

# From the Mountains to the Sea



## A Guide to the Skagit River Watershed

Saul Weisberg and John Riedel

Illustrations by Libby Mills

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June 1991

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*This guide is dedicated to all creatures,  
living and nonliving,  
that share the river's song.*

*From the Mountains to the Sea* was produced through funding from the Public Involvement and Education Project, financed by proceeds from the Washington State Centennial Clean Water Fund, and administered by the Puget Sound Water Quality Authority.

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## Origins

From far over the Pacific Ocean, looking east toward the Washington Coast, a glistening thread of light illuminates the body of water known as Puget Sound. In the early dawn the colors of the water lighten, turning from grey to green to gold. Further east, the mountain wall of the North Cascades is backlit by the rising sun.

Puget Sound is home to a rich and diverse marine ecosystem, including the waters of the sea, the mountains of the land, and all the living communities they contain. People and the works of people cluster around its shores. The busy lights of their lives break the darkness of the giant cities sleeping in the lowland valleys.

Puget Sound, as immense and important as it is, is only one small body of the Pacific Ocean, lying nestled inside the encircling arms of North America. The Sound in turn stretches its arms deep into the heart of the continent. The Puget Sound Watershed reaches deep into the mountains, its arms curling through dark, deep valleys, its fingers touching icy peaks.

The Sound is ancient, and was born of ancient geologic mutterings deep in the Earth. The Skagit River, too, is ancient, predating the rise of the mountains. Long before the mountains rose, the river was flowing to the sea.

As the mountains grew, slowly, into the sky, the Skagit shrugged its watery head and cut deep into the rock, continuing its journey home.

There is a direct link between the summits of the highest peaks and the marine environment. Water, sediment, and life itself, swimming as salmon or soaring as eagles, connects the mountains and the sea. The river delta is the joining place—where saltwater, freshwater, and the land come together. When we talk about Puget Sound we cannot forget the mountains where the sea is born. The ocean finds constant birth and renewal in the rivers that give it life. If we are to protect the waters of Puget Sound we must begin with the source—with the many wetlands, creeks, and rivers that tumble from the mountains. Rivers of the Puget Sound Watershed extend all the way to the crest of the Cascades. This guide is the story of the largest and oldest of these rivers—the Skagit.

The themes of this guide are the water, mountains, and living creatures that make up the Skagit River Basin. The enclosed map (inside back cover) illustrates the shape of the land—drainages, peaks, glaciers—free of human constructions and conventions (borders, boundaries, buildings) that too often shape our view of landscape. Our focus is on the Skagit River and the mountain lands that give it birth. Do not forget that the Skagit is but one of many rivers, all with their own stories to tell, that flow into Puget Sound. Our goal is to help you find your sense of place in this special part of the world.

This guide only tells part of the story, you have to fill in the rest yourself. Get your feet wet. Put your hands in the river and feel the chill of the glaciers that give it birth. Walk through the watershed, sit along the river's banks and listen to its song. Feel the movement, mystery, and power that lies within the living waters of the Skagit.

## A Land of Rivers

The North Cascades is a land of rivers. Rivers are born in mist and rain. They begin falling and never stop until they die in the arms of the sea. The journey of a river is a story that shapes the land. No matter where you travel in these mountains, there is no escaping the sound of moving water. Of all the streams that travel through the Cascades, none sings a song more beautiful than the river known as the Skagit.

The Skagit is one of the great rivers of North America. The river and its tributaries are the focus of life and energy for more than 1.7 million acres of the North Cascades—one of the most rugged mountain ranges in North America. Containing hundreds of glistening glaciers, tumbling waterfalls, rushing creeks, soaring eagles and spawning salmon, the Skagit is the largest watershed in the Puget Sound Basin, providing over 20 percent of the water flowing into the Sound. This translates into nearly ten billion gallons each day. With over 2,900 streams, it drains 3,100 square miles (2,730 square miles in Washington and 400 square miles in British Columbia). The Skagit, after the Columbia, is the largest river on the west coast of the contiguous United States. In Washington the river basin encompasses most of Skagit County and the northeastern and eastern parts of Snohomish and Whatcom counties.

The journey of the Skagit River begins in the mountains of Manning Provincial Park in British Columbia. From its headwaters, the river meanders southwest for 25 miles, then turns southeast for seven miles to the U.S. border. It then flows south for 20 miles in Washington until turning west to break through the crest of the North Cascades mountains on its way to Puget Sound.

The Skagit Watershed is a land of rugged peaks and deep valleys. The floors of its river valleys are low compared to their headwaters—lush lowland forests extend far into the mountains. Most of the basin lies above 2,000'. Its eastern boundary follows the crest of the Cascade Range where summits range from 7,000' to 9,000'. The highest points in the Skagit Basin are two volcanoes: Mt. Baker (10,773'), located in the northwest corner, and Glacier Peak (10,541'), at the southern boundary of the watershed.

### Watersheds and Drainage Basins

Watersheds, or river basins, are a basic feature of the landscape, covering every square inch of the Earth's surface. Learning how they develop and function helps us understand not only individual rivers and streams, but many other features of the landscape—geology, climate, vegetation, the distribution of plants and animals, and how and where people live, work and play.

In the most basic physical terms, the river and its tributary streams are a single, integrated system for returning water to Puget Sound and the Pacific Ocean. This system has been operating continuously for tens of millions of years. Through the eons the watershed has seen many changes. It has expanded into other drainage basins, capturing streams and adding to its complexity. It has leveled thousands of feet of rocks thrust into the sky by rising mountains. It has seen the birth and extinction of volcanoes and witnessed the growth and melting of glaciers.

The main feature of a drainage basin is its shape and pattern. The shape is defined by watershed divides. The divides of the Skagit have developed over many millions of years by glacial, river, tectonic and weathering processes that carved the typical and spectacular features of this heavily glaciated landscape—arêtes, horns, cirques, and canyons. Other important features of the Skagit basin are its floodplain and delta, and its many trunk streams and tributaries.

The pattern of a drainage system is similar to the branches of a tree, with many small tributaries joining larger creeks, that in turn merge with the larger trunk stream. Drainage patterns are often complicated, however, by the geology beneath them. We know that the Skagit and its larger tributaries (Cascade, Sauk and Baker rivers) were here before the mountains, because they cut across the grain of the mountains. Smaller tributaries such as Illabot, Newhalem and Goodell creeks, follow the northwest-southeast grain and structure of the range.

Although the drainage pattern of the Skagit is controlled by geology and is relatively static, its shape can change relatively quickly due to climatic variation. Since the uplift of the mountains, the watershed has expanded by the

retreat of its headwaters deeper into the mountains. Due to erosion and blockage of valleys by glaciers, several streams have been captured from adjacent basins. The Sauk-Suiattle system once flowed to Puget Sound via the Stillaguamish River. Erosion by glaciers and their meltwater lowered the divide between the Skagit and Stillaguamish rivers resulting in the Skagit capturing the Sauk-Suiattle system. Modern Lightning Creek, northeast of Ross Lake, captured Freezeout and Three Fools creeks as it carried water from the glacier-dammed Similkameen River to the Skagit. Today a lake forms the divide between the Skagit and the Similkameen. A low-elevation marsh forms the divide between the Skagit and the Fraser at Klesilkwa Pass in British Columbia. The low divides between the Skagit, Fraser, Similkameen and Stillaguamish have probably changed with each ice age.

### Weather and Climate

The Skagit Watershed is characterized by a temperate, mid-latitude, maritime climate. The moist marine air moderates both summer and winter weather. The characteristic winter rainy season gives way to a short, dry summer, often with a prolonged summer drought. The Olympic Mountains of the Washington coast and the Coast Range of British Columbia and Vancouver Island combine to offer some protection from winter coastal storms. There are strong climatic changes as one moves west to east across the basin and corresponding changes with increases in elevation. Temperatures range widely throughout the watershed. Recorded temperatures at Newhalem range from a low of -6° F to a high of 109° F with greater extremes likely in the mountains. The highest temperatures are commonly recorded in July, the lowest in January.

Running parallel to the coast, and only 30 miles from Puget Sound, the North Cascades intercept storms that sweep in from the Pacific. As warm, moisture-laden air is pushed up against the mountains it rises, cools, and drops its moisture as rain and snow. West-facing valleys receive more rain and snow because they lie more directly in the path of the prevailing winds. Average annual precipitation on the west side of the range is 110". The winter season may deposit as much as 46' of snow at elevations as low as 5,000'. Snow often falls in September and lasts through July.

The accumulation of snow and frequent storms in the spring and fall combine with generally cool temperatures to promote the conditions necessary for the formation and maintenance of glaciers. The great amount of precipitation means that most valleys have been able to erode down to near sea level nearly all the way to their headwaters. North



*Marsh marigold*



Cascade valleys characteristically are long, deep, and gentle, terminating abruptly in steep rises to their headwaters.

The east side of the North Cascades lies in a rain shadow formed by the Cascade Crest. Precipitation on the east side averages 31" at Hozomeen at the north end of Ross Lake, and only 12" at Harts Pass in the nearby Pasayten Wilderness, the eastern boundary of the Skagit River Basin. Precipitation exceeds 140" over most of the higher mountains of the North Cascades reaching a record 190" at Sloan Peak. The main river valleys typically receive less than 80". Over 75 percent of the precipitation falls as rain and snow between October and March.

**Table 1. West to East Precipitation Gradient Along the Skagit River**

<u>Location</u>	<u>Annual Precipitation (in.)</u>	<u>Elevation (ft.)</u>
Skagit Delta	25	30
Sedro Woolley	46	60
Concrete	67	195
Marblemount	84	300
Newhalem	79	525
Diablo Dam	74	891
Hozomeen	31	1,610

## Where the River Is Born: The North Cascades

From any of its many summits the North Cascades appear as a sea of mountains, an ocean of breaking waves frozen into spectacular shapes and forms. Glaciers tumble from the higher peaks. Sharp spires and jagged ridges twist from summit to summit, then abruptly plunge into deep valleys far below.

Water, ice and jagged peaks are the essence of the North Cascades landscape. Its dominant topographic characteristics are near-vertical cirque headwalls and steep-sided glacial valleys. The North Cascades contain most of the glaciers of the United States outside of Alaska. These are steep mountains—often ascending more than 5,000' from valley to summit. This amazing elevation gradient—beginning nearly from sea level—makes other mountains seem gentle by comparison.

The Cascade Mountains stretch northward for 500 miles from Mt. Lassen in California to the Fraser River in British Columbia. In northwestern Wash-

ington, the range is most rugged, reaching an average elevation of nearly 7,000' and stretching for 70 miles along the Canadian border. The North Cascades are separated from the Coast Mountains of British Columbia by the Fraser River. To the west lie the lowlands of Puget Sound, while the Okanogan Highlands and the Columbia River mark the eastern boundary of the range. To the south, Snoqualmie Pass divides the older granitic and metamorphic rocks of the North Cascades from the younger volcanic and sedimentary rocks of the southern Cascades.

Only within the last twenty years have geologists begun to unravel the complex geology of the Skagit River Basin. The distribution of rock types varies between two great faults that divide the watershed into thirds. The Straight Creek Fault trends north-south, crossing the Skagit River at Marblemount. The Ross Lake Fault runs north-south under Ross Lake, following the original path of the river.

West of the Straight Creek Fault to Puget Sound the rocks are primarily schists and phyllites of the Shuksan metamorphic suite. Between the Straight Creek Fault and the Ross Lake Fault are the ancient gneisses and granites that comprise the crystalline core of the North Cascades. Recent estimates suggest the crystalline core was once buried fifteen miles beneath the surface. East of the Ross Lake Fault, the rocks are less severely metamorphosed than the Shuksan metamorphic suite. Tropical fossils are preserved in these rocks at the headwaters of Freezeout, Three Fools, and Devil's creeks.

Superimposed upon the older rocks of the North Cascades are the geologically young volcanic rocks that make up Glacier Peak and Mt. Baker, fiery sentinels of the lower Skagit. Both are composite volcanoes built of lava flows, ash and other volcanic debris. Geologic evidence indicates most of Glacier Peak was built within the last 700,000 years, while Mt. Baker was built within the last 2 million years. Mt. Baker and Glacier Peak have been very active since the last ice age ended 10,000 years ago. Mt. Baker has been active most recently, with as many as 12 several small lava, ash and steam emissions within the last 200 years. While Glacier Peak lies hidden from view, Mt. Baker is clearly visible from Bellingham and Skagit Bays.

As volcanoes heat up, their glaciers melt, resulting in huge mudflows called lahars. Lahars from Glacier Peak have swept repeatedly down the mountain via the Whitechuck and Suiattle valleys. The largest Whitechuck lahar occurred 11,000 years ago, deposited 80' of rock and mud over Darrington, and followed the North Fork of the Stillaguamish River to Arlington. The mud blocked the Sauk River from entering the North Fork of the Stillaguamish, sending it down the Skagit instead. A lahar 8,700 years ago swept down the Suiattle River and into the Skagit River to Minkler Lake west of Lyman.



*Pyrola*

Puget Sound has more earthquakes than the North Cascades range because it is located nearer to the modern margin between the North American and Juan De Fuca (oceanic) plates. Earthquakes are a fairly frequent occurrence in the Skagit Watershed, indicating that the Earth's crust beneath the Skagit is still active. Glacier Peak and Mt. Baker are focal points of earthquake activity when erupting. The largest quakes on record occurred in 1872 (magnitude 7-7.5) and 1915 (magnitude 4-5) and shook the upper Skagit Valley from epicenters south of Ross Lake. Small earthquakes registering less than five on the Richter Scale are common; scientists predict a larger quake is imminent.



## The Shape of the Land

The rising mountains met with two considerable forces at the surface—water and ice—that move and shape the land. The higher the mountains rise, the more pronounced the activity of water. Water travels at varying speeds from the mountains back to the sea; rainwater finds its way to Puget Sound quickly while precipitation falling as snow may be trapped in a glacier for hundreds of years.

Climate controls the nature and intensity of processes of water erosion and deposition. The Earth's climate has changed many times during the life of the Skagit. The most dramatic, repeated and recent of these changes are the Great Ice Ages. During these many cold periods, glaciers expanded to cover over 90 percent of the Skagit Watershed; in contrast they cover less than 5 percent today.

### Mountains

Ice Age glaciers created one of the world's classic glacial landscapes in the Skagit River Basin. Alpine glaciers born of Skagit precipitation, as well as much larger ice sheets from British Columbia, have taken turns shaping the watershed. Local alpine glaciers have had the greatest effect on the landscape because they grew much more quickly in response to cooling climates than the ice sheet. The larger and more powerful Cordilleran ice sheets covered parts of the Skagit to elevations of over 6,000', but because it took many thousands of years for them to build, their excursions into the Skagit were brief.

High in the mountains the alpine glaciers left little of the sediment they eroded. Instead, the glaciers carved bowl-shaped depressions called cirques into the sides of the mountains. Where several cirques isolate a peak, the solitary summit is known as a horn (e.g. Mt. Shuksan, Mt. Fury, Mt. Redoubt). When cirques coalesce on the flank of a mountain, they form flat benches called parks (e.g. Devil's and McMillan parks). And when the cirques meet along two sides of a ridge they create jagged ridges called arêtes (e.g. Ripsaw Ridge, Tepeh Towers, Crescent Creek Spires).

The Cordilleran ice sheet covered all but the highest peaks of the Skagit Watershed. By noting the junction of the higher elevation rugged arête-horn topography and lower elevation rounded mountains and ridges covered by the ice sheet, one can discern the thickness of the ice sheet anywhere in the watershed. In the Ross Lake Basin remnants of once-towering ridges have been reduced to low-elevation humps, such as Pumpkin Mountain and Rowland Point.

The ice sheet reached its maximum extent 15,000 years ago. Over the next 5,000 years the ice sheet receded. Because of topography, it didn't retreat along a single front, but stagnated in large blocks within the Skagit Valley and its larger tributaries—by 10,000 years ago the ice sheet was gone.

The response of the watershed to the Fraser glaciation continues today as



*Fairy bells*

the crust rebounds from the weight of the ice sheet, rivers carve into the vast amount of sediment left in valley bottoms, and slopes fail (in-part) because of glacial over-steepening of valley walls.

Sediment eroded by ice age glaciers was deposited in the valley bottoms and grows thicker downvalley. At the base of Ross Dam in the river canyon, the valley fill is 30' deep. The fill deepens to 120' at Newhalem, 400' at the mouth of Bacon Creek, and over 1,000' at the delta.

The largest of many hundreds of landslides that have occurred in the Skagit since the end of the ice age occurred around 6,700 years ago. It began near the

crest of a ridge between Bacon and Damnation Creeks on the north side of the Skagit River. So large was the slide that it blocked the river for many months. Landslides are a fact of life in the steep mountains of the North Cascades. The largest ones are triggered by heavy rainfall, earthquakes, and volcanic activity. Smaller slope failures are a result of rock weathering and vegetation disturbances.

Glaciers continue to shape the summits of the Skagit Watershed today. The Skagit has more glaciers than any other watershed in the lower 48 states. Major concentrations of glaciers are found on the two volcanoes (Mt. Baker and Glacier Peak) and on higher non-volcanic massifs of the crystalline core.

These smaller glaciers have advanced and retreated as much as a mile from their icy summits several times since the end of the last Ice Age. The most recent period of glaciation is known as the Little Ice Age and lasted from 1200 A.D. to around 1900 A.D. Barren rock and small ridges of sediment, deposited below and along the edges of glaciers throughout the watershed, mark the extent of these Little Ice Age glaciers. Most glaciers in the watershed are continuing to retreat today.

### Valleys

The incredible erosive power of the glaciers deepened tributary valleys and the Skagit Valley itself to within a thousand feet of sea level very near to the high drainage heads. Ice age glaciers also straightened valleys by truncating tributary valley ridges, broadening them into U-shaped troughs. Larger tributary valleys are flat and poorly drained—the swamps of lower Big Beaver and Thunder creeks are good examples.

Where basins were too small to produce large glaciers that could erode deeply enough to join them with the main valley floor, hanging valleys were created. Waterfalls tumble hundreds of feet from the edges of hanging valleys such as Thunder, Fisher, Arctic and Skymo basins.

While glaciers have shaped the summits and valley walls of the Skagit Watershed, the river has shaped the valley bottom. The river adjusts to changes in discharge or availability of sediment by eroding into the glacial valley fill, steepening its slope to cut through landslide deposits, or by changing its position on the floodplain.

As glaciers retreated from the watershed at the end of the last Ice Age, the Skagit and its larger tributaries were choked with sediment eroded from the mountains. In response to this sediment burden, the river formed a series of braided streams instead of a single channel. These braided streams were only stable for days before they filled with sediment. Braided streams that appear like the Skagit did at the end of the last Ice Age are found today at the terminus of glaciers. Glacier-fed streams are also identified by the amount of fine-grained sediment they carry, which gives them a cloudy or milky appearance. Diablo Lake gets its jade-green summer color from glacial sediment carried by Thunder Creek.

As the sediment load delivered by glaciers decreased, the river responded by changing its shape and downcutting into the valley fill. The river changed from a braided stream to a single channel. The stability of the channel continued to increase as vegetation reoccupied the watershed.

Today the river is stable between large floods. Sediment is stored in terraces along the river banks and in riffles, gravel bars and islands within the channel. As the river's gradient changes, the sediment the river stores along its bed changes. Where the gradient is less than 5 feet per mile on the delta the river bed is composed of fine sand and silt. In reaches where the gradient is between 5 to 30 feet per mile, the river and its tributaries beds are composed of gravel and cobbles. Stream gradients of greater than 30 feet per mile result in a stream having the ability to remove all but boulders from its bed.

### The River Delta

The Puget Lowland is a part of a huge trough that includes the Fraser Lowlands and Strait of Georgia to the north and the Willamette Valley to the south. Thousands of feet of sediment stripped by glaciers and rivers from the North Cascades and Olympic Mountains fill the Puget Sound trough.

As the Cordilleran ice sheet grew on the Fraser Plateau, and in the Coast Mountains of British Columbia, it advanced into the Skagit watershed from two directions. One lobe of ice descended the upper valley, while a second lobe advanced up the lower valley from the Puget Lowlands. These two 6,000' walls of ice met somewhere between Concrete and Rockport.

The Cordilleran ice sheet filled the Sound to a depth of over 5,000' at Mount Vernon. Moving south, the ice sheet created the streamlined topography around Clear Lake and rounded the tops of the San Juan Islands. The tremendous weight the ice depressed the Earth's crust at the Skagit Delta over



450'. Even today Puget Sound is rebounding from the weight of the ice that disappeared over ten thousand years ago.

Although uplands in Puget Sound were shaped by glaciers, the delta of the Skagit River was, and is, being shaped by the interaction of the river with the waters of Puget Sound.

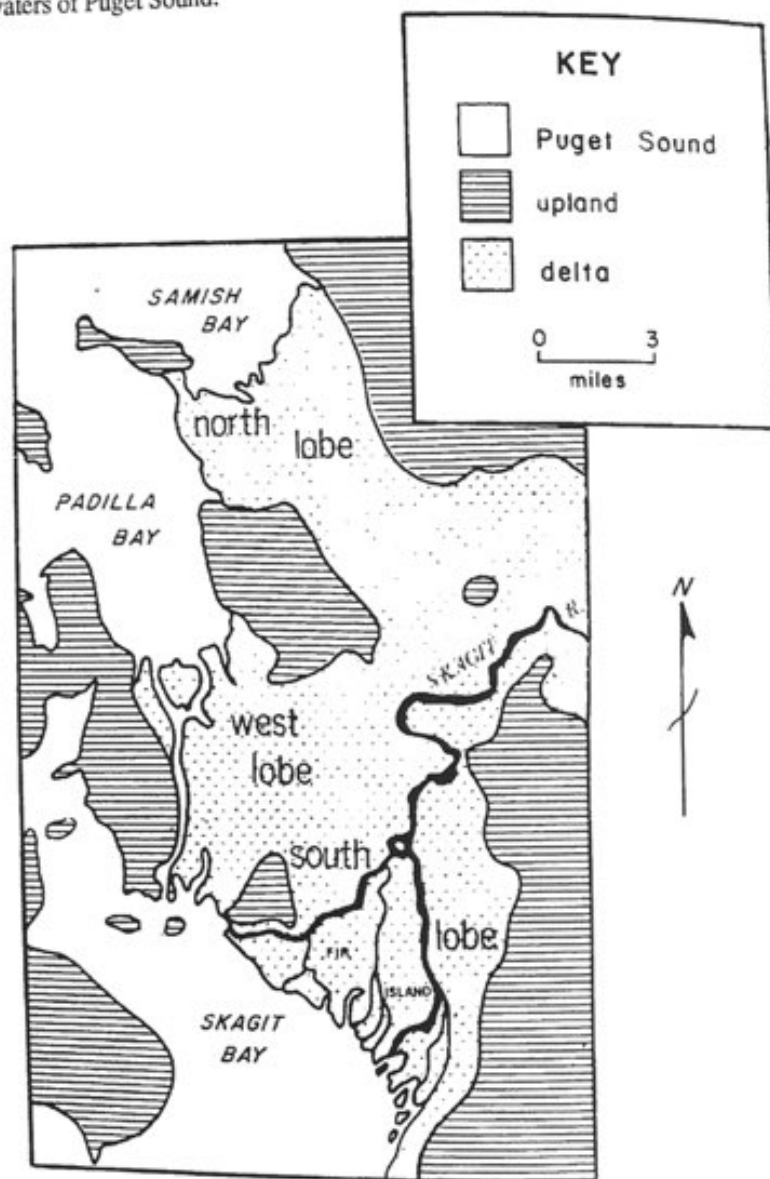


Figure 2. The Skagit River Delta

The river delta has formed at the mouth of the river since the last glaciation. At the end of the last ice age (10,000 years ago) the Skagit River met the sea near Hamilton. Five thousand years ago, the delta had grown to Burlington. As it grew to its present position it engulfed several former islands, including Burlington Hill, Bayview Ridge, and Cedar Hill. Eventually, Whidbey, Camano and Fidalgo islands will be incorporated into the mainland.

As the Skagit River nears Puget Sound, it slows, moving in meanders across the floodplain. As the river slows it begins to drop the sediment it is carrying, and the delta grows out into Skagit Bay. The Islands of the San Juans provide protection from storm waves that would wash the delta soils away.

The delta is composed of northern, western and southern lobes (Figure 2). The southern lobe is presently the only active (growing) part of the delta, although during large floods water spills from the Skagit River onto the west lobe of the delta. The northern lobe has been inactive for over 5,000 years.

## The Way of Water: Skagit Floods

Large floods are responsible for most changes on the river floodplain, although smaller ones occur more frequently and, therefore, carry more sediment to the delta. Dense forests on the valley bottom keep the river channel from changing position, but caused huge logjams on the river in the past. Floods are one of the most important features of the Skagit Watershed (Table 2). They are large and frequent because of the vast precipitation the Skagit receives. Floods occur rapidly because the steepness of the mountains and the many streams in the watershed ensure that water travels quickly from the mountains to the river. Skagit floods are destructive and costly because of human development, settlement and agriculture along the lower reaches of the river.

Floods on the Skagit take two forms, depending on the time of year they occur. Fall and winter floods occur in response to heavy fall and early winter rains. Because water runs quickly off of the steep mountain slopes, winter floods rise fast, but are of shorter duration than spring floods.

Spring floods occur in response to the melting of the immense winter snowpack in the mountains. Unlike winter floods, spring floods are smaller and last longer; it takes more time for snow to melt and reach a stream. Some of the largest floods on record in the Skagit occur when warm rains fall high on snow covered mountain slopes. These floods can occur at virtually any time during the late fall and early spring.

The November 1990 floods occurred as the freezing level rose rapidly and as much as 10" of rain fell on a heavy early-season snowpack within a few days. The flood rose to its fourth highest level since 1920. On the Lower Skagit, between Marblemount and Mount Vernon, the river eroded banks, washed down forests, and swept away homes. Levees failed on Fir Island, flooding the entire delta. Losses were in the millions of dollars and Fir Island looked like it had joined Puget Sound.

Five dams were constructed (in part) to diminish the magnitude of flooding on the Skagit. Two dams are located on the Baker River and three on the Skagit River above Newhalem (Baker Dam 1926, Diablo Dam 1930, Ross Dam 1949, Upper Baker Dam 1959, Gorge Dam 1960). Together the dams can store as much as 13 percent of the Skagit River's annual discharge. It is estimated that they have reduced the magnitude of floods by as much as 45 percent at Concrete. However, the dams provide limited flood protection. They are usually close to full in the fall, and therefore provide better protection against spring snowmelt floods. Furthermore, the dams only store enough water to protect against smaller floods. For example, Ross Lake filled within a few days during the November 1990 floods. Had rain continued to fall, the dams would not have provided additional flood water storage.

Over 65 miles of levees along the lower river are designed to keep the river and ocean tides from Puget Sound from flooding adjacent farmland. Levees are ridges of rock and earth along the banks of a river. Despite attempts to control flooding by the construction of dams and levees, the Skagit remains a flood-prone valley.

In contrast to large floods, periods of low water flow are infrequent on the Skagit River. Glaciers in the watershed store as much water as the Skagit River delivers to Puget Sound annually. Stored glacial water is released slowly to the rivers long after most of the snow has melted. This makes the Skagit an especially productive stream for salmon as glaciers provide water flow even during periods of extreme drought. The lowest recorded discharge on the Skagit occurred during the drought of 1943, when only 54 cubic feet per second (cfs) passed by the gage at Newhalem. Without the glaciers the river might have run dry.

**Table 2. Large Floods on the Skagit River**

<u>Year</u>	<u>Month</u>	<u>Peak Discharge (cfs)</u>
1815	- - -	500,000*
1856	- - -	350,000*
1897	November	275,000
1909	November	260,000
1917	December	220,000
1921	December	240,000
1932	February	147,000*
1949	November	154,000*
1951	February	139,000*
1980	December	148,000*
1990	November	142,000*

- \* discharge reconstructed from geologic evidence
- after construction of dams

## A Watershed Tour

The names of water in the North Cascades tell us of the peoples who lived here before. Native American and European, they speak to us of their presence. They tell us who they were, what they found, and what they dreamed: Skagit, Sauk, Suiattle, Cascade, Baker, Thunder, Ruby, Eldorado, Big Beaver, Granite, Terror. The tributaries of the Skagit River are all unique. The Skagit River Basin itself can be divided into the Upper and Lower Valleys, with the town of Marblemount as a dividing point, and the Skagit River Delta.

### The Upper Valley

Above Marblemount, the Upper Skagit watershed covers 1,380 square miles, of which 400 square miles lie within British Columbia. The Upper Skagit is known for its great vertical relief, rugged, sharp-crested ridges, and deep, steep-walled valleys. Devil's Creek drains one of the largest canyons on Ross Lake. Ruby Creek is one of the longest streams in the drainage basin. The valleys of Big Beaver and Little Beaver creeks drain the rugged east slope of the Picket Range, the most vertical and steep-sided divide in the basin. The gentle meanders of Big Beaver Creek produce many swamps and beaver ponds, and host the largest western redcedars in the North Cascades. This entire area is roadless and known for its pristine wilderness and abundant wildlife.

Ross Lake, located in the northeastern portion of Whatcom County, is the largest body of water in the watershed. Formed by the construction of Ross Dam, which was begun in 1937 and completed in 1949, Ross Lake is 24 miles long and extends one mile into British Columbia at full pool. The lake covers 11,200 acres in Washington and 480 acres in British Columbia. In the United States the lake and adjacent lands comprise the Ross Lake National Recreation Area, administered by North Cascades National Park Service Complex. Glacial meltwater produces a lake that is usually too cold for swimming, but provides excellent boating, fishing, hiking and camping.

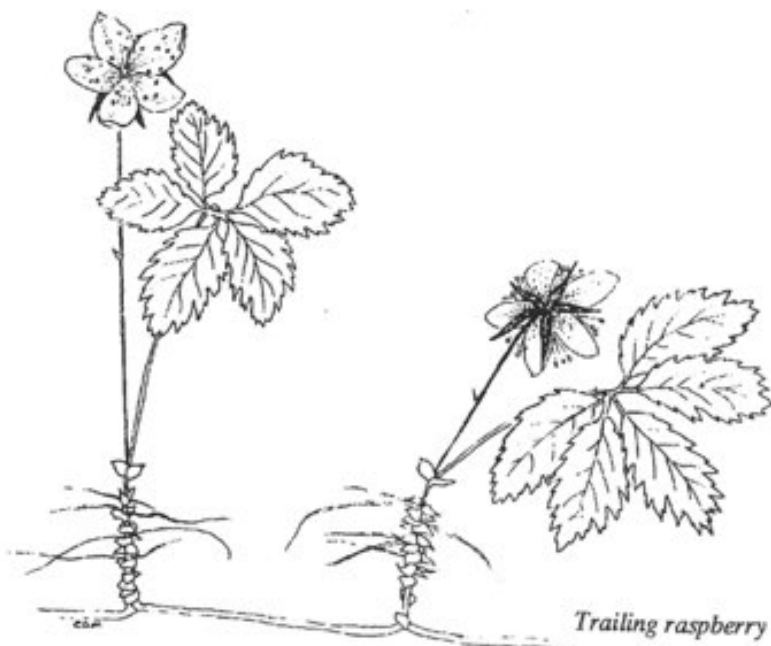
Above Ross Dam the valley is wide from the effects of repeated excursions of the Cordilleran ice sheet, and the river has a moderate gradient of 14 feet per mile. The tributaries to the Skagit, however, differ markedly on the east and west sides of the lake. Drier eastside tributary valleys such as Lightning, Devil's and Ruby creeks have broad U-shaped upper segments created by glaciers and narrow, winding lower canyons carved by running water. In contrast, the wetter westside valleys have U-shaped glacial troughs from headwater to mouth.

Between Ross Dam and the town of Newhalem the river plunges at a dizzying rate of 80 feet per mile through a gorge cut into the crystalline core of the North Cascades. The gorge was created by the activity of the Skagit River between ice ages and by meltwater from retreating glaciers. This narrow, winding canyon sits at the bottom of a glacial trough created by the many expansions of the Cordilleran ice sheet. The ice sheet filled the canyon, but did not excavate it into a U-shaped valley. Since the end of the last Ice Age the river

has cut some 20 feet into bedrock. Between Newhalem and Marblemount the river again flows through a glacial trough, dropping at 14 feet per mile.

Thunder Creek arises from glaciers nestled high on the slopes of Boston, Buckner, and Forbidden peaks. Thunder Creek is also fed by the waters of the aptly named Skagit Queen Creek, arising from the Boston Glacier, largest glacier in North Cascades National Park. Thunder Creek is predominantly glacier-fed and carries much glacial sediment, giving the water a milky appearance. Downstream, Thunder Creek enters Diablo Lake at the location of Colonial Creek Campground, from which beautiful trails entice hikers to explore along its turbulent waters.

The Cascade River joins the Skagit River at Marblemount, below the effects of the up-river dams. Travel along the Cascade River served as a major migration route for native peoples trading with tribes of the Columbia Basin. A federally-designated scenic river, the Cascade River originates from the high peaks near Cascade Pass. The highest peaks of the Cascade Watershed reach to 8,900'; all lakes in the basin lie above 2,500'.



*Trailing raspberry*

**Table 3. Major Tributary Streams, Glaciers and Lakes of the Skagit River Basin**

Stream	Size (sq.mi)	Glaciers	Lakes
<b>Upper Skagit</b>	771	177	138 (3 reservoirs)
Little Beaver Creek	54		
Lightning Creek	129		
Big Beaver Creek	68		
Ruby Creek	215		
Thunder Creek	114		
<b>Cascade River</b>	185	57	35 (no reservoirs)
<b>Lower Skagit</b>	535	5	96 (6 reservoirs)
Illabot Creek	42		
Finney Creek	52		
Day Creek	34		
Nookachamps Creek	72		
<b>Sauk-Suiattle Rivers</b>	732	96	79 (no reservoirs)
Sauk River	386		
Suiattle River	346		
White Chuck River	86		
<b>Baker River</b>	297	63	39 (2 reservoirs)
<b>Total</b>	<b>3,100</b>	<b>394</b>	<b>387</b> (11 reservoirs)

### The Lower Valley

From Marblemount, the lower Skagit Basin covers 535 square miles as the river flows westerly in a broad valley bordered by mountains. Below Sedro Woolley the river meanders for several miles across a flood plain to within 8 miles of Puget Sound. It then branches into north and south forks that flow into Skagit Bay. Between Marblemount and Sedro Woolley a narrow floodplain ranges from 1-2 miles in width. Below Sedro Woolley the floodplain widens to form an extensive delta, eventually widening into Puget Sound. The Skagit floodplain covers over 90,000 acres below Marblemount.

Between Marblemount and the delta, the river gradient eases to 6 feet per mile as the valley broadens into an widening glacial trough. As the river's gradient decreases, and sediments from the Cascade, Sauk and Baker rivers enter, the river begins to meander. Evidence of past meanders include old channels, oxbow lakes and sloughs that provide important wetlands and rich habitat for wildlife, including great blue herons, trumpeter swans, and many species of ducks and other waterfowl. Sloughs such as Barnaby Slough (Rockport), Gages Slough (Burlington), Jim's Slough (Lyman), Britt's Slough (Mount Vernon), Skiyou Slough (Sedro Woolley), and Minkler Lake (Lyman) are key components of the Skagit Watershed.

The combined streams of the Sauk and Suiattle rivers form the largest tributary of the Skagit. Draining the slopes of Glacier Peak, these rivers show a radial drainage pattern. The Sauk River Basin covers 732 square miles and is the largest subarea of the Skagit Watershed. Including the Suiattle and White Chuck rivers, its headwaters are in fields of glacial ice located near the crest of the Cascades. Altitudes within the basin range from 275' where it enters the Skagit at the town of Rockport, to 10,541' at Glacier Peak.

The Baker River is the only dammed tributary of the Skagit and drains the south and east slopes of Mt. Shuksan and Mt. Baker. The Baker River Basin is comprised of rugged mountains similar to those of the Upper Skagit. Altitudes range from 175' at Concrete to 10,773' at Mt. Baker. Water from the Baker River Basin is converted to hydroelectric power at dams on Baker Lake and Lake Shannon, as well as two small power plants in the Bear Creek drainage. Noisy Creek, which originates high in North Cascades National Park, tumbles into Baker Lake from the east. Home to spectacular ancient forests and wildlife, including spotted owls, Noisy Creek was the focus of an intense preservation effort that culminated in 1990 when the land was purchased from timber companies by the U.S. Forest Service. Noisy Creek now has the protection it deserves.

### The Skagit River Delta and Puget Sound

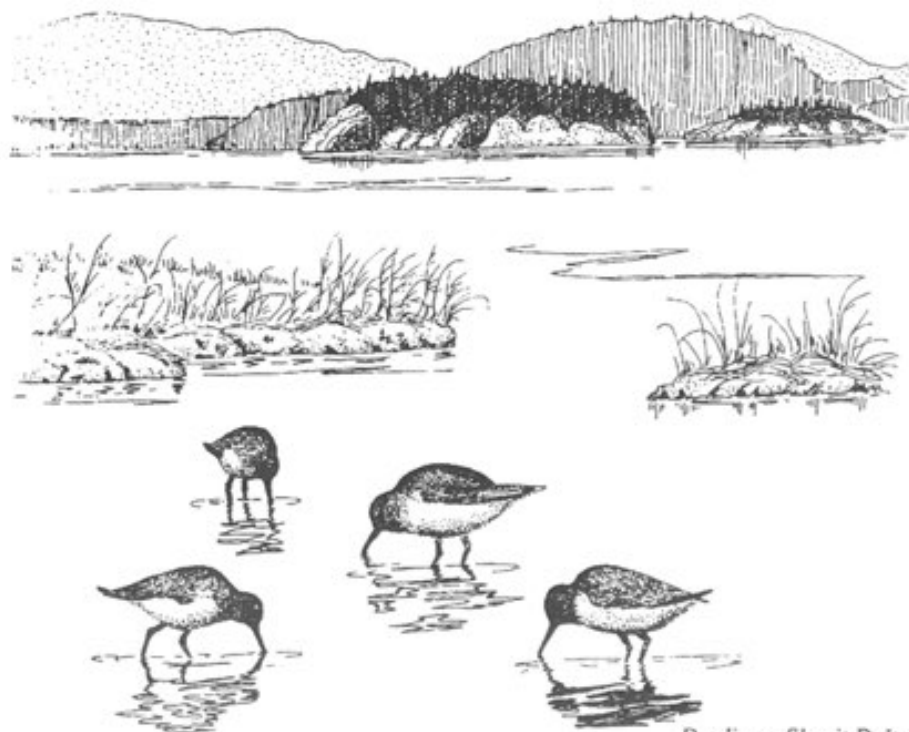
The delta is the dynamic end to the river's long journey to the sea. As the river nears Puget Sound, it slows; instead of tributaries joining the river, the river itself begins to divide. Below Mount Vernon it splits into north and south distributary channels, and into over a dozen channels at the delta's edge. At the delta the river offers the eroded mountains to Puget Sound at the rate of ten million tons of sediment per year.

The water and islands of Puget Sound work with the river to shape the delta. If not for the protection offered by Whidbey Island, the delta would be destroyed by the force of storms and waves from the Strait of Juan De Fuca.

Sand, silt, and other fine materials are deposited over the delta as the river current slows as it joins the Sound. New wetlands are created as the delta continues to advance, particularly in the protected waters of Skagit, Padilla and Samish bays. Deposition of sediment has outpaced erosion by tides, waves and currents. As a result the delta has grown rapidly for over 10,000 years.

Pioneer grasses provide sheltered habitats for developing communities of plants and animals. Tidal marshes merge into freshwater swamps and sloughs. These rich, alluvial lands attract large concentrations of wildlife, particularly migrating waterfowl.

The Skagit Wildlife Area provides 12,000 acres of river delta and shallow estuarine habitats for over 175 species of birds, including waterfowl, shorebirds, and raptors. Sand flats beyond the marsh provide wintering area for up to 26,000 snow geese which arrive in late fall and depart for Siberia in late April. Tundra swans are also present in large numbers.



*Dunlin on Skagit Delta*



## River Habitats: Plants and Wildlife

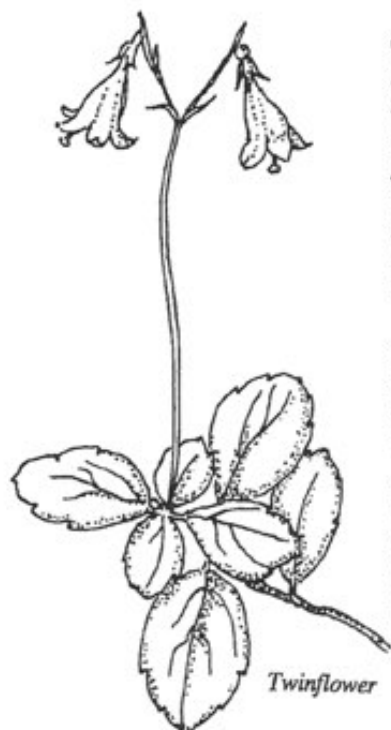
The Skagit River Basin is a rich and varied ecosystem—a landscape bound together by common threads of geography, climate and the interactions of living communities of plants and animals. It is the river that ties it all together—joining the icy slopes of the highest peaks with the open waters of Puget Sound. This is a land of dramatic changes: open marshes of the river delta contrast with dark forests of the river valleys; dwarf trees on an alpine ridge stand alone above lush green meadows. Not all differences between habitats are dramatic, however. There are many subtle changes as one habitat type grades almost imperceptibly into another.

A habitat is a combination of the physical environment, the rocks, land and water, as well as living things. Together these plants and animals make up an interacting, interdependent community. Habitats range from microhabitats of the forest floor, a world of decaying fir needles, rotting wood, and a rich flora of insects and other arthropods, to the quick, cold streams that tumble from the slopes of Eldorado Peak. Mountain forests support communities of plants and animals different from those of the river valleys; plants that flourish in subalpine meadows are strangers to the more severe conditions occurring on alpine ridges. Higher still, two black ravens ride swirling currents in the mountain winds.

### Lowlands and River Valleys

Water is the essence of the North Cascades. Small creeks and rivulets tumble from glaciers and snowfields and join together as rushing creeks. Hundreds of small lakes lie scattered throughout the watershed, isolated jewels accessible only by arduous cross-country hiking. Many of these mountain lakes, rich reservoirs of life surrounded by marsh and meadow, are tarns—remnants of glaciers that have long been gone.

Although many of the lowland valleys are accessible by road, the farther you journey into the mountains the more difficult travel becomes. In the National Park and Forests, hiking trails wind through most major river valleys. Travel off-trail is difficult at best and nearly impossible in many places. Creeks and stream banks are choked with dense brush including devil's club, salmonberry, thimbleberry, vine maple, and willow.



*Twinflower*

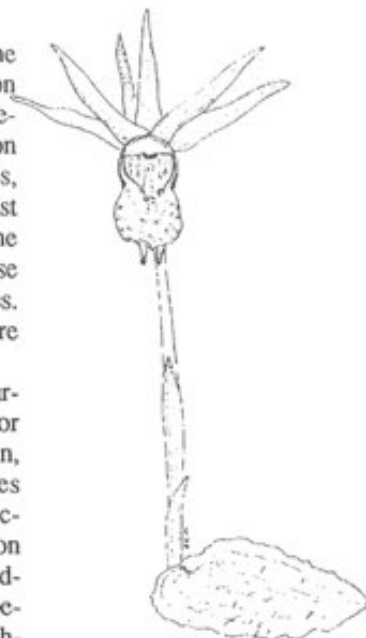
The distribution of plant communities in the Skagit Watershed is determined by a combination of topography and climate. Precipitation and elevation combine to create a series of vegetation zones, each with characteristic plant communities, as one moves from the Puget Sound lowlands east to the crest of the Cascades. The west side of the range is characterized by high precipitation, dense undergrowth, and forests of large coniferous trees. The east side of the mountains is drier, with more open country and much less brush.

Plant communities change over time. Disturbance, such as fire, landslide, windfall, floods, or development, whether natural or of human origin, creates conditions where plant communities change. Vegetation passes through various successional (seral) stages, as species composition changes from pioneer grasses and herbaceous wildflowers to climax plant communities. Some species have a wide latitude and are common throughout several zones; vine maple, red alder, and slide alder, for example, are common in disturbed areas at all but the highest elevations.

The Puget Lowlands were once almost completely covered with dense forests of two shade tolerant species—western hemlock and western redcedar. Seedlings of these two forest giants are able to germinate and grow in the shade of the mature forest. Together they comprise the climax community of the low-elevation forests of the watershed. This climax community is self-replenishing unless disturbed. These are the classic, low elevation, ancient forests of Puget Sound. Stretching from sea level up to around 2,500', these forests support a rich understory community.

In springtime the forest floor is thick with wildflowers. Trillium, bleeding heart, yellow violet, calypso orchid, twinflower, foam flower, and bunchberry display their delicate colors and brighten the forest shade. Mosses, lichens and fungi grow thickly over the ground and on exposed rock and fallen trees. Huckleberries tantalize hikers along the trail. In drier locations salal and Oregon grape, both evergreen shrubs, dominate the understory, while swordfern and its many relatives grow throughout the forest.

Western redcedar grows in moister sites, hemlock can tolerate slightly drier conditions. Growing in scattered open glades throughout the cedar-hemlock forest are red alder and bigleaf maple. These two deciduous trees must have at least some sunlight for their seedlings to grow. They appear along trails and streams and in openings created when forest giants fall during windstorms. Red alder is an important pioneer species that adds nitrogen to the soil through nodules of symbiotic bacteria on its roots.



*Calypso orchid*

Douglas-fir is an important component of these ancient forests. Douglas-fir needs more light than cedar or hemlock, and achieves rapid growth on freshly disturbed sites with mineral soil. In areas that have been disturbed, Douglas-fir may form a climax forest composed of huge trees 250' high, 8' in diameter and over 750 years old, .

The greatest concentration of remaining ancient redcedar in the Skagit Basin is along the lower reaches of Big Beaver Creek. Redcedars are a long-lived species, living more than 1,000 years. Growing in moist habitats they are ideally suited to the Skagit Watershed where summers are cloudy and winters are mild. Tapering from heavily buttressed bases 16' in diameter, they rise 200' above the forest floor balanced on a shallow, wide-spreading root system that provides stability in wet valley soils. They are distinguished by their stringy, fibrous bark and lacy sprays of flat needles. Native peoples of the Pacific Northwest used all parts of the cedar—bark for clothing and wood for totems, dugouts, and shelter.

The lowland river valleys contain magnificent forests. While some forests on public and private land are managed for timber harvest and some Forest Service areas are designated multiple use (recreation, timber production and resource extraction), others have been designated as wilderness (Figure 4). Ancient forests on public and private lands in the Skagit basin contain virgin forest with large, old trees together with trees of different ages. The diversity of age classes in an ancient forest provides a rich understory. Different canopy levels allow sunlight to touch the forest floor in places. Ancient forests contain many snags and logs that provide shelter for a variety of plant and animal life. Some of the most extensive stands of ancient forests left in the United States are the low elevation Douglas-fir forests of the Skagit River Basin.

### Mountain Forests

There is no clear dividing line between river valley and mountain forests, just a gradual change in the physical environment, and a corresponding change in plant and animal communities. We begin to feel a slight chill in the air, bringing an awareness of the snowy peaks that rise above. As we climb, the land becomes drier and more open. Even though precipitation increases with altitude, poor mountain soils do not retain water throughout the growing season. Western redcedars are left below, to be replaced by one of the loveliest of forest trees—Pacific silver fir. The Pacific silver fir zone extends from 2,000' up to around 4,500', and includes western hemlock as a co-dominant. As elevation increases, and the seasonal snowpack deepens, silver fir becomes more and more prominent. Scattered redcedars occur in moist pockets; noble fir is also an important tree in some areas. The understory species are very similar to that in the redcedar-western hemlock zone, with twinflower, bunchberry, and vanilla leaf often covering the ground along with a wide assortment of ferns. Red alder, Douglas-fir, and bigleaf maple still grow in sunlit openings.

Climbing higher still, we enter the mountain hemlock zone which stretches from 4,000' up to timberline at around 5,500'. Pacific silver fir is still



*Mountain hemlock and subalpine fir*

common and we pass through a silver fir-mountain hemlock forest as we continue our climb toward timberline. Western hemlock has pretty much dropped out of the picture at these higher elevations. Alaska yellow-cedar and subalpine fir begin to appear. Understory species include huckleberries and mountain ash.

### Land Above the Trees

As our path winds higher into the mountains, the dense stands of silver fir and mountain hemlock give way to open meadows and windblown ridges. We have entered the land above the trees. It is a land of lush wildflower meadows, scattered groves of dwarf trees, and a variety of plant and animal communities distinct from the forests below.

The transition from mountain forest to subalpine meadow is dramatic. Trees are replaced by grasses, herbaceous flowers, and small shrubs. Lush meadows of alpine phlox, Davidson's penstemon, false hellebore, Sitka valerian, mountain lupine, partridge foot, fanleaf cinquefoil, and glacier lily



*Luetkea*

cover the slopes. Patterns of snow accumulation and snowmelt are the determining factors in the distribution of subalpine plant communities. Snow blown off high alpine ridges accumulates on leeward slopes where luxuriant subalpine meadows thrive on meltwater in early summer.

In wetter subalpine habitats, pink and yellow monkeyflower, bog orchid, marsh marigold, blue gentian, and many species of saxifrage provide a brilliant display. Subalpine vegetation may be covered with snow well into July in many places. Dwarf sedge dominates these snow bank communities. The growing season usually lasts less than three months before winter storms begin again.

On the western side of the watershed the subalpine zone begins at around 5,500'. The elevation at which timberline occurs is determined by a combination of factors, including temperature, snow, slope aspect, and wind. Snowpack affects the length of the growing season and the amount of soil moisture available throughout the year; both affect the ability of trees to survive. Common timberline trees of the western slope are mountain hemlock and subalpine fir, although Pacific silver fir and Alaska yellow-cedar are also found.

Tree shape changes radically at timberline. The large upright growth forms of the forest become stunted dwarf trees growing in small clumps or tree islands. Krummholz, a German word meaning "crooked wood", describes the gnarled, twisted trees common at timberline. Tree islands usually become established around a single tree whose presence modifies the environment in its immediate vicinity. Its darker color causes earlier snowmelt and provides protection from the wind, allowing seedlings to become well established.

Subalpine trees commonly reproduce by layering; a branch touches the ground, takes root, and eventually becomes an independent tree. This leads to the common pattern of krummholz islands, with an upright tree in the center of a dense "skirt" of limbs and new shoots spreading around it. The height of the skirt shows the depth of winter snow; branches that protrude above the protective snowpack are pruned by wind and ice.

Contrasting with the dense herbaceous growth of the subalpine, the alpine zone is a more severe and limited habitat. The alpine tundra, from a Russian word meaning "treeless plain", is a harsh world dominated by the interaction of wind and snow. Storms and freezing weather can occur in any month of the year. Temperatures range from below freezing to over 90°F in August. Lichens, mosses and prostrate cushion plants are the dominant life forms.

Water is a severely limiting element in the alpine environment. Exposed ridges are blown free of winter snow. Rocky, nutrient-poor soils retain little

moisture for plant growth and strong, desiccating winds remove what water remains. These factors combine to cause a summer drought in the high country. Frost action and soil movement make it difficult for plants to take root and survive. Sheltered microhabitats promote the accumulation of moisture and the establishment of seedlings.

Alpine plants rely on many specialized adaptations in order to survive in a severe environment characterized by cold temperatures, a short growing season, and poor, unstable soil. Many species have a low, prostrate growth form that hugs the warmer and less windy microclimate near the ground. Cushion plants, such as alpine phlox and moss campion, appear as just a small mat until showy flowers bloom in early summer. Most alpine plants are perennials—it is difficult to depend on annual seed production in the alpine environment. Dwarf sedge, glacier lily and false hellebore may begin growing beneath the snow. Other species find shelter in rocky cracks and crevices.

### The Eastern Slope

On the east side of the watershed, similar changes occur as we move up the mountainside, although different tree species are involved in these drier habitats. Because the watershed divide occurs in the high country, there are relatively few low elevation, east slope, forests included in the Skagit River Basin. Less snow accumulation, and a longer growing season, on the eastern slope raise timberline to 6,500'. Timberline trees of the eastside of the river basin include subalpine fir, Engelmann spruce, subalpine larch and whitebark pine. The land is open and rolling, with a lush subalpine zone similar to that of the western Cascades.

Below the high country, from 1,000' to 5,000' is a zone that is dominated by dense stands of lodgepole pine and grand fir, with an understory that includes snowberry, wild rose, snow brush, and manzanita.

At lower elevations, extending from 1,000' to 2,500', fire resistant Ponderosa Pine predominates. Douglas-fir is common on moist sites. These Ponderosa Pine-Douglas-fir forests are open, with grassy meadows alternating with dappled sunlight on the forest floor. Yarrow, arrowleaf balsamroot, ceanothus, and elderberry are common understory plants. Black cottonwood and willow line the rivers.



*Kinnikinnik*





*Hoary marmot*

### Animal Diversity: Riparian Wildlife

Over millions of years living things have become adapted to their environment. Through the processes of adaptation and evolution, each species has become uniquely fitted to its habitat and community in shape, growth, behavior, and in many other ways. Life is limited by the physical environment (temperature, wind, moisture, space, length of growing season) and by other organisms (competition and predation). Animals must be able to cope with all these factors to survive.

The abundance and diversity of plant communities underlies the diversity of animal communities. There are approximately 276 wildlife species within the Skagit River Basin. These include 25 fish, 17 amphibians, 10 reptiles, 73 mammals, and 174 birds (Appendix).

The major difference between plants and animals is simple—animals can move. Animal adaptations to rivers and mountains is dominated by this basic difference. Wildlife use the lower river and Skagit Delta throughout the year while the mountains are mostly occupied in the summer. Humans are commonly found in the high country during summer, and most animals seen at that time are also summer residents.

Animals are dependent upon certain habitats: creek sides, plant communities or successional stages. Habitats dominated by freshwater, such as streams, rivers, and marshes, are called riparian areas. They form the boundary between aquatic and terrestrial habitats, and are crucial to the health of the ecosystem. Although comprising a very small amount of the total area of the watershed, they contain the greatest diversity of species. Riparian areas are used by many species as travel corridors as they move throughout the watershed or up or down in elevation.

Riparian vegetation is lush. There is a profusion of ferns, especially sword fern, deer fern and lady fern. Shrubs, including devil's club, salmonberry, thimbleberry, various species of willow, and vine maple form dense thickets along stream banks. Members of the Saxifrage family grow near creeks and in wet meadows.

Voracious dragonfly nymphs are common in streams and lakes, as are caddis fly and mayfly larvae. A rich population of aquatic insects provides food for many species of fish, amphibians, birds, and smaller mammals.

Larger lakes, including Ross Lake and Baker Lake host breeding populations of osprey, bald eagles and other fish-eating birds. Other birds found along the lower river and in wetlands and sloughs include common mergansers, great blue herons, kingfishers, bald eagles, and tundra and trumpeter swans. Living along high, cold, swift mountain streams we find spotted sandpipers, dippers, and harlequin ducks.

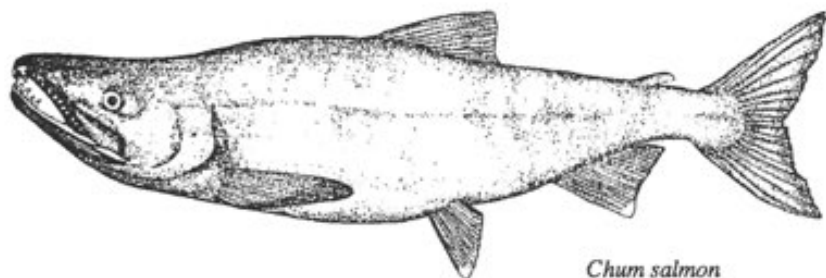
Riparian habitats in montane forests are home to many amphibians, creatures which are especially sensitive to water quality and pollution. Ensatina salamanders are found in bark piles at the bottom of snags. Olympic salamanders and tailed frogs breed in small, cold, clear, mountain streams. Pacific giant salamanders are one of the most important predators in mountain ponds and streams. Growing up to 12" in length, they eat mice, garter snakes, and smaller salamanders.

Mammals associated with riparian habitats include otter, mink, muskrat, water shrew, and beaver. Many others, such as black-tailed deer, elk, black bear, coyote, bobcat, cougar, lynx, and members of the weasel family (fisher, marten, mink, wolverine, short and long-tailed weasels) will congregate along riparian corridors to search for food or prey upon other species that are drawn to the river's edge.



Important and often overlooked habitats include snags and downed logs. In the Skagit Watershed, over 53 species (39 birds and 14 mammals) use dead, standing and fallen trees for nesting cavities and for feeding. After a Douglas-fir dies, it can remain standing for over a century. Ants, termites and woodbor-ing beetles eat the wood. The insects, in turn, are food for woodpeckers that excavate nesting cavities. When the nests are abandoned, brown bats may move in. Vaux's swifts nest in the chimney-like tops of snags.

The mountains provide a harsher environment than wetlands or along streams. During especially fierce storms many alpine birds and mammals temporarily leave the mountains to seek protection in the lowlands. Migration may occur on a seasonal or a daily basis. Deer often enter the subalpine mead-ows to browse but rarely stray far from the protection of the forest. Many subalpine animals, such as marmots and pikas, use microhabitats extensively, especially small rock crevices and shelter provided by krummholz clumps. In the winter most true alpine mammals hibernate in burrows below ground.



*Chum salmon*

### Salmon and Steelhead

As the largest river system in Puget Sound, the Skagit contains some of the best spawning habitat for salmon. It is the only large river system in the state that contains healthy populations of all five native salmon species and two species of anadromous trout. Runs include chinook, coho, pink, sockeye, chum and steelhead and cutthroat trout. The sport, commercial and tribal fisheries supported by the Skagit are essential to the local economy.

Salmon and trout are members of the salmonid family—dominant fish of cold, clear, gravel-bedded mountain waters. The six species of Pacific salmon living in the Skagit Watershed are not only the largest and most important predators in the freshwater environment of the river basin, they are also important indicators of the health of the watershed. Salmon require cold, unpolluted water that is high in dissolved oxygen and low in sediments. The high quality of the fish runs of the Skagit is due, in part, to the protection that the upper slopes of the watershed receive by inclusion in the wilderness areas of North Cascades National Park, Mt. Baker-Snoqualmie and Okanogan National Forests. Logging, and its attendant problems of erosion and stream siltation, are prohibited in federally-designated wilderness areas.

The life cycle of salmon in Skagit waters is one of the more amazing stories of the watershed (Figure 3). In the early stages of their lives, as eggs, hatchlings, and juveniles, they are dependant on streams and rivers. Adult salmon spend different amounts of time in the open sea before returning to their rivers of origin to reproduce and die. Most adults do not feed once they return to freshwater.

Chum salmon are one of the most important species in the Skagit River Basin, and are tied to all aspects of the river's ecology. A spawning female chum salmon, after locating a site to deposit her eggs, turns onto her side and lashes her tail to create a shallow depression known as a redd. As the female lays hundreds of eggs in the redd a male swims over and releases sperm-filled milt into the water. The eggs are fertilized, and the female then covers them up as she begins excavation of the next in a series of nests. The eggs, covered by gravel in the streambed, develop during a one to four month period in the winter. The developing eggs are dependent upon clear, cool water to provide oxygen and carry away waste products. If the eggs are covered by fine-grained sediment, they die.

The hatchling salmon, called an alevin, carries a large yolk sac attached to its belly as a source of food for the next few weeks or months as it continues to live in the gravelly streambed. The young salmon finally emerges as a fry and joins the life of the stream. Fry feed during the night, primarily on aquatic insects that drift with the current. In the day they hide around rocks and gravel, avoiding predators such as large salmon and sculpin. The fry soon grow into fingerlings which, in the case of chum salmon, move downstream to coastal estuaries. The fingerlings of other species remain in freshwater for between 2 months and 3 years before migrating back to the sea, where they may spend another 2 to 5 years in saltwater before returning to the river to complete their life cycle.

Chinook (king, blackmouth, tyee) are the largest salmon and tend to spawn in the main river channel or its larger tributaries. Spring-run chinook enter freshwater as early as March or April in order to reach upriver spawning grounds by September. Fall runs enter freshwater in September or October. Coho (silver) salmon are the most adaptable salmon and are found in nearly all streams. Coho often spawn in small tributaries, entering freshwater in September to November and spawning October through December. Chum (dog) salmon are extremely important in the Skagit, particularly as a food resource for the large bald eagle population during the winter months. Pink (humpies) salmon run only every other year (in odd-numbered years), with the largest run occurring every fourth year. Pinks tend to travel farther upstream and prefer faster water velocities than chum salmon. Sockeye (red) salmon often spawn in streams that are inlets or outlets for lakes. Steelhead (sea-run rainbow trou) have recently been put into the same genus as Pacific salmon. Their spawning migrations are spread out over a long period of time. Entering freshwater in all months of the year, steelhead have spawning runs in both summer and winter.

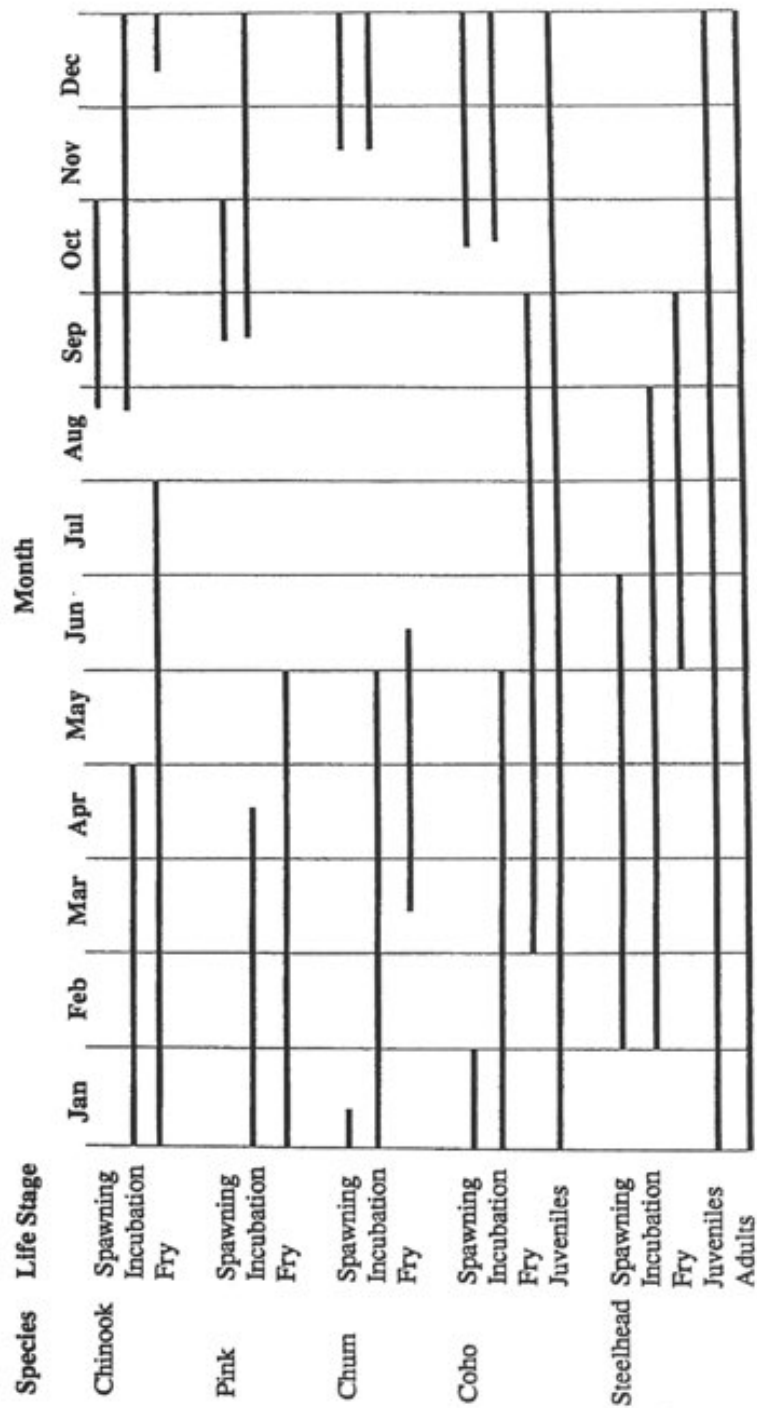


Figure 3. Timing of Life Histories of Skagit River Salmon

### Bald Eagles

The Skagit River supports the largest wintering bald eagle populations in the continental United States. A federally threatened species, the eagle population is dependent upon the size and timing of the runs of chum salmon, as well as winter weather conditions and flooding. As many as 600 bald eagles feed along the winter waters of the Skagit and its tributaries. Eagles begin to arrive in late October and early November, coinciding with the runs of coho and chum salmon. Eagle populations increase into the winter, reaching a peak in early to mid January. Depending upon the salmon runs, the numbers of eagles drop off in February and the eagles are generally gone by March. Coming from as far away as Alaska and Montana, the eagles depend upon the spawning runs of chum salmon for livelihood throughout the winter. In years when chum salmon runs are low, a smaller population of eagles remains and switch to coho salmon for food where available. Coho salmon are apparently more important later in the season and in the upper river (Newhalem area). Eagles also congregate along the Sauk and Suiattle rivers.

The Skagit Bald Eagle Natural Area, managed by The Nature Conservancy, lies along parts of the river between Rockport and Marblemount. Gravel bars and taller trees along the river's edge are favored eagle perch spots. The best locations to observe eagles include pullouts along Highway 20 at mileposts 98.5 and 100.

Early morning is the prime feeding time for eagles. The birds leave their roost sites and fly to the river to feed. Feeding begins at first light and reaches a peak by mid-morning. Eagles gather around spawned-out salmon along gravel bars, often surrounded by gulls, crows and ravens that join them at the carcasses. Feeding is usually finished by noon when the eagles retire to perch trees to rest and preen.

Midday hours are spent perching, preening, and generally conserving energy. If they were unable to get enough food in the morning they may feed again in late afternoon. About an hour before dark, eagles gather in staging areas at different sites along the river. They then fly, singly or in groups, to communal night roosts, perching in Douglas-fir or cottonwood trees in groups of between 4-100 birds. Some night roosts along Skagit tributaries attract in excess of one hundred eagles.



Bald eagle

The remaining patches of ancient forest along the valley walls are often used for night roosts, providing shelter and thermal cover (roost sites are often 15° F warmer than the surrounding forest). Eagles return to the same roost site over and over again, taking the same flight path each morning and night as they return to the river to feed.

The biggest threats to the eagles are human degradation of the environment and human disturbance. Shooting, herbicides, latent pesticides, and pollution can cause mortality. The eagles are most sensitive to disturbance when they are feeding on gravel bars along the river. Boat traffic has been implicated as a significant disturbance; people come too close to the birds, disrupting their feeding and causing them to fly. In severe weather these disturbances cause significant loss of energy and food reserves. Eagles are less sensitive when perching, although most birds fly when humans are approximately 300 yards away. Some individual birds may be more resistant to disturbance than others, these are the ones people most often see, and their presence leads to the erroneous conclusion that eagles are unaffected by people.

### Threatened and Endangered Species

Three federally-designated threatened species, the bald eagle, spotted owl, and grizzly bear, and two federally-designated endangered species, the American peregrine falcon and gray wolf, occur within the watershed.

Grizzly bears are secretive, and although adaptable to human activity, have fallen prey to poaching by humans throughout the watershed. An omnivorous and mobile animal, grizzlies historically occurred throughout the watershed. Following widespread persecution, they all but disappeared. Recent sightings, confirmed by the Washington Department of Wildlife, have been in the Mt. Baker-Snoqualmie and Okanogan National Forests and North Cascades National Park. Recovery of the grizzly is being closely watched by an interagency study team including the Washington Department of Wildlife, National Park Service, U.S. Forest Service, and U.S. Fish and Wildlife Service. Grizzlies prefer small meadows and openings in the forest for feeding. In the spring they frequent lower elevations and riparian areas, moving to the high country to feed in herbaceous meadows in the summer. Their diet consists of 90-95 percent vegetation, but includes insects, small mammals and carrion. In contrast to grizzlies, black bears are common throughout the watershed.



*Antennaria*

The spotted owl, a rare resident of ancient forests and deep river canyons of the Pacific Northwest, was declared a threatened species in 1990. As an indicator of the health of the ancient forests of the Pacific Northwest, the importance of inclusion under the Federal Endangered Species Act goes far beyond the survival of this seldom seen bird. The medium-sized, dark brown owl spends daylight hours among dense foliated trees where its cryptic, spotted patterning provides excellent camouflage. Its explosive barking call—*whoo-whoo-hoo-hoo*—provides clues to its presence. Feeding on flying squirrels and other small rodents, the spotted owl needs at least 2,400 acres of ancient forest per pair to survive. Listing of the species as threatened has created a firestorm of controversy, pitting the timber industry and environmentalists at odds over the relative values of jobs and wildlife. Hopefully a balance will be found that allows the survival of owls, ancient forests and local timber-dependant economies.

The gray wolf once roamed over most of the continent. Under heavy persecution its range shrunk rapidly and it is now found in only limited areas of the Pacific Northwest, Alaska and Canada. An adaptable predator, the wolf has lost ground primarily due to habitat loss with a resultant decline in its favored prey, elk and deer. The gray wolf is a social creature, regularly living in packs of from 2-15 animals. Wolves birth their pups in early spring, and soon move away from the den site. In recent years evidence has shown that there are breeding wolves in the Baker and Ross Lake areas. In a similar situation to the grizzly, an interagency team has been established to monitor and watch the recovery of the wolves.

Although seen in the mountains, the American peregrine falcon is a bird of the coast and river delta. Subsisting entirely upon birds which it captures in flight, peregrines prey upon shorebirds and migrating passerines along the lower river. Among the swiftest of all raptorial birds, peregrines often winter in the extensive tideflats of the Skagit Delta and Skagit Flats. Their numbers seem to be increasing after a disastrous decline due to DDT and attendant egg-shell thinning in the 1950's and 60's.



*Matted saxifrage*





## Living By Water

Not long ago in the Pacific Northwest, people lived their entire lives within the river basin where they were born. Local tribes of Native Americans often named themselves after the valley they lived in, as in the Skagit, Sauk-Suiattle, and Swinomish. Over many thousands of years of recorded and unrecorded history, people have lived in the Skagit Watershed. Native Americans and European-Americans have both shaped the land, and in turn have been shaped by it.



Sauk Mountain

## Native Peoples

Indians who lived within the Skagit River Basin were hunters, fishers, and gatherers who lived in a severe and changing environment. Their lives were closely tied to the landscape and were vulnerable to changes in the abundance or scarcity of the resources they depended upon.

To understand prehistoric use of this land by native peoples we must realize that for them this land was not a wilderness. They lived for thousands of generations along the river and in the mountains and were intimately acquainted with the land, plants and animals, rivers and peaks, all of which had names and meaning. The mountain world was their home—supplying their needs for food and shelter and providing a base for their culture. Native American interactions with the environment were flexible and adaptable to rapidly changing conditions. They made use of all altitudinal zones, using different areas of the watershed for different purposes at different seasons as food-gathering and settlement needs required.

The rugged landscape of the North Cascades separates two regions that contained large native populations: the peoples of the Puget Lowlands to the west and the Columbia River Basin to the east. These Native Americans were connected by a trade network that enabled them to share locally abundant resources for materials they lacked. All travelers in the North Cascades must of necessity follow the path of least resistance. The extreme topography places practical limitations on where humans can go, thus an intimate knowledge of the land is necessary. Like modern climbers and backpackers, prehistoric people followed animal trails in river valleys and along ridge crests whenever possible.

The Skagit Watershed was nearly completely forested until 1855, with members of many different Indian tribes living on it. These Salishan-speaking tribes included the Skagit, Sauk, Suiattle, Swinomish, and Samish. The Lower Skagit people occupied the Skagit Delta and parts of Camano, Whidbey, and Fidalgo islands. The Lower Skagit and Swinomish tribes concentrated almost exclusively on saltwater resources, primarily salmon fishing, shellfish gathering, and sea mammal hunting. The Lower Thompson tribe lived along the Skagit River above the Newhalem Gorge into British Columbia.

We must remember that these tribal designations are European-American interpretations of the region's cultural geography. There were, in fact, no formally organized bands. Rather, people who were usually related to one another chose to live in villages for some part of the year (usually winter) and to share the use of resources in a common territory.

Artifacts found within the watershed indicate that sites in the river basin were occupied, either continuously or intermittently, for over 11,000 years. Recent research in North Cascades archaeology indicates that all zones of the mountains, from river valleys to alpine ridge crests, were used by Native Americans. However, permanently inhabited sites were confined to the lowest elevations; severe winters prohibited individuals from living at high altitudes. The mountain landscape was used most heavily by people of the surrounding



lowlands—the same pattern of use that we see today. Villages were located along the major river valleys. Hunting camps and seasonal villages were located at sites important for food collecting, rock quarries, goat wool, and berries.

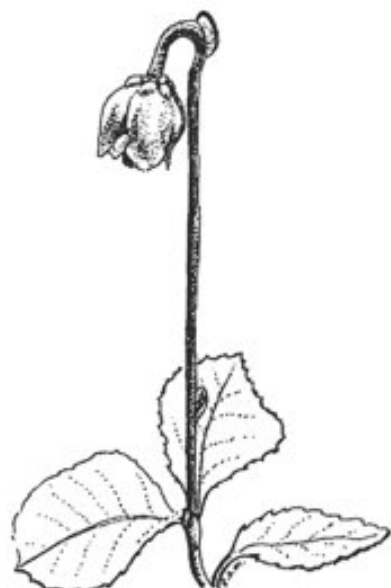
What were native peoples doing in the mountains? How did they live? We can gain an understanding of how prehistoric Indians used the Skagit landscape by examining land use in the early historic period as well as how we use the land today. In addition to permanent residences in the lower river valleys, early inhabitants used the mountains for three main purposes: travel, trade, and obtaining local resources.

The difficulty of travel across these rugged mountains made intimate knowledge of them extremely important. Routes to the major mountain passes were vital to the Indians. Upper Skagit Indians used Cascade Pass regularly as a trade route through the mountains. The Upper Skagit reportedly cached canoes at the head of Lake Chelan to use on their trips southward down the lake. The mountains were inhabited mainly in summer and fall when milder weather and melting snows permitted access into the high country, although there are reports that Cascade Pass might have been traversed in winter by Upper Skagit Indians enroute to Lake Chelan.

Native Americans living in the lower valleys penetrated deep into the North Cascades in summer. Stone artifacts found on ridges at altitudes of over 5,000' indicate that Indians quarried stone used in making tools. Another quarry site has recently been discovered near Lightning Creek along Ross Lake. Hunting camps have been found as high as 6,600'. There were hunting and gathering activities everywhere in the mountain world.

Native Americans hunted deer, elk, bear, and marmots. Salmon were especially important to the people living along the Skagit River below the Newhalem Gorge. The gorge of the Skagit River was a major physical barrier to migrating salmon, which therefore were not a major food resource for the Lower Thompson Indians living in the Ross Lake Basin. The gorge probably acted as a major physical and cultural barrier to prehistoric peoples. Even today it is a barrier; often closed in winter by avalanches, there are no major permanent towns upriver from Newhalem.

Mountain goats were one of the most important animals hunted throughout the watershed. Goats were hunted for their meat and for their wool, which



*Moneses*

possesses great insulating properties. Goat wool was one of the major trade items among the Salishan-speaking peoples. Goat bones 1,300 years old have been found in a rock shelter along Newhalem Creek ("Newhalem" is a Skagit word meaning "goat snare"). This site was most likely a hunting camp or a storage site rather than a permanent residence.

Other important trade goods among native people included dried salmon, stone for toolmaking, berries gathered in the high mountains in the fall, eulachon oil (a high-carbohydrate oil from a small smelt-like fish), and hemp (traded from the interior and used for rope and cordage).

Native American cultures changed quickly in the historic period. Smallpox spread rapidly through unresistant and previously unexposed Indian populations, even affecting those who had never seen the colonists. By the time Euro-Americans entered Puget Sound and the Skagit Drainage, the diseases of the settlers had already decimated the native populations. Major smallpox epidemics occurred about 1780 and from 1825 to 1835. Even the earliest written records about Native Americans are records of a dying culture.

The early white explorers and settlers who entered the river valleys and travelled into the mountains lived close to the land much as the Indians did. However, as white populations grew and centralized in villages, and became farmers and importers of food and materials, they became less dependent upon natural cycles of the land.

### Explorers and Settlers

All those who have lived in the Skagit River Basin have made use of the many resources here. Commercial exploitation begun by fur trappers of the early nineteenth century was continued by the miners, loggers, and dam builders of the 1900's.

Fur traders, travelling by canoe and foot, were among the first Euro-Americans to venture into the wild country of Puget Sound and the Skagit in the late 1700's. Seeking to follow the Columbia River to the Pacific Ocean, these explorers entered only the lower reaches of the mountains. The Skagit Delta was the first area to be explored and settled because of the easy water access. Travel into the mountains was difficult because of the dense vegetation; logjams on many of the rivers prevented boats to journey deeper into the mountains. The Delta and the Sound were heavily forested when European settlers arrived. Over the years as the forest was cleared, the primary land use changed from forestry to agriculture.

The earliest recorded crossing of the North Cascades by a Euro-American occurred in 1814. Alexander Ross, a fur trader, crossed Twisp Pass and descended Bridge Creek to the Stehekin River, which he then followed upstream. Finally crossing Cascade Pass, he traced the Cascade River downstream to its confluence with the Skagit River. Maps of Washington Territory in 1860 show large areas still labeled "unexplored."

The date of the first explorations of the Skagit Valley are unknown, but Hudson's Bay Company fur trappers probably started working in the lower

valley around the year 1810. In 1855 the basin was opened to white settlers with the signing of the Point Elliott treaty by the Skagit tribe and others. In 1878-1890, gold exploration in Ruby Creek drew settlers farther up the valley.

Initial settlement in the lower Skagit Valley was slow because of the dense vegetation and difficulty in navigating the Skagit River. In 1863 Samuel Calhoun became one of the first settlers when he planted crops in the Skagit Delta. With the help of his neighbors, Calhoun began construction of dikes along the lower delta. In 1870 an inland settlement was located at the present-day site of Mount Vernon. Other towns gradually became established: Burlington in 1882, Sedro Woolley in 1884, and Concrete in 1890. A local cement industry was founded in the town of Concrete by Amasa Everett in 1892.

Expeditions continued to penetrate the heartland of the North Cascades, although these explorers kept to the major river systems and passes. Cascade Pass was crossed for the second time in 1877 by the Otto Klement party in their search for gold. In 1882 Lieutenant Henry Pierce was assigned by the U.S. Army to explore the North Cascades region of Washington Territory. His party explored the Stehekin River valley, traversed Cascade Pass after 22 days of travel, and descended the Skagit River to Sedro Woolley. He found gold-bearing quartz west of Cascade Pass in the Eldorado Peak area. While exploration of the mountains continued, settlers began to sink roots into the lush river valleys.

The mountains provided formidable barriers to settlement. In 1846 the Territory of Washington opened to homesteading, but it was not until the late 1870's, with the clearing of the massive natural logjam on the Skagit River, that settlers moved upriver. The largest of these logjams blocked three miles of the river and had been in place for so long that a forest was growing on top of it. Its removal opened the river to steamboat traffic, but damaged downstream flood control.

Settlement along the the Skagit and Cascade rivers continued through the 1880's. Marblemount, at the confluence of the Cascade and Skagit rivers, was established as a base for miners; the first wagon road was built into the area in 1892. Early settlers faced many challenges; it was a rugged environment to live in. The majority of early settlers were not farmers but shopkeepers and innkeepers who came to sell goods and services to the trappers and prospectors who first ventured up the rivers.

Beavers, bears, wolves, lynx, fishers, martens, and foxes were all sought by fur trappers. Trapping was primarily a winter activity—the most difficult season to be afield in the mountains. Many of the early settlers trapped to supplement their income.

The story of mining in the upper Skagit Watershed is one of broken dreams. In the 1850's prospectors began searching for gold along the banks of the Skagit River. After gold was discovered along Ruby Creek in the late 1870's, hundreds of miners swarmed over the upper Skagit Valley. They found little gold, and the rush was over by 1880.

Over the next few decades miners turned their attention to other minerals, primarily silver and lead, located higher in the mountains. New claims were established in the high country around Cascade Pass, including Doubtful Lake, Boston and Horseshoe basins, and Bridge Creek. A rich silver deposit was found just below Boston Glacier near the headwaters of Skagit Queen Creek in 1892, and another rush was on. Some silver was located, but the costs of getting the ore out were too high. By 1913 most of the Thunder Creek mining companies had folded. Eventually the combination of short seasons, inhospitable terrain, unpredictable weather, and lack of transportation doomed these ventures to failure.

Many of the hundreds of miners who traveled into the Skagit Valley stayed on after their dreams were shattered. As the miners moved farther into the wilderness, they built trails, bridges, tunnels, cabins, and wagon roads. The construction of a miner's trail along the north bank of the Skagit River required dynamiting a ledge out of sheer canyon walls and building suspension bridges over open gorges. The Goat Trail had one particularly dangerous section known as the Devil's Corner, where a hanging bridge made of split logs traversed a narrow ledge.

It was not until 1972, with the completion of the North Cascades Highway, that a modern road traversed the North Cascades. Construction of this highway, which follows the Skagit River to Ruby Creek, then veers to cross Rainy and Washington passes, followed earlier exploration of possible routes through the Picket Range and over Cascade Pass. The North Cascades Highway is blocked by snow from late November through April; nature still rules in these mountains.

Timber was recognized as one of the major resources of the Cascades at an early date. Once the natural logjams that blocked the lower Skagit were cleared away in the 1870's, logging began to extend into the heart of the mountains. Originally logs were hauled down to the river by livestock and floated downstream to the mills. Later it became more efficient to move them by railroad, then by truck, and now by helicopter. Today's rapid removal of trees by helicopter and truck from areas inaccessible to earlier logging is putting pressure on what once seemed an inexhaustible forest.

The many glacier-fed streams and rivers of the North Cascades have always been recognized as an important resource. The rivers provided the



*Brewer's blackbird*

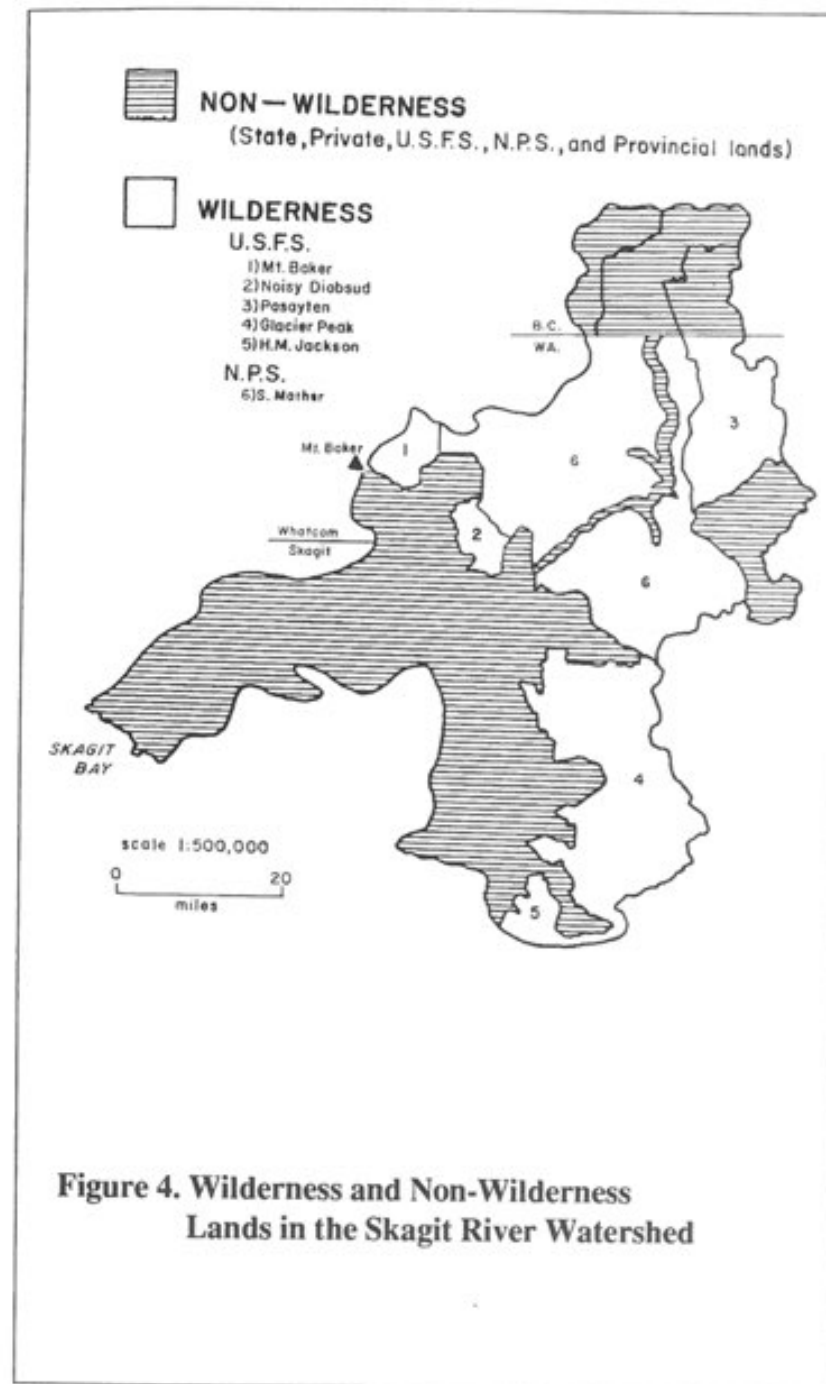
earliest pathways into the mountains, although these tumultuous waters have also hindered travel at times. The first power plant on the Skagit River was constructed in the 1920's by the Davis family at their homestead at Cedar Bar. Their small water wheel was powered by the nearby waters of Stettin Creek. Similar Pelton wheels were used to produce electric power along Thunder Creek.

Construction of major hydroelectric development began in 1918, when Seattle City Light was issued permits to begin construction of three dams along the Skagit River. Seattle City Light eventually built a railroad up the Skagit Valley to its company towns of Newhalem and Diablo. A diversionary dam at Gorge Creek was completed in 1924, and Diablo Dam—at that time the highest dam in the world—in 1930. Ross Dam, dedicated in 1940, was raised in 1949 to 540', making it the highest of the three dams providing power to the city of Seattle. Visible from Highway 20 between Newhalem and Diablo, the present Gorge Dam was completed in 1961. Two dams were constructed by Puget Power Company on the Baker River: Baker Dam in 1925, and Upper Baker Dam in 1959.

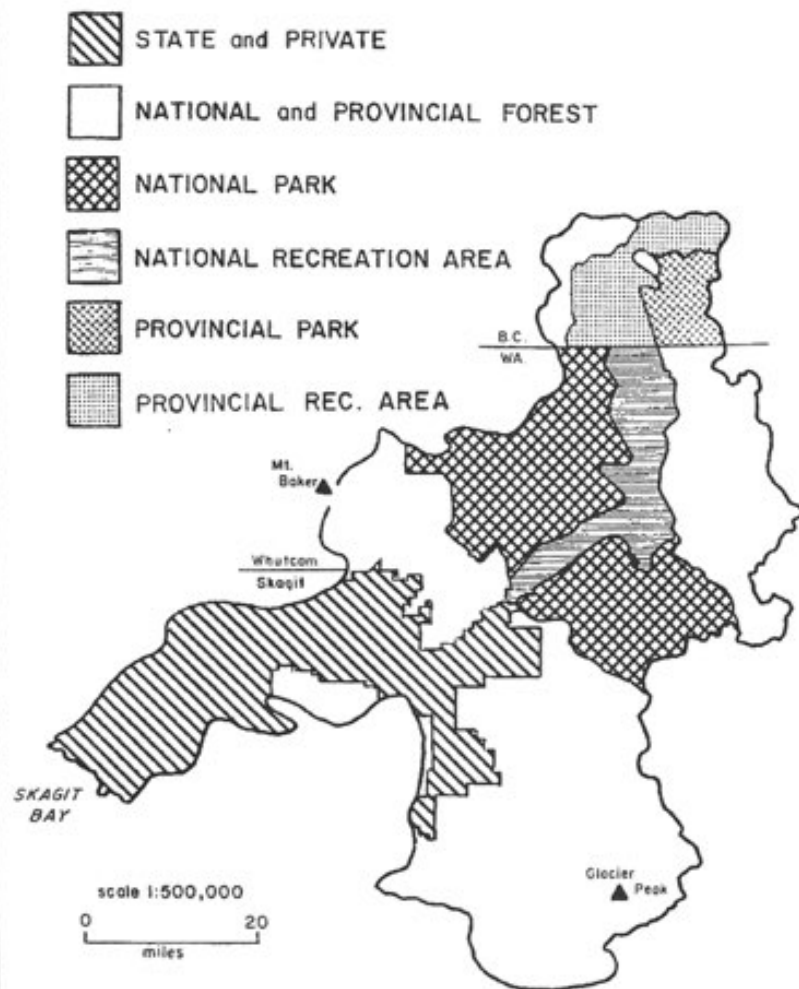
The magnificent wilderness mountains of the North Cascades have been admired for generations. In 1897 much of the area was closed to homesteading and managed as part of the Washington Forest Reserve. In 1924 this became part of Mt. Baker National Forest (later Mt. Baker-Snoqualmie National Forest). The idea of a North Cascades National Park was first proposed by the Mazama Outing Club of Portland, Oregon, in 1906.

Controversy arose over the appropriate uses of wild lands, with various factions favoring protection or resource exploitation. Continuing public pressure led to the North Cascades Act, passed by the Ninetieth Congress and signed by President Lyndon B. Johnson on October 2, 1968. The act created North Cascades National Park Service Complex, comprising 684,000 acres of wild lands, including north and south units of the national park as well as the Ross Lake National Recreation Area. This same act created the adjacent Pasayten Wilderness of 505,000 acres and enlarged the Glacier Peak Wilderness to 464,000 acres. In 1989, legislation was passed that designated much of the backcountry lands of North Cascades National Park as the Stephen J. Mather Wilderness. It also created many new, smaller wilderness areas within Mt. Baker-Snoqualmie National Forest, including Mt. Baker, Noisy Diobsud, and Boulder River wilderness areas (Figure 4).

Only about 3 percent of all the lands of the Skagit Watershed are devoted to farming and grazing. Most farms are located in the low, flat, fertile delta of the Skagit River. Good cropland extends farther upstream to Concrete. These rich farmlands are known for their production of seed, vegetables and grains. The Skagit lowlands and delta are especially important for the production of cabbage, turnip and beet seeds. Bulb crops, such as tulips and daffodils, are a major agricultural product of the Skagit Flats. Dairy farming is the primary form of agriculture in the flood plain and on the delta; dairies occupy more land than all other agricultural activities.



**Figure 4. Wilderness and Non-Wilderness  
Lands in the Skagit River Watershed**



**Figure 5. Land Ownership and Management in the Skagit River Watershed**

## Taking Care of the River

The Skagit River Watershed is one of the jewels of the North America. It is a landscape rich in natural wonders and human history, a land that deserves our continuing care. While much of the upper watershed has some measure of protection, the Skagit River Basin is coming under continually increasing threats.

The land encompassing the Skagit River Basin is a complex pattern of public and private ownership and management (Figure 5). Federal (North Cascades National Park, Mt. Baker-Snoqualmie and Okanogan National Forests), state (Washington Departments of Natural Resources, Fisheries, Wildlife, Ecology, Parks), tribal (Skagit, Sauk, Suiattle, and Swinomish tribes), cities, and private landowners all have a hand in owning and managing land within the river basin. The federal agencies, together with the Washington Department of Natural Resources, are the primary managers of activities within the large land area of the watershed.



*Great blue heron*



Important public resources on these lands include: water (for drinking, power generation, industry), timber, fish, wildlife, agricultural lands, and the wide range of recreational opportunities available along the water's edge. Private resources, including homes, businesses, factories and farms are also important and valuable.

There are many threats to the Skagit River and its tributaries: development, logging, agricultural practices, pollution, overuse of resources, small scale hydroelectric development, and flood control measures such as dams, dredging and diking. Threats to wildlife include poaching and habitat loss.

### Flooding, Logging and Agriculture

Flooding and flood control measures are the largest threat facing the lower Skagit watershed. The November 1990 floods underscored this point. Failure of the levee system on Fir Island cost farmers and homeowners millions of dollars. A truly large flood would cost tens of millions. The threat of floods has created calls for additional dams, higher levees, dredging of the river within the levees, and construction of a flood channel from Burlington to Padilla Bay. All of these remedial efforts pose threats to the river system.

Some people advocate a dam on the lower Sauk to control the Skagit's largest tributary. Such a dam would result in the loss of precious valley bottom land and the potential destruction of salmon and steelhead runs. Anadromous fish runs are already much smaller than they were at the turn of the century. One need only see the Ross Lake drawdown to witness the havoc reservoirs cause to river valleys. Dams also cut off the flow of sediment to the delta. This sediment will eventually fill the reservoirs with land that was destined for Puget Sound.

Despite an international treaty and agreement with Canada not to raise Ross Dam, the possibility exists that Seattle City Light could raise the dam by 125'. To fill and regulate this larger reservoir, additional dams would be constructed on Thunder Creek and below Newhalem. This project would flood ancient forests in the Big Beaver, Thunder, and Skagit River valleys, and impact salmon runs and bald eagles in the Ross Lake National Recreation Area.

Higher levees on the delta and lower river would protect against relatively small floods in the near future, but can never provide protection from the larger floods. Levees aggravate flooding and interfere with the river's natural response to flooding—spilling over its banks to deposit its sediment load. As a result of levees, sediment is deposited in the river channel and the river bed rises in elevation. The levees then must be built higher or the channel dredged. Frequent dredging, necessary because the river quickly fills the dredged area with sediment, destroys vital salmon habitat.

Attempts to control flooding have also destroyed one of the watershed's more precious resources—wetlands. Although much of the delta is preserved as the Skagit Wildlife Area, wetlands throughout the rest of the lower valley are in danger. Old river channels, sloughs, oxbow lakes and other wetland areas are being lost in Puget Sound at the rate of 1,000-2,000 acres per year. Wetlands

provide vital water storage, act as filtration systems for pollutants, and are critical migratory habitat for hundreds of thousands of waterfowl each year.

The Skagit is a flood-prone river. Human attempts to control flooding are temporary and only provide protection from smaller floods. We must expand our own attempts to adapt to the river. Farms and homes on the floodplain should be built above ground level to allow for periodic flooding. This will preclude expensive levees and environmentally destructive dredging. Human ingenuity and adaptation to flooding in other parts of the world can be applied by the people of the Skagit River Basin.

Logging has been a vital part of the watershed's economy since the first Euro-Americans entered the valley. Yet it is also a threat to the upper parts of the watershed. Large clearcuts expose mineral soil to erosion and accelerate runoff. Erosion of mineral soil and siltation of small streams effects the survival of clear water, gravel dependent spawning fish. The loss of forest cover increases the rate that water reaches the river once it falls on mountain slopes, which contributes to flooding.

Today, logging remains one of the main industries in communities throughout the Skagit Valley. As the supply of available timber shrinks, economic conditions change, and environmental restrictions on resource extractive activities increase, the future of sustainable forestry in the region is increasingly called into question.

Agriculture poses additional threats to the delta and lower watershed. Fertilizer and pesticides can enter surface water, degrading water quality. Over 80% of our domestic, agricultural and industrial water comes from surface water sources such as rivers and lakes.

Development has changed the face of the Puget Lowlands. Lands that were once forested have been converted to houses, cities, malls, and freeways. One of the most significant problems associated with development is the covering of the surface of the land with impermeable asphalt and concrete. Water that once entered the drainage basin slowly, after traveling through soil and vegetation, now flows rapidly into storm drains and sewers. This contributes to flooding and pollution; water flowing over pavement picks up particulate matter from automobile exhaust.



*Red-flowering currant*

## The Skagit Wild and Scenic River System

Rivers can be protected, they can also be degraded. The choice is ours. Parts of the Skagit and its tributaries are protected as part of national parks or forest service wilderness areas. Other sections of shoreline are protected under the auspices of the state parks system or local county and city parks. Federal protection can generally be assumed to be long term (although nothing is certain), however the protection afforded by local governments and private landowners who keep sections undeveloped is always open to change.

The purpose of the National Wild and Scenic Rivers Act of 1968 is to protect rivers in their current state. Designated rivers are managed by federal agencies; in the case of the Skagit, by the U.S. Forest Service. The laws governing use of a National Wild and Scenic River restrict hydroelectric development (both dams and powerhouses), timber practices, road building, and mining. Under current law, existing development can continue; new development along the river may be restricted.

The Skagit River System was designated as Washington's first, and largest, Wild and Scenic River in 1978. One hundred and fifty-eight miles of the Skagit, Sauk, Suiattle, and Cascade rivers are now protected. The Skagit is protected from the boundary of Ross Lake National Recreation Area downstream to just east of Sedro Woolley. The Sauk, Suiattle and Cascade rivers are protected from where they flow out of the Glacier Peak Wilderness to their confluences with the Skagit.

A river is eligible to be designated as Wild and Scenic if it is free-flowing and has one or more outstanding values. These values include scenery, recreation, fish and wildlife, geology, history, and culture. Dams or other water projects that would significantly interfere with these values may not be built. Designation effectively halts anyone from degrading the free-flowing nature of the Skagit.

Classification as "wild, scenic, or recreational" refers to the amount of human development that exists along the river at the time of designation. A wild river is one in nearly natural conditions. It is usually reachable only by boat or trail and cannot be paralleled by roads. There can be no evidence of logging or farming visible from the water, although livestock grazing is permitted. Few wild rivers exist in Washington outside of National Parks or Forest Service Wilderness Areas. A scenic river, such as the Cascade, Sauk, and Suiattle rivers, is largely natural but has evidence of human development along its banks. Roads, bridges, farms, or houses are permitted, but should generally not be visible from the river. A recreational river, such as the Skagit, may have almost any amount of development along its banks, but must retain at least one outstanding natural value.

Much of the land designated under the Wild and Scenic River Act is private. The surface waters of the Skagit Recreational River are managed by the Mt. Baker District of the Mt. Baker-Snoqualmie National Forest. The Forest is charged with maintaining the scenic, recreational, wildlife, and other resources of the Skagit River. The Forest Service only has jurisdiction over the surface

waters of the river, not over the land along the shoreline. More than 50 percent of the land along the Skagit Wild and Scenic River System is publicly-owned. The Forest Service is in the unusual situation of being responsible for waters flowing through private land that it does not own. Management of the Skagit system is an ongoing process and one that you can become involved in. You can obtain a copy of the Management Plan for the Skagit River and its tributaries by writing the Mt. Baker Ranger District, Mt. Baker-Snoqualmie National Forest.

Designation of the Skagit as a Wild and Scenic River was the result of a long process; a process that has not ended because parts of the river system are protected. There are many things that designation does not do. Wild and Scenic designation has no direct effect on private property or existing water rights. It does not stop timber harvesting, mining, or other resource development on Forest Service lands along the river, although it does place some limitations on resource-extractive activities to make sure that the river is not degraded. There must be a buffer strip between logging activities and the riverbank. Logging is restricted to selective cutting and small clearcuts. There can be no large clearcuts within 1/4 mile of the river. Efforts continue to have other sections of the Skagit river system protected, and to provide effective management for those stretches already within the system.



*White-crowned sparrow*

## The River and the Sound

Finding solutions to the threats the Skagit Watershed faces is difficult. We must achieve a balance between the needs of the watershed and the needs and desires of the people who now inhabit it. There are often competing values between the different groups.

Loggers want to sustain their livelihood, but anglers and eagle watchers bemoan the degradation of salmon runs. Farmers, homeowners and business people hope to control the river's floods, but can only count on short term, environmentally destructive solutions such as levee building and dredging. The demand for flood control and inexpensive electricity causes pressure for additional dams to be built. But again, recreationists, anglers, farmers and others fear the dams. Tidal marshes are being consumed in the face of increasing development—over 40 percent of the tidal marshes in Puget Sound are already gone—yet the call still goes out for more land to build on.

A line must be drawn. The values of the watershed can be shared, but the needs of the nonhuman inhabitants must also be heard. The song of the river is too precious to let go mute. Despite the threats the Skagit River Basin faces, one thing remains certain—it is a watershed worth protecting. The conservation of natural river systems is vital. On the Skagit we have a chance to continue to protect one of the great rivers of North America. In doing so we contribute to the protection of the world treasure that is Puget Sound.

## Getting Involved

No guide alone can tell the whole story. We hope to point out several ways you can continue to learn about the Skagit River Basin. The following sections—**Getting Involved** and **Selected References**—contain suggestions for involvement and further explorations. Contact the land managers and agencies who administer the river. They can tell you in greater detail what they are doing to preserve and protect the river. Discover in these books more details about watersheds, river systems and the creatures they contain.

There are some simple things that you can do. Ask questions. Get involved. Write a letter. Let your voice and opinions be heard. Support wetlands protection at the legislative level. Recycle. Encourage tertiary water treatment (advanced sewage systems). Support cumulative effects analysis of watersheds—look at the basin as a whole. Consider changing your lifestyle and encouraging others to change theirs so that the way we live on the land impacts it as little as possible.

A knowledgeable and engaged public is of immense assistance to those local, state and federal agencies charged with managing the public lands of the Skagit River Basin. The agencies have trained biologists, foresters, and other professional staff who can provide assistance—they welcome your questions and concerns.

The following citizen's organizations are at the forefront of environmental issues confronting the watershed. They are excellent sources of infor-

mation, but more importantly they can provide you with a chance to get directly involved yourself. Get your feet wet. Walk the riverbank and take notes. Report a polluter. Tell a manager when she is doing a good job. Go to public meetings and join the debate on the future of the Skagit and its tributaries. Informed advocacy is the key to keeping the songs of the Skagit flowing freely into the waters of Puget Sound.

## Citizen Groups

### Federation of Fly Fishers

16430 72nd Avenue W., Edmonds, WA 98026  
(206) 742-4651

The purpose of FFF is to protect, maintain, and enhance wild steelhead and salmon resources, and to maintain the integrity of steelhead river ecosystems.

### FOCUS (Forest Concerns of the Upper Skagit)

P.O. Box 93, Rockport, WA 98283 (206) 873-4712

FOCUS advocates ecologically and economically sustainable forestry that maintains the environmental integrity and economic health of the Upper Skagit.

### Greater Ecosystem Alliance

P.O. Box 2813, Bellingham, WA 98227 (206) 671-9950

GEA is a nonprofit organization dedicated to the conservation of Washington's ecosystems through conservation biology and ecosystem management.

### Mountaineers, The

300 3rd Ave W, Seattle, WA 98119 (206) 281-8509

Founded in 1906, The Mountaineers is an organization dedicated to exploring, studying, preserving, and enjoying the natural beauty of the Northwest.

### Nature Conservancy, The

217 Pine St., Suite 1100, Seattle, WA 98101 (206) 343-4344

TNC is committed to the preservation of natural diversity through a program of land purchase, protection and management of the best examples of communities, ecosystems, and endangered species.

### North Cascades Audubon Society

P.O. Box 5805, Bellingham, WA 98227

An affiliate of National Audubon Society, NCAS conservation programs focus on Whatcom County and include forests, education, wildlife, wetlands, and Noisy Creek.



*Bunchberry*



**North Cascades Conservation Council**

P.O. Box 95980, University Station, Seattle, WA 98145-1980

NCCC works tirelessly to protect and preserve the North Cascades' scenic, scientific, recreational, educational, wildlife, and wilderness values.

**North Cascades Institute**

2105 Highway 20, Sedro Woolley, WA 98284 (206) 856-5700

NCI is a nonprofit environmental education organization specializing in increasing the public's understanding and appreciation of the natural, historical, and cultural legacy of the Pacific Northwest.

**Northwest Rivers Council**

4516 University Way NE #201, Seattle, WA 98105 (206) 547-7886

A nonprofit conservation organization, Northwest Rivers Council works to protect free-flowing rivers and their watersheds throughout the region.

**Skagit Alpine Club**

P.O. Box 513, Mt. Vernon, WA 98273

The Skagit Alpine Club works to promote the use, and prevent the abuse, of outdoor recreational areas.

**Skagit Audubon Society**

2849 Francis Road, Mount Vernon, WA 98273 (206) 424-9098

An affiliate of the National Audubon Society, SAS conservation and education programs focus on Skagit County, forest practices, pollution, wetlands preservation, and wildlife management.

**Washington Environmental Council**

5200 University Way NE, Seattle, WA 98105 (206) 527-1599

WEC is a grass roots organization of citizens and groups working for a quality environment. Programs include wetlands, wildlife, forest practices, endangered species, air and water pollution, land use and growth management.

**Washington Native Plant Society**

Botany Dept., Univ. of Wash., 345 Johnson, KB-15, Seattle, WA 98195 (206) 543-1976

The Native Plant Society is involved in the preservation, conservation, enjoyment and study of Washington's native plants.

**Wildcat Steelhead Club**

P.O. Box 435, Sedro Woolley, WA 98284 (206) 855-2291

The club promotes the environment, fish, game, and habitat. It is a staunch supporter of cooperation between organizations, and feels that there is room on the river for everyone.

**Wilderness Society, The**

1424 Fourth Avenue #816, Seattle, WA 98101 (206) 624-6430

TWS is a nonprofit membership organization dedicated to the preservation of nature, wise management of resources on federal public lands, and enactment of ecologically and economically sustainable policies for large ecosystems.

**Public and Private Agencies****Cascade Provincial Recreation Area**

PO Box 10, 2950 Columbia Valley Hwy, Cultus Lake, B.C. V0X 1H0 (604) 840-8836  
Adjacent to Manning Provincial Park, the 16,680 hectare Cascade Recreation Area was established in 1987 to preserve the heritage, trails, and wilderness environment while the area is being evaluated for its mineral resources.

**Dewdney Provincial Forest**

Ministry of Forests, P.O. Box 159, Rosedale, B.C. V0X 1Y0 (604) 794-3361

This Dewdney Forest includes 604,826 hectares of land set aside for timber extraction, recreation, and wildlife.

**Howard Miller Steelhead Park**

Skagit County Parks and Recreation

Department P.O. Box 97, Rockport, WA 98283 (206) 853-8808

This 13-acre recreational park along the Skagit River includes campsites, boat launch, covered shelters, and play areas for children.

**Manning Provincial Park**

District Park Manager, Manning Park, British Columbia,

VOX 1R0 (604) 840-8822

Established in 1941, this wilderness park encompasses 71,400 hectares of rugged mountain topography, including the headwaters of the Skagit River.

**Mount Baker-Snoqualmie National Forest**

Mt. Baker Ranger District, 2105 Hwy 20, Sedro Woolley, WA 98284 (206) 856-5700

Darrington Ranger District, Darrington, WA 98241 (206) 436-1155

The Mount Baker-Snoqualmie National Forest is the primary manager of the Skagit Wild and Scenic River System, including portions of the Skagit, Sauk, Suiattle and Cascade rivers.

**North Cascades National Park**

2105 Highway 20, Sedro Woolley, WA 98284 (206) 856-5700

North Cascades National Park manages all natural resources within its boundaries. It includes the Skagit, Stehekin and Wilderness districts of the National Park, and the Ross Lake and Lake Chelan National Recreation Areas.

**Okanogan National Forest**

P.O. Box 950, Okanogan, WA 98840 (509) 422-2704

The Okanogan National Forest is responsible for managing the Pasayten Wilderness, a large area of beautiful mountains and high meadows east of Ross Lake. The Skagit Watershed extends east to Harts Pass.

**Okanogan Soil Conservation Service**

P.O. Box 872, Okanogan, WA 98840 (509) 422-2750

The Soil Conservation Service promotes wise use of soil, water, animal, and plant resources in Okanogan County.



**Puget Power**

825 Murdock St., Sedro Woolley, WA 98284

Puget Power operates the dams and powerhouses on the two Baker River reservoirs: Baker Lake and Lake Shannon.

**Puget Sound Water Quality Authority**

Mail Stop PV-15, Olympia, WA 98504-0900 (206) 493-9300

The PSWQA was created by the Washington legislature in 1985 to preserve and protect Puget Sound and the related inland watersheds of Washington. Activities include monitoring, education, research, and enforcement.

**Rockport State Park**

Park Manager, 5051 Highway 20, Rockport, WA 98237 (206) 853-8461

Located near the confluence of the Sauk and Skagit Rivers, this beautiful park includes ancient Douglas-fir forests, wildlife, and Sauk Mountain.

**Seattle City Light**

Skagit Project Manager, Newhalem, Rockport, WA 98283

#922 Seattle City Light Building, 1015 Third Avenue, Seattle, WA 98104

SCL manages the Skagit Hydroelectric Project which encompasses Ross, Diablo, and Gorge Dams and the towns of Diablo and Newhalem for the production and transmission of hydroelectric power for the city of Seattle

**Skagit County Department of Planning and Community Development**

2nd and Kincaid, Mt. Vernon, WA 98273 (206) 336-9410

The Planning Department oversees the planning and permit applications for all building and development in Skagit County.

**Skagit County Port Commission**

1180 Higgins Airport Way, Burlington, WA 98233 (206) 757-0011

The port promotes economic development within Skagit County.

**Skagit County Public Works Department**

2nd and Kincaid, Mt. Vernon, WA 98273 (206) 336-9400

The department oversees the construction, maintenance, and operation of public facilities in Skagit County.

**Skagit County Soil Conservation District**

227 N. 4th St., Mt. Vernon, WA 98273 (206) 336-2257

The Skagit Soil Conservation District promotes soil and water conservation within the county.

**Skagit Environmental Endowment Commission**

#922 Seattle City Light Building, 1015 Third Avenue, Seattle, WA 98104 (206) 625-3705.

Founded in 1984 as part of the High Ross Treaty between the United States and Canada, the SEEC endowment fund supports projects that promote wilderness preservation and enhancement of recreational and educational opportunities in the Upper Skagit Watershed.

**Skagit Provincial Forest**

Ministry of Forests, P.O. Box 159, Rosedale, B.C. V0X 1Y0 (604) 794-3361

The forest includes 45,326 hectares of land managed for integrated resources such as wildlife, outdoor recreation, timber production, and forage.

**Skagit Systems Cooperative**

P.O. Box 368, La Conner, WA 98257 (206) 466-3163

A cooperative of the Skagit, Sauk-Suiattle, and Swinomish tribes, the SSC is intimately involved with fisheries and timber issues in the watershed.

**Skagit Wildlife Area**

2214 Wylie Road, Mount Vernon, WA 98273 (206) 445-4441

The Skagit Wildlife Area encompasses much of the Skagit River Delta and provides exceptional habitat for migrating and wintering waterfowl, raptors, and seabirds.

**Skagit Valley Provincial Recreation Area**

P.O. Box 10, 2950 Columbia Valley Hwy, Cultus Lake, B.C. V0X 1H0 (604) 858-7161

Adjacent to Cascade Provincial Recreation Area and Manning Provincial Park, the Skagit Valley Recreation Area is under consideration for provincial park status.

**Washington Department of Fisheries**

Fisheries Biologist, 333 East Blackburn Way, Mount Vernon, WA 98273

(206) 428-1520

The DOF is responsible for management of fisheries in Washington, including research, regulations, enforcement, and education.

**Washington Department of Natural Resources**

Regional Forester, 919 North Township Rd., Sedro Woolley, WA 98284

(206) 856-0083

The DNR is responsible for management of timber and other natural resources on state and private land, enforcement of regulations, recreation and education. The DNR is the primary state agency responsible for supervising timber sales on private and state lands.

**Washington Department of Wildlife**

Regional Manager, 16018 Mill Creek Blvd., Mill Creek, WA 98012

(206) 775-1311

The DOW is responsible for management of game and nongame wildlife species in Washington. Activities include research, regulations, enforcement, and education.

**Whatcom County Planning Department**

401 Grand, Bellingham, WA 98225 (206) 676-6756

The Planning Department oversees planning and permit applications for all building and development in the county.

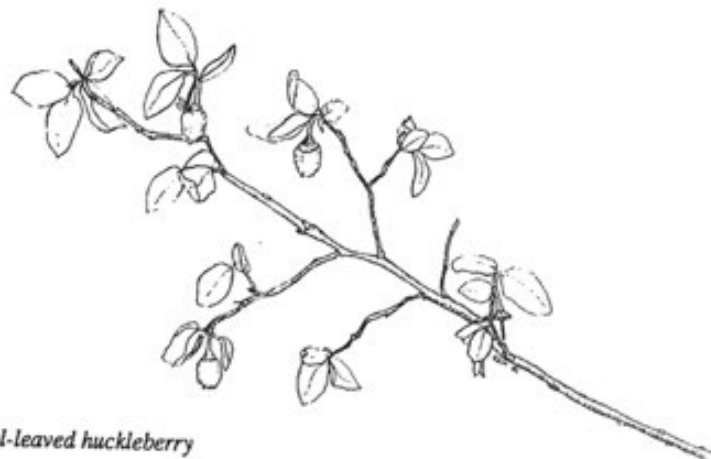
**Whatcom County Public Works Department**

316 Lottie, Bellingham, WA 98225 (206) 676-6692

The department supervises and controls the construction, maintenance and operation of public facilities in Whatcom County.

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White mountain-heather

## Appendix 1. Wildlife of the Skagit River Basin

### Fish

#### Salmon and Trout

sockeye salmon (anadromous)  
 chinook salmon (anadromous)  
 chum salmon (anadromous)  
 pink salmon (anadromous)  
 coho salmon (anadromous)  
 steelhead (rainbow trout)  
     (anadromous/resident)  
 cutthroat trout (anadromous/resident)  
 dolly varden (anadromous/resident)  
 golden trout (introduced)  
 eastern brook trout (introduced)  
 bull trout (candidate)  
 mountain whitefish

#### Minnows and Carp

peamouth  
 northern squawfish  
 longnose dace  
 redbelt shiner

#### Suckers

longnose sucker  
 largescale sucker  
 bridgelip sucker

#### Codfishes

burbot (ling)

#### Sculpins

slimy sculpin  
 torrent sculpin  
 coastrange sculpin  
 prickly sculpin

#### Sticklebacks

three-spined stickleback

### Reptiles and Amphibians

#### Turtles

painted turtle

#### Lizards

northern alligator lizard  
 western fence lizard  
 side-blotched lizard

#### Snakes

rubber boa  
 western garter snake  
 common garter snake  
 northwestern garter snake  
 racer  
 gopher snake

#### Salamanders

northwestern salamander  
 long-toed salamander  
 Pacific giant salamander  
 rough-skinned newt  
 long-toed salamander  
 western red-backed salamander  
 Van Dyke's salamander  
 Cope's giant salamander  
 Olympic salamander  
 Ensatina

#### Frogs and Toads

Pacific treefrog  
 tailed frog  
 red-legged frog  
 Cascades frog  
 spotted frog (candidate)  
 bullfrog (introduced)  
 western toad

## **Mammals**

### **Opossums**

opossum

### **Shrews**

masked shrew  
vagrant shrew  
dusky shrew  
northern water shrew  
Pacific water shrew  
Trowbridge's shrew

### **Moles**

shrew-mole  
coast mole  
Townsend's mole

### **Bats**

California myotis  
Yuma myotis  
little brown myotis  
long-eared myotis  
long-legged myotis  
hoary bat  
Townsend's big-eared bat  
silver-haired bat  
big brown bat

### **Pikas**

pika

### **Rabbits and Hares**

eastern cottontail (introduced)  
snowshoe hare

### **Mountain Beaver**

mountain beaver

### **Chipmunks, Marmots, Squirrels**

yellow-pine chipmunk  
Townsend's chipmunk  
hoary marmot  
Cascade golden-mantled ground  
squirrel  
western gray squirrel  
fox squirrel (introduced)

Douglas' squirrel  
northern flying squirrel

### **Beavers**

beaver

### **Mice, Woodrats, Voles**

deer mouse  
bushy-tailed woodrat  
red-backed vole  
heather vole  
meadow vole  
Townsend's vole  
long-tailed vole  
creeping vole  
water vole  
muskrat  
northern bog lemming  
norway rat (introduced)  
black rat (introduced)  
house mouse (introduced)

### **Jumping-Mice**

Pacific jumping mouse

### **Porcupines**

porcupine

### **Nutrias**

nutria (introduced)

### **Coyotes, Wolves, Foxes**

coyote  
gray wolf (endangered)  
red fox

### **Bears**

black bear  
grizzly bear (threatened)

### **Raccoons**

raccoon

### **Weasels**

marten  
fisher (candidate)  
ermine

long-tailed weasel  
mink  
wolverine (candidate)  
striped skunk  
western spotted skunk  
river otter

### **Cats**

mountain lion  
lynx (candidate)  
bobcat

### **Elk, Deer, Moose**

elk  
mule deer/black-tailed deer  
white-tailed deer  
moose

### **Goats**

mountain goat

### **Birds**

(\* = breeds within the watershed)

### **Loons**

common loon \* (sensitive)

### **Grebes**

pied-billed grebe  
horned grebe  
eared grebe \*  
western grebe

### **Hérons and Bitterns**

great blue heron \*  
green-backed heron

### **Swans, Geese, Ducks**

tundra swan  
trumpeter swan  
snow goose  
canda goose \*  
wood duck \*  
mallard \*  
northern pintail \*  
green-winged teal  
blue-winged teal \*

cinnamon teal  
northern shoveler  
gadwall  
American widgeon  
redhead  
ring-necked duck  
greater scaup  
lesser scaup  
harlequin duck \*  
common goldeneye  
Barrow's goldeneye \*  
bufflehead  
hooded merganser \*  
common merganser \*  
red-breasted merganser  
ruddy duck

### **Raptors**

turkey vulture  
osprey \*  
bald eagle (threatened)  
northern harrier  
sharp-shinned hawk \*  
Cooper's hawk \*  
northern goshawk \*  
red-tailed hawk \*  
rough-legged hawk  
golden eagle \*  
American kestrel \*  
merlin \*  
peregrine falcon (endangered)  
prairie falcon

### **Grouse, Ptarmigan, Quail**

spruce grouse \*  
blue grouse \*  
white-tailed ptarmigan \*  
ruffed grouse \*  
California quail (introduced)\*

### **Rails and Coots**

sora \*  
American coot

### **Shorebirds**

killdeer \*  
lesser yellowlegs  
greater yellowlegs



solitary sandpiper  
 spotted sandpiper \*  
 pectoral sandpiper  
 western sandpiper  
 least sandpiper  
 dunlin  
 Baird's sandpiper  
 common snipe  
 Wilson's phalarope  
 red-necked phalarope

#### **Gulls and Terns**

Bonaparte's gull  
 mew gull  
 ring-billed gull  
 California gull  
 glaucous-winged gull  
 common tern

#### **Alcids**

marbled murrelet

#### **Pigeons and Doves**

rock dove  
 band-tailed pigeon \*  
 mourning dove

#### **Owls**

common barn owl \*  
 western screech owl \*  
 great horned owl \*  
 northern pygmy owl \*  
 northern spotted owl \* (threatened)  
 barred owl \*  
 great gray owl  
 long-eared owl  
 short-eared owl  
 northern saw whet owl \*

#### **Nighthawks and Swifts**

common nighthawk \*  
 black swift \*  
 Vaux's swift \*

#### **Hummingbirds**

calliope hummingbird \*  
 rufous hummingbird \*

#### **Kingfishers**

belted kingfisher \*

#### **Woodpeckers**

Lewis' woodpecker \*  
 red-breasted sapsucker \*  
 downy woodpecker \*  
 hairy woodpecker \*  
 three-toed woodpecker \*  
 northern flicker \*  
 pileated woodpecker \*

#### **Flycatchers**

olive-sided flycatcher \*  
 western wood-peewee \*  
 willow flycatcher \*  
 Hammond's flycatcher \*  
 dusky flycatcher \*  
 pacific-slope flycatcher \*  
 Say's phoebe \*  
 western kingbird \*  
 eastern kingbird \*

#### **Larks**

horned lark

#### **Swallows**

tree swallow \*  
 violet-green swallow \*  
 northern rough-winged swallow \*  
 cliff swallow \*  
 barn swallow \*

#### **Jays, Crows, Ravens**

gray jay \*  
 Steller's jay \*  
 Clark's nutcracker \*  
 black-billed magpie  
 American crow \*  
 common raven \*

#### **Chickadees, Nuthatches, Creepers**

black-capped chickadee \*  
 mountain chickadee \*  
 boreal chickadee \*  
 chestnut-backed chickadee \*  
 bushtit  
 red-breasted nuthatch \*

white-breasted nuthatch \*  
 brown creeper \*

#### **Wrens**

Bewick's wren \*  
 winter wren \*  
 marsh wren

#### **Dippers**

American dipper \*

#### **Kinglets**

golden-crowned kinglet \*  
 ruby-crowned kinglet \*

#### **Bluebirds, Robins, Thrushes**

mountain bluebird \*  
 Townsend's solitaire \*  
 veery \*  
 Swainson's thrush \*  
 hermit thrush \*  
 American robin \*  
 varied thrush \*

#### **Catbirds**

gray catbird \*

#### **Pipits**

American pipit \*

#### **Waxwings**

Bohemian waxwing \*  
 cedar waxwing \*

#### **Shrikes**

northern shrike

#### **Starlings**

European starling (introduced)\*

#### **Vireos**

solitary vireo \*  
 warbling vireo \*  
 red-eyed vireo \*

#### **Warblers**

orange-crowned warbler \*  
 Nashville warbler \*

yellow warbler \*  
 yellow-rumped warbler \*  
 black-throated gray warbler \*  
 Townsend's warbler \*  
 hermit warbler  
 American redstart \*  
 northern waterthrush  
 Macgillivray's warbler \*  
 common yellowthroat \*  
 Wilson's warbler \*

#### **Tanagers**

western tanager \*

#### **Blackbirds, Meadowlarks, Orioles**

red-winged blackbird \*  
 yellow-headed blackbird  
 Brewer's blackbird \*  
 western meadowlark \*  
 brown-headed cowbird \*  
 northern oriole \*

#### **Grosbeaks, Buntings, Sparrows**

black-headed grosbeak \*  
 lazuli bunting \*  
 rufous-sided towhee \*  
 chipping sparrow \*  
 Savannah sparrow \*  
 fox sparrow \*  
 song sparrow \*  
 Lincoln's sparrow \*  
 golden-crowned sparrow  
 white-crowned sparrow \*  
 white-throated sparrow  
 dark-eyed junco \*  
 rosy finch \*  
 pine grosbeak \*  
 purple finch \*  
 house finch \*  
 red crossbill \*  
 white-winged crossbill \*  
 common redpoll  
 pine siskin \*  
 American goldfinch \*  
 evening grosbeak \*  
 house sparrow (introduced)\*

**Saul Weisberg, M.S.**, is a biologist, writer, and mountaineer who has been teaching about the natural and cultural history of North Cascades wild lands for the past fifteen years. As Executive Director of North Cascades Institute, he is committed to using the power of wilderness landscapes in learning, teaching, and caring for the Earth.

**Jon Riedel, M.S.**, has worked as a geographer, geologist and ranger for North Cascades National Park since 1980. His research focuses on landforms, glacial and fluvial geology and environmental change in the Skagit Basin. He teaches field seminars on glacial landforms, the Ross Lake Basin, and the Skagit River for North Cascades Institute.

**Libby Mills** is one of those fortunate people who is highly skilled as both artist and naturalist. Her professional work includes book illustration, wildlife biology, and lecturing on conservation. She is steward of The Nature Conservancy's Skagit River Bald Eagle Natural Area and teaches many classes for North Cascades Institute.

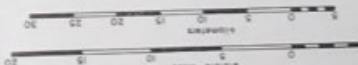
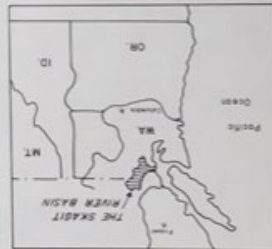
**North Cascades Institute** is an independent, nonprofit organization dedicated to wilderness and environmental education. The Institute seeks to increase understanding and appreciation of the rich natural, historical, and cultural legacy of the Pacific Northwest. We believe in an engaged and empowered public, one which speaks responsibly for the land, its creatures, and the people of this special place. Working cooperatively with the National Park Service, U.S. Forest Service, and Western Washington University, the Institute offers field seminars, children's programs, school outreach, teacher training, summer camps, Elderhostel classes, conferences, and other programs designed to help people learn about, and care for, the land and people of this special part of the world.

**North Cascades Institute  
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(206) 856-5700**

# THE SKAGIT RIVER WATERSHED

CARTOGRAPHY BY JON L. RIEDEL FOR THE NORTH CASCADES INSTITUTE AND PUGET SOUND WATER QUALITY AUTHORITY.

KEY	
	MAJOR NORTH CASCADE PEAK
	FOOTHILL (< 1500m elevation)
	GLACIER
	HIGH PASS
	LOW PASS and ADJACENT VALLEY
	LAKE or RESERVOIR
	SALTWATER
	TIDAL FLAT
	TOWN or CITY



Base from U.S. Geological Survey 1:250,000 scale, 1955-1957.

