Changing the climate: Bioarchaeology responds to deterministic thinking about human–environmental interactions in the past

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Abstract:

As members of the global public become increasingly concerned about climate change, popular presses promote "scientific" narratives about the success or failure of past societies (e.g., Diamond, Collapse: How societies choose to fail or succeed. New York: Viking, 2005), human security literature perpetuates a narrative that violence is a "natural" outcome of increased competition in such circumstances (e.g., Barnett and Adger, Political Geography 26(6):639–655, 2007), and generally, neither the public nor policy-makers are exposed to information about the topic of human-environmental interactions from those who know it best, anthropologists. This chapter explores the development of the human security field and the development of pseudo-evolutionary, ahistorical, adaptationist narratives about human behavior in the face of changing climates. The chapter also demonstrates implications of these narratives as they have been adopted by policy-makers at the EPA and DoD. Finally, the chapter provides an example of a bioarchaeological approach to research on human-environmental relations in the past and the complex dynamics that shaped the human experience of climate, social, and economic changes in the first and second millennium BCE in South Asia. Human security literature is the basis for planning for a warmer world. Anthropological perspectives are the necessary antidote to narratives of competition and violence that promote a governmental agenda to prevail at all costs.

Keywords: Climate change | Human security | Violent conflict | Vulnerability | Bioarchaeology | Indus civilization

Chapter:

Introduction

There is no doubt that we live in a warming world and that climate change is a very significant and important challenge facing human societies today. On Thursday, May 9, 2013, we passed 400 ppm of carbon dioxide in Earth's atmosphere, a level that has not been reached since the Miocene (a geological epoch from 23 to 5 million years ago, when the first apes evolved). Climate scientists predict 2–3 °C of warming above the mean annual surface temperatures we have enjoyed throughout most of the nineteenth century; average global temperatures are expected to increase from 15 °C (59 °F) to 17 °C (62.6 °F) by 2100; a larger increase is to be expected if we continue to emit fossil fuels into the atmosphere unabated. Unfortunately, warmer mean annual temperature is only one of the numerous impacts we will experience from global warming, and, as these changes begin to accumulate, the global public is becoming increasingly aware of climate change. Global warming feels alarming in particular because there is a lot of uncertainty about what warmer temperatures will mean for human life on Earth and there is also growing concern surrounding the tacit agreement that we are not rapidly or significantly going to change our behavior.

As public concern mounts about climate change, popular presses capitalize on "scientific" narratives about how climate drives the collapse of past societies (e.g., Diamond 2005). A scholarly literature has also developed over the past few decades, specifically with a goal of informing public policy. The human security field, for instance, is focused on understanding and predicting how humans will respond to the changing climate. A review of the literature in this field of inquiry is marked by some interesting differences from other kinds of intellectual work and scholarship on human societies, not the least of which is (1) a focus on adaptationist and deterministic thinking, (2) a belief that civilization quells humanity's naturally violent tendencies, and (3) the notion that climate change and environmental migration will invariably result in competition, increasing chaos, and possibly collapse (see, e.g., Barnett and Adger 2007; Gleick 2014, 2016; Hsiang et al. 2013; Raleigh and Urdal 2007; Scheffran et al. 2012). This is important because governmental and nongovernmental organizations (NGOs) worldwide rely on this literature as a basis for policy and planning; thus, essentialism and determinist approaches have real and disturbing implications.

It is our opinion that anthropological perspectives on the topic of human-environmental relations are particularly valuable, as they give voice to human biocultural variation and these voices should be more present in the policy and planning discourse about climate change. Human security literature is deeply concerned with the role of the state in moderating vulnerability and has a primary interest in assisting policy planners by making predictions about human behavior and "vulnerability" in the face of challenges like global warming. Information about the consequences of climate change for human communities in the past, the role of culture and history, and potential challenges to health, safety, and mortality should therefore be considered to be of tremendous value. Bioarchaeology—the contextualized study of archaeological human remains—has long examined the role of history, society, and culture in shaping human biocultural adaptations in cases of past environmental change and more specifically in climate change conditions (e.g., Gregoricka 2016; Harrod and Martin 2013; Robbins Schug 2011; Robbins Schug and Blevins 2016; Robbins Schug and Goldman 2014; Robbins Schug et al. 2012, 2013). Therefore, bioarchaeological evidence and inferences about past climate should be one of the primary sources for making evidence-based predictions about the future, mitigating

some of the uncertainty about the forces that shape the range of possible human responses worldwide and the differential long-term consequences of short-term strategies.

In this chapter, we begin with an examination of the claims made by the US government—the Environmental Protection Agency (EPA) and the Department of Defense (DoD)—about global warming and its potential impacts. We demonstrate the interweaving of determinist thinking and pseudo-evolutionary narratives, which ultimately pose a threat to reasonable and effective global relations. We then turn our attention to the human security literature, which was intended to provide a scientific foundation for understanding human vulnerability in the face of climate change as well as the role of the State in meeting those challenges. We describe the history of this field with the goal of demonstrating the development of these narratives about violence and collapse. Finally we describe bioarchaeological research that demonstrates the diversity of human-environmental relations, climate, and cultural changes in the past and could represent an alternative framework for making predictions about global warming.

Climate Change as "a Significant Threat to the Health of the American People"

For decades, Americans have avoided an effective response to climate change. Many politicians have redirected attention to a straw-man debate about whether climate change is real and if humans played a role. Behind the mirage of controversy though, governmental agencies responsible for ensuring the management of natural resources and our national security have accepted that global warming represents "a significant threat to the health of the American people" (USGCRP 2016). In documents composed by pre-2017 EPA, global warming is specifically framed as an evolutionary challenge. "Human societies have adapted to the relatively stable climate we have enjoyed since the last Ice Age, which ended several 1000 years ago. A warming climate will bring changes that can affect our water supplies, agriculture, power and transportation systems, the natural environment, and even our own health and safety" (EPA 2016a). Specifically, the pre-2017 EPA has publicly expressed concerns that global warming is melting glaciers, causing sea level rise, and changing patterns and distribution of rainfall, evaporation rates, fresh water supplies, and water quality (EPA 2016b). They publicly predicted that global warming will fundamentally alter ecosystems and transform habitats, food webs, life cycles of plants and animals, home ranges, and migration patterns, that it will affect the evolution and spread of pathogens and parasites, and that climate change is a primary driver of extinction (EPA 2016c).

Food and water security are almost certainly at stake in the face of global climate change, population growth, and growing global inequality. Domesticated plants and animals thrive in narrow temperature ranges, with rather specific nutrient requirements that must be met despite changes that often give advantage to unwanted species of weeds and pests. Food resource scarcity will result from declines in agriculture—plant growth may be stimulated by increased CO_2 levels in the atmosphere, but failure to adapt to changing irrigation and fertilization regimes, growing seasons, and ecozones will likely result in declines in production (EPA 2016c). In the context of increasing demand for fresh water, annual surface moisture trends in 2016 had already supported the suggestion that drought is a significant looming problem in the Midwest and the southern half of the United States (EPA 2016d). In the northern parts of the country, the concern

was that flooding and runoff that would overwhelm existing infrastructure and lead to water pollution problems.

These governmental and nongovernmental organizations and working groups are focused on predicting the impacts of global climate change for human populations for good reason. Perhaps a strongly negative tone is warranted, but the adaptationist framework should perhaps be equally alarming, particularly because it is often framed in terms of natural selection that humans are in a Malthusian competition for finite resources, and thus American national security interests and resource needs are de facto pitted against "others" around the world. In the EPA's public comments, this is expressed softly: "In developing countries, adaptation options like changes in crop management or ranching practices, or improvements to irrigation are more limited than in the United States and other industrialized nations. … Impacts to the global food supply concern the United States because food shortages can cause humanitarian crises and national security concerns" (EPA 2016d). But it is important to note that the DoD is also making plans for a warmer world, and in that case, pseudo-Darwinian paradigms might be more dangerous.

The DoD, in their public documents pertaining to global warming, has stated a preoccupation with maintaining American supremacy, unfettered acquisition of global resources, and even the maintenance of capitalist hierarchies. For example, in July of 2015, the DoD issued a report to the United States' Congress entitled *National Security Implications of Climate-Related Risks and a Changing Climate* (DoD 2015). Congress had tasked the DoD with identifying the most serious and most likely climate-related risks for military operations; developing mitigation plans for humanitarian aid, global security, capacity building in partner states, and sharing best practices; and describing their resource needs to conduct these operations. The report defined global climate change as "an urgent and growing threat to our national security, contributing to increased natural disasters, refugee flows, and conflicts over basic resources such as food and water" (DoD 2015, p. 3). The DoD claimed in this document that the impacts of global warming were already being experienced and "the scope, scale, and intensity of these impacts are projected to increase over time" (DoD 2015, p. 3). The document as a whole belies a philosophical orientation that the United States needs to "project power and win decisively" as the increasing risk of instability and conflict overseas creates "challenges to our national interests."

Based on published reports by national security agencies, the pre-2017 leadership at the DoD and the Environmental Protection Agency (EPA) has been in complete agreement with the United Nations (UN) and Intergovernmental Panel on Climate Change (IPCC) that Earth's mean annual temperature has risen and will continue to rise and global warming will lead to the following risks: "large and potentially dangerous" changes in the weather, intensity of heat waves, patterns of rainfall, frequency and severity of storms, flooding, and drought (EPA 2016a). In this chapter, we too are in complete agreement that climate change (global warming) is an important challenge for life on Earth. Our interest in this chapter is to challenge the adaptationist narrative—where environmental immigration and increased competition for resources will lead to inevitable violent clashes—that underlies these predictions and plans by the US government. Our goal is to trace the development of that narrative and to provide an alternative, anthropological framework for understanding potential human responses to climate change as a product of historical, social, and cultural factors.

Human Security Literature: A Basis for Planning and Public Policy

In the twentieth century, Western societies were impacted by major sociopolitical changes, like the fall of the Berlin Wall and the dissolution of the USSR (Tadjbakhsh and Chenoy 2007, p. 1). It is within this context that a new field of inquiry was welfare of ordinary people (Paris 2001) and to conduct research on the "insufficiency of a state-based approach" to individual and human "well-being" (Dabelko 2010, p. ix). Well-being was defined variously as freedom from fear, freedom from want, or freedom from any threats to safety. "Simply put, Human Security debunks the question of 'security' from its traditional conception of the safety of states from military threats to concentrate on the safety of people and communities" (Tadjbakhsh and Chenoy 2007, p. 9).

Initially, scholars in the human security field had interests spanning topics like state violence, environmental degradation, population displacement, and globalization (Stoett 1999; UNDP 1994). Eventually the focus of research attention narrowed to "vulnerability," state power, and natural resources, and eventually these three areas coalesced into a concern with global climate change as a persistent new research direction around the turn of the twenty-first century (Hampson and Hay 2002; Khong 2001; King and Murray 2002; Nef 1999; Newman and Richmond 2001; Stoett 1999; Suhrke 1999; Thomas and Wilkin 1999). A coherent model for research in this field of inquiry emerged around 2003 (Alkire 2003; Khagram et al. 2003; Oels 2012; Owen 2004). In a sense, climate change offered a new organizational framework for a field that was intensely struggling to redefine itself and to understand a world that seemed "random, turbulent, and chaotic" after the end of the Cold War (Nef 1999, p. 3).

Disturbingly, scholars in this field began to focus on an idea that climate change would inevitably catalyze a clash of cultures that would come to dominate global politics in the near future: "The fault lines between civilizations will be the battle-lines of the future" (Huntington 1993). Other scholars, particularly Nef, foresaw the dangers of a reemergence of the ethnocentric and deterministic paradigms of the past. He opined that this kind of thinking "shows a remarkable misunderstanding of both history and culture and cannot reflect the complex, nuanced, and dynamic nature of our age of extremes while perpetuating the cult of war and Western superiority" (Nef 1999, p. 4). How prescient this complaint would become in a field that shortly thereafter looked to explain the crises brought forth by the 2000 election—George W. Bush's wars, the rise of ISIL, and the crash of the global economy in 2008—and now the apparently tyrannical power relations developing early in 2017.

Unfortunately, as the field of human security embraced climate change as a promising new direction of research, determinist thinking began to dominate the formulation of new questions about human vulnerability and "well-being." The following quote encapsulates the vision that was articulated early on in this field:

> Throughout most of human history, the constraints imposed by local environmental conditions and their natural variability were powerful determinants of the security of individuals and societies: animals, droughts, floods, frosts, pathogens, storms, and other environmental perturbations were significant causes of mortality, morbidity, and social

> disruption. In today's modern societies, technology, trade, industrialization, the use of fossil fuels, occupational specialization, and higher levels of social organization have all weakened the constraints that local environments place on Human Security. … Across the world, the prospects for Human Security are deeply affected by local and global processes of environmental change… Our general argument is that global environmental change poses new and in some cases unprecedented threats to Human Security. …The point that is underscored throughout this volume is that global environmental change is inherently a question about the capacity to respond to new challenges and to reconcile the growing disparities that undermine Human Security. (Nef 1999, p. 4)

Another book, entitled *Global Environmental Change and Human Security*, which also intended to synthesize this emerging field of inquiry, also demonstrates a growing preoccupation with violent conflict as a result of changing environmental circumstances around the world (Matthew et al. 2010). What emerges from reading this literature is that (1) the field of inquiry known as human security is a topic that is deeply anthropological, (2) anthropological and archaeological perspectives are not a prominent feature in human security discourse, and (3) the absence of anthropology left a vacuum that would predominantly be filled by determinist perspectives.

Anthropologists—and our literature—remain largely ignored by the human security field despite participation by anthropologists at a 2004 symposium that outlined a new paradigm for the field of human security. Anthropologists Winslow and Eriksen (2004) called for a critical approach at this symposium, arguing for a recognition of human variation that is completely elided by the very definition of human security, as it was otherwise proposed. The anthropologists criticized the proposed paradigm, and specifically, they criticized the proposed definition of human security, saying it:

> …is fuzzy and needs to be problematized, but in fact its appeal lies in its very vagueness. As anthropologists, we do not limit ourselves to the traditional definition of Human Security as freedom from fear and freedom from want. Rather, we examine how security is defined in different social and cultural contexts, through symbolic and social processes, and how security and insecurity are dealt with through social institutions. (Floyd 2007, pp. 39–40)

However, this call for complexity and problematizing was deemed somehow too messy and ultimately unattractive to the mission of developing a new paradigm for research. Rather than take an anthropological turn, many scholars interested in human security instead took a policy-oriented approach or even more heavily began to draw from research on crises and natural disasters (Burton et al. 1993). Vulnerability had always been an organizing principle in this field, and now, the contours of vulnerability documented in a handful of modern, Western societies would be conceptualized as a human universal (Adger 1999).

To make things worse, the human security field in some ways became almost anti-anthropological as the Copenhagen School of Securitization gained prominence. The Copenhagen School is highly focused on the state's role in providing security or the failed state's failure to do so. Nordås and Gleditsch, for example, explicitly claimed, "Human induced climate change is one of the most drastic neo-Malthusian scenarios" (Nordås and Gleditsch 2007, p.

627). To summarize their perspective, the modern era represents "the first time in human history" that humans have had a profound influence on the environment and, as a brand new phenomenon, there are "profound gaps" in our knowledge of how humans will respond to climate change, which the human security field is poised to fill as there "are no peer-reviewed studies" relating climate change and conflict (Nordås and Gleditsch 2007, p. 630).

The next section reviews some of the ideas that have emerged from the human security literature about how human societies operate in the face of climate change and crisis. We find remarkable misconceptions of evolutionary biology and misunderstandings of the complex relationships between human biology, culture, and history. The literature is rife with implications of a false assumption that "human nature" is inherently violent, combined with a neo-Malthusian and pseudo-Darwinian misconception that climate change will bring increased competition for resources, which will inevitably result in increasing rates of violent behavior and eventually the collapse of the state system.

The Problem with Determinist Thinking

The consensus about climate change that has thus far emerged in the human security literature is that resource scarcity, social inequality, and environmental migration will result in increased conflict and interpersonal violence (Alvarez 2016; Carleton et al. 2016; Cramer 2002; de Soysa et al. 1999; Gilgan 2001; Gough 2002; Hsiang et al. 2013; Mochizuki 2004; Moran and Pitcher 2004; Ohlsson 1999, 2000). Barnett and Adger (2007) recently synthesized this paradigm thusly:

> …climate change increasingly undermines Human Security in the present day, and will increasingly do so in the future, by reducing access to and the quality of natural resources that are important to sustain livelihoods. We argue that in certain circumstances these direct and indirect impacts of climate change on Human Security may in turn increase the risk of violent conflict. (Barnett and Adger 2007, p. 639)

They then lay out the mechanism by which violence becomes a likely outcome:

> There are two broad ways in which conflict might be stimulated by climate change. First, conflict could come about through changes in the political economy of energy resources due to mitigative action to reduce emissions from fossil fuels (Rifkin 2002). The second issue is the prospect of conflict stimulated by changes in social systems driven by actual or perceived climate impacts. (Barnett and Adger 2007, p. 640)

Despite the strongly anthropological nature of the topic, this literature does not engage with anthropology, and it is often also ahistorical. For example, this passage about shifting patterns of El Niño in the nineteenth century (Davis 2001) incredibly references anthropological topics only as they are elucidated in a popular book written by Jared Diamond:

> Davis's arguments about the ways climatic variations have combined with stressed socio-ecological systems to result in dramatic social change is reinforced by Diamond (2005), who examines many cases of catastrophic social change and finds environmental change

> was a common factor in all of them, and climate change in particular was a cause of many. (Barnett and Adger 2007, p. 641)

The lack of anthropology explains that the preeminence of pseudo-Darwinian notions of an essentially violent human nature, neo-Malthusian emphasis on competition for resources, and a Jared Diamond-like imagining of societal collapse are clearly implied by this passage and by much of this literature (Barnett 2006; Barnett and Adger 2007; Ehrlich and Ehrlich 2013; Hsiang et al. 2013). The absence of history in this literature is justified by the notion that "the changes now underway in the Earth's climate system have no precedent in the history of human civilization (IPCC 2007; Stern 2007)" (Barnett and Adger 2007, p. 640). A bit of lip service is paid to archaeology when the authors state that "climatic variations have triggered large-scale social disruptions in the past." However, citations are notably absent.

Even worse, in some cases, this literature is explicitly racist, examining "Africa" as a homogenous entity, using worn tropes about chaos and failed statehood to suggest that a lack of organization among dark-skinned people is somehow more dangerous than the rising right-wing nationalism and authoritarian tendencies of nuclear-armed Western states, which have increasingly militarized police forces and a degenerate press (Brown et al. 2007). Fear of anarchy and wild people extends to analysis of rural communities in Asia as well. A recent paper about subsistence farmers in rural areas of East Timor promoted the notion that shifting patterns of rainfall, variability, unpredictability in optimal growth parameters for different crops, and a lack of penetrance for state systems will lead to food shortages and famine (e.g., Barnett et al. 2007). There is no discussion of colonialism, assimilation programs, land grabbing, geographical and social marginalization, pollution, genetically modified seeds, et cetera. Reading this literature, one might think that those historical processes did not shape the vulnerability of human populations at all; one might imagine that competition for resources always leads to social inequality because it is a natural part of being human.

To be fair, some researchers have pushed back against such analyses and have suggested the link between climate change and conflict is more complicated (Schiermeier 2010; Schleussner et al. 2016). The human security literature occasionally acknowledges the impacts of social inequality on human vulnerability and security. For example, Bartlett (2008) suggested that climate change would disadvantage low-income urban youth, especially in regard to health, learning, psychosocial well-being, and family dynamics. She predicted nutritional deficiency, poor sanitation, infectious disease, respiratory illness, heat stress, and quality of life would all have the most profound impacts in the most vulnerable communities—among children, people with low incomes, and others already affected by structural inequality.

While some of the literature acknowledges structural inequality, there is still an ahistorical elision of the systems of power underlying that inequality. The focus remains on discussing how the state should meet basic needs or risk civilizational collapse. There is no discussion of who is served by the naturalizing of everyday violence, hegemony, or the reproduction of inequality. Inequality is described in organic terms, as a correlate to or a variable of interest for modeling impacts of climate change. The state is regarded as responsible for human well-being (Gough 2002; Keen 2000); weak states do not meet this obligation and that is a prologue to societal collapse. The state is cast as the driver of injustice but also the most reasonable solution. The

concept of the failed state is invoked as a primary cause of suffering. The literature minimizes possibilities for alternative forms of organization, creative solutions to structural change, or perhaps even the possibility that failed statehood could be a solution to climate change.

Determinism is attractive to conservative thinkers because it supports the maintenance of the status quo—social inequality, structural and everyday violence, racism, sex and gender disparities, and narratives about humans that belie the desire for power and control. It is equally attractive to those who are interested in making predictions about human behavior to mitigate the impacts of climate change because its simplistic formula is readily applied. Accordingly, alongside the absence of history and anthropology, another theme is the absence of human agency as a force for sociocultural change. When structural inequality is mentioned, there is a notion that individual actors are passive recipients of state power and control. This literature ignores sociological and anthropological theory completely to make actors into objects; for example, there is no sense of awareness of basic theoretical frameworks in the social sciences and humanities, like "theory of society," wherein habitus is created through an interaction between individuals and social structures and noneconomic, symbolic forms of social control which play an important role in power relations (Bourdieu 1986). In fact, in some cases, it appears that scholars in human security believe they have invented critical social theory and as the originators of these ideas, no citations to anthropology or archaeology are required:

> While the focus of Human Security is in the individual, the processes that undermine or strengthen Human Security are often external to the locality of communities where individuals reside. In terms of environmental change, for example, upstream users of water, distant atmospheric polluters, multinational logging and mining companies, regional-scale climatic processes and a host of other distant actors and larger scale processes influence the security of individuals' entitlements to natural resources and services. Similarly in terms of the social determinants of vulnerability, warfare, corruption, trade dependency, macroeconomic policies, and a host of other larger scale processes associated with 'globalisation' shape the social and economic entitlements that are necessary to reduce an individual's vulnerability (or increase their ability to adapt) to environmental changes. Adger and Kelly (1999) refer to these larger scale processes as comprising the 'architecture of entitlements'. Furthermore, the determinants of Human Security are as temporally as they are spatially complex: past processes such as colonization and war shape present insecurities, and ongoing processes such as climate change and trade liberalization shape future insecurities. (Barnett and Adger 2007, p. 642)

Finally, this literature is often deeply ethnocentric, assuming that what is typical in "Western culture" is globally universal through time. This is untrue in regard to the histories of climate change, the responses of human societies to change, the meaning of environmental changes today, and the propensity within diverse cultural systems for humans to have different responses that succeed.

Anthropology as an Antidote to Determinist Thinking

In a sense, determinism, in its different forms, genetic, ecological, biological, and psychological, is an idea that everything (including human agency or history) can ultimately be explained by an extrinsic force—laws of nature, evolution, and "human nature"—or some previously existing cause that has the potential to be understood (de LaPlace 1820) and even used to make predictions. Determinism ultimately relies on a rational and thus potentially moral universe, and it undervalues complexity, agency, chaos, and stochasticity. Scientists cannot address problems by invoking an essential and unchanging human nature or an overarching trajectory of human responses to climate change (e.g., resource stress always leads to interpersonal violence). Rather, things that change should "force themselves on our attention far more than things that remain the same" (Gadamer 1960, p. xxii). As anthropologists, our comparative, cross-cultural approach to long-term processes allows a focus on variation in climate, an acknowledgment that human society and culture are ever-changing, and an abiding focus on diversity in human responses to the environment, culture change, and resiliency (Barnes et al. 2013; Dove 2014; Gaillard 2007; Redman 2005).

Anthropology offers the antidote to determinist thinking through a focus on diversity and variation. Physical changes to the environment, the perception of those changes, and the meaning of climate change will vary cross-culturally (Barnes et al. 2013; Roncoli et al. 2009). Perceptions are shaped by historical and sociocultural experiences; art and folklore; traditions, mores, and cultural values; political relations; and individual actors, the strength of their beliefs, desires for conformance or propensities for innovation, or risky behavior. There is a historical trajectory that informs our knowledge about the climate and environmental change. This knowledge is communicated and circulates in a large variety of forms. History and culture shape how we perceive opportunities and constraints posed by climate change and the tendency to accept some responses but not others. Although the human security literature is focused on a concept of "vulnerability," at the root of this construct are the sociocultural dynamics that determine risk among individuals, within communities, and in larger social forms (including states).

Anthropology has documented diverse human responses to environmental change, particularly over the long arc of the human past (e.g., Dove 2014; Faulseit 2015; Kaniewski et al. 2013; Kennett et al. 2012; McAnany and Yoffee 2010; McIntosh et al. 2000; Chap. 4). Archaeology is a subfield of anthropology that provides a historical, deep-time perspective on what it means to experience a changing environment. Archaeologists study how humans perceive and understand climatic and environmental shifts, how history and society unevenly constrain choices for coping with climate change, the types of responses that humans have had to climate changes in the past, and the long-term health and biocultural outcomes of different short-term strategies. Archaeologists have a unique view of the *longue durée*, the unfolding of catastrophic events (rapid climate change, volcanic eruptions, earthquakes, etc.). Archaeologists also have particular scientific mores, recognizing the value of working holistically and interdisciplinarily; we are trained to consider multiple lines of evidence and how they converge (or not) to address our hypotheses; and, importantly, variation is at the core of our perspective on the world.

Archaeologists too began with adaptationist perspectives on humans and environments in the past. Processual archaeology developed in the latter half of the twentieth century from a dissatisfaction with neo-Darwinian approaches to human populations (Binford 1962; Flannery 1968; Hardesty 1975; Smith and Winterhalder 1992; Winterhalder and Smith 1981).

Evolutionary anthropologists constructed "human habitats" from "the environment" and were focused on "biocultural adaptations" as solutions to evolutionary challenges. Evolutionary anthropologists often explained evidence for changes in material culture as adaptions to climate change, ignoring the fact that climate is one extrinsic force but it operates within a particular set of social, historical, and cultural circumstances.

Determinist modes of thinking in archaeology were eventually criticized for reducing complexity, downplaying the role of history, social relations, power, and human agency as forces for culture change in the service of easily digestible, unilineal, and unicausal explanations for the past (Hodder 1986; Leone 1984; Rappaport 1977; Renfrew and Bahn 1991). For decades, post-processual archaeology has shifted the focus away from determinist and adaptationist representations toward grappling with complexity (Brumfiel 1995; Crumley 1979, 1995, 2005; Gero 1985; Hodder 1982, 1992; Leone et al. 1987; Meskell 1996; Shanks and Tilley 1987). Human-environmental interactions are still an important focus for research but with the recognition that "nature" is not essentially different from—nor even necessarily divided from—"culture." There are established correlations between environmental changes and cultural or social changes in the past, but the observational nature of the discipline makes it difficult to directly link these datasets (Barnes, et al. 2013; Faulseit 2015; McAnany and Yoffee 2010; McIntosh et al. 2000).

Climate change has undoubtedly been an important factor in human history; it can even represent a form of "stress." History, sociocultural diversity, and human experience, however, will more deeply shape our perception of, interactions and relations with, and responses to "the environment" and environmental change. "Vulnerability"—defined above as freedom from fear and freedom from want—is social and cultural. This is not an environmentally determined phenomenon in any clear or straightforward manner. "Climate change is accompanied everywhere by other kinds of change in society. Although climate is sometimes the dominant factor driving change, just as often it is outweighed by other factors" (Barnes et al. 2013). Biocultural phenomena like health, subsistence and dietary changes, crop failure, migration, political and economic forces, or demographic dynamics change through time (Chap. 5). Correlation is not causation. There is no proof that climate is the principle driver of biocultural processes, today or in the past (Hulme 2011).

The key to avoiding determinism is to focus on local processes and developing a rich theoretical framework to explain the observable phenomena. Theory—the set of principles, or system of ideas that we use to explain our world—allows us to consider the nature of being and knowing at a fundamental level. Theory can also be practical, in some cases, serving to justify particular beliefs and actions. As a basic foundation for research, our theories must be developed independent of the subject of our inquiry; they must be broadly logical, coherent, systematic, and applicable. How our research is designed, the questions we ask, the methods we use to address our questions, and the interpretations at which we arrive are all embedded (explicitly or implicitly) in our theoretical underpinnings, and thus these should be carefully understood. The following section represents an example of how bioarchaeologists, as anthropologists, grapple with past climate change and its proximate and ultimate role in shaping the human past. Given a strongly anthropological perspective, bioarchaeological research should also contribute to

popular and cross-disciplinary discourse about climate change, particularly given our inherently informative data source, the physical remains of past people.

An Anthropological Bioarchaeology of Climate Change: An Example from South Asian Prehistory

Many bioarchaeologists have conducted research on the implications of climate change for human society in the past, particularly as it relates to interpersonal violence, dietary change, or migration (e.g., Baker and Tsuda 2015; Gregoricka 2016; Gregoricka and Sheridan 2017; Harrod and Martin 2013; Martin and Harrod 2016; Chap. 4; Stojanowski and Knudson 2011, 2014). Here we focus on the findings of 5 years research on climate change and "collapse" in the Indus civilization, a large, complex society that existed in South Asia during the second and third millennia BCE. Jared Diamond, in his book *Collapse* (Diamond 2005), highlighted the Indus case as an example of how societies "choose to fail." Importantly, research on this civilization has been revitalized recently, including large, funded archaeological projects to collect data on monsoon rainfall variability and hydrological change in the Indus Valley (Giosan et al. 2012; Petrie et al. 2017) and bioarchaeological research on the skeletal collections from a large Indus city, Harappa (Lovell 2014a, b, 2016; Robbins Schug 2016, 2017; Robbins Schug et al. 2012, 2013; Robbins Schug and Blevins 2016). In this chapter, we will summarize the paleoclimate and bioarchaeological research with the goal of addressing misconceptions about the Indus civilization in the popular literature and specific predictions from the human security literature, which suggest that resource scarcity and immigration in the face of climate change lead to increased vulnerability among human communities.

The first urbanization phase in South Asia, known as the Indus civilization (3300–1900 BCE), is characterized by socioeconomic, cultural, and political complexity. In the context of a generally semiarid climate that had been established in the latter half of the Holocene in Northwest India and Pakistan, urban centers grew up along river valleys spanning as much as a million square kilometers of territory during the mature phase (2600–1900 BCE). These cities—Harappa, Mohenjo-Daro, Dholavira, Rakhigarhi, and Ganweriwala—were supported by craft specialists participating in medium- and long-distance trade networks (Wright 2010) and by farmers in the hinterlands who had, over four millennia, developed locally viable agricultural and husbandry regimes well suited to the vagaries of a winter and summer monsoons system (Petrie et al. 2017). The most archaeologically dramatic among the sociocultural changes that occurred in the mature period of the Indus civilization is the rapid rise of these cities, some of which were founded as new settlements at the beginning of this period and grew to tens of thousands of people in less than two centuries (Shinde 2016).

The succeeding Late Harappan or disintegration period has often been characterized as a prehistoric "collapse" by Diamond; it is described as follows:

> By collapse, I mean a drastic decrease in human population size and/or political/economic/social complexity, over a considerable area, for an extended time. The phenomenon of collapses is thus an extreme form of several milder types of decline, and it becomes arbitrary to decide how drastic the decline of a society must be before it qualifies to be labeled as a collapse. Some of those milder types of decline include the

> normal minor rises and falls of fortune, and minor political/economic/social restructurings, of any individual society; one society's conquest by a close neighbor, or its decline linked to the neighbor's rise, without change in the total population size or complexity of the whole region; and the replacement or overthrow of one governing elite by another. By those standards, most people would consider the following past societies to have been famous victims of full-fledged collapses rather than of just minor declines: the Anasazi and Cahokia within the boundaries of the modern U.S., the Maya cities in Central America, Moche and Tiwanaku societies in South America, Mycenean Greece and Minoan Crete in Europe, Great Zimbabwe in Africa, Angkor Wat and the Harappan Indus Valley cities in Asia, and Easter Island in the Pacific Ocean. (Diamond 2005, p. iii)

Diamond laid out a five-point framework for "collapse": human-caused environmental degradation, climate change, hostile neighbors or decreased support from friendly neighbors, and ineffective responses to challenges (Diamond 2005). In his book, he did not solely attribute the decline of the Indus civilization to climate change, but rather in the footnotes for Chap. 9, he cited environmental changes combined with the completely discredited idea that there had been an Aryan invasion in the first half of the second millennium BCE. There is absolutely no archaeological or skeletal evidence of such a large-scale conflagration that could end a civilization stretching over a million square kilometers (Dales 1964; Danino 2016; Leach 1990; Shaffer 1984). This massacre is a myth, but the fact remains that after 1900 BCE we do see large urban centers like Mohenjo-Daro, Harappa, and others basically depopulated (Possehl 2002; Mughal 1997; Kenoyer 2005, 2008; Wright 2010). This depopulation occurred coincident with dramatic changes in the patterning and amount of rainfall in the Indus Valley (Petrie et al. 2017), the area around Harappa (Wright et al. 2008), and regionally (Giosan et al. 2012), but does Diamond's model hold? Did climate change, if not hostile neighbors, cause this "collapse?"

Firstly, archaeologists and bioarchaeologists know that before we can try to discuss large regional patterns in the past, we need a detailed locally contextualized record from each site (Chap. 4). As the Indus civilization covers an extensive and highly variable geographical area, with vast differences in environmental characteristics and climatic changes through time, archaeologists have tended to approach the rise and the eventual end of this civilization, as well as the social processes between, with a strong, local focus (Chakrabarti 2009; Petrie et al. 2017; Shinde 2016; Shinde et al. 2006; Wright 2010). In this chapter, we address the impact of climate change and the human security concept of "vulnerability" (defined above as freedom from fear and want) using bioarchaeological evidence for changing patterns of health and safety in one city, Harappa, which is located in the heart of the Indus Valley. We then contextualize the data from Harappa within the biocultural circumstances of other South Asian communities dealing with environmental changes in the millennium after the Indus civilization declined. Our research question is: Do we see evidence of challenges to health and safety and those that are principally derived from climatic changes across this transition? Alternatively, are there sociocultural and historical factors that shaped a particular experience at Harappa? Were those experiences different from the biocultural circumstances of climate changes in other late Holocene communities in South Asia? By examining the long arc of culture change in urban and rural communities across the Late Holocene in South Asia, we are proximately interested in demonstrating that a nuanced, locally contextualized view of climatic and cultural change is required to elucidate social and cultural factors affecting outcomes in human communities over

time. Our ultimate goal is to demonstrate how a strong foundation in anthropological theory can overcome determinist frameworks, repopulate the past with human agents, and suggest intricacies in the predictions for our human futures.

Climate and Bioarchaeology in Late Holocene South Asia

Evidence for climate change in the region around the city of Harappa has been accumulating for decades. In the Indus Valley, aridification seems to have intensified throughout the latter half of the Holocene (for the past 5000 years), but fluvial landscapes in Pakistan seem to have been remarkably stable during that time (Giosan et al. 2012). A decline in flood intensity corresponded with the initiation of rapid urbanization after 2500 BCE (Giosan et al. 2012), and there is good evidence for reductions in monsoon rainfall in the immediate area around Harappa beginning in 2200 BCE and continuing perhaps as late as 1600 BCE (Berkelhammer et al. 2013; Dixit et al. 2014; Staubwasser et al. 2003; Wright et al. 2008). The region around Harappa was primarily watered by monsoon rainfall and monsoon-fed rivers at the time, and many of these channels either dried up or became seasonal at this time (Giosan et al. 2012). During the late urban, the transitional, and throughout the post-urban (disintegration) periods at Harappa, there is good evidence that the decline in precipitation impacted rain-fed agriculture, perhaps contributing to decisions to diversify the subsistence economy (Fuller and Madella 2001; Giosan et al. 2012; Miller 2006; Petrie et al. 2017; Wright et al. 2008). By the end of the urban phase, cities like Harappa were primarily relying on the import of drought-resistant *rabi*, or winter crops—barley, wheat, lentils, peas, and chickpeas—but over time, increasingly incorporated *kharif* foods, millet, rice, and pulses, specifically adapted for summer rains (Fuller 2011; Fuller and Madella 2001; Madella and Fuller 2006; Petrie et al. 2016; Weber 2003; Weber et al. 2010).

The city of Harappa, at the heart of the Indus civilization, serves as a perfect archaeological case study for testing predictions from the human security literature over the *longue durée* because there are human skeletal communities preserved from the urban, mature phase (Cemetery R-37, 2550–2000 BCE), a transitional phase (Area G, 2000–1900 BCE), the disintegration era or post-urban phase (Cemetery H, Stratum I, 1900–1700 BCE), and to the succeeding Chalcolithic period (Cemetery H, Stratum II, 1700–1300 BCE). Large numbers of skeletons have been excavated from the diverse burial areas at the city of Harappa. In 2011, Robbins Schug evaluated 160 of 235 individuals excavated at Harappa (Table 6.1) for evidence of trauma (Robbins Schug et al. 2012), infection (Robbins Schug et al. 2013), and nutritional insufficiency (Robbins Schug and Blevins 2016). Lovell has evaluated an additional 19 complete adult skeletons from cemetery R-37 for evidence of trauma and other pathological conditions[1] (Lovell 2014a, b) and has addressed the bioarchaeological evidence as a whole on a variety of research questions about Indus people (Lovell 2016).

Based on these analyses, we know that the rate of cranial injury at Harappa (15.5%) was the highest of any skeletal collection in South Asia, from the Paleolithic through the Iron Age, when cremation became predominant. Despite having a larger sample of individuals from the mature period, the urban population only demonstrated a frequency of 4% of crania with evidence of traumatic injuries (Lovell 2014a; Robbins Schug et al. 2012). In contrast, 50% of the crania

[1] Lovell's analysis of pathological conditions included the same 19 individuals as the trauma study plus 1 additional individual she located on display in the Harappa Museum.

examined from the transitional period and 38% of the crania examined from the post-urban period were affected by traumatic injuries (Robbins Schug et al. 2012). Not only was the percentage of affected individuals greater, but there were also new types of injuries, and a wider variety of people were affected in terms of age and sex. In the transitional and urban periods, after 200 years of climatic change and biocultural adaptation, we find a risk of violent injury among men, women, and children at Harappa. Males were more likely to have broken noses and sharp force trauma. Women and children primarily sustained blunt force injuries, some of which were likely fatal.

Table 6.1. Age and Sex of skeletons from Harappa

Sample (date BCE)	N total	n examined	Immature	YA		MA		OA		Indet. adult
				F	M	F	M	F	M	
R-37 (2550–2000)	108	66	3	9	3	3	2	3	7	31
Area G (2000–1900)	23	23	9	2	1	2	3	0	1	5
H, stratum II (1900–1700)	78	45	15	5	0	2	0	1	3	19
H, stratum I (1700–1300)	26	26	6	4	0	2	0	1	0	13
Total	235	160	33	20	4	9	5	5	11	68

Robbins Schug also examined evidence of infection and infectious disease in the skeletal material from Harappa (Robbins Schug et al. 2013). Aside from one non-specific periosteal lesions and two individuals with localized periosteal reactions (probably related to trauma), four individuals suffered from a maxillary sinus infection, nine individuals with skeletal lesions consistent with leprosy, and two individuals with skeletal lesions not inconsistent with tuberculosis (Robbins Schug et al. 2013). Although the earliest evidence for maxillary infection and leprosy occurs in the mature period skeletons, the prevalence of leprosy increases dramatically though time, and the presence of tuberculosis is not demonstrated until the post-urban period. Both the evidence for violence and that of infectious disease was greatest in a marginal burial population that existed in an ossuary deposit in Area G. Area G was located southeast of the city walls around Mound E, and while new excavations in that area could prove there is another cemetery in that part of the site (Kenoyer, Personal Communication), the 20 isolated crania included in the present analysis were piled in a trench with a single prone burial (Fig. 6.1) and a collection of isolated post-cranial remains of humans and other animals. The first cervical vertebra (atlas) was present for the prone burial, and the presence of a cut mark across the left superior articular condyle suggests that humans deliberately disarticulated at least one of the crania piled in this trench (Fig. 6.2). That individual (G.289) also demonstrated lesions consistent with lepromatous leprosy (Robbins Schug et al. 2013).

FIGURE 6.1 IS OMITTED FROM THIS FORMATTED DOCUMENT
Figure 6.1. Photograph of the 1928–29 excavation at Area G, Trench II taken by M.S. Vats from the North-East corner of Am 42/22 (reproduced from the original at the British Library)

The social organization of the Indus civilization has been much disputed over time, largely framed in light of prevailing trends in archaeology as a whole (Robbins Schug 2017). Initially, based on a West Asian analogy, Piggott (1950) and Wheeler (1953) suggested that these ancient cities, like Harappa, fit a model of hierarchical and exploitative state formation because of their monumental architecture, craft specialization, standardization of weights and measures, and development of a writing system; these features suggested administration of a uniform social

landscape and material culture across vast distances (Robbins Schug 2017). A heterarchical framework (see, e.g., Crumley 1979, 1995) was later mapped onto the civilization based on the argument that the major urban centers were separated by hundreds of kilometers on average and were only integrated through ideological means and shared values, as opposed to a centralized administration. In this model, it was argued that the civilization would best be represented by a model of semiautonomous polities wherein shared authority was granted to independent but interacting sociopolitical units across this vast territory, a "first among equals" model (Possehl 1990, 1998, 2002). Based on the preeminence of this model for several decades in archaeology, the Indus civilization came to be widely viewed as a rare example of a large, urban, early civilization that had formed and was operated in the absence of structural violence, inequality, coercion, or exclusion. Unfortunately, on both sides of the argument, inferences about social organization were based on an absence of evidence for social exclusion and structural violence (Cork 2005, 2011). This makes sense in light of Crumley's (2005) suggestion that in hierarchical societies, exclusion should emerge from the archaeological record, or Price and Feinman's (2010) suggestion that hierarchy is evidenced by unequal access to power and resources.

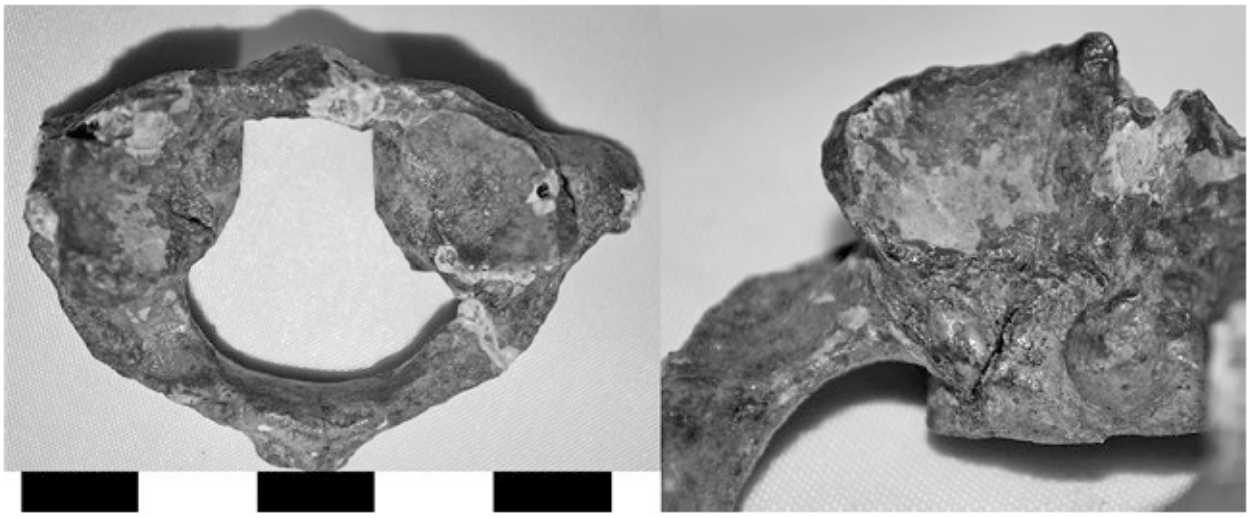

Figure 6.2. First cervical vertebra labeled G.289, suggesting it belonged to the articulated skeleton depicted in Fig. 6.1. A cutmark on the left occipital condyle is evidence of human mortuary behavior, possibly related to decapitation

The problem with constructing an argument based on an absence of evidence is obviously that new information will come to light eventually, upon further investigation. Although Harappa (and Indus cities in general) does not resemble the models of state power and coercion we see in Mesopotamia or Egypt from this same time period, an internal analysis of the skeletal evidence from Harappa demonstrates that individuals excluded from the city cemeteries in the transitional and post-urban periods were twice as likely to suffer from violent injury to the cranium and were at much greater risk of demonstrating skeletal evidence of leprosy (Robbins Schug 2017). As there were some individuals with cranial trauma, TB, and leprosy who were buried *in* the cemetery during this time, it is possible that the disease itself was not the basis for exclusion from the cemetery but rather that there were other social phenomena related to identity, community, or geographical origin that were driving the different mortuary treatment (Robbins Schug 2016, 2017). Those other aspects of identity may also have been associated with greater risk for infection or traumatic injury. In other words, at Harappa we see evidence that the human

security literature's predictions about rates of violence and other risks ("vulnerability") are at a surface level supported by these data.

On a deeper level, and in a comparative framework generally adopted in anthropology, we find a reductionist and environmentally determinate narrative falls apart. First, there is no evidence for increased competition for food or other resources as a driving force for violent interaction. In the human security literature, violent "human nature" manifests due to the increased pressure of migration and competition for resources. In the case of Harappa, migration was a much more significant force in the urban mature period, when the size of the city grew from a small village to a city with a population greater than 20,000 people in just 2 centuries. Evidence for this immigration is found in isotopic ratios of human skeletons from the mature period cemetery (Lovell 2016; Valentine 2016). Yet, this influx of immigrants was associated with a much lower frequency of violent injuries in the skeletal population. Additionally, there is no evidence of nutritional insufficiency or stress markers during the urban or the post-urban period, until the prevalence of abnormal porosity and vitamin C deficiency (scurvy) increases among neonates and immature skeletons in the Chalcolithic period burials of cemetery H stratum II (1700–1300 BCE) (Robbins Schug and Blevins 2016). Thus, the specific predictions of the human security model are not supported by the data at Harappa.

Rather than assuming that climate change is the primary threat to human security in the past, it appears more likely that there were cultural and ideological changes taking place at the same time, which likely had an influence on the human population to a larger degree than the increasing aridity, in and of itself. Evidence of changes in the mortuary treatment of people with leprosy through time suggest that the disease was first recognized and perhaps negatively signified, in the post-urban period. After 200 years of climate, economic, political, and ideological change, the Late Harappans began removing the foot bones from burials of people with leprosy, and based on Foucault's (1972) notion of tracing a trajectory of "othering" from the 0 point of a disease, it appears that while people buried in Area G (2000–1900 BCE) may have been vulnerable to violence and disease because of some other aspect of their identity, the Late Harappans (1900–1700 BCE) were making attempts to ameliorate the impacts of leprosy in the dead buried at Cemetery H through removing feet (Robbins Schug 2016). The commencement of this "othering" process in the mid-second millennium BCE is also evident in oral traditions of the time (e.g., the *Atharva Veda*), which described leprosy as a mark of corruption but one that was curable through medical and ritual practice. It was not until much later, in the Early Historic period (300 BCE), that this type of skin disease is described as completely stigmatized, a mark of intergenerational corruption, a divine retribution for particular criminal acts, and worthy of exclusion from basic social life (Robbins Schug 2016).

In the case of Harappa, climate change was associated with cultural changes, and over time, certain communities did face increased "vulnerability" (threats to health and safety). However, it appears that structural aspects of the hierarchical social organization, rapid urbanization, and failure of the long-distance exchange network first were the primary causes of this vulnerability. Later, the introduction of highly visible disfiguring infectious disease in combination with specific traditions, ritual, and spiritual beliefs may have set an "othering" process in motion and led to even greater risks of violence and exclusion. The story is much more nuanced still when we consider that there is little evidence for nutritional insufficiency until the Chalcolithic period

at Harappa (1700–1300 BCE), when maternal and infantile scurvy and abnormal porosity in immature remains suggest a profound disruption to the subsistence system at that time. The contrast with the apparent relative nutritional sufficiency of the urban and post-urban periods suggests competition for resources was not a driving factor in the violence we see over time, as climate changed at Harappa.

The concept of "vulnerability" (in the human security sense) has even less salience when it is examined in different types of human social organizations. For example, the Chalcolithic population living at Harappa (cemetery H, stratum I) can also be compared with a contemporaneous rural population from an agrarian community to the south, at a site called Inamgaon located along a different river valley in west-central peninsular India. In west-central India, aridification began after 1500 BCE, during a phase known as the Early Jorwe (1400–1000 BCE). Aridity at this time, similar to the mature period at Harappa, was initially associated with rapid population growth (Dhavalikar et al. 1988; Robbins Schug 2011). Toward the end of the second millennium BCE, the combination of rapid population growth and over-irrigation led to increasing soil salinity and declines in agricultural production (Kajale 1988). The majority of 200 villages and hamlets that had grown up in this region were abandoned around 1000 BCE. The people of Inamgaon persisted, shifting their agricultural strategy away from drought-resistant cereals, toward saline-tolerant lentils and peas (Kajale 1988), shifting from cattle-keeping to sheep and goat herding and increasing reliance on hunting and lacustrine resources (Thomas 1988).

Table 6.2. Demographic profile for immature skeletons from Harappa and Inamgaon

	Inamagon				**Harappa**	
	EJ		**LJ**		**Cemetery H (stratum I)**	
	(1400–1000 BCE)		**(1000–700 BCE)**		**(c. 1700–1300 BCE)**	
Age Category (months)	***n***	**%**	***n***	**%**	***n***	**%**
Perinatal	9	16	18	16	7	47
1–12	16	28	40	35	1	7
13–24	4	7	12	11	1	7
25–36	4	7	10	9	1	7
37–48	5	9	5	4		
49–60	1	2	5	4	2	13
61–72	1	2	6	5		
73–84	1	2	2	2	1	7

Percentages are calculated from the total number of subadults at each site, including individuals who died between 85 and 192 months of age, who were not included here. There were 57 subadults in total from the EJ and 114 from the LJ periods at Inamgaon and there were 15 total from Stratum I at Cemetery H, Harappa

The environmental changes that led to the abandonment of cereal agriculture had profound impacts on the human population. Of 171 infants and children who were buried under house floors in the Jorwe period at Inamgaon (Table 6.2), there is clear evidence of increasing numbers of infants affected by skeletal emaciation over time (Robbins Schug 2011; Robbins Schug and Goldman 2014). This skeletal emaciation appears to be related to nutritional deficiency, diarrheal disease, or some combination of biocultural stressors based on reduced bone strength (values for biomechanical proxies for strength, Zp and J) despite evidence for incipient locomotor acquisition (Robbins Schug 2011; Robbins Schug and Goldman 2014). In addition, histology demonstrated an increase in compact bone pore volume consistent with a disruption to

homeostatic balance in osteoblastic and osteoclastic activity (Robbins Schug and Goldman 2014).

While Chalcolithic period perinatal and infant skeletons from Harappa demonstrated evidence for vitamin C deficiency, the infants and children from Inamgaon were more likely to suffer from protein-calorie malnutrition. In neither case was there any evidence for interpersonal violence associated with resource scarcity. As opposed to the unified vision of collapse presented by the human security literature, the experience of environmental change and a massive reorganization of the human population was quite different in these two communities. In both cases, there is evidence for climate or environmental change. In both cases, the majority of the human population emigrated away from the settlements they had occupied for centuries. However, at Inamgaon the abandonment of cereal agriculture appears to have led to protein-calorie malnutrition and soaring infant mortality rates (Robbins Schug 2011), while in the post-urban Harappan population, we initially find high rates of violence and disease, but micronutrient deficiency does not occur in the skeletal assemblage until many centuries after the region is abandoned.

Conclusions

This chapter has reviewed perspectives on climate change and its impacts on human society from a variety of sources—US government planning and policy documents, the human security literature that informs policy-makers, and the popular authors, like Jared Diamond. We have demonstrated how tropes about human nature and human-environmental interactions have come to prominence in US government policy and planning about global warming. We have outlined the history of the human security field of inquiry and how it came to be dominated by determinist frameworks. We have described predictions that derive from this literature, and we have provided an evaluation of these predictions using bioarchaeological data on the biocultural consequences of climate change in a complex society in South Asia's prehistory. The predictions from the human security literature might appear reasonable on the surface, but a closer examination of the evidence demonstrates a great degree of complexity and nuance in the archaeological record, even for just this one time period in a single region.

It is our hope that bioarchaeologists will continue to accumulate research on the impacts of climate change in the past and that these expressions of complexity will be employed in an anti-determinist, alternative narrative in the discourse on global warming. Bioarchaeologists are uniquely situated to speak out on questions of "human nature," violence (see Chap. 3), and the "struggle to survive" in the face of a changing climate. Our voices must be raised to represent the true and actual diversity of human experiences in the past and human responses to climate change. Particularly given the present political context, nuanced research on climate change is almost imperative to avoid the real violence that is perpetuated when reductionist, essentialist, and determinist narratives proliferate (http://tinyurl.com/climatechangeandbioarchaeology). We hope this chapter will be a useful beginning in directly addressing public and scholarly discourse in the human security field and in the public planning and policy world.

References

Adger, W. N. (1999). Social vulnerability to climate change and extremes in coastal Vietnam. *World Development, 27*(2), 249–269.

Adger, W. N., & Kelly, M. (1999). Social vulnerability to climate change and the architecture of entitlements. *Mitigation and Adaptation Strategies for Global Change, 4*(3), 253–266.

Alkire, S. (2003). *A conceptual framework for human security* (CRISE working Paper 2). Oxford: Queen Elizabeth House, University of Oxford.

Alvarez, A. (2016). Borderlands, climate change, and the genocidal impulse. *Genocide Studies International, 10*(1). https://doi.org/10.3138/gsi.3110.3131.3103

Baker, B., & Tsuda, T. (2015). *Migration and disruptions*. Gainesville: University Press of Florida.

Barnes, J., Dove, M., Lahsen, M., Mathews, A., McElwee, P., McIntosh, R., et al. (2013). Contribution of anthropology to the study of climate change. *Nature Climate Change, 3*(6), 541–544.

Barnett, J. (2006). Climate change, insecurity, and injustice. In W. N. Adger, J. Paavola, S. Huq, & M. J. Mace (Eds.), *Fairness in adaptation to climate change* (pp. 115–129). Cambridge: MIT Press.

Barnett, J., & Adger, W. N. (2007). Climate change, human security and violent conflict. *Political Geography, 26*(6), 639–655.

Barnett, J., Dessai, S., & Jones, R. N. (2007). Vulnerability to climate variability and change in East Timor. *Ambio: A Journal of the Human Environment, 36*(5), 372–378.

Bartlett, S. (2008). The implications of climate change for children in lower-income countries. *Children, Youth and Environments, 18*(1), 71–98.

Berkelhammer, M., Sinha, A., Stott, L., Cheng, H., Pausata, F. S. R., & Yoshimura, K. (2013). An abrupt shift in the Indian monsoon 4000 years ago. *Climates, Landscapes, and Civilizations, 198*, 75–88.

Binford, L. R. (1962). Archaeology as anthropology. *American Antiquity, 28*(2), 217–225.

Bourdieu, P. (1986). The forms of capital. In J. C. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241–258). New York: Greenwood Press.

Brown, O., Hammill, A., & McLeman, R. (2007). Climate change as the 'new' security threat: Implications for Africa. *International Affairs, 83*(6), 1141–1154.

Brumfiel, E. M. (1995). Heterarchy and the analysis of complex societies: Comments. *Archeological Papers of the American Anthropological Association, 6*(1), 125–131.

Burton, I., Kates, R. W., & White, G. F. (1993). The Environment as Hazard. New York: Guilford.

Carleton, T., Hsiang, S. M., & Burke, M. (2016). Conflict in a changing climate. *The European Physical Journal Special Topics, 225*(3), 489–511.

Chakrabarti, D. K. (2009). *India: An archaeological history. Paleolithic beginnings to early historic foundations*. New Delhi: Oxford University Press.

Cork, E. (2005). Peaceful Harappans? Reviewing the evidence for the absence of warfare in the Indus civilisation of north-West India and Pakistan (c. 2500-1900 BC). *Antiquity, 79*(304), 411–423.

Cork, E. (2011). *Rethinking the Indus: A comparative re-evaluation of the indus civilisation as an alternative paradigm in the organisation and structure of early complex societies*. Oxford: BAR International Series 2213 Archaeopress.

Cramer, C. (2002). Homo Economicus Goes to War: Methodological individualism, rational choice and the political economy of war. *World Development, 30*(11), 1845–1864.

Crumley, C. L. (1979). Three locational models: An epistemological assessment for anthropology and archaeology. In *Advances in archaeological method and theory* (Vol. 2, pp. 141–173).

Crumley, C. L. (1995). Heterarchy and the analysis of complex societies. *Archeological Papers of the American Anthropological Association, 6*(1), 1–5.

Crumley, C. L. (2005). Remember how to organize: Heterarchy across disciplines. In C. S. Beekman & W. W. Baden (Eds.), *Nonlinear models for archaeology and anthropology* (pp. 35–50). Aldershot: Ashgate.

Dabelko, G. D. (2010). Foreword. In R. A. Matthew, J. Barnett, B. McDonald, & K. L. O'Brien (Eds.), *Global environmental change and human security* (pp. ix–ix). Cambridge: MIT Press.

Dales, G. F. (1964). The mythical massacre at Mohenjo-daro. *Expedition, 6*(3), 36.

Danino, M. (2016). Aryans and the Indus civilization: Archaeological, skeletal, and molecular evidence. In G. R. Schug & S. R. Walimbe (Eds.), *A companion to South Asia in the past* (pp. 205–224). Hoboken, NJ: Wiley.

Davis, M. (2001). *Late Victorian holocausts: El Niño famines and the making of the Thrid world*. London: Verso.

de LaPlace, P. S. (1820). *Theorie analytique des probabilites*. Paris: Courcier.

de Soysa, I., Gleditsch, N. P., Gibson, M., & Sollenberg, M. (1999). To Cultivate Peace: Agriculture in a world of conflict. *Environmental Change and Security Project Report, Issue, 5*, 15–25.

Dhavalikar, M. K., Sankalia, H. D., & Ansari, Z. D. (1988). *Excavations at Inamgaon* (Vol. 1). Deccan College Post Graduate Research Institute.

Diamond, J. (2005). *Collapse: How societies choose to fail or succeed* (Vol. Book, Whole). New York: Viking.

Dixit, Y., Hodell, D. A., & Petrie, C. A. (2014). Abrupt weakening of the summer monsoon in Northwest India~ 4100 yr ago. *Geology, 42*(4), 339–342.

DoD. (2015). *National security implications of climate-related risks and a changing climate*. Department of Defense. Retrieved November 28, 2016, from https://www.defense.gov/Portals/1/Documents/pubs/150724-congressional-report-on-national-implications-of-climatechange.pdf

Dove, M. R. (2014). *The anthropology of climate change: An historical reader*. Boston: Wiley-Blackwell.

Ehrlich, P. R., & Ehrlich, A. H. (2013). Can a collapse of global civilization be avoided? *Proceedings of the Royal Society B, 280*(1754), 20122845. https://doi.org/10.1098/rspb.2012.2845

EPA. (2016a). *Climate change: Basic information*. Environmental Protection Agency (EPA). Retrieved November 28, 2016, from https://www.epa.gov/climatechange/climate-change-basic-information

EPA. (2016b). *Climate impacts on ecosystems*. Environmental Protection Agency (EPA). Retrieved November 28, 2016, from https://www.epa.gov/climate-impacts/climate-impacts-ecosystems

EPA. (2016c). Climate impacts on agriculture and food supply. Environmental Protection Agency (EPA). Retrieved November 28, 2016, from https://www.epa.gov/climate-impacts/climate-impacts-agriculture-and-food-supply

EPA. (2016d). Climate impacts on water resources. Environmental Protection Agency (EPA). Retrieved November 28, 2016, from https://www.epa.gov/climate-impacts/climate-impacts-water-resources

Faulseit, R. K. (2015). *Beyond collapse: Archaeological perspectives on resilience, revitalization, and transformation in complex societies*. Carbondale: SIU Press.

Flannery, K. V. (1968). Archaeological systems theory and early Mesoamerica. *Anthropological archaeology in the Americas, 67*, 87.

Floyd, R. (2007). Human security and the Copenhagen School's securitization approach: Conceptualizing human security as a securitizing move. *Human Security Journal, 5*, 38–49.

Foucault, M. (1972). The archaeology of knowledge (Translated from French by A. M. Sheridan Smith). New York: Tavistock Publications Limited.

Fuller, D. Q. (2011). Finding plant domestication in the Indian subcontinent. *Current Anthropology, 52*(Suppl. 4), S347–S362.

Fuller, D. Q., & Madella, M. (2001). Issues in Harappan archaeobotany: Retrospect and prospect. In S. Settar & R. Korisettar (Eds.), *Indian archaeology in retrospect II: Protohistory* (pp. 317–390). Delhi: Manohar.

Gadamer, H. G. (1960). *Truth and Method (Wahrheit und Methode: Grundzüge einer philosophischen Hermeneutik)*. Tübingen: Mohr.

Gaillard, J.-C. (2007). Resilience of traditional societies in facing natural hazards. *Disaster Prevention and Management, 16*(4), 522–544.

Gero, J. M. (1985). Socio-politics and the woman-at-home ideology. *American Antiquity, 50*(2), 342–350.

Gilgan, M. (2001). The rationality of resistance: Alternatives for engagement in complex emergencies. *Disasters, 25*(1), 1–18.

Giosan, L., Clift, P. D., Macklin, M. G., Fuller, D. Q., Constantinescu, S., Durcan, J. A., ... & Adhikari, R. (2012). Fluvial landscapes of the Harappan civilization. *Proceedings of the National Academy of Sciences, 109*(26), E1688–E1694.

Gleick, P. H. (2014). Water, drought, climate change, and conflict in Syria. *Water, Climate, and Society, 6*, 331–340.

Gleick, P. H. (2016). Water strategies for the next administration. *Science, 354*(6312), 555–556.

Gough, M. (2002). Human security: The individual in the security question—The case of Bosnia. *Contemporary Security Policy, 23*(3), 145–191.

Gregoricka, L. A. (2016). Human Response to Climate Change during the Umm an‐Nar/Wadi Suq Transition in the United Arab Emirates. *International Journal of Osteoarchaeology, 26*(2), 211–220.

Gregoricka, L. A., & Sheridan, S. G. (2017). Continuity or conquest? A multi‐isotope approach to investigating identity in the Early Iron Age of the Southern Levant. *American journal of physical anthropology, 162*(1), 73–89.

Hampson, F. O., & Hay, J. B. (2002). Human security: A review of the scholarly literature. *The Human Security Bulletin, 1*(2), 1–36.

Hardesty, D. L. (1975). The niche concept: Suggestions for its use in human ecology. *Human Ecology, 3*(2), 71–85.

Harrod, R. P., & Martin, D. L. (2013). *Bioarchaeology of climate change and violence: Ethical considerations*. New York: Springer.

Hodder, I. (1982). *Symbols in action: Ethnoarchaeological studies of material culture*. Cambridge: Cambridge University Press.

Hodder, I. (1986). *Reading the past: Current approaches to interpretation in archaeology*. Cambridge: Cambridge University Press.

Hodder, I. (1992). *Theory and practice in archaeology*. New York: Routledge.

Hsiang, S. M., Burke, M. B., & Miguel, E. (2013). Quantifying the influence of climate on human conflict. *Science, 341*(6151), 1235367. https://doi.org/10.1126/science.1235367

Hulme, M. (2011). *Reducing the future to climate: a story of climate determinism and reductionism. Osiris, 26*(1), 245–266.

Huntington, S. P. (1993). The clash of civilizations? *Foreign Affairs, Summer, 1993*, 22–49.

IPCC. (2007). *Changing climate 2007: Synthesis report. Contributions of working group I, II, and III to the the fourth assessment report of the intergovernmental panel on climate change (IPCC)*. Cambridge: Cambridge University.

Kajale, M. D. (1988). Plant remains. In M. K. Dhavalikar, H. D. Sankalia, & Z. D. Ansari (Eds.), *Excavations at inamgaon* (pp. 727–732). Pune: Deccan College.

Kaniewski, D., Van Campo, E., Guiot, J., Le Burel, S., Otto, T., & Baeteman, C. (2013). Environmental roots of the Late Bronze Age crisis. *PLoS One, 8*(8), e71004.

Keen, D. (2000). Incentives and disincentives for violence. In M. Berdal & D. M. Malone (Eds.), *Greed and grievance: Economic agendas in civil wars* (pp. 19–42). Boulder: Lynne Rienner Publishers, Inc.

Kennett, D. J., Breitenbach, S. F., Aquino, V. V., Asmerom, Y., Awe, J., Baldini, J. U., et al. (2012). Development and disintegration of Maya political systems in response to climate change. *Science, 338*(6108), 788–791.

Kenoyer, J. M. (2005). Culture change during the late Harappan period at Harappa: New insights on Vedic Aryan issues. In E. F. Bryant & L. L. Patton (Eds.), *The Indo-Aryan controversy: Evidence and inference in indian history* (pp. 21–49). London: Routledge.

Kenoyer, J. M. (2008). Indus urbanism: New perspectives in its origin and character. In J. Marcus & J. A. Sablof (Eds.), *The ancient city: New perspectives in the old and new world* (pp. 85–109). Santa Fe, NM: SAR.

Khagram, S., Clark, W. C., & Raad, D. F. (2003). From the Environment and Human Security to Sustainable Security and Development. *Journal of Human Development, 4*(2), 289–313.

Khong, Y. F. (2001). Human security: A shotgun approach to alleviating human misery? *Global Governance, 7*(3), 231–236.

King, G., & Murray, C. J. L. (2002). Rethinking human security. *Political Science Quarterly, 116*(4), 585–610.

Leach, E. (1990). Aryan invasions over four millennia. *Culture through time: Anthropological approaches*, 227–245.

Leone, M. P. (1984). Interpreting ideology in historical archaeology: Using the rules of perspective in the William Paca Garden in Annapolis, Maryland. In D. Miller & C. Tilley (Eds.), *Ideology, representation, and power in prehistory* (pp. 25–35). Cabridge: Cambridge University Press.

Leone, M. P., Potter, P. B., Jr., Shackel, P. A., Blakey, M. L., Bradley, R., Durrans, B., et al. (1987). Toward a critical archaeology [and comments and reply]. *Current Anthropology, 28*(3), 283–302.

Lovell, N. C. (2014a). Additional data on trauma at Harappa. *International Journal of Paleopathology, 6*, 1–4.

Lovell, N. C. (2014b). *Skeletal paleopathology of human remains from cemetery R37 at Harappa, excavated in 1987 and 1988*. Edmonton: University of Alberta.

Lovell, N. C. (2016). Bioarchaeology of the Indus Valley. In G. R. Schug & S. R. Walimbe (Eds.), *A companion to South Asia in the past* (pp. 169–186). Hoboken, NJ: Wiley.

Madella, M., & Fuller, D. Q. (2006). Palaeoecology and the Harappan civilisation of South Asia: A reconsideration. *Quaternary Science Review, 25*, 1283–1301.

Martin, D. L., & Harrod, R. P. (2016). 10 the bioarchaeology of pain and suffering: Human adaptation and survival during troubled times. *Archeological Papers of the American Anthropological Association, 27*(1), 161–174.

Matthew, R. A., Barnett, J., McDonald, B., & O'Brien, K. L. (Eds.). (2010). *Global environmental change and human security*. Cambridge: MIT Press.

McAnany, P. A., & Yoffee, N. (2010). *Questioning collapse: Human resilience, ecological vulnerability, and the aftermath of empire* (Vol. Book, Edited). Cambridge: Cambridge University Press.

McIntosh, R. J., Tainter, J. A., & McIntosh, S. K. (2000). *The way the wind blows: Climate, history, and human action*. New York: Columbia University Press.

Meskell, L. (1996). The somatization of archaeology: Institutions, discourses, corporeality. *Norwegian Archaeological Review, 29*(1), 1–16.

Miller, H. M.-L. (2006). Water supply, labor requirements, and land ownership in Indus floodplain agricultural systems. In J. Marcus & C. Stannish (Eds.), *Agricultural strategies* (pp. 92–128). Los Angeles: Cotsen Institute.

Mochizuki, K. (2004). Conflict and peoples' insecurity: An insight from the experiences of Nigeria. In H. Shinoda & H.-W. Jeong (Eds.), *Conflict and human security: A search for new approaches of peace-building* (pp. 207–228). Hiroshima: IPSHU Research Report Series, Issue 19, Institute for Peace Science Hiroshima University (IPSHU).

Moran, M. H., & Pitcher, M. A. (2004). The 'basket case' and the 'poster child': Explaining the end of civil conflicts in Liberia and Mozambique. *Third World Quarterly, 25*(3), 501–519.

Mughal, M. R. (1997). *Ancient Cholistan: Archaeology and architecture*. Lahore: Ferozsons.

Nef, J. (1999). *Human security and mutual vulnerability: The global political economy of development and underdevelopment* (2nd ed.). Ottawa: International Development Research Centre.

Newman, E., & Richmond, O. P. (2001). *The United Nations and human security*. New York: Palgrave.

Nordås, R., & Gleditsch, N. P. (2007). Climate change and conflict. *Political Geography, 26*, 627–638.

Oels, A. (2012). From 'securitization' of climate change to 'climatization' of the security field: Comparing three theoretical perspectives. In J. Scheffran, M. Brzoska, H. G. Brauch, P. M. Link, & J. Schilling (Eds.), *Climate change, human security and violent conflict* (pp. 185–205). New York: Springer.

Ohlsson, L. (1999). *Environment Scarcity and Conflict: A study of Malthusian concerns* (Vol. Book, Whole). Göteborg: Department of Peace and Development Research, Göteborg University.

Ohlsson, L. (2000). *Livelihood conflicts: Linking poverty and environment as causes of conflict*. Stockholm: Sida - Swedish International Development Cooperation Agency, Department of Natural Resources and the Environment.

Owen, T. (2004). Human security—Conflict, critique and consensus: Colloquium remarks and a proposal for a threshold-based definition. *Security Dialogue, 35*(3), 373–387.

Paris, R. (2001). Human security: Paradigm shift or hot air? *International Security, 26*(2), 87–102.

Petrie, C. A., Bates, J., Higham, T., & Singh, R. N. (2016). Feeding ancient cities in South Asia: Dating the adoption of rice, millet and tropical pulses in the Indus civilisation. *Antiquity, 90*(354), 1489–1504.

Petrie, C. A., Singh, R. N., Bates, J., Dixit, Y., French, C. A., Hodell, D. A., et al. (2017). Adaptation to variable environments, resilience to climate change: Investigating land, water and settlement in Indus Northwest India. *Current Anthropology, 58*(1), 1–30.

Piggott, S. (1950). *Prehistoric India to 1000 B.C*. Middlesex: Penguin Books.

Possehl, G. L. (1990). Revolution in the urban revolution: The emergence of Indus urbanization. *Annual Review of Anthropology, 19*, 261–282.

Possehl, G. L. (1998). Sociocultural complexity without the state: The Indus civilization. In J. Marcus & G. M. Feinman (Eds.), *Archaic states* (pp. 261–291). Santa Fe: School of American Research.

Possehl, G. L. (2002). *The Indus civilization: A contemporary perspective*. Walnut Creek: Altamira Press.

Price, T. D., & Feinman, G. M. (2010). Social inequality and the evolution of human social organization. In T. D. Price & G. M. Feinman (Eds.), *Pathways to power* (pp. 1–14). New York: Springer.

Raleigh, C., & Urdal, H. (2007). Climate change, environmental degradation and armed conflict. *Political Geography, 26*, 674–694.

Rappaport, R. A. (1977). Ecology, adaptation and the ills of functionalism (being among other things, a response to Jonathan Friedman). *Michigan Discussions in Anthropology, 2*(2), 138–190.

Redman, C. L. (2005). Resilience theory in archaeology. *American Anthropologist, 107*(1), 70–77.

Renfrew, C., & Bahn, P. (1991). Archaeology. Theory and Methods. Thames and Hudson.

Rifkin, J. (2002). *The hydrogen economy: The creation of the worldwide energy web and the redistribution of power on earth*. Cambridge: Polity and Blackwell.

Robbins Schug, G. (2011). *Bioarchaeology and climate change*. Florida: University Press of Florida.

Robbins Schug, G. (2016). Begotten of corruption? Bioarchaeology and "othering" of leprosy in South Asia. *International Journal of Paleopathology, 15*, 1–9.

Robbins Schug, G. (2017). A hierarchy of values: The bioarchaeology of order, complexity, health and hierarchy at Harappa. In H. Klaus, A. R. Harvey, & M. N. Cohen (Eds.), *Bones of complexity: Osteological indicators of emergent heterarchy and hierarchy* (pp. 263–289). Gainesville: UPF.

Robbins Schug, G., Blevins, K. E., Cox, B., Gray, K., & Mushrif-Tripathy, V. (2013). Infection, disease, and biosocial processes at the end of the Indus civilization. *PLoS One, 8*(12), e84814.

Robbins Schug, G., Gray, K., Mushrif-Tripathy, V., & Sankhyan, A. R. (2012). A peaceful realm? Trauma and social differentiation at Harappa. *International Journal of Paleopathology, 2*(2), 136–147.

Robbins Schug, G. R., & Blevins, K. E. (2016). The center cannot hold: A bioarchaeological perspective on environmental crisis in the Second Millennium BCE. In *A companion to South Asia in the past* (pp. 255–273). Boston: Wiley-Blackwell.

Robbins Schug, G. R., & Goldman, H. M. (2014). Birth is but our death begun: A bioarchaeological assessment of skeletal emaciation in immature human skeletons in the context of environmental, social, and subsistence transition. *American Journal of Physical Anthropology, 155*(2), 243–259.

Roncoli, C., Crane, T., & Orlove, B. (2009). Fielding climate change in cultural anthropology. In S. A. Crate & M. Nuttall (Eds.), *Anthropology and climate change: From encounters to actions* (pp. 87–115). New York: Left Coast Press.

Schiermeier, Q. (2010). Climate Change not Linked to African Wars: Claims that global warming can drive civil unrest are hotly disputed. *Nature News*. https://doi.org/10.1038/news.2010.1451.

Scheffran, J., Brzoska, M., Brauch, H. G., Link, P. M., & Schilling, J. (Eds.). (2012). *Climate change, human security and violent conflict: challenges for societal stability* (Vol. 8). Springer Science & Business Media.

Schleussner, C.-F., Donges, J. F., Donner, R. V., & Schellnhuber, H. J. (2016). Armed-conflict risks enhanced by climate-related disasters in ethnically fractionalized countries. *Proceedings of the National Academy of Sciences of the United States of America, 113*(33), 9216–9221.

Shaffer, J. G. (1984). The indo-Aryan invasions: Cultural myth and archaeological reality. In J. R. Lukacs (Ed.), *The people of South Asia* (pp. 77–90). New York: Springer.

Shanks, M., & Tilley, C. Y. (1987). *Social theory and archaeology*. Cambridge: Polity Press.

Shinde, V. (2016). Current perspectives on the harappan civilization. In G. R. Schug & S. R. Walimbe (Eds.), *A companion to South Asia in the past* (pp. 127–144). Hoboken, NJ: Wiley.

Shinde, V., Deshpande, S., Osada, T., & Uno, T. (2006). Basic issues in Harappan archaeology: Some thoughts. *Ancient Asia, 1*, 63–72.

Smith, E. A., & Winterhalder, B. (Eds.). (1992). *Evolutionary ecology and human behavior*. New Brunswick, NJ: Transaction Publishers.

Staubwasser, M., Sirocko, F., Grootes, P. M., & Segl, M. (2003). Climate change at the 4.2 ka BP termination of the Indus Valley civilization and Holocene South Asian monsoon variability. *Geophysical Research Letters, 30*(8), 1425.

Stern, N. (2007). *Economics of climate change: The stern review*. Cambridge: Cambridge University Press.

Stoett, P. J. (1999). *Human and global security: An exploration of terms*. Toronto: University of Toronto Press.

Stojanowski, C. M., & Knudson, K. J. (2011). Biogeochemical inferences of mobility of early Holocene fisher-foragers from the Southern Sahara Desert. *American Journal of Physical Anthropology, 146*(1), 49–61.

Stojanowski, C. M., & Knudson, K. J. (2014). Changing patterns of mobility as a response to climatic deterioration and aridification in the middle Holocene southern Sahara. *American Journal of Physical Anthropology, 154*(1), 79–93.

Suhrke, A. (1999). Human security and the interests of states. *Security Dialogue, 30*(3), 265–276.

Tadjbakhsh, S., & Chenoy, A. M. (2007). *Human security: Concepts and implications*. New York: Routledge.

Thomas, P. K. (1988). Faunal assemblage. Excavations at Inamgaon, 1(part ii), 822–961.

Thomas, C., & Wilkin, P. (Eds.). (1999). *Globalization, human security, and the African experience*. Boulder: Lynne Rienner Publishers, Inc.

UNDP. (1994). *Human Development Report 1994*. United Nations Development Programme (UNDP). Retrieved December 16, 2016, from http://hdr.undp.org/sites/default/files/reports/255/hdr_1994_en_complete_nostats.pdf

USGCRP. (2016). *The impacts of climate change on human health in the United States: A scientific assessment*. U.S. Global Change Research Program. Retrieved November 28, 2016, from https://health2016.globalchange.gov

Valentine, B. (2016). More than origins: Refining migration in the Indus civilization. In G. R. Schug & S. R. Walimbe (Eds.), *A companion to South Asia in the past* (pp. 187–204). Hoboken, NJ: Wiley.

Weber, S. A. (2003). Archaeobotany at Harappa: Indications of change. In S. A. Weber & W. R. Belcher (Eds.), *Indus ethnobiology* (pp. 175–198). Lanham, MD: Lexington.

Weber, S. A., Barela, T., & Lehman, H. (2010). Ecological continuity: An explanation for agricultural diversity in the Indus civilisation and beyond. *Man and Environment, 35*(1), 62–75.

Wheeler, S. R. E. M. (1953). *The Indus civilization: The Cambridge history of India; supplementary volume*. Cambridge: University Press.

Winslow, D., & Eriksen, T. H. (2004). A broad concept that encourages interdisciplinary thinking. *Security Dialogue, 35*(3), 361–362.

Winterhalder, B., & Smith, E. A. (Eds.). (1981). *Hunter-gatherer foraging strategies: Ethnographic and archaeological analysis*. Chicago: University of Chicago Press.

Wright, R. P. (2010). *The ancient Indus: Urbanism, economy and society (Case Studies in Early Societies)*. Cambridge: Cambridge University Press.

Wright, R. P., Bryson, R. A., & Schuldenrein, J. (2008). Water supply and history: Harappa and the Beas regional survey. *Antiquity, 82*, 37–48.