EVALUATION AND MONITORING
OF
IDAHO HABITAT ENHANCEMENT
AND
ANADROMOUS FISH NATURAL PRODUCTION

Annual Report 1986

by

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EXECUTIVE SUMMARY

The Idaho Department of Fish and Game (IDFG) has been conducting an evaluation of existing and proposed habitat improvement projects for anadromous fish in the Clearwater River and Salmon River drainages over the last 3 years. Projects included in the evaluation are funded by or proposed for funding by the Bonneville Power Administration (BPA) under the Northwest Power Planning Act as off-site mitigation for downstream hydropower development on the Snake and Columbia rivers. This evaluation project is also funded under the same authority.

A mitigation record is being developed to use increased smolt production (i.e., yield) at full-seeding as the best measure of benefit from a habitat enhancement project. Determination of full benefit from a project depends on completion or maturation of the project and presence of adequate numbers of fish to document actual increases in fish production. The depressed nature of upriver anadromous stocks have precluded measuring full benefits of any habitat enhancement project in Idaho. Partial benefit will be credited to the mitigation record in the interim period of run restoration.

Approaches to evaluate habitat projects and document a record of mitigation were developed in 1984-1985. The IDFG evaluation approach consists of three basic, integrated levels: general monitoring, standing crop evaluations, and intensive studies. Annual general monitoring of anadromous fish densities in a small number of sections for each project will be used to follow population trends and define seeding levels. For most projects, standing crop estimates of parr will be used to estimate smolt production by factoring appropriate survival rates from parr to smolt stages. Intensive studies will determine parr to smolt survival rates and provide other basic biological information that is needed for evaluation of the Fish and Wildlife program.

A physical habitat and fish population data base is being developed for every BPA habitat project in Idaho. The data will be integrated at each level of evaluation. Compatibility of data is also needed between Idaho and other agencies and tribes in the Columbia River basin.

In 1986 field work was conducted in five areas: (1) general density monitoring; (2) anadromous fish introductions above treated barriers; (3) standing crop evaluations of five barrier removal projects; (4) standing crop evaluations of instream and off-channel developments of two projects; and (5) pretreatment evaluations of aquatic and riparian habitat for proposed riparian revegetation and sediment reduction projects.

Monitoring of wild chinook populations in Idaho has demonstrated a general increase in production during 1984-86. Generally, both wild and natural steelhead parr production also have increased during this period.

In 1986 partial benefits were estimated for projects implemented during 1983-1985 (Tables 8 and 9). Partial responses of anadromous fish to enhancement projects were expressed in terms of increased parr production. A complete mitigation record based on increased smolt yields cannot be developed until the intensive studies define appropriate conversion rates from parr to smolt stages and full-seeding is achieved.

Some measures of the relative effectiveness of the various enhancement techniques have been made at less than full-seeding levels. Data collected during 1984-1986 indicate that instream structures have not markedly increased the standing crop of salmon and steelhead Parr. Off-channel developments of connected ponds and side-channels have shown good potential to increase production in degraded streams. The addition of new increments of salmon and steelhead production through barrier removal appears to be one of the most cost-effective enhancement project types.

INTRODUCTION

The Idaho Department of Fish and Game (IDFG) conducted an evaluation of existing and proposed habitat improvement projects for anadromous fish in the Clearwater River and Salmon River drainages during the period 1984 through 1986. Projects included in the evaluation are funded by or proposed for funding by the Bonneville Power Administration under the Northwest Power Planning Act, Section 704(d), Fish and Wildlife program.

The primary objectives of this evaluation and monitoring project are: (1) document physical changes that result from habitat enhancement; (2) measure changes in steelhead and chinook parr/smolt production attributable to habitat enhancement projects; (3) determine project effectiveness to guide future enhancement activity; (4) determine benefits in terms of increased anadromous fish production resulting from each habitat enhancement project; and (5) monitor productivity, levels of seeding, and trends in natural and wild salmon and steelhead populations.

The Clearwater River and Salmon River drainages (Fig. 1) account for virtually all of Idaho's wild and natural production of summer steelhead and spring and summer chinook salmon, as well as a remnant run of sockeye salmon. Approximately 5,687 miles of streams were once available to anadromous fish in Idaho, of which some 40% was lost due to dam construction on the Snake river and the North Fork of the Clearwater River (Mallet 1974).

Although a majority of the habitat still available to steelhead and salmon is high quality, man's activity in Idaho has degraded many streams. Sedimentation has increased with widespread logging, road building, and associated activities. Intensive livestock grazing near streams has removed riparian vegetation, changed stream morphology, and accelerated soil erosion. Mining has had profound effects in parts of the drainages through stream channel alterations, discharge of toxic effluents, and increased sedimentation. Irrigation withdrawals have reduced flows, limiting adult passage and increasing water temperatures, often to critical levels for steelhead and salmon during summer.

Presently, public agencies, including the U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), Idaho Department of Fish and Game (IDFG), and the Shoshone-Bannock and Nez Perce tribes are cooperatively working on solutions to habitat problems for protection, enhancement and mitigation of anadromous fish throughout the Clearwater River and Salmon River basins. Although it is generally accepted that habitat projects increase juvenile production, actual increases and relative benefits have seldom been quantified in in the field. Under the Fish and Wildlife program, quantification of benefits are needed so that a record of credit for off-site mitigation on Columbia River tributaries can be established.

CLEARWATER RIVER
1. LOLO CR, ELDORADO CR
2. UPPER LOCHSA R
3. CROOKED R
4. RED R

SALMON RIVER
5. PANTHER CR
6. LEMHI R
7. EAST FORK SALMON R
8. UPPER SALMON R ALTURAS LAKE CR, POLE CR
9. VALLEY CR
10. SEAR VALLEY CR. ELK CR
11. MARSH CR
12. SULPHUR CR
13. CAMAS CR. LOON CR
14. SOUTH FORK SALMON R
16. JOHNSON CR
16. BOULDER CR

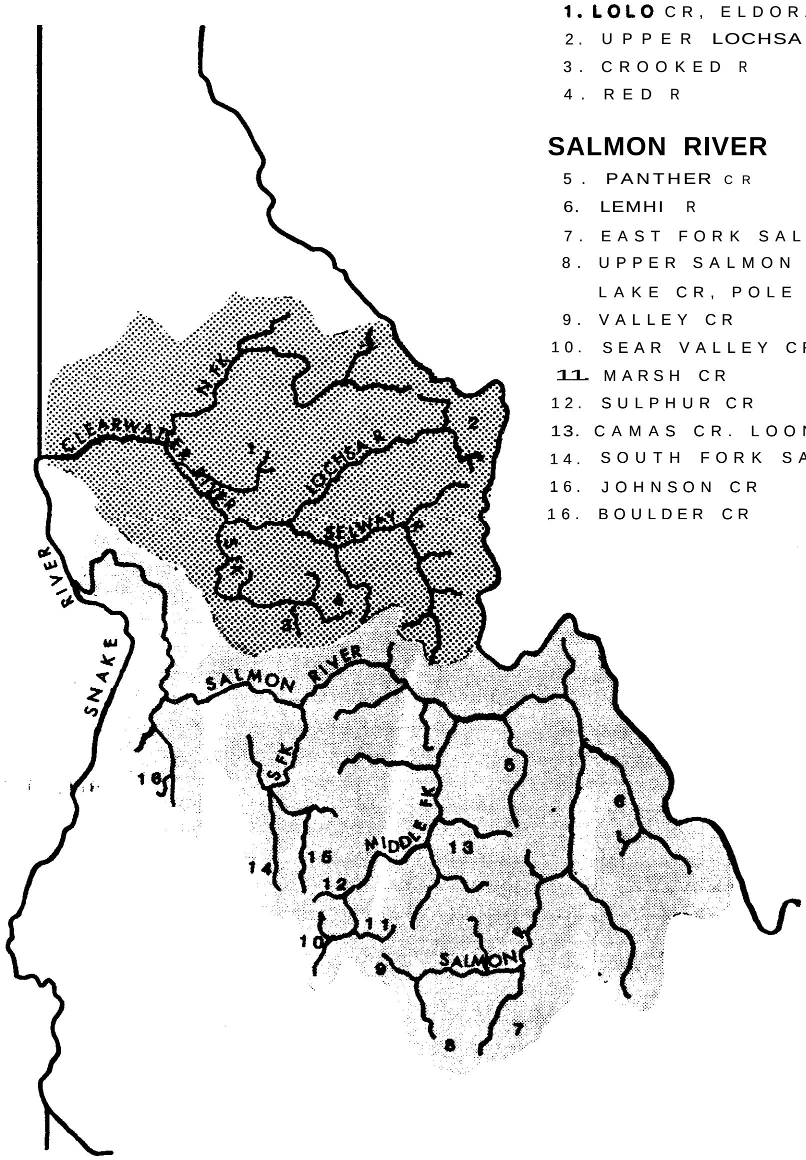

Figure 1. Project areas in Clearwater River and Salmon River drainages, Idaho.

Habitat enhancement projects are intended to increase either the amount of habitat or the carrying capacity of existing (usually degraded) habitat or both. Migration barriers, such as waterfalls, culverts, and water diversions, can be modified to make habitat available that is not being used or is underutilized by anadromous fish. EPA has funded or funding has been proposed for a number of these projects in Idaho on Eldorado Creek, Crooked Fork Creek, Crooked River, the upper Salmon River, Alturas Lake Creek, Pole Creek, Johnson Creek, and Boulder Creek (Fig. 1). Juvenile rearing habitat can also be added by creating side channels and connecting off-channel ponds to streams as on Crooked River. Control of toxic discharge from mining areas (Panther Creek) can eliminate partial blocks of anadromous fish passage and bring polluted stream reaches back into production. The amount of sediment entering streams from major "point sources," such as mines, can be reduced (Bear Valley Creek) to increase juvenile survival and carrying capacity. The carrying capacity of streams potentially can be increased by strategic placement of instream structures to reduce sedimentation, increase quality of rearing habitat for juvenile salmonids and increase hiding or spawning habitat for adults (Lo10 Creek, Crooked Fork Creek, White Sand Creek, Crooked River and Red River). High velocities in channelized reaches can be reduced to more optimal levels for rearing juvenile salmonids by reconstructing stream channels to simulate more natural conditions (Crooked River). Finally, riparian zones may be managed to reduce sedimentation and stabilize stream banks to increase carrying capacity by a variety of techniques, including livestock fencing, revegetation and bank revetments.

METHODS

Evaluation and Monitoring Approach

When the Idaho Department of Fish and Game initiated the Evaluation and Monitoring project, it was recognized that the best parameter for estimating the effectiveness of anadromous fish habitat enhancement projects was production of smolts. Since it is very difficult and costly to actually measure or estimate smolt production, an approach was adopted that estimates changes in summer standing crop or density of salmon and steelhead parr at every BPA-funded habitat enhancement project in Idaho. Steelhead fry density is being used only as a relative index of abundance because fry are still emerging during summer, and it is difficult to obtain accurate abundance estimates at this time. Physical changes in anadromous fish habitat are measured at every project.

The need to convert parr response to smolt response was also recognized. In 1986 intensive evaluation studies were initiated in the Salmon and Clearwater River drainages that will define the relationship of summer standing crop of parr to resultant smolt production. Intensive studies will determine conversion factors that can be applied to estimated increases in parr production to estimate increased smolt production for each project (Table 1).

IDFG developed a flexible evaluation approach in which intensity of sampling effort for the projects could vary with time because: (1) lag time for responses of habitat and fish populations will vary among projects; (2) intensive studies repeated every year cannot be justified for most projects at current low seeding levels; and (3) in many cases, once basic sample designs are established and seeding levels increase, the number of sample sections can be increased to gain precision in post-treatment evaluations. The schedule through 1986 of BPA project implementations and IDFG monitoring and evaluation is presented in Table 2.

Final determination of individual project benefits for the purpose of establishing a full mitigation record cannot be made until fish response can be documented at full-seeding levels. However, determination of the relative merits of various habitat enhancement measures can be made earlier and need not be dependent on attaining full-seeding levels. Comparison of partial responses of various types of enhancement measures can determine the relative merit of an individual technique. Supplementation with hatchery fish can, as supply allows, be used to create full-seeding conditions immediately after project implementation to allow early realization and determination of project benefits. Stocks used will be compatible with the Idaho Anadromous Fish Management Plan (IDFG, 1985).

Table 1. Hypothetical example of estimated mitigation benefits of BPA habitat enhancement projects.

Parameter	Hypothetical value
A. Estimated increase in juvenile density (summer)[a]	20/100m^2
2. Area enhanced[a]	X100,000m^2
3. Estimated increase in juvenile standing crop (summer) within project area [a]	20,000
4. Estimated increase in juvenile standing crop (summer) in downstream areas due to enhancement[ab]	+10,000
5. Total increase in juvenile standing crop	30,000
6. Survival factor (juvenile to smolt)[b]	X80%
7. OUTPUT - Annual smolt yield	24,000
POTENTIAL DOLLAR BENEFITS FROM PROJECT[c]	
8. Annual smolt yield	24,000
9. Survival factor (smolt to adult)	X1.0%
10. Total increase in adult population	240
11. Dollar value/adult (catch/escapement factor)	X$50
12. Value of increased adult production	$12,000
13. POTENTIAL OUTPUT - Total annual benefits	$12,000

[a] Determined from general monitoring and evaluation.
[b] Determined from intensive survival, production and yield studies.
[c] Outside scope of habitat enhancement evaluations.

Table 2. Schedule of BPA project implementation (I) and evaluation activities (P = pretreatement evaluation; M = monitoring; E= post-treatment evaluation) in Idaho, 1983-86.

Project	Project type[a]	1983	1984	1985	1986
Lolo Creek	IS	I	I,P,E	E	M
Eldorado Creek	PA		I,P	I,M	E
Upper Lochsa River	IS	I	I,P	M	M
Crooked Fork Creek	PA		I,P	I,P	E
Crooked River	PA		I,P	M	E
	IS		I,P	I,P,M	E
	BC		P	I,P	E
	OC		I,M	I,M	E
Red River	BC	I	I,M	M	M
	IS	I,M	I,M	I,M	E
	RR				
Panther Creek	SP		P	M	M
Lemhi River	IF			P	M
Upper Salmon River	IF		P	P	M
	RR		M	P	M
Alturas Lake Creek	IF		P	M	M
Pole Creek	PA	I	M	M	M
	RR		M	P	M
Valley Creek	RR			P	M
Bear Valley Creek	SP		I,P	I,P	I,M
	RR		M	P	P
Elk Creek	RR		M	P	P
Marsh Creek	RR		M	P	M
Camas Creek	RR		M	M	M
	BC		M	M	M
Johnson Creek	PA		I,P	I,E	I,E
South Fork Tributaries	PA				I,M
Boulder Creek	PA		P	I,P	E
Loon Creek	CO			M	M
Sulphur Creek	CO		M	M	P
South Fork Salmon	CO		M	M	M

[a] BC - bank/channel rehabilitation; CO = control stream; IF - improved flows; IS = instream structure; OC = off-channel developments; PA - passage; RR = riparian revegetation; SP = sedimentation and pollution control.

Difficulty of quantifying benefits for mitigation purposes will vary from project to project (Appendix A). Easiest to quantify will be those projects that add a new increment of production potential, such as barrier removals. Where complete barriers are removed, benefits can be calculated simply from the final estimates of numbers of anadromous fish reared at full seeding; where partial barriers are removed, some downward adjustment of estimated benefits based on pretreatment potential will be needed.

Localized increases in carrying capacity (e.g., instream structures and riparian fencing) will also be relatively easy to measure. For those projects which improve rearing habitat locally, the benefits can be measured at full seeding from the increase in density relative to untreated sections.

It will be difficult and costly to estimate benefits for some types of general land treatments, such as road paving, cut-bank seeding and other projects designed to decrease sedimentation, especially where a minor facet of a multi-faceted problem is treated. Costs of evaluation could easily exceed projected benefits for such projects.

As more data are collected to define fish population responses to physical habitat changes, models can be developed to predict fish benefits that would result from a predicted physical change in the habitat. In addition, the same data and model can be used to verify estimated benefits from a habitat project after implementation. These tools will be extremely useful in the feasibility stage of project development and should provide invaluable assistance to BPA and NPPC in planning for future direction of the Fish and Wildlife program. These same data will allow more accurate estimates of productivity of the various habitats in Idaho and assist in development of realistic natural production goals in the subbasin planning process.

<u>Density Monitoring</u>

Because most anadromous production streams in Idaho are very clear and have poor conductivity, snorkeling counts by trained observers are usually preferred over estimates obtained from electrofishing. In larger streams, electrofishing techniques are neither practical nor reliable for juvenile fish. Density estimates were obtained by snorkeling counts for all sections except those in the highly-conductive Lemhi River during 1984-1986. Census methods and fish population field forms are presented in Petrosky and Holubetz (1986). Densities (number1100 m^2) of juvenile anadromous fish were monitored in established sections of project streams. A total of 110 monitoring sections were sampled in July-August 1986.

In 1986 IDFG calibrated population estimates obtained by snorkeling with removal-type population estimates (Seber and LeCren 1967; Zippen 1958) in streams of different conductivity and water clarity. Predepletion population estimates were obtained by snorkeling one day before electrofishing. Section boundaries were block netted on day two, and fish were removed by electrofishing in three passes. We then obtained a post-depletion estimate by snorkeling before removing block nets and releasing catches. Estimates obtained by snorkeling were compared to two-pass and three-pass removal estimates.

Anadromous Fish Introductions

In 1986, chinook fry (510-712/pound) were stocked by truck or helicopter above barrier removal projects. Number of spring chinook stocked in Eldorado Creek, Crooked Fork Creek, and Boulder Creek were 199,000, 156,200, and 99,900, respectively. Johnson Creek received 186,000 McCall summer chinook. Chinook fry were not available in 1984-1986 to establish a population above the Pole Creek project.

The 1985 releases of ripe adult steelhead into Eldorado Creek (1,150: 78% female) and Crooked River (2,030; 79% female) provided high natural levels of seeding for yearling steelhead in 1986.

Project Evaluations - General

In 1986, the Evaluation and Monitoring project emphasized obtaining estimates of summer standing crops of anadromous fish produced above barrier removal projects (Eldorado Creek, Crooked Fork Creek, Boulder Creek, Johnson Creek, and Crooked River). We conducted an evaluation of instream structure and off-channel rearing projects in Crooked River and Red River. Additional pretreatment evaluation data for proposed riparian and sediment reduction projects in the Middle Fork Salmon River tributaries were also collected in 1986 in Elk, Bear Valley, and Sulphur creeks.

Project Evaluations - Intensive

The intensive evaluation project was initiated in 1986. A project biologist was hired to conduct the production studies, and plans for 1987 were developed. No field data were collected in 1986.

Partial Project Benefits

The first partial project benefits were estimated in 1986 according to project-specific approaches in Petrosky and Holubetz (1986). The interim benefits are expressed in terms of parr production until reliable estimates of Parr-to-smolt survival can be attained from the intensive studies.

RESULTS

Density Monitoring

Densities of rainbow-steelhead parr and age 0 chinook in established monitoring sections in 1986 are presented in Appendix B. Generally, production of wild and natural steelhead and chinook increased during 1984-86. Wild chinook populations in Sulphur Creek and Loon Creek of the Middle Fork Salmon River showed significant gains from 1985 seeding levels (Tables B16 and B17).

In 1986 population estimates were obtained to compare snorkeling and electrofishing techniques. Conductivity in the sections ranged from 40 to 280 umho/cm, and visibility ranged from 2.7 to 7.3 m (Table 3).

Estimates of juvenile chinook abundance obtained by snorkeling were generally consistent before and after depletion by electrofishing (Table 4). Electrofishing in the low conductivity of Eldorado Creek resulted in a severely biased (but precise) estimate of juvenile chinook abundance, whereas snorkeling estimates were consistent.

Both snorkeling and electrofishing techniques underestimated abundance of rainbow-steelhead fry during the tests (Table 5).

Abundance of rainbow-steelhead parr was best estimated by snorkeling in clear, low-conductivity water and by electrofishing in high-conductivity water with low visibility (Table 6).

Project Evaluations

In 1986 Phase I pretreatment evaluations of habitat conditions and fish populations were conducted in the Elk, Bear Valley, and Sulphur Creek drainages. Habitat data in the Elk and Bear Valley creek drainages were collected through subcontract by USFS Intermountain Forest and Range Experiment Station (Appendix C). Sampling in Sulphur Creek (Appendix D) was designed to complement data from the 1985 inventory and problem identification of the upper Middle Fork and Salmon River tributaries (OEA 1987a,b).

Standing crop estimates were obtained in 1986 for steelhead parr and age 0 chinook rearing above barrier removal projects in Eldorado Creek, Crooked Fork Creek, Crooked River, Johnson Creek, and Boulder Creek (Appendix E, Tables E1-E11).

Chinook fry introductions above barrier removal projects did not fully seed the rearing habitat of any stream. Chinook densities decreased with distance below a stocking site in both low-gradient (< 2.0%) and higher gradient (> 2.0%) sections (Table E7). The clumped distribution of chinook near stocking sites contributed to variation in

Table 3. Sections sampled for comparison of snorkeling and electrofishing population estimates, June 24 - July 3, 1986.

Stream	Section	1986 date	Section area(m^2)	Mean width(m)	Conductivity (umhos/cm)	Visibility (m)	Blocknets held	Blocknets failed
Eldorado Creek	2LG	7/2-3	665	8.5	40	4.6	X	
Marsh Creek	6A	6/26-27	567	5.4	60	5.3		X
Salmon River	Side channel	6/26-27	367	4.8	185	2.7	X	
Crooked River	Orogrande	6/30-7/l	667	8.3	190	7.3	X	
Big Springs Creek	LEM- IA	6/24-25	847	8.6	280	3.6		X

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Table 4. Comparison of snorkeling and electrofishing population estimates (depletion method) for age 0 chinook, June 24 - July 3, 1986.

Stream	Section	(a) Snorkeling count (pre-depletion)	(b) Depletion catch 1	(c) Depletion catch 2	(d) Depletion catch 3	(e) N̂ (C.I.) 2-pass	(f) N̂ (C.I.) 3-pass	(g) Snorkeling count (post-depletion)	(b+c+d+g) Depletion + post-depletion count
Eldorado Creek	2LG	903	97	45	11	177 (143-211)	161 (153-170)	734	887
Marsh Creek	6A	86	15	10	14	36 (25-65)	154 (39-689)	12	51
Salmon River	Side channel	94	57	14	6	(71-Z)	78 (77-81)	14	91
Crooked River	Orogrande	68	44	11	4	57 (55-62)	(59-i)	10	69
Big Springs Creek	LEM IA -	8	4	1	0	5 (5-7)	(5-i)	2	7

Table 5. Comparison of snorkeling and electrofishing population estimates (depletion method) for age 0 rainbow-steelhead, June 24 - July 3, 1986.

Stream	Section	(a) Snorkeling count (pre-depletion)	(b) Depletion catch 1	(c) Depletion catch 2	(d) Depletion catch 3	(e) $\hat{N}$ (C.I.) 2-pass	(f) $\hat{N}$ (C.I.) 3-pass	(g) Snorkeling count (post-depletion)	(b+c+d+g) Depletion + post-depletion count
Eldorado Creek	2LG	41	17	19	9		72 (45-123)	58	103
Marsh Creek	6A	1	1	0	1			0	2
Salmon River	Side channel	1	1	0	0			1	2
Crooked River	Orogrande	6	0	3	0			0	3
Big Springs Creek	LEM-IA	339	336	139	85	570 (519-620)	560 (597-661)	314	874

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Table 6. Comparison of snorkeling and electrofishing population estimates (depletion method) for age ≥ 1 rainbow-steelhead, June 24 - July 3, 1986.

Stream	Section	(a) Snorkeling count (pre-depletion)	(b) Depletion catch 1	(c) Depletion catch 2	(d) Depletion catch 3	(e) $\hat{N}$ (C.I.) 2-pass	(f) $\hat{N}$ (C.I.) 3-pass	(g) Snorkeling count (post-depletion)	(b+c+d+g) Depletion + post-depletion count
Eldorado Creek	2LG	90	17	12	6	(45-E)	56 (51-65)	45	80
Marsh Creek	6A	3	2	0	1			0	3
Salmon River	Side channel	10	9	4	0	(13-E)	13 (13-14)	0	13
Crooked River	Orogrande	12	0	0	0			5	5
Big Springs Creek	LEM IA	76	83	19	9	108 (100-116)	113 (109-117)	1	112

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the standing crop estimates (Tables E2, E4, E6, and Ell). The estimated survival of chinook fry to summer parr averaged 17% for Eldorado, Crooked Fork, Johnson, and Boulder creeks.

An evaluation of chinook and steelhead parr use of sections treated with instream structures and off-channel developments was conducted in Crooked River and Red River in 1986 (Fig. 2). Analysis of the instream structure projects indicates that no significant increases in densities of age 0 chinook or natural steelhead parr can be attributed to the projects in 1986 (Table 7) (Appendix E, Tables E12-E16). In Crooked River, residualized steelhead from smolt releases apparently preferred habitat altered by structures (Table E14). Off-channel developments, including side channels and connected ponds, reared high densities of age 0 chinook and also reared early life stages of steelhead (Tables El4 and E15).

Partial Project Benefits

Numbers of steelhead parr and age 0 chinook attributed to implemented projects from 1984-1986 are presented in Tables 8 and 9. Analysis of trends from monitoring data will be used to estimate benefits in nonevaluation years.

Largest benefits (number of parr produced) accrued to date have been from barrier removal projects where fish have been available for introductions. Total benefits from off-channel developments have been relatively small due primarily to the small area involved (Tables El7 and E18). We have not detected major increases in parr densities from any of the four instream structure projects implemented in Idaho, although the Lolo Creek project apparently resulted in a slight increase in steelhead rearing potential.

DISCUSSION

Success of the entire Fish and Wildlife program will be determined ultimately by the restoration of runs that are affected by hydropower operation, particularly the runs of depressed upriver stocks. Successful on-site mitigation to increase passage survival through improved flows and bypass systems at main stem Columbia and Snake River dams is essential to success of off-site mitigation projects, including the habitat enhancement actions listed in Measure 704(d). The aforementioned improvements are also essential to evaluation of the full benefits of habitat enhancement in Idaho.

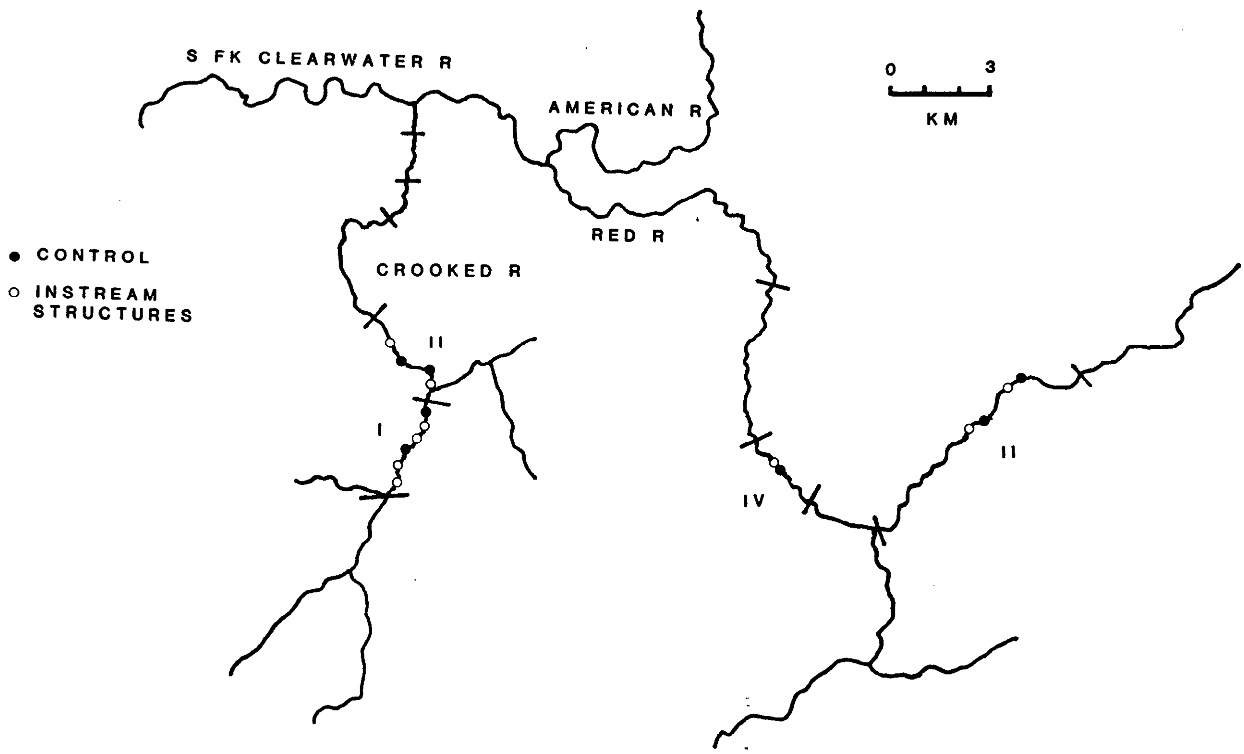

Figure 2. Sections and reaches (blocks) sampled in Crooked River and Red River to evaluate effectiveness of instream structures for rearing juvenile chinook and steelhead, July 14-18 and August 26-28, 1986.

Table 7. Mean density (number/100m2) by age-group of rainbow-steelhead and chinook in sections of Crooked River and Red River that were treated or not treated by instream structures, July 14-18 and August 26-28, 1986.

Species, age	Treatment: control (CO), instream structure (IS)	Period	Blocks (Reach) Crooked River I	Crooked River II	Red River II	Red River IV	Treatment mean	F (P>F)
Rainbow-steelhead								
Age 0	co	Jul	12.2	12.3	0.1	0.2	4.59	1.72 (0.28)
		Aug	3.2	8.4	0.0	0.2		
	IS	Jul	6.7	7.8	0.1	0.2	3.33	
		Aug	6.3	5.2	0.1	0.3		
Age 1	co	Jul	10.0	12.2	2.3	3.2	6.14	0.03 (0.88)
		Aug	6.9	7.0	3.1	4.5		
	IS	Jul	5.2	13.5	2.2	1.3	5.84	
		Aug	5.1	14.0	3.3	2.2		
Age > 1	co	Jul	10.2	13.5	2.8	3.5	6.70	0.05 (0.84)
		Aug	6.9	8.3	3.5	4.8		
	IS	Jul	5.6	14.4	2.7	1.6	6.33	
		Aug	5.2	14.8	4.0	2.3		
Chinook								
Age 0	co	Jul	11.2	30.6	12.2	34.3	24.6	0.13 (0.74)
		Aug	14.4	17.4	20.0	56.9		
	IS	Jul	12.9	19.0	25.4	39.7	26.1	
		Aug	17.4	19.7	30.9	43.7		

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Table 8. Standing crops of age 0 chinook attributed as benefits of implemented projects, 1984-86. Project benefits in nonevaluation years (PB) will be estimated at a later time from monitoring and evaluation data.

Project type, stream	Year implemented	Age 0 Chinook Standing Crop 1984	1985	1986	1987	1988
Barrier Removal - Complete						
Eldorado Creek	1984-85	-	0	30,319		
Crooked Fork Creek	1984-85	-	-	17,588		
Johnson Creek	1984-85	-	PB	23,711		
Boulder Creek	1985	-	-	28,112		
Barrier Removal - Partial[a]						
Crooked River (culvert)	1984	-	PB/f	7,413/f		
Pole Creek (screen)	1983	0	0	0		
Off-Channel Developments						
Crooked River	1984-85	-	12	739		
Red River	1985	-	-	215		
Instream Structures						
Lolo Creek	1983-84	PB	0	PB		
Upper Lochsa River	1983-84	0	PB	PB		
Crooked River	1984-85	-	PB	0		
Red River	1983-85	-	PB	0		

[a] Benefits from partial barrier removed projects to be calculated as a fraction (1/f) of standing crop based on analysis of pre-project potential.

Table 9. Standing crops of steelhead parr attributed as benefits of implemented projects, 1984-86. Project benefits in nonelevation years (PB) will be estimated at a later time from monitoring and evaluation data.

Project type, stream	Year implemented	Steelhead Parr Standing Crop				
		1984	1985	1986	1987	1988
Barrier Removal - Complete						
Eldorado Creek	1984-85	-	0	7,310		
Barrier Removal - Partial[a]						
Crooked Fork Creek	1984-85	-	PB/f	505/f		
Crooked River (culvert)	1984	-	PB/f	2,750/f		
Pole Creek (screen)	1983	0	376/f	PB/f		
South Fork tributaries	1986	-	-	-		
Off-Channel Developments						
Crooked River	1984-85	-	0	69		
Red River	1985	-	-	1		
Instream Structures						
Lolo Creek	1983-84	PB	2,752	PB		
Upper Lochsa River	1983-84	0	PB	PB		
Crooked River	1984-85	-	PB	0		
Red River	1983-85	-	PB	0		

[a] Benefits from partial barrier removal projects to be calculated as a fraction (1/f) of standing crop based on analysis of pre-project potential.

During the period of run restoration, most anadromous populations in Idaho will exhibit a wide range of seeding levels. The current under-seeded conditions and the expected trend for increasing steelhead and salmon escapements as main stem passage conditions improve preclude a simple "before and after" comparison of populations to estimate benefits from habitat projects.

The IDFG general evaluation approach relies heavily on monitoring populations' trends to define full-seeding levels and separation of those parts of "final" densities or standing crops due to specific enhancement activities (Petrosky and Holubetz 1985, 1986). Intensive production studies relating spawning escapements, standing crops of juveniles, and smolt yields (e.g., Bjornn 1978) will be integrated with the survey approach of the general evaluations starting in 1987 in Idaho. A common data base will be needed to apply results from a small number of intensive studies across a broad range of habitats and stocks. Monitoring will assist in applying knowledge gained over time, as well as over a broad range of habitat types, and is essential to estimating partial benefits prior to the project reaching full maturation and/or the parr densities reaching full seeding.

Parr densities have been determined primarily by trained snorkel observers. Some biologists have been critical of the accuracy and reliability of snorkel counts. Comparisons of snorkel counts and electrofishing estimates in typical Idaho anadromous fish streams in 1986 confirmed that the snorkel technique is an excellent method of censusing salmon and steelhead populations.

In 1986, most of the evaluation effort was concentrated in areas above migration barrier removal projects that were stocked with excess hatchery spawners or fry. Resultant densities of parr provided some insight into the effectiveness of supplementation techniques. Adult steelhead spawners placed in Crooked River in the spring of 1985 may have achieved full seeding of the habitat for that year class. In 1986, yearling steelhead densities in Crooked River ranged from 2.4/100 m2 to 16.2/100 m2 (yearlings only).

Stocking with both steelhead fry and chinook fry was very effective in establishing juvenile populations above barrier removal projects. For both species, release was accomplished soon after swim-up and prior to the fry being acclimated to the hatchery environment. The chinook fry survival to the parr stage (late summer) was estimated at 12 to 28% with the mean survival 17% (Appendix E). Numbers of chinook fry that were available did not allow any stream to be stocked at full seeding as demonstrated by decreases in densities downstream of the stocking site.

A priority effort for 1987 will be to estimate full seeding in different habitats in the Salmon and Clear-water drainages. Also, the 1987 work plans will include expanding the monitoring program to ensure that a complete set of representative data will be collected. Extrapolation from intensive study sites to general monitoring sites and from one evaluation site to another site will require that representative data be collected across a range of habitat types found in the Salmon River and Clearwater River systems.

The primary intended effect of many BPA habitat projects is a localized increase in carrying capacity. For projects designed to improve local rearing habitat (e.g., instream structures, some types of riparian revegetation, flood-plain development), IDFG reserved untreated (control) sections within project reaches. As juvenile populations increase and as physical effects of the treatments "mature," the differences in densities between treatments and controls can be estimated using analysis of variance techniques. Both the evaluation approach and initial enhancement rationale for these projects assume that quantity and quality of rearing habitat is likely the major limiting factor. Mass balance analyses of quantity of spawning and rearing habitat in Fish Creek, Oregon, and in Panther Creek tend to support this assumption (Everest et al. 1984; Reiser 1986).

Only marginal benefits have been detected thus far in evaluations of four instream structure projects in Idaho (Tables 8 and 9). Many instream structures in the upper Lochsa River failed within one year, and no increase in densities of either steelhead or chinook parr were detected in 1984 (Petrosky and Holubetz 1985, 1986). In 1985, areas of Lolo Creek treated with instream structures supported slightly higher densities of steelhead parr (1.81100 m2); no increases in chinook densities were detected. Evaluation in 1986 of structure projects in Crooked River and Red River indicates that instream structures did not significantly increase densities of either steelhead or chinook parr.

In the Idaho batholith, deposition of granitic sand is widely recognized as a major factor that potentially limits salmonid populations (Platts and Megahan 1975; Bjornn et al. 1977; Konopacky 1984). Fish response curves to fine sediments in spawning and rearing areas are being developed and refined for the South Fork Salmon River (Stowell et al. 1983). Drawbacks to general use of the present sediment model for BPA project evaluations include the model's reliance on laboratory experiments to simulate natural conditions and the need to calibrate the model to local conditions.

An alternative to extrapolating benefits from the sediment model is to develop empirical relationships between sedimentation and fish populations for project streams and statistically predict mean responses based on measured habitat change for specific projects (Petrosky and Holubetz 1986 and Appendix F).

The IDFG monitoring and evaluation data base is structured for eventual multiple regression or nonlinear analysis of the effects of habitat change on potential and actual parr production of steelhead and chinook. Due to the depressed nature of upriver stocks, the rearing potential of most anadromous fish habitat is not being realized and, therefore, it is difficult to model with certainty. However, some simple relationships can be inferred at existing seeding levels.

Stream gradient appears to influence summer densities of juvenile chinook and steelhead in different ways. Chinook parr density appeared to decrease substantially at gradients greater than 2X (Fig. 3), whereas the density of rainbow-steelhead parr tended to increase with gradient (Fig. 4).

Within low-gradient, meandered reaches (termed C channels in Rosgen 1985), sediment deposition appears to influence chinook and steelhead similarly. Densities of both species decreased as the percentage of sand increased (Figs. 5 and 6).

At least two sorting procedures can be applied to the density monitoring data to better represent rearing potential and reduce variation caused by low seeding. As escapements increase, the higher values from each density monitoring section could be separated into a subset to reduce the influence of years when the habitat was the most under-seeded. The remaining subset of low escapement values would be discarded as being not representative of the rearing potential.

A second sorting procedure was applied in the example in Appendix F. A pretreatment projection of benefits (potential parr production) was calculated for a project proposed in Marsh Creek and Valley Creek to reduce cattle grazing impacts and sediment levels. Projections were based on a subset of the upper 25th percentile of densities estimated for a given sediment class. A logistic sediment-response curve was fit to this subset, and the predicted asymptote was adjusted to fit the best available estimate of carrying capacity for unsedimented streams (Figs. Fl and F2). Existing and projected sediment levels for the affected stream reaches were then used to predict existing and post-treatment rearing potentials (Table Fl).

Post-treatment evaluations will include estimates of actual physical changes in each reach and the full seeding densities for each section. Full seeding will be estimated by continued density monitoring. The final prediction line for post-treatment evaluations of benefits can be derived from the full-seeding fish response to sediment and the estimated change in physical habitat.

At the present time, very few years and very few streams have provided escapements that were large enough to seed habitat at or near the full rearing potential. As future monitoring provides more data regarding full rearing potential, accuracy and precision of these predictive curves will increase greatly.

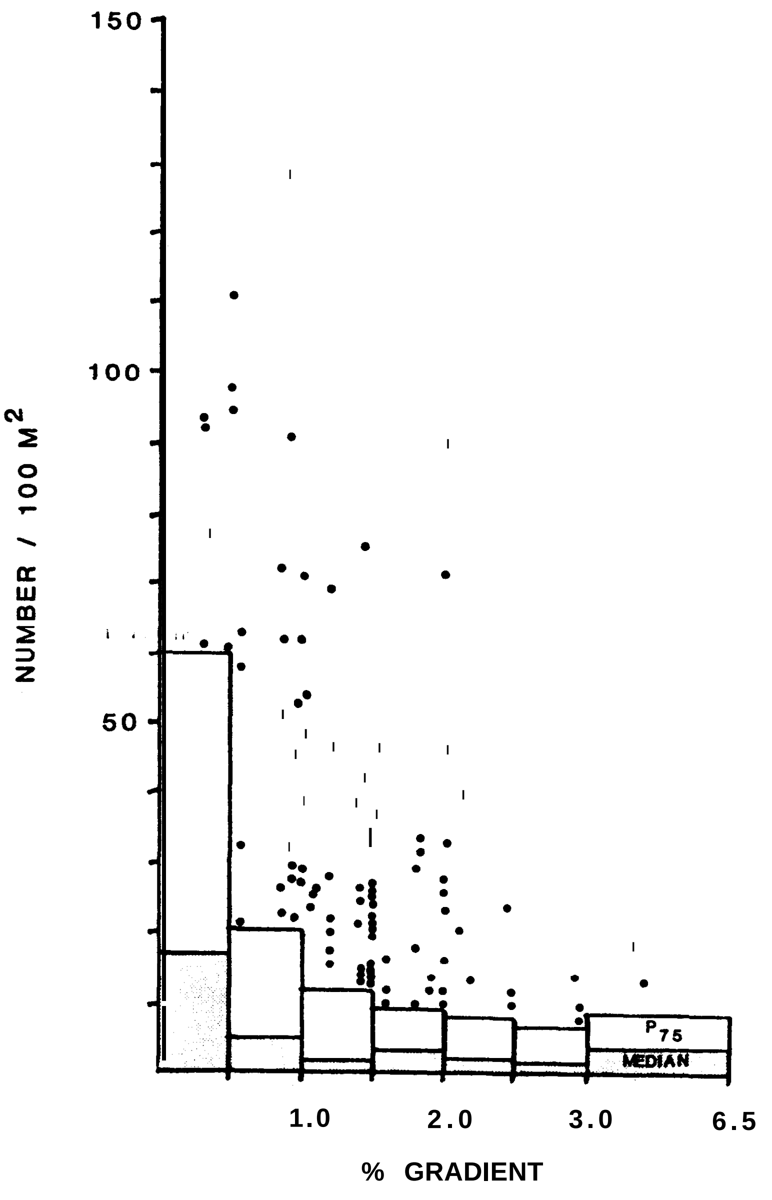

Figure 3. Chinook parr density (number/100m2) plotted against stream gradient, Salmon and Clearwater drainages, 1984-86. Histograms represent the 75th percentile (P75) and median for a gradient class.

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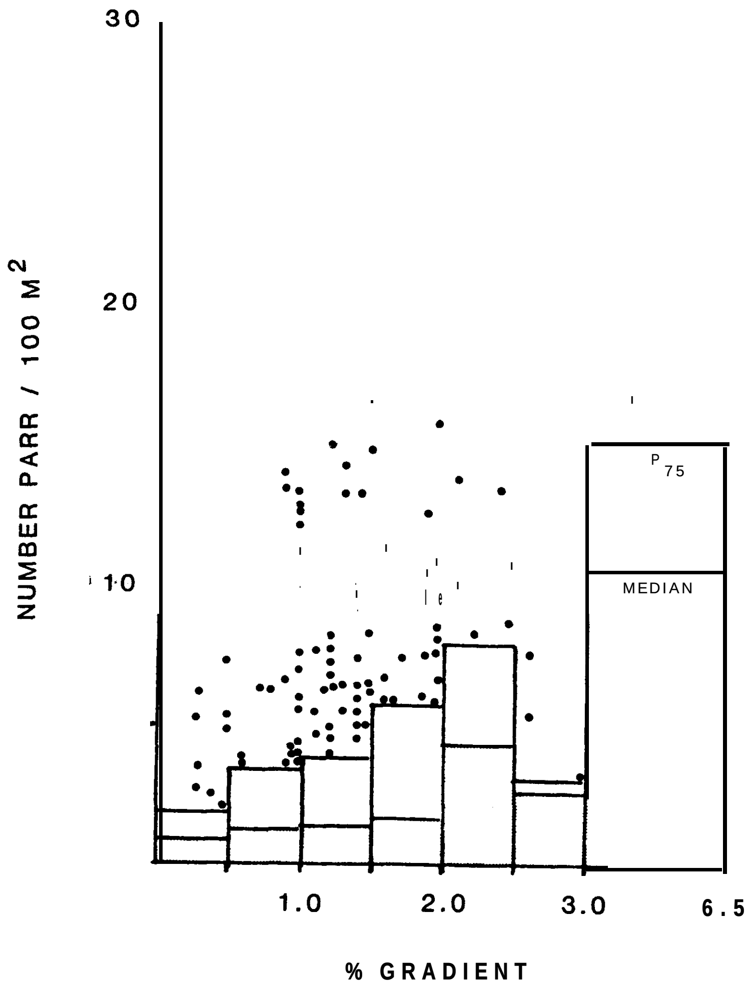

Figure 4. Rainbow-steelhead density (number/100m2) plotted against stream gradient, Salmon and Clearwater drainages, 1984-86. Histograms represent the 75th percentile (P75) and median densities for a gradient class.

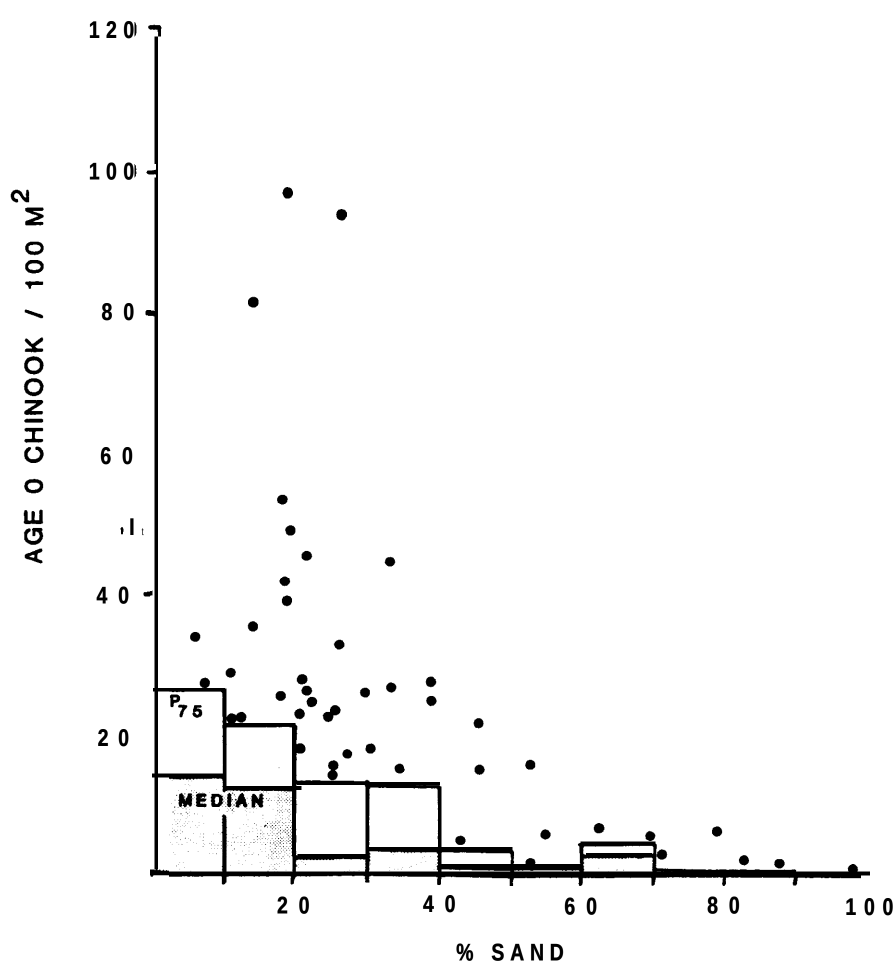

Figure 5. Chinook parr density (number/100m2) plotted against percent sand for low-gradient sections, upper Salmon and Middle Fork Salmon rivers, 1984-86. Histograms represent the 75th percentile (P75) and median for a sediment class.

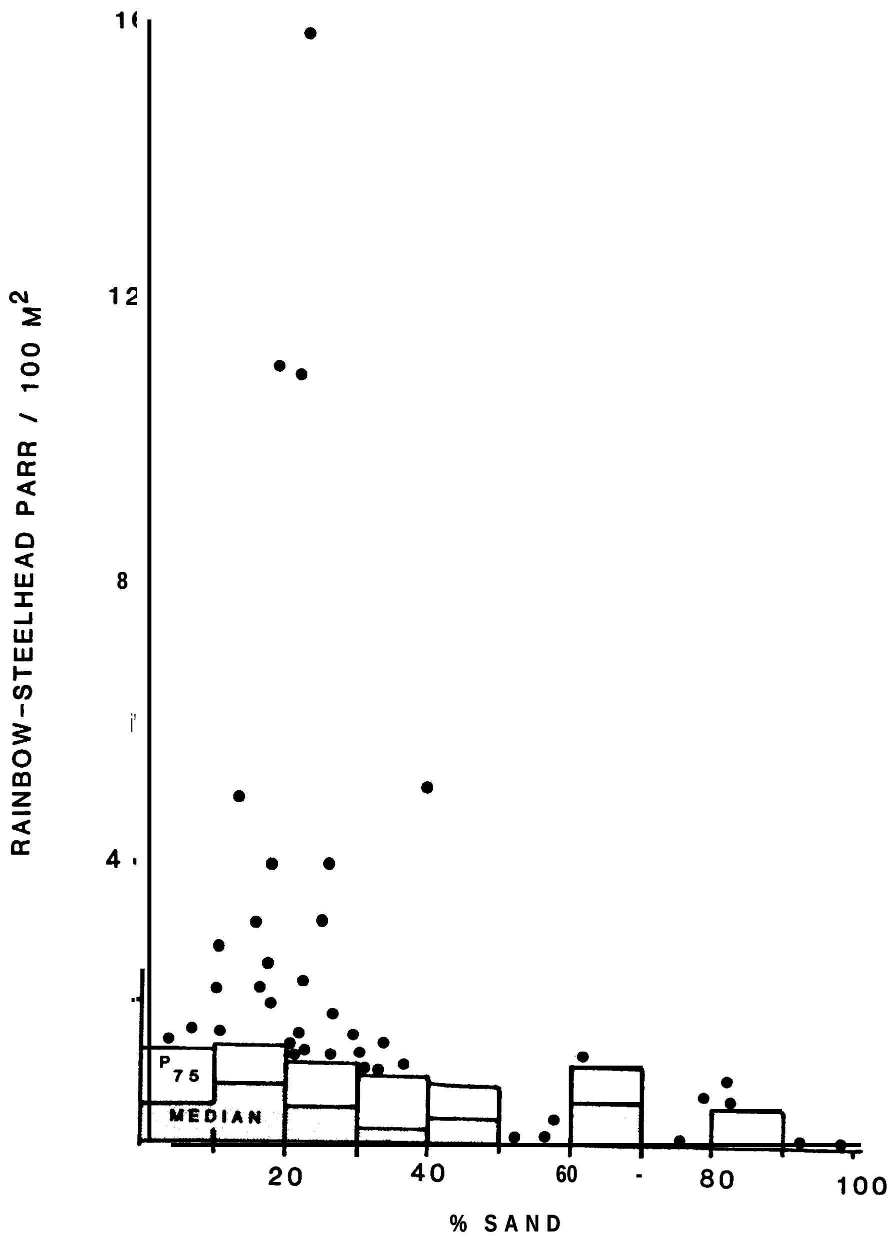

Figure 6. Rainbow-steelhead parr (number/100m2) plotted against percent sand for low-gradient sections, upper Salmon and Middle Fork Salmon rivers, 1984-86. Histograms represent the 75th percentile (P75) and median for a sediment class.

The data base that is being developed through this project will not only serve to determine the effectiveness of individual habitat enhancement projects but will also contribute to the determination of the effectiveness of major elements of the Fish and Wildlife program, such as:

Section 201	Program goals for anadromous fish
Section 304	Water budget and migrant survival
Section 404	Downstream migrant passage
Section 504	Ocean survival, harvest management, and escapement objectives
Section 704	Wild, natural, and hatchery propagation
	Integration of natural and hatchery propagation

Evaluation and monitoring data will provide a scientific basis for informed decisions. Planners, managers, researchers, and administrators will utilize a common data base to improve their ability to effectively perform their tasks.

A data collection system using standardized formats that would assimilate physical habitat data, juvenile density data, and spawning escapement data from all sources (fish and wildlife agencies, tribes, land management agencies, and private entities) into a common data base should be implemented for the entire Columbia River basin. This data base would better serve fisheries managers, land managers, and planners than the present data collection process.

A common format for collection of a minimum of physical and biological data should be established through the Fish and Wildlife program. The examples in Table 10 are suggested for a common data base.

The primary measurement for effectiveness of habitat enhancement measures and the mitigation record should be increased smolt production.

A complete and accurate determination of a mitigation record cannot be made until the following conditions are met:

1. The habitat enhancement project is completed or at full maturation:

2. The fish population affected is observed at a full seeding level, or the evaluators have determined what parr densities constitute full seeding for the affected habitat type; and

3. The evaluators have determined through intensive studies the appropriate survival rate from the parr stage (late summer) to the smolt stage.

Table 10. Proposed Idaho common data base for stream habitats.

I. General

1. Subbasin name or code
2. Stream name
3. Northwest Rivers Study reach designation code*
4. Reach or strata code
5. Section code
6. Date of data collection
7. Methods of physical and biological data collection
8. Collector

II. Biological

Fish density by species, race and age class

III. Physical

1. Geomorphological type*
2. Channel type classification for section*
3. Area of sample section
4. Length of sample section
5. Mean width
6. Mean depth
7. Section gradient
8. Habitat class data (displayed by percent of section)*
9. Substrate surface composition (percent of section in sand, gravel, rubble, boulder and bedrock)*

* Standardized methods will be developed.

The Fish and Wildlife Program and this Evaluation and Monitoring project should expeditiously strive to achieve the three conditions.

After an enhancement project has been implemented and prior to the time that the aforementioned conditions have been met, IDFG will construct a partial mitigation record based on estimated increases in parr production. At a later time, the interim parr responses can be converted to estimated smolt yields. Monitoring data will be essential to estimate partial benefits during those years that evaluations are not conducted (Fig. 7). Partial benefits were estimated in 1986 (Tables 8 and 9 and Appendix E), and will be estimated as the data base allows in future years until the full yield of benefit can be determined.

Annual evaluation and monitoring reports should display project expenditures. The following format illustrates the relative cost of evaluation and monitoring in relation to implementation cost and preliminary/feasibility cost:

IDAHO ANADROMOUS FISH HABITAT ENHANCEMENT SUMMARY
POLE CREEK PROJECT

Year	Preliminary/ Feasibility activity amount	Implementation amount	Evaluation amount	Total amount
1983	$0	$12,000	$ 0	$12,000
1984	0	0	600	600
1985	0	0	300	300
1986	0	$12,000	300	300
Cumulative to date	$0		$900	$12,900

The BPA has employed a consultant firm to gather the cost data for each project. That data will be tabulated as it becomes available. Additional project-specific information is presented in Appendices B-F of this report and the 1984 and 1985 Idaho habitat evaluation reports.

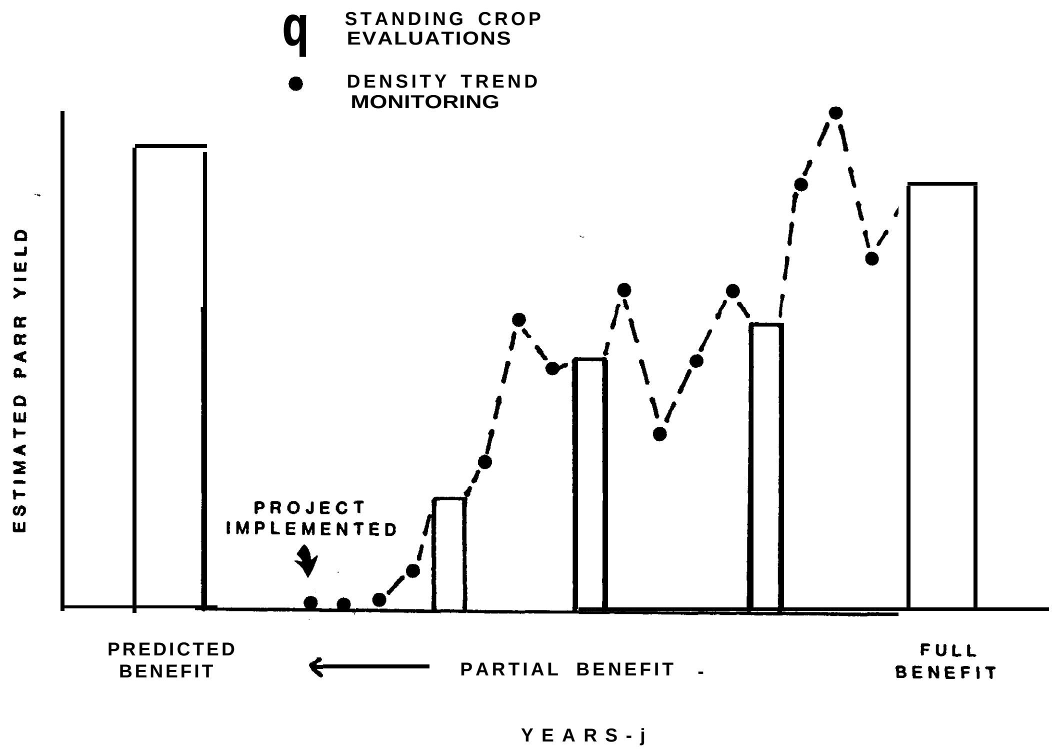

Figure 7. Hypothetical schedule for estimating partial and full benefits of a project (in terms of parr) from monitoring and evaluation programs.

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APPENDIX A

GENERAL AND INTENSIVE LEVEL EVALUATIONS

Benefits of BPA-funded habitat enhancement projects will be defined in terms of increased smolt yield. For most projects, standing crop estimates of parr will be used to estimate smolt yield by factoring appropriate survival rates from parr to smolt stages. Intensive studies will determine parr to smolt survival rates and provide other basic biological information that is needed for evaluation of the Fish and Wildlife Program.

Full seeding is important to evaluate benefits from a habitat enhancement project whether the objective is to add rearing habitat or increase the carrying capacity. Benefits measured from less than full seeding conditions may underestimate true benefits where rearing habitat is added (e.g., barrier removal) and be ambiguous where attempts are made to increase carrying capacity.

Where rearing habitat is added and carrying capacity is reached, measured increases in juvenile steelhead and chinook densities (apparent benefits) will approximate true benefits (Fig. Al-A). If carrying capacity is not reached, true benefits will be underestimated by measured increases in juvenile fish densities (Fig. Al-B). Representative stream sections will be sampled before and after treatment to determine extent of use of a stream reach by anadromous fish. Control reaches (e.g., below a barrier) will also be sampled to follow annual trends in density, but these data likely will not be used in final calculations of benefits. Benefits will be calculated from the increase in density from pretreatment (usually zero) to post-treatment at full seeding.

Where the project objective is to increase carrying capacity, we expect that measured benefits will also approximate true benefits when full seeding occurs (Fig. Al-C). Otherwise, densities of juvenile salmonids may bear little relationship to the quality of habitat and, thus, measured "benefits" would be misleading (Fig. Al-D). Without full seeding by steelhead and chinook, we cannot determine whether a differential in densities between treated and untreated sections indicates only habitat preferences or true increases in rearing potential. Conversely, without full seeding, a lack of differential in densities does not necessarily imply that rearing potential was not changed by habitat enhancement. At full seeding, intraspecific competition for food and space will force juveniles to distribute, thus assuring that juvenile densities will reflect rearing potential. At full seeding, benefits will be calculated from differences between post-treatment densities and densities in control sections. Pretreatment data will be necessary to establish comparative baselines for control and post-treatment sections.

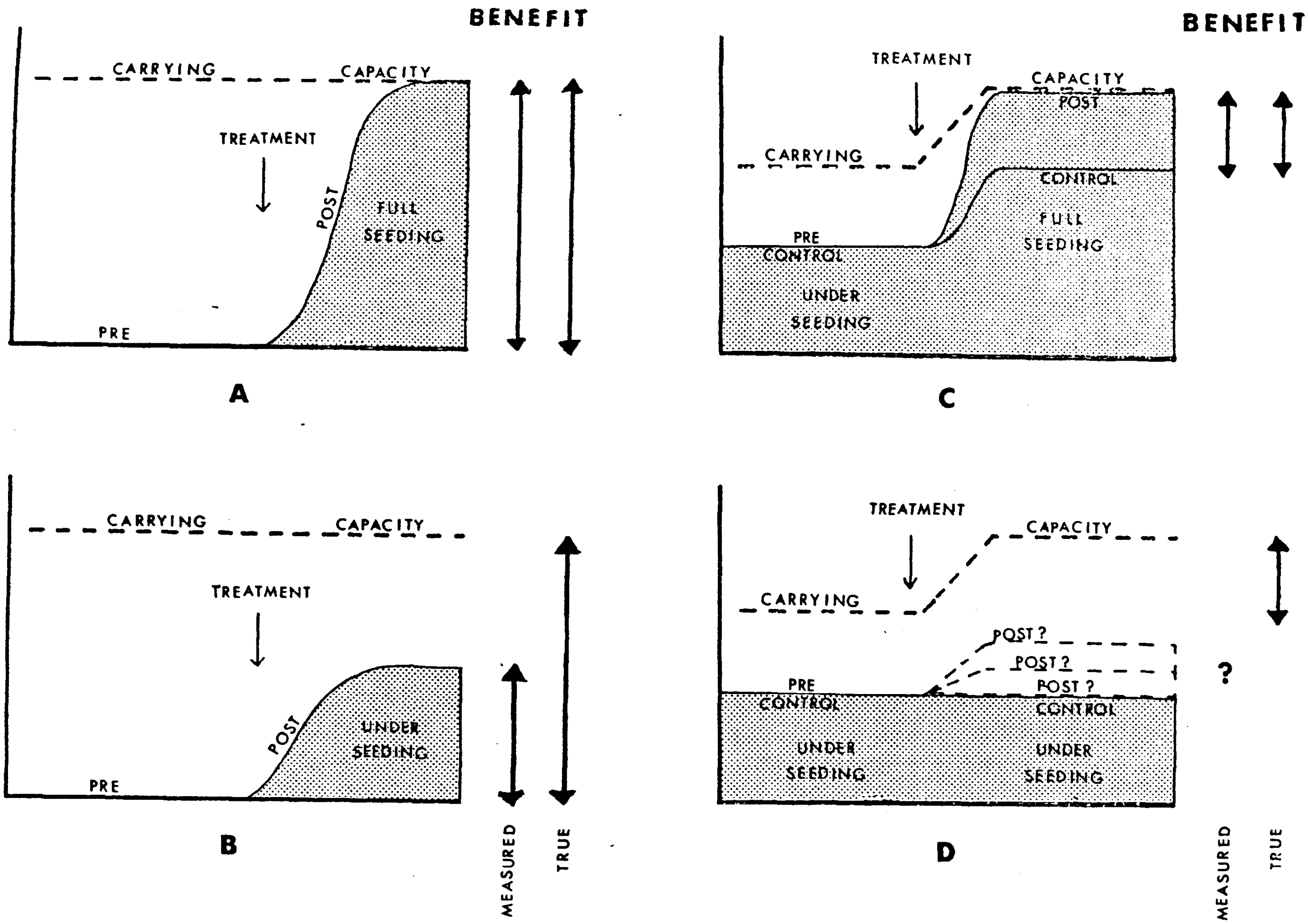

Figure A1. Expected measured and true benefits from projects that add habitat under conditions of full seeding (A) and partial seeding (B), and from projects that increase carrying capacity under conditions of full seeding (C) and partial seeding (D).

In defining the relationship of general level studies to intensive studies, the data compartments depicted in Fig. A2 by square boxes will be components of both general level and intensive level evaluations. The general level studies will be confined to these types of data. The data collected through this evaluation project in 1984-86 consisted of this general level-type data.

In 1987 the intensive level evaluation will be initiated and data compartments depicted in Fig. A2 by circles will be added in Idaho. Data collected through other management activity and research studies will complement the evaluation data base. These data compartments are depicted by hexagons in Fig. AZ.

Integration of these data components will assist in defining realistic estimates of smolt production and adult production which are depicted in Fig. A2 by triangles.

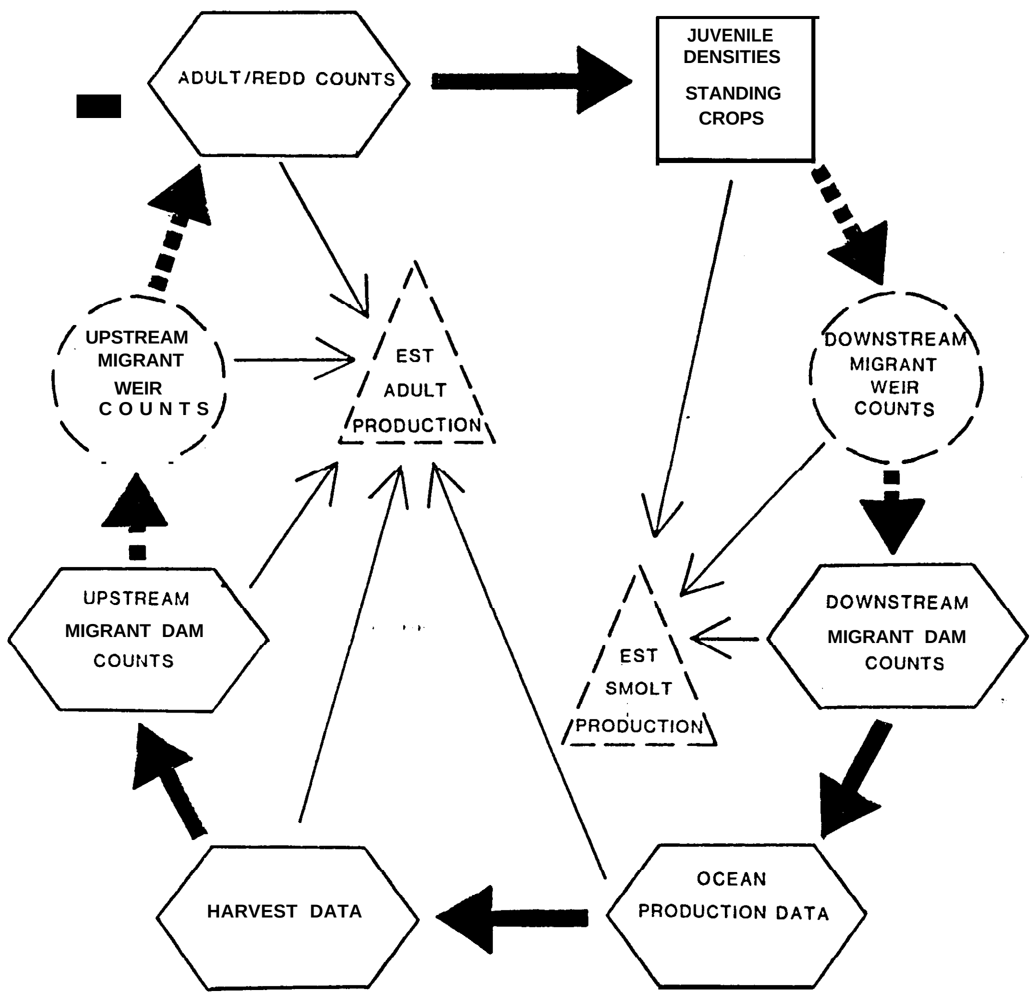

Figure A2. Relationships of major data compartments to estimated production of smolts and adults. General evaluation and monitoring will link (chinook) redd counts and juvenile densities or standing crops. Intensive studies will link actual spawning escapements, redd counts, juvenile densities, and downstream migrants.

APPENDIX B

Table B1. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Lolo Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a (/); evaluation years are indicated by shading.

Species, age	Treatment[a]	Section	83	84	85	86	87	88
Rainbow-steelhead								
Age $\geq$ 1	IS	8303	-	/ 4.4	3.6	2.4		
	C	RUN 1U	-	3.9	2.5	1.4		
	C	RUN 7U	-	-	6.9	2.2		
	IS	8360	-	/ 5.4	6.3	1.3		
	IS	DS 6	-	-	/ 1.0	14.2		
	C	RUN 6D	-	2.5	0.4	9.9		
		Mean	-	4.0	3.4	5.2		
Chinook								
Age 0	IS	8303	-	/ 6.3	25.2	38.3		
	C	RUN 1U	-	0	7.1	70.7		
	C	RUN 7U	-	-	0.2	1.1		
	IS	8360	-	/ 0.9	0.6	0.4		
	IS	DS 6	-	-	/ 0.7	1.0		
	C	RUN 6D	-	0	0	0		
		Mean	-	1.8	5.6	18.6		

[a] IS = Instream structure; C = control.

Table B2. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Eldorado Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section	83	84	85[b]	86[c]	87	88
Rainbow-steelhead								
Age $\geq$ 1	AU	2M	-	-	/ 0	0		
	AL	1HG	-	0	/ 0	11.1		
	AL	2LG	-	0	/ 0	4.3		
	B	1B	-	5.1	5.3	8.7		
		Mean		1.7	1.3	6.0		
Chinook								
Age 0	AU	2M	-	-	/ 0	111.6		
	AL	1HG	-	0	/ 0	2.6		
	AL	2LG	-	0	/ 0	61.4		
	B	1B	-	0	0	2.0		
		Mean		0	0	44.4		

[a]AU = above barriers, upper meadow; AL = above barriers, lower meadow; B = below barriers.

[b]Adult steelhead outplanted.

[c]Chinook fry introductions.

Table B3. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Crooked Fork Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section	83	84	85[b]		86[c]	87	88
Rainbow-steelhead									
Age ≥ 1	A	1A	-	0	0	/	0		
	A	2A	-	0.1	0	/	0		
	A	3A	-	0	0	/	0		
	A	4A	-	0	0	/	0.4		
	B	1B	5.3	5.3	0.8		0.5		
	B	2B	4.8	5.0	1.8		2.0		
		Mean	1.7[b]	1.7	0.4		0.5		
Chinook									
Age 0	A	1A	-	0	0	/	12.3		
	A	2A	-	0	0	/	24.2		
	A	3A	-	0	0	/	6.4		
	A	4A	-	0	0	/	5.2		
	B	1B	4.3	2.9	0.4		2.3		
	B	2B	8.6	3.8	0.5		5.8		
		Mean	2.2[b]	1.1	0.2		9.4		

[a]A = above barriers; B = below barriers.

[b]Densities above barriers assumed to be zero.

[c]Chinook fry introductions.

Table B4. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Crooked River. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Reach, treatment[a]	Section	83	84	85	86	87	88
Rainbow-steelhead								
Age ≥ 1	I,IS	Sill Log A	-	0.2 /	1.5	5.9		
	I,C	Control 1	-	0.7	0.5	5.7		
	II,IS	Treatment 2	-	-	1.5 /	13.7		
	II,C	Control 2	-	-	2.6	14.0		
	III,U	Natural	1.2	3.1	-	3.5		
	IV,U	Meander 1	-	-	0.4	6.1		
	IV,U	Meander 2	0.2	0.7	0.1	5.3		
		Mean	0.7	1.2	1.1	7.7		
Chinook								
Age 0	I,IS	Sill Log A	-	0 /	31.9	17.8		
	I,C	Control 1	-	0	9.7	12.2		
	II,IS	Treatment 2	-	-	52.4 /	21.9		
	II,C	Control 2	-	-	90.2	29.8		
	III,U	Natural	19.5	32.2	-	57.8		
	IV,U	Meander 1	-	-	91.9	93.4		
	IV,U	Meander 2	4.2	3.8	40.7	50.1		
		Mean	11.8	9.0	52.8	40.4		

[a]IS = instream structure; C = control; U = undetermined treatment.

Table B5. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Red River. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Reach, treatment[a]	Section	83	84	85	86	87	88
Rainbow-steelhead								
Age ≥ 1	II,IS	Treatment 2	-	- /	2.3	2.2		
	II,C	Control 2	-	-	1.1	1.3		
	IV,C	Control 1	-	1.9	0.3	-		
	IV,IS	Treatment 1	-	2.2	0.4	-		
	IV,C	Control 2	3.9	2.7	1.1	3.5		
	IV,IS	Treatment 2	1.8	1.6 /	0.8	1.6		
	V,C	Control 2	-	-	0.4	19.1		
	V,BSR	Treatment 2	-	- /	0.5	11.4		
		Mean	2.8	2.1	0.9	6.5		
Chinook								
Age 0	II,IS	Treatment 2	-	- /	75.4	19.3		
	II,C	Control 2	-	-	39.9	4.1		
	IV,C	Control 1	-	16.9	63.1	-		
	IV,IS	Treatment 1	-	35.7	99.3	-		
	IV,C	Control 2	11.7	9.8	77.8	34.3		
	IV,IS	Treatment 2	15.1	17.0 /	60.2	39.7		
	V,C	Control 2	-	-	7.2	49.4		
	V,BSR	Treatment 2	-	- /	8.0	15.1		
		Mean	13.4	19.8	53.9	27.0		

[a]IS = instream structure; C = control; BSR = bank stabilization, riparian revegetation.

Table B6. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Panther Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section	83	84	85[b]	86[c]	87	88
Rainbow-steelhead								
Age ≥ 1	A	M01	-	4.3	8.4	13.3		
	A	PC9	-	7.1	-	12.5		
	B1,A2	PC6	-	1.1	1.0	2.5		
	B1,B2	PC4	-	0	+	0.2		
	B1,B2	PC1	-	1.0	0.7	0.8		
		Mean	-	2.7	2.0	5.7		
Chinook								
Age 0	A	M01	-	0	0	0		
	A	PC9	-	0	-	0		
	B1,A2	PC6	-	+	0	0		
	B1,B2	PC4	-	0	0	0		
	B1,B2	PC1	-	0	0	0		
		Mean	-	+	0	0		

[a] A = above mine effluent; B1 = below Blackbird Creek; A2 = above Big Deer Creek; B2 = below Big Deer Creek.

[b] Engineering feasibility, habitat assessment only.

[c] Adult chinook outplanted.

Table B7. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Lemhi River. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section	83	84	85[b]	86	87	88
Rainbow-steelhead								
Age ≥ 1	Big Springs Cr.	LEM-1A	-	-	44.6	15.8		
	Lemhi R.	LEM-2B	-	-	20.0	21.5		
	Lemhi R.	LEM-3A	-	-	15.9	12.7		
	Bear Valley Cr.	HC-1B	-	-	1.0	0.3		
	Hayden Cr.	HC-2B	-	-	0	0.2		
	Hayden Cr.	HC-3B	-	-	0.5	4.1		
		Mean	-	-	13.7	9.1		
Chinook								
Age 0	Big Springs Cr.	LEM-1A	-	-	0.5	0.7		
	Lemhi R.	LEM-2B	-	-	1.4	5.0		
	Lemhi R.	LEM-3A	-	-	1.7	1.1		
	Bear Valley Cr.	HC-1B	-	-	0	0		
	Hayden Cr.	HC-2B	-	-	14.4	0		
	Hayden Cr.	HC-3B	-	-	7.3	0		
		Mean	-	-	4.2	1.1		

[a]All sections located above dewatered area.

[b]Engineering feasibility, habitat assessment only.

Table B8. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, East Fork Salmon River. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section	83	84	85[b]	86[b]	87	88
Rainbow-steelhead								
Age ≥ 1	AW	2	-	-	0.2	1.5		
	AW	3	-	-	0	0.7		
	BW	5	-	-	1.2	1.4		
	BW	8	-	-	6.2	2.6		
		Mean	-	-	1.9	1.6		
Chinook								
Age 0	AW	2	-	-	0	0.3		
	AW	3	-	-	0	6.5		
	BW	5	-	-	6.0	10.5		
	BW	8	-	-	21.0	1.3		
		Mean	-	-	5.2	4.7		

[a]AW = above East Fork weir; BW = below weir.

[b]Pretreatment evaluation by Shoshone-Bannock Tribe.

Table B9. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, upper Salmon River. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section[b]	83	84	85	86	87	88
Rainbow-steelhead								
Age ≥ 1	AD	10A	-	0	10.9	15.9		
	AD	9A	-	0.2	3.9	11.1		
	AD	8B	-	0	0.8	0.6		
	AD	8A	-	1.9	0.4	1.2		
	BD	7B	-	0.2	0.8	0.2		
	BD	7A	-	1.4	1.2	0.5		
	BD	6A	-	-	0.1	0		
	BW	3BRA	-	-	8.2	3.7		
	BW	2B	-	-	2.0	1.1		
		Mean	-	0.8	3.1	3.8		
Chinook								
Age 0	AD	10A	-	28.1	7.1	3.4		
	AD	9A	-	53.2	12.8	6.0		
	AD	8B	-	12.9	1.2	7.6		
	AD	8A	-	97.4	1.4	16.9		
	BD	7B	-	94.7	10.8	1.7		
	BD	7A	-	41.2	17.4	20.2		
	BD	6A	-	-	0	0.4		
	BW	3BRA	-	-	32.2	70.6		
	BW	2B	-	-	2.2	4.1		
		Mean	-	54.0	9.4	14.5		

[a] AD = above irrigation diversion; BD = below diversion; BW = below Sawtooth Hatchery weir.

[b] Sections 10A, 9A, 8B, 8A, and 7A were initially numbered in 1984 as 1, 2, 3, 4, 5, and 6, respectively.

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Table B10. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Alturas Lake Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section	83	84	85	86	87	88
Rainbow-steelhead								
Age ≥ 1	A,L	1A	-	0	0.1	0		
	A,L	2A	-	0	0	0		
	A	2	-	0.5	-	1.0		
	B	3	-	0.5	0.8	0.3		
		Mean	-	0.2	0.3	0.3		
Chinook								
Age 0	A,L	1A	-	0.1	0	0		
	A,L	2A	-	1.2	0	0.1		
	A	2	-	6.8	-	5.7		
	B	3	-	81.9	12.5	12.3		
		Mean	-	22.5	4.2	4.5		

[a]A = above irrigation diversion; B = below diversion; L = above Alturas Lake.

Table B11. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Pole Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section[b]	83	84	85[c]	86	87	88
Rainbow-steelhead								
Age ≥ 1	A	3B	- /	0	0	0.2		
	A	3A	- /	0	0	0		
	B	2B	-	0	0	0.3		
	B	2A	-	0.8	3.2	3.6		
		Mean	-	0.2	0.8	1.0		
Chinook								
Age 0	A	3B	- /	0	0	0		
	A	3A	- /	0	0	0		
	B	2B	-	45.2	0	0		
	B	2A	-	15.5	0	0.3		
		Mean	-	15.2	0	0.1		

a A = above irrigation diversion screen; B = below irrigation diversion screen.

b Sections 3B, 3A, 2B, and 2A were initially numbered in 1984 as 1, 2, 3, and 4, respectively.

c Habitat inventory and problem identification; not an evaluation of BPA screening project.

Table B12. Annual trends in density (number/100m[2]) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Valley Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Section	83	84	85[a]	86	87	88
Rainbow-steelhead							
Age $\geq$ 1	6B	-	-	0.2	0.3		
	3B	-	-	2.8	0.9		
	3A	-	-	3.5	0.7		
	1B	-	-	1.3	0.5		
	Mean	-	-	1.9	0.6		
Chinook							
Age 0	6B	-	-	5.4	0		
	3B	-	-	38.6	0.7		
	3A	-	-	45.5	3.5		
	1B	-	-	15.1	21.9		
	Mean	-	-	26.1	6.5		

[a]Habitat inventory and problem identification.

Table B13. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Bear Valley Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section[b]	83	84[c]	85[c,d]	86[c]	87	88
Rainbow-steelhead								
Age ≥ 1	AM	9B	-	0	0	0		
	BM	5A	-	0	0 /	0		
	BM	3A	-	0.2	0 /	0.8		
	BE	2A	-	+	0.1 /	0.1		
	BE	2B	-	+	0 /	0		
	BE	1A	-	1.1	0 /	3.3		
		Mean	-	0.2	+	0.7		
Chinook								
Age 0	AM	9B	-	5.9	0	0		
	BM	5A	-	5.4	0.2 /	4.1		
	BM	3A	-	2.0	1.0 /	4.7		
	BE	2A	-	4.7	1.9 /	3.0		
	BE	2B	-	1.3	0 /	0.3		
	BE	1A	-	3.2	0.2 /	0.5		
		Mean	-	3.8	0.6	2.1		

[a] AM = above mining area; BM = below mining area; BE = below mining area and Elk Creek.

[b] Sections 2A and 2B were initially numbered by IDFG in 1984 as sections 4 and 5; all other sections established by Shoshone-Bannock Tribe.

[c] Pretreatment and post-treatment evaluation by Shoshone-Bannock Tribe for "point-source" sediment reduction project.

[d] Habitat inventory and problem identification.

Table B14. Annual trends in density (number/100m²) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Elk Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section[b]	83	84	85[c]	86	87	88
Rainbow-steelhead								
Age ≥ 1	A	2A	-	0	0	+		
	A	2B	-	-	1.1	0.2		
	B	1A	-	-	0.4	0		
	B	1B	-	+	1.4	0.6		
		Mean	-	+	0.7	0.2		
Chinook								
Age 0	A	2A	-	0.5	0.5	0.9		
	A	2B	-	-	6.1	2.6		
	B	1A	-	-	2.8	0.1		
	B	1B	-	7.7	1.0	2.9		
		Mean	-	4.1	2.6	1.6		

[a]A = above Bearskin Creek confluence; B = below Bearskin Creek.

[b]Sections 2A and 1B were initially numbered in 1984 as 1 and 2, respectively.

[c]Habitat inventory and problem identification.

Table B15. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Marsh Creek drainage. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location[a]	Section[b]	83	84	85[c]	86	87	88
Rainbow-steelhead								
Age ≥ 1	KN,M	2B	-	-	0.6	0.3		
	KN,M	1A	0.2	-	1.0	0.7		
	MA,M	6A	0.4	-	0	0.5		
	MA,M	5A	-	-	0.4	1.2		
	MA,M	4B	1.3	1.0	1.3	1.2		
	CH,M	2B	-	-	0.2	0.5		
	CH,M	1A	-	-	0	0.6		
	BV,M	3B	-	-	1.2	2.1		
	BV,M	1A	-	-	1.4	0		
	MA,C	1B	-	-	1.5	1.6		
	MA,C	1A	-	-	1.7	0.2		
		Mean	0.6	1.0	0.8	0.8		
Chinook								
Age 0	KN,M	2B	-	-	0.4	0		
	KN,M	1A	16.9	-	23.6	7.2		
	MA,M	6A	25.9	-	9.7	8.3		
	MA,M	5A	-	-	35.7	45.4		
	MA,M	4B	21.6	17.9	22.2	26.2		
	CH,M	2B	-	-	48.0	12.6		
	CH,M	1A	-	-	25.0	14.5		
	BV,M	3B	-	-	10.8	28.6		
	BV,M	1A	-	-	12.9	7.2		
	MA,C	1B	-	-	10.6	1.7		
	MA,C	1A	-	-	5.4	0		
		Mean	21.5	17.9	17.7	13.8		

[a] Locations: KN = Knapp Creek; MA = Marsh Creek; CH = Capehorn Creek; BV = Beaver Creek. Habitat: M = meadow; C = canyon.

[b] Section 4B, Marsh Creek, was initially numbered in 1984 as 1.

[c] Habitat inventory and problem identification.

Table B16. Annual trends in density (number/100m²) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Sulphur Creek. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Section	83	84	85	/86	87	88
Rainbow-steelhead							
Age ≥ 1	4B	-	0	1.0	1.1		
	4A	-	-	0	0.2		
	Mean	-	0	0.5	0.6		
Chinook							
Age 0	4B	-	9.2	18.1	62.6		
	4A	-	-	0.1	25.8		
	Mean	-	9.2	9.1	44.2		

Table B17. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Camas Creek and Loon Creek (control stream). Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Location, habitat[a]	Section	83	84	85	86	87	88
Rainbow-steelhead								
Age ≥ 1	C,DM	1	0.4	0.8	1.9	4.6		
	C,DM	2	-	2.5	1.0	0.4		
	C,C	CAM-1	-	-	16.8	1.8		
	L,CM	1	-	-	1.7	4.0		
	L,CM	2	-	-	1.4	4.0		
	L,C	LNM-1	-	-	0.2	9.1		
		Mean	0.4	1.6	3.8	4.0		
Chinook								
Age 0	C,DM	1	2.5	0.8	3.0	10.0		
	C,DM	2	-	1.3	3.6	5.2		
	C,C	CAM-1	-	-	2.1	0.2		
	L,CM	1	-	-	3.3	19.8		
	L,CM	2	-	-	3.3	44.8		
	L,C	LNM-1	-	-	1.7	25.4		
		Mean	2.5	1.0	2.8	17.7		

[a] Stream: C = Camas Creek; L = Loon Creek. Habitat: DM = degraded meadow; C = canyon; CM = control meadow.

Table B18. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, South Fork Salmon River. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Stream	Section	83	84	85	86	87	88
Rainbow-steelhead								
Age ≥ 1	South Fork	Stolle-1	-	0.2	1.1	1.0		
	South Fork	Stolle-2	-	-	0	0.1		
	Dollar Creek	1	-	-	-	1.9		
	Six Bit Creek	1	-	-	-	0		
		Mean	-	0.2	0.6	0.8		
Chinook								
Age 0	South Fork	Stolle-1	-	14.6	75.0	19.0		
	South Fork	Stolle-2	-	-	7.5	19.7		
	Dollar Creek	1	-	-	-	0		
	Six Bit Creek	1	-	-	-	0		
		Mean	-	14.6	41.2	9.7		

Table B19. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Johnson Creek and tributaries. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Stream, habitat[a]	Section	83	84[b]	85[c]	86[c]	87	88
Rainbow-steelhead								
Age ≥ 1	J,MA	M1	-	0.6 /	0	0.3		
	J,MA	M2	-	0.2 /	0	0.5		
	J,MA	M3	-	0.8 /	0	0.3		
	S,MA	M2	-	0 /	0	-		
	R,MA	M1	-	0 /	0	0		
	J,CA	PW1A	-	0.5 /	0.2	0.1		
	J,CA	PW3A	-	8.1 /	-	9.3		
	J,CB	PW3B	-	3.1	-	0.7		
		Mean	-	1.7	+	1.6		
Chinook								
Age 0	J,MA	M1	-	0 /	2.8	17.4		
	J,MA	M2	-	0 /	0.3	21.3		
	J,MA	M3	-	0 /	1.6	5.2		
	S,MA	M2	-	0 /	8.0	-		
	R,MA	M1	-	0 /	4.0	15.8		
	J,CA	PW1A	-	0 /	0.8	1.0		
	J,CA	PW3A	-	0 /	-	13.6		
	J,CB	PW3B	-	0	-	0		
		Mean	-	0	2.9	10.6		

[a] Stream: J = Johnson Creek; S = Sand Creek; R = Rock Creek. Habitat: MA = meadow above barriers; CA = canyon above barriers; CB = canyon below barriers.

[b] Pretreatment survey.

[c] Success of chinook introductions evaluated through subcontract.

Table B20. Annual trends in density (number/100m^2) of yearling-and-older rainbow-steelhead and age 0 chinook in established monitoring sections, Boulder Creek and Little Salmon River. Sections are listed sequentially, upstream to downstream. Time of implementation is indicated by a slash (/); evaluation years are indicated by shading.

Species, age	Stream	Location[a]	Section	83	84	85[b]		86	87	88
Rainbow-steelhead										
Age ≥ 1	Boulder Cr.	A	1	-	6.3	3.7	/	6.8		
	Boulder Cr.	A	2	-	2.7	7.5	/	5.3		
	Boulder Cr.	B	3	-	8.1	13.3		-		
	Boulder Cr.	B	5	-	4.9	16.8		24.1		
	Little Salmon R.	B	1	-	-	13.2		9.8		
	Little Salmon R.	B	2	-	-	10.1		14.8		
			Mean	-	5.5	10.8		12.2		
Chinook										
Age 0	Boulder Cr.	A	1	-	0	0.4	/	3.7		
	Boulder Cr.	A	2	-	0	0	/	0		
	Boulder Cr.	B	3	-	2.5	3.9		-		
	Boulder Cr.	B	5	-	1.8	4.2		18.1		
	Little Salmon R.	B	1	-	-	0.1		0.1		
	Little Salmon R.	B	2	-	-	1.3		2.8		
			Mean	-	1.1	1.7		4.9		

a A = above Boulder Creek barrier; B = below barriers.

b Chinook fry introduction.

APPENDIX C

Aquatic and Riparian Habitat Conditions of the Bear Valley Area, 1986

Submitted to Terry Holubetz
Idaho Department of Fish and Game
January 1987

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Introduction

To improve stocks of anadromous fish within the Columbia Basin, and in accordance with the Congressional mandate to protect, mitigate, and enhance fish populations impacted by dams and the development of hydroelectric power in the Pacific Northwest (Pacific Northwest Electric Power Planning and Conservation Act of 1980), a number of stream enhancement projects are planned, or are being constructed in the National Forests of Idaho. These activities are supervised by the Idaho Department of Fish and Game and funded by the Bonneville Power Administration (BPA), with the overall goal of increasing numbers of anadromous salmonids, through stream rehabilitation and enhancement.

In some cases stream enhancement projects have been poorly designed with little regard to their effects on physical habitat and the various life history stages of anadromous salmonids (Buell 1986). Additionally, inadequate effort has been made to document existing habitat conditions and the post-treatment effect . of stream improvements. Meaningful enhancement efforts must be accompanied by careful description of habitat conditions not only before enhancement activities, but in the years following enhancement, so that effective rehabilitation efforts can be identified and documented. In an era of diminishing budgets, the management of anadromous fisheries must become cost-effective.

In Bear Valley Creek, rehabilitation efforts have been directed towards an abandoned 900 acre 'dredge mine, which has caused severe streambank instability and sediment loading. Mineral exploration for the rare earth metals; columbium, yttrium, and and tantalum began in 1955. The primary value of these metals was derived from their importance to the vacuum-tube electronics industry, so commercially profitable mining for them in Bear Valley was short-lived, and came to a halt at the end of the decade.

The environmental effects of these mining operations have proven to be severe because of poor management, and planning. No effort was made upon completion of mining to rehabilitate or return the stream to original conditions. Canals constructed to divert stream water from Bear Valley Creek and its tributaries were poorly constructed, resulting in both frequent dewatering and sediment innudation when canals were breached (Platts and Rountree 1972). Initial restorative efforts were undertaken in 1969, including closing the main canal, releasing Bear Valley to find its own channel, and excavation to divert the main channel away from tailing ponds. These efforts largely failed; the new channel could not resist the streams erosive power, and large amounts of tailing and bank materials were pumped downstream. It has been estimated that since 1969, at least 500,000 cubic yards of fine decomposed granitic material has been eroded from the two miles of stream bank and areas adjacent to the dredge mine (Konopacky et al 1986).

The ecological, sociological and economic impact of various land management activities have been tremendous. Platts (1968) estimated that the dredging operation directly altered about three acres of anadromous spawning habitat. Downstream impacts, including loss of spawning and rearing habitat for anadromous salmonids have also been severe. Historically, because of excellent water quality, low channel gradient, and in combination with abundant rubble and gravel channel substrates, Bear Valley has supported large runs of chinook salmon and steelhead trout. Chinook redd counts prior to the 1950's ranged from an estimated 600 to 1200 each year. However, redd counts have shown a continual decrease since 1955 (Figure 1).

A three-year rehabilitation project is being implemented in the Bear Valley area) consisting of the construct ion of a floodplain and the stabilization of slopes along Bear Valley Creek throughout a portion of the previously dredge mined area. The floodplain construct ion involves excavating 80,000 cubic yards of sand, sediments, and rocks along the existing stream channel to provide enough capacity for high spring runoff flows and to protect the banks from erosion (Konopacky et al. 1986). Dredge banks have been pulled away from the stream course, stabilized with boulders, synthetic coverings, and riparian plantings. The benefits of this project are expected to increase chinook and steelhead reproduction and early age-class survival primarily because of sediment reduction. However, it will be difficult to seperate the input of sediment from other land-uses

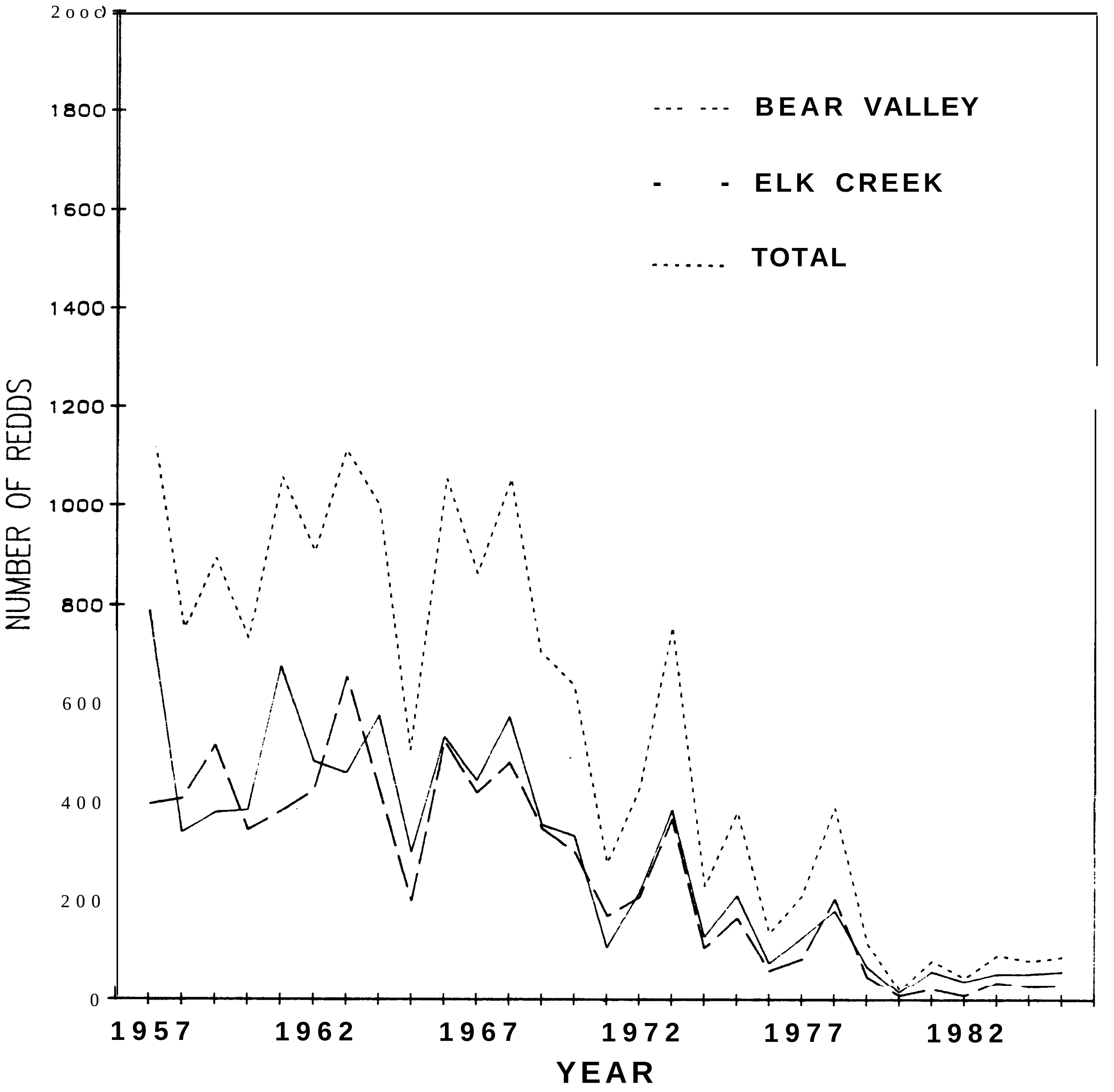

Figure 1. Redd counts in Bear Valley Creek and Elk Creek 19574985. Data from Pollard (1985).

such as grazing, logging, and natural sources. Additionally, escapement levels of anadromous salmonids are likely to flucuate in response to downstream influences of commercial/sport fishing, and passage problems over hydroelectric dams. These problems will likely hamper the evaluation process.

The other components of this study, Elk Creek, and its major tributary Bearskin Creek, have also been impacted by loading of fine sediments. In Elk Creek, sedimentation has increased above natural rates because of logging and livestock grazing and mass erosion in the Bearskin Creek. These non-point sources of fine sediment are considered responsible for the decline in anadromous salmonids that historically thrived in the drainage (Figure 1).

In order to evaluate the effectiveness of exisiting and future stream rehabilitation projects within the Bear Valley drainage, pre- and post-project physical habitat conditions must be documented. Biologists of the U.S. Forest Service, Intermountain Station, were contracted by the Idaho Department of Fish and Game to document the aquatic and riparian habitat of Bear Valley, Elk, and Bearskin Creek, during 1986. This report includes pre-‘treatment data for that calendar year only and makes no attempt to evaluate or recommend treatments for the Bear Valley drainage.

Study Area Description

Bear Valley Creek, 55 km long, joins Marsh Creek to form the Middle Fork Salmon River (Figure 2). Elk Creek, 35 km long, is the largest tributary to Bear Valley Creek. Other, important tributaries of Bear Valley Creek include Wyoming, Fir, Sack, Cache, and Pole Creek. The drainage is located entirely within the Boise National Forest, although 6.3 km of Bear Valley Creek runs through privately owned patented lands. The area is located in the Idaho batholith, a cryoplanated qranitic upland, characterized by alluvial deposits of highly erodible, poorly developed soi ls. Streams within the Bear Valley area are generally of low gradient, and have a high meander ratio.

Vegetation and Climate

Climatic conditions in the Bear Valley drainage are among the most severe in Idaho (Platts and Nelson 1986). Precipitation averages about 55 inches annually; approximately 75 percent of which falls as snow during long, cold winters in which the January mean temperature is 0 F. Summer weather is normally warm and dry, but is subject to occasional intense convectional storms.

Highland vegetation is composed of Englemann spruce (*Picea englemanni*), subalpine fir (*Abies lasiocarpa*), with long-term seral stands of lodgepole pine (*Pinus contorta*) descending to the valley floor. Val ley floor vegetation is predominatly grassy with upland areas dominated by Idaho fescue (*Festuca idahoensis*)

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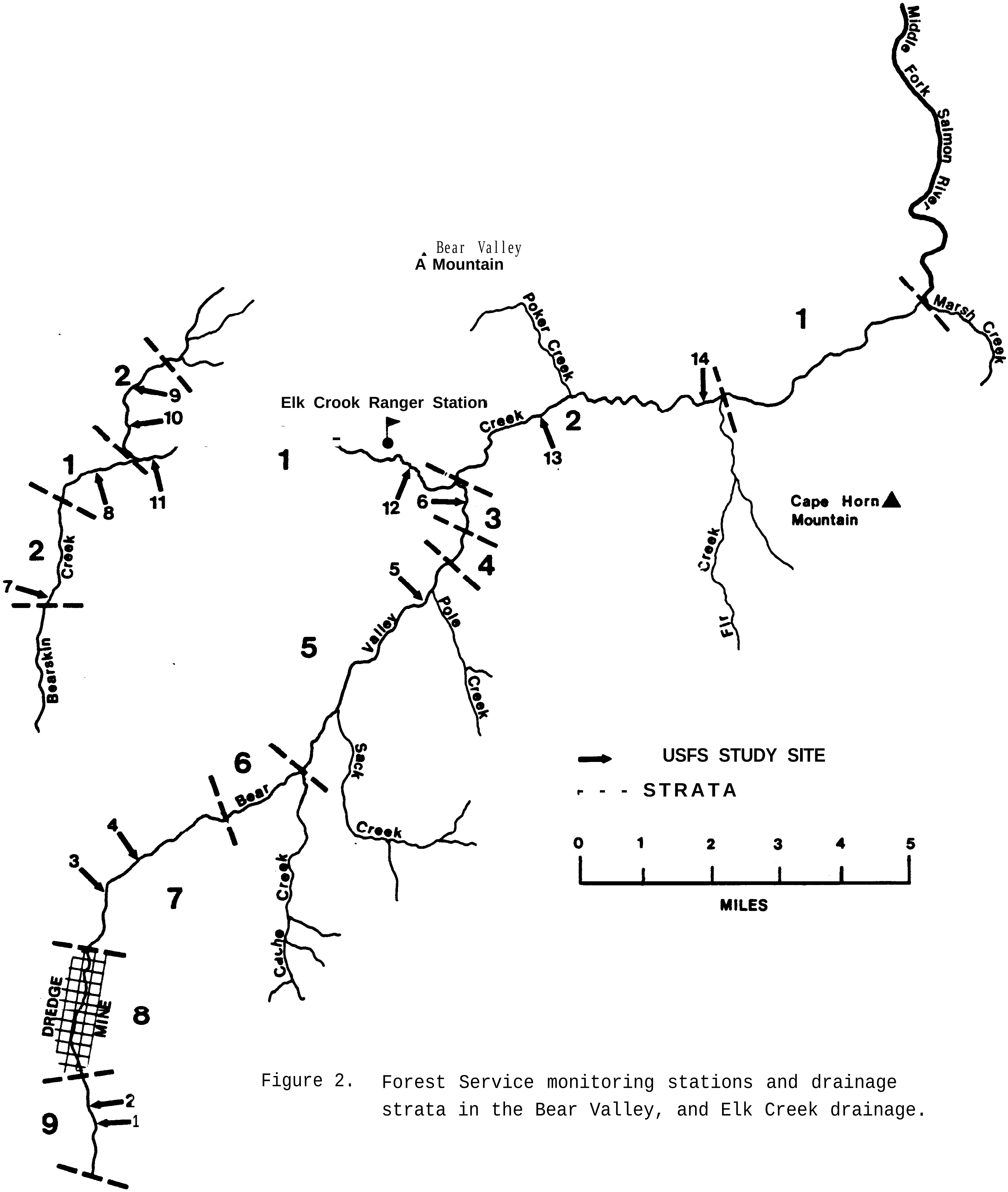

Figure 2. Forest Service monitoring stations and drainage strata in the Bear Valley, and Elk Creek drainage.

Table 1. U.S. Forest Service study site numbers, EPA strata and section, and collection years of habitat/fish data in the bear Valley drainage.

Steam	USFS Section	EPA Strata -	BPA Section	EPA Habitat* Data (Years)	BPA Fish Data (Years)
<u>Bear Valley Creek</u>					
Upper Dredge	1[b]	9	B	85	84, 85
Lower Dredge	2[b]	9	A	85	84, 85, 86
Big Meadows	3	7	-	--	----
Mace Creek	4	7	-	--	----
Pole Creek	5[b]	5	A	85	84, 85, 86
Campsite	6[b]	3	A	85	84, 85, 86
Poker Meadows	13	2	A	85	84, 85, 86
Fir Creek	14	2	B	85	84, 85, 86
<u>Elk Creek</u>					
Corduroy Mdws.	9	2	A	85	84, 85, 86
Canyon	10	3	B	85	85, 86
Bearskin	11	1	A	85	85. 86
Guard	12	1	B	85	84, 85, 86
<u>Bearskin Creek</u>					
Upper Bearskin	7	3	A	85	85
Lower Beat-skin	8	2	B	85	85

[a] OEA inventory
[b] Sections established and sampled by the Shoshone-Bannock Tribe in 1984-85.

and Columbia needlegrass (Stipa columbiana) grading into a tiparian ecosystem containing a variety of grasses, sedges, and willows. Representative riparian species include water sedge (Carex aquatilis), beaked sedge (C. rostrata), bluejoint (Calamogrostis canadensis), and several species of willow (Salix spp.).

Fisheries

Resident fish species in the Bear Valley drainage include several species of salmonids, including rainbow trout (Salmo gairdneri), cutthroat trout (S. clarki), brook trout (Salvelinus fontinalis), bull trout (S confluentus), and mountain whitefish (Prosopium williamsoni). The Bear Valley drainage has historically been an important spawning tributary for anadromous spring chinook sa 1 mon (Oncorhynchus twchawytscha), and summer steelhead trout (Salmo gairdneri). The Idaho Department of Fish and Game manages Bear Valley salmon and steelhead stocks as wild runs and prohibits stocking of hatchery strains into the drainage. Because of their current depressed population status, sport angling for these species is also prohibited. As an additional conservation measure) the Sho-Ban tribe has voluntar i ly ceased ceremonial and subsistence fishing operations in the drainage.

Methods

This study was designed to document the pre-treatment physical conditions found in Bear Valley Creek and its tributaries. To meet these objectives, eleven monitoring stations were established over nine different “strata” in the Bear Valley drainage (Figure 2). Stratification was used to isolate the natural variation of the different geomorphic/stream conditions encountered in the drainage . Strata were identified within the drainage based upon variables such as percent slope, stream depth, depth, and velocity (IDF&G Personal Communication). Six, three, and two stations were located in Bear Valley Creek, Elk Creek, and Bearskin Creek, respectively. Each stat ion consisted of 21 permanent transects located perpendicular to streamflow. Transects were spaced at 30-foot intervals to cover 600 linear feet of stream. Three additional stations, part of an ongoing U.S. Forest Service livestock grazing-fishery interaction study, were also used as monitor inq sites. In these sites, located in conjunction with 1 ivestock exclosures of Bear Valley Creek (2)) and Elk Creek, 60 transects of the upper control were selected for evaluation. Perpendicular transects were placed at 10 foot intervals to cover 600 1 inear feet of stream. The respective study sites, strata, and numbering scheme are depicted in Table 1.

Physical Habitat Variables

Physical measurements of aquatic and riparian condition were conducted at each monitoring area using the intensive transect sampling methodology of Platts et al (1983). At each transect a battery of measurements were taken. Specific types of measurements included:

Geomorphic Aauatic Variables

1. Channel surface substrate materials
   A. % Boulder 0304.8 mm)
   B. % Rubble (76.1-304.7 mm)
   C. % Gravel (4.74-76.0 mm)
   D. % Large Fines (0.84-4.75 mm)
   E. % Small Fines (<0.83 mm)

2. Substrate Embeddedness (%)

3. Stream Width

4. Stream Depth

5. Pool-Riffle Width

6. Pool Feature and Rating

7. Bank Angle
   A. Bank Undercut
   B. Bank Water Depth

8. Instream Vegetative Cover

Riparian Variables

1. Stream Habitat

2. Stream Cover

3. Streambank Alteration (%)

4. Streambank Stability (%)

5. Vegetation Overhang

All techniques are fully described in Platts et. al. (1983). Physical habitat variables were collected during August of 1986.

Statistical analysis was performed using an IBM PC and SAS software (Ray 1982).

Fish Populations

Density of resident and anadromous fish species were obtained by the Idaho Department of Fish and Game during August of 1986. Censuses were conducted using snorkeling techniques within the study areas of the different strata. Although snorkel censuses were made in all strata of the Bear Valley drainage, we reported only those strata in which physical habitat was measured in 1986. The data was summarized both in tabular and graphic form in Appendix 2.

RESULTS

Physical Habitat- Bear Valley Creek

Strata 94Jpper(l)/Lower Dredge(2)

Two sites were sampled in strata 9. The dredge sites are actually located above the dredge mine and represent habitat that has had little impact from human activities. The two sites were quite similar in terms of physical habitat (Tables 2 & 3). In strata 9, gradient exceeds 2% as a result, riffle area comprise5 22.5% and 36.5% of the area of sites 1 and 2, respectively. Stream width and depth are considerably less than in downstream sites reflecting the headwater location of these sites.

Channel substrates are dominated by gravel, rubble, and boulder at both sites, while embeddedness levels averaged 59.4 and 49.5%, the lowest encountered in Bear Valley during 1986. Because these sites are located above the mined area, substrate and embeddedness composition in strata 9 are probably the closest measure of "natural" substrate condition within the drainage. However, embeddedness levels in downstream strata could be naturally higher, as the higher gradient in strata 9 probably promotes transportation of smal ler sediments, whi le aqgradat ion is the dominant process in the low-gradient stretches of the lower strata. Additionally the contribution of other sediment sources) including natural are unknown.

Ripar ian and streambank conditions in strata 9 were generally good. Habitat type averaged eighteen, the highest encountered on Bear Valley Creek. This measurement reflected the

Table Z--Aquatic physical habitat and riparian condition at the Bear Valley Upper Dredge site, 1986

Variable	Bear Valley Upper Dredge (USE'S site 1)		
	$\bar{x}$ [1]	S.D. [2]	C.I. [3]
Water Column			
Stream width (feet)	10.0	2.9	3.9-6
Stream depth (feet)	0.6	0.1	0.3-0.8
Riffle width (%)	22.5	38.6	0.0-100.0
Pool width (%)	77.5	38.6	0.0-100.0
Pool feature	3.0	2.4	0.0-8.0
Pool rating	4.0	1.8	0.3-7.7
Streambanks			
Bank angle (R)	102.61(110.0)	42.3(33.7)	14.4-9.8(40.6-190.8)
Bank undercut (R)	0.2(0.0)	0.4(0.1)	0.0-1.0(0.0-0.3)
Bank water depth (R)	O.l(0.1)	0.3(0.2)	0.0-0.8(0.0-0.5)
Channel			
% fines (<.88 mm)	13.9	15.1	0.0-45.4
% fines (.88-4.75 mm)	16.2	13.7	0.0-44.9
% gravel	45.2	22.8	0.0-92.8
% rubble	18.7	22.4	0.0-65.3'
% boulder	6.0	10.6	0.0-28.0
Substrate embeddedness (%)	59.4	17.7	22.5-96.5
Instream veg. cover	3.6	2.4	0.0-7.2
Riparian			
Habitat type (R)	18.2(18.7)	5.2(4.4)	7.4-29.1(9.6-27.8)
Bank cover stab. (R)	85.0(86.8)	14.0(15.2)	55.8-114.1(55.1-118.5)
Stream cover (R)	2.7(2.5)	0.5(0.6)	1.7-3.7(1.2-3.7)
Bank alteration (R)	34:4(29.8)	25.9(20.2)	O.O-88.4(0.0-71.8)
Vegetation overhang (R)	0.5(0.8)	0.6(0.6)	0.0-1.8(0.0-2.0)

(R) Right Bank

[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

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Table 3--Aquatic physical habitat and riparian condition at the Bear Valley lower dredge site, 1986

Variable	Bear Valley Lower Dredge (USFS site 2)		
	$\bar{x}$ [1]	S.D. [2]	C.I. [3]
Water Column			
Stream width (feet)	9.7	1.8	5.9-13.5
Stream depth (feet)	0.5	0.2	0.2-0.9
Riffle width (%)	36.5	40.1	0.0-120.1
Pool width (X)	63.5	40.1	0.0-147.1
Pool feature	4.0	2.2	0.0-8.6
Pool rating	2.8	1.8	0.0-6.6
Streambanks			
Bank angle (R)	104.0(101.6)	44.4(46.7)	ll.O-196.7(5.2-200.0)
Bank undercut (R)	0.3(0.3)	0.6(0.5)	0.0-1.5(0.0-1.4)
Bank water depth (R)	0.2(0.1)	0.5(0.2)	0.0-1.2(0.0-0.6)
Channel			
% fines (<.88 mm)	9.4	15.5	0.0-41.8
% fines (.88-4.75 mm)	7.1	16.5	0.0-41.4
% gravel	28.2	19.0	0.0-67.8
% rubble	47.9	20.9	3.4-91.5
% boulder	7.4	9.7	0.0-27.6
Substrate embeddedness (%)	49.5	17.5	12.9-86.1
Instream veg. cover	1.0	1.2	0.0-3.5
Riparian			
Habitat type (R)	17.8(17.9)	6.4(5.8)	4.4-31.1(5.8-30.0)
Bank cover stab. (R)	83.3(80.7)	20.9(20.1)	39.8-126(38.7-122.7)
Stream cover (R)	2.4(2.5)	0.6(0.7)	1.2-3.7(1.1-3.9)
Bank alteration (R)	31.4(33.1)	27.9(26.9)	0.0-89.7(0.0-89.2)
Vegetation overhang (R)	0.4(0.3)	0.4(0.4)	0.0-1.2(0.0-1.1)

(R) Right Bank

[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

heavy willow/tree riparian cover present at the sites. Bank cover stability averaged 85.0 and 86.8% for the upper and lower sites, respectively. Similarly, vegetation overhang was the highest observed in Bear Valley Creek in 1986, averaging 0.65 feet for both banks in site 1 and 0.35 feet for site 2. Streambank alteration, a qualitative measure of natural and artificial damage to the streambank structure were exceptionally low (Tables 2 & 3). The comparitively high ratings of the physical habitat within strata 9 reflect the lack of land-use impacts on the sites. Downstream influences of the dredge mining operation, as well as grazing and logging, have significantly impacted both channel and riparian habitat downstream.

Strata 8-Dredge Mined Area

The dredge mine area has been rehabilitated through the efforts of the Sho-Ban tribe and Montgomery Engineering Company, with funding provided by the BPA. No sites were established or sampled in this strata in 1986.

Strata 7-Big Meadows(3)/Mace Creek(4)

Two existing USFS study sites were incorporated in strata seven for monitoring purposes by the Idaho Department Fish and Game (IDFG). These sites are both located adjacent to livestock exclosures that prevent cattle from grazing on approximately 600 linear feet of stream. The upper control area (existing management) of each livestock-fishery site was chosen for monitoring. Results for 1986 are repor ted in Table 4 (Big Meadows) and Table 5 (Mace Creek). Historical data concerning the livestock-fishery interaction studies from the 1975-1985 period are summarized in Platts and Nelson (1986).

In strata 7, physical characteristics are vastly different from strata 9. Stream width and depth have increased by 2-3 times, while gradient has decreased to approximately 1.0%. The resultant stream is characterized by reduced stream velocity, high meander ratio, and an abundance of pool habitat. Pool habitat dominated both sites averaging 91.9 and 97.9% of site 3 and 4, respectively. Pools are formed entirely by channel characteristics, as large organic debris was not seen below strata 9.

Gravel and rubble substrates were abundant components of the channel in both sites (Tables 4 & 5). Chinook salmon spawning activity was observed in gravel /rubble substrates within the upper Mace Creek site in 1986. However these spawning areas may have been significantly degraded by fine sediment. Surf ace substrate composition of both large and small fines was an aver age of 38.5% greater in strata seven than in strata nine. This probably reflects a combination of sediment from the dredge mine and other sources, a s well as deposition processes that occur within this low gradient strata. Substrate embeddedness mimic the increase in fine sediment, averaging 66.2 and 72.4% for both sites. Unfortunately, with present methodology it would be impossible to determine the relative contributions of sediments

Table 4-Aquatic physical habitat and riparian condition at the Bear Valley Big Meadows site, 1986

Variable	Bear Valley Big Meadows (USFS site 3)		
	I ʼ	S.D.[2]	C.I.[3]
Water Column			
Stream width (feet)	24.8	5.2	14.4-35.1
Stream depth (feet)	0.9	0.3	0.4-1.4
Riffle width (%)	8.1	21.2	0.0-49.9
Pool width (%)	91.9	21.2	50.1-133.7
Pool feature	5.0	0.0	5.0-5.0
Pool rating	3.5	0.5	2.5-4.8
Streambanks			
Bank angle (R)	114.9(98.9)	53.9(49.4)	8.8-221.1(1.6-196.2)
Bank undercut (R)	0.3(0.3)	0.5(0.4)	0.0.1-3(0.0-1.1)
Bank water depth (R)	0.3(0.4)	0.5(0.6)	0.0-1.3(-0.7-1.6)
Channel			
% fines (<.88 mm)	19.8	14.6	0.0-48.6
% fines (.88-4.75 mm)	13.8	12.1	0.0-37.0
% gravel	59.3	21.0	2.6-26.8
% rubble	4.9	4.7	0.0-18.0
% boulder	2.4	5.5	0.0-13.3
Substrate embeddedness (%)	66.2	15.4	35.9-96.5
Instream veg. cover	3.7	2.5	0.0-8.6
Riparian			
Habitat type (R)	8.3(7.5)	5.1(3.0)	0.0-18.3(1.5-13.4)
Bank cover stab. (R)	57.2(56.2)	27.5(26.0)	3.2-111.3(4.9-107.2)
Stream cover (R)	1.8(1.8)	0.4(0.4)	0.9-2.7(1.0-2.4)
Bank alteration (R)	56.7(60.7)	24.1(23.9)	9.1-104.2(13.7-107.7)
Vegetation overhang (R)	0.2(0.1)	0.3(0.2)	0.0-0.7(0.0-0.7)

(R) Right Bank
[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

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Table S-Aquatic physical habitat and riparian condition at the Bear Valley Mace Creek site, 1986

Variable	Bear Valley Mace (USPS site 4) ii'[1]	S.D.[2]	C.I.[3]
Water Column			
Stream width (feet)	33.1	9.1	15.3-51.0
Stream depth (feet)	0.8	0.3	0.2-1.5
Riffle width (%)	2.1	8.2	0.0-18.0
Pool width (%)	97.9	9.7	78-116.4
Pool feature	5.0	0.0	5.0-5.0
Pool rating	4.4	0.5	3.4-5.3
Streambanks			
Bank angle (R)	90.1(68.8)	46.7(42.5)	0.0-182.1(0.0-152.4)
Bank undercut (R)	0.4(0.6)	0.5(0.5)	0.0-1.4(0.0-1.5)
Bank water depth (R)	0.3(0.6)	0.4(0.7)	0.0-1.2(0.0-1.9)
Channel			
% fines (<.88 mm)	17.3	15.7	0.0-48.2
% fines (.88-4.75 mm)	24.6	14.5	0.0-53.1
% gravel	40.4	23.4	0.0-86.6
% rubble	16.1	19.1	0.0-53.7
% boulder	0.6	1.8	0.0-4.1
Substrate embeddedness (%)	72.4	15.1	42.6-102.1
Instream veg. cover	7.0	6.4	0.0-19.6
Riparian			
Habitat type (R)	12.0(14.0)	6.0(4.5)	0.2-23.9(5.1-22.8)
Bank cover stab. (R)	62.9(78.2)	30.4(18.2)	3.0-122.8(42.2-114-8)
Stream cover (R)	2.0(2.1)	0.6(0.4)	0.9-3.1(1.3-2.9)
Bank alteration (R)	46.2(36.1)	25.0(21.0)	0.0-95.5(0.0-77.4)
Vegetation overhang (R)	0.l(0.1)	0.2(0.2)	0.0-0.4(0.0-0.4)

(R) Right Bank

[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

by the dredge mine, grazing, and natural imputs.

Riparian variables reflect the degraded streambanks found within the study site. Habitat fell sharply as compared to conditions in strata seven (Tables 4 & 5). Streambank stability was reduced , possibly because of trampling and sheer stress induced by livestock grazing. Similarly, streambank alteration increased sharply, particularly in the Big Meadows site.

Strata 6

No sites were established or sampled in strata 6 by USFS personnel during 1986.

Strata 5-Pole Creek(5)

This site is located approximately 5.5 miles downstream from strata 7, just above the confluence of Elk and Bear Valley creeks. At this site, stream width has increased to 35.4 feet, while depth averaged 1.0 feet. Stream gradient has increased to 1.5% and riffle habitat composes 31.6% of the site. Substrate composition reveals the effects of increased gradient upon the site. Gravel and rubble constitute 89.7X of the channel substrates, while embeddedness averaged 51.2%, similar to the values found in strata 9. Based on the results at this site, strata 5 contains adequate anadromous spawning habitat.

Riparian condition is satisfactory (Table 6), as habitat type, bank stability, and alteration were improved in comparison to conditions in strata seven. Dense riparian cover, primarily

Table 6--Aquatic physical habitat condition at the Bear Valley Pole Creek site, 1986

Variable	Bear Valley Pole Creek (5)		
	$\bar{x}$ [1]	S.D.[2]	C.I.[3]
Water Column			
Stream width (feet)	35.4	8.2	18.4-52.4
Stream depth (feet)	1.0	0.3	0.4-1.5
Riffle width (%)	31.6	26.2	0.0-73.1
Pool width (%)	68.4	35.3	0.0-142.0
Pool feature	5.0	0.0	5.0-5.0
Pool rating	3.9	1.5	.8-7.0
Streambanks			
Bank angle (R)	103.8(148.3)	64.8(38.9)	0.0-231.0(73.5-223.1)
Bank undercut (R)	0.6(0.1)	0.7(0.4)	0.0-2.0(0.0-1.0)
Bank water depth (R)	0.5(0.1)	0.7(0.3)	0.0-2.0(0.0-0.8)
Channel			
% fines (<.88 mm)	6.5	9.1	0.0-25.4
% fines (.88-4.75 mm)	3.8	2.4	0.0-6.3
% gravel	47.5	7.6	10.8-84.1
% rubble	42.2	16.9	7.0-77.5
% boulder	0.0	0.0	
Substrate embeddedness (%)	51.2	11.1	28.0-74.4
Instream veg. cover	0.4	0.9	0.0-2.4
Riparian			
Habitat type (R)	12.7(10.5)	5.5(7.2)	0.3-24.0(0.0-25.4)
Bank cove&tab. (R)	58.3(50.5)	32.7(31.1)	0.0-126.1(0.0-115-4)
Stream cover (R)	1.6(1.8)	0.6(0.7)	0.3-2.8(0.2-3.4)
Bank alteration (R)	49.6(64.9)	34.6(29.2)	0.0-121.7(3.9-125.8)
Vegetation overhang (R)	0.1(0.1)	0.2(0.2)	0.0-0.5(0.0-0.4)

(R) Right Bank

[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

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of willow, may afford the streambanks some protection from livestock within this strata.

strata 4

No sites were established or sampled by USFS personnel in 1986.

Strata 3-Campsite(6)

The Bear Valley Campsite study area is located approximately 0.5 mile above the confluence of Elk and Bear Valley Creeks. Habitat condition at this site is generally good, being physically similar to that of the Pole Creek site. Stream width averaged 39.2 feet, while stream depth averaged 1.2 feet (Table 7). Pools made up 70.4% of the sites habitat class. Pool quality was excellent, avetaging 4.0, indicating an abundance of deep, well-covered rearing habitat. Adult chinook salmon were also observed resting in some of the larger pools at this site. Pools were formed by channel mechanisms, as large woody debris was again absent.

Channel substrates were comprised primarily of gravel (62.1%) and rubble (25.1%). Fine sediments composed only 12.8% of the channel surface substrates, while substrate embeddedness averaged 53.7%. Based on these characteristics, spawning and rearing habitat for anadromous species appeared to be sufficient.

Riparian and streambank conditions, however, were degraded. Streambank angle averaged 121.5 degrees, signifying that bank

Table 7-Aquatic physical habitat condition at the Bear Valley Campsite, 1986

Variable	Bear Valley Campsite (USFS site 6)		
	$\bar{x}$ [1]	S.D.[2]	C.I.[3]
Water Column			
Stream width (feet)	39.2	7.3	23.9-54.5
Stream depth (feet)	1.2	0.7	0.0-2.5
Riffle width (%)	29.6	'40.8	0.0-114.7
Pool width (%)	70.4	40.8	0.0-155.6
Pool feature	4.8	2.2	0.2-9.3
Pool rating	4.0	1.8	0.2-7.7
Streambanks			
Bank angle (R)	111.9(131.2)	62.6(51.0)	0.0-262.0(24.9-237.0)
Bank undercut (R)	0.5(0.3)	0.7(0.6)	0.0-2.0(0.9-1.5)
Bank water depth (R)	0.6(0.4)	0.9(0.7)	0.0-2.5(0.0-1.9)
Channel			
% fines (<.88 mm)	3.8	5.2	0.0-14.2
% fines (.88-4.75 mm)	9.0	14.0	0.0-38.3
% gravel	62.1	20.4	19.5-104.6
% rubble	25.1	14.7	0.0-55.8
% boulder	0.0	0.0	
Substrate embeddedness (%)	53.7	9.0	34.8172.5
Instream veg. cover	0.4	1.5	0.0-3.6
Riparian			
Habitat type (R)	10.5(9.5)	7.0(7.5)	O.O-25.0(0.0-24.3)
Bank cover-stab. (R)	45.2(45.3)	34.8(41.3)	0.0-117.9(0.0-131.8)
Stream cover (R)	1.7(1.5)	0.8(0.1)	0.1-3.3(0.1-3.0)
Bank alteration (R)	58.5(63.9)	31.5(37.0)	0.0-124.2(0.0-141.1)
Vegetation overhang (R)	0.4(0.1)	l.O(0.2)	0.0-2.5(0.4-0.6)

(R) Right Bank

[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

erosion has occurred. Stream cover averaged 1.6, indicating that much of the banks had little vegetative cover. Streambank stability averaged 45% offering further evidence of erosive processes and/or lack of vegatation.

Strata 2-Poker Meadows(l3)/Fir Creek(l4)

The sites in strata 2 have been monitored by USFS personnel since 1984 as part of a previous cooperative USFS-IDFG habitat evaluation program. This program was expanded in 1986 to include much of the Bear Valley/Elk Creek watershed. Three consecutive years of physical habitat data have been collected by USFS biologists. At the Poker Meadows site channel habitat conditions have changed little (Tables 8 & 9). Stream width has maximized reflecting the contribution of Elk Creek and other lower order streams to the system. Changes in stream width and depth over the period (Tables 8 & 9) are attributed primarily to flucuatins in precipitation and water regimes. Pools have consistently dominated the habitat of the Poker Meadows site, averaging 77.6% of the area since 1984.

Stream channel substrates are excellent, being dominated by gravel. Surface fine sediments have changed little in abundance, averaging 13.4, 16.3, and 12.8% since 1984 (Figure.3). Substrate embeddedness has also consistently averaged near 50%.

In contrast to channel variables, riparian habitat condition has shown a slight dec 1 ine since 1984. Bank angles have increased from 104.9 degrees in 1984 to 116.1 degrees in 1986

Table 9--Aquatic physical habitat and riparian condition at the Bear Valley Poker Meadows site, 1986

Variable	Bear Valley Poker Meadow6 (USFS site 13)		
	$\bar{x}$ [1]	S.D.[2]	C.I.[3]
Water Column			
Stream width (feet)	102.1	9.7	81.8-122.5
Stream depth (feet)	0.7	0.2	0.2-1.1
Riffle width (%)	17.3	16.3	0.0-51.3
Pool width (%)	82.7	16.3	48.7-116.6
Pool feature	5.0	0.0	5.0-5.0
Pool rating	4.0	0.0	4.0-4.0
Streambanks			
Bank angle (R)	116.1(118.2)	54.1(99.3)	3.2-229.0(0.0-325.3)
Bank undercut (R)	0.4(0.3)	0.5(0.4)	O.0-1.4(0.0-1.2)
Bank water depth (R)	0.2(0.2)	0.5(O.4)	0.0-1.3(0.0-1.0)
Channel			
% fines (<.88 mm)	3.2	3.0	0.0-9.4
% fines (.88-4.75 mm)	9.6	2.6	0.0-9.8
% gravel	69.3	15.7	36.5-102.1
% rubble	16.8	15.0	0.0-48.0
% boulder	1.6	3.0	0.0-7.4
Substrate embeddedness (%)	59.4	11.2	36.1-82.7
Instream veg. cover	10.6	15.0	0.0-41.8
Riparian			
Habitat type (R)	11.2(11.4)	6.4(5.6)	0.0-24.5(0.0-23.2)
Bank cover stab. (R)	48.5(59.0)	37.3(31.0)	0.0-126.3(0.0-123.8)
Stream cover (R)	1.6(1.8)	0.6(0.4)	0.4-2.8(1.0-2.6)
Bank alteration (R)	58.1(53.3)	30.5(29.7)	0.0-121.8(0.0-115.2)
Vegetation overhang (R)	0.0(0.2)	0.2(0.6)	0.0-0.4(0.0-1.5)

(R) Right Bank

[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

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Table 9. Aquatic physical habitat in Bear Valley Creek, Poker Meadows, and Fir Creek, 1985.

Variable	Poker Meadows			Fir Creek		
	x̄[1/]	S.D.[2/]	C.I.[3/]	21	S.D.	C.I.
Water Column						
Stream width (feet)	97.6	11.439	93.5-101.7	102.8	7.4	100.2-105.4
Stream depth (feet)	0.7	2.0	0.0-l .4	1.1	1.4	0.6-1.6
Riffle width (percent)	37.7	17.5	31.4-44.0	3.2	5.8	1.2-5.2
Pool width (percent)	62.3	17.5	56.0-68.6	96.8	5.8	94.8-98.8
Pool feature[4/]	5.1	0.4	4.9-5.3	5.0	0.0	
Pool rating[4/]	2.9	1.1	2.2-3.6	4.0	0.0	
Streambanks						
Bank angle (degrees)	107.0	42.6	91.7-122.3	78.4	31.9	67.0-89.8
Bank undercut (feet)	0.33	0.3	.22-.44	0.4	0.2	.31-.49
Bank water depth (feet)	0.26	0.3	.17-.37	0.24	0.18	0.18-.30
Vegetative use (percent)	5.5	8.9	2.3-8.7	2.3	2.9	1.2-3.4
Channel						
% fines (4.75-0.88mm)	3.8	4.5	2.2-5.4	23.0	7.5	21.3-25.7
% fines >.88mm	12.5	10.5	8.8-16.2	22.1	8.5	19.1-25.1
% gravel	45.5	30.9	34.4-56.6	38.1	15.2	32.6-43.6
% rubble	38.2	27.1	28.5-47.9	14.9	10.3	11.2-18.6
% boulder	0.4	0.2	.33-.47	1.7	1.8	1.0-2.4
Substrate embeddedncss	51.3	24.1	42.7-59.9	73.2	10.7	69.4-77.0
Instream veg. cover (feet)	11.3	14.5	6.1-16.5	61.4	8.5	58.4-66.4
Rlparlan						
Habitat **type**[4/]	13.1	5.0	11.3-14.9	16.3	2.8	15.3-17.3
Bank cover stability[4/]	54.7	26.7	45.1-64.3	87.4	8.7	84.3-90.5
Stream cover[4/]	**1.7**	0.6	1.5-1.7	2.3	0.5	2. I-2.5
Bank alteration (natural)	**41.5**	24.5	32.8-50.2	15.8	6.9	13.3-18.3
Bank l iteration (artificial)	8.5	8.6	5.4-11.6			
Vegetative overhang (feet)	0.3	0.46	0.1-0.5	0.24	0.3	.13-.35

1/ **x̄** - Arithmetic mean
2/ **S.D.** - Standatd deviation
3/ **C.I.** - 95 percent confidence Interval
4/ - Categorical data

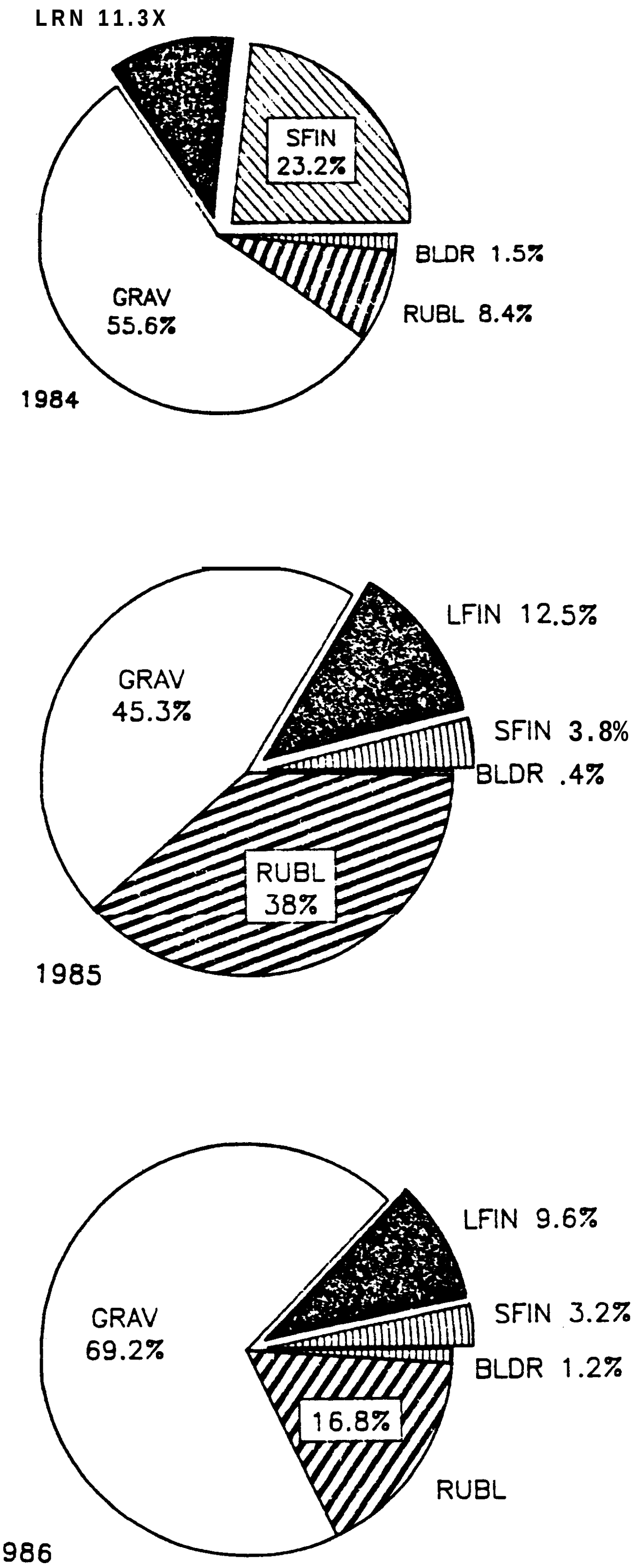

Figure 3. Substrate composition 1984-1986 in Bear Valley Poker Meadows monitoring site.

(Figure 4). The deterioration in riparian condition is further supported by reductions in bank stability, and increases in bank alteration (Tables 8& 9). The current grazing system may be inducing bank/riparian damage to Bear Valley Creek at Poker Meadows, Al though much of the variation may be attributable to observer variation. Additional years of data collection will be necessary to isolate this effect.

In contrast to the deteriorating trend at Poker Meadows. the Fir Creek site has exhibited few clear tendencies (Tables 10 & 11). Stream width has varied by only 1.0 foot since 1984, while depth has differed by only 0.3 feet. Pools dominate this section making up an average of 99% of the available habitat within the study area. Pool are formed primarily by channel features, and have been rated consistenly high (Tables 10 8 11).

Channel substrates have var i ed annually (Figure 5). Fine sediment composition averaged 34.5, 45.1, and 27. 1% for 1984, 1985, and 1986, respectively. This variation could be attributed to possible causes: 1) yearly observer variation/error, or 2) mass movement of sediments through the Bear Valley system. Because such flucuatiins in sediments were not observed at the Poker Meadows site, it appears unlikely that mass downstream sediment movement is occurring. Moreover) the high levels of fine sediment and percent embeddedness observed in the middle strata of Bear Valley Creek, the lower strata of Elk Creek, and in Bearskin Creek would indicate that much of the fine sediments

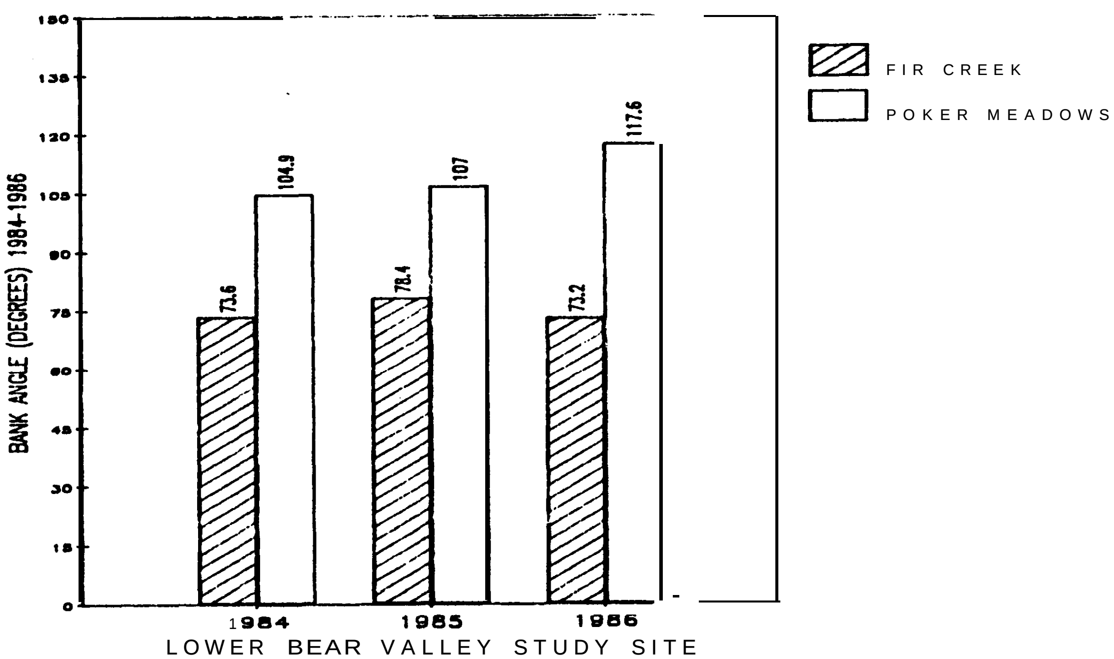

Figure 4. Average bank angles for Bear Valley Creek, Poker Meadows, and Fir Creek sites, 1984-1986.

Table lo--Aquatic physical habitat and riparian condition at the Bear Valley Fir Creek site, 1986

Variable	Bear Valley Fir Creek (USFS site 14)		
	$\bar{X}$ [1]	S.D.[2]	C.I.[3]
<u>Water Column</u>			
Stream width (feet)	101.7	7.2	86.7-116.7
Stream depth (feet)	1.1	0.1	0.8-1.4
Riffle width (%)	0.0	0.0	--
Pool width (%)	100.0	0.0	--
Pool feature	5.0	0.0	--
Pool rating	4.0	0.0	--
<u>Streambanks</u>			
Bank angle (R)	70.0(76.4)	45.3(49.0)	O.O-164.5(0.0-178.6)
Bank undercut (R)	0.6(0.5)	0.4(0.5)	0.0-1.5(0.0-1.5)
Bank water depth (R)	0.3(0.2)	0.2(0.3)	0.0-0.8(0.0-0.9)
<u>Channel</u>			
% fines (<.88 mm)	12.2	5.9	0.0-24.5
% fines (.88-4.75 mm)	14.9	6.4	1.3-28.2
% gravel	56.9	13.9	27.9-85.9
% rubble	14.2	10.2	0.0-35.5
% boulder	1.9	3.4	0.0-9.0
Substrate embeddedness (%)	65.8	8.8	47.4-84.3
Instream veg. cover	46.9	10.6	24.7-69.1
<u>Riparian</u>			
Habitat type (R)	15.9(13.7)	4.7(3.8)	6.1-25.7(5.8-21.6)
Bank cover stab. (R)	81.2(82.4)	14.5(10.7)	5.8-21.6(60.1-104.7)
Stream cover (R)	2.2(2.0)	0.4(0.2)	1.3-3.1(1.6-2.5)
Bank alteration (R)	31.9(33.6)	19.8(17.8)	0.0-73.2(0.0-70.6)
Vegetation overhang (R)	0.l(0.1)	0.l(0.3)	O.O-0.4(0.0-0.8)

(R) Right Bank
1 Arithmetic mean
2 Standard deviation
3 95% Confidence interval

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Table 11. Aquatic physical condition in Bear Valley Creek, Poker Meadows and Fir Creek sites, 1984.

Variable	Fir Creek Site Mean	S.D.[1]	C.I.[2]	Poker Meadows Site Mean	S.D.	C.I.
Water Column						
Stream width (feet)	102.7	6.[illegible]	99.7 -105.7	111.5	11.2	106.7-116.3
Stream depth (feet)	1.48	0.[illegible]1	1.43- 1.53	0.98	0.23	0.88- 1.08
Riffle width (percent)	0.1	0.[illegible]	0 - 1.5	12.2	15.5	5.5 - 18.9
Pool width (percent)	99.9	0.[illegible]	98.5 -101.3	87.8	15.5	81.1 - 94.5
Pool feature[3]	5.0	0	-	5.0	0	-
Pool quality rating[3]	5.0	0	-	3.5	0.6	3.2 - [illegible].8
Streambanks						
Bank angle (degrees)	73.6	29.7	60.9 - 86.3	104.9	42.6	86.7 -123.1
Bank undercut (feet)	0.54	0.31	0.41- 0.67	0,35	0.38	0.19- 0.51
Bank water depth (feet)	0.58	0.33	0.44- 0.72	0.37	0.35	0.22- 0.52
Channel						
Fines 4.75 - 0.8 mm (percent)	23.2	8.7	19.5 - 26.9	7.6	5.3	5.3 - 9.9
Fines 0.8 mm (percent)	11.3	3.8	9.7 - 12.9	5.8	5.3	3.5 - 8.1
Gravel (percent)	55.6	11.1	50.8 - 60.4	79.4	12.3	74.1 - 84.7
Rubble (percent)	8.4	6.6	5.6 - 11.2	6.3	5.9	3.8 - 8.8
Boulder (percent)	1.5	1.8	0.7 - 2.3	0.8	1.5	0.1 - 1.5
Substrate embeddedness[3]	2.0	0.2	1.9 - 2.1	2.0	0.3	1.9 - 2.1
Instream veg. cover (feet)	54.5	9.0	50.6 - 58.4	17.0	17.3	9.6 - 24.4
Riparian						
Habitat type[3]	17.5	2.[illegible]	15.7 - 19.3	13.3	4.3	11.5 - 15.1
Bank cover stability[3]	4.0	0	-	3.4	0.6	3.1 - 3.7
Stream cover[3]	2.3	0.5	2.1 - 2.5	1.9	0.4	1.7 - 2.1
Bank alteration (percent)						
Natural	20.0	7.8	16.7 - 23.3	28.1	9.9	23.[illegible] - 32.3
Artificial	6.6	7.5	3.3 - 9.7	14.5	10.8	9.[illegible] - 19.1
Total	26.6			42.6		
Vegetative overhang (feet)	0.32	0.23	0.22- 0.42	0.36	0.28	0.24- 0.48

[1] S.D. = Standard deviation
[2] C.I. = 95 percent confidence interval
[3] Categorical variables

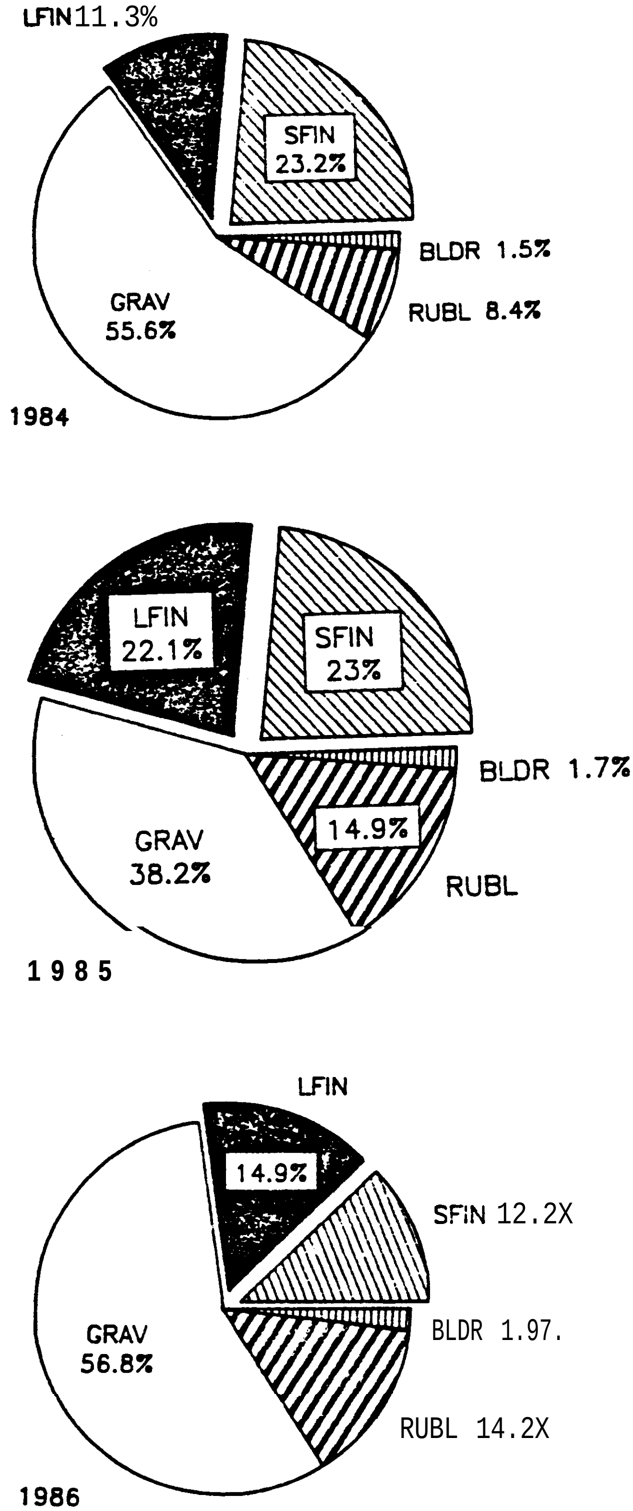

Figure 5. Substrate composition 1984-1986 in Bear Valley Fir Creek monitoring site.

are trapped within the low-gradient sections of the watershed. The possibility exists that natural flushing and scouring may not quickly remove the fine sediments trapped within the stream.

Strata 1

No sites were established or sampled by USFS personnel in 1986.

Physical Habitat-Bearskin Creek

Strata 2-Upper Bearskin Creek(7)

Bearskin Creek is the major tributary to Elk Creek, and has been impacted by land-uses such as logging, mining and brazing. The upper Bearskin site is characterized by low gradient, high meander ratio, abundant pools, and robust riparian cover. Beaver activity was observed within the site, and contributed to both pool quality and quantity. Physical habitat and riparian results are listed in Table 12.

Of particular interest at this site are channel substrates. Although the site contained ample gravel (69.6%)) its productivity to anadromous salmonids may be impacted by the high proportion of fine sediments (30.3%), and the high embeddedness rating (61.7%). The lack of rubble/boulder substrates may also limit juvenile chinook survival during the winter months, as such cover is an important refuge for the species.

Table 12-Aquatic physical habitat condition at the Upper Bearskin Creek study site, 1986

Variable	Upper Bearskin (USFS site 7) $\bar{X}$[1]	S.D.[2]	C.I.[3]
Water Column			
Stream width (feet)	19.1	7.3	4.8-33.4
Stream depth (feet)	1.1	0.5	0.1-2.1
Riffle width (X)	5.8	22.2	0.0-49.3
Pool width (%)	94.2	22.2	50.7-137.7
Pool feature	8.1	1.0	6.0-10.2
Pool rating	5.0	0.0	--
Streambanks			
Bank angle (R)	99.1(105.1)	43.8(42.4)	13.3-179.9(12.6-188.8)
Bank undercut (R)	0.3(0.3)	0.5(0.5)	0.0-1.3(0.0-1.3)
Bank water depth (R)	0.4(0.4)	0.6(0.7)	0.0-1.6(0.0-1.8)
Channel			
% fine6 (x.88 mm)	20.2	19.1	0.0-57.6
% fines (.88-4.75 mm)	10.1	12.3	0.0-34.2
% gravel	69.6	20.5	29.4-109.8
% rubble	0.0	0.0	--
% boulder	0.0	0.0	--
Substrate embeddedness (X)	61.7	16.3	29.8-93.6
Instream veg. cover	1.5	2.1	0.0-5.6
Riparian			
Habitat type (R)	15.4(13.8)	6.8(6.5)	2.1-28.7(0.2-27.3)
Bank cover stab. (R)	73.9(71.0)	23.3(25.9)	28.2-119.6(20.3-121.7)
Stream cover (R)	2.3(1.9)	0.7(0.8)	0.8-3.8(0.2-3.5)
Bank alteration (R)	43.5(45.5)	27.6(43.1)	0.0-97.6(0.0-130.0)
Vegetation overhang (R)	0.5(0.5)	0.7(0.8)	0.0-1.9(0.0-1.7)

(R) Right Bank

[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

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Strata l-Lower Bearskin Creek(8)

The lower Bearskin site was physically similar to the upper site, but because of the high proportion of pool habitat (100%) appears to be an area of sediment deposition. Fine sediments were the highest encountered in the drainage averaging 31.1 and 27.6% for small and large fines repectively (Table 13). Similarly, substrate embeddedness was also extreme, averaging 76.4%. Gravel (41.3%) constituted the remainder of the substrates. Sediment is a severe problem in Bearskin Creek, possibly limiting egg-larval survival,and increasing overwinter mortality.

Physical Habitat-Elk Creek

Strata 2-Corduroy Meadows(9)/Canyon(10)

The Corduroy Meadows site, an existing USFS livestock-fishery study area, was incorporated as an IDFG monitoring site in 1986. This site is located within the River of No Return Wilderness Area, but is currently grazed on a three-year rest rotation schedule. This site was extensively used by adult chinook salmon for spawning during 1986. Approximately 10 redds were observed by USFS personnel. Gravel substrates predominate (73.8%), and embeddedness averaged 56.1% (Table 14). However, the pool-tailwater spawning sites utilized by chinook salmon were far less embedded.

Livestock grazing may be causing some deteriorated riparian conditions, although at this stage of data developement, it is

Table 13--Aquatic physical habitat condition at the Lower Bearskin Creek study site, 1986

Variable	Lower Bearskin Creek 9USFS site 8)		
	$\bar{X}$ [1]	S.D.[2]	C.I.[3]
<u>Water Column</u>			
Stream width (feet)	22.3	4.4	0.0-13.0
Stream depth (feet)	1.2	0.5	0.0-1.5
Riffle width (%)	0.0	0.0	--
Pool width (%)	100.0	0.0	--
Pool feature	7.0	0.0	--
Pool rating	5.0	0.0	--
<u>Streambanks</u>			
Bank angle (R)	97.4(83.8)	45.3(44.5)	8.7-186.1(3.4-171.0)
Bank undercut (R)	0.4(0.6)	0.S(0.7)	0.0-1.2(0.0-2.1)
Bank water depth (R)	0.9(0.8)	1.3(1.2)	0.0-3.4(0.0-3.1)
<u>Channel</u>			
% fines (<.88 mm)	31.1	25.2	0.0-80.5
% fines (.88-4.75 mm)	27.6	18.8	0.0-64.6
% gravel	41.3	24.5	0.0-89.3
% rubble	0.0	0.0	--
% boulder	0.0	0.0	--
Substrate enbeddedness (%)	76.4	15.9	45.2-107.6
Instream veg. cover	0.9	1.4	0.0-3.6
<u>Riparian</u>			
Habitat type (R)	15.5(13.8)	3.2(4.7)	8.3-21.8(5.7-25.3)
Bank cover stab. (R)	78.2(64.1)	22.4(31.8)	34.3-122.1(1.8-126.4)
Stream cover (R)	1.8(2.0)	0.4(0.3)	1.0-2.6(1.5-2.7)
Bank alteration (R)	30.7(44.6)	25.4(29.8)	0.0-80.4(0.0-103.0)
Vegetation overhang (R)	0.3(0.05)	0.5(0.15)	0.0-1.3(0.0-.35)

(R) Right Bank

[1] Arithmetic mean

[2] Standard deviation

[3] 95% Confidence interval

Table 14--aQUATIC physical habitat condition at the Elk Creek Corduroy Meadow site, 1986

Variable	Elk Creek Corduroy (USFS site 9) $\bar{x}$ [1]	S.D.[2]	C.I.[3]
Water Column			
Stream width (feet)	24.6	6.1	12.5-36.6
Stream depth (feet)	1.1	0.6	0.0-2.2
Riffle width (%)	12.3	25.4	0.0-62.3
Pool width (%)	87.7	25.4	37.7-137.7
Pool feature	5.0	0.5	4.0-6.1
Pool rating	4.6	1.0	2.7-6.5
Streambanks			
Bank angle (R)	115.4(112.9)	57.6(55.8)	1.9-229.0(2.9-222.9)
Bank undercut (R)	0.4(0.7)	0.3(0.5)	0.0-1.8(0.0-1.3)
Bank water depth (R)	0.4(0.2)	0.7(0.5)	0.0-1.8(0.0-1.1)
Channel			
% fine6 (<.88 mm)	16.8	14.8	0.0-46.0
% fines (.88-4.75 mm)	5.0	6.5	0.0-17.8
% gravel	73.8	23.7	33.0-114.5
% rubble	4.4	7.4	0.0-18.9
% boulder	0.0	0.0	--
Substrate embeddedness (%)	56.1	13.3	29.9-82.2
Instream veg. cover	3.3	3.5	0.0-10.2
Riparian			
Habitat type (R)	10.8(9.4)	7.2(5.8)	0.0-25.0(0.0-20.7)
Bank cover stab. (R)	47.9(43.4)	39.4(36.4)	0.0-125.6(0.0-115.2)
Stream cover (R)	1.7(1.5)	0.8(0.5)	0.2-3.2(0.5-2.5)
Bank alteration (R)	62.3(64.5)	38.2(32.0)	0.0-137.7(0.0-127.6)
Vegetation overhang (R)	0.2(0.1)	0.6(0.3)	O.O-1.5(0.0-0.6)

(R) Right Bank

[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

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still difficult to quantify what is natural instability versus that instability influenced by livestock. Bank angles and total bank alteration averaged 114.1 degrees, and 63.5, while bank stability was only 45.2%. These figures are indicative of eroded streambanks.

The Canyon site, also located in the RONR Wilderness Area had adequate spawning gravels (75.4%) with small amounts of rubble (6.0%). Embeddedness was similar to that in Corduroy Meadows, averaging 52.2%. This site is composed primarily of pools (87.4%), although spawning activity was observed in some tailwater riffle-pool interfaces. Riparian variables, demonstrate some bank damage has taken place because of natural erosive processes or the influence of cattle grazing, and are listed in Table 15.

Strata l-Elk Creek Bearskin(ll)/Guard(l2)

The sites within strata 2 are locted below the confluence of Elk and Bearskin Creeks. Stream width and depth at the Bearskin site have increased to 52.2 feet, and 1.5 feet, the greatest of any Elk Creek site. Pools are the dominant habitat type (95.8%), and were of high quality (4.7 average). Embeddedness levels have increased over those in strata 2 (Table 16), possibly reflecting the sediment contribution of Bearskin Creek. Bank and riparian condition are good, probably due to the stabilizing influence of the dense willow vegetation found at the site.

Elk Creek Guard is located just above the confluence of Bear

Table 15--Aquatic physical habitat condition at the Elk Creek Canyon site, 1986

Variable	Elk Creek Canyon (USFS site 10)		
	$\bar{x}$ [1]	S.D. [2]	C.I. [3]
Water Column			
Stream width (feet)	39.2	7.2	24.2-54.1
Stream depth (feet)	1.3	0.9	0.0-3.2
Riffle width (%)	12.6	22.6	0.0-56.6
Pool width (%(	87.4	26.1	33.0-141.9
Pool feature	5.0	0.2	4.5-5.4
Pool rating	4.7	1.1	2.4-6.0
Streambanks			
Bank angle (R)	102.1(127.1)	51.5(54.3)	0.0-209.6(13.9-240.4)
Bank undercut (R)	0.3(0.2)	0.7(0.5)	0.0-1.8(0.0-1.2)
Bank water depth (R)	0.4(0.3)	0.8(0.6)	0.0-2.0(0.0-1.5)
Channel			
% fines (<.88 mm)	14.1	13.1	0.0-41.4
% fines (.88-4.75 mm)	4.5	5.4	0.0-15.8
% gravel	75.4	20.0	33.6-117.2
% rubble	6.0	14.7	0.0-36.6
% boulder	0.0	0.0	
Substrate embeddedness (%)	52.2	12.0	25.5-79.0
Instream veg. cover	0.8	0.9	0.0-2.7
Riparian			
Habitat type (R)	11.0(11.0)	7.7(9.6)	0.0-27.0(0.0-31.9)
Bank cover stab. (R)	54.5(42.6)	30.0(37.8)	0.0-117.0(0.0-121.4)
Stream cover (R)	1.9(1.7)	05(0.9)	0.9-2.9(0.0-3.6)
Bank alteration (R)	49(59.3)	27.5(37.7)	O.O-106.3(0.0-138.0)
Vegetation overhang (R)	0.2(0.1)	(0.6)(0.2)	0.0-1.4(0.0-0.4)

(R) Right Bank
[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

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Table 16-Aquatic physical habitat condition at the Elk Creek Bearskin site, 1986

	Elk Creek Bearskin (USFS site 11)		
Variable	I '	S.D.[2]	C.I.[3]
Water Column			
Stream width (feet)	52.2	10.6	30.1-74.3
Stream depth (feet)	1.5	1.0	0.0-3.6
Riffle width (%)	4.2	17.8	0.0-41.4
Pool width (%)	95.8	17.8	58.6-133.0
Pool feature	5.0	0.0	5.0-5.0
Pool rating	4.7	0.6	3.5-5.9
Streambanks			
Bank angle (R)	94.3(113.1)	60.4(64.8)	0.0-220.0(0.0-248.2)
Bank undercut (R)	0.39(0.5)	0.5(l.0)	0.0-1.3(0.0-2.7)
Bank water depth (R)	0.3(0.2)	0.6(0.5)	0.0-l.5(O.O-1.2)
Channel			
% fines (<.88 mm)	15.7	16.3	0.0-49.7
% fines (.88-4.75 mm)	8.5	10.5	0.0-30.4
% gravel	72.8	22.6	25.6-119.9
% rubble	1.4	3.9	0.0-9.5
% boulder	1.7	5.2	0.0-12.6
Substrate embeddedness (%)	57.5	17.3	21.4-93.6
Instream veg. cover	7.7	11.3	0.0-31.3
Riparian			
Habitat type (R)	12.4(11.4)	5.8(8.3)	0.2-24.6(0.0-28.8)
Bank cover stab (R)	52.4(35.6)	31.5(37.5)	0.0-118.0(0.0-113.8)
Stream cover (R)	2.1(1.7)	0.8(0.7)	0.5-3.7(0.1-3.2)
Bank alteration (R)	55.2(64.1)	28.7(37.3)	0.0-115.2(0.0-141.9)
Vegetation overhang (R)	O.l(O.3)	0.2(1.1)	0.4-0.5(O.O-2.6)

(R) Right Bank
[1] Arithmetic mean
[2] Standard deviation
[3] 95% Confidence interval

Valley Creek and Elk Creeks. Stream width averaged 49.5 feet, making Elk Creek considerably larger than Bear Valley Creek at their tributary. Low stream gradient through meadow habitats have created a stream with many pools (89.1%) of high quality (4.8).

Sediment deposition appears to be the greatest problem at this site. Fine sediments composed 31.8% of the channel substrate, while embeddedness averaged 64.1%. Gravel was fairly abundant (68.2%), but the high embeddedness would indicate poor anadromous production. Riparian conditions are listed in Table 17.

Table 170-Aquatic physical habitat and riparian condition at the Elk Creek Guard site, 1986.

Variable	Elk Creek Guard (USFS site 12)		
	$\bar{x}$ [1]	S.D. [2]	C.I. [3]
Water Column			
Stream width (feet)	49.5	13.3	21.7-77.4
Stream depth (feet)	1.0	0.5	0.0-2.0
Riffle width (%)	10.9	23.1	0.0-59.0
Pool width (%)	89.1	23.1	41.0-137.2
Pool feature	5.3	0.7	3.8-6.8
Pool rating	4.8	0.8	3.2-6.4
Streambanks			
Bank angle (R)	103.3(144.3)	56.7(42.4)	0.0-221.7(55.9-232.7)
Bank undercut (R)	0.5(0.1)	0.8(0.4)	0.0-2.2(-0.6-0.8)
Bank water depth (R)	0.5(0.1)	0.9(0.3)	0.0-2.3(-&S-2.3)
Channel			
% fines (<.88 mm)	14.1	12.6	0.0-40.5
% fines (.88-4.75 mm)	17.7	16.5	0.0-52.1
% gravel	68.2	22.6	21.5-115.3
% rubble	0.0	0.0	--
% boulder	0.0	0.0	--
Substrate embeddedness (%)	64.1	17.3	28.1-100.0
Instream veg. cover	5.0	6.0	0.0-17.5
Riparian			
Habitat type (R)	13.7(6.8)	6.9(5.2)	0.0-28.0(0.0-17.8)
Bank cover stab. (R)	61.0(33.7)	40.6(33.2)	0.0-145.7(0.0-103.0)
Stream cover (R)	1.8(1.4)	0.8(0.5)	0-3.5(0.4-2.5)
Bank alteration (R)	42.1(70.1)	38.2(31.6)	0.0-121.8(4.1-136.1)
Vegetation overhang (R)	0.2(0.1)	0.5(0.3)	0.0-1.2(0.0-0.8)

(R) Right Bank

[1] Arithmetic mean

[2] Standard deviation

[3] 95% Confidence interval

Conclusions and Recommendations

Stream physical habitat and riparian conditions were documented in the Bear Valley drainage at 14 sites during August, 1986. Riparian condition ranged from good to marginal. Riparian trends, although preliminary, indicate that bank stability and vegetation vigor are being impacted. It is however, unclear whether this erosion is attributable to natural erosion or erosion induced by livestock grazing. Sites with heavy riparian cover of willow seem to be more resiliant to stress associated with 1ivestock grazing. Sites without such cover are more vulnerable. Additional evaluation will help define ‘not only the trends of riparian zones) but the probable contributions of cattle grazing upon them.

Sediment loading particularly in Bearskin Creek, lower Elk Creek, and strata 7 of Bear Valley Creek is excessive (Figures 6 and 7), Although the quantity of spawning gravels appear to be adequate to support present seeding levels, gravel quality may severely limit survival of early age classes. Substrate embeddedness levels, an important indicator of gravel quality, indicate that habitat degradation has occurred in Bearskin, lower Elk Creek, and strata 2 and 7 of Bear Valley Creek (Figure 8). Because the fine sediments may remain entrained within the system indefinitely, land management practices must be conducted in ways to reduce any additional inputs of sediment. Although a major contributor of sediments within the watershed has been partially

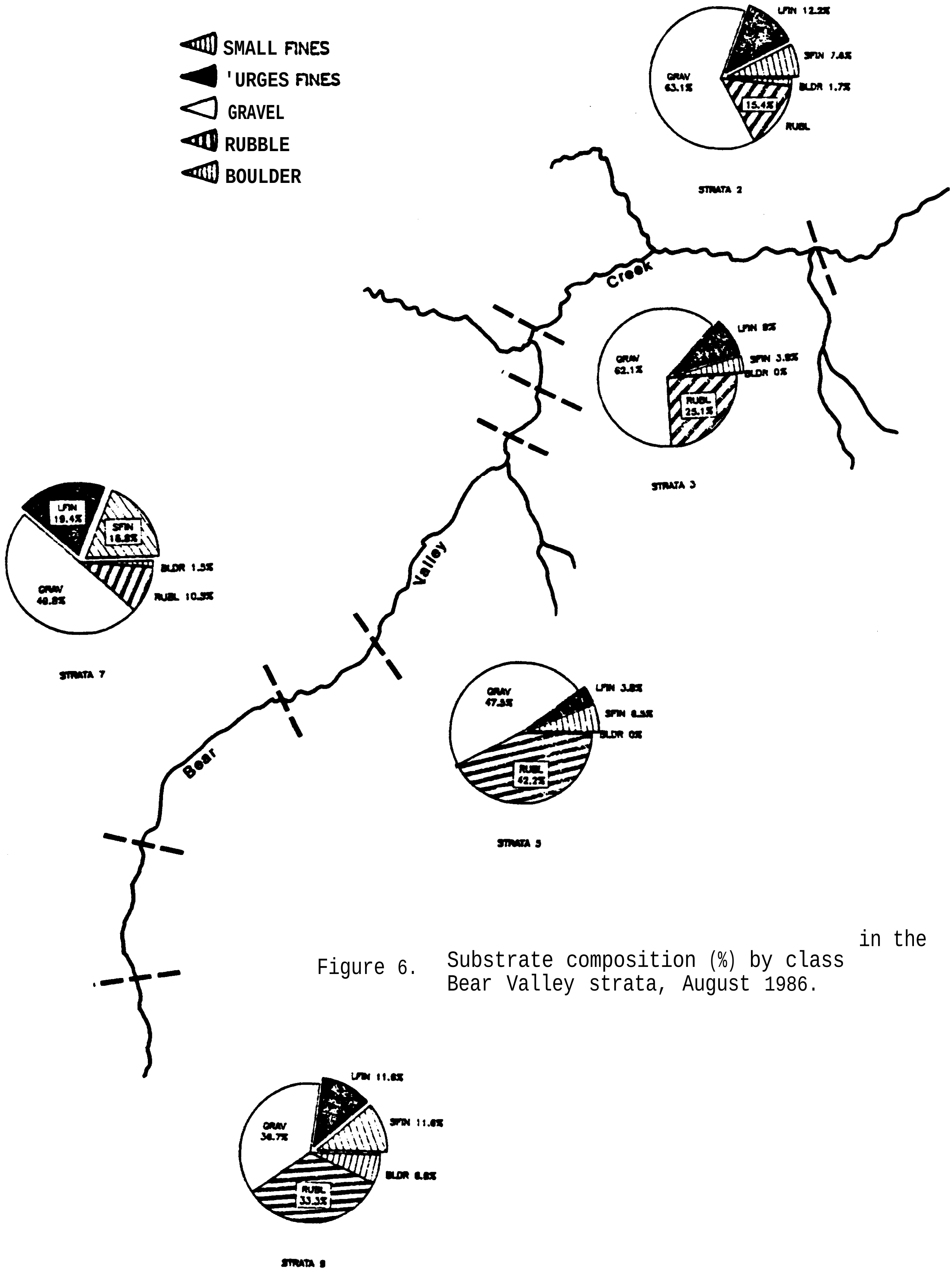

Figure 6. Substrate composition (%) by class in the Bear Valley strata, August 1986.

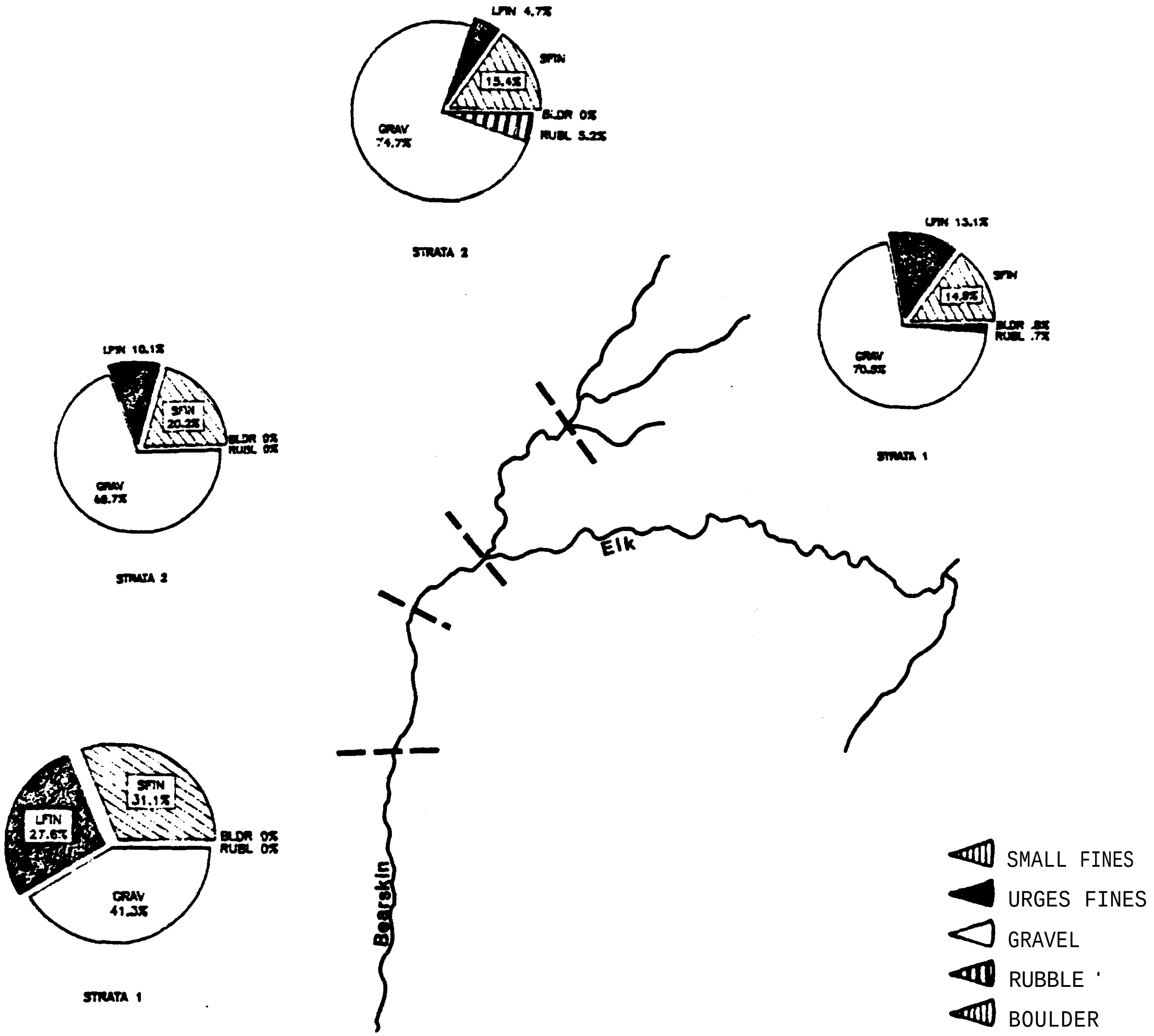

Figure 7. Substrate composition (%) by class in the Bearskin and Elk Creek strata, August 1986.

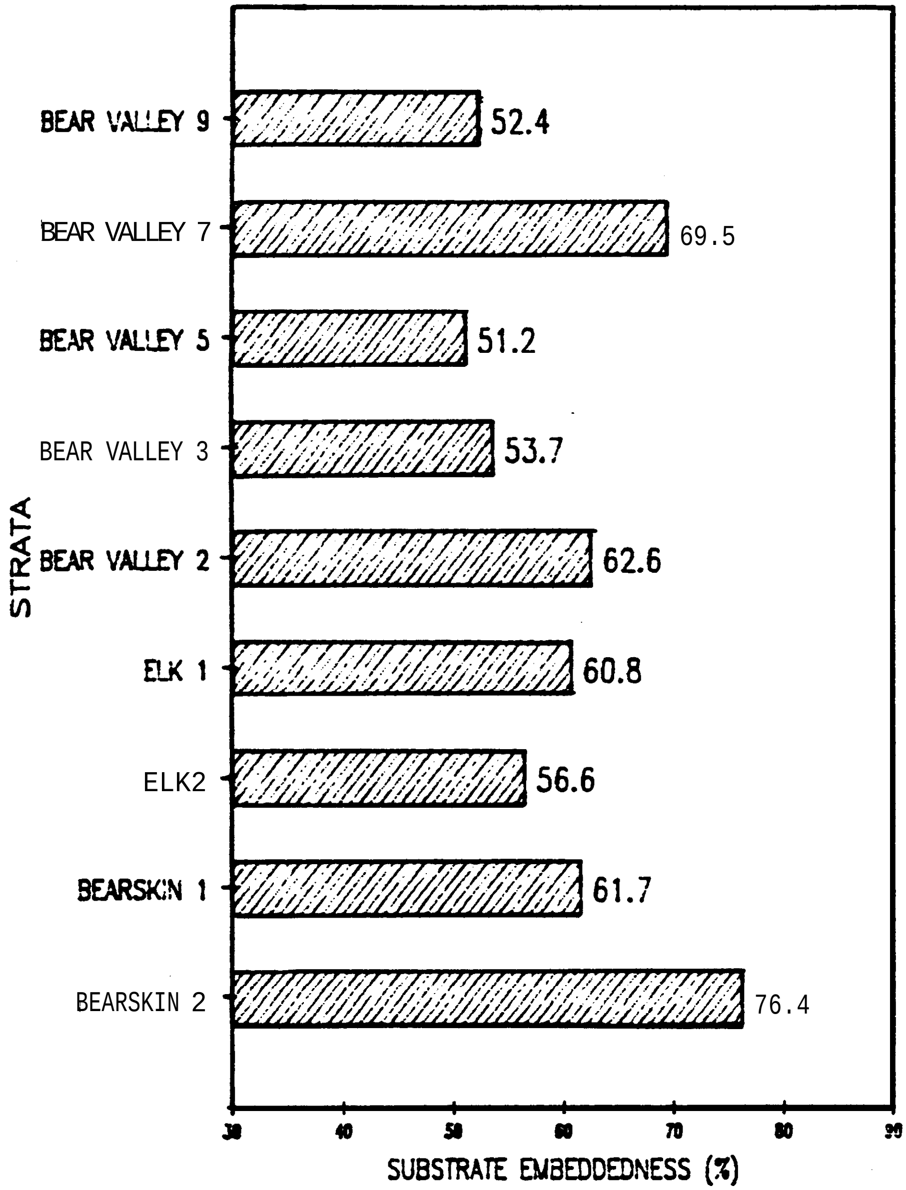

Figure 8. Substrate embeddedness (%) in the Bear Valley, Bearskin, and Elk Creek strata during August 1986.

rehabilitated, several other non-point sources may be contributing significant inputs of sediment. In order to isolate the relative contribution of sediments, it will be necessary to implement intensive sediment studies, as our methodology can only discern rough trends in sediment composition.

Monitoring in subsequent years should provide answers concerning sediment transport, and the ability of Bear Valley Creek to flush fine sediments. Again an intensive sediment study incorporating core tube or freeze core technoloqv and sediment collection basins may be desirable.

Identification of factors limiting anadromous production within the drainage should be a top priority. Although gross factors (dredge mine) are now being rehabilitated, a number of other activities are now occurring within the drainage that could hamper recovery efforts. Concentrating on major factors can be misleading, as other factors or combination of factors can be just as important in limiting production. We would therefore recommend proceeding cautiously, with additional rehabilitation contingent upon identification of limiting factors.

A cursory analysis of 1986 fish population data obtained from Idaho Department of Fish and Game , reveal possible relationships between stream channel and bottom characteristics (appendix 1) and fish densities (appendix 2). Of the physical habitat sites that were sampled by IDF&G personnel, fish population levels were generally higher in strata with lower embeddedness and fine sediment levels (figures 6-8, tables 18 &

Table 18 . Density (number/100 m^2) by age-group of rainbow-steelhead trout, and chinook salmon in Bear Valley Creek and Elk Creek, July and August, 1986.

Stream, Section	1986 Date	Rainbow-steelhead o+	1+	2+	>3+	Chinook o+	1+
Bear Valley							
9A	8/07	0	0	0	0	0	0
5A	8/07	4.9	0	0	0	4.1	0
2A	7/22	3.3	0.1	+	0	3.0	0
2A	8/18	5.7	0.4	0	0	0.9	0.1
2B	8/7	0.5	0	0	0	0.3	0
1A	7/22	0.3	2.0	1.3	0	0.5	0
1A	8/18	+	0.1	0.2	0.1	0	+
Elk Creek							
2A	7/22	0	+	0	0	0.9	0
2A		1.2	0	0	0	+	0
2B	8/20	4.4	0.2	0	0	2.6	0
1A	8/20	4.0	0	0	0	0.1	0
1B	7/22	0.5	0.4	0.2	0	2.9	0
1B	8/21	0.3	+	0	0	0.2	0

+ Fish density of less than 0.1 fish/100 m^2 was observed.

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Table 19. Density (number/100 m^2) by age-group of cutthroat trout, bull trout, brook trout and mountain whitefish in Bear Valley Creek and Elk Creek, July and August, 1986.

Stream, section	1986 date	Cutthroat	Bull		Brook		Whitefish	
		21	o+	21	o+	21	o+	≥1
Bear Valley								
9A	8/07	0	0	0	0.5	0.2	0	0
5A	8/07	0	0	0.1	0	0.1	3.0	0.4
3A	8/07	0	0	0	0	0	4.5	1.8
2A	7/22	0	0	0	0.1	0	4.8	0
2A	8/18	0	0	0	0	0	2.2	0
2B	8/07	+	0	0	0.2	0	2.2	0.1
1A	7/22	0	0	0	0	0	0	1.3
1A	8/18	0	0	0	0	0	0.1	1.5
Elk Creek								
2A	7/22	0	0	0	0.2	0	1.2	0
2A	8/20	0	0	0	+	0	1.1	0.1
2B	8/20	0	0	0	0.9	0	3.3	0.4
1A	8/20	0	0	0	0.1	0	0.7	0.5
1B	7/22	0	0	0	0	0	7.5	0.2
1B	8/21	0	0	0	0	0	3.3	0.4

+ Density of less than 0.1 fish/100 m^2 were encountered.

19). Fish species composition based on total fish density ranged from single species populations (e.g. brook trout in strata 9), to diverse communities of almost equal abundance for a particular year class (figures 9 & 10). Overall, the highest densities were encountered in sites closest to the Elk Creek / Bear Valley Creek confluence.

Chinook salmon spawner escapement within the Bear Valley drainage has dwindled to almost remnant proportions (figure 1), resulting in severely underseeded conditions. At present seeding levels, available habitat may be sufficient to support anadromous populations within the drainage. Investigations of limiting factors can be aided in these underseeded situations. Assuming that at underseeded levels, chinook salmon will utilize the best available habitat, the process of identifying limiting factors, particularly density-indenpendent (habitat quality) is simplified. For example, if fine sediments are limiting anadromous production in Bear Valley Creek, a significant decrease in fine sediment composition should lead to an increase in egg to alevin survival, and concurrent increase in juvenile fish. Once limiting factors are identified, population building, through enhancement should proceed. However, increases in habitat quality/quantity may not necessarily result in increases in fish populations due to downstream influences on the fishery. Regardless of offsite population influences, maximizing available habitat productivity in anticipation of increased anadromous runs, .and for the resident fisheries are worthy management goals.

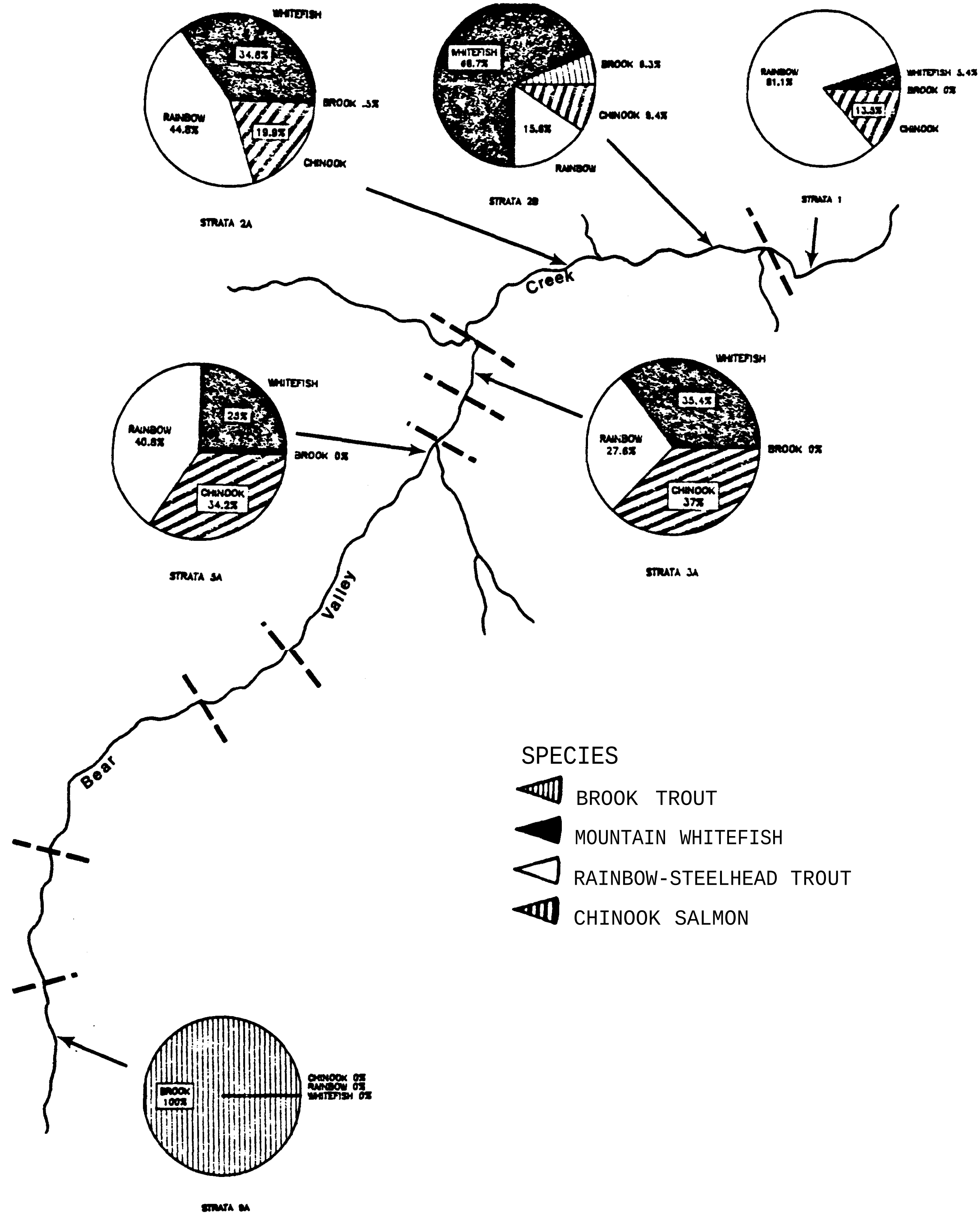

Figure 9. Percent composition of fish species by strata in the Bear Valley Creek watershed during August, 1986. Age 0+ fish only.

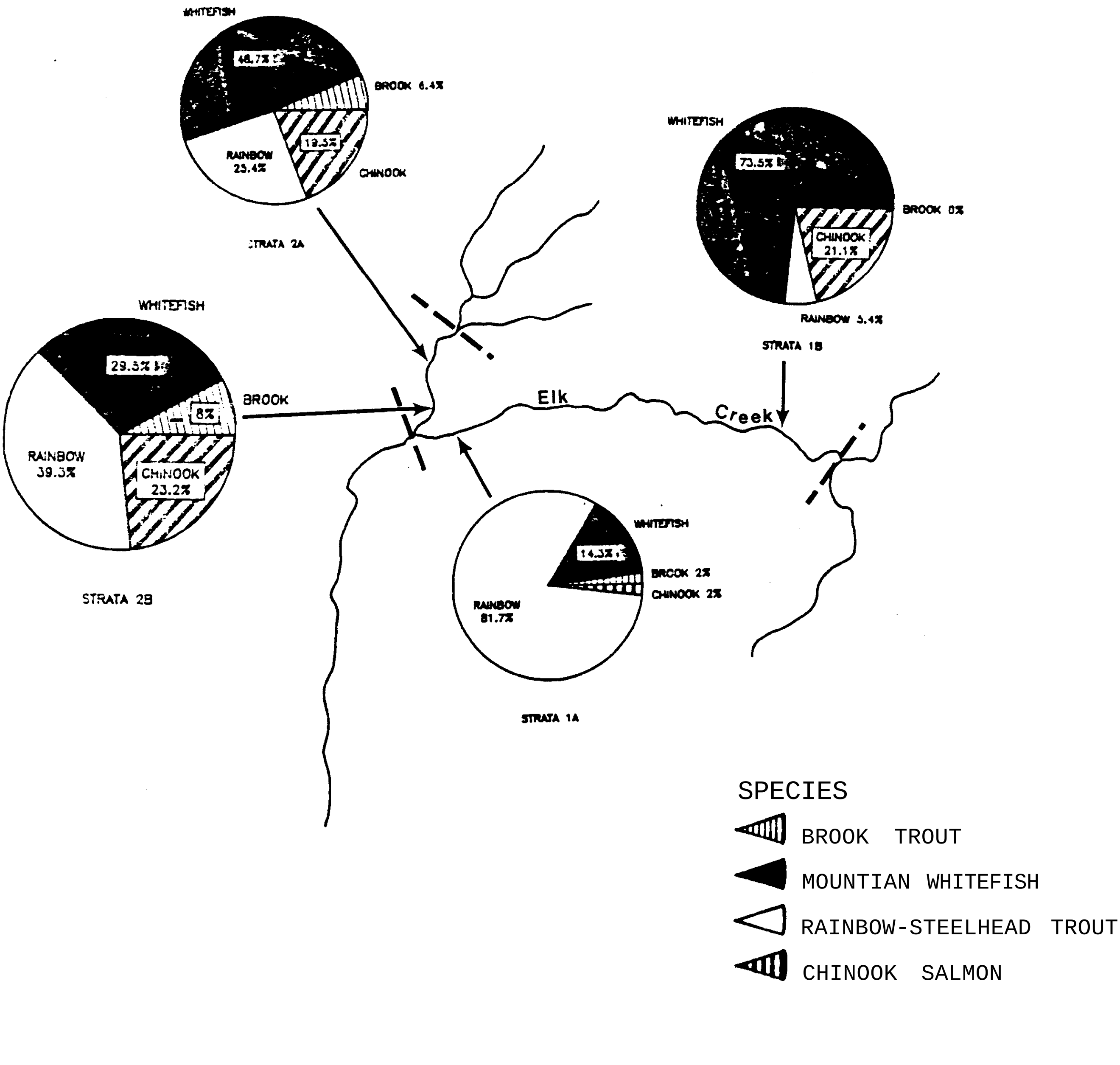

Figure 10. Percent composition of fish species by strata in the Bearskin and Elk Creek watersheds during August, 1986. Age 0+ fish only.

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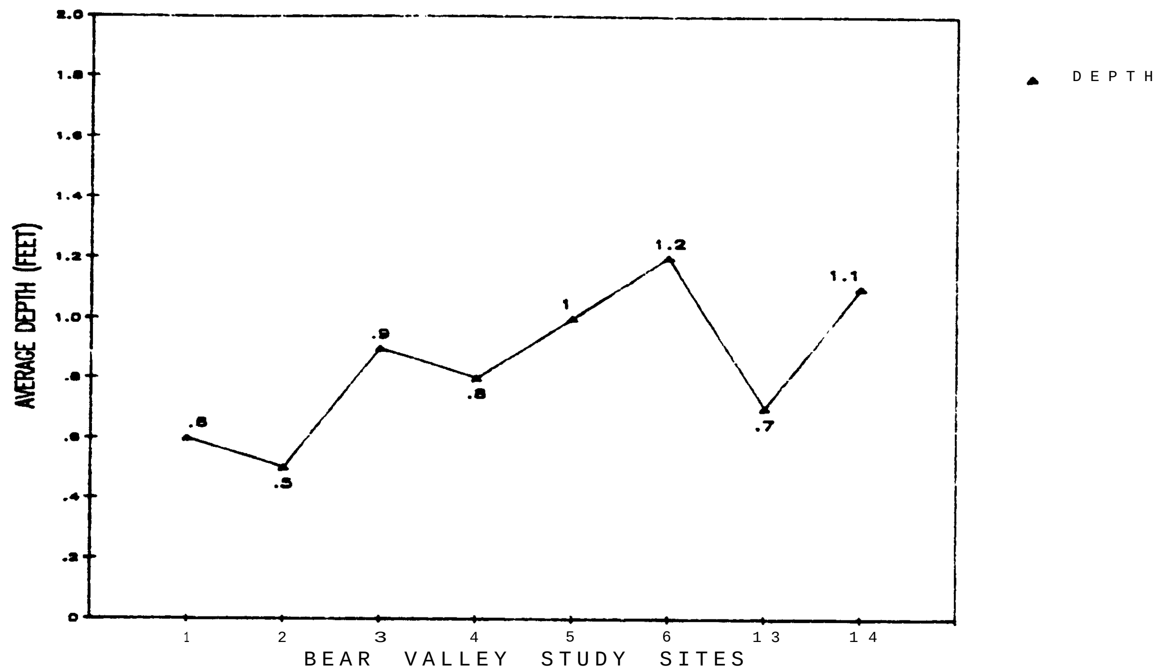
APPENDIX 1

Graphical representation of habitat conditions on the Bear Valley, Bearskin, and Elk Creek sites during August, 1986



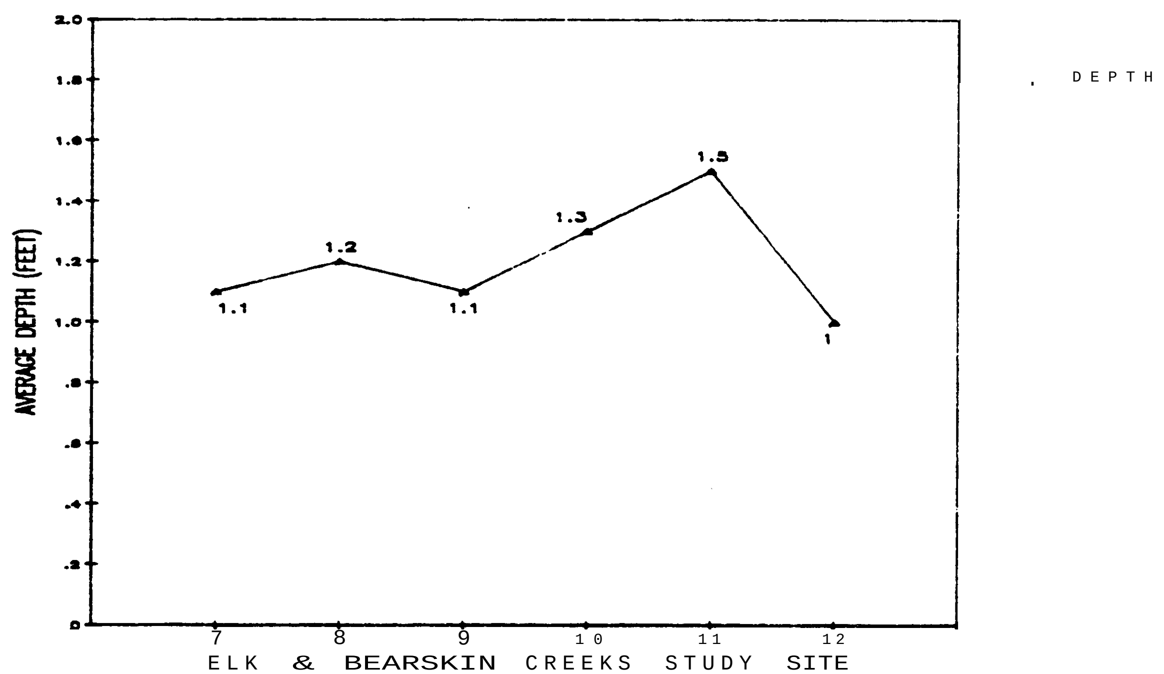


Figure 2a. Average stream depth at the Bear Valley, Bearkin, and Elk creek study sites during 1986.

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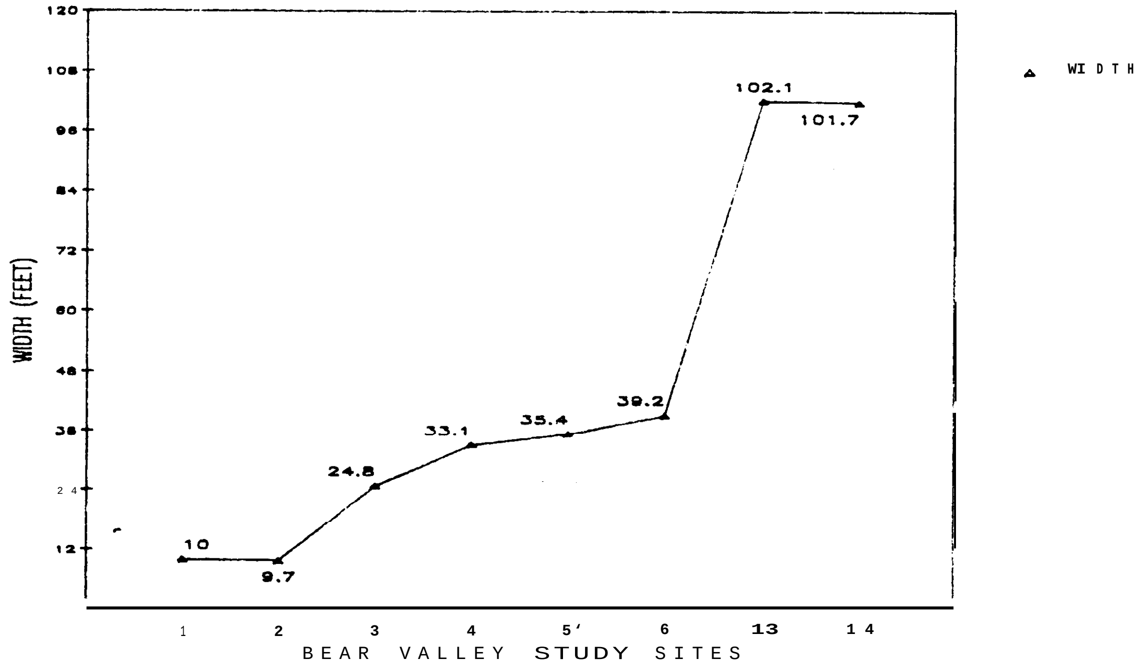

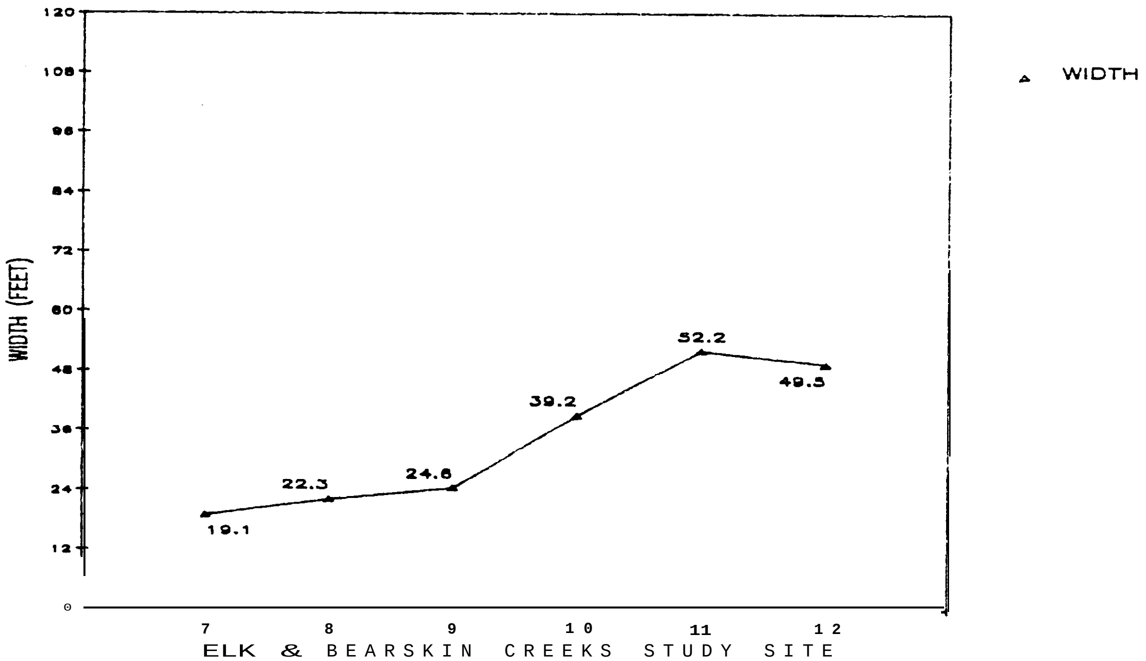

Figure 2b. Average stream width at the Bear Valley, Bearskin, and Elk creek study sites during 1986.

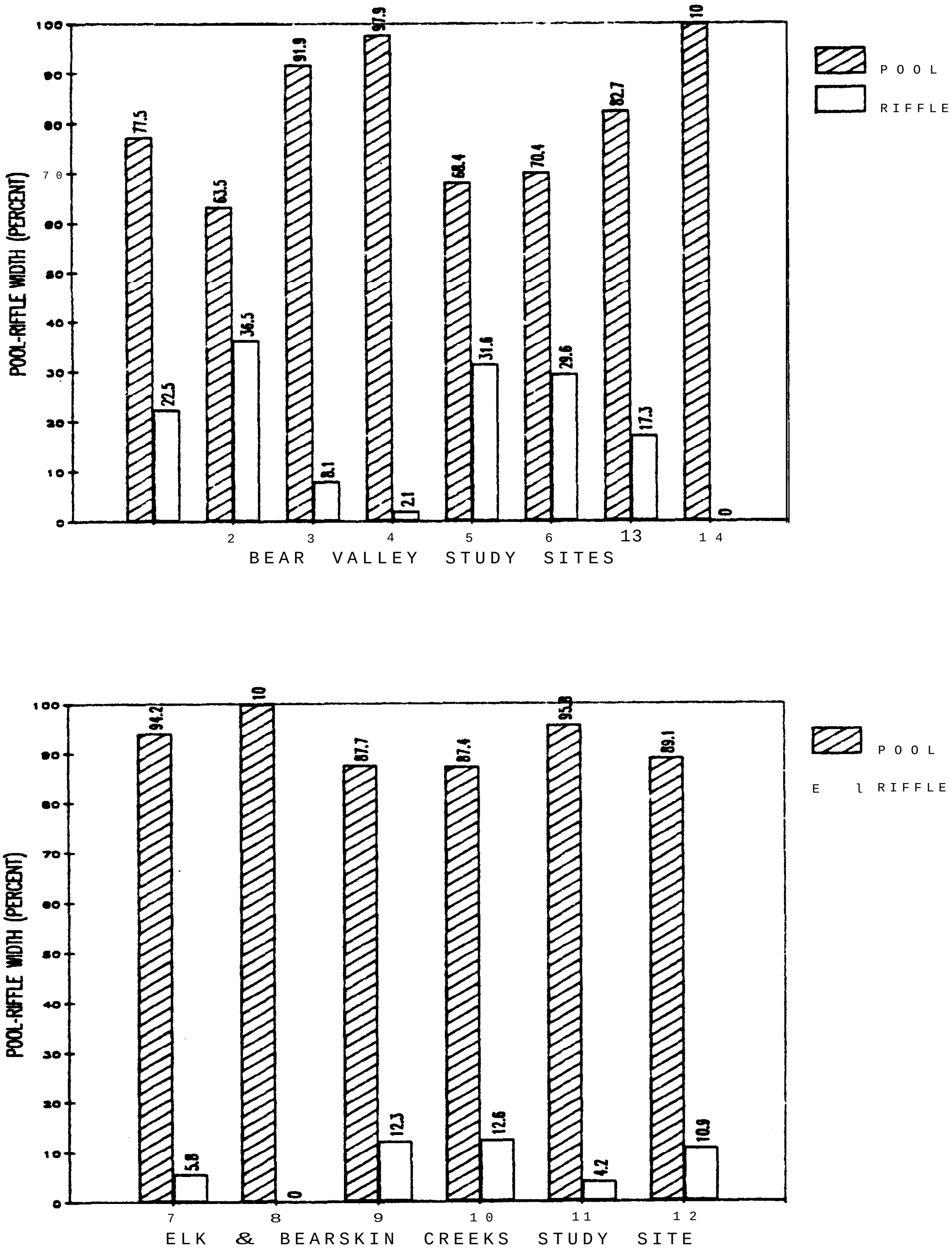

Figure 2c. Pool-Riffle habitat composition within the Bear Valley, Bearskin, and Elk creek study sites during 1986.

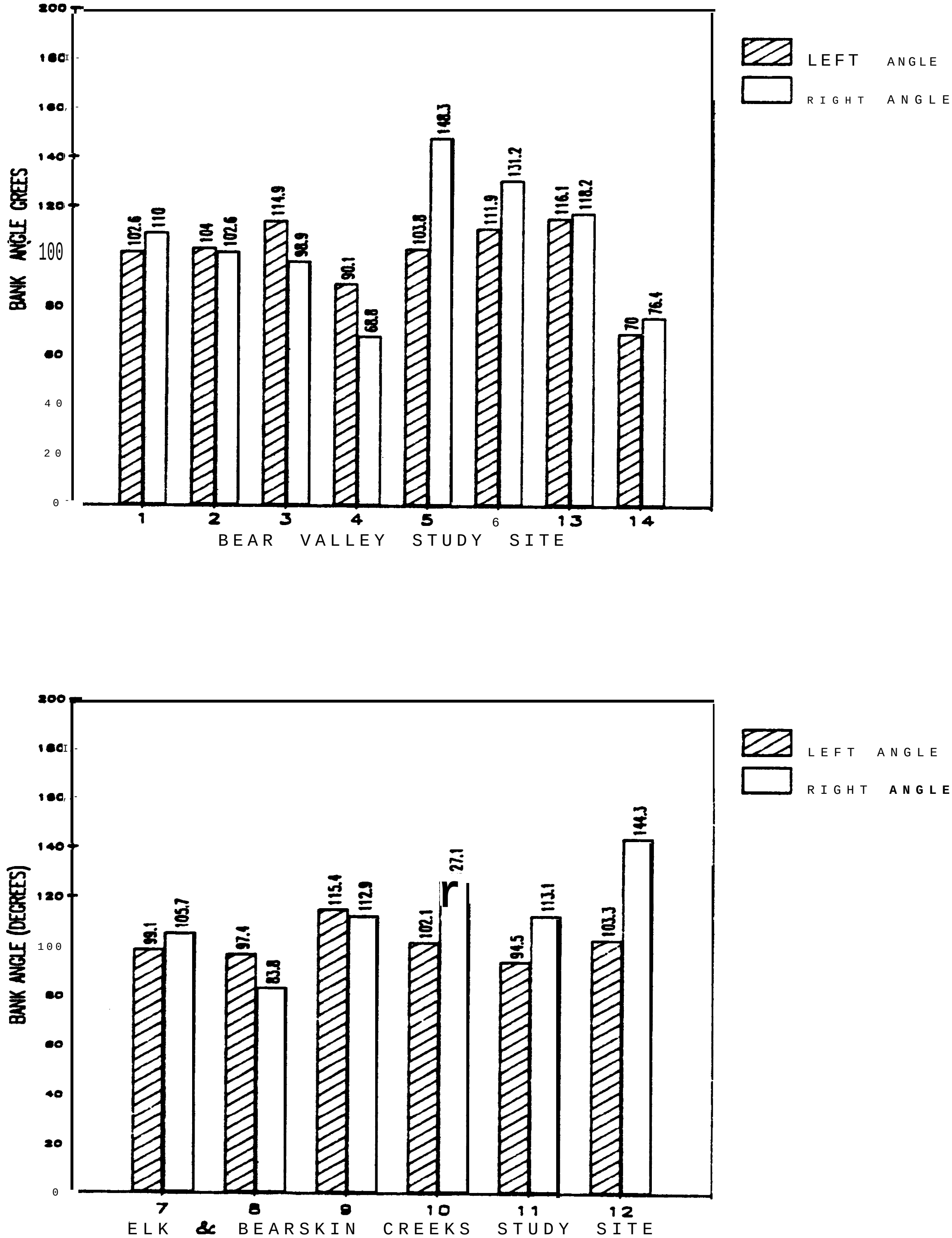

Figure 2d. Average bank angle for left and right streambanks at the Bear Valley, Bearskin and Elk creek study sites during 1986.

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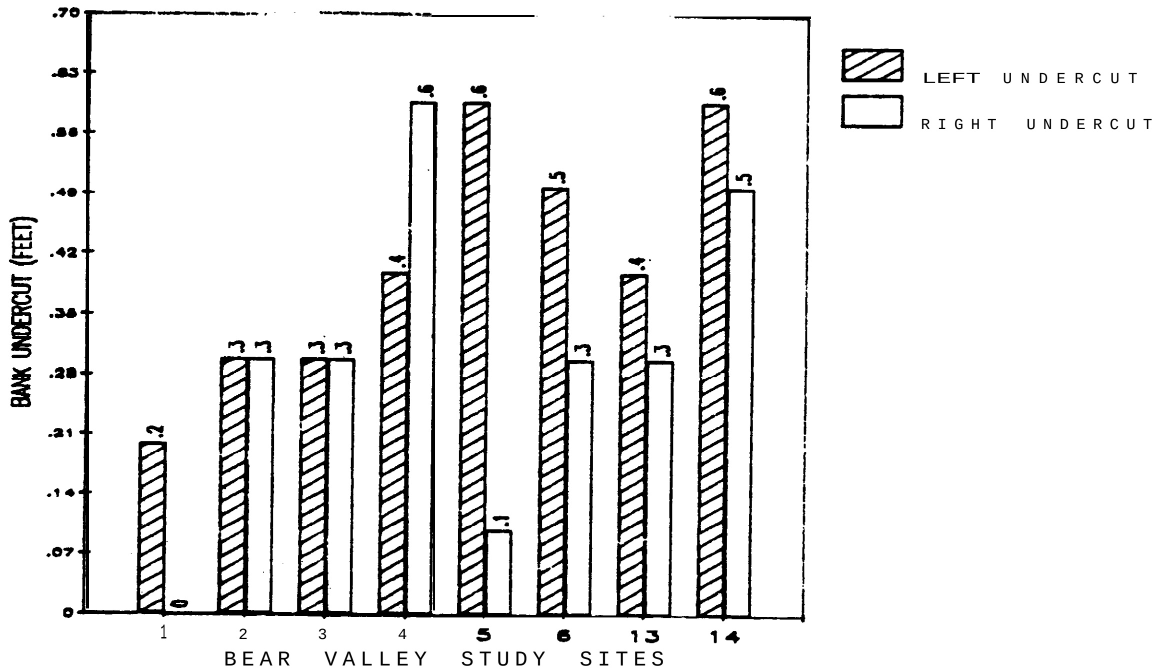


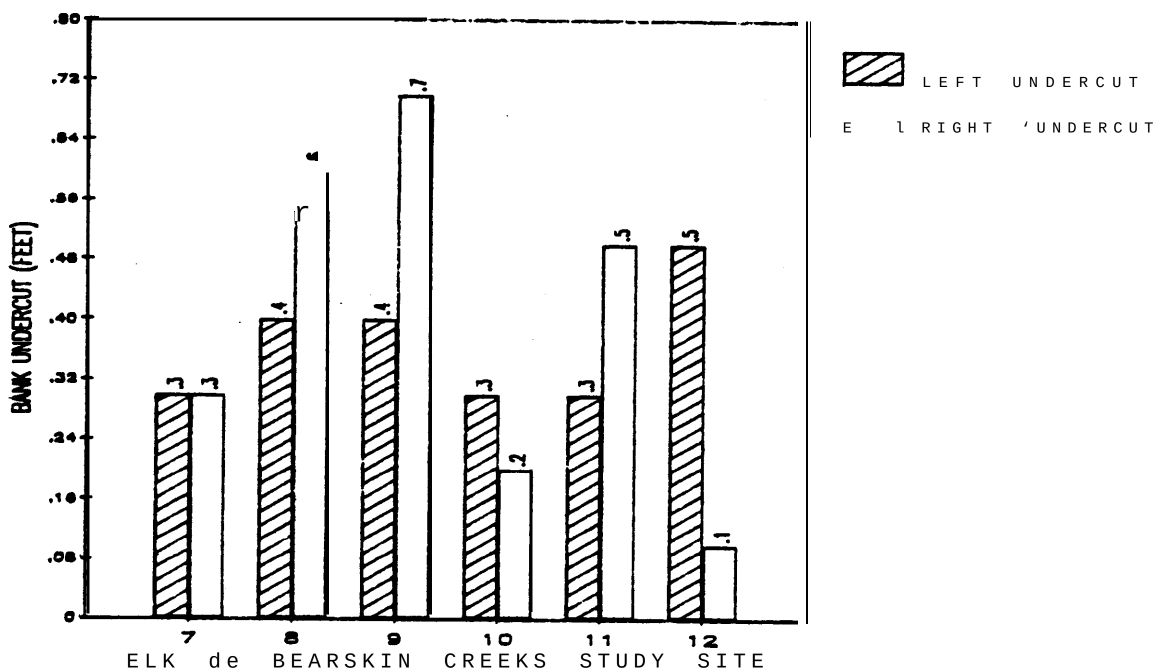
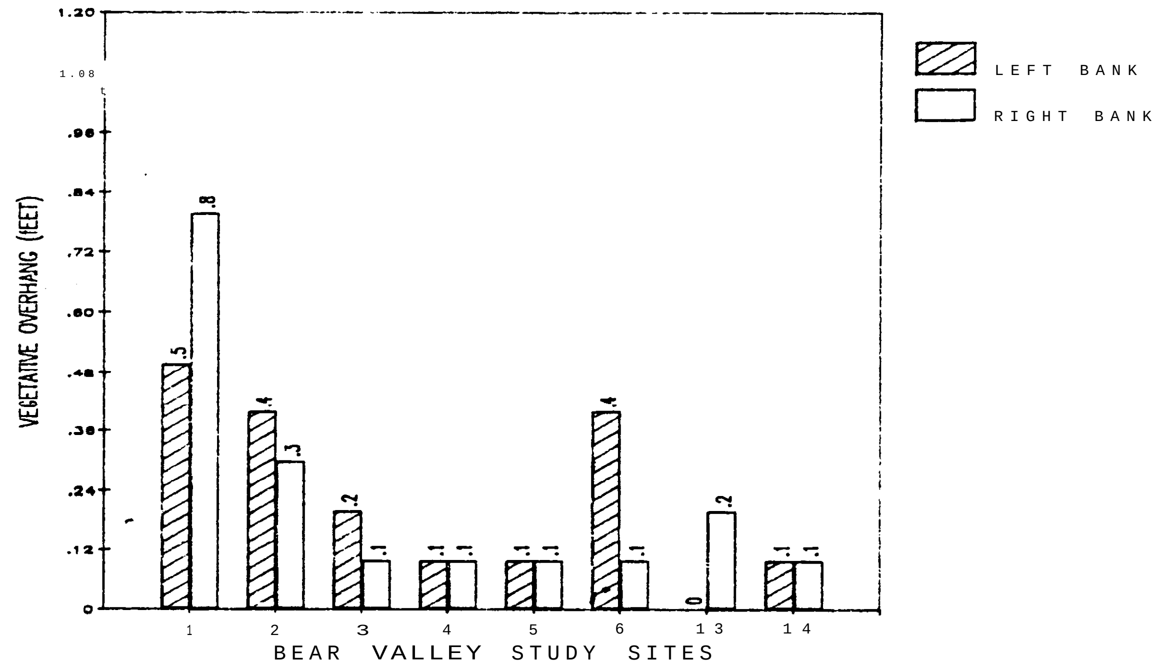


Figure 2e. Average bank undercut for left and right streambanks at the Bear Valley, Bearskin, and Elk creek study site during 1986.



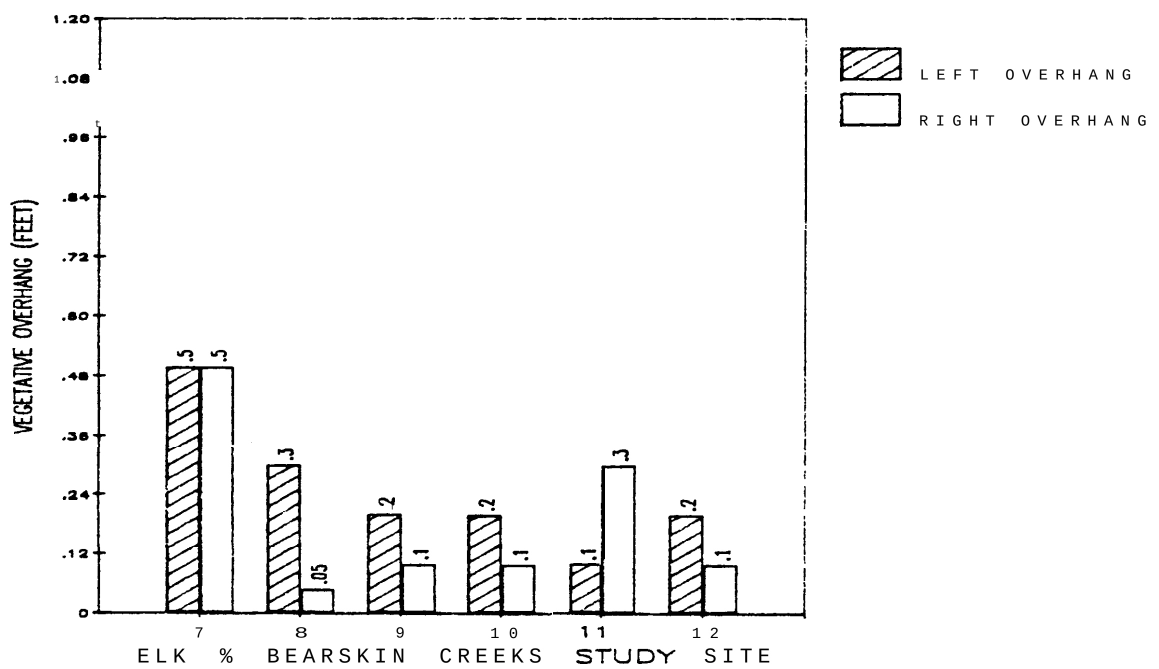


Figure 2f. Average vegetative overhang for left and right streambanks at the Bear Valley, Bearskin, and Elk creek study sites during 1986.

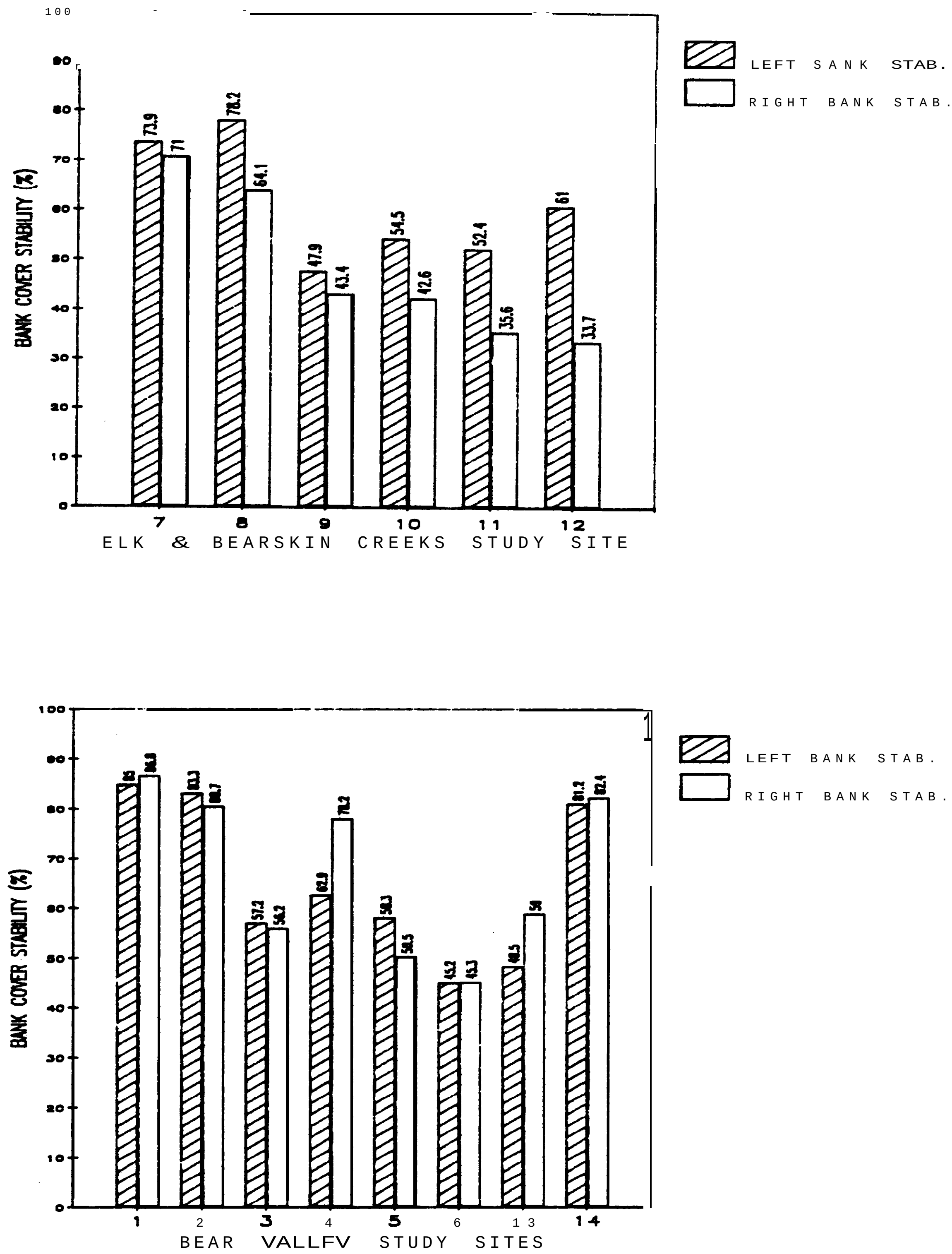
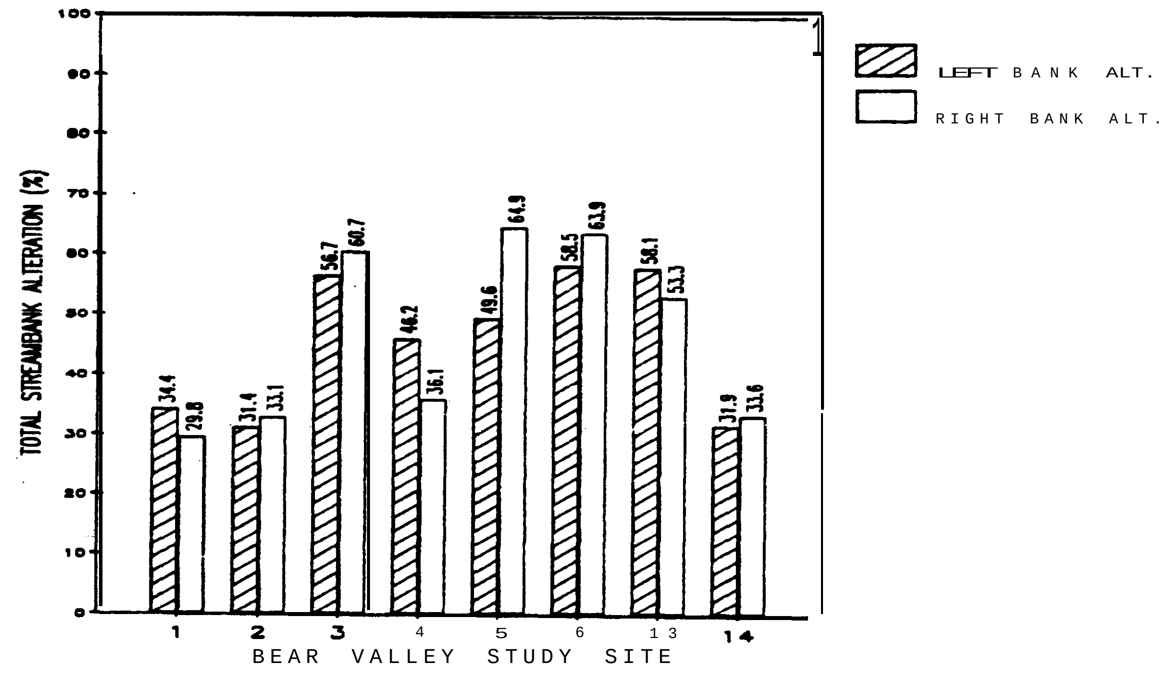


Figure 2g. Bank cover stability for left and right streambanks at the Bear Valley, Bearskin, and Elk creek study sites during 1986.



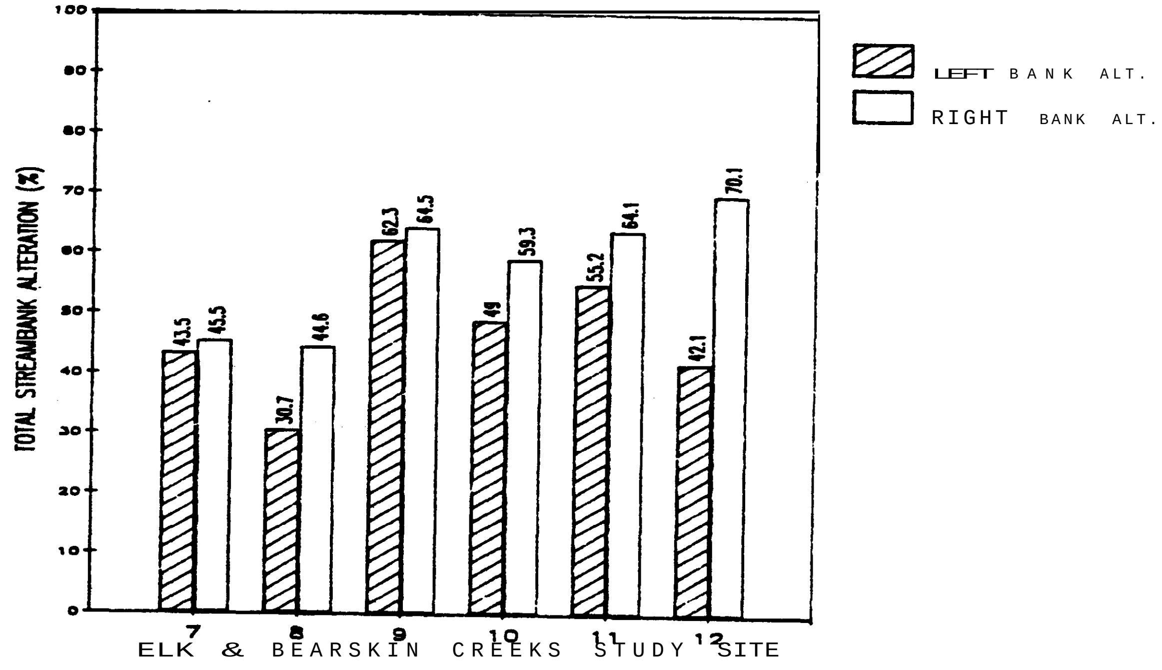
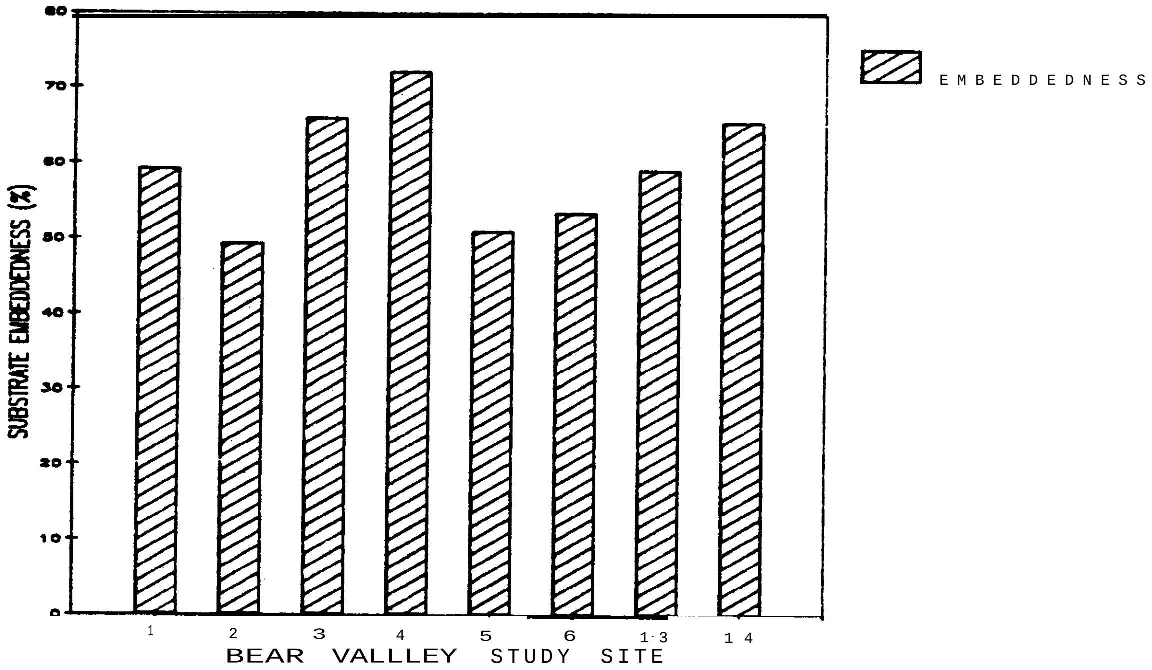


Figure 2h. Total streambank alteration for left and right streambanks at the Bear Valley, Bearskin, and Elk Creek study sites during 1986,



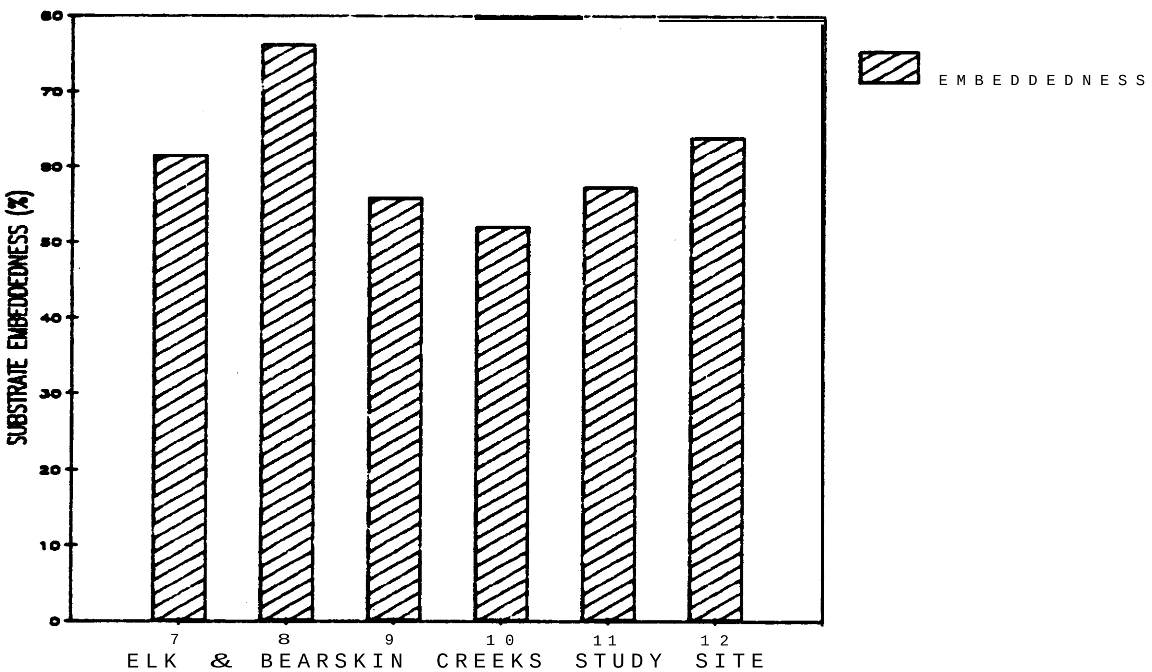


Figure 21. Channel substrate embeddedness at the Bear Valley, Bearskin, and Elk creek study sites during 1986.

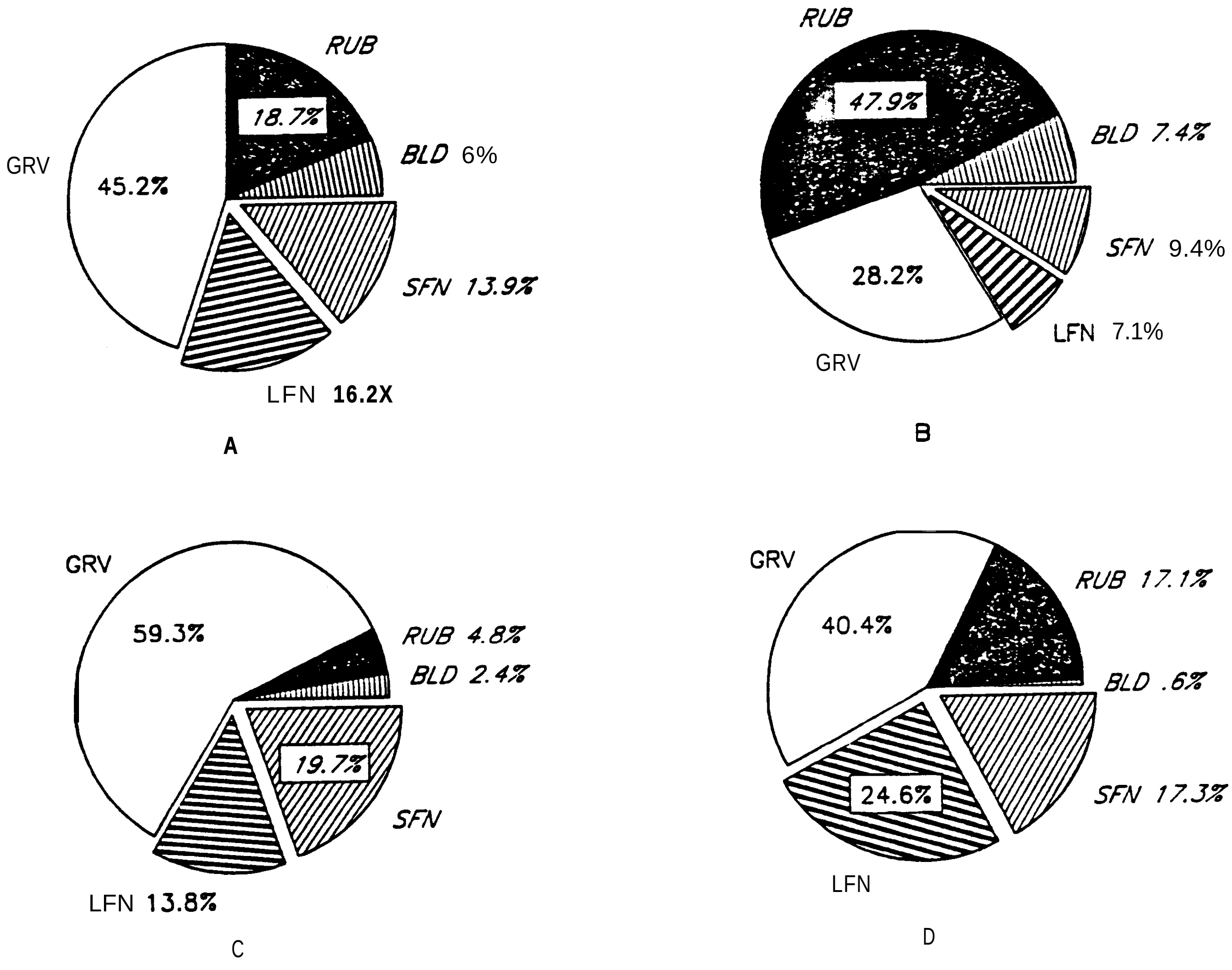


Figure 2j. Substrate composition in the Bear Valley drainage.
A=site 1, B=site 2, C=site 3, D=site 4.

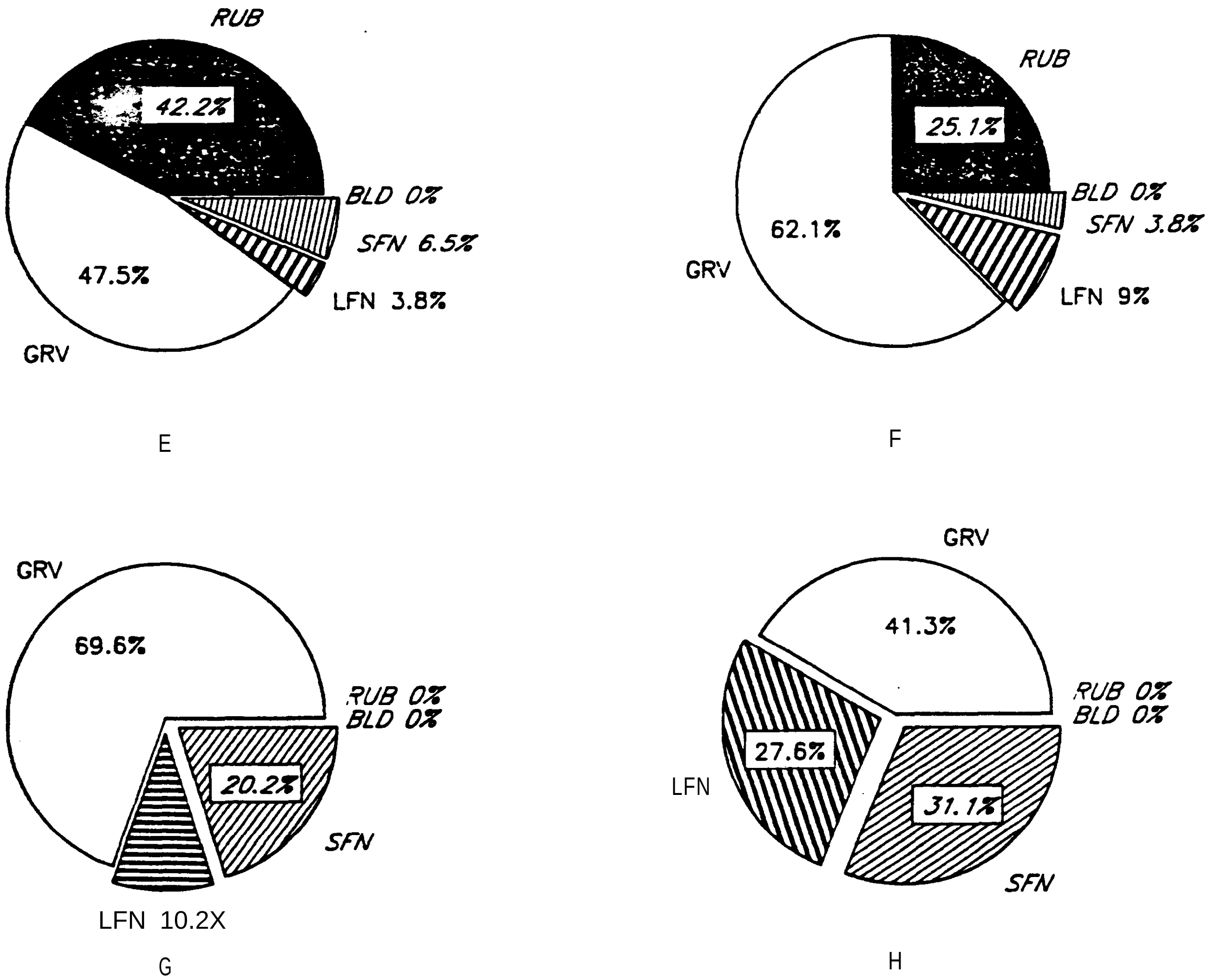


Figure 2k. Substrate composition in the Bear Valley drainage. E=site 5, F=site 6, G=site 7, H=site 8.

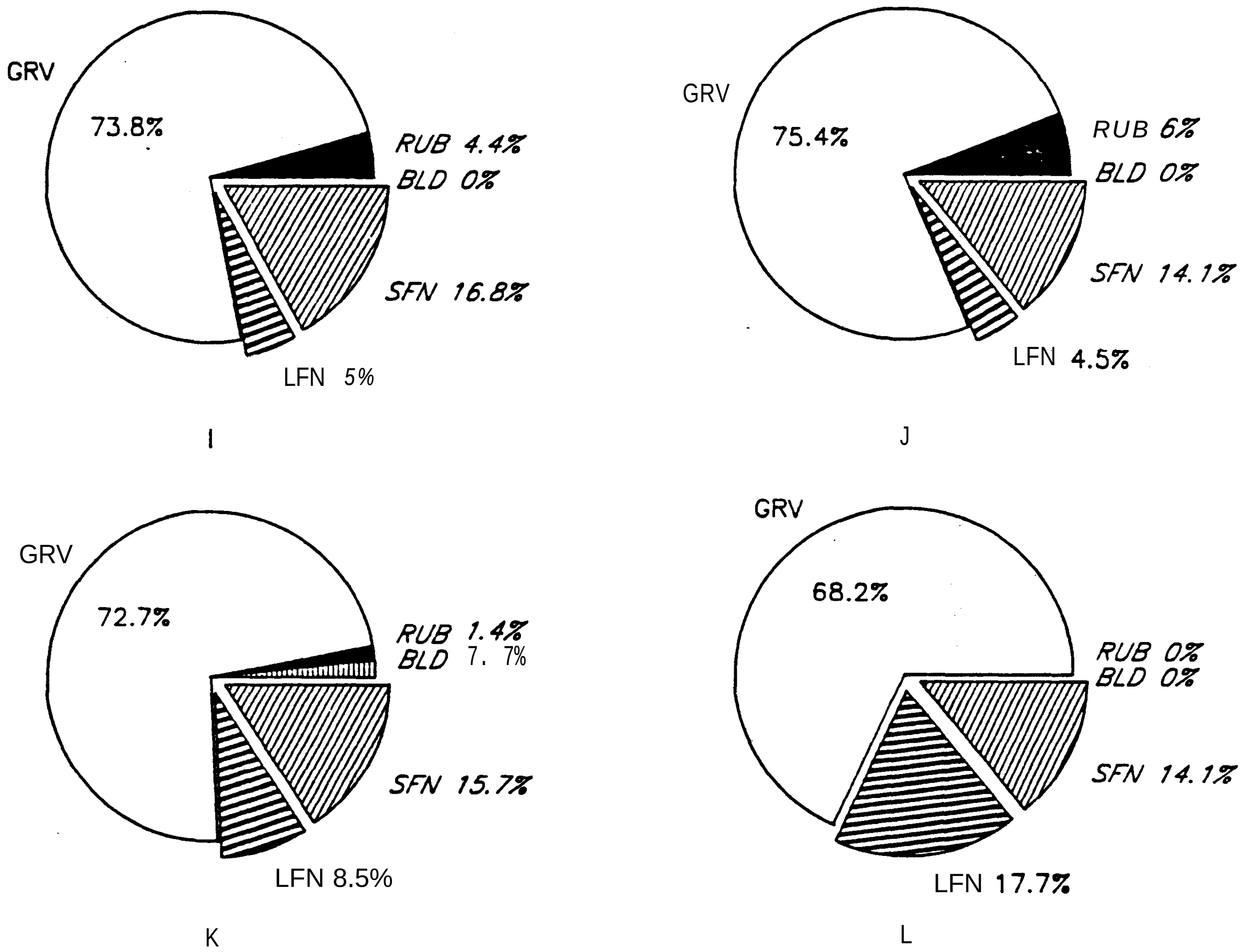


Figure 21. Substrate composition in the Bear Valley drainage. I=site 9, J=site 10, K=site 11, L=site 12.

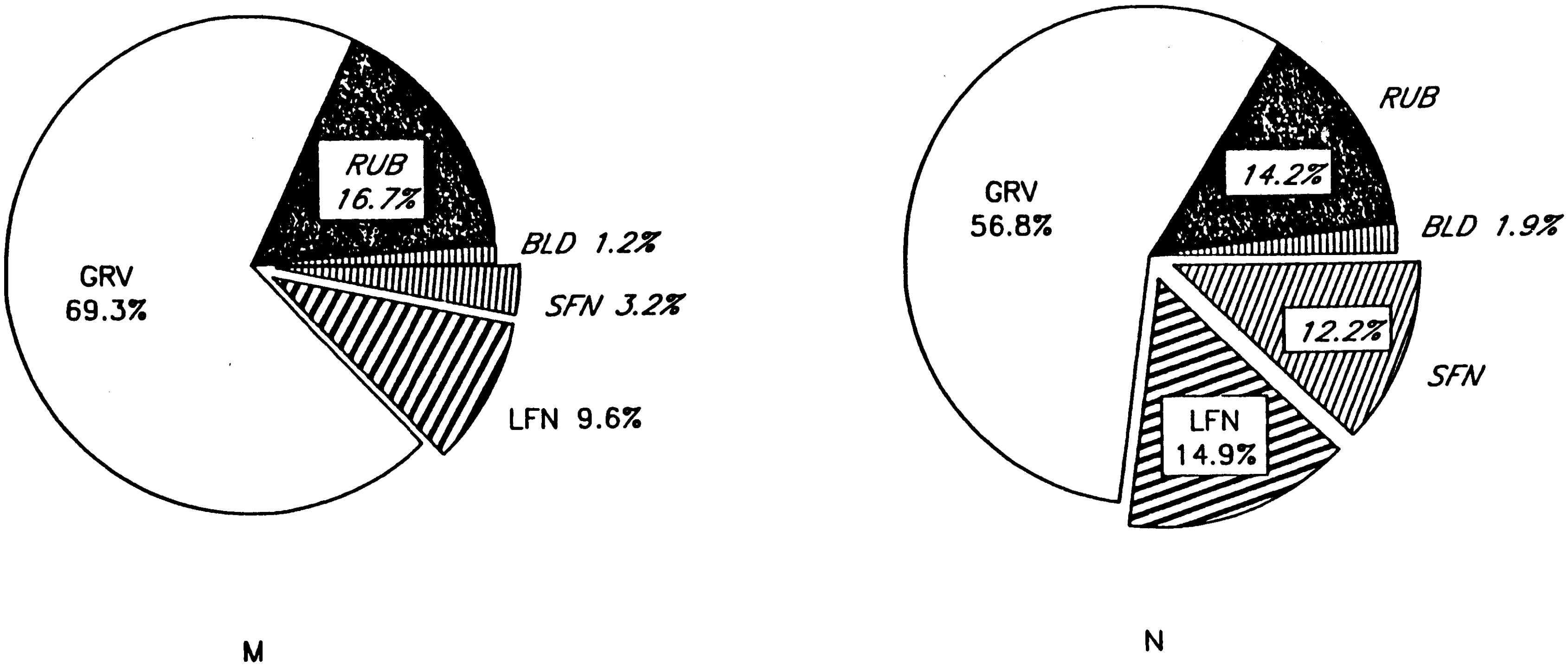


Figure 2m. Substrate composition in the Bear Valley drainage.
M=site 13, N=site 14.

APPENDIX 2

Results of the Idaho Department of Fish and Game fish population census in the Bear Valley Creek drainage, summer 1985-86.

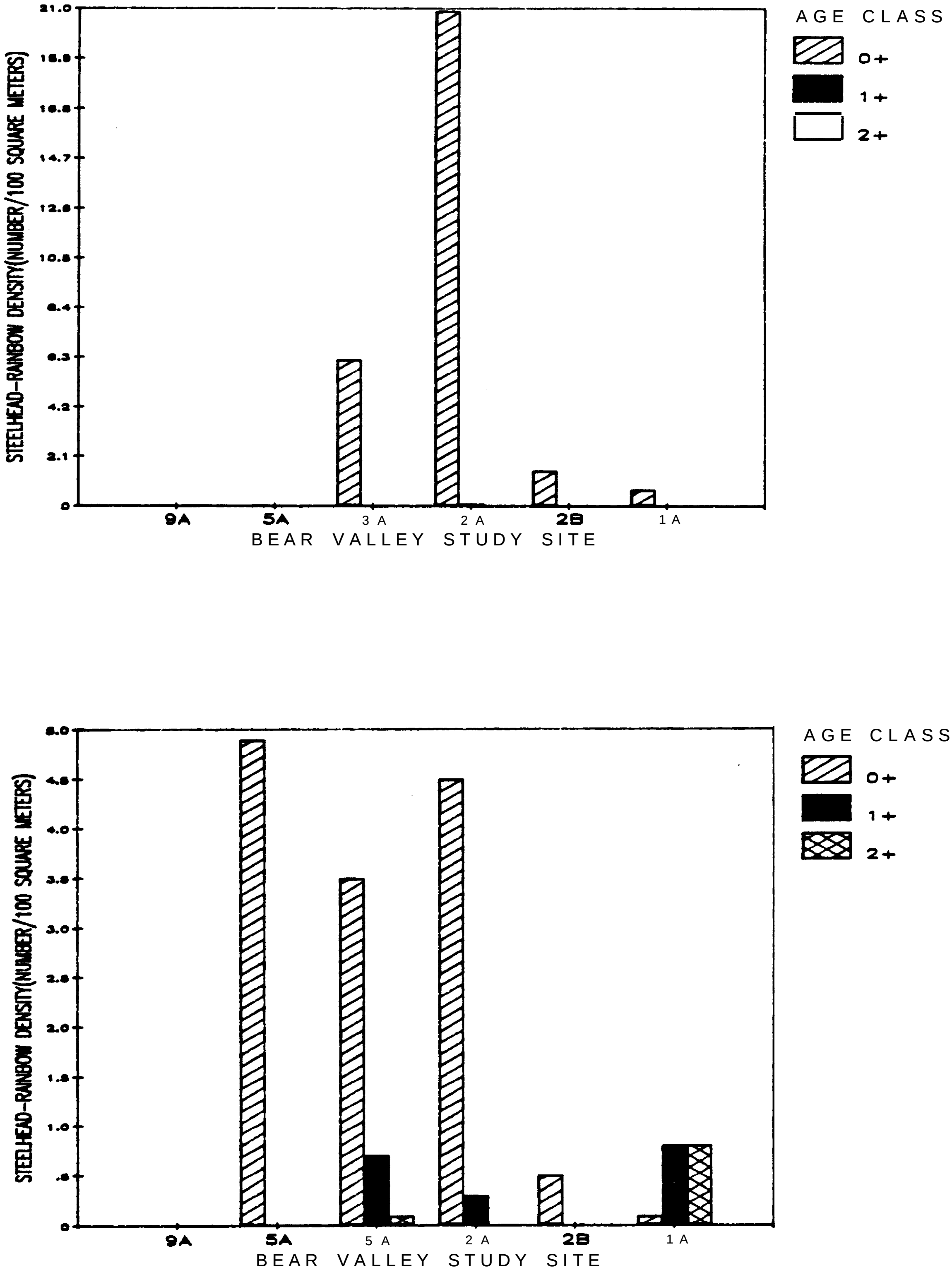
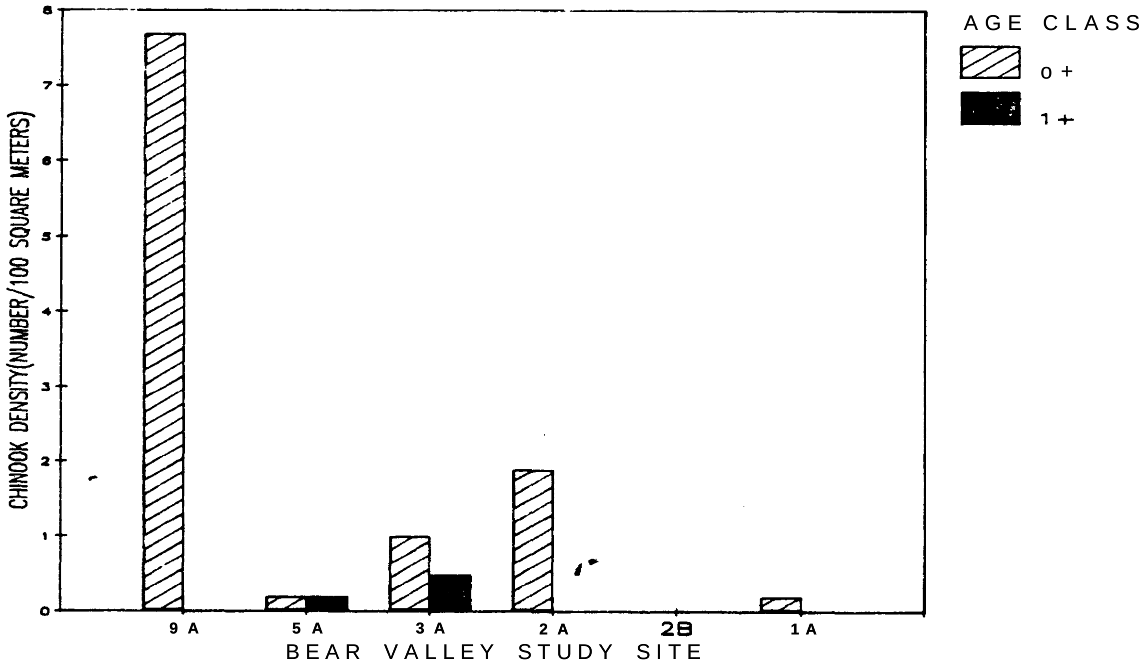


Figure 3a. Density of steelhead-rainbow trout in Bear Valley Creek during the summer of 1985(top) and 1986 (bottom).



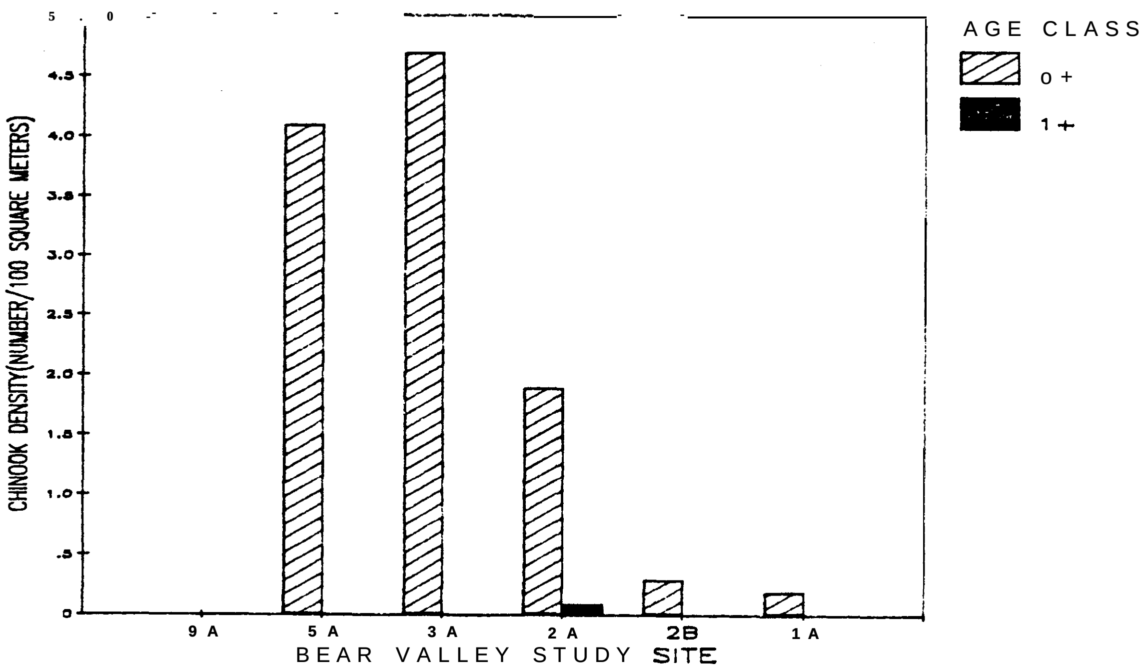


Figure 3b. Density of chinook salmon in Bear Valley Creek during the summer of 1985 (top) and 1986 (bottom)

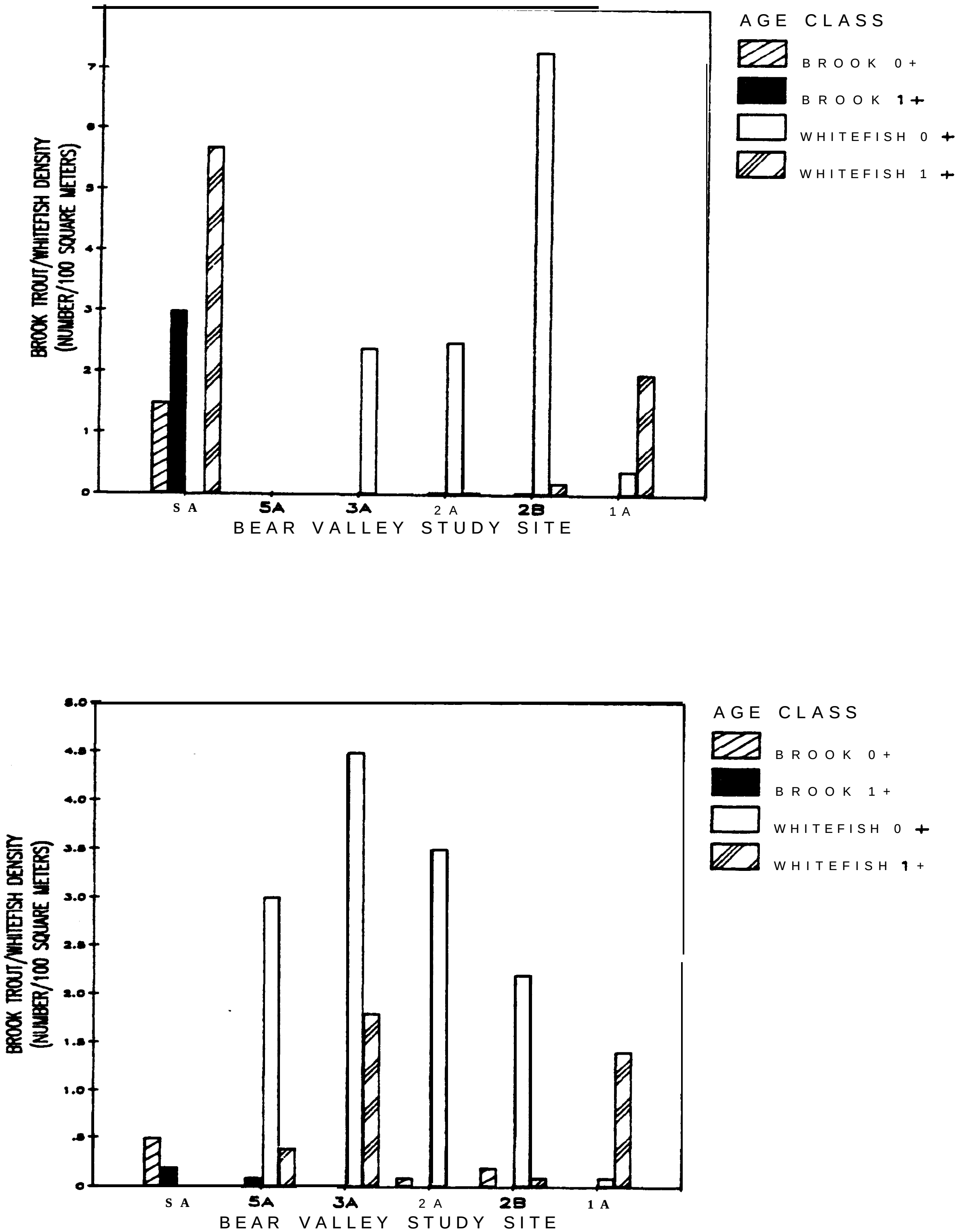
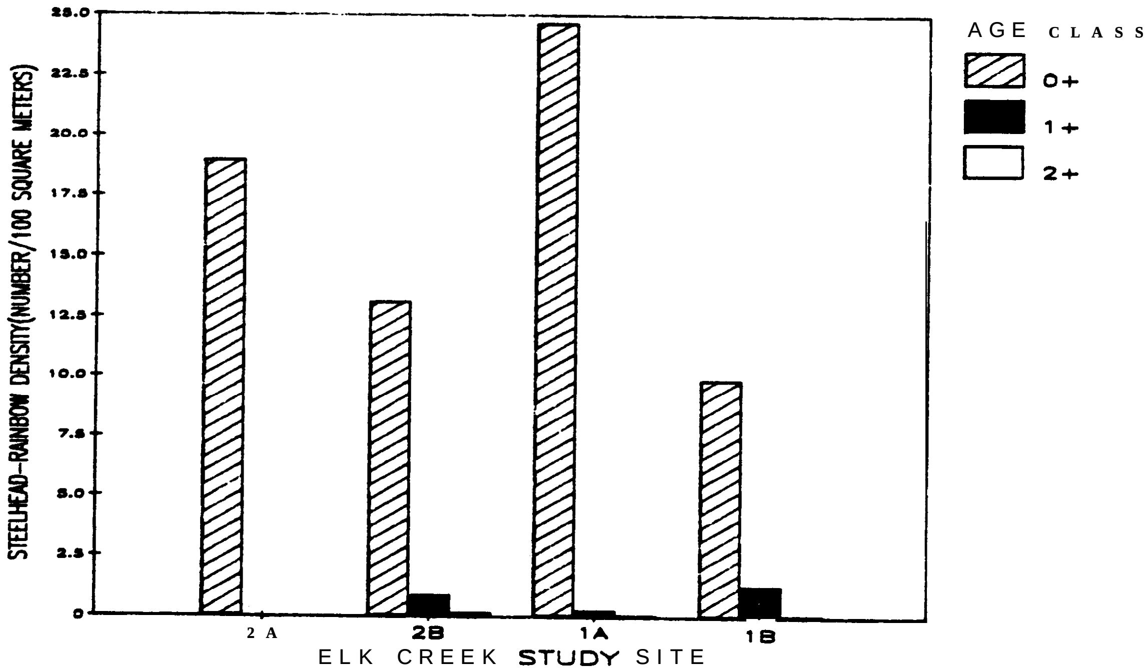


Figure 3c. Density of brook trout and mountain whitefish in Bear Valley Creek during the summer of 1985 (top) and 1986 (bottom).



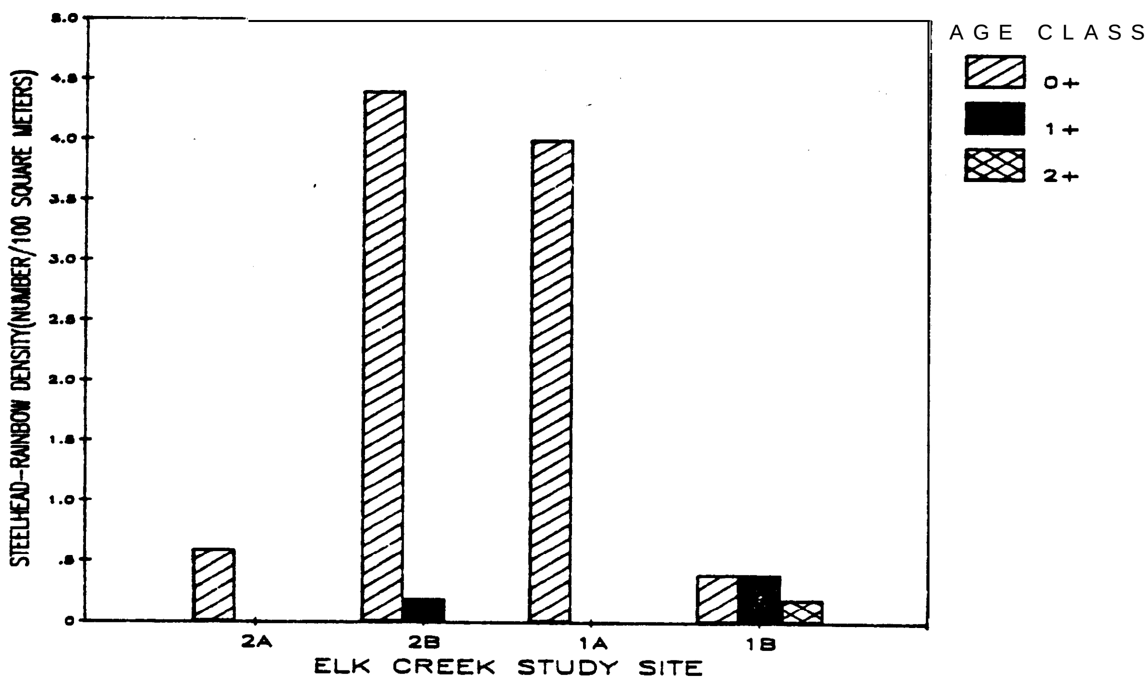


Figure 3d. Density of steelhead-rainbow trout in Bearskin and Elk Creeks during the summer of 1985 (top) and 1986 (bottom).

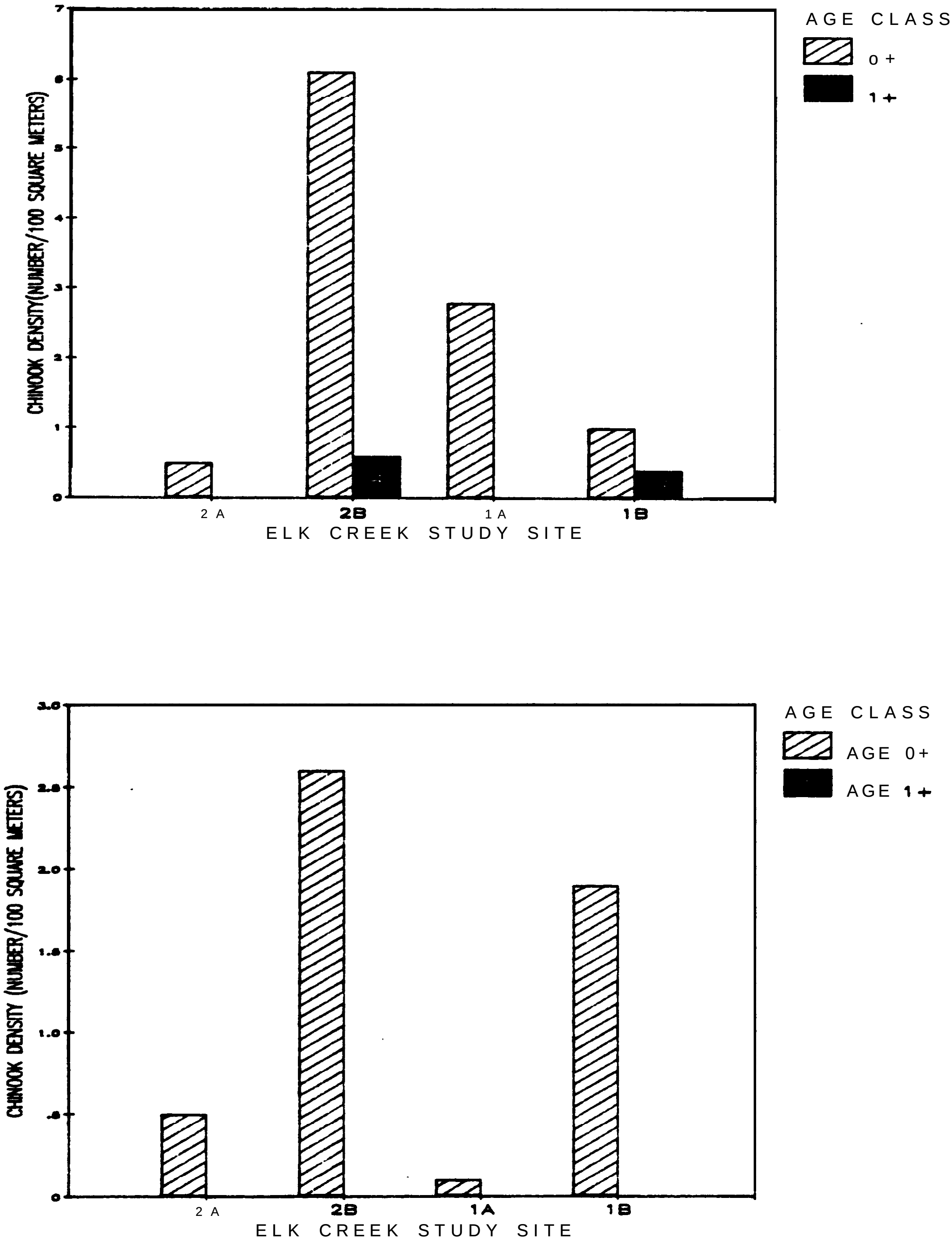


Figure 3e. Density of chinook salmon in Bearskin and Elk Creeks during the summer of 1985 (top) and 1986 (bottom).

APPENDIX D

Through BPA contract in 1985, OEA Research inventoried aquatic and riparian habitat of headwater streams in the Salmon River and Middle Fork Salmon River to define habitat problems and recommend treatments. The inventory was coordinated with ongoing monitoring and evaluation efforts by USFS, IDFG, and the Shoshone-Bannock Tribes.

The inventory identified cattle grazing as the major factor contributing to habitat degradation (OEA 1987a,b). OEA recommended a number of grazing management changes, extensive stream corridor fencing, and some structural and revegetation projects for these streams.

In 1986 IDFG expanded the aquatic and riparian inventory into Sulphur Creek, an adjacent wilderness stream which is not grazed by cattle or sheep. Five stream reaches (strata) and two sections per reach were defined. Aquatic habitat and fish density data were collected in the ten sections (Tables D1 and D2) Riparian habitat data were collected for the sections and reaches by Harvey Forsgren (Sawtooth National Forest). His report follows Table D2.

Table D1. Summary of physical habitat data collected in Sulphur Creek, August 18-20 1986.

Reach (strata)	Section	Channel type[a]	Percent gradient	Section length(m)	Mean width(m)	Mean depth(cm)	Percent Habitat Type: pool, run	Percent Habitat Type: riffle	Percent Habitat Type: pocket water	% Substrate Composition[b]: S	G	R	B
2	A	C	1.9	94	11.3	31	86.7	13.3	0	17.3	39.0	37.3	6.3
	B	C	2.0	60	10.2	28	50.0	50.0	0	27.1	27.9	41.7	3.3
3	A	B	3.0	46	10.2	35	33.3	0	66.7	21.1	11.1	32.2	35.6
	B	B	1.2	134	12.8	29	28.6	28.6	42.9	33.8	30.7	24.5	11.0
4	A	C	0.8	150	10.0	37	70.8	29.2	0	39.8	59.4	0.4	0
	B	C	0.6	205	10.4	26	71.4	28.6	0	30.5	54.8	14.8	0
5	A	C	1.0	92	9.8	22	73.3	26.7	0	17.0	75.7	7.3	0
	B	C	0.8	124	12.2	19	52.4	47.6	0	16.7	41.7	41.7	0
6	A	C		63	6.1	15	50.0	50.0	0	10.8	51.7	9.2	8.3
	B	C	0.4	71	7.0	38	100.0	0	0	43.8	46.7	9.6	0

[a] Rosgen (1985)

[b] S = sand; G = gravel; R = rubble; B = boulder.

Table D2. Density (number/lOOm2) by age-group of rainbow-steelhead and chinook in Sulphur Creek, July 27 and August 18-20, 1986.

Reach (strata)	Section	Month	Rainbow-Steelhead 0	1	2	>3	Chinook 0	I
2	A	August	3.3	2.6	0.5	0	6.9	0
	B	August	2.1	1.8	0	0	3.9	0
3	A	August	1.5	1.5	1.3	0.2	8.1	0.2
	B	August	6.0	0.7	0.2	0.1	4.7	0
4	A	July	0.1	0.2	0.1	0	25.8	0
	B	July	20.9	0.9	0.1	0	62.6	0.1
4	A	August	5.9	0.3	0	0	11.9	0
	B	August	18.7	0.7	0.2	0	34.0	0
5	A	August	6.6	2.1	0	0	14.5	0.3
	B	August	0.4	1.2	0.1	0.1	18.2	0
6	A	August	0	0	0	0	6.0	0
	B	August	5.7	2.4	0	0	0	0

Terry Holubetz
Idaho Department of Fish & Game
3806 S. Powerline Road
Nampa, ID 83651

22 September 1986

Dear Terry,

Attached you will find the raw data summaries for the data that I collected on Sulphur Creek this past August. The data presented are for each reach (collected on a stratified basis, either once ever 50 or 100 meters) and for each station within the reaches (collected on a Continuous transect basis). A table also presents rfparian community type/streambank stability relationships as measured in Sulphur Creek. The last table compares streambank stability characteristics, by community type, measured in Sulphur Creek to those measured in 1985 by OEA Research in ungrazed portions of the Main and Middle Forks of the Salmon River.

A few observations are noted by reach below.

Reach 2. Neither of the stations does a very good job of representing key characteristics of Reach 2. Both stations have far more bar C.T.'s represented than are within the reach (i.e. Station A and B have 36% and 51% respectively, bar communities streamside while the entire reach has only about 22%). Overall the reach has a mix of xeric, mesic and hydric community types (i.e. 19% 53%, and 29% respectively) while the station data *are* dominated by mesic communities (Station A and B have 97% and 100% mesic communities respectively). The stations (especially B) overestimate bank stability for the reach.

Reach 4. Overall the stations do a good job of representing Reach 4. stations have approximately the same portion o C.T.'s represented (A = 39%, B = 38%) as occur within the reach (40%). In combination the station data shows about the same mix of xeric, mesic and hydric C.T.'s (0% xeric, 75% mesic and 25% hydric) as occur within the reach (0% xeric, 73% mesic and 27% hydric). The stations do an excellent job of estimating bank stability for the reach.

Reach 5. Again neither of the stations does a very good job of representing key characteristics of Reach 5. Both stations have far more bar C.T.'s represented than are within the reach (i.e. Station A and B have 47% and 63% respectively bar communities streamside while the entire reach has only about 36%). Again the reach has a mix of xeric, mesic and hydric community types (i.e. 18% 66% and 16% respectively) while the station data are dominated by mesic communitities (Station A and B have 96% and 100% mesic communities respectively). The stations do, however, do a good job of estimating bank stability for the reach.

Reach 6. Station 6A does a fair job of representing the portion of Reach 6 that I inventoried. However, the station has fewer bar and bedrock C.T.'s (28%) than was measured for the reach (43%). The C.T. mix within the station (0% xeric, 97% mesic, and 3% hydrio) is similar to that within the reach (8%

xeric, 90% mesic, and 3% hydric). The station data over estimate streambank stability characteristics as measured within the reach.

The apparent non-representative nature of the stations in reaches 2 and 5 may be tied to apparent inconsistencies in gradient within those two reaches. It appeared to me that the stations were located in the lower gradient portions of the reaches. It may or not be of interest (or need) for you to investigate this theory further.

The comparisons made between OEA data for the Main and Middle Forks of the Salmon River and tbe data collected on Sulphur Creek are mildly interesting. With the exception of PICO/FEID, ABLA/CAGE, POPR, DECE, AB.A/CACA AND PICO/VAOC the percents of stable streambank are comparible. Each of these C.T.s, except ABLA/CACA, are represented in the Sulphur Creek data base by small sample sizes. Small sample size may account for the differences in mean stability. In general the mesic C.T.s measured in Sulphur Creek averaged nine percentage points less stable than the same C.T.s in ungrazed stream reaches inventoried by OEA. The hydric C.T.'s on the other hand averaged almost five percentage points more stable in Sulphur Creek than in the ungrazed stream reaches inventoried by OEA. I have no suggested reasons for these differences, other than to say that a number of factors may be interacting. Among these factors I would suggest that, 1) data collection in different year, 2) data collected by different person, and 3) unquantified differences in geomorphic characteristics between the two study areas could be significant.. I believe that the third factor identified probably accounts for most of the differences in the data sets. That is, I dont't believe that the geomorphic characteristics influencing the riparian community structure and streambank stability characteristics in the Sulphur Creek drainage are the same as the "average" characteristics influencing these same features in the area inventoried by OEA. This belief is substantiated by the preponderance of bar C.T.'s noted within the Sulphur Creek data set. More than 35% of the sampled C.T.'s in Sulphur Creek are bar C.T.'s. My examination of the OEA data would suggest that less than 20% of the C.T.'s sampled in ungrazed *stream* reaches are bar C.T.'s. It is apparent that Sulphur Creek is moving a tremendous amount of coarse bedload. The source of this material is unknown to me.

I appreciate the opportunity to have worked with you and your crew in the Sulphur Creek drainage. If I can provide any further information regarding these data please give me a call. After October 16 I can be reached at: Mt. Hood National Forest, 2955 N.W. Division Street, Gresham, OR 97030. Or by telephone at (503) 666-0700. My warmest regards to you and Charlie.

Sincerely,

Harv

Harv Forsgren

SULPHUR CREEK REACH 2 (Based on a sample interval of 100 meters)

	%Stable	%Unstable	%Bar
Sample Size Total = 76	75	14	11
Sample Size Non-Bar C.T.'s = 59	81	19	-

C.T.	% of Reach	%Stable	%Unstable	%Bar
ABLA/CACA	2.63	100		-
ABLA/CAGE	3.95	-	100	-
AGSC Bar	7.89	-	-	100
ALIN/COST	9.21	100	-	-
CARO	9.21	100	-	-
JUBA	1.32	100	-	-
PICO/FEID	1.32	-	100	-
PICO/VAOC	2.63	50	50	-
PIEN/EQAR	9.21	86	14	-
POPR	2.63	50	50	-
SABO/POPR	9.21	86	14	-
SADR/CACA	22.37	94	6	-
SAEX Bar	14.47	82	-	18
Salix/CARO	3.95	100		-

SULPHUR CREEK REACH 4 (Based on a sample interval of 100 meters)

	%Stable	%Unstable	%Bar
Sample Size Total = 307	51	11	37
Sample Size Non-Bar C.T.'s = 183	82	18	-

C.T.	% of Reach	%Stable	&Unstable	%Bar
ABLA/STAM	0.33	100	4;	-
ABLA/VACA	2.28	57		
AGSC Bar	38.76	3	1	96
CACA	2.61	75	25	-
CAR0	10.42	94	6	-
DECE	0.33	-	100	-
JUBA	0.98	67	33	-
PIEN/EQAR	0.33	-	100	-
POPR	3.91	67	33	-
SABO/POPR	3.26	50	50	-
SADR/CACA	30.29	85	15	-
SAM Bar	1.63	80	20	-
Salix/CARO	4.89	100	-	-

SULPHUR CREEK REACH 5 (Based on a sample interval of 100 meters)

	%Stable	%Unstable	%Bar
Sample Size Total = 230	58	15	27
Sample Size Non-Bar C.T.;s = 147	80	20	-

C.T.	% of Reach	%Stable	%Unstable	%Bar
ABLA/CACA	17.83	80	20	
ABLA/CAGE	5.22	17	83	-
ABLA/VACA	4.34	90	10	-
AGSC Bar	28.26	3	2	95
ALIN/COST	6.52	100	-	-
Bedrock	0.87	100	-	-
CARO	3.91	100	100	-
DECE	0.43	-		-
PICO/VAOC	0.87	-	100	
PIEN/EQAR	2.61	100	-	
POPR	0.43		100	..
SACO/CASC	1.74	100		
SABO/POPR	0.43	-	100	..
SADR/CACA	17.83	85	15	-
SAM Bar	6.96	69	25	6
SAEX/EQAR	0.43	100	-	-
Salix//CARO	1.30	100	-	-

SULPHUR CREEK REACH 6 (Based on a sample interval of 50 meters)

	%Stable	%Unstable	%Bar
Sample Size Total = 68	56	16	28
Sample Size Non-Bar C.T.'s = 39	74	26	-

C.T.	% of Reach	%Stable	%Unstable	%Bar
ABLA/CACA	17.65	58	42	-
ABLA/VACA	4.41	100	-	
AGSC Bar	27.94			
ALIN/COST	4.41	100	..	100 -
Bedrock	1.47	100	-	-
CACA	1.47	100	-	
PICO/VAOC	1.47	100	-	-
PIEN/EQAR	1.47	100	-	-
SABO/POPR	1.47	100		-
SADR/CACA	25.00	71	29	-
SAEX Bar	13.24	89	11	

SULPHUR CREEK STATION 2A (Based on continuous transect data)

	%Stable	%Unstable	%Bar
# Meters of Bank = 180	80	11	9
# Meters of Non-Bar C.T.'s = 115	83	17	-

C.T.	% of Station	%Stable	%Unstable	%Bar
AGSC Bar	2.22			100
CARO	2.22	100	-	-
SABO/POPR	12.22	64	36	
SADR/CACA	49.44	87	13	-
SAEX Bar	33.89	80	-	20

SULPHUR CREEK STATION 2B (Based on continuous transect data)

	%Stable	-	%Bar
# Meters of Bank = 132	50	3	47
# Meters of Non-Bar C.T.'s = 65	94	6	-

C.T.	% of Station	%Stable	%Unstable	%Bar
AGSC Bar	46.97	-	-	100
SADR/CACA	49.24	94	6	-
SAEX Bar	3.79	100	-	-

TOTALS FOR SULPHUR CREEK REACH 2 (Based on Station Data)

	%Stable	%Unstable	%Bar
# Meters of Bank Sampled = 312	67	8	25
# Meters of Non-Bar C.T.'s = 180	87	13	-

C.T.	% of Reach	%Stable	-	%Bar
AGSC Bar	21.15	100	-	100
CARO	1.28			
SABO/POPR	7.05	64	36	-
SADR/CACA	49.36	90	10	-
SAEX Bar	21.15	82	-	18

SULPHUR CREEK STATION 5A (Based on continuous transect data)

	%Stable	%Unstable	%Bar
# Meters of Bank = 198	57	18	25
# Meters of Non-Bar C.T's = 104	80	20	-

C.T.	% of Station	%Stable	%Unstable	%Bar
ABLA/CACA	6.57	100	-	
AGSC Bar	24.75	-	-	100
CACA	1.01	100	-	-
CARO	2.02	100	-	-
POPR	8.59	35	65	-
SABO/POPR	11.62	78	22	-
SADR/CACA	22.73	89	11	-
SAM Bar	22.73	67	33	-

SULPHUR CREEK STATION 5B (Based on continuous transect data)

	%Stable	%Unstable	%Bar
# Meters of Bank = 251	49	11	40
f Meters of Non-Bar C.T.'s = 92	85	15	-

C.T.	% of Station	%Stable	%Unstable	%Bar
ABLA/CACA	7.17	94	6	
AGSC Bar	40.24	-		100
POPR	2.39	-	-	
SADR/CACA	27.09	90	100	-
SAEX Bar	23.11	78	22	-

TOTALS FOR SULPHUR CREEK REACH 5 (Based on station data)

	%Stable	-	%Bar
# Meters of Bank Sampled = 449	53	14	33
# Meters of Non-Bar C.T.'s = 196	82	18	-

C.T.	% of Reach	%Stable	%Unstable	%Bar
ABLA/CACA	6.90	97	3	
AGSC Bar	33.41			-
CACA	0.45	100	..	100
CARO	0.89	100	-	-
POPR	5.12	26	74	-
SABO/POPR	5.12	78	12	-
SADR/CACA	25.17	89	11	-
SAEX Bar	22.94	73	27	-

SULPHUR CREEK STATION 4A (Based on continuous transect data)

	%Stable	%Unstable	%Bar
# Meters of Bank = 306	52	10	39
# Meters of Non-Bar C.T.'s = 188	84	16	-

C.T.	% of Station	%Stable	%Unstable	%Bar
AGSC Bar	38.56	-	-	100
CACA	7.84	83	17	-
CARO	20.59	92	8	
JUBA	0.65	100		-
PICO/VAOC	1.31	-	100	-
POPR	1.63	-	100	-
SABO/POPR	1.31	100	-	
SADR/CACA	28.10	86	14	-

SULPHUR CREEK STATION 4B (Based on continuous transect data)

	%Stable	%Unstable	%Bar
# Meters of Bank = 208	51	10	38
# Meters of Non-Bar C.T.'s = 128	84	16	-

C.T.	% of Station	%Stable	%Unstable	%Bar
ABLA/CACA	14.42	90	10	-
AGSC Bar	38.46			100
CARO	6.73	100		-
JUBA	1.44	100	-	-
POPR	6.25	8	95	-
SABO/POPR	3.85	63	38	-
SADR/CACA	28.37	95	5	-
Salix/CARO	0.48	100	-	-

TOTALS FOR SULPHUR CREEK REACH 4 (Based on station data)

	%Stable	-	%Bar
# Meters of Bank Sampled = 514	52	10	39
# Meters of Non-Bar C.T.*s = 316	84	16	-

C.T.	% of Reach	%Stable	%Unstable	%Bar
ABLA/CACA	5.84	90	10	-
AGSC Bar	38.54	-	-	100
CACA	4.67	83	17	-
CARO	14.98	94	6	-
JUBA	0.97	100	-	-
PICO/CAOC	0.78	-	100	-
POPR	3.50	6	94	-
SABO/POPR	2.33	75	25	-
SADR/CACA	28.21	90	10	
Salix/CARO	0.19	100	-	

SULPHUR CREEK STATION 6A (Based on continuous transect data)

	%Stable	-	%Bar
# Meters of bank = 122	64	12	29
# Meters of Non-Bar C.T.'s = 88	83	17	-

C.T.	% of Station	%Stable	%Unstable	%Bar
ABLA/CACA	5.74	100	-	
AGSC Bar	21.31		-	100
CARO	2.46	100		-
POPR	3.28	25	75	-
SADR/CACA	60.66	84	16	
SAM Bar	6.56	63	-	38

RIPARIAN COMMUNITY TYPE/STREAM BANK STABILITY RELATIONSHIPS FOR SULPHUR CREEK

C.T.	n	%Stable	%Unstable	%Bar
ABLA/CACA	55	76	24	-
ABLA/CAGE	15	13	87	-
ABLA/STAM	1	100		
ABLA/VACA	10	80	20	
AGSC Bar	209	4	1	96
ALIN COST	25	100	-	-
Bedrock	3	100	22	..
CACA	9	78		
CARO	48	96	4	-
DECE	2		100	-
JUBA	4	75	25	-
PICO/FEID	1		100	-
PICO/VAOC	5	40	60	-
PIEN/EQAR	15	87	13	-
POPR	15	60	40	
SABO/POPR	19	53	47	-
SACO/CASC	4	100		
SADR/CACA	168	85	15	
SAEX Bar	41	78	15	7
Salix/CARO	22	100	-	-

COMPARISON OF STREAMBANK STABILITY CHARACTERISTICS ASSOCIATED WITH COMMUNITY TYPES FOUND IN UNGRAZED PORTIONS OF THE MAIN AND MIDDLE FORKS OF THE SALMON RIVER, IDAHO

	Percent of Streambanks Stable	
	Main & Middle Forks Salmon River (OEA 1985)	Sulphur Creek[a] (Forsgren 1986)
XERIC Communities		
PICO/FEID	45	(0)
ABLA/CAGE	67	(13)
ALIN/COST	100	100
MESIC Communities		
POPR	20	(60)
DECE	59	(0)
JUBA	76	(75)
SABO/POPR	80	(53)
ABLA/CACA	84	76
ABLA/VACA	86	(80)
SADR/CACA	88	85
PICO/VAOC	96	(40)
HYDRIC Communities		
SACO/CASC	85	(100)
CARO	89	96
Salix/CARO	90	100
ABLA/STAM	96	(100)
PIEN/EQAR	100	(87)

[a] Samples with fewer than 20 measurements are in parentheses.

APPENDIX E

Table E1. Results of 1985 adult steelhead release above barrier removal project, Eldorado Creek, evaluated August 13-14, 1986.

Reach (strata)	Area (m^2)	Number of sections	1985 Adult Steelhead Number released	1985 Adult Steelhead Percent females	1986 Yearling Steelhead Density (no./100m^2)	1986 Yearling Steelhead Standing crop
Barriers to Lunch Creek	83,776	7	1,150	78.4	8.5±2.0	7,122±1,685
Above Lunch Creek	52,525	6	0	-	0.3±0.4	188±236
Dollar Creek	2,237	2	0	-	0	0
Total	138,538	15	1,150	78.4	4.4±1.0	7,320±1,701

Table E2. Results of 1986 chinook fry release above barrier removal project, Eldorado Creek, evaluated August 13-14, 1986.

Reach (strata)	Area (m^2)	Number of sections	4/29, 5/7/86 Release Number stocked	4/29, 5/7/86 Release Stocking density	1986 Age 0 Chinook Density (no./100m^2)	1986 Age 0 Chinook Standing crop
Barriers to Lunch Creek	83,776	7	50,700	61	10.2±8.5	8,575±7,010
Above Lunch Creek	52,525	6	132,300	252	35.2±21.7	18,569±11,226
Dollar Creek	2,237	2	16,000	715	153.4±50.7	3,059±2,043
Total	138,538	15	199,000	144	27.1±10.0	30,319±13,393

C9AD201CB

Table E3. Steelhead parr rearing above Crooked Fork Creek barrier removal project prior to steelhead introductions, evaluated July 31-August 2, 1986.

Reach (strata)	Area (m^2)	Number of sections	1986 Age ≥ 1 Steelhead Density (no./$100m^2$)	1986 Age ≥ 1 Steelhead Standing crop
Below Hopeful Creek	69,840	4	0.5±0.3	380±230
Above Hopeful Creek	25,440	3	0.4±0.7	114±176
Hopeful Creek	17,173[a]	3	0.05±0.1	11±22
Total	112,453	10	0.4±0.02	505±291

[a] Lower 3.2 km.

Table E4. Results of 1986 chinook fry release above barrier removal project, Crooked Fork Creek, evaluated July 31-August 2, 1986.

Reach (strata)	Area (m^2)	Number of sections	5/8/86 Release: Number stocked	5/8/86 Release: Stocking density	1986 Age 0 Chinook: Density (no./100m^2)	1986 Age 0 Chinook: Standing crop
Below Hopeful Creek	69,840	4	38,800	56	11.8±7.3	5,610±3,997
Above Hopeful Creek	25,440	3	62,300	245	23.2±20.0	5,847±4,604
Hopeful Creek	17,173[a]	3	55,100	320	36.1±53.8	6,131±8,317
Total	112,453	10	156,200	140	21.1±13.7	17,588±10,312

[a] Lower 3.2 km.

C9AD201CB

Table E5. Steelhead parr rearing above Boulder Creek barrier removal project, evaluated July 29-30, 1986. (The falls were considered a barrier only to chinook migration.)

Reach (strata)	Area (m^2)	Number of sections	1986 Age $\geq$ 1 Steelhead Density (no./100m^2)	Standing crop
Barrier to Yantis Ditch	97,117	9	2.8$\pm$1.3	2,688$\pm$1,299
Above Yantis Ditch	-	0	-	-
Total	97,117	9	2.8$\pm$1.3	2,688$\pm$1,299

Table E6. Results of 1986 chinook fry release above barrier removal project, Boulder Creek, evaluated July 29-30, 1986.

Reach (strata)	Area (m^2)	Number of sections	4/23, 4/30/86 Release: Number stocked	Stocking density	1986 Age 0 Chinook: Density (no./100m^2)	Standing crop
Barrier to Yantis Ditch	97,117	9	99,900	103	28.9±25.3	28,112±24,777
Above Yantis Ditch	-	0	0	0	-	-
Total	97,117	9	99,900	103	28.9±25.3	28,112±24,777

C9AD201CB

Table E7. Influence of distance from stocking site and gradient on density (number/100m^2) of age 0 chinook, Eldorado Creek, Crooked Fork Creek, and Boulder Creek projects, 1986.

km below stocking site	Gradient Class < 2.0%	Gradient Class ≥ 2.0 %
< 1.0	76.0±32.2 (n=11)	20.8±14.9 (n=4)
1.0-2.9	32.1±22.8 (n=6)	11.5±4.4 (n=4)
≥ 3.0	10.9±11.5 (n=6)	1.0±1.0 (n=7)

C9AD200CB

Table E8. Results of 1985 steelhead release above culvert barrier removal project, Crooked River River, evaluated August 26-27, 1986.

Reach (strata)	Area (m^2)	Number of sections	1985 Adult Steelhead Number released	1985 Adult Steelhead Percent females	1986 Yearling Steelhead Density (no./$100m^2$)	1986 Yearling Steelhead Standing crop
Culvert to Forks	53,148	6	2,030	78.7	5.7±1.6	2,573±683
West Fork Crooked River	-	0	0	-	-	-
East Fork Crooked River	-	0	0	-	-	-
Total	53,148	6	2,030	78.7	5.7±1.6	2,573±683

Table E9. Chinook fry rearing above culvert barrier removal project, Crooked River, evaluated August 26-27, 1986.

Reach (strata)	Area (m^2)	Number of sections	Chinook redd count 1985	4/24/86 fry released	1986 Age 0 Chinook Density (no./$100m^2$)	1986 Age 0 Chinook Standing crop
Culvert to Forks	53,148	6	10	14,000	16.4±5.9	7,413±2,543
West Fork Crooked River	-	-	-	-	-	-
East Fork Crooked River	-	-	-	-	-	-
Total	53,148	6	10	14,000	16.4±5.9	7,413±2,543

C9AD201CB

Table E10. Steelhead parr rearing above Johnson Creek barrier removal project, evaluated August 2-14, 1986[a]. (The Cascades were considered barriers only to chinook migration.)

Reach (strata)	Area (m^2)	Number of sections	1986 Age ≥ 1 Steelhead Density (no./100m^2)	Standing crop
Barriers to Landmark	210,772	3	0.31±0.25	644±526
Landmark to Tyndall	89,291	3	0.59±1.00	529±879
Tyndall Meadows	21,125	3	0.04±0.08	8±16
Rock Creek Meadow	13,760	5	0.01±0.01	2±3
Sand Creek Meadow	11,733	3	0.15±0.25	20±27
Total	346,681	17	0.35±0.33	1,202±1,025

a Welsh, personal communication.

Table E11. Results of 1986 chinook fry release above barrier removal project, Johnson Creek, evaluated August 2-14, 1986[a].

Reach (strata)	Area (m^2)	Number of sections	5/9/86 Release: Number stocked	5/9/86 Release: Stocking density	1986 Age 0 Chinook: Density (no./100m^2)	1986 Age 0 Chinook: Standing crop
Barriers to Landmark	210,772	3	0	0	4.0±3.7	8,454±7,809
Landmark to Tyndall	89,291	3	111,200	125	13.3±9.8	11,917±8,797
Tyndall Meadows	21,125	3	2,900[b]	14	5.0±3.6	1,058±768
Rock Creek Meadow	13,760	5	23,700[b]	172	9.9±2.6	1,410±370
Sand Creek Meadow	11,733	3	48,200[b]	411	6.8±3.7	872±468
Total	356,681	17	186,000[b]	54	7.4±3.6	23,711±10,100

[a] Welsh, personal communication.

[b] Includes 10,000 fry released June 30 and July 1, 1986 (Welsh, personal communication).

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Table E12. Sections sampled in Crooked River and Red River to evaluate effectiveness of instream structures for rearing juvenile chinook and steelhead, July 14-18 and August 26-28, 1986.

Stream, reach	Treatment: controls(CO), instream structure(IS)	Section	Percent gradient	Section width(m)		Section area(m^2)		Percent Habitat Type		
				Jul	Aug	Jul	Aug	pool, run	riffle	pocket water
Crooked River										
I	CO	Control 1	1.6	9.0	7.6	600	509	41.7	58.3	0
		Control 2	1.5	9.3	7.3	688	540	8.3	91.7	0
	IS	Sill Log A	1.8	8.0	8.4	573	594	91.7	8.3	0
		Sill Log B	1.2	7.3	6.3	540	465	91.7	8.3	0
		Boulder A	1.9	8.9	7.1	651	515	91.7	8.3	0
		Boulder B	1.5	9.5	7.8	927	769	66.7	33.3	0
II	CO	Control 1	1.0	9.9	8.1	790	651	66.7	33.3	0
		Control 2	0.9	10.6	10.6	1,110	1,113	88.3	16.7	0
	IS	Treatment 1	1.2	8.4	7.7	794	722	66.7	33.3	0
		Treatment 2	0.9	9.4	9.2	754	734	100.0	0	0
Red River										
II	CO	Control 1	2.1	8.0	6.7	473	398	0	0	100.0
		Control 2	1.2	10.3	9.4	1,032	938	0	0	100.0
	IS	Treatment 1	1.4	9.9	9.9	891	891	66.7	13.3	20.0
		Treatment 2	1.2	9.5	9.6	952	960	80.0	0	20.0
IV	CO	Control 1[a]	-	-	-	-	-	-	-	-
		Control 2	0.3	13.0	11.8	1,989	1,976	93.3	6.7	0
	IS	Treatment 1[a]	-	-	-	-	-	-	-	-
		Treatment 2	0.3	14.5	12.1	2,620	2,396	86.7	13.3	0

[a] Not sampled because treatment had not been applied.

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Table E13. Summary of physical habitat measurements (by percent) in treated and untreated sections, Crooked River and Red River, September 16-17, 1986.

Stream,			Depth(m)					Velocity (mps)					Substrate[b]				Embeddedness (%)				
reach	Treatment[a]	Section	< 0.2	0.2-0.4	0.5-0.7	0.8-1.0	≥ 1.1	< 0.3	0.3-0.5	0.6-0.8	0.9-1.1	≥ 1.2	S	G	R	B	< 5	5-25	25-50	50-75	> 75
Crooked River																					
I	CO	Control 1	41.7	58.3	0	0	0	50.0	41.7	8.3	0	0	10.0	31.7	35.8	22.5	75.0	8.3	0	8.3	8.3
		Control 2	50.0	50.0	0	0	0	25.0	50.0	16.7	8.3	0	10.8	41.7	43.3	4.2	58.3	41.7	0	0	0
	IS	Sill Log A	16.7	66.7	16.7	0	0	58.3	41.8	0	0	0	11.2	48.8	32.5	7.5	75.0	16.7	0	8.3	0
		Sill Log B	33.3	66.7	0	0	0	58.3	41.8	0	0	0	18.3	43.3	27.5	10.8	8.3	41.7	8.3	25.0	16.7
		Boulder A	25.0	75.0	0	0	0	58.3	33.3	8.3	0	0	17.5	32.5	42.5	7.5	41.7	33.3	0	25.0	0
		Boulder B	40.0	53.3	6.7	0	0	60.0	40.0	0	0	0	26.7	30.0	33.3	10.0	40.0	33.3	0	13.3	13.3
II	CO	Control 1	20.0	80.0	0	0	0	26.6	53.3	20.0	0	0	12.7	26.0	50.0	11.3	40.0	46.7	0	13.3	0
		Control 3	33.3	66.7	0	0	0	33.3	50.0	16.7	0	0	21.7	40.6	36.1	1.7	27.8	16.7	22.2	33.3	0
	IS	Treatment 1	33.3	66.7	0	0	0	40.0	53.3	6.7	0	0	16.0	36.0	33.3	14.7	46.7	20.0	0	26.7	6.7
		Treatment 2	6.7	86.7	6.7	0	0	73.3	20.0	6.7	0	0	33.3	25.3	34.7	6.7	33.3	6.7	0	13.3	46.7
Red River																					
II	CO	Control 1	11.1	88.9	0	0	0	44.4	44.4	11.1	0	0	27.2	6.1	32.2	34.4	22.2	22.2	11.1	33.3	11.1
		Control 2	46.7	53.3	0	0	0	26.7	60.0	13.3	0	0	26.3	7.7	27.3	38.0	6.7	6.7	0	46.7	40.0
	IS	Treatment 1	13.3	86.7	0	0	0	46.7	26.7	20.0	6.7	0	31.7	19.0	36.7	12.7	13.3	40.0	6.7	20.0	20.0
		Treatment 2	20.0	80.0	0	0	0	46.7	40.0	13.3	0	0	32.7	18.0	22.7	26.0	6.7	13.3	0	26.7	53.3
IV	CO	Control 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Control 2	6.7	53.3	40.0	0	0	66.7	33.3	0	0	0	49.7	14.3	34.0	2.0	0	13.3	0	26.7	60.0
	IS	Treatment 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Treatment 2	20.0	40.0	33.3	6.7	0	66.7	33.3	0	0	0	53.7	25.0	15.3	6.7	0	6.7	0	33.3	60.0

[a] CO = controls; IS = instream structures.

[b] S = sand; G = gravel; R = rubble; B = boulder.

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Table E14. Density (number/100m^2) by age-group of rainbow-steelhead and chiook in treated and untreated sections, and in off-channel ponds, Crooked River, July 14-18 and August 26-27, 1986.

		July							August						
		Rainbow-steelhead				Chinook		Adipose-clipped steelhead[a]	Rainbow-steelhead				Chinook		Adipose clipped steelhead[a]
Reach	Treatment section	0	1	2	≥ 3	0	I+		0	1	2	≥ 3	0	I+	
I	Control 1	14.3	5.5	0.2	0	12.2	0.2	16.5	4.3	7.1	0	0	19.4	0	6.5
	Control 2	10.2	14.4	0.4	0	10.2	0.7	7.4	2.2	6.7	0	0	9.4	0	6.7
	Structures														
	Sill Log A	14.1	5.9	0	0	17.8	0	47.3	5.6	2.4	0.5	0	28.1	0	12.3
	Sill Log B	3.7	3.5	0.9	0	2.0	0	60.9	5.0	4.7	0	0	8.4	0.2	26.0
	Boulder A	3.5	5.5	0.2	0.3	12.9	0.2	17.7	11.1	7.6	0	0	17.5	0.2	13.4
	Boulder B	5.6	5.7	0.5	0.1	19.0	0.2	19.0	3.6	5.7	0.1	0	15.6	0	14.2
	Connected Pond														
	Pond A	24.4	10.0	0	0	120.8	0	19.6	1.6	10.4	0.4	0	168.0	0	19.6
II	Control 1	18.1	11.5	1.5	0	31.4	0.1	1.6	7.2	6.0	2.2	0	16.0	0	0
	Control 2	6.5	12.8	1.2	0	29.8	0.4	0.2	9.7	8.0	0.3	0.1	18.8	0.1	0
	Structure 1	7.2	14.4	0.5	0.1	16.0	0.3	5.9	3.6	11.8	0.4	0	16.6	0	2.6
	Structure 2	8.4	12.6	1.1	0	21.9	1.9	3.7	6.8	16.2	1.2	0	22.8	0.4	3.5
	Connected Pond														
	Upper Pond	13.5	7.1	0.5	1.9	53.7	0	10.9	3.1	2.1	0.4	0.2	9.3	0	0.3
	Access 11	2.1	3.3	0.9	0	41.0	0	0	1.9	1.7	0	0	11.3	0.2	0
III-IV	Untreated														
	Natural	2.6	3.2	0.3	0	57.8	0.9	0	4.8	6.2	0.2	0	59.7	1.2	0
	Meander 1	3.6	4.8	0.4	0.9	93.4	1.2	0	5.5	6.4	0.4	0	77.4	1.0	0
	Meander 2	0.3	5.2	0.1	0	50.1	1.5	0	6.2	7.9	0.2	0	70.1	0.5	0

[a] Residualized steelhead from 1986 smolt releases.

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Table E15. Density (number/100m2) by age-group of rainbow-steelhead and chinook in treated and untreated sections and in connected side channels, Red River, July 16-17 and August 26-28, 1986.

		July						August					
	Treatment,	Rainbow-steelhead				Chinook		Rainbow-steelhead				Chinook	
Reach	section	0	1	2	≥ 3	0	I+	0	1	2	≥ 3	0	I+
II	Control 1	0	3.4	0.8	0.2	20.3	0.2	0	4.8	0.8	0	27.4	0
	Control 2	0.1	1.2	0.1	0	4.1	0	0	1.4	0	0	12.7	0
	Structure 1	0.1	2.5	0.7	0	31.6	0.8	0.1	4.9	0.8	0	42.3	0
	Structure 2	0	1.9	0.2	0.1	19.3	0.5	0	1.7	0.6	0	19.5	0.2
	Side Channel 1	0	0	0	0	61.9	0	0	0	0	0	0	0
	Side Channel 2	5.6	0.7	0	0	69.2	0	0	0	0	0	44.8	0
IV	Control 1[a]												
	Control 2	0.2	3.2	0.3	0	34.3	0.2	0.2	4.5	0.3	0	56.9	0.4
	Structure 1[a]												
	Structure 2	0.2	1.3	0.3	0	39.7	t	0.3	2.2	0.1	0	43.7	0.1
V	Control 1[a]												
	Control 2[b]							7.5	16.5	2.6	0	49.4	0.6
	Riparian 1[a]												
	Riparian 2[b]							1.6	10.9	0.5	0	15.1	0.1

a Not sampled because "treatment" sections remained untreated.

b No change apparent in aquatic habitat from riparian/bank stabilization work.

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Table E16. Analysis of variance summary for age-groups of rainbow-steelhead and chinook in sections that were treated or not treated with instream structures, Crooked River and Red River, July 14-18 and August 26-28, 1986.

		F(p>F)			
		Rainbow-steelhead			Chinook
Source of variation	df	age 0	age 1	age ≥ 1	age 0
Block (4 reaches)	3	23.21 (0.01)	5.67 (0.09)	7.69 (0.06)	7.86 (0.06)
Treatment (CO or IS)	1	1.72 (0.28)	0.03 (0.88)	0.05 (0.84)	0.13 (0.74)
Error(a):block*treatment	3				
Period (July or August)	1	2.60 (0.20)	0.25 (0.65)	0.36 (0.59)	1.30 (0.34)
Error(b):block*period	3				
Treatment*period	1	1.82 (0.19)	2.49 (0.13)	2.46 (0.13)	0.03 (0.86)
Error(c)	19				

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Table E17. Change in steelhead parr density and stream area (hectares) attributed to implemented projects from project evaluations, 1984-86.

Project type, stream	Year implemented	Steelhead Parr/100m2 (hectares) 1984	1985	1986	1987	1988
Barrier Removal - Complete						
Eldorado Creek	1984-85	-		4.4 (13.8)		
Barrier Removal - Partial[a]						
Crooked Fork Creek	1984-85	-		0.2 (11.2)		
Crooked River (culvert)	1984			5.7 (5.3)		
Pole Creek (screen)	1983		1.0 (2.9)			
South Fork tributaries	1986					
Off-Channel Developments						
Crooked River	1984-85	-	0.0 (0.02)	8.2 (0.08)		
Red River	1985			0.2 (0.05)		
Instream Structures						
Lo10 Creek	1983-84	-	1.8 (15.3)			
Upper Lochsa River	1983-84	0.0 (12.5)				
Crooked River	1984-85	-		0.0 (5.3)		
Red River	1983-85	-		0.0 (7.5)		

[a] Benefits from partial barrier removal projects to be calculated as a fraction of standing crop based on analysis of pre-project potential.

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Table E18. Change in chinook density and stream area (hectares) attributed to implemented projects from project evaluations, 1984-86.

	Year	Age 0 Chinook/100m2 (hectares)				
Project type, stream	implemented	1984	1985	1986	1987	1988
Barrier Removal - Complete						
Eldorado Creek	1984-85	-		27.1 (13.8)		
Crooked Fork Creek	1984-85	-		21.1 (11.2)		
Johnson Creek	1984-85	-		7.4 (34.7)		
Boulder Creek	1985			28.9 (9.7)		
Barrier Removal - Partial[a]						
Crooked River (culvert)	1984			16.4 (5.3)		
Pole Creek (screen)	1983		0.0 (2.4)	-		
Off-Channel Developments						
Crooked River	1984-85	-	6.7 (0.02)	88.0 (0.08)		
Red River	1985			44.0 (0.05)		
Instream Structures						
Lolo Creek	1983-84	-	0.0 (15.3)	-		
Upper Lochsa River	1983-84	0.0 (12.5)				
Crooked River	1984-85	-		0.0 (5.3)		
Red River	1983-85	-		0.0 (7.5)		

[a] Benefits from partial barrier removal to be calculated as a fraction of standing crop based on analysis of pre-project potential.

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APPENDIX F

A pretreatment projection of benefits (expressed in potential parr production) was made for a proposed project in Marsh Creek and Valley Creek to reduce cattle grazing impacts and sediment levels. Because this projection was based on assumed changes in sediment levels and manipulations of relationships between sediment and parr densities developed at low seeding, it must be considered preliminary.

The 1985 inventory of headwater streams in the upper Salmon River and Middle Fork Salmon River (OEA 1987a,b) defined pretreatment sediment levels and determined that sediment (% sand) in ungrazed reaches of the upper Salmon River averaged 73% of levels found in grazed reaches. This value was assumed to represent potential sediment reduction of the project.

Parr density and sediment data from low-gradient reaches of the upper Salmon and Middle Fork Salmon rivers (Figs. 5 and 6) were used in prediction equations. The upper 25th percentile of densities for both species were used as a subset to simulate rearing potential (Figs. Fl and F2).

Logistic equations of the form

DENSITY = k/(ltEXP(atbx))

where k = upper assymptote for density,

a and b = constants, and

x = proportion sand

were fit to the data subsets.

Parameter estimates were k = 39.4, a = -5.4, and b = 12.8 for chinook, and k = 4.2, a = -3.2, and b = 7.4 for steelhead. Values of k for both species were considered too low to represent full seeding densities in unsedimented, low-gradient habitat.

We adjusted the prediction equations by holding a and b constant and setting k = 110/100m2 for chinook and k = 10/100m2 for steelhead. These values were selected based on literature values (Sekulich 1980) and on maximum densities observed in low-gradient stream reaches from the Monitoring and Evaluation Project.

Potential increases in chinook and steelhead density were projected from the adjusted prediction equations based on the assumed reduction in sediment (Table Fl), and converted to increases in potential standing crop. The largest predicted increases in density coincide with the steeper portion of the prediction equations (Figs. Fl and F2).

Post-treatment evaluations will be necessary to estimate the actual sediment reduction, refine or develop new prediction equations at higher seeding levels, and test assumptions in the pretreatment projection.

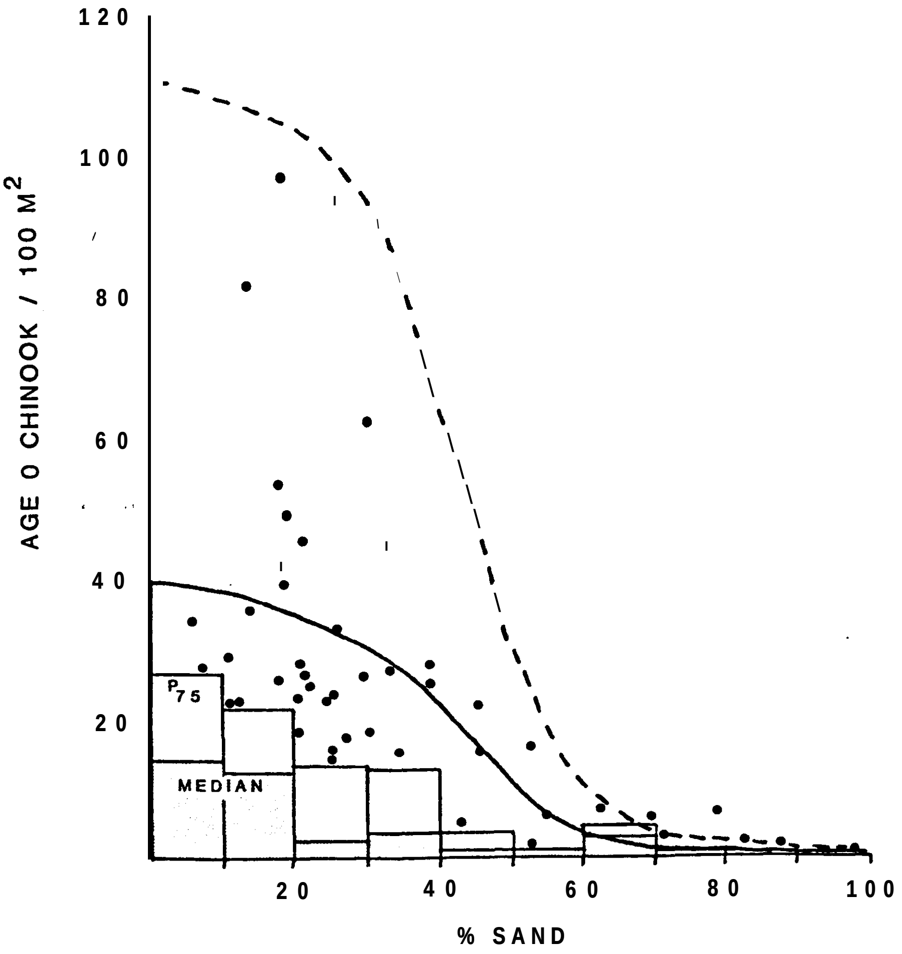

Figure F1. Projected response of chinook rearing density at full seeding to changes in sediment, low-gradient sections, upper Salmon and Middle Fork Salmon rivers, 1984-86. Solid line was fit to upper 25th'percentile of densities by logistic equation. Full seeding response (dashed line) was projected by setting k-110.

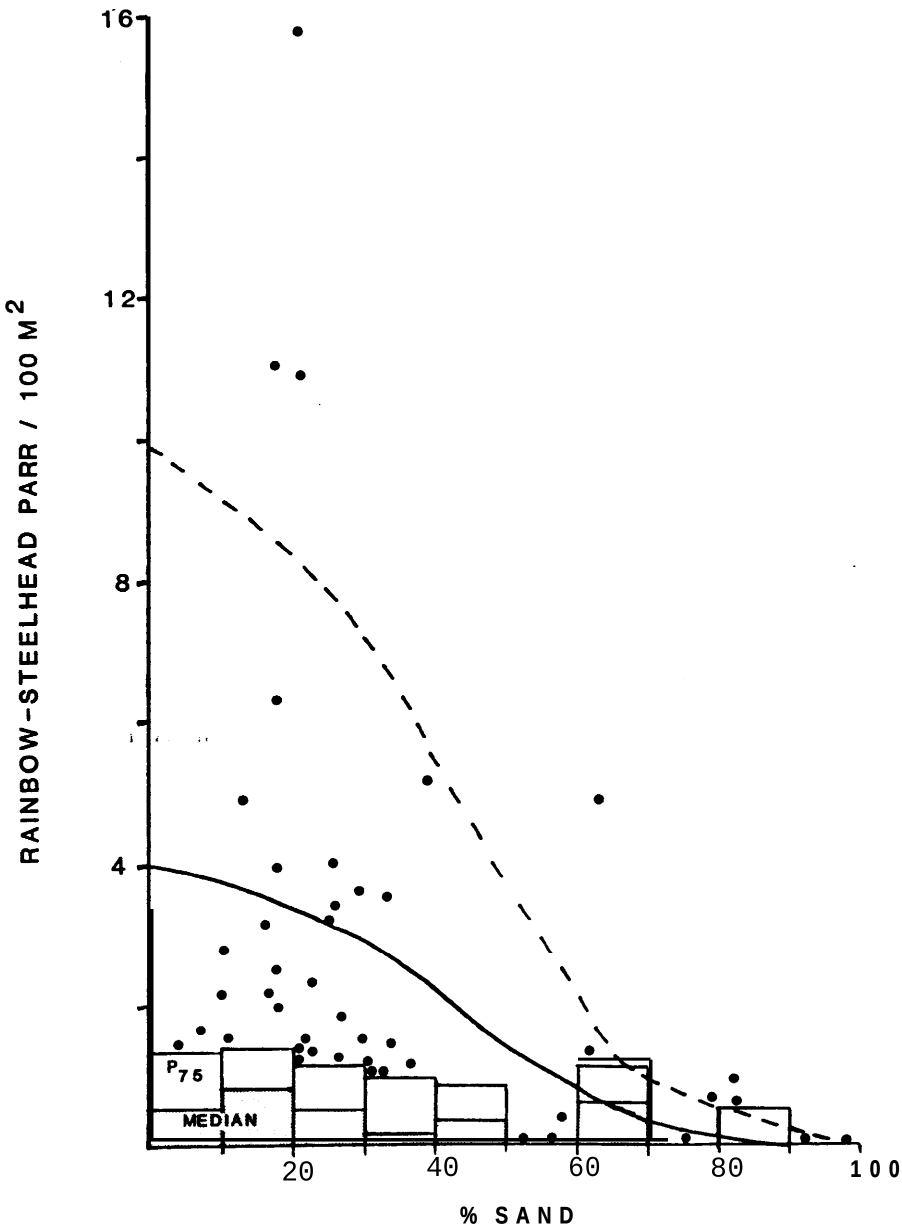

Figure F2. Projected response of rainbow-steelhead rearing density at full seeding to changes in sediment, low-gradient sections, upper Salmon and Middle Fork Salmon rivers, 1984-86. Solid line was fit to upper 25th percentile of densities by logistic equation. Full seeding response (dashed line) was projected by setting k = 10.

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Table F1. Projected increased parr production at full seeding due to proposed reduction in cattle grazing impacts and sedimentation.

		Percent Sand[a]		Reach	Projected increase[b]			
					Chinook		Steelhead	
Stream	Reach	1985	Projected	area(m^2)	Density	Standing crop	Density	Standing crop
Marsh Cr.	3	15.0	10.9	22,289	1.3	290	0.3	67
	4	19.0	13.8	19,275	2.5	482	0.4	77
	5	23.5	17.1	39,152	4.9	1,918	0.6	235
	6	55.5	40.3	31,393	44.8	14,064	2.7	848
Subtotal				112,109		16,754		1,227
Valley Cr.	1	36.5	26.5	97,973	22.7	22,240	1.5	1,470
	2	28.5	20.7	40,991	9.6	3,935	1.0	410
	3	26.0	18.9	76,707	6.9	5,293	0.8	614
	4	26.5	19.2	9,839	7.4	728	0.8	79
	5	25.0	18.1	15,332	6.1	935	0.7	107
	6	23.5	17.1	10,320	4.7	485	0.6	62
	7	38.5	27.9	49,258	26.9	13,250	1.7	837
Stanley Cr.	1	51.5	37.4	10,511	45.8	4,814	2.6	273
	2	95.0	69.0	7,272	3.4	247	1.0	73
Crooked Cr.		66.5	48.3	7,671	30.2	2,317	2.5	192
Trap Cr.	1	58.5	42.5	26,085	42.0	10,956	2.4	626
Elk Cr.	1	28.0	20.3	15,834	9.0	1,425	0.9	143
	3	64.0	46.4	36.025	34.2	12.321	2.6	937
Subtotal				403,818		78.946		5,823
Total				515,927		95,700		7,000

[a] Assumes a ratio of 0.73 for ungrazed (% sand): grazed (% sand) based on OEA (1987a,b).

[b] Assumes logistic response to sediment, with k = 110 for chinook and k = 10 for steelhead (see text

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