Popul Environ (2010) 31:3–19
DOI 10.1007/s11111-009-0088-y

ORIGINAL PAPER

Katrina in historical context: environment and migration in the U.S.

Myron P. Gutmann · Vincenzo Field

Published online: 21 November 2009

Abstract The massive publicity surrounding the exodus of residents from New Orleans spurred by Hurricane Katrina has encouraged interest in the ways that past migration in the U.S. has been shaped by environmental factors. So has Timothy Egan's exciting book, *The Worst Hard Time: The Untold Story of those who survived the Great American Dust Bowl*. This article places those dramatic stories into a much less exciting context, demonstrating that the kinds of environmental factors exemplified by Katrina and the Dust Bowl are dwarfed in importance and frequency by the other ways that environment has both impeded and assisted the forces of migration. We accomplish this goal by enumerating four types of environmental influence on migration in the U.S.: (1) *environmental calamities*, including floods, hurricanes, earthquakes, and tornadoes, (2) *environmental hardships and their obverse, short-term environmental benefits*, including both drought and short periods of favorable weather, (3) *environmental amenities*, including warmth, sun, and proximity to water or mountains, and (4) *environmental barriers and their management*, including heat, air conditioning, flood control, drainage, and irrigation. In U.S. history, all four of these have driven migration flows in one direction or another. Placing Katrina into this historical context is an important task, both because the environmental calamities of which Katrina is an example are relatively rare and have not had a wide impact, and because focusing on them defers interest from the other kinds of environmental impacts, whose effect on migration may have been stronger and more persistent, though less dramatic.

M. P. Gutmann (✉)
Department of History, Population Studies Center, Inter-university Consortium for Political and Social Research, University of Michigan, Ann Arbor, MI, USA
e-mail: gutmann@umich.edu

V. Field
Law School, University of Chicago, Chicago, IL, USA

Keywords Migration · Environment · Hurricane · United States

Environment and demographic change, both past and present, have produced a steady stream of news and comment in recent years. Not so long ago we reflected on the centennial of the San Francisco earthquake of April, 1906, a staggering magnitude 7.8 event that virtually leveled the city and made its population homeless. The most difficult years of the 1930s Dust Bowl occurred just over 70 years ago; this anniversary led reporter Timothy Egan of the *New York Times* to write a Pulitzer-prize winning book called *The Worst Hard Time: The Untold Story of Those who Survived the Great American Dust Bowl* (Egan 2006). More recently, in August 2005, a hurricane tore across the Gulf Coast, initially depopulating New Orleans in a dramatic example of environmentally driven demographic change, though—as we have seen—this episode was hardly the last. Even 4 years later, the population of the city of New Orleans is still less than 80% as large as it was in mid-summer 2005, and the metropolitan area less than 90% as large (Greater New Orleans Community Data Center 2009). The challenges have not ended, of course. In the summer of 2008, hurricanes Gustav and Ike reached the Gulf coast of the United States, mercifully sparing New Orleans from great harm but causing great damage to Galveston Island in Texas.

Hurricane Katrina has become symbolic of the role of environment in demographic change, but even this brief introduction reminds us that it is only one event among many, all of which are worthy of study because they reveal the ways in which environment has influenced the movement of population around the United States over the past 200 years and longer. Our goal in this article is simple. We propose to synthesize what we know about the history of migration and environment in the U.S. into a conceptual scheme that identifies and describes four different ways of looking at migration and environment: (1) *environmental calamities*, including floods, hurricanes, earthquakes, and tornadoes, (2) *environmental hardships and their obverse, short-term environmental benefits*, including both drought and short periods of favorable weather, (3) *environmental amenities*, including warmth, sun, and proximity to water or mountains, and (4) *environmental barriers and their management*, including heat, air conditioning, flood control, drainage, and irrigation. In U.S. history, all four of these have driven migration flows in one direction or another. Our challenge is to put Katrina in context, which is an important task in part because the environmental calamities of which Katrina is an example are relatively rare and have not had a wide impact, and in part because focusing on them displaces interest from the other kinds of environmental impacts that are worth noting. The conclusions we draw show the importance of all of these factors, and assert their relative strength, but they also put the Katrina experience in context. Katrina combined two of our forces, calamities and environmental management, in a situation where there were high levels of urban poverty and social differentiation. The result was an environmental and social catastrophe of very high magnitude.

Environmental calamities

Environmental calamities make big news. Hurricanes and earthquakes, (as we know from Katrina and the San Francisco earthquake), as well as floods and tornadoes, manage to attract attention no matter when or where they occur, and no matter whether the long-term damage is great or small. Clearly environmental, they arrive violently and suddenly, spurring out-migration through the destruction of homes and businesses. The questions to be asked are, how frequent are these events? How severe are their demographic consequences? How are those demographic consequences structured along social, economic, racial, ethnic, and other axes? How long does it take for recovery to occur? And what is the overall contribution of calamities to demographic change?

Despite the enormity of these calamitous events, they are both infrequent and have led to relatively little serious demographic research. There is a good general literature on the social consequences of natural disasters. Although much of this research and synthesis is now more than a decade old (Blaikie et al. 1994; Burton et al. 1993; Hewitt 1983; Steinberg 2000), it acknowledges that, while disasters may be natural, their consequences are socially determined. However, while this literature recognizes that migration can be a response to the specific shocks associated with natural hazards and disasters, it does not emphasize demographic change as an outcome of these events. We know quite a lot about migration following Hurricanes Katrina and Andrew, and much less about events earlier in time. Historical demography is ill-suited to most studies of catastrophe, because the very processes that disrupt normal life are those that disrupt the kind of long-term record keeping on which historical demographers rely.

The suddenness and unpredictability of environmental calamities makes them particularly difficult to understand and deal with. Science has worked hard on this problem since the disasters of the turn of the twentieth century (the 1900 Galveston hurricane and the San Francisco earthquake both led to massive numbers of fatalities), with some success (Burton et al. 1993). Many were aware of Hurricane Katrina's potential for destruction well in advance, and authorities ordered a total evacuation, even if it was not successful. More recently, the evacuations in advance of Hurricanes Gustav and Ike were much more successful (McKinley and Urbina 2008; Nossiter 2008), but because scientists are far less able to predict earthquakes and tornadoes than hurricanes, those events continue to be dangerous. Major floods may develop more gradually than other events, and therefore might be predicted, but many of the most catastrophic floods are smaller and arise suddenly.

We measure the demographic impact of recent large-scale hurricanes in two phases, one that involves the scale of the evacuation that precedes the hurricane, and a second that measures the scale of the longer-term out-migration of population from the region, and the nature and timing of the return of population, either those who originally evacuated or others who have come to take their places. We have chosen for this discussion to focus only on migration, and not on mortality or other demographic outcomes.

Hurricanes Katrina and Andrew

While it may still be too soon after Hurricane Katrina (which made landfall on August 29, 2005) to measure with precision the extent of long-term migration it produced, the short- and medium-term impact has been widely discussed. Of the 480,000 inhabitants of the city of New Orleans (the area hardest hit), press reports at the time of the storm suggested that 80%—roughly 385,000—evacuated. For the New Orleans region overall, estimates of short-term evacuees reached 1 million, and for the Gulf Coast region as a whole, the number must have been significantly larger. Many people moved, at least for a while.

The extraordinary devastation of homes, workplaces, and other facilities made the return to New Orleans a slow process. According to widely cited Census Bureau figures, by July 2006, the city's population was about 210,000, down more than 56% from the previous year. A year later, it had risen to about 239,000 (Brookings Institution 2008). More recently, reports on households receiving mail show that in June 2009, the number of households in the City of New Orleans (Orleans Parish) was still 23% lower than the July 2005 estimate (Greater New Orleans Community Data Center 2009).

Hurricane Andrew is better documented, largely because more time has passed and because it created less damage. Andrew made landfall in South Florida on August 24, 1992, before crossing the Florida Peninsula and hitting the Gulf coast again days later. More than 700,000 Florida residents evacuated as Andrew approached. The hardest hit areas included the farming and working class retirement communities of Homestead and Florida City about 25 miles south west of Miami (Solecki 1999). The middle and upper income areas of Kendall and Cutler Ridge were also severely affected. According to Oliver-Smith (2005), Andrew temporarily displaced 353,000 people, with about 40,000 or 11%, migrating permanently. About half of the 40,000 moved only a 30-min drive north, sparking a population boom in Plantation and other Broward County communities. This net loss of 20,000 was offset by migrants whose desire to live in Florida was not deterred by the threat of another hurricane. Smith and McCarty (1996) add depth to these straightforward figures: in South Dade County nearly half of the residents moved out of their homes after Andrew, but most of them did not go beyond Dade and Broward counties. Driven away primarily by the destruction of homes, two-thirds of the displaced residents had returned by the summer of 1994, but of those who had lived in the southern part of the county, only 61% returned.

Rather than causing a major shift in demographic patterns, Andrew sharply accelerated changes that were already underway (Solecki 1999). The spatial realignment of ethnic and racial groups that occurred after Andrew, particularly in the metro Miami area, had begun long before Andrew. For example, throughout the 1980s, the population of Dade County had become increasingly Hispanic as many non-Hispanic whites moved out of the more urbanized parts of Dade County to settle in Broward County to the north, or to the predominantly white, unincorporated, middle and upper income enclaves of Kendall, Kendall Lakes, and Cutler Ridge (Solecki 1999, p. 455). As such, Hurricane Andrew accelerated the Hispanicization of Dade County by encouraging the movement of non-Hispanic

whites to Broward County, increasing the spatial segregation of racial and ethnic groups throughout the area.

The experience of Hurricane Andrew suggests that the localization of the physical destruction of homes largely drives dislocation, which is strongly influenced by socio-economic and race-ethnic factors. Risk is not evenly distributed across society and those who are relatively privileged before a disaster have a greater diversity of options when facing calamity and a deeper well of resources to draw on in the aftermath (Steinberg 2000, 2001). The speed of reconstruction is also an important determinant of the return of out-migrants from a calamity, with slow reconstruction deferring return, and deferred returns eventually becoming permanent out-migration. On the other hand, the reconstruction of virtually all the housing in southern Dade County meant that the population was eventually restored, even if not by those who had left. The question after recovery was whether the new social system that was created was sufficiently resilient to survive future shocks (Pais and Elliot 2008).

San Francisco earthquake

Press reports in the spring of 2006 (see Rivlin 2006) stressed parallels between the San Francisco earthquake (April 18, 1906) and Hurricane Katrina, even though they differed in striking ways (Kich 2006). The earthquake and subsequent fire destroyed more than half of San Francisco's housing stock (Haas et al. 1977). 300,000 evacuated the city after the disaster; 65,000–75,000 of these evacuees never returned. Tracing the location of work and home on a yearly basis after the earthquake, Haas and colleagues used a sample of over 2,000 heads of households drawn from the 1905 city directory, each classified on ethnic and socio-economic grounds, to determine the timing of reestablishment and the path of locational change. During the reconstruction process, authorized and unauthorized tent camps, mostly located in city parks and plazas, provided temporary housing for about 20,000–40,000 individuals, many of whom worked on reconstruction projects.

One year after the disaster, many of these camps were closed, and about 20,000 individuals were housed in 6,200 newly erected wooden cottages on private property. These cottages primarily housed individuals and families for whom housing at suitable rents did not exist: the elderly, unskilled workers, and foreign born and female-headed families. From August 1906 to October 1907, 8,000 new homes were completed in San Francisco, replacing about one-third of the housing stock destroyed in the fire. By 1911, the city's housing stock was fully replaced.

As in the case of Hurricane Andrew, population return followed a discernible pattern and sequence structured by socioeconomic status and ethnic background. Upper class districts and individuals stabilized rapidly, while unskilled workers were still in transition 5 years after the disaster. The evidence suggests that by early in the second year after the disaster the upper income residential district had both reestablished itself and expanded, and that by 1908/1909 businesses and homes had been reestablished for most white collar workers. In contrast, the lowest income groups were forced to relocate on land unclaimed by the better-off, and in many cases faced the decision to relocate to other East Bay towns or leave the Bay Area

altogether. A large proportion of the 300,000 individuals who evacuated San Francisco after the disaster were from the lowest income groups, with 74% of the unskilled sample failing to return to the Bay Area by 1907, and 87% gone from the Bay Area by 1910 (Haas et al. 1977; Schwartz 2006). As Henderson (2005, 2006) shows, ethnic differentials and segregation were strong and demonstrate a pattern similar to that after Hurricane Andrew.

Lesser disasters

For every major hurricane, there are hundreds or thousands of smaller-scale events, such as the Seattle-Tacoma earthquake of 1965, or the Loma-Prieta earthquake of 1989. This leaves aside disasters that have affected small American places, such as the Yuba City, California flood of 1955, Hurricane Carla that hit Galveston, Texas in 1961, the Conway, Arkansas tornado of 1965, and the Topeka, Kansas tornado of 1966. While these smaller communities may actually be more vulnerable to natural disaster than are larger American cities, less attention has been paid to them (Cross, 2001). The majority of natural disasters in the U.S. do not *usually* cause damage extensive enough to lead to massive population movement. We define lesser disasters as those with small demographic impacts, limited to a small number of casualties and a very low rate of out-migration, most of which would have been temporary. What population shifts occur are brief and temporary, but as we have seen earlier, most significant for lower income residents of disaster areas. Even the Loma-Prieta earthquake, which killed 62 people and leveled 5,000 homes, was not destructive enough to cause any real change in migration patterns. In fact, the 5,000 homes lost represented only 0.3% of the total housing stock of the area affected by the earthquake (Hoag 1995), but most of those units were multifamily housing, and by 2000 only half of the affordable housing destroyed had been replaced (Steinberg 2000). Most natural disasters in the U.S. produce lower levels of devastation. The Seattle-Tacoma earthquake of 1965 destroyed only two homes and damaged three more, making an analysis of migration unnecessary.

Whatever the size of their impact, smaller natural disasters can have a long-term impact on their communities. In many respects, the populations of small cities and rural communities are far more vulnerable than are residents of large urban areas. While the aggregate level of destruction to these communities is much less than that caused by even minor disasters in more built-up areas, the devastation can be proportionally greater, in fact as well as perception. For example, Spencer, South Dakota was almost completely destroyed by a tornado in 1998 that killed 6, injured more than half of the population, obliterated all four of the community's churches, and leveled both the business district and 90% of the community's homes. Similar stories are not unusual (Cross 2001).

Compared to the destruction caused by the Loma-Prieta earthquake this is a minor event, but even 2 years later half of Spencer's residents had yet to return (Cross 2001; Paul 2005). Topeka, Kansas suffered a discernible loss of population after the tornado of 1966, but this loss was only temporary, lasting less than 2 years; the vast majority of people who moved out of the central area of the city relocated to the city's fringes and outer wards (Friesema 1979). Evidence about the permanent

effects of the tornado on Topeka's population, however scant, is more than is generally found for disasters affecting the United States, large or small. Rather, what we learn is the number of temporary evacuees, not whether and when they returned and how they lived their lives in the meantime. What we are learning about the victims of Katrina, because of the scale of the problem and the blunders involved, is new, but also heartbreaking if it reflects what has happened elsewhere.

The lack of attention to the long-term population effects of natural disasters is perhaps best illustrated by the *Quick Response Reports* published by the Natural Hazards Research and Application Information Center, which by their very nature do not deal with longer-term impacts. This is problematic because short-term evacuation from a devastated area is not a reliable indication of longer-term migration patterns. Field work conducted after a tornado devastated the residential areas of Hoisington, Kansas in 2001 showed that out-migration was only temporary and to nearby communities, while a study completed 1 year later revealed that 70 families had left this town of about 3,000 people because of the tornado (Paul 2005).

How many? How often? What impact?

The vividness with which the public and the academic community recall these great calamities of the U.S. is a sign of their significance, yet also a sign of their frequency: they just do not happen very often. Needless to say, these are not the only notable events that have had major demographic consequences. To them, we would surely add the Galveston Hurricane of 1900 (Larson 1999; Weems 1989) and the 1927 Mississippi flood (Barry 1997), even though there are few systematic research results that can inform us about migration.

The conclusion we draw is that environmental calamities are rare but dramatic and powerful: by causing the large-scale destruction of homes and places of work, they lead to massive movements of people, disproportionately affecting the poor and the powerless, many of them members of racial and ethnic minority groups. Although communities rebuild, evidence from San Francisco and Galveston (and perhaps eventually New Orleans) suggests that both destruction and migration diminish the urban trajectory: none of these cities will be as powerful in their region as they might otherwise have been.

Environmental hardship and short-term environmental benefits

The effects of environmental forces on living conditions are not always immediate or abrupt. Potentially more important than flood, hurricane, tornado, or earthquake, changes in climate conditions over longer periods of time have shaped the extent and routes of migration for Americans over the past centuries, as climate change in an agrarian landscape has the potential to erode or enhance chances of earning a living in agriculture. Drought is the obvious factor to mention here, especially if measured at the decadal scale: populations move in response to a number of sequential years of drought over a 5- or 10-year period and, conversely, 5- or 10-year spans of relatively high precipitation and relatively low heat can produce

unsustainable in-migration, inevitably counteracted later. Most of the literature about drought focuses on regions outside the United States, where researchers have learned a great deal about the demographic and social impacts of drought (Adamo 2009; Ezra and Kiros 2001; Findley 1994; McLeman 2006; Warrick 1983).

If calamities provide the most dramatic moments in the history of migration and environment, environmental hardship has produced the most sustained discussion. The drought of the 1930s, centered on the experience that is often called the "Dust Bowl," is most prominent in this discussion, but similar events can be found in other agricultural settings over the span of U.S. history. The human consequences of the 1930s drought were noted quickly in the press and described strikingly by Steinbeck in *The Grapes of Wrath* (1939). As Egan's (2006) book demonstrates, they continue to draw attention years later. Environmental hardship diminishes the ability to farm and, without income or food from the land, some members of the population move. The theory and the story are as old as *Genesis*.

Research abounds on the causes of the drought of the 1930s and on the migratory response to that drought. The dual linkage is necessary for our discussion, as a number of authors have asserted that in-migration, settlement, and agricultural exploitation were the essential causes of the disaster of the 1930s (see in particular Worster (1979), as well as Egan (2006) Sherow (2007), and Gutmann and Cunfer (1999)). Together with our colleague Geoff Cunfer, we have acknowledged that the environment puts strong limitations on the actions of humans in the Great Plains (Cunfer 2005; Gutmann et al. 2005b), but this conclusion also suggests that the link between human settlement activities in the Plains and the dust storms of the 1930s is probably weaker than Worster and others have suggested (Cunfer 2005; Gutmann and Cunfer 1999; Hewes 1965; Hewes and Schmiedling 1956). Nonetheless, even if dust storms were not caused by in-migration, and were not themselves the major cause of crop failure, it is still possible to argue that a combination of drought and economic depression led to a deterioration of the agricultural economy.

The demographic impact of the drought and depression should not be taken for granted. James Gregory (1989) has shown the complexity of the subject, a theme McLeman (2006) has further developed. It is not at all clear that the most out-migration came from the areas hardest hit environmentally, at least as seen from the perspective of Gregory's California Okies. Gutmann and colleagues measure the correlates of migration out of the counties of the Great Plains over the six decades from the 1930s to the 1980s (Gutmann et al. 2005a), demonstrating that migration in the earlier and later parts of this period responded to different environmental factors. From the 1930s to at least the 1950s, when the region's population and economy was still overwhelmingly agricultural, precipitation and temperature had measurable effects. During the second period, as we will mention again later, environmental impacts operate mostly for those counties with proximity to recreational amenities, especially lakes and mountains.

Gutmann et al (2005a) show that during the first population-environment regime, the impact of precipitation and temperature on migration operates over the whole region, not just the areas of the greatest dust storms, and it operates with some level of symmetry: drought (low precipitation and high temperatures) provoked out-migration, while its opposite (high precipitation and lower temperatures) provoked

in-migration. The fact that good climatic and environmental conditions attracted people as much as bad conditions drove them away is an important but under-emphasized factor in the relationship between migration and environment in U.S. history, despite an extensive literature (Graves and Knapp 1989; Gutmann et al. 2005a; Jobes 1992; Jobes et al. 1992a; Svart 1976; Ullman 1954). From the end of the civil war into the 1880s, the relatively rich grassland conditions attracted ranchers and cattle to the Great Plains, where they later experienced disaster with the drought of the mid-1880s. The subsequent decline of people and livestock was substantial enough that by the time of the next droughts in the 1910s and 1930s, few remembered the severity of the earlier drought. Good news had traveled as quickly as and more readily than bad news, and settlers were happy to forget the drought and benefit from excellent growing conditions (Warrick 1983).

The population of the Great Plains was vulnerable to environmentally induced economic change because of the region's combination of dependence on agriculture and relatively low precipitation, but this pattern is not unique. Other areas, such as those in earthquake-prone regions, those along the coasts, and those with temperature extremes (hot or cold) have been similarly vulnerable to environmental shocks. The implications of the environmentally driven migration experienced by the Plains as a result of hardship and its obverse are therefore great. We have not tried here to estimate the scale of that migration, but we would suggest that it was substantial, encompassing ebbs and flows that exceeded those associated with all but the most dramatic calamities: Galveston, San Francisco, New Orleans (but probably not Andrew or the 1927 Mississippi flood). Finally, the symmetricality of the response suggests that we need to be as sensitive to good weather leading to in-migration as we are to bad weather leading to out-migration.

Environmental amenities

The second era of environmental influence on migration in the Great Plains region noted by Gutmann et al. (2005a) is characterized by the role played by environmental amenities. This is no surprise. Students of migration and population distribution have known for a long time that social and environmental amenities affect how people choose the places they live. Some places are more fun than others to live in, and people migrate to places that have certain attractive qualities—temperature, proximity to water or mountains, etc. Conversely, some places are unpleasant to live in, for esthetic reasons or for environmental reasons related to health, including proximity to waste dumps and other toxic activities (Hunter 1998, 2000, 2005). These relationships have spurred the creation of a larger and more diverse literature on migration and environmental amenities than exists for any aspect of natural disasters and migration.

The relatively recent literature on environmental amenities builds on a considerably older body of work (much of it drawn from population geography and the sub-field of sociology called human ecology) that looked for the factors that drove migration to one city or region over another. Findings in this field emphasized that in addition to economic factors, various kinds of amenities attracted population

(Frisbie and Poston 1978; Jobes et al. 1992b; Svart 1976; Ullman 1954). More recent scholarship has demonstrated the importance of recreational amenities—themselves largely environmental—as an influence on overall patterns of migration (Cromartie 1998; Johnson 2003; Johnson and Beale 2002; Johnson and Fuguitt 2000; Johnson and Rathge 2006).

In addition to the demographic and human ecology literature about amenities, a substantial economics literature compares the relative importance of economic opportunities (the human capital theory of migration) to that of amenities, both natural/environmental and human built (the consumption theory of migration), as determinants of migration decisions. Simply put, authors question whether jobs or amenities drive migration decisions (Greenwood and Hunt 1989), ultimately finding evidence for both (Berger and Blomquist 1992; Cushing 2004). This apparent agreement has not hindered the flow of research, even if those who support the consumption theory of migration agree that the pull of amenities drives long-term migration patterns, while economic opportunities theory captures short-term fluctuations in the long-term patterns (Cushing, 2004). This discussion also recognizes a difference between amenities that attract households compared to those that attract firms. Using indicators like Quality of Life (the amount in real wages workers are willing to forgo for the opportunity to locate to a specific site) and Quality of Business Environment (the amount of additional input costs an employer is willing to incur for the opportunity to locate a worker at that site), economists argue that whereas households generally prefer non-metropolitan areas and cities in warm, coastal areas, firms generally prefer large, growing cities (Chen and Rosenthal 2008). However these debates are concluded, there is clear evidence that people move to be near certain locations, whether those locations are coastal (Rappaport and Sachs 2003), or more generally attractive, as Rappaport (2007) writes in an aptly-titled article, "Moving to nice weather."

Americans are obviously mobile, but why they move and at which point in the life cycle is a subject for research (according to the 2000 census, 45.9% of US residents moved at least once between 1995 and 2000, with 45.7% of these moving out of their original counties). Chen and Rosenthal (2008) argue that when you examine the migration decisions of individuals between 1995 and 2000, what is clear is that between the ages of 20 and 35, regardless of marital status, highly educated households move to places with high quality business environments. After age 55, regardless of education, married couples move away from places with favorable business environments towards places with highly valued bundles of consumer amenities. In contrast, a number of studies of the rural west demonstrate not only that the vast majority of recent migrants cite natural amenities as the single most important factor in their decision to migrate, but that migrants to these areas are much more likely to be young, educated professionals than retirees (Filkins et al. 1998; Rudzitis 1998).

If calamities, drought, and hardship lead to out-migration, environmental amenities generally lead to in-migration (although on balance the lack of amenities or the presence of disamenities may lead to out-migration). After more than a century in which the influence of environment on migration acted largely through agriculture and other economically motivated factors, in the last 50 years, there is

evidence of an increasing role for environmental amenities: people move to places better suited to recreation. Despite the attention to amenities as a driver of migration, however, the economics literature is notably silent on the question of what turns a characteristic of a place into an amenity or how features considered to be amenities and disamenities have changed (or reversed themselves) over time. Econometric analyses treat amenities as the residual term, such that any migration unaccounted for by the standard human capital variables is described as an amenity or disamenity, and an amenity is both defined and measured by the extent to which its effect on migration tilts the equilibrium between wages and costs (Graves et al. 1999; Treyz et al. 1993). For this reason, it is very difficult to disentangle these forces from larger economic and social factors that include a growing older population, an increase in post-retirement income, greater emphasis in the population at large on recreation, and a host of others. Recent work by Rappaport and Sachs (2003) and by Rappaport (2007) show the strong influence of amenities, including weather, but also the complexity of those amenities as causes of population change. The growth of population in coastal and mountainous regions, coupled with the growth of second and retirement homes, is tied to environmental conditions.

Environmental barriers and environmental management

In *The Great Plains* (1931), Webb colorfully describes would-be settlers stymied east of the 98th parallel until they learned to farm the semi-arid landscape and obtain lumber with which to build homes on the treeless expanse. The aridity and lack of local timber slowed in-migration until technology provided solutions to these barriers. This example is one way to start thinking about environmental barriers and their management, the last of our four themes. While the popular discussion of environmental calamities and climate changes (even if only on a decadal scale) have attracted a great deal of attention, it is valuable to remember that environment has played another role in driving or preventing population movement.

For most of human history, environmental conditions (heat, cold, humidity, aridity) made it difficult for people to live in some places. One big accomplishment of the twentieth century in the U.S. has been the advent of environmental management. Although such technologies originated in the Dutch polders and other drainage schemes, today environmental management means heat, air conditioning, flood control, drainage, and irrigation, all of which have allowed the migration of people into areas that were previously only sparsely populated. Some of these solutions, like those that allowed farmers to penetrate the Great Plains and make use of the waters of the Ogallala aquifer, have not required massive public investment in infrastructure (Opie 2000), while large-scale water management and power projects in Florida and the west have called for stupendous expenditures (Pisani 1992, 2002). Drainage, water management, and the provision of power for air conditioning have operated separately in some regions and together in others (metropolitan Phoenix is an example of the latter), but together or separately these kinds of environmental management have facilitated massive movements of population in the U.S. over the past century.

Environmental management has been the most important environmental cause of migration in U.S. history. It has spurred the dramatic growth of some of the sunbelt states, leading to massive population increase in Florida, Texas, Arizona, Georgia, Nevada, and New Mexico, and contributing to growth in southern California and Colorado (Lang and Rengert 2001). Places that had previously been unsuitable for dense habitation were the most rapidly growing areas in the United States in the 50 years preceding 2000 (Arsenault 1984; Biddle 2008; Holmes 1998). Without these kinds of environmental management, the demographic shape of the U.S., and the migration experience of its inhabitants, would have been different. Rappaport (2007) show that the story is considerably more complex than just the role of air conditioning as a factor that led to population growth. People have moved to places that require air conditioning for comfort, but also those that require heating for comfort. Put another way, people move to nice weather (Rappaport 2007), but the definition of nice weather is evolving, only partly because of new technologies. Despite the considerable research in these areas, most of the results have been estimates of the relative influence of different factors, and not aggregate estimates of how much population has moved because of each. While the difference may seem insignificant, it is only with those explicit estimates that we can compare the impact of different kinds of environmental factors on population change.

The importance of environmental management is especially critical if we connect this theme back to the environmental disasters discussed earlier. Environmental management has made it possible for large populations to develop in coastal areas, where hurricanes and a significant number of earthquakes have had their strongest impact. Population growth in such places as New Orleans and South Florida was facilitated by the management of previous environmental barriers, but the societies created in these places are now rendered vulnerable to environmental disaster by the large number of people who live there. The potential for environmental migration in these places is shaped by a confluence of these two themes: the management of environmental barriers produces slow but voluminous growth, while the collapse of human control in the face of disaster can produce sudden and dramatic, though potentially only short-term, population loss. When these factors combine with high levels of poverty and large social differences, the impact can nonetheless be dramatic and long-lasting.

Looking to the future while understanding the past

Our schema of the factors that have linked migration and environment in the past and present (see Table 1) is certainly relevant to the future, but that relevance is limited. Given how much change has occurred in the last century, more change is certain. All of the factors we have discussed thus far have antecedents far in the past, but the effects of environmental amenities and environmental management have been much greater in recent decades than earlier. Given recent trajectories, this development is likely to accelerate, reflecting the growth and technological sophistication of the American economy, which has made it possible to engineer

Table 1 A schema for the impact of environment on migration

Category	Examples	Time scale	Volume of migration
Environmental calamities	Floods, hurricanes, earthquakes, tornadoes	Minutes or days	Thousands to millions, structured by access to resources
Environmental hardships and short-term benefits	Drought or periods of good weather	Decades	Agriculturally dependent populations
Environmental amenities	Mountains, lakes, etc.	Consistently since about the 1950s	Mobile populations, particularly young people and retirees, increasing as the environment becomes a consumer good rather than a source of livelihood
Environmental barriers and their management	Heat, air conditioning, drainage, flood control, irrigation	Consistently over human history, but more rapidly in periods of great technological advance	Entire societies

massive projects that allow people to live in new areas while giving the residents of the U.S. the resources to afford to do so.

Energy costs and climate change are two reasons why the future is likely to differ from the past. Virtually all managed environments require massive amounts of energy, whether to provide household water or agricultural irrigation in arid climates, power to pump water out of dykes and polders in wet locations, air conditioning in hot and humid places, or fuel to power cars and trucks. As energy costs rise and liquid petroleum-based fuel becomes less available, the impact of environmental forces is likely to be substantial. Managed environments may shrink, and their ability to recover from hurricanes and earthquakes will diminish. Climate change is also likely to have a major impact, as a large and relatively new literature shows (Adamo 2009; Barnett and Adger 2003; Hugo 1996; McLeman and Smit 2006; Meze-Hausken 2000; Moore and Smith 1995; Reuveny 2007). Virtually all scientific studies conclude that global warming will raise sea levels (Bindoff et al. 2007), increasing the cost of managed environments and the risk of flooding from hurricanes and other storms. Taken together, these two likely future outcomes (energy costs and climate change) will heighten the likelihood of environmental events spurring short- and long-term migration, while they simultaneously reduce the amount of migration driven by amenities and managed environments.

This article has emphasized environmental factors that shape where people can and cannot live, and the events that drive decisions to move. While we stress natural disasters like Katrina, we try to go well beyond such calamities to include other environmental influences that have led to migration in the past and are certain to lead to migration in the future. Although we did not say so in the introduction, this article has suggested a gradually increasing role of these four factors, with dramatic

environmental calamities the most talked about but the least significant numerically, environmental hardship somewhat more important, amenities significant for the past 50 years, and environmental management strikingly important. Without drainage, irrigation, and air conditioning, the growth of Florida, Georgia, Texas, Arizona, Nevada, and even California and Colorado, could hardly have taken place.

Without detracting from the calamitous character of natural disasters, we have suggested that the most dramatic episodes of environmentally driven migration are far from the most significant in terms of the scale of population change. Our evidence demonstrates larger-scale but more gradual movements of population in response to longer-term climatic fluctuations, the changing relationship between land and livelihood, and the development of technology that has made previously inhospitable places amenable to large-scale settlement. We have also suggested that the effects of natural disasters are not entirely natural, as they are shaped both by human response, often structured along underlying racial/ethnic and socioeconomic inequalities, and by previous environmental management schemes that allowed populations to develop in vulnerable areas. While Katrina fits in these patterns, the combination of several factors at the moment of a single natural disaster is what makes it worth continued study—and makes this effort to put it in context have value.

Our goal is to use this set of assertions—both about categories and scale—to spur discussion about ways to develop and test our propositions. For our part, it is clear that an effort to quantify the scale of migration associated with each of these factors would be extremely valuable. The simple categories and assertions in Table 1 deserve more concrete estimates of their timing and extent, so that we know how much population migrated under each circumstance, how far, and whether and when the population was reconstituted. Fulfilling that research agenda would further enhance our understanding of the impact of Katrina.

Acknowledgment This research was supported by grant R01 HD33554 from the National Institute of Child Health and Human Development. An earlier version was presented at "The Moving Americans Conference: Interdisciplinary Conversations on Internal Migration," held at the University of Washington, Seattle, in May, 2006. We are grateful for advice from the other participants, the issue editors and the reviewers, and for the assistance of Emily Merchant.

References

Adamo, S. B. (2009). Environmentally induced population displacements. *International Human Dimensions Programme on Global Environmental Change Update, 1/09*, 13–21.

Arsenault, R. (1984). The end of the long hot summer: The air conditioner and Southern Culture. *The Journal of Southern History, 50*(4), 597–628.

Barnett, J., & Adger, W. N. (2003). Climate dangers and atoll countries. *Climatic Change, 61*, 321–337.

Barry, J. M. (1997). *Rising tide: The great Mississippi flood of 1927 and how it changed America*. New York: Simon and Schuster.

Berger, M. C., & Blomquist, G. C. (1992). Mobility and destination in migration decisions: The roles of earnings, quality of life, and housing prices. *Journal of Housing Economics, 2*, 37–59.

Biddle, J. (2008). Explaining the spread of residential air conditioning, 1955–1980. *Explorations in Economic History, 45*, 402–423.

Bindoff, N. L., Willebrand, J., Artale, V., Cazenave, A., Gregory, J., & Gulev, S. (2007). Observations: Oceanic climate change and sea level. In S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, H. L. Miller, et al. (Eds.), *Climate change 2007: The physical science basis.*

Contribution of working group I to the fourth assessment of the intergovernmental panel on climate change. Cambridge: Cambridge University Press.
Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (1994). *At risk: Natural hazards, people's vulnerability, and disasters*. London: Routledge.
Brookings Institution. (2008). The New Orleans index. Tracking the recovery of New Orleans & the metro Area. Retrieved November 14, 2008, from http://gnocdc.s3.amazonaws.com/NOLAIndex/NewOrleansIndexAug08.pdf.
Burton, I., Kates, R. W., & White, G. F. (1993). *The environment as hazard* (2nd ed.). New York: Guilford Press.
Chen, Y., & Rosenthal, S. S. (2008). Local amenities and life cycle migration: Do people move for jobs or fun? *Journal of Urban Economics, 64*, 519–537.
Cromartie, J. B. (1998). Net migration in the Great Plains increasingly linked to natural amenities and suburbanization. *Rural Development Perspectives, 13*(1), 27–34.
Cross, J. A. (2001). Megacities and small towns: Different perspectives on hazard vulnerability. *Environmental Hazards, 3*, 63–80.
Cunfer, G. (2005). *On the Great Plains: Agriculture and environment*. College Station: Texas A&M University Press.
Cushing, B. (2004). *Location-specific amenities, equilibrium, and constraints on location choices*. Paper presented at the 43rd annual meeting of the Southern Regional Science Association. Retrieved from http://www.rri.wvu.edu/pdffiles/cushing2004-11.pdf.
Egan, T. (2006). *The worst hard time: The untold story of those who survived the great American dust bowl*. Boston: Houghton Mifflin Company.
Ezra, M., & Kiros, G. (2001). Rural out-migration in the drought-prone areas of Ethiopia: A multilevel analysis. *International Migration Review, 35*, 749–771.
Filkins, R., Allen, J. C., & Cordes, S. (1998). *Leaving the good life: Predicting migration intentions of rural Nebraskans*. Paper presented at the Midwest Association for public opinion research annual conference. Retrieved from http://digitalcommons.unl.edu/caripubs/49.
Findley, S. E. (1994). Does drought increase migration? A study of migration from rural Mali during the 1983–85 drought. *International Migration Review, 28*(3), 539–553.
Friesema, H. P. (Ed.). (1979). *Aftermath: Communities after natural disasters*. Beverly Hills: Sage Publications.
Frisbie, W. P., & Poston, D. L. (1978). *Sustenance organization and migration in non-metropolitan America*. Iowa City: University of Iowa Press.
Graves, P. E., & Knapp, T. A. (1989). On the role of amenities in models of migration and regional development. *Journal of Regional Science, 29*, 71–87.
Graves, P. E., Sexton, R. L., & Arthur, M. M. (1999). Amenities and fringe benefits: Omitted variable bias. *American Journal of Economics and Sociology, 58*(3), 399–404.
Greater New Orleans Community Data Center. (2009). *The New Orleans index*, August 2009. Retrieved August 16, 2009, from http://www.gnocdc.org/NewOrleansIndex/index.html.
Greenwood, M. J., & Hunt, G. L. (1989). Jobs versus amenities in the analysis of metropolitan migration. *Journal of Urban Economics, 25*, 1–16.
Gregory, J. N. (1989). *American exodus: The dust bowl migration and Okie culture in California*. New York: Oxford University Press.
Gutmann, M. P., & Cunfer, G. (1999). *A new look at the causes of the dust bowl*. Lubbock: The International Center for Arid and Semiarid Land Studies, Texas Tech University.
Gutmann, M. P., Deane, G. D., Lauster, N., & Peri, A. (2005a). Two population-environment regimes in the Great Plains of the United States, 1930–1990. *Population and Environment, 27*(2), 191–225.
Gutmann, M. P., Parton, W. J., Cunfer, G., & Burke, I. C. (2005b). Population and environment in the U.S. Great Plains. In B. Entwisle & P. Stern (Eds.), *Population, land use, and environment: Research directions* (pp. 84–105). Washington, DC: National Research Council.
Haas, J. E., Trainer, P. B., Bowden, M. J., & Bolin, R. (1977). Reconstruction issues in perspective. In E. J. Haas, R. W. Kates, & M. J. Bowden (Eds.), *Reconstruction following disaster* (pp. 25–68). Cambridge: MIT Press.
Henderson, A. (2005). *Reconstructing home: Gender, disaster relief, and social life after the San Francisco earthquake and fire, 1906–1915*. Stanford: Stanford University.
Henderson, A. (2006). The human geography of catastrophe: Family bonds, community ties, and disaster relief after the 1906 San Francisco earthquake and fire. *Southern California Quarterly, 88*(1), 37–70.

Hewes, L. (1965). Causes of wheat failure in the dry farming region, Central Great Plains, 1939–1957. *Economic Geography, 41*, 313–330.
Hewes, L., & Schmiedling, A. C. (1956). Risk in the Central Great Plains: Geographical patterns of wheat failure in Nebraska, 1931–1952. *Geographical Review, 46*, 375–387.
Hewitt, K. (Ed.). (1983). *Interpretations of calamity from the viewpoint of human ecology*. Boston: Allen and Unwin.
Hoag, E. (1995). *The effect of the Loma Prieta earthquake on California migration*. Paper presented at the annual meeting of the Population Association of America.
Holmes, T. J. (1998). The effect of state policies on the location of manufacturing: Evidence from state borders. *Journal of Political Economy, 106*(4), 667–705.
Hugo, G. (1996). Environmental concerns and international migration. *International Migration Review, 30*(1), 105–131.
Hunter, L. M. (1998). The association between environmental risk and U.S. internal migration flows. *Population and Environment, 19*, 247–277.
Hunter, L. M. (2000). The spatial association between U.S. migrant residential concentration and environmental hazards. *International Migration Review, 34*, 460–488.
Hunter, L. M. (2005). Migration and environmental hazards. *Population and Environment, 26*, 273–302.
Jobes, P. C. (1992). Economic quality of life decisions in migration to a high natural amenity area. In P. C. Jobes, W. F. Stinner, & J. M. Wardwell (Eds.), *Community, society, and migration: Noneconomic migration in America* (pp. 335–362). Lanham, MD: University Press of America.
Jobes, P. C., Stinner, W. F., & Wardwell, J. M. (1992a). A paradigm shift in migration explanation. In P. C. Jobes, W. F. Stinner, & J. M. Wardwell (Eds.), *Community, society, and migration: Noneconomic migration in America* (pp. 1–32). Lanham, MD: University Press of America.
Jobes, P. C., Stinner, W. F., & Wardwell, J. M. (Eds.). (1992b). *Community, society, and migration: Noneconomic migration in America*. Lanham: University Press of America.
Johnson, K. M. (2003). Unpredictable directions of population growth and migration. In D. L. Brown & L. E. Swanson (Eds.), *Challenges for rural America in the twenty-first century* (pp. 19–31). University Park: Pennsylvania State University Press.
Johnson, K. M., & Beale, C. L. (2002). Nonmetro recreation counties: Their identification and rapid growth. *Rural America, 17*(4), 12–19.
Johnson, K. M., & Fuguitt, G. V. (2000). Continuity and change in rural migration patterns, 1950–1995. *Rural Sociology, 65*, 27–49.
Johnson, K. M., & Rathge, R. W. (2006). Agriculture dependence and changing population in the Great Plains. In W. Kandel & D. L. Brown (Eds.), *Population change and rural society* (pp. 197–217). Dordrecht: Springer.
Kich, M. (2006). Those who overstate the lessons of the past are condemned to draw erroneous conclusions. *Space and Culture, 9*(1), 38–40.
Lang, R. E., & Rengert, K. M. (2001). *The hot and cold sunbelts: Comparing state growth rates, 1950–2000*. Fannie Mae Foundation Census Note 02 (April).
Larson, E. (1999). *Isaac's storm: A man, a time, and the deadliest hurricane in history*. New York: Crown Books.
McKinley, J. C., & Urbina, I. (2008, September 13, 2008). Huge storm slams into coast of Texas. *The New York Times*, p. A1. Retrieved November 14, 2008, from http://www.nytimes.com/2008/09/13/us/13ike.html?partner=permalink&exprod=permalink.
McLeman, R. (2006). Migration out of 1930s rural eastern Oklahoma: Insights for climate change research. *Great Plains Quarterly, 26*(1), 27–40.
McLeman, R., & Smit, B. (2006). Migration as an adaptation to climate change. *Climatic Change, 76*, 31–53.
Meze-Hausken, E. (2000). Migration caused by climate change: How vulnerable are people in dryland areas? A case-study in northern Ethiopia. *Migration and Adaptation Strategies for Global Change, 5*, 379–406.
Moore, E. J., & Smith, J. W. (1995). Climatic change and migration from Oceania: Implications for Australia, New Zealand, and the United States of America. *Population and Environment, 17*(2), 105–122.
Nossiter, A. (2008, September 1, 2008). 2 Million flee storm; G.O.P. cuts back. *The New York Times,* p. 1, Retrieved from http://www.nytimes.com/2008/09/01/us/01gustav.html?partner=permalink&exprod=permalink.

Oliver-Smith, A. (2005). *Disasters and forced migration in the 21st century*. Paper presented at the understanding Katrina: Perspectives from the social sciences. Retrieved from http://understandingkatrina.ssrc.org.

Opie, J. (2000). *Ogallala: Water for a dry land* (2nd ed.). Lincoln: University of Nebraska Press.

Pais, J. F., & Elliot, J. R. (2008). Places as recovery machines: Vulnerability and neighborhood change after major hurricanes. *Social Forces, 86*(4), 1415–1453.

Paul, B. K. (2005). Evidence against disaster-induced migration: The 2004 Tornado in north-central Bangladesh. *Disasters, 29*, 370–385.

Pisani, D. J. (1992). *To reclaim a divided west: water, law, and public policy, 1848–1902*. Albuquerque: University of New Mexico Press.

Pisani, D. J. (2002). *Water and American government: The Reclamation Bureau, national water policy, and the West, 1902–1935*. Berkeley: University of California Press.

Rappaport, J. (2007). Moving to nice weather. *Regional Science and Urban Economics, 37*(3), 375–398.

Rappaport, J., & Sachs, J. D. (2003). The United States as a coastal nation. *Journal of Economic Growth, 8*(1), 5–46.

Reuveny, R. (2007). Climate change-induced migration and violent conflict. *Political Geography, 26*, 656–673.

Rivlin, G. (2006, April 16). In post-quake San Francisco, lessons for New Orleans after the flood. *The New York Times*, C6.

Rudzitis, G. (1998). Amenities increasingly draw people to the rural west. *Rural Development Perspectives, 14*(2), 9–13.

Schwartz, R. (2006). *Earthquake exodus, 1906: Berkeley responds to the San Francisco refugees*. Berkeley: RSB Books.

Sherow, J. E. (2007). *The Grasslands of the United States: An environmental history*. Santa Barbara: ABC-CLIO.

Smith, S. K., & McCarty, C. (1996). Demographic effects of natural disasters: A case study of hurricane Andrew. *Demography, 33*, 265–275.

Solecki, W. D. (1999). Environmental hazards and interest group coalitions: Metropolitan Miami after hurricane Andrew. In J. K. Mitchell (Ed.), *Crucibles of hazard: Mega-cities and disasters in transition*. New York: United Nations University Press.

Steinbeck, J. (1939). *The grapes of wrath*. New York: Viking.

Steinberg, T. (2000). *Acts of god: The unnatural history of natural disaster in America*. New York: Oxford University Press.

Steinberg, T. (2001). The secret history of natural disaster. *Environmental Hazards, 3*, 31–35.

Svart, L. M. (1976). Environmental preference migration: A review. *Geographical Review, 66*, 314–330.

Treyz, G. I., Rickman, D. S., Hunt, G. L., & Greenwood, M. J. (1993). The dynamics of U.S. internal migration. *Review of Economics and Statistics, 75*(2), 209–214.

Ullman, E. L. (1954). Amenities as a factor in regional growth. *Geographical Review, 44*(1), 119–132.

Warrick, R. A. (1983). Drought in the U.S. Great Plains: Shifting social consequences? In K. Hewitt (Ed.), *Interpretations of calamity from the viewpoint of human ecology* (pp. 67–82). Boston: Allen and Unwin.

Webb, W. P. (1931). *The Great Plains*. New York: Grosset and Dunlap.

Weems, J. E. (1989). *A weekend in September*. College Station: Texas A&M University Press.

Worster, D. E. (1979). *Dust bowl: The southern plains in the 1930s*. Oxford: Oxford University Press.