SALMON AND STEELHEAD RUNS AND RELATED EVENTS OF THE CLACKAMAS RIVER BASIN – A HISTORICAL PERSPECTIVE

Prepared for Portland General Electric

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[front cover photo: "Hatchery on the Clackamas River at the mouth of Clear Creek" 1897-1898 Oregon State Fish Commissioner Report]

[back cover photo: "Day's catch for local Clackamas River fisherman in May 1929" courtesy of Charles R. Mack]

FOREWORD...

Over the past 30 years I have had a chance to hike, fish, snorkel, SCUBA, boat and, on many occasions, fly over most of the Sandy and Clackamas rivers. Once you begin to know an area well, some of the most intriguing conversations are with the people who came before you, the "old timers". Invariably these conversations end up on the subject of fish. The knowledge these people have often brings a new perspective to how we got to where we are today. We can only wonder what it was like before today's "old timers".

Salmon and trout populations are molded by the environments of the watersheds from which they come. To understand the fish populations of today, we must examine the historical record of activities in the watershed. Now, as the concern for the future of salmon and trout populations become more critical, thousands of new people are moving into the area. Their historical perspective of these rivers may be only the past few years. As PGE prepares to relicense its hydroelectric projects on the Sandy and Clackamas rivers, there is an opportunity to compile the historical record related to fish. This should help us all have a common understanding of how the fish populations in these two rivers have evolved to where they are today.

I did not know Barbara before this project, and she did not know the Sandy or Clackamas rivers, which is probably good as she started with no preconceived notions. It has been exciting to see the new information she has found. This was a difficult job as she had to be part detective; the information from the last 100+ years is scattered in various libraries, museums, file cabinets and memories. Sometimes she was frustrated, knowing there had to be more hard information out there, but was unable to find it. Thank you, Barbara, for a job well done.

One thing that we humans seem to do well is manipulate and modify our environment to suit our current needs. Hopefully, as we review our history we can identify pathways for the future that provide for the fish as well as for us.

—Doug Cramer
PGE Biologist

TABLE OF CONTENTS

PAGE

EXECUTIVE SUMMARY 1
INTRODUCTION 4
THE PHYSICAL SETTING 5
- THE RIVER ENVIRONMENT 5
- LAND USE 7
- CLIMATE 7
- HYDROLOGY 8
  - Water Withdrawals 9
- WATER QUALITY 10
- SUMMARY 10

A CHANGING LANDSCAPE 11
- INTRODUCTION 11
- INDIAN USE 11
- SETTLEMENT AND USE BY EUROAMERICANS 13
- TIMBER HARVEST 17
- AGRICULTURE 21
- MINING 21
- INDUSTRIAL DEVELOPMENT — Including Associated Dams 22
- HYDROELECTRIC DEVELOPMENT 24
  - Cazadero/Faraday Dam 24
  - River Mill Dam 25
  - Oak Grove Project 25
  - North Fork Dam 26
- SALMON AND STEELHEAD HARVEST 28
- SUMMARY 30

SALMON AND STEELHEAD RUNS BEFORE 1900 31
- INTRODUCTION 31
- FISH PRODUCTION 32
- SUMMARY 35

SALMON AND STEELHEAD RUNS, 1900 TO 1940 37
- INTRODUCTION 37
- FISH PRODUCTION 37
- SUMMARY 43

SALMON AND STEELHEAD RUNS, 1940 TO PRESENT 45
- INTRODUCTION 45
- FISH PRODUCTION 46
- CURRENT RUNS 48
  - Spring Chinook 48
  - Fall Chinook 48
  - Coho Salmon 49
  - Winter Steelhead 49
  - Summer Steelhead 50
  - Resident Fish 51
- SUMMARY 52

ACKNOWLEDGMENTS 56
REFERENCES 57

LIST OF TABLES

PAGE

Table 1. Surface Water Withdrawals, USGS 1985. 9
Table 2. Chinook Salmon Egg-Takes at Clackamas River Hatcheries Before 1900 (Wallis 1960). 35
Table 3. Chinook Egg-Takes at Clackamas River Hatcheries from 1900 to 1940 (Wallis 1960). 38
Table 4. Chinook Egg-Takes at Clackamas River Hatcheries Since 1940 (Wallis 1960) 47

LIST OF FIGURES

Figure 1. The Clackamas River Basin. 6
Figure 2. Clackamas River and Tributaries. 55

EXECUTIVE SUMMARY

"I have lived! The American continent may now sink under the sea, for I have taken the best of it, and the best was neither dollars, love, nor real estate (Kipling 1889)."

The famous author Rudyard Kipling made this claim after spending a day steelhead fishing on the Clackamas in 1889. Many people have shared Kipling's feelings over the years after a good day on the river. One avid fisherman, Charles Mack, clearly recalls a particular fishing season in the late 1930s when he caught 68 spring chinook, weighing an average of 19 pounds each. Others value a memory of watching salmon spawn or seeing a winter steelhead jump for a fly on a warm spring day.

Today, native salmon and steelhead runs to the Clackamas River have fallen far below historic levels. In many ways, the decline of these runs has been linked to steady, rapid growth of human activity in the area over the last 150 years and a subsequent demand for more timber, power, salmon, and other resources. This growth dramatically changed the pristine Clackamas basin landscape that once supported abundant runs of spring chinook, fall chinook, coho salmon, winter steelhead and several resident trout populations. For centuries these runs had flourished in an environment containing majestic forests with a dense understory and clear, cold rivers with tumbling rapids and long, shallow gravel beds that filled each year with salmon.

In the early and middle 1800s, the Clackamas River was recognized for its salmon and steelhead runs. Livingston Stone, employed by the U.S. Fish Commission to explore potential hatchery sites throughout the Columbia River Basin, professed in 1877 that "*probably no tributary of the Columbia has abounded so profusely with salmon in past years as this river (the Clackamas)*" (US Commission of Fish and Fisheries 1877).

The runs began declining in the mid-1800s, primarily due to overharvest in the Columbia River and on the lower Clackamas. By the late 1870s the spring chinook run to the Columbia River had already dropped below historic levels. This drop led cannery personnel in the Pacific Northwest to start experimenting with fish culture as a means to improve the runs. The first hatchery in the Columbia River Basin (also the second in the United States) began operating on the Clackamas River in 1877. Hatchery propagators immediately began placing racks across the Clackamas to collect all possible adult salmon as brood stock for the hatcheries. In 1897, for example, hatchery operators collected 1,672,275 chinook eggs from the lower Clackamas near Clear Creek and another 5,045,000 eggs from the upper river. Heavy fishing continued through the 1800s with annual harvests reaching as high as 12,000 spring chinook in the late 1890s.

Destruction of habitat conditions in the lower basin contributed to the decline of Clackamas River salmon and steelhead runs as a steady stream of settlers moved into the area during the middle and late 1800s. The settlers altered habitat along the lower river and tributaries by harvesting pristine forests, driving logs downriver and mining stream channels. Developments in the basin also restricted fish migration. Records show that upstream salmon migration was restricted as early as 1868 after a dam was built on the Clackamas River near Gladstone. This dam, or another near it, continued to impede passage until a fish ladder was provided in 1895. Dams also existed on Clear Creek and probably other tributaries.

The resilience of the runs was further tested after the turn of the century. Activities in the basin — including timber harvest, road building, agriculture and other uses — escalated in the lower basin and slowly began to spread into the upper basin. The building and operating of the Cazadero (later named Faraday) and River Mill hydroelectric projects on the Clackamas River in the early 1900s also affected the basin's anadromous fish runs. While the dams were equipped with ladders, they were usually blocked to capture fish for eggs. The ladders also suffered repeated damage from high flows and needed regular repair. These factors limited fish migration to the upper basin. In 1917 the ladder at Cazadero Dam washed out and was not reconstructed until 1939. Hatchery egg collections immediately below River Mill Dam until 1940 further reduced natural production. Clackamas River salmon and steelhead runs also suffered from relentless fishing pressure during their journey to and from the ocean and from pollution in the Willamette River. As a result, the runs continued to fall through the early 1900s. By 1936 the basin's spring chinook run averaged between 1,500 and 2,000 spawners.

Events in 1939 and 1940 allowed native salmon and steelhead runs in the upper basin to begin rebuilding. In 1939 the fish ladders at Cazadero and River Mill dams were rebuilt, restoring passage to historic spawning and rearing habitat in the upper Clackamas River Basin. At the same time, fish propagators reduced their egg-taking operations on the Clackamas River considerably. Together, these events ended a long period of near denial of fish to upriver spawning and rearing grounds. Native salmon and steelhead returned to the upper basin after 1939 and the runs began to rebuild.

Several developments within the basin after 1940 influenced efforts to rebuild the runs. Developments, such as better techniques for rearing and releasing hatchery fish, improved fish passage at the dams, and regulations on fish harvest enhanced salmon and steelhead production and survival. Other developments such as escalating road construction and timber harvest in the upper basin and gravel mining in the Clackamas River caused new hardship. Beginning in the 1950s and 1960s, fish managers

also started releasing large numbers of hatchery produced fish in the basin annually.

Today, Clackamas River salmon and steelhead runs continue to persevere despite enduring increasing hardships over much of the last 150 years. The basin supports the last remaining substantial run of wild coho in the Columbia River Basin — though natural production of all native Clackamas River salmon and steelhead remains far below historic levels. Presently, the river's native winter steelhead population appears to be declining and the status of the native spring chinook is unknown. Still, there is good reason to believe the runs will improve. Fish production and habitat managers are continuously adjusting practices to eliminate factors that affect natural salmon and steelhead production. They are constantly revising timber harvest practices, angling regulations, and hatchery operations and release strategies to reduce impacts on native salmon and steelhead. They are also monitoring and updating conditions to improve fish passage around the dams. Because of such actions, the Clackamas basin is expected to remain an important producer of salmon, steelhead and resident fish in years to come.

INTRODUCTION

This report provides historical information on the Clackamas River, focusing primarily on its salmon and steelhead runs. Portland General Electric has developed this information as part of the relicensing effort for its Oak Grove and North Fork hydroelectric projects regulated by the Federal Energy Regulatory Commission.

The report looks at events and developments that have shaped conditions in the Clackamas River watershed over the years and influenced the basin's salmon and steelhead runs. It gives an overview of physical conditions in the basin, including hydrology characteristics, geography, water quality and other features that have supported healthy fish runs for centuries, and describes human settlement and development within and outside the watershed since the early 1800s. The discussion focuses on activities such as timber harvest, dam development and fishing, and discusses how these activities affected fish habitat and production.

Further, the report examines changes in salmon and steelhead production from the early 1800s to present times. This discussion is separated into three distinct periods. The first period covers salmon and steelhead production before 1900 when the runs were first being affected by overfishing, timber harvest, passage barriers, egg-take operations, and other activities. The second period extends from 1900 to 1940 and shows changes in fish production over years when hydroelectric development and other activities almost completely blocked migration to upriver habitat. The third period, from 1940 to the present, describes efforts to rebuild salmon and steelhead production in regained upriver habitats and hardships caused by escalating activities in the area.

Information available for this analysis, particularly describing salmon and steelhead runs and developments in the Clackamas River Basin before the middle 1900s, was often sketchy and limited in its scope. The report attempts to link various accounts of the events taking place in the basin over the years. As a result, it relies heavily on early records by fish propagators, harvesters and historians to depict the size and health of the runs before fish counts became available. It presents only limited information on coho and steelhead runs as the early reports (and activities) generally focused on chinook salmon, the preferred fish at the time.

THE PHYSICAL SETTING

THE RIVER ENVIRONMENT

The Clackamas River begins on the western slope of the Cascade Mountain range near Ollalie Lake between Mt. Hood and Mt. Jefferson (Figure 1). From an elevation of about 4,500 feet, it cuts through the watershed, first to the northwest and then west. After a distance of about 83 miles, it joins the lower Willamette River 1.5 miles below Willamette Falls. Several major tributaries flow into the Clackamas, including Clear Creek, Deep Creek and Eagle Creek in the lower basin, and the North Fork, South Fork, Fish Creek, Roaring River, Oak Grove Fork and Collawash River in the upper basin (Figure 2).

The upper Clackamas flows through a canyon contained by steep talus slopes and exposed rocks. It and many of its tributaries follow major fault lines that form steep mountain ridges. Many of these reaches, including the upper Clackamas, are too swift and steep for salmon production and support primarily steelhead and resident trout.

The river slows briefly in the Big Bottom area at river mile (RM) 72.8 where it braids through huge logjams and beaver dams. This meandering reach of the Clackamas provides highly diverse habitat for fish production. Below Big Bottom (RM 65) the river again gathers speed as it deepens and passes through nearly vertical cliffs. A highway parallels the river's north bank. From RM 65 to RM 57, the river contains few pools, but good fish habitat exists near its banks and in riffle areas and side channels where pockets of spawning gravel have settled. Many tributaries that enter this reach have steep drops and large waterfalls that prevent anadromous fish passage.

Near RM 56.8, the Clackamas becomes wider and faster as it gains new streamflow from the Collawash River. Between the mouth of the Collawash River and the North Fork Reservoir, the river features large rapids and deep pools — including the famous "Killer Fang", a series of rapids that have claimed the lives of several boaters and swimmers. From "Killer Fang" to the reservoir, the river rushes from one rapid to another. This river section contains the Oak Grove hydroelectric power plant. The plant generates power with water diverted from the Oak Grove Fork and then releases the water into the Clackamas River just below where the Oak Grove Fork joins the Clackamas. This river section also contains several dramatic features, such as "the Narrows", where the river has carved a narrow chute through the basalt.

Figure 1. The Clackamas River Basin

The Clackamas River becomes slow as it flows through the North Fork Reservoir (RM 32), but is soon recast as it leaves the reservoir and enters a deep gorge encased by rock cliffs. Near McIver Park, it is again transformed, this time becoming a quiet river, slowly meandering through surrounding farmlands to join with the Willamette River near Oregon City.

Several reaches of the Clackamas are protected by federal and state laws because of their outstanding beauty. The 47-mile reach of the Clackamas River from its headwaters to Big Cliff just upstream of North Fork Reservoir is included as part of the Federal Wild and Rivers System (USFS 1992). This, and several other reaches of the Clackamas River system, are also included in the Oregon Scenic Waterway System. These include the reach of the Clackamas from the Ollalie Lake Scenic Area Boundary to the North Fork Reservoir (RM 82 to RM 32), the South Fork Clackamas (RM 4 to the confluence with the mainstem), and the North Fork Clackamas River (source to North Fork Reservoir, 12 miles). The Clackamas from Carver (RM 8) to River Mill Dam (RM 23) is a "recreation river area" under Oregon's Scenic Waterway Program.

LAND USE

Most of the upper and middle sections of the Clackamas River Basin, about 72 percent of the watershed, is publicly owned. The Mt. Hood National Forest manages 70 percent of the basin and the Bureau of Land Management manages about 2 percent. Two sections of the Mt. Hood National Forest are protected as wilderness areas. The Bull of the Woods Wilderness Area preserves 34,900 acres of undisturbed forest land in the upper Collawash system. The western portion of the Salmon-Huckleberry Wilderness encompasses the headwaters of Eagle Creek. Another large tract of forest land in the upper basin is managed by the Confederated Tribes of the Warm Springs Indian Reservation. Tribal lands (2 percent of the basin) are found in the upper Clackamas and in the Oak Grove Fork drainage.

Lands in the lower drainage, representing about 26 percent of the total basin, are generally privately owned. The river flows through the communities of Estacada, Barton, Carver and Gladstone. Many people reside in the lower drainage because of its beauty and recreation opportunities and commute to work in the nearby Portland metropolitan area. Agricultural lands cover about 1/8 of the drainage and produce berries, tree fruit, field crops, Christmas trees and livestock. Several private wood lots are also scattered through lower subbasin forests.

CLIMATE

The basin's climate adjusts quickly in response to changes in elevation. In the lower drainage, the climate is temperate. The average temperature at Estacada, near RM 24, ranges from a low of 33°F in January to a high of about 80°F in July and August. The lower reaches receive about 61 inches of precipitation annually, with nearly 8 inches of snow. Winter conditions are more severe in the basin's higher elevations. The headwaters receive substantial snow and rainfall, amounting to about 130 inches of precipitation a year. Average daily

temperatures near Timothy Lake in the upper drainage range from 23°F in January to about 69°F in July and August.

HYDROLOGY

Unlike many river systems, the Clackamas River receives large amounts of both surface runoff and groundwater and maintains good, cool streamflows throughout the year. Like a sponge, the extensive groundwater system in the upper watershed absorbs much of the precipitation falling on the area. These groundwater reserves slowly release flow into the Clackamas River and tributaries, maintaining a strong consistent base flow in the upper Clackamas. Consequently, flows in the upper mainstem increase only gradually during peak rainstorms and snowmelt periods. The average monthly minimum low flow and average monthly minimum high flow in the Clackamas River differ only by 391 cubic feet per second (cfs) at the gauge just below Big Bottom (RM 65). This is a small difference considering the size of the watershed.

Some rivers in the Clackamas system are more volatile. Streamflows in several tributaries (including Fish Creek and the North Fork, Roaring and Oak Grove rivers) rise quickly when the area receives large amounts of rain (or rain-on-snow) because of shallow soils and steep topography in their watersheds. Flows in such areas are driven more by precipitation than by groundwater releases and respond faster to changes in climatic conditions. After a large rainfall, for instance, flows in Fish Creek are higher than in the upper Clackamas River where much of the rainfall is absorbed into the ground. Maximum discharge flow for the Clackamas is 90,000 cubic feet per second — 150 times the minimum natural discharge and 33 times the 2,700 cubic feet per second average flow rate.

In many parts of the watershed, timber harvest and road construction have increased the risk, both in frequency and magnitude, of rain-on-snow flood events. For example, the hydrologic regime has changed in about half of the upper watershed because of timber harvest and road construction (USFS 1995). These activities have increased the amount of openings in the forest environment and have left many areas less capable of intercepting overland flow. Riparian areas have also been affected by land management activities, including dispersed recreation, and are less able to reduce the effects of these floods.

Streamflows in the Clackamas climbed to a record high in December 1964 when a warm winter storm moved through the region. Flows in the river rose rapidly as ample snowmelt and rainfall entered the system. The river reached and then surpassed previous high flow records to peak at 86,900 cfs and a gauge height of 28.36 feet at Estacada (RM 23.1) — a level 50 percent greater than the record set back

in 1907. A second flood a month later in January 1965 washed the Cazadero Dam away and scoured a large portion of the channel. In comparison, the river peaked at 68,900 cfs and a gauge height of 27.57 feet during the flood of 1996 (USGS 1996).

During the 1964 flood, North Fork Reservoir accumulated more than 100 acres of debris. Flood-deposited material was retained in the lake by a double line of log booms installed to prevent a blockage of the spillway. Floodwaters deposited many trees with limbs and roots in the lake. Overall, wood waste in the debris accumulation was far greater than that encountered in any previous flood of historical record. To remove the timber from the lake, the company negotiated a timber purchase contract with the U.S. Forest Service. About 1.5 million board feet of timber were salvaged and sold to sawmills. Floodwaters also deposited a heavy load of silt in the North Fork forebay. Rocks, sand and silt filled the lower end of the North Fork fish ladder, and a slide above Faraday Dam cut through the highway and destroyed 200 feet of fishway structure.

Water Withdrawals

Substantial amounts of water may be withdrawn from the Clackamas River to meet municipal, industrial, power generation and agricultural needs (Table 1). These withdrawals could decrease flows in the Clackamas system below the levels needed for fish migration and production. However, there is no evidence that low flows are a problem. To protect instream flows, minimum streamflows were established for the Clackamas basin. These instream flows are set at levels needed to support the basin's salmon and steelhead populations.

Table 1. Surface Water Withdrawals, USGS 1985.

User	Water Use (acre feet)	Water Rights (acre feet/year)	Water Rights (cfs)
Municipal	33,000	0	112
Domestic	NA	0	1
Recreational	NA	0	2
Industrial	22	0	152
Agricultural (total)	145	59	262
Total	33,247	59	529

WATER QUALITY

Overall, water quality in the Clackamas River is considered excellent. Samples by the Oregon Department of Environmental Quality since 1990 show that the mainstem and tributaries have very low concentrations of sodium, potassium, phosphorous and other elements that reduce water quality. The mainstem Clackamas River above the mouth of the Collawash River and many tributaries also exhibit cool temperatures throughout the year because of groundwater releases. The measured water temperatures in the basin in 1994 approximate the optimum range of preferred temperatures for salmonids (USFS 1995). Samples show that, of all stream systems above North Fork Dam, the mainstem Clackamas River maintains the most stable and coolest temperature regime, while the Collawash River is often the warmest and has the largest temperature fluctuations (USFS 1995).

Sedimentation, however, can be a problem in some parts of the watershed, particularly during periods of high flow. This problem is greatest below areas disturbed through road construction, timber harvest or other activities. Heavy rains and snowmelt often carry large amounts of sediment from such areas into streams and rivers. The sediment is then suspended by swift flows and moved down the system where it is deposited in slower waters. The North Fork Reservoir has become a settling location for much of the sediment that enters the upper river system.

Bacteria may also reduce water quality in some stream reaches. While sampling for bacteria in the system has not been conducted, extensive dispersed camping along some reaches of the Clackamas may raise bacteria levels in the river immediately below the sites.

SUMMARY

Generally, the physical character of the Clackamas River and tributaries, especially in the upper basin, provides some of the best habitat for salmon and steelhead found in the Northwest. Salmon and steelhead have thrived in the river system's clear waters with an abundance of spawning and rearing area. As is discussed in the coming sections, these high-quality habitat conditions were discovered by fish propagators in the mid-1800s. The river's exceptional qualities led an early resident of the area, L.T. Barin, to declare in 1885:

> *"I have been on all the rivers and tributaries of the Columbia from the Cascades to Priest's Rapids, to which the Chinook salmon go . . . and I do not hesitate to say that the Clackamas River, with its clear, cold water, its rapids, and its long, shallow gravel beds, is the most natural and favorite region for salmon spawning (Barin 1885)."*

A CHANGING LANDSCAPE

INTRODUCTION

In 1800, the basin remained largely a wilderness, untouched by human development. A heavy growth of coniferous trees and understory vegetation armored most stretches of the Clackamas and its tributaries. The river systems' cool streamflows, long shallow gravel beds and deep pools supported mighty populations of salmon, steelhead and resident fish. This ecosystem was not absolutely stable. Natural events caused regular and sporadic changes over time. For example, seasonal floods often caused the stream channel to move or create meanders. Still, the Clackamas maintained a long-term balance as its overall health allowed it to recover from naturally occurring disturbances.

Human activities, especially those after the early 1800s, changed this ecosystem. As more people moved into the area, the natural landscape and river system were developed and harnessed to provide for their growing needs. By harvesting riparian forests, removing instream logs and other wood, extracting sand and gravel from the stream channel, building dams, and diverting streamflows, they altered habitat conditions that had supported Clackamas River salmon and steelhead populations for centuries.

This section reviews settlement in the basin over time. It also discusses many human activities and developments that impacted the Clackamas River landscape and affected salmon and steelhead production. Thus, it provides a context for understanding how a combination of actions through the years contributed to the decline of wild salmon and steelhead runs in the Clackamas River Basin.

INDIAN USE

As early as 10,000 years ago, Indians roamed the Clackamas River drainage and other parts of the lower Columbia River. In these early years, the Indians developed settlements along the banks of the Columbia — including an important trade center near The Dalles (USFS 1993). They were often travelers, moving between river valleys and nearby forests with the changing seasons to fish, hunt, or gather other food and materials. Often, they would travel great distances as they moved between different harvest areas along the Columbia River and tributaries, and into the Cascade mountains. Evidence of their presence in the northern Oregon Cascades dates back at least 8,000-10,000 years (Burtchard et al. 1993). By 2,000-3,000 years ago, however, most settlement in the Clackamas River Basin had moved to the river's lower floodplain. Research suggests that Indians likely established large, permanent villages on the floodplain and traveled in small groups to upland harvest areas.

More than 100 cultural resource sites have been recorded in the upper Clackamas River corridor. Many of these sites display peeled cedar trees where bark was removed for manufacturing baskets. Researchers have also documented almost 50 lithic scatters (Burtchard et al 1993). Findings at a few of these archaeological sites date back about 4,000-6,000 years.

The lower basin was the home of the Clackamas Indians. They were Chinookan speakers, a group that once occupied the Columbia River Valley from Celilo Falls to the Pacific Ocean. Their lands included the lower Clackamas River valley and lower Willamette River from the falls to its confluence with the Columbia River (except Sauvie Island) and reached into the foothills of the Cascade Range.

When Lewis and Clark visited the area in 1806 they found that the Clackamas tribe numbered about 1,800 individuals and occupied 11 villages. Records suggest that the tribe had already been reduced by smallpox in the 1770s. The villages contained lodges or houses built with split-cedar planks. A principal Indian village existed at Oregon City near Willamette Falls (Seaman 1946).

A large Indian village also existed at the mouth of the Clackamas River. One settler, Elisha Applegate, wrote in 1843 of a moss-covered, dilapidated Indian house near the mouth of the Clackamas. She said the building, 300 feet long, was the headquarters for the Clackamas tribe when they were not in their mountain homes. The long house was partitioned into several rooms opening to a porch that ran along the building's south side. This gave each family a separate entrance. Several other buildings existed nearby (Lynch 1973). Other Indian villages stood near the Clackamas River at Estacada and Eagle Creek. John Wacheno, a Clackamas tribe elder, wrote in 1934 of a traditional Clackamas Indian village and summer fishing place near Estacada with 11 or 12 houses. He also mentioned a winter village on Eagle Creek (Ellis 1997).

Many Indian families lived in lower river permanent villages during the winter months and moved to seasonal camps in warmer weather. They knew the land intimately and developed an extensive trail system over the years. This trail network brought Indians from throughout the region to fish at Willamette Falls. During the early- and mid-1800s, early explorers followed the old Indian trails into unexplored country. They knew that the best paths would have been found over the years. One of these trails became the Barlow Road in 1845.

The Indians used several techniques to harvest fish in the Clackamas River. According to Wacheno, the Indians fished with elkhorn toggle head harpoons arming spears thrown from canoes, gill nets, dip nets dropped from platforms and fish traps. The abundance of the harvest, according to Wacheno, kept the Clackamas people busy all summer drying fish to sell (Burtchard et al. 1993).

Several epidemics of smallpox, malaria and measles hit the Clackamas tribe hard in the early 1800s. In 1851, an epidemic so depleted the tribe that only about 88 Clackamas survived (Lynch 1973). The relentless pressures of European influence, including disease and the drive for land, proved too much for the tribe. As a result, in 1855 the Clackamas tribe signed a treaty ceding their lands. Many tribal people moved to the Grand Ronde Reservation. Others settled on the Warm Springs Reservation or stayed on their homeland. Nevertheless, the Estacada area remained a center of settlement and resource use by the Clackamas and Warm Springs Indians for many years (Ellis 1997).

After the turn of the century, Indians from the Warm Springs Indian Reservation still returned to their homeland to visit friends, fish, or to gather berries and other plants. Much of this use was upriver of Estacada (Ellis 1997), but Indian fishing was also popular at River Mill Dam after its construction. Settlers recall that as late as the 1930s, Indians from Warm Springs would camp at Sandy and the men would travel to River Mill Dam to fish while the women gathered berries. Today, some Warm Springs elders still remember drying fish at Estacada and camping near River Mill Dam. Researchers believe the River Mill Dam area was important for fishing before the construction of the dam, but that much of the earlier use took place in the area flooded by Estacada Lake (Ellis 1997).

SETTLEMENT AND USE BY EUROAMERICANS

In the early 1800s, settlers of European background joined Indians in the lower basin. Attracted to the basin's rich resources, many of these new settlers came up the Willamette River from the growing Portland and Oregon City areas. They settled along the lower river valleys and tributaries near the present communities of Gladstone, Carver, and Barton. Improved transportation on the Willamette River in the mid-1800s lured more settlers to the lower basin. Steamboat operations began on the Willamette River with service from Portland to Eugene starting in 1856-1857.

Few early explorers and travelers ventured into the rugged upper Clackamas River basin during the 19th century. Except for a few trails, nonnative travel and exploration routes usually skirted the high rugged mountains in favor of river and valley floors with more gentle terrain and readily available food.

Maps from as late as 1921 show no roads above Cazadero Dam near Estacada (Burtchard et al. 1993).

Two routes were generally used by early explorers and settlers. One of these routes, worn by years of Indian use, was the South Pass trail. It was discovered in November 1812 by Robert Stuart, an Astorian. Two fur trappers, Joseph Meek and Robert Newell, drove their wagons over the trail to Oregon a few years later. It was used again in 1830 when several members of the Rocky Mountain Fur Company brought their wagons, heavy with furs, over the mountains (Lynch 1973). Another old Indian trail, the Barlow Road, became a popular route for emigrants crossing the Cascades and traveling through the Clackamas drainage. It crossed Eagle Creek near the present location of Bonnie Lure Park, turned southward for two miles and crossed the Clackamas River at the old Feldheimer Ferry location (about four river miles downstream from River Mill Dam).

Settlement came slowly to the Clackamas River Valley until the late 1800s and early 1900s. The settlers were first drawn to lands along the lower reaches, which were close to activities in the Willamette Valley. The area saw more growth in the late 1800s after rails replaced the river as the transportation choice for travel from Portland to Oregon City. The Willamette Bridge Railway Company, a predecessor of Portland General Electric, began operating a trolley line in Portland in 1889. This was the first electric trolley on the Pacific Coast. Then in 1893, the company started running a 14-mile interurban electric railroad between Portland and Oregon City, the first in the United States. The electric railway had an enormous impact on the social and economic development of the Oregon City area. Business boomed in Oregon City when the trolley from Portland began service every half hour. The electric railway brought businesses same-day delivery of merchandise and supplies from Portland wholesalers. It also opened new weekend recreation destinations. Canemah Park, at the southern end of the line, became a popular recreation site (Portland General Electric 1982).

Through the 1800s, the area around the present town of Estacada remained at the edge of the settled lands. The area was sparsely populated and surrounded by dense forests. In 1859, settlers built a bridge across the Clackamas River near the mouth of Eagle Creek. The bridge was replaced and improved regularly after suffering flood damages, but remained an important point for crossing the Clackamas through the 19th century (Lynch 1973).

After the turn of the century, the Estacada area became the nucleus of hydro development. Power site investigations, and plant and railroad construction and operation all contributed to the stable economy

and growth of Estacada. In 1903, the Oregon Water Power and Railway Company, also a predecessor company of Portland General Electric, built a rail line to the area. The railway ran from Portland through Gresham and Boring to Estacada and served primarily to haul workers, equipment and supplies to the Cazadero site, just east of Estacada. The original plat for the "Town of Estacada" was filed in Oregon City on January 9, 1904 and the city was incorporated in 1905.

Development of the railroad also brought more pleasure seekers to the area — particularly after the company built a hotel and picnic park, and started running excursion trains on weekends. The electrified railroad brought crowds of Portlanders to Estacada and to recreation sites along the Clackamas River. The visitors would board the train in Portland and spend their day picnicking, fishing and swimming. The excellent, affordable meals offered by a local hotel drew other visitors.

The situation was well described in the *Street Railway Journal*, October 29, 1904:

> *"Estacada is a town of 300 or 400 people . . . where six months ago there was nothing but a small farm and standing timber . . . The Hotel Estacada is owned by the Oregon Water Power and Railway Company and has been constructed with a view of providing accommodations for those desiring short and inexpensive outings. ...As a special inducement for Sunday traffic, a rate of 50 cents is given for a round trip from Portland to Estacada, instead of the weekday fare of $1.35. A rate of $1.50 is offered for the round-trip including dinner at the hotel."*

The completion of River Mill Dam in 1911 brought more visitors and residents to the area. The dam formed Estacada Lake and created slack water up to the Cazadero powerhouse. Railway services were expanded, with as many as seven extra trains scheduled on Sundays for pleasure seekers. The interurban lines were advertised as "The Trout Route" in anglers' guides.

The basin's population expanded rapidly through the early 1900s. New settlers and entrepreneurs moved in, using the basin's rich resources to meet increasing demands for goods and services in local communities, and in Portland and Oregon City. For many years poor access limited development to the lower basin. At the time only a few roads existed and they were usually muddy or dusty. Consequently, settlers cut timber and cultivated lands along the lower Clackamas and tributaries.

Above Estacada, the Clackamas River Basin remained a 650-square-mile area of timbered wilderness until the 1920s. The country was too steep and rugged for roads, and contained few trails. In many places, sheer cliffs flanked the river, forcing trails to climb up and down the side of the canyon, and making a trip to the upper country a strenuous task. Fast flows and numerous boulders in the Clackamas restricted travel by boat. For many years, a Forest Service ranger station at Oak Grove, built about 1908, was manned only in the summer fire season because of its isolated location. All supplies were transported into the area by pack train.

Several major wildfires devastated forests in the upper basin between 1868 and 1912, sometimes blanketing the forest and adjacent lowlands so heavily with smoke that darkness fell at midday (Burtchard et al. 1993). Generally, the fires were left alone to complete their natural burn cycle.

Access to the upper basin improved after 1921 when Portland General Electric cut a road through the heavily forested area to reach the Oak Grove project site. About 30 miles of road were built — much of it along the narrow steep-walled Clackamas River canyon — to transport workers, equipment and supplies from the end of the railroad line at Cazadero into the project area. Once the road was in, the company immediately extended the railroad line to the site. The railroad was completed in 1923, bringing a rapid and convenient means of access to the upper Clackamas River Basin upstream from the North Fork.

Settlement in the Clackamas River Basin continued, and by the early 1950s about 86,000 people lived in the Clackamas County area. As the road network improved, the lower basin became a bedroom community to the city of Portland. People moved to the scenic river valleys of the Clackamas and commuted to work in the Portland area. The new residents primarily settled in or near the communities of Gladstone, Estacada and Oregon City. Many service-oriented businesses also sprouted in the lower basin to meet the needs of the growing number of residents and visitors.

Today, the basin is still experiencing rapid growth, particularly near the communities of Gladstone, Estacada and Oregon City. It also draws many visitors. With the development of good roads, people quickly discovered the scenic beauty of the Clackamas River and opportunities for good fishing and white-water boating. Consequently it has become a popular recreation area luring many people from the Portland area, less than two hours away, and from the nearby communities of Estacada, Molalla, Gresham and Sandy. Recreational activities include camping, fishing, scenic driving and hunting. Angling is particularly popular on the lower river below River Mill Dam. Most angling occurs from fall through spring when coho, winter steelhead and spring chinook can be caught. Other visits to the

basin continue to be primarily seasonal, heaviest in the summer months and active during spring and fall weekends.

TIMBER HARVEST

Timber harvest in the lower basin started in the early 1800s. The lack of good roads above the Estacada area and easy access to trees in the lower basin tied most logging activities to lower basin forests until the 1940s.

The first sawmill in Clackamas County was built in 1825 or 1826 on Sawmill Creek, probably the same stream on which Dr. McLoughlin had his flour mill (Lynch 1973). Timber harvest and sawing lumber developed into an important industry and soon sawmills existed all along the Clackamas and tributaries. Many of these sawmills were apparently washed away by flood waters in December 1849. According to notes by one early settler, Lot Whitcomb, "all (sawmills) but one on the Clackamas" washed away during the 1849 flood (Farnell 1979). Other mills were built in the 1850s, including one on Eagle Creek in 1850 and another on Deep Creek in 1856 (Lynch 1973). By the late 1800s, small sawmills, called "gyppo" mills were everywhere in the lower basin.

When possible, loggers used the Clackamas and tributaries to transport the timber to mill sites. The 1880 census records show that logs were floated to mills on Rock Creek, Clear Creek and the Clackamas River. Use of the river as a transportation corridor for timber continued for several years, with at least one early mill owner taking legal action to protect his right to drive timber downstream. Harvey Cross, owner of a sawmill at Gladstone on the Clackamas River (RM 0.8), moved to protect his right to float logs down the river after the 1891 state legislature passed "An Act to Protect the Title of Owners of Floating Logs, Timber and Lumber". In 1893 he registered the sign of a cross "as a mark and destination of all said logs owned by me and cut adjacent to and driven down said stream (the Clackamas)." Records suggest that in November 1895 Cross drove about 3,800 logs down the Clackamas River from about two miles above the mouth of Deep Creek. The following March, he drove 500,000 board feet of saw logs about ½ mile down Clear Creek and then down the Clackamas River to the mill (Farnell 1979).

Another company, the Clarkson and McIrvin Boom Company, also used the river to transport logs. In 1896, the company received permission from the Clackamas County Commissioners to use the Clackamas as "a public highway for the floating and transporting of logs, pilings and poles" and to lease the river to collect tolls for such use. The company proposed to charge tolls on the river below Eagle Creek, below the mouth of Deep Creek and portions of Deep Creek. An article in *The Oregonian* in 1896 discusses the company's actions. According to a newspaper article, the company removed 200,000 feet of piling from the Clackamas River and then gathered timber to transport. When the article was written, the company was waiting for a rise of water to move about 250,000 feet of

timber down the river. It expected to have another 250,000 feet of wood before the higher flows came (Farnell 1979).

Log drives continued into the 1900s. In 1912, two log drivers, the Himler brothers, claimed to have run 40,337 railroad ties down the river between May and November, enough to load 55 railroad cars (Farnell 1979). Another early resident of the area, Mr. Mumpower, also drove railroad ties down the Clackamas. In a conversation with James Farnell, a historian, he recalled driving logs from as high as the present site of McIver Park (RM 20.5) to a mill at Barton. He said that they only floated logs in summer and that the drives were often helped by a flash release from the dam (Farnell 1979).

Early logging practices often left scars on the landscape. Since timber harvest was generally unrestricted, loggers cut timber that could be easily reached and moved to markets. They removed timber from riparian areas, unstable slopes and other lands that would be protected today. Such disturbances affected habitat conditions along the lower river and tributaries. They reduced soil stability, leaving the exposed soils more susceptible to erosion during storms and high flows. Other habitat damage resulted from the driving of logs down streams. Log drives scoured stream channels, removed riparian vegetation, and created barriers to fish passage. The log drives also hindered hatchery efforts. In 1902, J. Wisner, a manager of the Clackamas hatchery, reported that about 2,000 cords of wood were being floated down the river. Hatchery personnel had to construct a boom above their egg-taking rack to guide the wood through a gate in the structure (Wisner 1902). Water quality was also affected by sawmill production and logging activities during this time. By 1890, sawdust and other mill waste were common pollutants in any stream in the state (Oregon Fish Commission 1889-1890).

Use of the river to transport logs declined after 1903 when developers brought railway services to the area. In 1904, more than 100,000 cords of wood were hauled by the Estacada line to Portland, which still burned wood almost exclusively for fuel. The rail also provided access to previously unreachable territory, thus supporting the growing logging industry.

Access to the basin's vast forests improved further in the 1920s when Portland General Electric built a road to the Oak Grove drainage, and the Forest Service started developing truck trails. These corridors established the primary network for the forest's road system in many areas. The Forest Service built Skyline Road (Road 4220) into the Ollalie Lake area in the later 1920s and extended roads into the Oak Grove Fork drainage in the 1930s. Road construction in the upper drainage continued with the addition of 23.4 miles in the 1940s and 61 miles in the 1950s. Many secondary roads were also developed. Road development took off in the 1960s when about 210.7 miles of road were constructed in the upper basin. By 1969, about 60 percent of the upper watershed's existing system was in place. During the 1970s, 90 miles of road were added to this system and many existing roads were converted to asphalt. Another 97.4 miles and 10 miles of new road were constructed in the 1980s and 1990s, respectively.

In addition, many existing roads were improved with asphalt. oday, the upper Clackamas watershed alone contains about 490 miles of roads (USFS 1995).

The new road system opened the upper basin to timber harvest. Vast quantities of timber were harvested after 1950, nearly all on national forest land. By 1960, approximately 880 acres in the upper basin had been clear-cut harvested using mainly tractor skidding techniques. Harvest increased during the 1960s, occurring throughout the upper watershed. By the end of the 1960s, an additional 7,393 acres had been clear-cut. Harvest escalated during the next 25 years. About 21,000 acres were cut between 1970 and 1994 using all types of harvesting techniques. Several other areas were also harvested during this time, primarily to salvage timber in areas hit by bark beetle or windstorm damage. Overall, between 1950 and 1994 timber harvests occurred on more than 29 percent of the upper Clackamas watershed (USFS 1995).

Road construction and timber harvest critically affected conditions in the upper basin. Logging road construction and timber harvest increased the risk of landslides in the drainage. Generally, logging roads are considered one of the biggest triggers of landslides because they compact soil and reduce its ability to absorb precipitation. Research outside the Mt. Hood National Forest has shown that 80-90 percent of the sedimentation associated with timber harvest can be attributed to road building (ODFW 1992). Studies in the Clackamas drainage support this finding. In 1988, the Mt. Hood National Forest identified active slide areas in the Collawash, Oak Grove Fork, Hot Springs Fork, Fish Creek and upper mainstem Clackamas drainages (ODFW 1992).

Road-building along the Clackamas River and tributaries also affected stream stability and habitat conditions. Loggers and road builders were often attracted to the floodplains because they were easier to reach and develop than the surrounding rugged territory. Consequently, road building along streams, including the development of several main access roads, caused stream realigning and straightening and the removal of large amounts of riparian vegetation. In the 1950s, for example, Forest Road 46 was extended by realigning the Clackamas River between RM 57 and RM 65. The realigned channel is about 20 percent shorter than the natural channel and contains significantly less fish habitat.
The logging of streamside trees, such as in the Fish Creek and upper Collawash systems, affected habitat diversity and channel stability and reduced stream shading. Loss of shade contributed to increases in water temperatures during late summer and fall. Water temperatures exceeding 65°F — a level affecting salmon and trout production — have been recorded in Fish Creek and the lower Clackamas, Hot Springs Fork, and Collawash rivers.

Studies conducted on Fish Creek in the middle Clackamas drainage illustrate some impacts associated with logging and road construction. The Fish Creek watershed has been the focus of intensive multi-year investigations. The results of these investigations are discussed below.

Fish Creek — A Case Study

Conditions in Fish Creek are believed to typify many middle and lower watersheds on the forest. Studies conducted in the Fish Creek drainage since 1982 show that more than 40 percent of the old growth trees have been logged and more than 140 miles of roads have been carved throughout the 30,000-acre drainage. When biologists evaluated aquatic habitat conditions and fish production capability as part of a major stream rehabilitation effort, they found that "present habitat conditions varied significantly from historical conditions" (USFS 1988).

Studies show that "between the middle and late 1950s and the early 1960s substantial changes in channel condition/stability, summer water temperature regimes and watershed conditions occurred." Changes in channel condition and stability include a 34 percent loss of low flow pool habitat (Everest et al. 1986), a 90 percent decline in large wood structure, and active channel widening and downcutting over at least 60 percent of the lower 11 miles of stream. In addition, maximum summer water temperatures at the stream mouth rose to between 68° and 75°F — eight to ten degrees above the estimated temperature regime in the late 1950s. Because of these changes, investigators found that the quality of accessible anadromous habitat has declined by an estimated 20-25 percent over the last 20 to 30 years (USFS 1988). Influencing factors include blocked access at tributary road crossings and reduced channel length due to downcutting and straightening.

Many disturbed areas in the Fish Creek drainage collapsed under the pressure of peak flows during the flood of 1996. After the flood, approximately 236 landslides resulted in the drainage. Approximately 36 percent of these slides were related to logging roads and another 42 percent were tied to timber work, particularly in young tree stands. The slides caused piles of logs and rock debris to clog roads and destroyed a 110-foot cement bridge (Bulletin 1997). They also increased sediment loading throughout the lower drainage.

Today, timber harvest continues to be one of the most important industries in the area. However, harvest practices have improved. Current harvest and regeneration techniques are designed to reduce impacts on the watershed. For example, the treatment of harvest areas improved in the mid-1980s when forest personnel began applying new methods to increase new tree growth and survival. These methods included using fertilizers and planting higher-quality trees in harvested areas. As a result, new tree growth has improved by 30 percent over the "normal yields" expected in the 1950s (USFS 1995).

AGRICULTURE

During the early and middle 1800s, suitable lands along the lower river valleys and plateaus were cultivated for agricultural production. However, many potential farmers were discouraged by the basin's narrow floodplain, rugged terrain, and dense forests. Settlers who chose to farm in the basin often had to remove a thick blanket of trees and brush from their land before preparing it for planting. Other times, emigrants settled on bare lands that had previously been harvested by loggers. Once the land was cleared, the rich soils were cultivated and planted to produce grains, berries, vegetable gardens and orchards. Truck farmers often took their fresh produce to markets or wholesalers in the Portland area. Crop selection changed in the 1890s after farmers began using the railroad to transport their goods to market. Some farmers started raising potatoes and other crops and shipping them to markets. This replaced a practice of growing hay and grain to fatten hogs and cattle, and then driving the beasts "on the hoof" the long distance to Portland (Lynch 1973).

Agricultural use in the lower Clackamas River Basin continued to grow through the early and middle 1900s. Farms in the area produced grass seed, dairy, berries and truck farm crops. Christmas tree production also became important in later years. Today, approximately 1/8 of the drainage is used to produce berries, tree fruit, field crops, Christmas trees and livestock.

These activities impacted habitat conditions in the lower river basin in several ways. Development of lands for agricultural use resulted in removal of streamside vegetation and caused streambank erosion. Removing streamflows for irrigation also reduced instream flows in some drainages. Generally, however, low flows caused by water withdrawals are not a problem in the drainage.

MINING

Small mining operations have occurred periodically in the drainage since the mid-1800s. A rock quarry existed on the south bank of the Clackamas (RM 8) near the present town of Carver by the late 1860s. Stone from the quarry was floated down the Clackamas to building sites in Portland (Farnell 1979). Other mining operations began in the early 1900s. Prospectors mined for gold, silver and copper during the 1910s in the Pansy Basin and along the North Fork and Oak Grove Fork rivers. A mine on the headwaters of Eagle Creek was also worked for a short period. In the late 1930s, several cinnabar mines were operated on Oak Grove Fork. These mines produced significant amounts of mercury until 1943 when the operations ended (Burtchard et al. 1993).

Gravel was also mined. Dredging has occurred at several locations on the main Clackamas River including near the river's mouth. Several upland gravel operations have also existed in the lower subbasin. One operation worked until recently had a major impact on the Clackamas River. Sand and gravel mining on the Clackamas near RM 14 began in the 1960s. Operators removed material from instream gravel bars and then moved into adjacent floodplain areas. They built a dike at the 100-year floodplain to keep water in its settling ponds from breaching into the river. Several pits ranging from 8 feet to 30 feet in depth were mined above the 200-year floodplain in the 1970s and 1980s. In 1996, floodwaters broke through the river channel above the dike and spilled into the gravel pits. As a result, about ½ mile of stream was lost when an oxbow was cut off. Further, pools have been lost upstream as the river system moved gravel downriver to fill the pits. Today, the river continues to seek a new equilibrium.

Such operations within or adjacent to the stream corridor have impacted natural stream characteristics. Disturbance of the stream channel through the removal of gravel, riparian vegetation and other material reduced spawning and rearing habitat and — as seen on the Clackamas during the 1996 flood — left the system more susceptible to erosion during high flows. Gravel removal also affected water quality in and immediately below the mined areas when washing operations were not properly contained in settling ponds.

INDUSTRIAL DEVELOPMENT — Including Associated Dams

Settlers in the 1800s started several industrial enterprises. In 1842, Philip Foster settled land on Eagle Creek[1] and built a grist mill (Lynch 1973). A larger operation began in 1867 when W.W. Buck and Henry Pittock established a paper mill at Park Place near Gladstone on the Clackamas River at the site of Buck's sawmill, which was to be torn down. Four waterwheels were installed to operate the mill and it started producing paper in 1868. The mill operated for 17 years. It closed after the increasing demand for paper in the early 1880s prompted its owners to develop a new site at Camas on the Columbia River where cottonwood trees were abundant (PGE 1982).

The dam associated with the paper mill near Gladstone is reported to have blocked upstream fish passage except during high flows. It, or another dam in the same vicinity, continued to hinder fish passage through the late 1800s. Records refer only to "the dam" and it is unclear whether they are

1 The creek was named Eagle Creek after Indians told early settlers that in the days of their fathers the salmon came to the creek by the thousands. When the salmon reached the shallows the eagles would swoop down and pick them out (Lynch 1975).

referring to the dam built on the Clackamas in 1869 or 1870, or to another dam built later. Some later reports refer to a sawmill dam near Gladstone. The impact of this early dam on the lower Clackamas River is described in a report by the State Fish Commission in 1890. The report says the commission was informed in late September that the dam across the Clackamas River at Gladstone was preventing salmon from ascending the river. The commissioner describes the dam as made of rock and brush, about 3 feet high, blocking fish passage during low flows.

A fishway was constructed at the dam in 1892 to provide fish passage (Oregon Fish Commission 1892). However, reports suggest the dam continued to hinder fish passage except during periods of high flow. A 1892 report notes that salmon did not appear at the Clear Creek station in late August as they could not pass the sawmill dam (U.S. Commission of Fish and Fisheries 1892). Another report during this time mentions a sawmill dam found 1 mile above the mouth of the Clackamas and 4 miles below the hatchery that stood about 7 feet high with no fish passage. The dam is also mentioned in fish harvest reports. According to records by a Mr. Seaburg, of Ilwaco, Washington — noted as one of the most extensive salmon packers at the time — in April and May 1893 about 140 tons of chinook salmon were caught below the dam in the Clackamas River with gillnets and seines. He explained that most of the fish were taken at the dam where the fish congregated in their attempts at passage. More than 100 tons were caught in 1894 at the same location (U.S. Fish Commission 1894). In 1894 the U.S. Commission of Fish and Fisheries recognized the Gladstone Dam as “one of the greatest evils now affecting the fisheries of the Columbia River Basin” (U.S. Fish Commission 1894). The problem was resolved in 1895 when the Columbia River Packers Propagation Company put a ladder over the dam providing adequate passage for anadromous fish.

A report by L.T. Barin in 1885 suggests that other small dams also existed in the basin during the middle and late 1800s. Barin (1885) mentions three dams on the Clear Creek — one built in 1852 at Hardings Mill three miles above the hatchery, another built in 1848 or 1850 at Viola, and a third built in 1865 at Springwater. Other settlers probably also built small dams on the Clackamas and tributaries during this period to support their mill operations.

HYDROELECTRIC DEVELOPMENT

Incredible population and industrial growth in the Portland metropolitan area during the early 1900s created a hunger for a large electric power supply. Power was needed to fuel the extensive system of interurban railroads and trolleys that would eventually spread from the Columbia River to Salem in the middle Willamette Valley. It was also needed to bolster the region's growing industrial and residential developments. As electric requirements increased at a rapid rate, low-cost hydroelectric generation became more attractive for bulk power supply. Hydro developers recognized the potential for power development on the Clackamas River at the turn of the century. They began site investigations in 1901 and acquired several potential power sites in 1902.

In 1948, the region again faced a shortage of energy to meet its growing needs. This propelled Portland General Electric Company to study developments that would increase its generation capability. Again, the company looked to the Clackamas River system to help meet these needs. They initiated several actions in the basin to improve the existing systems' capability. The various hydroelectric projects in the basin are discussed briefly.

Cazadero/Faraday Dam

In 1902, the Oregon Water Power and Railway Company, a predecessor of Portland General Electric, started work on Cazadero Dam in the Clackamas River about 1.25 miles upstream from the town of Estacada. Workers completed the timber-crib, rock-filled dam in 1907. A wooden fish ladder was included as part of the dam's original construction.

When the dam was completed, fish propagators began operating an egg-taking station just below it. These activities prevented full use of the ladder. The fish ladder also suffered repeated damage by floodwaters in the early years and was repaired frequently. Records show the ladder being repaired following a flood the winter of 1909-1910. The ladder was damaged badly by floods in 1917 and was not repaired because egg-taking activities downstream at River Mill Dam prevented fish from reaching Cazadero. In 1939, the company rebuilt the ladder at a cost of about $22,000.

During the 1950s, the company modified the project to handle the water discharged by two units operating on peaking loads at North Fork. A new intake was constructed above the original Cazadero Dam, and a ½-mile-long concrete-lined tunnel was built. The company also built a new turbine generator beside the original powerhouse. A new fish ladder, constructed as part of the North Fork

Project, provided passage around both the Cazadero and North Fork dams. The projects were completed in 1958.

In December 1964, a major flood on the Clackamas River severely damaged Cazadero Dam. The dam ``collapsed when another flood hit five weeks later in January 1965. It was replaced with a new concrete dam, named Faraday, in 1966.

River Mill Dam

The Oregon Water Power and Railway Company began building a second plant on the Clackamas River in 1909. The River Mill project, below the Cazadero plant and less than one mile northeast of Estacada, started generating power in 1911.

Upon completion, River Mill contained a concrete fish ladder that had received approval from Oregon's Master Fish Warden. The ladder was considered a model design for its day. Fish propagators immediately placed a fish rack below the ladder entrance to collect brood stock. The rack prevented full use of the fish ladder for migration over the dam until 1940. Eggs were taken below the ladder from 1913 through 1939, when the hatchery was abandoned.

In 1926, Portland General Electric improved the ladder at River Mill, although salmon migration was stopped most of the time by egg-taking operations. They constructed additional pools at the lower end of the ladder, widened turning and resting pools, and moved apertures between the pools to meet new state requirements. The ladder was improved again in late 1939. This time the company improved the fish ladder entrance and installed an attraction water pump and diffusion chamber as recommended by the U.S. Bureau of Fisheries.

Passage improvements made at Cazadero and River Mill dams in 1939 restored fish passage to the upper Clackamas basin. When the new North Fork ladder became operable in 1958, the ladder over Cazadero Dam was removed.

Oak Grove Project

In 1907, the Southern Pacific Company began looking to the Clackamas River Basin to secure power for its contemplated 340-mile Oregon electrification railroad system. The company took steps to secure this power source by filing notices of water appropriation on the Oak Grove Fork of the Clackamas in 1907 and on Three Lynx Creek in 1908. In 1911, the Portland Railway Light and Power

Company (a predecessor to Portland General Electric) assumed all legal liabilities and assets of the Oak Grove project.

After a lapse of 10 years, the company again started work on the project. They completed construction of a concrete diversion dam on the Oak Grove Fork in 1923, creating Lake Harriet. No fish passage facilities were required at the dam as two natural 24-foot falls about one mile downstream of the dam blocked fish migration. The plant began generating power in 1924.

In 1952, Portland General Electric began investigating sites for new facilities on the Oak Grove Fork of the Clackamas River to supply additional peak capacity for the two existing Oak Grove generating units. The company decided to create a 430-acre-feet capacity forebay at Frog Lake. They began excavation in 1953. The Frog Lake forebay was placed in service that year. In 1997, Frog Lake was reduced in capacity to 266 acre-feet to control movement associated with ancient landslide terrain.

The company also started investigations in the subbasin for another dam site in 1952. This dam would regulate flows to support increased energy generation at the Clackamas River hydro plants during the low flow period, September to April. The company selected a site at Timothy Meadows, about 1,000 feet downstream from a site investigated in 1910. In 1953-1954, they constructed a road up Oak Grove Fork Canyon from Lake Harriet to the selected dam site near the headwaters of the Oak Grove Fork under an agreement with the Forest Service. The company completed construction of a compacted-earth dam in 1956. The dam formed Timothy Lake, a 1,440-acre impoundment, which soon became a popular recreation site.

North Fork Dam

Investigations for a power site above the backwater of Cazadero Dam began in 1907. The project would ultimately become North Fork Dam. The company surveyed and mapped the site in 1907, and began extensive core drilling of the dam foundation in 1908. When the site was deemed suitable for development, the railroad was extended upriver from Cazadero Dam. Ultimate development of the project, however, did not occur until the power shortage period of the 1950s.

In 1954, nearly half a century after initial investigations, Portland General Electric began new studies for the North Fork hydroelectric development. The company received pre-license consent from the Federal Power Commission for the project in September 1956. This consent came after Portland General Electric and the Oregon Department of Fish and Game reached agreement on the scope of the facilities for handling migratory fish. The project was completed in 1958.

Upon completion, the North Fork project included extensive fish passage facilities bypassing both Cazadero (later named Faraday) and North Fork dams. The project's 1.9-mile fish ladder transported fish from the river below Faraday and deposited them above North Fork Dam after climbing 196 feet. The ladder, 10 feet wide and 6 feet deep, included a fish trap that has normally been operated from June to October.

The company also built facilities to help downstream migrants. These included a collection device above North Fork Dam to attract the migrants and convey them to the North Fork fishway. Near the lower end of the fishway, they assembled a "separator" to pass fish from the fishway into a pipeline to carry them to the river below River Mill Dam. Today, downstream migrants are counted at the separator. Downstream migrants can also leave North Fork Reservoir over the spillway during high water. Construction of the North Fork project significantly improved fish passage upstream from River Mill Dam and Estacada Lake. Studies have shown that the North Fork screen and diversion facility effectively attracts and passes salmon and steelhead smolts because they typically migrate downstream near the water surface. The downstream migrant bypass is less effective at attracting chinook smolts away from the turbines as chinook often migrate at greater depths.

After discussions with the State of Oregon regarding fish losses and enhancements, Portland General Electric proposed to pay up to one million dollars for building a fish hatchery to be operated by the State of Oregon. The company and State reached formal agreement in 1975. The company committed to paying up to one million dollars for a fish hatchery capable of producing 50,000 pounds of salmonids annually. The state agreed to pay for any expenses to enlarge the hatchery or to produce more fish. All costs of operating and maintaining the hatchery are to be shared equally by the company and State. In signing the agreement, Portland General Electric did not admit past or present liability for abundance of fish on the Clackamas River, but entered the agreement with the purpose of cooperatively increasing salmon production of the river. In addition, the agreement stipulated that the company was not required to construct additional fish passage facilities, protection devices or modify power operations to improve fish passage. Construction of the hatchery began in 1977 on land that the company deeded to the State. The 17.5-acre site, which now supports the Clackamas Hatchery, lies next to McIver State Park on the Clackamas River.

SALMON AND STEELHEAD HARVEST

Clackamas River salmon and steelhead runs dropped steadily in the mid- to late-1800s as the fishing industry expanded through the region. Fishing parties on the Columbia River, and on the lower Willamette and Clackamas rivers, caught scores of fish bound for spawning grounds in the Clackamas basin.

Harvest in these early years focused on spring chinook. Commercial harvest for spring chinook began on the Columbia River in the mid-1800s and grew quickly until it peaked around 1873 with a take of 43 million pounds (Oregon Game Commission 1951). Spring chinook harvest on the Columbia then declined significantly, suggesting that the river's spring chinook run had been weakened by overharvest. Records from 1877 show use of more than 1,000 drift nets in the Columbia, each about 1,200 feet long (U.S. Commission of Fish and Fisheries 1877). Commercial gear regulations were first adopted on the Columbia in 1878.

The Clackamas River also experienced heavy commercial fishing during this period, probably because of easy access from Oregon City and Portland. As on the Columbia, fishing parties on the Clackamas caught as many spring chinook as possible and then turned to silver salmon and fall chinook. Drift nets were the most common fishing gear, but traps and set-nets were also used. A report written in 1876 describes a trap at the mouth of the Clackamas River that almost completely closed the river to upriver fish passage. Records from 1877 show drift nets and two traps being used to catch fish on the lower Clackamas River. In September, a trap reached nearly across the mouth of the Clackamas to trap "silversides" (U.S. Commission of Fish and Fisheries 1877). In 1886, a commercial fisher, A.S. Abernethy, reported fishing by several parties on the Clackamas River near the mouth of Clear Creek. The various parties fished with drift nets and short set-nets, and one party used a trap. He estimated that approximately 3,500 chinook salmon were caught before July 10. Fishing pressure probably then dropped off as late-season fish became soft and unfit for markets (Abernethy 1886).

Heavy fishing continued through 1894. Gillnetters caught approximately 12,000 adult spring chinook in the lower Clackamas in 1893 (Smith 1974). Many more salmon were caught in 1894. According to reports by Hugh Smith, who was touring the Pacific Northwest, gillnetters on the lower Clackamas below the Gladstone Dam caught more than 100 tons of chinook in 1894. If these fish weighed an average of 22.76 pounds — the average weight for 104,831 chinook caught in the Columbia River in 1893 — about 8,000 chinook were caught in the lower Clackamas in 1984 (Smith 1974).

By 1895, about 82 commercial parties fished for salmon on the Clackamas and lower Willamette rivers, an area of about 30 miles. They harvested one run of large chinook from April 10 to May 10,

and a second run of smaller salmon through June. The fishing parties used drift gillnets to catch the larger fish and set nets with a smaller-sized mesh to catch the second run. Fishing resumed in late summer with silver salmon harvest from late-September to mid-November, and steelhead harvest from November until March 1. The fish were usually sold in Portland. Reports estimate that the total catch averaged 5/10 chinook, 1/10 silver, and 4/10 steelhead (U.S. Commission of Fish and Fisheries 1895).

Fishing pressure remained high on the Columbia River in the early 1900s, but an important change took place. While commercial fisheries maintained an average annual harvest of about 25 million pounds until 1922, spring chinook made up less of the catch. Around 1880, spring and summer chinook runs started declining and harvest shifted to fall chinook salmon. As a result, by 1920, the catch was estimated to be half fall chinook. Harvest emphasis also moved to steelhead (1890 to 1900) and then to coho (1920s) during this period. Peak commercial catches of chinook and coho occurred in 1883 and 1925, respectively (Lichatowich and Mobrand 1995). Commercial landings for all species declined steadily after 1923, with an average annual harvest of 15 million pounds from 1923 to 1958 (Lichatowich and Mobrand 1995).

In 1912, the ocean troll fishery (towing a hook and line behind a boat) began competing with the Columbia River fishery. The troll fishery initially began off the mouth of the Columbia River, the number of boats doubling from about 500 in 1915 to about 1,000 in 1919 (Northwest Power Planning Council 1987). There were few restrictions on the ocean fisheries until 1948.

Commercial fishing on the Clackamas River declined after the turn of the century. By 1908, only about five or six commercial operators were still fishing on the river. Seasons were designated for commercial fishing on the Clackamas around 1910. The seasons were eliminated for a short time in 1918 because of a discrepancy in the laws regulating commercial fishing, and the river became open to indiscriminate fishing again until the problem was rectified. Once regulations were reestablished, poaching became evident. The state received many complaints regarding heavy illegal fishing in the lower Clackamas basin. Illegal gillnetting below River Mill Dam remained heavy through the Depression years. In 1950 commercial fishing was banned on the Clackamas and Willamette rivers. Fish from the Clackamas continued to contribute to fisheries on the ocean and Columbia River. Spring chinook remained the most important commercial fish.

As access to the Clackamas River and tributaries improved, the basin saw an increase in sport fishing. Over the years, basin sport fisheries have continued to grow in popularity. Today, winter and summer steelhead and coho salmon are pursued in both the mainstem and tributaries, such as Eagle Creek. The basin also supports a strong resident trout fishery.

Clackamas spring chinook still attract a considerable number of sport anglers to the Clackamas and Willamette rivers. The run supports a highly popular sport fishery in the Portland metro area and contributes substantially to a large sport fishery in the Willamette River below the falls. In the Clackamas basin, annual sport harvest has increased from about 700 fish before 1977 to more than 3,000 fish in recent years. Most fishing occurs on the lower river below River Mill Dam.

SUMMARY

The Clackamas River Basin has seen significant changes since the early 1800s. Over the last 150 years human efforts to extract and harness resources have altered natural stream hydrology, streamflow patterns, channel structure and water quality within the Clackamas River system. Human impacts include timber harvest, road building, driving logs downstream, dam building and operations, extraction of instream and floodplain gravels and downed wood, removal of riparian vegetation, and the destruction of side channels and wetlands. These changes contributed to dramatic losses of salmon and steelhead habitat and productivity. The runs have also been greatly affected by hatchery egg-take operations and by overfishing in the Columbia River, ocean and Clackamas River.

The following sections discuss salmon and steelhead production in the Clackamas basin through the years. Human activities and developments discussed in this section directly influenced these runs and actions taken to improve them. Consequently, key events that shaped conditions in the Clackamas drainage during each period are often mentioned in the discussions and are summarized at the end of each section.

SALMON AND STEELHEAD RUNS BEFORE 1900

INTRODUCTION

In the early 1800s, large runs of salmon and steelhead returned each year to the Clackamas River. Estimates of run size are unavailable, but harvest and hatchery records from the mid- to late-1800s suggest that the fish returned in significant numbers. Native anadromous fish runs to the basin included spring chinook, fall chinook, coho salmon, and winter steelhead. The drainage also supported several resident fish species, including cutthroat, rainbow and bull trout, and mountain whitefish. A small run of summer steelhead may have also existed. In 1889 Rudyard Kipling described catching bright steelhead in what was late spring or early summer, when winter steelhead are not typically bright in color.

Pristine conditions in the watershed provided excellent habitat for salmon and steelhead production at the turn of the 19th century. It was an environment containing majestic forests with a dense understory and rivers of clear, cold water with rapids and long, shallow gravel beds that filled each year with an abundant supply of salmon.

As discussed previously, natural salmon and steelhead production began to drop sharply in the Columbia River and tributaries, including the Clackamas, in the 1870s. The primary cause of the decline is believed to have been overharvest in the Columbia River. Commercial harvest of spring chinook peaked around 1873 with a take of 43 million pounds. When this run began to decrease in size, fishing pressure moved to fall chinook and coho. Fish harvest also escalated on the Clackamas and lower Willamette rivers in the late 1800s — sometimes almost completely closing the river to upstream fish passage.

Destruction of habitat conditions in the lower basin contributed to the decline of Clackamas River salmon runs. The lower river area was undergoing tremendous growth and development during the late 1800s. Heavy harvest of forests in the lower basin resulted in erosion, silting of spawning gravels, loss of streamside vegetation and poor water quality. Other developments in the basin also restricted fish migration. Records show that upstream salmon migration was restricted as early as 1868 after a dam was built on the Clackamas River near Gladstone. This, or another dam near it, continued to impede passage until a fish ladder was provided in 1895. Dams also existed on Clear Creek. Further, while records are scarce, dams probably were also built at other sites on the Clackamas and tributaries to provide water for mills operating at the time. Thus, by the late 1800s fish runs faced overwhelming pressure to adapt to changing habitat conditions.

FISH PRODUCTION

The drop in salmon and steelhead runs in the Columbia River fostered the development of fish culture. In the mid-1870s, cannery personnel in the Pacific Northwest began looking at hatchery production as a means to improve salmon harvest in the Columbia River. Upon the recommendation of Livingston Stone, an agent for the U.S. Commission of Fish and Fisheries, they decided to construct their first hatchery on the Clackamas River. Stone had previously explored potential hatchery sites throughout the Columbia River Basin and found conditions on the Clackamas most acceptable for propagation. Hatchery interests acted quickly after salmon runs dropped significantly in 1876. Cannery personnel in the Pacific Northwest formed the Oregon and Washington Fish Propagating Company and began developing a hatchery on the Clackamas River at the mouth of Clear Creek.

Hatchery practices during this early period evolved through a process of trial and error. Fish propagators knew little about spawning, hatching and growing fish and generally learned by doing. Often they would hatch millions of fry and then release the unfed fry soon after they hatched. Consequently, the mortality rate was very high. A report by Waldo Hubbard, a superintendent of the Clackamas Station, describes some difficulties that early fish propagators faced. He reported that in January 1891 hatching took place very rapidly. They had to use troughs from a previously improvised hatchery to prevent the fry from suffocating. The hatching period ended in February. During and after this period, hatchery personnel released the fry within a three-mile stretch of river when they arrived at the age where they could begin taking food (U.S. Commission of Fish and Fisheries 1890-91). Other reports by early hatchery operators mention problems with disease, water supplies, and food sources that also resulted in high mortality.

Hatchery operators often gathered their brood stock from nearby streams. For many years, fish propagators on the Clackamas placed racks, or fences, with long pickets across streams to capture fish for egg-taking. The rack, placed in the stream before the fish arrived, kept the adults from passing above that point. As the fish neared the spawning period, they were driven downstream into collection traps. The females and males were then stripped for eggs and milt. This method was an adaption of Indian fishing methods. Gillnets were also used to catch fish at the racks or in deep holes such as at the base of dams.

The hatching house above the mouth of Clear Creek on the Clackamas was completed in late summer 1877 with a capacity for 1 million eggs (U.S. Commission of Fish and Fisheries 1877). Livingston Stone began operating the facility for the United Sates Commission of Fish and Fisheries immediately after its completion. The site was named Stone, and the hatchery became the first such operation in

Oregon and second in the United States (Lynch 1973).

The hatchery operated four years. During the first year, about 200,000 eggs were secured, but most were lost with a sudden rise of the river. Hatchery records show that 88,680 eggs were taken in 1877 at the hatchery site, and that 2,085,000, 2,035,100 and 2,838,000 eggs were taken in 1878, 1879 and 1880, respectively (Wallis 1960). Hatchery personnel estimated that they caught 2,000 adults in the racks in 1878 (U.S. Commission of Fish and Fisheries 1878). They released the young fall chinook fry in the Clackamas River soon after they hatched. Hatchery operations stopped in 1880 (Table 2).

In 1882, the U.S. Commissioner of Fish and Fisheries again directed Livingston Stone to explore the Columbia River Basin for potential hatchery sites. After completing his search in 1883 he suggested that if Washington Territory and the State of Oregon could agree upon a code of protective laws for salmon (to prevent further overfishing), the Clackamas River would again teem with salmon as before and, in that event, perhaps the best point for a breeding station would be on that river (the Clackamas) where the (previous) station was built in 1877 (Mattson 1950).

In 1887, the newly created Oregon Fish Commission leased the abandoned hatchery at Clear Creek. They operated the facility for about one year, then shared operations with the U.S. Commission of Fish and Fisheries in 1888 after funds fell short. The federal commission bought the facility in 1889. The property, purchased for $5,155.60, included a rack 400 feet long, a 160-foot dam across Clear Creek, a flume, filtering tanks, a dwelling house, a house for workers, a hatching house and a stable — all in good condition. Fry from the station were planted in the Clackamas River and tributaries.

In the late 1880s, hatchery operators moved some egg-taking operations to the lower Clackamas River after changes at a dam near Gladstone made it difficult for salmon to pass. Waldo Hubbard, superintendent at the Clackamas station, wrote that by July 1889 many quinnat [2] salmon had collected below the obstructing dam across the Clackamas River. Records show that from late August to early November the propagators collected 4,314,000 eggs from 957 females. They caught many more males than females. The fish were collected using four traps, one below the dam and the others in shallows downstream. Fish propagators placed another obstruction rack below the Gladstone area dam in 1890 and captured 1,094 females that September producing 5,860,000 eggs (Hubbard 1889-90). They went below the dam again in 1891 after collecting only 800,000 eggs near the hatchery and gathered the reminder of the 2,036,000 eggs secured that year (McGuire 1894). Records suggest that many of the

2 "Quinnat" salmon is believed to be a word for spring chinook adapted from the Indian tongue (Smith 1974).

fish taken below the dam may have been fall chinook since spring chinook could pass except during low flows.

The number of adults reaching the Clackamas Hatchery egg station continued to disappoint hatchery operators in 1892. As a result, they decided to establish an egg-taking station on the Sandy River and look for other opportunities to secure hatchery eggs. In 1894, hatchery managers decided to stop further egg-take operations at Clackamas Hatchery until passage could be provided at the Gladstone Dam. The hatchery managers resumed egg-taking operations in 1895 after the Columbia River Packers Propagating Company put a ladder into the Gladstone Dam, providing satisfactory passage. From 1896 to 1900, the Clear Creek Hatchery operated with salmon eggs from the Clackamas. The hatchery also received eggs from outside the basin, including Michigan, California, and from the Salmon (a tributary of the Sandy River) and Little White Salmon rivers.

In 1895, the Columbia River Packers Propagation Company built a hatchery on the upper Clackamas near the mouth of the Collawash River. The remote site, about 50 miles above the town of Clackamas, was considered especially valuable because it was believed to be the only place in the Columbia River Basin where chinook eggs could be secured before July. Access to the hatchery was by trail only. Hatchery workers spent two or three days traveling about 30 miles to outfit the station. The facility was turned over to the U.S. Commission of Fish and Fisheries in 1897. In June 1897, hatchery personnel placed racks across the Clackamas River and Oak Grove Creek. Fish began collecting below the racks in late June. Between July 17 and August 26, about 5,045,000 eggs were taken from 2,250 salmon after part of the run escaped during high water (USFWS 1950). After hatching, the eggs were liberated as fry into the Clackamas River.

In May 1898, fish propagators again built racks across the upper Clackamas River and Oak Grove Fork. This time they captured 675 females for eggs from mid-July through August. Afterward, hatchery managers concluded that the upper Clackamas station was of little value for egg collection. They decided to use the station to hatch and rear eggs collected at the site or transferred from substations on the Salmon and Little White Salmon. The hatchery was abandoned in 1906.

Hatchery managers also moved to limit operations at the lower Clackamas hatchery in 1898. They decided to stop egg collection at the station since arrangements had already been made to collect eggs on the upper river, the Salmon River and the Little White Salmon. Instead, they began using the facility for hatching and rearing fry from eggs received from other stations (Hubbard 1898-90). In 1899, egg-taking operations began in September at the lower station. Very few fish were seen below the rack.

Eggs for the hatchery were purchased from a Mr. Oldenburg who collected the eggs at a point about four miles below the station and sold them at a rate of 40 cents per 1,000 eggs (Downing 1900).

Table 2. Chinook Salmon Egg-Takes at Clackamas River Hatcheries Before 1900 (Wallis 1960).

Year	Lower Clackamas Hatchery	Upper Clackamas Hatchery
1877	88,680	
1878	2,085,000	
1879	2,038,100	
1880	2,838,000	

1887	1,500,000	
1888	4,500,000	
1889	4,314,000	
1890	5,860,000	
1891	2,036,000	
1892	3,265,000	
1893	277,000	
1894		
1895		4,000,000[3]
1896	1,062,500	2,500,000
1897	1,672,275	5,045,000
1898	704,000	3,421,000
1899	775,000	2,200,000

SUMMARY

Salmon and steelhead runs to the Clackamas River Basin fell significantly below historic levels by the late 1800s. The decline has been largely attributed to overfishing in the Columbia River. Scores of fish destined for the Clackamas were caught by fishing parties in the Columbia River and in the lower Willamette and Clackamas rivers, and never returned to their spawning grounds. Activities in the basin during the middle and late 1800s also contributed to the fall. Escalating timber harvest and related activities, such as driving logs down streams, damaged habitat conditions along parts of the lower Clackamas and tributaries. A dam across the Clackamas River near Gladstone seriously restricted salmon passage to upper basin spawning and rearing areas. The runs were further reduced by hatchery efforts. When the runs began to drop, cannery personnel tried to increase them through hatchery production. However, operations were very experimental. Many would-be natural spawners were captured and used as brood stock in hatchery operations that encountered high mortality.

3 Estimate (Wallis, 1960)

Many of the key events or developments that occurred in and outside the basin before 1900 are recapped below. Together, these events provide a snapshot of activities that caused salmon and steelhead runs in the Clackamas basin to enter a period of decline.

Key Events and Developments Before 1900	
1700	Explorations and settlement by early people and Clackamas Indians.
1806	Lewis and Clark and other early Euroamericans explore basin.
1820	Timber harvest in lower basin begins.
1840	Barlow Road brings new settlers to area, lower basin population grows with demand for resources.
1856	Steamboat operations begin on Willamette River
1868	Dam built on Clackamas River, frequently prevents salmon migration.
1873	Commercial harvest for spring chinook peaks on Columbia River.
1875	Livingston Stone explores Columbia River for U.S. Fish Commission and selects Clackamas as most suitable spot for hatchery.
1876	Salmon and steelhead runs in Clackamas drop sharply. Cannery personnel form Oregon and Washington Fish Propagating Company and begin developing a hatchery on the Clackamas River near Clear Creek.
1876	Salmon harvest heavy at mouth of Clackamas River, both traps and nets used.
1877	Hatchery on Clackamas at mouth of Clear Creek begins operating.
1877	Over 1,000 drift nets on Columbia River, each about 1,200 feet long.
1878	Commercial gear regulations first adopted for Columbia River fisheries.
1880	Hatchery operations at station near Clear Creek stopped after nearly three million eggs taken.
1887	Hatchery operations near Clear Creek resume.
1888	Over 4.5 million eggs taken at hatchery near Clear Creek.
1889	Dam on Clackamas below Gladstone continues to block some salmon migration. Fish propagators move some racks below dam to catch hatchery brood stock.
1893	Willamette Bridge Railway Company begins operating electric railroad service between Portland and Oregon City — the first interurban electric railroad in the United States.
1893	About 12,000 spring chinook caught by gillnets in lower Clackamas River.
1895	Fish propagators build fish ladder at Gladstone Dam to restore passage.
1895	About 82 commercial parties fishing for salmon on Clackamas and Willamette.
1895	Fish propagators build hatchery at headwaters of Clackamas River. Site believed to be spawning ground of earliest chinook run.
1897	About 5,045,000 eggs taken from 2,250 salmon at Upper Clackamas station racks after part of the run escaped during high water.
1896	Hatchery at Clear Creek operated with eggs from Clackamas River, California Michigan and Salmon River, a Sandy River tributary.
1899	Few fish caught at lower station. Eggs bought from Oldenburg at 40 cents/1,000.

SALMON AND STEELHEAD RUNS, 1900 TO 1940

INTRODUCTION

Salmon and steelhead runs to the Clackamas River in 1900 — though below historic levels — remained substantial compared to the size of present day runs. While information on run size is limited, hatchery and harvest records suggest that large runs of salmon and steelhead still returned to the Clackamas River. Gillnetters caught about 12,000 adult spring chinook on the lower Clackamas in 1893. Hatchery egg collectors also regularly saw large adult returns. In 1897, hatchery operators collected 1,672,275 chinook eggs from the lower Clackamas near Clear Creek and another 5,045,000 eggs from the upper river.

The resilience of these runs was further tested after the turn of the century. Activities in the basin — including timber harvest, road building, agriculture and other uses — continued to escalate in the lower basin and slowly began to spread into parts of the upper basin. The building and operating of the Cazadero and River Mill hydroelectric projects on the Clackamas River in the early 1900s also affected the basin's anadromous fish runs. While the dams were equipped with ladders, they were usually blocked to capture fish for eggs. The ladders were also damaged repeatedly by high flows and needed regular repair. These factors limited fish migration to the upper basin. Then, in 1917 the ladder at Cazadero Dam was allowed to completely deteriorate after suffering extensive flood damage. Natural fish production was further reduced by hatchery egg collections immediately below the dams until 1940. In addition, fish harvest remained heavy during much of the period.

Growth and development along the lower Willamette River further affected Clackamas River salmon and steelhead runs. By the early 1920s, the Willamette River had become the dumping ground for untreated waste from all industries and municipalities along the river — with pulp and paper mills producing much of the waste pollution. Consequently, pollution in the Willamette River reached alarmingly high levels. By the time the river reached the Portland harbor area it was extensively polluted (Gleeson 1972).

FISH PRODUCTION

Hatchery efforts grew after the turn of the century. The programs continued to focus primarily on spring chinook production, but some steelhead and coho were also raised at the facilities. For instance, production at River Mill Hatchery included about 493,000 steelhead in 1918 and 637,000 coho in 1914 (Table 3).

Table 3. Chinook Egg-Takes at Clackamas River Hatcheries from 1900 to 1940 (Wallis 1960).

Year	Lower Clackamas	Upper Clackamas	Cazadero/River Mill
1900	1,725,000	2,607,000	
1901	10,018,000	5,104,000	
1902	8,610,000	1,454,000	
1903	10,180,000	3,334,000	
1904	3,691,000	1,297,500	
1905	no data	no data	
1906	no data	no data	
1907	no data		2,495,000
1908	2,582,000		5,431,000
1909	4,079,300		3,191,000
1910	2,376,000		1,264,000
1911	no data		382,000
1912	no data		no data
1913	no data		15,000
1914	no data		84,000
1915	no data		195,000
1916	10,002,000		77,000
1917	3,019,500		398,000
1918	10,936,500		227,000
1919	2,845,000		1,266,000
1920	1,308,000		2,080,000
1921	360,000		841,000
1922	7,636,800		857,000
1923	2,750,600		1,721,500
1924	11,005,400		2,291,000
1925	2,223,000		1,721,500
1926			689,200
1927			
1928			1,165,000
1929			570,000
1930			2,025,000
1931			2,428,000
1932			540,000
1933			
1934			1,600,000
1935			1,650,000
1936			1,035,000
1937			300,000
1938			218,000
1939			520,000

Fish culture remained more art than science in the early 1900s as hatchery operators continued to experiment with techniques and adapt them based on their successes and failures. For instance, in 1901 operators of the lower hatchery station reported heavy losses after feeding the fry canned salmon and clippings from the gauge knives used in canneries. These losses declined after they began feeding the fry liver mixed with cereal and seasoned with salt. The report also mentions that eggs incubated at the hatchery in 1901 hatched after 50 days and most were planted soon after (6,000,000 planted and 2,412,000 retained) because the hatchery lacked space for rearing. When hatchery propagators reached their capacity at the hatchery early that year, they opened the station's rack and allowed the remaining salmon to pass upstream (Carter 1901).

In 1900, propagators moved the lower Clackamas station downstream because the old site at the mouth of Clear Creek had an insufficient egg supply and poor water quality. The hatchery was moved to the present site of the Oregon Fish Commission Research Laboratory where it was operated until 1942. Hatchery records from 1901 note that personnel built a rack below the station in early August and began fishing with gillnets in late September. They continued collecting eggs until early November because of lack of space in the hatchery (Hubbard 1890-1891).

In 1904, the state transferred ownership of the upper Clackamas hatchery to the U.S. Bureau of Fisheries, giving the federal agency full control over salmon propagation in the Clackamas River Basin. The facility was abandoned in 1906 after operating for 10 years. During its years of operation, egg collection at the upper Clackamas hatchery ranged from 1.3 million to 5.1 million eggs, with more than 5 million eggs taken in two of the years.

Hatchery operations were moved again once Cazadero Dam was completed on the Clackamas River. Records show that the Cazadero fish hatchery was planned to be operational at the time the dam was completed, although a fish ladder was constructed with the dam. The hatchery was originally to be built on the right bank of the river about one mile below the dam. Instead, fish propagators built a temporary station on the left bank below the dam's wooden flume. Before a permanent facility could be developed, propagators decided to abandon the site in favor of a new station below River Mill Dam, which was under construction.

Reports from fish propagators below Cazadero Dam show that the spring chinook run was still strong at the time. They reported in 1907 that they had collected spawn from 529 female and 1,010 male spring chinook at the site below the dam. They added that their collection was hampered by the bottom morphology in the rack enclosure allowing about one-third of the fish to spawn naturally within the

confines of the racks (Oregon Department of Fisheries 1909). Thus, about 2,309 spring chinook were taken at Cazadero Dam in 1907. This is a large number considering the river had been racked for hatchery egg collection since the late 1800s. From 1907 to 1911, more than 12.5 million salmon eggs were taken below Cazadero Dam.

In 1911, fish propagators moved the hatchery and egg-taking operations from the Cazadero site to one immediately below the newly constructed River Mill Dam. Hatchery construction coincided with the building of the dam. During construction of River Mill Dam, the Bureau of Fisheries asked the Oregon Water Power and Railway Company, Portland General Electric's predecessor, to place a pipe in the dam's bulkhead to supply water for the hatchery. Eggs were taken at this site below River Mill Dam from 1913 through 1939, when the hatchery was abandoned. Many eggs taken after 1935 were transferred to other hatcheries (Wallis 1960).

The Clackamas Hatchery continued to operate at the present site of the Oregon Fish Commission Research Laboratory until 1942. Eggs for the hatchery were collected on the Clackamas near the hatchery site and from below River Mill Dam. Eggs were also transferred in from as far away as Butte Creek and Battle Creek in California and the McKenzie River in Oregon. Releases of all races, local and foreign, were made directly into the Clackamas River.

In 1936, the U.S. Fish and Wildlife Service established a hatchery on Delph Creek, a tributary to Eagle Creek, on property that had previously been used for a state trout hatchery. The hatchery raised mainly spring chinook to rebuild the run in Eagle Creek. Some coho and steelhead were also reared at the facility.

FISH PASSAGE

Despite the dams, egg-taking operations, fish harvest, and habitat degradation, salmon and steelhead periodically passed over the dams to upriver habitat until 1917. Weirs and traps regularly washed out during floods or high flows and were not reinstalled until many fish had passed. For instance, correspondence shows that following a flood during the winter of 1909-1910 the company and Master Fish Warden agreed to postpone making fish ladder repairs until summer when high flows receded. This suggests that some fish were allowed to escape over the ladder that year. In 1917, the fish ladder at Cazadero suffered comprehensive damage during high flows. The company decided to let the ladder deteriorate since egg-take operations prevented salmon from ascending the stream.

Between 1917 and 1939 when the ladder was repaired, some steelhead and salmon continued to escape

over River Mill Dam. According to records from about 1930, fish that reached the River Mill Dam tailrace before it was racked would negotiate the ladder. Portland General Electric correspondence in 1930 mentions that a considerable number of steelhead had been seen going up the ladder at River Mill Dam. The author reported that, while some fish went as far as Cazadero Dam, a greater number were scattered between the dam and powerhouse where they spawned each year. Records over the years also show that managers sometimes opened the ladder rack to allow fish to pass upstream. Fish are not believed to have passed above Cazadero Dam after the ladder washed out in 1917 (Eicher 1977).

Charles Mack, a longtime Gladstone resident who fished the Clackamas River until the early 1940s, recalls strong runs of spring chinook in the lower Clackamas through the late 1930s. In 1939 he caught 68 spring chinook on the lower Clackamas, with each fish averaging about 19 pounds. He saw very few coho salmon or steelhead while fishing the river. He remembers that in the mid- to late-1930s few spring chinook escaped over the fish ladder at River Mill and large numbers of would-be spawners collected at the foot of the dam (Mack, personal communication 1998).

Public sentiment about the lack of passage over the dams was mixed. For instance, a 1921 letter to the editor of *The Oregonian* complained about lack of fish passage on the Clackamas River. The letter drew a response from the editor of the editorial page who wrote that the "concrete fishway built into the dam at River Mill is said to be one of the best in the Country" and that "there was formerly a fish ladder at Cazadero, but it washed out and has not yet been rebuilt. The law requires owners of dams to maintain fishways (Eicher 1977).

Poor water quality in the Willamette River influenced decisions about improving fish passage to the upper Clackamas River. By the 1920s, growing pollution in the Willamette River began to reduce the amount of dissolved oxygen in the river. By the mid-1920s, the dissolved oxygen content in the Portland harbor fell below the level of five parts per million (ppm) — the minimum level needed to support healthy fish. Water quality dropped below this level during the months of July, August and September in each year, and often from June into October. In 1929, the oxygen content in the Willamette River was measured at 3.9 ppm at the Sellwood Bridge and was likely completely exhausted through the Portland harbor area. It reached less than 0.5 ppm near the confluence of the Willamette and Columbia rivers (Gleeson 1972). These low oxygen levels influenced the health and survival of fish in the river — including fish destined for the Clackamas River. The situation prompted fish managers to suggest that pollution of the Willamette River in late summer was an important contributor to the decline of fall chinook when the run dropped in 1928 (USFWS 1950). The fear that poor water quality in the Willamette River was influencing salmon production in the Clackamas influenced management decisions for further hatchery production, including egg collection from the

Clackamas below the dams.

During the 1930s, interest grew in Clackamas County for the rebuilding of fish ladders over Cazadero and River Mill dams. In 1936, the Clackamas County Planning Commission petitioned the Oregon Fish Commission to sue Portland General Electric to build new ladders over Oak Grove and Cazadero dams and to improve the fish ladder at River Mill Dam. This action generated discussions between representatives of Portland General Electric, the Clackamas County Planning Department, U.S. Bureau of Fisheries, Commercial Fishermen's Protective Unions, and the state fish and game commissions. Generally, during the discussions, staff with the state fish commission and commercial fishermen's union expressed satisfaction with the present situation of racking the river at the dam for spawn, while the representative from the game commission questioned whether a certain number of salmon should be allowed to ascend upriver.

On August 3, 1936, Fred Foster, Regional Director of the U.S. Bureau of Fisheries, sent a letter to Lew Wallace, chair of the Oregon State Game Department. As shown, the letter discussed the situation and proposed a solution to the problem.

"As you know, our Bureau has collected eggs from the spring chinook run at River Mill Dam for a good many years. The procedure has been to block the ladder so that the fish at the dam cannot ascend and then to net and spawn them as they become ripe. The eggs are then taken to our Clackamas hatchery where they are hatched and the young fish reared to an age suitable for liberation below the dam. There are certain serious difficulties, such as trouble in removing the ripe fish from the impounded school below the dam, attendant to this routing which have led me to question its efficiency. This is particularly true when we consider that the run remained at the rather low level of from 1,500 to 2,000 adult spawners for a good many years.

Therefore, I was particularly pleased when our Bureau was able to secure the Delph Creek Hatchery because it gave us an opportunity to establish a program of artificial propagation, which we hope will be a distinct forward step in improving the run of spring chinook in the Clackamas. Our plan is briefly this. We propose to take the eggs from our collection to the Delph Creek and Clackamas stations. As soon as the young fry are old enough for safe transportation, all of them will be taken from the Clackamas station to Delph Creek where all of the young fish will be held and reared until they are of proper age for liberation. They will all be liberated in Delph Creek at that time.

Because of the well known homing instincts of chinook salmon, it is expected that these fish will return as adults to Eagle and Delph creeks. We can then rack Eagle Creek and hold our fish and take our eggs at that location more easily and efficiently than below the dam as at present. You will, of course, note that this plan amounts to a transfer of the chinook run from its present return location to that of Eagle and Delph creeks.

Since the run reaching the dam numbers only some 1,500 to 2,000 spawners, it is obvious that we cannot carry on our proposed program and at the same time permit enough spawners to ascend the

dams to have any material effect on naturally restocking the upper reaches of the Clackamas. In view of these facts, I would propose the following program, which is briefly, that our Bureau continue to take the eggs from the fish returning to the dam for the next four or five years and liberate the resulting fingerlings in Delph Creek. At the end of that period we should have our run established on Eagle and Delph Creeks and will be able to carry on our operations as planned.

In the meantime, it should be possible for you to secure spring chinook from your state sources, and to plant them in the headwaters of the river each year. These fish will return at the end of four years and at the same time that we will have established our run at Delph Creek, yours will have salmon returning from your plantings. We could then discontinue our egg-taking operations at the dam and let your run pass on to the upper river unhindered. In this way we can both accomplish our desired programs without hindrance."

Records suggest this plan was carried out. In 1936, all hatchery spring chinook releases were made in Delph Creek. The state game commission also stocked salmon and steelhead in the upper Clackamas River during the year. Propagators continued to place racks in the Clackamas below the River Mill powerhouse through 1939 to catch chinook (Eicher 1977).

Newspaper articles during the period show support for rebuilding salmon and steelhead runs in the upper Clackamas system and low tolerance for egg-taking operations. For instance, an article from *The Oregonian*, January 14, 1940, states that the state fish commission had opposed the building of the fishway ladders and may now prevent its use. They declare that "the people who secured the erection of these ladders will not tolerate the taking of eggs from salmon runs in the Clackamas River" (*The Oregonian* 1940).

In 1939, Portland General Electric completed construction of the new Cazadero ladder and modifications at River Mill Dam. The Bureau of Fisheries removed their racks from below River Mill Dam in January 1940 and fish passage to habitats above the dam was reopened.

SUMMARY

Salmon and steelhead populations in the Clackamas River Basin continued to fall through the early 1900s and reach low levels by 1939. The Clackamas River Basin saw many changes between 1900 and 1940. According to Fred Foster, U.S. Bureau of Fisheries Regional Director in 1936, the spring chinook runs had averaged between 1,500 and 2,000 spawners "for a good many years". Harvest and hatchery egg-take records also show a decline.

In many ways, the decline of salmon and steelhead production was linked to the area's growth in population and the subsequent demand for more timber, power, salmon and other resources. Key events that shaped conditions in the Clackamas basin during this time are recapped below.

Key Events and Developments from 1900 to 1940	
1900	Clackamas hatchery moved downstream because of insufficient egg supply and poor water quality at the old site.
1901	Hatchery operators report problems finding appropriate fish food, causing heavy losses. They also make early releases due to lack of rearing space.
1902	Timber harvest in lower basin continues to grow. Hatchery staff report seeing about 2,000 cords being floated down Clackamas River.
1902	Oregon Water, Power and Railway Co. starts work on Cazadero Dam.
1904	Plat for town of Estacada filed.
1904	More than 100,000 cords of wood hauled to Portland on Estacada line.
1906	Upper Clackamas hatchery abandoned.
1907	Cazadero Dam begins operating, complete with a wooden fish ladder.
1907	Hatchery and egg-taking operations initiated below Cazadero Dam. From 1907 to 1911, more than 12.5 million salmon eggs taken below the dam.
1907	Site investigations started for North Fork Dam.
1908	Railroad extended from Cazadero to North Fork Dam site.
1908	Only five or six commercial operators still fishing on Clackamas River.
1909	Work begins on River Mill Dam.
1910	Seasons designated for commercial fishing on Clackamas.
1911	River Mill Dam completed, includes a concrete fish ladder.
1911	Fish propagators move hatchery and egg-taking operations from a site below Cazadero to site below River Mill Dam fish ladder.
1917	Fish ladder at Cazadero Dam suffers extensive damage in flood and is not rebuilt due to egg-taking operations below the dam.
1917	Production at Clackamas Hatchery continues with eggs from stations on the Clackamas and from other areas.
1920	One half commercial catch of chinook on Columbia River are fall race.
1920	Forest Service builds roads to upper basin, including the Skyline Road.
1929	Water pollution in Willamette River begins to affect fish health/survival.
1936	Federal fish managers establish hatchery on Delph Creek and try to move chinook production from lower Clackamas to Eagle and Delph creeks.
1936	U.S. Bureau of Fisheries regional director writes that the spring chinook runs had averaged between 1,500 and 2,000 spawners "for a good many years."
1939	PGE rebuilds Faraday Dam ladder and modifies River Mill ladder.
1939	Five year program to transfer spring chinook runs to Delph Creek ends.
1939	Dam operators recall that large salmon runs no longer arrive at River Mill.
1940	Bureau of Fisheries stopped collection of chinook eggs at River Mill Dam. Egg-taking transferred to the Eagle Creek Hatchery.
1940	Passage to upper Clackamas above River Mill and Cazadero dams reopened.

SALMON AND STEELHEAD RUNS, 1940 TO PRESENT

INTRODUCTION

Two developments significantly affected Clackamas River salmon and steelhead runs in 1940. In 1939, the fish ladders at Faraday and River Mill dams were rebuilt, restoring passage to historic spawning and rearing habitat in the upper Clackamas River Basin. At the same time, fish propagators reduced their egg-taking operations on the Clackamas River considerably. Together, these developments ended a long period of near denial of fish to upriver spawning and rearing grounds that had seriously reduced natural fish production in the basin. Other improvements at the dams over the years further improved fish production in the Clackamas River Basin. Fish passage facilities included with North Fork Dam improved both upstream and downstream migration, though some downstream migrants bypassed the facilities in favor of the spillway.

The rebuilding of salmon and steelhead runs was met by the expansion of activities in the upper basin. Road construction accelerated in the 1940s and then took off. By 1969 about 60 percent of the upper basin's existing road network had been established. Timber harvest quickly followed the building of new roads and vast quantities of timber were harvested. Between 1950 and 1994, timber was harvested on more than 29 percent of the upper Clackamas watershed. These practices significantly reduced habitat quality in many parts of the upper basin.

Fishing pressure continued to affect the runs. While commercial fishing on the Clackamas and Willamette rivers dropped after 1950, harvest on the ocean and Columbia River began to climb again in the 1950s as declining wild runs were replaced by hatchery production. Sport fishing also increased.

Salmon and steelhead destined for the Clackamas were further affected by increasing development along the lower Willamette River. Water quality in the Willamette declined through the 1950s, despite steps initiated to reduce pollution. In 1950, the river's oxygen content had fallen to 3.6 parts per million (ppm) at Willamette Falls and to zero at the Portland Harbor (Gleeson 1972). A stream supporting healthy fish needs an oxygen content of at least 5 ppm. Water quality in the Willamette improved in the late 1960s as communities along the river adopted new ways to treat their waste. In this low water year, the river met water quality standards at all sample points above Newberg, Oregon.

FISH PRODUCTION

Records show that salmon and steelhead began returning to the upper Clackamas River soon after passage was restored at the dams. A December 19, 1939 article in the *Banner-Courier*, an Oregon City newspaper, reported that the fish had been seen going over the dam's ladder in good shape. According to workers at Cazadero Dam, the fish had appeared some days before and continued to go over and into the upper reaches of the Clackamas. The article suggests that the appearance of the fish (not battered) showed that they also mounted the River Mill Dam without trouble (*Banner-Courier 1939)*.

By the 1950s, the runs had begun to rebuild mostly through natural production. Counts conducted by the U.S. Fish and Wildlife Service for five years beginning in 1950 show this improvement. The counts were gathered through use of a trap in the River Mill Dam fish ladder exit. During the period, the coho numbered 416, 741, 1,378, 1,122, and 1,155 consecutively for an average of 962 fish. Steelhead counts totaled 1,484, 1,954, 1,559, 1,616, and 950 for an average of 1,513 fish. Chinook counts totaled 366, 496, 668, 533, and 407, respectively, for an average of 494 fish. No apparent artificial production programs were initiated for steelhead and coho during this time.

The strength of the steelhead, and to a lesser extent coho, runs suggest that these stocks may have been less damaged by the long period of denial to upstream habitat. They were not taken from the stream as often as were chinook and periodically escaped past River Mill Dam to spawn. Before 1917, when the ladder at Cazadero suffered deteriorating damage from floods, it is likely that steelhead and coho sometimes escaped to upriver habitat. Thus, they may have attained the upper hand over chinook in competition for upriver spawning and rearing grounds after passage was allowed. Also, harvest and hatchery efforts continued to focus on spring chinook after 1940. By 1964, steelhead and coho runs had improved to maximums of more than 4,000 and 3,000 fish, respectively, with little help from hatchery stocking. Chinook runs increased very little during the period (Eicher 1977).

Fish propagators continued to supplement low natural spring chinook runs through hatchery production. In 1940, hatchery operators moved their operations from River Mill Dam to a hatchery on Delph Creek, an Eagle Creek tributary. From 1942 to 1954, spring chinook eggs were taken from Eagle Creek and from the Clackamas River just below the mouth of Eagle Creek to support production at the facility. Hatchery operators also took a few coho eggs in 1946 and 1947, and steelhead eggs were taken in 1947 (Wallis 1960). During this period, hatchery propagators collected about 1.3 million salmon eggs from the Clackamas River for the hatchery (Table 4) (Wallis 1960). The hatchery facility was abandoned in 1955.

In 1957, the Fish and Wildlife Service started operating a hatchery on Eagle Creek. They raised spring chinook and released them into the Clackamas River Basin. According to one avid fisherman in the late 1950s, Earl Freeman, the spring chinook run improved after this hatchery began releasing fish into the Clackamas River. He recalls one week when he and his father caught 12 spring chinook, weighing about 30 pounds each (Freeman, personal communication 1998). Eagle Creek Hatchery is still used for production today.

Table 4. Chinook Egg-Takes at Clackamas River Hatcheries Since 1940 (Wallis 1960).

Year	River Mill Dam	Delph Creek Hatchery
1940		
1941		
1942		141,800
1943		152,800
1944		32,876
1945		126,500
1946		494,500
1947		10,000
1948		60,000
1949		13,000
1950		157,500
1951		57,500
1952		34,300
1953		22,000
1954		

Along with an increase in hatchery production came an increase in hatchery fish health and survival in the late 1950s and early 1960s. As hatchery operators learned more about fish culture, they began feeding fish better diets and improved fish rearing and release strategies. They also learned more about disease prevention and treatment. As a result, hatchery fish were healthier and had a better chance of surviving than those released in the early 1900s.

Salmon and steelhead reared at other hatcheries were also released into the Clackamas River Basin at this time to support an increasing number of sport anglers. Fish managers released tule fall chinook in the drainage from 1952 to 1981. They started releasing summer steelhead in the Clackamas River in 1968. Coho releases also began in the 1960s.

The spring chinook run improved significantly in the 1980s after the startup of an aggressive hatchery program. The Clackamas Hatchery at McIver State Park (RM 23) on the Clackamas River, began production in 1980. Before this time, the run was made up of hatchery fish from Eagle Creek Hatchery and a remnant population of about 530 native fish that spawned above North Fork Dam. The hatchery, operated by the

Oregon Department of Fish and Wildlife, has been used primarily for spring chinook production. Winter steelhead have also been produced at the facility since 1986.

CURRENT RUNS

Today, the Clackamas continues to be an important producer of salmon, steelhead and resident fish (ODFW 1992). It is the heaviest producer of anadromous fish in the Mt. Hood National Forest, providing 142 miles of habitat. Besides the remaining wild runs, several new fish stocks, including a summer steelhead run, have been introduced to the basin over the years to provide more harvest opportunity. The basin also supports strong resident trout populations. Current salmon, steelhead and resident fish populations in the basin are discussed below.

Spring Chinook

The Clackamas supports both naturally and hatchery produced spring chinook. Since 1980 — the first year of substantial adult returns from releases at Clackamas Hatchery — passage at North Fork fish ladder has increased substantially, reaching an annual average of 3,700 in 1990-1993. Biologists estimated that about 60-85 percent of the fish in this run were hatchery fish. In 1995, about 24 percent of the spring chinook run entering the Willamette River returned to the Clackamas.

Presently, the native spring chinook run to the Clackamas has been proposed for Threatened species status by the National Marine Fisheries Service. The size of this native run is unknown as the river has been steadily supplemented with spring chinook from the Clackamas Hatchery since the late 1970s.

Spring chinook spawn and rear in both the lower and upper parts of the Clackamas drainage. Spawning occurs between mid-September and early October. In the lower drainage, adults spawn in Eagle Creek, below River Mill Dam and between River Mill and Faraday Diversion dams. In the upper drainage, adults spawn in the mainstem from the head of North Fork Reservoir upstream to Big Bottom (RM 64 to RM 68), in the Collawash River, Hot Springs Fork of the Collawash River, lower Fish Creek and Roaring River. Currently, several spawning areas such as Big Bottom, which contains some of the highest quality spawning habitat in the subbasin, and the Hot Springs Fork may be underutilized.

Fall Chinook

The fall chinook run is currently supported through natural production. The run usually spawns and rears in the lower mainstem below River Mill Dam and in the lower reaches of Clear Creek. Fish managers believe the run is a remnant population of tule stock that was first released in the Clackamas basin in 1952. It may also include fall chinook from other Willamette River tributaries that strayed into the Clackamas. No fall chinook have been released in the basin since 1981.

Surveys suggest that an estimated run of 840 fall chinook adults returned annually to the Clackamas River from 1981 to 1991. However, this figure may be inflated since some spring chinook spawn in the same areas and at the same time as the fall chinook, and may have been mistaken for fall chinook. Some concern exists that the fall chinook may be interbreeding with spring chinook in the lower Clackamas. Information on the run is limited since it does not pass through a counting station before entering the Clackamas River and does not go above River Mill Dam where counting facilities exist.

Coho Salmon

The Clackamas system supports two coho stocks, an early run and a late run. The early run, which returns to the basin in August and September, is created through hatchery releases. Many of these fish return to Eagle Creek Hatchery. The basin also supports a self-sustaining early run of coho. These fish are the offspring of hatchery fish released during the 1960s and 1970s.

Wild fish make up the late run of coho. This run is the last remaining wild coho stock that sustains a substantial run to the Columbia River Basin. The wild run enters the Clackamas River from November to January. A radio tracking study conducted from 1989 through 1991 showed that more than 80 percent of the tagged fish spawned relatively close to the release site at the upper end of the North Fork Reservoir (Cramer and Merritt 1991). Today, the number of late run coho returning to the basin fluctuates widely. From 1961 to 1996, the number ranged from 50 to 3,314 fish. The average late run of coho numbered 1,047 fish from 1986-1987 through 1995-1996. It dropped to a record low in the 1993-1994 migration when only 50 late run fish were recorded at North Fork Dam (Massey and Keely 1996).

Many wild coho destined for the Clackamas have been caught in mixed-stock fisheries managed for hatchery stocks. Commercial harvest rates for ocean and Columbia River fisheries on Clackamas River late-run coho have been as high as 80 percent in recent years and exceeded 90 percent in the early 1970s (Cramer and Merritt 1991).

Winter Steelhead

The Clackamas basin supports a native winter steelhead run and two hatchery-reared stocks. The hatchery fish are released in the lower river below River Mill Dam and create an early run of winter steelhead. The native run returns to the basin in January, a few months after the hatchery-reared fish. The native run has naturally re-established itself in the upper basin.

Winter steelhead occupy more of the basin than either spring chinook or coho salmon. They also use more

diverse habitat types. Juvenile steelhead often prefer faster water than salmon and will migrate high into steep and fast-flowing stream reaches. Production of steelhead smolts is closely related to the amount and quality of large pools. Primary spawning areas in the upper basin include the mainstem of the Clackamas River; Oak Grove, North and Hot Springs forks of the Clackamas; Roaring and Collawash rivers; and Fish Creek.

After rebuilding for many years following the reopening of passage to the upper basin, the native run appears to be declining based on information collected from a photographic counter in the North Fork ladder. The counter records each fish passing through the ladder and is believed to provide the best index of run size for the native stock. Dam records show that from 1964 to 1973 approximately 2,000 wild winter steelhead passed North Fork Dam annually. From 1977 to 1988, the run dropped to about 1,600 adult winter steelhead annually (primarily wild fish, but with some hatchery fish). In 1991, only 837 fish were counted at the dam, the lowest number since 1973. The run rebounded briefly in 1992 when the count rose to 2,107 fish, the highest number in several years. Since then it has fallen steadily. The number of winter steelhead counted passing the dam dropped to 1,352 fish in 1993 and to 1,247 fish in 1994. Counts in recent years show a continuing decline in winter steelhead passage, with the number falling to 1,146, 325 and 530 fish in 1995, 1996 and 1997, respectively.

Recently, several actions have been carried out to restore the wild winter steelhead run. Each spring, about 40 wild adults are collected at the North Fork ladder to produce approximately 40,000 smolts. Early rearing occurs at the Clackamas Hatchery, followed by accelerated rearing in the warm water at Oak Springs Hatchery. The wild winter steelhead are raised at Oak Springs through the winter and then transferred to the Clackamas for release in the spring.

Fish managers have also changed harvest regulations in the basin to protect wild fish. These steps were taken after surveys showed that about 30 percent of the steelhead harvested from December to March are wild. In 1992, a late trout season was established for the entire Clackamas system. Managers also adopted a catch-and-release regulation for all unmarked adult steelhead on the Clackamas system. There are no commercial or tribal fisheries in the Clackamas system.

Summer Steelhead

Summer steelhead releases began in 1968 and provide angling opportunities within the basin from March through December. From 1981 to 1990, about 162,500 summer steelhead smolts were released annually into the subbasin from Gnat Creek Hatchery. About 75,500 pre-smolts were also released in the subbasin during three of the years. Through 1997, most summer steelhead were released in the upper subbasin.

The summer steelhead fishery in the Clackamas is extremely popular. Most of the harvest occurs in the mainstem above North Fork Dam and in the lower Clackamas. Limited fishing also occurs in the Collawash River and in Hot Springs Fork. The annual sport catch from 1985 through 1990 averaged 7,013 fish. Summer steelhead are popular with anglers because they bite well and have a reputation for being good fighters. They also have a long period of adult freshwater residency and hold their condition (brightness).

Concern exists that some summer steelhead are reproducing naturally in the upper basin. This production is not wanted as the hatchery-reared summer steelhead may compete with wild winter steelhead and coho for habitat. Nevertheless, records show that the number of naturally produced juvenile steelhead passing the Clackamas River dams has doubled since hatchery summer steelhead smolts releases began. To address these concerns, beginning in 1998 summer steelhead releases are restricted to below River Mill Dam.

Resident Fish

The Clackamas River Basin supports one of the largest trout fisheries in Oregon (ODFW 1992). It contains cutthroat trout, kokanee, rainbow trout, brook trout, brown trout, mountain whitefish, and possibly bull trout. Bull trout, cutthroat, rainbow and mountain whitefish are known to be indigenous to the basin. The other species have been introduced over the years.

Early settlers reported excellent trout fishing on the Clackamas. The stocks, however, were over-harvested as new road development improved access to the river. As a result, hatchery releases have been used for many years to supplement wild trout production and support harvest. W.L. Sharp wrote in 1936 that the Oregon State Game Commission regularly liberated large numbers of fingerling trout in the Clackamas River and tributaries above Cazadero Dam. These included a release in September 1935 of 175,000 fingerling rainbow trout in the Clackamas River near the Oak Grove Ranger Station and above the dam on the Oak Grove Fork (Sharp 1936).

The lower, middle and upper reaches of the Clackamas drainage each contain different habitat conditions and resident fish populations. Below River Mill Dam, the river supports primarily cutthroat and rainbow trout. Cutthroat reside in the Clackamas River during fall and winter months and migrate to the Willamette and Columbia rivers in the spring (ODFW 1992).

The middle reach of the Clackamas, from River Mill Dam to the head of the North Fork Reservoir, contains Estacada Lake, Faraday Lake, Faraday Reservoir and the North Fork Reservoir, all part of the Portland General Electric North Fork hydroelectric complex. The 1.5-mile stretch between Faraday Dam and the head

of Estacada Lake is the only free-flowing part of the reach. Fishing pressure is heaviest on the reservoirs and on Estacada and Faraday lakes where anglers catch large number of stocked hatchery trout and a few wild rainbow and cutthroat. The small free-flowing section of river also supports rainbow and cutthroat trout.

The upper Clackamas River from the head of North Fork Reservoir to the headwaters contains an abundance of spawning habitat and consistent, cool streamflows that provide good habitat for resident trout populations. These populations include wild rainbow, wild and hatchery cutthroat, brown, brook and possibly bull trout. Fish managers also release hatchery rainbow trout below RM 70. Most trout fishing in the basin occurs along these upper reaches. A survey conducted in 1988 suggested that over 35,000 anglers days were expended during the first month of the season in the reach. Harvest included more than 16,000 trout.

Tributaries in the upper and middle reaches of the Clackamas, including the North Fork, South Fork, Fish Creek, Roaring River, Oak Grove Fork and the Collawash, support good trout production. The tributaries provide a popular trout fishery. They often contain good spawning habitat and water quality for rainbow and cutthroat trout, and some brook and brown trout production. The tributaries may also support some bull trout production, though the fish have not been observed for several years. Some trout production also occurs in lower river tributaries, such as Clear Creek, Deep Creek, Rock Creek and Eagle Creek.

Stream reaches above barriers to anadromous fish provide isolated habitat for wild rainbow and cutthroat trout, and possibly some brook, brown and bull trout. Hatchery fish are not generally stocked in these areas. Fish within the upriver areas are generally smaller. The high mountain reaches usually attract anglers who want isolation and an opportunity to catch wild trout.

SUMMARY

Over the last 150 years, Clackamas River salmon and steelhead runs have persevered despite developments that severely restricted their migration and production. Their fall became noticeable by the late 1870s after spring chinook runs in the Columbia River declined due to overharvest. This drop in harvest led cannery personnel in the Pacific Northwest to start experimenting with fish culture as a means to improve the runs. The first hatchery in the Columbia River Basin began operating on the Clackamas River in 1877.

The runs continued to fall through the early 1900s, and by 1936 the basin's spring chinook run averaged between 1,500 and 2,000 spawners. As discussed throughout this document, many factors influenced this decline in salmon and steelhead production over the years. Before 1900, egg-takes linked to hatchery operations began collecting all possible would-be-spawners as brood stock. In addition, timber harvest and other developments in the lower basin — including construction of a dam across the lower Clackamas River

by 1868 — degraded habitat conditions and restricted fish migration to upriver spawning and rearing grounds. After 1900, salmon and steelhead production and migration were further confined by the development of several hydroelectric facilities. With egg-take operations, these facilities blocked fish passage to spawning and rearing areas above Estacada. The fish runs were also hit hard by fishing pressure during this time, including rampant illegal gillnetting on the lower Clackamas River.

In 1940, salmon and steelhead in the basin began to rebuild after regaining access to historical spawning and rearing habitat in the upper basin. During the ensuing years, several developments influenced efforts to rebuild the runs. Some developments — such as better techniques for rearing and releasing hatchery fish, improved fish passage at the dams, and regulations on fish harvest — enhanced salmon and steelhead production and survival. Other developments — such as escalating road construction and timber harvest in the upper basin, and gravel mining in the Clackamas River — caused new habitat degradation. Many of these practices, however, have also improved in recent years.

Today, while the runs are far below historic levels, the Clackamas River Basin remains an important producer of salmon, steelhead and resident fish. The basin supports native populations of spring chinook, late run coho, late winter steelhead, resident trout, cutthroat trout and bull trout. Large numbers of hatchery fish have been released in the basin since the 1950s and 1960s. These introduced populations include spring chinook, fall chinook, early run coho, winter steelhead and summer steelhead. Continuous efforts are under way to improve the native runs while maintaining popular sport fishing opportunities in the basin. Fish production and habitat managers are constantly working to protect and restore habitat, improve fish passage, and reduce interbreeding and competition between native and introduced stocks.

Key events that influenced the basin's salmon and steelhead runs after 1940 are shown below:

Key Events and Developments from 1940 to Present	
1940	Salmon and steelhead passage to upper basin reopened.
1940	Hatchery propagators remove egg-taking station below River Mill Dam and move activities to Delph Creek, an Eagle Creek tributary.
1940	Road construction in upper Clackamas basin intensifies.
1948	Region faces shortage of energy to meet growing demands.
1950	Pollution in Willamette River increases. Oxygen content in river drops below 3.6 ppm at Willamette Falls and to zero in Portland Harbor.
1950	Commercial fishing banned on Clackamas and Willamette rivers. Clackamas fish contribute to off-shore troll fisheries and commercial fishing on Columbia River.
1950	Salmon and steelhead runs show progress in rebuilding naturally.
1950	Road construction and timber harvest increase in upper basin. Extension of forest road 46 results in the realigning and straightening of Clackamas River.
1952	Portland General Electric initiates investigations for new projects on Oak Grove Fork leading to creation of Frog Lake forebay and dam at Timothy Meadows.
1954	Investigations begin for North Fork project.
1956	Dam on Oak Grove Fork completed, forming Timothy Lake.
1957	Fish production begins at Eagle Creek Hatchery.
1958	North Fork Hydroelectric project completed with extensive fish passage facilities.
1960	Building of 210.7 miles of additional road in upper Clackamas Basin begins.
1964	Steelhead and coho runs improve to maximums of over 4,000 and 3,000 respectively with no hatchery stocking. Chinook runs show little improvement.
1964	Flood on Clackamas River severely damages river conditions and Cazadero Dam.
1965	Non-native winter steelhead first released in basin.
1966	Faraday Dam completed, replacing Cazadero Dam.
1966	Water quality in Willamette River improves.
1968	Fish managers begin releasing summer steelhead in Clackamas basin.
1970	Work begins on construction of additional 90 miles of road in upper watershed, and paving of many existing roads.
1970	Timber harvest in upper basin escalates. Between 1970 and 1994, about 21,000 acres of timber cut in upper Clackamas basin.
1975	Portland General Electric and state of Oregon reach formal agreement on compensation package for hydro-related fish loses in Clackamas River system.
1977	Portland General Electric and National Marine Fisheries Service begin building Clackamas Hatchery.
1980	Clackamas Hatchery completed, salmon production program begins.
1980	Fish managers end release of fall chinook in basin.
1980	Spring chinook run improves significantly due to aggressive hatchery program.
1988	Mt. Hood National Forest identifies many active landslide areas in upper basin. Most of the slide risks related to timber harvest and road construction.
1992	Measures set up to protect wild steelhead run included a late trout fishing season and catch/release limits on Clackamas for all unmarked adult steelhead.
1995	About 24 percent of spring chinook that enter Willamette River return to Clackamas.

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PERSONAL COMMUNICATIONS

Earl Freeman, long-time fisherman on the Clackamas River.
Charles Mack, long-time fisherman on the Clackamas River.