ANNUAL REPORT

FISCAL YEAR 1992

IDAHO FISHERY RESOURCE OFFICE

AHSAHKA, IDAHO

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I. NARRATIVE SECTION

Introduction

The Idaho Fishery Resource Office (IFRO) was originally established as the Dworshak Fisheries Assistance Office in 1981 and became fully operational in FY 82. The name change to the Idaho Fishery Resource Office occurred in 1991 as part of a region-wide change to better reflect the office's responsibilities and functions. The IFRO is located on the grounds of Dworshak National Fish Hatchery, Ahsahka, Idaho, approximately 40 miles east of Lewiston, Idaho, on the main-stem Clearwater River. The office is staffed by nine full-time permanent employees and four full-time temporary employees. The primary purpose of the IFRO is to assist in management and evaluation of fishery resources which relate to federal issues, i.e., fishery resources of national significance, fishery mitigation for federal projects, assistance to Indian tribes, fishery work on federal lands and other fishery projects as called for under federal law. Activities are primarily directed toward protection, restoration and enhancement of anadromous fish resources in the Lower Snake River Basin.

During Fiscal Year 1991, we participated on the Endangered Species Technical Committee. Various technical committee meetings were attended throughout the year to review the status of the Salmon River sockeye salmon, Snake River chinook salmon, and lower Columbia River coho salmon. Endangered Species Act (ESA) status reviews were developed and our office drafted comments on the reviews for the U.S. Fish and Wildlife Service. The National Marine Fisheries Service (NMFS) listed Snake River sockeye salmon *(Oncoryhnchus nerka)* as endangered under the ESA in December 1991 and listed wild Snake River spring/summer and fall chinook salmon *(O. tshawytscha)* as threatened in May 1992. With this action, we have continued to be involved with various ESA related activities concerning these listed species during FY 92 which have become a major responsibility for our office.

Another major area of our office's work includes evaluation and fishery management planning for the three federally operated hatcheries in Idaho; Dworshak National Fish Hatchery (NFH), Hagerman NFH, and Kooskia NFH. Our office compiles the information required to assess how each of the three hatcheries are meeting their established mitigation goals. Our office also helps design studies to evaluate hatchery effectiveness and various management scenarios. We work closely with the Idaho Department of Fish and Game (IDFG), the Nez Perce Tribe, the Shoshone-Bannock Tribe, and the Shoshone-Paiute Tribe in evaluating various fish management programs in Idaho.

Developing databases for fisheries of national significance has also become a major activity of the IFRO. We are presently participating in two research/management projects: 1) Acquiring data on spawning, rearing, and migration of the threatened Snake River fall chinook salmon and 2) Acquiring data on the use of supplementation to increase natural/wild populations of spring chinook salmon in the Snake River Basin.

Station Operations

1. To produce the healthiest most viable smolts possible, our office, together with Dworshak NFH, developed a project in 1990 to evaluate the effect of rearing density on smolt survival and adult returns. Spring chinook salmon from BY 1989 and 1990 were reared at three densities; 15,000 fish/raceway, 30,000 fish/raceway, and 45,000 fish/raceway. Normal rearing densities were 40-45,000 per raceway. BY 1989 fish were released on 4/04/91 at about 18-20/lbs. BY 1990 fish were released on 4/15 and 4/16 at about 15-16/lbs.

   Very little variation was observed between density groups in relation to growth, fish health, and mortality for BY 1989. However, the high density group for BY 1990 had a higher incidence of mortality and BKD levels than the low or medium density groups.

   Based on PIT-tag information, the low density groups for both the 1991 and 1992 releases had significantly longer ($P<.05$) migration times to Lower Granite Dam than the medium or high density groups. For the 1991 releases, the percent of PIT-tagged fish detected at Lower Granite Dam did not vary significantly between density groups. However, for the 1992 releases, the low density group had a higher percent detection rate (57%) than the medium density group (53%), or high density group (39%). It appears that a lower rearing density may increase post-release survival to Lower Granite Dam, at least for the 1992 releases. However, comparisons between the 1991 and 1992 releases are complicated by the fact that the 1992 releases were made about 10 days later and were larger smolts at release compared to the 1991 releases.

   The final evaluation is awaiting completion of returning adults. We had I-ocean returns this year (1992) from the 1991 releases. Adult returns from the 1991 release should be completed by September 1994. Adults returning from 1992 releases will be completed in 1995.

2. Spring chinook have generally been released near the last part of March or first part of April at Dworshak NFH. Preliminary smolt assessment data indicate that spring chinook salmon smolts at Dworshak NFH may not be fully developed at the time of release. For this reason, our office developed a pilot study this year, in coordination with Dworshak NFH, to evaluate the effect of time of release on smolt survival to Lower Granite Dam and on the rate at which adults return from the ocean.

   We have proposed three release dates; April 8, April 22, and May 6, 1993. Each release group will be represented by two CWT groups of 60,000 fish each. Smolt survival will be examined using PIT-tags while smolt-to-adult survival will be determined using coded-wire tags. Data from this pilot study will be used to determine whether a full, multi-year (4-5) evaluation study of release time is warranted.

3. Releases of hatchery fish are sometimes dictated by logistics rather than what is best for fish survival. Some data we have gathered indicates that spring chinook salmon released from some hatcheries may not be fully

developed smolts. There is evidence that a more fully developed smolt emigrates faster. Associated with this faster emigration rate are a number of advantages, in terms of dam guidance and minimizing exposure to river hazards. In an effort to release a more developed smolt, four different releases of spring chinook salmon were made from Kooskia NFH between 7 April and 5 May, 1992. Data analysis has not been completed yet, but a complete evaluation of release time on migration of spring chinook salmon at Kooskia NFH should be completed soon. Release times will be correlated to smolt development as measured by gill ATPase levels. We will also relate travel time, river flows, water temperatures, and fish size. PIT-tags were used to measure travel time of the spring chinook salmon from time of release to arrival at Lower Granite and Little Goose dams. Preliminary data on travel times and recovery rates indicate that chinook salmon released at various times have similar recovery percentages at the dams. However, salmon released at the later date travelled significantly faster than fish released earlier.

4. With the listing of Snake River fall chinook salmon as threatened, a renewed interest has developed concerning natural fall chinook spawning, rearing, and outmigration in the Snake River below Hells Canyon Dam. Quick reviews of the literature demonstrated that our understanding of present day natural Snake River fall chinook salmon spawning habitat utilization, characteristics, and production is not sufficient for recovery planning. Likewise, there was almost no information on juvenile fall chinook of natural salmon parentage. We are expanding our understanding of fall chinook salmon spawning and rearing by gathering data in the Snake River during 1991 to 1994. Our work on fall chinook is part of a larger study being administered by the National Fishery Research Center, Columbia River Field Station. Our 1991 work was intended to be a pilot study, but in light of the dire need for fall chinook salmon data we initiated full scale field work. We directed our effort to accomplish two complicated objectives:

   1) Determine the production potential of Snake River fall chinook spawning habitat based on current use and habitat availability under the operations of Hells Canyon Dam.

   2) Use PIT tags to describe fall chinook salmon fry rearing behavior, outmigration timing, and migration rate as affected by flow and temperature.

   Our progress to date towards the accomplishment of the first objective is based on literature review, flow and temperature data base construction, field work, and data sharing. A review of USGS flow data showed in both 1990 and 1991 the drought has faced adult salmon with low flows during immigration and spawning that are roughly half of what the period of record averages suggest occurred in more "normal" water years. By placing thermographs at ten locations in the Snake River we were able to statistically demonstrate the effects of Hells Canyon Dam releases on downstream water temperature conditions. These data were shared with Columbia River Intertribal Fish Commission as part of their water temperature control study. Aside from running the water temperature

monitoring network on the Snake we also were a major cooperator during spawning surveys. We participated with Washington Department of Fisheries and Nez Perce Tribe personnel in aerial, ground, and deepwater redd counts during 1991. A total of 42 redds were counted by helicopter and verified on the ground in 1991. During redd counts we also assisted Washington Department of Fisheries with adult carcass collection for genetic analysis. SCUBA diving during this time turned up nine redd clusters in deepwater that were not seen from the air. A record low number of redds were counted in the Snake River in 1991 even though survey effort was expanded over past years. During the spawning season when the redd counts were being conducted the Idaho Power Company (IPC) stabilized flows to minimize the potential for redd dewatering during egg incubation. We took advantage of stable flows to collect flow data for modelling fall chinook salmon spawning habitat. While collecting these data we also trained IPC personnel in field measurement techniques. We are in the process of signing an Memorandum of Agreement to share data with IPC. The flow data we collected were recently forwarded to the Bureau of Indian Affairs (BIA) to assist in Snake River Water Adjudication studies. Throughout the salmon egg incubation season we watched over redd sites and continued to monitor flows and temperatures. On a number of occasions we provided in season data to the Fish Passage Advisory Committee (FPAC) to aide in Hells Canyon flow management. Data was provided to help insure that fall chinook redds were not dewatered before fry emerged in the spring.

Our progress to date on the second objective is based on literature review, field work, and data sharing. We gathered all the literature we could find on the juvenile fall chinook salmon. Using the literature and water temperature data from our first objective, we developed size criteria to distinguish between spring and fall chinook juveniles in the Snake River. Beach seining began in May and April in 1991 and 1992, respectively. We captured and PIT tagged 738 and 1100 salmon in 1991 and 1992, respectively. Many of the salmon we captured in both years were recaptured at the same site where they were originally tagged. During 1991 our peak catch occurred the third week of June, while in 1992 the peak occurred in the third week of May. Outmigration to Lower Granite Dam occurred the third week of July in 1991 and the third week of June in 1992. When our tagged salmon reached Lower Granite Dam, some of them were recaptured for electrophoresis by Washington Department of Fisheries. This cooperative effort showed that 94% of the salmon we tagged were fall chinook salmon and established a genetic baseline for natural fall chinook salmon for the first time. The observation rate of our tagged salmon at Lower Granite Dam in 1991 was twice as high as it was in 1992. The migration rate of our tagged salmon to Lower Granite Dam was twice as fast in 1991 than it was in 1992. Prior to the collection of these data an analysis to see how fast Snake River fall chinook salmon migrate through Lower Granite Reservoir was impossible. We shared our PIT tag data with the Fish Passage Center for in season flow management. Subsequently, summer flows were released to aide summer migrants for the first time. We are still uncertain of the benefits of these flows, but our statistical analysis of the 1991 data may provide insight. We found that once salmon reached a critical size higher flows increased their migration rate. Although the evidence is circumstantial at this time, it is interesting to note that salmon tagged in 1992 under lower

flow conditions migrated slower and were interrogated less often than salmon tagged in 1991 under higher flow conditions.

During the upcoming 1992 spawning season (FY 93) we will add redd survey diving below Lower Monumental Dam, to our fall chinook work.

5. We initiated a supplementation project in cooperation with the Idaho Supplementation Studies (ISS) program. Participants in ISS include IDFG (lead agency), FWS, Nez Perce Tribe, and Shoshone-Bannock Tribe. We will compare the success of naturally produced spring chinook salmon parr with hatchery produced parr (both outplants and direct releases). The overall ISS design will allow comparison with "natural" streams and streams being supplemented to various degrees. We are primarily looking at two tributaries in the Clearwater River drainage to evaluate impacts of hatchery produced smolts and/or releases. In 1992, 10 segments on Pete King Creek, a tributary of the Lochsa River, and 21 segments on Clear Creek, a tributary of the Middle Fork Clearwater River, were snorkeled and the substrate types sampled according to established protocol. The 1992 juvenile spring chinook salmon counts and densities are down dramatically from 1991. The 1991 parr population were progeny from an unusually good return year (1990).

   Redds and adult spawners were counted three times in Clear Creek and once in Pete King Creek. Twenty adults, 10 males and 10 females, were released above the Clear Creek weir. Two redds were located and a total of seven adults were observed at spawning time in Clear Creek. No adults or redds were found in Pete King Creek.

   We PIT-tagged 429 juvenile spring chinook salmon captured in Clear Creek. Most of the juveniles were found in a relatively small stream section immediately below the Nez Perce National Forest Service boundary. Low water conditions and associated high water temperatures hampered our PIT tagging efforts for much of the field season. We did not electrofish or PIT tag fish at water temperatures greater than 19°C. By adjusting our work schedule, we captured and tagged most fish before 10 a.m. when temperatures usually became critical. PIT tagging mortality was less than one percent. Electrofishing mortality was approximately one percent.

   When flows increase sufficiently this spring, a 5 foot rotary screw trap will be placed in Clear Creek below the adult weir for capturing outmigrants. As a low flow alternative to the screw trap, we are currently working on a method to trap outmigrants at the hatchery water intake structure upstream from the hatchery.

6. During FY 92, we have continued our work on mountain whitefish in the Lochsa River drainage which is part of a long-term nationwide National Fisheries Resource Monitoring Program looking at the possible effects of global warming on fish populations. We monitored mountain whitefish (MWF) in White Sand Creek, a tributary of the Lochsa River, which has its headwaters in the Selway-Bitterroot Wilderness area. This drainage is basically free from human impacts. Mountain whitefish inhabit the lower to

mid-sections of this creek in summer, then migrate downstream into the Lochsa River in winter.

In 1992, the upper limit of mountain whitefish summer distribution in White Sand Creek was determined and monitoring sites were established above and below this area. Control sites were also chosen on Crooked Fork Creek, which joins with White Sand Creek to form the Lochsa River, to look for possible differences due to human impacts. Crooked Fork Creek is subject to more timber harvest impacts.

Monitoring was done by snorkeling downstream through each site, counting MWF. Sites were monitored monthly until MWF began migrating downstream in late August. Sites were then monitored every two weeks as MWF began to "school-up" in pre-spawning staging.

Once in larger schools, MWF were captured using hook and line. Fish were measured for length and weight, sexed if possible, floy tagged, sampled for scales, and released. We had excellent results handling the fish without anesthetic. We tagged 170 fish in White Sand Creek and 139 fish in Crooked Fork Creek.

The majority of MWF spawning occurred during October 12-22, 1992. In conjunction with spawning, there was mass migration downstream. Tagged whitefish are being monitored as they move down the Lochsa River through the winter months in order to establish the downstream limit of winter distribution.

Within the next fiscal year, the distribution and the age structure of MWF populations will be documented in the study drainages. Continuing routine monitoring and examination of population age structure will allow us to detect any shift in distribution and/or age structure in the population. We also expect to see tagged fish return to Crooked Fork and White Sand creeks next summer, exhibiting the same homing behavior that was observed for MWF by other researchers working in the North Fork of the Clearwater River.

Water temperatures are being monitored continually throughout the year at six sites with Ryan TempMentors to correlate water temperature changes with changes in MWF distribution and/or population age structure.

7. We continued our program of stocking rainbow trout into Dworshak Reservoir as part of the mitigation for Dworshak Dam. In the recent past, we have planted two strains of rainbow trout, Arlee and Shasta at 100,000 fingerling of each strain, annually. Because of IHN concerns, the fish were reared at Hagerman NFH to an average size of 20/lb and then transported by truck to the reservoir. This year, the rainbow were reared at Kooskia NFH. A total of 101,186 rainbow trout at an average size of 20/lb were stocked into Dworshak Reservoir on 4/06/92. The program is being evaluated by the Idaho Department of Fish and Game and Nez Perce Tribe to determine species appropriateness and satisfaction with the mitigation agreement.

8. We continued to participate on the Endangered Species Technical Committee during FY 92 and a number of other meetings and associated workshops were attended. We participated as part of the Salmon Recovery Working Group and presented testimony to the Sockeye Salmon Recovery Team on the use of supplementation methodologies. We coordinated with NMFS and met with them to discuss issues and procedures for Section 7 and Section 10 consultations. We provided comments and suggestions on the Section 7 Biological Assessment for Snake River spring chinook salmon developed by the Lower Snake River Compensation Plan Office in Boise. With the listing of Snake River sockeye salmon as endangered and the Snake River spring/summer and fall chinook salmon as threatened by the National Marine Fisheries Service, we expect our activities and responsibilities in this area to expand in the future.

9. Our work with cryopreservation of male summer steelhead and spring chinook salmon gametes was continued this year. Sperm from 26 males collected in 1992 were frozen and subsequently used for fertilization of females. Eye-up success ranged from 65.0 to 1.0%. However, percent eye-up was mostly below 20%. Differences in success are attributed primarily to inconsistencies in our technique. We feel that this technique has excellent potential as a management tool, especially for preserving the genetic integrity of our endemic summer steelhead stock. Our short-term objectives for the next few years are to: (1) develop consistency in the cryopreservation technique to obtain at least 70-80% eye-up success, and (2) gauge sperm motility versus percent eye-up. Our long-range goals for the project are to: (1) compile an inventory of summer steelhead sperm for use when there are not enough males for one-to-one production needs, and (2) compile an inventory of wild summer steelhead sperm for purposes of genetic diversification and preservation.

10. We continued to sample kokanee for disease background. Samples were collected and analyzed from Breakfast, Isabella, and Skull creeks on the North Fork Clearwater River above Dworshak Reservoir. This year we collected 501 kokanee salmon spawners and five tested positive for IHN virus. This is 1% rate of positive IHN detection compared to past years ranging from 0- 59 1.5%.

11. Spring chinook salmon and steelhead run summaries and run prediction information were prepared for Dworshak and Kooskia NFH's (see Appendices A and B, respectively). This information, in conjunction with IDFG and Nez Perce Tribe information, is used to set fishing seasons and future hatchery production plans.

12. We continued to provide fishery management advice for the Shoshone-Paiute Tribe, of the Duck Valley Indian Reservation. We represented them on fishery issues as well as providing technical assistance on various projects. We also recommended alternatives to enhance their wetlands. We evaluated and made recommendations on growout pond usage. We continued to evaluate the Reservation's fisheries and our recommended stocking program. We also provided them with an annual report covering the year's activities.

13. We completed a five-year plan for the Lower Snake River Compensation Plan Program at Dworshak NFH. The plan covers evaluation activities, budgets, and schedules for the next five years.

14. We visited all six of the National Wildlife Refuges in Idaho in an effort to assess the fishery resources on the refuges and to acquaint each refuge manager with the types of fishery management services that our office provides. A cursory evaluation of aquatic resource availability on each refuge was made and ongoing management activities, sport fishing activities, and potential for increasing refuge involvement in fishery management were discussed. A summary of our field trips including our recommendations for future fisheries activities on each refuge was forwarded to Wildlife and Refuges in the Portland Regional Office.

15. IFRO has the responsibility for the fishery database for all three federal hatcheries in Idaho and very limited responsibility for Leavenworth NFH Complex in Washington. IFRO is gathering and computerizing distribution and return data as well as completing summary release files.

16. IFRO personnel have participated on the following Technical Advisory Committees (TAC) and study teams in 1991:

1. Member of the Nez Perce Tribal TAC on the development of a anadromous salmon hatchery.
2. Member of Dworshak outplanting subcommittee to establish priority, numbers, and places for outplanting steelhead fingerlings, smolts, adults, and spring chinook fingerlings from Dworshak and Kooskia NFHs.
3. We assist in planning for upcoming tagging, branding and clipping work at the various hatcheries particularly at Dworshak NFH and Kooskia NFH.
4. Member of Idaho Supplementation TAC. As a member of this committee, we review and provide technical guidance on developing Idaho supplementation projects. We also participate by sampling two study streams in the Idaho Supplementation Studies program.
5. Member of Supplementation Technical Work Group.
6. Pacific States Marine Fishery Commission/Pacific Salmon Commission. We contribute to their regional coded-wire tag database for release and recovery data as well as advise the mark committee on sample design and policy.
7. Member of Idaho Stream Segment of Concern Working groups. We provide technical fishery information to the various groups upon request.
8. Member of Endangered Species Technical Committee. This team reviews endangered species issues relating to anadromous salmon in the Columbia Basin.
9. Member of Columbia River PIT-tag Steering Committee.
10. Member of Clear Creek Coordinated Resource Management Planning Group.
11. Participated on the Dworshak/Kooskia NFH Complex Hatchery Evaluation Team.
12. Participated on the Salmon Recovery Working Group.
13. Participated in the resident fish substitution program of BPA funded Fish and Wildlife Program. We represent the Shoshone-Paiute Indian Tribe.

14. Member of the Idaho Fisheries Habitat Enhancement Coordination committee.
15. Participate in Region I Fisheries Visioning Teams:
    A. Supplementation Team
    B. Fish Passage Team
    C. Training/Team Building Team

Station Cyclical Maintenance/Construction

With the increased expansion of our staff, numbers of ongoing projects, and other activities, expenditures for FY 92 have increased significantly over FY 91.

A major expenditure is the leasing of a new office facility to accommodate the increased staff. The new facility is temporary while arrangements are being made for the construction of a new building. A new storage building for our boats was also added in FY 92.

Considerable equipment, supplies and services were purchased for the Snake River Fall Chinook Project this year. Two new jet boats, spawning area mapping equipment and contract, helicopter surveys, screw traps, radios, and video equipment were major purchases.

Other purchases included computer hardware to accommodate added staff (3 printers, 1 computer, 1 digitizer), safety equipment, boat equipment repair, and vehicle leasing.

Cost Summary:

1. Temporary Office Building, Storage Building and Associated Costs.

Building	$21,894
Associated costs	13,952
Storage building	24,861

2. Fall Chinook Project

24-foot jet boat	35,297
Boat trailer	3,161
22-foot jet boat	21,500
USFS mapping	24,946
Helicopter flights	5,400
5-foot screw trap & trailer	11,500
Mobile radios	3,570
Flowmeter	3,850
Video camera & housing	2,366

3.	Computer Hardware	7,526
4.	Vehicle leasing	3,240
5.	Safety equipment	3,444
6.	Boat equipment and repair	11,788

Future Outlook

Idaho FRO will continue to function as a key player in the complex problems stemming from anadromous salmonid production and management in the headwaters of the Columbia Basin. The outlook on the horizon is greater demand by more user groups for fewer resources.

We will be analyzing CWT returns from the steelhead broodstock study in the future. We will also be analyzing freeze brand data to determine if run timing, i.e. early or late adult arrival, is a heritable trait.

We are excited about the possibilities of cryopreservation of "wild" fish sperm as a means of maintaining genetic integrity of a stock, as well as broodstock management. This is especially critical in years when we experience less than 25 percent males return to the hatcheries. We believe that technology is on the threshold of successful cryopreservation of fish sperm.

Our personnel will become more involved in determining fishery contribution and project area escapements of adults produced by FWS operated facilities in the Columbia River Basin, especially the lower river fisheries.

This office will continue to provide a lead role in providing interagency coordination on hatchery operations and evaluation. We believe this role will expand in value as new hatcheries come on line in the Clearwater drainage.

We will continue to be involved in fishery management on the Duck Valley Indian Reservation. Future work will mainly be implementation of recommendations made in the Management Plan.

Our office is also becoming more involved in endangered species issues relating to proposed listings of anadromous salmon stocks in the Columbia Basin.

We will also be involved in key management research related to rebuilding fish runs. We will be a lead player in fall chinook studies in the Snake River. We will also be a player in evaluating hatchery supplementation as a means to rebuild natural salmon runs.

III. APPENDICES

APPENDIX A

ADULT SPRING CHINOOK SALMON RETURNS TO DWORSHAK-KOOSKIA NFH COMPLEX IN 1992 AND PROGNOSIS FOR 1993

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December 1992

Introduction

Dworshak NFH is located at the confluence of the North Fork and the main-stem of the Clearwater River near Ahsahka, Idaho. Construction of the hatchery was included in the authorization for Dworshak Dam and Reservoir (Public Law 87-847, October 23, 1962) to mitigate for losses of anadromous steelhead *(Oncorhynchus mykiss)* caused by the dam and reservoir.

The hatchery was designed and constructed by the U.S. Army Corps of Engineers (COE) and has been administered and operated by the U.S. Fish and Wildlife Service since the first phase of construction was completed in 1969. At that time, the hatchery had 25 Burrows ponds on a reuse system and 59 ponds on a single-pass system for rearing steelhead. In 1972, a second phase of construction placed all ponds on the reuse system with the option of operating some ponds on either reuse or single pass. Additional construction was completed in 1982 under the Lower Snake River Compensation Plan to provide rearing facilities for spring chinook salmon *(O. tshawytscha)*. A total of 30 8-foot by 80-foot raceways were constructed. Starting in 1986, 12 8-foot by 75-foot raceways were converted form rainbow trout rearing to chinook salmon rearing.

Dworshak NFH formed a "Complex" with Kooskia NFH on April 9, 1978. All administrative responsibilities and operations for both hatcheries were assigned to the Project Leader at Dworshak NFH. Kooskia NFH is located about 1.5 miles southeast of Kooskia, Idaho, near the confluence of Clear Creek and Middle Fork of the Clearwater River. Because of production constraints, disease considerations, and other factors, Dworshak NFH has held and spawned spring chinook salmon adults returning to Kooskia NFH, as well as incubated eggs and reared juveniles. With the inception of the Lower Snake River Compensation Plan (LSRCP) program for spring chinook salmon at Dworshak NFH, transfers between hatcheries have occurred frequently and for several years, the programs were combined. Recently, however, the programs have been separated and adults and offspring are being handled separately.

This report includes a summary of the 1992 adult returns of spring chinook salmon to Dworshak and Kooskia NFHs and predictions for the 1993 adult returns.

1992 Run Size

Rack Returns

The 1992 adult SCS return to the Dworshak-Kooskia NFH Complex was the second worst in recent years. Dworshak NFH had a low rack return of 369 adults replacing the 1986 return as our fourth lowest (Table 1). The adult SCS return to Kooskia NFH was the eighth lowest ever for that facility (Table 2), 312 fish. The lower Kooskia NFH return is partially due to a dramatic decrease (from over 750,000 to less than 400,000) in on-site smolt releases for the 1989 and 1990 release years. The 1990 SCS return was a benchmark for plausible return levels from normal production releases from both hatcheries.

In 1992, 440 adults were spawned at Dworshak NFH and an estimated 866,250 green eggs were taken (Table 3). This is the combined take for the Dworshak-Kooskia NFH Complex, since all spawning operations occurred at Dworshak NFH.

Table 1. Hatchery rack returns and age composition of spring chinook salmon to Dworshak NFH.

Year	I-salt	II-salt	III-salt	Unmeasured	Total Return
1984	14	52	16	0	82
1985	13	281	35	5	334
1986	78	346	91	0	516
1987	25	1604	376	12	2017
1988	163	569	1240	0	1972
1989	156	1322	221	1	1700
1990	7	1892	135	8	2042
1991	16	77	72	0	165
1992	22	286	40	21	369

Harvest

The 1990 run supported a tribal fishery, a sport fishery, and provided enough eggs for both hatcheries, as well as three Idaho Department of Fish and Game satellite facilities. The 1991 run was so low that there was no sport season and the Nez Perce tribe closed their fishery. Although the 1992 run was also low, a sport season was opened for spring chinook on the Clearwater River and the Nez Perce Tribe opened a subsistence fishery. The estimated sport harvest for 1992 was 54 and the Tribal subsistence harvest was estimated to be 160.

Table 2. Hatchery rack returns and age composition of spring chinook salmon to Kooskia NFH.

Year	I-salt	II-salt	III-salt	Unmeasured	Total Return
1972	5	0	0	0	5
1973	5	45	0	0	50
1974	16	35	2	0	53
1975	15	284	27	0	326
1976	409	286	106	0	801
1977	333	2539	154	0	3026
1978	23	1676	336	0	2035
1979	11	100	264	0	375
1980	9	55	3	0	67
1981	1	168	78	0	247
1982	3	116	139	0	258
1983	1	231	141	0	373
1984	55	80	206	0	341
1985	26	449	54	0	529
1986	21	159	103	0	283
1987	16	607	64	0	687
1988	39	363	193	0	595
1989	107	717	142	7	973
1990	11	921	209	0	1141
1991	10	98	350	9	467
1992	14	239	38	21	312

Table 3. Dworshak-Kooskia NFH Complex spring chinook salmon spawning data for 1992.

	Males	Females	Total
Adults Sexed	327	331	658
Adults Spawned	209	231	440
Green Eggs	--	--	866,250
Eyed Eggs	--	--	805,000
Percent Eye-up	--	--	93

Stock Description

We have complete rack returns for the 1989 release year at Dworshak NFH. We realized a 0.008 percent return with a genetic makeup of 100 percent Rapid River stock. The 1990 release year returned 286 II-salt fish to the Dworshak NFH rack. The 1991 release returned only 22 I-salts. (For the genetic make-up of Dworshak NFH releases see Table 4).

We also have complete rack returns for 1989 release year at Kooskia NFH. We had a smolt-to-adult return of 0.03 percent from Kooskia releases. The 1989 release year returned 9 III-salt fish, 98 II-salt fish, and 11 I-salt fish. The 1991 release returned only 14 I-salts. (For the genetic make-up of Kooskia NFH releases see Table 5).

Table 4. Genetic make-up of Dworshak NFH spring chinook salmon releases at the hatchery as smolts.

Release Year	Genetic Make-up*	% Rack Return
1983	75.1% LW	0.0741
	12.3% RR	
	12.6% LE	
1984	100% LE	0.2831
1985	67.8% LW	0.2570
	32.2% LE	
1986	100% LE	0.1610
1987	100% RR	0.0981
1988	100% RR	0.1898
1989	100% RR	0.0077

RR - Rapid River
LW - Little White Salmon
LE - Leavenworth

Table 5. Genetic make-up of Kooskia NFH spring chinook salmon released in Clear Creek as smolts.

Release Year	Genetic Make-up*	% Rack Return
1971	85.6% RR - 14.4% WR	0.0343
1972	100% RR	0.0698
1973	100% CA	0.0798
1974	100% CA	0.1498
1975	58% RR - 42% CA	0.4094
1976	100% SS	0.2338
1977	84% CA - 11% KK - 5% LW	0.0088
1978	75% RR - 25% CA	0.0123
1979	69% KK - 31% CA	0.0327
1980	31% KK - 69% CA	0.0336
1981	64% CA - 19% KK	0.0390
	17% RR	
1982	100% CA	0.0272
1983	65% KK - 35% LE	0.0970
1984	89% KK - 11% RR	0.0533
1985	100% KK	0.2721
1986	100% KK	0.1483
1987	100% CL	0.1263
1988	100% CL	0.1770
1989	100% CL	0.0300

*RR - Rapid River
CA - Carson
SS - South Santiam
LW - Little White Salmon
KK - Kooskia
LE - Leavenworth
CL - Clearwater

Age Composition

Age composition of the run is presently based on fork length categories. These length categories were derived from known age/length/sex data from CWT recovery databases. I-salts are 56 cm or less, II-salts are 57 through 81 cm, and III-salts are larger than 81 cm. The age composition for the 1992 adult return is displayed in Table 6.

Table 6. Age composition for 1992 spring chinook salmon returning to Dworshak-Kooskia NFH Complex.

Dworshak NFH			Kooskia NFH		
Age	Number	Percent	Age	Number	Percent
I-salt	22	6.3	I-salt	14	4.8
II-salt	286	82.2	II-salt	239	82.1
III-salt	40	11.5	III-salt	38	13.1
TOTAL MEASURED	348	100	TOTAL MEASURED	291	100

Survival

The III-salt returns in 1992 complete the returns from the 1,651,472 smolts released at Dworshak NFH and the 384,235 smolts released at Kooskia NFH in 1989. Total returns to the North Fork of the Clearwater (not including harvest estimates) from the 1989 release were 22 I-salts, 286 II-salts, and 40 III-salts for a hatchery return survival rate of 0.0077 percent (Table 7). Total returns to Clear Creek (not including harvest estimates) from the 1989 release were 107 I-salts, 921 II-salts, and 350 III-salts for a hatchery return survival rate of 0.1770 percent (Table 8).

Table 7. Return vs. release numbers for adult spring chinook salmon returns to Dworshak NFH.

Release Year	Smolts Released at Hatchery*	I-salts (% return)	II-salts (% return)	III-salts (% return)	Total (% return)
1988	1,547,219	156 (0.0101%)	2709 (0.1751%)	72 (0.0047%)	2937 (0.1898%)
1989	1,651,472	10 (0.0006%)	77 (0.0047%)	40 (0.0046%)	127 (0.0077%)
1990	1,251,247	16 (0.0013%)	286 (0.022%)		
1991	1,094,884	22 (0.0020%)			

*Includes smolt releases at hatchery only. Does not include off-site releases or fry/fingerling releases.

Table 8. Return vs. release numbers for adult spring chinook salmon returns to Kooskia NFH.

Release Year	Smolts Released at Hatchery*	I-salts (% return)	II-salts (% return)	III-salts (% return)	Total (% return)
1988	778,407	107 (0.0137%)	921 (0.1183%)	350 (0.0450%)	1378 (0.1770%)
1989	384,235	11 (0.0029%)	98 (0.0255%)	37 (0.0096%)	146 (0.0379%)
1990	403,701	10 (0.0025%)	239 (0.059%)		
1991	396,619	14 (0.0035%)			

*Includes smolts released at hatchery only. Does not include off-site releases or fry/fingerling releases.

Coded-wire Tag (CWT) Recoveries

Our facilities have significantly increased SCS marking from the contribution only level (1987 release year, at Dworshak, one CWT group) to the several studies level (1988-1992 release years, 9 to 24 CWT groups). At Kooskia NFH, we occasionally released CWT groups (1984, 1990). Now we mark everything at both hatcheries to allow separation of returning adults (1993 release year). This increase in marking has enlarged the CWT recovery database to a point where it is much more useful for hatchery evaluation. It also increased the workload for CWT sampling, recovery, and data processing.

A summary of adult SCS recoveries in the Dworshak NFH rack is shown in Table 9. Almost all recoveries that were not Dworshak NFH marks were part of National Marine Fisheries Service transportation studies. Occasional strays from other hatcheries do occur.

Table 9. Summary of CWT recoveries for adult spring chinook salmon in the Dworshak NFH rack (1987-1992).

Rack Year	Total Recoveries	Recoveries of Dworshak Marks
1987	25	19
1988	55	49
1989	77	47
1990	306	302
1991	30	10
1992	183	177

1992 Preseason Predictions

The 1990 SCS returns to Dworshak-Kooskia NFH Complex was both gratifying and disappointing. The very successful II-salt return gave us cause to celebrate but the abysmal I-salt return (only 7) forecast a grim 1991. We also overestimated the return for III-salts at Dworshak NFH in 1990 and 1991. We believe that this may be because of the shift in recent years to Rapid River stock which yields higher proportion of II-salt returns. The grim forecast came true, as only 77 II-salts returned to Dworshak NFH, for the lowest II-salt return since 1984, which was the first year Dworshak NFH operated their rack. This was not a big surprise for the II-salt portion of the 1991 run to be down, since the 1990 jack return was the lowest ever at Dworshak NFH. But the mammoth drop off in II-salts from 2720 to 77 was greater than expected. The 1991 jack return (16) did not predict a big recovery in 1992.

Kooskia NFH began an off-site distribution program in 1989. This program dictated a direct release of only 400,000 smolts at Kooskia NFH rather than a full production on-site release of around 800,000 smolts like 1987 and 1988. Therefore we expected a decrease in the number of II-salts returning to the 1991 rack (1989 release year). This decrease was greater than expected since there was only one-tenth as many II-salts as the previous year from a release that was one-half as large. However, the III-salt return was the second largest ever (350). Because of the large decrease in on-site releases future Kooskia NFH rack returns were expected to be lower even though Kooskia NFH maintains a relatively consistent rack return percentage. The 1991 jack return (10) and II-ocean return (98) did not indicate a big recovery at Kooskia either.

Dworshak NFH-1992

1992 Run Prediction		1992 Rack Return	
I-salt =	50	I-salt =	22
II-salt =	300	II-salt =	286
III-salt =	25	III-salt =	40
Total n =	375	Unmeasured =	21
		Total run =	369

Our prediction was a good news/bad news story. The "good news" was that our prediction was pretty close. The "bad news" was that the run was low.

Kooskia NFH-1992

1992 Run Prediction		1992 Rack Return	
I-salt =	25	I-salt =	14
II-salt =	200	II-salt =	239
III-salt =	100	III-salt =	38
Total n =	325	Unmeasured =	21
		Total Run =	312

1993 Run Predictions

The following is our prediction for the 1993 SCS run to the Dworshak-Kooskia Complex.

Dworshak NFH		Kooskia NFH	
I-salts	58	I-salts	44
II-salts	445	II-salts	235
III-salts	72	III-salts	106
TOTAL	575	TOTAL	385
Prediction	575 ± 200	Prediction	385 ± 100

Total predicted to return both hatcheries in 1993 is 960 ± 300.

The total hatchery spring chinook salmon predicted to return to Dworshak and Kooskia NFH's in 1993 will not meet the hatchery needs for eggs in the Clearwater drainage. The number of adults needed for supplying eggs to fill both hatcheries is estimated at 2500. Actual number needed varies, depending on number of eggs per female (which varies with size and age of fish returning) and sex ratio of any particular run. The Dworshak-Kooskia NFH Complex 1989 and 1990 spawning operations satisfied their needs as well as the egg requirements for the Lower Snake River Compensation Plan satellite station at Powell, Red River, and Crooked River. Unfortunately, this was not the case

in 1991 or 1992. The 1993 run will be an improvement over 1991 and 1992 but not a big enough improvement to meet our broodstock goal of 2500. However, we think both stations will see dramatic increases in jack counts in 1993 because of smolt assessment data. Better days may be ahead.

APPENDIX B

ADULT STEELHEAD RETURNS TO DWORSHAK NFH IN 1991-92 AND PROGNOSIS FOR 1992-93

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December 1992

Introduction

Dworshak NFH is located at the confluence of the North Fork and the main-stem of the Clearwater River near Ahsahka, Idaho. Construction of the hatchery was included in the authorization for Dworshak Dam and Reservoir (Public Law 87-847, October 23, 1962) to mitigate for losses of anadromous steelhead (*Oncorhynchus mykiss)* caused by the dam and reservoir.

The hatchery was designed and constructed by the U.S. Army Corps of Engineers (COE) and has been administered and operated by the U.S. Fish and Wildlife Service since the first phase of construction was completed in 1969. At that time, the hatchery had 25 ponds on a reuse system and 59 ponds on a single-pass system. In 1972, a second phase of construction placed all ponds on the reuse system with the option of operating some ponds on either reuse or single-pass.

The North Fork Clearwater River steelhead stock maintained by Dworshak NFH is unique in the Columbia River Basin. At maturity, males and females of this stock (also referred to as "B" run steelhead) average about 91 cm (36 inches) and 82 cm (33 inches) in length, respectively. Spawning stock is comprised primarily of three age classes; I-, II-, and III-"salt" fish. This nomenclature refers to the number of complete years fish have spent in salt water. Chronologically, the fish are 2 years older than this system indicates as they are reared for 1 year in the hatchery and spend another year emigrating and returning from the ocean to the hatchery.

The "B" run steelhead enter the Columbia River in August, later than the smaller size "A" run fish. The "B" run reaches the Snake and Clearwater Rivers in the fall, then overwinter until their final spawning run into the hatchery.

Releases of steelhead smolts from Dworshak National Fish Hatchery (NFH) began in 1970 with the first hatchery produced adults returning in 1972. The 1991-92 return marked the 20th year that artificially spawned North Fork Clearwater River steelhead have returned to Dworshak NFH. Table 1 summarizes the Dworshak NFH steelhead returns to the Clearwater from 1972-1992. This report reviews the statistics of the 1991-92 run and the prognosis for 1992-93.

1991-92 Adult Returns

The hatchery ladder was opened October 21, 1991 and remained open until December 6, 1991. A total of 729 steelhead entered the trap. The initiation of ladder operation in October was a continuing attempt to insure inclusion of early arriving SST in the hatchery gene pool. The ladder was reopened February 18, 1992 and was closed on May 4, 1992. A total of 2,966 adult steelhead entered the ladder during the spring of 1992. The total returns by age, sex, and time of return including a summary of spawning data is listed in Table 2. A total of 2,036 excess fish and carcasses from spawned adults and health samplings were donated to the Idaho Department of Education food bank.

Table 1. Number of steelhead trout returning to Dworshak National Fish Hatchery, estimates of hatchery fish harvested, and total hatchery returns to the Clearwater River, Idaho.

Return[1]	Number Back To DNFH	Estimated Sport Fisherman Harvest Clearwater R.	Estimated Tribal Harvest Clearwater R.	Hatchery Fish Return Upriver of North Fork (unharvested)[8]	Total Hatchery Fish Returning to Clearwater R.
1972-73	9,938	2,068	-	0	12,006
1973-74	7,910	2,320	-	0	10,230
1974-75	1,698	N.S.[3]	290	0	1,988
1975-76	1,858	N.S.	430	0	2,288
1974-77	3,100	N.S	410	0	3,510
1977-78	12,727	14,000	(1,000)[5]	0	27,727
1978-79	4,939	4,610	(500)	0	10,049
1979-80	2,519	N.S.	1,250	300	4,069
1980-81	1,968	4,510	(1,000)	500	7,978
1981-82	3,054	1,665	(1,000)	0	5,719
1982-83	7,672	13,967[4]	(1,500)	0	23,139
1983-84	3,284	6,500	(1,500)	100	11,384
1984-85	14,018	19,410	(1,500)	2,700	37,628
1985-86	4,462	7,240	1,471	1,800	15,002
1986-87	5,286[2]	15,679	4,210[6]	3,000	28,175
1987-88	3,764	8,766[9]	1,478[7]	2,000	16,008
1988-89	6,041	11,332[9]	1,242[10]	3,700	22,315
1989-90	10,630	27,953[9]	1,710[10]	3,650	43,943[11]
1990-91	7,876	12,810	1,211	2,250	24,147
1991-92	3,700	10,416	1,326	1,650	17,092

(1972-73 to 1983-84 data based on report from Pettit, 1985, IDFG Federal Aid Report, Project F-73-6, January, 1985.)

[1]Return year is from October through May.

[2]Actual number returned, ladder closed, not a complete return figure.

[3]N.S., no sport fishing season.

[4]Pettit included an additional 2,000 fish in harvest from Snake River for a total of 15,967.

[5]( ) guesstimate on tribal harvest by author.

[6]Mauney, J.L. et al. 1988. A survey of the Nez Perce subsistence fishery for steelhead trout (*Oncorhynchus mykiss*) the Dworshak National Fish Hatchery ladder North Fork of the Clearwater River, Idaho, 1986-87.

[7]Mauney, J.L. et. al. 1990. A survey of the Nez Perce subsistence fishery for steelhead trout (*Oncorhynchus mykiss*) North Fork of the Clearwater River, Idaho, 1987-88.

[8]Based on return percentage back to hatchery to calculate returning of II-salts from upstream releases.

[9]Kent Ball, IDFG, Salmon, Idaho, Personal Communication.

[10]Paul Kucera, Nez Perce Tribe, Lapwai, Idaho, Personal Communication.

[11]We believe the sport estimate of 27,953 is around 8,000 too high and the total number of Dworshak steelhead to the Clearwater River was in the range of 31,000 to 35,000. (See last paragraph on the previous page)

Table 2. Adult steelhead returns and spawning data for 1991-1992 at Dworshak National Fish Hatchery, Idaho.

	Males	Females	Total
Fall Run (10/21 to 12/6)			
I-salt	113	4	117
II-salt	145	395	540
III-salt	27	45	72
Spring Run (2/18 to 5/4)			
I-salt	170	26	196
II-salt	593	1,999	2,592
III-salt	75	103	178
Combined Total			
I-salt	283	30	313
II-salt	738	2,394	3,132
III-salt	102	148	250
Unmeasured Rack Returns	-	-	5
Total Rack Return	1,123	2,572	3,700
Total Number Spawned	851	1,263	2,114

Green Eggs = 8,768,053
Eyed Eggs = 5,937,000
Percent eye up = 81.0%

Adult Outplanting

On occasion when we have more adult steelhead return to the hatchery than can be accommodated, they are outplanted into streams. Usually the outplanting is to allow some natural spawning, but some Dworshak outplanting is solely to provide for a specific sport fishery. In 1992, Dworshak NFH outplanted 260 adult steelhead. Table 3 summarizes numbers and release locations of the outplanted adults.

Coded-Wire Tag Returns (CWT)

Data on coded-wire tag returns for 1992 are still being analyzed. For the most complete and up to date information on coded-wire tag returns, the reader is referred to Roseberg et al. (1992).

Age Composition

A good relationship has been developed between age and fork length at return for steelhead based on coded-wire tag returns at Dworshak NFH. The criteria for age determination of males and females is listed below:

	I-salt	II-salt	III-salt
Males	< 73 cm	73 - 92 cm	> 92 cm
Females	< 68 cm	68 - 90 cm	> 90 cm

The age composition of steelhead returning to Dworshak NFH in 1991 - 1992 was as follows:

	Number	Percent
I-salt	313	8.5
II-salt	3,132	84.7
III-salt	250	6.8

The adult return was comprised of 69.7 percent females and 30.3 percent males. For a more detailed summary of age and sex composition, see Table 2.

Survival

The return of Dworshak NFH steelhead to the rack was comprised of an estimated 84.7 percent II-salt fish. If this factor is applied to our estimated total of 17,092 steelhead to the Clearwater River, then 14,476 II-salt fish returned to the Clearwater. In 1989, Dworshak NFH released 1,073,900 steelhead smolts in the Clearwater River. Based on the estimated II-salt returns to the Clearwater of 14,476, this equals a 1.3 percent smolt to adult return.

Table 3. Dworshak NFH Adult Steelhead Outplants, 1992.

Date	Males	Females	Total	Site	Purpose
3/11/91	0	120	120	Main South Fork Clearwater River	Natural Spawning
3/12/91	0	120	120	Main South Fork Clearwater River	Natural Spawning
4/8/91	10	10	20	Crooked River	Natural spawning
TOTAL	10	250	260	Dworshak outplants	

Predictions for Adult Steelhead Returns

Predictions by the Idaho Fishery Resource Office (IFRO) are based primarily on the strength of returns of younger age classes for any given brood. For example, there is a strong linear correlation (r=0.95) for predicting the number of II-salt steelhead returning in a year based upon the number of I-salt fish that returned the previous year. A similar regression is used for predicting the III-salt return from the number of II-salt fish which returned the previous year. We do not have a consistent and accurate prediction method for I-salts. Instead, an average percentage return for I-salt fish is applied to the number of smolts released for the appropriate brood year. These three estimates are summed to predict the total hatchery return.

1991-1992 Adult Return

For the 1991-92 steelhead run, we had predicted 4,650 fish back to the Dworshak NFH rack (see our 1991 annual report). We overestimated the return to Dworshak NFH rack, which was 3,700 fish. Our estimate was off 26 percent. We also predicted a total return to the Clearwater River of 15,500. We may have slightly under-estimated the total return of DNFH steelhead to the Clearwater River. Using the adult return rates to Lower Granite of our indicator II-Ocean fish (groups that were coded wire tagged and freeze branded), 0.89 percent for hatchery released fish and 0.53 percent for off-site released fish, we estimated that 10,000 II-Ocean DNFH fish crossed Lower Granite Dam during the fall of 1991 and spring of 1992. Similar estimates for III-Ocean (1,600) and I-Ocean (250) bring the estimate to 11,850 for DNFH steelhead past Lower Granite. Jerry Harmon's NMFS crew took scale samples from trapped steelhead at Lower Granite. They estimated 13,745 hatchery "B" steelhead crossed Lower Granite in the 1991-92 run year. When we estimate the total harvest and escapement for the Clearwater River by adding up the various components of the run, we get a higher figure. Using the estimated sport harvest figure from IDFG, 6,875 fall harvest and 3,541 spring harvest (total 10,416), adding in the hatchery return of 3,700 fish, the estimated Nez Perce tribal harvest of 1,326 and non-harvested escapement to the drainage of 1,650, we get an estimated number of 17,092 DNFH fish to the Clearwater. (Note, the spring sport harvest numbers are preliminary and subject to possible revision). So, our original prediction of 15,500 falls roughly in the middle of Harmon's 13,745 and the component summary estimate of 17,092.

1992-1993 Adult Returns

Based on correlation of I-salts to II-salts and standard percentage for I and III-salts, we estimated the following for hatchery returns:

II-salts = 5074
III-salts = 300
I-salts = 300
TOTAL = 5674 back to hatchery

With an estimated Idaho sport harvest of 50 percent of hatchery fish entering the Clearwater and an estimated Nez Perce Tribal harvest in the Clearwater of 1,500 fish, we have estimated the following 1992-93 return for the Clearwater River.

1870	KNFH rack return
5674	DNFH rack return
7500	Sport harvest of fish destined for DNFH
3368	Return of upstream outplants - less sport harvest
3368	Upstream outplants - sport harvested
1500	Nez Perce Tribal harvest in Clearwater River
23280	TOTAL DNFH fish entering Clearwater

Putting a range estimate on the above, we feel comfortable in estimating between 21,000 and 25,000 DNFH steelhead will enter the Clearwater River during the 1992-1993 run year. A lot will depend on fall river flows, fall water temperature, and Zone 6 harvest season length. Another factor entering into our analysis is the downstream sport harvest below the Lower Snake River dams, in the reservoirs, and also the sport harvest in the Lower Columbia River. Downstream sport harvest by Washington and Oregon anglers of "B" steelhead is increasing.

The on-site releases in 1990 (the year class returning as II-salts) numbered 1.17 million steelhead smolts following the 1989 on-site releases of 1.07 million smolts. The total release to the Clearwater drainage in 1990 was 2.66 million, or considerably more than the 1.80 million of the previous year.

All in all, the 1992-93 steelhead season for the Clearwater looks to be much better than last year but not as quite good as the 1989-90 run.

Literature Cited

Roseberg, R.B., H.L. Burge, W.H. Miller and D. Diggs, 1992. A review of coded-wire tagged fish released from Dworshak, Kooskia, and Hagerman National Fish Hatcheries. 1976-1990. U.S. Fish and Wildlife Service Report. Ahsahka, ID.