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Transformative Relocation in the U.S. Southwest and Mesoamerica

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ABSTRACT

A comparative perspective, drawing from cases in the U.S. Southwest and Northern Mexico, is used to illuminate the iconic Classic Maya "collapse," and to define the concept of *transformative relocation.* In some of the cases we discuss—including La Quemada and Classic Mimbres, as well as Maya—the end of a social configuration is not the end of a people. Rather, a broad temporal and regional perspective demonstrates that the dramatic change we see in the archaeological record is best characterized as a transformative relocation in which people relocated themselves and adopted new ways of life. The comparative perspective allows us to identify factors that contribute to this kind of transformation, including a compounding of vulnerabilities and situations of path dependence. [transformative relocation, Maya, U.S. Southwest, northern Mexico, archaeology]

The Classic Maya "collapse" ca. C.E. 900 is an iconic case of a society's failure to sustain key relationships internally and with its biophysical environment (D. Chase and A. Chase 2004; Demarest 2004; Dunning 1996; Hodell et al. 2001; Houston and Inomata 2009; Rice 2007; Stuart 1993; Webb 1973; Webster 2002). As such, the Maya case begs comparison with other similar ancient instances. Diamond (2005) has undertaken such a comparison on a global scale, predictably bringing criticism by archaeologists familiar with the details of the various cases (McAnany and Yoffee 2010). Others too have independently examined socio-ecological disruptions in such disparate regions as the circum-Mediterranean (van der Leeuw and de Vries 2002), the North Atlantic (Dugmore et al. 2012), Africa (McIntosh et al. 2000), Polynesia (Kirch 2005), and the U.S. Southwest (Kohler et al. 2010). The many ancient instances of collapse and reorganization from the past continue to intrigue the public and scholars alike. While the Maya case has much to say about these issues on its own, framing the collapse of the Classic Maya as one of many in the past may allow for a more general understanding of these issues.

The chapters in this volume examine the transformations of the Classic Maya with awareness of their complexity, but also with the intent of teasing out the most salient explanatory variables and their interactions. Ultimately we seek to portray these explanations in a manner understandable to a wide audience. Part of that process is identifying principles that operate across cultural contexts by comparing multiple cases. Currently under exploration is a set of approaches to identifying key interactions with the labels "resilience approach" (e.g., Redman 2005; Hegmon et al. 2008) or "social-natural approach" (van der Leeuw and Redman

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2002) to past social complexity. Out of these approaches, conceptual frameworks are emerging for analyzing and comparing commonalties in cases of collapse and other major transformations. On an archaeological time scale, such transformations are frequently recurring phenomena. Many archaeologists, including Mayanists, assume that such transformations have multiple but not infinite underlying causes (Demarest 2004).

In this chapter we highlight a particular process manifested in the Classic-to-Postclassic Maya transition and compare it to similar aspects of change in the U.S. Southwest and Northern Mexico (Figure 12.1). We call this process *transformative relocation*, in contrast to in-situ transformations wherein significant reorganization occurs while populations remain in place, and in contrast to total collapses, where the society (and people) disappears (e.g., the end of the Norse settlements of Greenland [Dugmore et al. 2012]). The instances that we consider are not all contemporaneous nor were the societies organized at the same scale, but we will examine the proposition that some of their changes were structurally and processually similar and may involve similar social agency. Of particular interest are instances where settled groups (villages, ceremonial centers, cities) disintegrated in the face of socionatural difficulties and other similar groups were constituted, albeit with different membership and leadership, some distance away from the originally settled area. We suggest that these transformations may have shared two properties: multiple vulnerabilities and path dependence.

This kind of explanation takes the focus away from collapse and abandonment and allows us to see that within a given context, transformation and reconstitution are a continuum of results that stem from human efforts to resolve common issues. This kind of inference also may be of relevance to the human future, because it suggests how societies can paint themselves into corners where there are no alternatives to radical change, and therefore be forced to reorganize profoundly.

After briefly considering the resilience approach, we describe the collapse of southern Lowland Maya cities and the rise of new forms of cities in the northern Lowlands. This process has long intrigued archaeologists and has become even more interesting as a result of recent research, because of new details about some of the actions of affected people (Inomata and Webb 2003 at Aguateca; Demarest et al. 1997 at Dos Pilas). We also describe three other cases of transformative relocation in central and northern Mexico and the U.S. Southwest, pointing out the ways that they are similar to and different from that of the Maya. The depiction of these cases in the idealized framework of transformative relocation allows us to identify some aspects of the socio-ecological status of these groups at the time of their transformation. Doing so demonstrates the need for research about specific vulnerabilities to which particular societies were subject. The northern Mexican case of La Quemada illustrates how such research into ancient vulnerabilities—using a combination of archaeology, paleobotany, geomorphology, and formal modeling—is currently being conducted and could be extended elsewhere.

The resilience approach seeks to comprehend how socio-ecological systems may change while retaining aspects of their structure and identity, or alternatively fail to do so and undergo significant transformations. The focus of the resilience approach is on the indivisible relationship between human societies and their environments. Its terminology is general in an attempt to characterize processes that underlie many kinds and scales and scales of socio-ecological change. The Classic Maya collapse is an instance of transformation that has great potential for shedding light on the principles that govern socio-ecological change.

Researchers in many fields, including scholars who use a resilience perspective, are concerned with identifying vulnerabilities, especially their cumulative and combined effects. Vulnerabilities are conditions, which can sometimes be described as particular states of variables such as rainfall quantities, that threaten the viability of a socio-ecological system (e.g., a city-state). A key finding is that socio-ecological transformations are often preceded by multiple vulnerabilities (Anderies et al. 2006). In the face of multiple vulnerabilities, change may become dynamic, non-linear, or even catastrophic (e.g., epidemics). Such changes are often constituted or preceded by previously uncharacteristic feedbacks between components of different orders (Peters et al. 2011). Thus, understanding the nature of individual vulnerabilities as well as conditions that lead to their joint occurrences becomes a critical focus of analysis. Collapses are perhaps best viewed as radical transformations that occur when multiple vulnerabilities materialize simultaneously.

One very important question is why systems sometimes fail to change even when people in the system perceive vulnerabilities. Path dependence connotes a sense of becoming increasingly stuck in a particular way of doing things, an inability to change even when change would be advantageous (Hegmon in press). Vulnerabilities may compound in path dependent social configurations, leading to situations known as rigidity traps (Hegmon et al. 2008). In such situations change is resisted (whether consciously or as a consequence of the overall social and technological configuration); thus when change does come, it is often abrupt and severe, because relatively profound adjustments are required. Recent examinations of prehispanic cases in the U.S. Southwest have shown that path dependence may have had a powerful

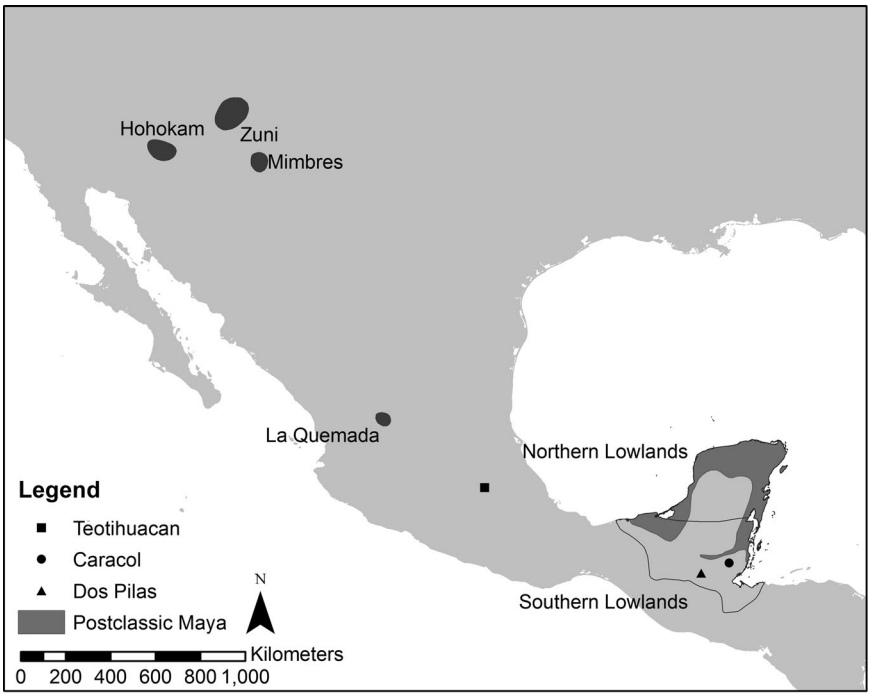

Figure 12.1. Sites and regions in the U.S. Southwest and Mesoamerica (with the Hohokam, Zuni, and Mimbres regions of the US Southwest, La Quemada in Northern Mexico, and the southern Maya Lowlands and Caracol and Dos Pilas within, and northern Maya Lowlands).

effect on the histories of some populations (Hegmon et al. 2008; Hegmon in press). This paper explores the potential of the Classic Maya collapse ca. C.E. 800–900 for adding data and perspectives to the understanding of collapse, especially instances of collapse that involve large-scale relocations of people.

Classic Maya

The ancient Maya occupied a semi-tropical environment stretching from contemporary Chiapas and the Yucatan Peninsula of Mexico, through Guatemala and Belize, into portions of Honduras and El Salvador. Access to fresh water, good agricultural soils, high quality flaked and ground stone raw materials, salt, hardwood, and marine resources varied through this region. From C.E. 250 with the widespread occurrence of polychrome ceramics to C.E. 900 with the political collapse in the southern Lowlands, Classic period site hierarchies existed in which polities combined smaller and larger centers. The largest centers maintained populations of over 100,000 people (Chase et al. 2011:389), integrating populations through market economies and internal road systems. However, the Maya context was not without its stresses and vulnerabilities. Agriculture was substantially dependent on seasonal rainfall and could be disrupted by excessively wet or dry conditions (Lucero et al., this volume).

Elite infrastructure, which included elaborate systems of personal glorification (inscriptions, murals, tombs, sculptural portraiture), as well as public spaces controlled by the elite (plazas, temples, palaces) was expensive to maintain, with sites and polities managing these stresses in different ways. Some, like Dos Pilas, Guatemala (Houston 1993; Demarest 2004), maintained smaller polities and population densities, with room for agricultural expansion. Others, like Caracol, Belize (A. Chase and D. Chase 1998), substantially modified their environments, probably both to intensify production and to buffer against climatic fluctuations by improving the retention of moisture and sediments.

The Classic period Maya ceased monumental construction and discontinued erection of dated stone monuments at some point during the 8th or 9th centuries. Significantly, the collapse and abandonment of the Lowland Maya cities took place over an extended period of time (A. Chase and D. Chase 2004) that was characterized by both unusual alliances and strife. For example, the Maya occupants of Dos Pilas left that site in the middle of the 8th century (Demarest 2004:108), but only after walling off parts of their city in an attempt to protect themselves from attack.

While 8th century Caracol also experienced increased warfare, it occurred at a time when major architecture was renovated, settlement expanded, and new alliances were formed with neighboring centers (A. Chase and D. Chase 1998; this volume; Chase et al. 1991). Elite diet and access to trade goods continued at Caracol throughout the 9th century, but cross-societal distribution mechanisms were not in place. Instead, the elite differentiated themselves from the rest of society (A. Chase and D. Chase 2007). Despite variation in timing, both Dos Pilas and Caracol succumbed to difficulties, which may have included climate change, warfare, and or political and economic failures—and which ultimately led to collapse, abandonment, and transformative relocation.

Postclassic period Maya populations generally relocated to sustainable locations near concentrations of groundwater (Chase and Rice 1985)—to some degree spawning the idea that the Maya collapse was drought inspired. Beginning in the 8th century, refugee populations may have further compounded problems, leading to sequent collapses elsewhere (Demarest 2004). Populations moved, but often not great distances; settlements do not appear to have relocated en masse. Disjunctions in ceramic transitions suggest intermingled populations and movements. There was no simple relocation from the south to the north, as was once thought (Cowgill 1964; Morley 1946); in some cases, it appears that northern populations moved further south (Chase and Chase 1982; Adams 1999).

The relocation was transformative not only because of population movement, but because institutions surrounding rulership were altered or discontinued, for example, as marked by cessation of several of the kinds of personal glorification of rulers mentioned above. Although more densely settled, Postclassic sites were not as spatially expansive as their Classic period counterparts and contained fewer people (Culbert and Rice 1990). Postclassic centers maintained some traditional aspects of Maya culture, but did not replicate others (D. Chase and A. Chase 2004). Ritual caches for both the Late Classic and Postclassic Maya were used for site integration, but the emphasis on eastern mortuary ritual found at many Classic period centers in the southern Maya Lowlands is not replicated in Postclassic sites. Many residential groups in the Classic period Maya area contained eastern ritual structures, something that is extremely pronounced at Caracol (A. Chase and D. Chase 2014). Monumental architecture also diminished between the two periods with the Late Classic practice of recording dynastic history on stone largely disappearing in the Postclassic period. Thus, the Classic period Maya provide an excellent example of both innovative adaptation and rigid path dependency. While changing environmental conditions may have set the stage, an accumulation of human choices led to the abandonment of Classic Maya cities and their transformative re-establishment in new locations. Although urban structures were re-invoked, it appears doubtful that the populations remained devoted to Classic period political structures or community identities.

The process of transformative relocation is not restricted to the Maya region. Prehispanic groups in northern Mexico and the U.S. Southwest, ca. C.E. 500–1400, manifested such changes at certain times and places. Co-authors of this chapter Nelson and Hegmon are part of a group of collaborators that has been examining the socio-ecological dynamics of five prehispanic cases in those regions. Some of these northern groups (with respect to the Maya) exhibit a pattern similar to the Classic-Postclassic Maya region, which makes them interesting to compare because they represent societies that were organized on much smaller scales than the Maya. While one might expect that different dynamics operate in societies of such different scale, we suggest to the contrary that many of the same issues, human responses, and systemic consequences were involved. In what follows we briefly describe three of these cases, La Quemada, Salt River Hohokam, and Mimbres, as comparative background for the explanations and methodological suggestions with which we conclude our observations about the Maya collapse.

Northern Mesoamerican Frontier

The northern frontier region of Mexico, which includes parts of Zacatecas, Durango, Jalisco, and Sinaloa, may have been at the distant end of a zone affected by population displacements from Central Mexico, in a pattern similar to that linking the different parts of the Maya region. As is noted above, Maya settlements began to develop in new locations well before C.E. 900, and the collapse was in part an attraction of population to those already established settlements. The northern frontier has a similar occupational history in relation to central Mexico. New centers began to form in the Bajío region north of the Rio Lerma-Santiago C.E. 350–600 (Cárdenas and Fernández 2004) and subsequently, as exemplified by La Quemada (Nelson 1997) in the northern frontier ca. C.E. 500/600–900. Throughout the latter period, central Mexico was experiencing the replacement of its major power center, Teotihuacan, by a series of smaller capitals such as Tula (Mastache et al. 2002), Teotenango (Piña Chan 1973), and Xochicalco (Hirth 1995), coupled with demographic shifts and stylistic changes implying connectivity with the northern frontier (Beekman and Christensen 2003; Crider 2011; Braniff and Hers 1998; Gaxiola 1999;

Jiménez Moreno 1959; Mastache and Cobean 1989; Nelson and Crider 2005; Rattray 1996).

La Quemada is the most intensively studied of several northern frontier ceremonial centers that were occupied from about C.E. 550–1000, corresponding to the Late Classic 1 through Late Terminal Classic as used in this volume. Abandoned ca. C.E. 900, the site was a spectacular mountaintop fortress and ceremonial center comprised of about 60 terraces (Nelson 1997). Architecture on the terraces includes a monumental core of masonry structures such as a 75 meter-long ball court, a roofed colonnaded hall about 20 × 25 meters in area. Smaller replicas of these features were placed around sunken patios on other, smaller terraces. Staircases, causeways, and walkways connected different parts of La Quemada, and causeways descended from the mountaintop to connect with more rural spaces occupied by over 200 villages.

The roughly synchronous abandonment of some of these northern frontier centers (Jiménez and Darling 2000; Kelley 1985; Nelson 1997; Trombold 1990) has been implicated in socio-ecological debates because ancient populations would have been vulnerable to crop failure. Pedro Armillas (1964) argued that appearance of these Late Classic–Early Postclassic centers suggested a climatically driven northward shift in the northern limit of Mesoamerica He proposed that Mesoamerican groups colonized the region when increased precipitation temporarily made maize agriculture viable, only to abandon their settlements when the old climatic conditions returned. Chronometric dates were not available at the time Armillas wrote, but his model implies that the climatic shift back to less favorable conditions should have happened ca. C.E. 900–1000. A key point is that, as legend suggests (Jimenez Moreno 1959), the centers in northern Mexico could have grown as a direct or indirect result of dispersive relocations in central Mexico. Armillas emphasized that the climatic element of his proposition required empirical testing. Sauer (1963) held that the semiarid conditions of northern Mexico meant that sedentism was contingent on agave cultivation. Parsons (2010) expands this hypothesis, arguing that the colonists would have needed to import algae and insects from the lake zones to the south. Why the northern frontier became Mesoamericanized (Foster 1986) remains an important question, as does the extent to which this transformation involved in situ lifeways changes as opposed to the arrival of immigrants. There are also questions about why some centers in the region were abandoned ca. C.E. 900. Other centers appear to have absorbed people from the ones that collapsed. Some of our recent work at La Quemada has focused on gauging the vulnerabilities of these seemingly oversized northern Mexican populations (see below).

U.S. Southwest

People in the Hohokam region seem to have experienced a transformation in place ca. C.E. 1150, followed by continued occupation till ca. C.E. 1350–1400, when they dispersed and reorganized in such a way as to be almost invisible archaeologically (Wells et al. 2004; Hill et al. 2004). The sequence is suggestive of resilience initially but later of path dependence leading to a difficult decline (Abbott 2003; Hegmon in press). Farmers in the Phoenix Basin became increasingly committed to a humanly modified landscape in which they built the largest prehispanic irrigation system in North America (Hunt et al. 2005), possibly supporting as many as 40,000 people. Hohokam territory as a whole expanded, and approximately 200 ball courts were constructed (Wilcox 1991). Analyses of ceramic production sources and exchange lead Abbott et al. (2007) to infer that by ca. C.E. 875 the ball courts became foci for markets at which pottery was exchanged for food and other products. The authors intentionally refer to "markets" because the scale and geography of distribution implies exchange among parties unknown to one another. The in-situ transformation came ca. C.E. 1150, possibly as a result of a change in the rainfall regime, reduction in river flow, and lessened ability to produce a crop surplus for exchange. Thus large scale specialist pottery production came to an end, and at the same time, the ball courts went into disuse. Marking the beginning of the misnamed Classic period, the population aggregated into the Phoenix Basin and territorial extent decreased, while platform mounds reminiscent of Mesoamerican structures became the focal points of social integration. The end of the Hohokam sequence came at ca. C.E. 1350 with dispersal so thorough that archaeologists are uncertain how to identify subsequent sites. Subsistence agriculturalists in this region would have been vulnerable to recurrent droughts, but that was not their only serious vulnerability. Large flood events in the late 1300s may also have damaged the canal systems. More deeply, this case can be considered one of path dependence in that the Phoenix Basin occupants had made a social commitment to a canal system that was robust to fluctuations of rainfall only within a certain range (Anderies et al. 2006; Hegmon in press).

The Mimbres region in the U.S. Southwest, long known for spectacular pottery, is now also known as a case of what resilience theorists call "reorganization." During the Classic Mimbres period (C.E. 1000–1130) people lived in large villages, and population grew, moving into marginal areas. Around C.E. 1130, a time of climatic downturn, many (but not all) people moved out of the villages and the pottery tradition ended. In contrast to earlier accounts, which argued that the Mimbres Valley and much of the region were

abandoned at the end of the Classic period (e.g., Shafer and Taylor 1986), recent work (Hegmon et al. 1998; Nelson 1999; Nelson et al. 2006) finds that it is better understood as a regional reorganization, in which some people moved (tens of kilometers) from aggregated villages to dispersed hamlets, while others left the region. In other cases, people seem to have moved between river valleys (Nelson and Anyon 1996). The reorganization phase hamlets are different from the earlier villages. An inward focus and intra-regional interaction was replaced by a broad network of inter-regional ties, indicated by the import of numerous kinds of decorated pottery. Household organization changed and came to be focused on a single multi-functional room as household mobility increased. This increase in autonomy lasted only a generation or two—possibly because of threats of violence—and by the end of the 13th century most people had moved back into aggregated villages.

Characterizing Vulnerabilities and Explaining Transformations

How do we get inside the dynamics of past societies to identify vulnerabilities and evaluate their roles in social transformations, for example to understand why relocation sometimes needs to be part of change? The above examples demonstrate the need for in-depth examination of specific vulnerabilities. It does not suffice to say that a population is vulnerable to drought because it inhabits a semiarid environment, or to say that land degradation could be a problem for agriculturalists who were deforesting portions of a landscape. We need rigorous ways of characterizing variable changes and their impacts, including vulnerabilities, response mechanisms, and the tradeoffs among different strategies as conditions change (again, in part recursively as a result of attempts to reduce vulnerabilities). Our approach in northern Mexico (e.g. Anderies, et al. 2008) and the U.S. Southwest (e.g., Anderies and Hegmon 2011) has been to work iteratively between socio-ecological data and formal models. Real-world data about vegetative change (some of which can be parsed between climatic and anthropogenic causes), stream behavior, precipitation, and temperature provide realistic input for models that characterize interactions among key variables. In the La Quemada case an interdisciplinary team tested both empirically (Elliott et al. 2008) and with formal models (Anderies et al. 2008) for environmental causes of the prehispanic abandonments ca. C.E. 900–1000. This approach did not identify environmental causes per se, but did afford insight into the socio-ecological challenges faced by prehispanic farmers, as two examples from La Quemada will illustrate.

Socio-ecological data-gathering has been crucial to evaluating Armillas's (1964) model of settlement opportunism, i.e, intrusive farmers' colonization of lands during a period of favorable climate followed by failure to cope with increasing aridity, outlined above. Armillas basically argued that centers such as La Quemada in the northern Mesoamerican frontier were occupied and later abandoned because of climatic change. To address this possibility, Elliott et al. (2010) collected pollen, phytolith, sedimentary, paleomagnetic, and radiocarbon samples from an area of productive floodplain in the Malpaso Valley at the heart of the La Quemada agricultural system. They cut backhoe trenches to expose off-site soil and sediment deposits dating before, during, and after the main occupation of La Quemada (C.E. 500–900).

The hypothesis of settlement opportunism led Elliott et al. (2010) to expect indications of decreased temperature and aridity, floodplain stabilization, pedogenesis, and differing vegetative cover corresponding to the time when dense, sedentary human settlement began, ca. C.E. 500. The converse hypothesis of succumbing to drought vulnerability implied that those conditions reversed ca. C.E. 900, producing increased temperature and aridity, erosion, downcutting, and vegetative change. Elliott et al. tested the floodplain and tributary arroyos that must have provided the main agricultural support for several thousand people. These occupants constructed a cluster of over 200 villages surrounding a massive regional ceremonial center, a road system, and agricultural terraces, all of which they abandoned after several centuries of sustained development. Was their settlement system made possible, and then made to fail, by climatic change as Armillas (1964) interestingly proposed? Indices of aridity and vegetative changes were constructed from phytoliths, indices of stream behavior and soil formation from loss on ignition, magnetic susceptibility, anhysteretic and saturation remanence, and sediment characterization. The changes were dated by radiocarbon analysis and compared to human settlement history.

The results indicate no correlation between these measures of environmental change and the settlement history of the Malpaso Valley (Elliott et al. 2010). The onset of the current level of aridity occurred long before the main prehispanic occupation, ca. 525–230 B.C.E., yet this climate still permitted pedogenesis, streambed aggradation, and regular overbank flooding, implying favorable conditions for floodplain agriculture. These conditions persisted for centuries before, during, and after the episode of dense prehispanic occupation and were interrupted only by the deforestation and overgrazing of the Spanish colonization, beginning ca. C.E. 1550 (Elliott et al. 2010). We concluded that the prehispanic abandonment was not associated with strong environmental

perturbation and that the environment experienced by the prehispanic population was markedly more productive than that of today. Either the perturbations were too short-lived to be detected by the measures used or the causes were in the social realm as opposed to the natural.

Because of the possibility that the types of socio-ecological data collected thus far may not be sensitive enough to capture short-term droughts, the archaeologists and other scientists dealing with the La Quemada case are experimenting with other approaches. One is to model subsistence security under different sets of crop mixes and climatic conditions. If farmers were vulnerable to droughts, it should be possible to simulate conditions under which farmers would be forced to migrate due to famine. Geographers and archaeologists have suspected that prehispanic people could not occupy the Northern Frontier without cultivating agave as a backup to maize, because maize is too sensitive to rainfall fluctuations. Agave, on the other hand, is a nutritionally productive perennial that stores its own supply of moisture (Parsons 2010; Parsons and Parsons 1990; Sauer 1963). Anderies et al. (2008) set out to determine how much difference agave cultivation made to the robustness of Northern Frontier farmers to drought. For example, in 100 years, how many famine events severe enough to cause migration would be avoided by a mixed maize and agave crop portfolio as opposed to one relying on maize alone? The model assumes that all farmers are employing the same crop mix and are subject to the same (stochastic) fluctuations in rainfall. Simulations were run with mean rainfall set at different percentages of the saturation point of maize (the point beyond which more precipitation makes no difference to yield).

Several key findings are suggested by the Anderies et al. (2008) model. First, mixing agave cultivation with that of maize can make a tremendous difference in a simulated context, eliminating as many as 95% of simulated famine events, but secondly, this difference is only achieved if the mean rainfall is within 70% of the saturation point of maize and variance of rainfall is relatively low, about 20% of the mean. Thirdly, these results suggest that increasing crop diversity does not automatically increase robustness. Thus one can conclude that under certain circumstances the vulnerability of northern frontier populations to drought can be significantly mitigated by the mixed annual-perennial strategy. Obviously, the populations had other ways of reducing vulnerability, such as using the most drought-resistant varieties of maize, terracing, building irrigation ditches, and hand-watering plants during dry years. Potentially, these practices could have made it possible to develop institutions that created short- or medium-term security but would not be adaptive in the long run because the practices or institutions were difficult to change.

As in the Mimbres, Hohokam, and Classic Maya cases, in the La Quemada example people stopped living in large settlements in what had been their main area of occupation, and many families must have relocated to form new social configurations. The environmental testing and formal modeling done this far have not pinpointed the causes of the relocation, but have identified some of the issues that the inhabitants were facing. Additional environmental testing and modeling are planned to sharpen the understanding of vulnerability to rainfall fluctuations, how plants and people responded to those fluctuations, and why some prehispanic groups ultimately dispersed to new environments and social settings.

Conclusion

One thing that should be clear from the above examples is that the processes that characterized the Classic Maya collapse may be echoed in many other cases, at a variety of scales, and in different institutional contexts. Path dependence, or the tendency of societies to follow established practices beyond the exhaustion of their utility, may contribute to many cases of collapse. Yet examples of greater resilience also exist in the prehispanic Americas (e.g., Zuni and its ancestral communities [Nelson et al. 2010]). We are quite far from understanding the mechanisms that permit societal transformations to occur with limited disruption, locational or otherwise, but significant advances are being made in data accumulation and conceptualization as we consider both empirical cases and broad concepts such as rigidity and path dependence. Mayanists of course are very active in these kinds of advances. The great questions raised by the Maya collapse can be asked of many other settings, and the comparative analysis of highly specific vulnerabilities may lead to further understanding of how security is promoted in complex human systems.

A benefit of the resilience approach is that it is amenable to formalization in mathematical models. By working between empirical cases and such models, researchers are able to explore possibilities and create better approximations of the key variable interactions in systemic transformations than they might with other, less formal analytical operations. Some of our work has been in these directions, and we believe that it has potential not only for improving the understanding of the Maya collapse but also for analyzing sets of collapses and understanding their common causes.

We suspect that southern Lowland Maya cities succumbed to ordinary issues that either assumed unusual

proportions, "flared" simultaneously, or both. In the face of these vulnerabilities, the social groups were not flexible enough to respond by changing, and instead disintegrated because the enactment of solutions in place was precluded by established social practice. While individual ecological and social stresses may not have led to collapse on their own (McAnany and Negrón 2010), the combination of these societal stresses may have made the problems facing the Classic Maya intractable. In such circumstances relocation to the northern Lowlands, not by cities wholesale, but in smaller social aggregates that were recruited to new, growing centers, may have been a way of escaping entrenched political regimes and other regimes of value (Appadurai 1986) that bound groups to untenable patterns of behavior. Relocation may have permitted the substitution of new leadership and social principles that could not occur in place.

Transformative relocation would not force people to wholly abandon their social identities, nor would it permanently free them from path dependence. Turner and Sabloff (2012) suggest that the people who abandoned southern lowland centers did not return, because once established in the north, they became engaged in oceangoing trade to an extent that returning to the southern Lowlands would have been problematic. The La Quemada, Hohokam, and Mimbres cases described above provide strong parallels to the paradoxically permanent abandonment of fertile areas that (at least until the availability of carbon-fuel powered irrigation) would have had potential for economic reintensification after a human generation or two of ecological recovery.

In comparative perspective, the Classic Maya collapse appears large and spectacular, but not unique. Hopefully the above juxtaposition of U.S. Southwestern and northern Mexican cases identifies some of the basis on which the Maya collapse can inform more broadly about collapse in general.

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