Development of Methods to Estimate Spawning Escapement of Spring Chinook Salmon in the John Day, Grande Ronde and Imnaha River Basins of Northeast Oregon

1989 Summary Report

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INTRODUCTION

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR), in conjunction with the Oregon Department of Fish and Wildlife (ODFW), and Nez Perce Tribe (NPT), conducted comprehensive spawning ground surveys for spring chinook salmon (Oncorhynchus tshawytscha) in the John Day, Grande Ronde, and Imnaha River basins in 1989. These surveys represent the fourth year of the US/Canada Pacific Salmon Treaty Monitoring Program implemented in 1986 by tribal, state and federal fishery agencies. The Pacific Salmon Treaty directs fishery management entities to conserve and rebuild chinook salmon stocks originating from the Columbia River Basin by appropriate ocean and in-river harvest controls. In order to monitor the success of the Pacific Salmon Treaty, annual spawner escapement of chinook salmon "indicator" stocks must be determined. The spring chinook salmon stocks of the John Day, Grande Ronde, and Imnaha River basins have been identified as potential indicator stocks for monitoring. These drainages were selected because of the unique wild salmon chinook stock in John Day River and wild stock component of spring chinook runs in the Grande Ronde and Imnaha Rivers. In addition, base line data have been established because ODFW has conducted spring chinook salmon spawning ground surveys in these basins since 1960.

The comprehensive and multiple index surveys completed in 1989 were developed to collect information which could provide an estimate of spawner escapement and be comparable to historic redd survey data. In addition to spawning ground surveys, a new method was implemented to estimate spawning escapement. In 1989, snorkel

and foot surveys were conducted in the Middle Fork John Day River to enumerate spring chinook salmon holding prior to spawning.

The Middle Fork of John Day River was selected as the study site because 1) the holding and spawning area is only 30 miles long (the entire 30 miles could be sampled within one week) 2) the 30 mile section has good access by road and 3) the 30 mile section is generally narrow and shallow. Snorkeling and foot surveys were chosen as the method because 1) there are no weirs on the John Day River to count fish 2) snorkeling is a low-impact method and 3) other studies have shown snorkeling to be both time and cost effective with good success for estimating fish population size (Northcote and Wilkie (1963); Zubik and Frayley (1988)).

The Objectives in 1989 were to:

1. Determine the number and location of spring chinook salmon holding in the Middle Fork of the John Day River prior to spawning.
2. Determine total number of spring chinook salmon redds in the John Day, Grande Ronde, and Imnaha Rivers.
3. Determine the relationship of redds in index areas with total numbers of redds in John Day, Grande Ronde, and Imnaha Rivers.
4. Determine the relationship of numbers of fish with numbers of redds (fish/redd) in the Middle Fork John Day River.
5. Describe the age composition of the spawning population in the John Day, Grande Ronde, and Imnaha Rivers.
6. Coordinate activities with state, federal and tribal agencies.

Study Area and Fish Resource

The John Day, Grande Ronde, and Imnaha Rivers are major tributaries of the Columbia and Snake River systems. The John Day River enters the Columbia River at rivermile 218 (RM 218), two miles above John Day Dam. The John Day River basin (Figure 1) encompasses approximately 8,010 square miles in northeast Oregon and is the third largest river basin in the state. The John Day River presently supports the largest run of wild spring chinook salmon in the Columbia River drainage. Based on previous spawning ground surveys, spring chinook salmon utilize over 150 river miles of spawning area in the North Fork, Middle Fork, and Mainstem John Day River and tributaries. Spawning begins at the end of August and is completed by the end of September (Lindsay et al. 1986). The peak spawning period usually occurs in the second and third weeks of September. The CTUIR and ODFW have established a "wild management" policy for the spring chinook salmon stock of the John Day River basin thereby eliminating future hatchery or stock supplementation.

The Grande Ronde River (Figure 2), located in Northeast Oregon and Southeast Washington, drains approximately 4,070 square miles. The Grande Ronde River enters the Snake River at river mile 169, 62 miles above Lower Granite Dam. Based on previous spawning ground data the Grande Ronde basin contains approximately 125 river miles of utilized spring chinook salmon spawning area. Spring chinook salmon spawn from mid-August to late September, peaking near the first and second weeks of September. Presently, wild and hatchery runs of spring chinook salmon exist in the Grande Ronde

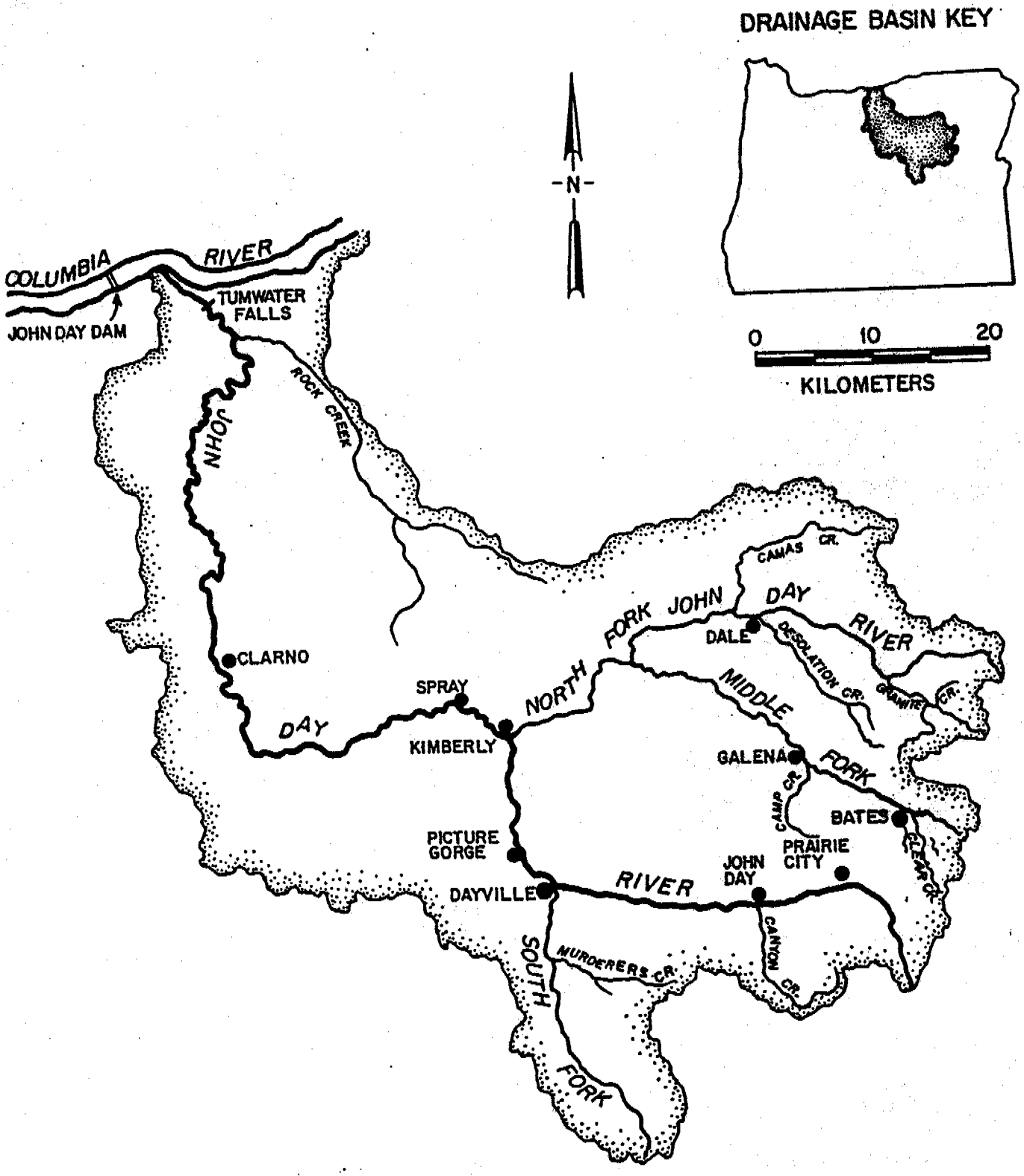

Figure 1. Map of John Day basin (Lindsay et al. 1986).

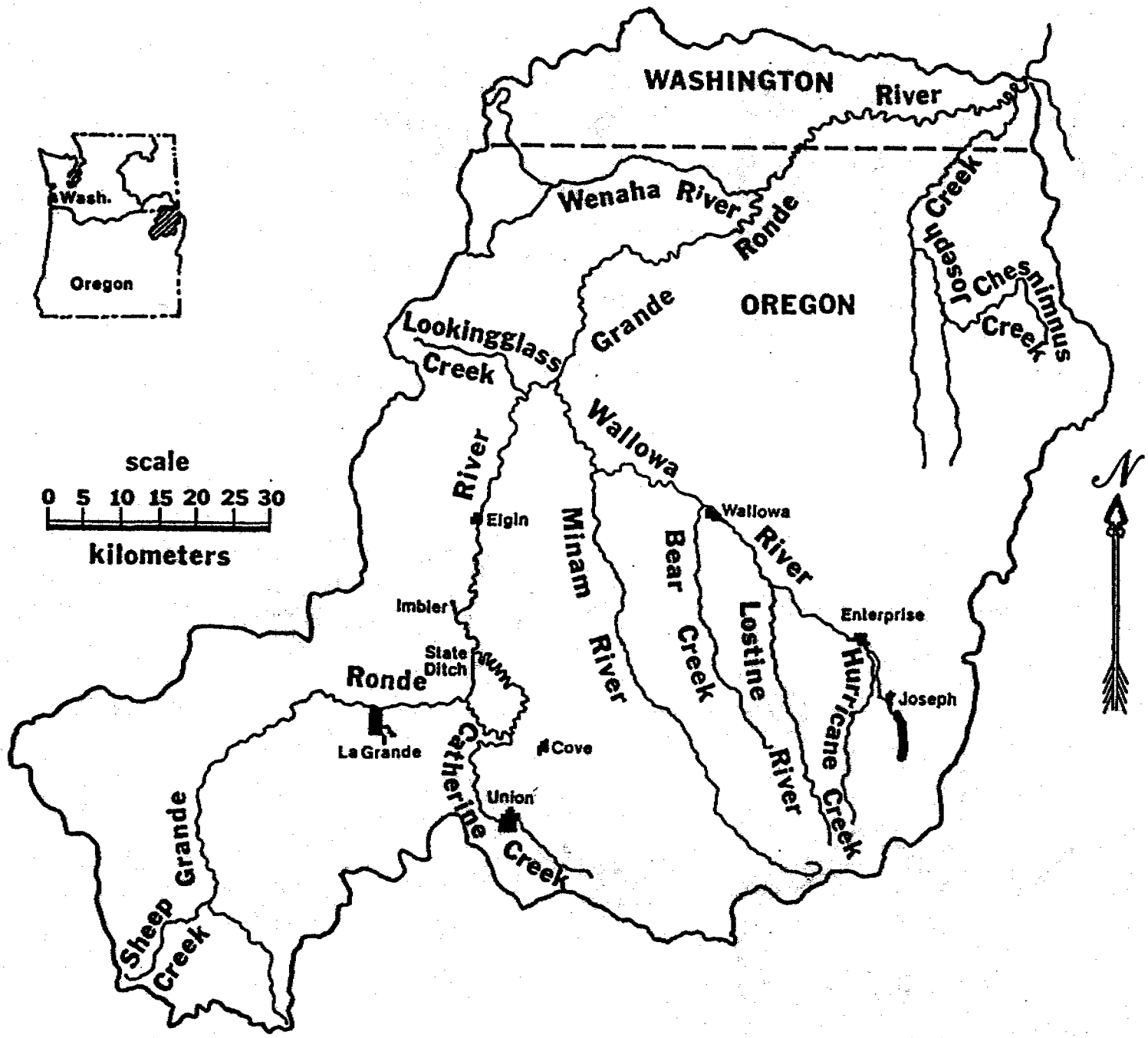

Figure 2. Grande Ronde River Subbasin (Bryson 1988).

Basin. Hatchery outplants of juvenile spring chinook salmon have occurred since 1980 and have recently increased as part of the Lower Snake River Compensation Program (LSRCP) (Appendix A). Excess adult spring chinook returning to Lookingglass Hatchery were also outplanted in the Grande Ronde River and tributaries in 1987, 1988 and 1989 (Appendix B).

The Imnaha River (Figure 3), enters the Snake River at rivermile 192 and drains approximately 950 square miles in Northeast Oregon. The Imnaha River supports wild runs of spring/summer chinook salmon. Since 1982, the Imnaha spring/summer chinook salmon run has been a source of broodstock for LSRCP hatchery program (Appendix C) and has received low-level hatchery supplementation (Appendix D). Based on 1986 to 1988 spawning ground information, spring/summer chinook salmon utilize approximately 50 river miles of spawning area in the Imnaha River basin. Spawning occurs from early August to mid-September, peaking near the end of August.

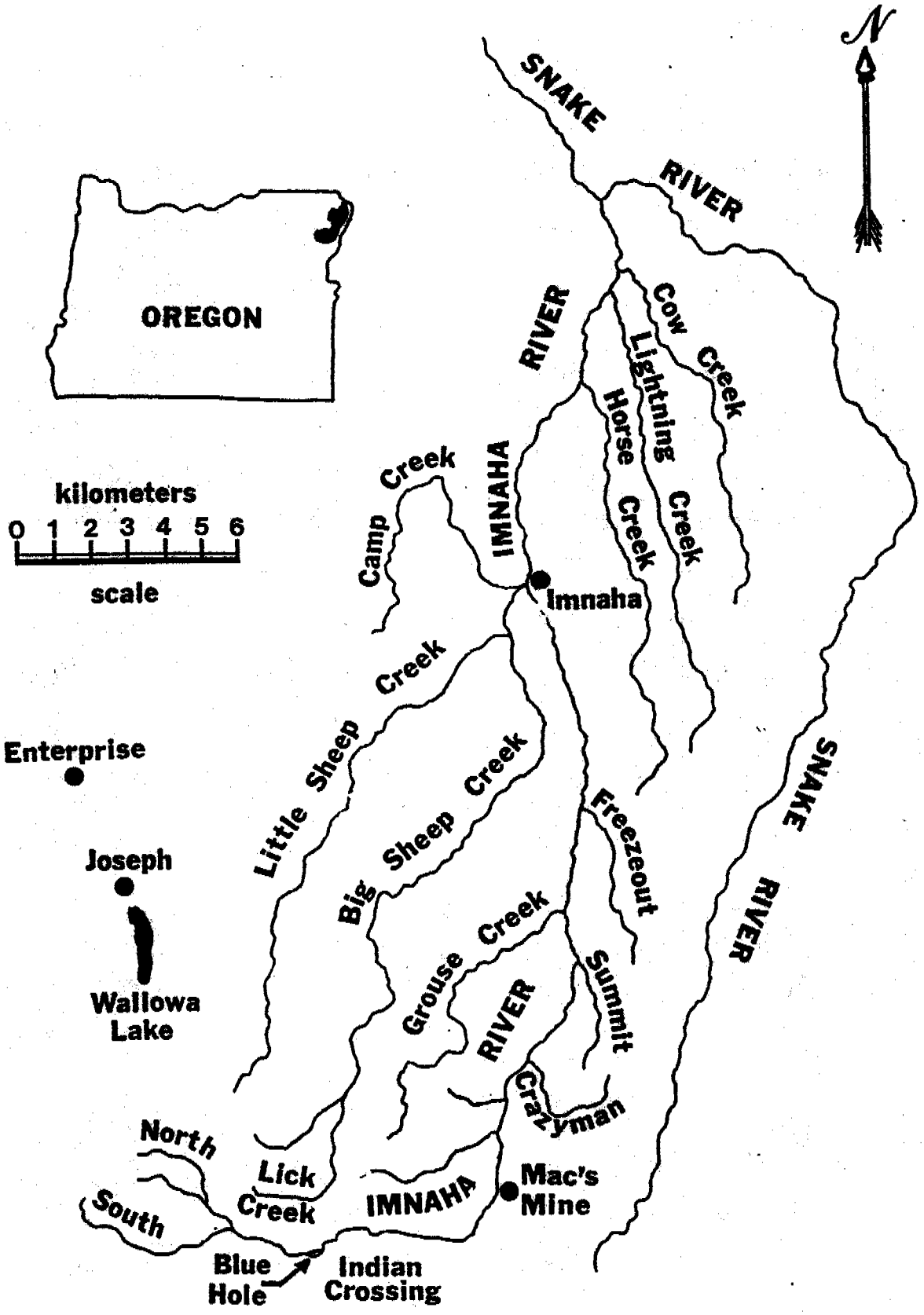

Figure 3. Imnaha River Subbasin.

METHODS

Holding Area Surveys

Adult and jack spring chinook salmon were enumerated by snorkel and foot surveys in the Middle Fork of John Day River. The objective was to estimate abundance and document location of spring chinook salmon holding in the Middle Fork prior to spawning. All suspected holding areas were surveyed. The area from Armstrong Creek (RM 42) to Phipps Meadow (RM 71.5) was subdivided into approximately 3 mile sub-sections (Figure 4). The entire 29.5 mile section was surveyed within a 4 day period in early and mid August. An additional 9 miles were systematically surveyed (3 miles surveyed + 6 miles skipped) x 3) in a 27 mile section from Ritter Bridge to Armstrong Creek to examine the possibility that fish were distributed lower in the River than expected.

The survey crew for the snorkel and foot surveys consisted of two, two-person teams. Each sub-section was surveyed by a two person team (one person snorkeled and one person surveyed from shore). The snorkeler and foot surveyor made independent counts then communicated with each other to obtain the combined estimate within a surveyed section. Originally the survey was performed from downstream to upstream but was changed to the upstream to downstream method. A block net was installed after each day to prevent fish from entering or leaving the non-surveyed section. The survey was initiated at RM 42 on day 1 and finished at RM 71.5 on day 4.

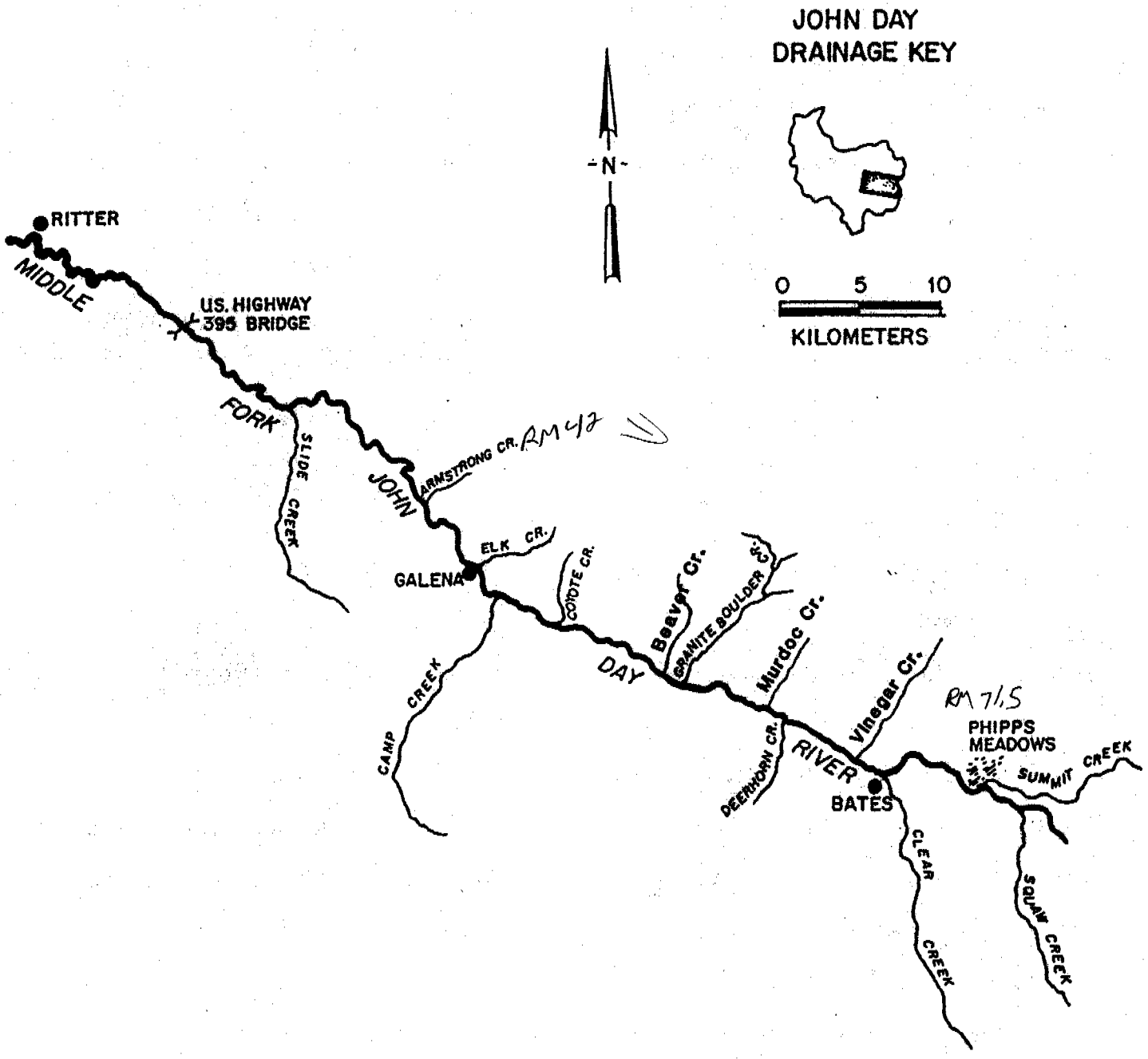

Figure 4. Map of the Middle Fork John Day River
(modified from Lindsay et al. 1986).

Multiple surveys were conducted at three sites to determine variability among surveyors and test the precision of the snorkeling technique. A spring chinook salmon holding area was block netted both upstream and downstream. The block-netted section was surveyed by the 2 teams in early and mid August. The same 3 sites were tested during both time periods. Comparisons between survey teams were tested by Chi-Square Analysis.

Accuracy of the snorkel foot technique was also tested. Within the same block netted section and after the above variability tests were conducted, the area was seined to enumerate fish. The lower block net was left in place while the upper block net was removed. Seining was conducted by "crowding" fish using either a one-quarter inch or two inch square mesh seine moving from downstream to upstream. Adults and jacks were counted by observers on each bank as the fish passed over a count strip near the upstream end of the section. After the variability tests, snorkel and foot surveys were conducted to check if delayed mortalities occurred.

Holding area habitat was described at areas where fish were sighted during snorkel and foot surveys. Habitat surveys were also conducted by ODFW to describe the general habitat features within the Middle Fork on private lands (ODFW 1989). Water temperature was monitored automatically by Ryan Tempmentors at three locations (Camp Creek, Murdoc Creek, and Vinegar Creek).

Spawning Ground Surveys

Spawning ground surveys to enumerate redds and spawners in index areas in the John Day, Grande Ronde, and Imnaha River basins were scheduled immediately after the "peak" spawning period in order to count the maximum number of redds at any one time. Historical redd survey information for each basin was reviewed to predict peak spawning periods for each stream. Index areas surveyed in each basin have been established by the ODFW and have remained relatively consistent since 1960.

In the John Day, Grande Ronde and Imnaha basins, "multiple" surveys were conducted to assess the timing of spawning activity in 1989 and determine total number of redds deposited. Designated areas were surveyed before, during and after the predicted peak period. In order to differentiate new and old redds in the multiple index surveys, each redd observed was flagged and numbered.

Extended spawning ground surveys were conducted outside of index areas in all three basins covering all known spawning areas. Extended surveys were conducted to estimate total spawning escapement and to determine the relationship of number of redds in index areas with total number of redds. The extended surveys were scheduled near the peak spawning period.

Surveys were conducted and data collected as described in Heindl (1987). The streams surveyed were divided into easily distinguishable segments. Index and extended sections were surveyed by one or two individuals depending on personnel available or extent of stream braiding. Redds were enumerated and noted as

being occupied (live fish on or near redd) or unoccupied. Live fish were counted in each survey section and identified as either jack or adult. Carcasses were sampled and enumerated in each survey section. Scale samples were collected from carcasses and placed in an envelope which noted the fork length, mid-eye to hypural length, sex, spawning condition of females (percent eggs retained in the carcass), date, location, and name of sampler. In the Grande Ronde and Imnaha River basins, snouts were removed from coded-wire tagged fish (hatchery fish with missing adipose fin). Also in the Grande Ronde River basin, disc tagged fish were identified (outplanted fish - see Appendix B).

Fish Per Redd Relationship

Adult holding and spawning ground counts in the Middle Fork John Day River were compared to determine if a fish per redd relationship for the entire John Day River could be developed. A fish per redd relationship for the Grande Ronde and Imnaha basins will be developed after weirs on the Imnaha River and Lookingglass Creek are completed by ODFW.

RESULTS

Holding Area Surveys

We observed a maximum of 141 adult spring chinook holding in the Middle Fork of John Day River during snorkel and foot surveys (Table 1). Jack salmon (<24") were not recognized during the holding area surveys. Foot surveyors usually observed the greatest number of fish but snorkelers observed fish not seen by the foot surveyor. Shallow water (<2ft.) prevented the snorkeler from swimming approximately 80% of the area surveyed. In these shallow water areas both people would conduct foot surveys with at least one person in the water walking. In deeper areas snorkelers would observe fish holding in under-cut banks, near woody debris or deep areas not visible to the foot surveyor. Many times the snorkeler displaced fish that the foot surveyor would not normally observe. Also when fish were displaced by the snorkeler, the fish would sometimes swim by the snorkeler and only be observed by the foot surveyor. Hence, the combined count is sometimes greater than the individual counts by foot and snorkel surveyors.

The original method of surveying from downstream to upstream was more time consuming than planned. In order to complete the planned 29.5 miles per week, the survey method was reversed (upstream to downstream). The only comparison of the two survey methods is the section from Armstrong Creek (RM 41.8) to RM 43.6, a total of 1.8 miles surveyed on 7/31 and 8/14 (Table 1). Three adults were observed 7/31 using downstream to upstream methodology while two adults were observed using upstream to downstream methodology on 8/14.

Table 1. Number of adult spring chinook salmon observed holding in the Middle Fork John Day River prior to spawning, 1989.

Stream Reach	Miles	No. Observed 7/31-8/3 Snorkel	Foot	Combined	No. Observed 8/14-17 Snorkel	Foot	Combined
Ritter Br.(RM 15) to Armstrong Cr.(RM 41.8) a/	9.0	NA	0	0	NA	NA	NA
Armstrong Cr.(RM 41.8) to RM 43.6	1.8	1	3	3	2	2	2
RM 43.6 to Deep Cr.(RM 45.3)	1.7	3	3	3 b/	1	1	1
Deep Cr.(RM 45.3) to RM 46.7	1.4	0	0	0	2	2	3
RM 46.7 to Camp Cr.(RM 48.0)	1.3	0	0	0	0	0	0
Camp Cr.(RM 48.0) to RM 49.7	1.7	0	1	1	0	0	0
RM 49.7 to Coyote Cr. (RM 51.3)	1.6	12	10	12	15	13	21
Coyote Cr. (RM 51.3) to RM 52.4	1.1	2	1	2	1	1	1
RM 52.4 to Big Boulder Cr. (RM 53.5)	1.1	1	1	1	0	1	1
Big Boulder Cr.(RM 53.5) to (RM 54.8)	1.3	0	0	0	1	0	1
RM 54.8 to Beaver Cr. (RM 56.0)	1.2	3	0	3	7	5	7
Beaver Cr.(RM 56.0) to Butte Cr.(RM 57.5)	1.5	6	7	10	9	9	11
Butte Cr. (RM 57.5) to Windlass Cr.(RM 59.0)	1.5	3	3	3	3	6	7
Windlass Cr.(RM 59.0) to Mid.Fk. CG.(RM 60.4)	1.4	0	0	0	0	0	0
Mid.Fk. CG.(RM 60.4) to Deerhorn Cr.(RM 61.8)	1.4	3	4	4	2	2	3
Deerhorn Cr.(RM 61.8) to RM 63.6	1.8	2	4	5	5	4	5
RM 63.6 to Vinegar Cr.(RM 65.3)	1.7	18	47	50	24	48	50
Vinegar Cr.(RM 65.3) to Hwy 7 Br.(RM 68.0)	2.7	11	12	14	14	14	16
Hwy 7 Br.(RM 68.0) to Phipps Mdw (RM 71.3)	3.3	4	11	13	0	12	12
TOTAL	38.5	69	107	124	86	120	141

a/ 9 miles of the 27 mile section was systematically sampled (33%), 8/7/89.
b/ Foot surveyor found 1 dead adult that is not included in the count.

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Precision of the snorkeling method was better during the second sampling period (Table 2). On August 9 (period #1) there was a significant difference (x^2, $P < 0.05$) between teams at Station 2. On August 16 (period #2) there was no significant difference (x^2, $P > 0.05$) between teams at any station.

Seining was an ineffective method of enumerating adults. Sampling station #1 was seined on two different occasions. On the 9th of August, 3 adults were observed by snorkeling prior to seining, while the 1/4" mesh seine captured none. On August 16, a minimum of 6 adults were observed by snorkeling prior to seining, while the 2" seine captured only 1 adult. The under cut banks and rocky shoreline are believed to be the cause of the seines ineffectiveness. No delayed mortalities were observed after conducting the variability tests.

Spring chinook adults were not distributed evenly throughout the holding area (Kolmogorov - Smirnov goodness of fit test, $P < 0.001$). Approximately 60% of the fish were observed in the upper 9.5 mile section. No adults were observed below the anticipated 29.5 miles of holding area.

The typical habitat where fish were observed holding included some type of cover (under cut banks, streambank vegetation, bridges, depth, boulders) and water depth of 1 to 6 feet, average 2.5 feet (Appendix E). Physical habitat of the area also varied but was generally in need of restoration (ODFW 1989). Over-grazing of riparian habitat, sediment load and temperature was less than optimum. Temperatures reached 23 C in August at the Murdoc Creek Station RM 61 (Appendix F). No temperature data was

Table 2. Variability of adult spring chinook salmon counts between survey teams at three sampling stations in the Middle Fork John Day River during two periods.

PERIOD 1: AUGUST 9, 1989

Sampling Station	TEAM #1			TEAM #2		
	Snorkel	Foot	Combined	Snorkel	Foot	Combined
1	3	3	3	1	3	3
* 2	18	19	19	8	36	38
3	15	9	15	8	11	11
POOLED	36	31	37	17	50	52

Ho: Each team will observe the same number of fish ($X^2 = (|f1-f2|-1)^2/n$).
Ho was not rejected at the 5% significance level for sampling stations 1 and 3.
* Ho was rejected at the 5% significance level for sampling station 2.
Ho was not rejected at the 5% significance level when all stations were pooled.

PERIOD 2: AUGUST 16, 1989

Sampling Station	TEAM #1			TEAM #2		
	Snorkel	Foot	Combined	Snorkel	Foot	Combined
1	4	6	6	6	8	9
2	25	17	25	19	24	24
3	8	8	8	7	8	8
POOLED	37	31	39	32	40	41

Ho: Each team will observe the same number of fish ($X^2 = (|f1-f2|-1)^2/n$).
Ho was not rejected at the 5% significance level for all tests.

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available at the Camp Creek and Vinegar Creek Stations because of problems associated with deploying the Ryan Tempmentors.

Spawning Ground Surveys

During the peak index and extended count, 358.2 miles were surveyed in the John Day (176.5 mi.), Grande Ronde (133.1 mi) and Imnaha (48.6 mi.) River basins (Tables 3, 4 and 5). Of the total miles surveyed, CTUIR surveyed approximately 25% of the miles covered in the Grande Ronde and Imnaha River basins and near 70% in the John Day River basin. CTUIR and NPT primarily surveyed the extended areas while ODFW surveyed the index areas.

The highest number of observed redds was in the John Day River basin with 842 redds, 96 live and 327 dead adults (Table 3). In the Grande Ronde River basin 164 redds, 88 live and 48 dead adults were observed (Table 4). In the Imnaha River basin 74 redds, 44 live and 15 dead adults were observed (Table 5).

After forest fires in the upper mainstem of the Grande Ronde River Basin, a flash flood on 8th of August caused high ash and sediment loading in the stream resulting in a severe fish kill down to near La Grande(ODFW La Grande District). No live spring chinook salmon adults or redds were observed during a survey on August 16th. High turbidity prevented subsequent surveys.

In all 3 basins over 50% of the redds observed were found in the index area during 1989 (Table 6). In the Grande Ronde River basin, the index area comprised 52% of the total miles surveyed and produced 74% of the total redds observed. In the Imnaha River basin, the index area (35% of total miles surveyed) produced 53% of the total redds observed. In the John Day River basin, the

Table 3. Spring chinook salmon spawning ground surveys in the John Day River Basin, 1989.

Stream Reach	Date	Miles	REDDS			FISH				Scale samples
			Occupied	Unoccupied	Total	Live	Dead	Jacks	Total	
MAINSTEM:	9/12									
Carter's Br. to Pine Cr.	to	2.0	0	0	0	0	1	0	1	
Pine Cr. to Hall Hill	9/13	4.0	1	1	2	1	0	0	1	
Hall Hill to Prairie City Br.		3.0	5	9	14	10	0	0	10	
Prairie City Br. to Dad's Cr.		2.0	1	6	7	1	1	0	2	
Dad's Cr. to Harvey Fields 1/			6	18	24	10	3	1	14	
Harvey Fields to French Lane 1/			6	49	55	7	20	0	27	
French Lane to Deardorff Cr. 1/		13.0	2	19	21	2	1	0	3	
Deardorff Cr. to Big Culvert 1/		---	6	59	65	6	5	0	11	
Big Culvert to Trout Farm		2.5	2	11	13	2	2	0	4	
Total count		26.5	29	172	201	39	33	1	73	6
Index count		13.0	20	145	165	25	29	1	55	
Canyon Cr.: J-L Resort to Wickiup C.G.		8.0	0	2	2	0	0	0	0	
MIDDLE FORK:	9/22									
Armstrong Cr. to Deep Cr.		3.0	2	1	3	2	0	0	2	
Deep Cr. to Camp Cr.		3.0	0	2	2	0	0	0	0	
Camp Cr. Coyote Cr.		3.0	0	9	9	0	5	0	5	
Coyote Cr. to Beaver Cr.		5.0	2	11	13	0	3	1	4	
Beaver Cr. to Butte Cr. 1/		1.5	0	12	12	0	4	0	4	
Butte Cr. to Windlass Cr. 1/		1.5	0	16	16	0	1	0	1	
Windlass Cr. to Deerhorn Cr. 1/		3.0	0	6	6	6	3	0	9	
Deerhorn Cr. to Vincent Cr. 1/		3.0	6	36	42	6	21	0	27	
Vincent Cr. to Vinegar Cr. 1/		1.0	0	14	14	0	5	0	5	
Vinegar Cr. to Hwy. 7 Br. 1/ 2/		2.0	0	23	23	1	11	0	12	
Hwy. 7 Br. to Phipps Mdw. F.S. bd.		4.0	0	23	23	1	19	1	21	
Total count		30.0	10	153	163	16	72	2	90	32
Index count		12.0	6	107	113	13	45	0	58	
LOWER NORTH FORK:										
RM 54 to Camas Cr.	9/18	3.0	1	2	3	3	0	0	3	
Camas Cr. to Desolation Cr.	to	3.0	0	2	2	0	1	0	1	
Desolation Cr. to Nye Cr.	9/21	7.0	3	19	22	4	6	0	10	
Nye Cr. to 1 mi. below Sulfur Cr. 1/		3.0	3	28	31	4	15	4	23	
1 mi. below Sulfur Cr. to Oriental Cr. 1/		3.0	2	23	25	2	11	0	13	
Oriental Cr. to Big Cr. 1/		4.0	0	43	43	0	15	0	15	
Big Cr. to Cougar Cr.		2.5	0	7	7	0	0	0	0	
Cougar Cr. to 1 mi. below Paradise 1/		2.5	0	23	23	2	4	0	6	
1 mi. below Paradise to Wind Rock 1/		2.5	0	46	46	0	4	0	4	
Wind Rock to Granite Cr. 1/		3.0	1	27	28	1	0	0	1	
Total count		33.5	10	220	230	16	56	4	76	14
Index count (lower)		10.0	5	94	99	6	41	4	51	
Index count (canyon)		8.0	1	96	97	3	8	0	11	
Desolation Cr.:										
Howard Cr. to Park Cr. 3/	8/15	7.0	0	0	0	4	0	0	4	
Mouth to Guard Station	9/21	23.0	0	0	0	0	0	0	0	

Table 3 (continued).

Stream Reach	Date	Miles	REDDS			FISH				Scale samples
			Occupied	Unoccupied	Total	Live	Dead	Jacks	Total	
Camas Cr.: 3/	9/22									
Ukiah to 4 Corners Cmgd.		19.0	0	1	1	0	2	0	2	
UPPER NORTH FORK:	9/19									
Granite Cr. to Bear G.		3.5	0	19	19	0	1	0	1	
Bear G. to McCarty G.		2.5	0	19	19	0	1	0	1	
McCarty G. to Thornberg		2.5	0	7	7	0	6	0	6	
Thornberg to Trout Cr.		2.5	0	5	5	0	0	0	0	
Trout Cr. to Northfk. Cmgd.		3.0	0	4	4	0	2	0	2	
Northfk. Cmgd. to Baldy Cr.		5.0	0	3	3	0	0	0	0	
Total		19.0	0	57	57	0	10	0	10	1
Granite Cr. System:	9/14									
Clear Cr.: Mouth to Bridge 1/		4.0	1	66	67	1	37	0	38	
Bridge to Alamo		1.0	0	5	5	0	1	0	1	
Bull Run Cr.: Boundary Cr. to Mouth 1/		2.5	3	12	15	3	7	0	10	
Granite Cr.:										
Trail Br. to Lick Cr.		2.5	3	20	23	3	8	0	11	
Lick Cr. to Buck Cr.		2.0	1	8	9	1	24	0	25	
Buck Cr. to Squaw Cr. 1/		1.0	2	30	32	11	23	4	38	
Squaw Cr. to Ten Cent Cr. 1/		1.5	1	11	12	1	29	1	31	
Ten Cent Cr. to Bull Run 1/		2.5	1	22	23	1	25	1	27	
Bull Run to Culvert 1/		0.5	0	2	2	0	0	0	0	
Total count		17.5	12	176	188	21	154	6	181	38
Index count		12.0	8	143	151	17	121	6	144	
JOHN DAY BASIN INDEX TOTAL		55.0	40	585	625	64	244	11	319	
JOHN DAY BASIN GRAND TOTAL		176.5	61	781	842	96	327	13	436	91

1/ Index Area. Data collected by ODFW.
All jack salmon (<24") were alive when sighted.
2/ Two mile section added to the Middle Fork index area in 1986 to present.
3/ Jackie Dougan, USFS, written comm., 12/13/89.

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Table 4. Spring chinook salmon spawning ground surveys in the Grande Ronde River Basin, 1989. 1/

Stream Reach	Date	Miles	REDDS			FISH			Scale samples
			Occupied	Unoccupied	Total	Live	Dead	Total	
Grande Ronde River:									
3 Penny Claim to Rd. 5125 Br.(a)	8/16	8.5	0	0	0	0	7	7	2
Rd. 5125 Br. to Starkey Br.	8/16	13.7	0	0	0	0	0	0	0
Total		22.2	0	0	0	0	7	7 (b)	2
Sheep Creek:									
Forks to Rd. 5182 culvert	8/25	3.0	0	1	1	0	0	0	0
Rd. 5182 culvert to mouth (a)	8/25	6.0	0	0	0	1	0	1	0
Total		9.0	0	1	1	1	0	1	0
Catherine Cr. Drainage:									
North Fork Catherine Creek:									
Middle Fork to Mouth (a)	8/29	3.0	0	6	6	0	1	1	0
South Fork Catherine Creek:									
Road Barrier to start of Index area	8/29	0.7	0	0	0	0	0	0	0
Index Area (a)	8/29	2.0	1	0	1	4	0	4	0
Catherine Creek:									
Forks to Badger Flat Rd. (a)	8/29	7.5	11	20	31	17	4	21	3
Badger Flat Rd. to 2nd Union City Bridge	8/29	7.0	2	2	4	3	2	5	2
Total Catherine Cr. Drainage		20.2	14	28	42	24	7	31	5
Lookingglass Creek:									
Summer Creek to Little Lookingglass Cr. (a)	9/08	6.2	0	18	18	2	5	7	4
L. Lookingglass Cr. to Mouth	9/11	3.8	6	17	23	7	5	12	5
Total		10.0	6	35	41	9	10	19	9
Wenaha River Drainage:									
North Fork Wenaha River:									
Lower 5.5 miles	9/06	5.5	0	0	0	0	0	0	0
South Fork Wenaha River:									
1 mi. upstream of Milk Creek	9/06	0.1	0	0	0	0	0	0	0
Milk Creek to Forks (a)	9/05	6.0	4	5	9	5	3	8	2
Wenaha River:									
Forks to mouth	9/06	15.5	6	3	9	9+1J	1	11	1
Wenaha River Tributaries:									
Beaver Creek									
Milk Creek	9/05	0.1	0	0	0	0	0	0	0
Rock Creek									
Butte Creek	9/06	1.5	0	0	0	0	0	0	0
Total - Wenaha River Drainage		28.7	10	8	18	14+1J	4	19	3

Table 4 (continued).

Stream Reach	Date	Miles	REDDS			FISH			Scale samples
			Occupied	Unoccupied	Total	Live	Dead	Total	
Wallowa River:									
McClarren Lane Br. to Hatchery intake (a)	8/21	4.5	0	0	0	0	0	0	0
Wallowa River Tributaries:									
Bear Cr.:									
Guard Station to Bridge (a)	8/21	6.5	1	1	2	1	1	2	1
Hurricane Cr.:									
Gravel Pit to Mouth (a)	8/21	3.0	1	1	2	5	0	5	0
Lostine River:									
Bowman Cr. to Williamson Cmpgd.	8/23	3.5	0	4	4	0	1	1	1
Log Jam to Six Mile Bridge	8/23	2.0	0	1	1	0	0	0	0
6 Mile Br. to OC Ranch Br. (a)	8/23	3.0	7	13	20	16	14	30	12
OC Ranch Br. to West Side Ditch	8/23	1.6	0	0	0	0	0	0	0
Lostine to McClean's	8/23	2.7	0	0	0	0	0	0	0
McClean's to Mouth	8/23	2.7	0	0	0	0	0	0	0
Total		15.5	7	18	25	16	15	31	13
Minam River:									
Upper Minam (a)	8/30	6.0	0	10	10	0	3	3	3
Lower Minam (a)	8/31	7.5	6	17	23	18	7	25	6
Total		13.5	6	27	33	18	10	28	9
GRANDE RONDE BASIN INDEX TOTAL		69.7	31	91	122	69	45	114	33
GRANDE RONDE BASIN GRAND TOTAL		133.1	45	119	164	74	54	143	42

1/ Table modified from Carmichael et al. In Preparation. ODFW.
(a) Index area.
(b) Grande Ronde River surveys conducted after flash flooding on 8 August 1989. High turbidity prevented subsequent surveys.

02/15/90 FN: GRON89

Table 5. Spring/summer chinook salmon spawning ground surveys in the Imnaha River basin, 1989. 1/

Stream Reach	Date	Miles	REDDS			FISH				Scale samples
			Occupied	Unoccupied	Total	Live	Dead	Jacks	Total	
Lick Cr. (a)	8/22	4.0	0	0	0	0	0	0	0	0
Big Sheep Cr.										
Bridge to Echo Canyon (a)	8/22	4.0	1	0	1	1	0	0	1	0
Echo Canyon down 5 miles	8/22	5.0	0	1	1	0	1	0	1	1
Total		9.0	1	1	2	1	1	0	2	1
South Fork Imnaha River										
Forks to Bear Cr.	8/28	2.4	0	3	3	0	0	0	0	0
Imnaha River										
Forks to Gorge	8/28	1.0	1	0	1	1	0	0	1	0
Blue Hole to Indian Xing (a)	8/28	2.0	6	10	16	7	2	0	9	2
Indian Xing to Macs Mine (a)	8/28	7.7	8	16	24	13	7	1	21	6
Macs Mine to Weir	8/28	4.0	1	2	3	2	1	0	3	1
Weir to Crazyman Cr.	8/28	4.0	9	3	12	11	4	2	17	4
Crazyman Cr. to Grouse Cr.	8/28	8.5	4	9	13	9	0	2	11	0
Grouse Cr. to Freezeout Cr.	8/28	6.0	0	0	0	0	0	0	0	0
Total		33.2	29	40	69	43	14	5	62	13
IMNAHA BASIN INDEX TOTAL		17.7	15	26	41	21	9	1	31	8
IMNAHA BASIN GRAND TOTAL		48.6	30	44	74	44	15	5	64	14

1/ Table modified from Carmichael et al. In Preparation. ODFW.
All jack salmon (<24") were alive when sighted.
(a) Index areas.

02/15/90 FN: IMNAHA89

Table 6. Comparison of index and extended area spring chinook salmon spawning ground surveys in some NE Oregon streams, 1989. a/

Basin, Stream	Date	Miles Surveyed		Redds		Live Fish		Dead Fish		% of redds in index area
		Inside Index	Outside Index	Inside Index	Outside Index	Inside Index	Outside Index	Inside Index	Outside Index	
Imnaha River Basin:										
Lick Cr.	8/22	4.0	0	0	--	0	--	0	--	--
Big Sheep Cr.	8/22	4.0	5.0	1	1	1	0	0	1	50
S.F. Imnaha River	8/28	0	2.4	--	3	--	0	--	0	--
Imnaha River	8/28	9.7	25.9	40	32	21	27	9	5	56
Total		17.7	33.3	41	36	22	27	9	6	53
Grande Ronde River Basin:										
Lostine River	8/23	3.0	12.5	20	5	16	0	14	1	80
Wallowa River	8/21	4.5	0	0	--	0	--	0	--	--
Grande Ronde River b/	8/16	8.5	13.7	0	0	0	0	7	0	--
Bear Cr.	8/21	6.5	0	2	--	1	--	1	--	--
Hurricane Cr.	8/21	3.0	0	2	--	5	--	0	--	--
Sheep Cr.	8/25	6.0	3.0	0	1	1	0	0	0	0
N.F. Catherine Cr.	8/29	3.0	0	6	--	0	--	1	--	--
S.F. Catherine Cr.	8/29	2.0	0.7	1	0	4	0	0	0	100
Catherine Cr.	8/29	7.5	7.0	31	4	17	3	4	2	89
Lookinglass Cr.	9/08, 11	6.2	3.8	18	23	2	7	5	5	44
Minam River	8/30-31	13.5	0	33	--	18	--	10	--	--
N.F. Wenaha River	9/06	0	5.5	--	0	--	0	--	0	--
Wenaha River	9/05-06	6.0 c	15.6	9	9	5	10	3	1	50
Wenaha River tribs.	9/05-06	0	1.6	--	0	--	0	--	0	--
Total		69.7	63.4	122	42	69	20	45	9	74
John Day River Basin:										
John Day River	9/12-13	13.0	13.5	165	36	26	15	29	4	82
Canyon Cr.	9/12	0	8.0	--	2	--	0	--	0	--
Middle Fork	9/22	12.0	18.0	113	50	13	5	45	27	69
North Fork	9/18-20	18.0	34.5	196	91	13	7	49	17	68
Granite Cr. d/	9/14	12.0	5.5	151	37	23	4	121	33	80
Desolation Cr.	8/15&9/21	0	23.0	--	0	--	4	--	0	--
Camas Cr.	9/22	0	19.0	--	1	--	0	--	2	--
Total		55.0	121.5	625	217	75	35	244	83	74

a/ Imnaha and Grande Ronde River basin data modified from Carmichael et al. In Preparation. ODFW.
John Day River index area data from ODFW, John Day District.
Desolation and Camas Creek data includes surveys by USFS, North Fork John Day District.

b/ Grande Ronde River surveys conducted after flash flooding on 8 August 1989. High turbidity prevented subsequent surveys.

c/ South Fork Wenaha River.

d/ Includes Granite, Clear, and Bull Run Creeks.

02/15/90 FN:USC89\T5CONP

index area (31% of total miles surveyed) produced 74% of the total redds observed.

Multiple surveys were conducted in some Grande Ronde and Imnaha basin streams (Table 7). The degree of spawning activity varied by sampling date and location. The greatest percent change in redd counts was from the peak index to the second survey period. This was particularly true in Hurricane Creek, a tributary of the Wallowa River where an increase from 2 to 29 redds were observed from index to last survey. Multiple surveys were also conducted in the Middle Fork of the John Day River. Three sections within the Middle Fork were surveyed before, during and after the standard index count period. No new redds were observed after the index count period (Table 8).

Fork length and scale samples were collected from 147 carcasses in the Grande Ronde (42), Imnaha (14) and John Day (91) River basins in 1989 (Tables 3, 4 and 5). Scale analysis was conducted by ODFW to determine ocean and freshwater age. The Gilbert and Rich (1927) nomenclature was used and denotes X years total/X years freshwater age. The length composition of fish sampled exhibited a modal length frequency distribution among age 3/2 jacks and age 4/2 and 5/2 adults (Table 9). The mean fork length of age 3/2, 4/2 and 5/2 fish also varied by sex and stream sampled. Almost all carcasses sampled were either age 4/2 or 5/2 adults, few age 3/2 jacks were sampled (Tables 10 and 11).

Table 7. Comparison of spawning ground counts conducted at the standard index survey time, and twice after the index survey on some Imnaha and Grande Ronde River Basin streams, 1989. Areas surveyed are index areas or within index areas. Percent change represents change from index to third survey. 1/

Basin, Stream, Section	Date	Miles	Redds			Live Fish				Dead Fish	
						On Redds		Off Redds			
			Occupied	Unoccupied	Total	Adults	Jacks	Adults	Jacks	Adults	Jacks
Imnaha river Basin:											
Imnaha River	8/28	7.7	8	16	24	9	1	4	0	7	0
Indian Crossing to	9/05	7.7	2	25	27	3	0	2	0	5	0
Mac's Mine	9/15	7.7	0	27	27	0	0	0	0	2	0
Percent Change					+13						
Grande Ronde River Basin:											
Hurricane Creek	8/21	1.3	1	1	2	1	0	4	0	0	0
Gravel Pit to	8/31	1.3	10	6	16	17	1	15	0	0	0
McCorman Ranch Bridge	9/12	1.3	9	20	29	12	0	1	0	13	0
Percent Change					+1350						
Lostine River	8/23	3.0	7	13	20	14	0	2	0	14	0
Six-mile Bridge to	8/31	3.0	11	30	41	21	0	6	0	2	1
OC Ranch Bridge	9/12	3.0	2	45	47	2	0	0	0	7	0
Percent Change					+135						
Catherine Creek	8/29	2.0	4	4	8	5	0	1	0	1	0
Bridge below forks to	9/07	2.0	2	9	11	2	0	0	0	6	0
Highway Bridge	9/14	2.0	0	12	12	0	0	0	0	2	0
Percent Change					+50						
Minam River											
USFS-ODFW Cabin to											
1 mile above Little	8/31	4.0	5	14	19	13	0	3	0	6	0
Minam River	9/14	4.0	0	24	24	0	0	0	0	1	0
Percent Change					+26						

1/ Table from Carmichael et al. In Preparation. ODFW.
02/15/90 FW:TBL7

Table 8. Comparison of spring chinook salmon spawning ground counts before, during and after the standard index count period on the Middle Fork John Day River, 1989.

Stream Reach	Date	Miles	REDDS			FISH			
			Occupied	Unoccupied	Total	Live	Dead	Jacks	Total
Deep Cr. to Elk Cr.	9/13	1.0	0	2	2	0	1	1	2
(RM 45 to RM 46)	9/22		0	2	2	0	0	0	0
	10/02		0	2	2	0	0	0	0
	Percent change from index count				0%				
Butte Cr. to Windlass Cr.	9/13	1.5	3	13	16	3	3	0	6
(RM 57.5 to RM 59)	9/22		0	16	16	0	0	0	0
	10/02		0	16	16	0	0	0	0
	Percent change from index count				0%				
Vincent Cr. to Vinegar Cr.	9/13	1.0	2	11	13	4	3	0	7
(RM 64.5 to RM 65.5)	9/22		0	14	14	0	5	0	5
	10/02		0	14	14	0	3	0	3
	Percent change from index count				0%				

02/15/90 FN:USC89\JDRT6

Table 9. Mean fork length (mm) for age specific groups of spring chinook salmon sampled on spawning ground surveys in some NE Oregon streams, 1989. Age nomenclature is that of Gilbert and Rich (1927). Standard deviation is shown in parentheses. a/

	Age 3/2				Age 4/2				Age 5/2				Age 6/2 (Male)	
	Males		Females		Males		Females		Males		Females			
Stream	N	Length	N	Length	N	Length	N	Length	N	Length	N	Length	N	Length
Imnaha River b/	0	--	0	--	13	741 (35)	4	772 (85)	5	980 (105)	3	888 (69)	1	1120
Big Sheep Cr.	0	--	0	--	0	--	1	740	0	--	0	--		
Grande Ronde River d/	0	--	0	--	2	753 (39)	0	--	0	--	0	--		
Catherine Cr. c/	0	--	0	--	3	767 (85)	6	720 (37)	0	--	1	760		
Lookingglass Cr. e/	0	--	0	--	0	--	7	724 (66)	0	--	2	795 (85)		
Lostine River c/	1	395	0	--	8	787 (49)	7	759 (31)	2	875 (67)	4	883 (17)		
Wallowa River	0	--	0	--	0	--	0	--	0	--	0	--		
Hurricane Cr. c/	2	605 (21)	0	--	1	770	4	734 (70)	3	953 (67)	3	857 (67)		
Bear Cr.	0	--	0	--	0	--	1	660	0	--	0	--		
Minam River c/	0	--	0	--	3	750 (35)	5	739 (44)	0	--	2	915 (36)		
Wenaha River	1	470	0	--	0	--	0	--	1	940	0	--		
John Day River	0	--	0	--	1	660	4	687 (51)	0	--	1	870		
Middle Fork	0	--	0	--	8	792 (49)	20	733 (46)	0	--	4	795 (111)		
North Fork	0	--	0	--	2	762 (72)	8	716 (61)	2	912 (68)	2	737		
Granite Cr. f/	0	--	0	--	6	725 (26)	25	711 (52)	3	881 (29)	3	877 (38)		

a/ Table and Imnaha and Grande Ronde River Basin data modified from Carmichael et al. In Preparation. ODFW.
John Day River Basin scales aged by Pat Frazer and Curt Melcher, ODFW.
b/ Includes samples from 16 carcasses found washed up on the Imnaha River weir.
c/ Includes outplanted adults from Lookingglass Hatchery observed or recovered on spawning ground surveys.
d/ Samples are from dead fish recovered after 8 August flash flooding.
e/ Includes one AdLV Imnaha stock female recovered on spawning ground survey.
f/ Includes Granite, Clear, and Bull Run Creeks.

FH:8979 02/15/90

Table 10. Percent age class composition of spring chinook salmon carcasses recovered in the John Day River, 1978-89. Age nomenclature is that of Gilbert and Rich (1927). a/

Stream, Year	Sample size	Age 3/2	Age 4/2	Age 5/2
Mainstem:				
1978	3	0.0	100.0	0.0
1979	22	0.0	100.0	0.0
1980	4	0.0	50.0	50.0
1981	8	0.0	62.5	37.5
1982	5	0.0	80.0	20.0
1983	22	0.0	95.5	4.5
1984	43	2.3	88.4	9.3
1985	58	10.3	82.8	6.9
1986	18	22.2	72.2	5.6
1987	29	0.0	89.7	10.3
1988	11	0.0	36.4	63.6
1989	6	0.0	83.3	16.7
Middle Fork:				
1978	56	3.6	94.6	1.8
1979	44	0.0	95.5	4.5
1980	17	5.9	29.4	64.7
1981	14	0.0	78.6	21.4
1982	33	0.0	97.0	3.0
1983	45	2.2	91.1	6.7
1984	56	5.4	87.5	7.1
1985	27	3.7	59.3	37.0
1986	4	25.0	75.0	0.0
1987	93	1.1	86.0	12.9
1988	63	0.0	65.1	34.9
1989	32	0.0	87.5	12.5
North Fork:				
1978	36	0.0	38.9	61.1
1979	32	0.0	84.4	15.6
1980	29	0.0	58.6	41.4
1981	125	4.0	72.0	24.0
1982	77	2.6	88.3	9.1
1983	67	0.0	76.1	23.9
1984	42	4.8	85.7	9.5
1985	87	9.2	77.0	13.8
1986	66	4.6	93.9	1.5
1987	134	0.7	72.4	26.9
1988	87	2.3	56.3	41.4
1989	14	0.0	71.4	28.6

Table 10 (continued).

Stream, Year	Sample size	Age 3/2	Age 4/2	Age 5/2
Granite Creek system: b/				
1978	85	2.4	37.6	60.0
1979	46	2.2	71.7	26.1
1980	36	0.0	66.7	33.3
1981	67	1.5	88.1	10.4
1982	98	4.1	87.8	8.1
1983	42	2.4	64.3	33.3
1984	50	10.0	82.0	8.0
1985	110	4.5	88.2	7.3
1986	86	9.3	89.5	1.2
1987	91	0.0	89.0	11.0
1988	39	0.0	53.8	46.2
1989	37	0.0	83.8	16.2

a/ Table modified from Lindsay et al. 1986.
Data for years 1986-87 from Eric Olsen, pers. comm., 12/28/88, ODFW.
Data for 1988 summarized by Pat Frazer, ODFW.
Scales from 1989 aged by Pat Frazer and Curt Melcher, ODFW.

b/ Includes Granite, Clear and Bull Run Creeks.

02/15/90 FN:USC89\89T10

Table 11. Percent age composition of spring chinook salmon carcasses sampled on spawning ground surveys in the Imnaha and Grande Ronde River Basins, 1986-89. Age nomenclature is that of Gilbert and Rich (1927). 1/

Year, Basin, Stream	N	Age 3/2	Age 4/2	Age 5/2
1986				
Imnaha River Basin				
Big Sheep Creek	6	0	66.7	33.3
Imnaha River	23	8.7	43.5	47.8
Grande Ronde River Basin				
Bear Creek	3	0	100.0	0
Lostine River	17	5.8	47.1	47.1
Grande Ronde River	8	0	87.5	12.5
Catherine Creek	8	0	100.0	0
Minam River	18	0	61.1	38.9
Wenaha River	7	0	42.9	57.1
1987				
Imnaha River Basin				
Imnaha River	26	0	34.6	65.4
Grande Ronde River Basin				
Hurricane River	13	0	76.9	23.1
Lostine River	35	0	60.0	40.0
Grande Ronde River	47	0	97.9	2.1
Catherine Creek	64	1.6	92.2	6.2
Lookingglass Creek a/	2	0	100.0	0
Minam River	6	16.7	33.3	50.0
Wenaha River	43	0	86.0	14.0
1988				
Imnaha River Basin				
Big Sheep Creek	1	0	0	100.0
Imnaha River	128	2.5	17.2	80.3
Grande Ronde River Basin				
Bear Creek	1	0	100.0	0
Hurricane Creek	12	0	41.8	58.3
Lostine River	73	0	21.9	78.1
Wallowa River	10	0	20.0	80.0
Prairie Creek	10	10.0	20.0	70.0
Grande Ronde River	50	6.0	40.0	54.0
Catherine Creek	135	2.2	52.6	45.2
Lookingglass Creek a/	25	0	36.0	64.0
Minam River	33	3.0	36.4	60.6
Wenaha River	54	0	31.5	68.5

Table 11 (continued).

Year, Basin, Stream	N	Age 3/2	Age 4/2	Age 5/2	Age 6/2
1989					
Imnaha River Basin					
Big Sheep Creek	1	0	100	0	
Imnaha River b/	34	11.8	55.9	29.4	2.9
Grande Ronde River Basin					
Bear Creek	1	0	100.0	0	
Hurricane Cr. c/	13	15.4	38.5	46.1	
Lostine River c/	22	4.5	68.2	27.3	
Grande Ronde River d/	2	0	100.0	0	
Catherine Creek c/	10	0	90.0	10.0	
Lookingglass Cr. e/	9	0	77.8	22.2	
Minam River c/	8	0	80.0	20.0	
Wenaha River	2	50.0	0	50.0	

1/ Table from Carmichael et al. In Preparation. ODFW.
a/ Above Lookingglass Hatchery weir.
b/ Includes 16 samples from carcasses found washed up on Imnaha River weir.
c/ Includes outplanted adults from Lookinglass Hatchery.
d/ Samples are from carcasses recovered after 8 August flash flooding.
e/ Includes one AdLV Imnaha stock female (Age 4/2) recovered on survey.

FN:TBL11 02/15/90

Fish Per Redd Relationship

The maximum number of spring chinook salmon and redds observed in the Middle Fork of John Day River was 141 adults and 163 redds. The fish per redd relationship based on holding area and spawning ground surveys is therefore 0.9 fish/redd.

DISCUSSION

Holding Area Surveys

The 141 adult spring chinook salmon observed during the second period of the snorkel-foot surveys is the maximum number observed and is believed to be the best estimate of the number of adults holding prior to spawning in the Middle Fork, John Day River. During the second survey period, there was an insignificant amount of variation between survey teams (high precision). Also in some British Columbia streams, Northcote and Wilkie (1963) found that the maximum count of fish by divers was close to that recovered by poisoning; Slaney and Martin (1987) found that a smaller count on the first replicate was common.

Although there is high precision in the 141 estimate of adult spring chinook salmon, the accuracy is unknown. Seining, the only gear used to test the accuracy of the snorkeling method, proved ineffective for enumerating adult spring chinook salmon. In addition, during the holding area surveys only 29.5 miles were covered rather than the 30.0 miles originally planned. The upper 0.5 mile of Phipps Meadow was not surveyed - a mistake in mileage calculation and communication with ODFW. By not surveying the upper one-half mile of the study area and changing the survey method (upstream to downstream) we may have under estimated the number of fish present. Recommendations for research in 1990 are to continue snorkel/foot surveys with precision tests, survey 30 miles rather than 29.5 miles, evaluate the downstream to upstream vs. the upstream to downstream technique, drop seining as a method for testing accuracy, and add new accuracy tests using a low-

impact method to obtain a total count with statistical error bounds.

Spawning Ground Surveys

During the past 10 years, redd counts and spawning densities in index areas have varied by basin, individual stream and year surveyed (Table 12). From 1979 to 1985, index area spawning densities in John Day River Basin were less than 10 redds/mile but since 1986 over 10 redds/mile have been counted (Figure 5). Since 1979 the Grande Ronde and Imnaha River basin index area spawning densities have been less than 10 redds/mile, decreasing dramatically in 1989. The Imnaha River basin spawning escapement has also been reduced by annual broodstock collection since 1982 (Appendix Table C). Prior to 1979, spawning densities greater than 10 redds/mile in index areas were frequently observed in all 3 basins (ODFW data as reported in Schwartzberg and Roger 1986).

In John Day River Basin streams from 1978 to 1989, the percent of total redds found in index areas have ranged from 45% in the Middle Fork to 100% in the Mainstem. A chi-square contingency table (Zar 1974) was used to test if the year in which redd counts were conducted is independent of the number observed in index and extended areas in the mainstem, Middle Fork, North Fork, and Granite Creek systems (Table 13). Chi-square analysis indicated a significant difference ($P<0.05$) of counts among years (1978-89) for all areas, indicating index counts are not consistent representatives of total redds. For years 1986 to 1989 an additional two miles were added to the Middle Fork index area. Chi-square analysis still indicated a significant difference (P<

Table 12. History of spring chinook salmon index area redd counts in the Imnaha, Grande Ronde, and John Day River Basins, 1979 to 1989. a/ Sample statistics include the 10 year mean (1979-88) and standard error of the mean (SE).

Basin, Stream	Miles Surveyed	YEAR OF SURVEY 1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	10 Yr Ave (1979-88) ± SE
Imnaha River Basin:													
Imnaha River	9.7	83	40	99	129	95	119	145	127	112	135	40	108
Lick Cr.	4.0	4	4	2	0	0	2	3	2	0	0	0	2
Big Sheep Cr.	4.0	0	0	2	9	11	7	6	15	3	14	1	7
Total	17.7	87	44	103	138	106	128	154	144	115	149	41	117 ± 11
Grande Ronde River Basin:													
Grande Ronde River	8.5	7	32	38	29	49	26	70	37	112	99	0 b	50
Sheep Cr.	6.0	0	8	8	18	5	18	30	4	7	0	0	10
Catherine Cr.	7.5	36	66	16	42	43	23	22	47	103	99	31	50
N. Fork Catherine Cr.	3.0	0	0	3	14	11	1	3	8	14	38	6	9
S. Fork Catherine Cr.	2.0	5	0	3	7	4	4	7	21	35	39	1	13
Lookingglass Cr.	6.2	13	29	7	26	7	NS	12	0	18	53	18	17
Lower Minam River	7.5	3	3	2	9	8	6	62	36	64	50	23	24
Upper Minam River	6.0	6	7	12	13	13	17	54	27	26	37	10	21
Wenaha River	6.0	5	24	20	27	23	12	36	68	62	98	9	38
Wallowa River	4.5	0	1	0	1	5	0	3	7	15	7	0	4
Bear Cr.	6.5	4	8	4	12	6	11	6	10	10	5	2	8
Hurricane Cr.	3.0	0	0	1	9	7	0	20	5	16	9	2	7
Lostine River	3.0	21	18	8	58	39	57	68	48	49	107	20	47
Total	69.7	100	196	122	265	220	175	393	318	531	641	122	296 ± 56
John Day River Basin:													
John Day River	13.0	68	16	51	49	133	73	116	159	247	82	165	99
Middle Fork	10.0	118	58	26	62	51	67	40	58 c	237 c	201 c	90 c	77
Lower North Fork	10.0	93	26	67	39	31	23	27	150	201	126	99	78
North Fork Canyon	8.0	107	52	71	68	45	40	83	107	174	119	97	87
Granite Cr.	5.5	86	47	58	66	40	32	83	111	77	69	69	67
Clear Cr.	4.0	28	28	45	43	4	8	33	46	56	44	67	34
Bull Run Cr.	2.5	16	3	7	13	2	8	16	6	14	3	15	9
Total	53.0	516	230	325	340	306	251	398	637	1006	644	602	465 ± 76

a/ Data for 1979-84 from ODFW index area spawning ground surveys as reported in Schwartzberg and Roger (1986) and Knox et al. (1984).
Grande Ronde and Imnaha River basin data for 1986-88 from ODFW index area spawning ground surveys as reported in Carmichael et al. In Preparation.
Grande Ronde and Imnaha River basin data for 1985 from ODFW index area spawning ground surveys as reported in LaGrande and Wallowa ODFW District reports.
John Day River basin data for 1985-88 from ODFW index area spawning ground surveys, John Day District reports.

b/ Grande Ronde R. surveys conducted after flash flooding on 8 August 1989. High turbidity prevented subsequent survey during index count period.

c/ Two miles were added to the John Day River Middle Fork index area survey in 1986 to the present.
Data in Table 12 represents the original 10 mile section. Table 3 presents the additional 2 mile section.

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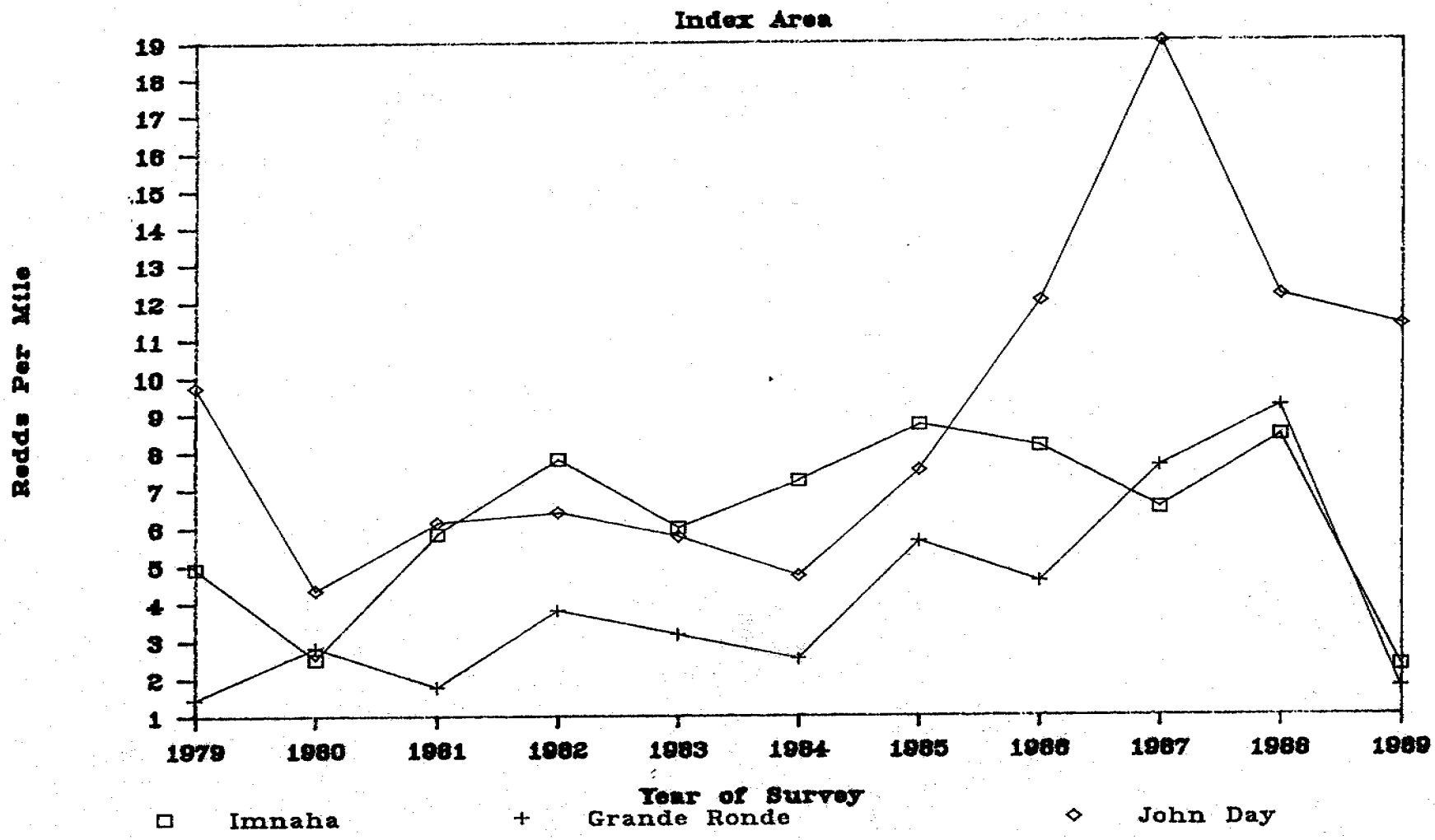

Figure 5. History of spring chinook salmon index area spawning densities (redds/mile) in the John Day, Grande Ronde and Imnaha River Basins, 1979-89.

Table 13. Spring chinook salmon redds observed in index and extended areas in the John Day River Basin, 1978-89. a/

Year	MAINSTEM Index	Extended	Total	MIDDLE FORK b/ Index	Extended	Total	NORTH FORK c/ Index	Extended	Total	GRANITE CR. d/ Index	Extended	Total
1978	58	0	58	107	81	188	108	59	167	165	31	196
1979	68	6	74	118	53	171	200	50	250	130	16	146
1980	16	0	16	58	39	97	78	26	104	78	11	89
1981	51	2	53	26	21	47	138	41	179	110	12	122
1982	49	2	51	62	69	131	107	66	173	122	24	146
1983	133	9	142	51	30	81	76	37	113	46	10	56
1984	73	7	80	67	83	150	63	19	82	48	15	63
1985	116	4	120	40	40	80	110	46	156	132	28	160
1986	159	24	183	58	52	110	257	160	417	163	36	199
1987	247	12	259	237	291	528	375	170	545	147	45	192
1988	82	30	112	201	114	315	245	186	431	116	20	136
1989	165	36	201	90	73	163	196	91	287	151	37	188

a/ Table modified from Lindsay et al. 1986. Data for 1978-84 reported in Knox et al. 1984.
b/ Two miles were added to the index area in 1986 to present. Data in Table 13 represents the original 10 mile section. Table 3 presents the additional 2 mile section.
c/ North Fork 'Total' includes redds found in Desolation and Camas Creeks in 1988 and 1989.
d/ Includes Clear and Bull Run Creeks.

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0.05) of redd counts among years 1986 to 1989 with this additional two miles of index area in the Middle Fork. Based on these results it is recommended that extended area surveys be continued in 1990 then re-examined to identify potential index areas that would be representative of total spawning in John Day River Basin streams.

Since no new redds were observed after the standard index count period, 163 redds is the best estimate of total redds deposited in the Middle Fork of John Day River. Possible problems were encountered. The surveyors commented that some of the redds flagged during the before index count period were difficult to identify in later surveys because of siltation. Hence, some redds may not have been observed during the index count period in areas that multiple surveys were not conducted. The middle of September may have been a better peak count period. Recommendations for research in 1990 are to continue extensive area redd counts with multiple surveys to determine total number of redds and also conduct multiple surveys with multiple counters to examine variability between surveyors.

Fish Per Redd Relationship

Is the 0.9 fish/redd relationship for John Day River Basin spring chinook salmon fact or fantasy? For comparison, 2.4 fish/redd is the relationship most recently used for Columbia River Basin spring chinook salmon (ODFW 1987). As previously discussed there are many unanswered questions regarding the holding area and spawning ground survey results in 1989. To estimate spawning escapement we need to continue our objectives to determine the total number of spring chinook salmon adults and redds in the John

Day River Basin. The on-going research in the Grande Ronde and Imnaha River Basins will further refine the spawning escapement estimates needed for these basins and will be reported by Carmichael et al. (In Prep.).

CONCLUSION

As previously discussed, the spawning escapement (redd counts) of the John Day, Grande Ronde, and Imnaha River Basin spring/summer chinook salmon stocks has fluctuated within and between basins prior to 1986 to the present. If the status of the individual spring/summer chinook salmon stocks is to be assessed, a conglomerate count of all spring/summer chinook salmon stocks at Bonneville Dam would not represent the spawning escapement to each individual basin. We need to continue developing methods to estimate spawning escapement of spring/summer chinook salmon in the John Day, Grande Ronde and Imnaha River Basins of Northeast Oregon.

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Appendix A. Supplementation releases of juvenile chinook salmon in the Grande Ronde River Basin.

Brood year	Stock	Hatchery of rearing	Number released	Date of release	Size (#/lb.)	Location of release
1980	Carson	Carson	100,000	04/82	20.0	Catherine Cr.
1982	Carson	Carson	101,870	04/84	16.7	Catherine Cr.
1983	Carson	Lookingglass	502,642	05-07/84	85.5-148.0	Upper G. Ronde
1983	Carson	Lookingglass	382,500	06/84	187.5	Catherine Cr.
1983	Carson	Carson	100,448	04/85	18.2-20.2	Catherine Cr.
1984	Carson	Lookingglass	100,072	04/86	10.4-10.8	Big Canyon Cr.
1984	Carson	Lookingglass	100,150	04/86	10.0-11.0	Catherine Cr.
1985	Carson	Irrigon	379,450	06/86	24.0-25.0	Grande Ronde R.
1985	Carson	Bonneville/ Lookingglass	88,667	02/87	10.1-11.7	Catherine Cr.
1985	Carson	Bonneville/ Lookingglass	84,295	03/87	11.5	Big Canyon Cr.
1985	Lookingglass	Lookingglass	37,760	07/86	53.5	Catherine Cr.
1985	Lookingglass	Lookingglass	111,711	04/87	17.1	Upper G Ronde
1986	Lookingglass	Lookingglass	136,675	03/88	17.6	Big Canyon Cr.
1986	Lookingglass	Lookingglass	49,634	04/88	20.6	Big Canyon Cr.
1986	Lookingglass	Lookingglass	151,888	03-04/88	20.6	Catherine Cr.
1987	Lookingglass	Lookingglass	83,160	04/89	13.2	Catherine Cr.
1987	Lookingglass	Lookingglass	89,102	04/89	14.9	Big Canyon Cr.

Data Source: R.T. Messmer, ODFW, written comm., 01/90.

FN:APPA 01/29/90

Appendix B. Release and recovery information for adult spring chinook salmon outplanted from Lookingglass Hatchery into Grande Ronde River Basin streams. Expanded number of fish recovered are presented in parentheses. a/

Year, Outplanting location	Dates outplanted	Number of fish outplanted			Location and number of disk tagged fish observations or recoveries				
		Untagged	Tagged	Total	Returned to Lookingglass	Observed live on survey b/	Recovered on survey b/	Tribal harvest c/	Volunteer recoveries
1987:									
Catherine Cr.	05/27-30	536	164	700	6(26)	5(21)	3(13)	16(68)	3
Upper G. Ronde R.	06/01-06/15	431	67	498	6(45)	4(30)	3(22)	3(22)	1
Wallowa R.	06/08	233	67	300	6(27)	0	2(9) d/	0	0
Wallowa R.	08/25	90	0	90	--	--	--	--	--
1988:									
Catherine Cr.	05/23-27,06/20,07/26	494	218	712	32(105)	9(29)	8(26)	6(20)	5
Upper G. Ronde R.	05/31,06/03,06/21,08/17	333	189	522	23(64)	11(30)	9(25)	20(55)	9
Wallowa R.	07/11	54	37	91	0	6(15)	11(27)	0	2
Wallowa R. e/	08/10	242	121	363	0	9(30)	10(30)	0	1
1989									
Catherine Cr.	06/09	29	52	81	12(20)	2(3)	0	0	1
Wallowa R.	06/12	42	46	88	18(27)	1(2) f/	5(8) g/	0	2

a/ Table modified from Carmichael et al. In Preparation. ODFW.
b/ Surveys conducted during peak count spawning ground surveys inside and outside of index areas.
c/ Tribal fishery data incomplete.
d/ Recovered in Hurricane Cr..
e/ After tagging, fish were hauled from Lookingglass Hatchery 06/06,13,17 and held at Wallowa Hatchery until release.
f/ Observed live in Minam River.
g/ Four tags recovered in Hurricane Cr. and one tag recovered in Lostine River.

PN:APPB 02/15/90

Appendix C. Adult spring/summer chinook salmon recoveries at the Imnaha River trap.

Return year	Total number	Number females	Number males	Jacks	Number females spawned
1982	28	14	14	0	10
1983	64	35	21	8	31
1984	35	17	9	10	11
1985	165	41	78	46	32
1986	340	120	199	21	61
1987 wild	165	65	96	4	38
hatchery	22	2	3	17	1
1988 wild	357	213	125	19	38
hatchery	37	26	11	a/	1
1989 wild	261	103	120	38	47
hatchery	125	7	3	115	7
hatchery		b/	/b		/b

a/ 1985 Imnaha brood released at Lookingglass Hatchery. 48 jacks returned to Lookingglass Hatchery in 1988.

b/ 1985 Imnaha brood released at Lookingglass Hatchery. 31 females (29 spawned) and 27 males returned to Lookingglass Hatchery in 1989.

Data Source: R.T. Messmer, ODFW, written comm. 01/90. Preliminary data for 1989.

FN:APPC 01/29/90

Appendix D. Juvenile spring/summer chinook salmon releases in the Imnaha River.

Brood year	Stock	Hatchery of rearing	Number released	Date of release	Size (#/lb.)
1982	Imnaha	Lookingglass	24,920	3/22/84	32.0
1982	Lookingglass	Lookingglass	4,258	3/22/84	31.0
1983	Imnaha	Lookingglass	56,235	9/14/84	24.4
1983	Imnaha	Lookingglass	59,595	3/22/85	17.4
1984	Imnaha	Lookingglass	35,265	3/28/86	10.8
1985	Imnaha	Lookingglass	125,530 a/	4/20/87	8.0-8.4
1986	Imnaha	Lookingglass	101,929	3/21-22/88	9.9-11.0
1986	Imnaha	Lookingglass	97,137	4/20-21/88	8.8-8.9
1987	Imnaha	Lookingglass	142,320	4/05/89	16.0

a/ This brood was released into Lookingglass Cr. of the Grande Ronde River.

Data Source: R.T. Messmer, ODFW, written comm. 01/90.

FN:APPD 01/29/90

APPENDIX E. Middle Fork John Day River Micro-habitat surveys, 1989.
Spring chinook salmon observed during snorkel and foot surveys, July 31 to August 17.

RIVER MI. (0.1)	NUMBER FISH ADULT & JACK SNORKEL & FOOT	MICRO HABITAT DESCRIPTION WATER DEPTH (MAX)	WIDTH (AVE)	LENGTH (AVE)	PRIMARY SUBSTRATE TYPE	COVER TYPE	COMMENTS
RM 42.0	3 Adults	6 ft.	30 ft.	100 ft.	Boulder	Bridge	Pool under Armstrong Cr. Bridge
RM 43.5	1 Adult	3 ft.	40 ft.	150 ft.	Cobble	Under cut bank	Long glide
RM 51.1	2 Adults	5 ft.	40 ft.	70 ft.	Cobble/Gravel	Boulder	Pool near Coyote Cr.
RM 55.5	6 Adults	6 ft.	35 ft.	70 ft.	Fines	Under cut rock	Rock ledge pool near Road 20 Br.
RM 56	1 Adult	4 ft.	40 ft.	15 ft.	Cobble	Bridge	Pool under Beaver Cr. Bridge
RM 56	1 Adult	1.5 ft.	35 ft.	100 ft.	Cobble	Bank vegetation	Glide upstream of bridge
RM 56.3	5 Adults	4 ft.	20 ft.	400 ft.	Cobble	Under cut bank	Glide
RM 56.5	1 Adult	1.5 ft.	20 ft.	100 ft.	Cobble	Bank vegetation	Fast moving glide, fish spooked
RM 57	1 Adult	1.5 ft.	35 ft.	10 ft.	Cobble/Fines	Bank vegetation	Pool, Female?
RM 57.2	1 Adult	1.5 ft.	20 ft.	70 ft.	Cobble/Fines	Bank vegetation	Riffle, fish spooked
RM 57.3	1 Adult	1 ft.	20 ft.	100 ft.	Cobble	Bank vegetation	Glide, fish in bank
RM 57.5	1 Adult	1 ft.	15 ft.	50 ft.	Cobble	Bank vegetation	Glide, fish spooked
RM 58	1 Adult	4 ft.	40 ft.	60 ft.	Cobble/Fines	Open water	Pool
RM 60.5	1 Adult	2 ft.	15 ft.	no data	Boulder/Cobble	Boulder	
RM 61	1 Adult	1 ft.	15 ft.	no data	Boulder/Cobble	Under cut bank	
RM 61	1 Adult	2 ft.	15 ft.	no data	Boulder/Cobble	Log jam	
RM 63.5	15 Adults	6 ft.	25 ft.	150 ft.	Gravel/Fines	5 Rock jetties	Variability site #3 (90% pool)
RM 64.0	6 Adults	4 ft.	25 ft.	150 ft.	Gravel/Fines	2 Rock jetties	Variability site #1 (60% pool)
RM 64.1	19 - 38 Adults	4 ft.	25 ft.	250 ft.	Gravel/Fines	Rock jetty,Log,	Variability site #2 (90% pool)
RM 66.5	2 Adults	2 ft.	10 ft.	no data	Gravel/Fines	Under cut bank	Glide below Bates Bridge, 1 Jack observed on 9/6 89
RM 69.7	1 Adult	4 ft.	10 ft.	10 ft.	Gravel/Fines	Log weir	Pool below USFS habitat dam
RM 70	1 Adult	4 ft.	10 ft.	10 ft.	Gravel/Fines	Log weir	Pool below USFS habitat dam
RM 71.1	12 Adults	3 ft.	10 ft.	.25 miles	Gravel/Fines	Bank vegetation Under cut banks	Fish sighted in shallow pools from Crawford Cr. to Cabin on 8/17/89
RM 71.1	16 Adults + 3 Jacks	3 ft.	10 ft.	.25 miles	Gravel/Fines	Bank vegetation Under cut banks	Fish sighted in shallow pools from Crawford Cr. to Cabin on 9/6/89

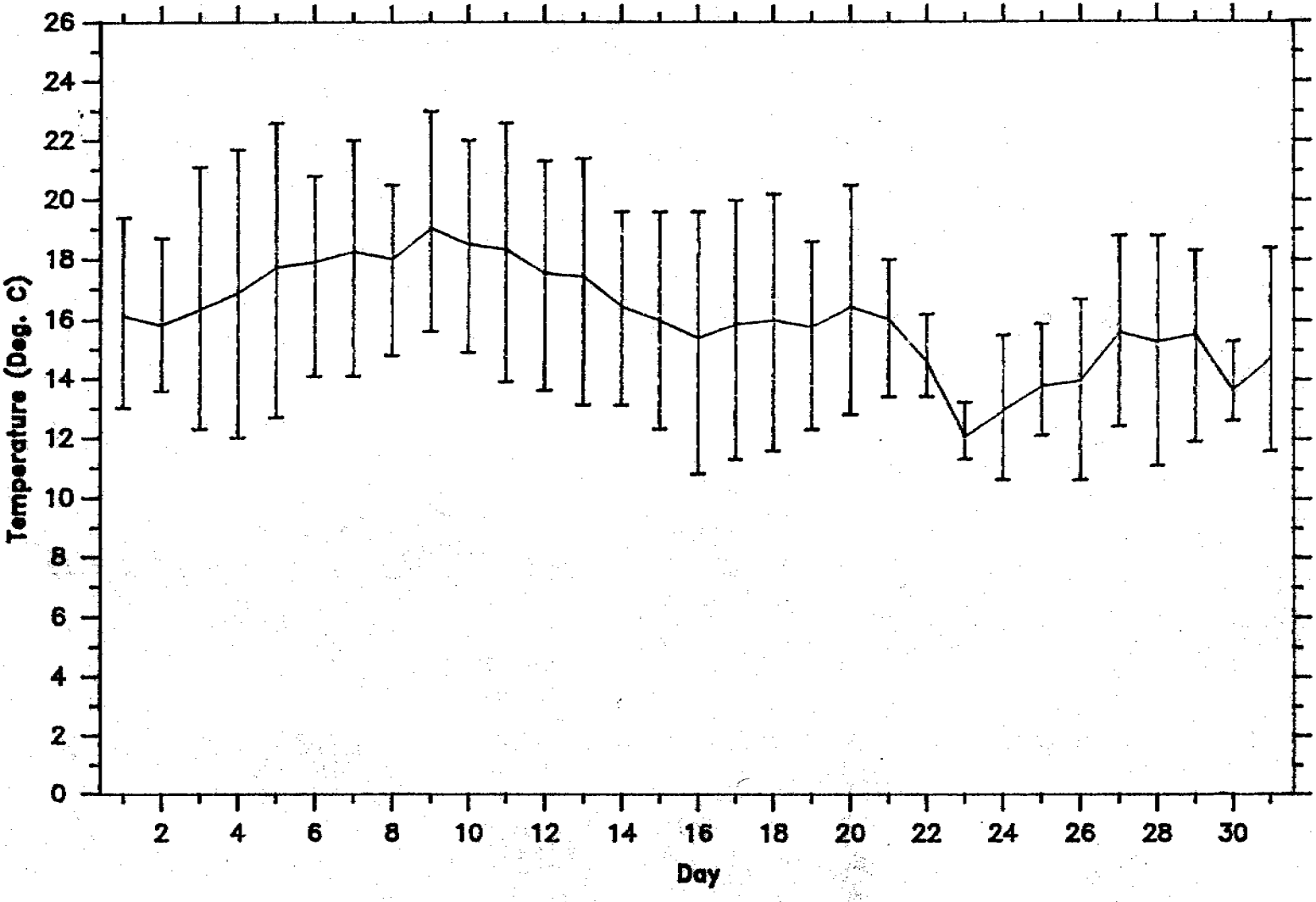
FH:MIC1

APPENDIX F

Temperature profile of the Middle Fork John Day River at Murdoc Creek, August and September, 1989.

Appendix F.1.

Daily Mean, Minimum, and Maximum Water Temperatures
MIDDLE FORK JOHN DAY RIVER, MURDOC CREEK STATION
August 1989



Appendix F.2.

Daily Mean, Minimum, and Maximum Water Temperatures
MIDDLE FORK JOHN DAY RIVER, MURDOC CREEK STATION
September 1989