



Resource Bulletin

Climate Change and Biotic Patterns

A Biologically Diverse Ecosystem

Glacier National Park is a highly heterogeneous landscape that is home to a rich diversity of plants and animals. One reason for this is the steepness of the terrain. With high mountains and low valleys, dense forests and open meadows, and numerous wetland habitats, Glacier can provide a home to an amazing array of species. But as climate changes, ecosystems will change too. Exactly how our current warming climate will affect Glacier's biotic communities is an active area of scientific research.

Climate helps determine what flora and fauna exist in a habitat. Every species has temperature and moisture ranges within which they can survive and thrive. Glacier's weather and climate can be highly variable from high to low elevations and also between the east and west sides of the Continental Divide. The cool, harsh high alpine environments support very different species than the milder conditions usually found at lower elevations. East of the divide tends to be colder and drier than west because the Pacific maritime climate delivers moisture and heat from west to east.

The temperature range, amount of rain, wind, and other climatic conditions that each part of the park receives helps to define the kinds of organisms found there. While not static, these microclimates create diversified and distinct communities within the landscape.

An Altered Landscape

As climate changes, plants and animals adapted to current conditions and locations



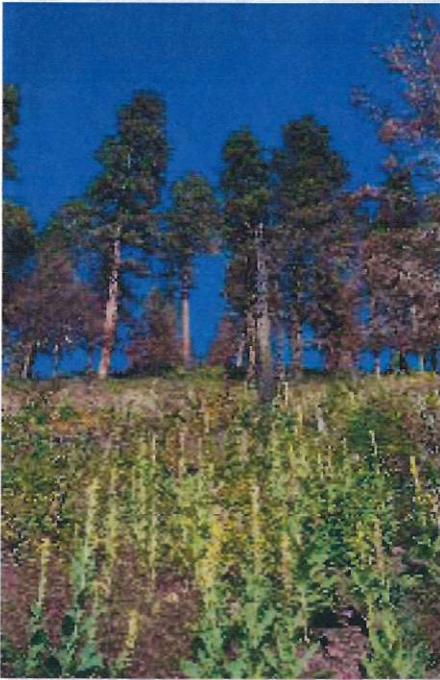
Glacier National Park is renowned for its spectacular biological diversity, such as this Indian Paintbrush meadow along the Garden Wall.

will either need to adapt to survive in different conditions or "follow" the temperature range in which they can survive. The ability of populations to adapt or move when climate changes depends on many factors, one which is the rate of change. The current warming climate is accelerated by human activities and it is unclear how, or even if, most modern species can adapt well enough to survive.

In a warming climate, vegetation zones will tend to migrate northward and/or upslope to higher elevations. Alpine treeline studies help scientists understand how this process takes place. Studies from Glacier suggest forest patches at high elevations are getting denser and are beginning to invade alpine meadows.

Of major concern is the potential loss of alpine and subalpine environments that provide prime habitat for plants such as Jones Columbine and White Mountain Avenes, animals like bighorn sheep and mountain goats, and winter hibernation space for bears. Species living here cannot migrate to higher ground.

While some species may be able to move and adapt to climate change, the current rapid rate of warming may present significant difficulties for others. Some vegetative communities, such as old growth forests, are not capable of migrating quickly. In other cases, migration may not occur due to lack of suitable corridors that connect current locations to higher or more northern territories where the plants can become established and thrive. Roads,



Common mullein, a non-native invasive species, spreads quickly in a burn area of the North Fork region in Glacier National Park.



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Resources for More Information

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Documents and web sites:

Glacier National Park Global Climate Change
<http://www.nps.gov/glac/resources/bio7.htm#Global>

Ecological Significance of Long-term Climate
Changes in Montane Ecosystems, and Global
Climate Change
http://nrmssc.usgs.gov/research/climate_changes.htm

The Millenium Ecosystem Assessment
<http://www.millenniumassessment.org/en/index.aspx>

US National Assessment on the Impacts of
Climate Variability and Change
<http://www.usgcrp.gov/usgcrp/nacc/forests/default.htm>

Bibliography: Climate Change and its Impact on
Species/Ecosystems
<http://eelink.net/~asilwildlife/CCWildlife.html>

urban and industrial areas, and agricultural fields all present obstacles to the migration potential of plants and animals. Species that cannot adapt or move, will not survive.

Changes In Disturbance Regimes

Climate change will affect not only the types of plants and animals that can survive in certain areas, it will also impact processes that shape the landscape such as fire. For example, changes to temperature and precipitation patterns will affect soil moisture as well as the frequency of storms (which bring lightening that start fires). In general, under warming conditions, scientists expect there to be a greater potential for more frequent, larger, more severe, and more intense wildland fires.

While fire is an important shaper of Glacier's landscape, too intense or too frequent fires may make it more difficult for native species to return. Disturbance by fire may create an ideal environment for non-native invasive species to thrive.

Glacier's Management Strategy

Climate change, especially the rapid change we are currently experiencing, is a serious

issue. As scientists work to understand how Glacier's ecosystems will be impacted, managers struggle to understand what kinds of decisions can and should be made in the face of these changes to protect park resources. It is unlikely that any management actions would be sufficient to preserve Glacier National Park in its current state. Some level of change is inevitable and may even be desirable. Unfortunately, there is no simple solution.

In some cases, managers may be forced to choose when and where to invest limited time and energy for resource protection and restoration. For example, areas such as old growth cedar hemlock forests, that evolved in a much colder climate, may simply have to be understood as remnants of another time. In other cases, park managers may need to work with other agencies and land managers to identify and protect corridors that connect important wildlife habitats to allow species to migrate.

Management strategies for disturbances such as fire and invasive plants will need to adapt to the context of climate change pressures. Research and internal education efforts can help park staff become aware of the issues and can encourage discussions that may provide new ideas and approaches. Engaging the support of our neighbors and partners will be critical as we seek solutions to these complex issues.



A warmer climate may allow forests to survive at higher elevations. If treeline migrates upward, the high elevation habitats of alpine and subalpine meadows will be reduced.