

Climate change and mountain environments

Quick facts:

- Mountain environments are likely to be among the most severely impacted ecosystems as a result of climate change.
- A warmer climate will cause lower-elevation habitats to move into higher zones encroaching on alpine and sub-alpine habitats.
- High-elevation plants and animals will lose habitat area as they move higher with some 'disappearing' off the tops of mountains. Rising temperatures thus increase the importance of connections between mountain areas.
- Rising temperatures may cause mountain snow to melt earlier and faster in spring shifting the timing and distribution of runoff. This in turn affects the availability of freshwater for natural systems and for human uses. Earlier melting leads to drier conditions with increased fire frequency and intensity.
- Glaciers around the world have been shrinking. In equatorial areas this has been particularly rapid. For example, Glacier Ururashraju, in the Cordillera Blanca of Peru, has receded 500 metres between 1986 and 1999. Retreating glaciers decrease the reliability of water flows and change habitats.

Global warming – what is it?

Global warming happens when heat-trapping greenhouse gases collect in the atmosphere - a bit like a down coat that keeps body heat from escaping into space. We need greenhouse gases, in fact without them the Earth would be a frozen wasteland. The problem is that things are getting out of balance. Human activities have increased greenhouse gases leading to global warming. Global average temperatures are forecast to rise between 1.4 and 5.5 degrees Celsius by 2100. It affects everyone, including mountain communities that depend on reliable snow falls and water flows.

Mountains – a special case

Mountains cover close to 20 percent of the Earth's surface, providing a home to approximately one-tenth of the global human population. With their steep and varied topography, and distinct altitudinal ecological zones, mountains support a high diversity of species and ecosystems and a large percentage of global endemic species. Mountainous areas throughout the world provide essential resources such as timber, minerals, recreational escapes, and a significant portion of the freshwater consumed by

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humans. They are rich sites for cultural diversity. Mountains have a special role in showing the effects of climate change.

The alpine and sub-alpine zones of mountain areas are climate-limited environments and may be particularly sensitive to changes in temperature and precipitation. In addition, alpine areas are threatened by loss of habitat. Most ecosystems are predicted to slowly migrate and shift their distribution towards the north and south poles in response to warming temperatures. However, alpine areas are often distributed as small, isolated islands surrounded by other habitats or are disconnected from each other by wide stretches of land developed for agriculture or other uses. Instead of shifts in latitude, alpine vegetation and animals will be limited to shifts in altitude unless connections between suitable habitats can be made. As these mountain plants and animals migrate upwards, they will be faced with reduced amounts of habitat, or may disappear completely. Scientists are already noticing shifts in vegetation boundaries from various alpine areas around the world.

The effects on mountains

Global climate change poses a number of potential risks to mountain habitats, although scientists cannot predict the impacts with confidence. Despite the uncertainties, researchers expect that over time, climate change generally will affect mountain and lowland ecosystems, the frequency and intensity of forest fires, the distribution of water, and the diversity of wildlife.

Studies suggest that a warmer climate would cause lower-elevation habitats to encroach on the higher alpine and sub-

alpine zones. Such a shift would impact on rare alpine meadows and other high-altitude habitats. High-elevation plants and animals have limited space available for new habitat as they move higher on mountains in response to long-term changes in temperature.

Changes in the depth of mountain snowpacks and glaciers, and changes in their seasonal melting, can have powerful impacts on areas that rely on freshwater runoff from mountains. Rising temperatures may cause snow to melt earlier and faster in the spring, shifting the timing and distribution of runoff. These changes could affect the availability of freshwater for natural systems and human uses, such as agriculture.

Changes in stream flow and higher water temperatures also could affect insects and other invertebrates that live in streams and rivers, with repercussions up the food chain for fish, amphibians, and waterfowl.

Researchers have documented rapid mountain glacier retreat in Greenland, the European Alps, the Himalayas, Ecuador, Peru, Venezuela, New Guinea, and East Africa, among other places. In the United States, Glacier National Park's largest remaining glaciers are now only a third as large as they were in 1850, and one study estimates that all glaciers in the park may disappear completely in the next 30 years.

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Further information:
Martin Price and Graham Neville: Designing strategies to increase the resilience of alpine/montane systems to climate change. In, Harmon, D. and Worboys, G.L. (Eds) *Managing mountain protected areas: Challenges and responses for the 21st Century*. Andromeda Editrice, Colledara.

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