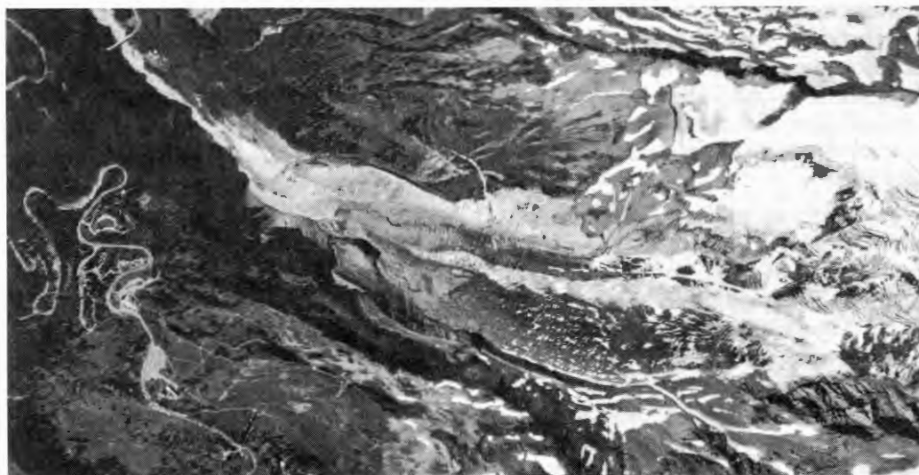


Nisqually Glacier Records a Century of Climate Change



By Barbara A. Samora

There are 25 major glaciers on Mount Rainier and numerous unnamed snow or ice patches. The Emmons Glacier has the largest area (4.3 square miles) and Carbon Glacier has the lowest terminus altitude (3600') of all glaciers in the lower 48 states. The Nisqually has shown dramatic changes in dimension within the last century (Heliker, Johnson and Hodge 1983).

Global temperatures are increasing at a rate 10 times more rapid than the average rate of natural change. Climate change may be most quickly seen in glacier terminus fluctuations and changes in mass balance. Global warming may decrease the size of large glaciers and smaller glaciers may disappear.

Glaciers store information on temperature (Meier 1991, Raymond 1991) and past atmospheric composition (Lorius 1990). The estimated freshwater runoff from glaciers is significant--14 percent of the runoff in the conterminous states (Mayo and Trabant, 1986). Glaciers exert a significant control on the flow and water quality of park streams and rivers. Increased glacial runoff may have significant effects on flow, temperature, and sediment regimes in downstream areas. Reduced stream temperatures may eliminate or alter life cycles of certain invertebrate species.

The Nisqually Glacier on Mount Rainier has one of the longest and most complete records in the Western hemisphere of terminus position observations and ice-surface altitude measurements along specific profiles. A. Kautz first described the Nisqually Glacier in 1857. The USGS began research on park glaciers in 1896 when C. Russell recommended the glacier be studied and include photo stations, measurements indicat-

ing flow rates, and mapping of the glacier termini. In 1905, LeConte studied the flow rate of the Nisqually. Matthew of the USGS made the first accurate determination of glacier locations with his 1913 topographic map of the mountain.

Terminus position was recorded annually by the NPS beginning in 1918 and has been located using historical records, the earliest in 1857 as described by Kautz. In 1931, the Tacoma City Light Department and the USGS initiated measurements of surface elevation along profiles upon the lower Nisqually Glacier. They were concerned that the source of water for Alder Lake dam, the Nisqually Glacier, and every other glacier on Mount Rainier, was experiencing rapid retreat. Measurements were continued until 1985, when the USGS could no longer support the project.

In 1991, through partnerships with the Nisqually River Council, the Nisqually tribe, and with technical advice from the USGS, the park resumed monitoring of surface elevation profiles on the glacier.

The Nisqually has shown dramatic changes in dimension within the last century (Heliker, Johnson and Hodge 1983). Between 1857 and 1979 the glacier receded a total of 1,945 meters and advanced a total of 294 meters. Advances occurred from 1963-68 and from 1974-79. Ice surface altitude changes of as much as 25 meters occurred between 1944 and 1955. A significant thinning of the ice has occurred since the mid-1980s. The 1991 survey documented a loss of 22 meters of ice thickness from 1983 to 1991 in the lower profile; the middle profile showed a loss of 11 meters during the same period. The higher profile was not surveyed in 1991, but we would expect similar thinning of the ice to be

Nisqually glacier on Mt. Rainier is shown at 1:24,000 in this NPS-contracted aerial photo. Paradise can be seen at lower right.

occurring (Driedger, pers. comm.). The 1992 survey was conducted in late September and results are not yet available.

Implications of the more recent changes in the Nisqually glacier are that we will see additional cliffs and erosion at the margins, additional exposure of ice-covered moraine, and changes in runoff characteristics. Additional crevassing in areas such as the Muir Snowfield, the most popular route to ascend the mountain, is likely. More exposure of the ice-covered moraine would result in a greater source of unstable debris moving downstream in the event of an outburst flood or heavy precipitation. Subsequent changes in runoff characteristics may result in increased flow in summer and less in winter.

Mount Rainier's glaciers are important indicators of climatic change, major visitor interpretive objects, and sources of water for park aquatic systems, as well as hydroelectric and recreation pursuits outside the park. The volcanic-glacial interactions on Mount Rainier pose a major flood hazard to developed areas downstream extending almost to Puget Sound. Interpretation of wilderness features, wilderness travel safety, and glacier hazards are important management concerns. Greater understanding of past history and glacial processes is needed to address resource management needs of the park and surrounding communities.

Samora is a Resource Management Specialist at Mount Rainier NP.

Literature Cited

- Driedger, C.L. 1986. A Visitor's Guide to Mount Rainier Glaciers. USGS and Pacific Northwest National Parks and Forests. 80 p.
- Heliker, C.C., A. Johnson, and S.M. Hodge. 1983. The Nisqually Glacier, Mount Rainier, WA, 1857-1979: A Summary of the Long-term Observations and a Comprehensive Bibliography. USGS, Tacoma, WA. 20p.
- Mayo, L.R. and T.C. Trabant. 1986. Recent growth of Gulkana Glacier, Alaska Range and its relation to glacier-fed runoff. In S. Subitzky (ed). Selected papers in the hydrological sciences. USGS Water Supply Paper 2290. p.91-99.
- Lorius, C. 1990. Polar ice cores: Paleo-climatic and environmental data, International Conf. on the Role of the Polar Regions in Global Change. June 1990. Fairbanks, AK. Abstract.
- Meier, M. 1991. Keynote speech at the Glacier Research Workshop, February 1991. Birchwood, AK.
- Raymond, C. 1991. How Glaciers Reflect Climate, presented at the Glacier Research Workshop, February 1991. Birchwood, AK.