Beyond Boom and Bust: Climate in the History of Medieval Steppe Empires (C. 550-1350 CE)

Nicola Di Cosmo

Abstract The use of paleoclimate data in historical work has become a new and dynamic endeavor in several areas of historical research. This chapter is concerned with the empires created by pastoral nomads in the steppe regions of Eastern and Central Eurasia over approximately three millennia, from the early appearance of complex Scythian and Siberian polities in the early first millennium BCE to the Dzungar empire of the seventeenth and eighteenth centuries. This essay aims to show how paleoclimate data may be used to illuminate connections, dynamics, and causal nexuses in the important, and yet often overlooked, historical experience of pastoral peoples and the empires they created. Paleoclimate data are especially important to supplement the scarce documentary sources left behind by pastoral nomads.

Keywords Medieval Inner Asia · Steppe nomads · Pastoralism · Mongol empire · Uyghur empire · Mongolia

The use of paleoclimate data in historical work has become a new and dynamic endeavor in several areas of historical research. This paper is concerned with one of these areas: the empires created by pastoral nomads in the steppe regions of Eastern and Central Eurasia for about three millennia, from the early appearance of complex Scythian and Siberian polities in the early first millennium BCE to the Manchus who conquered China in the seventeenth century and the Dzungar khanate of the eighteenth century. This essay aims to show how paleoclimate data may be used to illuminate connections, dynamics, and possible causal nexuses otherwise not visible in documentary or material sources. To assess and frame the relevance of climate within the broader discourse of steppe history, in the first part of this essay I will address specific issues that continue to define the historiography of steppe nomads, and in particular the role of climate within it. In the second part, I will describe three cases that illustrate salient aspects of the use of paleoclimate data in relation to nomadic empires, each of which addresses a separate climate event.

N. Di Cosmo (✉)
Institute for Advanced Study, Princeton, USA
e-mail: ndc@ias.edu

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Ethnographic literature on the environment of pastoral economies and nomadic societies have long recognized the vulnerability of semiarid rangelands to climatic downturns, a discourse often couched in terms of "disequilibrium" (Vetter 2005; von Wehrden 2012). Disequilibrium, in this context, refers to the asymmetric relationship between natural resources and economic productivity, whereby the grassland's above-average net primary production often generates an excess of animals that in turn deplete its resources through overgrazing, while below-average land productivity, as a result of climatic stresses, causes the animals' starvation, hypothermia (in winter), or illnesses, which may reduce the size of herds below the level required for human sustenance. Such conditions, among others, have militated against the establishment of a steady state between natural and human systems. A balanced exploitation of resources through rangeland management, usually achieved by the seasonal rotation of available pastures, has been essential to the life of nomads since the beginning of this particular mode of production, but their societies have remained exposed to high levels of vulnerability (Fernandez-Gimenez et al. 2015a).

Taking into consideration just the recent history of Mongolia, both winter disasters and droughts have caused catastrophic losses of animals, human starvation, and displacement of a magnitude that compelled the government to invoke international aid (Batima et al. 2005; Fernandez-Gimenez et al. 2015b; Begzsuren et al. 2004). Given the recurrent nature of such disasters, a reasonable and appropriate historical question is to ask how such events may have affected the vulnerability or resilience of the empires that nomads created, or, to put it in a different way, in what way climate, so essential to preserving life on the grassland, may be related to the nomads' social and political history. On the other hand, processes of accelerated political centralization may be favored by increased grassland productivity. Above-average precipitation and warmer temperatures, by lowering the aridity and prolonging the growing season, trigger a positive economic cycle that directly affects the well-being of the livestock, decreasing the rate of mortality and expanding the number of animals. Hypothetically, and under certain historical circumstances, augmented resources may lead to political changes. An expanded economy can keep a portion of the population permanently employed in other activities, which in premodern times were chiefly to do with military ventures. The abundance of healthy horses allowed more warriors to take the field, and such expanded military capability could translate into firmer and more durable political centralization.

Since Mongolia was the birthplace of most Inner Asian empires, its paleoclimate has become an essential source to inquire about the linkages between climatic fluctuations, environmental transformations, and political events. While most people may be familiar with the most macroscopic manifestations of nomadic history, such as the Mongol conquests, the "nomadic" or "steppe" empire as an historical category requires a few words of explanation, especially in light of various theories that have been advanced to explain their formation (Rogers 2012). In particular, the category of "steppe empire" is in itself an historical product that tends to obscure the diversity and variety that can be detected upon closer examination, and therefore it is useful to discuss briefly some of the notions that inform this category, which are also relevant

to how climate has been brought into the discussion of the formation or demise of these empires.

Nomadic empires emerged in central and eastern Eurasia probably already in the early first millennium BCE, and their appearance is closely related to the domestication and riding of the horse, and to the development of stratified societies, in which political and economic power was wielded by a warrior aristocracy. Even though these empires have occupied a place of central importance in Eurasian and world history, the reasons for their recurring emergence and disappearance are still, generally speaking, as much unknown to us as they were to ancient observers on both ends of Eurasia. Climatic theories have been hovering over the interpretation of the inner dynamics of nomadic politics but without ever rising beyond the stage of conjectures based on a generic understanding of the effects of climate variability in contracting or expanding the nomadic *lebensraum*, and thus supposedly leading to migration, conflict, and conquest (Kradin 2015). Such generic notions, however, have not generated specific knowledge, nor have they produced evidence that could contribute to explaining historical processes. Nonetheless, the environmental determinism that is at the root of these theories has found a new and rather powerful voice in scientific publications, which play an important role by promoting methods and concepts in the study of the role of climate in the history of steppe nomads.

Climatologists studying Mongolia, central Asia, and the northern regions of China, have been especially involved in the phenomenon of nomadic societies' response to climate-induced stresses. The premise, sometimes explicit and sometimes unstated, is that various types of disruption of environmental conditions acted on nomads as "push factors" that elicited a social or political response. The object of these studies is to find regularities that may explain the history of interaction of nomads with China, and presumably other settled civilizations. The assumption that conflicts between nomads and China are inherently reducible to climatic variability has produced (and sometimes justified a posteriori) a research model based on correlations between certain climatic events and the presumed behavior of nomads, concentrating, naturally, on precipitation and temperature (Bai and Kung 2011; Fang and Liu 1992; Su et al. 2016; Pei and Zhang 2014; Lee et al. 2017; Pei et al. 2019). Seeking to isolate the climate anomalies that are most likely to cause political and economic disruptions, leading to migrations and conflicts with settled peoples, these studies rely on statistical analysis as evidence, while the sources for their single-point data remain opaque at best. In any case, different studies have reached different conclusions, arguing at times that the cause of nomadic invasions and other historical events should be attributed to variations in moisture, such as droughts, and at times to drops in temperature, causing frosts or frigid winters.

The wide gulf separating statistical methods (and especially statistical "proof" of causation) from historical analysis has proved to be a formidable obstacle to collaborative ventures. While most climatologists, generally speaking, would be disinclined to endorse such extreme climatic reductionism, it is also true that the largest part of climatological literature available on nomads' history reflects or subscribes to this orientation, and therefore plays a rather important role in defining climatic

approaches to the history of nomads and attending methods and tools. What is necessary, however, is an historical approach to climate that seeks to comprehend actual historical events, which are (emphatically) not limited to questions of migrations or conflict, but rather to the analysis of critical junctures in nomadic history, and especially the interplay between climatic fluctuations and the structures and institutions that constituted the internal scaffolding of nomadic societies, and were essential to the formation of empires, their sudden disintegration, or slow demise. Such questions may include governance, fiscality, military expansion, trade, diplomacy, and other issues that need to be considered in relation to any transformational event, to the extent that such an event may be connected to changes in the pastoral nomadic economy due to climate-related environmental changes.

In this regard, and last in our list of preliminary observations, we need to address more directly the very object of our inquiry, namely, what we mean when we speak of "nomadic empire" and how we should frame questions that involve climate. As we mentioned above, a common assumption in both historical and climatological literature is that pastoral nomads "react" to climatic changes pretty much always in the same way, regardless of their degree of political organization, social complexity, or economic diversification. Occasionally, such "push factors" were responsible for the pastoral nomads' success in constituting large military forces and engaging in invasion and conquest. The formative process of these entities, however, lay beyond the horizon of the historical visibility of literate societies, and went largely unrecorded since it typically occurred in remote regions "beyond the pale" of civilization. It is exactly that extreme dearth of documentation that makes climatic data potentially valuable, based on the reasonable assumption, derived from anthropological, ethnographic, and environmental research, that severe, protracted or otherwise transformational climate events affect the pastoral economy and thus lead to deep modifications of social hierarchies and political systems. That does not mean that we should automatically associate such variability with specific societal responses, but that climate data (as we shall see below) can supplement our analysis in important ways, by directly disproving unfounded assumptions or by suggesting new avenues of inquiry, as well as otherwise unsuspected causal linkages and connections.

In particular, climatic data may shed light on processes of adaptation, resilience, or recalibration of economic and social policies that would be otherwise difficult to explain. In fact, the surprising diversity that can be observed within the "galaxy" of nomadic political formations has not been properly explained other than by attributing it to external influences and pressures. While there is certainly a degree of permeability between nomads and non-nomads, such osmotic properties neither determined nor qualified all aspects of nomadic political and economic life. Most of the major political formations that steppe nomads created in eastern Inner Asia were born out of periods of chaos that spun economic crises, internal warfare, and displacement before a new political order emerged. Even though some of the "building blocks" are comparable, such as political features, kinship structures, cultural underpinnings (e.g. religious authority), and especially economic bases, each case produced a different outcome, and a different empire. In the face of such diversity, assuming that all

nomads behaved in the same manner would introduce an irremediable bias into the analysis, and that applies also to the study of climate and environmental issues.

In order not to reduce this question to another case of "splitters versus lumpers," it is important to recognize that the pastoral economy has specific requirements that are based on the ecology of rangelands and the biological lifecycle of the livestock, but the social and political contexts in which pastoral production is organized may vary a great deal. One common characteristic of steppe nomadism is the mobility inherent to seasonal shifts between pasture grounds, which also controls significant aspects of their technology and social life. The dependency of nomads on their herds, and therefore on the environment that allows the animals to survive, is a consideration that is clearly connected to climate variability, as we shall see below. Far less obvious is the relationship between such climatic variability and the political life of nomads, especially in cases of "imperialization," that is, the rise of powerful and expansive polities. While historical analysis has steered away from investigating such connections, and one may speculate whether this was due to inaccessibility of data, methodological limitations, a distrust of climatic hypotheses, or a combination of these, it would seem extremely unlikely that climate events can be eliminated from consideration when natural environment and human existence are so closely intertwined.

In sum, even though new research has greatly advanced our knowledge of the role of steppe empires in world history (Biran 2019), we are still a long way from understanding the mechanisms and the dynamics that are behind the formation of such complex and powerful polities, a process that was a necessary condition for any projection and propagation of nomadic power outside its natural habitat. Likewise, as historical scholarship moves away from theories that attribute the presumed collapse of past societies and empires to natural disasters (Butzer 2012; Haldon et al. 2020), the notion of climatic reasons for the disappearance of nomadic empires must also be questioned. What may be represented as a climatic "turn" in the history of nomadic empires seeks to accomplish, at a minimum, three objectives. First, it aims to take stock of and introduce climate data into historical analysis, without allowing climate data to dominate it. Second, climate analysis has to be strictly related to the time and location of the events under discussion, specifically and explicitly indicated. Third, environmental and climatic data need to be properly contextualized and integrated with all sources available, especially textual and material, not just to achieve a better understanding of the events, but especially because such data can generate new questions that would not be raised by other sources. The cases discussed below are examples of a climate-informed approach to the history of Inner Asian empires.

Case Studies

The three case studies presented here are meant to illustrate different types of climatic variability in their historical context. While these studies cannot be assumed to be in any way paradigmatic of the relationship between climate and nomadic empires, they

may nonetheless be representative of a wider range of related issues and therefore are to be understood as exemplary, rather than normative, cases. What is especially relevant here, rather, is the implicit method of inquiry, which places a high premium on the use of climatic data for its inherent potential to allow new questions to arise, and for its uses in reconfiguring or reinterpreting other pieces of evidence associated with the historical events in question.

1. The fall of the Eastern Türk Empire (630 CE)

A widely discussed case in both the historical and climatological literature concerns the demise of the Eastern Türk empire (Zhang 2002; Fei et al. 2007; Fei 2008; Erkoç 2017b; Di Cosmo et al. 2017; Ganiev and Kukarskih 2018). This was a steppe nomadic polity, and a successor state of the Türk empire, established in Mongolia in the mid-sixth century CE. The Türk rulers expanded westward, but their state subsequently split into a western and an eastern branch after a civil war in the 580s. The Eastern Türk empire was ruled by a *qaghan* whose political and economic base was located in today's Inner Mongolia, although its sovereignty extended into the northern Mongolian region. Chinese historical sources indicate that a series of natural disasters might have been behind a famine that, beginning in 627 CE, ravaged the Türk empire, and in particular the region that was the base of the *qaghan*'s economic power and its political center, in the piedmontal region to the north of the Yellow River.

The harsh winters of 627–8 and 628-29 were described as extremely cold, causing a massive loss of herds and subsequent famine among the Türks. While the Türk ruler, Illig qaghan, had often raided in previous years the Chinese frontier and imposed a heavy tribute on the Tang dynasty, ruling in China, such raids were no longer possible due to military weakness. Increasing the fiscal pressure on other subordinate tribes led to rebellions and a weakening of the central authority of the *qaghan*, now vulnerable to internal and external challenges, such as the rise of the Xueyantuo confederacy in Mongolia. The Chinese army under general Li Jing (Erkoç 2017a), after having waited until the Türks had been severely weakened, launched their offensive in 630, bringing the Türk empire to an end. The *qaghan* himself was captured but died a few years later (Graff 2002).

This sequence of events occurred against the backdrop of an economic crisis caused by at least two extremely severe winters. Climatological analysis has indicated that the likely cause of the very low temperatures was the volcanic forcing due to an eruption dated to the year 626, which occurred during an already cold period in the Northern Hemisphere, lasting through much of the sixth and seventh centuries CE (Büntgen et al. 2016). The low temperatures caused early frosts and droughts, decimating the herds. The famine that ravaged the empire was a direct consequence of the loss of animals, causing widespread mortality among the people and reducing precipitously the economic and military power of the ruler. The rapid demise of the Eastern Türk empire under the shock of prolonged climatic adversity, and the overall unfolding of the crisis suggests a series of considerations that may clarify key aspects of Türk rulership as well as some salient causal linkages that may explain its collapse.

First, the Türk empire's fairly rapid breakdown underscores the fragility of its economy, which was ultimately based solely on pastoral production. This provided not only food and other necessities, but, most importantly, horses for military use. The other revenue streams were taxes from subordinate tribes and tributes from China, but such exactions could not be collected without the military power to enforce them. Therefore, as soon as both the Tang leadership in the south and the subordinate peoples in Mongolia realized the state of weakness of the Türk leadership, they began to take military action against the *qaghan*. Unable to support economically its people, and with an army increasingly feebler and less numerous, there were no options left to the *qaghan*, whose attempt to lead his people to areas with better pastures also failed due to internal political struggles, and probably because of the extent of the territory affected by the disaster. Long-distance migration was prevented by the deployment of Tang armies on the Chinese frontier, and by hostile nomads in the north.

In conclusion, the evident linkages between the natural disasters that ravaged the Eastern Türk empire from 627 to 629 and its subsequent demise allow us to contextualize the events in terms that connect economic, military and political aspects, and identify more clearly the vulnerability of the empire and its ability to withstand deep and sudden crises. The identification of clearly dated and spatially explicit climate data leave no doubt about the origin of the crisis, which was clearly identified also in the written sources. Unlike what statistically based studies on nomadic interaction with settled societies might suggest, the crisis did not lead to migrations, or to the nomads becoming more aggressive. On the contrary, they suffered a crushing defeat after nearly three years of a deeply debilitating crisis.

2. The Uyghur drought (783-747 CE)

Climate data are especially useful when they raise questions about which written sources are silent. This is the case for the discovery of the longest and most severe drought in the climate history of Mongolia, documented through two tree ring-based chronologies from central Mongolia. The period of the drought, between 783 and 850 CE, coincides for the most part with the rule of the Uyghur empire (744-840), whose capital, Qara Balgasun, was based in the Orkhon valley (Di Cosmo et al. 2018; Hessl et al. 2012). Contrary to the climate events reported during the Eastern Türk empire, this drought is not mentioned in the sources, and thus was never discussed in the history of the Uyghurs as a possible contributing factor to the demise of the empire. In sum, the evidence from tree-ring data points to environmental conditions that alter the historical narrative of the rise and fall of the Uyghur empire. The severe and protracted drought did not trigger any of the effects often assumed to be associated with droughts in a grassland environment, such as famine and migration, or the invasion, pillaging, and conquest of neighboring communities. On the contrary, the most significant events in Uyghur history were the diplomatic efforts to secure trade relations and peace.

The Uyghur empire was significantly different from the previous one, the Türk empire, in at least two ways, both of which are still poorly documented, namely, urbanization and economic complexity. The Uyghur elite included central Asian

families of Sogdian origin who were involved in long-distance trade between China and Central Asia. The state-regulated trade between the Tang dynasty in China and the Uyghur empire, through which Uyghur horses were exchanged for Chinese silk, constituted a major state revenue for the Uyghur *qaghan* and doubtless nourished an extensive international trade. Moreover, the Uyghur capital is the largest urban center ever built by a nomadic polity, and other urban centers and palace complexes have been documented as well. Finally, documentary sources attest to the existence of agriculture. Nonetheless, the state gradually lost military power, and eventually fell, partially because of internal dissent, but especially because it could not resist against the invading armies of the Kirgiz, another nomadic people. Historical sources indicate that a winter disaster similar to that suffered by the Türks compounded the crisis, but we have no independent supporting climate evidence, since tree-ring data only apply to the summer season.

Factoring the drought into this summary analysis of the evolution of the Uyghur empire and its salient traits can potentially transform our understanding in several ways. First, it might provide an explanation, albeit hypothetical, for the diversity and greater complexity of the Uyghur economy. If the pastoral economy suffered from the drought, it stands to reason that this situation would have a doubly negative impact, by hurting not just society at large but also the military, since horses (the essential component of all nomadic armies) would be fewer and less healthy. The poor quality of Uyghur horses has indeed been documented in Chinese sources. Lacking an efficient army, the Uyghur state resorted to diplomacy to secure commercial agreements. Moreover, agriculture was developed, which in droughty conditions would have to be done by artificial irrigation. The apparent urban expansion of Uyghurs could also point to market towns and production centers. However, since the archaeology of the Uyghur period is still in its early stages, such matters are as yet poorly known. Second, the progressive weakening of the Uyghur economy might have had negative effects on the state's political stability and its military effectiveness, precipitating the collapse of its leadership in the face of the attack by the Kirgiz, located to the north of the Uyghurs. Finally, the pastoral economy, weakened by decades of drought, would have been hit even harder than under normal circumstances even by moderate winter disasters of the type mentioned above. Eventually, the Uyghur empire was wiped out by the Kirgiz, and the survivors fled to northern China and to the Tarim basin (Drompp 2002).

In conclusion, the climate data provide critical evidence that allows us to "read" apparent anomalies as resulting from environmental stresses or as the product of reactions and adaptations to the same. The empire's diminished reliance on military activity in the latter part of its existence, and coincidental with the duration of the drought, could be placed in direct relation with the assumed downturn in the pastoral economy, while the diversification of its economic base could be interpreted as a response to the same, by way of compensating for the contraction of the pastoral economy with other forms of income and food production. In sum, on the basis of paleoclimatic data, we need to question whether, notwithstanding the silence of the textual sources, we might couch the history of the Uyghur empire as a history of resilience, defined by the attempt to overcome difficulties by building a different

economic structure and concurrently modifying their civil and military institutions. Such resilience may also stem from the formative process of Uyghur elites, which included commercial families, and their predisposition towards a more diversified economy. Framing the history of the Uyghur empire as a resilience narrative, in any case, advances our understanding of nomadic empires by focusing on economic questions that would otherwise not come to the surface.

3. The rise of the Mongol empire (1206-1226).

The assumption that environmental reversals are a necessary concurrent cause, if not the primary cause, of the formation and expansion of nomadic empires has no empirical basis. As we have seen above, understanding climatic stresses is indeed essential to framing their historical significance. A case in point has been evidenced by recent research on the climatic history of Mongolia. Tree-ring data from the lava field in the Orkhon Valley (Central Mongolia) show the occurrence of a "pluvial" period spanning fifteen years that coincided with the zenith of the military activity of Chinggis Khan and his nascent empire. After Chinggis Khan assumed supreme command of all Mongols he engaged in a series of campaigns that involved not only Mongolia but also northern China, against the Jin dynasty, the Xixia kingdom (in today's northwest China) and the kingdom of Khwarezm (in today's Uzbekistan and neighboring regions). Moreover, a Mongol army was sent on an exploratory mission into Caucasia and Russia, traveling around the Caspian Sea before returning to Mongolia. It is this intense military activity that lay the foundations for the later expansion of the Mongol empire into China, Iran, and Russia. The concurrence of the pluvial phase, lasting from 1211 to 1225, and the "burst" of Mongol armies outside the Mongol steppes during Chinggis Khan's lifetime, which occurred between 1209 and 1226, raises the question of the possible relationship between the two (Pederson et al. 2014; Putnam et al. 2016).

The pluvial period, which also took place during a relatively warm phase, increased the productivity of the steppes by mitigating the natural aridity of the region, increasing the water supply, and therefore supporting above-average growth of plants and nutrients, and a concurrent increase of biomass. The augmented energy in the local ecology, in turn, favored the reproductive cycle of animals, reduced their mortality rate, and produced a net increase in livestock and horses. As a secondary effect, the pluvial allowed for greater carrying capacity, that is, for a higher ratio between animals and land area, so that more animals could be supported by a relatively smaller territory for a longer period of time. This is an especially important aspect when we consider the requirements of the Mongol army, whereby each warrior had to be supported by several horses and sheep. If mounting an expedition required the concentration of a certain number of troops in a given region, higher carrying capacity would have eased logistic considerations.

The Mongol empire is anomalous with respect to other steppe empires because of its unprecedented territorial extension, and while most conquests occurred after Chinggis Khan's lifetime, no persuasive explanation has been given so far about the ability of the Mongols to sustain a long period of challenging military expeditions and campaigns outside of their ecological zone, with a relatively limited population,

and scant economic resources. However, based on the climate evidence and inferred environmental effects, it is possible to argue that the increased grassland productivity acted upon on-going political processes by extending and expanding the traditional potentialities of a nomadic empire. This hypothesis, which we may call "high-yield grassland productivity hypothesis," would not be, in itself, a "cause" for the Mongols' campaigns but would function as the material basis by which the nomads' potential for military expansion could be expressed and fulfilled for a longer time and over greater distances. This hypothesis would include, at the very least, the following four points.

First, the Mongol empire was unified under Chinggis Khan in 1206 after several decades of internecine war, which caused widespread economic and social distress. The new political order of Mongolia, based on centralized leadership, could thereafter rely on a long unbroken period of positive environmental conditions, and, through its military successes, acquire the revenues necessary to sustain the economic recovery and the new political establishment. Arguably, a negative climatic impact on the environment would have made it impossible for the Mongol society and economy to recover speedily, and thus threatened the existence of its newly-forged centralized state.

Second, a long strung of campaigns, in a traditional nomadic army like the early Mongols, required the constant supply of horses, who become mature for military use between three and four years of age. A lush grassland and low mortality would translate into a steady increase in the horse population, which meant that armies could be larger and horses lost in war could be quickly replaced. As we have seen above, the sudden loss of horses, in the case of the Eastern Türk empire, or the gradual dwindling of horse production, in the case of the Uyghur empire, reduced military capabilities, causing collapse in the first case and the loss of military preparedness as well as propensity for war in the second. In the case of the early Mongol expansion the opposite phenomenon took place, unleashing the expansion of military potential and its sustainability over a long period of time.

Third, on the political level, the increased carrying capacity of the land allowed Chinggis Khan himself to concentrate in his own estate a large number of soldiers, inclusive of his own large bodyguard (*keshik*) and other troops. The concentration of political and military power was an essential prerequisite for political centralization and the prevention of challenges from other leaders. The Orkhon valley was also used, according to some sources, as a gathering place for the army from which to organize and launch military campaigns. Political centralization and military logistics would thus directly benefit from the enhanced productivity of the land.

Fourth, there may have been an increase in agricultural production (Rösch et al. 2005). While at this stage such a hypothesis is purely conjectural, the concurrence of more abundant rainfall for irrigation and the availability of captives from raids into agricultural areas to be used as forced labor in Mongolia might have spurred the development of agriculture. Such a hypothesis is consistent with significant evidence of agricultural production in the area of Karakorum, which became the capital of the Mongol empire under Chinggis Khan's son and successor Ögödei.

In sum, the evidence from tree-ring data not only allows us to discard previous hypotheses that linked Mongol invasions to droughts (Jenkins 1974), but it also and most significantly provides insights into the connections between military activity, political power, and economic resources. Studying the underlying nexuses between such matters as horse supply, land productivity and campaign logistics, for instance, is not just central to any comprehensive historical analysis of Chinggis Khan's military success, but is especially important to achieve a higher degree of understanding of nomadic empires in general. The "discovery" of the pluvial period in the paleoclimate data provides unique evidence to reassess the extraordinary success of the Mongol conquest in its early phase.

Concluding Remarks

The close connection between the pastoral economy practiced by steppe nomads and environmental variability has always had profound implications for the fortunes of Inner Asian empires, but their degree of vulnerability and resilience in the face of climatic adversities, or their ability to leverage environmental advantages, have seldom been gauged. Extensive research on the ecology of rangelands, as well as ethnographic and anthropological studies on traditional uses of pastoral resources, show the degree and characteristics of the dependency of the nomads on the delicate balance between climate and ecology that controls their animals' life cycles. Historical cases, however, show how nomads who reached a higher level of political organization and greater social complexity strove to overcome the limitations imposed by that dependency. Nomadic empires availed themselves of an increasingly wide range of fiscal and other instruments to support their political structures (Di Cosmo 1999). The development of some of those instruments may find its roots in the search for security and survival that makes steppe nomadism a specific form of human adaptation to ecological conditions and to climate variability. The diversity of the cases presented here shows, on the one hand, the measures implemented to counter unfavorable conditions, and, on the other, the ability of nomadic leadership to use surplus productivity for political ends. Historical studies have concentrated especially on the consequences of nomadic empires' expansiveness and the connectivity they promoted in a "Eurasian exchange" in which armies, traders, and germs crossed the continent (Allsen 1997; Green 2020). Such a "world-history" approach has been fruitful, but does not answer the question of the formation of nomadic polities, as well as their relative diversity and complexity. The connection between environmental conditions, economic structures, and political configurations is key to a new approach to steppe history, integrating natural, material, and documentary data.

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