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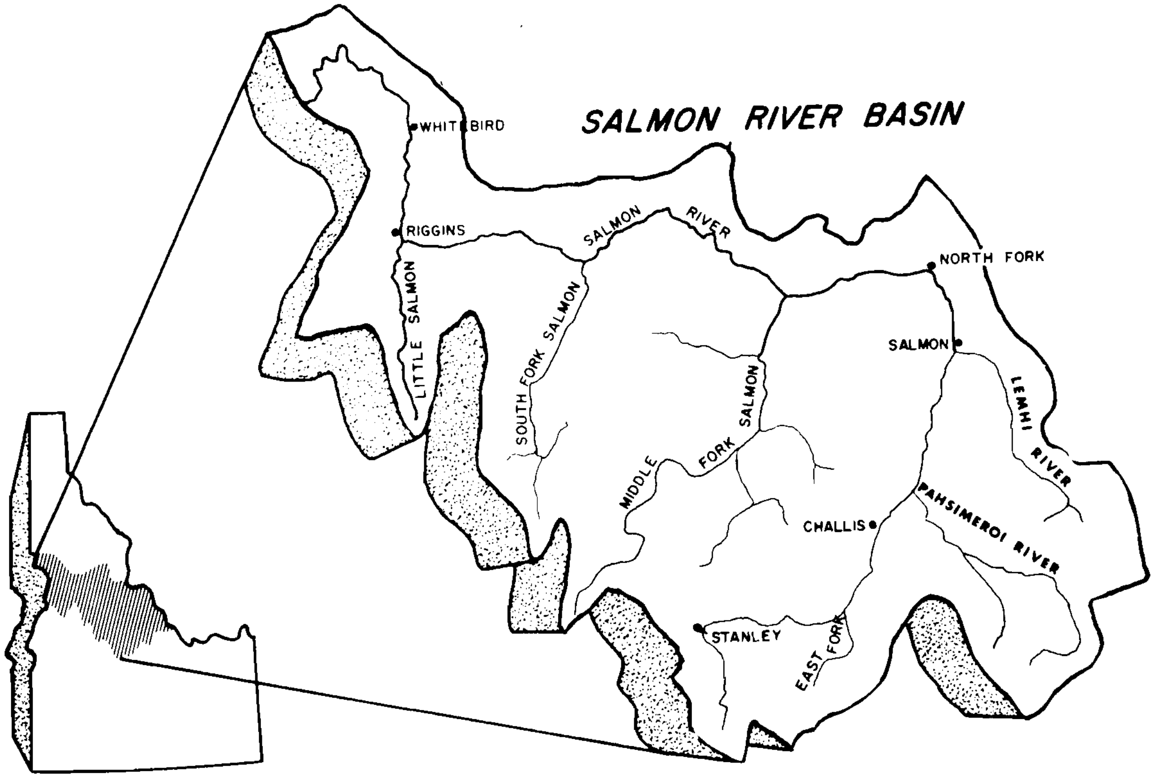
A Methodology Study To Develop Evaluation Criteria For Wild And Scenic Rivers



Report of

Sport and Commercial Fisheries Subproject

by

Jerry Mallet

and

Ted C. Bjornn

Water Resources Research Institute
University of Idaho
Moscow, Idaho

November, 1970

A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS

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PREFACE

Public Law 90-542 which passed the Congress of the U.S., October 2, 1968, provided for a National Wild and Scenic Rivers System. The purpose of the law is to protect for the enjoyment and benefit of the people of the United States certain rivers which in conjunction with lands bordering the waters possess outstandingly scenic, recreational, fish and wildlife, geologic land forms, and other desirable features.

Two categories of rivers are specified by the Act. "Instant Rivers" were authorized for immediate inclusion in the National Wild and Scenic Rivers System. The Middle Fork of the Salmon River and the Middle Fork of the Clearwater River were the two "instant" rivers located in Idaho. The second category, "study rivers", included rivers which are to be studied for possible inclusion in the Wild and Scenic Rivers System. These rivers include the main stems of the Bruneau, St. Joe, Priest, and Moyie rivers, and the Salmon River from North Fork to its confluence with the Snake River.

In addition to the two types of wild and scenic rivers specified by the Act, it is also possible to add other rivers to the Wild and Scenic Rivers System. The first of these ways is specified in section 2a of the Act which permits rivers that are designated by state legislatures as wild and scenic rivers. These rivers have to be permanently established and meet other conditions of the act, after which they can become part of the National Wild and Scenic Rivers System. The second way a river can be included in the National Wild and Scenic Rivers System is through section 5d of the Act which indicates that in all planning for land use and development by Federal Agencies that they will consider the potential of all rivers under study for wild and scenic river status.

The Act specifies three classes of wild rivers: wild, scenic, and recreational. A "wild river" refers to a river free from impoundments, with non-polluted water and essentially primitive shorelines, and accessible only by trail. A "scenic river" is free from impoundments with shorelines and watersheds still essentially primitive and undeveloped but which is accessible in places by roads. A "recreational river" is readily accessible by roads and railroads, may have development along the shorelines and may have undergone some impoundment or diversion in the past. Public Law 90-542 specifies a ten-year time limit on classification studies during which studies and recommendations on the disposition of "study rivers" are to be made to Congress.

There is little valid criteria available for evaluating rivers for inclusion in the National Wild and Scenic Rivers System. For this reason the Water Resources Research Institute at the University of Idaho has organized a Scenic Rivers Study Unit for the purpose of developing methodology to evaluate wild rivers. The goal of this study is to establish criteria which can be used to identify and evaluate the economic, aesthetic, scenic and other values of wild rivers.

The Salmon River in Idaho has been selected as the study river on which to develop evaluation criteria. This river originates in central Idaho and flows about 410 miles generally through precipitous undeveloped canyon country and discharges into the Snake River 49 miles above Lewiston. The average annual discharge of the Salmon River at its mouth is approximately 8,000,000 acre feet.

The portion of the Salmon from its mouth to the town of North Fork has been designated as a "study river" in the "Act". However, for the methodology study the entire Salmon drainage basin is being studied. There are two reasons for this. First, because any economic development-impoundments, diversions, mining, paper, industry, logging, etc.,--would affect the main stem wild river section. Second, because of the way much census data is reported it is more meaningful to include all the activities in the river basin and adjacent counties. The hydrologic basin unit (the Salmon drainage basin) was used for some portions of the Idaho Economic Base Study for Water Requirements (1969) and in the Idaho Water Resources Inventory (1968).

The purpose of the methodology study is to develop information pertinent to decision-making and planning as it pertains to the selection, use, and management of wild and scenic rivers. The methodology study has four broad objectives:

1. Inventory present quantities and qualities of natural resources in the river basin area, and estimate future quantities and qualities of these resources, establishing values in both situations.
2. Identify, describe, and quantify, where possible, benefits from scenic beauty, personal enrichment, and other intangible and/or aesthetic experiences derived from the river.
3. Develop a series of models to evaluate or determine resource use patterns consistent with a wild river system, and the resource use pattern which would exist under various levels of development in the river basin area.
4. Present recommendations for alternative resource uses for the river basin area, restrictions if classification is applicable, and describe the economic and social ramifications of each of the alternatives considered.

The plan for the methodology study is to divide the research into a series of subprojects, each covering an important activity related to the river. These subprojects consist of 15 resource and service functions:

1. Forest and range resources
2. Minerals
3. Outdoor recreation
4. Commercial fisheries
5. Irrigation
6. Water for municipal and industrial use
7. Water quality control
8. Hydroelectric power
9. Flood control
10. Navigation
11. Transportation and access
12. Anthropology
13. History
14. Agriculture
15. Hunting

Each of these 15 resource and service functions will be examined on an individual basis at their present level of development and at projected levels of development.

Once the above subprojects have been completed, a series of models will be developed to estimate costs and benefits for each of the resources included in the subprojects. This will permit comparisons of potential costs and benefits of alternative resource uses. A technique will be developed to extend the analysis to the years 2000 and 2020 consistent with the time projections of the Columbia-North Pacific Region Comprehensive Framework Study.

It is at this stage of the analysis that one purpose of the methodology study will be realized. This purpose is to make an economic evaluation of the Salmon River in its present state. The evaluation will be made consistent with the present levels of resource use indicated by the subprojects. This evaluation at the current level of resource use will then be compared with simulated levels of development on the river, and within the river basin area. At this stage of the analysis it will be possible to include in the study certain general considerations such as population, and economic growth, and the potential demand for recreation, electricity, timber, minerals and other resources in the area in the future.

Two general evaluations of the river resource base can then be made. First, the current and projected levels of economic activity based on the status quo, (1969). Second, a determination of the benefits foregone, (if this turns out to be the case) as a result of maintaining the river in its natural free-flowing state. Efforts will be made throughout the study to identify and quantify the aesthetic and personal enhancement values which the Wild and Scenic Rivers Act indicated an expressed national desire to protect and conserve.

INTRODUCTION

The Salmon River is approximately 410 miles long and enters the Snake River 49 miles above Lewiston. The uppermost headwaters of this stream are over 900 stream miles from the Pacific Ocean. The Salmon River drainage provides spawning grounds for more spring and summer chinook than any other drainage in the Columbia River system.

The Salmon River system contains chinook salmon, *Oncorhynchus tshawytscha* (Walbaum); sockeye salmon, *Oncorhynchus nerka* (Walbaum); and steelhead trout, *Salmo gairdneri* (Richardson). These salmon and steelhead stocks provide sport fishing in the ocean, lower Columbia River, and Idaho in addition to the annual commercial harvest.

A total of 1,923 stream miles containing 13, 164 acres of water are utilized by anadromous fish in the Salmon River drainage (Table 1) (Unpublished data, Idaho Fish and Game Department).

CHINOOK SALMON

Two "stocks" or "races" of chinook salmon enter the Salmon River drainage. The two "races" of chinook salmon are separated on the basis of their date of entry into the Columbia River and to some extent on their spawning times.

Spring chinook salmon enter the Columbia River in late March, April, and May and spawn in August and early September. They are harvested by the Columbia River commercial fishery during May. This stock of chinook salmon spawn in many streams throughout the Salmon River drainage (Fig. 1). Idaho produces approximately 34 precent of the upriver spring chinook salmon that enter the Columbia River.

Table 1. Anadromous fish stream utilization for spawning, rearing, and/or migration.

Stream	Total stream miles utilized	Percentage of total used	Total stream acres utilized	Percentage of total used
Main Salmon River and tributaries (excluding those listed below)	1,003	52.2	9,997	75.9
East Fork and tributaries	99	5.1	126	1.0
Lemhi River and tributaries	98	5.1	174	1.3
North Fork and tributaries	46	2.4	81	0.6
Middle Fork and tributaries	494	25.7	1,952	14.8
South Fork and tributaries	183	9.5	834	6.3
Total anadromous fish utilization-Salmon River drainage	1,923	100.0	13,164	100.0
Total utilization by chinook	1,783		13,029	
Total utilization by steelhead	1,923		13,164	
Total utilization by sockeye	398		9,223	

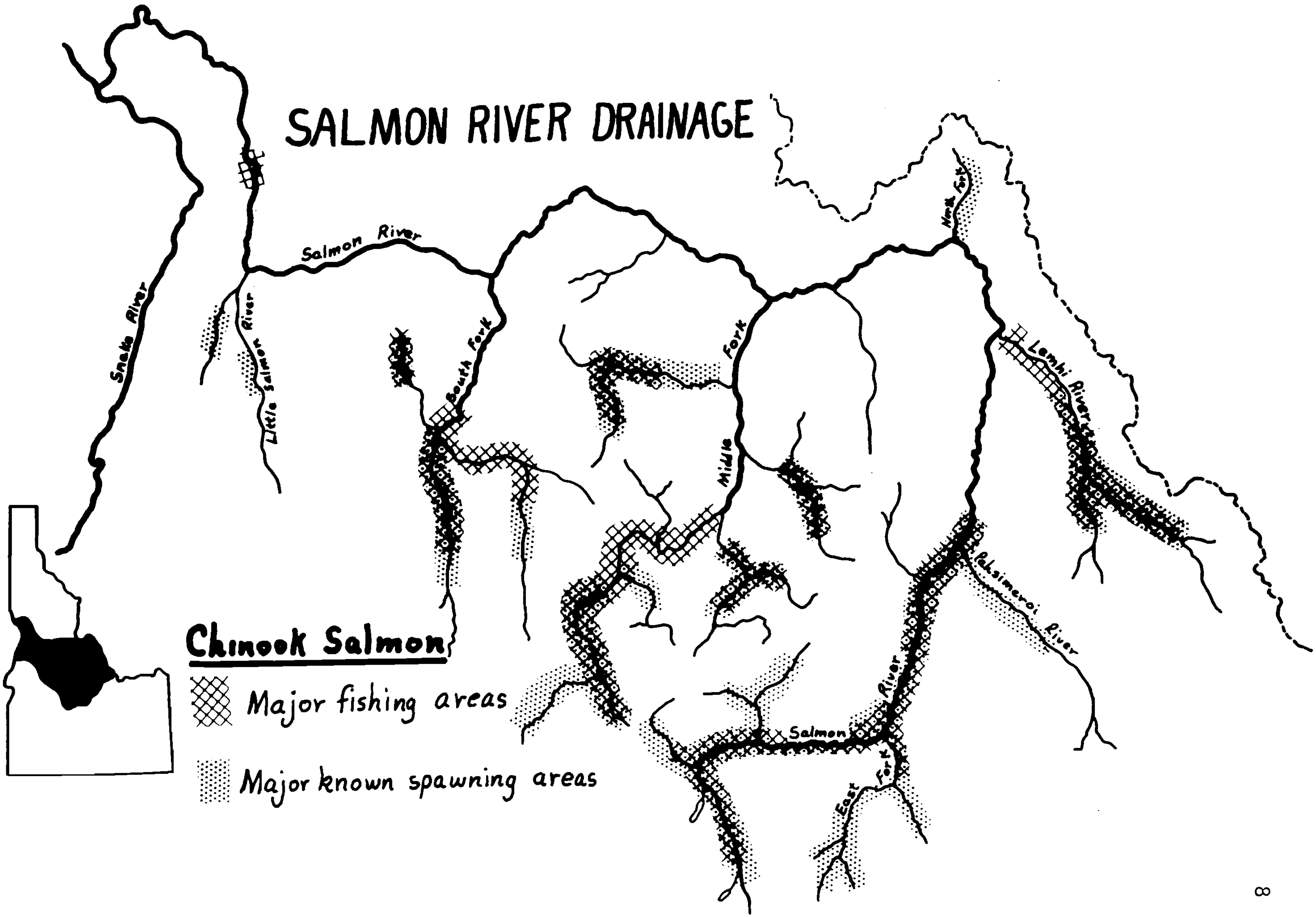

Figure 1. Major sport fishing and spawning areas for spring and summer chinook salmon in the Salmon River drainage.

Summer chinook salmon enter the mouth of the Columbia River in June and July and spawn in September. Few summer chinook have been harvested by the Columbia River Commercial fishery in recent years. Summer chinook salmon are found throughout the Salmon River drainage with the South Fork being the main producer. Idaho produces about 41 percent of the summer chinook salmon that enter the Columbia River.

Most mature spring and summer chinook salmon return from the ocean in their fourth or fifth year of life (Fig. 2). Chinook returning in their third year of life are small (usually under 24" in length) and contribute little to the reproductive process, although they could if the number of large males was abnormally low. Four-year fish are usually 27 to 30 inches in length and average 8 to 10 pounds and five-year fish 34 to 37 inches and 15 to 18 pounds.

Approximately 98 percent of the chinook harvest in Idaho is annually taken from the Salmon River drainage during June, July and August. The main stem of the Salmon River annually produces about 52.4 percent of the state chinook salmon harvest; the Middle Fork Salmon River and its tributaries, 26.7 percent; Lemhi River, 7.1 percent; East Fork Salmon River, 5.7 percent; Little Salmon River, 4.1 percent; and other Salmon River tributaries, 2 percent (Fig. 1 and Table 2). The percentage of the catch taken in a stream is not a completely accurate indicator of the distribution of salmon in various portions of the Salmon River drainage. Differential access to salmon fishing streams (example-the relatively inaccessible Middle Fork and the readily accessible main stem) greatly influence harvest.

Salmon nests or "redds" are counted on major salmon spawning streams in Idaho each year to indicate the relative abundance of this species in these streams and to obtain year-to-year information on the condition of these

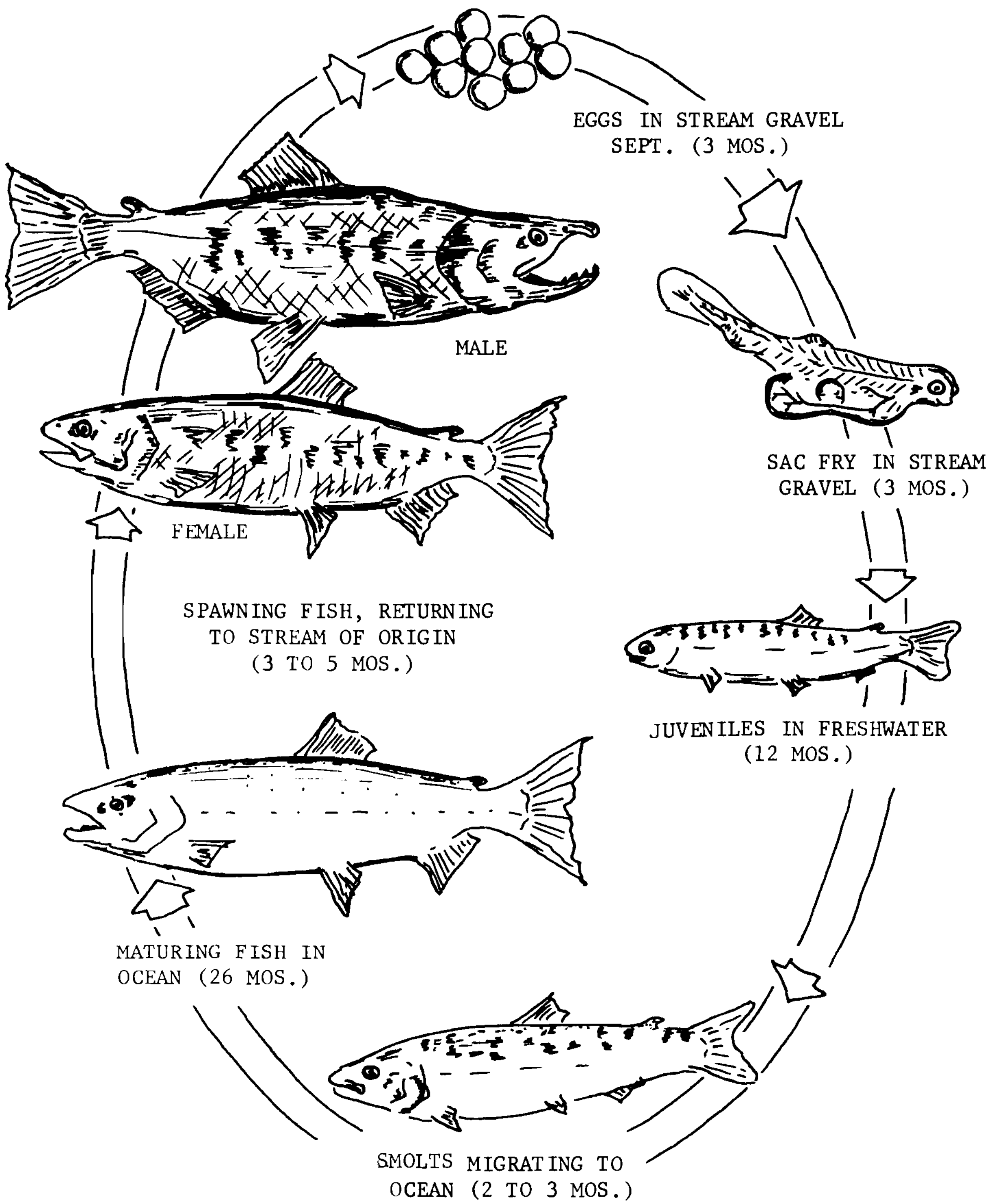

Figure 2. Life cycle of Salmon River chinook salmon.

Table 2. Idaho chinook harvest by stream with breakdown of Salmon River drainage, 1967-1969.

Stream	1969 No.	1969 %	1968 No.	1968 %	1967 No.	1967 %	1967-1969 No.	1967-1969 %
Salmon River	6,651	53.9	5,809	53.7	3,819	52.2	16,279	52.4
Valley Creek	38	0.3	0	--	0	--	38	0.1
East Fork	651	5.3	657	6.1	475	6.5	1,783	5.7
Pahsimeroi	94	0.8	0	--	0	--	94	0.3
Lemhi River	764	6.2	657	6.1	790	10.8	2,211	7.1
North Fork	38	0.3	60	0.6	38	0.5	136	0.4
Middle Fork	1,906)		2,883)		1,879)			
Marsh Creek	226)		0)		0)			
Bear Valley Cr.	104)		0)		0)			
Loon Creek	377)	(27.5	0)	(26.9	0)	(27.3	8,299	26.7
Camas Creek	557)		0)		0)			
Big Creek	226)		26)		115)			
	3,396		2,909		1,994			
South Fork	9	--	341	3.2	8	--	358	1.2
Little Salmon	690	5.6	383	3.5	192	2.6	1,265	4.1
Salmon River Drainage Total	12,331	97.0	10,816	98.3	7,316	99.1	30,463	98.0
Snake River and Clearwater River Total	377		188		65			
Idaho Total	12,708		11,004		7,381			

runs. These redd counts are probably the best index to the distribution of chinook salmon in Idaho. However, utilization of these figures have their limitation since tributaries with smaller runs are not counted; much of the counting is by airplane which provides minimum figures (since all redds cannot generally be seen); aerial visibility on various streams varies due to topography; varying harvests occur prior to spawning; and because large numbers of chinook salmon are returning to Rapid River Hatchery to be spawned and thus are not accounted for in the annual redd counts. An average of 31.9 percent of the chinook salmon redds counted annually are in the Middle Fork Salmon River and its tributaries; 24.4 percent in the main stem of the Salmon River and its upper tributaries; 19.2 percent in the South Fork Salmon River drainage; 11.0 percent in the Lemhi River; 10.6 percent in the East Fork Salmon River; and 2.9 percent in the remainder of the counted streams (Fig. 1 and Table 3).

STEELHEAD TROUT

Idaho waters produce approximately 55 percent of the Columbia River summer steelhead trout and this species is found throughout the Salmon River drainage.

Many of the steelhead trout destined for the Salmon River migrate into the river during the fall while the remainder lie over the winter in the Snake and Columbia Rivers and then enter the spawning areas in the spring. A portion of the fish that migrate to the Salmon River in the fall are taken there in the fall fishery. As the water temperatures warm in the spring and the remainder of the fish move upstream, some are taken in the spring fisheries.

Table 3. Chinook redd counts in important Salmon River tributaries, 1962-1969.

Stream	1962	1963	1964	1965	1966	1967	1968	1969	Average	Percent of Total
Salmon River										
Upper (Sunny Gulch sheep bridge upstream)	638	638	706	472	699	943	637	313	631	9.3
Lower (Salmon to sheep bridge)	467	195	415	201	390	365	223	120	297	4.4
Alturas Lake Cr.	138	86	80	101	119	74	110	41	94	1.4
Upper Valley Cr.	157	141	199	204	219	253	330	35	192	2.8
Lower Valley Cr.	115	50	71	57	184	79	63	22	80	1.2
Upper Yankee Fork	60	128	146	77	112	250	234	53	132	2.0
Lower Yankee Fork	68	92	54	63	132	65	97	44	77	1.1
West Fork Yankee Fork	127	142	78	93	210	283	284	17	154	2.3
Upper East Fork	334	646	405	138	511	614	622	174	430	6.3
Lower East Fork	244	265	306	131	216	234	235	138	221	3.3
Herd Creek	58	202	49	31	79	32	57	43	69	1.0
Pahsimeroi River	320	75	99	16	113	99	--**	--**	120	1.8
Lemhi River	1455	364	1151	454	819	804	589	360	750	11.0
North Fork	84	71	86	5	70	66	145	82	76	1.1
Middle Fork	61	49	213	39	91	30	31	15	66	1.0
Marsh Cr. Drainage	341	372	709	414	406	650	466	235	448	6.6
Bear Valley Cr.	484	460	576	301	534	445	574	356	466	6.9
Elk Cr.	426	654	425	203	525	420	483	349	436	6.4
Sulphur Cr.	169	332	97	43	142	134	142	138	150	2.2
Loon Cr.	N.C.*	261	361	166	49	96	135	110	168	2.5
Camas Cr.	124	252	279	51	212	256	251	94	190	2.8
Upper Big Cr.	231	181	51	75	127	67	90	65	111	1.6
Lower Big Cr.	360	220	121	83	51	94	33	72	129	1.9
South Fork	1589	1057	1124	656	980	854	515	636	926	13.6
Johnson Cr.	295	266	310	116	110	286	127	273	223	3.3
Secesh R.-Lake Cr.	292	163	181	134	140	140	58	104	152	2.2
TOTALS	8637	7362	8292	4314	7240	7633	6531	3889	6788	100.0

* N.C. -- not comparable

** Count discontined

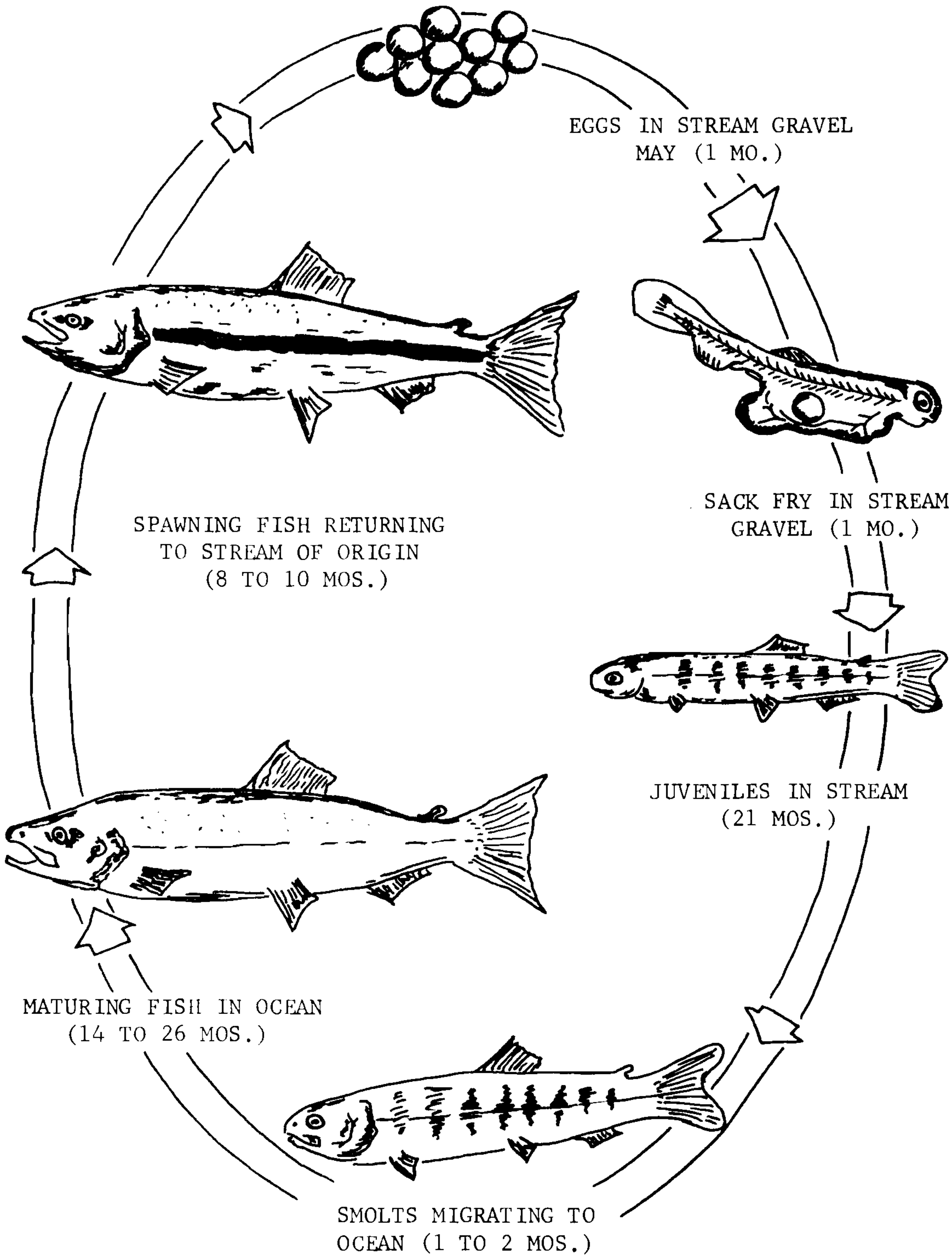

Figure 3. Life cycle of Salmon River steelhead trout.

The spawning season is from late March through early June. The young steelhead trout emerge from the gravel in late summer and remain in fresh water one to three years before migrating to the ocean (Fig. 3).

Four year adults normally are 25 to 27 inches in length and average 6 pounds, while five year fish are 32 to 34 inches and average 12 to 14 pounds.

About 50 percent of the steelhead trout harvested in Idaho are taken from the Salmon River drainage. The harvest of steelhead in the Salmon River drainage is taken mostly in easily accessible areas while the Middle Fork Salmon River, with a large steelhead trout run, is lightly fished due to its inaccessibility (Fig. 4).

The main stem of the Salmon River annually produces 45.6 percent of the statewide steelhead trout harvest; the Middle Fork Salmon River, 2.2 percent; the South Fork Salmon River, 1.2 percent; and the remainder of the Salmon River drainage, 0.8 percent (Fig. 4 and Table 4).

An average of 21,000 steelhead trout have been harvested in Idaho annually. (Table 5)

Steelhead trout utilizing the Middle Fork Salmon River and South Fork Salmon River drainage appear to be "Group B" steelhead which are larger and enter the Columbia and Snake rivers later than "Group A" fish. The remainder of the Salmon River drainage appear to be composed mostly of "Group A" steelhead.

SOCKEYE SALMON

A small sockeye salmon run returns to Redifsh Lake (897 miles from the Pacific Ocean) each year. This run was considerably larger during the

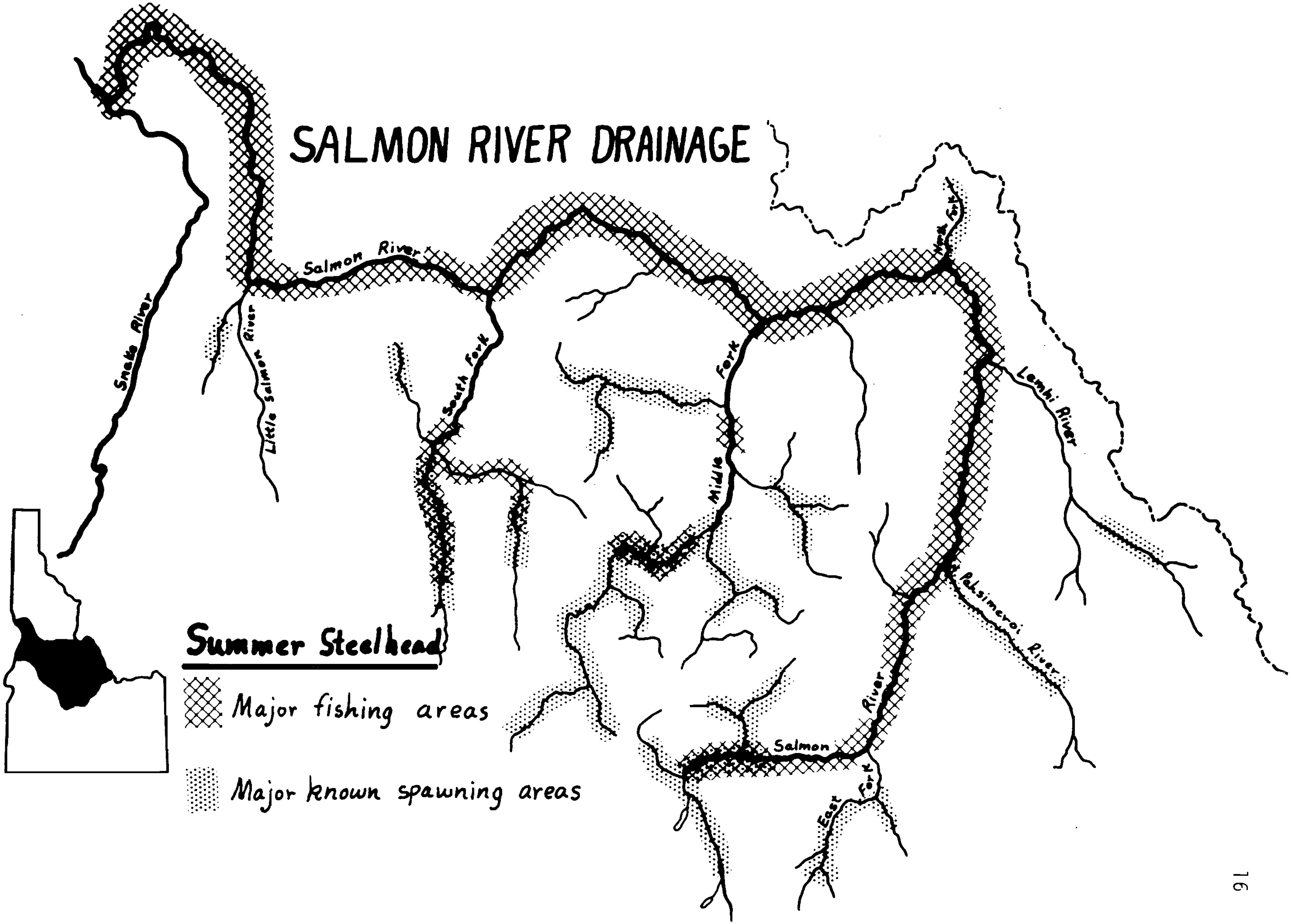

Figure 4. Major sport fishing and spawning areas for summer steelhead in the Salmon River drainage.

Table 4. Idaho steelhead trout harvest by stream with breakdown of Salmon River drainage, 1967-1969.

	1969		1968		1967		1967-1969	
	No.	%	No.	%	No.	%	No.	%
Salmon River	8,914	52.4	10,295	42.1	10,650	44.3	29,859	45.6
East Fork	0	--	0	--	36	0.1	45	--
Pahsimeroi	0	--	0	--	0	--	9	--
Lemhi	0	--	8	--	88	0.4	96	0.1
North Fork	62	0.4	94	0.4	125	0.5	281	0.4
Middle Fork	249)		561)		480)			
Marsh Creek	18)		0)		0)			
Bear Valley Cr.	9)	(1.9	0)	(2.5	0)	(2.0	1,421	2.2
Loon Creek	9)		0)		0)			
Camas Creek	0)		0)		0)			
Big Creek	36)		47)		12)			
	321		608		492			
South Fork	44	0.3	229	0.9	495	2.1	768	1.2
Little Salmon R.	36	0.2	47	0.2	30	0.1	113	0.2
Salmon River Drainage Total	9,395	55.2	11,281	46.1	11,916	49.5	32,592	49.8
Clearwater River Total	5,061	29.8	9,174	37.5	8,564	35.6	22,799	34.8
Snake River Total	2,544	15.0	3,995	16.3	3,572	14.8	10,111	15.4
Idaho Total	17,000		24,450		24,052		65,502	

Table 5. Idaho salmon and steelhead harvest estimates, 1954-1969.*

Year	Chinook salmon catch estimate	Year	Steelhead trout catch estimate
1954	15,000	1954	12,000
1955	19,000	1955	13,000
1956	21,000	1956	8,000
1957	39,000	1957	20,000
1958	24,000	1958	30,000
1959	20,000	1959	31,000
1960	21,000	1960	30,000
1961	13,000	1961	25,000
1962	12,000	1962	19,000
1963	12,000	1963	26,000
1964	8,000	1964	18,000
1965	-Season Closed-	1965	20,000
1966	8,500**	1966	20,000
1967	7,500**	1967	24,500
1968	11,500**	1968	24,500
1969	13,000**	1969	17,000
Average	16,300	Average	21,125

Data since 1963 based on random sampling of permits; 1954-1963 are adjusted estimates from questionnaires.

* From Keating (1970)

** Chinook harvested during these years are considered to be primarily spring chinook.

1800's but was eliminated by the construction of Sunbeam Dam in 1913. A portion of the dam was removed in 1934 and the present small run was re-established.

Hauck (1955) suggests that the sockeye salmon run was probably reestablished from: (1) sockeye salmon continuing to spawn in the river below Sunbeam Dam during the years they were blocked and returning to the lake after removal of the dam and/or (2) seaward drift of kokanee or little redfish from Redfish Lake and their return from the ocean as adults.

The majority of the Redfish Lake sockeye salmon spend two years in the sea after one or two in fresh water as juveniles (Fig. 5). The adults enter the Columbia River during June and July and reach Redfish Lake from July to September (Bjornn, Craddock & Corley, 1968). Sockeye returning to Redfish Lake are generally 19 to 25 inches in length and weigh 3 to 4 pounds.

A sockeye is seldom caught in Idaho and this run contributes between 0.5 and 1.0 percent of the Columbia River run. The Columbia River commercial fishery reaps most of the economic benefits from this run.

ECONOMIC VALUE OF SALMON RIVER ANADROMOUS FISH POPULATIONS

We estimated the annual net economic value of anadromous fish produced in the Salmon River drainage at approximately three million dollars. This estimate was obtained by combining Gordon's (1970) estimate for the Salmon River sport fishery and a prorata share of Richards' (1968) estimate for the Columbia River sport and commercial fishery and that portion of the Pacific Ocean harvest that was attributable to the Columbia River.

The conceptual problems involved in estimating the value of sport and commercial fisheries resources are varied and complex. Combination and comparison of economic estimates for sport and commercial fisheries in this report was done with some recognition of the limitations inherent in the estimates.

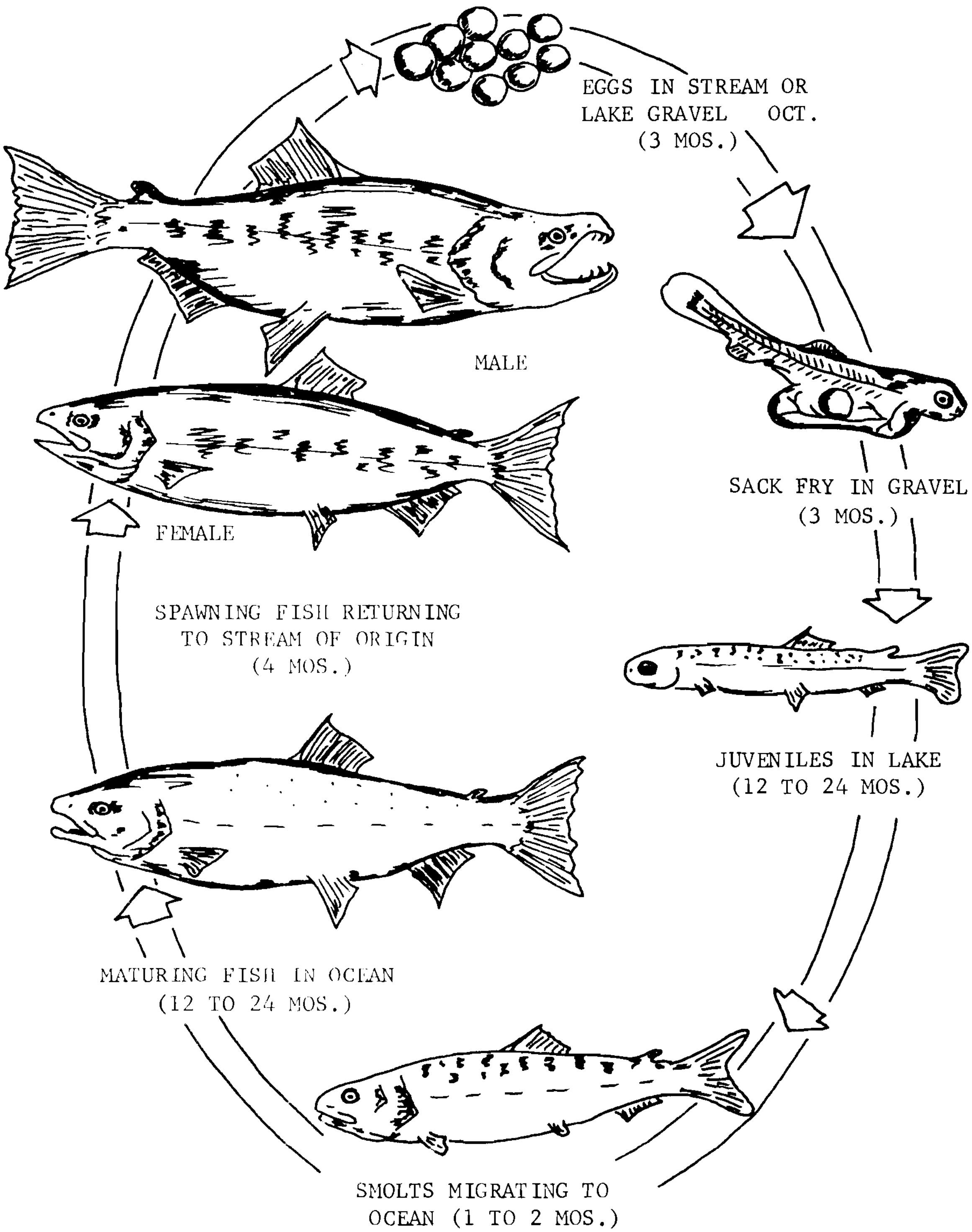

Figure 5. Life cycle of Redfish Lake sockeye salmon.

The gross value of a commercial harvest is usually determined as the exvessel price received by fishermen. This is the total revenue received by the fishermen for their labor, management, and capital. The gross value of a sport fisheries is normally calculated by estimating the expenditures of anglers for durable equipment and for transfer costs associated with fishing. Durable equipment includes such items as boats, rods, and reels. Transfer costs include expenses such as transportation, food, lodging, etc., incurred while traveling to, using, and returning home from a sport fishery.

The concept of "regulated inefficiency" was used by Richards (1968) to estimate net economic values for Columbia River commercial fisheries. If legal, social, or institutional restraints did not prevent the use of the most efficient harvesting techniques Richards contends the commercial anadromous fish harvest could probably be achieved with about 10% of the resources (gear, people, etc.) used to harvest the fish under present restricted methods. He therefore proposes that the net economic value of a fishery is 90% of the existing gross values determined by physical supply and consumer demand.

Richards (1968) evaluated the sport and commercial fisheries of the Columbia River and that portion of the Pacific Ocean harvest that was attributable to the Columbia River in 1965, a year when the spring chinook run was 6.2 percent below average; summer chinook 37.5 percent below average; and summer steelhead 9.9 percent below average (Table 6). No summer commercial season was held for the first time during 1965. Richards value of the commercial fishery that year was therefore smaller than during a prior average year since limited numbers of summer chinook and about one-half the normal steelhead were taken in the commercial fishery for 1965.

Table 6. Run size of anadromous fish into Columbia River, 1950-1969.

Year	Upriver Spring Chinook	Summer Chinook	Summer Steelhead
1950	119,653	69,350	179,000
1951	205,860	116,397	244,000
1952	245,844	114,452	383,000
1953	229,403	94,973	361,000
1954	188,717	114,751	289,000
1955	281,004	147,683	299,000
1956	216,910	195,202	201,000
1957	252,990	206,995	230,000
1958	198,543	187,497	211,000
1959	137,511	169,737	232,000
1960	133,909	142,606	200,000
1961	161,448	129,164	229,000
1962	199,769	109,306	253,000
1963	147,299	98,841	229,000
1964	168,639	91,137	160,000
1965	175,507	75,974	206,000
1966	175,106	71,997	179,000
1967	151,009	100,797	166,000
1968	133,515	89,463	148,500
1969	220,643	106,162	171,000
Average run size	187,164	121,624	228,525
Estimated Percentage of runs produced in Idaho	34%	41%	55%

Richards estimated that the commercial catch (including the Indian fishery) had a net value of $8,005,000. The estimated net value of the Columbia River sport catch was $5,805,098. The total net value of the Columbia River fisheries when maximized separately was $13,810,098. Idaho contributes 15.1 percent of the anadromous fish entering the Columbia River (Table 7) and a proration of the net value of the Columbia River anadromous fisheries indicate that Idaho fish provide $2,085,000 of that net value.

During 1965, smaller than average runs, overfishing by commercial fishermen and larger than normal interdam losses occurred so that no chinook sport fishery was allowed in Idaho. Consequently Richards did not include Salmon River sport fishery economic values.

Estimates of the net value of sport fisheries, in the absence of traditional market prices, are estimated on the basis of a simulated market (Clawson 1959). Making use of a derived demand curve, "net economic value" is assumed to be the maximum revenue obtainable by a non-discriminating monopolist (one who owns the resource and charges only one price) for permitting anglers to fish.

Gordon (1970) conducted an economic evaluation of the Salmon River chinook salmon and steelhead trout sport fisheries during 1968. Gordon found the chinook sport fishery in the Salmon River drainage had a net value of $217,000 and the steelhead fishery $649,000. The spring chinook run in 1968 was 28.7 percent below average, the summer chinook 26.4 percent below average, and the summer steelhead 35 percent below average. No summer chinook fishery was allowed.

By adding Richards' 1965 estimates and Gordon's 1968 figures, we can arrive at a rough estimation of the total net value of the Salmon River fishery of $2,951,000 (Table 8). Since both Richards' and Gordon's studies were undertaken in years of below average runs, these estimates should be considered minimum values.

The net value of a fishery can be capitalized to indicate the number of dollars that would have to be invested annually to generate a similar net value. The interest rate used to capitalize this net economic value was the standard national project rate used in 1970, 4 3/4 percent. The formula used to determine the capitalized value was:

$$V = \frac{R}{r}$$

where V = capitalized value,
R = total net value,
r = water project interest rate.

The capitalized value attributable to Idaho fish using the above formula was $62, 126,000 (Table 8). This value includes the contribution of anadromous fish from the Salmon River to the Idaho, Oregon and Washington sport fisheries and the commercial fisheries of the Columbia River.

We have estimated net and capitalized values for the anadromous fish stocks of the Salmon River drainage in Idaho. How do these estimated values relate to the "real world" and decisions that have been made regarding the Salmon River? Do the values we have computed approximate the value placed on the Salmon River anadromous fish resource by the public?

Sewell and Marts (1961) state that a decision to build two dams (High Mountain Sheep-Lower Canyon) versus one dam (Nez Perce) to obtain essentially the same benefits but save the Salmon River anadromous fish runs was an expression of the value placed on those fish runs by the public. Sewell and Marts list $148 million as the extra or fish preservation cost of the two-dam plan versus the single dam plan.

Table 7. Average numbers of fish entering the Columbia River and production from Idaho waters, 1962-1967.

Species	Estimated Number of fish in run	Idaho contribution to fish Runs	
		Percentage	Number
Spring chinook	237,000	34	80,600
Summer chinook	90,500	41	37,100
Fall chinook	378,000	5	18,900
Chinook total	706,300	19.3	136,600
Summer steelhead	216,900	55	119,300
Winter steelhead	200,000	0	0
Sockeye	99,800	1	1,000
Coho	479,000	0.5	2,400
Chum	12,000	0	0
Total	1,714,000	15.1	259,300

Table 8. Estimated net and capitalized values for the Salmon River anadromous fish populations.

Fishery	Net* Value	Capitalized** Value
Ocean and Columbia River commercial and sport harvest (1965)	$2,085,000	$43,895,000
Salmon River salmon sport harvest (1968)	217,000	4,568,000
Salmon River steelhead sport harvest (1968)	649,000	13,663,000
Total annual value of Salmon River anadromous fish resource	$2,951,000	$62,126,000

* Net Value - maximum revenue obtainable by a non-discriminating monopolist from anglers for the privilege of fishing.

** Capitalized value - the number of dollars that would have to be invested every year by a business to generate a similar net value.

At the time (circa 1960) the Nez Perce-High Mountain Sheep decision was made, we believe preservation of the anadromous fish runs was the major issue. If preservation of the anadromous fish runs was the sole reason for incurring the extra cost of the two-dam plan, then all the extra cost would be an expression of the value of the fishery. If factors other than saving the fish runs were important in the decision to adopt the two-dam plan, then only a portion of the extra cost would be an expression of the value of the fishery. We agree with Sewell and Marts that all or nearly all of the extra cost of the two-dam plan might be viewed as an expression of the value placed on the Salmon River fish runs by the public. As Sewell and Marts point out, however, we should also add the Salmon River share of other costs incurred to perpetuate the fish runs (fish passage facilities, research, management, etc.). Thus the $148 million extra cost is not an expression of maximum value of the Salmon River fish runs.

The $148 million the public was apparently willing to spend for the two-dam plan in order to save the Salmon River anadromous fish runs might be compared with the capitalized value ($62 million) of our estimated net value of Salmon River runs (Table 8). The yield of $148 million invested at 4 3/4% would be $7 million annually, more than double our net economic value estimate.

Our estimates of net and capitalized values should probably be viewed as user (fishermen) oriented values. The difference in cost between the one and two-dam plans might be viewed as a measure of the value of the fish resources to all the public, user and non-user. If the difference in cost between plans for hydroelectric development of the Mid-Snake and Salmon rivers is a valid (but less than maximum) expression of the amount the public is willing to pay to preserve the fish runs, our user oriented net and capitalized values significantly underestimate the total value of the fish resource.

In the current situation, with public concern for preservation of some wild rivers, to forgo hydro-development in the Salmon River for example or select a more expensive alternative plan of development would not reflect public concern for the fish alone. We believe the benefits foregone or extra cost of a more expensive development plan would be an expression of the value the public is currently placing on all the values present including anadromous fish runs and wild rivers.

FUTURE RUN SIZE AND ECONOMIC VALUES

The abundance of Idaho salmon and steelhead stocks has declined in recent years primarily as a result of conditions created by dams constructed in their migration routes or rearing areas. If the problems (nitrogen supersaturation, turbine passage, etc.) currently facing these upriver stocks of fish are solved satisfactorily and additional problems do not develop, the runs could eventually be enlarged by improved natural and artificial propagation.

Development of the hydroelectric or flood control potential of the Salmon River could have detrimental effects on the anadromous fish stocks produced in that system. Construction of a high dam (over 100 feet high with large storage pool) in the lower main stem of the Salmon River would probably cause the loss of most anadromous fishery benefits.

Salmon and steelhead (particularly juveniles) do not migrate through the reservoirs behind high dams in sufficient numbers to maintain runs upstream from the dams. A hatchery located downstream from the dam might be used to maintain a run downstream from the dam but the fishery and associated economic values upstream from the dam would be lost. A part of the loss might be offset if another type of fishery could be developed and was utilized in the reservoir and stream areas upstream from the dams. Presently most of the sport fishery in the Salmon River occurs upstream from the major proposed main stem dam sites.

Dams constructed on tributaries would have a proportionate effect on the anadromous fishery resources dependent upon the relative contribution of the particular tributary to the fish runs.

If the Salmon River and its tributaries were left in their present free-flowing condition, a relatively modest investment in fish rearing facilities could provide a substantial increase in fishery values. The early success of the Rapid River spring chinook hatchery on a tributary of the Little Salmon River provides some measure of increases in run size that may be possible in the future. The returns to Rapid River in 1970 (as a result of release of 1 1/2 million smolts) provided a 22.9 percent increase in the Salmon River spring chinook salmon run (Table 9). During 1970 the hatchery released 3 million smolts; reaching its goal that will be adhered to in the future. If we assume a similar return rate on the fish released in 1970, we might expect them to increase the Salmon River spring chinook salmon run in 1972 by 46 percent. Initial construction cost of the Rapid River Hatchery was $560,000 and annual operation and maintenance costs are approximately $80,000.

A hatchery of similar capacity on the upper Salmon River could produce a similar increase in the Salmon River spring chinook salmon run or a combined total increase of approximately 92 percent. A doubling of run size by hatchery production could more than double economic benefits since a smaller portion of the hatchery returnees are needed to produce the desired

Table 9. Percentage increases in the Salmon River spring chinook runs due to the Rapid River Hatchery program (1967-1970)

Year	Spring chinook count at Ice Harbor Dam	Rapid River count	Clearwater River count	Ice Harbor minus Rapid River and Clearwater River	Oregon and Washington contributions at Ice Harbor (17 1/2%)	Salmon River fish at Ice Harbor (82 1/2%)	Percent increase in Salmon River run due to Rapid River Hatchery	Smolts released to provide run
1967	35,495	1,039	428	34,028	5,959	28,069	3.7	
1968	44,773	4,156	990	39,627	6,935	32,692	12.7	500,000
1969	51,895	3,979	2,529	45,387	7,943	37,444	10.6	500,000
1970	47,931	7,357	1,699	38,875	6,803	32,072	22.9	1,500,000
1971							15.3*	1,000,000
1972							46.0*	3,000,000

*Expected increase provided conditions remain stable.

number of smolts than in a wild population and thus more fish would be available to the fishery.

Experimental hatchery programs undertaken for steelhead and summer chinook in the upper Salmon River may lead to similar increases in abundance for those two species.

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