



# Resource Bulletin

## Climate Change and Mountain Streams

### Water Towers of the World

Glacier National Park is famous for its mountainous landscape and glacially carved terrain. What many people don't realize is that mountain glaciers provide more than just scenery. Glaciers are an integral part of the ecosystem, providing water to mountain and downstream environments. In today's warming climate, these giant marvels of snow and ice are rapidly disappearing.

Mountains have been called "water towers of the world". More than 50% of the world's fresh water supply comes from runoff in mountain environments. While much of the runoff from mountains comes from rain, alpine glaciers are an important contributor to mountain streamflow. Globally, glacial meltwater provides one-fourth of the water in mountain streams.

By providing a dependable source of cool, fresh water, glaciers are essential to the health of aquatic and riparian ecosystems. They also provide fresh drinking water for downstream populations and dilute pollutants that are generated mostly in lowland areas. As climate warms and glaciers melt, these ecosystems are losing an important source of fresh water.

Glacier National Park has already lost more than 70% of its glaciers in the last century. Today there are 27 of the 150 glaciers that were recorded in 1850, the end of the period called the Little Ice Age. At the present rate of warming, scientists predict that all of the glaciers in Glacier Park will be gone by the year 2030. The demise of glaciers will affect both the amount and timing of mountain streamflow.



Sperry Glacier, shown in the very back of the picture, provides meltwater for many lakes and streams, including Avalanche Lake, in the cirque below the glacier.

### Stream Regulators

Mountain streams in Glacier National Park are fed by alpine glaciers and snowpack. In summer, once it becomes warm enough to melt the snowpack, a rush of water comes down the mountains from glaciers to join the streams and rivers. Then, for the rest of the warm season, mountain streams are augmented by a constant flow from the melting glaciers. When rain is sparse, as in the late summer and during drought years, mountain glaciers may be the only source of base flow in these streams.

As climate warms, this pattern is changing. With a warming climate, less winter precipitation falls as snow but more of it falls as rain. Also,

spring comes earlier and a longer warm season will allow more snow and ice to melt overall. Earlier, warmer summers mean spring runoff from mountains happens earlier in the year, and often in a bigger rush of water downstream. One concern with global warming is the possibility of more spring floods due to the pulses of rain with melting snow and ice.

As mountain glaciers melt and spring runoff happens earlier, there is less water later in the season. For many small mountain streams in the park, melting glaciers provide the only source of base flow in late summer. With no glacial meltwater to augment them, some streams may become ephemeral, which means they may dry up late in the season. This will have major consequences for stream ecology.



Glaciers, such as Grinnell Glacier, are so sensitive to climate changes that even a few degrees of difference could melt them away forever.

In addition to regulating stream flow, glacial meltwater affects the temperature of mountain streams and rivers. Many of the invertebrates that live in Glacier National Park's waters are very temperature sensitive, and can only live within a narrow temperature range. Because aquatic invertebrates are at the base of the food chain, putting them at risk threatens the entire stream ecosystem.

## Glacier's Management Strategy

Changes to the health of aquatic systems due to climate change is of great concern to Glacier Park managers and employees work closely with research scientists to monitor stream health. Healthy streams have been identified as a park "vital sign", which means they are an important indicator of the overall integrity of Glacier's ecosystems.

Vital Signs monitoring is part a national program in the National Park Service to understand the state of natural resources and provide an early warning for park managers of changes in ecosystem health.

Many natural resource in the National Park System are subjected to unfavorable impacts from a variety of sources, including climate change. Left unchecked, the very existence of many natural communities can be threatened. To help prevent the loss or impairment of such communities in approximately 270 parks nationwide, the Natural Resource Inventory and Monitoring (I&M) Program was established.

The principal functions of the I&M Program are the gathering of information about the resources and the development of techniques for monitoring the ecological communities in the National Park System. Ultimately, the inventory and monitoring of natural resources are integrated with park planning, operation and maintenance, visitor protection, and interpretation to establish the preservation and protection of these resources.

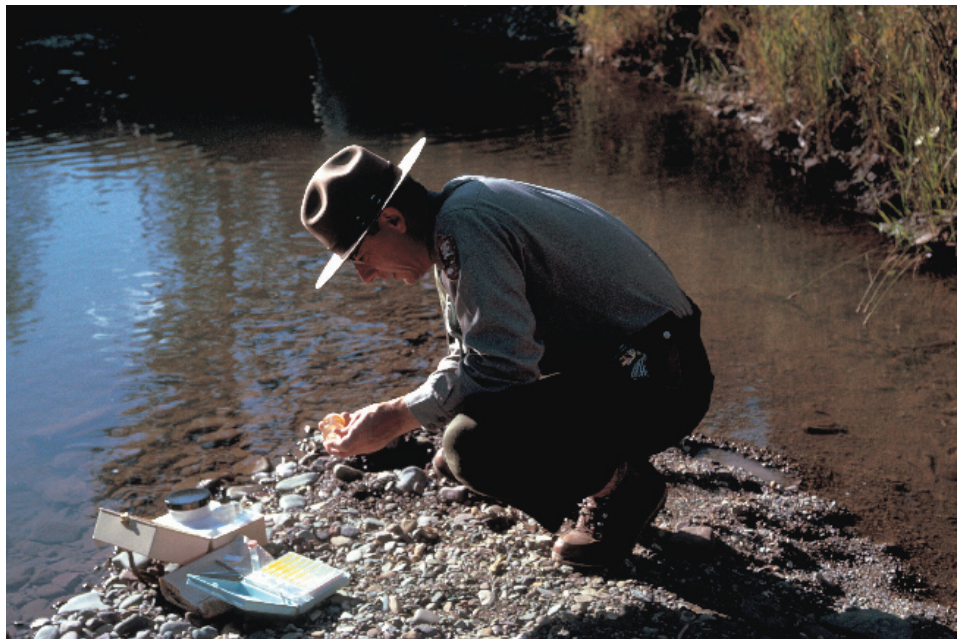
The I&M Program is designed to help parks preserve healthy parks by acquiring timely and accurate information about the condition of natural resources and monitoring the change of conditions over time so that managers can act on that information with confidence.



### Resources for More Information

Glacier National Park staff:  
Leigh Wellings, Director, Crown of the Continent Research Center  
Dan Fagre, Ecologist, USGS Glacier Field Station

Documents and web sites:  
Glacier National Park Global Climate Change webpage: <http://www.nps.gov/glac/resources/bio7.htm#Global>  
USGS website: Ecological Significance of Long-term Climate Changes in Montane Ecosystems, and Global Climate Change: [http://nrmsc.usgs.gov/research/climate\\_changes.htm](http://nrmsc.usgs.gov/research/climate_changes.htm)  
Global Water Cycle <http://www.unesco.org/science/waterday2000/Cycle.htm>  
Green Nature website: Glacier National Park Losing Glaciers: <http://greennature.com/article979.html>  
CNN.com: Melting Glaciers May Make Billions Thirsty: <http://www.cnn.com/2003/TECH/science/11/28/glaciers.melting.reut/>



Park employees monitor the health of aquatic environments.