Stock Assessment of Columbia River Anadromous Salmonids

Volume II: Steelhead Stock Summaries
Stock Transfer Guidelines - Information Needs

Final
Report
1984

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FINAL REPORT

STOCK ASSESSMENT OF COLUMBIA RIVER ANADROMOUS SALMONIDS

VOLUME II: STEELHEAD STOCK SUMMARIES STOCK TRANSFER GUIDELINES - INFORMATION NEEDS

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VOLUME II

II. STOCK SUMMARIES

Steelhead Trout

Lower Columbia River (Oregon) Winter Steelhead (wild)

PRODUCTION

Winter steelhead production in the lower Columbia tributaries in Oregon consists of mixed wild and hatchery stocks. Bear and Beaver creeks are managed for wild production. This summary focuses on available information on native wild stocks. Consult "Big Creek Winter Steelhead (hatchery)" for information on the hatchery stock.

GEOGRAPHIC LOCATION

Streams

Columbia River tributaries in Oregon below the Willamette River (Figure 1).

ORIGIN

Winter steelhead are native to the lower Columbia tributaries; however, steelhead production in these streams has been routinely supplemented with hatchery releases. Big Creek stock has been used primarily, although coastal stocks from egg takes at Cedar Creek and Alsea hatcheries have also been previously released. The influence of hatchery stocks on the composition of wild populations in lower river tributaries is uncertain.

ADULT LIFE HISTORY

Run size, catch, and escapement

There are no data available specifically for wild lower Columbia winter steelhead stocks. Sport catch of hatchery and wild stocks combined is summarized in Table 1. Sale of steelhead by non-Indians has been prohibited since 1975.

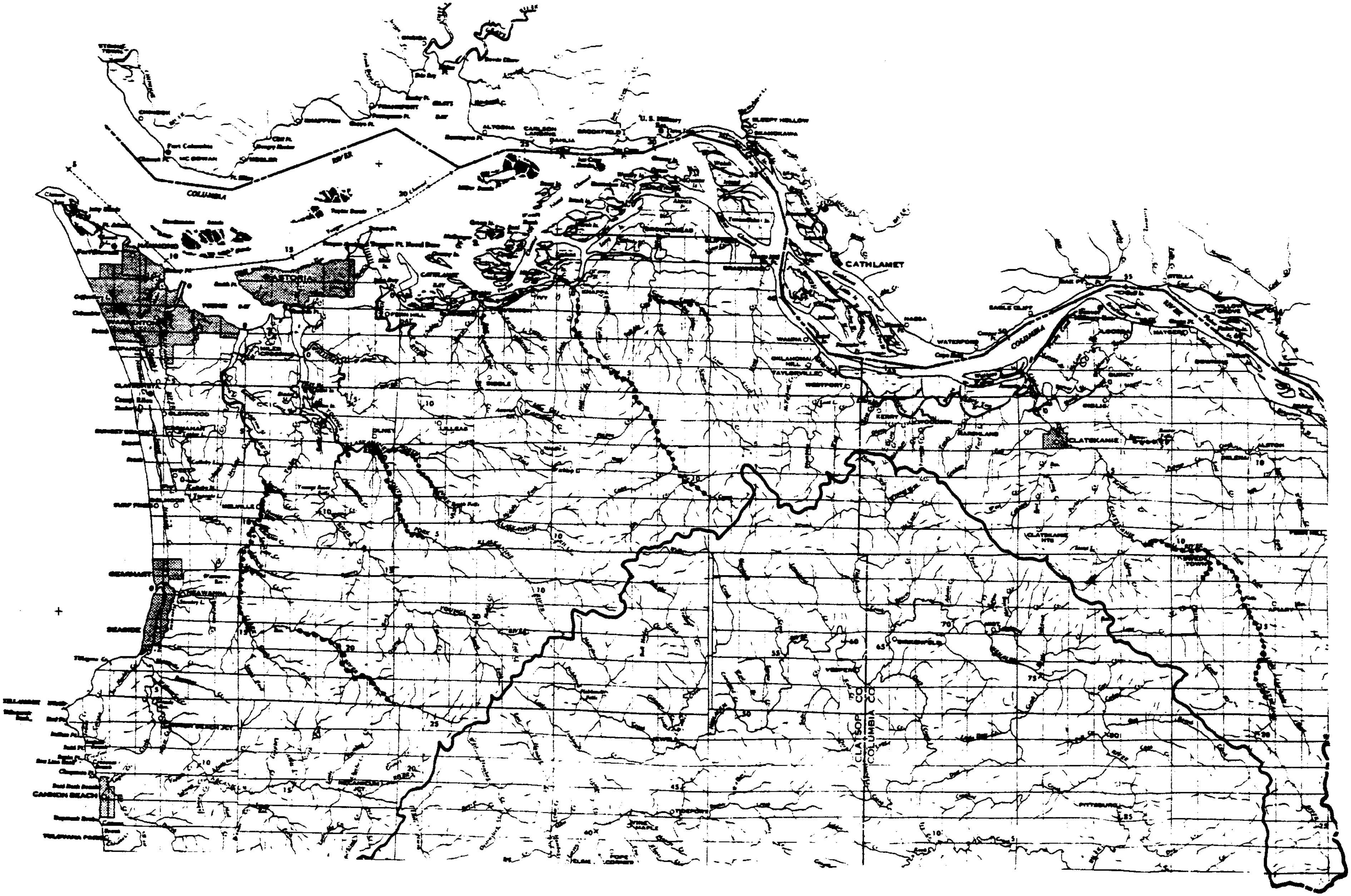

Figure 1. Steelhead spawning areas (....) in lower Columbia tributaries (Thompson and Fortune 1968).

Table 1. Sport catch of winter steelhead in tributaries of the lower Columbia River by run year[a], 1971-80 (Berry 1981).

Stream	Run year 71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80
Bear Creek	23	0	0	13	13	13	22	25	29
Big Creek	3,946	2,333	2,080	3,705	2,042	1,147	3,419	1,238	3,216
Clatskanie River	673	271	686	1,027	1,198	222	783	455	816
Gnat Creek	351	250	319	668	499	163	423	202	754
Klaskanine River	1,833	1,531	2,531	2,927	2,906	1,157	3,315	1,598	3,962
Lewis & Clark R.	345	189	164	566	407	320	577	402	859
Youngs River	--	--	--	--	--	6	14	0	23
Total	7,171	4,574	5,780	8,906	7,065	3,028	8,553	3,920	9,659

[a] Estimated from punch-card returns corrected for non-response bias.

Time of migration

Tagging studies to determine the timing of the winter steelhead run in the lower Columbia were conducted 1954-56 (Korn 1961). However, recoveries in lower Columbia tributaries were too small to draw any conclusions (5 recoveries from 4,199 tagged fish). For all stocks combined, winter steelhead numbers in the lower Columbia increased from November through March.

The Gnat Creek weir studies (1955-62) provide most of the information available on characteristics of native wild winter steelhead stocks in the lower Columbia. Although a few fish arrived at Gnat Creek as early as November, the peak of the run did not occur until March (Figure 2). Adults remained in the stream an average of 33 days (range = 2 to 79 days) (Kruse, undated). Post-spawning survival to migration out of Gnat Creek ranged from 11% to 81% (Table 2).

Table 2. Numbers of adult steelhead counted at the Gnat Creek weir during upstream and downstream migration, 1955-62 (Willis 1962).

Calendar year	Number: Upstream	Number: Downstream	Percent of upstream migrants captured downstream
1955-56	262	213	81.3
1956-57	234	154	65.8
1957-58	60	30	50.0
1958-59	114	53	46.5
1959-60	88	10	11.4
1960-61	41	6	14.6
1961-62	65	31	47.7
Total	864	497	
7-year average	123.4	71.0	57.5

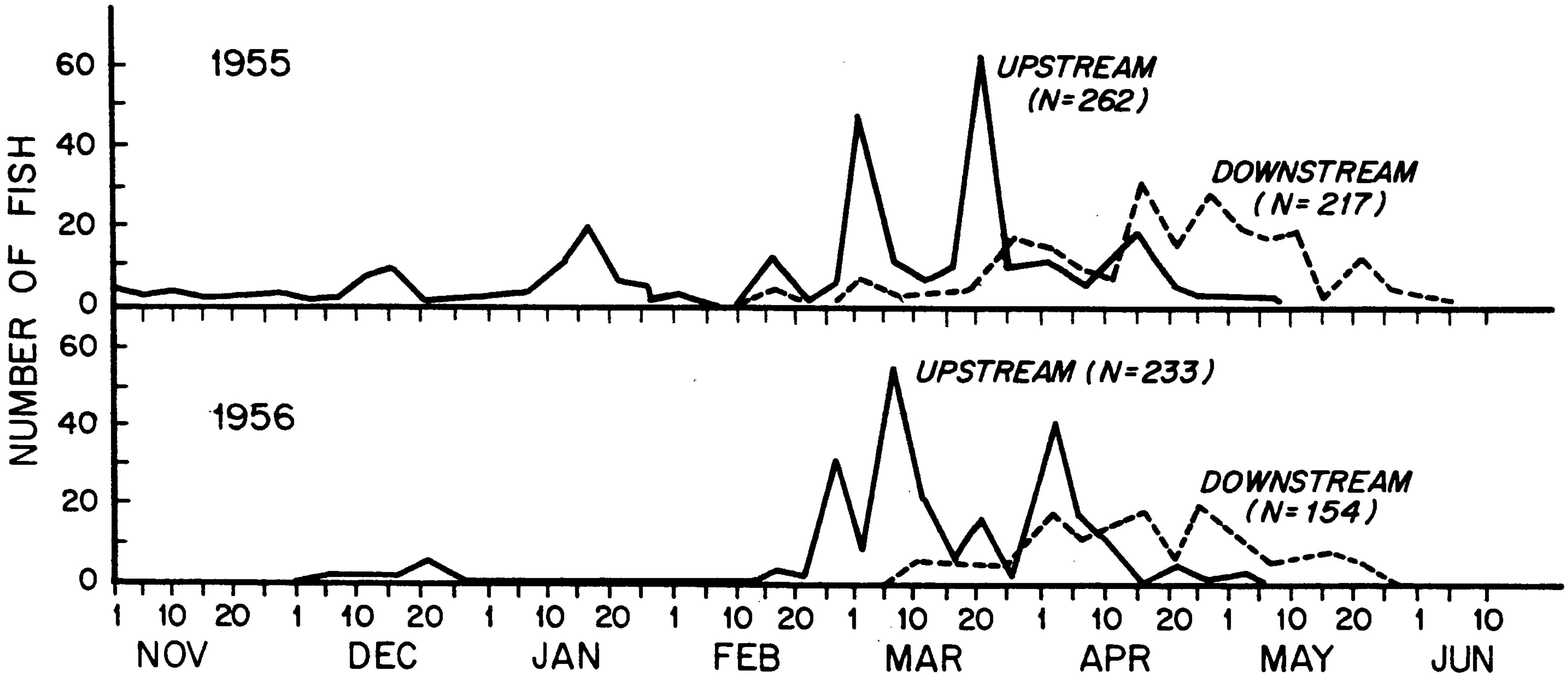

Figure 2. Numbers of adult steelhead migrating upstream and downstream past the Gnat Creek weir by 5-day intervals, 1955-56. Numbers trapped are in parentheses (Kruse, undated).

Spawning period

Based on timing of downstream kelts past the Gnat Creek weir, spawning in Gnat Creek appears to have occurred primarily from March through May.

Spawning areas

Fulton (1970) listed the following spawning areas of winter steelhead in the lower Columbia:

Lewis and Clark River
Youngs and Klaskanine rivers (Klaskanine Hatchery)
Big Creek (Big Creek Hatchery)
Gnat Creek (Gnat Creek Hatchery)
Clatskanie River

Figure 1 also indicates that steelhead spawn in Bear and Beaver creeks.

Age composition

No information.

Size

Lengths of adult steelhead trapped at the Gnat Creek weir are shown in Figure 3.

Sex ratio

No information.

Fecundity

No information.

Biochemical-genetic characteristics

No information.

JUVENILE LIFE HISTORY

Time of emergence

No information.

Time, age, and size at migration

Juvenile downstream migration in Gnat Creek peaked in April and May for age 2+ fish (Figure 4). Lesser peaks for age 1+ and 0+ fish occurred in June and November, respectively. However, the number of 0+ steelhead reported

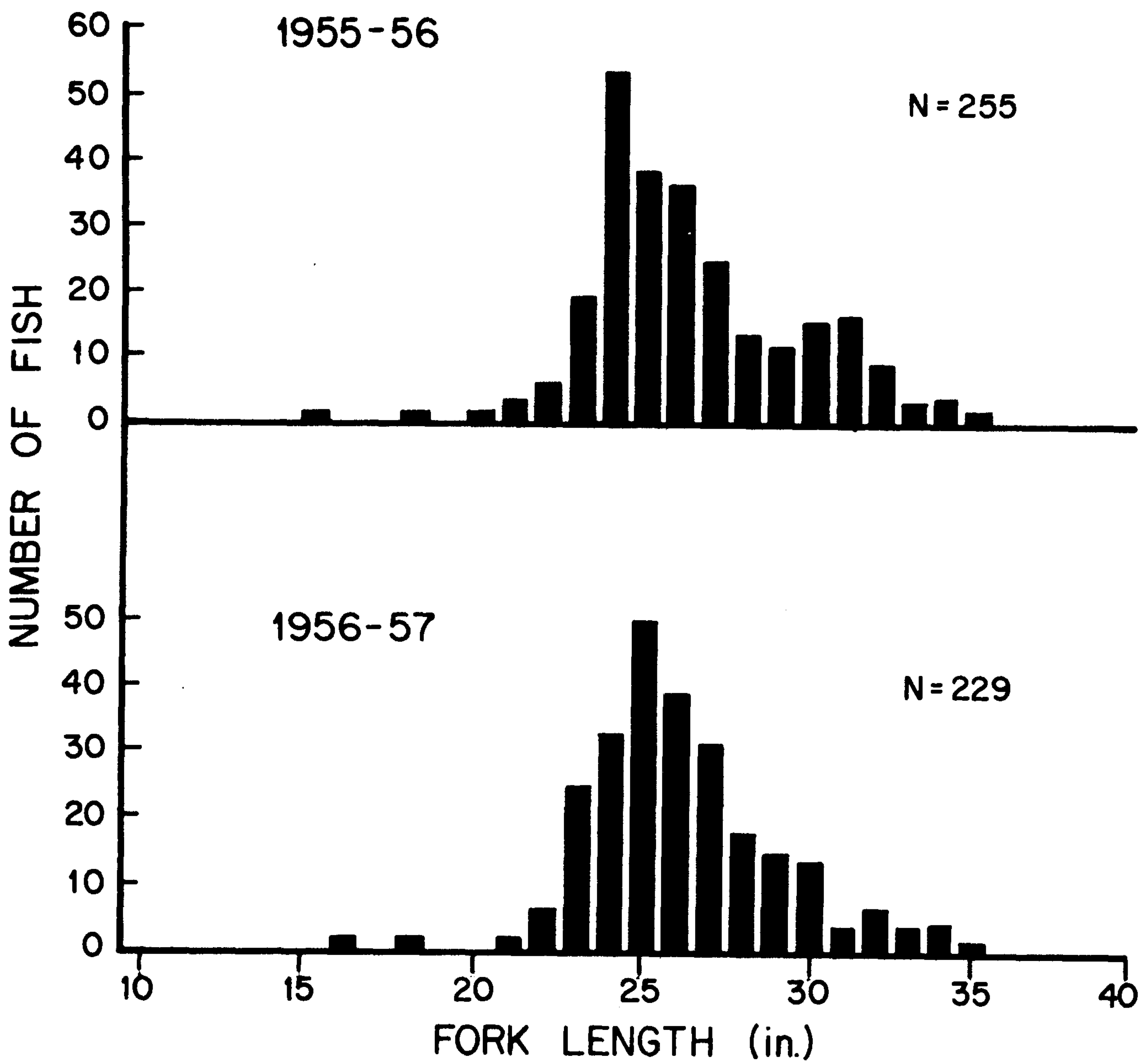

Figure 3. Size composition of adult steelhead counted at the Gnat Creek weir, 1955-57 (Kruse, undated). Fish were measured to the nearest one-half inch and grouped to the next lower inch.

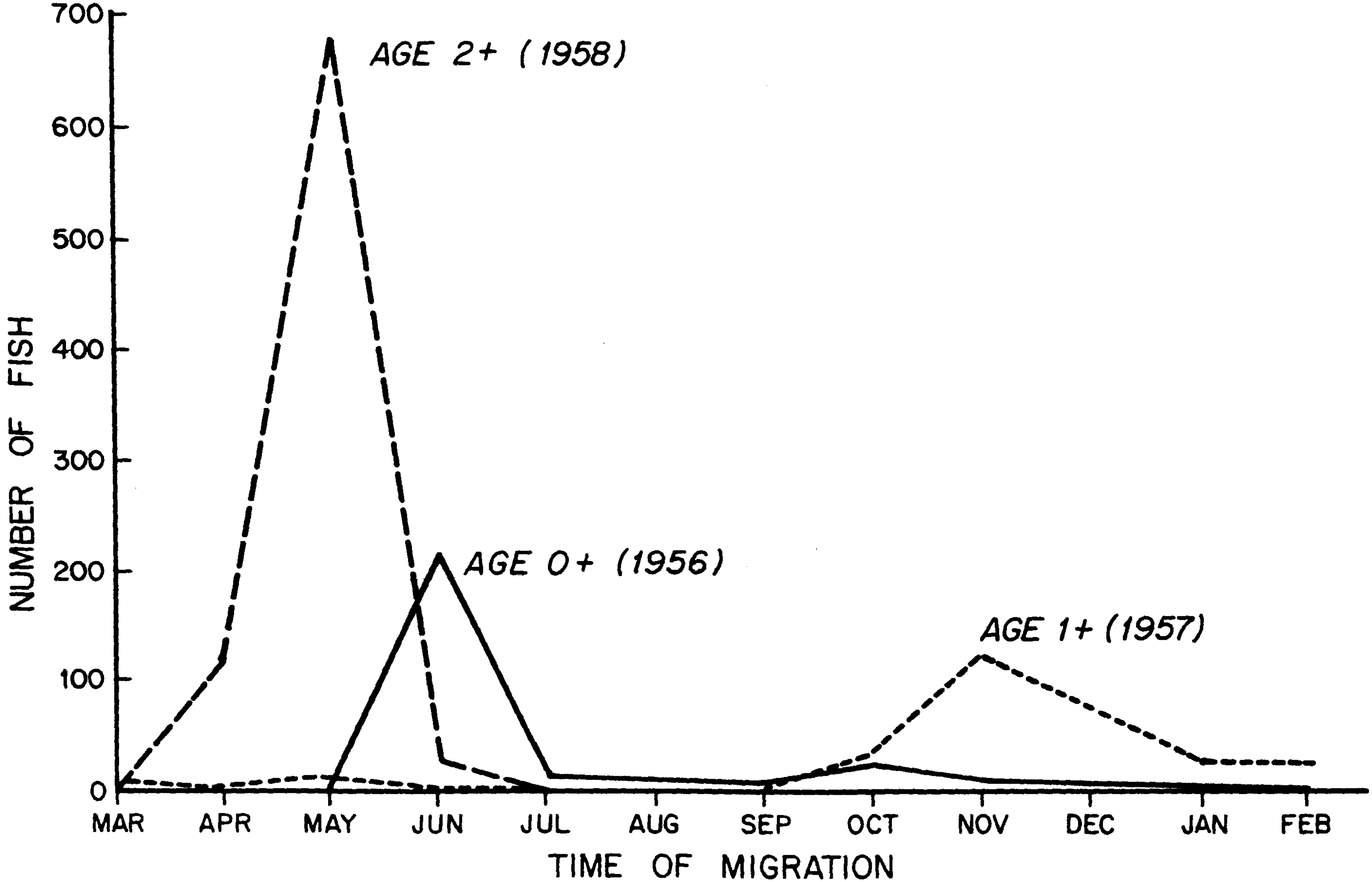

Figure 4. Numbers of wild juvenile steelhead (1956 brood; ages 0+, 1+, and 2+) downstream past the Gnat Creek weir 1956-58 (Kruse, undated).

was inflated since small cutthroat trout and steelhead could not be distinguished. Most of the juveniles smolted at age 2+ (Table 3).

Table 3. Age composition of downstream migrating juvenile steelhead captured at the Gnat Creek trap, October 1, 1955-October 31, 1958[a] (data from Kruse, undated).

Brood	Age 0+		Age 1+		Age 2+		
year	No.	%	No.	%	No.	%	Total
1954	NA		133	--	1,072	--	1,205
1955	25	1	131	7	1,710	92	1,866
1956	284	20	249	18	886	62	1,419
1957	87	--	303	--	NA		390
1958	16	--	NA		NA		16

[a] Percentage age composition was only calculated for 1955 and 1956 brood years. Other brood years had incomplete data.

Survival rate

No information.

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Catch and escapement of wild stock

2. Smolt production levels and capacities

3. Interactions of hatchery and wild stocks

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Big Creek Winter Steelhead (hatchery)

PRODUCTION

The Big Creek stock is the principal winter steelhead hatchery stock used in the lower Columbia system in Oregon. Annual smolt production averages about 700,000 fish (Table 1). Presmolt juveniles are also released.

Big Creek winter steelhead have established naturally reproducing populations in the Willamette River system. Approximately 20% and 25% of the returning adults were wild in 1982 and 1983, respectively (Buchanan and Wade 1982; Wade and Buchanan 1983).

Table 1. Big Creek winter steelhead production, 1976-82.

	Big Creek		Gnat Creek		Klaskanine		Roaring River	
Brood year	Finger-lings	Smolts	Finger-lings	Smolts	Finger-lings	Smolts	Finger-lings	Smolts
1976		73,378		522,327		61,079		144,078
1977		67,294		466,565		50,041		244,980
1978		145,665	292,587	527,194		64,224	36,634	165,031
1979		62,540	147,590	402,856		50,890	202,892	151,129
1980	127,581[a]	62,820		420,909		57,695	66,891	146,901
1981	5,604[a]	62,988		149,680		38,862		130,496
1982		62,084	22,221	448,557		69,826	44,787	140,603
Average		76,681		419,727		56,088		160,460

[a] Fry.

GEOGRAPHIC LOCATION

Streams

Oregon tributaries of the lower Columbia River, lower Willamette River (including the Molalla, Tualatin, and Clackamas rivers), Sandy River, and Hood River (Appendix Figure 3).

Hatcheries

Big Creek, Gnat Creek, Klaskanine, and Roaring River hatcheries.

ORIGIN

The Big Creek stock was developed in the 1960s to provide an early fishery in December and January prior to the arrival of later returning native stocks. For this purpose, adults from the native Big Creek stock were selected that exhibited the earliest run timing and maturity.

ADULT LIFE HISTORY

Run size, catch, and escapement

Total run size entering the Columbia River is not known. The only available information on run size are counts made at Willamette Falls. Since 1970, the Big Creek component of the winter steelhead run above Willamette Falls has averaged 5,500 fish/year and ranged between 2,662 and 8,600 fish (Table 2). The estimated sport catch of Big Creek stock is not available. Combined catch of hatchery and wild stocks in streams where Big Creek stock may occur is listed in Table 3.

Table 2. Estimated numbers of adult Big Creek winter steelhead passing Willamette Falls,[a] 1970-85 (modified from Buckman and Warren 1983).

Run year	Run size
1970-71	8,016
1971-72	6,572
1972-73	6,239
1973-74	6,292
1974-75	3,096
1975-76	4,204
1976-77	5,323
1977-78	8,600
1978-79	2,835
1980-81	2,662
1981-82	6,106
1982-83	4,598
1983-84	6,680
1984-85	4,549

[a] Passing from October 15 to February 15; count may include some early migrating Willamette steelhead stocks (wild and hatchery).

Time of migration

Fish return to Big Creek and Klaskanine hatcheries December through March. The median time of return is in January. Winter steelhead passing

Table 3. Sport catch of winter steelhead by run-year in Oregon tributaries of the Columbia River system where Big Creek stock may occur, 1971-80 (Berry 1981).[a] Catch consists of Big Creek and native wild stocks.

Stream	Year								
	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Big Creek	3,946	2,333	2,080	3,705	2,042	1,147	3,419	1,238	3,216
Bullrun River	--	--	--	--	--	15	123	40	74
Butte Creek	--	--	--	--	--	21	32	16	36
Clackamas River[b]	8,856	2,612	1,628	4,753	2,335	2,083	4,863	3,252	6,467
Clatskanie River	673	271	686	1,027	1,198	222	783	455	816
Clear Creek	--	--	--	--	--	6	75	23	73
Collowash River	--	--	--	--	--	18	23	21	30
Collowash River, Hot Sp. Fork	--	--	--	--	--	--	--	113	7
Columbia River, Lower	930	896	507	725	460	1,215	651	237	626
Deep Creek	--	--	--	--	--	0	24	7	42
Eagle Creek (Columbia R.)	--	--	--	--	--	0	52	105	134
Gales Creek	--	--	--	--	--	145	209	11	324
Gnat Creek	351	250	319	668	499	163	423	202	754
Johnson Creek	19	12	10	32	4	0	21	14	9
Kellogg Lake	--	--	--	--	--	--	4	0	3
Klaskanine River	1,833	1,531	2,531	2,927	2,906	1,005	1,710	560	1,290
Klaskanine River, N.F.	--	--	--	--	--	152	1,433	951	2,283
Klaskanine River, S.F.	--	--	--	--	--	0	172	87	389
Lewis and Clark River	345	189	164	566	407	320	577	402	859
Mill Creek (Yamhill Co)	--	--	--	--	--	3	10	13	26
Milton Creek	--	--	--	--	--	0	20	13	29
Molalla River	323	570	419	589	573	882	1,294	498	2,062
Pudding River	--	--	--	--	--	3	23	3	33
Salmon River (Sandy R.)	--	--	--	--	--	--	--	--	19
Sandy River	10,315	5,640	5,937	8,738	7,566	3,286	11,385	6,867	12,926
Scappoose Creek	56	22	59	101	26	3	42	7	23
Scappoose Creek, N.F.	--	--	--	--	--	0	21	6	171
Scappoose Creek, S.F.	--	--	--	--	--	0	10	0	40
Silver Creek	--	--	--	--	--	--	--	--	20
Sucker Creek	35	6	21	5	0	3	17	6	33
Tanner Creek	--	--	--	--	--	3	14	13	16
Tualatin River	--	--	--	--	--	62	87	26	55
Willamete River, Lower	2,256	1,415	823	986	1,380	690	755	465	1,121
Willamina Creek	--	--	--	--	--	9	135	29	69
Yamhill River	--	--	--	--	--	--	8	0	3
Yamhill River, N.F.	--	--	--	--	--	9	18	0	7
Yamhill River, S.F.	--	--	--	--	--	--	15	0	0
Youngs River	--	--	--	--	--	6	14	0	23
Total	29,938	15,747	15,184	24,822	19,396	11,471	28,462	15,680	34,108

[a] Estimated from punch card returns and adjusted for non-response bias. Prior to 1977 the catch in most tributary streams was included in mainstem catch.

[b] Catch consists of Big Creek, Eagle Creek, and native wild stocks.

Willamette Falls prior to February are considered to be primarily Big Creek stock; fish passing after that date are classified as Willamette stock. The exact timing of the Big Creek run past Willamette Falls has not been determined. In 1980-81, most suspected Big Creek fish passed the falls between December 5 and January 15 (Figure 1). In 1981-82, the peak passage was December 25 to February 5 (Figure 1).

Spawning period

Adults are usually spawned in January.

Spawning areas

Big Creek Hatchery

Age composition

Scale analysis indicated that Big Creek winter steelhead returned primarily as 2-salt fish in 1982 and 1983. The remainder return as 3-salt fish, many of which are repeat spawners (M. Wade, ODFW, personal communication).

Size

The adults trapped at Willamette Falls in January and early February 1984 ranged in size from 61 cm to 81 cm (M. Wade, ODFW, personal communication).

Sex ratio

The sex ratio of fish passing Willamette Falls from 1 January through 15 February 1984 was approximately 50:50 (M. Wade, ODFW, personal communication). At Big Creek Hatchery in 1983-85, males comprised 41.5-57.5% of the returning adults.

Fecundity

The fecundity of females returning to Big Creek Hatchery in 1978-81 and in 1984 averaged between 4,000 and 5,000 eggs.

Biochemical-genetic characteristics

Preliminary data on isozyme gene frequencies have been reported by Schreck et al. (1984).

JUVENILE LIFE HISTORY

Time of emergence

Big Creek winter steelhead are spawned in mid-January at Big Creek Hatchery and the fertilized eggs are placed in 47°F spring water. The eggs require approximately 28-29 days to reach the eyed-egg stage. The fry are ponded about 38 days later (D. Rieben, ODFW, personal communication).

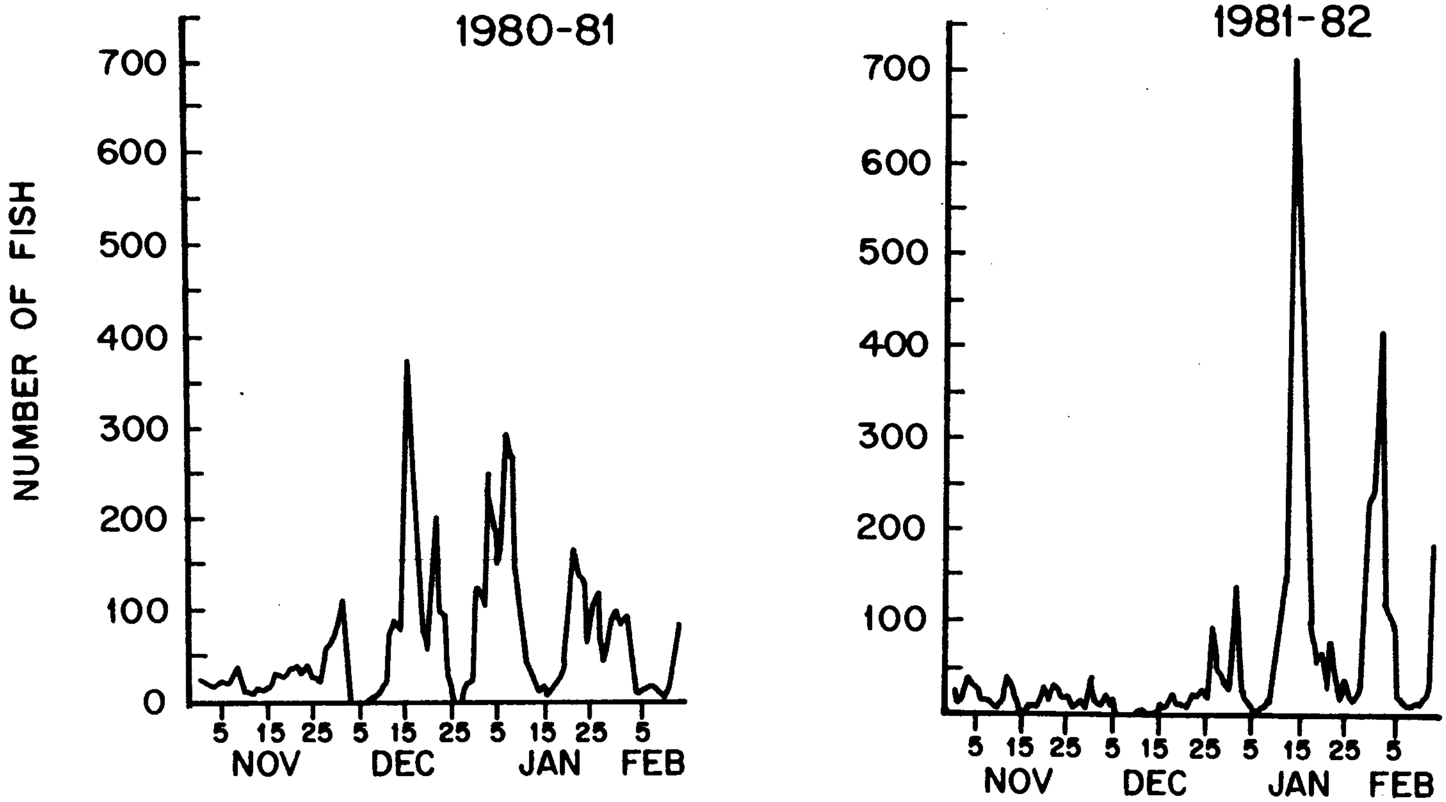

Figure 1. Daily counts of adult winter steelhead passing Willamette Falls, November 1-February 15, 1980-81 and 1981-82 (modified from Bennett 1982; 1983).

Time, age, and size at migration

Oregon hatcheries release Big Creek winter steelhead in April and May as age 1+ smolts. Smolts released in the Willamette River tributaries migrate over Willamette Falls from late April to late May, similar to the Willamette hatchery stock (Figure 2) (Buchanan and Wade 1982).

Survival rate

The egg-to-fry survival for Big Creek winter steelhead was 83% in 1984. Smolt-to-adult survival to return was approximately 1.0-1.5% at Big Creek Hatchery in 1983-85 (D. Rieben, ODFW, personal communication).

DISEASE HISTORY

Furunculosis, enteric redmouth, cold-water disease, and ectoparasites are common diseases affecting Big Creek stock in Oregon hatcheries (Table 4). No viruses were detected in winter steelhead at Big Creek Hatchery from 1978-85 (R. Holt, ODFW, personal communication).

PRIORITY INFORMATION NEEDS

1. Run size, catch, and escapement
2. Contribution to natural production
3. Mortality of smolts passing through downstream migrant facilities at Willamette Falls
4. Time of migration over Willamette Falls
5. Spawning period and location
6. Smolt-to-adult survival rate
7. Distribution in the Willamette system
8. Interactions with native wild stocks
9. Validation of Willamette Falls fish counts (possible inflation of counts due to fall back).

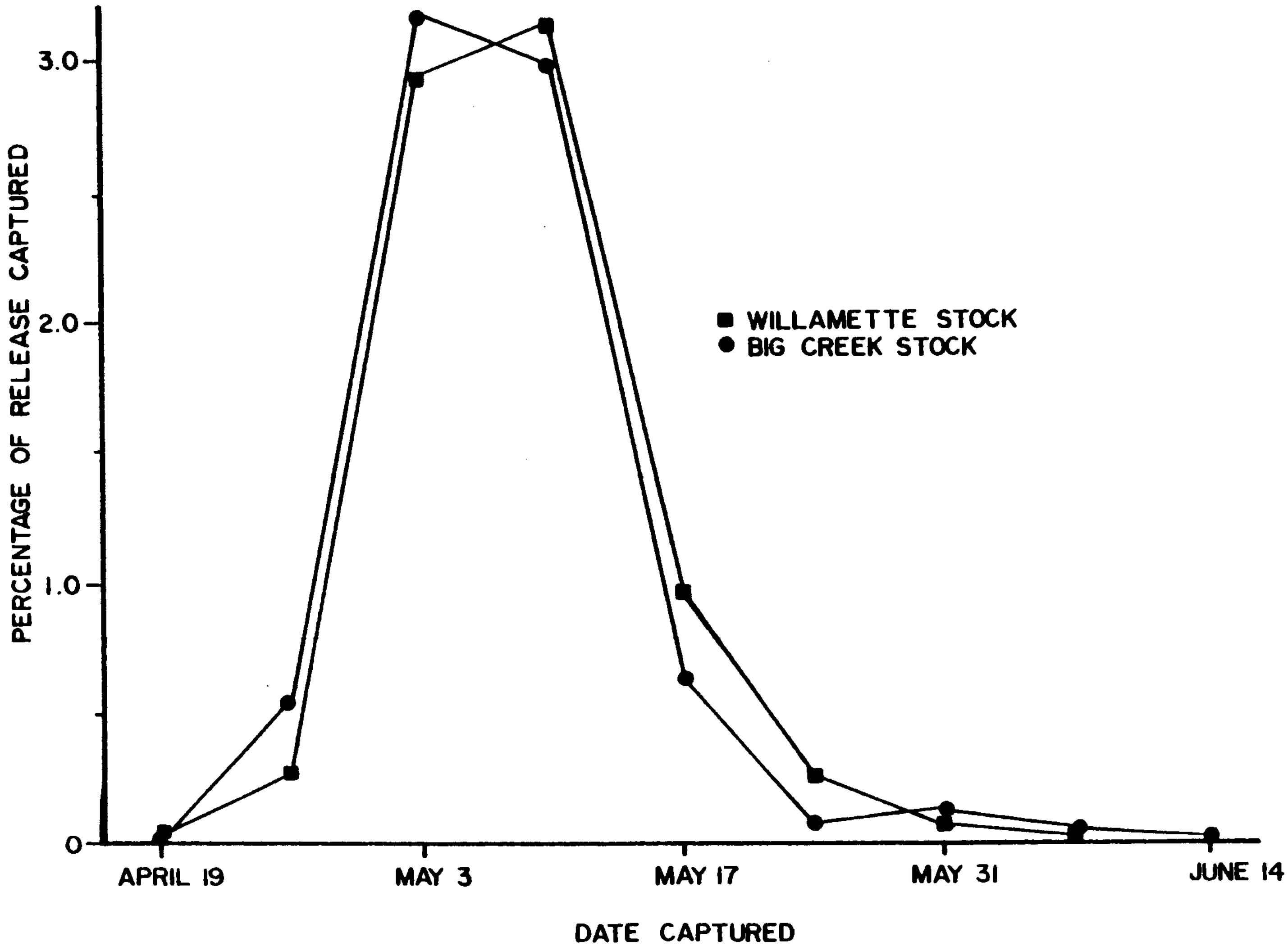

Figure 2. Timing and rate of capture at Willamette Falls of Big Creek and Willamette smolts released in the Molalla River in spring 1982 (Buchanan and Wade 1982).

Table 4. Disease history of Big Creek winter steelhead in Oregon hatcheries[a] (T. Kreps, ODFW, unpublished data).

Date/ year disease found	Diseases Certifiable					Diseases Noncertifiable						
	BKD	Furunc.	E. Redmouth	Virus: IHN, IPN VEN	Myxo- sporidian	CWD	Columnaris	Bacterial Gill Disease	Ecto- parasites Costia, etc.	Gill Amoeba	ICH	Misc. Bact.
1968		+							+		+	
1969		+							+			
1970		+	+			+			+			
1971		+	+			+			+			
1972		+			+	+			+			+
1973		+							+			
1974									+			
1975		+	+					+	+			
1976		+	+			+			+			
1977	+	+	+						+			
1978			+			+			+			
1979			+			+			+			
1980			+			+			+			

[a] Big Creek, Gnat Creek, and Klaskanine hatcheries.

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Grays River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Grays River, Washington, a tributary to the lower Columbia River (RM 20.8) that drains a watershed of 124 square miles.

ORIGIN

The Grays River stock is native, although some interbreeding with the introduced Chambers Creek, Cowlitz and Elochoman winter-run hatchery steelhead stocks has likely occurred.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement exist. Stock abundance has likely declined from former levels of nearly 2,000 fish in the 1920's and 30's due to habitat degradation in the Grays River watershed (WDG 1936; B. Crawford, WDG, personal communication). Harvest of the stock occurs in the mainstem Columbia recreational fishery, as well as in the Grays River. The annual sport harvest of wild and hatchery-origin winter steelhead in the Grays River is approximately 600 (5-year average, based on punchcard returns). An interim escapement goal of 1,422 spawners has been established for this stock.

Time of migration

Wild winter steelhead enter the Grays River from January through May, peaking in March.

Spawning period

March through June.

Spawning areas

Wild steelhead extensively utilize spawning and rearing habitat in the Grays River watershed, including most of the mainstem and portions of the East, South and West Forks (Figure 1).

Age composition

Unknown.

Size

Unknown.

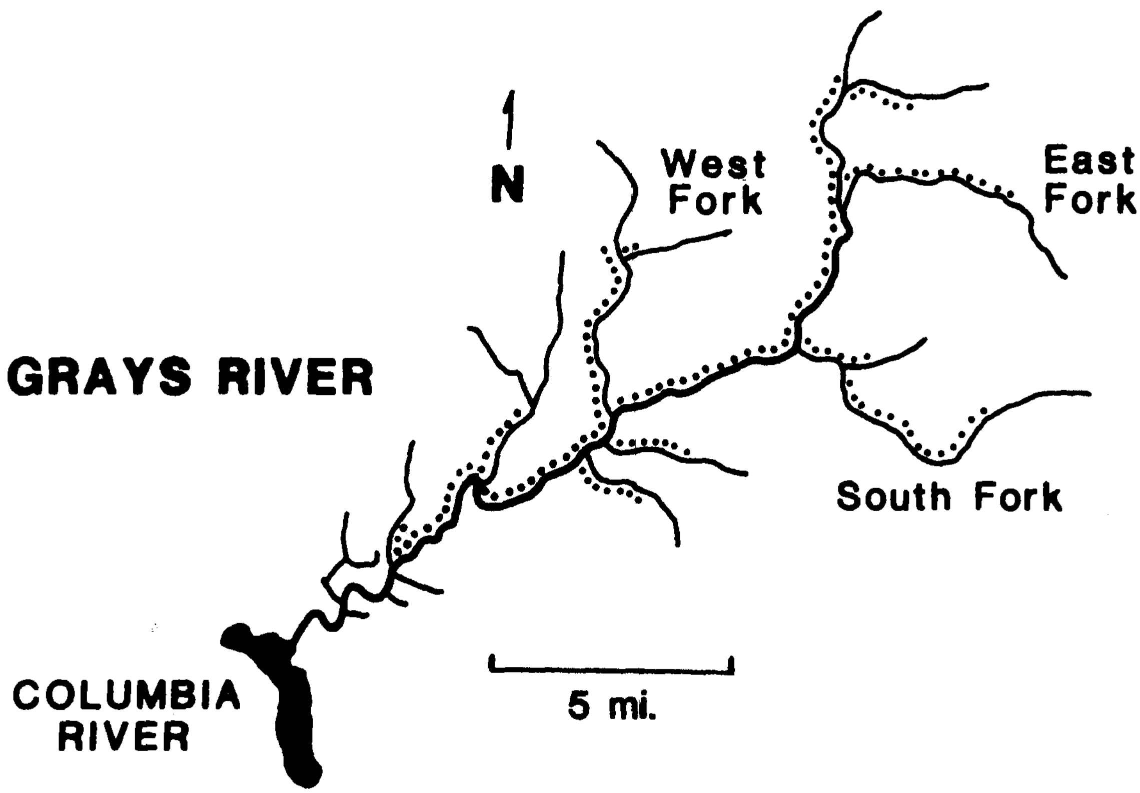

Figure 1. Probable spawning areas of wild steelhead trout in Grays River, Washington (B. Lucas, WDG, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts outmigrate in April and May (peak in early May) at an age of 2 years and a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

WDG (Washington Department of Game). 1936. Commercial catch of steelheads - Columbia River watershed. Unpublished report.

Skamokawa Creek Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Skamokawa Creek, Washington, a tributary to the lower Columbia River (RM 33.3) that drains a watershed of 50.6 square miles.

ORIGIN

The Skamokawa Creek stock is indigenous, but some interbreeding with the introduced Chambers Creek, Cowlitz and Elochoman River winter-run hatchery steelhead stocks has probably occurred.

ADULT LIFE HISTORY

Runsize, catch and escapement:

No accurate estimates of wild run size, catch or escapement are available. Harvest of the stock occurs in the mainstem Columbia recreational fishery and in Skamokawa Creek. The annual sport harvest of wild and hatchery-origin winter steelhead in Skamokawa Creek is approximately 10 (5-year average, based on punchcard returns). To date, no escapement goal has been formulated for this stock.

Time of migration

Probably similar to other wild winter steelhead in lower Columbia River tributaries - January through May with a peak in March.

Spawning period:

March through June.

Spawning areas

Steelhead utilize much of Wilson Creek and the mainstem Skamokawa (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

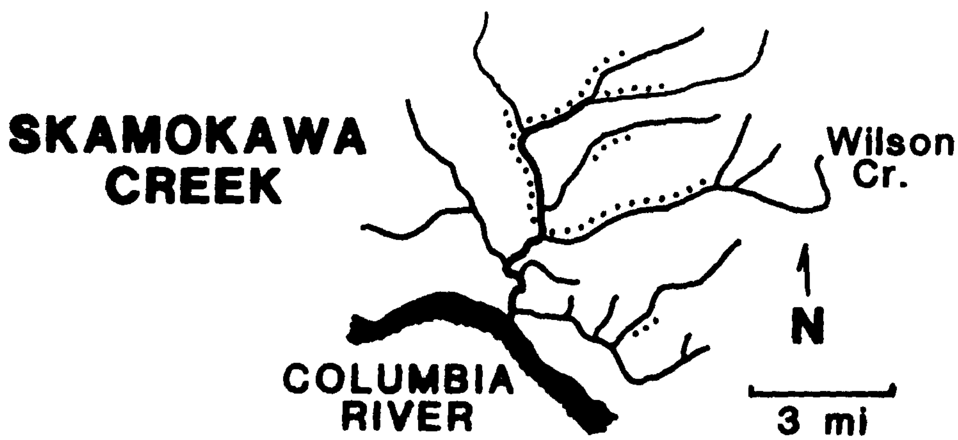

Figure 1. Probable spawning sites of wild winter steelhead in Skamokawa Creek, Washington (B. Lucas, Washington Department of Game, personal communication).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts migrate to the ocean in April and May at 2 years of age and at a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Elochoman River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Elochoman River, Washington, a tributary to the lower Columbia River (RM 39.1) that drains an area of 73.3 square miles.

ORIGIN

The Elochoman River stock is native, although interbreeding with the introduced Chambers Creek, Cowlitz and Elochoman hatchery-origin winter steelhead stocks has probably taken place.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement are not available. Harvest of the stock occurs in mainstem Columbia and Elochoman River sport fisheries. The annual sport harvest of wild and hatchery-origin winter steelhead in the Elochoman is approximately 3,550 (5-year average, based on punchcard returns). An interim escapement goal of 1,078 wild steelhead has been established for this stock.

Time of migration

January through May, peaking in March. Formerly, wild steelhead were found in the Elochoman as early as December (Watson 1964). However, heavy fishing pressure directed at hatchery-origin adults in December and January may have selected for late-returning wild fish, causing a shift in the migration timing of the wild stock.

Spawning period

March through June.

Spawning areas

Wild steelhead spawn throughout the mainstem Elochoman and in the lower reaches of Beaver Creek and the East, North and West Forks (Figure 1).

Age composition

Unknown.

Size

Watson (1964) separated wild and hatchery adults based on dorsal fin condition and determined the average length of wild Elochoman winter steelhead to be 27 inches (Table 1).

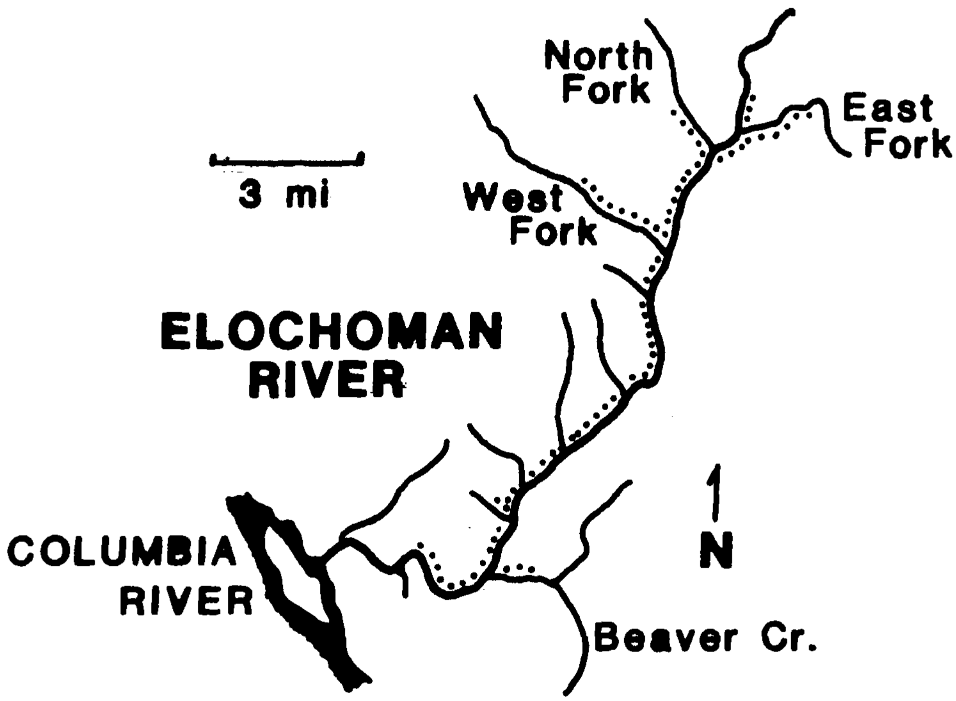

Figure 1. Probable spawning locations of wild winter steelhead in the Elochoman River, Washington (B. Lucas, Washington Department of Game, personal communication).

Table 1. Average length of wild winter steelhead in the Elochoman River, Washington, 1962-63 and 1963-64 runs.

RUN YEAR	AVERAGE LENGTH (IN.) MALE	FEMALE
1962-63	26.9	27.3
1963-64	26.6	26.6

Sex ratio

The male:female ratio of the wild stock was 1.69 (n = 35) in 1962-63 and 1.05 (n = 39) in 1963-64 (Watson 1964).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

The majority of wild smolts outmigrate in April and May (peak in early May) at an age of 2 years and a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

Watson, R. 1964. Elokomin River adult steelhead tagging report, 1963-1964. Washington Department of Game.

Elochoman River Winter Steelhead (hatchery)

PRODUCTION

Elochoman stock steelhead are artificially propagated in hatchery environments. Approximately 400,000-500,000 smolts of this stock are released annually.

GEOGRAPHIC LOCATION

Streams

Since 1970, Elochoman stock steelhead have been planted in numerous Washington tributaries to the Columbia River, including Grays River (RM 20.8), Skamokawa Creek (RM 33.3), Elochoman River (RM 39.1), Abernathy Creek (RM 54.3), Germany Creek (RM 56.2), Coal Creek (RM 56.4), Coweeman River (tributary to Cowlitz River, RM 68.0), Kalama River (RM 73.1), North and East forks of Lewis River (RM 87.0), Salmon Creek (tributary to Lake River, RM 87.5), Washougal River (RM 120.7), and Big White Salmon River (RM 168.3).

Hatcheries

Eggs are taken from Elochoman stock adults returning to Beaver Creek Hatchery, located on the Elochoman River, Washington, a tributary to the Columbia River at RM 39.1. Juveniles are reared primarily at Beaver Creek Hatchery, but the following facilities have also reared Elochoman stock steelhead in recent years: Cowlitz, Vancouver and Skamania hatcheries, and Alder and Gobar creek rearing ponds.

ORIGIN

The Elochoman stock was developed in the late 1950's at Beaver Creek Hatchery. Original brood stock were predominantly native Elochoman River steelhead and Chambers Creek hatchery stock steelhead, and to a lesser degree native Cowlitz River steelhead (Crawford 1979; J. Gearheard, Washington Department of Game (WDG), personal communication).

ADULT LIFE HISTORY

Run size, catch, and escapement

Data concerning run size, catch and escapement of Elochoman stock returnees are limited (see "Survival rate" section of this stock summary). Harvest of the stock occurs primarily in rivers where juveniles were planted, but also in mainstem Columbia fisheries. The interim escapement goal to Beaver Creek Hatchery is 492.

Time of migration

Elochoman hatchery-stock steelhead arrive at the Elochoman River in mid-November, peaking in December and January (S. Woody, WDG, personal communication).

Spawning period

On the average, spawning at Beaver Creek Hatchery begins in mid-December, peaks in January, and tapers off by mid-February (Table 1).

Spawning areas

Beaver Creek Hatchery.

Age composition

Length-frequency data indicate approximately 70-90% of hatchery winter steelhead returning to Beaver Creek Hatchery are age 1.1+ (B. Lucas, WDG, personal communication). Using a modified notation of Narver and Withler (1971), age 1.1+ represents a fish with 1 year of freshwater growth (i.e., hatchery-origin) and approximately 1-1/2 years of marine growth (1+) prior to its capture in freshwater on its spawning migration. Hence, Elochoman stock steelhead are predominantly 2-salts.

Size

Steelhead spawned in 1983-84 averaged 65.1 cm in length, ranging from 55.4 cm to 80.0 cm (L. Sisson, WDG, personal communication).

Sex ratio

Of adults trapped at Beaver Creek Hatchery in 1982-83 and 1983-84, male:female sex ratios were 0.80 and 1.01, respectively (L. Sisson, WDG, personal communication).

Fecundity

Average fecundity of this stock is 2,850 eggs per female (Table 1).

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

After a year of freshwater rearing, smolts are planted in April and May at a size of 4-7 to the pound.

Table 1. Fecundity of Elochoman hatchery stock winter steelhead, 1978-79 through 1982-83 (data from WDG 1980, 1981, 1982, 1984a and 1984b, respectively).

RUN YEAR	NUMBER FEMALES	EGG-TAKE DECEMBER	JANUARY	FEBRUARY	TOTAL	FECUNDITY (EGGS/FEMALE)
1978-79	185	-	-	-	546,960	2,957
1979-80	147	0	209,212	284,836	494,048	3,361
1980-81	323	655,428	495,360	0	1,150,788	3,563
1981-82	430	70,227	384,592	398,696	853,515	1,985
1982-83	360	63,000	795,000	0	858,000	2,383

Survival rate

Crawford (WDG, personal communication) estimates egg to plant survival of this stock to be about 75% in the absence of major disease outbreaks. Accurate estimates of egg to plant survival are not available at present.

Smolt to adult survival rates for juvenile Elochoman stock steelhead planted in the Elochoman River between 1976 and 1982 ranged from 2.06% to 4.46%, averaging 3.15% (Table 2). However, these survival estimates are likely low due to bias originating from: 1) failure to account for harvest of hatchery adults in the lower Columbia River sport fishery; 2) use of a "best-guesstimate" of hatchery composition of sport catch; and 3) failure to account for natural spawning escapement of hatchery adults. Accurate estimation of smolt to adult survival is contingent upon correcting these biases.

DISEASE HISTORY

Elochman stock steelhead have periodically been afflicted with infectious hematopoietic necrosis (IHN) virus in recent years.

PRIORITY INFORMATION NEEDS

Three characteristics of Elochoman stock steelhead merit detailed study: 1) timing of spawning in the natural environment, 2) contribution of resulting offspring to wild populations, and 3) extent of sport and tribal interceptions of upriver-bound Elochoman stock adults in the mainstem Columbia River.

Table 2. Smolt to adult survival rates of Elochoman hatchery-stock winter steelhead planted in the Elochoman River, Washington, between 1976 and 1982.

RUN YEAR	SPORT CATCH 1/ TOTAL	HATCHERY	NO. ADULTS TRAPPED 2/	HATCHERY RUN SIZE 3/	SMOLT PLANT 4/	PERCENT RETURN 5/
1977-78	3,050	2,288	537	2,825	96,857	2.92
1978-79	2,406	1,804	744	2,548	93,988	2.71
1979-80	4,655	3,491	675	4,166	107,416	3.88
1980-81	3,816	2,862	1,111	3,973	115,894	3.43
1981-82	2,004	1,503	557	2,060	99,964	2.06
1982-83	2,948	2,211	649	2,860	109,175	2.62
1983-84	4,318	3,238	2,148	5,386	120,870	4.46

1/ Estimated from punchcard returns; catch of hatchery-origin fish equals total catch multiplied by 75% hatchery composition (B. Crawford, WDG, personal communiction).

2/ All trapped adults assumed hatchery-origin since all adults trapped in 1981-82 and 1982-83 had stubbed dorsal fins, indicating hatchery-origin (WDG 1984a, 1984b); trap counts from WDG (1978, 1980, 1981, 1982, 1984a, and 1984b) and L. Sisson (WDG, personal communication).

3/ Run size assumed equal to hatchery sport catch plus number of adults trapped, although three biases exist: a) some trapped fish are released and thus may be counted twice or more if they return to the trap or are harvested; b) some hatchery-origin returnees likely escape capture to spawn naturally; c) some hatchery-origin adults are harvested in the lower Columbia River sport fishery.

4/ Smolt plant 1-1/2 years earlier used (e.g. 1982 plant for 1983-84 run) since a majority of hatchery-origin adults return after 1-1/2 years of marine growth (B. Lucas, WDG, personal communication).

5/ % return = hatchery run size divided by smolt plant.

REFERENCES

Crawford, B. A. 1979. The origin and history of the trout brood stocks of the Washington Department of Game. Washington Department of Game report.

Narver, D. W., and F. C. Withler. 1971. Age and size of steelhead trout (Salmo gairdneri) in anglers' catches from Vancouver Island, British Columbia, streams. Fish. Res. Bd. Can. Circ. 91.

WDG (Washington Department of Game). 1978. Operation and maintenance - Beaver Creek and Skamania Hatcheries and Ringold Rearing Pond: October 1, 1977-September 30, 1978. Washington Department of Game report.

WDG. 1980. Operation and maintenance - Beaver Creek and Skamania Hatcheries and Ringold Rearing Station: October 1, 1978-September 30, 1979. Washington Department of Game report 80-4.

WDG. 1981. Operation and maintenance - Beaver Creek and Skamania Hatcheries and Ringold Rearing Station: October 1, 1979-September 30, 1980. Washington Department of Game report 81-3.

WDG. 1982. Operation and maintenance - Beaver Creek and Skamania Hatcheries and Ringold Rearing Station: October 1, 1980-Sepgember 30, 1981. Washington Department of Game report.

WDG. 1984a. Operation and maintenance - Beaver Creek and Skamania Hatcheries and Ringold Rearing Station: October 1, 1981-September 30, 1982. Washington Department of Game report 84-1.

WDG. 1984b. Operation and maintenance - Beaver Creek and Skamania Hatcheries and Ringold Rearing Station: October 1, 1982-September 30, 1983. Washington Department of Game report 84-7.

Chambers Creek Winter Steelhead (hatchery)

PRODUCTION

Chambers Creek steelhead are artificially propagated in hatchery environments. Numbers of Chambers Creek smolts released annually into the Columbia Basin vary (e.g. over 400,000 in 1983, none in 1984).

GEOGRAPHIC LOCATION

Streams

Columbia River tributaries receiving plants of this stock since 1970 include Grays River (Columbia RM 20.8), Skamokawa Creek (RM 33.3), Elochoman River (RM 39.1), Abernathy Creek (RM 54.3), Germany Creek (RM 56.2), Coweeman and Toutle rivers (tributaries to Cowlitz River, RM 68.0), Kalama River (RM 73.1), North and East forks of Lewis River (RM 87.0), Salmon Creek (tributary to Lake River, RM 87.5), Washougal River (RM 120.7), and Big White Salmon River (RM 168.3).

Hatcheries

Eggs are taken primarily from adults returning to Chambers Creek (a tributary to Puget Sound), but also from Chambers Creek stock adults returning to the Bogachiel, Green, Samish, Skagit, Snohomish and Stilliguamish rivers, Washington. Most Chambers Creek steelhead are released in Puget Sound and coastal rivers, but this stock has been used in the Columbia River to develop the Elochoman, Cowlitz, and Skamania winter steelhead stocks and to supplement existing hatchery production (B. Crawford and J. Gearheard, Washington Department of Game (WDG), personal communication). In the Columbia River Basin, juveniles have been reared at Beaver Creek and Skamania hatcheries and Alder Creek Rearing Pond.

ORIGIN

The Chambers Creek stock was developed in the mid-1940's from predominantly native Chambers Creek stock and, to a lesser extent, other winter steelhead returning to Chambers Creek, Washington (Crawford 1979; J. Gearheard, WDG, personal communication).

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of stock run size, catch and escapement are unavailable. Harvest of the stock occurs primarily in rivers where juveniles were planted, but also in mainstem Columbia sport and tribal fisheries. No escapement goal has been established for this stock in the Columbia Basin.

Time of migration

Chambers Creek steelhead return to tributaries of the Columbia River from mid-November through February, peaking in December and early January.

Spawning period

Eggs are presently taken in December and January from adults returning to Chambers Creek (Crawford 1979).

Spawning areas

Chambers Creek adults are spawned primarily at Chambers Creek weir.

Age composition

Age composition of Chambers Creek adults returning to the Columbia Basin is unknown.

Size

Sizes of Chambers Creek adults returning to the Columbia Basin are unknown.

Sex ratio

Sex ratios of Chambers Creek adults returning to the Columbia Basin are unknown.

Fecundity

Average fecundity of adult returns to Chambers Creek is 4,443 eggs, with a range of 2,562 to 7,425 (Crawford 1979).

Biochemical-genetic characteristics

Approximately 45.5% of Chambers Creek winter steelhead have 59 chromosomes and 54.5% have 60 chromosomes (Thorgaard 1977).

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

After a year of freshwater rearing, smolts are planted in April and May at a size of 4-7 to the pound.

Survival rate

Survival rates of Chambers Creek fish in the Columbia Basin are unknown.

DISEASE HISTORY

Disease history of Chambers Creek fish in the Columbia Basin is unknown.

PRIORITY INFORMATION NEEDS

Three characteristics of Chambers Creek steelhead in the Columbia Basin merit detailed study: 1) timing of spawning in the natural environment, 2) contribution of resulting offspring to wild stocks, and 3) extent of sport and tribal interceptions of upriver-bound Chambers Creek adults in the mainstem Columbia River.

REFERENCES

Crawford, B. A. 1979. The origin and history of the trout brood stocks of the Washington Department of Game. Washington Department of Game report.

Thorgaard, G. H. 1977. Chromosome studies of steelhead. In Genetic implications of steelhead management. California Cooperative Fishery Research Unit Special Report 77-1.

Mill Creek Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Mill Creek, Washington, a tributary to the lower Columbia River (RM 53.9) that drains a watershed of 29.1 square miles.

ORIGIN

The Mill Creek stock is native, although some genetic influence (i.e., interbreeding) from stray hatchery fish is likely.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement exist. The stock is harvested in mainstem Columbia and Mill Creek sport fisheries. The annual sport harvest of wild and stray winter steelhead in Mill Creek is approximately 10 (5-year average, based on punchcard returns). At present, no escapement goal has been set for this stock.

Time of migration

December through March (based on timing of sport catch).

Spawning period

Probably similar to other wild winter steelhead spawners in the lower Columbia River - March through June.

Spawning areas

Wild winter steelhead utilize the lower 6-7 miles of mainstem Mill Creek and the lower reaches of Little Mill Creek (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

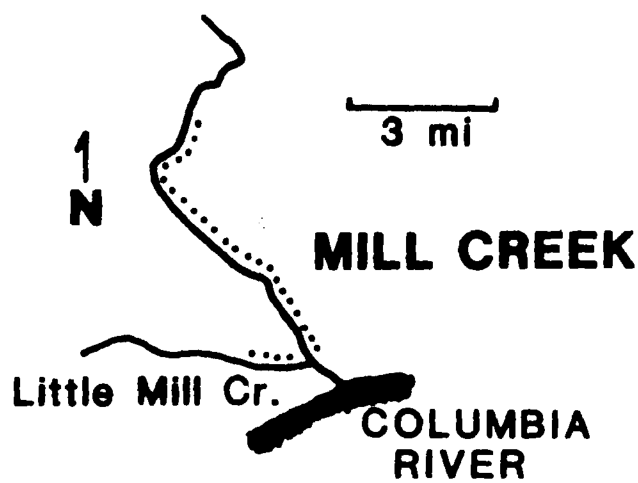

Figure 1. Probable spawning areas of steelhead trout in Mill Creek, Washington (B. Lucas, Washington Department of Game, personal commuication).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts likely migrate from fresh to saltwater in April and May at 2 years of age and at a length of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Abernathy Creek Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Abernathy Creek, Washington, a tributary to the lower Columbia River (RM 54.3) that drains a watershed of 28.7 square miles.

ORIGIN

The Abernathy Creek stock is native, although some interbreeding with the introduced Chambers Creek, Cowlitz and Elochoman hatchery-origin winter steelhead stocks has probably occurred.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement are available, although Lucas (Washington Department of Game (WDG), personal communication) electrofished much of the drainage and found it underseeded with juveniles. Harvest of the stock occurs in the mainstem Columbia recreational fishery, as well as in Abernathy Creek. The annual sport harvest of wild and hatchery-origin winter steelhead in Abernathy Creek is approximately 80 (5-year average, based on punchcard returns). As yet, no escapement goal has been assigned to this stock.

Time of migration

Probably February through May, peaking in March.

Spawning period

March through June.

Spawning areas

Steelhead spawn through most of mainstem Abernathy Creek and in the lower portions of many of its tributaries (Figure 1).

Age composition

Unknown.

Size

Unknown.

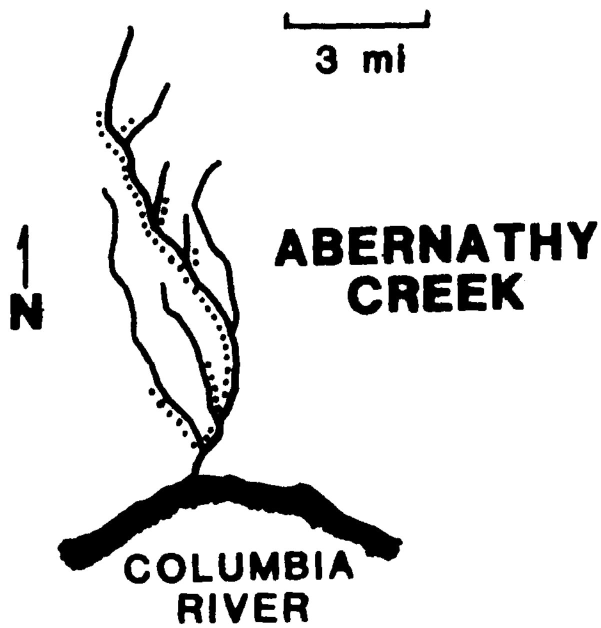

Figure 1. Probable spawning locations of wild winter steelhead in Abernathy Creek, Washington (B. Lucas, WDG, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wild juveniles in Abernathy Creek likely outmigrate as 2-year old smolts in April and May, having attained a length of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unkown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Germany Creek Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRPAHIC LOCATION

Germany Creek, Washington, a tributary to the lower Columbia River (RM 56.2) that drains a watershed of 22.5 square miles.

ORIGIN

The Germany Creek stock is indigenous, but some interbreeding with the introduced Chambers Creek, Cowlitz and Elochoman hatchery winter steelhead stocks has probably taken place.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement are unavailable, but Lucas (Washington Department of Game (WDG), personal communication) believes Germany Creek is underseeded. The stock is harvested in mainstem Columbia and Germany Creek recreational fisheries. The annual sport catch of wild and hatchery-origin winter steelhead in Germany Creek is approximately 240 (5-year average, based on punchcard returns). To date, no escapement goal has been formulated for this stock.

Time of migration

Likely January through May, with peak movement in March.

Spawning period

March through June.

Spawning areas

Wild steelhead spawn through most of mainstem Germany Creek (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

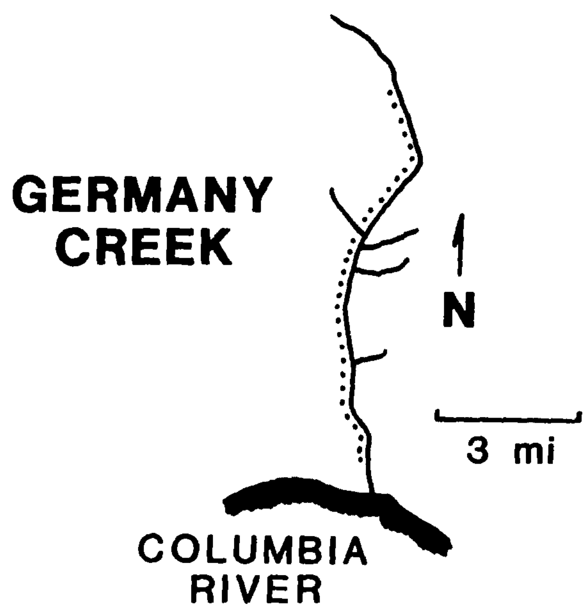

Figure 1. Probable spawning sites of steelhead trout in Germany Creek, Washington (B. Lucas, WDG, personal communication).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Much like other wild winter fish in the lower Columbia, Germany Creek smolts are estimated to be 2 years old when they outmigrate in April and May at a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Coal Creek Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Coal Creek, Washington, a tributary to the lower Columbia River (RM 56.4) that drains a watershed of 26.9 square miles.

ORIGIN

The Coal Creek stock is native, although some interbreeding likely occurred with introduced Elochoman hatchery-origin winter steelhead and other hatchery strays.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement exist. Harvest of the stock occurs in the mainstem Columbia recreational fishery, as well as in Coal Creek. The annual sport catch of wild and hatchery-origin winter steelhead in Coal Creek is approximately 20 (5-year average, based on punchcard returns). An escapement goal has yet to be established for this stock.

Time of migration

January through March (based on timing of sport catch).

Spawning period

Probably March through June.

Spawning areas

Steelhead spawn in the lower reaches of Coal Creek (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

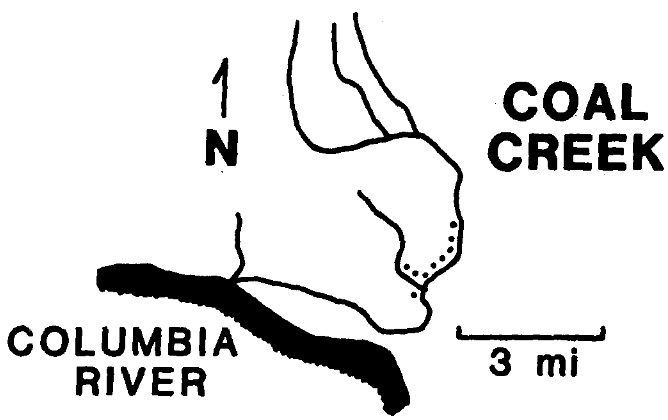

Figure 1. Probable spawning areas of steelhead trout in Coal Creek, Washington (B. Lucas, Washington Department of Game, personal communication).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wild Coal Creek winter steelhead smolts likely outmigrate in April and May as 160 mm 2-year olds.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Coweeman River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Coweeman River, Washington, a tributary to the Cowlitz River (Columbia RM 68.0) that drains a watershed of 127 square miles.

ORIGIN

The Coweeman River stock is native, but some interbreeding with the introduced Chambers Creek, Cowlitz and Elochoman hatchery winter steelhead stocks has probably occurred.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement are not available. Harvest of the stock occurs in the mainstem Columbia recreational fishery and in the Coweeman River. The annual sport harvest of wild and hatchery-origin winter steelhead in the Coweeman River is approximately 550 (5-year average, based on punchcard returns). An interim escapement goal of 1,488 steelhead has been established for this stock.

Time of migration

Probably January through May, peaking in March.

Spawning period

March through June.

Spawning areas

Wild steelhead utilize most of the mainstem Coweeman and Goble Creek, and the lower portions of Mulholland and Baird creeks (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

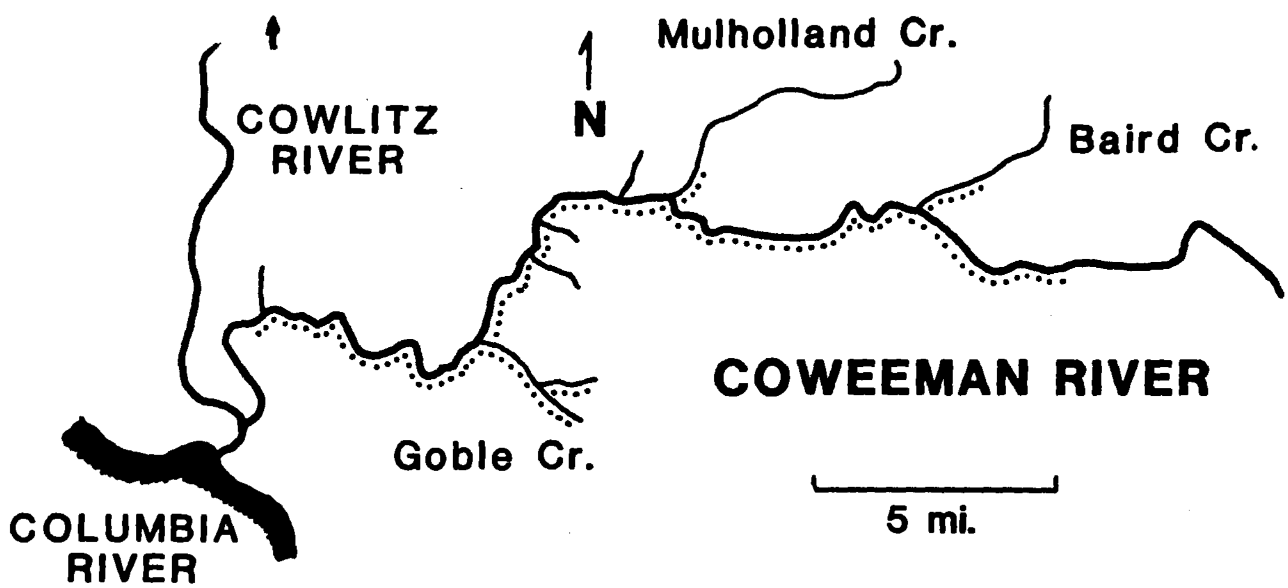

Figure 1. Probable spawning sites of wild winter steelhead in the Coweeman River, Washington (B. Lucas, Washington Department of Game, personal communication).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wild Coweeman River juveniles probably outmigrate in April and May (peaking in early May) at an age of 2 years and a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

Toutle River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Toutle River, Washington, a tributary to the Cowlitz River (Columbia RM 68.0) that drains a watershed of approximately 512 square miles.

ORIGIN

The Toutle River stock is native, although some genetic influence (i.e., interbreeding) from the introduced Chambers Creek and Cowlitz hatchery-origin winter steelhead stocks is likely.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size exist. Harvest of the stock occurs in the mainstem Columbia and lower Cowlitz River sport fisheries. There has been no sport harvest of steelhead in the Toutle River since the eruption of Mount St. Helens in May of 1980. The interim escapement goal for this stock is 3,527 wild fish.

Time of migration

January through May, with peak movement in March and April (B. Lucas, Washington Department of Game (WDG), personal communication).

Spawning period

March through June.

Spawning areas

A significant portion of the spawning gravels available to steelhead prior to 1980 were rendered useless by the eruption of Mount St. Helens (Figure 1).

Age composition

Age of returning wild adults was obtained during trap operations on the South Fork Toutle River in April and May of 1981 (Table 1). Of fish with readable scales, 8.1% were 1-ocean, 70.3% were 2-ocean, 10.8% were 3-ocean and 10.8% were repeat spawners.

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 2.1+S+ would represent a fish with 2 years of freshwater growth, approximately 1-1/2 years of marine growth prior to spawning (1+), part of a

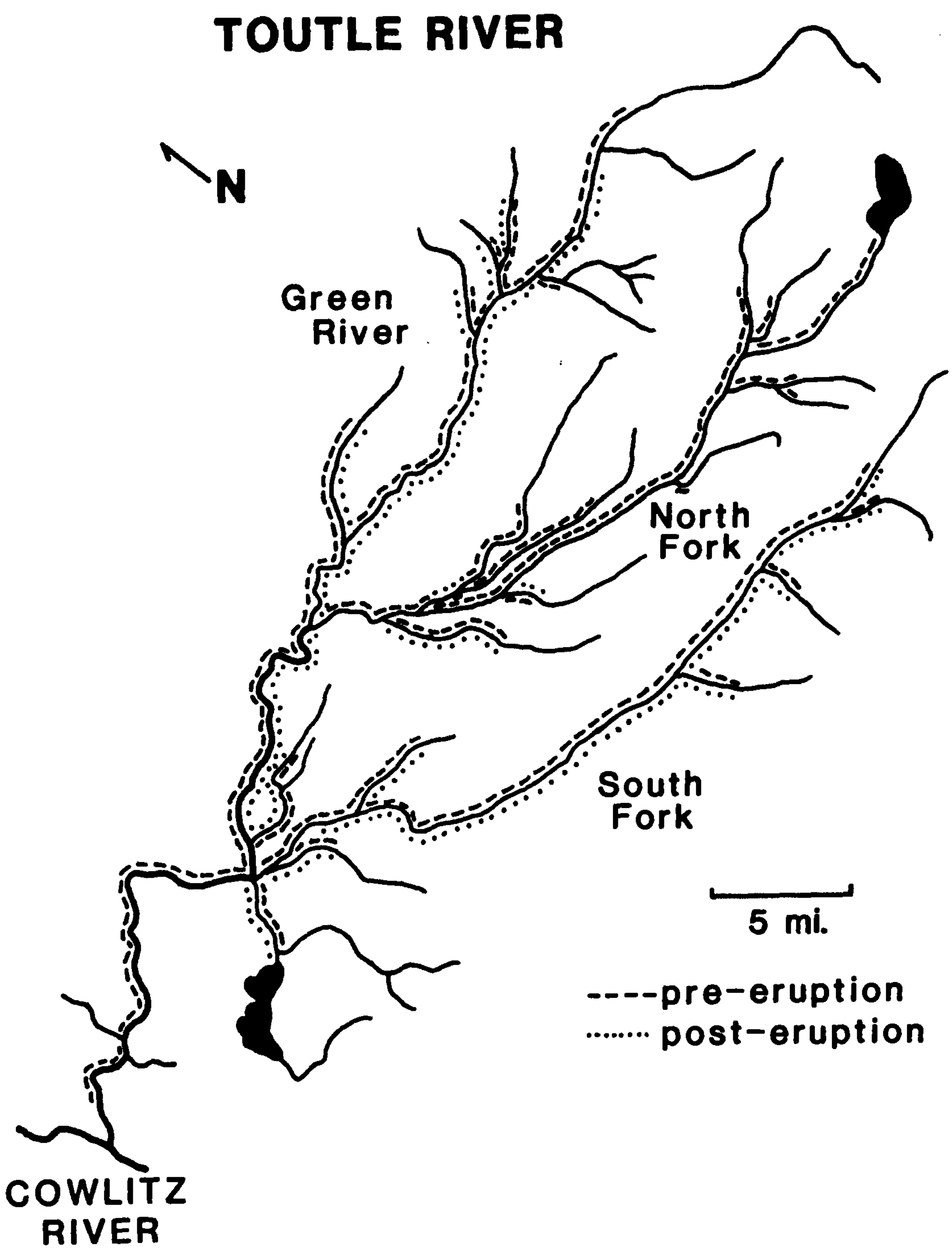

Figure 1. Probable pre- and post-eruption (i.e., late 1970's vs. 1984) spawning areas of wild winter steelhead in the Toutle River, Washington (B. Lucas, WDG, personal communication).

winter and spring in freshwater for spawning (S), followed by another summer of ocean growth (+) prior to its capture in freshwater on its second spawning migration. As a result, this fish would be more than 4 years old.

Size

Mean length of wild adults trapped in 1981 were 44.7 cm for 1-ocean fish, 69.0 cm for 2-ocean fish, 81.4 cm for 3-ocean fish, and 82.0 cm for repeat spawners (Table 1).

Sex ratio

The male:female ratio for steelhead trapped in the spring of 1981 was 23:23, or 1.00 (Table 1).

Fecundity

Thirteen female winter steelhead trapped on the South Fork Toutle River in April and May of 1981 were live-spawned for 58,532 eggs, or an average of 4,502 eggs per female (Schuck and Kurose 1982; M. Schuck, WDG, personal communication). Only one of the 13 females was of hatchery origin; hence, the mean fecundity value is considered representative of the wild Toutle River stock.

Table 1. Age, size and sex of wild steelhead trapped in the South Fork Toutle River, Washington, in April and May, 1981 (From - Schuck and Kurose 1982; M. Schuck, WDG, personal communication); regenerated and non-scale sampled fish were assumed wild in the analysis.

AGE	SEX MALE	SEX FEMALE	TOTAL	% OF TOTAL READABLE	AVERAGE LENGTH (cm) MALE	AVERAGE LENGTH (cm) FEMALE
2.+	1	0	1	2.7	47.2	---
2.1+	10	14	24	64.9	70.1	67.9
2.1+S+	2	0	2	5.4	83.7	---
2.1+S+S+	0	1	1	2.7	---	81.0
2.2+	0	4	4	10.8	---	81.4
3.+	2	0	2	5.4	43.4	---
3.1+	1	1	2	5.4	66.0	76.5
3.1+S+S+	0	1	1	2.7	---	79.8
Total Readable	16	21	37			
Regenerated	7	1	8	---	---	---
No Scale Sample	0	1	1	---	---	---
Grand Total	23	23	46			

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Smolts likely outmigrate in April and May (peak in early May) at a size of 160 mm. Of adults returning in 1981, 86.5% had 2 years of freshwater residence and 13.5% had 3 years (Table 1).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

Narver, D.W., and F.C. Withler. 1971. Age and size of steelhead trout (*Salmo gairdneri*) in anglers' catches from Vancouver Island, British Columbia, streams. Fish. Res. Bd. Can. Circ. 91.

Schuck, M.L., and H.T. Kurose. 1982. South Fork Toutle River fish trap operation and salmonid investigations, 1981-1982. Washington Department of Game report 82-11.

Cowlitz River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Cowlitz River, Washington, a tributary to the lower Columbia River (RM 68.0) that drains a watershed of 1,841 square miles (not including the Toutle and Coweeman drainages).

ORIGIN

The wild Cowlitz winter steelhead stock is indigenous, but considerable interbreeding has likely occurred with Cowlitz and late Cowlitz hatchery-stock steelhead.

ADULT LIFE HISTORY

Run size, catch, and escapement

Historical abundance of wild Cowlitz steelhead is unknown, but given the former distribution of this stock, annual returns likely numbered in the thousands. Mayfield and Mossyrock dams block steelhead migrations to the upper Cowlitz Basin and, through instream flow manipulation, cause redd dessication and fry stranding in the lower Cowlitz mainstem (Tipping et al. 1979). Wild juveniles are further impacted by competition with the one million plus anadromous salmonid juveniles released into the Cowlitz annually.

No accurate estimates of wild run size or escapement exist. Harvest of the stock occurs in the mainstem Columbia recreational fishery, as well as in the Cowlitz River. Approximately 100-300 wild fish are harvested annually in the Cowlitz sport fishery (Table 1). To date, no escapement goal has been established for this stock.

Time of migration

Wild winter steelhead reach the upper Cowlitz River barrier dam in November, but abundance peaks between mid-March and mid-May (Tipping 1984).

Spawning period

April and May (Tipping 1984).

Spawning areas

Steelhead formerly spawned throughout the mainstem Cowlitz River and in large portions of the Tilton and Cispus rivers (Figure 1). Construction of

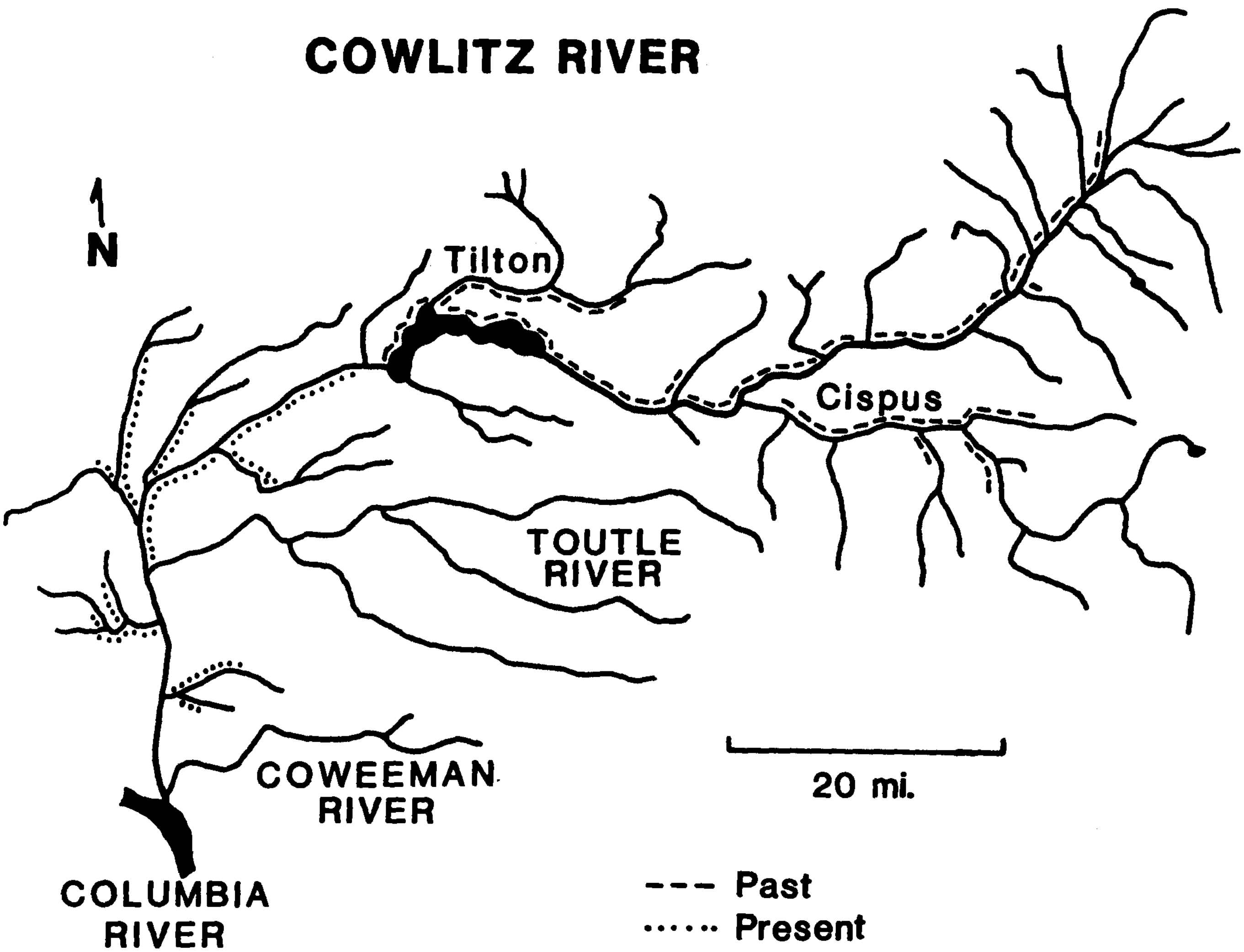

Figure 1. Probable past and present spawning areas of steelhead trout in the Cowlitz River, Washington (Fulton 1970; B. Crawford and J. Tipping, Washington Department of Game, personal communication).

Mayfield and Mossyrock dams in the 1960's blocked anadromous salmonid migrations into the upper Cowlitz Basin, eliminating more than 50% of the spawning and rearing habitat available for use by this stock (habitat in the Coweeman and Toutle rivers is not considered in the present analysis since these streams support their own native winter stocks).

Age composition

Of wild adults returning to the Cowlitz in 1977-78, 1978-79 and 1983-84, an average of 62.6% were 2-salts, 32.2% were 3-salts, 2.0% were 4-salts and 3.3% were repeat spawners (Table 2).

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 2.1+S+ would represent a fish with 2 years of freshwater growth, approximately 1-1/2 years of marine growth prior to spawning (1+), part of a winter and spring in freshwater for spawning (S), followed by another summer of ocean growth (+) prior to its capture in freshwater on its second spawning migration. Hence, this fish would be more than 4 years old.

Size

Mean length of wild adults returning to the Cowlitz in 1977-78, 1978-79 and 1983-84 and 69.4 cm for 2-salts, 81.3 cm for 3-salts, 86.0 cm for 4-salts, and 74.5 cm for repeat spawners (Table 2).

Sex ratio

Male:female sex ratios for 1977-78, 1978-79 and 1983-84 were 0.56, 0.56 and 0.70 (Table 2).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most smolts likely outmigrate in April and May. Of adults returning in 1977-78, 1978-79 and 1983-84, 91.1% outmigrated after rearing 2 years in freshwater and 8.9% outmigrated after 3 years (Table 2).

Table 1. Harvest of wild winter steelhead in the Cowlitz River, Washington, 1977-78, 1978-79 and 1983-84.

RUN YEAR	COWLITZ RIVER SPORT CATCH 1/	PERCENT WILD 2/	HARVEST OF WILD STEELHEAD
1977-78	18,146	1.31	238
1978-79	12,781	2.08	266
1983-84	6,415	1.48	95

1/ Punchcard catch estimates for Cowlitz River system (not including Coweeman and Toutle rivers).

2/ Adapted from Tipping (1984).

Table 2. Age, length and sex of wild winter steelhead in the Cowlitz River, Washington, 1977-78, 1978-79 and 1983-84 (adapted from Tipping 1984).

RUN YEAR	AGE	MALES NUMBER	MALES LENGTH (cm)	FEMALES NUMBER	FEMALES LENGTH (cm)	TOTAL NUMBER	TOTAL PERCENT
1977-78	2.1+	2	75.6	5	67.1	7	50.0
	2.2+	2	80.0	4	78.3	6	42.9
	3.1+	1	72.4	0	--	1	7.1
1978-79	2.1+	5	69.2	7	70.6	12	48.0
	2.2+	3	88.0	6	81.8	9	36.0
	2.2+S+	0	--	1	83.0	1	4.0
	3.1+	1	72.0	2	74.0	3	12.0
1983-84	2.1+	6	67.2	5	66.8	11	64.7
	2.1+S+	1	66.0	0	--	1	5.9
	2.2+	0	--	3	78.3	3	17.6
	2.3+	0	--	1	86.0	1	5.9
	3.1+	0	--	1	71.0	1	5.9

<u>Survival rate</u>

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

REFERENCES

Fulton, L. A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye and chum salmon in the Columbia River Basin - past and present. NMFS Special Scientific Report, Fisheries No. 618.

Narver, D. W. and F. C. Withler. 1971. Age and size of steelhead trout (*Salmo gairdneri*) in anglers' catches from Vancouver Island, British Columbia, streams. Fish. Res. Bd. Can. Circ. 91.

Tipping, J. 1984. A profile of Cowlitz River winter steelhead before and after hatchery propagation. Washington Department of Game report 84-11.

Tipping, J., S. Springer, P. Buckley, and J. Danielson. 1979. Cowlitz River steelhead spawning, fry emergence and stranding, 1977-79, and adult life history study, 1977-79. Washington Department of Game.

Cowlitz River Winter Steelhead (hatchery)

PRODUCTION

Cowlitz stock winter steelhead are artificially propagated in hatchery environments. Approximately 650,000 smolts of this stock are released annually.

GEOGRAPHIC LOCATION

Streams

Most Cowlitz stock outmigrants are released into the Cowlitz River, Washington, but since 1970 the following streams have received occasional plants of Cowlitz stock winter steelhead: Grays River (Columbia RM 20.8), Skamokawa Creek (RM 33.3), Elochoman River (RM 39.1), Abernathy Creek (RM 54.3), Germany Creek (RM 56.2), Coweeman and Toutle rivers (tributaries to Cowlitz River, RM 68.0), Kalama River (RM 73.1), North and East forks Lewis River (RM 87.0), Salmon Creek (tributary to Lake River, RM 87.5), Washougal River (RM 120.7) and the lower Columbia River mainstem.

Hatcheries

Eggs are taken from Cowlitz stock adults returning to Cowlitz Hatchery, located on the Cowlitz River, a tributary to the Columbia River at RM 68.0. Juveniles are reared primarily at Cowlitz Hatchery and occasionally at Beaver Creek, Vancouver and Skamania hatcheries and Alder Creek Rearing Pond. Prior to discovery of IHN virus in the stock, Cowlitz eggs were shipped to Puget Sound and coastal stations, as well as out-of-state (J. Gearheard, Washington Department of Game (WDG), personal communication).

ORIGIN

The Cowlitz stock was developed in the late 1960's at Cowlitz Hatchery. Original brood stock were native Cowlitz River fish and Chambers Creek hatchery stock steelhead (Crawford 1979; J. Gearheard and J. Tipping, WDG, personal communication).

ADULT LIFE HISTORY

Run size, catch, and escapement

Data concerning run size, catch and escapement of Cowlitz stock returnees are limited (see "Survival rate" section of this stock summary). Harvest of the stock occurs primarily in the Cowlitz River, but also in the mainstem Columbia sport fishery and in other rivers where juveniles were planted. The interim escapement goal for winter steelhead to Cowlitz Hatchery is 600 fish, 500 of Cowlitz stock origin and 100 of late Cowlitz stock origin (see Late Cowlitz stock).

Time of migration

Cowlitz hatchery-stock winter steelhead return to the Cowlitz River beginning in late November, peaking in December and January, and tapering off into February and early March (Tipping 1984; J. Tipping, WDG, personal communication).

Spawning period

Spawning of this stock at Cowlitz Hatchery begins in mid-December and is usually completed by February (Table 1); instream spawning continues through March (J. Tipping, WDG, personal communication).

Spawning areas

Cowlitz Hatchery.

Age composition

Of Cowlitz hatchery-stock adults returning in 1977-78, 1978-79 and 1983-84, 0.3% were 1-salt jacks, 63.5% 2-salts, 32.8% 3-salts, 0.5% 4-salts, and 2.9% repeat spawners. (Table 2).

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 1.2+S+ would represent a fish with 1 year of freshwater growth (i.e., hatchery-origin), approximately 2-1/2 years of marine growth prior to spawning (2+), part of a winter and spring in freshwater for spawning (S), followed by another summer of ocean growth (+) prior to its capture in freshwater on its second spawning migration. Hence, this fish would be more than 4 years old.

Size

Lengths of Cowlitz adults returning in 1977-78, 1978-79 and 1983-84 ranged from an average of 46.8 cm for jack males in 1983-84 to a high of 99.0 cm for a repeat-spawn male in 1978-79 (Table 2).

Sex ratio

Male:female sex ratios for the 1977-78, 1978-79 and 1983-84 Cowlitz hatchery stock winter runs were 1.04, 1.07 and 1.78, respectively (Tipping 1984). Curiously, 1-salt returns were dominated by males (M = 10, F = 0), as were 2-salts (M = 1,273, F = 640) and 4-salts (M = 13, F = 1); however, females dominated 3-salts (M = 361, F = 620) and repeat spawners (M = 18, F = 67).

Fecundity

Tipping (WDG, personal communication) determined that the fecundity of the Cowlitz winter stock was 4,672 eggs in 1980-81 (n = 659 females), 4,567 in 1981-82 (n = 378), 5,228 in 1982-83 (n = 299), and 4,172 in 1983-84 (n = 365).

Table 1. Percent of Cowlitz stock winter steelhead egg-take at Cowlitz Hatchery, Washington, 1973-74 through 1982-83; fish spawned at Cowlitz Hatchery from December through March are assumed to be of Cowlitz stock origin (adapted from Tipping 1984).

RUN YEAR	EGG-TAKE (AS PERCENTAGE OF TOTAL)			
	DECEMBER	JANUARY	FEBRUARY	MARCH
1973-74	1.9	30.5	67.6	0.0
1974-75	2.6	59.7	37.8	0.0
1975-76	2.4	70.4	27.2	0.0
1976-77	7.1	76.3	16.6	0.0
1977-78	14.5	73.2	12.3	0.0
1978-79	7.4	44.5	48.1	0.0
1979-80	49.0	41.3	0.0	9.7
1980-81	13.0	76.1	0.0	10.9
1981-82	16.4	39.7	36.4	7.4
1982-83	43.0	53.3	3.7	0.0

Biochemical-genetic characteristics

Thorgaard (1977) estimated 34.5% of Cowlitz stock winter steelhead have 58 chromosomes, 55.2% have 59 chromosomes, and 10.3% have 60 chromosomes. These findings were expected since this stock was derived from native Cowlitz fish (which, like the late Cowlitz stock, probably had 58 chromosomes) and the Chambers Creek hatchery stock (45.5% with 59 chromosomes, 54.5% with 60 chromosomes).

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Following a year of freshwater rearing, smolts are planted in April and May at 4-7 per pound.

Survival rate

Fry to smolt survival of this stock is approximately 33% (J. Tipping, WDG, personal communication). Poor survival is attributed to *Ceratomyxa shasta* infestations.

Plant to adult survival rates for the Cowlitz stock ranged from 2.1% to 4.8% for the return years 1975-76 through 1979-80 (Table 3). These values are only rough approximations of survival; accurate estimation of plant to adult survival is contingent upon accurate estimation of 1) sport fishery exploitation rates and 2) brood year contributions to returning runs.

Table 2. Age, size and sex of Cowlitz stock winter steelhead returns to Cowlitz Hatchery, Washington, December through March 1977-78, 1978-79, and 1983-84 (adapted from Tipping 1984).

RUN YEAR	AGE	MALES		FEMALES		TOTAL	
		NUMBER	LENGTH (cm)	NUMBER	LENGTH (cm)	NUMBER	PERCENT
1977-78	1.+	1	48.0	0	--	1	0.1
	1.+S+	1	53.0	0	--	1	0.1
	1.1+	426	71.6	324	69.0	750	71.0
	1.1+S+	3	73.2	9	73.2	12	1.1
	1.2+	107	83.5	182	80.1	289	27.3
	1.2+S+	0	--	2	77.5	2	0.2
	1.3+	2	89.5	0	--	2	0.2
1978-79	1.+	4	48.8	0	--	4	0.4
	1.1+	377	71.0	198	69.0	575	59.7
	1.1+S+	5	77.4	35	78.1	40	4.2
	1.2+	109	86.3	224	81.5	333	34.6
	1.2+S+	1	99.0	5	83.4	6	0.6
	1.3+	5	91.4	0	--	5	0.5
1983-84	1.+	5	46.8	0	--	5	0.5
	1.1+	470	67.2	118	65.7	588	59.8
	1.1+S+	7	84.1	8	77.1	15	1.5
	1.1+S+S+	0	--	1	72.0	1	0.1
	1.2+	145	84.0	214	79.0	359	36.5
	1.2+S+	1	94.0	7	82.4	8	0.8
	1.3+	6	93.8	1	88.0	7	0.7

DISEASE HISTORY

Cowlitz stock winter steelhead reared at Cowlitz Hatchery have been repeatedly infested with the myxosporidian *Ceratomyxa shasta* . In addition, infectious hematopoietic necrosis (IHN) virus has been detected in this stock (Tipping 1982; Crawford et al. 1984).

PRIORITY INFORMATION NEEDS

Three characteristics of Cowlitz stock steelhead merit detailed study: 1) timing of spawning in the natural environment, 2) contribution of resulting offspring to wild stocks, and 3) extent of sport fishery interceptions of upriver-bound Cowlitz stock adults in the mainstem Columbia River.

Table 3. Harvest, run size and percent return (i.e., plant to adult survival) of Cowlitz hatchery-stock winter steelhead in the Cowlitz River, Washington, 1975-76 through 1979-80 (data from later years excluded due to mortality and straying associated with the Mount St. Helens eruption).

RUN YEAR	COWLITZ RIVER SPORT CATCH 1/	COWLITZ-STOCK SPORT CATCH 2/	COWLITZ-STOCK RUN SIZE 3/	JUVENILE PLANT 4/	PERCENT RETURN 5/
1975-76	9,079	8,897	14,828	622,933	2.4
1976-77	10,103	9,901	16,502	557,556	3.0
1977-78	18,146	17,783	29,638	623,556	4.8
1978-79	12,781	12,525	20,875	1,015,910	2.1
1979-80	18,249	17,884	29,807	769,361	3.9

1/ Punchard catch, Cowlitz River System minus Coweeman and Toutle rivers.

2/ Approximately 98% of Cowlitz winter run is of Cowlitz hatchery stock origin (J. Tipping, WDG, personal communication).

3/ Run size calculated using sport fishery exploitation rate of 60% (J. Tipping, WDG, personal communication).

4/ Plant 1-1/2 years earlier used (e.g., 1978 for 1979-80 run) because the majority of Cowlitz stock steelhead return after 1-1/2 years of marine growth (Table 2).

5/ Percent return = run size divided by juvenile plant.

REFERENCES

Crawford, B. A. 1979. The origin and history of the trout brood stocks of the Washington Department of Game. Washington Department of Game report.

Crawford, B. A., R. E. Lucas, and J. M. Tipping. 1984. Report on gamefish fisheries in southwestern Washington (Region V) for April 1, 1981 to March 31, 1982. Washington Department of Game.

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Thorgaard, G. H. 1977. Chromosome studies of steelhead. In Genetic implications of steelhead management. California Cooperative Fishery Research Unit Special Report 77-1.

Tipping, J. 1982. Cowlitz steelhead rearing and production progress report. Washington Department of Game report 82-19.

Tipping, J. 1984. A profile of Cowlitz River winter steelhead before and after hatchry propagation. Washington Department of Game report 84-11.

Late Cowlitz River Winter Steelhead (hatchery)

PRODUCTION

Late Cowlitz steelhead are artificially propagated in a hatchery environment. Approximately 50,000 smolts of this stock are released annually.

GEOGRAPHIC LOCATION

Streams

All late Cowlitz winter steelhead smolts are released into the Cowlitz River, Washington, a tributary to the Columbia River at RM 68.0.

Hatcheries

Eggs are collected from late Cowlitz adults returning to Cowlitz Hatchery, where all juveniles of this stock are reared.

ORIGIN

The late Cowlitz stock was developed in the latter 1960's from late returning/spawning winter steelhead native to the Cowlitz River (J. Gearheard and J. Tipping, Washington Department of Game [WDG], personal communication).

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of late Cowlitz run size, catch and escapement are not available. Harvest of the stock occurs in the Cowlitz River as well as in the mainstem Columbia sport fishery. The interim escapement goal for winter steelhead to Cowlitz Hatchery is 600 adults, 100 of which should be of late Cowlitz stock origin.

Time of migration

Late Cowlitz stock steelhead arrive at Cowlitz Hatchery from late March through May (J. Tipping, WDG, personal communication).

Spawning period

Adults of this stock are spawned at the hatchery in April and May (Tipping 1984).

Spawning areas

Cowlitz Hatchery.

Age composition

Of late Cowlitz stock adults returning to the hatchery in 1979 and 1984, an average of 2.4% were 1-salt jacks, 91.6% were 2-salts, 3.9% were 3-salts, 0.2% were 4-salts, and 1.9% were repeat spawners (Table 1).

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 1.2+S+ would represent a fish with 1 year of freshwater growth (i.e., hatchery-origin), approximately 2-1/2 years of marine growth prior to spawning (2+), part of a winter and spring in freshwater for spawning (S), followed by another summer of ocean growth (+) prior to its capture in freshwater on its second spawning migration. Hence, this fish would be more than 4 years old.

Size

Lengths of late Cowlitz returnees in 1978-79 and 1983-84 ranged from an average of 46.4 cm for jacks in 1983-84 to a high of 97.0 cm for a 4-salt male in 1978-79; mean length of 2-salt steelhead was 67.7 cm (Table 1).

Sex ratio

Male:female sex ratios for scale-sampled fish were 2.79 in 1978-79 and 2.24 in 1983-84 (Table 1).

Fecundity

Fecundity of the late Cowlitz stock was 4,331 eggs per female (n = 105 females) in 1981, 4,112 (n = 73) in 1982, and 5,254 (n = 46) in 1983 (J. Tipping, WDG, personal communication).

Biochemical-genetic characteristics

Thorgaard (1977) reported that 100% of the late Cowlitz stock steelhead that were sampled had 58 chromosomes.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Smolts are planted at 4-7 per pound in April and May following a year of freshwater rearing.

Table 1. Age, size and sex of late Cowlitz stock winter steelhead returns to the Cowlitz Hatchery, Washington, 1978-79 and 1983-84 (adapted from Tipping 1984).

RUN YEAR	AGE	MALES NUMBER	MALES LENGTH (cm)	FEMALES NUMBER	FEMALES LENGTH (cm)	TOTAL NUMBER	TOTAL PERCENT
1977-78	1.+	3	47.3	0	--	3	1.4
	1.1+	150	69.7	50	68.7	200	92.6
	1.1+S+S+	0	--	1	76.0	1	0.5
	1.2+	5	88.2	6	81.2	11	5.1
	1.3+	1	97.0	0	--	1	0.5
1983-84	1.+	5	46.4	0	--	5	3.4
	1.1+	97	65.3	38	64.7	135	90.6
	1.1+S+	0	--	2	75.5	2	1.3
	1.1+S+S+	0	--	2	74.5	2	1.3
	1.2+	1	87.0	3	76.3	4	2.7
	1.2+S+	0	--	1	81.0	1	0.7

Survival rate

Fry to plant survival of this stock is estimated to be 80-90%, in large part due to the pure (i.e., disease-free) well water used for rearing (J. Tipping, WDG, personal communication). Plant to adult survival of this stock is unknown.

DISEASE HISTORY

Infectious hematopoietic necrosis (IHN) virus has been detected in members of this stock (Crawford et al. 1984).

PRIORITY INFORMATION NEEDS

Three characteristics of late Cowlitz steelhead merit detailed study: 1) timing of spawning in the natural environment, 2) contribution of resulting offspring to wild stocks, and 3) extent of sport fishery interceptions of upriver-bound late Cowlitz adults in the mainstem Columbia River.

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Crawford, B. A., R. E. Lucas, and J. M. Tipping. 1984. Report on gamefish fisheries in southewestern Washington (Region V) for April 1, 1981 to March 31, 1982. Washington Department of Game.

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Tipping, J. 1984. A profile of Cowlitz River winter steelhead before and after hatchery propagation. Washington Department of Game report 84-11.

Cowlitz River Summer Steelhead (hatchery)

PRODUCTION

Cowlitz summer steelhead are artificially propagated in a hatchery environment. Approximately 300,000 smolts of this stock are released annually.

GEOGRAPHIC LOCATION

Streams

Most Cowlitz stock juveniles are liberated into the Cowlitz River, Washington, a tributary to the Columbia River at RM 68.0. In recent years, a few Cowlitz summer-runs have been planted in the lower Columbia mainstem and in the Washougal River (RM 120.7).

Hatcheries

Eggs are taken from Cowlitz stock summer steelhead returning to Cowlitz Hatchery, where most juveniles of this stock are reared.

ORIGIN

The Cowlitz summer stock was developed in the early 1970's at Cowlitz Hatchery. Original brood stock were predominantly Skamania hatchery-stock steelhead (J. Gearheard and J. Tipping, Washington Department of Game [WDG], personal communication).

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of stock run size, catch and escapement are not available. Harvest of the stock occurs primarily in the Cowlitz River, but also in the mainstem Columbia River sport fishery. The interim escapement goal to Cowlitz Hatchery is 200 adults.

Time of migration

Cowlitz stock returnees initially appear in the lower Cowlitz River as early as April, peak in June and July, and taper off by October (Tipping et al. 1979). Approximately 70% of these fish enter the Cowlitz Hatchery in October and November (J. Tipping, WDG, personal communication).

Spawning period

Cowlitz stock summer steelhead are spawned at Cowlitz Hatchery from mid-December through February (J. Tipping, WDG, personal communication).

Spawning areas

Cowlitz Hatchery.

Age composition

Of summer steelhead returning to the Cowlitz River in 1979 and 1981, 9.7% and 10.4%, respectively, had scale growth patterns characteristic of wild fish - i.e., as juveniles they had spent more than 1 year in freshwater (Table 1). Because the Cowlitz River system did not historically support a native summer run of steelhead (Lavier 1970; Ayerst 1977), the "wild" fish observed these years were likely strays, or hatchery-reared steelhead that residualized 1 or more years in the Cowlitz prior to outmigrating, or steelhead produced in the Cowlitz by naturally-spawning adults of hatchery origin. In the absence of these fish, an average of 8.9% of the returning Cowlitz stock adults were 1-salts, 76.7% were 2-salts, 11.8% were 3-salts, and 2.6% were repeat spawners.

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 1.2S1 would represent a fish with 1 year of freshwater growth (i.e., hatchery-origin), 2 years of marine growth prior to spawning, approximately 1 year spent in freshwater for spawing (S), followed by antoher year of ocean growth (1) prior to its capture in freshwater on its second spawning migration. Hence, this fish would be about 5 years old.

Size

Mean length of Cowlitz returnees in 1979 and 1981 was 62.8 cm for 1-salts, 73.2 cm for 2-salts, 84.0 cm for 3-salts, and 96.0 cm for repeat spawners (Table 1). Again, "wild" fish were not included in the analysis.

Sex ratio

Male:female sex ratios for this stock (excluding "wild" fish) were 1.80 in 1979 and 0.94 in 1981 (Table 1).

Fecundity

Fecundity of Cowlitz stock summer steelhead averaged 4,553 eggs per female for the 1980 through 1983 summer runs (i.e., 1981 through 1984 brood stock), ranging from 4,433 to 4,653 (J. Tipping, WDG, personal communication).

Biochemical-genetic characteristics

Thorgaard (1977) reported that 83.3% of Cowlitz stock summer steelhead have 58 chromosomes and 16.7% have 59 chromosomes; these values are not unusual given that 100% of Skamania stock steelhead, from which the Cowlitz stock was developed, have 58 chromosomes.

Table 1. Age, length and sex of summer steelhead harvested in the Cowlitz River, Washington, sport fisheries of July-October 1979 and August-October 1981; data from Tipping and Springer (1980) and Tipping (1982a), respectively.

YEAR	AGE	MALES	FEMALES	TOTAL	% TOTAL	LENGTH (cm)
1979	1.1	4	1	5	16.1	62.8
	1.1S1	1	0	1	3.2	97.0
	1.2	13	8	21	67.7	72.1
	1.3	0	1	1	3.2	67.0
	2.2	0	2	2	6.5	68.0
	2.3	1	0	1	3.2	90.0
1981	1.2	22	25	47	70.1	73.7
	1.2S1	1	0	1	1.5	95.0
	1.3	6	6	12	17.9	85.4
	2.2	3	2	5	7.5	78.6
	2.3	0	1	1	1.5	81.0
	3.2	0	1	1	1.5	71.0

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Cowlitz stock smolts are released in April and May at a size of 4-7 per pound, having reared in freshwater for 1 year.

Survival rate

Fry to smolt survival of this stock is approximately 30%, in large part due to *Ceratomyxa shasta* infestations (J. Tipping, WDG, personal communication). Smolt to adult survival of Cowlitz stock releases is unknown.

DISEASE HISTORY

Cowlitz stock summer steelhead have repeatedly been infested with the myxosporidian *Ceratomyxa shasta*. In addition, infectious hematopoietic necrosis (IHN) virus has been detected in this stock (Tipping 1982b; Crawford et al. 1984).

PRIORITY INFORMATION NEEDS

Three characteristics of Cowlitz summer steelhead merit detailed study: 1) timing of spawning in the natural environment, 2) contribution of resulting offspring to wild stocks, and 3) extent of sport fishery interceptions of upriver-bound Cowlitz stock adults in the mainstem Columbia River.

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Kalama River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Kalama River, Washington, a tributary to the lower Columbia River (RM 73.1) that drains a watershed of 205 square miles.

ORIGIN

The wild winter steelhead stock in the Kalama River is native, although interbreeding with introduced steelhead of Chambers Creek, Cowlitz and Elochoman hatchery stock origin has likely occurred. Further, steelhead strays that abandoned the Cowlitz system following the eruption of Mount St. Helens in 1980 probably contributed some genetic material to the native Kalama stock. In addition, Chilcote et al. (1980a) and Leider et al. (1984) noted that winter and summer steelhead in the Kalama are not entirely reproductively isolated: they have observed the spawning activity of several known winter-summer steelhead pairs.

ADULT LIFE HISTORY

Run size, catch, and escapement

Counts of wild winter steelhead passing Kalama Falls Hatchery (Washington Department of Fisheries) averaged 693 for the years 1976-77 through 1979-80 and 1982-83 (Table 1). Counts in 1980-81 and 1981-82 were excluded from the average because they were likely inflated by volcano-related straying. Winter steelhead run composition (i.e., % wild) estimates from fish passing the hatchery were applied to estimates of total sport catch to determine that an average of 1,000 wild winter steelhead were harvested annually over the same 5-year period. Average spawning escapement (estimated from tagging studies and rack counts) for these years was 1,184 wild fish, hence mean run size for the stock was 2,184. The interim escapement goal for this stock is 1,108 winter steelhead.

Time of migration

Wild winter steelhead return to Kalama Falls Hatchery from November through June, peaking in late April and early May (Figure 1). Data from 1980-81 and 1981-82 were excluded due to the disruptive influence of the Mount St. Helens eruption.

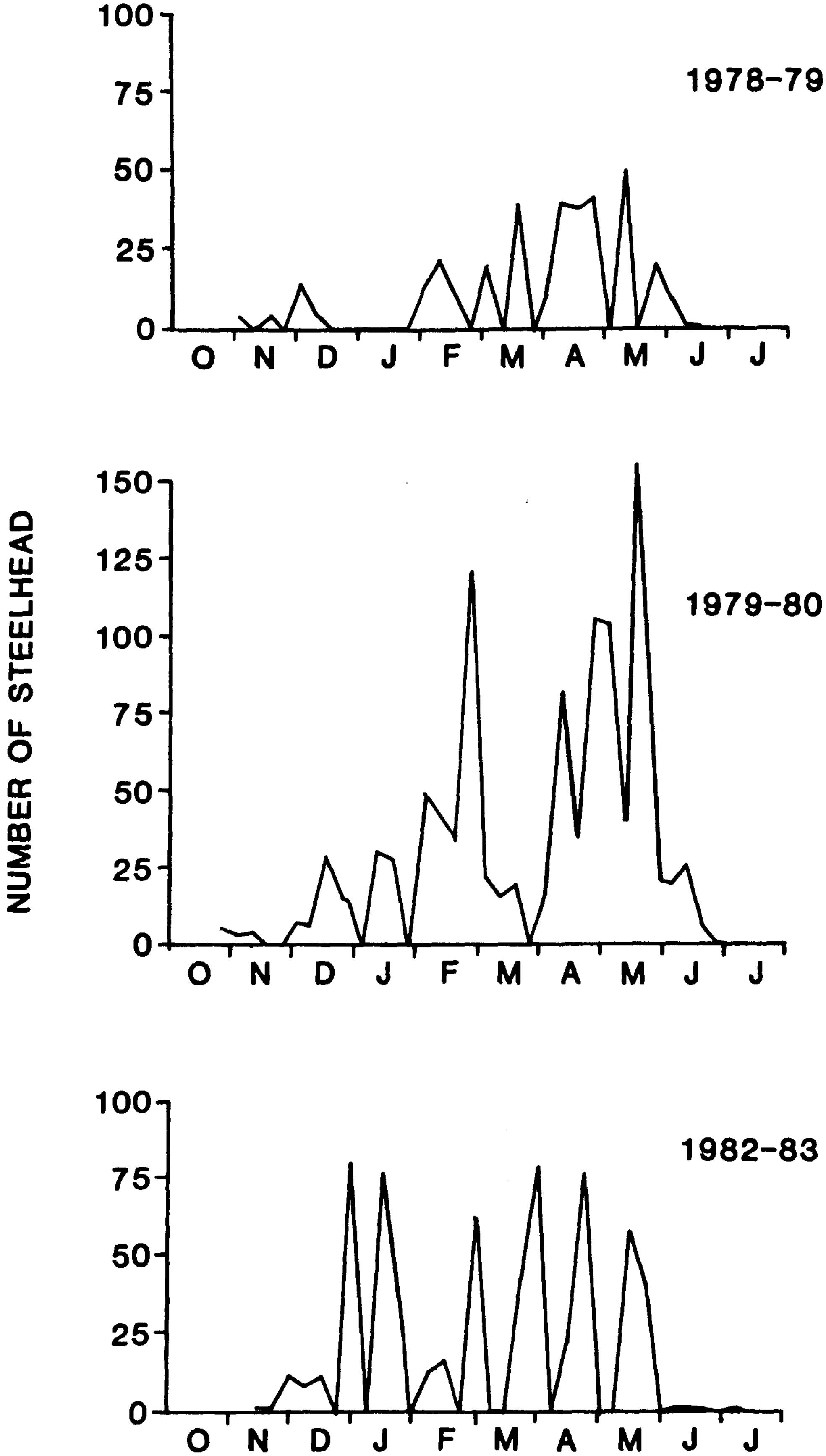

Figure 1. Number of wild winter steelhead passing Kalama Falls Hatchery by week, 1978-79, 1979-80 and 1982-83 (adapted from Chilcote et al. 1980b, 1981 and 1984).

Table 1. Kalama Falls Hatchery trap counts, run composition, sport catch, escapement and run size of wild winter steelhead in the Kalama River, 1976-77 through 1982-83 (counts, composition and escapement data from Chilcote et al. 1984).

	RUN YEAR							
	76-77	77-78	78-79	79-80	80-81	81-82	82-83	MEAN 1/
Wild Trap Count 2/	703	772	404	1,054	2,441	972	531	693
% of Run Wild	63.4	36.7	69.5	63.2	78.5	76.0	58.4	---
Total Sport Catch 3/	1,565	1,884	1,750	1,772	4,859	2,279	1,679	1,730
Wild Sport Catch	992	691	1,216	1,120	3,814	1,732	981	1,000
Wild Escapement 4/	1,178	1,280	714	1,806	4,164	1,648	942	1,184
Wild Run Size	2,170	1,971	1,930	2,926	7,978	3,380	1,923	2,184

1/ 1976-77 through 1979-80 and 1982-83 (1980-81 and 1981-82 biased by volcano-related straying).

2/ Counts exclude fallback returnees, but include racially indeterminate steelhead estimated to be winter fish.

3/ Estimated from punchcard returns.

4/ Estimated from tagging studies and rack count data.

Spawning period

March through early June, peaking in early May (Chilcote et al. 1981; B. Crawford, WDG, personal communication).

Spawning areas

Both winter and summer steelhead utilize spawning gravel through most of the mainstem Kalama River and the North Fork, Gobar Creek and Wild Horse Creek (Figure 2).

Age composition

Ages of wild winter steelhead were obtained during trapping operations at Kalama Falls Hatchery (Table 2). Again, data from 1980-81 and 1981-82 were not included due to the high incidence of volcano-related straying those years. Of fish with readable scales, an average (3-year) of 4.1% were 1-ocean, 59.5% were 2-ocean, 26.2% were 3-ocean, and 10.2% were repeat spawners.

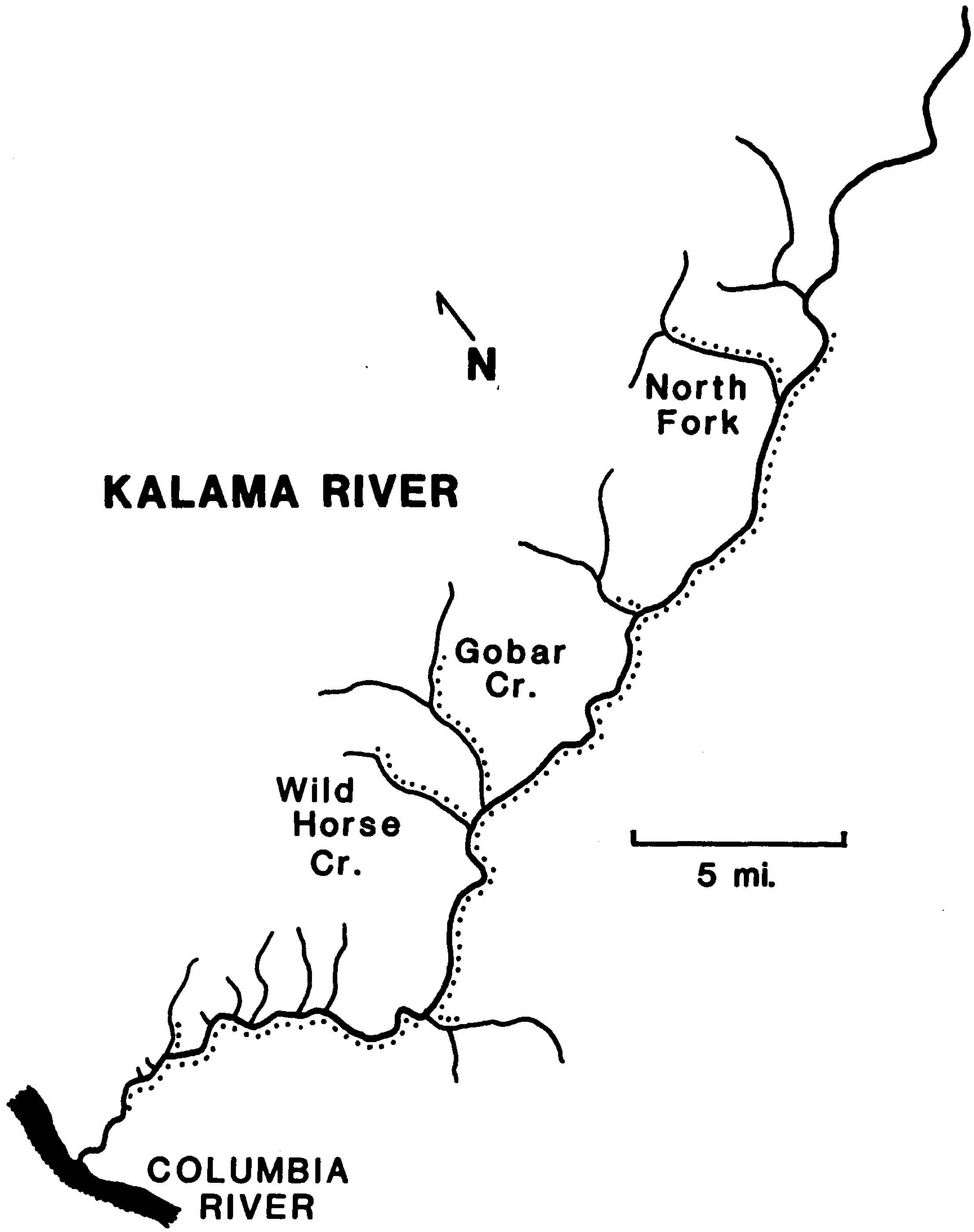

Figure 2. Probable spawning areas of wild winter and summer steelhead trout in the Kalama River, Washington (B. Crawford, WDG, personal communication).

Table 2. Age and length of wild winter steelhead trapped at Kalama Falls Hatchery, Washington, 1978-79, 1979-80 and 1982-83 (from Chilcote et al. 1980b, 1981 and 1984); RS = repeat spawners.

RUN YEAR	AGE	NUMBER	PERCENT	LENGTH (CM)	% AT SALT AGE
1978-79	2.+	14	4.4	51.1	I - 5.3
	2.+S+	1	0.3	57.2	II - 66.8
	2.1+	175	54.9	70.8	III - 21.0
	2.1+S+	16	5.0	78.3	RS - 6.9
	2.1+S+S+	1	0.3	77.8	
	2.2+	67	21.0	85.9	
	2.2+S+	1	0.3	86.2	
	3.+	2	0.6	50.5	
	3.1+	38	11.9	72.1	
	3.1+S+	3	0.9	75.2	
	4.+	1	0.3	46.7	
	TOTAL	319			
1979-80	2.+	11	1.2	54.1	I - 1.5
	2.+S+	6	0.7	58.8	II - 78.0
	2.+S+S+	1	0.1	67.5	III - 15.1
	2.1+	615	66.9	68.6	RS - 5.3
	2.1+S+	30	3.3	75.7	
	2.1+S+S+	1	0.1	81.3	
	2.2+	123	13.4	83.1	
	2.2+S+	6	0.7	85.6	
	3.+	3	0.3	50.5	
	3.+S+	2	0.2	61.7	
	3.1+	102	11.1	68.8	
	3.1+S+	2	0.2	79.0	
	3.1+S+S+	1	0.1	81.4	
	3.2+	16	1.7	82.5	
	Total	919			
1982-83	2.+	7	5.6	48.9	I - 5.6
	2.+S+	2	1.6	56.6	II - 33.6
	2.1+	33	26.4	69.4	III - 42.4
	2.1+S+	13	10.4	72.8	RS - 18.4
	2.1+S+S+	2	1.6	75.2	
	2.1+S+S+S+	1	0.8	85.5	
	2.2+	52	41.6	81.1	
	2.2+S+	3	2.4	87.0	
	3.1+	9	7.2	68.5	
	3.1+S+	2	1.6	76.1	
	3.2+	1	0.8	81.1	
	Total	125			

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 2.1+S+ would represent a fish with 2 years of freshwater growth, approximately 1.5 years of marine growth prior to spawning (1+), part of a winter and spring in freshwater for spawning (S), followed by another summer of ocean growth (+) prior to its capture in freshwater on its second spawning migration. Hence, this fish would be more than 4 years old.

Size

Mean lengths of wild adults sampled at Kalama Falls Hatchery were 51.4 cm for 1-ocean fish, 69.2 cm for 2-ocean fish, 83.4 cm for 3-ocean fish, and 75.1 cm for repeat spawners (Table 2).

Sex ratio

Male:female sex ratios for the wild winter runs of 1976-77 and 1977-78 were 0.80 and 1.05, respectively (Crawford et al. 1978, 1979).

Fecundity

Unknown.

Biochemical-genetic characteristics

A genetic study of Kalama River steelhead was undertaken in the mid-1970's to determine if hatchery steelhead were capable of producing viable offspring under natural spawning and rearing conditions. Electrophoretic procedures were used to determine enzyme gene frequencies for several groups of steelhead in the system, including wild winter steelhead adults (Table 3).

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wild steelhead smolts in Gobar Creek outmigrate from mid-March through early June, peaking in early May (Table 4). Most of these fish are 2 years old (Table 5); the average size and weight of the outmigrants is 161 mm and 41 grams (Table 6). No methods were available to separate winter and summer smolts in the course of the Kalama River studies, hence these data may not be representative of "pure" winter-run smolts.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

Table 3. Frequencies for the common allele of wild Kalama River (Washington) winter steelhead adults, 1976-77 through 1979-80 (from Crawford et al. 1978, 1979, and Chilcote et al. 1980b, 1981).

RUN YEAR	SAMPLE SIZE	LOCI 1/ AGP-1	LDH-4	MDH-3,4	SOD-1	PGI-3
1976-77	300	0.964	-----	-----	-----	-----
1977-78	194 2/	0.99	0.91	0.90	0.70	0.96
1978-79	189	0.968	0.942	0.840	0.669	0.963
1979-80	233	0.996	0.914	0.783	0.612	0.980

1/ Complete names of the enzyme loci are as follows:
AGP = alpha-glycerophosphate dehydrogenase,
LDH = lactate dehydrogenase,
MDH = malate dehydrogenase,
SOD = superoxide dismutase, and
PGI = phosphoglucoisomerase.

2/ Sample size for each locus was 194, 189, 194, 141 and 195, respectively.

Table 4. Emigration of Gobar Creek (Kalama River, Washington) wild steelhead smolts by sampling interval, expressed as percent of total outmigrant run size, 1977-1979 and 1983 (from Chilcote et al. 1984).

INTERVAL	1977	1978	1979	1983	AVERAGE
March 16 - March 31	6.6	7.5	2.1	4.5	5.2
April 01 - April 15	18.4	10.7	5.7	4.1	9.7
April 16 - April 30	37.6	27.0	28.9	34.6	32.0
May 01 - May 15	24.9	41.4	52.6	43.9	40.7
May 16 - June 01	12.5	13.5	10.8	13.0	12.4

Table 5. Age of wild steelhead smolts expressed as percent of total sample trapped in Kalama River (Washington) in 1978, 1979 and 1983 (from Chilcote et al. 1983, 1984).

YEAR	SAMPLE SIZE	STEELHEAD AGE 1	2	3	4
1978	59	2.0	95.0	3.0	0.0
1979	126	7.1	64.3	27.9	0.7
1983	82	10.9	76.8	12.2	0.0
AVERAGE		6.7	78.7	14.4	0.2

Table 6. Mean fork length and weight of wild steelhead smolts in the Kalama River (Washington), 1978, 1979 and 1983 (from Crawford et al. 1979 and Chilcote et al. 1980b, 1984).

YEAR	SAMPLE SIZE	FORK LENGTH (mm)	WEIGHT (g)
1978	228	163	42
1979	120	159	40
1983	70	161	--
Average		161	41

PRIORITY INFORMATION NEEDS

Continued run size, catch and escapement data; refinement of escapement goal.

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Kalama River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Kalama River, Washington, a tributary to the lower Columbia River (RM 73.1) that drains a watershed of 205 square miles.

ORIGIN

The wild summer steelhead stock in the Kalama River is native, although some interbreeding with the introduced Skamania hatchery stock has taken place (Crawford et al. 1978; M. Chilcote, Washington Department of Game (WDG), personal communication). In addition, some genetic influence was likely exerted by strays that abandoned the Cowlitz system after the eruption of Mount St. Helens in 1980. Further, Chilcote et al. (1980a) and Leider et al. (1984) noted that summer and winter steelhead in the Kalama are not entirely reproductively isolated: they have observed the spawning activity of several known summer-winter steelhead pairs.

ADULT LIFE HISTORY

Run size, catch, and escapement

Counts of wild summer steelhead at the Kalama Falls Hatchery (Washington Department of Fisheries) trap averaged 541 for the years 1976 through 1979 and 1982 (Table 1). Counts in 1980 and 1981 were excluded from the average because they were distorted by the volcano-related straying of other steelhead stocks. Summer steelhead run composition (i.e., % wild) estimates from fish passing the hatchery were applied to estimates of total sport catch to determine that an average of 849 wild summer steelhead were harvested annually over the same 5-year period. Average spawning escapement (estimated from tagging studies and rack counts) for these years was 1,093 wild fish, hence mean run size for the stock was 1,942. An interim escapement goal of 944 wild steelhead has been established for this stock.

Time of migration

Wild summer steelhead return to Kalama Falls Hatchery from late March through January, peaking in early September and late October/early November (Figure 1). Data from 1980 and 1981 were not included due to the disruptive effects of the Mount St. Helens eruption.

Spawning period

January through April, peaking in February and March (Crawford et al. 1979; Chilcote et al. 1980b, 1981, 1983).

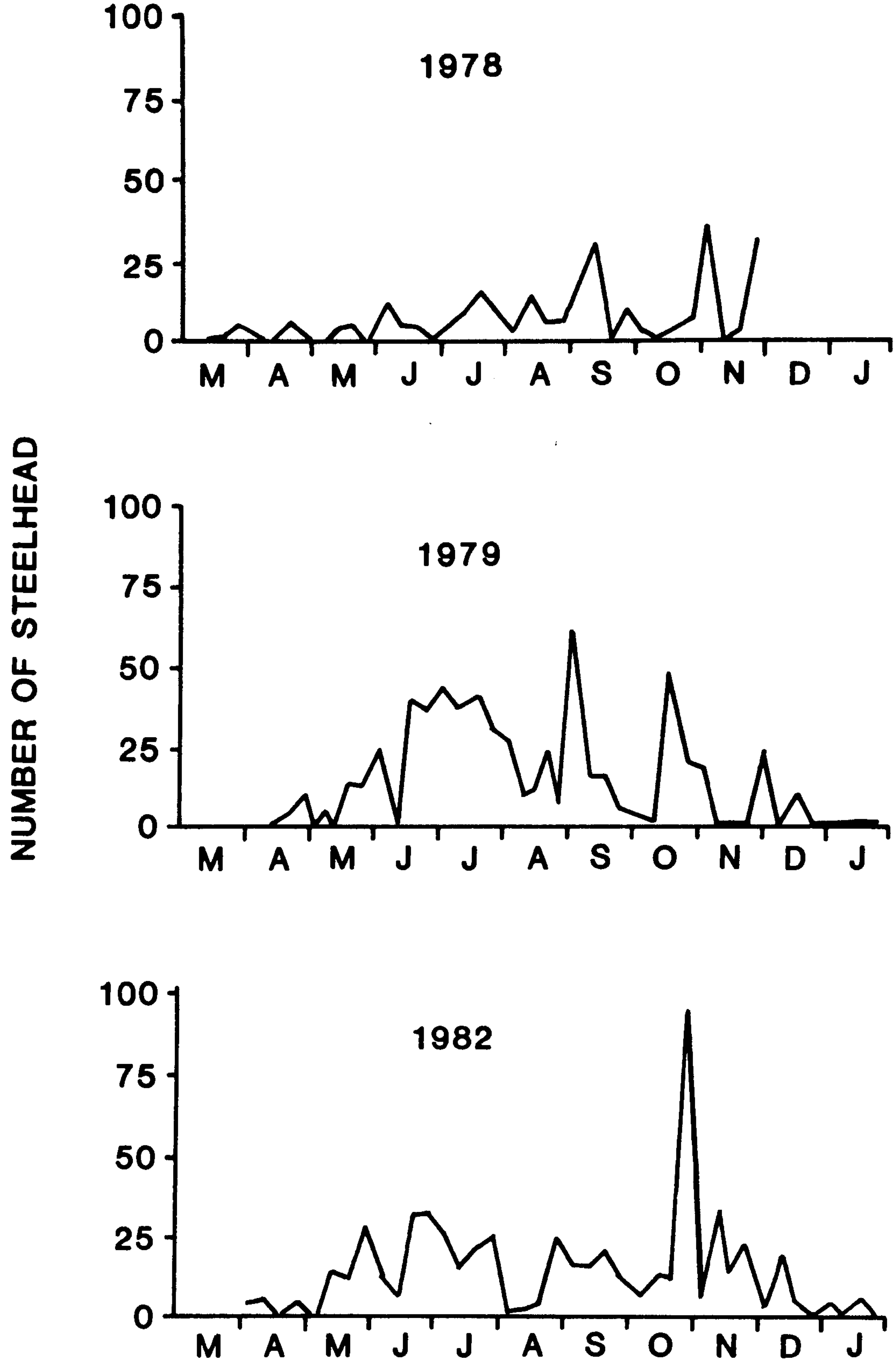

Figure 1. Number of wild summer steelhead passing Kalama Falls Hatchery by week, 1978, 1979 and 1982 (adapted from Crawford et al. 1979 and Chilcote et al. 1981 and 1984).

Table 1. Kalama Falls Hatchery trap counts, run composition, sport catch, escapement and run size of wild summer steelhead in the Kalama River, 1976 through 1982 (counts, composition, and escapement data from Chilcote et al. 1984).

	RUN YEAR							
	1976	1977	1978	1979	1980	1981	1982	MEAN 1/
Wild Trap Count 2/	488	746	287	531	2,364	824	655	541
% of Run Wild	31.5	18.3	14.7	23.2	24.9	9.3	15.3	----
Total Sport Catch 3/	2,665	5,117	3,073	2,569	8,912	7,669	9,310	4,547
Wild Sport Catch	839	936	452	596	2,219	713	1,424	849
Wild Escapement 4/	876	1,548	680	1,120	5,244	1,644	1,240	1,093
Wild Run Size	1,715	2,484	1,132	1,716	7,463	2,357	2,664	1,942

1/ 1976 through 1979 and 1982 (1980 and 1981 biased by volcano-related straying).

2/ Counts exclude fallback returnees, but include racially indeterminate steelhead estimated to be summer fish.

3/ Estimated from punchcard returns.

4/ Estimated from tagging studies and rack count data.

Spawning areas

Both summer and winter steelhead spawn through most of the mainstem Kalama River and the North Fork, Gobar Creek and Wild Horse Creek (Figure 2).

Age composition

Ages and lengths of wild summer steelhead were determined through trapping operations at Kalama Falls Hatchery (Table 2). Again, data from 1980 and 1981 were not included due to the high incidence of volcano-related straying at that time. Of fish with readable scales, an average (3-year) of 14.6% were 1-ocean, 71.7% were 2-ocean, 7.4% were 3-ocean, and 6.3% were repeat spawners.

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 3.2S1 would represent a fish with 3 years of freshwater growth,

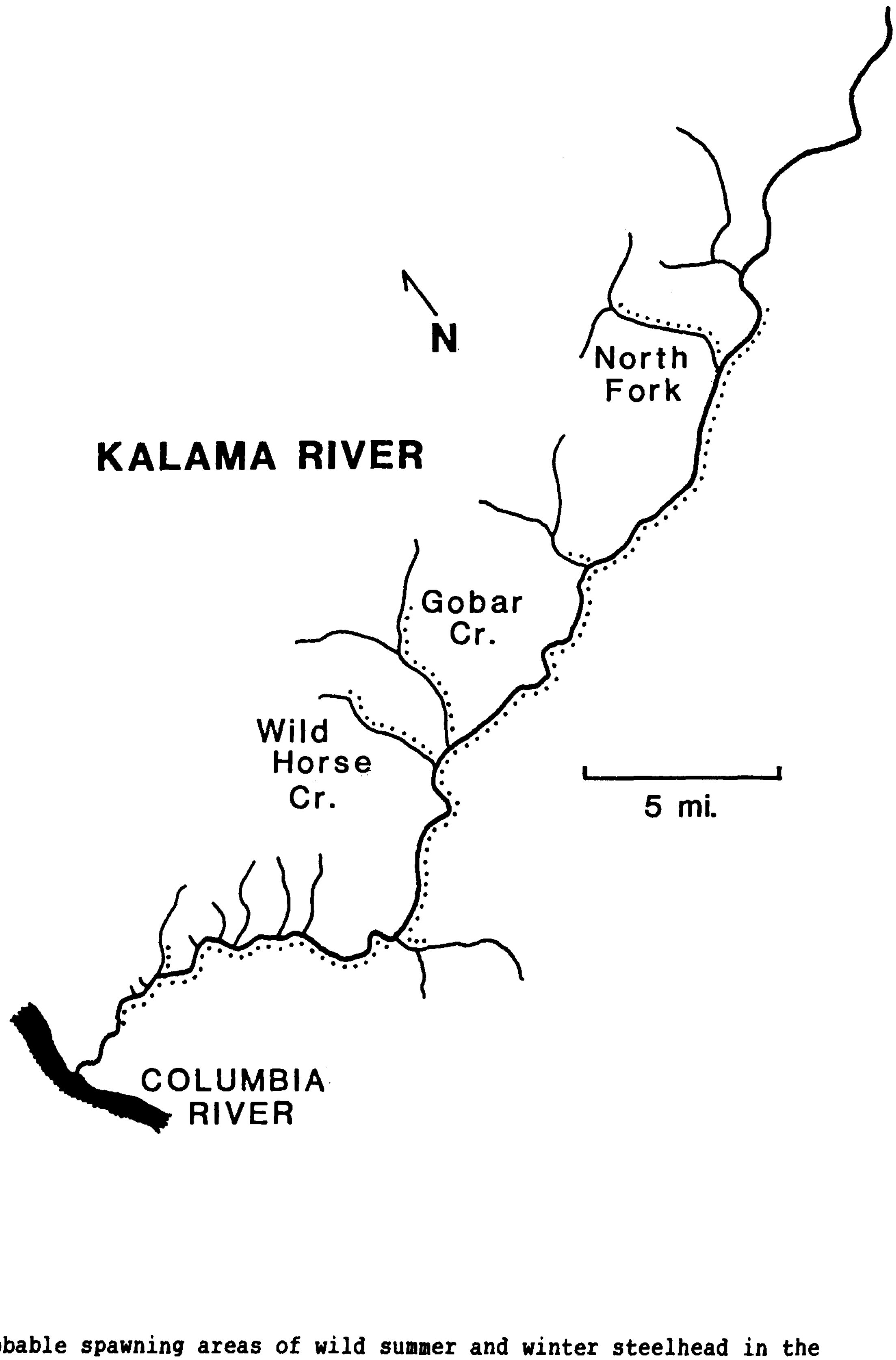

Figure 2. Probable spawning areas of wild summer and winter steelhead in the Kalama River, Washington (B. Crawford, WDG, personal communication).

Table 2. Age and length of wild summer steelhead captured at Kalama Falls Hatchery, Washington, 1978, 1979 and 1982 (from Crawford et al. 1979 and Chilcote et al. 1981 and 1984); RS = repeat spawners.

RUN YEAR	AGE	NUMBER	PERCENT	LENGTH (CM)	% AT SALT AGE
1978	2.1	30	12.3	59.0	I - 16.6
	2.1S1	2	0.8	79.2	II - 70.9
	2.2	153	61.9	72.8	III - 4.9
	2.2S1	9	3.6	76.8	RS - 7.7
	2.2S1S1	2	0.8	81.0	
	2.3	9	3.6	83.5	
	2.3S1	3	1.2	81.7	
	3.1	11	4.5	57.9	
	3.1S1	1	0.4	73.2	
	3.2	22	8.9	73.5	
	3.2S1	2	0.8	73.6	
	3.3	3	1.2	80.4	
	TOTAL	247			
1979	2.1	108	22.3	58.2	I - 24.5
	2.1S1	6	1.2	73.3	II - 65.8
	2.2	282	58.1	73.3	III - 3.1
	2.2S1	22	4.5	81.0	RS - 6.6
	2.2S1S1	3	0.6	84.0	
	2.2S1S1S1	1	0.2	91.4	
	2.3	13	2.7	86.3	
	3.1	11	2.3	57.8	
	3.2	37	7.6	73.0	
	3.3	2	0.4	78.5	
	Total	485			
1982	2.1	5	2.8	57.0	I - 2.8
	2.1S1	3	1.7	72.0	II - 78.5
	2.1S1S1	1	0.6	84.2	III - 14.1
	2.2	130	73.4	72.4	RS - 4.5
	2.2S1	3	1.7	80.0	
	2.3	24	13.6	81.5	
	2.3S1	1	0.6	90.0	
	3.2	9	5.1	71.1	
	3.3	1	0.6	80.0	
	Total	177			

2 years of marine growth prior to spawning, approximately 1 year spent in freshwater for spawning (S), followed by another year of ocean growth (1) prior to its capture in freshwater on its second spawning migration. Hence, this fish would be about 7 years old.

Size

Mean lengths of wild adults sampled at Kalama Falls Hatchery were 58.3 cm for 1-ocean fish, 73.0 cm for 2-ocean fish, 82.8 cm for 3-ocean fish, and 79.2 cm for repeat spawners (Table 2).

Sex ratio

Male:female sex ratios for the wild summer runs of 1976, 1977 and 1978 were 0.98, 0.69 and 1.15, respectively (Crawford et al. 1977, 1978, 1979).

Fecundity

Unknown.

Table 3. Frequencies for the common allele of wild Kalama River (Washington) summer steelhead adults, 1976 through 1979 (from Crawford et al. 1977, 1978 and 1979, and Chilcote et al. 1981).

RUN YEAR	SAMPLE SIZE	LOCI 1/				
		AGP-1	LDH-4	MDH-3,4	SOD-1	PGI-3
1976	146	0.95	-----	-----	-----	-----
1977	217	0.961	-----	-----	-----	-----
1978	204 2/	0.95	0.92	0.84	0.72	0.95
1979	391	0.899	0.886	0.848	0.737	0.972

1/ Complete names of the enzyme loci are as follows:
AGP = alpha-glycerophosphate dehydrogenase,
LDH = lactate dehydrogenase,
MDH = malate dehydrogenase,
SOD = superoxide dismutase, and
PGI = phosphoglucoisomerase.

2/ Sample size for each locus was 204, 201, 191, 203 and 204, respectively.

Biochemical-genetic characteristics

A genetic study of Kalama River summer steelhead was initiated in the mid-1970's to determine if hatchery steelhead were capable of producing viable offspring under natural spawning and rearing conditions. Electrophoretic procedures were used to determine enzyme gene frequencies for several groups of steelhead in the river, including wild summer steelhead adults (Table 3). Research to date has shown some Skamania hatchery stock genes appearing in the wild summer steelhead stock (M. Chilcote, WDG, personal communication).

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wild steelhead smolts in Gobar Creek outmigrate from mid-March through early June, peaking in early May (Table 4). Most of these fish are 2 years old (Table 5); the average size and weight of the outmigrants is 161 mm and 41 grams (Table 6). No methods were available to separate winter and summer smolts in the course of the Kalama River studies, hence these data may not be representative of "pure" summer-run smolts.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Continued run size, catch and escapement data; refinement of escapement goal.

Table 4. Emigration of Gobar Creek (Kalama River, Washington) wild steelhead smolts by sampling interval, expressed as percent of total outmigrant run size, 1977-1979 and 1983 (from Chilcote et al. 1984).

INTERVAL	1977	1978	1979	1983	AVERAGE
March 16 - March 31	6.6	7.5	2.1	4.5	5.2
April 01 - April 15	18.4	10.7	5.7	4.1	9.7
April 16 - April 30	37.6	27.0	28.9	34.6	32.0
May 01 - May 15	24.9	41.4	52.6	43.9	40.7
May 16 - June 01	12.5	13.5	10.8	13.0	12.4

Table 5. Age of wild steelhead smolts expressed as percent of total sample trapped in Kalama River (Washington) in 1978, 1979 and 1983 (from Chilcote et al. 1983, 1984).

YEAR	SAMPLE SIZE	STEELHEAD AGE 1	2	3	4
1978	59	2.0	95.0	3.0	0.0
1979	126	7.1	64.3	27.9	0.7
1983	82	10.9	76.8	12.2	0.0
AVERAGE		6.7	78.7	14.4	0.2

Table 6. Mean fork length and weight of wild steelhead smolts in the Kalama River (Washington), 1978, 1979 and 1983 (from Crawford et al. 1979 and Chilcote et al. 1980b, 1984).

YEAR	SAMPLE SIZE	FORK LENGTH (mm)	WEIGHT (g)
1978	228	163	42
1979	120	159	40
1983	70	161	--
Average		161	41

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North Fork Lewis River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

North Fork Lewis River, Washington, a tributary to the Lewis River (Columbia RM 87.0) that drains a watershed of 828 square miles.

ORIGIN

The North Fork Lewis stock is indigenous, although some interbreeding with introduced steelhead of Chambers Creek, Cowlitz and Elochoman hatchery-stock origin has probably occurred. Further interbreeding likely took place with strays that abandoned the Cowlitz system following the eruption of Mount St. Helens in 1980.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size or escapement exist. Smoker et al. (1951) believed combined native runs of winter and summer steelhead above Merwin Dam formerly exceeded 1,000 adults. Harvest of the stock occurs in mainstem Columbia and mainstem Lewis River sport fisheries, as well as in the North Fork Lewis River. Annual sport harvest of the stock in the mainstem Lewis and North Fork was estimated to range from 24-90 for the years 1977-78 through 1983-84 (Table 1). The interim escapement goal for this stock is 698 spawners.

Time of migration

Probably January through May, peaking in March.

Spawning period

March through June.

Spawning areas

Construction of Merwin Dam in 1929 blocked anadromous fish passage to most of the usable spawning and rearing habitat in the watershed (Figure 1). Most natural steelhead production in the North Fork Lewis presently occurs in Cedar Creek.

Age composition

Of the 12 wild winter steelhead sampled from 1977-78 through 1979-80, 17% were 1-ocean jacks and 83% were 2-ocean adults (Table 2). The notation of Narver and Withler (1971) was modified and used to report age data

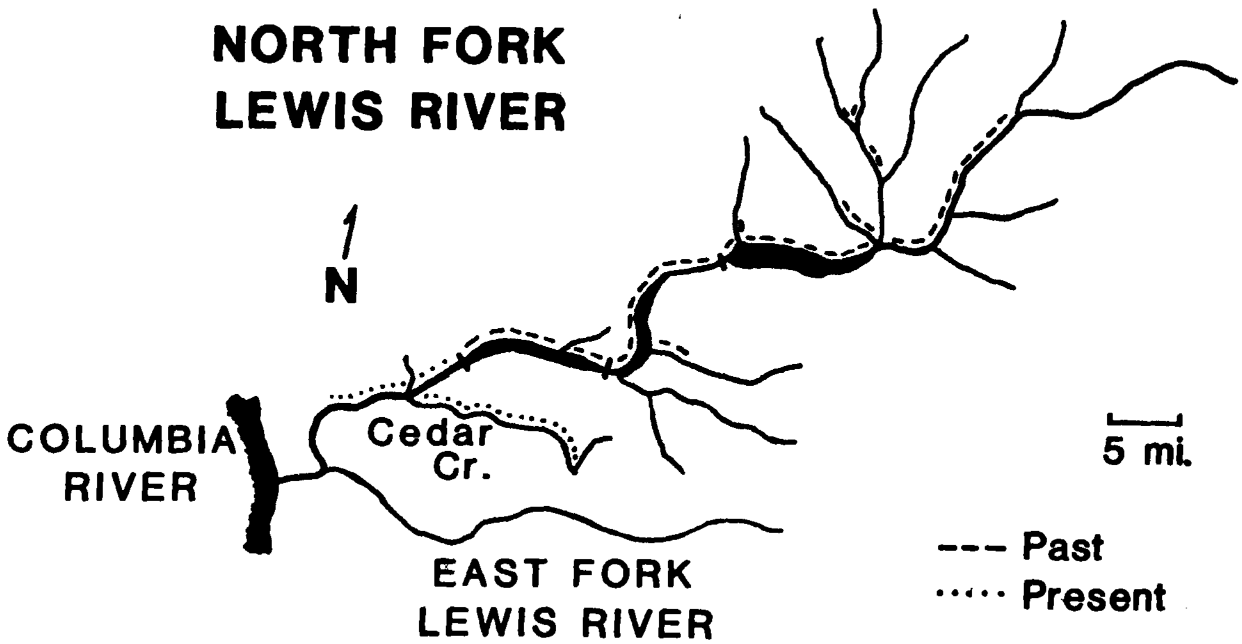

Figure 1. Probable past and present spawning areas of wild winter and summer steelhead in the North Fork Lewis River, Washington (Fulton 1970; B. Crawford, Washington Department of Game, personal communication).

Table 1. Estimated harvest of wild North Fork Lewis (WA) winter steelhead, 1977-78 through 1979-80, 1982-83 and 1983-84 (data from 1980-81 and 1981-82 were not included due to volcano-related straying of Cowlitz fish into the Lewis).

	RUN YEAR				
	1977-78	1978-79	1979-80	1982-83	1983-84
Sport Catch (from punchcards)					
North Fork Lewis	598	374	418	802	1,460
Cedar Cr.	21	4	10	50	34
Mainstem (N.F.-bound) 1/	106	76	62	203	205
North Fork Lewis Total	725	454	490	1,055	1,699
% Wild 2/	3.8	5.3	6.8	5.3	5.3
Sport Catch of Wild Steelhead	28	24	33	56	90

1/ Interception of North Fork-bound steelhead in the mainstem Lewis was estimated as:

$$\text{Mainstem catch X} \quad \frac{\text{(NF + Cedar Creek catch)}}{\text{(NF + Cedar Creek + EF + Rock Creek catch)}}$$

2/ From LaVoy and Fenton (1983); 1982-83 and 1983-84 % wild = 3-year average % wild, 1977-78 through 1979-80.

Table 2. Age of wild winter steelhead harvested in the North Fork Lewis River, Washington, 1977-78 through 1979-80 (from LaVoy and Fenton 1983).

AGE	1977-78	1978-79	1979-80
2.+	0	1	0
2.1+	3	1	5
3.+	0	1	0
3.1+	1	0	0

derived from steelhead scales because it distinguishes fresh vs. saltwater growth. For example, age 2.1+ would represent a fish with 2 years of freshwater growth and approximately 1 and 1/2 years of ocean growth (1+) prior to its capture in freshwater on its spawning migration. Hence, this fish would be more than 3 years old.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts probably outmigrate in April and May at a size of 160 mm. Of adults returning between 1977-78 and 1979-80, 83% had smolted at 2 years of age and 17% at 3 years (Table 2).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye and chum salmon in the Columbia River Basin - past and present. NMFS Special Scientific Report, Fisheries No. 618.

LaVoy, L., and G. Fenton. 1983. North Lewis River steelhead study. Washington Department of Game.

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North Fork Lewis River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

North Fork Lewis River, Washington, a tributary to the Lewis River (Columbia RM 87.0) that drains a watershed of 828 square miles.

ORIGIN

The North Fork Lewis summer steelhead stock is native, although some influence (i.e., interbreeding) from introduced Skamania stock hatchery steelhead is likely. Additional genetic material was probably contributed by strays that avoided the Cowlitz system following the eruption of Mount St. Helens in 1980.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size or escapement exist. Smoker et al. (1951) believed combined native runs of winter and summer steelhead above Merwin Dam formerly exceeded 1,000 adults. The stock is harvested in mainstem Columbia, mainstem Lewis, and North Fork Lewis sport fisheries. Harvest of the stock in the mainstem Lewis and North Fork was estimated at fewer than 20 fish annually in recent years (Table 1). To date, no escapement goal has been established for this stock.

Time of migration

Probably similar to wild summer steelhead in the Kalama River - i.e., April through December, peaking July through October.

Spawning period

Similar to wild summer steelhead in the Kalama River - i.e., January through April, peaking in February and March.

Spawning areas

Construction of Merwin Dam in 1929 blocked anadromous fish passage to most of the prime spawning and rearing habitat in the watershed (Figure 1). Most natural steelhead production in the North Fork Lewis presently occurs in Cedar Creek.

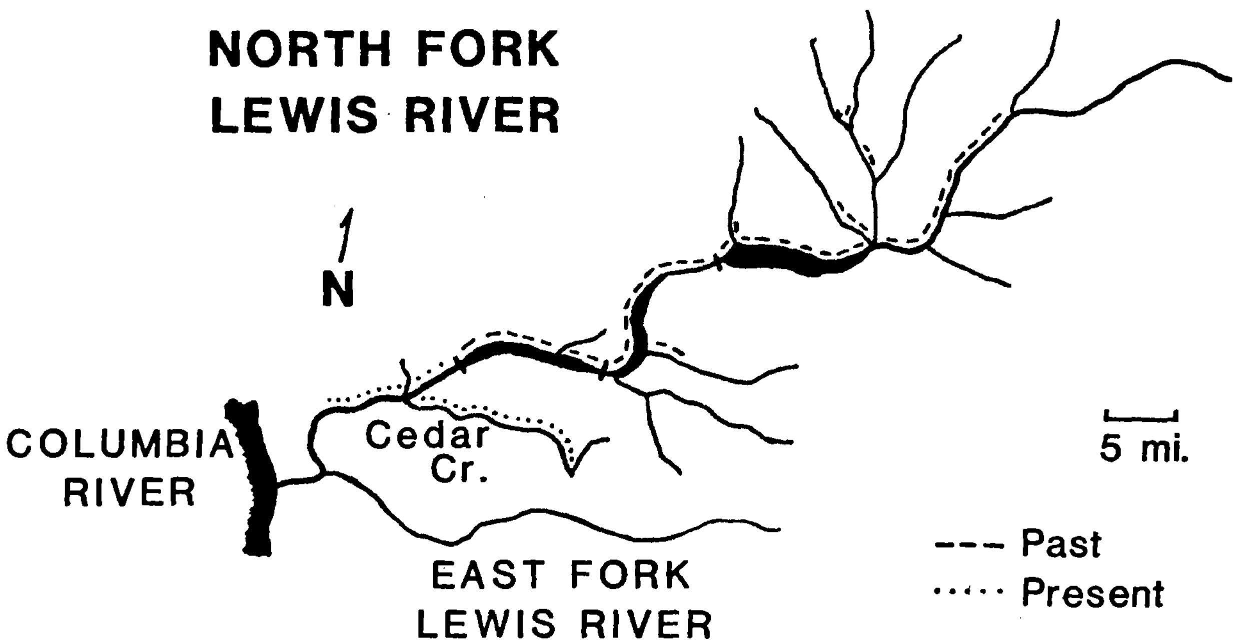

Figure 1. Probable past and present spawning areas of wild winter and summer steelhead in the North Fork Lewis River, Washington (Fulton 1970; B. Crawford, Washington Department of Game, personal communication).

Table 1. Estimated harvest of wild North Fork Lewis (WA) summer steelhead, 1978, 1979, 1982 and 1983 (data from 1980 and 1981 were not included due to volcano-related straying of Cowlitz fish).

	RUN YEAR			
	1978	1979	1982	1983
Sport Catch (from punchcards)				
North Fork Lewis	1,733	741	3,278	1,641
Cedar Cr.	0	0	28	2
Mainstem (N.F.-bound)1/	255	181	195	141
North Fork Lewis Total	1,988	922	3,501	1,784
% Wild 2/	0.7	2.0	0.3	1.0
Sport Catch of Wild Steelhead	14	18	11	18

1/ Interception of North Fork-bound steelhead in the mainstem Lewis was estimated as:

$$\text{Mainstem catch X} \quad \frac{\text{(NF + Cedar Creek catch)}}{\text{(NF + Cedar Creek + EF + Rock Creek catch)}}$$

2/ From LaVoy and Fenton (1983); 1983 % wild = 3-year average % wild, 1978, 1979 and 1982.

Age composition

Of the three wild summer steelhead sampled in the sport fishery in 1978, 1979 and 1982, two were age 2.2 and one was age 3.2 (LaVoy and Fenton 1983). Again, data from 1980 and 1981 were excluded due to volcano-related straying. Using the notation of Narver and Withler (1971), an age 3.2 fish would have spent 3 years in freshwater and 2 years in the ocean prior to is capture in freshwater on its spawning migration.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts probably outmigrate in April and May (peak in early May) at an age of 2 years and a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

REFERENCES

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye and chum salmon in the Columbia River Basin - past and present. NMFS Special Scientific Report, Fisheries No. 618.

LaVoy, L., and G. Fenton. 1983. North Lewis River steelhead study. Washington Department of Game.

Narver, D.W., and F.C. Withler. 1971. Age and size of steelhead trout (*Salmo gairdneri*) in anglers' catches from Vancouver Island, British Columbia, streams. Fish. Res. Bd. Can. Circ. 91.

Smoker, W.A., J.M. Hurley, and R.C. Meigs. 1951. Compilation of observations on the effect of Ariel Dam on the production of salmon and trout in the Lewis River. Washington Department of Fisheries.

East Fork Lewis River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

East Fork Lewis River, Washington, a tributary to the Lewis River (Columbia RM 87.0) that drains a watershed of 212 square miles.

ORIGIN

The East Fork Lewis winter stock is native, although interbreeding with introduced steelhead of Chambers Creek, Cowlitz and Elochoman hatchery-stock origin has probably taken place. Additional genetic mixing likely occurred with strays that abandoned the Cowlitz system following the eruption of Mount St. Helens in 1980.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement are unavailable. Harvest of the stock occurs in mainstem Columbia, mainstem Lewis, and East Fork Lewis sport fisheries. The annual sport catch of wild and hatchery-origin winter steelhead in the East Fork is approximately 2,410 (5-year average, based on punchcard returns, skipping 1980-81 and 1981-82 due to volcano-related straying). An interim escapement goal of 875 wild winter steelhead has been set for this stock.

Time of migration

Likely January through May, peaking in March.

Spawning period

March through June.

Spawning areas

Wild steelhead spawn throughout the mainstem East Fork Lewis River and Rock Creek (Figure 1).

Age composition

Unknown.

Size

A portion of the wild East Fork stock returns as 3-4 ocean adults weighing 18-25 pounds (Lavier 1972; B. Crawford, WDG, personal communication).

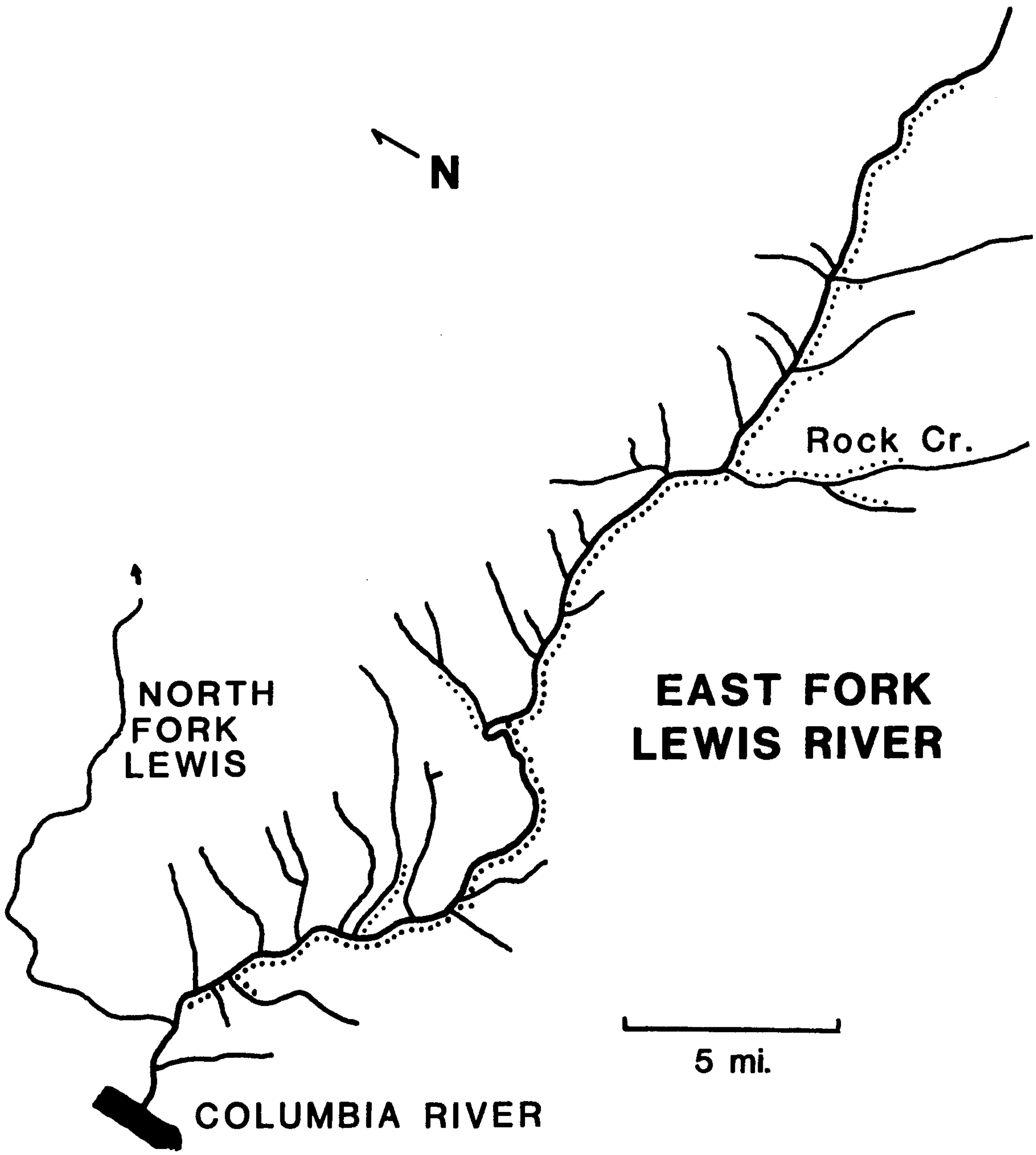

Figure 1. Probable spawning sites of steelhead trout in the East Fork Lewis River, Washington (B. Crawford, WDG, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts probably outmigrate in April and May as 160 mm 2-year olds.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

Lavier, D.C. 1972. Annual report, 1972/Proposed program, 1973; Region 9. Washington Department of Game.

East Fork Lewis River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

East Fork Lewis River, Washington, a tributary to the Lewis River (Columbia RM 87.0) that drains a watershed of 212 square miles.

ORIGIN

The East Fork Lewis summer steelhead stock is native, although interbreeding with Skamania hatchery-stock fish has likely occurred. Additional genetic influence was probably exerted by Cowlitz River strays for several years following the 1980 eruption of Mount St. Helens.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement exist. Harvest of the stock occurs in mainstem Columbia, mainstem Lewis and East Fork Lewis recreational fisheries. The annual sport catch of wild and hatchery-origin summer steelhead in the East Fork is approximately 2,050 (5-year average, based on punchcard returns, skipping 1980 and 1981 due to volcano-related straying from the Cowlitz). The interim escapement goal for this stock is 610 fish.

Time of migration

Likely April through December, peaking between July and October.

Spawning period

January through April, peaking in February and March.

Spawning areas

Spawning locations of both summer and winter steelhead are assumed to overlap in the East Fork (Figure 1), although summer-runs may not pass over falls in the upper mainstem as readily as winter-runs.

Age composition

Unknown.

Size

Unknown.

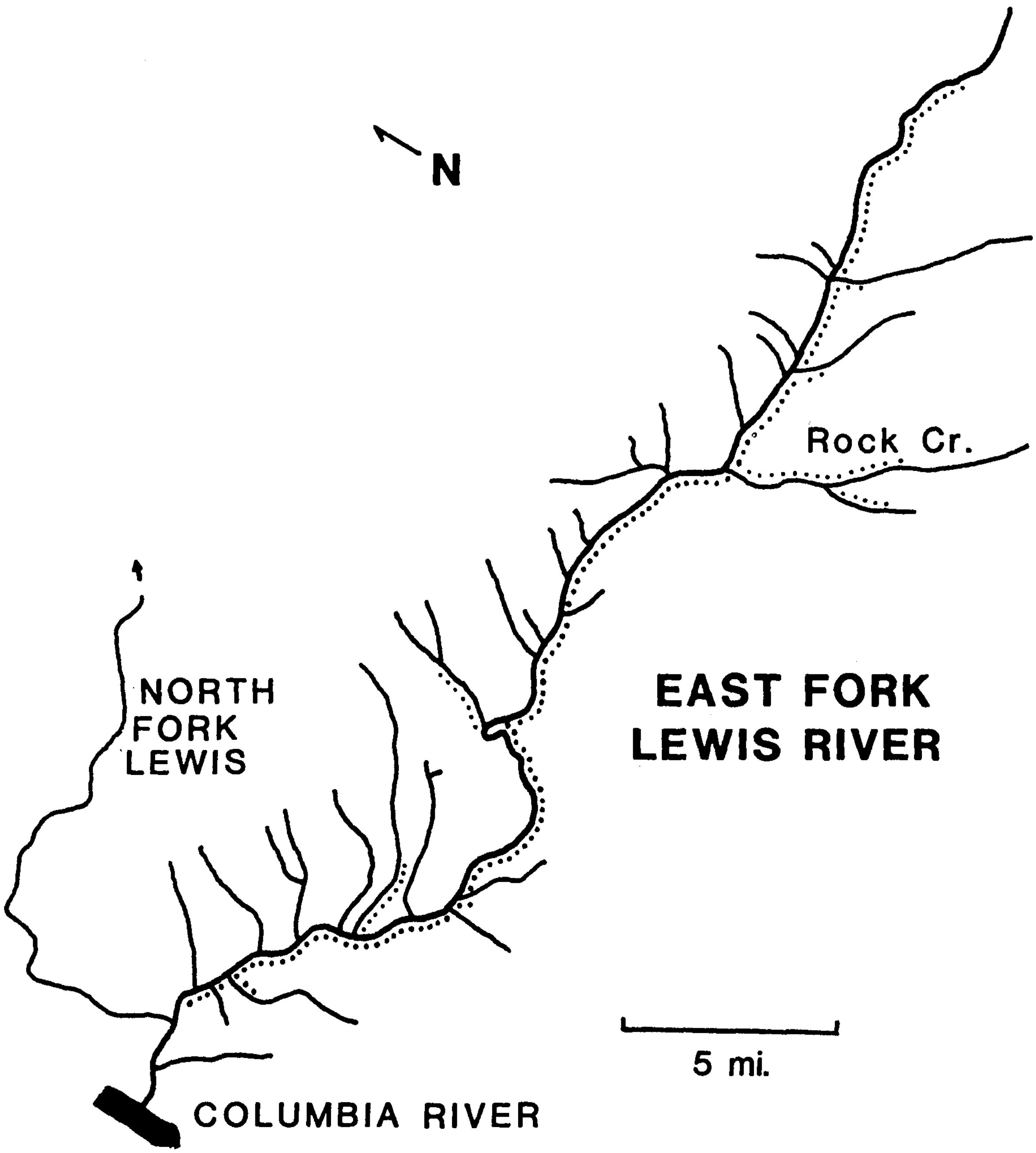

Figure 1. Probable spawning areas of wild summer and winter steelhead in the East Fork Lewis River, Washington (B. Crawford, Washington Department of Game, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

The majority of Lewis River steelhead smolts are probably 2 years old and 160 mm in length when they outmigrate during high flows in April and May (peak in early May).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Salmon Creek Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Salmon Creek, Washington, a tributary to the Lake River (Columbia RM 87.5) that drains a watershed of approximately 90 square miles.

ORIGIN

The Salmon Creek winter steelhead stock is native, although limited interbreeding with introduced Chambers Creek, Cowlitz and Elochoman hatchery-stock steelhead has probably occurred.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch and escapement are available. Harvest of the stock occurs in the mainstem Columbia sport fishery, as well as in the Lake River drainage. The annual sport catch of wild and hatchery-origin winter steelhead in Salmon Creek is approximately 50 (5-year average, based on punchcard returns). An interim escapement goal of 639 wild fish has been established for this stock.

Time of migration

January through April, peaking in February (based on historical sport catch timing).

Spawning period

Likely March through June.

Spawning areas

Wild winter steelhead spawn through most of the Salmon Creek mainstem, the lower reaches of Gee, Whipple and Burntbridge creeks, and portions of the Lake River (Figure 1).

Age composition

Unknown.

Size

Unknown.

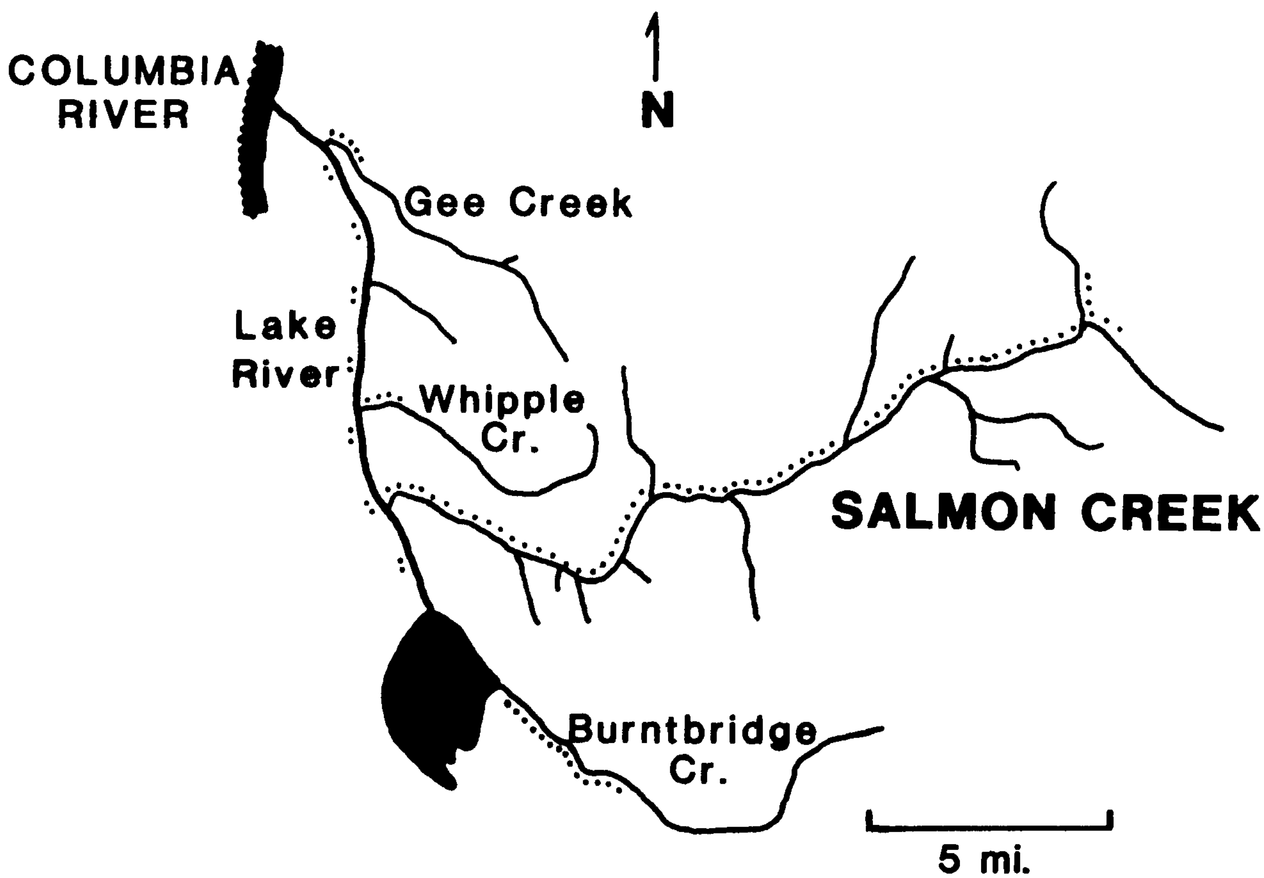

Figure 1. Probable spawning areas of steelhead trout in the Lake River system, Washington (B. Crawford, Washington Department of Game, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Similar to steelhead smolts in other tributaries to the Lower Columbia within Washington State - i.e., juveniles outmigrate in April and May at a size of 160 mm and an age of 2 years.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

Willamette River Winter Steelhead (wild)

PRODUCTION

Winter steelhead in the Willamette system are produced from wild and hatchery stocks. This summary presents information related primarily to the wild stock. Consult the "Willamette Winter Steelhead (hatchery)" and "Big Creek Winter Steelhead (hatchery)" summaries for information on the hatchery stocks of winter steelhead used in the Willamette system.

GEOGRAPHIC LOCATION

Streams

Willamette winter steelhead occur in the Willamette River and tributaries above Willamette Falls (Figure 1). Crabtree and Thomas creeks (S. Santiam), Calapooia River, and the Middle Fork Willamette including Fall Creek are managed solely for wild production.

ORIGIN

Winter steelhead are indigenous to the Willamette River system. Wild production in the North and South Santiam rivers has been supplemented with releases of Willamette hatchery stock (developed from native wild stock) since 1952. Big Creek stock has been released in lower tributaries since 1966. The Willamette hatchery stock was introduced in the Middle Fork Willamette below Dexter Dam and in Fall Creek in 1953 and quickly developed into a self-sustaining, naturally reproducing run. Winter steelhead were first reported in the McKenzie River in 1957, possibly a result of the Middle Fork introduction (Wood and Wallis, undated).

ADULT LIFE HISTORY

Run size, catch, and escapement

Since 1971 the late run of winter steelhead above Willamette Falls, which is thought to consist principally of native wild and hatchery stocks, has fluctuated between 3,000 and 18,000 (Table 1). In 1982 85% of the late run was estimated to be wild (n=284) (Buchanan and Wade 1982). The run size objective above Willamette Falls is 14,000 Willamette steelhead (ODFW 1980).

Sport harvest of winter steelhead is shown in Table 2. The highest catches are in the lower Willamette River and the Santiam River and tributaries. The proportion of wild fish in these estimates is unknown.

There are no estimates of total spawning escapement in the system. Counts at Foster, Green Peter, and Fall Creek dams reflect trends in spawning escapement of wild fish above these dams (Table 1). In 1971 more than 4,000 adults or 23% of the native adult steelhead counted at Willamette Falls

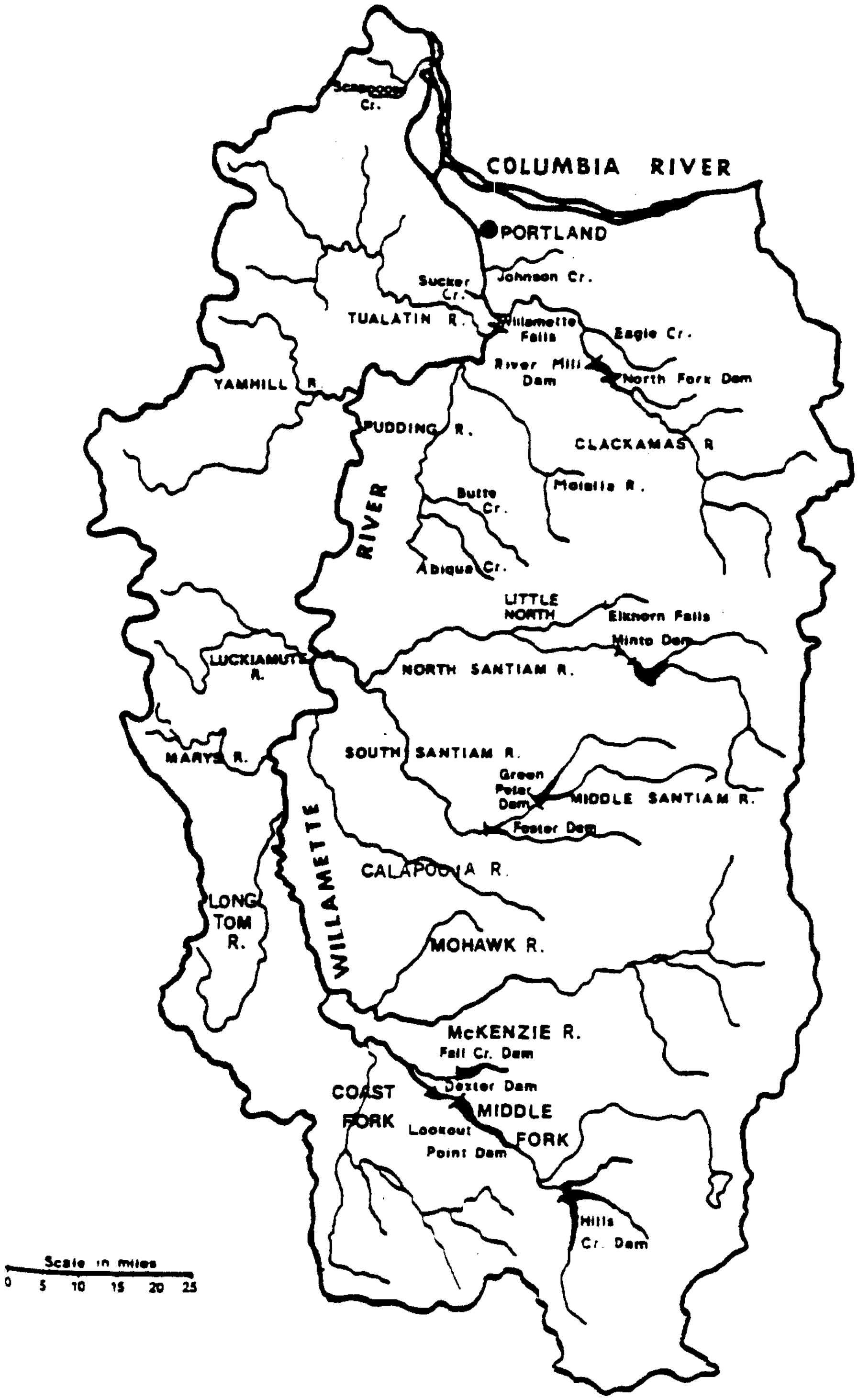

Figure 1. The Willamette River system.

migrated to Foster Dam. Returns to Foster Dam have declined to an average of 309 adults in 1979-84 or 3.4% of the Willamette Falls counts. Returns to Green Peter Dam have dwindled to only a few fish.

Table 1. Number of Willamette winter steelhead migrating past Willamette Falls, Foster Dam, Green Peter Dam and Fall Creek Dam, 1971-84[a] (modified from Wade and Buchanan 1983; R. Hooton, ODFW, personal communication).

Year	Willamette Falls	Foster Dam No.[b]	Foster Dam Percentage of Willamette Falls	Green Peter Dam No.[b]	Green Peter Dam Percentage of Foster Dam	Fall Creek Dam[b]
1971	18,314	4,254	23.2	766	18.0	943
1972	16,588	2,153	13.0	289	13.4	461
1973	11,511	755	6.6	83	11.0	393
1974	8,528	695	8.1	84	12.0	378
1975	3,034	353	11.6	20	5.7	132
1976	5,196	302	5.8	25	8.3	547
1977	8,277	503	6.1	92	18.3	290
1978	8,270	488	5.9	96	19.8	190
1979	5,865	149	2.5	0	0	95
1980	16,142	515	3.2	0	0	230
1981	9,038	317	3.5	13	4.1	157
1982	6,894	234	3.4	4	1.7	260
1983	4,702	134	2.9	6	4.5	72
1984	10.720	504	4.7	3	0.6	161

[a] The number of Willamette stock winter steelhead above Willamette Falls was calculated as the number of winter steelhead passing the falls after February 15. This count includes wild and hatchery fish.
[b] Wild fish only.

Time of migration

The native Willamette steelhead stock is a late winter run. Tagging studies indicated that the fish enter the Columbia primarily in March and April and move rapidly upstream (Korn 1961). Peak passage at Willamette Falls from 1957 to 1966 occurred in April (Thompson et al. 1966). March and May accounted for 9.5% and 7.3% of the run, respectively.

It is uncertain whether the run timing at Willamette Falls has changed without further analysis. However, after completion in 1970 of Entrance 2 to the fishway on the west side of the falls, which is used by most winter steelhead, a large portion of the run in the succeeding four years passed the falls in March and April (Figure 2). Since then most of the peaks in the late portion of the run (February through May) have occurred in February and March (Buchanan 1977; Bennett 1982, 1983, 1984, 1985).

Table 2. Willamette River winter steelhead sport catch by run-year, 1971-80[a,b] (Berry 1981).

	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Abernathy Cr.	-	-	-	-	-	3	7	7	6
Abiqua Cr.	-	-	-	-	-	207	111	35	253
Beaver Cr.	-	-	-	-	-	-	25	7	6
Butte Cr.	-	-	-	-	-	21	32	16	36
Calapooia R.	169	182	51	33	177	80	0	96	122
Crabtree Cr.	-	-	-	-	-	28	4	6	51
Fall Cr.	-	-	-	-	-	53	26	3	6
Gales Cr.	-	-	-	-	-	145	209	11	324
Johnson Cr.	19	12	10	32	4	0	21	14	9
Luckiamute R.	-	-	-	-	-	0	6	4	0
Marys R.	-	-	-	-	-	3	10	3	16
McKenzie R.	34	0	0	0	0	0	0	0	0
Mill Cr. (Marion Co.)	-	-	-	-	-	9	4	0	9
Mill Cr. (Yamhill Co.)	-	-	-	-	-	3	10	13	26
Milton Cr.	-	-	-	-	-	0	20	13	29
Molalla R.	323	570	419	589	573	882	1,294	498	2,062
Pudding R.	-	-	-	-	-	-	4	15	9
Santiam R.,	1,224	1,528	698	679	636	966	965	395	818
Santiam R., N.F.	-	-	-	321	277	791	1,391	437	1,129
Santiam R., Little N.F.	-	-	-	-	-	15	139	92	118
Santiam R., S.F.	-	-	-	64	127	207	748	57	74
Scappoose Cr.	56	22	59	101	26	3	73	13	234
Thomas Cr.	-	-	-	-	-	125	145	23	102
Tualatin R.	-	-	-	-	-	62	87	26	55
Willamette R., Lower[c]	2,256	1,415	823	986	1,380	690	755	465	1,121
Willamette R., Upper	-	-	-	-	-	10	111	125	299
Willamette R., Coast F.	-	-	-	-	-	-	12	20	3
Willamette R., Mid. F.	-	-	-	-	-	28	60	0	32
Willamina Cr.	-	-	-	-	-	9	135	29	69
Yamhill R.	-	-	-	-	-	-	8	0	3
Yamhill R., N.F.	-	-	-	-	-	9	18	0	7
Yamhill R., S.F.	-	-	-	-	-	-	15	0	0
Total	4,081	3,729	2,060	2,805	3,200	4,340	6,445	2,423	7,028

[a] 1977 is the first year to list catch in all open streams; prior to that catch in tributary streams was included in mainstem catch. All catch estimates corrected for non-response bias.

[b] Catches include Big Creek and Willamette stocks.

[c] Catch may include Clackamas (wild) and Eagle Creek (hatchery) stocks.

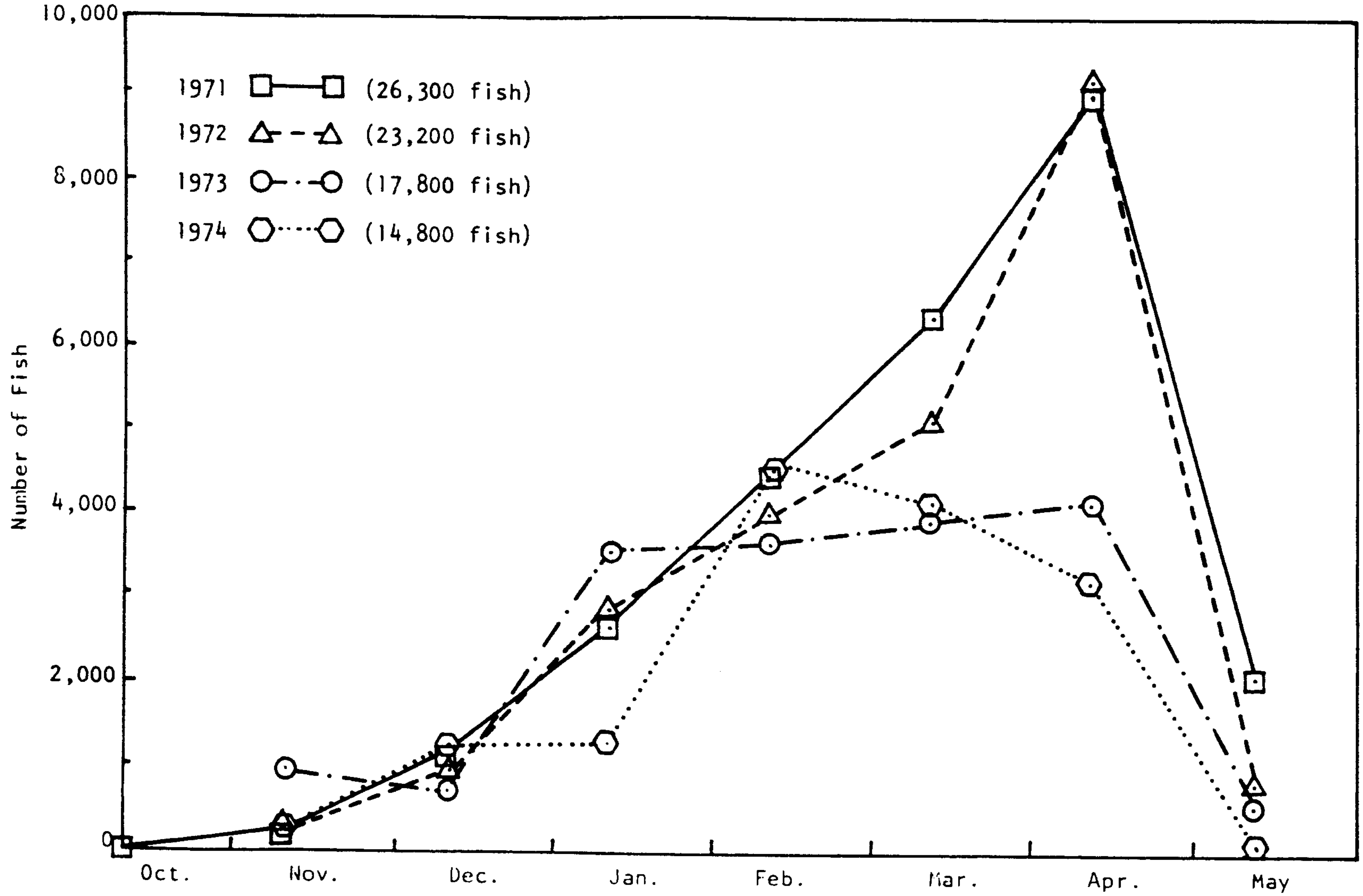

Figure 2. Timing of winter steelhead past Willamette Falls, 1971-74. Run size is shown in parentheses for each calendar year (Buchanan 1977).

Counts in the early portion of the late run may be inflated by unknown numbers of late-returning Big Creek stock. February 1-15 has been used as the cut-off between Big Creek and Willamette stocks at Willamette Falls, but the actual overlap in the run timing of the two stocks has not been determined.

The peak of the run timing at Foster Dam (Table 3) and Fall Creek Dam (Figure 3) has been in April. DeCew (1969) reported that adults arrived at Minto on the North Santiam from May to mid-July.

Spawning period

Spawning occurs as early as March (Hutchison and Aney 1964). The peak of spawning occurs in April in tributaries on the west side of the Willamette River and in May in eastside tributaries (Hutchison et al. 1966).

Spawning areas

Winter steelhead were historically found in most eastside tributaries of the Willamette River below the McKenzie River. Small populations are also found in some westside tributaries. In the mid-1960s, the largest portion of the run above Willamette Falls was in the North and South Santiam rivers (Table 4). Detroit and Big Cliff dams have blocked access to spawning areas and inundated rearing areas on the North Santiam. About 27% of the wild production in the South Santiam River above Foster Dam was lost following construction of Foster and Green Peter dams (Buchanan and Hooton 1979).

Spawning primarily occurs high in the upper tributaries. Spawning areas described by Fulton (1970) are listed in Table 5. Winter steelhead also spawn in Rock and Mad creeks (North Santiam); Moose and McDowell creeks (South Santiam); Little Fall, Hills, and Lost creeks (Middle Fork Willamette); and Coast Fork Willamette (J. Wetherbee and B. Hooton, ODFW, personal communication).

Table 3. Numbers and percentages of wild steelhead collected at Foster Dam by month, 1971-79 (R. Hooton, ODFW, unpublished data).

Year	71-72		72-73		73-74		74-75		75-76		76-77		77-78		78-79		
Month	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	$\bar{x}$ %
January	5	0.2	20	2.7	0	0	0	0	5	1.7	1	0.2	0	0	0	0	0.6
February	91	4.2	32	4.3	29	4.2	14	4.1	5	1.7	0	0	15	3.2	2	1.4	2.9
March	303	14.1	225	30.5	147	21.5	34	9.8	72	24.5	82	16.8	148	31.1	35	23.6	21.5
April	1,110	51.5	355	48.1	372	54.4	206	59.5	112	38.1	300	61.7	237	49.7	74	50.0	51.6
May	640	29.7	106	14.4	124	18.1	89	25.7	98	33.3	96	19.7	75	15.8	35	23.6	22.5
June	6	0.3	0	0	11	1.6	3	0.9	2	0.7	8	1.6	1	0.2	2	1.4	0.8
July	0	0	0	0	1	0.2	0	0	0	0	0	0	0	0	0	0	0.1
Total	2,155		738		684		346		294		487		476		148		

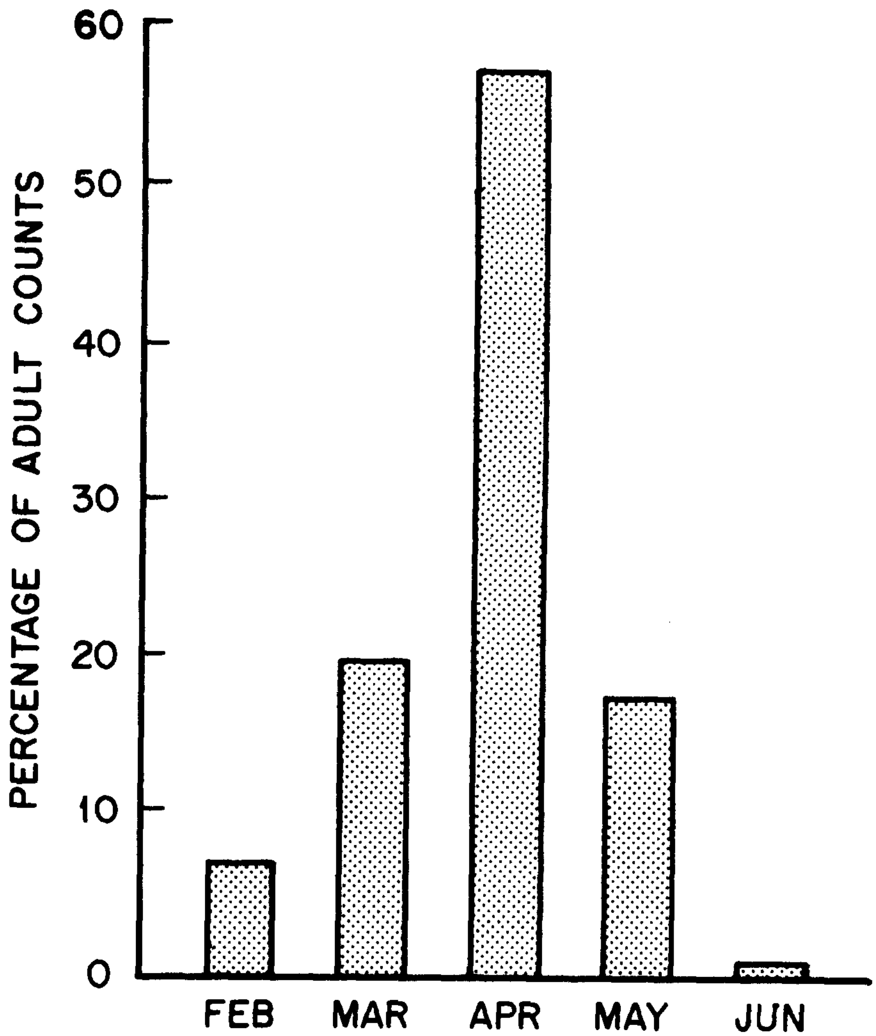

Figure 3. Timing of the winter steelhead run past Fall Creek Dam, 1965-83 (R. Hooton, ODFW, unpublished data).

Table 4. Estimated steelhead spawning in several Willamette River tributaries, 1965-66 (Clady 1971).

River	Estimated number of fish	Percentage of fish count at Willamette Falls (13,910)
Coast Fork	21	0.2
Middle Fork	415	3.0
McKenzie	345	2.5
Santiam	8,261[a]	59.4
Molalla	4,454	32.0
Tualatin	414	3.0

[a] Includes 1,000 to 2,000 Calapooia River fish.

Table 5. Spawning areas of steelhead in the Willamette River basin above Willamette Falls (from Fulton 1970).

Willamette River
- Upper mainstem

Abernathy Creek
- Mainstem
- Holcomb Cr.

Tualatin River
- Upper Gales Cr.

Molalla River
- Mainstem
- Lower North Fork
- Butte Cr.
- Abiqua Cr.
- Upper Milk Cr.

Yamhill River
- North Yamhill River
- Upper South Yamhill River

North Santiam
- Mainstem
- Lower Little North Santiam River

South Santiam
- Upper mainstem
- Thomas Creek
- Crabtree Creek
- Wiley Creek
- Canyon Creek

Middle Santiam River
- Mainstem
- Quartzville Creek

Calapooia
- Upper mainstem

McKenzie River
- Upper Mohawk River

Middle Fork Willamette River
- Mainstem below Dexter Dam
- Fall Creek
- Winberry Creek

Age composition

All adults (n = 105) sampled from 1957-59 brood years that returned to Minto rack on the North Santiam had spent two years in the ocean (Table 6). Likewise, all fish examined from the Middle Fork Willamette River were 2-salts

(Table 7). An analysis of adult age composition for juveniles smolting in the South Santiam River in 1977 and 1978 also indicates that adult returns to Foster Dam were predominantly 2-salts: 78% and 88%, respectively (Table 8).

Table 6. Age of North Santiam River adult steelhead, 1957-59 broods (DeCew 1969).

Brood year	No. fish	Age groups	Adult run
1957	3	3/2	1962
1958	30	2/2	1962
1958	9	3/2	1963
1959	63	2/2	1963

Table 7. Age of Middle Fork Willamette River adult steelhead, 1958 and 1959 broods (DeCew 1969).

Brood year	No. fish	Age group	Adult run
1958	22	2/2	1962
1959	14	2/2	1963

Table 8. Ocean age of winter steelhead adults trapped at Foster Dam for smolt years 1977 and 1978 (D. Buchanan and R. Youker, ODFW, unpublished data).

Smolt year	Return year	Ocean age (yr)	n	%
1977[a]	1979	2	130[b]	77.8
	1980	3	36	21.6
	1981	4	1	0.6
1978	1979	1	9[b]	1.7
	1980	2	452	87.4
	1981	3	54	10.4
	1982	4	2	0.4

[a] Estimated 1-salt returns in 1978 are not available.
[b] Actual sample sizes of 83 2-salt and 6 1-salt returns were expanded for total adult run to Foster trap in 1979 (149 fish).

Although outmigrating kelts averaged 58% of the upstream run in the Clackamas River from 1956-64 (Gunsolus and Eicher 1970), there were no repeat spawners among any of the sample of returns to Minto from 1957-59 brood years (DeCew 1969). There were 2% repeat spawners among adults trapped at Foster Dam on the South Santiam in 1979 and 1980 (n = 95 and 515, respectively) and 4% repeat spawners in 1981 (n = 309). All but one of the repeat spawners at Foster Dam had 3-salt life histories (R. Youker, ODFW, unpublished data).

Size, sex ratio, and fecundity

Raw data are available for wild adults trapped at Foster Dam, but they have not yet been summarized (M. Wade, ODFW, personal communication).

Biochemical-genetic characteristics

Preliminary data for isozyme gene frequencies of samples taken from Thomas Creek and the Calapooia River are presented in Table 9.

JUVENILE LIFE HISTORY

Time of emergence

No information.

Time, age, and size at migration

Based on scale analyses of adults, juveniles generally spend 2 years in freshwater before smolting (Tables 6, 7, and 10).

Smolt migration past Willamette Falls begins in early April and extends through early June (Figure 4). The peak migration period is usually from mid-April to mid-May. Dams on the South Santiam River have sometimes delayed normal smolt migration timing (Buchanan et al. 1983).

Weekly mean lengths of wild smolts sampled at Willamette Falls (1976-78) ranged from 170 to 220 mm. Larger smolts migrated significantly earlier than the smaller smolts (Figure 5).

Table 10. Freshwater age of adult winter steelhead trapped at Foster Dam, 1979-82 (R. Youker, ODFW, unpublished data).

Freshwater	1979		1980		1981		1982	
age (yr)	%	n	%	n	%	n	%	n
1	0	0	2	9	2	5	0	0
2	60	57	89	430	87	246	89	180
3	40	38	9	43	11	32	9	19
4	0	0	0	0	0	0	2	4[a]

[a] Freshwater age may have been 3 yr.

Table 9. Isozyme gene frequencies and sample sizes (n) as determined by electrophoresis for upper Willamette River wild winter steelhead. Numbers at the top of each column are relative mobilities for each allele present in the enzyme system (Schreck et al. 1984).

Sampling	ADH			ACO				ACPD-1			CK			GOT 1,2			GOT 4		
location	-100	-76	n	100	83	66	n	100	140	n	100	70	n	100	112	n	100	77	n
Thomas Creek	1.00		90	0.98		0.02	50												
Calapooia River	1.00		80																

	IDH 3,4					CDH-4			MDH-1,2				MDH-3,4				
	100	40	71	120	n	100	76	n	100	70	140	n	100	83	90	70	n
Thomas Creek	0.72	0.04	0.24	0	58	0.60	0.40	100	0.98	0.02		50	0.93	0.07			97
Calapooia River	0.74	0.04	0.21	0.01	68	0.41	0.59	98	0.99	0.01		100	0.99	0.01			89

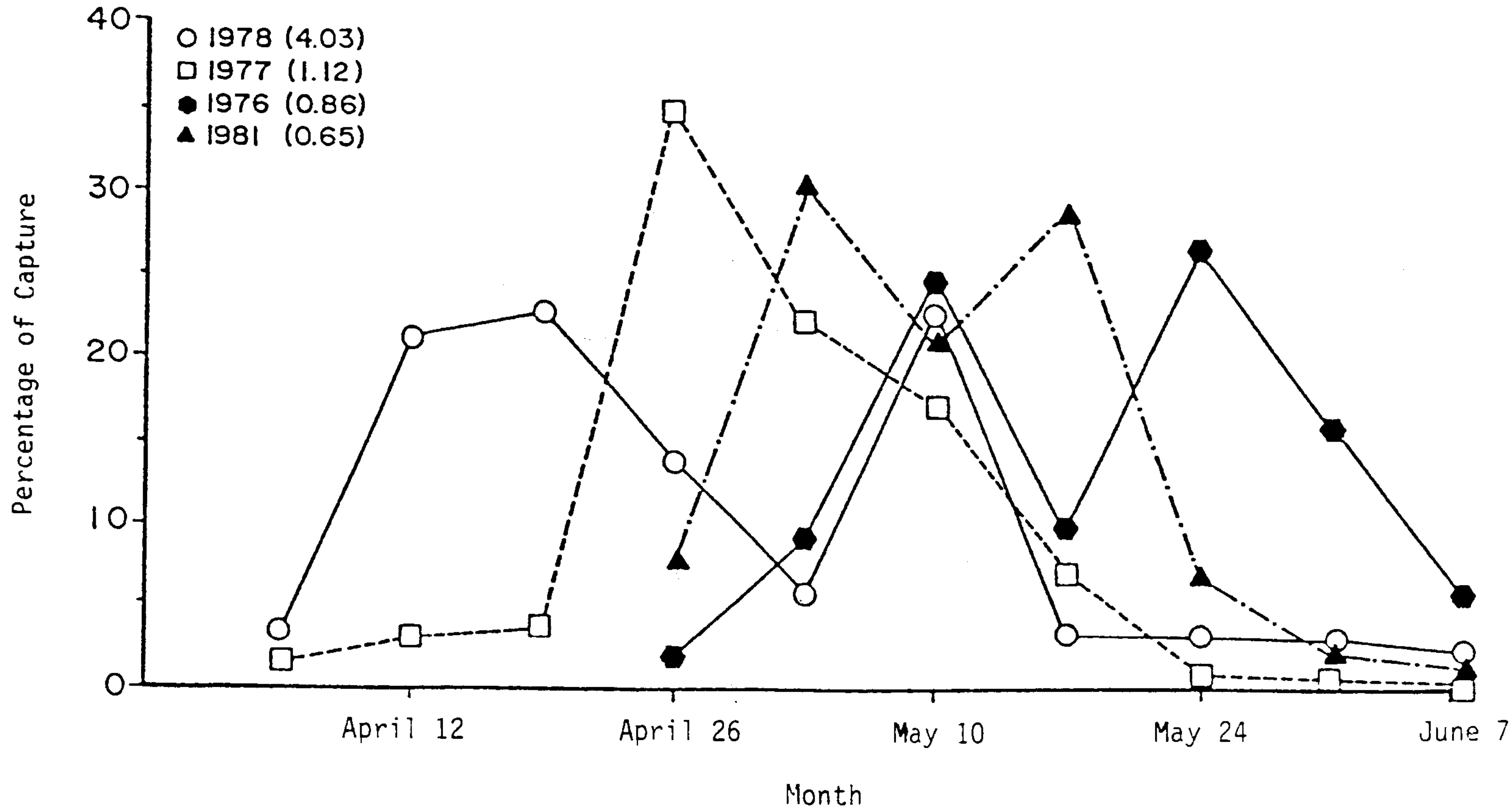

Figure 4. Wild steelhead smolt timing at Willamette Falls, 1976-79 and 1981. The progeny to parent ratios or relative survival rates are shown in parentheses (Buchanan, ODFW, unpublished data).

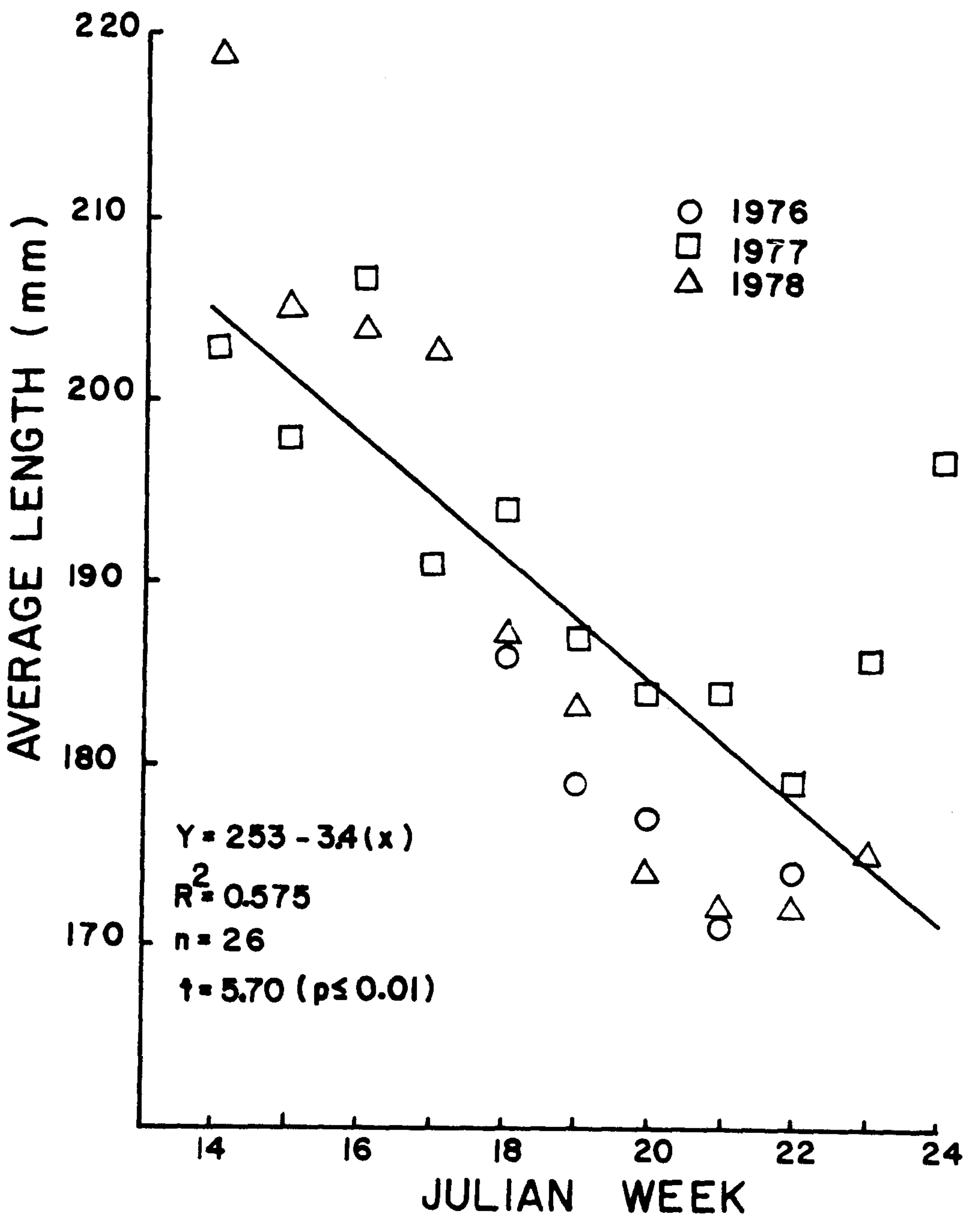

Figure 5. The relationship between mean fork length of wild steelhead smolts and time captured at Willamette Falls, 1976-78. (Each point represents a mean of at least 25 individuals) (Buchanan et al. 1979).

Survival rates

No estimates of egg-to-smolt or smolt-to-adult survival are available. Progeny-to-parent ratios based on Willamette Falls counts have ranged from 0.34 to 3.09 for 1974-82 smolts (Table 11).

Table 11. Progeny to parent ratios of winter steelhead counted at Willamette Falls (M. Wade,ODFW, unpublished date).

Smolt migration year	Parent run[a]	Progeny run[b]	Progeny:parent ratio
1974	16,850	5,738	0.34
1975	12,273	8,725	0.71
1976	8,975	8,189	0.91
1977	3,858	5,455	1.41
1978	4,872	18,028	3.70
1979	7,815	7,452	0.95
1980	8,271	6,795	0.82
1981	6,226	4,333	0.70
1982	14,601	11,847	0.81

[a] Assumes 85% 2-year smolts and 15% 3-year smolts.
[b] Assumes 85% of the adults return as 2-salts and 15% return as 3-salts; adjusted for strength of parent run.

DISEASE HISTORY

Willamette steelhead are resistant to *Ceratomyxa shasta* (D. Buchanan, ODFW, personal communication) but may be susceptible to bacterial infections (e.g., *Aeromonas salmonicida* and *A. liquefaciens*) at temperatures above 62°F (Buchanan 1975).

PRIORITY INFORMATION NEEDS

1. Improved estimates of run size, catch, and escapement
2. Migration timing differences of Willamette and Big Creek stocks
3. Improved estimates of smolt-to-adult survival
4. Smolt production levels and capacities
5. Validation of Willamette Falls counts (possible inflation due to fall-back)
6. Evaluation of downstream migrant passage at Willamette Falls and Fall Creek Reservoir facilities

7. Spawning period in west-side tributaries

8. Spawning locations

9. Possible stock differentiation among tributary populations

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Willamette River Winter Steelhead (hatchery)

PRODUCTION

Smolt releases averaged about 115,000/year (Table 1). Fry and presmolts were also released. Experimental presmolt releases ranged from 8,000 to 50,000 annually during 1982-84.

Table 1. Releases of Willamette winter steelhead reared at Marion Forks Hatchery, 1976-1982.

Brood year	Fry	Fingerings	Smolts
1976			88,480
1977			101,179
1978	96,038	29,000	117,756
1979	75,586		142,660
1980	223,889		110,791
1981		28,130	138,563
1982	187,900	23,600	115,086

GEOGRAPHIC LOCATION

Streams

Mainstem North Santiam River and mainstem South Santiam River and its tributaries above Foster Dam (Figure 1)

Hatcheries

All fish are reared at Marion Forks Hatchery.

ORIGIN

The Willamette winter steelhead hatchery stock was developed from wild fish in the North Santiam River. A mix of wild and hatchery adults are currently used for broodstock. It is referred to as a "late-run" stock because the run timing is later than that of the coastal and Big Creek (hatchery) winter steelhead stocks.

ADULT LIFE HISTORY

Run size, catch, and escapement

The total late run of native winter steelhead above Willamette Falls includes both the hatchery and wild Willamette stocks (Table 2). In 1982 15% of the late run was estimated to be of hatchery origin (Buchanan and Wade 1982a).

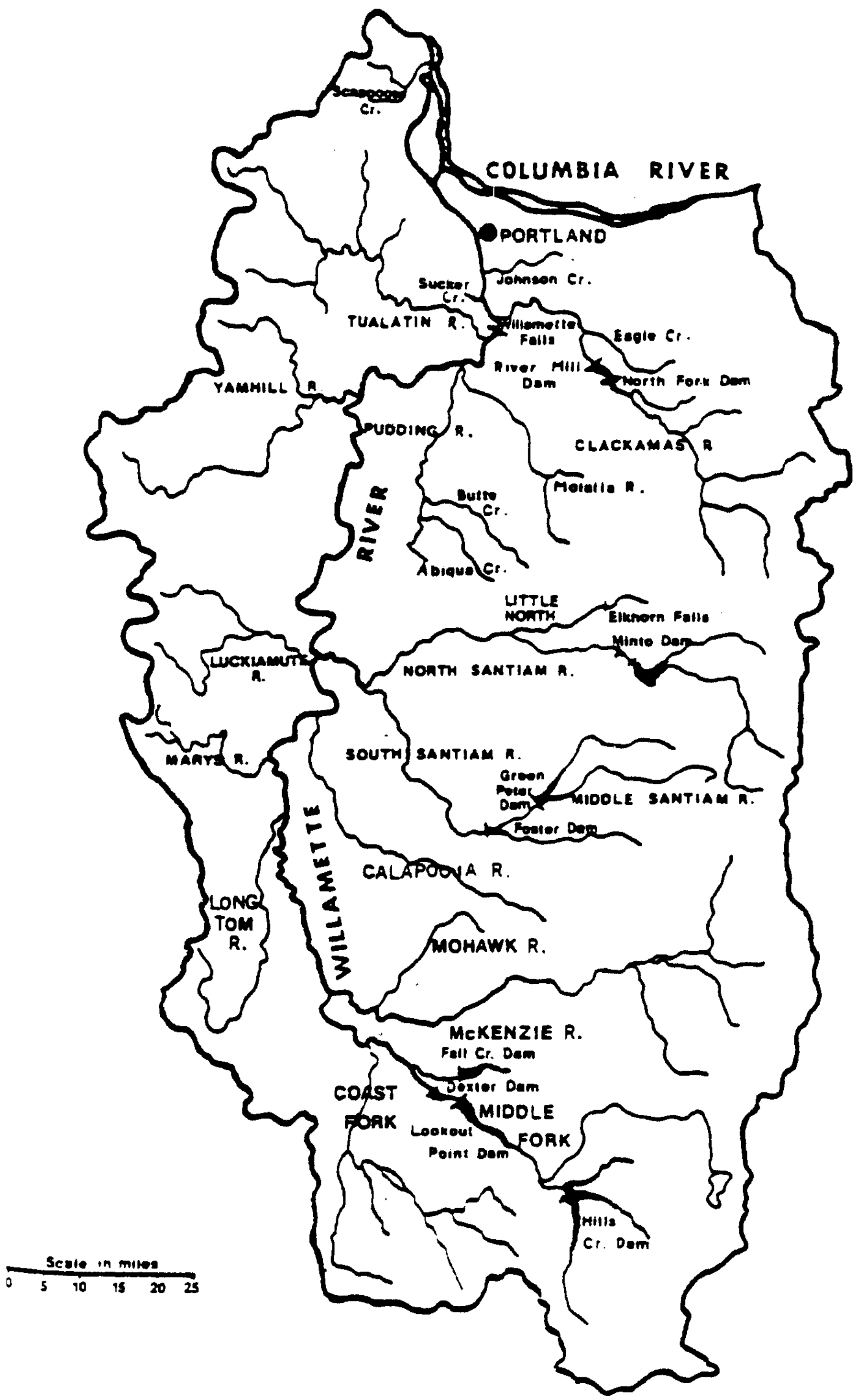

Figure 1. The Willamette River system.

Table 2. Estimated numbers of hatchery and wild adult winter steelhead passing Willamette Falls, February 15 to May 15, 1971-84 (modified from Buchanan et al. 1983).

Run year	Run size
1971	18,314
1972	16,588
1973	11,511
1974	8,528
1975	3,034
1976	5,196
1977	8,277
1978	8,270
1979	5,865
1980	16,142
1981	9,038
1982	6,894
1983	4,702
1984	10,720

A large number of Willamette winter steelhead harvested in the Willamette system are caught in the North and South Santiam rivers (Table 3). The proportions of hatchery fish in the catch and spawning escapement are unknown.

Time of migration

Willamette winter steelhead are counted at Willamette Falls from February through May (Figure 2). Winter steelhead that are counted prior to February are considered Big Creek stock winter steelhead. It is not known what proportion of the Willamette stock run passes Willamette Falls before February. Adults are collected at Foster Dam on the South Santiam River between mid-February and early June. The median time of return ranges from mid-April to early May. Adults are collected at Minto (Marion Forks collection facility) during April, May, and June. The run peaks in late April and May at this location.

Spawning period

Females are spawned at Marion Forks Hatchery during late April and May. A few wild fish are also spawned from mid-April through mid-May at Foster Dam for experimental presmolt releases.

Spawning areas

Marion Forks Hatchery and Foster Dam facility

Table 3. Sport catch of native winter steelhead (wild and hatchery stocks) by run-year in the Santiam River and its tributaries, 1971-80[a] (Berry 1981).

Stream	Run year 1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Santiam River	1,224	1,528	698	679	636	966	965	395	818
Santiam River, N.F.	--	--	--	321	277	791	1,391	437	1,129
Santiam River, Little N.F.	--	--	--	--	--	15	139	92	118
Santiam River, S.F.	--	--	--	64	127	207	748	57	74
Total	1,224	1,528	698	1,064	1,040	1,979	3,243	981	2,139

[a] Estimated from punch-card returns adjusted for non-response bias. Prior to 1977 the catch in tributaries was included in mainstem catch.

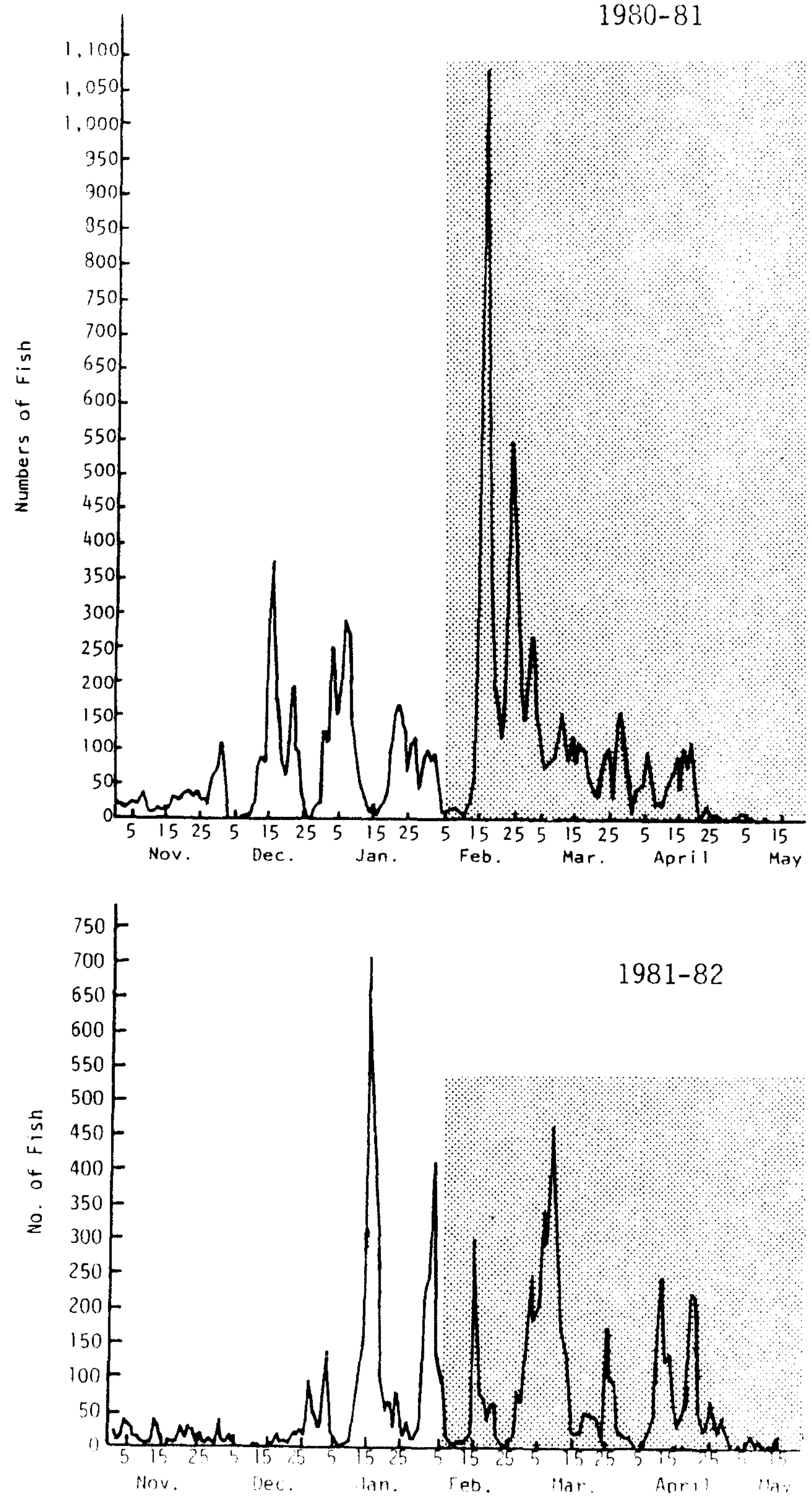

Figure 2. Daily counts of winter steelhead (wild and hatchery) passing Willamette Falls, 1981 and 1982 (modified from Bennett 1982; 1983).

Age composition

Most returning adults (84%) from the 1978 brood were 2-salt fish. The remaining 16% were 3-salt fish. Less than 1% were 1-salt fish. Few of the 3-salt fish were repeat spawners (Buchanan et al. 1983).

Size

Average fork lengths of a subsample of 1978 and 1980 brood adults were as follows (M. Wade, ODFW, personal communication):

	1978 brood	1980 brood
1-salt male		45.0 cm
2-salt male	67.9 cm	69.5
2-salt female	66.2	66.3
3-salt male	81.6	
3-salt female	77.7	

Sex ratio

Females and males returned to Minto in equal numbers but returned to Foster Dam in a ratio of 1.6-1.9:1 in 1983 and 1984.

Fecundity

Average fecundity ranged from a low of 3,640 eggs/female in 1984 to a high of 4,700 eggs/female in 1979 during 1978-80 and in 1984. Length-fecundity relationships are not available.

Biochemical-genetic characteristics

Preliminary isozyme gene frequency data was reported by Schreck et al. (1984).

JUVENILE LIFE HISTORY

Time of emergence

Marion Forks Hatchery incubates the Willamette winter steelhead in 41°F creek water. The eggs require 45 days of incubation to reach the eyed-egg stage and another 36 days to hatch.

Time, age, and size at migration

Winter steelhead are reared at Marion Forks Hatchery in 41°F creek water. Experimental presmolts are released in the spring as yearlings and smolts are released in the spring at age 2+ at an average size of 5/lb. Approximately 10-25% of the smolts are precocious males.

Juveniles released in the upper South Santiam River in early to mid-April pass Green Peter Dam from mid-April through early May, pass Foster and Lebanon dams late April through mid-May, and pass Willamette Falls from late April through late May (Buchanan and Wade 1982b). Juveniles released in the North Santiam River also pass Willamette Falls from late April to late May. Two groups of smolts released into the North Santiam River in 1977 averaged 17-21 cm in length prior to release and 19-24 cm upon arrival at Willamette Falls (Figures 3 and 4).

Survival rate

Egg-to-fry survival averaged 83% at Marion Forks Hatchery in 1984. Smolt-to-adult survival to hatchery return has averaged 0.1% to above 2% for the 1980-82 brood year steelhead released below Foster Dam (Buchanan and Wade, ODFW, unpublished data):

Brood year	No. fish released	No. adults returning	Percent survival
1980	18,700	147	0.8
1981	14,179	16	0.1
1982	15,274	341[a]	2.2

[a] 2-salt returns only.

DISEASE HISTORY

No viruses have been detected in Willamette winter steelhead at Marion Forks Hatchery from eggs collected at Minto facility and South Santiam Hatchery, 1980-84. However, IHN virus was found in summer steelhead and spring chinook adults at Minto Pond on the North Santiam River. Juvenile winter steelhead at Marion Forks Hatchery were infected with Trichodiner and Gyrodastylus parasites and bacterial gill disease. Eggs collected at South Santiam Hatchery and reared at Marion Forks also had motile bacterial gill disease (R. Holt, ODFW, personal communication).

Willamette steelhead are resistant to Ceratomyxa shasta but are susceptible to furunculosis (Aeromonas salmonicida and A. liquafaciens) when exposed to water temperatures greater than 62°F (Figure 5) (Buchanan 1975).

PRIORITY INFORMATION NEEDS

1. Improved estimates of run size, catch, and escapement
2. Adult migration timing over Willamette Falls
3. Effects of the downstream migrant facility at Willamette Falls on smolt mortality

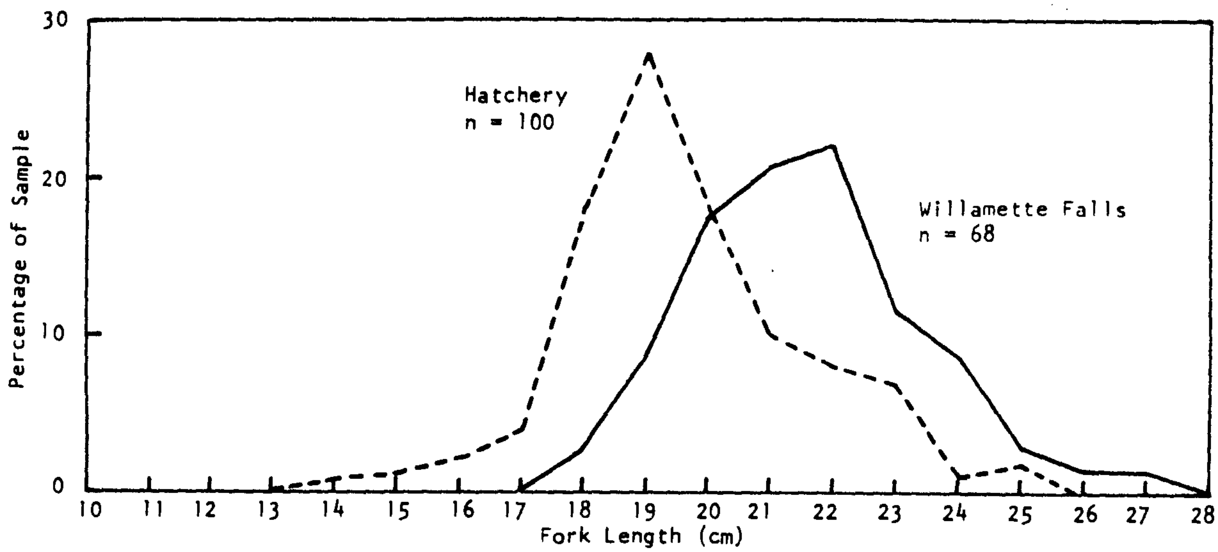

Figure 3. Length frequency distributions for Willamette winter steelhead smolts prior to release into the upper North Santiam River near Minto Dam and upon arrival at the Willamette Falls trap (Buchanan 1977).

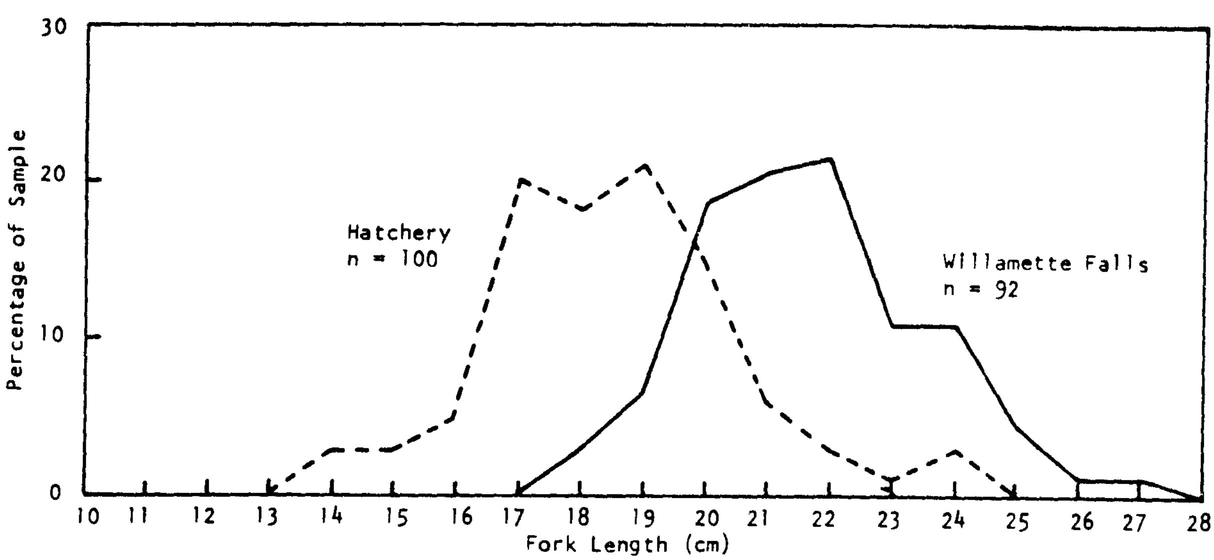

Figure 4. Length frequency distributions for Willamette winter steelhead smolts prior to release into the lower North Santiam river near Green's Bridge and upon arrival at the Willamette Falls trap (Buchanan 1977).

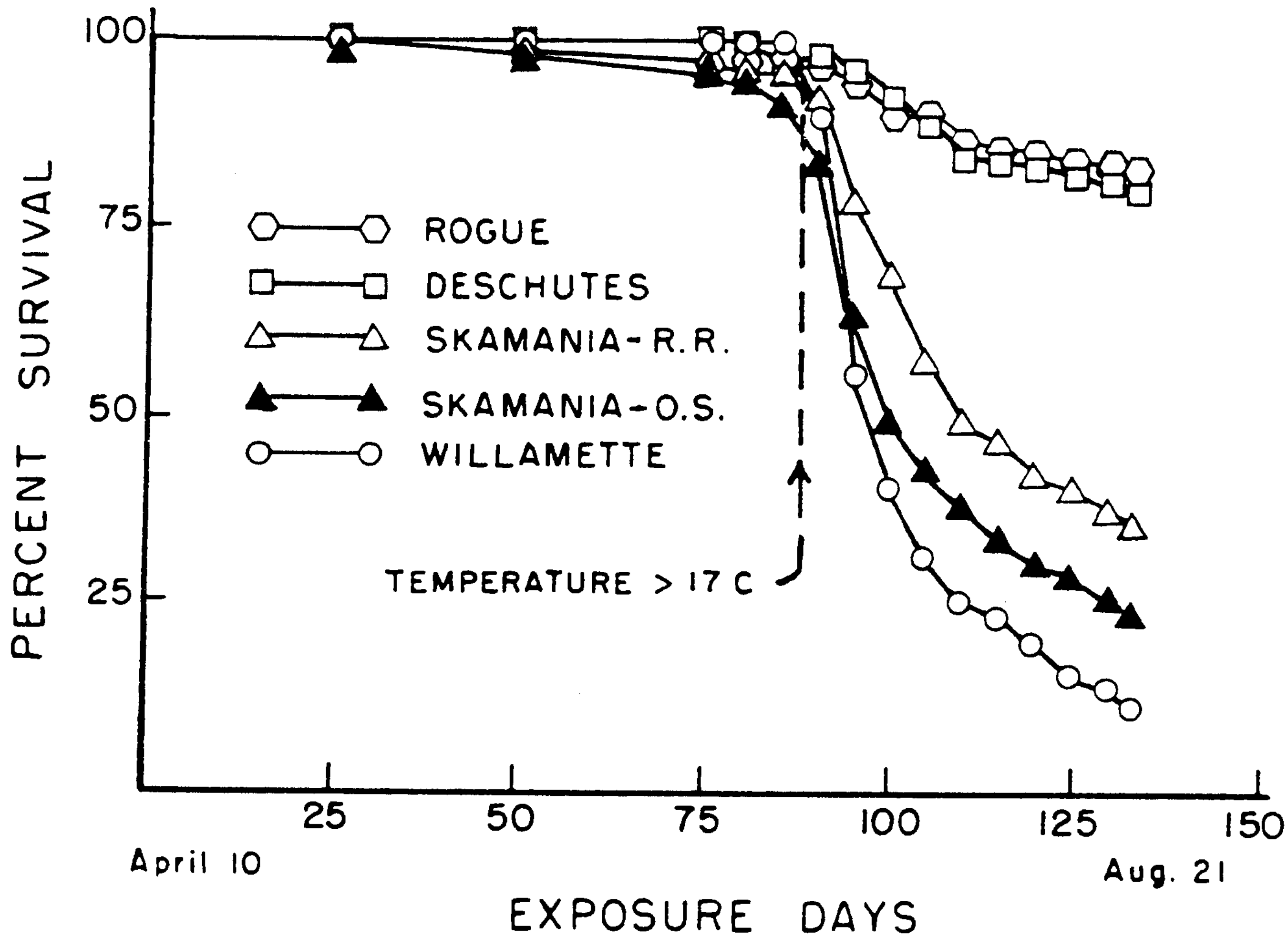

Figure 5. Survival of five groups of steelhead smolts held in the Willamette River in 1975 (Buchanan et al. 1983).

4. Influence of size and time at release on survival

5. Hatchery:wild ratios of returning adults in tributaries

6. Validation of Willamette Falls counts (possible inflation of counts resulting from fallback)

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Clackamas River Winter Steelhead (wild)

PRODUCTION

Winter steelhead stocks produced in the Clackamas sub-basin include wild and hatchery stocks. This summary discusses the wild winter steelhead stock. Consult the Big Creek and Eagle Creek winter steelhead summaries for more information on the hatchery stocks.

GEOGRAPHIC LOCATION

Streams

Clackamas River and tributaries (Figure 1)

ORIGIN

Steelhead were restricted to the lower 27 miles of the Clackamas River and tributaries following construction of Cazadero Dam in 1905 until the Cazadero ladder was rebuilt in 1939. Except for a release of 22,000 steelhead in 1936, winter steelhead were reestablished in the upper Clackamas after 1939 by the passage of wild spawning adults above River Mill, Cazadero, and North Fork dams (Gunsolus and Eicher 1970).

Production from the native wild winter steelhead stock in the Clackamas River has been supplemented with releases of Big Creek stock and a hatchery stock developed at Eagle Creek National Fish Hatchery from native stock and returns from releases of Big Creek stock. The Big Creek stock was first introduced in 1966 to establish an early season fishery in the lower river. From 1965 to 1975 coastal stocks from Alsea and Cedar Creek hatcheries (winter steelhead) and Siletz Hatchery (summer steelhead) were also released, but survival was probably poor due to their susceptability to *Ceratomyxa shasta* present in the Willamette and Columbia rivers (Buchanan et al. 1983). Most of the hatchery winter steelhead have been released below North Fork Dam. Since 1970 Skamania summer steelhead have been released in the Clackamas above North Fork Dam. Large numbers of catchable rainbow trout are also stocked in the Clackamas.

ADULT LIFE HISTORY

Run size, catch, and escapement

Combined sport catch of wild and hatchery stocks is presented in Table 1. The proportion of the wild stock in the catch is unknown.

Since 1957 escapement above North Fork Dam has fluctuated between 500 and 4,400 fish (Figure 2). Steelhead also spawn in tributaries below North Fork, but no estimates of abundance are available. No escapement goal for winter steelhead has been established for the Clackamas River.

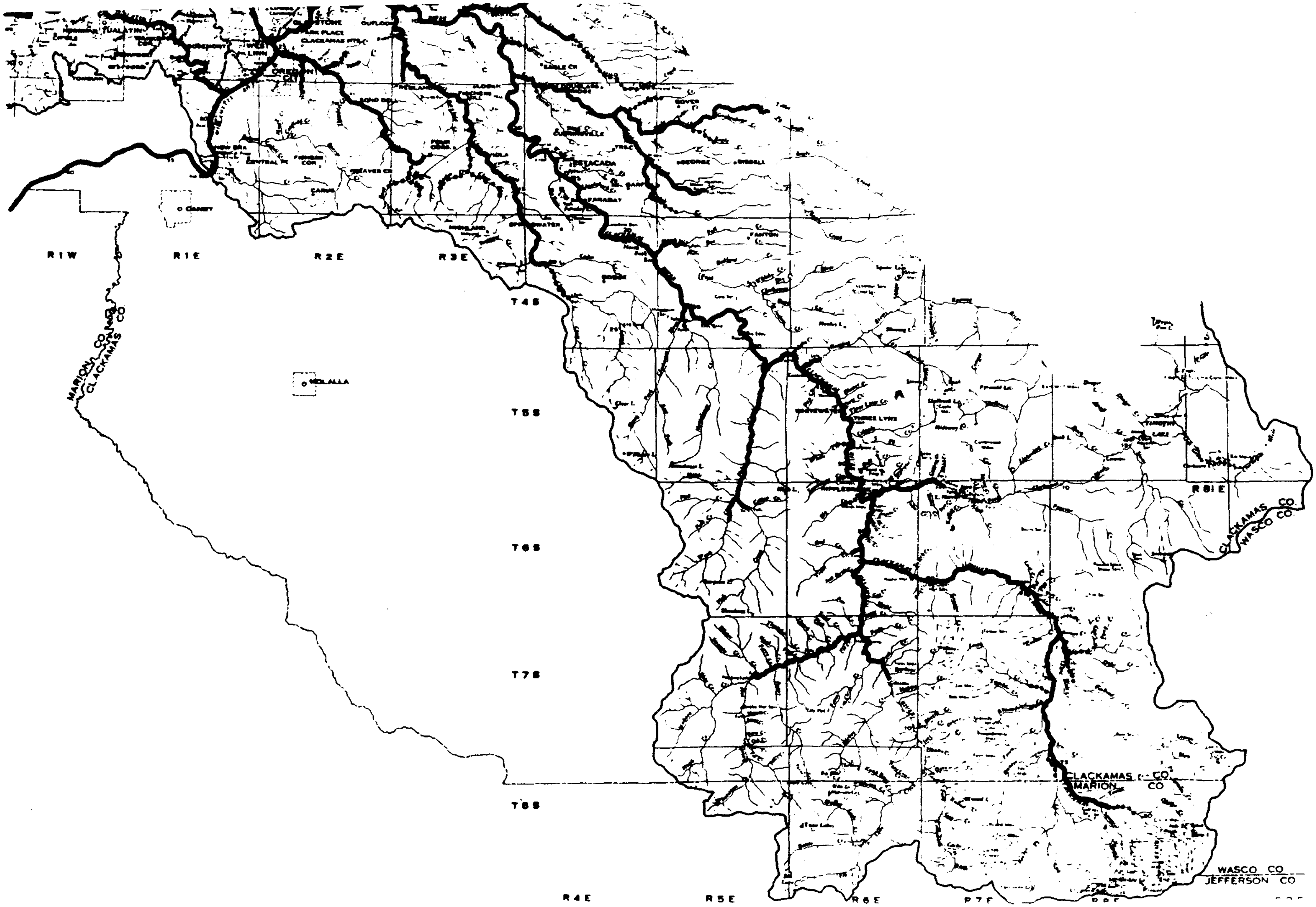

Figure 1. Distribution of winter steelhead in the Clackamas River system (Hutchison and Aney 1964).

Table 1. Clackamas River winter steelhead sport catch by run-year, 1971-80[a] (modified from Berry 1981).

Stream	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Clackamas R.	8,856	2,612	1,628	4,573	2,335	2,083	4,863	3,252	6,467
Clear Cr.	-	-	-	-	-	6	75	23	73
Collowash R.	-	-	-	-	-	18	23	21	30
Hot Sp. Fork	-	-	-	-	-	-	-	113	7
Deep Cr.	-	-	-	-	-	0	24	7	42
Eagle Cr.	-	1,697	1,095	2,418	1,449	425	1,923	514	1,549
Total	8,856	4,309	2,723	7,171	3,784	2,532	6,908	3,930	8,168

[a] Estimated from punch-card returns adjusted for non-response bias. Prior to 1977 catch in tributaries (except Eagle Creek) was included in mainstem catch.

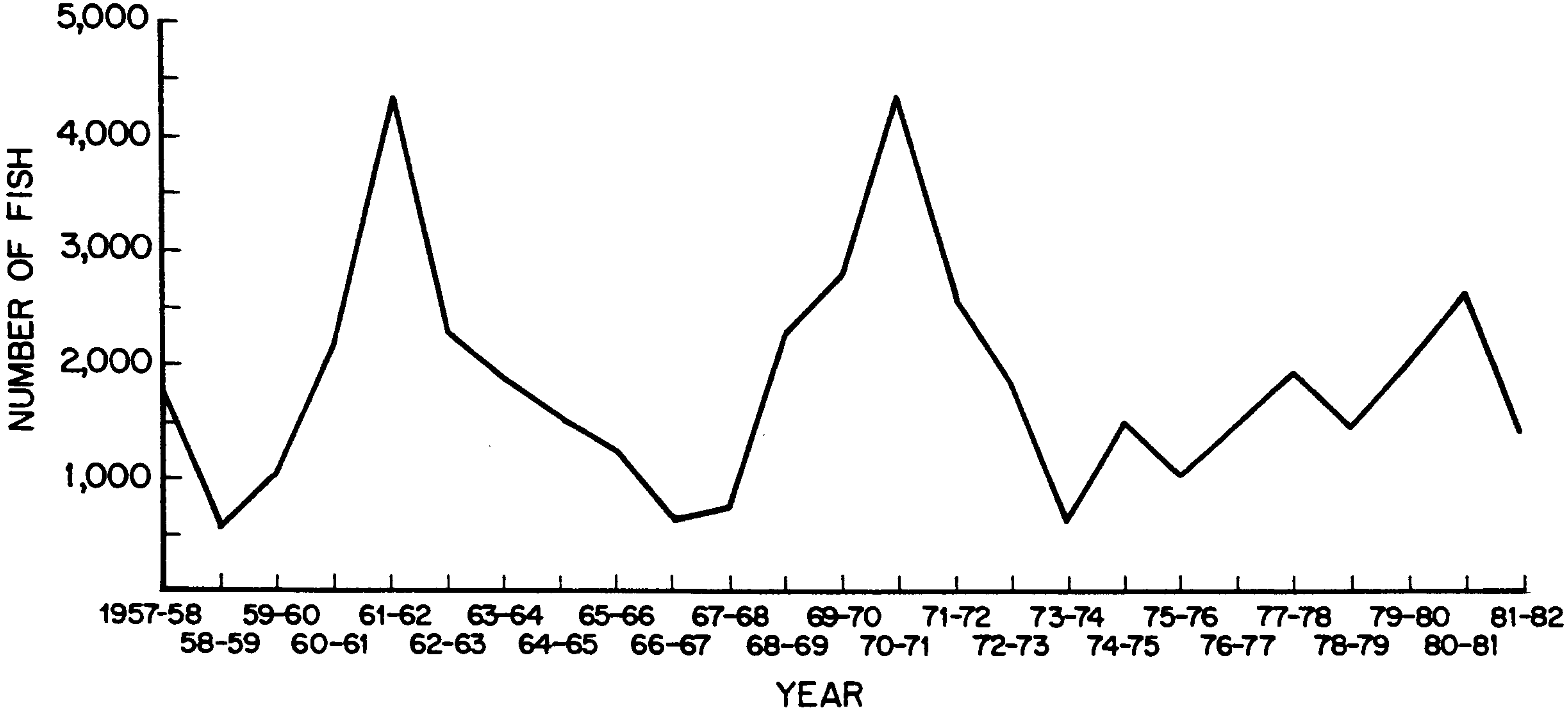

Figure 2. Total counts of adult steelhead at North Fork Dam, Clackamas River, 1957-82.

Time of migration

Tagging studies in the 1950s indicated that most native winter steelhead destined for the Willamette River enter the Columbia River in March and April (Korn 1961). Prior to large releases of Big Creek stock, 78% of the run past North Fork Dam occurred in May (Table 2). Following the introduction of Big Creek stock the numbers of winter steelhead passing North Fork Dam prior to May has increased from 16% to 46% (Table 2). Since 1972 an additional peak of summer steelhead occurs in July (Figure 3).

Hutchison and Aney (1964) reported that winter steelhead are present in the Clackamas year-round. Sport catch data for 1956 to 1965 prior to the introduction of Big Creek stock and Skamania summer steelhead indicate that winter steelhead were caught in all months (Table 3). However, catches in July through October may be kelts and identification errors expanded from punch-cards. The catch data do indicate that about 60% of the catch of native steelhead occurred during December through February, 4-6 months prior to peak passage at North Fork Dam.

Spawning period

Data on downstream passage of kelts suggest that spawning is largely completed by June (Table 4). From 1960 to 1963, the number of kelts moving downstream past North Fork Dam averaged 46.6% of the upstream runs.

Spawning areas

Winter steelhead are distributed throughout the Clackamas system (Figure 1). Fulton (1970) listed the following spawning areas:

- Upper Clackamas River
- Clear Creek
- Deep Creek
- Eagle Creek
- Fish Creek
- North Fork
- Roaring River
- Oakgrove Fork
- Collawash River
- Hot Springs Fork

Age composition

No information.

Size

No information.

Sex ratio

No information.

Table 2. Monthly counts of adult winter steelhead at North Fork Dam, Clackamas River, 1957-82.

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Total
1957-58	11	5	3	4	0	399	1,192	34	1,648
58-59	0	10	1	0	0	137	376	32	556
59-60	0	0	2	0	0	75	890	181	1,148
60-61	0	0	0	0	1	343	1,788	72	2,204
61-62	0	0	0	0	1	1,506	2,502	351	4,360
62-63	1	0	0	2	11	94	2,069	60	2,237
63-64	1	0	1	0	0	218	1,554	109	1,883
64-65	0	3	0	5	0	196	1,312	36	1,552
65-66	3	0	1	0	0	2	1,158	126	1,290
66-67	0	0	1	3	2	28	608	40	682
Total 1957-67	16	18	9	14	15	2,638	13,449	1,041	17,200
%	0.1	0.1	0.1	0.1	0.1	15.3	78.2	6.1	
67-68	3	3	2	10	5	35	721	11	790
68-69	16	17	4	2	32	341	1,787	117	2,316
69-70	10	13	2	30	81	946	1,692	35	2,809
70-71	14	6	86	133	202	1,212	2,514	182	4,349
71-72	4	20	18	64	62	559	1,784	123	2,634
72-73	21	8	2	3	47	979	834	3	1,897
73-74	1	2	9	7	11	132	451	58	671
74-75	31	9	33	10	12	384	1,047	0	1,526
75-76	5	55	26	11	60	350	675	0	1,182
76-77	8	0	0	109	215	724	432	39	1,527
77-78	9	139	75	177	515	738	329	14	1,987
78-79	0	231	2	151	177	458	474	18	1,511
79-80	0	0	120	116	136	853	840	0	2,065
80-81	0	233	125	250	291	632	1,161	5	2,697
81-82	60	132	25	8	68	445	692	16	1,446
Total 1967-82	82	868	529	1,081	1,914	8,788	15,433	621	29,416
%	0.6	3.0	1.8	3.7	6.5	29.9	52.5	2.1	

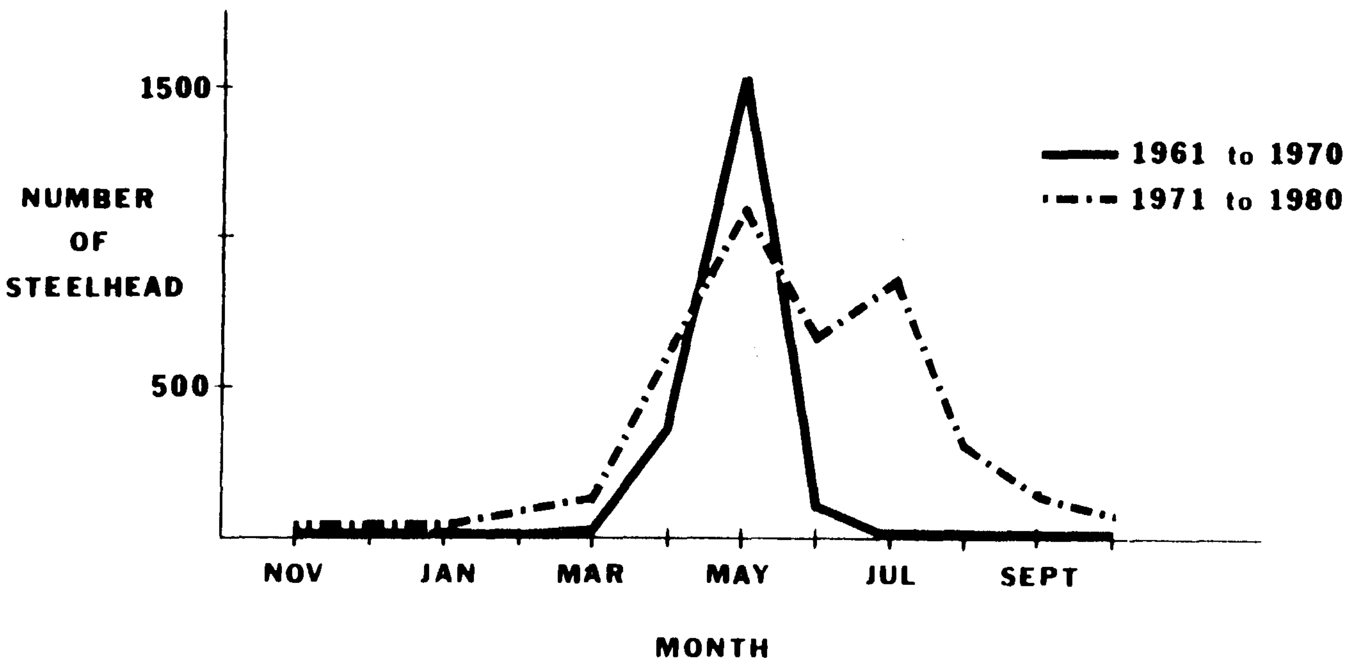

Figure 3. Timing of upstream passage of adult steelhead at North Fork Dam, Clackamas River, 1961-70 and 1971-80 (Everest and Sedell 1983).

Table 3. Monthly sport catch of steelhead in the Clackamas River, 1956-65.[a]

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1956	232	249	461	693	154	186	55	29	12	20	52	322	2,465
1957	103	159	301	210	60	39	4	18	4	12	27	56	994
1958	302	181	221	178	103	47	6	31	3	-	31	171	1,295
1959	362	239	222	145	64	4	4	21	51	102	38	371	1,624
1960	263	348	185	224	85	6	-	3	6	10	29	202	1,362
1961	251	143	283	208	43	4	25	29	10	22	56	626	1,693
1962	729	351	511	1,115	85	37	14	31	27	37	41	440	3,419
1963	100	291	191	446	116	16				23	113	423	1,718
1964	565	565	464	474	56	14	24	10	10	20	57	507	2,764
1965	526	649	457	372	84	12	4	27	31	15	61	200	2,438
Average	343	318	330	407	85	37	14	20	15	26	51	332	
%	20.6	19.1	19.8	24.4	5.1	2.2	0.8	1.2	0.9	1.6	3.0	19.9	

[a] Estimated from punch-card returns. Not corrected for non-response bias.

Table 4. Monthly counts of spawned adult steelhead passing downstream at the North Fork Dam on the Clackamas River, 1960-1964 (Gunsolus and Eicher 1970).

Year	Size of run passed upstream	Number passed downstream: April	May	June	July[a]	Total	Percent of run passed downstream
1960	1,148	0	299	250	4	533	48.2
1961	2,204	1	128	703	1	833	37.8
1962	4,365	0	597	1,319	62	1,978	45.3
1963	2,242	1	578	591	61	1,231	54.9
1964[b]	1,884	6	779	793	61	1,639	87.0
Total	11,843	8	2,381	3,656	189	6,234	Average 52.6

[a] Includes fish moving after July.
[b] Included in downstream count, but not in numbers available upstream, are 802 adult steelhead from Eagle Creek National Fish Hatchery released in the river above North Fork Reservoir. Large numbers of these passed downstream unspawned shortly after release.

Fecundity

No information.

Biochemical-genetic characteristics

No information.

JUVENILE LIFE HISTORY

Time of emergence

No information.

Time, age, and size at migration

Most of the juvenile downstream movement occurs from April through June and peaks in May (Table 5).

The average number of wild smolts migrating past North Fork Dam since 1975 is almost double the number from 1962 to 1974 (Table 6, Figure 4). However, the trend in production of native winter steelhead smolts cannot be distinguished in those counts from increases in wild smolts from Big Creek hatchery stock or summer steelhead. Since adult summer steelhead averaged 62% of the run past North Fork from 1972 to 1982, the potential production of wild summer steelhead smolts could be substantial.

Survival rate

The number of smolts produced per adult passing North Fork Dam varied from 7 to 32 from 1958 to 1962, and the survival of smolts to adult return ranged from 6% to 13% from 1957 to 1960 (Table 7).

Table 5. Counts of downstream migrating juvenile steelhead at the North Fork Dam, Clackamas River, 1959-84.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1959				5,151	30,293	682	9	0	0	0	0	0
1960	0	0	14	3,427	39,927	2,390	1	0	-	0	0	0
1961	0	0	0	3,427	13,177	1,090	0	-	0	0	0	0
1962	0	0	0	2,985	16,923	2,555	9	-	-	11	14	34
1963	3	2	87	2,914	20,603	1,058	4	0	0	0	110	27
1964	22	27	10	1,070	26,535	2,891	47	90	0	0	7	0
1965	0	-	2	2,358	11,001	496	1	0	-	-	0	0
1966	0	0	60	1,770	8,698	505	2	0	0	0	0	0
1967	0	0	23	1,848	25,562	3,973	0	-	-	0	0	0
1968	0	0	221	5,683	28,490	1,360	4	-	0	0	0	0
1969	0	0	0	2,544	21,952	4,681	10	0	0	0	0	0
1970	0	0	74	2,975	27,069	7,400	18	6	0	1	1	0
1971	0	0	50	1,834	15,144	2,072	11	-	-	0	0	0
1972	0	0	191	2,361	29,487	8,520	8	0	0	0	0	0
1973	0	0	12	3,817	60,089	3,004	0	0	0	0	0	0
1974	3	0	87	2,024	45,524	21,197	55	2	1	0	0	0
1975	0	0	14	698	86,734	23,151	74	1	1	0	0	4
1976	1	13	64	6,332	86,110	12,881	132	16	8	14	6	20
1977	9	4	18	13,877	121,525	15,080	14	0	0	12	94	32
1978	2	12	722	23,701	198,558	9,011	132	136	11	-	-	178
1979	2	33	52	2,190	95,125	8,666	25	1	0	97	224	59
1980	6	1	63	11,639	118,939	8,956	16	0	0	0	0	0
1981	0	53	526	21,198	110,452	4,492	8	0	0	0	0	0
1982	0	0	489	3,870	175,065	7,515	4	0	0	0	0	0
1983	0	4	260	7,870	57,799	1,821	58	2	0	0	0	0
1984	14	2	135	4,112	113,717	11,362	366	1	0	0	0	0
Average	2	6	127	5,449	60,942	6,416	39	12	1	6	19	14
%	0	0	0.2	7.5	83.4	8.7	0.1	0	0	0	0	0

Table 6. Counts of hatchery and wild steelhead smolts at the North Fork Dam, Clackamas River, 1962-84.

Year	Hatchery	Wild	Average number of wild
1962	6,758	22,531	
1963	8,372	24,808	
1964	7,867	30,671	22,968
1965	0	13,865	
1966	0	11,016	
1967	0	31,406	
1968	0	31,755	26,961
1969	0	29,187	
1970	6,085	31,439	
1971	0	19,113	
1972	25,091	15,476	
1973	45,519	21,403	22,403
1974	41,587	27,306	
1975	82,654	28,020	
1976	105,597[a]		
1977	116,680	33,607	
1978	154,910	77,356	
1979	63,987	40,841	50,451
1980	91,321	50,000	
1981	93,229	40,149	
1982	142,399	44,544	
1983	35,977	31,849	38,436
1984	92,646	37,201	

[a]Combined count; hatchery and wild fish not differentiated.

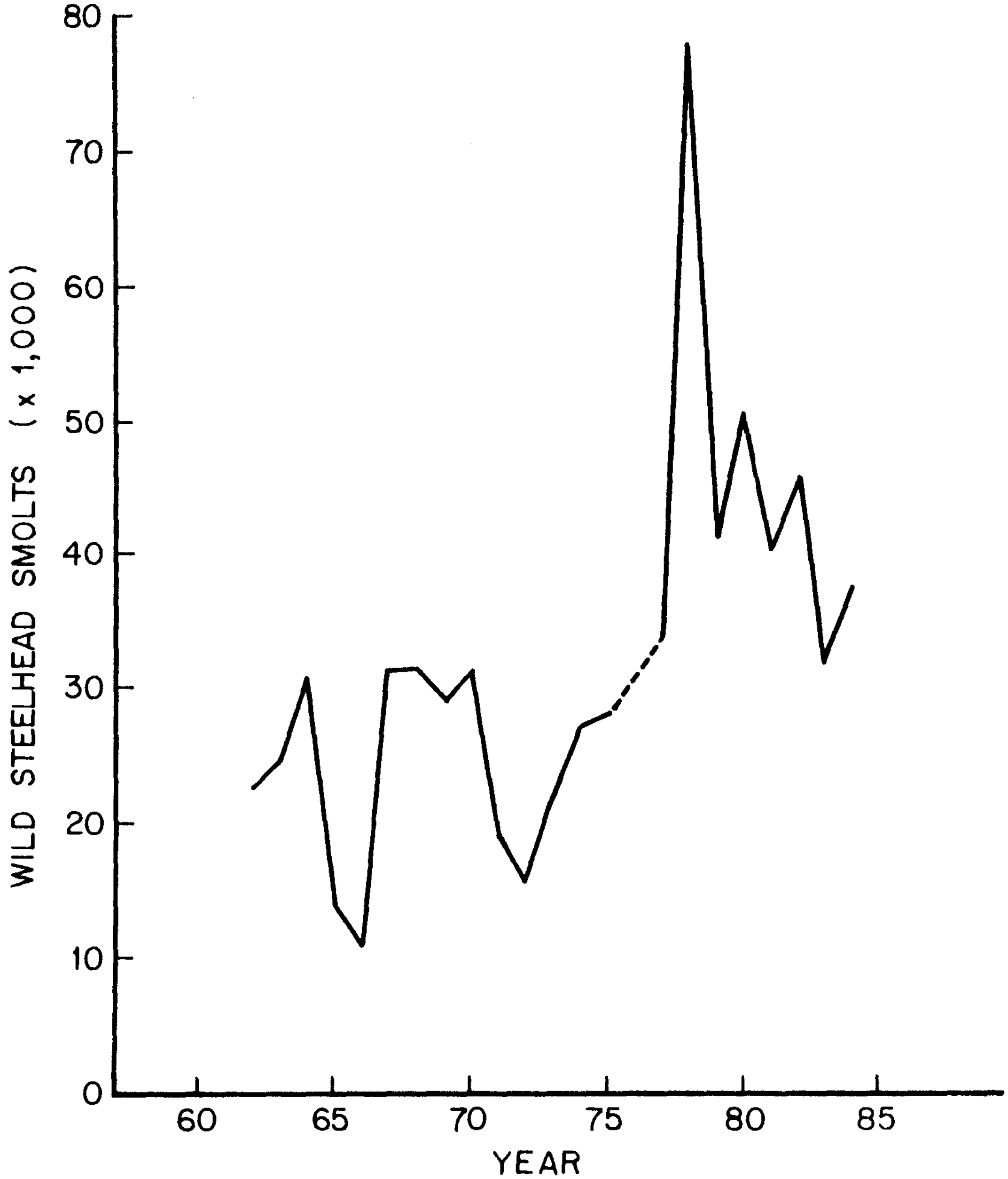

Figure 4. Number of wild steelhead smolts counted at the North Fork Dam, Clackamas River, 1962-84 (no data for 1976).

Table 7. Steelhead smolt production and survival in the Clackamas River above North Fork Dam, 1957-1962 (modified from Gunsolus and Eicher 1970).

Brood year	Adult parents	Smolts	Smolts per parent	Adult returns[a]	Percent smolts to adults
1957	NA	37,328	--	2,204	5.9
1958	1,642	38,929	24	4,365	11.2
1959	556	17,694	32	2,242	12.7
1960	1,148	22,472	20	1,889	8.4
1961	2,204	24,730	11	NA	--
1962	4,365	30,833	7	NA	--

[a] Assumes a 4-year life cycle.

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Catch and escapement of wild stock
2. Smolt production levels and capacities, including tributaries below North Fork Dam
3. Size and age compositon of adults and smolts
4. Interactions of wild and hatchery steelhead stocks and catchable rainbow trout
5. Genetic comparison with Willamette and lower Columbia stocks

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Eagle Creek Winter Steelhead (hatchery)

PRODUCTION

Eagle Creek National Fish Hatchery (ECNFH) releases approximately 100,000 winter steelhead smolts annually into Eagle Creek, a tributary of the Clackamas River (Table 1). Fingerlings and fry are also released.

GEOGRAPHIC LOCATION

Streams

Eagle Creek, Clackamas River (Appendix Figure 3)

Hatcheries

Eagle Creek National Fish Hatchery

ORIGIN

ECNFH developed its winter steelhead stock from the late-run native Clackamas stock and early-run Big Creek stock. Releases of Clackamas stock and Big Creek stocks began with the 1957 and 1965 broods, respectively. Native Clackamas broodstock were collected in Delph Creek and Eagle Creek. Big Creek stock eggs were obtained from Big Creek Hatchery through 1974. Eggs are currently taken from adults returning to ECNFH throughout the duration of the run (January through April). Approximately half of the eggs are taken during January and February and half during March and April. Juveniles from the early and late portions of the run are mixed during the course of production.

ADULT LIFE HISTORY

Run size, catch, and escapement

Annual escapement to ECNFH averaged 795 adults, and ranged from 40 to 2,021 fish during 1961-83 (Table 2). An average of 1,384 and 4,094 adults (Eagle Creek, Big Creek, and wild Clackamas stocks) were caught by sport anglers in Eagle Creek and Clackamas Rivers, respectively, from 1971 to 1980 (Table 3).

Time of migration

Winter steelhead return to ECNFH from January through April. Fish returning in January and February are considered to be primarily descendants from previous releases of Big Creek stock and early returning native stock. Fish arriving in March and April are considered to be from native stock (J. Holway, USFWS, personal communication). March and April returns are the largest portion of the run.

Table 1. Distribution of winter steelhead from ECNFH for brood years 1975-83.

Brood year	Distribution date	Number	Destination	Size (#/lb.)	Pounds
1975	5/76	119,382	Eagle Cr.	8.0	15,082
	5/76	44,838	Clackamas R.	9.0	5,095
1976	5/2/77	95,843	Eagle Cr.	7.9	12,132
1977	4/24/78	56,361	Eagle Cr.	4.5	12,525
	4/24/78	51,714[a]	Eagle Cr.	7.2	7,182
	6/14/78	4,845	Eagle Cr.	7.7	633
	11/5/78	37,900	N.F. Reservoir	9.0	4,200
1978	5/1/79	165,914	Eagle Cr.	9.6	17,240
1979	5/28/79	177,000	Eagle Cr.	2102	84
	6/4/79	82,399	Eagle Cr	736	112
	8/6/79	7,436	Eagle Cr.	96	77
	8/13/79	7,873	Eagle Cr.	108	73
	8/31/79	18,960	Eagle Cr.	38	498
	5/1/80	83,040[a]	Eagle Cr.	6.3	13,180
	5/1/80	82,801	Eagle Cr.	7.9	10,481
1980	7/23/80	96,001	N.F. Reservoir	519	185
	9/2/80	22,469	Eagle Cr.	250	75
	9/4/80	11,465	Eagle Cr.	194	59
	9/5/80	77,376	Eagle Cr.	78	992
	9/4/80	15,743	Eagle Cr.	271	58
	4/22/81	74,423	Eagle Cr.	8.5	8,705
	4/23/81	18,643	Eagle Cr.	7.6	2,469
	4/24/81	55,834	Eagle Cr.	7.6	7,395
1981	5/4/82	100,796	Eagle Cr.	7.1	14,287
1982	5/2/83	113,088	Eagle Cr.	6.7	16,910
1983	4/30/84	99,758	Eagle Cr.	8.0	12,470

[a] Big Creek Hatchery stock.

Table 2. Returns of Eagle Creek winter steelhead to Eagle Creek National Fish Hatchery, 1961-83.

Return year	Female	Male	Jack[a]	Total
1961	589	386	209	1,184
1962	1,226	689	106	2,021
1963	328	317	2	647[b]
1964	667	710	33	1,410
1965	328	195	9	532[c]
1966	510	673	4	1,187
1967	204	73	18	295
1968	254	178	0	432
1969	294	211	0	505
1970	17	23	0	40
1971	53	58	0	111
1972	623	507	0	1,130
1973	709	441	4	1,154[d]
1974	208	229		437[e]
1975	686	960		1,646
1976	493	310		803
1977	288	241		529
1978	531	814		1,345
1979	210	104		314
1980	260	308		637[f]
1981	NA	NA		NA
1982	199	287		486
1983	377	264		641

[a] Basis for jack distinction (1961-73) is unknown (B. Cates, USFWS, personal communication).
[b] Does not include estimated 25 unsexed steelhead which passed over the rack.
[c] Does not include estimated 100 unsexed steelhead which passed over the rack.
[d] Does not incude 174 summer steelhead which returned but were transferred.
[e] Does not include 11 summer steelhead which returned but were transferred.
[f] Total incudes 69 unsexed fish transferred to ODFW.

Table 3. Sport catch of winter steelhead by run-year in Eagle Creek and the Clackamas River, 1971-80[a] (Berry 1981). Catch consists of Eagle Creek, Big Creek, and native wild stocks.

Stream	1971-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80
Eagle Creek	-	1,697	1,095	2,418	1,449	425	1,923	514	1,549
Clackamas River	8,856	2,612	1,628	4,753	2,335	2,083	4,863	3,252	6,467
Total	8,856	4,309	2,723	7,171	3,784	2,508	6,786	3,766	8,016

Spawning period

Adults are spawned January through April.

Spawning areas

Eagle Creek National Fish Hatchery

Age composition

Eagle Creek steelhead return primarily as 3-year old fish following slightly less than 2 years in the ocean (J. Holway, USFWS, personal communicaton).

Size

Adults range from 5-10 lbs at return, with the average about 7 lbs (J. Holway, USFWS, personal communication).

Sex ratio

The ratio of females:males averaged 0.92:1 for 1974-83 return years (Table 2).

Fecundity

Fecundity averages 2,800 eggs/female (J. Holway, USFWS, personal communication).

Biochemical-genetic characteristics

Preliminary data on isozyme gene frequencies have been reported by Schreck et al. (1984).

JUVENILE LIFE HISTORY

Time of emergence

Eggs are incubated 48 days in 45°F Eagle Creek water until hatching.

Time, age, and size at migration

Production consists primarily of yearling smolts released in April and May at a size of 6-10 fish/lb. Fry and fingerlings have also been released from ECNFH from May through September at a size of 40-2,000 fish/lb.

Survival rate

No information.

DISEASE HISTORY

Steelhead at ECNFH do not have any significant disease problems, although bacterial kidney disease (BKD) and furunculosis have periodically been detected (J. Holway, USFWS, personal communication).

PRIORITY INFORMATION NEEDS

1. Harvest and survival rates of early and late segments of the run

2. Comparison of genetic characteristics of early and late portions of the run, Big Creek (hatchery) stock, and Clackamas (wild) stock

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Washougal River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Washougal River, Washington, a tributary to the Columbia River (Columbia RM 120.7) that drains a watershed of 211 square miles.

ORIGIN

The Washougal winter steelhead stock is native, although some genetic influence has probably been exerted by introduced Chambers Creek, Cowlitz and Elochoman hatchery-stock steelhead. In addition, some interbreeding likely occurred with winter steelhead strays that abandoned the Cowlitz River System after the eruption of Mount St. Helens in 1980.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, harvest and escapement do not exist. The stock is harvested in the mainstem Columbia sport fishery, as well as in the Washougal River. The annual sport catch of wild and hatchery-origin winter steelhead in the Washougal River is approximately 1,620 (5-year average, based on punchcard returns, excluding 1980-81 and 1981-82 due to bias from volcano-related straying). An interim escapement goal of 630 has been set for this stock.

Time of migration

Likely January through May, with peak movement in March.

Spawning period

March through June.

Spawning areas

Wild steelhead utilize spawning and rearing habitat throughout the mainstem Washougal and in the West Fork, Stebbins Creek, Cougar Creek and the Little Washougal River (Figure 1).

Age composition

Unknown.

Size

Unknown.

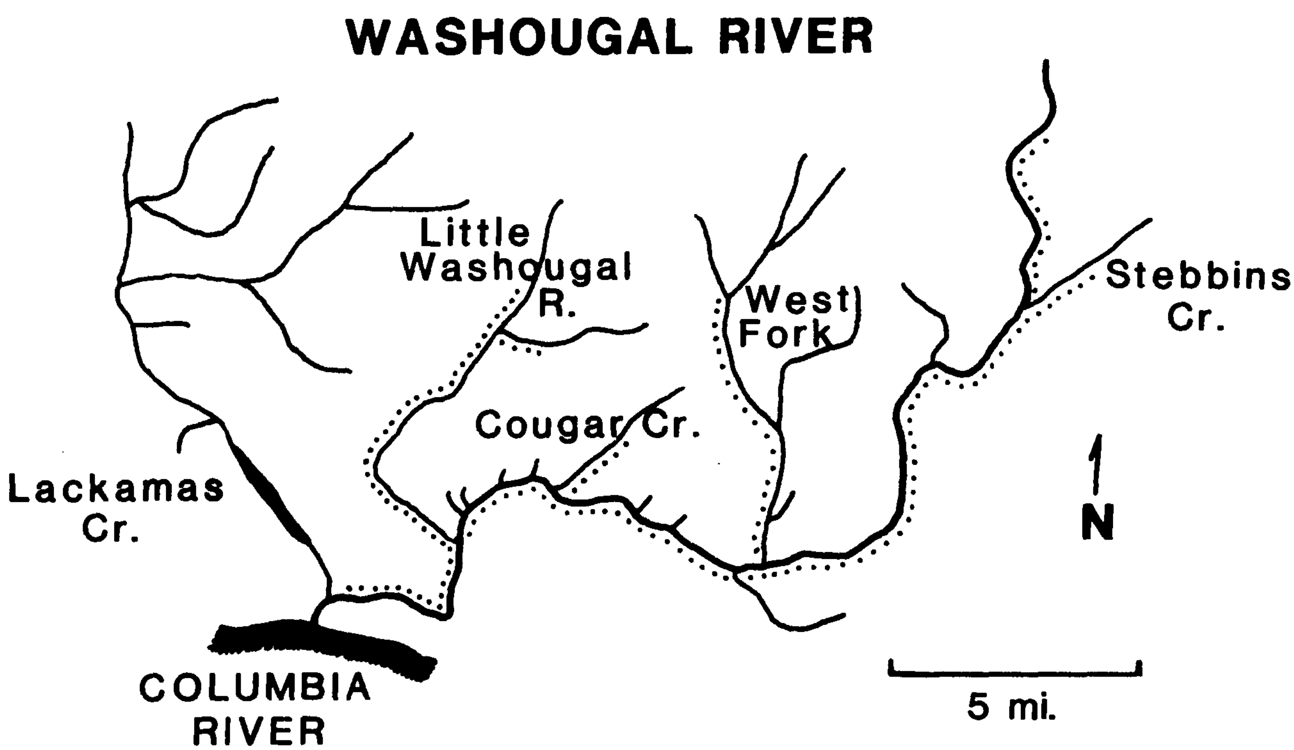

Figure 1. Probable spawning locations of steelhead trout in the Washougal River, Washington (B. Crawford, Washington Department of Game, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Like steelhead smolts in other southwest Washington streams, wild juveniles in the Washougal River probably outmigrate in April and May at an age of 2 years and a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

Washougal River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Washougal River, Washington, a tributary to the lower Columbia River (RM 120.7) that drains a watershed of 211 square miles.

ORIGIN

The Washougal River summer steelhead stock is indigenous, although some interbreeding with the introduced Cowlitz and Skamania hatchery stocks has probably occurred. Further genetic influence was likely exerted by fish that strayed from the Cowlitz River System following the Mount St. Helens eruption of 1980.

ADULT LIFE HISTORY

Run size, catch, and escapement

Wild run size, catch and escapement estimates are available only for 1979. Schuck (1980), using creel census, tag recovery and scale analysis data, estimated that of 282 wild adults returning to the Washougal (6.6% of total run), 88 were caught by anglers and 194 escaped to spawn. The annual sport harvest of wild and hatchery-origin summer steelhead in the Washougal is approximately 1,840 (5-year average, based on punchcard returns, skipping 1980 and 1981 due to volcano-related straying). The stock is also harvested in the mainstem Columbia sport fishery. Wild summer steelhead in the Washougal River are subject to increasing harassment and poaching from swimmers, picnickers and other recreationists (Crawford et al. 1981). The interim escapement goal for this stock is 906 adults.

Time of migration

Probably similar to that of wild Kalama River summer steelhead - i.e., April through December, peaking between July and October. In fact, three of the seven wild fish sampled in the 1979 creel census were caught in mid-September (Schuck 1980).

Spawning period

January through April, peaking in February and March.

Spawning areas

Wild steelhead spawn throughout the mainstem Washougal and in the West Fork, Stebbins Creek, Cougar Creek and the Little Washougal River (Figure 1).

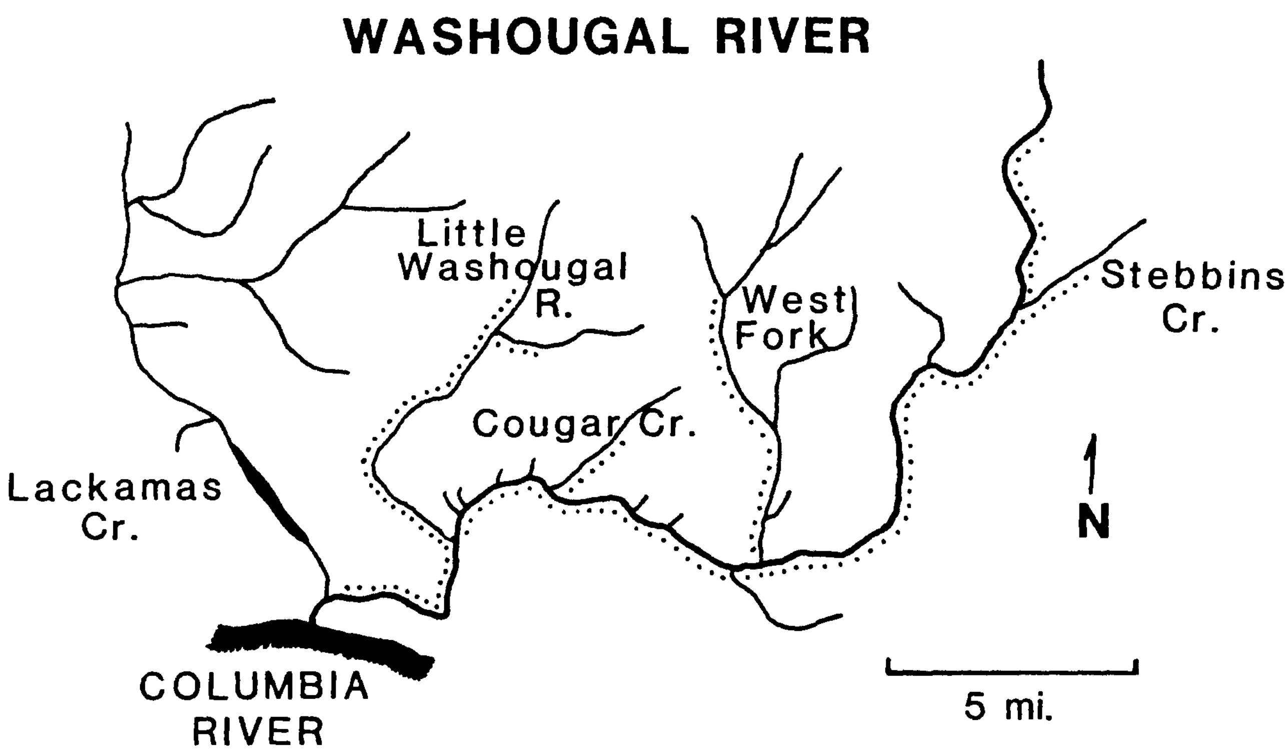

Figure 1. Probable spawning sites of wild steelhead in the Washougal River, Washington (B. Crawford, Washington Department of Game, personal communication).

Age composition

Although sample size was small, results from the 1979 creel census indicate 71.4% of the wild steelhead were 2-ocean fish (Table 1). The notation of Narver and Withler (1971) was modified and used to report age data derived from scales because it distinguishes fresh vs. saltwater growth. For example, age 2.1 would represent a steelhead with 2 years of freshwater growth and 1 year of marine growth prior to its capture in freshwater on its spawning migration.

Size

Average length of wild 1-, 2- and 3-ocean adults sampled in 1979 was 57 cm, 76 cm and 97 cm, respectively (Table 1).

Sex ratio

Of seven wild adults sampled in 1979, four were males and three were females (Table 1).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

Table 1. Age, sex and length of wild summer steelhead sampled in the 1979 Washougal River, Washington, sport fishery (data from Schuck 1980).

AGE	NUMBER MALES	NUMBER FEMALES	TOTAL	% TOTAL	LENGTH (CM)
2.1	1	0	1	14.3	57
2.2	2	3	5	71.4	76
2.3	1	0	1	14.3	97

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Juvenile steelhead in the Washougal outmigrate in April and May at an average age of 2 years and an average size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

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Skamania Winter Steelhead (hatchery)

PRODUCTION

Skamania winter steelhead are artificially propagated in hatchery environments. Approximately 110,000 smolts of this stock are released annually.

GEOGRAPHIC LOCATION

Streams

Skamania winter-run juveniles are planted into the Washougal River, Washington (Columbia RM 120.7) to boost brood stock returns, but this stock has also been released in the Elochoman and North Fork Lewis rivers.

Hatcheries

Eggs are taken from winter steelhead returning to Skamania Hatchery, located on the Washougal River. Fish are reared primarily at Skamania Hatchery and to a lesser extent at Vancouver and Beaver Creek hatcheries.

ORIGIN

The Skamania winter stock is presently being developed at Skamania Hatchery. Brood stock are predominantly Elochoman and Cowlitz hatchery-stock steelhead, but also include some native Washougal River winter steelhead (B. Crawford, Washington Department of Game, personal communication).

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of Skamania winter stock run size, catch and escapement are not available. Harvest of the stock occurs primarily in the Washougal River. The interim escapement goal to Skamania Hatchery is 50 adults.

Time of migration

Of winter-run adults returning to Skamania Hatchery in 1982-83, 34 arrived in December, 139 in January, 106 in February, 16 in March and 1 in April (WDG 1984).

Spawning period

The 1982-83 Skamania stock winter-run was spawned from January 13 through February 24, 1983 (WDG 1984).

Spawning areas

Skamania Hatchery.

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Of winter steelhead returning to Skamania Hatchery in 1982-83, 55 females were spawned for 257,844 eggs, or an average of 4,688 eggs per female (WDG 1984).

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Skamania winter steelhead smolts are released in April and May at 4-7 per pound following a year of freshwater rearing.

Survival rate

Unknown.

DISEASE HISTORY

Skamania hatchery-stock winter steelhead have been afflicted with infectious hematopoietic necrosis (IHN) virus in recent years (WDG 1984).

PRIORITY INFORMATION NEEDS

Not identified to date.

REFERENCES

WDG (Washington Department of Game). 1984. Operation and maintenance - Beaver Creek and Skamania hatcheries and Ringold Rearing Station: October 1, 1982 - September 30, 1983. Washington Department of Game report 84-7.

Skamania Summer Steelhead (hatchery)

In this report "Skamania Summer steelhead (hatchery)" is used to refer to fish returning to both Skamania Hatchery <u>and</u> Ringold Springs Rearing Pond; however, there is evidence that the two runs should be considered separate stocks. Since 1980, juveniles reared at Ringold Springs Rearing Pond have been progeny of returns trapped at Ringold. Ringold Rearing Pond was also used to rear progeny of fish destined for the mid and upper Columbia in the 1960's.

PRODUCTION

Skamania summer steelhead are artificially propagated in hatchery environments. Approximately 1,000,000 smolts of this stock are released annually.

GEOGRAPHIC LOCATION

Streams

Skamania juveniles have been planted into the following Washington streams at least once since 1970: Elochoman River (Columbia RM 39.1), Toutle River (tributary to Cowlitz River, RM 68.0), Kalama River (RM 73.1), North and East forks of Lewis River (RM 87.0), Washougal River (RM 120.7), Wind River (RM 154.5), Big White Salmon River (RM 168.3), Klickitat River (RM 180.4), Walla Walla River (RM 314.6), Snake River mainstem (RM 324.2), Tucannon River (Snake RM 63), Grande Ronde River (Snake RM 169), Yakima River (RM 335.2), mainstem Columbia at Ringold (approx. RM 350), Crab Creek (RM 410.8), and Wenatchee River (RM 468.4). Other areas receiving Skamania stock steelhead include Puget Sound, Washington, the states of Oregon, Idaho, California, Indiana, Rhode Island, Vermont, Pennsylvania, South Carolina and North Carolina, and the countries of Ireland and Korea (WDG 1978; Crawford 1979; WDG 1982).

Hatcheries

Eggs are taken from Skamania stock adults returning to Skamania Hatchery (located on the Washougal River, Washington) and Ringold Springs Rearing Pond (located on the mainstem Columbia River 15 miles above the Tri-cities, Washington). Progeny of fish spawned at Skamania Hatchery are reared primarily at that facility, but also at Beaver Creek and Vancouver hatcheries. These facilities collectively rear approximately 600,000 smolts annually for release into Washington tributaries to the Columbia River from the Klickitat River (RM 180.4) downstream. Fish collected at Ringold Springs are spawned at Yakima Hatchery. In general, their progeny are reared at Ringold Springs, but also at Naches and Columbia Basin hatcheries and Turtle Rock Rearing Pond (a satellite pond of Chelan Falls Hatchery located on the mainstem Columbia below the hatchery). Collectively, these facilities rear approximately 400,000 smolts annually for release into Washington tributaries to the Columbia River from the Klickitat River upstream.

ORIGIN

The Skamania summer stock was developed in the late 1950's at Skamania Hatchery. Original brood stock were native Washougal and Klickitat River steelhead (Crawford 1979).

ADULT LIFE HISTORY

Run size, catch, and escapement

Data concerning run size, catch and escapement of Skamania summer-run returnees are limited (see "Survival rate" section of this stock summary). Harvest of the stock occurs primarily in rivers where juveniles were planted, but also in mainstem Columbia and Snake river sport and tribal fisheries. Interim escapement goals to Skamania Hatchery and Ringold Springs are 500 and 600 adults, respectively.

Time of migration

Skamania stock summer steelhead are harvested by sport anglers in the lower Columbia River primarily between mid-June and mid-July (Figure 1). Skamania steelhead migrate through the Kalama River (RM 73.1) from mid-March through early February, peaking in June and July (Crawford et al. 1977, 1978, 1979; Chilcote et al. 1981). Skamania stock returns to Skamania Hatchery on the Washougal River (RM 120.7) peak in July (Figure 2). Skamania summer runs arrive at Ringold Springs (approx. RM 350) from mid-July through mid-September (B. Walters, Washington Department of Game [WDG], personal communication).

Spawning period

Skamania stock summer steelhead are spawned from mid-December through February at both Skamania and Yakima hatcheries (Crawford 1979; WDG 1984a; B. Walters, WDG, personal communication).

Spawning areas

Skamania and Yakima hatcheries.

Age composition

Of adult Skamania stock steelhead returning to the Kalama and Klickitat rivers (RM 73.1 and 180.4) and Skamania Hatchery, an average of 86.4%, 91.8% and 82.8% were 2-ocean fish, respectively (Tables 1, 2 and 3). Repeat spawners comprised an average of 3.6% of the Kalama returnees and 1.4% of the Klickitat returnees.

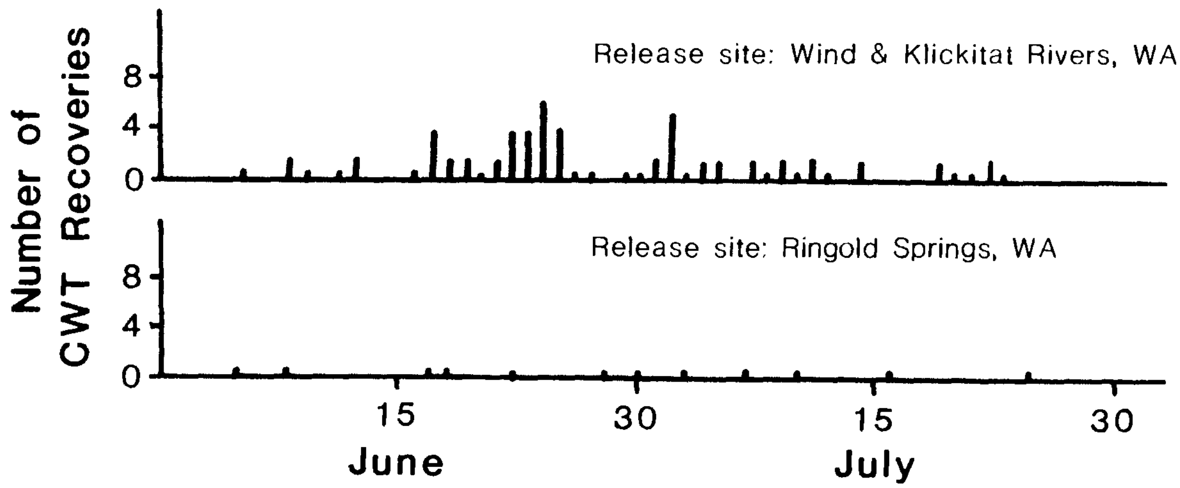

Figure 1. Recoveries of coded-wire tagged Skamania stock summer steelhead from the lower Columbia River sport fisheries of June-July, 1978 through 1982 (S. King, ODFW, unpublished data).

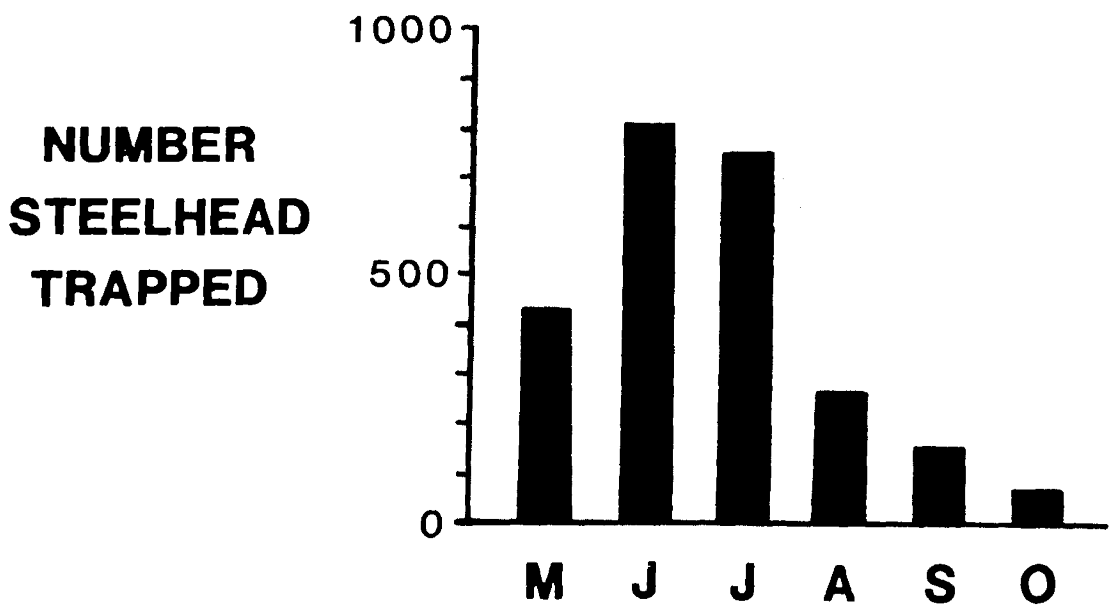

Figure 2. Monthly trap counts of steelhead at Skamania Hatchery, Washington (5-year weighted average, 1979-1983).

Table 1. Age, length and sex of Skamania stock steelhead adults in the Kalama River, Washington, 1976 through 1979 (from Crawford et al. 1977, 1978, 1979 and Chilcote et al. 1981, respectively); data from 1980 through 1984 were excluded due to bias associated with Mt. St. Helens volcano-related straying.

YEAR	AGE	MALES	FEMALES	TOTAL	PERCENT	LENGTH (CM)
1976	1.1	50	14	64	7.3	----
	1.1S1	2	2	4	0.5	----
	1.1S1S1	2	1	3	0.3	----
	1.2	313	338	651	74.6	----
	1.2S1	32	45	77	8.8	----
	1.2S1S1	1	1	2	0.2	----
	1.3	44	28	72	8.2	----
1977	1.1	42	19	61	4.8	60.6
	1.1S1	9	4	13	1.0	69.3
	1.1S2	2	0	2	0.2	71.7
	1.2	451	693	1,144	89.4	73.0
	1.2S1	5	13	18	1.4	77.1
	1.3	22	20	42	3.3	78.3
1978	1.1	79	13	92	6.4	59.3
	1.1S1	1	0	1	0.1	73.5
	1.2	708	579	1,287	90.1	72.6
	1.2S1	7	7	14	1.0	77.2
	1.3	26	7	33	2.3	83.7
	1.3S1	0	2	2	0.1	78.2
1979	1.1	---	---	70	4.2	58.7
	1.2	---	---	1,512	91.5	74.7
	1.2S1	---	---	14	0.8	78.2
	1.3	---	---	57	3.4	83.8

Table 2. Age, length and sex of Skamania stock steelhead adults in the Klickitat River, Washington, 1979 and 1980 (from Schuck 1980 and Schuck et al. 1981).

YEAR	AGE	MALES	FEMALES	TOTAL	PERCENT	LENGTH (CM)
1979	1.1	3	4	7	6.5	60.2
	1.1S1	--	--	1	0.9	----
	1.2	35	59	94	87.9	75.4
	1.2S1	1	0	1	0.9	88.0
	1.3	3	1	4	3.7	91.4
1980	1.1	1	3	4	2.1	64.3
	1.2	61	123	184	95.8	69.9
	1.2S1	0	2	2	1.0	75.0
	1.3	2	0	2	1.0	86.5

Table 3. Salt age of marked summer steelhead returns to Skamania Hatchery, Washington (WDG 1984a).

RELEASE YEAR	MARK	NUMBER RELEASED	YEARS OF OCEAN GROWTH			
			1	2	3	4
1972	R. MAX.	60,000	24	396	236	5
1973	R. PEC.	50,000	37	1,375	178	9
1974	L. PEC.	25,000	24	304	13	5
1975	L. VEN.	30,000	27	1,118	47	2
1976	R. PEC.	58,055	177	2.013	139	15
1977	L. PEC.	26,976	4	471	64	10

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 1.2S1 would represent a fish with 1 year of freshwater growth (i.e., hatchery origin), 2 years of marine growth prior to spawning, approximately 1 year spent in freshwater for spawning (S), followed by another year of ocean growth (1) prior to its capture in freshwater on its second spawning migration. Hence, this fish would be about 5 years old.

Size

Mean length of 2-salts returning to the Kalama River between 1976 and 1979 was 73.5 cm (Table 1), while Skamania 2-salts returning to the Klickitat River in 1979 and 1980 averaged 71.8 cm (Table 2).

Sex ratio

Male:female sex ratios at Skamania Hatchery from 1976 through 1982 were 0.72, 0.75, 0.70, 0.60, 0.58, 0.63 and 0.69, respectively (WDG 1977, 1978, 1980, 1981, 1982, 1984a, and 1984b). Sex ratios of Ringold Springs returnees average 0.67 (B. Walters, WDG, personal communication).

Fecundity

Females spawned at Skamania Hatchery from 1976-77 through 1982-83 yielded an average of 4,024 eggs each, ranging from 3,674 to 4,591 (Table 4). Females spawned at Yakima Hatchery (i.e., Ringold Springs returnees) yielded an average of 3,981 eggs in 1982-83, a value within the normal range of 3,500 to 4,000 for these adults (B. Walters, WDG, personal communication).

Biochemical-genetic characteristics

Thorgaard (1977) reported that Skamania stock summer steelhead have 58 chromosomes.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Skamania stock smolts are typically released as 1-year old fish in April and May at a size of 4-7 per pound. Skamania outmigrants released in the Wind and Klickitat rivers (RM 154.5 and 180.4) from April 17-30, 1980 were recovered in the Columbia River estuary from April 30 thrugh June 3, with a median recapture date of May 10 (Dawley et al. 1982). Outmigration of Skamania steelhead released in the Kalama River (RM 73.1) occurs within a week of planting, and residualism through the following October is on the order of 0.3% - 1.2% (Crawford et al. 1977, 1978, 1979).

Table 4. Fecundity (eggs per female) of Skamania stock summer steelhead spawned at Skamania and Yakima hatcheries, Washingtn, approximately mid-December through February, 1976-77 through 1982-83 (WDG 1977, 1978, 1980, 1981, 1982, 1984a, and 1984b).

HATCHERY	YEAR	EGGS	FEMALES	FECUNDITY
Skamania	1976-77	3,753,392	950	3,951
	1977-78	6,138,563	1,671	3,674
	1978-79	6,567,486	1,597	4,112
	1979-80	5,483,225	1,398	3,992
	1980-81	6,640,309	1,733	3,832
	1981-82	1,511,200	376	4,019
	1982-83	1,830,211	398	4,591
Yakima	1982-83	1,433,000	360	3,981

Survival rate

Egg to plant survival rates for progeny of adults spawned at Skamania Hatchery are approximately 75-80% in the absence of major disease outbreaks (B. Crawford, WDG, personal communication). Fry to smolt survival for Ringold Springs progeny is approximately 70-90% in the absence of major disease outbreaks (B. Walters, WDG, personal communication).

Return rates of Skamania stock juveniles planted into the Kalama River (RM 73.1) in 1975 and 1976 were 6.6% and 6.0% respectively (Crawford et al. 1979; Chilcote et al. 1981). Smolt to adult survival of Skamania stock fish in the Washougal River (RM 120.7) averaged 4.7% from 1970 through 1982 (Table 5). Returns to Ringold Springs (approx. RM 350) average only 1% - 1.5% (B. Walters, WDG, personal communication), likely due to outmigration mortality associated with downstream passage through four hydroelectric projects on the mainstem Columbia River. None of the survival rates reported above account for harvest of Skamania fish in mainstem Columbia recreational and tribal fisheries.

DISEASE HISTORY

Skamania hatchery-stock steelhead at Skamania Hatchery have been afflicted with infectious hematopoietic necrosis (IHN) virus in recent years (WDG 1984a).

PRIORITY INFORMATION NEEDS

Three characteristics of Skamania stock steelhead merit detailed study: 1) timing of spawning in the natural environment, 2) contribution of resulting offspring to wild stocks, and 3) extent of sport and tribal interceptions of upriver-bound Skamania adults in the mainstem Columbia and Snake rivers.

Table 5. Percent return of hatchery-origin steelhead to Skamania Hatchery, Washington, 1970 through 1982 (Crawford 1984).

YEAR	HATCHERY RETURN	SPORT CATCH	TOTAL RETURN	HATCHERY-ORIGIN RETURN 1/	WASHOUGAL PLANT 2/	PERCENT RETURN
1970	3,750	767	4,517	4,466	100,120	4.5
1971	3,924	1,049	4,973	4,904	97,700	5.0
1972	3,945	1,094	5,039	4,967	137,000	3.6
1973	1,857	1,024	2,881	2,813	120,517	2.3
1974	2,642	1,556	4,198	4,095	129,250	3.2
1975	2,967	1,536	4,503	4,402	100,200	4.4
1976	2,600	2,459	5,059	4,897	103,740	4.7
1977	4,008	2,560	6,568	6,399	99,320	6.4
1978	3,936	2,287	6,223	6,072	100,045	6.1
1979	2,693	1,388	4,081	3,989	116,349	3.4
1980	3,494	2,321	5,815	5,662	115,110	4.9
1981	3,202	5,042	8,244	7,911	114,896	6.9
1982	3,478	1,673	5,151	5,041	98,434	5.1

1/ Assumes 93.4% of run is hatchery-origin (Schuck 1980).

2/ Juvenile plant 2 years earlier used because Skamania adults return predominantly as 2-salts.

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WDG. 1984a. Operation and maintenance - Beaver Creek and Skamania hatcheries and Ringold Rearing Station: October 1, 1982 - September 30, 1983. Washington Department of Game report 84-7.

WDG. 1984b. Operation and maintenance - Beaver Creek and Skamania hatcheries and Ringold Rearing Station: October 1, 1981 - September 30, 1982. Washington Department of Game report 84-1.

Skamania Summer Steelhead (hatchery)
Willamette substock

PRODUCTION

Approximately 600,000-700,000 Skamania summer steelhead are released annually into Oregon tributaries of the Columbia River (Table 1). Overall, very few summer steelhead in the Willamette River system are produced from natural spawning. Only 2.5% of the adult summer steelhead passing Willamette Falls in 1981 were wild and none were wild in 1983 (Wade and Buchanan 1983). However, summer steelhead spawn in most accessable tributaries of the upper McKenzie River. Approximately 18,000-20,000 wild smolts were counted at Leaburg Dam in 1981, although only 200 to 300 were counted annually in other years (D. Buchanan, ODFW, personal communication).

GEOGRAPHIC LOCATION

Streams

The Skamania stock is currently released in the Hood, Sandy, and Willamette (McKenzie, Middle Fork Willamette, North Santiam, South Santiam, Molalla, and Clackamas) river systems (Appendix Figure 3). Skamania summer steelhead have also been released into Gnat Creek (1970-74) and Deschutes (1965), John Day (1966), Umatilla (1967-69), and Wallowa (1974-75) rivers. The majority of the fish are released in the Willamette Basin.

Hatcheries

Gnat Creek, Leaburg, McKenzie, Oak Springs, Roaring River, and South Santiam hatcheries

ORIGIN

Following improvements in passage facilities at Willamette Falls completed in 1971, summer steelhead were able to pass above the falls at the time of migration. In addition, water quality in late summer was improved with pollution abatement and releases from dams on Willamette tributaries. Attempts to introduce the coastal Siletz stock of summer steelhead into the Willamette River failed due to its susceptibility to *Ceratomyxa shasta* present in the Willamette and Columbia rivers (Buchanan et al. 1983). The Skamania stock, which is resistant to *C. shasta*, was first introduced into the Willamette system in 1966 (ODFW 1980) and into Hood River in 1967.

Skamania hatchery collected eggs from native stock in the North Fork of the Washougal River, Washington, in 1956 (Rosentreter 1975). As a result of egg scarcity, the Skamania stock was crossed with Klickitat River, Washington, native stock for the following two years. In subsequent years, only Klickitat males were crossed with the hybrid summer steelhead. Broodstock for production of Skamania stock in Oregon are now collected at South Santiam and McKenzie hatcheries to supply all of Oregon's hatcheries. The use of fish

Table 1. Skamania summer steelhead production from hatcheries in Oregon, 1976-82.

Brood	Gnat Creek		Leaburg Hatchery		McKenzie Hatchery		Oak Springs		Roaring River		South Santiam	
year	Fingerlings	Smolts	Fingerlings	Smolts	Fingerlings	Smolts	Fingerlings	Smolts	Fingerlings	Smolts	Fingerlings	Smolts
1976	--	160,013	--	44,400	--	--	--	228,668	--	85,831	--	149,936
1977	--	160,763	17,049	80,152	--	--	44,000	216,533	--	113,756	--	158,525
1978	--	162,863	53,889	81,970	--	--	101,950	204,966	5,120[a]	76,674	--	191,332
1979	36,206	166,534	25,985	97,156	--	--	81,726	206,065	116,054	81,047	--	191,165
1980	39,718	184,470	78,509	128,179	--	--	99,600	210,680	65,000	81,769	--	142,795
1981	--	129,740	--	102,877	16,000	98,807	--	160,868	--	76,475	--	139,333
1982	--	186,206	84,569	106,446	52,656	91,634	146,443	169,209	64,980	72,977	36,733	126,435

[a] Fry.

produced at South Santiam Hatchery in the McKenzie system will be discontinued when adult returns to McKenzie Hatchery are sufficient to support the smolt program.

ADULT LIFE HISTORY

Run size, catch, and escapement

Run size and escapement in the Willamette system are estimated at North Fork Dam (Clackamas River), Willamette Falls, Foster Dam (South Santiam River), Leaburg Dam (McKenzie River), and Marmot Dam (Sandy River) (Table 2). Since 1978 the run passing Willamette Falls has averaged 13,150 fish. Average escapement above North Fork Dam on the Clackamas during the same period was 5,167.

The highest sport catches are in the Clackamas, North and South Santiam, McKenzie and Hood rivers (Table 3).

Table 2. Numbers of adult summer steelhead counted at dams in the Willamette River system, 1971-84, and Sandy River, 1978-84 (modified from Buckman and Warren 1983 and Bennett 1985).

Run year	Clackamas River (North Fork Dam)	Willamette Falls	South Santiam River (Foster Dam)	McKenzie River (Leaburg Dam)	Sandy River (Marmot Dam)
1971	0	2,308	2,318	96	
1972	202	657	859	11	
1973	66	1,686	1,110	9	
1974	849	4,858	4,499	175	
1975	2,326	2,910	1,170	236	
1976	1,515	3,876	1,509	1,467	
1977	3,447	9,200	4,772	837	
1978	4,087	15,174	4,976	2,624	1,170
1979	4,352	7,670	2,641	1,497	1,914
1980	5,803	11,200	2,261	982	3,385
1981	4,778	15,200	2,424	1,365	2,992
1982	4,140	12,567	2,162	746	2,694
1983	1,949	5,301	1,296	364	1,324
1984	11,062	25,002	4,930	1,310[a]	7,142[b]

[a] Through July 25.
[b] Through August 31.

Time of migration

Summer steelhead pass Willamette Falls from March through October (Figure 1). The peak passage is in June and July. Summer steelhead pass North Fork Dam on the Clackamas River from April through November. Approximately 70% of the fish pass in June and July (Table 4). Summer

Table 3. Sport catch of Skamania summer steelhead by run-year in Oregon tributaries of the Columbia River system, 1971-80[a] (Berry 1981).

Stream	Year 1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Columbia River System									
Abernathy Creek	--	--	--	--	--	--	--	4	0
Bullrun River	--	--	--	--	--	0	8	95	417
Calapooia River	--	--	--	--	--	--	--	8	0
Chenoweth creek	--	--	--	--	--	--	--	4	6
Clackamas River	0	582	359	576	1,095	1,495	2,117	5,092	3,382
Collowash River	--	--	--	--	--	37	201	487	266
Collowash River, Hot Sp. F.	--	--	--	--	--	--	--	9	26
Crabtree Creek	--	--	--	--	--	0	12	8	22
Deep Creek	--	--	--	--	--	--	--	4	0
Eagle Creek (Clackamas R)	0	--	476	51	60	128	84	34	42
Fall Creek (Willamette R)	--	--	--	--	--	--	--	4	0
Foster Reservoir	--	--	--	--	--	0	33	27	0
Gnat Creek	--	--	--	--	--	0	3	0	0
Hood River[b]	899	1,045	1,395	2,307	2,670	1,169	1,696	2,878	1,021
Hood River, E.F.[b]	--	--	--	--	--	0	6	9	22
Hood River, W.F.[b]	--	--	--	--	--	3	68	177	62
Lindsay Creek	--	--	--	--	--	--	--	--	--
McKenzie River	--	23	24	366	610	473	732	2,958	1,406
Mill Creek (Marion Co)	--	--	--	--	--	0	15	11	0
Milton Creek	--	--	--	--	--	--	--	4	0
Molalla River	--	--	--	--	--	--	--	14	0
Salmon River	--	--	--	--	--	0	1,793	1,154	1,569
Sandy River	--	--	--	--	--	0	458	900	821
Santiam River[c]	452	283	204	1,745	129	496	1,552	1,024	751
Santiam River N.F.[c]	--	--	--	--	385	1,140	1,641	3,198	1,985
Santiam River, Little N.F.[c]	--	--	--	--	--	0	36	104	115
Santiam River, S.F.[c]	--	--	--	--	91	274	1,374	4,742	1,293
Sucker Creek	--	--	--	--	--	0	3	0	0
Tualatin River	--	--	--	--	--	--	--	8	0
Willamette River, Lower	--	128	85	147	250	148	202	306	195
Willamette River, Upper	--	--	--	--	--	0	4	38	71
Willamette River, Mid F.	--	--	--	--	--	--	--	0	12
Willamina Creek	--	--	--	--	--	--	--	4	0
Yamhill River	--	--	--	--	--	--	--	--	--
Total	1,351	2,061	2,543	5,192	5,290	5,363	12,038	23,305	13,484

[a] Estimated from punch-card returns adjusted for non-response bias. Prior to 1977 the catch in most tributaries was included in the mainstem catch.
[b] Hood River catch includes native wild stock.
[c] Extensive creel surveys in the Santiam River system indicated that punch card estimates may over estimate actual harvest (Buchanan et al. 1979).

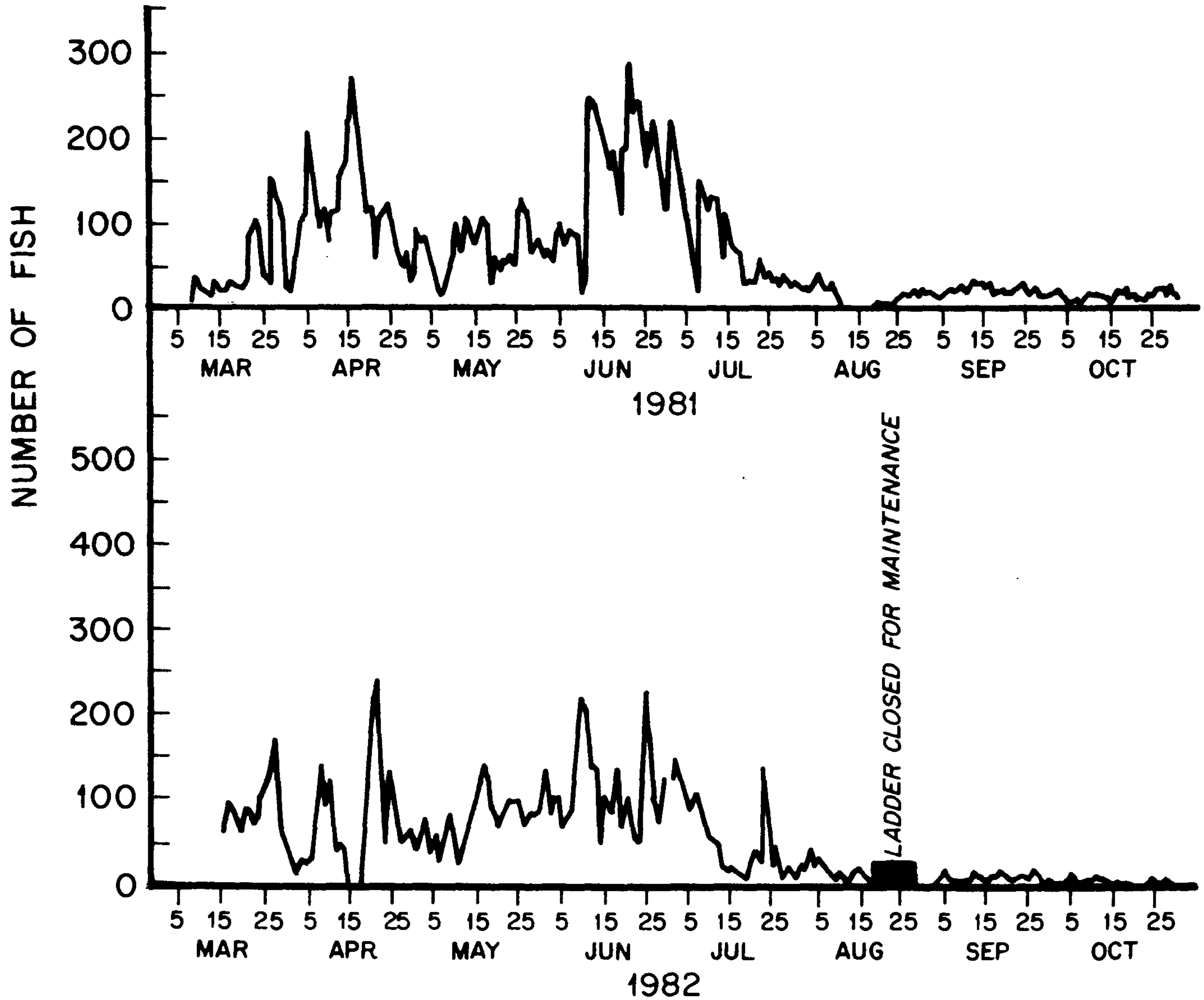

Figure 1. Daily counts of summer steelhead passing Willamette Falls, 1981 and 1982 (Bennett 1982; 1983).

steelhead also pass Marmot Dam on the Sandy River April through October, and peak in June and July (Table 5).

Table 4. Counts of adult summer steelhead at the North Fork Dam, Clackamas River, 1972-83.

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
1972	0	0	4	86	93	19	5	0
1973	0	0	10	15	27	26	13	6
1974	0	0	66	408	282	44	10	0
1975	10	54	1,063	867	206	30	30	9
1976	0	21	484	651	254	88	9	0
1977	16	417	1,242	982	295	196	137	145
1978	84	440	1,626	984	348	533	94	11
1979	0	574	1,192	1,459	340	330	401	62
1980	0	207	506	3,082	1,314	364	137	193
1981	0	285	1,727	2,310	223	98	71	0
1982	11	482	1,751	1,476	325	95	45	3
1983	4	35	300	725	483	201	53	147
Total	125	2,515	9,971	12,995	3,876	1,066	1,005	576
%	0.5	7.8	31.0	40.5	12.1	3.3	3.1	1.8

Table 5. Counts of adult summer steelhead at Marmot Dam, Sandy River, 1978-84.

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1978	65	157	329	323	126	133	37
1979	0	166	621	678	220	119	110
1980	0	168	689	1,466	612	331	119
1981	0	535	955	1,361	74	43	24
1982	89	621	1,090	703	151	29	11
1983	22	174	414	242	364	105	3
1984	29	540	2,243	3,191	1,139	NA	NA
Total[a]	176	1,821	4,098	4,773	1,547	760	304
%	1.3	13.5	30.4	35.4	11.5	5.6	2.3

[a] 1978-83.

Spawning period

Skamania steelhead are spawned from January through March.

Spawning areas

Leaburg and South Santiam hatcheries

Age composition

About 85% of the run are 2-salt fish (Table 6). The original North Fork Washougal stock consisted of 40-60% 1-salt fish, whereas the Klickitat stock was composed primarily of 2- and 3-salt steelhead (Rosentreter 1975). Releasing larger smolts skews the age distribution of fish at return towards 2-salts, but also increases the number of 3-salts due to higher total survival of larger smolts (Table 7) (Wade and Buchanan 1983).

Table 6. Age composition of adult Skamania summer steelhead returning to Foster Dam, South Santiam River, 1969-1979.

Brood	Returning adult age composition (%)			
year	1-salt	2-salt	3-salt	4-salt
1969	8.7	72.8	16.3	2.2
1970	7.5	84.4	8.0	0.2
1971	5.2	87.8	6.8	0.1
1972	5.1	85.6	9.3	0.0
1973	11.0	86.7	2.9	0.0
1974	21.1	86.6	2.1	0.0
1975	8.1	88.0	4.2	0.0
1976	2.8	88.9	8.3	0.0
1977	6.1	76.8	17.1	0.0
1978	2.9	94.2	2.9	0.0
1979	1.5	87.6	11.0	0.0
Mean	7.3	85.4	8.1	<0.1

Table 7. Ocean age at return of adult Skamania summer steelhead captured at Foster Dam, South Santiam River, from three sizes of smolts released in 1980.

Size at	1-salt		2-salt		3-salt		
release (cm)	No.	Percent	No.	Percent	No.	Percent	Total
<18	1	3.5	21	72.4	7	24.1	29
18 to 20	1	0.5	127	85.6	19	13.9	147
>20	6	2.1	272	89.1	25	8.8	303

Size

The average length of each age and sex category of Skamania summer steelhead was as follows (M. Wade, ODFW, unpublished data):

Brood year	Sex	Saltwater age	Length (cm)	n
1981	M & F	1-salt	56.5	50
1979	M	2-salt	70.6	650
1979	F	2-salt	68.0	618
1979	M	3-salt	81.8	50
1979	F	3-salt	78.3	50

Sex Ratio

No information.

Fecundity

Fecundity averaged 3,700 eggs per female at both Leaburg (n = 51) and South Santiam (n = 415) hatcheries in 1984.

Biochemical-genetic characteristics

Preliminary data on isozyme gene frequencies are presented in Table 8.

JUVENILE LIFE HISTORY

Time of emergence

Eggs taken at South Santiam Hatchery are incubated in 38-43°F water for 6 weeks until hatching (approximately mid-April). The alevins are shipped to Oak Springs Hatchery for rearing in warmer water until the fry reach a size of 300/lb in June. They are then shipped back to South Santiam for rearing until the following April.

Time, age, and size at migration

Skamania summer steelhead are released as age-0+ fingerings in the fall or as age-1+ smolts in March and April. On the South Santiam River, all the smolts migrated past Lebanon Dam from mid-April, soon after release, until mid-May (Wade and Buchanan 1983). Fish greater than 22 cm fork length migrated one week earlier than fish less than 22 cm fork length. Fish released in the Santiam and McKenzie rivers migrated past Willamette Falls from late April though mid-June.

Survival rate

Egg-to-fry survival of the 1984 brood averaged 87% and 85% at Leaburg and South Santiam hatcheries, respectively.

Table 8. Isozyme gene frequencies and sample sizes (#) as determined by electrophoresis for Skamania (Willamette) hatchery summer steelhead stocks. Numbers at top of each column are relative mobilities for each allele present in the enzyme system. Minus signs indicate cathodal migration (Schreck et al. 1984).

Location/	ADH			ACO				ACPD-1			CK			GOT 1,2			GOT 3		
hatchery	-100	-76	#	100	83	66	#	100	140	#	100	70	#	100	112	#	100	77	#
Eagle Creek Hatchery	1.00		100	0.99	0.01		80	0.97	0.03	51	1.00		100	1.00		80			
McKenzie (Leaburg Hatchery)	1.00		100	0.99	0.01		100	0.92	0.08	97	1.00		100	0.99	0.01	100	1.00		100
South Santiam (Leaburg Hatchery)	1.00		97	0.98	0.02		97	0.93	0.07	96	1.00		97	0.97	0.03	97			97

	IDH 3,4					LDH-4			MDH-1, 2				MDH-3, 4						ME		
	100	40	71	120	#	100	76	#	100	70	140	#	100	83	110	90	70	#	100	85	#
Eagle Creek Hatchery	0.70	0.12	0.15	0.03	94	0.78	0.22	80	1.00			70	0.85	0.14			0.01	95			
McKenzie (Leaburg Hatchery)	0.62	0.19	0.14	0.05	95	0.88	0.12	100	1.00			90	0.84	0.13	0.03			100	0.96	0.04	100
South Santiam (Leaburg Hatchery)	0.70	0.18	0.10	0.02	89	0.80	0.20	96	0.99	0.01		94	0.91	0.07	0.02			95	0.96	0.04	92

	PGI-1			PGI-2			PGI-3				PEP-GL-1				PEP-LGG			PGM-1				PGM-2		
	100	130	#	100	120	#	100	92	120	#	100	110	95	#	100	74	#	-100	-85	-115	#	-100	-140	#
Eagle Creek Hatchery	1.00		80	1.00		80	1.00			80	1.00			100	1.00		40	1.00			70	1.00		70
McKenzie (Leaburg Hatchery)	1.00		95	1.00		95	0.96	0.04		95	0.95	0.05		95	1.00		100	1.00			95	1.00		95
South Santiam (Leaburg Hatchery)	1.00		97	1.00		97	0.95	0.05		97	0.94	0.06		97	1.00		97	1.00			47	1.00		47

	PGK-2				PMI				SDH-1, 2			SOD			
	100	120	160	#	100	110	94	#	100	195	#	100	152	48	#
Eagle Creek Hatchery					1.00			90	1.00		100	0.74	0.26		64
McKenzie (Leaburg Hatchery)					1.00			100	1.00		100	0.78	0.22		97
South Santiam (Leaburgh Hatchery)									1.00		97	0.72	0.28		97

Smolts greater than 20 cm fork length at release returned at twice the rate of smolts 18-20 cm fork length and ten times the rate of smolts less than 18 cm fork length (Table 9) (Wade and Buchanan 1983). Survival rates (catch plus escapement to Foster Dam) as high as 8.8% have been reported (Buchanan and Wade 1978). Returns of tagged groups to Foster Dam ranged from <1% to 6% for 1969-79 brood years (M. Wade, ODFW, personal communication).

DISEASE HISTORY

Red mouth and furunculosis have been reported in Skamania summer steelhead at Willamette hatcheries. Mortality from bacterial infections such as furunculosis (*Aeromonas salmonicida*, *A. liquefaciens*) increases in water at temperatures greater than 62°F (Figure 2) (Buchanan 1975). Adult Skamania summer steelhead have died at South Santiam Hatchery from *C. shasta* even though the juveniles are highly resistant.

Adults returning to South Santiam Hatchery were checked for viruses each year. No viruses have been detected (R. Holt, ODFW, personal communication).

PRIORITY INFORMATION NEEDS

1. Reasons for poor natural production
2. Continual monitoring of time of return to insure that adult migration timing does not further overlap with native Willamette winter steelhead
3. Resistance to bacterial diseases
4. Mortality of smolts passing downstream migrant facilities at Willamette Falls
5. Validation of Willamette Falls fish counts (possible inflation of counts resulting from fallback)
6. Estimates of sport harvest in tributaries
7. Evaluation of summer steelhead and wild trout interactions in the McKenzie River--possible competition for spawning and rearing areas

Table 9. Recaptures of Skamania summer steelhead released as smolts at Foster Dam, South Santiam River, in the spring of 1980 (Wade and Buchanan 1983).

Size at release (cm)	Number of smolts released	Number of smolts captured near Lebanon Dam in 1980	Percentage of release captured near Lebanon Dam	Number of adults captured at Foster Dam in 1981	Number of adults captured at Foster Dam in 1982	Number of adults captured at Foster Dam in 1983	Percentage of release captured at Foster Dam
<18	25,328	134	0.5	1	55	17	0.3
18 to <20	37,947	295	0.8	3	476	77	1.5
≥20	27,271	207	0.9	17	737	73	3.0

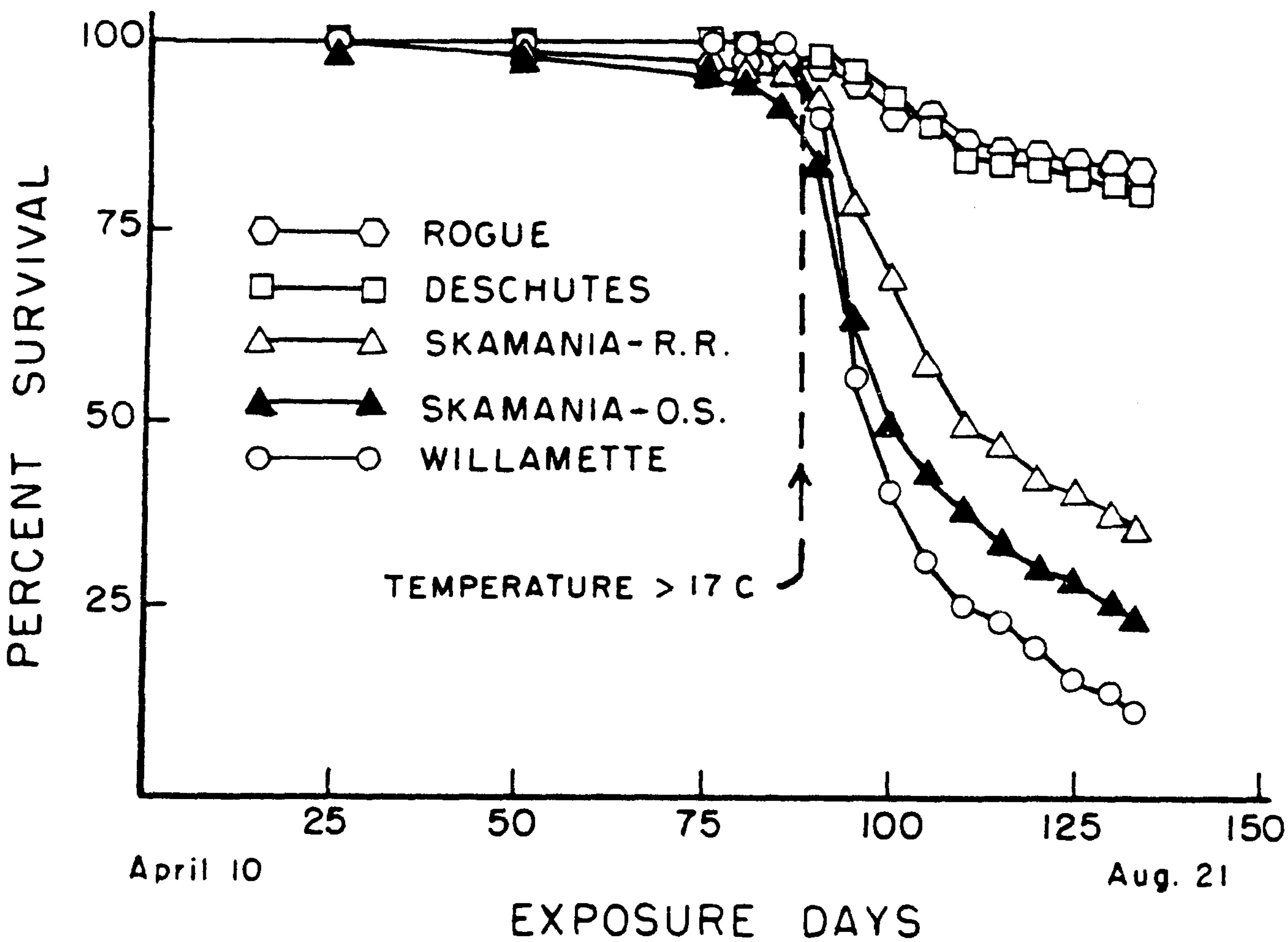

Figure 2. Survival of five groups of steelhead smolts held in the Willamette River in 1975 (Buchanan[2] et al. 1983).

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Woodward Creek Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Woodward Creek, Washington, a tributary to the lower Columbia (RM 141.4) that drains a watershed of 8.1 square miles.

ORIGIN

The Woodward Creek wild winter steelhead stock is native.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement are available. Harvest of the stock likely occurs in the mainstem Columbia sport fishery, and possibly in Woodward Creek. No escapement goal has been set for this stock to date.

Time of migration

Probably similar to wild winter steelhead in Hamilton Creek - December through April, peaking between January and March.

Spawning period

March through June.

Spawning areas

Steelhead spawn in the lower reaches of Woodward Creek (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

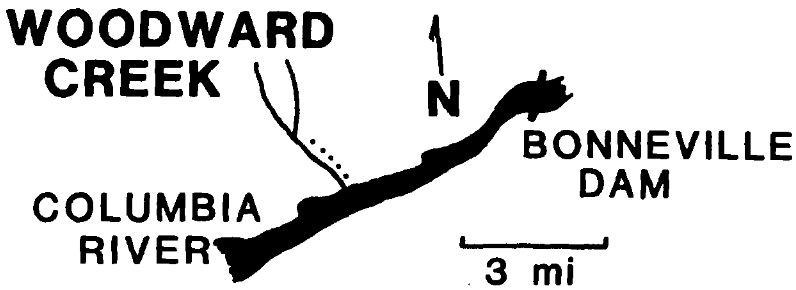

Figure 1. Probable spawning locations of native steelhead in Woodward Creek, Washington (B. Crawford, Washington Department of Game, personal communication).

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Presumed similar to other steelhead smolts in the lower Columbia River - i.e., most juveniles outmigrate in April and May (peak in early May) at a size of 160 mm and an age of 2 years.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Sandy River Winter Steelhead (wild)

PRODUCTION

Winter steelhead production in the Sandy River consists of mixed hatchery and wild stocks. This summary focuses principally on the wild stock. Consult the "Big Creek Winter Steelhead (hatchery)" stock summary for additional information on the hatchery stock.

GEOGRAPHIC LOCATION

Streams

Sandy River winter steelhead occur in the mainstem Sandy River and tributaries (Figure 1). The Salmon River fork is managed for wild production of winter steelhead.

ORIGIN

From 1955 through 1967, Chambers Creek, Alsea River, Eagle Creek, Big Creek, and native Sandy River hatchery stocks were released into the Sandy River (Table 1) (Wagner 1967). Releases of Big Creek stock have continued since that time (J. Massey, ODFW, personal communication).

Prior to 1964 all hatchery fish were released above Marmot Dam (RM 27) (Wagner 1967). Currently, Big Creek stock are not released above Sleepy Hollow Bridge (RM 34.3) (J. Massey, ODFW, personal communication), although strays may reproduce in areas above that point. Skamania summer steelhead are also stocked in the Sandy system.

ADULT LIFE HISTORY

Run size, catch, and escapement

There is an intense sport fishery for winter steelhead on the Sandy River, primarily on the mainstem. The catch of wild and hatchery stocks combined fluctuated from 3,300 to 13,000 with an average catch of 8,100 steelhead from 1971 through 1980 (Table 1).

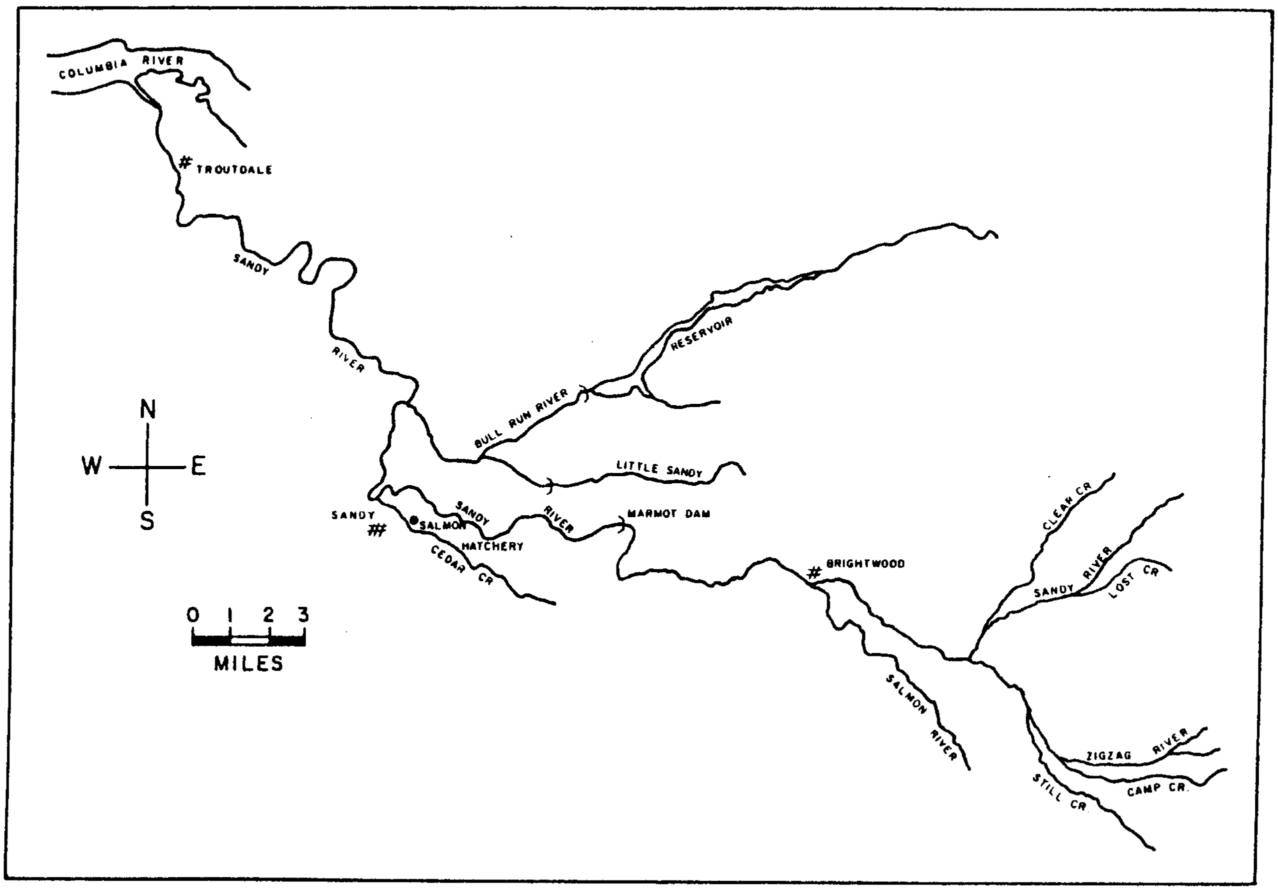

Figure 1. Sandy River and major tributaries (Wagner 1967).

Table 1. Sandy River winter steelhead sport catch (hatchery and wild) by run year, 1971-1980[a] (Berry 1981).

	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Beaver Cr.	-	-	-	-	-	-	25	7	6
Bullrun R.	-	-	-	-	-	15	123	40	74
Salmon R.	-	-	-	-	-	-	-	-	19
Sandy R. (mainstem)	10,315	5,640	5,937	8,738	7,566	3,286	11,385	6,867	12,926
Total	10,315	5,640	5,937	8,738	7,566	3,301	11,533	6,914	13,025

[a] Estimated from punch-card returns adjusted for non-response bias. Prior to 1977 the catch in tributary streams was included in the mainstem catch.

Counts at Marmot Dam represent the spawning escapement since there is negligible harvest above the dam and little spawning in tributaries below it. Prior to 1962-63 escapement was predominantly wild stock (Table 2). The proportion of hatchery stocks in the escapement increased in subsequent years as hatchery releases increased. Run size, catch, and escapement of the wild stock in recent years are unknown (Table 3).

Table 2. Run size, catch, and escapement of wild steelhead in the Sandy River, 1954/55-1965/66[a] (data from Wagner 1967).

	Catch		Escapement		
Run year	No.	Percentage of run	No.	Percentage of total escapement	Run size
1954-55	958	38	1,581	b	2,539
1955-56	1,157	34	2,240	b	3,397
1956-57	741	27	1,975	96	2,716
1957-58	1,581	35	2,917	92	4,498
1958-59	1,213	35	2,290	97	3,503
1959-60	1,824	54	1,578	98	3,402
1960-61	1,312	32	2,749	88	4,061
1961-62	1,056	21	3,871	96	4,927
1962-63	1,107	31	2,425	73	3,532
1963-64	2,064	48	2,252	58	4,316
1964-65	2,694	44	3,456	62	6,150
1965-66	2,155	49	2,239	63	4,394

[a] Estimated from a ratio of marked (hatchery) fish to unmarked (wild) fish.
[b] Previous hatchery releases were not marked.

Table 3. Escapement of wild and hatchery stocks of winter steelhead over Marmot Dam 1966/67-69/70 and 1978/79-82/83.[a]

Run year	No. of fish	Run year	No. of fish
1966-67	4,075	1978-79	1,834
1967-68	2,932	1979-80	3,022
1968-69	2,793	1980-81	4,228
1969-70	2,385	1981-82	2,678
		1982-83	2,451

[a] Counts were not taken from 1971-1977.

Time of migration

Winter steelhead migrate upstream in the Sandy River from November through May. The peak of the run has shifted from March and April (1960-70) to February (1978-83) (Figure 2).

Spawning period

It is suspected that wild winter steelhead spawn in mid- to late spring (April-June) after the Big Creek hatchery stock.

Spawning areas

Winter steelhead presently spawn above Marmot Dam in nonglacial streams (Wagner 1967). Substantial numbers of steelhead enter the Salmon River (Collins 1974). Adult fish have also been observed in Still, Devil Canyon, and Lost creeks and in Clear Fork.

Age composition

No information.

Sex ratio

No information.

Fecundity

No information.

Biochemical-genetic characteristics

No information.

JUVENILE LIFE HISTORY

Time of emergence

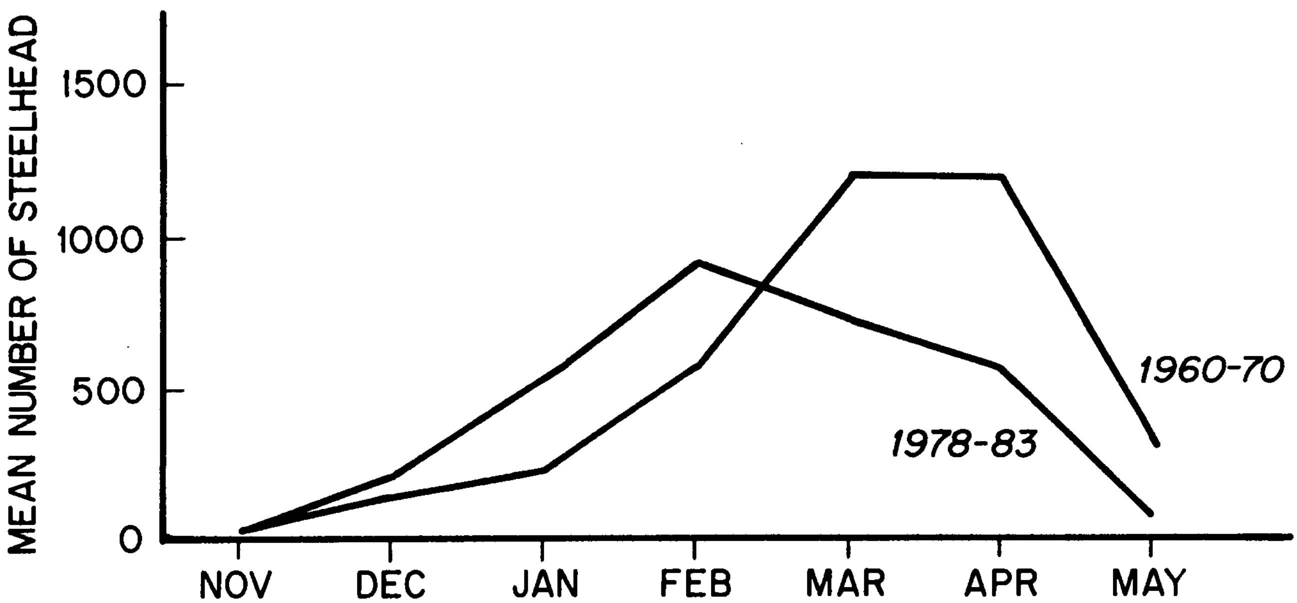

Figure 2. Mean timing of adult winter steelhead migration over Marmot Dam 1960-70 and 1978-83 (no counts were made from 1971-1977).

Time, age, and size at migration

No information.

Survival rate

No information.

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Catch and escapement of wild stock
2. Smolt production levels and capacity
3. Contribution of hatchery stock to natural production

REFERENCES

Berry, R.L. 1981. Oregon salmon and steelhead sport catch statistics, 1970-80. Oregon Department of Fish and Wildlife, Portland, Oregon.

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Wagner, H.H. 1967. A summary of investigations of the use of hatchery-reared steelhead in the management of a sport fishery. Oregon State Game Commission, Fishery Report No. 5, Portland, Oregon.

Hamilton Creek Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Hamilton Creek, Washington, a tributary to the lower Columbia River (RM 143.3) that drains a watershed of 11.8 square miles.

ORIGIN

The Hamilton Creek wild winter steelhead stock is indigenous, although some interbreeding with introduced and stray hatchery-origin steelhead has probably taken place.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement exist. Harvest of the stock occurs in mainstem Columbia and Hamilton Creek sport fisheries. The annual sport catch of wild and hatchery-origin winter steelhead in Hamilton Creek is approximately 20 (5-year average, based on punchcard returns). At present, no escapement goal has been established for this stock.

Time of migration

December through April, peaking between January and March (based on timing of sport catch).

Spawning period

March through June.

Spawning areas

Wild steelhead spawn for 1-2 miles upstream of the mouth of Hamilton Creek, Washington (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

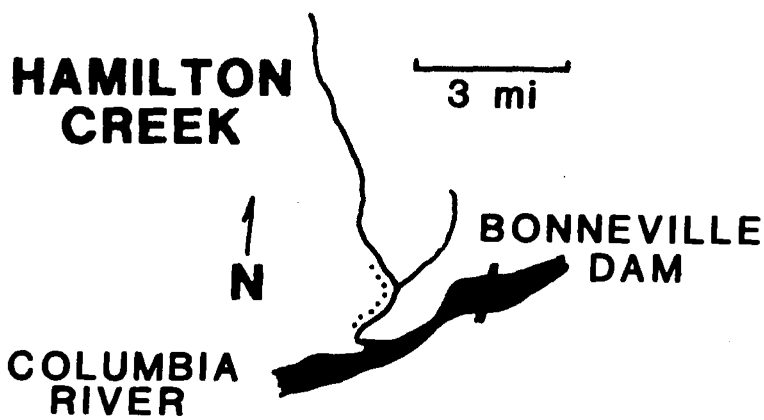

Figure 1. Probable spawning areas of steelhead trout in Hamilton Creek, Washington (B. Crawford, Washington Department of Game, personal communication).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most juveniles likely outmigrate in April and May as 160 mm 2-year olds.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Wind River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Wind River, Washington, a tributary to the Columbia River at RM 154.5 (8.4 miles above Bonneville Dam) that drains a watershed of 226 square miles.

ORIGIN

The Wind River wild winter steelhead stock is native, although some interbreeding with introduced Chambers Creek hatchery-stock fish may have occurred in the late 1950's and early 1960's.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement do not exist. Harvest of the stock occurs in mainstem Columbia sport and tribal fisheries, as well as in the Wind River. Steelhead harvested by Wind River sport anglers and reported on punchcards are assumed to be summer-run fish. However, approximately 25-50 of the adults caught in late winter are probably wild winter steelhead (B. Crawford, Washington Department of Game (WDG), personal communication). Stock abundance is further impacted by mortalities associated with passage of juveniles and adults through Bonneville Dam and Pool. No escapement goal has been formulated for this stock to date.

Time of migration

Probably January through May, peaking in March.

Spawning period

March through June.

Spawning areas

Wild winter-run steelhead spawning activity has only been documented as far upstream as Trout Creek (Figure 1).

Age composition

Unknown.

Size

Unknown.

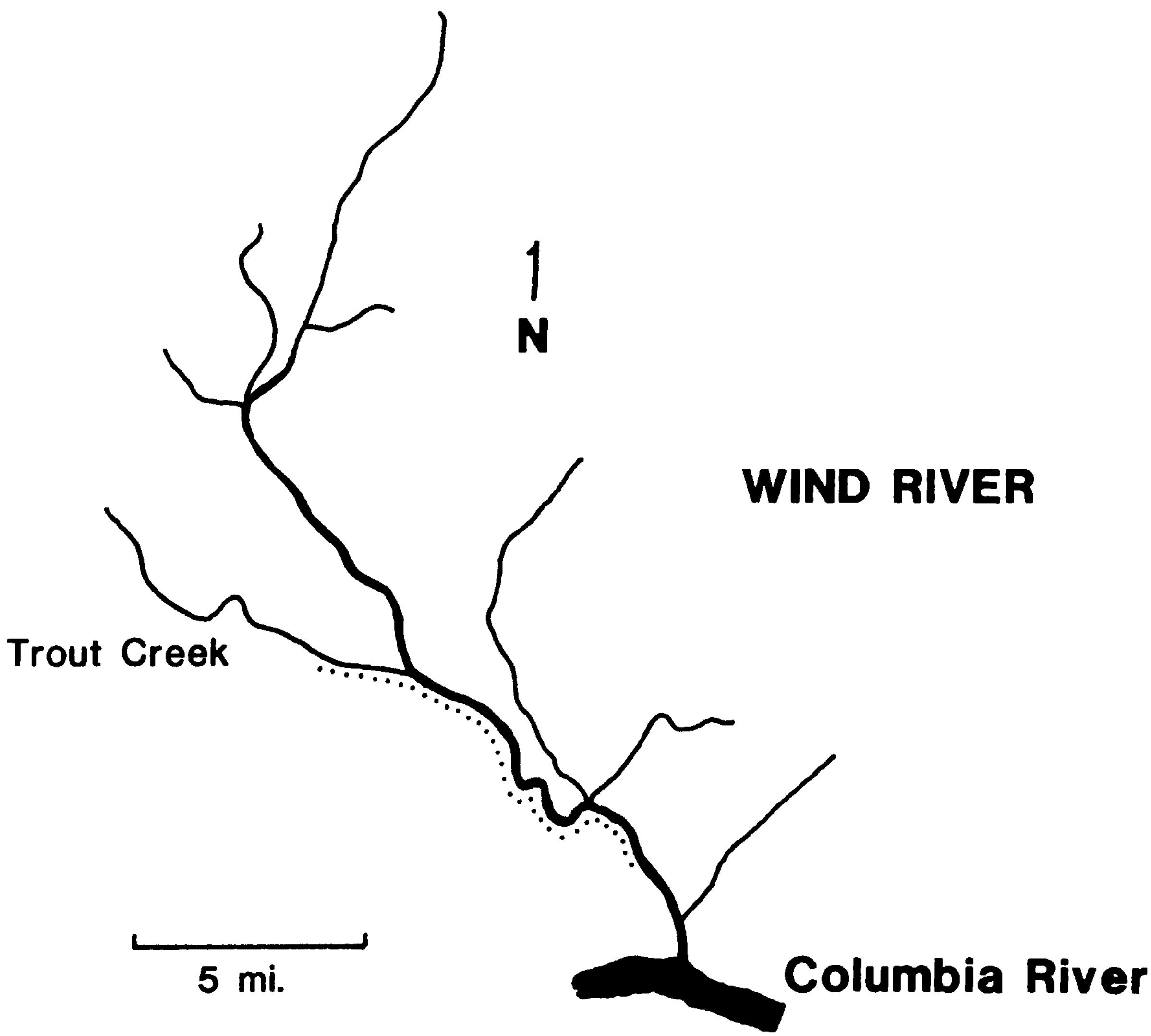

Figure 1. Probable spawning areas of wild winter steelhead in the Wind River, Washington (B. Crawford, WDG, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts likely outmigrate in April and May at 2 years of age and 160 mm in length.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Wind River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Wind River, Washington, a tributary to the Columbia River at RM 154.5 (8.4 miles above Bonneville Dam) that drains a watershed of 226 square miles.

ORIGIN

Wild summer steelhead in the Wind River are indigenous, although some interbreeding with introduced Skamania hatchery-stock steelhead has likely occurred.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch and escapement exist. Overfishing, habitat degradation, and mortalities associated with fish passage through Bonneville Dam and Pool reduced wild summer steelhead runs from former levels of 2,500 to 3,500 adults (WDG 1936; WDF and USFWS 1951; Crawford 1982, 1983). Harvest of the stock occurs in mainstem Columbia recreational and tribal fisheries, but wild catch-and-release regulations have protected the stock in the Wind River since 1982. The interim escapement goal for this stock is 1,035 fish.

Time of migration

April through December, peaking between July and October.

Spawning period

Likely February through May, peaking in March and April.

Spawning areas

Wild summer steelhead presently spawn through most of the Wind River system (Figure 1).

Age composition

Of wild summer fish sampled in 1981 and 1982, 68.4% were 2-ocean, 26.3% were 3-ocean, and 5.3% were repeat spawners (Table 1). The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 2.1S would represent a fish with 2 years of freshwater growth, 1 year of marine growth prior to spawning, approximately 1 year spent in freshwater for spawning (S), likely followed by several months of ocean growth prior to its capture in

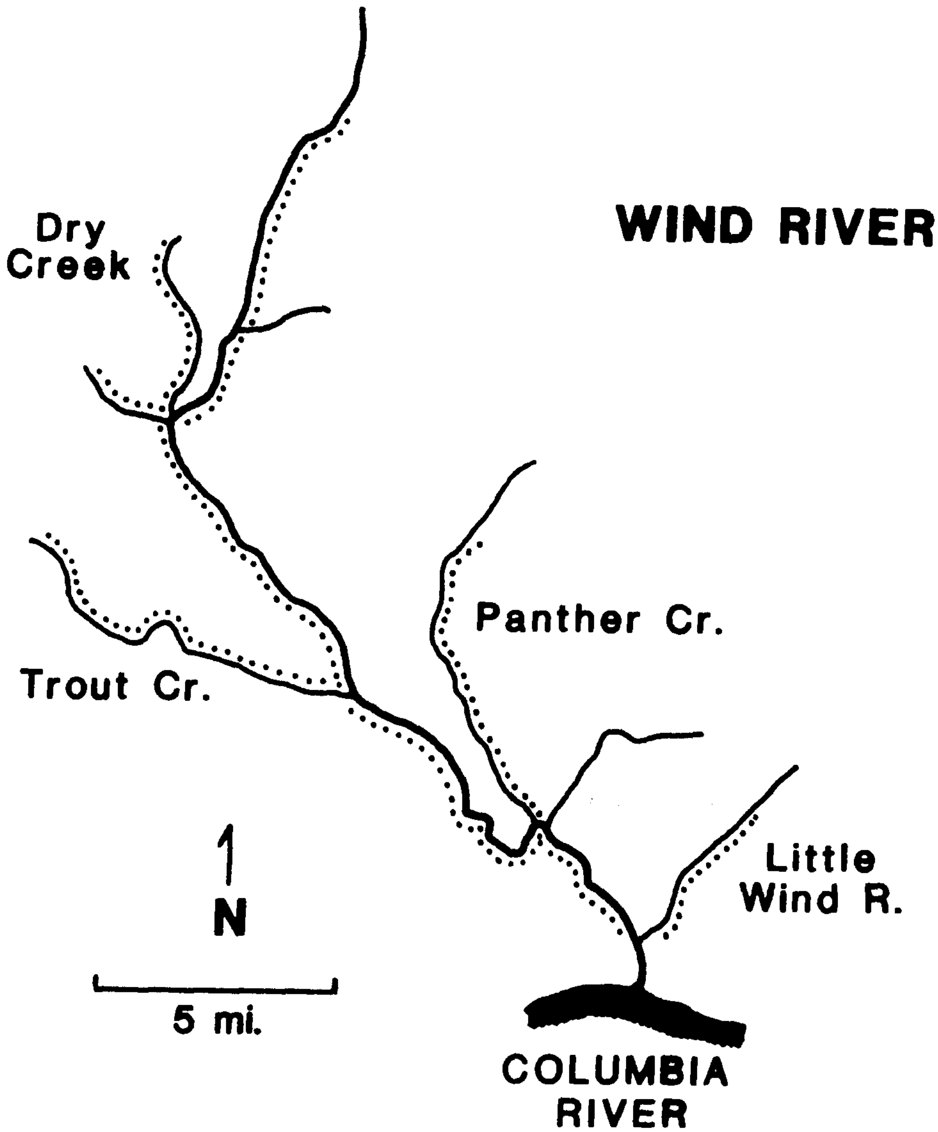

Figure 1. Probable spawning sites of summer steelhead trout in the Wind River, Washington (B. Crawford, Washington Department of Game, personal communication).

Table 1. Age, sex, length and weight of wild summer steelhead harvested in the Wind River, Washington, in August-September 1981 (Morrill 1982) and June-July 1982 (Morrill in prep.).

AGE	SEX MALE	FEMALE	TOTAL	LENGTH (CM)	WEIGHT (KG) 1/
1.2	1	0	1	65	---
2.1S	0	1	1	76	3.8
2.2	4	7	11	70	3.5
2.3	2	3	5	84	4.1
3.2	0	1	1	74	2.5

freshwater on its second spawning migration. However, this fish may have been caught in freshwater after spawning but prior to migrating back to sea.

Size

More than half (57.9%) of the wild steelhead sampled in 1981 and 1982 were age 2.2, averaging 70 cm in length and 3.5 kg in weight (Table 1).

Sex ratio

The male:female sex ratio of fish sampled in 1981 and 1982 was 7:12, or 0.58 (Table 1).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Of adults returning in 1981 and 1982, 5.3% smolted at age 1, 89.5% at age 2, and 5.3% at age 3 (Table 1). Most probably outmigrated in April and May (peak in early May) at an average size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

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WDF and USFWS (Washington Department of Fisheries and U.S. Fish and Wildlife Service). 1951. Feasibility study of laddering Shipherd Falls. *In* Crawford, B.A. 1982. Wind River management plan. Unpublished Washington Department of Game report.

WDG (Washington Department of Game). 1936. Commercial catch of steelheads-Columbia River watershed. Unpublished report.

White Salmon River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Big White Salmon River, Washington, a tributary to the Columbia River at RM 168.3 (22.2 miles above Bonneville Dam) that drains a watershed of 390 square miles.

ORIGIN

Indigenous, although interbreeding may occur with adults of Chambers Creek and Elochoman hatchery-stock origin that are due to return from plants made in the early 1980's.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement are available. Construction of Condit Dam on the White Salmon River in 1913 ultimately blocked anadromous fish passage to 30-40 miles of usable spawning and rearing habitat in the watershed, hence contemporary runs are undoubtedly smaller than historical magnitudes. Construction of Bonneville Dam and overfishing likely further impacted the depleted populations.

At present, the stock is harvested in mainstem Columbia recreational and tribal fisheries, and in the White Salmon River. Annual sport catch of wild and hatchery-origin steelhead in the White Salmon between November and April (i.e., when winter steelhead are present) is approximately 30 (5-year average, based on punchcard returns). However, some of these fish are probably summer-runs. As yet, no escapement goal has been assigned to this stock.

Time of migration

January through May, peaking in March.

Spawning period

March through June.

Spawning areas

Construction of Condit Dam and the failure of its passage facilities in subsequent years eliminated approximately 30 miles of steelhead spawning habitat in the White Salmon River (Figure 1). Steelhead presently spawn in the 2-3 miles of free-flowing, anadromous water below the dam.

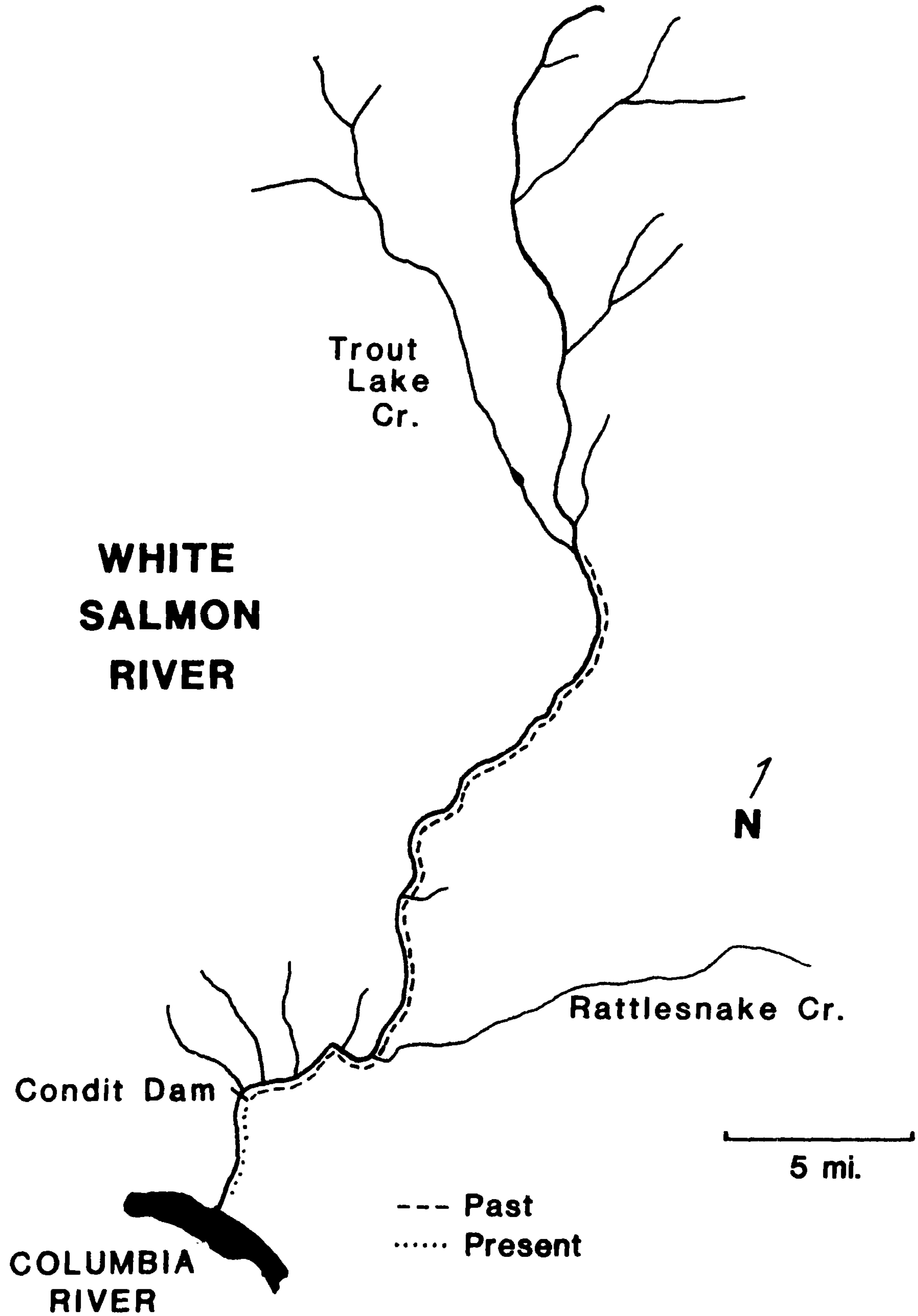


Figure 1. Probable past and present spawning locations of wild winter and summer steelhead in the White Salmon River, Washington (Fulton 1970; B. Crawford, Washington Department of Game, personal communication).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Like winter steelhead in the lower Columbia River, wild White Salmon River smolts probably outmigrate in April and May at a size of 160 mm and an age of 2 years.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch escapement data; establishment of escapement goal.

REFERENCES

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye, and chum salmon in the Columbia River Basin - past and present. NMFS Special Scientific Report, Fisheries No. 618.

White Salmon River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Big White Salmon River, Washington, a tributary to the Columbia River at RM 168.3 (22.2 miles above Bonneville Dam) that drains a watershed of 390 square miles.

ORIGIN

The wild summer steelhead stock in the White Salmon river is native, but genetic influences (interbreeding) will likely be exerted by adults of Skamania and Wells hatchery-stock origin that are expected to return from plants made in the early 1980's.

ADULT LIFE HISTORY

Run size, catch and escapement

Accurate estimates of wild run size, catch and escapement are not available. Construction of Condit Dam in 1913 was ultimately responsible for the elimination of 30-40 miles of steelhead spawning and rearing habitat in the upper White Salmon River, hence present runs are undoubtedly depleted relative to former levels. Construction of Bonneville Dam and overfishing likely reduced run sizes further.

The stock is currently harvested in mainstem Columbia recreational and tribal fisheries, as well as in the White Salmon River. Annual sport harvest of wild and hatchery-origin steelhead in the White Salmon is approximately 1,060 (5-year average, based on punchcard returns); most of these fish are summer-runs. At present, there is no escapement goal for this stock.

Time of migration

April through December, peaking July through September.

Spawning period

January through April, peaking in February and March.

Spawning areas

Construction of Condit Dam and the failure of its laddering system several years later blocked anadromous fish passage to approximately 30 miles of steelhead spawning habitat in the White Salmon River (Figure 1). Steelhead presently spawn in the 2-3 mile anadromous reach below the dam.

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wild smolts likely outmigrate from the White Salmon in April and May at an age of 2 years and a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

REFERENCES

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye and chum salmon in the Columbia River Basin - past and present. NMFS Special Scientific Report, Fisheries No. 618.

Major Creek Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Major Creek, Washington, a tributary to the Columbia River at RM 177.4 (31.3 miles above Bonneville Dam) that drains a watershed of approximately 10 square miles.

ORIGIN

The wild summer steelhead stock in Major Creek is indigenous.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement are unavailable. Harvest of the stock likely occurs in mainstem Columbia sport and tribal fisheries, and in Major Creek. Runs are further impacted by mortalities associates with passage of juveniles and adults through Bonneville Dam and Pool. No escapement goal has been established for this stock to date.

Time of migration

Likely April through December, peaking between July and October.

Spawning period

January through April.

Spawning areas

Steelhead spawn and rear in the lower 2-3 miles of Major Creek (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

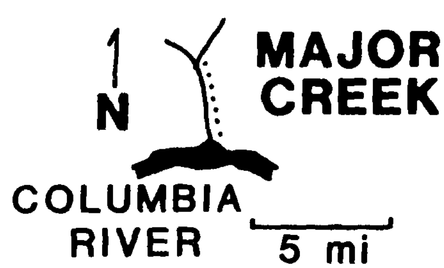


Figure 1. Probable spawning locations of native steelhead trout in Major Creek, Washington (B. Crawford, Washington Department of Game, personal communication).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts probably outmigrate in April and May after attaining a size of 160 mm and an age of 2 years.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Hood Basin Winter and Summer Steelhead (wild)

PRODUCTION

The Hood River system is managed for both wild and hatchery production of winter and summer steelhead. Other Columbia River tributaries in the Hood Basin are managed for wild production of what are considered to be winter races; however, the coincidence of reported catches of summer steelhead and the timing of A run summer steelhead past Bonneville suggest that summer steelhead may enter the lower portions of these streams during the course of their upriver migration (D. Swartz, ODFW, personal communication).

This summary presents information primarily on the wild stocks. Consult "Big Creek Winter Steelhead (hatchery)" and "Skamania Summer Steelhead (hatchery)--Willamette Substock" for information on the hatchery stocks used in the Hood Basin.

GEOGRAPHIC LOCATION

Streams

Hood River and tributaries; Tanner, Eagle, Herman, Chenoweth, Mill, Threemile, and Fifteenmile creeks (Figure 1). Fifteenmile Creek is the easternmost distribution of winter steelhead in the Columbia River Basin.

ORIGIN

Winter and summer steelhead are native to the Hood River system, while only winter steelhead are thought to occur in the smaller Columbia tributaries located in the Hood Basin. Winter steelhead fingerlings (Big Creek stock) were stocked in Clear Lake/Lawrence Reservoir in 1969-70. The first smolt releases (40,000) of Big Creek stock will be made in 1985. About 80,000-100,000 summer steelhead (Skamania stock) smolts are released annually in West Fork, Hood River (J. Newton, ODFW, personal communication). From 1958 to 1966 summer steelhead derived from native wild broodstock were released in Hood River.

ADULT LIFE HISTORY

Run size, catch, and escapement

Most of the sport harvest of steelhead takes place in the mainstem of Hood River (Tables 1a and 1b). Because of the overlap in the migration timing of the winter and summer runs in the spring (see "Time of migration"), some of the reported catches may include mixed winter and summer races. The winter steelhead catch in recent years may be declining (J. Newton, ODFW, personal communication).

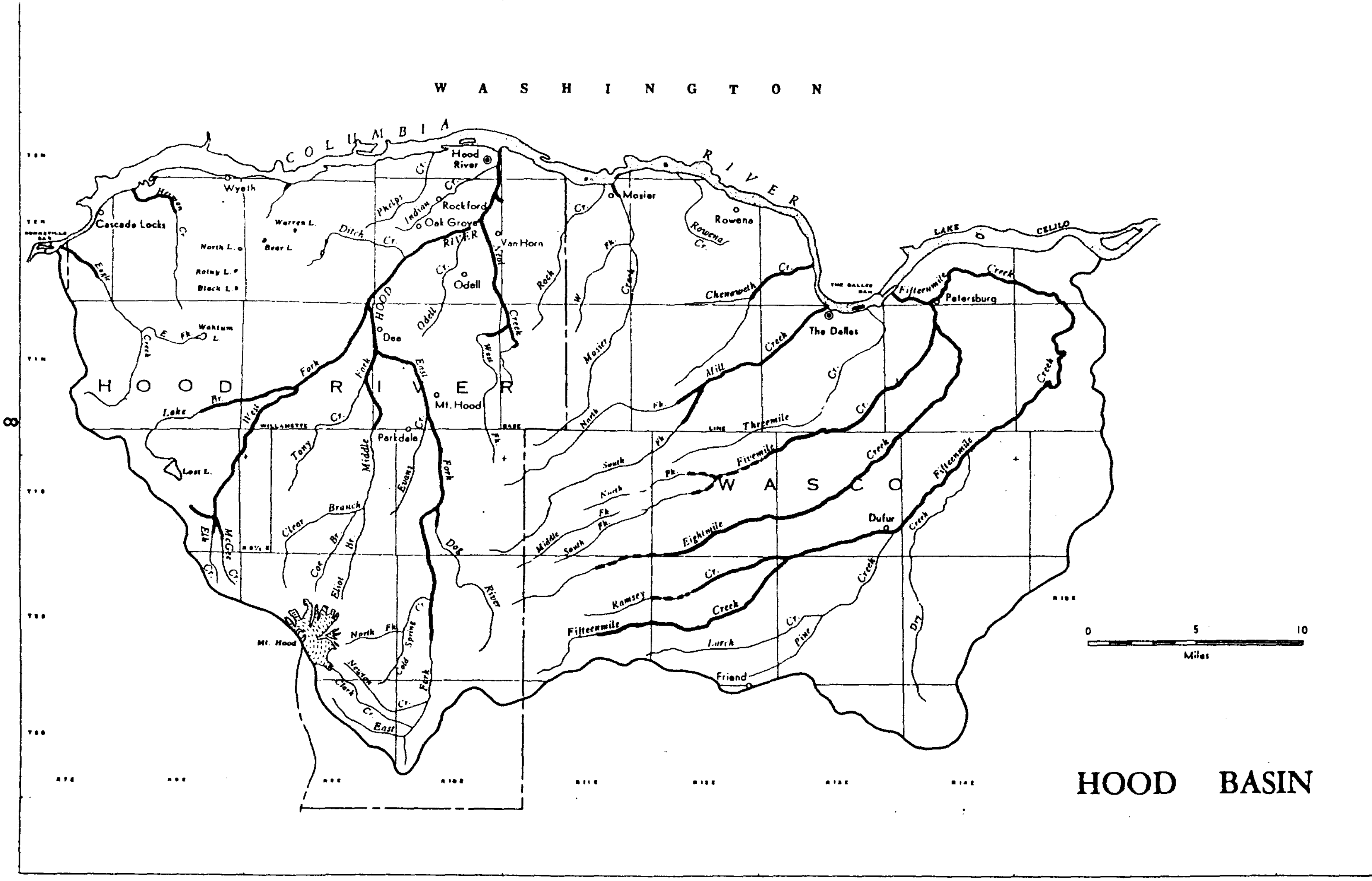


Figure 1. Distribution of summer and winter steelhead in the Hood Basin (modified from Smith 1973). Solid lines are known distribution. Dotted lines are suspected distribution.

Table 1a. Sport catch of winter steelhead by run-year in Hood Basin streams, 1971-80[a] (Berry 1981).

Stream	1971-72	1972-73	1973-74	1974-75	Year 1975-76	1976-77	1977-78	1978-79	1979-80
Eagle Creek	--	--	--	--	--	0	52	105	134
Fifteenmile Creek	--	--	--	--	--	28	54	0	0
Herman Creek	--	--	--	--	--	--	14	0	6
Hood River	--	--	--	--	--	572	1,437	780	1,127
Hood River, E.F.	--	--	--	--	--	97	155	60	86
Hood River, W.F.	--	--	--	--	--	--	1	20	45
Mill Creek (Wasco Co)	--	--	--	--	--	--	19	4	0
Mosier Creek	--	--	--	--	--	3	23	3	33
Tanner Creek	--	--	--	--	--	3	14	13	16

Table 1b. Sport catch of summer steelhead by run-year in Hood Basin streams, 1971-80[a] (Berry 1981).

Stream	1971-72	1972-73	1973-74	1974-75	Year 1975-76	1976-77	1977-78	1978-79	1979-80
Eagle Creek	--	--	--	--	--	58	0	64	89
Fifteenmile Creek	--	--	--	--	--	--	--	0	3
Herman Creek	--	--	--	--	--	0	90	134	41
Hood River	899	1,045	1,395	2,307	2,670	1,169	1,696	2,878	1,021
Hood River, E.F.	--	--	--	--	--	0	6	9	22
Hood River, W.F.	--	--	--	--	--	3	68	177	62
Mill Creek (Wasco Co)	--	--	--	--	--	--	--	3	19
Tanner Creek	--	--	--	--	--	0	19	43	29

[a] Estimated from punch-card returns adjusted for non-response bias. Prior to 1977 the catch in tributary streams was included in the mainstem Hood River.

Steelhead were counted passing Powerdale ladder in 1955 and 1962-71 (Table 2) and the Punch Bowl ladder (Table 3). There are no data on trends in abundance in Hood River since that time. Periodic spawning ground counts have been conducted on Fifteenmile Creek (Table 4). Escapement goals for steelhead in the Hood River Basin streams have not been established.

Ocean distribution is largely unknown; however, one tagged adult which was released in the West Fork, Hood River was recovered in the north Pacific Ocean, south of the Aleutian Islands, approximately 180° longitude and 45°N latitude (International North Pacific Fisheries Commission 1981).

Time of migration

Adult steelhead occur in Hood River throughout the year. The peak of the run passes Powerdale Dam from mid-March through mid-May (Lichens and Haxton, undated) (Table 5). The run peaked at the Punch Bowl ladder in mid-May through mid-July (Table 6).

Steelhead ascending Powerdale and Punch Bowl ladders were classified by Haxton (1965) as follows:

1. Summer steelhead--enter the river from early spring through late summer as bright immature fish.

2. Winter steelhead--enter the river from late fall through spring as bright mature fish.

3. Unclassified steelhead--ascend Powerdale from March 15 through early summer as dark mature fish. These fish could be either winter steelhead that had been in fresh water for some time or summer steelhead that entered fresh water the previous year.

   Since a large portion of the run occurs during this period and 70-80% of these fish are mature, it is difficult to segregate Hood River steelhead into discrete summer and winter races based on coloration and migration timing at Powerdale and Punch Bowl ladders.

Tag recoveries indicated an average upstream migration rate of 0.2 miles per day from Powerdale to Punch Bowl. Total travel time in that section (7.5 miles) ranged from 6 days to 160 days (Haxton 1965).

Winter steelhead enter Herman, Chenoweth, Fifteenmile, and Threemile creeks in March and April (J. Newton, ODFW, personal communication).

Spawning period

Both winter and summer steelhead appear to spawn in the Hood Basin during about the same time period, principally May-July. Spawning of winter steelhead is usually completed in the smaller Columbia River tributaries in the basin by mid-June (J. Newton, ODFW, personal communication).

Table 2. Total counts of summer and winter adult steelhead at Powerdale ladder, Hood River, 1955, 1962-71 (J. Newton, ODFW, personal communication).

Year[a]	Summer steelhead Wild	Summer steelhead Hatchery	Winter steelhead	Unclassified[f] steelhead	Total
1955[b]	189	0	693	-	882
1962[c]	363	217	522	-	1,102
1962-63	515	179	68	856	1,618
1963-64	283	91	88	962	1,424
1964-65[d]	173	50	233	540	996
1965-66	356	533	244	1,424	2,557
1966-67	196	177	87	695	1,155
1967-68	344	591	93	433	1,461
1968-69	210	130	28	1,196	1,564
1969-70[e]	210	436	N.A.	294	940
1970-71	572	303	1,018	0	1,893

[a] Except where noted, yearly counts cover the period from November through October.
[b] February-July.
[c] April-October.
[d] November-August.
[e] Incomplete.
[f] See text--Time of migration.

Table 3. Total counts of summer and winter adult steelhead at Punch Bowl ladder, Hood River, 1962-64 (Haxton 1965).

Year	Summer steelhead Wild	Summer steelhead Hatchery	Winter steelhead	Unclassified[a] steelhead	Total
1962[b]	153	11	85	-	249
1962-63[c]	106	55	3	40	204
1963-64[c]	33	18	0	85	86

[a] See Text--Time of migration.
[b] April-October.
[c] November-October.

Table 4. Spawning counts of winter steelhead in Fifteenmile Creek.[a]

Year	Redds	Steelhead observed	Redds per mile
1964	87	29	17.4
1966	20	5	4.0
1967	32	7	6.4
1968	23	5	4.6
1970	2	0	0.4
1984	24	0	4.8

[a] Surveys conducted in late April or early May.

Table 5. Monthly[a] counts of adult steelhead at Powerdale ladder, Hood River, 1962-63 through 1969-70.

	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	Average percentage[c]
Nov	14[b]	25	6	36	31	21	21	18	1.6
Dec	20	9	15[b]	11	10	24	5	4	0.8
Jan	29	35	-	18	50	10	1	-	1.1
Feb	68	27	40[b]	33	35	33	15	-	1.7
Mar	73	202	161	296	81	160	211	-	11.1
Apr	577	399	530	736	277	182	355	-	23.0
May	432	446	119	694	387	227	611	323	28.5
Jun	204	103	80	318	113	361	135	110	13.8
Jul	113	122	45	226	63	290	94	195	9.5
Aug	35	26	-	80	24	105	63	203	4.0
Sept	37	23[b]	-	84	30	43	49	60	3.1
Oct	15	4	24[b]	31	50	24	8	22	1.7

[a] Month covers from the 16th of the previous month to the 15th of the listed month.
[b] Incomplete.
[c] For years with complete counts: 1965 through 1968-69.

Table 6. Monthly[a] counts of adult steelhead at Punch Bowl ladder, Hood River, 1962-64 (data from Haxton 1965).

Month	1961-62	1962-63	1963-64
Nov	-	8	1
Dec	-	-	-
Jan	-	-	-
Feb	-	-	-
Mar	-	2	-
Apr	7[b]	11	1
May	39	10	13
Jun	83	42	20
Jul	64	62	16

Spawning areas

Steelhead distribution in the Hood River basin is shown in Figure 1. East Fork Hood River is utilized primarily by winter steelhead, whereas summer steelhead are largely found in West Fork Hood River (OSGC 1963). From 1962 to 1964, 70% of the steelhead entering the Punch Bowl ladder on the West Fork were classified as summer steelhead (Haxton 1965).

Age composition

No information.

Size

No information.

Sex ratio

No information.

Fecundity

No information.

Biochemical-genetic characteristics

Preliminary data on isozyme gene frequencies of samples collected in Fifteenmile Creek have been reported by Schreck et al. (1984).

JUVENILE LIFE HISTORY

Time of emergence

No information.

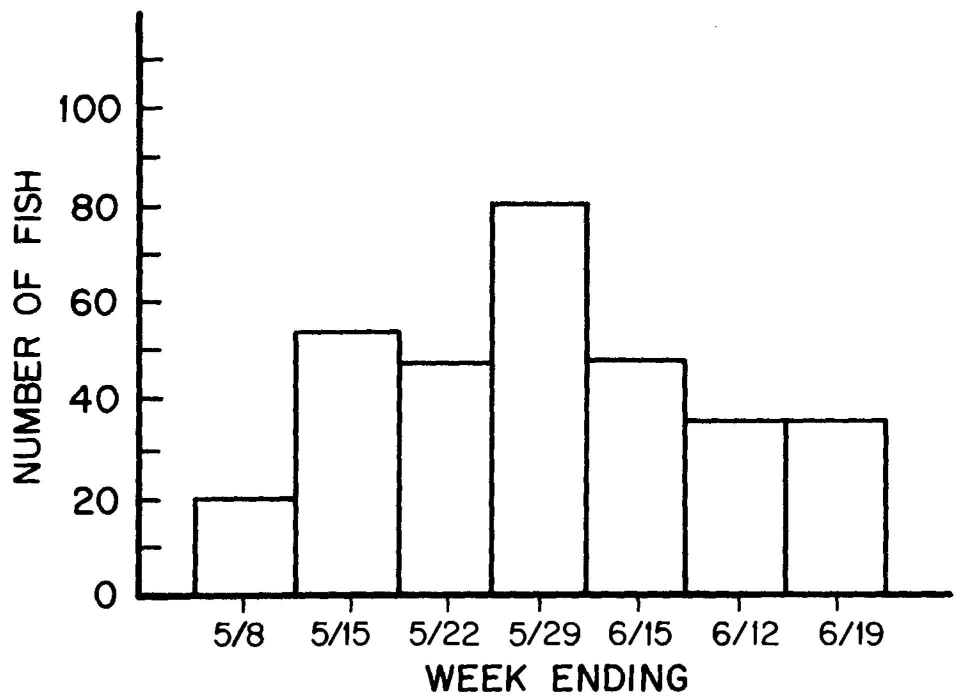
Time, age, and size at migration

In 1964 and 1965 the downstream migration of wild juveniles in Hood River peaked in late May during the periods sampled (Figure 2). Outmigration in the fall has also been reported (Haxton 1965), but has not been verified or measured.

In 1965 90% of the 20 wild smolts sampled in Hood River were age 2+. In 1966 the age compositon of the smolts sampled (n = 40) was 45% age 1+, 27.5% age 2+, and 27.5% age 3+. Differences between the two years may have been due to size selectivity of the different types of traps used each year and mortalities during the 1964 flood (Lichens and Haxton, undated).

Survival rates

No information.



igure 2. Timing of wild juvenile steelhead downstream migration past Powerdale Dam, 1965 (modified from Haxton 1965).

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Estimates of run size, catch, and escapement of wild and hatchery stocks of winter and summer races

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Klickitat River Winter Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Klickitat River, Washington, a tributary to the Columbia River at RM 180.4 (34.3 miles above Bonneville Dam) that drains a watershed of 1,350 square miles.

ORIGIN

The wild Klickitat River winter steelhead stock is native.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement are unavailable. Harvest of the stock occurs in mainstem Columbia sport and tribal fisheries, as well as in the Klickitat River. Steelhead caught by Klickitat River sport anglers and reported on punchcards are assumed to be summer-run fish, but some of the 50-100 adults caught in late winter are probably wild winter steelhead. The Yakima Indian dipnet fishery at Lyle Falls on the lower Klickitat is believed to severely impact spawning escapement of this stock (B. Crawford, Washington Department of Game (WDG), personal communication). Wild winter runs are further reduced by mortalities associated with passage of juveniles and adults through Bonneville Dam and Pool. As yet, no escapement goal has been set for this stock.

Time of migration

January through May, peaking in March.

Spawning period

March through June.

Spawning areas

Wild winter steelhead enter the Klickitat a short distance and probably spawn in the lower river (Figure 1).

Age composition

Unknown.

Size

Unknown.

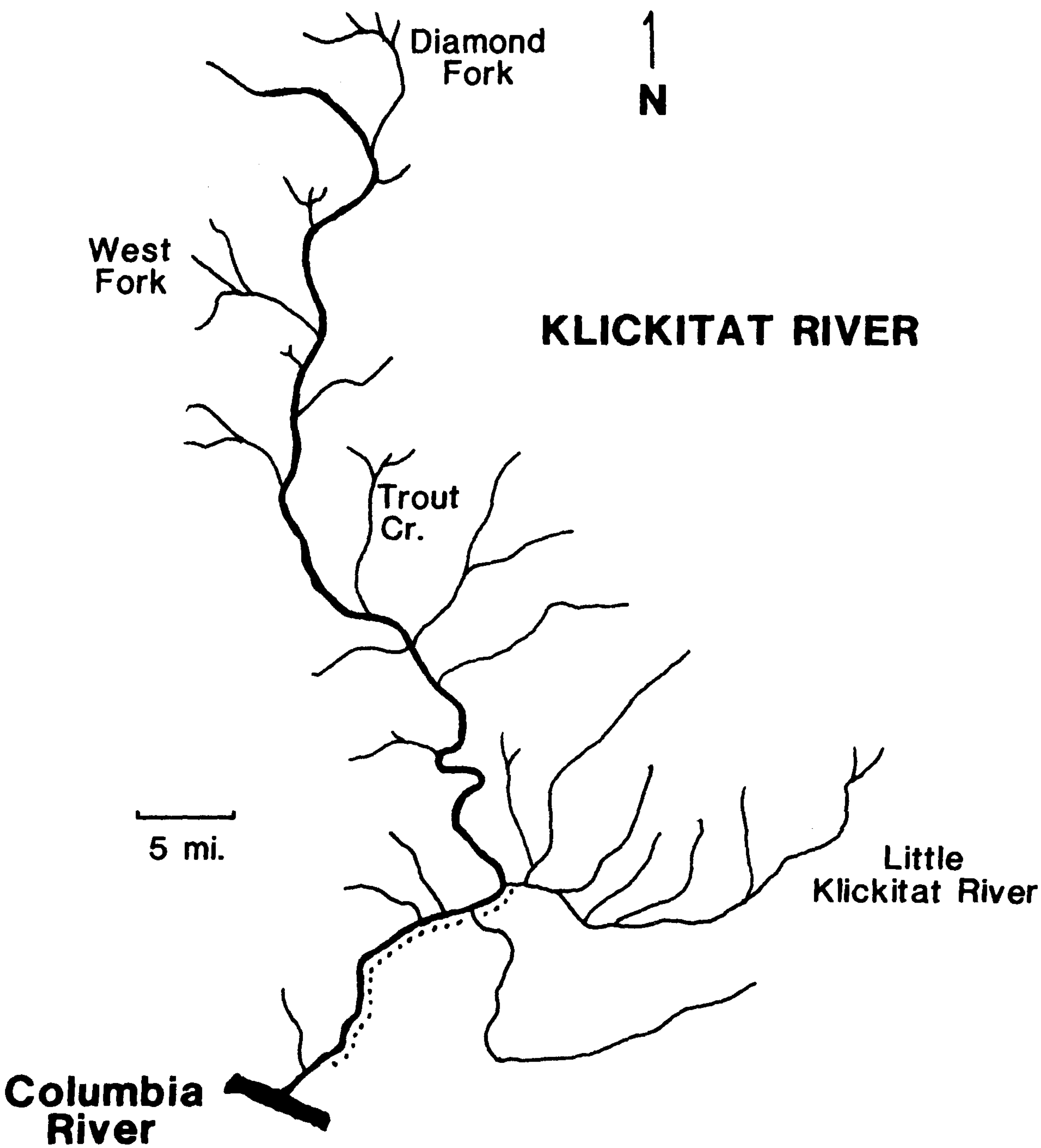

Figure 1. Probable spawning locations of wild winter steelhead in the Klickitat River, Washington (B. Crawford, WDG, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts in tributaries to the mid-Columbia River outmigrate in April and May at an age of 2 years and a size of 160 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Klickitat River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Klickitat River, Washington, a tributary to the Columbia River at RM 180.4 (34.3 miles above Bonneville Dam) that drains a watershed of 1,350 square miles.

ORIGIN

The wild summer steelhead stock in the Klickitat is native, although some interbreeding has probably occurred with introduced Skamania hatchery-stock steelhead.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size or escapement are available. Harvest of the stock occurs in mainstem Columbia sport and Indian fisheries, as well as in the Klickitat River. Recreational and tribal harvests of wild summer steelhead in the Klickitat were estimated to average 1,035 fish for the years 1979 through 1981 (Table 1). Stock abundance has been adversely impacted by overfishing, water withdrawals, habitat degradation, and construction of Bonneville Dam. An interim escapement goal of 2,965 wild adults has been set for this stock.

Time of migration

April through December, peaking July through October.

Spawning period

January through April.

Spawning areas

Summer steelhead spawn throughout most of the mainstem Klickitat and in the lower reaches of several tributary streams (Figure 1).

Age composition

Of wild summer steelhead sampled in the Klickitat River sport fishery between 1979 and 1981, 13.9% were 1-ocean, 77.5% were 2-ocean, 5.3% were 3-ocean, and 3.3% were repeat spawners (Table 2).

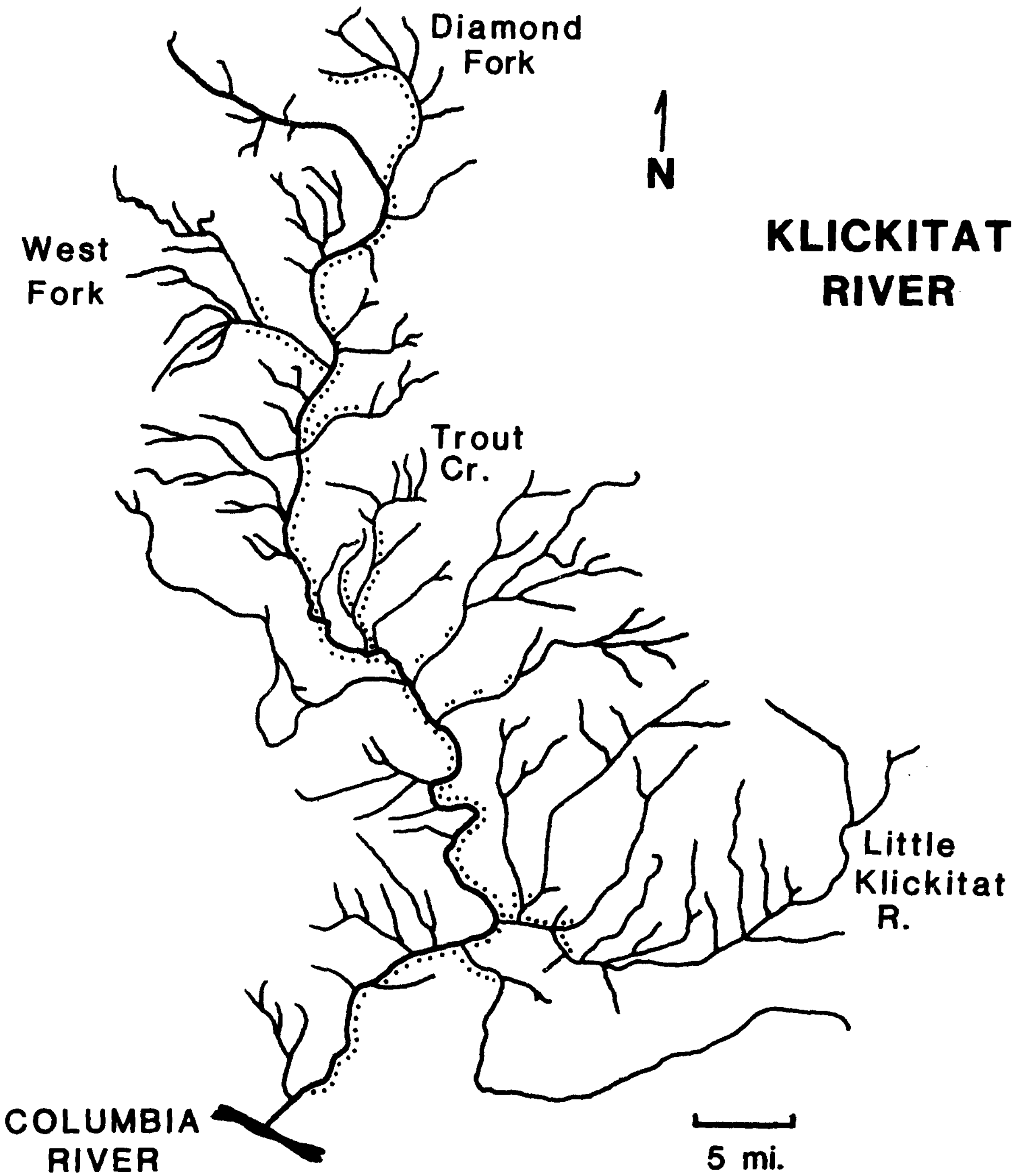

Figure 1. Probable spawning areas of wild summer steelhead in the Klickitat River, Washington (B. Crawford, WDG, personal communication).

Table 1. Estimated harvest of wild summer steelhead in the Klickitat River, Washington, 1979 through 1981.

	1979	1980	1981	AVERAGE
Sport catch from punchcards	2,660	1,485	3,972	2,706
% Wild 1/	30.1	29.2	32.0	---
Sport catch of wild fish	801	434	1,271	835
Tribal catch of wild fish 2/	200	200	200	200
Total catch of wild fish	1,001	634	1,471	1,035

1/ From scale analysis data of Schuck (1980), Schuck et al. (1981), and Morrill (1982); 1981 data for August and September only.

2/ Estimates of tribal harvest of steelhead at Lyle Falls are difficult to obtain; however, total catch is believed to range from several hundred to more than a thousand fish (Schuck et al. 1981; Morrill 1982; Crawford et al. 1984; B. Crawford, Washington Department of Game (WDG), personal communication). For the present analysis, tribal harvest of wild steelhead is estimated to be at least 200 fish.

Table 2. Age, length and sex of wild summer steelhead in the Klickitat River, Washington, 1979 through 1981 (data from Schuck 1980, Schuck et al. 1981, and C. Morrill, WDG, personal communication).

YEAR	AGE	NUMBER OF MALES	NUMBER OF FEMALES	TOTAL	% OF TOTAL	LENGTH (CM)
1979	2.1	3	7	10	21.7	63
	2.1S1	1	0	1	2.2	76
	2.1S1S1	1	0	1	2.2	84
	2.2	15	12	30	65.2	75
	2.2S1	0	1	1	2.2	71
	2.2S1S1	0	1	1	2.2	82
	3.1	1	1	2	4.3	51
	TOTAL	21	22	46		
1980	2.1	2	5	7	8.9	60
	2.2	28	36	64	81.0	72
	2.2S1	0	1	1	1.3	73
	2.3	1	1	2	2.5	81
	3.1	1	0	1	1.3	53
	3.2	2	2	4	5.1	66
	Total	34	45	79		
1981 1/	2.1	0	1	1	3.8	65
	2.2	6	11	17	65.4	72
	2.3	3	3	6	23.1	79
	3.2	1	1	2	7.7	74
	Total	10	16	26		

1/ August-September only.

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales because it distinguishes fresh vs. saltwater growth and enumerates the incidence of repeat spawning. For example, age 2.1S1 would represent a fish with 2 years of freshwater growth, 1 year of marine growth prior to spawning, approximately 1 year spent in freshwater for spawning (S), followed by another year of ocean growth (1) prior to its capture in freshwater on its second spawning migration. Hence, this fish would be about 5 years old.

Size

Average length of 1-, 2-, and 3-ocean adults and repeat spawners sampled in the Klickitat River from 1979 to 1981 was 60 cm, 73 cm, 80 cm and 77 cm, respectively (Table 2).

Sex ratio

The male:female sex ratio of wild Klickitat returnees was 0.95 in 1979, 0.76 in 1980, and 0.62 in 1981 (Table 2).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild steelhead smolts in the Klickitat River probably outmigrate in April and May at a size of 160 mm. Of wild adults sampled between 1979 and 1981, 94% had 2 years of juvenile freshwater residence and 6% had 3 years (Table 2).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

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Deschutes River Summer Steelhead (wild)

PRODUCTION

Both wild and hatchery stocks occur in the Deschutes River. Information in this summary pertains primarily to the wild stock, although some characteristics may be similar to the hatchery stock, which was derived from the native wild stock. For more information on the hatchery stock refer to the "Deschutes River Summer Steelhead (hatchery)" summary.

GEOGRAPHIC LOCATION

Streams

Deschutes River and tributaries (Figure 1)

ORIGIN

Summer steelhead are native to the Deschutes River basin. However, a large number of other Columbia River stocks of summer steelhead stray into the Deschutes. Lindsay et al. (1981) estimated that 80% of the 59,000 summer steelhead that entered the Deschutes River in 1981 were strays. These strays included wild fish as well as hatchery fish. In 1980 and 1981 28% and 31%, respectively, of the Ad+CWT-marked strays recovered in the fishery were wild (Tables 1 and 2). This may actually represent a much higher proportion of wild strays since a considerably larger proportion of hatchery fish released in the Columbia basin are Ad+CWT marked. It is not known how many of the strays entering the Deschutes River spawn in the system.

It was formerly assumed that steelhead passing Sherars Falls (RK 75) were native Deschutes stocks (wild and hatchery). Most of the spawning tributaries are above Sherars Falls. In 1983 75 fish tagged at Sherars Falls were recovered in other rivers (Table 3). In 1981 20 of the 385 wild fish tagged at Sherars Falls were recovered in the Pahsimeroi River in Idaho (Lindsay et al. 1981).

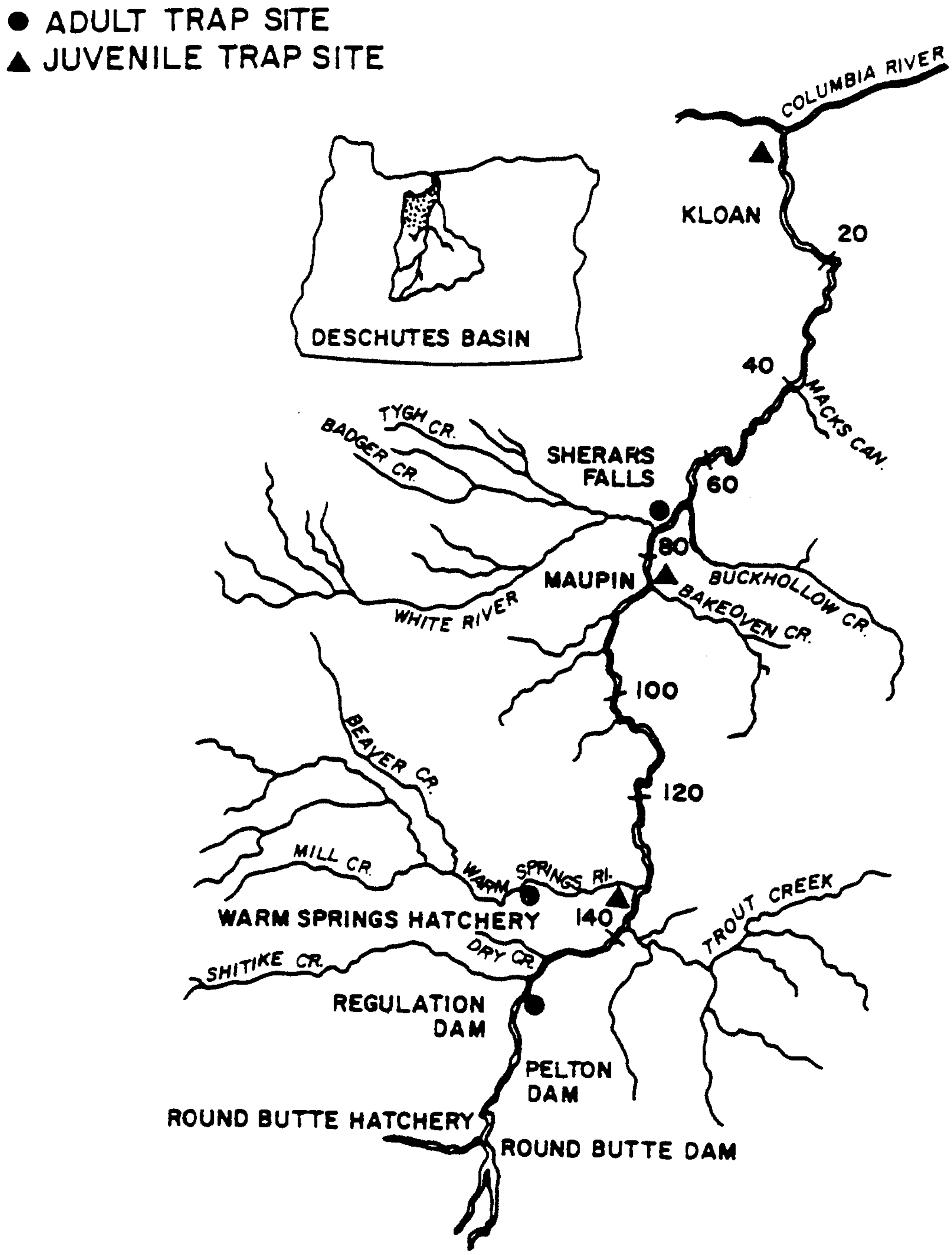

Figure 1. Deschutes River and major tributaries below Pelton Dam.

Table 1. Origin of Ad+CWT-marked steelhead harvested in the Deschutes River from Mack's Canyon to the mouth, 1980 (Lindsay et al. 1980).

Hatchery	Release site	No. of tags recovered
Dworshak	Clearwater R.	3
Dworshak	Middle Fork Clearwater R.	5
Niagra Springs	Pahsimeroi R.	1
Chelan	Columbia R. below Bonneville Dam	32
Wells	Columbia R. below Bonneville Dam	6
Tucannon	Columbia R. below Bonneville Dam	24
Skamania	Klickitat R.	1
Dworshak	Columbia R. below Bonneville Dam	3
Wild	Columbia R. below Bonneville Dam	26
Wild	Snake R.	1
Wild	Snake R. below Lower Granite Dam	2
Wild	Columbia R. above McNary Dam	3
Wild	Columbia R. below McNary Dam	1
No tags		9

Table 2. Origin of stray Ad+CWT-marked steelhead harvested in the Deschutes River, 1981 (Lindsay et al. 1981).

Number	Agency	Hatchery	Release site
7	FWS	Dworshak + Hagerman	Pahsimeroi River
1	FWS	Hagerman	Pahsimeroi River
8	ODFW	Wallowa	Wallowa River and Spring Creek
7	IDFG	Niagra Springs	Pahsimeroi River
1	IDFG	Dworshak	North Fork Clearwater River
1	WDG	Skamania	Washougal River
3	WDG	Ringold	Columbia River
4	NMFS	Chelan	Columbia River
1	NMFS	Chelan	Icicle River
21	NMFS	Tucannon	Columbia River
24	NMFS	Wild	Columbia River

Table 3. Summer steelhead tagged at Sherars Falls in 1983 and recovered outside the Deschutes River, 1983-84 (Jonasson and Lindsay 1983).

Number	Location
1	Kalama River, Washington
1	John Day River
2	Wallowa Hatchery
21	Salmon River, Idaho
1	Snake River, Idaho
1	Clearwater River, Idaho
48	Pahsimeroi Hatchery, Idaho

ADULT LIFE HISTORY

Run size, catch, and escapement

The Deschutes River and its tributaries support a substantial run of wild summer steelhead. Wild adults composed one-third to two-thirds of the adult run passing Sherars Falls during 1977-83 (Jonasson and Lindsay 1983) (Table 4). The wild component of the run averaged 5,629 and 351 summer steelhead annually at Sherars Falls and Warm Springs National Fish Hatchery (WSNFH), respectively, from 1977-83 (Table 4).

Table 4. Escapement of wild (unmarked) steelhead above Sherars Falls and to WSNFH, 1977-84 (Jonasson and Lindsay 1983; B. Cates, USFWS, personal communication).

	Sherars Falls				
Year	Total	Wild	95% C.L	Percent wild	WSNFH wild
1977	13,600	6,600	(5,100- 8,000)	49	136
1978[a]	6,300	2,800	(2,300- 3,200)	44	417
1979[b]	10,200	4,200	(3,200- 5,300)	41	381
1980[b]	10,100	4,100	(3,200- 5,000)	41	311
1981[b]	11,900	6,900	(5,600- 8,300)	58	397
1982[b]	11,400	6,600	(4,500-10,100)	58	569
1983[b]	23,600	8,200	(6,400-10,500)	35	245
1984	NA	NA		NA	431

[a] Sport fishery closed 20 August.
[b] Sport harvest of unmarked steelhead prohibited.

Harvest of Deschutes stock in the tribal gill-net fishery is unknown. The steelhead fishery in the Deschutes River is concentrated at the mouth, Kloan, Mack's Canyon and below Sherars Falls. Current regulations limit the sport harvest to hatchery fish. The only harvest of wild steelhead in the Deschutes River is incidental to the spring chinook harvest by the Indian dip net fishery at Sherars Falls.

Since there is no harvest of wild steelhead above Sherars Falls, counts of wild steelhead passing Sherars Falls represent the potential spawning escapement of the wild stock (Table 4). Hatchery fish passing above Sherars Falls that are not trapped at Pelton Dam may also spawn. There is no estimate of the number of steelhead above Sherars Falls that leave the Deschutes prior to spawning. From 1977 through 1983 an average of 5,600 wild summer steelhead (44% of the run) passed Sherars Falls.

The escapements in Buckhollow, Bakeoven, and Trout creeks were estimated to be 200, 200, and 400 fish, respectively (J. Newton, ODFW, personal communication). An average of 55 redds were counted annually in Shitike Creek in 1976, 1978-82, and 1984.

Time of migration

Deschutes summer steelhead migrate past Bonneville from mid-June through August, peaking in mid-July (TAC 1984). Adult steelhead pass Sherars Falls from July through October with peak movement occurring in late September or early October (Figure 2). The trap at Sherars Falls is removed in early November so immigration of steelhead after this time is not known.

Wild adults returned to WSNFH between 17 February and 26 May in 1981. The run peaked in mid-April. The runs during 1977-81 peaked from mid-March through early May (Figure 3). Tagged wild steelhead remained in the Deschutes River an average of 198-233 days before reaching WSNFH during 1977-81 (Cates 1984).

Spawning period

Spawning in the mainstem and larger tributaries west of the river occurs from March through early May. Steelhead spawning in smaller tributaries east of the Deschutes move out of the mainstem during periods of high winter streamflow and spawn from mid-January through April (Fessler 1974).

Spawning areas

Construction of the Pelton-Round Butte hydropower project eliminated steelhead spawning in the upper mainstem, Crooked and Metolius rivers, and Squaw Creek.

Currently, adult steelhead have been observed in the following Deschutes tributaries:

Buck Hollow Creek
White River (below falls)
Bakeoven Creek
Wapinitia Creek
Shitike Creek
Nena Creek
Eagle Creek
Warm Springs River
Trout Creek

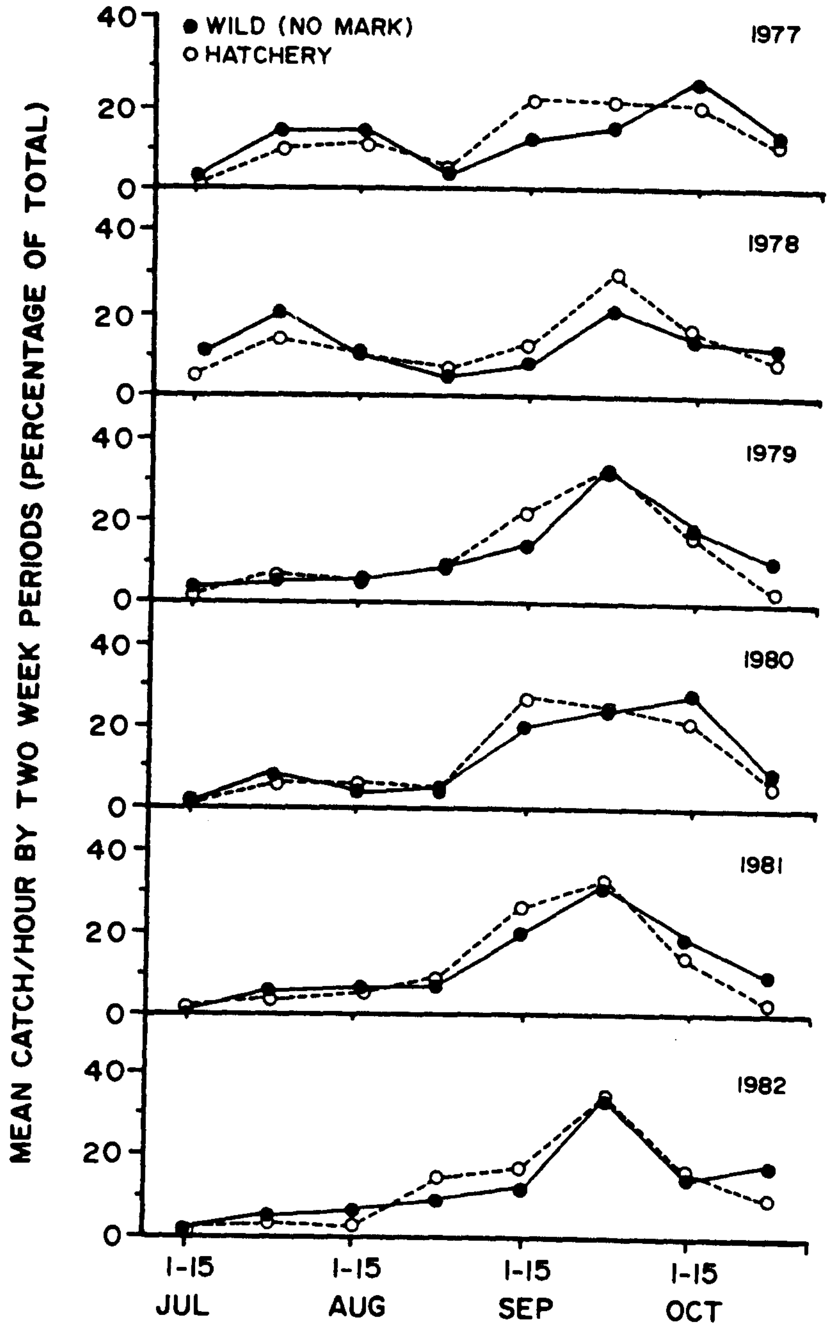

Figure 2. Migration timing of steelhead past Sherars Falls, 1977-82 (Lindsay et al. 1982).

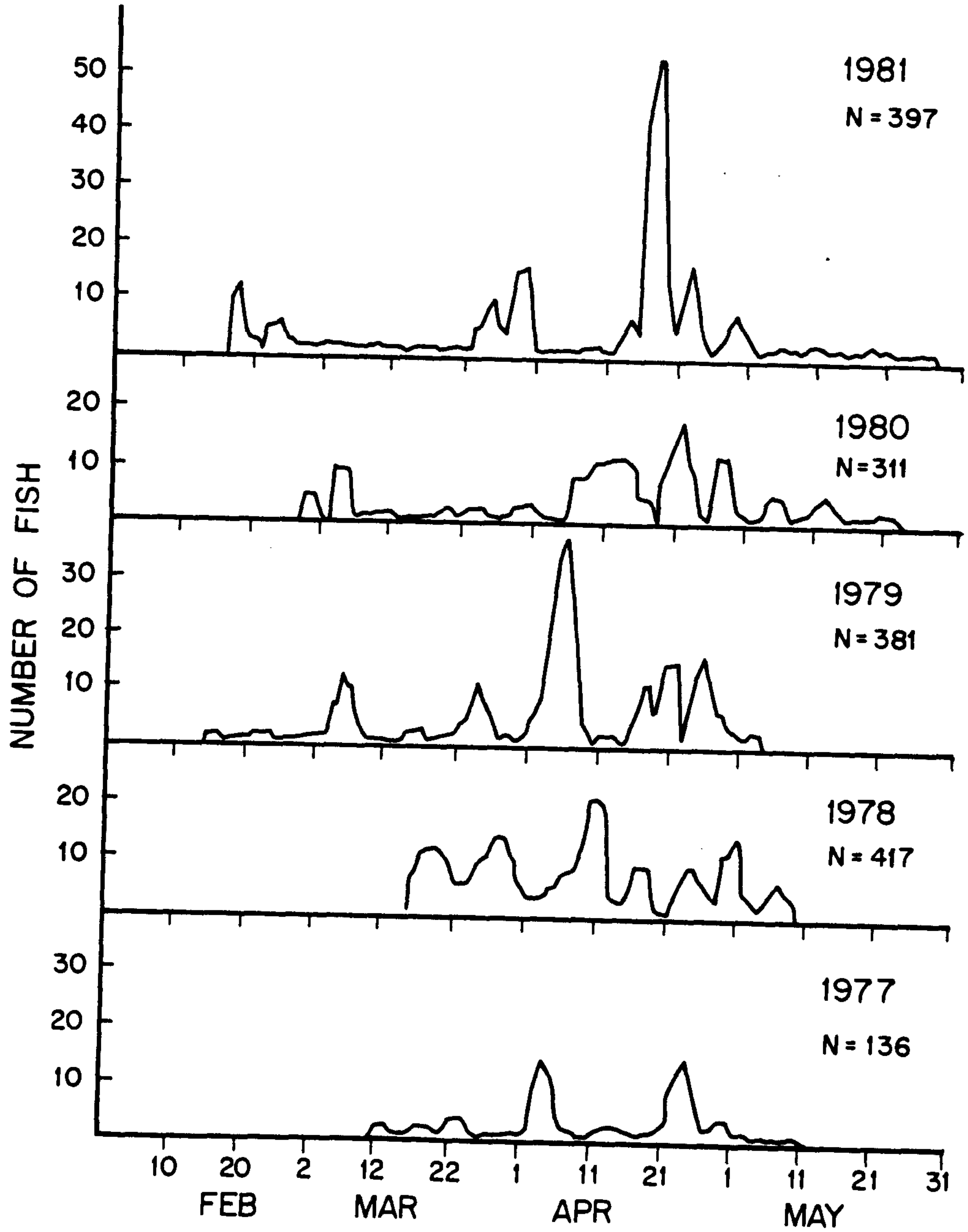

Figure 3. Run timing of wild summer steelhead past WSNFH, 1977-81. Graphs are 3-day running averages (Cates 1984).

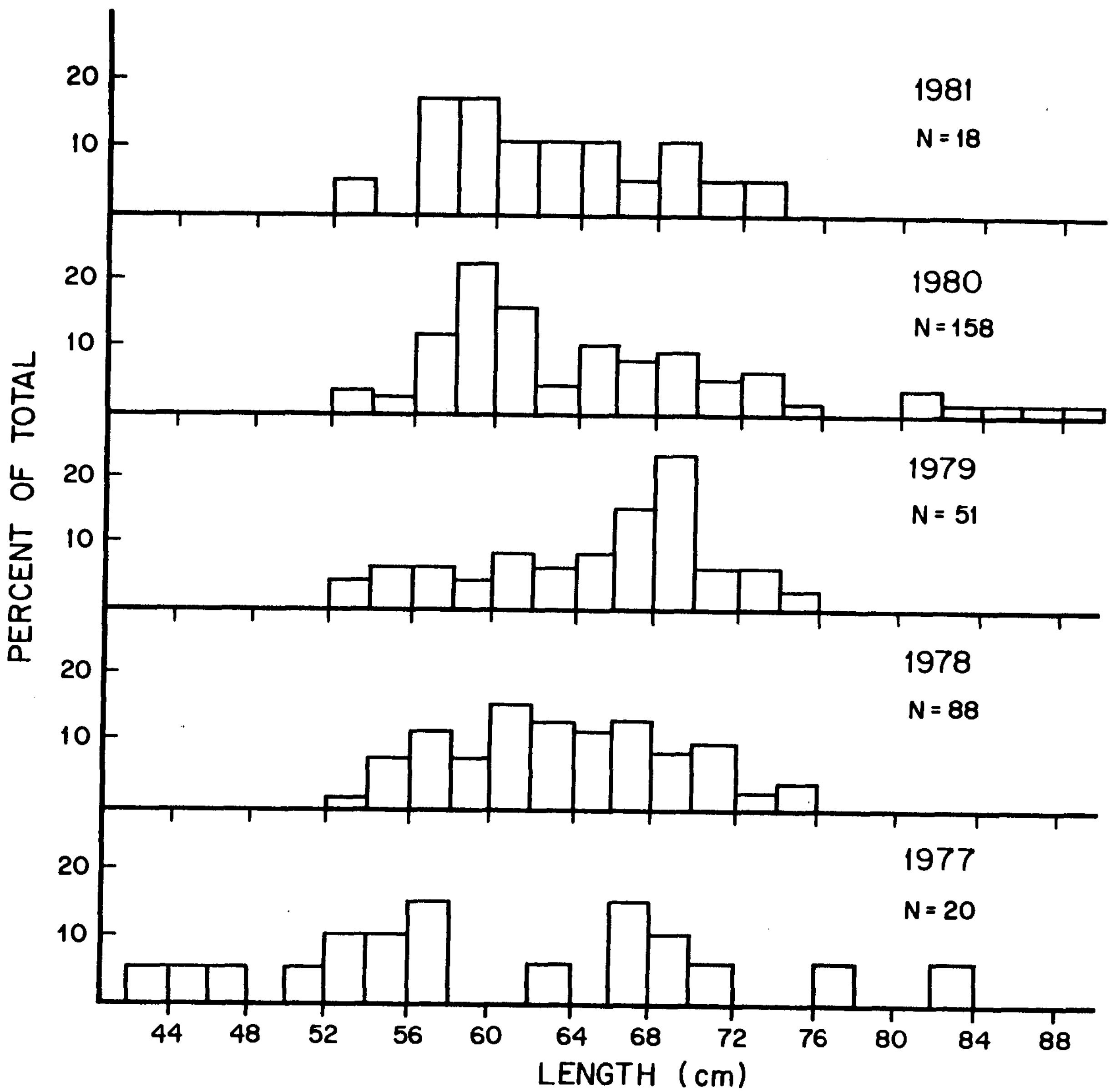

Figure 4. Length frequencies of adult steelhead passing WSNFH, 1977-81 (Cates 1984)

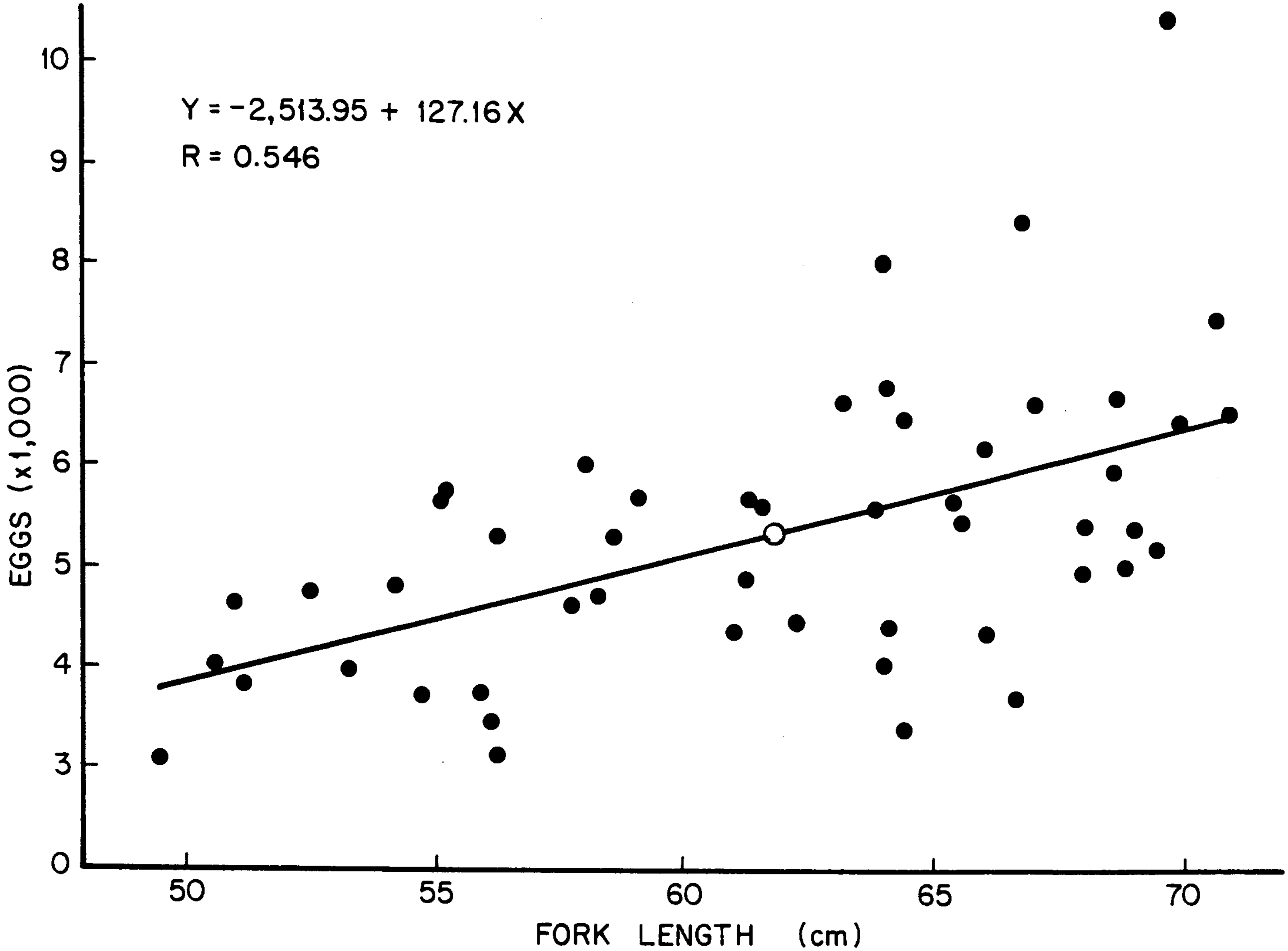

Figure 5. Relation of fecundity to body length for wild summer steelhead from the Deschutes River (Burck 1981).

Biochemical-genetic characteristics

No information.

JUVENILE LIFE HISTORY

Time of emergence

Fry emerge from redds in the spring or early summer depending on time of adult spawning and temperature of the stream during the incubation period.

Time, age, and size at migration

Weirs installed in Trout, Buck Hollow, and Bakeoven creeks captured downstream migrant steelhead during the period of operation from April through June in 1971 and 1972 (Figures 6-8). Peak migration occurred during the first two weeks in May in Trout Creek. Juvenile migration in Buck Hollow Creek peaked in late April in 1971 and in early June in 1972. In Bakeoven Creek the peak occurred the first week of May in both years.

Scale analysis of 270 downstream migrants (2.5 to 26.0 cm in length) in Bakeoven Creek in 1970 showed them to be age 0+ to 3+ (Burck 1981). Fish smaller than 6 cm were considered to be age 0. Fish between 7 and 14 cm in length were classified as age 1+, and those longer than 16 cm were age 2+ or 3+. All juvenile rainbow trout were classified as steelhead. Resident rainbow trout also occur in the Deschutes system; however, resident rainbow and steelhead juveniles cannot be distinguished.

Age-0+ fish first appeared in the catch in Bakeoven Creek, 1970-73, the third week of May, after the peak migration of older migrants (Figure 9). Fry continued to emigrate through mid-July in 1971, the only year the weir was operated in June and July. Based on age-length relationships, modal distributions suggest that juveniles sampled in the Warm Springs River were primarily 1+ and 2+ or older migrants except in 1978 (Figure 10). Scales analyzed from adults (Table 5) indicate that more than 70% of the Deschutes stock smolts enter the ocean at ages 2+ to 4+. It appears that many of the juveniles produced in the tributaries, particularly east-side tributaries, continue to rear in the mainstem prior to smolting.

Survival rate

No information.

DISEASE HISTORY

No information.

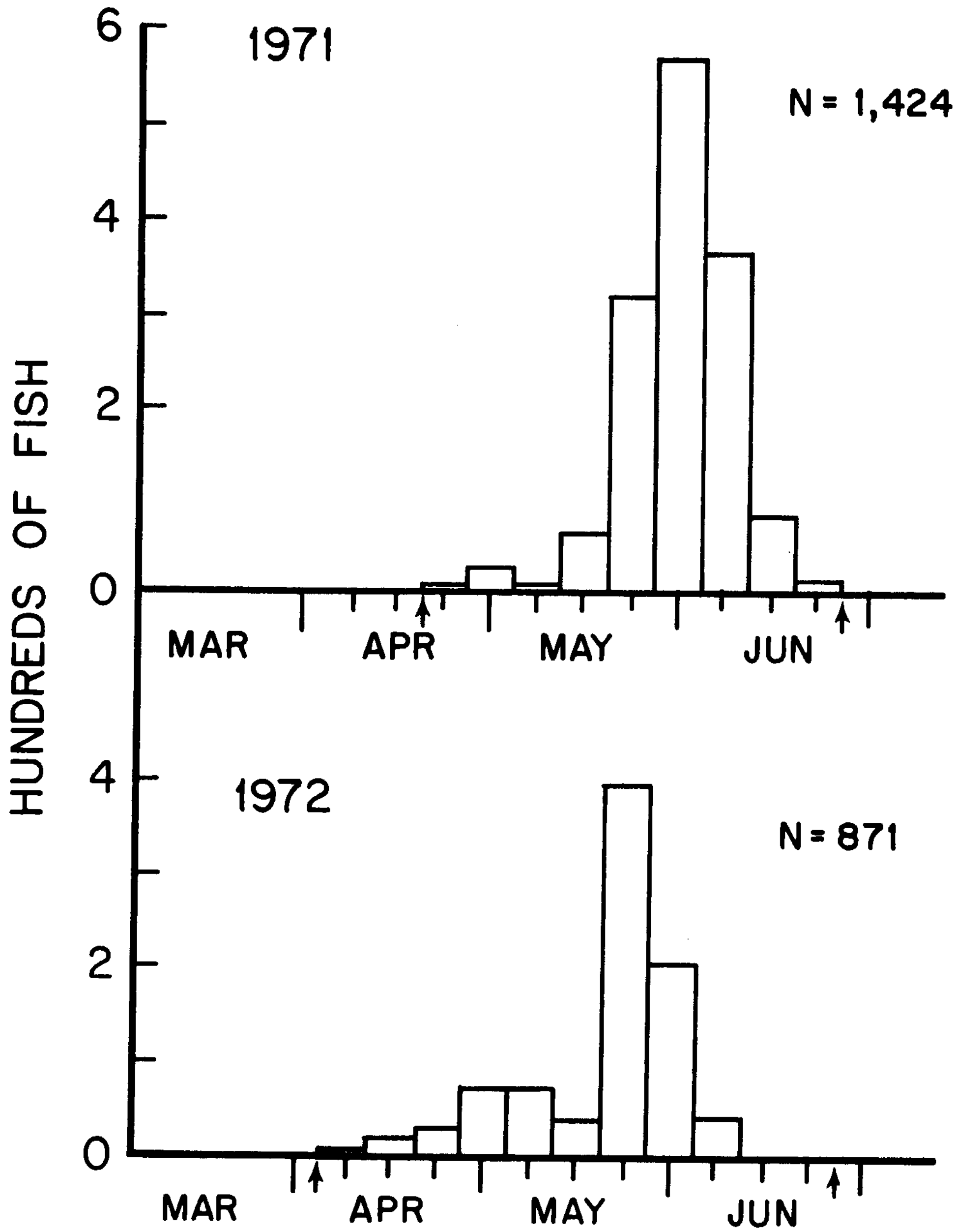

Figure 6. Catch of wild downstream migrant juvenile steelhead at the weir in Trout Creek 1971 and 1972 (data from Burck 1981). The interval between the arrows indicates the time the trap was in operation.

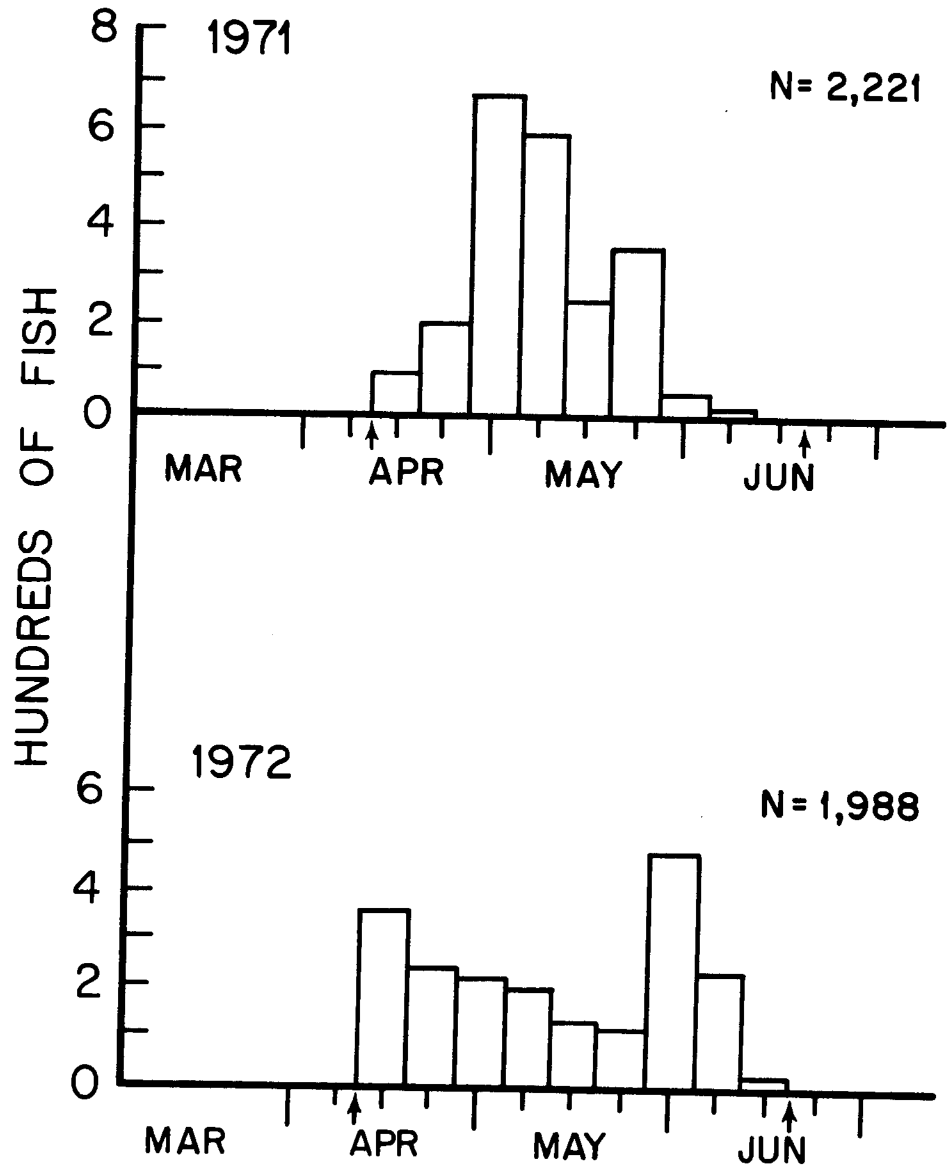

Figure 7. Catch of wild downstream migrant juvenile steelhead at the weir in Buck Hollow Creek 1971 and 1972 (data from Burck 1981). Arrows indicate start and end of trapping.

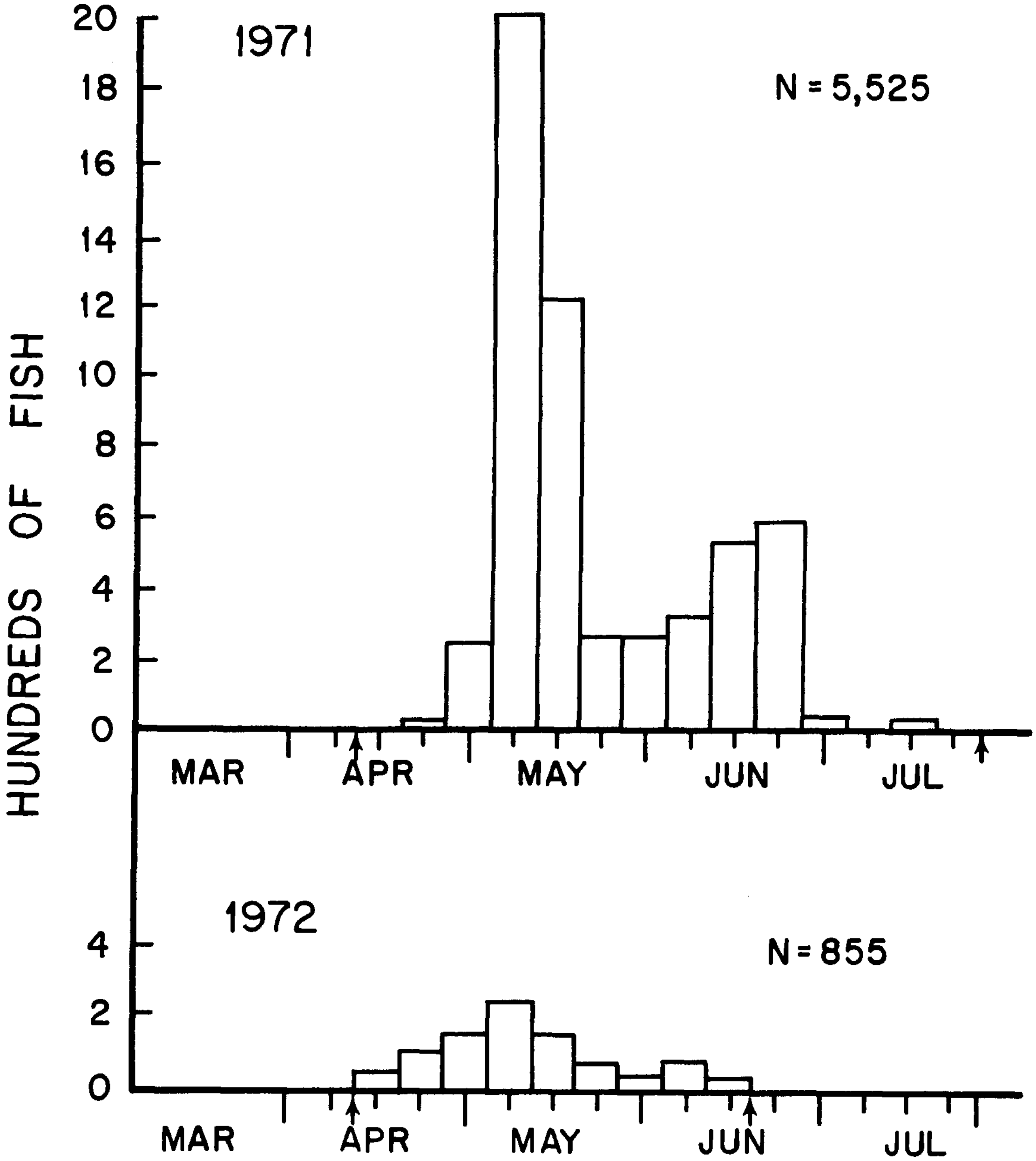

Figure 8. Catch of wild downstream migrant juvenile steelhead at the wier in Bakeoven Creek 1971 and 1972 (data from Burck 1981). Arrows indicate start and end of trapping.

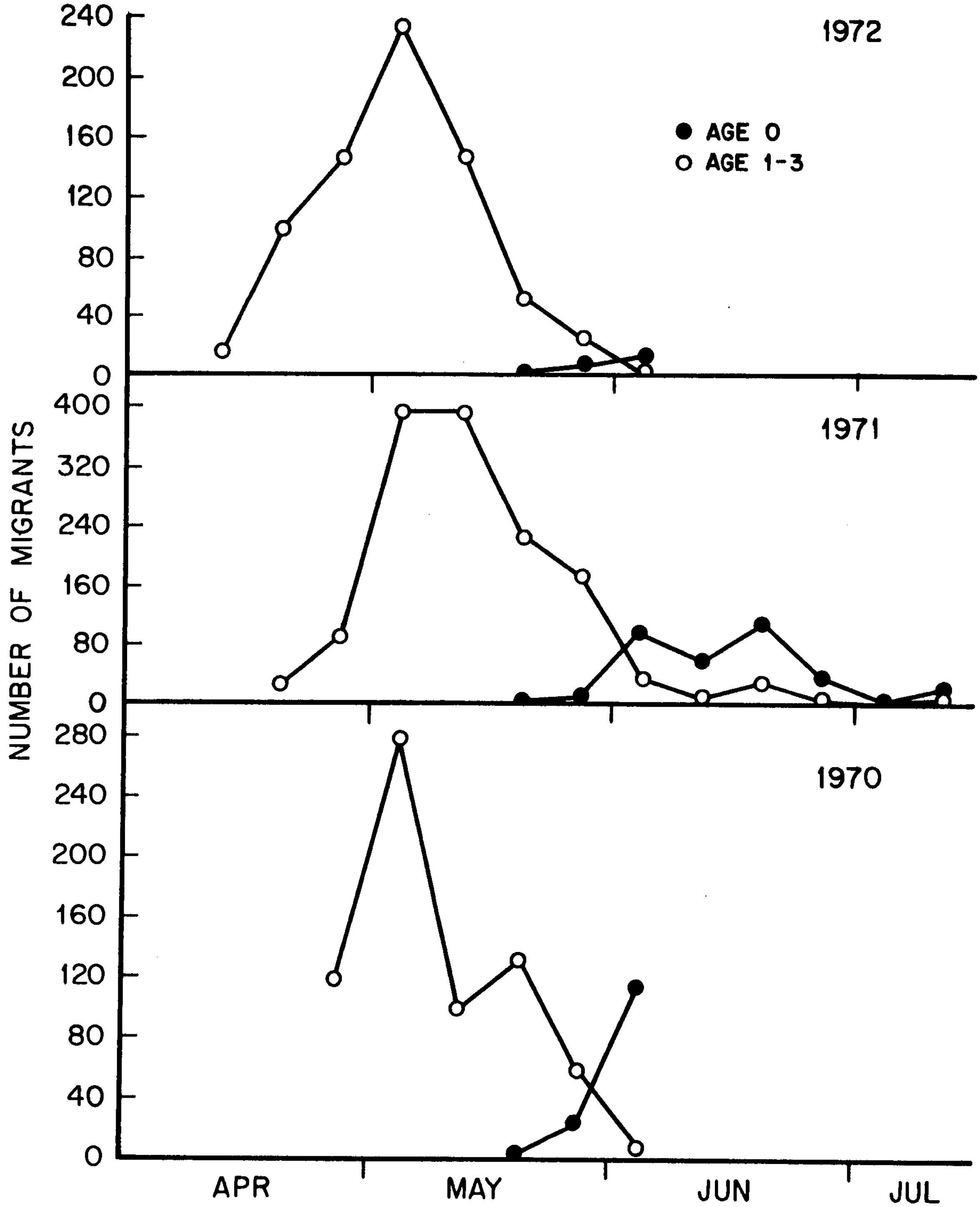

Figure 9. Time of downstream migration of juvenile steelhead/rainbow trout in Bakeoven Creek, 1970-72 (data from Burck 1981).

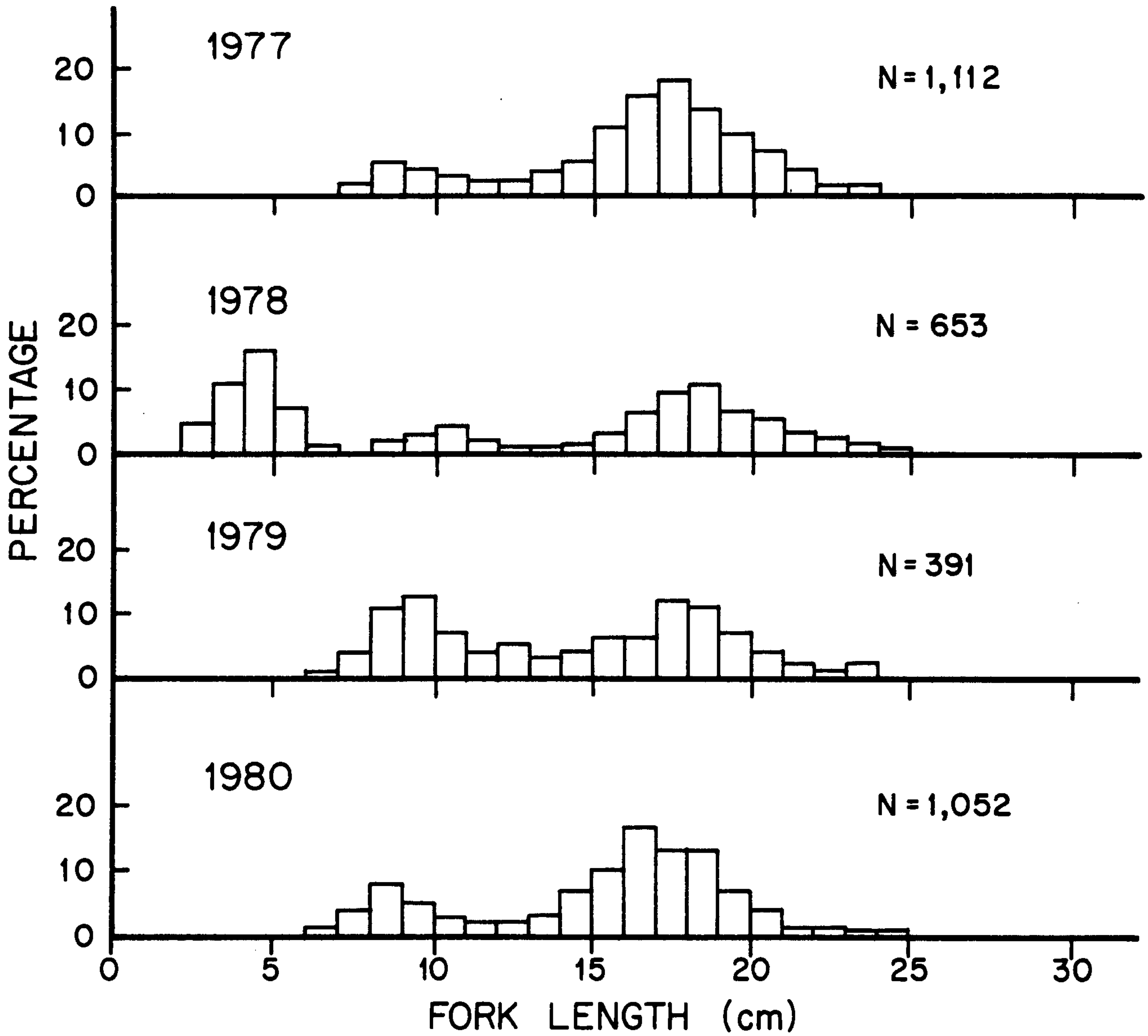

Figure 10. Size composition of wild downstream migrant juvenile steelhead/ rainbow trout captured in the Warm Springs River scoop trap, 1976 and 1978-80 (Burck 1981).

PRIORITY INFORMATION NEEDS

1. Improved estimates of run size and escapement of wild stock

2. Proportion of wild and hatchery strays in the spawning population

3. Smolt production levels and capacities including parr rearing in the mainstem

4. Survival rates

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Deschutes River Summer Steelhead (hatchery)

PRODUCTION

Since 1977 Round Butte Hatchery has produced 160,000-200,000 smolts annually (Table 1). Presmolts are also released. Warm Springs National Fish Hatchery (WSNFH) produced smolts from the 1978 and 1980 brood. Since 1981 summer steelhead releases from WSNFH have been fingerling outplants (Table 1).

Table 1. Deschutes River summer steelhead releases, 1976-83.

Brood	Round Butte		Warm Springs NFH[a]	
year	Fingerlings	Smolts	Fingerlings	Smolts
1976	329,369	285,626	-	-
1977	408,495	191,079	-	-
1978	30,720	201,834	0	140,962[b]
1979	422,351	162,652	0	0
1980	68,629	156,499	0	102,486[c]
1981	19,411	187,155	27,332	0
1982	0	169,105	149,416	0
1983	NA	NA	101,118	0

[a] Beginning with 1981 brood year, all WSNFH releases were outplants.
[b] 53,582 were smolt outplants.
[c] 98,000 were smolt outplants.

GEOGRAPHIC LOCATION

Streams

Deschutes River, Oregon (Figure 1)

Hatcheries

Although summer steelhead have been reared by a number of hatcheries and released into the Deschutes River, Round Butte Hatchery has been the primary source of hatchery-reared summer steelhead in the river since 1973. WSNFH has also reared Deschutes stock.

ORIGIN

Hatchery summer steelhead produced from native wild stock collected in Squaw Creek were first released into the Deschutes River in 1952 (1951 brood) and continued through 1957 (1956 brood). Approximately 34,000 to 62,500 fish per year were raised at Wizard Falls Hatchery and released into the Deschutes River, Metolius River, Suttle Lake, and Squaw Creek.

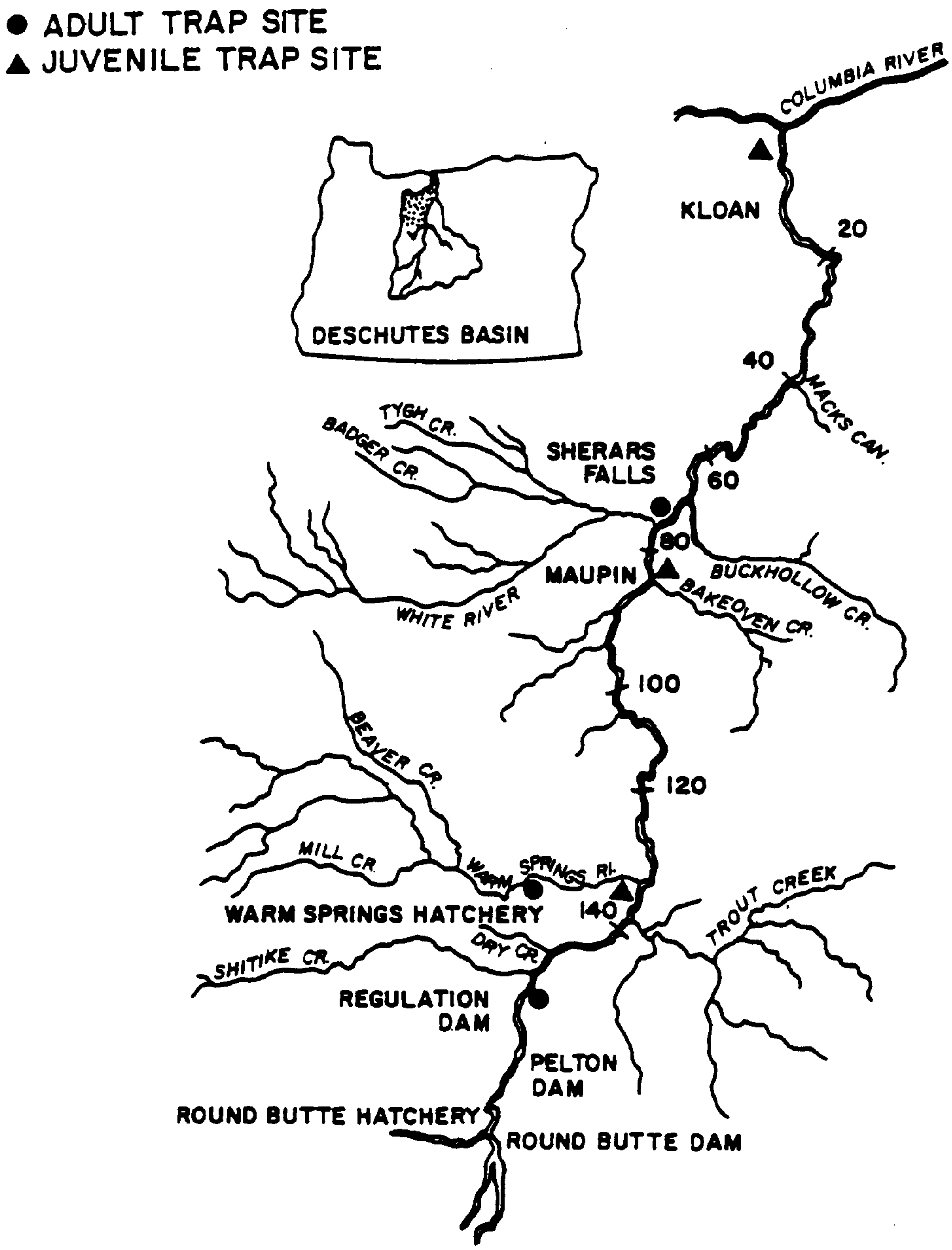

Figure 1. Deschutes River and tributaries below Pelton Dam.

Construction of Round Butte Dam on the Deschutes River was completed in 1964. When it became apparent that the downstream migrant facilities at Round Butte Dam were not successful, hatchery production was resumed beginning with the 1965 brood year (Burck 1981).

Skamania and Siletz summer steelhead were released into the Deschutes River during 1965-67:

Year	Stock	No. released	Fish/lb
1965	Skamania	4,505	85
1966	Siletz	19,592	32
1967	Siletz & Round Butte	26,435	22

Beginning with the 1972 brood year, native Deschutes River summer steelhead were used to develop the brood stock at Round Butte Hatchery. WSNFH developed its brood stock from wild adults trapped at the hatchery on the Warm Springs River. Both returning hatchery adults and wild fish are currently used for broodstock at WSNFH.

Not all hatchery steelhead in the Deschutes River are of Deschutes origin (Table 2). In 1983 stray steelhead composed 51% of the hatchery steelhead run above Sherars Falls and 65% of the harvest of hatchery steelhead (Jonasson and Lindsay 1983). Of 50 marked hatchery fish returning to WSNFH, only 4 were released from WSNFH; 35 were from Round Butte Hatchery, and 11 from other release sites (Table 3).

Table 2. Origin of stray Ad+CWT marked steelhead recovered in the Deschutes River, 1983 (Jonasson and Lindsay 1983).

Number	Agency	Hatchery	Release site
157	IDFG	Hagerman	Pahsimeroi River
344	IDFG	Niagra Springs	Pahsimeroi River
20	IDFG	Dworshak	Clearwater River
2	FWS	Dworshak	N.F. Clearwater River
3	NMFS	Dworshak	Clearwater River
15	NMFS	Dworshak	Columbia River, Beacon Rock
9	NMFS	Wells	Columbia River, Priest Rapids
15	NMFS	Wells	Methow River
17	WDG	Tucannon	Grande Ronde River, Snake River
2	WDG	Skamania	Klickitat River
14	ODFW	Irrigon	Spring Creek (Wallowa River)
17	ODFW	Wallowa	Spring Creek (Wallowa River)

Table 3. Marked steelhead returning to WSNFH in 1981 (Cates 1984).

Mark	Code	Number	Origin
LVRV		1	Round Butte
LVRM		2	Round Butte
LVLM		2	Round Butte
RVLM		13	Round Butte
LP		2	Round Butte
LPRM		2	Round Butte
LVRVLM		8	Round Butte
LPLM		2	Round Butte
LPRVLM		3	Round Butte
Ad	9-16/36	6	Wallowa
Ad	5-4/39	4	Warm Springs
Ad	Red-yellow-Red	1	Below McNary
Ad	Negative	4	--

ADULT LIFE HISTORY

Run size, catch, and escapement

An average of 6,800 hatchery summer steelhead migrated past Sherars Falls each year since 1977 (Table 4). During 1977-81, 1,600 to 4,800 hatchery steelhead were available to spawn naturally above Sherars Falls (Table 4). These fish passed over Sherars Falls but were not counted at the Pelton trap. An average of 112 hatchery summer steelhead returned to WSNFH annually since 1981.

Summer steelhead are caught by sport and Indian fishermen in the Deschutes River at and below Sherars Falls (Table 5). In 1983 3,581 marked hatchery fish were caught out of a total catch of 17,541 fish (all fish retained had hatchery marks or stubbed dorsal fins). Estimates of harvest in the tribal gill-net fishery in the Columbia River are not available.

Little is known about ocean distribution. One summer steelhead tagged in the Deschutes River was recovered in the north-central Pacific Ocean (International North Pacific Fisheries Commission 1981).

Time of migration

Hatchery summer steelhead migrate past Sherars Falls from July through October (Figure 2). The run peaks in late September and early October.

Spawning period

Hatchery fish are spawned three times each year at Round Butte Hatchery: the last week of January, February, and the first week of March (B. Jonasson, ODFW, personal communication).

Spawning areas

Broodstock are spawned at Round Butte Hatchery and at WSNFH.

Age composition

Deschutes summer steelhead return as 1- and 2-salt adults. The relative proportions of the two age classes are not known.

Size

Fork lengths (cm) of summer steelhead released as juveniles from Round Butte Hatchery were measured at Sherars Falls. One-salt adults averaged 58 cm and 2-salt adults averaged 68 cm (brood years 1978-82) (Table 6).

Table 6. Fork length (cm) of 1- and 2-salt adults sampled at Sherars Falls, 1978-82 brood years (R. Lindsay, ODFW, personal communication).

	1-salt		2-salt	
Brood year	Length	N	Length	N
1978			68.2	340
1979	57.5	258	67.2	182
1980	58.3	25	67.2	182
1981	59.9	322	69.2	183
1982	58.3	90		

Sex ratio

The precentage of males returning to Round Butte Hatchery were 36.3%, 50.1%, and 43.3% in 1983, 1984, and 1985, respectively (R. Robart, ODFW, personal communication).

Fecundity

Fecundity averaged 4,919 eggs per female at Round Butte Hatchery in 1984.

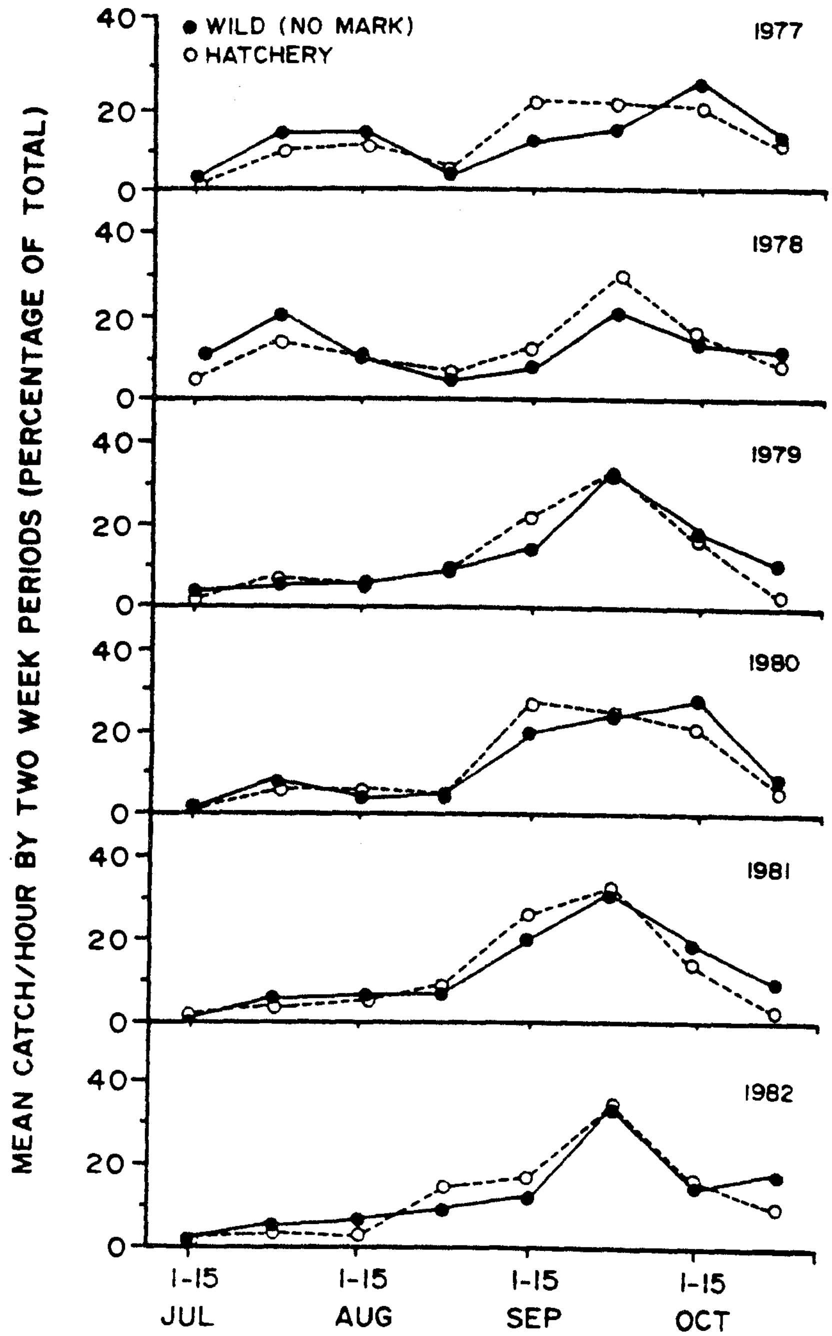

Figure 2. Migration timing of adult steelhead past Sherars Falls, 1977-82 (Lindsay et al. 1982).

Biochemical-genetic characteristics

Preliminary data on isozyme gene frequencies are listed in Table 7.

JUVENILE LIFE HISTORY

Time of emergence

Round Butte Hatchery uses 50°F well water for incubation. The eggs require 21 days of incubation to reach the eyed-egg stage and another 21 days to emergence.

Time, age, and size at migration

Yearling summer steelhead smolts are released in the spring from Round Butte Hatchery at a size of 6-8 fish/lb. WSNFH released smolts (age 1+) in April and May in 1978 and 1980. Fingerling outplants (age 0+) were released in June. Some smolts migrated immediately to the Columbia River estuary in May and June (mean size = 185 mm). Others migrated out of the Warm Springs River in the fall and entered the Columbia River estuary the following spring at age 2 (mean size = 288 mm) (Cates 1984).

Survival rate

Egg-to-fry survival of the 1984 brood year steelhead at Round Butte Hatchery was 68%. Average smolt-to-adult survival (% return to Sherars Falls) has ranged from 1.58% to 6.93% for the 1975-79 brood year releases (Table 8).

Table 8. Survival (% return to Sherars Falls) of Deschutes summer steelhead released from Round Butte Hatchery (Jonasson, ODFW, personal communication).

Brood year	Mean survival (%)	Range	No. groups
1975	6.93	2.83 - 8.63	5
1976	1.58	1.17 - 2.42	4
1977	6.63	4.91 - 8.85	6
1978	4.42	1.09 - 6.19	5
1979	4.11	1.44 - 6.10	6

DISEASE HISTORY

At Round Butte Hatchery, infectious hematopoietic necrosis (IHN) virus was found nearly every year in spawning adults, 1979-85. Epizootics of IHN virus have occurred most years in juveniles. Fry are reared in small groups so if only a few tanks develop clinical IHN virus, they can be destroyed while the others are reared for release. Infectious pancreatic necrosis (IPN),

Table 7. Isozyme gene frequencies and sample sizes (#) as determined by electrophoresis for Round Butte Hatchery summer steelhead. Numbers at top of each column are the relative mobilities for each allele present in the enzyme system. Minus signs indicate cathodal migration. An asterisk indicates that an allele was present at a frequency of less than 0.005 (Schreck et al. 1984).

ADH			ACO				AGPD-1			CK			GOT 1,2			GOT 3		
-100	-76	#	100	83	66	#	100	140	#	100	70	#	100	112	#	100	77	#
0.99	0.01	100	0.73	0.27		92	0.99	0.01	100	0.96	0.04	93				1.00		100

IDH 3,4					LDH-4			MDH-1, 2				MDH-3, 4						ME		
100	40	71	120	#	100	76	#	100	70	140	#	100	83	110	90	70	#	100	85	#
0.68	0.15			97	0.44	0.56	100	1.00			100	0.95		*		0.05	98	1.00		1.00

PGI-1			PGI-2			PGI-3				PEP-GL-1				PEP-LGG			PGM-1				PGM-2		
100	130	#	100	120	#	100	92	120	#	100	110	95	#	100	74	#	-100	-85	-115	#	-100	-140	#
1.00		100	1.00		100	0.99	0.01		100	0.86	0.14		97	0.99	0.01	100	0.99	0.01		78	1.00		78

PGK-2				PMI				SDH-1, 2			SOD			
100	120	160	#	100	110	94	#	100	195	#	100	152	48	#
0.55	0.45		95								0.91	0.05	0.04	100

furunculosis, and cold water disease were also present (R. Holt, ODFW, personal communication). Deschutes summer steelhead are highly resistant to *Ceratomyxa shasta* (Buchanan et al. 1983).

The primary diseases affecting the summer steelhead program in WSNFH were yearly infestations of *Glochidia* and IHN in returning adults (B. Cates, USFWS, personal communication). In addition, the 1979 brood of juveniles was destroyed after becoming infected with IPN.

PRIORITY INFORMATION NEEDS

1. Contribution of adults to natural production
2. Harvest in tribal gill-net fishery in the Columbia River
3. Migration timing in the Columbia River
4. Age composition of adults
5. Fecundity/length relationship

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John Day River Summer Steelhead (wild)

PRODUCTION

Steelhead production in the John Day Basin is entirely from wild stock.

GEOGRAPHIC LOCATION

Streams

John Day River and tributaries (Figure 1)

ORIGIN

This stock is the largest remaining native wild steelhead stock in eastern Oregon. Releases of Sandy, Eagle Creek, and Alsea hatchery stocks of winter steelhead and Skamania and Oxbow stocks of summer steelhead were made in the 1960s (Table 1). Since all of the hatchery releases were fry and presmolts, returns were probably few (E. Clair, ODFW, personal communication). There have been no hatchery releases in the John Day since 1969.

Table 1. Releases of hatchery steelhead stocks in the John Day River system.

Year	Location	Number	Size	Race	Hatchery stock
1962	Camas Cr. Cable Cr. Bowman Cr.	200,000	45/lb	N.A.	N.A.
1962	Granite Cr.	375,000 (only 10% survived at time of release)	Fry	Winter	Eagle Creek
1964	John Day R.	10,200	4.5"	Winter	Sandy
1965	John Day R., S.Fk.	27,900	3.5"	Winter	Alsea
1966	John Day R., M.Fk.	55,568	2.0"	Summer	Skamania
1967	John Day R. Camas Cr.	99,000 71,500	2.5" 3.0"	Summer Summer	Idaho (Oxbow) Idaho (Oxbow)
1969	Bridge Cr.	22,400	3.0"	N.A.	N.A.

Based on scale analysis, hatchery strays accounted for 15% and 4% of the fish sampled during the 1982-83 and 1983-84 sport fishing seasons, respectively (Tables 2 and 3). Since these fish were taken in the sport

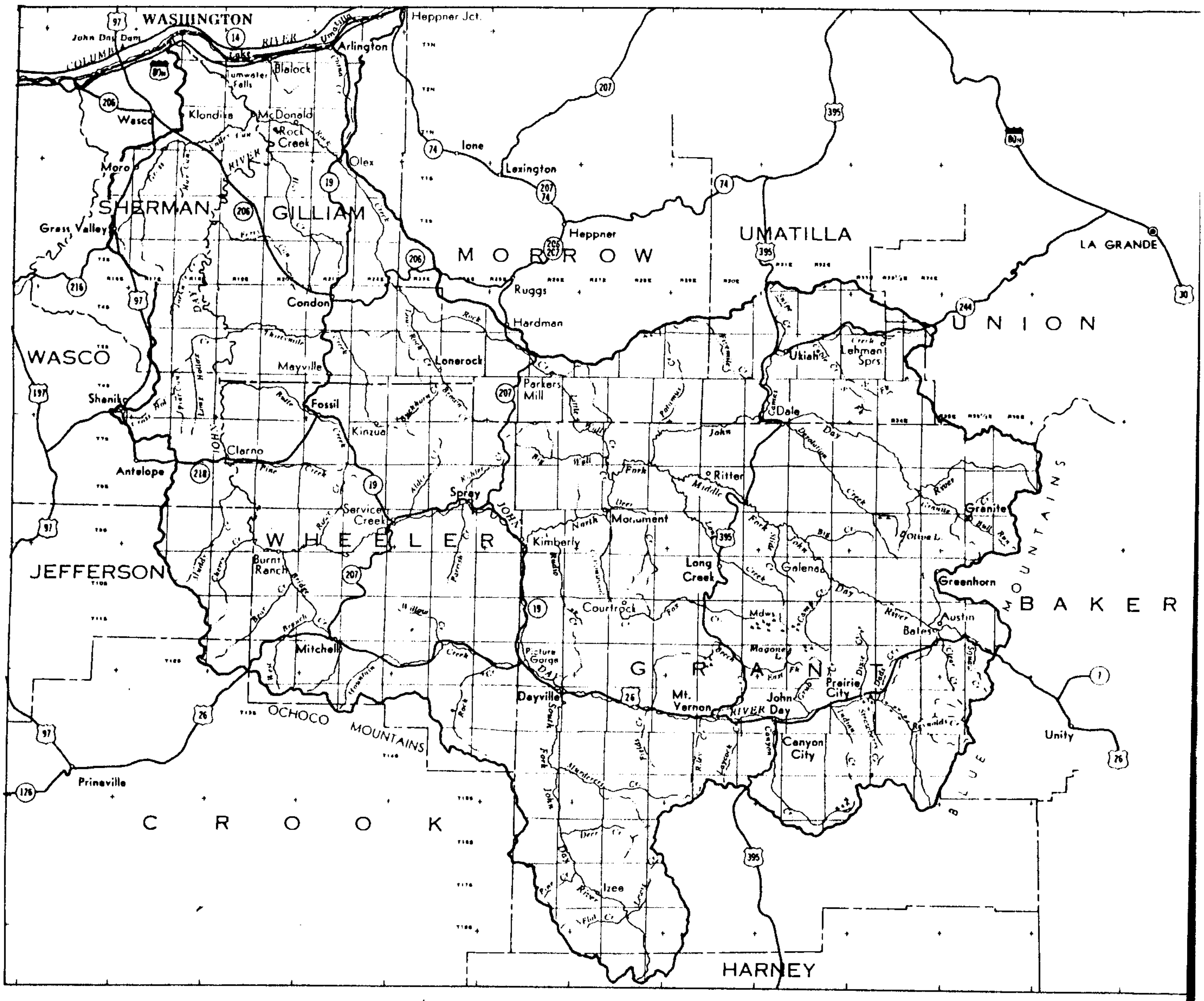

Figure 1. John Day River Basin.

fishery, these percentages may not represent the proportion of hatchery strays in the spawning population. Straying rates of this magnitude are considered to have an insignificant impact on the wild stock (MacHugh 1984).

Table 2. Hatchery and wild components of the sport catch in the John Day River. All fish were caught between January 18 and May 6, 1983 (McHugh 1984).

	Hatchery	Wild
Lower river (RM 22-40)	4 (50%)	4 (50%)
Upper river (above RM 170)	2 (7%)	25 (93%)
N.F. John Day	1 (8%)	12 (92%)
Combined	7 (15%)	41 (85%)

Table 3. Hatchery and wild components of the sport catch in the John Day River. All fish were caught between December 17, 1983 and April 14, 1984[a] (MacHugh 1984).

	Hatchery	Wild
Lower river (RM 22-40)	--	--
Upper river (above RM 170)	2 (10%)	19 (90%)
N.F. John Day	--	25 (100%)
Combined	2 (4%)	44 (96%)

[a] Two additional samples caught October 21 and 22, 1983 in the mainstem (no precise location given) were aged as a hatchery 1-salt and a wild 2-salt.

ADULT LIFE HISTORY

Run size, catch, and escapement

John Day steelhead are primarily harvested by tribal gillnet fisheries in the Columbia River and sport fishermen in the John Day system. No estimates of harvest in the tribal gillnet fishery are available. The John Day drainage was a historically important fishing area for the Umatilla, Rock Creek, Columbia River, and Warm Springs tribes (James 1984). Sport harvest based on punch card returns have been estimated since 1959 (Table 4). Creel survey data are summarized in Table 5.

Table 4. Estimated sport harvest of summer steelhead in the John Day River system, 1957-81.[a]

Year	Catch	Year	Catch
1957-58	3,136	1969-70	2,629
1958-59	2,694	1970-71	2,381
1959-60	7,381	1971-72	3,068
1960-61	4,326	1972-73	3,290
1961-62	1,366	1973-74	891
1962-63	2,930	1974-75	2,784
1963-64	2,149	1975-76	1,506
1964-65	2,574	1976-77	2,919
1965-66	4,676	1977-78	1,421
1966-67	4,568	1978-79	305
1967-68	3,506	1979-80	666
1968-69	2,870	1980-81	1,721

[a] Catch adjusted for non-response bias.

Table 5. Steelhead creel summary for the John Day River, 1958-84 (Claire and Smith 1985).

Year	Anglers checked	Hours angled	Number of fish	Hours per landed fish	Fish landed per angler
1958	197	457	72	6.3	0.36
1959	373	1,499	78	19.2	0.21
1960	270	993	99	10.7	0.36
1961	200	654	29	22.5	0.14
1962	193	639	35	18.2	0.18
1963	263	991	42	23.6	0.16
1964	430	1,386	53	26.1	0.12
1965	278	946	79	11.9	0.28
1966	495	1,505	153	9.3	0.31
1967	437	1,523	104	14.6	0.24
1968	298	1,171	62	18.8	0.21
1969	500	1,351	122	11.1	0.24
1970	299	597	50	1.9	0.21
1971	111	401	34	10.8	0.31
1972	341	928	38	24.4	0.11
1973	581	1,966	69	28.5	0.12
1974	353	1,094	44	24.9	0.12
1975	517	1,628	128	12.7	0.25
1976	242	1,002	46	21.1	0.14
1977	613	2,200	139	15.8	0.23
1978	454	1,330	63	21.1	0.14
1979	166	436	4	109.0	0.02
1980	296	1,094	32	34.2	0.11
1981	365	1,054	41	25.7	0.11
1982	489	2,096	136	15.4	0.28
1983	373	1,604	54	29.7	0.15
1984	468	1,801	131	13.8	0.28
Average	353.0	1,198.0	71.7	16.7	0.20

Steelhead redd counts, which provide an index of spawning escapement, have been generally declining since 1977 (Figure 2 and Table 6). The estimated average escapement for the past 15 years (1970-84) is 19,165, compared to 35,440 for 1959-70 (Claire and Smith 1985).

Time of migration

Adults pass Bonneville Dam July 15-August 15 and pass John Day Dam July-March (W. Bowers, ODFW, personal communication). Fish begin migrating up the John Day River in September when water temperatures cool and flow increases (Figure 3) (James 1984).

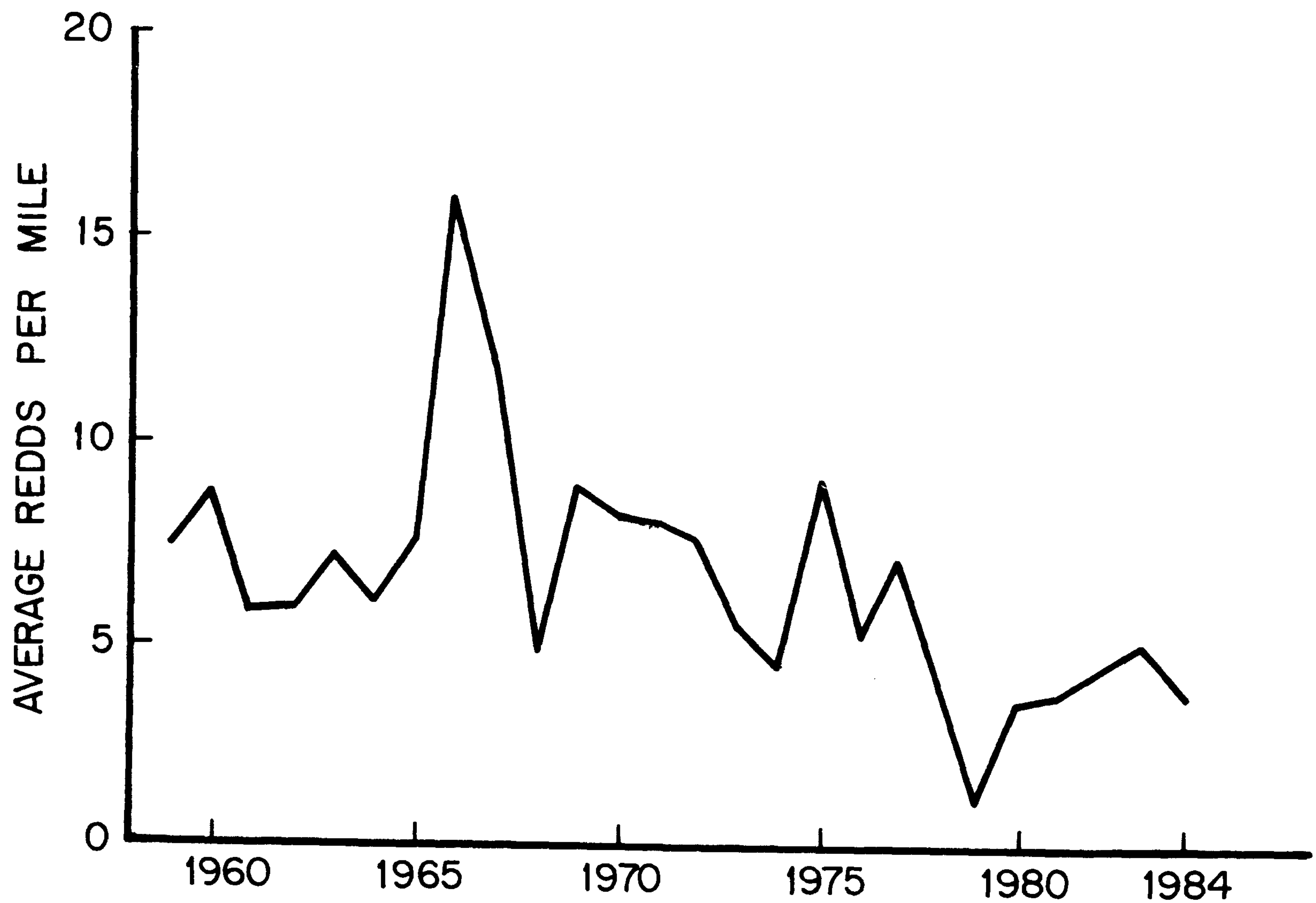

Figure 2. Average annual redds per mile for summer steelhead in spawning index streams of the John Day River, 1959-1984 (modified from James 1984).

Table 6. Steelhead spawning ground summary for the John Day River, 1959-84 (modified from James 1984).

Year	Number of streams surveyed[a]	Miles surveyed	Steelhead	Redds	Redds per mile
1959	6	14.5	30	108	7.4
1960	10	22.0	60	194	8.8
1961	8	24.5	56	166	6.8
1962	10	26.5	56	184	6.9
1963	11	30.5	47	216	7.1
1964	13	43.5	51	266	6.1
1965	19	45.0	88	344	7.6
1966	23	69.0	141	1,103	16.0
1967	25	78.0	61	905	11.6
1968[b]	23	74.5	19	358	4.8
1969	27	91.5	76	806	8.9
1970	21	65.0	58	530	8.1
1971	8	22.5	18	181	8.0
1972	16	53.5	41	409	7.6
1973	25	76.4	22	402	5.3
1974[c]	14	38.0	4	167	4.4
1975[c]	14	34.0	21	302	8.9
1976	21	59.8	8	308	5.2
1977	30	75.5	69	535	7.1
1978	35	102.7	21	438	4.3
1979	29	78.7	4	81	1.0
1980	34	90.1	11	305	3.4
1981	33	86.1	12	319	3.7
1982	32	71.8	34	301	4.2
1983	31	89.3	39	438	4.9
1984	29	76.7	33	299	3.9

[a] Present steelhead index streams include Bear, Beaver, Beech, E. Fk. Beech, Black Canyon, Canyon, Mid. Fk. Canyon, Cottonwood, Deep, Deer, Fields, Indian, Kahler, Lane, Lick, E. Fk. Lick, McClellan, Murderers, Olive, Owing, Parrish, Reynolds, Riley, N. Fk. Trail, Tex, Vance, Wall, Wilson, and Wind creeks. Not all streams were surveyed every year.

[b] Low water year; irrigation took entire stream flows on several tributaries causing steelhead spawning escapement to be 0 in some areas. The poor count is reflected in redd/mile figure for that season.

[c] Counts low due to high water in spring which smoothed out early redds and caused poor counting conditions.

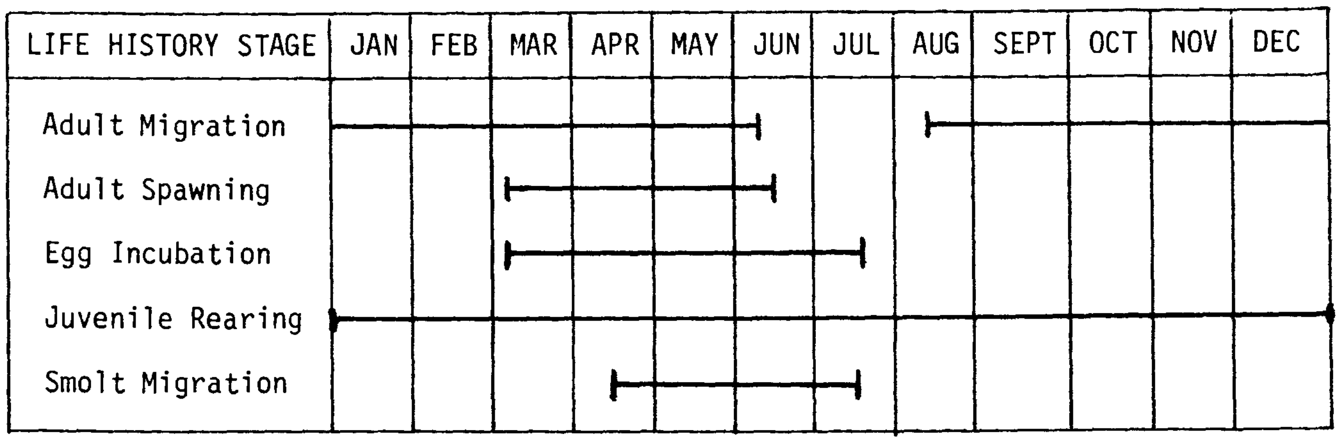

Figure 3. Periodicity chart for summer steelhead life history stages in the John Day River system (modified from James 1984).

Spawning period

The earliest spawning begins in lower tributaries in mid-March. Spawning progresses upstream and continues through mid-June in the upper tributaries (E. Claire, ODFW, personal communication). Adult migration and timing were monitored on Tex Creek, a tributary of Murderers Creek, which flows into the South Fork of the John Day (Table 7). In most years the spawning period extended through May. Each female spent an average of 7 days in the stream and dug an average of two redds (West et al. 1965).

Spawning areas

Steelhead can be found throughout the John Day system. A detailed listing of spawning and rearing distribution is available from ODFW. The greatest number of adults are found in the North Fork (Table 8).

Age composition

Scale analysis suggests that there is considerable variability in the adult life history between 1-salt and 2-salt patterns (Table 9).

Table 7. Adult steelhead migration and spawning data, Tex Creek (West et al. 1965).

Year	Total run	Females	Redds	Spent fish returned to the trap	First arrival	Last arrival
1961	46	23	43	36	May 3	June 4
1962	16	8	8	11	May 7	June 6
1963	12	6	5	10	May 20	May 27
1964	16	8	5	0	May 6	May 25

Table 8. Steelhead spawning percentages in sections of the John Day River system based on most recent 5 year average spawning densities and estimated miles of habitat (Claire and Smith 1985).

Area	Average index count (1980-84)	Miles	Estimated total redds	%
Lower John Day	3.7/mi	290	1,073	15
Upper John Day	4.0/mi	368	1,472	21
Middle Fork	4.3/mi	295	1,269	18
North Fork	3.7/mi	760	2,812	39
South Fork	5.5/mi	95	522	7
	4.2/mi	1,808	7,148	100

Table 9. Age composition of John Day steelhead.[a]

	Freshwater age				Ocean age						Repeat spawners	
	2		3		1		2		3			
Year	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
1955-61	15	55.6	12	44.4	0	0	23	85.2	4	14.8	-	-
1982-83	25	58.1	18	41.9	21	46.7	24	53.3	0	0	5	11.1
1983-84	30	71.4	12	28.6	38	88.3	4	9.3	1	2.3	1	2.3

[a] Based on scales of fish taken in the sport fishery.

Size

No information.

Sex ratio

The adult runs in Tex Creek, 1961-64, were comprised of 50% females and 50% males (Table 7) (West et al. 1965).

Fecundity

No information.

Biochemical-genetic characteristics

Schreck et al. (1984) reported that samples have been collected for electrophoretic analysis, but no results are available.

JUVENILE LIFE HISTORY

Time of emergence

Fry emerged in Tex Creek in early July (West et al. 1965).

Time, age, and size at migration

The most extensive set of data documenting juvenile migration patterns are records of rotary screen bypass traps on irrigation diversions. Interpretation of those data is complicated by varying trap effeciencies, numbers of traps, and timing of installation, which are dependent upon precipitation, flows, and irrigation demands. It is also not possible to readily distinguish juvenile steelhead from resident rainbow trout, both of which are present in the streams.

Peak downstream movement of juveniles generally occurs in June and October (Table 10 and Figure 4). Early trapping in Tex Creek indicated that when minimum water temperatures are in the 30s°F prior to late March and April few fish migrate. In Tex Creek peak spring migration occurred in mid-May and early June (West et al. 1965).

Table 10. Downstream migrant juvenile steelhead captured in rotary screen bypass traps in the John Day River system, 1972-83.

Month	Week	Average catch per trap											Average
		'72	'73	'74	'75	'76	'77	'78	'79	'81	'82	'83	'72-'83
April	1	3.3	15.9	-	-	-	-	-	-	-	-	-	9.6
	2	2.7	58.6	3.5	-	58.3	92.0	-	-	3.9	-	-	36.5
	3	9.1	68.5	32.6	1.0	10.9	33.0	2.3	17.0	19.5	-	-	21.5
	4	12.5	41.5	10.7	33.0	14.7	53.9	4.2	7.5	33.2	-	-	23.5
May	1	21.2	50.9	8.3	14.5	15.2	81.3	7.6	3.8	17.4	-	-	24.5
	2	25.0	71.9	9.2	9.5	11.0	74.3	7.5	21.2	9.3	10.4	-	24.9
	3	24.4	66.4	4.8	22.3	6.4	76.3	11.3	23.2	6.3	10.8	19.1	24.7
	4	18.6	38.2	8.8	27.7	13.1	70.7	4.8	27.6	7.1	11.0	29.6	23.4
June	1	35.9	27.9	4.4	97.1	8.5	78.5	9.1	23.8	9.2	11.6	8.3	28.6
	2	46.1	28.0	9.6	29.6	10.7	115.0	64.4	61.3	7.4	11.0	19.9	36.6
	3	30.3	22.7	38.5	30.4	12.3	44.1	152.2	54.9	7.5	11.8	14.9	38.1
	4	27.3	25.2	17.0	19.3	10.9	31.8	8.8	29.8	10.5	14.8	10.3	18.7
July	1	25.6	26.8	72.4	17.9	9.6	21.6	5.2	29.1	8.3	13.4	16.8	22.4
	2	31.4	17.0	31.7	37.8	5.9	10.5	9.2	55.9	6.1	30.3	6.4	22.0
	3	30.5	16.3	50.3	18.2	6.7	10.9	13.1	13.5	2.8	14.5	3.9	16.4
	4	48.6	11.6	17.0	22.5	12.0	10.0	28.0	14.6	2.3	6.5	5.2	16.2
August	1	10.4	9.2	21.6	9.1	13.1	11.9	18.6	11.1	2.8	2.6	6.6	10.6
	2	14.1	7.3	39.2	12.6	8.0	18.7	20.1	5.0	3.1	3.8	4.1	12.4
	3	26.4	8.0	26.0	23.2	14.4	11.0	13.5	16.3	6.8	3.2	2.9	13.8
	4	14.8	24.0	12.8	35.6	9.6	30.1	19.3	7.4	7.9	8.6	2.3	15.7
September	1	36.5	11.2	11.0	11.8	5.9	22.4	44.0	5.7	4.5	4.5	1.8	14.5
	2	89.3	5.2	12.6	12.9	8.0	10.8	144.8	12.8	4.1	21.6	1.8	29.4
	3	19.7	12.0	9.8	16.6	15.8	27.7	38.3	78.0	-	11.2	3.3	23.2
	4	37.6	57.2	3.5	12.8	3.9	26.6	14.0	25.8	86.0	22.4	1.7	26.5
October	1	30.6	19.2	11.1	7.5	6.1	32.8	4.6	12.5	25.6	8.9	16.2	15.9
	2	67.7	35.2	22.7	118.1	4.0	17.1	2.9	34.3	23.3	83.0	35.3	40.3
	3	49.8	74.4	10.0	65.2	8.1	1.3	-	42.0	-	-	-	35.8
	4	45.4	60.5	32.9	57.2	8.8	21.0	-	265.3	-	-	-	70.2

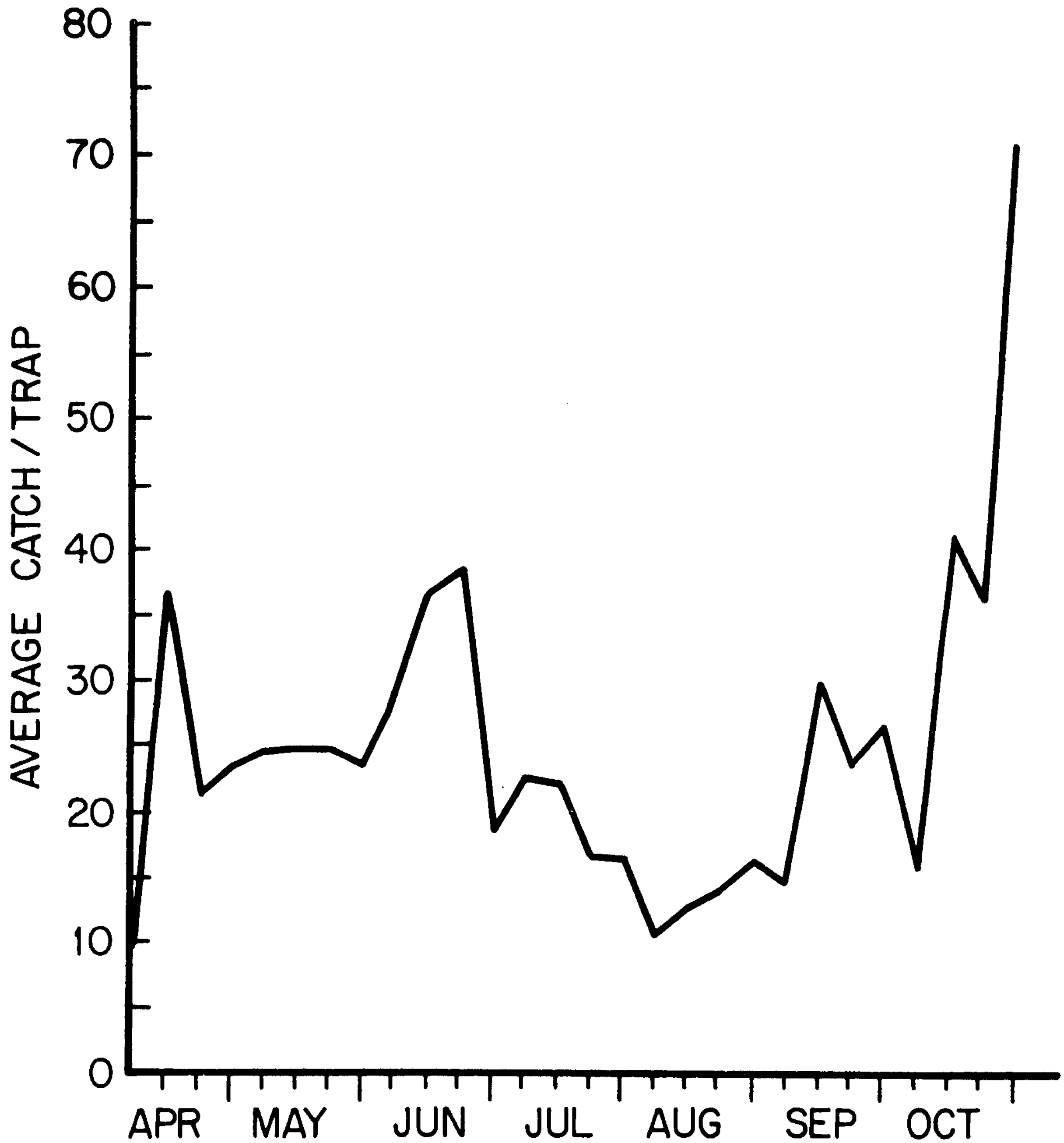

Figure 4. Average catch per trap of juvenile steelhead/rainbow in rotary screen bypass traps in the John Day Basin, 1972-84.

Peak spring movement of juveniles (Figure 4) is usually associated with smolt outmigration. Steelhead juveniles in the John Day system smolt at ages 2 and 3 (Table 9). However, downstream migrants sampled in Camp Creek during spring 1984 were primarily age 1 fish (Table 11). Similarly, none of the downstream migrants sampled in Tex Creek during the spring were classified as "smolts." Downstream migrants in Tex Creek were not aged; however, 61% were less than 102 mm (4 in).

Other downstream movements occur periodically during the summer and fall. Many of the steelhead counted in bypass traps in July were newly emerged 0-age rainbow/steelhead. In Tex Creek juveniles also migrated upstream as summer flows decreased (West et al. 1965). More fish migrate downstream in late summer/early fall than in spring (Table 10, Figure 4). These later migrations may be related to increases in precipitation and flow (Figure 5).

Table 11. Age of downstream migrant steelhead/rainbow in Camp Creek, 1984 (L. Lutz, ODFW, unpublished data).

Age	Number	Percentage
1	330	66.3
2	133	26.7
3	27	5.4
4	2	0.4

It is apparent that juvenile rearing at various stages of development occurs throughout the basin. The larger tributaries and mainstem may be particularly important habitats during the latter stages of juvenile rearing prior to migration out of the John Day system.

Survival rates

No information.

DISEASE HISTORY

Tissue samples from eight adult steelhead and 50 rainbow trout spawners were tested for viral hemorrhagic speticemia, infectious pancreatic necrosis (IPN), and infectious hematopoietic necrosis (IHN). No evidence of these viruses was found (Knox et al. 1984).

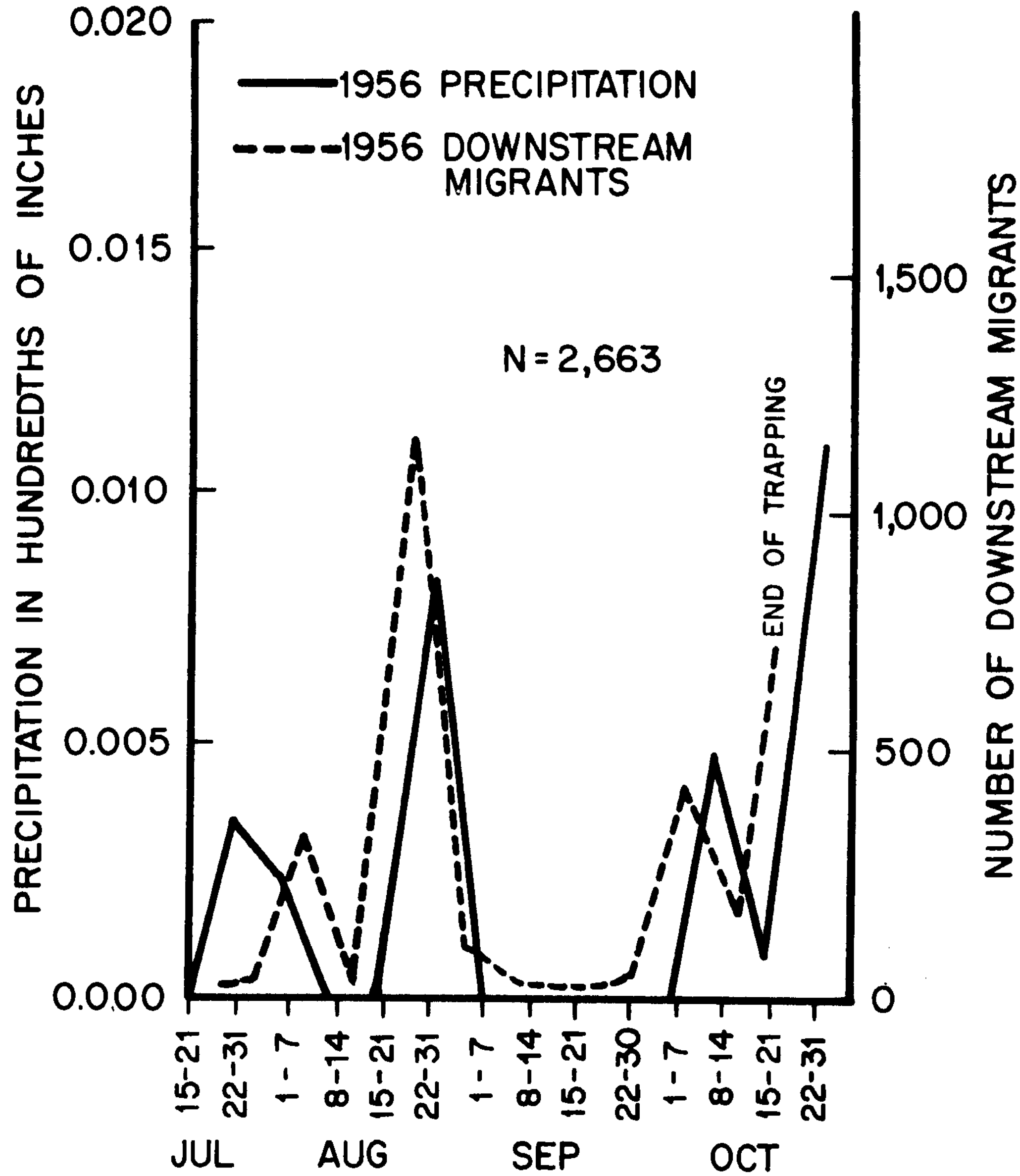

Figure 5. Relationship of precipitation to number of downstream migrant juvenile steelhead/rainbow in Laycock Creek, 1956 (modified from OSGC 1956).

PRIORITY INFORMATION NEEDS

1. Estimate of harvest in the Columbia River

2. Estimate of total spawning escapement

3. Estimate of smolt production levels and capacities including presmolt migrants rearing in the mainstem and larger tributaries

4. Adult and juvenile steelhead distribution in lower tributaries

5. Fecundity/length relationship

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Rock Creek Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Rock Creek, Washington, a tributary to the Columbia River at RM 228.5 (12.9 miles above John Day Dam) that drains a watershed of 222 square miles.

ORIGIN

The wild summer steelhead stock in Rock Creek is native.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement do not exist. Harvest of the stock likely occurs in mainstem Columbia sport and tribal fisheries, as well as in Rock Creek. Stock abundance is further impacted by mortalities associated with fish passage through three hydropower dams on the mainstem Columbia. At present, there is no escapement goal for this stock.

Time of migration

Likely June through October.

Spawning period

Probably January through April.

Spawning areas

Steelhead spawn in mainstem Rock Creek upstream to the confluence of Squaw Creek (Figure 1).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

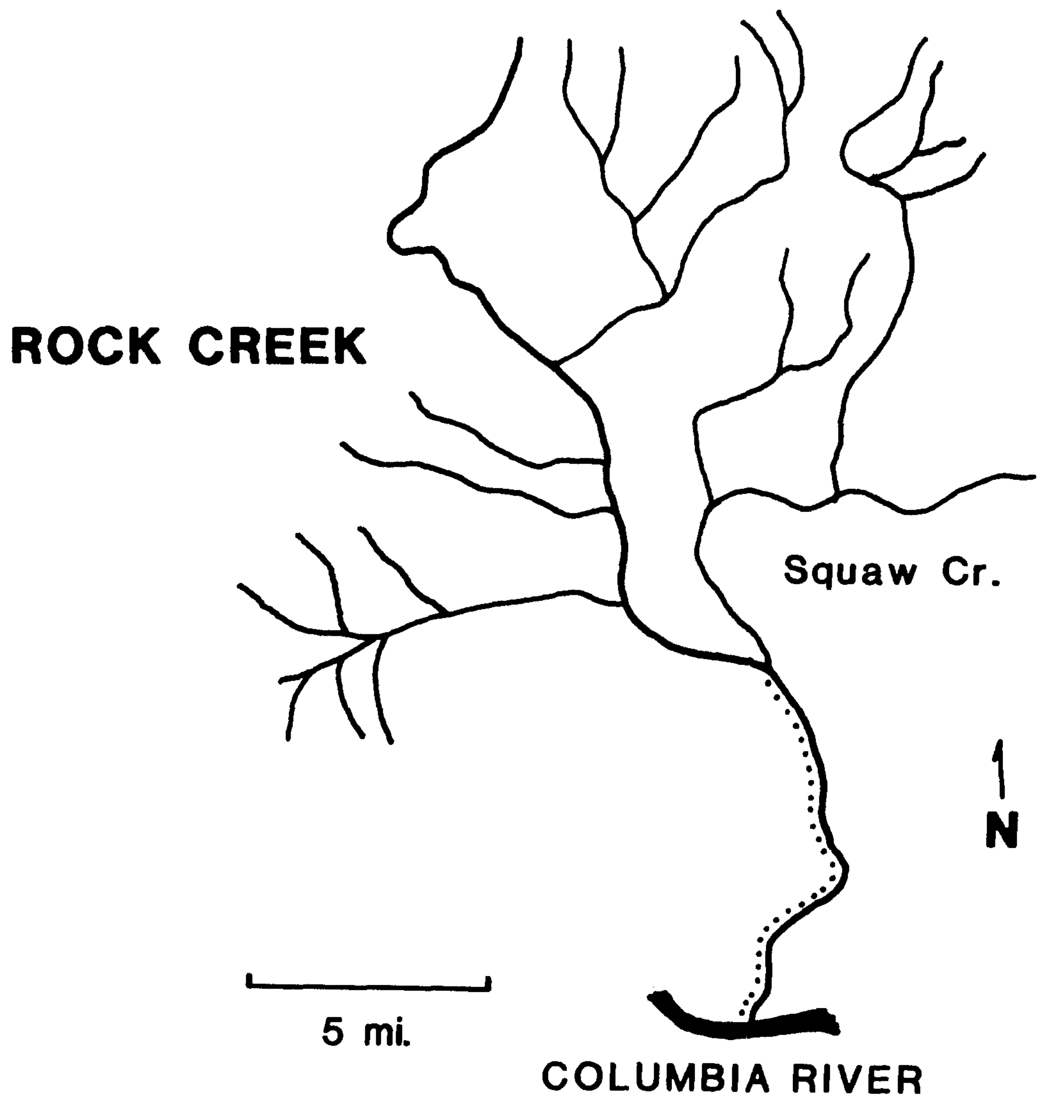

Figure 1. Probable spawning sites of steelhead trout in Rock Creek, Washington (B. Crawford, Washington Department of Game, personal communication).

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild summer steelhead smolts outmigrate in April and May at a size of 160 mm and an age of 2 years.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Umatilla River Summer Steelhead (wild)

PRODUCTION

Presently adults returning to the Umatilla River are mostly wild stock. A hatchery program was begun in 1981 with a production goal of 50,000 smolts/year [see "Umatilla River Summer Steelhead (hatchery)"] so the hatchery component of the run should increase in future years.

GEOGRAPHIC LOCATION

Streams

Umatilla River and tributaries (Figure 1)

ORIGIN

Summer steelhead are indigenous to the Umatilla system. From 1967 through 1969 Skamania and Idaho (Oxbow) stocks were released (Table 1). The hatchery stock now used was developed from wild broodstock trapped at Three Mile Dam on the Umatilla River.

Table 1. Releases of introduced stocks of summer steelhead in the Umatilla River, 1967-69.

Year	Hatchery	Number released	Fish/ pound	Mean length (in.)	Stock
1967	Gnat Creek	109,805	75	3	Skamania
1967	Oak Springs	272,900	117	3	Idaho (Oxbow)
1967	Wallowa	142,240	240	2	Idaho (Oxbow)
1968	Gnat Creek	23,100	66	3	Skamania
1969	Oak Springs	174,341	145	3	Skamania

ADULT LIFE HISTORY

Run size, catch, and escapement

The best data on run size and escapement are counts made at Three Mile Dam (Table 2). However, the reliability of much of this data is questionable (e.g., see footnotes for Table 2). These counts do not represent total escapement since some harvest occurs above Three Mile Dam.

Steelhead sport catches (1971-82) are summarized in Table 3. Catch has varied somewhat independently of counts at Three Mile Dam. Before 1982 most of the sport harvest occurred in the area immediately below Three Mile Dam where adults concentrated prior to passing the dam. A 700-ft. no-fishing

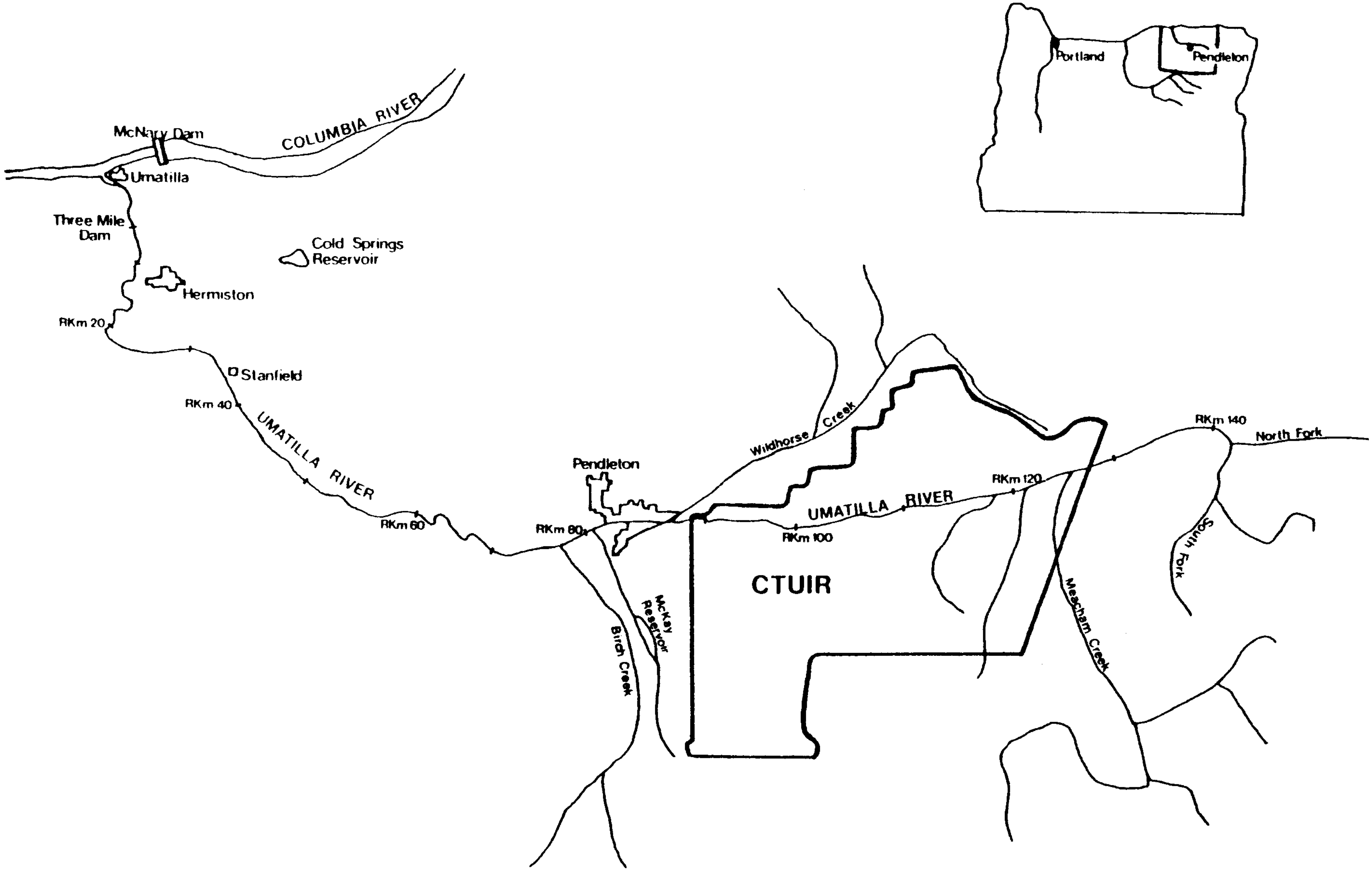

Figure 1. Umatilla River and principal tributaries.

Table 2. Counts of adult summer steelhead at Three Mile Dam, Umatilla River, 1966-83 (modified from James 1984).

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
1966-67	0	1	110	288	394	376	338	271	1,778
1967-68	44	174	60	281	357	14	0	0	930
1968-69	0	200	0	4	95	243	543	832	1,917
1969-70	0	0	39	7	537	407	1,229	0	2,298
1970-71[a]	0	249	404	19	-	-	-	-	NA
1971-72[b]	-	-	-	-	-	-	-	-	NA
1972-73	0	0	0	32	204	1,821	0	0	2,057
1973-74[c]	0	680	557	558	284	478	0	0	2,257
1974-75[d]	0	0	264	315	1,476	59	40	17	2,171
1975-76[e]	0	0	258	966	1,190	108	12	0	2,534
1976-77[f]	0	22	100	163	21	222	25	0	553
1977-78[g]	0	0	828	1,432	641	179	0	0	3,080
1978-79[h]	-	-	-	-	-	-	-	-	NA
1979-80	0	0	870	147	427	609	269	45	2,367
1980-81	0	210	492	319	47	142	78	10	1,298
1981-82	34	91	155	77	73	178	129	31	768
1982-83	32	95	133	218	225	276	280	5	1,264
Percent[i]	<1	7.6	14.0	11.8	21.6	24.1	15.6	6.3	

[a] Counter damaged January 5 and not replaced.
[b] Counter not installed.
[c] In addition to the 1973-74 total, 83 steelhead were taken as hatchery brood stock. Twelve of these (8 females and 4 males) were taken in January, and the other 71 (50 females and 21 males) were taken in Feburary.
[d] One fish shown for May was passed upstream manually on June 4.
[e] Good numbers of fish passed upstream before the counter was operable on December 24. Therefore, this count was quite low. The ladder was opened October 22.
[f] Extremely low flows prevented steelhead passage during much of the season. A total of 205 steelhead (98 females and 107 males) were transported upstream near Rieth. Also the counter was out and passage conditions were good for a two-week period in late March-early April. Probably at least 500 steelhead passed during that time.
[g] Counter did not operate the first 12 days after installation (November 30 to December 12). Counter damage following March 10 count by vandalism. Some fish still coming.
[h] No count available. Counter was not calibrated accurately.
[i] Years excluded: 1970-71, 1971-72, 1975-76, 1976-77, 1977-78, 1978-79.

zone below the dam was established in 1982-83 and resulted in only 24 summer steelhead captured in the sport fishery that year (Phelps 1983).

Table 3. Steelhead sport catch in the Umatilla River[a] (Berry 1981).

Run year	
1971-72	735
1972-73	1,913
1973-74	326
1974-75	338
1975-76	379
1976-77	116
1977-78	866
1978-79	280
1979-80	878
1980-81	630
1981-82\b\	343

[a] Estimated from punch card returns corrected for non-response bias.
[b] The 1981 catch only.

The catch of the Umatilla Tribes in the Umatilla River is only with rod and reel and is reported to be less than 20 fish annually (USBR 1983).

Time of migration

The timing of the Umatilla steelhead run in the Columbia River is not well defined. Adult steelhead are thought to pass Bonneville Dam in July and the John Day Dam from July through March (W. Bowers, ODFW, personal communication). Upstream migration of steelhead in the Umatilla River begins in October as soon as flow conditions permit (USBR 1983). Peak passage at Three Mile Dam generally occurs in February and March (Table 2).

Spawning period

Spawning occurs from January through May (D. Heckeroth, ODFW, personal communication), primarily in April and May (James 1984).

Spawning areas

The largest number of spawners are found in Meacham Creek and its tributaries, including Camp and North Fork Meacham creeks, and in the mainstem Umatilla below the forks (Table 4). Other spawning streams are Birch and Squaw creeks (James 1984). Historically steelhead also spawned in the upper mainstem (Thompson and Haas 1960).

Table 4. Estimated adult summer steelhead escapement in the Umatilla River system (OSGC 1973).

Stream	Number of spawners
Mainstem Umatilla below N. and S. forks	630
North Fork Umatilla River and tributaries	205
South Fork Umatilla River and tributaries	350
Meacham Creek and tributaries	790
TOTAL	1,975

Age composition

Adult steelhead remain in the ocean from 1 to 3 years and return as 2- to 6-year olds (USBR 1983). J. Phelps (ODFW, personal communication) reported that adults are mainly 2-salt fish and less than 10% are repeat spawners.

Size

No information.

Sex ratio

No information.

Fecundity

No information.

Biochemical-genetic chracteristics

No information.

JUVENILE LIFE HISTORY

Time of emergence

No information.

Time of migration

Most juvenile steelhead (74%) migrate in May (Table 5), based on counts of fish captured in irrigation diversion bypass traps in years for which there are complete counts. Steelhead must migrate out before June or in autumn or winter while flows are still adequate (J. Phelps, ODFW, personal communication). Since irrigation screens are not operated in autumn or winter, it is not known if steelhead migrate during this time.

Table 5. Steelhead smolts captured at Umatilla River screens, 1960-82 (Phelps 1983).

Year	April No.	April %	May No.	May %	June No.	June %	Total
1960	7,098		16,469		2,342		25,909
1961	18,733	32.6	35,689	62.0	3,112	5.4	57,534
1962	3,056		15,190		515		18,761
1963	1,848		17,346		1,310		20,513
1964	537		8,563		1,527		10,627
1965	4,947		1,932		166		7,045
1966	4,619	20.2	15,709	68.9	2,486	10.9	22,814
1967	1,189		6,154		2,150		9,611
1968	3,886	10.0	29,571	75.9	4,404	14.1	38,959
1969	556		16,352		5,905		22,813
1970	170		1,329		8,884		10,383
1971	637		10,345		2,865		13,847
1972	706		6,257		1,457		8,420
1973	5,218	11.0	36,077	81.2	3,123	7.1	44,418
1974	0		0		0		0
1975	0		0		3,464		3,464
1976	0		2,438		6,920		9,358
1977	6,039	5.6	89,950	83.8	11,409	10.6	107,398
1978	0		324		182		506
1979	0		208		2,490		2,698
1980	0		23,300		2,585		25,885
1981	175		450		150		775
1982	0		0		1,650		1,650
Average[a]	7,707	16.0	41,399	74.4	4,906	9.6	54,224

[a] For years with complete data: 1961, 1966, 1968, 1973, 1977.

Juvenile steelhead rear from 1 to 3 years before migrating in the spring as smolts. Most juveniles smolt at age 2+ (J. Phelps, ODFW, personal communication).

Lengths of juvenile steelhead captured at the Westland screen bypass trap are shown in Table 6. An average of 72% of migrant steelhead were 6-10 in. from 1965 through 1972.

Table 6. Lengths (in.) of juvenile steelhead taken at the Westland screen by-pass trap on the Umatilla River (Golden 1972).

	0 - 4"		4 - 6"		6 - 10"		Over 10"	
Year	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1965	505	7	3,624	53	2,673	38	137	2
1966	970	5	2,471	12	16,637	71	2,479	12
1967	479	5	2,512	27	5,201	55	1,169	13
1968	1,041	3	3,987	10	25,585	65	8,546	22
1969	18	1	5,299	23	16,484	72	1,065	4
1970	10	1	436	4	9,730	94	207	1
1971	0	0	751	5	12,930	94	161	1
1972	20	0	636	7	7,484	90	235	3

Survival rate

No information.

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Improved estimates of run size and escapement

2. Juvenile migration characteristics and smolt production levels and capacities

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Umatilla River Summer Steelhead (hatchery)

PRODUCTION

The current hatchery program began in 1980. Approximately 60,000 smolts have been released each year since 1981 (Table 1). Fingerlings are also released. Plans calls for the eventual release of 200,000 smolts into the Umatilla system.

Table 1. Summer steelhead releases in the Umatilla system, 1980-84 brood years.

Brood year	Date of release	Number	Size	Mark
1980	Apr. 1981	17,558	6.9/lb	None
1981	Nov. 1981	9,400	63.0/lb	None
1981	May 1982	59,534	7.6-10.5/lb	None
1982	Nov. 1982	67,980	124.0/lb	None
1982	May 1983	60,500	11.0/lb	None
1983	Dec. 1983	52,700	62.0/lb	None
1983	May 1984	58,012	6.4/lb	100% Ad
1984	Nov. 1984	22,005	135.0/lb	None
1984	May 1985	n.a.	smolt	100% Ad

GEOGRAPHIC LOCATION

Streams

Umatilla River (Figure 1)

Hatcheries

Umatilla summer steelhead are incubated and reared at Oak Springs Hatchery. The Bonnifer Springs facility (Meacham Creek RK 3) and the Minthorn facility (Umatilla RK 103) (construction to begin in 1985) will be used for adult collection and spawning, acclimation (2-4 weeks), and release of 75,000 and 125,000 smolts, respectively. Currently, broodstock are held and spawned at McNary Dam.

ORIGIN

The original broodstock were wild adults trapped at Three Mile Dam. Broodstock collection of primarily unmarked adults at Three Mile Dam will

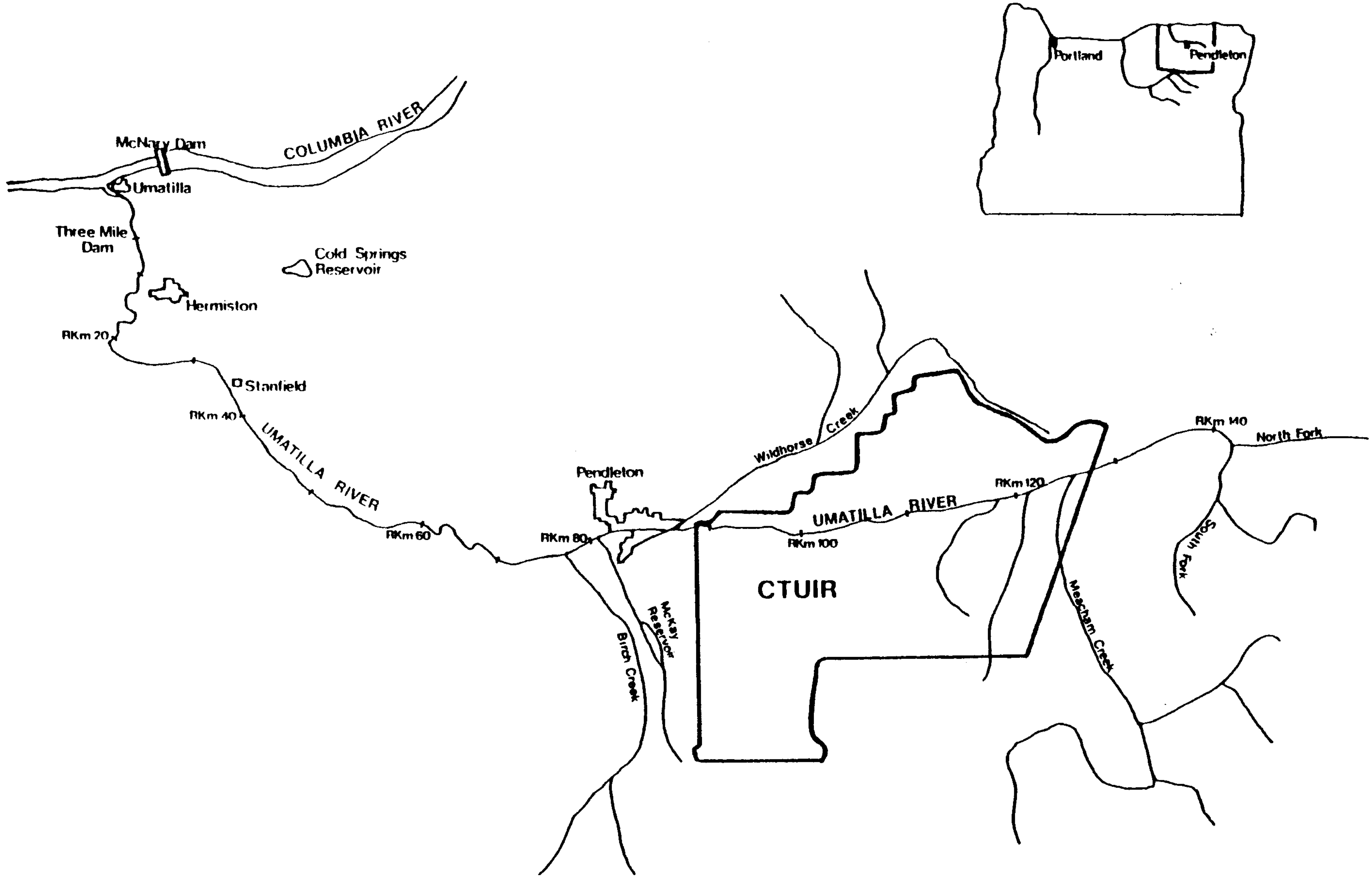

Figure 1. Umatilla River and major tributaries.

continue until a sufficient number of adults return to the Bonnifer trapping facility. Limited trapping may continue at Three Mile Dam for maintenance of genetic variability. Strays from other hatcheries have been reported (R. Boyce, ODFW, personal communication).

ADULT LIFE HISTORY

Run size, catch, and escapement

Since hatchery releases prior to the 1983 brood were not marked, the number of hatchery adults passing Three Mile Dam are unknown. Few steelhead returned to the Bonnifer facility in the 1983-84 or 1984-85 season. Marked steelhead will begin returning in 1985-86.

Time of migration

No information.

Spawning period

No information.

Spawning areas

Adults have been spawned at McNary Dam.

Age composition

No information.

Size

No information.

Sex ratio

No information.

Fecundity

The average fecundity of 25 females trapped at Three Mile Dam in 1984 was 4,480 eggs/female.

Biochemical-genetic characteristics

Preliminary data on isozyme gene frequencies have been reported by Schreck et al. (1984).

JUVENILE LIFE HISTORY

Time of emergence

Oak Springs Hatchery incubates eggs in 54°F spring water. Eggs incubate approximately 14 days to eyed stage, eyed-eggs incubate 10 days to hatch, and alevins emerge in 4-11 days.

Time, age, and size at migration

Juveniles are reared in 54°F spring water at Oak Springs Hatchery until the acclimation period prior to release. Juveniles are released in November or December as age-0+ fingerlings at a size of 62-135/lb or in April or May as age-1 smolts at a size of 6-11/lb (Table 1). Fry and smolts are released from the Bonnifer facility.

Survival rate

Egg-to-fry survival of the 1984 brood at Oak Springs Hatchery was 90%. Smolt-to-adult survival is unknown.

DISEASE HISTORY

No viruses were detected in Umatilla summer steelhead from 1980-85. Juveniles contracted enteric redmouth and bacterial gill diseases; however, these diseases were not severe (R. Holt, ODFW, personal communication).

Eggs are incubated in isolation (chlorinated effluent). After a viral exam is completed and tests are negative, the fish are ponded.

PRIORITY INFORMATION NEEDS

1. Run size, catch, and escapement

2. Smolt-to-adult survival

3. Survival and interactions of hatchery presmolts with wild juveniles

REFERENCES

Schreck, C.B., H.W. Li, R.C. Hjort, and S.B. Yamada. 1984. Stock identification of Columbia River chinook salmon and steelhead trout. Annual progress report submitted to the Bonneville Power Administration, Divison of Fish and Wildlife, Portland, Oregon.

Walla Walla River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Walla Walla River, Oregon and Washington, a tributary to the Columbia River at RM 314.6 (22.6 miles above McNary Dam) that drains a watershed of 1,758 square miles, 1,275 of which are in Washington State. The Touchet River is the major tributary to the Walla Walla in Washington, draining approximately 750 square miles.

ORIGIN

Wild summer-run steelhead in the Walla Walla are native, although in Washington's portion of the drainage interbreeding may have occurred with introduced fish of Skamania, Wells, and Dworshak hatchery-stock origin.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch or escapement exist. Irrigation, livestock grazing, and silvicultural activities have hindered or blocked steelhead migrations in the Walla Walla and eliminated a considerable portion of the basin's steelhead spawning and rearing habitat. These factors, in conjunction with overfishing and construction of four hydroelectric dams on the mainstem Columbia River, have reduced stock abundance from former levels of 4,000 to 5,000 wild fish (Eldred 1964; Strickland 1968; Junge 1980).

Presently, harvest of the stock occurs in mainstem Columbia recreational and tribal fisheries, as well as in the Walla Walla River. The annual sport catch of wild and hatchery-origin summer steelhead in the Walla Walla (OR and WA) is approximately 530 (5-year average, based on punchcard returns). The interim escapement goal for the system is 1,600 wild adults.

Time of migration

Wild steelhead bound for the Walla Walla likely enter the Columbia River and migrate upstream between June and September. These fish enter the Walla Walla River between December and March, peaking in February and March (Eldred 1966; M. Schuck, Washington Department of Game (WDG), personal communication).

Spawning period

April and May (Hunter and Cropp 1975).

Spawning areas

Irrigation, grazing and logging have reduced usable steelhead spawning habitat in the Walla Walla system by approximately 50% (Figure 1).

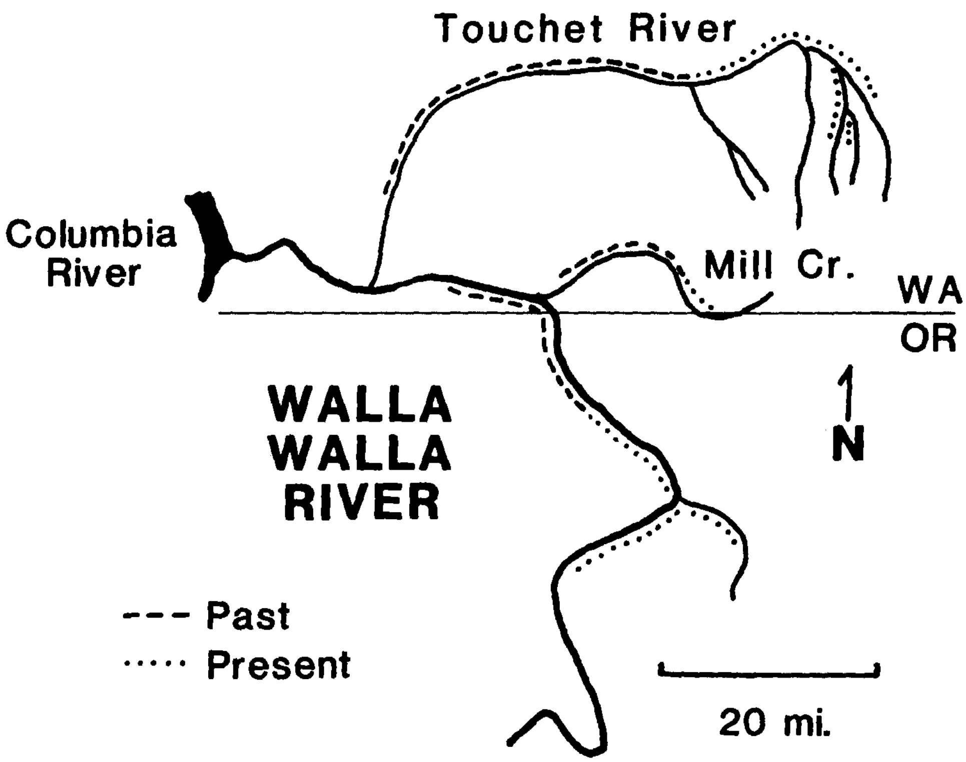

Figure 1. Probable past and present spawning areas of summer steelhead trout in the Walla Walla River system, Oregon and Washington (Fulton 1970; M. Schuck, WDG, personal communication).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most juvenile steelhead in the Walla Walla system outmigrate in late April and May at a size of 170 mm and an age of 2 years (M. Schuck, WDG, personal communication).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

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Junge, C. 1980. Techniques for assessing responsibility for passage losses at Columbia and Snake River dams. ODFW report to Columbia River Fisheries Council. Portland, OR.

Strickland, R. 1968. Washington Department of Game (WDG) correspondence to R. Larson, WDG. March 8, 1968.

Tucannon River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Tucannon River, Washington, a tributary to the Snake River at RM 63 (21 miles above Lower Monumental Dam) that drains a watershed of 504 square miles.

ORIGIN

The wild steelhead stock in the Tucannon River is native, although limited interbreeding may have occurred with introduced Skamania and Wells hatchery-stock steelhead.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size, catch and escapement do not exist. Former runs of wild steelhead to the Tucannon River were estimated to range from 3,400 to 4,000 adults (Eldred 1960; USACE 1975). Decreased production of wild fish is attributed to: 1) construction of six hydropower dams on the mainstem Columbia and Snake rivers below the mouth of the Tucannon; 2) overfishing on the mainstem Columbia River; 3) habitat degradation resulting from agricultural and silvicultural activities in the Tucannon watershed; and 4) hindrance or blockage of migrations due to irrigation practices. Harvest of the stock occurs in mainstem Columbia sport and tribal fisheries and in the Snake River recreational fishery. The Tucannon River has been closed to steelhead sport angling in recent years. An interim spawning escapement goal of 600 adults has been established for this stock.

Time of migration

Wild Tucannon steelhead likely enter the Columbia River and migrate upstream from June through September. However, these fish do not enter the Tucannon from the Snake River until winter - i.e., December through March (Parkhurst 1950; Eldred 1966; Kelley and Associates 1982).

Spawning period

April and May.

Spawning areas

Wild steelhead spawn in the upper mainstem Tucannon and in Cummings and Panjab creeks (Figure 1).

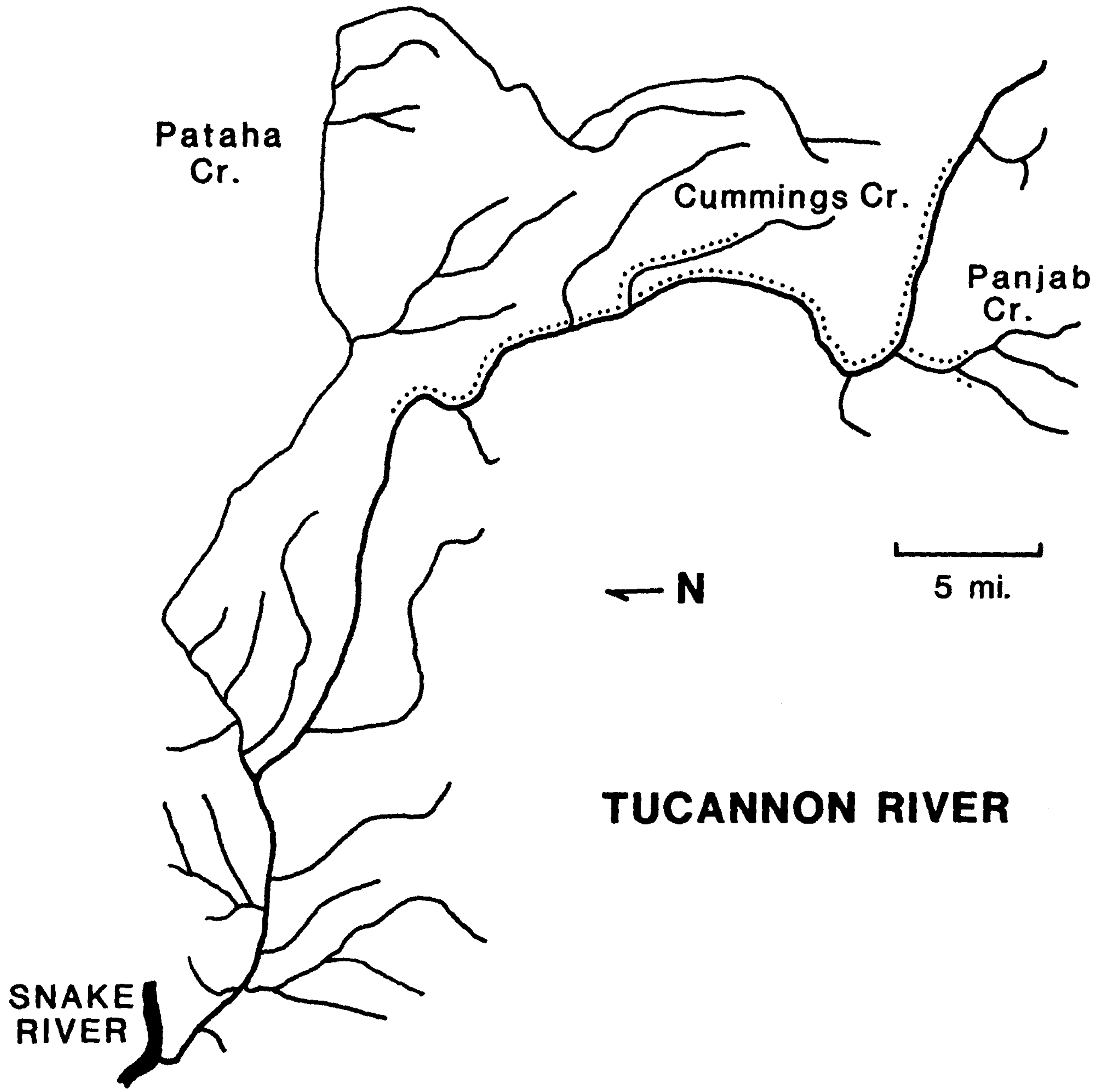

Figure 1. Probable spawning locations of steelhead trout in the Tucannon River, Washington (M. Schuck, WDG, personal communication).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Steelhead smolts outmigrate from the Tucannon in late April and early May after attaining a size of 170-200 mm and an age of 2 years (Simons 1973; M. Schuck, WDG, personal communication).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

Eldred, D.R. 1060. Washington Department of Game correspondence to F. Hauck, Idaho Department of Fish and Game. June 25, 1960.

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Simons, R.R. 1973. Preliminary report of steelhead parr-smolt transformation study, Tucannon Hatchery, 1971-72. Washington Department of Game.

USACE (U.S. Army Corps of Engineers). 1975. Lower Snake River Fish and Wildlife Compensation Plan. US Army Engineer District, Walla Walla, Washington.

Asotin Creek Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Asotin Creek, Washington, a tributary to the Snake River at RM 145 (38 miles above Lower Granite Dam) that drains a watershed of 322 square miles.

ORIGIN

Wild steelhead in Asotin Creek are indigenous, although limited interbreeding with introduced Wells hatchery-stock fish may have occurred.

ADULT LIFE HISTORY

Run size, catch, and escapement

Runs of wild steelhead to Asotin Creek averaged in excess of 800 fish annually for the years 1954 through 1960 (Table 1). Contemporary run sizes are unknown, but are believed to be reduced relative to former levels. Stock abundance has been adversely impacted by overfishing, construction of eight hydropower dams on the mainstem Columbia and Snake rivers, and deterioration of spawning and rearing habitat in the Asotin Creek watershed.

Table 1. Counts of wild summer steelhead adults trapped at the Washington Water Power Company diversion dam on Asotin Creek, 8 miles above its mouth, 1954 through 1961 (from Eldred and Douglas 1960; Eldred 1961).

YEAR TRAPPED	RUN YEAR	MALES	FEMALES	TOTAL	CORRECTED TOTAL 1/
1954	1953	---	---	371	408
1955	1954	332	609	941	1,035
1956	1955	533	1,140	1,673	1,840
1957	1956	249	289	538	592
1958	1957	153	357	510	561
1959	1958	124	264	388	427
1960	1959	326	467	793	872
1961	1960	55	169	242 2/	266

1/ 20% of run estimated to jump dam, but 10% of run thought to fall back and pass through fishway again; hence, corrected total = total + 10%.

2/ 18 fish not sexed; counts low due to theft of fish from trap.

Harvest of the stock occurs in mainstem Columbia tribal fisheries, as well as in mainstem Columbia and Snake sport fisheries. Asotin Creek has been closed to recreational steelhead angling in recent years. An interim escapement goal of 225 steelhead has been set for this stock.

Time of migration

Asotin Creek steelhead probably migrate through the Columbia mainstem reservoirs between July and September. Eldred (1961) indicated that these fish may be among the last to pass McNary Dam and that they do not typically enter Asotin Creek until mid-February, peaking in March and April.

Spawning period

April and May.

Spawning areas

Wild summer steelhead spawn in upper mainstem Asotin creek and in the lower reaches of the North and South Forks (Figure 1).

Age composition

Eldred (1961) noted that Asotin Creek outmigrants predominantly returned to the stream 2 years from the time of release.

Size

Unknown.

Sex ratio

The male:female sex ratio of wild summer steelhead in Asotin Creek averaged 0.54 for the years 1955 through 1961 (Table 1).

Fecundity

Eighteen native Asotin Creek females were spawned in 1954 for 65,062 eggs, an average of 3,615 eggs per female (Kray 1959).

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most Asotin Creek smolts likely outmigrate in late April and May as 170-200 mm 2-year olds.

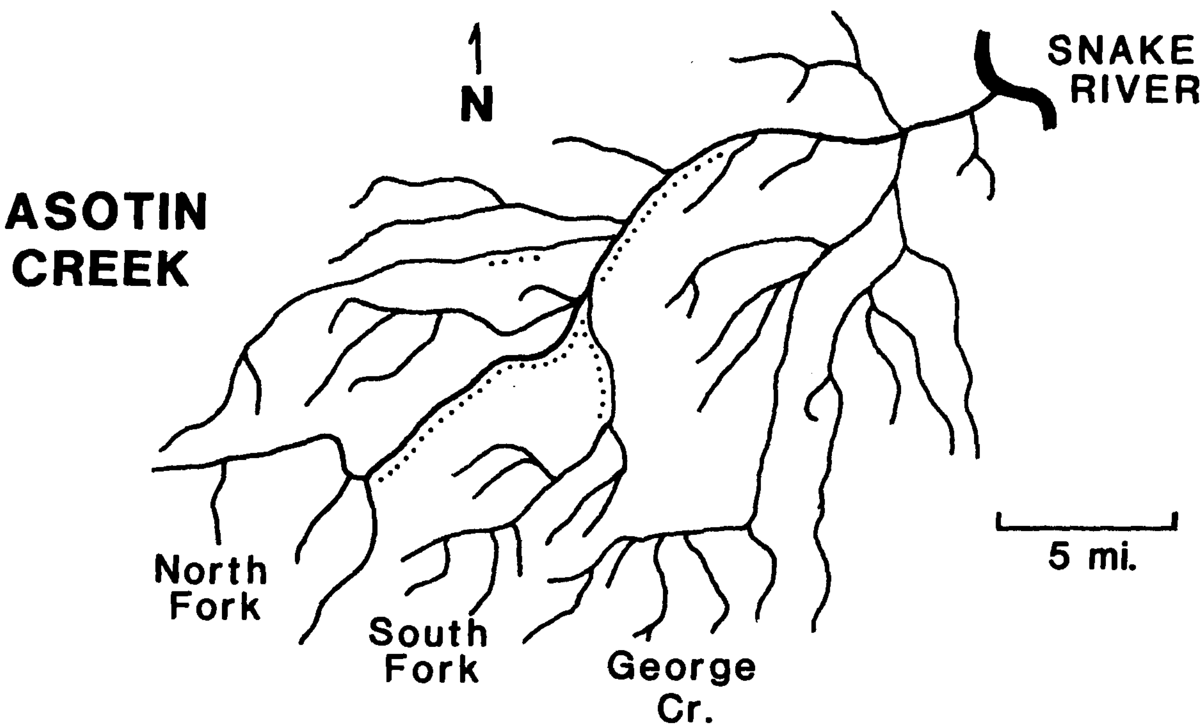

Figure 1. Probable spawning areas of steelhead trout in Asotin Creek, Washington (M. Schuck, WDG personal communication).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

Eldred, D.R. 1961. Summary of activities for the year 1961, District 3. Washington Department of Game.

Eldred, D., and J. Douglas. 1960. A report of factors influencing the production of steelhead in southeast Washington. Washington Department of Game.

Kray, A. 1959. A survey of the Yakima River Basin with recommendations for the rehabilitation of steelhead runs. Washington Department of Game.

Dworshak Hatchery Summer Steelhead

Dworshak National Fish Hatchery (DNFH) was constructed by the U.S. Army Corps of Engineers to maintain the North Fork of the Clearwater River steelhead run that was blocked by Dworshak Dam. DNFH is operated by the U.S. Fish and Wildlife Service.

PRODUCTION

Fish are spawned, reared and released as smolts primarily at DNFH (Table 1). Since 1982, Kooskia NFH has assisted with early rearing of steelhead. Steelhead eyed eggs have also been hatched at artificial spawning channels at Red River and Meadow Creek (South Fork Clearwater River drainage) and at Hayden Creek Hatchery. Subsmolts, smolts and unspawned adults have been released into many Clearwater River tributaries and occasionally into the Snake River and Salmon River drainages (Table 2) (USFWS file records).

GEOGRAPHIC LOCATION

DNFH is at the mouth of the North Fork Clearwater River near Orofino, Idaho. Smolts are released primarily at the hatchery site into either the North Fork or mainstem Clearwater River. Fish are also released as subsmolts, smolts and unspawned adults throughout much of the Clearwater River drainage; limited introductions have occurred in the Snake and Salmon River drainages.

ORIGIN

The stock was developed from native North Fork Clearwater River steelhead beginning in 1969.

ADULT LIFE HISTORY

Run size, catch and escapement

The run size by migration class (years at sea) of DNFH steelhead returning to the Clearwater River since 1972 has ranged from 1,841 in 1974-75 to 25,413 in 1977-78, with two-ocean fish predominating (Table 3) (Lukens 1984).

DNFH steelhead are harvested in the fall and spring in Clearwater River sport fisheries and by Nez Perce tribal anglers. Estimated catches for these fisheries are presented in Tables 4-6 (Lukens 1984).

Harvest estimates based on coded-wire tag returns for the 1977 brood year in 1981 indicate that the Idaho sport fishery, the Nez Perce tribe Clearwater River fishery and the Zone 6 Indian gillnet fishery accounted for most of the identified harvest of DNFH steelhead (Table 7) (Duke 1984).

DNFH steelhead with coded wire tags have been caught in Canadian and Japanese gillnet fisheries and in experimental sampling in the ocean (Table 8) (Duke 1984).

Table 1. Number and age of steelhead smolts released from Dworshak NFH, and total and percent returns to the Clearwater River.

Year released	% of smolts reared to age 1	age 2	Number of smolts released at DNFH	Return Total	%
1970	100	0	1,371,543	11,656	.850
1971	42.7	57.3	3,143,573	10,222	.325
1972	0	100	976,554	3,320	.340
1973	51.7	48.3	2,628,719	1,916	.073
1974	100	0	3,397,859	3,084	.091
1975	100	0	1,761,900	28,180	1.600
1976	100	0	1,753,300	9,315	.531
1977	84.5	15.5	1,850,000	3,794	.205
1978	96.8	3.2	1,597,695	7,315	.458
1979	97.3	2.7	1,227,312	8,161	.664
1980	84.0	16.0	2,696,601	24,394	.905
1981	85.5	14.5	2,632,861	(5,537) [a]	--
1982	75.6	24.4	2,678,497	(3,466) [a]	--
1983	100	0	2,144,947	--	--
1984	100	0	1,961,372	--	--

[a] Incomplete returns

Table 2. Summary of outplants of Dworshak NFH steelhead by subbasin and stream, 1969-84.

Subbasin and stream	Life stage	Years stocked	Number
CL1 - Clearwater River			
Potlatch Creek	subsmolt	1979-81	395,000
	adult	1978, 83	2,632
CL3 - Clearwater River			
Eldorado Creek	subsmolt	1983	325,000
Lolo Creek	subsmolt	1973, 78-80	1,268,335
	smolt	1974	101,995
	adult	1974, 78, 79, 83	2,372
Musselshell Creek	subsmolt	1973	230,335
CL4 - S. Fork Clearwater R.	subsmolt	1973, 78, 79, 80	4,246,641
	smolt	1981-84	1,600,596
American River	smolt	1984	117,177
Crooked River	subsmolt	1969, 71, 74, 81	700,380
	smolt	1984	15,850
	adult	1978	660
Legget Creek	subsmolt	1981	148,000
Meadow Creek	egg	1981-83	2,888,500
	subsmolt	1979, 80	559,766
Mill Creek	adult	1978	400
Newsome Creek	subsmolt	1969, 78, 81	765,120
	smolt	1984	62,132
	adult	1974, 78, 79	1,522
Rainy Day Creek	adult	1978	1,400
Red River	egg	1978-83	8,533,200
	subsmolt	1969	502,040
	smolt	1984	82,929
	adult	1974, 78	550
CL5 - Middle Fork			
Clearwater River	subsmolt	1977, 79	496,271
Clear Creek	smolt	1978, 81, 83, 8	889,984
CL6 - Lochsa River	subsmolt	1979-81	1,177,250
	adult	1973	1,194
Badger Creek	subsmolt	1982	58,000
Boulder Creek	smolt	1977	27,763
	adult	1974	407
Brushy Fork Creek	subsmolt	1973, 80, 81	939,180
Canyon Creek	subsmolt	1978	150,000

Table 2. continued.

Subbasin and stream	Life stage	Years stocked	Number
Crooked Fork Creek	subsmolt	1973	374,195
Deadman Creek	subsmolt	1978	300,000
Papoose Creek	subsmolt	1974, 78, 81	640,000
Pete King Creek	subsmolt	1978, 81, 82	348,500
Shotgun Creek	subsmolt	1978	300,000
Spruce Creek	subsmolt	1978	300,000
Squaw Creek	subsmolt	1974, 78, 82	400,000
White Sand Creek	subsmolt	1978, 79	456,250
	adult	1974, 81	735
SN1 - Snake River	adult	1983	611
Captain John Creek	subsmolt	1981	23,855
SN2 - Snake River	smolt	1978	1,227,312
SA1 - Salmon River	subsmolt	1980	500,000
Slate Creek	adult	1983	171
SA6 - Salmon River			
N. Fork Salmon River	subsmolt	1980	100,000
SA7 - Lemhi River			
Hayden Creek	subsmolt	1974	550,000
	smolt	1978	119,300
SA8 - Pahsimeroi River	smolt	1978	34,246

Table 3. Run size by migration class and return to hatchery by Dworshak NFH steelhead, 1972-84.

Year	Run size to Clearwater River				Return to Dworshak NFH
	One-ocean	Two-ocean	Three-ocean	Total	
1971-72	834	--	--	834	834
1972-73	1,421	9,916	--	11,337	9,830
1973-74	1,872	8,767	906	11,545	7,910
1974-75	414	1,393	34	1,841	1,560
1975-76	345	1,450	55	1,850	1,850
1976-77	1,115	2,345	52	3,512	3,100
1977-78	905	25,413	394	26,712	12,730
1978-79	507	7,920	1,612	10,039	4,940
1979-80	320	2,950	490	3,770	2,580
1980-81	178	6,617	327	7,122	2,590
1981-82	628	3,714	328	4,670	3,054
1982-83	650	21,696	4,269	26,615	7,662
1983-84	3,466	4,887	2,067	10,420	3,384

Table 4. Fall steelhead fishing effort and catch rates for Nez Perce tribal anglers fishing the lower Clearwater River, 1976-1983. (Number of steelhead released in parentheses.)

Year	Hours	Fish	Hours/fish
1976	2,025	374	5.4
1977	903	137	6.6
1978	1,375	236	5.8
1979	1,066	277 (13)	3.7
1980	354	46	7.7
1981	1,659	346	4.8
1982	269	66	4.1
1983	328	27	12.1

Table 5. Fall Clearwater River steelhead catch, effort and catch rates for non-tribal boat and shore anglers, 1969-1983. (Number of steelhead released in parentheses.)

Year	Shore Anglers Hours	Shore Anglers Catch	Shore Anglers Hours/fish	Boat Anglers Hours	Boat Anglers Catch	Boat Anglers Hours/fish
1969	26,939	708	38.0	25,882	1,437	18.0
1970	22,144	583	38.0	22,144	1,130	19.6
1971	24,379	915	26.6	15,587	664	23.5
1972	29,867	1,049	28.5	28,694	1,949	14.7
1973	15,386	385	40.0	29,866	1,756	17.0
1974	6,182	130	47.6	8,066	277	29.1
1975	1,543	192	7.9	1,515	238	6.0
1976	3,944	696	5.7	3,094	782	4.0
1977	32,268	1,482(546)	16.0	49,287	2,411(676)	16.0
1978	3,568	631	5.6	5,992	1,598	3.8
1979	2,895	558	5.2	4,194	1,076	3.9
1980	20,954	552(168)	40.1	52,894	1,994(507)	21.2
1981	4,080	674	6.1	5,634	1,446	3.9
1982	38,965	1,425(336)	27.3	99,816	6,035(1,205)	16.5
1983	30,276	1,277(507)	23.7	80,734	4,272(712)	18.9

Table 6. Estimated non-tribal angler effort, catch and catch rates during spring steelhead seasons (January-April) on the Clearwater River, 1970-74, 1978, 1979 and 1981-84 (Number of steelhead released in parentheses.)

Year	Boat Anglers Hours	Boat Anglers Catch	Boat Anglers Hrs/fish	Shore Anglers Hours	Shore Anglers Catch	Shore Anglers Hrs/fish
1970	8,171	282	29.0	6,324	47	134.5
1971	7,432	390	19.1	5,120	113	45.3
1972	323	12	26.9	1,020	25	40.8
1973	12,114	1,064	11.4	10,587	600	17.7
1974	8,490	723	11.7	5,706	252	22.6
1978	42,093	2,774	15.2	68,071	6,190	11.0
1979	57,786	2,545	22.7	54,874	2,064	26.6
1981	65,353	1,854	35.2	35,484	624	56.8
1982	12,005	372	32.3	16,617	573	29.0
1983	79,349	4,050(282)	19.6	63,409	1,837(104)	34.5
1984	50,731	1,649(109)	30.8	29,666	530(24)	56.0

Table 7. Expanded harvests and hatchery returns for 1977 brood year, summer steelhead released from Dworshak National Fish Hatchery, Idaho, in 1981.

	Hatch[a] rack	Deschutes sport	Indian Gill	Indian Cere.[b]	Indian Idaho[c]	Ocean	Idaho sport[d]	Illegal har.	Total[e]
Number	2,392	59	1,061	8	1,344	13	4,088	5	8,970
Percent of total	26.7	0.7	11.8	0.09	15.0	0.1	45.6	0.05	100

a Enumerated at the spawning rack and based on length frequency data.
b Tag recovery data not expanded because sampling information is unavailable.
c Estimated harvest for 1979-80 season, fall season only for years 1981-82, all adjusted for appropriate age classes in expected years of return (Lukens 1983).
d No sport harvest in 1980-81. Estimates for 1981-83 adjusted for appropriate age classes in expected years of return (Lukens 1983).
e Total percent not exact due to rounding.

Table 8. Coded-wire tag (CWT) recoveries for Dworshak NFH steelhead in ocean fisheries and experiments.

Fishery or experiments	Location	Age	Length (mm)	Recovery date	Release date	CWT group
Canada-gill net	Northern	2	643	9/21/79	4/21/78	100231
	Juan de Fuca	4	868	8/17/79	5/21/77	101307
	Northern	3	856	9/02/79	5/21/77	101309
	Northern	2	900	9/20/79	4/15/77	101310
Japan-gill net	High seas	2	604	7/22/81	5/20/80	102119
Japan-experiment	High seas	2	778	6/17/82	4/25/80	102161
OSU-experiment	Warrenton	1	206	5/21/81	5/06/81	102252

Spawner returns to DNFH since 1972-73 have ranged from 1,560 in 1974-75 to 12,730 in 1977-78 (Table 3) (Lukens 1984).

The spawning escapement objective for DNFH is 3,200 steelhead, based on a sex ratio of 60 females:40 males (pers. comm., D. Diggs, USFWS).

Time of migration

The Columbia River group B steelhead, of which the Dworshak stock is a part, are considered to enter the lower Columbia River from late-August through October, peaking at Bonneville Dam in September. Dworshak steelhead move through the Columbia River into the Snake River, with some fish reaching the Clearwater River by September and others remaining in the lower Snake River over the winter period.

Coded-wire tag recoveries in the Columbia River fisheries come primarily from the Zone 6 Indian gillnet fishery during September and February through March and from the Clearwater River sport fishery during October through April (Table 9) (Duke 1984). Occasional tagged fish have been recovered in Oregon's Deschutes River sport fishery during August through October. Timing of the recoveries reflects fishing intensity at a particular time as well as migrational timing of the run.

Steelhead enter the trap at DNFH primarily during March, April and May (Table 9).

Spawning period

Spawntaking has begun as early as January 26 and as late as April 26 (Table 10) (USFWS file records). Generally, half the fish have been spawned by mid-April. End of spawntaking has ranged from May 6 to June 30.

Spawning areas

The DNFH stock formerly spawned in the North Fork Clearwater River and its tributaries (Fulton 1970). Since being blocked at Dworshak Dam, spawning is done artificially at DNFH. Some adults not needed for spawntaking have been outplanted to upper Clearwater River drainage waters to supplement natural spawning stocks (Table 2).

Age composition

Age at maturity ranges from 3 to 6 years, depending on the age of smolts at release and the number of years spent at sea. A one-ocean adult that was released as a 1-year-old smolt has had a total life of 3 years; 1 year in the hatchery, 1 year at sea and 1 year on the returning freshwater migration. A three-ocean adult that was released as a 2-year-old smolt has had a 6-year lifespan. Returning adults have been classified by the number of years at sea but not by their age at release (except for experimental tag groups; e.g., Bjornn and Ringe 1984).

Table 9. Recoveries by month of coded-wire tagged adult steelhead from Dworshak NFH, 1977-80 smolt releases into North Fork Clearwater River and Clearwater River (tag groups 50425, 50455, 100231, 101310, 101311, 101313, 102161, and 102162 combined).

rea and type of recovery	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
Ocean fisheries													
Canada, Japan	1			2									3
Columbia River													
Below Bonn. Dam													
Sport, illegal				7									7
Bonneville Dam													
Experiment						1							1
Columbia Zone 6													
Indian gill net			2	143				10	32	1			188
Indian-Cer.,													
Treaty, Subsist.					1						2		3
Deschutes River													
Sport			3	6	1								10
Snake River													
Sport						1	3						4
Salmon River													
Sport						1			1				2
Clearwater River													
Sport					16	19	17	12	11	26	8		109
Dworshak NFH													
Hatchery rack								2	6	352	536	186	1,081
Other													
Orofino Cr-sport									1				1
Kooskia NFH											1		1
Pahsimeroi Hatchery											1		1

Table 10. Yearly spawntaking record for Dworshak NFH steelhead, 1970-84.

Year	Total number spawned	Begin spawntaking	Median number spawned	End spawntaking
1970	2,856	--	--	6/8
1971	2,312	--	--	6/30
1972	2,324	4/26	4/26	6/26
1973	9,938	3/19	4/12	5/29
1974	7,910	2/20	4/15	5/15
1975	1,698	3/3	4/21	6/9
1976	1,858	2/13	4/20	6/4
1977	3,100	2/22	4/5	5/20
1978	12,727	2/14	3/28	5/9
1979	4,939	2/20	4/3	5/15
1980	2,519	3/11	4/15	5/13
1981	1,968	3/10	3/31	5/19
1982	2,804	2/2	4/20	5/18
1983	3,125	1/26	3/29	5/10
1984	2,866	2/2	4/17	5/5

DNFH steelhead primarily spend 2 years at sea. The percentage of adults returning as two-ocean fish has ranged from 42-90%; one-ocean fish have made up 2-56% of returns and three-ocean fish have made up 0.3-52% (Table 11) (Lukens 1984).

Size

Years-in-ocean is determined by USFWS as: one-ocean--<30 inches, total length; two-ocean--30-36 inches; three-ocean-->36 inches. Length frequency distributions of adult steelhead returning to DNFH in 1978, 1979 and 1983 are shown in Figures 1-3 (Pettit and Lindland 1979; Lukens 1984).

Sex ratio

The sex ratio of returning adults averages 60 females:40 males (pers. comm., D. Diggs, USFWS).

Fecundity

Adult females contain an average 6,000 eggs (pers. comm., D. Diggs, USFWS).

Biochemical-genetic characteristics

Milner (1977) determined allele frequencies at 25 loci for 15 Columbia River steelhead populations, including DNFH stock. He found that DNFH stock conformed to the pattern of geographical variation between populations east and west of the Cascades crest and a uniquely high frequency of the allele for the peptidase locus. Thus, the DNFH population was distinguished from all other Columbia River systems that had been examined up to that time.

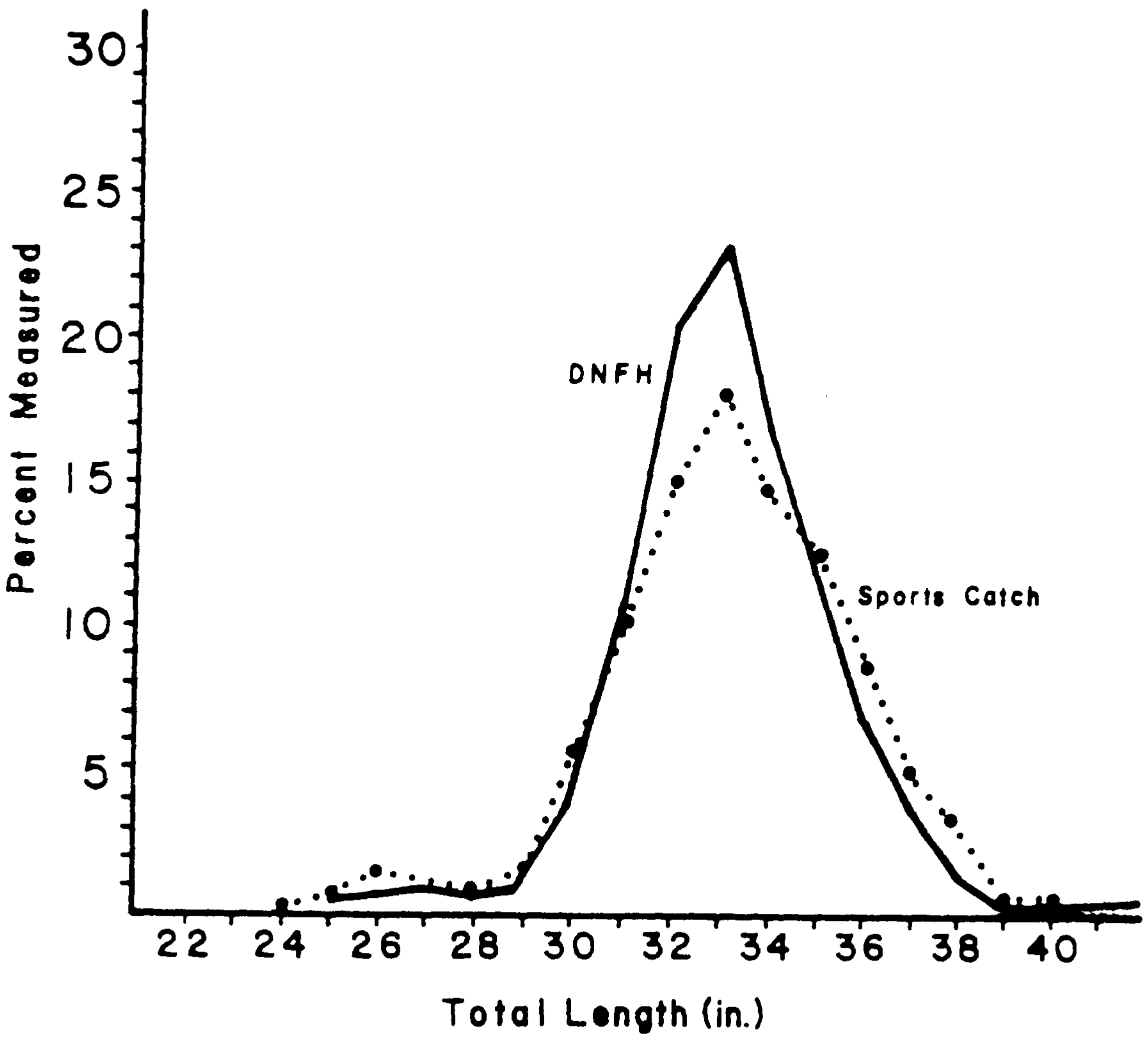

Figure 1. The length frequency of Dworshak hatchery steelhead during the 1977-1978 fish year. Distributions for fish measured in the sports catch are shown separately from those taken during spawning operations at the hatchery.

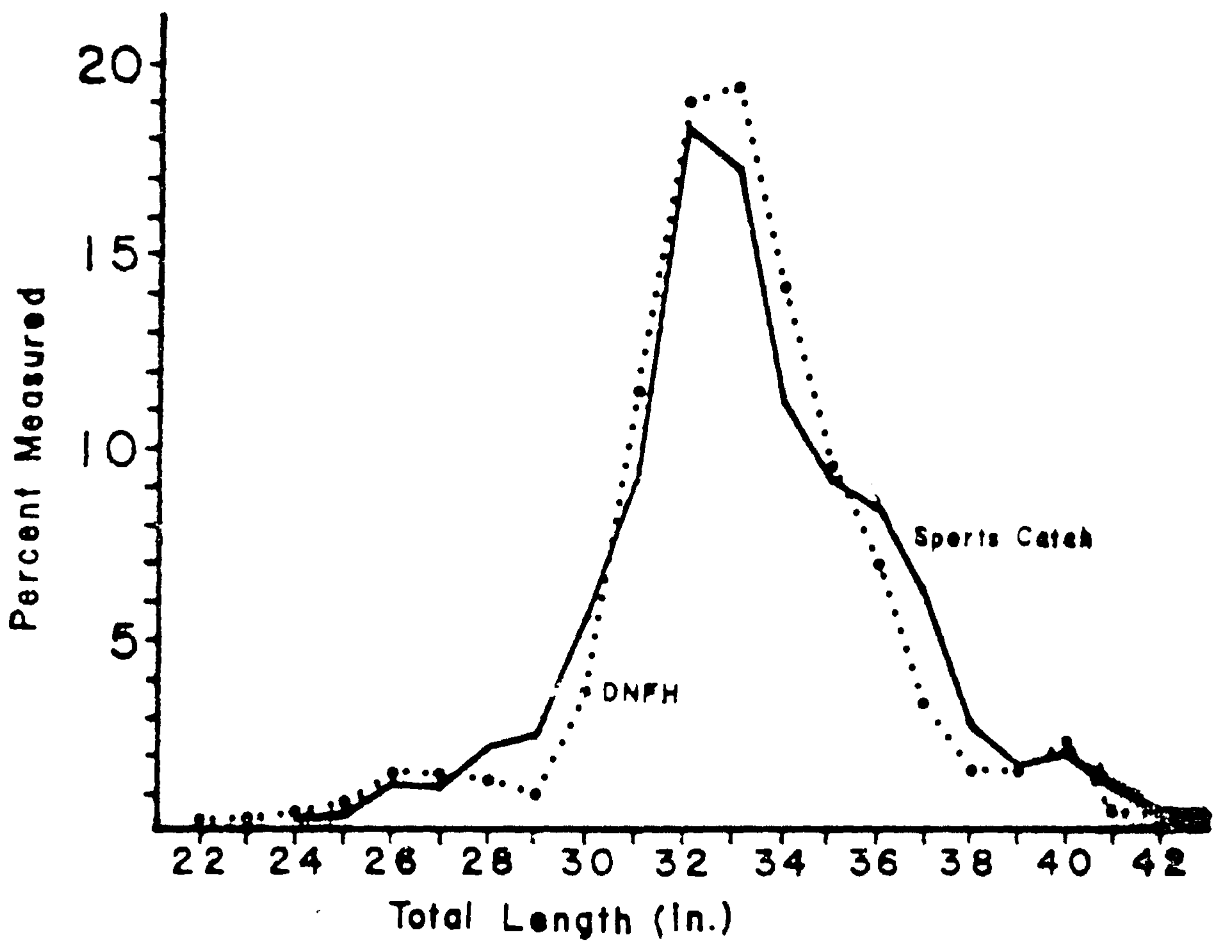

Figure 2. The length frequency distribution of adult, summer run hatchery fish returning to Dworshak Hatchery and from hatchery fish measured in angler's creels during the spring season, 1979. The sports catch sample was 650 and the sample taken at DNFH was 4,366.

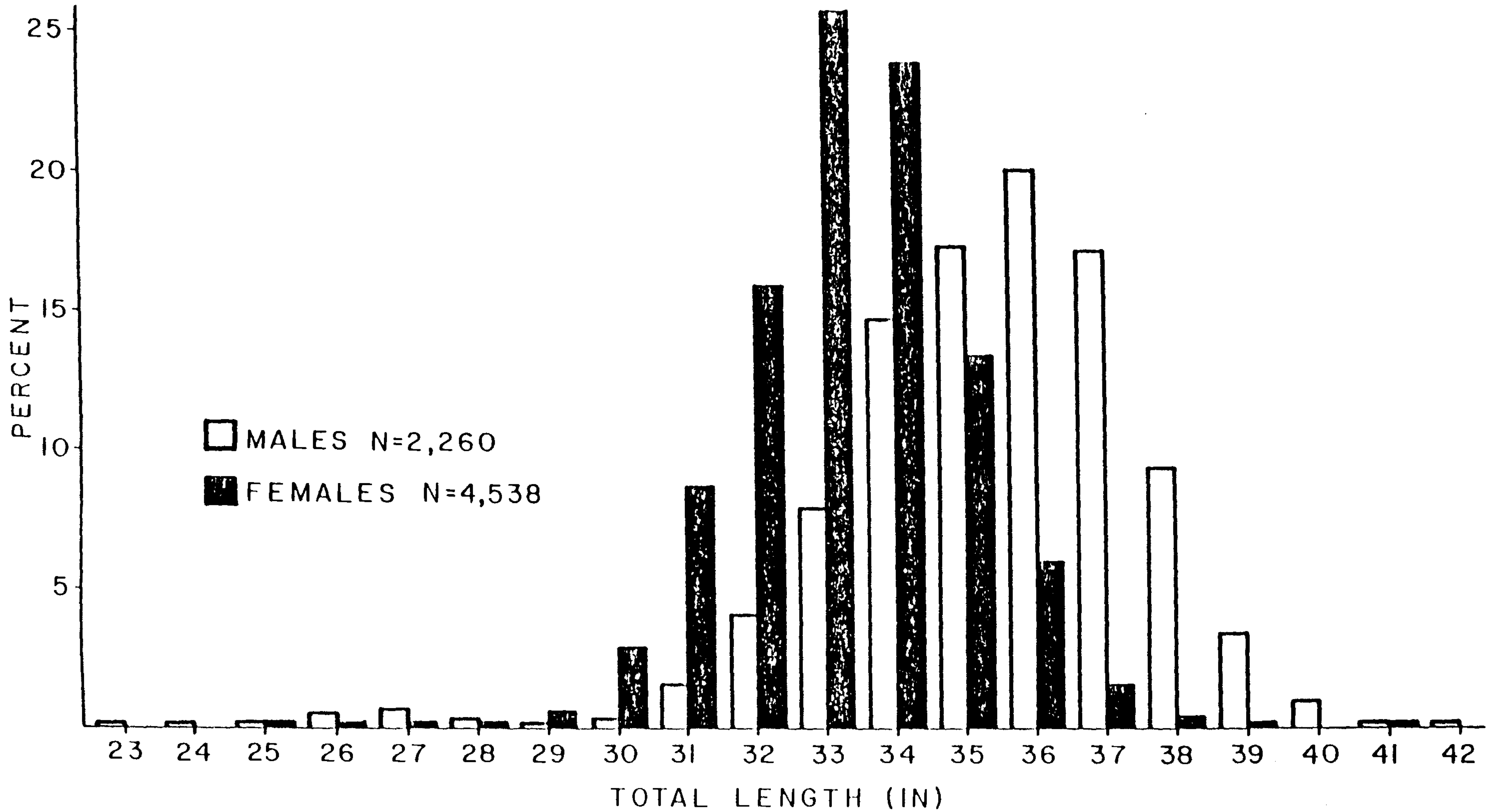

Figure 3. Length frequency of adult steelhead returning to Dworshak National Fish Hatchery during the 1983 spawning operation.

JUVENILE LIFE HISTORY

Time of emergence

In DNFH, hatching usually occurs in April and May and swim-up in late May and early June (pers. comm., G. Pratschner, USFWS).

Time, age and size at migration

Steelhead smolts are released form DNFH at either age 1 or age 2 (Table 1) (USFWS file records). Size of smolts released have generally averaged between 14.2/pound and 5.0/pound (5.8-8.3 inches, total length; pers. comm., D. Diggs, USFWS).

Smolts are generally released form DNFH during the period April 12 through May 20. Depending on the release date and flow conditions in the Snake and Columbia rivers, naturally migrating steelhead smolts from DNFH reach the lower Columbia River at Jones Beach (Rkm 75) during May through early June, 1 to 8 weeks after their release (Table 12) (Dawley et al. 1982, 1984).

Table 11. Percentage by release year of Dworshak NFH adult steelhead returning to the Clearwater River after 1, 2, and 3 years in the ocean.

Release	Total adult	One-ocean		Two-ocean		Three-ocean	
year	return	(year)	%	(year)	%	(year)	%
1970	11,656	(1972)	7.2	(1973)	85.1	(1974)	7.8
1971	10,222	(1973)	13.9	(1974)	85.8	(1975)	0.3
1972	3,320	(1974)	56.4	(1975)	42.0	(1976)	1.7
1973	1,916	(1975)	21.6	(1976)	75.7	(1977)	2.7
1974	3,084	(1976)	11.2	(1977)	76.0	(1978)	12.8
1975	28,180	(1977)	4.0	(1978)	90.2	(1979)	5.7
1976	9,315	(1978)	9.7	(1979)	85.0	(1980)	5.3
1977	3,794	(1979)	13.4	(1980)	78.0	(1981)	8.6
1978	7,315	(1980)	4.4	(1981)	90.5	(1982)	5.2
1979	8,161	(1981)	2.2	(1982)	45.5	(1983)	52.3

Survival rate

Survival from smolt-to-adult returns to the Clearwater River has ranged from 0.073% for the 1973 release to 1.600% for the 1975 release (Table 1) (Lukens 1984; USFWS file records).

DISEASE HISTORY

Major disease problems affecting steelhead production at DNFH have been *Ichthyopthirius* ("Ich"), infectious hematopoietic necrosis (IHN), external parasites and occasionally, bacterial gill disease. Prior to mineral additions (sodium, potassium and chloride) in 1981, steelhead suffered from an ion exchange imbalance (pers. comm., J. Leintz, USFWS).

IHN first appeared at DNFH in 1980 in adult Kooskia spring chinook which were being held at Dworshak. Losses of juvenile steelhead to IHN began in 1981 and have since been a chronic problem. Culling for IHN positive fish began in 1982, and 3-3.5 million eggs have been transferred annually for early rearing to Kooskia NFH, which is free of the virus.

Water quality at DNFH is high, except that the extremely soft water makes fish more sensitive to disease. Nitrogen gas saturation caused problems before 1974. The hatchery has established a monitoring program for fish health and water quality.

Other diseases reported for DNFH steelhead include:

1. Bacterial kidney disease
2. Furunculosis
3. Glochidia
4. Enteric red-mouth disease

PRIORITY INFORMATION NEEDS

1. Detailed knowledge of the pathology and effective control methodologies for IHN.

Table 12. Recapture dates of Dworshak NFH steelhead smolts with coded wire tags at Jones Beach (RKm 75).

Release year	Coded wire tag group	Release date [a]	Recapture date: 10 percentile	Recapture date: Median	Recapture date: 90 percentile	Number of days
1977	101310[b]	4/15	5/4	5/10	5/31	19-46
	101311	4/20	5/4	5/5	5/11	14-21
	101313	4/21	5/5	5/5	5/5	14
1978	100231	4/21	5/3	5/14	6/17	12-57
	101315	4/25	5/3	5/9	5/30	8-35
1979	50425	4/6	5/2	5/14	6/1	26-56
	100533	5/23	5/30	5/30	6/2	7-9
1980	50455	4/17	5/5	5/5	5/5	18
	102162	4/17	4/29	5/6	5/14	12-27
	102161	4/25	5/3	5/9	5/19	8-24
1981	102341	4/29	5/7	5/16	5/31	8-32
	102251	5/4	5/12	5/18	5/28	8-24
	102252	5/4	5/11	5/13	6/14	7-41
	102253	5/4	5/11	5/12	5/31	7-27
1982	51024	5/3	5/15	5/20	6/3	12-31
	51025	5/3	5/13	5/20	5/29	10-26
	51027	5/5	5/14	5/20	6/17	9-43
	51026	5/6	5/16	5/20	5/26	10-20

[a] Duke (1984).

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Lower Snake River Summer Steelhead (Wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Snake River, Washington, a tributary to the Columbia River at RM 324.2.

ORIGIN

The stock is native, although interbreeding has likely occurred with steelhead bound for rivers and streams tributary to the Snake River.

ADULT LIFE HISTORY

Run size, catch, and escapement

Present run sizes of wild lower Snake River steelhead are unknown, but believed to be considerably less than the historical magnitude of 4,600 (USACE 1975). Depletion of the stock is attributed to overfishing, elimination of spawning/rearing habitat, and mortalities associated with fish passage through eight hydroelectric dams on the mainstem Columbia and Snake rivers. Harvest of the stock occurs in mainstem Columbia sport and tribal fisheries, as well as in the Snake River. Snake River sport catch data are not presented here as most fish harvested in the mainstem Snake are bound for upriver spawning grounds or hatchery release sites in Idaho and Oregon. An interim escapement goal of 225 adults has been established for this stock.

Time of migration

Unknown.

Spawning period

Unknown.

Spawning areas

Construction of Ice Harbor, Lower Monumental, Little Goose and Lower Granite dams on the lower Snake River eliminated approximately 80% of the mainstem spawning and rearing habitat available to steelhead (Figure 1). Spawning is presently limited to that portion of the mainstem upstream from the town of Asotin (RM 145), to parts of Alpowa Creek, and the extreme lower reaches of the following independent tributaries to the Snake: Deadman, Meadow, Penawawa, Almota, Steptoe Canyon, Tenmile and Couse creeks (Eldred and Douglas 1960; Fulton 1970; Mendel 1981; G. Mendel and M. Schuck, Washington Department of Game, personal communication).

Age composition

Unknown.

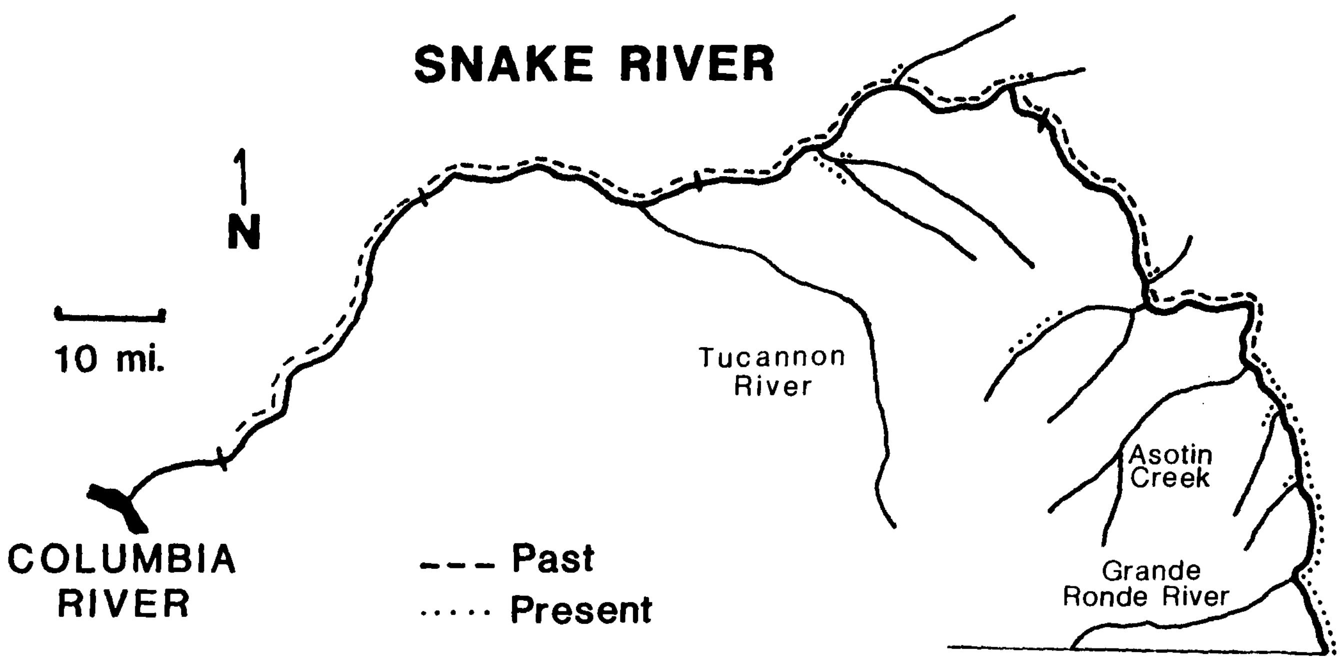

Figure 1. Probable past and present spawning areas of wild steelhead trout in the lower Snake River, Washington.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Like juvenile steelhead in other portions of the Snake River, most wild smolts produced in the mainstem and small independent tributaries probably outmigrate in April and May at an age of 2 years and a size of 170 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

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Grande Ronde River Summer Steelhead (wild)

PRODUCTION

Steelhead production in the Grande Ronde Basin consists of wild and hatchery stocks. Information in this summary primarily deals with the wild stock. Consult "Wallowa Summer Steelhead (hatchery)" for information on the hatchery stock.

GEOGRAPHIC LOCATION

Streams

Grande Ronde River and tributaries (Figure 1).

ORIGIN

Summer steelhead are native to the Grande Ronde River system. Parkhurst (1950) reported that steelhead eggs were taken in the lower Wallowa River for propagation in the early 1900s. Skamania and Idaho (Oxbow) hatchery stocks have been released in the system, and since 1976 various Snake River hatchery stocks have been released as part of the Lower Snake River Compensation Plan (see "Wallowa Summer Steelhead"). An objective of the plan is to maintain native stocks of wild summer steelhead in the Minam and Wenaha rivers and in Joseph Creek.

ADULT LIFE HISTORY

Run size, catch, and escapement

Sport harvest of steelhead in the Grande Ronde system declined rapidly from 1966 to 1973 (Tables 1 and 2). Since then the area in Oregon has been closed to sport fishing. There has been no sport catch in the Washington portion of the drainage since 1980. Estimates of harvest in the tribal gill-net fishery in the Columbia River are unavailable.

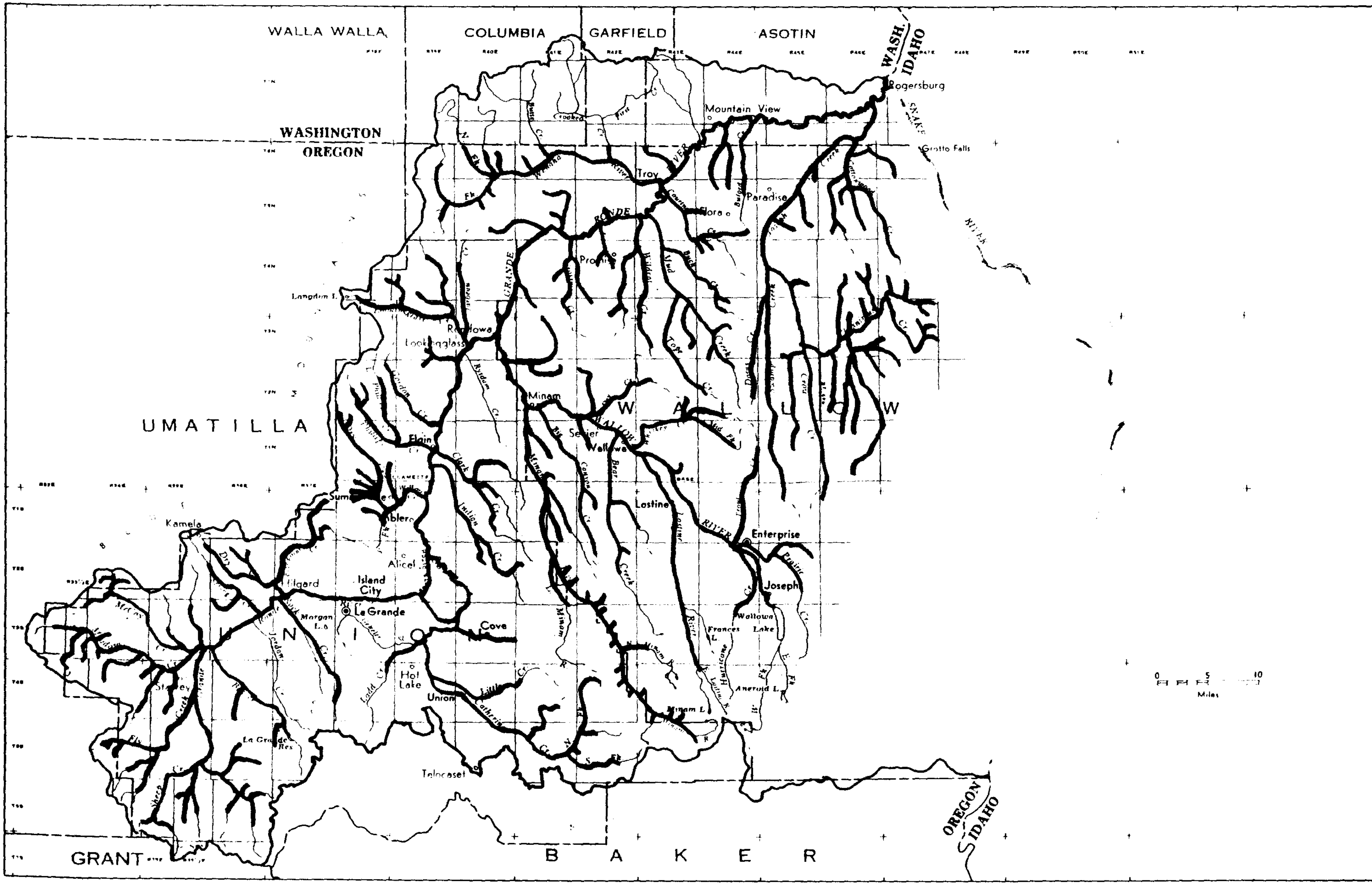

Figure 1. Distribution of summer steelhead in the Grande Ronde River system (modified from Smith 1975).

Table 1. Estimated Oregon sport harvest of steelhead in the Grande Ronde River and major tributaries 1959-1973.[a]

Year	Grande Ronde River	Wenaha River	Wallowa River	Minam River	Catherine Creek	Total
1959	1,590	72	260	30	90	2,024
1960	709	85	221	65	59	1,139
1961	838	104	122	90	21	1,175
1962	1,278	68	44	27	27	1,444
1963	1,049	81	200	42	3	1,375
1964	691	9	177	148	--	1,025
1965	1,574	35	261	81	--	1,951
1966	1,921	60	115	26	13	2,130
1967	1,385	90	453	100	--	1,028
1968	1,252	18	272	121	--	1,663
1969	1,319	75	61	38	-	1,493
1970	1,237	14	284	43	5	1,583
1971	766	120	78	106	5	1,075
1972	706	23	35	0	0	764
1973[b]	268	4	107	16	8	403

[a] Catches prior to 1971 not adjusted for non-response bias.
[b] Grande Ronde drainage has been closed to angling after October 1974.

The Umatilla and Nez Perce tribes have historically fished in the Grande Ronde for subsistence; however, the Umatilla tribes closed the area in 1982 and 1983 (James 1984).

Recent spawning ground counts have declined to about one-third of their level in 1967-71 (Table 3, Figure 2). Reduction of harvest has failed to reverse this trend. Mortality resulting from hydroelectric dams on the Columbia and Snake rivers and habitat degradation have been related to the decline (Hirose 1984; K. Witty, ODFW, personal communication).

Time of migration

Adults bound for the Grande Ronde pass Bonneville Dam during July and pass John Day Dam primarily during August through October (TAC 1984). Like most stocks in the Snake River Basin, Grande Ronde summer steelhead migrated through the lower Snake River during two periods: a fall movement which peaked mid-to late September and a spring movement which peaked between early April and mid-May (Thompson et al. 1958). Adults enter the lower Grande Ronde as early as July (James 1984) and the larger tributaries in early fall (Figure 3). Fish move into smaller spawning tributaries in the following spring. May was the peak month for migration into Lookingglass Creek (Table 4).

Table 2. Washington sport catch of steelhead in the Grande Ronde River, 1947-83.[a]

Run year	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
1947-48								--	--	--	--	--	16
1948-49								--	--	--	--	--	0
1949-50								--	--	--	--	--	10
1950-51								--	--	--	--	--	164
1951-52								--	--	--	--	--	2,716
1952-53								--	--	--	--	--	108
1953-54								46	82	136	494	--	758
1954-55								64	106	194	243	-	607
1955-56								34	72	156	26	--	288
1956-57								38	35	38	11	--	122
1957-58								68	74	25	82	--	249
1958-59								13	13	11	48	--	85
1959-60								292	34	51	7	--	384
1960-61								70	--	--	--	--	70
1961-62	-	-	-	--	--	--	--	--	24	--	2	--	--
1962-63	-	-	2	93	463	877	608	323	2	2	--	--	2,370
1963-64	-	-	-	37	173	716	286	55	--	--	2	2	1,271
1964-65	-	-	4	83	427	589	192	15	--	--	--	--	1,310
1965-66	6	4	2	15	415	899	367	133	71	172	63	8	2,164
1966-67	5	2	-	11	82	904	386	140	61	39	25	17	1,682
1967-68	2	-	2	8	77	764	291	50	52	19	19	4	1,288
1968-69	4	2	4	37	298	693	250	48	17	75	62	2	1,492
1969-70	-	-	8	38	184	512	263	64	11	34	11	2	1,127
1970-71	-	4	5	49	306	480	40	19	37	20	15	7	982
1971-72	2	5	5	5	231	469	112	68	32	16	16	4	965
1972-73	2	-	8	18	191	290	93	4	--	--	--	--	606
1973-74	-	2	-	4	44	166	4	4	--	--	--	--	224
1974-75	-	-	-	4	38	47	--	--	--	--	--	--	89
1975-76	-	-	-	--	--	--	--	--	--	--	--	--	0
1976-77	-	-	-	--	--	--	--	--	--	--	--	--	0
1977-78	-	-	-	--	3	100	18	3	3	9	--	--	136
1978-79	-	-	-	--	--	--	--	--	--	--	--	--	0
1979-80	-	-	-	--	--	--	--	--	--	--	--	--	0
1980-81	-	-	-	--	--	13	--	--	--	--	--	--	13
1981-82	-	-	-	--	--	--	--	--	--	--	--	--	0
1982-83	-	-	-	--	--	--	--	--	--	--	--	--	0

[a] Based on punch-card returns corrected for non-response bias.

Table 3. Steelhead redd counts in Grande Ronde index areas, 1967-83 (James 1984).

	Meadow (7.0 mi)	Five Points (6.0 mi)	Phillips (2.5 mi)	McCoy (2.0 mi)	Fly (4.0 mi)	Wallowa (4.0 mi)	Elk (10.0 mi)	Spring (1.0 mi)	Hays Fork (1.0 mi)	Swamp (6.0 mi)	Total (43.5 mi)	Five year average
1967	57	18	14	31	39	90	204	26	28	52	559	
1968	6	29	3	6	26	44	52	24	0	13	203	
1969	21	31	11	11	8	83	100	11	4	39	319	297
1970	11	7	7	6	7	54	116	15	12	13	248	
1971	8	22	6	15	6	22	28	15	12	22	156	
1972	16	17	3	5	8	53	21	24	15	70	232	
1973	19	53	11	16	10	22	6	7	13	20	177	
1974	6	8	2	0	7	29	20	14	13	28	127	142
1975	5	5	4	3	0	44	5	24	16	6	112	
1976	4	0	3	0	2	24	9	6	10	3	62	
1977	6	27	5	1	22	14	3	8	11	7	106	
1978	7	16	10	2	12	15	0	12	12	15	101	
1979	0	0	1	1	0	9	2	4	3	0	20	100
1980	27	26	14	1	6	12	29	16	0	43	174	
1981	0	9	3	0	4	29	16	24	0	12	97	
1982	1	16	2	0	4	36	18	18	4	15	114	

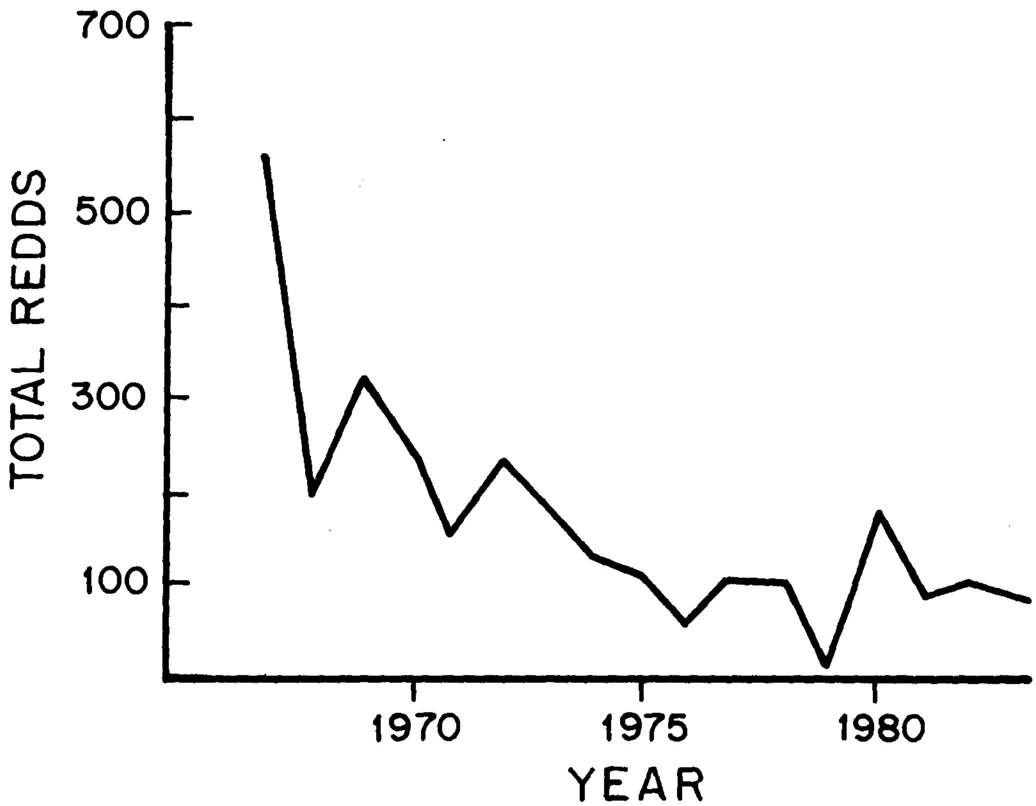

Figure 2. Trend in redd counts of summer steelhead in index surveys of the Grande Ronde River, 1967-83 (James 1984).

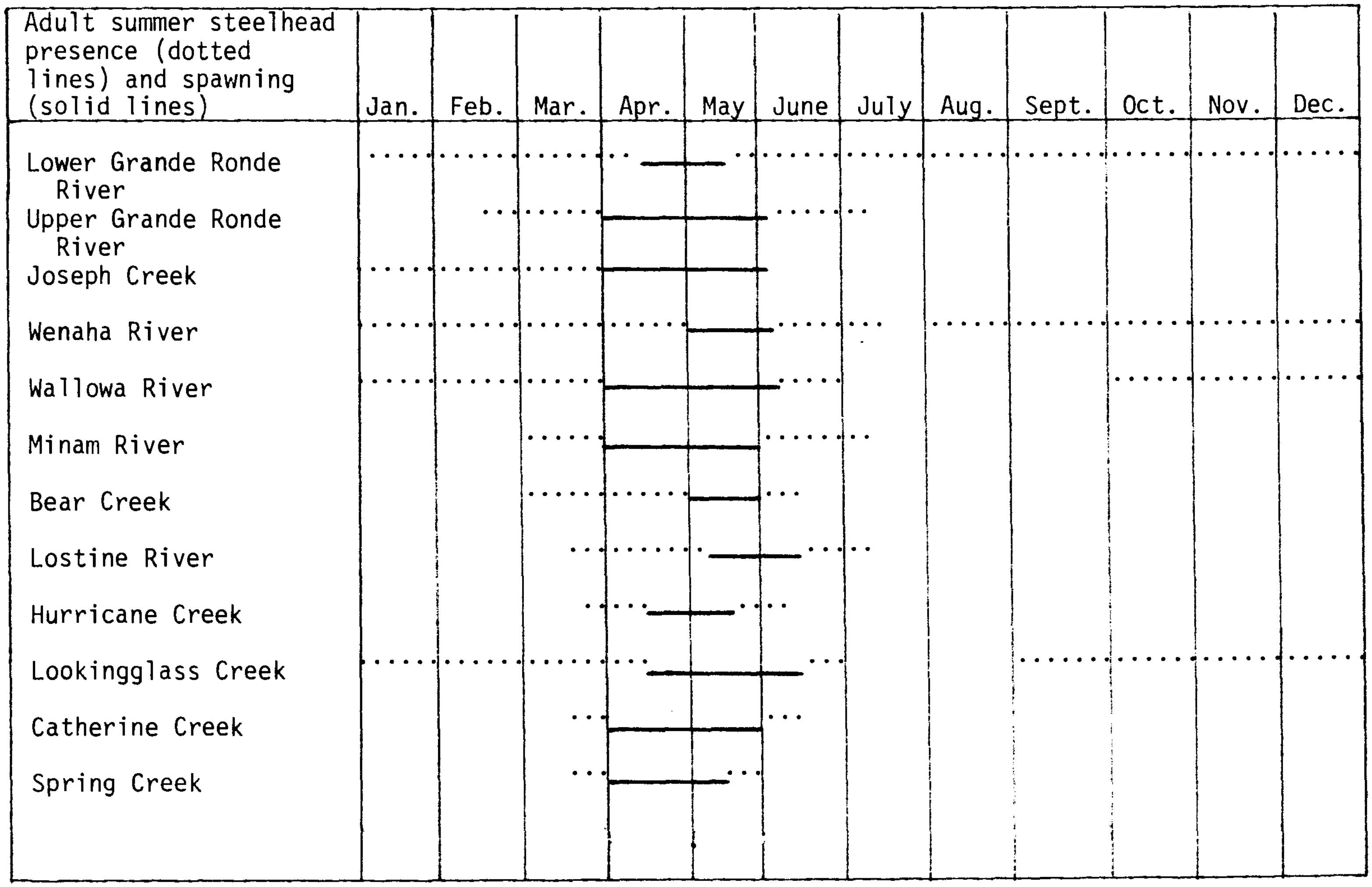

Figure 3. Periodicity chart for Grande Ronde Basin adult summer steelhead presence (dotted lines) and spawning (solid lines) (modified from Smith 1975).

Table 4. Number of adult steelhead trapped by month in Lookingglass Creek, 1964-1974 (modified from Burck, ODFW, unpublished).

Year	March	April	May	June
1964[a]	-	-	17	7
1965	0	13	41	2
1966	0	1	13	3
1967	0	4	30	52
1968	5	15	33	2
1969	0	11	27	5
1970	6	13	54	39
1971	0	25	71	24
1972	1	24	41	19
1973	0	18	31	1
1974	0	7	7	17
Average percentage	2	19	54	25

[a] Trap began operation on May 16, 1964.

Spawning period

Spawning occurs in March through early June (Williams 1975; James 1984).

Spawning areas

Steelhead are found throughout the Grande Ronde Basin (Figure 1). The principal spawning areas listed by Fulton (1970) are the following:

Grande Ronde River (middle and upper mainstem tributaries)
Joseph Creek
Wenaha River
Wallowa River
Minam River
Big Canyon Creek
Bear Creek
Lostine Creek

Age composition

No information.

Size

No information.

Sex ratio

No information.

Fecundity

No information.

Biochemical-genetic characteristics

Cluster analysis and pairwise comparisons of 14 samples taken from various locations in the Snake River drainage indicates that there were no significant genetic differences between steelhead sampled in Chesnimnus Creek in the Grande Ronde system (Type A), Little Sheep Creek (Imnaha River--Type A), and Mission, Cottonwood, and Big Canyon creeks (Clearwater River--Type B) (Figure 4).

Additional preliminary data on isozyme gene frequencies has been reported by Schreck et al. (1984).

JUVENILE LIFE HISTORY

Time of emergence

Fry emerged from the gravel in Lookingglass Creek in July and August (Mullarkey 1971).

Time, age, and size at migration

The peak downstream migration of juveniles usually occurs in May (Figures 5 and 6). There is a much smaller pulse of fish in the fall, when juveniles are thought to migrate to lower stream reaches to avoid freezing conditions in upper tributaries. Upstream areas may be repopulated the following spring (Smith 1975).

In Lookingglass Creek, juvenile emigrants were primarily age 1+ and 2+ (Table 5). The number of 3+ smolts declined from April through October (Mullarkey 1971). The high percentage of 0+ and 1+ steelhead that migrated during this period suggest that downstream reaches in the system may be important rearing areas during the latter stages of development prior to migration out of the system.

Length-frequencies of juvenile steelhead age classes in Lookingglass Creek are described in Figure 7. Inability to distinguish juvenile steelhead from resident rainbow trout, which also occur in the system, make interpretation of these data difficult.

Survival rate

No information.

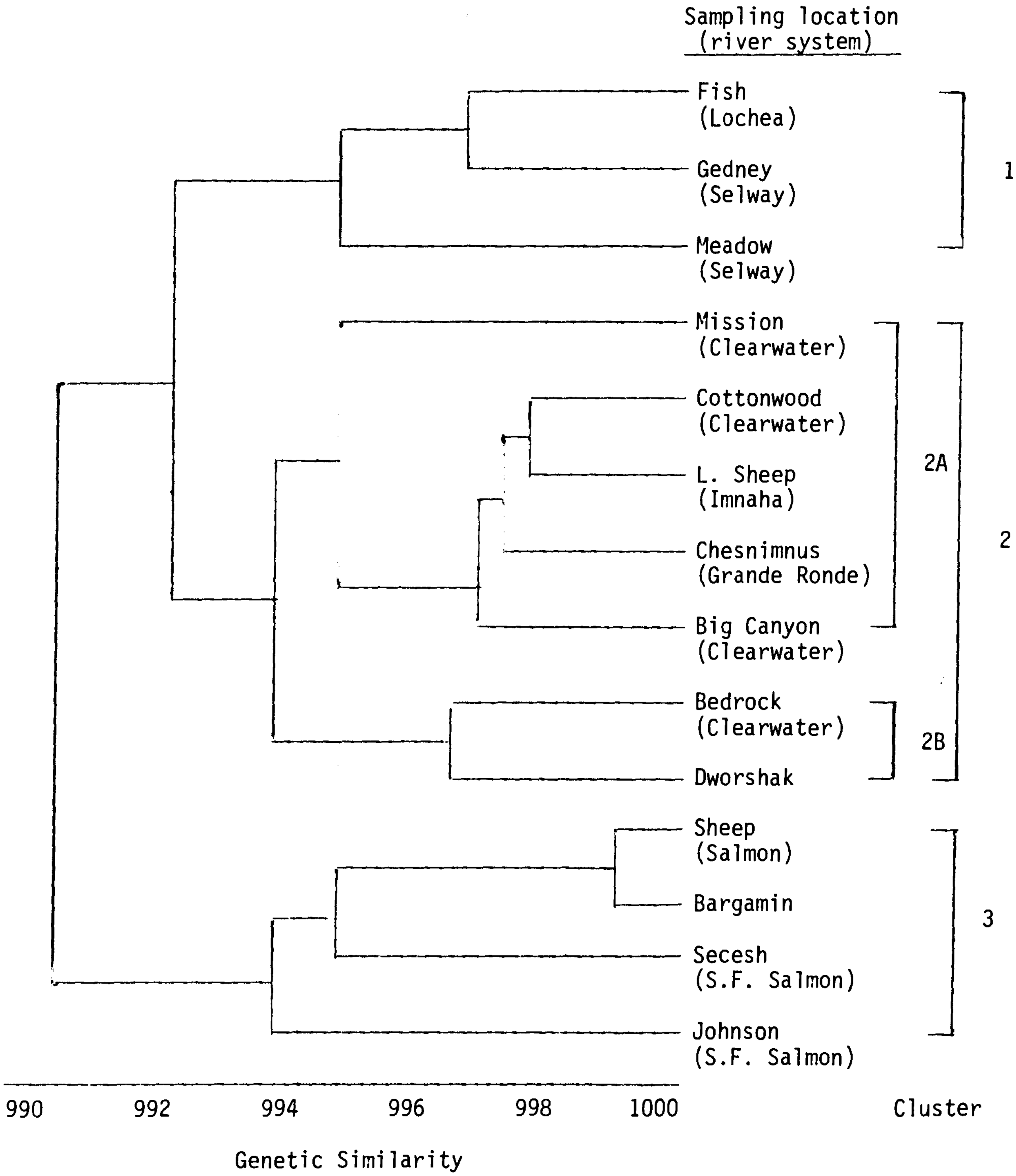

Figure 4. Cluster analysis of steelhead populations in the Snake River Basin based on genetic similarity (34 loci) (Milner and Teel 1984).

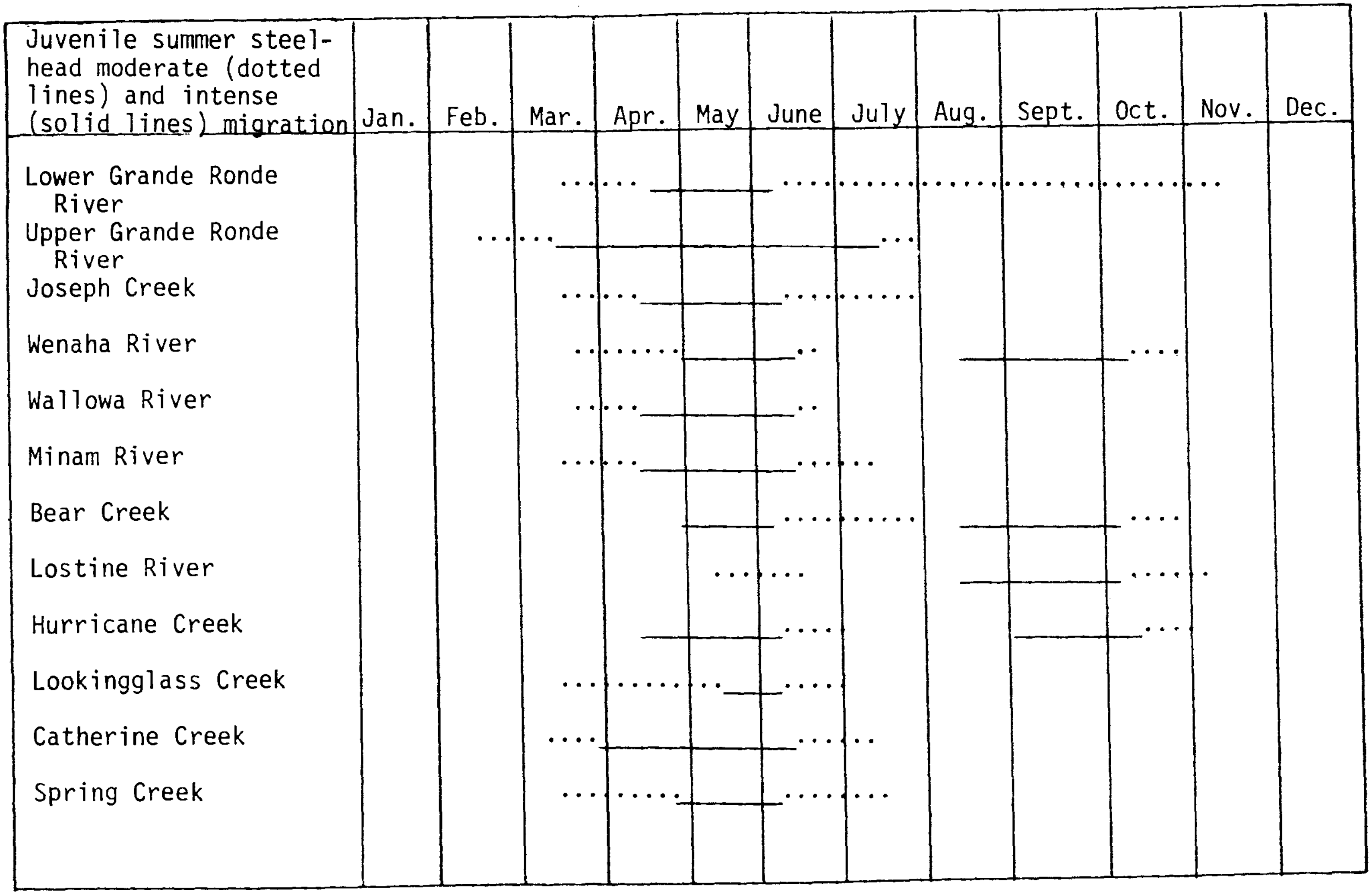

Figure 5. Migration periods of juvenile summer steelhead in the Grande Ronde River basin (Smith 1975). Dotted lines show periods of moderate migration. Solid lines show periods of intense migration.

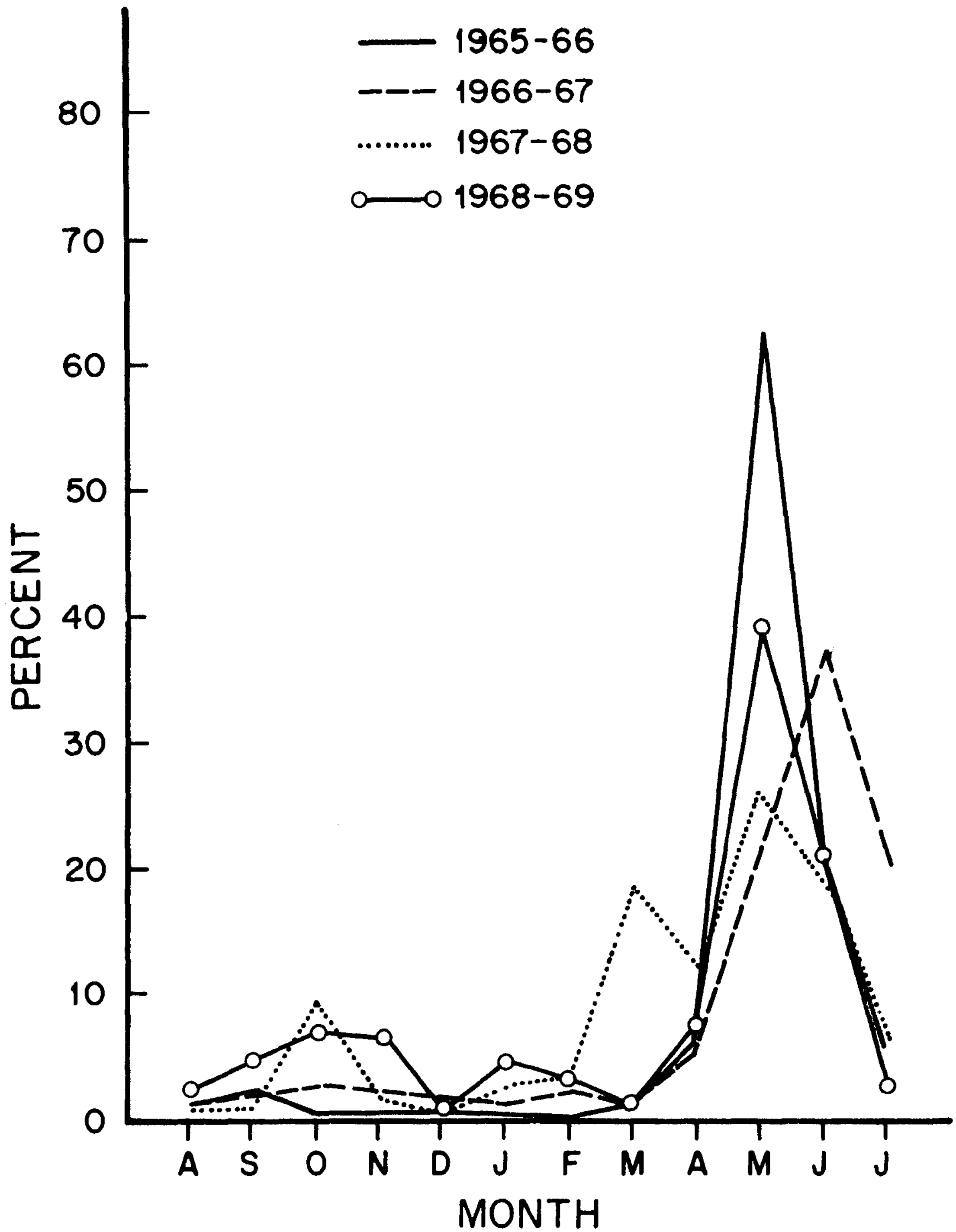

Figure 6. Percentage emigration by month of juvenile steelhead/rainbow trout past Lookingglass Falls, 1965-69 (Mullarkey 1971).

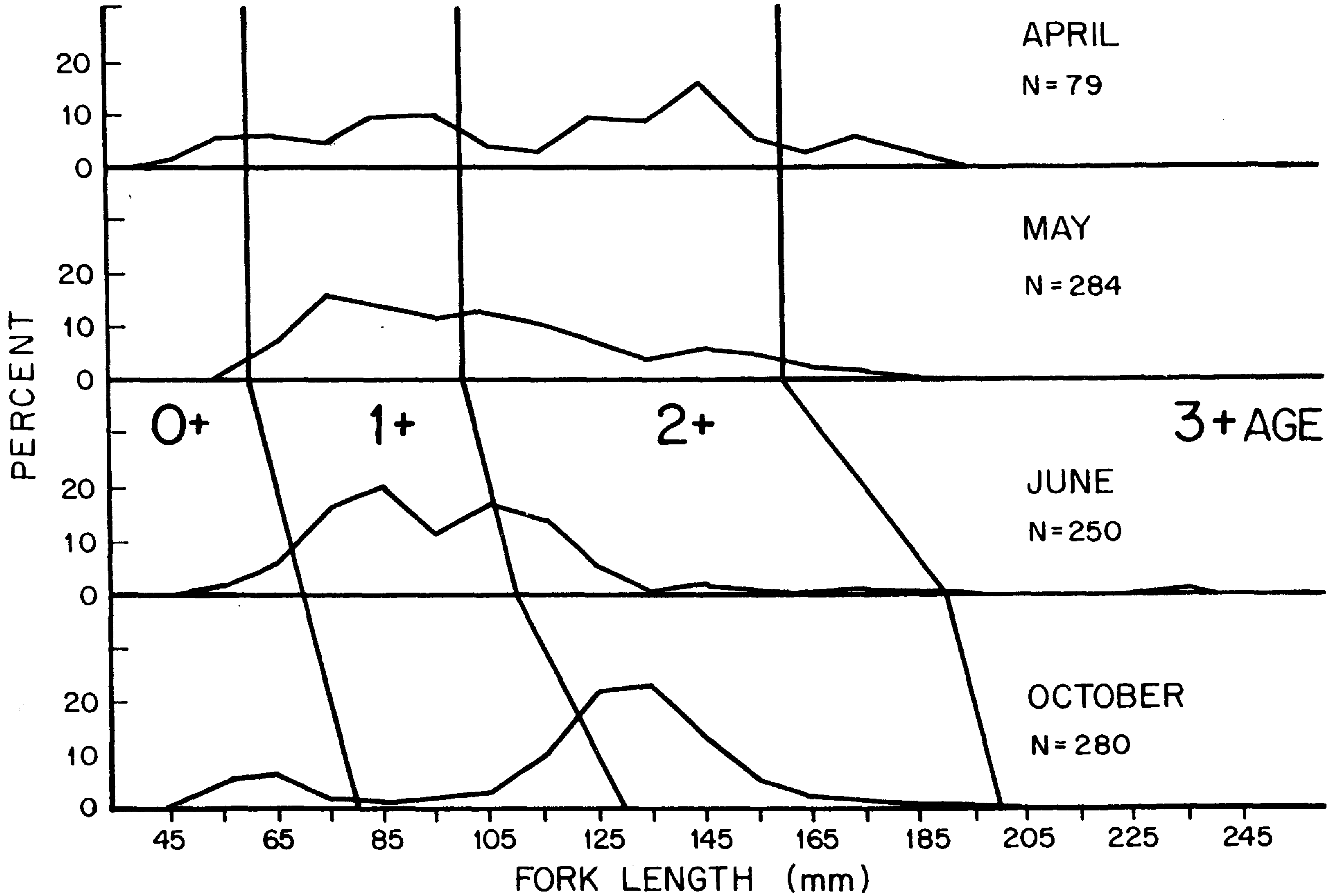

Figure 7. Length-frequency distribution of juvenile steelhead caught in the Lookingglass Creek trap by age group during 1969 (Mullarkey 1971).

Table 5. Age composition of juvenile steelhead migrants trapped in Lookingglass Creek, 1969 (data from Mullarkey 1971).

Age	Month (%) April	May	June	October
0+	7.6	0.7	8.0	12.8
1+	31.6	48.2	65.2	37.2
2+	46.9	45.0	26.0	50.1
3+	13.9	6.0	0.8	0.0

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Improved estimates of run size and escapement
2. Smolt production, particularly from pre-smolt migrants
3. Timing of the run in the Columbia River
4. Imprinting in fall juvenile migrants
5. Length/age fecundity relationships

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Wallowa Summer Steelhead (hatchery)

PRODUCTION

The Wallowa summer steelhead stock is being developed to meet production goals of the Lower Snake River Compensation Plan, which calls for the annual release of 1.35 million smolts in the Grande Ronde River system (Table 1). Releases to date have been principally made to establish returning runs to Wallowa Hatchery and Big Canyon Creek adult trapping facility (Table 2).

Table 1. Proposed releases of Wallowa stock summer steelhead in the Grande Ronde River system (Carmichael 1984).

Release site	No. to be released	Type of release
Wallowa Hatchery	600,000	Hatchery
Big Canyon Creek	225,000	Advanced rearing ponds
Wildcat Creek	200,000	Stream
Catherine Creek	62,500	Stream
Upper Grande Ronde	200,000	Stream
Upper Wallowa	62,500	Stream
Total	1,350,000	

Table 2. Summer steelhead smolt releases in the Grande Ronde River system, 1976-83 (modified from Carmichael 1984).

Brood year	Stock	Hatchery of rearing	Number released	Date of release	Location of release	Size (fish/lb)
1976	Snake River	Wallowa	79,608	5/8/78	Spring Creek	6.2
1977	Snake River	Wallowa	20,020	5/12/78	Spring Creek	13.0
1977	Snake River	Wallowa	75,259	4/30/79	Spring Creek	6.8-8.9
1978	Snake River	Wallowa	21,095	5/16/79	Spring Creek	14.7
1978	Snake River	Wallowa	34,900	4/5/80	Spring Creek	5.0
1979	Pahsimeroi	Wallowa	28,308	4/21/80	Spring Creek	10.6
1979	Pahsimeroi	Wallowa	62,000	4/3-4/8/81	Spring Creek	5.1-5.3
1980	Wallowa	Irrigon	37,418	4/3-5/4/81	Spring Creek	5.0-6.0
1980	Wallowa	Wallowa	43,763	4/9/82	Spring Creek	5.0-8.0
1981	Wallowa	Irrigon	76,896	4/9-4/27/82	Spring Creek	5.0-7.6
1981	Wallowa	Wallowa	64,950	5/10/82	Spring Creek	10.0-15.0
1981	Wallowa	Cascade	57,250	4/25-4/29/83	Big Canyon Creek	6.6-6.9
1982	Wallowa	Lyons Ferry	75,878	5/2-5/5/83	Spring Creek	4.7-7.4
1982	Wallowa	Lyons Ferry	18,600	5/5/83	Spring Creek	15.5
1982	Wallowa	Lyons Ferry	64,591	5/4-5/5/83	Spring Creek	8.3-10.4
1982	Wallowa	Wallowa	41,600	5/6/83	Spring Creek	8.4
1983	Wallowa	Wallowa	46,818	4/24/84	Spring Creek	7.1-9.0
1983	Wallowa	Lyons Ferry	443,175	4/23-5/2/84	Spring Creek	5.0-9.3
1983	Wallowa	Lyons Ferry	57,100	4/27-5/3/84	Big Canyon Creek	6.8-9.3
1984[a]	Wallowa	Lyons Ferry	96,040	4/25-4/26/85	Big Canyon Creek and Catherine Creek	7.0-8.0
1984[a]	Wallowa	Wallowa	630,355	4/29/85	Spring Creek	6.0
1984[a]	Wallowa	Wallowa	15,690	3/1/85	Spring Creek	6.0

[a]Preliminary.

GEOGRAPHIC LOCATION

Streams

Wallowa summer steelhead are released into Big Canyon Creek, Wildcat Creek, Catherine Creek, Upper Grande Ronde River, Upper Wallowa River, and other areas of the Grande Ronde system (Figure 1).

Hatcheries

Wallowa Hatchery is used for adult collection, spawning, initial incubation, and acclimation prior to release. Rearing takes place at Irrigon Hatchery. The Big Canyon Creek facility is used for advanced rearing and release of smolts and adult collection. Lyons Ferry and Cascade hatcheries have also produced Wallowa stock (Table 2).

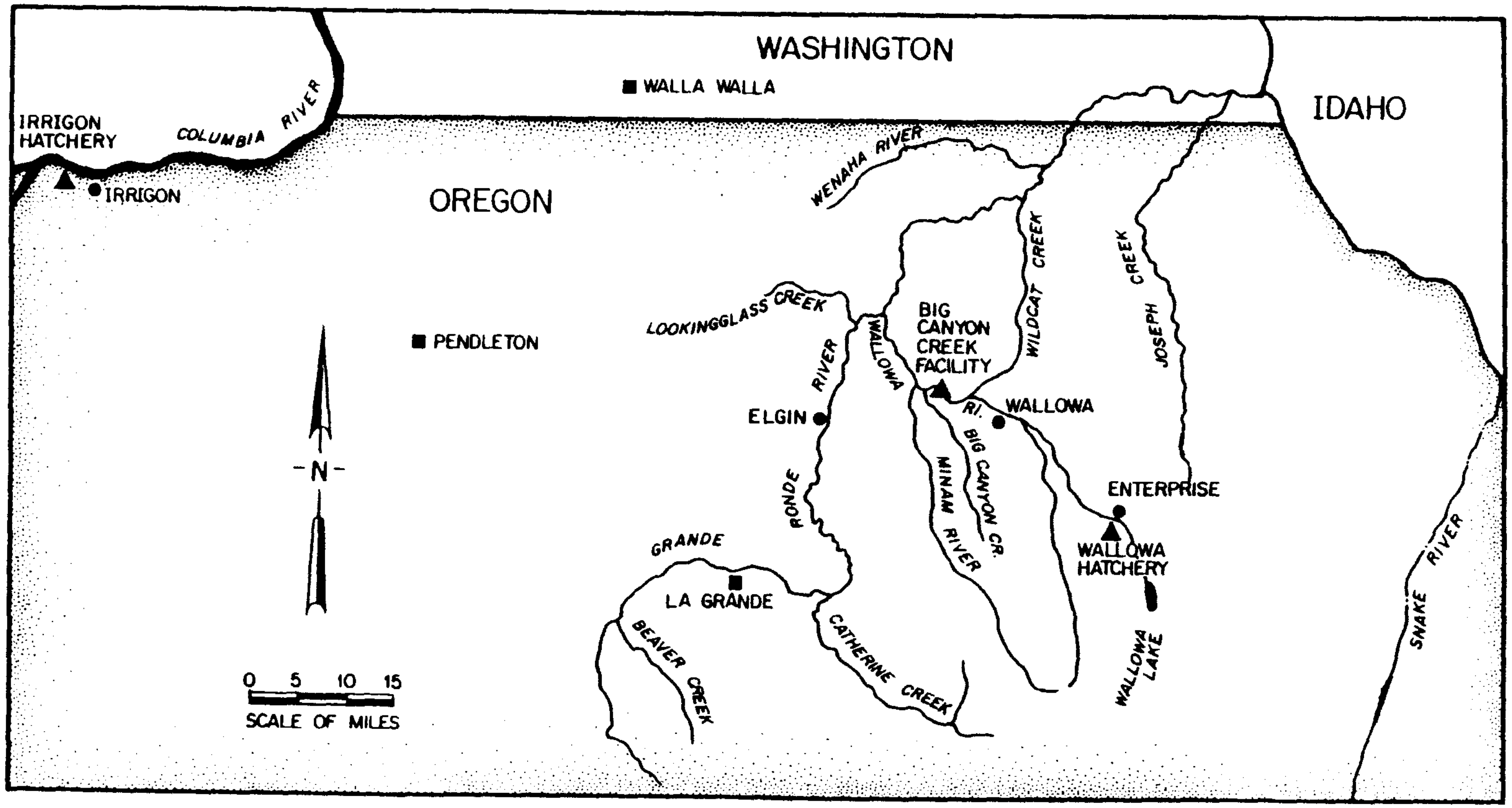

Figure 1. Grande Ronde River system and location of hatchery production facilities (modified from Carmichael 1984).

ORIGIN

The Wallowa summer steelhead stock was originally developed from adults trapped at Ice Harbor and Little Goose dams (Table 3). Since 1980, adults returning to Wallowa Hatchery from releases of Snake River and Pahsimeroi stocks have been used as broodstock (Table 3). Native wild adults may also be included in broodstock trapped at Wallowa Hatchery. Oxbow and Skamania summer steelhead stocks were also released into the Grande Ronde system in 1969-75 (Table 4).

ADULT LIFE HISTORY

Run size, catch, and escapement

Returns to Wallowa Hatchery have been increasing each year, with 906 adults returning in 1984 (Table 3). The Grande Ronde system has been closed to sport harvest since 1974 in Oregon and since 1980 in Washington.

Table 3. History of adult trapping for the development of Wallowa Hatchery stock steelhead (Carmichael 1984).

Return year	Location	Total number	Number of females	Number of males	Number females spawned
1976	Ice Harbor Dam	85	--	--	35
1977	Little Goose Dam	83	55	28	48
1978	Little Goose Dam	86	57	29	43
1980	Spring Creek/ Wallowa Hatchery	142	85	57	85
1981	Spring Creek/ Wallowa Hatchery	205	153	52	142
1982	Spring Creek/ Wallowa Hatchery	140	111	29	111
1983	Spring Creek/ Wallowa Hatchery	308	225	83	216
1984	Spring Creek/ Wallowa Hatchery	906	431	475	184

Table 4. Releases of introduced stocks of summer steelhead into the Grande Ronde River system, 1969-75.

Release site	Year	Number released	Pounds	Number per pound	Stock
Grande Ronde	1969	70,600	23	3,070	Idaho (Oxbow)
Wallowa	1971	264	44	6.0	Idaho (Oxbow)
Wallowa	1972	45,419	7,401	6.1	Idaho & Wallowa
Wallowa	1973	73,375	9,125	8.0	Skamania
Wallowa	1974	695		Smolt	Skamania
Wallowa	1975	49,650	3,310	15	Skamania

Time of migration

Wallowa summer steelhead return to the Wallowa Hatchery in March through May (Table 5). The median date of return varied from 19 April to 30 April during 1979-81.

Table 5. Time of return and spawning data for adult summer steelhead at Wallowa Hatchery.[a]

	Time of return		Spawned				
Year	Median date	Range	Female	Median date	Range	Eggs taken	Est. fecundity
1979	4/21	4/21	33	4/30	4/21-5/31	223,000	6,758
1980	4/19	4/12-5/31	85	4/25	4/12-5/31	279,000	3,282
1981	4/30	3/31-5/31	145	4/30	3/31-5/31	570,000	3,931
1984	N.A.	N.A.	184	N.A.	N.A.	794,000	4,313

[a] Dates listed are the end of the reporting period.

Spawning period

The females are spawned soon after returning (Table 5). The median date of spawning was 25 April in 1980 and 30 April in 1979 and 1981. All fish were spawned between mid-March and mid-May.

Spawning areas

Wallowa summer steelhead are spawned at Wallowa Hatchery.

Age composition

Most of the adults (90%) that returned in 1984 were 1-salt fish (R. Carmichael, ODFW, personal communication). Another 9% were 2-salt fish, and the remaining 1% were 3-salt fish.

Size

The 1-salt adults averaged 59.5 cm (males) and 58.0 cm (females) in length. The 2-salt adults averaged 76.0 cm (males) and 72.0 cm (females).

Sex ratio

Two to three times as many females returned to Wallowa Hatchery as males during 1979-81 (Table 3). However, more males (475) than females (431) returned in 1984.

Fecundity

The average fecundity of the returning females was 4,571 eggs/female during 1979-81 and in 1984 and ranged from 3,282 eggs/female in 1980 to 6,758 eggs/female in 1979.

Biochemical-genetic characteristics

No information.

JUVENILE LIFE HISTORY

Time of emergence

Alevins hatch following 3-4 weeks of incubation in 50-55°F water at Wallowa Hatchery.

Time, age, and size at migration

The juveniles are released in the spring as yearlings at a size of 5-15 fish/lb (Table 2). Scale analysis indicates that most Wallowa summer steelhead enter into the ocean as 2+ smolts (R. Carmichael, ODFW, personal communication).

Survival rate

Egg-to-fry survival of the 1984 brood is estimated at 76%.

DISEASE HISTORY

No viruses were detected in adult or juvenile Wallowa summer steelhead, 1979-84, although IHN virus was detected in 1985. Fish pathogens found in spawning adults include *Ceratomyxa shasta*, *Myxidium minteri*, *Cytophaga psychrophila*, *Dermocystidum*, and *Chloromyxum*. Pathogens detected include BKD in juveniles reared at Cascade Hatchery and bacterial gill disease and *Costia* in juveniles at Wallowa Hatchery (R. Holt, ODFW, personal communication). *Columnaris* has also been detected in juveniles at Wallowa Hatchery (K. Witty, ODFW, personal communication).

All spawning adults are sampled for viruses and eggs are kept in discrete groups until virus checks are shown to be negative.

PRIORITY INFORMATION NEEDS

1. Improved estimates of run size, catch, and escapement

2. Migration timing and mortality of juveniles and adults in the Snake and Columbia rivers

3. Rearing pattern of age 1+ releases that enter the ocean at age 2+

4. Smolt-to-adult survival rate

5. Natural production resulting from hatchery releases

6. Wild and hatchery stock interactions, including monitoring of straying of hatchery fish in the Minam and Wallowa rivers, which are being managed to maintain wild native stock

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Niagara Springs Hatchery Steelhead

The Niagara Springs Hatchery Steelhead production program is part of Idaho Power Company's mitigation for the Brownlee, Oxbow and Hells Canyon dams on the mid-Snake River. All facilities and costs of the program are provided by Idaho Power Company.

PRODUCTION

From the year of first operation, 1964 to 1983, the goal for hatchery output was to release 200,000 pounds of smolts into the Pahsimeroi River. The number of fish in the goal was originally 1.6 million, later revised to 1.0 million as the size of fish reared increased.

In 1980, the production goal was expanded to provide yearly releases of 1 million smolts into the Snake River below Hells Canyon Dam as well as 1 million into the Pahsimeroi River. The rearing capacity of Niagara Springs Hatchery is now 380,000 pounds.

The history of stocking from Niagara Springs Hatchery is presented in Table 1.

GEOGRAPHIC LOCATION

Hatcheries

Pahsimeroi River Hatchery (spawning station), on 1st order tributary to Salmon River near Challis, Idaho, and Niagara Springs Hatchery (offsite rearing) near Wendell, Idaho.

ORIGIN

Transplanted from mid-Snake River at Hells Canyon Dam, beginning in 1965, these fish formerly occupied waters above Hells Canyon Dam.

ADULT LIFE HISTORY

Run size, catch, and escapement

This run can contribute substantially to the Columbia River sport and gill net, Deschutes River sport, Snake River sport, and Salmon River sport fisheries.

In some years, the Salmon River sport fishery has harvested over 50% of the fish available at that point (Table 2). Harvests in other fisheries have not been quantified to date.

Table 1. Stocking history of Niagara Springs Hatchery.

Brood year	Number of fish stocked (x 1,000) Pahsimeroi River	Snake River	Upper Salmon River
1966	0	588[a]	0
1967	1,664	342[a]	0
1968	1,645	109	0
1969	1,622	1,143[a]	0
1970	1,630	671[a]	0
1971	1,555	216[a]	0
1972	1,292	631[a]	0
1973	1,607	15[a]	354
1974	1,331	0[a]	0
1975	1,610	41[a]	80
1976	1,448	212[a]	0
1977	1,266	281[a]	0
1978	1,372	345[a]	0
1979	1,098	329,549[a]	0
1980	862	613,192[a]	0
1981	995	804	0
1982	621	355	0
1983	NA	408,220[a]	0

a Subsmolts

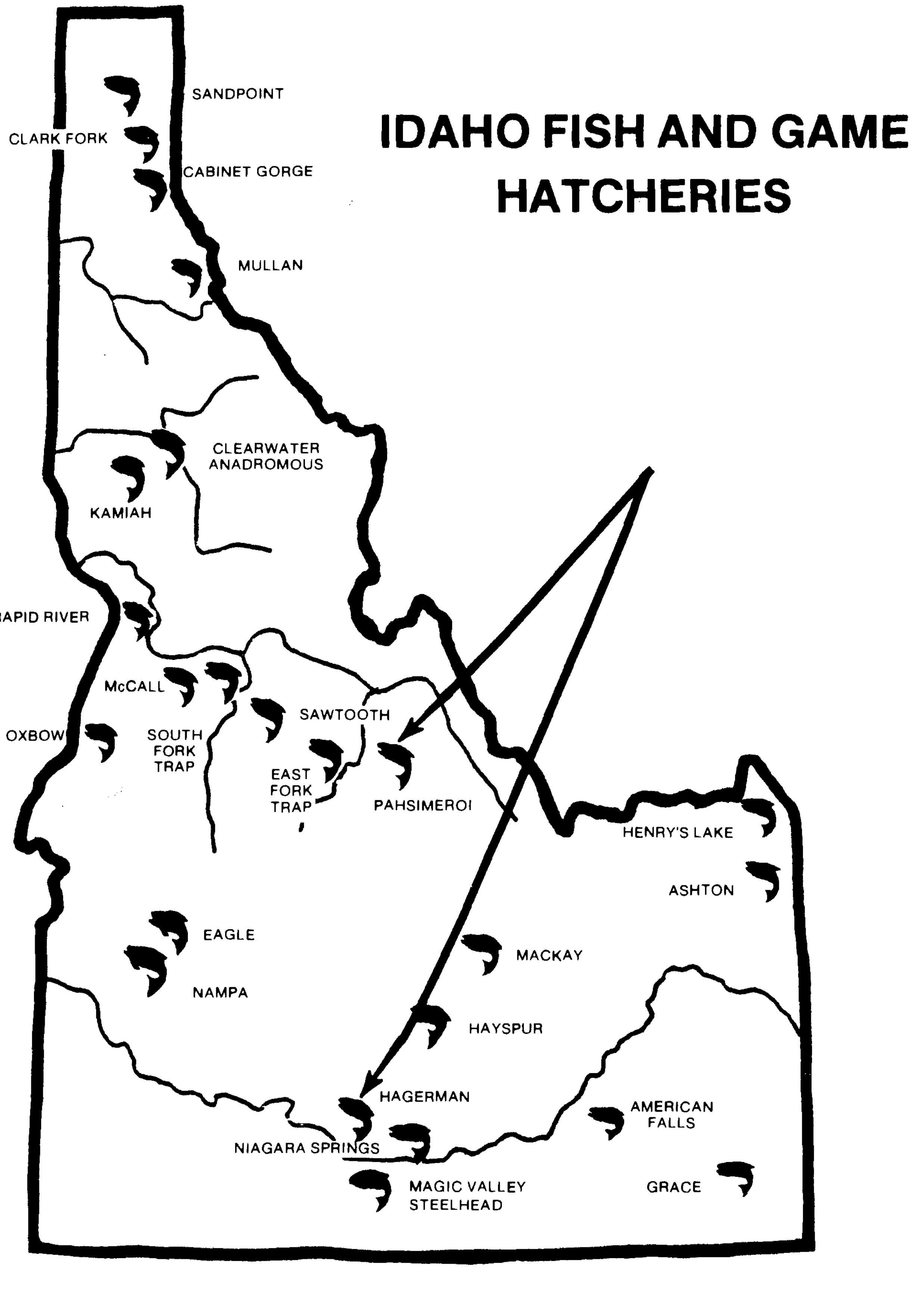

Figure 1. Location of Niagara Springs steelhead hatchery and Pahsimeroi River spawntaking station.

Table 2. Niagara Springs Hatchery steelhead releases and returns to Pahsimeroi River weir, 1965 through 1979 brood years.

Brood year	Year released	Smolts released (thousands)	Adults returned 1-ocean	(%)	2-ocean	(%)	Total	Salmon River sport harvest	Adults smolts
1965	1966	65	NA	--	NA	--	NA	NA	NA
1966	1967	1,292	798	(89)	107	(11)	905	590	0.001
1967	1968	1,484	401	(86)	66	(14)	467	390	0.0006
1978	1969	1,645	647	(80)	162	(20)	809	727	0.0009
1969	1970	1,622	4,742	(91)	474	(9)	5,216	4,373	0.006
1970	1971	1,442	984	(79)	269	(21)	1,253	1,380	0.002
1970	1972	175	36	(82)	8	(18)	44	30	0.0004
1971	1972	1,555	1,490	(77)	455	(23)	1,945	1,253	0.002
1972	1973	1,292	228	(81)	54	(19)	282	13	0.0002
1973	1974	0[a]	--	--	--	--	--	--	--
1974	1975	1,331	1,395	(72)	533	(28)	1,928	2,320	0.003
1975	1976	1,610	2,242	(49)	2,306	(51)	4,548	3,816	0.005
1976	1977	1,448	195	(67)	97	(33)	292	151	0.0003
1977	1978	1,266	1,523	(74)	524	(26)	2,047	2,140	0.003
1978	1979	1,372	2.967	(59)	2,081	(41)	5,048	4,730	0.007
1979	1980	1,098	1,011						

Table 3. Recoveries of coded wire tags reported from the Deschutes River fishery, Oregon, for Niagara Springs Hatchery steelhead, fall 1980 to fall 1982.

Month	Number of tags	(%)
July	4	(8.3)
August	14	(29.2)
September	24	(50.0)
October	6	(12.5)
TOTAL	48	(100.0)

Table 4. Recoveries of coded wire tags reported from the Salmon River fishery, for Niagara Springs Hatchery steelhead, fall 1980 to spring 1983.

Month	Number of tags	(%)
February	38	(10.9)
March	57	(16.4)
April	10	(2.9)
September	24	(6.9)
October	128	(36.8)
November	91	(26.1)
TOTAL	348	(100.0)

Table 5. Timing of Niagara Springs Hatchery steelhead run at Pahsimeroi River trap, 1969 to 1983.

Year	spawntaking	Peak	Finish
1969	03/10	04/21	05/26
1970	03/30	04/13	05/25
1971	04/12	04/08	05/27
1972	03/23	04/10	06/02
1973	03/30	04/16	05/21
1974	03/29	04/22	05/31
1975	04/01	04/21	05/23
1976	03/25	04/12	05/11
1977	04/05	04/18	05/31
1978	03/17	03/27	05/26
1979	03/30	04/16	05/18
1980	04/08	04/21	05/13
1981	03/10	03/15	04/30
1982	03/12	04/11	05/19
1983	03/11	03/11	05/22

Table 6. Yearly spawntaking period for group A steelhead at Pahsimeroi Hatchery, 1969 to 1984.

Year	Begin spawntaking	End spawntaking
1969	03/28	06/11
1970	03/30	06/01
1971	04/12	06/03
1972	03/23	06/05
1973	03/30	05/29
1974	03/29	05/23
1975	04/01	06/02
1976	03/25	05/17
1977	04/05	05/24
1978	03/17	04/07
1979	03/30	05/08
1980	04/08	05/09
1981	03/10	04/24
1982	03/12	05/04
1983	03/11	05/10
1984	03/27	05/04

Time of migration

The Columbia River group A steelhead run, of which the Niagara Springs Hatchery fish are a part, is generally considered to enter and move though the lower Columbia in June through August, peaking at Bonneville Dam about June 20 to June 30.

Numerous recoveries in the Columbia River of coded-wire tags from this group of fish have been made; however, the timing of the recoveries reflects fishing intensity at a particular time rather than migrational timing of the run. Tag recoveries have been concentrated in Zone 6 in September during Indian gill net fishing (Duke 1984).

Some of the Niagara Springs steelhead adult run is known to enter Oregon's Deschutes River. The commonly held notion is that fish are reacting to a temporary haven with preferred water temperature; however, some tag recoveries have been reported throughout September and in October, past the time when Columbia River water temperature might be avoided. Most recoveries of coded-wire tags from the Deschutes River fishery have been in August and September (Table 3) (Duke 1984). The decrease in tag recoveries from the Deschutes River after September indicates that the fish re-enter the Columbia to continue migration toward the Pahsimeroi River.

The run arrives in Idaho's Salmon River beginning in September, as evidenced by recoveries of coded-wire tags in the sport fishery (Table 4) (Duke 1984). Infrequently, a few steelhead have entered the Pahsimeroi trapping facility in the fall of the year. Practically speaking, the run enters the trap in the spring; it has arrived as early as February 11 and as late as March 10. The peak at the hatchery trap is usually mid-April, and cessation of the run has ranged from April 30 to June 2 (Table 5) (IDFG, Bureau of Fisheries file records).

Spawning period

Spawntaking at Pahsimeroi Hatchery has commenced as early as March 10 and as late as April 12. The range for completing spawn taking is April 7 to June 11 (Table 6) (IDFG, Bureau of Fisheries file records).

Spawning areas

Fish are spawned and incubated to eyed stage at the Pahsimeroi River station.

Age composition

The race primarily spends one year at sea. A one-ocean fish has had a total life of 3 years; one year in the hatchery, one year at sea and one year on the returning freshwater migration. As high as 91% and as low as 49% of a brood year has returned as one-ocean fish; the average return of a brood year as one-ocean fish is 76.3% for the 14 years for which data are available (Table 2) (Reingold 1975, 1977; Ball 1984).

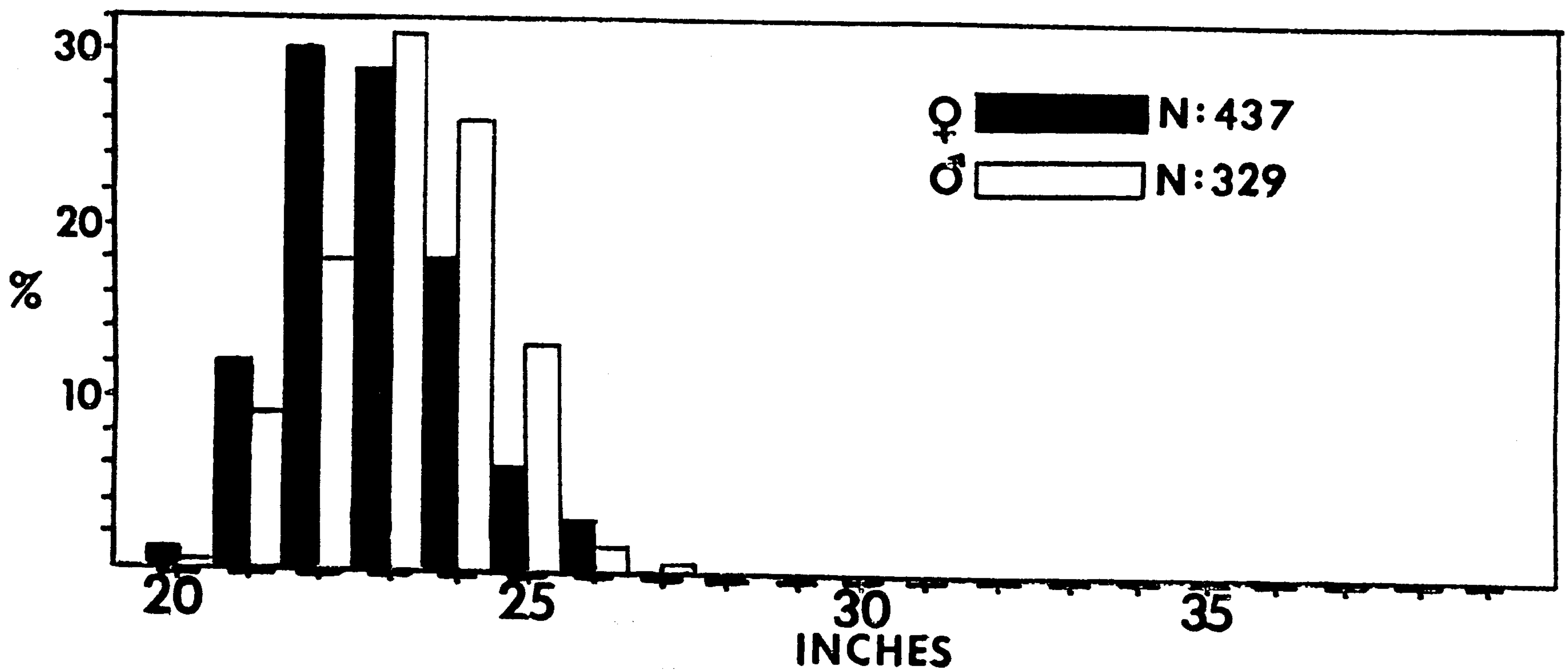

Figure 2. Total length frequency of 766 hatchery origin Snake River steelhead captured at the Pahsimeroi River adult steelhead facilities in 1969. No two-ocean steelhead will show up at the weir until the spring of 1970.

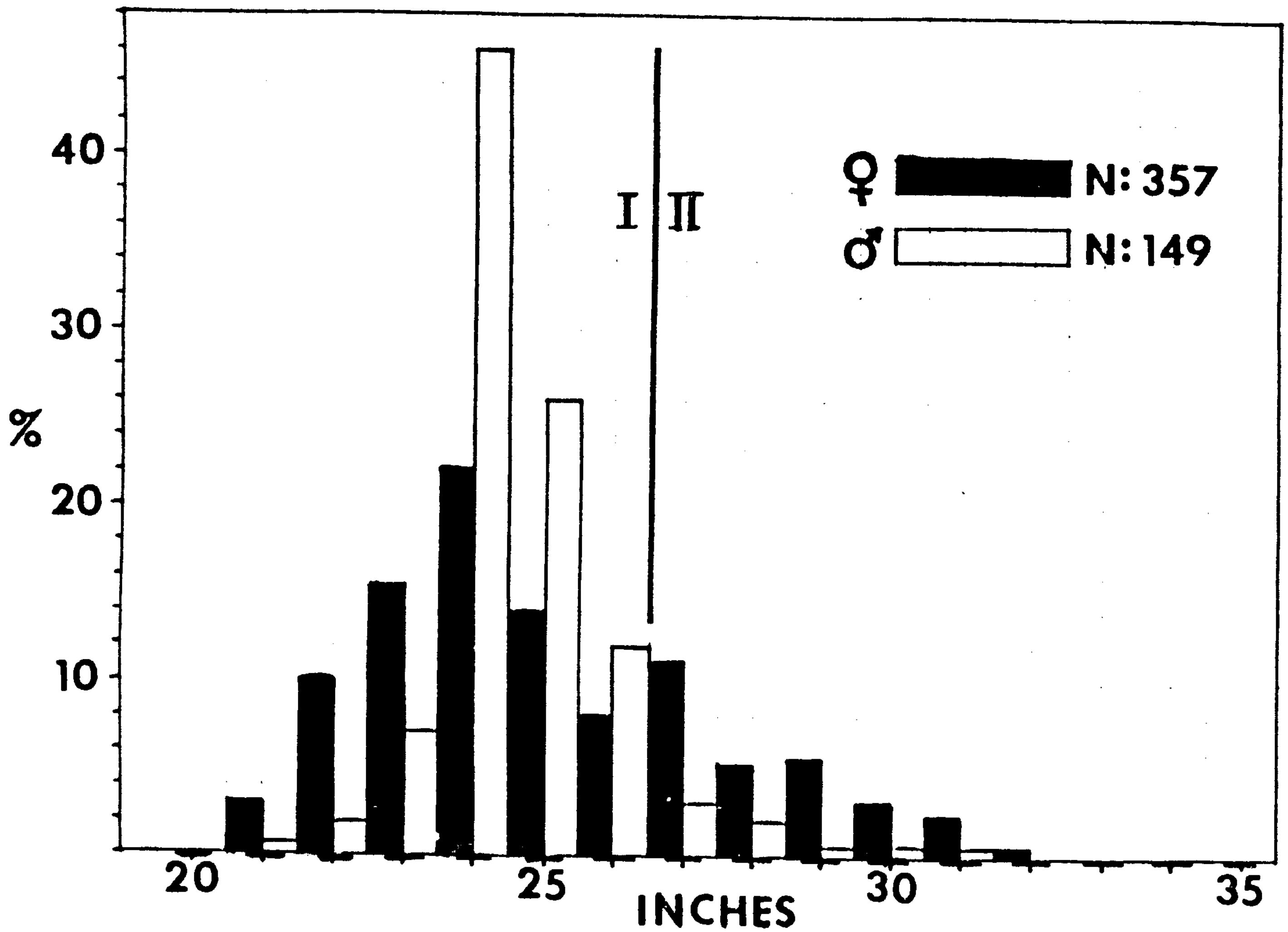

Figure 3. Length frequency and age classification of the 1970 hatchery steelhead run returning to the Pahsimeroi adult facilities. Group one fish (I) represent adults from the 1968 smolt releases. Group two fish (II) represent adults from the 1967 smolt releases.

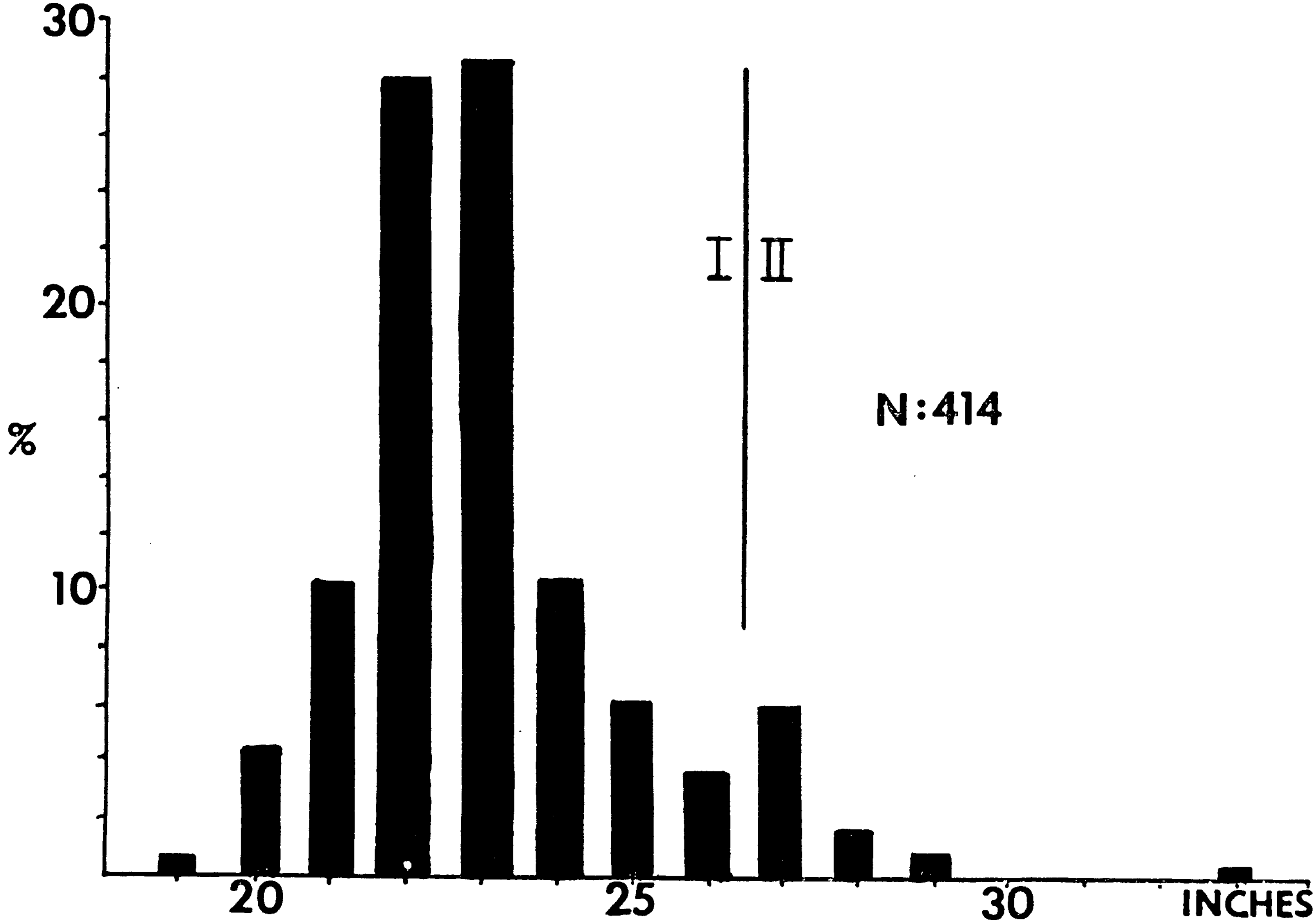

Figure 4. Length frequency and age classification of 414 steelhead from the 1971 hatchery steelhead run returning to the Pahsimeroi facilities. Group one fish (I) represent adults from the 1969 smolt releases. Group two fish (II) represent adults from the 1968 smolt releases.

Size

Weight data for adult Niagara Springs steelhead are not available. Steelhead adults less than 27 inches have been verified as one-ocean fish, while those 27 inches or more are two-ocean fish (Reingold 1972). Three-ocean fish in this stock appear to be rare.

Some length data for adults were recorded in early years of the operations (Figs. 2, 3, 4).

Sex ratio

The sex ratio of returning adults was recorded for runs in 1980 through 1983. The percentage of females yearly ranged from 52.5 to 63.0; the combined run for the four years contained 58.8% females (Table 7) (IDFG, Bureau of Fisheries file records).

Fecundity

The yearly average number of eggs per female during 1980 to 1983 spawning operations ranged from 3,625 to 5,368. The average for the four-year period was 4,538 (IDFG, Bureau of Fisheries file records).

JUVENILE LIFE HISTORY

Time of emergence

No information.

Time, age, and size at migration

Eyed eggs are shipped to Niagara Springs Hatchery for final incubation and rearing (Fig. 1). One-year-old smolts are transported by tanker trucks back to the Pahsimeroi River and released.

Survival rate

Major influences on smolt-to-adult survival rates for this race of fish are probably fish health at release, emigration conditions, and adult harvest rate. For brood years 1966 through 1978, the returns to the Salmon River (sport harvest plus hatchery returns) ranged from 0.02% to 0.7% (Table 5). The low of 0.02% resulted from downstream migration during the 1973 drought which caused near-total losses to smolts.

A more complete analysis of survival to adult should include Columbia River harvest.

DISEASE HISTORY

Two viral diseases have been periodic acute problems in the stock at Niagara Springs Hatchery. Infectious pancreatic necrosis (IPN) led to the intentional destruction of the 1973 brood year. Although IPN disease has

Table 7. Sex composition of adult group A steelhead returning to Pahsimeroi Hatchery, 1980 to 1984.

Year	Females		Males		Total	
	Number	(%)	Number	(%)	Number	(%)
1980	2,817	(61.6)	1,755	(38.4)	4,572	(100.0)
1981	1,949	(63.0)	1,143	(37.0)	3,092	(100.0)
1982	1,789	(52.5)	1,619	(47.5)	3,408	(100.0)
1983	902	(55.7)	718	(44.3)	1,620	(100.0)
1984	7,953	(57.7)	5,833	(42.3)	13,786	(100.0)
Weighted avg. %		(58.1)		(41.9)		(100.0)

persisted beyond 1973, losses have been minimized through special practices such as avoidance of crowding in the hatchery.

Infectious hematopoietic necrosis (INH) impacted production seriously in 1981 and 1982. A 52% loss of inventory due to IHN occurred in June 1982.

Other diseases that have been noted in hatchery records are:

1. Furunculosis
2. Bacterial Gill Disease
3. Columnaris
4. Sanguinicola
5. Sunburn
6. Red-mouth

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HAGERMAN HATCHERY SUMMER STEELHEAD

Hagerman National Fish Hatchery (HNFH) is owned and operated by the U.S. Fish and Wildlife Service and was originally built to rear catchable trout for federal projects in the region. Under the Lower Snake River Fish and Wildlife Compensation Plan (LSRCP) the hatchery was rebuilt and expanded to rear 340,000 pounds of steelhead smolts for stocking in the Salmon River system (Partridge 1984).

PRODUCTION

The production program for HNFH calls for rearing both group A and group B summer steelhead hatchery stocks. Although the new facility was completed only in 1983, HNFH has been rearing steelhead in the LSRCP program since 1978. The steelhead rearing history for HNFH is presented in Table 1 (Partridge 1984).

GEOGRAPHIC LOCATION

HNFH is located in the Thousand Springs area adjacent to the Snake River near Hagerman, Idaho. Stocking requires trucking the fish off site approximately 150 miles to upper Salmon River waters. The LSRCP stocking program now specifies group A steelhead to be released at the Sawtooth Hatchery site and group B fish to be released at the East Fork Salmon River station (Fig. 1).

The intent of the program is to develop the program's own group A stock which will be released at Sawtooth Hatchery, and have adults return to the Sawtooth trap for spawntaking. The group B stock will be similarly developed and maintained by stocking and spawntaking at the East Fork Salmon River trap.

ORIGIN

Group A steelhead have been obtained from Idaho Power Company's Niagara Springs Hatchery (see stock assessment report for Niagara Springs summer steelhead trout).

Group B steelhead have been obtained from Dworshak National Fish Hatchery (see stock assessment report for Dworshak National Fish Hatchery summer steelhead trout) and from HNFH-reared B stock which have returned to the Pahsimeroi trap (Table 1).

ADULT LIFE HISTORY

Run size, catch and escapement

Quantitative data on run size, catch and escapement are not yet available and await pending returns to the newly constructed trapping facilities at Sawtooth and the East Fork. Coded-wire tag returns show harvest occurring in various Columbia River, Deschutes River and Idaho fisheries (Duke 1985) (see Appendix).

The spawning escapement requirements are 800 group B fish at the East Fork trap and 900 group A fish at the Sawtooth trap (IDFG 1984).

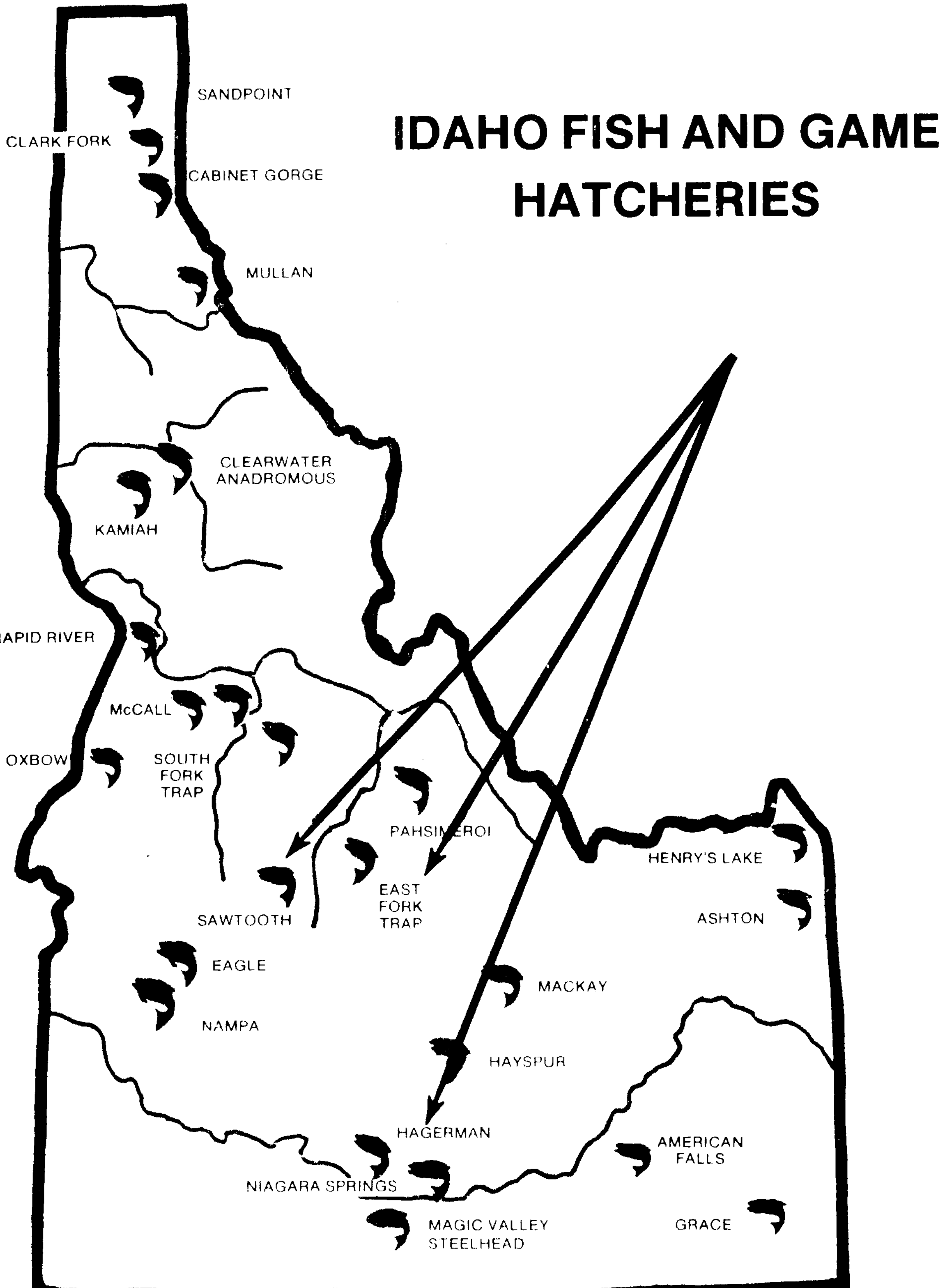

Figure 1. Location of Hagerman NFH, Sawtooth Hatchery and East Fork Salmon River trap.

Table 1. Steelhead rearing history for Hagerman HFH, 1978 to 1983 brood years.[a]

Brood year	Race source	Survival (%) eyed egg to smolt	No./lb	Mean length (in)	No. released	Release period	Release site
1978	A/Pahsimeroi	ND	4.8	8.4	181,290	01/27/79-03/08/79	Lemhi R.
1978	A/Pahsimeroi	ND	4.5	8.6	126,537	03/13/79-04/09/79	Lemhi R.
1978	A/Pahsimeroi	ND	4.7	8.5	117,134	02/09/79-04/23/79	Pahsimeroi R.
1979	A/Pahsimeroi	ND	6.8	ND	29,616	02/04/80	Pahsimeroi R.
1979	A/Pahsimeroi	ND	6.8	ND	40,514	11/01/79-04/22/80	Lemhi R.
1979	A/Pahsimeroi	ND	6.5	ND	109,321	02/06/80-04/23/80	Pahsimeroi R.
1979	B/Dworshak	ND	4.7	8.5	246,272	04/30/80-05/13/80	S. Fk. Salmon R.
1980	A/Pahsimeroi	ND	22.9	ND	191,400	10/23/80-10/30/80	Snake R.
1980	A/Pahsimeroi	ND	3.4	9.4	23,228	04/10/81-04/14/81	Upper Salmon R.
1980	A/Pahsimeroi	ND	3.3	9.5	294,394	04/15/81-05/04/81	Upper Salmon R.
1980	B/Dworshak	ND	4.7	8.5	6,400	05/05/81	S. Fk. Salmon R.
1980	A/Pahsimeroi	ND	29.9	ND	191,400	10/06/80-10/16/80	E. Fk. Salmon R.
1980	A/Pahsimeroi	ND	3.6	9.2	177,323	03/25/81-04/17/81	E. Fk. Salmon R.
1980	A/Pahsimeroi	ND	3.8	9.1	52,351	04/01/81-04/07/81	Pahsimeroi R.
1980	B/Dworshak	ND	7.1	ND	39,173	04/02/81-04/06/81	Pahsimeroi R.
1981	B/Pahsimeroi	ND	3.7	8.1	5,997	04/08/82	E. Fk. Salmon R.
1981	B/Dworshak	ND	6.1	ND	52,387	04/08/82-04/09/82	E. Fk. Salmon R.
1981	A/Pahsimeroi	ND	2.2	ND	359,772	04/12/82-05/10/82	Upper Salmon R.
1981	A/Pahsimeroi	ND	2.5	ND	60,784	03/30/82-04/07/82	Pahsimeroi R.
1981	B/Pahsimeroi	ND	3.8	9.1	58,281	04/01/82-04/07/82	Pahsimeroi R.
1982	A/Pahsimeroi	84.8[b]	3.1	9.7	84,194	02/28/83-03/01/83	Pahsimeroi R.
1982	A/Pahsimeroi	84.8[b]	2.8	10.0	31,348	04/11/83-04/12/83	E. Fk. Salmon R.
1982	A/Pahsimeroi	84.8[b]	2.1	ND	40,573	04/18/83-04/20/83	Upper Salmon R.
1982	A/Pahsimeroi	84.8[b]	5.3	8.1	40,548	04/18/83-04/20/83	Upper Salmon R.
1982	B/Pahsimeroi	63.6[c]	3.4	9.4	201,587	04/04/83-04/11/83	E. Fk. Salmon R.
1982	B/Pahsimeroi	63.6[c]	3.7	9.2	26,173	04/18/83-04/21/83	Upper Salmon R.
1983	A/Pahsimeroi	ND	3.7	9.2	50,487	02/28/84-03/06/84	Snake R.
1983	A/Pahsimeroi	ND	2.6	ND	477,164	04/02/84-05/03/84	Upper Salmon R.
1983	A/Pahsimeroi	ND	2.6	ND	96,425	04/19/84-04/26/84	Little Salmon R.
1983	B/Pahsimeroi	ND	4.4	8.6	393,452	03/27/84-04/13/84	E. Fk. Salmon R.
1983	B/Pahsimeroi	ND	4.3	8.7	191,248	04/19/84-04/26/84	Little Salmon R.

[a] All data furnished by HNFH personnel.
[b] Average survival of four release groups.
[c] Average survival of two release groups.

Time of migration

Coded-wire tag recoveries reported by Duke (1984) show that HNFH steelhead adults have been present in the Columbia River Zone 6 fishery in September, and also have appeared relatively frequent in February and March (Table 2). The figures used in this context may reflect the timing and intensity of fishing effort, perhaps more than the abundance of fish in any given month.

Spawning period

Not yet determined for HNFH stocks. Adult trapping facilities at the East Fork and Sawtooth became operational for steelhead beginning in the spring of 1985.

Spawning areas

Beginning in 1985, fish arriving at the Sawtooth and East Fork traps will be used for spawntaking.

Age composition

No information is available yet for HNFH production. (See stock assessment reports for donor stocks.)

Size

No information is available yet for HNFH production. (See stock assessment reports for donor stocks.)

Sex

No information is available yet for HNFH production. (See stock assessment reports for donor stocks.)

Fecundity

No information is available yet for HNFH production. (See stock assessment reports for donor stocks.)

Biochemical-genetic characteristics

No information.

JUVENILE LIFE HISTORY

Time of emergence

Timing of swim-up will depend on the temperature regimen at incubation facilities. This has not yet been experienced at Sawtooth. Eggs taken at East Fork and Sawtooth will be eyed at Sawtooth, then shipped to HNFH for final incubation and rearing (pers. comm., Evan Parrish, IDFG Bureau of Fisheries).

Table 2. Columbia River coded-wire tagged fish recoveries, by month of capture, for Hagerman NFH summer steelhead.

Month	Number of tagged fish	
	Zones 1-5	Zone 6
February	0	23
March	0	51
April	0	1
July	1	0
September	3	79

Time, age and size at migration

Smolts are trucked from HNFH to the release sites in March and April at one year of age. Size at release has varied considerably, partly due to experimental design in seeking the optimum size for release (Table 1).

Survival rate

Limited data available for eyed eggs to smolt survival indicates 84.8% for group A and 63.6% for group B stocks (Table 1).

Three experimental coded-wire tag groups of the 1978 brood year that were released at the Pahsimeroi trap had smolt-to-adult returns of 0.4%, 0.3% and 0.2%. The highest return reported to date is 0.8% smolt-to-adult, for 1-ocean returns only.

DISEASE HISTORY

Low levels of infectious pancreatic necrosis (IPN) have been diagnosed, but not in recent years. Incidental occurrences of bacterial kidney disease (BKD) and bacterial gill disease have also been noted, neither of which were serious or long-standing (David Bruhn, HNFH, pers. comm.).

PRIORITY INFORMATION NEEDS

1. Extent of straying of returning adults among the Pahsimeroi, East Fork and Sawtooth traps.

2. Comparative survivals in-hatchery and smolt-to-adult for group A and group B stocks.

3. Comparative contributions to the Columbia River and Idaho fisheries for the group A and group B stocks.

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APPENDIX

DATACODE: 50635 SPECIES: STLHD HATCHERY OF RELEASE: HAGERMAN SITE OF RELEASE: PAHSIMEROI R

RELEASE YEAR: 1980 TOTAL GROUP RELEASE: 38,915 TOTAL TAG RELEASE: 36,775 PURPOSE OF RELEASE: IDCCSR

LOCATION	TYPE RECOVERY	NUMBER OBSERVED	
PAHSIMEROI	HATCH RACK	4	
OREGON ZON 6	INDIAN GILL	2	
DESCHUTES R	SPORT FISH	1	
		1 OCEAN TOTAL	7
PAHSIMEROI	HATCH RACK	98	
OREGON ZON 6	INDIAN GILL	11	
WARM SPRINGS	INDIAN CTS	1	
MACKS CANYON	SPORT FISH	1	
SHERARS FALL	SPORT FISH	1	
LOWER SNAKE	VOLUNTARY	2	
CLEARWATER 1	VOLUNTARY	1	
SALMON SEC 1	VOLUNTARY	3	
SALMON SEC 2	VOLUNTARY	2	
SALMON SEC 3	VOLUNTARY	2	
SALMON SEC 3	SPORT FISH	2	
SALMON SEC 4	SPORT FISH	1	
SALMON SEC 5	VOLUNTARY	1	
SALMON SEC 5	SPORT FISH	4	
		2 OCEAN TOTAL	130
PAHSIMEROI	HATCH RACK	2	
		3 OCEAN TOTAL	2
		GRAND TOTAL	139

DATACODE: 50636 SPECIES: STLHD HATCHERY OF RELEASE: HAGERMAN SITE OF RELEASE: PAHSIMEROI R

RELEASE YEAR: 1980 TOTAL GROUP RELEASE: 41,571 TOTAL TAG RELEASE: 39,825 PURPOSE OF RELEASE: IDCCSR

LOCATION	TYPE RECOVERY	NUMBER OBSERVED	
PAHSIMEROI	HATCH RACK	11	
OREGON ZON 3	EXPERIMENT	1	
OREGON ZON 6	INDIAN GILL	1	
SALMON SEC 2	SPORT FISH	2	
		1 OCEAN TOTAL	15
PAHSIMEROI	HATCH RACK	97	
OREGON ZON 6	INDIAN GILL	19	
DESCHUTES R	SPORT FISH	1	
L GOOSE	VOLUNTARY	1	
L GRANITE	SPORT FISH	1	
SALMON SEC 1	VOLUNTARY	6	
SALMON SEC 2	VOLUNTARY	2	
SALMON SEC 2	SPORT FISH	1	
SALMON SEC 4	SPORT FISH	2	
SALMON SEC 5	VOLUNTARY	5	
SALMON SEC 5	SPORT FISH	4	
SALMON SEC 6	VOLUNTARY	2	
		2 OCEAN TOTAL	141
PAHSIMEROI	HATCH RACK	6	
		3 OCEAN TOTAL	6
		GRAND TOTAL	162

DATACODE: 50637 SPECIES: STLHD HATCHERY OF RELEASE: HAGERMAN SITE OF RELEASE: PAHSIMEROI I

RELEASE YEAR: 1980 TOTAL GROUP RELEASE: 36,375 TOTAL TAG RELEASE: 34,300 PURPOSE OF RELEASE: IDCCSR

LOCATION	TYPE RECOVERY	NUMBER OBSERVED	
PAHSIMEROI	HATCH RACK	24	
OREGON ZON 6	INDIAN GILL	4	
SALMON SEC 4	SPORT FISH	1	
SALMON SEC 5	SPORT FISH	1	
		1 OCEAN TOTAL	30
PAHSIMEROI	HATCH RACK	180	
ABOVE BONVLE	EXPERIMENT	1	
OREGON ZON 6	INDIAN GILL	25	
SHERARS FALL	SPORT FISH	1	
SALMON SEC 1	VOLUNTARY	3	
SALMON SEC 1	SPORT FISH	1	
SALMON SEC 2	VOLUNTARY	1	
SALMON SEC 2	SPORT FISH	3	
SALMON SEC 3	VOLUNTARY	3	
SALMON SEC 3	SPORT FISH	3	
SALMON SEC 4	VOLUNTARY	3	
SALMON SEC 4	SPORT FISH	9	
SALMON SEC 5	VOLUNTARY	2	
SALMON SEC 5	SPORT FISH	11	
SALMON SEC 6	VOLUNTARY	2	
SALMON SEC 6	SPORT FISH	1	
		2 OCEAN TOTAL	249
PAHSIMEROI	HATCH RACK	11	
		3 OCEAN TOTAL	11
		GRAND TOTAL	290

DATACODE: 51020 SPECIES: STLHD HATCHERY OF RELEASE: HAGERMAN SITE OF RELEASE: PAHSIMEROI R

RELEASE YEAR: 1982 TOTAL GROUP RELEASE: 60,784 TOTAL TAG RELEASE: 58,950 PURPOSE OF RELEASE: PASTID

LOCATION	TYPE RECOVERY	NUMBER OBSERVED
PAHSIMEROI	HATCH RACK	232
JUAN DE FUCA	GILL NET	1
ASTORIA	SPORT FISH	1
OREGON ZON 6	GILL NET	1
OREGON ZON 6	INDIAN GILL	2
L GRANITE D	HATCH RACK	1
CLEARWATER 2	SPORT FISH	1
CLEARWATER 4	SPORT FISH	1
SALMON RIVER	VOLUNTARY	1
SALMON SEC 1	VOLUNTARY	1
SALMON SEC 1	SPORT FISH	2
SALMON SEC 2	VOLUNTARY	1
SALMON SEC 3	VOLUNTARY	1
SALMON SEC 4	SPORT FISH	3
SALMON SEC 5	VOLUNTARY	3
SALMON SEC 5	SPORT FISH	56
SALMON SEC 6	VOLUNTARY	3
SALMON SEC 6	SPORT FISH	4

1 OCEAN TOTAL 315

GRAND TOTAL 315

DATACODE: 51021 SPECIES: STLHD HATCHERY OF RELEASE: HAGERMAN SITE OF RELEASE: PAHSIMEROI I

RELEASE YEAR: 1982 TOTAL GROUP RELEASE: 58,281 TOTAL TAG RELEASE: 56,525 PURPOSE OF RELEASE: PBSTID

LOCATION	TYPE RECOVERY	NUMBER OBSERVED	
PAHSIMEROI	HATCH RACK	34	
SALMON SEC 2	VOLUNTARY	1	
SALMON SEC 3	SPORT FISH	1	
SALMON SEC 4	SPORT FISH	3	
SALMON SEC 5	SPORT FISH	7	
SALMON SEC 6	SPORT FISH	2	
		1 OCEAN TOTAL	48
		GRAND TOTAL	48

940

DATACODE: 102240 SPECIES: STLHD HATCHERY OF RELEASE: HAGERMAN SITE OF RELEASE: PAHSIMEROI I

RELEASE YEAR: 1981 TOTAL GROUP RELEASE: 39,173 TOTAL TAG RELEASE: 38,425 PURPOSE OF RELEASE: IDSTDB

LOCATION	TYPE RECOVERY	NUMBER OBSERVED	
PAHSIMEROI	HATCH RACK	6	
SALMON SEC 5	SPORT FISH	1	
		1 OCEAN TOTAL	7
PAHSIMEROI	HATCH RACK	29	
OREGON ZON 6	INDIAN GILL	12	
BONNEVILLE D	EXPERIMENT	1	
SALMON SEC 3	SPORT FISH	1	
SALMON SEC 4	SPORT FISH	1	
SALMON SEC 5	SPORT FISH	1	
		2 OCEAN TOTAL	45
		GRAND TOTAL	52

DATACODE: 102239 SPECIES: STLHD HATCHERY OF RELEASE: HAGERMAN SITE OF RELEASE: PAHSIMEROI R

RELEASE YEAR: 1981 TOTAL GROUP RELEASE: 52,351 TOTAL TAG RELEASE: 49,550 PURPOSE OF RELEASE: STID

LOCATION	TYPE RECOVERY	NUMBER OBSERVED	
PAHSIMEROI	HATCH RACK	94	
OREGON ZON 6	INDIAN GILL	6	
DESCHUTES R	SPORT FISH	2	
PELTON DAM	HATCH RACK	1	
MACKS CANYON	SPORT FISH	1	
SHERARS FALL	SPORT FISH	1	
CLEARWATER 1	VOLUNTARY	1	
SALMON SEC 2	VOLUNTARY	1	
SALMON SEC 3	VOLUNTARY	1	
SALMON SEC 3	SPORT FISH	1	
SALMON SEC 4	SPORT FISH	2	
SALMON SEC 5	VOLUNTARY	2	
SALMON SEC 5	SPORT FISH	12	
SALMON SEC 6	VOLUNTARY	1	
		1 OCEAN TOTAL	126
PAHSIMEROI	HATCH RACK	6	
OREGON ZON 6	INDIAN GILL	1	
SALMON SEC 4	SPORT FISH	1	
SALMON SEC 6	VOLUNTARY	1	
		2 OCEAN TOTAL	9
		GRAND TOTAL	135

MAGIC VALLEY HATCHERY SUMMER STEELHEAD

The Magic Valley steelhead hatchery is under construction at the time of this writing (April 1985). The hatchery is scheduled to be completed in October 1985, and will be operated by the Idaho Department of Fish and Game as part of the Lower Snake River Fish and Wildlife Compensation Plan (Partridge 1984). The following material pertains to the hatchery as it will initially be operated. Changes in stocks reared or stocking areas may occur as experience guides the program.

PRODUCTION

Hatchery.

GEOGRAPHIC LOCATION

The hatchery is located on the south side of the Snake River, northeast of Buhl, Idaho.

Streams to be stocked are tributaries of the Salmon River. The stocking plan is not yet firm, but candidate streams for stocking include Little Salmon River, Slate Creek, Allison Creek and Whitebird Creek.

ORIGIN

Group A steelhead will be obtained from Pahsimeroi Hatchery (Niagara Springs stock) or Sawtooth Hatchery. Group B steelhead will be obtained at the East Fork Salmon River trap or Dworshak National Fish Hatchery (Pollard, H. A., II, IDFG Bureau of Fisheries, pers. comm.).

ADULT LIFE HISTORY

Run size, catch and escapement

The purpose of the program will be to improve sport catches of steelhead in locations where hatchery stocks presently contribute relatively light. Although smolt releases will be made into habitat with potential for natural spawning by returning adults, management of the stock for particular spawning escapements will not be a priority concern.

Time of migration

No information.

Spawning period

No information.

Spawning areas

The program will depend on donor stocks (Niagara Springs, Sawtooth, Hagerman NFH, Dworshak NFH or East Fork Salmon River Trap) for yearly supplies of eggs.

Age composition

No information.

Size

No information.

Sex ratio

No information.

Fecundity

No information.

Biochemical-genetic characteristics

No information.

JUVENILE LIFE HISTORY

Time of emergence

No information.

Time, age and size at migration

No information.

Survival rate

No information.

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

Information needs will mainly be developed as experience with the program occurs. An initial primary information need will be to determine the extent to which the program augments the Salmon River sport fishery.

REFERENCES

Partridge, F. E. 1984. Fish hatchery evaluations - Idaho. U.S. Fish and Wildlife Service Contract 14-16-0001-832687. Idaho Department of Fish and Game.

SOUTH FORK SALMON RIVER SUMMER STEELHEAD

PRODUCTION

Natural, classified as a "wild" stock in IDFG anadromous fish management plan. Dworshak NFH stock was released in the South Fork Salmon River drainage in four years at fry or smolt stage (Table 1).

GEOGRAPHIC LOCATION

Streams

South Fork Salmon River drainage (SFSR), Idaho, a tributary to the Salmon River, 215 km above its confluence with the Snake River (Fig. 1).

Hatcheries

None.

ORIGIN

The South Fork Salmon River system contains native steelhead. Surveys of steelhead on spawning grounds in 1982 revealed minor returns of adults from hatchery releases listed in Table 1 (IDFG, Thurow, R. pers. comm.).

Table 1. History of steelhead stocking in South Fork Salmon River drainage.

Brood year	Year stocked	Stream	Number stocked	Life stage	Data source
1977	1977	S.Fk. Salmon	300,000	fry	Ortmann (1979)
1977	1977	Johnson Creek	300,000	fry	Ortmann (1979)
1978	1978	S. Fk. Salmon	193,450	fry	Ortmann (1980)
1978	1978	E. Fk. of S. Fk.	193,450	fry	Ortmann (2980)
1978	1978	Johnson Creek	96,725	fry	Ortmann (1980)
1979	1980	S. Fk. Salmon	246,472	smolt	Pettit (in press)
1980	1981	S. Fk. Salmon	6,400	smolt	Pettit (in press)

ADULT LIFE HISTORY

Run size, catch and escapement

Current wild steelhead escapements total approximately 500 to 1,000 fish (Thurow 1985). Historically, the SFSR supported substantial runs which probably exceeded 3,000 fish. Since the 1940's, man-caused activities (primarily road construction and logging) have caused erosion of unstable, granitic soils and severe damage to fisheries habitat. Steelhead populations were simultaneously reduced by accelerated hydroelectric dam construction on the Columbia and Snake rivers.

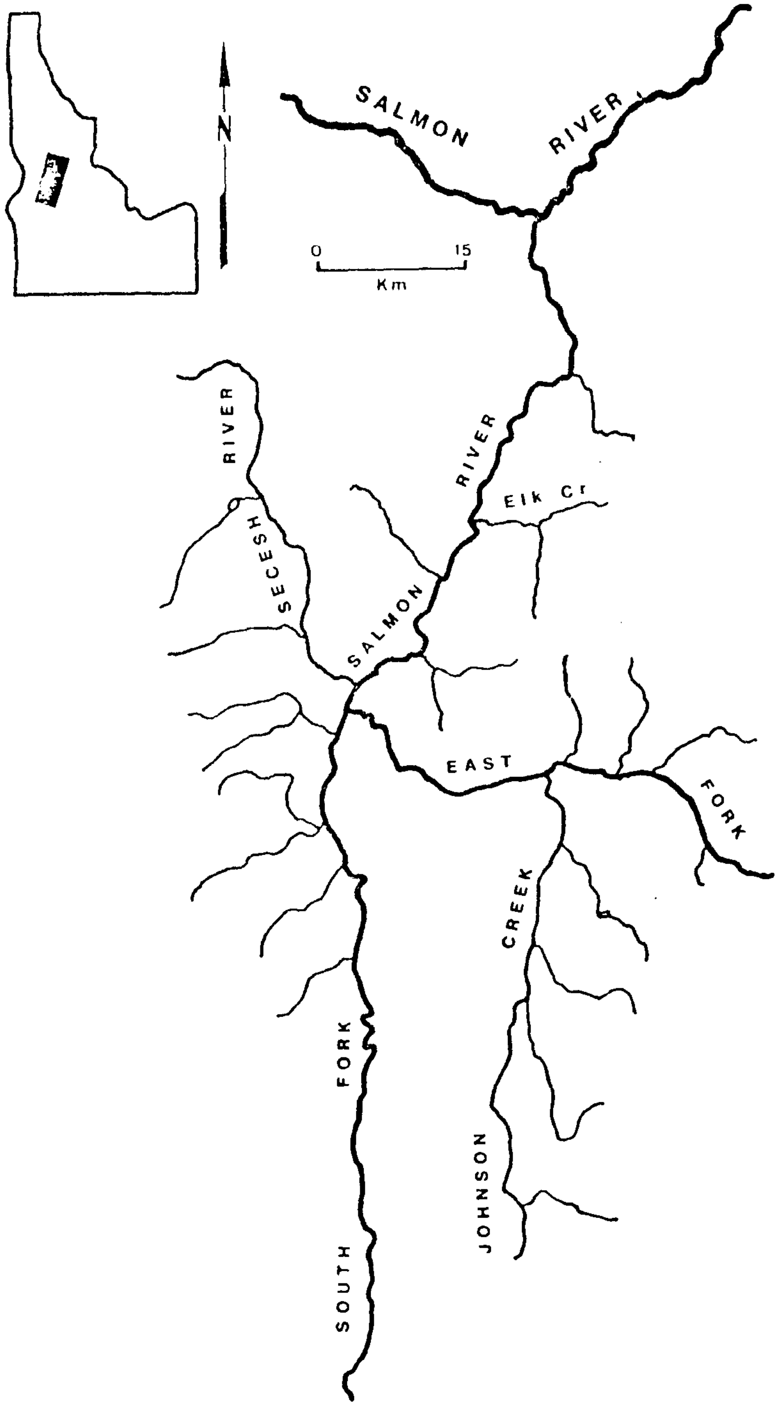

Figure 1. South Fork Salmon River drainage, Idaho.

SFSR wild steelhead formerly contributed to the Columbia, Snake, Salmon and South Fork Salmon river sport fisheries. The proportion of SFSR steelhead in the Columbia and Snake river sport catch is unknown. The Salmon River sport fishery probably harvested a significant portion of the SFSR run. Since 1982, a differential harvest regulation (based on dorsal fin height) has required that anglers release 97% of the wild steelhead, thereby increasing escapements to the SFSR. An excellent steelhead fishery formerly existed on the SFSR and 10 to 15% of Idaho's steelhead angling effort occurred there. In 1963, anglers harvested 810 steelhead on the SFSR (Ortmann 1966).

Time of migration

SFSR steelhead trout appear to be predominately "Group B" fish which, by definition, pass Bonneville Dam after August 25. Most fish destined for the SFSR appear to stage in the Salmon or Snake rivers. Steelhead begin ascending the SFSR in February and March and proceed to spawning areas (Thurow 1985).

Spawning period

Spawning commences in early April and peak activity occurs in May (Fig. 2) (Thurow 1985).

Spawning Areas

Steelhead spawn in the main stem SFSR and sections of the following tributaries: Burntlog, Buckhorn, Camp, Fitsum, Fourmile, Johnson and Lick creeks; and the East Fork South Fork and Secesh rivers (Thurow 1985).

Age composition

Thurow (1985) reported 81% with ocean life of 2 years or more, with the remainder being 1-ocean fish.

Size

A sample of 50 adults from the SFSR averaged 85 cm and ranged to 101 cm (Fig. 3) (Thurow 1985).

Sex ratio

Sex ratios averaged 1.3 males per female for steelhead observed in holding and spawning areas (Thurow 1985).

Fecundity

No information.

Biochemical-genetic characteristics

An electrophoretic analysis was performed on steelhead parr collected from the SFSR in 1985. Oregon State University personnel isolated 23 enzyme system alleles (Schreck et al. 1985).

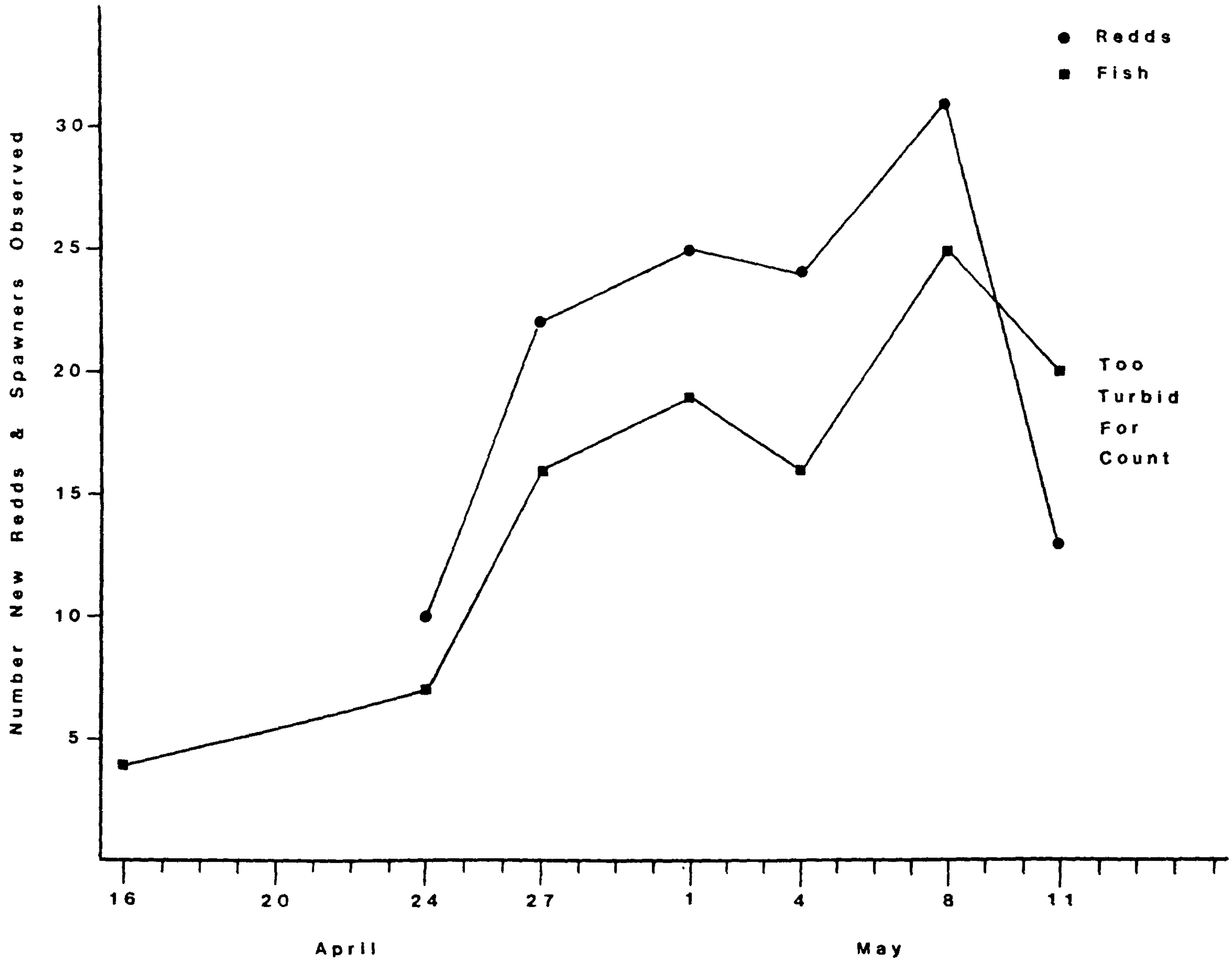

Figure 2. Steelhead trout redds and spawners observed on the Poverty Flat spawning area, South Fork Salmon River, 1984.

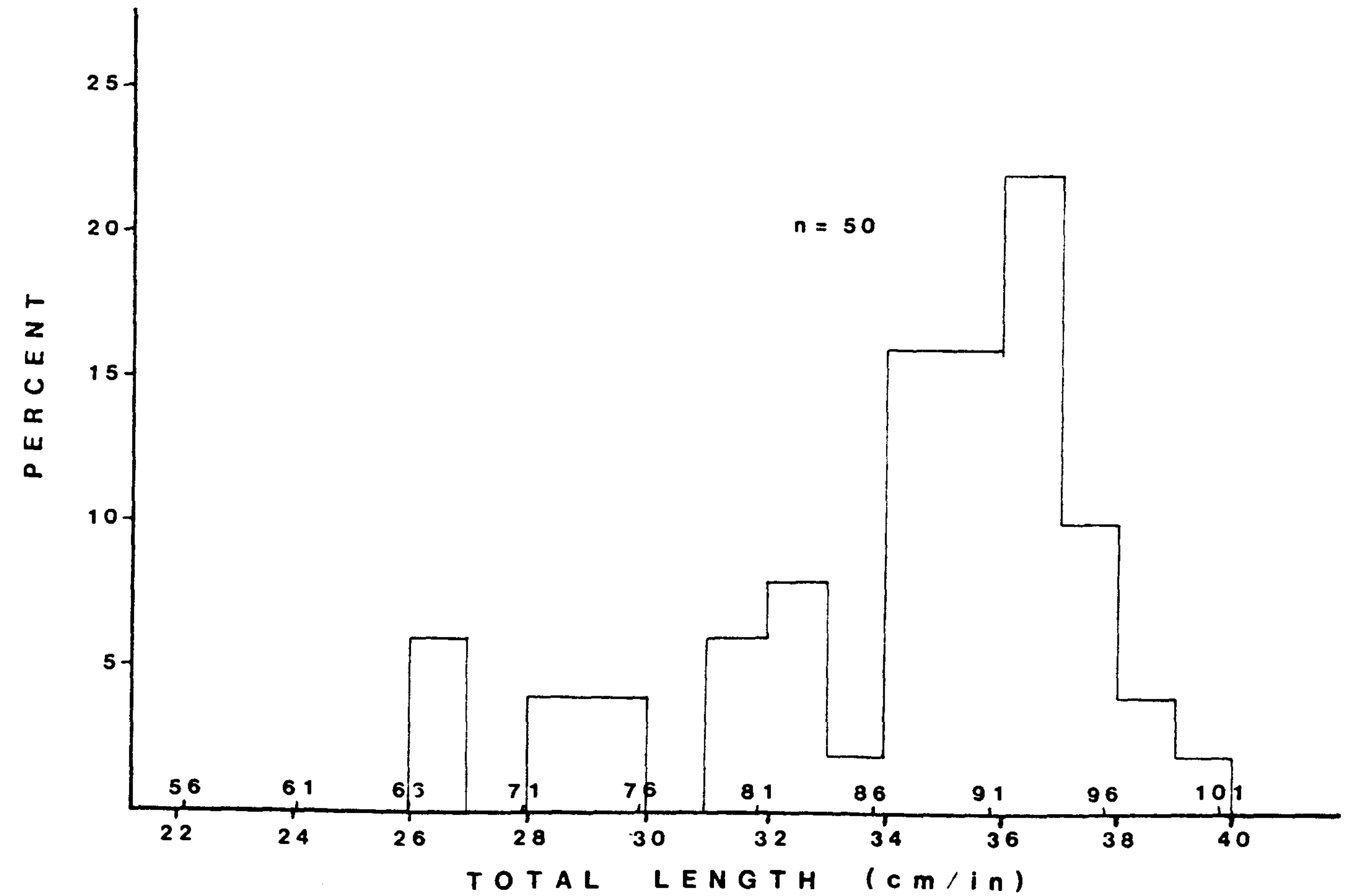

Figure 2. Length frequency of wild steelhead trout caught in the South Fork Salmon River.

JUVENILE LIFE HISTORY

Time of emergence

Fry begin emerging in July and most emergence is complete by early September (Thurow 1985).

Time, age and size at migration

Wild steelhead smolts migrate down the Salmon River in April and May. A scoop trap, located 129 km below the confluence of the SFSR, captured wild smolts between April 25 and May 22 (Scully et al. 1983). Wild steelhead smolts averaged 190 mm total length. There is no information on age at emigration for SFSR stock.

Survival rate

For hatchery steelhead brood years since 1975, adult returns have ranged from 0.03% to 1.35% to the upper Salmon River (Ball 1984, 1985). The return of 1-ocean adults from the 1982 brood year totaled 2.3% (K. Ball, Idaho Department of Fish and Game , pers. comm.). The lower rate of descaling of wild steelhead smolts captured in the Salmon River suggests that survival of wild smolts may be better than survival of hatchery smolts (Scully et al. 1983).

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Juvenile rearing capacity of SFSR drainage habitat.

2. Adult numbers required to optimally seed the habitat.

3. Timing of the adult run as it moves from the Columbia River mouth to the SFSR.

4. Assessment of age and size characteristics of population compared to other group B stocks.

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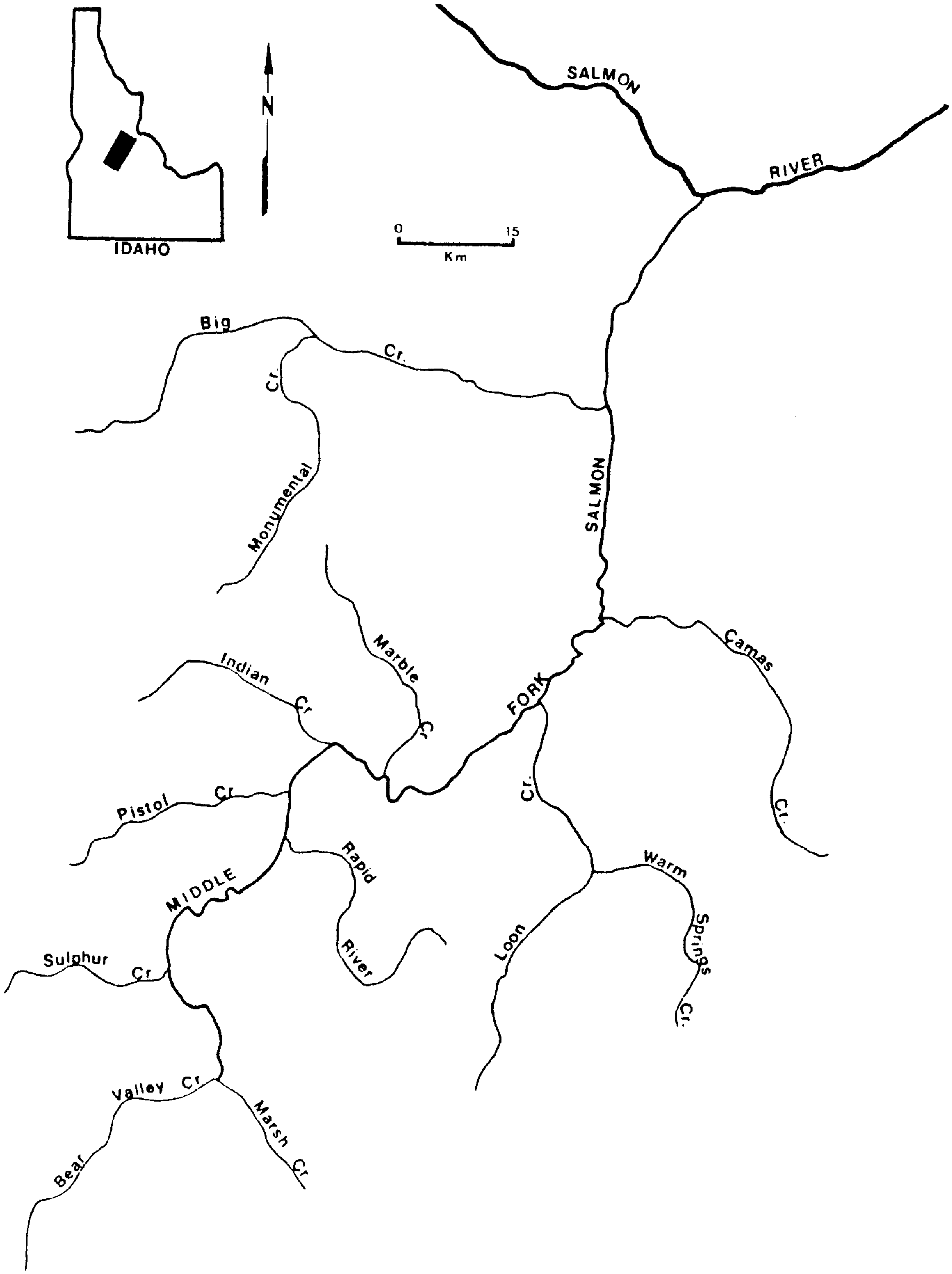


Figure 1. Middle Fork Salmon River drainage, Idaho.

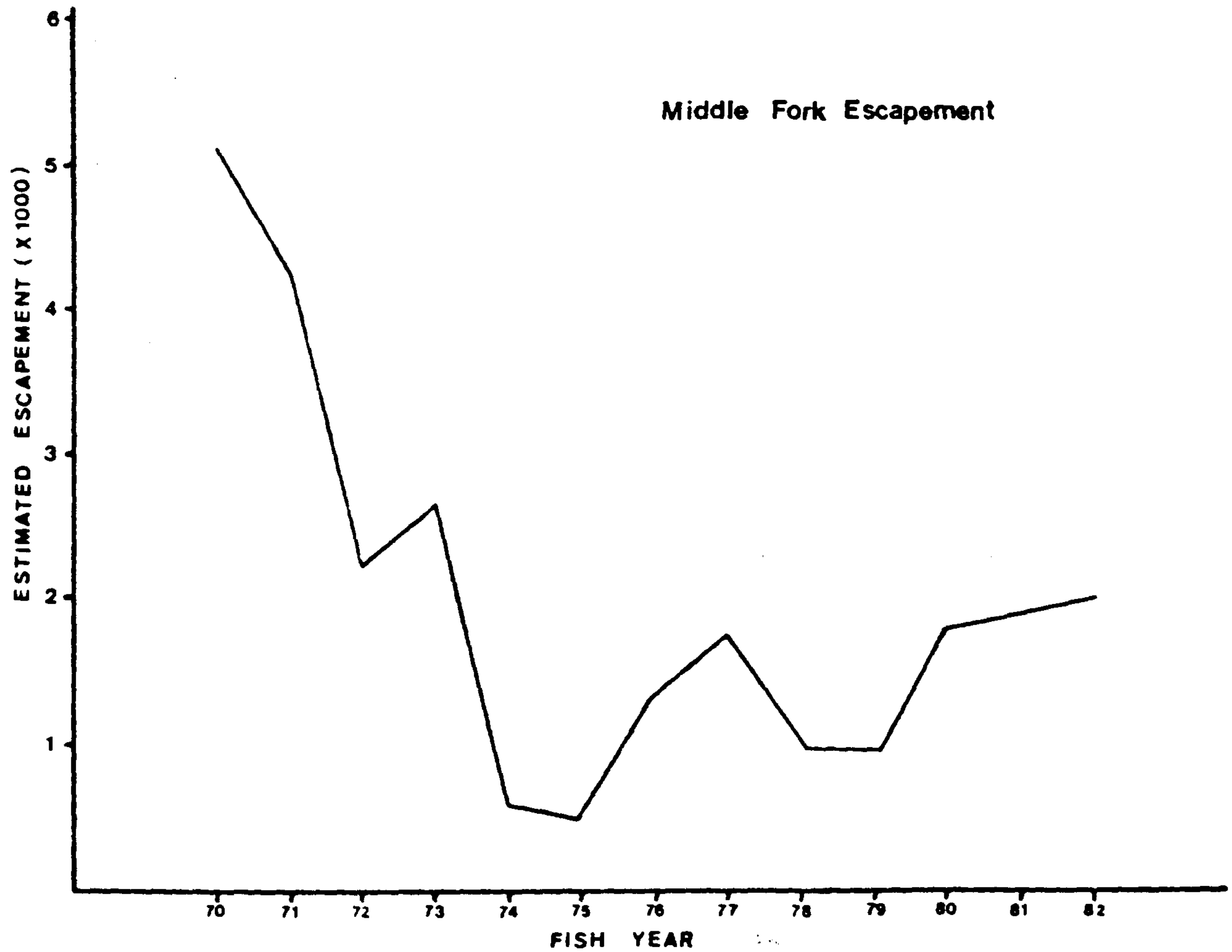


Figure 2. Estimated annual escapements of wild steelhead trout to the Middle Fork Salmon River, 1970-1983.

enters the lower portions of the MFSR in fall but most fish re-enter the main Salmon River with the onset of winter (Thurow 1985). Steelhead begin entering the MFSR in February and March and proceed to spawning streams.

Spawning period

Spawning commences in early April and peak activity occurs in May (Fig. 3) (Thurow 1985).

Spawning areas

Steelhead spawning is documented in, but not believed to be limited to, sections of the following tributaries: Bear Valley, Big, Brush, Camas, Indian, Loon, Marble, Marsh, Pistol, Rapid River, Sheep, Sulphur and Wilson creeks (Thurow 1985).

Age composition

Thurow (1985) reported over 80 percent of the population is 2-ocean fish, with most of the remainder being 1-ocean.

Size

A length of 71 cm appears to separate 1-ocean and 2-ocean fish (Reingold 1972). A sample of 167 adults from the MFSR averaged 81 to 86 cm and ranged to 99 cm (Fig. 4) (Thurow 1983).

Sex ratio

Sex ratios averaged 1:1 for steelhead observed in holding and spawning areas (Thurow 1985). Data from other wild stocks trapped in Idaho exhibit a larger proportion of females than males, averaging 1.5 females per male.

Fecundity

No information.

Biochemical-genetic characteristics

Results of electrophoretic analysis illustrated heterogeneity among steelhead in tributaries to the MFSR (Thurow 1985). MFSR steelhead stocks share characteristics of other Snake River stocks, but differ from coastal and lower Columbia River populations.

JUVENILE LIFE HISTORY

Time of emergence

Fry begin to emerge in July and most emergence is complete by early September (Thurow 1985).

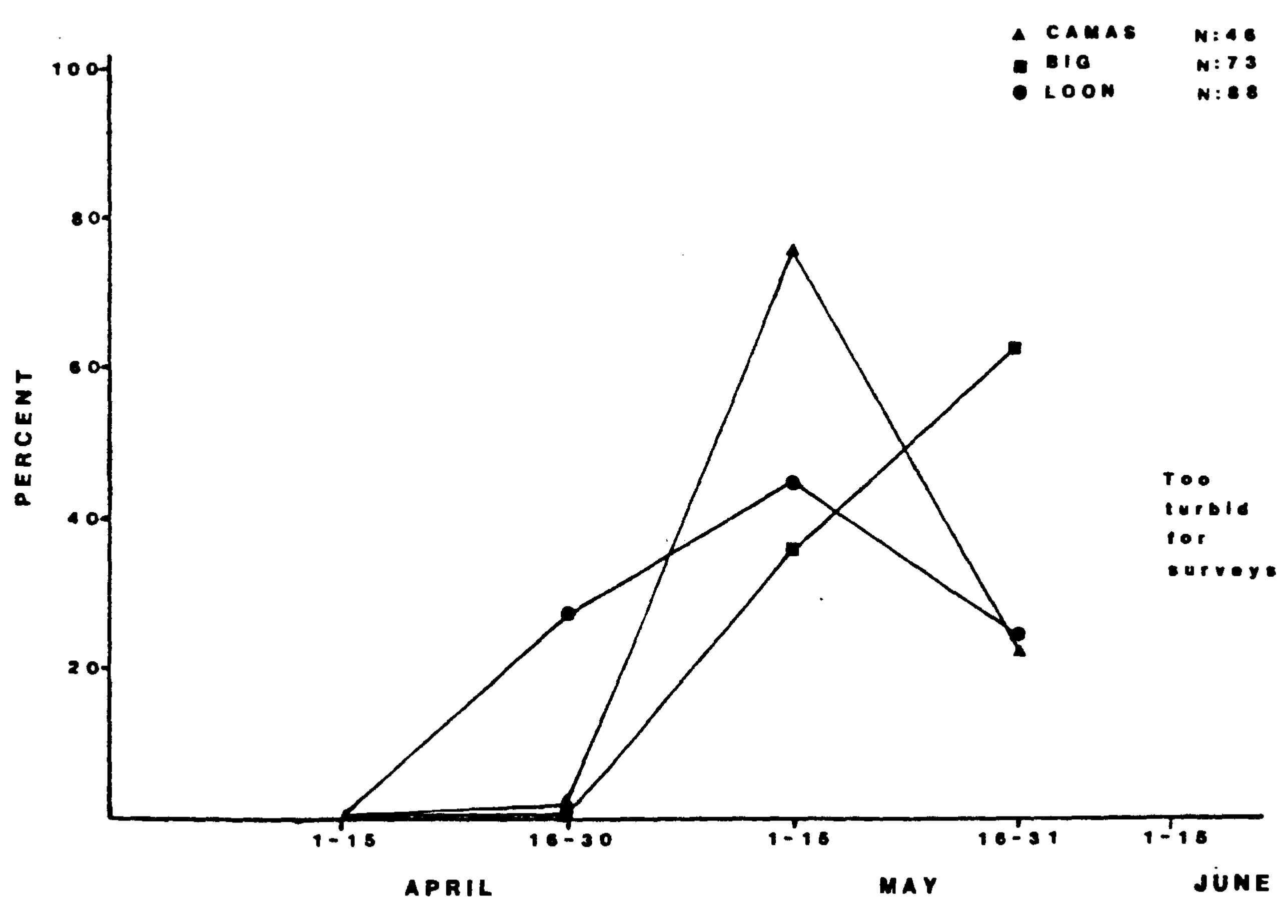
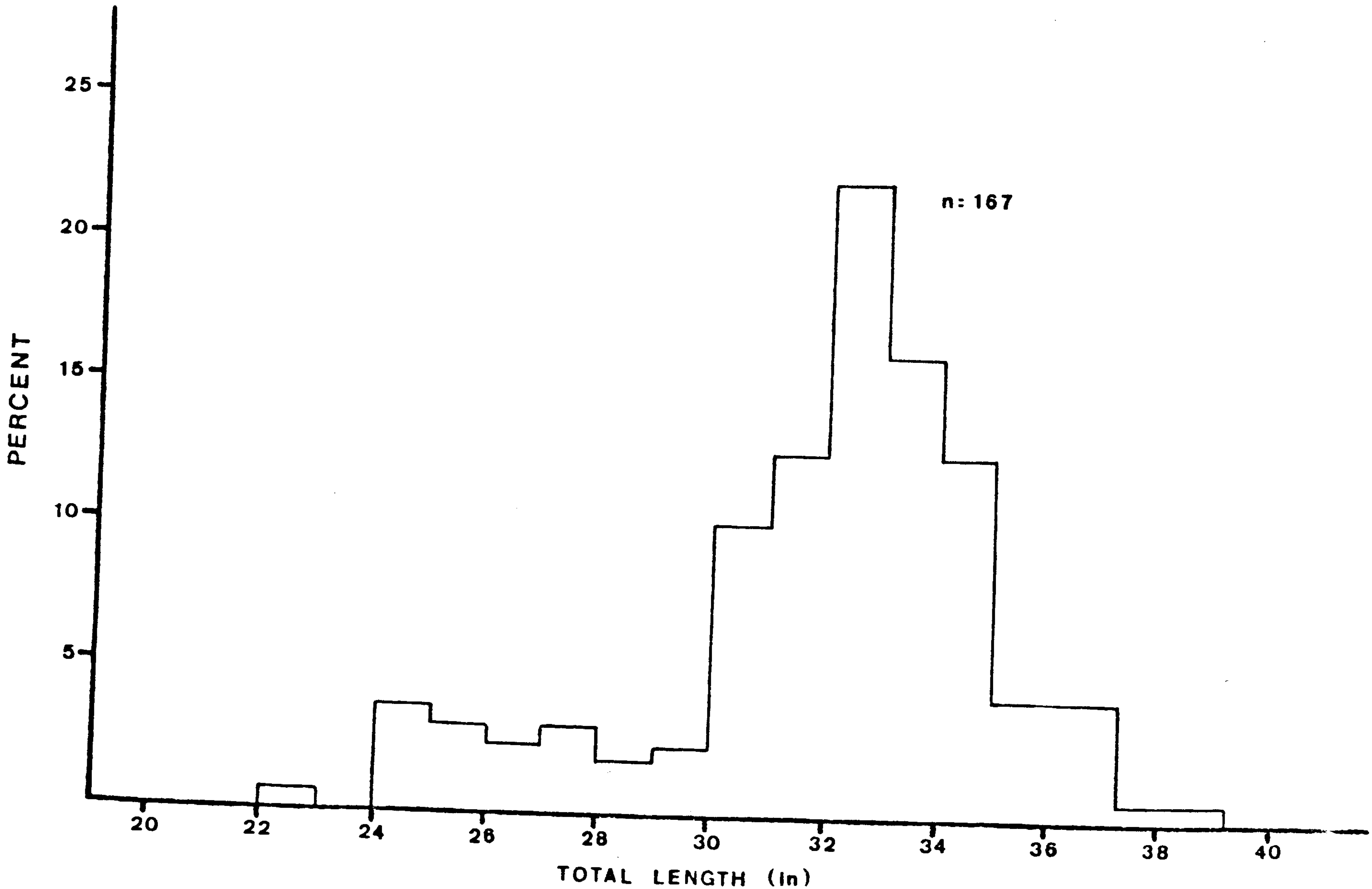


Figure 3. Percent of steelhead spawners and redds (combined) observed in Big, Camas and Loon creeks during specified periods, 1968-1983.


PERCENT
25
20
15
10
5
n: 167
20
22
24
26
28
30
32
34
36
38
40
TOTAL LENGTH (in)

Time, age and size at migration

Wild steelhead smolts migrate down the Salmon River in April and May. A scoop trap, located 233 km below the confluence of MFSR, captured wild smolts, among which, presumably, were MFSR stock, between April 25 and May 22 (Scully et al. 1983). Wild steelhead smolts averaged 190 mm total length.

Thurow (1985) reported snorkeling surveys in which age 1 and 2 fish predominated over age 3 fish, indicating that the major emigration occurs at age 2+, with age 3+ migrants also being important.

Survival rate

For hatchery steelhead brood years since 1975, adult returns have ranged from 0.03 percent to 1.35 percent to the upper Salmon River (Ball 1984, 1985). The return of 1-ocean adults from the 1982 brood year totaled 2.3 percent (K. Ball, Idaho Department of Fish and Game, personal communication). The lower rate of descaling of wild steelhead smolts captured in the Salmon River suggests that survival of wild smolts may be better than survival of hatchery smolts (Scully et al. 1983).

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Improved knowledge of juvenile rearing capacity of MFSR drainage habitat.

2. Improved knowledge of adult numbers required to optimally seed the habitat.

3. Improved knowledge of the timing of the adult run as it moves from the Columbia River mouth to the MFSR.

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Imnaha River Summer Steelhead (wild)

PRODUCTION

To date, adult steelhead production in the Imnaha River Basin has been from wild stock. However, under the Lower Snake River Compensation Plan approximately 330,000 Imnaha hatchery stock smolts (developed from native broodstock) will be released each year into the Imnaha system [see "Imnaha River Summer Steelhead (hatchery)"].

GEOGRAPHIC LOCATION

Streams

Summer steelhead occur in all of the major and most of the smaller tributaries throughout the Imnaha River basin (Figure 1).

ORIGIN

There have been no known introductions of non-native steelhead stocks in the Imnaha River system.

ADULT LIFE HISTORY

Run size, catch, and escapement

The spawning escapement was estimated at 3,000 fish in the early 1970s (James 1984). The size of the steelhead run in the Imnaha drainage is unknown at present but is thought to have ranged between 800 and 1,500 fish in recent years (James 1984). Redd counts in Camp Creek have declined since 1965 (Figure 2). However, it is difficult to estimate trends in spawning abundance because of high flows at the time of spawning and the widespread distribution of spawning areas in the system.

From 1959 to 1968, sport harvest fluctuated between 350 and 1,350 fish (Table 1). The catch then declined to a low of 455 fish in 1973. The Imnaha drainage was closed to sport angling in 1974. Estimates of harvest in the tribal gill-net fishery in the Columbia River are not available.

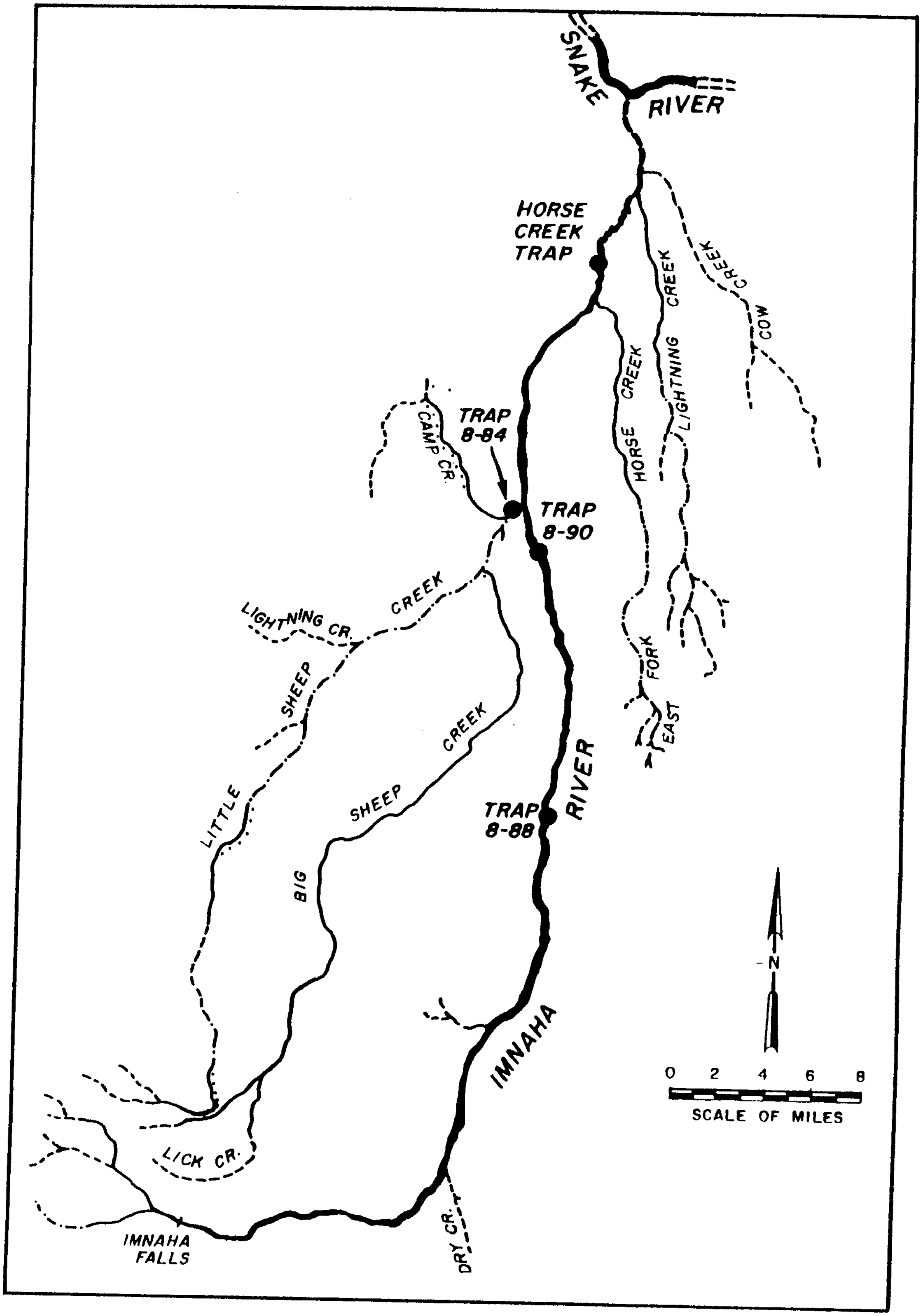

Figure 1. The Imnaha River system (modified from Gaumer 1968).

Figure 2. Summer steelhead redd counts in the lower 6 miles of Camp Creek, tributary to the Imnaha River, 1965-1983 (James 1984).

Table 1. Estimated sport harvest of steelhead in the Imnaha River, 1959-73[a] (ODFW unpublished data; Berry 1981).

Year	Catch[b]	Year	Catch[b]
1959	1,334	1967	1,066
1960	1,018	1968	1,282
1961	995	1969	831
1962	931	1970	660
1963	704	1971	746
1964	354	1972	589
1965	937	1973	455
1966	784		

[a] Imnaha drainage has been closed to sport angling since 1974.
[b] Catch prior to 1971 has not been adjusted for non-response bias.

Time of migration

Imnaha summer steelhead enter the Columbia River in June and July and pass Bonneville Dam in July (TAC 1984). Adults migrate through the lower Snake River in two groups. The majority of fish in the first group migrate through the area upstream from the confluence of the Clearwater and Asotin rivers with the Snake the last two weeks of September. Peak passage of the second group was between early April and mid-May. Migration ceases in the mainstem Snake River from November through March. Apparently, steelhead in the Snake River stop migrating when water temperatures drop below 3°C and begin in the spring when it rises above 4°C (Thompson et al. 1958). The first adults of the run enter the lower Imnaha River as early as August; they enter tributary streams between fall and spring (James 1984).

Spawning period

Summer steelhead generally spawn between late April and early June in the Imnaha River system. However, fish spawn earlier in April in Camp Creek (James 1984).

Spawning areas

Spawning has been documented in all major and some smaller tributaries of the Imnaha River (James 1984).

Age composition

Wild adults trapped in Little Sheep Creek in 1984 for hatchery broodstock were primarily 1-salts.

Size

The 1-salt adults trapped for broodstock in 1984 ranged from 53.0 cm to 65.0 cm in length. The average was 58.0 cm (males) and 57.8 cm (females). The 2-salt adults ranged from 69.0 to 73.0 cm in length (R. Carmichael, ODFW, personal communication).

Sex ratio

No information.

Fecundity

The average fecundity of 35 wild females spawned for hatchery egg-take in 1984 was 5,130 eggs/female.

Biochemical-genetic characteristics

In a genetic comparison of Snake River steelhead populations, the Imnaha (Little Sheep Cr.) sample was not significantly different from the Chesnimnus sample (Grande Ronde River) or 3 of 5 groups from the lower Clearwater River (Figure 3) (Milner and Teel 1984). Loci variability based on isozyme gene frequencies of wild Imnaha summer steelhead (via Irrigon Hatchery) is presented in Table 2.

Table 2. Variability of 34 loci in summer steelhead from Little Sheep Creek (standard errors in parentheses) (Milner and Teel 1984).

Mean sample size per locus	Mean no. of alleles per locus	Percentage of loci polymorphic[a]	Mean heterozygosity: Direct count	Mean heterozygosity: HDYBG expected[b]
55.0 (1.2)	1.5 (0.1)	41.2	0.097 (0.029)	0.100 (0.028)

[a] A locus is considered polymorphic if more than one allele was detected.
[b] Biased estimate.

Preliminary data on isozyme gene frequencies reported by Schreck et al. (1984) are presented in Table 3.

JUVENILE LIFE HISTORY

Time of emergence

Zero-age summer steelhead first appeared in lower Big Sheep Creek and the upper Imnaha River in June and July (Gaumer 1968).

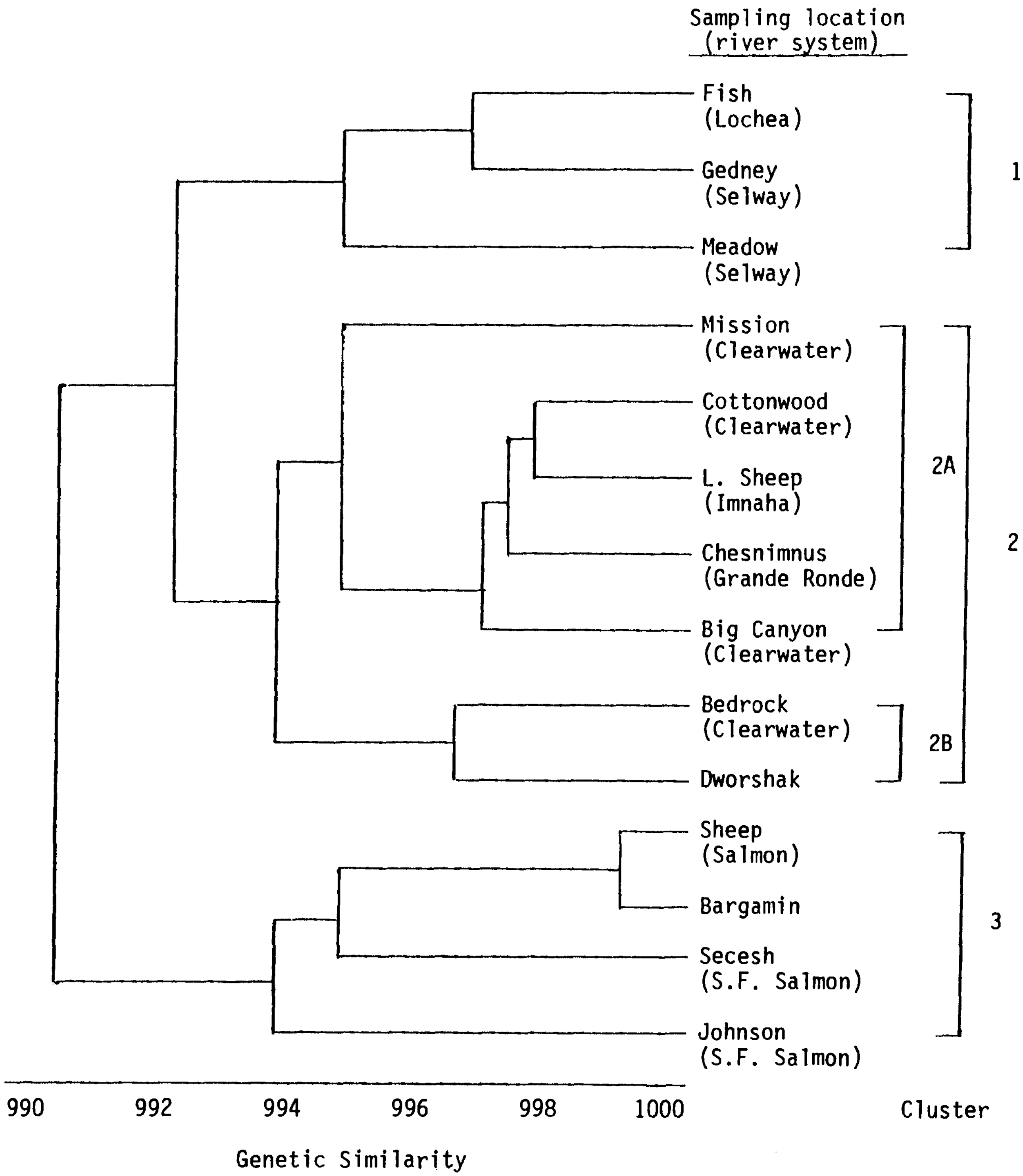

Figure 3. Cluster analysis of Snake River steelhead populations based on genetic similarity (34 loci) (Milner and Teel 1984).

Table 3. Isozyme gene frequencies and sample sizes (#) as determined by electrophoresis for wild Imnaha summer steelhead. Numbers at top of each column are the relative mobilities for each allele present in the enzyme system. Minus signs indicate cathodal migration (Schreck et al. 1984).

ADH			ACO				AGPD-1			CK			GOT 1,2			GOT 3		
-100	-76	#	100	83	66	#	100	140	#	100	70	#	100	112	#	100	77	#
1.00		96	0.78	0.21	0.01	89				1.00		81	1.00		86	1.00		96

IDH 3,4					LDH-4			MDH-1, 2				MDH-3, 4						ME		
100	40	71	120	#	100	76	#	100	70	140	#	100	83	110	90	70	#	100	85	#
0.70	0.14	0.16	0	96	0.29	0.71	96	1.00			96	1.00					96			

PGI-1			PGI-2			PGI-3				PEP-GL-1				PEP-LGG			PGM-1				PGM-2		
100	130	#	100	120	#	100	92	120	#	100	110	95	#	100	74	#	-100	-85	-115	#	-100	-140	#
1.00		96	1.00		96	1.00			96					1.00		100	1.00			96	1.00		96

PGK-2				PMI				SDH-1, 2			SOD			
100	120	160	#	100	110	94	#	100	195	#	100	152	48	#
				0.98	0.01	0.01	96	1.00		96	0.95	0.04	0.01	86

Time, age, and size at migration

Juvenile steelhead migrated downstream throughout the Imnaha River system during the spring (April through June) and fall (August through November) (Gaumer 1968). Steelhead migrated through the upper Imnaha primarily in August and September, through Big Sheep Creek in November, and the lower Imnaha during September through November (Table 4). Spring migrations are not well documented due to sampling inefficiencies (Gaumer 1968).

Spring migrants consisted primarily of age 1+ and 2+ juveniles. In Big Sheep Creek, the age 1+ and 2+ migrants had modal sizes of 9.5 cm in June and 14.5 cm in May, respectively. In the lower Imnaha River, the age 2+ spring migrants had a modal length of 16.0 cm in May (Gaumer 1968).

In the upper Imnaha, age 0+ fish of the 1965 brood were 3.5-4.0 cm (modal length) in July/August, 6.5 cm in the following April, and 8.0 cm in July 1966 (Gaumer 1968). In the lower Imnaha, September migrants were mainly age 0+ (mode = 4.5 cm). October migrants were age 0+ through 2+ since lengths ranged from 5 cm to 21.5 cm.

Most wild adults trapped for broodstock in 1984 entered the ocean at age 2+ (R. Carmichael, ODFW, personal communication).

Survival rate

No information.

DISEASE HISTORY

No information.

PRIORITY INFORMATION NEEDS

1. Run size, catch, and escapement

2. Smolt production levels and capacity

3. Spawning distribution

4. Survival rates

Table 4. Summary of juvenile summer steelhead caught in the Imnaha River system, by diversion trap and month, September 1965-June 1967[a] (Gaumer 1968) See Figure 1 for trap locations.

Trap No.	8-90		8-88		8-84		Horse Creek Trap
Location	Imnaha River		Imnaha River		Big Sheep Creek		Imnaha River
Month	1964-65	1965-66	1964-65	1965-66	1964-65	1965-66	1966-67
August	-	-	-	-	-	-	11
September	3	22	-	74	19	46	134
October	19	14	-	17	126	35	256
November	11	10	-	52	266	46	161
December	31	22	-	11	121	11	24
Janaury	32	2	-	20	105	16	3
February	9	1	-	1	51	1	15
March	4	7	-	75	24	57	40
April	25	25	-	48	53	25	26
May	36	10	7	97	71	33	84
June	11	12	28	100	43	37	22
July	8	44	48	83	11	34	-
August	33	97	135	189	27	19	-
September	-	-	-	163	-	-	-
Totals	222	266	218	930	917	360	776

[a] Intermittant or inefficient operation of the diversion traps from December through June may have obscured movements during this period.

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Imnaha River Summer Steelhead (hatchery)

PRODUCTION

The Imnaha hatchery summer steelhead stock is being developed as part of the Lower Snake River Compensation Plan to restore depressed steelhead runs in the Imnaha River system (Carmichael 1984). The first hatchery releases were made in 1983 (1982 brood) (Table 1).

Table 1. Summer steelhead releases in the Imnaha River system (modified from Carmichael 1984).

Brood year	Stock	Hatchery of rearing	Number released	Date of release	Location of release	Size (fish/lb)
1982	Imnaha	Irrigon	46,803	5/2-5/5/83	Little Sheep Creek	5.0-7.4
1982	Imnaha	Wallowa	16,428	5/5/83	Little Sheep Creek	5.6
1983	Imnaha	Irrigon	22,819	4/23/84	Little Sheep Creek	4.7
1983	Imnaha	Irrigon	35,786	4/30-5/2/84	Little Sheep Creek	7.8-10.2
1984[a]	Imnaha	Wallowa	6,850	5/1/85	Little Sheep Creek	5.0
1984[a]	Imnaha	Irrigon	55,301	4/10-4/30/85	Little Sheep Creek	5.0-10.0
1984[a]	Imnaha	Wallowa	17,074	4/30/85	Little Sheep Creek	5.0

[a] Preliminary.

GEOGRAPHIC LOCATION

Streams

The 1982, 1983, and 1984 brood year smolts were released in Little Sheep Creek. Future release sites will include Horse Creek and Upper Imnaha as well (Table 2, Figure 1).

Table 2. Proposed releases of Imnaha stock summer steelhead (Carmichael 1984).

River system	Release site	No. to be released	Type of release
Imnaha	Horse Creek	40,000	Stream
Imnaha	Little Sheep Creek	250,000	Advanced rearing ponds
Imnaha	Upper Imnaha	40,000	Stream
Total		330,000	

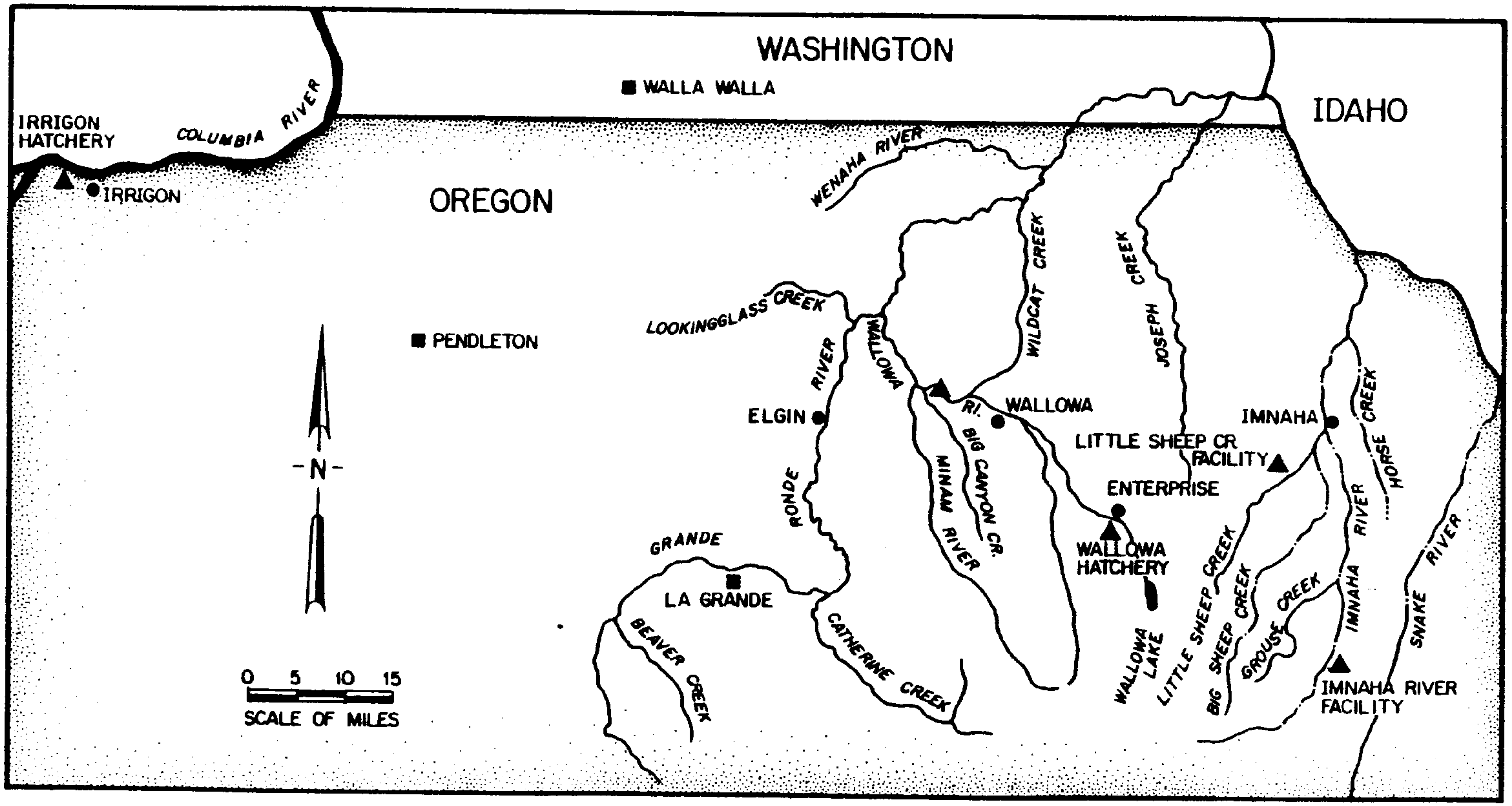

Figure 1. The Imnaha River system and the location of hatchery production facilities (modified from Carmichael 1984).

Size

No information.

Sex ratio

No information.

Fecundity

No information.

Biochemical-genetic charcteristics

See "Imnaha River Summer Steelhead (wild)."

JUVENILE LIFE HISTORY

Time of emergence

Imnaha summer steelhead eggs incubate 3-4 weeks prior to hatching in 50-55°F water at Wallowa Hatchery.

Time, age, and size at migration

Juveniles are reared to a size of 5-10 fish/lb and released as yearlings in April or May (Table 1). It is not known when or at what size these fish enter the ocean.

Survival rate

Survival of the 1984 brood from egg-to-fry was 63%. Survival from smolt-to-adult is unknown.

DISEASE HISTORY

All spawning adults were sampled for viral infections. IHN virus was not found in 1982-84, but was detected in 1985. Other disease problems affecting adults include external fungi (saprolegnia), *Ceratomyxa shasta*, cold water disease and leeches. Diseases noted in juveniles include BKD, bacterial gill disease, and *Costia*. Eggs held at Wallowa Hatchery were kept in isolation (chlorinated effluent) in discrete gorups until virus checks were shown to be negative (R. Holt, ODFW, personal communication).

PRIORITY INFORMATION NEEDS

1. Estimates of run size, catch, and escapement

2. Smolt-to-adult survival

3. Natural production resulting from hatchery releases
4. Migration timing of adults into the Columbia River
5. Interactions of hatchery and wild stocks.

REFERENCES

Carmichael, R.W. 1984. Evaluation of the lower Snake River compensation plan facilities in Oregon. Project proposal by the Oregon Department of Fish and Wildlife.

Yakima River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Yakima River, Washington, a tributary to the Columbia River at RM 335.2 (43.2 miles above McNary Dam) that drains a watershed of 6,155 square miles. Its principal tributary, the Naches River, drains a basin of 1,106 square miles.

ORIGIN

The Yakima River steelhead stock is native, although interbreeding with introduced fish of Skamania and Wells hatchery-stock origin has probably taken place.

ADULT LIFE HISTORY

Run size, catch, and escapement

Competing demands for water in the Yakima River Basin resulted in the construction of a network of diversion dams, canals and storage reservoirs throughout the system over the past century. Prior to 1890, anadromous salmonid runs to the Yakima River exceeded 600,000 fish, of which approximately 87,500 were steelhead (Bell and Mar 1974; Lavier 1976). Accurate estimates of contemporary wild run sizes are unavailable, but stock abundance is believed to be less than 1% of former levels. Depletion of wild runs is attributed to deterioration of habitat in the Yakima Basin and overfishing and dam construction on the mainstem Columbia.

Harvest of the stock occurs in mainstem Columbia and Yakima River sport and tribal fisheries. The annual sport catch of wild and hatchery-origin steelhead in the Yakima River is approximately 470 (5-year average, based on punchcard returns). More than half the sport catch occurs in spring; scales collected from adults harvested during this time period indicate that only 11.4% of the sport catch is wild (Morrill 1982; Morrill in prep.). Indian harvest of steelhead in the Yakima River spring chinook dipnet fishery was 20 and 25 fish in 1983 and 1984, respectively (Wasserman 1985). There has not been a tribal dipnet fishery targeting on steelhead in the Yakima River for at least the past 7 years.

An interim escapement goal of 2,000 wild adults has been established for this stock.

Time of migration

Wild Yakima River steelhead likely pass through the lower Columbia River between July and September, enter the Yakima River from August to November, and migrate upstream throughout winter and early spring (J. Cummins, Washington Department of Game (WDG), personal communication).

Spawning period

Likely April and May.

Spawning areas

Hydropower and irrigation development over the past century considerably reduced the amount of usable steelhead spawning habitat in the Yakima River Basin (Figure 1). However, despite the habitat loss, steelhead probably underutilize available spawning gravels (J. Cummins, WDG, personal communication).

Age composition

Of 12 wild fish sampled for scales in the spring of 1983, six were age 2.1 and six were 2.2 (Morrill in prep.). Using a modification of the Narver and Withler (1971) age notation, age 2.1 represents a fish with 2 years of freshwater growth and 1 year of marine growth prior to its capture in freshwater on its spawning migration.

Size

Age 2.1 fish sampled in the spring of 1983 averaged 58.7 cm, while age 2.2 adults averaged 71.5 cm (Morrill in prep.).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild steelhead smolts outmigrate from the Yakima River from mid-April through May (Table 1). These fish average 189 mm in length (Table 2) and a majority are probably 2 years of age. Approximately 84% of outmigrant smolts trapped at Prosser Dam on the lower Yakima in 1983 and 1984 were naturally produced (Wasserman and Hubble 1984; Wasserman 1985).

Survival rate

Unknown.

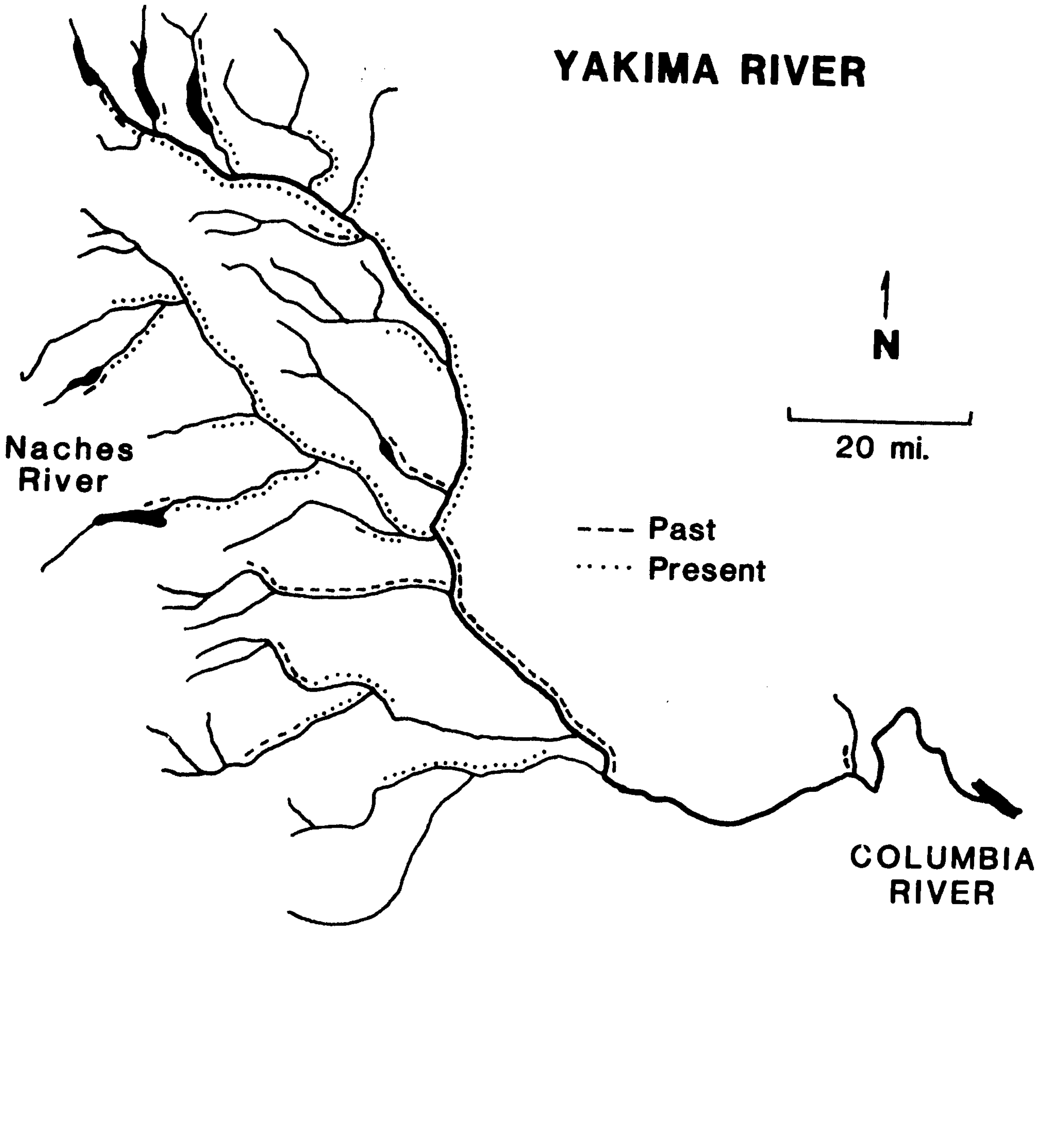

Figure 1. Probable past and present spawning areas of steelhead trout in the Yakima River, Washington (Fulton 1970; Lavier 1976; Blomstrom and Detrick 1980; J. Cummins, WDG, personal communication).

Table 1. Counts of wild steelhead smolts migrating downstream past Prosser Dam on the lower Yakima River, Washington, 1983 and 1984 (Source - Wasserman and Hubble 1984; C. Morrill, WDG, personal communication); "----" indicates that no count was made.

DATE	NUMBER SMOLTS		PERCENT		CUMULATIVE PERCENT	
	1983	1984	1983	1984	1983	1984
March 05 - 18	----	11	----	<0.1	----	<0.1
March 19 - April 03	----	861	----	2.4	----	2.4
April 04 - 17	1,337	4,019	11.5	11.4	11.5	13.8
April 18 - 30	3,026	9,705	26.1	27.6	37.6	41.4
May 01- 14	2,780	15,020	23.9	42.7	61.5	84.1
May 15 - 31	4,134	4,952	35.6	14.1	97.1	98.2
June 01 - 14	165	540	1.4	1.5	98.5	99.7
June 15 - 30	166	36	1.4	0.1	99.9	99.8
July 01 - 15	----	31	----	0.1	----	99.9
July 16 - 31	----	1	----	<0.1	----	100.0

Table 2. Length-frequency of wild steelhead smolts trapped at Prosser Dam on the lower Yakima River, Washington, in 1983 (data from Wasserman and Hubble 1984).

LENGTH (MM)	FREQUENCY	PERCENT
80-120	27	2.8
120-160	167	17.1
160-200	424	43.5
200-240	306	31.4
240-280	38	3.9
280-330	12	1.2

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

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Hanford Reach Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Hanford Reach of the Columbia River (Washington), the last free-flowing stretch of the mainstem Columbia, extending approximately 44 miles from the upper end of McNary Pool (RM 353) upstream to Priest Rapids Dam (RM 397).

ORIGIN

Indigenous, although interbreeding with Wells and Skamania hatchery-stock fish has probably occurred.

ADULT LIFE HISTORY

Run size, catch, and escapement

The Hanford Reach steelhead population is the sole remnant of wild mainstem Columbia River steelhead stocks that formerly spawned upstream into Canada. Completion of Grand Coulee Dam (RM 597) in 1941 and Chief Joseph Dam (RM 545) in 1955 blocked steelhead migrations to at least 200 miles of mainstem spawning and rearing habitat in the upper Columbia River. Construction of five more dams between the Hanford Reach and Chief Joseph Dam inundated an additional 200 miles of mainstem steelhead spawning habitat. Wild stocks that formerly utilized these areas are presumed extinct.

No accurate estimates of wild run size, catch or escapement exist. Harvest of the stock occurs in mainstem Columbia sport and tribal fisheries. Because the Hanford Reach flows through the Hanford Atomic Energy Reservation, sport angler access to the area is limited. Hanford Reach sport catch data are not presented here as most fish harvested in the area are bound for upriver spawning grounds or hatchery release sites. An interim escapement goal of 1,500 wild fish has been established for this stock.

Time of migration

Probably July through October.

Spawning period

February through May (Fickeisen et al. 1980).

Spawning areas

The Hanford Reach contains the only remaining steelhead spawning habitat in the mainstem Columbia River. Mainstem spawning formerly occurred upstream to at least the Pend Oreille River, RM 745, in Canada (Figure 1). At present, spawning of this stock is confined to portions of the Hanford Reach (Figure 2).

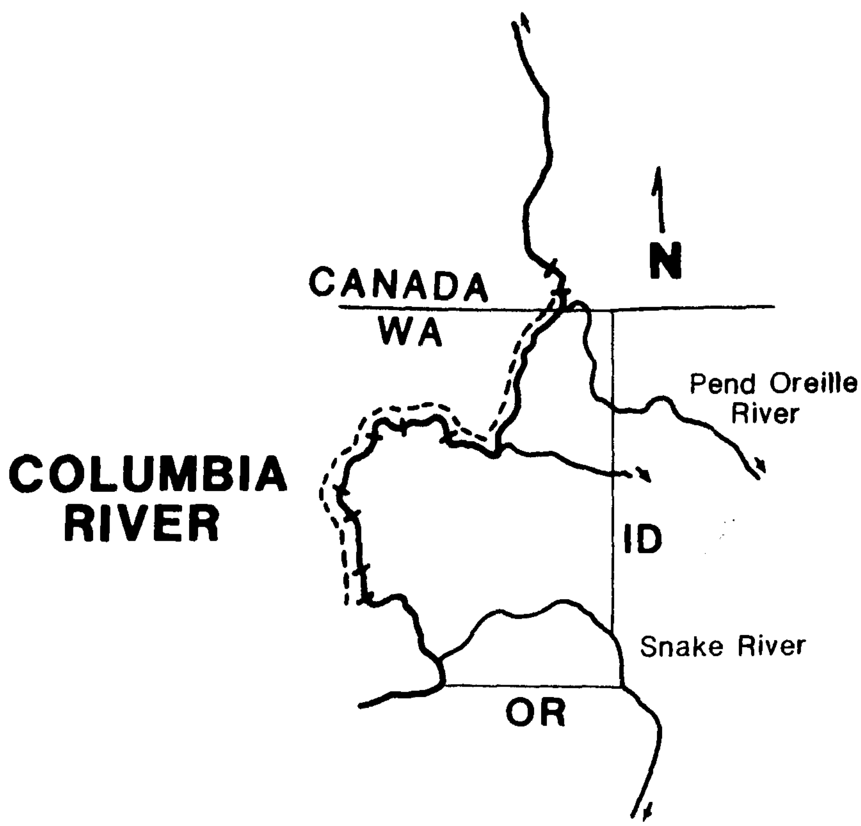

Figure 1. Probable former spawning areas of steelhead trout in the mainsteam Columbia River above the mouth of the Snake River (Fulton 1970).

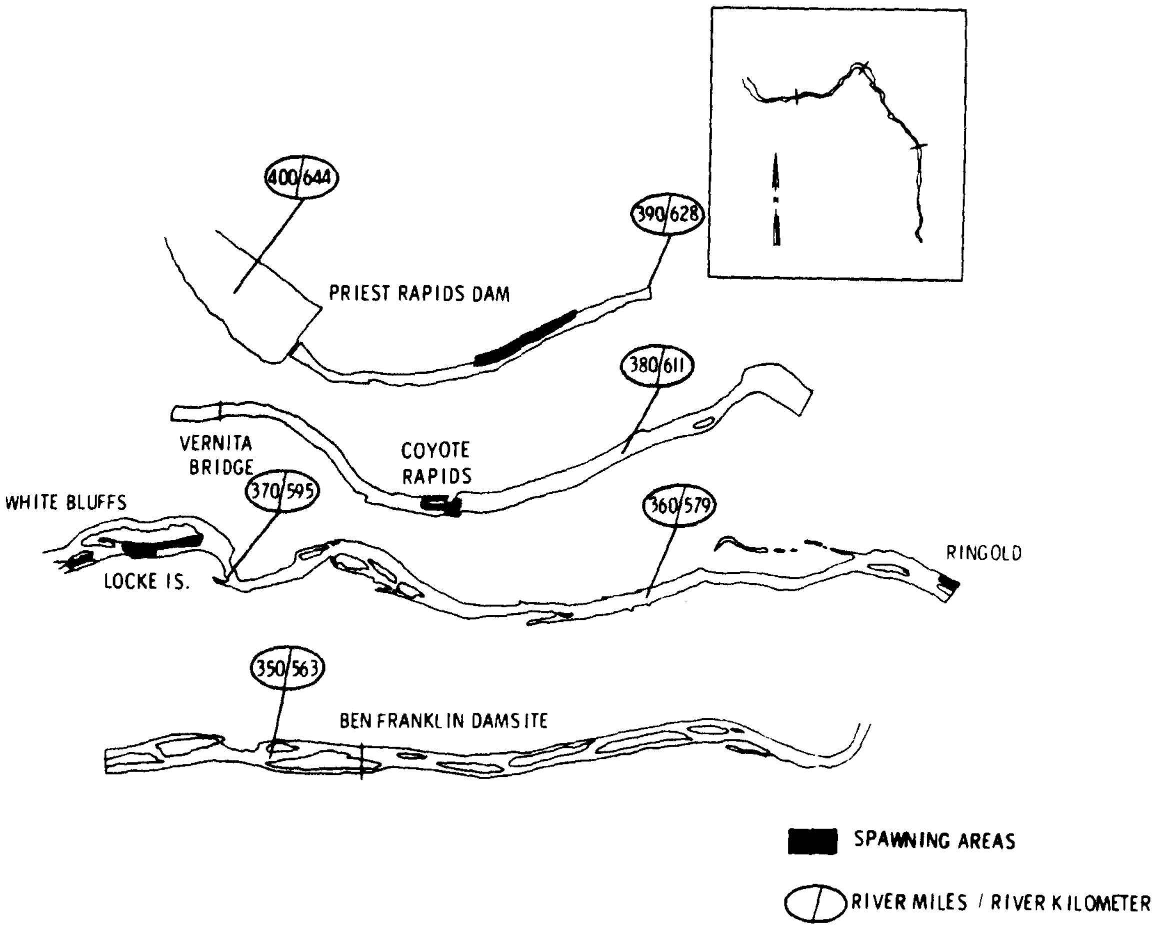

Figure 2. Probable present spawning areas of steelhead trout in the Hanford Reach of the Columbia River, Washington (Fickeisen et al. 1980).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Steelhead juveniles likely outmigrate from the Hanford Reach in April and May at a size of 170-200 mm. Most of these smolts are 2 years of age (Gray and Dauble 1977).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

REFERENCES

Fickeisen, D.H., D.D. Dauble, D.A. Neitzel, W.H. Richard, R.L. Skaggs, and J.L. Warren. 1980. Aquatic and riparian resource study of the Hanford Reach, Columbia River, Washington. Battelle Pac. NW Labs.

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye and chum salmon in the Columbia River Basin - past and present. NMFS Special Scientific Report, Fisheries No. 618.

Gray, R.H., and D.D. Dauble. 1977. Synecology of the fish community near WNP 1, 2 and 4, and assessment of suitability of plant area for salmonid spawning. In U.S. Department of Energy. 1982. Demonstration for test of N reactor in plutonium-only mode of operation. DOE operations office, Richland, Washington.

Upper Columbia Summer Steelhead (wild)

The upper Columbia stock is actually a conglomeration of several tiny, native spawning stocks which, because of their persistence, merit consideration in this report.

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Several small independent tributaries to the Columbia River between Wanapum Dam (RM 416) and the mouth of the Wenatchee River (RM 468), Washington.

ORIGIN

Native.

ADULT LIFE HISTORY

Run size, catch, and escapement

Aggregate spawning escapement of these stocks may approach several hundred fish, but individual streams may only support runs of 10-20 adults (L. Brown, Washington Department of Game (WDG), personal communication). These stocks are harvested in mainstem Columbia sport and tribal fisheries, but actual numbers caught are unknown. No escapement goal has been set for these stocks to date.

Time of migration

Likely July through October.

Spawning period

Unknown; probably between February and May.

Spawning areas

Tributaries supporting spawning populations of wild steelhead include Brushy and Quilomene (RM 433.0), Tekison (RM 437.5), Tarpiscan (RM 445.4), Colockum (RM 450.0), Stemilt (RM 461.9), and Squilchuck (RM 464.0) creeks (Figure 1).

Age composition

Unknown.

Size

Unknown.

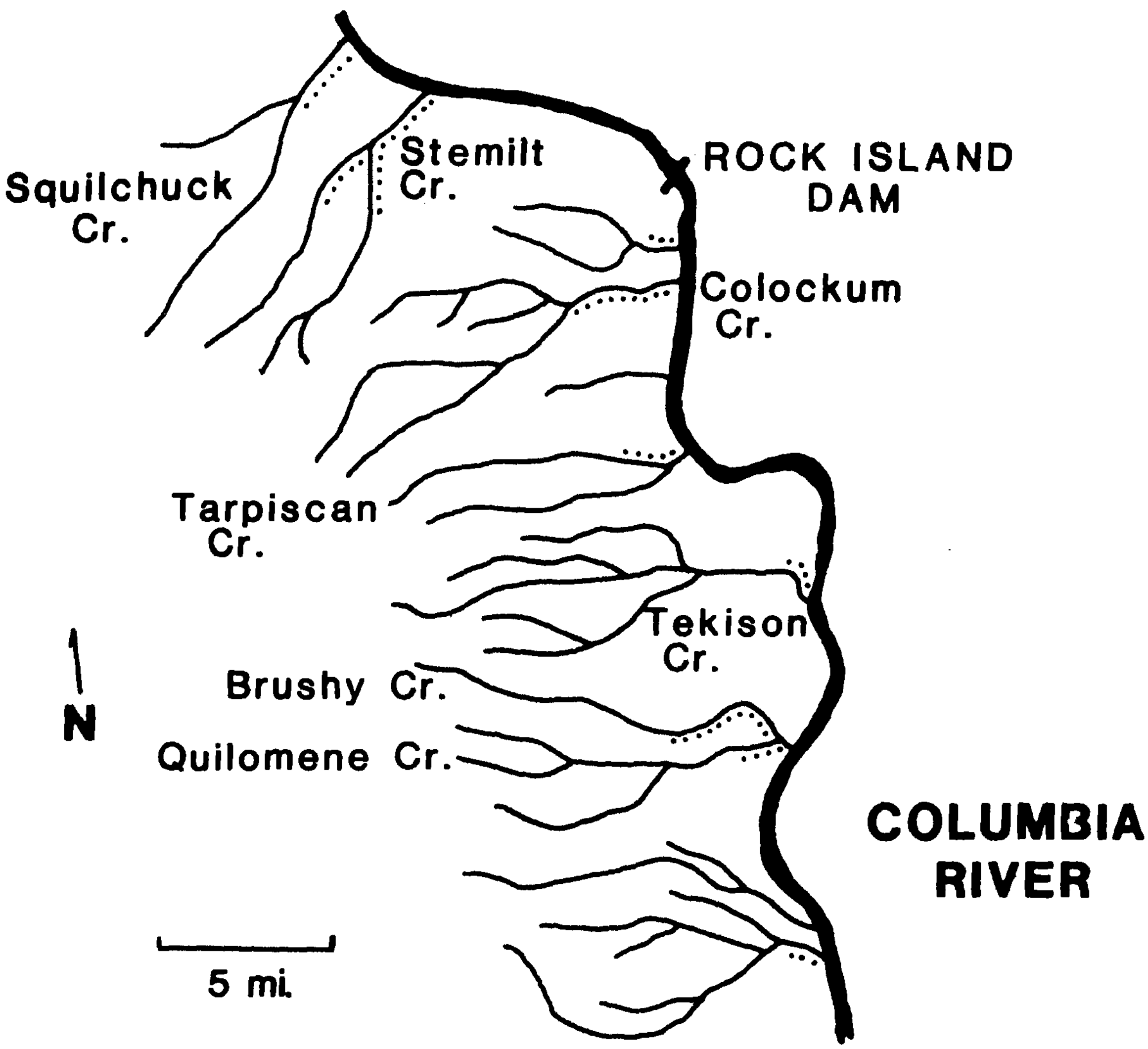

Figure 1. Probable spawning locations of wild steelhead stocks in small independent tributaries to the upper Columbia River, Washington (L. Brown, WDG, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wild juveniles produced in these small streams likely outmigrate in April and May at a size of 170-200 mm and an age of 2 years.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

Wenatchee River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Wenatchee River, Washington, a tributary to the Columbia River at RM 468.4 (15.0 miles above Rock Island Dam) that drains a watershed of 1,327 square miles.

ORIGIN

Wild Wenatchee River summer steelhead are native, although interbreeding with returnees from Wells hatchery-stock smolt plants has likely occurred. Between 1939 and 1943, all adult steelhead bound for the upper Columbia River were trapped at Rock Island Dam as part of the Grand Coulee Fish Maintenance Project (Fish and Hanavan 1948). Trapped steelhead were released into the Wenatchee, Entiat, and Methow rivers, hence wild Wenatchee River fish are, to some degree, descendants of transplanted upper Columbia River stocks.

ADULT LIFE HISTORY

Run size, catch, and escapement

Run size, catch and escapement of wild fish in the Wenatchee River averaged 370, 100 and 270, respectively, for the period 1979 through 1983 (Table 1). Runs of wild steelhead to the Wenatchee in the early 1960's were on the order of 3,000 adults annually (L. Brown, WDG, personal communication). Decreased stock abundance is attributed, in part, to mortalities associated with passage of juveniles and adults through seven hydroelectric projects on the mainstem Columbia River. The stock is further impacted by harvest losses in mainstem Columbia recreational and tribal fisheries. The interim escapement goal for wild steelhead to the Wenatchee is 3,000 fish.

Time of migration

Wenatchee-bound wild fish likely enter the Columbia River between June and August. Movement through the lower Wenatchee River begins in mid-August, peaks in the latter part of September and early October, and tapers off by early November (French and Wahle 1959; L. Brown, WDG, personal communication).

Spawning period

March through June, peaking in early May (L. Brown, WDG, personal communication).

Table 1. Estimated run size, catch and escapement of hatchery- and wild-origin steelhead (TOTAL) vs. wild-origin steelhead (WILD) in the Wenatchee River system, Washington, 1979 through 1983.

RUN YEAR	PERCENT WILD 1/	RUN SIZE 2/ TOTAL	RUN SIZE 2/ WILD	CATCH 3/ TOTAL	CATCH 3/ WILD	ESCAPEMENT 4/ TOTAL	ESCAPEMENT 4/ WILD
1979	11.8%	2,528	298	1,079	127	1,449	171
1980	6.2%	2,672	166	1,500	93	1,172	73
1981	9.0%	1,988	179	757	68	1,231	111
1982	9.0%	3,582	322	783	70	2,799	252
1983	9.0%	9,968	897	1,674	151	8,294	746
AVERAGE	9.0%	4,148	373	1,159	104	2,989	269

1/ 1979 percentage from Kurose (1980); 1980 percentage from Schuck et al. (1981); 1981-83 percentages are average of 1979 and 1980 figures.

2/ Total run size calculated as difference between Rock Island and Rocky Reach Dam steelhead counts (L. Brown, Washington Department of Game (WDG), personal communication).

3/ Punchcard-reported sport catch, May through April.

4/ Run size minus catch.

Spawning areas

Wild steelhead spawn throughout the mainstem Wenatchee, in lower Mission, Peshastin, Icicle, and Chiwaukum creeks, in lower and middle Nason Creek, and in the Little Wenatchee, White and Chiwawa rivers (Figure 1).

Age composition

Of wild steelhead sampled for scales during creel census activities on the Wenatchee in 1979 and 1980, an average of 65.2% were 1-salts, 31.9% were 2-salts, and 2.9% were 3-salts (Table 2). Using a notation modified from Narver and Withler (1971), age 2.3 would represent a fish with 2 years of freshwater growth and 3 years of marine growth prior to its capture in freshwater on its spawning migration.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

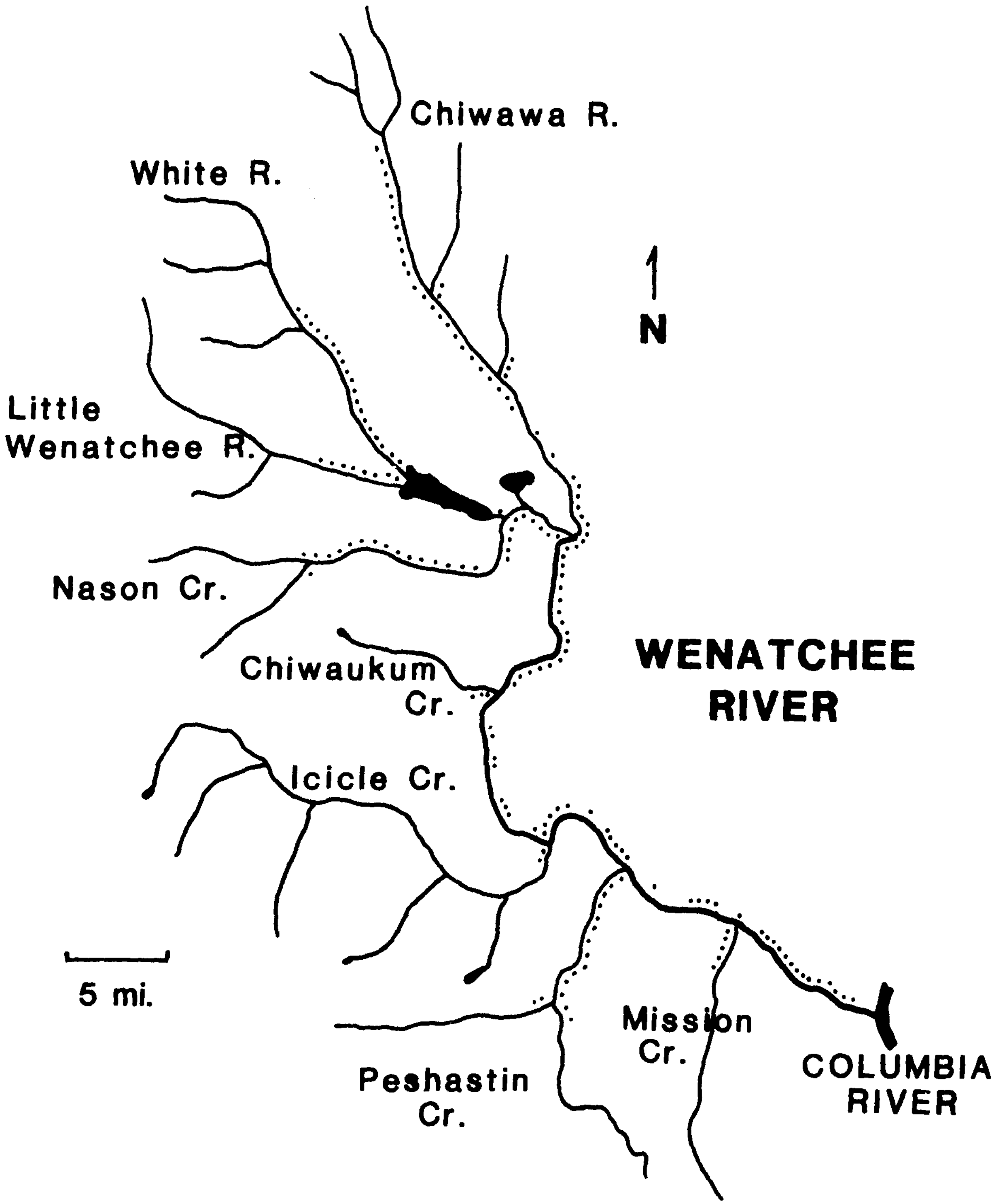

Figure 1. Probable spawning areas of steelhead trout in the Wenatchee River, Washington (Fulton 1970; L. Brown, WDG, personal communication).

Table 2. Age of wild steelhead harvested in the sport fishery on the Wenatchee River, Washington, 1979 and 1980 run years (from Kurose 1980 and Schuck et al. 1981).

AGE	1979 NUMBER	1979 PERCENT	1980 NUMBER	1980 PERCENT
2.1	11	64.7	7	53.8
2.2	1	5.9	6	46.2
2.3	1	5.9	0	0.0
3.1	2	11.8	0	0.0
3.2	2	11.8	0	0.0

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wild smolts outmigrate from early April through mid-June, peaking in early May (L. Brown, WDG, personal communication). Most of these juveniles are likely 170-200 mm in length. Of adults returning in 1979 and 1980, 86.7% outmigrated as 2 year olds and 13.3% as 3 year olds (Table 2).

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Precise run size, catch and escapement data; refinement of escapement goal.

REFERENCES

Fish, F.F., and M.G. Hanavan. 1948. A report upon the Grand Coulee fish-maintenance project, 1939-1947. USFWS Special Scientific Report 55.

French, R.R., and R.J. Wahle. 1959. Biology of chinook and blueback salmon and steelhead in the Wenatchee River system. USFWS Special Scientific Report, Fisheries No. 304.

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye and chum salmon in the Columbia River Basin - past and present. NMFS Special Scientific Report, Fisheries No. 618.

Kurose, H.T. 1980. Wenatchee River creel census. In Hisata et al. 1979-1980 Columbia River and tributary tag recovery. Washington Department of Game report 80-17.

Narver, D.W., and F.C. Withler. 1971. Age and size of steelhead trout (Salmo gairdneri) in anglers' catches from Vancouver Island, British Columbia, streams. Fish. Res. Bd. Can. Circ. 91.

Schuck, M.L., M.W. Mobbs, G. Van Lom, T.Y. Cho, R.G. Biscordi, and J.W. Ebel. 1981. 1980-81 Columbia River and tributary tag recovery. Washington Department of Game report 81-19.

Entiat River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Entiat River, Washington, a tributary to the Columbia River at RM 483.7 (10.0 miles above Rocky Reach Dam) that drains a watershed of 419 square miles.

ORIGIN

The wild Entiat River steelhead stock is native, but interbreeding with introduced Wells hatchery-origin fish has probably taken place. All adult steelhead bound for the upper Columbia River were captured at Rock Island Dam from 1939 to 1943 as part of the Grand Coulee Fish Maintenance Project (Fish and Hanavan 1948). Intercepted steelhead were released into the Wenatchee, Entiat and Methow rivers, hence wild Entiat River fish are, to some extent, remnants of transplanted upper Columbia River stocks.

ADULT LIFE HISTORY

Run size, catch, and escapement

No accurate estimates of wild run size, catch and escapement exist. Harvest of the stock occurs in mainstem Columbia sport and tribal fisheries, as well as in the Entiat River. The annual sport catch of wild and hatchery-origin steelhead in the Entiat is approximately 90 (5-year average, based on punchcard returns). Stock abundance is adversely impacted by: 1) poor system productivity and habitat, 2) overfishing, and 3) mortalities associated with fish passage through eight hydroelectric dams on the mainstem Columbia (L. Brown, Washington Department of Game (WDG), personal communication). As yet, no escapement goal has been set for this stock.

Time of migration

Wild Entiat River steelhead probably enter the Columbia River between June and August. Timing of migration of wild fish into the Entiat is likely similar to timing of Wenatchee River steelhead: i.e., migrations begin in mid-August, peak in late September/early October, and taper off by early November (French and Wahle 1959; L. Brown, WDG, personal communication).

Spawning period

March through June, peaking in early May (L. Brown, WDG, personal communication).

Spawning areas

Steelhead spawn in the lower Mad River and in the mainstem Entiat River upstream approximately 30 miles to a barrier falls (Figure 1).

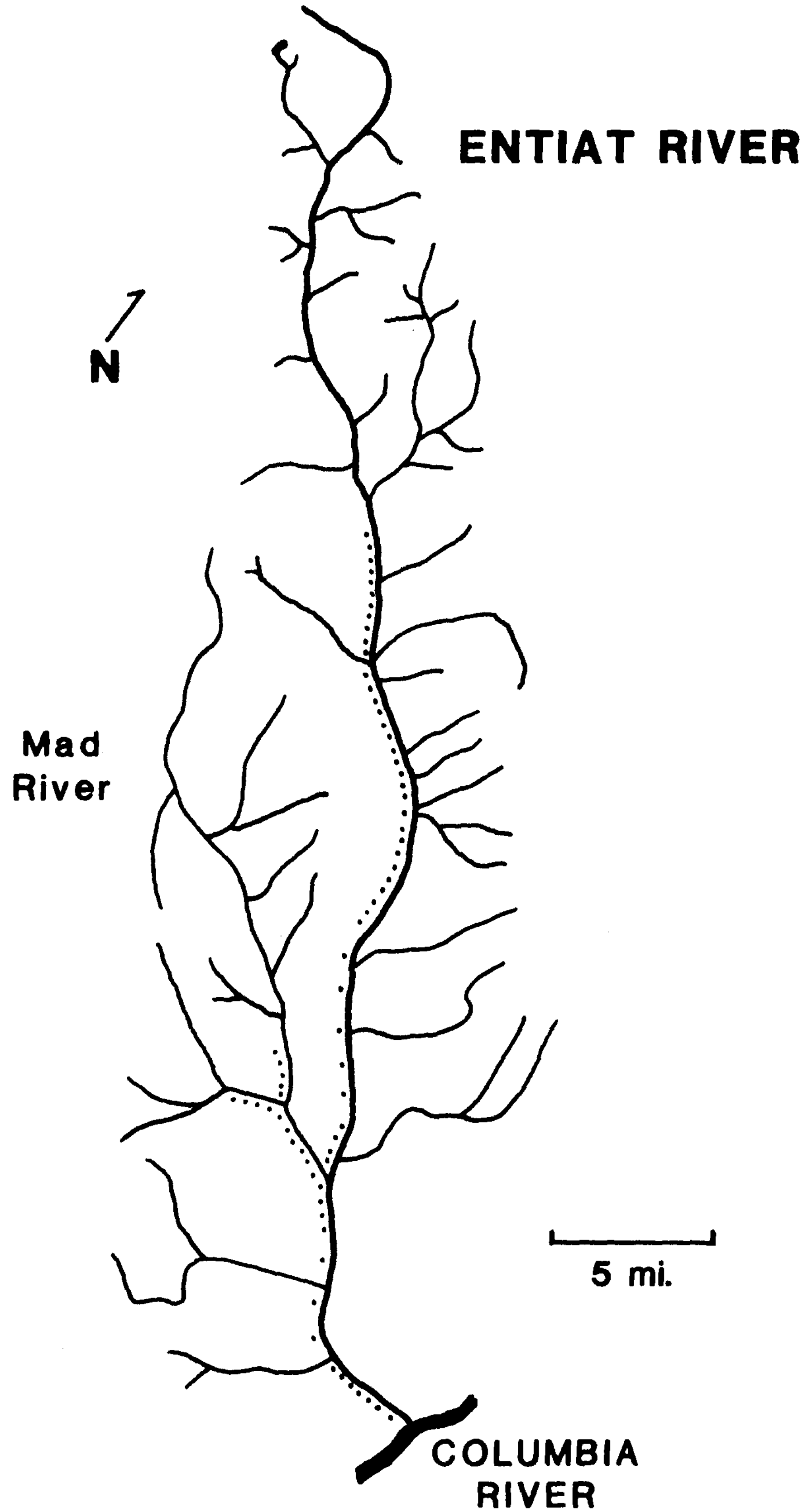

Figure 1. Probable spawning locations of wild steelhead trout in the Entiat River, Washington (L. Brown, WDG, personal communication).

Age composition

Of adults returning in 1979 and 1980, 87.5% were 1-ocean and 12.5% were 2-ocean fish (Table 1). The notation of Narver and Withler (1971) was modified and used to report age data derived from scales because it distinguishes fresh vs. saltwater growth. For example, age 2.1 would represent a fish with 2 years of freshwater growth and 1 year of marine growth prior to its capture in freshwater on its spawning migration.

Size

Of adults sampled in 1979 and 1980, 1-salt steelhead averaged 62.4 cm and 2.4 kg, while the single 2-salt fish was 72.4 cm and 3.6 kg.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

Table 1. Age, length and weight of wild summer steelhead checked in conjunction with creel census activities on the Entiat River, Washington, 1979 and 1980 run years (from Cho 1980 and Schuck et al. 1981).

	1979			1980		
AGE	NUMBER	LENGTH (CM)	WEIGHT (KG)	NUMBER	LENGTH (CM)	WEIGHT (KG)
2.1	3	65.3	2.9	4	60.2	2.1
2.2	1	72.4	3.6	0	--	--

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Most wild smolts likely outmigrate from the Entiat River between mid-April and early June at a size of 170-200 mm and an age of 2 years.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

REFERENCES

Cho, T.Y. 1980. Columbia River at Wenatchee and Entiat River creel census. In Hisata et al. 1979-1980 Columbia River and tributary tag recovery. Washington Department of Game report 80-17.

Fish, F.F., and M.G. Hanavan. 1948. A report upon the Grand Coulee fish-maintenance project, 1939-1947. USFWS Special Scientific Report 55.

French, R.R., and R.J. Wahle. 1959. Biology of chinook and blueback salmon and steelhead in the Wenatchee River system. USFWS Special Scientific Report, Fisheries No. 304.

Narver, D.W., and F.C. Withler. 1971. Age and size of steelhead trout (*Salmo gairdneri*) in anglers' catches from Vancouver Island, British Columbia, streams. Fish. Res. Bd. Can. Circ. 91.

Schuck, M.L., M.W. Mobbs, G. Van Lom, T.Y. Cho, R.G. Bisordi, and J.W. Ebel. 1981. 1980-81 Columbia River and tributary tag recovery. Washington Department of Game report 81-19.

Wells Summer Steelhead (hatchery)

PRODUCTION

Wells stock steelhead are artificially propagated in hatchery environments. Approximately 1,000,000 Wells smolts are released annually.

GEOGRAPHIC LOCATION

Streams

Wells Hatchery, Washington (Columbia RM 516) liberates 450,000 outmigrants into the Methow and Similkameen rivers, Chelan Falls Hatchery (RM 503) plants 250,000 smolts into the Wenatchee and Entiat rivers, Leavenworth National Fish Hatchery (on Icicle River, tributary to Wenatchee River) periodically releases 100,000 fish into the Wenatchee River, and Lyons Ferry Hatchery (Snake RM 63) liberates 300,000 juveniles into the Walla Walla, mainstem Snake, Tucannon and Grande Ronde rivers and Asotin Creek. Other tributaries to the Columbia River in Washington receiving Wells stock smolts since 1970 include the Big White Salmon and Yakima rivers and Crab Creek. Hence, the Wells stock has been distributed in the Columbia River from the Big White Salmon River (Columbia RM 168.3) upstream to the Grande Ronde River (Snake RM 168.9) and the Similkameen River, a tributary to the Okanogan River (Columbia RM 533.5).

Hatcheries

Wells eggs were formerly taken from adults at Priest Rapids Dam (RM 397) and Wells Dam (RM 516), but are presently collected from fish captured at Wells Dam and spawned at Wells Hatchery. Wells steelhead are reared at Wells, Chelan Falls, Leavenworth, Naches and Lyons Ferry hatcheries.

ORIGIN

The Wells stock was developed in the early 1960's at Wells Hatchery. Original brood stock were wild summer steelhead stocks above Priest Rapids Dam (J. Gearheard and K. Williams, Washington Department of Game [WDG], personal communication).

ADULT LIFE HISTORY

Run size, catch and escapement

Data concerning run size, catch and escapement of Wells stock returnees are limited (see "Survival rate" section of this stock summary). Harvest of the stock occurs primarily in rivers where juveniles were planted, but also in mainstem Columbia and Snake sport and tribal fisheries. The interim escapement goal to Wells Hatchery is 650.

Time of migration

Wells stock adults migrate over Bonneville Dam from July through September, pass Priest Rapids Dam from mid-August through mid-October, and arrive at Wells Dam from August through November, peaking in September and October (Figure 1, Table 1).

Spawning period

Brood stock are collected at Wells Dam from August through November, but primarily in September (K. Williams, WDG, personal communication). Spawning of Wells steelhead at Wells Hatchery begins in early January, peaks in late January and early February, and is completed by early March (Figure 2). Wild fish are often included as brood stock (e.g. 4.6% of females spawned in 1983), but they ripen later than hatchery-origin fish.

Spawning areas

Wells Hatchery.

Age composition

Wells stock adults return to the upper Columbia River predominantly as 1- and 2-ocean fish (Table 2). In four of five age composition studies conducted from 1978 to 1982, only two life-history categories were identified: 1.1 and 1.2. In the fifth study, Williams (1984) determined that 14.5% of returning hatchery adults had residualized in freshwater for at least 1 year following their release, and he suggested that the previous age analyses were incorrect in classifying steelhead with freshwater ages of 2 or more years as wild-origin fish. Further, he noted that the two 3-ocean fish he identified were the first observed in the Wells stock and were likely the product of abnormally low rates of marine growth. No repeat spawners have ever been found among Wells steelhead sampled above Priest Rapids Dam (Hisata et al. 1979, 1980; Schuck et al. 1981; Loeppke et al. 1983; Williams 1984).

Table 1. Counts of adult steelhead at Wells Dam, Washington, 1978-1983 (J. McGee, Douglas County PUD, personal communication); approximately 95% of run over Wells is hatchery-origin (K. Williams, WDG, personal communication), hence counts reflect timing of Wells stock returns.

YEAR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
1978	177	32	12	399	432	528	--	1,580
1979	72	2	22	1,212	938	1,040	355	3,641
1980	202	24	15	382	1,032	1,358	413	3,426
1981	139	23	107	212	1,702	1,401	513	4,097
1982	149	7	67	814	2,428	3,733	730	7,928
1983	26	2	145	1,891	11,074	5,294	1,327	19,759

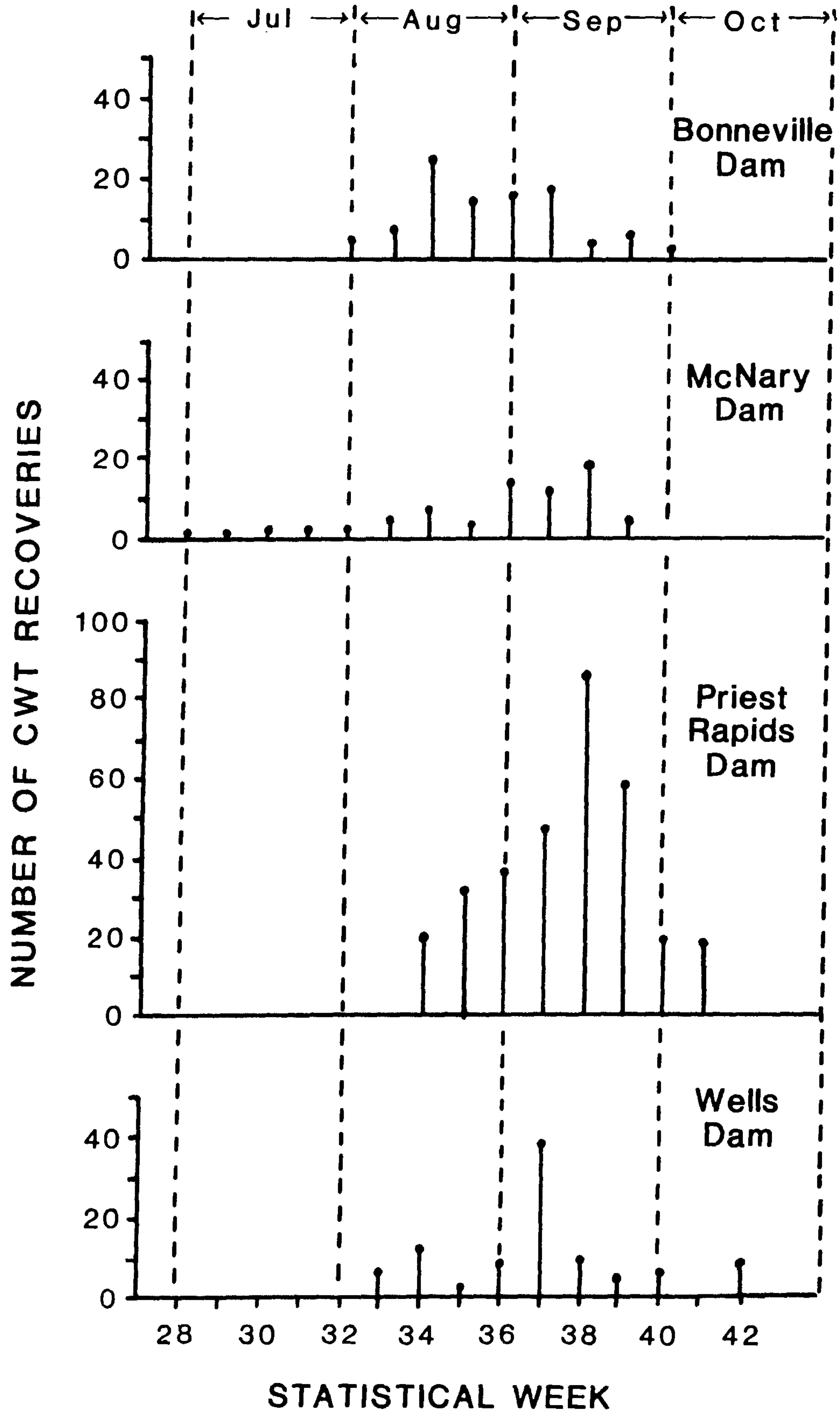

Figure 1. Count of branded, coded-wire tagged Wells stock summer steelhead adults at four mainstem Columbia River dams in 1983 (adapted from Morrill 1983).

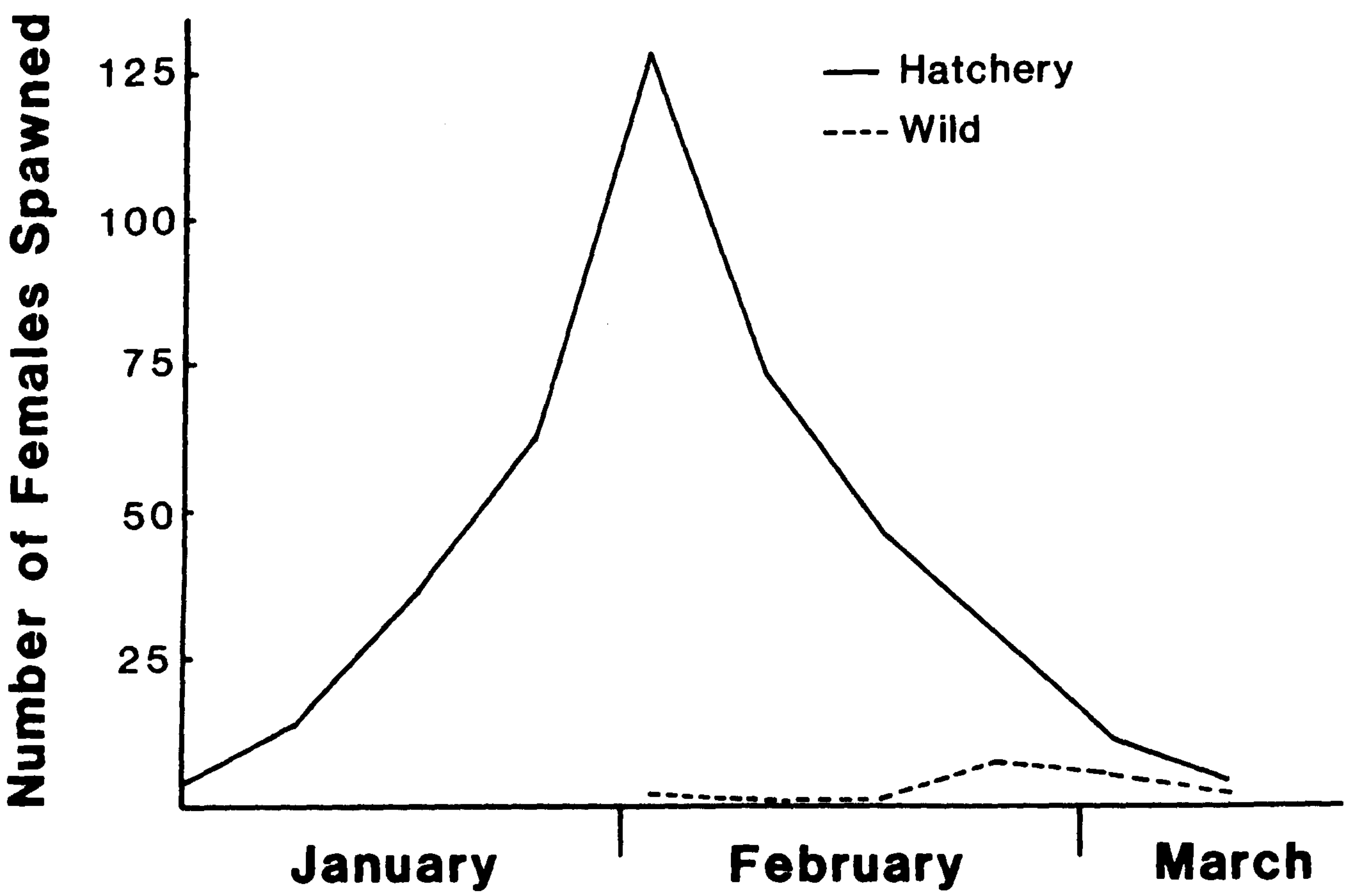

Figure 2. Spawning period of Wells steelhead at Wells Hatchery, Washington, 1983 - i.e., 1982 summer run (Williams 1984).

Table 2. Age and length of Wells stock steelhead sampled at Wells Dam and in the lower Methow River and Wells Pool fisheries, Washington, 1978-1980 and 1982 runs (from Mobbs 1979, Mobbs and Pederson 1980, Schuck et al. 1981, Loeppke et al. 1983, and Williams 1984).

YEAR	AGE	NUMBER	PERCENT	LENGTH (cm)	WEIGHT (kg)
1978	1.1	18	26.5	61.9	2.2
	1.2	50	73.5	76.4	4.1
1979	1.1	103	92.8	64.3	2.4
	1.2	8	7.2	75.1	3.7
1980	1.1	256	75.1	61.4	--
	1.2	85	24.9	74.5	--
1982 1/	1.1	81	28.7	60.6	--
	1.2	201	71.3	71.3	--
1982 2/	1.1	40	13.5	--	--
	1.2	212	71.4	--	--
	1.3	2	0.7	--	--
	2.1	2	0.7	--	--
	2.2	35	11.8	--	--
	3.2	4	1.3	--	--
	4.2	2	0.7	--	--

1/ Loeppke et al. (1983).

2/ Williams (1984).

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales and otoliths because it distinguishes fresh vs. saltwater growth. For example, age 1.2 would represent a fish with 1 year of freshwater growth (i.e. hatchery-origin) and 2 years of ocean growth prior to its capture in freshwater on its spawning migration. Thus, this fish would be about 3 years old.

The variable dominance of 1- vs. 2-ocean returns is characteristic of the Wells stock (Table 3). Initially, Williams (1984) believed Wells stock steelhead tended to return as 1-ocean fish and he attributed strong 2-ocean returns to high water years (i.e., good smolt out-migrant survival) followed by low water years (i.e., poor smolt survival). However, he noted that the strong 2-ocean returns in 1981 and 1982 were independent of flow conditions. Williams (WDG, personal communication) now believes the variable dominance of 1- vs. 2-ocean returns is explained by variable rates of ocean growth. Specifically, if the marine environment does not allow a fish to attain adequate size after one summer of growth, that fish may remain in saltwater for an additional year.

Table 3. Contribution of 1-ocean vs. 2-ocean fish to runs of Wells stock steelhead returning to the upper Columbia River, Washington, 1973-1983.

YEAR	1-OCEAN	2-OCEAN	TECHNIQUE	REFERENCE
1973	59%	41%	Length-frequency	K. Williams, WDG, pers. comm.
1974	23%	77%	Length-frequency	Williams (1975)
1975	82%	18%	Length-frequency	Williams (1975)
1976	79%	21%	Length-frequency	Williams (1976)
1977	76%	24%	Length-frequency	Williams (1977)
1978	26%	74%	Scale analysis	Mobbs (1979)
	14%	86%	Length-frequency	Williams (1981a)
1979	93%	7%	Scale analysis	Mobbs & Pederson (1980)
	96%	4%	Length-frequency	Williams (1981b)
1980	75%	25%	Scale analysis	Schuck et al. (1981)
1981	7%	93%	Length-frequency	K. Williams, WDG, pers. comm.
1982	29%	71%	Scale analysis	Loeppke et al. (1983)
	14%	85%	Otolith analysis	Williams (1984)
1983	82%	18%	Length-frequency	K. Williams, WDG, pers. comm.

Size

Wells stock summer steelhead return to the upper Columbia River predominantly as 1- and 2-ocean adults averaging 61.9 and 72.9 cm in length and 2.4 and 4.0 kg in weight, respectively (Table 2).

Sex ratio

Williams (WDG, personal communication) examined Wells brood stock from the 1983 run and determined that the male:female sex ratios for 1- and 2-ocean adults were 0.91 (n = 885) and 1.90 (n = 194), respectively.

Fecundity

Fecundity of Wells adults ranges from approximately 5,000 eggs per 1-ocean female to 6,000 eggs per 2-ocean female (K. Williams, WDG, personal communication).

Biochemical-genetic characteristics

Loeppke et al. (1983) investigated eight enzyme systems of both hatchery-and wild-origin Wells steelhead spawners and guardedly concluded that the hatchery and wild stocks are genetically indistinguishable. Their conclusion is not surprising given that some wild fish are used as brood stock at Wells Hatchery and that Wells stock steelhead likely interbreed with wild fish in the natural environment. However, tissue sampling for electrophoresis was biased toward the early portion of the run, and some fish they identified as wild origin may have been residual hatchery steelhead that spent at least

2 years in freshwater prior to outmigrating. These factors, in conjunction with Williams' (1984) observation that wild brood stock at Wells Hatchery are brighter and later maturing than hatchery fish, indicate that the findings of Loeppke et al. may be incorrect and that the Wells hatchery stock is genetically distinct from wild upriver stocks.

Thorgaard (1977) reported that of hatchery steelhead sampled at Wells Dam (i.e., Wells stock), 87.5% had 58 chromosomes, 6.2% had 59, and 6.2% had 60.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Wells stock juveniles are released in late April and early May at a size of 5-7 per pound. Peak movement of smolts over Priest Rapids Dam occurs in mid-May (McEntee and Weitkamp 1984), and Wells outmigrants typically arrive at the Columbia River estuary by the end of May (Dawley et al. 1982).

Of hatchery-origin adults returning in 1982, 85.5% were reared in freshwater for 1 year while 14.5% residualized in freshwater an additional 1-3 years prior to migrating downstream (Table 2). Most residuals outmigrated after 1 additional year (86.0%), but 9.3% and 4.6% remained in freshwater for 2 and 3 additional years, respectively. Williams (1984) believes the lower Methow River and Wells Reservoir are the principal areas utilized by residual Wells stock juveniles.

Survival rate

Smolt to adult survival rates for Wells stock steelhead averaged 1.45% for juveniles planted above Wells Dam between 1972 and 1981 (Tables 4 and 5). These survival rates do not account for Wells fish that were harvested in mainstem Columbia recreational and tribal fisheries.

DISEASE HISTORY

Infectious pancreatic necrosis (IPN) virus has been detected in Wells brood stock at Tucannon and Wells hatcheries (Brunson and Roberts 1983).

PRIORITY INFORMATION NEEDS

Three characteristics of Wells stock steelhead merit detailed study: 1) timing of spawning in the natural environment, 2) contribution of resulting offspring to wild stocks, and 3) extent of sport and tribal interceptions of upriver-bound Wells stock adults in the mainstem Columbia and Snake rivers.

Table 4. Return of 1- and 2-ocean Wells stock steelhead to Wells Dam, Washington, 1973-1983 (1- vs. 2-ocean run proportions from Table 3).

YEAR	TOTAL RUN SIZE 1/	WELLS-STOCK RUN SIZE 2/	1-OCEAN PERCENT	1-OCEAN NUMBER	2-OCEAN PERCENT	2-OCEAN NUMBER
1973	2,459	2,336	59%	1,378	41%	958
1974	739	702	23%	161	77%	541
1975	743	706	82%	579	18%	127
1976	4,980	4,731	79%	3,737	21%	994
1977	5,679	5,395	76%	4,100	24%	1,295
1978	1,936	1,839	20%	368	80%	1,471
1979	4,008	3,808	94%	3,580	6%	228
1980	3,798	3,608	75%	2,706	25%	902
1981	4,747	4,510	7%	316	93%	4,194
1982	8,518	8,092	22%	1,780	78%	6,312
1983	20,083	19,079	82%	15,645	18%	3,434

1/ Wells Dam counts plus steelhead trapped for Wells Hatchery brood stock (J. McGee, Douglas County PUD, personal communication).

2/ Approximately 95% of run is of Wells hatchery-stock origin. The 95% value was obtained in 1982 and is used in the present analysis because it accounts for the high rate of residualism exhibited by Wells stock releases; i.e., residual hatchery fish were likely identified as wild in earlier age analyses (Williams 1984; K. Williams, WDG, personal communication).

Table 5. Smolt to adult survival rates of Wells stock juveniles planted above Wells Dam, Washington, 1972 through 1981 (1- and 2-ocean returns from Table 4; smolt plant data from K. Williams, WDG, personal communication).

YEAR PLANTED	NUMBER PLANTED	NUMBER OF RETURNS 1-OCEAN	NUMBER OF RETURNS 2-OCEAN	NUMBER OF RETURNS TOTAL	PERCENT RETURN
1972	327,902	1,378	541	1,919	0.6
1973	146,880	161	127	288	0.2
1974	182,111	579	994	1,573	0.9
1975	249,279	3,737	1,295	5,032	2.0
1976	238,405	4,100	1,471	5,571	2.3
1977	172,978	368	228	596	0.3
1978	164,259	3,580	902	4,482	2.7
1979	268,252	2,706	4,194	6,900	2.6
1980	471,420	316	6,312	6,628	1.4
1981	358,234	1,780	3,434	5,214	1.5

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Methow River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Methow River, Washington, a tributary to the Columbia River at RM 523.9 (8.3 miles above Wells Dam) that drains a watershed of 1,794 square miles.

ORIGIN

The Methow River stock is native, although interbreeding with introduced Wells hatchery-stock steelhead has likely occurred. From 1939 through 1943, all upstream-migrant steelhead were trapped at Rock Island Dam as part of the Grand Coulee Fish Maintenance Project (Fish and Hanavan 1948). Trapped steelhead were released into the Wenatchee, Entiat and Methow rivers, hence wild Methow fish are, to some degree, remnants of transplanted upper Columbia River stocks.

ADULT LIFE HISTORY

Run size, catch, and escapement

Accurate estimates of wild run size at Wells Dam can be calculated by applying run composition (i.e., percent wild) estimates to counts of steelhead passing over the dam. Run composition proportions ranging from 1.7% to 18.9% wild were obtained through analysis of scales and otoliths removed from adults captured at Wells Dam and in the Methow River and Wells Pool sport fisheries between 1977 and 1982 (Williams 1977; Mobbs 1979; Mobbs and Pederson 1980; Schuck et al. 1981; Williams 1981; Loeppke et al. 1983; Williams 1984). However, the local biologist believes past estimates of wild contribution may be high because of the high rate of residualism exhibited by Wells Hatchery stock juveniles. If these juveniles migrate and return as adults, the scales and otoliths of residual hatchery fish would show 2 years of freshwater growth, hence these returnees would be classified as "wild" (Williams, 1984; K. Williams, Washington Department of Game (WDG), personal communication). In 1982, the wild run contribution was estimated by examination of dorsal fins and the reading of scales and otoliths. This approach generated an estimate of 5.1% which the local biologist believes is the most reliable available. Applying this proportion to the 1982 steelhead count at Wells Dam (8,518) yields a wild run size estimate of 434. Because most wild steelhead migrating over Wells Dam are bound for the Methow River, the run size of the Methow stock in 1982 was likely close to 400 fish.

Harvest of the stock occurs in mainstem Columbia sport and tribal fisheries, as well as in the Methow River. In 1982, recreational harvest of wild and hatchery-origin steelhead in the Methow, Okanagan and Similkameen rivers and Wells Pool was 3,672 (based on punchcard returns). Applying the 5.1% wild proportion to this figure yields a wild catch estimate of 187 fish, hence nearly 250 wild adults escaped harvest to spawn. Again, most of these fish were likely bound for the Methow River. An interim escapement goal of 1,500 steelhead has been set for this stock.

The ability of this stock to self-perpetuate is limited by poor survival of outmigrant smolts passing through nine hydroelectric dams on the mainstem Columbia River. Williams (1984) suggests that the reduced abundance of contemporary wild steelhead runs may also be attributed to destruction of rearing habitat in the mainstem Columbia. Specifically, he believes Methow River spawning and mainstem Columbia rearing was a genetic response by this stock to the unproductive Methow River environment. Hence, impoundment of free-flowing mainstem Columbia waters would have eliminated much of the rearing area available to wild Methow River juveniles.

Time of migration

Methow-bound wild fish likely migrate through the lower Columbia River between June and September, and arrive at the Methow River from mid-August through early November. A substantial number of steelhead do not migrate up through the mainstem Methow until spring, but instead overwinter in Wells Pool near the mouth of the Methow.

Spawning period

April and May (K. Williams, WDG, personal communication).

Spawning areas

Wild spawners utilize the mainstem Methow river upstream to Winthrop, lower Gold Creek and Twisp river, and likely portions of the mainstem upper Methow and Chewack rivers (Figure 1).

Age composition

Wild adult returns in some years are dominated by 1-ocean steelhead, but returns in other years are predominantly 2-ocean fish (Table 1). For example, 93.3% and 87.5% of the 1979 and 1980 wild runs, respectively, were 1-ocean, while 100% of the 1982 run was composed of 2-ocean adults.

The notation of Narver and Withler (1971) was modified and used to report age data derived from steelhead scales and otoliths because it distinguishes fresh versus saltwater growth. For example, age 2.1 would represent a fish with 2 years of freshwater growth and 1 year of marine growth prior to its capture in freshwater on its spawning migration.

Size

Of wild adults collected between 1978 and 1982, 1-ocean fish averaged 63.3 cm and 2.2 kg, and 2-ocean fish averaged 72.6 cm and 3.7 kg (Table 1).

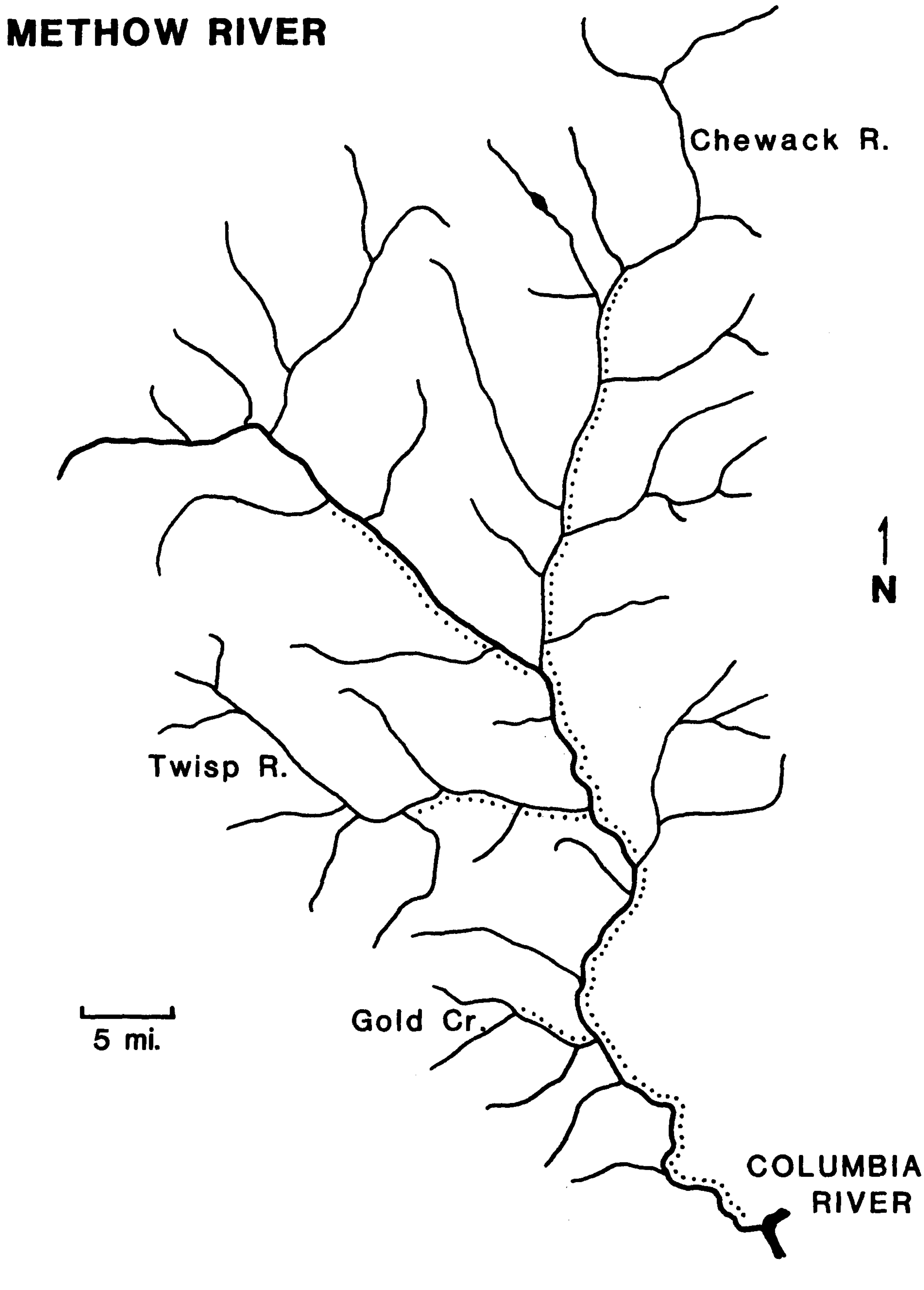

Figure 1. Probable spawning locations of wild steelhead trout in the Methow River, Washington (Fulton 1970; K. Williams, WDG, personal communication).

Sex ratio

Unknown.

Fecundity

Unknown.

Table 1. Age and size of wild steelhead captured at Wells Dam and in the Methow River and Wells Pool sport fisheries, Washington, 1978 through 1982.

RUN YEAR	AGE	NUMBER	LENGTH (CM)	WEIGHT (KG)
1978 1/	2.1	7	59.3	1.6
	2.2	8	75.8	4.1
	3.1	2	63.0	2.2
	3.2	3	67.7	3.0
1979 2/	2.1	9	67.3	2.7
	2.2	1	74.0	2.9
	3.1	5	63.8	2.3
1980 3/	2.1	5	61.8	---
	3.1	2	62.0	---
	3.2	1	67.0	---
1982 4/	2.2	31	72.4	---
	3.2	3	72.4	---
1982 5/	2.2	12	----	---
	3.2	10	----	---
	4.2	4	----	---

1/ Mobbs (1979)

2/ Mobbs and Pederson (1980)

3/ Schuck et al. (1981)

4/ Loeppke et al. (1983)

5/ Williams (1984)

Biochemical-genetic characteristics

Loeppke et al. (1983) studied eight enzyme systems of both wild and hatchery-origin Wells steelhead spawners and guardedly concluded that the hatchery and wild stocks are genetically indistinguishable. Their conclusion is not surprising given that some wild fish are used as broodstock at Wells Hatchery and that wild-hatchery stock interbreeding probably occurs in the natural environment. However, their sampling of tissues for electrophoresis was biased toward the early portion of the run, and some fish they identified as wild-origin may have been residual hatchery fish that spent at least 2 years in freshwater prior to smolting. These considerations, in conjunction with the observation that wild broodstock at Wells Hatchery are brighter and later maturing than hatchery fish (Williams 1984), indicate that the findings of Loeppke et al. may be incorrect and that the wild Methow stock is genetically distinct from the Wells Hatchery stock.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Of wild adults returning to the Methow River from 1978 through 1982, 70.9%, 25.2%, and 3.9% outmigrated at 2, 3, and 4 years of age, respectively (Table 1). Williams (1984) believes the extended duration of freshwater residence of this stock relative to other wild stocks is related to growth. Specifically, cold and unproductive waters in the drainage often necessitate an additional 1 to 3 years of freshwater residence in order for wild juveniles to achieve smolt size.

Wild smolts likely begin their seaward migration in April and early May at a size of 170-200 mm. Strickland (1967) reported that wild outmigrants pass Priest Rapids Dam (Columbia RM 397.1) in peak abundance between mid-May and early June.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; refinement of escapement goal.

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Okanogan River Summer Steelhead (wild)

PRODUCTION

Natural.

GEOGRAPHIC LOCATION

Okanogan River, Washington and Canada, a tributary to the Columbia River at RM 533.5 (17.9 miles above Wells Dam) that drains a watershed of 8,342 square miles (2,300 in Washington, the remainder in Canada).

ORIGIN

Indigenous, although hatchery supplementation (Wells stock) was undertaken in an attempt to enhance wild runs.

ADULT LIFE HISTORY

Run size, catch, and escapement

Williams (Washington Department of Game (WDG), personal communication) believes that the Okanogan system formerly supported a native run of summer steelhead. Overfishing, habitat destruction, and construction of hydroelectric dams depressed stock abundance to the point where few, if any, wild fish remain. Harvest of the stock occurs in mainstem Columbia sport and tribal fisheries and in the Okanogan River. The annual sport harvest of wild and hatchery-origin steelhead in the Okanogan River is approximately 15 (5-year average, based on punchcard returns). No escapement goal has been established for this stock to date.

Time of migration

Unknown, but likely June through October.

Spawning period

Unknown, but likely April and May.

Spawning areas

Steelhead formerly spawned through much of the mainstem Okanogan and Similkameen rivers (Figure 1). Completion of Enloe Dam in 1918 blocked steelhead migrations to most of the Similkameen River and agricultural development destroyed valuable spawning and rearing habitat in the lower Okanogan drainage. The historical extent of steelhead penetration into the upper mainstem Okanogan in Canada is unknown, but construction of outlet dams on Okanogan and Vaseux lakes curtailed upstream anadromous migrations (Thompson 1973). At present, spawning activity is restricted to a small portion of the mainstem Okanogan and to the lower reaches of Inkaneep and Vaseux creeks and the Similkameen River.

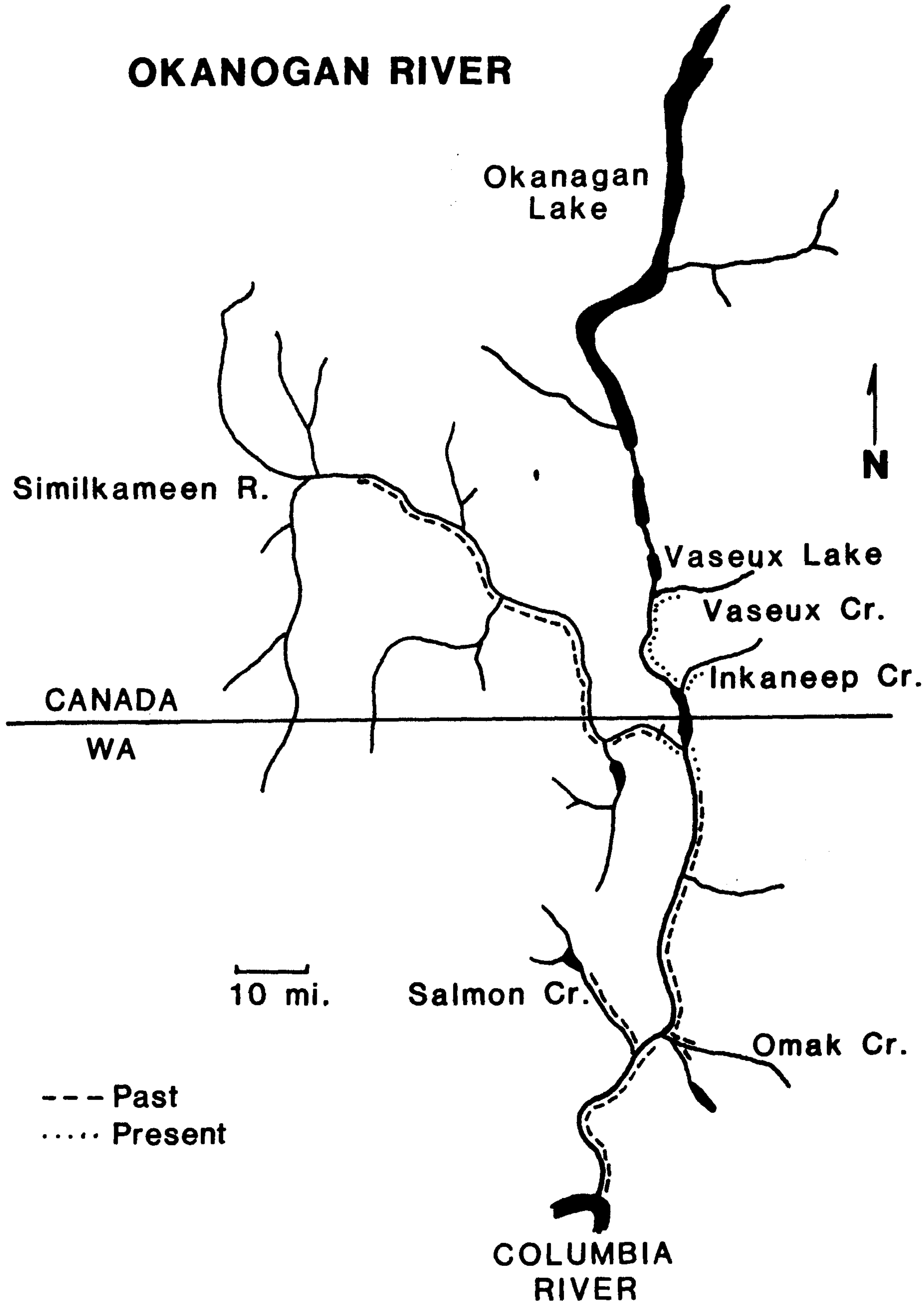

Figure 1. Probable past and present spawning locations of steelhead trout in the Okanogan River, Washington and Canada (Fulton 1970; Thomason 1974; K. Williams, WDG, personal communication).

Age composition

Unknown.

Size

Unknown.

Sex ratio

Unknown.

Fecundity

Unknown.

Biochemical-genetic characteristics

Unknown.

JUVENILE LIFE HISTORY

Time of emergence

Unknown.

Time, age, and size at migration

Unknown, but smolts probably outmigrate in April and May at an age of 2 years and a size of 170-200 mm.

Survival rate

Unknown.

DISEASE HISTORY

Unknown.

PRIORITY INFORMATION NEEDS

Run size, catch and escapement data; establishment of escapement goal.

REFERENCES

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III. Existing Stock Transfer Guidelines for Oregon, Washington, and Idaho

OREGON (Oregon Department of Fish and Wildlife)

Draft stock transfer guidelines for coho salmon and steelhead are described below. The coho guidelines are taken from the Coho Salmon Plan Status Report (ODFW 1985). The Coho Salmon Plan is currently undergoing agency and public review. The steelhead guidelines are taken from the draft Steelhead Plan and consequently may be revised. Specific stock transfer guidelines for chinook and chum salmon have not yet been developed.

Coho salmon

Interim stock transfer guidelines for coho in the Columbia River in Oregon (ODFW 1985).

Reach	Management designation	Recommended stock
Lower Columbia River (west of The Dalles Dam)	H[1]	Early run Late run (WDF hatcheries) Intermediate[2]
Upper Columbia River (east of The Dalles Dam and Snake River)	N[3]	Undetermined[4]

[1] Routine stocking of hatchery fish.

[2] Under consideration for development.

[3] Emphasis on chinook and steelhead production.

[4] Under consideration for development (See Grande Ronde Coho summary).

Steelhead

Interim management designation and stock transfer guidelines for winter steelhead and summer steelhead in Columbia River tributaries in Oregon.

	Winter Steelhead		Summer Steelhead	
Tributary	Management designation[1]	Permitted hatchery stock	Management designation	Permitted hatchery stock
Lewis & Clark	C	Big Creek	--	
Klaskanine R.	C	Big Creek	--	
N. Fork	H	Big Creek	--	
S. Fork	C	Big Creek	--	
Bear Creek	W		--	
Big Creek	H	Big Creek	--	
Gnat Creek	C	Big Creek	--	
Clatskanie R.	C	Big Creek	--	
Beaver Cr.	W	Big Creek	--	
Scappoose Cr.	C	Big Creek	--	
Willamette R. sys.				
Clackamas R. sys.				
Lower Clackamas	C	Big Creek Eagle Creek - early run Eagle Creek - late run	H	Skamania
Upper Clackamas	W	Eagle Creek - late run	H	Skamania
Eagle Cr.	C	Eagle Creek - early run Eagle Creek - late run	--	
Tualatin R. sys.	C	Big Creek		--
Molalla R. sys.	C	Big Creek	H	Skamania
Yamhill R.	C[2]	Big Creek	--	
Santiam R.	C	Willamette	H	Skamania
N. Santiam	C	Willamette	H	Skamania
S. Santiam	C	Willamette	H	Skamania
Calapooia R.	W		--	
McKenzie R.	--		H	Skamania[3]
Mid. Fk. Will. R.	W		H	Skamania
Sandy R. sys.	C	Big Creek Sandy[4] Eagle Creek - late run	H	Skamania
Salmon R.	W		H	Skamania
Tanner Cr.	W		--	
Eagle Cr.	W		W	
Herman Cr.	W		W	
Hood R. sys.	C	Big Creek	C	Skamania
Mill Creek	W		W	
Fifteenmile Cr.	W		--	
Deschutes R. sys.	--		C	Deschutes
John Day R. sys.	--		W	
Umatilla R. sys.	--		C	Umatilla
Walla Walla R. sys.	--		C	Umatilla Wells
Grande Ronde R.	--		C	Wallowa
Wenaha R.	--		W	
Minam R.	--		W	
Imnaha R. sys.	--		C	Imnaha
Snake R.	--		C	Snake Wallowa

[1] W - wild, H - hatchery, C - wild and hatchery.
[2] Discontinued stocking in 1983.
[3] ODFW is attempting to develop a hatchery stock of summer steelhead adapted to the McKenzie River by using returning adults from releases of Willamette Skamania stock.
[4] A hatchery stock developed from wild broodstock trapped at Marmot Dam is under consideration for development.

WASHINGTON

Salmon (Washington Department of Fisheries)

The following list contains the current guidelines formulated by WDF for salmon stock transfers with Washington. This list may be modified pending fishery resource management negotiations between the treaty tribes and the states of Oregon, Washington, and Idaho. Generally, WDF stresses utilizing local stock first. If local stock is insufficient, then an alternate should either come from adjacent areas/hatcheries or from stocks that are linked to the local stock through historical stock transfers.

Table 1. Stock transfer list for spring chinook in Washington.

Hatchery/tributary	Preferred stock/substock	Alternate
Cowlitz Hatchery	1. Cowlitz Hatchery	None
Kalama Falls Hatchery	1. Kalama Hatchery	1. Cowlitz Hatchery [a] 2. Lewis Hatchery [d]
Lewis River Hatchery	1. Lewis Hatchery	1. Cowlitz Hatchery [a] 2. Kalama Hatchery
Carson Hatchery	1. Carson Hatchery-Wind River	None
Little White Salmon Hatchery	1. Little White Salmon Hatchery	1. (Carson Hatchery) 2. (Leavenworth Hatchery) [b]
Kilickitat Hatchery	1. Klickitat Hatchery	None
Tucannon River	1. Tucannon River	None
Yakima River\[c]\	1. Upper Yakima River 2. Naches River	1. Leavenworth Hatchery [b]
Ringold	1. Any upriver stock	None
Wenatchee River	1. Wenatchee River	None
Leavenworth Hatchery	1. Leavenworth Hatchery	1. (Winthrop Hatchery, [b] Entiat Hatchery) b 2. Carson Hatchery
Entiat Hatchery - Entiat River	1. Entiat Hatchery	1. (Leavenworth Hatchery, Winthrop Hatchery [b] 2. (Carson Hatchery)
Winthrop Hatchery-Methow Hatchery River	1. Winthrop Hatchery	1. Leavenworth Hatchery,\[b]\Entiat 2. Carson

(   ) = alternate stock considered nearly identical to local stock.

[a] This is historical contributor, IHN concerns restrict transfer at this time.
[b] Must be certified IHN free.
[c] Two distinct substocks seem to be present in river, but it is recognized they cannot be managed separately.
[d] IHN concerns restrict transfer at this time. \

Table 2. Stock transfer list for summer chinook in Washington, based on genetic and disease considerations.

Hatchery/tributary	Preferred stock	Alternate
Wells Hatchery	1. Wells Dam	None
Wenatchee River	1. Wenatchee River	None
Methow River	1. Methow River	1. Wells Hatchery
Entiat River	1. Entiat River	1. Wells Hatchery
Okanogan River	1. Okanogan River	1. Wells Hatchery 2. Similkameen River
Similkameen River	1. Similkameen River	1. Wells Hatchery 2. Okanogan River

Table 3. Stock transfer list for fall chinook in Washington, based on genetic and disease considerations.

Hatchery/tributary	Preferred stock	Alternate
Grays Hatchery	1. Grays Hatchery	1. (Any Columbia River tule)
Abernathy Hatchery	1. Abernathy Hatchery	1. (Any lower Columbia River tule)
Elokomin Hatchery	1. Elokomin Hatchery	1. (Any Columbia River tule)
Cowlitz Hatchery[a]	1. Cowlitz Hatchery	None
Kalama Hatchery complex	1. Kalama Hatchery	None
Lewis Hatchey complex	1. Lewis Hatchery	None
Washougal Hatchery	1. Washougal Hatchery	1. Bonneville Hatchery 2. (Any Columbia River tule)
Little White Salmon Hatchery	1. Any Bonneville pool hatchery tule	1. (Any Bonneville pool hatchery tule)
Spring Creek Hatchery	1. Spring Creek Hatchery	1. Issue being resolved
Klickitat Hatchery	1. Klickitat Hatchery	1. (Any Bonneville pool hatchery tule) 2. Bonneville Hatchery stock 3. Any Columbia River tule
Ringold Hatchery	1. Priest Rapids Hatchery/ Ringold Hatchery URB	1. Mainstem Columbia River brights
Priest Rapids Hatchery	1. Priest Rapids Dam/ Hatchery	1. Mainstem Columbia River brights
Lyons Ferry Hatchery	1. Snake River	None

(   ) = alternate stock considered nearly identical to local stock.

[a] IHN concerns restrict transfer at this time.

Table 4. Stock transfer list for coho in Washinton.

Hatchery/tributary	Preferred stock	Alternate
Grays Hatchery[a]	1. Grays Hatchery early	None
Elokomin Hatchery[a]	1. Elokomin Hatchery late	1. Cowlitz late 2. (Any other Lower Columbia River late coho)
	2. Elokomin Hatchery early	1. Grays early 2. (Any other Lower Columbia River early coho)
Cowlitz Hatchery	1. Cowlitz Hatchery late - October	None
	2. Cowlitze Hatchery late - September segment	None
	3. Cowlitz Hatchery late - late December to February segment	None
Kalama Hatchery complex[a]	1. Kalama Hatchery early	1. (Any lower Columbia River early)
Lewis Hatchery	1. Lewis Hatchery late	1. (Any lower Columbia River late)
Speelyai Hatchery	1. Lewis Hatchery early	1. (Any lower Columbia River early)
Washougal Hatchery[a]	1. Washougal Hatchery early	1. (Any lower Columbia River early)
	2. Washougal Hatchery late	1. (Any lower Columbia River late)
Klickatat Hatchery	1. Klickitat Hatchery late	1. (Any Columbia River late)
Rocky Reach	1. Columbia River early	1. (Any Columbia River early)
Big/Little White Salmon Hatchery	1. Little White Salmon Hatchery early	1. (Any Columbia River early)

(   ) = alternate stock considered nearly identical to local stock.

[a] While these represent alternative sources, egg needs have generally been met by station returns. This should remain our preferred objective and only in unusual circumstances should alternates be used.

Steelhead (Washington Department of Game)

This policy will apply to ongoing programs and any new stocking proposals of the WDG and any other entity wishing to stock steelhead in Washington State. Stocking permits will not be issued unless the criteria in this policy are met. This policy becomes effective February 1, 1983.

(A) Steelhead Smolt Stocking for the Purpose of Producing Harvestable Returns

1. Ongoing WDG smolt stocking programs will be continued at current level. Stocking levels, dates, and locations will be determined by District Biologists and approved by the appropriate Regional Biologist. Significant deviation in stocking levels established in regional management plans, plus or minus 20%, must be approved by the Anadromous Fish Program Manager.

2. Planting locations will be selected to provide appropriate harvest opportunity to all user groups. Harvest division shall be subject to applicable treaties and laws.

3. Smolts stocked shall average at least 10/lb and be stocked between March 1 and June 15. Past studies have indicated maximum returns of adult fish may be expected from plants made between April 15 - May 15. On rivers with late May sport fishing openers, smolts must be planted at least one week prior to the opening unless specific approval has been received from the Anadromous Fish Program Manager.

4. Culture of smolts for release must be consistant with fish disease policy established by the Washington Departments of Game and Fisheries.

5. Stocks should be selected that minimize harvest management conflicts with viable wild stocks. In the case of winter-run steelhead, non-marked adults must return primarily in December and January. Winter-run hatchery fish returning concurrently with viable wild stocks can be utilized if adipose-marked and harvested by acceptable selective fishing methods.

6. When an identified management or research need exists, a portion of the smolts should be marked. At least two months before actual marking, the Regional Biologist will submit a proposal to the Anadromous Program Manager for approval including the purpose of the experiment, nature of mark, river system to be stocked, total number of smolts to be released, number of smolts to be marked, and the anticipated recovery program. Marking should be done before the smoltification process begins.

7. Steelhead which fail to reach minimum size by desired release times as outlined in #3 (grade-offs) will either be destroyed or planted into areas where there is no possibility of adverse impacts on wild game fish. Plants of these subsmolts must be approved by the appropriate Regional Biologist and the Program Manager.

8. Documented evaluation of any marking project (except adipose-only) is required, regardless of success or failure.

(B) Steelhead Smolt Stocking to Rehabilitate Wild Runs

1. A report outlining the rehabilitation plan must be approved by the appropriate WDG Regional Biologist and the Anadromous Fish Program Manager. Rehabilitation means to increase wild runs until they are self sustaining and can provide harvest at which time smolt plants will be discontinued.

2. Smolts stocked shall average at least 20/lb and be stocked between March 1 and June 15. On rivers with late May sport fishing openers, smolts must be planted at least one week prior to the opening unless specific approval has been received from the Anadromous Fish Program Manager.

3. Culture of smolts for release must be consistant with fish disease policy established by the Washington Departments of Game and Fisheries.

4. Smolts must be the progeny of stocks indigenous to the river system they are stocked into, if available. If they are not available, stocks with similar biological characteristics should be used (close geographical source, from similar size stream, etc.).

5. When an identified management or research need exists, a portion of hte smolts should be marked. At least two months before actual marking, the Regional Biologist will submit a proposal to the Anadromous Program Manager for approval including the purpose of the experiment, nature of mark, river system to be planted, total number of smolts to be released, number of smolts to be marked, and the anticipated recovery program. Marking must be done before the smoltification process begins.

6. Documented evaluation of any rehabilitation project is required, regardless of success or failure.

(C) Steelhead Juvenile Stocking to Utilize Rearing Habitat not Fully Seeded by Wild Steelhead

1. A report outlining the plan must be approved by the appropriate WDG Regional Biologist and the Anadromous Fish Program Manager.

2. Juveniles should be between 350-500/lb and less than 9 months of age at release time. Juveniles should be scatter planted at appropriately low densities (usually less than 1 fish/m^2) based on salmonid species diversity and abundance.

3. Stocking of juveniles will be limited to areas historically utilized by steelhead. In areas where the species can be expected to maintain itself through natural reproduction, stocking will be limited to five years, then the results of the project must be evaluated.

In areas where the species cannot reasonably be expected to maintain itself without fry stocking, continuing plants may be made to take advantage of natural rearing potential, provided the project is evaluated within five years and documents benefits to recreational or commercial fisheries. If projects are above natural barriers or in sea-run cutthroat spawning zones, then the five year evaluations must include impacts on other fish species.

NOTE: Eyed egg plants may be used instead of juvenile plants with the approval of the Regional Biologist and Anadromous Fish Program Manager.

4. Cultural programs for juvenile releases must be consistant with fish disease policy established by the WDG and WDF.

5. Juveniles must be progeny of stocks indigenous to the river system they are stocked into (if available). If indigenous stocks are not available, another stock may be used with the approval of the appropriate Regional Biologist and Anadromous Fish Program Manager. In such cases, stocks with similar biological characteristics to the indigenous stock and from the closest watershed of similar size where they are available should be used.

IDAHO (Idaho Department of Fish and Game)

IDFG's transfer plan is based in part on the following criteria (major items 1, 2, and 3 are in priority ranking):

1. Propagate indigenous stocks by the natural processes.

2. Artificial supplementation will utilize indigenous stocks whenever possible.

3. Upon loss of ability to propagate indigenous stocks, the following inherent and behavioral characteristics of potential donor stocks will be considered (not necessarily in priority order):

    a. Donor stocks will be of the same race or strain, e.g., spring chinook, summer chinook.

    b. Geographically, donor stocks should be closely related.

    c. Upstream and downstream migration timing should be matched as closely as possible.

    d. Spawning time should be matched as closely as possible.

    e. Genetic makeup, when known, should be closely matched.

    f. For geographically distant donor stocks, as with sockeye in Idaho's program, utilize a stock with a lengthy freshwater migration.

    g. Differences in migration timing of donor stocks may be sought to enhance fishing opportunity.

    h. Differences in size of mature fish in the fishery (a function of the number of years at sea) may be sought in a donor stock when it would enhance a fishery.

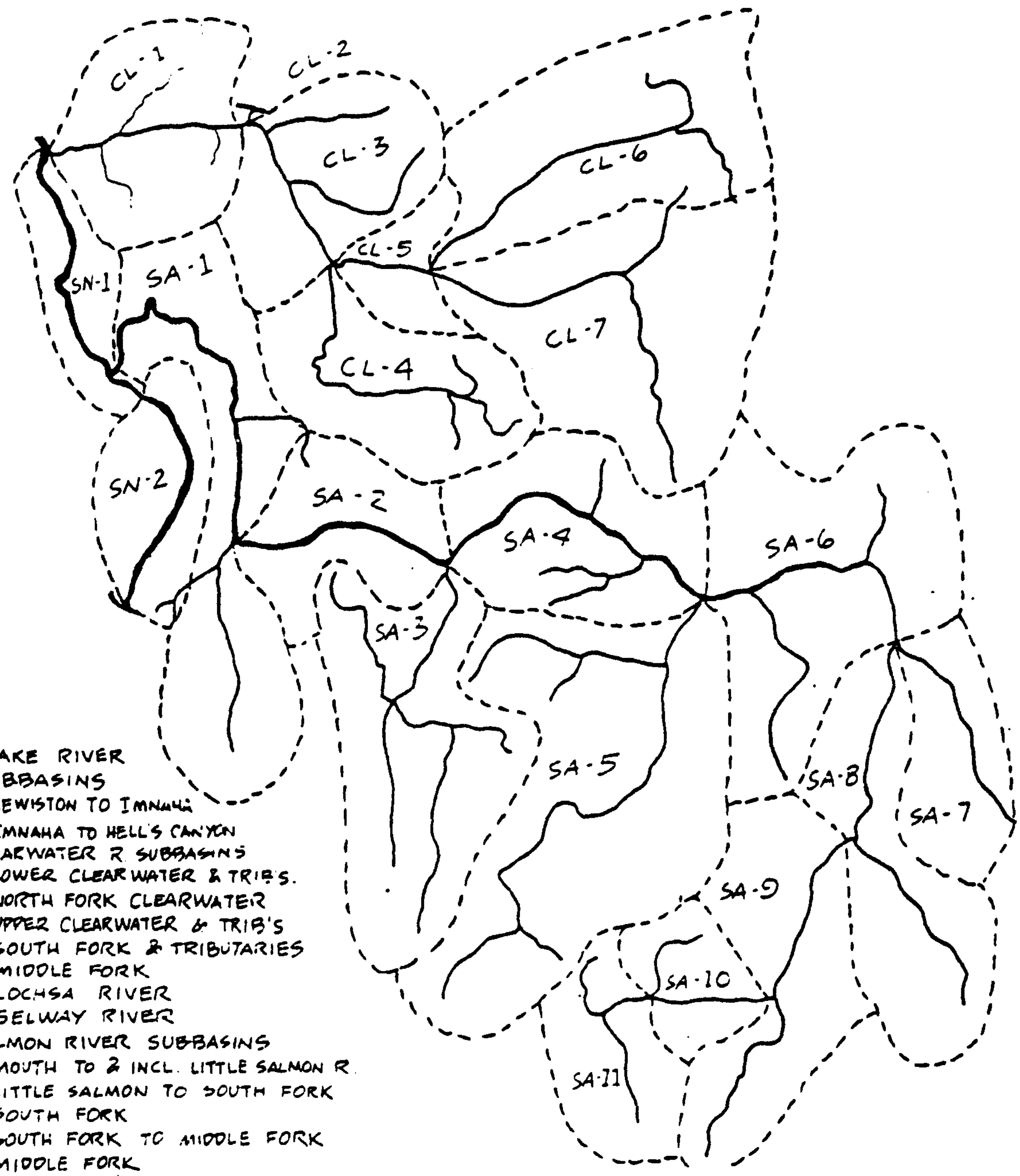
    i. Survival rates, usually expressed as smolt-to-adult, but with particular emphasis on headwaters-to-ocean and in-ocean survival rates, should be compared among potential donor stocks.

    j. Disease histories of donor stocks should be no worse than or, ideally, better than, the original stocks. Fish disease control policies presently being deveoped may impact stock transfers.

List of Idaho anadromous fish stocks indicating identified stocks of management emphasis and appropriate donor stocks for inter-basin transfers (See the following figure for stream locations).

Stream	Stock	Appropriate Donor Stock
<u>Summer Chinook</u>		
South Fork Salmon	Indigenous	None
Middle Fork Salmon	Indigenous	None
Main Salmon (SA-10)	Indigenous	East Fork Salmon
Pahsimeroi	Indigenous	None
East Fork Salmon	Indigenous	None
Main Salmon (SA-9)	Indigenous	East Fork Salmon, Pahsimeroi
<u>Fall Chinook</u>		
Snake River	Indigenous	None
Clearwater River	Snake River	Snake River
<u>Sockeye</u>		
Redfish Lake	Indigenous	None
Alturas Lake	Babine Lake	Redfish Lake
Warm Lake	Babine Lake	Redfish Lake
Stanley Lake	Babine Lake	Redfish Lake
<u>Spring Chinook</u>		
Snake (SN-2)	Rapid River	None
North Fork (CL-2)	Rapid River	Rapid River, Leavenworth, any Clearwater returns
Clearwater (CL-3)	Rapid River	Leavenworth, any Clearwater returns
South Fork (CL-4)	Rapid River	Lochsa, Kooskia
Middle Fork (CL-5)	Rapid River	South Fork, Lochsa, Kooskia
Lochsa (CL-6)	Indigenous	Rapid River, Kooskia, South Fork
Selway (CL-7)	Indigenous	None
Salmon (SA-1)	Indigenous	Rapid River
Salmon (SA-2)	Indigenous	Rapid River
South Fork (SA-3)	None	None
Salmon (SA-4)	Indigenous	None
Middle Fork (SA-5)	Indigenous	None
Salmon (SA-6)	Indigenous	East Fork, Upper Salmon
Lemhi (SA-7)	Indigenous	East Fork, Upper Salmon
Pahsimeroi (SA-8)	Indigenous	Lemhi, East Fork, Upper Salmon, Rapid River
East Fork (SA-9)	Indigenous	Upper Salmon
Yankee Fork (SA-10)	Indigenous	Upper Salmon, East Fork Salmon
Upper Salmon (SA-11)	Indigenous	East Fork Salmon, Lemhi
<u>Steelhead</u>		
Snake (SN-1)	Indigenous	Snake A
Snake (SN-1)	Snake A	None
Clearwater (CL-1)	Indigenous	None
North Fork (CL-2)	Clearwater B	None
Clearwater (CL-3)	Indigenous	Clearwater B
South Fork (CL-4)	Clearwater B	None
Middle Fork (CL-5)	Indigenous	Clearwater B
Lochsa (CL-6)	Indigenous	Clearwater B
Selway (CL-7)	Indigenous	None
Salmon (SA-1)	Indigenous	Snake A (Clearwater B, in Slate Creek only)
Salmon (SA-2)	Indigenous	Snake A
South Fork (SA-3)	Indigenous	None
Salmon (SA-4)	Indigenous	None
Middle Fork (SA-5)	Indigenous	None
Salmon (SA-6)	Indigenous	Snake A (Clearwater B, in Panther Creek)
Lemhi (SA-7)	Indigenous	Snake A
Pahsimeroi (SA-8)	Snake A	None
East Fork (SA-9)	Clearwater B	None
Yankee Fork (SA-10)	Indigenous	Snake A
Salmon (SA-11)	Indigenous	Snake A

IDAHO ANADROMOUS FISHERY MANAGEMENT PLAN
SUB-BASIN DESIGNATION



• SNAKE RIVER SUBBASINS
SN1 LEWISTON TO IMNAHA
SN2 IMNAHA TO HELL'S CANYON
• CLEARWATER R. SUBBASINS
CL 1 LOWER CLEARWATER & TRIB'S.
CL 2 NORTH FORK CLEARWATER
CL 3 UPPER CLEARWATER & TRIB'S
CL 4 SOUTH FORK & TRIBUTARIES
CL 5 MIDDLE FORK
CL 6 LOCHSA RIVER
CL 7 SELWAY RIVER
• SALMON RIVER SUBBASINS
SA 1 MOUTH TO & INCL. LITTLE SALMON R.
SA 2 LITTLE SALMON TO SOUTH FORK
SA 3 SOUTH FORK
SA 4 SOUTH FORK TO MIDDLE FORK
SA 5 MIDDLE FORK
SA 6 MIDDLE FORK TO LEMHI
SA 7 LEMHI RIVER
SA 8 LEMHI TO & INCL PAHSIMEROI
SA 9 PAHSIMEROI TO & INCL. EAST FORK
SA 10 EAST FORK TO & INCL. YANKEE FORK
SA 11 UPSTREAM FROM YANKEE FORK

IV. Information Needs for Columbia Basin Salmonid Stocks

I. Existing stock data assembled during this study needs to be analyzed to more fully describe the status and characteristics of individual stocks.

II. Data assembled on individual stocks need to be compared to indicate differences and similarities among stocks and to suggest characteristics for differentiating stocks.

III. Uniform criteria and improved techniques for differentiating stocks need to be developed.

IV. Stock-specific information needs for stock assessment and identification:

- A. Harvest (number, age and size composition)
  1. Sport (salmon and steelhead)
     - a. Hatchery and wild stock components
     - b. Validation of punch-card estimates
  2. Wild and hatchery stock components of tribal steelhead and salmon fisheries
  3. Non-tribal commercial harvest of wild salmon stocks
- B. Time of migration and spawning of adults, particularly steelhead stocks
- C. Improved accounting of run sizes between mainstem dams
- D. Spawning escapement of wild and hatchery stocks
  1. Development of methods to estimate total escapement (e.g., expansion of spawning ground index counts)
  2. Extent of straying between stocks
  3. Escapement necessary for full seeding
  4. Age composition
- E. Length-specific fecundity of wild and hatchery stocks
- F. Natural production
  1. Estimates of current smolt production and potential capacity, including the mainstems of tributaries and the Columbia River
  2. Contribution of hatchery stocks to natural production
  3. Egg-to-smolt and smolt-to-adult survival rates
- G. Juvenile life history information for wild stocks
  1. Temporal and spatial distribution
  2. Age and length composition of migrants
- H. Effects of hatchery stocks on wild anadromous and resident salmonid stocks (e.g., competition, displacement, genetic make-up, disease resistance)
- I. Susceptibility and resistance of wild stocks to diseases
- J. Relationship of life history characteristics and environmental conditions

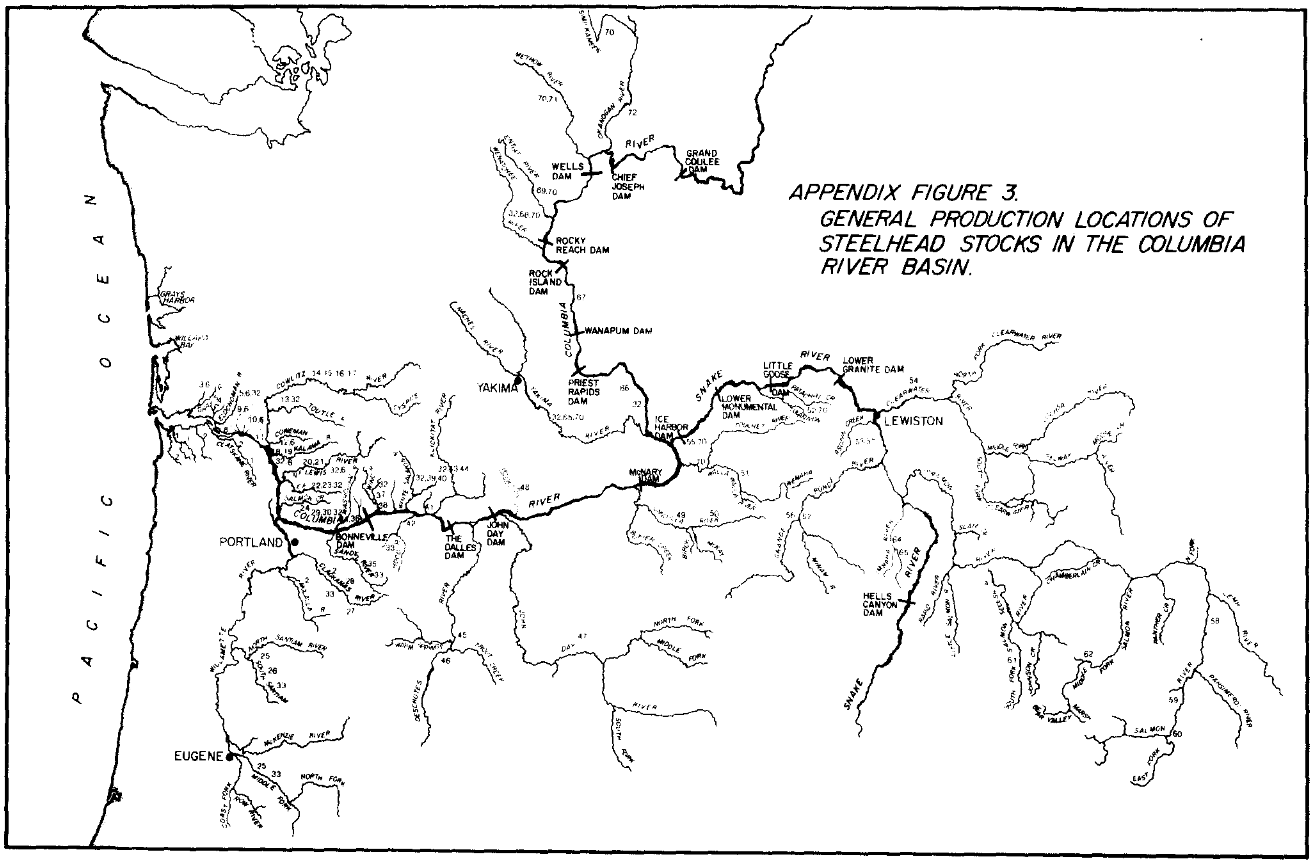
KEY TO STEELHEAD STOCKS ON APPENDIX FIGURE 3

Steelhead Trout

1. Lower Columbia River (Oregon) Winter Steelhead (wild)
2. Big Creek Winter Steelhead (hatchery)
3. Grays River Winter Steelhead (wild)
4. Skamokawa Creek Winter Steelhead (wild)
5. Elochoman River Winter Steelhead (wild)
6. Elochoman River Winter Steelhead (hatchery)
7. Chambers Creek Winter Steelhead (hatchery)
8. Mill Creek Winter Steelhead (wild)
9. Abernathy Creek Winter Steelhead (wild)
10. Germany Creek Winter Steelhead (wild)
11. Coal Creek Winter Steelhead (wild)
12. Coweeman River Winter Steelhead (wild)
13. Toutle River Winter Steelhead (wild)
14. Cowlitz River Winter Steelhead (wild)
15. Cowlitz River Winter Steelhead (hatchery)
16. Late Cowlitz River Winter Steelhead (hatchery)
17. Cowlitz River Summer Steelhead (hatchery)
18. Kalama River Winter Steelhead (wild)
19. Kalama River Summer Steelhead (wild)
20. North Fork Lewis River Winter Steelhead (wild)
21. North Fork Lewis River Summer Steelhead (wild)
22. East Fork Lewis River Winter Steelhead (wild)
23. East Fork Lewis River Summer Steelhead (wild)
24. Salmon Creek Winter Steelhead (wild)
25. Willamette River Winter Steelhead (wild)
26. Willamette River Winter Steelhead (hatchery)
27. Clackamas River Winter Steelhead (wild)
28. Eagle Creek Winter Steelhead (hatchery)
29. Washougal River Winter Steelhead (wild)
30. Washougal River Summer Steelhead (wild)
31. Skamania Winter Steelhead (hatchery)
32. Skamania Summer Steelhead (hatchery)
33. Willamette Substock (hatchery)
34. Woodward Creek Winter Steelhead (wild)
35. Sandy River Winter Steelhead (wild)
36. Hamilton Creek Winter Steelhead (wild)
37. Wind River Winter Steelhead (wild)
38. Wind River Summer Steelhead (wild)
39. White Salmon River Winter Steelhead (wild)
40. White Salmon River Summer Steelhead (wild)
41. Major Creek Summer Steehead (wild)
42. Hood Basin Winter and Summer Steelhead (wild)
43. Klickitat River Winter Steelhead (wild)
44. Klickitat River Summer Steelhead (wild)
45. Deschutes River Summer Steelhead (wild)
46. Deschutes River Summer Steelhead (hatchery)
47. John Day River Summer Steelhead (wild)
48. Rock Creek Summer Steelhead (wild)
49. Umatilla River Summer Steelhead (wild)
50. Umatilla River Summer Steelhead (hatchery)

Steelhead Trout (continued)

51. Walla Walla River Summer Steelhead (wild)
52. Tucannon River Summer Steelhead (wild)
53. Asotin Creek Summer Steelhead (wild)
54. Dworshak Hatchery Summer Steelhead
55. Lower Snake River Summer Steelhead (wild)
56. Grande Ronde River Summer Steelhead (wild)
57. Wallowa Summer Steelhead (hatchery)
58. Niagara Springs Steelhead
59. Hagerman Hatchery Summer Steelhead
60. Magic Valley Hatchery Summer Steelhead
61. South Fork Salmon River Summer Steelhead
62. Middle Fork Salmon River Summer Steelhead
63. Imnaha River Summer Steelhead (wild)
64. Imnaha River Summer Steelhead (hatchery)
65. Yakima River Summer Steelhead (wild)
66. Hanford Reach Summer Steelhead (wild)
67. Upper Columbia Summer Steelhead (wild)
68. Wenatchee River Summer Steelhead (wild)
69. Entiat River Summer Steelhead (wild)
70. Wells Summer Steelhead (hatchery)
71. Methow River Summer Steelhead (wild)
72. Okanogan River Summer Steelhead (wild)



APPENDIX FIGURE 3.
GENERAL PRODUCTION LOCATIONS OF STEELHEAD STOCKS IN THE COLUMBIA RIVER BASIN.

KEY TO STEELHEAD HATCHERY FACILITIES ON APPENDIX 4

Washington

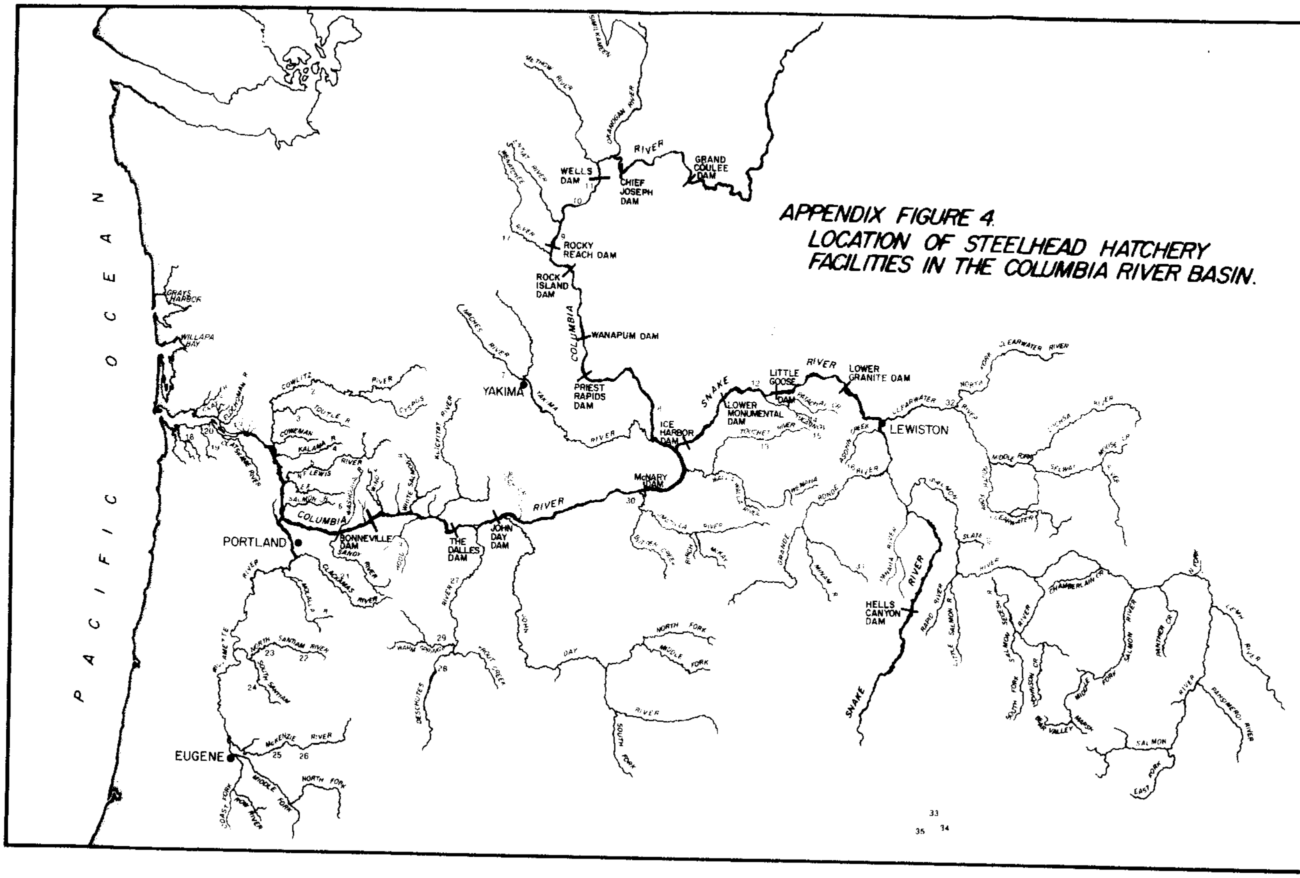
1. Beaver Creek
2. Cowlitz
3. Alder Creek Pond
4. Gobar Pond
5. Lewis River (proposed)
6. Skamania
7. Naches
8. Ringold Pond
9. Turtle Rock Pond
10. Chelan P.U.D.
11. Wells
12. Lyons Ferry
13. Dayton Pond (proposed)
14. Tucannon
15. Curl Lake Pond (proposed)
16. Cottonwood Pond
17. Leavenworth NFH

Oregon

18. Klaskanine
19. Big Creek
20. Gnat Creek
21. Eagle Creek NFH
22. Marion Forks
23. Roaring River
24. South Santiam
25. McKenzie
26. Leaburg
27. Oak Springs
28. Round Butte
29. Warm Springs NFH
30. Irrigon
31. Wallowa

Idaho

32. Dworshak NFH
33. Niagara Springs
34. Hagerman NFH
35. Magic Valley



APPENDIX FIGURE 4.
LOCATION OF STEELHEAD HATCHERY FACILITIES IN THE COLUMBIA RIVER BASIN.