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IDAHO WATER RENTAL PILOT PROJECT PROBABILITY COORDINATION STUDY RESIDENT FISH AND WILDLIFE IMPACTS PHASE III

Annual Report 1996

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IDAHO WATER RENTAL PILOT PROJECT
PROBABILITY/COORDINATION STUDY
RESIDENT FISH AND WILDLIFE IMPACTS

PHASE III

ANNUAL REPORT

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EXECUTIVE SUMMARY

Phase III began in 1995 with the overall goal of quantifying changes in resident fish habitat in the Snake River basin upstream of Brownlee Reservoir resulting from the release of salmon flow augmentation water. Existing data, in the form of weighted usable area versus flow relationships, were used to estimate habitat changes for white sturgeon (Acipenser *transmontanus)* and rainbow trout *(Oncorhynchus mykiss)* in the Snake River between C.J. Strike Dam and Brownlee pool. The increased flows resulted in increased white sturgeon habitat for most life stages. Rainbow trout adult and spawning habitat increased while juvenile'and fry habitat generally decreased. Whether or not these short term increases in habitat result in long term benefits to the fish populations has yet to be determined.

INTRODUCTION

The use of stored Snake River water to aid anadromous fish migration in the Snake River downstream of Lewiston, Idaho, and in the Columbia River began in 1982 with the adoption of the first Columbia Basin Fish and Wildlife Program (Program) by the Northwest Power Planning Council (NPPC). The Program called for a total of 1.19 million acre-feet (af) of water from the Snake River Basin to be delivered to Lower Granite Dam between April 15 and June 15 each year to aid spring outmigrating anadromous fish (the water budget) (NPPC 1982). This water would come primarily from Dworshak and Brownlee reservoirs.

The water budget evolved and became more specific in the NPPC's Strategy for Salmon (NPPC 1992) in the use of Snake River water for flow augmentation. It called for a total of 427,000 af of . water to come from the upper Snake River upstream of Brownlee Reservoir, up to 900,000 af from Dworshak Reservoir to aid spring migrants and up to 200,000 af from Dworshak Reservoir to aid fall migrants. Then with the listing of Snake River salmon stocks on the endangered species list, the National Marine Fisheries Service (NMFS) in its Biological Opinion (NMFS 1995) on endangered Snake River salmon, replaced the water budget with flow targets for the Snake and Columbia rivers while maintaining the requirement to use at least 427,000 af of upper Snake Basin water for flow augmentation. In 1996, the Idaho Legislature approved the use of the 427,000 af on an experimental basis through the year 2000.

The Idaho Water Rental Pilot Project began in 1991 as part of the 1990 Non-Treaty Storage Fish and Wildlife Agreement (NTSF'WA) between Bonneville Power Administration (BPA) and the Columbia Basin Fish and Wildlife Authority (CBFWA). This agreement resulted from concerns over potential impacts to fish and wildlife resulting from the Non-Treaty Storage Agreements (NTSA) signed between BPA and the mid-Columbia utilities, and between BPA and British Columbia Hydro and Power Authority. The NTSFWA contained several provisions designed to ensure the NTSA did not adversely impact fish and wildlife. One of the provisions called for identifying conditions needed for resident fish and wildlife and to protect those needs.

The Idaho Water Rental Pilot Project was designed to "identify resident fish and wildlife issues, concerns, and resources in the Snake River system, estimate impacts, and provide management recommendations to protect and enhance those resources" as impacted by the release of water in the upper Snake River Basin

(upstream of Brownlee Reservoir) for enhancing juvenile salmon outmigration (Riggin and Hansen 1992). After the initial-three years of the project, it was integrated into the NPPC's Fish and Wildlife Program. The project was divided into these three phases:

1. Phase I focused on summarizing and identifying existing resident fish and wildlife resources, issues, and concerns as well as making flow recommendations (Riggin and Hansen 1992).

2. Phase II focused on conducting an Instream Flow Incremental Methodology (IFIM) study on the Snake River upstream of American Falls Dam and summarizing Snake River basin water issues and flow augmentation releases since the completion of phase I (Stovall 1994).

3. Phase III is focusing on quantifying changes in resident fish habitat in the upper Snake River resulting from salmon flow augmentation releases and has these specific objectives:

   Determine impacts to resident fish habitat (in weighted usable area (WUA)) in the upper Snake River Basin, for selected native fish species, resulting from salmon flow augmentation releases.

   Develop a model that estimates changes in fish habitat (WUA) in the upper Snake River resulting from salmon flow augmentation releases.

   Coordinate with state, federal, and tribal agencies to ensure that duplication of effort does not occur in efforts to explore water management opportunities in the upper Snake River Basin for salmon flow augmentation.

STUDY AREA

The study area encompasses the Snake River upstream of Brownlee pool to the Idaho border, the Henrys Fork, Boise River, and Payette River drainages. The flow augmentation water comes from these BOR facilities on the Snake River: American Falls

Reservoir, Minidoka (Lake Walcott), Palisades Reservoir, and Jackson Lake in Wyoming. Ririe Reservoir on Willow Creek in the upper Snake River upstream of Milner Dam was used in 1994. The Boise River facilities include Lucky Peak, Arrowrock, and Anderson Ranch reservoirs. The Payette system includes Black Canyon, Cascade, and Deadwood reservoirs (Figure 1).

METHODS

The first step in attempting to quantify impacts to resident fish habitat was to conduct a literature search for habitat versus flow data in the upper Snake River Basin. A subset of the water rental technical team (formed during phase I to guide the development, direction, and scope of the project) was used to assist in the search. This subgroup included biologists from the Bureau of Reclamation (BOR), U. S. Fish and Wildlife Service (USFWS), Idaho Power Company (IPC), and the Shoshone-Bannock Tribes (SBT), as well as one representative from the Idaho Water Users Association (IWUA).

The data from the literature was analyzed to determine if it would be useful in quantifying changes in fish habitat resulting from the salmon flow augmentation water. To be useful, the literature data needed to be complete (with the raw data used to produce habitat versus flow curves), relatively current, a direct measurement of habitat, and be based on data from the Snake River or similar large river system (Bovee et al. 1995). At this time, only data from the USFWS's Swan Falls Instream Flow Study (Anglin et al. 1992) have proven useable.

The Swan Falls Instream Flow Study (SFIFS) covered the Snake River from C.J. Strike Dam to Brownlee Pool. This section was divided into five study reaches:

1. From C.J. Strike Dam downstream to Swan Falls Pool;
2. Swan Fall Dam downstream to Walters Ferry;
3. Walters Ferry downstream to the mouth of the Boise River;
4. The Boise River mouth downstream to the mouth of the Payette River;
5. The Payette River mouth downstream to Brownlee Pool.

Habitat versus flow relationships were developed for six species in each study reach: white sturgeon *(Acipenser transmontanus),*

rainbow trout *(Oncorhynchus mykiss),* mountain whitefish *(Prosopium williamsoni),* smallmouth bass (Micropterus dolomieui), flathead catfish *(Pylodictis olivaris),* and channel catfish *(Ictalurus punctatus).* The analysis used in this report covered the same five study reaches. Due to time constraints, only white sturgeon and rainbow trout were used in this analysis. Total WUA was expressed in millions of square feet in each reach.

There are several other studies we hope to use in the near future if the raw data used to develop the habitat versus flow relationships and a more accurate accounting of the flow augmentation water upstream of Milner Dam can be found. One is an IFIM study on the South Fork of the Snake River below Palisades Dam (Schrader and Griswold 1994). One is an IFIM study on the Snake River upstream of American Falls Reservoir (Holden et al. 1987). There are several studies (some are ongoing) conducted by Idaho Power Company as part of their relicensing efforts for Bliss, Upper Salmon Falls, and Lower Salmon Falls hydropower projects that may also prove useful (Anglin et al. 1994; Addley and Hardy 1995; Lepla and Chandler 1995a; Lepla and Chandler 1995b).

The Idaho Department of Fish and Game, in cooperation with the Idaho Department of Water Resources (IDWR), conducted minimum flow studies on much of the Snake River in the 1970s and 1980s using the wetted perimeter method (White and Cochnauer 1975; Cochnauer 1976, 1977; Cochnauer and Buettner 1978; Cochnauer and Hoyt 1979; Horton and Cochnauer 1980; Cochnauer and Mabbott 1981). This data was not used because the method is a standard setting method used to define minimum flows. It is based on the assumption that if minimum flows over narrow riffles are adequate for food production, passage, and spawning, then all other habitats will be adequately protected as well (Stalnaker et al. 1994). The wetted perimeter is an indirect measure of habitat and thus could not be used to quantify habitat changes resulting from increased flow.

Data tracking the movement of the flow augmentation water from the upper Snake River Basin were collected and summarized from the BOR and IDWR. One problem with this data is that the agencies' tracking of the data is incomplete from a biological perspective. IDWR has detailed information on the water including days, volumes, flow rates, etc., but it is only monitored at three locations in the upper Snake River Basin. These locations are Milner Dam on the main Snake River, Letha Bridge on the lower Payette River, and the Middleton Gage on the lower Boise River. The Murphy Gage, downstream from Swan Falls Dam, would be an excellent location to account for and

demonstrate impacts of the flow augmentation water in the lower Snake River. Unfortunately, it is not being used for this purpose at this time (B. Ondrechen, IDWR personal communication). The BOR data, on the other hand, give the total volumes released from each reservoir but do not give when it was released nor the resulting flows. Much of the water coming from the upper Snake River appears to come from several reservoirs upstream of Milner Dam. It is impossible to tell from their data how much water came from what reservoirs and when it was released. The major problem with keeping track of flow augmentation water has been the difference between the accounting of the water and the actual physical movement of water through the system. On paper, the data from the BOR and IDWR show the water is being moved out of various reservoirs at various times of the year (primarily in the upper Snake River Basin). The reality, however, is that the water is physically moved only out of American Falls Reservoir (R. Larson BOR personnel communication) while other reservoir storage accounts are charged with the flow augmentation releases. For example, individuals that own storage rights in any of the reservoirs upstream of Milner Dam (water district 01) may put some of their stored water into the district's rental pool. If the BOR purchases water from the rental pool, it will physically be moved out of American Falls Reservoir even though the storage right may have been from someplace else. The accounting of the water will be charged to the reservoirs where the storage right exists. The only time the water will be physically moved from a reservoir other than American Falls Reservoir in the upper Snake Basin is during a very low water year when there is not enough water in American Falls (R. Larson BOR personal communication). This has greatly hampered the ability to estimate resident fish habitat changes due to these releases.

A Lotus spreadsheet was developed that calculated the change in WUA expressed in millions of square feet for these four age classes of sturgeon in each reach: adult, larvae, spawning, and incubation. The age classes for rainbow trout were adult, juvenile, spawning, and fry. The spreadsheet took United States Geological Survey (USGS) daily stream gauge data and subtracted the flow augmentation releases from IDWR. The resulting values represented what the flow in the river would have been without .the flow augmentation releases. The stream gauge data represents the flow in the river with the flow augmentation water. Then using the SFIFS data, WUA was calculated for each flow. These values were subtracted to get the change in WUA resulting from the flow augmentation releases. The SFIFS habitat versus flow curves were developed using flows from 5,000 to 17,000 cubic feet per second (cfs) in 1,000 cfs increments (5,000, 6,000, 7,000, etc.). Actual flows were somewhere between these points, so WUA

for the actual flows were estimated by linear interpolation between the two closest increments. If the actua.1 flow was 6,500 cfs, the WUA was calculated to be half-way between the WUA at 6,000 and 7,000 cfs. If the actual flow was 8,900 cfs, the WUA was estimated to be 90% of the difference between the WUA at 8,000 and 9,000 cfs. This analysis was done for the 1994 and 1995 flow augmentation releases by month. Habitat changes were summarized for each month the flow augmentation water was released.

The data from IDWR give the dates the flow augmentation water passes the three control points (Milner Dam on the Snake River, Letha Bridge on the Payette River, and the USGS gage on the Boise River near its mouth) and the dates the water reaches Brownlee Pool. From this it was possible to determine the number of days it took the water to travel from the control points to Brownlee Pool. It was assumed that the water traveled an equal distance each day in order to estimate when the water reached each of the five study reaches between C.J. Strike Dam and Brownlee Pool.

RESULTS AND DISCUSSION

Flow augmentation releases for 1994 and 1995 are summarized in Tables 1 and 2. Although the total volumes are similar between years (428,112 af in 1994 and 427,235 af in 1995) the timing and duration of the releases, the reservoirs used, and volumes from each reservoir were quite different. The 1994 releases started and ended much earlier than in 1995. The Snake River releases began mid-April and ended mid-August (four months), while the 1995 releases started the first of July and ended late September (three months). The Payette release was much later in 1995. It began in mid-December and ended late February. This was done to benefit resident fish in the Payette River system downstream from Cascade and Deadwood reservoirs. Winter has been identified as a critical period for salmonids in the Payette River system. It is thought to be the time when additional flows would benefit the fishery the most (Riggin and Hansen 1992). The volume of water released in the Payette system more than doubled between 1994 and 1995, while the volume released in the Boise system decreased by 9,000 af. The volume that was released out of the Snake River upstream of Milner Dam was almost 100,000 af more in 1994 than 1995. All this variability in augmentation releases makes modeling or predicting impacts to fish habitat extremely difficult, if not impossible. Unfortunately, this variability will most likely continue due to the unpredictable mountain

snowpack and water availability each year.

Table 3 lists flow releases since 1987. The flows from the upper Snake River were less than 200,000 af prior to 1993. The release of approximately 427,000 af has occurred only the last three years.

The habitat versus flow relationship data that were pulled together from the literature search is summarized in Table 4. Most of the data were not used in this analysis because they were outdated, the data were suspect, or there was not enough data to perform the analyses. Either the values used to produce the habitat versus flow curves were missing or the data were from sections of the basin where it was not possible to determine when, how much, and at what rate the flow augmentation water was released. These last two problems are being addressed and hopefully, more sections of the Snake River Basin can be included in future reports.

Tables 5-24 summarize the changes in fish habitat for white sturgeon and rainbow trout in the five study reaches in the Snake River from C.J. Strike Dam to Brownlee Pool for 1994 and 1995. Anglin et al. (1992) summarized the spawning, incubation, larval, and adult/juvenile time periods for each species in each of the five sections. Those for white sturgeon and rainbow trout are listed in Table 25. The changes in habitat were not estimated for much of the white sturgeon and rainbow trout spawning, white sturgeon incubation, and white sturgeon larval life stages because they either ended prior to (as in 1995) or partially through (as in 1994) the flow augmentation releases.

In almost all cases the increased flows resulted in increased habitat for all age classes of white sturgeon (Tables 5-9 for 1994; Tables l0-14 for 1995). The only decreases in sturgeon habitat due to these increased flows in 1994 were for sturgeon larvae in the Swan Falls Dam to Walters Ferry Reach in all months, and for larvae in the Payette River mouth to Brownlee Pool reach during the month of May. Losses were relatively small, ranging from 90,000 square feet (sf) to 200,000 sf. All the larval sturgeon habitat versus flow curves in the SFIFS declined at the higher flows, implying a loss of habitat at these flows. But, this is more an artifact of the inability to adequately sample larval fish in large rivers during high flows than it is an actual loss of habitat (D. Anglin personal communication). We know that historically we had healthy sturgeon populations and flows in the Snake River that were much higher during the spawning and larval stages than were observed in 1994. Also, Lepla and Chandler (1995b) identified sturgeon in

the middle Snake River as-habitat generalists, using a wide variety of habitats. Physical habitat variables (depth, velocity, and substrate) accounted for only 28% of the variability in sturgeon location. Lepla and Chandler (1995b) suggested other factors such as prey abundance and availability may be more important than physical habitat in determining the distribution of white sturgeon in the middle Snake River. This concurs with other work in the Columbia River (Parsley and Beckman 1992). So, apparent losses in larval sturgeon habitat and gains in adult sturgeon habitat should be interpreted cautiously, with the knowledge of the limitations of the techniques.

The 1994 increases in adult/juvenile white sturgeon habitat ranged from a low of 170,000 sf in the Swan Falls Dam to Walters Ferry Reach during May to 7,330,OOO sf in the Boise River Mouth to Payette River Mouth Reach during July. Increases in larval white sturgeon habitat ranged from a low of 70,000 sf in the C.J. Strike Dam to Swan Falls Pool Reach during May to a high of 4,060,OOO sf in the Walters Ferry to Boise River Mouth Reach during June. The only month where spawning occurred during flow augmentation releases was April. Increases in spawning habitat ranged from 400,000 sf in the Swan Falls Dam to Walters Ferry Reach to a high of 1,770,OOO sf in the Payette River Mouth to Brownlee Pool Reach. The only months where incubation occurred during flow augmentation releases were April and May. The habitat increases ranged from 200,000 sf in the Swan Falls Dam to Walters Ferry Reach during May to 2,350,OOO sf in both the Walters Ferry to Boise River Mouth Reach and the Boise River Mouth to Payette River Mouth Reach during April.

The 1995 flow augmentation releases were much later than 1994. They began in July. Therefore, only the adult/juvenile life stage was present. Habitat for adult/juvenile white sturgeon increased for all months in all reaches. Increases ranged from 40,000 sf in the Swan Falls Dam to Walters Ferry Reach in October to 6,330,OOO sf in the Boise River Mouth to Payette River Mouth Reach during August. The reasons the October increases were relatively small are that the flows only lasted for the first several days of the month, and they were being reduced to base flow.

Interpretation of the rainbow trout results is not as straight forward as the sturgeon. The results are summarized in Tables 15-19 for 1994, and Tables 20-24 for 1995. Habitat increased for adult rainbow trout in all sections both years except for October 1995 in the Boise River Mouth to Payette River Mouth Reach. Adult habitat was reduced by l,OOO,OOO sf. This is most likely

explained by the fact that total WUA for adults peaked at 10,000 cfs, and there was a relatively minor change in flow due to augmentation releases (376 cfs - flows were being reduced to base flow). So, both the total flow and the net flow remained higher than the 10,000 cfs peak. In 1994, increases ranged from 910,000 sf in the Walters Ferry-Boise River Mouth Reach during May to 26,570,OO sf in the Boise River Mouth to Payette River Mouth Reach during July. In 1995, the increases ranged from 140,000 sf in the Boise River Mouth to Payette River Mouth Reach during September to 25,600,OOO sf in the Walters Ferry to Boise River Mouth reach during August.

Flow augmentation water was released during the rainbow trout spawning period only in 1994 (April). Spawning habitat increased in four of the five reaches. The Swan Falls Dam-Walters Ferry Reach lost only 20,000 sf of spawning habitat. Spawning habitat increased in the other reaches from 620,000 sf in the C.J. Strike-Swan Falls Pool Reach to 17,910,OOO sf in the Walters Ferry-Boise River Mouth Reach.

In the majority of cases, the flow augmentation releases appear to result in losses of juvenile and fry rainbow trout habitat during both 1994 and 1995. In 1994, there was only one section that experienced an increase in juvenile rainbow trout habitat. The increase was only for three of the five months (June, July, and August). The increases were minor, ranging from 240,000-430,000 sf. Juvenile habitat losses ranged from 90,000 s.f in the Swan Falls Dam-Walters Ferry Reach during April to 12,650,OOO sf in the Walters Ferry to Boise River Mouth Reach during May. Fry habitat increased in two reaches of the Snake River: Boise River Mouth-Payette River Mouth (three months) and from the Payette River Mouth-Brownlee Pool (two months). These increases were small to moderate ranging from 550,000 sf (Payette River Mouth-Brownlee Pool in June) to 6,730,OOO sf (Boise River Mouth-Payette River Mouth in August). Fry habitat losses ranged from 270,000 sf in the C.J. Strike Dam to Swan Falls Pool Reach during August to 12,670,OOO sf in the Walters Ferry - Boise River Mouth Reach during July.

In 1995, all reaches and months show a loss of both juvenile and fry habitat with one exception. Juvenile habitat increased only in the Swan Falls Dam-Walters Ferry Reach during August. The increase was minor, only 70,000 sf. Estimated juvenile habitat losses ranged from 40,000 sf in the Swan Falls Dam-Walters Ferry Reach during October to 13,870,OOO sf in the Walters Ferry-Boise River Mouth Reach during July. Estimated fry habitat losses ranged from 330,000 sf in the C.J. Strike Dam-Swan Falls Pool Reach during July to 13,800,OOO sf in the Walters Ferry to Boise

River Mouth Reach during August.

As with white sturgeon, it is extremely difficult to sample large rivers for juvenile and fry life stages, especially at high flow. Because of this, the suitability index (SI) curves used for rainbow trout were not site specific. They were taken from the literature (Raleigh et al. 1984). These curves were developed on small, clear trout streams in Colorado. This calls into question the appropriateness of using these SI curves. Because they were developed for small streams, the preference or use of the habitat (as expressed by depth, velocity, cover, and temperature) will undoubtedly be narrow, especially when compared to the broader range of habitat that would be expected in a larger river. These fish may use a greater range of habitat in a larger river simply because it is available. Thus, using SI curves developed for small streams may result in an artificially reduced or restricted estimate of available habitat when applied to large rivers.

The flow recommendations in the SFIFS (Anglin et al. 1992) are summarized in Table 26. It is interesting to note that actual flows in 1994 and 1995 (including the flow augmentation water) were not close to the integrated fish flows (the target or preferred fish flows), the recommended flows for average water years, or the recommended flows for wet years. They were at best 2,000 cfs below the integrated fish flows. Even during the wet year of 1995, the flows in three of the four months only exceeded the dry year flow recommendation and were about 100 cfs below the average year recommendation. There were only two of the five months in 1994 where the total flows exceeded the dry year recommendation. Clearly, although the additional flow provided by the flow augmentation water provides benefits to resident fish (primarily sturgeon), it is not enough to avoid further degradation of sturgeon habitat because Anglin et al. (1992) defined these minimum flows as that which would prevent "further degradation of resident fish habitat." This analysis also raises several questions. Does a short-term (three to five month) increase in flows provide any long-term benefits to resident fish habitat and thus resident fish? When are the flow (or habitat) bottlenecks for sturgeon and rainbow trout (or other resident fish species) in this section of the Snake River? If they are not during the summer, then does this water have any long-term benefit to resident fish? If there is a summer flow bottleneck once these flows are reduced to base flow in the fall, are the benefits then lost because the flow bottleneck has just been delayed to later in the year? These questions are beyond the scope of this project but need to be addressed if this water is to be to benefit resident fish.

CONCLUSIONS

It is clear that the flow augmentation provides benefits to most white sturgeon life stages and rainbow trout adults and spawning. The picture is not so clear for other rainbow trout life stages. Habitat losses could be real, or they could just as easily be an artifact of not having site-specific data on which to base habitat versus flow relationships. There are questions regarding the long-term benefit to sturgeon and other species with a short-term (summer) flow enhancement. If this is not a critical time period for the species in question, it is doubtful that any benefits will be sustained. Despite the benefits, the additional water provided by flow augmentation rarely added enough water to meet the minimum flows recommended in the SFIFS. These minimum flows were what Anglin et al. (1992) felt would prevent "further degradation of resident fish habitat." Further decreases in resident fish habitat quality and quantity can be expected despite this increase in flow through the Snake River.

There are not enough IFIM data in the Snake River Basin to estimate resident fish habitat changes resulting from this flow augmentation water in most of the basin. Even where the data exist, quantification of habitat changes are further complicated by the water accounting system established by the BOR and IDWR. The present system is inadequate for describing when the water is released, the source reservoir for the water, and at what daily rate the water is released (in cfs), especially in the Snake River upstream of Milner Dam. Until a more detailed method for tracking and recording flow augmentation water is developed, quantifying impacts to resident fish habitat will be very limited.

The 1995 water year does not accurately reflect the impacts of flow augmentation on resident species. High flows and cool temperatures over an extended period of time during the spring and summer of 1995 masked potential benefits. IPC relicensing information indicates the change in timing of the hydrograph, and increased water temperatures in the spring may be having the greatest impact on the spawning success and recruitment of juvenile white sturgeon. Future flow augmentation releases should attempt to simulate the natural timing of high spring flows and provide water temperatures suitable for the successful sturgeon spawning and survival of the eggs, larvae, and juveniles. We hope to better quantify the flow timing and temperature requirements for white sturgeon in the upper Snake River in 1996.

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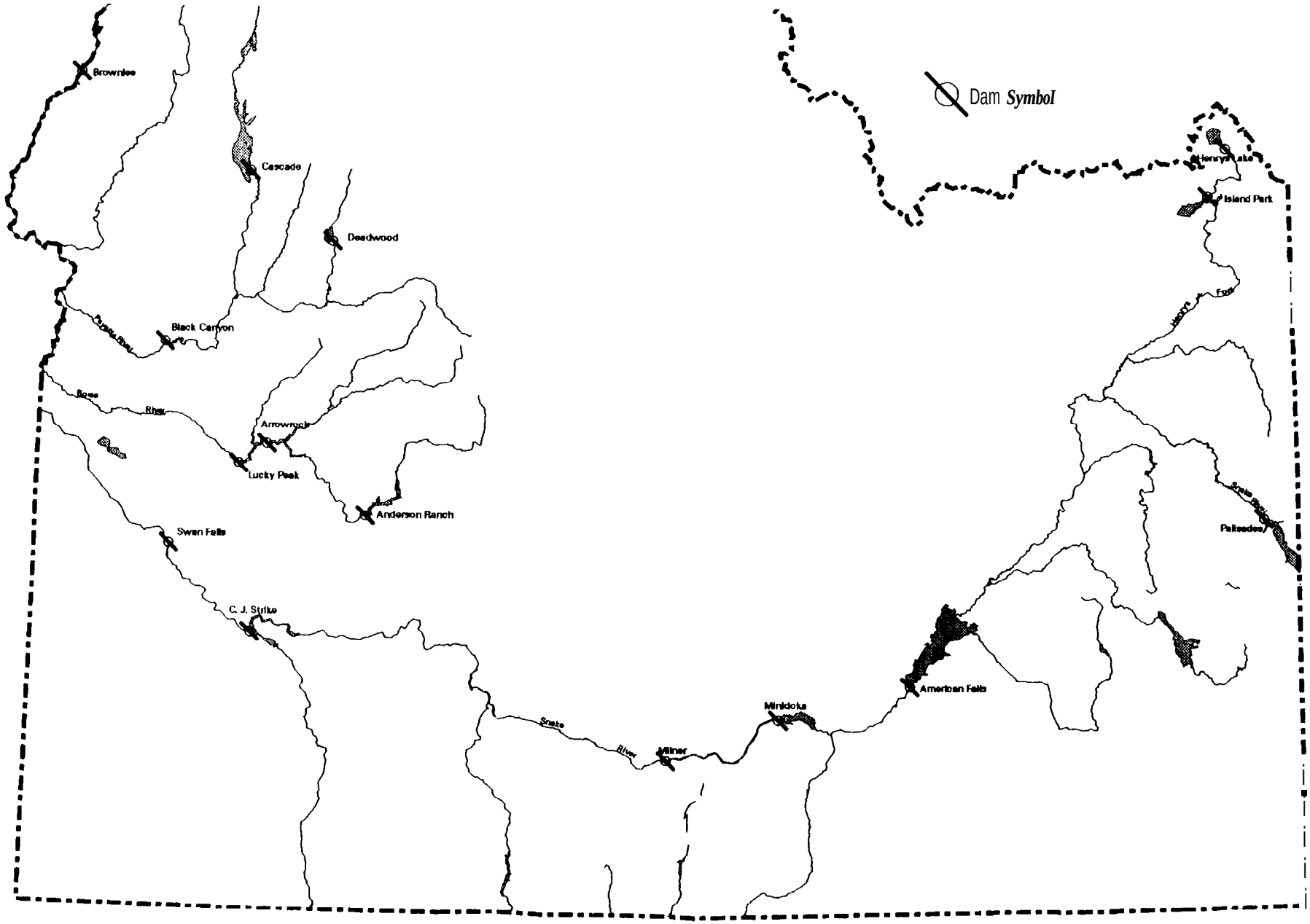

Figure 1. Idaho water rental pilot project study area.

Table 1. Stored water provided for salmon flow augmentation from Bureau of Reclamation reservoirs in acre-feet, 1994 (data from Bureau of Reclamation and IDWR).

SYSTEM/ RESERVOIR	Reclamation Space		Rental Pool	Total
	Power Head	Uncontracted		
Upper Snake				
Minidoka	99,240			99,240
Palisades	153,530	15,754	44,325	213,609
Ririe		17,430		17,430
Subtotal	252,770	33,184	44,325	330,279
Payette				
Cascade		26,845		26,845
Deadwood		35,038		35,038
Subtotal		61,883		61,883
Boise				
Anderson Ranch	10,950			10,950
Lucky Peak		25,000		25,000
Subtotal	10,950	25,000		35,950
GRAND TOTAL	263,720	120,067	44,325	428,112

System	Source/Space	Start Date	End Date
Upper Snake	Rental Pool	7/26/94	8/13/94
	Uncontracted	4/13/94	4/25/94
	Powerhead	4/25/94	7/26/94
Payette	Uncontracted	7/2/94	8/16/94
Boise	Uncontracted	7/5/94	8/19/94
	Powerhead	7/5/94	8/19/94

Table 2. Stored water provided for salmon flow augmentation from Bureau of Reclamation reservoirs in acre-feet, 1995 (data from Bureau of Reclamation and IDWR).

SYSTEM/ RESERVOIR	Reclamation Space		Rental Pool	Total
	Power Head	Uncontracted		
Upper Snake				
American Falls		8,951		
Jackson		3,923		
Palisades		9,522		
Subtotal		22,396	232,839	255,235
Payette*				
Cascade		68,842		
Deadwood		25,400		
Subtotal		94,242	50,758	145,000
Boise				
Anderson Ranch		3,000		
Lucky Peak		22,000		
Subtotal		25,000	2,000	27,000
GRAND TOTAL		140,396	286,839	427,235

system	Source/Space	Start Date	End Date
Upper Snake	Rental Pool Uncontracted	7/l/95 9/16/95	9/16/95 9/29/95
Boise	Rental Pool Uncontracted**	8/17/95 7/17/95	8/20/95 8/17/95
Payette*	Rental Pool Uncontracted	12/10/95 12/10/95	2/29/96 2/29/96

* Approximate start date for Cascade release = December 10, 1995. Approximate completion date = February 29, 1996. Flows will be approximately 1,000 cfs above base flow.

** According to IDWR Boise River water came from the rental pool and the instream flow account.

Table 3. Water provided for flow augmentation from the Snake River basin upstream of Hell's Canyon Dam, 1987-1995. Values are in acre-feet.

System	1987	1988	1989	1990	1991	1992	1993	1994	1995
Upper Snake									
USBR Space	0	0	0	0	0	0	206,617	285,954	22,396
Rentals	150,000	50,000	100,000	63,000	0	0	65,000	44,325	232,839
BPA Purchase	0	0	0	0	50,000	49,000	0	0	0
Subtotal	150,000	50,000	100,000	63,000	50,000	49,000	271,617	330,279	255,235
Payette									
USBR Space	0	0	0	0	0	90,000	95,000	61,883	94,242
Rentals	0	0	0	0	0	0	34,971	0	50,758
BPA Purchase	0	0	0	0	51,000	51,000	0	0	0
Subtotal	0	0	0	0	51,000	141,000	129,971	61,883	145,000
Boise									
USBR Space	0	0	0	0	0	0	23,000	35,950	25,000
Rentals	0	0	0	0	0	0	0	0	2,000
Subtotal	0	0	0	0	0	0	23,000	35,950	27,000
upper Snake contribution	150,000	50,000	100,000	63,000	101,000	190,000	424,588	428,112	427,235
Brownlee	0	0	50,000	87,000	174,000	110,000	102,000	327,000	
Grand Total	150,000	50,000	150.000	150,000	275,000	300,000	526,588	755,112	427,235

Table 4. Habitat curves available for the Snake River and selected tributaries. WP = wetted perimeter versus flow curves; WUA = weighted usable area versus flow curves.

STREAM	SECTION	CURVES	SPECIES
Henrys Fk	Henrys Lake-Island Park	WP	CTT/RBT/BRKT/MWF/KOK
Henrys Fk	Island Park-Ashton Res.	WP	CTT/RBT/BRKT/MWF
Henrys Fk	Ashton Res.-Mouth	WP	CTT/RBT/BRKT/MWF
Falls River	Sguirrel-USFS Boundary	WP WUA	RBT,MWF,BRKT RBT
S.F. Snake	Palisades-Henrys Fk	WP WUA'	CTT/BRNT/MWF CTT/BRNT/MWF
Snake R.	Henrys Fk-American Falls	WP WUA[2]	CTT/RBT CTT/RBT/MWF/BRNT
Snake R.	American Falls-Minidoka	WP	RBT/BRNT/MWF/LMB
Snake R.	Minidoka-Milner	WP	RBT/BRNT/MWF/LMB/CCAT
Snake R.3	Milner-Twin Falls Res.	WP WUA	CTT/RBT/BRNT/STUR RBT
Snake R.[3]	Twin Falls Res.-Buhl Gauge Sta.	WP WUA[4]	CTT/RBT/BRNT/STUR RBT
Snake R.	Buhl Gauge Sta.-King Hill	WP WUA5	CTT/RBT/MWF/STUR/LMB SMB/CCAT RBT/MWF/STUR/SSCULP/BRNT
Snake R.	King Hill-C.J. Strike Res.	WP	MWF/STUR/LMB/SMB/CCAT
Snake R.	C.J. Strike-Swan Falls	WP WUA	RBT/MWF/LMB/SMB/STUR CCAT/BCRAP RBT/MWF/STUR/SMB/CCAT/FHCAT

Table 4. Continued.

STREAM	SECTION	CURVES	SPECIES
Snake R.	Swan Falls-Bernard's Ferry	WP	RBT/MWF/LMB/SMB/STUR CCAT/BCRAP
		WUA	RBT/MWF/STUR/SMB/ CCAT/FHCAT
Snake R.	Bernard's Ferry-Boise R.	WP	RBT/MWF/LMB/SMB/STUR CCAT/BCRAP
		WUA	RBT/MWF/STUR/SMB/ CCAT/FHCAT
Snake R.	Boise R.-Payette R.	WP	RBT/MWF/LMB/SMB/STUR CCAT/BCRAP
		WA	RBT/MWF/STUR/SMB/ CCAT/FHCAT
Snake R.	Payette R.-Brownlee Res.	WP	RBT/MWF/IMB/SMB/STUR CCAT/BCRAP
		WUA	RBT/MWF/STUR/SMB/ CCAT/FHCAT
S.F.Boise R.	Anderson Ranch-Lucky Peak	WP	RBT/BRKT/BULT
Boise R.	Lucky Peak-Mouth	WP	RBT/BRNT/BULT
N.F.Payette R	Cascade Res-Banks	WP	RBT/MWF/BCRAP
Deadwood Cr.	Deadwood Res.-Mouth	WP	CTT/RBT/BULT
S.F.Payette R	Lowman-Deadwood R.	None	
	Deadwood R.-Mouth	WUA	RBT/MWF
Payette R.	Banks-Black Canyon Res.	WP	RBT/MWF/BRNT/SMB
		WUA	RBT,BRNT,MWF
Payette R.	Black Canyon Res.-Mouth	WP	RBT/MWF/BRNT/SMB/LMB CCAT

1 = For only age 0 fish in the winter
2 = Includes the Shelley hydropower site.
3 = Combined into one section in Cochnauer 1976.
4 = Boulder Rapids.
5 = For the reach between Lower Salmon Falls Dam and.Bliss Reservoir, between power plants at the Upper Salmon Falls project, and Kanaka and Empire Rapids upstream of Upper Salmon Falls Reservoir.

NOTE: CTT = Cutthroat trout; RBT = Rainbow trout; BRKT = Brook trout; MWF = Mountain whitefish;,BRNT = Brown trout; BULT = Bull trout; KOK = Kokanee salmon; LMB = Largemouth bass; CCAT = Channel catfish; STUR = White sturgeon; SMB = Smallmouth bass; SSCULP = Shoshone sculpin; BCRAP = Black crappie; FHCAT = Flathead catfish.

Table 5. Changes in white sturgeon habitat in the Snake River from C.J. Strike Dam to Swan Falls Pool resulting from salmon flow augmentation releases during the summer of 1994. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult /Juv.	Larvae	Spawn	Incub	Adult 8/Juv.	Larvae	Spawn	Incub	Adult /Juv. (%)	Larvae (%)	Spawn (%)	Incub (%)
April 4/16-4/30	8110	1269	6841	23.82	16.89	6.04	15.58	21.92	16.70	4.36	13.78	t1.91 (8.71)	to.19 (1.14)	t1.68 (38.53)	+1.81 (13.13)
May 5/1-5/31	8292	1358	6934	24.06	16.83	6.28	15.82	22.07	16.76	4.48	13.92	+1.99 (9.02)	+0.07 (12.89)	N/A	+1.90 (13.65)
June 6/1-6/30	6934	1465	5469	22.07	16.76	4.48	13.92	19.55	15.67	2.70	11.48	+2.52 (12.89)	+1.09 (6.96)	N/A	N/A
July 7/l-7/31	6641	1492	5149	21.59	16.58	4.11	13.47	18.96	15.35	2.34	10.88	+2.63 (13.87)	N/A	N/A	N/A
Auq. 8/1-8/19	6058	963	5095	20.63	16.23	3.38	12.57	18.86	15.30	2.28	10.78	t1.77 (9.38)	N/A	N/A	N/A

Table 6. Changes in white sturgeon habitat in the Snake River from Swan Falls Dam to Walters Ferry resulting from salmon flow augmentation releases during the summer of 1994. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Total Flow Adult/ Juv.	Total Flow Larvae	Total Flow Spawn	Total Flow Incub	Net Flow Adult/ Juv.	Net Flow Larvae	Net Flow Spawn	Net Flow Incub	% Change Adult/ Juv. (%)	% Change Larvae (%)	% Change Spawn (%)	% Change Incub (%)
April 4/17-4/30	7947	1360	6587	3.97	2.44	2.02	3.14	3.77	2.63	1.61	2.92	+0.21 (5.57)	-0.20 (7.60)	+0.40 (24.84)	+0.22 (7.53)
May 5/1-5/31	8341	1309	7032	4.02	2.38	2.12	3.19	3.84	2.58	1.76	3.00	+0.17 (4.43)	-0.20 (7.75)	N/A	+0.20 (6.67)
June 6/1-6/30	7004	1465	5539	3.84	2.58	1.75	2.99	3.56	2.74	1.26	2.72	+0.28 (7.87)	-0.16 (5.84)	N/A	N/A
July 7/1-7/31	6565	1515	5050	3.76	2.64	1.61	2.92	3.46	2.77	1.10	2.62	+0.30 (8.67)	N/A	N/A	N/A
Aug. 8/1-8/20	6225	954	5271	3.73	2.70	1.53	2.87	3.53	2.80	1.18	2.70	+0.20 (5.67)	N/A	N/A	N/A

rable 7. Changes in white sturgeon habitat in the Snake River from Walters Ferry to the Boise River resulting from salmon flow augmentation releases during the summer of 1994. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult /Juv.	Larvae	Spawn	Incub	Adult /Juv.	Larvae	Spawn	Incub	Adult /Juv. (%)	Larvae (%)	Spawn (%)	Incub (%)
April 4/17-4/30	7947	1360	6587	41.96	36.16	3.89	11.32	36.72	33.07	2.57	8.98	+5.24 (14.27)	+3.09 (9.34)	+1.32 (51.36)	+2.35 (26.17)
May 5/1-5/31	8341	1309	7032	43.45	36.75	4.36	12.03	38.50	34.23	2.98	9.79	+4.95 (12.86)	+2.52 (7.36)	N/A	+2.24 (22.88)
June 6/1-6/30	7004	1465	5539	38.40	34.17	2.95	9.75	32.46	30.11	1.68	6.94	+5.94 (18.30)	+4.06 (13.48)	N/A	N/A
July 7/1-7/31	6565	1515	5050	36.64	33.01	2.55	8.94	30.43	28.62	1.30	5.92	+6.21 (20.61)	N/A	N/A	N/A
Auq. B/l-8/20	6225	954	5271	35.45	32.52	2.18	8.45	31.45	29.58	1.36	6.54	+4.00 (12.72)	N/A	N/A	N/A

Table 8. Changes in white sturgeon habitat in the Snake River from the Boise River to the Fayette River resulting from salmon flow augmentation releases during the summer of 1994. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult /Juv.	Larvae	Spawn	Incub	Adult /Juv.	Larvae	Spawn	Incub	Adult/ Juv. (%)	Larvae (%)	Spawn (%)	Incub (%)
April 4/18-4/30	9189	1465	1724	45.91	35.26	2.99	12.24	41.02	33.55	1.77	9.88	+4.89 (11.92)	+1.71 (5.10)	+1.22 (68.93)	+2.35 (23.74)
May 5/1-5/31	10270	1260	9010	48.88	36.03	4.00	13.54	45.42	35.12	2.83	12.02	+3.46 (7.62)	+0.91 (2.59)	N/A	+1.51 (12.56)
June 6/1-6/30	7902	1465	6437	41.68	33.82	1.91	10.29	36.07	31.32	0.90	6.65	+5.61 (15.55)	+2.50 (7.98)	N/A	N/A
July 7/31	7663	1857	5806	40.79	33.46	1.73	9.14	33.46	29.99	0.58	4.96	+7.33 (21.91)	N/A	N/A	N/A
Aug. a/1-8/21	7253	1203	6050	39.28	32.84	1.42	8.79	34.50	30.54	0.68	5.58	+4.77 (13.83)	N/A	N/A	N/A

Table 9. Changes in white sturgeon habitat in the Snake River from the Payette River to Brownlee Pool resulting from salmon flow augmentation releases during the summer of 1994. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult /Juv.	Larvae	Spawn	Incub	Adult /Juv.	Larvae	Spawn	Incub	Adult /Juv. (%)	Larvae (%)	Spawn (%)	Incub (%)
April 4/19-4/30	12200	1489	10711	45.56	30.39	9.56	19.80	43.47	30.26	7.79	17.80	+2.08 (4.78)	+0.13 (0.43)	+1.77 (22.72)	+1.99 (11.18)
May 5/1-5/31	12710	1248	11462	46.13	30.28	10.18	20.40	44.59	30.37	8.68	18.84	+1.54 (3.45)	-0.09 (0.30)	N/A	+1.56 (8.28)
June 6/l-6/30	8847	1465	7382	39.73	29.67	5.55	15.00	36.01	28.64	3.84	12.28	+3.72 (10.33)	N/A	N/A	N/A
July 7/1-7/31	0790	2641	6157	39.61	29.64	5.49	14.91	32.29	27.29	2.47	9.55	+7.32 (22.67)	N/A	N/A	N/A
Auq. 8/l-8/22	8170	1550	6620	38.06	29.26	4.73	13.82	33.78	27.86	2.98	10.62	+4.28 (12.67)	N/A	N/A	N/A

Table 10. Changes in white sturgeon habitat in the Snake River from C.J. Strike Dam to Swan Falls Pool resulting from salmon flow augmentation releases during the summer of 1995. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv. (%)	Larvae (%)	Spawn (%)	Incub (%)
July 7/5-7/31	8069	1492	6577	23.77	16.91	5.98	15.53	21.48	16.55	4.03	13.37	+2.29 (10.66)	N/A	N/A	N/A
Aug. 8/1-8/31	7735	1553	6182	23.28	16.90	5.54	15.06	20.83	16.31	3.54	12.76	+2.45 (11.76)	N/A	N/A	N/A
Sept. 9/1-9/30	8697	1326	7371	24.59	16.69	6.82	16.35	22.74	16.85	5.05	14.55	+1.85 (8.14)	N/A	N/A	N/A
Oct 10/1-10/2	8190	244	7946	23.97	16.95	6.14	15.71	23.60	16.92	5.82	15.36	+0.37 (1.57)	N/A	N/A	N/A

Table 11. Changes in white sturgeon habitat in the Snake River from Swan Falls Dam to Walters Ferry resulting from salmon flow augmentation releases during the summer of 1995. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Total Flow Adult/ Juv.	Total Flow Larvae	Total Flow Spawn	Total Flow Incub	Net Flow Adult/ Juv.	Net Flow Larvae	Net Flow Spawn	Net Flow Incub	Change Adult/ Juv. (%)	Change Larvae (%)	Change Spawn (%)	Change Incub (%)
July 7/6-7/31	7941	1491	6450	3.97	2.44	2.01	3.14	3.74	2.65	1.57	2.90	+0.23 (6.15)	N/A	N/A	N/A
Aug. a/1-8/31	7400	1533	5847	3.90	2.52	1.86	3.05	3.63	2.72	1.37	2.79	+0.27 (7.44)	N/A	N/A	N/A
Sept. 9/1-9/30	8413	1361	7052	4.03	2.37	2.13	3.20	3.85	2.57	1.76	3.00	+0.18 (4.68)	N/A	N/A	N/A
Oct. lO/l-10/3	7930	316	7614	3.97	2.44	2.01	3.14	3.93	2.49	1.92	3.09	+0.04 (1.02)	N/A	N/A	N/A

Table 12. Changes in white sturgeon habitat in the Snake River from Walters Ferry to the Boise River resulting from salmon flow augmentation releases during the summer of 1995. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net FlOW (cfs)	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv. (%)	Larvae (%)	Spawn (%)	Incub (%)
July 7/6-7/31	7941	1491	6450	41.94	36.15	3.88	11.31	36.17	32.70	2.44	8.72	+5.76 (15.92)	N/A	N/A	N/A
Aug. 8/1-a/31	7400	1553	5047	39.89	35.00	3.35	10.41	33.74	31.04	1.91	7.57	+6.16 (18.26)	N/A	N/A	N/A
Sept. 9/1-9/30	8413	1361	7052	43.72	36.85	4.44	12.16	38.58	34.27	3.00	9.83	+5.14 (13.32)	N/A	N/A	N/A
Oct. lO/l-10/3	7930	316	7614	41.90	36.12	3.87	11.29	40.70	35.46	3.56	10.77	+1.19 (2.92)	N/A	N/A	N/A

Table 13. Changes in white sturgeon habitat in the Snake River from the Boise River to the Payette River resulting from salmon flow augmentation releases during the summer of 1995. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	Incub	Incub	Adult/ Juv. (%)	Larvae (%)	Spawn (%)	Incub (%)
July 7/7-7/31	10632	1697	8935	49.85	36.17	4.37	13.97	45.17	35.04	2.77	11.91	+4.68 (10.36)	N/A	N/A	N/A	N/A
Aug. 8/1-8/31	9075	1824	7251	45.60	35.17	2.89	12.10	39.27	32.84	1.42	8.79	+6.33 (16.12)	N/A	N/A	N/A	N/A
Sept. 9/1-9/30	10580	1394	9186	49.71	36.15	4.32	13.91	45.90	35.26	2.99	12.23	+3.81 (8.30)	N/A	N/A	N/A	N/A
Oct. lO/l-10/4	10525	376	10149	49.56	36.12	4.26	13.85	48.55	35.98	3.88	13.39	+1.01 (2.08)	N/A	N/A	N/A	N/A

Table 14. Changes in white sturgeon habitat in the Snake River from the Payette River to Brownlee Pool resulting from salmon flow augmentation releases during the summer of 1995. Juv. = juvenile; Spawn = spawning; Incub = incubation; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult/ Juv..	Larvae	Spawn	Incub	Adult/ Juv.	Larvae	Spawn	Incub	Adult/ Juv. (%)	Larvae (%)	Spawn (%)	Incub (%)
July 7/8-7/31	12982	1688	11294	46.44	30.22	10.52	20.72	44.36	30.35	0.48	18.61	+2.08 (4.69)	N/A	N/A	N/A
Aug.	10110	1837	8273	42.46	30.12	7.08	16.94	38.31	29.32	4.86	14.00	+4.15 (10.83)	N/A	N/A	N/A
Sept. 9/1-9/30	11520	1422	10098	44.67	30.38	8.74	18.92	42.44	30.12	7.07	16.92	+2.23 (5.25)	N/A	N/A	NA
Oct. 10/1-10/5	11580	435	11145	44.75	30.38	8.81	19.00	44.16	30.34	8.30	18.41	+0.60 (1.36)	N/A	NA	N/A

Table 15. Changes in rainbow trout habitat in the Snake River from C.J. Strike Dam to Swan Falls Pool resulting from salmon flow augmentation releases during the summer of 1994. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
April 4/16-4/30	8110	1269	6841	44.31	15.35	3.18	6.89	43.19	16.63	2.55	7.17	+1.12 (2.59)	-1.28 (7.70)	+0.62 (24.31)	-0.29 (4.04)
May 5/1-5/31	8292	1358	6934	44.43	15.23	3.25	6.70	43.31	16.51	2.56	7.14	+1.11 (2.56)	-1.28 (7.75)	N/A	-0.44 (6.16)
June 6/1-6/30	6934	1465	5469	43.31	16.51	2.56	7.14	40.86	18.54	2.49	7.59	+2.45 (6.00)	-2.04 (11.00)	N/A	-0.45 (5.93)
July 7/1-7/31	6641	1492	5149	42.94	16.89	2.54	7.23	40.11	19.03	2.48	7.68	+2.83 (7.06)	-2.14 (11.25)	N/A	-0.44 (5.73)
Aug. 8/1-8/19	6058	963	5095	42.18	17.65	2.51	7.42	39.98	19.11	2.48	7.69	+2.20 (5.50)	-1.46 (7.64)	N/A	-0.27 (3.51)

Table 16. Changes in rainbow trout habitat in the Snake River from Swan Falls Dam to Walters Ferry resulting from salmon flow augmentation releases during the summer of 1994. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life Stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
April 4/17-4/30	7947	1360	6587	8.59	6.35	0.38	2.35	7.46	6.44	0.40	3.06	+1.13 (15.15)	-0.09 (1.21)	-0.02 (0.27)	-0.71 (9.52)
May 5/1-5/31	8341	1309	7032	8.80	6.23	0.38	2.12	7.89	6.46	0.34	2.90	+0.91 (11.53)	-0.23 (2.92)	N/A	-0.78 (9.89)
June 6/1-6/30	7004	1465	5539	7.87	6.46	0.34	2.92	6.28	6.22	0.48	3.40	+1.59 (25.31)	+0.24 (3.82)	N/A	-0.49 (7.80)
July 7/1-7/31	6565	1515	5050	7.44	6.44	0.40	3.07	5.66	6.01	0.48	3.55	+1.77 (31.27)	+0.43 (7.60)	N/A	-0.49 (8.66)
Aug. 8/1-8/20	6225	954	5271	7.10	6.42	0.45	3.18	5.94	6.10	0.48	3.49	+1.15 (19.36)	+0.32 (5.39)	N/A	-0.30 (5.05)

able 17. Changes in rainbow trout habitat in the Snake River from Walters Ferry to the Boise River resulting from salmon flow augmentation releases during the summer of 1994. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juvem.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
April 4/17-4/30	7947	1360	6587	233.82	76.59	102.21	30.91	214.98	89.39	84.31	43.48	+18.83 (8.75)	-12.80 (5.95)	+17.91 (8.33)	-12.57 (5.85)
May 5/1-5/31	8341	1309	7032	236.87	73.01	106.46	28.25	222.91	85.66	90.51	39.55	(6.26)	-12.65 (5.67)	N/A	-11.30 (5.07)
June 6/l-6/30	7004	1465	5539	222.58	85.94	90.15	39.81	196.55	97.38	73.72	52.37	+26.03 (13.24)	-11.44 (5.82)	N/A	-12.56 (6.39)
July 7/1-7/31	6565	1515	5050	214.58	89.57	84.00	43.67	188.38	100.73	71.23	56.34	+26.21 (13.91)	-11.16 (5.92)	N/A	-12.67 (6.73)
Aug. 8/l-8/20	6225	954	5271	208.3	92.37	79.23	46.65	192.07	99.22	72.36	54.55	+16.30 (8.49)	-6.84 (3.56)	N/A	-7.89 (4.11)

Table 18. Changes in rainbow trout habitat in the Snake River from the Boise River to the Payette River resulting from salmon flow augmentation releases during the summer of 1994. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
April 4/18-4/30	9189	1465	7724	231.44	65.45	80.66	20.47	220.24	72.42	76.60	35.47	+11.20 (5.09)	-6.97 (3.16)	+4.06 (1.84)	-7.00 (3.18)
May 5/1-5/31	10270	1260	9010	232.39	60.59	76.73	24.72	231.07	66.35	81.31	29.16	+1.32 (0.57)	-5.76 (2.49)	N/A	-4.44 (1.92)
June 6/1-6/30	7902	1465	6437	222.57	71.79	77.46	34.68	202.39	74.56	69.79	34.02	+20.18 (9.97)	-2.77 (1.37)	N/A	+0.65 (0.32)
July 7/1-7/31	7663	1857	5806	219.45	72.63	76.31	35.74	192.87	74.22	66.01	30.52	+26.57 (13.78)	-1.59 (0.82)	N/A	+5.21 (2.70)
Aug. 8/1-8/21	7253	1203	6050	214.09	74.06	74.32	37.56	196.62	74.29	67.51	30.82	+17.47 (8.88)	-0.23 (0.12)	N/A	+6.73 (3.42)

Table 19. Changes in rainbow trout habitat in the Snake River from the Payette River to Brownlee Pool resulting from salmon flow augmentation releases during the summer of 1994. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
April 4/19-4/30	12200	1489	10111	131.54	46.16	38.18	14.31	129.60	53.72	32.82	18.37	t1.94 (1.50)	-6.95 (5.36)	t5.36 (4.14)	-4.00 (3.09)
May 5/1-5/31	12710	1248	11462	131.62	44.63	39.88	13.44	130.69	50.16	35.42	16.32	to.93 (0.71)	-5.52 (4.22)	N/A	-2.88 (2.20)
June 6/1-6/30	8847	1465	7382	124.00	62.42	26.00	*23.11*	115.31	65.51	19.99	23.22	t8.69 (7.54)	-3.09 (2.70)	N/A	to.55 (0.48)
July 7/1-7/31	8798	2641	6157	123.73	62.59	25.78	23.05	106.37	67.71	15.78	24.32	t17.36 (16.32)	-5.12 (4.81)	N/A	-0.48 (0.45)
Aug. a/1-8/22	8170	1550	6620	120.29	64.83	22.88	24.82	109.91	66.52	17.38	23.08	+10.39 (9.44)	-1.69 (1.541	N/A	t1.74 (1.58)

Table 20. Changes in rainbow trout habitat in the Snake River from C.J. Strike Dam to Swan Falls Pool resulting from salmon flow augmentation releases during the summer of 1995. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
July l/5-7/31	8069	1492	6577	44.28	15.37	3.16	6.93	42.85	16.97	2.54	7.26	+1.43 (3.34)	-1.60 (3.73)	N/A	-0.33 (0.77)
Aug. 8/l-S/31	7735	1553	6182	44.02	15.69	2.90	7.03	42.34	17.49	2.52	7.30	+1.67 (3.94)	-1.81 (4.21)	N/A	-0.35 (0.83)
Sept. 9/1-9/30	8697	1326	*7371*	*44.69*	14.96	3.42	6.28	43.71	16.05	2.77	7.08	+0.98 (2.24)	-1.09 (2.49)	N/A	-0.80 (1.83)
Oct. IO/l-10/2	8190	244	7946	44.40	15.23	3.24	6.98	44.19	15.41	3.10	7.01	+0.20 (0.45)	-0.24 (0.54)	N/A	N/A

Table 21. Changes in rainbow trout habitat in the Snake River from Swan Falls Dam to Walters Ferry resulting from salmon flow augmentation releases during the summer of 1995. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry
												(%)	(%)	(%)	(%)
July 7/6-7/31	7941	1491	6450	8.59	6.35	0.38	2.36	1.32	6.43	0.42	3.11	+1.27 (17.35)	-0.09 (1.23)	N/A	-0.15 (10.25)
Aug. e/1-8/31	7400	1553	5847	8.17	6.41	0.36	2.68	6.68	6.35	0.48	3.31	+1.50 (22.46)	+0.07 (1.05)	N/A	-0.63 (9.43)
Sept. 9/l-9/30	8413	1361	7052	8.84	6.20	0.30	2.08	7.91	6.45	0.34	2.89	+0.93 (11.76)	-0.25 (3.16)	N/A	-0.91 (10.24)
Oct. lO/l-10/3	7930	316	7614	a.58	6.35	0.38	2.36	0.34	6.39	0.36	2.55	+0.24 (2.88)	-0.04 (0.48)	N/A	N/A

Table 22. Changes in rainbow trout habitat in the Snake River from Walters Ferry to the Boise River resulting from salmon flow augmentation releases during the summer of 1995. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
July 7/6-7/31	7941	1491	6450	233.75	76.65	102.14	30.97	212.48	90.52	82.38	44.68	+21.27 (10.01)	-13.87 (6.53)	N/A	-13.71 (6.45)
Aug. 8/1-8/31	7400	1553	5847	227.30	82.01	95.22	36.07	201.70	95.28	75.28	49.87	+25.60 (12.69)	-13.26 (6.57)	N/A	-13.80 (6.84)
Sept. 9/1-9/30	8413	1361	7052	237.39	72.37	107.21	27.79	223.15	85.46	90.77	39.36	+14.24 (6.38)	-13.10 (5.87)	N/A	-11.57 (5.18)
Oct. 10/1-10/3	7930	316	7614	233.62	76.75	101.99	31.07	229.85	79.89	97.95	34.05	+3.77 (1.64)	-3.13 (1.36)	N/A	N/A

Table 23. Changes in rainbow trout habitat in the Snake River from the Boise River to the Payette River resulting from salmon flow augmentation releases during the summer of 1995. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
July 7/7-7/31	10632	1697	8935	231.44	59.55	75.41	23.90	230.58	66.73	81.13	29.53	+0.86 (0.37)	-7.18 (3.11)	N/A	-5.63 (2.44)
Aug. B/l-8/31	9075	1824	7251	231.20	66.02	61.08	28.91	214.06	74.07	74.31	36.07	+17.14 (8.01)	-8.05 (3.76)	N/A	-7.16 (3.34)
Sept. 9/1-9/30	10580	1394	9186	231.57	59.70	75.60	24.02	231.43	65.46	80.67	28.48	+0.14 (0.06)	-5.76 (2.49)	N/A	-4.46 (1.93)
Oct. 10/1-10/4	10525	376	10149	231.72	59.86	75.80	24.14	232.72	60.93	77.17	24.99	-1.00 (0.43)	-1.08 (0.46)	N/A	N/A

Table 24. Changes in rainbow trout habitat in the Snake River from the Payette River to Brownlee Pool resulting from salmon flow augmentation releases during the summer of 1995. Juven. = juvenile; Spawn = spawning; N/A = not applicable, life stage not present during that month.

Habitat Estimates - Weighted Usable Area in millions of square feet

				Total Flow				Net Flow				Change			
Month	Mean Daily Flow (cfs)	Mean Augment Flow (cfs)	Mean Daily Net Flow (cfs)	Adult	Juven.	Spawn	Fry	Adult	Juven.	Spawn	Fry	Adult (%)	Juven. (%)	Spawn (%)	Fry (%)
July 7/8-7/31	12982	1688	11294	131.66	43.50	40.78	12.97	130.43	50.95	34.76	16.82	+1.23 (0.94)	-7.46 (5.72)	N/A	-3.85 (2.95)
Aug. 8/1-8/31	10110	1837	8273	128.81	56.56	31.19	19.78	120.86	64.47	23.35	24.66	+7.95 (6.58)	-7.91 (6.54)	N/A	-4.88 (4.03)
Sept. 9/1-9/30	11520	1422	10098	130.78	49.88	35.64	16.15	128.79	56.62	31.16	19.81	+1.99 (1.55)	-6.74 (5.23)	N/A	-3.66 (2.84)
Oct. 10/1-10/5	11580	435	11145	130.87	49.60	35.88	15.97	130.20	51.66	34.18	17.26	+0.67 (0.51)	-2.07 (1.60)	N/A	N/A

Table 25. White sturgeon and Rainbow trout life stages and time of occurrence in the Snake River (from Anglin et al. 1992). Incub.= incubation; Juven.= juvenile.

Species/ Life Stage	C.J. Strike to Swan Falls	Swan Falls to Walters Ferry	Walters Ferry to Boise River	Boise River to Payette River	Payette River to Brownlee Pool
Sturgeon Spawning	March-April (2 months)	March-April (2 months)	March-April (2 months)	March-April (2 months)	March-April (2 months)
Sturgeon Larvae	April-June (3 months)	April-June (3 months)	April-June (3 months)	April-June (3 months)	March-May (3 months)
Sturgeon Incub.	March-May (3 months)	March-May (3 months)	March-May (3 months)	March-May (3 months)	March-May (3 months)
Sturgeon Adult/Juven	all year	all year	all year	all year	all year
Rainbow Trout Spawning	March-April (2 months)	March-April (2 months)	March-April (2 months)	March-April (2 months)	March-April (2 months)
Rainbow Trout Fry	April-Sept. (6 months)	April-Sept. (6 months)	April-Sept. (6 months)	April-Sept. (6 months)	April-Sept. (6 months)
Rainbow Trout Juvenile	all year	all year	all year	all year	all year
Rainbow Trout Adult	all year	all year	all year	all year	all year

Table 26. Integrated (target) fish flows and recommended minimum stream flows by month for average, wet and dry years, and actual flows recorded at the Murphy Gage on the Snake River downstream of Swan Falls Dam during the flow augmentation period in 1994 and 1995. The integrated and recommended minimum flows are also for the Murphy Gage. Data is from Anglin et al. (1992). Flows are in cubic feet per second.

Flow	April	May	June	July	August	September	October
Integrated Fish Flow	15,000	12,500	9,000	12,500	12,500	12,500	12,500
Recommended Minimum Flow							
Average Year	13,600	12,500	9,000	0,100	7,500	0,500	10,700
Wet Year (20% exceedence)	15,000	12,500	9,000	0,800	8,100	9,300	12,300
Dry Year (80 exceedence)	0,400	7,400	7,300	6,500	6,700	7,900	0,700
Actual Flows							
1994	7,947	8,341	7,004	6,565	6,225	--	--
1995	--	--	--	7,941	7,400	8,413	7,930