor a monolithic system. The Adaptive Cycle thus integrates the rising or declining potential of a Complex Adaptive System with the levels of connectedness that inhere within it.

At smaller spatial and temporal scales, it appears that these systems are continually and profoundly changing as they move through each phase of the cycle. Thus it would seem they are not stable, sustainable or resilient. However, by considering the entirety of the adaptive cycle, the systems have the capacity to progress through the four phases described above. By doing so, they incorporate a 'memory' of the previous stages, and thus maintain the form of the System over the long term. This deep-time or larger-scale perspective is consistent with a built-in elasticity and capacity for adaptation without fundamental change. This of course is a conceptual model and living systems do not always progress through these phases in a unidirectional manner (Walker et al. 2004).

Resilience has been deployed in ecological studies as a way of representing the potential of a given ecosystem to absorb changes and deal with stress factors while retaining its fundamental systemic characteristics (Perrings 1998; Holling 1973). Most recently, the concept of resilience has been exploited by social scientists and others to describe the ways in which social groups and communities deal with economic, political and environmental shocks. In all these examples, resilience is taken to imply the ability of a 'system' to withstand the changes stimulated by stress factors of varying degrees and types and to retain its fundamental shape and defining characteristics (Brand and Jax 2007).

In these ways, the concept of resilience is distinct from the concepts of adaptability and transformation. Resilience may be defined as the capacity of a given system to absorb energy and to redirect or to convert it, without losing the fundamental features and shape of the system as a whole. Adaptability and sustainability are concepts related to agency, and can be a measure of the capacity of individuals in a system to manage resilience. Their presence in a system reflects the degree to which there exists a conceptual and decision-making framework that is able to respond to stress-factors and challenges, physical/environmental or conceptual, and guide societal responses. Transformation relates to the unsustainable phase of the Adaptive Cycle, and occurs when external forces (such as climatic or environmental change) and/or internal pressures (social or political) stimulate responses that generate non-linear changes in systems and social or ecological environments, thus driving the system to become fundamentally new and different (Walker et al. 2004; Anderies et al. 2013; Pelling et al. 2015).

The concept of Resilience in this more heuristic form provides an alternative to examining human social processes and political-economic systems exclusively at the largest scale. That approach leads to conceptualizing large monolithic units of study such as a 'state' or an 'empire' as one body that reacts

to environmental or other external stresses in a unified manner. A much more informative approach is to take a multi-scalar view of these systems within a context of climatic and environmental change, to compare and contrast the subsystems as interlinked adaptive cycles that may prove resilient or, conversely, may suffer from over-connectedness and rigidity over short or long-term time frames. This approach necessarily brings with it answers to the question ‘resilience of what, to what?’ (Carpenter *et al.* 2001). One such example is work in the American Southwest by Nelson *et al.* (2010) who examined the impacts of climate change and the trade-offs between resilience and vulnerability in three very different irrigation planning strategies among the Zuni, Hohokam, and Mogollon Anasazi societies. In their study, they showed that the Zuni irrigation systems were small-scale water-control systems that had a much lower level of complexity than the Hohokam irrigation technology, which was based on extensive canal networks. The Hohokam system invested in a substantial infrastructure that minimized the effects of hydrological variation and increased the agricultural productivity of the desert. But this investment led to vulnerabilities due to population growth and depletion of resources (Anderies 2006). The simpler Zuni agricultural system was impacted by short-term changes in hydrological productivity, yet the Zuni mitigated these points of stress by maintaining social flexibility to migrate during times of environmental degradation.

Researchers may effectively apply resilience theory (or the Theory of Adaptive Change) to ancient Mediterranean empires by comparing and contrasting components of these large complex systems rather than analyzing empires as a whole. For example, concentrating on subsistence provisioning at the level of colonies at the peripheries of the empires versus the core of the empire, or satellite farming villages within the hegemony of a state. Subsistence is a key subsystem of the economy since it is one of the most sensitive to climate changes; moreover, agricultural economies of the peripheries of empires and states functioned differently from the large cities of the core regions, with different parameters of connectedness, resilience and rigidity. Abandonment and apparent ‘collapse’ of populations during times of environmental stress may give the appearance of a lack of resilience, particularly since it is often the most archaeologically and historically ‘visible’ systems that disappear, such as monumental architecture and the infrastructures that initiated them (Nelson *et al.* 2006).

But in studying the inevitable ‘reorganizations’ that ensue, it is evident there are often elements of previous social, economic and political entities that persist as strong cultural transmissions. This persistence indicates that only parts of the infrastructure lacked resilience, while much of the social institutions and culture remained intact (Nelson *et al.* 2006). So researchers need to define carefully what exactly it is that they think collapsed. A political system of power-relationships or a fiscal apparatus based on certain forms of income and societal

relationships may break down or collapse without in itself leading to societal collapse *tout court*. For example, the social relations between farmers and consumers of their goods, between peasants and landlords, between urban and rural markets and producers may not ‘collapse’ in the same way and with the same outcomes as the collapse of a political structure. So to speak of collapse requires us to differentiate between the degree, intensity and speed of the changes located in the historical record. And the only way to do that, as we shall see, is to examine the individual cases in both as much detail but also as holistically as the evidence and data permit.

For the purposes of the present contributions, therefore, we will adopt a theoretically and methodologically pluralist approach, in which resilience-theoretical paradigms will be employed where appropriate within a multi-scalar analytical framework prioritizing human agency as a driver of adaptability. But human agency is, of course, constrained by social-institutional boundaries, including the culturally-determined rationalities of the societies in question, legal and bureaucratic structures and practices, institutional arrangements of the state or dominant political organizations, sets of socio-cultural relationships that define economic relations, and access to and consumption of resources. All these should be understood as operating within the framework established by the dialectic between environment and social action at multiple scales of analysis. Our central motif is thus setting human agency - in all its variously structured forms, including the subjectivity, indeterminacy and spontaneity of agents in their societal loci - within an ecological context in order to interrogate the dynamics of change. This is an important point, emphasized in recent discussion on ‘quantum social theory’ and its advantages when attempting to take these aspects of human social praxis into account with regard to contemporary policy-making processes (O’Brien 2016; Wendt 2015; Haven and Khrennikov 2013). In this respect, therefore, ‘resilience’ will be employed primarily, and unless otherwise specified, to mean the capacity of any set of socio-economic and cultural relations to respond to pressure and stress - of any kind - in such a way as to permit the survival of the fundamental patterns of said relations, even if significant inflections and nuancing of the original framework does take place in the process.

We perceive this view of Resilience as consistent with a Sustainable System in the sense that sustainability includes the capacity for change in controlled and sometimes predictable manners that allow the flexibility of subsystems to cycle through changes in the adaptive cycles while maintaining the fundamental integrity of the system. This is very different from the unsustainable transformative change, which results in new social and/or environmental parameters that lack cultural or ecological continuity (Berkes and Ross 2016).

Analyzing Societal Complexity

Historians and comparative social scientists require different strategies for different problems. For the study of those cultures for which there exists little or no written testimony, we need to deploy models based on a broad appreciation of the dynamics of human social existence, situated within the known material cultural context – the archaeology, for example – in order to try to understand how change and transformation took place. For cultures where literacy is well-established, even if limited to certain socio-cultural groups, we can deploy the same approach, but we can also test this approach by invoking the documentary evidence at our disposal as well.

One concept that can become problematic in this discussion is that of ‘society’. Societies or social systems have been classified under various headings, largely dependent on the research agendas of those who do the describing. In the work of Émile Durkheim, for example, we find a distinction drawn between ‘segmented’ and ‘organic’ socio-economic structures, where the first category describes societies in which the parts are merely a range of loosely-connected or juxtaposed replicas of one another, and the second describes societies that display complex differentiation with organic relationships between the different elements. There are others, but the point is that they are all functional, that is, they serve a heuristic purpose in the terms of whichever debate or discussion generates them, intended to highlight and clarify particular types of relationship or institutional arrangement. In the end, a single universal definition is pointless, since each contributor to a given debate about a specific society will have his or her own particular questions to ask and own research agenda. This is especially important to keep in mind as we investigate the differing effects of external stresses induced by adverse climate change on subsystems and institutions of a given society and the relationships between these subsystems.

This is an important point, because the concept as well as the term ‘society’ or ‘social system’ is problematic from another point of view. As has been pointed out, it can mislead us into thinking that a particular society is in many respects a bounded entity, distinct from or separated from the societies around it (see discussion in Mann 1986: 1–33). But this cannot be the case throughout most of history. To start with, even where obvious religious or ideological boundaries exist, the people of different creeds on either side will inevitably have things in common, such as agrarian practices and domestic economic organisation, particularly in situations where climate and seasonal factors are common to both. Peasant farmers in the Balkans or in southern or eastern Anatolia in the eighth and ninth centuries CE on one side of a political frontier can hardly have differed greatly in the seasonal practices which dominated their agrarian existences from similar communities on the other side of the political divide. Yet at a

different level there may have been real and obvious differences – in habits of worship, in language and dress, in the vocabulary, expression, and instrumental value attributed to different positions within a set of kinship relations, and so forth. In other words, there are multiple, layered overlaps bridging the political, religious or linguistic divisions that we commonly identify as marking the boundaries of a given society. In discussing a given ‘society’, we need to bear in mind that in practice social boundedness is challenged at every turn.

Treating social-economic systems as such, as bounded entities, is thus inherently problematic. Yet much of the discussion about the resilience, robustness or sustainability of contemporary as well as earlier societies depends upon treating societies in this way, since in order to analyze any system its boundaries or limits need to be defined. While this does not invalidate this approach – far from it – it does mean that key issues of scale (temporal and spatial) need to be taken into account so that each system is appropriately described. Boundedness is represented in different ways through different forms of social praxis, social institutions, economic relationships, as well as through temporal and spatial – territorial – scales. No complex socio-political system exists in a vacuum. The causal connections between the dynamics of any culture or polity and the wider conditions of its existence are generally such that ‘external’ and ‘internal’ elements are closely linked (Turchin 2003; Turchin and Nefedov 2009). Foreign policy, for example, can reflect both the needs of a ruling dynasty, an elite establishment or a state in maintaining or enhancing its international position as well as the vested interests of the same groups within their own society.

A second important point bears upon the role of ideas and belief: the fact that patterns of belief affect the causal logic or rationality of a culture and therefore the way that culture (or parts of it) react to challenges or stresses. Work relating to questions of societal resilience, collapse, or transformation have often left out or ignored this fact, resulting in overly simplistic accounts of causal relationships that in fact may be crucial to understanding the societal response to environmental or other stress (Haldon 2014: 220–235, 2016: 12–15). Yet this bears fundamentally on issues of sustainability and adaptation, as noted already. This is evident, for example, in analyses in which collapse, transformation, resilience and survival are described in terms of complex or simple social-institutional and political arrangements. Here, a high degree of complexity is understood to have a much more fragile internal balance due to over-connected chains of command and over-committed institutions and resources that are slow to respond to external stress, whereas institutionally and organisationally simpler social systems often (if not always) possess a greater degree of flexibility in the face of adversity, due to their greater capacity to accept innovation and change. On closer examination, though, the ‘thought-world’ of the social-cultural systems dealt with receives little or no attention

as parts of a complex of causal relationships. There is a tendency to present developments as though people at the time were conscious of the larger picture – environmental and political – that they inhabited, and as though they made conscious choices towards simplification – perhaps an unintentional by-product of the influence of organisation- and systems-theoretical approaches (e.g., Tainter 2000a, b: 4–10). The result is that we have an explanation that goes only some of the way to helping us understand why, for example, the eastern Roman state survived the crisis of the seventh–eighth centuries CE, or why the Third Dynasty of Ur collapsed in the later third millennium BCE, or why the Abbasid state fragmented after the later ninth century (Tainter 2006, 2000a, b, 1988; Allen *et al.* 1999). Such an approach makes much more historical sense – and is heuristically more useful – if we acknowledge that the potential for such processes inhered to different degrees at different levels or scales within the structures of a given socio-cultural system.

The degree to which certain key ideas are held across a society as a whole, or the extent to which the beliefs and ideology of the dominant political elite are relevant or irrelevant for the day-to-day interests and identities of the mass of the population, has a crucial bearing on social cohesion, whether in times of stress or not. It must be a significant factor in how a given state system organizes its control of resources and whether it has the internal strength or flexibility to weather particular political, social or economic crises or longer periods of pressure. Popular beliefs are never simply a fixed quantity; and even where we have some idea of those beliefs, at any period of human history, we cannot explain actions and responses as a direct consequence. Beliefs, and how they fit into the broader complex of concepts and tacit knowledge that people have of their world, certainly set limits to and/or facilitate how they respond and react to their environment. Beliefs respond to perceptions of the world as much as they represent a narrative about the world: a dynamic interaction that implies conjuncture and contingency.

Yet at the same time, how people respond to changes they see or events that concern them does permit us to limit the range of motives underlying those actions and responses. While we cannot know much, if anything, about the beliefs of most individuals who populate the history of the eastern Roman world, for example, we may still deduce something of their views and of the issues that concerned them from their reactions to events as described in chronicles and histories, in letters and in sermons, in the acts of church councils or in the writings of hagiographers and theologians. The extent to which a religious ideology or a political theology of rule and rulership penetrates to the roots of a society affects both the way in which people perceive and respond to the challenges they face, even whether they perceive them at all, as well as the means through which a cultural system hangs together under stress. Belief systems are also not static. When given

enough information, we can model their changes as they pass through adaptive cycles of resilience (α -Phase) through institutionalization, leading to rigidity and vulnerability (K-Phase). Only by taking such factors into account (where we have the evidence, naturally) and seeing how they overlap, interlink and act upon one another, can we hope to glimpse something of the social mechanisms behind people's actions and the reasons why a particular culture or system responds effectively or fails to respond to the challenges it faces at different times (Goldstone and Haldon 2009: 11–15). But again, we must keep in mind a multi-scalar approach and consider the contingencies, since any complex society is an amalgamation of social groups, each with potentially differing motivations, belief systems and varying capacities for adaptation and change.

Complexity and dynamism are key aspects of most social-cultural systems, even if they vary considerably in degree from one case to another. A number of scholars have looked for the reasons behind the collapse of these systems from the perspective of their increasing complexity and sophistication. As Tainter emphasizes, the more complex they become, the finer the balance between the mutually-interdependent parts of which they consist and the greater the potential for disequilibrium to set in when one feature becomes unstable, generating a domino-effect breakdown of the whole. This is a useful way to think about large-scale systemic breakdown in, for example, patterns of trade and exchange, as well as in respect of international political systems (Sherratt 2003: 53–54; Bell 2006: esp. 15, regarding ancient trading systems). But we need to be careful not to turn the tendency into a general principle, since complex systems may also demonstrate great flexibility, and resilience is a key feature to look out for in these systems. Indeed, resilience is perhaps a more constructive way to think about non-collapse and collapse, whether we think in terms of a single cultural entity or an international system (e.g., Rosen 2007; Middleton 2017). Resilience is now a key theme in contemporary environmental planning, for example: see the webpages of the Resilience Alliance: <http://www.resalliance.org/>).

One complementary approach to some of these questions is embodied in 'complexity theory'. Here the aim is to account for the result of interactions among systems and sub-systems over a specific period of time and in a specific context. Also described as the science of 'non-linear dynamics', it was taken originally from mathematics (for example, chaos theory), computer science and the physical sciences. Its basic point is to challenge the assumption of linear explanation and causation. Even within behaviour-determining social, institutional and environmental contexts, the interplay of multiple human actors with one another renders causation unpredictable, instead resulting in 'emergent' social praxis. Since societies and states can be seen as complex adaptive systems, emphasis is placed on the unpredictability of possible outcomes (or, in historical terms, of knowing all the causal elements leading

to a particular outcome) (Johnson 2009: 3–17; Middleton 2012; Lewin 1999; Byrne 1998). To some extent, of course, this describes what historians have always done when working at this level of causal explanation, but the introduction of the term and the ideas it embodies is a useful reminder of the complex nature of causal dynamics in a historical context. ‘Chaos’ does not signify something random or arbitrary, since while human societies are chaotic, in the sense deployed in complexity theory, they are not necessarily random. All human social action is constrained by certain physical and spatial conditions as well as by pre-existing cultural limitations and norms (if this were not the case, the writing of history as causal analysis would be impossible). This is the point at which quantum social theory and complexity theory intersect, although historians have for the most part paid little attention to the possibilities that this might offer. But it does force us to pay greater attention to the range of causes and effects that are possible within a given historical context, and the fact that however multi-factorial and sophisticated, no historical model can predict a historical outcome, even if it can help to explain why one particular outcome rather than any other in fact prevailed.

The other central feature of historical analysis is its processual aspect. Historians aim to identify particular conjunctures, or points at which a set of relationships (a ‘system’) is confronted by pressures that promote changes or shifts. Resilience theory, as deployed by prehistorians and archaeologists of pre-literate cultural systems to account for the processes that bring about change, is certainly helpful here. Historians may take as a starting point the nature of the adaptive cycles that the evidence reflects, in terms of strategies of risk minimization (in periods of insecurity or stress, whether environmental or anthropogenic) or maximization (in times of stability and demand for increased gains from production processes and relations of exploitation). They can read the evidence against the range of possible alternative interpretations it permits in order to theorize the ways in which different types of political organizations, from small-scale lineage structures to imperial systems, respond to challenges with more or less success. Resilience theory offers a set of paradigms within which historians and archaeologists might try to understand their often highly problematic and patchy data. To be heuristically useful, as underlined already, it needs to take into account as much as can be known about *mentalités*, about attitudes and beliefs, about the ‘world view’ of the cultures in question. This is always a very problematic area, but it is essential insofar as social practice, and the ability to react effectively to changes in circumstances, are also built into the thought-world, into the conceptual environment inhabited by people in the society under study (e.g., Gunderson and Holling 2002; Gunderson and Pritchard 2002; Butzer 2012).

Finally, the power relations within a historical culture play a critical role. Disaffected elites, for example, can rapidly

undermine a central imperial or state regime, whether in difficult times or not. The structure of political relationships between center and periphery or province, between different elements of a segmentary elite founded on kinship and clan identities and between these and a central political authority – as well as between all of these and the producing populations of the major cities and the provinces – also play a crucial role in determining the potential for a political system to respond to environmental or political challenges. So looking for ‘simplification’ as a response to such challenges needs to take account of both the multi-faceted as well as the multi-causal nature of social and cultural praxis.

Case Study: The Eastern Roman (Byzantine) Empire ca 650–750. Complexity, Resilience, Adaptation

The examples and case studies in this issue both illustrate how we might set about grasping the complexities of societal responses and adaptive strategies and also offer some examples of the varied and largely unpredictable ways in which human social systems can respond to pressure. As a brief illustration of the complex and dynamic interplay between environment, social and political institutions, cultural identities and religion, we may survey the case of the medieval Eastern Roman Empire (known as the Byzantine empire) in the period from the early seventh and well into the eighth century. The dominant power in the Mediterranean in the sixth century, with territory stretching from southern Spain and N. Africa in the west and south across to the Syrian desert in the east, its power collapsed in the first half of the seventh century following wars with the Sasanian empire in Iraq and Iran and then with the expanding Arab-Islamic empire. Between the early 630s and 740s CE, the empire lost some 75% of its territory (Fig. 1a and b) and an equivalent portion of its annual revenue. How it survived such a catastrophic loss, and how it was able to recover stability and go onto the offensive in the later ninth and tenth centuries has traditionally been ascribed to the brilliant leadership of certain of its emperors, such as Heraclius (610–641 CE) who, it used to be thought, introduced an entirely new system of military recruitment and finance; or to the fact of internecine fighting and civil war in the new Arab-Islamic polity during the later 650s, 660s and 680s; or to the ‘simplification’ of state administration; or to a combination of some or all of these (Tainter 2000a, b, for example). In fact, there are many other factors, among which environmental aspects have hitherto been largely disregarded.

Describing the Eastern Roman empire as a Complex Adaptive System provides a helpful heuristic framework for representing societal complexity, precisely because it foregrounds the need to differentiate between the different sub-systems or adaptive cycles within the whole (Poblome 2014),



Fig. 1 a The east Roman (Byzantine) empire in the sixth century CE. b The east Roman (Byzantine) empire ca. 717 CE

while also keeping in mind that not all aspects of the system were bounded by the same constraints. From this perspective the eastern Roman empire can be described as a panarchy as discussed above, within which its socio-cultural institutions, economic relationships or political arrangements on the one hand, or its provinces and their societal infrastructures on the other can be understood as sets of interconnected adaptive cycles. Thus kinship structures and terminologies, families and households; systems of property-rights, land-tenure and control of resources; status identities and social class; or urban-rural relationships, exchange networks, linguistic variations and so forth each represent a particular adaptive cycle with its own temporal and spatial rhythm.

As we have noted, identifying an adaptive cycle helps to isolate the quantitative nature of change within a system or set of systems and to assess its qualitative impact on the whole. Different levels or instances of societal being can thus be described, functioning at different timescales; and the ways in which these different systems interact can help to identify the reasons for the particular historical trajectory appearing in the data. In the case of the Eastern Roman empire and the so-

called crisis of the seventh-eighth centuries, therefore, we might consider the following as systems, and thus subject to adaptive cycles: (1) the symbolic universe and its component sets of beliefs and political ideologies; (2) the basic economic cycle of production of food and necessities (taken in both its cultural and environmental contexts) and the economic/socio-economic class relationships through which these are articulated; (3) political-institutional arrangements (control of resources and their appropriation, distribution and consumption; administration, military organization, justice, court and government organs); (4) local and interregional networks of exchange and commerce; (5) local and international political relationships; (6) conjunctural challenges. In terms of social praxis these are all inextricably connected, in part because of a shared geographical and spatial context, in part because of a shared historical trajectory. At the same time, a micro-analysis of each would no doubt reveal and isolate further sub-systems and cycles.

Each of these six basic instances (which we might also describe as systems) operates on a different chronological and temporal scale from the others. The basic economic cycle

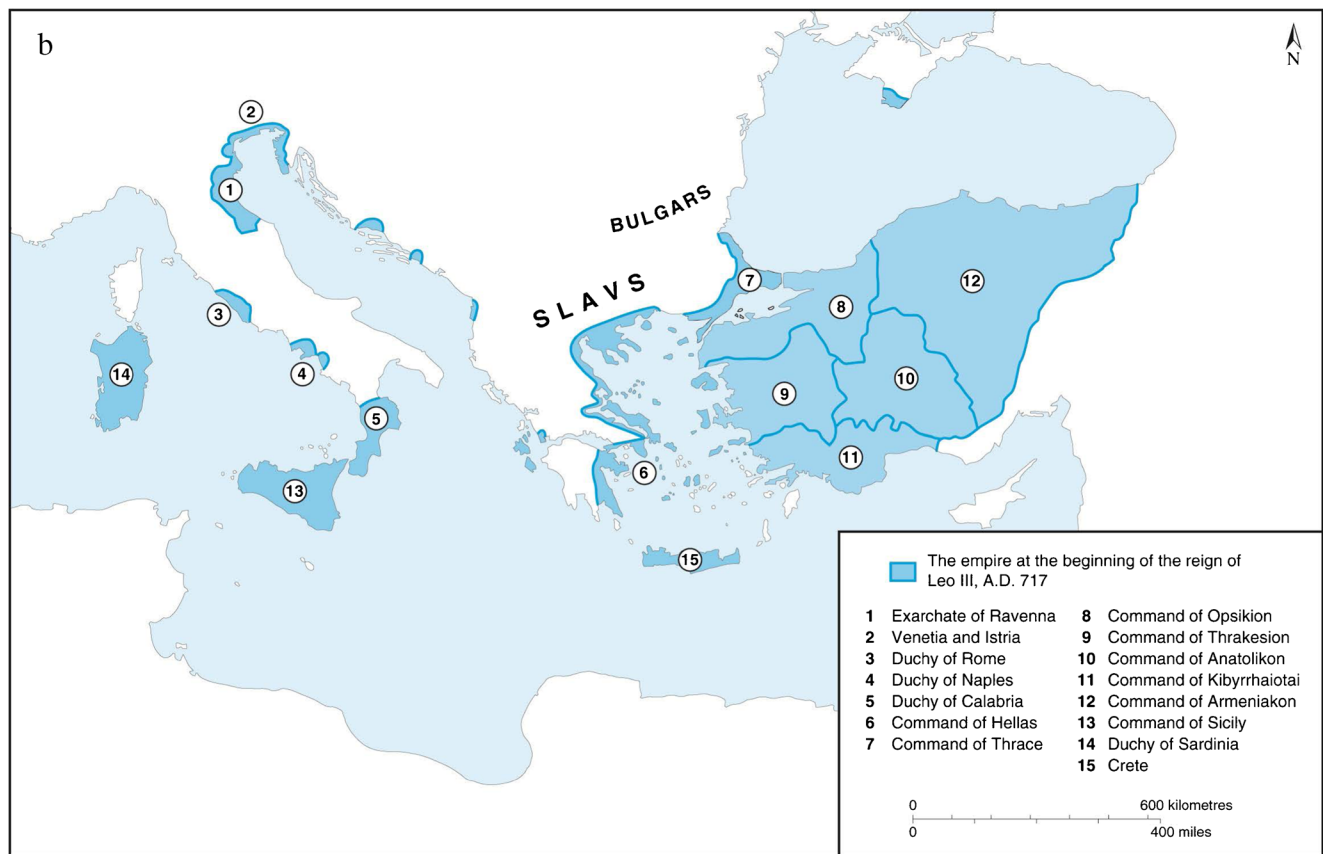


Fig. 1 (continued)

of production of food and necessities was determined by the landscape and geography of the empire's territories, and in particular those of Anatolia. Arable and pastoral land here was, with sub-regional variations, put to relatively intensive use during the sixth and first decades of the seventh century, characterized, in effect, by complexity, connectedness and eventually conservatism: an r-phase leading into a K-phase. Both the palynological and the archaeological evidence indicate that much of the region was densely inhabited and characterized by mixed farming. Much of Anatolia experienced a rather wetter climate than hitherto during the sixth and up to the later seventh century, stretching in some areas into the early eighth century (Fig. 2). This is a pattern that is supported by textual evidence, with a comparatively greater number of very severe winters and apparently unusually severe frosts and snows, but with relatively few events related to periods of aridity or drought and similar climate issues. But the evidence for agriculture, and for what was being produced from the land, does not parallel these climatic changes. Pollen data show that beginning in the middle of the sixth century the intensive and relatively homogenous exploitation of land in Anatolia receded. There took place a simplification of the agrarian regime. At different rates according to area, the established pattern was gradually replaced, by either natural vegetation or a more limited range of crops, with a particular

emphasis on grain and livestock at the expense of viticulture and oleoculture (Fig. 3 and Table 1).

The onset of this simplification cannot always be made to coincide with known political events, such as the impact of warfare and the Arab invasions, nor can it be made to fit neatly with any single 'climate change' event. Nor indeed were the political consequences of the warfare of the period all on one side. Indeed, there is pollen evidence for 'rupture' in the rural economy on what becomes from the 640s and 650s the Arab side of the frontier, too, at Golbaşı (between Malatya and Diyarbakir), in what would have been a similarly-challenged frontier zone: this is a subject that has thus far received no attention at all from historians. Importantly, in some areas of Anatolia the simplified regime does indeed coincide with the onset of the more humid conditions, but in others it begins much later without any obvious environmental stimulus, and in others there is no change at all. This development might be described by the crisis and catastrophe – as an Ω -phase – of the Adaptive Cycle. So a first conclusion must be that while some farmers responded to a change in their environment, others did so only later and in response to different pressures, while yet others did not need to introduce any changes at all. Why might this have been the case?

The shift towards a grain and livestock-focused agrarian régime does seem to intensify during the Arab-Islamic

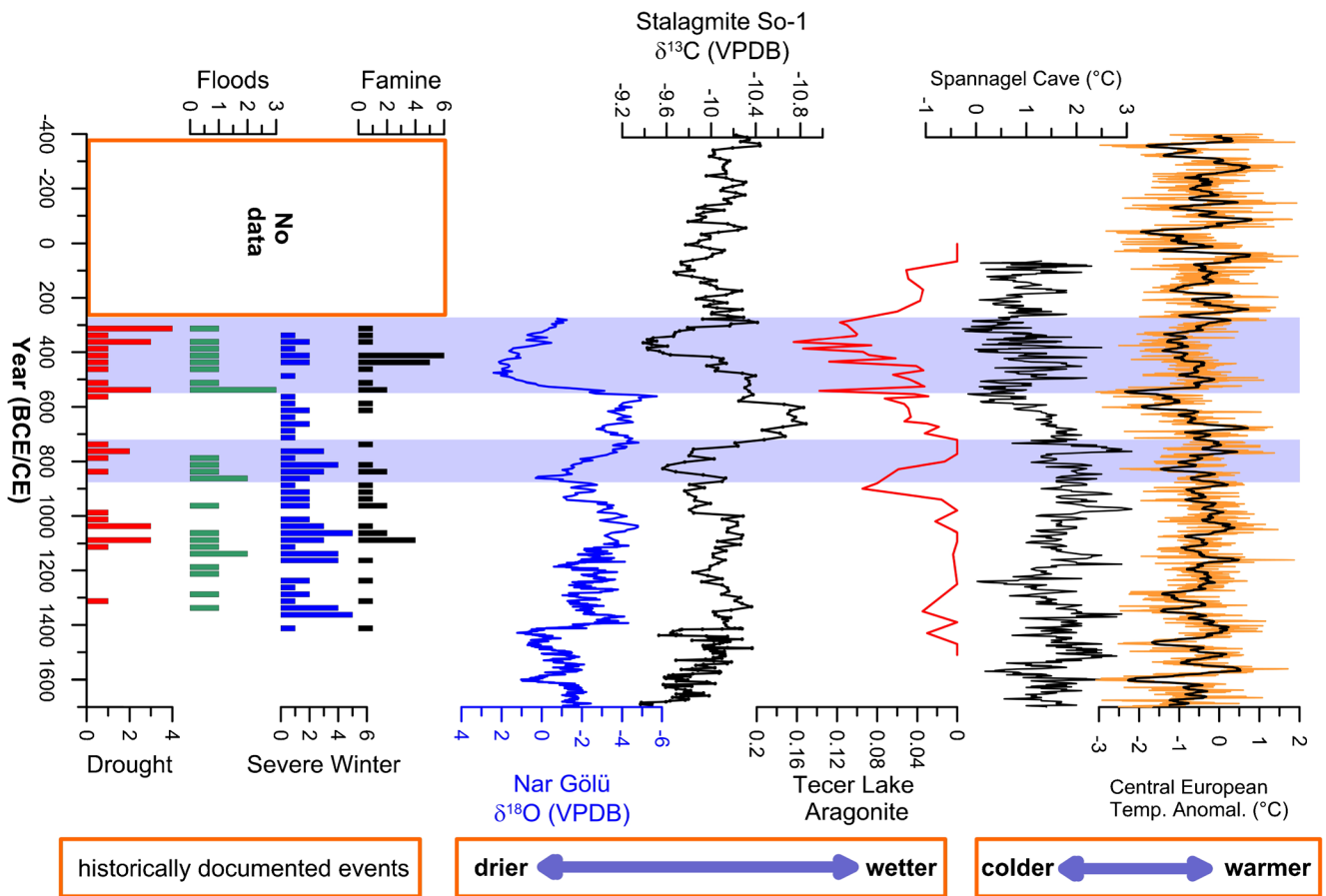


Fig. 2 Historically documented climate-related events, climatic moisture conditions in central and western Anatolia and proxy records of temperature from Central Europe. Shaded bars mark notable periods of dry climate (after Haldon *et al.* 2014)

invasions and raids into Anatolia, which had significant consequences for urban life and the demography of the region. It is here that the response of the eastern Roman state becomes

especially relevant. One factor that played a role is that of the grain supply of the empire (Fig. 4). The loss of Egypt in 618 to the Persians, and then permanently to the Arabs from 641, was

Fig. 3 Sites with pollen data for the first millennium CE in central and western Anatolia (after Haldon *et al.* 2014). Site numbers in Table 1

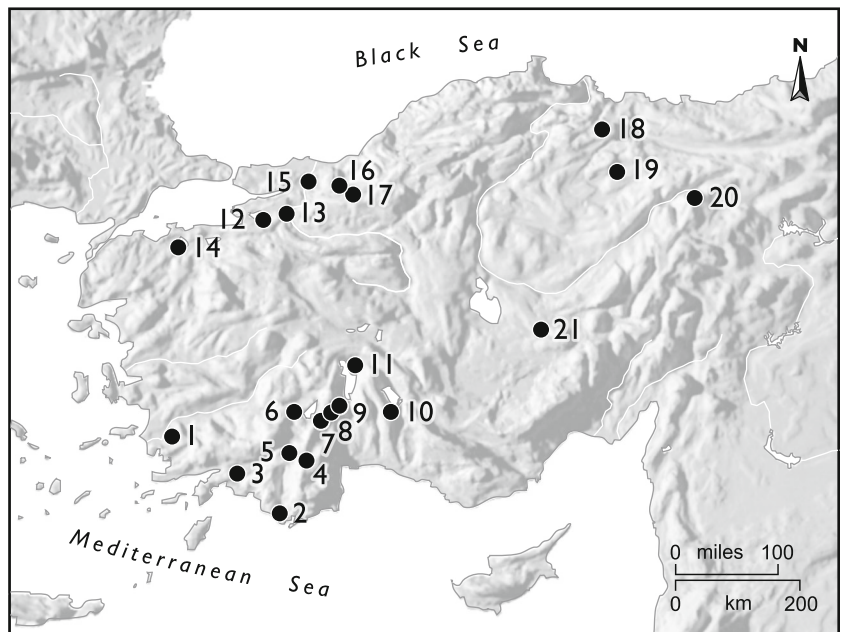


Table 1 Estimated end dates for the BOP in Anatolia. After Haldon 2016, Fig. 6.2; Haldon *et al.* 2014, Table 2 (based on Izdebski 2013: 145–201)

Site number	Site name	Estimated end date	Age-depth model (number of radiocarbon dates)	Original publication
Aegean Coast				
1	Bafa (n/Miletus)	3rd c. CE	Radiocarbon-based (3)	Knipping <i>et al.</i> 2007
South-Western Asia Minor				
2	Ova	2nd c. BC?	Radiocarbon-based (2)	Bottema <i>et al.</i> 1984
3	Köyceğiz	2nd–3rd c. CE	Radiocarbon-based (2)	van Zeist <i>et al.</i> 1975
4	Söğüt	4th–5th c. CE	Radiocarbon-based (2)	van Zeist <i>et al.</i> 1975
5	Göhlhisar	Mid-7th–mid-8th c. CE	Radiocarbon-based (11 for 3 cores)	Eastwood <i>et al.</i> 1999
6	Pinarbaşı	9th–10th c. CE	Radiocarbon-based (2)	Bottema <i>et al.</i> 1984
7	Ağlasun	7th–8th, or early 11th c. CE	Radiocarbon-based (5)	Vermoere 2004/ Bakker <i>et al.</i> 2012
8	Bereket	Early 4th c. CE	Radiocarbon-based (11)	Kaniewski <i>et al.</i> 2007
9	Gravgaz	Mid-7th c. CE	Radiocarbon-based (7)	Bakker <i>et al.</i> 2012
10	Beyşehir Gölü I	4th–6th c. CE	Radiocarbon-based (2)	van Zeist <i>et al.</i> 1975
11	Hoyran	4th–6th c. CE	Radiocarbon-based (1)	van Zeist <i>et al.</i> 1975
Bithynia				
12	Adliye (n/Iznik)	6th–7th c. CE	Radiocarbon-based (2)	Argant 2003
13	Göksü (Iznik)	6th–7th c. CE	Radiocarbon-based (2)	Argant 2003
14	Manyas	8th c. CE	Radiocarbon-based (2)	Leroy <i>et al.</i> 2002
15	Küçük Akgöl	5th–6th, then 11th c. CE	Radiocarbon-based (2)	Bottema <i>et al.</i> 1993
16	Melen	10th–11th c.	Radiocarbon-based (1)	Bottema <i>et al.</i> 1993
17	Abant	11th c. CE	Radiocarbon-based (5)	Bottema <i>et al.</i> 1993
Pontus				
18	Ladik	8th–9th c. CE?	Radiocarbon-based (4)	Bottema <i>et al.</i> 1993
19	Kaz	5th–6th c. CE	Radiocarbon-based (2)	Bottema <i>et al.</i> 1993
20	Demiryurt	6th–7th c. CE	Radiocarbon-based (1)	Bottema <i>et al.</i> 1993
Cappadocia				
21	Nar	670 s CE	Varve years	England <i>et al.</i> 2008

a serious blow, because Egypt had been the breadbasket of the empire. New sources of grain for the capital were needed, while the presence of armies in Anatolia from the 640s and 650s onward also meant that the provinces had to feed substantial numbers of additional mouths, both human and animal. Documentary evidence for fiscal and resource management from the 660s into the first half of the eighth century suggests that the empire was able to reorientate its management of both the Constantinopolitan supply as well as the centers of grain production for some of its provincial armies. Northern Anatolia (the Pontic region stretching from Paphlagonia eastwards) seems to have stepped in as at least one substantial supplier (Haldon 2016: 215–282).

The simplification of agrarian output across Anatolia, and more especially the greater emphasis on cereal production and livestock, were opportune for the eastern Roman state under the intense pressure that it experienced at this time, especially pressure on the fisc to generate the supplies needed by its armies: livestock and grain, or precisely the products that the

pollen record suggests came to dominate. The proxy data for the production of cereals (Fig. 3 and Table 1) thus supports this hypothesis, even if other causal factors (such as changing patterns of demand and market relations) also contributed. There were precedents. For example, the Roman government in fifth-century Italy seems likewise to have been able, through fiscal pressure, to encourage landlords and landowners to increase emphasis on grain production, so the response of the government in Constantinople during the later seventh century was not without precedent and was clearly possible (Haldon 2016: 281). We may thus suggest that it was the state, through its fiscal system, that contributed to this shift in the pattern of agrarian output. Evidence for a change in technical language in the tax system and in the military administration of the empire supports such a conclusion – this was, in Hollings' model of the Adaptive Cycle, the α -Phase, of systemic reorganization. Paradoxically, the conditions of climatic instability that provided the background and context for the gradual transformation of the Roman Empire in the



Fig. 4 Grain sources of the Eastern Roman Empire 6th–7th c CE

course of the third-fifth centuries were precisely the conditions that – along with a range of other political, social and economic factors – permitted the survival of the eastern Roman state in the seventh century. Here we see the consequences for a historical society of the adaptation of individual farmers to changing environmental and market exchange circumstances, a response or reaction that took place, however, in part at least because the central government was itself responding flexibly to pressures placed upon its administrative, military and fiscal arrangements resulting for demographic changes and warfare.

While these conditions might seem at first glance a sufficient explanation for the empire's survival, several other elements need to be taken into account, elements that belie any attempt to account for the developments of the period ca 640–740 as a simplification in comparison with what had gone before. First, and crucially, there was the identity of vested interests between the court and elite. The Anatolian elite identified its interests – physical survival, wealth and income, social status and access to prestige and honors – with the imperial court. They perceived themselves as Roman and Christian, their fates bound together by common enemies and shared challenges to their future wellbeing. The contrasting fates of the empire's Italian territories and, more importantly, its North African provinces highlight the central importance for the court at Constantinople of keeping the elites on

board. Where they failed – as they did in North Africa – they lost the provinces in question. That was by no means the only reason for the loss of North Africa, but it was an especially important one (Haldon 2016: 159–214; 2009).

Second, and especially relevant to the shared identity of court and elite, orthodox Christianity and Roman-ness represented two key ideological narratives through which the court and social elite in the capital and in the provinces reinforced the differentness (and the superiority) of the Romans as against those who attacked or threatened them. Christianity and its attendant institutions served also to bind the mass of the ordinary provincial and urban population of the empire to the traditional establishment (Haldon 2016: 79–119). Still other factors played a role as well. Within a reduced strategic-geographical field, imperial defenses were more readily organised around limited resources, a situation that worked to the advantage of the emperors, who were able to control and monitor the provinces and their elites more effectively. Taken together, these different processes of adaptation meant that, while some aspects of East Roman society were transformed (the nature of urban society and economy, for example), others were modified or re-articulated in response to the challenges they faced. There was no convergence of vulnerabilities across most or all systems, and there was neither collapse nor total transformation.

The empire's history during much of the sixth century may thus be described as one of increasing complexity, connectedness and conservatism (r-Phase) reaching by the early seventh century the stage at which its various networks had become over-connected (K-Phase). This limited its ability to respond effectively to exogenous challenges, which included the occupation or economic disruption of many Balkan and Italian provinces by external enemies; as well as to endogenous points of stress, such as tensions between elite magnates and the central government, and between exploited rural populations and landowners; and major ideological rifts between different Christian confessions. The impacts of first the war with the Persian empire from 602 to 626, and second of the early Arab-Islamic conquests (esp. the period 640 s–670 s, with consequent massive territorial contraction) were of course felt throughout society. But while the dramatic territorial, fiscal and political losses of these decades can be seen as a period of crisis and catastrophe – as an Ω -Phase – the overall impact was mitigated by substantial flexibility within the imperial fiscal and military administration, as well as by a strengthened relationship between provincial elites and the court/government. By the first half of the eighth century, the subsequent α -Phase of systemic reorganization that set in from the 660 s produced a new equilibrium with different key characteristics from those previously dominant (Haldon 2016; for a somewhat different chronology reflecting a regional study see Poblome 2014). The system as a whole was altered in many aspects of its internal structuring as well as in aspects of its external form, but it survived as identifiably the Eastern Roman empire, rather than something completely different.

Rethinking the Eastern Roman empire in this period as a Complex Adaptive System is thus quite helpful in contextualizing and assessing the nature of the changes that took place as well as in making comparisons with other societies in other places and periods. It helps us differentiate between those elements or instances of societal organization that were transformed and those that were not. Of course, the vast mass of data, the complexity of the historical and archaeological record as well as of the East Roman state and society themselves has had to be greatly simplified for the purposes of this example. But the point is that we are hardly confronted here with a simplified socio-cultural or political-administrative system, even if simplification can be said to have taken place at some levels. So we should perhaps think less in terms of simplification as a general explanation and see it rather as a reflection of the ways in which some adaptive cycles restructured their connection with others while remaining nested within the broader societal framework. From this perspective, resilience reflects a complex combination of factors that generate emergent practices and arrangements at multiple scales. It formed part of the response of different groups, with both common as well as conflicting interests, whose behaviors were

determined by their institutional situation, and framed by their perceptions of what was happening around them. The crucial relationship that needs to be interrogated, where the evidence permits, is that between agency and structure, belief and practice.

Conclusion

In these paragraphs we have raised the importance of a number of complex systems and sub-systems relating to political, economic and historical relationships specific to Constantinople and the eastern Roman empire. The key point is that resilience, change and adaptation are very complex issues, and responses to climate change do not tell the whole story. But we should not allow this to distract us from an equally significant point: that while we cannot tell the whole story through the lens of environmental change, we need to take it piece by piece. In other words, we are working to fill in the puzzle pieces relating to where and how climate change might impact an imperial system – and how this might exert pressure on other sub-systems – by examining the most vulnerable segments of the agricultural economy, including raising of subsistence crops, particularly at the peripheries of the empire, as well as the effects of climate change on the ability to produce cash crops for market exchange.

The story of the medieval Eastern Roman Empire (Byzantium) presents further useful examples of this set of relationships and the association between environment and human agency at several scales of analysis. The developments described above can be identified as one set of systemic elements that represent state, institutional and elite responses to change – an adaptive cycle that is nested within a wider adaptive cycle as outlined in the article by Roberts *et al.* (this issue), reaching from the sixth to the twelfth century. In this schema, the period of crisis discussed above represents the Ω -phase of this broader adaptive cycle. The political and economic stabilisation of the empire inaugurated a significant recovery of the empire from the later eighth century. This coincided with the end of a drier (and cooler) period that started in the course of the eighth century. This period witnessed the expansion of large-scale pastoral farming, and the reappearance of a number of cultivars that had had a much reduced presence since the seventh century, in particular vines, olives, and fruits. The palynological data from Nar Gölü (Cappadocia) indicate a significant agrarian recovery during the second half of the tenth century CE, presenting a new configuration in the region's rural economy (England *et al.* 2008). At about the same time, in the 960 s, Anatolian landlords began to invest in expanding their estates, an investment that coincided with the height of imperial political and military power and expansion and widespread growth of the agrarian economy in the Byzantine world. The evidence strongly suggests that this improvement in the

economic, political, and military fortunes of the empire and the rise of a powerful magnate elite was aided by an amelioration in the climate regime (Eastwood *et al.* 2009; Haldon 2007).

The Byzantine case exemplifies the value of the theory of adaptive cycles in pinpointing the key shifts within a social-ecological system and at the same time shows very clearly how the palaeoenvironmental, archaeological and historical data reflect a complex interaction of anthropogenic and natural factors that throw significant light on the history of the empire and its neighbors. But at the same time it challenges any simplistic explanation of societal change that tends towards either monocausality or that relies on a superficial notion of how ‘resilience’ is to be understood.

The other case studies in this Special Issue discuss the different forms through which complex historical societies can demonstrate resilience in the face of environmental pressures. Izdebski *et al.* show how states can play both positive and negative roles in creating the conditions for resilient responses at different social levels. They suggest that environmental stress and resilience must be analysed in the context of broader societal transformations, since societal resilience is generally costly to achieve, and is frequently at the expense of less privileged groups. Doonan *et al.* are particularly concerned with the human processes of agricultural adaptation in Byzantine Anatolia and the issue of the extent to which a connection can be established between the major changes in settlement patterns that can be observed in the seventh- and eighth- century archaeological data and the larger questions of systemic collapse and resilience in the face of climate change.

Roberts *et al.* undertake a quantification of the consequences of the socio-economic and material cultural changes in different regions of Anatolia across the period from the 6th – 10th centuries, examining the archaeological and proxy environmental data for rural settlement and land-use as well as the impact of climate changes on the agrarian system. They are able to identify a significant demographic downturn of the 6th–8th centuries and the regionally highly-differentiated recovery that followed. Mordechai’s paper categorizes a series of natural hazards (droughts, earthquakes, volcanoes, epidemics, locusts, etc.) as short-term cataclysmic events (SCEs) that, although different in primary impacts, disrupt premodern human societies in similar ways. Societal resilience to their cascading effects is stressed rather than a catastrophalist perspective. Mordechai and Pickett then examine earthquakes as the main type of SCE that has a signature in historical records, archaeological findings, and paleoclimate proxies and assess the ways in which different social groups (central government, local elites) respond. They also emphasize the regenerative aspects of seismic events and conclude that as a rule the societal impacts of earthquakes were usually transient.

Mordechai and Sohmoush follow this analysis with a discussion of the impact of another type of SCE, flooding, distinctive because its regularity and long-term predictability generally facilitated societal adaptation. Floods could cause short-term disruption, but could also stimulate a reorganization and regeneration of economic resources, as the two case studies of ancient Egypt and Mesopotamia indicate. Finally, Xoplaki *et al.* demonstrate that integrated analysis of palaeoclimate proxies, climate reconstructions and model simulations can shed light on our understanding of past climate change and its societal impact. They analyze high-quality hydroclimate proxy records and spatial reconstructions from the Central and Eastern Mediterranean and compare them with two Earth System Models for three periods between the 12th and 17th centuries CE during which societies were stressed by climatic and environmental and climatic pressures. They show that multidecadal precipitation and drought variations in the Central and Eastern Mediterranean during these periods cannot be explained by external forcings (solar variations, tropical volcanism) but were instead driven by internal climate dynamics.

Taken together, we hope that these studies will serve to demonstrate three key points: first, the many different ways through which resilience was articulated in past complex societies; second, the high degree of resilience, in the general sense of the term, inherent in many historically-attested societies; and thirdly, the fundamental importance of an integrated and consilient approach to studying the societal dimension of environmental and climate change in the past if we are properly to understand the complex role that climate has played in human history.

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