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FISH RESOURCES

OF THE

WILLAMETTE BASIN

Willamette Basin Review
Appendix D. Fish and Wildlife
Section II. Present Status

A Report to the Outline - Schedule Team
of the
Willamette Basin Task Force

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PREFACE

This report was written by the authors with input data and invaluable editorial assistance from various members of the Fish and Wildlife Appendix Committee. The General section was prepared by Charles Simmons, Chairman, Fish & Wildlife Appendix Committee.

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00. GENERAL

Background Studies

Willamette Basin Study Area contains between 9- and 10,000 miles of streams, at least 565 named lakes, and approximately 33,000 acres of reservoirs. Its lakes range from warm water ponds to cold, mountain tarns; its streams from polluted rivers to clear brooks. Fish produced in the basin are caught not only within the basin, but in the Columbia River, along the shore of the Pacific Ocean from Alaska to California, and in Puget Sound waters. This vast mix of organisms and environments had been studied piecemeal for years, but early in Willamette Review Study biologists assigned to the investigation realized that large and critical gaps existed in the store of knowledge essential to a truly comprehensive study of the fish resources. It became apparent that neither time nor money were available with which to gather all the information that could be used. It was decided that only the most essential studies to correct critical data deficiencies could be undertaken.

One of the principal voids involved the amount of use by sport fishermen on the resident fish of the basin. Although fairly acceptable information was available on use and harvest from some local areas, no over-all assessment of fisherman use of Willamette Basin waters had ever been made. This deficiency was corrected when Bureau of Commercial Fisheries contracted with Oregon State Game Commission and Oregon State University for a study of fisherman use and harvest in the basin, using Willamette Basin Study funds. This resulted in publication in 1966 of Survey of Angler Effort in Oregon in 1965, by Lyle D. Calvin and T. D. Burnett, a contribution of the Department of Statistics of the University.

A large amount of data on fish habitat in the basin had been gathered in previous years, particularly as a result of studies by Fish Commission of

Oregon in cooperation with Bureau of Commercial Fisheries under the Columbia River Fisheries Development Program. A concentrated effort was instituted by Oregon State Game Commission, Fish Commission of Oregon and Bureau of Commercial Fisheries personnel to fill the major gaps in this data. One result of this cooperative effort was publication of A Physical Inventory of Streams in the Upper Willamette Watershed Above the Confluence of Middle and Coast Forks of the Willamette River by Kenneth E. Thompson, Oregon State Game Commission, 1964.

Use of spawning habitat in the basin, particularly by coho salmon and steelhead trout, was imperfectly known because counts of the escapement of these species over Willamette Falls could not be obtained at the fish passage facilities before the fall of 1965 and because no over-all spawning ground surveys had ever been made. Completion of part of the new facilities at the falls in time for fall, winter, and spring passage enabled practically complete counts to be made for the first time. In addition, Fish Commission of Oregon, Oregon State Game Commission and Bureau of Commercial Fisheries personnel made intensive spawning ground studies in the spring of 1966. These studies resulted in publication of Aerial Surveys for Steelhead Trout Spawning in the Willamette River Basin, by Fish Commission of Oregon, 1966 and Number and Distribution of Steelhead Trout Spawning in the Willamette Basin in 1966, by James M. Hutchison, K. E. Thompson, and G. J. Hattan, Oregon State Game Commission, 1966.

As a result of these studies, similar special studies conducted in the past, such routine investigations as creel census studies, salmon and steelhead punch card analyses and commercial fish harvest data compilations, it has been possible to assemble data with which to estimate numbers of fish, amount of fisherman use, and other basic information indicated in this section of the appendix.

Fish and Fish Habitat of Willamette Basin Study Area

Fishes of the basin and a rough approximation of their abundance are shown in Table 00.1. These fishes are discussed under four general groupings in the appendix: anadromous fish, those that spend part of their lives in the ocean but return to fresh water to spawn, including salmon, steelhead and searun cutthroat trout, eulachon, American shad, and white sturgeon; cold-water game fish, the trouts, kokanee, and mountain whitefish; warm-water game fish, the bass, catfish and panfish of the basin; nongame fish, all the rest. Both anadromous and resident races of rainbow trout (steelhead), cutthroat trout (searun cutthroat) and sockeye salmon (kokanee) occur in the basin. The lampreys, although anadromous, are usually regarded as nongame fish.

Table 00.1 Fishes of the Willamette Basin

Scientific Name	Common Name	Abundance
Petromyzontidae		
Lampetra planeri	Western brook lamprey	High
Lampetra tridentata	Pacific lamprey	High
Acipenseridae		
Acipenser transmontanus 1/	White sturgeon	Moderate
Clupeidae		
Alosa sapidissima 1/ 2/	American shad	High below Willamette Falls; low above falls
Salmonidae		
Oncorhynchus keta 1/	Chum salmon	Low
Oncorhynchus kisutch 1/	Coho salmon	Moderate
Oncorhynchus nerka 1/ 2/	Sockeye salmon or kokanee	Low
Oncorhynchus tshawytscha 1/	Spring chinook salmon	Moderate to high
Oncorhynchus tshawytscha 1/	Fall chinook salmon	Low
Prosopium williamsoni 1/	Mountain whitefish	Low to moderate
Salmo aquabonita 1/ 2/	Golden trout	Low
Salmo clarki 1/	Cutthroat trout	High
Salmo gairdneri 1/	Rainbow (steelhead) trout	Moderate
Salmo salar 1/ 2/	Atlantic salmon	Low

Table 00.1 (continued)

Scientific Name	Common Name	Abundance
Salmo trutta 1/ 2/	Brown trout	Low
Salvelinus fontinalis 1/ 2/	Brook trout	Low
Salvelinus malma 1/	Dolly Varden	Low
Salvelinus namaycush 1/ 2/	Lake trout	Low
Osmeridae		
Thaleichthys pacificus 1/	Eulachon (smelt)	High in Sandy R. some years
Cyprinidae		
Acrocheilus alutaceus	Chiselmouth	High
Carassius auratus 2/	Goldfish	Low
Cyprinus carpio 2/	Carp	High
Hybopsis crameri	Oregon chub	Low
Mylocheilus caurinus	Peamouth	Moderate
Ptychocheilus oregonensis	Northern squawfish	High
Rhinichthys cataractae	Longnose dace	High
Rhinichthys falcatus	Leopard dace	High
Rhinichthys osculus	Speckled dace	High
Richardsonius balteatus	Redside shiner	High
Tinca tinca 2/	Tench	Low
Catostomidae		
Catostomus macrocheilus	Largescale sucker	High
Pantosteus platyrhynchus	Mountain sucker	High above Corvallis; low in downstream areas
Ictaluridae		
Ictalurus melas 1/ 2/	Black bullhead	(Unauthenticated reports)
Ictalurus natalis 1/ 2/	Yellow bullhead	Moderate
Ictalurus nebulosus 1/ 2/	Brown bullhead	Moderate
Ictalurus punctatus 1/ 2/	Channel catfish	Low to moderate
Gasterosteidae		
Gasterosteus aculeatus	Threespined stickleback	High
Poeciliidae		
Gambusia affinis 2/	Mosquitofish	Low to moderate
Percopsidae		
Percopsis transmontana	Sand roller	Low to moderate

Table 00.1 (continued)

Scientific Name	Common Name	Abundance
Centrarchidae		
Chaenobryttus gulosus 1/ 2/	Warmouth	High
Lepomis gibbosus 1/ 2/	Pumpkinseed	High
Lepomis macrochirus 1/ 2/	Bluegill	High
Micropterus dolomieui 1/ 2/	Smallmouth bass	Moderate
Micropterus salmoides 1/ 2/	Largemouth bass	High
Pomoxis annularis 1/ 2/	White crappie	High
Pomoxis nigromaculatus 1/ 2/	Black crappie	High
Percidae		
Perca flavescens 1/ 2/	Yellow perch	High
Cottidae		
Cottus asper	Prickly sculpin	Low
Cottus bairdi	Mottled sculpin	Low
Cottus beldingi	Piute sculpin	Moderate
Cottus perplexus	Reticulate sculpin	Moderate
Cottus rhotheus	Torrent sculpin	Low

1/ Species defined as "game fish" in 1965-66 Oregon Game Code.
2/ Introduced species, others are indigenous to Willamette Basin.
Note: This table was constructed with the assistance of Dr. Carl E. Bond, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon. The terms "low", "moderate" and "high" refer to the relative abundance of a species as compared to the other listed species, particularly those of the same family.

The production of fish in Willamette Basin is limited by both natural and artificial factors. The amount of spawning and rearing habitat available is a finite limitation on the number of fish that can be produced naturally. The principal natural limiting factors are low stream flows and barriers, such as falls and cataracts, that impede the movements of fish. Several of the principal artificial limiting factors are similar, in a sense, to the adverse natural factors. Dams limit the movement of fish; other uses of water contribute to low stream flow conditions. Almost without exception each dam, each water diversion, each pollutant entering the basin's water, reduces production and rearing habitat for some species of fish. Contrariwise, water

development projects can frequently be operated to produce beneficial effects by modifying limiting factors. Many reservoirs produce more sport fishing (though usually of lower quality) than the stream reaches they inundate. Some species of fish, kokanee for example, require lake or reservoir habitat to survive. It has been possible to establish populations of these fish in some areas of Willamette Basin where they could not possibly live under preproject conditions. Under some circumstances reservoirs may be operated to release cold water during summer and fall when natural flows are critically low and warm. Stored water has been released in Willamette Basin to dilute pollution during periods when dissolved oxygen concentrations in the lower reaches were at extremely low levels. The flood control effects of some reservoirs have benefitted fish by reducing siltation of spawning gravel, reducing erosion of redds and stranding of young fish. Unfortunately fish enhancement is not authorized as a project purpose for any of the water development projects, constructed or authorized for construction, in Willamette Basin at the present time. This serves to severely restrict the operation of these projects to produce fishery benefits.

Fish passage facilities have been constructed at several falls and cataracts in the basin. The largest project of this kind, eliminating one of the major factors limiting anadromous fish production, was Willamette Falls Fishway. The falls had probably always restricted fish passage, particularly during low water flow periods, but a dam constructed around the lip in 1903 or 1904 blocked all passage. Efforts to provide fish passage between 1904 and 1965 were only partially successful, and large amounts of potentially good anadromous fish habitat remained unused. Between 1965 and 1967 fish passage facilities were constructed at the falls under the Columbia River Fishery Development Program of the Bureau of Commercial Fisheries in cooperation with Fish Commission of Oregon and industries at the falls. These were successful in passing fish so a major factor limiting anadromous fish production in the basin was eliminated.

The Fish Commission of Oregon, Oregon State Game Commission and U. S. Fish and Wildlife Service in anticipation of improved passage at the falls instituted a program of massive plantings of anadromous fish in the basin. This insured that runs of fish would increase at a higher rate than would naturally occur, and that runs of species heretofore blocked by the falls could be established. Table 00.2 illustrates the planting program undertaken by the fisheries agencies before passage conditions were improved.

Waters of Willamette Basin are not productive enough to furnish all the resident cold-water fish required by the sport fishery at its present level of excellence. Large numbers of trout are planted each year, mostly by Oregon State Game Commission, to partially supply the demand for sport fishing in the basin (Table 00.3).

Anadromous salmonids will be considered in greater detail in this appendix than will any of the other groups of fishes because they are the most valuable fish of the basin in terms of both commercial catch and sport fisherman use. They also have the greatest potential for increase in natural environment, are the most widely distributed, and have received the most intensive study of all the basin's fish. Both in Willamette Basin and elsewhere, natural limiting factors, water development projects, urban and industrial development and land use practices have had greater adverse effects on these than on resident species.

The spawning escapement (excluding jacks) of these fish into study area waters in the 1965-1966 season was estimated to be 43,600 coho, 36,500 spring chinook, 7,200 fall chinook and 26,000 steelhead trout. The 1965 commercial catch of anadromous salmonids produced in Willamette Basin waters, but harvested elsewhere, was estimated to be 2,983,000 pounds of fish valued at $1,540,000. The sport fisherman use of fish produced in the study area was estimated at 539,000 days valued at $3,234,000. Sport use of American shad and white sturgeon was estimated to be 39,000 days valued at $117,000.

Table 00.2 Numbers of anadromous fish stocked, by species, 1960 to 1965.

Species	1961	1962	1963	1964	1965	Total
Fall Chinook	6,182,600	6,869,100	4,657,800	18,699,900	14,185,000	50,594,400
Spring Chinook	4,597,800	3,271,900	5,536,100	15,515,300	6,191,300	35,112,400
Coho	3,571,700	4,325,100	9,289,400	4,147,200	12,604,000	33,937,400
Steelhead Trout	1,024,600	1,569,700	1,394,400	1,007,900	739,100	5,735,700
Totals	15,376,700	16,035,800	20,877,700	39,370,300	33,719,400	125,379,900

Table 00.3 Numbers of cold-water game fish stocked, by species, 1960 to 1965.

Species	1961	1962	1963	1964	1965	Total
Rainbow Trout	4,164,500	3,461,500	4,596,000	2,900,800	3,568,200	18,691,000
Brook Trout	711,900	1,045,100	616,500	481,800	434,500	3,289,800
Cutthroat Trout	23,000	102,700	125,700	62,200	80,300	393,900
Golden Trout	1,200	11,100	5,900	5,800	0	24,000
Kokanee	489,500	328,600	732,200	431,900	968,000	2,950,200
Totals	5,390,100	4,949,000	6,076,300	3,882,500	5,051,000	25,348,900

The study area contains thousands of miles of streams, hundreds of mountain lakes and about a dozen large reservoirs. Nearly all these waters furnish sport fishing for cold-water species of fish. In 1965 the stream trout fishery furnished an estimated 473,000 angler days of use valued at $1,419,000; some of the lakes and reservoirs furnished 431,000 days valued at $862,000.

Warm-water game fish are found in the mainstem Willamette, the lower reaches of many tributary streams, in many low-elevation lakes and ponds, and in several of the large flood-control reservoirs. The 1965 fisherman use of these species was estimated to be 88,900 days valued at $133,000. This figure is conservative because it does not include the active fisheries in the Columbia Slough-Sauvie Island area.

Economic Considerations

Sport fisherman day unit values used in this appendix are: salmon and steelhead fishing, $6 per day; white sturgeon, American shad, and cold water stream fishing, $3 per day; cold water lake and reservoir fishing, $2 per day; fishing for warm-water species, $1.50 per day. These are within the range of values prescribed in Evaluation Standards for Primary Outdoor Recreation Benefits. 1/ They may be defined as the rent that could be charged for the privilege of fishing if all fishing rights were controlled by a single monopolist. They represent net economic values over and above actual expenditures by sportsmen.

A recent unpublished preliminary study by Bureau of Commercial Fisheries 2/ indicates that for salmon and steelhead from the Columbia River and its tributaries, the net economic value, 1962 to 1964, was $8.87 per fish. This study draws heavily on Brown's 3/ 1964 paper, and indicates that Oregon anglers spent $51.14 to catch a salmon or steelhead in 1962, not including expenditures for licenses or salmon-steelhead punch cards. The study also explores Knetsch's 4/ method of calculating net economic value and concludes that under his system the

net value per fish would be over two and one-half times the $8.87 calculated using Brown's equations.

1/ Ad Hoc Water Resources Council, Supplement No. 1 to Senate Document 97, Policies, Standards and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources, 1964.

2/ Norton, Virgil J., William G. Brown, and Jack A. Richards, An Economic Evaluation of Columbia River Anadromous Fish Programs, A Preliminary Study, Bureau of Commercial Fisheries, 1967.

3/ Brown, William G., Ajmer Singh, Emery N. Castle, An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery, Oregon State Game Commission, 1964.

4/ Knetsch, Jack L. Economics of Including Recreation as a Purpose of Eastern Water Projects, Journal of Farm Economics, December 1964.

FISH & FISHING VALUE

Such studies indicate that the sport fishing values expressed in this appendix are conservative estimates. They should be considered as only a part of the total tangible and intangible values that could be assigned to the resources. The intangible values are by definition not evaluatable. The other tangible values that could be considered, such as the meat value of the catch, the enhancement of land values attributable to the presence of the fish, and secondary values such as the net profit from the sale of fishing equipment, have not been considered in this evaluation.

The commercial fishery is bound by legal restraints to a system of inefficient harvest, and since the number of fish that can be harvested is limited, but the number of fishermen is not, it is always operating on the margin. Under such conditions a net profit, in the economic sense, is not possible.

The commercial catch values indicated in this appendix are derived from the off-vessel prices received by fishermen. They do not include secondary values, but are gross values not strictly comparable with the net values assigned to the sport fishery.

0. WILLAMETTE RIVER MAIN STEM

0. MAIN STEM WILLAMETTE RIVER

In this and the following sections of this appendix the present status of the fish resources of the study area including species, habitat, population, use and value are discussed in some detail by subregions. The Willamette River main stem, which extends from the confluence of the Coast and Middle Forks to the river mouth, (Figure 0.1), has been treated as a specific subbasin to avoid the necessity of describing individual sections of the river which border, or pass through, other subbasins. Information concerning sloughs and oxbow lakes closely associated with Willamette River is also incorporated in this section.

Habitat

Approximately 11,200 square miles are drained by the Willamette River system. Formed near Eugene by the confluent Coast and Middle Forks, the river flows north for 187 miles before entering the Columbia River at Portland (Figure 0.1). Stream gradient is low, from about 12 feet per mile near Eugene to less than 0.1 foot per mile below Willamette Falls.

Average river discharge recorded by the U.S. Geological Survey's Wilsonville gage at river mile 38.5 from September 1948 to October 1965 was 29,400 cubic feet per second. Extremes during this interval were 3,600 cfs in November 1952 and 339,000 cfs in December 1964. This gage, the lowermost on the river, is located upstream from the Clackamas, Tualatin, Molalla, and Pudding Rivers.

The Willamette River serves as a route for the upstream and downstream migration of anadromous fish. Table 0.1, listing migration data by species, shows that the river is important in this role at all times of the year.

There is abundant spawning and rearing habitat for anadromous fish in the Willamette. The supply of spawning gravel is good above Newberg and is particularly plentiful above Corvallis. Salmon and steelhead occasionally spawn in the upper river although most spawn in tributaries. Main stem rearing takes place but is limited by pollution and warm water temperatures in low flow months.

FIGURE 0.1

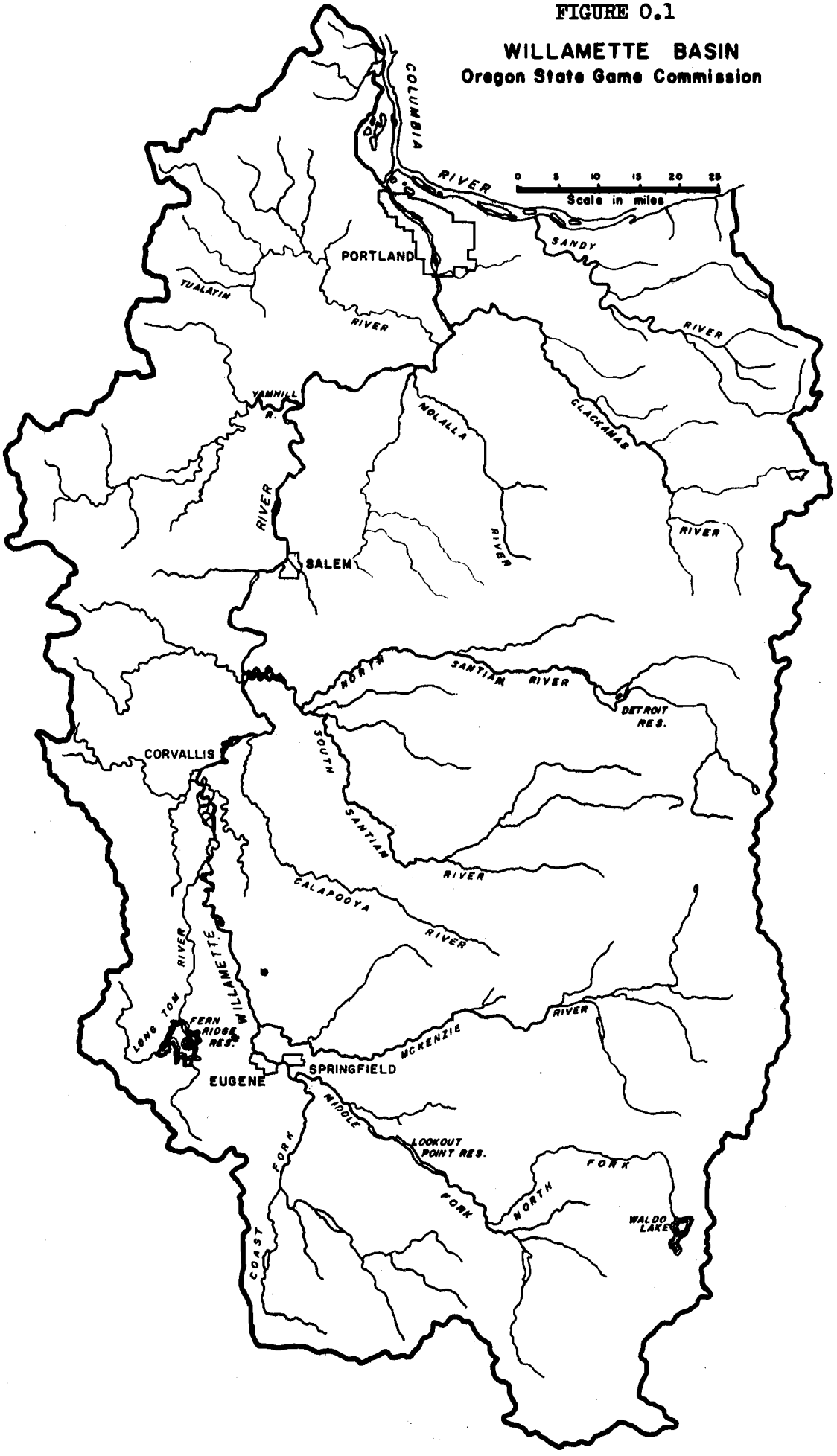

WILLAMETTE BASIN
Oregon State Game Commission
COLUMBIA
RIVER
0 5 10 15 20 25
Scale in miles
PORTLAND
SANDY
RIVER
TUALATIN
RIVER
YAMHILL
R.
MOLALLA
RIVER
CLACKAMAS
RIVER
SALEM
NORTH
SANTIAM
RIVER
DETROIT
RES.
CORVALLIS
SOUTH
SANTIAM
RIVER
CALAPOOYA
RIVER
WILLAMETTE
RIVER
LONG TOM
RIVER
FERN
RIDGE
RES.
EUGENE
SPRINGFIELD
MCKENZIE
RIVER
MIDDLE
FORK
LOOKOUT
POINT RES.
COAST
FORK
NORTH
FORK
WALDO
LAKE

Table O.1. Periodicity of adult and juvenile anadromous fish migration over Willamette Falls as percent of average annual migration by month.

Species	Age	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Upstream Migrants [1]													
Coho Salmon	Adult									16.1	65.1	18.6	0.2
Spring Chinook	"				18.6	75.6	5.8						
Winter Steelhead	"		5.9	9.5	76.6	7.3	0.2	0.2				0.1	0.2
Shad [3]	"												
Downstream Migrants [2]													
Coho Salmon	Juv.					0.04	13.5	73.7	11.2	1.5		0.06	
Spring Chinook	"	0.6	1.1	6.7	13.1	14.6	39.3	21.0	0.3	1.6	0.8	0.3	0.6
Winter Steelhead	"	0.1	0.3	18.0	57.4	21.5	1.5				0.5	0.6	0.1
	Adult			0.2	4.6	56.8	35.1	3.3					
Shad	Juv.								0.7	5.8	75.1	17.5	0.9
	Adult						18.0	11.7		3.2	20.2	24.5	22.4

1/ Based on counts by Fish Commission of Oregon between 1957 to 1966.

2/ Based on downstream migrant study by Oregon State Game Commission, 1964-66.

3/ No counts available, peak upstream passage occurs in June and July.

The optimum water temperature for salmonid rearing is between 45 and 60 F. However, Willamette River temperatures exceed the upper limit throughout most summer and autumn periods. Frequently, water temperatures exceed 65 F in the upper river and 70 F in the lower river. Water this warm adversely influences survival of salmon and trout. Table 0.2 lists temperature and dissolved oxygen data obtained at five sites along the Willamette in summer months. These measurements were made once a week at various times of day and, therefore, do not represent true averages or extremes.

Willamette Falls is situated in the Willamette at river mile 26.6 near the town of Oregon City. Height of the falls, about 45 feet in the summer, is appreciably decreased in winter and spring from raises in tailwater levels caused by increased flow in the Willamette and Columbia Rivers. Slight tidal influence also extends upstream to the falls.

Willamette Falls formed a barrier to the upstream migration of salmon and steelhead even before man initiated changes there late in the nineteenth century. Although it was not a complete barrier previous to that time, the falls probably prevented establishing runs of certain anadromous fish such as summer steelhead, and fall chinook which run during low flow periods.

Species and Distribution

In 1965, 43,600 coho salmon and 26,000 winter steelhead escaped into the basin. This run is believed to approximate the average. The average escapement of spring chinook was 36,500 from 1962 through 1964. Of these runs, about 10,500 coho, 14,300 winter steelhead and 31,000 spring chinook ascended Willamette Falls. The remainder entered the Sandy and Clackamas rivers and a few small tributaries below the falls. Sea-run cutthroat trout occur in significant numbers in the lower Willamette River. Shad, usually numbering in the thousands, spawn in May, June and July between the river's mouth and Willamette Falls. Limited numbers pass over the falls via the fishway.

Table 0.2. Willamette River temperature and dissolved oxygen data for July, August, and September, 1953-65. 1/

	Springfield; River mile 185.0		Independence; River mile 95.0		Newberg; River mile 50.0		Marina Mart; River mile 27.0		S.P. & S.; River mile 7.0	
	Temperature (°F)									
Year	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.
1953	68	68	68	72	70	73	72	75	68	73
1954	59	61	64	68	68	70	68	72	66	72
1955	59	59	61	61	64	64	68	73	66	72
1956	64	64	68	70	70	77	70	75	70	77
1957	64	68	68	70	70	73	70	73	70	73
1958	63	68	70	79	72	79	73	79	73	81
1959	64	66	66	75	68	79	70	79	68	79
1960	64	68	70	73	70	75	70	75	68	75
1961	61	63	68	75	70	77	70	75	70	77
1962	59	61	68	73	68	70	68	75	68	73
1963	59	61	68	72	68	72	68	72	64	70
1964	62	64	66	73	67	73	62	72	66	70
1965	58	61	67	72	68	75	68	72	66	71

				Dissolved Oxygen (ppm)						
Year	Mean	Min.	Mean	Min.	Mean	Min.	Mean	Min.	Mean	Min.
1953	9.5	8.8	8.7	8.4	7.6	7.4	6.3	6.0	2.0	0.7
1954	9.4	9.0	9.0	8.5	8.0	7.6	7.3	6.5	4.2	2.7
1955	9.2	9.2	9.0	9.0	7.6	7.4	6.7	5.9	4.1	2.2
1956	9.4	9.1	8.6	7.8	7.1	6.5	6.3	5.3	4.2	2.5
1957	9.5	8.8	8.6	8.0	7.1	6.0	5.3	3.5	2.4	1.2
1958	9.5	8.7	8.5	7.8	7.4	6.2	6.9	5.1	4.0	2.0
1959	10.4	9.4	9.2	8.0	7.7	7.0	6.6	3.9	4.3	2.2
1960	9.8	9.7	9.1	7.9	7.8	7.3	7.1	5.1	4.3	3.0
1961	9.3	8.6	9.3	7.7	7.6	6.9	6.9	4.3	3.7	1.8
1962	9.1	8.7	9.4	8.7	7.6	6.1	6.5	4.5	3.9	2.7
1963	9.4	9.1	9.2	8.4	7.7	6.8	5.6	3.4	3.6	2.0
1964	10.2	9.9	9.2	7.9	7.7	7.0	6.1	5.1	4.4	3.3
1965	8.9	8.7	8.8	8.3	7.7	7.1	6.4	4.3	3.9	3.0

1/ From measurements made weekly by the Oregon State Sanitary Authority.

Many resident cutthroat trout inhabit the entire river. When mature, these fish average 14 inches in length. They commonly leave the Willamette in winter and spring to spawn in tributary streams. Small populations of resident rainbow trout are centered primarily in the river near Eugene. A few other salmonids are distributed throughout the stream in limited numbers. Numerous white sturgeon occur in the river, particularly below Willamette Falls.

During the summer, warm water in the lower Willamette, especially in sloughs and oxbow lakes provides favorable environment for warm-water game fish (Table 0.3). Largemouth bass, bluegill, white crappie, black crappie, yellow perch, bullhead catfish, and warmouth bass are the predominant species. Channel catfish, stocked in recent years, are becoming established.

Nongames

Large populations of nongame fish are found throughout the stream. Nongame species most detrimental to game fish are usually those occurring in highest numbers. Largescale suckers, carp, squawfish, chiselmouth, and redside shiners prey on, or severely compete with, game fish for food and living space.

Developments and Conditions Adversely Affecting Fish Resources

Oregon's most critical pollution problems affecting fish production and angling are found in the Willamette River (Figure 0.2). These problems are generally greatest in the lower sections during periods of reduced stream flow. Pollution of the Willamette limits aquatic life, especially game fish and the food organisms upon which they feed. The most detrimental effect of pollution is the depression of the river's concentration of dissolved oxygen which fish must have for respiration (Table 0.2). Toxic materials discharged into the river also impair fish production and cause mortalities. Chemical wastes have at times tainted salmon flesh, making it unpalatable. Slime growths and wood fibers commonly foul sport fishing gear, form sludge rafts, and decompose to release fetid gases.

Table 0.3. Lakes influenced by the Willamette River which provide angling for warm-water game fish 1/

Lake	County	Surface Acres	Public Access	Location
Ramsey	Multnomah	150	Yes	One mile south of the Columbia at confluence with Willamette River.
Oak Grove	Clackamas	35	Yes	In town of Oak Grove two miles south of Milwaukie.
Skookum	Marion	20	Charge	Three miles south of Newberg and west of State Highway 219.
Horseshoe	Marion	35	Charge	Two miles west of St. Paul.
Hubbard	Marion	25	No	Two miles east of Wheatland Ferry.
Deep	Marion	10	No	Three miles southeast of Wheatland Ferry. North of Waconda Road.
Mission	Marion	40	Charge	Just east of Wheatland Ferry.
Goose	Marion	30	No	Immediately south of Mission Lake.
Collard	Marion	5	No	East of Goose Lake, next to the Wheatland-Salem highway.
Finney & Egan	Marion	5	No	Three miles southeast of Wheatland Ferry and south of Waconda Road.
Clear	Marion	35	No	At village of Clear Lake, seven miles north of Salem.
Willow	Marion	15	With permission	One mile west of Keizer at north edge of Salem.
Hayden	Polk	30	No	Five miles north of Independence, between Hiway 51 & the Willamette R.
Humbug	Polk	45	No	Two miles north of Independence and south of Hayden Lake.
Wilson	Linn	10	No	Five miles north of Albany and 0.5 mile east of the Willamette River.
Fourth	Linn	10	No	East of Willamette River and 2.5 miles north of Albany.
Third	Linn	10	No	East of Willamette River and two miles north of Albany.
Second	Linn	5	No	East of Willamette River and one mile north of Albany.
First	Linn	5	No	East of Willamette River and on the north edge of Albany.

Table 0.3 (continued)

Lake	County	Surface Acres	Public Access	Location
Thorton	Benton	20	No	One mile northwest of Albany.
Bryant	Linn	10	No	One mile west of Albany and one mile south of the Willamette River.
Asbahr	Benton	35	No	At Children's Farm Home two miles northeast of Corvallis.
Stewart	Benton	5	No	At east edge of Corvallis and 0.8 mile north of the Willamette River.
Colorado	Linn	50	Charge	Three miles east of Corvallis & one mile north of Corvallis-Lebanon road.
Porter	Benton	15	No	Four miles south of Corvallis and 0.5 mile east of Highway 99W.
McBee	Benton	50	No	Five miles south of Corvallis and 0.7 mile east of Highway 99W
Whitaker	Benton	19	No	Six miles south of Corvallis and 0.7 mile east of Highway 99W.
Black	Benton	15	Yes	Seven miles south of Corvallis on south end of Smith Loop Road.
Miller	Benton	20	With permission	One mile southwest of Black Lake, near Smith Loop Road.
Wagner	Benton	15	No	Just south of Miller Lake.
Oliver	Benton	20	No	Three miles north of Monroe and 0.5 mile east of Highway 99W.
Garlinghouse	Benton	15	No	One and one-half miles northeast of Monroe.
Goodman	Lane	15	With permission	Two miles south of Monroe and one mile east of Territorial Road.
Graham	Lane	15	With permission	Two and one-half miles south of Monroe and one mile east of Territorial Road.
Hulbert	Lane	20	Yes	Three miles southeast of Monroe and one mile west of Highway 99W.
Goodpasture	Lane	20	Yes	Near Beltline Road on north edge of Eugene and 100 yards east of the Willamette River.

1/ The most common game fish found in these lakes are white crappie, black crappie, bluegill, largemouth bass, warmouth, and brown bullhead.

A MAJOR POINT

In spite of improvements being made in pollution abatement in the Willamette River, an even higher degree of treatment will be required in the future to adequately treat pollutants that would otherwise be detrimental to aquatic life. Table 0.2 lists Willamette River dissolved oxygen data from 1953 to 1965. In 1947 the Sanitary Authority adopted a regulation stating that no industrial waste or sewage which cause the dissolved oxygen content to fall below 5 parts per million may be discharged into any Oregon waters. This concentration approximates the minimal level necessary for anadromous fish migration in the Willamette. However, 5 ppm is considerably below the optimum range of about 9 to 12 ppm. Low dissolved oxygen concentrations occur in the river for extensive periods each year (Table 0.2), notably from June to October. In the summer of 1965, levels did not exceed 5 ppm for 110 consecutive days at an automatic monitoring system of the Federal Water Pollution Control Administration in the Portland harbor near river mile 8. Such low dissolved oxygen concentrations not only influence survival of fish but also block or delay the entry of coho salmon and other anadromous species into the river system. Relatively small delays in salmon spawning migration may reduce the reproductive capacity of the fish to the extent that they die without spawning. Since many predatory species of fish have lower dissolved oxygen requirements than salmonids, and thrive in warmer waters, they are able to compete more successfully in Willamette River under present conditions than formerly. Large populations of predator fish are especially hazardous to juvenile salmon and steelhead during the latters' downstream migration. Successful introductions of fall chinook and summer steelhead in the Willamette drainage, and increases in the runs of existing anadromous fish, will largely depend upon improved pollution abatement.

LOWER

Willamette Falls became a total barrier to anadromous fish with the completion of a dam around the lip of the falls in 1903 or 1904. A fish ladder

was constructed over the falls and dam in the latter year, but fish passed upstream under only the most favorable flow conditions before the present ladder was partially completed in 1966.

Many juvenile salmon and steelhead are killed in their downstream migration by passing through the power turbines at Willamette Falls. A major portion of the flow is used to turn 50 turbines at the falls (Figure 0.3). The Oregon State Game Commission conducted studies in 1960 and 1961 to determine the mortality to fish passing through the major turbines. Mortality ranged from 7.7 to 100 percent in all turbines tested; however, no estimate of the total mortality was possible.

Most of the turbines discharge into a bay-like area on the west bank of the river known as the "Cul-de-sac." This is a short distance below the falls. Large numbers of adult anadromous fish are attracted into this blind alley by the large flows and are thus delayed in finding the ladder entrances. This and other upstream passage problems have improved with completion of the new Willamette Falls fishway (Figure 0.3).

Periodic gravel mining, bank revetment, and channel deepening operations have deleterious effects upon fish habitat. These activities cause increased water turbidity and bottom siltation, and they frequently remove valuable spawning gravel.

Access to fishing waters has become a problem. Not only is access to most lakes in the Willamette area restricted (Table 0.3), but access to the main river is difficult in many places.

Several unscreened diversions on tributaries are responsible for additional losses of downstream migrant fish. Diversions for consumptive use also accentuate undesirable low flow conditions.

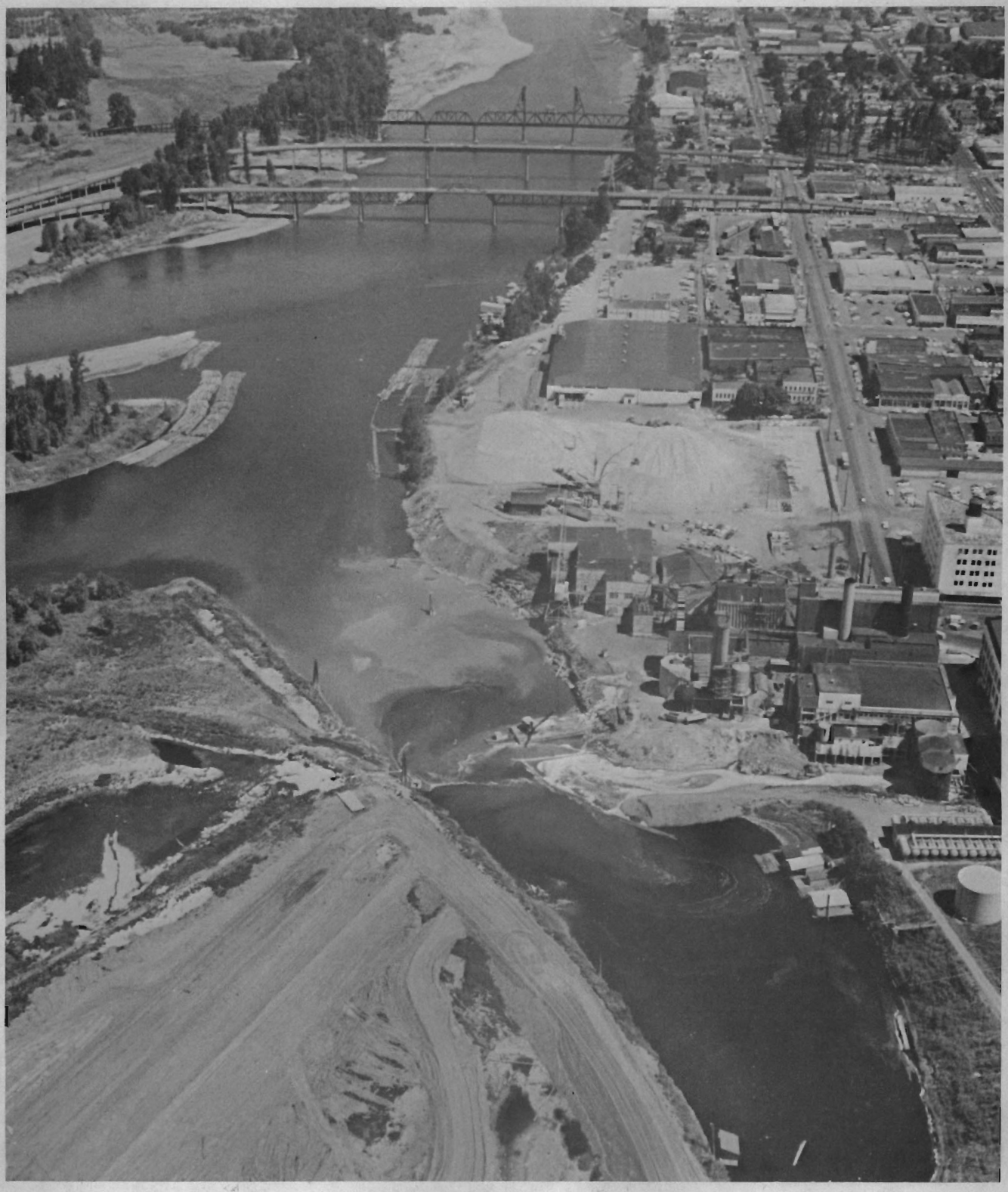


Figure 0.2. Effluents from Boise-Cascade's paper mill discharge directly into a slough adjoining the Willamette River at Salem, Oregon. July, 1966. Photograph by Oregon Statesman.

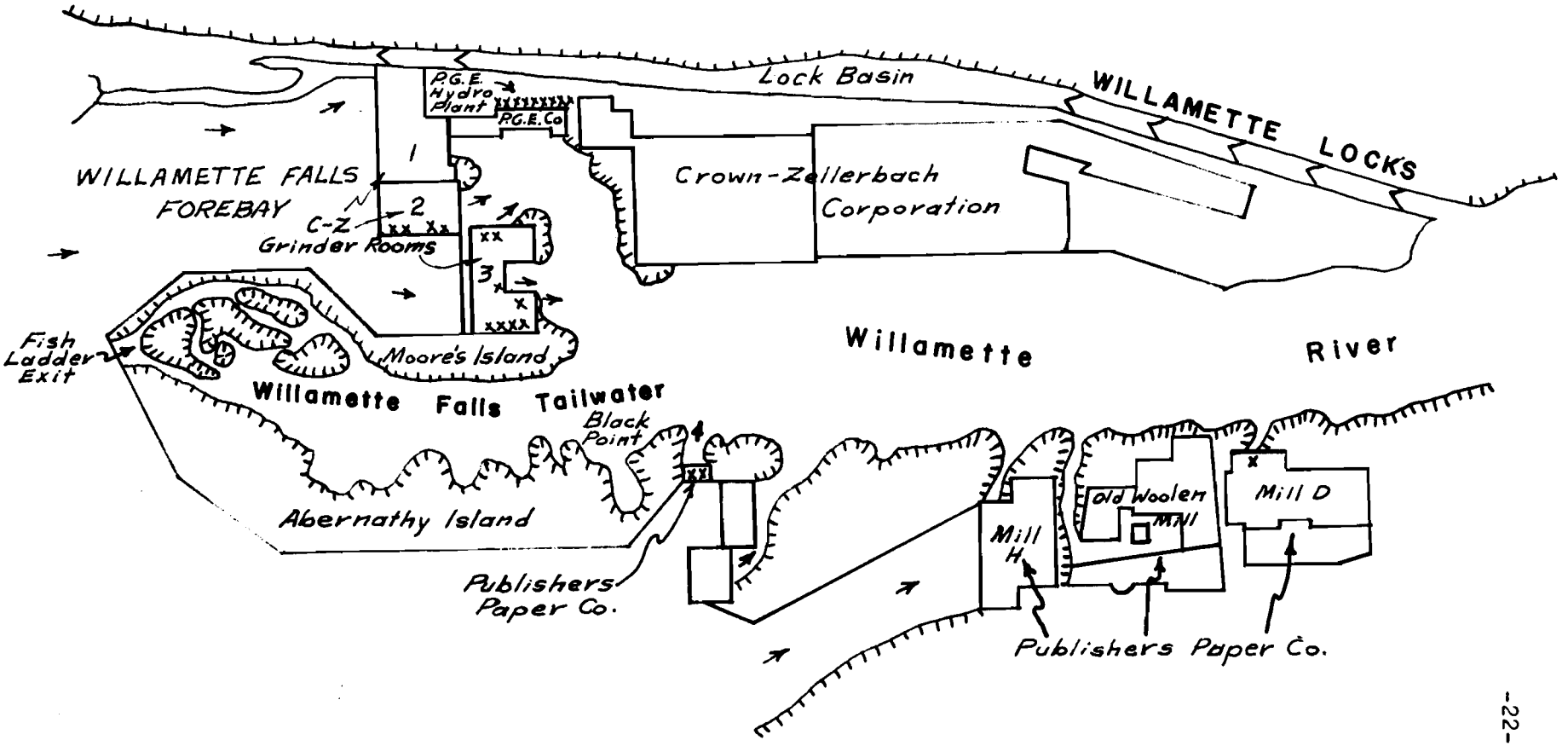


FIGURE O.3. WILLAMETTE FALLS VICINITY

Flood plain potholes along the river, particularly near the city of Corvallis, trap fish following high water levels. A large natural depression below Willamette Falls, called the "Wet Hole," also frequently traps fish when water levels drop.

Developments Beneficial to Fish Resources

Provision of fishway facilities at Willamette Falls began about 1885. A ladder located near the center of the falls was completed in 1904. Several alterations were made in the ladder, but it was never adequate. During periods of high river discharge, excessive water velocities in the ladder impeded fish passage. Conversely, in low flow periods most water was diverted around the falls for industrial uses, leaving inadequate flows passing over the falls to attract fish to the ladder entrances. Construction of an improved fishway started in 1966, has now been completed.

Table 0.4 presents minimum flows set in 1963 by the Oregon State Water Resources Board at three locations on the Willamette River. The U. S. Corps of Engineers has agreed to provide the listed storage minimums when possible from upstream reservoirs. Since 1963 these storage minimums, or greater volumes, have usually been furnished. Combined with the listed natural minimums, they are of sufficient quantity for salmon and trout in the Willamette. The good water quality of the storage releases assists materially in improving the river's pollution problems.

Only limited stocking of trout and anadromous fish is made in the Willamette as compared with important tributary systems maintaining better rearing conditions. Table 0.5 gives fish release data for the 1961-1965 interval. Large plants of fall chinook were undertaken in 1964 and 1965 with anticipation of increased pollution control measures and construction of the new Willamette Falls fishway. There is sporadic stocking of warm-water game fish in the area but this is not shown in Table 0.5.

Table 0.4. Minimum stream flow stipulations beneficial to fish

Stream	Location	Minimum Flows in Cubic Feet per Second	
		Natural	Storage
Willamette River	USGS Gage 14-1980 at Wilsonville	1,500	4,700
Willamette River	USGS Gage 14-1910 at Salem.	1,300	4,700
Willamette River	USGS Gage 14-1740 at Albany	1,750	3,140

Table 0.5. Fish stocking in Willamette River main stem, 1961-1965.

Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency 1/
Fall Chinook	--	406				1,836,000	2,587,930	USFWS
"	--	1,150					895,000	OFC
Spring Chinook	--	25-40		2,571	4,011			"
Rainbow	8 & over			2,501	3,003	5,000		OSGC

1/ Abbreviations used in this table are: "USFWS", U.S. Fish & Wildlife Service; "OFC", Fish Commission of Oregon; "OSGC", Oregon State Game Commission.

Present Economy

Commercial fishing is currently prohibited in the Willamette River and its tributaries. Few anadromous fish presently spawn in the Willamette main stem so the contribution to the Columbia River and Pacific Ocean commercial fisheries from this reach is largely one of providing transportation for migrating fish. The main stem contribution will increase significantly if fall chinook become established in the river.

Heaviest sport angling pressure for anadromous fish on the main stem is exerted upon spring chinook salmon. This fishery takes place almost entirely below Willamette Falls, extending from a deadline below the falls to the river's mouth and throughout Multnomah Channel (Figure 0.4). It is Oregon's largest inland salmon fishery exclusive of the Columbia River.

Angling for spring chinook is conducted mainly from boats in the months of March, April, and May during the period of upstream migration. Some bank angling occurs at the mouth of the Clackamas River and at Black Point near Willamette Falls. Estimation of the catch was initiated in 1941 by the U. S. Fish and Wildlife Service and resumed in 1946 as a joint study by the Oregon State Game Commission and Fish Commission of Oregon. Basic angler effort and catch data are obtained from airplane counts of boats and from catch records of cooperating moorage operators. For the 20-year period beginning in 1946, anglers have harvested an average 11,939 spring chinook in 91,760 angler-days annually. Table 0.6 includes angler effort and catch figures.

Table 0.6. Escapement and sport catch of Willamette River spring chinook salmon, 1946-1965

Year	Willamette Falls Escapement (calculated) 1/	Sport Catch below Willamette Falls	Angling Intensity in Man-days	Average catch per man-day
1946	53,000	12,600	61,900	0.20
1947	45,000	12,000	91,900	0.12
1948	30,000	8,500	83,600	0.10
1949	27,000	9,100	85,500	0.11
1950	14,500	8,800	73,400	0.12
1951	34,300	13,300	92,600	0.14
1952	52,200	12,500	91,100	0.13
1953	76,400	16,400	102,800	0.16
1954	31,100	11,500	104,100	0.11
1955	22,000	9,000	77,700	0.12
1956	58,600	16,000	84,100	0.19
1957	39,300	11,500	95,500	0.12
1958	45,200	15,500	137,900	0.11
1959	31,900	18,500	134,100	0.14
1960	14,400	8,000	92,300	0.09
1961	18,900	6,400	75,100	0.09
1962	26,000	9,100	74,000	0.12
1963	30,300	13,600	84,800	0.16
1964	36,300	18,600	118,700	0.16
1965	29,100	9,000	74,000	0.12

1/ Based upon counts in the fishway.

Figure 0.4. Spring chinook sport fishery below Willamette Falls. Spring, 1964.

Most angling for coho salmon and steelhead trout takes place just below Willamette Falls and at the mouth of the Clackamas River. Both boat and bank fishing are popular. Fishing pressure, as compared with the spring chinook fishery, is moderate. Angling for coho occurs mainly in November and December and for steelhead from December until the spring chinook fishery begins. Fishermen catch approximately 7,900 coho and 900 steelhead in 12,100 fisherman days.

There is moderate to heavy fishing pressure on shad just below Willamette Falls in May, June, and July. Angling for sturgeon is light to moderate throughout the river during much of the year. Heaviest pressure occurs in spring months in the vicinity of Oregon City. Sport fisheries for both sturgeon and shad are gaining in popularity. The 1965 harvest was calculated to be 13,300 shad and 7,600 sturgeon. A calculated 39,000 angler days, valued at $117,000.00 were expended on these fisheries. The expenditure of time on these fisheries in 1965 is believed to approximate the time expended during an average year.

Warm-water game fish get more angling pressure than other fish species, with the possible exception of spring chinook salmon. Largemouth bass, bullhead catfish, bluegill, and crappie make up the bulk of the catch. Fishing effort along the entire river is directed more upon slough areas and adjacent oxbow lakes than upon the main river channel. Although permitted year around, the fishery receives most attention in spring and summer. Oxbow lakes experiencing greatest angler use are described in Table 0.3. This fishery produced an estimated 48,500 fish in 26,600 angler days in 1965, valued at $40,000.00 annually.

Light to moderate fishing for resident cutthroat is conducted in all portions of the river during trout season. This fishery is commonly overlooked and somewhat limited because of generally low angler success rates and competition from more popular areas. Approximately 17,000 trout are caught in an estimated 9,800 angler-days, valued at $29,000.00 annually.

1. COAST FORK SUBBASIN

1. COAST FORK SUBBASIN

All streams of the Coast Fork Willamette River system, (Figure 1.1), including Row River, are considered to have important fish populations. Cottage Grove Reservoir on the Coast Fork and Dorena Reservoir on Row River contain important managed sport fisheries. Crawfish Lake, 2 acres in area, is the only high mountain lake in the subbasin.

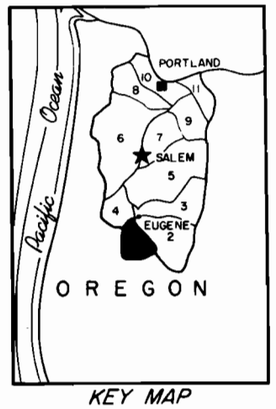
Habitat

The Coast Fork Willamette River, 51 miles long and draining 665 square miles, flows from the north slope of the Calapooya Mountains and joins the Middle Fork Willamette River near Eugene to form the Willamette River main stem. Row River, which drains nearly 60 percent of the subbasin area, enters from the east at river mile 20.7.

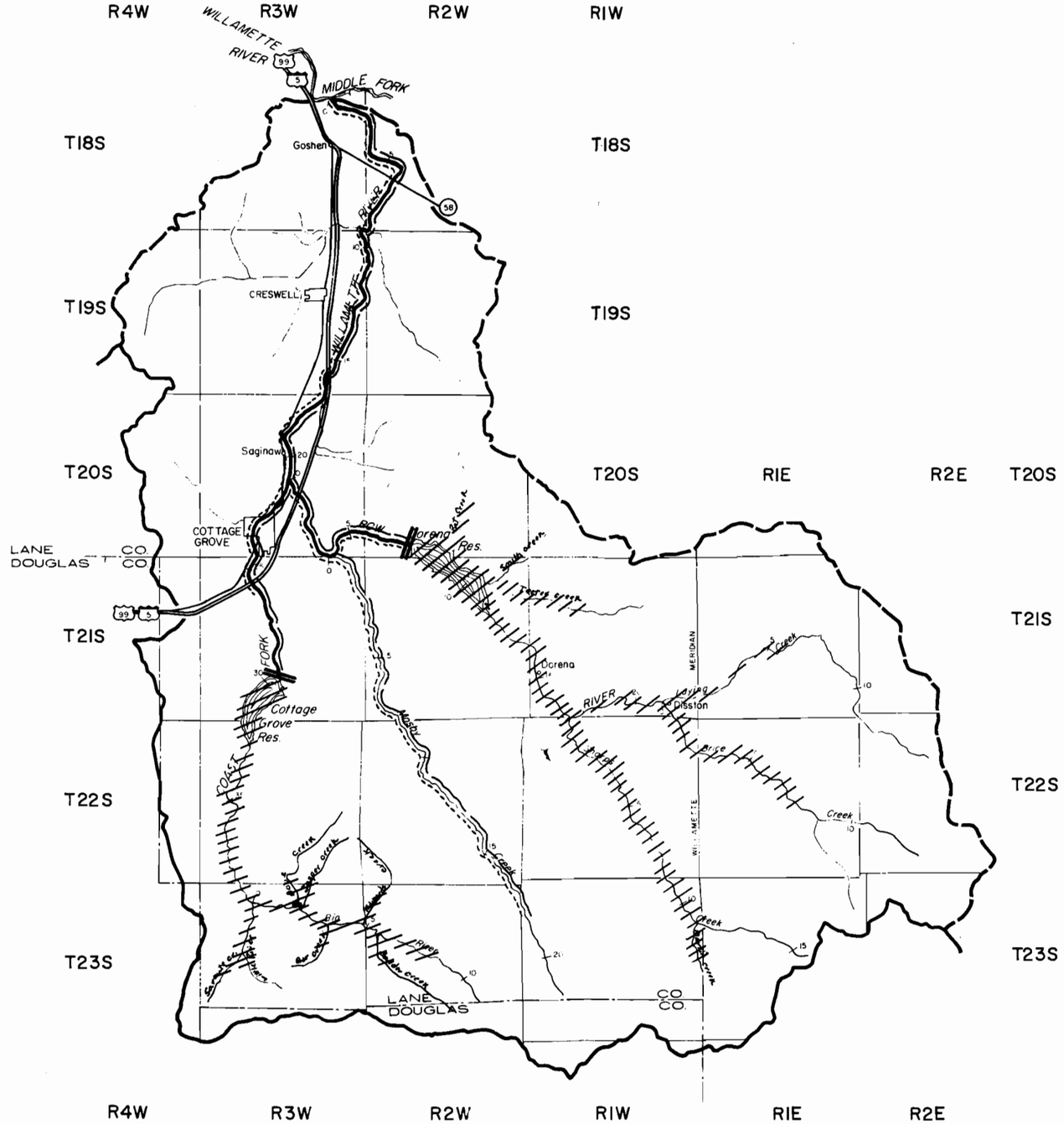
Spawning gravel is scarce in many streams, but this paucity limits production of salmonids in only a few of the smaller tributaries. Stream discharges are relatively low in summer but higher than those in most tributaries entering the Willamette River from the west.

Cottage Grove Reservoir is located on the Coast Fork at river mile 29.5. It is an impoundment of 1,140-surface acres. Another reservoir, Dorena, is situated at river mile 7.5 on Row River and is a 1,900-surface acre impoundment. Both dams are unladdered, closing many miles of stream habitat to anadromous fish.

Minimum summer flows of 50 and 100 cubic feet per second, respectively, are usually released from Cottage Grove and Dorena Reservoirs. Water temperatures seldom exceed 70 F during summer and fall months in streams above the two reservoirs. These temperatures are adequate for cutthroat and rainbow trout. But water temperatures in the rivers and their tributaries below the impoundments commonly reach 80 F, which are unfavorable for cold-water species such as trout. Temperatures of Dorena and Cottage Grove Reservoirs favor production of warm-water game fish and



KEY MAP



LEGEND:

Present distribution (May 1966)

- STEELHEAD — — — —
- COHO - - - - - - - -
- CHINOOK ———
- Unaccessible habitat for onadromous fish, blocked by dams

SCALE OF MILES

FIGURE 1.1

SUB-BASIN 1

Coast Fork

nongame fish. Rainbow and cutthroat trout exist in the reservoirs, but their numbers are limited by the warm water and by competition from warm-water fish better suited to the environment.

Crawfish Lake, the subbasin's only natural lake habitat, was stocked with rainbow trout in 1964.

Species and Distribution

Before construction of Dorena and Cottage Grove Dams, some spring chinook, and possibly winter steelhead, entered the Coast Fork and Row River. In recent years small, sporadic runs of both species have been recorded in lower portions of the two rivers. Coho salmon have been planted since 1963 in the Row River system, but it is too early to measure the success of the introductions.

Resident cutthroat and rainbow trout are common in streams of the upper drainage. Most of the trout in Dorena Reservoir are planted rainbow, while cutthroat predominate in Cottage Grove Reservoir. Cutthroat numbers are moderate and native rainbow occur infrequently in the river sections below the reservoirs.

Warm-water game fish maintain substantial populations in Cottage Grove and Dorena Reservoirs. Largemouth bass and bullhead catfish are the most abundant species. Several species of warm-water game fish, including smallmouth bass, exist in low to moderate numbers in the river areas below the two impoundments.

Largescale suckers, squawfish, redside shiners, and other nongame fish populations thrive in the rivers below the reservoirs. A few of these species, notably the largescale sucker, were common in Cottage Grove Reservoir and lower parts of its tributary system and prompted a rehabilitation project there in 1966. Subsequently, rainbow and cutthroat trout and largemouth bass were stocked in the reservoir and smallmouth bass were introduced in the Coast Fork above the reservoir.

Developments and Conditions Adversely Affecting Fish Resources

The U. S. Army Corps of Engineers dams in the subbasin were constructed primarily for flood control purposes. Cottage Grove Dam, 95 feet high, was completed in 1942 on the Coast Fork at river mile 29.5. Dorena Dam, 145 feet high, was completed at river mile 7.5 on Row River in 1949. Neither dam is provided with fish passage facilities.

Dorena and Cottage Grove Dams prevent anadromous fish access to the subbasin's better spawning and rearing streams. Approximately half of the 160 stream miles of habitat for these species is located above the two impoundments. The release of warm water from the reservoirs appreciably reduces the value of the lower Coast Fork and Row River for salmonid production. Also, the release of water in the fall is often inadequate for salmon migration and spawning. The impoundments provide good habitat for nongame fish, which exist in large numbers.

Water rights for surface water in the subbasin total over 150 cfs (Table 1.1). Most of this volume is for consumptive use. The major points of diversion for consumptive use, excluding Layng Creek, are downstream from Cottage Grove and Dorena Dams. During the summer, reservoir releases compensate for much of the consumptive water use and also provide significant flows in the lower river channels. The City of Cottage Grove obtains its municipal water from Layng Creek, a principal tributary of upper Row River, thereby further reducing naturally low summer flows.

An unladdered dam, 4 feet high, on the Coast Fork near river mile 23.0 blocks the upstream migration of fish during low flows. Another 4-foot dam which has an inadequate ladder for anadromous fish is located on the Coast Fork at river mile 25.3 immediately downstream from Interstate Highway 5. Two dams on Layng Creek limit intra-stream migration by trout.

Fish production is impaired by low dissolved oxygen concentrations in the river resulting from log pond wastes that occasionally enter the Coast Fork about one-half mile below Martin Creek and Row River near the mouth of Culp Creek. Improper logging activities that contribute to stream siltation and debris jams in the streams still occur in the upper watershed but are not as prevalent as they once were. Periodic gravel mining operations along lower Row River and Coast Fork cause high turbidity of water and thick deposits of silt on the streambed. Waters of Cottage Grove Reservoir are frequently turbid because of wave action. At such times the river downstream is also discolored.

There is significant habitat for salmon and steelhead production above 15-foot Wildwood Falls at mile 18.5 on Row River. Potential habitat above other falls in upper portions of several streams is small, and probably not sufficient to justify fish passage improvements.

The basin contains meager quantities of spawning gravel, and much of the rearing area is of limited value to anadromous fish because of low summer flows, high summer and fall water temperatures, and low water quality. Conversely, conditions favor nongame fish which compete directly with more valuable species.

Developments Beneficial to Fish Resources

Cottage Grove and Dorena Reservoirs create habitat favorable for warm-water game fish. Increases in number of nongame fish, and the drawdown of the reservoirs in summer and fall lessen the quality of this habitat.

The number of fish liberated into streams of the subbasin in the 1961-1965 interval are listed in Table 1.2. Winter steelhead and spring chinook were stocked between 1950 and 1960, but returns have been small.

Because of large populations of nongame fish, occasional chemical treatment of Cottage Grove and Dorena Reservoirs has been necessary. The impoundments are then restocked with game species only.

Table 1.1 Appropriated surface water and minimum stream flow measurement data, Coast Fork Subbasin.

Stream Area	Appropriated Surface Water (cfs) 1/ Non-Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
Coast Fork Willamette R. below Cottage Grove Dam	0.03	70	"Practically no flow"	0.3 mile below Cottage Grove Dam	July 1945 & August 1947 (1939-1965)	U.S. Geological Survey
Tribs to Coast Fork below Cottage Grove Dam	0.7	26	--	--	--	--
Coast Fork Willamette R. above Cottage Grove Dam	0.0	13	10	River mile 35.9	Several days in 1936 (1935-1965)	U. S. Geological Survey
Tribs to Coast Fork above Cottage Grove Dam	0.0	1.5	--	--	--	--
Row R. below Dorena Dam	0.0	5.5	0.2	2.1 miles below Dorena Dam	Sept.25,-Oct.7, 1958(1939-1965)	U.S. Geological Survey
Mosby Creek System	0.0	5.5	3.9	Mile 1.0	Aug. 21-23,1961 (1946-1965)	U.S. Geological Survey
Other tribs to Row R. below Dorena Dam	0.0	0.0	--	--	--	--
Row R. above Dorena Dam	9.3	12	10	River mile 13.2	Sept.24,25,1951 Oct. 7,8,1958 (1935-1965)	U.S. Geological Survey
Brice Cr. System	0.0	0.3	9.3	Mile 1.0	Oct. 12, 1964	Ore. Game Comm.
Layng Cr. System	0.0	14	5.3	Mouth	Oct. 12, 1964	" " "
Sharps Cr. System	4.9	1.1	5.6	Mouth	Aug. 25, 1964	" " "
Other tribs to Row R. above Dorena Dam	0.0	0.0	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.

2/ U.S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1964 and 1965.

Table 1.2. Fish stocking in Coast Fork Willamette Subbasin, 1961-1965.

Stream System or Reservoir	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency 1/
Coast Fork Willamette River	Rainbow	8 & over	--	8,002	8,029	8,075	8,001	4,000	OSGC
Row River System	Coho	--	1100-1168			300,000		511,276	OFC
" " "	Rainbow	8 & over	--	36,664	38,081	38,560	37,950	29,983	OSGC
Dorena Reservoir	Rainbow	2-4	--			100,101	90,000	151,000	"
" "	"	4-6	--					50,410	"
" "	"	8 & over	--	8,397	28,015	24,996	26,830	28,243	"
Cottage Grove Res.	"	"		3,849	5,004	4,680	5,001		"

1/ Abbreviations used in this table are: "OFC", Fish Commission of Oregon; and "OSGC", Oregon State Game Commission.

Table 1.3. Minimum stream flow stipulations beneficial to fish.

Stream	Location	Minimum Flows in Cubic Feet per Second 1/ Natural	Storage
Coast Fork Willamette River & tributaries	Above mouth	40	250
Coast Fork Willamette River & tributaries	Above confluence with Row R.	15	100
Row River and tributaries	Above mouth	40	150

1/ "Natural" minimum flow stipulations were set by the Oregon State Water Resources Board in 1962. The "storage" volumes are provided in addition whenever possible from U.S. Army Corps of Engineers dams located upstream.

Table 1.3 lists legal minimum stream flow stipulations established in the subbasin. Future appropriations may be made for only domestic or livestock uses from natural flows of the listed stream areas.

Present Economy

The contribution of anadromous fish from the subbasin to commercial and sport fisheries is negligible. In spring and summer, heavy angling pressure is exerted on wild rainbow and cutthroat trout and hatchery rainbow trout in streams above the two reservoirs. Hatchery rainbow provide most of the trout catch from the river areas below the dams. The stream fishery contributed an estimated 1,800 angler-days in 1965 valued at $5,500. Angling pressure exerted on this fishery in 1965 is believed to approximate the pressure exerted during an average year.

Fishing in Dorena and Cottage Grove Reservoirs is permitted all year. Of the two reservoirs, Dorena receives the greater fishing intensity and therefore receives larger plants of fish. Most trout fishing at these impoundments occurs between the months of October and June. The reservoirs provided an estimated 37,600 trout fisherman-days in 1965 valued at $75,000. This approximates an average year.

2. MIDDLE FORK SUBBASIN

2. MIDDLE FORK SUBBASIN

This subbasin encompasses the Middle Fork Willamette River and its tributaries (Figure 2.1). Within it, approximately 110 lakes in the Cascade Range provide important habitat for trout. Fall Creek, Hills Creek, Lookout Point, and Dexter Dams have created additional nonstream environment.

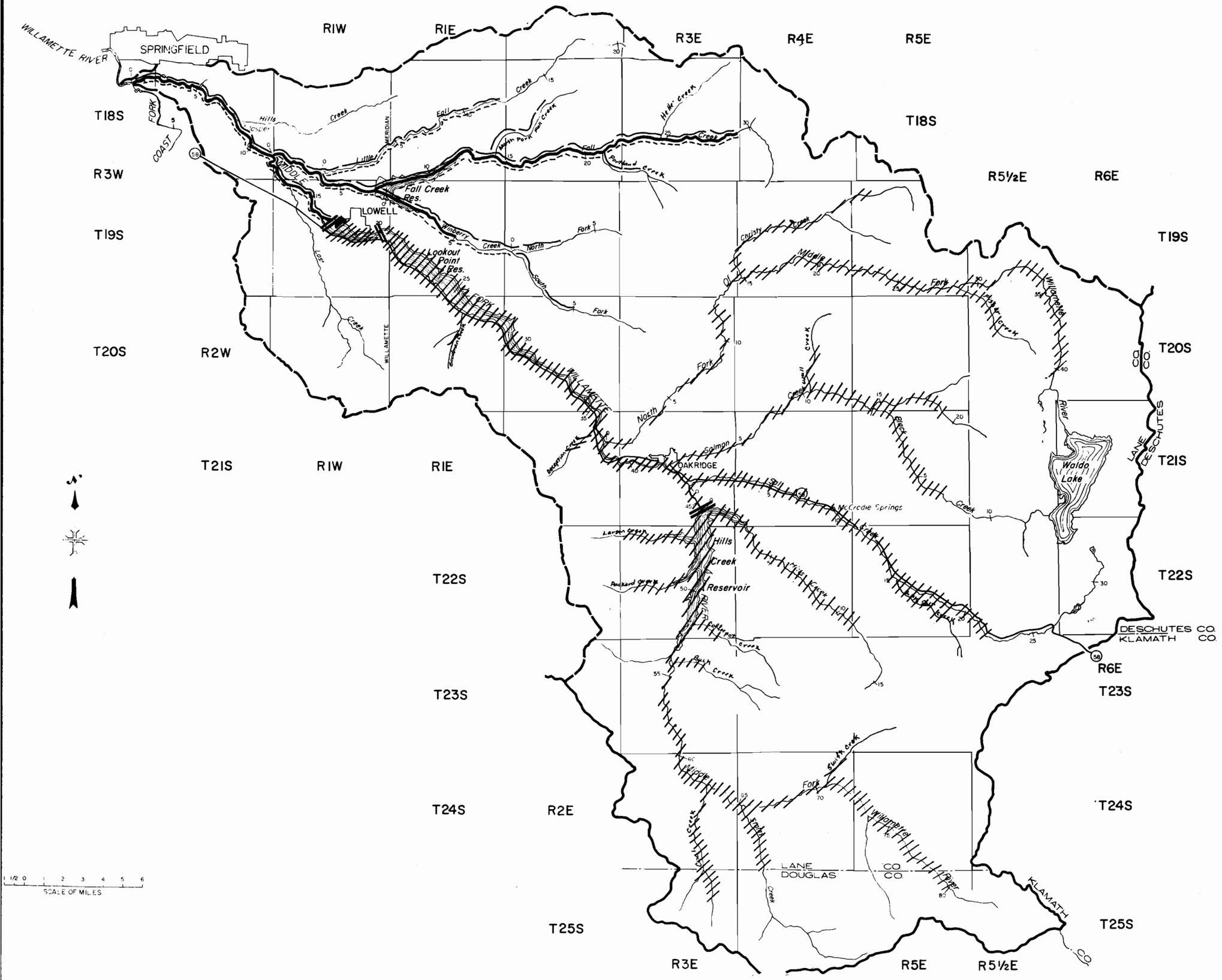
Habitat

The Middle Fork originates at Timpanogas Lake near the summit of the Cascade Range and flows northwesterly for 83.5 miles to join the Coast Fork near Eugene and form the main stem of the Willamette River. The watershed covers 1,354 square miles. North Fork, a major tributary, flows from Waldo Lake for 43.5 miles to enter the Middle Fork at river mile 37.5. Other major tributaries are Fall Creek, Salmon Creek, and Salt Creek.

Most of the subbasin is mountainous with 75 percent of the area above 2,000 feet elevation. Average annual discharge of the Middle Fork is about 4,000 cubic feet per second. Discharge is regulated by four large U. S. Army Corps of Engineers dams and seldom drops below 1,000 cfs at the mouth.

Stream flow quantity and quality are generally favorable for salmonids except in tributaries entering the river below Lookout Point Reservoir. In these tributaries, summer water temperatures commonly range between 65 and 75 F, which limits production of salmonids. Streams in the watershed above Lookout Point Reservoir are cool with water temperatures rarely exceeding 65 F.

The dams on the Middle Fork are Dexter Dam at river mile 16.8, Lookout Point Dam at river mile 20, and Hills Creek Dam at river mile 45.5 (Figure 2.1). Respective reservoir areas are 1,025, 4,360, and 2,740 surface acres. None of the three dams has fish passage facilities. A fourth Corps of Engineers dam, that has fish passage facilities, is located at river mile 7.0 on Fall Creek. Fall Creek Dam forms a reservoir of 1,880 surface acres. Good habitat for salmonids



LEGEND:

Present distribution (May 1966)

- STEELHEAD — — — —
- COHO - - - - - - - -
- CHINOOK ————
- Unaccessible habitat for anadromous fish, blocked by dams

FIGURE 2.1

SUB-BASIN 2

Middle Fork

exists in all the above impoundments, but large numbers of nongame fish preclude the production of trout and salmon in Dexter and Lookout Point Reservoirs.

Water conditions favor salmonid production in the Cascade Lakes. The largest, Waldo Lake, covers 5,500 surface acres and supports substantial populations of rainbow and brook trout.

Species and Distribution

In 1965, over 400 winter steelhead and 6,100 spring chinook salmon entered the Middle Fork Willamette River. This is believed to approximate the average run. Of these, 100 spring chinook and about 60% of the winter steelhead entered Fall Creek. Considerable natural spawning takes place in the river below Dexter.

The subbasin above Dexter Dam is closed to anadromous fish, and therefore many of the Middle Fork fish are trapped at Dexter Dam and artificially spawned. The Fish Commission of Oregon's hatchery at Oakridge has been instrumental in maintaining the spring chinook runs in the Middle Fork. This hatchery was constructed by the Corps of Engineers as mitigation for fish lost because of Lookout Point and Dexter Dams. Fall chinook, coho, and sockeye salmon have been stocked in the lower Middle Fork since 1953, but no significant runs have yet been established. The establishment of these and other anadromous species that enter the Willamette River in summer and fall months depends largely upon reduction of pollution in the lower river and improvement of fish passage at Willamette Falls.

Resident cutthroat and rainbow trout occur throughout the drainage. Cutthroat numbers are moderate to high in most streams. The rainbow populations are low to moderate and confined more to low-elevation areas. Hatchery rainbow are stocked in all larger streams and in Fall Creek and Hills Creek Reservoirs. Whitefish are common in larger streams and a few Dolly Varden are found here too. The lakes in the Cascade Range receive periodic plants of rainbow and brook trout. Kokanee have been liberated into Waldo Lake in recent years and have become established.

Nongame fish common in the Middle Fork drainage are largescale suckers, squawfish, redside shiners, and chiselmouth. These four species, particularly suckers and squawfish, are numerous in Dexter and Lookout Point Reservoirs and the lower portions of their tributary systems. Low numbers of warm-water game fish extend upstream from the Willamette River a short distance into Middle Fork and Fall Creek.

Developments and Conditions Adversely Affecting Fish Resources

Dams have adversely affected game fish and their harvest. More than 215 miles of stream environment, 80 percent of the subbasin's total, are closed to salmon and steelhead by Dexter Dam. Lookout Point, Hills Creek, and Hines Lumber Company Dams, upstream from Dexter, are also impassable. Excellent runs of spring chinook once utilized the upper Middle Fork and its tributaries, North Fork, Salmon Creek, and Salt Creek. The magnitude of these runs was comparable to, and possibly exceeded, runs of the nearby McKenzie River.

Hatchery facilities provided by the Corps of Engineers as mitigation for losses from construction of dams are not capable of rearing the number of juvenile salmon and steelhead that could be produced in the streams isolated by the barriers. Adult spring chinook are now forced to remain in the lower river or in a holding pond at the Dexter Dam fish trap during summer and fall months prior to spawning. Before construction of the dams, salmon ascended to cooler, higher elevation streams to mature. Spring chinook compelled to remain below Dexter Dam occasionally suffer severe losses from disease associated with warm water temperatures. Losses have been relatively light since 1961, however, possibly because of cool water released from Hills Creek Reservoir.

Quantities of water released into the river from Dexter Reservoir are normally adequate for fish life. However, releases are sometimes quickly and drastically reduced for flood control purposes. These reductions strand many fish in side

channels and pools, resulting in heavy mortality. If lowering of the river level were done more slowly, fewer fish would be killed.

Nongame species have found a haven in the warm pools formed by Dexter and Lookout Point Dams. Many have spread upstream from Lookout Point Reservoir to streams where they previously were uncommon or nonexistent. Trout stocked in the impoundments following construction of the two dams thrived for a few years until competition from suckers, squawfish, and other nongame species became intense. Angler effort and catch dropped from 25,000 angler-trips and 45,200 trout at Lookout Point in 1955 to a relatively few angler-trips and 1,500 trout in 1959. The pattern at Dexter was quite similar with 19,200 angler-trips to catch 26,900 trout in 1956, while only a handful of anglers took less than 2,000 fish three seasons later. Trout are no longer planted in either reservoir because of the large populations of competing nongame fish.

Hills Creek, Lookout Point, and Dexter Reservoirs inundate 31.8 miles of stream habitat that formerly produced salmon and trout, and where anglers came to fish.

Hills Creek Dam, located in the Middle Fork 12.6 miles above Lookout Point Reservoir, was completed in 1962. Shortly before impoundment of water commenced, the river system upstream was chemically treated to reduce or, if possible, eliminate redside shiners, largescale suckers, and squawfish. To date the redside shiner is the only undesirable species known to survive the treatment. It is becoming numerous and poses a threat to salmonid production within the reservoir and in adjoining streams.

Fall Creek Dam was completed in 1965. A study is under way to evaluate effects of the dam and appurtenant fish passage facilities upon salmon and steelhead. Prior to completion of the dam, the watershed above it was chemically

treated to reduce the numbers of nongame fish. These fish could become re-established and preclude production of salmonids as they have in Dexter and Lookout Point reservoirs.

Historically, more spring chinook salmon were produced in the North Fork than in any other Middle Fork tributary. A 24-foot high dam now owned by the Hines Lumber Company was constructed prior to 1928 in the North Fork of the Middle Fork at river mile 1.4. Prior to the construction of Dexter and Lookout Point Dams, the structure blocked the upstream migration of spring chinook because of its inadequate fishway. At present it has no fishway at all.

Recurring introductions of bark and sawdust into the North Fork from the Hines Lumber Company mill were reduced in 1960, but pollution still occurs. Decomposition of the mill waste lowers dissolved oxygen concentrations of the river and reservoirs downstream. There are no other subbasin pollution sources seriously affecting fish.

Water rights for consumptive use of surface water total about 100 cfs (Table 2.1). The volumes are about evenly divided for irrigation, industrial, and municipal uses. Diversion of most water occurs along the Middle Fork below Dexter Dam. The amount of water diverted is more than offset by water released from the reservoir, and thus diversion has little adverse effect on fish life. An exception is an unscreened ditch diverting water to a log pond near river mile 3.8. The water returns to the Willamette River over a 6-foot falls at Springfield.

Past plans for tapping Waldo Lake to utilize its waters for downstream power development have been suppressed. Legal measures should be afforced to prevent withdrawals from the lake in the future because of its high value for angling and other recreational use.

Table 2.1. Appropriated surface water and minimum stream flow measurement data, Middle Fork Subbasin.

Stream Areas	Appropriated Surface Water (cfs) 1/ Non-Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
Middle Fork Willamette River below Lookout Point Dam	0.0	31	100(daily mean)	2.7 miles below Dexter Dam	Nov. 25, 1960 (1946-1965)	U.S. Geological Survey
Fall Creek System	0.0	9.7	19	River mile 6.1	Dec. 1, 1936 (1935-1965)	U.S. Geological Survey
Lost Creek System	--	21	2.0	River mile 1.7	Sept. 8, 1965	Ore. Game Comm.
Other tribs to Middle Fork below Lookout Point Dam	0.5	17	--	--	--	--
Middle Fork Willamette River above Lookout Point Dam	0.1	0.1	322	4.2 miles below North Fork	Aug. 30, 1961 (1923-1965)	U.S. Geological Survey
North Fork of Middle Fork Willamette R. System	0.0	10	26	River mile 1.0	Oct. 14, 1939 (1909-1916) (1935-1965)	U.S. Geolog-Survey
Salmon Creek System	82	2.6	63 (freezeup)	River mile 5.0	Jan. 8, 1937 (1933-1965)	U.S. Geological Survey
Salt Creek System	0.9	6.6	55 (freezeup)	River mile 0.7	Jan. 8, 1937 (1933-1951)	U.S. Geological Survey
Other tribs to Middle Fork above Lookout Point Dam	9	1.8	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.
2/ U.S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listing is the lowest of flows measured monthly in low discharge periods of 1964 and 1965.

Developments Beneficial to Fish Resources

Table 2.2 shows legal minimum stream flow stipulations established in the subbasin. Future appropriations may be made only for domestic or livestock uses from natural flows of the listed stream areas. Additionally, natural lakes other than those privately owned are protected from substantial water withdrawals by State Water Resources Board programming.

Table 2.2. Minimum stream flow stipulations beneficial to fish.

Stream	Location	Minimum Flows in Cubic Feet per Second 1/	
		Natural	Storage
Middle Fork Willamette River and Tributaries	Mouth	640	1,475
Middle Fork Willamette River and Tributaries	Above confluence with North Fork of Middle Fork Willamette River	285	690
Fall Creek and Tributaries	Mouth	40	470
North Fork of Middle Fork Willamette River and Tributaries	USGS Gage 1.0 mile above mouth	115	---

1/ "Natural" minimum flow stipulations were set by the Oregon State Water Resources Board in 1962. The "storage" volumes are provided in addition whenever possible from U.S. Army Corps of Engineers dams located upstream.

Two fish hatcheries are located on lower Salmon Creek at Oakridge. The one operated by the Fish Commission of Oregon rears anadromous fish from eggs of adults trapped at Dexter Dam. The adjacent Oregon State Game Commission hatchery rears mostly rainbow trout for stocking in the upper Willamette watershed. Fish liberations made into subbasin waters in the 1961-65 interval are listed in Table 2.3.

Table 2.3. Fish stocking in Middle Fork Willamette Subbasin, 1961-1965.

Stream system or lake	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency
Middle Fork	Spring								
Willamette	Chinook	--	12-27	1,459,963	1,184,979	2,455,714	3,916,099	1,750,862	OFC
" "	"	--	1,150				170,536		"
" "	Coho	--	16		42,559	93,339			"
" "	"	--	1,250					200,000	"
" "	Steelhead	--	8	122,295	3,484				"
" "	"	--	48-78			275,860	125,970		"
" "	Kokanee	0-2	--				6,885		OSGC
" "	Rainbow	0-2	--	1,395,894					"
" "	"	2-4	--	58,609					"
" "	"	4-6	--	3,333					"
" "	"	8 & over	--	118,600	130,761	125,970	306,915	91,169	"
Fall Creek	Coho	--	1,100-1,200			350,000		410,000	OFC
" "	Rainbow	8 & over	--	18,032	17,832	13,006	13,217	9,971	OSGC
" "	"	4-6	--					189,773	"
Waldo Lake	Brook Trout	2-4	--	258,706	668,860	300,170	213,867	193,273	OSGC
" "	Kokanee	"	--			174,980	219,169	337,080	"
" "	Rainbow	0-2	--	286,500	963,500	326,000			"
" "	Rainbow	2-4	--	3,740	100,016		240,625	414,235	"
" "	"	4-6	--			54,919	103,135		"
Other Cascade									
Lakes	Brook Trout	2-4	--	66,017	84,385	69,706	83,570	66,858	"
" "	Golden "	"	--		886	3,392	1,972		"
" "	Rainbow	2-4	--	52,874	58,010	640,810	74,424	78,467	"
Dexter Reservoir	"	8 & over	--	6,112	10,009				"
Hills Cr. "	"	0-2	--			245,760			"
" " "	"	2-4	--	69,975	101,972	300,596	84,477	12,569	"
" " "	"	4-6	--	308,595	43,186	6,200	200,185	201,435	"
" " "	"	8 & over	--		38,666	160			"

Present Economy

The subbasin provides an annual average of 16,000 spring chinook and a few winter steelhead to the Columbia River and Pacific Ocean commercial fisheries. This represents a catch of 277,000 pounds of fish valued at $155,000 annually.

Most sport catches of anadromous fish produced in the Middle Fork drainage are made in areas outside the subbasin, but the fishery in the Middle Fork is gaining in popularity and the catch there is expected to increase. Approximately 8,200 spring chinook and steelhead produced in the subbasin furnish an estimated 65,500 days of fishing valued at $393,000 annually.

Resident cutthroat or rainbow trout provide fishing in nearly all streams. Heaviest trout angling is absorbed by the larger streams where stocks are supplemented with hatchery rainbow. Subbasin streams contributed an estimated 52,500 days of trout fishing valued at $158,000 in 1965.

The Cascade lakes supply considerable angling through the summer season. Brook and rainbow trout stocked as fingerlings from airplanes are the main species harvested. Kokanee are caught only in Waldo Lake. Good fishing has resulted from rainbow plants in Hills Creek Reservoir, and similar success is expected in Fall Creek Reservoir as long as numbers of nongame fish remain low.

An estimated 28,000 angler-days valued at $56,000 was exerted to harvest 132,000 trout annually from Hills Creek Reservoir in 1963. Other trout fisheries of considerable magnitude, but unmeasured, exist on numerous high Cascade lakes in the subbasin. The catch, and angler use value, of warm-water game fish is negligible.

3. McKENZIE SUBBASIN

3. McKENZIE SUBBASIN

Nearly all streams in the McKenzie River system support important game fish populations (Figure 3.1). Reservoir habitat is provided by three impoundments of the Eugene Water and Electric Board and by Cougar and Blue River Reservoirs of the U. S. Army Corps of Engineers. Approximately 90 lakes in the Cascade Range furnish valuable trout environment.

Habitat

The McKenzie River originates at Clear Lake near the Cascade summit and flows west for 90 miles before entering the Willamette River at river mile 175 near Eugene. The watershed area is 1,342 square miles. About 70 percent of the subbasin lies above the 2,000-foot elevation. Most streams are thus mountainous in character. The gradients are moderate to steep, and spawning gravel is plentiful. Summer stream flows are relatively high, partially due to extensive lava areas near the Cascade Range crest that act as subsurface reservoirs. Since 1944, average discharge of the McKenzie at a U. S. Geological Survey gage 7.1 miles above the mouth has been about 6,000 cubic feet per second. The minimum flow recorded at this location was 1,250 cfs on September 27, 1961.

Summer stream temperatures seldom exceed 65 F except in the lower watershed. Diurnal water temperatures occasionally reach 70 F in the lower river and 75 F in the Mohawk River system, tributary to the McKenzie at river mile 14.0.

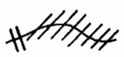
Impassable falls exist in upper portions of several streams, but there is little habitat of value to anadromous fish above them. Prior to construction of Eugene Water and Electric Board's Trail Bridge Dam in 1963, 60-foot Tamolitch Falls at river mile 85.8 was the upper limit of anadromous fish distribution. Now the upper limit is a low dam at river mile 81.6 situated immediately downstream from Trail Bridge Dam. This dam is a "water velocity barrier" for diverting spring chinook adults into an adjacent artificial spawning channel. The channel was

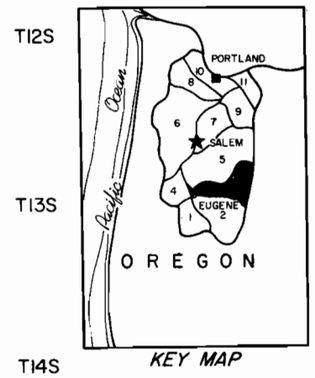
LEGEND:

Present distribution (May 1966)

- STEELHEAD — — — —
- COHO - - - - - - - -
- CHINOOK ——————

Unaccessible habitat for anadromous fish, blocked by dams





KEY MAP

T12S T13S T14S T15S T16S T17S T18S T19S

R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E

LINN CO. LANE CO. JEFFERSON CO. DESCHUTES CO.

Willamette River, McKenzie River, Coburg, EUGENE, SPRINGFIELD, Walterville, Leaburg, pVida, Marcola, Mohawk River, McKenzie River, Blue River, Blue River Res., McKenzie Bridge, Belknap Springs, Lava Lake, Fish Lake, Clear Lake, Big Lake, Carmen Res., Smith Res., Trail Bridge Res., Cougar Res., North Sister, Middle Sister, South Sister

1 1/2 0 1 2 3 4 5 6
SCALE OF MILES

FIGURE 3.1

SUB-BASIN 3

McKenzie

provided as mitigation for spring chinook habitat blocked by Trail Bridge and Smith River Dams (Figure 3.2).

At least 90 Cascade lakes in the subbasin offer excellent trout habitat. Big Lake, the largest, covers 223 surface acres. Trail Bridge Reservoir, 73 surface acres; Smith River Reservoir, 170 surface acres; and Carmen Reservoir, 31 surface acres, are Eugene Water and Electric Board impoundments in the upper McKenzie River watershed providing additional waters for salmonids and angling. Cougar Dam, which was completed in 1963 on the South Fork of the McKenzie River at river mile 4.5, covers 1,280 surface acres. Blue River Dam, a 975-acre impoundment at river mile 1.7 on Blue River, was completed in 1968.

Species and Distribution

About 50 percent of the spring chinook which ascend Willamette Falls, or about 14,500 fish, enter the McKenzie River. Principal spawning streams, in order of descending importance, are: McKenzie River main stem, South Fork, Horse Creek, Lost Creek, and Gate Creek. Small numbers of spring chinook also utilized Blue River but were displaced by Blue River Dam.

Annual spawning populations of coho and winter steelhead total about 50 and 350 fish, respectively. The coho are from recent plants and were first recorded spawning in the subbasin in the fall of 1964. Most of the winter steelhead enter the Mohawk River system. Why there is only a token run of steelhead in the McKenzie system above the Mohawk is unknown, since the large number of spring chinook indicates the habitat is excellent. Figure 3.1 shows known anadromous fish distribution in the McKenzie drainage.

Rainbow and cutthroat trout exist in moderate to high numbers throughout the subbasin. Native rainbow in the main stem McKenzie, traditionally called "redsides", normally range from 13 to 16 inches long when mature and occasionally exceed 24 inches. Relatively low numbers of Dolly Varden trout and whitefish inhabit most

Figure 3.2. Carmen-Smith Artificial Spawning Channel at River Mile 81.6. July, 1966.

of the larger, high-elevation streams. Stocked brook and rainbow trout are the predominant species in the Cascade lakes. A few of these lakes contain native cutthroat and planted golden trout. Kokanee salmon are well established in Big Lake. Stocked rainbow trout are prevalent in the subbasin's reservoirs.

Cool water temperatures limit warm-water game fish and nongame fish populations in most of the watershed. Dace, sculpins, and suckers are the only nongame species found in the drainage above the mouth of Blue River. Moderate numbers of squawfish, dace, sculpins, suckers, lamprey, redside shiners, and chiselmouth are present in the lower McKenzie system upstream to and including the Mohawk River.

Developments and Conditions Adversely Affecting Fish Resources

The kraft paper plant of Weyerhaeuser Company in Springfield is a major source of pollution. Several million gallons of polluted water are discharged daily into the McKenzie from this plant at river mile 10.0. These noxious wastes threaten fish directly by lowering the dissolved oxygen concentration, and indirectly by reducing the production of aquatic organisms serving as fish food.

Sand and gravel mining operations along the lower McKenzie periodically cause high turbidity that is detrimental to salmonid spawning and rearing, and interferes with angling. Logging and road building create similar stream siltation problems in most years.

Construction activity associated with Cougar Dam has resulted in high silt loads in lower South Fork. Silt put in suspension during the 1964-65 floods settled slowly in Cougar Reservoir; consequently, water released throughout the following spring and summer was turbid.

An evaluation of fish passage facilities has indicated that Cougar Dam and Reservoir are harmful to spring chinook in the South Fork. Adult chinook are trapped below the dam and hauled to a release site in the river above the reservoir. An elaborate "fish horn" collection system is incorporated into the dam to provide downstream passage for juvenile salmon.

The South Fork is the McKenzie River's major spring chinook spawning tributary. In 1958, prior to construction of Cougar Dam, the South Fork run was calculated to be 4,400 fish. Table 3.1 lists numbers of adults trapped at the damsite and released above the reservoir since 1960. Altered flow conditions in 1965 in the South Fork below the dam are suspected to be the cause for the low numbers trapped that year.

Blue River and Trail Bridge Dams eliminate approximately 5 miles of stream area formerly utilized by spring chinook. Numbers of chinook entering the artificial spawning channel below Trail Bridge Dam since its construction in 1961 are included in Table 3.1. Efficiency of this facility is also being evaluated.

Table 3.1. Adult spring chinook counts at Cougar Dam and Carmen-Smith spawning channel.

Year	Cougar Dam Trap	Carmen-Smith Spawning Channel
1960	629	--
1961	1,046	169
1962	2,121	121
1963	2,050	160
1964	740	169
1965	68	56
1966	263	87

Source: Fish Commission of Oregon.

Two Eugene Water and Electric Board canals remove large volumes of water from the McKenzie for power generation. Walterville canal, the lower diversion, begins at river mile 28.4 and re-enters at river mile 21.0. This bifurcation is at stream level and requires no diversion dam. Leaburg Canal, the upper diversion, begins at river mile 38.9 and re-enters the McKenzie at river mile 33.3. Leaburg Dam, the 20-foot high diversion structure, is provided with two ladders. However, about

200 spring chinook spawn within 150 yards of the dam each year, indicating that a passage problem exists.

Walterville and Leaburg Canals, since their construction in 1911 and 1930, respectively, have created other problems affecting spring chinook. The 13 miles of river channel bypassed by the canals contain extensive gravel supplies which are heavily used by spawning chinook. Spawning occurs in September and October, normally the season of lowest stream flows. During this period substantial amounts of water are removed by the two canals, leaving minimal flows in the river for the spawning salmon. Also, flow regulation through the canals at this time occasionally causes large fluctuations in water levels in the affected river sections. Redds of salmon spawning at high flows are thus exposed as flows are rapidly decreased. Joint studies conducted by Fish Commission of Oregon and Oregon State Game Commission biologists in 1952 and 1955 resulted in agreements with Eugene Water and Electric Board whereby certain minimum flows are provided in the two river areas. These are better than prior conditions, but provisions should be made to further modify the large flow fluctuations which sometimes occur during the spawning season.

Large numbers of spring chinook are falsely attracted into Walterville and Leaburg canals. Walterville power plant is located 2 miles above the lower end of its canal, whereas the Leaburg power plant is 200 yards above the lower end of its canal. Flows through the power plants are sometimes purposefully reduced so the fish will drop downstream and return to the river. The greater problem is at Walterville power plant because of its longer tailrace canal. An additional small canal built specifically for fish passage, connects the Walterville canal with the river and partially alleviates the problem.

Neither Walterville nor Leaburg canal is screened to prevent loss of fish migrating downstream. Mortality studies conducted by the Oregon State Game Commission

at the two power plants in 1956 revealed significant losses of fish as a result of passage through the turbines.

The Secretary of the Interior has requested that the Federal Power Commission include in any license granted for these projects provision that at least agreed-upon minimum flows be allowed to pass down McKenzie River past Walterville Canal and at least 500 cfs be permitted past Leaburg Dam at all times. Construction, maintenance, and operation of permanent upstream and downstream fish protection devices at the entrance and exit of the Leaburg Canal, and the entrance to Walterville Canal were also requested.

Present consumptive uses of surface water (Table 3.2) do not conflict seriously with fish, but one unexercised right for 1,216 cfs of McKenzie River water for irrigation is a potential threat to fish life and recreational uses. Such a withdrawal would take most of the water during low discharge periods.

Developments Beneficial to Fish Resources

Oregon's largest trout hatchery, located at Leaburg Dam, is operated by the Oregon State Game Commission. Rainbow trout, the predominant species reared there, are released into the McKenzie system and other waters of the state. Another hatchery 2.5 miles downstream is managed by the Fish Commission of Oregon. This installation rears juvenile spring chinook salmon from eggs of adults trapped in the Walterville Canal tailrace. The young salmon are subsequently released back into the McKenzie. Fish liberations in streams of the subbasin for the 1961-65 period are listed in Table 3.3.

Table 3.4 lists legal minimum stream flow stipulations established in the subbasin and future appropriations may be made only for domestic or livestock uses from natural flows of these stream areas. Additionally, the McKenzie River's flows above river mile 76.9, including tributary Smith River, are protected by State Water Resources Board programming from future appropriations for nearly all consumptive uses. Natural lakes, other than those privately owned, are also protected from substantial water withdrawals.

Table 3.2. Appropriated surface water and minimum stream flow measurement data, McKenzie Subbasin.

Stream Areas	Appropriated Surface Water (cfs) 1/ Non Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
McKenzie River	9,478	1,854	1,250	River Mile 7.1	Sept. 27, 1961 (1944-1965)	U.S. Geological Survey
Blue River System	1.0	0.05	11	River Mile 5.1	Aug. 21,22,1961 (1935-1965)	U.S. Geological Survey
Gate Creek System	40	0.3	16	Mouth	Sept. 2, 1965	Ore. Game Commission
Horse Creek System	0.1	0.7	277	River Mile 3.4	Oct. 15-20,1963 (1962-1965)	U.S. Geological Survey
Mohawk River System	0.2	5.4	11	River Mile 1.6	Sept. 17, 1938 Sept. 22, 1951 (1935-52)(1963-65)	U.S. Geological Survey
South Fork McKenzie River System	0.0	0.0	36	0.6 mile below Cougar Dam	Mar. 30, 1964 (1947-1965)	U.S. Geological Survey
Other tributaries to the McKenzie River	1020	46	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.
2/ U. S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listing is the lowest of flows measured monthly in low discharge periods of 1964 and 1965.

Table 3.3. Fish stocking in McKenzie Subbasin, 1961-1965.

Stream system or lake	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency 1/
McKenzie	Fall Chinook	--	943-981				2,279,815		USFWS
"	Spring "	--	19-42	520,409	145,064	445,565	479,212	634,546	OFC
"	" "	--	443-978			32,629		63,721	"
"	Coho	--	17					10,000	"
"	"	--	1100-1250		233,562	500,000		500,000	"
"	Rainbow	8 & over	--	163,992	179,931	180,019	119,917	162,741	OSGC
"	"	4-6	--					60,400	"
Big Lake	Brook trout	2-4	--	26,000	24,810	25,000	24,990		OSGC
" "	Kokanee	"	--	38,520	49,811	24,858	25,040	25,370	"
" "	Rainbow	"	--		37,130				"
Clear Lake	Brook trout	2-4	--		50,015	39,985			"
" "	Rainbow	"	--			25,012		56,975	"
" "	"	4-6	--	21,419		25,039	50,000		"
" "	"	8 & over	--	30,995	30,140	30,000	31,804	40,000	"
Other Cascade Lakes	Brook trout	2-4	--	82,809	81,945	67,790	78,965	71,957	"
" "	Golden trout	"	--	1,185	559	1,921	1,740		"
" "	Rainbow	"	--	15,580	67,795	38,030	17,400	27,036	"
" "	"	4-6	--					20,023	"
" "	"	8 & over	--					11,201	"
Carmen-Smith Reservoirs	"	0-2				650,120			OSGC
" "	"	2-4	--			95,995		113,900	"
" "	"	4-6	--				71,702		"
" "	"	8 & over	--			28,053	33,512	23,140	"
Cougar Reservoir	"	"	--				9,087	30,001	"
" "	"	4-6	--					49,564	"
" "	"	2-4	--					100,270	"

1/ Abbreviations used in this table are: "USFWS", U.S. Fish & Wildlife Service; "OFC", Fish Commission of Oregon; "OSGC", Oregon State Game Commission

Table 3.4. Minimum stream flow stipulations beneficial to fish.

Stream 1/	Location	Minimum Flows in Cubic Feet Per Second 2/ Natural	Storage
McKenzie River	Above Interstate 5 Highway	1,025	700
McKenzie River	Above USGS Gage 14-1625 at River Mile 47.7	1,400	580
Mohawk River	Above mouth	20	-
Gate Creek	Above mouth	20	-
Blue River	Above mouth	30	350
South Fork McKenzie River	Above mouth	200	230

1/ Includes all tributaries above the listed locations.

2/ "Natural" minimum flow stipulations were set by the Oregon State Water Resources Board in 1962. The "storage" volumes are provided in addition whenever possible from U.S. Army Corps of Engineers dams located upstream.

Present Economy

Streams of the subbasin provide an average annual catch in the Columbia River and Pacific Ocean commercial fisheries of 39,000 spring chinook salmon valued at $380,000. The commercial catch of coho and steelhead is estimated at 150 fish valued at $400 annually.

Light to moderate sport angling for spring chinook salmon is concentrated between the McKenzie River mouth and Leaburg Dam. This fishery, conducted from both boats and the bank in spring months, is gradually gaining in popularity. The sport catch of coho and steelhead is insignificant. In 1965 the subbasin furnished about 19,000 spring chinook salmon and small numbers of steelhead and coho to the McKenzie, lower Willamette River, Columbia River, and Pacific Ocean sport fisheries. This fishery supported an estimated 155,000 angler days of fishing valued at $930,000.

4. LONG TOM SUBBASIN

4. LONG TOM SUBBASIN

Streams of this subbasin are those of the Long Tom River system, (Figure 4.1). Fern Ridge Reservoir and an adjacent borrow pit form the major nonstream environments.

Habitat

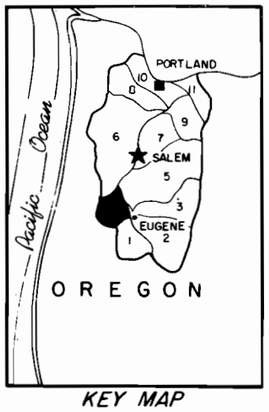
Long Tom River, 55 miles long, enters the Willamette River from the west at river mile 149 between Corvallis and Eugene and drains 410 square miles. Stream flows in the subbasin are low and warm in summer months, being typical of west side Willamette River tributaries. Less than half of the 700 miles of stream in the subbasin maintain perennial flows. Only the upper portions of the Long Tom River and some of its tributaries flow from the Coast Range mountains, thus 95 percent of the drainage area lies below 1,000-feet elevation.

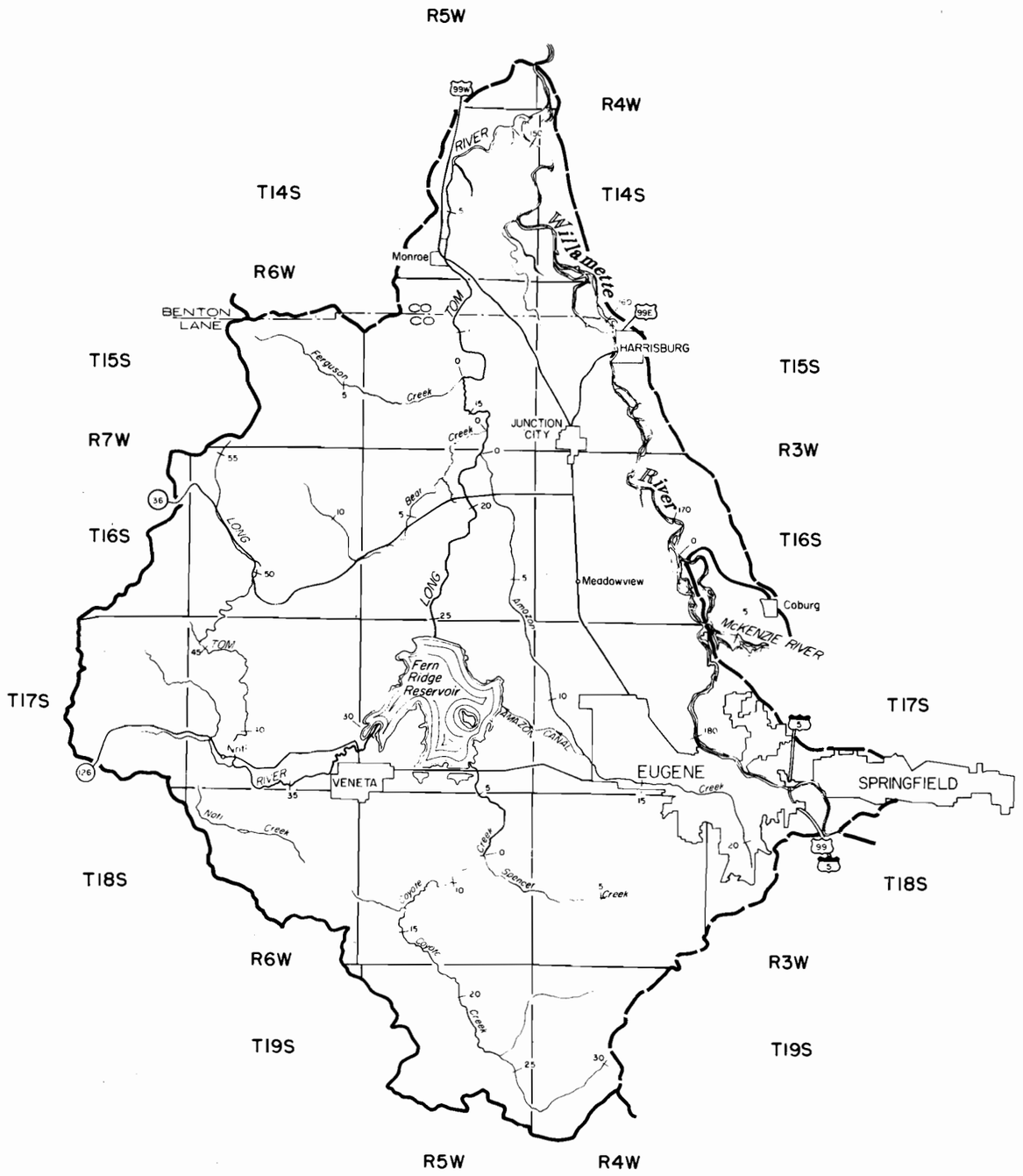
Stream temperatures in summer months commonly exceed 75 F. Some of the highest occur in the section of the Long Tom River between its mouth and Fern Ridge Reservoir. In this area, diurnal water temperatures during the summer generally range from 70 to 80 F and have been recorded as high as 84 F.

Fern Ridge Reservoir was constructed on the Long Tom River at river mile 26 by the U. S. Army Corps of Engineers in 1941. The unladdered earthen dam, 44 feet high, forms an impoundment of 9,360 surface acres. Although built mainly for flood control, the reservoir is heavily used for angling and other forms of recreation.

Immediately below Fern Ridge Dam is a large borrow pit from which construction material for the dam was obtained. Now filled with water, the borrow pit offers good habitat for fish, and more anglers use it than the reservoir itself.

Numerous sites for small reservoirs are scattered throughout the watershed. Some of these, if developed, could create favorable fish habitat. Impoundments most beneficial would be those which would improve downstream flows.





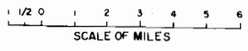


FIGURE 4.1

SUB-BASIN 4

Long Tom

Species and Distribution

No anadromous fish utilize the Long Tom drainage. Because of poor summer rearing conditions, it is doubtful if these species were ever present in significant numbers.

Despite unfavorable summer water conditions, native cutthroat trout exist in moderate numbers in all streams maintaining perennial flows. Through evolution, these fish have adapted themselves to survive in the system. Many other salmonid species could not tolerate the high water temperatures in the summer if introduced into the subbasin. Cutthroat also inhabit Fern Ridge Reservoir, but their numbers are limited by competition from warm-water game fish and nongame fish.

Bullhead catfish, crappie, and largemouth bass are the predominant warm-water game species in Fern Ridge Reservoir. Bluegill and pumpkinseed are less common inhabitants. Several forms, particularly white crappie, maintain substantial populations in the river below the reservoir. Fish species composition in the adjacent borrow pit is similar to that of the reservoir and river below.

Nongame species, such as suckers, squawfish, carp, and redside shiners, are numerous in the lower Long Tom system and in Fern Ridge Reservoir and its tributaries.

Developments and Conditions Adversely Affecting Fish Resources

Fern Ridge Reservoir is favorable for the production of nongame fish that compete with more desirable game species. Reduction of water levels for flood control further limits the production of game fish. The release of warm water from the reservoir contributes to the high temperatures in the river below. These high temperatures limit or prohibit the production of cold-water species and promote the production of warm-water and nongame fish.

A laddered concrete dam, 10 feet high, stands in the Long Tom River at Monroe. Two unladdered dams, 6 and 10 feet high, are located between Monroe and Fern Ridge

Reservoir. These latter two barriers virtually preclude the upstream migration of salmonids, but are not a serious problem since there is little spawning area between them and Fern Ridge Dam.

Numerous withdrawals of water for consumptive use occur from subbasin streams. Water rights have been issued for the consumptive use of about 130 cfs (Table 4.1). Most surface water rights are for small irrigation withdrawals.

Developments Beneficial to Fish Resources

Fern Ridge Reservoir and its adjoining borrow pit furnish extensive game fish habitat. Minimum releases of 30 cfs are made from the impoundment in summer months. These flows provide favorable habitat for warm-water game fish in the river below.

In 1949, Fern Ridge Reservoir was chemically treated to remove large numbers of nongame fish. It was subsequently restocked with game species. Similar treatment may be repeated periodically as the need arises.

Table 4.2 lists trout releases in the subbasin between 1961 and 1965. No anadromous fish are stocked in the subbasin.

Present Economy

Fishing pressure is heavy on Fern Ridge Reservoir and the borrow pit below the dam. Cutthroat trout, largemouth bass, bullhead catfish, bluegill, and crappie are the predominant species caught. Warm-water game fish and trout are also taken by fishermen in the river immediately below the reservoir. Six smaller borrow pits located along the west side of Highway 99W between Eugene and Junction City provide additional warm-water game fish angling. The warm water and reservoir fishery provided an estimated 30,000 angler days of fishing valued at $45,000 annually in 1965.

Approximately 1,300 trout were caught in subbasin streams in 1965. The harvest includes stocked rainbow trout of catchable size liberated in the upper Long Tom

Table 4.1. Appropriated surface water and minimum stream flow measurement data, Long Tom Subbasin.

	Appropriated Surface Water (cfs) 1/		Instantaneous Minimum Flows Measured			
Stream Areas	Non Consumptive	Consumptive	Instantaneous Discharge (cfs)	Location	Date 2/	Source
Long Tom River below Fern Ridge Dam	0.0	22	0	At Monroe, River mile 6.8	Oct. 20-22,1944 (1927-1965)	U.S. Geological Survey
Tributaries to Long Tom R. below Fern Ridge Dam	0.1	29	--	--	--	--
Long Tom River above Fern Ridge Dam	0.0	9.8	7	Near Noti, River mile 37.4	Sept. 25-27,1939 (1935-1965)	U.S. Geological Survey
Tributaries to Long Tom River above Fern Ridge Dam	1.5	69	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.
2/ Periods of available records are shown in parenthesis.

Table 4.2. Fish stocking in Long Tom Subbasin, 1961-1965.

Stream system or lake	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency
Long Tom River	Rainbow	8 & over	--	3,999	4,013	3,930			OSGC 1/
Fern Ridge Reservoir	Rainbow	8 & over	--	5,264	5,005	5,002			OSGC
Fern Ridge Borrow Pit	Rainbow	8 & over	--				5,967		OSGC

1/ Oregon State Game Commission

River. Trout angling pressure occurs mostly in the spring shortly after stocking. Many cutthroat trout from Fern Ridge Reservoir are caught incidentally by bait fishermen angling for warm-water game fish species. Stream caught trout furnished an estimated 900 angler-days fishing valued at $2,700 in 1965.

5. SANTIAM SUBBASIN

5. SANTIAM SUBBASIN

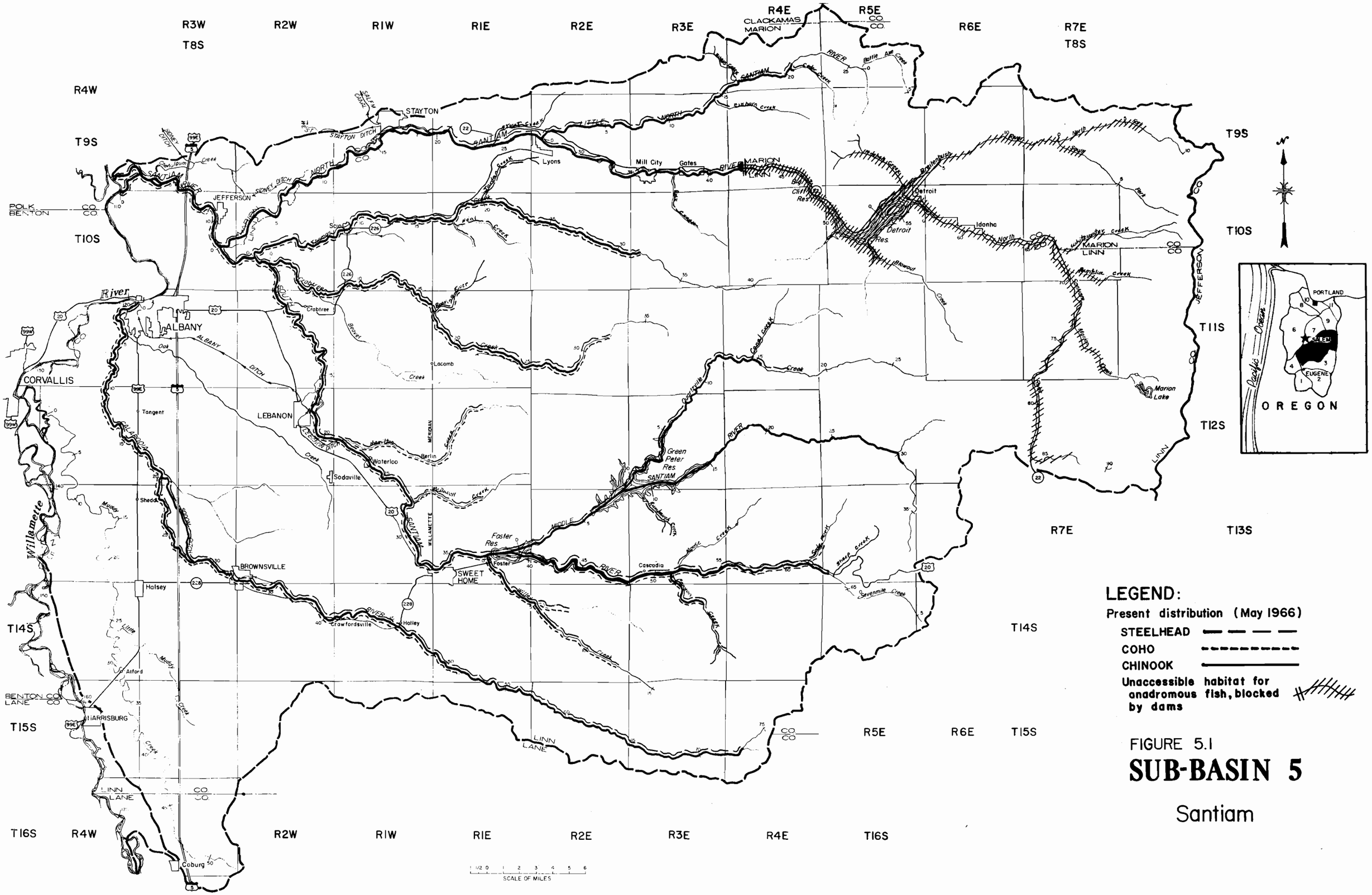
The Santiam and Calapooia River drainages comprise this subbasin (Figure 5.1). Nonstream waters with managed fish populations include approximately 125 Cascade mountain lakes, a few lowland lakes, Detroit and Big Cliff Reservoirs on the North Santiam River, and Foster and Green Peter Reservoirs in the South Santiam River drainage.

Habitat

The North Santiam River, 92 miles long, and the South Santiam River, 66 miles long, join to form the Santiam River near the town of Jefferson. The Santiam River, 11 miles long, enters the Willamette River from the east at river mile 109 between Salem and Albany. The entire Santiam River watershed covers 1,827 square miles.

Both forks of the Santiam drain forested watersheds extending to the Cascade Range summit. Without flow diversion or regulation, summer stream discharge would rarely drop below 500 cfs at the mouth of the North Santiam, or below 150 cfs at the mouth of the South Santiam. Substantial amounts of water are diverted from each stream for municipal, industrial, power generation, and agricultural purposes. Release of water from Detroit Reservoir in the low flow periods, however, normally compensates for the North Santiam diversion losses. Green Peter and Foster Reservoirs supplement summer flows in the South Santiam.

Calapooia River, 75 miles in length, drains 374 square miles and joins the Willamette River from the east at Albany. The upper river drains the Cascade Range foothills. Near the community of Holley at river mile 45, the gradient begins to flatten as the river approaches the Willamette Valley floor. Below Brownsville (river mile 33) the gradient is flat, and the river meanders through agricultural land. River discharge in the summer is seldom less than 25 cfs either at Holley or at the mouth, but owing to numerous irrigation withdrawals, summer flow commonly



LEGEND:

Present distribution (May 1966)

- **STEELHEAD** — — — —
- **COHO** - - - - - - - -
- **CHINOOK** ——————
- **Unaccessible habitat for anadromous fish, blocked by dams** ////////

FIGURE 5.1

SUB-BASIN 5

Santiam

falls below this volume in sections of the river downstream from Holley. Since 1940 the lowest instantaneous flow recorded by a U. S. Geological Survey gage near the river mouth was 4 cfs.

Stream flow quantities and qualities are usually favorable for salmonids except in lower areas of the subbasin where the gradient is flat. In the summer and early fall, lower portions of the Calapooia and South Santiam Rivers and their tributaries experience reduced flows which are not conducive to salmonid rearing. Diversion from these two rivers aggravates the problem. Water temperatures of the Calapooia below Holley and the South Santiam below Waterloo commonly exceed 75 F and occasionally rise above 80 F in summer months. Paper mill wastes introduced at Lebanon further limit the value of the South Santiam for trout and salmon. Releases of water with temperatures generally less than 55 F from Detroit and Big Cliff Reservoirs contribute to the favorable salmonid environment in the lower North Santiam River.

About 125 Cascade lakes, averaging 8.5 surface acres each, provide excellent trout habitat. Marion Lake, the largest, covers 325 acres and is 180 feet deep.

Detroit Reservoir, a 3,580-surface acre impoundment on the North Santiam River at river mile 49.1, offers extensive habitat for salmonids and is nearly devoid of nongame fish species. Habitat of similar quality is furnished by the 100-surface acre Big Cliff Reservoir located immediately downstream. Beginning in 1953, Detroit and Big Cliff Dams, since they have no fishways, closed over 84 miles of spawning and rearing area to large runs of steelhead trout and spring chinook salmon.

Foster and Green Peter Dams, which were recently completed on South and Middle Santiam Rivers, furnish nearly 5,000 acres of reservoir that may prove to be good salmonid habitat. There is, however, danger that rough fish may become a problem in these reservoirs, thus reducing their value to cold-water species.

Species and Distribution

Santiam subbasin streams produce annual spawning escapements averaging 8,700 winter steelhead trout and 9,900 spring chinook salmon. The distribution of winter

steelhead and spring chinook is shown in Figure 5.1. Fall chinook salmon have been stocked in the watershed in recent years, but it is too early to evaluate the return of adults. A few adult coho in Hamilton Creek, tributary to South Santiam River, in the 1965-66 spawning season were the first recorded returns of attempts to establish runs of coho salmon in the subbasin.

Of the total number of winter steelhead spawning each year in the subbasin, approximately 4,100 enter the South Santiam River, 3,500 the North Santiam River and 1,000 the Calapooia River. The number of steelhead trapped below Big Cliff Dam and artificially spawned is included in the North Santiam total. This trap is located at Minto Dam, a low structure in the North Santiam River 2.8 miles downstream from Big Cliff Dam. It was built specifically for anadromous fish collection and egg-taking purposes. The numbers of steelhead and spring chinook entering the Minto trap since its installation in 1952 are listed in Table 5.1.

Table 5.1. Adult anadromous fish counts, Santiam Subbasin, 1952-1965.

	Minto Dam Trap North Santiam River 2/		Elkhorn Falls Electronic Counter Little North Santiam River 3/	
Year 1/	Spring Chinook	Winter Steelhead	Spring Chinook	Winter Steelhead
1952	906			
1953	1,744			
1954	1,334			
1955	770			
1956	843			
1957	2,214			
1958	2,181			
1959	1,586		225	6
1960	932		395	28
1961	689		328	21
1962	1,316		286	514
1963	2,983		No count	78
1964	2,580		438	76
1965	1,918		No count	No count

1/ Runs are listed in the year they terminate
Source: 2/ Fish Commission of Oregon
3/ U. S. Fish and Wildlife Service

Table 5.1 also includes adult steelhead enumerated by an electronic fish counter in the ladder ascending Elkhorn Falls. The falls is situated at river mile 16 on Little North Santiam River, a tributary of the North Santiam River. About 20 percent of the steelhead in the Little North Santiam system spawn above Elkhorn Falls.

The number of spring chinook spawning annually in the North and South Santiam drainages is about 6,100 and 3,700, respectively. The North Santiam total includes the number of spring chinook trapped at Minto Dam. The subbasin's remaining spring chinook, averaging about 100 adults, enter the Calapooia River. About 43 percent of the spring chinook run of the Little North Santiam spawn above Elkhorn Falls. South Santiam's largest tributary, the Middle Santiam River, enters at river mile 39.5. Most of the spring chinook in the South Santiam River drainage spawn there.

Resident cutthroat trout are common in lower portions of the watershed and are usually plentiful in higher elevation streams. Populations of wild rainbow trout are normally smaller than those of cutthroat but are similarly distributed. Whitefish are numerous in larger, higher elevation streams. Planted rainbow and brook trout constitute the bulk of the trout populations in the Cascade lakes. Native cutthroat and exotic golden trout also inhabit a few of these lakes. Stocked rainbow trout and kokanee salmon are the prevalent fish in Detroit Reservoir.

The distribution of warm-water game fish in streams is limited primarily to the lower Calapooia River. Largemouth bass, bullhead catfish and probably a few other species exist there in moderate numbers. Several small lowland lakes and ponds not associated with the Willamette River also contain warm-water game fish. The names and locations of most of these waters are listed in Table 5.2.

Dace and sculpins are common throughout most streams and are the only nongame fish known to inhabit the North Santiam River system above Detroit Dam. Cool water from Big Cliff and Detroit Reservoirs limits the population of redside shiners,

largescale suckers, and squawfish in the lower North Santiam River, but these fish are numerous in the lower portions of the Calapooia and South Santiam systems.

Table 5.2. Santiam Subbasin low elevation lakes and ponds providing public angling for warm-water game fish 1/

Water	Total Surface Acres	Location
Talbot Lake	30	One-half mile east of Talbot and 3 miles northeast of Santiam and Willamette River confluence.
Meridian Lake	20	Two miles north of Jefferson on south side of Talbot Road.
Jefferson Borrow Pit	2	Just off west side of Interstate 5 freeway at the northern Jefferson junction.
Waverly Lake	5	At northern edge of Albany city limits. Juvenile anglers only.
Timber-Linn Lake	5	One-half mile northeast of Albany in Timber-Linn Park and east of the Albany airport.
Oak Creek Borrow Pits (two)	10	One pit on either side of Interstate 5 freeway, 3 miles south of Albany.

1/ Predominant game fish species in these waters are white crappie, black crappie, bluegill, largemouth bass, warmouth bass and brown bullhead.

Developments and Conditions Adversely Affecting Fish Resources

Detroit Dam, 463 feet high, was constructed on the North Santiam River primarily for flood control by the U. S. Army Corps of Engineers. The dam and its re-regulating structure, Big Cliff Dam, 191 feet high, are unladdered and have completely blocked anadromous fish since 1953. Prior to that date, large runs of steelhead and spring chinook spawned above the site. Because anadromous fish have been precluded above the dams, these structures have been grossly detrimental. Mitigation is provided by artificial propagation of the runs now intercepted below Big Cliff Dam at Minto Dam. To date this mitigative effort, coupled with natural reproduction in the river below Minto, has succeeded in maintaining steelhead and

spring chinook runs (Table 5.1). The effort is expensive, however, and the existing facilities are capable of rearing only a fraction of the anadromous fish which could be produced naturally in stream areas above Detroit Reservoir. State and Federal fish management agencies are optimistic that, with provision of funds for passage facilities, continued technological advancement in passing anadromous fish around high dams will result in re-establishing runs in these stream areas.

The U. S. Army Corps of Engineers has recently constructed Foster Dam on the South Santiam River at river mile 37.7 and Green Peter Dam another 7.5 miles farther upstream on the Middle Santiam River. Foster Dam is 126 feet high and impounds a 1,220 surface acre reservoir. Green Peter Dam is 327 feet high and has a 3,720 acre reservoir. Green Peter Dam is used largely for flood control, power generation and water storage. Foster Dam is mainly for re-regulation of water released at Green Peter Dam, but is also used for power generation and flood control. Fish passage facilities are incorporated into Foster and Green Peter Dams. The majority of the South Santiam River's steelhead and spring chinook presently spawn above Foster Dam.

Foster and Green Peter Reservoirs inundate about 22 miles of good anadromous fish habitat, approximately 19 percent of the total above the Foster damsite. There is danger that suckers and squawfish will over populate the reservoirs to the detriment of salmonids, as occurred in Lookout Point and Dexter Reservoirs on the Middle Fork Willamette River. As in the case of the latter reservoirs, suckers and squawfish in Foster and Green Peter Reservoirs could spread to upper stream areas formerly free of these undesirable species. The stream system above Foster Dam was treated prior to impoundment in an attempt to erradicate rough fish and avoid these undesirable situations.

Upstream fish passage is seriously impeded at Sodom Dam on Calapooia River (Figure 5.2) and Upper Bennett Dam on the North Santiam River (Figure 5.3).

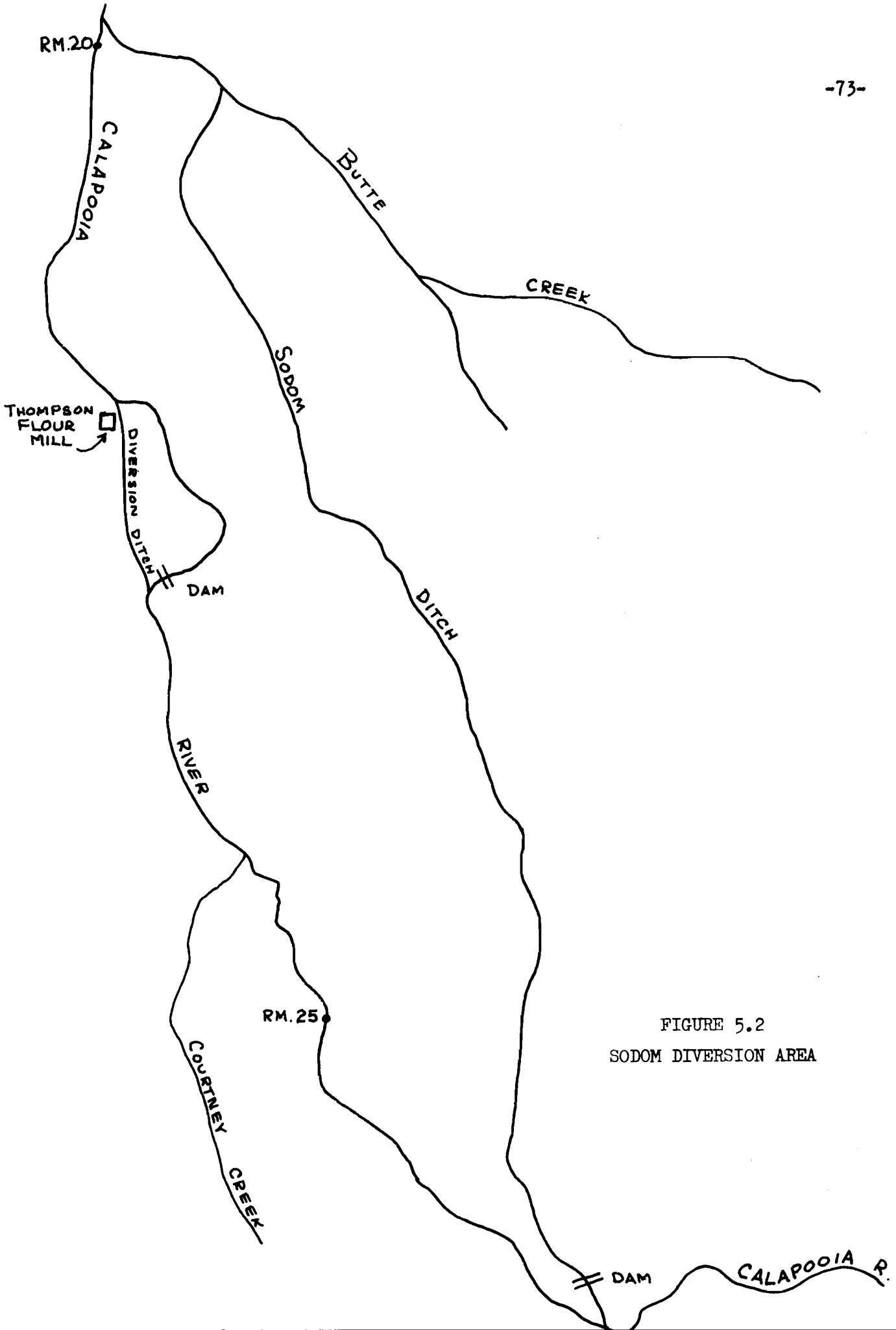


FIGURE 5.2
SODOM DIVERSION AREA

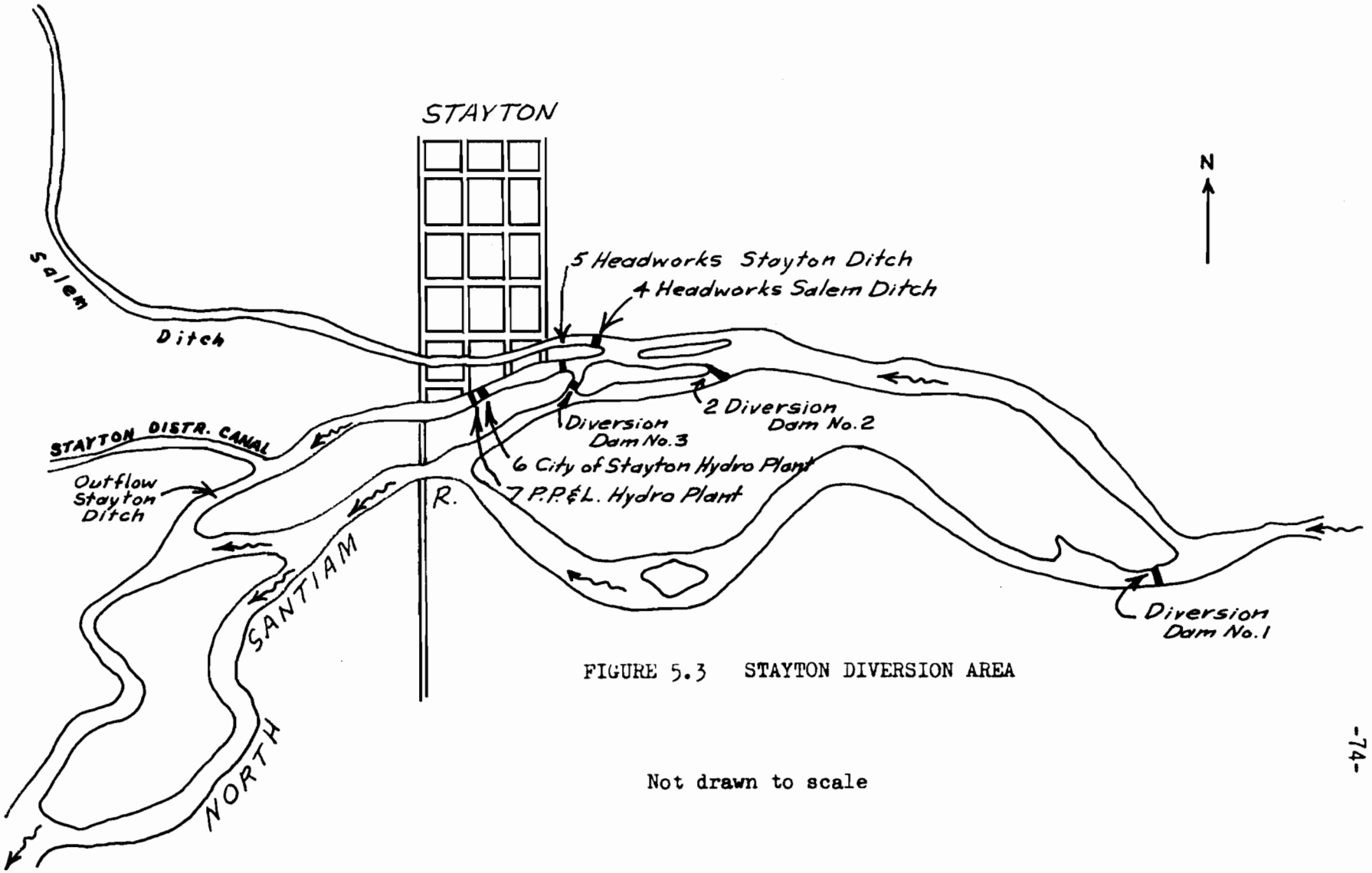


FIGURE 5.3 STAYTON DIVERSION AREA

Not drawn to scale

The status of fish passage facilities at other subbasin dams is summarized in Table 5.3.

Associated with many of the dams listed in Table 5.3 are ditches or canals diverting water for irrigation, power generation, and industrial purposes. None of the large diversions, some with capacities of over 200 cfs, are screened to prevent fish loss. Mortality and injury incurred by salmonids, notably juvenile anadromous fish, are greatest in the larger power diversions. Studies of the unscreened diversions indicate that heaviest losses occur at Pacific Power and Light Company turbines in the Stayton power canal. Table 5.4 lists existing flow and appropriated surface water information.

The South Santiam River in the Lebanon-Sweet Home area has been heavily polluted for many years. Municipal, domestic, and industrial effluents contribute to the deteriorated water quality. Figure 5.4 illustrates one of several such sources of pollution. Sulfite effluent from the Crown Zellerbach Corporation paper mill in Lebanon is the most serious offender damaging the river's aquatic life. In low flow periods prior to Foster and Green Peter Dam construction, salmonids usually could not survive between Lebanon and the river's mouth. Dissolved oxygen concentrations in the river water in this section often drop below 5 parts per million.

Several factors limiting fish production in the subbasin are not entirely man-caused. Seasonally, low, warm flows in low elevation streams impair rearing of anadromous fish. Large populations of nongame fish in lower Calapooia and South Santiam River systems compete with game fish for food and living space. At least 25 falls and cascades in the Santiam River system are believed to warrant study of passage feasibility at the present stage of demand for fish and fishing area.

Table 5.3. Major falls, dams and diversions affecting anadromous fish, Santiam Subbasin

Stream	Location and Name of Falls or Dam	Description 1/
Calapooia River	Thompson Dam. River mile 23.5	Concrete dam 5 feet high. Passable but inadequate ladder. Diverts flows into unscreened Thompson Ditch for a flour mill.
Sodom Ditch	Headgate near river mile 28.3 on Calapooia River	Concrete dam 8 feet high. Sodom Ditch acts as an overflow river channel. Fish ladder is passable but inadequate.
North Santiam River	River mile 8.0 Sidney Ditch dam	Low gravel wing dam diverts into unscreened Sidney Ditch for irrigation.
North Santiam River	River mile 17.9. Lower Bennett Dam; in river's north channel around Stayton Island.	Wooden dam 5 feet high. Passable but inadequate ladder is being replaced. Diverts flows into unscreened Stayton power canal. An unscreened irrigation ditch diverts from the canal.
North Santiam River	River mile 19.7. Upper Bennett Dam; in river's south channel around Stayton Island	Wooden dam 5 feet high. Passable but inadequate ladder is being replaced. Assists in diverting to Stayton power canal and Salem Power Canal, both unscreened.
North Santiam River	River mile 18.0. Salem Power Canal Dam (Salem Ditch)	A wing dam (Salem Power Canal Dam) and Lower Bennett Dam immediately downstream divert flows into Salem Power Canal.
Salem Power Canal	Pacific Power and Light Co. Dam in Stayton.	Concrete dam. Passable but inadequate ladder.
North Santiam River	River mile 43.5. Minto Dam; 2.8 miles below Big Cliff Dam.	Concrete unladdered dam 10 feet high. Diverts anadromous fish adults into Minto trap facility.
North Santiam River	River mile 46.9. Big Cliff Dam	Concrete dam, 191 feet high. Re-regulating structure. No fish passage facilities.
North Santiam River	River mile 49.1 Detroit Dam	Concrete dam, 463 feet high. Multi-purpose structure. No fish passage facilities.
Little North Santiam River	River mile 16.0. Elkhorn (Salmon) Falls.	Rock falls 25 feet high. Adequate concrete ladder.

Table 5.3 (continued)

Stream	Location and Name of Falls or Dam	Description
South Santiam River	River mile 20.8. Lebanon-Albany Power Canal Dam.	Concrete dam 9 feet high. Three passable ladders. Diverts flows into unscreened Lebanon-Albany Power Canal for various uses (Figure 5.5).
South Santiam River	River mile 37.7. Foster Dam	Rock fill dam 126 feet high. Fish passage facilities provided. A flow re-regulation dam.
Middle Santiam River	River mile 5.7. Green Peter Dam	Concrete dam 377 feet high. Fish passage facilities provided. For flood control and other purposes.
Crabtree Creek	River mile 24.7. Lacomb Dam.	Low gravel dam diverts flows for irrigation into unscreened Lacomb Ditch.
Thomas Creek	River mile 31.5.	Fifty-foot unladdered rock falls. Blocks spring chinook and steelhead.
Wiley Creek	River mile 0.3.	Concrete dam 30 feet high. Passable ladder which often clogs with debris. (Figure 5.6)

1/ Status as of July 1966 (excluding Foster and Green Peter Dams).

Table 5.4. Appropriated surface water and minimum stream flow measurement data Santiam Subbasin

	Appropriated Surface Water (cfs) 1/		Instantaneous Minimum Flows Measured			
Stream Area	Non Consumptive	Consumptive	Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
Santiam River	0.0	4.9	260	At Jefferson River mile 9.6	Aug. 15-22, Aug. 24-Sept. 2, 1940 (1939-1965)	U.S. Geological Survey
Tribs to Santiam R. below & excluding North & South Forks	0.0	2.3	--	--	--	--
N.Fk. Santiam R. below Detroit Dam	1,471	940	358	At Mehama, River mile 38.7	Aug. 22, 1963 (1921-1965)	U.S. Geological Survey
Little N. Fork System	63	2.6	13	River mile 2.0	Aug. 30, 1961 (1931-1965)	U.S. Geological Survey
Other tribs to N. Fk. Santiam R. below Detroit Dam	16	53	--	--	--	--
N. Fk. Santiam R. above Detroit Dam	0.0	6	250	River mile 70.7	Sept. 13, 1909 (1907-09)(1928-65)	U.S. Geological Survey
Breitenbush R. System	70	0.7	87	River mile 2.0	Sept. 2, 1940 (1932-1965)	U.S. Geological Survey
Other tribs to N. Fk. Santiam R. above Detroit Dam	75	11	--	--	--	--
S. Fk. Santiam R. below Foster Dam	50	22	96	At Waterloo, River mile 23.3	Sept. 1,2,1940 (1923-1965)	U.S. Geological Survey
Crabtree Creek System	17	82	18	River mile 1.6	Aug. 30, 1962	Ore. Game Commission

Table 5.4 (continued)

Stream Area	Appropriated Surface Water (cfs) 1/ Non Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
Thomas Cr. System	19	79	9.7	River mile 4.7	Aug. 25, 1961	Ore. Game Commission
Other tributaries to S. Fk. Santiam River below Foster Dam	16	26	--	--	--	--
S.Fk. Santiam R. above Foster Dam	0.0	11	23	Near Cascadia, River mile 48.5	Dec. 1,2,1936 (1935-1965)	U.S. Geological Survey
Middle Santiam River System	6	2.8	72	Near Foster, River mile 0.7	Sept. 22-24,1951 (1950-1963)	U.S. Geological Survey
Other tributaries to S.Fk. Santiam R. above Foster Dam	14	1.1	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.
2/ U.S. Geological Survey Periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1961 and 1962.

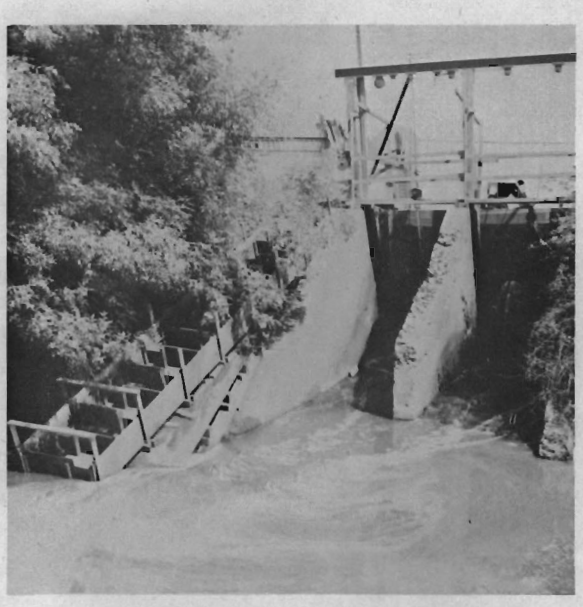


Figure 5.4. Log pond dam on Ames Creek. Note poorly designed and impassable fish ladder and pollution. July, 1966.

Figure 5.5. Lebanon-Albany power canal diversion dam on the South Santiam River at river mile 20.8. July, 1966.

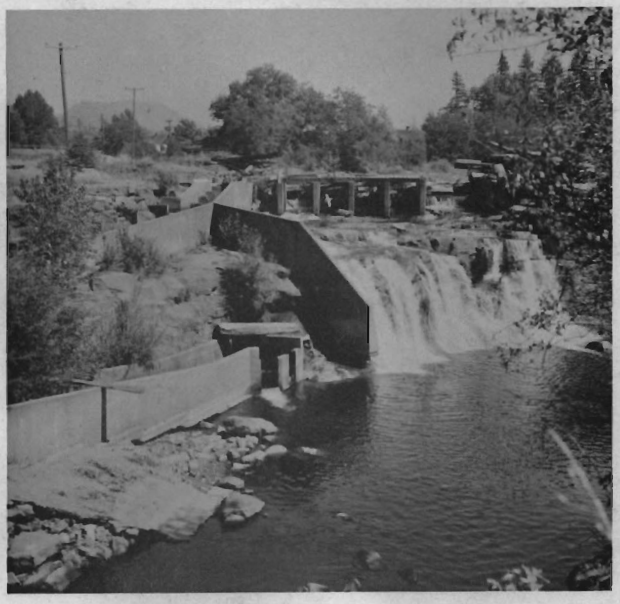


Figure 5.6. Dam 0.1 mile above the mouth of Wiley Creek. July, 1966. (See Figure 5.7)

Figure 5.7. Dam on Wiley Creek. Debris accumulation in forebay often creates difficult passage conditions for fish. July, 1966.

Developments Beneficial to Fish Resources

Fish passage facilities existing at falls are described in Table 5.4. Occasionally logjams are removed and low falls or cascades are altered to improve adult anadromous fish passage conditions.

Detroit Reservoir receives heavy use from trout anglers and other recreationists, and provides flow releases for fish life downstream. To this extent the reservoir can be considered beneficial. Studies to determine the impact of Foster and Green Peter Reservoirs on fish and fishing are in progress. Since mitigative features have been incorporated into the projects there is some reason for hope that project effects will be beneficial.

Three fish hatcheries are located in the subbasin. Marion Forks Hatchery near river mile 73 on the North Santiam River is operated by the Fish Commission of Oregon. This installation, provided by the Corps of Engineers as mitigation for Detroit and Big Cliff Dams, rears spring chinook and steelhead from eggs of fish trapped at Minto Dam. Another Fish Commission salmon hatchery on the Middle Santiam River was recently relocated downstream due to inundation by Foster Reservoir.

The Oregon State Game Commission's Roaring River Hatchery is located in the Crabtree Creek drainage, a tributary to the lower South Santiam River. Many of the rainbow trout stocked in the Willamette Basin streams are reared here. Trout and anadromous fish stocked in Santiam Subbasin waters in the 1961-1965 period are listed in Table 5.5. Summer steelhead introductions were initiated in the Little North Santiam in 1966.

Table 5.6 lists legal minimum stream flow stipulations established in the subbasin. Future appropriations may be made for only domestic or livestock uses from natural flows of these stream areas. Additionally, natural flows of major portions of many streams in the upper watershed are protected by State Water Resources

Table 5.5. Fish stocking in Santiam Subbasin, 1961-1965.

Stream system or lake	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency 1/
North Santiam	Fall Chinook	--	1,044					860,790	OFC
" "	Spring Chinook	--	23-60	1,810,839	1,606,834	1,503,305	1,225,857	1,942,790	"
" "	"	--	1,264				1,677,427	345,315	"
" "	Coho	--	1,162		194,054				"
" "	Steelhead	--	7.6-17		72,050	315,285	164,597	150,930	"
" "	"	--	24-46	551,195					"
" "	"	--	28		194,935	125,890		30,019	USFWS
" "	"	--	63-95		699,060		41,999		OFC
" "	"	--	291		212,800				"
" "	"	--	2,746					112,228	"
" "	Rainbow	8 & over	--	121,889	116,551	113,942	114,492	58,146	OSGC
South Santiam	Fall Chinook	--	1,150					800,000	OFC
" "	Spring Chinook	--	15-27	273,140	154,118	157,893	147,751		"
" "	"	--	139				58,380		"
" "	"	2-4	--					398,402	"
" "	Coho	--	17					68,998	"
" "	"	--	57-80					370,482	"
" "	"	--	102-302	100,913				50,400	"
" "	"	--	1100-1210			850,000		697,020	"
" "	Steelhead	Brood	--		3				OSGC
" "	"	2-4	--					8,000	"
" "	"	4-6	--					17,005	"
" "	Rainbow	8 & over	--	28,893	36,919	33,561	34,975	38,108	"
Calapooia	Coho	--	1100-1250		280,042	502,444		494,728	OFC
"	Rainbow	8 & over	--	12,007	12,008	12,052	12,034	11,999	OSGC
Fay Lake	Brook trout	2-4	--	1,100			930	2,120	"
" "	Golden trout	"	--				2,040		"
" "	Rainbow	"	--	1,175	1,080	1,170	1,560	3,200	"
" "	"	8 & over	--				999		"

Table 5.5 (continued)

Stream system or lake	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency 1/
Lost Lake	Brook trout	2-4	--	26,080	20,130	9,990			OSGC
" "	Cutthroat	2-4	--					7,340	"
" "	Rainbow	"	--		19,994			33,596	"
" "	"	4-6	--	20,016		30,030			"
Marion Lake	"	2-4	--	30,354	27,765	27,915	29,520	29,400	"
Other Cascade Lakes	Brook trout	2-4	--	49,347	18,963	34,710	26,270	28,265	"
" "	Golden trout	0-2	--			409			"
" "	"	2-4	--	592		905	8,744		"
" "	"	8 & over	--	399					"
" "	Rainbow	2-4	--	43,519	30,295	25,425	15,780	12,760	"
" "	"	4-6	--	2,672					"
" "	"	8 & over	--	132		2,011	2,000	2,062	"
Detroit Res.	Kokanee	0-2	--	430,916				365,368	"
" "	"	2-4	--		150,025	314,969			"
" "	Rainbow	"	--	399,869	593,831	599,939		802,844	"
" "	"	4-6	--			200,053	666,657	50,350	"
" "	"	8 & over	--	95,585	104,168	93,160	94,981	99,570	"

1/ Abbreviations used in this table are: "USFWS", U. S. Fish and Wildlife Service; "OFC", Fish Commission of Oregon; "OSGC", Oregon State Game Commission.

Table 5.6. Minimum stream flow stipulations beneficial to fish.

Stream 1/	Location	Minimum Flows in Cubic Feet per Second 2/ Natural	Storage
Santiam River	Mouth	320	1,570
Santiam River	USGS gage 14-1890 at river mile 9.6	330	1,570
North Santiam River	USGS gage 14-1841 at river mile 14.6	430	640
North Santiam River	USGS gage 14-1830 at river mile 38.7	580	640
North Santiam River	USGS gage 14-1815 at river mile 57.3	500	640
North Santiam River	USGS gage 14-1780 at river mile 70.7	345	--
Little North Santiam R.	USGS gage 14-1825 at river mile 2.0	40	--
South Santiam River	USGS gage 14-1875 at river mile 23.3	170	930
South Santiam River	USGS gage 14-1850 at river mile 48.5	50	--
Wiley Creek	Mouth	10	--
Middle Santiam River	USGS gage 14-1865 at river mile 0.7	110	260
Calapooia River	USGS gage 14-1735 at river mile 3.0	20	340
Calapooia River	USGS gage 14-1720 at river mile 45.4	30	340

1/ Includes all tributaries above the listed locations.
2/ "Natural" minimum flow stipulations were set by the Oregon State Water Resources Board in 1964. The "storage" volumes are provided in addition whenever possible from U.S. Army Corps of Engineers dams located upstream.

Board programming from significant future water withdrawals. All waters of natural lakes above the 2,000 foot level, with exception of those privately owned, are similarly protected.

Present Economy

Each year the subbasin provides an estimated 100 coho, 700 steelhead and 26,400 spring chinook to the commercial fisheries of the Columbia River and Pacific Ocean. This 467,000 pound annual harvest is valued at $254,000.

Approximately 300 steelhead and 400 spring chinook were harvested in 1965 by sport fishermen from the subbasin's streams. Heaviest catches occur in the South Santiam above Lebanon and in the North Santiam above Stayton. The Little North Santiam, Middle Santiam, and Calapooia Rivers also contribute to the creel. Fishing for both steelhead and spring chinook occurs in spring months and is conducted almost entirely from the bank. In total, sport fisheries of the subbasin, Pacific Ocean and Columbia and Willamette Rivers, took about 4,300 steelhead and 13,200 spring chinook and a few coho of Santiam Subbasin origin in 1965. Total angler use of steelhead and salmon produced in the subbasin amounts to an estimated 140,000 angler-days valued at $840,000.

Intensive trout angling takes place in the spring and summer for stocked rainbow trout in larger, higher elevation streams and in Detroit Reservoir. Resident cutthroat are caught in good numbers from upper stream areas. Kokanee provide additional fishing in Detroit Reservoir. Lakes in the Cascade Range support much angling through the summer season but are capable of withstanding higher pressure. An estimated 41,000 angler-days valued at $123,000 were spent catching 76,000 trout and whitefish in the streams of the subbasin in 1965. Detroit Reservoir has supported a 4-year average catch of an additional 270,000 trout and kokanee in 137,000 angler-days valued at $274,000. Other trout fisheries of considerable magnitude exist on numerous high Cascade Lakes. Green Peter and Foster

reservoirs are expected to receive angling pressure similar to that experienced at Detroit Reservoir.

Warm water species, mostly from lower Clapooia River and lakes and ponds listed in Table 5.2, furnished an estimated 15,000 fisherman-days valued at $22,000 to the sport fishery in 1965.

6. COAST RANGE SUBBASIN

6. COAST RANGE SUBBASIN

The Marys, Luckiamute, and Yamhill Rivers and Rickreall Creek are the major stream systems in the subbasin (Figure 6.1). Corral and Boeckman Creeks and a few other small Willamette River tributaries have lesser, yet significant, value for fish. Carlton Lake, a 350-surface acre impoundment on the North Yamhill River, is the only lake of consequence, except for a few small private ponds and reservoirs.

Habitat

Major subbasin streams originate in the Coast Range and enter the Willamette River from the west. Physical characteristics of the streams closely resemble those found in Tualatin Subbasin to the north and Long Tom Subbasin to the south.

Elevations range from 4,100-foot Marys Peak to less than 100 feet along the Willamette River. Stream gradient is therefore variable but mostly it is flat. Warm, low flows in summer and fall severely limit production of salmonids in most streams (Table 6.1). Many streams become intermittent or completely dry.

Diurnal stream temperatures in summer generally range from 55 to 70 F and occasionally reach 80 F on the Willamette Valley floor. Temperatures of streams on the upper Coast Range slopes are cooler with daily maximums in summer usually below 65 F. Sustained flows of cooler water at these higher elevations provide good salmonid habitat.

Natural falls are common in upper portions of several streams. A 20-foot falls on Little Luckiamute River at river mile 13 is the only one blocking significant potential upstream habitat for anadromous fish. Spawning gravel is adequate in the middle and upper portions of most streams.

Species and Distribution

In 1965, 5,350 coho salmon entered streams in the Coast Range Subbasin. This run is believed to approximate the average run. Of this total, 1,200 entered the

LEGEND:

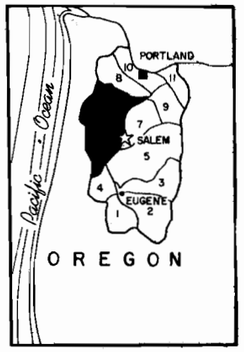
Present distribution (May 1966)

STEELHEAD

COHO

CHINOOK

Unaccessible habitat for anadromous fish, blocked by dams



KEY MAP

FIGURE 6.1

SUB-BASIN 6

Coast Range

Luckiamute, 4,000 in the Yamhill, 100 in Rickreall Creek, and 50 in Marys River. Steelhead have been stocked in the subbasin in recent years, but there are no known established runs as yet. Figure 6.1 illustrates anadromous fish distribution.

Resident cutthroat trout are scattered in moderate to high numbers throughout most streams having perennial flow, with largest populations occurring in headwater areas. Substantial numbers of Willamette River cutthroat enter subbasin streams to spawn in winter and spring. These fish, ranging from 12 to 18 inches long, are of larger average size than cutthroat inhabiting subbasin streams the entire year.

Small numbers of whitefish are indigenous and have distributions similar to cutthroat. Catchable-size rainbow trout are stocked annually in larger streams to supplement wild cutthroat stocks. No self-sustaining populations of wild rainbow are found in this subbasin or in other tributaries entering the Willamette River from the west.

Warm-water game fish, particularly crappie, largemouth bass, bluegill, pumpkinseed, and bullhead catfish, are common in lower portions of streams near the Willamette River. Highest numbers inhabit the lower Yamhill River and Carlton Lake.

Nongame fish are plentiful and are well adapted to the warm water temperatures prevailing in most streams. Numbers of nongame fish increase progressively as the waters of the streams approach the Willamette River. Large populations of squawfish, redside shiners, suckers, and several other forms are present in the lower sections of the major streams. Suckers extend into foothill areas but numbers dwindle in higher elevation streams leaving dace and sculpins as the only nongame species.

Developments and Conditions Adversely Affecting Fish Resources

Low, natural stream flows in summer and fall, which limit production of desirable fish species more than any other factor, are further reduced by widespread diversion. The most substantial water diversions are for irrigation, a consumptive use. Table 6.1 lists minimum recorded flows and surface water rights for consumptive and nonconsumptive use.

The Oregon State Water Resources Board estimates that only about one-third of all present water rights in the subbasin are used to their maximum legal extent. This use pattern is partially due to unavailability of water in low flow periods.

Return flows from irrigation and other uses increase stream temperatures and lessen water quality in various ways. Reduced stream flow contributes to low dissolved oxygen concentrations because the dilution of decaying organic matter is less. Dissolved oxygen concentrations of less than 5 parts per million have been recorded in the lower Yamhill River, and they approach this level occasionally in other streams. The major pollution source is the Dallas sewage outfall into Rickreall Creek near mile 13.0. The effluent receives only primary treatment and renders the stream below unfit for salmonids in summer months.

Several dams impede the upstream migration of salmon and trout. Those of primary importance are described in Table 6.2. Most of these dams are partial or complete barriers to fish passage, with the dam on Marys River at mile 2.3 the most serious of all (Figure 6.2). Yamhill lock and dam on the Yamhill River near Lafayette formed a serious block to fish, especially coho salmon, until it was breached in 1963. Carlton Dam at river mile 10 on the North Yamhill had a dilapidated wooden ladder that was impassable to fish for many years. The dam, to be rebuilt, will be provided with a new ladder.

Table 6.1. Appropriated surface water and minimum stream flow measurement data
Coast Range Subbasin

Stream Area	Appropriated Surface Water (cfs) 1/ Non Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source
Marys River System	64	73	4.7	River mile 9.4	Oct. 15, 1952 (1940-1965)	U.S. Geological Survey
Luckiamute River System	9.2	92	13	River mile 13.5	Oct. 17,18,1952 (1940-1965)	U.S. Geological Survey
Rickreall Creek System	0.6	44	0.0	River mile 19.1	"at times" (1957-1965)	" "
North Yamhill River System	12	76	4.7	River mile 20.5	Aug. 23, 1961 (1948-1965)	" "
South Yamhill River System	0.1	159	8.5	River mile 16.7	Sept. 24,26,1952 (1940-1965)	" "

1/ Oregon State Water Resources Board records, April 1966.
2/ U. S. Geological Survey periods of available records are shown in parenthesis.

In the Luckiamute River drainage, the only serious barrier is the 20-foot high falls at river mile 13 on the Little Luckiamute River.

Table 6.2. Major dams affecting anadromous fish, Coast Range Subbasin.

Stream	Dam Location (river mile)	Description 1/
Marys River	2.3	Concrete dam 12 feet high. Fish ladder is inadequate.
Yamhill River	7.3	Yamhill lock and dam. Blocked anadromous fish for many years. Breached in 1963. Fish passage presently good.
North Yamhill River	10.0	Carlton Dam, approximately 25 feet high. Blocked anadromous fish for many years. New dam with fish ladder built in 19__.
Baker Creek	9.0	Concrete water supply dam 15 feet high. Impassable wooden ladder.
Haskins Creek	5.5	Earth fill dam 90 feet high. Unladdered. McMinnville water supply dam.
Turner Creek	3.0	City of Yamhill water supply dam. Concrete, 8 feet high. Fish ladder is passable but inadequate.
Rickreall Creek	24.2	Earth fill dam 50 feet high. Unladdered. Dallas water supply dam.

1/ Status as of August, 1966.

Developments Beneficial to Fish Resources

Table 6.3 lists fish stocked in the 1961-1965 period. Coho salmon stocking was initiated in 1954. Returns of coho have been encouraging particularly in the South Yamhill River tributaries. Except for a liberation in the South Yamhill system in 1958, the first steelhead stocked in the subbasin are those listed in Table 6.3.

By withdrawing waters of a number of streams from further appropriation, the Oregon State Water Resources Board has benefited fish life. A list of the streams

Figure 6.2. Twelve foot high diversion dam with inadequate fish ladder on the Marys River at river mile 2.3. July, 1966.

Table 6.3. Fish stocking in Coast Range Subbasin, 1961-1965.

Stream system	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency 1/
Luckiamute	Coho	--	1,082-1,162		104,580	400,000		392,587	OFC
"	Rainbow	8 & over	--	17,994	14,080	14,017	11,998	8,896	OSGC
Marys	Coho	--	1,080-1,100			350,000		1,178,570	OFC
"	Rainbow	8 & over	--	5,001	4,952	4,950	5,001	3,937	OSGC
Rickreall Cr.	Coho	--	1,082					304,872	OFC
" "	Rainbow	8 & over	--	3,007	3,034	3,000	2,991	2,943	OSGC
Yamhill	Coho	--	17-66	91,784	63,158	60,365	61,814	244,036	OFC
"	"	--	1,082-1,200		598,634	754,793		1,827,239	"
"	Steelhead		11					43,950	"
"	"		2,000				109,065		"
"	Cutthroat	8 & over	--	2,004	2,000	2,013	1,996		OSGC
"	Rainbow	"	--	20,026	18,998	17,005	14,418	18,955	"

1/ Abbreviations used in this table are: "OFC", Fish Commission of Oregon; "OSGC", Oregon State Game Commission.

Table 6.4. Minimum flow stipulations established by the Oregon State Water Resources Board in 1964.

Stream 1/	Location	Minimum Flows in Cubic Feet Per Second
Marys River	Mouth	5
Marys River	USGS gage 14-1710 at river mile 9.4	10
Luckiamute River	Mouth	20
Luckiamute River	USGS gage 14-1905 at river mile 13.5	25
Luckiamute River	USGS gage 14-1900 at river mile 29.7	20
Luckiamute River	USGS gage 14-1895 at river mile 43.2	10
Rickreall Creek	USGS gage 14-1907 at river mile 19.1	5
Yamhill River	USGS gage at Lafayette	15
South Yamhill River	USGS gage 14-1940 at river mile 16.7	15
South Yamhill River	USGS gage 14-1925 at river mile 45.5	20
Willamina Creek	USGS gage 14-1930 at river mile 6.2	20
North Yamhill River	USGS gage 14-1970 at river mile 20.5	10

1/ Includes tributary systems above the listed locations.

thus protected is found in Table 6.4. Future appropriations may be made for only domestic or livestock uses from natural flows of these streams.

Present Economy

Potential for establishment, or increase, of runs of coho salmon and steelhead trout exists in streams of Coast Range Subbasin, but runs to date are relatively low. An estimated 12,800 coho produced in this subbasin are harvested annually in the Columbia River and Pacific Ocean commercial fishery. This represents approximately 90,000 pounds of fish valued at $35,000.

Sport angling for anadromous fish is not permitted in the subbasin. This regulation is to protect the relatively low spawning populations. Streams in the subbasin provided an estimated 3,200 coho salmon to sport fisheries of the Willamette and Columbia Rivers and the Pacific Ocean in 1965. The 3,200 angler-days expended in this fishery were valued at $19,000.

Trout angling in streams is popular for wild cutthroat and hatchery cutthroat and rainbow. Most fishing is conducted in larger streams in spring and early summer. Stocking is discontinued in summer because of low stream flows and accompanying high water temperatures. An estimated 13,000 angler-days valued at $39,000 were expended to catch 28,000 trout from the subbasin's streams in 1965.

Moderate angling pressure on warm-water game fish occurs in Carlton Lake and in the Yamhill River near Lafayette. Species caught most frequently are bullhead catfish, largemouth bass, crappie, bluegill, and yellow perch. The river fishery represented an estimated 7,000 angler-days valued at $10,000 in 1965.

7. PUDDING SUBBASIN

7. PUDDING SUBBASIN

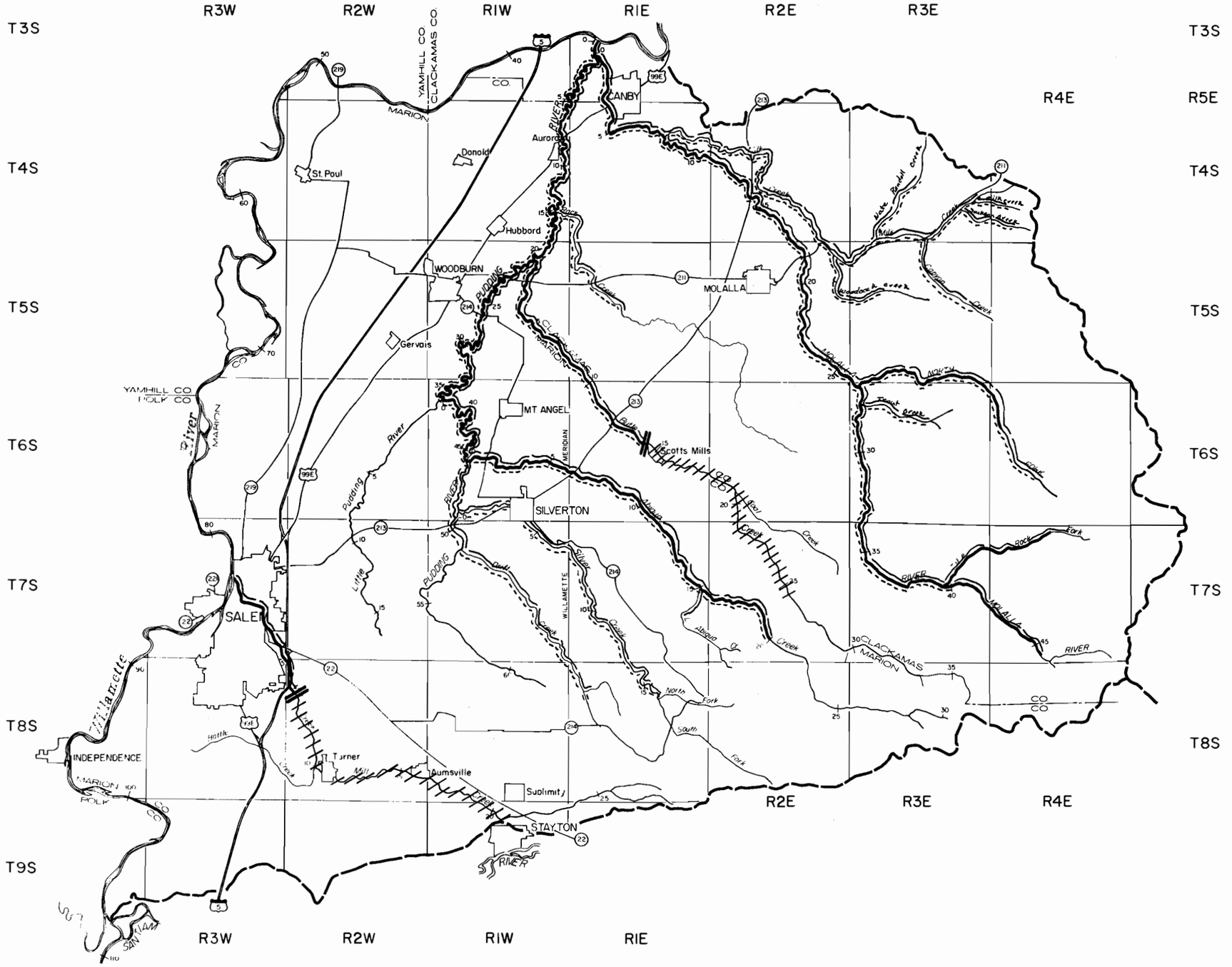
Pudding Subbasin is made up of the watersheds of Molalla and Pudding Rivers and Mill Creek, a tributary to the Willamette River at Salem (Figure 7.1). The primary lacustrine areas of value to fish are four small lakes in the Cascade Range.

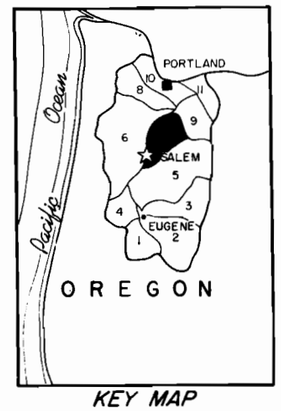
Habitat

Waters of the Molalla River, 49 miles long, and Pudding River, 62 miles long, mingle for only three-quarters of a mile before entering the Willamette River 9 miles upstream from Willamette Falls. The Molalla watershed of 348 square miles extends higher into the Cascade Range and receives cooler water than the 530 square mile Pudding River system. Pudding River's main stem lies entirely within the Willamette Valley floor, but its five major tributaries, Abiqua, Butte, Silver, Drift, and Rock Creeks, drain foothills of the Cascade Range.

Average annual discharges of over 1,100 cubic feet per second in both the Molalla and Pudding Rivers are subject to large seasonal variation. Low summer flows, caused partly by diversion for agriculture and other uses, occur in the two rivers and their lower tributaries. Minimum volumes recorded since 1928 by U. S. Geological Survey gages in the Molalla and Pudding Rivers near their confluence have been 20 and 26 cfs, respectively. However, the Molalla normally maintains somewhat higher and less variable summer flows than Pudding River.

The other major subbasin stream is Mill Creek. It flows 29 miles, mostly through low-elevation agricultural land and drains 114 square miles of area. The Salem Power Canal diverts water from the North Santiam River near Stayton and empties into Mill Creek at stream mile 18.6. The canal normally contributes flows of between 100 and 200 cfs except during high rainfall periods when reductions are necessary to lessen flood danger. The water is used for irrigation and industry, including a few small power plants. Most of the water use is nonconsumptive,





KEY MAP

LEGEND:

Present distribution (May 1966)

- **STEELHEAD** — — — —
- **COHO** - - - - - - - - - -
- **CHINOOK** ——————
- **Unaccessible habitat for onadromous fish, blocked by dams** ////////

FIGURE 7.1

SUB-BASIN 7

Pudding

leaving large quantities to continue to the creek's confluence with the Willamette. Above the canal, the flow in Mill Creek is normally small; summer flows often become intermittent, partly because of diversions. The importance of Mill Creek for salmonids has been greatly increased by the large amounts of cool water from the North Santiam River.

Maximum summer stream temperatures seldom exceed 65 F in upper areas of the subbasin. This is well below the lethal level for salmonids. Pudding River, Molalla River below river mile 25, and low-elevation tributaries of both, however, often have temperatures exceeding 75 F. These temperatures, although not usually lethal in themselves, are unfavorable for salmonids. Large numbers of nongame fish compete with, and further reduce the production of salmonids.

Spawning gravel is plentiful throughout much of the Molalla River system, most Pudding River tributaries, and the entire length of Mill Creek, but is almost nonexistent in the main stem Pudding River. Rearing habitat is normally good in higher elevation streams of the subbasin, but is frequently impaired elsewhere by low, warm stream flows in summer and fall.

Several miles of stream habitat are closed to anadromous fish access by falls. These barriers are listed and briefly described in Table 7.1.

The four small mountain lakes furnish good trout habitat.

Species and Distribution

In 1965, 1,600 coho salmon and 4,500 winter steelhead entered the subbasin. These runs are believed to approximate the average runs. The 1962 through 1964 average spring chinook salmon run was 500. Most salmon and steelhead spawning occurs in the Molalla River system.

Steelhead have a wide distribution (Figure 7.1). A high percentage of the subbasin's coho spawn in the Milk Creek drainage, tributary to the Molalla River

Table 7.1. Major falls and dams affecting anadromous fish, Pudding Subbasin

Stream	Location of Obstruction	Description 1/
Molalla River	River mile 46.1, 20 yards below Henry Creek.	Falls 35 feet high, impassable.
North Fork Molalla River	River mile 4.5, 0.7 mile below Deadhorse Canyon Creek.	Falls 5 feet high. Passage difficult. Several other natural barriers upstream.
Butte Creek	River mile 15; at Scotts Mills.	Combination dam and falls 21 feet high. Unladdered and impassable. A 10-foot falls is located 11.5 miles farther upstream.
Abiqua Creek	River mile 11, Silverton water supply dam.	Concrete dam 10 feet high with a passable but inadequate ladder.
Abiqua Creek	River mile 20, Abiqua Falls.	Falls 100 feet high. Impassable.
Silver Creek	River mile 3.9 in Silverton.	Concrete dam 5 feet high. Small, concrete ladder.
North Fork Silver Creek	River mile 0.8.	Several high impassable falls and cascades begin at this point.
South Fork Silver Creek	River mile 0.3, Lower South Falls.	Falls 93 feet high. Other impassable falls above.
Mill Creek	River mile 2.8, City Ice Works dam.	Concrete dam 6 feet high. Small, concrete ladder.
Mill Creek	River mile 3.1, 60 yards south of State Street, Salem.	Concrete dam 6 feet high. New concrete ladder. Diverts water to Boise Cascade Corporation paper mill.
Mill Creek	River mile 4.1, lower State Penitentiary dam.	Concrete and board dam 9 feet high. Temporary passage facilities; ladder pending.
Mill Creek	River mile 6.8, upper State Penitentiary dam.	Concrete and board dam 6 feet high. Temporary passage facilities; ladder pending.
Mill Creek	River mile 16.5, in Aumsville. Highberger Ditch dam.	Dam 3 feet high. Unladdered but probably passable. Unscreened diversion.

1/ Status as of July, 1966.

at river mile 8. Spring chinook spawn almost entirely in the main stem Molalla River above river mile 25. A few also spawn in its larger tributaries above that point and in Abiqua Creek, a Pudding River tributary.

Table 7.2 lists SCUBA counts of adult spring chinook made in Molalla River pools each summer since 1961. These are not total runs but do reveal population trends. In 1941 a spawning count in only a portion of this area tallied 993 spring chinook, far more than have been known to spawn in recent years.

Table 7.2. Spring chinook salmon counts in selected pools of the Molalla River between river miles 27.0 and 46.1, August 1961-65.

Year	Number of Adults
1961	238
1962	245
1963	274
1964	173
1965	95

Source: Oregon State Game Commission. SCUBA equipment used.

Reduction of spring chinook numbers in Abiqua Creek have been more drastic. In 1940 approximately 200 spawning chinook were observed in a 6-mile section. A similar count in 1961 revealed only eight fish.

Wild cutthroat trout inhabit nearly all streams that maintain perennial flows. Population densities are low to moderate in stream areas within the Willamette Valley floor and become higher at upper elevations. Wild rainbow trout and whitefish are scattered in limited numbers in upper portions of the watershed. Rainbow and brook trout are found in the Cascade lakes. Rainbow are stocked in the larger streams to supplement wild trout populations for the sport fishery.

Warm-water game fish are restricted mainly to the Pudding River and lower portions of its larger tributaries. Populations of largemouth bass and bullhead

catfish are substantial owing to the warm, sluggish flows that prevail in the summer.

Several species of nongame fish are abundant throughout lower elevation streams, but their numbers diminish with increases in elevation and decreases in water temperature. Exclusive of dace and sculpins, largescale suckers possess the most extensive distribution and occasionally are found in some higher elevation streams.

Developments and Conditions Adversely Affecting Fish Resources

Developments within the subbasin most detrimental to salmonid production are those affecting the quantity and quality of stream flow. Consumptive water use, pollution, gravel mining, logging, and other watershed alterations all contribute to deteriorated fish habitat. Water rights for consumptive use of surface water exist for over 300 cfs (Table 7.3). Over three-fourths of this amount is for irrigation; much of it is pumped from the Molalla and Pudding Rivers. Simultaneous removal of large volumes of the appropriated water could dry major portions of both stream channels which presently experience critically low summer flows.

Extensive logging in the upper Molalla drainage impairs water quality and contributes to formation of logjams that block the upstream migration of anadromous fish. A gravel mining operation in the Molalla River near Canby often causes high stream turbidity and siltation of the streambed. Considerable bank revetment and channel straightening have recently been conducted in the 15-mile section of the Molalla between the cities of Canby and Molalla. Reduction in fish spawning and rearing area, creation of passage problems over riffles, loss of shelter and living space, and increases in water temperature have resulted.

Pollution impairs water quality in the lower portions of Pudding River and Mill Creek. Cannery wastes are dumped into the Pudding near Woodburn, and pollutants

Table 7.3. Appropriated surface water and minimum stream flow measurement data, Pudding Subbasin

Stream Areas	Appropriated Surface Water (cfs) 1/ Non Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
Molalla River	25	36	20	River mile 6.0	Aug. 27, 1959 (1928-59)(1963-65)	U.S. Geological Survey
Milk Creek System	12	35	18	Mouth	Sept. 26, 1962	Ore. Game Comm.
Other tributaries to Molalla River	11	27	--	--	--	--
Pudding River	0.0	60	26	River mile 8.1	Aug. 13,14,1961 (1928-1964)	U.S. Geological Survey
Abiqua Creek System	1.4	55	14	River mile 1.2	Aug. 28, 1962	Ore. Game Comm.
Butte Creek System	0.3	42	4	At Monitor, River mile 8.0	Aug. 28, 1962	" " "
Drift Creek System	42	5.6	--	--	--	--
Silver Creek System	0.4	15	10	River mile 1.0	Aug. 28, 1962	Ore. Game Comm.
Other tributaries to Pudding River	1.2	1.4	--	--	--	--
Mill Creek System	320	24	0	At Salem, River mile 2.1	Oct. 2, 1938 (1938-1965)	U.S. Geological Survey

1/ Oregon State Water Resources Board records, April 1966.
2/ U.S. Geological Survey Periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1961 and 1962.

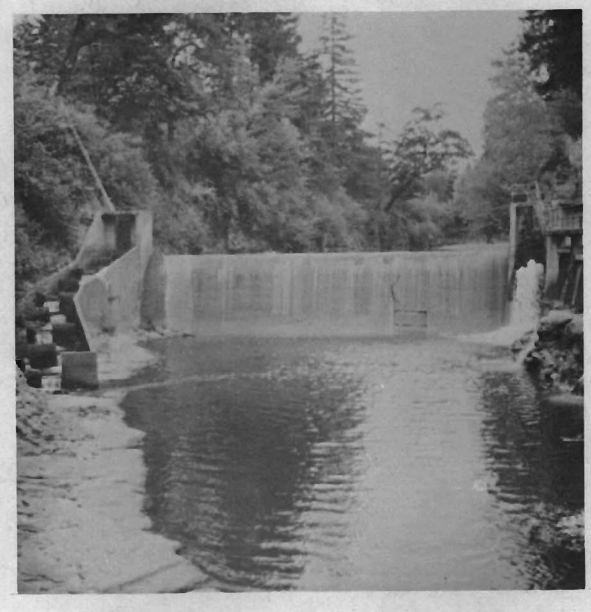


Figure 7.2. Silverton Muncipal water supply dam on Abiqua Creek at mile 11.0. August, 1966.

from several industrial and domestic sources are discharged into Mill Creek as it flows through Salem.

A few unladdered or inadequately laddered dams influence anadromous fish migration. Two dams on Mill Creek were recently fitted with temporary passage facilities by the Fish Commission; action is under way toward the construction of proper ladders. All other major Mill Creek dams are now laddered. The 12-foot high Silverton municipal water supply dam on Abiqua Creek at river mile 11 is equipped with an inadequate fish ladder (Figure 7.2). The ladder entrance is situated about 50 feet below the dam, and salmon and steelhead commonly bypass the entrance to jump unsuccessfully at the dam. Location and description of dams limiting fish production are given in Table 7.1.

The mainstem Pudding River contains small quantities of gravel suitable for anadromous fish spawning. Low elevation portions of both Molalla and Pudding Rivers are subject to low flows and have high water temperatures during seasonally low flow periods. This serves to limit the value of these areas for salmonid rearing and favors production of warm-water species that compete with salmonids.

Developments Beneficial to Fish Resources

Descriptions of fish ladders over natural barriers in subbasin streams are included in Table 7.1. Occasionally logjams have been removed and cascades or low falls have been blasted to improve passage for anadromous fish.

Table 7.4 lists numbers of fish stocked from 1961 through 1965. Large numbers of anadromous fish, particularly coho, were liberated in several years prior to 1961.

Table 7.5 shows legal minimum stream flow stipulations established in the subbasin. Future appropriations may be made for only domestic or livestock uses from natural flows of these streams. Also, the Molalla River system, above and

Table 7.4. Fish stocking in Pudding Subbasin, 1961-1965.

Stream System	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency 1/
Molalla	Fall Chinook	--	950				3,703,123		USFWS
"	" "	--	1200					401,773	OFC
"	Spring Chinook	--	27				181,144		USFWS
"	" "	--	139				72,975		OFC
"	Coho	--	17					19,720	"
"	"	--	918-1200		117,356	324,329		400,000	"
"	Steelhead	--	26-38	19,738	106,050	50,300		50,668	USFWS
"	Rainbow	8 & over	--	21,203	23,000	16,151	14,016	12,990	OSGC
Mill Creek	"	"	--	1,506	1,501	1,562	1,508	1,360	"
Pudding	Spring Chinook	--	139				62,550		OFC
"	Coho	--	80-140					231,295	"
"	"	--	918-1325		43,840	361,812			"
"	Rainbow	8 & over	--	18,505	18,525	18,588	16,126	17,083	OSGC

1/ Abbreviations used in this table are: "USFWS", U.S. Fish & Wildlife Service; "OFC", Fish Commission of Oregon; "OSGC", Oregon State Game Commission.

Table 7.5. Minimum stream flow stipulations established by the Oregon State Water Resources Board in 1964.

Stream	Location	Minimum Flows in Cubic Feet per Second
Pudding River and tributaries	Above USGS gage 14-2020 at river mile 8.1	35
Pudding River and tributaries	Above USGS gage 14-2010 at river mile 40.4	10
Molalla River and tributaries	Above USGS gage 14-2000 at river mile 5.7	60
Molalla River and tributaries	Above USGS gage 14-1985 at river mile 32.3	35

including the Table Rock Fork drainage, is protected by State Water Resources Board programming from significant future water withdrawals. This stipulation applies as well to all natural lakes, other than those privately owned, located above the 2,000-foot elevation.

Present Economy

Subbasin streams furnish an estimated 400 winter steelhead, 3,800 coho, and 1,300 spring chinook to the annual commercial harvest from the Columbia River and Pacific Ocean. This amounts to 53,000 pounds of fish valued at $24,000.

Approximately 100 winter steelhead, and 100 coho and spring chinook salmon were caught by anglers during 1965 in the subbasin. Relatively low angling pressure occurs in the streams, with most of it directed upon steelhead in the Molalla River. A total of 700 winter steelhead, 1,000 coho, and 700 spring chinook produced in subbasin streams were caught in 1965 by sport fishermen in the Pacific Ocean, Columbia and Willamette Rivers and in the subbasin. Angler use of steelhead and salmon produced in the subbasin amounted to 12,000 fisherman-days in 1965 valued at $72,000.

Angling pressure for wild cutthroat and hatchery rainbow trout is heavy in the spring on subbasin streams. There is little angling pressure on the lakes in the basin. An estimated 25,500 trout, including some juvenile anadromous fish, were caught in 25,000 angler-days valued at $75,000 in 1965 in the total trout fishery.

There is little angling pressure on warm-water species in the basin, and little is known of the overall species composition and catch. Economic value of these fish in the subbasin is low compared to the value of cold-water species.

8. TUALATIN SUBBASIN

8. TUALATIN SUBBASIN

The Tualatin Subbasin is composed of the Tualatin River watershed (Figure 8.1). Nearly all the basin's streams and a few small ponds provide important habitat for fish.

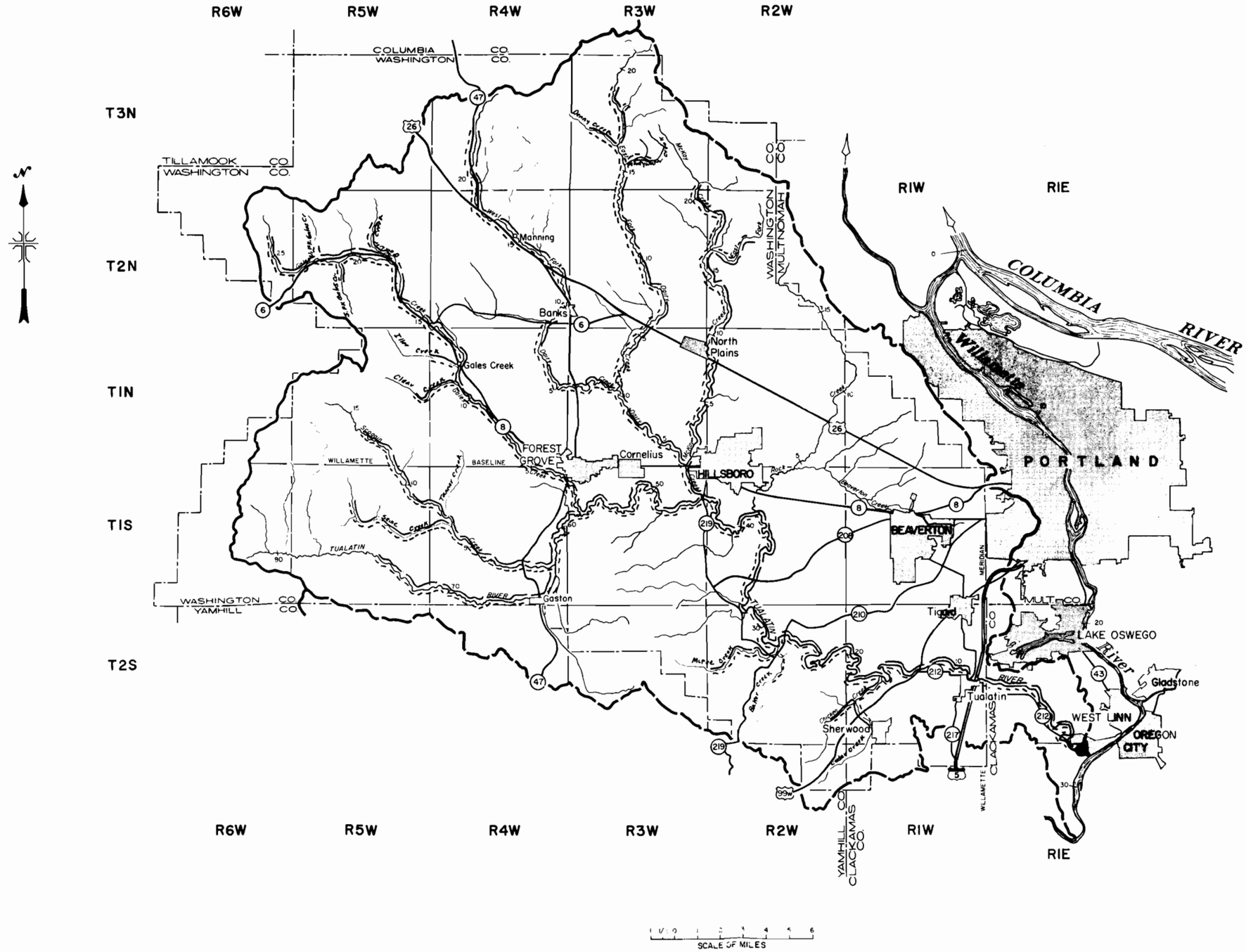
Habitat

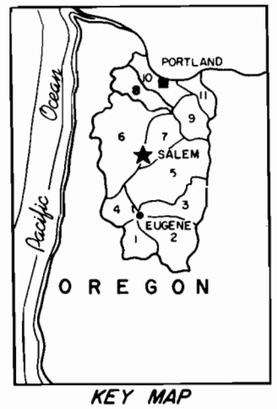
The Tualatin River, 83 miles in length, drains 712 square miles and enters the Willamette River from the west about two miles upstream from Willamette Falls. Most of the drainage lies in the flat Willamette Valley floor and a majority of the streams flow through agricultural land. Only the upper 10 miles of the river and upper portions of a few of its tributaries rise on the western slope of the Coast Range. Stream gradients are therefore predominantly slight.

The most critical factor limiting salmon and trout production is low, warm stream flow in the summer. These reduced volumes afford poor shelter conditions for fish and greatly increase competition for food, shelter, and living space. This competition between individual salmonids is not generally as serious as the added competition from nongame fish which thrive in the deteriorated environments.

Stream discharges are typical of west side Willamette River tributaries, being subject to large seasonal variations. Flows in the lower 65 miles of the Tualatin River become extremely low or intermittent each summer. Normally, low flows occur in nearly all tributaries in summer and autumn (Table 8.1).

Flat stream gradients, reduced flows, and a general paucity of watershed plant cover contribute to warm stream temperatures during summer periods of low rainfall. Summer temperatures in all but higher elevation streams usually range from 55 to 75 F. Temperatures as high as 75 and 80 F commonly occur throughout most of the main stem Tualatin River and greatly limit salmon and trout production.





KEY MAP

LEGEND:

Present distribution (May 1966)

- STEELHEAD — — — —
- COHO - - - - - - - -
- CHINOOK ————————
- Unaccessible habitat for onadromous fish, blocked by dams ////////

FIGURE 8.1

SUB-BASIN 8

Tualatin

Table 8.1. Appropriated surface water and minimum stream flow measurement data, Tualatin Subbasin

Stream Areas	Appropriated Surface Water (cfs) 1/ Non Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
Tualatin River	58	123	0.3	Near Dilley, River mile 58.8	Sept. 8, 1962 (1939-1965)	U.S. Geological Survey
Gales Creek System	6	52	1.0	About River mile 9.0	Aug. 19, 1947 (1940-1956)	" "
Dairy Creek System	5.3	102	7.0	East Fork at about River mile 8.0	Sept. 10-12,1944 (1940-1951)	" "
McKay Creek System	0.1	21	0.4	River mile 13.0	Aug. 17,18,22,1951 (1940-1943) (1948-1956)	" "
Scoggin Creek System	10	20	0.1	Near Gaston, River mile 1.7	Several days in 1958 & 1961 (1939-1965)	" "
Other tribs to the Tualatin River	3	97	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.
2/ U.S. Geological Survey periods of available records are shown in parenthesis.

Spawning gravel for anadromous fish and trout is plentiful in most major tributary systems and in the Tualatin River from Cherry Grove near river mile 70 upstream approximately five miles to Lee Falls. Of the tributaries, Gales, Scoggin, East Fork Dairy, and McKay Creeks contain the best gravel and receive the heaviest use by anadromous fish. The Tualatin River downstream from Cherry Grove has limited quantities of spawning gravel but is valuable as a salmon and steelhead migration route and for its rearing potential for trout and salmon.

Lee Falls, 12 feet high, is the only major natural barrier affecting anadromous fish. There is adequate habitat above the falls to produce significant runs of coho and steelhead.

Species and Distribution

Coho salmon are the most numerous and widespread of the anadromous fish. The annual spawning escapement averages approximately 3,400 coho. The upper Tualatin River (above Cherry Grove) and Gales, McKay, Scoggin, and East Fork Dairy Creeks produce the bulk of the run.

The 1965 winter steelhead run was 400 fish, all or most of which spawned in Gales Creek. This run is believed to approximate the average run. Figure 8.1 shows known steelhead and coho distribution in subbasin streams. Records indicate the subbasin once supported a small run of chinook salmon (Parkhurst, Bryant and Nielson, 1950).

Wild cutthroat trout are found in low to moderate numbers in most streams with perennial flows. Highest populations are present in the headwater streams having cool summer water temperatures. Substantial numbers of large cutthroat trout from the Willamette River enter the Tualatin system in winter and spring months to spawn. Catchable-sized rainbow or cutthroat are stocked in the larger streams each spring to supplement natural cutthroat populations for trout angling.

Species of warm-water game fish common to the Willamette River also inhabit the streams of the lower Tualatin drainage. Populations of these species, particularly largemouth bass and bullhead catfish, are more dense in the main stem Tualatin than in any other Willamette River tributary, with the possible exception of the Yamhill and Long Tom Rivers.

Many nongame fish species are scattered throughout the subbasin. Largescale suckers and redside shiners have the widest distribution and largest populations, with the possible exception of dace and sculpins. Dace and sculpins are the only nongame forms common in the small, higher elevation streams.

Developments and Conditions Adversely Affecting Fish Resources

A dam of concrete and board construction is located in the Tualatin River at river mile 3.8. This structure is used to divert water to Oswego Lake through a large unscreened canal that leaves the river about 3 miles above the dam. The dam, with boards installed, is approximately 6 feet high and forms a barrier to the upstream migration of adult coho salmon, especially during low flow periods in the fall. A wooden ladder over the dam was washed away in 1959 and has not been replaced. Sometimes practically no water passes the dam in summer and fall months, preventing upstream migration of adult coho through the lower 3.8 miles of river. Steelhead and cutthroat migrate upstream during periods of higher stream flow and thus have less difficulty in passing the dam. Effects of the unscreened Oswego Lake canal upon juvenile salmon and steelhead are discussed in the Columbia Subbasin "Developments Adversely Affecting Fish Resources" section.

Dissolved oxygen concentrations below 5 parts per million are now common in the lower river in low flow periods. Increased pollution, coupled with existing deteriorated water quality in this area, could eliminate resident trout and warm-water game fish populations in the area and preclude establishment of runs of fall chinook that migrate during low flow periods in the fall.

Surface water rights in the subbasin total nearly 500 cubic feet per second (Table 8.1), with about 85 percent for consumptive use. The major consumptive use is for irrigation from the Tualatin River, Dairy Creek, McKay Creek, and Gales Creek.

Twelve-foot high Lee Falls at river mile 74.7 and 16-foot Haines Falls at river mile 76.9 on the main river are the most limiting of the few natural barriers to anadromous fish migration in the subbasin.

Developments Beneficial to Fish Resources

No hatcheries are located in the subbasin. Table 8.2 lists trout and anadromous fish liberations made in the Tualatin drainage in the 1961-1965 period. Coho runs in some streams have increased significantly, partially resulting from liberations initiated in 1954.

Table 8.3 shows legal minimum flow stipulations established in the subbasin in 1966. These stipulations substantially limit future water appropriations from natural flows of the listed stream areas and should greatly benefit fish resources.

Table 8.2. Fish stocking, Tualatin Subbasin, 1961-1965.

Species	1961	1962	1963	1964	1965	Agency 1/
Coho fry			195,600			OFC
Legal Cutthroat	9,010		5,032	5,996	1,996	OSGC
Legal Rainbow	10,003	4,012	13,000	7,996	30,736	"

1/ Abbreviations used in this table are: "OFC", Fish Commission of Oregon; "OSGC", Oregon State Game Commission.

Table 8.3. Minimum stream flow stipulations established by the Oregon State Water Resources Board in 1966.

Stream	Location	Minimum Flows in Cubic Feet Per Second
Tualatin River or tributaries	Above river mile 70.0	10 (July 16-Nov. 15) 65 (Nov. 16-May 31) 20 (June 1-July 15)
Tualatin River or tributaries	Above USGS gage 14-2035 near Dilley, Oregon	15 (Aug. 1-Sept. 30)
Tualatin River or tributaries	Above USGS gage 14-2075 at West Linn, Oregon	15 (July 16-Sept. 30) 30 (Oct. 1-May 31) 20 (June 1-July 15)
Seine Creek or tributaries	Above the mouth	2 (July 1-Nov. 15) 25 (Nov. 16-May 31) 8 (June)
Tanner Creek or tributaries	Above the mouth	1 (Aug. 1-Sept. 30) 9 (Nov. 15-May 31)
Gales Creek or tributaries	Above the mouth	12 (July 16-Oct. 31) 100 (Nov. 1-May 31) 35 (June 1-July 15)
Gales Creek or tributaries	Above river mile 12.0	8 Sept. 1-Oct. 15) 70 (Nov. 15-May 31)
Beaver Creek or tributaries	Above the mouth	1 (July 16-Nov. 15) 17 (Nov. 16-May 31) 3 (June 1-July 15)
Little Beaver Creek or tributaries	Above the mouth	1 (Aug. 1-Sept. 30)
North Fork of Gales Creek or tributaries	Above the mouth	1.5 (July 16-Nov. 15) 25 (Nov. 16-May 31) 3 (June 1-July 15)
South Fork of Gales Creek or tributaries	Above the mouth	1 (July 16-Nov. 15) 20 (Nov. 16-May 31) 2 (June 1-July 15)
East Fork Dairy Creek or tributaries	Above river mile 13.0	12 (July 16-Nov. 15) 50 (Nov. 16-May 31) 24 (June 1-July 15)
Denny Creek or tributaries	Above the mouth	2 (Aug. 1-Nov. 15) 15 (Nov. 16-May 31) 3 (June 1-July 31)
Plentywater Creek or tributaries	Above the mouth	1 (Aug. 1-Nov. 15) 5 (Nov. 16-May 31) 2 (June 1-July 31)

Table 8.3 (continued)

Stream	Location	Minimum Flows in Cubic Feet Per Second
McKay Creek or tributaries	Above river mile 15.5	4 (Aug. 1-Sept. 30) 36 (Nov. 16-May 31)
East Fork of McKay Creek or tributaries	Above the mouth	2 (Aug. 1-Sept. 30)
McFee Creek or tributaries	Above Gulf Canyon Creek	2 (Aug. 1-Sept. 30) 12 (Nov. 15-May 31)

Present Economy

The streams of the Tualatin system annually provide an estimated 8,200 coho salmon and steelhead trout to the commercial fisheries of the Pacific Ocean and Columbia River. This catch amounts to an estimated 57,000 pounds of fish valued at $22,000.

The winter sport fishing season for anadromous fish, presently November to April, is open in the lower 45 miles of the Tualatin River. Angling pressure is light. Tributaries and the upper river are closed to fishing during this period to protect spawning fish. In 1965, 2,100 coho and steelhead of subbasin origin were harvested in the sport fisheries of the subbasin, Willamette River, Columbia River, and the Pacific Ocean. Total angler use of salmon and steelhead trout produced in subbasin streams was an estimated 2,600 angler-days valued at $15,600.

Wild cutthroat and hatchery-produced rainbow and cutthroat trout are subjected to moderate to high angling pressure. Most stocking and fishing occur in the larger streams during spring and early summer months when flows are still relatively ample and cool. An estimated 35,100 trout were caught from subbasin streams in 1965. An estimated 20,200 angler-days valued at $60,600 were expended on this fishery.

Warm-water game species receive light to moderate angling pressure. Fishing is concentrated principally in the lower main stem Tualatin River in spring and summer months. Bullhead catfish and largemouth bass are the species most commonly caught. This fishery supports an estimated 11,100 angler-days use valued at $16,600 annually.

9. CLACKAMAS SUBBASIN

9. CLACKAMAS SUBBASIN

The Clackamas Subbasin is made up of the Clackamas River watershed (Figure 9.1). Nearly all streams in the system are important for fish production and angling. Over 60 mountain lakes in the Cascade Range and 5 Portland General Electric Company reservoirs also contribute to the sport fishery.

Habitat

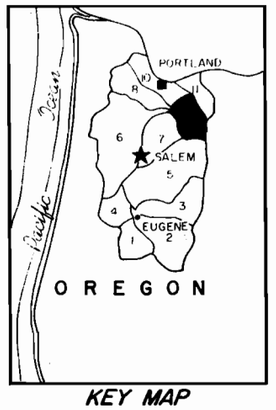
The Clackamas River system contains approximately 840 miles of stream and drains 937 square miles of land. It is a clear mountain stream, with an average flow at the mouth of about 3,700 cubic feet per second. Clackamas River flows, neglecting fluctuations caused by dams, are more uniform than many Willamette Basin streams.

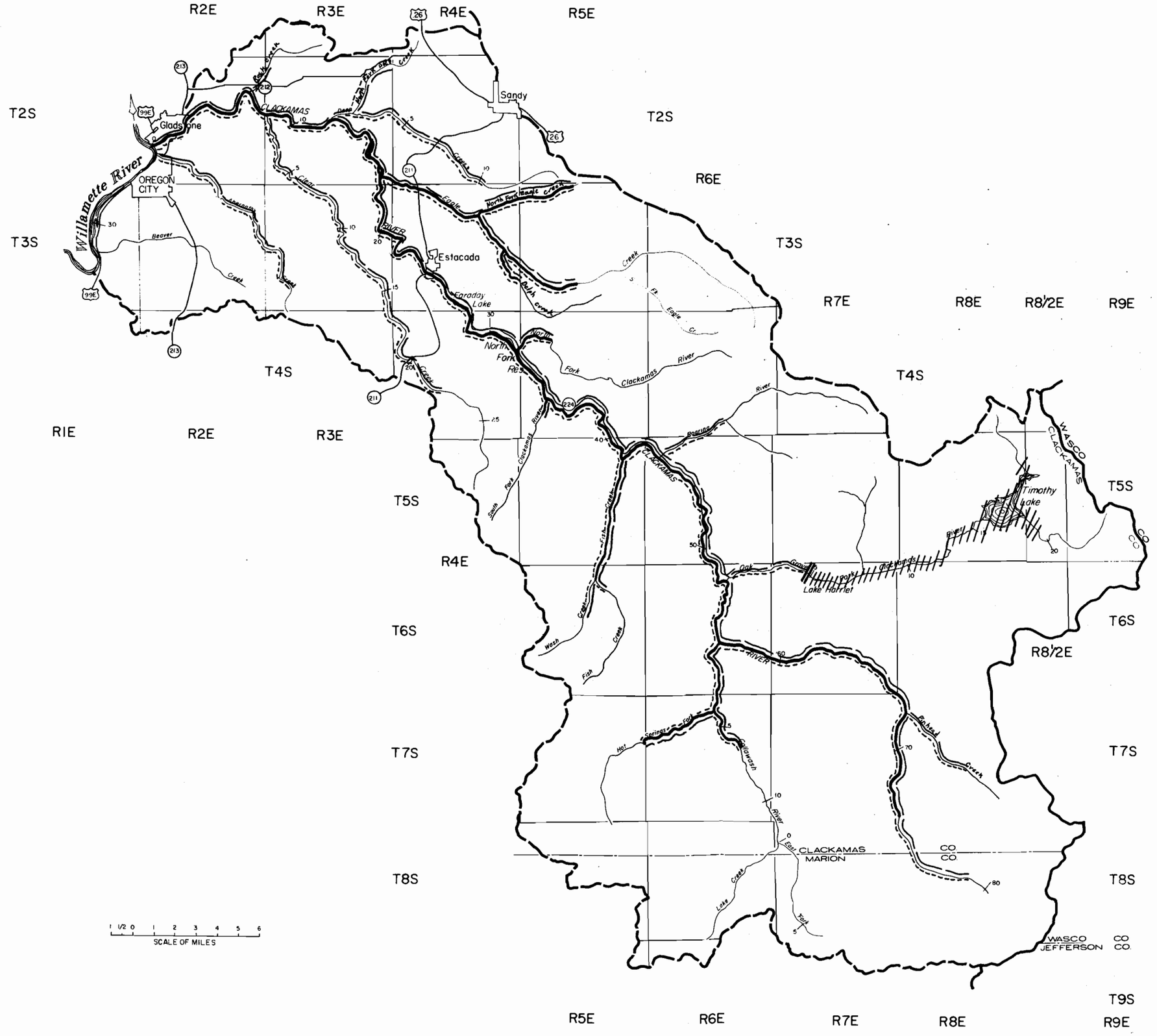
About 85 percent of the watershed is forested, and the stream is well shaded above river mile 25. Because of elevation and shading, water temperatures are relatively cool. Summer maximums usually are less than 70 F except in the lower sections of low elevation tributaries.

Below river mile 25, much of the land has been cleared for agricultural purposes. Consequently, summer flows in the streams draining these areas -- Deep, Eagle, and Clear Creeks -- become low and water temperatures often exceed 70 F.

The Clackamas River provides excellent habitat for trout and salmon. Stream gradient is moderate to steep throughout its length, and the stream bed is rich in gravel suitable for their spawning. Abundant rearing area is provided by the relatively stable flows of high-quality water.

According to the Annual Report of the Oregon Fish Commissioners for 1899, the Clackamas River was considered to be the best spring chinook stream in the state at that time. There are indications that runs prior to 1900 were several





LEGEND:

Present distribution (May 1966)

- STEELHEAD — — — —
- COHO ----------
- CHINOOK ——————
- Unaccessible habitat for anadromous fish, blocked by dams

FIGURE 9.1

SUB-BASIN 9

Clackamas

times greater than they are at present. Commercial fishing in the lower Clackamas River before the turn of the century, extensive egg-taking for Clackamas River salmon hatcheries, construction of hydroelectric dams, and perhaps other factors, contributed to depletion of the runs.

A number of falls on tributaries limit stream area available to anadromous fish. Significant habitat is thus unavailable in the North Fork, South Fork, Oak Grove Fork, Collawash River and Roaring River systems.

Mountain lakes in the subbasin are small in size, but provide good habitat for trout. The largest, Elk Lake, covers 63 surface acres.

Reservoirs formed as part of Portland General Electric Company's hydroelectric developments, also provide habitat for fish. Timothy Lake, 1,200 surface acres, and Harriet Lake, 23 surface acres, are located on the Oak Grove Fork. North Fork Reservoir, 350 surface acres, and River Mill Reservoir, 100 surface acres, are located on the Clackamas main stem, and 70-acre Faraday Lake is situated between the two and adjacent to the main stem (Figure 9.2). Although commonly called "lakes", Timothy, Harriet and Faraday are actually reservoirs.

Species and Distribution

The river produces chinook salmon, coho salmon and steelhead trout that contribute to the commercial and sport fisheries in the Columbia River and Pacific Ocean, as well as to the sport fishery in the Willamette and Clackamas River systems. Anadromous fish distribution is shown in Figure 9.1.

In 1965, 12,000 coho salmon entered the Clackamas River; approximately 6,100 of these resulted from Eagle Creek National Fish Hatchery releases. The 1965 steelhead and 1962 through 1964 average spring chinook runs were 5,500 and 4,700 fish, respectively. The 1965 coho salmon and steelhead runs are believed to approximate the average runs. Small numbers of fall chinook, approximately 100,

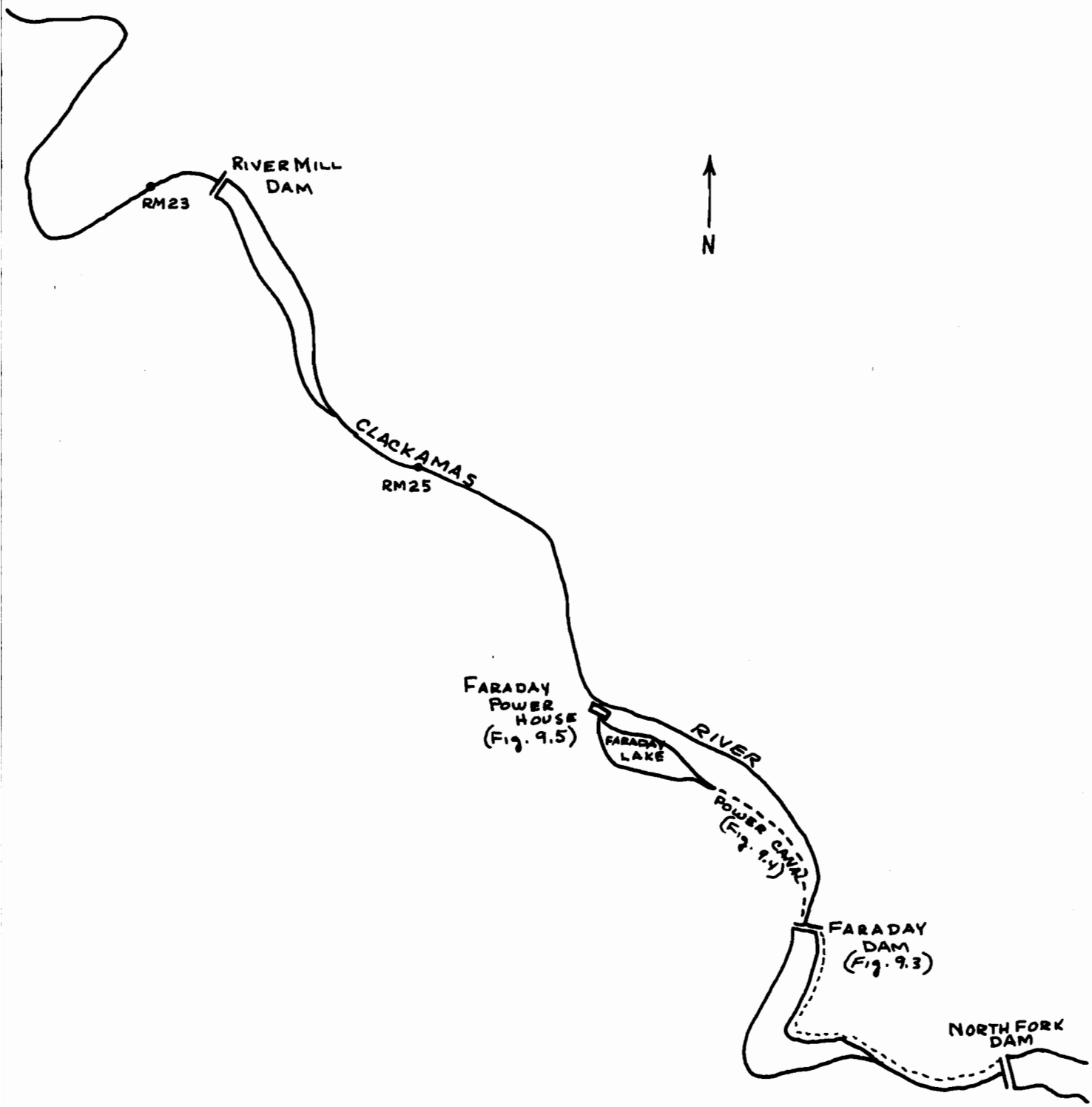


FIGURE 9.2. CLACKAMAS RIVER HYDRO-ELECTRIC DEVELOPMENTS

spawn in the lower river and in Eagle Creek, a tributary entering the Clackamas at river mile 16.7.

Sport fishermen annually catch large numbers of rainbow and cutthroat trout, and lesser numbers of whitefish, Dolly Varden and brown trout. Searun cutthroat trout are taken by anglers as far upstream as River Mill Dam. Brook trout are present in some headwater streams and in many of the lakes and reservoirs. Through stocking, a self-sustaining population of kokanee has been established in Timothy Lake. Few warm-water game fish, such as bass, perch, bluegill and catfish, are present in subbasin streams because the water is too cold for favorable growth and reproduction.

Above North Fork Reservoir there are few species of nongame fish, and these only in small numbers, to compete with and prey on salmonids. Suckers are plentiful in North Fork Reservoir, however, and in the river and reservoirs downstream. Carp and squawfish are common in the river below River Mill Dam.

Developments and Conditions Adversely Affecting Fish

Dams have probably been the type of development most adverse to anadromous fish in the subbasin. The First and Second Annual Reports of the Fish and Game Protector to the Governor (1894) reported that a grist mill dam near Gladstone had eliminated most of the Clackamas River salmon run in 1891. The state hatchery located 4 miles upstream reported a decrease in egg take from 5,860,000 in 1890, to 800,000 the following year.

Two hydroelectric dams (River Mill and Cazadero) at river miles 23.4 and 28.2, at least in the past, have hindered or blocked the upstream migration of salmon and trout (Figure 9.2). The precise effect of the dams is undocumented, but they may well have decimated the runs of salmon and steelhead in the river.

The lower dam, River Mill, was constructed in 1911. It is a concrete structure 80 feet high. The middle dam, Cazadero, was a timber-crib structure about 70 feet high built in 1906. It was replaced in 1965 by a concrete structure and renamed Faraday Dam (Figure 9.2). A third dam, North Fork, was built in 1958 at river mile 30. It is also a concrete structure and is 206 feet high.

Whether the steep, narrow fishway at River Mill is adequate to pass salmon and steelhead is a moot question. The fishery management agencies have believed for some time that it is inadequate, and a study financed by Portland General Electric Company is now under way to answer the question. The fishway at Cazadero Dam washed away in 1917 and was not replaced until 1939, twenty-two years later. Thus, the streams above this point were closed for a considerable time to salmon and steelhead entry.

Since 1958 the fish passage picture at the mainstem hydroelectric dams has brightened. Adult salmon and steelhead enter the North Fork Dam fishway below Faraday Dam and exit above North Fork Dam (Figure 9.3). Smolts, too, take advantage of this fishway. They are screened from the ladder and shunted downstream through a pipe to the pool below River Mill Dam. Adult runs of coho and steelhead have increased since the North Fork Dam fishway became operable, but spring chinook numbers have remained about the same.

Power peaking operations at River Mill Dam cause severe daily fluctuations of flow. River discharges of 295 and 1,780 cfs measured at the U.S. Geological Survey gaging station just below River Mill Dam on September 18, 1964, are typical of daily flow extremes that occur while spring chinook are spawning. Even more severe discharges occur in the fall and winter. Several detrimental effects result downstream from flow fluctuations below River Mill Dam. This condition retards production of fish food organisms, disrupts salmon spawning, interferes with angling and other recreational uses, and strands fish.

Two Portland General Electric Company dams are located on the Oak Grove Fork of Clackamas River. Because of natural falls below the dams, only resident trout are affected. The lower dam forms a 23-acre impoundment, Harriet Lake, from which water is diverted for power generation (Figure 9.6). The upper dam forms Timothy Lake, a popular trout fishing impoundment of approximately 1,200 acres. Water from Timothy Lake is released to augment Harriet Lake. Law requires a minimum release of at least 10 cubic feet per second from Harriet Dam.

Four small dams exist in Clackamas River tributaries, and fish passage at these structures is inadequate in some cases. The location of these barriers and the status of fish passage is given in Table 9.1.

Excluding power rights, appropriations for surface water are not substantial from most streams. Table 9.2 lists water right and related minimum stream flow data.

There are many impassable falls, and falls hindering fish passage, on tributary streams. Some of these isolate significant amounts of spawning and rearing habitat, but few can be considered limiting factors at the present time because runs of fish are not large enough to utilize presently available habitat.

Figure 9.3. Faraday Dam and North Fork fishway at river mile 28.2. August, 1966.

Figure 9.4. Faraday power canal. (See Figure 9.2). August, 1966.

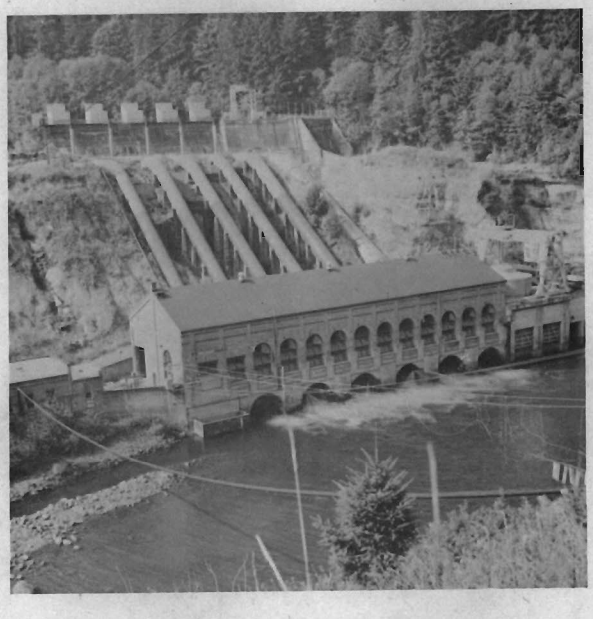


Figure 9.5. Faraday powerhouse at river mile 26.5. August, 1966.

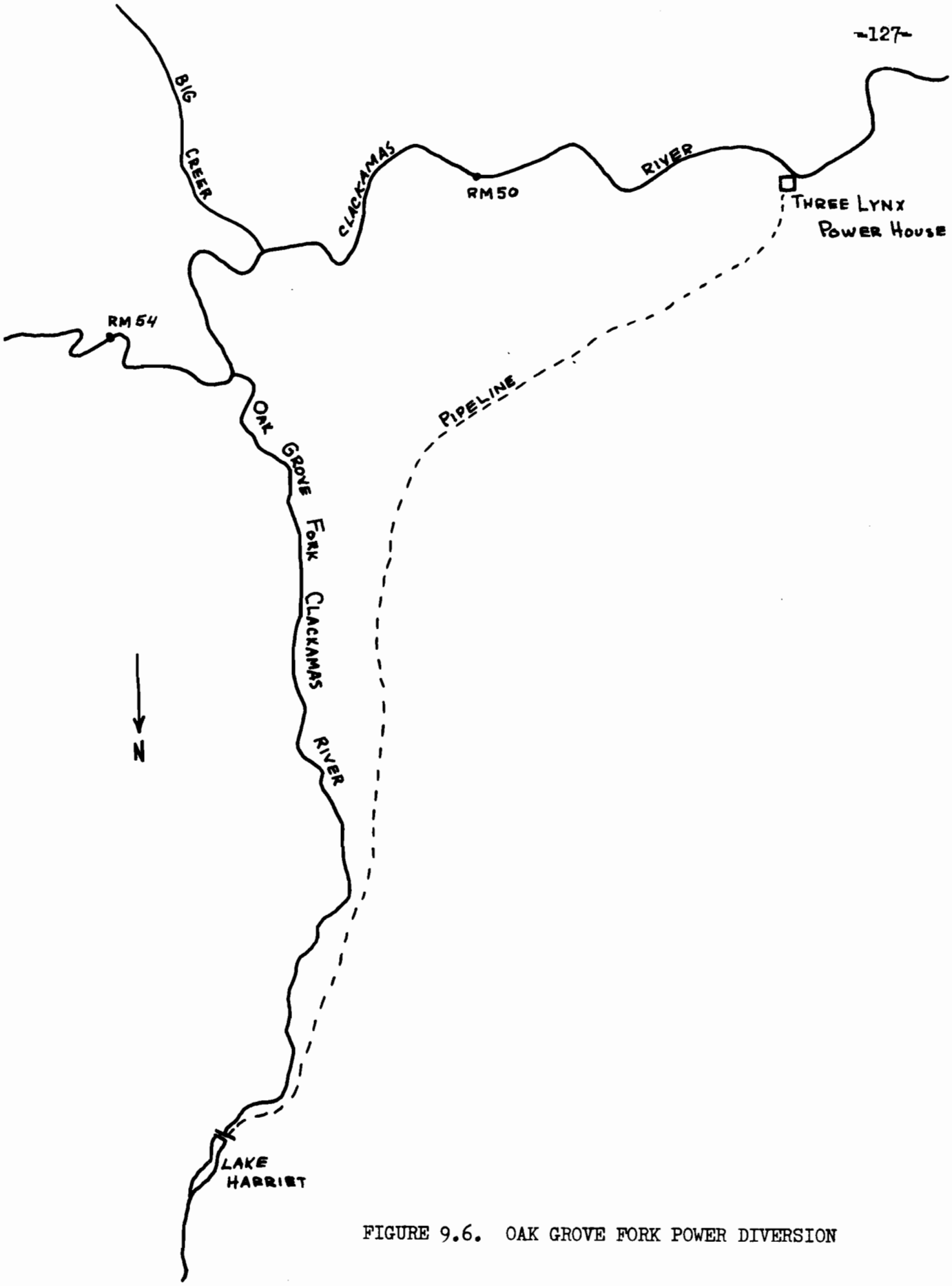


FIGURE 9.6. OAK GROVE FORK POWER DIVERSION

Table 9.1. Location and description of upstream fish passage facilities at barriers on Clackamas Subbasin streams

Stream [1]	Barrier Description & Location	Description of Fish Facility [1]
Clackamas R.	River Mill Dam, concrete. About 80 feet high. Mile 23.4.	A steep, narrow concrete ladder. Anadromous fish pass with difficulty.
Clackamas R.	Faraday and North Fork Dams. High concrete structures at mile 28.2 & 30.0, respectively.	A 1.7-mile concrete ladder by-passes both dams. Probably adequate.
Deep Creek	Sersanous Dam. Earthen, 20 feet high. Mile 8.	Inadequate concrete ladder. Passes some coho and steelhead.
N.Fk. Deep Cr.	Valberg Lumber Company Dam. Wooden dam, 7 feet high at Boring.	Recently improved, passable ladder.
Eagle Creek	Dwyer Falls, 6-foot rock falls at mile 5.	Adequate concrete ladder.
Eagle Creek	Rock falls 10 feet high at mile 9.	Adequate concrete ladder.

1/ Status as of August, 1966.

Table 9.2. Appropriated surface water and minimum stream flow measurement data, Clackamas Subbasin.

Stream Area	Appropriated Surface Water (cfs) 1/ Non Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
Clackamas R. below and including River Mill Dam	950	89	385	Gage 14-2110 River mile 4.8	Sept. 13, 1963 (1911-1912) (1962-1965)	U.S. Geological Survey
Clear Creek System	5	15	20	Mouth	Sept. 4, 1963	Ore. State Game Comm.
Deep Creek System	0.6	12	7	River mile 0.6	Aug. 21, 1962	" "
Eagle Creek System	114	2.1	32	River mile 0.5	Aug. 21, 1962	" "
Tickle Creek System	1.2	3.7	4	River mile 1.1	Aug. 21, 1962	" "
Other tribs to Clackamas R. below River Mill Dam	3.3	7	-	--	--	--
Clackamas R. above River Mill Dam	8,450 3/	2.2	324	Gage 14-2095 River mile 47.8	Oct. 17, 1958 (1909-13)(1921-65)	U.S. Geological Survey
Collawash River System	0.0	0.0	58	Mouth	Sept. 5, 1963	Ore. State Game Comm.
N.F. Clackamas R. System	0.8	0.1	10	Mouth	Aug. 21, 1962	" "
Oak Grove Fork System	See footnote 3	0.4	90	River mile 16	Oct. & Nov. 1926 (1913-1929)	U.S. Geological Survey
South Fk. Clackamas R. System	0.0	56	21	Mouth	Sept. 5, 1963	Ore. State Game Comm.
Other tribs to Clackamas R. above River Mill Dam	1.2	2.6	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.

2/ U.S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1962 and 1963.

3/ Includes Oak Grove Fork power rights.

Table 9.3. Fish stocking in Clackamas Subbasin, 1961-1965.

Stream System or lake	Species	Mean Length (Inches)	Number per pound	1961	1962	1963	1964	1965	Agency 1/
Clackamas	Fall Chinook	---	421-821					2,096,386	OFC
"	" "	---	26-45	2,193,611	2,435,531		1,427,326	544,290	USFWS
"	Spring Chinook	---	1150-1264				3,795,169	1,001,264	OFC
"	" "	---	36-62	533,372	180,945	940,579	3,728,264	1,630,747	USFWS
"	Coho	---	1,168					2,269,972	OFC
"	"	---	20-21					99,709	"
"	"	---	22-29	1,270,679	1,012,977	750,151	1,293,801		USFWS
"	Steelhead	Yearling ---			7,984				OSGC
"	"	---	15-44	98,816	179,727	451,141	333,865	117,361	USFWS
"	Cutthroat	8 & over	---	8,006					OSGC
"	Rainbow	" "	---	113,730	125,754	126,922	102,278		"
Elk Lake	Brook Trout	2-4	---				20,020		OSGC
" "	Cutthroat	0-2	---			30,680			"
" "	Kokanee	2-4	---	20,029	19,900	20,247			"
Other Cascade Lakes	Brook Trout	2-4	---	86,445	30,282	32,809	26,260	33,510	"
" "	Golden Trout	0-2	---			617			"
" "	Rainbow	2-4	---	2,160	9,982		4,200	8,800	"
" "	"	4-6	---	32,530			1,008		"
" "	Cutthroat	2-4	---					428	"
Harriet Lake	Rainbow	2-4	---	5,038	10,080				"
" "	"	4-6	---	7,636		8,785			"
" "	"	8 & over	---	2,200		998	3,995	7,261	"
North Fork Res.	"	2-4	---	110,070					"
" " "	"	4-6	---	72,144					"
" " "	"	8 & over	---	26,879	8,698	23,469	11,137	24,035	"
Timothy Lake	Brook Trout	2-4	---	102,300	49,950	25,000	25,990	25,105	"
" "	Cutthroat	0-2	---		108,800	109,615	50,233		"
" "	"	2-4	---					70,500	"
" "	Kokanee	0-2	---				105,975	75,170	"
" "	"	2-4	---		108,821	197,100	74,877	165,050	"
" "	Rainbow	0-2	---		30,150				"
" "	"	2-4	---	250,352	299,949	15,540		100,281	"
" "	"	4-6	---			84,826	138,855	140,690	"
" "	"	8 & over	---		4,980				"
Faraday Lake	"	4-6	---					17,061	"

1/ Abbreviations used in this table are: "USFWS", U.S. Fish & Wildlife Service; "OFC", Fish Commission of Oregon; "OSGC", Oregon State Game Commission.

Developments Beneficial to Fish Resources

Existing developments beneficial to fish include one hatchery and the ladders over natural barriers described in Table 9.1. The large Federal hatchery located on Eagle Creek rears coho and spring chinook salmon as well as steelhead and rainbow trout. Reservoirs formed as a part of the hydroelectric generation system provide some angling and rearing of salmonids. The reservoirs do not compensate for the loss of anadromous fish, however, because the dams impede both their upstream and downstream migration. The fishway built as a part of the North Fork Dam project has partially corrected the fish passage problem that was caused by the hydroelectric developments.

Waters of the subbasin are stocked each year with both resident and anadromous fish. Table 9.3 indicates numbers and species of fish stocked in the watershed in recent years.

Table 9.4 shows legal minimum flow stipulations established in the subbasin in 1966. These stipulations substantially limit future water appropriations from natural flows of the listed stream areas and should greatly benefit fish resources and recreation.

Table 9.4. Minimum stream flow stipulations established by the Oregon State Water Resources Board in 1966.

Stream	Location	Minimum Flows in Cubic Feet per Second
Clackamas River or tributaries	Above USGS gage 14-2080 at Big Bottom	150 (July 1-Sept. 15) 240 (Sept. 16-June 30)
Clackamas River or tributaries	Above USGS gage 14-2095 above Three Lynx, Oregon	400 (July 1-Aug. 31)
Lowe Creek or tributaries	Above the mouth	2 (July 1-Oct. 31) 8 (Nov. 1-June 30)
Pinhead Creek or tributaries	Above the mouth	50 (June 1-Oct. 31) 75 (Nov. 1-May 31)

Table 9.4 (continued)

Stream	Location	Minimum Flows in Cubic Feet per Second
Collawash River or tributaries	Above the mouth	75 (July 16-Sept. 15) 250 (Sept. 16-May 31) 200 (June 1-July 15)
East Fork Collawash R. or tributaries	Above the mouth	10 (Aug. 1-Sept. 30)
Elk Lake Creek or tributaries	Above the mouth	15 (Aug. 1-Sept. 30)
Hot Springs Fork, Collawash River or tributaries	Above the mouth	15 (July 16-Sept. 15) 75 (Sept. 16-July 15)
Oak Grove Fork Clackamas River or tributaries	Above the mouth	10 (Aug. 1-Sept. 30)
Roaring River or tributaries	Above the mouth	40 (July 1-Oct. 15) 100 (Oct. 16-June 30)
Fish Creek or tributaries	Above the mouth	15 (July 1-Oct. 31) 60 (Nov. 1-June 30)
Wash Creek or tributaries	Above the mouth	3 (July 16-Oct. 31) 25 (Nov. 1-June 15) 10 (June 16-July 15)
Eagle Creek or tributaries	Above the mouth	40 (July 16-Oct. 31) 125 (Nov. 1-May 31) 100 (June 1-July 15)
North Fork Eagle Creek or tributaries	Above the mouth	10 (Aug. 1-Oct. 31) 45 (Nov. 1-May 31) 30 (June 1-June 30) 20 (July 1-July 31)
Deep Creek or tributaries	Above the mouth	10 (July 16-Oct. 31) 35 (Nov. 1-May 31) 20 (June 1-July 15)
North Fork Deep Creek or tributaries	Above the mouth	1 (Aug. 1-Oct. 31) 20 (Nov. 1-May 31) 3 (June 1-July 31)
Tickle Creek or tributaries	Above the mouth	4 (July 1-Oct. 31) 30 (Nov. 1-May 31) 6 (June 1-June 30)
Clear Creek or tributaries	Above the mouth	20 (Aug. 1-Sept. 30) 40 (June 1-July 31)
Clear Creek or tributaries	Above Viola, Oregon	15 (July 16-Sept. 30) 25 (June 1-July 15)

Present Economy

Each year Clackamas Subbasin provides an estimated 500 steelhead trout, 28,800 coho, and 12,500 spring chinook salmon to the commercial fisheries of Columbia River and Pacific Ocean. This 420,000 pound harvest is valued at $199,000 annually.

An estimated 7,200 coho, 6,300 spring chinook salmon, and 900 steelhead trout of Clackamas Subbasin origin furnished 64,700 angler-days valued at $388,000 in 1965 to the Clackamas River, Willamette River, Columbia River, and Pacific Ocean sport fisheries.

Clackamas River sport fisheries for steelhead trout and coho and spring chinook salmon extend from the mouth upstream to River Mill Dam. Of the three, the steelhead fishery is the largest and is still growing. Seasonally, it extends from December into May. Coho angling takes place from October through December, and spring chinook angling occurs in April and May.

Stream trout fishing is supported mainly by hatchery-reared rainbow trout (Table 9.3). Most of the trout are stocked in streams above North Fork Reservoir. Access to these streams is easy, and the intensity of angling effort is heavy. Moderate angling effort is expended for resident cutthroat trout in the upper portions of most streams. An estimated 173,500 angler-days valued at $520,000 are expended annually on stream trout in the subbasin.

The Cascade lakes and Timothy, North Fork, Harriet and Faraday reservoirs receive considerable angling pressure. This pressure, however, is less than the total exerted upon streams. Stocked rainbow trout make up the bulk of the catch from the reservoirs. Significant numbers of cutthroat trout and kokanee salmon are also taken in Timothy Lake, the largest and most heavily utilized impoundment. Brook trout is the species most frequently caught in the Cascade lakes. The lakes and reservoirs of the subbasin support a sport fishery estimated to total 160,000 angler-days valued at $320,000 annually.

10. COLUMBIA SUBBASIN

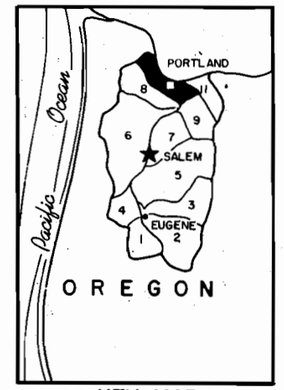
10. COLUMBIA SUBBASIN

Major streams in the Columbia Subbasin are Scappoose and Milton Creeks, tributaries of the Columbia River, and Johnson, Kellogg, and Sucker Creeks, tributaries of the Willamette River (Figure 10.1). Other important areas are Oswego Lake and numerous sloughs and floodplain lakes along the Columbia River, including those of Sauvie Island northwest of Portland.

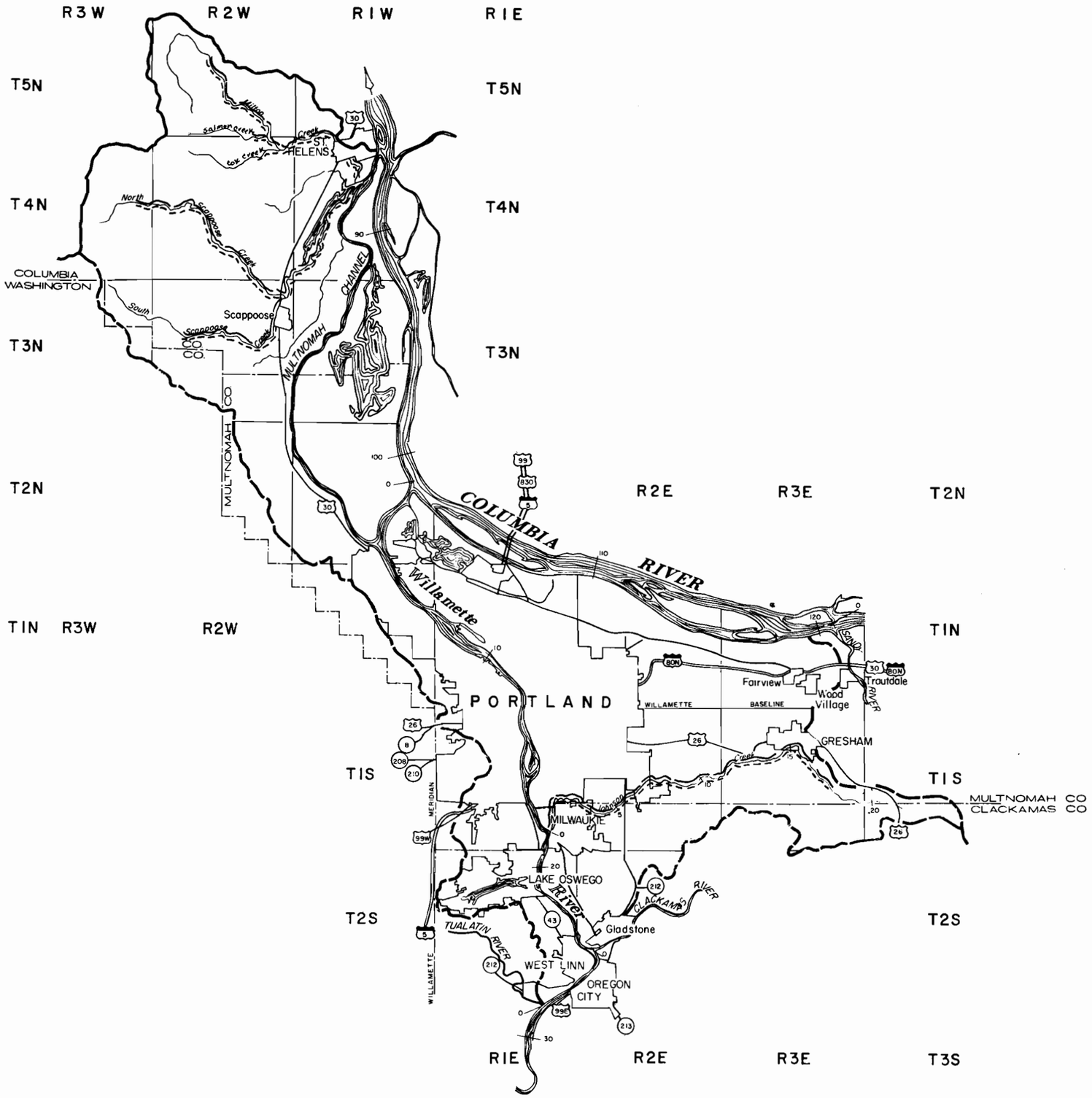
Habitat

Streams in the subbasin are few in number and relatively small in size. They all drain low-elevation watersheds and are often incapable of providing flows of adequate quality or quantity for salmonid rearing in summer months. Effects of dense human population in the area, principally those depleting water quality and quantity, further reduce fish populations in many streams. In late summer months, flows in the main stems of two of the largest stream systems, Johnson and North Fork Scappoose Creeks, commonly drop near 2 and 5 cubic feet per second, respectively. Water temperatures in lower portions of streams in the subbasin frequently range between 65 and 75 F in the summer. These temperatures approach critical levels for salmon and trout; consequently, most rearing takes place in the upper stream areas where the water is cooler. A notable exception is Crystal Springs Creek, a short, spring-fed tributary of lower Johnson Creek that discharges between 14 and 20 cfs at a temperature of less than 65 F in most summer periods.

Warm water temperatures that prevail in the majority of the subbasin's non-stream areas favor the production of warm-water game fish, but are also favorable for nongame fish such as carp and squawfish. Water temperatures in the lakes are so warm that stocked trout cannot be maintained to provide angling.



KEY MAP



1/2 0 1 2 3 4 5 6
SCALE OF MILES

LEGEND:

Present distribution (May 1966)

- STEELHEAD — — — —
- COHO - - - - - - - - - -
- CHINOOK ——————
- Unaccessible habitat for anadromous fish, blocked by dams ////////

FIGURE 10.1

SUB-BASIN 10

Columbia

Species and Distribution

Despite the foregoing limitations in stream habitat, which is much less than optimum because of low flows and high temperatures, significant numbers of anadromous fish are produced in the Johnson, Scappoose, Milton, and Kellogg Creek drainages. Average annual spawning populations of 1,100 coho salmon and an equal number of winter steelhead trout are estimated to utilize these four systems. Substantial but undetermined numbers of sea-run cutthroat trout enter the subbasin streams to spawn. Fall chinook salmon, usually fewer than 100, spawn in lower Scappoose Creek, while sporadic runs of chum salmon, usually fewer than 200, spawn in Milton Creek. Low stream flows during periods of fall chinook and chum salmon spawning are largely responsible for the small runs of these two species. Figure 10.1 shows anadromous fish distribution in the subbasin.

Resident cutthroat trout occur in moderate to high numbers in upper sections of streams where summer water quantity and quality conditions are best. Rainbow or cutthroat trout are stocked each year in Johnson Creek, Milton Creek, and both forks of Scappoose Creek.

Mixed populations of 12 species of warm-water game fish and at least 13 species of nongame fish are widespread in the slough and lake areas along the Columbia River. Many of these fish are also present in Oswego Lake, a 400-acre lake immediately south of Portland.

Developments and Conditions Adversely Affecting Fish Resources

Poor water quality affects fish in Scappoose Bay. This large slough-like area at the mouth of Scappoose and Milton Creeks adjoins the Columbia River at St. Helens. Two industrial developments, Kaiser Gypsum softboard plant and Crown Zellerbach Corporation pulp and paper plant, contribute organic wastes to the bay. Low dissolved oxygen concentrations which affect salmonids in Scappoose

Bay are caused primarily by organic effluents from the Kaiser Gypsum plant. Toxic substances occasionally kill fish in the area. Pollution commonly prevents or delays entry of anadromous fish into Scappoose and Milton Creeks.

Low stream flows that occur naturally in summer months are further reduced by consumptive water uses. Surface water rights for consumptive use in the major fish-producing stream systems total more than summer flows (Table 10.1). The consumptive water rights on Johnson and Kellogg Creeks are predominantly for irrigation, while those on Milton and Scappoose Creeks are mainly for municipal use. Although the water right amounts commonly exceed discharges in the low flow seasons, unused water, seepage, or tributary accretion prevent complete drying of most streams.

The 20-foot dam forming Oswego Lake is located just above a waterfall which is also 20 feet high (Figure 10.2). Neither barrier is provided with fish passage facilities. The dam and falls provide head for a power plant that receives portions of the lake outflow at a point a short distance below the falls. Large amounts of Tualatin River water are diverted by a two-mile long canal into Oswego Lake for eventual use at the power plant.

Adult coho and steelhead bound for the Tualatin River are attracted into the lake outlet, Oswego Creek, by Tualatin River water. The 0.1-mile section of the creek below the 20-foot falls has only limited spawning area (Figure 10.3). In recent years attempts have been made to alleviate the problem by capturing the fish and planting them elsewhere; however, a better solution would be to prevent the fish from entering the creek.

An associated problem is the diversion of juvenile and anadromous fish into Oswego Lake via the unscreened canal. These fish are subject to predation

Table 10.1. Appropriated surface water and minimum stream flow measurement data, Columbia Subbasin

Stream Area	Appropriated Surface Water (cfs) 1/ Non Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous Discharge (cfs)	Location	Date 2/	Source 2/
Johnson Creek System	6.9	7.7	0.2	River mile 10.2	Portions of 4 yrs. (1940-1965)	U.S. Geological Survey
Kellogg Creek System	21	2.6	--	--	--	--
Milton Creek System	0.3	72	4	Mile 1.0	Sept. 11, 1962	Ore. State Game Comm.
Scappoose Creek	--	--	--	--	--	--
North Fork Scappoose Creek	0.02	4.2	5	Highway 30 crossing	Sept. 11, 1962	Ore. State Game Comm.
South Fork Scappoose Creek	0.1	22	3	Near mouth	Sept. 11, 1962	" "
Other streams exclusive of Willamette R. & Multnomah Channel	3.2	114	--	--	--	--
Scappoose Bay	3.7	4.4	--	--	--	--
Multnomah Channel	2.0	103	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.
2/ U. S. Geological Survey period of available records is shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1962 and 1963.

by high populations of nongame and warm-water game fish in the lake, and to injury and mortality inflicted at the powerhouse below the lake.

The City of Scappoose has a municipal water supply dam on Gourlay Creek, 0.7 mile above its mouth. The dam is 5 feet high and has no fish ladder, thus blocking the migration of trout and salmon to 2 miles of stream habitat. The diversion is unscreened. Another dam for the City of Scappoose municipal water supply is located on the South Fork of Scappoose Creek near stream mile 6.5. This one has a passable fish ladder.

Developments Beneficial to the Fish Resources

A concrete fish ladder was constructed in 1951 over 20-foot high "Bonnie Falls" on the North Fork of Scappoose Creek 4.5 miles above its mouth. There are no hatcheries in the subbasin. Numbers of anadromous fish and trout liberated into waters of the subbasin in the 1961-1965 period are given in Table 10.2.

Table 10.3 shows legal minimum flow stipulations established in the subbasin in 1966 by the Oregon State Water Resources Board. These stipulations substantially limit future water appropriations from natural flows of the listed stream areas and should greatly aid fish resources.

Figure 10.2. Oswego Lake outlet dam and Oswego Creek. August, 1966.

Figure 10.3. Oswego Creek Falls just downstream from Oswego Lake outlet dam. August, 1966.

Table 10.2. Fish stocking in Columbia Subbasin, 1961-1965.

Stream system	Species	Mean Length (Inches)	Number per Pound	1961	1962	1963	1964	1965	Agency
Johnson Creek	Steelhead	Yearling	--	16,960					OSGC 1/
" "	Rainbow	8 & over	--	2,000	2,001	2,026	3,078	2,006	"
Milton Creek	Steelhead	Yearling	--				15,194		"
" "	"	2-4			10,260				"
" "	"	4-6	--			5,008		29,952	"
" "	Cutthroat	8 & over	--		4,900	4,013	1,986		"
" "	Rainbow	" "	--	3,002	2,002	999	1,000	1,997	"
Scappoose Creek	Steelhead	Yearling	--				16,830		"
"	"	2-4	--		20,514				"
"	"	4-6				5,008		29,978	"
"	Cutthroat	8 & over	--	4,004	5,004	5,019	1,998		"
"	Rainbow	" "	--	1,003	1,000	1,000	999	1,998	"

1/ Oregon State Game Commission

Table 10.3. Minimum stream flow stipulations established by the Oregon State Water Resources Board in 1966.

Stream	Location	Minimum Flows in Cubic Feet per Second
Milton Creek or tributaries	Above Salmon Creek	25 (Nov. 1-Apr. 30)
Cox Creek or tributaries	Above the mouth	6 (Nov. 1-Apr. 30)
Salmon Creek or tributaries	Above the mouth	5 (Nov. 1-Apr. 30)
North Scappoose Creek or tributaries	Above the mouth	5 (July 16-Oct. 31) 40 (Nov. 1-May 31) 20 (June 1-July 15)
Alder Creek or tributaries	Above the mouth	1 (July 1-Oct. 31) 8 (Nov. 1-May 31) 3 (June 1-June 30)
Cedar Creek or tributaries	Above the mouth	1 (July 1-Oct. 31) 6 (Nov. 1-May 31) 3 (June 1-June 30)
Chapman Creek or tributaries	Above the mouth	1 (July 1-Oct. 31) 6 (Nov. 1-May 31) 3 (June 1-June 30)
North Fork of North Fork Scappoose Creek or tributaries	Above the mouth	1 (July 16-Oct. 31) 7 (Nov. 1-May 31) 3 (June 1-July 15)
Sierkes Creek or tributaries	Above the mouth	0.5 (June 16-Oct. 31) 7 (Nov. 1-June 15)
South Fork of North Scappoose Creek or tributaries	Above the mouth	1 (July 1-Oct. 31) 8 (Nov. 1-May 31) 4 (June 1-June 30)
South Scappoose Creek or tributaries	Above Raymond Creek	5 (July 1-Oct. 31) 25 (Nov. 1-May 31) 12 (June 1-June 30)
Gourlay Creek or tributaries	Above the mouth	0.5 (July 16-Oct. 31) 10 (Nov. 1-May 31) 2 (June 1-July 15)
Raymond Creek or tributaries	Above the mouth	0.5 (July 16-Oct. 31) 8 (Nov. 1-May 31) 1 (June 1-July 15)

Present Economy

Anadromous fish originating in the subbasin's streams furnish an estimated 2,600 coho and 100 steelhead annually to the commercial fisheries of the Columbia River and Pacific Ocean. This represents a catch of 19,000 pounds of fish valued at $7,500 annually.

Sport angling pressure for coho and steelhead in Johnson, Scappoose, Milton, and Sucker Creeks, the only streams open to winter fishing, is high compared to streams of similar size elsewhere in the Willamette Basin. A large percentage of the angling is conducted by youngsters living nearby. An estimated 700 coho and 200 steelhead produced in these streams are harvested there and in the Willamette and Columbia Rivers and Pacific Ocean sport fisheries. Salmon and steelhead production in this subbasin furnish an estimated 2,000 fisherman-days valued at $12,000 annually.

Trout angling is usually heavy and directed mainly toward hatchery fish liberated in Johnson, Scappoose and Milton Creeks. This fishery furnishes approximately 20,000 days fishing valued at $60,000 annually.

Intensive fishing pressure is exerted throughout the year upon warm-water game fish; the fishery has a substantial, but unknown monetary value. The waters of Sauvie Island receive by far the greatest angler concentrations (Figure 10.4). Species caught in greatest abundance are white crappie, black crappie, bullhead catfish, largemouth bass, yellow perch, and bluegill sunfish.

SAUVIE ISLAND GAME MANAGEMENT AREA

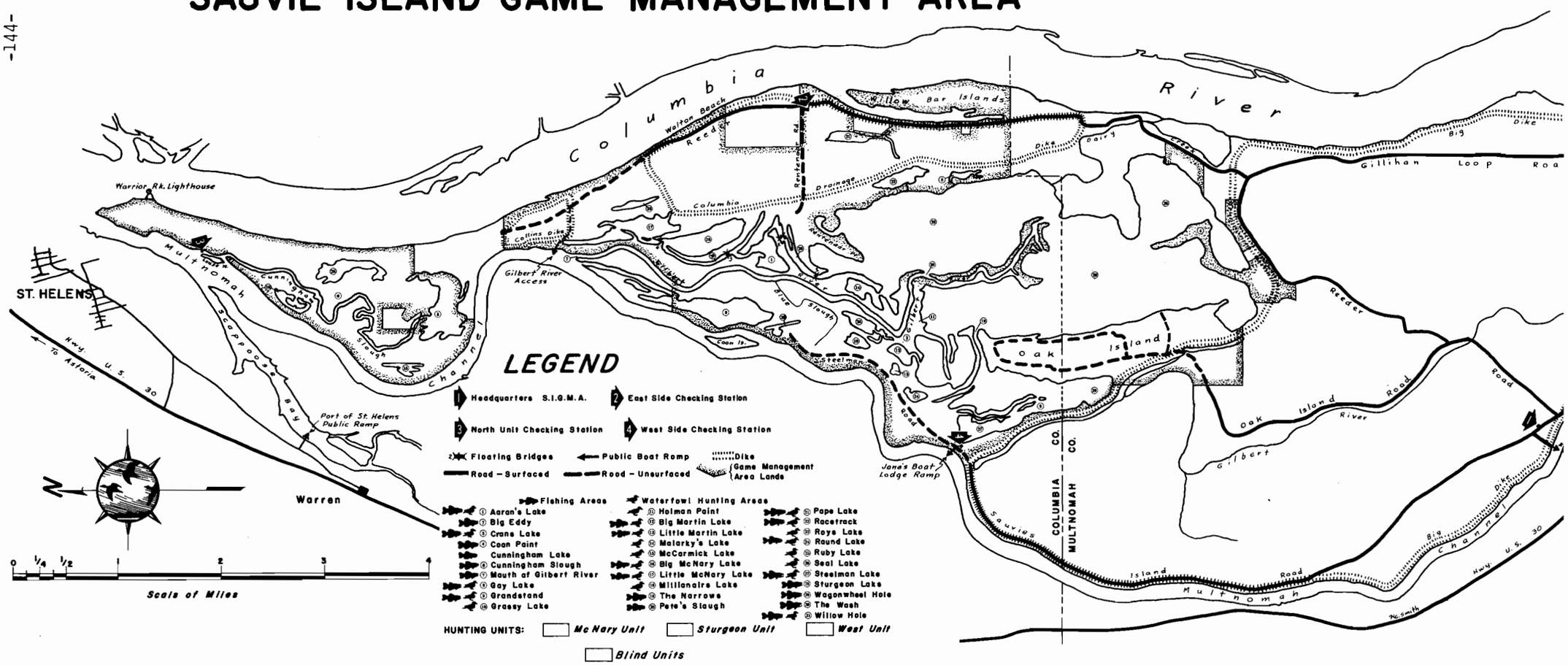


FIGURE 10.4

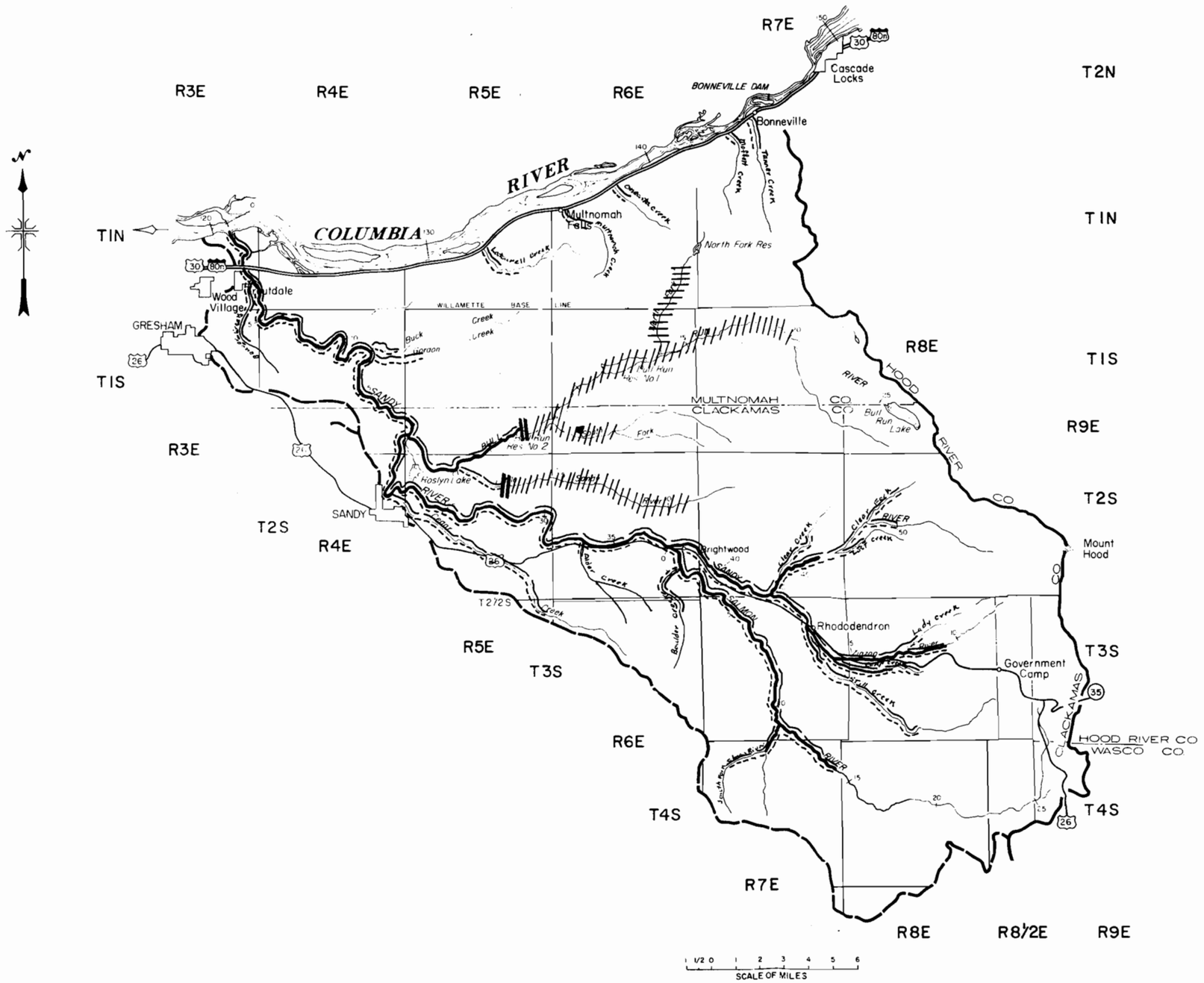
11. SANDY SUBBASIN

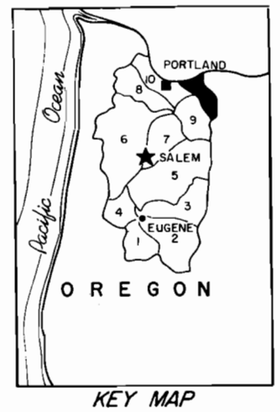
11. SANDY SUBBASIN

The Sandy River system, plus the watersheds of nine small Columbia River tributaries between the mouth of Sandy River and Bonneville Dam, comprise the subbasin (Figure 11.1). Important nonstream waters include slough areas along the Columbia River, at least 14 high mountain lakes, and three low-elevation lakes. Two of the latter, Benson and Wahkeena Lakes, are oxbow lakes created by high flows in the Columbia River. Each is approximately 20 surface acres in size and both have become better stabilized by the Columbia River Highway (Interstate 80N) which now protects them from high river flows. The third low-elevation lake, Roslyn Lake, is a Portland General Electric Company reservoir located near the confluence of the Sandy and Bull Run Rivers. It is 160 acres in size and stores water for use in Bull Run Powerhouse situated on Bull Run River 1.5 miles above its mouth.

Habitat

Most subbasin streams provide favorable habitat for spawning and rearing of salmon and trout. All major streams arise from well-forested watersheds on the western slope of Mount Hood and the Cascade Range. The Sandy River main stem is 55 miles long and drains 508 square miles. Stream shading is generally good, which helps keep the water cold. Water temperatures in streams other than the lower Sandy River seldom exceed 65 F. Summer water temperatures of the lower Sandy generally range between 55 and 70 F, and have been recorded as high as 71 F. Sandy River water discharge averages over 2,400 cubic feet per second. If the river was not regulated for power and municipal water supply purposes, flows would seldom drop below 400 cfs at the mouth. However, these water uses frequently cause the flow at the river mouth to drop below 100 cfs during the summer.





KEY MAP

LEGEND:

Present distribution (May 1966)

- **STEELHEAD** — — — —
- **COHO** - - - - - - - -
- **CHINOOK** ———
- **Unaccessible habitat for onadromous fish, blocked by dams** ////////

FIGURE 11.1

SUB-BASIN 11

Sandy

Large amounts of glacial silt enter the river from Mount Hood during warm summer periods giving the water a milky color. The Sandy was named for the enormous quantity of sand that washes from the slopes of Mount Hood and settles on the bottom of the river, particularly in the lower 10 miles. These sand deposits reduce spawning and rearing area for salmon and trout.

Other than the Willamette River main stem, the Sandy is the only large stream in the Willamette Basin Review that enters the Columbia River directly; consequently, the Sandy's anadromous fish runs are not subject to pollution in the Willamette River or fish passage problems at Willamette Falls.

Species and Distribution

The Sandy River system supports natural spawning populations of 2,200 coho salmon, 5,000 winter steelhead trout, 1,000 fall chinook salmon, and 800 spring chinook salmon annually. Fish spawning in the nine Columbia River tributaries, excluding hatchery runs, totals 200 coho, 100 winter steelhead and 100 fall chinook. The contribution of hatcheries is discussed in the section "Developments Beneficial to Fish Resources." The distribution of anadromous fish is illustrated in Figure 11.1.

Total counts of spring chinook and winter steelhead that ascend Marmot Dam, located at river mile 30 on the Sandy River, have been made since 1954 with a trap or electronic counter in the fish ladder. Coho salmon counts began in 1958. These counts are shown in Table 11.1. Fall chinook salmon are not included in the table since this species spawns almost entirely below Marmot Dam. A remnant run of summer steelhead exists in Bull Run River, a large Sandy River tributary entering at river mile 18.5. Prior to 1952, small numbers of chum salmon were recorded in Beaver Creek, a tributary entering Sandy River near Troutdale.

The Sandy River has long been Oregon's main producer of Columbia River smelt or eulachon. Smelt frequently have not entered the Sandy for periods of one to several years, and there has been no run in the Sandy since 1957, the longest recorded absence. Table 11.2 lists smelt data compiled since 1919.

Large numbers of shad enter the lower river each spring on their spawning run. Resident cutthroat trout inhabit subbasin streams; the largest populations are located in headwater areas. Sea-run cutthroat trout in undetermined but significant numbers spawn in the Sandy Subbasin. Whitefish are common in the larger streams and brown trout are also found occasionally. Both rainbow and brook trout inhabit the small Cascade lakes. Benson and Roslyn Lakes are stocked with rainbow trout each year.

Warm-water game fish are restricted to the Columbia River and its slack water areas. Dace, Pacific lamprey, and sculpins are the only nongame species known to be present in the subbasin streams. Nongame species common in the Columbia River, such as suckers and squawfish, probably enter the lower Sandy River system, but their numbers and distribution are limited by cold water.

Table 11.1. Marmot Dam fish counts.

Migratory season	Steelhead	Coho	Spring Chinook
1953-54	2,200	1/	400
1954-55	1,581	1/	5
1955-56	2,240	1/	0
1956-57	2,054	1/	10
1957-58	3,166	264	78
1958-59	2,359	330	304
1959-60	1,612	68	23
1960-61	3,124	1,670	37
1961-62	4,046	1,769	65
1962-63	3,326	1,458	122
1963-64	3,893	2,198	660

1/ Records not available.

Table 11.2. Sandy River smelt run data, 1908-1965 1/

Year	Run Started	Run Ended	Remarks	Number of Licenses Sold	License Funds Received
1908-1916	-	-	No record of runs.		
1919	March 29	-	Large run of fish taken for hatchery food.		
1920	No run	-			
1921	No run	-			
1922	April 11	-	Second run began on April 17.		
1923	April 4	-	Very light because of obstruction in Sandy River.		
1924	March 28	-	Channel still blocked.		
1925	March 14	April 4	One of longest runs. Fish Commission transferred some smelt to Clackamas R.		
1926	March 12	-	50,000 people out.		
1927	March 28	-	Poor run.		
1928	March 12	-			
1929	April 9	-		793	$ 396.00
1930	March 18	-		5,786	1,893.00
1931	No run	-		-	-
1932	March 26	-		193	96.50
1933	No run	-		-	-
1934	March 4	-		1,860	930.00
1935	No run	-		-	-
1936	March 27	April 8	Also ran heavily in Columbia R. at mouth of Tanner and Eagle Creeks.	2,536	1,268.00
1937-1939	No runs	-		-	-
1940	March 6	March 18		2,760	1,380.00
1941	March 14	March 24		2,775	1,398.50
1942	March 19	April 1		7,699	3,849.50
1943	March 25	April 1		6,596	3,298.00
1944	No run	-		-	-
1945	April 1	April 15		17,754	8,876.00
1946	March 28	April 8		19,725	9,862.50
1947	No run	-		-	-
1948	March 27	April 11		32,422	16,211.00
1949	March 24	April 9		42,612	21,306.00
1950	No run	-		-	-
1951	April 5	April 10		25,650	12,825.00
1952	-	-		1,960	980.00
1953	April 19	April 29		59,503	29,751.00
1954	April 1	April 7		11,662	5,831.00
1955	No run	-		-	-
1956	March 29	April 10		34,288	17,194.00
1957	March 26	April 1		26,690	13,345.00
1958-1966	No runs	-		-	-

1/ Source: Oregon State Game Commission.

Developments and Conditions Adversely Affecting Fish Resources

Three prominent dams have varying effects upon salmonid production. Largest of the three is Marmot Dam, a concrete and wooden structure 30 feet high, which was constructed on the Sandy River in 1912. This Portland General Electric Company installation diverts up to 600 cfs of water through a system of canals and tunnels to Roslyn Lake where it eventually drops through the Bull Run Powerhouse to the lower Bull Run River (Figure 11.2).

In summer and fall months, the volume of Sandy River water diverted at Marmot Dam far exceeds that passing over the dam. Resulting low flows between the dam and the mouth of Bull Run River, 11.5 miles downstream, reduce rearing, interfere with spawning, and retard upstream migration of anadromous fish. Flows through this 11.5-mile portion of river often fall below 50 cfs in the summer and fall, and have done so for many years. In lowest discharge months, the flow arriving at Marmot Dam usually is between 300 and 400 cfs.

Some of the river's best summer resting pools for adult spring chinook salmon are located in the canyon area below Marmot Dam. Spring chinook, fall chinook, and coho salmon attempt to spawn or migrate through the area in late summer and autumn before there has been sufficient rainfall to increase flows below Marmot Dam. Salmon and steelhead pass upstream through the fish ladder at Marmot Dam, but the structure probably delays their migration slightly.

The second major dam affecting fish, Little Sandy Dam, is an unladdered, concrete structure located on the Little Sandy River 1.7 miles above its mouth. (Figure 11.2). It precludes salmon and steelhead access to more than 15 miles of spawning and rearing habitat. The 15-foot dam is owned by Portland General Electric Company. Little Sandy River enters Bull Run River at river mile 2.9. At Marmot Dam on the Sandy River, water is diverted into a canal that enters

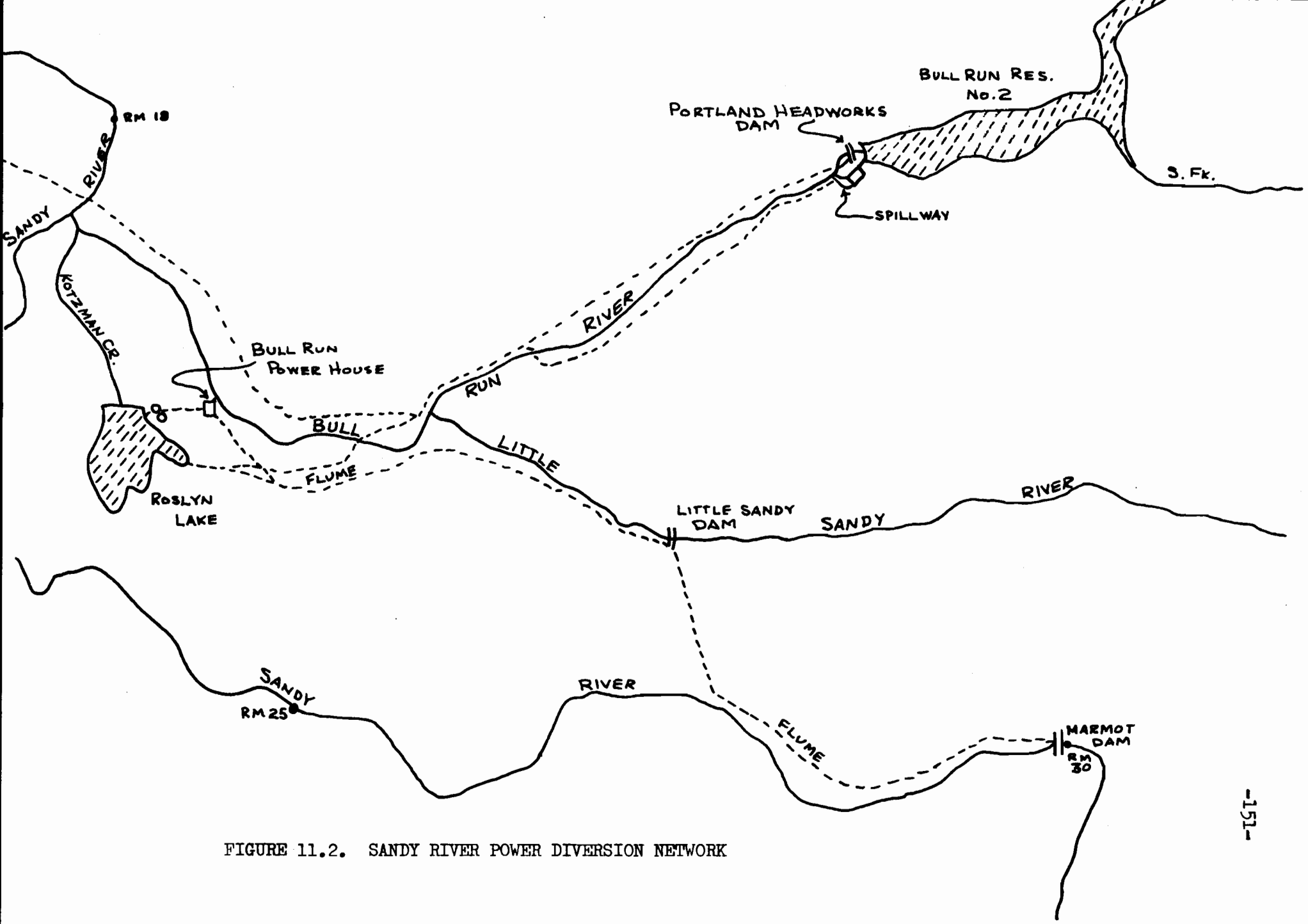


FIGURE 11.2. SANDY RIVER POWER DIVERSION NETWORK

a tunnel and discharges into the Little Sandy River about 75 yards upstream from Little Sandy Dam. Little Sandy Dam diverts water from both Marmot canal and Little Sandy River into another canal leading to Roslyn Lake. The Company attempts to stop flow below Little Sandy Dam. As a result, few anadromous fish are attracted to this barrier except during high flows when some spilling is unavoidable.

Power peaking operations of the Bull Run Powerhouse, especially in the low flow periods of summer and fall, cause severe daily fluctuations in the flow of the Sandy River. Diurnal discharges in the 18.5-mile section of the Sandy below the confluence of Bull Run River vary as much as eightfold. Extremes of 100 to 855 cfs measured on October 11, 1963 at river mile 5, during a time of active chinook salmon spawning, typify the range of daily flow fluctuations. Since 1929, the lowest flow recorded at the U. S. Geological Survey gage one mile below the confluence of Bull Run River was 45 cfs on September 26, 1962. Discharges approaching this rate occur frequently and are wholly inadequate for fish migration and spawning. The large diurnal fluctuations in flow also strand fish, impede migration, encourage poaching, and generally impair fish production.

The third dam affecting salmonids is the City of Portland's headworks dam at river mile 6.2 on Bull Run River (Figures 11.3 and 11.4). It is approximately 20 feet high and diverts municipal water to the City of Portland (Figure 11.2). The dam is unladdered and thus is the upstream limit of anadromous fish in Bull Run River. Water permitted to flow past the headworks dam dwindles to almost nothing in late summer periods (Figures 11.4 and 11.5). Two storage dams, Bull Run No. 2 (Figure 11.6) and Bull Run No. 1 are positioned 0.1 mile and 4.8 miles farther upstream, respectively.

Some anadromous fish ascend the Bull Run River above the Bull Run Powerhouse. However, the stream bed in the 6.2-mile section of the river below the headworks

Figure 11.3. Portland Headworks Dam on the Bull Run River at river mile 6.2. August, 1966.

Figure 11.4. Portland Headworks Dam. Note extremely low flow escaping in natural channel. August, 1966.

Figure 11.5. Bull Run River 0.5 mile downstream from Portland Headworks Dam. August, 1966.

Figure 11.6. Bull Run Reservoir (No. 2) spillway. Rock fill barrier in foreground is the upper limit of the river's summer steelhead. August, 1966.

dam is composed primarily of bedrock and large rubble, and spawning gravel is scarce compared to supplies located in the upper Bull Run watershed. In recent years less than a dozen adult spring chinook and summer steelhead have been observed during the summer in the pool beneath the headworks dam. None could be found in 1965. These are the only summer steelhead believed to remain in the subbasin.

Numerous salmon and steelhead are falsely attracted into the Bull Run River by large volumes of Sandy River water released at the Bull Run Powerhouse. The fish must then either spawn in unfavorable habitat or return to the Sandy River. This false attraction is greatest in the summer and fall when flows below Marmot Dam are low.

About 1965, a six-foot high, unladdered rock dam was constructed across the Bull Run River immediately below headworks dam (Figure 11.5). An electric barrier was placed in the stream in 1966 a short distance farther downstream to prevent lampreys from ascending into the City of Portland's water supply network. If operated during anadromous fish migration periods, this barrier, along with the six-foot high rock dam and minimal flow releases, will surely eliminate the river's summer steelhead and spring chinook runs entirely.

Waters of nearly the entire Bull Run drainage, 102 square miles containing eight Cascade lakes, three reservoirs, and approximately 90 miles of favorable salmonid habitat, are removed by law for exclusive use as the City of Portland's water supply. Public entry to the watershed is prohibited, thereby eliminating fishing and other recreational uses.

Channel straightening and bank revetment of approximately 23 miles of the upper Sandy River and tributaries were conducted in 1965 following the 1964-65 floods. As in most such instances, salmonid habitat was adversely affected by altering the natural environment.

Table 11.3. Appropriated surface water and minimum stream flow measurement data, Sandy Subbasin

Stream Areas	Appropriated Surface Water (cfs) 1/ Non Consumptive	Consumptive	Instantaneous Minimum Flows Measured Instantaneous 1/ Discharge(cfs)	Location	Date 2/	Source 2/
Sandy River below Marmot Dam	0.0 3/	0.0	45	0.9 mile below Bull Run River.	Sept. 26, 1962 (1910-14)(1929-65)	U.S. Geological Survey
Bull Run R. System	4	1.1 4/	9	Below Bull Run Power Plant.	1951 and 1952 (1949-1954)	" "
Beaver Creek System	0.0	3.7	1	Mile 1.4 Mile 0.3	Sept. 6, 1963	Ore. Game Commission
Cedar Creek System	33	3.4	6	Mile 1.3	Sept. 12, 1962	" "
Gordon Creek System	0.0	19	20	Mouth	Sept. 6, 1963	" "
Other tributaries to Sandy River below Marmot Dam	4	19	--	--	--	--
Sandy River above Marmot Dam	0.0	0.0	195	0.8 mile above Marmot Dam	Nov. 27,28,1952 (1911-1965)	U.S. Geological Survey
Salmon River	8.6	2.5	59	River mile 2.25	1936 & 1940 (1936-1952)	" "
Other tributaries to Sandy River above Marmot Dam	14	13	--	--	--	--
Small Columbia River tributary systems	98	5.2	--	--	--	--

1/ Oregon State Water Resources Board records, April 1966.

2/ U.S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1962 and 1963.

3/ Not shown is a federal power right to Portland General Electric Company for 800 cubic feet per second of Sandy and Little Sandy Rivers water.

4/ Not included is the substantial municipal water withdrawal by the City of Portland.

Excluding a power right for 800 cfs and municipal use of Bull Run system waters, appropriation in the subbasin is slight (Table 11.3).

Developments Beneficial to Fish Resources

During warm summer periods, melting glaciers on Mount Hood discolor the main river and some upper tributaries. Sand from canyons in the headwaters reduces the value of the lower 10 miles of the river as fish habitat.

The Fish Commission of Oregon operates two fish hatcheries in the subbasin, Bonneville Hatchery at the mouth of Tanner Creek on the Columbia River and Cedar Creek Hatchery on Cedar Creek, near the town of Sandy (Table 11.4). Fish liberations made into the waters of the subbasin for the 1961-1965 period are listed in Table 11.5.

Table 11.4. Trap counts at Fish Commission of Oregon's Sandy Subbasin hatcheries 1/

Species	Sandy River Hatchery	Bonneville Hatchery
Winter steelhead	53	--
Fall chinook	223	2,987
Coho	6,254	7,418

1/ 1955-65 average

Flows from the Sandy River and its tributaries, with a few exceptions, have been withdrawn by legislative act from further appropriation except for stock, domestic, municipal and public park and recreational purposes. Flows in most of the subbasin's small Columbia River tributaries have been withdrawn from all uses other than fish culture.

Table 11.5. Fish stocking in Sandy Subbasin, 1961-1965.

Stream System	Species	Mean Length (Inches)	Number per Pound	1961	1962	1963	1964	1965	Agency 1/
Sandy River	Fall Chinook	--	1000-1150			106,528		1,000,000	OFC
" "	Coho	--	17-64	97,840					"
" "	"	--	1048-1325		100,346	973,262	889,692	939,980	"
" "	Steelhead Yearling	--	--	162,992	168,861	216,176	200,336		OSGC
" "	"	4-6	--					50,682	"
" "	"	--	11	72,300					USFWS
" "	"	8 & over	--					148,906	OSGC
" "	Rainbow	8 & over	--	29,115	34,103	52,236	25,279	20,170	"
Cedar Creek	Fall Chinook	--	12.3				65,384		OFC
" "	"	--	80-483	557,162	231,999	79,464	969,154	1,085,699	"
" "	Coho		15-24	641,122	580,796	955,494		801,927	"
" "	"	--	300	50,000					"
" "	"	--	1,137				23,881		"
Tanner Creek	Fall Chinook	--	150-342	3,431,833	4,201,566	4,471,800	10,797,524	9,601,061	"
" "	Coho	--	19-29	1,319,284	893,178	1,024,331	1,877,957	2,614,426	"
" "	"	--	1000-1200			240		10,000	"
Horsetail Cr.	Rainbow	2-4	--					480	OSGC
Collins Lake	Brook Trout	2-4	--	640	1,052			1,160	"
" "	Rainbow	8 & over	--	1,777	1,990	2,883	1,499	2,305	"
Trillium Lake	Brook Trout	2-4	--	4,960	7,294		3,100	4,968	"
" "	Rainbow	2-4	--		4,080	9,975		10,200	"
" "	"	8 & over	--	13,897	3,000	9,790	9,729	9,206	"
Other Cascade Lakes	Brook Trout	2-4	--	7,520	7,424	11,340	4,070	7,280	"
" "	Golden Trout	0-2	--		9,680				"
" "	Rainbow	2-4	--	1,440			1,080	1,100	"
" "	"	8 & over	--	1,777	1,990	2,883	1,499		"
Benson Lake	Rainbow	8 & over	--	7,479	4,008	6,001	8,006	7,189	"
Roslyn Lake	"	2-4	--			14,999		10,044	"
" "	"	4-6	--		7,992	23,080			"
" "	"	8 & over	--	6,501	9,436	8,004	5,986	7,981	"

1/ Abbreviations used in this table are: "USFWS," U.S. Fish and Wildlife Service; "OFC", Fish Commission of Oregon; "OSGC", Oregon State Game Commission

Present Economy

Salmonids produced in streams of the subbasin provide an average annual catch in the Columbia River and Pacific Ocean commercial fisheries of 60,000 coho, 43,500 fall chinook, 2,100 spring chinook salmon, and 400 winter steelhead trout. This contribution is estimated to be 932,000 pounds of fish valued at $463,000 annually.

Almost all salmon and steelhead sport fishing in the Sandy River main stem is from the bank. The fishery extends from the mouth upstream to Brightwood at river mile 38, but angling pressure is concentrated mainly in the lower 25 miles. Tanner Creek, a Columbia River tributary, and the lower Bull Run River are the only other streams open to winter angling for anadromous fish.

Steelhead receive more angling pressure than salmon. Total Sandy River (including Bull Run River) steelhead angler effort and catch data collected from 1954 to 1966 are given in Table 11.6. A few Sandy River steelhead are harvested in the Columbia River by sport fishermen. The catch from Tanner Creek each year averages about 50 steelhead.

Averages of 900 coho and 50 chinook salmon are taken annually by anglers in the subbasin. An estimated 12,000 coho, 10,900 fall chinook and 1,100 spring chinook of Sandy Subbasin origin are harvested yearly in the Pacific Ocean, lower Columbia River and Sandy Subbasin sport fisheries. The contribution of steelhead trout, coho, fall chinook, and spring chinook salmon produced in Sandy Subbasin to the sport fishery is estimated to be 93,000 angler-days valued at $558,000 annually.

An intensive sport fishery for shad takes place in the Sandy River each spring. Angling is conducted primarily from boats near the river mouth as shad enter to spawn in the lower reaches. Fishing effort for shad is also concentrated at the mouth of Tanner Creek. Shad produced in Sandy River contribute to the

Table 11.6. Sandy River steelhead sport fishery, 1954-1966

Angling Season	Total Anglers	Hatchery Fish Number	Hatchery Fish Percent	Wild Fish Number	Wild Fish Percent	Total Steelhead	Fish per Angler
1954-55	16,000	1/		958		958	0.06
1955-56	10,413	1/		1,157		1,157	0.11
1956-57	17,027	231	24	741	76	972	0.06
1957-58	24,485	312	16	1,581	84	1,893	0.08
1958-59	27,934	93	7	1,213	93	1,306	0.05
1959-60	30,079	247	12	1,824	88	2,071	0.07
1960-61	32,391	182	12	1,312	88	1,494	0.05
1961-62	20,354	15	1	1,056	99	1,071	0.05
1962-63	25,074	195	15	1,107	85	1,302	0.05
1963-64	23,421	1,756	46	2,062	54	3,818	0.16
1964-65	19,516	2,204	45	2,694	55	4,898	0.25
1965-66	18,074	2,582	55	2,155	45	4,737	0.26

1/ None expected

commercial harvest but neither the commercial nor sport fishery for this species has been evaluated.

In the years that smelt enter the Sandy, sport fishing for this species is intensive in the lower three miles of the river. Dip nets are used primarily to catch this highly prized fish. Sport catch records are not available, but Table 11.2 lists numbers of smelt licenses sold since 1929. Those years showing high license sales indicate the largest runs and heaviest catches. The present daily bag limit is 25 pounds per person.

Stream angling is popular for both wild cutthroat and hatchery rainbow trout. Most of the trout fishing, and therefore most of the trout stocking, is concentrated in the Sandy drainage above Brightwood. Several of the small Columbia River tributaries also furnish angling for wild cutthroat and rainbow trout. Angling intensity in the Cascade lakes is variable, depending to a large degree upon accessibility. Benson and Roslyn Lakes receive considerable angling pressure for planted rainbow. An estimated 5,800 angler-days valued at $17,400 and 61,500 angler-days valued at $123,000 are expended on stream and lake trout fishing, respectively, each season in the waters of the subbasin. Angling intensity for warm-water game fish is light and is limited to areas along the Columbia River.