

GLACIER PAGE 2001

North Cascades National Park Glacier Monitoring Program

The National Park Service began monitoring glaciers in North Cascades National Park in 1993. Goals for this program and additional data can be found at North Cascades National Park home page at <http://www.gov/noca/massbalance.htm>.

The four glaciers monitored are located at the headwaters of four park watersheds, each with large hydroelectric operations (Figure 1). The glaciers represent a range in elevation from 8500 to 5700 feet, and a range in climatic conditions from maritime to continental. Methods include at least two visits annually to each glacier to measure winter accumulation and summer melt. Measurements are taken at a series of points down the centerline of each glacier (Table 1), then integrated across the entire glacier surface to determine annual mass balance for the entire glacier. Glaciers east of the hydrologic crest of the park (Silver and Sandalee) have recently had more positive mass balances than the west-side glaciers (Noisy, North Klawatti, South Cascade) due to their higher elevations, continental climate, and north aspects (Figure 2). Year to year variation is also large, as net mass balance varied 11.5 ft/yr. between 1993 and 2000.

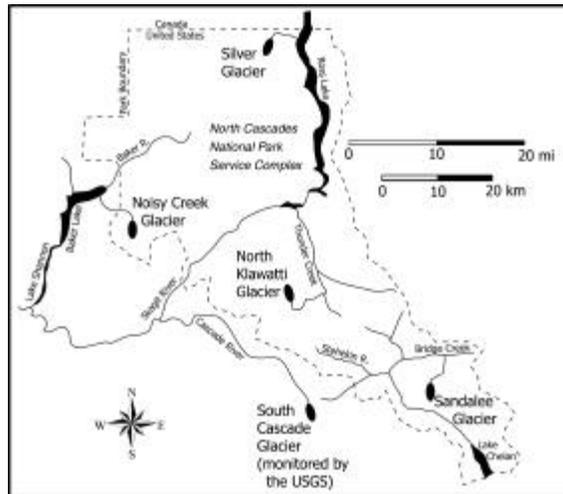


Figure 1. Glaciers monitored in North Cascades N.P.S. Complex.

Glacier:	Elev. (feet)	2001 Accumulation (inches W.E.)	1999 Accumulation (inches W.E.)	Average Accumulation (inches W.E.)
Noisy Creek	6050	104	214	137
	6020	112	190	135
	5940	102	165	120
	5800	94	167	117
	5650	96	171	117
Silver	8450	82	189	127
	7920	79	141	111
	7540	73	164	124
	7100	12	63	57
North Klawatti	7670	75	182	123
	7300	86	191	122
	6900	78	167	120
	6300	80	168	107
	6130	60	130	94
Sandalee	7360	67	153	120
	7100	80	185	138
	6810	76	152	119
	6530	71	214	147

Table 1 presents this spring's winter accumulation data, along with average values and data from water year 1999, a year of heavy winter accumulation. Accumulation generally increases with elevation, but on steep slopes snow can be redistributed by wind and avalanches. This year's accumulation values are below the eight-year average. Winter balances are 80% of average for Noisy Glacier, 64% for Silver, 64% for North Klawatti, and 57% for Sandalee. The winter balance for Noisy Glacier is closer to the average because the Baker watershed receives more snow than any other in the park.

Table 1. Snow water equivalent (W.E.) measured at monitored glaciers in late April/early May.

Estimates of total glacial contribution to runoff for three watersheds are based on the mass balance measurements and GIS analysis to determine glacier area within 165 ft elevation bands (Table 2). Glaciers reduce the variation of flow in these watersheds by providing meltwater from ice in dry/warm years, and by storing water in wet/cool years. Glacial stream buffering capacity in these watersheds varies by as much as 100% annually. Magnitude of glacial contribution to streamflow is large, but varies by the amount of glacial cover in each watershed. Thunder Creek is 13% glaciated, while Baker River and Stehekin River are 6% and 3%, respectively (Post and others, 1971).

Relative importance of glacial contribution to streamflow increases from west to east. For example, glaciers annually contribute a higher percentage of meltwater to streamflow in the Stehekin watershed than in the Baker, despite the fact that the Baker is more glaciated. This is due to lower snowfall east of the hydrologic crest of the North Cascades. In this low accumulation year we anticipate that glacial contribution to summer runoff will be above average in these watersheds.

	Mean Glacial Runoff	Range of Glacial Runoff		Percent Glacial Runoff to Total Summer Runoff	
		Minimum	Maximum	Minimum	Maximum
Noisy Creek Glacier	1.6	1.3	2.1	---	---
Baker River Watershed	73	52	93	2.4	5.1
North Klawatti Glacier	3.9	2.9	5.1	---	---
Thunder Creek Watershed	101	80	135	15	30
Sandalee Glacier	0.4	0.4	0.5	---	---
Stehekin River Watershed	68	54	91	4.9	8.9

Table 2. Glacial contribution to summer stream flow for three watersheds. Runoff units are thousands of acre-feet. Data from 1993-2000 except the Sandalee Glacier and Stehekin River Watershed (1995-2000).

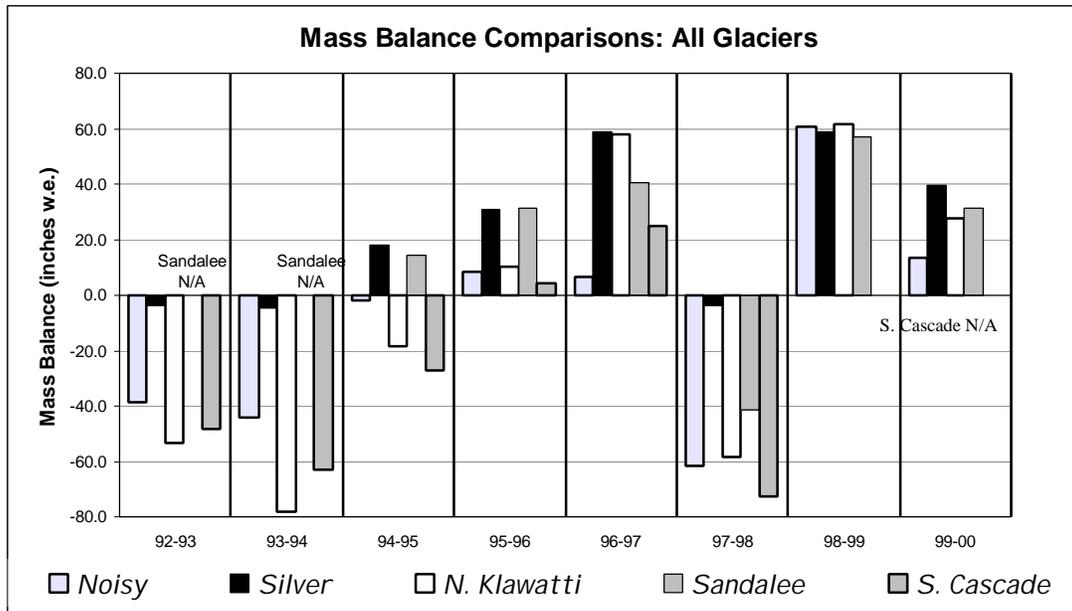


Figure 2. Net annual mass balance for the five glaciers monitored in the North Cascades