THE FISH AND WILDLIFE RESOURCES OF THE UPPER WILLAMETTE BASIN, OREGON, AND THEIR WATER REQUIREMENTS

A Report with Recommendations to the

OREGON STATE WATER RESOURCES BOARD

By
James M. Hutchison
Kenneth E. Thompson
John D. Fortune, Jr.

OREGON STATE GAME COMMISSION

Basin Investigations Section

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Progress Report

Fisheries Stream Flow Requirements
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INTRODUCTION

The Oregon State Game Commission's Basin Investigations Section began studies in the Upper Willamette Basin relevant to this report in the spring of 1964. These investigations were continued into 1966. Primary objectives were to define water problems and needs associated with the basin's fish and wildlife resources and to submit findings and recommendations to the State Water Resources Board. This will enable the Board to consider these needs along with other beneficial water uses when reconsidering its comprehensive programs for the area.

Results of the study are contained in this report. Similar reports concerning the fish and wildlife resources of the Middle and Lower Willamette Basins were completed in February 1963 and June 1964, respectively.

A review is made of the status of the resources,- including abundance, distribution, and value of various species. Explanations of methods employed and tabulations of data gathered in the field studies are also included. One of the most important sections of this report is the list of recommended minimum stream flows for fish production which is found in Appendix I.

Field surveys were conducted primarily by James M. Hutchison, Gregory J. Hattan, Wernald H. Christianson, Kenneth E. Thompson and Gary M. Hewitt, Aquatic Biologists, and Ronald Sloan and Jay Watson, Student Trainees. Personnel of the Fish Commission of Oregon, U. S. Fish & Wildlife Service, State Water Resources Board and U. S. Geological Survey cooperated in various phases of the study.

FISH RESOURCES OF THE UPPER WILLAMETTE BASIN

COAST FORK SUBBASIN

The Coast Fork Willamette River system, including Row River, comprise the Coast Fork Subbasin. Cottage Grove Reservoir on the Coast Fork and Dorena Reservoir on Row River are important impoundments.

Habitat

The 51-mile long Coast Fork Willamette River drains the north slope of the Calapooya Mountains and joins the Middle Fork Willamette River near Eugene to form the Willamette River proper. Row River, which drains nearly 60 percent of the subbasin area, enters from the east at river mile 20.7. There is significant habitat for salmon and steelhead production above a 10-foot falls on the Coast Fork near river mile 31, and 15-foot Wildwood Falls at river mile 18.5 on Row River, but because both falls are upstream from large, impassable dams, the falls are unladdered and the habitat is presently inaccessible. Potential habitat above falls in upper portions of several other streams is small, and probably not sufficient to merit fish passage improvements.

Spawning gravel (Table 1) is scarce in many streams, but this paucity limits production of salmonids in only a few smaller tributaries.

Cottage Grove Reservoir is located on the Coast Fork at river mile 29.5. Another reservoir, Dorena, is situated at river mile 7.5 on Row River. Both dams are unladdered, closing many miles of stream habitat to anadromous fish.

Stream discharges are relatively low in summer but higher than those in Willamette tributaries draining the east slope of the Coast Range. Minimum summer flows of 50 and 100 cubic feet per second, respectively, usually are released from Cottage Grove and Dorena Reservoirs. Water temperatures seldom exceed 70 F during summer and fall months in streams above the two reservoirs, and are adequate for cutthroat and rainbow trout. Temperatures in the rivers and 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 and nongame fish. Rainbow and cutthroat trout exist in the reservoirs but numbers are limited and suffer from competition by warm-water fish which are better suited to the environment.

Species

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 in the Row River system since 1963, 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 trout in Cottage Grove and Dorena Reservoirs are hatchery rainbow. Cutthroat numbers are moderate and wild rainbow occur infrequently in the river sections below the reservoirs.

Table 1. Distribution and density of spawning gravel for salmonids, Coast Fork Subbasin 1/

Stream	Stream Section (miles)	Good Gravel (Square Yards)	Marginal Gravel (Square Yards)	Total Gravel (Square Yards)	Percentage of Bottom With Gravel
Coast Fork Willamette R.	0 - 19.2			128,050	18.9
"	19.2 - 29.7			27,500	9.9
"	32.5 - 36.4	785	3,710	4,495	13.1
"	36.4 - 39.6	590	2,390	2,983	10.6
Coast Fork Willamette R. and Big R.	39.6 - 5.4	1,271	3,853	5,124	12.6
Big R.	5.4 - 8.4	358	1,136	1,494	16.9
Anderson Cr.	0.0 - 11.3	18	11	29	1.3
Beaver Cr.	0.0 - 0.5	31	-	31	2.7
Bar Cr.	0.0 - 0.5	31	10	41	2.3
"	0.5 - 1.0	48	5	53	3.0
"	1.0 - 1.3	2	2	4	0.5

Table 1 (continued)

Stream	Stream Section (Miles)	Good Gravel (Square Yards)	Marginal Gravel (Square Yards)	Total Gravel (Square Yards)	Percentage of Bottom With Gravel
Cedar Cr.	0.0 - 0.5	14	279	293	25.6
"	0.5 - 1.0	11	16	27	2.4
"	1.0 - 1.5	14	2	16	1.8
"	1.5 - 1.9	9	3	12	1.6
Combs Cr.	0.0 - 1.6	114	60	174	2.3
Drue Cr.	0.0 - 1.4	71	7	141	2.9
"	1.4 - 2.4	23	3	46	1.3
Edwards Cr.	0.0 - 1.5	278	491	769	29.1
Jasper Cr.	0.0 - 0.8	21	12	33	1.3
Johnson Cr.	0.0 - 0.5	2	-	2	0.2
Little R.	0.0 - 1.0	611	160	771	8.8
"	1.0 - 2.0	22	68	90	1.4
"	2.0 - 3.0	3	16	19	0.3
"	3.0 - 4.0	4	16	20	0.6
"	4.0 - 5.0	37	34	71	2.0
"	5.0 - 5.5	-	2	2	0.1
Blood Cr.	0.0 - 0.3	-	25	25	2.9
Saroute Cr.	0.0 - 1.0	118	102	220	3.1
"	1.0 - 2.0	27	48	75	1.0
"	2.0 - 2.3	-	22	22	1.6
W. Cinnabar Cr.	0.0 - 0.2	-	1	1	0.3
S. Fk. Big R.	0.0 - 4.3	357	214	571	4.5
Row R.	0.0 - 7.5	4,435	29,500	33,935	11.0
"	11.5 - 16.5	-	30	30	0.03
"	16.5 - 21.0	18	150	168	0.2
Brice Cr.	0.0 - 2.0	-	-	Negligible	-
"	2.0 - 4.0	12	15	27	0.1
"	4.0 - 6.0	239	1,099	1,338	7.6
"	6.0 - 8.0	301	584	885	6.3
"	8.0 - 10.0	30	24	54	0.3
"	10.0 - 15.0	121	530	651	0.9
Champion Cr.	0.0 - 2.0	79	82	161	1.7
Layng Cr.	0.0 - 2.0	2	23	25	0.2
"	2.0 - 4.0	-	25	25	0.2
"	4.0 - 6.0	28	50	78	0.8
"	6.0 - 8.5	11	28	39	0.4
Sharps Cr.	0.0 - 2.0	369	105	474	2.0
"	2.0 - 4.0	228	455	683	3.2
"	4.0 - 6.0	175	449	624	2.7
"	6.0 - 8.0	2,542	169	2,711	15.4
"	8.0 - 10.0	277	1,270	1,547	11.0
Martin Cr.	0.0 - 2.3	32	97	129	1.0
Wilson Cr.	0.0 - 1.0	24	6	30	0.5
"	1.0 - 2.0	31	41	72	1.5
"	2.0 - 2.7	24	28	52	2.1

1/ Source: Thompson, 1965.

Warm-water game fish maintain substantial populations in Cottage Grove and Dorena Reservoirs. Largemouth bass and bullhead catfish are the most abundant specie 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 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. Rainbow and cutthroat trout and largemouth bass were stocked in the reservoir. Smallmouth bass were introduced in the Coast Fork above the reservoir.

Developments Adversely Affecting Fish Resources

Two U.S. Army Corps of Engineers dams were constructed in the subbasin, primarily for flood control purposes. Cottage Grove Dam, 100 feet high, completed in 1942, is situated on the Coast Fork at river mile 29.5. Dorena Dam, 115 feet high, completed in 1949, is located on Row River at river mile 7.5. 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 is located above the two impoundments (Table 1). 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 amount of water released in the fall is often inadequate for salmon migration and spawning. The impoundments provide excellent habitat for nongame fish.

Surface water appropriations in the subbasin (Table 2) total more than 150 cfs. Most of this amount is for consumptive use. The major points of diversion, excluding Layng Creek, are downstream from the two storage dams. During the summer, reservoir releases provide for the consumptive water use and for significant downstream flows. The City of Cottage Grove obtains its municipal water from Layng Creek, a principal tributary of upper Row River.

Table 2. Appropriated surface water and minimum stream flow measurement data, Coast Fork Subbasin

Stream Area	Appropriated Surface Water (cfs) 1/ Non Consumptive	Con-sumptive	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, to 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)	
Brice Cr. System	0.0	0.3	9.3	Mile 1.0	Oct. 12, 1964	
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.

An unladdered dam, 4 feet high, on the Coast Fork near river mile 23.0, blocks the upstream migration of fish during periods of low flow (Figure 1). Another 4-foo high 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.

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. Some logging activities that contribute to siltation and debris jams in the streams still exist 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 highly turbid water and thick deposits of silt on the streambed. Waters of Cottage Grove Reservoi are frequently turbid because of wave action on the shore. At such times, the river downstream is also discolored.

Developments Beneficial to Fish Resources

Cottage Grove and Dorena Reservoirs create habitat favorable for warm-water game fish. However, frequent increases in numbers of nongame species and the seasonal drawdown of the reservoirs lessen the quality of this habitat. Summer releases of cold water could provide improved habitat for salmonids in the downstream river sections.

The number of fish liberated in the 1961-1965 interval are listed in Appendix III. 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. Following treatment, the impoundments have been restocked with game species.

Figure 1. Inadequately laddered four-foot high dam on Coast Fork Willamette River, river mile 25.3.

Harvest

The contribution of anadromous fish from the subbasin to commercial and sport fisheries is negligible. In spring and summer, heavy angling pressure is exerted o wild rainbow and cutthroat trout and hatchery rainbow trout in streams above the tw reservoirs. Planted rainbow provide the majority of the trout catch from the river areas below the dams.

Fishing in Dorena and Cottage Grove Reservoirs is permissible all year. Of the two reservoirs, Dorena receives the greater angling intensity and therefore heavier trout stocking. Most trout fishing at both impoundments occurs between October and June.

Angling for warm-water game fish is popular in the reservoirs throughout the year, with largemouth bass and bullhead catfish the predominant species caught. Light angling intensity for warm-water game fish exists on the lower portions of Row River and Coast Fork.

MIDDLE FORK SUBBASIN

This subbasin encompasses the watershed of the Middle Fork Willamette River and its tributaries. 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. It joins the Coast Fork near Eugene to form the main stem of the Willamette River. The 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 in 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.

Quantity and quality of spawning gravel is generally excellent throughout the system (Table 3).

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. Respective reservoir areas are 1,025, 4,360, and 2,740 surface acres at full pool. None of the three dams has fish passage facilities. A fourth Corps of Engineers dam is located at river mile 7.0 on Fall Creek. It has fish passage facilities. Fall Creek Dam

forms a reservoir of 1,880 surface acres at full pool. Good habitat for salmonids 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 a substantial population of trout.

Table 3. Distribution and density of spawning gravel for salmonids, Middle Fork Subbasin 1/

Stream	Stream Section (miles)	Good Gravel (Square Yards)	Marginal Gravel (Square Yards)	Total Gravel (Square Yards)	Percentage of Bottom With Gravel
Middle Fork Willamette River	0.0 - 4.0	22,000	72,000	94,000	33.4
"	4.0 - 8.0	11,000	22,000	33,000	11.7
"	8.0 - 12.0	35,000	46,000	81,000	28.8
"	12.0 - 16.8	51,000	76,000	127,000	37.6
"	16.8 - 31.0	-	-	-	-
"	31.0 - 45.5	20,000	46,000	66,000	9.0
"	45.5 - 52.9	-	-	-	-
"	52.9 - 57.0	430	885	1,315	0.8
"	57.0 - 61.0	-	225	225	0.2
"	61.0 - 64.0	420	715	1,135	1.3
"	64.0 - 68.0	430	1,280	1,710	1.6
"	68.0 - 72.0	350	1,070	1,410	1.5
"	72.0 - 75.1	100	435	535	1.0
"	75.1 - 81.0	313	745	1,058	1.5
Coal Cr.	0.0 - 5.5	659	340	999	2.1
Coffeepot Cr.	0.0 - 1.0	50	60	110	2.7
Deception Cr.	0.0 - 1.5	-	15	15	0.2
Fall Cr. 2/					
Gold Cr.	0.0 - 3.0	-	60	60	0.6
Goodman Cr.	0.0 - 1.0	30	45	75	2.6
Hills Cr.(lower) 2/					
Hills Cr.(upper)	0.0 - 3.0	-	-	-	-
"	3.0 - 7.0	1,227	42	1,269	3.6
"	7.0 - 11.0	340	200	540	1.5
"	11.0 - 16.0	45	30	75	0.3
Larison Cr.	1.2 - 3.5	42	104	146	1.4
Lost Cr. 2/					
Noisy Cr.	0.0 - 2.0	25	40	65	0.7

Table 3 (continued)

Stream	Stream Section (miles)	Good Gravel (Square Yards)	Marginal Gravel (Square Yards)	Total Gravel (Square Yards)	Percentage of Bottom With Gravel
N. Fk. of Mid. Fk. Willamette R.	0.0 - 5.0	135	720	885	0.4
"	5.0 - 11.0	197	2,773	2,970	1.3
"	11.0 - 14.6	110	205	315	0.6
"	14.6 - 18.6	1,854	355	2,209	3.3
"	18.6 - 22.6	565	544	1,109	1.4
"	22.6 - 26.6	425	888	1,313	1.6
"	26.6 - 30.6	370	930	1,300	1.6
"	30.6 - 34.6	280	520	800	0.9
"	34.6 - 38.4	150	125	275	0.3
Christy Cr.	0.0 - 3.0	120	315	435	1.7
"	3.0 - 6.0	195	380	575	3.3
"	6.0 - 11.0	-	-	Negligible	-
Fisher Cr.	0.0 - 4.0	840	460	1,300	7.9
Packard Cr.	0.0 - 2.0	-	75	75	0.5
Salmon Cr.	0.0 - 3.0	170	460	630	0.9
"	3.0 - 6.0	1,500	1,930	3,430	4.9
"	6.0 - 9.0	200	980	1,180	1.7
"	9.0 - 12.0	380	1,900	2,280	2.6
"	12.0 - 15.0	360	80	440	1.3
"	15.0 - 18.0	400	165	565	1.6
"	18.0 - 21.0	15	19	34	0.1
Black Cr.	0.0 - 4.0	370	865	1,235	3.5
"	4.0 - 8.0	140	195	335	1.2
"	8.0 - 11.0	340	715	1,055	4.5
Furnish Cr.	0.0 - 1.5	40	120	160	2.3
Salt Cr.	0.0 - 5.0	591	1,134	1,725	2.9
"	5.0 - 10.5	785	464	1,249	1.9
"	10.5 - 14.5	179	67	246	0.5
"	14.5 - 22.4	48	49	97	0.1
"	22.4 - 25.9	516	182	698	1.1
"	25.9 - 27.2	-	12	12	0.2
S.Fk. Salt Cr.	0.0 - 0.9	-	-	Negligible	-
"	0.9 - 2.9	2,779	1,381	4,160	39.4
"	2.9 - 3.9	-	-	Negligible	-
Schweitzer Cr.	0.0 - 1.0	-	40	40	1.73
Snake Cr.	0.0 - 1.2	-	20	20	0.7
Staley Cr.	0.0 - 8.8	400	800	1,200	1.6
Swift Cr.	0.0 - 7.5	87	105	192	0.4

1/ Source: Thompson, 1965.

Species

The main stem of the Middle Fork and its tributary Fall Creek support annual spawning runs of spring chinook and winter steelhead. Since the subbasin above Dexter was made inaccessible to anadromous fish, the runs that formerly used that area are now trapped at Dexter (Table 4), and artificially spawned. Their progeny are reared at the Fish Commission's Oakridge Hatchery and released in the river to perpetuate the run. Fall chinook, coho, and sockeye salmon have been stocked in the lower Middle Fork since 1953. The returns from the coho and sockeye stocking have been small and sporadic. The eventual establishment of these and other anadromous species that enter the Willamette River system in summer and fall months depends upon reduction of pollution in the lower river and improvement of fish passage at Willamette Falls.

Table 4. Adult steelhead trout and spring chinook salmon entering Dexter holding ponds 1/

Year	Steelhead	Spring Chinook Salmon
1957	198	1,348
1958	194	3,259
1959	68	2,663
1960	79	802
1961	175	807
1962	199	2,513
1963	42	6,005
1964	831	5,184
1965	(No trapping)	6,657
1966	"	5,477
Average	223	3,472

1/ Fish Commission counts. These adults, other than some transplanted to other streams in 1964 and 1965, were artificially spawned.

Wild cutthroat and rainbow trout occur throughout the drainage. Cutthroat numbers are moderate to high in most streams. 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 and a few Dolly Varden occur in larger streams. The lakes in the Cascade Range receive periodic plants of rainbow and brook trout. Kokanee have been stocked into Waldo Lake and are well established.

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

Developments Adversely Affecting Fish Resources

Dams have adversely affected game fish, their habitat and their harvest. In excess of 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. Even today, the North Fork has perhaps the finest spring chinook habitat in the state.

Fish hatcheries provided as mitigation for losses resulting from Corps of Engineers dam construction 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 holding facilities during summer and fall months prior to spawning. Before construction

of the dams, salmon ascended to cooler, higher elevation streams to rest and mature. Spring chinook compelled to remain below Dexter Dam often suffer severe losses from disease associated with warm water temperatures.

Quantities of water released into the river from Dexter Reservoir are normally adequate for fish life. However, releases are sometimes quickly and drastically fluctuated for flood control purposes. Severe 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 lost.

Hills Creek, Lookout Point, and Dexter Reservoirs inundate 51.8 miles of stream habitat.

Nongame species have found a haven in the warm pools formed by Dexter and Lookout Point Dams. Great numbers 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 trips and 45,200 trout at Lookout Point in 1955 to relatively few trips and 1,500 trout in 1959. The pattern at Dexter was quite similar with 19,200 anglers catching 26,900 trout in 1956, while despite continued stocking, 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 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 project and appurtenant fish passage facilities upon salmon and steelhead. The upstream area was chemically treated to eliminate nongame fish but the treatment was not totally effective; rough fish may become a deterent to 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 owned by the Hines Lumber Company has existed for many years in the North Fork of the Middle Fork at river mile 1.4. Prior to 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 have been substantially reduced in recent years. Decomposition of the mill waste lowered dissolved oxygen concentrations of the river and reservoir downstream. There are no other subbasin pollution sources seriously affecting fish.

Rights for consumptive use of surface water total about 100 cfs (Table 5). This amount is about evenly divided for irrigation, industrial, and municipal uses. Diversion of most water occurs along the Middle Fork below Dexter Reservoir and thus has little influence 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.

Table 5. Appropriated surface water and minimum stream flow measurement data, Middle Fork Subbasin

Stream Area	Appropriated Surface Water (cfs) 1/ Non Consumptive	Con-sumptive	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. Geological 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.

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

Developments Beneficial to Fish Resources

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 and spawned at Dexter Dam. The adjacent Oregon State Game Commission hatchery rears predominantly rainbow trout that are stocked in the upper Willamette watershed and other areas of the state.

Harvest

Most sport catches of anadromous fish produced in the Middle Fork drainage are made in areas outside the subbasin. Limited numbers of spring chinook are caught by anglers each year from the Middle Fork below Dexter Dam, but this fishery is gaining in popularity and the catch is expected to increase. In 1967, the Middle Fork was opened to steelhead angling up to the powerline crossing below Dexter Dam.

Wild cutthroat or rainbow trout provide fishing in nearly all streams. Heaviest trout angling takes place on the larger streams where stocks are supplemented with hatchery rainbow.

The Cascade lakes provide considerable angling through the summer season. Brook and rainbow trout stocked as fingerlings from airplanes are the prevalent species harvested. Kokanee are caught only from Waldo Lake. Good fishing is provided by hatchery rainbow in Hills Creek Reservoir, and similar success is expected in Fall Creek Reservoir as long as numbers of nongame fish remain low. The catch of warm-water game fish is negligible in the subbasin.

MCKENZIE SUBBASIN

This subbasin is composed of the watershed of the McKenzie River system. Nearly all streams contain important game fish populations. Reservoir habitat is provided by four impoundments of the Eugene Water and Electric Board and by Cougar Reservoir of the U.S. Army Corps of Engineers. Another large Corps dam is presently under construction on Blue River, a McKenzie River tributary. 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 southerly and westerly for 90 miles before entering the Willamette River at river mile 175 near Eugene. 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 fields near the Cascade Range crest that provide subsurface regulation of seasonal runoff. Since 1944, average annual 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, and the maximum was 88,200 cfs on December 29, 1945.

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.

Little habitat is obstructed to anadromous fish because of impassable falls that exist in upper portions of several streams. Prior to construction of Eugene Water and Electric Board's Trail Bridge Reservoir in 1963, 60-foot Tamolitch (Lower) Falls at river mile 85.8 was the upper limit of anadromous fish distribution. Now

the upper limit is a dam at river mile 81.6. The structure serves as a velocity barrier and diversion facility to an artificial spawning channel that provides mitigation for the loss of spring chinook habitat now isolated by the Carmen-Smith project.

At least 90 Cascade lakes in the subbasin offer excellent trout habitat (Appendix IV). Big Lake, the largest, covers 223 surface acres. Trail Bridge, Smith River, Carmen, and Leaburg Reservoirs, are Eugene Water and Electric Board impoundments in the McKenzie River watershed providing additional waters for salmonids and angling. Cougar Dam was completed in 1963 on the South Fork of the McKenzie River at river mile 4.5. The impoundment, 1,280 surface acres, created favorable trout habitat; however, even though extensive fish passage facilities were constructed, spring chinook salmon are not being maintained in the upriver habitat.

Species

About 50 percent of the spring chinook which ascend Willamette Falls enter the McKenzie River. Principal spawning streams, in order of descending use, are: McKenzie River main stem, South Fork, Horse Creek, Lost Creek, and Gate Creek (Table 6). Small numbers of spring chinook also utilize Blue River but these will be displaced by Blue River Dam now being constructed 1.8 miles above its mouth.

Annual spawning populations of coho and winter steelhead total about 50 and 350 fish, respectively. The coho are the survivors of recent plants and were first recorded spawning in the subbasin in the fall of 1964. Winter steelhead have maintained small runs for several years. Knowledge is lacking to explain why there is only a token run of steelhead since the large number of spring chinook indicates the habitat is excellent.

Plates 1, 2 and 3 show known anadromous fish distribution in the McKenzie drainage.

Table 6. Spring chinook spawning ground counts, McKenzie Subbasin, 1964 1/

Area	Date	Source 2/	Method	Chinook	Remarks
McKenzie River System					
McKenzie R. from S. Fk. to Hayden Br.	9-23-64	FWS	Aerial	1,177	Includes 117 fish counted in lower 2½ mi. of Walterville Canal
McKenzie R. from Hayden Br. to Armitage Park	10-2-64	Weyer-haeuser & OFC	Boat	57	
McKenzie R. around Walterville Canal	9-18-64	OSGC	Boat	34	Seven miles of the main channel was checked. An estimated 60 percent of the fish were counted.
McKenzie R. around Leaburg Canal	9-17-64	OSGC	Boat	534	Approximately 200 of the 534 fish were counted within 300 yds. of Leaburg Dam. About 5.8 miles of stream was surveyed.
Blue River	9-26-64	FWS	SCUBA	20	Section surveyed was from falls at river mile 4.5 to a point 0.9 miles downstream.
S. Fk. from Cougar Dam to mouth	9-23-64	OFC	Aerial	245	
S. Fk. from Elk Creek to the Reservoir	10-6-64	OFC	Foot	91	
Lost Creek	10-7-64	OSGC	Foot	155	One mile section adjacent to Limberlost Campground.

1/ Table not indicative of total numbers, but of relative spawning densities by area.
2/ FWS, United States Fish & Wildlife Service; Weyerhaeuser Timber Co.; OFC, Fish Commission of Oregon; OSGC, Oregon State Game Commission.

Rainbow and cutthroat trout exist in moderate to high numbers throughout the subbasin. Native rainbow in the main stem McKenzie, traditionally called "redsides", average 12 to 16 inches long when mature. Relatively low numbers of Dolly Varden trou and whitefish inhabit most 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 wild cutthroat and planted golden trout. Kokanee are well established in Big Lake. Hatchery rainbow trout are prevalent in the 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, redside shiners, chiselmouth and lamprey are present in the lower McKenzie system upstream to and including the Mohawk River.

Developments Adversely Affecting Fish Resources

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

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

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.

Cougar Dam and Reservoir appears to be harmful to spring chinook in the South Fork. Efficiency of the fish passage facilities is currently being evaluated. Adult chinook are trapped below the dam and hauled to a release site in the river above the reservoir. An elaborate collection system is incorporated into the dam to provide downstream passage for juvenile salmon. In spite of these facilities, the numbers of salmon using this stream has declined seriously.

The South Fork was the McKenzie River's major spring chinook spawning tributary. In 1958, prior to construction of Cougar Dam, the run was calculated to be 4,400 fish. Table 7 lists numbers of adults trapped at the dam site and released above the reservoir since 1960. Altered flow conditions, especially quality factors, below the dam in 1965 and 1966 are suspected to cause the low numbers.

Blue River and Trail Bridge Dams block 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 7. Efficiency of this facility is also being evaluated.

Table 7. 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 take large amounts of water from the McKenzie for power generation. Walterville canal, the lower diversion, heads 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 begins at river mile 38.9 and re-enters the McKenzie at river mile 33.3. Leaburg Dam, the 20-foot diversion structure, has 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 contain extensive gravel supplies which have been 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 diverted, leaving minimal flows in the river to accommodate the spawning. Alsc, 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 water levels drop. Joint studies conducted with the Fish Commission of Oregon 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 improvements over some prior conditions, but do not alleviate damages resulting from the fluctuations in flow that occur during the spawning season.

Large numbers of spring chinook are falsely attracted into Walterville and Leaburg canals. Walterville power plant is located two miles above the lower end of the tailrace, whereas the Leaburg power plant is 200 yards from the river. When concentrations of fish are apparent below the power plants, flows are sometimes purposefully reduced so the fish will drop downstream to the river.

The greater problem has been at Walterville power plant because of its longer tailrace. A bypass channel, from the tailrace to the river, is provided by the Board each year. Fish Commission personnel construct a temporary fish barrier across the tailrace immediately above the bypass, which is reasonably effective in shunting most of the salmon back to the river.

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 1957 and 1958 revealed significant losses of fish as a result of passage through the turbines.

Present consumptive uses of surface water (Table 8) do not conflict seriously with fish; but one unexercised irrigation right for 1,216 cfs of McKenzie River water 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 Willamette Basin. A salmon hatchery is operated by the Fish Commission of Oregon in the Leaburg area. This installation rears juvenile spring chinook salmon from eggs of adults trapped in the Walterville tailrace. The young salmon are subsequently released into the McKenzie.

Harvest

Streams of the subbasin provide substantial numbers of spring chinook to the Columbia River and Pacific Ocean commercial fisheries, and the sport fisheries of the Columbia and Willamette Rivers. Coho salmon and steelhead runs and fisheries, both commercial and sport, are small.

Table 8. Appropriated surface water and minimum stream flow measurement data, McKenzie Subbasin

Stream Area	Appropriated Surface Water (cfs) 1/ Non Consumptive	Con-sumptive	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	OSGC
Horse Creek System	0.1	0.7	277	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	1,020	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.

Light to moderate 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 McKenzie River is renowned for its trout fishery. Both native "redsides" and hatchery rainbow are caught in large numbers. The widespread recognition of this fishery renders it a substantial economical asset to the area. Table 9 presents guided angler catch data from 1961 through 1965. The table does not include unguided anglers and therefore represents only a fraction of the total annual McKenzie River catch. Wild cutthroat and rainbow trout provide much fishing in nearly all streams of the McKenzie watershed. Wild stocks are supplemented with hatchery rainbow in most larger streams. Trout fishing in Cascade lakes is popular from late May through October. Most of these lakes are stocked by airplane. Cougar, Trail Bridge, Carmen, and Smith River Reservoirs receive moderate to heavy angling pressure for hatchery and wild trout.

Table 9. Catch reports from parties fishing with professional guides, McKenzie River, 1961-1965 1/

Year	Number of Guides Reporting	Boat Trips	Anglers	Hours	Trout Caught	Trout per Angler
1961	7	261	483	3,496	3,094	6.6
1962	9	300	608	4,330	4,121	6.8
1963	10	348	657	4,234	5,247	8.0
1964	11	417	755	4,258	5,881	7.8
1965	10	412	760	5,025	4,617	6.1

1/ Most guided trips are reported, but not all. Therefore, the information should not be construed as the total fishery.

LONG TOM SUBBASIN

Streams of the Long Tom River system comprise this subbasin. 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. Stream flows generally are low and warm in summer months, which is typical of west side Willamette River tributaries. Less than half of the 700 miles of stream in the subbasin maintain perennial flows. Ninety-five percent of the area lies below 1,000 feet elevation. Only the upper portions of the Long Tom River and some of its tributaries drain directly from the Coast Range.

Stream temperatures in summer months commonly exceed 75 F. Some of the highest temperatures 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 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 9,000 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.

Species

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, wild cutthroat trout exist in moderate numbers in all streams maintaining perennial flows. Through evolution, these fish have adapted themselves to survive in the system. 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 sunfish are less common inhabitants. Several forms, particularly white crappie, escape to the river below the reservoir where they have become well established. 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 Long Tom system and Fern Ridge Reservoir.

Developments Adversely Affecting Fish Resources

Fern Ridge Reservoir contributes to high rough fish numbers and increased water temperatures of the lower Long Tom River. The reservoir's potential for fish production is lessened when it is drawn down each fall to provide storage for flood control. Nevertheless, it still provides a substantial fishery.

A laddered, 10-foot high concrete dam, is located in the river at Monroe. Two unladdered dams, 6 and 10 feet high, are located between Monroe and Fern Ridge Reservoir. These two barriers virtually preclude the upstream migration of game fish, but are not a serious problem since there is little spawning area between them and Fern Ridge Dam.

Numerous consumptive withdrawals of water are made from subbasin streams (Table 10). Water rights exist for about 130 cubic feet per second, composed mostly of small irrigation withdrawals.

Table 10. Appropriated surface water and minimum stream flow measurement data, Long Tom Subbasin

Stream Area	Appropriated Surface Water (cfs) 1/ Non Consumptive	Con-sumptive	Instantaneous Discharge (cfs)	Instantaneous Minimum Flows Measured 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.

Developments Beneficial to Fish Resources

Fern Ridge Reservoir and its adjoining borrow pit furnish extensive game fish environment. 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 will be repeated periodically as the need arises. Appendix III lists fish stocking data.

Harvest

Angling pressure in the subbasin is heaviest on Fern Ridge Reservoir. Although fishing is permitted all year, angler use is greatest in the spring. Cutthroat trout, largemouth bass, bullhead catfish, bluegill, and crappie are the predominant species caught. In 1956, 5,700 pounds of these game fish were harvested from the reservoir. Warm-water game fish and trout are also taken by fishermen in the river immediately below the reservoir and in the adjacent borrow pit. Six smaller borrow pits located along the west side of Highway U.S. 99 between Eugene and Junction City provide some additional warm-water game fish angling.

Trout angling pressure is concentrated 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.

STREAM FLOW STUDY

Flows affecting fish life were studied in major streams of the basin from the spring of 1964 to summer of 1966. Emphasis was placed on determining the minimum spawning and rearing flows necessary to maintain present levels of both resident and anadromous species. These recommendations are presented by semi-monthly periods for individual streams in Appendix I.

Recommended flows are based primarily upon biological requirements of fish life. These requirements are described in Appendix VIII and will be discussed briefly in the rearing and spawning flow sections of this report. Flow information was obtained from measurements made in this study and from U.S. Geological Survey records.

Most recommended flows are at or below the average stream discharge for the periods listed. Some exception occurs for low elevation streams in the late summer and fall months of adverse years when recommendations are often above existing flows. Reduction of flows below those listed, whether caused by hydrological conditions or withdrawal, would diminish fish production.

Angling and other recreational uses were not considered in developing flow recommendations; however, those listed would permit reasonably adequate continuation of these activities.

Recommendations for flows that would provide for the development of each stream's full potential (optimum flows) are not given. Neither are the recommendations in Appendix I intended to represent the most desirable amounts for release from future impoundment sites. If flows in excess of the listed minimums are now or become available in the future, additional study should be conducted to determine optimum flow for fish life and for recreational angling.

Wherever possible, the flow locations shown in Appendix I have been designated at mouths or confluences of streams, U. S. Geological gage sites, or some other easily recognizable landmark. The flows listed for each location are those which should always arrive at the designated point and be maintained downstream to the mouth unless superseded by a recommendation at some lower point.

Water quantities in the main stem of the Willamette River within the basin are generally considered adequate for salmonid production. No flow recommendations are included in this report for the main stem. Continued pollution at levels critical to fish life in the middle and lower Willamette River may necessitate greater summer and fall releases of good quality water from Upper Willamette Basin storage projects.

Rearing Flows

Streams important to game fish were examined periodically throughout the summer rearing periods of 1964 through 1966. On these visits, stream flows and temperatures were measured and sections of the streams were studied to determine minimum flows necessary for fish rearing. Recommended minimum rearing flows derived from the studies are included in Appendix I.

Although stream rearing of most juvenile salmonids occurs throughout the entire year, flows during summer and early fall months are those usually considered in "rearing flow" discussions because they are the most critical. Natural rearing flows and accompanying temperatures measured in the 1964-65 investigations are presented in Appendix II.

In this report we will confine our discussion to quantity, assuming adequate quality for anadromous fish. Comprehensive consideration of water quality problems are currently outside the limits of our field studies. In general, where water quali problems exist they are usually caused by man's activities, especially where pollutant are involved.

It was determined during rearing flow studies conducted in the South Coast Basin in 1961 and 1962 that certain minimum volumes normally fulfill food, shelter and suitable medium requirements. To satisfy these basic requirements it was determined that each stream must possess a particular flow over its entire length. This flow should have a minimum depth of between 0.1 to 0.2 foot over a substantial portion of each riffle regardless of stream size.

Spawning Flows

To formulate the minimum spawning flows listed in Appendix I, measurements of two primary criteria were considered: water depth and water velocity over available spawning gravel. Minimum water depth for chinook salmon spawning was considered to be 0.8 of a foot, while coho salmon and steelhead require at least 0.6 of a foot of water. Resident trout requirements are similar to steelhead, although this does vary somewhat depending upon the size of the individual fish involved. Proper spawning velocities for all three species were considered to range between 1.0 and 2.5 feet per second as measured 0.4 of the stream depth from the bottom. Smaller resident fish may spawn in somewhat lesser velocities. These criteria were selected as the result of measurements of numerous redds of the species concerned by Oregon Game Commission personnel and other fishery workers. 1/

In determining recommended spawning flows included in Appendix I, the desirable depths and velocities described above were required over substantial portions of each stream's spawning areas.

Fish Distribution

Supplementary investigations were made during this flow requirement study to ascertain the distribution and relative abundance of fish species. This information (Appendix VI) had application to the stream flow study by defining areas most

1/ "The Fish and Wildlife Resources of the Lower Willamette Basin, Oregon, and Their Water Use Requirements, June 1964, pp. 54."

important to game fish, was indicative of relative stream values, and provided basic data for fishery evaluations at future water developments.

Sampling was conducted on the majority of the accessible streams that were included in periodic flow and temperature measurements. Length of the stream and distribution of fish species generally determined the number of locations sampled on a stream. Length of the sample sections varied from 50 to 100 feet. Both pool and riffle areas were sampled in most sections.

Fish collection was done by electroshocking. This method has proven highly successful except in larger streams. The electrofishing apparatus used consisted of a 115-volt A.C. gasoline generator, an AC-DC voltage regulator and pulsator, and electrodes.

GAME RESOURCES OF THE UPPER WILLAMETTE BASIN

General

Consumptive water requirements of game animals are small; but water shortage can be a critical limiting factor, as in parts of Eastern Oregon. In the Upper Willamette, where average annual precipitation exceeds 40 inches, supply and distribution of water adequately satisfies the needs of the basin's game animals. Waterfowl and furbearers have the most significant water requirements. Marshes, lakes, and pollution-free streams are essential habitat for their existence.

Except for ducks and certain furbearers, game populations in the basin are believed to be the largest in history. The introduction of the ring-necked pheasant and the beneficial effect of logging on deer habitat have greatly enhanced the recreational opportunities for the hunter. By managing wildlife resources and the land and water they depend on, conservationists have been able to increase numbers of several game species and preserve the presence of others. The goal of wildlife management is to maintain an optimum-sized population based on available habitat and conflicts with other land uses. To stabilize game population fluctuations,

which occur when densities are not in balance with habitat provisions, biologists strive to balance harvest with supply. Trend counts shown in Table 11 are indices to population densities.

Big Game

The most valuable game animal in terms of recreational utilization is the black-tailed deer. The average basin-wide population density is probably over 11 deer per square mile. With the advent of extensive logging and controlled harvest deer numbers have increased sharply. Black-tailed deer can be found in every suitable ecological niche available in the basin. They inhabit various lowland areas in winter and spread to the summit of the Cascade Range in summer.

Table 11. Population trend counts in the Upper Willamette Basin

Species	Miles 1/ Traveled	Animals Observed per Mile				
		1962	1963	1964	1965	1966
Black-tailed Deer	376	6.0	6.0	6.0	5.8	6.0
Roosevelt Elk	59	-	-	3.0	3.5	4.0
Blue Grouse	22	0.13	0.24	0.25	0.43	0.18
Ruffed Grouse	22	0.02	0.06	0.00	0.00	0.09
Mountain Quail	22	0.79	1.10	1.15	0.95	0.36
Valley Quail	Birds per 100 acres	5.5	5.9	2.5	3.4	2.8
Ring-necked Pheasant	Birds per 100 acres	51.6	52.7	36.8	30.0	8.5

1/ Several counts overlapped into areas outside the Upper Willamette Basin.

The annual sport harvest of approximately 6,700 deer supports about 78,900 hunter-days (Table 12).

In Western Oregon water impoundments are detrimental to big game. Key winter ranges and migration routes normally coincide with reservoir sites. Game population densities relying on these lowland stream bottom areas commonly are several times

the densities occurring elsewhere. The seasonal altitudinal migrations of deer and elk along streams have been blocked by the construction of impoundments and has caused them to remain at high elevations during the winter.

Table 12. Estimated deer and elk harvest in the Upper Willamette Basin

Species	Year	Harvest	No. of Hunters	Hunter-Days
Black-tailed Deer 1/	1961	5,000	9,500	38,200
	1962	7,300	10,000	76,500
	1963	7,900	17,600	118,700
	1964	7,500	8,800	78,300
	1965	5,600	10,200	79,600
	Average	6,700	11,100	78,200
Roosevelt Elk 2/	1961	149	1,170	7,000
	1962	141	1,150	6,000
	1963	179	1,100	7,000
	1964	255	1,130	8,000
	1965 3/	101	820	4,500
	Average	165	1,070	6,600

1/ Deer harvest data is 70 percent of the calculated harvest and hunter effort expended in the Oregon State Game Commission's McKenzie Big Game Management Unit, the northern boundary of which is the North Santiam River. Thirty percent of the McKenzie Management Unit lies north of the Upper Willamette Basin.

2/ Elk harvest in the McKenzie Big Game Management Unit not within the boundaries of the Upper Willamette Basin is negligible.

3/ First year of separate Rocky Mountain and Roosevelt elk tags, reducing hunting pressure on Roosevelt elk.

Note: Data are derived from the annual random hunter surveys.

Upland Game

Upland game birds of the basin include blue and ruffed grouse, mountain quail, valley quail, bob white quail and ring-necked pheasant.

Grouse and mountain quail are forest dwellers with relatively low population densities. Their population trends are difficult to evaluate but are little affected by the light hunting pressure. The estimated grouse harvest probably is less than 1,000 birds annually.

Valley quail and pheasant are most common in the lowland agricultural areas. After their introduction in the late 1800's valley quail and ring-necked pheasant populations flourished, expanding into practically all suitable habitat, then soon leveled off and became fairly stable. Habitat quality and food abundance more than any other factors regulate density of valley quail and pheasants. Because of the abundance of these lowland game birds and their popularity with hunters they support an important sport harvest.

Inundation of habitat by reservoir impoundments is probably the most detrimental form of water development to upland game birds in the Willamette Basin.

Waterfowl

Waterfowl are most abundant in the Upper Willamette Basin during their fall and winter migration (Table 13). Camas Swale Game Management Area and several large reservoirs such as Fern Ridge, Cottage Grove, Dorena, Dexter and Lookout Point Reservoirs have provided several attractive resting areas for ducks and geese. Duck populations on the Pacific flyway have gradually declined since the drought years around 1930. Intensive management and more rigid control of wetland drainage have recently helped level off this decline. Wintering goose populations in the Upper Willamette Basin are fairly stable. Hunting pressure on them is fairly heavy. Several species of ducks commonly nest in the basin.

Water developments draining wetlands or causing pollution are principal threats to waterfowl nesting or wintering in the basin. Conversely, developments most beneficial to waterfowl would be shallow impoundments which would create additional nesting or resting sites.

Table 13. Winter duck and goose inventory in the Upper Willamette Basin

Species	1962	1963	1964	1965	1966	1967	Mean
Mallard	5,220	3,547	16,119	30,625	7,100	5,734	11,390
Gadwall	-	-	-	-	7	100	18
Widgeon	2,265	1,290	5,092	28,420	4,000	6,995	8,009
Teal	1,650	790	1,100	1,250	1,000	3,090	1,480
Shoveller	4	-	4	2	2	10	4
Pintail	3,247	4,227	8,284	9,215	3,000	4,067	5,340
Wood Duck	10	-	-	-	-	-	2
Canvasback	150	106	66	30	17	1	62
Scaup	41	71	2,450	90	10	160	470
Ring-necked	250	2	50	2	5	-	52
Goldeneye	8	-	15	-	6	5	6
Bufflehead	522	125	184	113	18	85	175
Ruddy Duck	535	228	1,525	3,540	1,141	430	1,233
Merganser	18	35	27	61	12	24	30
Scoter	40	17	40	-	43	25	28
Unidentified	-	1,170	4,200	-	5,000	1,000	1,895
Total	13,960	11,605	39,156	73,348	21,361	21,726	30,193
Snow Goose	-	-	-	-	-	7	1
Canada Goose	1,132	1,000	1,100	43	300	700	713
Lesser Canada	200	-	-	-	-	68	45
Cackling Goose	300	-	100	-	-	-	67
Total	1,632	1,000	1,200	43	300	775	825
Grand Total	15,592	12,605	40,356	73,391	21,661	22,501	31,018

Furbearers

Furbearers provide harvestable commodities which have substantial market value (Table 14). Certain species, such as river otter, beaver, muskrat, fisher and marten, have declined in numbers because of over-trapping and settlement. The harvest of these animals is now well regulated but they still suffer from loss and degradation of habitat.

Since its introduction nutria has spread rapidly in the entire Willamette Basin. Because of its abundance and habitat competition with muskrat and beaver, nutria are now considered nuisance animals.

The water requirements of furbearers are probably most satisfactorily provided by a natural or undisturbed environment; however, creation of stable, shallow impoundments with marsh edge could be beneficial. Water developments which reduce available water supplies or pollute water would be detrimental to furbearers.

Table 14. Fur trapping in the Upper Willamette Basin 1/

Species	1963-64 Harvest	1963-64 Value	1964-65 Harvest	1964-65 Value	1965-66 Harvest	1965-66 Value
Beaver	965	$10,180	684	$5,431	976	$11,614
Mink	186	1,546	137	1,047	139	1,019
Muskrat	967	1,073	681	667	405	502
Otter	17	355	12	261	27	661
Nutria	499	629	96	117	83	166
Wildcat	8	42	19	110	41	577
Raccoon	140	227	81	118	151	349
Civit Cat	28	32	58	84	66	113
Coyote	2	6	2	9	16	103
Red Fox	7	23	1	2	11	44
Gray Fox	2	1	7	8	19	35
Skunk	22	16	4	3	5	6
Weasel	2	1	12	6	2	1
Totals	2,845	$14,131	1,794	$7,863	1,941	$15,190

Note: Marten and badger are also occasionally trapped. Species are listed in order of the monetary value of each species' total average annual harvest between 1963 and 1966. Pelt supply and demand regulate these highly fluctuating figures.

1/ Upper Willamette Basin fur harvest shown is 83 percent of the calculated harvest in Lane County based on trappers' reports. Seventeen percent of Lane County lies outside the Upper Willamette Basin.

SUMMARY OF FACTORS ADVERSE TO GAME FISH PRODUCTION

Coast Fork Subbasin

Natural Conditions:

1. Rearing potential for salmonids is significantly limited by low, warm, summer flows which occur throughout much of the subbasin.

2. Extensive nongame fish populations are highly competitive with game fish.

3. Meager quantities of spawning gravel are present in portions of the subbasin.

4. Several impassable falls existing above Dorena and Cottage Grove Dams block intra-stream trout migrations.

Developments:

1. Cottage Grove and Dorena Dams are unladdered and impassable to fish. Both reservoirs release water warmed by impoundment during summer, thus providing favorable environment for nongame fish production in the rivers below the dams.

2. Extensive surface water withdrawal occurs throughout the summer, leaving inadequate flows for fish in some streams.

3. Two 4-foot high dams on the Coast Fork Willamette River below Cottage Grove Dam hinder fish passage.

4. Gravel mining operations impair stream habitat by creating turbid conditions and causing deposition of silt over gravel.

5. Two dams on Layng Creek above Dorena Reservoir block trout migrations.

Middle Fork Subbasin

Natural Conditions:

1. Cold water temperatures retard growth of fish in some streams at higher elevations.

2. Several falls existing on the upper portions of many headwater streams are impassable to fish.

Developments:

1. Multipurpose reservoir projects of the Corps of Engineers:

a. Dexter re-regulating dam is the lowermost unladdered structure on the Middle Fork; it blocks all anadromous fish. The reservoir is infested with high numbers of nongame fish. Low flow releases during flood control periods are inadequate for game fish downstream.

b. Lookout Point Dam is unladdered and impassable to fish. Warmed reservoir waters are detrimental to game fish both within and downstream from the impoundment.

c. Hills Creek Dam is unladdered and a barrier to potential fish runs. Its reservoir forms favorable habitat for nongame fish, which limits production of game fish.

2. Unladdered Hines Lumber Company Dam on the North Fork is a barrier to trout migration and to potential anadromous fish runs.

3. A diversion from the Middle Fork near the city of Springfield is unscreened and is a hazard to downstream migrant fish.

4. Channel straightening and revetment construction in Salt Creek adversely affect stream environment by eliminating pools and natural cover.

McKenzie Subbasin

Developments:

1. Cougar Dam and Reservoir impede utilization of upstream areas by anadromous fish.

2. Substantial spawning and rearing areas of the chinook salmon were displaced by Carmen-Smith and Trail Bridge Reservoirs.

3. Leaburg Dam hinders fish passage.

4. High mortality to downstream migrants frequently occurs when the fish enter the unscreened Leaburg or Walterville power canals and pass through turbines at the respective powerhouses.

5. Large water fluctuations occur in portions of the river when Leaburg and Walterville canals divert water for power peaking operations. Flows from the tailraces frequently lure salmon from the river to the bases of the powerhouses.

6. Although presently unexercised, water rights exist for 1,216 cfs which wou leave residual stream flows inadequate for fish.

7. Sand and gravel mining operations on the lower river adversely affect stream habitat by creating turbid conditions and causing silt deposits over gravel.

8. Industrial pollution deteriorates water quality in the river near Springfield.

Long Tom Subbasin

Natural Conditions:

1. Naturally low, warm summer flows have precluded anadromous fish from the subbasin.

2. Abundant nongame fish readily compete with desirable species.

3. Spawning gravel is scarce below Fern Ridge Dam.

Developments:

1. Fern Ridge Reservoir provides a nucleous for rough fish production and releases warmed water to the detriment of game fish downstream.

2. Two unladdered dams, 6 and 10 foot high, between Monroe and Fern Ridge Dam, block fish migrations.

3. Water rights for substantial withdrawals are detrimental to fish when exercised during low flow periods, because there is inadequate flow remaining to sustain fish life.

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A P P E N D I C E S

Appendix I

Recommended Minimum Flows for Fish Life, Upper Willamette Basin [1]

Stream	Location	Dec-May	June	July	Aug.	Sept.	Oct.	Nov.
Coast Fk. Willamette R.	USGS Gage 14-1525	100	40 30	20 15	10	10	10	10 100
" " " "	USGS Gage 14-1535 [2]	125	70 50	50	50	50	50	75 125
" " " "	USGS Gage 14-1575 [2]	200	150	150	150	150	150	150 200
Big River	Mouth	45	25 15	10 8	6	6	6	25 45
Sarouti Creek	Just above Big R.	25	12 10	8 6	4	4	4	20 25
Wilson Creek	Mouth	10	3 2	2 1	1	1	1	5 10
Row River	USGS Gage 14-1545	150	100 60	40 25	20	20	20	90 150
" "	USGS Gage 14-1555 [2]	175	125 100	100	100	100	100	100 175
Brice Creek	Mouth	75	60 50	25 15	8	8	8	50 75
Champion Cr.	"	15	12 8	6 3	1	1	1	10 15
Layng Creek	"	65	50 40	20 12	5	5	5	40 65
Mosby Creek	USGS Gage 14-1565 [2]	90	40 25	15 10	10	10	10	75 90
Rat Creek	Mouth	12	3	2 1	0.5	0.5	0.5	7 12
Sharps Creek	"	70	50 30	15 10	5	5	5	50 70
" "	Just above Martin Creek	20	10 8	3 2.0	1	1	1	15 20
Martin Creek	Mouth	20	10 8	3 2.0	1	1	1	15 20
Smith Creek	Just above Teeter Creek	15	3	2 2.0	2.0	2.0	2.0	10 15
Teeter Creek	Just above Smith Creek	20	8	6 4	2	2	2	12 20
Middle Fk. Willamette R.	USGS Gage 14-1448	300	300	250	250	250 300	300	300
" " " "	USGS Gage 14-1455	285	285	285	285	285	285	285
" " " "	USGS Gage 14-1480	1200	1000	1000	1000	1000 1200	1200	1200
" " " "	USGS Gage 14-1520 [2]	1500	1025	1025	1025	1025 1500	1500	1500
Big Willow Creek	Mouth	8	3 2	1 0.5	0.5	0.5	0.5	5 8
Buck Creek	"	25	10 5	3.0 2	2	2	2	18 25
Coal Creek	"	45	40 30	20 15	10	10	10	30 45
Coffeepot Creek	"	13	8 4	2	1	1	1	8 13
Fall Creek	USGS Gage 14-1503	125	75 50	25	25	25 125	125	125
" "	USGS Gage 14-1510 [2]	150	100 75	40	40	40 150	150	150
Alder Creek	Mouth	15	10 8	5 3	2.0	2.0	2.0	10 15
Delp Creek	"	30	20 12	8 5	3	3	3	20 30
He He Creek	"	35	25 15	8 6	4	4	4	20 35
Pernot Creek	"	15	8 4	2	1	1	1	10 15
Little Fall Creek	"	80	60 40	25 15	10	10	10	60 80
North Fk. Fall Cr.	"	15	10 6	3 2	1	1	1	10 15
Portland Creek	"	50	30 20	10 6	4	4	4	40 50
Winberry Creek	"	50	40 20	10 6	5	5	5	30 50
N.Fk. Winberry Cr.	"	25	20 10	6 3	2	2	2	15 25
S.Fk. Winberry Cr.	"	40	30 15	8 4	2	2	2	30 40
Gold Creek	"	20	10 4	2 1	0.5	0.5	0.5	12 20
Hills Creek (Lower)	"	12	8 4	2	1	1	1	6 12
Hills Creek (Upper)	USGS Gage 14-1449 [2]	70	60 40	25	25	20	20	50 70
Larison Creek	Mouth	10	6 3	2	1	1	1	6 10
Lost Creek	"	50	25 15	8 6	3	3	3	30 50
" "	Just above Guiley Cr.	18	10 6	4 3.0	2	2	2	11 18
Guiley Creek	Mouth	15	7 4	2	1	1	1	10 15

Appendix I (continued)

Stream	Location	Dec-May	June	July	Aug.	Sept.	Oct.	Nov.
N.Fk. Willamette R.	USGS Gage 14-1475 2/	200	200	150 115	115	115 200	200	200
" " " "	Just above Plateau Cr.	150	150	125 100	100	100 150	150	150
Christy Creek	Mouth	100	75 50	25 15	10	10	10	60 100
Fisher Creek	"	35	30 20	15 10	8	8	8	20 35
Packard Creek	"	12	8 4	2	1	1	1	8 12
Salmon Creek	USGS Gage 14-1465 2/	175	175	125 100	100	100 175	175	175
Black Creek	Mouth	70	60	50 40	30	30	30	50 70
Wall Creek	"	25	20 12	8 5	3	3	3	15 25
Salt Creek	"	125	125	100 90	90	90 125	125	125
Eagle Creek	"	40	35	30	25	25	25	25 40
S.Fk. Salt Creek	"	25	15 10	7 5	3	3	3	15 25
Simpson Creek	"	25	15 10	6 4	2	2	2	15 25
Staley Creek	"	60	40 30	25 20	15	15	15	40 60
Swift Creek	"	80	70 60	50 40	30	30	30	50 80
Windfall Creek	"	10	4 2	0.5	0.5	0.5	0.5	8 10
McKenzie River	USGS Gage 14-1588.5	750	750	750	650	650 750	750	750
" "	USGS Gage 14-1590	1200	1200	1200	1000	1000 1200	1200	1200
" "	USGS Gage 14-1625	2000	2000	2000	1400	1400 2000	2000	2000
" "	USGS Gage 14-1655 2/	2000	2000	2000	1025	1025 2000	2000	2000
Blue River	Mouth	30	30	30	30	30	30	30
" "	USGS Gage 14-1611	90	50 30	25 20	15	12	12	50 90
Cook Creek	Mouth	25	15 8	4 2	1	1	1	20 25
Lookout Creek	USGS Gage 14-1615 2/	60	30 20	15 12	9	9	9	40 60
McRae Creek	Mouth	17	10 6	3 2	1	1	1	12 17
Quartz Creek	"	20	12 8	6 3	2.0	2.0	2.0	12 20
Quentin Creek	"	25	15 10	5 3	1	1	1	20 25
Simmonds Creek	"	15	10 5	3 1	0.5	0.5	0.5	10 15
Tidbits Creek	"	25	15 12	8 5	3	2	2	20 25
Camp Creek	"	30	10 4	2 1	0.5	0.5	0.5	25 30
Deer Creek (Lower)	"	40	20 12	9 6	4	4	4	30 40
Deer Creek (Upper)	"	80	30 18	15 12	10	10	10	40 80
Elk Creek	"	8	1	0.5	0.5	0.5	0.5	4 8
Ennis Creek	"	18	6 4	3 2	2	2	2	10 18
Finn Creek	"	12	3 2	2.0 1	1.0	1.0	1.0	7 12
Gate Creek	"	80	50 35	25 20	20	20	20	50 80
N.Fk. Gate Creek	"	45	30 20	15 12	10	10	10	30 45
S.Fk. Gate Creek	"	35	20 15	10 8	6	6	6	20 35
Holden Creek	"	12	3 1.5	1	0.5	0.5	0.5	8 12
Horse Creek	USGS Gage 14-1591 2/	300	300	300	250	250 300	300	300
King Creek	Mouth	18	3 1	1	1	1	1	14 18
Indian Creek	"	10	4 2	2	2.0	2.0	2.0	6 10
Kink Creek	"	18	4 3	2	1	1	1	10 18
Lost Creek	"	150	100	100	100	150	150	150

Appendix I (continued)

Stream	Location	Dec-May	June	July	Aug.	Sept.	Oct.	Nov.
Marten Creek	Mouth	30	15 10	8 6	4	4	4	20 30
Mohawk River	USGS Gage 14-1650 2/	200	100 60	40 25	20	20	20	100 200
" "	River Mile 21	80	30 20	15 12	10 7	7	7	60 80
Cartwright Creek	Mouth	12	5 3.0	2	1	0.5	0.5	8 12
Cash Creek	"	15	3 2.0	1	0.5	0.5	0.5	10 15
Drury Creek	"	8	2	1	0.5	0.5	0.5	6 8
McGowan Creek	"	17	2 1	1	0.5	0.5	0.5	12 17
Mill Creek	"	50	15 9	7 5	4	3	3	30 50
Parsons Creek	"	25	2 1	0.5	0.5	0.5	0.5	20 25
Shotgun Creek	"	25	8 4	3	2	2	2	20 25
Olallie Creek	"	100	75	75	75	75	75	75 100
Quartz Creek	"	60	25 18	12 10	8	8	8	40 60
Scott Creek	"	20	8 3	3	3	3	3	15 20
S.Fk. McKenzie River	USGS Gage 14-1592	250	250	250	200	200 250	250	250
" " " "	USGS Gage 14-1595 2/	400	400	250	250	250 400	400	400
Augusta Creek	Mouth	40	25 15	6 4	3	3	3	25 40
Elk Creek	"	50	30 20	15 12	8	8	8	30 50
East Fork	"	50	30 20	10 6	4	4	4	30 50
French Pete Creek	"	60	40 30	20 15	8	8	8	40 60
Rebel Creek	"	15	8 5	2	2	2	2	10 15
Roaring River	Mouth	70	50	50	50	50	50	50 70
McBee Creek	"	30	20 15	12	8	8	8	20 30
Long Tom River	River Mile 50	25	12 8	4	4	4	4	15 25
" " "	USGS Gage 14-1665	75	40 25	15 10	10	10	10	50 75
" " "	USGS Gage 14-1690	30	30	30	30	30	30	30
" " "	USGS Gage 14-1700 2/	25	25	25	25	25	25	25
Bear Creek	1 mile above mouth	8	3 1	0.5	0.5	0.5	0.5	6 8
Ferguson Creek	3 miles above mouth	20	5 3	2 1	0.5	0.5	0.5	12 20
Noti Creek	Just above Poodle Creek	12	4 2	2.0 1	1	1	1	8 12
Poodle Creek	Just above Noti Creek	30	12 8	4 3.0	2	2	2	15 30

1/ These recommended minimum stream flows are not intended to be used as desirable flow releases below future impoundments. Recommended reservoir releases for fish life would require additional investigations.

2/ From listed gage to mouth of listed stream.

Appendix II

Miscellaneous Flows and Temperatures Obtained in Upper Willamette Basin Streams, 1964-66

Stream	Date	Time	Temp °F Water	Temp °F Air	Flow (cfs)	Location	Remarks
Coast Fork Willamette R.	6-2-64	10:20 AM	53	66		USGS Gage 14-1535	
"	6-24-64	9:25 AM	53	60		"	
"	7-27-64	11:15 AM	58	78		"	
"	8-25-64	12:00 noon	61	76		"	
"	10-12-64	11:30 AM	61	57		"	
"	3-11-64	10:00 AM	47	52		"	
"	6-2-64	12:20 PM	56	66		USGS Gage 14-1525	USGS thermo graph in gage house
"	6-24-64	9:50 AM	56	61		"	
"	7-27-64	11:50 AM	63	79		"	
"	8-25-64	11:45 AM	62	75		"	
"	10-12-64	12:30 PM	54	61		"	
"	3-11-65	10:35 AM	46	52		"	
"	6-5-64	10:00 AM	--	--		USGS Gage 14-1575	USGS thermo graph in gage house
Big River	6-2-64	11:20 AM	54	65	30*	Mouth	
"	6-24-64	10:15 AM	56	61	36*	"	
"	7-27-64	12:05 PM	63	80	12.7*	"	
"	8-25-64	11:15 AM	62	74	8*	"	
"	10-24-64	12:15 PM	53	59	7.1*	"	One 12" suc
"	3-11-65	11:00 AM	44	53	51*	"	
Little River	6-2-64	11:35 AM	54	65	12*	Mouth	
"	6-24-64	10:25 AM	55	61	13.5*	"	
"	7-27-64	12:15 PM	60	80	9.8*	"	
"	8-25-64	11:30 AM	59	74	4.4*	"	
"	10-12-64	12:10 PM	53	59	4.4*	"	
"	3-11-65	10:50 AM	45	52	25*	"	
Row River	4-24-64	11:00 AM	48	54		USGS Gage 14-1555	
"	6-2-64	1:55 PM	52	70		"	
"	6-24-64	11:45 AM	54	71		"	
"	7-27-64	1:40 PM	57	81		"	
"	8-25-64	1:40 PM	69	82		"	
"	10-12-64	1:20 PM	62	65		"	
"	3-11-65	12:15 PM	50	55		"	

* Measured flow, others gaged or estimated.

Stream	Date	Time	Temp °F Water	Air	Flow (cfs)	Location	Remarks
Row River	4-24-64	12:30 PM	45	48		USGS Gage 14-1545	
"	6-2-64	3:00 PM	56	78		"	
"	6-24-64	1:15 PM	59	72		"	
"	7-27-64	6:15 PM	74	80		"	
"	8-25-64	2:40 PM	72	82		"	
"	10-12-64	4:40 PM	59	62		"	
"	3-11-65	5:00 PM	48	55		"	
Brice Cr.	4-24-64	2:45 PM	44	52	145*	1 mi. above mouth	
"	6-2-64	5:30 PM	53	76	212*	"	
"	6-24-64	4:20 PM	62	74	125*	"	
"	7-27-64	5:00 PM	72	85	19*	"	
"	8-25-64	4:35 PM	69	82	9.5*	"	
"	10-12-64	2:55 PM	57	65	9.3*	"	
"	10-12-64	2:40 PM	51	66	2	10 yds. above Champion Cr.	
"	3-11-65	3:50 PM	46	58	88*	1 mi. above mouth	
Champion Cr.	6-24-64	3:45 PM	56	73	40	Mouth	
"	7-27-64	5:30 PM	62	80	3.5	"	
"	8-25-64	5:15 PM	60	80	1.8	"	
"	10-12-64	2:30 PM	53	66	1.5	"	
"	3-11-65	4:30 PM	45	55	11	"	
Layng Cr.	4-24-64	3:30 PM	45	52	162*	0.2 mi. above mouth	
"	6-2-64	5:45 PM	58	76	100	Mouth	
"	6-24-64	3:10 PM	61	73	125	"	
"	7-27-64	4:35 PM	72	85	18*	"	
"	8-25-65	4:15 PM	70	82	6*	"	
"	10-12-64	3:10 PM	53	65	5.3*	"	
"	3-11-65	3:25 PM	45	60	81*	"	
Mosby Cr.	4-24-64	10:15 AM	48	54		USGS Gage 14-1565	
"	6-2-64	1:15 PM	60	78		"	
"	6-24-64	11:30 AM	64	70		"	
"	7-27-64	1:15 PM	--	81		"	
"	8-25-64	1:30 PM	69	80		"	
"	10-12-64	1:00 PM	57	64		"	
"	3-11-65	11:50 AM	49	55		"	
Rat Cr.	4-24-64	11:15 AM	--	58	9	Mouth	
"	6-2-64	2:10 PM	60	75	4	"	
"	6-24-64	12:00 noon	58	71	5.7*	0.5 mi. above mouth	
"	7-27-64	2:05 PM	67	86	2.2*	"	
"	8-25-64	1:55 PM	67	82	1*	"	
"	10-12-64	5:25 PM	57	60	0.8	"	
"	3-11-65	12:30 PM	49	55	7.3*	"	

Appendix II (continued)

Stream	Date	Time	Temp °F Water	Air	Flow (cfs)	Location	Remarks
Sharps Cr.	4-24-64	1:00 PM	46	56	100*	1 mi. above mouth	
"	6-2-64	3:30 PM	59	78	73*	"	
"	6-24-64	1:50 PM	63	72	58*	"	
"	7-27-64	4:05 PM	72	85	13*	Mouth	
"	8-25-64	4:00 PM	68	82	5.6*	"	
"	10-12-64	3:25 PM	54	65	6.3*	"	
"	3-11-65	2:05 PM	49	60	63*	0.6 mi. above mouth	
"	6-2-64	4:15 PM	50	76	32	20 yds. above Martin Cr.	
"	6-24-64	2:20 PM	56	73	15.4*	1 mi. above Martin Cr.	
"	8-25-64	3:30 PM	63	82	1.5	20 yds. above Martin Cr.	
"	10-12-64	4:10 PM	--	69	1	"	
"	3-11-65	2:50 PM	43	60	14	"	
Martin Cr.	4-24-64	1:45 PM	45	54	22*	Mouth	
"	6-2-64	4:00 PM	64	76	7.6*	"	
"	6-24-64	2:05 PM	62	72	11.3*	"	
"	7-27-64	3:30 PM	69	85	1.8*	"	
"	8-25-64	3:15 PM	65	82	1.5*	"	
"	10-12-64	4:00 PM	53	64	0.9*	"	
"	3-11-65	2:40 PM	46	60	14.3*	"	
Smith Cr.	4-24-64	12:20 PM	52	58	20*	100 yds. above Teeter Cr.	
"	6-2-64	2:40 PM	68	78	5	"	
"	6-24-64	12:45 PM	64	71	6.7*	"	
"	7-27-64	2:40 PM	74	88	2.6*	"	
"	8-25-64	2:30 PM	72	82	1.5*	"	
"	10-12-64	5:10 PM	58	61	2*	"	
"	3-11-65	1:05 PM	49	59	13*	"	
Teeter Cr.	4-24-65	12:00 noon	49	58	28*	120 yds. above mouth	
"	6-2-64	2:25 PM	64	78	13.5*	"	
"	6-24-64	1:00 PM	63	71	17*	"	
"	7-27-64	2:25 PM	69	88	5.4*	"	
"	8-25-64	2:10 PM	66	82	3.2*	"	
"	10-12-64	5:00 PM	55	61	3.4*	"	
"	3-11-65	1:25 PM	48	59	18.3*	"	
Wilson Cr.	6-2-64	10:40 AM	55	66	5	Br. 200 yds. above mouth	
"	6-24-64	10:55 AM	56	68	5.7*	"	
"	7-27-64	11:30 AM	62	78	1.7*	"	
"	8-25-64	12:10 PM	63	80	1.3*	"	
"	10-12-64	11:45 AM	53	58	1.0*	"	
"	3-11-65	10:15 AM	44	52	4.8*	"	

Stream	Date	Time	Temp °F Water	Air	Flow (cfs)	Location	Remarks
Mid. Fk. Willamette R.	6-5-64	4:35 PM	54	60		USGS Gage 14-1520	
"	6-26-64	10:00 AM	55	58		"	
"	7-29-64	10:00 AM	57	75		"	
"	10-9-64	10:50 AM	58	57		"	
"	3-15-65	11:35 AM	48	50		"	
"	7-30-65	2:50 AM	65	86		"	
"	9-2-65	10:25 AM	--	--		"	Moderately turbid
"	4-16-64	10:00 AM	42	44		USGS Gage 14-1480	
"	6-3-64	12:15 PM	49	74		"	
"	6-29-64	11:00 AM	51	64		"	
"	7-28-64	10:30 AM	56	60		"	
"	8-31-64	11:20 AM	62	59		"	
"	3-30-65	10:00 AM	45	54		"	
"	4-16-64	10:45 AM	44	44		USGS Gage 14-1455	
"	6-3-64	1:30 PM	48	75		"	
"	6-29-64	11:25 AM	--	64		"	
"	7-28-64	11:25 AM	58	62		"	
"	8-31-64	12:15 PM	50	59		"	
"	3-30-65	4:00 PM	45	56		"	
"	7-29-65	2:05 PM	49	86		"	
"	4-16-64	1:30 PM	44	--		USGS Gage 14-1448	
"	6-3-64	3:30 PM	49	78		"	
"	6-29-64	1:25 PM	--	74		"	
"	7-28-64	4:40 PM	58	65		"	
"	8-31-64	4:35 PM	57	59		"	
"	9-8-65	11:10 AM	--	65		"	USGS thermograph in gage house
Big Willow Cr.	4-14-64	12:15 PM	42	46	17*	Mouth	
"	6-3-64	2:20 PM	60	75	5	"	
"	6-29-64	12:15 PM	55	66	6	"	
"	7-28-64	2:20 PM	65	80	0.6	"	
"	8-31-64	2:30 PM	59	62	0.3	"	
"	3-30-65	2:45 PM	50	56	3.0*	"	
"	7-29-65	1:45 PM	72	85	0.4	"	
"	9-8-65	11:15 AM	60	73	0.3	"	
Buck Cr.	6-3-64	3:20 PM	49	75	65	200 yds. above mouth	
"	6-29-64	4:00 PM	53	73	27*	"	
"	7-28-64	4:50 PM	60	72	7.1*	"	
"	8-31-64	4:40 PM	53	59	4.5*	"	
"	3-30-65	11:25 AM	45	55	15*	"	
"	7-29-65	11:25 AM	65	81	2.8*	"	
"	9-8-65	11:00 AM	53	64	1.8	"	

Appendix II (continued)

Stream	Date	Time	Temp °F Water	Temp °F Air	Flow (cfs)	Location	Remarks
Coal Cr.	4-16-64	2:00 PM	42	46	105*	250 yds. above mouth	
"	6-3-64	4:00 PM	46	75	115	"	
"	6-29-64	1:45 PM	53	78	77*	"	
"	7-28-64	2:50 PM	59	73	25*	"	
"	8-31-64	3:15 PM	55	60	15.4*	"	
"	3-30-65	12:30 PM	43	55	43*	"	
"	7-29-65	11:55 AM	60	82	26*	"	
"	9-8-65	11:35 AM	53	65	11.9*	"	
Coffeepot Cr.	4-16-64	12:00 noon	42	46	29*	Mouth	
"	6-3-64	2:00 PM	50	74	32*	"	
"	6-29-64	12:05 PM	52	64	11	"	
"	7-28-64	2:15 PM	62	80	2.8*	"	
"	8-31-64	2:25 PM	56	62	1.5	"	
"	3-30-65	2:30 PM	48	56	6.8*	"	
"	7-29-65	1:35 PM	68	85	1.8	"	
"	9-8-65	1:05 PM	55	72	0.6	"	
Fall Cr.	4-20-64	4:30 PM	47	48		USGS Gage 14-1510	
"	6-5-64	3:45 PM	54	63		"	
"	6-26-64	10:55 AM	58	58		"	
"	7-29-64	10:50 AM	68	75		"	
"	10-9-64	12:00 noon	56	62		"	
"	3-15-65	11:50 AM	45	52		"	
"	7-30-65	10:35 AM	72	75		"	Very tu
"	9-2-65	11:00 AM	--	62		"	
"	4-20-64	3:25 PM	47	47		USGS Gage 14-1503	
"	6-5-64	3:15 PM	54	60		"	
"	6-26-64	1:40 PM	54	58		"	
"	7-29-64	1:00 PM	62	75		"	
"	10-9-64	2:00 PM	55	63		"	
"	3-15-65	1:55 PM	45	63		"	
Alder Cr.	4-20-64	1:55 PM	--	48	25	75 yds. above mouth	
"	6-5-64	1:25 PM	50	60	20	"	
"	6-26-64	2:30 PM	51	58	11.5*	"	
"	7-29-64	1:45 PM	59	72	4.5*	"	
"	10-9-64	2:30 PM	54	62	2.5*	"	
"	3-15-65	2:45 PM	49	63	7.7*	"	
"	7-30-65	12:40 PM	60	79	3.0	"	
"	9-2-65	2:15 PM	59	65	1.6*	"	
Delp Cr.	4-20-64	3:15 PM	44	47	55*	Mouth	
"	6-5-64	2:20 PM	50	59	37*	"	
"	6-26-64	3:15 PM	51	58	17*	"	
"	7-29-64	2:45 PM	60	63	7*	"	
"	10-9-64	3:15 PM	53	62	7.5*	"	
"	3-15-65	3:50 PM	45	60	24*	"	
"	7-30-65	1:30 PM	66	82	5.7*	"	
"	9-2-65	3:10 PM	57	65	3.6*	"	

Stream	Date	Time	Temp. °F Water	Air	Flow (cfs)	Location	Remarks
HeHe Cr.	4-20-64	2:30 PM	45	48	48*	75 yds. above mouth	
"	6-5-64	1:55 PM	55	59	35*	"	
"	6-26-64	3:00 PM	54	58	22	"	
"	7-29-64	2:20 PM	63	73	4.7*	"	
"	10-9-64	3:00 PM	55	62	6.1*	"	
"	3-15-65	3:20 PM	47	61	23*	"	
"	7-30-65	1:10 PM	65	80	7.0*	"	
"	9-2-65	2:45 PM	59	65	4.1*	"	
Pernot Cr.	4-20-64	2:15 PM	45	48	17*	50 yds. above mouth	
"	6-5-64	1:45 PM	53	60	11*	"	
"	6-26-64	2:40 PM	51	58	5.8*	"	
"	7-29-64	2:05 PM	58	72	1.4*	"	
"	10-9-64	2:45 PM	53	62	1.0*	"	
"	3-15-65	3:05 PM	43	62	5.8*	"	
"	7-30-65	1:00 PM	60	79	1.6*	"	
"	9-2-65	2:30 PM	55	65	1.2*	"	
Little Fall Cr.	4-20-64	5:00 PM	47	48	170*	1 mi. above mouth	
"	6-5-64	4:00 PM	57	63	98*	"	
"	6-26-64	10:45 AM	58	58	88*	"	
"	7-29-64	10:40 AM	66	75	35*	"	
"	10-9-64	11:45 AM	57	57	24*	"	
"	3-15-65	11:00 AM	43	49	103*	"	
"	7-30-65	2:20 PM	72	85	17.5*	"	
"	9-2-65	10:50 AM	59	62	14.2*	"	
N.Fk.Fall Cr.	4-20-64	3:30 PM	47	48	22*	Mouth	
"	6-5-64	3:20 PM	55	60	15*	"	
"	6-26-64	1:40 PM	53	58	11.5*	"	
"	7-29-64	1:00 PM	60	75	4	"	
"	10-9-64	2:00 PM	54	63	67	"	
"	3-15-65	2:00 PM	45	63	10	"	
"	9-2-65	1:30 PM	56	63	1.5	"	
Portland Cr.	4-20-64	1:35 PM	46	48	65*	200 yds. above mouth	
"	6-5-64	1:10 PM	50	60	86*	"	
"	6-26-64	2:10 PM	52	58	35*	"	
"	7-29-64	1:25 PM	64	73	12*	"	
"	10-9-64	2:20 PM	55	63	9*	"	
"	3-15-65	2:25 PM	43	65	35*	"	
"	7-30-65	12:20 PM	66	78	5.6*	"	
"	9-2-65	2:00 PM	59	63	4.4*	"	

Appendix II (continued)

Stream	Date	Time	Temp °F Water	Air	Flow (cfs)	Location	Remarks
Winberry Cr.	4-20-64	12:15 PM	45	51	170*	Mouth	
"	6-26-64	11:10 AM	55	58	77*	"	
"	7-29-64	11:15 AM	66	74	20*	"	
"	10-9-64	12:20 PM	55	62	17*	"	
"	3-15-65	12:00 noon	44	54	38*	"	
"	7-30-65	10:50 AM	69	76	5.8*	"	
"	4-20-64	12:30 PM	45	51		USGS Gage 14-1508	
"	6-5-64	11:25 AM	50	60		"	
"	6-26-64	11:30 AM	53	58		"	
"	7-29-64	11:30 AM	64	74		"	
"	10-9-64	12:20 PM	55	62		"	
"	3-15-64	12:15 PM	45	55		"	
"	7-30-65	11:05 AM	68	76		"	
"	9-2-65	11:45 AM	--	63		"	
N. Fk. Winberry Cr.	6-5-64	12:00 noon	--	63	55	Mouth	
"	6-26-64	12:15 PM	52	58	30*	"	
"	7-29-64	11:45 AM	62	75	9.1*	"	
"	10-9-64	12:35 PM	54	62	4.5*	"	
"	3-15-65	1:00 PM	44	59	16.8*	"	
"	7-30-65	11:20 AM	62	77	3.8*	"	
"	9-2-65	12:00 noon	57	63	2.9*	"	
S. Fk. Winberry Cr.	4-20-64	1:00 PM	--	50	40	Mouth	
"	6-5-64	11:45 AM	49	60	102*	0.5 mi. above mouth	
"	6-26-64	12:20 PM	52	58	55*	Mouth	
"	7-29-64	11:55 AM	62	75	8.5*	"	
"	10-9-64	12:45 PM	54	62	5*	"	
"	3-15-65	1:10 PM	43	59	29*	"	
"	7-30-65	11:30 AM	63	77	3.4*	"	
"	9-2-65	12:05 PM	57	63	2.7*	"	
Gold Cr.	4-16-64	1:10 PM	43	46	36*	225 yds. above mouth	
"	6-3-64	3:00 PM	49	75	29*	"	
"	6-29-64	1:00 PM	54	66	5.8*	"	
"	7-28-64	1:55 PM	63	78	1.8*	"	
"	3-30-65	11:05 AM	44	54	10*	"	
"	7-29-65	11:15 AM	62	80	0.8	"	
"	9-8-65	10:25 AM	55	62	0.5	"	
Hills Cr. (lower)	4-20-64	5:20 PM	48	50	18*	Mouth	
"	6-5-64	4:40 PM	60	60	13	"	
"	6-26-64	10:15 AM	59	58	6.3*	"	
"	7-29-64	10:15 AM	67	75	1.8*	"	
"	10-9-64	11:05 AM	57	57	1.4*	"	
"	3-15-65	11:30 AM	48	50	6.4*	"	
"	7-30-65	2:45 PM	79	86	0.5	"	
"	9-2-65	10:30 AM	60	61	0.4	"	

Stream	Date	Time	Temp °F Water	Air	Flow (cfs)	Location	Remarks
Hills Cr. (upper)	4-16-64	6:00 PM	41	--		USGS Gage 14-1449	
"	6-3-64	6:45 PM	48	--		"	
"	6-29-64	4:50 PM	54	68		"	
"	7-28-64	5:50 PM	60	71		"	
"	8-31-64	5:20 PM	54	59	26*	"	
"	3-30-65	3:30 PM	47	55	68*	"	
"	7-29-65	2:25 PM	64	86		"	Slightly tu
"	9-8-65	1:40 PM	--	75		"	
Larison Cr.	7-28-64	12:15 PM	59	70	2	Mouth	
"	8-31-64	1:45 PM	55	60	1.7	"	
Lost Cr.	4-20-64	10:30 AM	46	53	43*	Hiway 58 Br.	
"	6-5-64	10:25 AM	57	59	33*	"	
"	6-26-64	4:50 PM	61	58	36*	"	
"	7-29-64	4:10 PM	74	82	9*	"	
"	10-9-64	5:20 PM	59	62	7	"	
"	3-15-65	10:00 AM	42	45	40*	"	
"	7-30-65	9:45 AM	68	75	5.4*	"	
"	9-8-65	9:20 AM	58	62	1.5	"	
"	7-29-64	3:50 PM	66	81	3.5*	15 yds. above Guiley Cr.	
"	10-9-64	4:55 PM	56	62	3.5	"	
"	3-15-65	10:30 AM	41	46	11.3*	"	
"	7-30-65	10:15 AM	63	75	2.9*	"	
Guiley Cr.	4-20-64	11:00 AM	45	53	14*	Mouth	
"	6-5-64	10:40 AM	54	59	8.1*	"	
"	6-26-64	4:30 PM	54	58	5*	"	
"	7-29-64	3:45 PM	63	81	2.5*	"	
"	10-9-64	4:45 PM	54	62	1.6*	"	
"	3-15-65	10:20 AM	40	46	8.5*	"	
"	7-30-65	10:05 AM	59	75	1.6*	"	
N.Fk. Mid. Fk. Willamette R.	4-17-64	3:15 PM	45	56		USGS Gage 14-1475	
"	6-4-64	12:30 PM	46	55		"	
"	6-30-64	1:00 PM	55	70		"	
"	7-29-64	3:00 PM	65	72		"	
"	9-1-64	3:00 PM	56	53		"	
"	10-9-64	5:15 PM	57	58		"	
"	3-31-65	4:30 PM	48	60		"	
"	9-1-65	11:20 AM	63	78		"	
"	6-30-64	3:15 PM	56	82	437*	0.8 mi. above Plateau Cr.	
"	7-29-64	1:10 PM	57	73	199*	"	
"	9-1-64	1:30 PM	50	55	126*	"	
"	10-9-64	12:25 PM	50	58	112*	"	
"	3-31-65	2:50 PM	45	65	320	"	
"	7-29-65	7:00 PM	--	--	118*	"	
"	9-1-65	12:30 PM	57	76	136*	"	

Appendix II (continued)

Stream	Date	Time	Temp °F Water	Air	Flow (cfs)	Location	Remarks
Christy Cr.	4-17-64	1:05 PM	43	50	385	1 mi. above mouth	Used meter c part of velc estimate
"	6-4-64	1:30 PM	44	58	360	"	"
"	6-30-64	1:35 PM	53	83	142*	"	
"	7-29-64	12:45 PM	60	70	29*	"	
"	9-1-64	1:00 PM	53	53	20*	"	
"	10-9-64	12:00 noon	52	58	17.4*	"	
"	3-31-65	2:15 PM	44	65	150	"	
"	9-1-65	11:50 AM	58	67	12	"	
Fisher Cr.	6-4-64	2:30 PM	43	57	97*	200 yds. above mouth	
"	6-30-64	2:30 PM	50	85	36*	"	
"	7-29-64	1:55 PM	53	70	13*	"	
"	9-1-64	2:00 PM	48	55	12.4*	"	
"	10-9-64	12:55 PM	48	58	12.7*	"	
"	3-31-65	3:30 PM	43	60	33*	"	
"	9-1-65	1:05 PM	52	69	9.1*	"	
Packard Cr.	7-28-64	1:15 PM	61	71	3	Mouth	
"	8-31-64	1:45 PM	55	60	1.7	"	
Salmon Cr.	4-17-64	9:45 AM	39	39		USGS gage 14-1465	
"	6-4-64	10:25 AM	44	56		"	
"	6-30-64	11:10 AM	50	67		"	
"	7-29-64	10:35 AM	55	72		"	
"	9-1-64	10:25 AM	49	54		"	
"	10-9-64	3:15 PM	52	59		"	
"	3-31-65	11:00 AM	42	52	250	"	Gage washed
"	7-29-65	5:00 PM	-	-	189*	"	
"	9-8-65	4:10 PM	56	81	135*	"	
Black Cr.	4-17-64	11:00 AM	42	48	134*	400 yds. above mouth	
"	6-4-64	11:15 AM	45	53	180	"	Used meter c part of velc estimate
"	6-30-64	11:50 AM	47	69	240	"	"
"	7-29-64	11:20 AM	50	74	117*	"	
"	9-1-64	11:30 AM	47	55	74*	"	
"	10-9-64	2:30 PM	43	59	53*	"	
"	3-31-65	12:00 noon	45	58	107*	"	
"	7-30-65	5:40 PM			133*	"	
"	9-8-65	5:00 PM	49	79	145*	"	

Appendix II (continued)

Stream	Date	Time	Temp °F Water	Air	Flow (cfs)	Location	Remarks
Wall Cr.	4-17-64	10:15 AM	39	40	54*	Mouth	
"	6-4-64	10:45 AM	43	53	90	"	
"	6-30-64	11:30 AM	49	67	42*	"	
"	7-29-64	10:50 AM	56	73	12.3*	"	
"	9-1-64	10:50 AM	50	55	5*	"	
"	10-9-64	2:50 PM	52	59	5*	"	
"	3-31-65	11:25 AM	43	52	31*	"	
"	7-30-65	5:15 PM	-	-	7.5	"	
"	9-8-65	4:30 PM	53	80	3.5	"	
Salt Cr.	4-17-64	8:20 AM	39	36	390	Second hiway 58 Br. above mouth	Measured ½ creek
"	6-4-64	9:45 AM	44	55	700	Third hiway 58 Br. above mouth	
"	6-30-64	9:40 AM	49	63	400	1.8 mi. above first hwy. 58 Br. above mouth	
"	7-29-64	10:10 AM	56	68	174*	"	
"	9-1-64	9:45 AM	50	53	152*	"	
"	10-9-64	3:50 PM	51	59	121*	Second hiway 58 Br. above mouth	
"	3-31-65	8:10 AM	44	50	180*	1.8 mi. above 1st Hwy. 58 Br. above mouth	
"	7-30-65	2:55 PM	61	88	124*	"	Very turbid
"	9-8-65	2:15 PM	56	79	150*	"	" "
Eagle Cr.	4-17-64	9:00 AM	39	37	38*	Mouth	
"	6-4-64	8:35 AM	43	51	86*	"	
"	6-30-64	9:20 AM	44	56	59*	"	
"	7-29-64	8:45 AM	48	63	51*	"	
"	9-1-64	9:15 AM	54	53	46*	"	
"	10-9-64	4:10 PM	45	60	42*	"	
"	3-31-65	8:45 AM	43	50	59*	"	
"	7-30-65	4:05 PM	-	-	42*	"	
"	9-8-65	2:40 PM	46	80	40*	"	
S.Fk. Salt Cr.	6-4-64	9:30 AM	40	50	85	First Br. (Beamer Br.) above mouth	
"	6-30-64	8:30 AM	43	48	64	"	
"	7-29-64	9:10 AM	50	64	11.8*	"	
"	9-1-64	8:45 AM	57	52	7.2*	"	
"	3-31-65	9:15 AM	42	50	17.3*	"	
"	7-30-65	3:30 PM	58	88	6.2*	"	
"	9-8-65	2:50 PM	55	81	3.6*	"	Dry at 2nd
"	6-30-64	9:05 AM	43	48	20	2nd Br. above mouth	
"	7-29-64	9:30 AM	57	68	3.9*	"	Water subbi under grave

Appendix II (continued)

Stream	Date	Time	Temp °F. Water	Air	Flow (cfs)	Location	Remarks
S.Fk. Salt Cr.	9-1-64	9:00 AM	-	-	0	2nd Br. above mouth	No water surface
"	3-31-65	9:30 AM	43	50	7	"	
"	7-30-65	3:35 PM	-	-	0.8	"	
Simpson Cr.	4-16-64	3:00 PM	42	43	25	80 yds. above mouth	
"	6-3-64	4:35 PM	51	64	25	"	
"	6-29-64	2:35 PM	53	78	18*	"	
"	7-28-64	4:25 PM	59	65	9*	"	
"	8-31-64	4:20 PM	51	59	9.3*	"	
"	3-30-65	1:15 PM	44	56	21*	"	
"	7-29-65	1:15 PM	69	85	6.5	"	
"	9-8-65	12:00 noon	54	66	2.2	"	
Staley Cr.	4-16-64	2:35 PM	43	43	150*	400 yds. above mouth	
"	6-3-64	4:25 PM	48	68	185	"	
"	6-29-64	2:20 PM	53	78	90*	"	
"	7-28-64	3:15 PM	59	75	30	"	
"	8-31-64	3:30 PM	53	60	27*	"	
"	3-30-65	1:00 PM	44	56	70*	"	
"	7-29-65	12:10 PM	61	82	32*	"	Moderately turbid
"	9-8-65	11:50 AM	53	66	17.7*	"	
Swift Cr.	4-16-64	4:00 PM	41	40	118*	First Br. above mouth (0.6 mi)	
"	6-3-64	5:15 PM	44	60	226*	"	
"	6-29-64	3:05 PM	48	64	166*	"	
"	7-28-64	4:00 PM	50	63	50*	"	
"	8-31-64	4:00 PM	47	60	60*	"	
"	3-30-65	1:40 PM	44	58	101*	"	
"	7-29-65	12:50 PM	52	84	53*	"	
"	9-8-65	12:30 PM	47	69	42*	"	
Windfall Cr.	4-16-64	12:40 PM	43	46	23*	125 yds. above mouth	
"	6-3-64	2:45 PM	54	75	19.3*	"	
"	6-29-64	12:45 PM	60	68	3.5*	"	
"	7-28-64	1:45 PM	67	75	1.3	"	
"	8-31-64	2:00 PM	59	61	0.8	"	
"	3-30-65	11:00 AM	46	55	5.6*	"	
"	7-29-65	10:55 AM	69	79	0.5	"	
"	9-8-65	10:45 AM	57	62	0.3	"	Lower 100 pot holes

Appendix II (continued)

Stream	Date	Time	Temp °F. Water	Air	Flow (cfs)	Location	Remarks
McKenzie R.	4-23-64	3:00 PM	45	52		USGS Gage 14-1625	
"	6-23-64	2:15 PM	53	69		"	
"	7-27-64	12:05 PM	55	75		"	
"	8-26-64	11:20 PM	52	60		"	
"	10-8-64	11:45 PM	48	62		"	
"	7-23-65	11:55 AM	54	63		"	
"	9-7-65	1:50 PM	-	-		"	Moderately turbid
"	4-22-64	9:00 AM	43	39		USGS Gage 14-1590	
"	5-28-64	10:45 AM	45	60		"	
"	6-25-64	10:25 AM	47	69		"	
"	7-31-64	12:15 PM	48	72		"	
"	8-28-64	9:25 AM	47	52		"	
"	10-8-64	5:00 PM	46	59		"	
Blue R.	6-1-64	12:00 noon	46	64		USGS Gage 14-1620	
"	7-31-64	9:00 AM	57	64		"	
"	8-28-64	11:25 AM	57	52		"	
"	7-27-65	1:15 PM	65	80	39*	100 yds. below Lookout Cr.	
"	5-27-64	1:25 PM	45	67	122*	20 yds. above Quentin Cr.	
"	6-1-64	11:45 AM		73		USGS Gage 14-1610	
"	7-31-64	10:10 AM	54	64		"	
"	8-28-64	11:35 AM	57	52		"	
"	10-8-64	12:30 PM	52	58		"	
"	"	1:15 PM	52	63	5	20 yds. above Quentin Cr.	
"	9-7-65	3:00 PM	59	85	13.1*	100 yds. above Lookout Cr.	
Cook Cr.	4-21-64	1:35 PM	44	58	58*	50 yds. above mouth	
"	5-27-64	1:10 PM	47	66	57*	"	
"	6-24-64	12:20 PM	54	75	28*	"	
"	7-31-64	10:25 AM	56	66	4.7*	"	
"	8-28-64	12:10 PM	54	53	2.6*	"	
"	10-8-64	12:55 PM	53	61	2.0*	"	
"	7-27-65	2:15 PM	66	87	2.7*	"	
"	9-7-65	3:20 PM	56	84	0.8	"	
Lookout Cr.	4-21-64	12:15 PM	44	53		USGS Gage 14-1615	
"	5-27-64	11:00 AM	45	62		"	
"	6-24-64	11:00 AM	50	73		"	
"	7-31-64	9:20 AM	54	64		"	
"	8-28-64	2:15 PM	56	53		"	
"	10-8-64	11:45 AM	52	58		"	
"	7-27-65	1:30 PM	63	80		"	
"	9-7-65	2:30 PM	-	85		"	

Appendix II (continued)

Stream	Date	Time	Temp °F. Water	Air	Flow (cfs)	Location	Remarks
McRae Cr.	4-21-64	12:45 PM	44	53	40*	200 yds. above mouth	
"	5-27-64	11:30 AM	44	62	41*	"	
"	6-24-64	11:25 AM	48	73	23*	"	
"	7-31-64	9:45 AM	54	64	3.8*	"	
"	8-28-64	2:40 PM	55	53	2.7	"	
"	10-8-64	12:00 noon	52	58	1.8*	"	
"	7-27-65	1:40 PM	63	80	2.0	"	
"	9-7-65	2:45 PM	58	85	0.9	"	
Quartz Cr.	4-21-64	5:45 PM	48	46	46*	Mouth	
"	6-1-64	11:30 AM	48	63	78*	"	
"	6-23-64	10:40 AM	53	66	12*	"	
"	7-27-64	3:40 PM	66	89	5.4*	"	
"	8-26-64	4:30 PM	60	64	3.2*	"	
"	10-8-64	3:15 PM	57	62	1.7*	"	
Quentin Cr.	4-21-64	2:05 PM	45	58	60*	Mouth	
"	5-27-64	1:20 PM	47	67	61*	"	
"	6-24-64	12:40 PM	54	77	35*	"	
"	7-31-64	11:00 AM	56	67	2.8*	"	
"	8-28-64	12:30 PM	55	53	2.3*	"	
"	10-8-64	1:10 PM	54	63	1.8*	"	
"	7-27-65	2:30 PM	69	83	3.0*	"	
"	9-7-65	3:30 PM	62	84	1.0*	"	
Simmonds Cr.	4-21-64	5:30 PM	48	47	22*	70 yds. above mouth	
"	6-1-64	11:10 AM	50	62	32*	"	
"	6-23-64	10:55 AM	55	66	8.7*	"	
"	7-27-64	3:20 PM	68	89	1.8*	"	Considerab
"	8-26-64	4:15 PM	60	64	1.6*	"	subbing c
"	10-8-64	3:00 PM	58	63	0.8*	"	
"	7-23-65	2:50 PM	68	71	0.8	"	
"	9-7-65	2:15 PM	60	84	0.4	"	
Tidbits Cr.	4-21-64	1:25 PM	44	58	50	200 yds. above mouth	
"	5-27-64	12:30 PM	48	64	117*	Mouth	
"	6-24-64	11:55 AM	55	74	38*	200 yds. above mouth	
"	7-31-64	10:15 AM	56	65	8*	"	
"	8-28-64	12:00 noon	54	52	6.7*	"	
"	10-8-64	12:40 PM	53	60	3.8*	"	
"	7-27-65	2:00 PM	67	82	6.5*	"	
"	9-7-65	3:10 PM	60	85	2.8	"	
Camp Cr.	4-13-64	5:10 PM	50	60	50	200 yds. above mouth	
"	5-26-64	1:40 PM	57	76	15.8*	"	

Stream	Date	Time	Temp °F Water	Air	Flow (cfs)	Location	Remarks
Camp Cr.	6-23-64	12:10 PM	61	70	17*	200 yds. above mouth	
"	7-28-64	1:40 PM	69	80	2.3*	"	
"	8-24-64	12:35 PM	69	84	0.8*	"	
"	10-7-64	1:50 PM	57	58	3.5*	"	
"	6-30-65	12:00 noon	67	74	2.5*	"	
"	9-7-65	12:45 PM	60	83	0.3	"	
Deer Cr. (Lower)	4-23-64	3:15 PM	47	54	54*	Mouth	
"	6-1-64	3:00 PM	58	67	19.3*	"	
"	6-23-64	2:30 PM	62	70	17.2*	"	
"	7-27-64	12:25 PM	62	77	9.8*	"	
"	8-26-64	11:35 AM	58	60	8.8*	"	
"	10-8-64	12:00 noon	54	58	6.4*	"	
"	7-23-65	12:10 PM	60	64	7.3*	"	
"	9-7-65	1:40 PM	56	86	4.6*	"	
Deer Cr. (Upper)	4-22-64	10:00 AM	40	38	130*	0.5 mi. above mouth	
"	5-28-64	12:30 PM	44	65	200	"	
"	6-25-64	11:15 AM	47	71	110*	"	
"	7-31-64	1:00 PM	57	75	26*	"	
"	8-28-64	8:55 AM	52	52	15*	"	
"	10-8-64	5:50 PM	50	55	14*	"	
"	9-7-65	5:10 PM	60	66	10.1*	"	
Elk Cr.	4-23-64	10:25 AM	44	46	13*	300 yds. above mouth	
"	6-1-64	10:40 AM	54	62	4.4*	"	
"	6-23-64	11:10 AM	54	66	6.7*	"	
"	7-27-64	3:00 PM	62	89	1*	"	
"	8-26-64	4:00 PM	58	62	1.2*	"	
"	10-8-64	2:50 PM	55	62	0.8*	"	
"	7-27-65	4:40 PM	55	84	18.6*	"	
"	9-10-65	1:10 PM	49	68	11.9*	"	
Ennis Cr.	4-23-64	11:30 AM	47	48	27*	150 yds. above mouth	
"	6-1-64	1:30 PM	56	68	11.9*	"	
"	6-23-64	12:15 PM	58	68	5.9*	"	
"	7-27-64	2:15 PM	65	83	4.5*	"	
"	8-29-64	2:50 PM	60	62	2.9*	"	
"	10-8-64	2:00 PM	57	63	2.9*	"	
"	7-23-65	2:00 PM	67	66	3.2*	"	
"	9-2-65	4:15 PM	61	71	1.9*	"	
Finn Cr.	6-1-64	5:25 PM	57	63	5	Mouth	
"	6-23-64	3:10 PM	63	72	4.5	"	
"	7-27-64	11:25 AM	60	75	2.5	"	
"	8-26-64	10:35 AM	57	60	2.4*	"	
"	10-8-64	11:00 AM	55	61	1.3*	"	

Stream	Date	Time	Temp. °F. Water	Air	Flow (cfs)	Location	Remarks
Gate Cr.	4-23-64	12:40 PM	46	50	180*	150 yds. above mouth	
"	6-1-64	5:05 PM	59	64	80*	"	
"	6-23-64	12:35 PM	59	68	77	"	
"	7-27-64	1:55 PM	66	83	38	"	
"	8-26-64	2:20 PM	61	60	25	"	
"	10-8-64	1:30 PM	57	64	17	"	
"	7-23-65	1:35 PM	65	65	19.5*	"	
"	9-2-65	4:40 PM	62	69	16.1*	"	
N.Fk. Gate Cr.	4-23-64	1:10 PM	47	50	129*	Mouth	
"	6-1-64	4:20 PM	60	67	53*	"	
"	6-23-64	12:55 PM	60	69	51*	"	
"	7-27-64	1:30 PM	64	79	24*	"	
"	8-26-64	2:10 PM	60	60	14.5*	"	
"	10-8-64	1:15 PM	56	64	10.5*	"	
"	7-23-65	1:00 PM	63	64	14.1*	"	
"	9-2-65	5:10 PM	61	65	12.1*	"	
S.Fk. Gate Cr.	4-23-64	1:30 PM	46	50	64*	Mouth	
"	6-1-64	4:00 PM	59	67	26*	"	
"	6-23-64	1:10 PM	58	69	27*	"	
"	7-27-64	1:45 PM	63	79	14*	"	
"	8-26-64	1:50 PM	59	60	10.2*	"	
"	10-8-64	1:30 PM	56	64	6.8*	"	
"	7-23-65	1:15 PM	62	64	6.5*	"	
"	9-2-65	4:55 PM	61	66	8.0*	"	
Holden Cr.	6-1-64	5:30 PM	58	63	3	0.4 mi. above mouth (Hwy. 126 Br.)	
"	6-23-64	3:25 PM	62	72	4	"	
"	7-27-64	11:15 AM	59	75	2	"	
"	8-26-64	10:20 AM	57	60	1.6*	"	
"	10-8-64	10:40 AM	55	61	1.2*	"	
"	7-23-65	11:20 AM	59	63	1.5*	"	
"	9-7-65	1:00 PM	56	84	0.4	"	
Horse Cr.	5-28-64	9:15 AM	44	58		USGS Gage 14-1591	
"	6-25-64	8:30 AM	49	64		"	
"	7-31-64	11:50 AM	49	70		"	
"	8-28-64	9:30 AM	48	52		"	
"	10-8-64	4:45 PM	48	60		"	
"	6-25-64	9:30 AM	49	65	350	20 yds. above Separation Cr.	
King Cr.	4-22-64	8:30 AM	39	39	~~25~~	100 yds. above mouth	
"	5-28-64	9:30 AM	43	58	45*	"	

Stream	Date	Time	Temp. °F Water	Air	Flow (cfs)	Location	Remarks
King Cr.	6-25-64	8:45 AM	49	65	12*	100 yds. above mouth	
"	7-31-64	12:00 noon	54	71	2.4*	"	
"	8-28-64	9:50 AM	54	52	1.7*	"	
"	9-10-65	4:15 PM	54	72	1.3	0.5 mi. above mouth	Total flo subbing above mou
Indian Cr.	6-1-64	5:20 PM	57	63	9	Mouth	
"	6-23-64	1:25 PM	60	69	9	"	
"	7-27-64	1:15 PM	63	77	3.5	"	
"	8-26-64	12:15 PM	58	60	3	"	
"	10-8-64	1:00 PM	56	62	1.7	"	
Kink Cr.	5-28-64	2:00 PM	44	65	13*	100 yds. above mouth	
"	6-25-64	12:45 PM	49	83	7.2*	"	
"	7-31-64	2:00 PM	54	73	1.7*	"	
"	8-28-64	8:15 AM	50	52	1*	"	
Lost Cr.	4-22-64	9:15 AM	44	38	212	0.3 mi. above mouth (Hwy. 126 Br.)	
"	5-28-64	11:15 AM	47	65	400	"	
"	6-25-64	10:45 AM	46	70	300	"	
"	7-31-64	12:30 PM	46	73	275	"	
"	8-28-64	9:15 AM	45	52	250	"	
"	10-8-64	5:20 PM	44	58	225	"	
"	9-10-65	4:50 PM	46	72	275	"	
Marten Cr.	4-23-64	2:15 PM	47	52	39*	200 yds. above mouth	
"	6-1-64	3:30 PM	57	67	20*	"	
"	6-23-64	1:50 PM	59	69	21*	"	
"	7-27-64	11:45 AM	59	65	9.7*	"	
"	8-26-64	11:00 AM	57	60	9.5*	"	
"	10-8-64	11:20 AM	54	62	4.3*	"	
"	6-30-65	11:45 AM	59	77	10.8*	"	Slightly
"	9-7-65	1:20 PM	57	84	4.5*	"	Moderatel turbid
Mohawk R.	4-13-64	11:30 AM	46	61		USGS gage 14-1650	
"	5-26-64	1:20 PM	57	75		"	
"	6-23-64	1:15 PM	62	73		"	
"	7-28-64	2:05 PM	72	80		"	
"	8-24-64	1:00 PM	70	85		"	
"	10-7-64	1:30 PM	58	62		"	
"	4-13-64	2:30 PM	49	67	140*	R.M. 20.5	
"	5-26-64	10:00 AM	47	67	65*	"	
"	6-23-64	3:45 PM	59	82	68*	"	

Appendix II (continued)

Stream	Date	Time	Temp °F. Water	Air	Flow (cfs)	Location	Remarks
Mohawk R.	7-28-64	10:25 AM	58	69	29*	R.M. 20.5	
"	8-24-64	10:10 AM	59	73	16.5*	"	
"	10-7-64	10:30 AM	52	55	11*	"	
"	6-30-65	9:45 AM	59	72	23*	"	
"	7-27-65	9:50 AM	58	60	14.3*	"	
"	9-7-65	10:45 AM	52	76	7.5*	"	
Cartwright Cr.	4-13-64	4:30 PM	52	60	15*	0.7 mi. above mouth	
"	5-26-64	12:00 noon	53	74	5.9*	"	
"	6-23-64	2:10 PM	62	76	5*	"	
"	7-28-64	12:45 PM	66	81	1.4	"	
"	8-24-64	11:45 AM	64	80	1.1*	"	
"	10-7-64	12:10 PM	54	58	1.0*	"	
"	6-30-65	10:40 AM	61	75	2.3	"	
"	7-27-65	11:20 AM	63	67	1.7*	"	
"	9-7-65	12:15 PM	57	79	0.5	"	
Cash Cr.	4-13-64	2:55 PM			8	200 yds. above mouth	
"	5-26-64	11:00 AM	50	68	5.9*	"	
"	6-23-64	3:05 PM	63	79	9	"	
"	7-28-64	11:15 AM	62	70	1*	"	
"	8-24-64	10:45 AM	59	74	0.7*	"	
"	10-7-64	11:17 AM	52	54	0.6*	"	
"	6-30-65	10:25 AM	61	74	1.3	"	
"	7-27-65	10:25 AM	59	61	1.6*	"	
"	9-7-65	11:15 AM	52	77	0.6	"	
Drury Cr.	4-13-64	2:00 PM	54	67	6	100 yds. above mouth	
"	5-26-64	10:45 AM	53	68	3*	"	
"	6-23-64	3:30 PM	64	80	3	"	
"	7-28-64	10:40 AM	63	69	1.1*	"	
"	8-24-64	10:20 AM	64	73	0.6	"	
"	10-7-64	11:00 AM	53	55	0.5*	"	
"	6-30-65	10:10 AM	62	72	1.1	"	
"	7-27-65	10:10 AM	63	61	1.1*	"	
"	9-7-65	11:00 AM	56	76	0.5	"	
McGowan Cr.	4-13-64	11:45 AM	50	61	20*	0.3 mi. above mouth	
"	5-26-64	1:05 PM	57	75	9*	"	
"	6-23-64	1:35 PM	62	73	5.5*	"	
"	7-28-64	1:05 PM	66	82	1.3*	"	
"	8-24-64	12:00 noon	66	83	0.5*	"	
"	10-7-64	1:15 PM	55	60	0.8*	"	
"	6-30-65	10:50 AM	61	76	0.9	"	
"	7-27-65	11:40 AM	63	71	0.8*	"	
"	9-7-65	12:30 PM	58	81	0.3	"	

Appendix II (continued)

Stream	Date	Time	Temp. °F. Water	Air	Flow (cfs)	Location	Remarks
Mill Cr.	4-13-64	3:30 PM	52	64	75	200 yds. above mouth	
"	5-26-64	11:15 AM	52	68	36*	"	
"	6-23-64	2:50 PM	65	79	35*	"	
"	7-28-64	11:55 AM	64	70	8.3*	"	
"	8-24-64	11:25 AM	63	75	4.1*	"	
"	10- 7-64	11:30 AM	53	55	3.2*	"	
"	6-30-65	10:30 AM	60	74	8.8*	"	
"	7-27-65	10:45 AM	60	63	5.9*	"	
"	9- 7-65	11:25 AM	56	78	2.8*	"	
"	4-13-64	3:15 PM	-	-	45	100 yds. above falls at Wendling Park	
"	5-26-64	11:30 AM	50	68	29*	"	
"	6-23-64	2:30 PM	59	76	23*	"	
"	7-28-64	11:35 AM	59	70	9*	"	
"	8-24-64	11:00 AM	58	74	4.5*	"	
"	10- 7-64	11:40 AM	51	54	4.3*	"	
"	7-27-65	11:00 AM	58	65	6.6*	"	
"	9- 7-65	11:40 AM	51	77	1.7*	"	
Parsons Cr.	4-13-64	12:45 PM	52	62	40*	0.3 mi. above mouth	
"	5-26-64	12:45 PM	56	75	14.2*	"	
"	6-23-64	1:50 PM	63	73	12.5*	"	
"	7-28-64	12:55 PM	68	81	1.2	"	
"	8-24-64	11:55 AM	68	82	1	"	
"	10- 7-64	1:00 PM	57	61	1.6*	"	
"	6-30-65	10:45 AM	63	76	0.8	"	
"	7-27-65	11:30 AM	67	69	0.5	"	
"	9- 7-65	12:20 PM	64	80	0.1	"	
Shotgun Cr.	4-13-64	1:30 PM	51	62	37*	0.5 mi. above mouth	
"	5-26-64	10:30 AM	50	68	11.5*	0.3 mi. above mouth	
"	6-23-64	3:15 PM	63	80	11.7*	"	
"	7-28-64	10:55 AM	62	69	3.8*	"	
"	8-24-64	10:35 AM	61	73	4.3*	"	
"	10- 7-64	11:10 AM	51	56	2.7*	"	
"	6-30-65	10:20 AM	60	74	3.8	"	
"	7-27-65	10:20 AM	60	61	4.4*	"	
"	9- 7-65	11:10 AM	52	77	1.9*	"	
Olallie Cr.	4-22-64	10:30 AM	40	36	170	200 yds above mouth	Measured part of stream
"	5-28-64	1:00 PM	42	65	105	"	"
"	6-25-64	11:35 AM	43	73	135	"	"
"	7-31-64	1:10 PM	42	73	130	"	"
"	8-28-64	8:40 AM	41	52	125	"	"
"	10- 8-64	6:10 PM	40	55	125	"	"
"	9-10-65	5:20 PM	42	65	150	"	"

Appendix II (continued)

Stream	Date	Time	Temp °F. Water	Air	Flow (cfs)	Location	Remarks
Quartz Cr.	4-23-64	10:45 AM	45	47	180*	150 yds. above mouth	
"	6-1-64	1:15 PM	50	64	300	"	
"	6-23-64	11:40 AM	56	66	170*	"	
"	7-27-64	2:35 PM	72	84	30*	"	
"	8-26-64	3:40 PM	63	62	16.4*	"	
"	10-8-64	2:20 PM	58	58	23*	"	
"	7-23-65	2:15 PM	69	68	12.4*	"	
"	9-2-65	3:50 PM	63	70	9.7*	"	
Scott Cr.	5-28-64	11:50 AM	44	68	40*	200 yds. above mouth	
"	6-25-64	11:00 AM	48	70	12	"	
"	7-31-64	12:45 PM	50	73	7.5*	"	
"	8-28-64	9:05 AM	48	52	4.2*	"	
"	10-8-64	5:30 PM	48	57	4.8*	"	
"	9-10-65	5:00 PM	50	67	3.2*	"	
S. Fk. McKenzie R.	4-21-64	5:10 PM	41	50		USGS Gage 14-1595	
"	5-27-64	6:30 PM	46			"	
"	6-24-64	2:00 PM	48	78		"	
"	7-30-64	12:30 PM	52	65		"	
"	8-27-64	5:45 PM	49	65		"	
"	10-8-64	4:30 PM	-	-		"	Very turbid
"	6-30-65	1:45 PM	65	89		"	
"	7-27-65	-	-	-		"	Moderately
"	4-21-64	4:15 PM	44	56		USGS Gage 14-1592	turbid
"	5-27-64	2:55 PM	46	65		"	
"	6-24-64	2:30 PM	-	79		"	
"	7-30-64	1:00 PM	51	65		"	
"	8-27-64	3:10 PM	51	72		"	
"	10-8-64	1:45 PM	-	65		"	
"	7-27-65	5:20 PM	58	83		"	Very turbid
"	9-10-65	11:30 AM	-	67		"	
Augusta Cr.	4-21-64	3:25 PM	43	57	66*	50 yds. above Duck Cr.	
"	5-27-64	4:00 PM	43	62	138*	"	
"	6-24-64	3:15 PM	53	83	63*	"	
"	7-30-64	1:55 PM	56	66	7.7*	"	
"	8-27-64	2:35 PM	59	72	5.5*	"	
"	10-8-64	2:30 PM	52	66	5.5*	"	
"	7-27-65	4:10 PM	66	84	3.7*	"	
"	9-10-65	12:15 PM	53	68	3.4*	"	
Elk Cr.	5-27-64	4:45 PM	40	58	69*	0.6 mi. above mouth	
"	6-24-64	4:10 PM	49	79	82*	"	
"	7-30-64	3:15 PM	49	65	19.5*	"	
"	8-27-64	1:45 PM	50	72	17.5*	"	

Appendix II (continued)

Stream	Date	Time	Temp °F. Water	Air	Flow (cfs)	Location	Remarks
Elk Cr.	10-8-64	2:55 PM	47	66	16.3*	0.6 mi. above mouth	
"	7-27-65	4:40 PM	55	84	18.6*	"	
"	9-10-65	1:10 PM	49	68	11.9*	"	
E.Fk. S.Fk. McKenzie R.	4-21-64	4:45 PM	43	52	65*	Mouth above Res.	
"	5-27-64	5:50 PM	-	-	80	"	
"	7-30-64	4:15 PM	55	63	13	"	
"	8-30-64	4:00 PM	54	70	7*	"	
"	9-10-65	3:00 PM	54	70	4.2*	"	
French Pete Cr.	4-21-64	4:05 PM	44	56	130	100 yds. above mouth	
"	5-27-64	3:15 PM	44	65	260*	"	
"	6-24-64	2:45 PM	49	80	230	"	
"	7-30-64	1:15 PM	55	66	33*	"	
"	8-27-64	3:00 PM	54	72	15.5*	"	
"	10-8-64	2:00 PM	51	66	21*	"	
"	7-27-65	3:30 PM	62	84	24*	"	
"	9-10-65	11:45 AM	52	68	10*	"	
Rebel Cr.	4-21-64	3:50 PM	44	56	18*	100 yds. above mouth	
"	5-27-64	3:30 PM	43	63	42*	"	
"	6-24-64	3:00 PM	51	82	26*	"	
"	7-30-64	1:30 PM	54	66	4.7*	"	
"	8-27-64	2:50 PM	55	72	3.1*	"	
"	10-8-64	2:15 PM	51	67	3.0*	"	
"	7-27-65	4:00 PM	59	84	1.5*	"	
"	9-10-65	11:55 AM	56	68	1.4	"	
Roaring R.	5-27-64	4:25 PM	42	60	100	0.4 mi. above mouth	
"	6-24-64	4:00 PM	46	79	180	"	
"	7-30-64	2:45 PM	44	65	140*	"	
"	8-27-64	2:05 PM	44	72	125	"	
"	10-8-64	3:15 PM	42	65	125	"	
"	7-27-65	4:50 PM	44	83	140	"	
"	9-10-65	1:45 PM	43	70	110	"	
Long Tom R.	4-14-64	4:00 PM	60			USGS Gage 14-1700	
"	6-2-64	4:35 PM	67	75		"	
"	6-30-64	9:45 AM	67	65		"	
"	7-28-64	5:45 PM	82	84		"	
"	8-24-64	4:20 PM	79	86		"	
"	4-14-64	9:05 AM	52	58		USGS Gage 14-1690	
"	6-2-64	1:00 PM	-	70	30	"	

Appendix II (continued)

Stream	Date	Time	Temp °F. Water	Air	Flow (cfs)	Location	Remarks
Long Tom R.	4-14-64	12:30 PM	54	62		USGS Gage 14-1665	
"	6-2-64	1:30 PM	59	70		"	
"	6-30-64	12:10 PM	58	57		"	
"	7-28-64	4:20 PM	68	80		"	
"	8-24-64	2:45 PM	67	85		"	
"	6-30-64	10:45 AM	56	56	10.5*	R.M. 49.5	
"	7-28-64	5:05 PM	68	83	5*	"	
"	8-24-64	3:40 PM	69	85	3.8*	"	
Bear Cr.	4-14-64	2:45 PM	52	65	9*	0.5 mi. above Jones Cr.	
"	6-30-64	10:25 AM	58	63	1.1*	1.1 mi. above Nails Cr. (1st Hwy. 36 crossing)	
"	7-28-64	5:20 PM	66	83	0.2	"	
"	8-24-64	3:55 PM	67	85	0.1	"	
Ferguson Cr.	4-14-64	3:20 PM	57	66	22*	R.M. 2.1	
"	6-2-64	4:25 PM	61	72	6	"	
"	6-30-64	10:10 AM	57	65	3.8*	"	
"	7-28-64	5:30 PM	72	83	1.5*	"	
"	8-24-64	4:10 PM	73	86	0.7*	"	
Noti Cr.	4-14-64	1:45 PM	58	63	19*	10 yds. above Poodle Cr.	
"	6-2-64	3:00 PM	59	70	5.4*	"	
"	6-30-64	11:20 AM	56	57	2.1*	"	
"	7-28-64	4:45 PM	69	80	1.1	"	
"	8-24-64	3:05 PM	67	85	0.8*	"	
Poodle Cr.	4-14-64	12:15 PM	54	61	48*	Mouth	
"	6-2-64	3:20 PM	60	70	16.3*	"	
"	6-30-64	11:10 AM	58	56	13.4*	"	
"	7-28-64	4:35 PM	70	80	3.2*	"	
"	8-24-64	3:00 PM	69	85	3.1*	"	

APPENDIX III

Numbers of Rainbow Trout Released by the Oregon State Game Commission in the Upper Willamette Basin, 1959-1964

Stream	Size in Inches	1959	1960	1961	1962	1963	1964
Blue River	8 & over	5,030	8,008	10,875	9,997	12,049	10,761
Fall Creek	"	13,995	13,947	12,001	11,834	9,001	11,215
Gate Creek	"	1,000	3,049	1,078	1,000	3,235	2,752
Hills Cr. (below Fall Cr.)	"	1,002	--	2,999	1,001	998	--
Hills Cr. (Oakridge)	"	3,998	2,999	5,999	10,050	12,288	10,007
Horse Creek	"	3,840	10,069	8,885	9,011	12,018	12,133
Layng Creek	"	3,999	3,996	3,998	4,002	4,002	5,004
Little Fall Cr.	"	4,002	4,000	4,031	3,998	4,005	2,002
Long Tom River	"	4,000	3,998	3,999	4,013	3,930	--
Lost Creek	"	2,000	3,008	3,021	3,000	3,002	1,001
McKenzie R. E.Fk./S.Fk.	"	--	--	2,517	--	--	--
McKenzie R., S.Fk.	"	10,031	15,999	13,583	15,011	19,970	24,395
McKenzie R., Sec. 1	"	49,807	59,458	24,906	45,219	36,742	45,084
" " " 2	"	23,622	47,902	88,123	85,626	85,846	93,770
Mill Cr. (Tr. Mohawk)	"	1,000	2,006	2,001	2,034	2,006	2,003
Mohawk R.	"	4,000	4,025	4,000	4,015	4,157	3,998
Mosby Creek	"	6,001	8,004	6,602	7,862	7,964	8,003
Quartz Cr. (Tr. McK. R.)	"	2,000	3,014	2,998	3,000	3,000	3,000
Row River	"	15,998	14,599	16,066	16,200	16,595	14,893
Salmon Creek	"	6,409	6,999	7,996	10,042	10,088	9,007
Salt Creek	"	7,013	13,999	9,997	12,003	11,916	12,985
Sharps Creek	"	4,001	8,002	6,000	6,015	6,000	6,020
Willamette R., Coast Fork	"	12,031	12,007	8,003	8,029	8,075	8,001
Willamette R. Mid Fk., Sec. 1	2-4	--	--	18,430	--	--	--
"	8 & over	18,149	9,900	15,778	25,640	4,001	17,023
Willamette R. Mid Fk., Sec. 2	0-2	--	--	698,980	--	--	--
"	2-4	--	--	40,179	--	--	--
"	4-6	--	--	3,333	--	--	--
"	8 & over	--	3,097	--	2,501	3,003	245,889
Willamette R. N.Fk. of Mid Fk.	0-2	--	--	295,550	--	--	--
"	8 & over	14,998	16,040	11,943	12,012	21,617	12,004
Winberry Creek	"	4,002	3,980	2,000	2,000	--	--

Appendix IV

Upper Willamette Basin Lake and Reservoir Data

Lake	Location T	R	Sec	Acres	Max Depth (feet)	Species	Stocking Number	Frequency 1/
Abernathy, Lower	23S	5½E	2	2	8			
" , Upper	23S	5½E	2	16	20	BT	2,000	Bi
Aerial	18S	7E	28	5	12	Rb	1,500	
Alameda	24S	5E	25	3	6.5			
Alpine	24S	5E	25	12	5			
Amos	25S	5½E	14	8	10	GT	1,000	
Amstutz	16S	7½E	28	1	20			
Andy	25S	5½E	14	12	13	GT	500	
Benson	15S	7E	36	30	55	BT	3,000	
Benson						Rb	3,000	
Big	14S	7½E	10	225	60	Rb	3,000	
Big						BT	25,000	
Big						K	50,000	
Betty	22S	6E	8	24	28	Rb	37,000	
Betty, Lower	22S	6E	8					
Bingo	22S	5E	1	15	9	BT		
Birthday	22S	5E	23	6	11			
Blair	20S	5E	17	35	21	BT	3,500	
Blue	23S	5E	34	18		Rb	2,000	
Bongo	22S	5½E	2	9	14			
Booboo	22S	7½E	27					
Boot	19S	7E	15	8	20	BT	2,000	
Bounty	18S	7E	1	3	15			
Brittany	21S	6E	5	2	29			
Burnt Top	18S	7E	2	20	28			
Campers	15S	7½E	35	4	13	BT	1,000	
Canim	21S	6E	7	3	6			
Cardiac	21S	5½E	26	4	15			
Ceruus	20S	6E	32,33	9				
Chetlo	20S	5½E	12			BT	2,000	
Clear	14S	7E				BT	50,000	
						Rb	25,000	Ann
Cliff	19S	7E	16			BT	5,000	Bi
Clipper	20S	6E	2					
Copepod	19S	7E	9					
Corner	19S	7E	8			BT	3,000	
						Rb	3,000	Ann
Corrigan	24S	5E	3					
Craig	15S	7½E				BT	1,000	
Craig	15S	7½E				GT	500	
Cygnet	20S	5½E	1					
Dans	20S	6E	5					
Davis						BT	300	

Appendix IV (continued)

Lake	Location T	R	Sec	Acres	Max Depth (feet)	Species	Stocking Number	Frequency 1/
Dea	17S	7E	4					
Denude	18S	7E	1			BT	1,000	
Desane	19S	7E	20	6				
Devils	20S	5E	15			BT	1,000	Bi
Dubbie	18S	7E	1					
Dumbell	19S	7E	8	6		BT	1,500	Bi
Easternbrook	20S	6E	29	11		BT	5,000	Ann
Eddeeleo, Lower	21S	5E	1			Rb	5,000	
" , Upper	21S	5E	1			BT	7,000	
Edna	20S	6E	20	2.5		Rb	1,000	
Eileen	16S	7E	28			BT	2,000	
Elbow	21S	5½E	13	10		BT	2,500	Bi
Elf	15S	7E	36			BT	5,000	
Emma	20S	6E	29	4		Rb	1,500	Ann
Erma Bell, Lower	20S	6E	17			Rb	3,000	Ann
Erma Bell, Middle	20S	6E	17			Rb	3,000	Ann
Erma Bell, Upper	20S	6E	20			Rb	3,000	Ann
Ernie	21S	6E	6	4	19	BT	1,000	
Fern Ridge Borrow Pit						Rb	5,000	Ann
Fields	20S	6E	29,32	1				
[illegible]ig	21S	5½E	29					
[illegible]ir	24S	5½E	19			BT	1,500	Bi
Fish	13S	7E	32			Ct		
Fisher, East	18S	7E	27	2		BT		
Fisher, West	18S	7E	27	2.5		BT		
						Rb	500	
Fry	17S	8E	7					
Gander	20S	5½E	34			Rb	3,000	Ann
Glaze	15S	7E	35			Rb	600	
Gnat	19S	7E	16	3				
Goose	19S	7E	9					
Gosling	21S	5E	3					
Grace	22S	5½E	4					
Green	21S	5½E	24					
Hand	15S	7½E	23,33			BT	1,000	Ann
Happy	23S	5E	27					
Harvey	21S	6E	5			Rb	3,000	
Hawkins	22S	6E	3			BT	1,000	
Hawkum	22S	6E	8			BT	1,000	
Heart	14S	6E	3	13	22	BT		
Helen	20S	6E	28	6		Rb	500	Bi
Herb	18S	7E	27	3		Rb	1,000	Bi
Hidden	18S	5E	8			Rb	7,000	
Honey	17S	7E	15	15		Rb	2,500	Ann

Appendix IV (continued)

Lake	Location T	R	Sec	Acres	Max Depth (feet)	Species	Stocking Number	Frequency 1/
Horse, Lower	18S	7E	22					
Horse, Middle	18S	7E	21			BT	2,000	Bi
Horse, Upper	18S	7E	22			BT	6,000	
Horsefly	22S	6E	8			BT	1,000	Bi
Horseshoe	19S	7E	16			BT	5,000	Ann
Howie						BT	1,000	
Huckleberry						BT	700	
Husband	17S	7E	1					
Indigo	25S	5½E	22			Rb	2,000	
Island	19S	7E	10	3		BT	1,000	Bi
Island, Lower	22S	5½E	23			BT	2,000	Bi
Island, Upper	22S	5½E	23			BT	2,000	Bi
Jo Ann	22S	5½E	24					
Junction	19S	7E	18			BT	4,000	Ann
June	25S	5½E	21			BT	1,500	Ann
Kidney	17S	7E	15	8		Rb	1,000	Ann
Kidney, North	17S	7E	15			BT	900	
Kinglet	20S	5½E	13	2				
Kiwa	21S	6E	5			Rb	2,000	
Krag	19S	7E	4					
Lancelot	18S	7E	1			BT	700	Bi
Last	21S	5½E	26			Rb	2,000	Ann
Ledge	19S	7E	12			BT	1,000	Bi
Lempy								
Lindh	19S	7E	5,8	8		BT	2,000	Ann
Lindick	20S	6E	12					
Linton	16S	7½E	18			BT	10,000	
Lo								
Lookout	19S	7E	27					
Lorin	22S	5½E	24			BT	600	Bi
Lucas								
Mac	19S	7E	21			BT	2,000	Bi
Marie	24S	5½E	17					
Marilyn, Lower	22S	6E	31			BT	3,000	Bi
Marilyn, Upper	22S	6E	31			BT	3,000	Ann
Marten	19S	7E	18	8				
McBee	18S	7E	32	3				
McFarland	20S	6E	2					
McFarland, East	20S	6E	11					
Melakwa	16S	7E	1			BT	2,000	Ann
Merrill	19S	7E	16	7		BT	3,000	Ann
Mickey	21S	6E	5			Rb	1,500	
Midnight	23S	5½E	13			Rb	2,000	Bi
Mile	18S	7E	22	7		BT	1,500	
Mink	19S	7E	17,18			BT	5,000	Ann
						Rb	5,000	Ann

Appendix IV (continued)

Lake	Location T	R	Sec	Acres	Max Depth (feet)	Species	Stocking Number	Frequency 1/
Moody	19S	7E	16	5		BT	5,000	Ann
Moolack	20S	5E	24			BT	3,000	Ann
Moonlight	18S	7E	16	7.5		BT	2,000	Bi
Mouse	18S	7E	33					
Mud	20S	6E	20	7		BT	2,000	Ann
Nanack	24S	5½E	5	1	12			
Nash	18S	7E	3					
Nightshade, East	19S	7E	4	4				
" , West	19S	7E	4	4				
North Torry	20S	6E	33	8	8	BT	1,000	Ann
Notch	23S	5E	14			BT	1,500	
NRA	23S	5E	34					
Opal	25S	5½E	9			BT	1,000	Ann
Otter	20S	6E	8			BT	3,500	Ann
Paddock	24S	5E	25			BT	1,000	Ann
Park	18S	7E	21,22					
Patjens, Lower	14S	7½E	17			BT	800	
Patjens, Upper	14S	7½E	17			BT	1,000	
Pepsi	25S	5½E	14	2	14			
Pete's	18S	7E	33	2		BT		
Photo	21S	5½E	26					
Platt	18S	7E	27	7.5		Rb	1,000	Bi
Plump	19S	7E	7			BT	3,000	Ann
Porky	19S	7E	17			BT	6,000	Ann
Question Mark	19S	7E	4	8				
Quinn, Lower	20S	5E	25			BT	1,500	Ann
Quinn, Upper	20S	5E	24			BT	1,500	Ann
Rigdon, Lower	21S	6E	8			Rb	2,000	Ann
Rigdon, Upper	21S	6E	8			BT	5,000	Ann
Robinson	15S	7E	3			BT	2,500	Ann
Rock	19S	7E	18			BT	2,000	Bi
Rockpile	24S	5½E	17					
Round	21S	5E	1			Rb	3,000	Ann
Ruth	24S	5E	24			BT	600	Ann
Salmon, Lower	21S	5E	14			Rb		
Sapphire	20S	5½E	14			BT	1,000	
Sandy	19S	7E	4					
Scott, Lower	15S	7½E	32			BT	4,500	Ann
Scott, Upper	15S	7½E	32			BT	4,000	
Separation	17S	6½E	13			BT		
						Rb	1,000	
Shadow	22S	6E	5			BT	1,000	Bi
Shallow	18S	7E	1					
Skinner	17S	8E	4					
Skookum	20S	6E	-					
Spirit	21S	5E	24			BT	2,500	

Appendix IV (continued)

Lake	Location T	R	Sec	Acres	Max Depth (feet)	Species	Stocking Number	Frequency 1/
Spring						Rb	1,500	
Spruce	24S	5½E	29					
Sunrise	24S	5E	25					
Sunset (Tr. McKenzie)	18S	7E	26			BT	5,000	Ann
Sunset (Tr. Fir Lake)	24S	5E	25			BT	600	Ann
Swan	20S	5½E	35			BT	2,500	Ann
Tenas, Lower	15S	7E	26			BT	900	
Tenas, Middle	15S	7E	26			BT	600	
Tenas, Upper	15S	7E	26			BT	600	
Timpanogus, Lower	25S	5E	15			BT	1,000	Bi
" , Upper	25S	5E	15			Rb	7,000	
Tokatee	17S	7E	7			BT	1,000	Bi
Top	18S	7E	2					
Torrey	20S	6E	33			BT	7,000	Ann
Triad (Howkum)	22S	6E	8					
Triad (Horsefly)	22S	6E	8					
Trio #2	22S	6E	5					
Trio #3	22S	6E	5					
Turtle	18S	7E	12					
Valley	23S	5½E	20	1.5	9	GT	500	
Vera	19S	7E	10	2				
Verde	22S	5½E	25					
Vivian	23S	5E	1			BT	5,000	Ann
Vogel	19S	7E	15,16			BT	5,000	Ann
Wahanna	20S	6E	32			Rb	5,000	Ann
	21S	5E						
Waldo	22S	6E				BT	300,000	Ann
						K	175,000	
Waldo						Rb	500,000	Ann
Whig	20S	6E	33	15				
Williams	20S	6E	20	4	9	Rb	1,000	Ann
Young	23S	5½E	14	3.5	19	GT	500	
Yoran	23S	5½E	27					
Zircon	20S	5½E	13	5				

1/ Abbreviations: Ann, annual and Bi, biennial

Appendix V

Lake and Stream Random Creel Census Data, Upper Willamette Basin

Stream	1961 Anglers Checked	1961 Fish Per Hour	1962 Anglers Checked	1962 Fish Per Hour	1963 Anglers Checked	1963 Fish Per Hour	1964 Anglers Checked	1964 Fish Per Hour
Black Creek	3	1.67	9	1.09	14	0.90	13	1.63
Blue River	--	--	26	0.50	8	0.79	14	1.16
Brice Creek	2	0.64	7	0.81	41	0.80	--	--
Brush Creek	--	--	7	1.29	3	1.00	--	--
Camp Creek	5	--	--	--	--	--	5	0.75
Champion Creek	--	--	2	10.00	--	--	--	--
Coal Creek	--	--	--	--	--	--	5	0.75
Courtney Creek	--	--	7	1.75	2	0.50	3	2.67
Coyote Creek	3	1.09	--	--	--	--	8	0.21
Deer Creek	--	--	--	--	4	2.64	--	--
Edwards Creek	--	--	--	--	--	--	3	3.00
Fall Cr. (Big)	119	0.53	84	0.91	61	0.37	29	0.95
Fall Cr. (Little)	9	0.82	13	0.44	--	--	8	0.56
Ferguson Creek	8	0.33	--	--	--	--	--	--
French Pete Cr.	3	0.83	--	--	--	--	--	--
Gate Creek	--	--	--	--	11	0.35	--	--
Hardy Creek	--	--	--	--	--	--	2	3.33
Hills Cr. (Oakridge)	27	1.23	122	2.09	108	0.62	181	0.73
Horse Creek	17	0.52	36	1.39	--	--	21	0.92
Kelsey Creek	--	--	--	--	--	--	1	1.50
Layng Creek	17	1.22	1	1.60	--	--	--	--
Leaburg Canal	4	0.43	--	--	--	--	--	--
Long Tom River	183	1.04	102	1.13	100	1.74	304	1.01
Lookout Creek	--	--	3	2.38	--	--	--	--
Lost Creek	48	0.99	14	1.53	7	5.53	100	0.65
McKenzie River	717	0.84	675	0.81	508	0.74	810	0.63
McKenzie River (South Fork)	122	0.76	205	1.00	128	0.81	126	0.85
Mill Creek	--	--	29	1.42	--	--	--	--
Mohawk River	29	0.17	13	0.92	1	1.00	6	1.00
Mosby Creek	3	1.17	4	0.60	11	1.43	64	1.10
Parsons Creek	2	2.00	2	1.00	--	--	--	--
Portland Creek	6	0.41	8	0.30	--	--	--	--
Potts Creek	--	--	--	--	--	--	2	0.41
Quartz Creek	--	--	--	--	--	--	8	0.76
Rebel Creek	--	--	--	--	--	--	2	3.75

Appendix V (continued)

Stream	1961 Anglers Checked	1961 Fish Per Hour	1962 Anglers Checked	1962 Fish Per Hour	1963 Anglers Checked	1963 Fish Per Hour	1964 Anglers Checked	1964 Fish Per Hour
Roaring Creek	4	1.67	--	--	--	--	3	1.00
Row River	42	0.44	14	0.41	45	1.07	17	0.89
Salmon River	89	0.86	58	0.56	88	0.75	35	0.93
Salt Creek	141	1.11	49	1.32	195	0.84	57	1.26
Sharps Creek	40	1.29	20	2.07	80	0.95	--	--
Shotgun Creek	3	0.67	1	3.00	--	--	--	--
Staley Creek	21	1.15	38	1.34	3	1.71	8	0.90
Swift Creek	4	2.00	7	1.68	2	1.50	2	1.50
Teeter Creek	--	--	--	--	--	--	2	1.25
Wall Creek	--	--	--	--	15	1.38	5	0.67
Willamette R. (Coast Fork)	61	0.49	29	1.02	22	0.49	35	1.06
Willamette R. (Middle Fk.)	620	1.06	759	1.29	433	0.85	238	1.10
Willamette R. (North Fork)	178	0.73	526	0.70	128	0.87	135	0.94
Winberry Creek	75	0.65	16	0.06	--	--	--	--
Lake								
Abernathy	--	--	--	--	1	2.0	5	0.91
Aerial	4	0.83	5	1.67	--	--	4	0.12
Benson	4	1.38	18	0.70	16	0.73	61	1.20
Betty	5	0.57	9	0.03	10	0.52	--	--
Birthday	--	--	2	0.33	--	--	--	--
Blair	4	0.33	2	1.00	77	0.35	13	1.36
Blue	4	0.50	5	0.90	5	0.43	4	1.29
Bongo	11	0.44	2	2.50	3	1.83	--	--
Burnt Top	6	1.17	3	2.17	1	2.00	--	--
Campers	--	--	2	1.00	4	0.80	7	0.65
Clear	810	0.47	1,191	0.60	748	0.52	471	0.64
Cliff	--	--	--	--	10	0.13	2	0.92
Colt	--	--	--	--	--	--	1	1.00
Denude	2	0.50	--	--	--	--	--	--
Devils	--	--	3	0.82	1	0.65	7	0.05

Appendix V (continued)

Stream	1961 Anglers Checked	1961 Fish Per Hour	1962 Anglers Checked	1962 Fish Per Hour	1963 Anglers Checked	1963 Fish Per Hour	1964 Anglers Checked	1964 Fish Per Hour
Dumbell	--	--	--	--	2	3.75	--	--
Eastern Brook	9	0.81	--	--	8	1.75	1	1.00
Eddeeleo, Lower	8	3.61	--	--	6	0.46	12	1.21
" , Upper	18	0.60	17	1.79	19	0.88	22	0.93
Edna	5	0.59	--	--	--	--	1	0.97
Elbow	3	1.00	--	--	6	0.92	13	0.38
Elf	--	--	2	2.50	7	1.50	8	0.92
Emma	2	0.44	--	--	--	--	1	0.00
Erma Belle, Lower	103	0.21	40	0.30	51	0.87	62	0.62
" " , Middle	70	0.44	7	0.26	35	0.82	80	0.73
" " , Upper	10	0.69	--	--	10	0.47	14	0.45
Fern Ridge Borrow Pit	--	--	--	--	23	0.21	--	--
Fir	2	0.50	1	0.67	--	--	--	--
Fisher, East	2	3.50	3	2.00	4	2.66	6	2.00
Fisher, West	--	--	3	2.00	2	4.00	4	0.43
Gander	6	0.17	9	1.34	40	0.37	20	0.92
Glaze	--	--	5	4.00	--	--	--	--
Gold	210	0.25	130	0.36	139	0.21	171	0.46
Hand	13	0.40	9	0.23	26	0.25	12	0.78
Hart	6	0.53	3	0.60	--	--	--	--
Harvey	5	0.00	--	--	--	--	9	0.73
Helen	--	--	--	--	3	0.67	5	0.70
Hemlock	1	0.00	--	--	--	--	--	--
Herb	2	1.00	--	--	--	--	--	--
Hidden (McKenzie)	24	0.74	41	0.96	7	0.84	--	--
Hidden (Waldo L.)	--	--	--	--	2	2.33	--	--
Honey	--	--	--	--	--	--	2	1.83
Horse, Lower	2	3.00	18	2.11	9	5.69	7	2.66
Horse, Middle	--	--	--	--	--	--	11	1.32
Horse, Upper	73	1.32	62	1.79	79	1.15	107	1.39
Howie	--	--	2	1.00	1	2.00	3	6.00
Huckleberry	9	0.26	--	--	--	--	2	0.75
Indigo	6	1.15	8	0.42	24	0.95	8	1.14
Island	--	--	2	2.50	6	2.29	3	4.33
Kidney	--	--	--	--	--	--	4	1.58

Appendix V (continued)

Stream	1961 Anglers Checked	1961 Fish Per Hour	1962 Anglers Checked	1962 Fish Per Hour	1963 Anglers Checked	1963 Fish Per Hour	1964 Anglers Checked	1964 Fish Per Hour
Kidney, North	--	--	--	--	--	--	2	1.00
Last	--	--	--	--	3	2.05	--	--
LeMay	--	--	--	--	--	--	5	0.50
Lindh	--	--	1	1.67	3	0.56	--	--
Linton	57	0.20	51	0.50	57	0.51	10	0.42
Lo	--	--	--	--	--	--	1	10.00
Long	--	--	--	--	3	0.17	8	0.59
Mac	--	--	--	--	--	--	3	5.50
Marilyn, Lower	14	0.06	9	0.27	17	0.66	--	--
" , Upper	61	0.17	34	0.40	44	0.66	--	--
Martin	--	--	3	2.00	--	--	--	--
McFarland	--	--	--	--	--	--	3	0.33
McFarland, East	--	--	--	--	--	--	3	0.78
Melakwa	--	--	--	--	--	--	51	0.51
Mickey	1	3.00	--	--	--	--	--	--
Midnight	3	0.71	--	--	--	--	12	0.51
Mile	--	--	15	1.82	--	--	--	--
Mink	6	0.63	--	--	6	0.60	2	0.25
Moolack	--	--	--	--	--	--	1	1.75
Moonlight	--	--	--	--	12	0.60	1	0.15
Mud	5	1.50	--	--	--	--	--	--
Notch	--	--	--	--	2	0.13	1	1.50
Opal	25	0.50	15	0.97	10	1.00	24	1.07
Otter	15	0.39	23	0.49	24	0.28	24	0.14
Platt	10	0.32	5	0.29	8	0.15	--	--
Porky	2	1.00	--	--	10	0.07	--	--
Quinn, Upper	3	2.33	--	--	--	--	--	--
Rigdon, Lower	17	0.60	--	--	3	0.56	10	1.00
Rigdon, Upper	--	--	--	--	--	--	7	0.05
Robinson	--	--	--	--	14	1.39	--	--
Round	11	0.85	3	0.50	15	0.57	18	0.63
Ruth	16	0.54	--	--	--	--	--	--
Salmon, Lower	6	0.20	13	0.53	18	0.24	7	0.10
Salmon, Upper	52	1.24	44	1.40	32	0.89	44	2.23
Saphire	--	--	--	--	8	0.09	--	--
Scott, Upper	4	0.50	8	0.98	5	1.20	13	0.32
Separation	3	0.33	--	--	--	--	--	--

Appendix V (continued)

Stream	1961 Anglers Checked	1961 Fish Per Hour	1962 Anglers Checked	1962 Fish Per Hour	1963 Anglers Checked	1963 Fish Per Hour	1964 Anglers Checked	1964 Fish Per Hour
Skookum	4	0.18	--	--	--	--	--	--
Spirit	9	2.86	3	2.36	12	2.19	34	1.11
Spring	2	2.75	--	--	--	--	--	--
Spy	2	0.00	--	--	--	--	--	--
Sunrise	5	0.50	2	1.60	7	0.03	--	--
Sunset (Horse L.)	--	--	--	--	4	0.08	--	--
Sunset (Summit L.)	3	0.00	1	0.33	5	0.20	--	--
Tenas (Middle)	--	--	--	--	2	2.00	9	0.39
Tenas (Upper)	--	--	--	--	4	3.92	--	--
Timpanogas, Lower	45	0.62	3	0.50	13	1.50	--	--
" , Upper	8	0.27	32	0.51	38	0.46	17	0.58
Torrey	--	--	--	--	5	0.40	10	0.23
Vogel	--	--	--	--	--	--	2	1.07
Wahana	18	0.60	2	0.25	3	0.60	--	--
Waldo	200	0.11	63	0.05	196	0.19	65	0.37
Whig	2	1.17	--	--	4	0.25	4	0.13
Reservoirs								
Beaver Marsh	--	--	--	--	79	1.03	168	0.78
Cottage Grove	71	0.24	24	0.33	--	--	71	0.36
Dexter	67	0.12	15	0.14	--	--	8	3.00
Dorena	603	0.84	252	0.54	349	0.45	457	0.49
Fern Ridge	45	1.28	30	0.67	15	2.40	--	--
Lookout Point	38	0.22	88	0.63	--	--	--	--
Smith River	--	--	--	--	23	1.43	--	--
Trail Bridge	--	--	--	--	110	0.46	--	--

Appendix VI

Results of Fish Distribution Studies Conducted by Shocking in Upper Willamette Basin Streams, 1964

Stream	Station Number	Date	Flow (cfs)	Temperature (°F)	Location	Stream Mile	Species and Numbers
COAST FK. WILLAMETTE R.							
Coast Fk. Willamette R.	1	8-21-64	15	63	3.7 mi. below Big & Little Rivers	36.3	Cot 3, Ct 7, D 5, Rb 5, Su 1
Bear Creek	1	7-22-64	3	61	4.0 mi. above mouth	4.0	Cot 30, Ct 29, D 4, RsS 2, Su 1
Big River	1	8-21-64	10	60	Mouth	0.0	Cot 3, Ct 4, D 8, Rb 1
" "	2	7-1-64	5	56	0.3 mi. above Jasper Creek	2.4	Cot 1, Ct 1, D 1
" "	3	7-1-64	6	56	0.7 mi. above Edwards Creek	6.5	Cot 5, Ct 16, D 2
Jasper Creek	1	7-1-64	-	56	25 yds. above mouth	0.1	Ct 10, D 2
Little River	1	7-1-64	12	56	100 yds. above first br.	0.6	Cot 8, Ct 4
" "	2	7-1-64	-	55	1.2 mi. above Saroute Creek	3.5	Cot 4, Ct 2
Saroute Creek	1	7-1-64	-	54	1.0 mi. above mouth	1.0	Cot 3, Ct 9
Wilson Creek	1	7-1-64	3.5	56	1.0 mi. above mouth	1.0	Cot 4, Ct 11
ROW RIVER							
Row River	1	8-20-64	30	72	3.9 mi. below mouth of Sharps Creek	13	Cot 73, Ct 5, D 53, Rb 1
" "	2	8-21-64	20	68	Mouth of Sharps Creek	17	Cot 15, D 44, Rb 1
" "	3	8-20-64	15	70	0.4 mi. below Brice and Layng Creeks	20.5	Cot 26, Ct 2, D 78
Brice Creek	1	8-6-64	11	69	0.3 mi. above mouth	0.3	Cot 5, Ct 4, D 4, Rb 1
" "	2	7-3-64	55	53	1 mi. above Alder Creek	3.0	Cot 10, Ct 2
" "	3	8-6-64	10	63	3.3 mi. below Champion Cr.	5.2	Ct 2
" "	4	8-6-64	10	60	0.2 mi. below mouth of Champion Cr.	8.6	Ct 7, Rb 2
" "	5	7-2-64	25	51	0.2 mi. above mouth of Champion Cr.	9.0	Ct 7
" "	6	8-6-64	5	59	2.3 mi. above mouth of Champion Cr.	11.1	Ct 10
Champion Creek	1	7-2-64	15	50	0.3 mi. above mouth	0.3	Ct 2
Layng Creek	1	8-6-64	12	63	0.3 mi. above mouth	0.3	Cot 17, Ct 1, D 6
" "	2	8-6-64	8	59	3.2 mi. above mouth	3.2	Cot 14, Ct 2, D 16
" "	3	7-3-64	18	54	0.8 mi. above Patterson Creek	7.8	Ct 11, D 7
Mosby Creek	1	8-6-64	15	73	0.7 mi. above mouth	0.7	Cot 52, D 3, LB 7, RsS 2, Su 1
" "	2	8-6-64	13	75	4.3 mi. above mouth	4.3	Cot 2, D 6, RsS 18
" "	3	7-22-64	19	68	.5 mi. below Fall Cr.	7.7	Cot 6, Ct 4, Ct or Rb fry 6, Rb or St 3, RsS 20, Su 4, Sq 1
" "	4	7-22-64	15	66	Near Allen Creek	13.5	Cot 15, D 20, Rb or St 2
" "	5	7-22-64	10	63	Between Shea & Gray Creeks	18.3	Cot 4, Ct 4, Ct or Rb fry 6, D 42, Rb or St 4
Rat Creek	1	7-2-64	6	53	0.8 mi. above mouth	0.8	Cot 10, Ct 25
Sharps Creek	1	7-3-64	33	63	1.6 mi. above mouth	1.6	Cot 8, Ct 2, D 4
" "	2	7-3-64	23	62	2.5 mi. below Martin Creek	8.5	Cot 4, Ct 7, D 8
" "	3	7-3-64	15	56	0.9 mi. above Martin Creek	11.8	Cot 3, Ct 13
Martin Creek	1	7-3-64	8	62	0.7 mi. above mouth	0.7	Cot 8, Ct 3, D 8
Smith Creek	1	7-2-64	12	55	1.8 mi. above Teeter Creek	2.3	Cot 7, Ct 12, D 2
Teeter Creek	1	7-2-64	9	54	100 yds. above mouth	0.1	Ct 6, D 8
LONG TOM RIVER							
Long Tom River	1	6-30-64	--	58	Alderwood State Park	50	Cot 8, D 14, L 5, RsS 2, Su 2
Bear Creek	1	6-17-64	3	58	Hall Rd. Br. ¼ mi. from Goldson Rd. Junction	4.9	Cot 6

Appendix VI (continued)

Stream	Station Number	Date	Flow (cfs)	Temperature (°F)	Location	Stream Mile	Species & Numbers
Bear Creek	2	6-17-64	3	58	Just below mill 1 mi. above first station	5.9	Cot 2, D 15, RsS 14
" "	3	6-17-64	3	59	.5 mi. W of Fern Ridge Hwy 36 junction	9	Cot 7
" "	4	6-17-64	--	60	2 mi. N of Hwy. 36 on Goldson Rd.	10.4	No fish taken
" "	5	6-17-64	1.0	56	From Br. at headwaters	11.3	Cot 22, Ct 4
Jones Creek	1	6-17-64	2.5	62	Culvert on Hall Rd.	2	BG 1, Cot 6, Ct 6, D 6 RsS 3,
Nails Creek	1	6-17-64	--	59	Smythe Rd. Br.	1.2	Cot 2, Ct 1, RsS 2 Su 1
Owens Creek	1	6-17-64	2.5	59	Br. on Hall Rd.	1.2	Cot 10, Ct 4
Ferguson Creek	1	6-17-64	--	58	First Br. on Turnbow Rd.	3.5	Cot 12, Ct 2
" "	2	6-18-64	2	54	Second Br. on Ferguson Rd.	6.9	Cot 8, Ct 5
Noti Creek	1	6-30-64	2.1	56	Confluence of Poodle Creek	0.0	Cot 8, Ct 5
Poodle Creek	1	6-30-64	13.4	58	Mouth	0.0	Cot 5
McKENZIE RIVER							
Blue River	1	8-18-64	--	62	3.1 mi. below Lookout Creek	4.6	Cot 3, D 10, Ct or Rb 2, Rb 2
" "	2	8-14-64	--	--	0.8 mi. below Tidbits Creek	8.0	Cot 2, Ct 5, D 2, Ct or Rb 3, Rb 3
" "	3	8-18-64	12	57	0.3 mi. below Cook Creek	11.3	Cot 3, Ct 5, D 1, Rb 3
Cook Creek	1	8-18-64	6	56	Br. at mouth	0.0	Cot 2, Ct 10, Rb 1
Lookout Creek	1	8-18-64	15	57	1.9 mi. above mouth	1.9	Cot 4, Ct 3, Ct or Rb 13, Rb 2
" "	2	8-18-64	11	52	1.6 mi. above McRae Creek	5.6	Cot 9, Ct 20
McRae Creek	1	8-18-64	3	61	Br. just above mouth	0.1	Cot 16, Ct 23
Quartz Creek	1	7-24-64	8	63	Mouth	0.0	Ct 2, Ct or Rb 8, Rb 8
Quentin Creek	1	8-18-64	3	58	Mouth	0.0	Ct 22
Simmonds Creek	1	7-24-64	5	66	Culvert near mouth	0.1	Cot 12, Ct 3, Ct or Rb 30, Rb or St 3
Tidbits Creek	1	8-18-64	9	58	Mouth	0.0	Cot 1, Ct 21, D 5, Rb 3
" "	2	8-18-64	2	55	1.8 mi. above Ore Creek	3.5	Ct 33
Boulder Creek	1	8-17-64	1.5	53	Hwy. 126 culvert	0.1	Ct 62
Camp Creek	1	6-29-64		61	0.5 mi. above mouth	0.5	Cot 5, RsS 2
" "	2	6-29-64		58	5 mi. above mouth	5	Cot 5, Ct 6, RsS 8
Deer Creek (Lower)	1	7-24-64	15	57	Just above mouth	0.1	Ch 2, Cot 4, D 2, Ct or Rb 4
Deer Creek (Upper)	1	8-19-64	13	53	0.5 mi. above mouth	0.5	Cot 18, Rb 10
" "	2	8-19-64	5	52	3.2 mi. above Fritz Creek	5.7	Ct 20
Elk Creek	1	7-24-64	4	60	Second Br. above mouth	0.2	Ch 5, Ct 11, Ct or Rb 5, Rb 3
Ennis Creek	1	7-23-64	3	57	First Br. above mouth	0.2	Ch 5, Cot 9, Ct 6, D 7, LB 1, Rb 2
Finn Creek	1	7-23-64	3	57	Hwy Br. above mouth	0.2	Ch 6, Cot 17, Ct 12, Rb 2, Su 5
Gate Creek	1	7-15-64	50	60	0.3 mi. above mouth	0.3	Cot 4, Ct 1, D 2, Rb 2
N. Fk. Gate Creek	1	7-15-64	30	58	0.1 mi. above mouth	0.1	Cot 4, Ct 1, Ct or Rb 10, D 1
" " " "	2	7-15-64	12	58	0.3 mi. above N. Fk. of N.Fk. of Gate Cr.	2.6	Cot 13, Ct 4, Ct or Rb 2, Rb 3
" " " "	3	7-15-64	7	58	0.9 mi. above N.Fk. of N.Fk. of Gate Cr.	3.2	Cot 3, Ct 11, Rb 1
Holden Creek	1	7-23-64	2	55	0.2 mi. above mouth	0.2	Ch 5, Cot 12, Ct 2, D 4, RsS 8
" "	2	7-23-64	2	55	Hwy. 58 bridge	0.8	Cot 10, Ct 10

Appendix VI (continued)

Stream	Station Number	Date	Flow (cfs)	Temperature (°F)	Location	Stream Mile	Species and Numbers
West Fk. Horse Creek	1	8-17-64	200	56	Mouth	0.0	Cot 4, Ct 10, Rb 1
King Creek	1	8-17-64	3	58	Br. on King Road	0.2	Cot 9, Ct 20
Indian Creek	1	7-23-64	10	57	Highway 126 bridge	0.3	Cot 6, Ct 9, Ct or Rb 2, Rb 8
Kink Creek	1	8-19-64	2	48	50 yds. below McKenzie Hwy culvert	0.2	Cot 1, Ct 38
Whitebranch Creek	1	8-17-64	4	49	McKenzie Hwy. Br.	1.0	Ct 25
Marten Creek	1	7-15-64	15	58	Br. near mouth	0.2	Cot 7, Rb or St 2
Mohawk River	1	6-29-64	65	51	2 mi. below Weyerhaeuser shops	21.4	Cot 1, Ct 7, L 20, St or Rb 3
Cash Creek	1	6-18-64	6	54	Hiway Bridge	0.1	Cot 5, Ct 1
McGowan Creek	1	6-18-64	4.5	55	Br. by Mohawk School	0.5	Cot 10, Ct 6, RsS 3
" "	2	6-29-64	4	58	Culvert 2.8 miles above mouth	2.8	Cot 11, Ct 11
Mill Creek	1	6-18-64	43	54	Br. above mouth	0.2	Cot 8, Su 2
" "	2	6-29-64	18	18	Wendling Park	5.4	Cot 4, Ct 5
Parsons Creek	1	6-18-64	8	53	0.5 mi. above Hwy Br.	0.9	Cot 9, Ct 4
" "	2	6-29-64	6	54	3rd bridge above mouth	3.8	Cot 11, Ct 10
Shotgun Creek	1	6-18-64	9	54	1.7 mi. above Hwy. Br.	1.8	Cot 8, Ct 5, D 1
" "	2	6-18-64	7	54	3.1 mi. above Hwy. Br.	3.2	Cot 10, Ct 5
Quartz Creek	1	7-23-64	35	70	Br. above mouth	0.1	Cot 8, D 20, Rb 24
" "	2	7-23-64	20	64	Br. .3 mi. above Wycoff Creek	4.9	Cot 11, Ct 1, Rb or Ct 20, D 7, Rb 7
" "	3	7-23-64	11	54	1.5 mi. above Nat'l Forest Boundary	9	Cot 3, Ct 19
Scott Creek	1	8-17-64	4	51	McKenzie Hwy. Br.	0.1	Cot 7, Ct 26
S. FK. McKENZIE RIVER							
Augusta Creek	1	8-19-64	6	56	1.5 mi. above mouth	1.5	Cot 33, Ct 7, Ct or Rb 14, Rb 21
E. Fk. of S. Fk. of McKenzie River 1/	1	8-27-64	7	54	0.3 mi. above res.	2.1	Ct 10, Rb 8
Rebel Creek	1	8-19-64	4	56	Br. near mouth	0.2	Cot 9, Ct 14, Ct or Rb 9, Rb 1
McBee Creek	1	8-19-64	10	43	Just above mouth	0.1	Ct 4
MIDDLE WILLAMETTE							
Big Willow Creek	1	9-2-64	0.4	60	Mouth	0.0	Ct 19, Ct or Rb fry 10, D 4
Buck Creek	1	9-3-64	6	53	0.2 mi. above mouth	0.2	Cot 3, Ct 4, D 4, Rb 6, RsS 400
" "	2	9-3-64	2.5	51	4 mi. above mouth	4	Ct 12
Coal Creek	1	9-2-64	17	55	0.1 mi. above mouth	0.1	Cot 7, Rb 9
" "	2	9-2-64	9	48	4.9 mi. above mouth	4.9	Ct 11
Coffeepot Creek	1	9-2-64	2.5	55	Mouth	0.0	Cot 11, Ct 7, Ct or Rb fry 8, D 1, Rb 1
Fall Creek	1	8-20-64	25	66	Just above Winberry Creek	7.9	Cot 25, D 15, RsS 10
" "	2	8-20-64	23	65	0.9 mi. above Winberry Creek	8.6	Cot 18, D 9, RsS 4
" "	3	8-20-64	20	62	5.7 mi. above Winberry Creek	13.3	Cot 8, D 4, Rb or St 1, Wf 2
" "	4	8-20-64	15	58	0.4 mi. below Clark Cr.	17.7	Cot 11, D 8, St or Rb 7
" "	5	8-20-64	10	58	1 mi. above Portland Creek	22.8	Cot 18, D 6, Rb or St 1
" "	6	7-14-64	7	56	Just below Platt Creek	30.7	Ct 23
Delp Creek	1	7-14-64	10	57	0.2 mi. above mouth	0.2	Cot 3, Ct 2
He He Creek	1	7-14-64	10	61	0.5 mi. above mouth	0.5	Cot 13, Ct 4, Rb or St 8
" " "	2	7-14-64	6	62	0.9 mi. above Pernot Creek	3	Cot 9, Ct 7

Appendix VI (continued)

Stream	Station Number	Date	Flow (cfs)	Temperature (°F)	Location	Stream Mile	Species and Numbers
Pernot Creek	1	7-14-64	4	58	Mouth	0.0	Cot 3, Ct 5
Little Fall Creek	1	8-20-64	15	64	1.5 mi. above mouth	1.5	Cot 19, D 16
" " "	2	7-21-64	35	62	8.4 mi. above mouth	8.4	Cot 10, Ct 3, Ct or Rb 1, D 4, Rb or St 2
" " "	3	7-21-64	17	58	2.6 mi. above Sturdy Creek	13.5	Cot 18, Ct 6
Portland Creek	1	7-14-64	18	62	0.8 mi. above mouth	0.8	Ct or Rb 4, D 8, Rb 1
Winberry Creek	1	7-13-64	20	73	0.5 mi. above mouth	0.5	Ch 2, Cot 13, D 7, RsS 4
" "	2	7-13-64	17	71	5.2 mi. above mouth	5.2	Cot 2, Ct 1, D 2
N. Fk. Winberry Cr.	1	7-13-64	8	63	1.2 mi. above mouth	1.2	Cot 10, Ct 10
S. Fk. Winberry Cr.	1	7-13-64	9	67	0.7 mi. above mouth	0.7	Cot 6, Ct 5
" " " "	2	7-13-64	8	63	Just below Cabin Creek	5.1	Cot 9, Ct 11
Hills Creek (Lower)	1	7-21-64	3	70	0.3 mi. above mouth	0.3	Cot 4, Ct 2, D 13
Hills Creek (Upper)	1	8-7-64	40	63	3.1 mi. above res. influence	6.2	Cot 3
Lost Creek	1	7-13-64	11	77	Hwy. 58 Bridge	0.5	Cot 5, D 6, Rb or St 1, RsS 20
" "	2	7-21-64	15	62	Mouth of Dexter Creek	4.5	Cot 16, D 55, RsS 100
" "	3	7-21-64	6	58	1.1 mi. above Guiley Creek	9	Cot 16, Ct 19
Guiley Creek	1	7-21-64	5	57	Mouth	0.0	Cot 20, Ct 14
Wall Creek	1	9-3-64	12	52	Just above mouth	0.1	Cot 12, Ct 8
Eagle Creek	1	8-7-64	30	49	Br. above mouth	0.1	Cot 1, Rb 4
" "	2	8-7-64	15	46	3 mi. above mouth	3	No fish taken
S. Fk. Salt Creek	1	8-7-64	8	52	Br. 1 mi. above mouth	1.0	Cot 3, Ct 8
" " " "	2	8-7-64	1	59	2.5 mi. above mouth	2.5	Ct 4
Simpson Creek	1	9-3-64	9	49	Culvert 80 yds. above mouth	0.1	Cot 6, Ct 11
Staley Creek	1	9-2-64	25	54	0.3 mi. above mouth	0.3	Cot 8, Ct 6, RsS 150
" "	2	9-2-64	30	52	4.7 mi. above mouth	4.7	Cot 6, Ct 7
Swift Creek	1	9-3-64	40	43	First Br. above mouth	0.6	Cot 11, Ct 3, Rb (planted) 7
" "	2	9-3-64	2.5	45	2nd Br. above mouth	4.2	Ct 10
Windfall Creek	1	9-2-64	.5	59	Culvert above mouth	0.1	Cot 19, Ct 7, D 35, Rb 3, RsS 20

1/ The East Fork of South Fork McKenzie was sampled by angling.

APPENDIX VII

Known Fish Species Present and Their Distribution in the Upper Willamette Basin

Species	Abbreviation	General Distribution
Lamprey (2 species)	Lam	Several streams; spawn in areas similar to steelhead
Sturgeon (white) 2/	WSg	In main stem Willamette near mouth of Long Tom R.
Salmonids 2/		
Whitefish	Wf	Many cooler streams. A few in Hills Cr. Reservoir
Brook trout 1/	BT	Common in high lakes and extending into outlet streams
Dolly Varden trout	DV	Common in McKenzie R., Mid. & N.Fks. of Willamette
Lake trout 1/	LT	Big Lake and other high elevation lakes
Brown trout 1/	Br	Linton Lake
Rainbow trout	Rb	Native to several areas and planted in many others. Planted in several Cascade lakes.
Cutthroat trout, coastal	Ct	Common in high elevation streams. Common in lower portions of the drainage. Several Cascade Lakes
Golden trout 1/	GT	Amos, Andy, Shinner, Young, Valley, Divide, Louie, Amstutz and Fry lakes
Steelhead trout	St W	See Figures
Kokanee salmon 1/	K	Waldo Lake and Big Lake
Chinook salmon, spring	ChS	See Figures
Coho salmon	Co	Planted in several streams including Mosby Cr. and Mohawk R. in 1964
Suckers (2 species)	Su	Common in streams and reservoirs of low to moderate elevations
Minnows		
Carp 1/	Cp	Common in lowland lakes and streams
Chiselmouth	Clm	In Willamette and Coast Fork of Willamette and Dexter and Lookout Point Reservoirs
Dace	D	Common in most lakes, streams & reservoirs
Goldfish 1/	Gf	Scattered throughout lower areas of basin
Peamouth	Pm	
Redside shiner	RsS	Common in lowland streams and lakes and extending above Hills Creek Reservoir
Squawfish	Sq	Common in lowland lakes and streams
Catfish 1/ 2/		
Black bullhead	BlB	Fern Ridge Reservoir & Long Tom River
Brown bullhead	BrB	Cottage Grove & Dorena Reservoirs and lowland streams and lakes
Yellow bullhead	YB	Planted in private lakes and ponds

APPENDIX VII (continued)

Species	Abbreviation	General Description
Channel catfish	CC	Main stem Willamette
Mosquito fish 1/	MF	Several low elevation log ponds
Troutperch	TP	In Willamette R. and its lower tributaries
Sunfish 1/ 2/		
Bass, largemouth	LB	Most lowland waterways
Bass, smallmouth	SB	Main stem Willamette near Springfield and Eugene
Bluegill sunfish	Bg	Most lowland waterways
Crappie, black	BC	" " "
Crappie, white	WC	" " "
Green sunfish	GS	" " "
Pumpkinseed	Pk	" " "
Warmouth bass	Wm	" " "
Sculpins (cottids)	Cot	Common in most streams and lakes
Stickleback	Skb	May be in Willamette River sloughs

1/ Introduced species, others are indigenous to the Willamette Basin.

2/ These species are designated as game fish by Oregon law.

Appendix VIII

Biological Requirements of Salmonids

A stream must present certain physical characteristics and provide water of adequate quantity and quality in order to support a population of fish. These criteria for salmon and steelhead are reviewed in this appendix. Conditions suitable for these anadromous fish will also accommodate resident game fish.

Spawning requirements

Salmon and trout must have gravel for spawning. For salmon and steelhead, gravel should range between one quarter inch and six inches in diameter with extremes in sizes being least desirable. Chinook salmon normally select slightly larger gravel than do coho and steelhead, while trout choose the smaller gravels. Gravel must be relatively free of fines and silt and must not be seriously compacted. Excessive fines and silt create adverse conditions for eggs and fry in the gravel by causing low intergravel flows at reduced velocities which result in low supplies of available dissolved oxygen, and inhibit the escapement of fry from the gravel. Adequate depth of gravel is necessary for construction of a redd or nest by the female fish. Chinook salmon dig slightly deeper redds than do the coho salmon and steelhead. Redd depths may vary from approximately six inches to fifteen inches.

Suitable water temperatures for spawning range from about 42 to 55 F. Temperatures outside these limits cause excessive losses of viable eggs.

Eggs from most salmon and steelhead hatch in about two months and the fry emerge from the gravel about two weeks later. This is controlled by the prevailing water temperatures.

The dissolved oxygen requirements for egg and fry survival in the gravel are higher (8 ppm) than for larger fish (5 ppm). These higher requirements of eggs and fry are provided through having good permeability and rate of intergravel flow which are influenced by gravel size and interspaces and stream gradient.

Oregon State Game Commission personnel and other fishery workers have made measurements at numerous redds of the three species concerned. From the results of these studies, water depth and velocity criteria have been selected for proper spawning conditions. Minimum water depth for chinook salmon spawning is considered to be 0.8 foot, while coho salmon and steelhead require at least 0.6 foot. Proper velocities for spawning by all three species ranges between 1.0 and 2.5 feet per second as measured 0.4 foot from the bottom.

Rearing

The size and success of an anadromous fish population is largely dependent on certain conditions within the stream during the rearing period. Steelhead trout, coho and spring chinook salmon spend up to three years in fresh water before migrating to the ocean. Fall chinook normally migrate from their parent stream within three months after hatching. The most critical time in the fresh water life of young salmonids is the period of low flow during the summer. This is generally referred to as the period of "rearing" flows. To support the young fish during this period, the stream must contain sufficient flow to provide food, shelter and a suitable medium in which to live.

Food

Food of juvenile salmon and steelhead during residency consists primarily of immature aquatic insects. Production of these organisms is confined almost entirely to riffle areas. The best producing riffles are those composed of large gravel or rubble. Clean, well aerated water flowing over these areas is necessary for proper maintenance of these food forms.

Shelter

Shelter has been described as any place a fish will remain or return to when frightened or disturbed. Such places may be found within riffles, but are

usually associated more with deeper pool areas. Shelter is necessary as a resting area and as a place where fish may escape from predators.

Suitable medium

A suitable medium in which to live refers primarily to water quality requirements. Good rearing water is high in dissolved oxygen (above 5 ppm), low in turbidity, not greatly acid or alkaline and with temperatures not exceeding 65° F for extended periods.

High water temperatures contribute to mortalities by simply exceeding the tolerances of salmonids. In addition, water loses its capacity to hold dissolved oxygen as its temperature increases, yet the metabolic rate and resultant oxygen requirement of cold-blooded animals tends to increase at higher temperatures. This causes a condition of greater need with a reduced supply. The incidence of disease also increases with rising temperatures.

Turbid waters generally cause greater damage to fish habitat than to fish themselves, primarily from the siltation of food-producing and spawning areas. Heavy silt loads, however, can drive fish from a stream, impair health and result in actual mortalities.

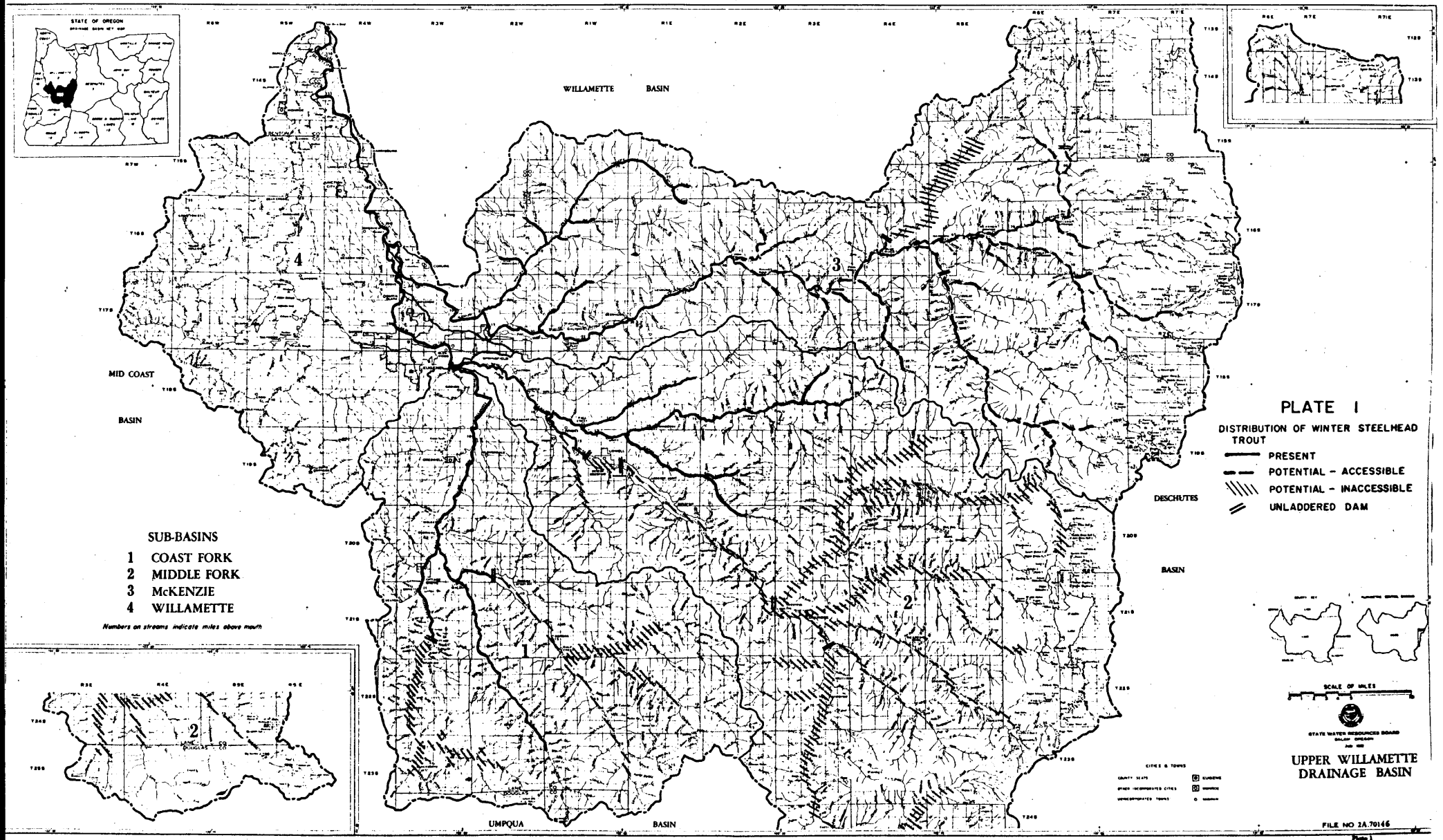
Adequate summer stream flows play a vital part in meeting each of the three basic rearing requirements. Without an adequate flow, any or all of the conditions may not be satisfied, and the elimination of but one necessary factor can be sufficient to have a definite limiting effect upon a fish population.

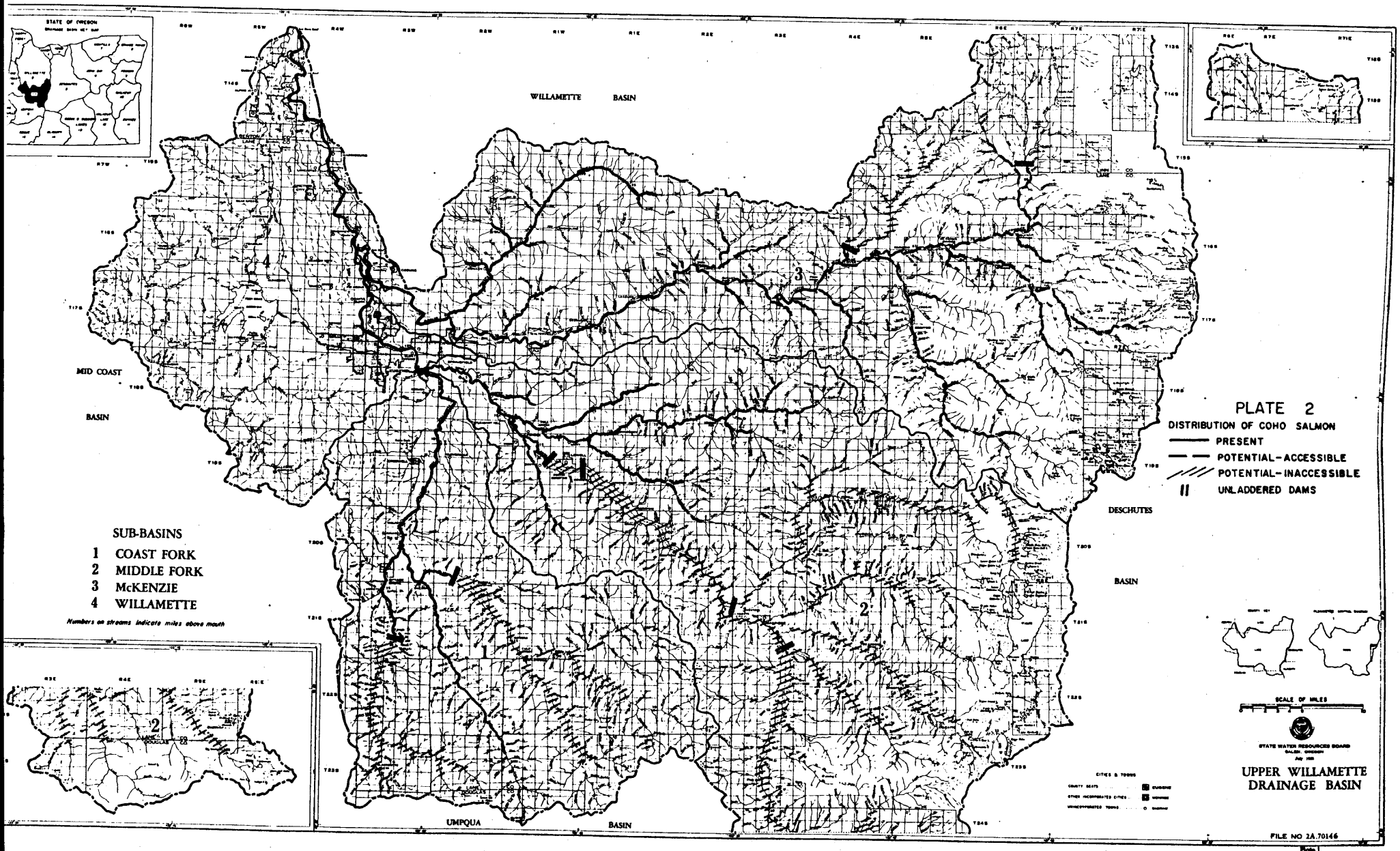
Passage

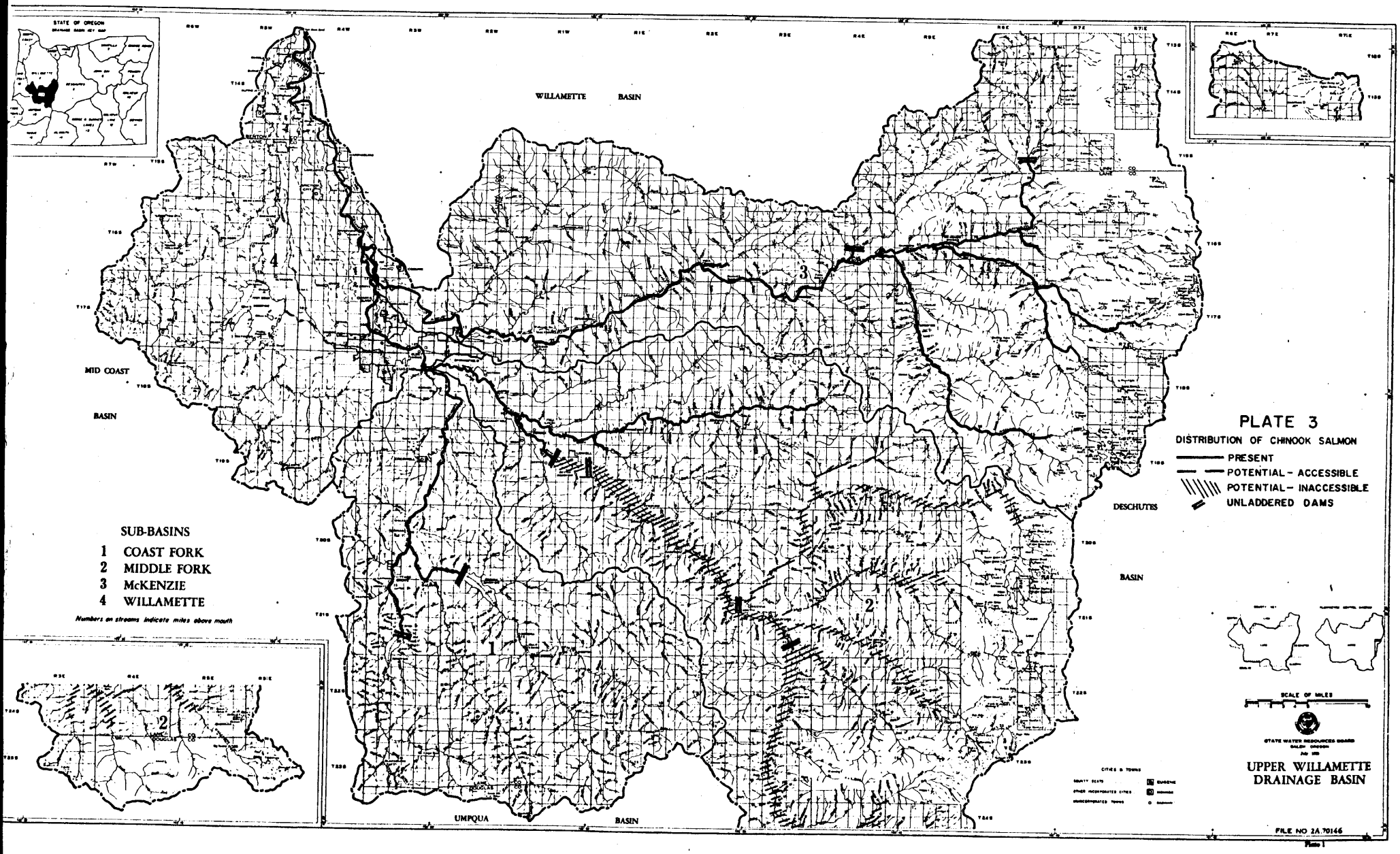
By definition, anadromous fish migrate between the ocean and fresh water. To complete the cycle, the fish must have adequate stream flow for passage. As upstream migrants, adult salmon and steelhead require a portion of the stream cross-section to have sufficient depth so passage will not be impeded. Much remains to

learned of these requirements which may vary from one situation to another. Tentatively, depths of 0.8 foot for chinook, and 0.6 foot for coho and steelhead are recommended as desirable passage conditions.

The juvenile fish in fresh water must have enough water for interstream movement during their rearing period and a flow adequate to support an uninterrupted seaward migration. Though much of the downstream migration takes place during seasons of higher flows, a minimum stream depth of 0.1 - 0.2 foot is required throughout the year to accommodate the movement of young fish.


STATE OF OREGON
WILLAMETTE BASIN
MID COAST BASIN
DESCHUTES BASIN
UMPQUA BASIN
SUB-BASINS
1 COAST FORK
2 MIDDLE FORK
3 McKENZIE
4 WILLAMETTE
Numbers on streams indicate miles above mouth
PLATE I
DISTRIBUTION OF WINTER STEELHEAD TROUT
PRESENT
POTENTIAL - ACCESSIBLE
POTENTIAL - INACCESSIBLE
UNLADDERED DAM
SCALE OF MILES
STATE WATER RESOURCES BOARD
SALEM, OREGON
UPPER WILLAMETTE DRAINAGE BASIN
FILE NO 2A.70146
Plate 1


STATE OF OREGON
WILLAMETTE BASIN
MID COAST BASIN
DESCHUTES BASIN
UMPQUA BASIN
SUB-BASINS
1 COAST FORK
2 MIDDLE FORK
3 McKENZIE
4 WILLAMETTE
Numbers on streams indicate miles above mouth
PLATE 2
DISTRIBUTION OF COHO SALMON
PRESENT
POTENTIAL-ACCESSIBLE
POTENTIAL-INACCESSIBLE
UNLADDERED DAMS
SCALE OF MILES
STATE WATER RESOURCES BOARD
UPPER WILLAMETTE DRAINAGE BASIN
FILE NO 2A.70146


STATE OF OREGON
WILLAMETTE BASIN
MID COAST BASIN
DESCHUTES BASIN
UMPQUA BASIN
SUB-BASINS
1 COAST FORK
2 MIDDLE FORK
3 McKENZIE
4 WILLAMETTE
Numbers on streams indicate miles above mouth
PLATE 3
DISTRIBUTION OF CHINOOK SALMON
PRESENT
POTENTIAL - ACCESSIBLE
POTENTIAL - INACCESSIBLE
UNLADDERED DAMS
SCALE OF MILES
STATE WATER RESOURCES BOARD
UPPER WILLAMETTE
DRAINAGE BASIN
FILE NO 2A.70146
Plate 1