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20. Taking stock of transformative research and education on mountains. What future avenues?

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20.1

Donkeys, Deer, and Death around the Swiss National Park: Developing a relational values approach to align environmental values in sustainable development

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Environmental values are important for many sustainable development and transformation contexts in mountain regions—particularly in participatory decision making (Fish, 2011; see Gregory, Failing, Harstone, Long, & McDaniels, 2012) or ecosystem services assessments (Millennium Ecosystem Assessment, 2003) and implicitly in policies and programs for sustainable development (O’Neill, Holland, & Light, 2008; West, 2006). When values are included in sustainable development efforts, usually one of two approaches is used: instrumental values focus on the benefits from nature for people whereas intrinsic values reflect the idea of nature’s value for its own sake.

Yet neither of these approaches effectively captures a wide range of values that motivate many people to care for land, ecosystems and species. For many people, relationships with nature and with other people via nature better characterize how they value and view their biophysical environment. This research project seeks to elaborate a relational values approach to sustainable development with a focus on Swiss alpine agro-ecosystems. Relational values include values such as stewardship and care, kinship and connection towards nature, concepts such as ‘eudaemonia’ which refers to living a good life in harmony with nature, as well as values around responsibility towards nature (Chan et al., 2016).

Interviews with farmers in the vicinity of the Swiss National Park along with philosophical analysis serve to elaborate an approach to relational values and develop the conceptual foundations of this emerging research area. We present preliminary results from 32 interviews conducted in March 2019 with farmers in Val Müstair and the Lower Engadine. We also discuss the broader implications of a relational values approach for transformative research and education, in particular in agricultural mountain landscapes.

Figure 1. Relationships and Relational Values of Farmers (examples)
Farmers relate to different types of entities in their environment, such as those shown in the figure above. Qualitative interviews with farmers involved a dialogue and conversation guided by the researcher that provides participants with the opportunity to express and reflect upon their valued relationships and examine the limits and motivations for these values.
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20.2
Complexity in minds – young peoples’ pre-concepts about interactions of climate change in High Alpine Mountains spheres

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The complex interactions of climate change on different spheres in the High Alpine Mountains with their temporal and spatial delays as well as secondary and feedback effects present great challenges for learners (McNeal et al., 2014). As transformative knowledge about tackling climate change and its consequences ought not to be generated by natural science studies alone, transdisciplinarity in science-society interactions are required. With today’s generation of children and youths who will be confronted by the effects of climate change during their entire lifetime, access to comprehensive interdisciplinary system knowledge is facilitated by a planned research-education cooperation. By applying the scientific learning format of the long-lasting Austrian climate education initiative of k.i.d.Z.21 – competent into the future (Keller et al., 2019), an increase of climate change awareness of 14-year old high-school students from Austria and Germany has already been scientifically proven (Kuthe et al., 2019). As an innovative High Alpine research area, Kauner Valley located in the eastern central Alps will be opened up in which students will do their inquiry-based research with the help of visible climate change indicators on soil, permafrost, vegetation and geomorphology at the end of a school year. For providing an effective learning intervention, this paper examines pre-concepts of 350 high school students regarding the effects of climate change on the High Alpine Mountain cryosphere and pedosphere at the beginning of the school year of 2019/2020. Aiming at fostering conceptual change by transdisciplinary, moderate constructivist learning intervention, in particular replacement, differentiation, coalescence and assimilation (Carey, 1985, & Krüger, 2007) of pre- and misconceptions regarding the effects of climate change on cryosphere, pedosphere and adjacent fields, like vegetation and geomorphology, will be analysed during an overall time period of three years (Heckmann & Morche, 2019; Moscatelli et al., 2017; Puissant et al., 2017; Zollinger et al., 2015).

By a mixed-method approach, containing an online survey with qualitative and quantitative questions which is further complemented by conceptual maps (Sellmann, Liefländer, & Bogner, 2015), the learning intervention will be analyzed before and after a school year by MaxQData and by IBM SPSS Statistics. Based on these results, the learning settings will be further adapted and developed for enabling transformative climate change education programmes in High Alpine Mountains.

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20.3

Knowledge flows and co-production of knowledge: rural climate change adaptation of populations near glaciers in Peru and Switzerland

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Measures to address climate change adaptation respond to multiple and diverse knowledge demands. However, the types of knowledge that are considered relevant, and how these transform as they flow from source to users, are less understood in context. A project was designed and implemented to identify and clarify the diverse types of knowledge, including information, that are considered as relevant by different actors in a given rural mountain context, as basis for responding to climate change and that transformations that ensue in social-ecological context such as communities in mountains. Through this project, a process to first analyse the flow of knowledge and information from its source, to how it is accessed, understood, valued, and ultimately used, was designed and elaborated. This is important to understand and address as a key condition for improving the co-production of knowledge that is relevant and amenable to the context, given the imperatives to ensure successful and effective adaptation through implementation. These analyses as crucial input for the elaboration of future projects. For the design process, a focus on rural mountain communities living near glaciers, given the current trends surrounding risks from glacial retreat. Following the principles of transdisciplinary research in a transboundary context, it was deemed important to intensify an existing productive collaboration between partners from Peru and Switzerland in this project, and establish a working foundation from which to extend a collaboration also with partners from other mountain regions in the Andean countries such as e.g. Bolivia, Chile or Ecuador as part of a proposed future project. In this presentation, I focus on presenting the results achieved with the whole research team and partners consortium, and engage with the symposium participants to invite feedback.
Wildfire and transformation. Shedding light on the challenges of transformative research in mountains through wildfires

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As stated in the symposium description, key interdependencies and complexities of environmental problems have not been sufficiently accounted for to fully explore the solutions space in transformative research. In this paper we use wildfires to shed light on this question. Wildfires are treated as empirical phenomena which analysis facilitates a synthetic diagnosis of the key social-ecological links underlying the unsustainability of mountain regions, as well as an attractive entry point for both researchers and practitioners to better grasp the solution space.

My contribution is based on two interrelated research types conducted in the Spanish region of Catalonia during the last years: 1) Analysis of social-ecological relationships and processes underlying wildfire risk through qualitative research (Otero & Nielsen, 2017), and 2) Analysis of my (and my colleagues) attempts to change those relationships and processes through action-research interventions (Otero et al., 2018).

In Catalonia, changing land-uses and settlement patterns (rural outmigration, land abandonment and urbanisation) and a warmer climate have resulted in a very fragile social-ecological system concerning wildfires. After the large wildfires of the 1980s and 1990s, a reconfiguration of the wildfire management system was enacted by the regional government based on a reduction of fires starting and a rapid response with water from fire engines and aerial means. In the late 1990s a group of wildfire fighting specialists was created in the Fire Department that incorporated the use of fire as a prevention and suppression technique and that emphasized the need to understand wildfires as an inherent part of Mediterranean mountains. According to our analysis, the consolidation of this group highlights how learning to coexist with wildfire in Catalonia has triggered a set of transformative processes in institutional arrangements and power relationships of both the wildfire management system and forested mountain ranges. Our data also illustrate why and how coexisting with wildfire under a changing climate entails a dramatic and still incomplete social-ecological transformation in terms of land-uses, settlement patterns, energy supply systems and social values about nature. Efforts so far are unable to reverse the general historical trajectories underlying risk (urbanization and forest transition). Data suggests that in the absence of such systemic changes, management improvements might reinforce risk.

Through several action-research projects co-designed with wildfire managers and other stakeholders, we have tried to intervene in this context in order to transform its main social-ecological relationships and processes underlying risk. In particular, we have focused on the development of participatory planning networks composed of scientists, decision-makers and citizens across governance scales to build resilient landscapes and communities. Our method combined expert knowledge on wildfire regime, participatory co-valuation of landscape, and deliberation about alternative policy options. Integrating the data on landscape values into the wildfire models of the Fire Department allowed us to identify strategic areas where preventive interventions would minimize the loss of social values. In turn, sessions facilitated a debate about transformative measures and policies to reduce wildfire risk down to acceptable levels. Our action-research shows that these networks have the potential to build resilient landscapes by reducing the fuel continuity of mountain ranges, re-defining agency over landscape and fostering re-learning on fire among community members. We identified several challenges that would need to be tackled if the transformative potential of these endeavours is to be maximized: the difficulty of implementing the preventive interventions once the project finishes, institutional and funding obstacles to long-term engagement in trans-disciplinary research projects, and a trade-off between high wildfire risk and democratic management resulting from the current social-ecological setup. Our experience reveals the that legitimacy and conflict management within wildfire planning networks may have a key role to enhance their transformative potential in mountain regions and beyond.

In conclusion, wildfire (social-ecological) studies are well suited to inform research on and for the transformation of mountain regions. First, they facilitate a shift in analytical focus: from managerial improvements (technical knowledge) to the conditions for and implications of their effective implementation (transformative knowledge), including potential side-effects of “solutions”. Second, they show how interventions to accelerate transformations can benefit from such an analysis, as well as some of the challenges ahead. Finally, they suggest that one priority avenue for transformative research in mountains should be the identification of research objects that facilitate synthetic approaches. In the face of pressing environmental problems, such objects could help us to rapidly integrate apparently contrary disciplines and guide us in the acquisition of transformative knowledge.
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P 20.1

Socio-ecological and environmental survey of a cinchona plantation village situated in the Eastern Himalayas, India: Ecotourism and sustainable development perspectives

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The Eastern Himalayas in India demonstrate diverse ecological characters in its varied range of flora and fauna. The local communities also form an integral part of the ecological landscape; deriving various services from the forest and mountain ecosystems. Many scattered hamlets are found in this zone and some of them are proximate to the forests enriched with endemic biodiversity. Wholesale (27°1'59" N, 88°51'45"E) is a small village situated in Kalimpong district, India and is proximate to Neora Valley National Park and Gorumara National Park in the Eastern Himalayas. The village has 98 houses with a total population of 451 individuals. Wholesale village has extensive coverage of Cinchona plantation and is a part of Dalagaon division of Rongo cinchona plantation in West Bengal, established in 1938. A detail survey of the village was done in April, 2019 to explore the socio-environmental and socio-ecological dynamics of the landscape. Structured questionnaires and semi-structured interviews supplemented by field notes were arranged to collect data from the village. There was particular focus on agriculture, livestock management, traditional water management, waste management, disaster management, biodiversity and ecosystem services. The development of ecotourism was analysed through the number of homestays, modes of communication and promotion, tourist inflow data and ecotourism activities (trekking, bird watching, camping, rafting, cultural visits etc.). Biodiversity of the region was documented by visiting the forest areas in Neora Valley National Park and Gorumara National Park; possible threats to biodiversity were documented. Management strategies were suggested for conservation of forest biodiversity and sustainable development of the village areas. Coexistence of ecotourism and conservation measures can have significant impact on the sustainable development in the transboundary Himalayan landscapes. Detailed study is needed in the Eastern Himalayan villages to explore the socio-ecological dynamics in the context of climate change.

REFERENCES
P 20.2

Integration of ecological, socio-economic and food quality indicators of extensive sheep grazing systems in mountain marginal lands the case of Cantabrian Mountain Range (Northern Spain)

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Rural landscapes are facing numerous transformations under the influence of competing global markets, new policies (e.g. the Common Agriculture Policy in Europe), industrialization of the food industry and changing lifestyles, among others. The consequences of these changes are remarkable in mountain areas where extensive sheep grazing systems, developed since ancient times, are at risk. In this context, it becomes critical to assess the ecological, economic and nutritional benefits of these systems in order to ensure their sustainability. Based in a research experience developed over the last 15 years in a mountain area in the Cantabrian Mountain Range (Northern Spain), this article assesses the contribution of mountain sheep grazing in socio-economic, ecological and nutritional terms. With this purpose, we develop an integrated evaluation that combines ecological, socio-economic and food quality indicators. The study shows that in addition to the benefits associated with the production of healthy and high quality food; these systems contribute to biodiversity conservation and rural development, through the generation of employment and income, in mountain marginal lands with low productivity and few economic alternatives. Urgent measures are needed to maintain these benefits and associated socio-cultural values. In addition to the effort of integrating disciplines that work at different scales and narratives, we would like to open the debate on how to include the transformative research approach to our agenda.
P 20.3

Empowering you women from Central Asia on glaciers: A new scientific communications program

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"Adventure of science: Women and glaciers in Central Asia" is a program which takes young Central Asian women from diverse backgrounds to an expedition in an alpine environment. The instructor team consists of female scientists and a female mountain guide. During the program, the participants (i) get an introduction into glaciology, cryospheric sciences and environmental change; (ii) they acquire mountaineering and wilderness camping skills; (iii) their observational and critical thinking competences are fostered; and (iv) tailored specific activities provide an introduction into scientific methods. The expedition is surrounded by pre- and post-course events, where the experiences gained by the participants are discussed with a wider public. A further aim of the project is to build up a regional network of female scientists and professionals working in domains affected by climate change.

The idea of the program is based on the "Girls on Ice" (i.e. "Girls on Ice Switzerland") programs coordinated by "Inspiring Girls Expeditions" (IGE 2019). The basic teaching concepts such as inquiry-based teaching and experimental learning are adopted therefrom. The programs combine science, art and mountaineering subjects. A central course element are scientific projects, which are planned and realised as a team work by participants and supervised by the instructors. The new program is addressed to young adults whereas “Girls on Ice” participants are teenage girls. Therefore, “Adventure of Science: Women and glaciers in Central Asia” includes capacity building components. Whereas “Girls on Ice” mainly aims on the personal development of the participants, “Adventure of science: Women and glaciers in Central Asia” not only aims on making young women more self-confident to proceed a career in male dominated domains, but also envisages to grow a network of young women across national borders.

Participants from different countries in a region prone to conflicts (Tashtemkhanova, 2015) grow together as an expedition team and events organised within the project gather women from different countries to provide platforms of exchange. The program focus on glaciology and the hands-on research project raises the participants’ awareness of the relevance of in-situ data. The project also aims on an institutional impact by highlighting the ongoing changes in mountain environments and the necessity of cryospheric data. Furthermore, local institutions are encouraged to include young female scientists and students into academic activities and research. For the first two years “Adventure of science: Women and glaciers in Central Asia” is organised within the project CICADA financed by the Department of Geosciences of the University of Fribourg and the Swiss Agency for Development and Cooperation in close collaboration with the UNESCO Office in Almaty and local institutions. From the beginning, local women from the different target countries have been part of the organisational and instructor team. A stepwise handover of the program to only local instructors is aimed on.

REFERENCES
Transformative interdisciplinary research on mountains. The role of serendipity

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The complexity and urgency of the environmental crisis have triggered calls for research that transcends disciplinary boundaries and that effectively responds to societal challenges since decades. Such a call is prominent in mountain studies, where this kind of research is supposed to play a key role in the transformation of mountain regions towards sustainability. Deeper knowledge of inter- and transdisciplinary research processes on mountains is thus crucial to better understand the prospects and priority avenues for transformative research.

In this paper we explore this topic by drawing on the first year of activities of the Interdisciplinary Center for Mountain Research (ICMR) of the University of Lausanne. The ICMR was created in September 2018 with the goal of promoting interdisciplinary research to contribute to the sustainable development of mountain regions. Our goal is to shed light on the interdisciplinary research processes underway at ICMR and the role that mountains as research objects play in such processes. We are likewise interested in exploring the potential contribution of such processes to the transformation of both mountain regions and researchers. Our methods are based on 1) a series of internal workshops with ICMR members where the goal was to advance interdisciplinary work, and 2) qualitative content analysis of interviews with ICMR researchers and notes from participant observation in workshops. We focus on key aspects that according to the literature on inter- and transdisciplinarity are relevant to diagnose research prospects and thus transformation avenues: researchers’ motivations, types of interactions between disciplines, modes of interaction with stakeholders, challenges, learning processes, and leverages for successful work. In addition, we pay attention to serendipity (accidental discovery of things), a crucial element of scientific discovery which has nevertheless received little attention in the literature on interdisciplinarity and transformative research.

Our results show that motivations to engage in interdisciplinary projects ranged from a need to respond to fundamental (disciplinary) research questions to solving concrete societal problems in collaboration with stakeholders. ICMR researchers reported to use diverse ways to make the interaction between disciplines possible, including: quantitative analysis of qualitative data, methodological juxtaposition to answer common research questions across disciplines, and connecting sub-system models to understand landscape dynamics in a holistic way. Challenges faced by interdisciplinary researchers included difficulty of integrating qualitative and quantitative approaches, disparity of disciplinary languages and methods, and lower evaluative performance in terms of publications. ICMR’s interdisciplinary research projects had diverse ways to engage non-academic actors. The role of the latter ranged from being only beneficiaries of the project’s results (through dissemination) to active co-producers of research questions and methods. A crucial challenge mentioned by our researchers regarding non-academic actors was to actually know what they want from scientific research. The role of intermediaries was highlighted as necessary to ensure a fruitful link with them.

Several factors – somehow contrasting – were listed as leverages of success in ICMR’s interdisciplinary projects. On the one hand, a careful planning of interdisciplinary exchange (e.g. including it in the agenda of meetings as a point in itself) was considered crucial. On the other hand, researchers mentioned the importance of having a common site where unexpected interactions between projects from the natural and social sciences can occur (serendipity). Actually, serendipity – being open to unexpected discoveries – emerged in our data as a potentially constitutive element of transformative interdisciplinary research. Not only this was mentioned as a source of significant disciplinary and interdisciplinary discoveries (in topics as distant as glacier flow and ancient history), but it also emerged as the possibility of discovering something unknown in general. Indeed, when talking about their interdisciplinary research projects on mountains, ICMR researchers referred to an unknown world which remains to be discovered. Our data suggest that mountains are particularly suitable objects for transformative interdisciplinary research. This is so not only because they show clearly observable social-ecological interlinkages, but also because via different characteristics – such as beauty or peace – they are able to attract the attention of scientists in such a way that their research can move forward in unexpected, creative and transformative ways.

By shedding light on several aspects of the research processes on mountains underway at ICMR, our paper advances the literature on interdisciplinarity and transformative research in the mountain community and beyond. In particular, it confirms
or nuances some of the debates held in this literature regarding motivations, challenges and leverage factors. In addition, our paper adds the insight that serendipity seems to be a constitutive element of interdisciplinary research, and that being open to the unexpected at the personal and institutional levels can unveil creative solutions to transform mountains, mountain communities and the researchers working on them.
Towards transformation: on the path between climate change challenges, resilience and sustainable development.

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Even if current attempts to terminate anthropogenic emissions of greenhouse gases are successful, future generations will have to cope with many impacts of climate change. For that reason, the development and implementation of appropriate strategies to adapt to a changing climate is vital, both on a local and on a global scale. In the Alps the capacity to adapt to climate change is higher than in many other mountain areas. Even though, the Alps belong to the regions most affected by the impacts of climate change, their financial power, political stability and existing institutions for interregional and international cooperation provide favourable conditions for effective adaptation (EEA 2009).

Furthermore, there is growing evidence that especially education is a key determinant for which adaptation path we choose (Noble et al. 2014). Culture, by evoking collective outlooks and behaviours, is crucial to how societies react to climate-related risks (Adger et al. 2013). Changes in cultural norms and values affect adaptation limits positively or negatively (Klein et al. 2014). Therefore, adequate adaptation to the impacts of a changing climate involves a social learning process (Noble et al. 2014), which can be fostered by educational activities. A central question that needs to be addressed a priori in this context is, though, how we define successful adaptation.

Initially, adaptability has been understood as the capacity to preserve the status quo of natural and human systems by incremental adjustments to observed changes in climate. Recently, potential limits of incremental adaptation to progressing climate change have attracted considerable attention. Facing the uncertainty of the characteristics and cumulative impacts of future climate, transformational adaptation may be essential, altering the system itself (Klein et al. 2014, Noble et al. 2014, O’Brien 2012). Nonetheless, it has to be taken into account that transformational pathways naturally threaten the interests of those who benefit most from the present state (Pelling 2011, cited in O’Brien 2012). This seems to constrain transformational adaptation on different scales and in different ways and also might represent a key challenge for educational approaches concerning the climate change adaptation in the Alps.

We evaluated the potential of an educational project focusing on adaptation to climate change to foster local climate-resilient sustainable development pathways in North and South Tyrol. The content analysis of posters, presented by secondary school students after a one-year educational intervention incorporating both scientific and lay knowledge, revealed the challenges of such actions.

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