

# High Mountain Glacial Watershed Program

Quarterly Newsletter



## Issue 2

# From the Himalayas to the Andes: Building Local Capacity

One of the exciting aspects of the High Mountain Glacial Watershed Program (HMGWP) is its effort to link the natural and social sciences. Research outputs are used to inform climate change adaptation strategies, and in the process, the HMGWP aims to strengthen social, scientific, and institutional capacity in the places we work. This newsletter will highlight some of those efforts: from community consultations on climate change in Nepal to collaboration with the Glaciology Unit in Peru.

In order to effectively address emerging threats in the high mountains, such as glacial lake outburst floods (GLOFs), a balance between technical information and community engagement is essential. Detailed scientific studies of the hydrological changes occurring in the high mountains, of the glaciers themselves, and of the predicted impacts of these new threats provide a foundation on which solutions can be built. Yet, to develop effective solutions requires consultation and collaboration with local communities, who have their own insights and knowledge of the changes occurring in their environment. This combination of approaches should lead to more successful and resilient climate change adaptation.

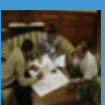
During our Spring fieldwork in Nepal, the HMGWP continued to work on both technical and social aspects of the project in the Khumbu and Hinku valleys. Now, with the monsoon season in Nepal, our fieldwork shifted from the Himalayas to the Andes. Peru has extensive experience in both the scientific and community components of climate change adaptation in the high mountains and glacial watersheds. By working in both the Andes and the Himalayas, and by transferring knowledge between the two regions, our hope is that the experience in Peru can inform the current efforts in Nepal. The Risk Perception Study and the Glacial Lake Handbook from Peru (both featured on page 4) are two outputs that will be essential to this knowledge exchange.

Summer in the Cordillera Blanca is a whirlwind of research activities. In addition to our HMGWP research, our colleagues from Ohio State University and the University of California, Santa Cruz were continuing their work on glacial watersheds, and we developed new connections with the University of Zurich and the Glaciology Unit of Peru. Next summer, the Glaciology Unit will bring together all of the key researchers in the region to discuss current gaps in knowledge and research plans to ensure coordination and synergies. This meeting will complement our third High Mountain Glacial Watershed Program International Conference, which will bring together the HMGWP Community of Practice as well as local stakeholders to experience the "living laboratory" that is Peru's Cordillera Blanca, and to gain first-hand experience with both environmental and social issues in the region through several hands-on modules.

We hope to see you next summer!

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# Insight to Peru's Glaciology Unit: An Interview with Jesus Gomez

Jesus Gomez works for the Glaciological and Hydrological Resources Unit, part of Peru's National Water Authority. He is a member of the Glacier Studies team, and has been a key participant in the HMGWP Community of Practice, having participated in the 2009 Andean workshop as well as the 2011 workshop to Imja Lake. In this interview, Gomez provides insight to the operations of the Glaciology Unit as well as a new capacity building initiative that will provide core hydrology, climatology, and glaciology education to the Unit's employees.



Jesus Gomez at Arteson Glacier during fieldwork in July 2012. Photo by: Daene McKinney

**Kate Voss (KV):** Can you provide an overview of the Glaciology Unit? When was it formed, how is it organized, where do you work?

**Jesus Gomez (JG):** The Unit was formed in 1969. There are currently 13 employees, divided into three areas of work: Inventory, Glacier Studies, and Lake Studies. The Inventory group works to identify all glaciers and lakes in all of Peru. The Glacier Studies team is in charge of monitoring the glaciers and conducting basic research, specifically mass balance and longitudinal changes in the glacier's length. There are four glaciers that we consistently monitor, two in the Cordillera Blanca (Yanamarey and Arteson), one in the Cordillera Vilcabamba, and one in the Cordillera Vilcanota. In the Cordilleras Vilcabamba and Vilcanota, we work closely with the National Service for Protected Areas (SERNANP), the National Water Authority (ANA), and the National Meteorological and Hydrological Service (SENAMHI). The Lake Studies group focuses mainly on inspecting lakes in the Cordillera Blanca and in other parts of Peru, if needed. The inspections are mainly observations, looking for anything dangerous, like overhanging ice or seepage, but we also conduct bathymetry studies on the lakes.

**KV:** How often do you conduct the monitoring? Do you visit each glacier or lake every month?

**JG:** Yes, we try to monitor the monthly changes of the glaciers and lake, especially to compare the dry and the wet seasons.

**KV:** What about the bathymetry, the measurement of the depth of the lake, which provides valuable data regarding the volume as well as the "topography" of the bottom of the lake? Do you repeat those surveys?

**JG:** Definitely. Because the lakes are very dynamic and constantly changing, the bathymetry surveys need to be repeated. For example, with Laguna Palcacocha, we have conducted a bathymetry survey probably three times in the past 10 years.

**KV:** What would you say is the overall mission or responsibility of the Glaciology Unit?

**JG:** Investigation. We collect information about Peru's glaciers and lakes, as well as basic hydrological data, from the less accessible regions of the high mountains in order to inform water management.

**KV:** Does the Glaciology Unit construct any water management systems? I'm thinking in particular about glacial lake control.

**JG:** No, that is not a current responsibility. In the past, yes, the Glaciology Unit constructed the systems to control glacial lakes. Now, the regional government monitors and controls those lakes. We simply provide the data and information, but are not involved in the actual management decisions, policy development, and action.

**KV:** OK. One more question. Can you speak a little about the new education program with the Swiss Development Agency?

**JG:** Yes. It is a very exciting project! The project is with the Swiss Development Agency, the University of Zurich, and the Glaciology Unit to implement an education program, which started in June. There are several professors from the University of Zurich involved in the program. It is a very important project because it is the first time that glaciology education is available in Peru, the first time that glacier-related academic information is here. There are 23 Peruvians in the program, who are from our Glaciology Unit, from the regional government, from SENAMHI, SERNANP, and local universities. The program consists of three 3-week sessions, the first of which was on glaciology and took place last month in Huaraz, the second is climatology and will take place in Cusco in October, and the third is hydrology and will take place in Lima in October as well. It is a project with a profound impact, because as I said, there is no formal glaciology education in Peru, and yet this academic information is very important for our work, and for our understanding of glaciers and lakes in the high mountains.



The Arteson Glacier and new glacier lake during fieldwork with Glaciology Unit in July 2012. Photo Credit: Daene McKinney

## Notes from the Field: Vulnerability and Adaptation Training in Nepal

After the September 2011 Workshop and expedition to Nepal's Imja Lake, the HMGWP developed a plan for more extensive fieldwork in the Khumbu Valley, including additional technical research and the development of a community-driven climate change adaptation strategy. The work in the Khumbu Valley builds on The Mountain Institute's (TMI) strong relationships in the region, particularly with the Khumbu Alpine Conservation Council (KACC). TMI has extensive knowledge of the social, political, and religious dynamics in the valley, so the HMGWP is well positioned to collaborate with communities in the region. Through both technical research and community consultations, the project will identify and evaluate the vulnerabilities that are emerging due to climate change. The HMGWP will work with people in the Khumbu to develop potential adaptation solutions that improve their resiliency to these climate challenges.

Beginning with fieldwork in May 2012, IRG/Engility's Meghan Hartman worked closely with TMI's Alton Byers and Ang Rita Sherpa to design adaptation planning measure throughout the Khumbu region of Nepal. The process works directly with local communities to educate them about climate change, identify assets that are climate sensitive (such as farmland or homes in a floodplain), discuss potential solutions to reduce vulnerability, and develop potential adaptation strategies. The process is driven by the active participation and input of local communities – the facilitators moderate a dialogue and spark ideas.



Based on the plan developed in May, a Community Consultation and Adaptation Planning course was conducted in July 2012 by Hartman and Dr. Glen Anderson, also of IRG/Engility. The course educated Nepali staff from TMI and other local organizations on climate change-related material. Four TMI staff – Ang Rita Sherpa, Phurba Sherpa, Bheem Raj Rai, and Dambar Thapa – will act as the core facilitators for the community consultations in the Khumbu.

The adaptation planning consultation approach uses a variety of methods to educate a community about climate change, to identify the community's development priorities, and to discuss the different climate and non-climate stressors that impact these priorities. Resource mapping exercises, such as the activity illustrated in the photos, are just one interactive tool used during the workshop. After identifying the assets that matter for development and livelihoods, the participants discuss the different climate and non-climate stressors that affect the local environment and the potential impact of these changes on the community. The community may already have experience with specific changes (such as a change in the timing of the monsoon) or may identify larger threats (such as from a glacial lake). In addition, the participants develop and discuss various adaptation options that can be used in planning for climate vulnerability. The curriculum is interactive and is driven by the participation, knowledge, and goals of the community.



In September 2012, the four facilitators will begin consultations throughout the Khumbu region. The goal is to meet with a geographically diverse set of communities in the valley. Three separate consultations will take place in the villages of Phakding, Namche Bazaar, and Dingboche. Each consultation will seek to facilitate a dialogue through which the communities identify their priorities for development, the vulnerabilities unique to their geographic area, and potential adaptation strategies for reducing those vulnerabilities. In addition, University of Texas at Austin's Marcelo Somos and Daene McKinney will update these communities on the newest ground-penetrating radar (GPR) research results from the fieldwork in May and will discuss how these data are being used to predict the impacts of a potential Imja Lake glacial lake outburst floods (GLOF) using flood models.

Top Right: Hartman and Byers discuss the V&A training framework in Dingboche, May 2012. Photo by: Ang Rita Sherpa. Bottom Left: Bheem Rai at the V&A Training of Trainers in Kathmandu, Nepal in July 2012. Photo by: Glen Anderson. Bottom Left-Center: A group discusses the V&A curriculum at the Training of Trainers. Photo by: Glen Anderson. Bottom Right-Center: Phurba Sherpa practices the V&A curriculum during the Training of Trainers. Photo by: Glen Anderson.

## Case Studies of Glacial Lake Management: Peru's Experience

Cesar Portocarrero, a Peruvian engineer with over 50 years of experience addressing the emerging threat of glacial lakes, is completing a glacial lake handbook with approximately 20 case studies of glacial lake risk mitigation. Each case study explains why the lake is dangerous, what was done to reduce the risk, and provides photos – and, in some cases, blueprints – for construction.



There are three case studies with extensive detail: Laguna Palcacocha, Laguna Paron, and Laguna 513. The case studies of these three lakes provide lessons for glacial lake management, and the strategies used in these three lakes can inform current glacial lake management around the world. Portocarrero found that two strategies often emerged as the core solution to glacial lake risk reduction: (1) digging an open cut to drain the lake or (2) constructing a tunnel to drain the lake.

Besides the fact that this portfolio of case studies represents an important body of knowledge for the international community, Portocarrero says that he is proud that this history of glacial lake management was purely a Peruvian success: "It was a Peruvian effort – the money, knowledge, government support, people working at the construction site – all Peruvian. It was an investment of the whole of society. And now, our society is not just addressing problems of glacial lakes, but water management as a whole."

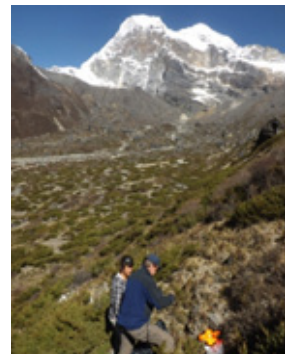


Top Right: Drainage tubes in Laguna Palcacocha. Bottom Right: The drainage outlet at Laguna Palcacocha. Now that the lake has been drained to a stable level, the water is regulated by the local municipality as the main water source for Huaraz.

## Mera Alpine Conservation Group: Success in Alpine Restoration

During our May 2012 fieldwork in Nepal, we traveled to the Hinku valley to conduct GPR research on two glacial lakes (Dudh Pokhari and Tama Pokhari) and to meet with local communities. The main community organization in the area is the Mera Alpine Conservation Group (MACG), which TMI helped to form in 2007.

A joint TMI-MACG alpine conservation project to support the recovery of shrub juniper in the area has seen great success. Dr. Alton Byers and Ang Rita Sherpa ran a systematic belted transect of the region during our fieldwork in May and found that between 2007 and 2012 the shrub juniper has shown significant recovery. Much of this recovery can be attributed to the MACG's efforts to restrict the use of shrub juniper for fuel by developing petrol depots throughout the valley. This is a great alternative to the destruction of the shrub juniper forests, but the MACG has plans for other improved fuel sources. In the future, the MACG hopes to replace petrol with a more sustainable energy source, such as solar power and mini hydropower.



We met with the MACG on May 12, 2012 to share the successful results from the shrub juniper conservation work, to explain our technical research on glacial lakes in the region, and to discuss future opportunities for collaboration. During the meeting, the community expressed interest in a project to develop sustainable energy sources. In addition, we gained new and valuable insight about the hydrological dynamics of the region. While discussing the Tama Pokhari Lake, Dr. Daene McKinney mentioned the possibility of smaller floods due to icefall avalanches into the lake. His suggestion immediately sparked excited dialogue. The community informed us that they had already experienced two smaller floods in 2009 and 2011. This information is vital to understanding the risk of Tama Pokhari. The knowledge gained from this two-way interaction, as well as the successful conservation work, are just two examples of the necessity to collaborate, communicate, and support local communities.



Above: Byers conducting a belted transect of the region during fieldwork in May 2012. Photo by: Ang Rita Sherpa. Below: MACG members during a community meeting in May 2012. Photo by: Kate Voss.

## Building Connections in Peru: Presentations During the July Fieldwork

### Effects of the Reduction of High Mountain Glaciers on Water Resources

On July 2, 2012, HMGWP co-manager Dr. Daene McKinney and TMI Peru Director Dr. Jorge Recharte presented at a conference titled "Effects of the Reduction of High Mountain Glaciers on Water Resources." The conference was organized by CARE International, the University of Zurich, and the Swiss Agency for Development and Cooperation. The event was hosted at Peru's National Water Agency (ANA) and provided a unique opportunity to strengthen relationships with ANA as well as the other organizations in attendance. One of the main issues raised at the conference was the need to increase technical capacity for glaciology in Peru. There are currently no university programs in glaciology, which is a significant obstacle for a country seeking to understand glacier dynamics in the high mountains and to successfully manage emerging glacial lakes. As a solution to this lack of capacity, CARE and the University of Zurich, led by Dr. Wilfred Haeberli, have been implementing glaciology curriculum modules to educate practitioners in Peru's Glaciology Unit in essential glaciology and hydrology concepts, such as mass balance, modeling, and fluid dynamics.

McKinney, Recharte, and TMI's Kate Voss met with Dr. Haeberli before the conference to discuss the HMGWP's current work in Peru and to begin forging a partnership for both capacity building and research activities related to glacial watersheds in Peru's high mountains. One immediate project will bring together the HMGWP, the University of Zurich, and the Glaciology Unit is the evaluation of an emerging glacial lake at the Arteson Glacier. There is limited information about the lake, but it may pose a threat as it continues to grow and evolve in the upcoming years. By linking the expertise of these three organizations, the hope is to better understand the dynamics of the Arteson Glacier and the new glacial lake in order to develop the best strategy to limit the risk of a glacial lake outburst flood.

### Ground Penetrating Radar (GPR) Results of Pastoruri Glacier

During our summer fieldwork, the HMGWP conducted a GPR survey of the Pastoruri Glacier. On July 13, 2012, Marelo Somos, a Ph.D candidate at the University of Texas at Austin, presented the results to the Huascan National Park and the Municipality of Catac. The National Park is planning an interactive climate change exhibit that will be located at the Pastoruri Glacier. The National Park and Municipality were excited to receive the data results as well as the accompanying images of the glacier layers, which they hope to use for the climate change exhibit and for future management of the Pastoruri Glacier.

## TMI Partners with EWB in Peru

The Mountain Institute is partnering with Engineers Without Borders (EWB) – Greater Austin Chapter to complete a water resources project in Huasta, a small village in the Tres Cuencas Commonwealth. The main goal of the project is to develop a new community irrigation system from three potential water sources. While collaborating with the community on improving a water treatment plant, the Huasta community members informed the EWB team of a new vision for an irrigation system. The irrigation water would be used to grow alfalfa or other crops as pasture for dairy cattle. With dairy cattle, the town can begin producing cheese to participate in a new "mountain cheese" market that is rapidly emerging, with demand in the Cordillera Blanca and other parts of Peru, including Lima. During two weeks of fieldwork in July, the EWB team met with the local community assembly and municipality officials, and began to survey the three potential water sources.

## Khumbu Alpine Conservation Council: A Core Partner in the Khumbu

The Khumbu Alpine Conservation Council (KACC) was formed in 2005 with the support of The Mountain Institute, and was the region's first local NGO. The KACC gained a reputation through its alpine conservation and restoration work, and has since initiated projects for alternative energy, sustainable tourism, and community development in the Khumbu region. The KACC has actively supported the HMGWP work in the Imja valley, and is a core ally of the program.

During our fieldwork in May 2012, we presented the KACC with new informational panels for their headquarters and to provide an update of our work.

We were also excited to see two wind-power turbines at the entrance to the HQ, a new addition since we were last in the Khumbu in September 2011. The KACC is implementing alternative energy trials in an effort to find the best power sources for the valley. In the future, the KACC expressed interest in developing mini-hydropower in the area. The HMGWP has plans to collaborate with the KACC to facilitate a feasibility study, and to continue to support the KACC in their conservation efforts.



Ang Rita Sherpa presenting the new informational panels to the Khumbu Alpine Conservation Council in Dingboche, Nepal, May 2012.

Photo by: Kate Voss

## Congratulations to the Climber-Scientist Grant Recipients!

The Climber-Scientist Small Grant program seeks to provide field-based, hands-on research opportunities for scientists and practitioners in many of the world's most poorly studied mountain regions. The grants program supports the next generation of high mountain physical and social scientists, including those with little climbing experience. Below are the first-round grant recipients and project titles.

### Adam French (UC Santa Cruz)

Integrated and Participatory Risk Management in Peru's Lake Paron Glacier Basin

### Ms. Ulyana Nadia Horodyskyj (CU-Boulder)

Quantifying Supraglacial Lake Changes: Contributions to Glacial Ice Volume Loss and Runoff Inputs to Rivers in Nepal and Tibet

### Raúl Augusto Loayza Muro (Universided Peruana Cayetano Herida)

Natural acid and metal leaching in Andean headwaters: an interdisciplinary approach to evaluate water quality and potential sources for remediation in a climate change context in the Cordillera Blanca (Peru)

### Stephanie Spray (Harvard University)

Snow River Film Project, Nepal

### Laura Read (Tufts University)

Community Water Management in the Tres Cuencas Commonwealth

### Shah Raees Khan (University of Manitoba)

Understanding Vulnerabilities to Environmental Hazards in Mountain Areas: A Case Study of Climate Change Analysis on Livelihoods in Northern Pakistan

### Institute of Environmental Engineering (Zurich, Switzerland)

Including the Sherpa Factor in Water Resources Projections in the Nepalese Himalaya

### ATREE (India-Nepal)

Climate change in Kanchenjunga TCA: Vulnerabilities and adaptive capacities

### Resources Himalaya Foundation (Nepal)

Building Climate Change Resilience Capacity of Mountain People in Nepal

### The Research Foundation of SUNY (Russia-Altai)

Climate change in the Altai Mountains

### Geo-Science Innovations (Nepal)

Investigation of the Seti River disaster (May 5, 2012) and assessment of past and future mountain hazards facing Pokhara, Nepal and upstream communities

## Summer 2012 Peru Fieldwork Summary

During the July 2012 fieldwork, ground-penetrating radar (GPR) surveys of one glacial lake (Laguna Palcacocha) and two glaciers (Pastoruri and Arteson Glaciers) were completed. The results of the Pastoruri Glacier survey were presented to the Huascarón National Park, the Municipality of Catac, and the Glaciology Unit. The data from Laguna Palcacocha and the Arteson Glacier are still being processed, and will be presented to key stakeholders in Fall 2012.

The GPR survey at the Arteson Glacier is of particular interest because there is a new glacial lake forming at the tongue of the glacier. If this lake continues to form, it could burst and cause a catastrophic flood when it merges with the downstream Laguna Paron. UT-Austin Ph.D candidate Rachel Chisolm will use the GPR data collected during our summer fieldwork to predict the formation of the lake and share this information with stakeholders in Huaraz to inform future management of the glacier and the lake.

TMI Peru completed a risk perception study that describes community opinions about the threat of glacier lakes and climate change in the Cordillera Blanca. The findings are being summarized and will be published in August 2012. In addition, TMI Peru provided key support to a new Engineers Without Borders project in Huasta, a village in the Tres Cuentas Commonwealth.

The HMGWP continued to develop relationships with the Municipality of Catac, the Huascarón National Park, the Glaciology Unit, CARE International, and the University of Zurich. HMGWP will partner with these agencies and organizations on future projects, including a climate change exhibit at the Pastoruri Glacier as well as research that will predict the formation of glacial lakes in the Cordillera Blanca in order to inform proper management.

July 2012 fieldwork participants include: Dr. Alton Byers, Dr. Daene McKinney, Dr. Jorge Recharte, Marcelo Somos, Rachel Chisolm, Cesar Portocarero, Jesus Gomez, Alejo Cochachin, Kate Voss, Carie Goodman McKinney, Gabriela Lopez, and Neil Borland.



Conducting a GPR survey on Pastoruri Glacier in the Cordillera Blanca in Peru during fieldwork July 2012. Photo by: Kate Voss