

Title: Expert survey data on key challenges, drivers, and ecosystem services across mountains worldwide.

Abstract: Mountain social-ecological systems (MtSES) are vital to humanity, providing ecosystem services to over half the planet's human population. Despite their importance, there has been no global assessment of threats to MtSES, even as they face unprecedented challenges to their sustainability. With survey data from 57 MtSES sites worldwide, we test a conceptual model of the types and scales of stressors and ecosystem services in MtSES and explore their distinct configurations according to their primary economic orientation and land use. We find that MtSES worldwide are experiencing both gradual and abrupt climatic, economic, and governance changes, with policies made by outsiders as the most ubiquitous challenge. Mountains that support primarily subsistence-oriented livelihoods, especially agro-pastoral systems, deliver abundant services but are also most at risk. Moreover, transitions from subsistence- to market-oriented economies are often accompanied by increased physical connectedness, reduced diversity of cross-scale ecosystem services, lowered importance of local knowledge, and shifting vulnerabilities to threats. Addressing the complex challenges facing MtSES and catalyzing transformations to MtSES sustainability will require cross-scale partnerships among researchers, stakeholders and decision-makers to jointly identify desired futures and adaptation pathways, assess tradeoffs in prioritizing ecosystem services, and share best practices for sustainability. These transdisciplinary approaches will allow local stakeholders, researchers and practitioners to jointly address MtSES knowledge gaps while simultaneously focusing on critical issues of poverty and food security.

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Keywords: social-ecological systems, mountains, sustainability, drivers, ecosystem services

Format: .xls and .pdf

Location: Survey data are from experts working in 57 different mountain systems around the world.

Time period: Survey responses were collected between 2014 – 2016

File information: a single Excel workbook file titled “Synthesis_Data” is provided. There are three sheets within the workbook titled “MtSES_57sites”, “ES_scales”, and “Drivers_scales”. The “MtSES_57sites” sheet has 77 variables, which are described under Variable Information. The “ES_scales” sheet has 15 variables, and the “Drivers_scales” sheet has 5 variables, all described below.

An archival copy of the data has also been produced using the ExcelArchivalTool (<http://z.umn.edu/ExcelTool>) and included in ExcelArchivalTool-output.zip. This includes .csv files for each sheet and a HTML snapshot of Excel formatting.

Variable information:

“MtSES_57sites” variables:

Code: Individual code for each of the 57 sites

Site: Name and country of each site

Contributor: Site expert who completed the survey

LandUseCluster: Name of the cluster resulting from our analysis of variables L-1 through L-8

Mountain Characteristics: five variables that indicate the relative importance of these characteristics for each site. 1 = Not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important

MC-1 Geographic and cultural complexity and diversity

MC-2 Remoteness and isolation

MC-3 Marginalization (social, economic, political)

MC-4 Cross-scale ecosystem services

MC-5 Hazards

Incongruities (“Paradoxes” in the manuscript): six variables that indicate the relative importance of each incongruity/paradox for each site. High importance was given only when BOTH aspects of the incongruity/paradox applied to the site. 1 = Not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important

I-1 Resource-rich, but fundamental scarcities exist

I-2 Policies affecting mountain systems are often made by outsiders

I-3 Remote, but a range of actors connected to mountains through mountain ES

I-4 MtSEs experience multi-directional demographic shifts (i.e., in- and out-migration by different populations)

I-5 Isolated, yet highly vulnerable to global change due to high exposure and low adaptive capacity

I-6 Require fine-scale data, but data are lacking

Incongruity Components: The incongruities/paradoxes were broken down to understand relative importance of each component to the site. 1 = Not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important

I-1a Resource rich

I-1b Local resource scarcities and/or locally income poor (local scarcity can be seasonal and not occur over the whole year)

I-2a Policies and control largely within mountain region

I-2b Policies largely by outsiders

I-3a Remote and isolated

I-3b A range of actors is connected to the mountains through mountain ES

I-4a People are moving into this mountain region (in-migration)

I-4b People are leaving this mountain region (out-migration)

1-5a High exposure to global change

1-5b High sensitivity to global change

1-5c Low adaptive capacity to deal with impacts of global change

I-6a Requires fine-scale data

I-6b Data lacking

Land Use Activity: Eight variables indicate the degree to which land uses are important to the system. 1 = Not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important

L-1 Agriculture: Pastoral/ranching

L-2 Agriculture: Crops

L-3 Logging (does not include firewood collection)

L-4 Non-timber forest products (e.g. firewood collection, mushroom harvesting, etc.)

L-5 Non-livestock rangeland products

L-6 Mining (includes clay and pigmented soils)

L-7 Tourism

L-8 Residential

Subsistence or Market-based? 1 = subsistence, 0 = market based

L-9 Predominantly subsistence based? (Here, just check "Yes" or "No")

Ecosystem Services: thirteen variables represent the level of importance of each service for the site. 1 = Not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important

For each ES, we asked for the scale of importance too: local/regional/global

ES-1 Forage

ES-2 Food

ES-3 Fuel/Power

ES-4 Fresh water

ES-5 Timber

ES-6 Non-timber forest products

ES-7 Minerals

ES-8 Tourism/recreation

ES-9 Spiritual/religious/cultural/aesthetic

ES-10 Medicine

ES-11 Hazard protection (e.g., from avalanche, flood, etc.)

ES-12 Maintenance of cultural and/or biological diversity

ES-13 Payment for carbon sequestration programs in place

Local Knowledge: the scale of importance for local or traditional ecological knowledge in the site. 1 = Not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important

K-1

Social and Biophysical Presses and Pulses: forty variables indicating the degree to which these presses and pulses are important drivers of change in the site. 1 = Not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important

For five variables, we ask for the scale of importance: local/state/national/international

SocPulse_1 Markets (e.g., economic crises, etc.)

SocPulse_2 Governance/policy changes

SocPulse_3 Land tenure change

SocPress-1 Markets (e.g., globalization, increased amenity value, etc.)

SocPress-2 Policies

For the remaining 35 variables, we asked for the scale of importance: local/state/national

SocPulse_4 In-migration

SocPulse_5 Out-migration

SocPulse_6 Land use change

SocPulse_7 Resource extraction

SocPress-3 Cultural change

SocPress-4 Population growth / In-migration

SocPress-5 Out-migration

SocPress-6 Land use change

SocPress-7 Technological / Infrastructure change

BioPulse-1 Extreme weather events

BioPulse-2 Fire

BioPulse-3 Pest outbreaks

BioPulse-4 Landslide/avalanche/flood

BioPulse-5 Land cover change

BioPress-1 Climate change (temp/precip)

BioPress-2 Biological invasions

BioPress-3 Biodiversity loss

BioPress-4 Glacier melt

BioPress-5 Permafrost thaw

BioPress-6 Water scarcity

BioPress-7 Land cover change

SocPress-1 Markets

SocPress-2 Policies

SocPress-3 Cultural Change

SocPress-4 In-migration

SocPress-5 Out-migration

SocPress-6	Land Use Change
SocPress-7	Technological / Infrastructure change
BioPress-1	Climate change (temp/precip)
BioPress-2	Biological invasions
BioPress-3	Biodiversity loss
BioPress-4	Glacier melt
BioPress-5	Permafrost thaw
BioPress-6	Water scarcity
BioPress-7	Land cover change

“ES_scales” variables:

Code: Individual code for each of the 57 sites

Scale: categorical variable reporting “Local”, “Regional”, or “Global” importance of each ecosystem service

13 Ecosystem services are given in columns with binary responses indicating their relevant scales of importance

Forage:

Food:

Fuel/Power:

Freshwater:

Timber:

NTFP: non-timber forest products

Minerals:

Tourism:

Spiritual:

Medicine:

Hazards:

Diversity:

Carbon:

“Drivers_scales” variables:

Code: Individual code for each of the 57 sites

Scale: categorical variable reporting “Local”, “Regional”, or “Global” importance of each driver

Frequency: A “1” in this column represents that particular scale was relevant for that given driver at that site. A “0” in this column represents that particular scale was not relevant for that driver at the site.

Type: categorical variable reporting “socialpress”, “socialpulse”, “biopress”, or “biopulse”

Exact: the name of the driver (described under MtSES_57sites Social and Biophysical Presses and Pulses)

Uncertainty, precision, and accuracy of measurements: These data were solicited from 46 experts.

Likert scale data can be subjective due to individual interpretations of what constitutes “importance” in their site.

For “ES_scales” data, a cell is highlighted yellow if author did not enter any X's in the original survey. If they marked it "not at all important", we inferred these were 0 in scale. If they marked it of any importance, we left them blank representing missing data. A cell is highlighted green if author marked it important, but then did not put a scale ranking. We inferred the scale based on notes and importance ranking.

For “Drivers_scales” data, a cell is highlighted yellow if author did not enter any X's in the original survey. If they marked it "not at all important", we inferred these were 0 in scale. If they marked it of any importance, we left them blank representing missing data. A cell is highlighted green if author marked it not at all important, but then put a scale ranking. Cara changed these values to 0's.

Methods: Experts were contacted via email and asked to submit responses to the survey in an Excel file for each mountain site. Some respondents worked together to answer the survey when multiple experts per site existed.

Date dataset was last modified: Cara Steger last performed quality control in Spring 2016, following up with expert contributors on missing or irregular responses.

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