THE ORIGINS OF THE SUSTAINABILITY CONCEPT: RISK PERCEPTION AND RESOURCE MANAGEMENT IN EARLY URBAN CENTERS

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ABSTRACT

Purpose − *This paper examines the conditions under which ancient peoples might have developed a concept of "sustainability," and concludes that long-term resource management practices would not have been articulated prior to the development of the first cities starting c. 6,000 years ago.*

Methodology/approach − *Using biological concepts of population density and niche-construction theory, cities are identified as the first places where pressures on resources might have triggered concerns for sustainability. Nonetheless, urban centers also provided ample opportunities for individuals and households to continue the same ad hoc foraging strategies that had facilitated human survival in prior eras.*

Social implications − *The implementation of a sustainability concept requires two things: individual and institutional motivations to mitigate collective risk over the long term, and accurate measurement devices that can discern subtle changes over time. Neither condition was applicable to the ancient world. Premodern cities provided the first expression of large population sizes in which there were niches of economic and social mutualism, yet individuals and households persisted in age-old approaches to provisioning by opportunistically using urban networks rather than focusing on a collective future.*

Originality/value − *Archaeological and historical analysis indicates that a focus on "sustainability" is not an innate human behavioral capacity but must be specifically articulated and taught.*

Keywords: Urbanism; risk; environment; institutions; infrastructure

INTRODUCTION

The concept of "sustainability" has garnered considerable contemporary interest as a rubric for the management of populations and extractive resource activities, often highlighted by a concern that "The world's present development path is not sustainable" (Kates et al., 2001, p. 1; see also Blaikie & Brookfield, 1987; Redman, 2014; White, 2010). Archaeologists have enthusiastically engaged in the literature of sustainability and human−environmental dynamics, suggesting that "knowledge generated by archaeology can play a unique and valuable role in developing the tools to make more informed decisions that will shape our future" (Barton, Ullah, Bergin, Mitasova, & Sarjoughian, 2012, p. 42; see also Costanza et al., 2012; Ellis et al., 2013, p. 7983; Kintigh et al., 2014, p. 12; Minnis, 2010; Redman, 1999, 2014, p. 5, M.E. Smith, 2010). The implication is that ancient peoples' approaches to the environment provide models for contemporary human action, whether through examples of human−environmental balance or through cautionary tales elicited from ecological disaster (summarized in Hames, 2007).

But when was "sustainability" first recognized and articulated? Did ancient humans also perceive that they overused or were in danger of overusing their environments with reference to past experiences and future expectations? Under what circumstances were environmental conditions

and human−environmental interactions viewed as deleterious or in need of change? Environmental fluctuations in both slow and rapid forms were certainly perceptible, necessitating human response and accommodation. Rapid fluctuations can be caused by earthquakes, tsunamis, volcanoes, landslides, forest fires, hurricanes, oceanic storms, tornadoes, warfare, floods, and El Niño events, all of which entail changes of unpredictable duration, magnitude, and effect. Some of these large-scale changes have precursors on the scale of days or weeks, and others arrive without warning, resulting in an inability to plan for anything but a post hoc response. There also have been a number of slow changes over the course of the past 1.8 million years, including rises in sea level and the inception of the Holocene era in which climate became warmer and drier (di Lernia, 2006; Richerson, Boyd, & Bettinger, 2001).

Through periods of both rapid and slow change, an awareness of human−environmental dynamics would have been most obviously discerned when there was a disbalance between supply and demand. Population and carrying capacity are directly interrelated, such that areas of high population density are the likely locations of human−environmental challenges (Browman, 1987; Lambin et al., 2001). Although high population densities can be found in rural areas (e.g., a small mountain valley with densely distributed villages), cities were the first places where populations became sufficiently large to put consistent pressure on resources. The first cities were formed c. 6,000 years ago and faced the same opportunities and constraints as their modern-day counterparts. Because cities, in general, must acquire resources from outside of their boundaries (particularly, food and fuel produced in the surrounding hinterlands), city dwellers were the ones most likely to have first conceptualized ideas of "sustainability" as they assessed their past, present, and future access to needed resources for both daily needs and for the long term. Pressures were augmented by the fact that urban residents were for the most part not full-time farmers, and thus were reliant on attenuated networks of provisioning through markets, redistributive institutions, and/or direct reliance on kin in the countryside.

The objective potential for resource-acquisition stress in ancient cities need not have been perceived that way by their inhabitants, however, given that there is no simple equation between population density and perceptions of environmental stress. Blaikie and Brookfield (1987, p. 13) note that concepts such as degradation and resilience are social terms incumbent on observations of natural and cultural conditions, and circumstances have to first be identified and conceptualized as a "problem" before they can be

addressed (see also Anscheutz, Wilshusen, & Scheick, 2001; Colten, 2005, p. 12; Mustafa, 2005). Even when phenomena such as pollution, crowding, waste management, or resource shortfall are recognized as "problems," they still may be viewed selectively because "One person's degradation is another's accumulation …" (Blaikie & Brookfield, 1987, p. 14; see also Browman, 1987; Marcuse, 1998). And even if a phenomenon is defined as a "problem," there may not be any solution that can be identified or proposed by those who are affected (Douglas et al., 2008).

THE IDEA OF SUSTAINABILITY

Sustainability has been defined as the search for a balance between the present and future use of resources. One of the first articulations of this concept was by the forester Gifford Pinchot in 1910, who noted "our obligation … to use what we need [such] that our descendants shall not be deprived of what they need" (cited in Owens, 2003, p. 6; see also Redman, 1999, p. 122, 2014). The concept of sustainability faces numerous challenges of implementation, however, even in the twenty-first century. Does sustainability mean that we should seek to manage our environment in order to restore prior conditions, to stabilize our current use, or to plan for anticipated needs at target thresholds of population and resources? If sustainability is to be measured against future targets, what levels of population, land-use, and food types are to be modeled and anticipated? Who is to be tasked with maintaining the trajectory to the target threshold, what incentives can be utilized to encourage or force compliance, and can thresholds be changed in light of new developments in technology that mitigate, reverse, or exacerbate prior adverse effects?

An additional challenge to the actualization of sustainability goals is the time frame for desired future outcomes. Sustainability today is assessed somewhere between one and four centuries in the future, which is an infinitesimally small slice of geologic time but well beyond the lifespan of an individual (cf. Weitzman, 1998). Although people can and do conceptualize long-term outcomes on the multigenerational scale, human beings appear to be better-equipped to assess short-term outcomes (on the scale of hours and days) and, to a certain extent, medium-term outcomes (on the scale of several years or an individual lifetime, measured by one's own growth and decline, as well as by the growth trajectory of offspring). The recognition of cognitive challenges to goals on a longer scale is found in various

literatures dealing with the psychology of human behavior, ranging from daily acts of hygiene to the sequestering of funds for retirement and old age (e.g., Dubas & Jonsson, 2005; Rise, Åstrøm, & Sutton, 1998).

The observed propensity to focus on short-term and medium-term eventualities may be the result of the evolution of human cognitive limits: with short life spans until the modern period, there were few benefits to expending energy on unknown future outcomes. The time-scale of risks perceived by individuals can be linked to the notion of "future discounting" in economics, in which greater value is placed on the here-and-now rather than on the future (Weitzman, 1998). Instead of direct planning, which would have required knowledge of multivariate elements of environmental management and the capacity to proactively alter trajectories of use, our human ancestors instead relied on five other strategies to mitigate the potential of future loss. The first strategy was the propagation of large families to ensure the biological survival of at least some descendants who would also rely on each other in times of need through an extensive kin-network. The second strategy was the use of memory and information-sharing to stockpile knowledge that could be of use in case of future need; information is cheap, easily disseminated, and storable in ways that the physical storage of goods or food cannot be. A third strategy was "social storage" in which individuals share resources in anticipation of recalling those obligations in future (Halstead & O'Shea, 1989, p. 4). A fourth strategy was the development and use of physical technologies to resolve problems as they appeared (Boyd, Richerson, & Henrich, 2013). A final strategy was to develop new social traditions when crises occurred such as new forms of communal sharing or entitlements to scarce resources (di Lernia, 2006; Rautman, 2013; M. L. Smith, 2013). All of these strategies can be categorized as "real-time" or "just-in-time" strategies that yielded immediate results in the present as well as serving as insurance against future need.

THE ORIGINS OF ENVIRONMENTAL PERCEPTION

Prior to the Holocene, our ancestors were mobile foragers who migrated through landscapes engaging in cycles of resource acquisition in which adaptability and omnivory facilitated the successful use of many different environmental niches (Zeder, 2012). Resource differentiation was perceived both in spatial terms across landscapes and as in-place fluctuations over time, but conspecific competition for resources was relatively low. In a

landscape that was distinctly underpopulated compared to today, individuals could personally identify and consistently engage with other known parties to identify, address, and forestall the known ranges of existing risk. Interactions with strangers may have taken place relatively infrequently, and in the context of several hundred people at most in which gatherings were primarily focused on ritual and mating opportunities (see Layton, O'Hara, & Bilsborough, 2012).

In the course of their movements, ancient peoples did recognize both the detrimental and generative effects of human agency on their surroundings and had the capacity to affect their local environments on a massive scale. One of the first widespread human technologies was fire, which was used to clear vegetation, drive game animals into traps, and improve soil fertility (Bliege Bird, Bird, Codding, Parker, & Jones, 2008; Roos, Sullivan, & McNamee, 2010). Hunting technologies such as improved projectile points enabled humans to become the apex predator in many novel environments and a likely factor in the extirpation of species in the Americas, Australia, and many islands (Loehle & Eschenbach, 2011; Prado, Arroyo-Cabrales, Johnson, Alberdi, & Polaco, 2012). Long before the development of full-time agriculture, foragers assisted plants by watering, tending them, or providing appropriate conditions for natural growth (B. Smith, 2001). Although the effects of such actions could be perceived by those other than the instigators, nearly all of these strategies were individual and household ones in which the focus of actions and consequences was the immediate present and short-term future.

Collective human effects on landscapes became more widespread starting c. 10−12,000 years ago in the Holocene (Ellis et al., 2013; Richerson et al., 2001), in which the adoption of plant and animal husbandry entailed significant social trade-offs including settled village life. Household mobility was constrained both through positive feedback (control over resources through accumulation) and negative feedback (inability to take over others' land and resources due to concepts of usufruct and ownership). The relationship between people and the groups in which they found themselves, always a component of human−environmental dynamics, became increasingly intertwined as population sizes increased. As households stayed in place to labor in fields and to safeguard harvested produce, they invested in more substantial dwellings, more extensive storage structures, and permanent cooking facilities that often involved heavy grinding equipment and immoveable features such as ovens. They also modified their landscapes and reacted to localized events of erosion and soil degradation through the construction of terraces and other remedial features (Borejsza, Rodríguez

López, Frederick, & Bateman, 2008). These individual and household actions were accompanied by the concomitant development of small-scale political hierarchies and more elaborate rituals of mutual aid and interaction including feasting and other forms of food redistribution (Bogaard et al., 2009; Hegmon, 1991; M. L. Smith, 2010).

Human actions have only recently been pervasive enough to result in measurable changes, as seen in ice-core studies that show an increase in methane gas produced through rice farming and animal husbandry starting 4,000 years ago (Fuller et al., 2011) and atmospheric pollutants that were the result of large-scale lead mining in the Carthaginian and Roman periods starting c. 600 BC (Rosman, Chisholm, Hong, Candelone, & Boutron, 1997). The broader global impacts of these practices, visible to us today through the use of measurement devices on longitudinal samples, were unlikely to have been perceived by ancient peoples except at a very localized level such as through the health effects on individuals working in those industries. Examples of ancient measuring devices for large-scale environmental variability are extremely rare, such as the so-called Nilometers of Egypt which consisted of both portable devices and marks carved into living rock, the measurements of which were recorded in royal annals starting with the First Dynasty c. 3050 BC (Bell, 1970) and coincident with initial expressions of regional political authority.

The Nilometer example illustrates the role of cultural awareness as an essential starting-point in perceptions of environmental variability. Political authorities needed to measure the Nile not as a matter of general curiosity but to predict agricultural yields for taxation and provisioning purposes. Elsewhere in the world, other types of "problems" became defined as populations increased, particularly in urban centers where the opportunities and constraints of shared landscape management were heightened. Even simple everyday acts such as the disposal of human waste and the discard of trash impinged on others' proximate use of space in ways that were not the case in village environments. As a result, cities became places where we can see a transition from simple cooperative behavior to more complex collective actions (cf. Carballo, Roscoe, & Feinman, 2014), manifested in the physical organization of urban spaces. For ancient urban dwellers, there were many arenas of interdependence between rural and urban realms related to gross inputs of food, water, and fuel, and many points of intersection among residents related to the net acquisition of raw ingredients and cooked meals, as well as spaces for social interactions, ritual activity, and economic pursuits. The feelings of competition for any of these elements introduced to urban inhabitants a level of stress and anxiety about procuring needed

resources, such that a concept of "sustainability" can be envisioned as potentially applying to the planning for future resource acquisitions and maintenance to preserve investments in household and community welfare.

CITIES AND THEIR ENVIRONMENTS

For the first time in human history, cities represented places where large numbers of people willingly traded off direct control of their food supplies for a reliance on indirect provisioning through intermediaries. Rather than foraging directly for needed resources or storing a harvest's worth of grain within the household, individuals acquired small, regular distributions of food through a variety of mechanisms ranging from a reliance on rural family members, to wage labor compensated in kind or converted into comestibles through market mechanisms, to redistributions from authorities housed in temples or palaces. Although the development of often-indirect forms of resource acquisition required a "leap of faith" that should have been accompanied by an increased sense of risk and anxiety, cities in their diversity of provisioning systems may actually have represented reduced risk for individual inhabitants because they reinforced strategies of foraging to which our species had long been adapted.[1] In cities, individuals were able to simulate mobile hunting-and-gathering through the use of interdigitated economic, social, and institutional networks that provided "foraging" opportunities.

Cities represent accelerated patterns of production, consumption, distribution, and discard in which the increased scale of the economy provides employment for both skilled professionals and manual laborers (cf. Iyenda, 2005; Kemper, 2010; Sanders, Nee, & Sernau, 2002). Urban centers also provide a greater number of social opportunities, which substantiate Michael Batty's observation that "information flows both replace and complement material flows of resources" in urban contexts (2008, p. 770). The increase of population in urban areas enabled people to avail themselves of a larger variety of groups, including those with selective membership (such as co-ethnic groups, religious groups, and sporting and spectator groups) as well as groups based on the happenstance of mere proximity such as living in the same structure or neighborhood. Urban centers have many points of contact that result in what Granovetter (1973) has identified as "weak ties" of social engagement that enable low-cost casual interactions to be productively transformed

into information leading to desired outcomes such as assistance, employment, and resource acquisition.

Weak-tie relationships also may result in the perception of increased security in cities through "safety in numbers" (Cowgill, 2003, p. 47). Although this safety generally is assumed to be related to military action, factors of increased group size likely resulted in other types of risk reduction. In the animal kingdom, "safety in numbers" has a counterintuitive beneficial effect related to food intake because group size can increase foraging efficiency as noted by Winterhalder et al. (1999, pp. 324−325). This effect is found in a number of group-living organisms ranging from birds to carnivores, and can be conceptualized for human groups as well. For small-scale and impoverished individuals, perhaps the city with its masses of population is equivalent to a herd of wildebeest or school of fish, in which the sheer mass of population enables each individual to weather risk on the personal level more easily (bad things might happen to someone else, because there were so many other people around). Individuals also had a greater range of consumption opportunities, because cities draw in a large supply of goods from the hinterlands despite the costs of transportation (cf. Drennan, 1984). The resultant diversity and abundance of provisions provide the opportunity for sanctioned acquisition as well as what Blurton Jones (1987, pp. 31−35) and others have described for forager groups as "tolerated theft" or "tolerated scrounging."

The mutualisms expressed within urban settings can be assessed through a variety of theoretical frameworks, one of the most promising of which is niche construction theory. First developed in biology to explain the evolutionary advantages of species mutualisms, niche-construction theory has recently been utilized by archaeologists to analyze the way in which organisms and their environments act upon each other in reciprocal and dynamic relationships (Crawford, 2014, p. 147; Laland & O'Brien, 2011, p. 193; B. Smith, 2011; Spisak, O'Brien, Nicholson, & Van Vugt, 2015). Mutualisms are not limited to physical interactions, however, as humans also learn from and integrate their activities with other human beings through learning and communication, creating interpersonal configurations described by Laland and O'Brien (2011, p. 198) as *social niche construction*. The effects of social niche construction are particularly visible in urban areas, where people interact with and modify their social ecosystems through many forms of interdependence (cf. Spisak et al., 2015). Specialized craftsmakers became dependent on a larger consumer base that in turn made use of diverse goods for social signaling; elites and their followers relied upon each other in cycles of

patronage and service; and manufacturers, workers, and consumers created interdependencies of production and distribution.

One of the most significant urban social niches is found in the creation of institutions as collective groups charged with particular tasks related to newly emergent economic, social, political, and ritual needs. The concept of the "institution" merits some unpacking in order to understand its impact on the urban form, as the term is utilized to describe both physical and conceptual forms of interaction. Institutions can be framed as a codification of culture, consisting of "organizational and ideological norms that shape practical interactions of agents and communities" (Frachetti, 2012, p. 5, following North, 1990; see also Tomasello, 1999, p. 510). But institutions also exist as physical entities that have a visual, material presence. In the modern world, examples of such "institutions" include the armed forces, schools and colleges, religious venues, police precincts, halfway houses, hospitals, prisons, and courthouses. Many of these configurations were historically developed for the very first time in cities, when leaders at a variety of scales materialized norms into configurations whose physical presence resulted in fixed-place recognition of their authority. Institutions are *how* states and cities grow up together and represent the way in which the political entity of the state is dependent on cities for growth and viability.

Anthropologists have long identified the importance of institutions in the creation of social complexity, citing institutions as a key factor in the transition from a kin-based society to hierarchies that functioned through impersonal "offices" that could be held by different individuals interchangeably (e.g., Flannery, 1972; Fried, 1967; Spencer, 2009). Institutions enable programs of action to be initiated and developed through teamwork directed by replaceable bureaucrats rather than being dependent on the charisma of a single individual. Institutions are designed to outlast their founders and constitute entities to which large numbers of differentially enfranchised individuals can belong. Within institutions, leadership provides a kind of "safety in numbers" that buffers individuals from threats and abuses while often providing structured opportunities for training and skill upgrades (Spisak et al., 2015). In urban centers, institutions such as guilds and workshops provided employment opportunities in which labor was compensated in cash or rations, while non-governmental organizations provided food (and sometimes, shelter) in return for adherence to doctrine. By far, the most significant institutions in cities, however, were those formed by government organizations to address needs of urban spatial organization, infrastructure, and defense.

When institutions grow in size, their risk-buffering capacity increases proportionately, such that "the greater the degree of risk, the wider the range of social institutions to share the risk" (Browman, 1987, p. 173). Designed to outlive any single participant, institutions nonetheless have the same risk-management strategies as individuals in focusing on immediate and short-term gain. Even when long-term solutions are sought, managers are constrained and have more intense and more diverse pressures on investment and performance (Blaikie & Brookfield, 1987, p. 10).[2] Institutions articulate short-term gains through a variety of physical means including resource assessment and land-modification projects. Like modern ones, ancient cities were invested with formal infrastructure signaling the presence of an organizational dynamic beyond the level of the household, including roads (Branting, 2004), sewer and drainage systems (Ortloff & Kolata, 1989), water provisioning (Hodge, 2013), open spaces (Fleischer, 2014), internal walls (Kenoyer, 1998), fortifications and gateways (Mohanty & Smith, 2008), harborworks (Marriner & Morhange, 2007), marketplaces (Hutson, 2000), and other venues that were the simultaneous result of top-down managerial initiatives and bottom-up individual actions. The cumulative effects of landscape-scale interactions can be described as "landesque capital," defined as the materialization of large-scale labor investment (Blaikie & Brookfield, 1987, p. 9) that results in a cumulative effect over generations (Erickson & Walker, 2009).

Urban institutional investment in landesque capital extended to the surrounding countryside. Cities and their rural hinterlands are mutually constituted and interdependent (Adams, 1972; M. L. Smith, 2014; Yoffee, 1995, p. 284), but the relationship is not equal because cities have decision-enforcing capacity and concentrated resources for investment as they draw in raw materials, food, and labor for the support of urban populations (Blaikie & Brookfield, 1987, p. 21; Pires, 2004). Leaving aside the question of whether hierarchical organization is required for landscape-scale changes such as irrigation, it is clear that the construction and maintenance of terraces, canals, and other forms of productive agricultural infrastructure necessitate the coordination of large numbers of people. Archaeological indicators of ancient urban-dominated infrastructure can be seen, for example, in the agricultural terraces in the hinterlands of Cerro Jazmín in Mesoamerica (Peréz Rodríguez, Anderson, & Neff, 2011), the raised fields of the highland Andes (Erickson & Walker, 2009), and Greek and Roman harbors in the Mediterranean (Marriner & Morhange, 2007). The economic pull of ancient cities also restructured distant supply lines for daily-use goods in indirect ways (see, e.g., Larsen, 1987, p. 51 for the woolen textile

trade of the second-millennium BC Mesopotamian cities and Dermody et al., 2014 for the Roman practice of importing grain from North Africa as an agricultural outsourcing project that bypassed local Italian farmers). The resulting structural adjustments for the benefit of urban populations were not unlike the conditions that prevail in the global trade of foodstuffs and raw materials today (see Adger, 2000; Lambin et al., 2001; Logan, 2012; Wutich & Brewis, 2014).

Although cities hold the balance of power in urban–rural relationships, rural residents also benefit socially and materially from the presence of urban centers. Familiarity with urban styles enables rural residents to demonstrate savoir-faire and other forms of cultural capital (Jeffery, Jeffery, & Jeffery, 2011), as well as acquiring remittances that can be invested in hinterland settings. Through circular migration for employment and education, rural inhabitants increase their capacity for "foraging" success by diversifying their activities even if they are tied to the land, enabling them to increase household wealth and resilience. Researchers have noted in studies of modern dwellers of the Himalayan region that urban migration and remittances can enable rural households to recover from an environmental shock but that the practice is most effective when utilized as a consistent strategy of diversification and not just as a response to a specific event (Gioli, Khan, Bisht, & Scheffran, 2014). Households that engaged in migration prior to environmental shortfall used remittances to engage in longer-term investments such as education and health that helped to weather shocks when they did occur, whereas households who initiated migration only after adversity found themselves using remittances for basic survival needs in a manner that was primarily reactive. The reliance on rural dwellers upon cities illustrates that the interactions created in the process of urban formation result in dynamic, mutually reinforcing configurations in both the urban and hinterland environments.

DISCUSSION

A longitudinal assessment of the transition from foraging to settled societies indicates that local fluctuations of resource productivity were likely to have been recognized by our earliest human ancestors. Approaches to subsistence throughout human history, however, have been based on an expectation of individualized mitigation of environmental challenges: through self-provisioning in forager societies, through household storage in

agricultural societies and through networking and alliances in urban socie-
ties. Although cities were the places where individuals might have been
expected to express the greatest anxiety about access to resources, urban
centers actually provided the greatest stability from the individual perspec-
tive because of the comparatively greater array of foraging opportunities
made available through mutually reinforcing phenomena that promoted
urban growth (Figs. 1 and 2).

 Batty (2008, p. 769) notes that cities "appear to be barely sustainable
but paradoxically resilient networks," an observation confirmed by the fact
that many ancient cities survived for centuries and weathered numerous
environmental and political challenges. Even in the world's first cities,
resource-acquisition anxiety was counterbalanced by the coincident growth
of governmental and non-governmental institutions. Temples, guilds,
armies, and other collectivities became enmeshed in the social conditions of
its members under conditions of either normal function (cf. Van de Pol &
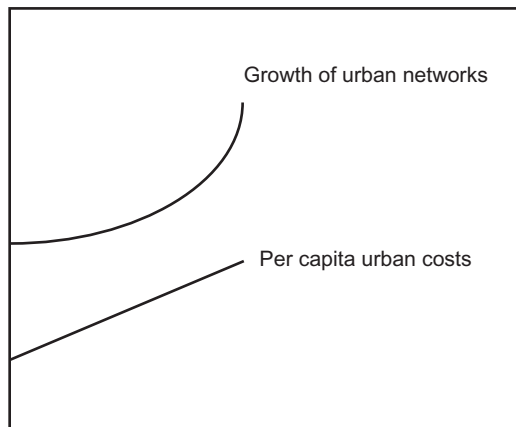Kuijpers, 2005) or under conditions of crisis (Richardson & McBride,

Fig. 1. From the perspective of any individual, it almost always makes sense to
come into the city, because individuals can immediately utilize the networks of
which they are now a part to provide a more diverse set of solutions to the problem
of obtaining food (or other desirables ranging from consumer goods to finding
mates). For each new person who comes into the city, there is a single-unit
incremental increase in costs (of food, raw materials, water, and other inputs) that
produces a linear trajectory, but network construction is an exponential function
(following Metcalfe's Law, which states that "the value of a network grows as the
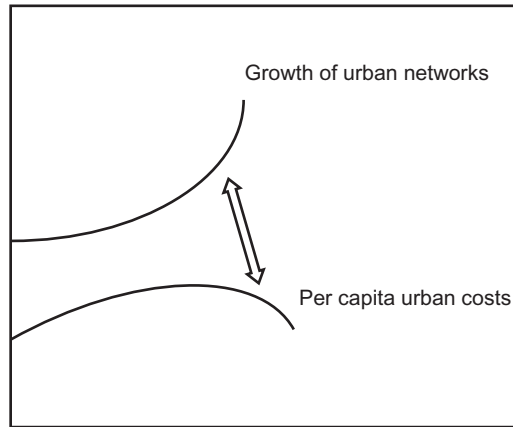square of the number of its users," Metcalfe, 2013, p. 26).

Fig. 2. From the institutional perspective, costs per individual increase initially because of the need to build transportation and storage infrastructure, but then the cost per person decreases as more people come into the urban environment in which that infrastructure is already built (cf. O'Meara, 1999). As a result, cities become larger and larger.

2009). These institutions provided conditions for what could be termed "optimal social foraging" as long as institutions and infrastructure were maintained at a functional level. Cases of modern cities surviving, and even growing, under conditions of warfare and the bankruptcy of formal governments indicate the extent to which a city *sui generis* represents a locus of sustainability from the individual and household perspective, even if the goal of sustainability is never explicitly articulated by any individuals or institutions within the urban realm.[3]

When, then, did "sustainability" become a deliberate concept? The answer is: only recently, when the coincidence of real human effects on the population was combined with measuring devices that enable the quantification of change. The current level of global population is a unique configuration compared to prior eras; as identified by Klein Goldewijk, Beusen, and Janssen (2010, pp. 568–570), global populations have risen dramatically over time from a total of only six million people on Earth in 10,000 BC, to 18 million by 5,000 BC at the time of the earliest cities, to 200 million in AD 500. Global population has been rising extremely rapidly in the modern era, with a total count of 3.6 billion people in 1970 that has nearly doubled today. Not only is overall global population density higher than at any time in human history, but humans also are experiencing population

density in ways that are distinct from ancestral configurations of group size and mobility.

Our current array of measuring devices is unprecedented in human history, ranging from long-term climate records captured in ice cores to real-time satellite imagery that can monitor vegetation growth or oceanic surface temperatures over large expanses of the earth. Many parts of the world now have precise temperature and rainfall records for the past century or more, providing robust data sets from which can be gleaned statistical evaluations of past fluctuations that also provide a baseline for projecting future conditions. These measurements, along with the simultaneous development of human technologies capable of altering the environment on a global scale, have resulted in the conceptualization of the modern world as a "risk society" (Beck, 1992[1986]), in which advances in mathematics and quantification provide the basis for the calculation of risk (White, 2010, p. 91).

Because resource acquisition problems are socially defined, the facts of population growth and the quantification of risk do not in and of themselves necessarily result in a perception of a need for human–environmental rebalancing. The next logical question to ask is *why* sustainability has become a focal concept today. Three potential explanations can be identified: a philosophical turn against modernism and consumption; an interest in using environmental language in the pursuit of social justice; and an expression of anxiety by the middle class.

The philosophical assessment of sustainability can be placed within a long-running theme on the evils of the modern consumer society (for a recent summary and contextualization of this theme, see Pallandini-Simányi, 2014). With a particular reference to the natural environment, Hames (2007) has observed that the myth of the "noble savage" with its connotations of premodern environmental stewardship has a long history in the Euro-American philosophical tradition. Time and again, archaeological research has indicated the ways in which ancient societies outstripped their resources resulting in long-term damage (see, e.g., Redman, 1999), but popular media continues to engage with the trope that small-scale, indigenous societies harmonize with nature and thus constitute a more authentic form of human–environmental interaction.

Sustainability also has become part of the language of environmental and social justice (Harper, 2007). In analyzing the goals of sustainability science, Redman (2014, p. 3) notes that sustainability is "aspirational and requires iterations of improvements," and that ideals of advocacy and activism permeate the language of environmental planning. The concept of

"future discounting" can be applied to these social movements as well: physical outcomes are encompassed within so many complexities that the effects of mitigation are largely unknowable (cf. Weitzman, 1998), but a focus on social justice under the rubric of "sustainability" still yields benefits in the form of measurable community cohesion and social well-being in the present.

A final rationale for the modern concern with "sustainability" is an expression of anxieties sustained by a particular type of group within the modern context, namely, the middle class. Although there is good evidence for an intermediate producer−consumer stratum that emerged in tandem with the world's first cities, the numbers and proportion of the middle class today are much larger than in any prior era. Concern for environmental sustainability as an expression of being able to pass along inheritance to heirs may be a psychological outgrowth of a generalized state of anxiety about a challenging, risk-laden future. In India, for example, Amita Baviskar has discussed the zeal of urban "bourgeois environmentalists" for whom "environmentalism is a mode of expressing and addressing their anxieties about themselves in relation to their habitat, that is, their physical surroundings, both proximate and distant, and other species" (2011, p. 401; see also Harper, 2007 for Hungary; Marcuse, 1998; Strang, 2011 for Australia). Although risk and vulnerability are concepts familiar to all social strata, the concept of sustainability may well be a middle-class one indicative of a desire to protect limited assets in coordination with the apparatus of the state (e.g., through legislation protecting the environment, class-action lawsuits requiring the mitigation of damaged ecosystems, and fund-raising for direct acquisition and protection of targeted natural areas).

CONCLUSIONS

Humans have entered the current age of high population density with a cognitive and social apparatus that is more comfortably attuned to the perception and mitigation of short-term risks (such as natural disasters, warfare, interpersonal violence, and household dissolution) than to the long-term risks encompassed in incremental climate change, sea-level rise, species extinction and global resource depletion. From the perspective of the ancient individual, the acquisition of desired resources was not a matter of sustainability viewed as long-term stasis, but survival as a matter of

short-term access. Just at the historical moment when population pressure might have induced a greater level of anxiety, however, cities emerged as a complex nexus of provisioning opportunities. Through the development of redistributive institutions, markets, and other resource-providing mechanisms, individuals could revert to age-old foraging strategies amidst a vastly expanded array of resource types and localities. With their far-flung economic networks and capacity for political leverage over hinterlands, cities enabled environmental challenges to be masked by an apparent abundance. Even in the rare cases when long-term measurements were developed, for example, in the form of the Nilometer that measured the annual height of Egypt's life-giving river, the concern was for the mitigation of proximate shortfalls or, at the most, the calculation of the probability of the type, periodicity, and scale of shortfalls that could be expected.

Although the concept of sustainability now appears essential for long-term human viability and the future of our planet, it is a concept that faces considerable challenges in both articulation and actualization. Individuals, households, and institutions have identified stop-gap strategies over time and have significant difficulties in cognizing long-term risks, meaning that "sustainability" as a future-directed stability optimum is an unfamiliar and recent paradigm. The benchmark for sustainability is unclear, and each permutation is equally valid: whether to strive for some past pristine condition, a reduction of present impact, or a target of some percentage of future calculated growth. Although measurement devices can pinpoint with greater and greater accuracy the historical variability of climate and the cause-and-effect relationships of human actions on the environment, those devices cannot in and of themselves identify the best approach for present-day and future actions. Given that human cognition is most effectively directed to the understanding of short-term consequences, concerns for long-term "sustainability" must be taught rather than assumed as an inherent perceptive capacity.

NOTES

1. Given its prevalence in our species' behavior for the past two million years, foraging is a highly successful adaptation that should be considered the default adaptive mode. This mode of resource acquisition is highly distinct from sedentary agriculture, which only became practiced (or practicable, see Richerson et al., 2001) after the Holocene. Sedentary agriculture would appear to greatly reduce mobility because of the necessity to continually tend crops throughout the growing cycle and safeguard the post-harvest comestibles, but even sedentary agriculturalists still

engage in strategies of flexibility that mimic forager mobility (see Winterhalder & Goland, 1997). These strategies include diversification of crop types or herd composition, sharing of produce, and storage of temporary surpluses for future use (Winterhalder, Lu, & Tucker, 1999, pp. 335−336); innovation by changing crop mixtures under conditions of stress (M. L. Smith, 2006); taking up new economic activities such as pastoralism (Murty & Sontheimer, 1981); modifying cultural norms to engage in practices such as early marriage and adoption of offspring (Forbes, 1989); sending some family members for external work with the goal of remittances (Adger, 2000; Whittaker & Goody, 2001); and/or going into debt (Wutich & Brewis, 2014).

2. Institutions can, of course, undertake very significant long-term planning for the future, as seen in the urban water-resource projects of New York City starting in the 19th century (Pires, 2004) and Los Angeles in the early 20th century (Gumprecht, 2005). Both of these examples illustrate that the planning for the future still contains a strong present-gain component, however, as seen in the explicit statements of politicians of their power over hinterland resources.

3. A related question, beyond the scope of this paper: if cities are loci of sustainability in and of themselves, why do cities ever collapse? One telling point is the way in which ancient cities collapsed but modern ones rarely do; if anything, as states become unstable their urban areas tend to be viewed as the only viable node of interaction and continue to grow (examples of which include Kinshasa and other cities in so-called "failed states"; see Iyenda, 2005). Although ancient states had fewer means of direct control available to them in a pre-firearms era, it is not clear the extent to which the strength or weakness of a political authority could affect a city if that city was a robust node of ritual or economic activity.

ACKNOWLEDGMENTS

REFERENCES

Adams, R. M. (1972). Patterns of urbanization in early Southern Mesopotamia. In P. J. Ucko, R. Tringham & G. W. Dimbleby (Eds.), *Man, settlement and urbanism* (pp. 735−749). Cambridge, MA: Schenkman.

Adger, W. N. (2000). Social and ecological resilience: Are they related? *Progress in Human Geography*, *24*, 347–364.

Anscheutz, K. F., Wilshusen, R. H., & Scheick, C. L. (2001). An archaeology of landscapes: Perspectives and directions. *Journal of Archaeological Research*, *9*, 157–211.

Barton, C. M., Ullah, I. I. T., Bergin, S. M., Mitasova, H., & Sarjoughian, H. (2012). Looking for the future in the past: Long-term change in socioecological systems. *Ecological Modeling*, *241*, 42–53.

Batty, M. (2008). The size, scale, and shape of cities. *Science*, *319*, 769–771.

Baviskar, A. (2011). Cows, cars and cycle-rickshaws: Bourgeois environmentalists and the battle for Delhi's streets. In A. Baviskar & R. Ray (Eds.), *Elite and everyman: The cultural politics of the Indian middle classes* (pp. 391–418). New Delhi: Routledge.

Beck, U. (1992[1986]). *Risk society: Towards a new modernity*. Los Angeles, CA: Sage.

Bell, B. (1970). The oldest records of the Nile floods. *The Geographical Journal*, *136*, 569–573.

Blaikie, P., & Brookfield, H. (1987). Defining and debating the problem. In P. Blaikie & H. Brookfield (Eds.), *Land degradation and society* (pp. 1–26). London: Methuen.

Bliege Bird, R., Bird, D. W., Codding, B. F., Parker, C. H., & Jones, J. H. (2008). The "fire stick farming" hypothesis: Australian Aboriginal foraging strategies, biodiversity, and anthropogenic fire mosaics. *Proceedings of the National Academy of Sciences*, *105*, 14796–14801.

Blurton Jones, N. G. (1987). Tolerated theft, suggestions about the ecology and evolution of sharing, hoarding and scrounging. *Social Science Information*, *26*, 31–54.

Bogaard, A., Charles, M., Twiss, K. C., Fairbairn, A., Yalman, N., Filipović, D., Arzu Demirergi, G., Ertuğ, F., Russell, N., & Henecke, J. (2009). Private pantries and celebrated surplus: Storing and sharing food at Neolithic Catalhöyük, central Anatolia. *Antiquity*, *83*, 649–668.

Borejsza, A., Rodríguez López, I., Frederick, C. D., & Bateman, M. D. (2008). Agricultural slope management and soil erosion at La Laguna, Tlaxcala, Mexico. *Journal of Archaeological Science*, *35*, 1854–1866.

Boyd, R., Richerson, P. J., & Henrich, J. (2013). Cultural evolution of technology: Facts and theories. In P. J. Richerson & M. H. Christiansen (Eds.), Cultural evolution*: Society, technology, language, and religion* (pp. 119–142). Cambridge, MA: The MIT Press.

Branting, S. A. (2004). *Iron Age pedestrians at Kerkenes Dağ: An archaeological GIS-T approach to movement and transportation*. Ph.D. dissertation, State University of New York, Buffalo.

Browman, D. L. (1987). Agro-pastoral risk management in the central Andes. *Research in Economic Anthropology*, *8*, 171–200.

Carballo, D. M., Roscoe, P., & Feinman, G. M. (2014). Cooperation and collective action in the cultural evolution of complex societies. *Journal of Archaeological Method and Theory*, *21*, 98–133.

Colten, C. E. (2005). *An unnatural metropolis: Wresting New Orleans from nature*. Baton Rouge, LA: Louisiana State University Press.

Costanza, R., van der Leeuw, S., Hibbard, K., Aulenbach, S., Brewer, S., Burek, M., … Steffen, W. (2012). Developing an Integrated History and Future of People on Earth (IHOPE). *Current Opinion in Environmental Sustainability*, *4*, 106–114.

Cowgill, G. L. (2003). Teotihuacan: Cosmic glories and mundane needs. In M. L. Smith (Ed.), *The social construction of ancient cities* (pp. 37–55). Washington, DC: Smithsonian Institution Press.

Crawford, G. W. (2014). *Food production and niche construction in pre-contact southern Ontario*. Midwest Archaeological Conference Inc. Occasional Papers No. 1, pp. 135–160.

Dermody, B. J., van Beek, R. P. H., Meeks, E., Klein Goldewijk, K., Schiedel, W., van der Velde, Y., Bierkens, M. F. P., Wassen, M. J., & Dekker, S. C. (2014). A virtual water network of the Roman world. *Hydrology and Earth Systems Sciences*, *18*, 5025–5040.

di Lernia, S. (2006). Building monuments, creating identity: Cattle cult as a social response to rapid environmental changes in the Holocene Sahara. *Quaternary International*, *151*, 50–62.

Douglas, I., Kurshid, A., Maghenda, M., McDonnell, Y., McLean, L., & Campbell, J. (2008). Unjust waters: Climate change, flooding and the urban poor in Africa. *Environment and Urbanization*, *20*, 187–205.

Drennan, R. D. (1984). Long-distance transport costs in pre-Hispanic Mesoamerica. *American Anthropologist*, *86*, 105–112.

Dubas, K. M., & Jonsson, P. (2005). Rationality in consumer decision making. *Proceedings of the Academy of Marketing Studies*, *10*, 5–8.

Ellis, E. C., Kaplan, J. O., Fuller, D. Q., Vavrus, S., Goldewijk, K. K., & Verburg, P. H. (2013). Used planet: A global history. *Proceedings of the National Academy of Sciences*, *110*, 7978–7985.

Erickson, C. L., & Walker, C. L. (2009). Precolumbian causeways and canals as landesque capital. In J. E. Snead, C. L. Erickson & J. A. Darling (Eds.), *Landscapes of movement: Trails, paths, and roads in anthropological perspective* (pp. 233–252). Philadelphia, PA: University of Pennsylvania Museum of Archaeology and Anthropology.

Flannery, K. V. (1972). The cultural evolution of civilizations. *Annual Review of Ecology and Systematics*, *3*, 399–426.

Fleischer, J. (2014). The complexity of public space at the Swahili town of Songo Mnara, Tanzania. *Journal of Anthropological Archaeology*, *35*, 1–22.

Forbes, H. (1989). Of grandfathers and grand theories: The hierarchised ordering of responses to hazard in a Greek rural community. In P. Halstead & J. M. O'Shea (Eds.), *Bad year economics: Cultural responses to risk and uncertainty* (pp. 87–97). Cambridge, MA: Cambridge University Press.

Frachetti, M. D. (2012). Multiregional emergence of mobile pastoralism and nonuniform institutional complexity across Eurasia. *Current Anthropology*, *53*, 2–38.

Fried, M. (1967). *The evolution of political society*. New York, NY: Random House.

Fuller, D. Q., Van Etten, J., Manning, K., Castillo, C., Kingwell-Banham, E., Weisskopf, A., … Hijmans, R. J. (2011). The contribution of rice agriculture and livestock pastoralism to prehistoric methane levels: An archaeological assessment. *The Holocene SI*, 1–17.

Gioli, G., Khan, T., Bisht, S., & Scheffran, J. (2014). Migration as an adaptation strategy and its gendered implications: A case study from the upper Indus basin. *Mountain Research and Development*, *34*, 255–265.

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, *78*, 1360–1380.

Gumprecht, B. (2005). Who killed the Los Angeles river? In W. Deverell & G. Hise (Eds.), *Land of sunshine: An environmental history of metropolitan Los Angeles* (pp. 115–134). Pittsburgh, PA: University of Pittsburgh Press.

Halstead, P., & O'Shea, J. (1989). Introduction: Cultural responses to risk and uncertainty. In P. Halstead & J. O'Shea (Eds.), *Bad year economics: Cultural responses to risk and uncertainty* (pp. 1−7). Cambridge, MA: Cambridge University Press.

Hames, R. (2007). The ecologically noble savage debate. *Annual Review of Anthropology*, *36*, 177−190.

Harper, K. (2007). Does everyone suffer alike? Race, class, and place in Hungarian environmentalism. In C. A. Maida (Ed.), *Sustainability and communities of place* (pp. 109−126). New York, NY: Berghahn.

Hegmon, M. (1991). The risks of sharing and sharing as risk reduction: Interhousehold food sharing in egalitarian societies. In S. A. Gregg (Ed.), *Between bands and states* (pp. 309−329). Carbondale, IL: Southern Illinois University Center for Archaeological Investigations Occasional Paper No. 9.

Hodge, A. T. (2013). Aqueducts and water supply. In J. DeRose Evans (Ed.), *A companion to the archaeology of the Roman Republic* (pp. 285−295). Oxford: Blackwell.

Hutson, S. R. (2000). Carnival and contestation in the Aztec marketplace. *Dialectical Archaeology*, *25*, 123−149.

Iyenda, G. (2005). Street enterprises, urban livelihoods, and poverty in Kinshasa. *Environment and Urbanization*, *17*, 55−67.

Jeffery, R., Jeffery, P., & Jeffery, C. (2011). Are rich rural jats middle-class? In A. Baviskar & R. Ray (Eds.), *Elite and everyman: The cultural politics of the Indian middle classes* (pp. 140−163). New Delhi: Routledge.

Kates, R. W., Clark, W. C., Corell, R., Hall, J. M., Jaeger, C. C., Lowe, I., … Svedin, U. (2001). *Sustainability science (December 2000)*. KSG Working Paper No. RWP00-018. Retrieved from http://dx.doi.org/10.2139/ssrn.257359

Kemper, R. V. (2010). The extended community: Migration and transformation in Tzintzuntzan, Mexico. In G. Gmelch, R. V. Kemper & W. P. Zenner (Eds.), *Urban Life* (pp. 285−299). Long Grove, IL: Waveland Press.

Kenoyer, J. M. (1998). *Ancient cities of the Indus Valley civilization*. Karachi: Oxford University Press.

Kintigh, K. W., Altschul, J. H., Beaudry, M. C., Drennan, R. D., Kinzig, A. P., Kohler, T. A., … Zeder, M. A. (2014). Grand challenges for archaeology. *American Antiquity*, *79*, 5−24.

Klein Goldewijk, K., Beusen, A., & Janssen, P. (2010). Long-term dynamic modeling of global population and built-up area in a spatially explicit way: HYDE 3.1. *The Holocene*, *20*, 565−573.

Laland, K. N., & O'Brien, M. J. (2011). Cultural niche construction: An introduction. *Biological Theory*, *6*, 191−202.

Lambin, E. F., Turner, B. L., Geist, H. J., Agbola, S. B., Angelsen, A., Bruce, J. W., … Xu, J. (2001). The causes of land-use and land-cover change: Moving beyond the myths. *Global Environmental Change*, *11*, 261−269.

Larsen, M. T. (1987). Commercial networks in the ancient Near East. In M. Rowlands, M. Larsen & K. Kristiansen (Eds.), *Centre and periphery in the ancient world* (pp. 47−56). Cambridge, MA: Cambridge University Press.

Layton, R., O'Hara, S., & Bilsborough, A. (2012). Antiquity and social functions of multi-level social organization among human hunter-gatherers. *International Journal of Primatology*, *33*, 1215−1245.

Loehle, C., & Eschenbach, W. (2011). Historical bird and terrestrial mammal extinction rates and causes. *Diversity and Distributions*, *18*, 1−8.

Logan, A. L. (2012). *A history of food without history: Food, trade, and environment in west-central Ghana in the second millennium* AD. Ph.D. dissertation, Department of Anthropology, University of Michigan.

Marcuse, P. (1998). Sustainability is not enough. *Environment and Urbanization*, *10*, 103−111.

Marriner, N., & Morhange, C. (2007). Geoscience of ancient Mediterranean harbours. *Earth-Science Reviews*, *80*, 137−194.

Metcalfe, B. (2013). Metcalfe's law after 40 years of Ethernet. *Computer*, *46*(12), 26−31.

Minnis, P. (2010). Ancient anthropogenic ecology: Beyond the past. In R. M. Dean (Ed.), *The Archaeology of Anthropogenic Environments* (pp. 373−379). Carbondale, IL: Center for Archaeological Investigations Southern Illinois University. Carbondale Occasional Paper No. 37.

Mohanty, R. K., & Smith, M. L. (2008). *Excavations at Sisupalgarh*. New Delhi: Indian Archaeological Society.

Murty, M. L. K., & Sontheimer, G. D. (1981). Prehistoric background to pastoralism in the Southern Deccan in the light of oral tradition and cults of some pastoral communities. *Anthropos*, *75*, 163−184.

Mustafa, D. (2005). The production of an urban hazardscape in Pakistan: Modernity, vulnerability, and the range of choice. *Annals of the Association of American Geographers*, *95*, 566−586.

North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge, MA: Cambridge University Press.

O'Meara, M. (1999). *Reinventing cities for people and the planet*. Washington, DC: Worldwatch Institute Worldwatch Paper No. 147.

Ortloff, C. R., & Kolata, A. L. (1989). Hydraulic analysis of Tiwanaku aqueduct structures at Lukurmata and Pajchiri, Bolivia. *Journal of Archaeological Science*, *16*, 513−535.

Owens, S. (2003). Is there a meaningful definition of sustainability? *Plant Genetic Resources*, *1*, 5−9.

Pallandini-Simányi, L. (2014). *Consumption norms and everyday ethics*. New York, NY: Palgrave Macmillan.

Peréz Rodríguez, V., Anderson, K. C., & Neff, M. K. (2011). The Cerro Jazmín archaeological project: Investigating prehispanic urbanism and its environmental impact in the Mixteca Alta, Oaxaca, Mexico. *Journal of Field Archaeology*, *36*(2), 83−99.

Pires, M. (2004). Watershed protection for a world city: The case of New York. *Land Use Policy*, *21*, 161−175.

Prado, J. L., Arroyo-Cabrales, J., Johnson, E., Alberdi, M. T., & Polaco, O. J. (2012). New World proboscidean extinctions: Comparisons between North and South America. *Archaeological and Anthropological Sciences*, doi 10.1007/s12520-012-0094-3.

Rautman, A. E. (2013). Social integration and the built environment of aggregated communities in the North American Puebloan Southwest. In J. Birch (Ed.), *From prehistoric villages to cities: Settlement aggregation and community transformation* (pp. 111−133). New York, NY: Routledge.

Redman, C. L. (1999). *Human impact on ancient environments*. Tucson, AZ: University of Arizona Press.

Redman, C. L. (2014). Should sustainability and resilience be combined or remain distinct pursuits? *Ecology and Society*, *19*, 37. Retrieved from http://dx.doi.org/10.5751/ES-06390-190237

Richardson, G., & McBride, M. (2009). Religion, longevity, and cooperation: The case of the craft guild. *Journal of Economic Behavior and Organization, 71*, 172−186.

Richerson, P. J., Boyd, R., & Bettinger, R. L. (2001). Was agriculture impossible during the pleistocene but mandatory during the Holocene? A climate change hypothesis. *American Antiquity, 66*, 387−411.

Rise, J., Åstrøm, A. N., & Sutton, S. (1998). Predicting intentions and use of dental floss among adolescents: An application of the theory of planned behavior. *Psychology and Health, 13*, 223−236.

Roos, C. L., Sullivan III, A. P., & McNamee, C. (2010). Paleoecological evidence for systematic indigeous burning in the upland Southwest. In R. M. Dean (Ed.), *The archaeology of anthropogenic environments* (pp. 142−171). Carbondale, IL: Center for Archaeological Investigations Southern Illinois University. Carbondale Occasional Paper No. 37.

Rosman, K. J. R., Chisholm, W., Hong, S., Candelone, J.-P., & Boutron, C. F. (1997). Lead from Carthaginian and Roman Spanish mines isotopically identified in Greenland ice dated from 600 B.C. to 300 AD. *Environmental Science and Technology, 31*, 3413−3416.

Sanders, J., Nee, V., & Sernau, S. (2002). Asian immigrants' reliance on social ties in a multi-ethnic labor market. *Social Forces, 81*, 281−314.

Smith, B. D. (2001). Low-level food production. *Journal of Archaeological Research, 9*, 1−43.

Smith, B. D. (2011). A cultural niche construction theory of initial domestication. *Biological Theory, 6*, 260−271.

Smith, M. E. (2010). Sprawl, squatters and sustainable cities: Can archaeological data shed light on modern urban issues? *Cambridge Archaeological Journal, 20*, 229−253.

Smith, M. L. (2006). How ancient agriculturalists managed yield fluctuations through crop selection and reliance on wild plants: An example from central India. *Economic Botany, 60*, 39−48.

Smith, M. L. (2010). *A prehistory of ordinary people*. Tucson, AZ: University of Arizona Press.

Smith, M. L. (2013). Caste as a cooperative economic entitlement strategy in complex societies of the Indian subcontinent and subsaharan Africa. In D. M. Carballo (Ed.), *Cooperation and collective action* (pp. 275−297). Boulder, CO: University Press of Colorado.

Smith, M. L. (2014). The archaeology of urban landscapes. *Annual Review of Anthropology, 43*, 307−323.

Spencer, C. S. (2009). Testing the morphogenesist model of primary state formation: The Zapotec case. In A. M. Prentiss, I. Kuijt & J. C. Chatters (Eds.), *Macroevolution in human prehistory* (pp. 133−155). New York, NY: Springer.

Spisak, B. R., O'Brien, M. J., Nicholson, N., & Van Vugt, M. (2015). Niche construction and the evolution of leadership. *Academy of Management Review, 40*, 291−306.

Strang, V. (2011). Fluid forms: Owning water in Australia. In V. Strang & M. Busse (Eds.), *Ownership and appropriation* (pp. 171−195). Oxford: Berg.

Tomasello, M. (1999). The human adaptation for culture. *Annual Review of Anthropology, 28*, 509−529.

Van de Pol, L., & Kuijpers, E. (2005). Poor women's migration to the city: The attraction of Amsterdam health care and social assistance in early modern times. *Journal of Urban History, 32*, 44−60.

Weitzman, M. L. (1998). Why the far-distant future should be discounted at its lowest possible rate. *Journal of Environmental Economics and Management, 36*, 201−208.

White, I. (2010). *Water and the city: Risk, resilience and planning for a sustainable future*. New York, NY: Routledge.

Whittaker, D., & Goody, J. (2001). Rural manufacturing in the Rouergue from antiquity to the present: The examples of pottery and cheese. *Comparative Studies in Society and History*, *43*(2), 225−245.

Winterhalder, B., & Goland, C. (1997). An evolutionary ecology perspective on diet choice, risk, and plant domestication. In K. J. Gremillion (Ed.), *People, plants, and landscape: Studies in paleoethnobotany* (pp. 123−160). Tuscaloosa, AL: The University of Alabama Press.

Winterhalder, B., Lu, F., & Tucker, B. (1999). Risk-sensitive adaptive tactics: Models and evidence from subsistence studies in biology and anthropology. *Journal of Archaeological Research*, *7*, 301−348.

Wutich, A., & Brewis, A. (2014). Food, water, and scarcity: Toward a broader anthropology of resource insecurity. *Current Anthropology*, *55*, 444−468.

Yoffee, N. (1995). Political economy in early Mesopotamian states. *Annual Review of Anthropology*, *24*, 281−311.

Zeder, M. A. (2012). The broad spectrum revolution at 40: Resource diversity, intensification, and an alternative to optimal foraging explanations. *Journal of Anthropological Archaeology*, *31*, 241−264.