The Long-Term Threats from Climate Change to Rural Alaskan Communities

By Don Callaway

The traditional way of life in much of rural Alaska is at risk. Alaska Native and long-term non-Native villagers are undergoing a series of challenges related both to climate change and to deteriorating economic circumstances. Rapid climate change brings a multitude of physical impacts to villages from erosion, subsidence, floods, changing terrestrial habitats, large-scale melting of sea ice, thawing permafrost and storm surges that in some cases require significant emergency response efforts, massive investments in infrastructure and/or full-scale community relocation (*Callaway 2000*).

Other climate changes include shifts and dislocations of subsistence species that have the potential to interrupt traditional sharing practices and compromise subsistence contributions to diet. Changes in subsistence harvests, can, as we shall describe later, have drastic impacts to social networks, which can in turn have substantial impacts to emotional and physical health. These two impacts of climate change often receive less emphasis than they deserve, although a major exception to this generalization is the work produced by the Center for Climate and Health, a division of the Alaska Native Tribal Health Consortium (*ANTHC, see Brubaker et al. 2012*).

Two of the traditional adaptations to deal with environmental and subsistence uncertainty have been to:

1. Have flexible harvest strategies and compensate for short falls in one resource type by harvesting more from other available resource categories (e.g., see Kivalina below).
2. Utilize social networks, which spread the risk from uncertainty, by sharing available subsistence harvests, technology, labor and income widely within and between extended families.

Both these strategies, as we will describe below, are currently being compromised by climate change.

1. Resilience - Flexible Harvesting Strategies:

The ecosystems in which traditional Alaska Native communities were embedded exhibited far less diversity of animal and plant species than can be found at lower latitudes; they also exhibited dramatic seasonal variation in both the number of species and the density of those species. Both these factors contribute to making Alaska Native communities more vulnerable to the current dramatic changes in arctic ecosystems.

One traditional (and ongoing) strategy for combating fluctuating resources is to harvest multiple species and to trade any excess harvest to other communities. This usually takes the form of coastal communities trading marine mammal products inland in exchange for land mammals or fish.

Another strategy employed by Inupiat and others is to maintain a consistent amount of harvest in terms of pounds over time by varying the composition and proportion of those harvests on a year to year basis. Figure 2 demonstrates this strategy for the community of Kivalina.

In general, when one resource such as marine mammals become unavailable or inaccessible, harvesting more of another resource, e.g., caribou or white fish, tends to make up the shortfall (*Figure 3*). Climate change has the potential to severely impact both strategies mentioned above and in fact is already doing so. Some preferred marine mammals such as walrus and seal populations are already in sharp decline with the retreating arctic ice cap, caribou have already suffered a 50% decline throughout the arctic, and parasitic organisms such as *Ichthyphonus* (associated with warmer waters) are starting to infest salmon stocks. Thus, climate change presents a new, more encompassing threat, in that multiple subsistence resource categories maybe at risk at the same time, although from different climate drivers. These impacts limit the opportunity within a community to ramp up the harvest of alternative species.

2. Resilience – Sharing though Extensive Social Networks:

In general, the most substantial traditional practice to limit the risk of starvation involves a complex strategy of sharing harvests within and between extended families. This strategy has historically evolved into social networks that dynamically share and reciprocate subsistence resources, cash, and domestic labor (e.g., babysitting) relationships that exist within and between extended families, although current basic household units often live in separate dwellings (*Figure 3*). These transactions and relationships buffer and adapt indigenous communities to change and scarcity, scarcity in the availability of subsistence species, scarcity in employment and wage work, and the vicissitudes of services delivered by state and federal entities. It

Figure 1. A young boy's attempt to build a beach wall for his community of Kivalina. In the background you can see the effects of storm surges which have defied previous attempts to mitigate beach erosion.

Photo courtesy of Michael Brubaker, Alaska Native Tribal Health Consortium

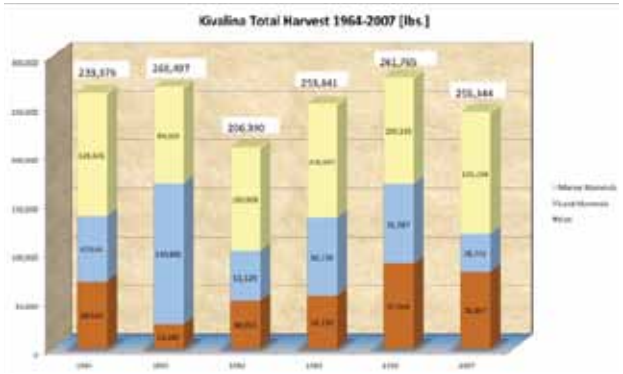


Figure 2. Subsistence Harvests in Kivalina over 3 Decades Estimated TOTAL Harvest: 1964, 1965, 1982, 1983, 1992, 2007

is the potential breakage of these dynamic exchanges and sharing behaviors that constitutes climate change' greatest threat especially when other stressors such as mineral development add to the cumulative effects.

Jim Magdanz's research in Northwest Alaska clearly demonstrates the resilience of the extended family as an essential entity. Over the last decade and a half research in northwest Alaska has documented the extensive nature of sharing networks in rural indigenous communities. To illustrate contemporary adaptations we will use the small community of Deering in Northwest Alaska as an example. While one of the smallest communities in northwest Alaska with about 125 people, it is fairly representative with respect to income and per capita harvest amounts.

An earlier article in Alaska Park Science described in some detail the sharing networks between extended families in the communities of Wales and Deering (*Callaway 2003*), and was based upon an extensive ADF&G Technical Paper (*Macgdanz et al. 2002*).

In this article we focus on the internal interactions, the exchanges within one extended family in Deering to indicate how a combination of subsistence harvests, wage income, and steady but low "unearned" income allows the primary unit in Alaska Native traditional society to sustain itself. This example highlights the dependency on subsistence foods and the key roles of extended family households in obtaining income to sustain both their subsistence activities and other basic needs for survival, e.g., fuel for heating and transportation. Figure 4 expands the attributes of Social Network A in the community of Deering. All five households are related, each household being either a son or a daughter to the active woman in household #19 (whose husband is deceased). Having one of their children live with their grandmother further links two households, #2 and #27.

Household #32, termed a developing household (household head is younger than 39 years of age), is occupied by a couple, one of whom is a wage earner that provides about 90% of the wage income for the entire social/extended kin network.

The single male in household #21 provides nearly 60% of the total harvest of wildlife resources for the entire network. Finally, household #19, the matriarch for the network, provides nearly 60% of the unearned income, primarily in the form of social security, a small but steady source of income, for the entire extended family.

This diagram dramatically illustrates how income both earned and unearned and wildlife resources are pooled within the extended family to provide security and resilience for all five households. No household can survive independently but by sharing resources such as income, labor and food this social entity is buffered against fluctuations in both the social and natural environment.

Thus we see that the major traditional adaptation strategies, the harvesting of a variety of wildlife resources that are shared intensively within the extended family and with much less frequency with other households and networks within the community are a major pillar of the resilience of traditional society throughout Alaska.

Declining Economic Circumstances Exacerbate Climate Change Impacts:

In addition to profound changes in the geophysical environment, we find severe impacts to the ecology of subsistence species and dramatic impacts to the infrastructure of communities. Also becoming prominent are deteriorating economic conditions that include increasing unemployment, decreasing flows of money and services to rural areas all coupled with spiraling increases in cost of living as rising energy prices preclude many households from heating their houses and/or purchasing the gas and technology needed for hunting and fishing.

Institutional Failures:

Space does not permit a detailed description of the institutional failures that exacerbate climate change impacts to coastal (and riverine) rural communities such as Newtok. Emigration or relocation of families within impacted communities to larger communities is usually one of the first suggested institutional responses. However, such

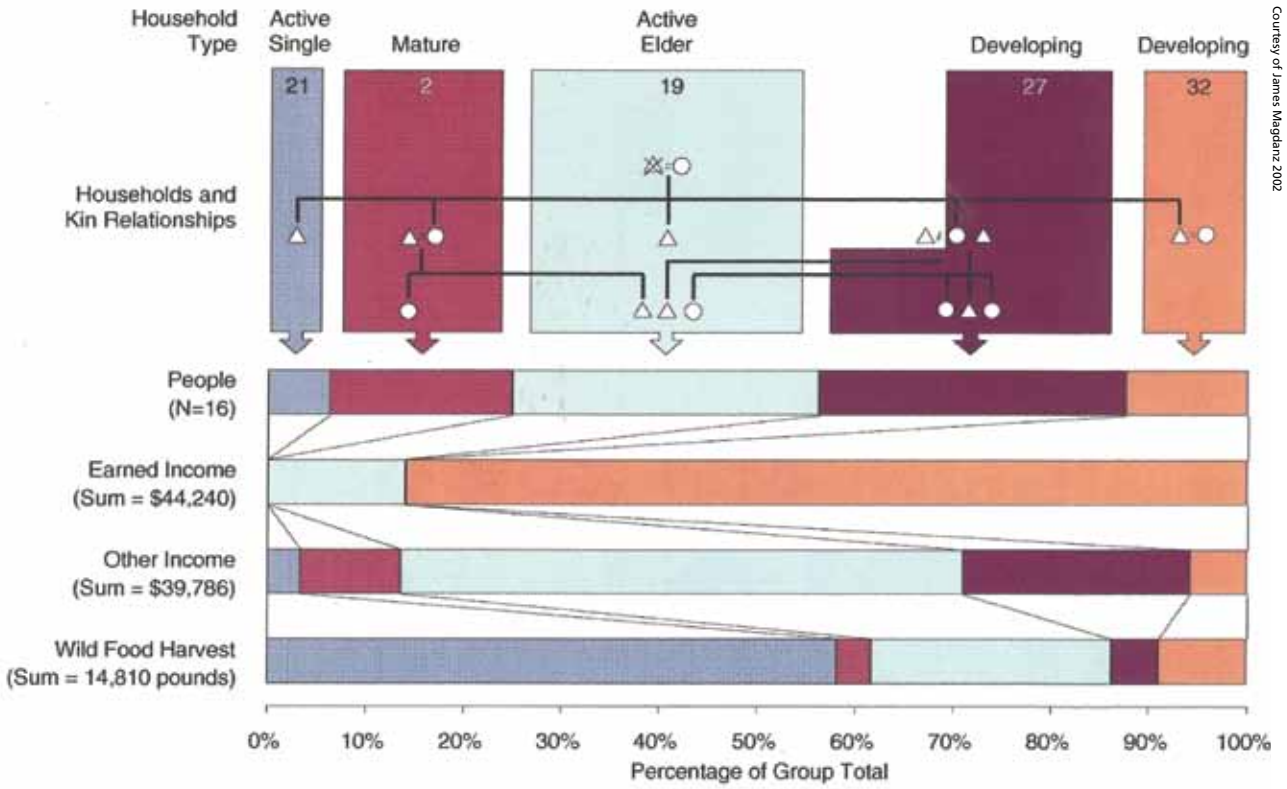
Figure 3. The annual harvest per household, at about 113,400 kg (250,000 lbs.), remains fairly consistent over time although the proportional contribution from fish, land mammals, and marine mammals varies from year to year. For example, the proportional contribution from fish and land mammals changes rather dramatically between 1964 and 1965.

Year	Marine Mammals	Land Mammals	Fish
1964	48%	26%	26%
1965	37%	54%	9%

proposals almost always underestimate the total costs because they do not factor in indirect costs such as new demands on the school system (requiring more teachers and more buildings), and infrastructure additions such as roads, sewer, and water treatment plants. In addition, previous experience (e.g., the relocation of the community of King Island) has demonstrated post-relocation problems from increased drinking, domestic violence and other social problems. Uprooting your entire life is traumatic and brings with it tremendous stresses. Contributing to these stresses is the fact that male hunters lack traditional access to the hunting areas in their new communities. In addition, they lack the necessary finely grained knowledge of the new landscapes to hunt effectively. Households moving into new communities may not receive the respect and political influence that they enjoyed in their home community, and most importantly social networks rarely transfer intact and the underlying support that households and families enjoyed in their home communities maybe fractured or may cease to function altogether.

A GAO report indicates about 190 rural Alaskan communities are at considerable risk from erosion and flooding as the impacts of climate change ramify through the next few decades (*GAO 2003*). For Alaska alone and interpolating, based upon per household costs from Shishmaref, it could cost $34 billion dollars to relocate the 192 communities currently at risk or exhibiting substantial vulnerability over the next decades. This is an enormous amount of money and in current dollars is about equal to the gross domestic product of the entire state of Alaska for 2009.

Linked to this issue of cost is the enormous problem of coordination and logistics between multiple bureaucratic entities that are responsible for providing federal, state and regional responses to communities affected by climate change. Proposals to relocate families to larger, more secure villages have been rejected by numerous communities (including Newtok, Shishmaref, and Kivalina). The reasons expressed for the rejection of these alternatives center on loss of ready access to



Courtesy of James Magdanz 2002

Figure 4. Social Network "A" Subsistence and Economic Relationships, Deering.

well-known subsistence resources, loss of history and a sense of an intact community and fear of loss of support from extended kin (social networks) integral to survival.

The possible relocation of extended families or whole communities to more urban areas is most disturbing. Such a dislocation can destroy traditional social networks, as seen in the outcomes of Russian policy in the Soviet Far East during the 1950's. During this period a number of isolated settlements in Chukotka were declared to be "settlements without prospects." Based on a concept of centralized delivery of services, these communities were struck from centrally planned budgets and were effectively left without fiscal resources with which to maintain community infrastructure. Left with no choice many families relocated to larger and more "centralized" communities. These families are still feeling the repercussions of these relocations, as levels of alcoholism, domestic violence and social disintegration are ubiquitous. In Alaska, whether deep-seated cultural values of sharing and supporting social networks can survive the destruction and relocation of their communities in an incoherent political and bureaucratic structure seems extremely problematic.

Health Impacts Linked to Climate Change:

As climate change restructures the environment, a number of current and potential health problems have also begun to impact rural individuals, families and communities (*AAG 2010*).

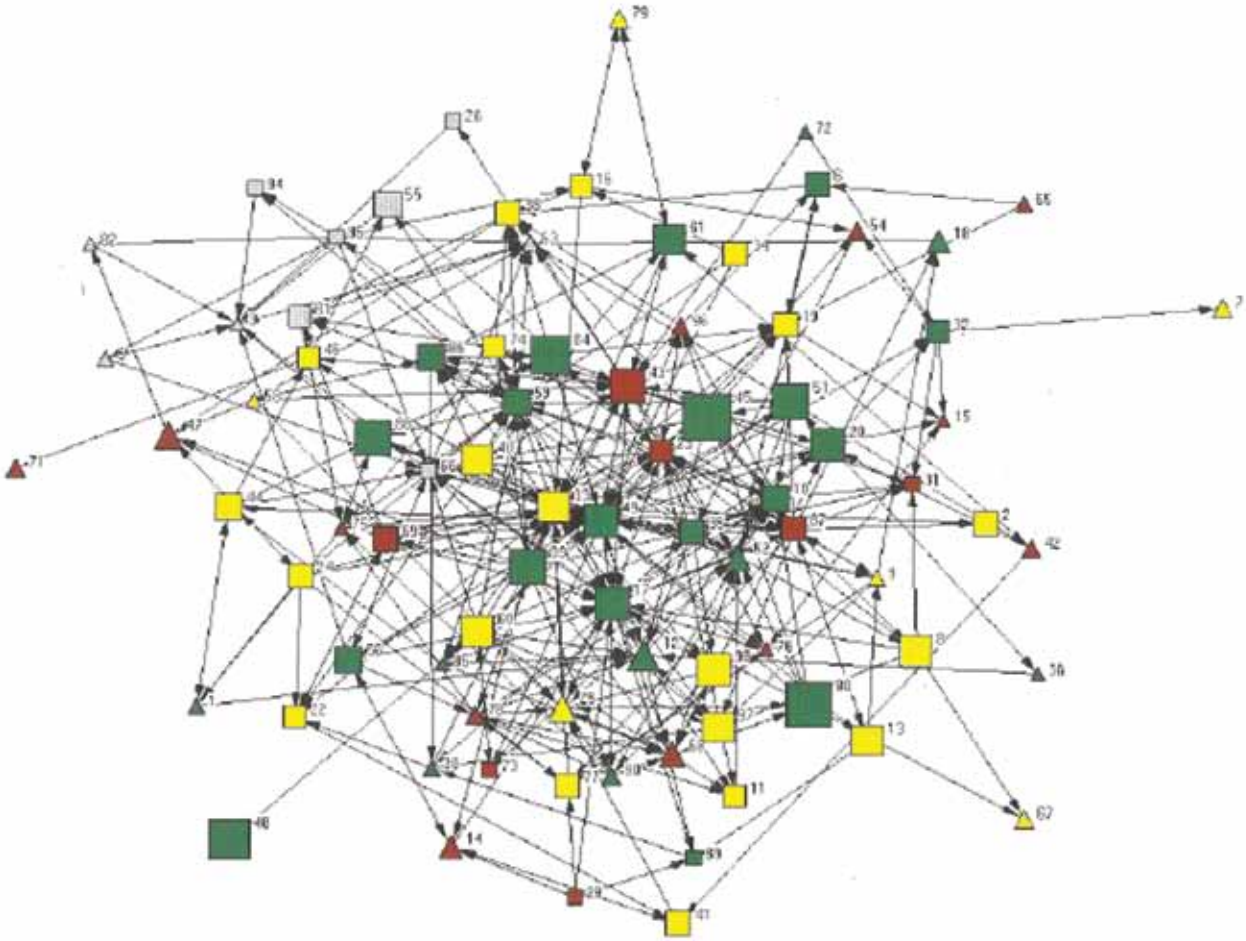


Figure 4. Social network derived by Jim Magdanz using Netdraw.

Diseases:

Increasing temperatures have enabled new diseases to expand in Alaska - such as *Vibrio parahaemolyticus* and gastroenteritis in Prince William Sound oysters. Epidemiologists have noticed increases in the number and extent of existing diseases such as botulism (e.g., Shishmaref), paralytic shellfish poisoning, giardiasis; *Trichinella* from walrus; and anisakiasis from anadromous and marine fishes. Also noted is a geographic expansion of diseases such as Giardia (as beavers expand their territories) and increases in bacterial skin infections from a variety of sources.

Projections indicate a greater number and extent of diseases including *Echinococcus multilocularis* (parasitic tape worm disease), and a greater incidence of skin infections. In addition there is considerable concern about the emergence of new or existing vector-borne diseases as temperatures become warm enough to support ticks, different species of mosquitoes, etc. (e.g., West Nile virus, Lyme disease, tularemia) and the emergence of new viral diseases transmissible to humans from rodents due to expanding populations and latitudinal shifts in distribution (e.g., "roboviruses" in white footed deer mice and voles).

Finally, collapsing community infrastructure has already affected some communities (e.g., Newtok) and is projected to impact many more communities, for example when collapsing of sewage containment structures or land fills cause an increase in disease-based health problems.

Air Quality:

Climate change induced increases in forest and tundra fires (e.g., over 11 million acres burned in 2004/2005 have contributed smoke and other respiratory irritants to the atmosphere, resulting in respiratory disease exacerbations.

Water quality and availability issues:

Climate change brings decrease in quality of potable water from drought (e.g., Nanwalek and Mountain Point), saltwater intrusion, source depletion, permafrost aquifer loss (e.g., Kwigillingok), seawater surges overtopping and contaminating freshwater

reservoirs (e.g., Numan Iqua in 2004). Projections indicate more of these impacts leading to increasing health problems for communities and individuals.

Injuries:

Climate change is resulting in thinner shore-fast ice, sea ice, and river ice, with increasing probability of injury and death (e.g., a recent death in Shishmaref); increased possibility of injury and death from separated ice (e.g., North Slope); increased possibility of injury and death from exposure to more intense or more frequent storms (e.g., whaling boat capsized near Gambell due to unusually rough seas, killing four people); and greater injuries from increased icy road conditions throughout much of the state.

Insect and other bites and stings:

Currently the state is experiencing increases in yellow jacket (an expanding population linked to climate warming) attacks (two deaths in Alaska in 2006) and spider bites.

Toxic exposure:

Currently new toxic chemical exposures are occurring as landfills with barrels containing toxic chemicals thaw. In a curious feedback it is projected that there will be increasing exposure to pesticides as they are introduced to control mosquitoes carrying West Nile virus (itself an outcome of increased warming trends).

Extreme events:

As we are currently experiencing increases in extreme events such as flooding, fires, heat waves, and storms; possible infrastructure failures; possible introduction of new diseases; and clinical issues resulting from community and individual response to adverse socio-cultural and economic circumstances (e.g., failures in fisheries and subsistence activities) there will be greater demands on health care and emergency response systems, especially during major events.

Psychological impacts:

At numerous gatherings, people throughout the state, but especially rural Alaskans, express concern and depression about present changes and projected future changes to Alaska's climate and the resulting impacts on culture, subsistence, traditional knowledge and ways of knowing, fish, and wildlife. In addition, continuing losses in community infrastructures, community relocation and dislocation, and changed winter recreational activities all have the potential to impact the rural Alaskan way of life. All these impacts portend drastic outcomes for mental health, community wellness, family integrity, and potential increase in alcoholism, drug use, and other destructive coping behaviors.

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