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"No harvest was reaped": demographic and climatic factors in the decline of the Neo-Assyrian Empire

Adam W. Schneider · Selim F. Adalı

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Abstract In the 9th century BC, Assyrians based in northern Iraq started a relentless process of expansion that within two centuries would see them controlling most of the ancient Near East. Traditional explanations for the decline of the Neo-Assyrian Empire in the 7th century BC have emphasized the role of military conflict, and especially the destruction of the Assyrian capital, Nineveh, by a coalition of Babylonian and Median forces in 612 BC. However, it remains unclear how the Assyrian state, the most powerful military machine of its age and the largest empire the Old World had ever seen up to that time, declined so quickly. In this paper, we highlight two potential factors which may have had some influence upon the Assyrian decline that have not been previously explored. The first is a major increase in the population of the Assyrian heartland area at the dawn of the 7th century BC, which substantially reduced the drought resilience of the region. The second factor is an episode of severe drought affecting large portions of the Near East during the mid-7th century BC. We propose a series of testable hypotheses which detail how the combination of these two factors may have contributed to the development of considerable economic and political instability within the Assyrian Empire, and argue that these demographic and climatic factors played a significant role in its demise.

1 Introduction

The Neo-Assyrian Empire (or simply the Assyrian Empire) dominated the Near East from the early 9th to the late 7th century BC (Radner 2014). In the space of a few decades during the latter half of the 7th century, the Assyrian Empire declined from being the greatest military power of the age to meeting its destruction at the hands of Babylon and the Medes, an ancient Iranian people. How and why this mighty empire collapsed so suddenly continues to puzzle archaeologists and ancient historians. Clearly, the process by which the Assyrian Empire

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A. W. Schneider (✉)
Department of Anthropology, University of California-San Diego, Social Sciences Building Room 210, 9500 Gilman Drive, La Jolla, CA 92093-0532, USA
e-mail: awschnei@ucsd.edu

A. W. Schneider · S. F. Adalı
Research Center for Anatolian Civilizations, Koç University, İstanbul, Turkey

declined and ultimately met its demise was complex, and many economic, political, and social factors were involved. In this paper, we seek to highlight two such factors which have not previously been given much consideration: the dramatic and ultimately unsustainable demographic expansion of the Assyrian heartland in the early decades of the 7th century BC, and a regional episode of increased aridity in the Near East during the mid-to-late 7th century, which produced at least one episode of severe drought. We will also propose a series of testable hypotheses which integrate these two framing factors into the historical record, and provide some suggestions about their potential impacts upon the Assyrian economy and political structure during the latter half of the 7th century BC.

2 The regional setting

2.1 Modern climate and geography of the Assyrian heartland

The traditional Assyrian heartland was the Tigris floodplain of northern Iraq, which consisted of a triangle defined by the cities of Assur in the south, Nineveh (modern Mosul) in the north and Arbela (modern Erbil) in the east (Radner 2011). Most of the Assyrian heartland lies in steppe-deserts known as the *jazirah*, which is a transitional ecological zone between the oak-pistachio forests of the Taurus piedmont in southeastern Turkey and the deserts of central and southern Iraq and Syria (Reculeau 2011).

The climate of the region can be broadly classified as hot and semi-arid. Precipitation is highly seasonal, with the majority falling as a result of mid-latitude cyclones that form over the Mediterranean during the winter months. There is a strong north–south precipitation gradient throughout the Near East, with conditions being comparatively humid in the north and drier in the south (Wilkinson 1994). The northern parts of the region receive between 350 and 400 mm/year of precipitation, and are generally (though not always) capable of supporting rain-fed agriculture, while in the southernmost parts of the region mean annual rainfall is generally insufficient (i.e., less than c. 250 mm/year) without irrigation (Wilkinson 2000).

The Assyrian heartland area is a climatically sensitive region, and there is a high degree of interannual variability in the amount of precipitation that it receives each year. Droughts are a frequent occurrence; these typically take the form of multi-year dry periods of 4 or 5 years (Reculeau 2011), which in modern Iraq often include at least one moderate-to-severe dry year (Al-Timimi and Al-Jiboori 2013). Because the Tigris and its eastern tributaries are fed mainly by precipitation in the highlands of its drainage basin, interannual variability of precipitation strongly influences their discharge rates, as well as the timing of peak river flow (Reculeau 2011).

2.2 Historical and paleoclimate proxy evidence for climatic conditions during the 8th-7th century BC

Numerous recently-published paleoclimate proxy data from various parts of the Near East (Fig. 1; see also Figs. 3 and 4 in supplementary materials) indicate that conditions became more arid across much of the region during the latter half of the 7th century BC. At Tecer Lake in the central Anatolian plateau, the presence of a 6–7 cm thick calcite crust in sediment layers dated to c. 670–630 BC was interpreted as evidence of a short-term, intense episode of desiccation within an otherwise humid phase (Kuzucuoğlu et al. 2011). Stable oxygen isotope data obtained from the sediments of Eski Acıgöl, a former crater lake also located in the central Anatolian highlands, indicates that a gradual increase of aridity over two or three centuries reached its peak during the mid-7th century BC, which was one of the driest periods in the vicinity for the entire Holocene (Jones and Roberts 2008). At Lake Iznik in northwestern Anatolia, a shift towards drier conditions at c. 650 BC was inferred from numerous changes in the sediments, including an increase in total inorganic content (TIC) (Ülgen et al. 2012). From changes in the geochemical composition of alluvial sediments from the Rumailiah River in the coastal Jableh Plain of northwestern Syria, Kaniewski et al. (2008) inferred that a transition from humid to arid conditions took place at c. 600 BC. Finally, stable oxygen isotope data obtained from authigenic calcites of Lake Zeribar in the central Zagros Mountains of western Iran also indicate that a short-term arid phase, which began in approximately 750 BC, reached its peak intensity during the mid-7th century, after which conditions again became more humid into the following century (Stevens et al. 2006). Taken together, the proxy records appear to indicate that many parts of the Near East experienced a short but widespread dry phase during the mid-to-late 7th century, which probably reached its greatest intensity during the mid-7th century BC.

While the synchronicity of these proxies is highly suggestive, they need to be interpreted with caution for two reasons. First, the temporal resolution of these paleoclimate records is relatively low (see Table 1 in supplementary materials) in comparison to that of the archaeological and historical record, which in some cases can be dated at an annual or even a monthly scale. (This is particularly true in the case of Eski Acıgöl, which has a very large error range.) Thus, these proxies only permit the identification of broad climatic trends for the Near East at a decadal or centennial scale, and as a result cannot by precisely correlated with specific historical events. Second, so far as we are aware, there are no available proxy records for the 1st millennium BC within the Assyrian heartland. So while the proxies that we do have can give us a general picture of Near Eastern regional climate during the 7th century BC, the available proxy evidence does not reveal what conditions were like in different parts of northern Iraq, or for that matter, in northern Iraq as a whole.

However, while we lack the paleoclimate proxy evidence needed to reconstruct 1st millennium conditions in the Assyrian heartland, ancient texts recovered from Assyrian royal archives can at least provide us with some glimpses of what conditions in this area were generally like during the final century of the Assyrian Empire. For example, judging from the few extant reports we have dating to the reign of Sargon II (see Table 2 in supplementary materials for a chronological list of the reigns of Assyrian kings discussed in the text), rainfall was relatively plentiful during the late 8th century BC, apart from two or three reports of localized drought (Parpola 1987; Lanfranchi and Parpola 1993; Radner 2000; Fuchs and Parpola 2001; Saggs 2001). We have no reports of climatic conditions from the reigns of

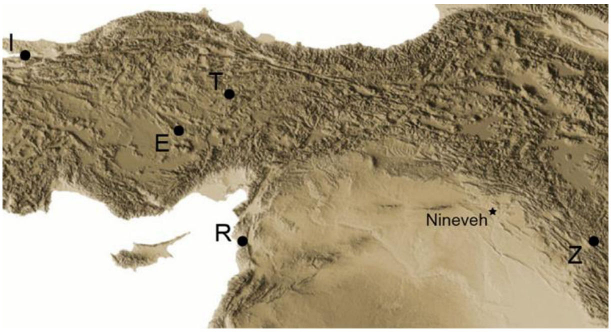


Fig. 1 Map showing the locations of paleoclimate proxy data sources discussed in the text (E: Eski Acıgöl; I: Lake Iznik; R: Rumailiah River; T: Tecer Lake; Z: Lake Zeribar), and the Assyrian capital of Nineveh

Sargon II's immediate successors, Sennacherib or Esarhaddon. There are, however, some brief mentions of flood events in texts dating to the reign of the latter (Borger 1956; Parpola 1983, 1993), which some historians have taken as evidence of a relatively "cool and rainy" period (e.g., Neumann and Parpola 1987).

Several descriptions of climatic conditions can be found in texts from the reign of Assurbanipal. The first of these is a letter, written to the king in 666 BC, which contains a very formulaic section of praise that includes a declaration that Assurbanipal's accession to the throne coincided with a time of plentiful rainfall: "A good reign—righteous days, years of justice, *copious rains, huge floods*, a fine rate of exchange! The gods are appeased…" (Parpola 1993, *emphasis added*). Assurbanipal's own royal inscriptions also emphasize that favorable climatic conditions accompanied the king's accession to the throne (Borger 1996; Parpola 1983). (However, because these descriptions of favorable rainfall conditions accompanying the first years of Assurbanipal's reign are part of Assyrian royal propaganda, they need not necessarily be taken as objective reports of climate during this time.) However, a letter written approximately a decade after Assurbanipal's ascension clearly demonstrates that substantial climatic variability existed within the imperial realm during the mid-7th century BC. This letter, written by the astrologer and priest Akkulanu to Assurbanipal in 657 BC, interprets the astrological implications of important current events, including an episode of severe and apparently widespread drought (Parpola 1993). Specifically, Akkulanu writes: "And *about this year's rains that were diminished and that no harvest was reaped*; this is a good omen for the life and well-being of the king my lord" (Parpola 1993, *emphasis added*). It is very clear from the wording of the text that Akkulanu is describing a total loss of the harvest for the year (Parpola 1983), which was the result of severely dry conditions. From the wording of the letter itself it is not clear whether this was an isolated incident, or part of a larger chain of drought events. However, because the typical modern pattern of drought in the region features several consecutive drier-than-average years, as discussed above, it is likely that the 657 BC drought took place during a series of relatively arid years in the Assyrian heartland.

3 The last century of the Assyrian Empire: archaeological and historical evidence

Any analysis of the implications of drought events discussed above must be placed within the context of the available archaeological and historical evidence for the final century of the Assyrian Empire. There are, to be sure, large gaps remaining in our knowledge, but in our view it is nevertheless possible to make informed inferences about the potential impacts of drought upon the historical trajectory of the Assyrian state from the (admittedly meager) data available to us. What follows is a brief discussion of pertinent details, insofar as known, of the Assyrian agricultural economy and specific historical processes and events that took place during the late 8th and 7th centuries BC which bear on the hypotheses we propose.

3.1 The Assyrian agricultural economy

The economy of the Assyrian Empire was largely based upon agricultural production (although trade and plunder were also important.) Most cities in northern Mesopotamia, including most of the urban centers of the Assyrian heartland, primarily practiced rain-fed agriculture (aka dry-farming.) Although dry-farming was, and still is, a viable form of subsistence in northern Iraq (FAO 2011), this region is on the margin of rain-fed agriculture, particularly in areas which receive less than 400 mm/year of precipitation on average. Wilkinson (1994; 2000) has convincingly shown that, even during periods of relatively plentiful rainfall, cities in this area which exclusively practiced dry-farming were restricted to a maximum size of 100–150 ha in antiquity, depending on the population density; beyond this limit, population levels could not be reliably maintained. Prior to Neo-Assyrian times (which will be discussed further below), agricultural intensification via irrigation was not a realistic possibility in the Assyrian heartland, as the channels of the Tigris and other rivers in the northern plains of Iraq are too deeply incised into the landscape for simple irrigation channels to passively redirect water into nearby fields (Ur 2005). As a result, the cities of northern Mesopotamia were generally much smaller and less populous than those located in areas where large-scale irrigation agriculture was feasible, such as the alluvial plains of Babylonia (i.e., central and southern Iraq) or the Nile Valley in Egypt.

Riehl et al. (2012) have provided an excellent summary, based on numerous archaeological finds and textual evidence, of the crops grown in the northern Fertile Crescent during the Middle and Late Holocene. During the Neo-Assyrian period, cereals, especially barley and free-threshing wheat, were the main staple crops; these were supplemented by numerous fruits and vegetables, including grapes, cucumbers, and pomegranates, among others. In addition to these subsistence crops, plants whose fibers were used for textile production, such as flax and cotton, were also cultivated in some parts of the Empire. Another important agricultural product was straw for use as animal fodder (Postgate 1979).

Because the Assyrian Empire was an agrarian society, control of agriculturally-productive land was an essential component of revenue generation. One source of palace revenue was the direct taxation, in kind, of agricultural produce from farms (Postgate 1979). The majority of the land under Assyrian control was directly owned by the royal household (*ibid*; Bedford 2005). Although much of this land was administered by the state, in order to mitigate the burden and expense of having the royal administration directly manage all of these vast holdings, tracts of this state-owned land were also parceled out as "maintenance land" (*ma'uttu*) to high-ranking administrative officials, who were permitted to accrue personal wealth from these estates in exchange for maintaining them at their own personal expense, and paying a share of the yields from their holdings to the state (Radner 2000). This policy thus obviated the need for the state to expend its own resources to maintain these lands, while simultaneously serving as a means to reward government officials for their service (Bedford 2005).

3.2 Demographic and urban expansion in the Assyrian heartland (704–612 BC)

The population of the Assyrian heartland region appears to have increased considerably during the late 8th and early 7th century BC. This expansion was primarily a result of the forcible resettlement of peoples from conquered lands into the core area of the Empire. To judge from the documentary evidence, the use of deportation and resettlement reached its peak during the reign of Sennacherib, who appears to have overseen the resettlement of nearly half a million people from outlying areas into the heartland during at least 20 known acts of mass deportation (Oded 1979).

It is likely that the population explosion of the heartland area was part of a larger, politically-motivated project of urban expansion undertaken by Sennacherib. Upon his accession to the throne, Sennacherib decided to move the Assyrian capital to the city of Nineveh. Over the course of his reign, he greatly expanded the city, which by the time of its destruction in 612 BC had grown from c. 150 ha to a staggering 750 ha in size, making it by far the largest city that had ever existed in northern Mesopotamia up to that time (Wilkinson et al. 2005). The new city featured numerous monumental constructions that exemplified royal power, and showed Sennacherib's superiority over contemporary political rivals and his own predecessors (Grayson and Novotny 2012). The city of Nineveh, and the prosperity which it represented, was designed to be seen as an unmistakable symbol of the economic and political strength of the Assyrian Empire.

While the expansion of Nineveh carried clear political benefits for Sennacherib, the archaeological record suggests that this project also substantially reduced the city's agricultural productivity. Large areas of Nineveh's prime cultivable land were built over during its enlargement, and the low hills around the city, which had little agricultural potential, prevented a concurrent expansion of its agricultural catchment to replace the fields which were lost (Wilkinson et al. 2005). At the same time, the population of the newly-enlarged capital was also greatly increased by the forced immigration of large numbers of deportees to serve as laborers in and around the new imperial metropolis (Oded 1979; Ur 2005). As a result, it seems very likely that the immediate agricultural hinterland of Nineveh could not have produced enough food to reliably support the capital's considerable urban population without significant agricultural intensification and the importation of additional surpluses from elsewhere (Wilkinson et al. 2005).

We tentatively suggest that the expansion of Sennacherib's new capital also placed additional stress upon the food supply of the wider heartland region. Given Nineveh's location in the northern part of the heartland, where mean annual precipitation was relatively plentiful, it is very possible that by diminishing the city's agricultural catchment, Sennacherib reduced the overall productivity of the Assyrian harvest, particularly during drier-than-average years. Moreover, because Nineveh was apparently forced to obtain some of its food supply from other parts of the heartland, this would have reduced the capacity of those other areas to draw upon surplus food stocks during periods of low agricultural productivity.

In fairness to Sennacherib, it does seem that he and his administrators attempted to resolve this problem though technological means. In order to greatly increase the agricultural productivity of the heartland region, and perhaps offset the risks posed by interannual precipitation variability, Sennacherib's engineers constructed an extensive and sophisticated system of canals, dams, reservoirs, and related structures, which transported large quantities of water from great distances to Nineveh, and also to the rural agricultural hinterland (Bagg 2000; Ur 2005). This system, which has been extensively mapped and studied via remote sensing and archaeological field surveys, was able to draw water from highland sources as far away as 150 km to the northeast of the Assyrian capital (Ur 2005). The Neo-Assyrian canal system is justly viewed as a remarkable feat of ancient hydroeningeering, and it is generally accepted that it probably provided the Assyrian state with some measure of protection against the precipitation variability that plagued dry-farming communities in northern Mesopotamia (Ur 2005; Wilkinson et al. 2005). However, because the amount of precipitation that falls in the highlands to the north and east of the Assyrian heartland has a strong influence upon the annual discharge rates of many of the rivers and wadis that fed the canal system (Reculeau 2011), we find it unlikely that the system would have been able to nullify, or even substantially mitigate, the agricultural impacts of particularly intense droughts. Indeed, Akkulanu's observation that the failed harvest in 657 BC was caused by "rains that were diminished" suggests that Sennacherib's hydraulic infrastructure was not capable of transporting enough water to the Assyrian heartland to sustain agricultural production levels during significantly drier-than-average years.

3.3 Major historical events during the final century of the Assyrian Empire

The Assyrian Empire reached its zenith during the final decades of the 8th century and first half of the 7th century BC. Sennacherib established Assyrian dominance in the eastern Mediterranean coast, central and southeastern Turkey, the Arabian Desert, the Persian Gulf, and Babylonia (Grayson and Novotny 2012). In 681 BC, he was assassinated by his son Urdu-Mullissu, who opposed Sennacherib's decision to name another son, Esarhaddon, as his successor. This event led to a civil war over the succession, from which Esarhaddon emerged victorious. The new king sought to protect the territorial gains made by his father, and also launched a major invasion of Egypt, which he conquered in 671 BC (Leichty 2011).

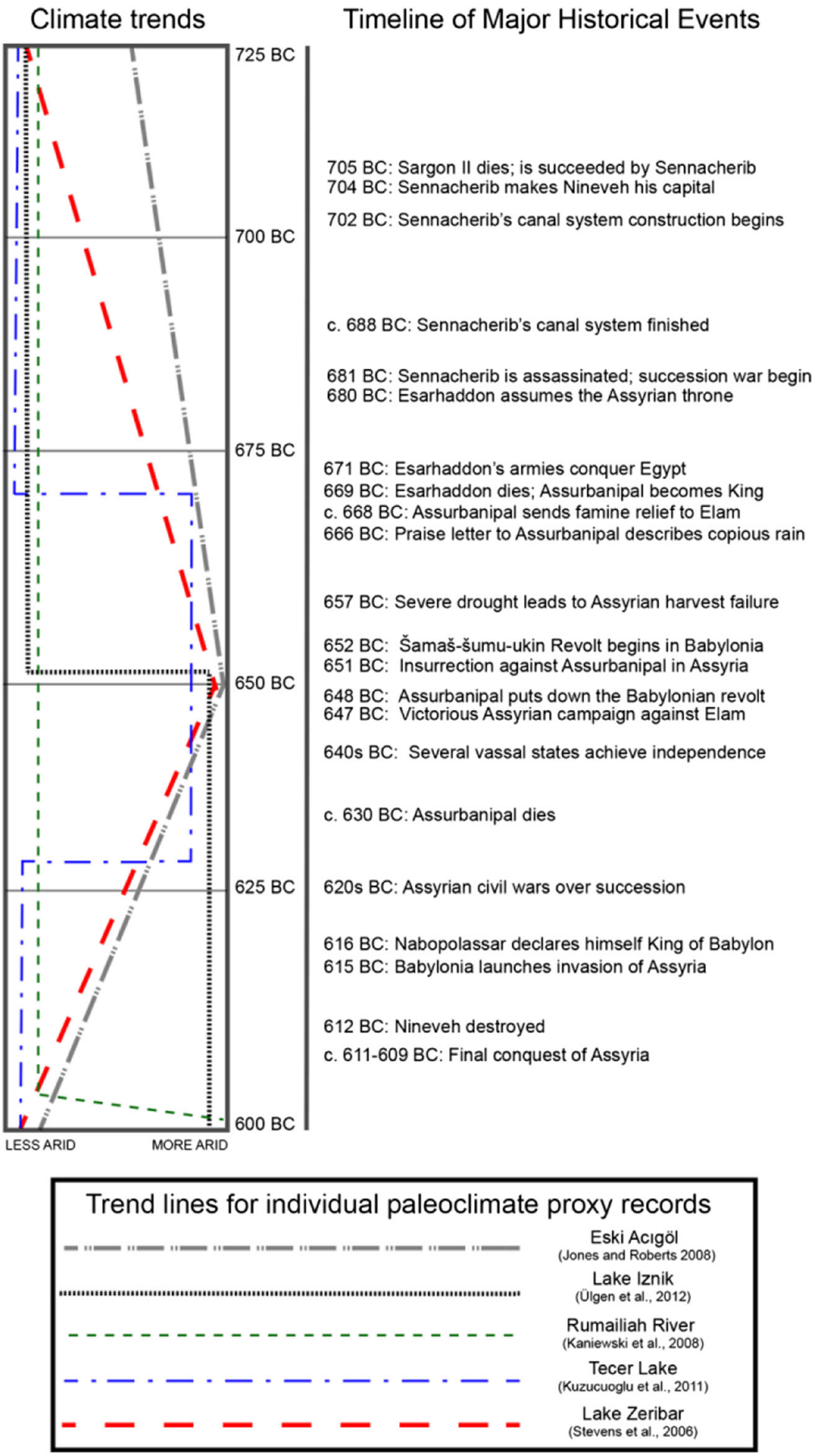
Esarhaddon was succeeded by his son Assurbanipal in 669 BC; the new king's brother Šamaš-šumu-ukin was enthroned as king of Babylonia (a subservient political office) the next year. Because the succession was realized without open conflict, the first years of Assurbanipal's reign were a time of stability, apart from unrest in the newly-added province of Egypt, which proved difficult to control (Grayson 1980; Kuhrt 1995). This period was also apparently a time of bountiful harvests, as Assurbanipal felt secure enough in his own food supply to send grain to the kingdom of Elam in southwestern Iran to relieve a severe famine there in c. 668 BC; he also allowed Elamite refugees to temporarily settle in Assyria until the situation had improved in their homeland (Potts 1999).

However, this early period of success was followed by decades of turmoil. In 657 BC, as already noted, the harvest failed, apparently because of an unusually severe drought. We cannot say with precision how this event impacted the Assyrian Empire, but given that the Empire was an agrarian society, and that the "health of the empire's economy naturally depended very much on the success of the harvest" (Postgate 1979), it is almost certain that this event inflicted considerable economic damage. One might also speculate that because of its economic consequences, drought may have been an indirect cause of political instability in the years that followed, but there is no clear indication of such a link from the available evidence.

Whatever effect the drought of 657 BC may or may not have had, within 5 years Assurbanipal's brother, Šamaš-šumu-ukin, launched a revolt that raged between 652 BC and 648 BC (Grayson 1980; Frame 1992). A second insurrection took place within the Assyrian heartland itself in 651 BC (Grayson 1975), which Frame (1992) suggests may have prevented Assurbanipal from sending sufficient numbers of troops to Babylonia to quell Šamaš-šumu-ukin's rebellion immediately, thus prolonging the civil war. Assurbanipal was ultimately victorious, but as Frame notes, Assyria was "likely exhausted" by the conflict, and the Šamaš-šumu-ukin Revolt probably marked the beginning of the Assyrian decline (Frame 1992). In the aftermath of the civil war, the Assyrians lost control over several vassal states (Grayson 1980; Adalı 2013; Radner 2014). Moreover, with the notable exception of one victorious campaign against the kingdom of Elam in 647 BC, the Assyrian Empire was forced permanently onto the defensive after the Šamaš-šumu-ukin Revolt.

Documentation becomes extremely scarce after Assurbanipal's death in c. 630 BC, but the limited evidence indicates that the reigns of his successors were marked by political turmoil and a series of civil wars (Kuhrt 1995). Assyrian texts from this time provide some indication that the economy was also struggling. Several legal documents dating to the 620 s BC testify to comparatively high grain prices during this period (Deller 1964), which Neumann and Parpola (1987) consider to be an effect of the political instability of the Empire. It is possible that increased regional aridity, as indicated by the paleoclimatic proxy records discussed earlier, may also have been a factor in rising grain prices, though this question must remain unresolved pending further research. In any event, "the Assyrian heartland had lost any real significance by the end of the seventh century" (Kuhrt 1995).

By 620 BC, the Assyrian Empire was fatally wounded, but it would be another decade or so before the final blow was struck. In 616 BC, a former Assyrian subject named Nabopolassar declared himself king of Babylon, and took to the offensive against the moribund Assyrian state. As the war unfolded, an alliance was forged between Nabopolassar and Cyaxares, king


Climate trends
Timeline of Major Historical Events
725 BC
700 BC
675 BC
650 BC
625 BC
600 BC
LESS ARID
MORE ARID
705 BC: Sargon II dies; is succeeded by Sennacherib
704 BC: Sennacherib makes Nineveh his capital
702 BC: Sennacherib's canal system construction begins
c. 688 BC: Sennacherib's canal system finished
681 BC: Sennacherib is assassinated; succession war begin
680 BC: Esarhaddon assumes the Assyrian throne
671 BC: Esarhaddon's armies conquer Egypt
669 BC: Esarhaddon dies; Assurbanipal becomes King
c. 668 BC: Assurbanipal sends famine relief to Elam
666 BC: Praise letter to Assurbanipal describes copious rain
657 BC: Severe drought leads to Assyrian harvest failure
652 BC: Šamaš-šumu-ukin Revolt begins in Babylonia
651 BC: Insurrection against Assurbanipal in Assyria
648 BC: Assurbanipal puts down the Babylonian revolt
647 BC: Victorious Assyrian campaign against Elam
640s BC: Several vassal states achieve independence
c. 630 BC: Assurbanipal dies
620s BC: Assyrian civil wars over succession
616 BC: Nabopolassar declares himself King of Babylon
615 BC: Babylonia launches invasion of Assyria
612 BC: Nineveh destroyed
c. 611-609 BC: Final conquest of Assyria
Trend lines for individual paleoclimate proxy records
Eski Acıgöl
(Jones and Roberts 2008)
Lake Iznik
(Ülgen et al., 2012)
Rumailiah River
(Kaniewski et al., 2008)
Tecer Lake
(Kuzucuoglu et al., 2011)
Lake Zeribar
(Stevens et al., 2006)

◀ **Fig. 2** This chart demonstrates the temporal correlation of historical events (as described in Sections 3.2 and 3.3) with the shift toward greater regional aridity which can be inferred from the proxy data (as discussed in Section 2.2)

of the Medes, against Assyria. This coalition eventually conquered Nineveh in 612, and by 609 BC had achieved the total destruction of this remarkable civilization.

4 A new hypothesis for the cause of instability during the final half-century of the Assyrian Empire

The archaeological, historical, and paleoclimatic proxy evidence presently discussed indicates that the decline of the Assyrian Empire was a complex process which involved numerous interconnected causal factors. In her review of the available textual evidence regarding the rapid Assyrian decline, Kuhrt observes that "the process and circumstances, and possible underlying causes, all remain obscure" (Kuhrt 1995:541). The need arises, therefore, to generate testable hypotheses which will focus further investigation of the complex web of causal factors that figured in the political collapse of the Assyrian Empire.

In this paper, we call attention to two potential causal factors for that collapse that have up to now been underexplored. The first of these is the dramatic and ultimately unsustainable demographic expansion of the Assyrian heartland during the reign of Sennacherib, which we contend made the region dangerously vulnerable to crop shortages during severe droughts. The second, related factor, which is reflected in recently published Near Eastern paleoclimate proxy records and Assyrian royal correspondence, is that regional aridification during the mid-7th century BC resulted in at least one known episode of severe drought.

In order to integrate these two factors into the existing historical accounts of the Assyrian collapse, we propose the following series of testable hypotheses. In our scenario, at least some of the seeds of the Assyrian decline were sown during the reign of Sennacherib. We suggest that the mass deportation of laborers into the Assyrian heartland, coupled with the urban renovation and extension of the new capital at Nineveh, created a population level that greatly exceeded the region's natural carrying capacity, particularly during dry years. As a result, despite the presence of Sennacherib's sophisticated hydraulic infrastructure, the overall resiliency of the Assyrian heartland to the effects of significant drought events was considerably reduced.

From the available evidence, we posit that severe drought, though apparently not a problem in Sennacherib's time, eventually afflicted much of the Near East, including the Assyrian heartland itself, during the mid-7th century BC. Given the tendency for severe droughts to occur as part of multi-year dry periods in modern Iraq, we suspect that the drought reported by Akkulanu in 657 BC took place within a similar series of drier-than-average years. If so, it is very likely that such a multi-year drought would have placed serious stress on the agricultural economy of the Assyrian state, and by extension, upon the imperial political system.

Although we cannot say with any certainty what the specific impacts of such an agricultural disaster might have been, there are hints from the historical records which permit some tentative speculation as to its possible effects. One obvious major problem would have been a shortage of food for important cities in the core area of the Empire, especially in the capital. Under such circumstances, the price of agricultural produce would presumably have increased significantly, as it did during the 620 s BC (see above). Crop shortages would also have created problems with providing adequate provisions of food and animal fodder for the army, thus weakening the military strength of the Assyrian state.

We also strongly suspect that any economic damage inflicted upon the Assyrian Empire by drought would have served as a key stimulus for the increasing unrest which was to characterize its final decades, although this notion cannot be conclusively demonstrated from the available evidence, and for the present must remain in the realm of conjecture. While there is no direct evidence from which a causal relationship can be inferred between drought and political dissatisfaction with Assurbanipal's regime, the fact that insurrections apparently broke out not only in Babylonia but within the Assyrian heartland itself in 652 and 651 BC, respectively (Fig. 2), is suggestive that political unrest may have been partly influenced by economic hardship that resulted from drought earlier in the decade. Some of this disaffection could conceivably have arisen from the officials administering royal land under the *ma' uttu* system, who would likely have faced increased pressure from Nineveh to yield greater and greater percentages of the harvest from their estates to the royal treasury at their own personal expense.

Our hypothesis also provides a potential explanation for the paradoxical situation which follows the civil war between Assurbanipal and his brother: despite emerging victorious and laying waste to much of Babylonia, Assyria steadily declined after 648 BC, while the strength of Babylonia appears to have gradually increased at the same time. If multi-year episodes of drought were a persistent feature of regional Near Eastern climate during the late 7th century BC—a plausible scenario in light of the paleoclimate proxy data discussed earlier – then Babylonia's irrigation-based agricultural system, which was considerably less vulnerable to drought than the dry-farming practiced in the Assyrian heartland, would have been comparatively well-suited to maintaining agricultural production during such arid periods. The ascendancy of Babylonia during the final decades of the century, then, might have partly resulted from the relative resiliency of the local subsistence economy that featured irrigation agriculture and the exploitation of protein rich marsh resources in comparison with that of the Assyrian Empire, which was heavily reliant upon rain-fed agriculture.

It would be misleading, however, to suggest that episodes of drought caused by a change in climate were the only—or even the primary – causal factor for the decline of the Assyrian Empire. We must assume that there were many other important known and unknown contingent factors that also influenced the historical trajectory of the Assyrian state during its final century. Clearly, more research is needed if we are to develop a more complete picture of the events which led up to the destruction of the Assyrian state. We hope that this paper will stimulate future study of the roles played by the factors which we have highlighted here, and further elucidate if and how these shaped the rapid political decline of Assyria during the mid-to-late 7th century BC.

In closing, we would like to draw attention to some instructive parallels between the scenario laid out in this paper for the Assyrian Empire's decline and some of the potential economic and political consequences of climate change in the same area during our own era. One particularly grim example is the connection between severe drought and the development of contemporary political conflict in Syria and northern Iraq (e.g., de Châtel 2014; Gleick 2014), which bears some striking similarities to the relationship we propose between drought and the civil wars which took place in this same region during the Assyrian Empire's final half-century. At a more global level, the fate of the Assyrian Empire also teaches modern societies about the consequences of prioritizing policies intended to maximize short-term economic and political benefit over those which favor long-term economic security and risk mitigation. Of course, the Assyrians can be "excused" to some extent for focusing on short-term economic or political goals which increased their risk of being negatively impacted by climate change, given their technological capacity and their level of scientific understanding about how the natural world works. We, however, have no such excuses, and we also possess the additional benefit of hindsight, which allows us to piece together from the past what can go wrong if we choose not to enact policies that promote longer-term sustainability.

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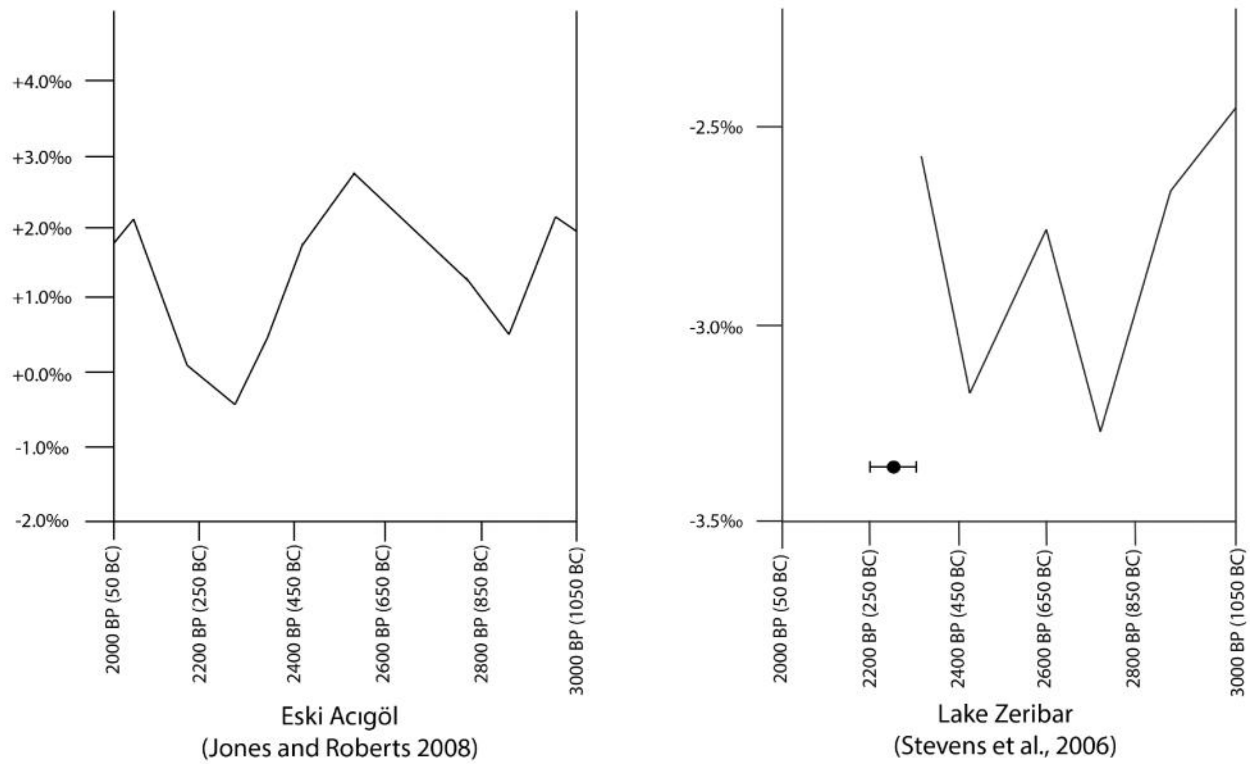


Figure 3: Climate trends indicated in stable oxygen isotope ratios from Eski Acıgöl and Zeribar. AMS radiocarbon date and error range for Zeribar is shown as a closed symbol and bar, respectively. It should be noted that the AMS date for Zeribar was derived from Stevens et al., 2001: Table 1.

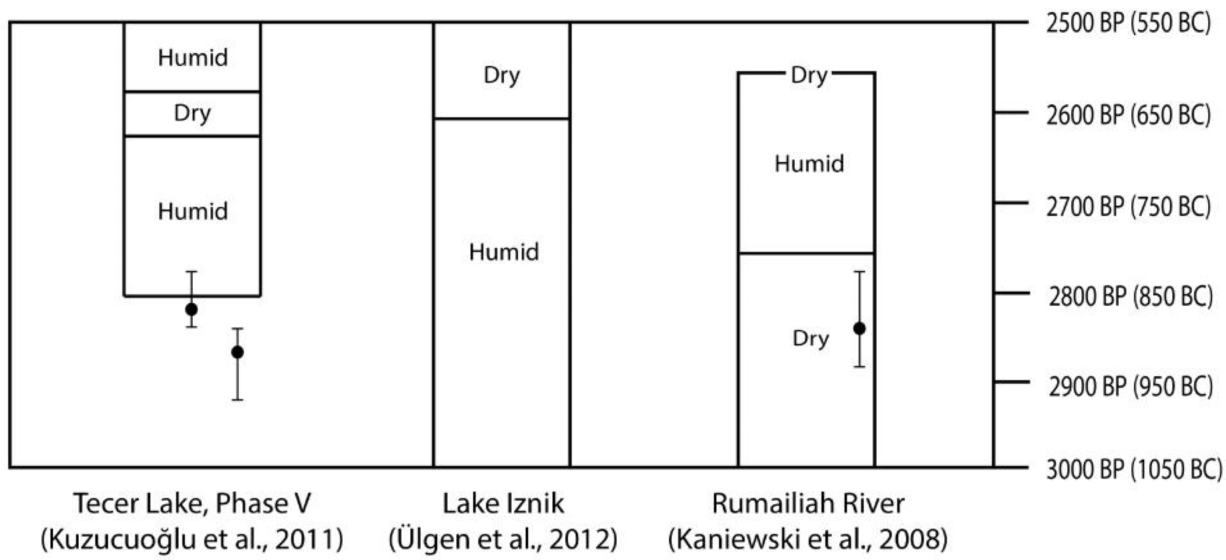


Figure 4: Trends indicated in soil sediment profiles for Tecer, Iznik, and Rumailiah. AMS radiocarbon dates and error ranges, where available, are shown as closed symbols and bars, respectively.

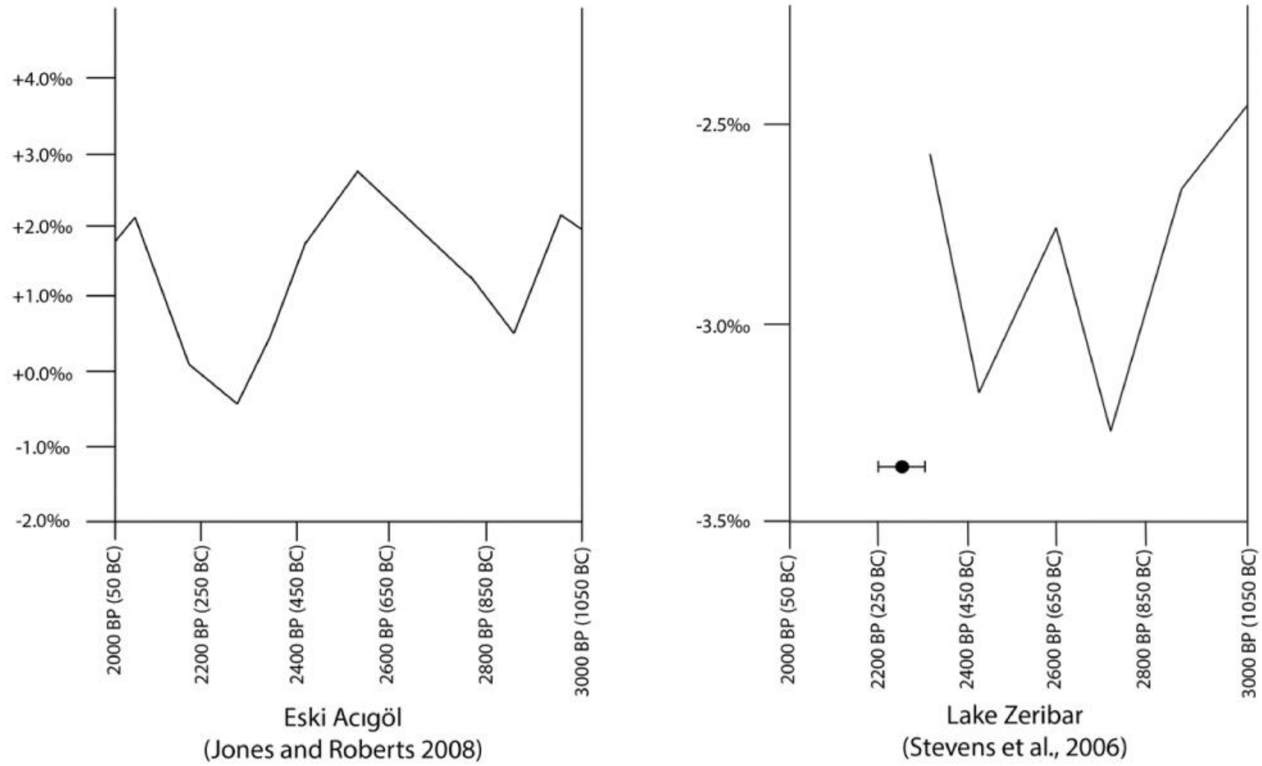


Figure 3: Climate trends indicated in stable oxygen isotope ratios from Eski Acıgöl and Zeribar. AMS radiocarbon date and error range for Zeribar is shown as a closed symbol and bar, respectively. It should be noted that the AMS date for Zeribar was derived from Stevens et al., 2001: Table 1.

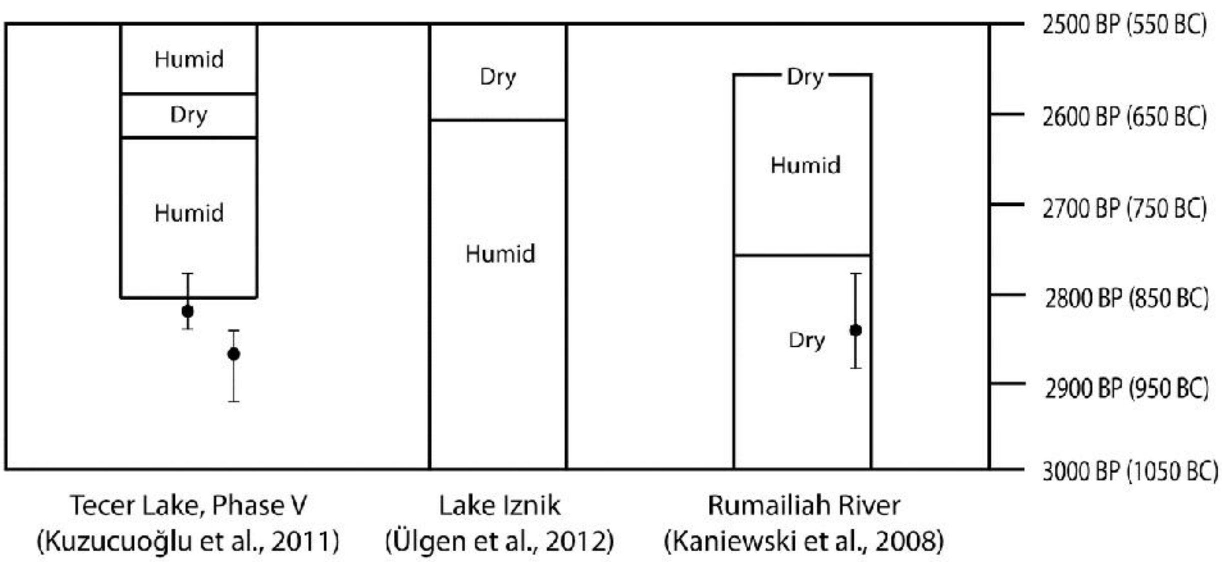
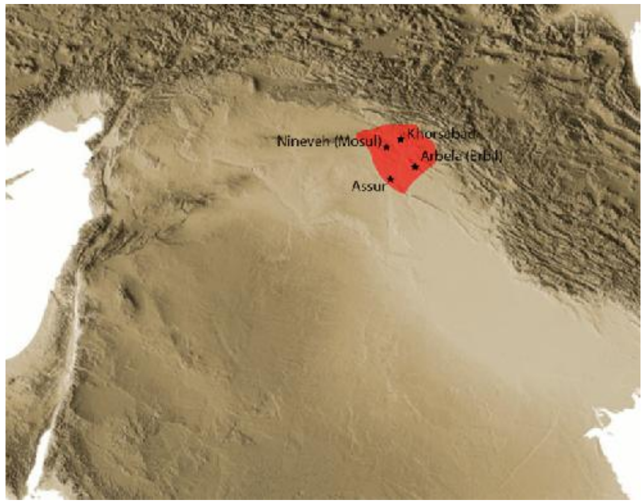


Figure 4: Trends indicated in soil sediment profiles for Tecer, Iznik, and Rumailiah. AMS radiocarbon dates and error ranges, where available, are shown as closed symbols and bars, respectively.



Map showing the traditional Assyrian heartland region and cities mentioned in the text

The clay tablet containing Akkulanu’s letter to Assurbanipal, written in 657 BC
(Photo provided courtesy of the Trustees of the British Museum)

Site	**Type**	**# Overall Dates**	**Oldest date (cal. BP)**	**Youngest date (cal. BP)**	**# 1st mil. BC Dates**	**Mean Error Range** (2-σ unless otherwise indicated)
Eski Acıgöl	TIMS	6	23,200±2000	0	0	2066.67
Iznik	AMS	9	4723	290	2	43.94
Rumailiah	AMS	4	4050	2850	1	115 (1-σ)
Tecer	AMS	11	5830	670	3	71.91 (1-σ)
Zeribar	AMS	5	16387±295	2260±50	1	137.6

Table 1 A list of chronometric dates, age ranges, number of dates for the 1st millennium BC, and calculated mean error ranges for climate proxies discussed in this paper. All data was obtained from the following sources: Eski Acıgöl: Roberts et al., 2001: Table 2; Lake Iznik: Ülgen et al., 2012: Table 3; Rumailiah River: Kaniewski et al., 2008: Table 1; Tecer Lake: Kuzucuoglu et al., 2011: Table 2; Lake Zeribar: Stevens et al., 2001: Table 1.

Sargon II	721-705 BC
Sennacherib	704-681 BC
Esarhaddon	680-669 BC
Assurbanipal	668-c. 630 BC
Aššur-etel-ilani	c. 630-627 BC
Sin-šumu-lišir	c. 626 BC
Sin-šarru-iškun	c. 626-612 BC
Aššur-uballiṭ II	c. 611-609 BC

Table 2 The succession of Assyrian kings who reigned during the last century of the Assyrian Empire.