

MOUNTAIN GEOGRAPHY FINAL STUDY TOPICS

Chapter 5: Mountain Landforms and Geomorphic Processes (the post-Midterm sections)

Hillslope Components

Slope processes are of utmost importance, precipitation the major factor at intermediate elevations, low temperatures the major factor at high elevations, importance of the glacial system, nivation, the periglacial system, convex vs. concave surfaces, the overall instability of the mountain landscape, spatial and temporal variability in stability, mass-wasting, rockfall, talus/debris avalanches, debris flows, rock glaciers, valley floors, fluvial processes

Weathering

Physical Weathering – frost action, frost wedging, hydration shattering, importance of water and surface area, granular disintegration, exfoliation

Chemical Weathering – Poorly understood in mountains, traditionally thought not to be important in cold regions and high elevations, but that may be somewhat in error. Importance in tropical areas, carbonation, oxidation, carbonation

Also: importance of biology in these processes

Frost-Related Features and Processes

Frost heaves, needle-ice growth, seasonally frozen ground, permafrost (continuous vs. Discontinuous), effect of vegetation and geomorphology on frozen ground processes, patterned ground origins and development (such as sorted circles, polygons)

Mass Wasting

Creep, solifluction, mudflows, lahars, debris flows, slumping, rockfalls, landslides, debris avalanches, talus, rock glaciers

Fluvial Processes and Landforms

Importance to human populations through issues such as hazards, water supply, hydropower, etc., overall erosion by streams and development of drainage networks, mountain river erosion contributes disproportionately large sediment loads to overall river basins, Himalayan fluvial denudation of 1mm/yr, Alps are 0.4 – 1mm/yr, Alaska Range is 0.6mm/yr, Rockies 0.1mm/yr, knickpoints, Glacial Outburst Floods, alluvial fans

Eolian Processes

Not well understood in mountains, wind deposition that is later eroded into large landforms, loess, redistribution of snow

Chapter 6: Mountain Soils (The Short, Short Version...)

What is a “soil”?

Soil Forming Factors

“CLORPT”: Climate, Organic Processes, Relief, Parent Material, Time; Mtn Clims affect vegetation which then affect soil processes, which then can affect vegetation patterns, and so on, importance and reason for the thinness of soils, importance of climate change on soils, Importance of burrowing animals and treethrow, Parent material affects soil texture, structure, moisture-holding capacity, chemistry; Time – Anak Krakatoa now has a well-developed soil after only a few decades, some high-latitude mountains may take millennia for soil formation

Potential and Limitations of Mountain Soils

Generally, less soil development and productivity with increasing elevation, use of soil for mountain agriculture is constrained by these characteristics to a large degree, especially at higher elevations, extreme effects and feedbacks of soil erosion in mountains (for example, Madagascar), Agricultural Mountain Terracing is an erosion control practice as well as an agricultural practice

Chapter 7: Mountain Vegetation

Striking patterns in mountains including (a) vertical zonation, (b) treeline, (c) elevation-induced decrease in stature and species diversity

Vegetation Zones and the Mountain Environment

Concepts of environmental gradients, ecotones, nonrelation of alpine and arctic vegetation, other processes such as evolution, dispersal, competition, importance of humans, Phytogeography: importance of mountains to evolution and distribution of plants as corridors and barriers, Disjunct plant distributions in mountains and climate change, mountains often serve as habitat islands related to island biogeography theory (bigger mountain masses, more species numbers, etc.), importance of genetic isolation

Mountain Forests

Northern Hemisphere Mountain Forests: Importance of evergreen conifers (pines, spruce, fir), generalists well-suited to cold-winters and short grazing periods, shapes shed snow, needles have low evapotranspiration, diffusion of light and low-light tolerance, early season growth, frost tolerant, low nutrient requirements, Broadleaf Deciduous at lower and middle elevations (oak, maple, elm, hickory, ash), these also occur more frequently where there has been disturbance

Tropical and Subtropical Mountain Forests: High species diversity, dominance of broadleaf evergreen trees, these also show elevational zonation, decrease in height, species richness, number of canopy levels, A typical example of progression with increasing elevation: lowland tropical, submontane, subalpine forest, alpine grasses and shrubs; Also mossy forest, cloud forest, elfin woodland; mountain mass effect on vegetation zones (perhaps through effects of cloud cover), trees attain highest elevations in dry subtropical mountains such as in Mexico and Bolivia

Timberline

Ecotone between subalpine forest and alpine tundra, global occurrence, sensitivity to climate change, various slightly different terms such as timberline, treeline, frostline, krummholtz line; timberline elevations generally increase towards the equator, but are highest in the subtropics, dominance of long-lived evergreens, in northern hemisphere there is often pine, fir, spruce, but can be other things, there is also broadleaf deciduous timberline in some areas of Scandinavia, East Asia, parts of the Himalaya, more timberline diversity on the southern hemisphere, upper treeline positioning is also influenced by latitude, continentality, topography, there have been huge observations of decadal-century scale treeline shifts, especially in North America, causes of the upper treeline? Snow, wind, solar radiation, biotic factors, temperature, disturbances; ecotone patterns – not always a straight line, can be patchy islands, ribbons, gradual krummholtz

Alpine Tundra

Long thought to be related to Arctic vegetation processes, but this has been almost entirely disproven, much more species richness in the Alpine tundra than in Arctic zones, there are low, middle, and high tundra zones Low zones are mostly a complete cover of shrubs, herbs, and grasses, middle zones are more discontinuous covering and inclusion of flowering plants, high zones contain mostly mosses, lichens, and eolian-derived vegetation

Chapter 8: Mountain Wildlife

The study of mountain wildlife is more difficult than vegetation, but they share some of the same characteristics, there is a decrease in the number of species and diversity with elevation, this may mean less competition at higher elevations, many more wildlife numbers in the Pleistocene than today (especially megafauna, birds), smaller creatures were less affected by the Pleistocene extinction, most mountain animals are pioneers and quite mobile, unspecialized, largest number of species are in the Himalaya (recall the basic island biogeography theory)

Limiting Factors: (1) temperature (less dominant than once thought) – thresholds, metabolic, indirect; (2) environmental oscillation (highest ranges at high latitude; growing season, daily oscillations, both enabling and limiting); (3) nutrient availability (generally decreases with elevation), (4) Lack of habitat diversity (though this is questionable, importance of microtopography); (5) youthfulness of the ecosystem (slow regeneration); (6) island-like distribution – number and diversity of species increases with increasing mountain mass, fewer species with increasing distance from other mountains (example of Hyrax -- Highland vs. Lowland); (7) Is colonization from the lowlands or is it directly from other highlands? (8) Lack of Oxygen

Survival Strategies: Annual migration (sheep, birds, insects, elk, bears, wolves, not so much in reptiles, amphibians, non-salmon fish); hibernation (ground squirrels, marmots, grizzly and black bears, all cold-blooded animals); use of microhabitats; timing activities (reproduction, migration, hibernation, molting)

Morphological and Physiological Adaptations: Antipredatory strategies (goats, ibex); Body size/proportions/temperature (body size increases with altitude initially, followed by a sharp reversal, heat dissipation reduced by increasing insulation and reducing temperature of extremities; in cold-blooded animals, smaller size, winglessness & flightlessness; darker coloration; adaptation to lack of oxygen not well understood)

Chapter 9: Attitudes Towards Mountains

“Positive attitudes towards mountains have not always been universal.”

The Prehistoric Era

Difficult to know, study is through archaeology and modern indigenous societies; mountains as homes of powerful deities and demons, you should treat mountains with care and respect! Power and capriciousness of weather and mountains identified together, reaction of bodies to altitude could have been believed to be a transgression on hallowed ground (not the Inca, however), mountains were the source of fear and awe, but also a source of life, fertility, refuge, they were the home of strange beasts (some mythical) – including large cats, bears, apes, yeti, Sasquach; sheep-driving by hunting parties in Rocky Mountain tundra zone 10,000 – 12,000 years ago, seasonal migration of North American cultures in summer to mountains for hunting and gathering, sacred mountains in North America, such as the San Francisco Peaks (Hopi, Navajo), origin stories such as at Ktaadin (Algonquin), Mt. St. Elias (Tlingit), Chiborazo (Piruha), as home of deities, such as Apu – villagers nearby still leave August offerings

The Western Tradition

Biblical Period – Mountains as objects of veneration and symbols of strength in the Old Testament, meeting of Heaven and Earth, Mt. Ararat, Mt. Sinai, Mt. Zion, Mt. Carmel, Calvary, Sermon on the Mount

Classical Heritage – Greeks: Home of the gods, Olympus, abode of muses, nymphs, wild beasts, centaurs; development of weather cults; many shrines and temples, artists and others however preferred the aesthetic of cities and gardens due to the perceived asymmetry of mountains, Herodotus and Aristotle studied mountains; Romans: Besides Seneca and Pliny (who studied mountains) mountains were mostly seen as a barrier to commerce and conquest, as wastelands, people would have a certain amount of dread there, Celts of that time had a considerably more sacred view of the same mountains

Medieval to Romantic Periods – Middle ages: mountains as abode of demonic beings (like dragons), dual role as guardians of Hell and closest place to Heaven, dangerous places, places where pre-Christian sacred groves used to be and therefore a place that should be altered (these sacred groves cut), unaesthetic, Burnett's Sacred Theory of the Earth as a middle ground between Medieval and Romantic views; individuals started to climb and write for aesthetic reasons: Petrarch (1336), Da Vinci, Conrad Gesner (1541), Rousseau (1759), Goethe, Wordsworth, de Saussure (Mt. Blanc, climbing as a pastime)

The East

Transitioned much more quickly and directly from the awe/aversion of prehistoric times to admiration and love (3rd Century BC, Yi-Fu Tuan), mountain reverence is incorporated into Buddhism, Hinduism, Taoism, Confucianism, Shintoism; Chinese cultural mythos of the mountains in China are as a body of a great cosmic being (Bones, blood, hair, breath); mountains as divine sources of rain and water, humanity is an integral part of nature, inanimate objects have spirits and souls as do animate ones, mountain worship as far back as 2000 BC, but especially with the rise of Taoism and Confucianism

Four Great Mountains of Historical Reckon (More Taoist) -- Tai (East – sunrise, birth, renewal), Hua (West – underworld, immortality seekers), Heng (at Hunan; South), Heng (at Shanxi; North), Song (Center – Shaolin Temple, Zen Buddhism); Four Sacred Mountains of Chinese Buddhism – Wutai, Emei, Jiuhua, Putuo

Importance of mountains and clouds in Chinese art – sometimes clouds as dragons, the modern practice of going to the mountains for sport and recreation was born in China, the word/phrase for “landscape” in Chinese: Shan Shui – “Mountains and Water”, In Japan: Mountains as symbols of divine beauty and power, many sacred mountains, especially Fuji, up until the 19th century, climbing mountains was seen as a direct metaphor for following the path to enlightenment; Southeast Asia – mountain worship extensive, Popa (Burma) sacred for 2000 yrs; Mt. Meru as the mythical cosmic place in legends of Hinduism, Buddhism, Javanese Legends, Jainism, center of all physical, metaphysical, and spiritual universes; Mt Kailas (Kailash) – Abode of Hindu deity Shiva, regarded by over a billion people as the most sacred mountain in the world, pilgrimages, circumambulation, importance in Buddhism, Hinduism, Jainism, Bon peoples

The Modern Period

Changes in the Enlightenment and the Romantic periods, examples such as Rousseau, de Saussure, Muir), Scientific, artistic, health center of activities in the West, the development of mountaineering clubs, “Mountaineering as a Religion”, powerful financially, important in colonialism, mountaineering as a sport, clashes over sacred peaks, large numbers of people visiting and moving to mountain areas (“amenity migration”), conflicts of positive mountain attitudes vs. “progress” (dams, hilltop removal, roads, etc.)

Chapter 10: People in the Mountains (the First section)

10% - 20% of global population, Nepal, Peru, India, China, Central America; Standard of living in rural mountain poor vs. Western developed areas; physiological population density vs. arithmetic population density; history of mountain population density (North American Cordillera, for example)

Urbanizing Mountain Populations

Large mountain city growth as a 20th century phenomenon, (> 1million): Mexico City, Caracas, Bogata, Quito, La Paz, Santiago, Denver, Seattle, Vancouver, Calgary, Geneva, Zurich, Addis Ababa, Nairobi, Tehran, Chandigarh, Dehra Dun, Siliguri, Kathmandu, Chengdu, Kunming; Smaller, more integrated urban areas: Innsbruck, Blozano, Darjeeling, Aspen (as examples); Driving forces: Amenity migration, resource extraction and processing, growth of service needs

Permanent Residents

Common isolation of permanent residents, but also a history of large-scale resettlement of mountain peoples (in Andes by Inca and Colonial Spanish, Kikuyu in Kenya by the British, India and China by dam-building; etc.), continuous population shifting associated with prospectors, miners, loggers, secondary employment, out-migration from mountains to work – then sending of remittances back home – very significant, this “circular migration” is strongly male-dominated

Semipermanent Residents

Nomadic transhumance, seasonal economic migrants, amenity migrants (compare Alps and North American Cordillera with Nepalese construction migrants), semi-permanent patterns also in history such as the Silk Road and the Roman Trans-Alpine, Amenity migration has roots in ancient China and Greece, now expanding in many developing nations (Argentina, Costa Rica, China, Indonesia, Morocco), effects of amenity migration on prices, services, culture, environmental stress; spiritual pilgrimage related to amenity migration

Transient People

We are skipping most of these people because of time; they include peoples such as tourists, recreationalists, businesspeople, pilgrims

Chapter 11: Agricultural Settlement & Land Use in Mountains (The Short Version...)

Challenges: Keeping water, soil, nutrients in place, market isolation, transportation difficulties, lack of investment and subsidy issues from national governments and international agencies, expanding populations, mechanization/modernization

Going Vertical

Von Humboldt's example of altitudinal zonation of agriculture in Latin America subsistence farming: Tierra Helada (<4600m) – grains & tubers, sheep, llamas and alpacas, Tierra Fria (1800 – 3600m) – Wheat, barley, apples, pears, dairy cows, Tierra Templada (900 – 1800m) – coffee, cut flowers, short-horn cattle, Tierra Caliente (<900m) – sugar cane, maize, poultry, pigs; how appropriate is a system like this more generally, or in the “modern age”? For example, Karl Zimmerer notes long-term agricultural practices produces as much of a “patchwork” as it does a vertical zonation

Generalists and Specialists

Larger mountains tend to have more specialists (cultivation vs. livestock vs. agro-forestry)

Modernization

Mountain agriculture is undergoing rapid change, especially since WWII (internal vs external factors?); importance of mountain roads, cash monocrops and neoliberalization, population mobility increase; importance of enhanced seed stock and fertilizers (GMOs?), importance of non-agrarian income in traditionally agrarian areas (such as tourism)

Sedentary Agriculture

Intensive, permanent settlement, links with lowland populations; most widely practiced in tropics as (a) shifting cultivation and (b) terraced agriculture; greater yields than in lowlands, also less disease, in the tropics cultivation is year-round and livestocking is often a secondary activity; shifting cultivation is decreasing through time, terraced agriculture is generally increasing (but not in the Andes and S. Europe); cash crops and plantation agriculture becoming very important (spices, nuts, seeds, coffee, tea, peppers, opium, coca, marijuana)

Mountain Pastoralism – livestock grazing more dominant in middle and higher latitudes

- (1) Nomadic pastoralism (no permanent settlement base; Tibet, Mongolian steppe)
- (2) Transhumance (lower permanent settlements, higher summer grazing and secondary living)
- (3) Mixed grazing with farming
- (4) Agroforestry

Pastoralism has environmental variety as its advantage; risks, however, include environmental uncertainty, human competition, thieves and predators, property and other conflicts; modern pastoralism often combines walking livestock with industrialized movement

Chapter 12: Sustainable Mountain Development

Sustainable Development: Definitions and Indicators

“A process that aims at ensuring that current needs are satisfied while maintaining long-term perspectives regarding the use & availability of natural (and often other) resources into the long-term future, and equity concerns about the well-being of future generations.”; controversies over the phrase “sustainable development”, defined differently by different people; Indicators: units of information, measured over time that document changes in a specific condition; Pressure vs. State vs. Impact vs. Response indicators; the FAO uses population of mtn areas (density, growth, migration) to measure Pressure, and nutritional anthropometry (welfare) and soil quality assessment to measure State; other authors use indicators based on ecological, economic, social, ethical factors; some case studies use specifics such as freshwater concerns/cooperation, mtn forests/forestry, mtn agriculture and land management, poverty, local and indigenous knowledge, migration, mtn, tourism, legislation on mountains.

Key Issues to Sustainable Mountain Development

Access & communication (roads & railroads, other means, information and communication technology; poverty, out-migration, and conflict & drugs (balancing dependence and integration); tourism and amenity migration, protected areas (linking conservation and development, biodiversity hot spots, protected areas, partnerships), Water (different uses and priorities, dams, sharing benefits).

Implementing Sustainable Mountain Development

Regional and national initiatives; Principles (from Mountain Agenda): (1) Recognizing mountains as important development areas (flight marginalization and centralization), (2) restitution for goods and services rendered to surrounding areas, (3) diversification and multifunctionality of mountain economies, (4) taking full advantage of the local potential for innovation (combat the “brain drain”), (5) cultural change without the loss of site-specific knowledge, (6) conservation of mountain ecosystems and early warning function, (7) institutionalizing sustainable mountain development (at the national level).

Case Study: Marston's "Land, Life, and Environmental Change in Mountains" (2008)

Location: Nanga Parbat Massif (Pakistan), Garwhal Himalya (India), Manaslu-Ganesh Himals (Nepal); study areas often include agricultural terraces, local hazards of hillslope instability, tremendous rates of erosion from hillslopes and through rivers; residents in many areas lack the full capacity to adapt to hazards because of limited access to technology, capital, and government.

Grand challenge for mountain scholars: separate environmental change caused by human activities from change that would have occurred without human interference.

From 1970's onward, a rising tide of perceived crisis in the Himalaya: linking deforestation to flooding and slope failures locally and to locations far downstream in the lowland areas such as the Ganges plain; this idea is known as the HED (Himalayan Environmental Degradation theory); this narrative has been developed and is mostly correct in the Oregon Coast Range and Cascades. Is it true in the Himalaya?

A group of scholars (including Marston) visited these areas more than a decade ago and then completed a number of analyses; they found: (1) forest cover had no influence on patterns of monsoon flooding (unexpected), (2) slope failures occurred at a lower frequency in disturbed lands than in land where the forest cover was intact (very unexpected), (3) the cause, form, and frequency of failures were geological & geomorphological factors rather than land use and land cover factors, (4) road building does influence and increase slope failures.

A key conclusion: "Place Matters" – understanding how processes interact in one area does not mean that understanding can be automatically transferred to a new area; the narrative of HED has led to a sustained political force (national and international) to change people's livelihoods in those areas; these forces still exist.

Another key conclusion: these studies required multiple tools and perspectives – "muddy boots" fieldwork, geological & geomorphological interpretation, erosion dating techniques, GIS analysis, social theory (such as how effective response to environmental change is confounded to power politics & failure to fully regard differential impact by gender and social class), cartography and visualization, even artificial intelligence (part of the remote sensing portion of the work).

Pitfall to avoid: Making simple linkages between cause and effects.

Slope failures are directly linked to extremely fast local uplift rates, positions of main central thrust faults, and varying rock types.