

## **Field Project 8—Decision-making under the Impact of Glacial Retreat among Residents of Vulnerable Zones: Perception of and Response to Climate Change (Ben Orlove, 2006-2008)**

The main focus of this project is detection of climate change through direct experience. We focus on glacial retreat, a highly visible accompaniment to warming in Alpine environments. Glacial retreat offer unique opportunities as an object of study of human decision-making about climate change; it is a consequence of climate change that is already taking place, that is directly observable, that can be linked to long-term datasets, and that occurs in widely separated areas, thus permitting comparative research.

Glacial advances and retreats are often measured accurately; thus, misperceptions or incorrect recall can be identified. Moreover, glacial changes can have important effects on resources (stream flow) and on hazards (floods, rockfalls), and hence can elicit action plans. Studies of perception and response to glacial retreat therefore permit us to evaluate effects of various factors on perception and recall in connection with climate change. The gradual nature of glacial retreat presents a typical example of the psychological challenges posed by climate change phenomena. Expectations about change and temporal reference points against which future conditions are compared influence the detection and evaluation of change. Extreme events, such as floods or years of low stream flow, may affect expectations of change and might alter time horizons and reference points. This project will identify community and individual attributes that influence expectations, encoding, and temporal framing of glacial retreat, and thus affect responses to climate change. Community variables studied will include spatial proximity to glaciers, vulnerability to impacts of glacial retreat, balance of individual and public ownership of natural resources, and relevant organizations in the community. Individual variables will include socioeconomic and demographic characteristics, ownership of resources impacted by glacial retreat, size of social networks, and extent of participation in community organizations. Three levels of action plans will be observed: 1) household-based (e.g., insurance purchase or altered economic activity); 2) community-based (e.g., joint investments); 3) externally-linked (decision-makers seek help from other communities or regions).

We will study three Alpine regions faced with glacial retreat, declining water availability, and flood risks: Swiss Alps, Peruvian Andes, and US Cascades. These regions have been selected for several reasons. These regions all have significant glacial retreat and long historical records to document the physical and social processes of change, and all have readily available GIS data for the location of human settlements, hydrology and physical hazards. The establishment of the field research will be facilitated by Orlove's social networks, with close contacts with natural and social scientists who have long been active in the first and third regions, and decades of field research in the second. Orlove is currently directing one master's thesis (Elizabeth Madden) on glacial retreat in Switzerland and participating in a doctoral dissertation (Mark Carey) on glacial retreat in the Peruvian Andes. They differ in other key variables. The first and second regions have much longer histories of settlement than the third; if groups that have observed an environmental change for a longer period are more likely to note and to respond to it, we should see, *ceteribus paribus*, differences between the regions. The first and third regions have higher levels of economic development and government involvement than the second, so residents of those countries would be hypothesized to

have higher levels of trust of government information. The first has a highly decentralized political system, while the second and third are somewhat more centralized, so that the relations of local communities to national governments will differ in these cases.

In the first year, we will conduct field reconnaissance and ethnography for each region. We will establish a GIS database of settlements, hydrology, hazards and institutions to select clusters of communities to study more intensively, and we will obtain local histories of glacial movements and glacier-related disasters and of human settlements.

In the second year, we will conduct surveys, focus groups, and observation of community meetings. Data will be obtained in 15-20 communities in each range, with the communities grouped in 3-4 clusters in each case, with a target of 500 completed surveys in each region. Measurements of glacial area and volume, available from the World Glacier Monitoring Service ([www.geo.unizh.ch/wgms/](http://www.geo.unizh.ch/wgms/)) and the World Data Center for Glaciology (<http://www.nsidc.org/wdc/>), allow comparison of perceived to actual changes. Topics will include perceptions and memory of past and present glacial extent, the perceived impacts of glacial change, respondents' planning horizons, and aspects of household and community economic activities and infrastructure that relate to glacial retreat. Initial work in Switzerland and Peru indicates that residents of single particular communities vary greatly along three critical variables. The first is length of family residence in villages (the mean in both areas is between 3 and 4 generations, with high variability), which can influence the time horizon framing. The second is ownership of land in areas influenced by glacier-related hazard risk and glacier-related hydrology, which can affect reference point and status quo framing. The third is patterns of movement that affect visits to glacier edges and that affect the frequency of viewing the glacier, which can affect experience-based and description-based decision-making.

To assess risk models, we will gather data on the spatial, temporal and social relations to extreme events. Individual responses and group discussions will be analyzed for the way in which glacial changes are naturally framed, and for the way in which framing affects described past actions or anticipated responses. We will assess the locus of explanation of glacial movement (natural, random, religious), the affect related to this movement, and the association between the two. Following models developed in Madden's thesis, we will gather data on personal and family histories of migration and settlement and of work-related movement (pasture and woodland management, road building) through glacial landscapes. We will also gather extensive community-level data. Of particular interest are the organizational forms of response to glacial-related hazards and resource impacts (individual and collective systems of water distribution; local vs. external responsibility for maintenance of transportation networks threatened by glacial-related landslides; forms of insurance for damage from glacier-related flooding). We will also collect data on public commemorative markers of glacial movement, such as the chapels in Peruvian and Swiss villages that mark points of former glacial advance and memorials to victims of glacial floods. We will examine the effects of histories of settlement, of the proportion of long-established residents and recent migrants, and of the presence of public forms of commemoration on temporal horizons.

In the second year, we will also begin the organization of preliminary results into informational packages. These will be developed for each region in a way that will

address the region-specific framing effects. Other regional characteristics will also be followed in the preparation of these packages. (for example, the lower level of literacy in the Peruvian Andes; the importance of local dialects in the Swiss Alps).

In the third year, we will refine these packages. These packages will be presented in workshops in additional communities in each region. Surveys will be conducted both before the workshops and several months after them in workshop and matched non-workshop communities to assess the effects of these informational materials on individual and community perceptions and encodings of ongoing change and their actions or reactions to such change.

We will then distribute information through networks of mountain and glacier specialists. Orlove had been an editor of the journal *Mountain Research and Development* [http://www.mrd-journal.org/about\\_mrd.htm](http://www.mrd-journal.org/about_mrd.htm) in the early 1990s and maintains ties to colleagues associated with that journal. The International Centre for Integrated Mountain Development (ICIMOD) <http://www.icimod.org.np/index.htm> offers other links. Orlove also has ties to environmental and development organizations in Peru (Oxfam, Lima; Asociación Ancash, Huaraz), Switzerland (International Environmental Studies Unit, Institute for Advanced International Studies, Geneva; Wengen Workshops on Global Change Research, Fribourg) and the western US (Sierra Nevada Research Center, Pacific Research Station, US Forest Service; Alaska Cooperation Research Unit, US National Park Service).

The collective discussions studied here afford an excellent opportunity to examine group processes and goals in framing decisions and in using scientific information, within well-established and cohesive community groups. It will be interesting to see in what respects (if any) these group processes differ from those in more formal and less closely-knit decision-making groups studied in other projects proposed for this Center. Specific links to other components include the following:

Lab 1. This field component will address issues of reference points and temporal horizon framings that are explored in this lab project that centers on framing effects. In our field setting, we will observe inter-individual and inter-group variations in the setting and consequences of these framings. .

Lab 2. This field component will examine the question of prior experiences and risk, since some communities will have had faced glacier-related hazards (floods, landslides) while other will not. This component will also assess the effects of individual differences and group processes in use of forecasts.

Lab 3. This field component will examine differences in strategic orientation. We anticipate that the Peruvian populations will emphasize assuring subsistence needs while US and Swiss populations will emphasize cash income and profit. There may also be substantially different strategic orientations within populations based on age, occupation and other characteristics.

Lab 4. This field component will consider inter-community differences in group identity and goals. We can measure such differences through scoring of group meetings about non-glacier topics, and observe the relations of these differences to decision-making about glacier-related change.

Field 1. This field component will examine water-related issues with some significant similarities to the hydrological issues in Ceará, Brazil. In the areas near glaciers, water

availability can increase (as water stored as ice in glaciers flows in greater amount) or decrease (as glacial retreat increases the distance from sites to the glacier edge, allowing greater loss of water in streams). Water allocation processes will therefore adapt to these shifts.

Field 6. This field component will address responses to extreme events—landslides and floods—which are analogous to the extreme events faced by farmers in the northeastern US. The role of reference point and experience-based framing is particularly relevant.

Field 7. As a high-latitude region, Alaska resembles the high-altitude glaciated regions in its direct experience of climate change at present. This component includes some similar experience-based framing issues and methods of assessing inter- and intra-community variation as well.

Theoretical 1. This field component will examine historical processes of change. The history of human settlement in the near-glacial areas of the Andes stretches back some 5000 years, roughly the same length as the settlement in the Alps, while the Euro-American settlement in the Cascades is barely 150 years. Archaeological and historical research has traced adaptations in the first two cases; it will be interesting to see whether these influence the framing of current glacial change.

Theoretical 4. This field component will examine the role of interdependence on investment, the focus of this theoretical component, through an examination of the investment in community-level adaptations to glacial change, such as construction of new water facilities and of works to prevent damage from landslides. These actions present the same free-rider problems as other forms of collective action, and are therefore a useful case to consider.