

## INTRODUCTION

This is the story of how a climate event, the so-called “Little Ice Age,” nearly brought down the Ottoman Empire around 1600 AD. And although that would be a story worth telling on its own, this study offers to explain much more. Through the narrative of climate and crisis, the following pages will explore the rise of an empire and its provisioning, settlement, and population. We will see how a complex set of circumstances conspired to create a climate-led catastrophe; and how the crisis of the Little Ice Age marked a critical conjuncture in the human ecology of Ottoman lands, as centuries of growth and expansion turned for a time to contraction and retreat. The story that follows describes much more than a single episode in the life of an empire. It represents nothing less than a turning point in the history of the Near East and by extension the making of the modern world.

In its simplest outlines, the plot runs as follows: In the fourteenth and fifteenth centuries, as the Ottoman Empire grew from a small band of warriors into a major world power, it instituted a number of systems for the management and provisioning of resources for its capital city and its military, all the while directing the expansion of settlement and cultivation across the region. In the sixteenth century, as Ottoman population soared, land and resources began to fall short. War and natural disasters, exacerbated by climate fluctuations, placed new pressures on peasant subsistence and imperial provisioning. Finally, in the last decade of the 1500s, the fierce cold of the Little Ice Age and the longest Eastern Mediterranean drought of the past six centuries brought unprecedented famine and mortality. As the imperial government continued to squeeze its subjects for supplies to support an ongoing war with the Habsburgs, central Anatolia erupted in a revolt – the Celali Rebellion – which pushed the empire into an intractable crisis. Over the following century, further climate disasters, nomadic invasion, rural insecurity, and flight from the land drove a vicious circle of demographic and agricultural contraction.

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Despite some promising starts, the empire did not fully recover from the crisis for more than a hundred years, entering the nineteenth century still loosely governed and thinly populated.

The full story is considerably more complex. Climate certainly plays a leading role in the ensuing drama, and the onset of the Little Ice Age marks the turning point in our history. Nevertheless, climate shares the stage with many actors, whether environmental, geographic, economic, or political. The story that follows does not simply thrust the Little Ice Age into the usual narrative of Ottoman history. It represents a reinterpretation of that history, taking together both natural and human forces. Moreover, we see how at critical moments in our story even the leading figures of the drama – the Little Ice Age, provisioning, sultans, and war – were upstaged by something even more unexpected: the Ottoman sheep.

Unsurprisingly, few of these environmental factors (and least of all sheep) have so far played much part in Ottoman historiography. Despite its important place in world history, serious scholarly research on the Ottoman Empire remains a fairly new and cautious field of study, often hindered by extraordinary difficulties of language and sources. Apart from some older research influenced by the French *Annales* school, and the recent work of Faruk Tabak (discussed in Chapter 11), Ottomanists have yet to venture far into environmental history.<sup>1</sup> Many parts of this book have had to draw on numerous obscure, often regional studies published only in Turkish. Even the most central elements of our narrative such as the Ottoman provisioning system, population pressure, and the Celali Rebellion have so far received only a couple of dedicated monographs apiece. Other major developments – including those of critical importance such as the drought and famine of the 1590s – were virtually unknown, even among specialists.

Much of the story that follows, therefore, draws on wholly original or hitherto overlooked evidence. Remarkably, the usually parsimonious Ottoman and foreign archives and chronicles have proven a fairly generous source of information on environmental and particularly climatic affairs. This evidence, laid out in detail over the following chapters, has led me to draw up a new narrative of developments in the Ottoman

<sup>1</sup> This looks set to change. As this book goes to press, the *International Journal of Middle East Studies* is publishing an issue dedicated to environmental history, Oxford University Press is publishing a volume of collected essays on Middle East environmental history, and Cambridge University Press is publishing a monograph on the environmental history of Ottoman Egypt by Alan Mikhail.

Empire up to the eighteenth century – one that seriously incorporates environmental changes. Over the following pages, it will become clear just how much this perspective might contribute to the history of the region.

Not least, the narrative presented here offers a different approach to the ongoing historiographical debate over the so-called Ottoman “decline” of the seventeenth and eighteenth centuries. It has long been evident that once popular narratives of degenerate sultans and decadent political institutions relied too much on uncritical readings of a few primary sources.<sup>2</sup> Too often, authors wrote from an anachronistic or politicized perspective that equated modernity and progress with the kind of centralizing, secularizing, or etatist policies typical of nineteenth- and twentieth-century reformers.<sup>3</sup> And so, many widely accepted explanations of Ottoman stagnation or decay have been questioned or dismissed, and now a range of revisionist studies have emerged stressing the empire’s resilience and adaptability and reinterpreting the sixteenth and seventeenth centuries as an era of “transformation” or even “privatization” and “proto-democratization.”<sup>4</sup>

Suffice it to say, nothing in this book is intended to raise the old specter of “decline.” In most respects, the evidence fully supports the reinterpretation of the seventeenth century as a period of turbulence and transformation rather than stagnation and decay. Likewise, I make the case that the eighteenth century represented a period of modest revival. Nevertheless, this book often parts company with the revisionist literature as well. The recent emphasis on the imperial flexibility and

<sup>2</sup> See Cornell Fleischer, *Bureaucrat and Intellectual in the Ottoman Empire: The Historian Mustafa Âli (1541–1600)* (Princeton: Princeton University Press, 1986) and David Howard, “Ottoman Historiography and the Literature of ‘Decline’ in the Sixteenth and Seventeenth Centuries,” *Journal of Asian History* 22 (1988): 52–76 for a critical analysis of Ottoman declensionist writing and its influence on modern historians.

<sup>3</sup> Probably the most influential works in this regard have been Nizazi Berkes, *The Development of Secularism in Turkey* (Montreal: McGill University Press, 1964) and Bernard Lewis, *The Emergence of Modern Turkey* (New York: Cambridge University Press, 1968), both of which tend to frame later Ottoman history as a struggle between reactionary (usually religious, provincial) and progressive (usually elite, centralizing) forces.

<sup>4</sup> Among the more important works in this genre: Rifaat Abou-el-Haj, *The Formation of the Modern State* (Binghamton: State University of New York [SUNY] Press, 1991); Linda Darling, *Revenue-Raising and Legitimacy* (Leiden: Brill, 1996); Karen Barkey, *Bandits and Bureaucrats* (Ithaca, NY: Cornell University Press, Cornell University Press, 1994); Karen Barkey, *Empire of Difference* (New York: Cambridge University Press, 2008); Ariel Salzmann, “Measures of Empire: Tax Farmers and the Ottoman *Ancien Régime* 1695–1807” (PhD diss., Columbia University, 1995); and Baki Tezcan, *The Second Ottoman Empire* (New York: Cambridge University Press, 2010).

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adaptation inaccurately minimizes both the degree of the empire's success in the sixteenth century and the depth of its crisis in the century that followed. As we see in the following chapters, after nearly doubling in the 1500s, parts of the Ottoman Empire may have lost half or more of their population in the early 1600s; and it appears that core Ottoman lands still held fewer subjects around 1830 than they had around 1590. This remains a crucial development that historians need to explain – not just explain away. As some Ottomanists have begun to argue, it is time to find a more balanced approach to this important middle period of Ottoman history.<sup>5</sup>

This work reevaluates the era of Ottoman crisis and transformation from the perspective of global environmental history, focusing on the decades from 1590 to 1610 as a key turning point. It makes the case that Ottoman troubles formed part of a world crisis borne of widespread ecological pressures and climate fluctuations, but that environmental factors particular to the Near East exacerbated both the extent and duration of that crisis in the Ottoman Empire. Consequently, this book embraces three broader world historical issues: the seventeenth-century “general crisis,” the long-term environmental history of the Near East, and the role of climate events in history. These three topics, discussed here in the introduction, delineate the context of events and the themes of analysis in the chapters to follow.

### *The Seventeenth-Century Crisis*

First, this book adds a significant chapter to the history of the seventeenth-century “general crisis,” the common catastrophes that beset the world over the early to mid-1600s. Once confined to the historiography of Europe,<sup>6</sup> studies of this phenomenon now range from Mexico<sup>7</sup> to Ming

<sup>5</sup> See Cemal Kafadar, “The Question of Ottoman Decline,” *Harvard Middle East and Islamic Review* 4 (1997–98): 30–75 and Dana Sajdi, “Decline and Its Discontents” in *Ottoman Tulips, Ottoman Coffee: Leisure and Lifestyle in the Eighteenth Century*, ed. Dana Sajdi (London: I. B. Tauris, 2007), 1–40.

<sup>6</sup> For the original debate on the “general crisis” among historians of early modern Europe, see T. H. Aston, ed., *Crisis in Europe, 1560–1660* (Garden City, NY: Anchor, 1967).

<sup>7</sup> E.g., Jonathan Israel, “Mexico and the ‘General Crisis’ of the Seventeenth Century,” *Past and Present* 63 (1974): 33–57 and Ruggiero Romano, *Conyunturas opuestas: Las crisis del siglo XVII en Europa e Hispanoamérica* (Mexico City: El Colegio de México, 1993). On Little Ice Age droughts and famines, see, e.g., Georgina Endfield, *Climate and Society in Colonial Mexico* (London: Blackwell, 2008).

China,<sup>8</sup> and demonstrate remarkable parallels and connections in the histories of these far-flung regions.<sup>9</sup> It is true that specialists of many regions (and not least the Ottoman Empire) have often been reluctant to acknowledge the global ties among these events. Nevertheless, the concept of a “general crisis” has gained traction in world history in recent years, as various regional and comparative studies have accumulated evidence for the synchronicity of demographic contraction, economic recession, and political upheaval across the globe.<sup>10</sup>

Two theories have emerged to offer an explanation for this worldwide outbreak of disasters, neither exclusive of the other. The first, advanced by Jack Goldstone, emphasizes the role of rising population pressure over the century building up to the general crisis.<sup>11</sup> As all parts of Eurasia recovered from the demographic disaster of the Black Death, and as new and more stable states and empires emerged, so each suffered from the common problems of diminishing land and rising inflation. As early modern agrarian-bureaucratic states struggled to adapt, this volatile combination of pressures blew up into conflicts and ultimately revolutions and rebellions, from the English Civil War to the Ming-Qing transition. The second theory, presented most forcefully in the recent work of Geoffrey Parker, concentrates on the role of extreme cold and droughts associated with the Little Ice Age – a phenomenon we explore in more depth in later chapters.<sup>12</sup> These climatic disasters provoked widespread shortages and famines, precipitating political violence and popular unrest.<sup>13</sup>

<sup>8</sup> See, e.g., William Atwell, “A Seventeenth-Century ‘General Crisis’ in East Asia?,” *Modern Asian Studies* 24 (1990): 661–82; William Atwell, “Some Observations on the ‘Seventeenth-Century Crisis’ in China and Japan,” *The Journal of Asian Studies* 45 (1986): 223–34; Richard von Glahn, “Myth and Reality of China’s Seventeenth-Century Monetary Crisis,” *The Journal of Economic History* 56 (1996): 429–54; and Frederic Wakeman, “China and the Seventeenth-Century Crisis,” *Late Imperial China* 7 (1986): 1–26.

<sup>9</sup> See G. Parker and L. Smith, eds., *The General Crisis of the Seventeenth Century*, 2nd ed. (London: Routledge, 1997).

<sup>10</sup> For recent historiography, see Jonathan Dewald, “Crisis, Chronology, and the Shape of European Social History,” *American Historical Review* 113 (2008): 1031–52 and Michael Marmé, “Locating Linkages or Painting Bull’s-Eyes around Bullet Holes? An East Asian Perspective on the Seventeenth-Century Crisis,” *American Historical Review* 113 (2008): 1080–99.

<sup>11</sup> Jack Goldstone, *Revolution and Rebellion in the Early Modern World* (Berkeley: University of California Press, 1991).

<sup>12</sup> See Geoffrey Parker, “Crisis and Catastrophe: The Global Crisis of the Seventeenth Century Reconsidered,” *American Historical Review* 113 (2008): 1053–79. (My thanks to Prof. Parker for sharing parts of his forthcoming book manuscript as well.)

<sup>13</sup> See also William Atwell, “Volcanism and Short-Term Climate Climatic Change in East Asian and World History c.1200–1699,” *Journal of World History* 12 (2001): 29–99.

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Case studies from around the globe confirm the depth of the crisis and the prominent role of the two factors just described. At the turn of the seventeenth century, extreme cold and harvest failures plunged Russia into its “Time of Troubles,” bringing flight, famine, and chaos in the midst of a serious succession crisis.<sup>14</sup> In 1618, central Europe erupted in the Thirty Years War, in which a third or more of Germany’s population may have perished from violence and famine, exacerbated by Little Ice Age climate events.<sup>15</sup> In the 1630s and 1640s, the crisis reached England (the civil war), France (the Fronde and other uprisings),<sup>16</sup> and China (the Ming-Qing transition),<sup>17</sup> all of which suffered from severe climate and economic and political upheaval. Those same decades witnessed recurring drought and famine as far afield as West Africa<sup>18</sup> and Southeast Asia,<sup>19</sup> spelling the end of an era of flourishing trade and population growth in both regions.

However, these regional examples also illustrate the variations from one crisis to the next. Not all parts of the world suffered equally nor recovered in the same manner. For example, Mughal India also suffered a serious famine in the Deccan during the 1630s – yet it did not fall into serious political or economic turmoil until the waning years of the emperor Aurangzeb (r.1658–1707).<sup>20</sup> In Tokugawa Japan, the

<sup>14</sup> Chester Dunning, “Does Jack Goldstone’s Model of Early Modern State Crises Apply to Russia?” *Comparative Studies in Society and History* 39 (1997): 572–92, fits this disaster into the “general crisis” model; and his history of the Time of Troubles – *Russia’s Civil War* (University Park, PA: Penn State University Press, 2001) – refers frequently to the role of Little Ice Age weather events.

<sup>15</sup> Peter Wilson, *The Thirty Years War: Europe’s Tragedy* (Cambridge, MA: Harvard University Press, 2009), 786–96. On Little Ice Age impacts in Central Europe, see Wolfgang Behringer et al., *Kulturelle Konsequenzen der “Kleinen Eiszeit”* (Göttingen: Vandenhoeck & Ruprecht, 2005) and Wolfgang Behringer, *A Cultural History of Climate* (Cambridge, UK: Polity Press, 2010).

<sup>16</sup> Emanuel Le Roy Ladurie, *Histoire humaine et comparée du climat, 1: Canicules et glaciers* (Paris: 2004), chapter 8, discusses the role of climate in these events.

<sup>17</sup> The role of the Little Ice Age in the Ming crisis is emphasized in Timothy Brook, *The Troubled Empire: China in the Yuan and Ming Dynasties* (Cambridge, MA: Harvard University Press, 2010), chapters 3 and 10.

<sup>18</sup> George Brooks, *Landlords and Strangers* (Boulder, CO: Westview, 1993) and James Webb, *Desert Frontier* (Madison: University of Wisconsin Press, 1995). For a more recent reconstruction of seventeenth-century West African droughts, see T. Shanahan et al., “Atlantic Forcing of Persistent Drought in West Africa,” *Science* 324 (2009): 377–80.

<sup>19</sup> Anthony Reid, “The Seventeenth Century Crisis in Southeast Asia,” *Modern Asian Studies* 24 (1990): 639–59; Anthony Reid, “Southeast Asian Population History and the Colonial Impact,” in *Asian Population History*, ed. C. Liu (New York: Oxford University Press, 2001); and Peter Boomgaard, “Crisis Mortality in Seventeenth Century Indonesia,” in *ibid.*

<sup>20</sup> John Richards, “The Seventeenth-Century Crisis in South Asia,” *Modern Asian Studies* 24 (1990): 625–38.

so-called Kan'ei Famine of the same years may have left millions of victims in its wake; however, the Japanese quickly overcame the disaster and embarked on another two centuries of relative stability and economic development.<sup>21</sup> Furthermore, even regions that suffered real political and economic collapse often emerged stronger and more stable from the crisis than ever before. At opposite ends of Eurasia, both Britain and China recovered their losses in blood and treasure within two or three generations.<sup>22</sup> And even as Iberian empires and Mediterranean commerce retreated, Dutch wealth and population continued to grow, often picking up the losses of the former.<sup>23</sup>

By contrast, the Near East faced some of the worst and most enduring losses in the general crisis. As we see over the following chapters, the region suffered sooner and recovered less from the disasters of the age than perhaps any other part of the world. Therefore, this book makes a significant contribution to the study of the general crisis. The Ottoman case not only highlights the role of population pressure and climate disasters in this global event, but also emphasizes the importance of the general crisis as a turning point in world history.

### *Near East Environmental History*

Second, this book offers an original contribution to the still emerging field of Near Eastern environmental history. Traditionally, most writings on the Near Eastern environment have grappled with the thorny issue of decline. Declensionist narratives of the region, emphasizing the degradation of the land and the desiccation of the climate, influenced Western perceptions even in ancient and medieval times. Starting in the seventeenth century, Enlightenment observers remarked on the

<sup>21</sup> Atwell, "Some Observations" and Alan Macfarlane, *The Savage Wars of Peace: England, Japan and the Malthusian Trap* (Oxford: Blackwell, 1997). Conrad Totman, in *Early Modern Japan* (Berkeley: University of California Press, 1993) and *A History of Japan* (Oxford: Blackwell, 2000), also puts particular emphasis on Japan's peculiar ecological path during this period.

<sup>22</sup> For studies of China's population and agricultural recovery in the wake of the crisis, see Robert Marks, *Rice Tigers Silt and Silk* (New York: Cambridge University Press, 1998) and Peter Perdue, *Exhausting the Earth* (Cambridge, MA: Harvard University Press, 1987).

<sup>23</sup> On climate events and social response in the Netherlands, see Leo Noordegraf, "Dearth, Famine, and Social Policy in the Dutch Republic at the End of the Sixteenth Century," in *The European Crisis of the 1590s*, ed. Peter Clark (London: Allen and Unwin, 1985). On Dutch social and economic history, see Jan de Vries, *The Dutch Rural Economy in the Golden Age 1500–1700* (New Haven, CT: Yale University Press, 1974); J. de Vries and A. van der Woude, *The First Modern Economy* (New York: Cambridge University Press, 1997); and Jan de Vries, "The Economic Crisis of the Seventeenth Century after Fifty Years," *The Journal of Interdisciplinary History* 40 (2009): 151–94.

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supposed decay of Biblical landscapes;<sup>24</sup> in turn, this tendency found its way into the work of early environmentalists of the nineteenth century, such as George Perkins Marsh, who imagined that grazing and deforestation had provoked permanent desertification.<sup>25</sup> Then in the early twentieth century, climate determinist theories, particularly the work of Elsworth Huntington, argued simplistically for the rise and fall of Near Eastern empires based on long cycles of rainfall and drought.<sup>26</sup> In more recent decades, perceptions of degradation in the region have worked their way into the writings of environmental historians such as J. Donald Hughes<sup>27</sup> and J. V. Thirgood,<sup>28</sup> who have blamed irresponsible farming and grazing for the apparent decay of the landscape. Furthermore, a sense of long-term Near Eastern decline, whether climatic or man-made, has reentered the popular imagination through more recent popular histories such as the work of Jared Diamond.<sup>29</sup>

In response to some of these claims, other contemporary geographers and historians have painted an entirely different picture of the region, one emphasizing its long-term environmental stability. These works have challenged the declensionist models of landscape degradation and climatic deterioration, and have attacked the evidence and assumptions of earlier writers. The work of A. T. Grove and Oliver Rackham, in particular, has convincingly argued for the resilience of vegetation and

<sup>24</sup> C. J. Glacken, *Traces on the Rhodian Shore* (Berkeley: University of California Press, 1967); Richard Grove, *Green Imperialism* (New York: Cambridge University Press, 1995); Ann Thomson, "Perceptions des populations du Moyen-Orient," in *Orient et lumières*, ed. A. Moalla (Grenoble: Université de Grenoble, 1987).

<sup>25</sup> George Perkins Marsh, *Man and Nature* (Seattle: University of Washington Press, 2003), 161–2, 249–50, *et passim*.

<sup>26</sup> Elsworth Huntington, *The Pulse of Asia* (Boston: Houghton Mifflin, 1907). On the historiography of climate determinism, see A. Issar and M. Zohar, *Climate Change – Environment and Civilization in the Middle East* (Berlin: Springer, 2004), chapter 1, and James Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 1998), chapter 8.

<sup>27</sup> J. Donald Hughes, *Ecology in Ancient Civilizations* (Albuquerque: University of New Mexico Press, 1975); *An Environmental History of the World* (London: Routledge, 2002); and *The Mediterranean: An Environmental History* (Santa Barbara, CA: ABC-CLIO, 2005).

<sup>28</sup> J. V. Thirgood, *Man and the Mediterranean Forest* (New York: Academic Press, 1981) and "The Barbary Forests and Forest Lands, Environmental Destruction and the Vicissitudes of History," *Journal of World Forest Management* 2 (1986): 137–84.

<sup>29</sup> Jared Diamond, *Guns, Germs, and Steel* (New York: Norton, 2001) discusses the decline of the region in terms of desiccation in the conclusion; and David Montgomery, *Dirt: The Erosion of Civilizations* (Berkeley: University of California Press, 2007) has recently argued for the collapse of Near Eastern civilizations in terms of soil salination and erosion.



soil in Mediterranean Europe, at least before the damage inflicted by modern development and industry.<sup>30</sup> Drawing on more empirical studies and archaeological evidence, these writers and others have made a strong claim that such landscapes can recover in the long term from human land use and, moreover, that the drought-prone terrain has evolved a native flora and fauna more naturally resistant to clearing, burning, and grazing than that of other lands. From the evidence, it would appear that the Mediterranean littoral, at least, has not somehow irrevocably degraded from what it was in ancient times, nor has it suffered from any steady desiccation of climate, at least in the past three millennia.<sup>31</sup> Furthermore, the recent work of Diana Davis has called into question the motivations and ideology of the declensionist narrative, particularly the way that accusations of environmental degradation may have been used to justify colonial rule and the expropriation of land in North Africa.<sup>32</sup>

Nevertheless, there may be problems with this revised interpretation as well, especially as we move from Mediterranean Europe to the more arid eastern shore. The evidence of long-term environmental continuity has not meant that the human ecology of the Near East has always been “stable or sustainable” or that the region has enjoyed an “environmental history without catastrophe” as claimed for the Mediterranean in general.<sup>33</sup> The arid and semiarid lands of the region have long proven a challenging environment for human societies, and the evidence of environmental continuity over the very long run does not mean that Near Eastern societies avoided ecological disasters in the shorter term. In other recent studies of the region, we might discern a third paradigm for the environmental history of the Near East: neither environmental decline nor stability, but recurring ecological crisis and protracted recovery.

Research in ancient history and archaeology offers some of the most compelling evidence for this historical pattern. Since the end of the last Ice Age, the Near East has witnessed dramatic fluctuations in temperature and rainfall with profound consequences for human population

<sup>30</sup> A. Grove and O. Rackham, *The Nature of Mediterranean Europe* (New Haven, CT: Yale University Press, 2001).

<sup>31</sup> E.g., B. D. Shaw, “Climate, Environment, and History: The Case of Roman North Africa,” in *Climate and History*, ed. T. Wigley et al. (New York: Cambridge University Press, 1981). For an overview of the evidence from palynology and paleoclimatology, especially in Anatolia, see Neil Roberts, *The Holocene: An Environmental History* (Oxford: Blackwell, 1998).

<sup>32</sup> Diana Davis, *Resurrecting the Granary of Rome* (Athens: Ohio University Press, 2007).

<sup>33</sup> Quotes from P. Horden and N. Purcell, *The Corrupting Sea* (Oxford: Blackwell, 2000), 328–38.

and settlement, including the Younger Dryas of the eleventh millennium BC (associated with the collapse of Natufian culture and the eventual rise of agriculture) and the 8kya cooling event (associated with the collapse of late Neolithic societies and the mid-Holocene transitions to urban civilizations).<sup>34</sup> For early historical times, the work of Harvey Weiss and others has presented strong evidence for a spectacular collapse of civilizations throughout the Near East and beyond driven by a pronounced climate shift around 2200 BC.<sup>35</sup> From other research, it appears that similar albeit less severe episodes may have marked the later Bronze Age<sup>36</sup> and perhaps late Antiquity as well<sup>37</sup> – although these interpretations are not universally accepted.

Research on the medieval Near East has also presented less dramatic but better documented cases. In particular, the work of Peter Christensen has demonstrated a pattern of periodic crisis and protracted recovery across Mesopotamia and western Iran from late Antiquity to the later Middle Ages. While explicitly rejecting the declensionist narrative, Christensen has argued forcefully that historians need to take environmental

<sup>34</sup> For overviews of such climatic instability and its human consequences in the region, see, e.g., Frank Hole, “Agricultural Sustainability in the Semi-Arid Near East,” *Climate of the Past* 3 (2007): 193–203; Arlene Rosen, *Civilizing Climate* (Lanham, MD: Altamira, 2007); and Issar and Zohar, *Climate Change*. For a summary of the literature on climate change and mid-Holocene transitions, see Nick Brooks, “Cultural Responses to Aridity in the Middle Holocene and Increased Social Complexity” *Quaternary International* 151 (2006): 29–49.

<sup>35</sup> H. Dalfes, G. Kukla, and H. Weiss, eds., *Third Millennium BC Climate Change and Old World Collapse* (Berlin: Springer, 1997) and Harvey Weiss, “Beyond the Younger Dryas: Collapse as Adaptation to Abrupt Climate Change in Ancient West Asia and the Ancient Eastern Mediterranean” in *Environmental Disasters and the Archaeology of Human Response*, ed. G. Bawdon and R. Rey craft (Albuquerque, NM: Maxwell Museum of Anthropology, 2000).

<sup>36</sup> Barry Weiss, “The Decline of Late Bronze Age Civilization as a Possible Response to Climatic Change,” *Climatic Change* 4 (1982): 173–98; J. Neumann and S. Parpola, “Climatic Change and the Eleventh-Tenth-Century Eclipse of Assyria and Babylonia,” *Journal of Near Eastern Studies* 46 (1987): 161–82; J. Neumann, “Climatic Changes in Europe and the Near East in the Second Millennium BC,” *Climatic Change* 23 (1993): 231–45; and Neville Brown, *History and Climate Change: A Eurocentric Perspective* (London: Routledge, 2001), chapter 4.

<sup>37</sup> E.g., I. Orland et al., “Climate Deterioration in the Eastern Mediterranean as Revealed by Ion Microprobe Analysis of a Speleothem That Grew from 2.2 to 0.9 kya Soreq Cave, Israel,” *Quaternary Research* 71 (2009): 27–35. Other research has examined the connection between volcanic events, climate change, the Plague of Justinian, and the crisis of the middle Byzantine Empire: See J. Gunn, ed., *The Years without a Summer: Tracing A.D. 536 and Its Aftermath* (Oxford: Archaeopress, 2000) and Richard Stothers, “Volcanic Dry Fogs, Climate Cooling and Plague Pandemics in Europe and the Middle East,” *Climatic Change* 42 (1999): 713–23.