METROPOLITAN MASS MIGRATION:

REPERCUSSIONS FROM THE LOSS OF COASTAL CITIES

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As of 2003, approximately 80 percent of the United States' population was projected to be located in cities within 100 miles of coastlines. If the Global Warming hypotheses are confirmed by further warming of the ice caps, and with attendant inland drought, sea levels may rise to the point that coastal areas will become unlivable by today's standards. When public infrastructure is incapable of further supporting the coastal cities, the author proposes that mass migrations may occur inland. This historical journey will be directed towards communities with dwindling resources to support the new migrants. If food supplies are also interrupted, due to increasingly volatile and unreliable weather patterns, the movement of new populations may lead to societal instabilities and cultural chaos. Disaster planning is needed now to prepare for this transition process in order to reduce the likely impacts of a mass exodus.

Introduction

The emergency management community is responsible for the actions to protect the public health and safety from disasters, through the actions of emergency planning, preparedness, response and recovery coordination, and mitigation. Until very recently, few in that community of planners believed or paid attention to the issues described in the scientific community as being related to Global Warming. This planning group's mindset has persisted even in the face of recent droughts, record breaking heat and cold, great hurricanes, gigantic forest fires, massive floods, and devastating winter storms along the West Coast that were driven by the forces of El Niño.

Emergency management is slow to move in a new direction, as illustrated in the recent difficult process of integrating terrorism into the national planning base. The emergency planning community, and the elected officials they support, must now act quickly to develop long-term planning strategies for the impacts of a far different future climate. A future without these strategies will lead to immense tragedies and immeasurable suffering.

Background

The discussions of Global Warming in the 1980's and 1990's focused on climatic impacts primarily caused by human releases of carbon compounds, fluorocarbons, and reductions of forested leading to desertification. The turn of the Century revealed more concerns about automobile emissions, soil degradation, and long-term warming and cooling cycles caused by climatic instabilities. Some climatologists began to evaluate the human activities as minor

compared to natural cycles that occurred regularly through the Earth's geological history. This was supported through a compilation of data from geological strata, tree ring analysis, and ice core research from the Antarctic (Alley, 200) (Mayewski and White, 2002). Ideas once thought unsubstantiated, such as "snowball Earth," began to take shape as realistic scenarios (Walker, 2003). Full equatorial coverage is no longer a fringe discussion. There is now clear evidence that glaciation has reached the equator perhaps several times in Earth's past, based on deposits left in the equatorial zones throughout the world. Many theorists previously described this as a long-term process, until recently (U.S. National Academy of Sciences, 2002). Several Global Warming investigators now propose that a "snap" process could occur in as little as two decades, once climatic instability reaches a crisis point **(**Gagosian, 2002).

> **"Fossil evidence clearly demonstrates that Earth's climate can shift gears *within a decade*, establishing new and different patterns that can persist for decades to centuries. In addition, these climate shifts do not necessarily have universal, global effects. They can generate a counterintuitive scenario: Even as the earth as a whole continues to warm gradually, large regions may experience a precipitous and disruptive shift into colder climates."**

If the Earth's environment is indeed in a period of instability just prior to a rapid onset of dramatic change, humanity could be facing a serious crisis in its continuity of government, society, and even survival systems before the year 2020. If even half of the worst-case scenarios are occurring at an advance rate then careful surveillance of catastrophic indicators is of the utmost importance. Projects such as the ARGO array (which provides live measurements of salinity and temperatures of the upper 2000 meters of the oceans) and the World Ocean

Circulation Experiment (WOCE) (which measures ocean currents) may be critical to providing triggers that driver political policy and will. These triggers would be clear warnings that mass migration from coastal and northern latitude cities was inevitable.

Federal mass migration policies exist for the legal movement of political refugees and illegal entry of aliens entering the United States. There are also policies for emergency reentry of large numbers of repatriated Americans from unstable foreign nations. However, no policy is in place for mass migrations of existing populations within the continental United States, nor for large-scale movements of immigrants from Canada into the United States, should Canadians have to move south away from a new ice age. Current evacuation schemes for natural and man-made disaster address short-term dislocation, not permanent relocation.

Discussion

The history of the Americas was forged in the traumas of mass migrations. The initial movement of native populations across the frozen wastes of the Bering Straits is well established. But since then there have been wave after wave of humans moving to and over the land. All of these migrations involved development along and near water, especially coastal areas. Notable highlights in human resettlement include the arrival of the Viking and others, even before the Spanish conquerors came to the New World. They would be followed by the wave of European pioneers. These included Colonial developments, movement into the Ohio and Mississippi Valleys (Lowery, 2000), the slave trade, the Gold Rush of 1849 in conjunction with the Diaspora of the Irish from the potato famines, and the pioneer trails through the West

from the Conestoga Wagons to the railroads. Each movement left its scars on the face of the land and upon the indigenous peoples: the American Indians.

The migrations did not stop in the 1800s. The great depressions in Europe packed the U.S. cities with immigrants at the turn of the 20th century, causing severe urban pressures. The 1930's saw the great migration to California of the failed farmers of the "Dust Bowl," as chronicled in "The Grapes of Wrath," by John Steinbeck. In this case the migrating masses were terribly mistreated, only to become some of the wealthiest landowners and farmers in California.

The 1950s saw further urbanization in North America. This urbanization was followed by a flight from cities to surrounding suburbs in the 1960s and 1970s, until urban sprawl made travel in and around urban centers an increasing daily burden. In the late 1990s suburbanites migrated further out from the suburbs and revitalized outlying rural areas. This was facilitated by the use of technology to allow electronic remote workers in the "Third Wave" of telework. At the same time, a huge influx of illegal aliens began to enter the U.S. cities in alarming numbers from around the world. All of these new ebbs and flows of urban populations are particularly relevant in evaluating the cultural impacts of the relocations to come, should a new global winter manifest in the next thirty years.

Challenges Caused by Poor Planning

Future events typically involve a series of levels of severity from A to C. A-level events are based on projections that little or nothing will change in the foreseeable future, which will

allow for progressive and measured change without great disruption. In actuality, this has rarely happened based on the history of natural disasters and political upheaval. This perspective, however, does allow local and state governments to address the most immediate daily emergencies, while maintaining a myopic view of larger potential events in a distant future.

Type B-level events are very intense events, with a few being serious enough to cause major disruptions of the status quo. However, planners addressing B events believe it is possible to recover, even after expensive and painful losses. This pragmatic approach assumes that consistent recoveries are the standard outcome of their planning. Planning for C-level events may be considered relevant and important, but most C events are considered beyond any of the government schemes for addressing crisis.

Type C events are typically worst case, with some being catastrophic, resulting in massive loss of life. C-level event planners are open to exploring threats that could exterminate humanity. Doomsday projections are considered as valid projections as day-to-day emergencies. In the worst-case scenarios, no amount of planning will succeed because the events will be far beyond any government or government's capacities. These are situations with minimal survivability, which would require extraordinary decision-making.

There should be little confidence placed in single-level planning. The most likely serious climatic events should fall into the B area. However, this discussion will address A, B, and C event preparations. This paper also describes the possible impacts due to lack of preparations for

coastal cities and northern latitude cities in the United States should there be a dramatic climatic shift.

The A-level planner's primary focus is on a continuity of planning operations that address natural and technological hazards, with the occasional event of record, whether flood, fire, hurricane, etc. These planners seek to achieve gradual improvements in the planning basis, which may require large evacuations of cities during hurricanes, after hazardous materials release, during riverine flooding, and after severe earthquakes. Planning is based on local risk analyses, which typically assess losses within the last hundred years, and in the case of larger events, to the largest known event in reasonable historical record (usually no more than 500 years).

Spectacular events occur at the local and state level typically once or twice in the careers of those involved in emergency planning, so it is not unexpected to find the A planner perspectives as practical, and immersed in narrow planning demands for annual projects, while managing resource limitations. The complete loss of a metropolitan area is not even a consideration. The most serious expectations are that portions of a city may be severely impacted, but that through reconstruction and mitigation, these losses can be ameliorated. Local government planners anticipate that all large-scale losses in the United States will be recoverable through assistance from the federal government.

Strategies for B-level events usually fall within the purview federal planners. These considerations are necessary when governing large territories and geographic land types. Larger

areas provide more potential for a variety of risks to become a major threat, leading to disastrous impacts. Planners at this level have more frequent experience with large-scale events, and have an overarching view of losses and recovery efforts. Again, the baseline assumption is that large urban areas can recover. The idea that a large metropolitan area would be completely lost is untenable.

Federal assets are extensive and dwarf those of the local and state government response capabilities. This ready, but slow moving resource base provides strong confidence to the A-level planner that they can indeed cope with even the impacts of historical size. One of the weaknesses in this system occurs when there are relatively simultaneous, major disasters at the national level. This occurred recently when Hurricane Andrew struck the East Coast in 1992, followed by the Mid-Western floods of 1993, and finally the California Northridge Earthquake in 1994. Federal disaster resources in the United States, as well assets of the primary insurance companies, were stretched to the point of breaking. This period served as a warning call to federal planners. Whether the serious potential for overwhelming the federal resources was truly integrated into a new planning paradigm is still a matter of discussion.

Federal planners concede that major damage can occur to a city due to natural disasters, to technological accidents, and to terrorism or war. There is no perspective, however, for multiple simultaneous losses of cities outside of a nuclear war. Natural hazards have not been considered as a feasible source for total destruction of numerous cities in a short time frame. The federal consensus continues to be that there will not be complete losses of a metropolitan area, or the need to relocate millions of residents after such a loss.

Strategies for C-level planners originate in several theatres of thought. Some ideas come from think tanks and special research facilities formed to assess the truly catastrophic events beyond the scope of current government planning. Some of the studies come from federal laboratories and specialty scientific interests. A few arise out of universities that support unique and creative thinking forums. Reports may come from military strategists with concerns about the logistics of operating field mission before, during, or after challenging climatic events. An example of this type of planning is the recently released white paper that was prepared for the U.S. Department of Defense by Andrew Marshall (Stipp, 2004). It clearly explains the potential threats of a C-level scenario if global glaciation returns.

The emergency planners in the A school of thought would consider many of these catastrophe reports as fringe thinking that have little or no practical value. Those at the B-level consider them intriguing or disturbing, but without relevance to the resources, policies, and practices in place for federal government. In fact, with such frequent turnovers in Congress and the Presidency, it is unlikely that any administration would tackle a 20-year planning effort, as might be needed for "snap" glaciation. That is the weakest aspect of dealing with C strategies. A-level planners will not listen, and Bs will not act in a timely manner. However, Bs hold the keys to the funding that make planning for climatic threats possible. So, although the Cs warn of Global Warming, snap-theory glaciation, emerging diseases, near-earth orbiting objects, global tilt and magnetic field collapses, solar and magnetic storms, and elevated vulcanism, few active planners are ready to take any actions. Any strategies for C-level events are often considered impractical, as the events proposed would probably overwhelm the world community's resources, not to mention those from a single nation.

Defining Policy Triggers

It is now time for all levels of planners to unite to consider strategies for the C-level warnings. This will take a clear paradigm shift, lead by consistent and focused world leadership. Those two elements have not appeared yet. The planners at each level will need indicators that they understand, called "triggers," before proactive actions are likely to be coordinated at all levels.

Table 1 depicts a likely series of events and reactive policies that will be forced upon the United States if it delays in making reasonable choices before climatic events limit options. The goal for using such a trigger table is to awaken policy makers to action to protect residents of metropolitan cities (in the case of sea rise) and northern cities (in the case of glaciation). If consideration is not given, then the impacts of late and forced migration may occur as depicted.

The scenarios start from minimal impacts and finish with the catastrophic, which includes the extinction of humanity. This paper is not intended to create fear, but rather to define the logical progression of crises that can occur due to sudden climatic changes. The most serious events will manage mankind if prior mitigation measures are not taken.

The contrarian position is that Global Warming will create a gradual climate change, and may indeed expand arable lands much farther north than present. This would establish new grain baskets in Canada and across the sweeping steppes of Eurasia. This scenario would stabilize world economies for a time and help manage world hunger. It would also support additional

population increases, creating more need for fossil fuels, and thus expanding the production of more carbon dioxide and air pollutants. Water supplies would become more contaminated and eventually wars would be struck over livable space and non-food related commodities. The Global Warming theorists supporting gradual climate modifications envision stable equatorial conditions rather than renewed glaciation. This paper does not claim that either hypothesis is correct. The focus of this paper is on preparing for the risks that hold the greatest short-term challenges.

TABLE 1 TRIGGER TABLE FOR METROPOLITAN MASS MIGRATIONS

CLIMATE	GEOLOGY	BIOLOGY	RESPONSE MEASURE
Drought creates a dust bowl in the Central U.S. and California Valleys	Earthquake, tsunami, and seiche activities threaten coastlines and inland lakes	Crop failures increase due to changing climatic cycles	A: Implements existing plans and searches for additional water sources. B: Expands plans and funding in case of further impacts, and extends support for local and state governments. Expands imports of foods to stabilize national prices. C: Develops strategies for early warning and large temporary evacuations from areas likely to be impacted most. Directs investments in more climate tolerant foods through genetic research.
Heavy unseasonable rainfall, super storms (hurricanes and tornadic swarms), and record snowfalls continue to occur every year	Underwater sea mounts begin to overheat and erupt raising ocean temperatures; earthquakes increase in heavily populated areas along coastlines	Animal disease outbreaks occur with alarming frequencies; large die-off's occur (e.g., birds with West Nile Virus); emerging zoonotic diseases become more virulent (e.g., new variants of avian flu and equine encephalitis)	A: Increases use of advanced weather-warning systems and reinforced safe-havens. Coastal evacuations are more frequent. Health Departments increase outreach and efforts in surveillance and vaccination. B: Purchases and supports long-range weather modeling to provide strategic enhancement for warning and evacuations. Geologists, climatologists, and virologists become members of planning processes. Multi-state agreements are fostered to support large numbers of displaced residents for up to two weeks. National laboratories are assigned additional funds for research for emerging disease surveillance. C: Political and economic strategists began to design scenarios for impacts from continued climate instability. Of particular interest are the problems with the stability of governments, markets, and social structures. Military organizations begin to evaluate the needs to defend borders if neighboring countries become desperate for food, water, or even livable space.

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Inundation begins along sea coasts in some areas, while drought continues inland; metropolitan areas loose land and infrastructure due to saline intrusion including roads, low lying developments, or fresh water supplies; metropolitan areas have to ration water, causing the loss of water-dependent industries including leisure attractions.	Subsidence of land occurs in some areas, including large sinkholes; domes begin to rise in geologically active areas (e.g., the Cascades, Glacier National Park, and Mono Lake). An undersea quake occurs in a magnitude of greater than 9.0 on the Richter Scale, creating a massive tsunami that strikes at least one coastal community causing massive damage.	Disease outbreaks begin that are of the same proportion as the 1916 Pandemic flu. Hundreds of millions die worldwide. Governments become unstable and food becomes very expensive. Those dependent on government support begin to face slow starvation. Economies collapse and unemployment is rampant. The middle class begins civil unrest and protests. Disease vectors and pests have population booms, and become resistant to most chemical controls.	A: Spends much of their remaining time forming alliances of aid as personnel are worn out from the constant challenges and dwindling resources. Structures of local government become weakened to the point that promises of aid are no longer given to the public. Local government officials withdraw from public forums and must be protected. B: Prepares plans for food and water rationing, as well as defenses against potential actions of other countries in need of foodstuffs. Exports are now limited to only a few selected trade and defense partners. Stores of emergency foods are increased as much as is possible without creating excessive pricing on the market. Farmers and ranchers are forced to begin using genetically manipulated foods and livestock to ensure the continuity of food production. Large feeding centers are set up in metropolitan areas for the additional provision of vaccinations (some which may still be experimental due to the pressures of the loss of lives to disease outbreak). Martial law is invoked as needed to protect the stability of key urban areas. C: Requires the best minds in every scientific field to develop long-term plans for movement of urban residents inland to unaffected areas. This will include providing military support to monitor abandoned coastlines from invasion and to monitor further intrusion by the oceans. Estimates will be developed for the life of aquifers, once large populations become dependent on them, without sufficient rainfall to recharge groundwater. Initial forced migration plans will be developed that include the use of holding camps, tent cites, and even forced bivouacking in the homes of current residents. Plans will be developed for taking

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			resources from neighboring countries, if they have unused resources they are not willing to share, including food, water, and livable space. Public works programs will be developed to address unemployment.
The Ocean Conveyors slow including the Gulf Stream; North Atlantic waters loose salinity as freshwater intrusion increases; the Pacific water temperature continues to rise; average climatic temperatures decline an average of 1^0 C worldwide per year.	A single massive volcanic eruption occurs in the South Pacific. Sunlight is blocked up to 30% for almost five months, in the middle of growing seasons throughout the world. It is a year without a summers as in 1816	Diseases once under control begin to kill tens of millions, from typhus to diphtheria. The infant mortality rate increases drastically in all mammals. Food supplies dwindle. Spontaneous evacuations begin to occur from the urban areas as people search for food, water, warmth, and safety from the growing criminal elements. Religious fervor, bigotry and fear explode leading to further cultural splintering. Kidnapping by criminal elements is	A: Emergency planners try to unite with federal planners (B) without success, as transportation routes are clogged and unreliable due to gang violence and robbery. Airplanes can no longer fly due to the unstable weather conditions and the volcanic dust. Continuity of Government is failing at the local level as many of the leaders leave early to sanctuaries deeper inland and further south. B: Resources are no longer made available to state and local governments. Federal leadership is pulling back into its strongholds. Martial law is enforced where possible as troops are pulled back from foreign countries. U.S. citizen's abroad are at the mercy of local residents. Food is now priceless. Those charged with hoarding can be hanged. Radio and television broadcasts are limited to emergency announcements. Larger, more industrialized nations have invaded numerous, less developed nations and taken over their agricultural resources and water supplies. Indigenous populations are enslaved, as oil supplies diminish, reducing agriculture to manual labor. Policies are now focused on protecting federal leadership and key employees. C: Safe havens are opened for the retreat of government and business leaders, as they try to rebuild civil authority. Many leaders have died from disease, or have been assassinated. Continuity of Government at the federal level is tenuous.

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		common in order to barter for food and transportation to escape the cities.	Mass migration is projected to occur in several waves as people leave the urban areas. Those who left ten years before were able to find the best places to build safe homes, with water and with food storage. They have blended into the society that was already in place. The second wave, five years later, found poorer housing and lower paying jobs. Their existence is dependent on finding income each day, as well as rations they can afford. The third wave, in the last year, lives in shanty camps and sometimes in military stockades near the rural areas already settled by earlier waves. In many ways they are not part of the culture and they keep to themselves. There is additional racial, religious and economic bigotry against them. The societal pressures between the three groups are capable of igniting over the least suspected injustice. The black market is the only place available to get food or medications. Cigarettes, alcohol, and illegal drugs are worth their weight in gold. Clothing must now be spun by hand as the retail industry no longer exists. Few people have the skills to make tools, furnishings, power, or raise their own food.

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Extended winter begins in the northern latitudes, with the arrival of massive glaciers. Winters now continue through what was once spring and fall. Summer is now more like a wet, brief spring, with high winds and diminishing sunlight.	The "Year of Six Volcanoes" creates semi-darkness during much of the year. Earthquake activity along the Ring-of-Fire intensifies, as does the New Madrid Fault and many hidden faults in mountainous areas. Parts of Hawaii slip into the Pacific, creating a spectacular tsunami along the western Pacific coastlines.	Societies dependent on fishing fail and move inland. Hundreds of millions move south towards the southern edges of the United States, as resistance occurs from Mexico about illegal migration across their borders. 1 in 8 Americans has died in the last three years. Each day is a battle for most to find enough to eat. Livestock, pets, and zoo animals have disappeared. The migrating masses have killed all forms of wildlife that were edible. Some people have resorted to eating bark and grasses when nothing else was available.	A: No planners exist at this level. B: The remaining core of emergency planners in federal facilities struggle to evaluate the life expectancy of the core of specialized evacuees now forced to live underground. Food supplies and water supplies will provide basic existence possible for about ten years. Power supplied, including nuclear reactors below ground also have a limited capability due to repair and operational maintenance. The military has withdrawn with the remaining Central government to underground strongholds. Dried stores of food are all that are available. No crops have been raised for three years, and imports are unavailable. C: Begin discussing potentials for invasion from other countries across frozen land bridges in the Pacific. Canada is now fully migrated into the Southern United States and Mexico is overwhelmed with refugees. Treaties must be signed with Central America for support. Long-term plans for reestablishing a Central Government are redesigned. People "outside" now live in small groups and communities that do not allow any strangers to enter. Violence and crime are still uncontrolled, but the reasons for these acts are almost always over food or water. Little else matters. There are few children, and most of the elderly have died off form malnutrition and lack of medical care. Illiteracy rates begin to rise as educational systems have all but disappeared. Many mechanical devices are now useless as electrical power is spotty or non-existent. Diseases from contaminated water sources are common.

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Temperatures drop another 3^0 C worldwide. Glaciation has covered most of Canada and the northern 1/3 of the United States. The Great Lakes are frozen over. The Mississippi and Missouri Rivers have dried to a trickle. Great sand deserts are forming throughout the central plains.	Volcanic activity continues to increase across the Ring of Fire, through Europe, Asia, and Africa. Japan is no longer populated due to first massive earthquake activity and then coverage by ice. Instabilities in the balance of the Earth have exacerbated by a severe displacement of the magnetic core. Glaciation now speeds toward "snowball Earth".	Extinction rates for all life forms have reached a crisis level. As more of the plankton and other basic animal forms perish, those on the top of the food chain begin to disappear. New species begin to emerge in insects. All amphibians and reptiles in the United States have disappeared, as have most native fishes and mammals. Human reproduction rates have declined to a level threatening the continuation of the human race.	B: This level of planning no longer exists. C: There are only two alternatives available, since no life forms can continue on the surface. Humans must either leave the Earth or go under the surface. Space travel has been unavailable for over two decades. The remaining survivors must be found to increase a stable breeding population. Teams are sent out to find whatever viable humans are remaining to return to the underground caverns. Scientific capabilities are reduced but research has found methods for using bioluminescence to create usable albeit dim lighting underground. New forms of fungus are genetically manipulated to produce complex carbohydrates and simple proteins to support dietary needs. New hydroponic techniques produce enough vegetables and fruit to support vitamin requirements. No livestock or fowl remain for food sources. The remaining culture digs deeper into the Earth to find areas of natural heat to produce power and provide comfort. Earthquakes have destroyed many of the underground enclaves.

Impacts from Late or Forced Mass Migration from Metropolitan Areas

In his book *Centennial*, James Michener speaks to the pressures of cultural change and conflict as peoples move across and onto the same land. His book focuses on the State of Colorado, but the implications in the novel apply to the problems associated with climatic chaos anywhere in the world. The history of mankind is always about the land, who owns it and who wants it. The pressures of mass migrations will emphasize challenges that are already felt in cultures under pressure. Sociologists have predicted an open conflict in the United States since the 1960s in what is often termed the "Second Civil War." Through some unidentified pressure relief valves, this outburst of social unrest has not emerged. However, forced movement of millions of people out of the established cities into an unfamiliar rural environment could indeed allow for the emergence of complete civil disorder.

The next period in Earth's climate may be more severe than the "Little Ice Age" experienced by Northern Europe in from 1300 to 1850. That period of climatic instability and cooling stretched across Europe where there had been a stable and mild climate. The losses to cultural integrity and stability have been described in detail (Fagan, 2000). However, if the next glacial conditions are as extensive the Younger Dryas of some 12,700 years ago, the implications are intimidating. If the last great intrusion of glacial creep in North America is draped over the existing geopolitical map the implications of mass migration are compelling. Something will have to give. Severe cold, combined with the rise or fall in coastal waters, could drive most of the United States' coastal residents inland and to the South. Emergency planners involved with tsunami and hurricane planning often quote the figure that in 2003, 80% of the U.S. population

was expected to be living within 100 miles of the coastlines (Tobin, 1996). That could mean relocating hundreds of millions of Americans.

Relatively early dislocations could originate in Canada and the Northeast, Midwest, and Northwest United States. All of these people would be pressed southward and inland. Some of the early social pressures from the first large wave of migrations would include competition for jobs, stresses on societal resources (hospitals, schools, law enforcement, fire, emergency medical, social services, and low-cost housing), and erosion of critical infrastructure (roads and highways, bridges, power distribution, water and sewage systems, parks, solid waste management, and mass transit including train, bus, and air services).

Access to housing, food, water, and living space would become primary concern as the various waves of migrants encountered one another. The social integration issues would come to a boiling point in short order. This could manifest through a number of already sensitive areas including racial prejudices, class conflict (financial, education, and influence), sexual preference prejudice, political and religious conflicts, drug and alcohol abuse, physical abuse from family stress, and finally outright threats and attacks against any newcomers. These issues are well documented in studies of mass migration, including work describing the social instabilities during the creation of the State of Israel in the 1950s (Kaplan 2000).

Further social disruptions would be expected including the formation of new criminal elements and organized crime, intolerance and abuse of migrants, disease outbreaks from overcrowding and poor public health practices, and the destruction of food and water sources.

That mass migration of humans would, if continued to its most logical conclusion, simulate the onslaught of a locust swarm. Far more would be consumed than could be produced. If supplies and resources were denied from other countries, albeit from similar circumstances, nations might resort to warfare to obtain necessary supplies. Finally, failing in this, whole nations would face general starvation, declines in reproduction, and increased child mortality rates. National, desperation would require political leaders to take whatever act was necessary to prevent annihilation.

As indicators grow clearer to the scientific community that this scenario is indeed coming to pass, efforts must be made to prepare the citizenry to begin the painful process of movement. There will be range of initial responses from the public. On one side of the spectrum will those in fear of the change, who will refuse to move (the Harry Truman/Spirit Lake response). These residents will swear their allegiance to the land (especially the land they own) and to their ancestral home from the days of the pioneers. The other side of the spectrum will start their exodus far earlier than necessary, based on the indicators, even before public policy is revealed. These individuals are sometimes years ahead of the planning community through their own assessment of C-level reports and research. Early voluntary migrations might be viewed as positive, as the first migrants should blend casually into existing cultures. Unfortunately, this is not always the case. Some early evacuees have grandiose views of themselves as “visionaries”. These are the elitists who often believe the have been chosen to escape disasters through divine intervention. Californians have been leaving the State in large numbers for over a decade. The attitudes of these new migrants as they entered Oregon, Washington, Nevada, Arizona and

Colorado have created tensions and mistrust, which future migrants will have to face. So, spontaneous, preemptive migrations do not always smooth the path for others to follow.

Proposed Actions To Relieve Impacts from Sudden Climatic Change

This paper does not propose that there are any solutions to the catastrophic climatic hypotheses proposed at the C-level. Rather, there are actions that can be taken to reduce human suffering and loss in the more likely events. The end result should be the avoidance of situations that cause large-scale epidemics, starvation, civil unrest, and warfare.

The first step is to develop new policy centers. There, a new cadre of redevelopment mitigation experts would be formed to help smooth the transition through climatic change. This would include public outreach, national planning blended with local and state plans, and a true international partnership in visioning sustainability through the climatic chaos.

The second step is to begin citing and building relocation centers, not internment camps. The centers would allow for new migrations to be received and then blended into existing civil structures. The centers would be built as public works programs and would use local labor to build better relations with existing communities. The focus would be to prepare housing that was affordable and valued by new migrants, rather than forcing them into shantytowns and tent cities. It would also allow for the construction of smaller, more sustainable outlying villages that would not add to strains on existing community infrastructures. Precedence for such operations

were set during WWII when entire communities were built in short order for support of nuclear weapons development in the southeast and in New Mexico.

The third step is to develop plans for measured migration. This will prevent boomtown economies and crisis overpopulation in rural areas with marginal resources. Policies will need to be balanced against the personal freedoms of movement enjoyed by U.S. citizens. This however must be made acceptable to prevent stampede mentality. In addition to this measure, the federal government must begin the careful restructuring and development of unpopulated inland areas. This may mean purchases of large sectors of privately held property. It may also mean construction on previously protected federal forest and parklands. This process will be particularly unpopular with environmental groups and the media. However, once the climatic impact triggers appear this policy must be implemented without delay.

Fourth, the national policy must be strengthened for using genetics and careful hybrid selection to change crops and herd/flock animals. There must be strong, productive strains of foods that can withstand the rigors of a colder, dryer, and possibly darker climate. National research labs and private sector agribusiness must team to provide these new strains in short order. This will also be very unpopular with many groups who oppose genetic manipulation. The alternative is mass starvation as current food crops and stocks fail.

Fifth, new water sources must be developed to harness marginal supplies. Desalinization will be critical for cities that want to continue to survive along coastlines. Additional long-term planning is needed for strategies to mine glaciers as they creep southward. Depleting glaciers for

agricultural and potable water supplies may mitigate two consequences at once. A realistic plan should also be developed for use and protection of the great aquifers under the United States. Their capacities and current threats from industrial pollution (especially mercury, cyanide, and MTBE intrusion) must be evaluated and mitigated.

Sixth, there needs to be a sound reevaluation of the movement of massive numbers of people further south into Mexico and Central America. These policy discussions will be difficult and will require careful reassessment of the relationships of the countries in the Western Hemisphere. Canada faces particularly dark times if glaciation does return.

Seventh, the initiation of floating cities that can be moved to warmer environments without loosing infrastructure, as ocean levels either rise or fall. There are futuristic designs for such large-scale projects, but none have ever been attempted, outside of the cruise ship industry. These would be nuclear powered, providing fresh water through desalinization. Recycling would be critical for their continuity of operations. Fossil fuels would be restricted or denied.

Eighth, construction of safe havens for orphans left behind during the likely severe natural and human-caused disasters that will follow the chaos from severe climatic change. As noted in the triggers, the loss of reproductive capacity and the loss of existing children to disease, starvation and war could lead to a reproductive crisis. This sounds like fantasy in a current world population explosion. However, biologists are well aware of the die-off of species after they reach a population boom, as resources no longer support their number, disease becomes rampant,

and behaviors within the species become self-destructive. There must be sites for protecting and educating orphaned children who are susceptible to the dangers inherent in mass migration.

Ninth, providing social systems that act as pressure relief valves. Social systems fail under the stresses of environmental chaos as civil unrest, terrorism, and religious radicalism flourish. Other Western Hemisphere cultures failed to initiate adequate adaptive behaviors during crises. The Maya, Inca, Aztec, Anasazi all fell as great societies partially because they were inflexible to radical changes. New social and governmental structures must be available to manage the cultural shock that will inevitably arrive under "snap" glaciation.

Possible Solutions to the Worst Case Scenario

If the "snowball Earth" hypothesis occurs, along with major geological disruptions, there are few options left for the survival of the human species. The habitability of Mars is now coming into clearer focus. Expecting space colonization to develop fast enough to relocate a meaningful number of humans is dubious. If the "snap" hypothesis prevails, there will not be enough time to use space as a safe haven. That leaves only two other options.

The first option is the development of deep-sea colonies that derive their resources from underground volcanoes and rifts. Nuclear energy would be needed to support and retain such colonies. Not enough is known about long-term effects of deep-sea existence on a human culture. A new field of study would have to be initiated quite quickly in order to be functional within twenty years. This option may be viable because even during Precambrian freezes of the

entire Earth's surface the oceans remained viable to some extent, and did not freeze to the bottom.

The second option is to return to existing in deep caverns. This has practical problems as there would be difficult challenges in food production, waste management, oxygen production, and power production. Even nuclear power stations have limits due to refueling cycles and repair of technologies to manage waste and heat. Social structures would also have to be reinvented, especially with the separation of societies from the rest of the humanity. Predictions of the likely cultural conditions after decades of self-entombment are not part of the current body of sociological study. It is not possible to foresee what the long-term survival chances would be if those in subterranean environments were permanently isolated from the surface.

Summary

Several hypotheses exist about short and long-term effects of Global Warming. If changes are gradual, toward a more tropical condition, then few immediate considerations need to be made for disaster consequences to metropolitan areas. If, however, the glacial theories of "snap" glaciation and "snowball Earth" come to pass, there is a pressing need to begin the planning process for implementing survival methodologies. These include strategies for stabilization of social systems including government continuity, critical infrastructure, financial institution, health care systems, educational processes, and agricultural productivity. Without timely planning and program implementation there could be immeasurable suffering and cultural chaos, with the potential for the extinction of humanity.

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