Making Global Change Science Matter in Mountains: An Interview with Greg Greenwood, Executive Director, Mountain Research Initiative (MRI)

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Making Global Change Science Matter in Mountains

An Interview with Greg Greenwood, Executive Director, Mountain Research Initiative (MRI)

FIGURE 1 Greg Greenwood at the Sefinenfurgge, Bernese Oberland, Switzerland. (Photo by C. Perey)

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MRD *readers will be aware of the Mountain Research Initiative (MRI) and its activities, as MRI publishes its Newsletter in* MRD*'s "MountainPlatform" section twice a year. Ed.*

MRD: What is your personal interest in MRI's main goal of "supporting the design of integrated research strategies and programs that further the understanding of impacts of global change in mountain areas and lead to tangible results for stakeholders and decision-makers"?

Greg Greenwood: I suspect that I am MRI's Executive Director exactly because my professional objectives coincide precisely with those of MRI. Making science matter to management and policy has always been my professional interest. When I worked for the California Department of Forestry, it was within the Fire and Resource Assessment Program that produced a periodic assessment of California's wildlands and forests, which are principally mountainous, for use by state government. This assessment was developed around a list of policy-relevant questions. The Assessment was widely quoted and referenced in wildland and forest management debates. Later, when I worked as Science Advisor to the California Resources Secretary, the goal was similarly to ensure by all means available that science informed budget and legislative proposals by the Administration.

At the Glochamore workshop in Granada, you presented the results of a questionnaire sent to 28 managers of Mountain Biosphere Reserves (MBRs). A surprising result of this survey was that managers do not consider the impact of climate change to be as important as such issues as tourism, fire, water quality, etc.

I think you are mischaracterizing somewhat the results of the GLOCHAMORE questionnaire. The MBR managers reported cogently on the likely impacts of climate change on their reserves and on such specific aspects as tourism, fire, water resources, and so on. Thus they clearly saw the importance of climate change as a driver within their reserves.

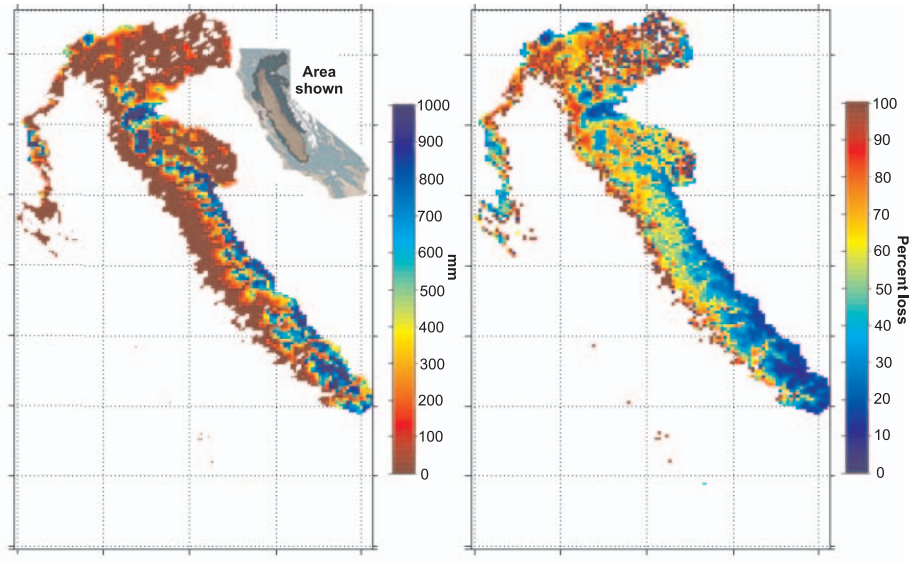
Of course, we at MRI understand that climate change is only one of many global and regional change drivers that affect the MBRs. Climate change is thus embedded within a matrix of other drivers. Frequently, local land use changes or global change drivers such as increases in tourism or new invasive plants pose acute and immediate problems. The questionnaire reflected this understanding and asked MBR managers to report on these drivers as well. The managers reported extensively on development, tourism, and water resources—and not just as sectors that receive impacts from climate change but as sources of change themselves.

From an implementation perspective, it is crucial to understand these other drivers, as it is the cumulative impact of these drivers that the managers are called upon to manage. The surest way to ensure a manager's help in establishing and running a research program is to ensure that the research program addresses issues as they are perceived by the managers themselves. For instance, while scientists may perceive a driver (eg climate change) more clearly, managers are more likely to see issues (eg water resources) driven in part by climate change but also by other drivers (eg tourism development, downstream irrigation needs and distant municipal supply). By developing research programs that quantify those drivers—climate change as well as others—and estimate impacts on the values that matter in a particular MBR, we have a much greater chance of advancing our particular climate change concern in an institutionally sustainable manner.

Do you think there is sufficient understanding of climate change in mountain areas to begin to formulate forward-looking strategies to adapt to future climate change?

Yes and no. Certainly in some sectors we have an understanding sufficient to drive some adaptation strategies. Using a California example and assuming only that temperatures will rise—something that seems like a pretty safe bet—Noah Knowles and Dan Cayan at Scripps have developed scenarios for the reduction of the Sierra snowpack (Figure 2). These scenarios are very useful for planning different water management schemes for the

FIGURE 2 A hydrologic model of the San Francisco Bay watershed (region shown in inset) was run using present-day meteorological inputs and projected 2060 inputs corresponding to a 1.6°C warming projected for California by the Parallel Climate Model. Present-day April snow water equivalents (left) are projected to be reduced by percentages shown on the right by 2060 under this scenario. These changes were further translated into downstream runoff changes and into estimates of increased summer salinity in San Francisco Bay. (Figure 2 reprinted from: Knowles N, Cayan DR. 2004. Elevational dependence of projected hydrologic changes in the San Francisco estuary and watershed. *Climatic Change* 62:319–336. With kind permission of Springer Science and Business Media)



Sierra Nevada and the Cascades, mountain ranges that provide most of the water in the state.

But on a broader scale we do not have sufficient understanding of climate change and its impacts in mountain regions to predict outcomes and plan accordingly. For instance, while we may have great confidence that there will be on average less snow in the Sierra, we have much less confidence in estimating central tendencies and variances in the total amount of precipitation. While knowing that California will receive on average more rain and less snow is helpful, knowing total amounts of expected precipitation would be even more useful.

And as we move away from climatologic variables such as precipitation, toward such variables such as forest composition or rates of fire, we add our uncertainties related to these processes to those of the climate, and therefore have even less certainty. Thus we need much more research on how biophysical and economic systems respond to climate change in order to evaluate adaptation options.

The economic response to uncertainty is savings and insurance, and therefore in the most abstract sense, adaptation at all levels starts with greater savings and insurance, be they in the form of additional food storage, more reserve water (either through more storage or greater conservation), or more diverse economic strategies—all the way to more commercial insurance. However, more savings (ie reducing current consumption in order to create a buffer) is probably an extremely difficult option for those mountain inhabitants who are already living an economically marginal existence. Thus it will be incumbent on higher levels of social organization to create insurance pools in order to spread the risk associated with climate change. However, climate change as a global driver raises some interesting questions: is the risk so pervasive that it is in fact impossible to spread it around? How large must the pool become before one can be confident that only a fraction of those within it will be negatively affected? It may be that with climate change the pool must be quite large.

Thus research provides a key economic benefit by reducing the uncertainty in the estimation of impacts and therefore allowing for a more appropriate level of insurance, in whatever form it might take. The more accurately we know the impacts of climate change, the more we can substitute engineering or other management solutions for insurance.

Besides, prediction is in my mind one of the key characteristics of scientific understanding. Climatology, hydrology, ecology: even if these sciences are unable today to predict outcomes without very wide confidence intervals, the imperative to achieve prediction is still central to their status as sciences. Indeed all my experience indicates that the single most important thing we scientists can do in the policy arena will be to move from asserting the existence of climate change to describing the future climate in terms relevant to policy- and decision-makers. I understand that there are fundamental limits to the confidence with which we can forecast because of the specification of initial conditions, but still it is hardly better than hand waving to present multiple divergent scenarios and state that they are all equally probable. Our goal must be to attach some degree of probability to outcomes.

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"… it seems to me rare that scientists listen to the needs of the investment and policy communities in the development of their research programs, or that these latter communities actively seek the counsel of scientists, when in fact scientists have done relevant research. I would like to see the exchange of information and knowledge institutionalized."

What data and information are needed?

At the very basis of prediction will be better climate scenarios at a scale relevant to mountain regions. To pursue what I said above: presenting a range of divergent but equally (im)probable climate scenarios may be a first step in moving managers away from historically inaccurate characterizations of climate. But the real step forward will be scenarios with associated probabilities at scales that reflect the topographic realities of mountains and in terms of variables relevant to models of other resources sectors.

Just as important will be better land use scenarios for mountain regions. Liberalization of trade and movement is leading to land use change in mountains, be it through the increase in tourism and active recreation, substitutions in subsistence and commercial crops, or intensification of forestry activities. Developing a strategy for biodiversity conservation based on land use or climate change alone would be nonsensical and yet that is largely how it is currently done.

Next we will need much better models that can translate future climatic and environmental conditions into values as perceived by people. For instance, we need hydrologic models that can translate precipitation and snowmelt patterns into stream hydrographs useful for planning power generation, irrigation schedules, and fisheries management. We need species models that will begin with altered climatic patterns, and work through mortality, recruitment and dispersion to generate new patterns of species abundance.

Just which translators we need depends on the issues at play in specific mountain regions. In some areas, mountain economies are imbedded in larger industrial economies and provide tourism and recreation. In other areas, mountains are still areas of subsistence economies. No single set of translators will work for all areas.

What institutional challenges of climate change are specific to mountains?

I hesitate to generalize about all mountains of the world, but with that caution in mind, I would say that mountains, unlike, say, cities, generally do not have a single coherent network of authority that can be mobilized to respond to climate change. Each individual resource within mountain ranges is frequently under the jurisdiction of a different governmental agency, none of which necessarily work or communicate with each other. This fragmentation of authority means that the mountain range as a geographic entity has no concrete existence within the institutions of governance. There is no single venue within which one can discuss the mountain range, its conditions and responses, as a single entity.

In addition, many of the agencies managing mountain resources operate for the benefit of constituencies outside the mountain range. Water resources are a good example: mountain waters are seldom managed for the benefit of mountain peoples but rather for distant urban or lowland constituencies. While this issue is not unique to mountains—it afflicts many peripheral rural areas—it is nonetheless a serious institutional impediment to achieving a strategy that is beneficial to all parties with an interest in the mountains.

What factors do you consider the most important for enabling mountain communities to increase their resilience and adaptation capacity?

Once again I hesitate to generalize: it seems dangerous to lump together Telluride, Cusco, Gilgit, and Innsbruck as if their only differences were locational. At an abstract level, one can work backward from the importance of prediction and insurance to say that knowledge and wealth are the most important factors. Knowledge, as I have described above, would provide communities with the ability to develop new strategies in the light of expected directional changes in climate. Thus research programs that aim at a holistic understanding of mountain climate and ecology, such as those advocated by MRI, are a key prerequisite for improved capacity, as are the existence of research institutions and dedicated funding. Wealth set aside in the form of savings and insurance provides a safety net in the event of unforeseeable

changes. Since mountain regions generally are not areas of great capital formation, or at least do not tend to retain the wealth generated within the region, mechanisms for reinvestment by parties benefiting from mountain resources back into the mountain resource system are essential.

If you could design an adaptation project for a rural mountain community, what would be the focus of the project, and what might be a promising entry point?

Livelihood is the most compelling entry point. Livelihood is the first priority of most people, and global change will certainly affect livelihoods in most mountain regions. For instance, in mountains where most people are involved in subsistence agriculture, the impacts of global change on water supply, slope stability, fire, forage resources, invasive organisms, and disease could be very important. In mountains where tourism, recreation, and other forms of commercial exchange predominate, global change will likely affect the same resources plus the mix of activities and relative attractiveness of the region. If any research project is likely to garner the resources, it would be one focused on livelihood.

Are the specificities of mountain areas reflected in the international agenda, eg in the IPCC, the Kyoto Protocol, or the Clean Development Mechanism?

While I cannot claim an encyclopedic understanding of all the international agreements and programs, their emphasis has been on the very global-ness of climate change (ie the earth science of the atmosphere, the oceans, and the land surface) and the role of anthropogenic emissions, and to a lesser extent land cover change in these inherently global systems. The policy outcomes are therefore focused principally on greenhouse gas (GHG) emissions reduction. To the extent that mountain forests can sequester carbon, the international agenda overlaps with that of mountain areas. But the specific needs of mountain areas to adapt to that component of climate change that has already been engaged because of historic GHG emissions has not been the focus of the international agenda.

There are signs that this is changing slowly. The IPCC reports and the UNFCCC national communications, though still focused on GHG emissions, do have sections that discuss sectors vulnerable to climate change and possible adaptation measures. However, the lack of geographically specific integrated assessment models (IAMs, ie models that translate climate change into impacts on economic, ecological and social values) means that many of these reports are cursory in nature and unable to inform investment or management decisions. The Global Environment Facility has recently begun a pilot program to fund climate change adaptation measures. One of my personal goals is to submit to the GEF a targeted research proposal that establishes a more rigorous IAM for a mountain area, thereby establishing a basis for investment decisions.

What is your vision of interaction between research communities, development agencies and their programs, and governments, with a view to enabling mountain communities to adapt to climate change?

My vision is that there *be* interaction between research, investment, and policy. Again, it is dangerous to generalize, but it seems to me rare that scientists listen to the needs of the investment and policy communities in the development of their research programs, or that these latter communities actively seek the counsel of scientists, when in fact scientists have done relevant research. I would like to see the *exchange* of information and knowledge institutionalized, and MRI is working toward that end. MRI, for instance, is a cosponsor of the CONCORD meeting, to be held in Mendoza, Argentina in 2006, which will bring together the scientific and policy communities to discuss the scientific agenda for climate change research in the American Cordillera. From such meetings may come more permanent and robust exchanges between researchers, agencies, and donors.

Dr. Gregory B. Greenwood, a natural resources specialist trained in agricultural ecology, population ecology, and ruminant nutrition, is Executive Director of the Mountain Research Initiative (MRI) in Berne, Switzerland. His mandate is to develop a strategy to increase and focus global change research in mountain regions throughout the world as part of IHDP and IGBP programs, and as a policy objective of the Swiss National Science Foundation. Greg Greenwood was previously Bioenergy and Climate Science Advisor for the California Department of Forestry and Fire Protection and Deputy Assistant Secretary for Resources/Science Advisor for the California Resources Agency, Sacramento. He has extensive experience with and publications on land use development and ecology, including global change in mountains. *MRD* Assistant Editor Susanne Wymann von Dach interviewed Greg Greenwood in August 2005.