SALMON RIVER HABITAT ENHANCEMENT

Annual Report FY 1984

Prepared By

Dr. Richard C. Konopacky, Project Leader
Phillip J. Cernera, Project Biologist
Edward C. Bowles, Project Biologist
James M. Montgomery, Consulting Engineers, Inc.

of the

Shoshone - Bannock Tribes Fisheries Department
P.O. Box 306
Fort Hall, Idaho 83201

Prepared for

Larry B. Everson, Fish Biologist
Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, Oregon 97208

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PREFACE

This project, No. 83-359, was funded by the Bonneville Power Administration (BPA) under Contract No. DE-AI79-84BP14383.

This report has four volumes: a Tribal project annual report (Part 1) and three reports (Parts 2, 3, and 4) prepared for the Tribes by their engineering subcontractor, J.M. Montgomery, Consultant Engineers, Incorporated of Boise, Idaho. The Tribal project annual report contains reports for four subprojects within Project 83-359. Subproject I involved habitat and fish inventories (pretreatment during 1984 and 1985) in Bear Valley Creek, Valley County, Idaho that will be used to evaluate responses to ongoing habitat enhancement. Subproject II is the coordination/planning activities of the Project Leader in relation to other BPA-funded habitat enhancement projects that have or will occur within the traditional Treaty (Fort Bridger Treaty of 1868) fishing areas of the Shoshone-Bannock Tribes, Fort Hall Reservation, Idaho. Subproject III involved habitat and fish inventories (pretreatment) and habitat problem identification on the Yankee Fork of the Salmon River (including Jordan Creek). Subproject IV during 1985 involved habitat problem identification in the East Fork of the Salmon River and habitat and fish inventories (pretreatment) in Herd Creek, a tributary to the East Fork. J. M. Montgomery was charged with producing Part 2, a report entitled, "Biological Evaluation of the Northern Rocky Mountain Gray Wolf, Bear Valley Creek Fish Habitat Enhancement Project." Part 2 was necessary before any actual construction took place on Bear Valley Creek. Montgomery, as required by Tribal Contract, also submitted Part 3, a report entitled, "Construction Report, Bear Valley Creek Fish Habitat Enhancement Project." Montgomery was also contracted to complete a feasibility study (Part 4) on what could be done to enhance anadromous salmonid habitat on Herd Creek, a tributary to the East Fork of the Salmon River. Part 4 of the Annual Report is Montgomery's findings and recommendations and is entitled, "Feasibility Report, Herd Creek, Idaho: Fish Habitat Enhancement Project."

The format of this years Report has changed somewhat from the 1984 Report. Part I of the 1984 Report contained synopses of the following three Parts. All Parts of the 1985 Report are intended to stand alone and apart from the other volumes.

Copies of the Annual Report may be obtained from:

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife - PJ
P.O. Box 3621
Portland, OR 97208

SUBPROJECT I

Bear Valley Creek:

Inventory, 1984 and 1985

ABSTRACT

Fine sediments from a privately-owned (Bear Valley Minerals, Inc., Denver) inactive dredge mine (4.5 km) near the headwaters of Bear Valley Creek have covered spawning gravels and filled in rearing areas of chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Salmo gairdneri) in the stream from the mid-1950's to the present.

Pre-treatment (control erosion and sedimentation from mine) effects were evaluated by monitoring aquatic habitat and fish communities during 1984 and 1985. Physical (1 time/year) and biological (2 times/year) variables were measured in seven sites within each of seven strata along the length (55 km) of Bear Valley Creek. Fish data were collected via snorkel-observations, electrofishing and seining.

Minimum and maximum temperatures were similiar within a stratum between 1984 and 1985. Downstream strata had more degree-days during than upstream strata during 1985. Lower flows during 1985 caused significant differences in pool width within at least one stratum between 1984 and 1985. Riffle area, pool area, riparian cover, gradient, substrate fines, riffle fines, and pool embeddedness differed significantly among strata but not between 1984 and 1985. Maximum pool depth differed significantly among strata and was significantly deeper in 1985 than in 1984. Low flows (less erosion) allowed the stream to flush some fines out of some strata between 1984 and 1985.

Substrate aggradation was significantly higher in downstream strata while substrate degradation was significantly higher upstream (mine).

Age 0+ chinook salmon were the most abundant salmonid in 1984 while mountain whitefish (Prosopium Williamson) was the most abundant in 1985. Bear Valley Creek contained 18,100+4,093 age 0+ chinook salmon in August 1984 and 4,815+1,583 in August 1985. Redd counts in the stream were 55 in 1983 and 17 in 1984. Length, weight, and condition of age 0+ chinook salmon differed significantly in at least one stratum between 1984 and 1985. Densities of age 0+ chinook salmon, age 0+ and age 2+ steelhead/rainbow trout, age l+ and older bull trout (S. confluentus), and age 0+ and juvenile mountain whitefishdiffered significantly within at least one stratum between 1984 and 1985. Densities of age l+ chinook salmon, age l+ and age 2+ brook trout (S. fontinalis), age 0+ bull trout, and adult mountain whitefishdiffered significantly among strata but not between 1984 and 1985. Densities of age l+ steelhead/rainbow trout, and age 2+ and older cutthroat trout (S. clarki) differed significantly among strata and between 1984 and 1985.

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INTRODUCTION

Bear Valley Creek, a major tributary of the Middle Fork of the Salmon River, is a spawning and rearing stream for wild stocks of spring chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Salmo gairdneri). Past redd counts (Internal data, Idaho Department of Fish and Game) indicate Bear Valley Creek was the primary spawning stream for wild spring chinook salmon in the Salmon River, if not in the entire Columbia River system, Redd counts that exceeded one thousand per year in the mid-1950's declined to less than 60 per year during the early 1980's. Although verified as a steelhead spawning and rearing stream, extensive redd count data for the species does not exist.

Increased sedimentation in Bear Valley Creek has caused a general degradation of the aquatic habitat. Spawning riffles have been covered with layers of fine soils while rearing pools, important to salmon and steelhead trout up to and including the pre-smolt stage, have filled in with sand. Although other point and non-point sources may contribute sediment to the stream, an inactive placer mine (active during mid- and late-1950's) near the headwaters has deposited large amounts (over 500,000 cubic meters since late 1950's; Brian Liming, personal communication) of sediment into the stream. Bear Valley Creek has downcut 2 to 5 m through 2.3 km of unconsolidated overburden in the mine. Sediment recruitment from the mine has ranged from 600 to 1100 cubic meters per year during the past 11 years, predominately from side cutting into the mining overburden. However, an additional 200,000 to 400,000 cubic rneters of mining overburden has the potential of being added to the stream if a 5O- or l00-year water event should occur. Patented land below the mine (4.0 km), now owned by Bear Valley Minerals, Inc. of Denver, Colorado, still contains a large and very valuable ore body (euxenite (tantalum and columbium), thorium, and uranium). The strategic nature of the metals in the ore body and the Bear Valley deposit being the only deposit in the United States makes the ore body quite unique. Present and future mining of the ore body remains questionable because of the Idaho Dredge Mine Act and the Wild and Scenic Rivers Act although the intent of he mining company is to mine at some point in the future.

Members of the Shoshone-Bannock Indian Tribes have fished in Bear Valley Creek (guaranteed by the Fort Bridger Treaty of 1868) for salmon from aboriginal times to 1978. Since 1978, the Tribes have voluntarily ceased fishing in the stream as a conservation effort. Tribal members hope the declining wild stock will respond to the cessation of fishing with an increase in numbers. In addition, Idaho Department of Fish and Game considered Bear Valley Creek a "wild" stream which excluded the use of hatchery stocks to enhance the

chinook salmon stock. Thus, local harvest management by the Tribe and State (no harvest since 1977) was one method of protecting and enhancing the wild stock of spring chinook salmon in Bear Valley Creek during the late 1970's and early 1980's.

In 1982, the Northwest Power Planning Council: recognized the importance of protecting and enhancing wild stocks of spring chinook salmon and steelhead trout in Bear Valley Creek: identified sedimentation as a key problem in the stream: and, listed the stream as a candidate for a habitat improvement project in their Columbia River Basin Fish and Wildlife Program (Northwest Power Planning Council 1982). The Planning Council was aware of the Shoshone-Bannock's interests and treaty rights on the stream and instructed the Bonneville Power Administration (BPA) to fund the enhancement project on Bear Valley Creek with the Tribes as project sponsor. Tribal sponsorship and project funding by BPA was endorsed by all state and federal resource agencies interested in wild fish stocks and the stream. BPA funded the project as an offsite mitigation effort for impacts caused by Columbia and Snake river hydroelectric projects on anadromous fish stocks.

A number of non-Tribal entities have taken an active and interested role in the enhancement project. An Interagency Task Force composed of representatives of the Bonneville Power Administration, Idaho Fish and Game, Boise National Forest, Fish and Wildlife Service, and the Bureau of Land Management have given freely of advice, suggestions, and technical expertise in the planning, permitting, and coordination phases of the study. More specifically and since the private land is surrounded by the Lowman Ranger District, the ranger and his staff have been very helpful in giving the project a priority status. Bear Valley Minerals, Inc., the private landowner, heavily endorsed the project, has signed easements for the feasibility study and construction efforts, and has given of its employees and material resources in an effort to accelerate the enhancement. Lastly, ranchers grazing their cattle on the private land and adjoining Forest Service land have recommended the type of fence that will best protect the enhancement investment over time.

During 1984, a study was undertaken to determine the feasibility of rehabilitating anadromous salmonid habitat on patented land in upper Bear Valley Creek. The feasibility study determined which enhancement alternatives were available, which alternative was the most feasible after application of a set of criteria and preferred by all interested parties, and cost of the preferred alternative. During September through November 1985, enhancement efforts began on a reach of the stream within the mine that was diagnosed as having the greatest erosion problems.

Since sediment from the mine has affected fish habitat

downstream, an enhancement effort to eliminate a sediment source near the headwaters of the stream will have an effect, over time, on fish and their habitats below the mine. Associated with the implementation of an enhancement effort was a task designed to evaluate effects of enhancement or treatment on the habitat and fish community throughout Bear Valley Creek. The objective of this study was to make pre-treatment habitat and fish inventories during 1984 and 1985 that will be used to evaluate effects of habitat enhancement on the habitat and fish community in Bear Valley Creek over time.

STUDY AREA

Bear Valley Creek, located in Valley County, Idaho, joins with Marsh Creek to form the Middle Fork of the Salmon River (Fig. 1). Elk Creek is the largest tributary to Bear Valley Creek and is similar in size to Bear Valley Creek at their confluence. Other notable tributaries to Bear Valley Creek include Fir, Wyoming, Sack, Cache, and Casner creeks, none of which serve as substantial spawning or rearing areas for chinook salmon (Parkhurst 1950; Thurow 1985; Newberry and Corley 1984). Bear Valley Creek is a generally low to medium gradient system which flows through sub-alpine (1970 m mean elevation) meadows and lodgepole pine (Pinus contorta) forests in a granitic batholith. Alluvial deposits of highly erosive sandy soils characterize the region.

Bear Valley Creek (54.5 km long) is located on Boise National Forest (48.2 km) and private patented (6.3 km) lands. Salmonid habitat enhancement on the stream in this project will be limited to 638 ha of patented land (Bear Valley Minerals, Inc., portions of Sections 10, 15, and 22, Township 11 North, Range 8 East, Boise Meridian) near the headwaters of the stream. Effects of the proposed habitat enhancement are being evaluated on the entire length of Bear Valley Creek.

In the past, Bear Valley Creek provided spawning sites for a large number (1085 redds in 1956; Internal Report, Idaho Department of Fish and Game) of spring chinook salmon. A number of reasons, i.e. sedimentation of habitat, passage at Columbia River dams, have caused redd counts to decline from lOOO+ redds per year to less than 85 redds per year since the mid-1950's (Fig. 2). In addition to providing spawning sites, Bear Valley Creek is an important rearing stream for juvenile chinook salmon up to the pre-smolt stage. Other fish species present in Bear Valley Creek include steelhead/rainbow trout (S. gairdneri) , brook trout (Salvelinus fontinalis) bull trout (S. confluentus) , cutthroat trout (S. clarki) mountain whitefish (Prosopium williamsoni) , and shorthand sculpin (Cottus confusus) .

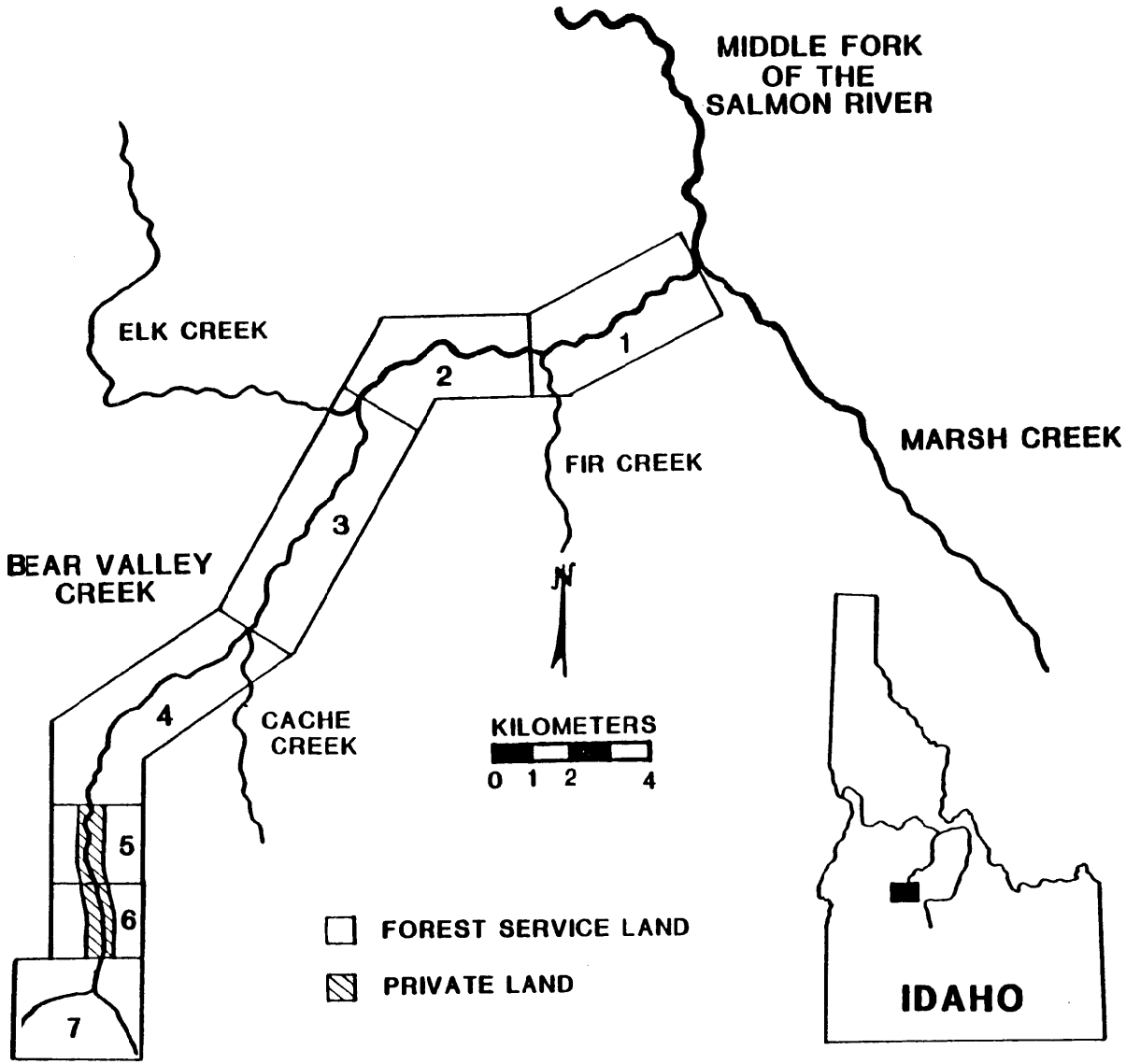


Figure 1. Bear Valley Creek. Idaho, study area nd strata location.

Figure 2. Counts of spring chinook salmon redds in Bear Valley Creek, Idaho, 1951-1985. Pre-1960 counts were made by walking the stream while counts in later years were made from the air. Counts with asterisks above them were made by Tribal biologists.

METHODS

Variables

Habitat and biological variables were collected during 1984 and 1985 (pre-treatment) to evaluate habitat enhancement of the patented land on upper Bear Valley Creek and subsequent effects on upstream (if any) and downstream areas. Habitat variables measured were: water temperature, flow, riffle area, pool area, stream width, pool depth, gradient, embeddedness of pool substrate, several measures of riffle substrate, pool riparian cover, and channel substrate aggradation/degradation (Table 1). Biological variables measured were: species composition, relative abundance and densities of salmonid species, and length and weight of age 0+ chinook salmon (Table 1). Condition of age 0+ chinook salmon was calculated from length and weight data. Tribal biologists counted chinook salmon redds in the stream during the fourth week of August.

Chinook salmon and steelhead trout utilize Bear Valley Creek for spawning and rearing purposes. Collection of evaluation data for chinook salmon (age 0+ and 1+ fish) was emphasized, however, because: chinook salmon comprised most of the fish in Bear Valley Creek; past studies and redd counts on the stream for chinook salmon; a paucity of existing information for steelhead trout on Bear Valley Creek, and the difficulty in distinguishing between juvenile steelhead and rainbow trout.

Variable Measurement

Stream length (km; total and by strata) was determined from 7.5 minute series topographic maps (U.S. Geological Survey).

Water temperature (C) was monitored with a thermograph in each stratum between 30 June and 27 September 1985 in all strata most of the time. Equipment failure caused a loss of data in some strata in some weeks during the summer. Total degree-days (1C x 24 hours) and temperature maximums and minimums were estimated for each stratum from thermograph tapes. During 1984, temperature was monitored with two Taylor maximum-minimum thermometers between 8 August and 23 September in each stratum (lower and upper ends). Water temperature extremes were recorded for each stratum in August and September.

Water velocities (m/second) and depth (m) were measured at one cross-section in eachstrata with a Marsh-McBirney flow meter and meter rod, respectively, to determine flows (m^3/second). Each cross section was located mid-strata in a run or tail of a pool.

Surface areas of riffles and pools were calculated from

Table 1. Habitat and biological variables monitored in Bear Valley Creek, Idaho during 1984 and 1985.

Habitat	Biological (Fish)
Temperature	Species composition
Flow (discharge)	Relative abundance
Surface area	Density
Stream width	Population number
Stream depth	Fish length
Stream gradient	Fish weight
Riparian cover	Fish condition
Stream substrate (5 types)	Chinook redd count
Channel aggradation/degradation	

length and width measurements. Mean length (m) of riffles and pools were determined with tape measures or pacing each stream bank. Mean width (m) of riffles and pools were determined from a minimum of four systematic width measurements (water edge to water edge) in each riffle and pool, respectively. Maximum depth (m) was recorded in each width cross-section with a marked wading staff.

Riparian cover (cm) in pools was measured on each stream bank at a minimum of four systematically determined locations per bank. Riparian cover represented the extent to which shoreline vegetation (<90 cm height above water surface) and streambank extended over the water column. Riparian cover was analyzed as absolute or real cover (amount measured) extending over a pool from both banks and as a percent of stream width in a pool.

Percent of pool substrate that were fines (sand, silt, clay) was estimated visually. Larger substrate particles were assumed present at some depth but embedded by surface fines.

Riffle substrate particle sizes (mm) were measured at 25 equidistant points in each of three cross-sections (at the l/4, l/2, and 3/4 intervals of the riffle length) on a riffle. Size measurements were categorized into phi particle size-classes from which size-frequency distributions were determined.

Stream gradient (%) was determined by measuring the change in water surface elevation on a 61 m section of stream near each site. Elevations were measured with a Wild auto level and Philadelphia rod.

Permanent cross sections, selected systematically within each stratum, were used to collect stream profile data for sedimenation/erosion rates, Cross sections were marked with 0.6 m rebar (benchmark) on each bank 0.5 m or more from the stream channel. Channel profile and water level were mapped using a Wild auto level, Philadelphia rod and tape measure (Fig.3). A minimum of 12 measurements were made between rebar stakes. Annual aggradation/degradation rates (m3/yr) for the riparian zone, stream zone (B-C-E-F-B polygon in Fig. 3), and total stream channel (riparian zone plus stream zone) were estimated from 1985 and 1984 data. In Figure 3, the left (A-B-F-LBB-A polygon) and right (C-D-RBB-E-C polygon) riparian zone were summed to create the riparian rate. Riparian, stream, and channel rates or areas from 1984 were subtracted from rates in 1985 and resulted in positive (aggradation) or negative (degradation) values. Volume rates (m3/yr) for each stratum were calculated using stratum lengths (m) as a multiplier.

Fish were counted and ages (0+, l+, and 2+ and older based on length) estimated of all salmonid species in each riffle-pool sequence by underwater snorkel observations. Chinook salmon were differentiated into two groups: age 0+ fish and age l+ residualized males. Steelhead trout (which

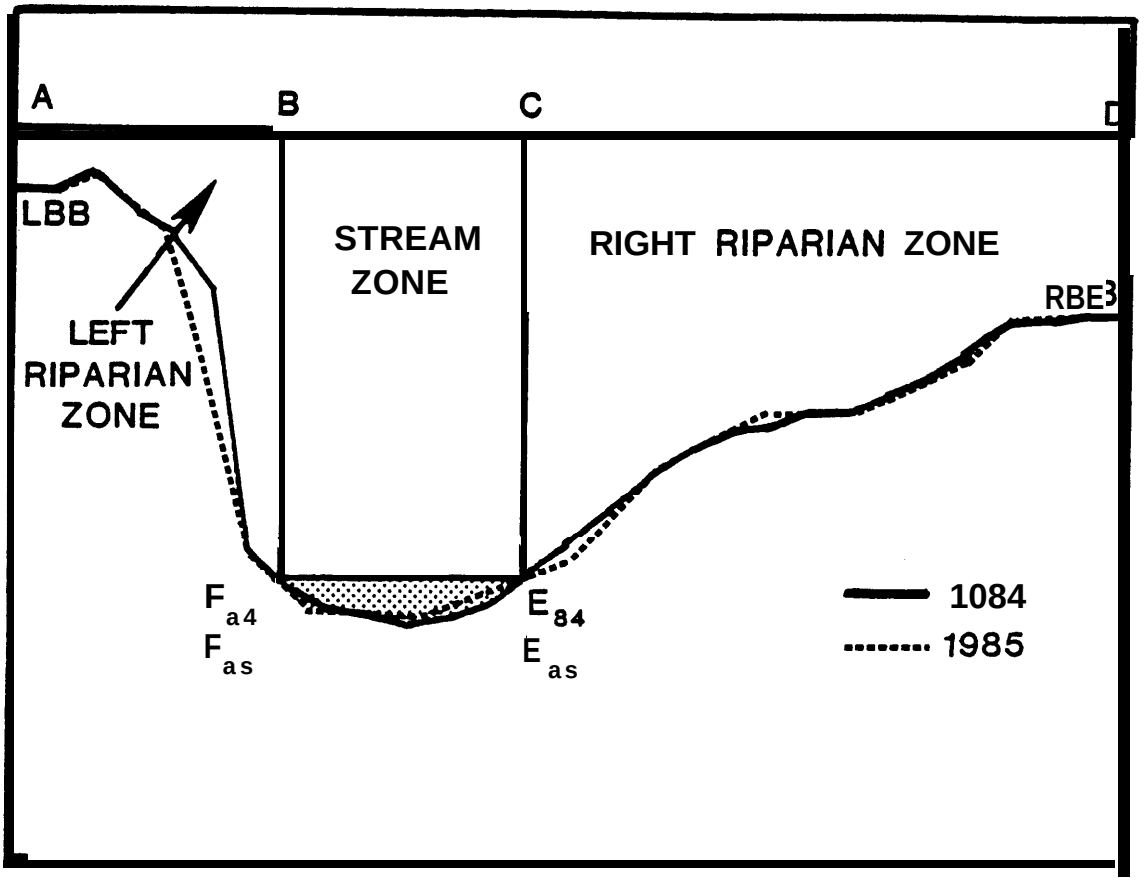


Figure 3. Typical stream channel cross-section measured to detect the amount of substrate aggradation or degradation in the stream channel of Bear Valley Creek, Idaho between 1985 and 1984. LBB=left bank benchmark; RBB=right bank benchmark; F84=left bank low water mark in 1984; E85=right bank low water mark in 1985; A-B-F84-LBB-A-polygon= area of left riparian zone in 1984 (to be subtracted from the area of A-B-F85-LBB-A in 1985).

were indistinguishable from rainbow trout) and brook trout were each separated into three groups: age 0+, age l+ and age 2+ and older fish. Bull trout were differentiated into age 0+ and age 1+ and older fish. Cutthroat trout were noted but only considered as adults. Adult sea-run chinook salmon and shorthead sculpin were noted but not included in any analyses. Thus; a total of 14 species by age-class categories were defined for analyses. Relative abundance (%) was calculated as the number of fish in each class divided by the total number of fish present multiplied by 100. Density (number of fish/m pool) of each species class was calculated as the abundance of fish in each size-class divided by pool area.

Lengths (mm) and weights (+0.0l g) of 5 to 21 age 0+ chinook salmon, collected via electrofishing (DC) and/or seining (10 mm mesh), were measured in each site of each stratum. Salt was used to increase water conductivity and enhance electrofishing efficiency. Collected fish were anesthesized with MS-222 prior to measurement. Condition of age 0+ chinook salmon was calculated using length and weight data (Carlander 1979).

Redd counts were made on 23 August 1985 by two counters from a Bell bubble-type helicopter flown by a pilot. Airspeed was held below 20 km/hr. The two counts (83 and 87 redds) were averaged for the year. Photographs (Fig. 4) of many redds were taken.

Experimental Design

Variables were measured in one riffle-pool sequence (experimental unit) at seven systematically determined sites (replicates) within each of seven strata (plots) (Fig. 1). Stratification was based on stream size, valley width, gradient, land use, and land ownership (Table 2).

Habitat variables were measured once (early August) and biological variables twice (July and August during 1985; August and September during 1984) (Tables 3 and 4). Biological variables were compared in August between 1984 and 1985 and between July and August In 1985. Combining the data for July and August 1985 with August and September 1984 would have resulted in an unbalanced data set that would have had the same number of degrees of freedom in error terms as the analyses used.

In addition, a comparable sampling scheme (split plot in time or repeated measure) will be utilized during 1986 and subsequent years with sampling taking place during July and August, July sampling will be utilized because out-migration of age 0+ chinook salmon occur in early September. During post-treatment evaluations, the hypothesis of interest for habitat variables will be the interaction of stratum between, and later among, years; for biological variables, the years x stratum x times interaction will be the hypothesis of

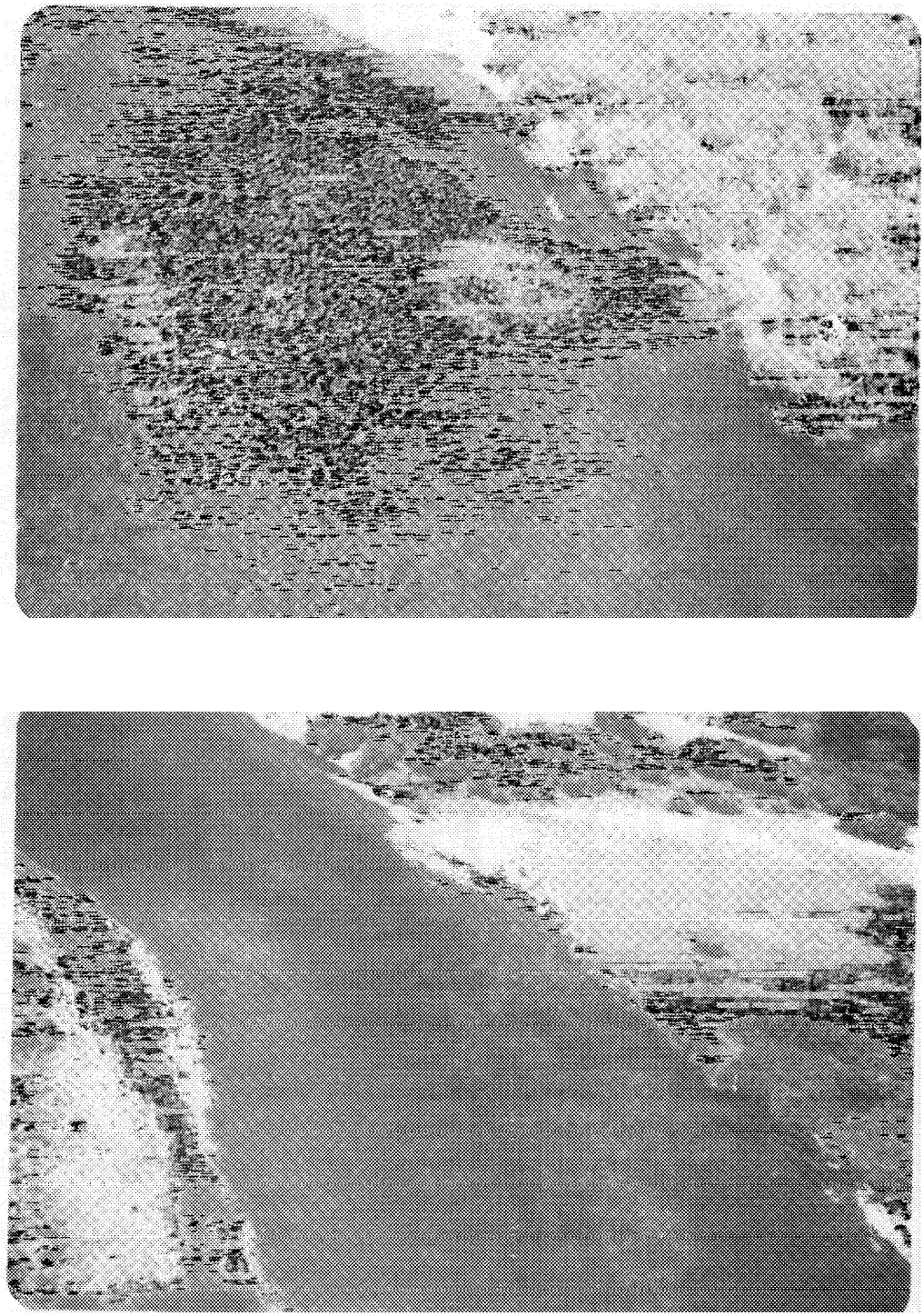


Figure 4. Redds of spring chinook salmon in stratum 2 (upper) and stratum 3 (lower) in Bear Valley Creek, Idaho during August 1985.

Table 2. Strata characteristics, Bear Valley Creek, Idaho.

Stratum	Length	Gradient	Land type	Land ownership	Land use
la	7.7[b]	Medium	Narrow, forested valley	USFS[c]	Non-consumptive
2	11.1	Low	Wide valley, meadow/forest	USFS	Grazing[d]
3	12.7	Low	Wide valley, meadow/forest	USFS	Grazing
4	11.2	Low	Wide valley, meadow/forest	USFS	Grazing
5	4.0	Low	Wide valley, meadow	BVM	Grazing
6	2.3	Medium	Wide valley, mine/meadow	BVM[e]	Mined (1950's)
7[f]	5.5	High	Narrow forested valley	USFS	Grazing, logging

[a] stream mouth.
[b] kilometers.
[c] U.S. Forest Service, Boise National Forest.
[d] three-year rest-rotation, two on and one off.
[e] Bear Valley Minerals, Inc., Denver, Colorado.
[f] stream headwaters.

Table 3. Experimental designs, used in 1984, 1985, and proposed for 1986, for sampling habitat variables on Bear Valley Creek, Idaho.

Source	Degrees of freedom
1984	
7 Strata	6
7 Sites (Stratum), Error A	42
TOTAL	48
1985	
7 Strata	6
7 Sites (Stratum), Error A	42
2 Years	1
Years x strata	6
Error B	42
TOTAL	97
1986	
7 Strata	6
7 Sites (Stratum), Error A	42
3 Years	2
Years x strata	12
Error B	84
TOTAL	146

Table 4. Experimental designs, used in 1984, 1985, and proposed for 1986, for sampling biological variables on Bear Valley Creek, Idaho.

Source	Degrees of freedom
1984	
7 Strata	6
7 Replicates (Stratum), Error A	42
2 Times per year	1
Times x strata	6
Error B	42
TOTAL	97
1985	
7 Strata	6
7 Replicates (Stratum), Error A	42
2 Times per year	1
Times x strata	6
Error B	42
TOTAL	97
AND	
7 Strata	6
7 Replicates (Stratum)	42
2 Years	1
Years x strata	6
Error B	42
TOTAL	97
1986	
7 Strata	6
7 Sites (Stratum), Error A	42
2 Times per year	1
Times x strata	6
Sites x times (Stratum), Error B	42
3 Years	2
Years x strata	12
Years x times	2
Years x times x strata	12
Error C	168
TOTAL	293

interest in later years.

Unless otherwise stated, main effect hypotheses were analyzed through a one-way analysis of variance (alpha=0.05) using a Statistical Analysis System (SAS) computer package (Helwig and Council 1979). Specific differences among strata were determined with Duncan's New Multiple Range Test (Ott 1977). Riffle substrate particle size distributions were compared between strata within a year and within a stratum between years with the chi-square goodness-of-fit test (SAS). Significant interaction hypotheses required the calculation of least significant difference (LSD) (Steele and Torrie 1960) to delineate differences between/among and within interaction terms. Normality and homogeneity of variance were tested and appropriately monotonically transformed, when necessary, prior to using parametric statistics (Helwig and Council 1979).

RESULTS

Variables in the habitat inventory of Bear Valley Creek, Idaho were measured once in early August (unless otherwise noted) both in 1984 and 1985 and were compared among strata, between years, and among strata within/between years. Variables in the biological or fish inventory were measured twice a year, in early August and early September in 1984 and in early July and early August in 1985. Variables were compared among strata, between July and August 1985, and among/between strata in July and August 1985. Variables were also compared among strata, between August 1984 and August 1985, and among/between strata in August 1984 and August 1985.

Habitat Inventory

Water temperature ranged from 5.0 to 20C during July, 0.0 to 19.OC in August, and 0.0 to 16C in September (Table 5). Minimum temperatures among strata ranged from 5.0 to 11C in July, 0.0 to 9.7C in August, and from 0.0 to lO.OC in September. Maximum temperatures among strata ranged from 11.0 to 20.0 in July, 11.0 to 19.OC in August, and 9.0 to 16.OC in September. Maximum and minimum temperatures were very similar within strata between 1984 and 1985.

Degree-days (C x 24 hours) ranged from 112 in stratum 7 to 214 in stratum 2 between 7 and 20 July (only dates when all thermographs were working) (Fig. 5). Degree-days ranged from 203 in stratum 7 to 382 in stratum 2 between 7 and 20 July plus 4 to 17 August (insufficient data in stratum 4). Strata 1, 2, and 3 consistently had more degree-days than strata 4, 5, 6, and 7 throughout July, August, and September (Fig. 6). Stratum 7 had only 8 degree-days during the week of 21-27 September.

September flows ranged from 2.86 m3/sec in stratum 1 to 0.12 m3/sec in stratum 7 and decreased exponentially from downstream to upstream strata (Fig. 7A). Flows were lower in all strata (Fig. 7A) and for the stream proper during 1985 than during 1984 (Fig. 7B).

Riffle area differed ($F=68.5$; $P<0.000l$) among strata but not ($F=l.l$, $P=0.3062$) between 1984 and 1985. Riffle area ranged from 6 to 2194 m2 among strata (Fig. 8A) and was 450 m2 and 507 m2 in 1984 and 1985, respectively (Fig. 8B). Riffle area did not differ significantly among strata 3, 4, 5, 6, and 7. Riffle area was significantly larger in stratum 1 than in the other strata and in strata 2 than in strata 3, 4, 5, 6, or 7.

Pool area differed ($F=44.8$, $P<0.000l$) among strata but not ($F=1.8$, $P=0.1290$) between 1984 and 1985. Pool area ranged from 40 to 1737 m2 among strata (Fig. 8C) and was 677

Table 5. Water temperature (C) extremes by month and stratum in Bear Valley Creek, Idaho from 8 August to 23 September 1984 and 1 July to 30 September 1985.

	July		August		September	
Stratum	1984	1985	1984	1985	1984	1985
1		9.0-16.0		9.7-12.0	3.3-12.8	10.0-12.0
2		11.0-17.5	9.4-18.9	9.0-16.5	3.9-17.2	4.0-14.0
3		10.0-20.0	5.6-15.0	6.0-18.5	0.5-15.6	2.0-15.2
4		11.0-16.0		3.5-19.0	0.0-16.7	-
5		6.0-20.0	2.2-17.8	0.0-16.7	3.5-19.0	-
6		6.0-19.0	3.3-16.7	3.5-19.0	0.0-15.0	3.5-16.0
7		5.0-11.0	3.3-12.8	4.0-11.0	0.0-12.2	o.o- 9.0

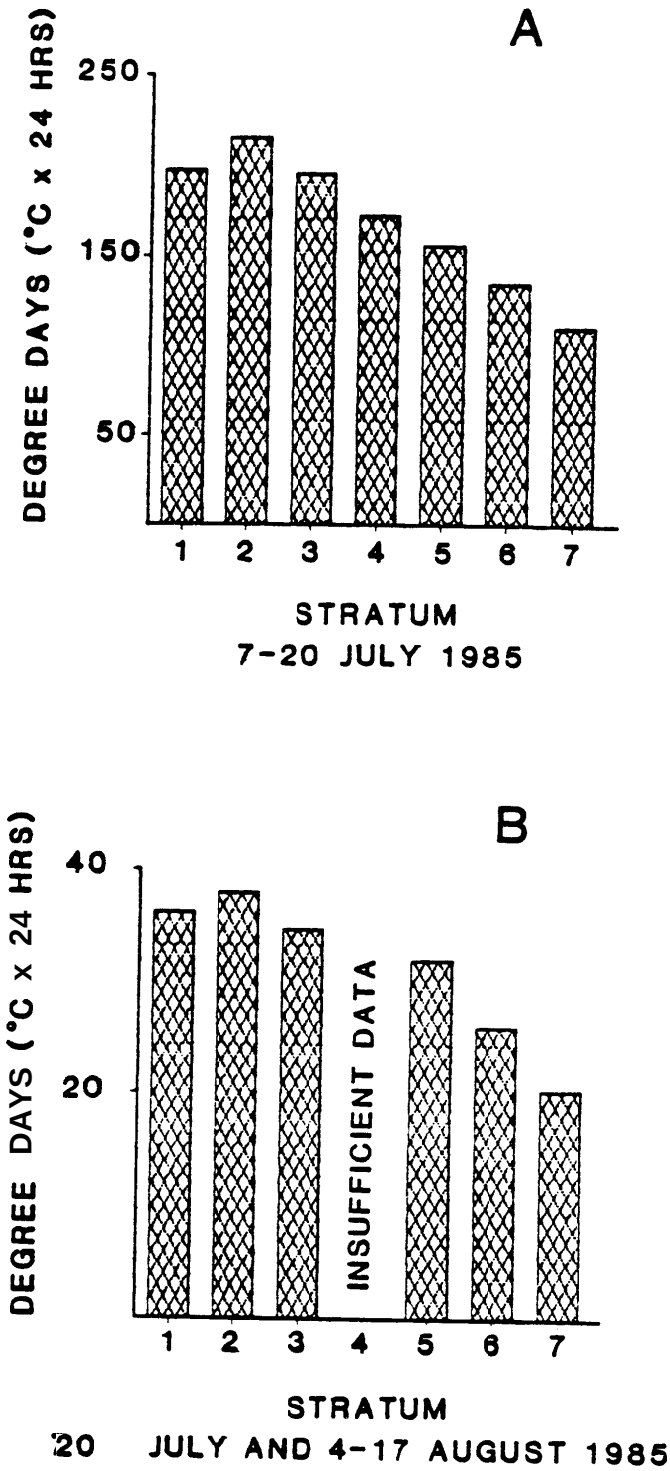


Figure 5. Degree-days during the periods of 7 to 20 July 1985 (A) and 7 to 20 July and 4 to 17 August 1985 in strata of Bear Valley Creek, Idaho.

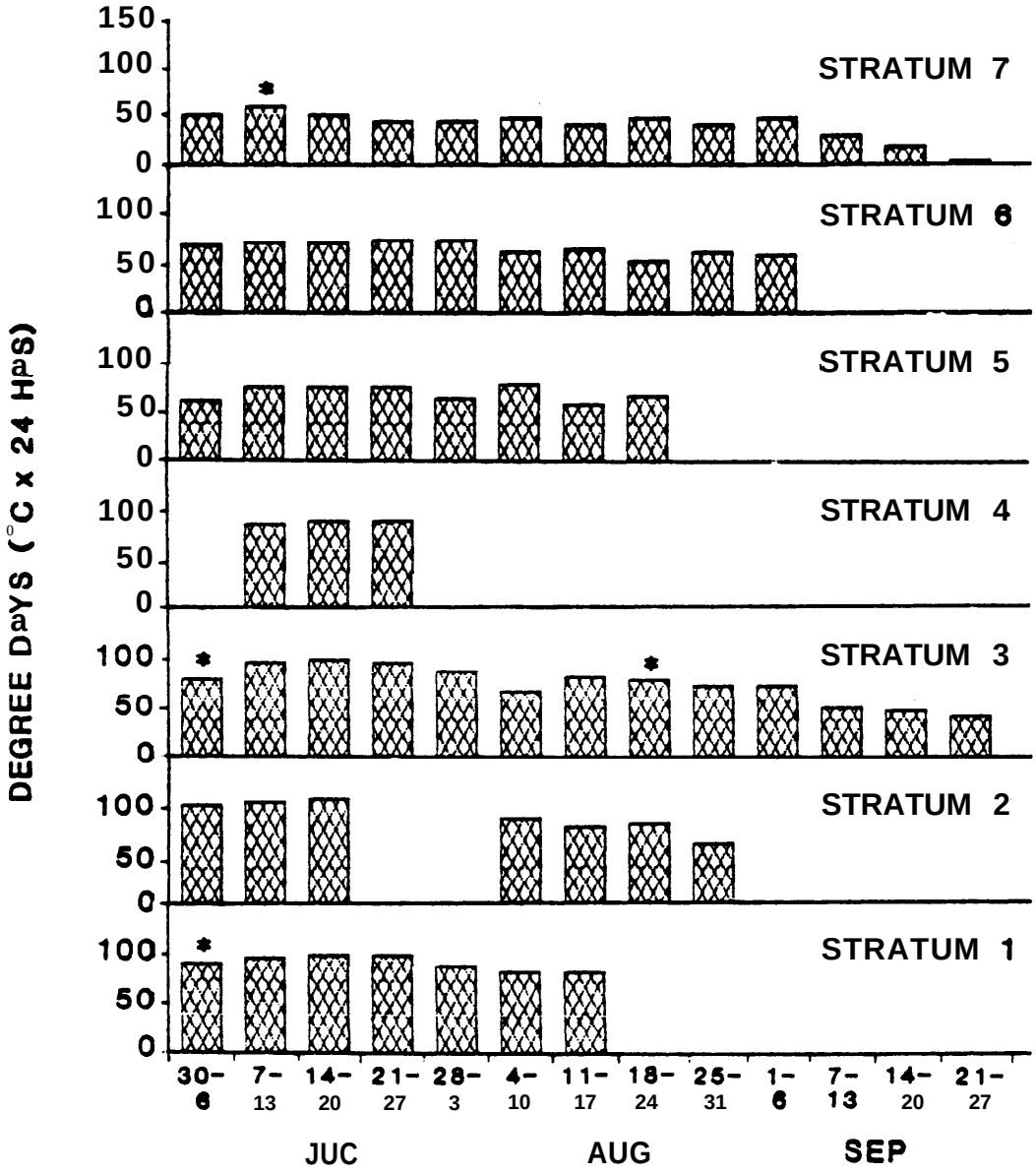


Figure 6. Degree-days during the weeks of July, August, and September 1985 in strata of Bear Valley Creek, Idaho.

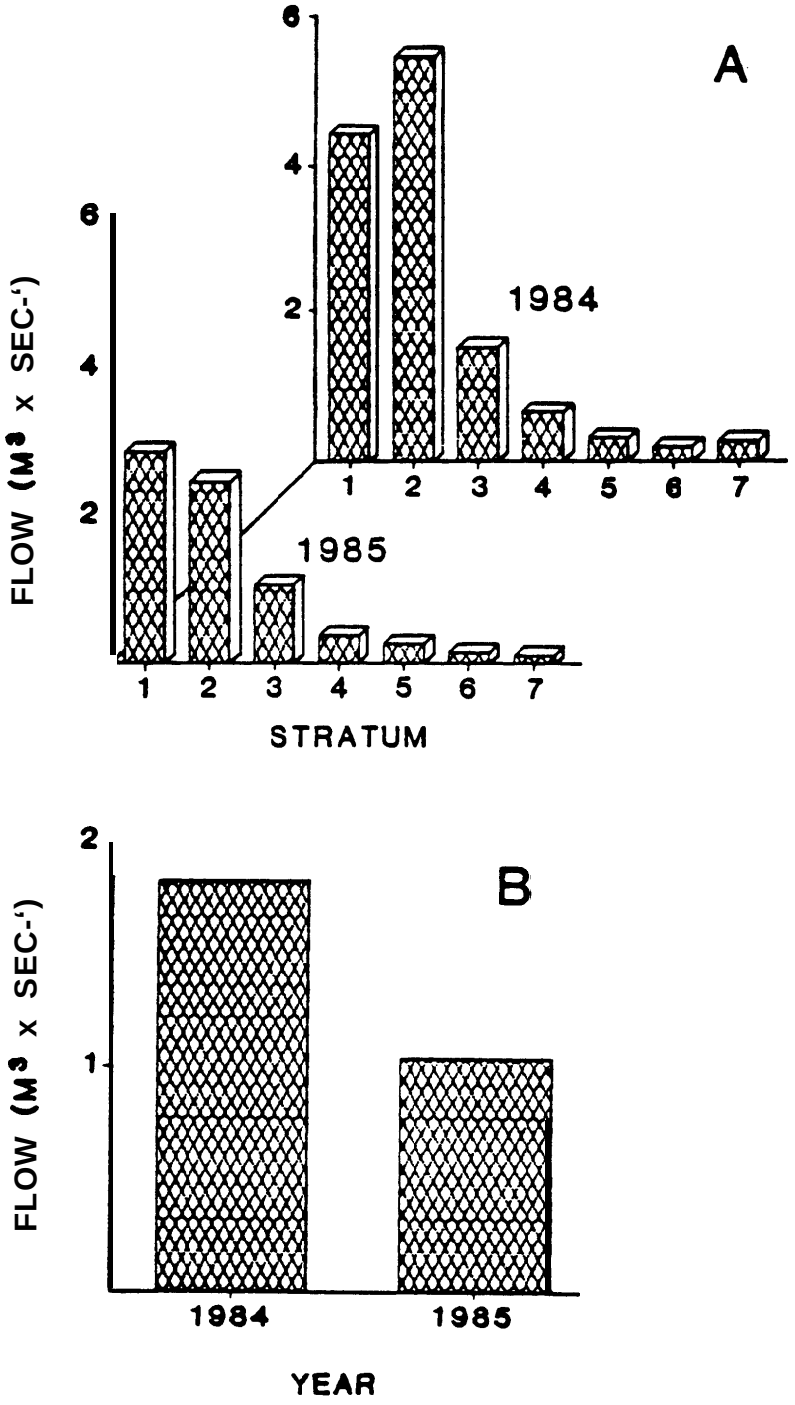


Figure 7. Flow, by stratum (A) and for the entire stream B, in Bear Valley Creek, Idaho during early September 1984 and 1985.

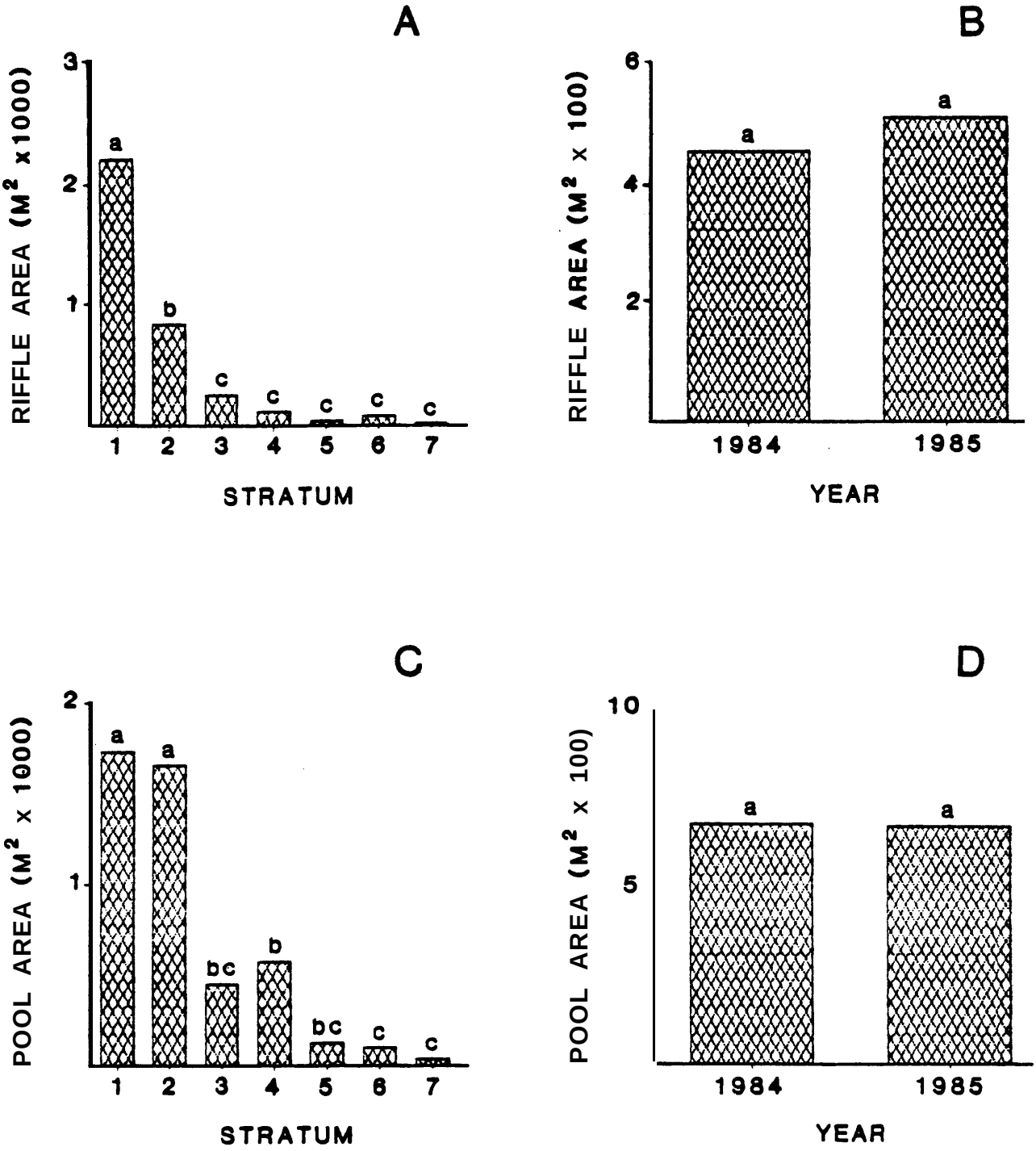


Figure 8. Mean (n=7 per stratum/year) area of riffles among strata (A) and between 1986 and 1985 (B). Mean area of pools among strata (C) and between 1984 and 1985. All areas from Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

m and 671 m2 in 1984 and 1985, respectively (Fig. SD). Pool area did not differ significantly in strata 1 and 2, strata 3, 4, and 5, or strata 3, 5, 6, and 7. Riffle area was significantly larger in stratum 1 and 2 than in the other strata and in stratum 4 than in strata 3, 5, 6, or 7.

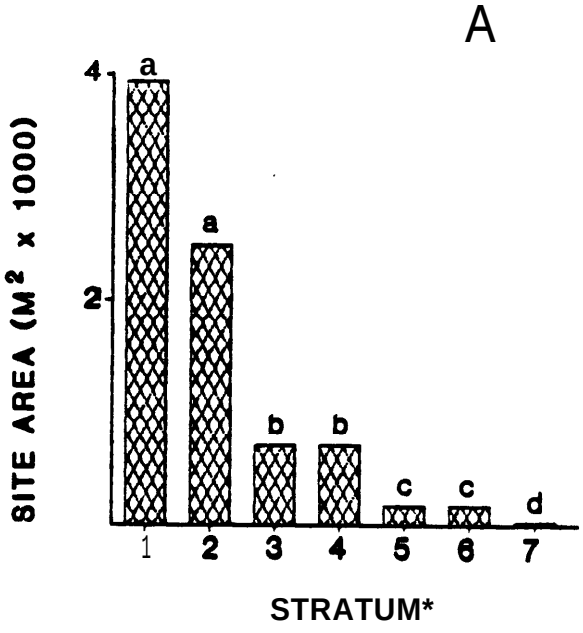
Site area (riffle plus pool) differed (F=44.8, P<O.OOOl) among strata but not (F=3.1, P=O.O85l) between 1984 and 1985. Site area ranged from 46 to 3931 m among strata (Fig. 9A) and was 1127 and 1180 m in 1984 and 1985, respectively (Fig 9B). Site area did not differ significantly between strata 1 and 2, strata 3 and 4, or strata S and 6. Site area was significantly larger in strata 1 and 2 than in the other strata, in strata 3 and 4 than in strata 5, 6, or 7, and in strata 5 and 6 than in strata 7.

Pool width differed (F=3.1, P=O.O129) among strata between 1984 and 1985 (interaction). Pool width ranged from 2.7 to 21.0 m in 1984 and from 2.6 to 21.0 m in 1985 (Fig. 10A). In 1984, pool width did not differ significantly between strata 1 and 2; strata 3 and 4; or strata 5 or 6. Pool width was significantly larger in strata 1 and 2 than in the other strata, in strata 3 and 4 than in 5 and 6, and in strata 5 and 6 than in stratum 7. In 1985, pool width did not differ significantly between strata 1 and 2, or strata 5 and 6 in 1985. Pool width was significantly larger in strata 1 and 2 than in the other strata, in stratum 3 than in stratum 4, 5, 6, or 7, in stratum 4 than in strata 5, 6, or 7, and in strata S and 6 than in stratum 7. No stratum differed in pool width between 1984 and 1985.

Maximum pool depth differed (F=16.4, P<O.OOOl) among strata and (F=6.25, P=O.O1164) between 1984 and 1985. Pool depth ranged from 0.38 to 1.32 m among strata (Fig. 10B) and was 0.8 m and 0.9 m in 1984 and 1985, respectively (Fig. 1OC). Pool depth did not differ significantly between strata 1 and 2, strata 4 and 6, or in strata 6 and 7. Pool depth was significantly greater in strata 1 and 2 than in the other strata, in stratum 5 than in strata 3, 4, 6, or 7, in stratum 3 than in strata 4, 6, or 7, and in stratum 4 than in stratum 7.

Riparian cover over pools, expressed as real or measured cover, differed (F=2.8, P=O.O230) among strata but did not differ (F=3.3, P=O.O749) between 1984 and 1985. Measured riparian cover ranged from 39 to 101 cm among strata (Fig. 1lA) and was 60 and 67 cm in 1984 and 1985, respectively (Fig. 11 B). Riparian cover did not differ significantly between strata 1 and 7, strata 1 and 4, strata 3 and 4, strata 2 and 5, or strata 2 and 6. Riparian cover was significantly greater in strata 1 and 7 than in strata 2, 3, 5, or 6, in strata 1 and 4 than in strata 2, 5, or 6, in strata 3 and‘ 4 than in strata 2, 5, or 6, and in stratum S than in stratum 6.

Riparian cover over pools, expressed as a percent of pool width, differed (F=2.8, P=O.O240) among strata but did



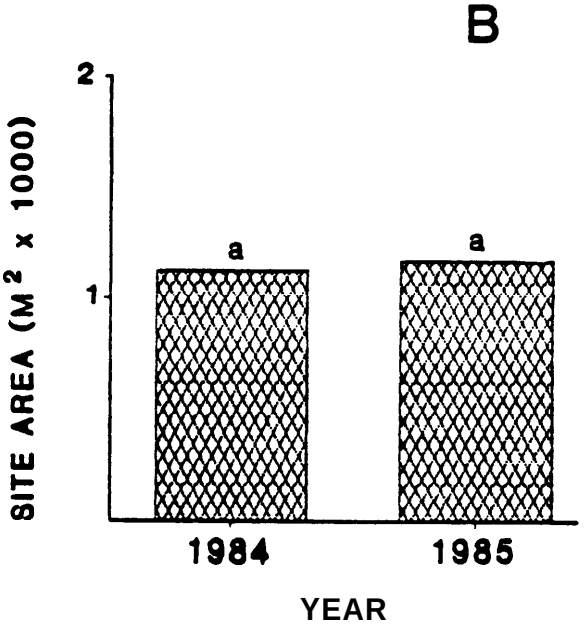


Figure 9. Mean (n-7 per stratum per year) area of riffle-pools of sites among strata (A) and between 1984 and 1985 (B) in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means within each method of measurement.

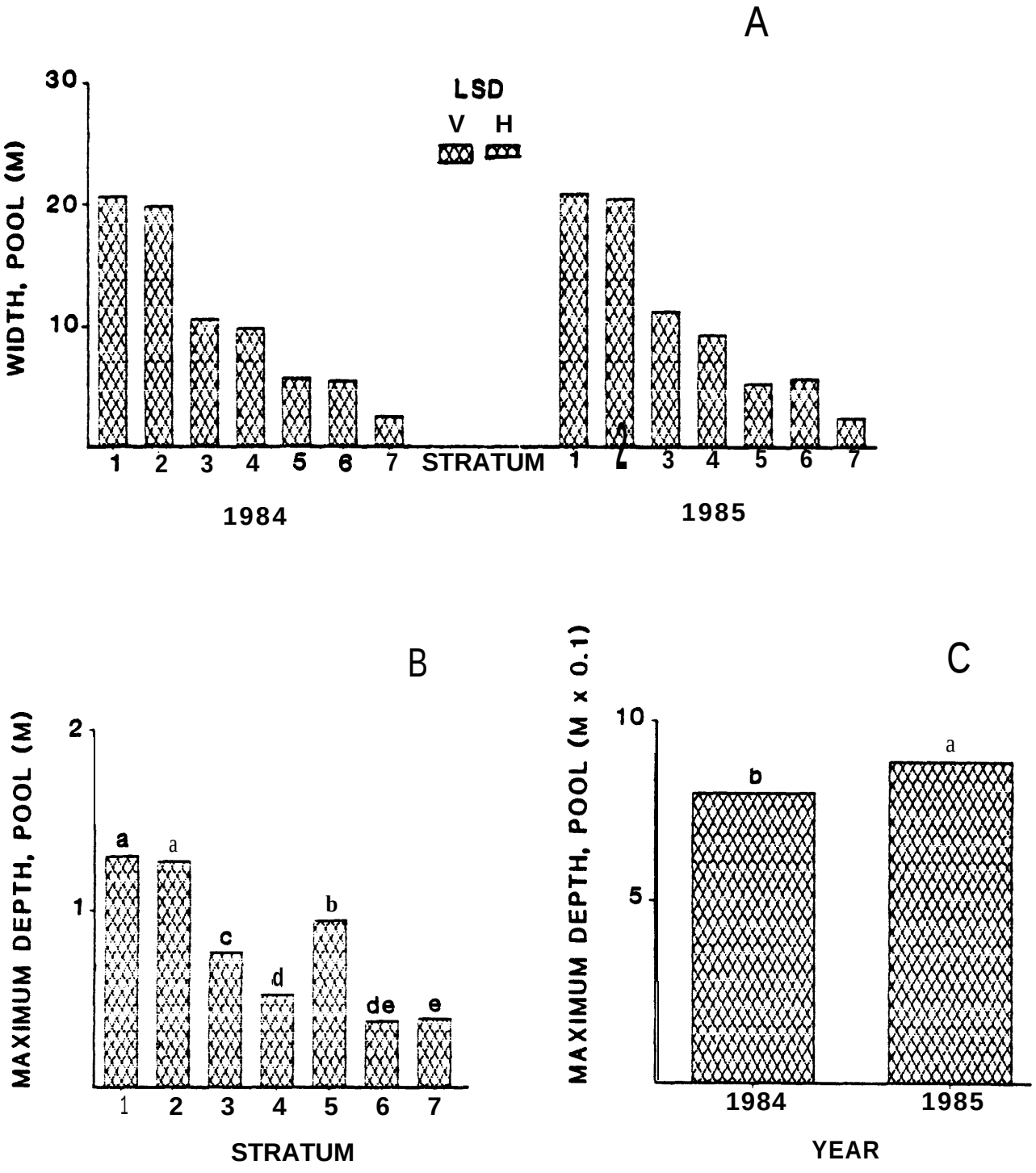


Figure 10. Mean (n=7 per stratum per year) pool width in strata between 1984 and 1985 (A). Mean maximum depth of pools among strata (B) and between 1984 and 1985 (a). All measurements from Bear Valley Creek, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means. A common letter above means indicate a non-significant ($P > 0.05$) difference among strata means.

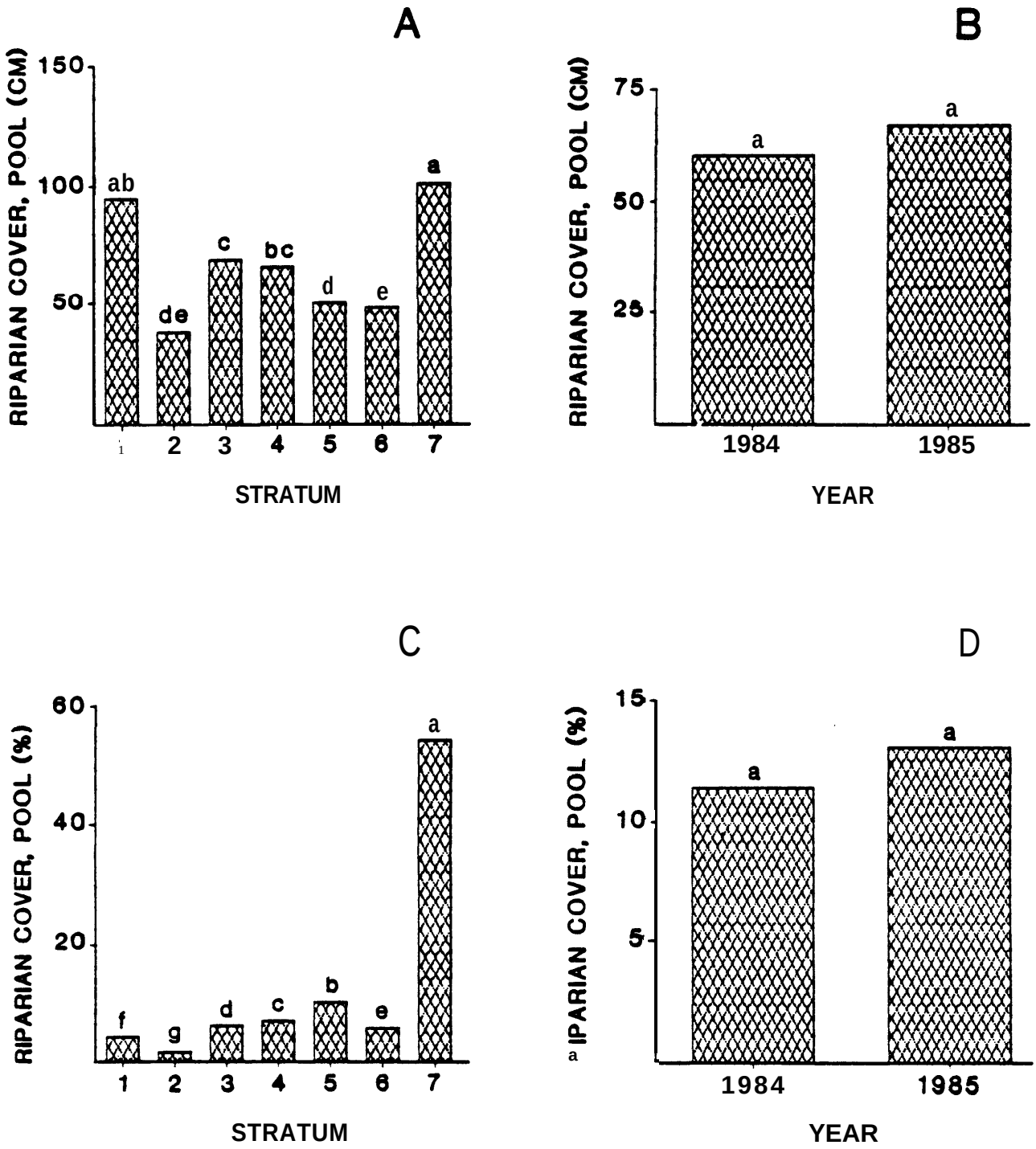


Figure 11. Mean (n=7 per stratum/year) amount of measured riparian cover among strata (A) and between 1986 and 1985 (B). Mean amount of riparian cover, expressed as a percent of pool width, among strata (c) and between 1984 and 1985. All areas from Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

not differ (F=3.4, P=0.0750) between 1984 and 1985. Percent riparian cover ranged from 2.1 to 54.3% among strata (Fig. 11C) and was 11.4 and 13.1% in 1984 and 1985, respectively (Fig. 11D). Percent riparian cover was significantly greater in stratum 7 than in all other strata, in stratum 5 than in strata 1, 2, 3, 4, or 6, in stratum 4 than in strata 1, 2, 3, or 6, in stratum 3 than in strata 1, 2, or 6, in stratum 6 than in strata 1 or 2, and in stratum 1 than in stratum 2.

Gradient differed (F=26.2, P<0.0001) among strata but did not differ (F=0.01, P=0.9281) between 1984 and 1985. Gradient ranged from 0.14 to 1.37% among strata (Fig. 12A) and was 0.50 and 0.49 in 1984 and 1985, respectively (Fig. 12B). Gradient did not differ significantly between strata 1 and 6, strata 4 and 5, or strata 2 and 5. Gradient was significantly larger in stratum 7 than in other strata, in strata 1 and 6 than in strata 2, 3, 4, or 5, in stratum 3 than in strata 2, 4, or 5, and in stratum 4 than in stratum 2.

Size-frequency (%) distributions of riffle substrate particles differed (Q=1257, P<0.0001) among strata within 1985 and within 1984. All pairs of strata substrate distribution differed significantly within 1984 and 1985 (Figs. 13A and 13B). Substrate distributions differed within strata 2, 5, and 6 between 1984 and 1985. Between 1984 and 1985 in stratum 2, particle size ranges 1 to 1 mm, 4 to 8 mm, and 8 to 16 mm decreased while 16 to 32 mm and 32 to 64 mm increased, in stratum 5, particle size ranges 2 to 16 mm decreased and 16 to 64 mm increased, and in stratum 6 particle size ranges 0 to 1 mm decreased while 1 to 1 mm, 8 to 16 mm, and 32 to 64 mm increased.

Percent of riffle substrate particles less than or equal to 4 mm or 8 mm in diameter differed (F=11.2, P<0.0001; F=12.6, P<0.0001, respectively) among strata but did not differ (F=1.6, P=0.2072; F=2.4, P=0.1266, respectively) between 1984 and 1985. Percent riffle particles less than 4 mm in diameter ranged from 0.94% to 25.3% among strata (Fig. 14A) and were 14.9% and 12.7% in 1984 and 1985, respectively (Fig. 14B). Percent riffle particles less than 8mm in diameter ranged from 3.9 to 39.4% among strata (Fig. 14C) and were 20.5 and 22.2% in 1984 and 1985, respectively (Fig. 14D). Percent riffle particles less than 4 mm or 8 mm in diameter did not differ significantly in strata 4 and 5, in strata 2, 5, and 6, or in strata 3 and 7. Percent riffle particles less than 4 mm or 8mm in diameter were significantly larger in strata 4 than in strata 1, 2, 3, 6, or 7, in strata 2 and 6 than in strata 1, 3, or 7, and in strata 3 and 7 than in stratum 1.

Percent of larger riffle substrate covered with colloidal silt differed (F=4.43 P=0.0015) among strata (first year measured was 1985). Percent of riffle substrate covered by silt ranged from 0.0 to 9.2% among strata (Fig. 15A). Percent of riffle substrate covered by silt did not differ

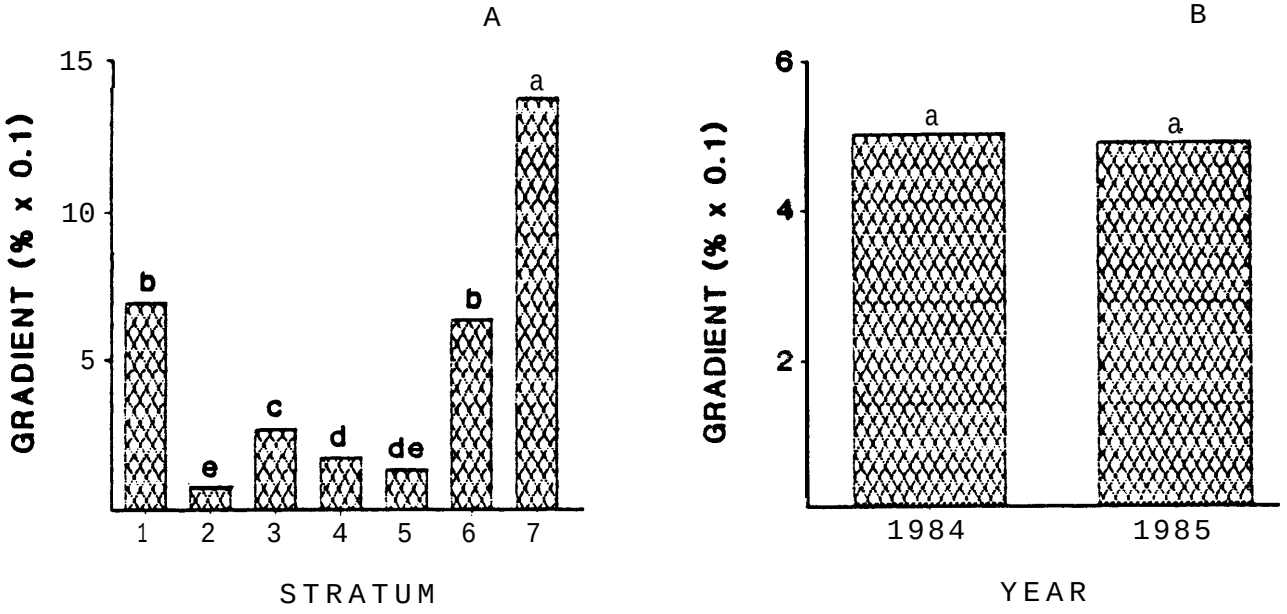


Figure 12. Mean (n=7 per stratum per year) gradient among strata (A) and between 1984 and 1985 (B) in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means within each method of measurement.

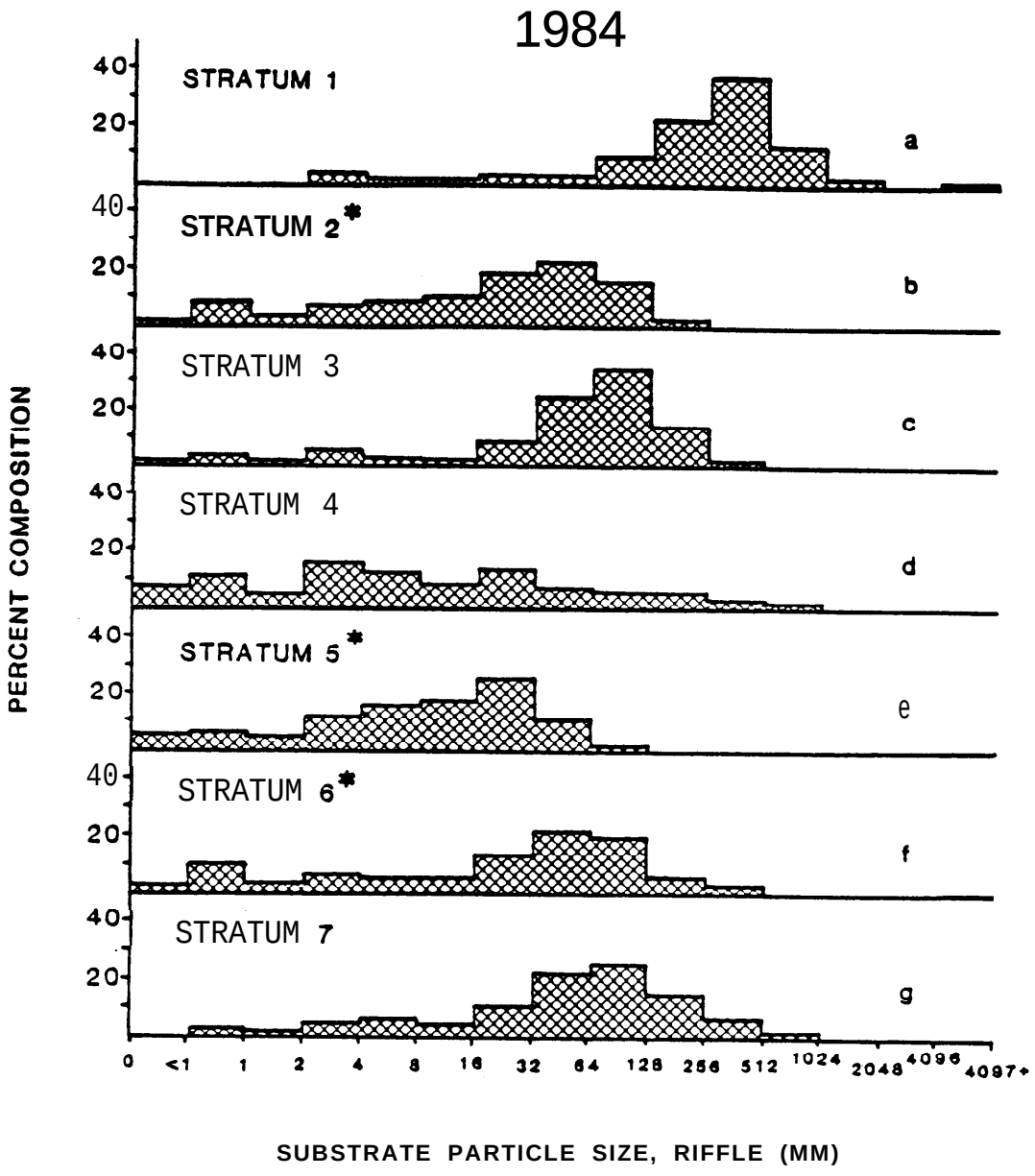


Figure 13A. Mean (n=7 per stratum) distributions of substrate particle sizes in riffles by stratum, Bear Valley Creek, Idaho, 1984. A common letter next to distributions indicate a non-significant (P>0.05) difference between distributions. An asterisk connotes a significant (P<0.05) difference in that stratum between 1984 and 1985.

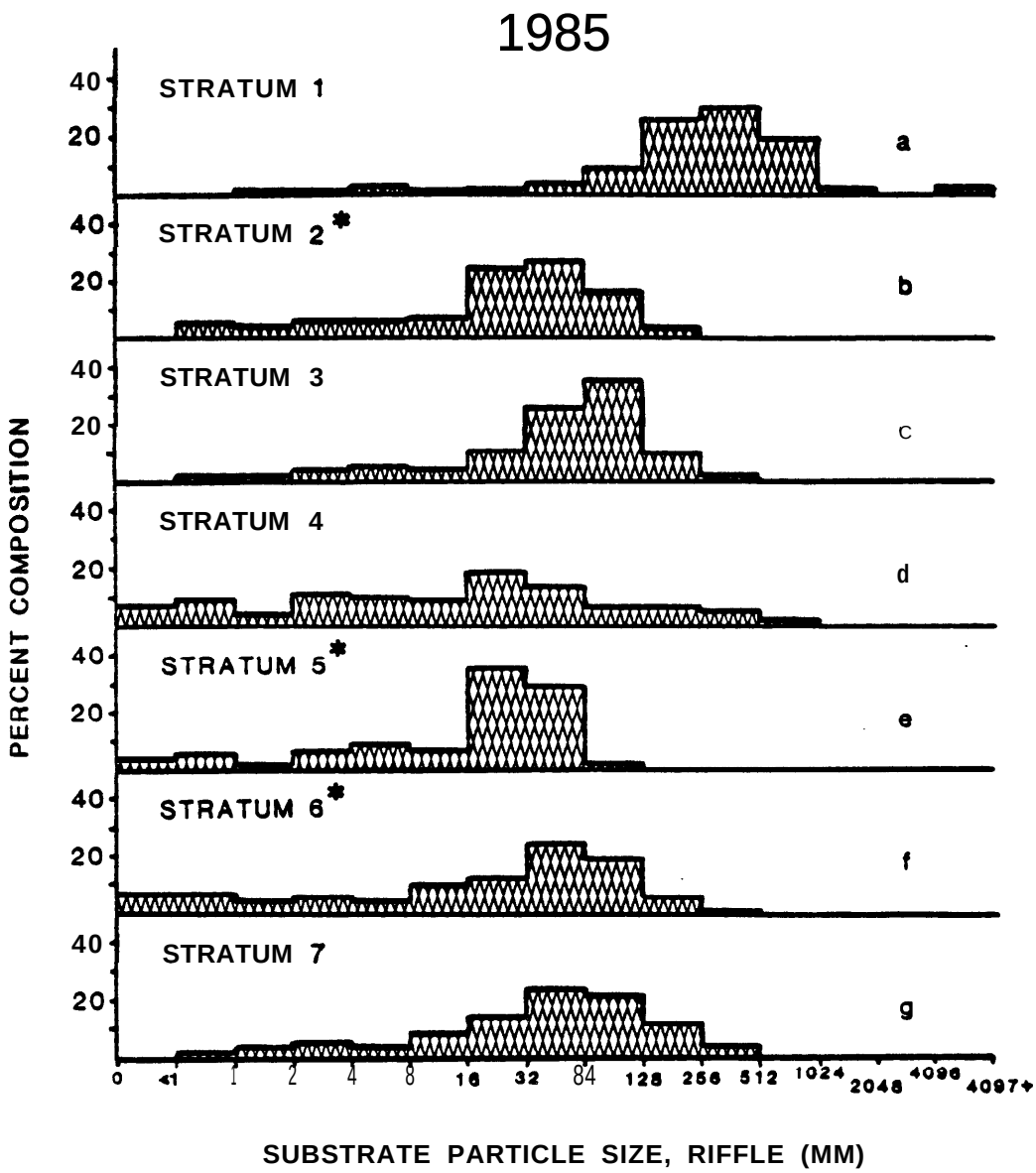


Figure 13B. Mean (n=7 per stratum) distributions of substrate particle sizes in riffles by stratum, Bear Valley Creek, Idaho, 1984. A common letter next to distributions indicate a non-significant (P>0.05) difference between distributions. An asterisk connotes a significant (P<0.05) difference in that stratum between 1984 and 1985.

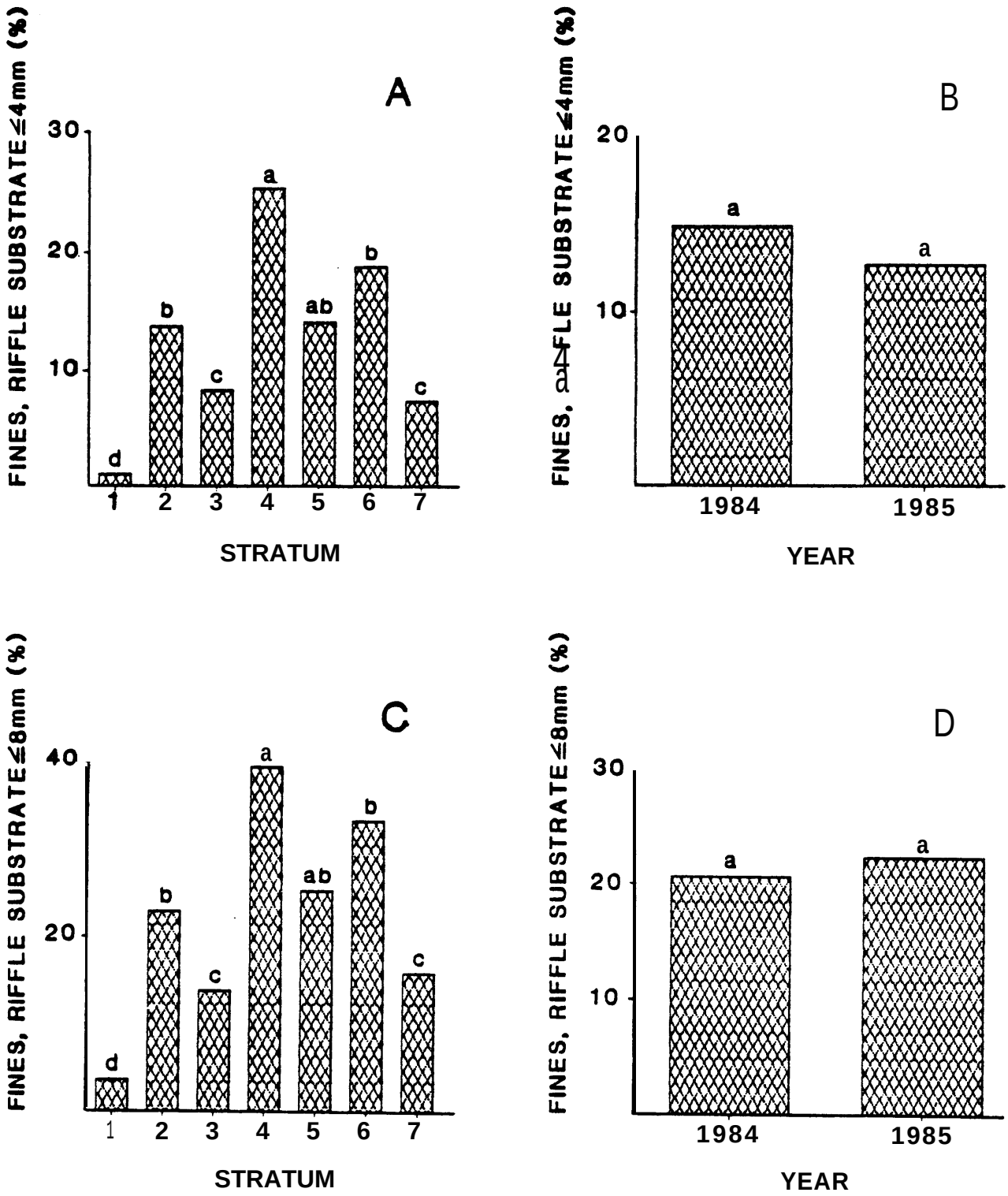


Figure 14. Mean (n=7 per stratum/year) percentage of fines in a riffle less than 4 mm diameter among strata (A) and between 1984 and 1985 (B). Mean percentage of fines in a riffle less than 8 mm diameter among strata (C) and between 1984 and 1985. All areas from Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

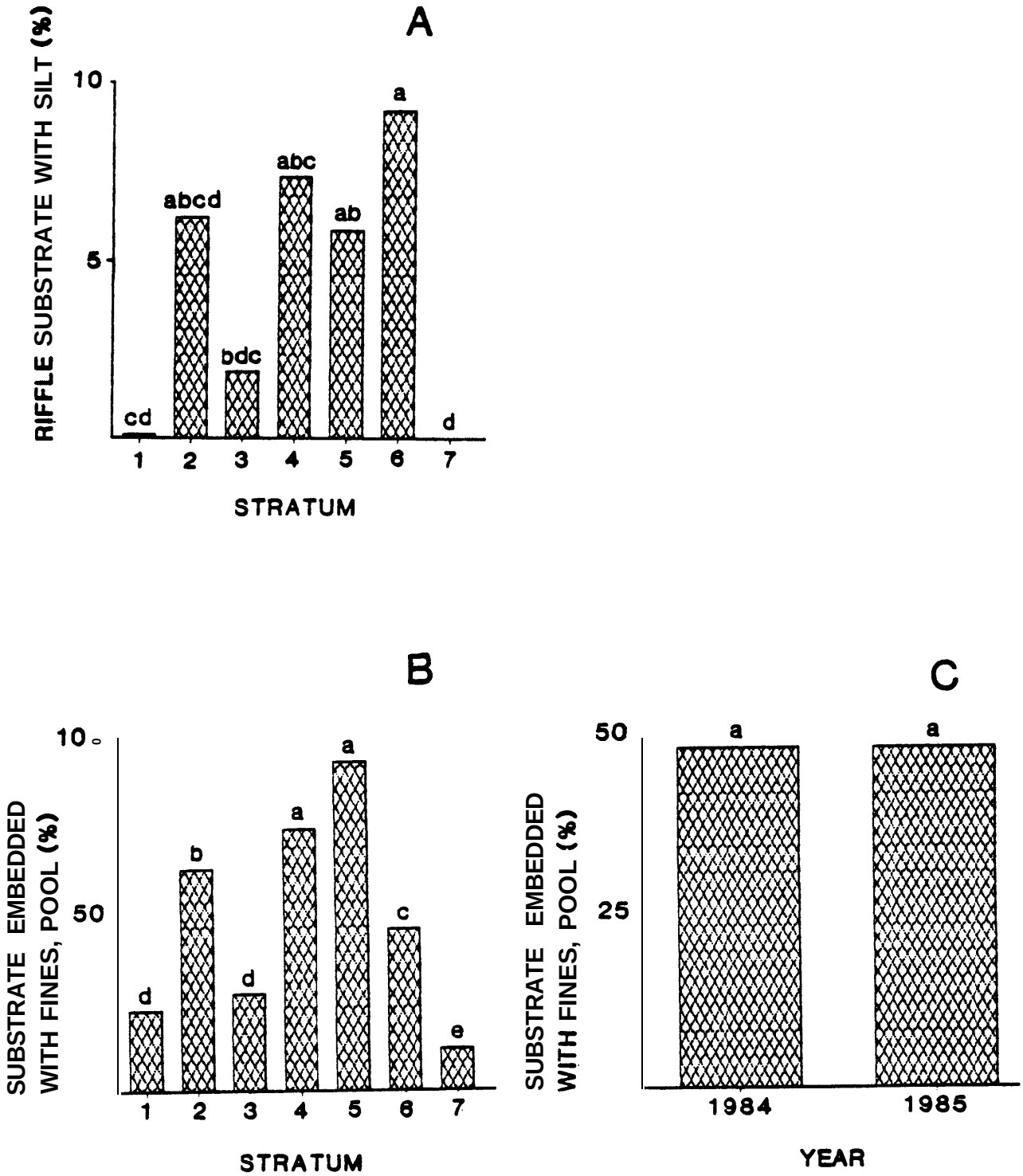


Figure 15. Mean (n=7 per stratum/year) percentage of riffle substrate covered with silt among strata in 1985 (A). Mean percentage of pool substrate embedded with fines, pools among strata (B) and (C). All areas from Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

significantly among strata 2, 4, 5, and 6, in strata 2, 3, 4, and 5, in strata 1, 2, 3, and 4, or in strata 1 and 7. Percent of riffle substrate covered by silt was significantly larger in strata 6 than in strata 1, 3, or 7, in strata 2, 3, 4, and 5 than in strata 1 or 7, and in strata 1, 2, 3, and 4 than in stratum 7.

Percent of pool substrate embedded with fines differed (F=17.3, P<0.000l) among strata but did not differ (F=0.l, P=0.7519) between 1984 and 1985. Percent of pool substrate embedded with fines ranged from 12 to 93% among strata (Fig. 15B) and was 48% in 1984 and 1985 (Fig. 15C). Pool embeddedness did not differ significantly in strata 4 and 5 or in strata 1 and 3. Pool embeddedness was significantly higher in strata 4 and 5 than in the other strata, in stratum 2 than in strata 1, 3, 6, or 7, in stratum 6 than in strata 1, 3, or 7, and in strata 1 and 3 than in stratum 7.

Rate of change, as substrate aggradation or degradation between 1985 and 1984, within the riparian zone (both left and right banks) differed (F=1.8, P=0.1223) among strata. Rate of riparian change ranged from -0.91 to 1.5 m2/year among strata (Fig. 16A). Rate of riparian change did not differ significantly in strata 2, 3, 4, 5, and 7 or in strata 1, 2, 4, 5, 6, and 7. Rate of riparian change was significantly larger (aggradation) in stratum 3 than in strata 1 or 6.

Rate of change, as substrate aggradation or degradation between 1985 and 1984, within the stream zone did not differ (F=l.l, P=0.3614) among strata. Rate of stream zone change ranged from -0.74 to 1.4 m2/year among strata (Fig. 16B).

Rate of change, as substrate aggradation or degradation between 1985 and 1984, within the stream channel (riparian plus stream zones), differed (F=l.l, P=0.2341) among strata (Fig. 16C). Rate of channel change ranged from -0.26 to 0.8 m2/year among strata. Rate of channel change did not differ significantly in strata 1, 2, 3, 4, 6, and 7 or in strata 1, 2, 4, 5, 6, and 7. Rate of channel change was significantly higher (aggradation) in stratum 3 than in stratum 5.

Substrate generally aggraded in the riparian zone (20,543 m2/yr) and in the stream channel (14,454 m2/yr) but degraded in the stream zone (-6,089 m2/yr) between 1984 and 1985 (Table 6). Substrate in the mine strata (6) aggraded in the stream zone but degraded in the riparian zone. Aggradation or deposition on shoreline bars in strata 3 (18,445 m2/yr) and in the stream zone of strata 1 (11,041 m2 /yr) were the largest changes between 1984 and 1985.

Fish Community Inventory

Total Density and Relative Abundance

In July 1985, fish densities (all species combined) were higher in strata 2, 3, and 4 than in strata 1, 5, and 6 (Fig. 17A). In August 1985, fish densities were higher in strata

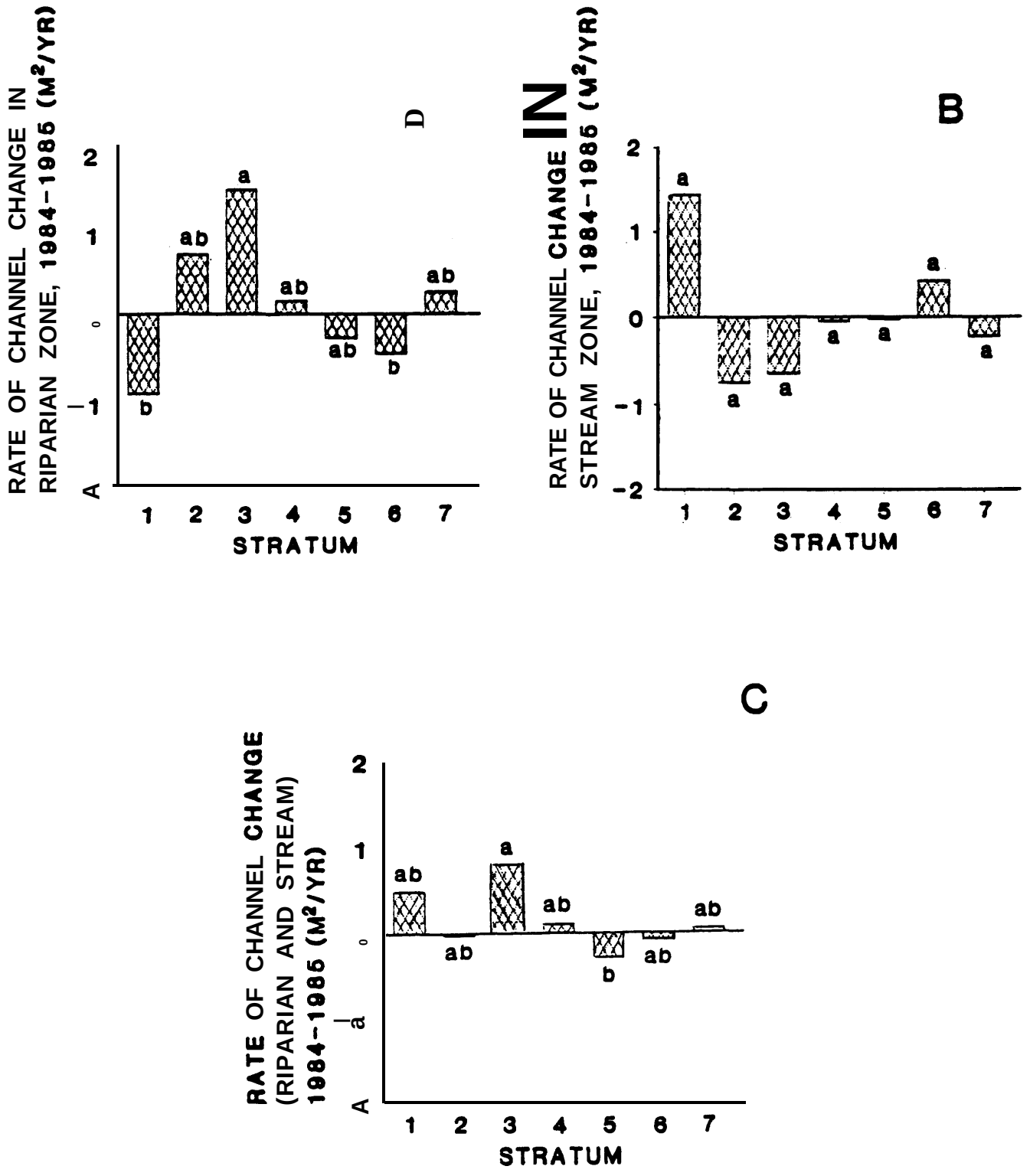


Figure 16. Mean (n=7 per stratum per year) rate of aggradation or degradation in the riparian zone (A), stream zone (B), and stream channel (C) in strata of Bear Valley Creek, Idaho between 1984 and 1985. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

Table 6. Substrate aggradation and degradation in the riparian, stream, and stream channel (riparian plus stream) zones in strata of Bear Valley Creek, Idaho between August 1984 and August 1985.

Stratum	Mean channel change (m2/yr)	95% Confidence interval (+)	Stratum length (m)	Stratum change (m3/yr)
		Riparian		
1	-0.91 [a]	1.23	25,327	- 7,014
2	0.72 [b]	0.96	36,305	7,989
3	1.45	0.81	41,698	18,455
4	0.16	1.43	36,780	1,754
5	-0.25	2.86	13,228	- 1,019
6	-0.47	0.94	7,525	- 1,062
7	0.26	0.33	17,975	1,440
				20,543
		Stream		
1	1.43	1.60	25,327	11,041
2	-0.74	1.00	36,305	- 8,185
3	-0.64	1.87	41,698	- 8,179
4	-0.05	1.39	36,780	544
5	-0.01	3.14	13,228	29
6	0.41	0.91	7,525	938
7	-0.21	0.38	17,975	- 1,131
				- 6,089
		Total channel		
1	0.52	0.77	25,327	4,027
2	-0.02	0.17	36,305	196
3	0.81	1.81	41,698	10,276
4	0.11	0.12	36,780	1,210
5	-0.26	0.37	13,228	- 1,048
6	-0.05	0.25	7,525	124
7	0.06	0.10	17,975	309
				14,454

[a] degradation
[b] aggradation

4, 5, and 6 than in the other strata. Fish densities increased in upstream strata between July and August.

During July 1985, relative abundance of age 0+ chinook salmon ranged from 0 to 59% among strata (Fig. 17A). The most abundant species-age class group by stratum were: adult mountain whitefish in strata 1 and 2; age 0+ chinook salmon in stratum 3; age 0+ mountain whitefish in stratum 4; age 2+ and older brook trout in stratum 5; age 0+ steelhead/rainbow trout in stratum 6; age l+ and older bull trout in stratum 7.

During August 1985, relative abundance of age 0+ chinook salmon ranged from 0 to 57% among strata (Fig. 17A). The most abundant species-age class by stratum were: adult mountain whitefish in strata 1 and 2; age 0+ mountain whitefish in strata 3, 4, 6, and 7; and age 0+ chinook salmon in stratum 5.

In 1984, fish densities (all species combined) were higher in strata 4 to 7 than in strata 1 to 3 during August (Fig. 17B). Fish densities decreased in upstream strata between August and September and resulted in similar fish densities among strata during September.

During August 1984, relative abundance of age 0+ chinook salmon ranged, by strata, from 25 to 78% (Fig. 17B). Age 0+ chinook salmon was the most abundant species-age class in all strata except stratum 2, where adult mountain whitefish were most abundant. Relative abundance of other species-age classes were low (<12%) in upstream strata during August. Relative abundances of age 0+ steelhead/rainbow trout and adult mountain whitefish were high in strata 2 and 3 (17%) and strata 1 and 2 (15%), respectively.

During September 1984, relative abundance of age 0+ chinook salmon ranged, by strata, from 0 to 69% (Fig. 17B). Relative abundance of age 0+ chinook salmon during September was higher than other age-classes of species in all strata except adult mountain whitefish which were more abundant in strata 1 and 2 (53%). Relative abundance of age 0+ and juvenile whitefish were high in strata 4, 5, 6, and 7 (19%) and strata 1 and 3, respectively.

Densities

Age 0+ chinook salmon in July and August 1985. Densities differed ($F=15.3$, $P<0.0001$) among strata between July and August (interaction). Densities ranged from 0 to 0.062 fish/m^2 pool among strata in July and from 0 to 0.146 fish/m^2 pool among strata in August (Fig. 18A). In July, densities did not differ significantly in strata 1, 5, 6, and 7. Densities were significantly higher in stratum 3 than in strata 2 or 4 and in stratum 2 than in stratum 4. In August, densities did not differ significantly in strata 1, 2, and 7. Densities were significantly higher in stratum 6 than in the other strata, in stratum 5 than in strata 1, 2, 3, 4, or 7, in stratum 4 than in strata 1, 2, 3, or 7, and in stratum 3 than in strata 1, 2, or 7. Between July and August 1985,

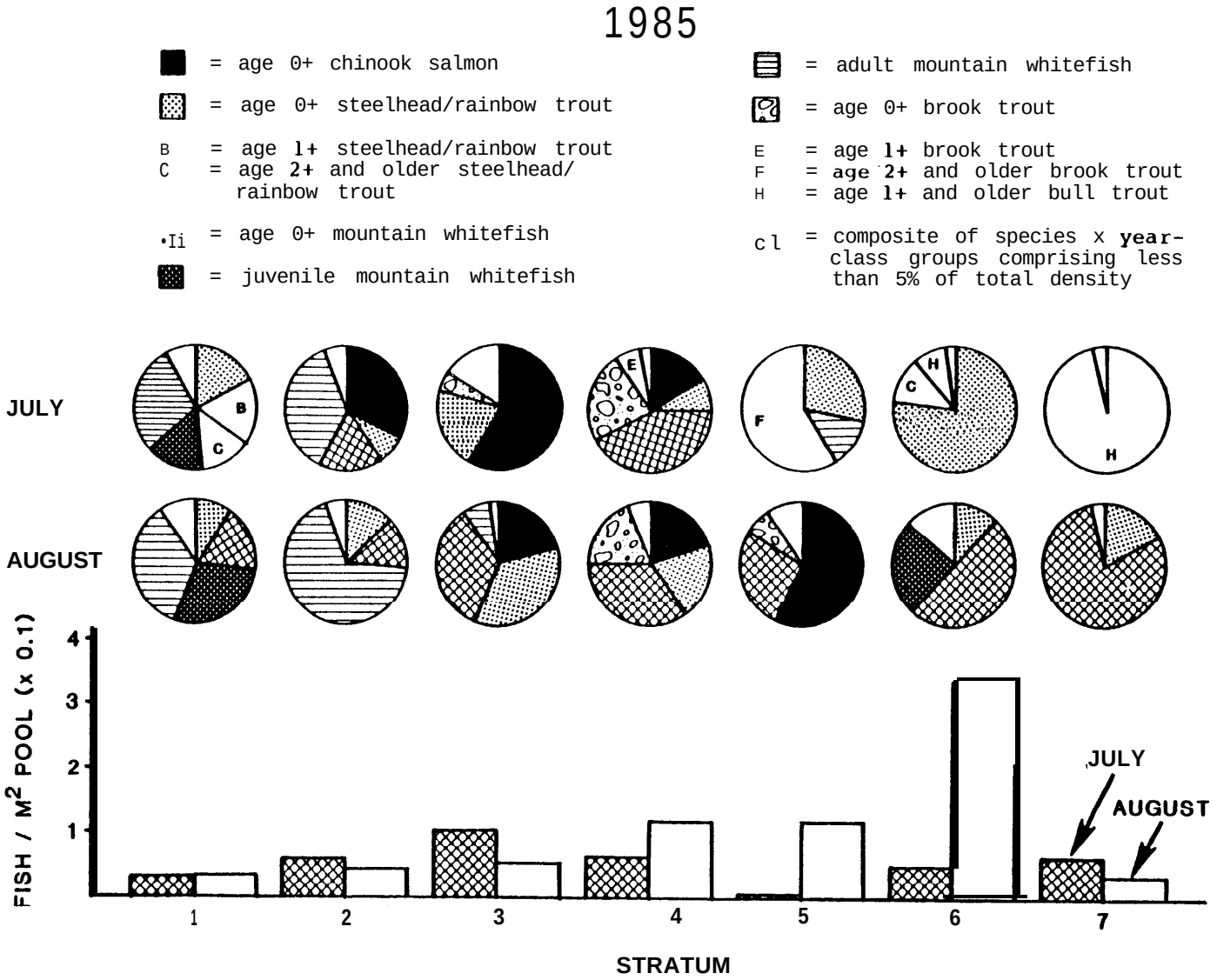


Figure 17A. Mean (n=7 per stratum) fish densities of all species and age-classes (histogram) and relative abundance of species by age-classes (pie-charts) by stratum and month, Bear Valley Creek, Idaho, 1985.

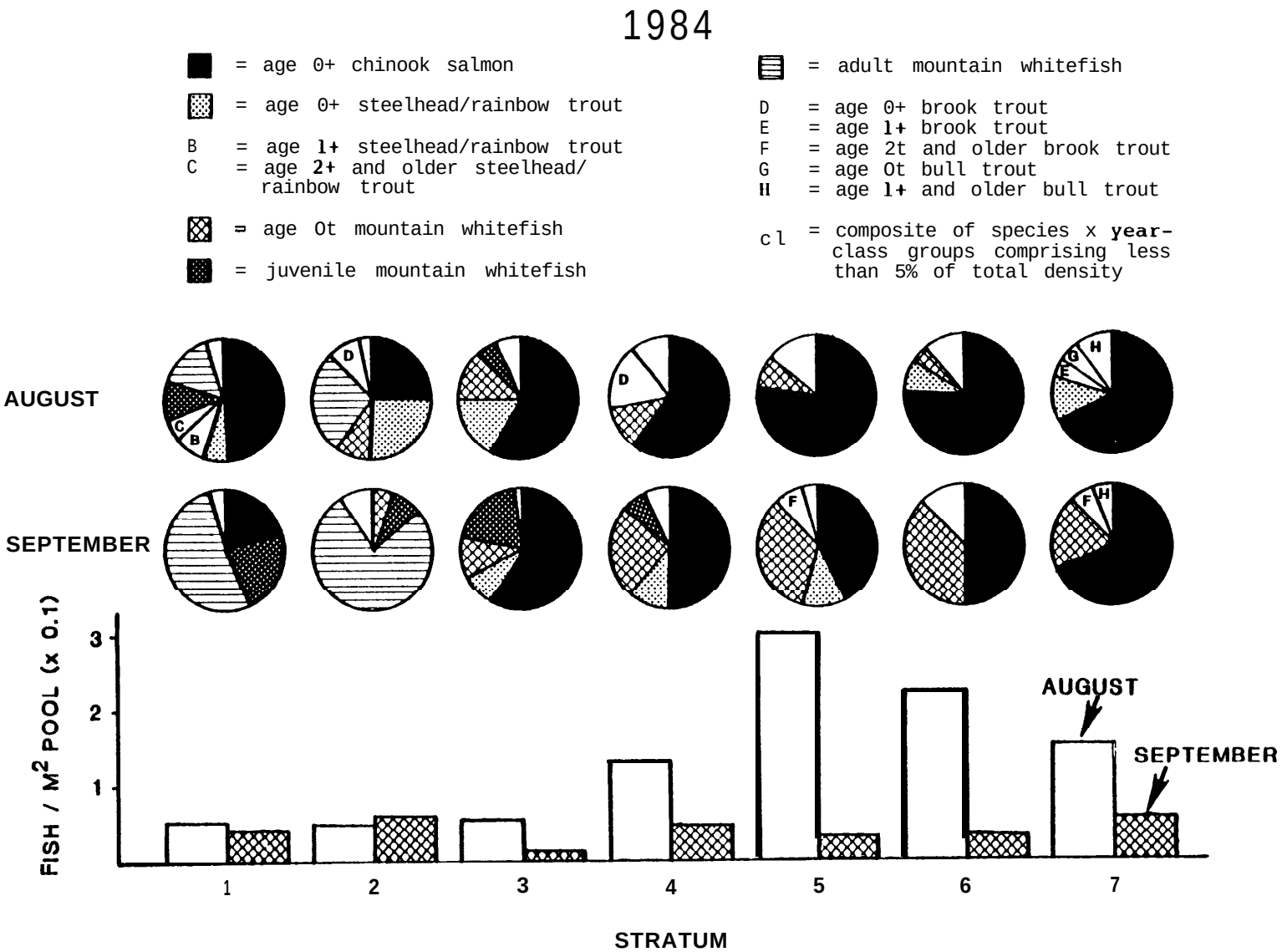


Figure 17B. Mean (n=7 per stratum) fish densities of all species and age-classes (histogram) and relative abundance of species by age-classes (pie-charts) by stratum and month, Bear Valley Creek, Idaho, 1984.

densities in strata 4, 5, and 6 significantly increased and densities in strata 2 and 3 significantly decreased.

Age 0+ chinook salmon in August 1984 and 1985. Densities differed (F=3.2, P=0.0108) among strata between August 1984 and 1985. Densities ranged from 0.02 to 0.31 fish/m^2 pool in 1984 and from 0 to 0.15 fish/m^2 pool in 1985 (Fig. 18B). In 1984, densities did not differ in strata 1 and 3. Densities were significantly higher in stratum 5 than in the other strata, in stratum 6 than in strata 1, 2, 3, 4, and 7, in stratum 4 than in strata 1, 2, 3, and 7, in stratum 7 than in strata 1, 2, and 3, and in strata 1 and 3 than in stratum 2. In 1985, densities did not differ significantly in strata 1, 2, 3, and 7. Densities were significantly higher in stratum 6 than in the other strata, in stratum 5 than in strata 1, 2, 3, 4, or 7, and in stratum 4 than in strata 1, 2, 3, or 7. Densities in strata 1, 3, 4, 5, 6, and 7 were significantly higher in August 1984 than in August 1985.

Age l+ chinook salmon in July and August 1985. Densities did not differ (F=1.6, P=0.1828) among strata or (F=1.2, P=0.2769) between July and August. Densities ranged from 0 to 0.07 fish/m^2 pool among strata (Fig. 19A) and were 0.0002 and 0.0008 fish/m^2 pool in July and August, respectively (Fig. 19B).

Age 1+ chinook salmon in August 1984 and 1985. Densities differed (F=2.5, P=0.0379) among strata but did not differ (F=2.2, P=0.0622) between August 1984 and August 1985. Densities ranged from 0 to 0.004 fish/m^2 pool among strata (Fig. 19C) and were 0.0008 and 0.0018 fish/m3 pool in August 1984 and August 1985, respectively (Fig. 19D). Densities did not differ significantly in strata 1, 3, 4, 6, and 6 or in strata 1,2, 3, 4, 6, and 7. Densities were significantly higher in stratum 5 than in strata 2 or 7.

Age 0+ steelhead/rainbow trout in July and August 1985. Densities differed (F=2.7, P=0.0272) among strata but not (F=1.6, P=0.1806) between July and August: Densities ranged from 0.0029 to 0.0200 fish/m^2 pool among strata (Fig. 20A) and were 0.0112 and 0.0088 fish/m^2 pool in July and August, respectively (Fig. 20B). Densities did not differ significantly in strata 1, 2, 3, 4, and 6 or in strata 1, 2, 5, 6, and 7. Densities were significantly higher in strata 3 and 4 than in strata 5 or 7.

Age 0+ steelhead/rainbow trout in August 1984 and 1985. Densities differed (F=2.5, P=0.0349) among strata between August 1984 and August 1985. Densities ranged from 0.0043 to 0.0208 fish/m^2 pool in August 1984 and from 0.0023 to 0.0229 fish/m2 pool in August 1985 (Fig. 20C). In August 1984, densities did not differ significantly in strata 2 and 7, in strata 2, 3, and 5, or in strata 1, 3, 4, and 5. Densities were significantly higher in stratum 6 than in other strata, and in strata 2 and 7 than in strata 1 or 4. In August 1985, densities did not differ significantly in strata 3 and 4, or

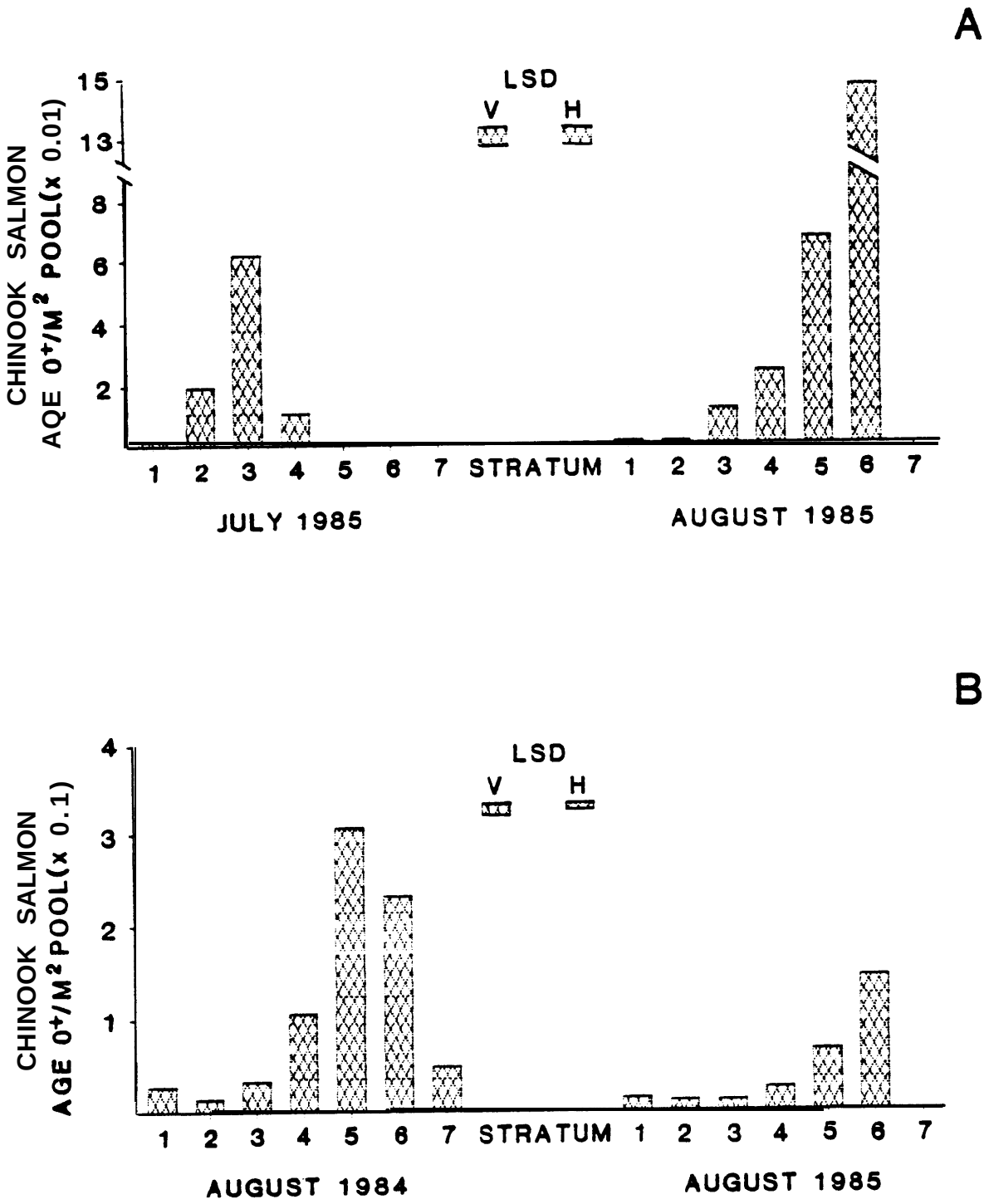


Figure 18. Mean densities (n=7 per stratum) of age 0+ chinook salmon in strata between July and August 1985 (A) and between August 1984 and 1985 (B) in Bear Valley Creek, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means.

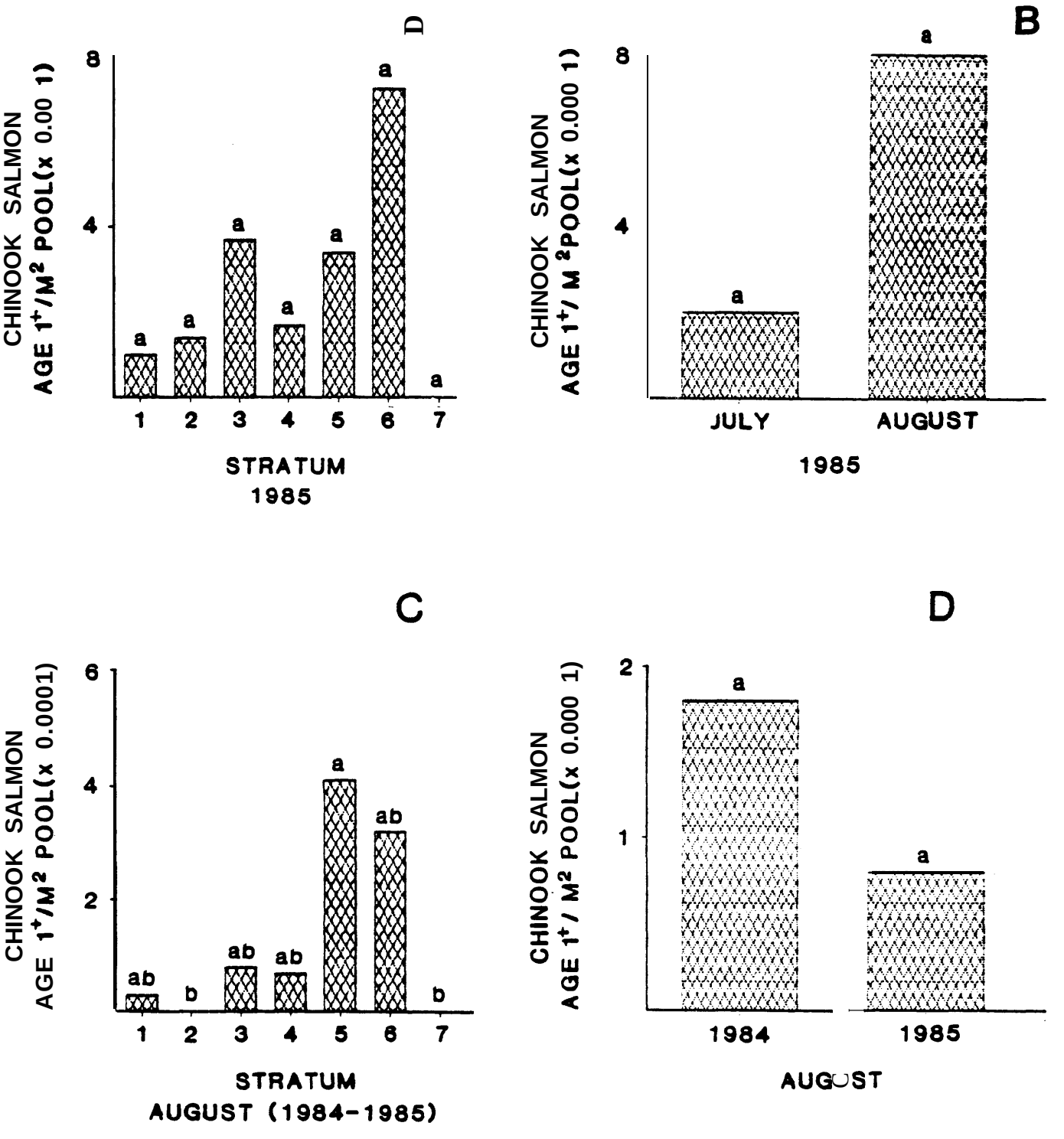


Figure 19. Mean (n=7 per stratum per month) of age 1+ chinook salmon among strata in 1985 (A), between July and August 1985 (B), among strata in 1984 and 1985 (C), and between 1984 and 1985 in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

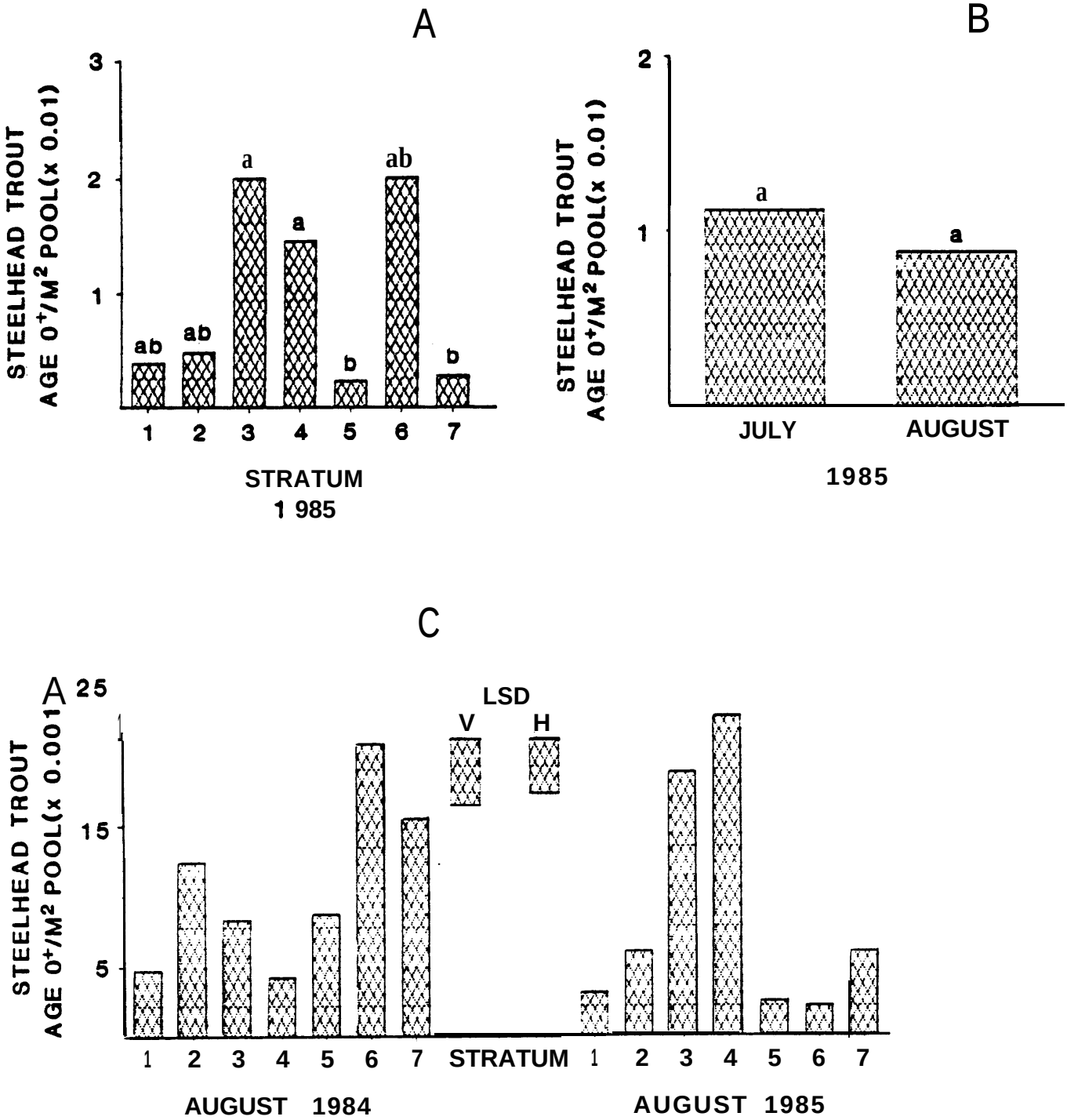


Figure 20. Mean (n=7 per stratum per month) densities of age 0+ steelhead/rainbow trout among strata in 1985 (A), between July and August 1985 (B) , and in strata between August 1984 and 1985 (C) in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means within each method of measurement. Mean differences within or between months that are greater than vertical '(V) or horizontal (H) LSD's, respectively, indicate signif icant)P<0 .05) differences between those means.

in strata 1, 2, 5, 6, and 7. Densities were significantly higher in strata 3 and 4 than in other strata. Densities in strata 2, 5, 6, and 7 were significantly higher in August 1984 than in August 1985. Densities were significantly lower in strata 3 and 4 in August 1984 than in August 1985.

Age I+ steelhead/rainbow trout in July-and August 1985. Densities differed (F=6.6, P<0.000l) among strata between July and August 1985. Densities ranged from 0 to 0.0061 fish/m2 pool in July and from 0 to 0.0025 fish/m' pool in August (Fig. 21A). In July, densities did not differ significantly in strata 4, 5, 6, and 7. Densities were significantly higher in stratum 1 than in other strata, in stratum 3 than in strata 2, 4, 5, 6, or 7, and in stratum 2 than in strata 4, 5, 6, or 7. In August densities did not differ significantly in strata 2, 3, 4, 5, and 7. Densities were significantly higher in stratum 6 than in other strata, and in stratum 1 than in strata 2, 3, 4, 5, or 7. Between July and August 1985, densities increased in stratum 6 and decreased in strata 1, 2, and 3.

Age l+ steelhead/rainbow trout in August 1984 and 1985. Densities differed (F=6.2, P<0.000l) among strata and (F=7.9, P=0.0076) and between August 1984 and August 1985. Densities ranged from 0 to 0.0032 fish/m^2 pool among strata (Fig. 21B) and were 0.0214 and 0.0067 fish/m^2 pool in August 1984 and August 1985, respectively (Fig. 21C). Densities did not differ significantly in strata 2, 3, 4, and 6, or in strata 2, 3, 5, 6, and 7. Densities were significantly higher in stratum 1 than in othr strata, and in strata 4 than in strata 5 or 7.

Age 2+ and older steelhead/rainbow trout in July and August 1985. Densities differed (F=6.1, P<0.000l) among strata between July and August. Densities ranged from 0 to 0.0063 fish/m^2 pool in July and from 0 to 0.0045 fish/m^2 pool in August (Fig. 22A). In July, densities did not differ significantly in strata 2, 3, 4, 5, and 7. Densities were significantly higher in stratum 6 than in other strata, and in stratum 1 than in strata 2, 3, 4, 5, or 7. In August, densities did not differ significantly in strata 1, 2, 3, 4, and 7. Densities were significantly higher in stratum 5 than than in other strata, and in stratum 6 than in strata 1, 2, 3, 4, or 7. Between July and August 1985, densities increased in stratum 5 and decreased in strata 1, 3, and 6.

Age 2+ and older steelhead/rainbow trout in August 1984 and 1985. Densities differed (F=6.3, P<0.000l) among strata between August 1984 and August 1985. Densities ranged from 0 to 0.0031 fish/m^2 pool in August 1984 and from 0 to 0.0045 fish/m^2 pool in August 1985 (Fig. 22B). In August 1984, densities did not differ significantly in strata 2, 3 4; 6, and 7. Densities were significantly higher in stratum 1 than in other strata, and in stratum 5 than in strata 2, 3, 4, 6, or 7. In August 1985, densities did not differ significantly in strata 1, 2, 3, 4, and 7. Densities were significantly

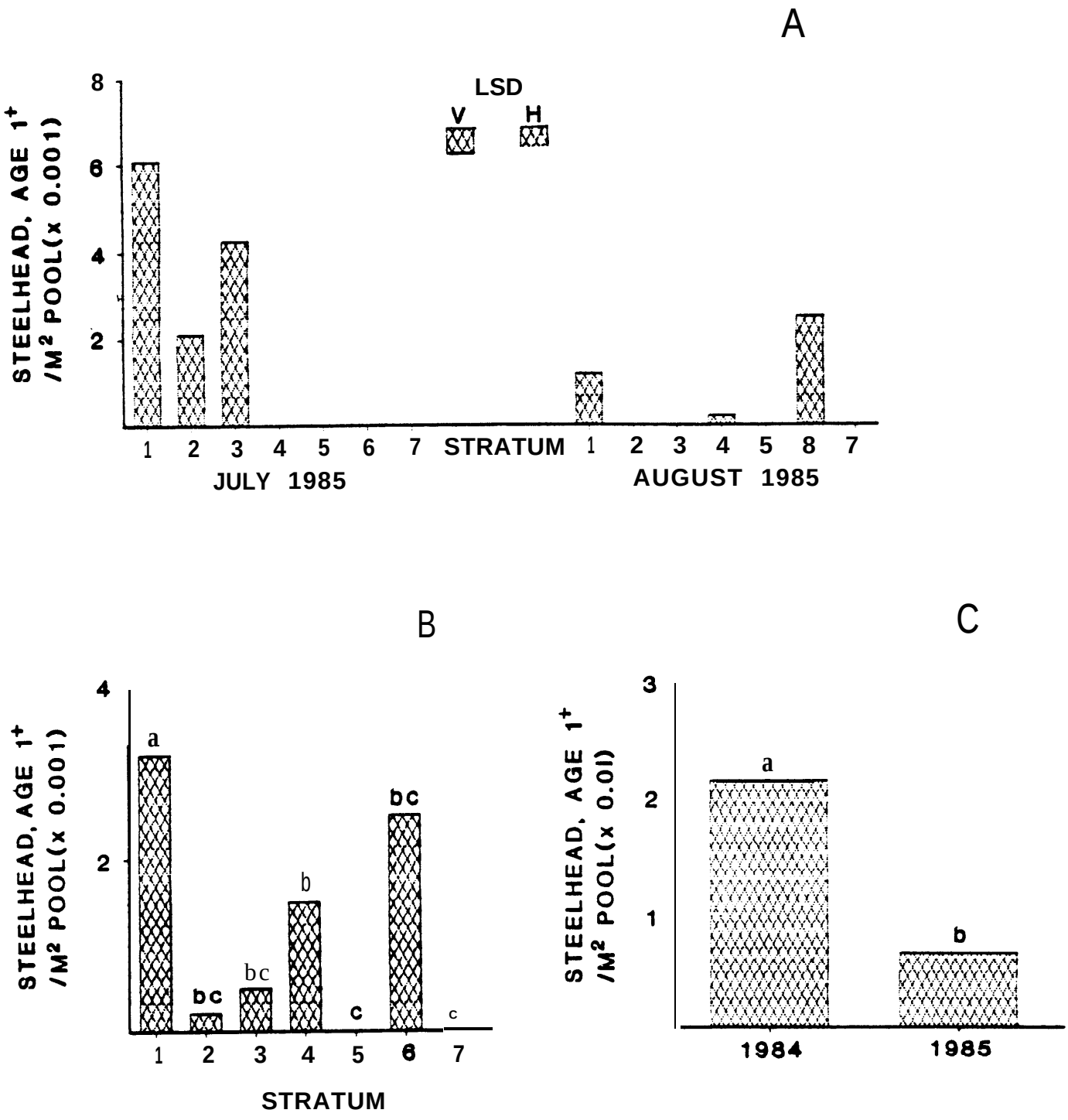


Figure 21. Mean (n=7 per stratum per month) densities of age l+ steelhead/rainbow trout among strata in 1985 (A), between July and August 1985 (B), and in strata between August 1984 and 1985 (C) in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means within each method of measurement. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant (P<0.05) differences between those means.

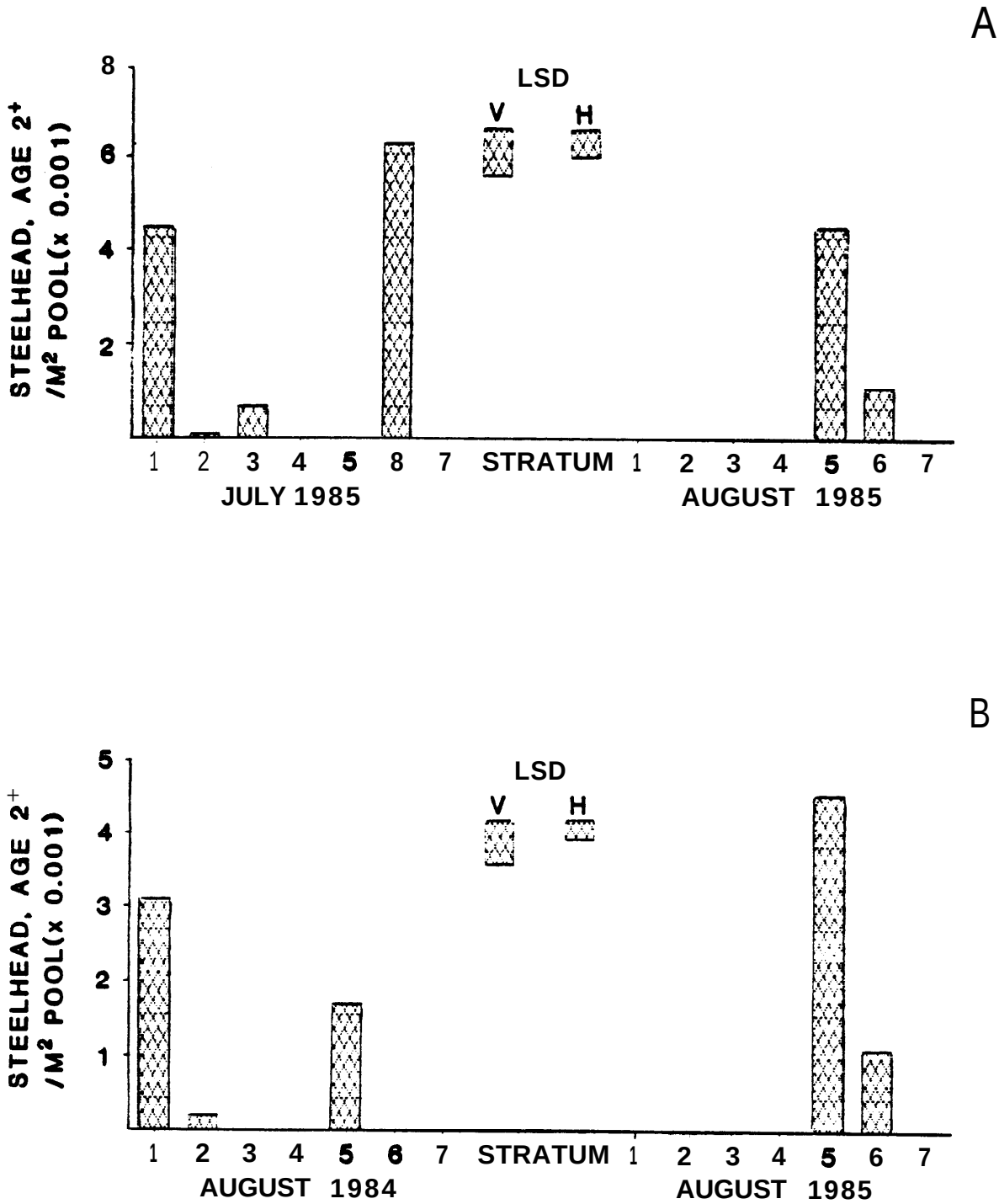


Figure 22. Mean densities (n=7 per stratum) of age 2+ steelhead/rainbow trout in strata between July and August 1985 (A) and between August 1984 and 1985 (B) in Bear Valley Creek, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P<0.05$) differences between those means.

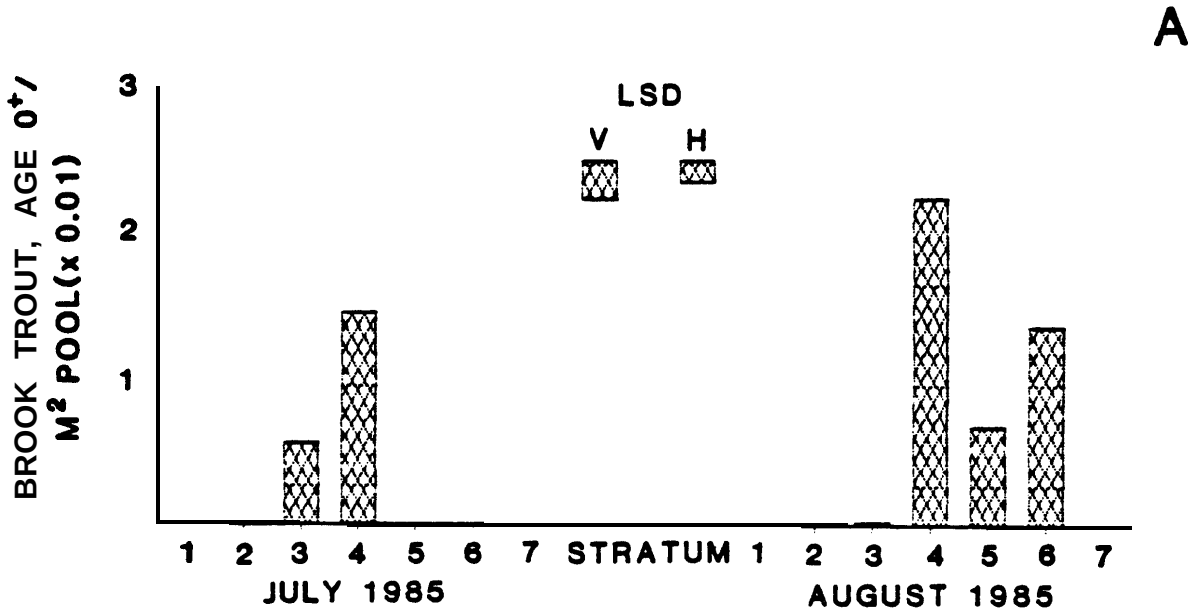
higher in stratum 5 than in other strata, and in stratum 6 than in strata 1, 2, 3, 4, or 7. Density in stratum 1 was significantly higher in August 1984 than in August 1985. Densities in strata 5 and 6 were lower in August 1984 than in August 1985.

Age 0+ brook trout in July and August 1985. Densities differed (F=4.6, P=0.0012) among strata between July and August. Densities ranged from 0 to 0.0143 fish/m^2 pool in July and from 0 to 0.0221 fish/m^2 pool in August (Fig. 23A). In July, densities did not differ significantly in strata 1, 2, 5, 6, and 7. Densities were significantly higher in stratum 4 than in other strata and in stratum 3 than in strata 1, 2, 5, 6, or 7. In August, densities did not differ significantly in strata 1, 2, 3, and 7. Densities were significantly higher in stratum 4 than in other strata, in stratum 6 than in strata 1, 2, 3, 5, or 7, and in stratum 5 than in strata 1, 2, 3, or 7. Between July and August 1985, densities decreased in stratum.3 and increased in strata 4, 5, and 6.

Age 0+ brook trout in August 1984 and 1985. Densities differed (F=3.2, P=0.0113) among strata between August 1984 and August 1985. Densities ranged 0 to 0.0151 fish/m^2 pool in August 1984 and from 0 to 0.0221 fish/m^2 pool in August 1985 (Fig. 23B). In August 1984, densities did not differ significantly in strata 2, 5, and 6, or in strata 1, 3, and 7. Densities were significantly higher in stratum 4 than in other strata and in strata 2, 5, and 6 than in 1, 3, or 7. In August 1985, densities did not differ significantly in strata 1, 2, 3, and 7. Densities were significantly higher in stratum 4 than in other strata, stratum 6 than in strata 1, 2, 3, 5, or 7, and in stratum 5 than in strata 1, 2, 3, or 7. Densities were significantly higher in stratum 2 in August 1984 than in August 1985. Densities were significantly lower in strata 4 and 6 in August 1984 than in August 1985.

Age l+ brook trout in July and August 1985. Densities differed (F=4.5, P=0.0014) among strata between July and August. Densities range 0 to 0.0039 fish/m^2 pool in July and from 0 to 0.0092 fish/m^2 pool in August (Fig. 24A). In July, densities did not differ significantly in strata 1, 2, 3, 5, 6, and 7. Densities were significantly higher in stratum 4 than in other strata. In August, densities did not differ significantly in strata 1, 2, 3, 5, and 7. Densities were significantly higher in stratum 6 than in other strata and in stratum 4 than in strata 1, 2, 3, 5, or 7. Between July and August 1985, densities increased significantly in strata 4 and 6.

Age l+ brook trout in August 1984 and 1985. Densities differed (4.9, P=0.0007) among strata and did not differ (F=1.8, P=0.1283) between August 1984 and August 1985. Densities ranged from 0 to 0.0559 fish/m^2 pool among strata (Fig. 24B) and were 0.0033 and 0.0021 fish/m^2 pool in August



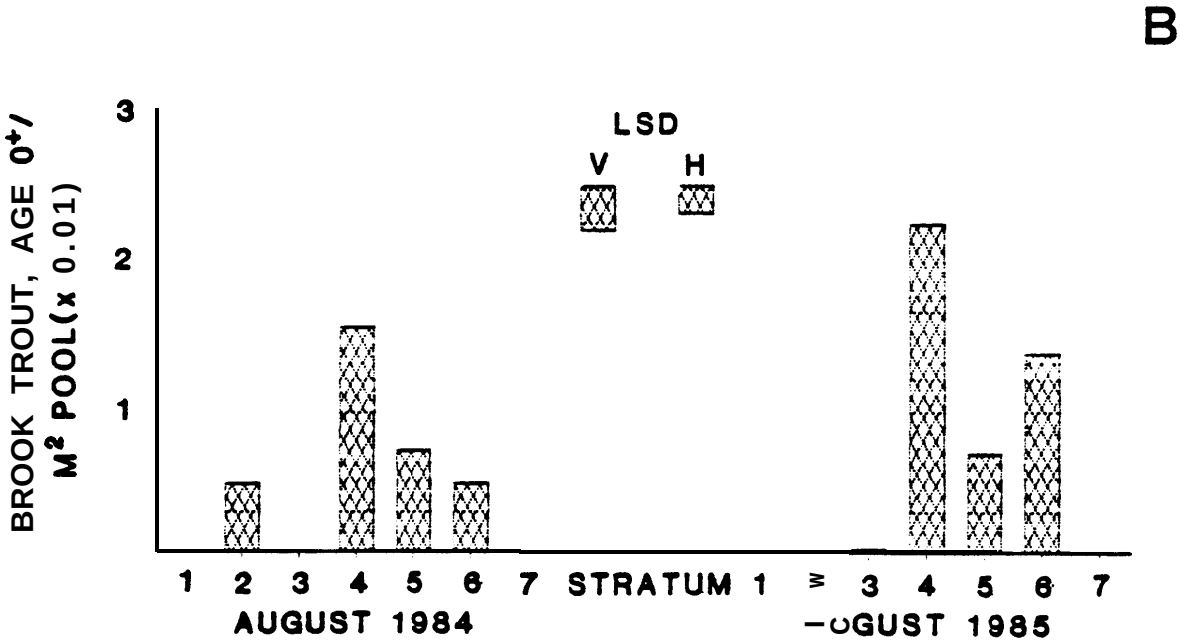


Figure 23. Mean densities (n=7 per stratum) of age 0+ brook trout in strata between July and August 1985 (A) and between August 1984 and 1985 (B) in Bear Valley Creek, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means.

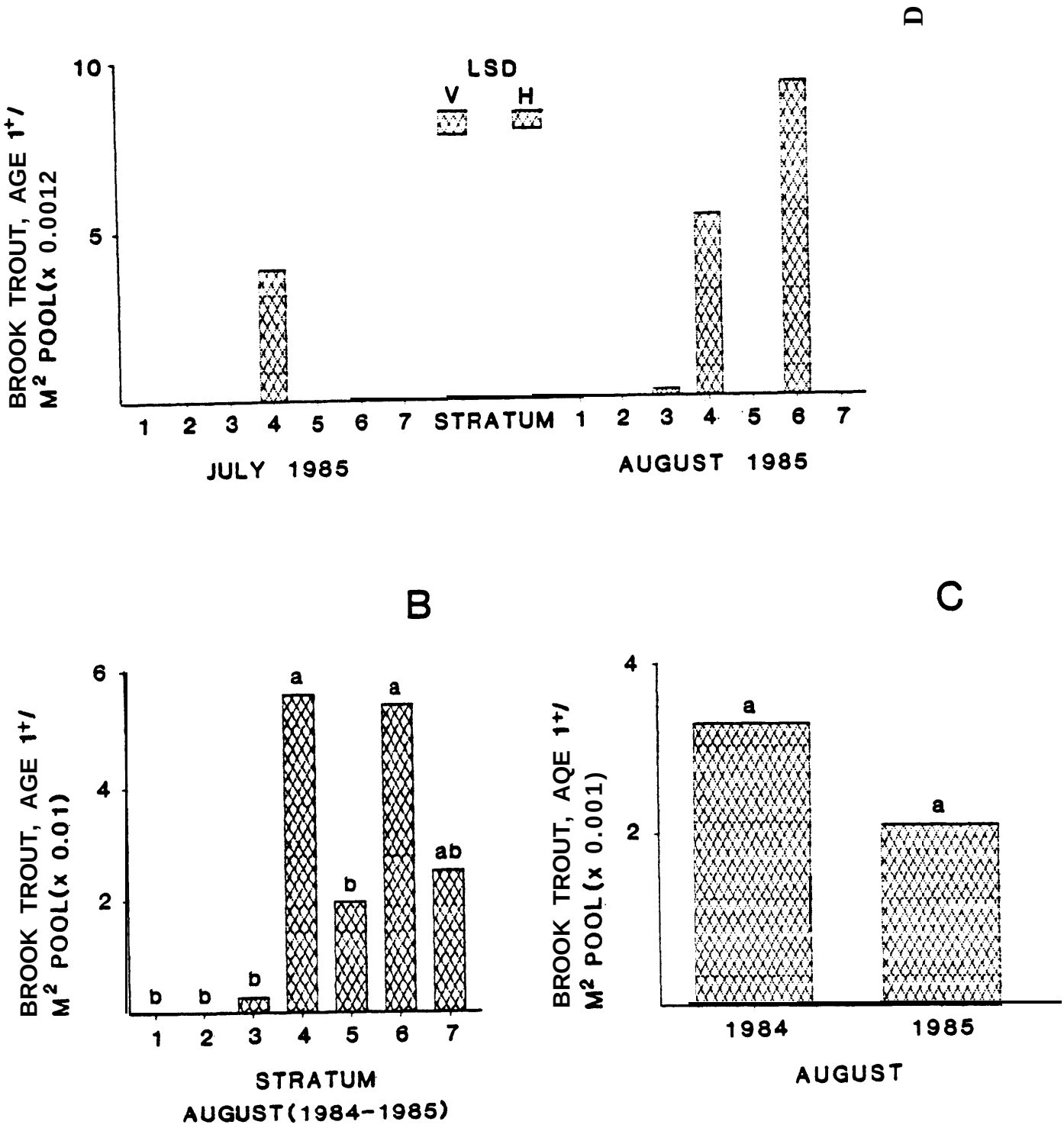


Figure 24. Mean (n=7 per stratum per month) densities of age 1+ brook trout among strata in 1985 (A), between July and August 1985 (B), and in strata between August 1984 and 1985 (C) in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant ($P>0.05$) difference among strata means within each method of measurement. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P\leq 0.05$) differences between those means.

1984 and August 1985, respectively (Fig. 24C). Densities did not differ significantly in strata 4, 6, and 7, or in strata 1, 2, 3, 5, and 7. Densities were significantly higher in strata 4 and 6 than in strata 1, 2, 3, or 5.

Age 2+ and older brook trout in July and August 1985. Densities did not differ (F=0.7, P=0.6851) among strata or (F=0.6, P=0.4388) between July and August. Densities ranged from 0 to 0.0031 fish/m^2 pool among strata 2 (Fig. 25A) and were 0.0008 and 0.0015 fish/m^2 pool in July and August, respectively (Fig. 25B).

Age 2+ and older brook trout in August 1984 and 1985. Densities did not differ (F=2.1, P=0.0778) among strata or (F=2.3, P=0.0511) between August 1984 and August 1985. Densities ranged from 0 to 0.0036 fish/m2 pool among strata (Fig. 25C) and were 0.0011 and 0.0015 fish/m2 pool in August 1984 and August 1985, respectively (Fig. 25D).

Age 0+ bull trout in July and August 1985. Densities did not differ (F=1.2, P=0.3481) among strata or (F=0.l, P=0.7969) between July and August. Densities ranged from 0 to 0.0013 fish/m^2 pool among strata (Fig. 26A) and were 0.0008 and 0.0015 fish/m^2 pool in July and August, respectively (Fig. 26B).

Age 0+ bull trout in August 1984 and 1985. Densities differed (F=2.6, P=0.0310) among strata but did not differ (F=1.9, P=0.1800) in August 1984 and August 1985. Densities ranged from 0 to 0.0054 fish/m^2 pool among strata (Fig. 26C) and were 0.0019 and 0.0002 fish/m^2 pool in August 1984 and August 1985, respectively (Fig. 26D). Densities did not differ significantly in strata 6 and 7 and in strata 1, 2, 3, 4, 5, and 7. Densities were significantly higher in stratum 6 than in strata 1, 2, 3, 4, or 5.

Age l+ and older bull trout in July and August 1985. Densities differed (F=11.4, P<0.000l) among strata between July and August (interaction). Densities ranged from 0 to 0.0632 fish/m^2 pool in July and from 0 to 0.0031 fish/m^2 pool in August (Fig. 27A). In July, densities did not differ significantly in strata 1, 2, , 4, and 5. Densities were significantly higher in stratum 7 than in other strata and in stratum 6 than in strata 1, 2, 3, 4, or 5. In August, densities did not differ significantly in strata 1, 2, 3, 4, 5, and 7. Densities were significantly higher in stratum 6 than in other strata. Between July and August 1985, densities decreased significantly in stratum 7.

Age l+ and older bull trout-in August 1984 and 1985. Densities differed (F=4.7, P=0.00l0) among strata between August 1984 and August 1985. Densities ranged from 0 to 0.0216 fish/m^2 pool in August 1984 and from 0 to 0.0031 fish/m^2 pool in August 1985 (Fig. 27B). In August 1984, densities did not differ significantly in strata 1, 2, 3, 4, and 5. Densities were significantly higher in stratum 7 than in other strata, and in stratum 6 than in strata 1, 2, 3, 4, or 5. In August 1985, densities did not differ significantly

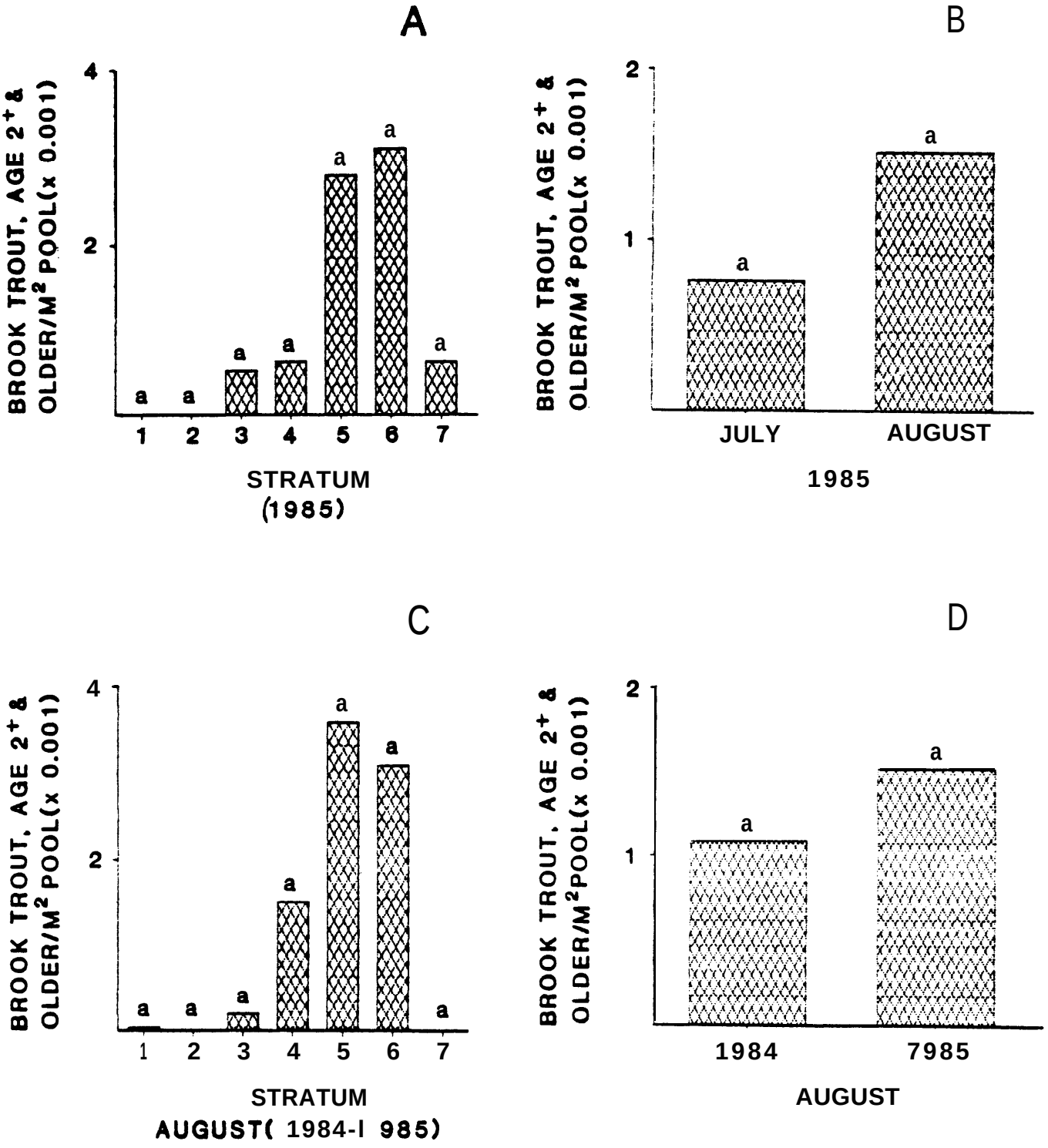


Figure 25. Mean (n=7 per stratum per month) of age 2+ and older brook trout among strata in 1985 (A), between July and August 1985 (B), among strata in 1984 and 1985 (C), and between 1984 and 1985 in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

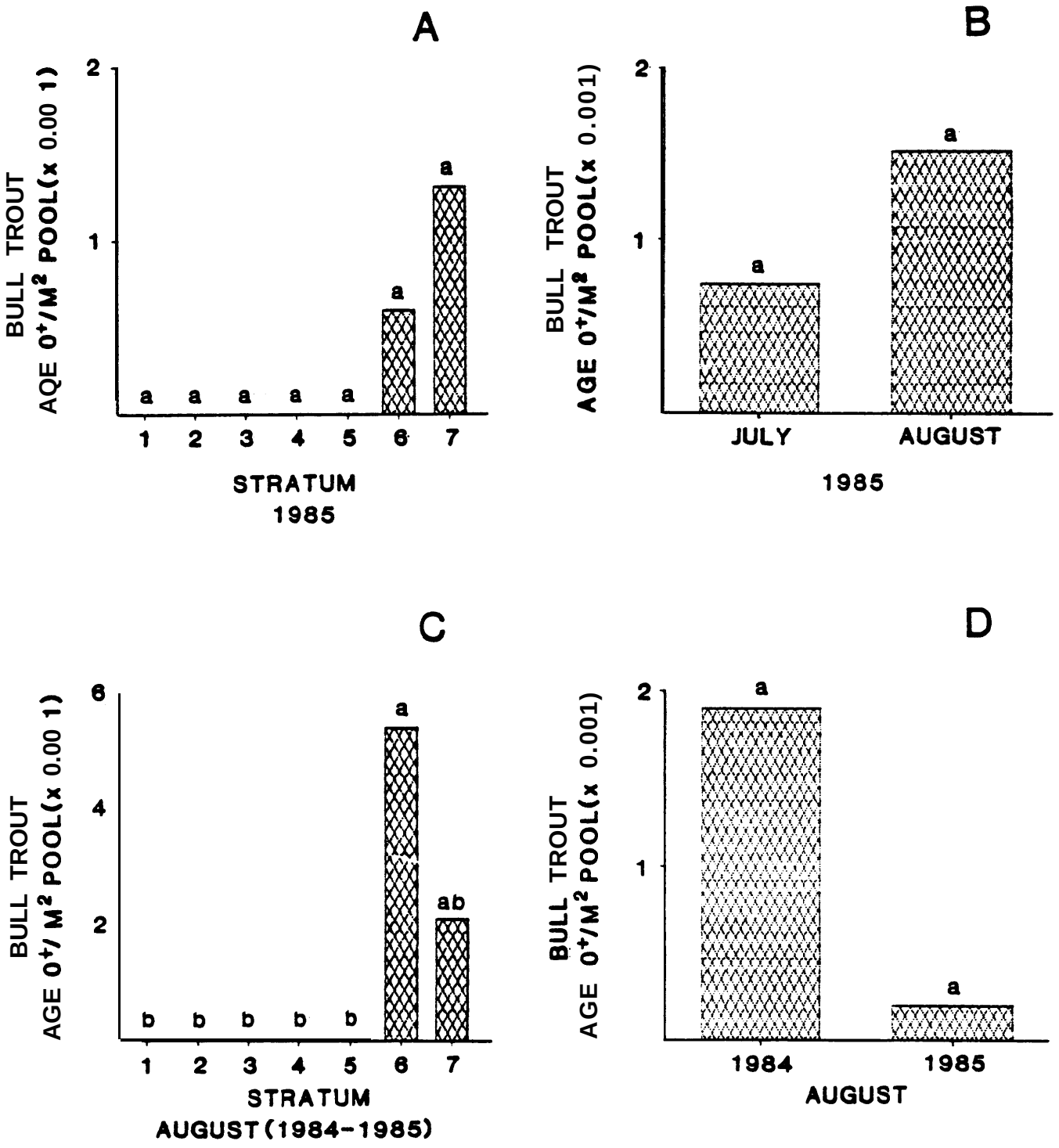


Figure 26. Mean (n=7 per stratum per month) of age 0+ bull trout among strata in 1985 (A), between July and August 1985 (B), among strata in 1984 and 1985 (C), and between 1984 and 1985 in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

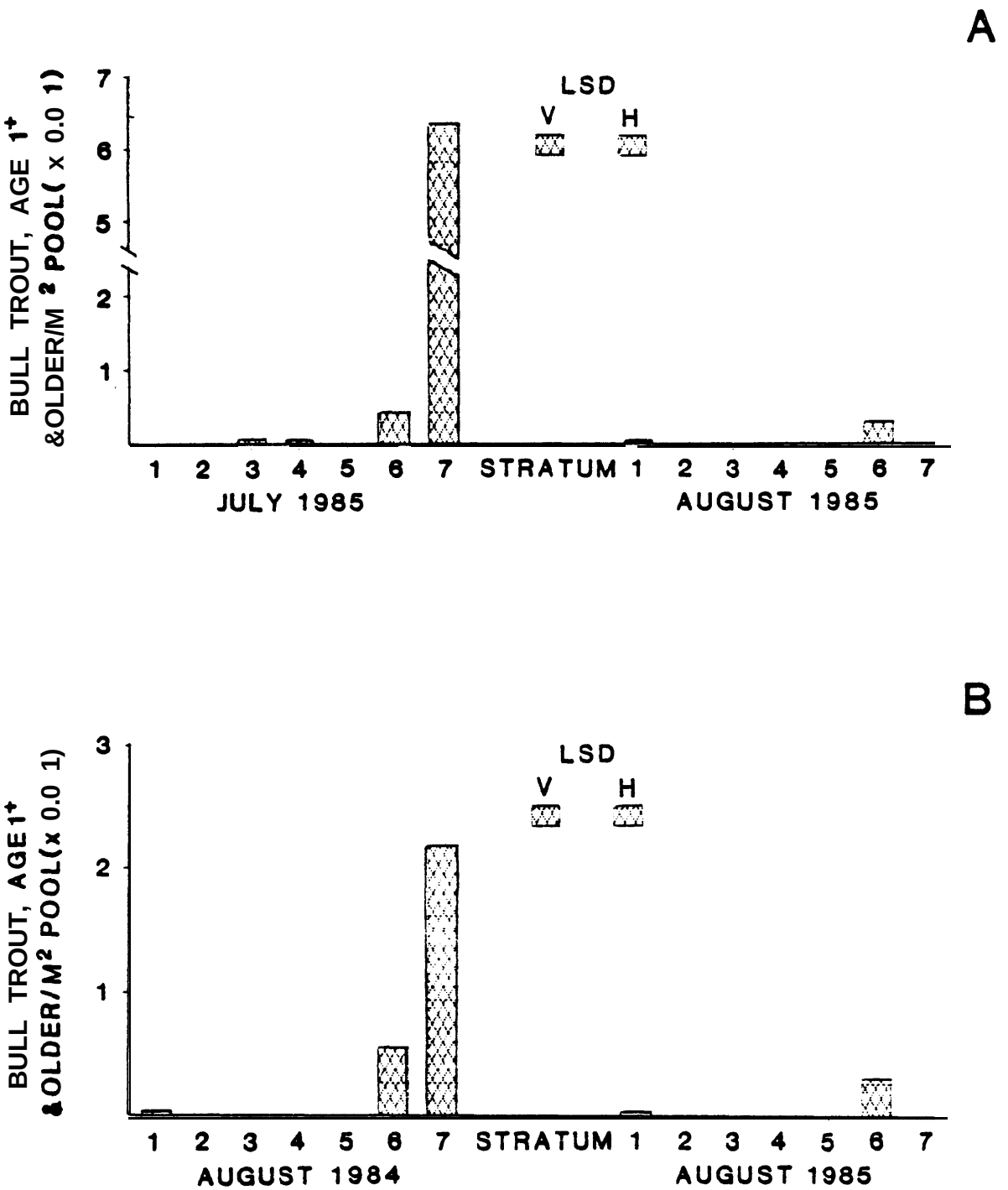


Figure 27. Mean densities (n=7 per stratum) jof age 1+ and older brook trout in strata between July and August 1985 (A) and between August 1984 and 1985 (B) in Bear Valley Creek, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means.

in strata 1, 2, 3, 4, 5, and 7. Densities were significantly higher in stratum 6 than in other strata. Densities were significantly higher in strata 6 and 7 in August 1984 than in August 1985.

Adult cutthroat trout in July and August 1985. Densities differed (F=5.3, P=0.0004) among strata and did not differ (F=1.3, P=0.2703) between July and August. Densities ranged from 0 to 0.00011 fish/m^2 pool among strata (Fig. 28A) and were 0.0003 and 0.0005 fish/m^2 pool in July and August, respectively (Fig. 28B). Densities did not differ significantly in strata 1 and 2 or in strata 3, 4, 5, 6, and 7. Densities were significantly higher in strata 1 and 2 than in the other strata.

Adult cutthroat trout in August 1984 and 1985. Densities differed (F=3.9, P=0.0038) among strata and (F=7.4, P=0.0094) between August 1984 and August 1985. Densities ranged from 0 to 0.0011 fish/m^2 pool among strata (Fig. 28C) and were 0.0001 and 0.0005 fish/m^2 pool in August 1984 and August 1985, respectively (Fig. 28D). Densities did not differ significantly in strata 1 and 6 or in strata 3, 4, 5, 6, and 7. Densities were significantly higher in statum 2 than in other strata, and in stratum 1 than in strata 3, 4, 5, or 7.

Age 0+ mountain whitefish in July and August 1985. Densities differed (F=6.1, P<0.0001) among strata between July and August. Densities ranged from 0 to 0.0271 fish/m^2 pool in July and from 0.0057 to 0.1696 fish/m2 pool in August (Fig. 29A). In July, densities did not differ in strata 2 and 3, or in strata 1, 3, 5, 6, and 7. Densities were significantly higher in stratum 4 than in other strata, and in stratum 2 than in 1, 5, 6, or 7. In August, densities did not differ significantly in strata 4 and 5, in strata 5 and 7, in strata 3 and 7, or strata 1 and 2. Densities were significantly higher in stratum 6 than in other strata in strata 4 and 5 than in strata 1, 2, or 3, and in strata 3 and 7 than in strata 1 or 2. Between July and August, densities increased in strata 3, 4, 5, 6, and 7.

Age 0+ mountain whitefish in August 1984 and 1985. Densities differed (F=3.4, P=0.0078) among strata between August 1984 and August 1985. Densities ranged from 0 to 0.0341 fish/m^2 pool in August 1984 and from 0.0057 to 0.1696 fish/m^2 pool in August 1985, respectively (Fig. 29B). In August 1984, densities did not differ significantly in strata 4 and 5, in strata 4 and 6, in strata 3 and 6, in strata 1, 2, and 3. Densities were significantly higher in strata 4 and 5 than in strata 1, 2, 3, or 7, and in stratum 6 than in strata 1, 2, or 7. In August 1985, densities did not differ significantly in strata 4 and 5, in strata 5 and 7, in strata 3 and 7, and strata 1 and 2. Densities were significantly higher in stratum 6 than in other strata, in stratum 4 than in strata 1, 2, 3, or 7, and in stratum 7 than in strata 1 or 2.

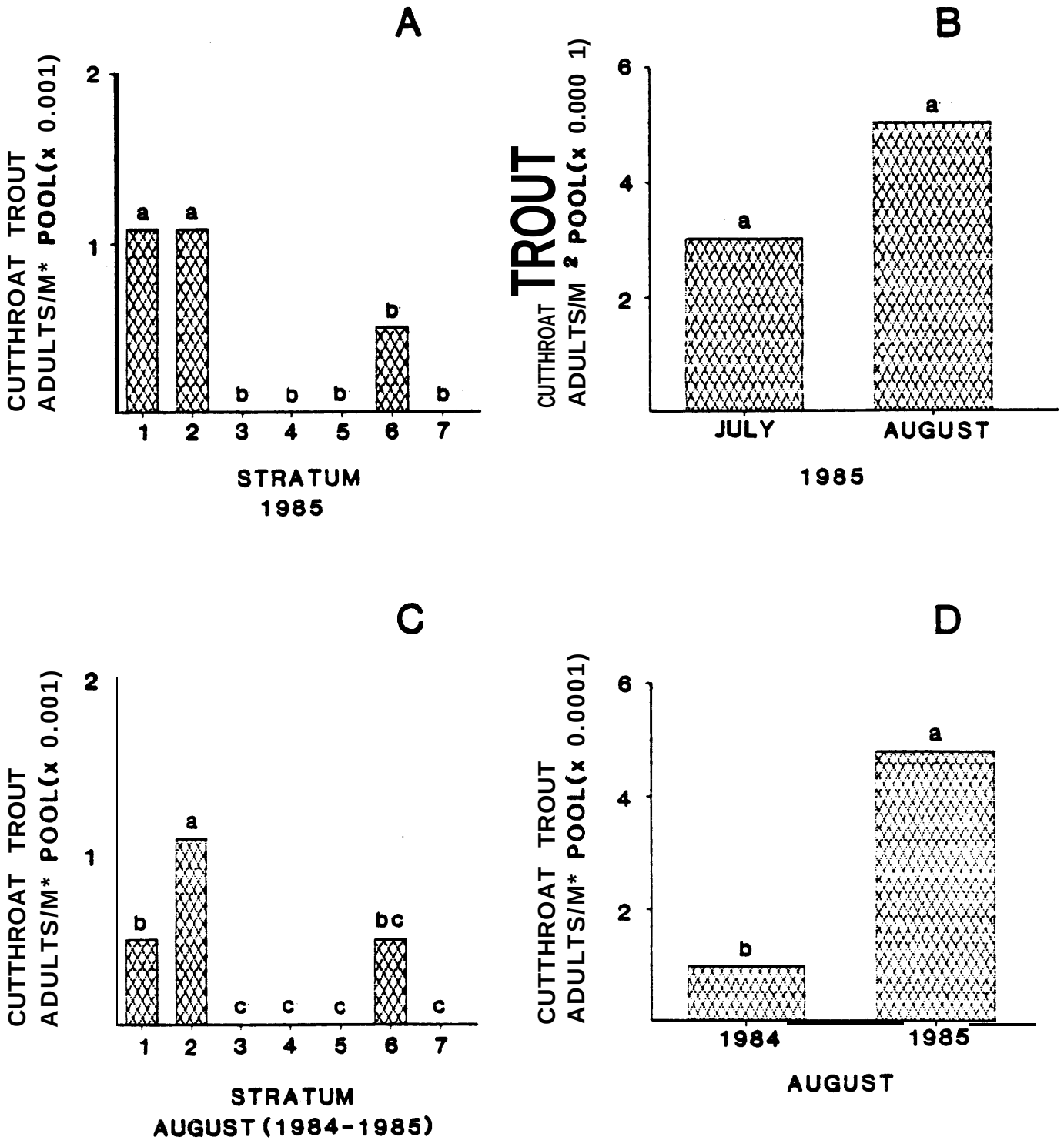


Figure 28. Mean (n=7 per stratum per month) of age 1+ adult cutthroat trout among strata in 1985 (A), between July and August 1985 (B), among strata in 1984 and 1985 (C), and between 1984 and 1985 in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

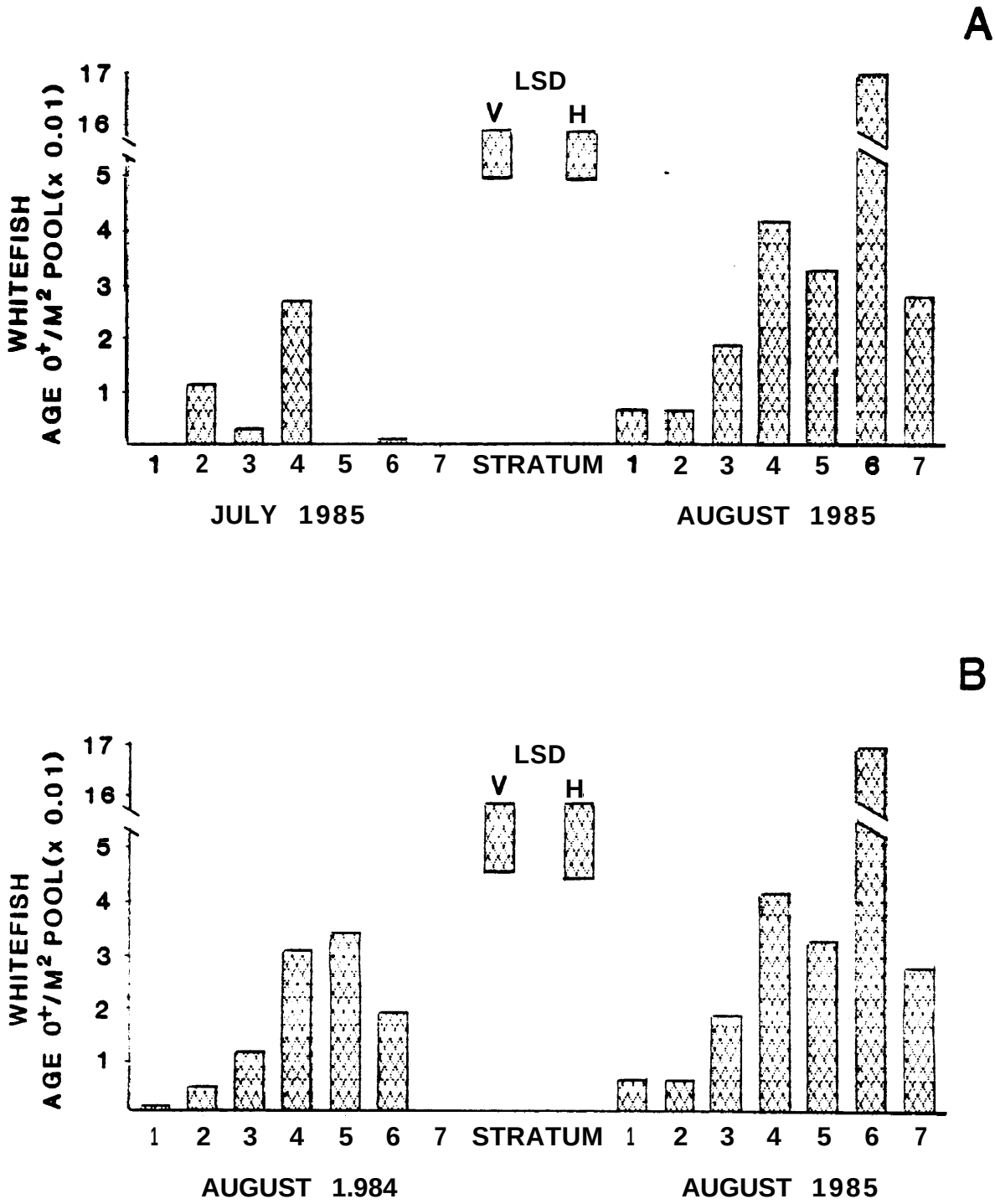


Figure 29. Mean densities (n=7 per stratum) of age 0+ mountain whitefish in strata between July and August 1985 (A) and between August 1984 and 1985 (B) in Bear Valley Creek, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P<0.05$) differences between those means.

Juvenile mountain whitefish in July and August 1985. Densities differed (F=2.4, P=0.0472) among strata between July and August (interaction). Densities ranged from 0 to 0.0055 fish/m2 pool in July and from 0 to 0.0828 fish/m^2 pool in August (Fig. 30A). In July and August, densities did not differ significantly among strata. Between July and August, densities increased significantly in stratum 6.

Juvenile mountain whitefish in August 1984 and 1985. Densities differed (F=3.1, P=0.0135) among strata between August 1984 and August 1985. Densities ranged from 0 to 0.0081 fish/m^2 pool in August 1984 and from 0 to 0.0828 fish/m^2 pool August 1985 (Fig. 30). In August 1984 and 1985, densities did not differ among strata. Densities were significantly lower is strata 6 in August 1984 than in August 1985.

Adult mountain whitefish in July and August 1985. Densities differed (F=11.9, P<0.000l) among strata and did not differ (F=0.7, P=0.6654) between July and August. Densities ranged from 0 to 0.0262 fish/m^2 pool among strata and were 0.0053 and 0.0086 fish/m^2 pool in July and August, respectively (Fig. 31B). Densities did not differ significantly in strata 3, 4, 5, and 6, or in strata 4, 5, 6, and 7. Densities were significantly higher stratum 2 than in other strata, in stratum 1 than in strata 3, 4, 5, 6, or 7, and in stratum 3 than in stratum 7.

Adult mountain whitefish in August 1984 and 1985. Densities differed (F=6.9, P<0.000l) among strata but did not differ (F=0.l, P=0,7536) bewteen August 1984 and August 1985. Densities ranged from 0 to 0.0245 fish/m^2 pool among strata (Fig. 31C) and were 0.0079 and 0.0086 fish/m^2 pool in August 1984 and August 1985, respectively (Fig. 31D). Densities did not differ significantly in strata 1, 2, and 5, in strata 3, 4, and 6, or in strata 3, 4, 6, and 7, Densities were significantly higher in strata 1, 2, and 5 than in the other strata.

Age 0+ Chinook Salmon

Total length in July and August 1985. Fish length differed (F=7.7, P<0.000l) among strata and between (F=879.1, P<0 .000l) July and August. Length ranged from 67.9 to 85.3 mm (Fig. 32A) and were 56.2 and 77.9 mm in July and August, respectively (Fig. 32B). Fish length did not differ significantly in strata 2, 3, and 6, Fish length was significantly longer in stratum 1 than in other strata, in stratum 4 than in strata 2, 3, 5, or 6, and in stratum 5 than in strata 2, 3, or 6.

Total length in August 1984 and 1985. Fish length differed (F=5.1, P=0.0002) among strata between August 1984 and August 1985. Fish length ranged from 68.8 to 81.8 mm in August 1984 and from 67.9 to 85.4 mm in August 1985 (Fig. 32C). In August 1984, fish length did not differ significantly in strata 1 and 2, or in strata 5, 6, and 7.

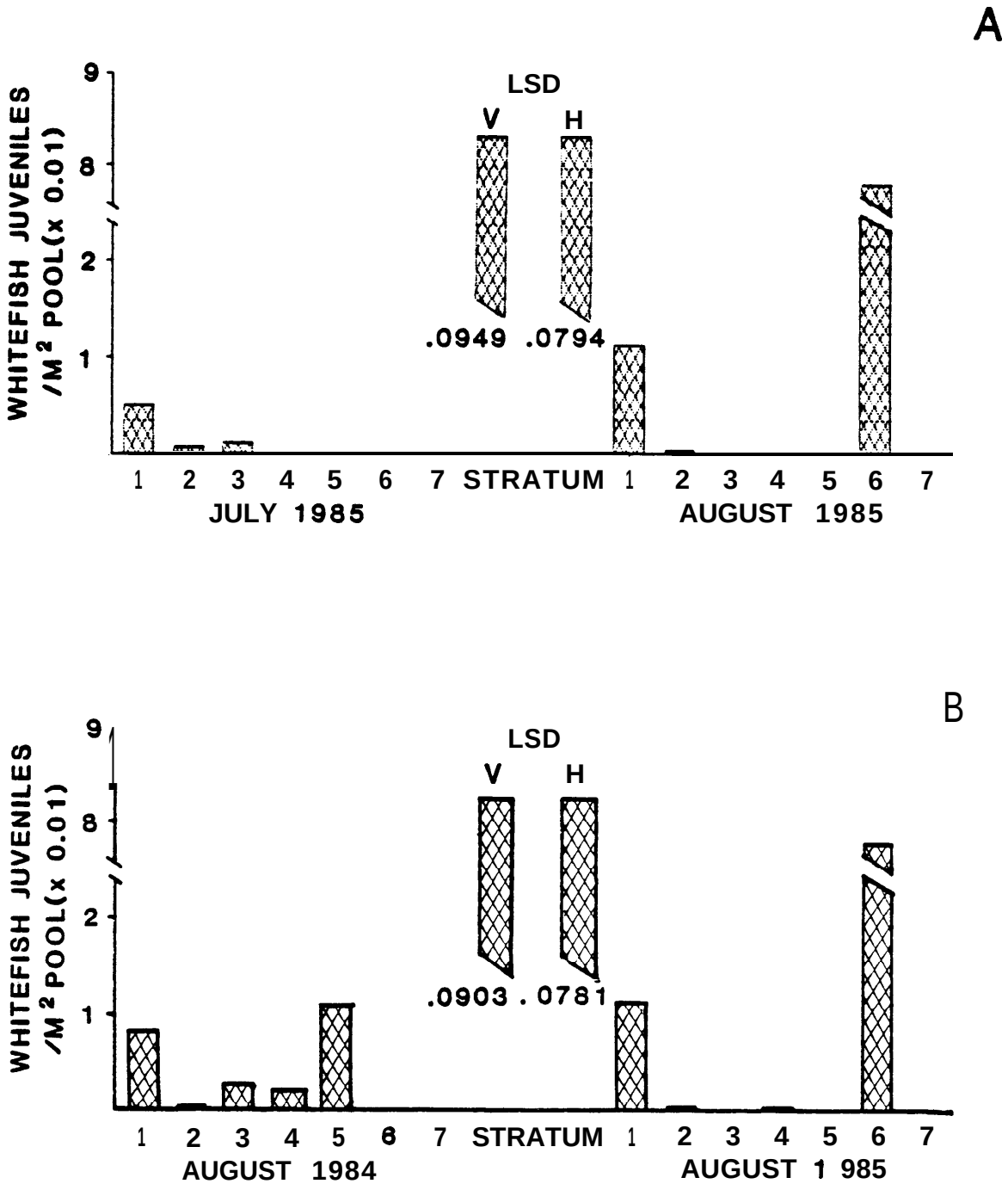


Figure 30. Mean densities (n=7 per stratum) of age 0+ juvenile mountain whitefish in strata between July and August 1985 (A) and between August 1984 and 1985 (B) in Bear Valley Creek, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant $P < 0.05$) differences between those means.

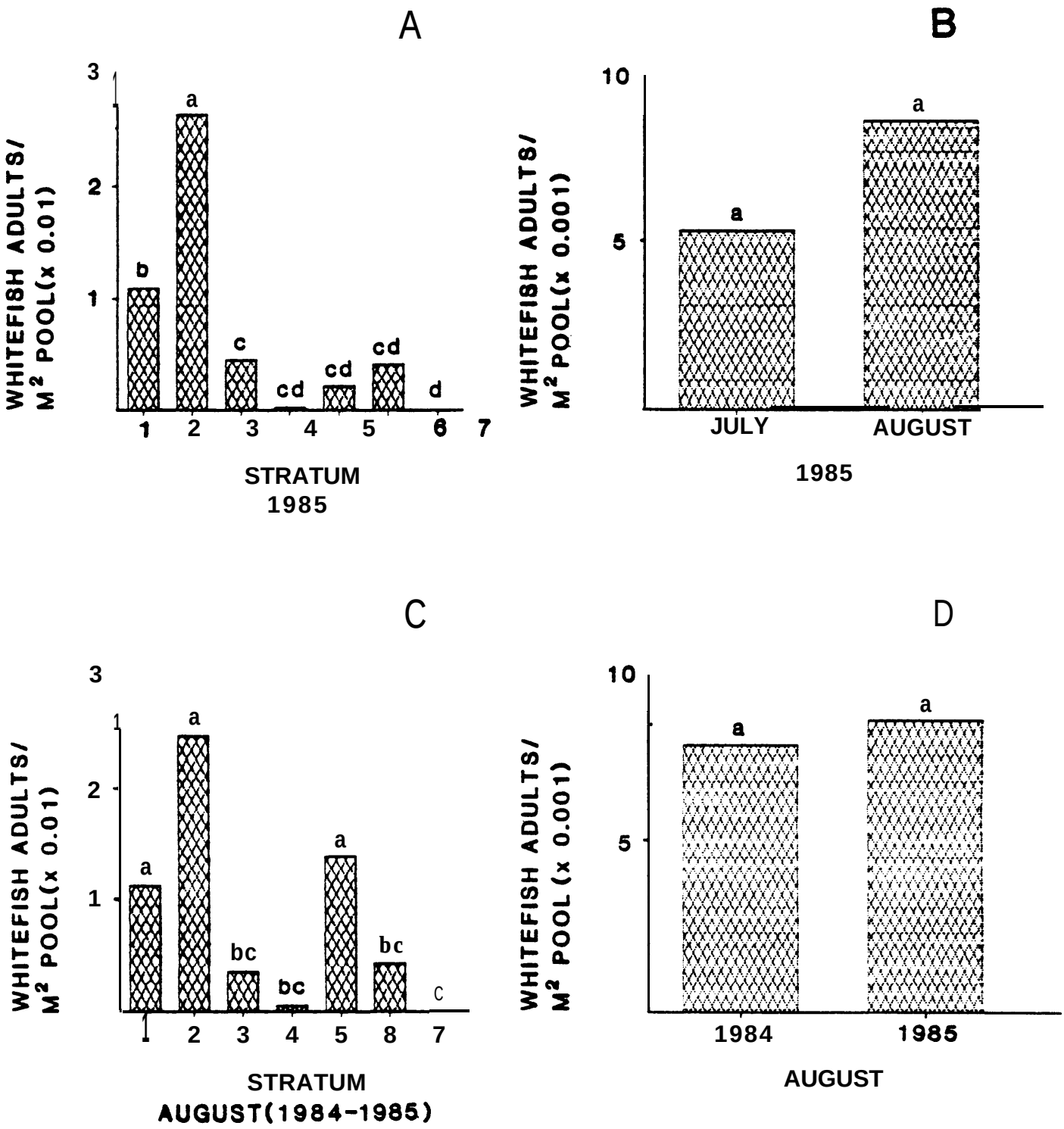


Figure 31. Mean (n=7 per stratum per month) of age 1+ adult mountain whitefish among strata in 1985 (A), between July and August 1985 (B), among strata in 1984 and 1985 (C) , and between 1984 and 1985 in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

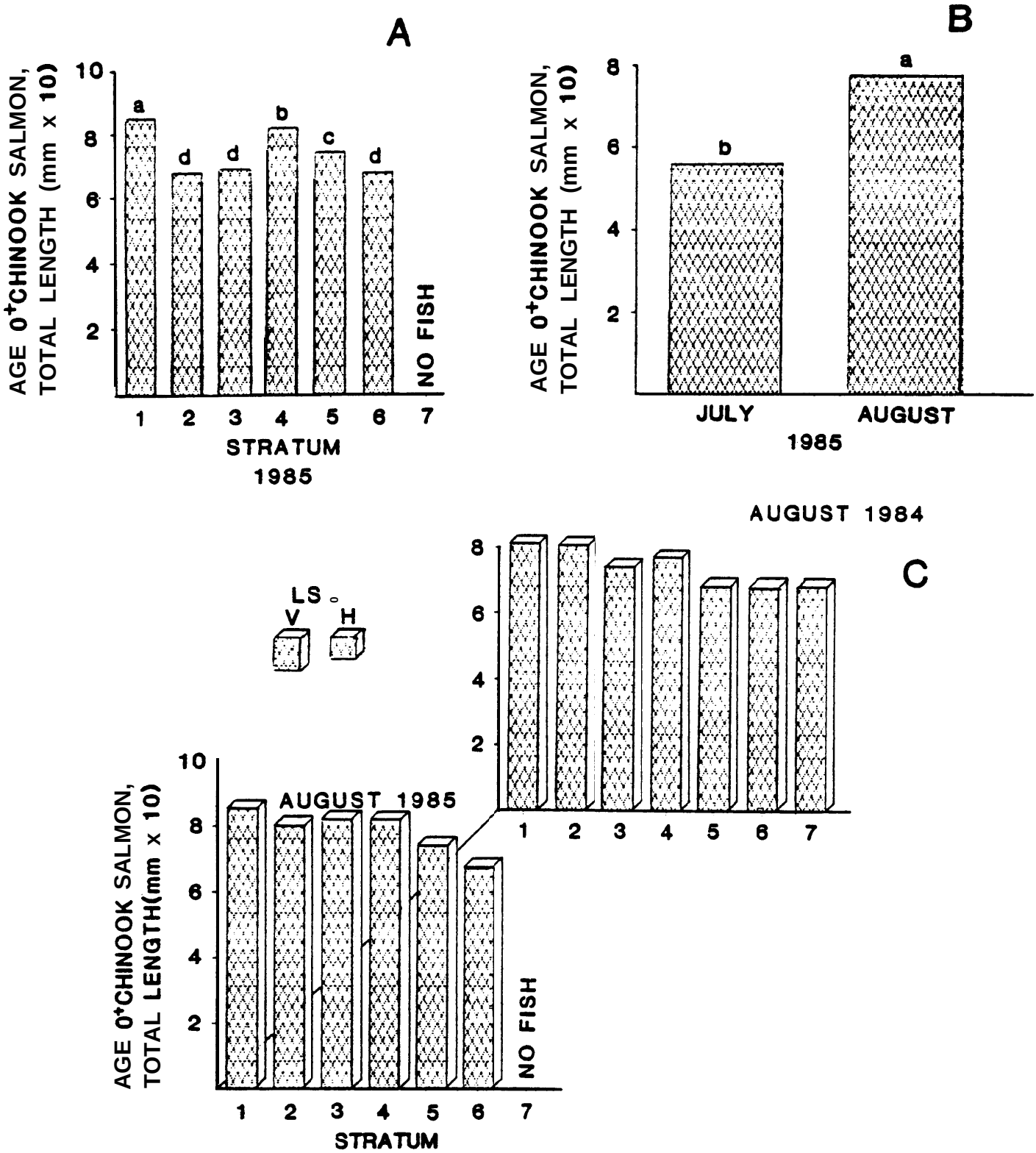


Figure 32. Mean (n=7 per stratum per month) total length of age 0+ chinook salmon among strata in 1985 (A), between July and August 1985 (B), and in strata between August 1984 and 1985 (C) in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant (P>0.05) difference among strata or month means. Mean differences wtihin or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant (P≤0.05) differences between those means.

Fish length was significantly longer in strata 1 and 2 than in the other strata, in stratum 4 than in strata 3, 5, 6, or 7, and in stratum 3 than in strata 5, 6, or 7. In August 1985, fish length did not differ significantly in strata 3 and 4. Fish length were significantly longer in stratum 1 than in other strata, in strata 3 and 4 than in strata 2, 5, 6, or 7, and in stratum 2 than in strata 5, 6, or 7. Fish length was significantly shorter in strata 1, 3, 4, and 5 in August 1984.

Live weight in July and August 1985. Fish weight differed (F=8.1, P<0.000l) among strata and (F=790.8, P<0.000l) between July and August. Fish weight ranged from 3.0 to 6.2 g/fish among strata (Fig. 33A) and were 1.8 and 4.9 g/fish in July and August, respectively (Fig. 33B). Fish weight did not differ significantly in strata 1 and 4, or in strata 2, 3, 6. Fish weight was significantly heavier in strata 1 and 4 than in strata 2, 3, 5, or 6, and in stratum 5 than in strata 2, 3, or 6.

Live weight in August 1984 and 1985. Fish weight differed (F=4.8, P=0.0003) among strata between August 1984 and August 1985. Fish weight ranged from 2.7 to 5.2 g/fish in August 1984 and from 3.0 to 6.2 g/fish in August 1985 (Fig. 33C). In August 1984, fish weight did not differ significantly in strata 1, 2, 3, and 4, or in strata 3, 4, 5, 6, and 7. Fish weight was significantly heavier in strata 1, 2, 3 and 4 than in the other strata. In August 1985, fish weight did not differ significantly in strata 1, 2, 3, and 4, in strata 2, 3, 4, and 5, or in strata 5 and 6. Fish weight was significantly heavier in strata 1, 2, 3 and 4 than in strata 5 or 6, and in strata 2, 3, and 4 than in stratum 6. Fish weight was significantly less in strata 3 and 4 in August 1984 than in August 1985.

Condition in July and August 1985. Fish condition differed (F=9.1, P=0.0027) among strata between July 1984 and August. Fish condition ranged from 0.97 to 0.99 in-July and from 0.96 to 1.02 in August (Fig. 34A). In July, fish condition did not differ significantly in strata 2 and 3 (only strata with fish). In August, fish condition did not differ significantly in strata 3, 4, and 5, or in strata 1, 2, and 6. Fish condition was significantly higher in strata 3, 4, and 5 than in strata 1, 2, or 6. Fish condition was significantly less in strata 3 during July than August 1985.

Condition in August 1984 and 1985. Fish condition differed (F=3.3, P=0.0068) among strata between August 1984 and August 1985. Fish condition ranged from 0.82 to 0.95 in August 1984 and from 0.96 to 1.04 in August 1985 (Fig. 34B). In August 1984 and 1985, fish condition did not differ significantly among strata. Fish condition was significantly less in strata 3, 4, and 5 in August 1984 than in August 1985.

Abundance in July and August 1985. In July, total number of fish was 9,013 + 2,199 (95% bounds) (Fig. 35 and

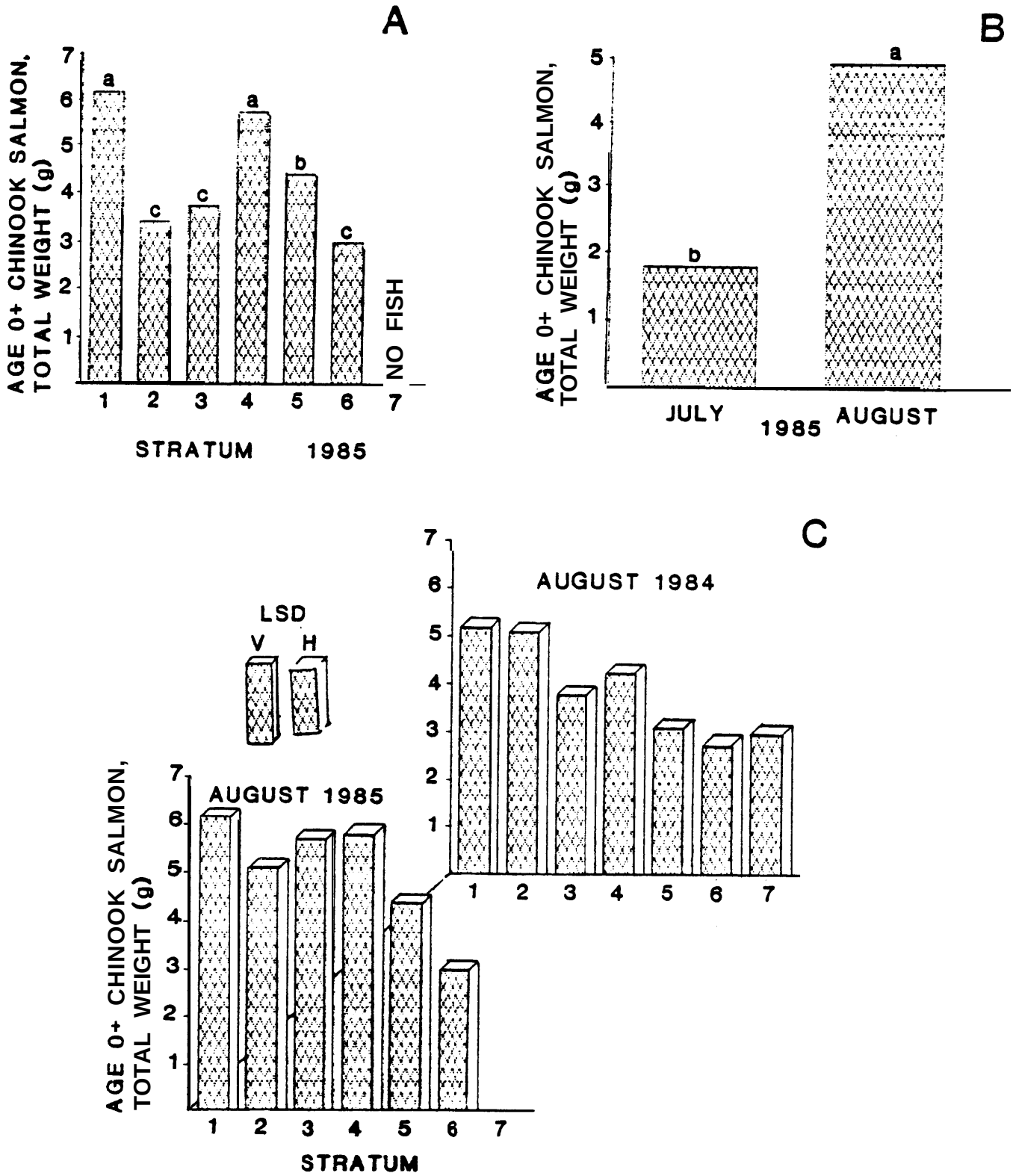


Figure 33. Mean (n=7 per stratum per month) total live weight of age 0+ chinook salmon among strata in 1985 (A), between July and August 1985 (B), and in strata between August 1984 and 1985 (C) in Bear Valley Creek, Idaho. A common letter above means indicate a non-significant ($P>0.05$) difference among strata or month means. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P\leq0.05$) differences between these means.

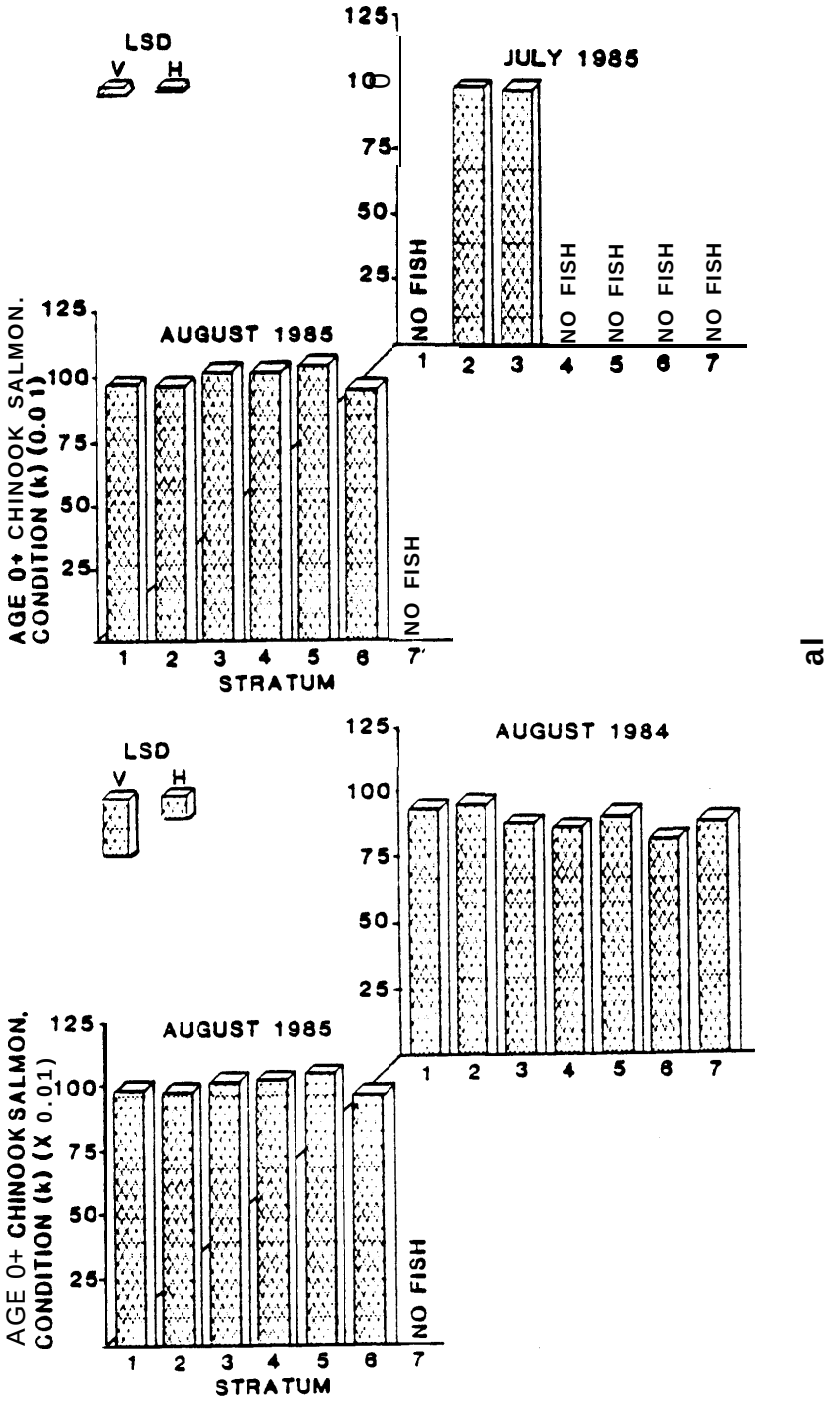


Figure 34. Mean (n=7 per stratum per month) condition factor of age 0+ chinook salmon in strata between July and August 1985 (A) and between August 1984 and 1985 (B) in Bear Valley Creek, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means.

Table 7). Highest numbers (6,353 + 4,819) were observed in stratum 3. Lowest numbers (0) were observed in strata 5, 6, and 7. Fish numbers did not differ significantly in strata 2 and 3, or in strata 1, 5, 6, and 7. Fish numbers were significantly larger in strata 2 and 3 than in other strata, and in stratum 4 than in strata 1, 5, 6, and 7. In August, total number of fish was 4,815 + 1,584. Highest numbers were 1,515 + 1,310 in stratum 4. Lowest numbers (0) were observed in stratum 7. Fish numbers did not differ significantly in strata 1, 2, 3, 4, 5, and 6. Fish numbers were significantly higher in strata 1, 2, 3, 4, 5, and 6 than in stratum 7.

Abundance in August 1984 and 1985. Fish numbers differed significantly between August 1984 and August 1985 (Fig. 36 and Table 7). Fish numbers were 18,100 + 4,093 in August 1984 and were 4,814 + 1,583 in August 1985.

Adult spring chinook salmon

Redd count in 1985. Total number of redds on 23 August 1985 was 85 (Table 8). A majority of the redds were located in the middle and upper portions of stratum 2 and the lower portion of stratum 3.

Assuming that each redd contained 3,500 viable embryos upon deposition in 1983 (55 redds; IDFG count) and 1984 (17 redds; Sho-Ban count), we observed a survival from redd to presmolt the following August of9.4% in 1984 and 8.1% in 1985.

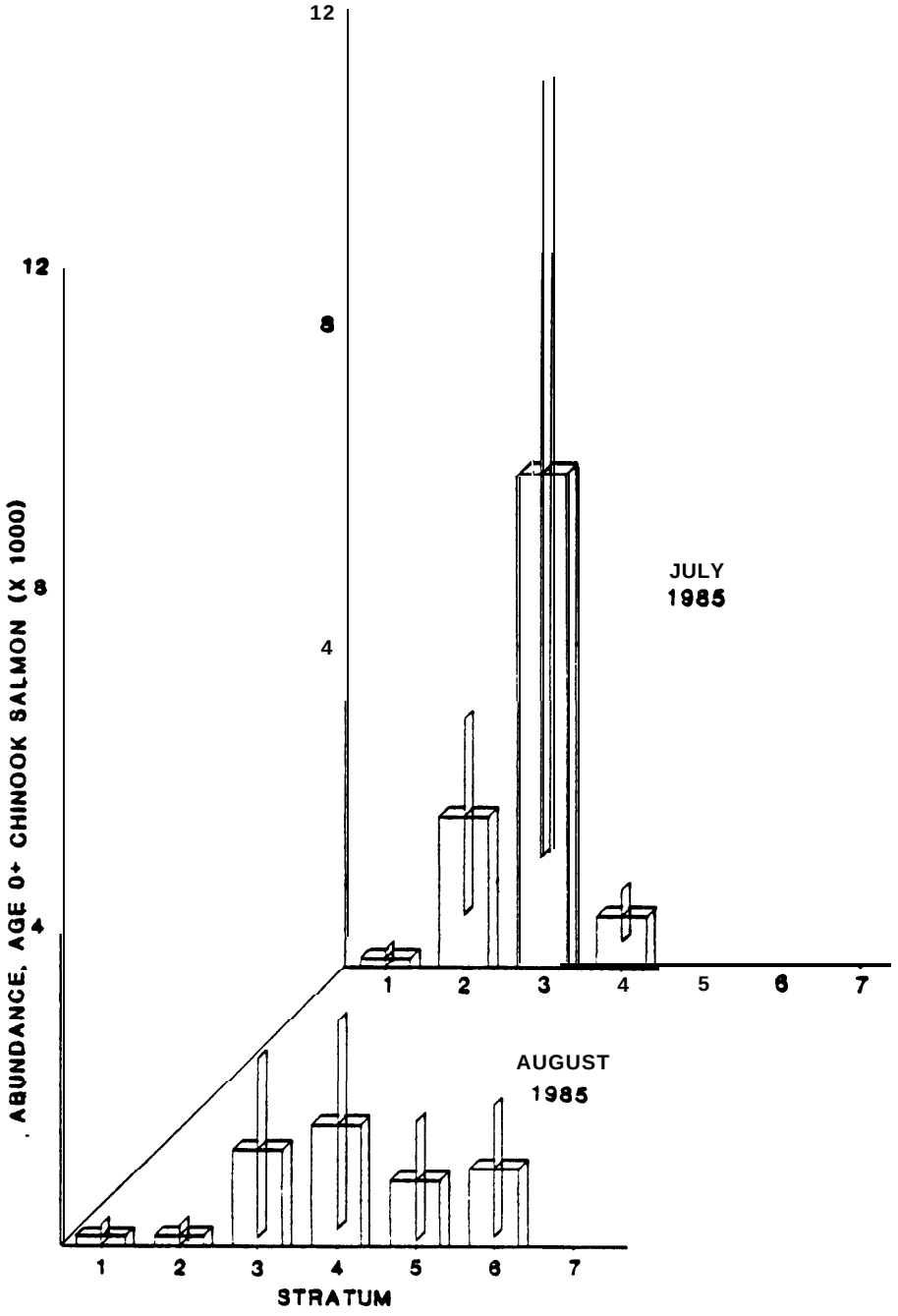


Figure 35. Estimated abundance of age 0+ chinook salmon by stratum during July and August 1985, Bear Valley Creek, Idaho. Vertical lines represent 95% confidence intervals.

Table 7. Abundance and associated 95% bounds of age 0+ chinook salmon in strata of Bear Valley Creek, Idaho, 1985 and 1984.

	Stratum		Abundance		
Month	Number	Length (km)	Estimate	Bounds	Percent of total
		1985			
July	1	7.7	118	o-239	1
July	2	11.1	1887	636-3111	21
July	3	12.7	6353	1534-11172	71
July	4	11.2	654	357-951	7
July	5	4.0	0	o-o	0
July	6	2.3	0	o-o	0
July	7	5.5	0	o-o	0
Totals		54.5	9,013	6,813-11,213	100
		1985			
August	1	7.7	147	O-308	3
August	2	11.1	127	o-259	3
August	3	12.7	1206	39-2373	25
August	4	11.2	1515	206-2824	31
August	5	4.0	825	42-1608	17
August	6	2.3	995	102-1888	21
August	7	5.5	0	o-o	0
Totals		54.5	4,815	3,232.6,400	100
		1984			
August	1	7.7	2409	1544-3274	13
August	2	11.1	1808	O-3176	10
August	3	12.7	2894	1295-4889	16
August	4	11.2	4144	1319-6969	23
August	5	4.0	4610	3347-5873	26
August	6	2.3	1226	403-2049	7
August	7	5.5	938	8694007	5
Totals		54.5	18,100	14,007-22,193	100

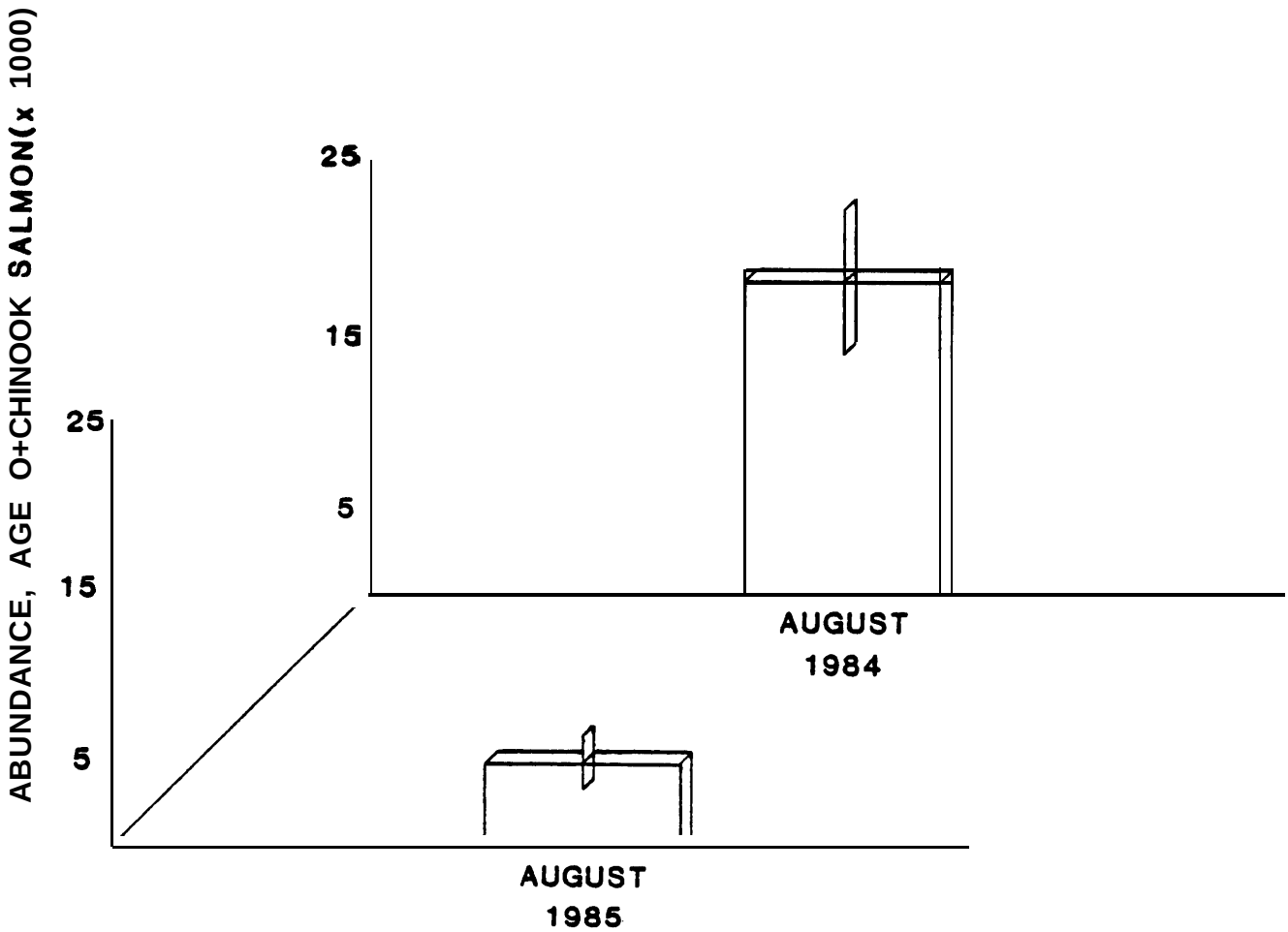


Figure 36. Estimated abundance of age 0+ chinook salmon in Bear Valley Creek, Idaho during August 1984 and 1985. Vertical lines represent 95% confidence intervals.

Table 8. Distribution of 85 redds counted by aerial observers in strata of Bear Valley Creek on 23 August 1985.

Stratum	Redd count			
	Lower	Middle	Upper	Total
1	0	2	1	3
2	1	14	25	40
3	29	7	2	38
4	1	0	0	1
5	1	1	0	2
6	0	0	1	1
7	0	0	0	0
Total				85

higher in strata 1, 2, 3, 4, 5, and 6 than in stratum 7.

Abundance in August 1984 and 1985. Fish numbers differed significantly between August 1984 and August 1985 (Fig. 36 and Table 7). Fish numbers were 18,100 + 4,093 in August 1984 and were 4,814 + 1,583 in August 1985.

Adult spring chinook salmon

Redd count in 1985. Total number of redds on 23 August 1985 was 85 (Table 8). A majority of the redds were located in the middle and upper portions of stratum 2 and the lower portion of stratum 3.

Assuming that each redd contained 3500 viable embryos upon deposition in 1983 (55 redds; IDFG count) and 1984 (12 redds; Sho-Ban count), we observed a survival from redd to presmolt the following August of 9.4% in 1984 and 8.1% in 1985.

DISCUSSION

Habitat Inventorv

Bear Valley Creek experienced a low water year in 1985. Flows in September 1985 were approximately 65% of flows in September 1984. Lower flows did not have a large dewatering effect on spawning riffles or reduced depths appreciably in pools.

Riffle and pool area did not differ between 1984 and 1985. As in 1984, less than 100 salmon spawned in the stream during August 1985. Packhurst (1950), based on 1950 conditions, stated 9,735 salmon could spawn in Bear Valley Creek. Thus, even though spawning areas are heavily impacted from sediment, most of potential spawning area is still underutilized (Fig. 4), because of low escapement.

Water temperatures in Bear Valley Creek ranged from 0.0 to 20.0c during 1985 and from 0 to 19C during 1984. Daily temperatures were very cyclic. High daily temperatures occurred between and 1200 hours each day. Low daily temperatures occurred between 0400 and 0630 each morning. Preferred range of water temperature for juvenile chinook salmon is 7 to 15C with an upper lethal temperature of 25C (Reisei and Bjornn 1979). High and low temperatures in Bear Valley Creek only occurred for short periods each day. Water temperature did not seem to be largely affected by the lower flows of 1985 which may partially explain, i.e. static but good environment, why Bear Valley Creek has sustained a good population of chinook salmon over the years.

Very few degree days were available to fish in stratum 7 (above mine). A lack of degree day during the summer may explain why the fish community in stratum 7 was somewhat less diverse than in other strata and possibly why no chinook spawn or rear in that strata.

Sediment condition of Bear Valley Creek may limit salmon production if higher escapement occurs but actually improved generally between 1984 and 1985. Fines in strata 2, 5; and 6 decreased between years. Low water, thus low bank erosion, may have contributed to the improvement. Spring flows do not have the flushings potential in Bear Valley Creek as in higher gradient streams. Given some flushings and a lack of sediment input caused by weekly and monthly events, we may have witnessed a slight improvement between years that may be masked next year by a normal flow year.

Fine sands have partially filled in most pools used for rearing by age 0+ chinook salmon in Bear Valley Creek. Impacts of the sedimentations may be limited, however, impacts of the 500,000 m of sand already moved downstream into the Middle Fork proper way have long range impact on chinook salmon. Pre-smolts leave Bear Valley Creek to overwinter in the Middle Fork. Sand may have filled in interslated spaces used by pre-smolts to overwinter in the Middle Fork. If this is so, the effective bottleneck of impact of sediment is downstream of Bear Valley Creek. Still a hypothesis, overwinter conditions

may be the key limiting factor, not spawning or rearing space, in the upper Middle Fork drainage (most fish from tributaries overwinter in Middle Fork) and should be addressed, at least in a qualitative manner, in the near future.

Fish Community Inventory

Age 0+ in mountain whitefish were the most abundant species-age class in 1985 while age 0+ chinook salmon were most abundant in 1984. In August 1985, density of mountain whitefish was higher (0.01 to 0.17 fish/m^2 pool) than density of age 0+ chinook salmon (0 to 0 .15 fish/m2 pool) in all strata except stratum 5. Densities of age 0+ chinook salmon were well below rearing potential (0.3 to 1.7 fish/m^2 pool) typical of Idaho streams (Schulich and Bjornn 1977; Bjornn 1978).

Total abundance of age 0+ chinook salmon in August 1985 was 4,815 while in August 1984 the stream contained 18,100 fish. Given that 55 redds were counted in 1983 and 17 in 1984 and that each female deposited 3,500 eggs (embryos in gravel), survival from deposition in August of one year to August the following year was 8.1% in 1985 and 9.4% in 1984. Redds in both years were placed in probably the best gravel conditions available in the stream even though those conditions were not optimum. All areas available for spawning were not utilized because of low escapement. A probiem with using fry per redd survival as an indicator of treatment of enhancement success might be that if escapement continues to be low i.e. because of harvest increases, and assuming no other catastrophic sedimentation event occurs, survival might not change significantly until all available spawning areas are filled. Better indicators of project specific treatment effects might be physical changes in substrate or cover, adults returning per fry year class, or just numbers of fry in August. The former two suggestions are long term while the latter may have a downstream bottleneck, i.e. overwintering in the Middle Fork affecting it off-site.

Age 0+ chinook salmon in August 1385 were generally longer, heavier, and in better condition than fish in August 1984. Reduced intraspecific competition for food and space probably contributed to the better growth in 1985.

Age l+ chinook salmon, age l+ brook trout, age 2+ and older brook trout, age 0+ bull trout, and adult mountain whitefish had significantly different densities among strata but did differ between 1984 and 1985. Age l+ steelhead/ rainbow trout and adult cutthroat trout densities differed significantly among strata although steelhead trout decreased between 1984 and 1985 while cutthroat trout increased between years. Age 0+ steelhead/rainbow trout, age 2+ steelhead/rainbow trout, age 0+ brook trout, age l+ and older bull trout, age 0+ mountain whitefish and juvenile whitefish densities differed in at least one stratum between 1984 and 1985. Bear Valley Creek's fish communities and is very dynamic relative to abundance, density, and composition. With decreases in age 0+ chinook salmon, age 0+ brook trout and age

0+ mountain whitefish increased. In addition, increases in adult cutthroat trout, and the same number of age 1+ and 2+ and older brook trout between years suggests opportunistic use of food and space and possibly an increase in the rate of predation (number of predators increasing with number of prey decreasing). We may have a classic predator trap situation in Bear Valley Creek in years such a 1985. Relative to enhancement, we may inadvertently be enhancing the environment of the introduced resident predator, i.e. brook trout, for number of years before we might expect to see a response from an anadromous target species.

Data Analyses and Models

After two years each of pre-treatment and post-treatment data have been collected, a need will be to approach the data set in a more complex manner, i.e. ultravariate analyses, models, dependent variables are probably responding to number of independent variables, i.e. redd counts, predator density, water year, degree-days, in a more predictive manner than simple one or two physical, i.e. treatment effects, factors.

As mentioned above modelling and future analyses may not detect a biological response to treatment because of off-site interactions with physical, i.e. overwintering space in middle fork or biological, i.e. downstream harvest, variables. Systematic error, i.e. number of redds per female, number of eggs per female, may have a lesser overall effect but might need to be fine tuned to account for unexplained variation.

LITERATURE CITED

Bjornn, T.C. 1978. Survival, production, and yield of trout and chinook salmon in the Lemhi River, Idaho. Bulletin No. 27, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, USA.

Carlander, K.D. 1979. Handbook of freshwater fishery biology, Volume 1. The Iowa State University Press, Ames, Iowa, USA.

Helwig, J.T. and K.A. Council, editors, 1979. SAS user's guide. SAS Institute, Inc., Cory, North Carolina, USA.

Newberry, D.D., and D.R. Corley. 1984. Salmon and steelhead habitat surveys of the Bear Valley Creek drainage. Completion Report, Boise National Forest, U.S. Forest Service, Boise, Idaho, USA.

Northwest Power Planning Council. 1984. Columbia River Basin fish and wildlife program. Portland, Oregon, USA.

Ott, L. 1977. An introduction to statistical methods and data analysis. Duxbury Press, North Scituate, Massachusetts, USA.

Parkhurst, Z.E. 1950. Survey of the Columbia River and its tributaries, Part VII. Special Scientific Report: Fisheries No. 40. U.S. Department of the Interior, Fish and Wildlife Service.

Reiser, D.W., and T.C. Bjornn. 1979. Habitat requirements of anadromous salmonids. Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow and Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon, USA.

Sekulick, P.T., and T.C. Bjornn. 1977. The carrying capacity of streams for rearing salmonids as affected by components of the habitat. Completion Report for Supplement 99, USDA Forest Service.

Steele, R.G., and J.H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Company, Inc., New York, New York, USA.

Thurow, R. 1985. Middle Fork Salmon River fisheries investigations. Study VI, Job Completion Report, Project F-73-R-6. Idaho Department of Fish and Game, Boise, Idaho, USA.

SUBPROJECT II

Middle Fork/Upper Salmon River:
Planning and Coordination

ACTIVITIES

Dr. Richard C. Konopacky, Project Leader (PL) of BPA Project No. 83-359 and a representative of the Shoshone-Bannock Indian Tribes, consulted with personnel from Bonneville Power Administration (BPA), Idaho Department of Fish and Game, the Boise National Forest (BNF), the Sawtooth National Recreation Area (SNRA), other land management agencies, BPA-contracted consulting firms, and private land owners on aquatic habitat enhancement projects (ongoing and proposed) on the Salmon River and the Middle Fork of the Salmon River above their confluence. Four BPA habitat projects consumed most of the PL's time within this subproject. The four projects are: 1) BPA Project No. 83-415, Alturas Lake Creek and Upper Salmon River Flow Augmentation; 2) BPA Project No. 84-24, Marsh, Elk, Valley, Upper Salmon River, Idaho; 3) BPA Project No. 84-28; Lemhi River Rehabilitation; and 4) BPA Project No. 84-29, Panther Creek. The Fort Bridger Treaty of 1868 entitles tribal members to fish in those drainages mentioned above and was used as the criteria for Tribal involvement in project coordination efforts and the cooperative management of anadromous fish resources within Treaty areas.

The PL attended two meetings concerning the Alturas Lake Creek/Salmon River Flow Augmentation Project during 1985. The PL met in Ketchum, Idaho with personnel from BPA, IDFG, SNRA, and Dr. Enright, the owner of the Busterback Ranch (problem area), and discussed possible alternatives to the dewatering (flood irrigation) problem on his ranch. Dr. Enright made a decision during the summer to convert from the present flood irrigation to a center pivot alternative that had been proposed to him and that could be funded by BPA. SNRA officials then reviewed the request by Dr. Enright and found that a center pivot system would impair the visual esthetics of the SNRA even though they had submitted the alternative as a viable solution to the landowner in the initial meeting. The PL met with representatives of BPA, IDFG, and the SNRA on 7 November and discussed the future direction of the project. Dr. Enright has turned the matter over to his lawyers while the SNRA has transferred the decision process to the Regional level. Future meeting are planned.

The PL attended seven meetings concerning the Marsh, Elk, Valley, Upper Salmon River, Idaho Project during 1985. On 24 January, the PL met with Harvey Forsgren (SNRA) and Terry Holubetz (IDFG) and discussed Forsgren's past methodologies for collecting terrestrial plant community data and their application in the upcoming project. Estimates of the number of samples necessary in the upcoming project were calculated from the existing data base. An RFP for the contract was put out by th BNF in th spring. On 8-9 May the PL met with representatives of BPA, IDFG, SNRA,

Challis National Forest, and the BNF, reviewed proposals submitted for the contract, and chose OEA, Inc. (high technical marks, low bid) of Helena, Montana to do the work. On 4 June the PL met with other agency representatives and Chris Hunter of OEA and discussed project approach, coordination, and planning. The PL met wih BNF personnel on I2 August and discussed progress on the project. The PL again met with agency personnel and the OEA representative and discussed a possible work statement change in the project which would reflect a request to compare project findings to existing or past land management activities, The PL met with agency personnel and reviewed OEA's draft final report for the project. The report was found to be lacking in data analyses and conclusions, OEA was given direction and other steering committee meetings were planned. On 16 December, the PL and the agency personnel met and developed a list of analyses still needed to be done on the project data base. A memo listing the analyses and other correction necessary to the draft was forwarded to OEA by the BNF. Future meetings are planned.

The PL attended three meetings concerning the Lemhi River Rehabilitation Project during 1985- On 6 May, the PL met with personnel from BPA, IDFG, and Ott Water Engineers (contractor) and discussed progress on the project to that date. Most work was to be completed during the 1985 field season. On 11 September, the PL met with the same representatives and discusses the data that had been collected during th summer, the analyses to be run, and future meetings necessary to fulfill contract commitments. On 19-20 November, the PL along with the agency and contractor reps met with approximately 20 local ranchers and citizens of the Salmon, Idaho area and discussed the projects findings, recommendations of local solutions in the dewatered areas, and other possible directions the project could take. Discussions followed a slide presentation by the contractor. Future meetings are planned.

The PL attended three meetings concerning the Panther Creek Project during 1985, On 29-30 July, the PL met personnel from BPA, IDFG, Idaho Attorney General's Office, Noranda Mining, Inspiration Mining, and Bechtel, Inc. (contractor) and discussed the preliminary findings (solutions and costs) of the contractor. All parties agreed that a future mining plan and a possible refinement of Bechtels preliminary findings should be reviewed before any decisions on direction could be made. An update of the findings and a mining plan was reviewed and discussed on 30 September. On 5 December and after Inspiration Mining pulled out of the project, the PL met with the other agency reps and discussed direction of the project from biological and legal standpoints. Future meetings are planned.

SUBPROJECT III

Yankee Fork of the Salmon River: Inventory and Problem Identification

ABSTRACT

Extensive dredge mining has altered much of the aquatic habitat in the Yankee Fork of the Salmon River drainage. Aquatic habitat and fish communities were inventoried in the Yankee Fork of the Salmon River (the latter two streams are tributaries to the Yankee Fork) during August in 1984 and 1985 for use as pre-treatment data to evaluate anticipated habitat enhancement. Physical and biological variables were measured (one time) in four sites within each of six strata (49 km) during 1984 and in six sites within each of seven strata (61 km) during 1985 over most of the Yankee Fork. Fish data were collected via snorkel-observations, electrofishing, and seining. Minimum and maximum water temperatures were similiar during like periods of 1984 and 1985. Lower flows in 1985 than in 1984 caused a significant change in riffle area, pool area, and pool width in at least one stratum between years. Natural and human-caused changes in sedimentaion rates caused changes in substrate size distributions and the amount of fines on riffles and in pools. Stream gradient, maximum pool depth, and larger substrate particles did not significantly change within strata between years. Aggradation/degradation of substrates from the riparian zone, stream zone, and stream channels, ranged from -1.25 to 0.89 m 2/yr, -1,OO to 1.10 m2/yr, and -0.74 to 1.09 m2/yr, respectively, among strata but did not differ significantly. In decreasing order of abundance, during 1984 and 1985, salmonid species in the Yankee Fork drainage included: steelhead/rainbow trout (Salmo gairdneri) chinook salmon (Oncorhynchus tshawytscha) , mountain whitefish (Prosopium williamsoni) cutthroat trout (S. clarki) , bull trout (Salvelinus confluentus) , and bull trout (Salvelinus confluentus) , and brook trout (S. fontinalis) . The Yankee Fork contained 12,847+6,131 age 0+ chinook salmon in August 1984 and 13,495+6,014 in August 1985. Age 0+ chinook salmon were generally longer and heavier in 1984 than in 1985. Bull and brook trout densities significantly increased in at least one stratum between 1984 and 1985. Densities of other salmonids differed among strata but not between 1984 and 1985 nor within a stratum between 1984 and 1985. Salmonid habitat and passage problem areas were identified and prioritized for remediation in stratum 5. Major sedimentation problem types, in (part of Reach C) descending order of potential sediment input, included: sloughing stream banks, roading adjacent to the stream, washouts, and open slopes. Passage problems included stranded pools and log jams.

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INTRODUCTION

The Yankee Fork of the Salmon River, a major tributary of the mainstem Salmon River, is a spawning and rearing stream for anadromous salmonids. Past redd counts (Internal data, Idaho Department of Fish and Game) indicate the Yankee Fork was an important spawning stream for wild spring chinook salmon (Oncorhynchus tshawytscha) in the Salmon Rive; drainage. Redd counts are depressed to less than 50 redds per year during the 1980's from approximately 400 redds per year during the 1960's through early 1970's. No hatchery supplementation of these salmon stocks have occurred to date. Although no redd count data exists, wild steelhead trout (Salmo gairdneri) also utilize the Yankee Fork for spawning and rearing. Steelhead have been supplemented by hatchery outplanting during recent years.

The Yankee Fork of the Salmon River system has a long history of adverse land use practices which have contributed to the decline of anadromous fish runs. Dredge-mining for gold since the'late 1800's has severely altered stream conditions for several miles in the lower Yankee Fork and lower Jordan Creek. Extensive unconsolidated and unvegetated dredge tailings have increased sedimentation of spawning riffles and rearing pools and reduced riparian cover.

The Yankee Fork system is an important (and treaty guaranteed) anadromous fishing area for members of the Shoshone-Bannock Tribes. As a conservation measure, the Tribes have voluntarily chosen not to exercise this treaty right since 1978. Through BPA funding and in anticipation of potential habitat enhancement, the Tribes conducted fish and habitat inventories and identified habitat problems in the drainage during 1984 and 1985. Prioritization of habitat problems affecting fish and their habitats throughout the system, relative to sediment recruitment (identified as the primary problem in the drainage) and remediation was also accomplished.

Objectives of this study were: 1) to inventory fish populations and their habitats in the Yankee Fork system; and 2) to identify on-site problems affecting fish populations and their habitats and prioritize the problems for remediation.

STUDY AREA

The Yankee Fork of the Salmon River, located in Custer County, Idaho, is a major tributary of the upper Salmon River (Fig. 1). The West Fork of the Yankee Fork of the Salmon River is the largest tributary to Yankee Fork. Other notable tributaries to the Yankee Fork include Jordan, Lightning and Eightmile creeks. The Yankee Fork of the Salmon River is a low to medium gradient system which flows through narrow canyons, moderately wide valleys of lodgepole pine (*Pinus contorta*) forests, and wide meadowed valleys. Most of the system is roaded and lies in an area of the Challis Volcanics which are characterized by highly erosive sandy and clay-loam soils. Adjacent lands are owned predominately by the U.S.Forest Service (Challis National Forest) and mining permittees.

The inventory and problem identification studies addressed 60.6 km of the Yankee Fork system which extended from the mouth to the confluence with McKay Creek; the West Fork Yankee Fork up to the confluence with Cabin Creek; and, Jordan Creek up to the Loon Creek Summit road.

Substantial sections of the mainstem Yankee Fork (9.7 km) and lower Jordan Creek (2.4 km) have been dredge-mined for gold which resulted in extensive barren dredge tailings adjacent to the stream. Smaller dredge, placer, deep rock, and open pit mines continue to operate in upper Yankee Fork and Jordan Creek. Permits are for both commercial and recreational operations. Roads parallel the entire system except the West-Fork of the Yankee Fork. Livestock grazing is limited to the upper mainstem Yankee Fork.

The Yankee Fork system is an important spawning and rearing stream for chinook salmon and steelhead/rainbow trout. Utilization by chinook salmon has declined since the mid 1960's (Fig. 2). Other fish species present in the Yankee Fork system include bull trout (*Salvelinus confluentus*), cutthroat trout (*S. clarki*), mountain whitefish (*Prosopium williamsoni*), and short head sculpin (*Cottus confusus*).

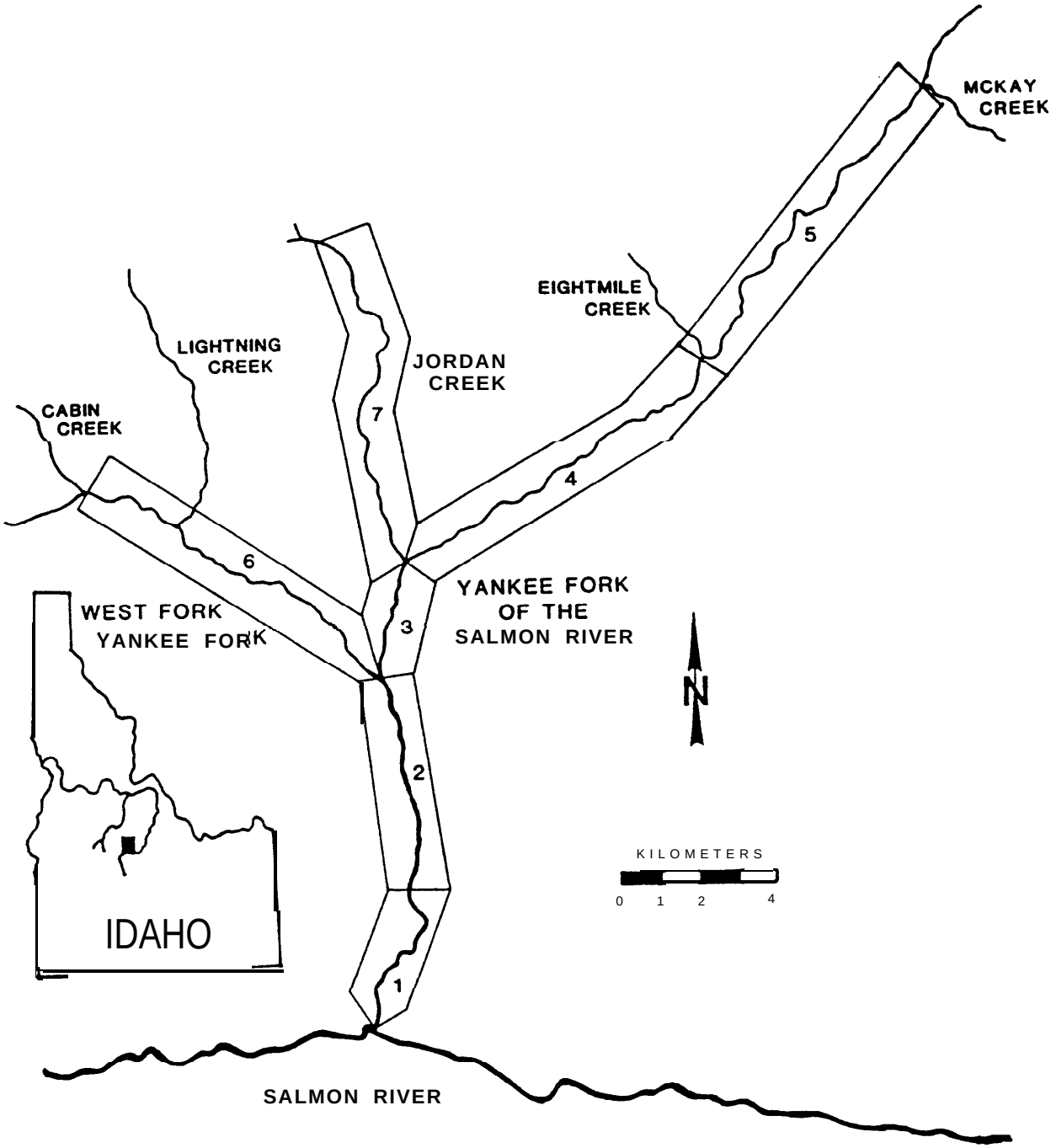


Figure 1. Yankee Fork of the Salmon River, Idaho, study area and strata location.

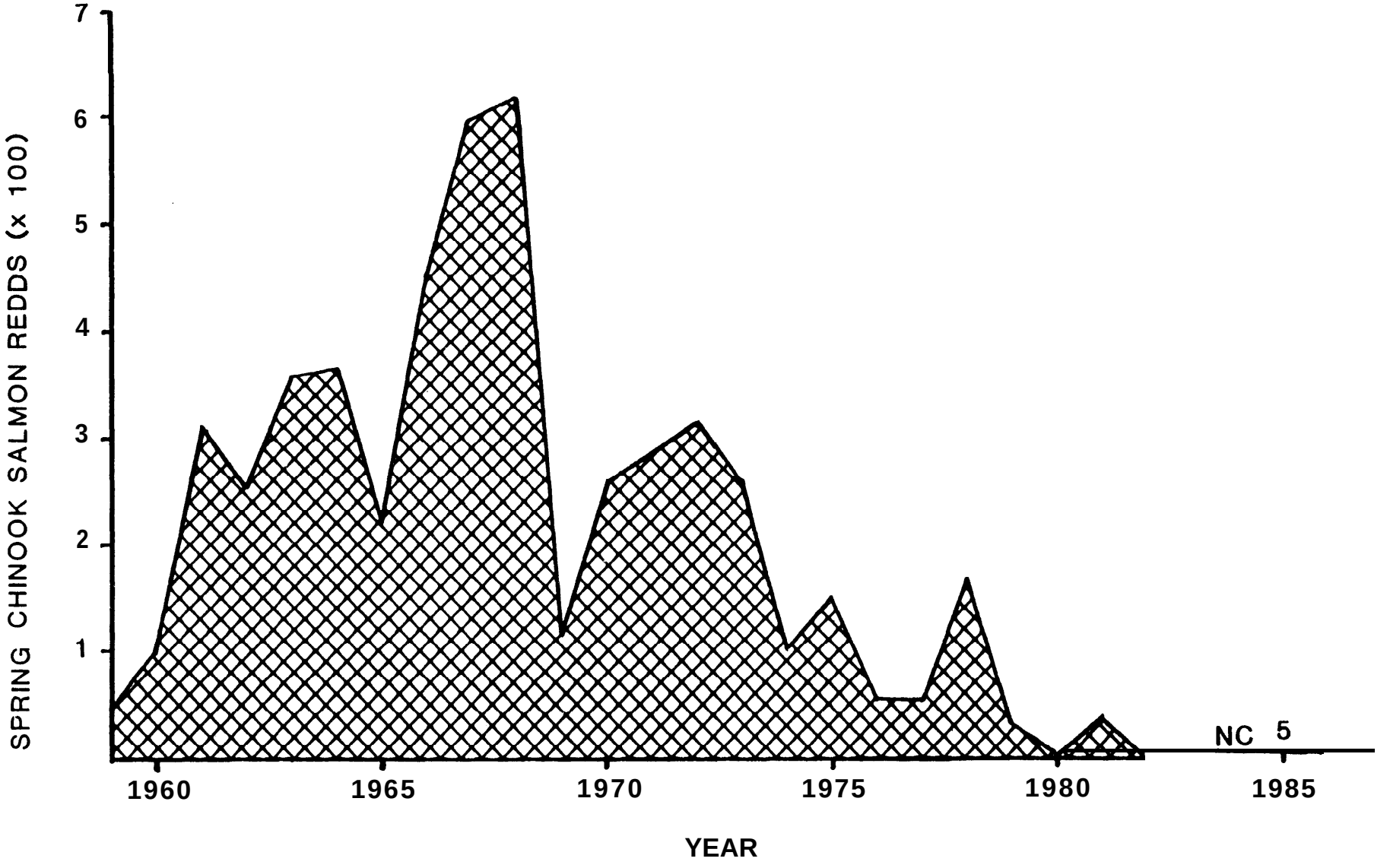


Figure 2. Counts of spring chinook salmon redds in Yankee Fork of the Salmon River, Idaho, 19594985. Pre-1960 counts were made by walking the stream while counts in later years were made from the air.

METHODS

Habitat and Fish Community Inventories

Variables

Habitat and biological variables measured in Yankee Fork (Table 1) were similar to variables measured in Bear Valley Creek during 1985 (Methods, Sub-project 1, BPA Project 83-359, FY 1985 Annual Report).

Variable Measurement

Measurement of variables in Yankee Fork followed methodologies used in Bear Valley Creek during 1985 (Methods, Sub-project 1, BPA Project 83-359, FY 1985 Annual Report).

Experimental Design

A sampling scheme (split plot in time or repeated measure) similar to the one used in Bear Valley Creek (Methods, Subproject 1, BPA Project 83-359, FY 1985 Annual Report) was used in Yankee Fork in 1985 (Tables 2 and 3) with two exceptions: measurements were at six sites within each of seven strata (seven and seven in Bear Valley Creek) (Fig. 1); and, measurement of biological variables occurred once in August (July and August in Bear Valley Creek). Stratification of the Yankee Fork was based on stream size, valley width, gradient, land use, and land ownership (Table 4) l

During 1984 in the Yankee Fork, all variables were measured at four sites within each of six strata during August. Strata 5, the strata added during 1985, was labeled as that strata upstream of strata 4 on the mainstem Yankee Fork. Strata 5 and 6 during 1984 are now and will continue to be strata 6 and 7, respectively. All data has been analyzed according to the 1985 locations. During 1986 and later years, biological variable will be measured in July and August.

Problem Identification

In 1984, the Yankee Fork drainage was separated into 5 reaches (one or more strata) on the basis of mining activities (past or present), stream size, valley width, and location in the drainage (Table 4). The entire length of each reach (one or more strata) was walked and the physical characteristics of the reach and problem areas described. The addition of stratum 5 in 1985 required that the stratum be walked and all habitat problems be documented. Only stratum 5 was walked during 1985.

Strata 5 was included in Reach C only (stratum 4 in 1984) since physical characteristics and problems were simiar to those of stratum 4. Data from Reach C in 1984 was modified to include stratum 5 in 1985. We assumed that the

Table 1. Habitat and biological variables monitored in the Yankee Fork of the Salmon River, Idaho during 1984 and 1985.

Habitat	Biological (Fish)
Temperature	Species composition
Flow (discharge)	Relative abundance
Surface area	Density
Stream width	Population number
Stream depth	Fish length
Stream gradient	Fish weight
Riparian cover	Fish condition
Stream substrate (5 types)	
Channel aggradation/degradation	

Table 2. Experimental designs, used in 1984, 1985, and proposed for 1986, for sampling habitat variables on the Yankee Fork of the Salmon River, Idaho.

Source	Degrees of freedom
1984	
6 Strata	5
4 Sites (Stratum), Error A	18
TOTAL	23
1985	
7 Strata	6
6 Sites (Stratum), Error A	35
2 Years	1
Years x Strata	5*
Error B	18*
TOTAL	65*
1986	
7 Strata	6
6 Sites (Stratum)	35
3 Years	2
Years x strata	10*
Error B	54*
TOTAL	

* unbalanced because of a change in the number of strata and sites per strata between 1984 and 1985.

Table 3. Experimental designs, used in 1984, 1985, and proposed for 1986, for sampling biological variables on the Yankee Fork of the Salmon River, Idaho.

Source	Degrees of freedom
1984	
6 Strata	5
4 Sites (Stratum), Error A	18
TOTAL	23
1985	
7 Strata	6
6 Sites (Stratum), Error A	35
2 Years	1
Years x strata	5*
Error B	18*
TOTAL	65*
1986	
7 Strata	6
6 Sites (Stratum)	35
3 Years	2
Years x strata	l0*
Error B	54*
TOTAL	107*

* unbalanced because of a change in the number of strata and sites per stratum between 1984 and 1985.

Table 4 Strata characteristics, Yankee Fork of the Salmon River, Idaho.

Stratum	Length	Gradient	Land type	Land ownership	Land use
1[a]	5.5[b]	Medium	Narrow forested valley	USFS[c]	Non-consumptive
2	6.0	Low-medium	Wide valley, sparse forest	USFS, JRS[d], private	Mining
3	3.8	Medium	Wide valley, sparse forest	USFS, JRS, private	Mining
4	11.8	Medium	Moderately wide valley, forest	USFS, private	Mining, grazing
5[e]	11.4	Medium-High	Moderately wide valley, forest	USFS	Grazing
6[f]	12.7	Low-medium	Moderately wide valley, forest/meadow	USFS	Non-consumptive
7[g]	9.6	High	Narrow forested valley	USFS, JRS, private	Mining

[a] stream mouth.
[b] kilometers.
[c] U.S. Forest Service, Challis National Forest.
[d] J.R. Simplot, Boise, Idaho.
[e] stream headwaters.
[f] West Fork of the Yankee Fork of the Salmon River.
[g] Jordan Creek, tributary to the Yankee Fork of the Salmon River.

physical charactristics and problem areas in stratum 4 did not change between 1984 and 1985. Reach characteristics included: stream, size and gradient; riffle-pool type; extent and quality of spawning and rearing habitat; stream bank type, stability and riparian cover: valley width; and, upland slope cover. Problem areas were identified in relation to sediment sources, habitat degradation, and passage barriers. The type, extent and relative severity of each problem was estimated during the walk through and recorded. Air photos were taken at low levels along each reach. Problem sites were marked on acetate overlays to help measure their frequency and extent within each reach. Length of similar problem types were summed from each reach and the percent of the total reach each problem type comprised was calculated. Problem types for each reach were ranked according to their estimated contribution of sediment into the reach. This ranking was based on the extent, instability, proximity, and type of erosive material for each problem type. Problem areas for each reach were also ranked according to their estimated priority for correction. Priority was based on sediment contribution, size, ease and feasibility of correction, and cause (natural or unnatural) for each problem type.

RESULTS

Variables in the habitat and the biological or fish inventories of the Yankee Fork of the Salmon River, Idaho were measured once in early September in 1984 and again in mid-August in 1985. Variable means were compared among strata, between 1984 and 1985, among strata within 1984 or 1985, and within a stratum between 1984 and 1985.

Habitat Inventory

Water temperature ranged from 0.5 to 18.9 C during August and September (Table 5). Minimum temperatures among strata in 1985 ranged from 0.5 to 14.4 C. Maximum temperatures among strata in 1985 ranged from 4.4 to 18.9 C. Minimum temperatures among strata in 1984 ranged from 0.0 to 9.0 C. Maximum temperatures among strata in 1984 ranged from 2.0 to 14.0 C.

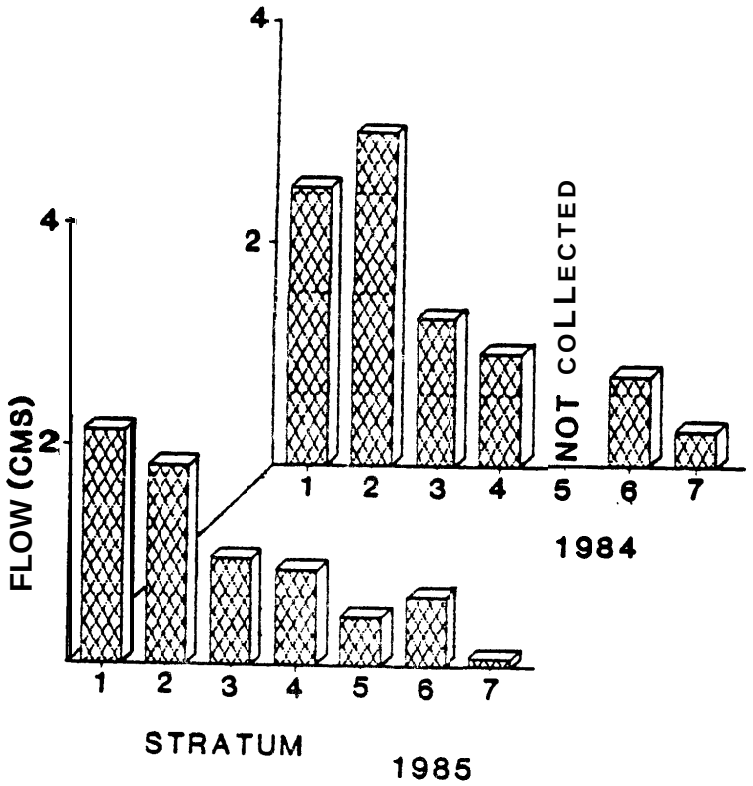
September flows during 1985 in main stem Yankee Fork ranged from 0.46 m^3 /second in stratum 7 to 2.13 m^3 /second in stratum 1 (Fig. 3A). Flows in the West Fork of Yankee Fork (stratum 6) and Jordan Creek (stratum 7) were 0.66 and 0.08 m /second, respectively (Fig. 3A). September mean flow in 1984 was 1.44 m^3 /second. September mean flow in 1985 was 1.00 m /second (Fig. 3B).

Riffle area differed (F=5.0, P=0.0047) among strata between 1984 and 1985 (interaction), Riffle area ranged from 45.0 to 881.7 m in 1984 and from 36.8 to 760.2 m^2 in 1985 (Fig. 4B). In 1984, riffle area differed significantly among all strata. Riffle area was significantly larger in stratum 1 than in other strata, in stratum 2 than in strata 3, 4, 6, or 7, in stratum 6 than in strata 4 or 7, and in stratum 4 than in stratum 7. In 1985, riffle area did not differ significantly in strata 4 and 5. Riffle area was significantly larger in stratum 2 than in other strata, in stratum 3 than in strata 1, 4, 5, 6, or 7, in stratum 6 than in strata 4, 5, or 7, and in strata 4 and 5 than in stratum 7. Riffle area differed significantly in each stratum between 1984 and 1985.

Pool area differed (F=6.7, P=0.00ll) among strata between 1984 and 1985 (interaction), Fool area ranged from 55.3 to 1727.9 m^2 in 1984 and from 53.4 to 1540.0 m^2 in 1985 (Fig. 4A). In 1984 and 1985, pool area differed significantly among all strata. Pool area was significantly larger in stratum 2 than in other strata, in stratum 1 than in strata 3, 4, 6, or 7, in stratum 3 than in strata 4, 6, or 7, in stratum 4 than in strata 6 or 7, and in stratum 6 than in stratum 7. In 1985, pool area was significantly larger in stratum 2 than in other strata, in stratum 1 than in strata 3, 4, 5, 6, or 7, in stratum 3 than in strata 4, 5, 6, or 7, in stratum 4 than in strata 5, 6, or 7, in stratum 6 than in

Table 5. Water temperature (C) extremes by stratum in the Yankee Fork of the Salmon River, Idaho from 7 September to 28 September 1984 and from 1 August to 16 September, 1985.

Stratum	Temperature range (C)	
	1984	1985
1	2.0 - 14.0	2.2 - 18.9
2	0.0 - 14.0	4.4 - 16.7
3	0.0 --	2.7 - 18.3
4	1.0 9.0	2.7 - 17.8
5	-- --	4.4 - 18.3
6	-- --	3.3 - 17.2
7	2.0 - 12.0	0.5 - 14.4



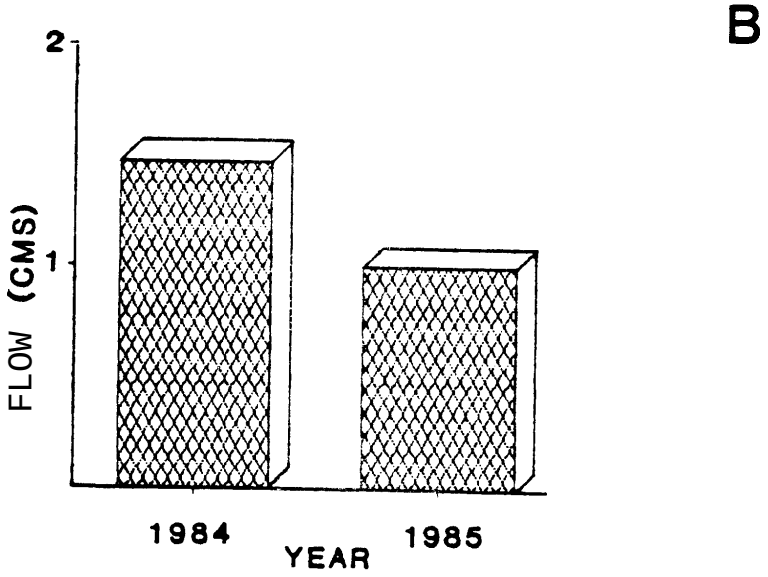


Figure 3. Flow, by strata (A) and for the entire stream (B) in the Yankee Fork of the Salmon River, Idaho, 1984 and 1985.

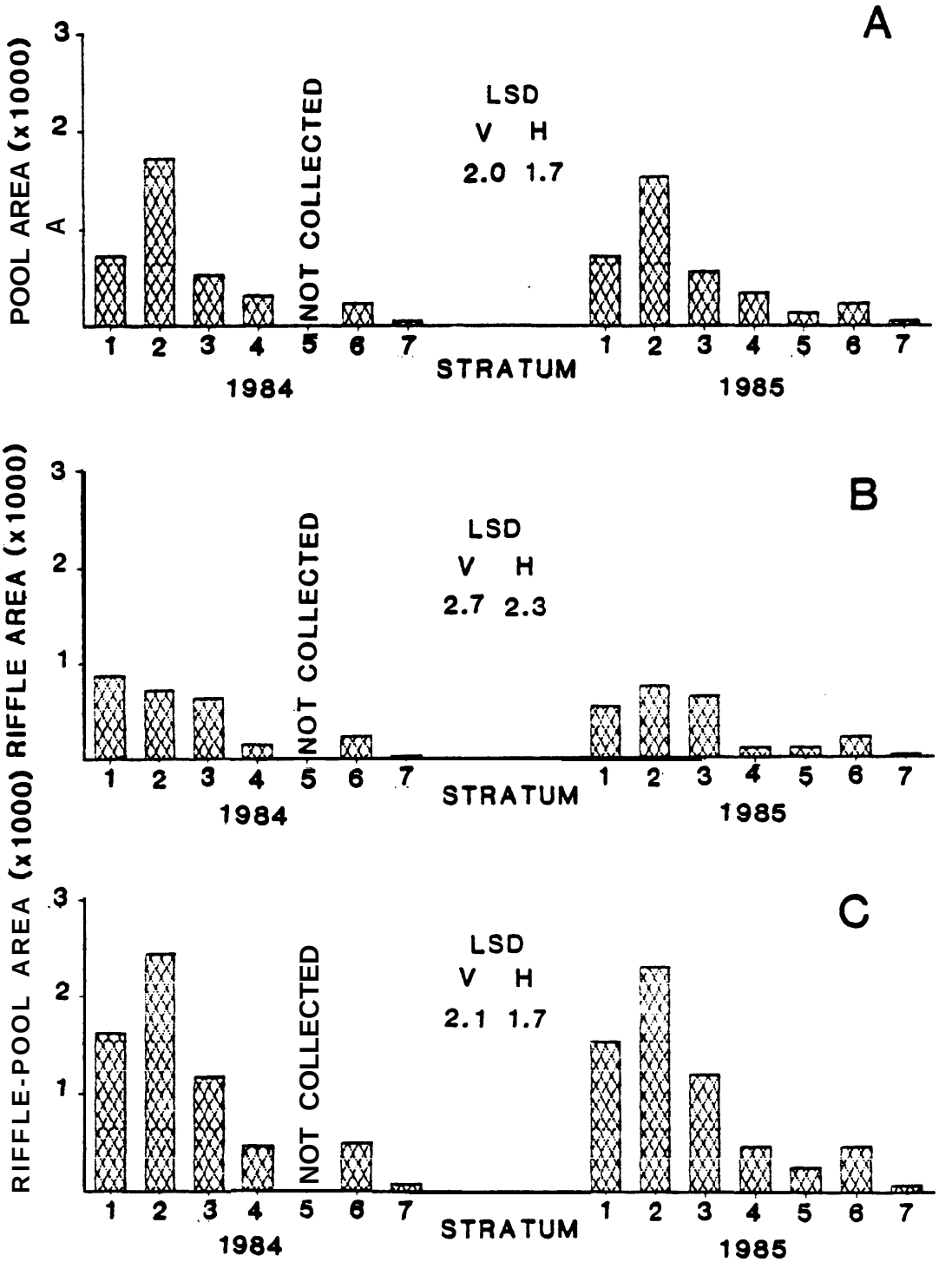


Figure 4. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) area of riffles (A) pool, and riffle-pool sites by stratum between 1984 and 1985, Yankee Fork of the Salmon River, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means.

strata 5 or 7, and in stratum 5 than in stratum 7. Pool area in strata 3 and 4 was significantly smaller in 1984 than in 1985. Pool area in all other strata was significantly larger in 1984 than in 1985.

Site area (riffle plus pool) differed (F=9.5, P<0.000l) among strata between 1984 and 1985 (interaction). Riffle pool area ranged from 100.3 to 2470.6 m in 1984 and from 90.3 to 2304.4 m in 1985 (Fig. 4C). In 1984, site area differed significantly among all strata. Site area in stratum 2 was significantly larger than other strata, stratum 1 than in strata 3, 4, 6, or 7, stratum 3 than in strata 4, 6, or 7, stratum 6 than in strata 4 or 7, and in stratum 4 than in stratum 7. In 1985, site area was significantly larger in stratum 2 than in other strata, in stratum 1 than in strata 3, 4, 5, 6, or 7, in stratum 3 than in strata 4, 5, 6, or 7, in stratum 6 than in strata 4, 5, or 7, in stratum 4 than in strata 5 or 7, and in stratum 5 than in stratum 7. Site area was significantly larger in 1984 than in 1985 in strata 1 and 2. Site area was significantly smaller in 1984 than in 1985 among all other strata.

Pool width differed (F=9.3, P=0.0002) among strata between 1984 and 1985 (interaction). Pool width ranged from 4.6 to 15.0 m in 1984 and from 4.1 to 15.1 m in 1985 (Fig. 5A). In 1984, pool width did not differ significantly between strata 1 and 3. Pool width was significantly larger in stratum 1 than in other strata, in strata 1 and 3 than in strata 2, 4, 6, or 7, in stratum 4 than in strata 6 or 7, and in stratum 6 than in stratum 7. In 1985, pool width did not differ significantly between strata 1 and 3. Pool width was significantly larger in stratum 2 than in other strata, in strata 1 and 3 than in strata 4, 5, 6, or 7, in stratum 6 than in strata 5 or 7, and in stratum 5 than in stratum 7. No stratum differed in pool width between 1984 and 1985.

Maximum pool depth differed (F=8.8., P<0.000l) among strata but did not differ (P=2.6, F=0.0587) between 1984 and 1985. Maximum pool depth ranged from 0.46 to 1.13 m among strata (Fig. 5B) and was 0.78 and 0.73 m in 1984 and 1985, respectively (Fig. SC). Maximum pool depth did not differ significantly between strata 2 and 4, strata 3 and 4, or strata 6 or 7. Maximum pool depth was significantly larger in stratum 1 than in other strata, in strata 2 and 4 than in strata 6 or 7, and in stratum 3 than in strata 6 or 7.

Gradient differed (F=8.14, P<0.000l) among strata but did not differ (F=0.04, P=0.8362) between 1984 and 1985. Gradient ranged from 0.67 to 2.50% among strata (Fig. 6A) and was 1.27 and 1.10% in 1984 and 1985, respectively, (Fig. 6B). Gradient did not differ significantly in strata 1, 3, 4, and 6 or in strata 1, 2, and 6. Gradient was significantly higher in stratum 7 than in the other strata and in strata 3 and 4 than in stratum 2.

Riparian cover over pools, expressed as real or measured cover, differed (F=3.8, P=0.0168) among strata between 1984

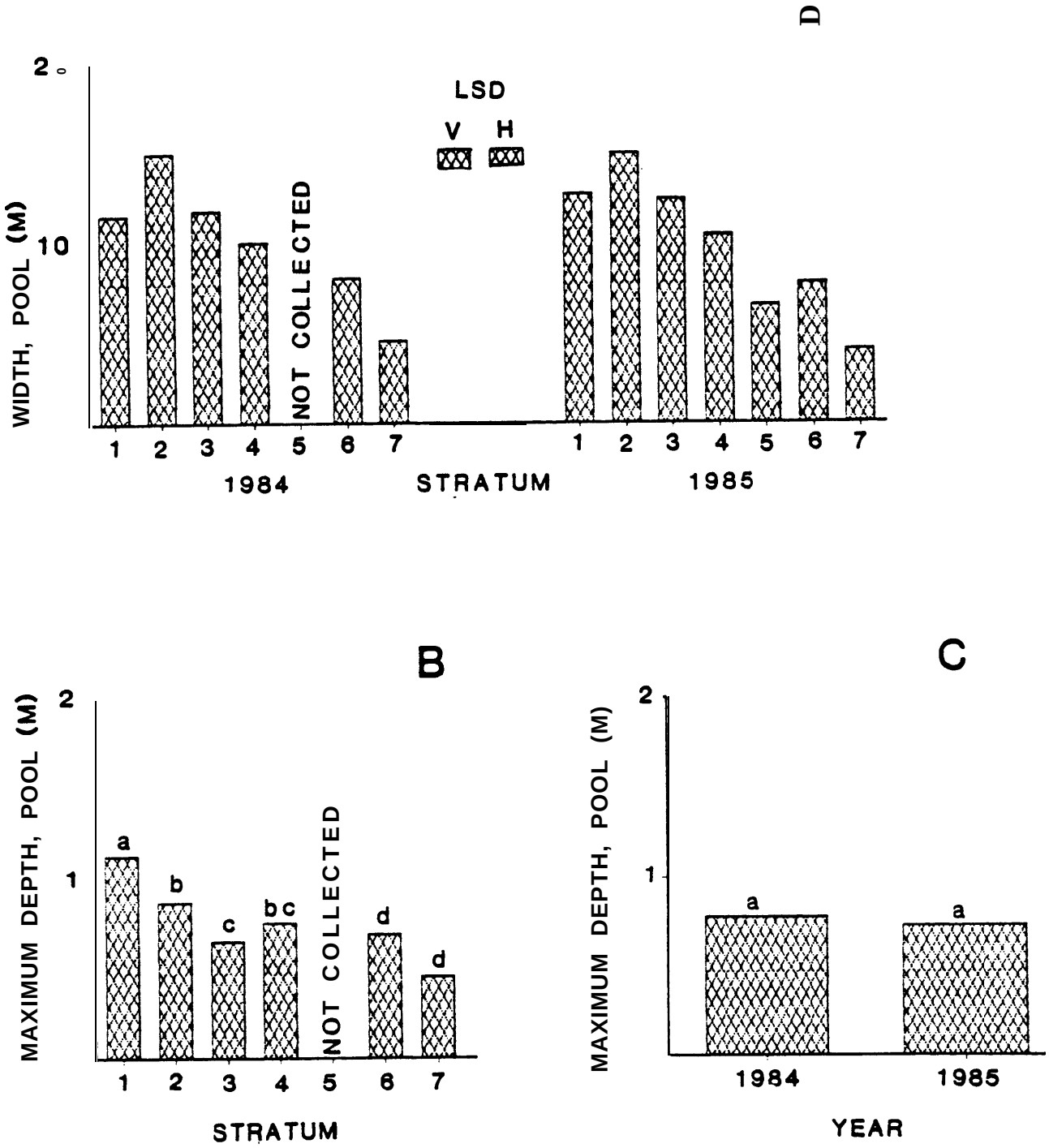


Figure 5. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) pool width in strata between 1984 and 1985 (A) and mean pool depth in strata (B) and between 1984 and 1985 (C), Yankee Fork of the Salmon River, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means. A common letter above means indicates non-significance ($P > 0.05$) between all pairs of means with that letter.

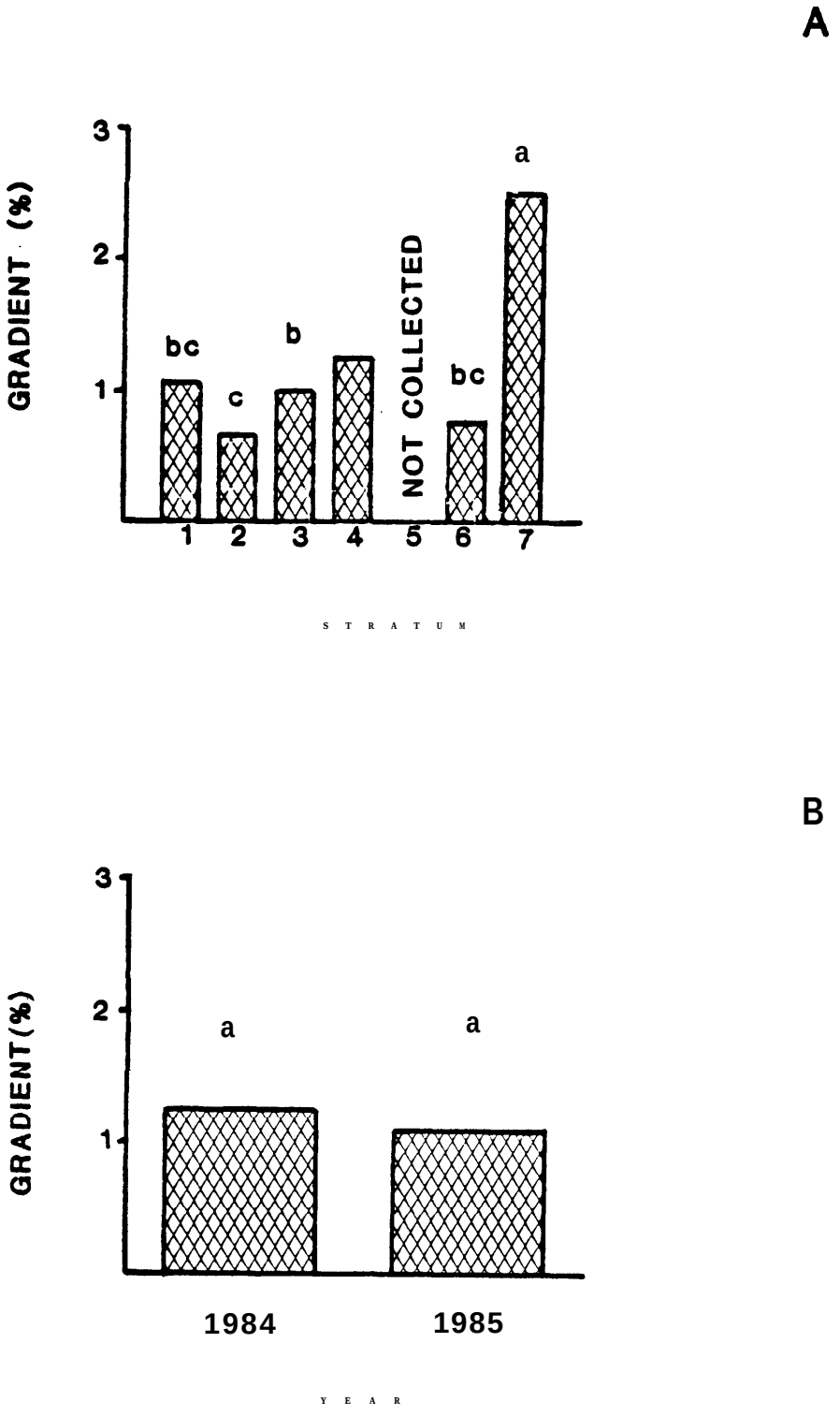
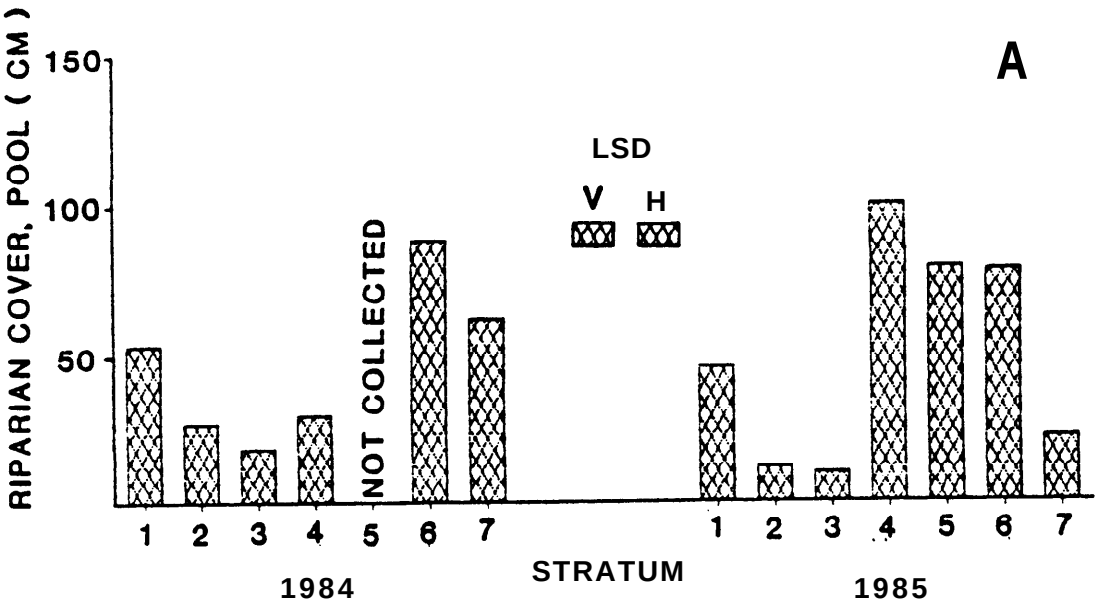


Figure 6. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) stream gradient in strata (A) and between 1984 and 1985 (B), Yankee Fork of the Salmon River, Idaho. A common letter above means indicates non-significancz(P>0.05) between all pairs of means with that letter.

and 1985 (interaction). Riparian cover ranged from 19 to 89 cm in 1984 and from 11 to 101 cm in 1985 (Fig. 7A). In 1984, riparian cover differed significantly among all strata. Riparian cover was significantly larger in stratum 6 than in other strata, in stratum 7 than in strata 1, 2, 3, or 4, in stratum 1 than in strata 2, 3, or 4, in stratum 4 than in strata 2 or 3, and in stratum 2 than in stratum 3. In 1985, riparian cover did not differ significantly in strata 5 and 6. Riparian cover was significantly larger in stratum 4 than in other strata, in strata 5 and 6 than in strata 1, 2, 3, or 7, in stratum 1 than in strata 2, 3, or 7, in stratum 7 than in strata 2 or 3, and in stratum than in stratum 3. Between 1984 and 1985, riparian cover increased significantly in stratum 4 and decreased significantly in strata 1, 2, 3, 6, and 7 in 1984.

Riparian cover over pools, expressed as a percent of pool width, differed (F=3.0, P=0.0368) among strata between 1984 and 1985 (interaction). Riparian cover, expressed as a percent of pool width, ranged from 1.8 to 15.0% in 1984 and from 1.2 to 12.8% in 1985 (Fig. 7B). In 1984, percent riparian cover differed significantly among all strata. Percent riparian cover was significantly larger in stratum 7 than in other strata, in stratum 6 than in strata 1, 2, 3, or 4, in stratum 1 than in strata 2, 3, or 4, in stratum 4 than in strata 2 or 3, and in stratum 2 than in stratum 3. In 1985, percent riparian cover differed significantly among all strata. Percent riparian cover was significantly larger in stratum 5 than in other strata, in stratum 4 than in strata 1, 2, 3, 6, or 7, in stratum 6 than in strata 1, 2, 3, or 7, in stratum 7 than in strata 1, 2, or 3, in stratum 1 than in strata 2 or 3, and in stratum 3 than in stratum 2. Between 1984 and 1985, riparian cover (percent of width) increased significantly in stratum 4 and decreased significantly in strata 1, 2, 6, and 7.

Size frequency (%) distribution of riffle substrate particles differed (Q=48.5, P=0.000l) among strata. During 1985, size distributions differed significantly between all pairs of strata (Figs. 8A and 8B). During 1984, distribution in stratum 2 did not differ significantly from strata 3 or 5. Distributions varied significantly among other strata-pair combinations. Between 1984 and 1985, substrate distributions differed significantly in strata 2, 3, 4, and 6. In stratum 2, particle size ranges 1 to 2 mm, 2 to 4 mm, 4 to 8 mm, 8 to 16 mm, and 32 to 64 mm decreased while ranges 128 to 256 mm and 256 to 512 mm increased. In stratum 3, particle size ranges' 0 to 1 mm, 4 to 8 mm, 8 to 16 mm, 128 to 256 mm, and 1024 to 2048 mm decreased while ranges 64 to 128 mm increased. In stratum 4, particles size ranges 0 to 1 mm, 1 to 2 mm, 2 to 4 mm, 4 to 8 mm, and 32 to 64 mm decreased while ranges 64 to 128 mm, 128 to 256 mm, and 256 to 512 mm increased. In stratum 6, particle size ranges 32 to 64 mm and 64 to 128 mm decreased while range 128 to 256 increased.



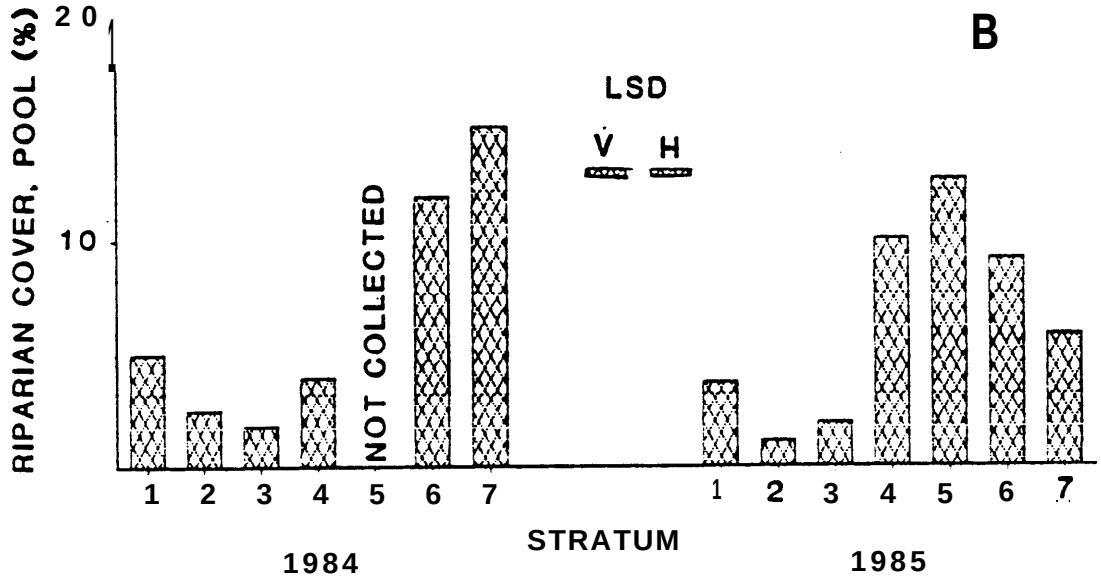


Figure 7. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) riparian cover over pools as measured (A) and as a percent of pool width (B) in strata between 1984 and 1985, Yankee Fork of the Salmon River, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P<0.05$) differences between those means.

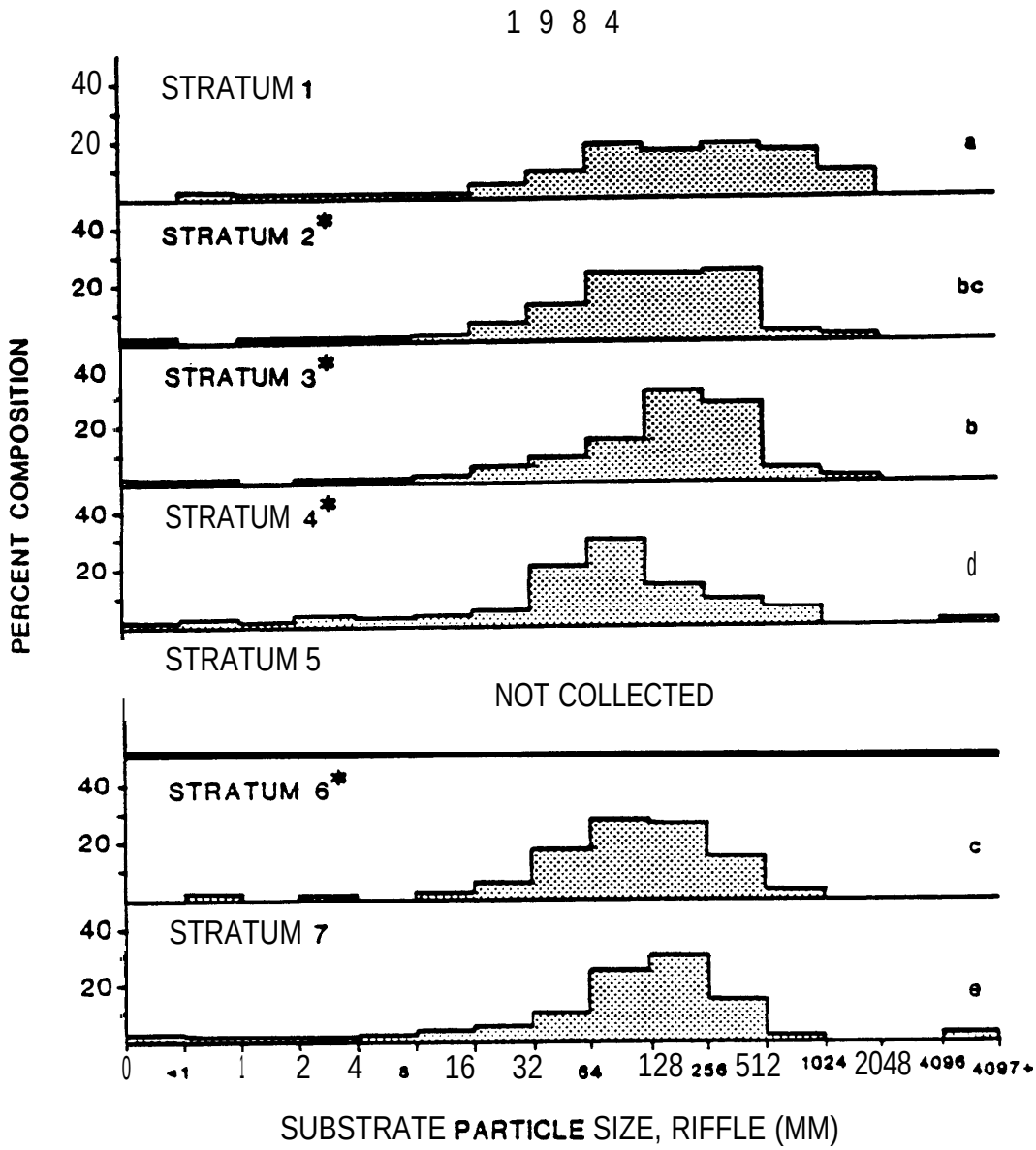


Figure 8a. Mean (n=4 per stratum) distributions of substrate particle sizes in riffles by stratum, Yankee Fork of the Salmon River, Idaho, 1984. A common letter next to distributions indicate a non-significant (P<0.05) difference between distributions. An asterisks connotes significant (P<0.05) difference in that stratum between 1984 and 1985.

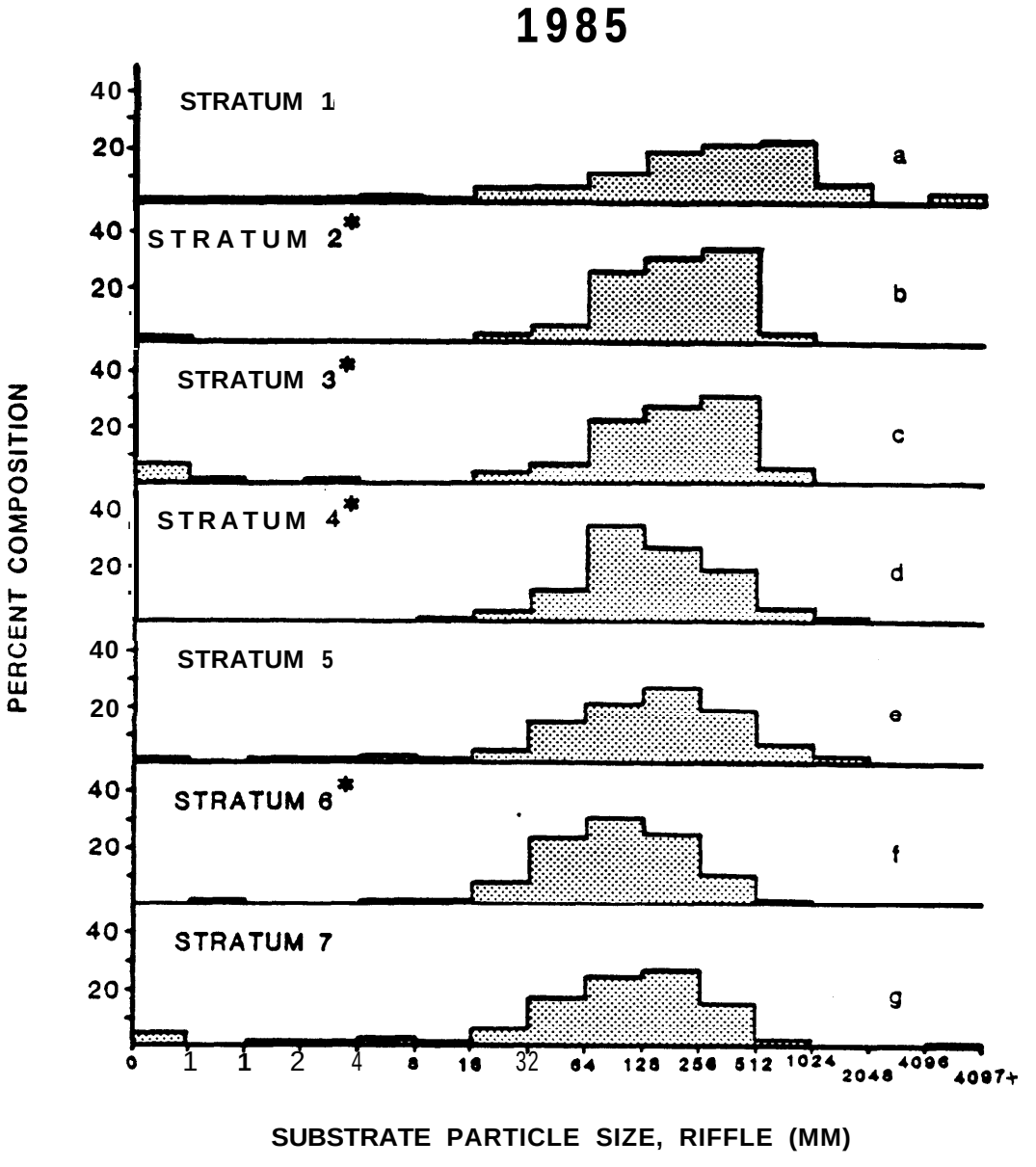


Figure 8b. Mean (n=4 per stratum) distributions of substrate particle sizes in riffles by stratum, Yankee Fork of the Salmon River, Idaho, 1385. A common letter next to distributions indicate a non-significant (P<0.05) difference between distributions. An asterisk connotes significant (P<0.05) difference in that stratum between 1984 and 1985.

Frequency (%) of riffle substrate less than 4 mm in diameter differed (F=3.5, P=0.0127) among strata between 1984 and 1985. Frequency ranged from 2.0 to 6.4% in 1984 and from 1.3 to 8.4% in 1985 (Fig. 9A). In 1984, frequency did not differ significantly in strata 1 and 4, in strata 1, 2, 3, and 7, or in strata 2, 3, and 6. Frequency was significantly larger in strata 1 and 4 than in the other strata, in strata 1, 2, 3, and 7 than in stratum 6. In 1985, frequency did not differ significantly in strata 3 and 7, in strata 1 and 5, or in strata 2, 4, 5, and 6. Frequency was significantly larger' in strata 3 and 7 than in the other strata, and in strata 1 and 5 than in strata 2, 4, or 6. Between 1984 and 1985, frequency increased significantly in strata 3 and 7 and decreased significantly in strata 2 and 4.

Frequency (%) of riffle substrate less than 8 mm in diameter did not differ (F=1.2, P=0.3510) among strata or (F=0.9, P=0.3596) between 1984 and 1985. Frequency ranged from 2.4 to 6.4% among strata (Fig. 9B) and were 5.0 and 5.2% in 1984 and 1985, respectively (Fig. 9C).

Percent of riffle substrate covered with superfines differed (F=4.5, P=0.0076) among strata between 1984 and 1985. Percent ranged from 10.6 to 35.4% in 1984 and from 1.5 to 38.9% in 1985 (Fig. l0A). In-1984, percent did not differ significantly in strata 3 and 7. Percent was significantly larger in strata 3 and 7 than in the other strata, in stratum 2 than in strata 1, 4, or 6, in stratum 4 than in strata 1 or 6, and in stratum 1 than in stratum 6. In 1985, percent did not differ significantly in strata 2 and 3 or in strata 5 and 6. Percent was significantly larger in strata 2 and 3 than in other strata, in stratum 7 than in strata 1, 4, 5, or 6, in stratum 4 than in strata 1, 5, or 6, and in stratum 1 than in strata 5 or 6. Between 1984 and 1985, percent increased significantly in strata 1, 2, 3, and 4 but decreased significantly in strata 6 and 7.

Percent of pool substrate embedded with fines differed (F=4.1, P=0.0122) among strata between 1984 and 1985. Percent ranged from 11.3 to 56.3% in 1984 and from 11.3 to 65.0% in 1985 (Fig. 10B). In 1984, percent did not differ significantly in strata 4 and 6 or in strata 3 and 4. Percent was significantly larger in stratum 2 than in other strata, in stratum 1 than in strata 3, 4, 6, or 7, and in stratum 7 than in strata 3, 4, or 6. In 1985, percent differed significantly in all strata. Percent was significantly larger in stratum 2 than in other strata, in stratum 3 than in strata 1, 3, 4, 5, 6, or 7, in stratum 7 than in strata 1, 4, 5, or 6, in stratum 1 than in strata 4, 5, or 6, in stratum 4 than in strata 5 or 6, and in stratum 6 than in stratum 5. Between 1984 and 1985, percent significantly increased in all strata.

Rate of change, as substrate aggradation or degradation between 1984 and 1985, within the riparian zone (both left and right banks) did not differ (F=0.2, P=0.9539) among

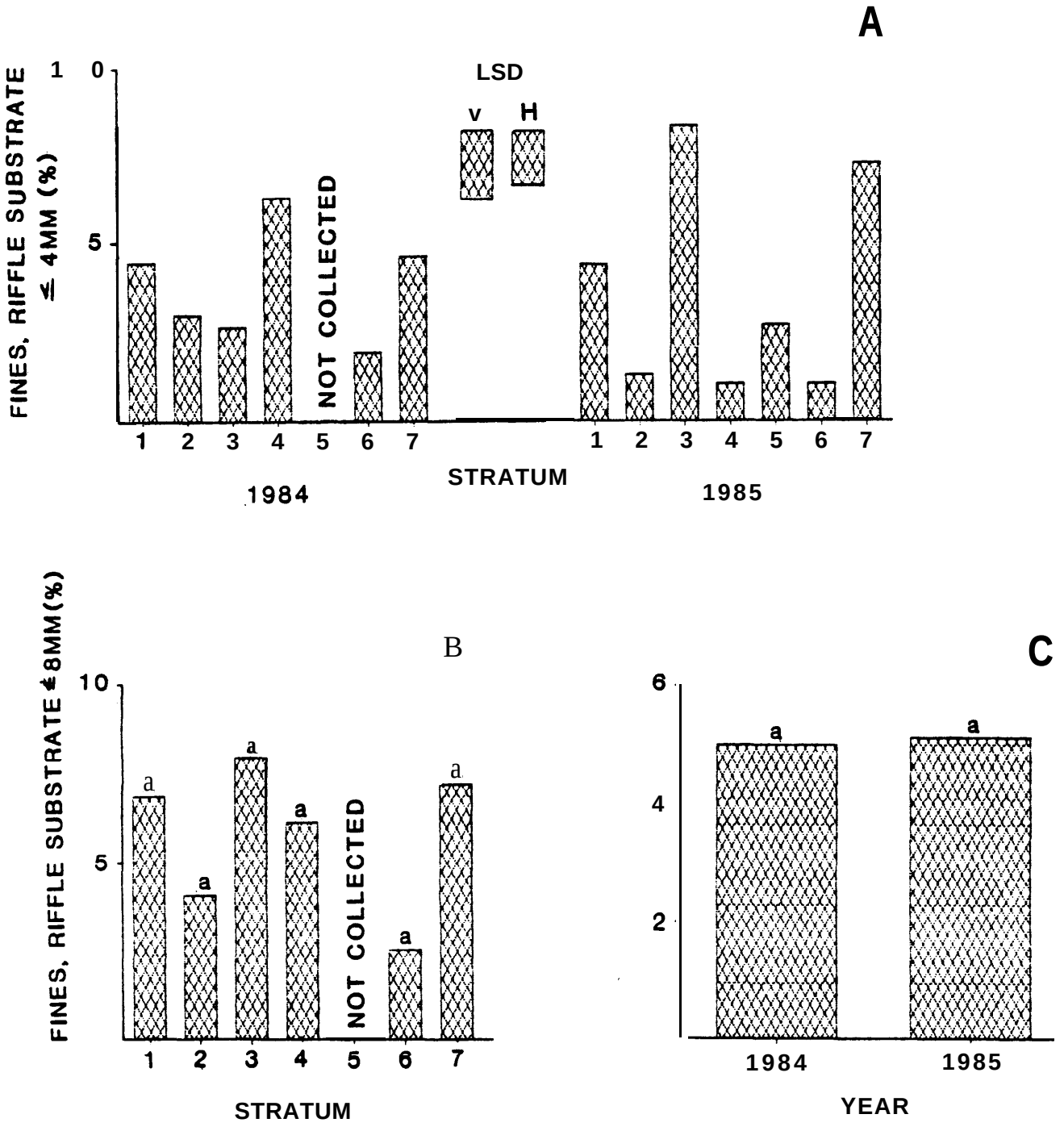


Figure 9. Mean (n=4 per stratum in 1984: n=6 per stratum in 1985) level of fines (as percent of riffle substrate 4 mm) in strata between 1984 and 1985 (A). Mean level of fines (as percent of riffle substrate 8 mm) in strata (B) and between 1984 and 1985 (C) all measurements from Yankee Fork of the Salmon River, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant (P<0.05) differences between those means. A common letter above means indicates non-significance (P>O.O5) between all pairs of means with that letter.

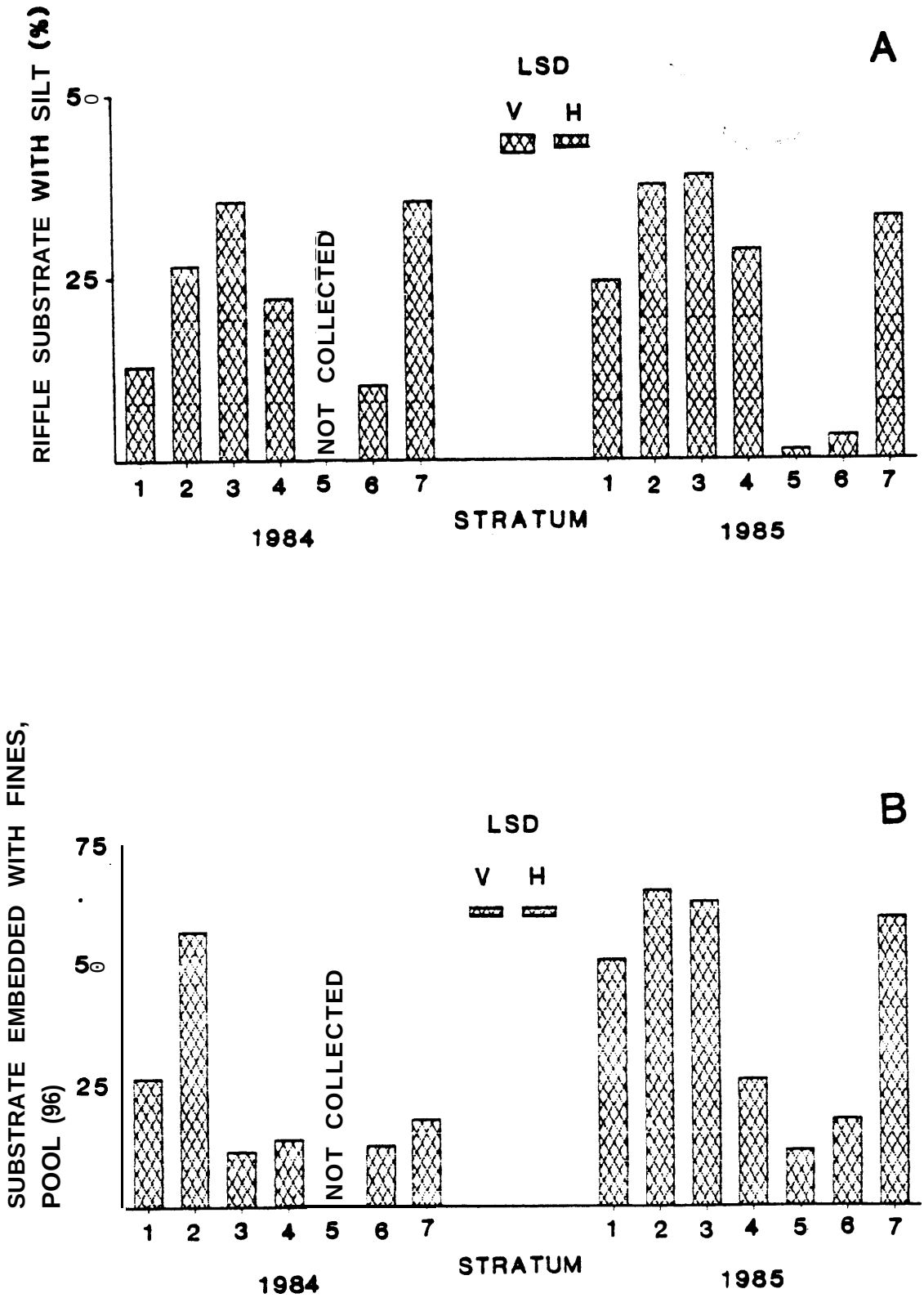


Figure 10. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) percent of riffle substrate covered with silt (A) and pool substrate embedded with fines (B) in strata between 1984 and 1985, Yankee Fork of the Salmon River, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means.

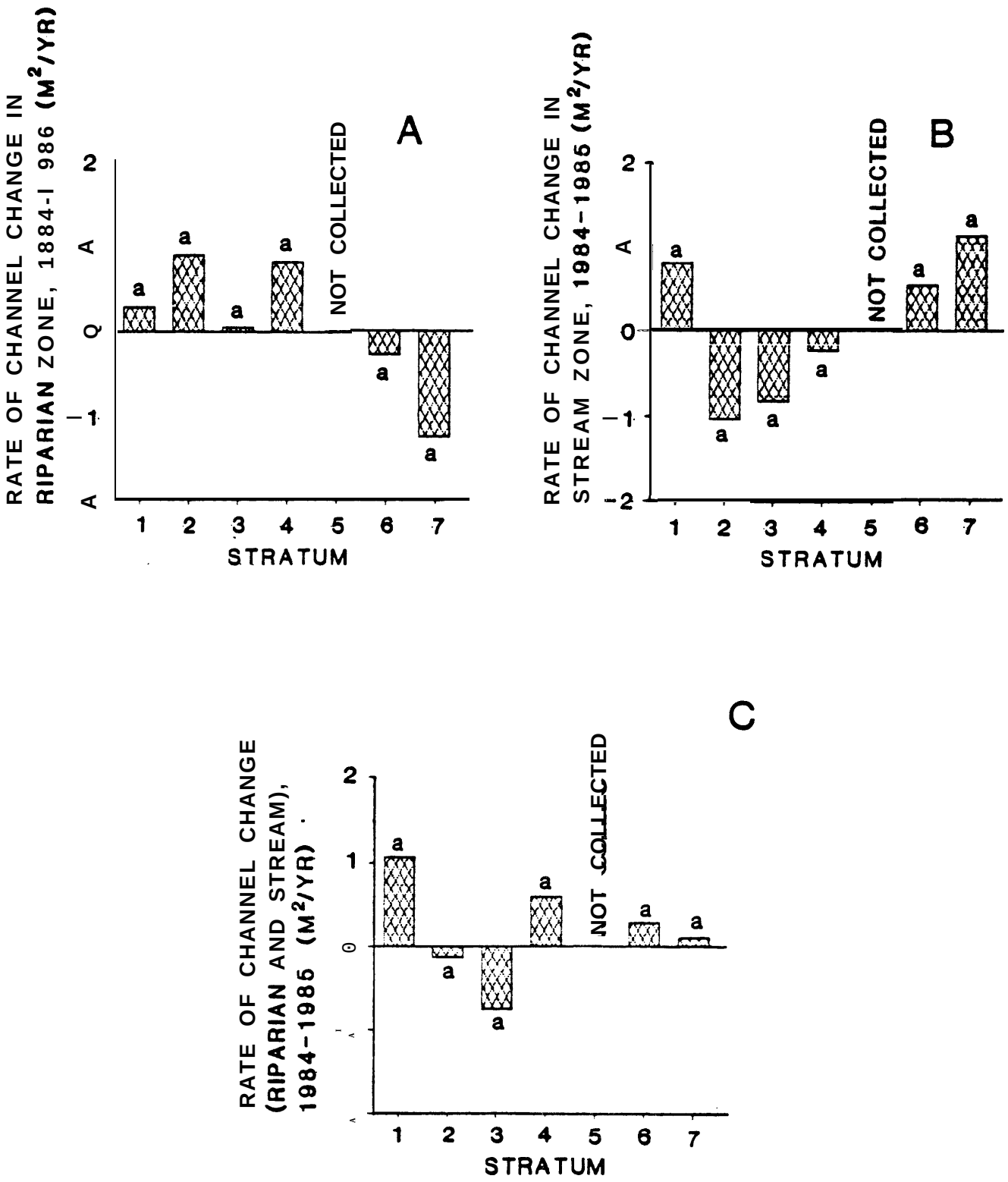


Figure 11. Mean rate of aggradation of degration in the riparian zone (A), stream zone (B), and stream channel (C), in strata between 1984 and 1985, Yankee Fork of the Salmon River, Idaho. A common letter above means indicates non-significance (P>0.05) between all pairs of means with that letter.

strata. Rate of riparian zone change ranged from -1.25 to 0.89 m^2 /yr among strata (Fig. 11A).

Rate of change, as substrate aggradation or degradation between 1984 and 1985, within the stream zone did not differ (F=0.4, P=0.8583) among strata. Rate of stream zone change ranged from -1.0 to 1.1 m^2 /yr among strata (Fig. 11B).

Rate of change, as substrate aggradation or degradation between 1984 and 1985, with in the stream channel (riparian zone plus stream zone) did not. differ (F=1.7, P=0.1816) among strata. Rates of channel change ranged from -0.74 to 1.09 m2 /yr among strata (Fig. 11C).

Substrate generally remained constant in the riparian zone (1,239 m^3 /yr) but aggraded in the stream zone (10,777 m3 /yr) and in the total stream channel (12,016 m^3 /yr) between 1984 and 1985 (Table 6). Degradation or erosion of substrate from the riparian zone in strata 7 (-12,006 m^3 /yr) and aggradation or deposition on shoreline bars again in stratum 7 (10,813 m^3 /yr) were the largest changes in the drainage between 1984 and 1985.

Fish Community Inventory

Total Density and Relative Abundance

During 1985, fish densities (all species combined) were highest in strata 4 and 6 and lowest in stratum 5 (Fig. 12). Fish densities were similar in strata 4 and 6 and in strata 1, 2, and 3.

During 1985, relative abundance of age 0+ chinook salmon ranged from 0 to 70% among strata (Fig. 12). The most abundant species-age class group by stratum were: age 0+ steelhead/rainbow trout in strata 1, 2, and 3; age 0+ chinook salmon in strata 4 and 6, age l+ and older bull trout in stratum 5, and age 2+ and older steelhead/rainbow trout in stratum 7.

During 1984, fish densities (all species combined) were highest in strata 4 and 6 and lowest in stratum 2 (Fig. 8). Total fish densities were similar among strata 1, 3, and 7.

Relative abundance of age 0+ chinook salmon ranged from 5% of total fish abundance in stratum 2 to 80% of total fish abundance in stratum 6 (Fig. 8). Relative abundance of age 0+ chinook salmon was higher than other species-age classes in strata 4 and 6. Relative abundance of age 0+ steelhead/rainbow trout was high in all strata except stratum 6 (<8%) and ranged from 20% (stratum 1) to 45% (stratum 2). Relative abundance of adult mountain whitefish was high (20 to 25%) in strata 1, 2, 3 and 7.

Densities

Age 0+ chinook salmon in 1984 and 1985. Densities differed (F=6.4, P<0.000l)) among strata but did not differ (F=3.5, P=0.0765) between 1984 and 1985. Densities ranged from 0.0017 to 0.1377 fish/m^2 pool among strata (Fig. 13A)

Table 6. Substrate aggradation and degradation in the riparian, stream, and stream channel (riparian plus stream) zones in strata of the Yankee Fork of the Salmon River, Idaho between August 1984 and August 1985.

Stratum	Mean channel change (m2/yr)	95% Confidence interval (+)	Stratum length (m)	Stratum change (m3/yr)
		Riparian		
	0.28[a]	0.16	5,450	1,514
2	0.89	0.27	5,945	5,268
3	0.06	3.23	3,775	219
4	0.82	6.32	11,812	9,661
5	--	--	12,659	--
6	-0.27[b]	0.38	9,604	- 3,417
	-1.25	0.57	11,399	-12,006
				1,239
		Stream		
	0.81	0.07	5,450	4,402
2	-1.00	0.34	5,945	- 5,963
3	-0.80	2.08	3,775	- 3,028
4	-0.22	1.01	11,812	- 2,623
5	--	--	12,659	--
6	0.57	0.01	9,604	7,176
	1.13	0.01	11,400	10,813
				10,777
		Total channel		
1	1.09	0.05	5,450	5,919
2	-0.12	0.03	5,945	692
3	-0.74	0.47	3,775	- 2,807
4	0.60	0.19	11,812	7,041
5		--	12,659	--
6	0130	0.03	9,604	3,735
7	-0.12	0.01	11,399	- 1,180
				12,016

[a] aggradation

[b] degradation

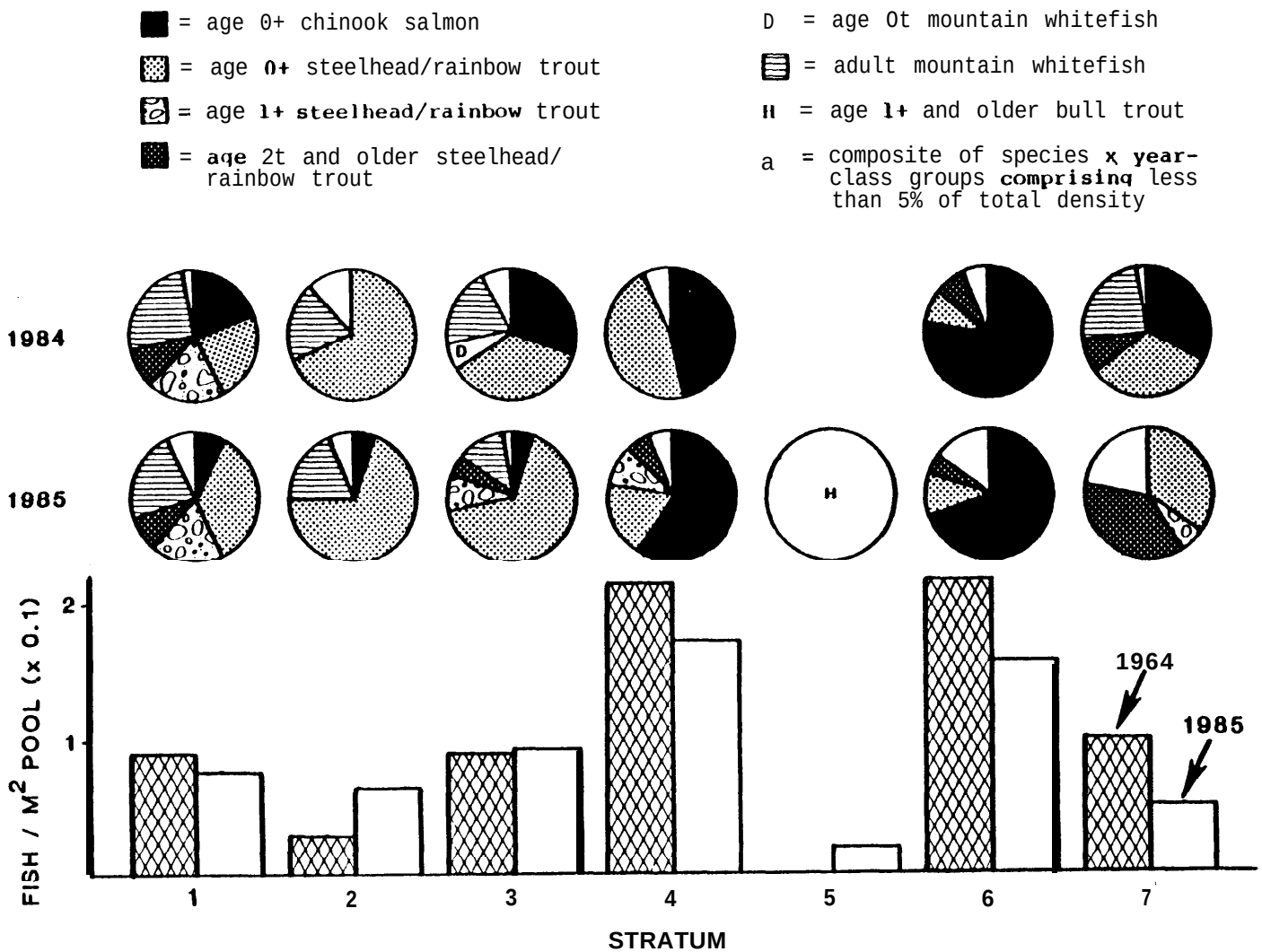


Figure 12. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) of all species and age-classes (histogram) and relative abundance of species by age-classes (pie-chart) by stratum, Yankee Fork of the Salmon River, Idaho, 1984 and 1985.

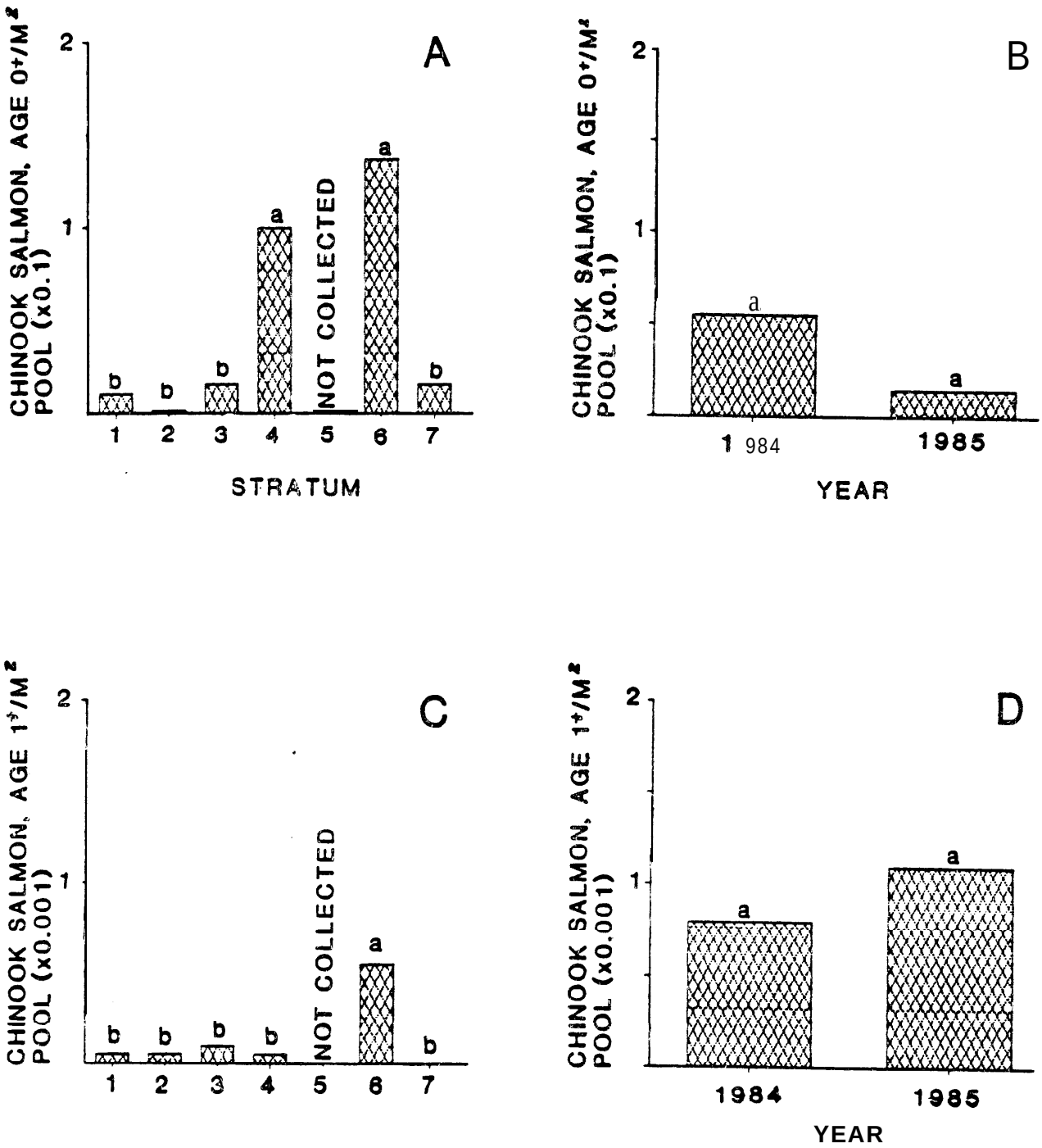


Figure 13. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) densities of age 0+ chinook salmon among strata (A) and between 1984 and 1985 (B). Mean densities of age 1+ chinook salmon among strata (C) and between 1984 and 1985. All densities from Yankee Fork of the Salmon River, Idaho. A common letter above means indicate non-significance (P>0.05) between all pairs of means with that letter.

and were 0.0562 and 0.0159 fish/m2 pool in 1984 and 1985, respectively (Fig. 13B). Densities did not differ significantly in strata 4 and 6 or in strata 1, 2, 3, and 7. Densities were significantly higher in strata 4 and 6 than in other strata.

Age l+ chinook salmon in 1984 and 1985. Densities differed (F=4.7, P=0.0013) among strata but did not differ (F=1.7, P=0.2049) between 1984 and 1985. Density ranged from 0 to 0.0055 fish/m^2 pool among strata and were 0.0008 and 0.0011 fish/m 2 pool in 1984 and 1985 (Fig. 13D). Densities did not differ significantly in strata 1, 2, 3, 4, and 7. Density was significantly larger in stratum 6 than in other strata.

Age 0+ steelhead/rainbow trout in 1984 and 1985. Densities differed (F=4.9, P=0.0010) among strata but did not differ (F=0.65, P=0.4318) between 1984 and 1985. Densities ranged from 0.0025 to 0.0650 fish/m^2 pool among strata (Fig. 14A) and were 0.0373 and 0.0283 fish/m^2 pool in 1984 and 1985, respectively (Fig. 14B). Densities did not differ significantly in strata 1, 2, 3, 4, and 6, or in strata 1, 2, 4, 6, and 7. Density was significantly larger in stratum 3 than in stratum 7.

Age l+ steelhead/rainbow trout in 1984 and 1985. Densities differed (F=3.8, P=0.0048) among strata but did not differ (F=0.2, P=0.6976) between 1984 and 1985. Densities ranged from 0.0002 to 0.0168 fish/m^2 pool among strata and were 0.0068 and 0.0072 fish/m^2 pool in 1984 and 1985, respectively (Fig. 14B). Densities did not differ significantly in strata 1 and 3, in strata 1 and 6, in strata 3, 4, 6, and 7, in strata 2 and 4, or in strata 2 and 7. Densities were significantly higher in strata 1 and 3 than in stratum 2, in strata 1 and 6 than in stratum 2, and in strata 3, 4, 6, and 7 than in stratum 2.

Age 2+ and older steelhead/rainbow trout in 1984 and 1985. Densities did not differ (F=2.2, P=0.0643) among strata or (F=0.9, P=O.3350) between 1984 and 1985. Densities ranged from 0.0008 to 0.0128 fish/m^2 pool among strata (Fig. 15A) and were 0.0054 and 0.0068 fish/m2 pool in 1984 and 1985, respectively (Fig. 15B).

Age 2+ and older cutthroat trout in 1984 and 1985. Densities differed (F=4.0, P=0.0036) among strata but did not differ (F=3.2, P=0.0886) between 1984 and 1985. Densities ranged from 0 to 0.0213 fish/m^2 pool among strata (Fig. 15C) and were 0.0036 and 0 fish/m^2 pool in 1984 and 1985 (Fig. 15D). Densities did not differ significantly in strata 1, 2, 3, 4, and 6. Densities were significantly higher in stratum 7 than in other strata.

Age 0+ bull trout in 1984 and 1985. Densities did not differ (F=0.2, P=O.9752) among strata or (F=l.0, P=O.3306) between 1984 and 1985. Densities ranged from 0 to 0.0001 fish/m^2 pool among strata (Fig. 16A) and were 0 and 0.0001 fish/m 2 pool in 1984 and 1985, respectively (Fig. 16B).

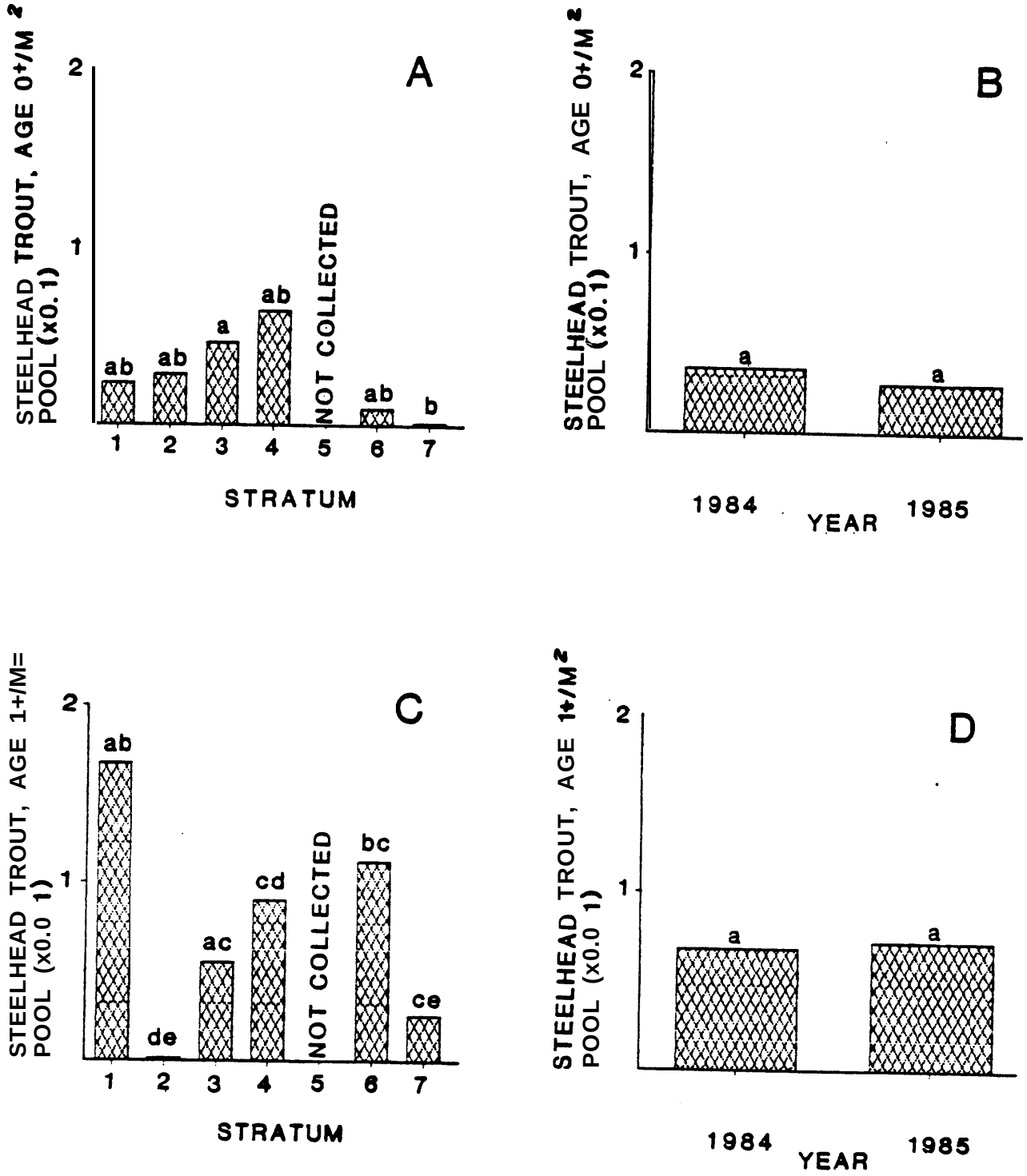


Figure 14. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) densities of age 0+ steelhead/rainbow trout among strata (A) and between 1984 and 1985 (B). Mean densities of age 1+ steelhead (rainbow trout asmong strata (C) and between 1984 and 1985 (D). All densities from Yankee Fork of the Salmon River, Idaho. A common letter above means indicates non-significance ($P > 0.05$) between all pairs of means with that letter.

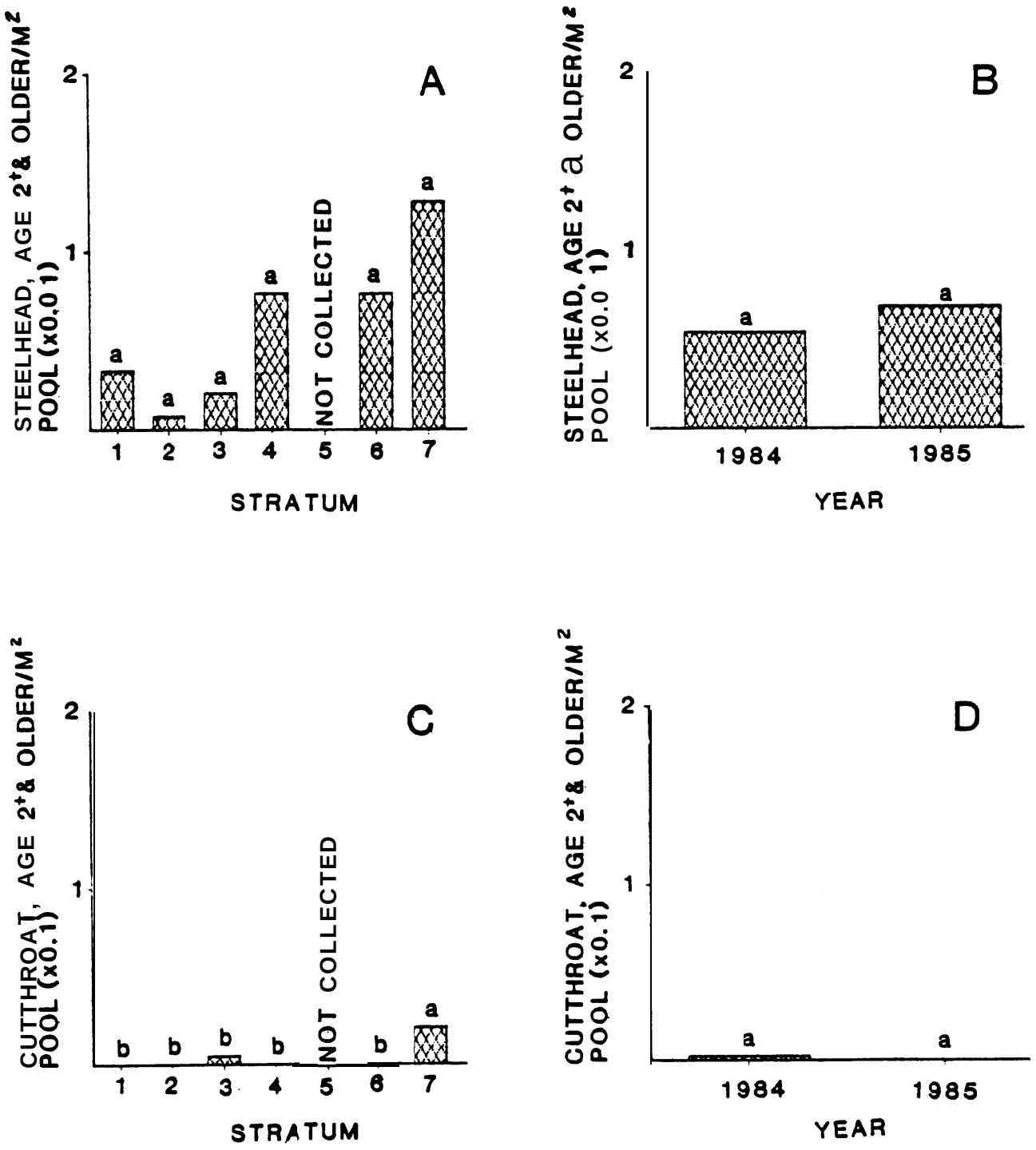


Figure 15. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) densities of age 2+ steelhead/rainbow trout among strata (A) and between 1984 and 1985 (B). Mean densities of age 2+ and older cutthroat trout (rainbow trout among strata (C) and between 1984 and 1985 (D). All densities from Yankee Fork of the Salmon River, Idaho. A common letter above means indicates non-significance ($P \leq 0.05$) between all pairs of means with that letter.

Age l+ and older bull trout in 1984 and 1985. Densities differed (F=2.8, P=0.0497) among strata between 1984 and 1985. Densities ranged from 0 to 0.002 fish/m^2 pool in 1984 and from 0 to 0.0178 fish/m^2 pool in 1985 (Fig. 16C). In 1984, densities did not differ significantly among strata. In 1985, densities did not differ significantly in strata 1, 2, 3, 4, and 6. Densities were significantly higher in stratum 5 than in other strata and in stratum 7 than in strata 1, 2, 3, 4, or 6. Between 1984 and 1985, densities increased significantly in stratum 7.

Age 0+ mountain whitefish in 1984 and 1985. Densities did not differ (F=1.4, P=0.2471) among strata or (F=0.02, P=0.8976) between 1984 and 1985. Densities ranged from 0 to 0.0008 fish/m^2 pool among strata (Fig. 17A) and were 0.0013 and 0.0006 fish/m^2 pool in 1984 and 1985, respectively (Fig. 17B).

Juvenile mountain whitefish in 1984 and 1985. Densities did not differ (F=2.0, P=0.0869) among strata or (F=2.3, P=0.1506) between 1984 and 1985. Densities ranged from 0 to 0.0009 fish/m^2 pool among strata (Fig. 17C) and were 0.0005 and 0.0009 fish/m^2 pool in 1984 and 1985, respectively (Fig. 17D).

Adult mountain whitefish. Densities differed (F=2.5, P=0.0406) among strata but did not differ (F=1.64, P=0.1996) between 1984 and 1985. Densities ranged from 0 to .21 fish/m2 pool (Fig. 18A) and were .09 and .08 fish/m^2 in 1984 and 1985, respectively (Fig. 18B). Densities did not differ significantly in strata 1 and 3; strata 2, 3, and 4, or in strata 6 and 7. Density was significantly higher in strata 1 than in strata 2, 4, 6, or 7 and in strata 2 and 4 than in strata 6 or 7.

Age 0+ brook trout Densities differed (F=2.9, P=0.0429) among strata between 1984 and 1985. Densities were 0 fish/m^2 pool in all strata in 1984 and ranged from 0 to 0.05 fish/m^2 pool in 1985 (Fig. 18C). In 1984, densities did not differ among strata. In 1985, densities did not differ among strata 1, 2, 3, 4, 5, and 7 in 1985. Densities in stratum 6 was significantly higher in stratum 6 than in the other strata. Density in stratum 6 increased significantly between 1984 and 1985.

Age 0+ Chinook Salmon.

Total Length in August 1984 and 1985. Fish length differed (F=16.2, P<0.000l) among strata between August 1984 and August 1985. Fish length ranged from 72.2 to 89.4 mm in August 1984 and from 59.4 to 73.0 mm in August 1985 (Fig. 19A). In August 1984, fish length did not differ significantly in strata 6 and 7. Fish length was significantly longer in strata 6 and 7 than in other strata, in stratum 3 than in strata 1, 2, or 4, in stratum 2 than in stratum 1 or 4, and in stratum 1 than in stratum 4. In August 1985, fish length did not differ significantly in strata 2 and 3. Fish length was significantly longer in

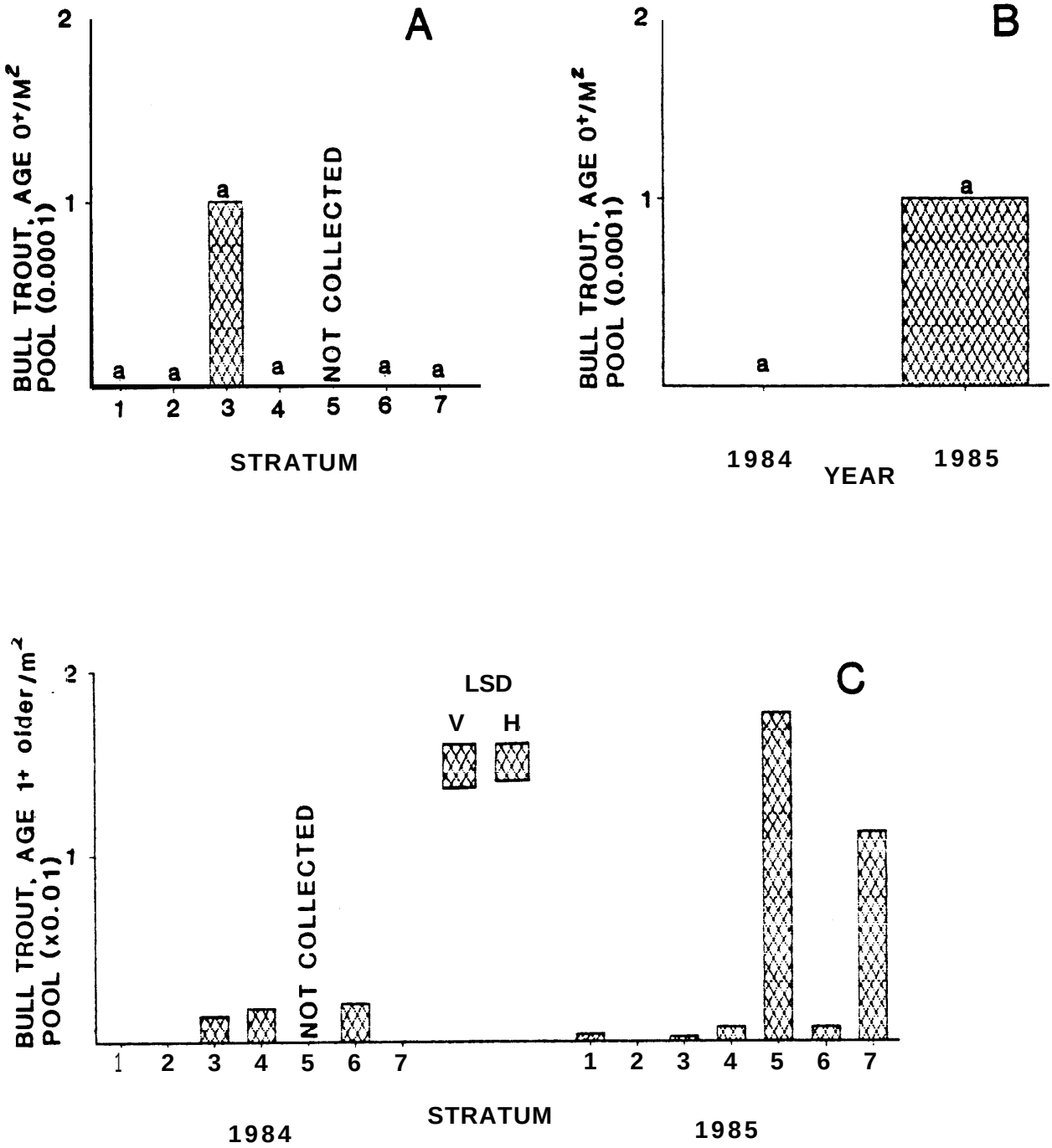


Figure 16. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) densities of age 0+ bull trout among strata (A) and between 1984 and 1985 (B). Mean densities of age l+ and older bull trout in strata between 1984 and 1985 (C). All densities from Yankee Fork of the Salmon River, Idaho. A common letter above means indicates non-significance (P>0.05) between all pairs of means with that letter. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant (P<0.05) differences between those means.

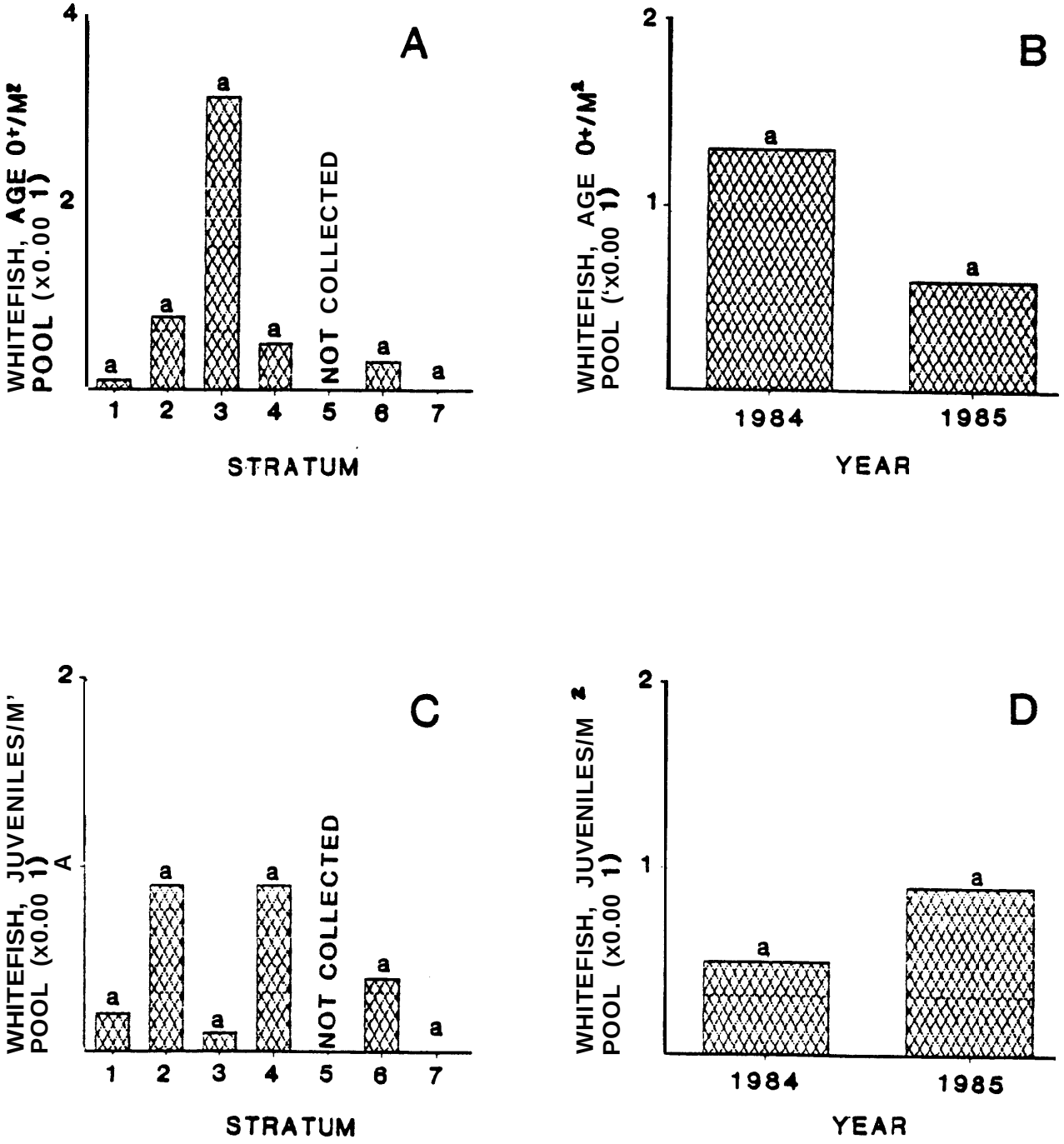


Figure 17. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) densities of age 0+ mountain whitefish among strata (A) and between 1984 and 1985 (B). Mean densities of juvenile mountain whitefish among strata (C) and between 1984 and 1985. All densities from Yankee Fork of the Salmon River, Idaho. A common letter above means indicates non-significance (P>0.05) between all pairs of means with that letter.

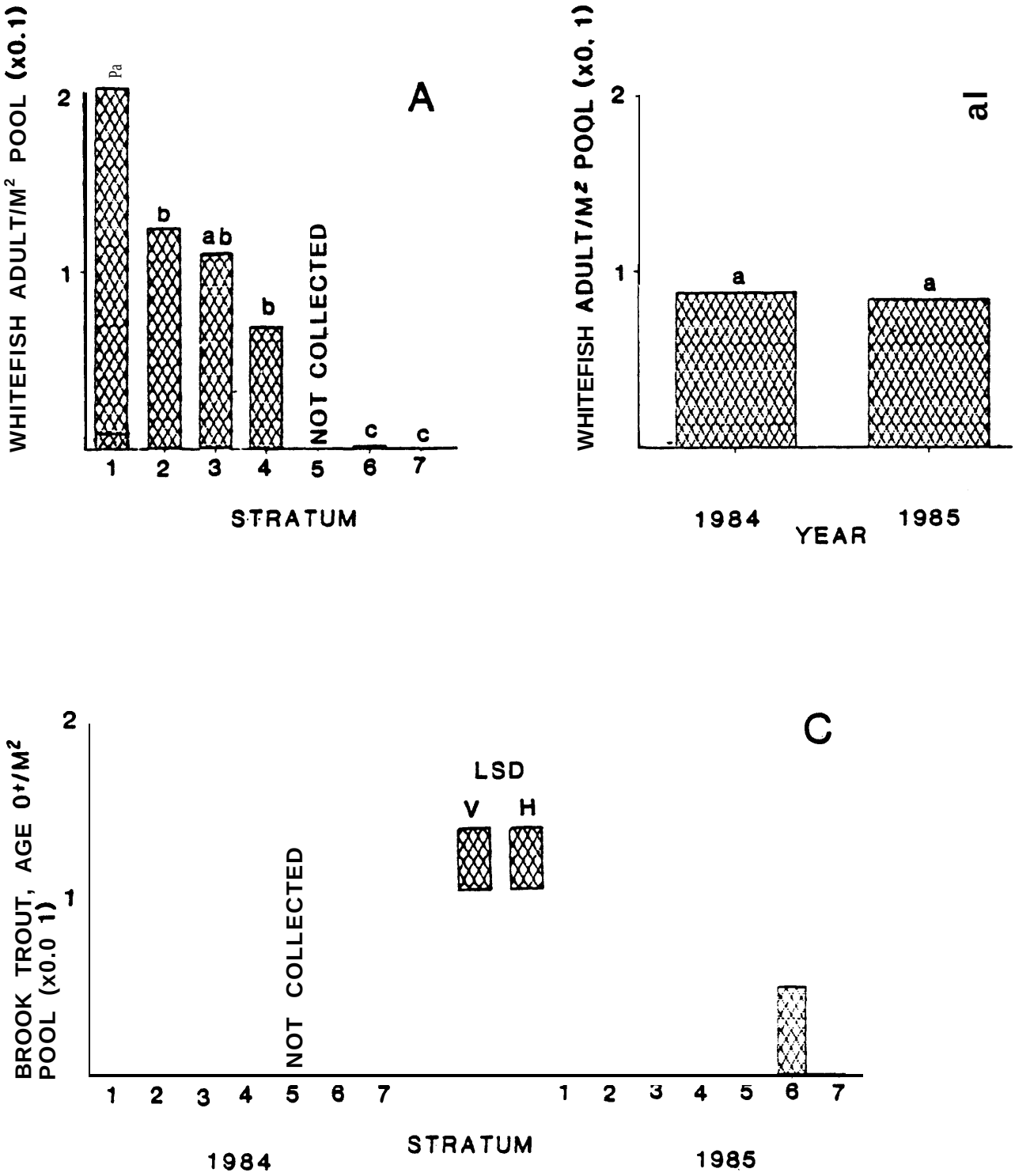


Figure 18. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) densities of age 0+ adult mountain whitefish among strata (A) and between 1984 and 1985 (B). Mean densities of age 0+ brook trout in strata between 1984 and 1985 (C). All densities from Yankee Fork of the Salmon River, Idaho. A common letter above means indicates non-significance (P>0.05) between all pairs of means
with that letter. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means.

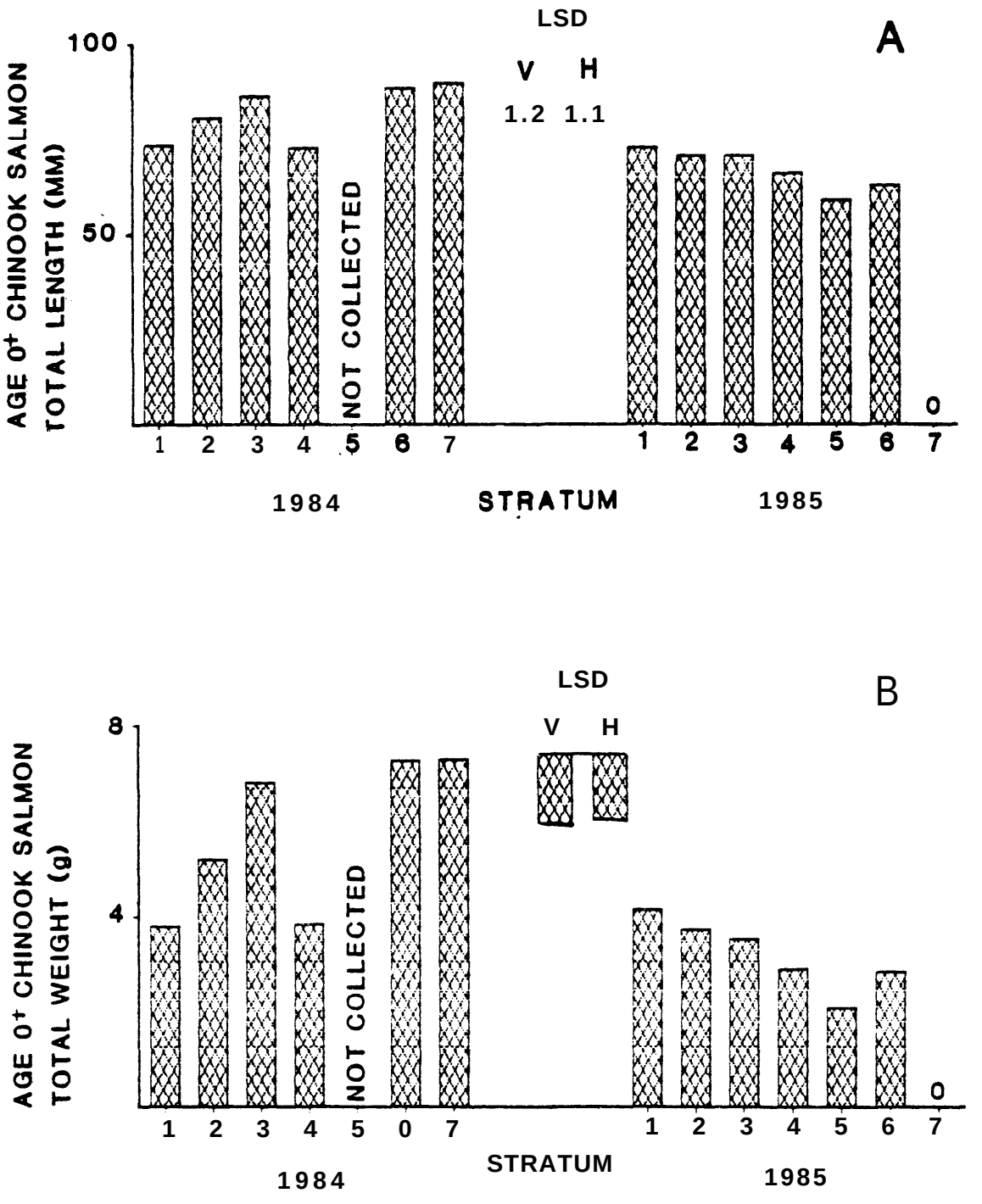


Figure 19. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) total length (A) and total live weight (B) of age 0+ chinook salmon in strata between 1984 and 1985, Yankee Fork of the Salmon River, Idaho. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P<0.05$) differences between those means.

stratum 1 than in other strata, in strata 2 and 3 than in strata 4, 5, 6, or 7, in stratum 4 than in strata 5, 6, or 7, in stratum 6 than in strata 5 or 7, and in stratum 5 than in stratum 7. Fish length did differ significantly among all strata between August 1984 and August 1985.

Live weight in August 1984 and August 1985. Fish weight differed (F=14.0, P<0.000l) among strata between August 1984 and August 1985. Fish weight ranged from 3.8 to 7.3 g in August 1984 and from 2.1 to 4.2 g in August 1985 (Fig. 19B). In August 1984, fish weight did not differ significantly in strata 3, 6, and 7 or in strata 1, 2, and 4. Fish weight was significantly heavier in strata 3, 6, and 7 than in other strata. In August 1985, fish weight did not differ significantly in strata 1, 2, 3, 4, and 6. Fish weights was significantly heavier in strata 1, 2, 3, 4, and 6 in than stratum 5. In August 1984 and August 1985, fish weights did not differ significantly in strata 1, 2, and 4. Fish weights was significantly heavier in strata 3 and 6 than in August 1984 than in August 1985.

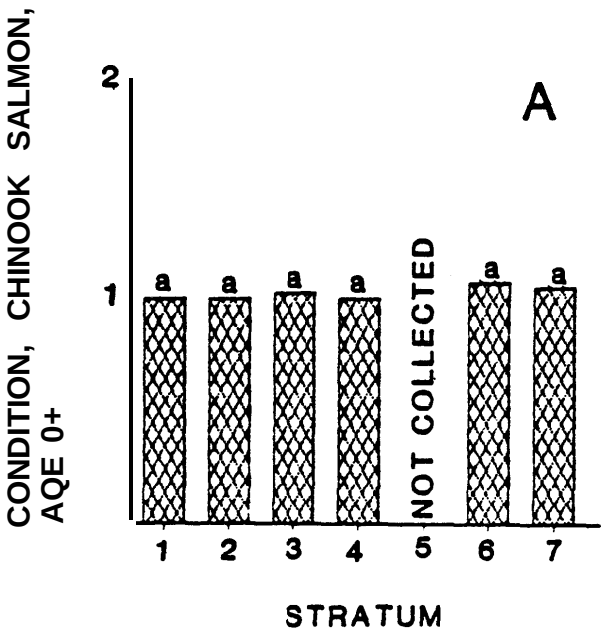
Condition in August 1984 and August 1985 Fish condition did not differ (F=1.3, P=0.3554) among strata between August 1984 and August 1985. Fish condition ranged from 0.94 to 1.13 (Fig. 20A). Fish condition did not differ (F=0.9, P=0.3551) between August 1984 and August 1985 (Fig. 20B).

Abundance in August 1984 and August 1985. In August 1984, total fish numbers were 12,847 + 6,131 (95% bounds) (Fig. 21 and Table 7). Highest numbers (7,505 + 4,367) were observed in strata 6. Lowest numbers (41 + 35) were observed in stratum 2. Fish numbers did not differ significantly in strata 2, 3, and 7. Fish numbers were significantly higher in stratum 6 than in other strata, in stratum 4 than in strata 1, 2, or 3 and in stratum 1 than in stratum 2. In August 1985, total fish numbers were 13,495 + 5,014 (95% bounds). Highest numbers (7,256 + 8,172) were observed in stratum 4. Lowest numbers (0) were observed in strata 5 and 7. Fish numbers did not differ significantly among strata 1, 2, 3, and 4. Fish numbers were significantly higher in stratum 6 than in strata 1, 2, and 3. Fish numbers did not differ significantly between August 1984 and August 1985 (Fig. 22).

Reach Description and Problem Identification

Habitat Problem Types

Problems characteristic of the Yankee Fork system which affect fish habitat include: dredge tailings, sloughing stream banks, roading, open slopes, washouts and barriers . Dredge tailings were either barren of vegetation or had a



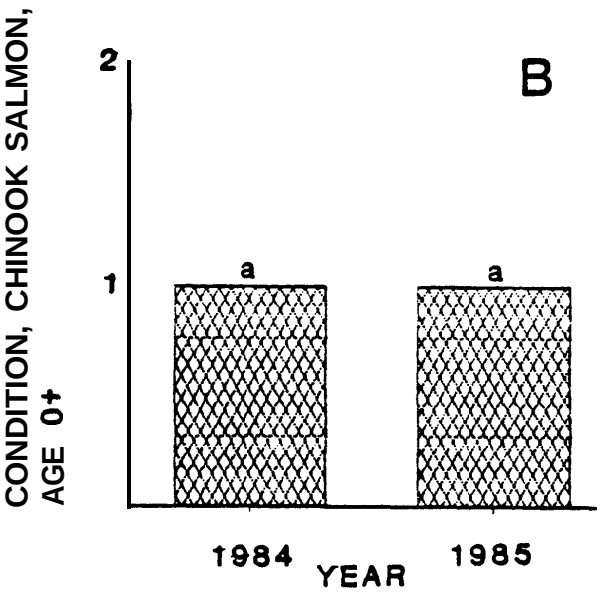


Figure 20. Mean (n=4 per stratum in 1984; n=6 per stratum in 1985) condition factor (K) of age 0+ chinook salmon among strata (A) and between 1984 and 1985 (B), Yankee Fork of the Salmon River, Idaho. A common letter above means indicates non-significance (P>0.05) between all pairs of means with that letter.

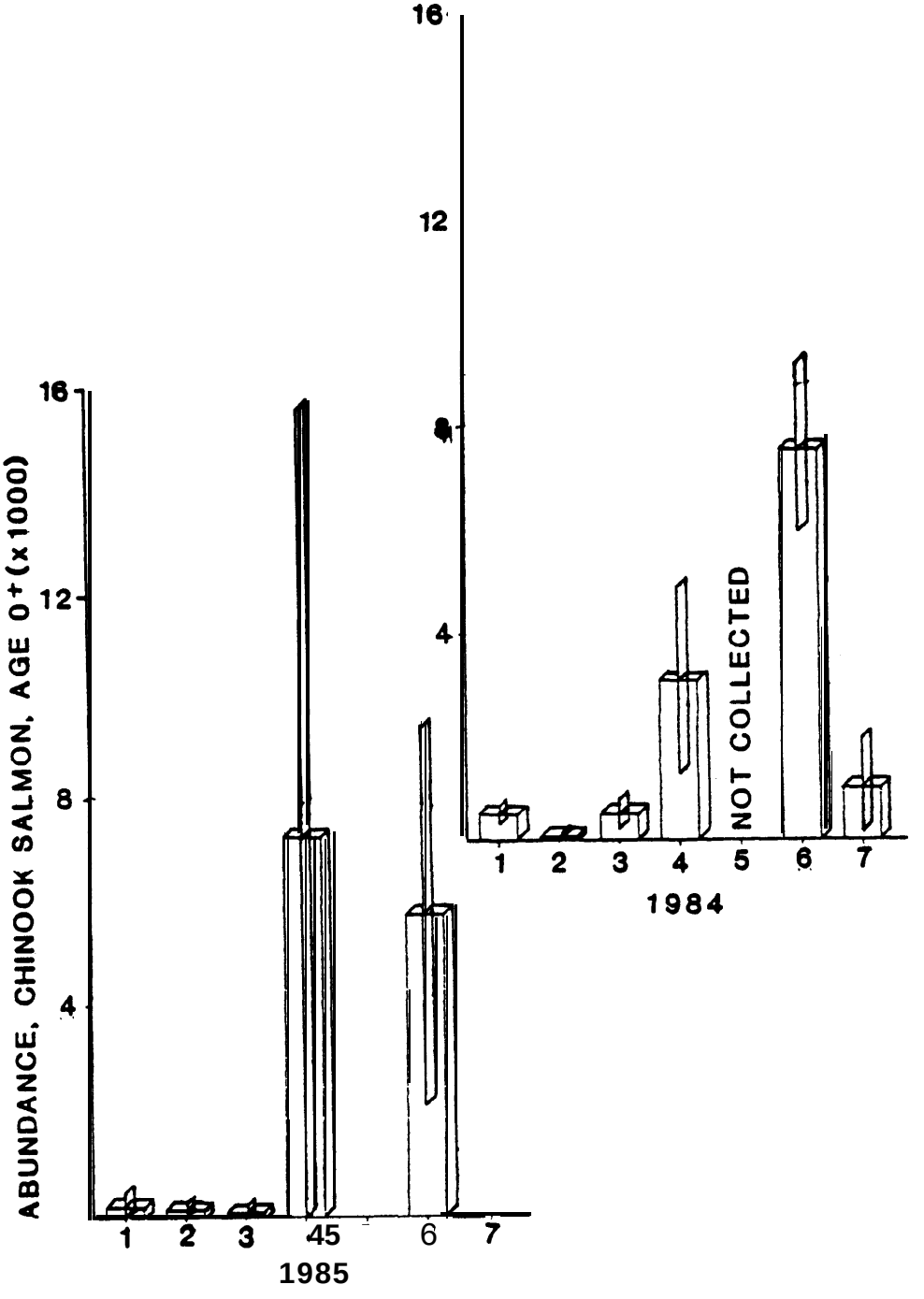


Figure 21. Estimated abundance of age 0+ chinook salmon by stratus during 1984 and 1985, Yankee Fork of the Salmon River, Idaho, during August, 1984. Vertical lines represent 95% confidence intervals. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P < 0.05$) differences between those means.

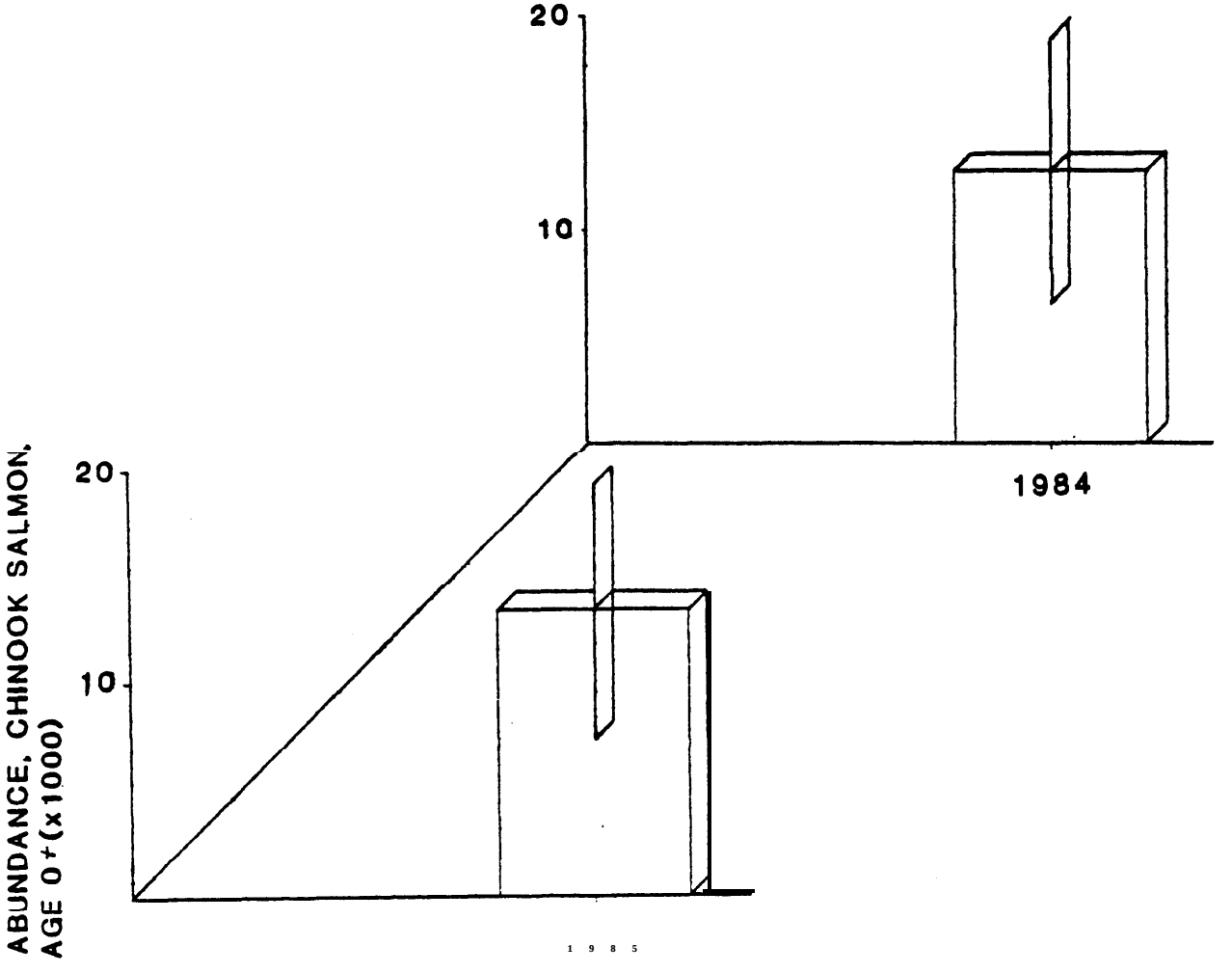


Figure 22. Estimated abundance of age 0+ chinook salmon in the Yankee Fork of the Salmon River, Idaho, during August, 1984 and August, 1985. Vertical lines represent 95% confidence intervals.

Table 7. Abundance and associated 95% bounds of age 0+ chinook salmon in strata of Yankee Fork of the Salmon River, Idaho, 1985 and 1984.

	Stratum		Abundance		
Month	Number	Length (km)	Estimate	Bounds	Percent of total
		1985			
August	1	5.5	231	0-474	2
August	2	6.0	170	59-281	1
August	3	3.8	113	0-256	1
August	4	11.8	7256	0-15428	54
August	5	11.4	0	0-0	0
August	6	12.6	5725	2012-9438	42
August	7	9.6	0	0-0	0
Totals		60.6	13,495	7,481-19,509	100
		1984			
August	1	5.5	596	274-918	5
August	2	6.0	41	6-76	0
August	3	3.8	593	55-1131	5
August	4	11.8	3083	0-6840	24
August	5	--	--	---	--
August	6	12.7	7505	3138-11872	58
August	7	9.6	1029	0-3029	8
Totals		49.4	12,847	6,716-18,978	100

Table 8. Identification, extent, sediment input (relative to other reaches), and priority for remediation of habitat problems in Reach C (Strata 4 and 5), Yankee Fork of the Salmon River, Idaho, 1985.

Problem type	Length (m)	Percent of total length (48,942 m)[a]	Ranking of potential sediment input	Priority for remediation
Sloughing banks				
low, natural	253	0.5	8	8
low, unnatural	50	0.1	9	7
medium, natural	1214	2.5	3	5
medium, unnatural	851	1.7	5	2
high, natural	1071	2.2	2	6
high, unnatural	643	1.3	4	1
Open slopes				
exposed soil	564	1.2	6	16
sparse vegetation	2042	4.0	1	17
Adjacent road				
poorly riprapped	327	0.7	7	3
riprapped	11	0.0	10	14
vegetated	159	0.3	11	15
Dredge tailings				
without vegetation	42	0.1	13	13
Washouts				
road	32	0.1	12	9
tributary stream	lb	NA	14	12
culvert	lb	NA	15	10
Barriers				
stranded pools	5[b]	NA	NA	11
log jams	11[b]	NA	NA	4

a total length represents the length of streambank in reach (two times the length of reach).

b frequency of occurrence, not length.

thin buffer of vegetation next to the waters edge. Sloughing streambanks were of low (<1 m), medium (l-2 m) or high (>2 m) height and caused by natural or unnatural sources. Roads adjacent to the stream were either poorly rip-rapped, rip-rapped without vegetative cover or rip-rapped with vegetative cover. Open slopes adjacent to the stream had sparse vetetative cover or exposed soil. Washouts occurred in roaded sections, stream tributaries, and as a result of inadequate culverts. Barriers to fish passage (adult) include log jams and low flows. During 1985, reach C was expanded to include 11.4 km of the Yankee Fork, from the confluence of 8 Mile Creek with the Yankee Fork upstream to Mackay Creek. Complete descriptions of Reaches A, B, D, E, and F can be found in the FY 1984 Annual Report.

Reach C

Reach C (Stratum 4 & 5) extends from the confluence of Yankee Fork with Jordan Creek to the confluence of Yankee Fork with Mackay Creek (23.21 km) (Fig. 1). Throughout most of this reach, the stream flows with moderate gradient through a moderately wide valley. Extensive braiding occurs in the lower one-third of strata 5. The stream flows with high gradient through a narrow canyon for a short distance near the upper end of strata 4. The entire reach is roaded, occasionally adjacent to the stream. Upland areas have moderate to steep slopes of dense forest or expansive open slopes either vegetated with grass and sage or not vegetated.

Stream habitat is dominated by riffles and pools, although stretches of pocket water are also present in sections with higher gradient. Riffles contain high quality gravels for spawning but riffle substrates in the lower half of reach are coated with a thin layer of silt and algae. Spawning potential in pocket water is poor. Pools have adequate instream and riparian cover for rearing salmonids. Instream cover is in the form of depth, boulders, downed trees and turbulence. Riparian cover is provided from willows, alders and undercut banks. Banks in the upper half of reach are well stabilized by dense root systems.

Problems in Reach C which affect fish habitat include: sloughing stream banks (4,062 m); steep, unstable open slopes adjacent to the stream (2,606 m); roading adjacent to the stream (18 occurrances); unstable dredge tailings adjacent to the stream (42 m); Log jams (11 occurrences), which potentially (But not to date) can create passage problems; road (32 m), culvert and tributary (1 occurrence each) washouts (Table 8).

DISCUSSION

Habitat Inventory

Water temperature ranges within strata were similar for 1984 and 1985 (Table 5). Temperature extremes probably occurred for only short periods of time during a die1 cycle. Recorded temperatures did not appear to limit growth or survival of chinook salmon (preferred temperature range: 7 to 15 c; Reiser and Bjornn 1979).

September flows were lower in 1985 than in 1984 (Fig. 3A). Flow did not limit chinook salmon passage or survival during September throughout most of the drainage. Adult passage may have been restricted near the mouth of Jordan Creek as a result of flow (<0.20 m water depth) moving underground (through interstitial spaces in tailings) in both years for adequate passage (Thompson 1972). Lower flows in 1985 caused pool width and, hence, riffle area, pool area, to be narrower or smaller, respectively, than in 1984 (Figs. 4 and 5A). Maximum depth in pools and stream gradient were not, however, affected significantly by the lower flow in 1985. Significant difference in riparian cover within strata between years was probably caused by the change in sampling intensity between years and not changes in land management.

The quality of riffles and pools for spawning and rearing probably limited potential chinook salmon production in 1985 more so than in 1984. Most riffle substrates in the Yankee Fork system have the cobble-gravel size preferred by anadromous salmonids (6-102 mm; Reiser and Bjornn 1979). In 1984, inundation of riffles with fine sediments was minimal throughout the Yankee Fork system (<l0%) and did not pose a limitation to spawning and emergence of anadromous salmonids. Riffles with less than 20% fines (<6.4 mm diameter) do not usually have adverse affects on spawning success (Bjornn et al. 1977). In 1985, increased mining activity together with monthly rainfall events in strata 7 (Jordan Creek) had an effect on substrate conditions in strata 1, 2, 3, and 7. Increases in riffle fines < 4 mm diameter, riffle substrate covered with superfines, and pool substrate embedded with fines took place in strata below Jordan Creek in 1985. Photo documentation of mixing and settling zones and filed notes were compiled (but not presented).

Aggradation and degradation of substrate in the riparian zone, stream zone, and stream channel was highly variable within strata between 1984 and 1985 (Fig. 11). Measuring more sites on isolated problem sites over time might have better resolution as to real changes in substrate in the drainage, i.e. a non-random problem site chosen in 1984 degraded 12.1 m2/yr by 1985; the site was 125 m long, thus, a real degradation of 1512.5 m^2/yr of substrate. Measurements at non-random sites may have more application than strata means when applying remediation or prioritizing remediation.

Fish Community Inventory

Density of fish (combined species and age-classes) was highest (approximately 2.0 fish/m^2 pool) in strata 4 and 6, and lowest (approximately 0.3 fish/m2 pool) in strata 2 and 5 (Fig. 12) both in 1984 and 1985. Highest relative abundance of age 0+ chinook salmon also occurred in strata 4 and 6 in 1984 and 1985. Stratum 6 is the relatively pristine West Fork of the Yankee Fork. Chinook salmon fry numbered between 5,700 and 7,500 fish(one half of which must be considered wild) in-the entire drainage in 1984 and 1985. Stratum 4, above the confluence with Jordan Creek and 39% of total drainage, contained an average of 5,000 fish in 1984 and 1985. Relative abundance of age 0+ chinook salmon decreased appreciably in strata 7 (Jordan Creek), and 3 (directly below confluence with Jordan Creek), thus, priority for enhancement might be given to those strata that have supported the most fish or lost the most fish to some identified problem during the baseline study. If we assume redd counts in the drainage between 1983 and 1984 were static, increased sedimentation between 1984 and 1985 in and from Jordan Creek may have had an impact on the incubation and survival of age 0+ chinook salmon during fall 1984 and 1985, respectively.

Abundance of age 0+ steelhead/rainbow trout was high in 1984 and 1985. Idaho Fish and Game outplanted fry in the drainage during both years which probably had an effect on densities.

Only age l+ and older bull trout were observed in the new strata 5 (11.4 km) (Fig. 12), although no anadromous fry were counted in strata 5, spawning and rearing conditions seemed acceptable throughout most of the reach. Densities of age 0+ chinook salmon, age l+ chinook salmon, age 0+ steelhead/rainbow trout, age l+ steelhead/rainbow, age 2+ and older cutthroat trout, and adult mountain whitefish differed significantly among strata (main effect) but did not differ significantly beetween 1984 and 1985 (main effect). Data from 1984 and 1985, showed in most cases, that we detected differences among strata and that the drainage supported fish communities within the two baseline data years.

Densities of age 2+ steelhead (rainbow trout, age 0+ bull trout, age 0+ mountain whitefish, and juvenile mountain whitefish did not differ significantly among strata (main effect) or between 1984 and 1985 (main effect). Variability within strata usually accounted for our inability to detect differences within the strata source of variation. Non-significance in the species again showed a relatively static composition of the fish community in the drainage between years. Only char species showed changes in mean densities within strata between years. Bull trout densities decreased significantly between 1984 and 1985 in Jordan Creek which could have resulted from a number of factors. Brook trout fry were formed for the first time in the drainage in two years of study. Both species/year classes were a minor constituent of the fish community between years.

Age 0+ chinook salmon were shorter and weighed less in 1985 than in 1984. Since we did not monitor degree days,

food availability, or summer and spring chinook redd success in the drainage between years, we did not conclude why the differences occurrred. Underseeding and, thus, competition for food and space given other densities were static between years.

Effectiveness of Sampling Design and Sampling Methods

The sampline design of 1985 (6 sites in each of seven strata) produced higher confidence in our estimates than the design of 1984 (4 sites in each of six strata). Increased effort reduced the variability associated with means in each strata although confidence intervals remained large in some instances, i.e. numbers of age 0+ chinook salmon in strata 4 and 6, because of high variability within strata. For the most part confidence intervals of density means were in the range necessary to detect responses to enhancement, given, after variation because of redd counts, if complete in the future, can be blocked out.

Reach Description and Problem Identification

Adding strata 5 to Reach C (only strata 4 in 1984) doubled the length of the strata to 4.8 km and added two problem types. Eleven log jams, that could be potential barrier for migrating adult salmon, were located in the new portion of Reach C. Few if any redds and no chinook fry were counted in strata which makes the problems and the reach lower priority for enhancement, at least at this time, than other areas in the drainage.

When conducting fish inventories in the upper half of the reach (strata 5) no age 0+ chinook salmon were found above a certain point. This section was walked and problems were identified, however, no apparent physical barriers were documented. This upper section of stream does contain some good spawning and rearing habitat for anadromous salmonids thus more intensive evaluations should be conducted to pinpoint the barrier for fish movement.

LITERATURE CITED

Bjornn, T. C. 1978. Survival, production, and yield of trout and chinook salmon in the Lemhi River, Idaho. Bulletin No. 27, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, USA.

Bjornn, T. C., M.A. Brusven, M.P. Molnau, J.H. Milligan, R.A. Klamt, E. Chacho, and C. Schaye. 1977. Transport of grantic sediment in streams and its effects on insects and fish. Bulletin No. 17, Forestry, Wildlife and Range Experimental Station, University of Idaho, Moscow, USA.

Reiser, D.W., and T.C. Bjornn. 1979. Habitat requirements of anadromous salmonids. Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow and Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon, USA.

Sekulich, P.T., and T.C. Bjornn. 1977. The carrying capacity of streams for rearing salmonids as affected by components of the habitat. Completion Report for Supplement 99, USDA Forest Service.

Thompson, K. 1972. Determining stream flows for fish life. In Proceedings of Instream Flow Requirement Workshop, Pacific Northwest River Basin Commission, Vancouver, Washington, USA.

SUBPROJECT IV

East Fork Salmon River: Problem Identification, 1985

and

Herd Creek: Habitat and Fish Inventory, 1985

ABSTRACT

Ranching and agricultural practices have altered a substantial portion of the aquatic habitat in the East Fork of the Salmon River drainage. Aquatic habitat and fish community of Herd Creek, a tributary to the East Fork, were inventoried for use as pre-treatment data to evaluate response to anticipated habitat enhancement, Physical and biological variables were measured in six sites within four strata along most of Herd Creek (15 km) during July and August 1985. Fish data were collected via snorkel-observations, electrofishing, and seining. Minimum and maximum water temperatures ranged from 1 to 7C and 16 to 19C, respectively, between 26 June and 19 September. Riffle area, pool area, flow, stream width, pool depth, gradient, and riparian cover did not differ significantly among strata. A significantly higher frequency of fine (0<8 mm diameter) sediments occurred in downstream strata 1 and 2. In decreasing order of abundance, salmonid species in Herd Creek included: chinook salmon (Oncorhynchus tshawtscha), mountain whitefish (Prosopium williamsoni), steelhead/rainbow trout (Salmo gairdneri) bull trout (Salvelinus confluentus), and brook trout (S. fontinalis). Estimated abundance of age 0+ chinook salmon was 16,201 fish in July and 19,884 fish in August. Density was highest (0.69 fish/m2 pool) in stratum 3 and lowest (0.03 fish/m^3 pool) in stratum 1. Length, weight, and condition of age 0+ chinook salmon were higher in downstream than in upstream strata and 'in August than in July. Densities of age 0+ and adult mountain whitefish ranged from 0.04 to 0.23 and 0.02 to 0.06 fish/m^2 pool, respectively. Age 0+ steelhead/rainbow trout densities ranged from 0 fish/m^2 pool in the stratum 4 in July to 0.03 fish/m^2 pool in strata 1 and 2 in August. Density of age l+ and older bull trout (range: 0.002 to 0.011 fish/m^2 pool) was highest in strata 1 and 3. Brook trout were found only in stratum 2 in July (0.005 fish/m^2 pool). Salmonid habitat and passage problem areas were identified and prioritized for remediation throughout the entire East Fork system, Major sedimentation problem types, in descending order of potential sediment input, include: sloughing stream banks, roading adjacent to the stream, cattle crossings, washouts, and open slopes. Passage problems included irrigation diversions and log jams.

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INTRODUCTION

The East Fork of the Salmon River, a major tributary of the mainstem Salmon River, is a spawning and rearing stream for anadromous salmonids. Past redd counts (Internal data, Idaho Department of Fish and Game) indicate the East Fork and Herd Creek, a major tributary to the East Fork, were important spawning streams for wild spring and summer chinook salmon (Oncorhynchus tshawytscha) in the Salmon River drainage. Redd counts are depressed to less than 40 redds per year during the 1980's from approximately 700 redds per year during the early 1960's. No hatchery supplementation of these salmon stocks have occurred to date. Although no redd count data exists, wild steelhead trout (Salmo gairdneri) also utilize the East Fork for spawning and rearing. Steelhead runs have been supplemented by hatchery outplanting during recent years. Idaho Fish and Game has recently constructed a weir facility approximately 29 km upstream from the East Fork mouth (above Herd Creek) that will improve fish counting procedures in the drainage.

Sections of the East Fork of the Salmon River have a history of adverse land use practices which have contributed to the decline of anadromous fish runs. Most of the stream is associated with range and ranching operations. Natural sinuosity and sandy substrates in floodplain sections have created extensive streambank erosion. Grazing practices have further aggravated the unstable nature of the banks. Both point and non-point sources of sedimentation have increased siltation and, thus, reduced spawning substrate quality.

The East Fork system is an important (and treaty guaranteed) anadromous fishing area for members of the Shoshone-Bannock Tribes. As a conservation measure, the Tribes have voluntarily chosen not to exercise this treaty right since 1978. Through BPA funding and in anticipation of potential habitat enhancement, the Tribes identified habitat problems in the East Fork drainage and conducted habitat and fish inventories on Herd Creek during 1985. An access easement for the only ranch on Herd Creek allowed the inventories to take place during 1985. All other land on Herd Creek is federally owned. Prioritization of habitat problems affecting fish and their habitats throughout the system, relative to sediment recruitment (identified as the primary problem in th drainage) and remediation was also accomplished.

Objectives of this study were: 1) to identify on-site problems affecting fish populations and their habitats and prioritize the problems for remediation in the entire East Fork Salmon River drainage, and; 2) inventory the fish community and their habitat on Herd Creek.

STUDY AREA

The East Fork of the Salmon River, located in Custer County, Idaho, is a major tributary of the upper Salmon River (Fig. 1). Herd Creek is the largest tributary to East Fork. Other notable tributaries to the East Fork include Big Boulder, Little Boulder, Wickiup, Germania, Bowery, and West Pass creeks. The East Fork of the Salmon River is a low to medium gradient system which flows through moderately wide valleys of lodgepole pine (Pinus contorta) forests, wide meadowed ranchlands, sagebrush/grass valleys, and narrow canyons. Most of the system is roaded and-lies in an area of the Challis Volcanics which are characterized by highly erosive sandy and clay-loam soils. Adjacent lands are owned predominately by the U.S. Forest Service (Challis National Forest), Bureau of Land Management (Salmon District), and private landowners.

Problem identification and prioritization for remediation addressed 46.2 km of the East Fork system which extended from the mouth to U.S. Forest Service guard station at Bowery; Herd Creek up to the confluence with East Pass Creek; Big Boulder Creek up to the Livingston mine; Wickiup Creek upstream for 2 km; Germania Creek upstream for 2.0 km; Bowery Creek upstream for 2.0 km; and West Pass Creek upstream for 2.0 km. Intensive habitat and fish population inventories were conducted on the 15.5 km of Herd Creek from its confluence with the East Fork to its confluence with East Pass Creek.

Substantial sections of the mainstem East Fork and Herd Creek (2.4 km) pass through pastures and grazed forests. Roads parallel almost all of the East Fork, Big Boulder Creek, Herd Creek, and some other smaller tributaries.

The East Fork system is an important spawning and rearing stream for spring and summer chinook salmon and steelhead/rainbow trout. Utilization by chinook salmon has declined in the East Fork and Herd Creek (Fig. 2) since the early 1960's. Other fish species present in the East Fork system include bull trout (Salvelinus confluentus), cutthroat trout (Salmo clarki), mountain whitefish (Prosopium williamsoni), and short head sculpin (Cottus confusus)

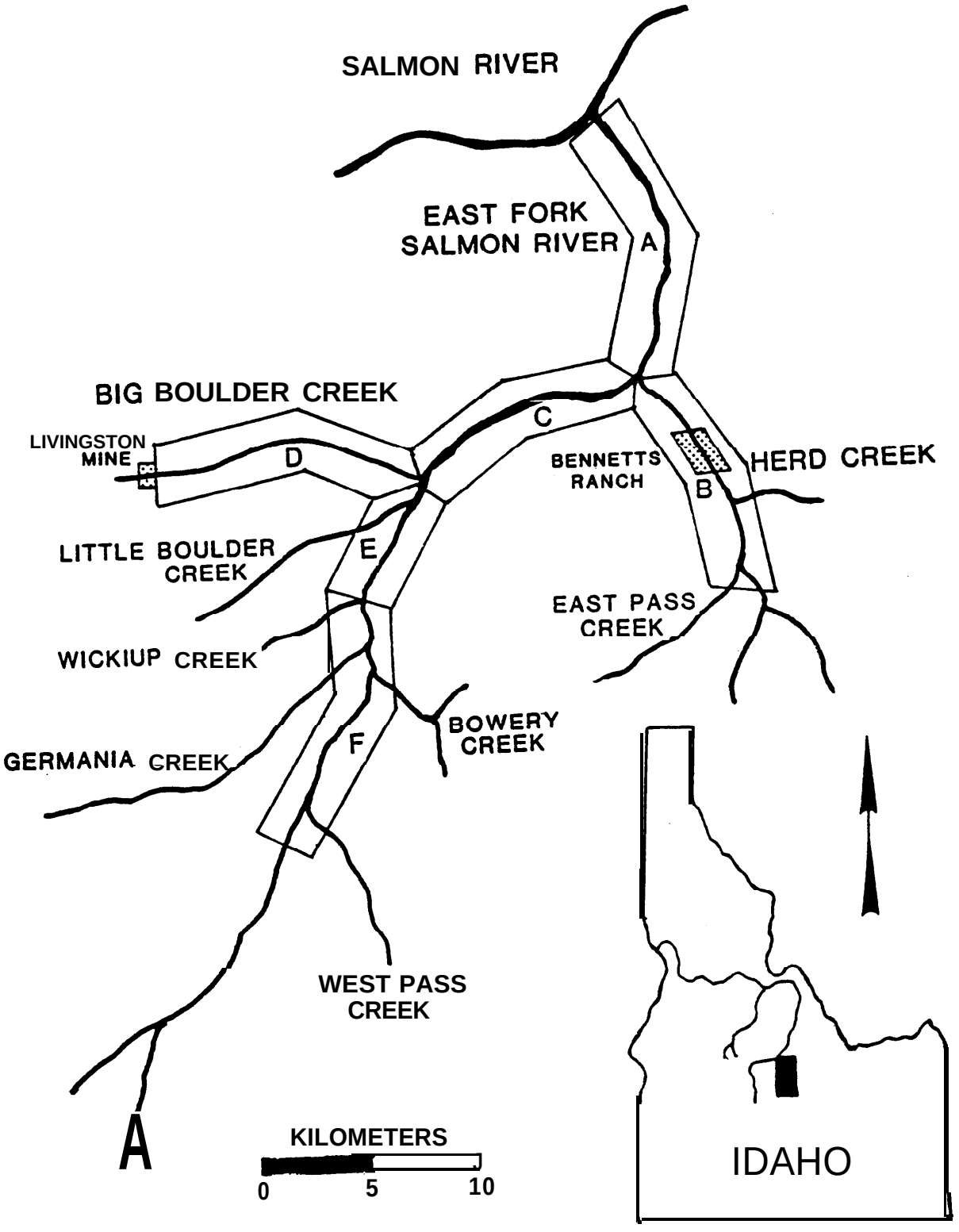


Figure 1. East Fork of the Salmon River, Idaho, study area and reach location.

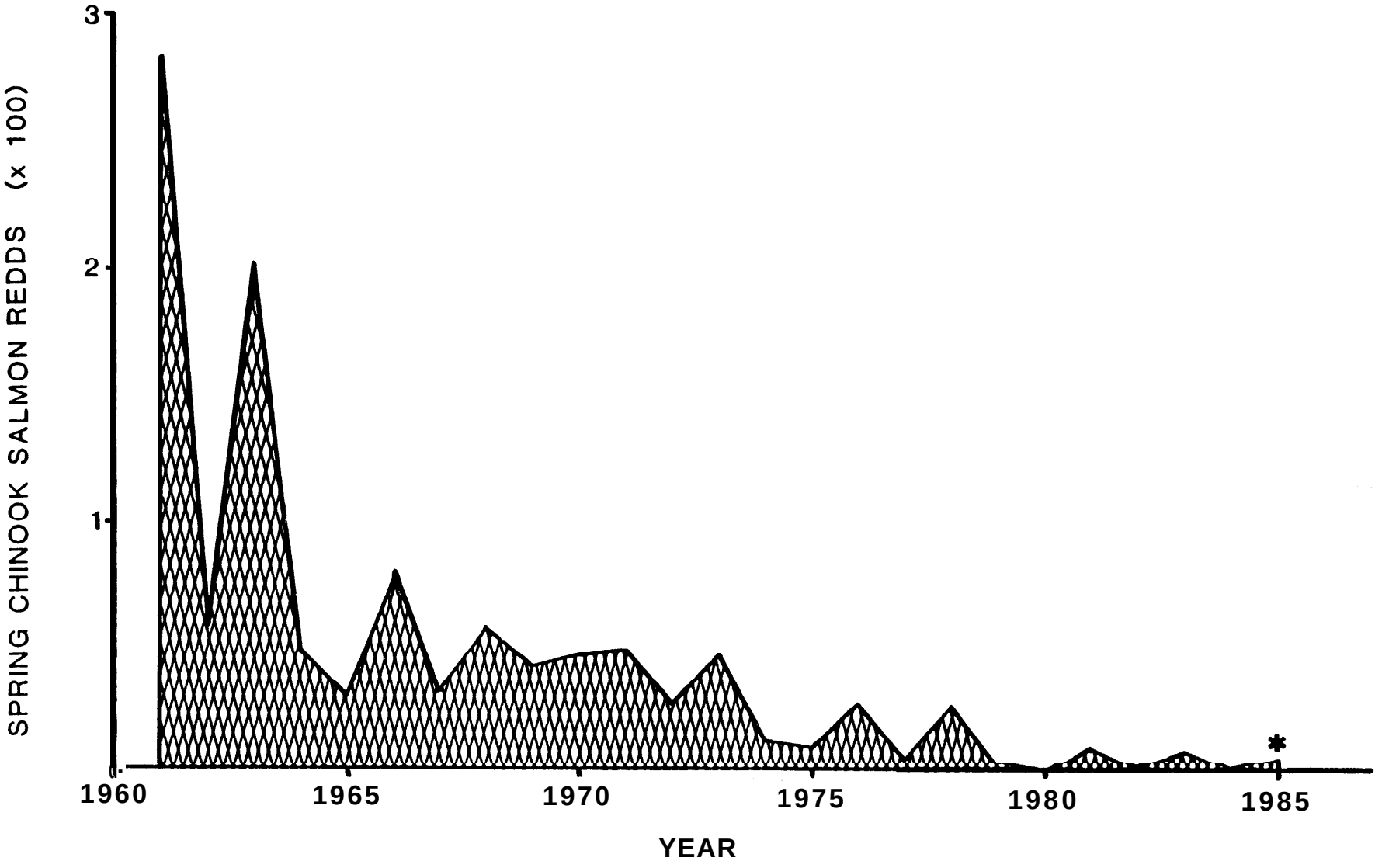


Figure 2. Counts of spring chinook salmon redds in Herd Creek, Idaho,1961-1985. An asterisk connotes counts by Tribal Biologists.

METHODS

Habitat and Fish Community Inventories

Variables

Habitat and biological variables measured in Herd Creek (Table 1) were similar to variables measured in Bear Valley Creek during 1985 (Methods, Sub-project 1, BPA Project 83-359, FY 1985 Annual Report).

Variable Measurement

Measurement of variables in Herd Creek followed methodologies used in Bear Valley Creek during 1985 (Methods, Sub-project 1, BPA Project 83-359, FY 1985 Annual Report).

Experimental Design

A sampling scheme (split plot in time or repeated measure) similar to the one used in Bear Valley Creek during 1985 (Methods, Subproject 1, BPA Project 83-359, FY 1985 Annual Report) was used in Herd Creek (Tables 2 and 3) with two exceptions: measurements were at six sites within each of four strata (seven and seven in Bear Valley Creek) (Fig. 1); and, measurement of biological variables occurred once in August (July and August in Bear Valley Creek). Stratification of the Herd Creek was based on stream size, valley width, gradient, land use, and land ownership (Table 4, Figs. 3 and 4).

Problem Identification

The East Fork drainage was separated into 6 reaches on the basis of stream size, valley width, land use activities, location in the drainage (Table 5 and Figs. 1 and 5). The entire length of all reaches except Reach D (time constraints during 1985) were walked and reach characteristics' and problem areas described. Reach characteristics included: stream, sinuosity, size and gradient; riffle-pool type; extent and quality of spawning and rearing habitat; stream bank type, stability and riparian cover: valley width; extent and type of land use associated with the stream, and upland slope cover. Problem areas were identified in relation to sediment sources, habitat degradation, and passage barriers. The type, extent and relative severity of each problem was estimated during the walk through and recorded. Air photos were taken at low levels of Bennetts' ranch in Reach B. Low-level air photos of the remaining five reaches will take place in 1986. Ground-level photos of individual problem sites were taken in 1985. Problem sites in Reach B were marked on acetate overlays to help measure their frequency and extent within each reach. Length of similar problem types were summed from each reach walked and the percent of the total reach each problem type comprised was calculated. Problem types for each reach walked were ranked according to

Table 1. Habitat and biological variables monitored in Herd Creek, Idaho, 1985.

Habitat	Biological (Fish)
Temperature	Species composition
Flow (discharge)	Relative abundance
Surface area	Density
Stream width	Population number
Stream depth	Length
Stream gradient	Weight
Riparian cover	Condition
Stream substrate	

Table 2. Experimental designs, used in 1985 and proposed for 1986, for sampling habitat variables on Herd Creek, Idaho.

Source	Degrees of freedom
1985	
4 Strata	3
6 Sites (Stratum), Error A	20
TOTAL	23
1986	
4 Strata	3
6 Sites (Stratum), Error A	20
2 Years	1
Years x strata	3
Error B	20
TOTAL	47

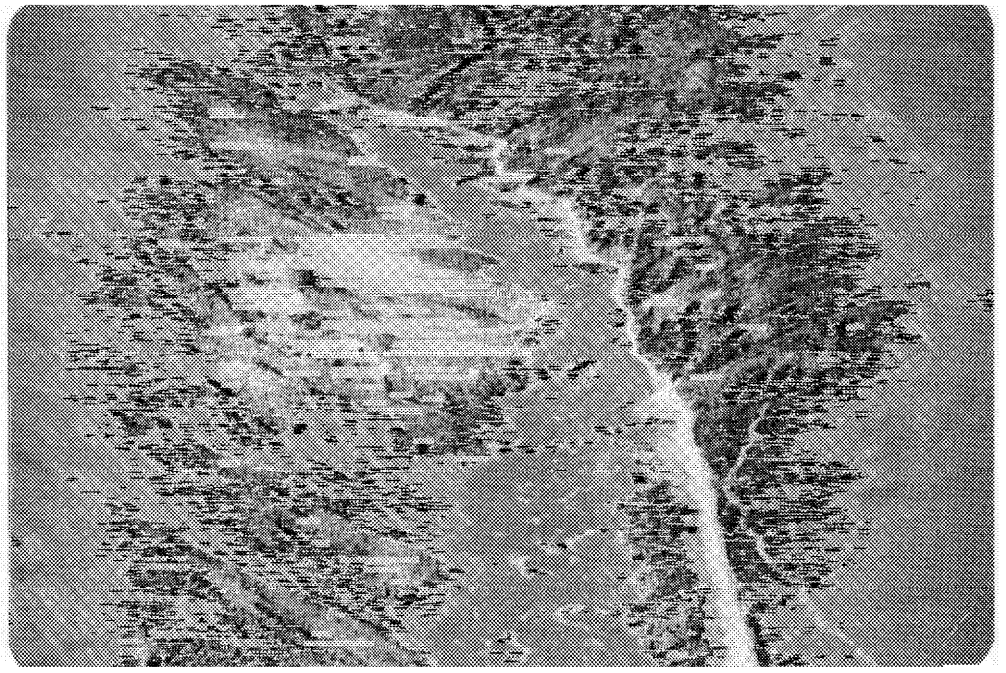
Table 3. Experimental designs, used in 1985 and proposed for 1986, for sampling biological variables on Herd Creek, Idaho.

Source	Degrees of freedom
1985	
4 Strata	3
6 Sites (Stratum), Error A	20
2 Times per year	1
Times x strata	3
Sites x times (Stratum), Error B	20
TOTAL	47
1986	
4 Strata	3
6 Sites (Stratum), Error A	20
2 Times per year	1
Times x strata	3
Sites x times (stratum), Error B	20
2 Years	1
Years x strata	3
Years x-times	1
Years x strata x times	3
Error C	88
TOTAL	143

Table 4. Strata characteristics, Herd Creek, Idaho.

Stratum	Length	Gradient	Land type	Land ownership	Land use
1[a]	4.6[b]	0.78%	Narrow brushy valley	BLM[c]	Non-consumptive[d]
2	4.0	0.73%	Wide valley, irrigated meadow	JRB[e]	Grazing[f]
3	2.6	0.97%	Narrow brushy valley, fenced	BLM	Non-consumptive[d]
4[g]	3.8	0.89%	Narrow brushy valley	USFS[h]	Grazing[i]

[a] Stream mouth
[b] Kilometers
[c] Bureau of Land Management, Salmon District
[d] Incidental and/or unauthorized grazing does take place
[e] James R. Bennetts, Challis, Idaho
[f] Voluntary within-year rotation
[g] Stream headwaters
[h] U. S. Forest Service, Challis National Forest
[i] Three-year rest-rotation, two on and one off



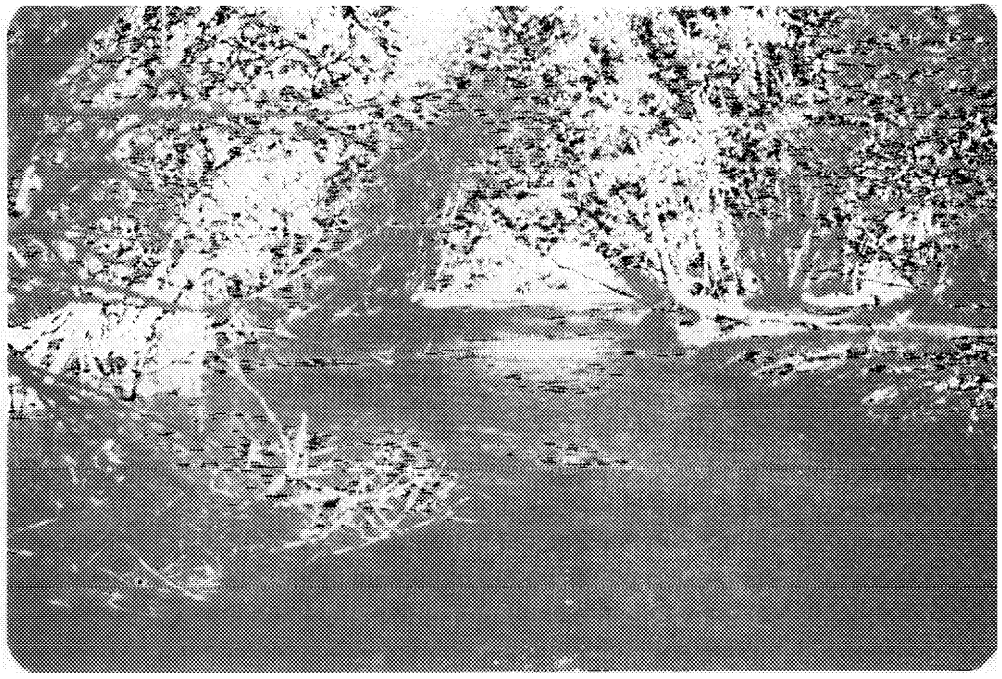


Figure 3. Typical reaches in study area strata, Herd Creek, Idaho, 1985. Upper: stratum 1, looking downstream. Lower: stratum 1, closeup.

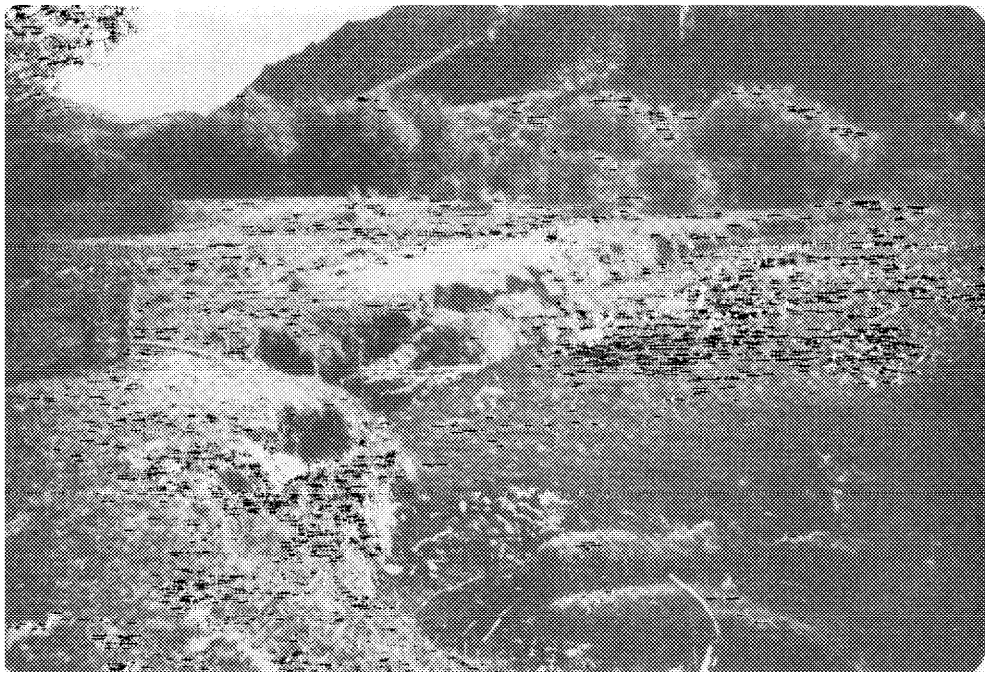
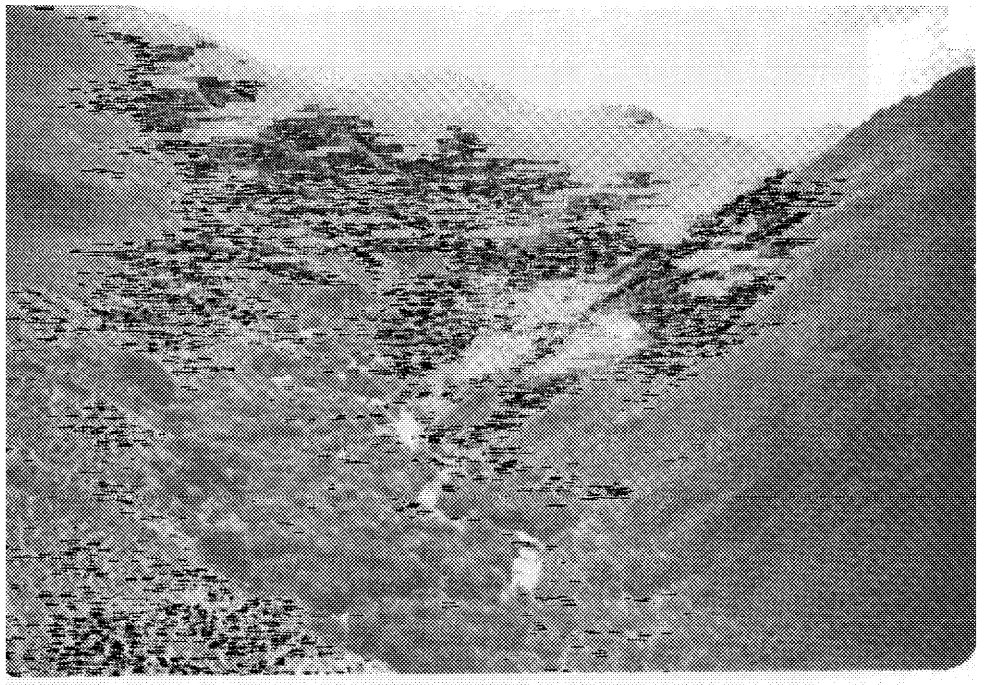


Figure Continued, Upper: stratum 2, looking upstream, Lower: stratum 2, closeup.



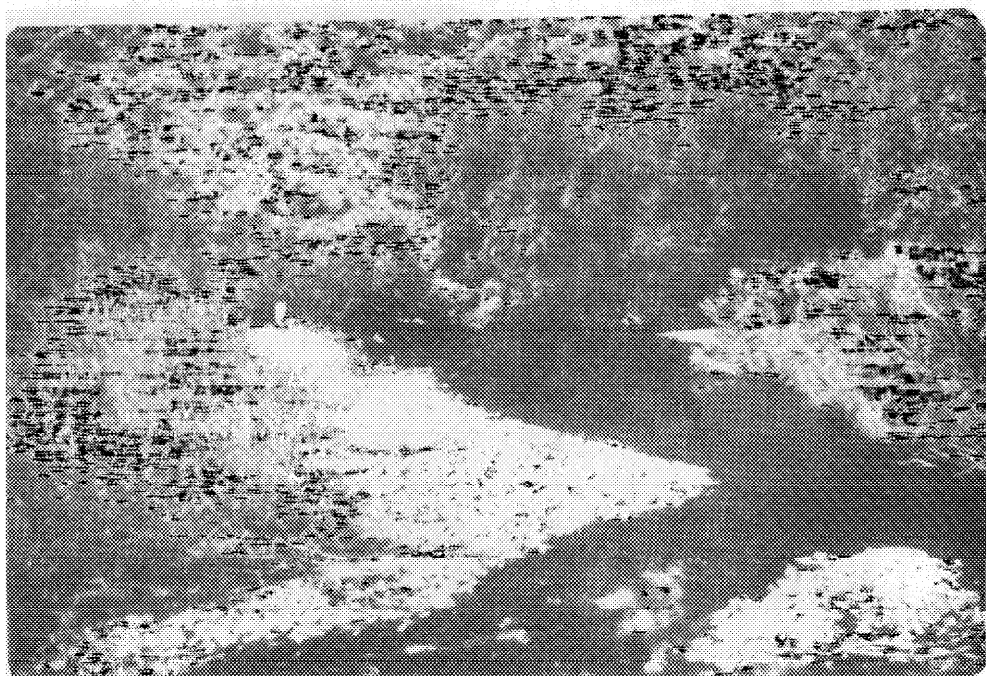
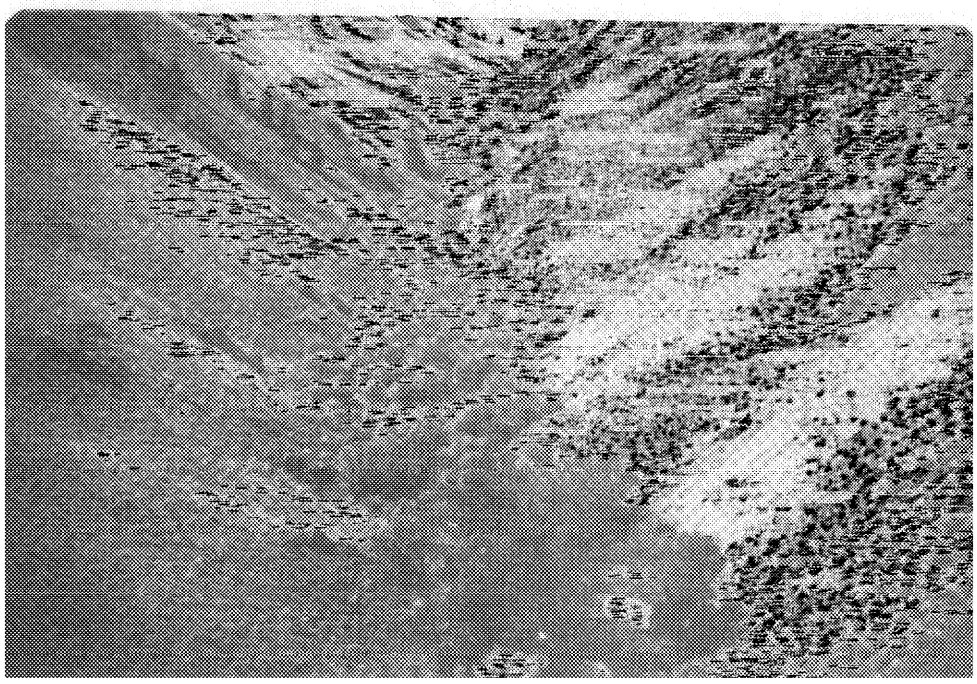


Figure 3. Continued. Upper: stratum 3, looking upstream, Lower: stratum 3, closeup.



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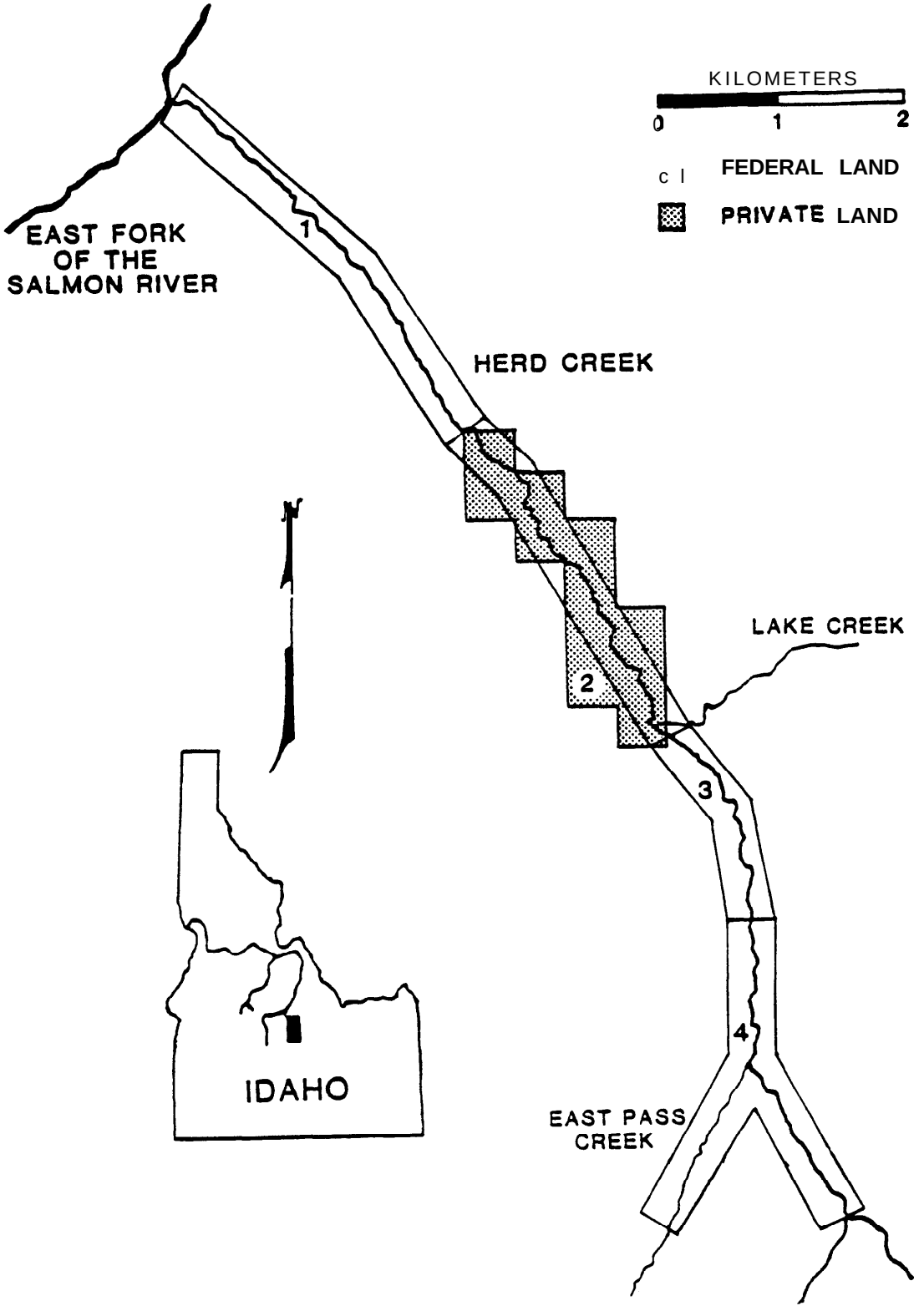
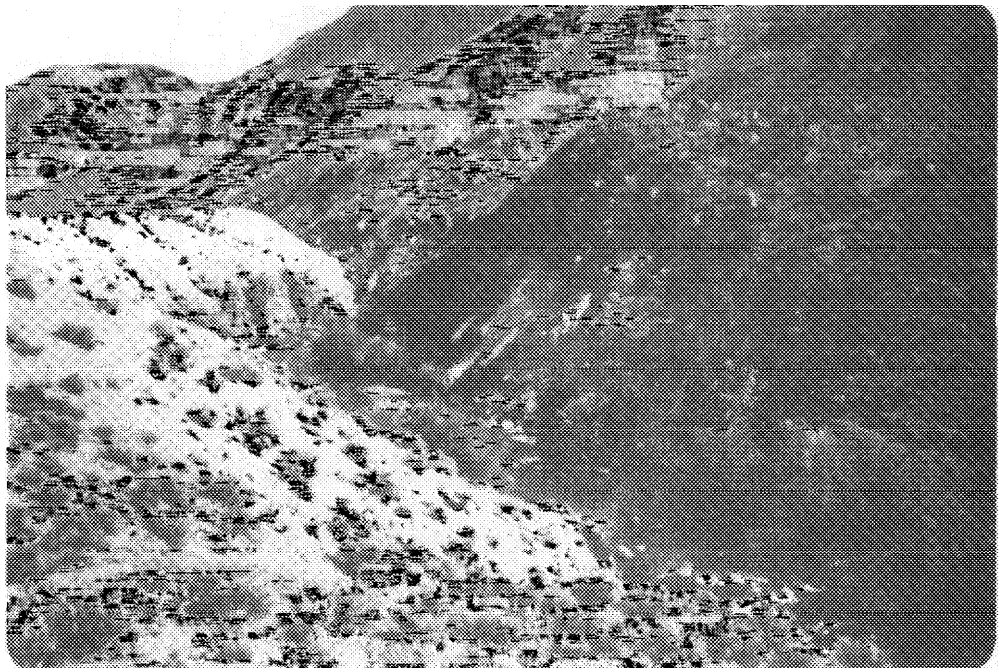


Figure 4. Herd Creek, Idaho study area and strata location.

Table 5. Reach characteristics, East Fork of the Salmon River, Idaho.

Reach	Length	Gradient	Land type	Land ownership	Land use
A[a]	15.6[b]	Low-medium	Narrow sagebrush valley, moderately wide ranchland	BLM[d] private	Farming, grazing
B[c]	15.5	Low-medium	Narrow sagebrush valley, moderately wide ranchland	USFS[e] private	Grazing
C	13.2	Medium	Wide valley, ranchland	Private	Farming, grazing
D[f]	7.2	Medium-high	Narrow forested valley	USFS	Grazing
E	7.1	Medium	Moderately-wide sparsely forested floodplain	Private, USFS	Farming, grazing
F	10.3	Medium	Moderately wide, forested	USFS	Grazing

[a] Stream mouth
[b] Kilometers
[c] Herd Creek
[d] Bureau of Land Management
[e] U.S. Forest Service, Challis National Forest
[f] Big Boulder Creek



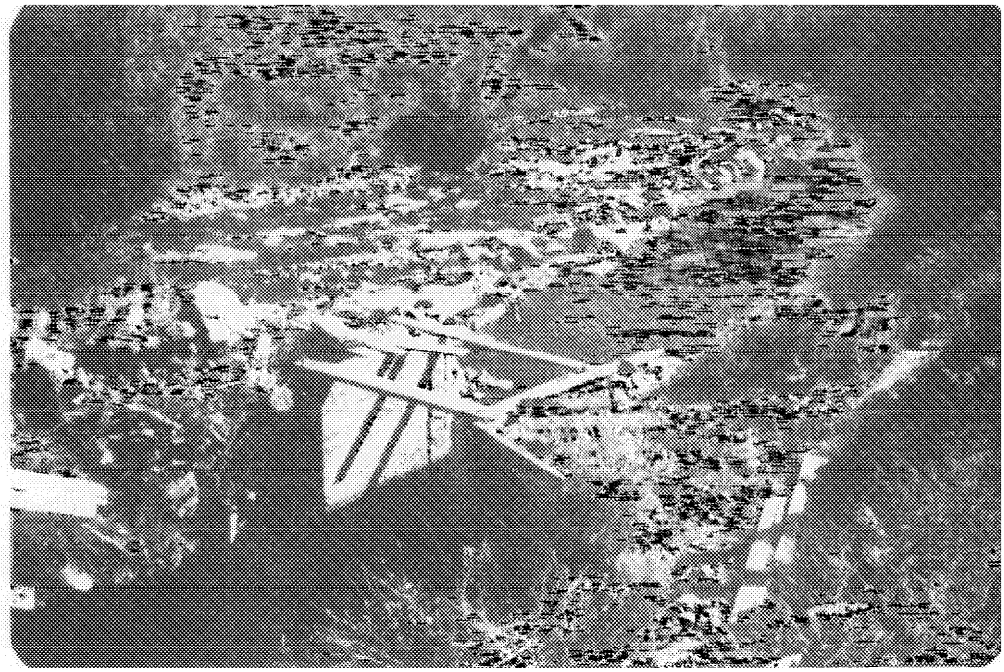
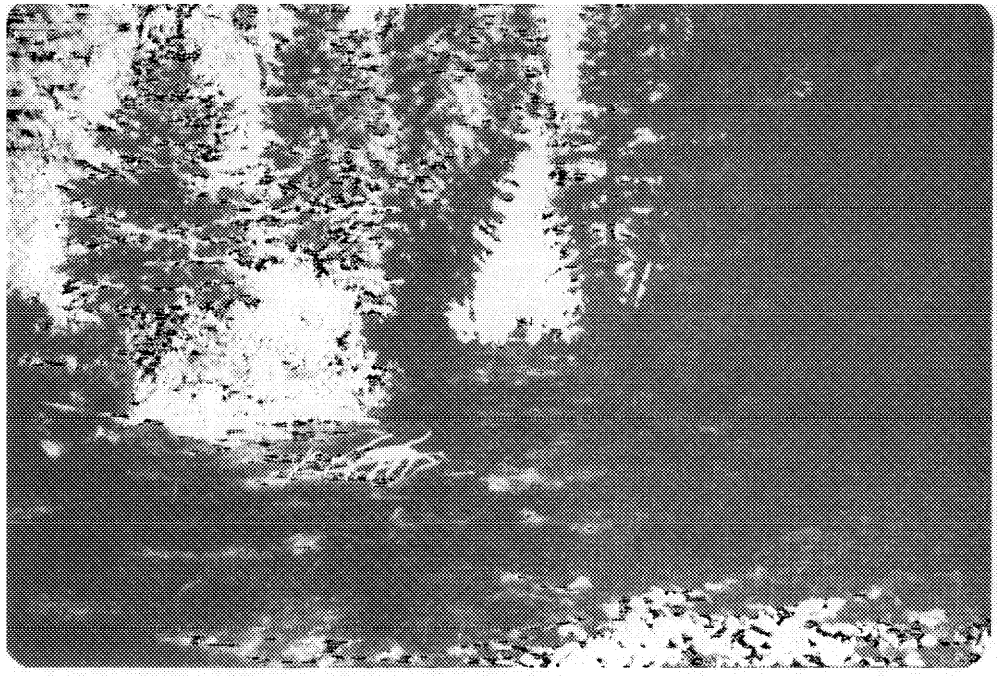


Figure 5. Typical reaches in study area, East Fork of the Salmon River, Idaho, 1985. Upper: Reach A (meduim gradient sagebrush valley). Lower: Reach B (low-medium stream with irrigation diversion).



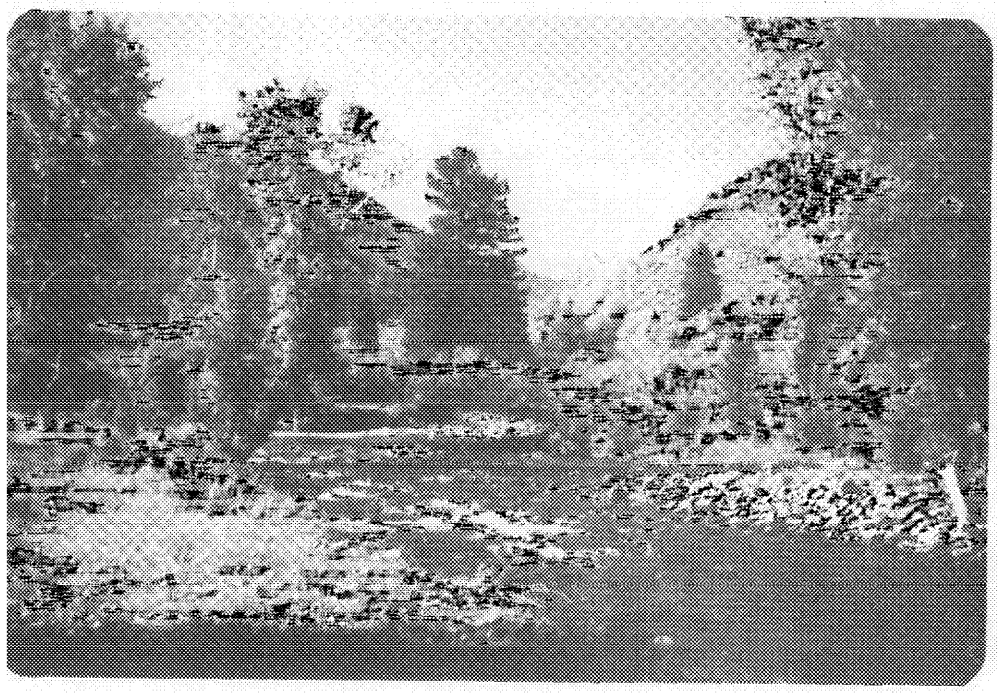


Figure 5. Continued, Upper: Reach F (high gradient canyon). Lower: Reach F (grazed National Forest land).

their estimated contribution of sediment into the reach. This ranking was based on the extent, instability, proximity, and type of erosive material for each problem type. Problem areas for each reach walked were also ranked according to their estimated priority for correction. Priority was based on sediment contribution, size, ease and feasibility of correction, and cause (natural or unnatural) for each problem type.

RESULTS

Variables in the habitat inventory of the Herd Creek, Idaho were measured once in early August during 1985 and were only compared among the four strata. Variables in the biological or fish inventory were measured twice, once in mid-July and again in mid-August and were compared among strata, between July and August, among all strata within July or August, and within a stratum between July and August.

Habitat Inventory

Water temperature ranged from 1 to 19C during June through September 1985 (Table 6). Minimum temperatures ranged from 1 to 5C among strata. Maximum temperatures ranged from 16 to 19C among strata.

July flows in Herd Creek ranged from 0.88 m^3/second in stratum 1 to 0.79 m^3/second in stratum 4 (Fig. 6A).

Riffle areas did not differ (F=0.2; P=0.9036) among strata and ranged from 75 m in stratum 4 to 98 m in stratum 2 (Fig. 6B).

Pool areas did not differ (F=1.7, P=0.l978) among strata and ranged from 73 m in stratum 3 to 126 m^2 in stratum 1 (Fig. 6B).

Riffle-pool (site) area did not differ (F=0.9, P=0.4564) among strata and ranged from 155 m^2 in stratum 3 to 211 m^2 in stratum 1 (Fig. 6B).

Pool width did not differ (F=0.8, P=0.5109) among strata. Pool width ranged from 5 m in stratum 3 to 7 m in stratum 1 (Fig. 7).

Maximum pool depth did not differ (F=0.8, P=0.5232) among strata and ranged from 0.66 m stratum 4 to 0.86 m in stratum 2 (Fig. 7).

Percent of pool bottom covered with fines (pool embeddedness) did not differ (F=2.7; P=0.0751) among strata and ranaged from 30% in stratum 3 to 66% in stratum 2 (Fig. 7).

Gradient did not differ (F=0.8, P=0.5060) among strata and ranged from 0.73% in stratum 2 to 0.97% in stratum 3 (Fig. 7).

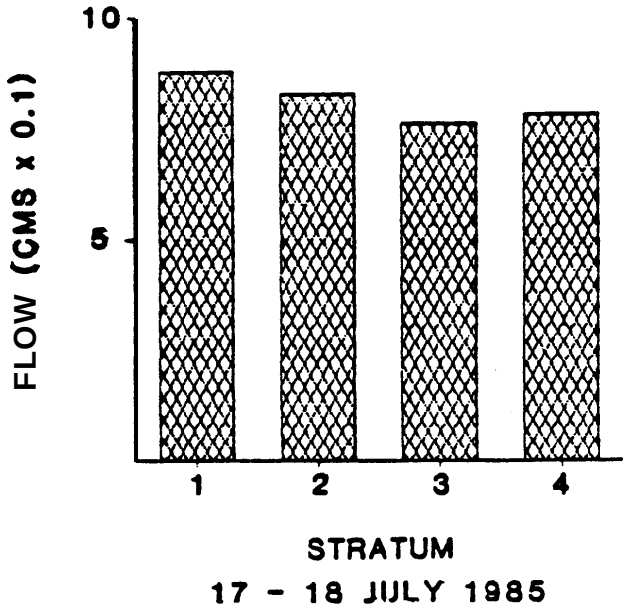
Pool riparian cover, expressed as real or measured cover, did not differ (F=1.4, P=0.2721) among strata and ranged from 92 cm in stratum 2 to 159 cm in stratum 1 (Fig. 8).

Riparian cover, expressed as a percent of stream width, did not differ (F=1.2, P=0.3508) among strata and ranged from 17% in stratum 2 to 31% in stratum 3 (Fig. 8).

Size-frequency (%) distributions of riffle substrate particles differed (Q=647.4 $P < 0.0001$) among strata. Distributions differed significantly ($P<0.05$) between all pairs of strata (Fig. 9). Highest frequency of large (>256

Table 6. Water temperature (C) extremes by stratum in Herd Creek, Idaho from 26 June to 19 September, 1985.

Stratum	Temperature (C)	
	Minimum	Maximum
1	5	19
2	7	18
3	4	16
4	[illegible]	17



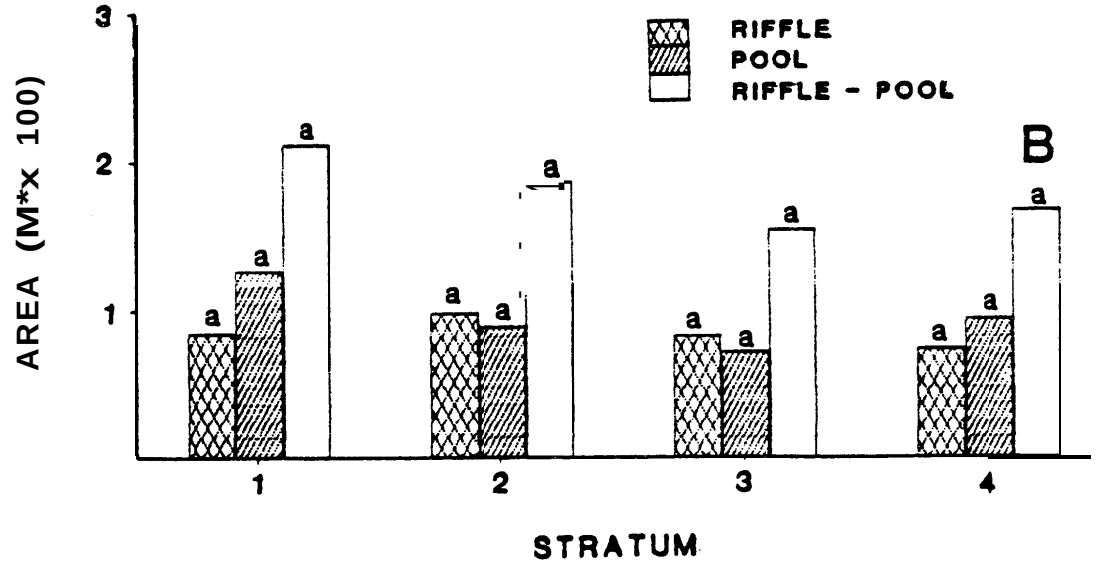


Figure 6. Flow (A) and mean (n=6 per stratum) riffle, pool and combined riffle-pool areas (B) by stratum, Herd Creek, Idaho, 1985. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

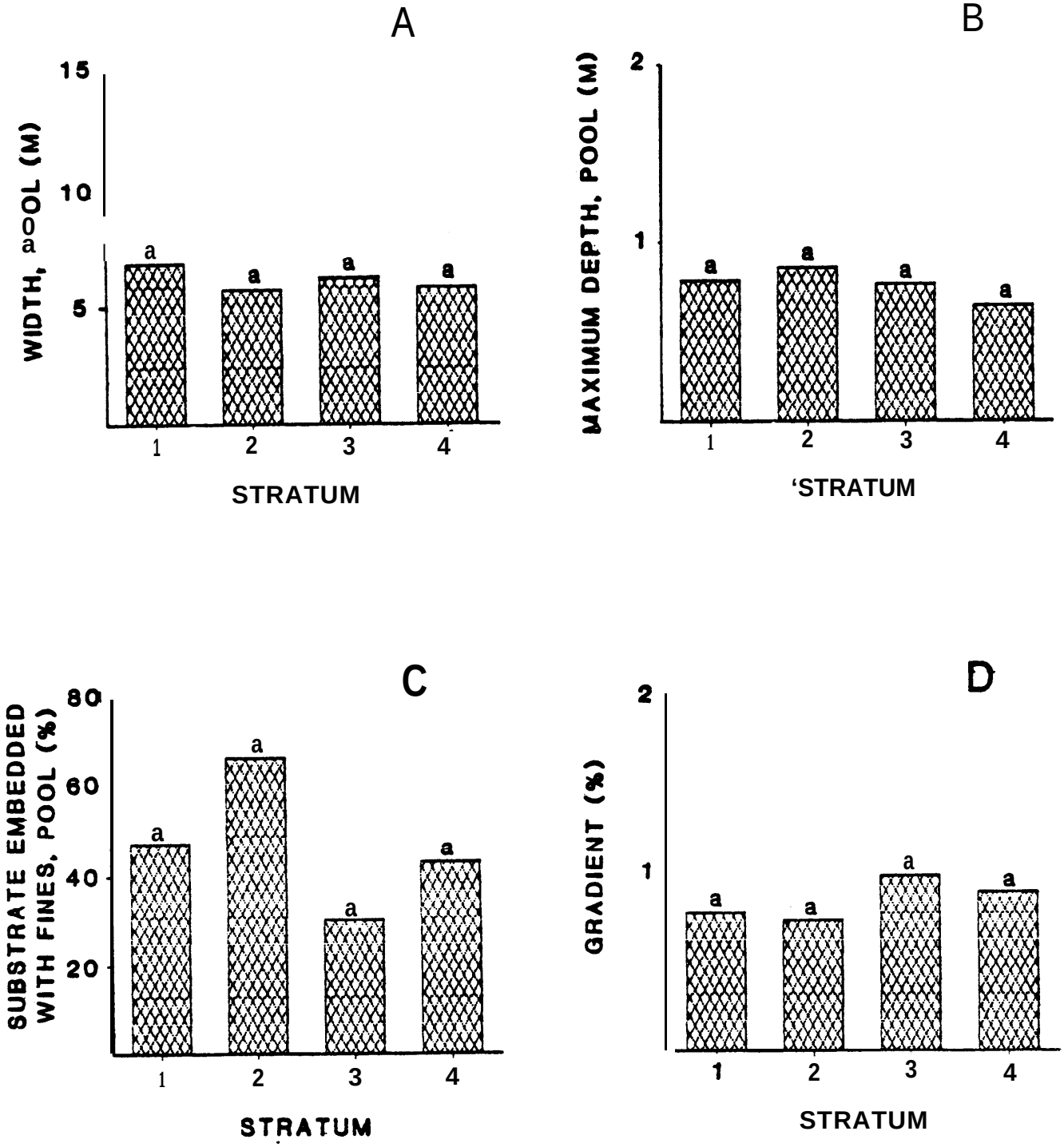


Figure 7. Mean (n=6 per stratum) pool width (A), maximum pool depth (B), percent of pool substrate embedded with fines (C), and gradient (D), by stratum, Herd Creek, Idaho, 1985. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

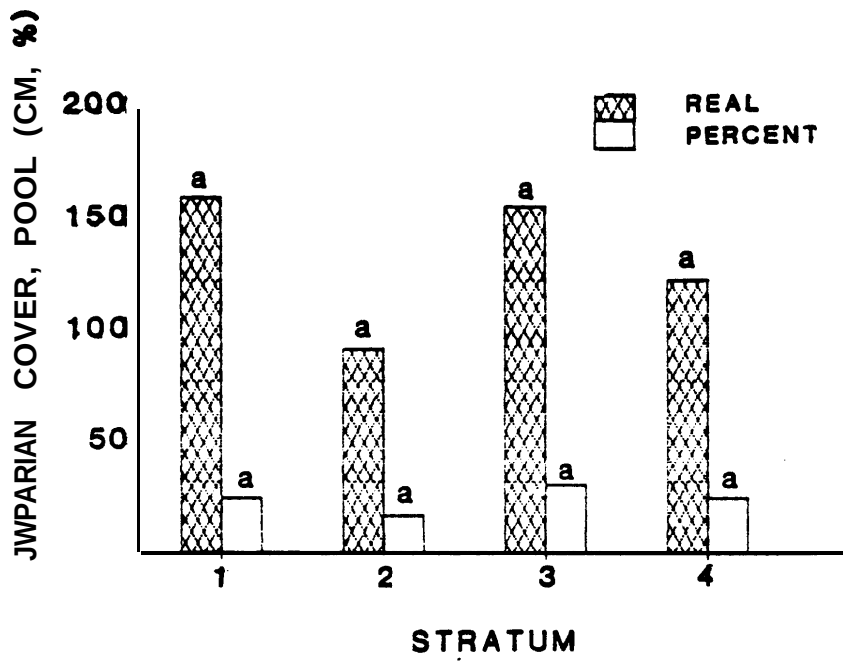


Figure 8. Mean (n=6 per stratum) riparian cover (real or measured and percent of pool width) by stratum, Herd Creek, Idaho, 1985. A common letter above means indicate a non-significant (P>0.05) difference among strata means within each method of measurement.

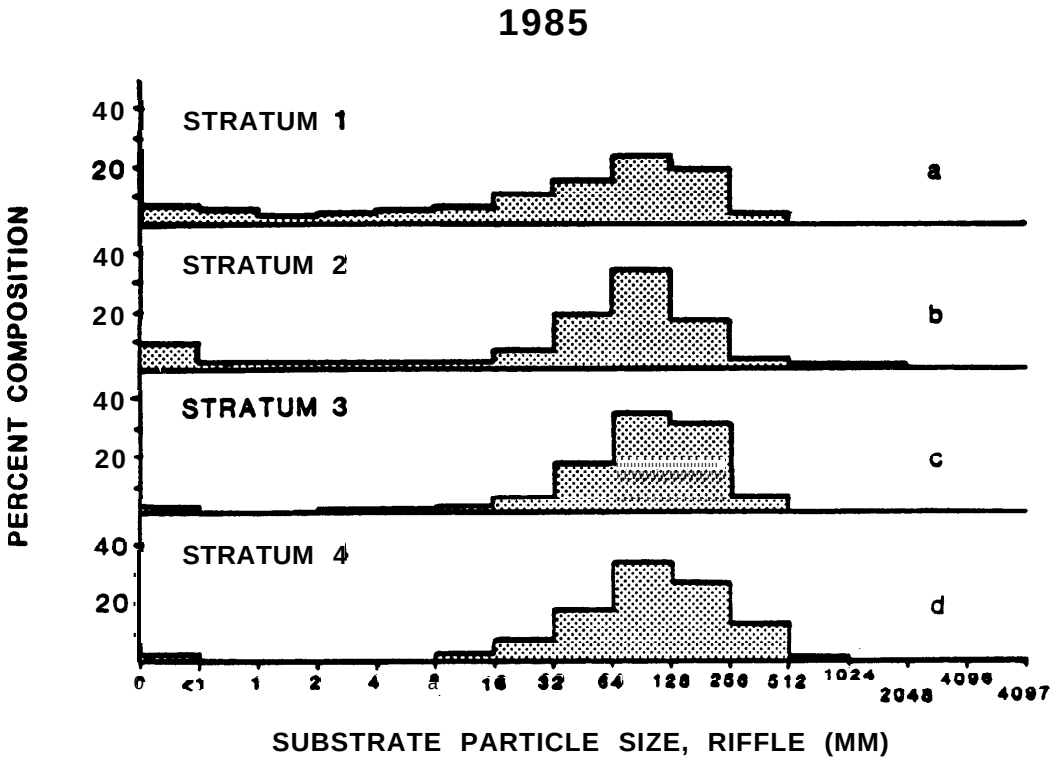


Figure 9. Mean (n=6 per stratum) distributions of substrate particles sizes in riffles by stratum, Herd Creek, Idaho, 1985. A common letter next to distributions indicate a non-significant (P>0.05) difference between distributions.

mm diameter) riffle substrate occurred in stratum 4. Highest frequencies of small ((4 or <8 mm diameter) riffle substrate occurred in strata 1 and 2 (Fig. 9).

Frequency (%) of fine riffle substrate less than 4 mm in diameter differed (F=l0.l, P=0.0003) among strata and ranged from 14% in stratum 1 to 2% in stratum 4 (Fig. 10). Frequency did not differ significantly (P<0.05) between strata 1 and 2 or strata 3 and 4. Frequencies in strata 1 and 2 were significantly higher than in strata 3 or 4.

Frequency (%) of fine riffle substrate less than 8 mm in diameter differed (F=14.7, P<0.000l) among strata and ranged from 24% in stratum 1 to 2% in stratum 4 (Fig. 10). Frequency did not differ significantly between strata 1 and 2 or strata 3 and 4. Frequencies in strata 1 and 2 were significantly higher than in strata 3 or 4.

Percent of riffle substrate covered with superfines (silt) differed (F=6.0, P=0.0045) among strata and ranged from 34% in stratum 2 to 6% in stratum 4 (Fig. 10). Percent in strata land 2, strata 2 and 3, and strata 3 and 4 did not differ significantly. Percent in strata 1 and 2 were significantly higher than in strata 4.

Fish Community Inventorv

Total Density and Relative Abundance

Fish densities (all species combined) were higher upstream (strata 3 and 4) than downstream (strata 1 to 2) during July and August (Fig. 11). Fish densities increased in strata 1 and 3 and decreased in strata 2 and 4 between July and August.

During July, relative abundance of age 0+ chinook salmon ranged, by strata, from 10 to 79% (Fig. 11). Age 0+ chinook salmon was the most abundant species-age class in strata 3 and 4. Age 0+ mountain whitefish was the most abundant species-age class in strata 1 and 2. Abundance of other species-age classes were low (<12%) in strata 3 and 4 during August. Abundance of age l+ steelhead/rainbow trout was moderate (30%) in stratum 1.

During August, relative abundance of age 0+ chinook salmon ranged, by strata, from 16 to 89% (Fig. 11). Relative abundance of age 0+ chinook salmon during August was higher than other age-classes of species in all strata except age 0+ mountain whitefish which was more abundant in strata 1 (34%). Abundance of adult whitefish was moderate in strata 1 and 2 (>18%).

Densities

Age 0+ chinook salmon. Densities differed among strata (F=43.5, P<0.000l) but not between July and August (F=3.2, P=0.0872). Densities ranged from 0.03 to 0.69-fish/m2 pool among strata in 1985 (Fig. 12A) and were 0.32 and 0.36 fish/m^2

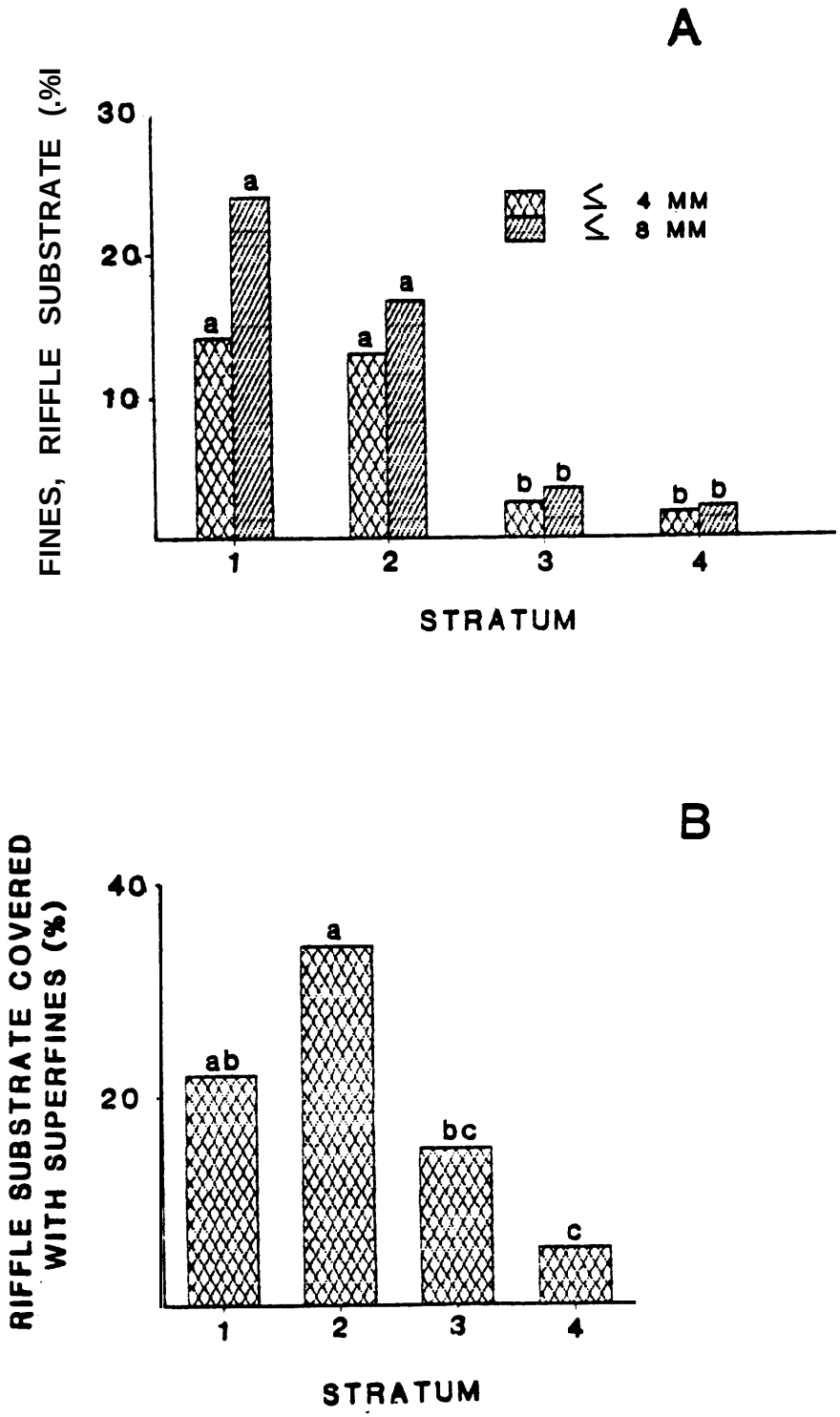


Figure 10. Mean (n=6 per stratum) percent of riffle substrate particles less than or equal to 4 and 8 mm diameter (A) and percent of riffle substraten particles coated with superfines (B), by stratum, Herd Creek, Idaho, 1985. A common letter above means indicate a non-significant (P>0.05) differences among strata means for each size class.

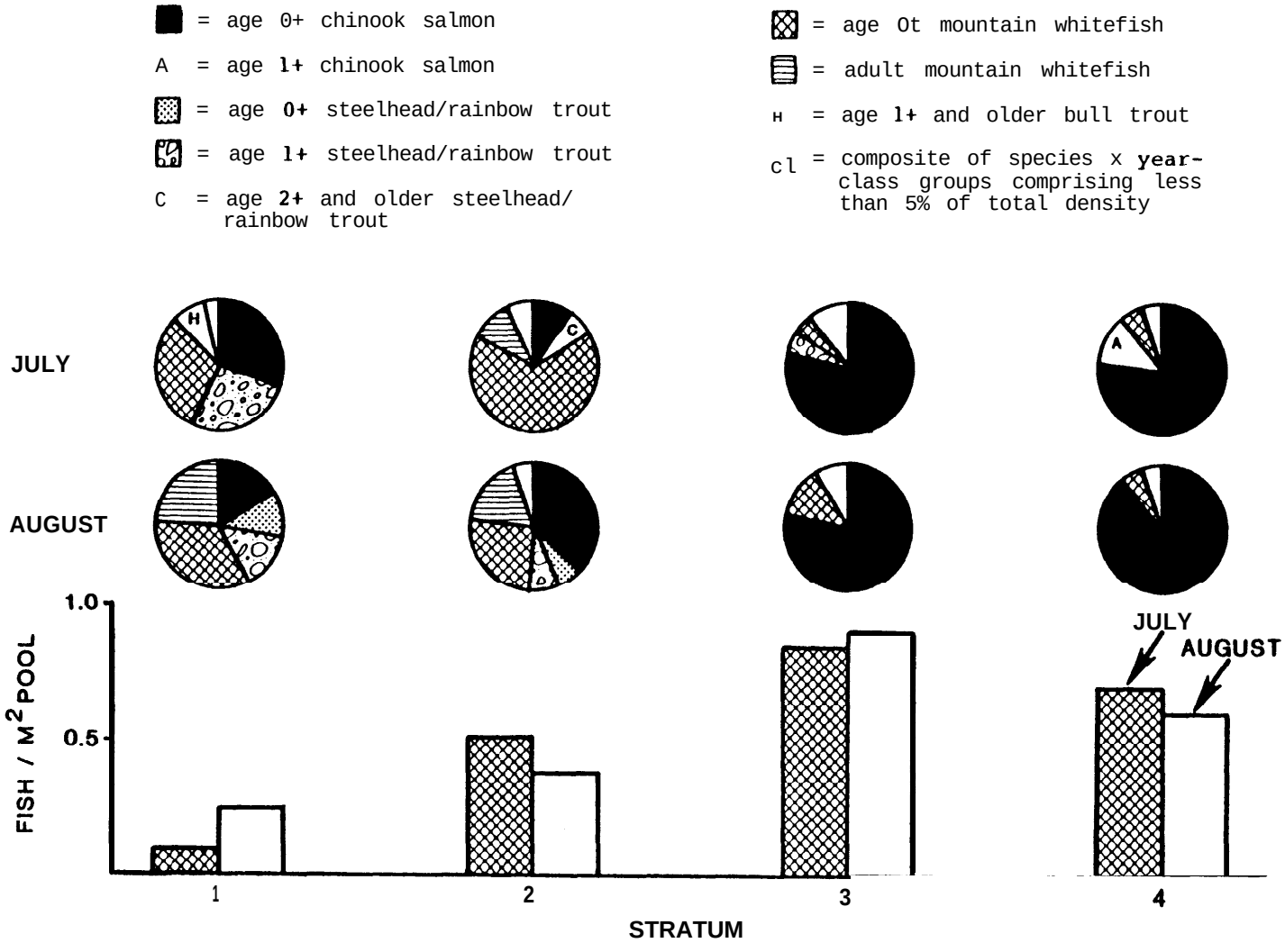
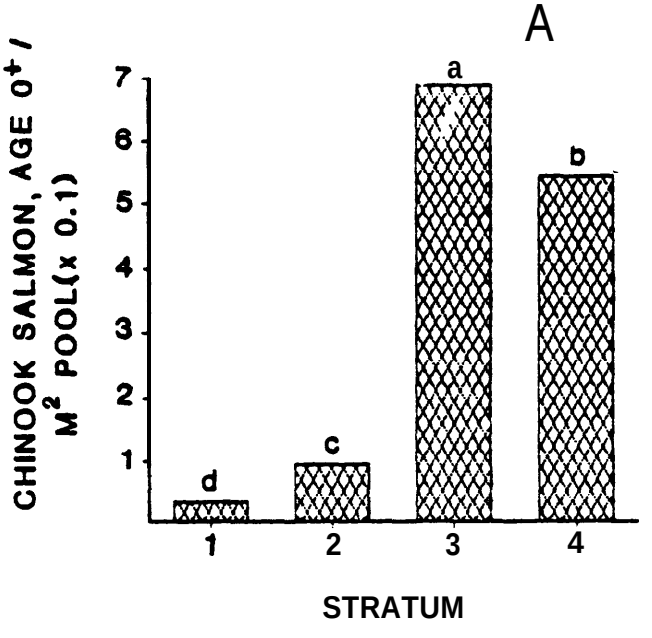
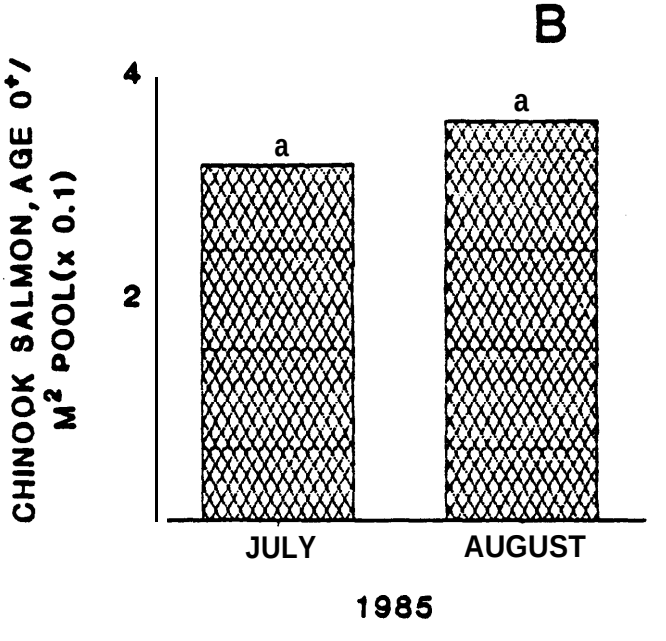
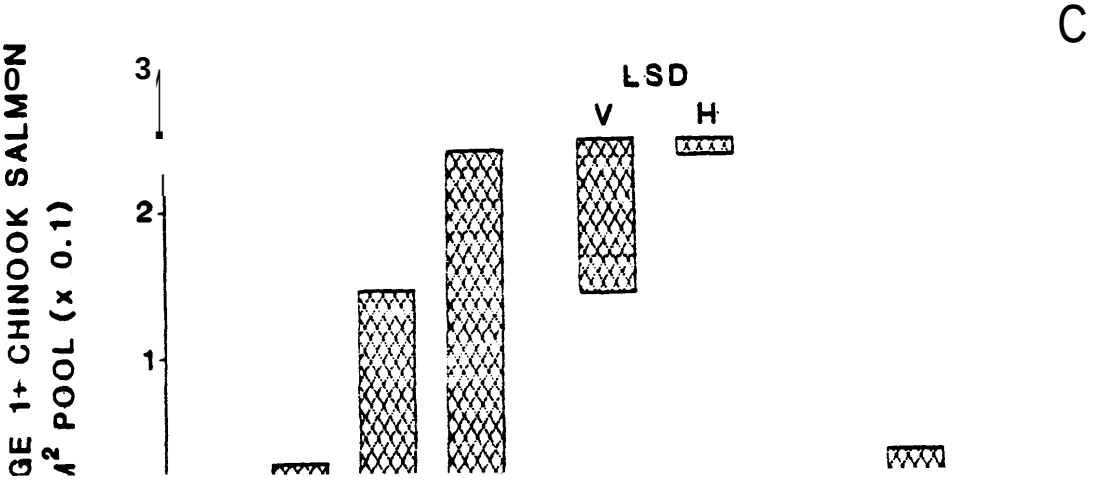


Figure 11. Mean (n=7 per stratum) fish densities of all species and age-classes (histogram) and relative abundance of species by age-classes (pie-chart)by stratum, Herd Creek, Idaho, July and August, 1985.


A
CHINOOK SALMON, AGE 0+ / M2 POOL(x 0.1)
7
6
5
4
3
2
1
a
b
c
d
1
2
3
4
STRATUM


B
CHINOOK SALMON, AGE 0+/ M2 POOL(x 0.1)
4
2
a
a
JULY
AUGUST
1985


C
GE 1+ CHINOOK SALMON
M2 POOL (x 0.1)
3
2
1
LSD
V
H

pool in July and August, respectively (Fig. 12B). In 1985, densities were significantly higher in stratum 3 than in the other strata, in stratum 4 than in strata 1 or 2, and in stratum 2 than in stratum 1.

Age l+ chinook salmon. Densities differed (F=7.7, P=0.0013) among strata between July and August (interaction). Densities ranged from 0 to 0.24 fish/m^2 pool in July and from 0 to 0.03 fish/m^2 pool in August (Fig. 12C). In July, densities were significantly higher in strata 3 and 4 than in strata 1 or 2. In August, densities did not differ among strata. Between July and August, densities decreased significantly in strata 3 or 4.

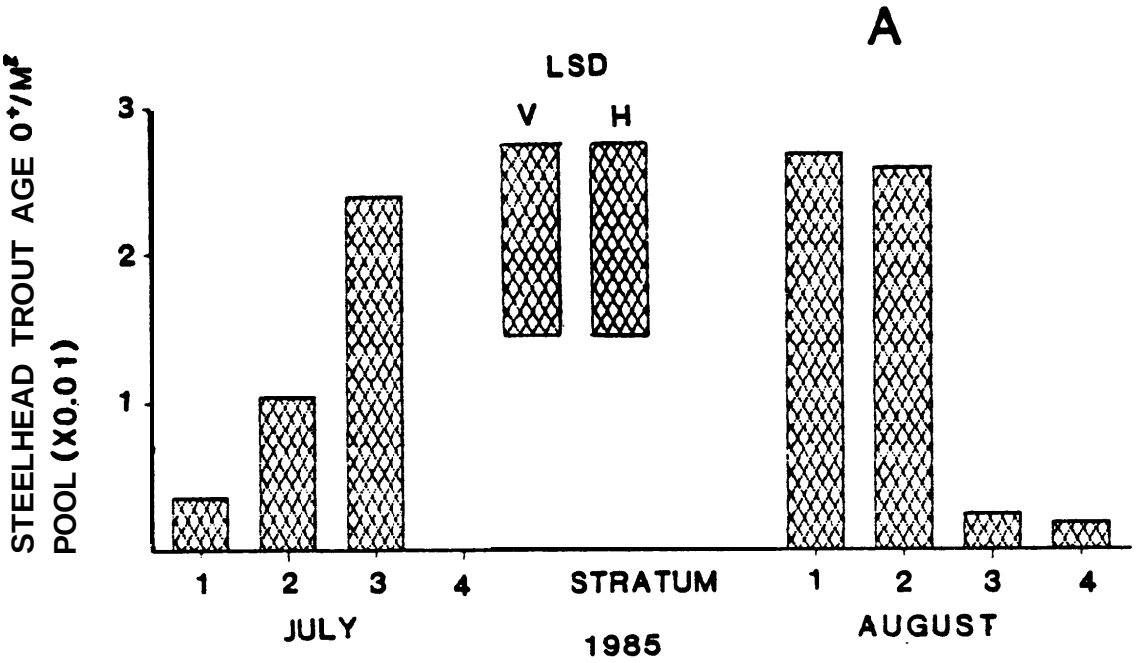
Age 0+ steelhead/rainbow trout. Densities differed (F=3.8, P=0.0269) among strata between July and August (interaction). Densities ranged from 0 to-O.024 fish/m^2 pool in July and from 0.002 to 0.027 fish/m^2 pool in August (Fig. 13A) In July, density was significantly higher in stratum 3 than in the other strata. In August, densities were significantly higher in strata 1 and 2 than in strata 3 or 4. Between July and August, densities increased significantly in strata 1 and 2 and decreased significantly in stratum 3.

Age l+ steelhead/rainbow trout. Densities differed (F=3.8, P=0.0264) among strata between July and August (interaction). Densities ranged from 0.06 to 0.17 fish/m^2 pool among strata in July and from 0.07 to 0.19 fish/m^2 pool in August (Fig. 13B). In July, densities were significantly higher in strata 3 than in the other strata, in stratum 1 than in strata 2 or 4, and in stratum 4 than in stratum 2. In August, densities were significantly higher in stratum 1 than in the other strata, in stratum 2 than in strata 3 or 4, and in stratum 3 than in stratum 4. Between July and August, densities increased significantly in strata 1 and 2 and decreased significantly in strata 3 and 4.

Age 2+ and older steelhead/rainbow trout. Densities differed (F=5.7, P=0.0055) among strata between July and August (interaction). Densities ranged from 0 to 0,029 fish/m^2 pool in July and from 0 to 0.033 fish/m^2 pool in August (Fig. 14A). In July, densities were significantly higher in stratum 2 than in other strata. In August, densities were significantly higher in stratum 3 than in the other strata. Between July and August, density decreased significantly in stratum 2 and increased significantly in stratum 3.

Age 0+ brook trout. Densities did not differ (F=l.0, P=0.4133) among strata (Fig. 14B) or between July and August (F=l.0, P=0.4133) (Fig. 14C). Densities ranged from 0 to 0.005 fish/m^2 pool among strata and were 0.0027 and 0 fish/m^2 pool in July and August, respectively.

Age l+ and older bull trout. Densities did not differ (F=1.4, P=O.2747) among strata but did differ (F=4.6, P=0.0453) between July and August. Densities ranged from 0.002 to 0.011 fish/m^2 pool among strata (Fig. 15A) and were



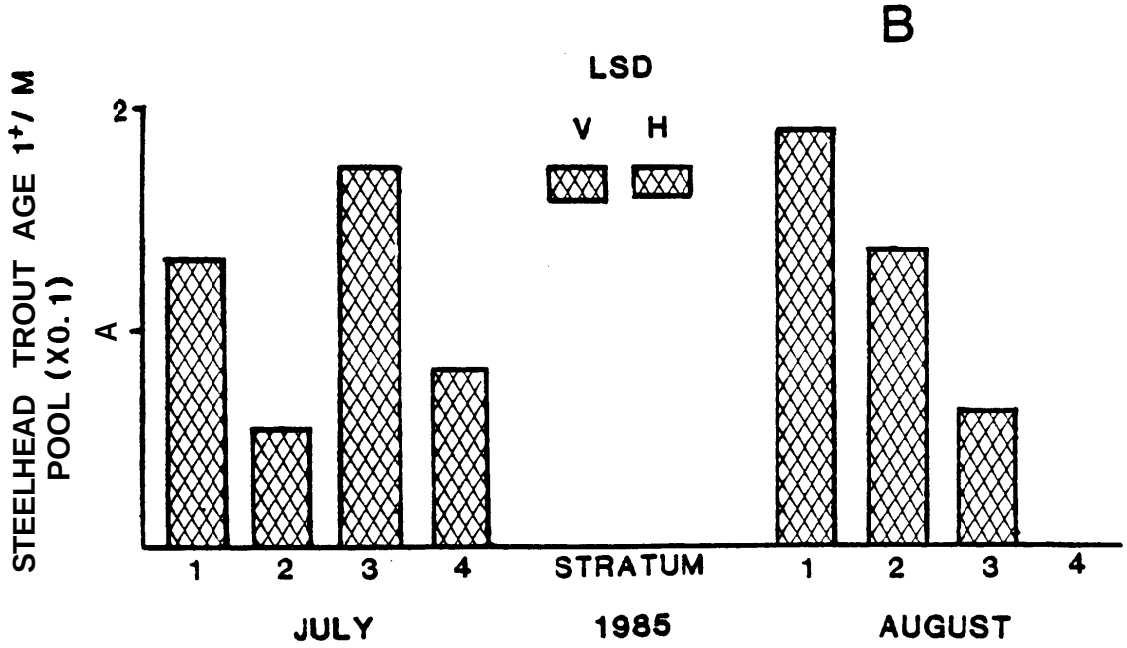


Figure 13. Mean (n=6 per stratum) densities of age 0+ (A) and age 1+ (B), steelhead/rainbow trout by stratum between months Herd Creek, Idaho, 1985. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant ($P \leq 0.05$) differences between those means.

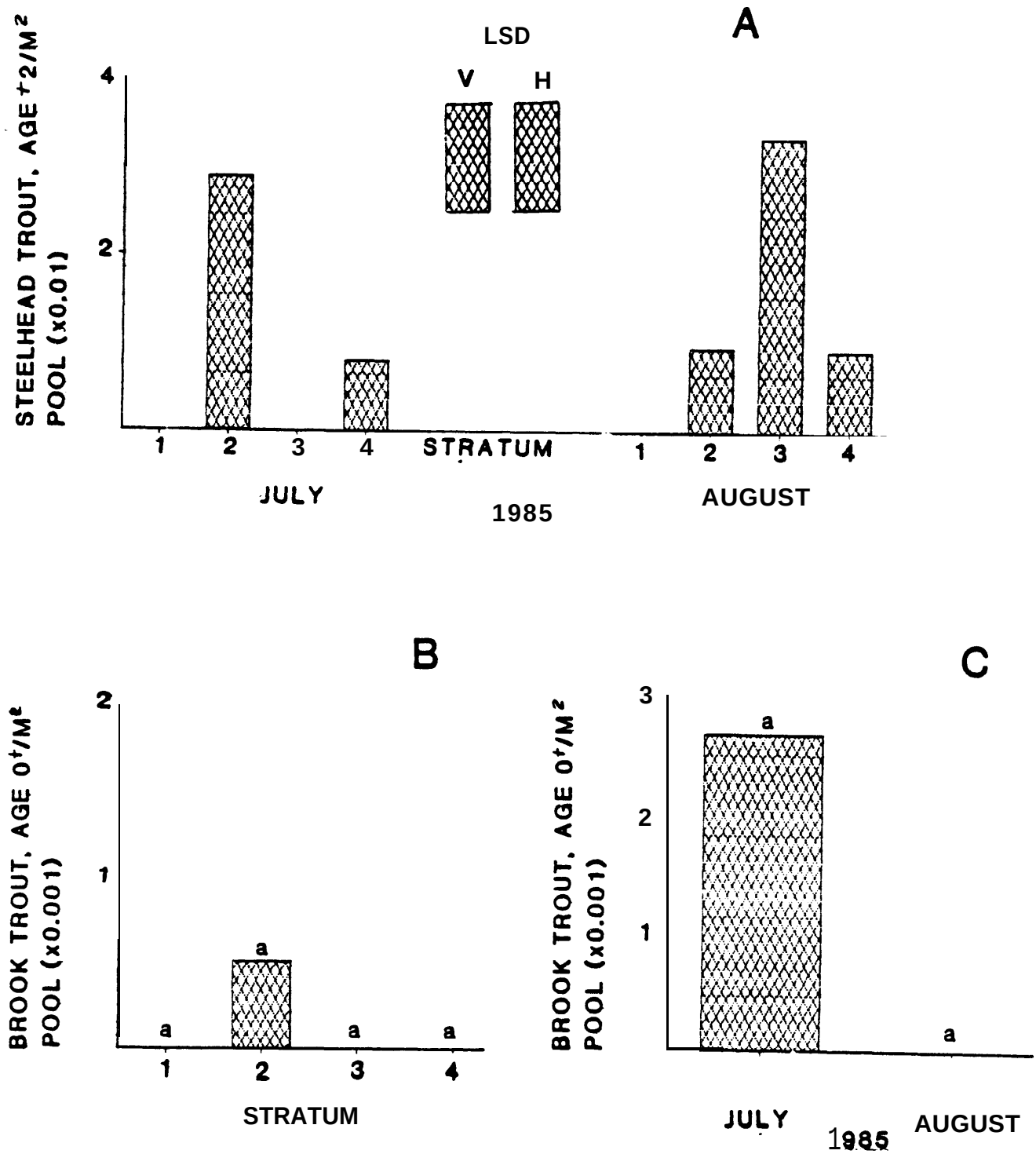


Figure 14. Mean (n=6 per stratum) densities of age 2+ and older steelhead/rainbow trout by stratum between months (A) and age 0+ brook trout by stratum (B) and month (C) in Herd Creek Idaho, 1985. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's, respectively, indicate significant (P<0.05) differences between those means. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

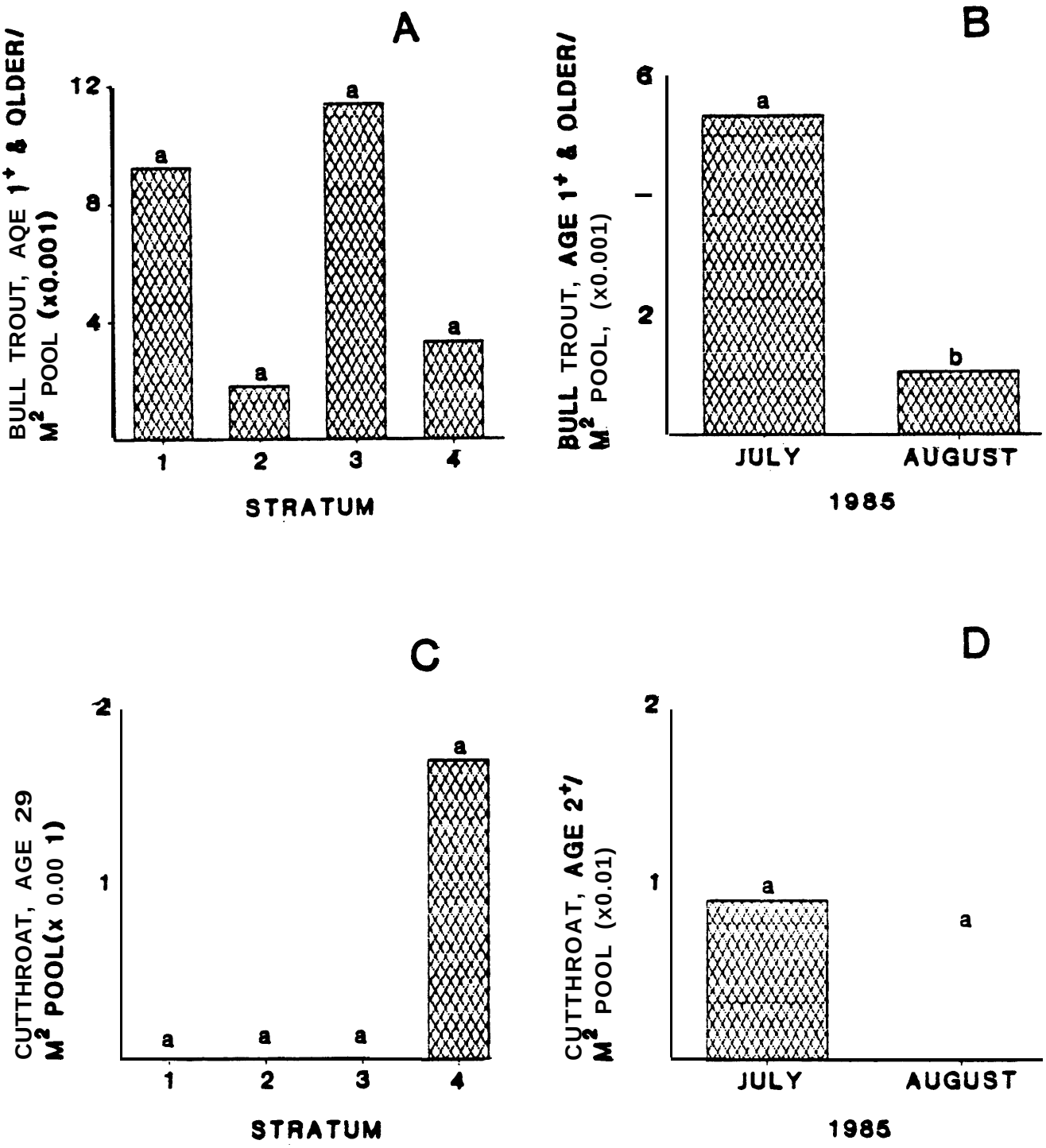


Figure 15. Mean (n=6 per stratum) densities of age 1+ and older bull trout by stratum (A) and month (B) and age 2+ cutthroat trout by stratum (C) and month (D) in Herd Creek, Idaho, 1985. A common letter above means indicate a non-significant (P>0.05) difference among strata means.

0.0054 and 0.0011 fish/m^2 pool in July and August, respectively, (Fig. 15B).

Adult cutthroat trout. Densities did not differ (F=2.5, P=0.0925) among strata or (F=2.5, P=0.1326) between July and August. Densities ranged from 0 to 0.002 fish/m^2 pool among strata (Fig. 15C) and were 0.0009 and 0 fish/m^2 pool in July and August, respectively (Fig. 15D).

Age 0+ mountain whitefish. Densities did not differ (F=1.6, P=0.2224) among strata but did differ (F=4.8, P=0.0404) between July and August. Densities ranged from 0.039 to 0.226 fish/m pool among strata (Fig. 16A) and were 0.108 and 0.087 fish/m pool in July and August, respectively (Fig. 16B).

Adult mountain whitefish. Densities did not differ (F=1.9, P=0.1713) among strata or (F=0.l, P=0.7508) between July and August. Densities ranged from 0.015 to 0.062 fish/m^2 pool among strata (Fig. 16C) and were 0.031 and 0.044 fish/m^2 pool in July and August, respectively (Fig. 16D).

Age 0+ Chinook Salmon

Total length. Fish length differed among strata (F=11.5, P<0.000l) and (F=276.9, P<0.000l) between July and August. Fish lengths ranged from 64.0 to 78.6 mm among strata (Fig. 17A) and were 59.3 and 77.4 mm in July and August, respectively (Fig. 17B). In 1985, fish length did not differ significantly between strata 3 and 4. Fish length was significantly longer in stratum 1 than in the other strata and in stratum 2 than in strata 3 or 4.

Live weight. Fish weight differed (F=14.6, P<0.000l) among strata and (F=280.2, P<0.000l) between July and August. Fish weight ranged from 3.3 to 6.2 g among strata (Fig. 17C) and were 2.5 and 5.4 g in July and August, respectively (Fig. 17D). Fish were significantly heavier in stratum 1 than in the other strata, in stratum 2 than in strata 3 or 4, and in stratum 3 than in stratum 4.

Condition. Fish condition differed among strata (F=3.4, P=0.0369) and (F=4.2, P=0.0411) between July and August. Fish condition ranged from 1.06 to 1.17 among strata (Fig. 17E) and were 1.07 and 1.10 in July and August, respectively (Fig. 17F). Fish condition did not differ signficantly among strata 2, 3, and 4. Fish condition was significantly larger in stratum 1 than in the other strata.

Abundance. Total number of fish in July was 16,201 + 4,176 (95% bounds) and in August was 19,884 + 4,030 (Figs. 18 and 19; Table 7). In July, highest numbers (7,564 + 2,683) were observed in stratum 4. Lowest numbers (2,129 + 924) were observed in stratum 2. In August, highest numbers (7,227 + 2,623) were observed in stratum 4. Lowest numbers (843 + 581) were observed in stratum 2. Fish numbers increased significantly in stratum 1 between July and August. Only 1 redd was counted in strata 1 and 2 by Idaho Fish and Game in 1984 (Fig. 1).

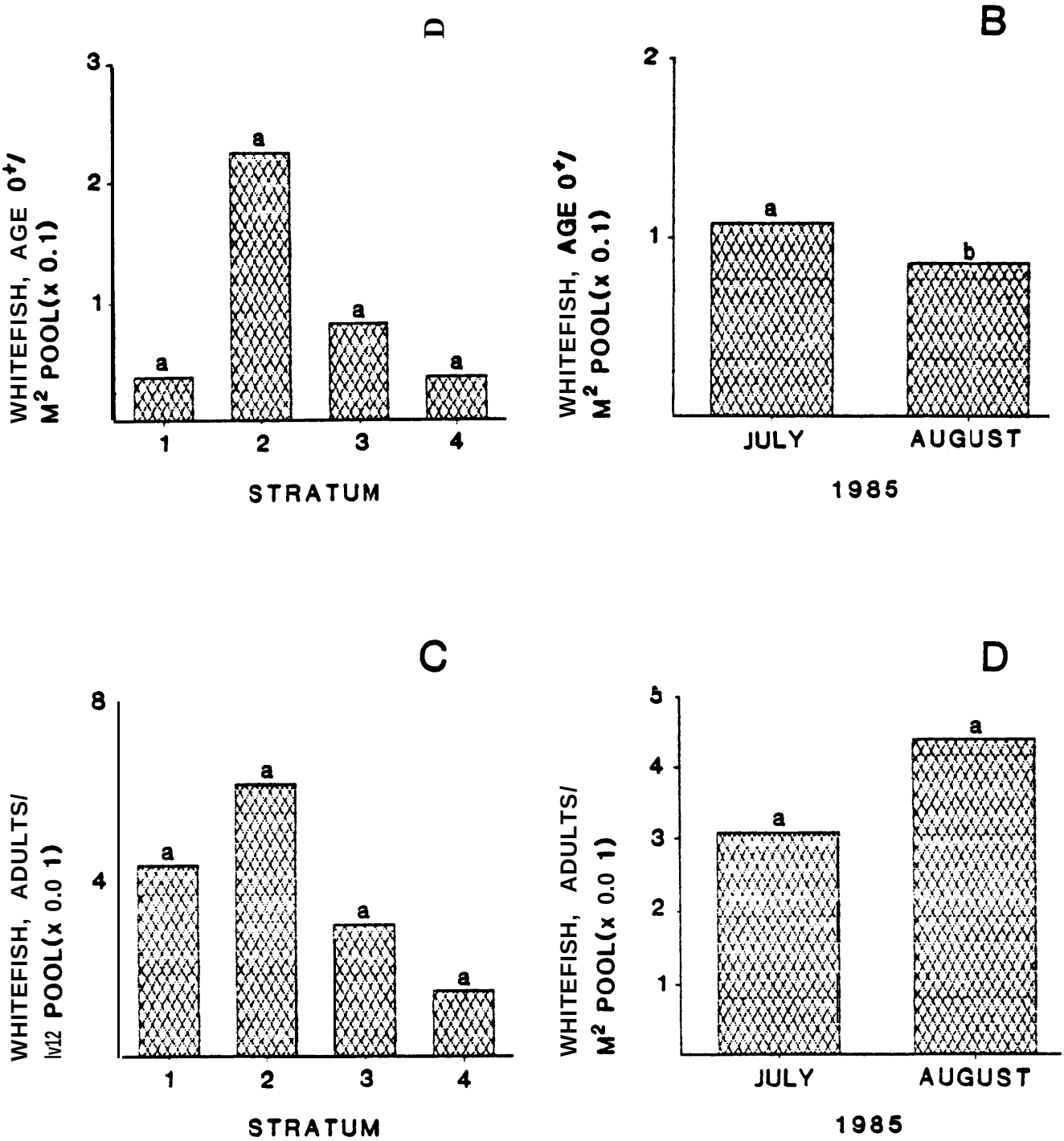


Figure 16. Mean (n=6 per stratum) densities of age 0+ mountain whitefish by stratum (A) and month (B) and of adult mountain whitefish by stratum (C) and month (D) in Herd Creek, Idaho, 1985. A common letter above means indicate a non-significant (P>0.05) difference among strata means within each method of measurement.

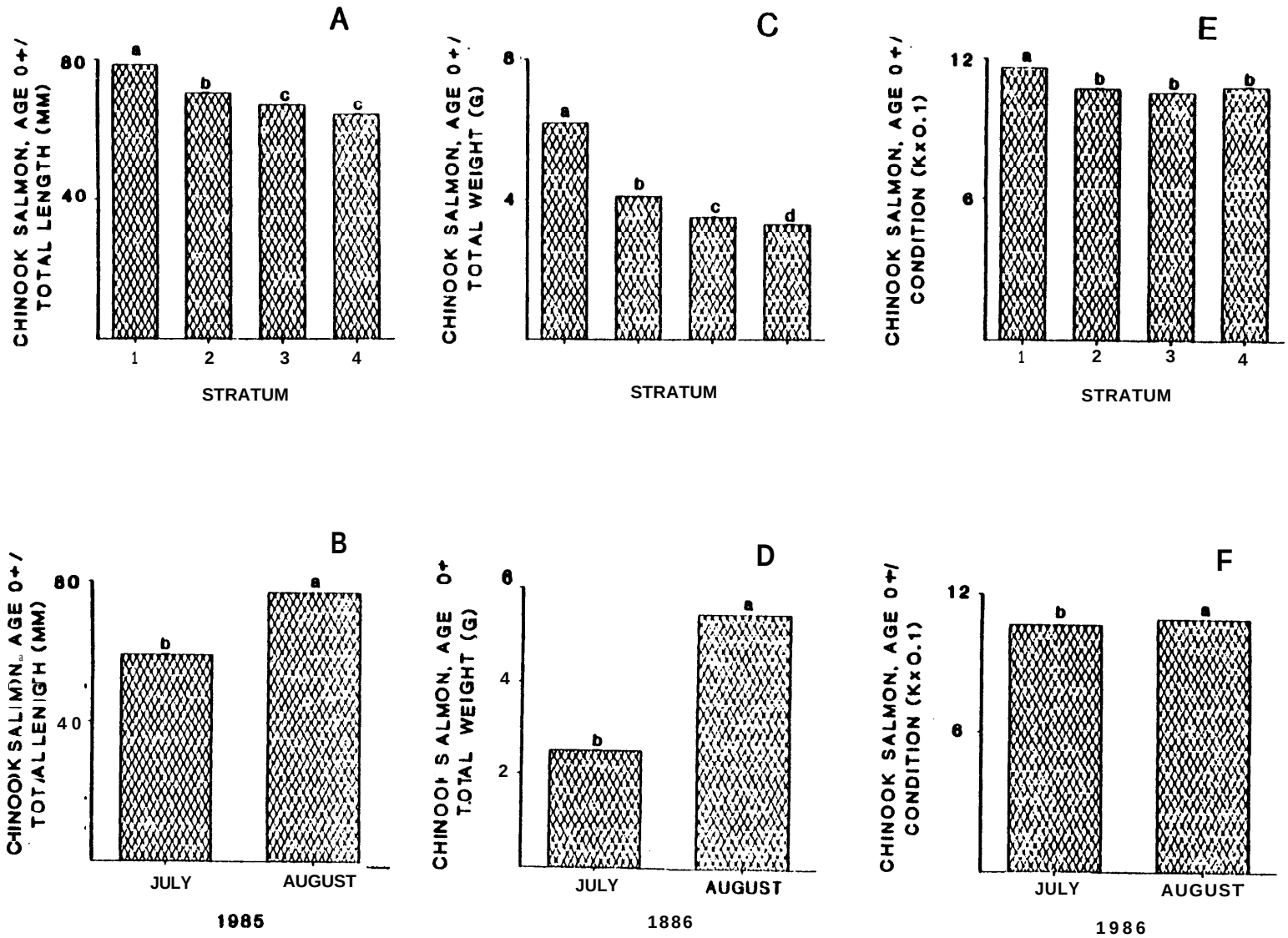


Figure 17. Mean (n=6 per stratum) total length (A and B), weight (C and D), and condition (E and F) of age 0+ chinook salmon by strata and month, respectively, in Herd Creek, Idaho, 1985. A common letter above means indicate a non-significant (P>0.05) difference among strata or month means.

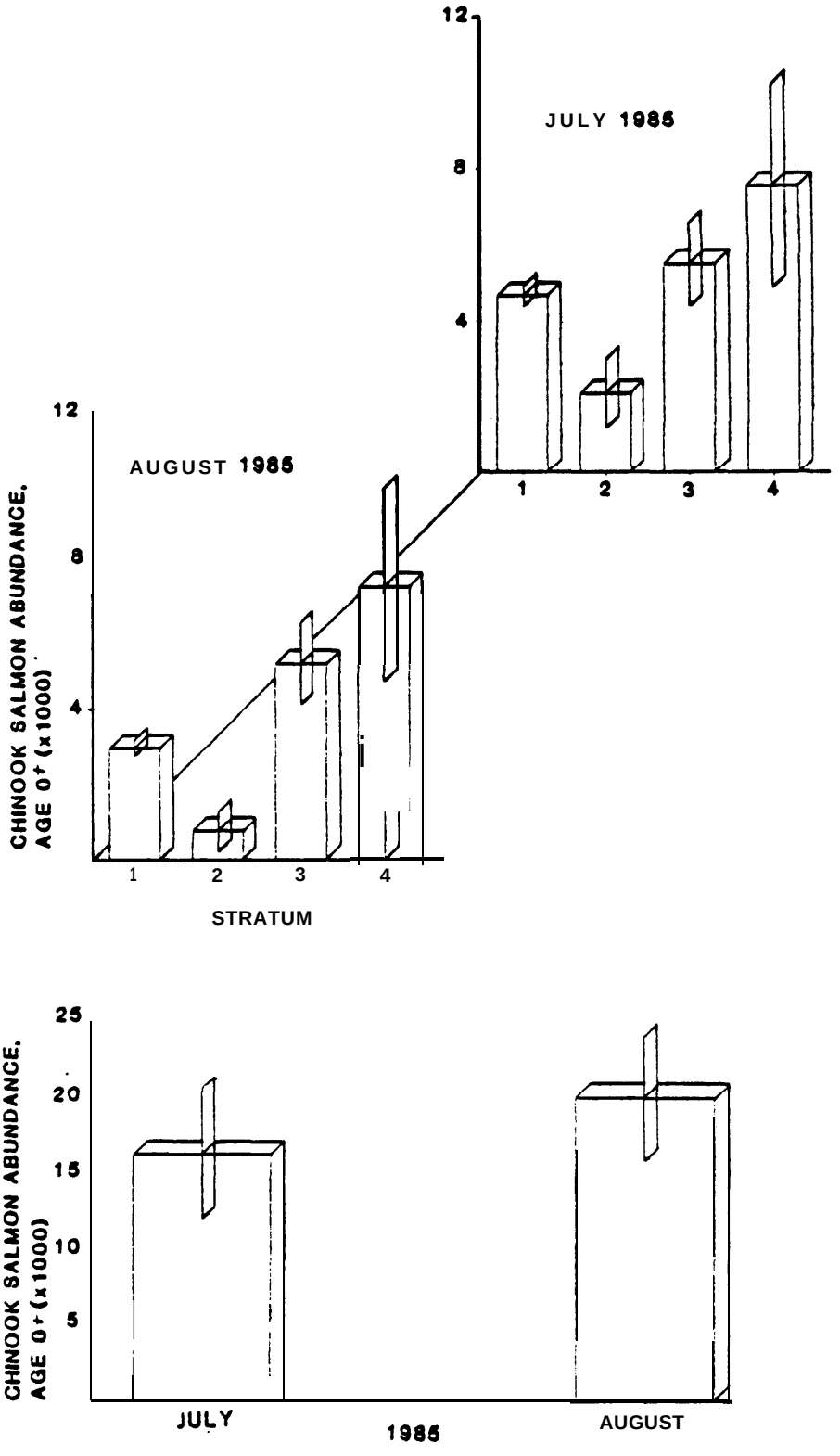


Figure 18. Estimated abundance of age 0+ chinook salmon by stratum between months (A) and for the entire stream between months (B) in Herd Creek, Idaho, 1985. Vertical bars represent 95% confidence intervals.

Table 7. Abundance and associated 95% bounds of age 0+ chinook salmon in strata of Herd Creek, Idaho, 1985.

	Stratum		Abundance		
Month	Number	Length (km)	Estimate	Bounds	Percent of total
July	1	4.6	2959	2506-3410	18
July	2	4.0	843	498-1188	5
July	3	2.6	5172	3290-7054	32
July	4	3.8	7227	2167-12287	45
Totals		15.0	16,201	12,024-20,377	100
August	1	4.6	4691	4154-5228	24
August	2	4.0	2129	0-4687	11
August	3	2.6	5500	4331-6668	28
August	4	3.8	7564	3344-11784	37
Totals		15.0	19,884	15,855-23,914	100

Reach Description and Problem Identification

Habitat Problem Types

Problems characteristic of the East Fork of the Salmon River system which affect fish habitat include: sloughing stream banks including those aggravated by ranching and grazing activities, roads, open slopes, washouts, and both natural and unnatural barriers (Fig. 19). For photos of problem types other than those listred above, please see (Results, Subproject II, BPA Project 83-359, FY 1984 Annual Report). Sloughing stream banks were of' low (<l m), medium (l-2 m), or high (>2 m) height and caused by natural or unnatural sources. Roads adjacent to the stream were either poorly riprapped, riprapped without vegetative cover, or riprapped with vegetative cover. Open slopes adjacent to the stream had sparse vegetative cover or exposed soil. Washouts occurred in isolated roaded sections. Barriers to fish passage include: unscreened irrigation diversions, diversions without adequate outflow, logjams, and beaver dams.

Reach A

Reach A extends from the confluence of the East Fork with the mainstem of the Salmon River upstream to the confluence of Herd Creek with the East Fork of the Salmon River (15.6 km) (Fig. 1). The stream flows with low to moderate gradient through a wide flood plain (approximately 0.5 km) of pastureland. Land not in pasture is sparsely vegetated sagebrush/grassy mountain slopes or canyons (i.e. Zieglers Hole).

Riparian zone characteristics include: stable well-defined banks, low stream sinousity in areas of alder, cottonwood, and willow overstory. Moderate to low stability of banks and moderate sinousity are associated with sections in pasture and or having sagebrush/grass vegetative types.

Stream habitat is dominated by deep pools and large riffle-pool sequences. Riffle-run areas have high velocity flows cascading over boulder and bedrock substrate. Water turbidity was high. Spawning potential is poor and confined to small isolated areas of cobble and gravel. Pools have adequate instream cover (depth, boulders, turbulence, and downed trees) for rearing salmonids, as well as, adequate holding areas for adult salmonid.

Problems in Reach A which affect fish habitat include: sloughing stream banks (900 m); road washouts (10 m); livestock watering and or crossing areas (7); passage restriction (1); poorly riprapped sections of road adjacent to the stream (25 m); irrigation ditches too close to stream (402 m); and open slopes with exposed soil (210 m) (Table 8). These problems are sources of in-reach sedimentation, although, upstream problem areas also input sediment into the reach.

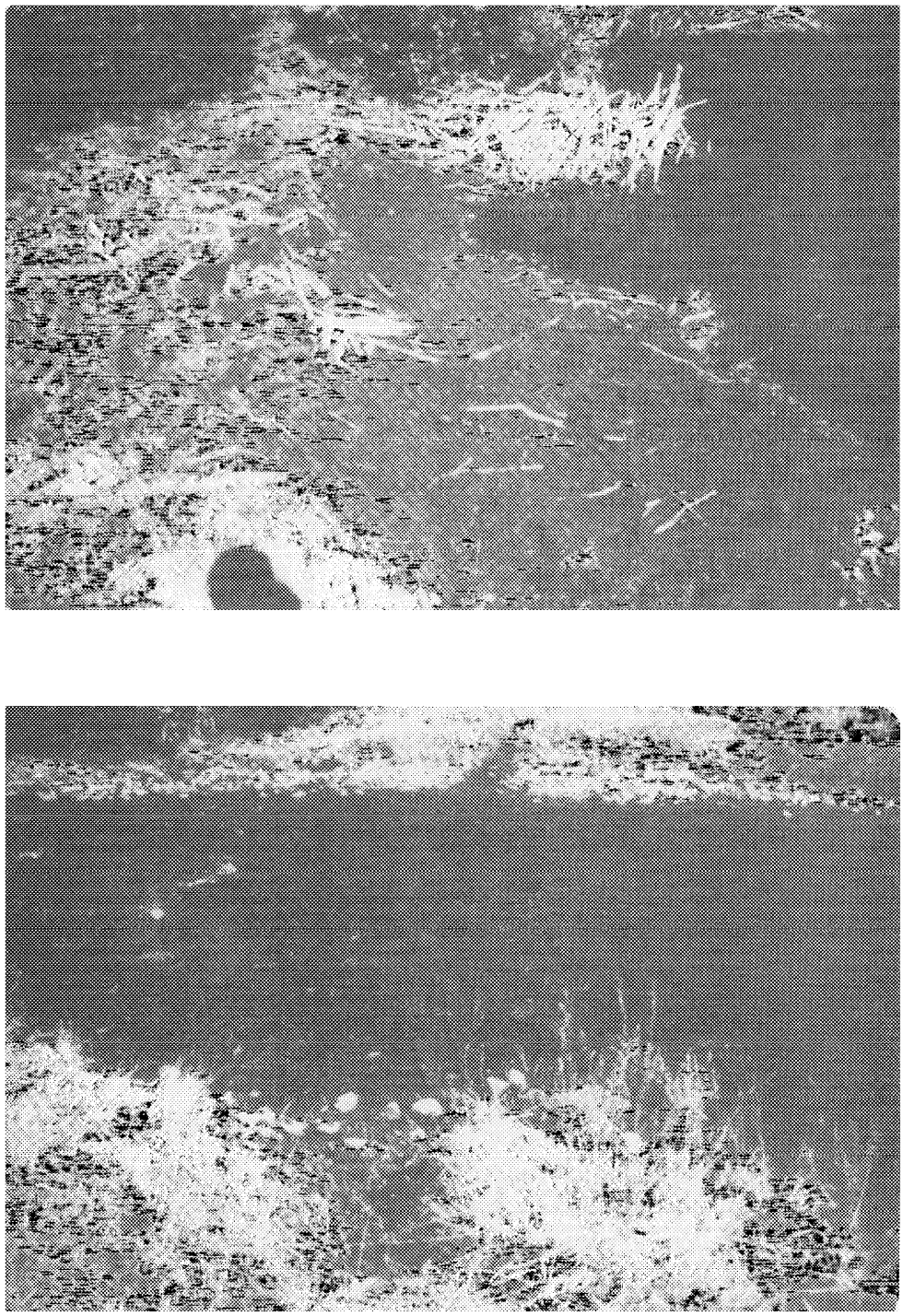
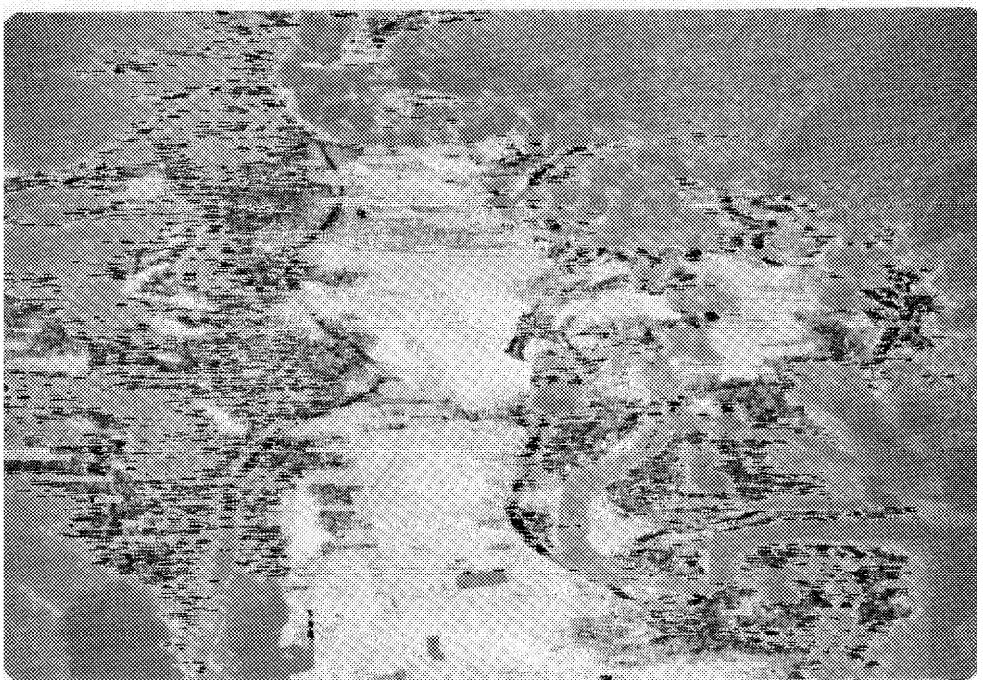


Figure 19. Habitat problem types in the East Fork of the Salmon River, Idaho, 1985. Upper: cattle watering area. Lower: cattle stream crossing.



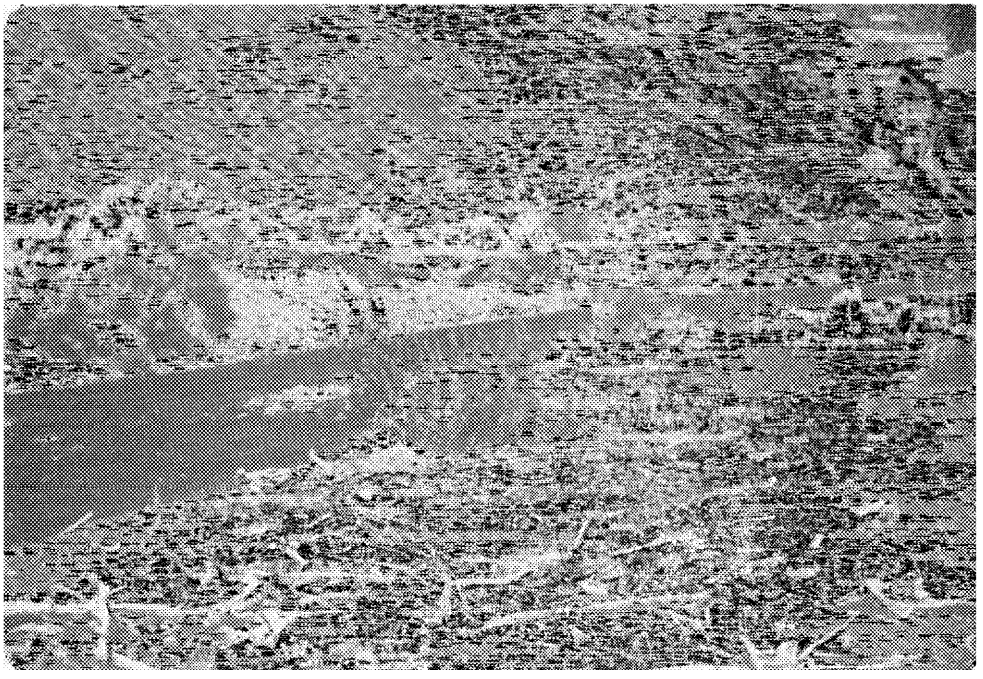
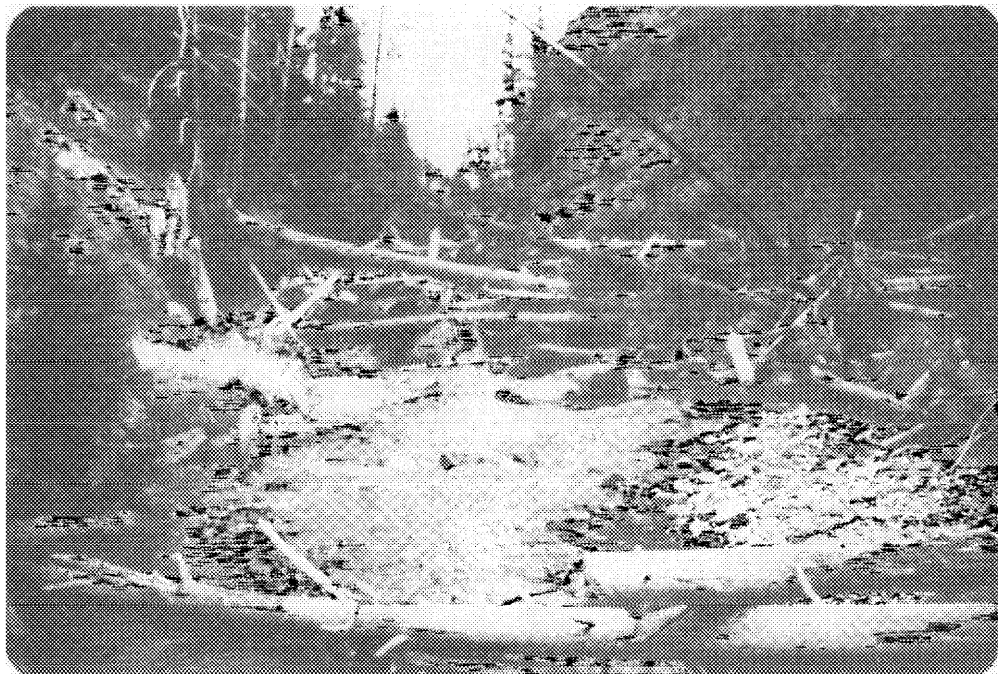


Figure 19. Continued. Upper: grazing and ranching activities. Lower: medium-high cutbank, aggravated by grazing use,



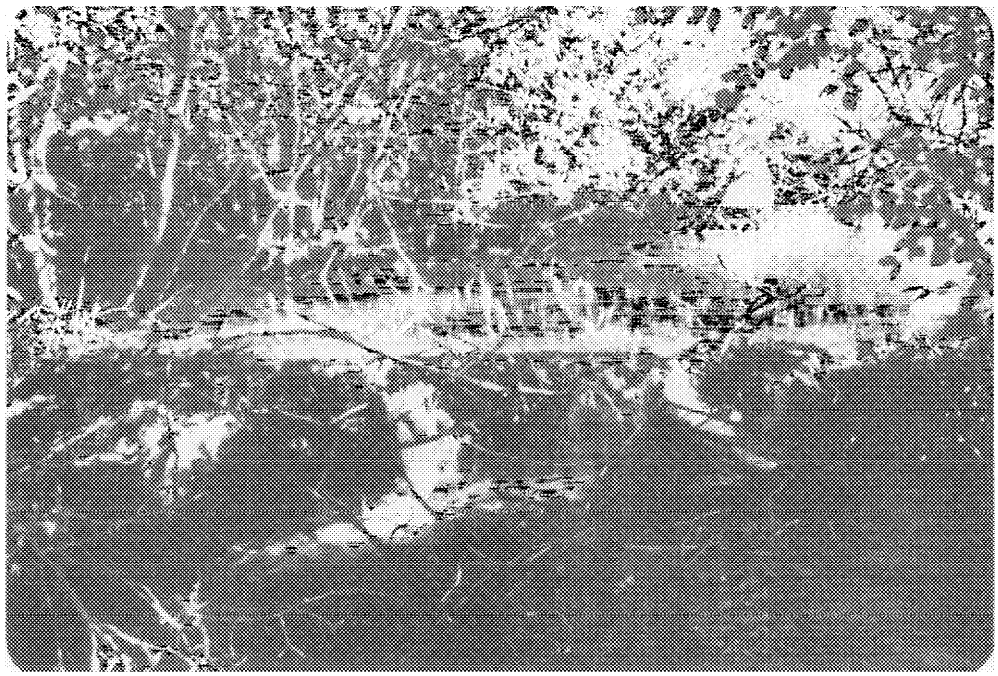


Figure 19. Continued. Upper: log jams, Lower: beaver dam.

Table 8. Identification, extent, sediment input (relative to other reaches), and priority for remediation of habitat problems in Reach A, East Fork of the Salmon River, Idaho, 1985.

Problem type	Length (m)	Percent of total length (31,220 ma)	Ranking of potential sediment input	Priority for remediation
Sloughing bank				
low, natural	10	0.0	8	9
medium, natural	130	0.4	5	8
high, natural	185	0.6	2	7
low, unnatural	50	0.2	7	6
medium, unnatural	250	0.8	4	2
high, unnatural	275	0.9	1	1
Washout				
road	10	0.3	9	10
Livestock crossing/ watering	7b	NA	10	11
Passage restriction				
screened but no outflow	lb	NA	13	3
Adjacent road				
poorly riprapped	2s	0.1	6	4
Irrigation ditch too close to stream	402	1.3	12	S
Open slopes				
exposed soil with sparse vegetation	210	0.7	3	12

[a] total length represents the length of streambank in reach (two times the length of reach).

[b] frequency of occurrence, not length.

Reach B

Reach B extends from the mouth of Herd Creek upstream to East Pass Creek confluence with Herd Creek proper (15.5 km) (Fig. 1). A large portion of the stream flows with low to moderate gradient and moderate to high sinousity through a narrow valley except where the stream flows through the Bennetts ranch. A road exists along the lower half of the stream (adjacent to stream for short distances only). Upland areas have moderate to extremely steep slopes of sage/grass vegetative cover.

Riparian cover is very dense and consists of alder, willow, rose, and grasses. This cover type is consistent . throughout the reach except on Bennetts' property. Bennetts' land is a wide grazed valley with little riparian cover.

Stream habitat is dominated by classic riffle-pool sequences. Riffles have good spawning potential with increased quality (less silt coating substrate) of spawning material upstream. Pools have adequate instream cover (depth, vegetation, and undercut banks) as well as good riparian cover for rearing salmonids.

Problems in Reach B which affect fish habitat include: sloughing banks (3,487 m); open slopes adjacent to stream (160 m); road adjacent to stream (6); livestock crossing/watering areas (49); passage restriction (5); irrigation ditches too close to stream (2); and vehicle crossings (1) (Table 9).

Reach C

Reach C extends from the confluence of Herd Creek and the East Fork of the Salmon River up stream to the Idaho Fish and Game weir and fish trap facility (13.2 km) (Fig. 1). Throughout most of the reach, the stream flows with moderate gradient and high sinuosity through grazed floodplain (approximately 0.3 km wide). Upland areas have moderate to steep slopes of sagebrush/grass.

Stream habitat is primarily composed of riffles and pools. Riffles have excellent spawning potential with silt-free cobble/gravel substrate. Pools are deep and have adequate instream cover (boulders, turbulence, and logs). Riparian zone varies from areas of thick alders, willows, and cottonwoods to sections of pasture. The upper one-third of the reach is heavily braided.

Problems in Reach C which affect fish habitat include: sloughing banks (2,981 m); open slopes adjacent to stream (172 m); poorly riprapped road adjacent to stream (200 m); passage restriction (4); vehicle crossing (2); livestock activity (8); and irrigation diversions (3)(Table 10).

Reach D

Reach D (Big Boulder Creek) extends from the mouth of Big Boulder Creek upstream to the Livingston mine (7.2km) (Fig. 1). The stream flows with moderate to high gradient

Table 9. Identification, extent, sediment input (relative to other reaches), and priority for remediation of habitat problems in Reach B (Herd Creek), East Fork of the Salmon River, Idaho, 1985.

Problem type	Length (m)	Percent of total length (30,190 ma)	Ranking of potential sediment input	Priority for remediation
Sloughing bank				
low, natural	186	0.6	8	10
medium, natural	361	1.2	4	9
high, natural	576	1.9	3	8
low, unnatural	453	1.5	7	5
medium, unnatural	1,291	4.3	1	2
high, unnatural	620	2.1	2	1
Open slope				
exposed soil	10	0.5	S	13
sparse vegetation	1	0.0	9	14
Adjacent road				
poorly riprapped	lb	NA	10	3
Livestock crossing/ watering site	49[b]	NA	6	4
Irrigation ditch too close to bank	2b	NA	11	12
Passage restriction, beaver dams	5[b]	NA	12	6
Vehicle crossing				
spawning area	lb	NA	13	11
road too close to stream	lb	NA	14	7

[a] total length represents the length of streambank in reach (two times the length of reach).

b frequency of occurrence, not length.

Table 10. Identification, extent, sediment input (relative to other reaches), and priority for remediation of habitat problems in Reach C, East Fork Salmon of the Salmon River, Idaho, 1985.

Problem type	Length (m)	Percent of total length (13,196 ma)	Ranking of potential sediment input	Priority for remediation
Sloughing bank				
low, natural	210	0.8	9	13
medium, natural	128	0.5	4	12
high, natural		1.6	2	7
low, unnatural	275	1.0	8	S
medium, unnatural	758	2.9	3	4
high, unnatural	1185	4.5	1	3
Livestock crossing/ watering	8[b]	NA	12	6
Vehicle crossing spawning area	2b	NA	14	11
Open slope				
exposed soil	160	0.6	S	14
sparse vegetation	12	0.0	10	15
Riprapped bank				
poor	200	0.8	6	8
adequate	500	1.9	11	NA
Washout tributary	2[b]	NA	7	.9
Irrigation ditch too close to bank	7s	0.3	13	10
Passage restriction				
unscreened diversion	lb	NA	NA	1
screened with no outflow	3b	NA	NA	2

[a] total length represents the length of streambank in reach (two times the length of reach).

b frequency of occurrence, not length.

and sinuosity through a moderately narrow mountain valley vegetated with sage/grass, alder/aspen/cottonwood, and sparse pine forest. A road is near the stream along the entire reach.

Stream habitat is dominated by small riffle-pool sequences and large sections of pocket-water in areas of steep gradient and to a lesser degree small riffle-pool sequences. Riffles, where present, have good spawning potential with clean cobble-gravel substrate. Pools had depths of up to five (5) feet and have adequate instream cover (depth and downed logs). Riparian cover is good and is provided by alder with an overstory of aspen and cottonwood. Bank stability is fair with some exposed cutbanks.

Because of time constraints, problems in reach D were not catagorized and total lengths were not calculated. Cursory snorkle inventories were done and the presence of age 0+ chinook, adult bulltrout and adult rainbow trout were found. The need to fully evaluate Big Boulder Creek is slated for the 1986 field season.

Reach E

Reach E extends from the Idaho Fish and Game weir and fish trap facility upstream to the confluence of Wickiup Creek (7.1 km) (Fig. 1). The stream flows with low to moderate gradient through a large flood plain. Upland areas have moderate slopes of forest or grass and sagebrush. The lower one-half of reach E is braided with many exposed cobble bars.

Stream habitat is dominated by riffle-runs in the upper one-half of the reach and classic riffle-pool sequences in the lower. Riffles have excellent substrate size (silt-free) for spawning. Pools have little overhanging riparian cover. Instream cover is depth, turbulence and boulders. Riparian cover is limited and consists of willow and grasses.

Problems in reach E which affect fish habitat include: sloughing banks (580 m); poorly rip-rapped road adjacent to stream (65 m); and livestock activity (1) (Table 11).

Reach F

Reach F extends from the confluence of Wickiup Creek upstream to the U.S. Forest Sevice guard station at Bowery Creek (10.3 km) (Fig. 1). Throughout most of the ranch, the stream flows with moderate gradient through a forested valley. The stream flows with moderate to high gradient through a narrow canyon for a short distance near the middle of the reach. Canyon slopes are steep screen, exposed bedrock, and sparse forest.

Stream habitat is mainly classic riffle-pool sequences except in the canyon where pocket water is common. Potential spawning riffles contain high quality gravels with minimal to no siltation apparent. Pools have adequate instream cover (depth, boulders, turbulence, and logs) for rearing

salmonids. Riparian cover is good and ranges from undercut banks (well-developed root system) of grasses and forbs in meadow sections and aspens, alders, and pines in the canyon section.

Problems in Reach F which affect fish habitat include: sloughing stream banks (1,215 m); livestock activity (4); vehicle crossing (1); open slopes adjacent to stream (140 m); vehicle crossing (1); open slopes adjacent to stream (140 m); poorly riprapped road adjacent in stream (20 m); passage restriction (1); and irrigation washouts (1) (Table 12).

Table 11. Identification, extent, sediment input (relative to other reaches), and priority for remediation of habitat problems in Reach E, East Fork of the Salmon River, Idaho, 1985.

Problem type	Length (7081 m)	Percent of total length (14162 ma)	Ranking of potential sediment input	Priority for remediation
Sloughing bank				
medium, natural	15	0.1	4	6
high, natural	815	5.8	2	5
medium, unnatural	455	3.2	3	2
high, unnatural	125	0.9	1	1
Livestock crossing/ watering	1[b]	NA	7	7
Vehicle crossing spawning area	lb	NA	8	4
Adjacent road poorly riprapped	65	0.0	5	3
Irrigation diversion	1[b]	NA	NA	NA

[a] total length represents the length of streambank in reach (two times the length of reach).

b frequency of occurrence, not length.

Table 12. Identification, extent, sediment input (relative to other reaches), and priority for remcdiation of habitat problems in Reach F, East Fork of the Salmon River, Idaho, 1985.

Problem type	Length (m)	Percent of total length (20,600 ma)	Ranking of potential sediment input	Priority for remediation
Sloughing bank				
low, natural	125	0.6	7	8
medium, natural	228	1.1	5	7
high, natural	365	1.8	2	6
medium, unnatural	160	0.8	4	5
high, unnatural	337	1.6	1	3
Livestock crossing/ watering	4[b]	NA	NA	11
Vehicle crossing	1[b]	NA	NA	12
Open Slope				
exposed soil	140	0.7	3	10
Adjacent road				
poorly riprapped	20	0.0	6	4
Irrigation ditch				
too close	1[b]	NA	NA	9
Passage restriction				
screened with no outflow	3b	NA	NA	1
log jam	lb	NA	NA	2

[a] total length represents the length of streambank in reach (two times the length of reach).

b frequency of occurrence, not length.

DISCUSSION

Habitat Inventory

Water temperature ranged from 0 to 19 C from 26 June through 19 September in Herd Creek (Table 6). Temperature extremes probably occurred for only short periods of time during a die1 cycle. These temperatures did not appear to limit growth or survival of chinook salmon (preferred temperture range: 7 to 15 C; Reiser and Bjornn 1979).

Flows were adequate for adult passage and juvenile survival even though 1985 was a low water year (Fig. 6A). Most riffles in the study area had at least some area of 0.25 in depth. Adult spring chinook require water depths of at least 0.24 m for adequate passage (Thompson 1972). The quality of riffles and pools for spawning and rearing probably limit some potential chinook salmon production. Most riffle substrates in Herd Creek were of the cobble-gravel size preferred by anadromous salmonids (6-102 mm; Reiser and Bjornn 1979) but riffles on and below the Bennetts' ranch (Strata 2) contained higher amounts of fines (Fig. 10A) fewer fish spawn on the ranch now than in the past, given a known run size (Personal Communication, J. Bennetts) .

Riffles with more than 20% fines (<6.4 mm diameter) usually have adverse effects on spawning success (Bjornn et al. 1977). Many (8 to 34%) riffle substrate particles were coated with a thin to moderate layer of silt and algae which could reduce emergent fry survival (Fig. 19B). Sedimentation of pool rearing areas was minimal. Riparian cover was similar in all strata.

Fish Community Inventory

Density of fish (combined species and age-classes) was highest (0.9 fish/m^2pool) in strata 3 (fenced BLM land), and lowest (0.2 fish/m^2 pool) in stratum 1 (Fig. 11). Relative abundance of age 0+ chinook salmon ranged from less than 10% in stratum 2 in July to 89% in stratum 4 in August. Relative abundance of age 0+ chinook salmon increased in strata 2, 3, and 4 between July and August suggesting that seeding from upstream was taking place. Age 0+ and adult but no juvenile mountain whitefish were found in strata 1 and 2. Whitefish may spawn in Herd Creek but rear downstream in the East Fork. Densities of age 0+ chinook salmon in the Yankee Fork ranged from (0.03 fish/m^2 pool) typical of Idaho streams (Sekulich and Bjornn 1977; Bjornn 1978).

Total abundance of age 0+ chinook was 16,201 fish in mid-July and 19,884 in mid-August (Table 7). The increase in numbers, although not significant statistically, again suggest seeding from upstream since all strata showed an increase in numbers (significant in stratum 1) between months. Numbers of juvenile chinook salmon were most surprising, however, since the number of redds counted in the stream in the past few years was between 0 and 5. The stream

and the wild fish seem to be holding their own and, although some habitat could be enhanced, i.e. fenced from cattle impacts, outplanting does not seem necessary at this time.

Predation of juvenile anadromous salmonids by piscivores was probably low throughout the system. Highest potential for predation occurred from adult bull trout in strata 1 and 3 (Fig. 15A) and from adult rainbow trot in strata 2 and 3 (Fig 14A). Densities of potential predators was low (< 0.03 fish/m2 pool).

Intra- and interspecific competition for food and space was probably minimal for anadromous salmonids. Low fish numbers and an apparent abundance of suitable habitat preclude adverse competition effects on age 0+ chinook salmon and steelhead trout.

Effectiveness of Sampling Design and Sampling Methods

The sampling design used to inventory fish populations and their habitats in Herd Creek during 1985 provided good confidence in most estimates. Samples were collected from 6 sites within each of 4 strata (24 sites total) to estimate most biological and habitat variables. We were able to statistically decern differences in mean fish densities of l0-100% among strata (Figs. 12, 13, 14, 15). Strata means for habitat variables required differences from 30 to 100% to discern statistical differences (Figs. 9 and 10).

The 1985 sampling design would be intensive enough to evaluate treatment effects over time between strata. Data collected from 24 sites to estimate age 0+ chinook salmon numbers produced a 20% estimation error for the total estimate (Table 7). Thus, age 0+ chinook salmon numbers must change approximately 40%, given the same precision in some future year, to attribute that response to enhancements.

Density data for 1986 will have 88 degrees-of-freedom in the error term for testing the strata x year hypotheses give investigators a better detection level for real density differences. Blocking out variation because of changes in redd counts (if available) will also help what responses caused by some treatment. No change in intensity should occur, given, some enhancement work in Herd Creek is to be evaluated in a pre-post treatment fashion (repeated measure or split plot in time).

Reach Description and Problem Identification

The East Fork of the Salmon River contains some very good anadromous spawning and rearing habitat by the stream also has some habitat problems. Our inventory found that 9,986 m of streambank or off stream sites affecting the stream needed enhancement work or attention. The 10 km represents 7.2% of the total stream length (x2 for both banks) inventored. A large portion (3,652 m) of the problem areas were located in Reach B (Herd Creek) near roads and ranches which might facilitate enhancement efforts. Reaches E and F had the smallest (1,416 m and 1,360 m, respectively)

lengths of stream segments that needed work or some land management change.

Reach A

Reach A is a roaded canyon/agriculture section of lower East Fork. Spawning potential for anadromous salmonids is poor as a result of pocket water, cascades and few riffles. Adequate instream cover and fair riparian cover results in only fair rearing potential for anadromous salmonids.

Recruitment of sediment into Reach A was predominatly from sloughing stream banks and open slopes with exposed soil (Table 8). Riprapping toes of slopes and fencing in those areas where the riparian zone is grazed could eliminate some of these problems.

Reach B

Reach B (Herd Creek) is located in a narrow bushy valley except on Bennetts ranch where the valley floor (floodplain) widens substantially. Spawning potential was generally good except that from Bennetts' ranch downstream most gravel is covered with superfines and partially embedded with fines. Recruitment of sediment into Reach B was mainly from sloughing banks and cattle crossings (Table 9). Poor instream and riparian cover on the ranch resulted in reduced rearing potential for anadromous salmonids. Remediation on the Bennetts ranch could range from laying back banks and fencing (may be a problem since the banks could be totally in the floodplain) to fencing and a reduction in grazing pressure. Problems below the ranch on the BLM land were intensified in 1985 by the pushing of a large herd of cattle through the pasture for a short period of. time in the early summer. If possible, cattle should be kept off the BLM land near the mouth of Herd Creek because of its limited forage value and high value of holding water for adult Chinook Salmon and rearing area for juvenile Chinook Salmon.

Reach C

Reach C flows through a medium-width valley that has been grazed and ranched for many years. The stream has excellent spawning and rearing potential for salmon and steelhead. Most of the stream has good cover in the form of deep pools and bushy material instream.

Sedimentation from Reach C probably ends up in Reaches A and B because of gradient differences. Sloughing banks need to be addressed either by riprapping and fencing or reducing cattle grazing in the riparian zone.The potential for remediation in this reach is high because of the easy acess from the road to the streamside.

Reach D

Big Boulder Creek was only subjectively inventoried during 1985 but was found to hold age 0+ chinook salmon and had some obvious habitat problems. Reach D will be inventoried in 1986 so that habitat information will be availible to a fiesibility study subcontractor for problem prioritzation.

Reach E and F

Reach E has a wider floodplain (some braiding) than Reach F but both reaches have generally good spawning and rearing habitat for anadromous salmonids. Recruitment of sediments into both reaches is again mainly from sloughing banks. Riprapping, laying back banks, changes in land-use management could all have an effect on sedimentation rates. Reaches E and F in their present condition, are lower priorities for remediation than downstream reaches A and C.

LITERATURE CITED

Bjornn, T.C. 1978. Survival, production, and yield of trout and chinook salmon in the Lemhi River, Idaho. Bulletin No. 27, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, USA.

Bjornn, T.C., M.A. Brusven, M.P. Molnau, J.H. Milligan, R.A. Klamt, E. Chacho, and C. Schaye. 1977. Transport of grantic sediment in streams and its effects on insects and fish. Bulletin No. 17, Forestry, Wildlife and Range Experimental Station, University of Idaho, Moscow, USA.

Reiser, D.W., and T.C. Bjornn. 1979. Habitat requirements of anadromous salmonids. Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow and Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon, USA.

Sekulich, P.T., and T.C. Bjornn. 1977. The carrying capacity of streams for rearing salmonids as affected by components of the habitat. Completion Report for Supplement 99, USDA Forest Service.

Thompson, K. 1972. Determining stream flows for fish life. In Proceedings of Instream Flow Requirement Workshop, Pacific Northwest River Basin Commission, Vancouver, Washington, USDA.

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

Argonaut Building Suite 210. 1301 Vista Avenue Boise, Idaho 83705 / (208) 3455865

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October 29, 1985

Shoshone-Bannock Tribes
P. 0. Box 306
Fort Hall, ID 83203

Attention: Dr. Richard C. Konopacky, Project Manager

Subject: Bonneville Power Administration Contract No. 83-359
Final Report, Biological Evaluation of the Northern Rocky Mountain Gray Wolf for the Bear Valley Creek Fish Habitat Enhancement Project

Gentlemen:

We are pleased to submit two copies of the Final Report, Biological Evaluation of the Northern Rocky Mountain Gray Wolf for the Bear Valley Creek Fish Habitat Enhancement Project. This report was prepared under Contract Amendment No. 2 to our August 27, 1984 agreement. At your instruction, we have mailed copies of this draft report to Larry Everson and Kevin Ward representing the Bonneville Power Administration (BPA).

The Draft Report (dated August 21, 1985) was provided to the U.S. Fish and Wildlife Service, the Lowman Ranger District - Boise National Forest, BPA, and Bear Valley Minerals, Inc. Only the U.S. Fish and Wildlife Services responded in writting (see Appendix A). The U.S. Forest Service Boise National Forest and Bear Valley Minerals, Inc. both made several minor editorial comments by telephone that have been incorporated in the Final Report.

We appreciate the assistance and cooperation provided to JMM by all of the agencies involved in the overall project. If you have any questions, please call me at (208) 345-5865.

Very truly yours,

Brian D. Liming

Brian D. Liming
Project Engineer/Scientist

Enclosure

BPA PROJECT NO. 83-359
FY 1985 ANNUAL REPORT
PART 2 OF 4

BIOLOGICAL EVALUATION OF THE NORTHERN ROCKY MOUNTAIN GRAY WOLF BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Prepared by:

James M. Montgomery,
Consulting Engineers, Inc.

Prepared for:

Shoshone-Bannock Tribes
Fisheries Department

Submitted to:

Bonneville Power Administration
Division of Fish and Wildlife

October 1985

Abstract: The proposed Bear Valley Creek Fish Habitat Enhancement Project is located on private land surrounded by the Boise National Forest near the headwaters of Bear Valley Creek. The project area includes potential key wolf habitat components that could be important during the spring season. Historical wolf sightings within and surrounding an "area of project influence" on potential wolf activity are reviewed in this report, and limited data on the prey base are provided. The potential project effects on wolves are discussed along with the welfare of the wolf prey base. The potential for direct wolf mortality due to wolf-human encounters also is addressed. Possible cumulative effects on the wolf from other area activities in combination with the proposed project are noted. Potential mitigation measures are discussed including delay of the construction activity until after July 15, construction personnel transportation. hunter education. and general education of project personnel on the gray wolf and current recovery efforts. The report concludes that the proposed project will not endanger the continued existence of the wolf, and that a "no-effect" decision is justified.

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FINAL REPORT

BIOLOGICAL EVALUATION OF THE NORTHERN ROCKY MOUNTAIN GRAY WOLF FOR THE BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

INTRODUCTION

The Northern Rocky Mountain Gray Wolf (Canis lupus irremotus) is currently classified as an Endangered Species under the Endangered Species Act of 1973, and Amendments of 1982. Wolves have been sighted on the Boise National Forest since 1905 and current records indicate low wolf densities (Kaminski and Boss, 198 1). Most observations of wolves or wolf sign involve lone individuals. Occasional pairs of wolves have been sighted, however, groups of three or more individuals have been rarely sighted. Wolf sightings and/or evidence of wolf activity in Idaho have been rated as "possible" or "probable" by researchers with the U.S. Forest Service (USFS) and U.S. Fish and Wildlife Service (USFWS) (Kaminski and Boss, 1981) (J. Hansen, personal communication, 1985). Current records indicate one confirmed wolf sighting on the Boise National Forest, Lowman Ranger District, near Deadwood Reservoir in 1978 when a hunter shot and killed a gray wolf. Subsequent investigations in the Bear Valley-Warm Lake area and vicinity have led researchers to estimate that the present wolf population on the Boise National Forest consists of four to nine individuals, based on reported observations from 1978 to 1989 (Kaminski and Boss, 1981). These individuals may be scattered seasonally throughout adjacent National Forest and wilderness lands.

Records of wolf observations provide an indication of wolf activity throughout the central Idaho area. These records have aided resource managers and wolf researchers in identifying and selecting gray wolf recovery areas. The Northern

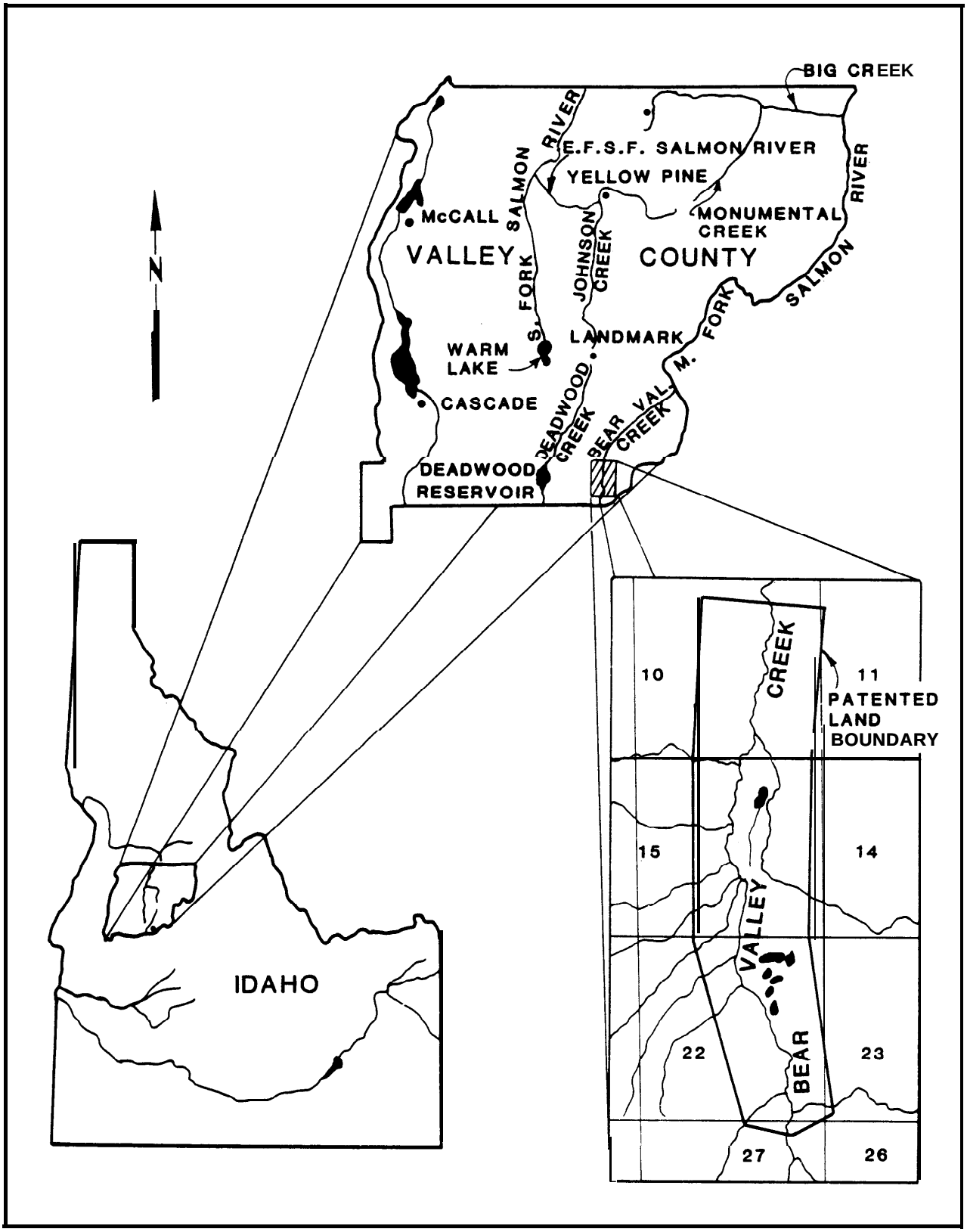
Rocky Mountain Wolf Recovery Team has selected the Frank Church River of No Return Wilderness as part of the central Idaho area for recovery of the gray wolf. The recovery team is currently refining wolf management guidelines for the recovery area.

The objective of this biological evaluation is to determine if there will be any positive or negative effects on the wolf or its habitat as a result of the Bear Valley Creek Fish Habitat Enhancement Project. The two major concerns with regard to the proposed project and the wolf are: 1) the welfare of the wolf prey base; and 2) the potential for direct wolf mortality due to human-wolf encounters.

DESCRIPTION OF THE PROPOSED PROJECT

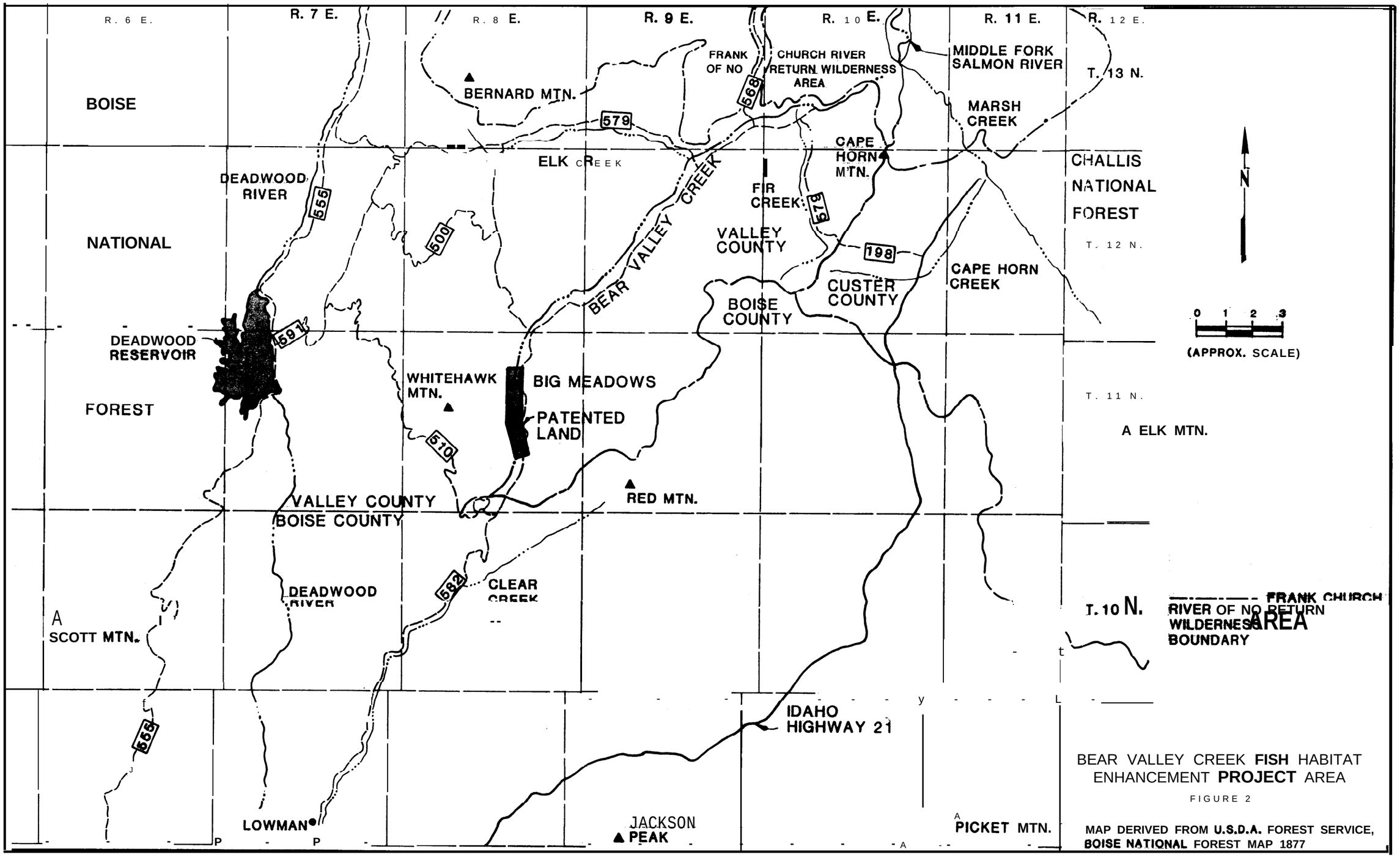
The proposed Bear Valley Creek Fish Habitat Enhancement Project is located in southeast Valley County, Idaho (Figure 1). The project area is situated in the Big Meadows area of the Bear Valley Creek drainage (Figure 2). Bear Valley Creek, a major tributary of the Middle Fork of the Salmon River. is a spawning and rearing stream for wild stocks of anadromous fish. The proposed project is sponsored by the Shoshone-Bannock Tribes (Tribes) and funded by the Bonneville Power Administration (BPA) under contract number 83-359 as part of the Salmon River Habitat Enhancement Program. The intent of the project is to provide offsite enhancement as partial compensation for fish habitat damage and migration problems related to hydroelectric power projects in the Columbia River Basin. The project will involve construction on a portion of the 910 acres of private, patented land owned by Bear Valley Minerals, Inc. The proposed project is located 9.5 miles south of the Frank Church River of No Return Wilderness.

During the period from 1954 to 1959 the presently patented (privately owned) land (Figures 1 and 2) in Big Meadows was dredge mined for the strategic minerals columbite and euxenite. The past mining operation incorporated reclamation methods appropriate to the technology of the times, however. the site has increasingly become a chronic problem area as a result of these earlier



BEAR VALLEY CREEK
FISH HABITAT ENHANCEMENT PROJECT
LOCATION MAP

FIGURE 1



BEAR VALLEY CREEK **FISH** HABITAT ENHANCEMENT **PROJECT** AREA

FIGURE 2

MAP DERIVED FROM **U.S.D.A.** FOREST SERVICE, **BOISE NATIONAL** FOREST MAP 1877

activities. During the past 26 years, the stream has eroded the dredge tailing and undisturbed placer material vertically and horizontally, resulting in the generation of substantial quantities of sediment which subsequently were transported to downstream reaches. The sedimentation has contributed to a reduction of spawning and other critical habitat areas for chinook salmon. The overall purpose of the project is to reduce the erosion and sedimentation and enhance the fish habitat.

The project feasibility study (JMM, 1985) was started in October 1984 and included preliminary field reconnaissance. The feasibility study resulted in selection of a project alternative which is conceptually agreeable to all involved agencies and Bear Valley Minerals, Inc. Additional field studies have been con--ducted during spring and summer 1985 to verify assumptions made in the feasibility study and help plan for construction of the habitat enhancement project. These field studies include water quality monitoring, stream flow measurement, vegetative community analyses, soil sampling, stream cross section surveying, and general field/photographic reconnaissance.

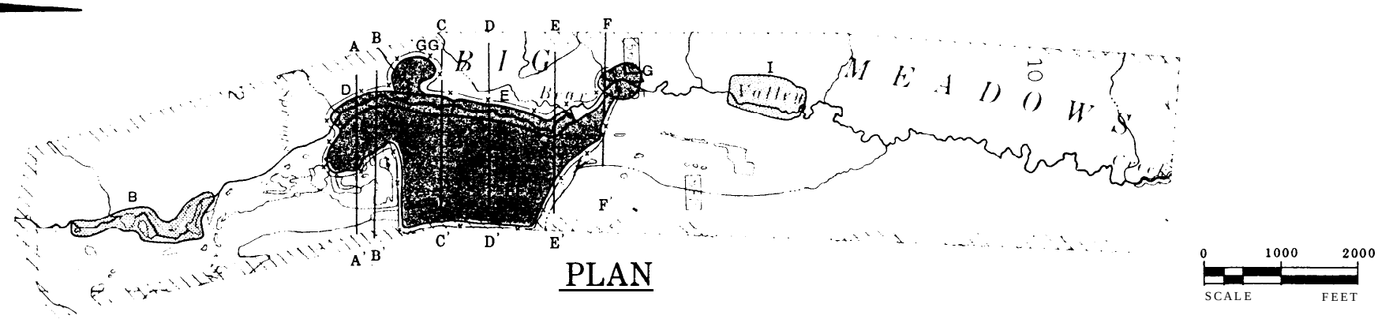
The proposed project consists of constructing a floodplain and stabilizing slopes along Bear Valley Creek throughout a portion of the previously dredge mined area (Figure 3). The floodplain construction will involve excavating approximately 80,000 cubic yards of sand, sediments, and small rocks along the existing stream channel to provide enough capacity for high spring snowmelt runoff flows and protect the banks from erosion. The streambank and floodplain stabilization and revegetation are schematically shown in section (Figure 4) and plan (Figure 5). The low flow channel of Bear Valley Creek will not be altered as part of this project. The entire project area delineated in the plan portion of Figure 3 will utlimately be fenced to exclude livestock from the stabilized areas and protect the overall investment in the fish habitat enhancement project.

Construction on the project will be phased over several years due to funding limits, the short construction season, high spring runoff flows. and potential early season wildlife use of the Big Meadows area. The construction planned for

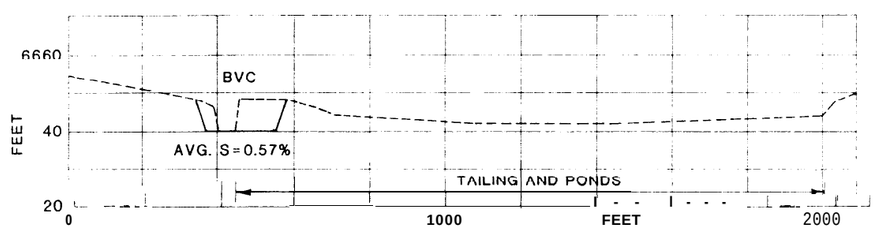
BEARVALLEYCREEK FISH HABITAT ENHANCEMENT PROJECT

FIGURE 3

CONCEPTUAL PROJECT PLAN AND SECTIONS



PLAN



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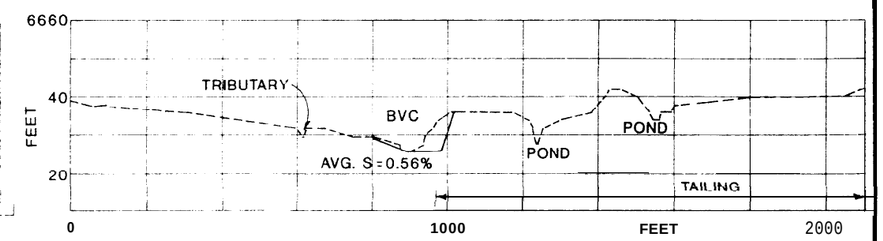

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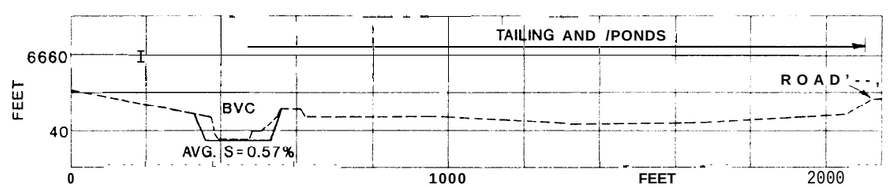

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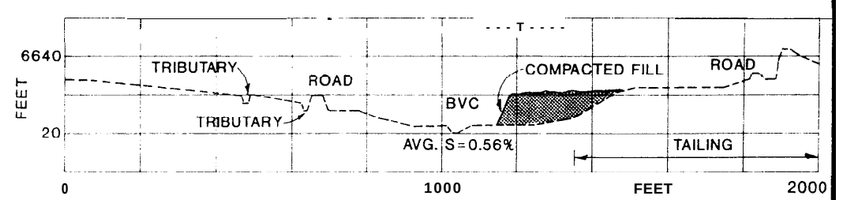

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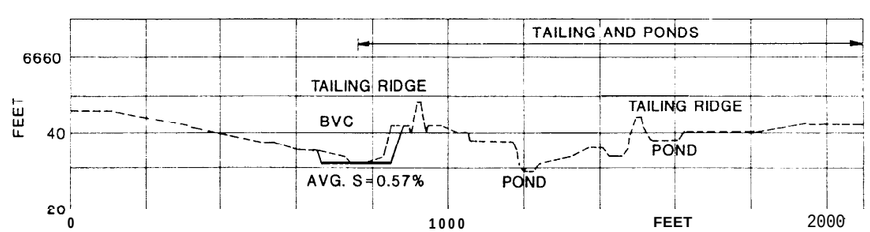

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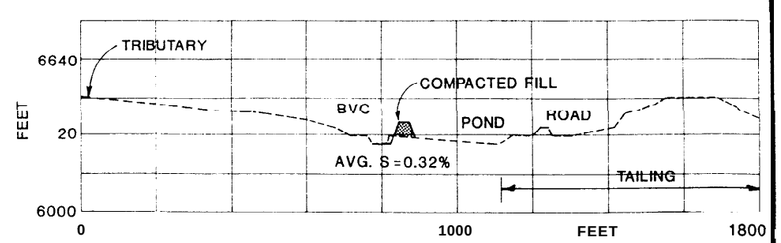


SECTION F-F'

SECTIONS

LEGEND

PLAN

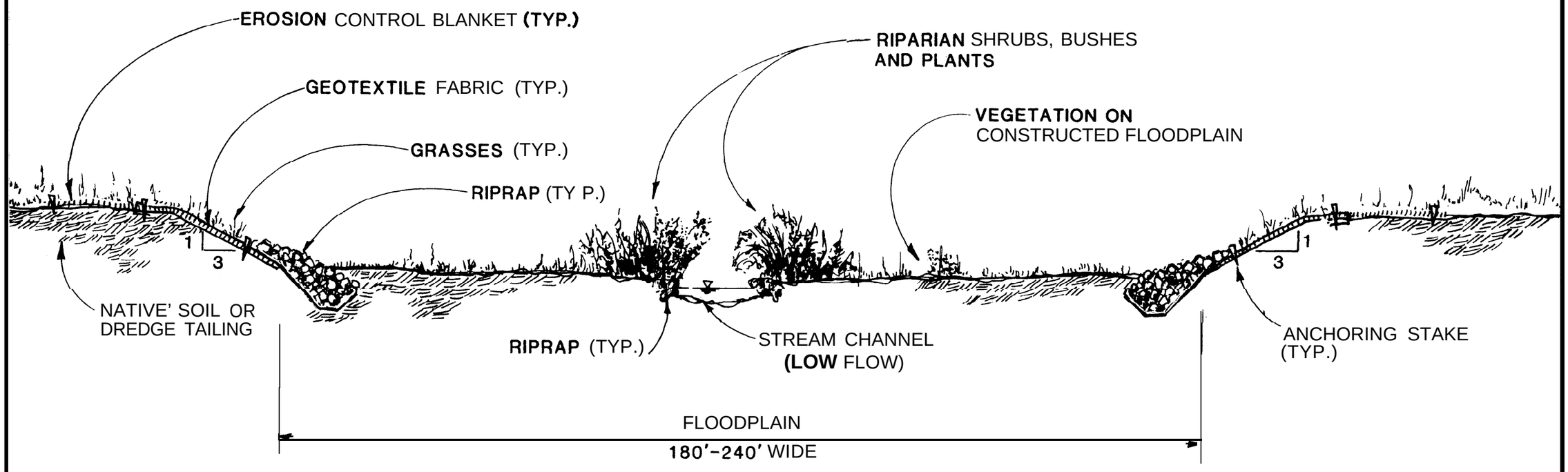
- PATENTED LAND BOUNDARY
- D — STABILIZATION AND REVEGETATION OF STREAM REACHES
- GG — STABILIZATION AND REVEGETATION OF ADJACENT AREAS
- I — STREAM REACHES TO RECEIVE FURTHER STUDY IN THE FIELD
- E — E' — CROSS SECTION LOCATIONS
- —i - x - PROPOSED FENCING

SECTIONS

- PROPOSED CONSTRUCTED FLOODPLAIN
- EXISTING CROSS SECTIONS
- AVG. S — AVERAGE SLOPE
- BVC — REAR VALLEY CREEK
- COMPACTED FILL

NOTE: ALL CHANNEL SIDE SLOPES ARE 3:1. CROSS SECTION SCALE IS 10 TO 1 VERTICAL EXAGGERATION.

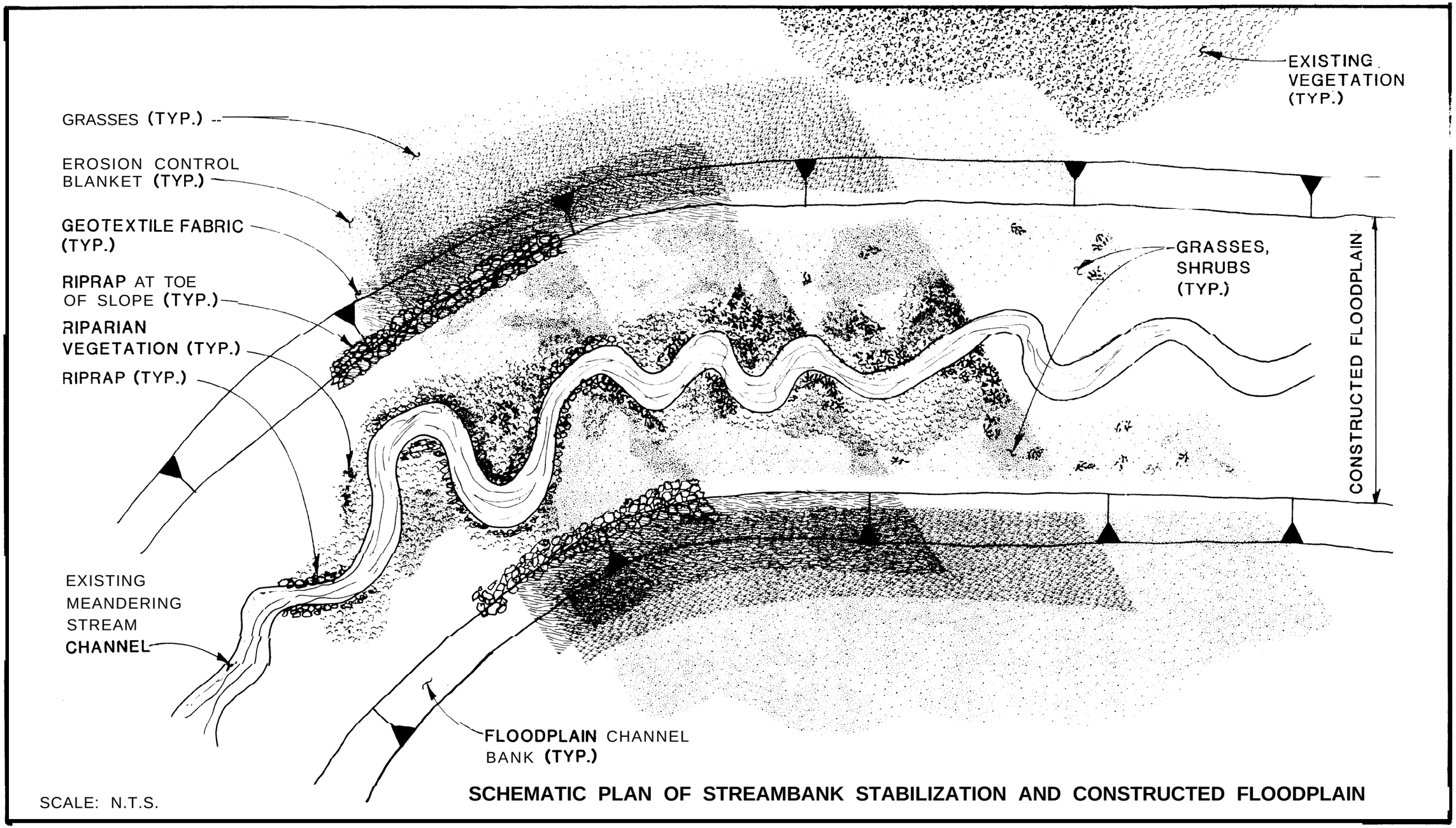
JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.



SCHEMATIC SECTION OF STREAMBANK STABILIZATION AND CONSTRUCTED FLOODPLAIN

SCALE: N.T.S.

FIGURE 4



SCALE: N.T.S.

SCHEMATIC PLAN OF STREAMBANK STABILIZATION AND CONSTRUCTED FLOODPLAIN

FIGURE 5

1985 will begin in September and continue until the end of October. Construction during future years would begin in mid-July and end in mid to late October.

The proposed project will require a maximum work force of 20 persons during the height of construction activity. The work force will be housed in the Lowman, Idaho area which is approximately 17 road miles from the project construction site. Road access from Lowman to the project site will involve the use of Forest Route 582. A portable house trailer will be located at the project site to provide temporary housing for a night watchman (if necessary). The trailer will be removed from Bear Valley at the close of each construction season during the contractor's demobilization period.

The general contractor for the proposed construction project will be James M. Montgomery, Consulting Engineers, Inc. (JMM). JMM will hire construction subcontractors for each portion of the project. The subcontractors will work under the direction and supervision of JMM. A JMM construction supervisor will work in the field on a full time basis during each construction season.

BIOLOGICAL DATA ANALYSIS - WOLF AND PREY BASE

Historical Reports of Wolves in the Bear Valley Creek Area

The Northern Rocky Mountain gray wolf occurred historically throughout the entire state of Idaho, the northwestern two-thirds of Montana, the northern two-thirds of Wyoming. and the southern third of Alberta (Goldman, 1944). The Bear Valley-Warm Lake area contains the majority of probable wolf reports on the Boise National Forest (Kaminski and Hansen, 1984). There are several recent reports of wolves in the immediate project area and near the dredge ponds.

Reported wolf sightings in the Bear Valley Creek area are summarized in Table 1. The locations of these sightings are shown on Figure 6. Many of the sightings shown in Figure 6 are within the "area of project influence" on potential wolf activity.

TABLE 1

WOLF SIGHTINGS IN THE VICINITY OF BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT AREA

Date*	Legal Description	Location	Rating
Feb. 1923**	T.l2N., R.7E., Sec. 28	Near Mary Blue Mine north of Deadwood Reservoir, mid-winter	Probable Sighting
June-Oct. 1931	T.l2N., R.6E., Sec. 30	Peace Valley between Peace Creek and Silver Creek	Probable Pair Sighting
1941	T.9N., R.llE., Sec. 21	North Fork Boise River near Picket Mountain	Probable Trapped 1 male am 1 female
June 1947	T.l3N., R.8E.. Sec. 1,2, 11,12	Near Elk Meadow	Probable Sighting
June 1947	T.l3N., R.8E., Sec. 13,14, 23,24	Near Elk Meadows	Probable Sighting
Oct. 1952	T.9N., R.l0E. Sec. 24	Wapiti Creek near Grandjean	Probable Sighting
Fall 1955	T. 13N., R.8E.	Near Deadwood Ridge	Probable Sighting
Fall 1957**	T.l2N., R.8E., Sec. 6	In meadow near Deer Creek	Probable Sighting
Aug. 1961	T.l3N., R.8E., Sec. 13	Junction of Porter Creek and North Fork Elk Creek	Probable Sighting
July 1963**	T.l3N., R.l0E., Sec. 31	Bruce Meadows	Probable Sighting
Oct. 1963**	T.l3N., R.8E., Sec. 35	Near Elk Creek and Twin Bridges	Probable Sighting
Oct. 1963**	T.l2N., R.8E., Sec. 4	Wet meadows near Elk Creek Road	Probable Sighting and Howling
Fall 1965-66	T.l0N., R.llE., Sec. 35 or 36	In Trail Creek Draw near Grandjean	Probable Wolf Chasing Cow Elk
Oct. 1967**	T.l3N., R.l0E., Sec. 31	Bruce Meadows	Probable Sighting
Fall 1967-68	T.l0N., R.6E., Sec. 19	Near Scott Mountain	Probable Sighting
Aug. 1968-69	T.l0N., R.6E., Sec. 35	On Pine Creek Road to Scott Mount ain	Possible Sighting

TABLE 1 (cont.)

Date*	Legal Description	Location	Rating
July 1970**	T.l3N., R.8E., Sec. 28	Little Beaver Creek Meadow	Probable Sighting
July 1971**	T.l2N., R.8E., Sec. 16	Near Elk Trap Meadow and Bearskin Creek	Probable Sighting
Sept. 1971**	T.l2N., R.8E., Sec. 4,9	Bearskin Road near Elk Trap Meadow	Probable Sighting
Summer 1972**	T.l2N., R.8E., Sec. 5	Wet Meadows near South Fork Deer Creek	Probable Sighting
July-Aug. 1973**	T.l2N., R.8E., Sec. 4	Near confluence of Wet Meadows and Bearskin Creek	Probable Sighting
July 1974**	T.llN., R.8E., Sec. 2	North end of Big Meadows in Bear Valley	Probable Sighting
Aug. 1974**	T.l2N., R.9E., Sec. 17	l/2 mile north of Sack Creek	Possible Sighting
Summer 1975**	T.l2N., R.8E., Sec. 28	Meadows at south end of Bearskin Creek	Probable Sighting
Aug. 1976	T.l3N., R.8E., Sec. 3,4	West Fork Elk Creek Meadow Chain	Probable Sighting
Fall 1976**	T.l3N., R.lOE., Sec. 26,27	Bruce Meadows	Probable Sighting
Fall 1976**	T.l3N., R.lOE., Sec. 31	Bruce Meadows	Probable Sighting
Oct. 1976	T.llN., R.7E., Sec. 17	Southeast of Deadwood Reservoir l/2 mile from airs trip	Probable Sighting
1978**	T. 12N., R.8E.	Sheep Trail Creek	Probable Sighting
1978**	T.l3N., R.8E., Sec. 34	Near Cow Camp	Probable Sighting
April 1978	T.l0N., R.6E., Sec. 4	Near Packsaddle Creek	Probable Sighting
June 1978**	T.llN., R.8E., Sec. 15	Near dredge ponds in Bear Valley	Probable Sighting
Sept. 1978**	T.l3N., R.9E., Sec. 3	Near Portland Mine Meadows	Possible Sighting
Fall 1978**	T.l2N., R.9E., Sec. 16	Crossed road in front of pickup	Probable Sighting
Oct. 1978**	T. 12N., R.8E., Sec. 18	Near South Fork Deer Creek: Bear Valley	Confirmed Male Wolf Shot/Killed

TABLE 1 (cont.)

Date*	Legal Description	Location	Rating
Apr. 1979	T.9N., R.7E., Sec. 34	Near Lowman	Possible Sighting
Aug. 1979**	T.1 2N., R.8E., Sec. 35	Junction of Bear Valley Creek and Cub Creek	Possible Sighting
Aug. 1979**	T.l2N., R.8E., Sec. 35,36	Near junction of Bear Valley Creek and Cub Creek	Possible Pup Sight:
Oct. 1979**	T.l2N., R.8E., Sec. 10	In Bear Valley near Bearskin Creek	Probable Sighting
Oct. 1979**	T.l2N., R.8E., Sec. 10	Near Bearskin Creek	Possible Sighting
Apr. 1980	T.9N., R.7E., Sec. 36	Near Lowman	Possible Sighting
May 1980	T.llN., R.12E.	Near Lowman-Stanley Road	Possible Sighting
June 1980**	T.l3N., R.9E., Sec. 26,27	North side Poker Meadows	Probable Sighting
June 1980**	T.l3N., R.9E., Sec. 26,27	Grassy meadow on southeast end of Poker Meadow	Probable Sighting
June 1980**	T.l3N., R.9E., Sec. 26,27	In meadows between Tennessee Creek and Poker Meadows	Probable Sighting
July 1980**	T.13N., R.9E., Sec. 26,27	Between Tennessee Creek and Poker Meadows	Possible Sighting
July 1980**	T.l3N., R.8E., Sec. 35	Near Twin Bridges Elk Creek	Possible Sighting
Sept. 1980**	T.l2N., R.8E., Sec. 21	Bearskin Creek	Possible Sighting, Scat
Sept. 1980**	T.l2N., R.8E., Sec. 22	Bearskin Road, Bear Valley	Possible Sighting
Sept. 1980**	T.1 2N., R.8E., Sec. 9	Near confluence of Willow Creek and Crooked River	Possible Sighting
Oct. 1980	T.l3N., R.l0E., Sec. 6	North of Ayers Meadow near Dagger Creek	Possible Sighting
Oct. 1980**	T.13N., R.9E., Sec. 14,15, 22,23	Near Poker Meadows	Probable Sighting
Oct. 1980	T.llN., R.l2E., Sec. 22	Near Dry Creek in Stanley Basin	Probable Sighting
Oct. 1980**	T.l2N., R.9E., Sec. 20	Near Sack Creek	Probable Sighting

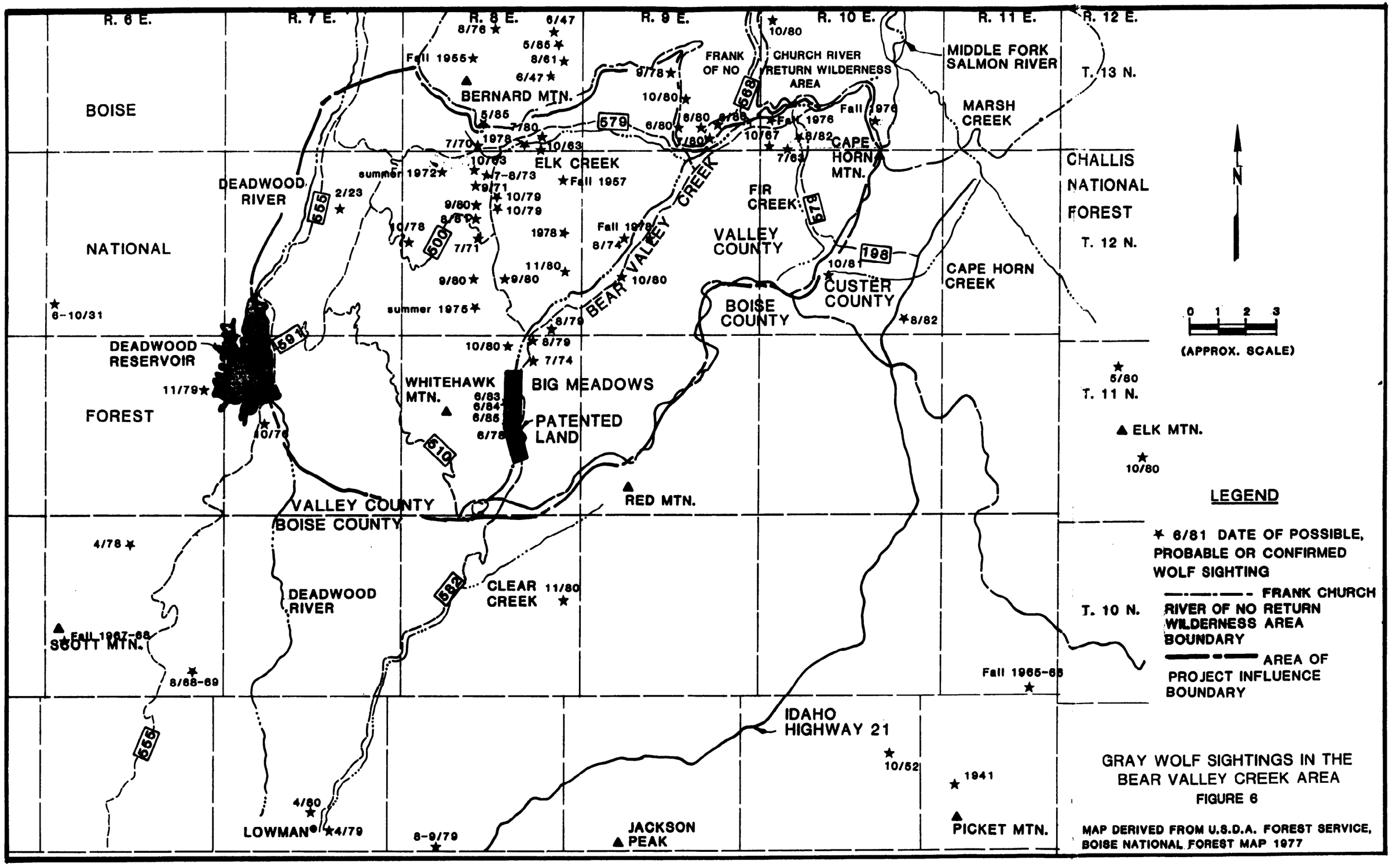
TABLE 1 (cont.)

Date	Legal Description	Location	Rating*
Oct. 1980**	T.llN., R.8E., Sec. 3	North of Bearskin and Bear Valley Creek Road Junction	Probable Sighting
Nov. 1980**	T.l2N., R.8E., Sec. 23, 24, 25,26	Sheeptrail Creek; less than 1 mile from Sack Creek	Probable Sighting
Nov. 1980	T.l0N., R.8E., Sec. 13	Near Corral Creek	Probable Sighting
Aug. 1981**	T.l2N., R.8E., Sec. 9	Lower end of South Fork Deer Creek	Probable Sighting
Oct. 1981	T.l2N., R.l0E., Sec. 21	Near Fir Creek	Probable Sighting
Aug. 5, 1982	T.l2N., R.lOE., Sec. 35	Near Banner Creek	Probable Sighting
Aug. 11, 1982**	T.l3N., R.l0E., Sec. 32	Bruce Meadows	Probable Sighting
June 1983-85**	T.llN., R.8E., Sec. 15,22	Near dredge ponds in Bear Valley	Sightings currently under investigation
May 24, 1985**	T.l3N., R.8E., Sec. 33	Between Elk Creek and wet meadow off of road	Possible Sighting

Sources: Kaminski and Boss, 1981.
Donohoo, 1985. Personal communication.

*Sightings are listed in order by date.

**Sightings reported within "are of project influence." See Figure 6.



GRAY WOLF SIGHTINGS IN THE BEAR VALLEY CREEK AREA
FIGURE 6

MAP DERIVED FROM U.S.D.A. FOREST SERVICE, BOISE NATIONAL FOREST MAP 1977

There are other signs of potential wolf activity in the Bear Valley Creek area. Reported observations of wolf scat. tracks, and howling incidents in the Bear Valley Creek area are summarized in Table 2. The locations of reported wolf scat, tracks and howling incidents are shown on Figure 7. and many occur within the "area of project influence" as defined by USFWS biologists.

Causative factors responsible for the decline of the wolf population include trapping, hunting, poisoning, land development, loss of habitat. and the inability of man to tolerate the wolf. Human caused mortality has had a major impact on wolves throughout the historical range of the Northern Rocky Mountain gray wolf. Wolf mortality directly attributed to humans following legal protection of wolves has been documented by several prominent research biologists (Mech. 1977; Fritts and Mech, 1981; Berg and Kuehn, 1982). The present range of the gray wolf in the Northern Rocky Mountains is limited to western Montana, northwestern Wyoming, and the central and northern mountains of Idaho. based on reported sightings within the last ten years (Flath, 1980; Kaminski and Hansen, 1984).

Potential for Wolf Activity in the Bear Valley Creek Project Area

The Bear Valley Creek Project area and vicinity contains some of the key wolf habitat components found on the Boise National Forest. These key habitat components include traditional elk calving and nursery areas, ungulate summer range, beaver and other alternate prey habitat, and potential wolf homesites (dens and rendezvous sites) (Kaminski and Hansen? 1984). The primary use of the immediate project area by wolves would be during the late spring and early summer months when elk are present along the fringes of Big Meadows. The reported sightings in the immediate project area help affirm that wolves use the south Big Meadows area during the spring and early summer months. Reports of wolf sightings during the month of June over the past three years within the dredge mined area are currently under investigation by biologists from the USFWS, Idaho Department of Fish and Game (IDFG), and USFS (L. Donohoo, personal communication. 1985). Several wolf sightings have been reported in the north Big Meadows area from July through October in recent years.

TABLE 2

WOLF SIGN OBSERVATION IN THE VICINITY OF BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT AREA

Date*	Legal Description	Location	Rating
May 1945	T.l3N., R.8E., Sec. 13,14, 23,24	Corduroy Meadows	Probable Tracks around freshly killed elk calf
June 1946-47	T.llN.? R.llE.	10 miles north of Grandjean	Probable Tracks
July 1976	T.l3N., R.8E., Sec. 13	Near junction of Porter Creek-Elk Creek	Probable Howling
July 16, 1979**	T.l2N., R.10E Sec. 6	Bruce Meadows	Probable Howling
July 1979**	T.l3N., R.8E., Sec. 25	2 miles northeast of Elk Creek R. S. in Bear Valley	Possible Scat
July 1979**	T.l3N., R.9E., Sec. 26	Near Bruce Meadows	Probable Howling
Aug. 1979**	T.l3N., R.9E., Sec. 31	Bear Valley, l/2 mile south-west of Elk Creek Road	Probable Howling
Aug. 1979**	T.l3N., R.9E., Sec. 30	1 mile northwest of Elk Creek Road	Probable Howling
Aug.-Sept. 1979	T.9N., R.8E.	Ridge above Kirkham Hot Springs	Probable Sighting, Howling
Sept. 1979**	T.2N., R.9E., Sec. 20,21	Near Sack Creek Campground	Probable Howling
Nov. 14, 1979**	T.llN., R.7E, Sec. 12	Whitehawk Basin	Probable Tracks
Nov. 1979	T.llN., R.6E., Sec. 12	Near South Fork Beaver Creek	Probable Tracks
Feb. 1980	T.l3N., R.7E.: Sec. 14	Bernard Creek and north of East Fork Deadwood River	Probable Tracks
Sept. 1980**	T.l3N., R.8E., Sec. 26	West of Lower Corduroy Meadows	Possible Scat
July 1981**	T.l3N., R.8E., Sec. 35 or 36	Near Elk Creek Ranger Station	Probable Howling
Oct. 1981**	T.9N., R.8E., Sec. 20	Near Lick Creek	Probable Tracks

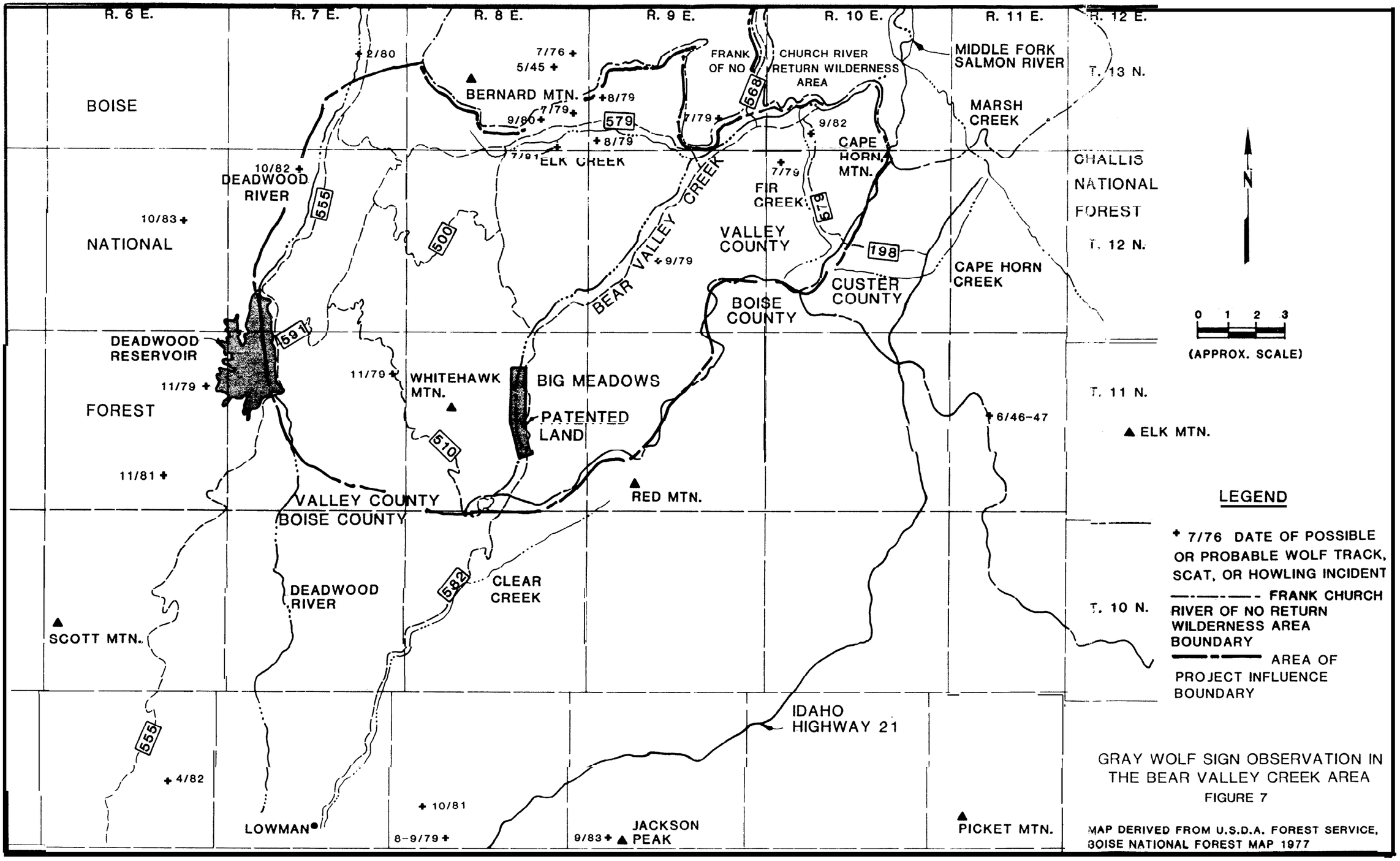
TABLE 2 (cont.)

Date*	Legal Description	Location	Rating
Nov. 1981	T. 11 N., R.6E., Sec. 27	Near Lightning Creek	Probable Tracks
April 1982	T.9N., R.6E., Sec. 23	Near Fir Creek	Possible Tracks
Sep. 16, 1982**	T.13N.. R.10E., Sec. 32	Bruce Meadows	Probable Howling
Oct. 1982	T.l2N., R.7E., Sec. 4	Near Deadwood River	Probable Howling
Sept. 1983	T.9N., R.9E., Sec. 32	Near Jackson Peak	Possible Tracks
Oct. 6, 1983	T.l2N., R.6E., Sec. 14	Near Silver Creek	Possible Tracks. Howling

Source: Kaminski and Boss, 1981.

*Observations are listed in order by date.

**Observations reported within "area of project influence." See Figure 7.



GRAY WOLF SIGN OBSERVATION IN THE BEAR VALLEY CREEK AREA
FIGURE 7

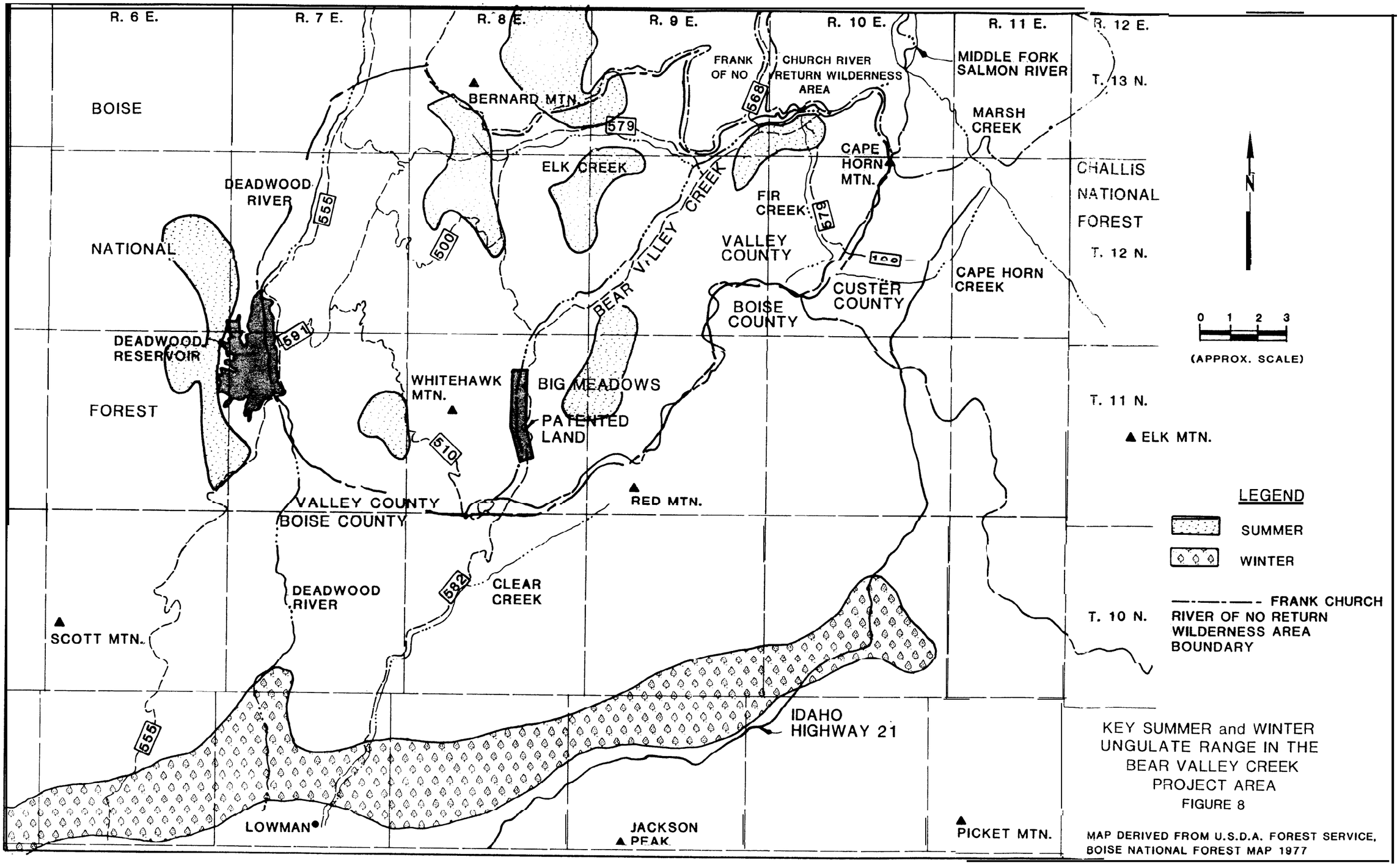
Wolf use of the Big Meadows area could potentially increase during years that the upper Bear Valley Creek pasture is rested from livestock grazing. There is a high degree of potential conflict between wolves and livestock grazing in the Bear Valley Creek area (Kaminski and Hansen, 1984). The grazing allotments in Bear Valley Creek overlap areas of key wolf habitat components.

The total number of wolves which could be supported within the Boise National Forest has been estimated using an equation developed by Keith (1982). This equation estimates the wolf population that could be supported by population estimates of prey base including elk and mule deer within game management units. An estimate of 26 wolves has been calculated based on 1981 population counts of elk and mule deer on IDFG game management units 25. 33, 34. and 35 (Kaminski and Hansen, 1984).

Analysis of wolf reports from the Bear Valley-Warm Lake area indicate that reproduction has been successful (Kaminski and Boss, 1981; Kaminski and Hansen, 1984). Several sightings of adult wolves with pups and/or pairs of adult wolves are documented in reports filed with the USFWS. Identical groups of wolves have been reported by separate parties in different locations several weeks apart.

Prey Base

The primary prey base for the gray wolf consists of elk (Cervus elaphus nelsoni) and mule deer (Odocoileus hemionus). Beaver (Castor canadensis) is a secondary prey species where available. The Bear Valley Creek project site is located within IDFG Management Unit 34. Ungulate winter range in the region is located along the South Fork of the Payette River drainage, outside of the area of project influence (Figure 8). Ungulate summer range is found throughout the Bear Valley Creek drainage (Figure S), however, elk will avoid these areas if livestock are grazing in the meadows (L. Donohoo, personal communication. 1985). The presence of livestock in the summer ungulate range causes a displacement of elk into the higher ridges and meadow areas. Elk are the primary wolf prey species that occupy the upper Bear Valley Creek drainage.



KEY SUMMER and WINTER UNGULATE RANGE IN THE BEAR VALLEY CREEK PROJECT AREA

FIGURE 8

MAP DERIVED FROM U.S.D.A. FOREST SERVICE, BOISE NATIONAL FOREST MAP 1977

The wildlife management agencies estimate that IDFG Unit 34 had a 1981 elk population of 650. Recent management activities within Unit 34 have resulted in a 1985 elk population estimated at approximately 850 animals (Kaminski and Hansen, 1984). Donohoo (personal communication, 1985) estimates that up to 60 elk graze in the Big Meadows area during years when the pasture is being rested from livestock grazing. The 1985 estimate of mule deer within Management Unit 34 is approximately 1400 animals, however, most of the mule deer population inhabits areas outside of the upper Bear Valley Creek drainage. The Bear Valley Creek area receives moderate hunting pressure due to accessibility from the Boise area.

DISCUSSION

Area of Project Influence

The area of project influence was established by USFWS biologists through comparison of the proposed construction activity with the general topography of the region and an overview of wolf sightings in the project vicinity (J. Gore and J. Hansen, personal communication, 1985). The area of project influence shown in Figures 6, 7, and 8 extends north to the Frank Church River of No Return Wilderness, west to Deadwood River and Deadwood Reservoir? and south and east to the Valley County/Boise County line along the natural drainage boundary of Bear Valley Creek. The boundary was delineated solely based on potential impacts or effects the project could have on any wolves inhabiting the Bear Valley Creek region. Establishment of the area of project influence also provides a specific area within which potential impacts on wolves and wolf habitat can be estimated.

Potential Project Effects on Wolves

The proposed Bear Valley Creek Fish Habitat Enhancement project is not expected to have direct adverse effects of either wolves or their prey base. Based

upon reported sightings to date? wolves utilize the immediate project area only during the spring. Wolf sightings within the private land boundaries have been reported only for the month of June, which corresponds to the period that elk inhabit the meadow fringe areas. The immediate project area is not expected to provide potential homesites for wolves because of the main road access through Bear Valley and the amount of human related activity in Bear Valley Creek during the summer months. Probable use of the area surrounding the project site by wolves is for securing prey during the spring months.

The proposed project, as presently planned, would be under construction in September 1985 and after July 15 in future years. Construction of the improvements including use of heavy equipment probably would not have a direct effect on the wolf, because sightings reported during these periods are concentrated in an area north of the patented land. There are no reported wolf sightings along Forest Route 582 from Lowman to the project site during the months of planned construction activity. Project requirements for riprap (rock) material will involve development of a source located outside of the immediate project area. A tentative riprap site has been identified in conjunction with the USFS. The riprap site is located in Bear Valley approximately two miles southeast of the project site along Forest Route 502. Development of the riprap site will include surface clearing, drilling, blasting, loading, and hauling the rock material. There are no reported wolf sightings in the area surrounding the riprap site or along the road to the site.

The project area will be fenced following completion of construction during each year to protect the stabilized and revegetated slopes from livestock use. The fencing is not expected to have any direct effects on wolves that may use the immediate project area.

The proposed project may have minor indirect effects on wolves. The wolf sightings shown on Figures 6 and 7 occur mostly during the summer and fall recreation seasons. The increase in activity at the south end of Bear Valley due to the construction could result in an increase in potential wolf activity in the

north end of Bear Valley. This effect would be temporary because the overall project construction will be completed within several years. The daytime increase in human activity within the immediate project area will increase the potential for a wolf-human encounter. However, wolves have not been sighted in the immediate project area during the months of proposed construction activity. The increased number of people in Bear Valley raises the potential for illegal hunting activities during non-hunting seasons, which could affect the welfare of prey species or even result in wolf mortality. Beneficial indirect effects on the wolf may include an improvement in the riparian habitat which could attract potential prey. Fencing of the improved area to exclude livestock could result in attraction of prey species to the project area following completion of construction activity.

Long term effects of the proposed project are difficult to estimate due to the cumulative effects of other human activity in the area of project influence. The Bear Valley Creek Fish Habitat Enhancement project is generally not expected to have any long term effects on wolves. Long term effects could only be identified after specific monitoring for wolf activity in the area of project influence.

The Draft Wolf Management Guidelines for the Northern Rocky Mountains has been developed by the Wolf Recovery Team for continued management of the wolf on National Forest System lands, wilderness areas, and in National Parks. Three management zones have been established by the Wolf Recovery Team? however, the zones have not been assigned to specific areas. The proposed project site would probably fall within Zone 1 which includes key habitat components. The proposed project involves habitat improvement activities which are consistent with the draft management guidelines for maintaining and improving wolf habitat. Stabilization and revegetation of the riparian zone along Bear Valley Creek as planned would improve habitat for ungulates and other prey species, which could in turn improve the wolf habitat.

Welfare of the Wolf Prey Base

The welfare of the wolf prey base, believed to be primarily elk, is crucial to the survival of the wolf. In addition to elk kills by wolves, the herds are controlled by other factors including sickness leading to death, seasonal starvation. legal hunting, illegal hunting, and road kills. The legal elk hunting season for IDFG Management Unit 34 begins October 2 and continues for 30 days. unless closed earlier. The legal deer hunting season for Unit 34 begins October 16 and ends November 10, unless closed earlier. Legal game animals include only antlered elk and antlered deer.

The increased number of people in Bear Valley during the project construction seasons could increase the number of legal and illegal big game kills in the area. Elk herds inhabiting the Bear Valley Creek area are considered a key habitat component and primary prey base for wolves. Increased legal hunting of big game as a result of the proposed project is not expected to affect the wolf opulation. Any potential increased hunting pressure related to the proposed project would be counteracted by housing construction workers in the Lowman area. Deliberate illegal game taking would also be controlled by housing construction workers outside of the Bear Valley area. However, road hunting could increase during daily commuting periods and illegal road hunting could potentially affect a herd that functions as a primary prey base.

The prey base can also be disrupted by activity on roads. Elk will avoid habitat adjacent to open forest or meadow roads with traffic for distances up to 0.5 miles (Lyon, 1979; Perry and Overly, 1976). The increased commuter and construction related traffic may keep elk and deer away from the project site. The potential for road kills of big game would increase during the project construction, however, loss of animals due to road kills is not expected to significantly affect the ungulate population.

The long term effects of the project on the prey base are expected to be beneficial. The project would improve riparian habitat and cover for ungulates, and

the improved areas would be fenced to exclude livestock. The fencing is not expected to prevent elk and deer from utilizing the stabilized and revegetated areas. The riparian stabilization and revegetation also may attract beaver into the completed project area. All of these beneficial effects would be long term and could only be verified through post project monitoring.

Potential for Direct Wolf Mortality Due to Wolf-Human Encounters

The proposed project has some potential for resulting in direct wolf mortality due to wolf-human encounters. The short term increase in human population due to construction within Bear Valley increase the potential for a wolf-human encounter. Carrying of firearms in vehicles increases the potential of direct wolf mortality if a wolf-human encounter should occur. However? the only reported sightings of wolves in and near the project area occur before the construction personnel would be on the site during any year of the phased stabilization and revegetation activity. The presence of a night caretaker at the site during the construction season would increase the potential for a wolf-human encounter.

The closest established human population is located at Lowman 15 miles from the Bear Valley Creek project site. Highway access between Lowman and the Boise metropolitan area is maintained throughout the year. Bear Valley is a popular winter recreation area for snowmobilers, however, no winter sightings of wolves have been reported for the Big Meadows area. Wolves appear to avoid areas seasonally inhabited by humans, however, they may use these same areas when people are not present (Peterson, 1975).

Cumulative Effects

Possible cumulative effects of the proposed project on the gray wolf are evaluated in terms of other projects and/or activity in the vicinity of the Bear Valley Creek project site. Other human activities in the Bear Valley Creek area include fish habitat studies, livestock grazing, transportation. recreation (camping, hiking, hunting, sightseeing), woodcutting, and timber harvesting. All of these

activities increase the seasonal human population in the area and consequently increases the potential for a wolf-human encounter. There are five separate 1985 fish habitat studies being conducted within the area of project influence. These studies are research and/or monitoring oriented, and each group involves several people. The studies are being conducted by the following entities:

- Shoshone-Bannock Tribes Fisheries Department in field, with subcontractor (JMM) making intermittent trips into the project area;
- Shoshone-Bannock Tribes Fisheries Department in-field aerial and instream studies;
- USFS-Boise National Forest, through a field subcontractor;
- USFS-Intermountain Forest and Range Experiment Station;
- USFWS, through a field subcontractor; and
- IDFG, primarily using an aerial survey.

The potential cumulative effect of these habitat studies would be to displace wolves from key habitat into areas with less desirable habitat because of the human activity. Some of these fish habitat studies are scheduled only for 1985, and others are being conducted as long term studies. The studies are generally being conducted from June through October.

Livestock grazing effectively displaces the primary prey base for wolves throughout much of Bear Valley (L. Donohoo, personal communication, 1985). The potential for direct conflict between wolves and livestock is high throughout the Bear Valley area. However, there are no records or reports of depredation on livestock by wolves within the area of project influence (Kaminski and Hansen, 1985). Livestock use of the immediate project area during construction is expected to be minimal.

The Bear Valley Creek project area provides a transportation corridor for numerous government and private vehicles throughout the summer and fall months. Passenger vehicles, light duty trucks, and large multiple axle trucks utilize Forest Route 582 for access into Bear Valley or other nearby areas. There are no reported vehicle-wolf accidents, however, many of the sightings listed in Table 1 were made from vehicles. The primary effect of vehicular transportation on wolves is potential displacement to other areas with little or no human activity. The Bear Valley Creek project will cause increased seasonal traffic on the road between Lowman and the construction site, however, this area has no reported wolf sightings. There will be no project related traffic north of the construction site.

Recreation including camping, sightseeing, hiking, and hunting within the Bear Valley Creek area is aided by the relatively easy access from Lowman and Stanley. Recreation use of Bear Valley is not expected to increase as a result of the project construction because the contractor's employees will be housed in Lowman. Hunting increases the potential for a wolf-human encounter and direct wolf mortality. However, the project is not expected to significantly increase the hunter population in Bear Valley.

Woodcutting and timber harvest activities in the Bear Valley Creek area are expected to have minimal effects on the wolf. Woodcutting by individuals is generally done in roaded areas above the valley floor, and the primary effect on wolves may be avoidance of the area of activity. There are no timber sales planned by the USFS in the upper Bear Valley Creek drainage during the next five years (D. Hale, personal communication, 1985). The entire drainage is within the Lowman Ranger District and tributary to the Middle Fork of the Salmon River. This area is not within an existing or proposed wilderness and is scheduled for 1 million board feet of timber harvest per year during the next five years. Most of this harvest will be accomplished in small commercial cuts which can benefit managed populations of wildlife.

The potential cumulative effect of all the above activities on the wolf is avoidance of the Bear Valley Creek area during periods of human activity. The proposed project is not expected to have additional short term effects on the wolf because the construction activity will be conducted during months when wolves historically are not reported in the upper Big Meadows area. Any potential cumulative effects on the wolf resulting from the proposed project may be mitigated by specific measures enforced during the construction activity. Other unrelated human activity as discussed above is controlled and managed by the USFS through the Lowman Ranger District.

Potential Mitigation

Potential mitigation of the effects of the proposed Bear Valley Creek Fish Habitat Enhancement project on the wolf and its habitat are numerous and would be implemented by JMM as the general contractor. These potential mitigation measures include the following:

- Construction will not be started during any year until July 15 or later, and the construction activity will generally last until the end of October.

- Construction employees will commute daily to and from the project site in vans or private vehicles. All construction personnel will live in Lowman except for a night caretaker (if necessary) who will be housed at the site.

- Construction personnel will be discouraged from hunting in the project area before, during, or after the working day.

- The construction personnel will be encouraged to comply with hunting and fishing regulations as part of a hunter education program.

- Firearms (rifles, shotguns, etc.) will not be allowed in company construction vehicles traveling to and from the project site.

- Education on the wolf, its habitat, and current recovery efforts will be provided to the construction personnel through seminar presentations, pamphlet distribution, and posters provided on the construction site. The education program will emphasize reporting and documenting wolf sightings to the agencies (IDFG, USFWS, or USFS) as soon as possible.

The mitigation measures listed above will each help protect the wolf and its key habitat components in the Bear Valley Creek area. Delay of construction until July 15 or later will help avoid potential wolf-human encounters, based on current reported sightings in the immediate project vicinity. This date is consistent with the start of USFS and IDFG activities in Bear Valley each year. Provision of transportation for employees to and from the project site would help control illegal hunting and poaching activity. Discouragement of hunting from the project site on working days will also help control illegal hunting and decrease the potential for direct wolf mortality. Hunter education for construction personnel also will help to control illegal hunting. Restrictions on carrying firearms to and from the project site in company vehicles will help control road hunting and reduce the potential for direct wolf mortality during any potential wolf-human encounters. Education of employees about the wolf through seminars and distribution of literature will help the construction personnel in their understanding the importance of recovering the wolf population. The education program will also help in monitoring potential wolf activity by emphasizing the importance of reporting wolf sightings to the wildlife management agencies. Overall mitigation would be achieved by observing the Draft Wolf Management Guidelines, which will be used in developing the education program.

SUMMARY

The proposed project by the Shoshone-Bannock Tribes is not expected to affect the wolf in a negative way and may have some long term positive impacts on

wolf recovery. Although intermittent sightings have been reported in the immediate project area during the month of June over the last seven years, no wolf activity has been recorded during the planned periods of construction. The potential for wolf-human encounters is increased anytime there is an increase in people, however, the project work force will not be living at the construction site. The potential for affecting big game herds by the project is increased, however, mitigation measures discouraging hunting and restricting the type of firearms allowed on the construction site will help protect prey base populations. Education of the construction employees about the wolf, prey base, and hunting safety will help minimize any undesirable wolf-human encounters and protect elk and deer populations- from illegal over-utilization. The long term benefits of the project in stabilization and revegetation along Bear Valley Creek may be realized by providing more prey base habitat in the riparian zone.

Based upon the above evaluation, it is our conclusion that the Bear Valley Creek Fish Habitat Enhancement project, as proposed by the Shoshone-Bannock Tribes, will not endanger the continued existence of the wolf, and that a “no-effect” decision is justified.

REFERENCES

Berg, W.E. and D.W. Kuehn. 1982. Ecology of wolves in north-central Minnesota. In F. Harringon and P. Paquet (eds.), Wolves of the World. Noyes, NJ.

Flath, D.L. 1980. The nature and extent of wolf activity in Montana: Montana Fish and Game Report, February 1, 1979, Missoula, Montana. 17 pages.

Fritts, S.H. and L.D. Mech. 1981. Dynamics, movements, and feeding ecology of a newly protected wolf population in northwestern Minnesota. Wildl. Monogr. 80. 79 pages.

Goldman, EA. 1944. The wolves of North America, Part II: Classification of Wolves. The American Wildlife Institute, Washington, D.C. p. 389-636.

JMM. 1985. Draft Feasibility Report, Bear Valley Creek, Idaho, Fish Habitat Enhancement Project. Prepared for the Shoshone-Bannock Tribes. 150 pages.

JMM. 1985. Preferred Alternative Report, Bear Valley Creek, Idaho. Fish Habitat Enhancement Project. Prepared for the Shoshone-Bannock Tribes. 30 pages.

Kaminski, T. and A. Boss. 1981. Gray Wolf: History, Present Status, and Management Recommendations. Boise National Forest, USDA-Forest Service. 111 pages.

Kaminski, T. and J. Hansen. 1984. Wolves of Central Idaho. Montana Cooperative Wildlife Research Unit. 197 pages.

Keith, L.B. 1982. Population dynamics of wolves. Pages 66-77 in Wolves in Canada and Alaska. Can. Wildl. Ser. Rep. Ser. No. 45.

Lyon, L.J. 1979. Influences of logging and weather on elk distribution in western Montana. USDA Forest Service, Research paper INT-236, Intermountain Forest and Range Experiment Station. U.S. Department of Agriculture, Forest Service, Ogden, Utah.

Mech, L.D. 1977. Population trend and winter deer consumption in a Minnesota wolf pack. Pages 55-83 in R.L. Phillips and C. Jonkel (eds.), Proc. 1975 Predator Symp. Missoula, MT 268 pages.

Perry, C. and R. Overly. 1976. Impact of big game distribution in portions of the Blue Mountains of Washington. Proc. Elk-Logging-Roads Symp. Forest, Wildl. and Rge. Exp. Sta., University of Idaho, Moscow. 62-68.

Peterson, R.O. 1975. The wolves of Isle Royale - new developments, in Klinghammer, ed., The behavior and ecology of wolves. New York, Garland Press. 599 pages.

ADDITIONAL SOURCES

W. Bodie. 1985. Personal communication. Regional Wildlife Biologist, Region 3, Idaho Department of Fish and Game.

Boss, A. 1980. Biological data and evaluation, Deadwood area proposal to manage the mountain pine beetle, Lowman Ranger District, Boise National Forest, USDA-Forest Service.

Donohoo, L. 1980. Biological evaluation of the Gray Wolf - Trail Creek Timber Sale. Lowman Ranger District, Boise National Forest, USDA-Forest Service.

Donohoo, L. 1982. Biological evaluation of the Rocky Mountain Gray Wolf for the Whitehawk Timber Sale. Lowman Ranger District, Boise National Forest. USDA-Forest Service.

Donohoo, L. Biological evaluation of the Gray Wolf - Mary Blue Timber Sale. Lowman Ranger District, Boise National Forest, USDA-Forest Service.

Donohoo, L. 1985. Personal communication. Wildlife Biologist, Lowman Ranger District, Boise National Forest, USDA-Forest Service.

Gore, J. 1985. Personal communication. Asst. Field Supervisor, Division of Endangered Species, USDI-Fish and Wildlife Service.

Hale, D. 1985. Personal communication. Minerals Specialist, Lowman Ranger District, Boise National Forest, USDA-Forest Service.

Hansen, J. 1985. Personal communication. Research Biologist, Division of Endangered Species, USDI-Fish and Wildlife Service.

Hershey, T.J. and T.A. Leege. 1982. Elk movements and habitat use on a managed forest in north-central Idaho. Wildlife Bulletin No. 10, Idaho Department of Fish and Game.

Kaminski, T. 1981. Wolf Recovery: Status in the Northern Rockies. Boise National Forest, USDA-Forest Service.

Lyon, L.J. 1979. Habitat effectiveness for elk as influenced by roads and cover. Journal of Forestry 77(10):658-660.

USDA Forest Service, Intermountain Forest and Range Experimental Station. 1978. Elk-Roads-Logging Relationships: A current resume of findings.

APPENDIX A
COMMENTS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
BOISE FIELD OFFICE
4696 Overland Road, Room 576
Boise, Idaho 83705

August 30, 1985

Mr. Brian Liming
James V. Montgomery Consulting Engineers, Inc.
1301 Vista Avenue
Argonaut Building, Suite 210
Boise, Idaho 83705

Re: 1-4-85-I-386

Dear Mr. Liming:

We have reviewed the draft biological evaluation of the northern Rocky Mountain gray wolf for the Bear Valley Creek Fish Habitat Enhancement Project, which we received on August 22, 1985. Our major concern with the project is the increased potential for human caused wolf mortality due to the addition of at least twenty construction people into the Bear Valley area. As mentioned in our June 26, 1985 meeting, we would like to see the employees transported to and from the construction site every day in company vans or buses. This will help insure that no guns are brought to the construction site and that employees are not driving roads in private vehicles before and after work. This particular mitigative measure should replace the second measure on page 14 of the draft biological evaluation.

With other activities and studies ongoing in Bear Valley this summer, and those to follow, we feel that this conservation measure will help alleviate potential cumulative impacts to the wolf.

Because of the large number of wolf reports from this key wolf area, the existence of an occupied den site or rendevous site near the project site is possible. Should one be discovered, potential project impacts on the occupied site will be immediately evaluated by the U.S. Fish and Wildlife Service and the Idaho Department of Fish and Game. Changes in the construction schedule may be necessary.

Thank you for the opportunity to comment.

Sincerely yours,

John P. Wolflin
J Field Supervisor

cc: FWS, AFA-SE, Portland
IDFG, Hdqtrs., Boise
IDFG, Region 3, Boise

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

Argonaut Building, Suite 210, 1301 Vista Avenue, Boise, Idaho 83705 / (208) 345-5865

713.0045

April 3, 1986

Shoshone-Bannock Tribes
P. 0. Box 306
Fort Hall, ID 83203

Attention: Mr. Philip Cernera, Fisheries Biologist

Subject: Bonneville Power Administration (BPA) Contract No.' 83-359
Bear Valley Creek Fish Habitat Enhancement Project

Gentlemen:

We are pleased to submit 15 copies of the Construction Report for the Bear Valley Creek Fish Habitat Enhancement Project, Part 3 of 4, FY 1985 Annual Report for BPA Project No. 83-359. This report was prepared, as requested by the Shoshone-Bannock Tribes (Tribes), under Amendment No. 4 to our August 27, 1984 contract. The Construction Report will be submitted to Bonneville Power Administration as a part of the Tribes FY 1985 Annual Report on projects under BPA Contract No. 83-359.

James M. Montgomery, Consulting Engineers, Inc. (JMM) wishes to express its appreciation for the review, technical input, and information provided by Mr. Cernera and Dr. Richard Konopacky of the Tribes Fisheries Department. The JMM project team also wishes to express their gratitude for the patient assistance and guidance on the project by Bear Valley Minerals, Inc., the Bonneville Power Administration, the USDA-Forest Service, the Idaho Department of Fish and Game, and members of the Interagency Task Force.

This report presents a summary of the 1985 construction activities on the patented land in Bear Valley Creek. The construction activities are described, and the project plans and specifications are included. The 1985 monitoring studies results are presented as part of the report. Projections for future construction on the project also are included in the report.

Again, we appreciate all of the assistance and cooperation provided to JMM in conducting this project . We look forward to continue working closely with the

Tribes, Bonneville Power Administration, the agencies represented on the Interagency Task Force, and Bear Valley Minerals, Inc. in successful implementation of this important project in Bear Valley Creek. If you have any questions or comments, please call us at (208) 3455865.

Very truly yours,

Brian D. Liming
Project Engineer/Scientist

Edwin T. Cryer
Project Manager

/ln

Enclosure

BPA PROJECT NO. 83-359
FY 1985 ANNUAL REPORT
PART 3 OF 4

CONSTRUCTION REPORT

BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Prepared by:

James u. Montgomery,
Consulting Engineers, Inc.

Prepared for:

Shoshone-Bannock Tribes
Fisheries Department

Submitted to:

Bonneville Power Administration
Division of Fish and Wildlife

April 1986

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CHAPTER 1

CHAPTER 1

SUMMARY

The Construction Report provides a description of the 1985 construction activities related to implementation of the preferred alternative for stabilizing and enhancing salmonid habitat in Bear Valley Creek, Idaho. Chapter 2 presents an introduction to the report and includes background information and authorization for the project. Construction activities performed during 1985 on the private land along upper Bear Valley Creek are summarized in Chapter 3. The construction summary presented in Chapter 3 includes quantities and costs of the 1985 work. Chapter 4 is comprised of record drawings for the construction work completed in 1985. The project specifications are presented in Chapter 5 and include recommended post-construction modifications based on 1985 experience. Chapter 6 provides a summary of the 1985 monitoring studies including water quality, hydrology, vegetation, soils, and surveying. Projections for completion of the project as presently defined are included in Chapter 7.

CHAPTER 2

CHAPTER 2

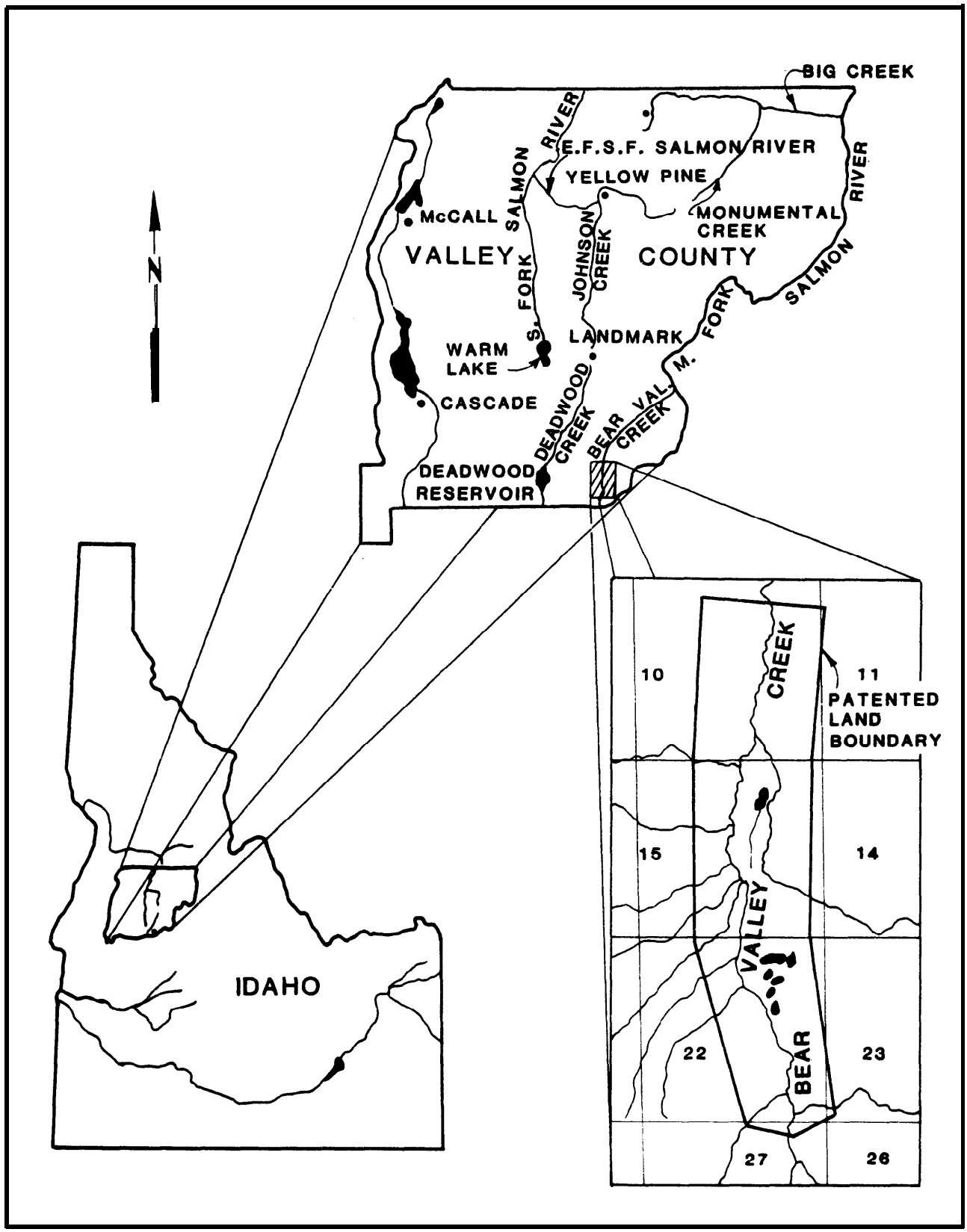
INTRODUCTION

BACKGROUND

The past thirty years have shown a significant decline in the return of chinook salmon and steelhead to their natural spawning areas in Idaho. There are several significant reasons for the loss of this important resource, including the dams on the lower Columbia and Snake and Clearwater Rivers, increased fishing pressures by commercial, sport and subsistence fishermen, reduced flows during critical migration periods, water quality problems, and the continuing destruction of spawning and rearing habitat by natural and human accelerated modification of stream channels and bed substratum. Numerous studies and reports have attempted to quantitatively and qualitatively assess the impacts of the various reported reasons for the observed decline in wild and natural anadromous fish spawning.

Bear Valley Creek, located within the Salmon River drainage of Idaho, has historically been considered one of the most productive spring chinook salmon spawning and rearing streams in the entire Columbia River system. In recent years, portions of Bear Valley Creek have been impacted by soil erosion and sedimentation. The continual problem of sediment production has affected extended areas of downstream spawning and rearing habitat. The primary problem area is the privately held, previously mined lands in the Big Meadows area of the Bear Valley Creek drainage in central Idaho (Figure 2-l). During the period from 1954 to 1959 the patented land in Big Meadows was dredge mined for the strategic minerals columbite and euxenite. The past mining operation incorporated reclamation methods appropriate to the technology of the times, however, the site has increasingly contributed fine, decomposed granitic material from approximately two miles of stream bank. During the past 25 years, the stream has eroded the dredge tailing and undisturbed placer material vertically and horizontally, resulting in the generation of an estimated 500,000 cubic yards of material which has been transported downstream. This material has subsequently been redeposited in the downsteam headwaters of the Middle Fork of the Salmon River, which includes a significant portion of the historical anadromous fish habitat within the Salmon River drainage. Spring chinook salmon redd counts in Bear Valley Creek prior to the 1950's ranged from an estimated 600 to 1200 during each year. The 1984 and 1985 spring chinook salmon redd counts were estimated at 60 and 85, respectively, for Bear Valley Creek. The overall decrease of spring chinook salmon redds in Bear Valley Creek over time has led to identification of the need for preserving the diversity of the gene pool of these wild fish.

The Bear Valley Creek Fish Habitat Enhancement project has been undertaken in conjunction with other concurrent studies that fall under the Salmon River Habitat Enhancement Program funded by the Bonneville Power Administration (BPA). Division of Fish and Wildlife. This program provides offsite enhancement as partial compensation for fish habitat damage and migration problems related to hydroelectric power projects in the Columbia River Basin. The other concurrent studies will evaluate the feasibility of making improvements on the public lands in Bear Valley Creek in order to protect downstream habitat and provide mitigation measures for the problem areas. The project is listed in program measure 704.(d)(l), Table 2 of the Northwest Power Planning Council's 1984 Columbia River Basin Fish and Wildlife Program.



BEAR VALLEY CREEK
FISH HABITAT ENHANCEMENT PROJECT
LOCATION MAP

FIGURE 2-1

The Shoshone-Bannock Tribes (Tribes) have a contract with BPA to study, monitor, and implement the Bear Valley Creek Fish Habitat Enhancement Project. The Tribes are sponsoring this project because the Middle Fork of the Salmon River drainage is part of their traditional subsistence fishing ground, as provided in the Treaty with the Eastern Band Shoshoni and Bannock, 1868 and its amendments. The Tribes have invested significant manpower and resources into various studies and management programs for the protection and enhancement of wild and natural anadromus fish in the Salmon River drainage. The Bear Valley Creek Fish Habitat Enhancement Project is one of the primary habitat protection efforts undertaken by the Tribes. The primary objective of the Bear Valley Creek Fish Habitat Enhancement Project is to develop and implement alternatives which will stabilize upstream erosion problem areas and prevent downstream sedimentation affecting wild anadromous fish spawning and rearing habitat. A secondary objective of the project is to stabilize and enhance Bear Valley Creek throughout the mined area to provide additional wild anadromous fish habitat.

The Bear Valley Creek project is being conducted in cooperation with Bear Valley Minerals, Inc., owners of the 910 acres of patented mining lands within Big Meadows. Bear Valley Minerals, Inc. granted an easement to the Tribes in May 1984 for conducting the feasibility study. A second easement for the construction of sediment control measures was granted to the Tribes in August 1985. Bear Valley Minerals, Inc. has maintained active interest and provided full cooperation throughout the feasibility and implementation stages of the habitat enhancement project.

The Tribes have retained James M. Montgomery, Consulting Engineers, Inc. (JMM) to perform the feasibility study, design, and construction of erosion and sediment control measures for the Bear Valley Creek Fish Habitat Enhancement Project. The initial Bear Valley Creek project output was the Project Work Plan (JMM, November 1984). The Draft Feasibility Report, which addressed all potential alternatives and recommended an alternative for implementation, was submitted to the Tribes in March 1985 (JMM, March 1985). JMM prepared the Selected Alternative Report to summarize the feasibility report and include the recommendations of an Interagency Task Force set up for review of the project (JMM, April 1985). Bear Valley Minerals, Inc. had specific comments on- the Selected Alternative Report pertaining to consideration of future mining on their property, and the Tribes directed JMM to prepare a Preferred Alternative Report addressing potential future mining (JMM, June 1985). These reports completed by JMM were submitted by the Tribes to BP.4 as appended parts of the FY 1984 Annual Report, BPA Project No. 83-359, Salmon River Habitat Enhancement (Shoshone-Bannock Tribes, June 1985).

Design and permitting acquisition phases for the Bear Valley Creek project were conducted during July and August 1985. The initial construction activities were started in Bear Valley during early September 1985. The construction activities were closed for 1985 in early November. The remaining chapters of this report are devoted to the 1985 construction, related field activities, and projected future construction in Bear Valley Creek.

AUTHORIZATION

The Bear Valley Creek, Idaho, Fish Habitat Enhancement Project is being performed by JMM for the Tribes, under BPA contract number 83-359. The project is funded by BPA's Division of Fish and Wildlife as part of the overall effort to

protect, mitigate, and enhance fish habitat and resources impacted by hydroelectric development and operation in the Columbia River Basin. Bear Valley Minerals, Inc. has granted an easement to the Tribes for construction of sediment control and fish habitat enhancement measures on the patented land in Bear Valley.

ABBREVIATIONS

In order to conserve space and improve readability, the following abbreviations have been used throughout this report:

BPA.....	Bonneville Power Administration
cfs.....	cubic feet per second
COE.....	U.S. Army Corps of Engineers
cu yd.....	cubic yard
cu yd/yr.....	cubic yard per year
°C.....	degree centigrade
°F.....	degree Fahrenheit
USFS.....	USDA-Forest Service
ft.....	foot (feet)
fps.....	feet per second
USFWS.....	USDI-Fish and Wildlife Service
HEC.....	Hydrologic Engineering Center
IDFG.....	Idaho Department of Fish and Game
IDWR.....	Idaho Departmen tof Water Resources
JMM.....	James M. Montgomery, Consulting Engineers, Inc.
lin ft.....	linear foot (feet)
man-hr.	man-hour
mi.....	mile
mg/l.....	milligram(s) per liter
ml.....	milliliter
mm.....	millimeter
lb.....	pound
MSL.....	mean sea level
pCi/l.....	pica Curies per liter
SCS.....	USDA-Soil Conservation Service
sq ft.....	square feet
sq mi.....	square mile(s)
sq yd.....	square yard
Sta.....	station
tons/sq mi/yr	tons per square mile per year
tons/yr.....	ton per year
Tribes.....	The Shoshone-Bannock Tribes
USGS.....	USDI-Geological Survey
yr.....	Year

CHAPTER 3

CHAPTER 3

1985 CONSTRUCTION SUMMARY

INTRODUCTION

This chapter provides a summary of the construction work performed in Bear Valley during 198 5. The summary includes a narrative description of the construction activities and a review of actual construction quantities and costs. The information presented in this chapter was developed based on detailed JMM field notes made during the construction phase, the construction contractor's billings and estimated quantities of work, and JMM records of the work completed in the Phase I plans. The 1985 construction summary is presented below.

CONSTRUCTION NARRATIVE

Permitting and Design

The 1985 construction activities in Bear Valley were centered on stabilization of stream banks and mine tailing piles having the greatest potential for continued erosion and sediment production. Permitting and design were necessary steps preceding the actual construction activities. The permitting involved four separate agency permits and/or approvals, as summarized below.

- Stream Channel Alteration Permit, IDWR. This permit was required by the IDWR for construction activity adjacent to the existing stream channel. The stream channel alteration permit was granted for the project on September 13, 1985 with a list of stipulations.

- Permit for Discharge of Dredged or Fill Materials (Sec. 404), COE. This permit was applied for jointly with the Stream Channel Alteration Permit (IDWR), however, the COE determined that no 404 permit was required because there were no plans to place fill exceeding 200 cubic yards below the mean high water mark of the stream. The COE sent a letter to the Tribes and JMM on September 12, 1985 indicating there was no 404 permit required for the Bear Valley Creek project.

- Special Use Permit for Riprap Production and Commercial Hauling, USFS-Boise National Forest, Lowman Ranger District. This permit involved locating a site for riprap production, obtaining approval of Lowman Ranger District personnel on the riprap production site, and posting of a bond to cover reclamation costs for the riprap production area and maintenance of the haul route. The Special Use Permit was approved on September 11, 1985, and included a list of stipulations.

- Informal Consultation (Biological Evaluation) on the Gray Wolf, USFWS. Section 7 of the Endangered Species Act of 1973 and amendments requires consultation with wildlife management and enforcement agencies when any action may affect the existence of threatened or endangered species. The Gray Wolf, an endangered species, is thought to inhabit portions of Bear Valley during the spring

months of each year. JMM completed an informal consultation through contacts with the USFWS, USFS, and IDFG, and by analyzing existing data on potential wolf sightings in the Bear Valley area. The informal consultation was approved by the USFWS in a letter to the Tribes and JMM dated August 30, 1985. The biological evaluation was finalized on October 29, 1985.

Design of the project was adapted from the concepts presented in the Preferred Alternative Report (JMM, June 198%. These concepts included construction of a floodplain sized to convey the estimated 100 year snowmelt runoff flow without contributing sediment to the stream. The floodplain width was initially set equal to the pre-mining meander belt width of the stream and then was verified using the HEC-2 backwater curve computer model. The new floodplain would be stabilized with vegetation, and the outside edge of the floodplain would consist of a heavy riprap blanket and incorporation of slope stabilization methods. One of the primary criteria for the design was that it be self maintaining.

The design effort was started in mid-July, 1985 and JMM was directed by BP-4 and the Tribes to &maximize field engineering under a "time and materials" type contract with the construction contractor. JMM was retained by the Tribes to function as the general contractor and engineer for the project, allowing some decisions to be made by the field engineer. JMM maintained a field engineer at the site throughout the duration of construction activity in Bear Valley. The design was completed in early September 1985. The Phase I plans for construction of the improvements along Bear Valley Creek, including a record of the work completed in 1985, are presented in Chapter 4 of this report.

General Construction Details

The Bear Valley Creek project site is located in Valley County, Idaho, approximately 17 road miles north of Lowman and 100 road miles north of Boise (see location map on record drawings, Chapter 4). The project site has an elevation of 6650 feet MSL and is typical of depositional environments associated with the Idaho batholith. The depositional materials found on the construction site include clay, silt, sand, gravel, and cobble derived from the granitic batholith bedrock. The construction site has gently sloping topography (see record drawings, Chapter 4). During the 1985 below-average water year, ground -water was encountered within the construction zone. The construction activity was started on September 9, 1985 and stopped on November 8, 1985. The weather during this period included sunny, cool days, and several significant snowstorms leaving up to 16 inches of snow on the site.

JMM contracted Alan Hess Construction of LakeFork, Idaho, to perform the construction work on the Bear Valley Creek project. Alan Hess Construction was selected by JMM through an analysis of competitive labor and equipment rates submitted by two contractors. The employees of Alan Hess Construction were housed in Lowman 17 miles from Bear Valley Creek, and they commuted by vehicle to and from the project site each day. The contractor maintained a five day work week throughout most of the 1985 construction activity. The construction contractor also maintained a night and weekend security -watch throughout the project. The contractor's staging area (see record drawings, Chapter 4) included an office trailer, a supply van, a fuel storage tank, and a parking area for wheeled construction equipment. The types of construction equipment used

by Alan Hess Construction on the Bear Valley Creek project during 1985 are listed below.

- tracked excavator, l-l/4 cu yd bucket
- D8 equivalent bulldozer
- D7 equivalent bulldozer
- D3 equivalent bulldozer
- wheeled frontend loader, 4 cu yd bucket
- end dump truck, 12 cu yd
- road grader
- tree skidder
- service truck
- chain saw
- water pump, 3 inch and 4 inch
- power generator

Construction Activities

The construction activities were started with surveying and construction staking performed by JMM subcontractor Howard L. Myers Co. of Boise. The construction staking included location of permanent reference points, and baseline, slope, daylight, and reference point staking from Sta. 56+00 left to Sta. 74+00 left (see record drawings, sheets 6 and 7, Chapter 4). The reference point stakes also provided the limits of clearing for the contractor. Site clearing was performed after completion of the construction staking, and lodgepole pine trees growing on the site were cleared and stockpiled as shown on the record drawings (Chapter 4).

The riprap exploration was one of the first construction activities of the 1985 season for the Bear Valley Creek project. The initial riprap site selected for exploration did not contain the volume of rock as had originally been projected. A second riprap site was located in the vicinity of the initial riprap site. The first riprap exploration site was recontoured and reclaimed. Access to the second riprap site involved construction of 1.1 miles of road at an average six percent grade. The riprap from this site is mostly within the gradation listed in the construction specifications (Chapter 5). The riprap rock is comprised of andesite, a durable and hard volcanic intrusive into Idaho batholith. After completion of the access road, riprap was loaded into end dump trucks and transported to the stream construction site throughout the 1985 season. A riprap stockpile was developed to store the rock until it could be installed later during the 1985 construction season.

Excavation of soils from Sta. 56+OO left to Sta. 74+00 left along Bear Valley Creek was conducted during the period September 16 through mid-October, 1985. The excavation was performed as part of the floodplain construction effort. An example of the excavation work is presented by the photographs shown in Figure 3-l. The excavation work was performed by tracked excavators, bulldozers, and a front end loader. The material was removed in zones down to the finished floodplain grade. Ground water was intercepted at several places in the excavated floodplain, and the JMM field engineer made a decision to raise the finished grade of the floodplain in an effort to keep the water from running over the soil surface and into the stream.

Photo A

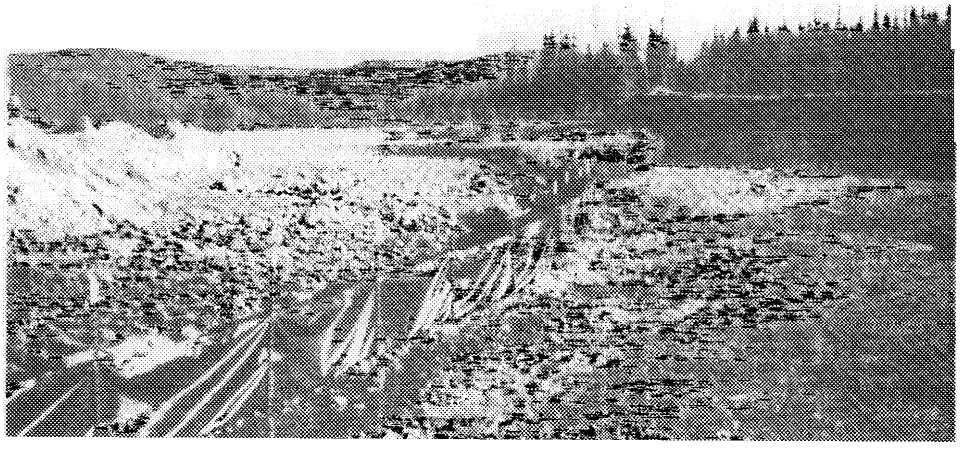


Photo B

Figure 3-1. Photo A: Bear Valley Creek project site at Sta. 57+00 left prior to construction. Bear Valley Creek meanders through a "canyon" of exposed granular soils. Soil materials on left side of stream will be removed as part of floodplain construction in 1985.
Photo B: Bear Valley Creek project site at Sta. 57+50 left during construction. Majority of floodplain excavation is completed. Black silt fence along stream channel is a temporary measure designed to contain the excavated soils and keep sediment out of the stream.

The black fence or silt fence shown between the excavation area and the stream in Photo B, Figure 3-1, was a temporary installation used to prevent excavated soils from entering the stream. The silt fence also acted as a barrier to the contractor to help keep equipment and construction activity out of the stream. During several rainstorms, the silt fence was observed to detain turbid runoff from the construction site and pass clean, clear water droplets out the other side of the fence into the stream. The silt fence material is comprised of polypopylene woven monofilament, and was attached to five foot metal fence posts with nylon electrician ties.

The material excavated from the left bank of Bear Valley Creek, Sta. 56+00 to Sta. 74+00, was deposited away from the existing low flow stream channel. The granular materials were used to construct a berm that defines the edge of the new constructed floodplain. The berm extends from Sta. 62+00 left to Sta. 74+00 left, where it is tied into an existing earthen dike remaining from previous mining activity. Topsoil excavated from the site, including most of the existing dike, was stockpiled at Sta. 60+00 for use later in final reclamation of disturbed areas. Muck excavated from several places in the new floodplain was transported to a dredge depression which has no surface outlet to the stream. A portion of the existing earthen dike is shown in Figure 3-2, with before and after photographs of this phase of the floodplain construction. The vegetated area to the left of the “dike island” in Photos A and B was not excavated because it is already at the finished grade of the floodplain. This vegetated area will function as an important center of distribution for seeds in the natural, long term revegetation of the floodplain.

The completion of floodplain excavation coincided with the beginning of riprap placement along the toe of the 3:1 slope defining the floodplain. A trench was excavated to a depth of four feet below the existing invert of the Bear Valley Creek channel. Water filling the trench was pumped up the 3:l slope and into an area away from the stream. A layer of nonwoven filter fabric was laid into the trench, and riprap from the stockpile was installed using a front end loader and an excavator. The riprap layer is approximately two and one half feet thick and twelve feet deep at a 2:1 slope toward the active stream channel. The finished floodplain was graded to intercept the riprap layer. The riprap layer extends under the floodplain to prevent any future meanders of Bear Valley Creek from eroding the 3:l slope. The riprap layer is shown in Figure 3-3, Photo B. Photo A shows the stream bank at the same point before floodplain construction and stabilization.

The construction floodplain was seeded, fertilized, and stabilized with an erosion control blanket. The seed mixture is comprised of high altitude grasses and other vegetation adapted to growing in wet soils similar to those of the floodplain. The erosion control blanket consists of wood excelsior fibers woven into a mat and covered with a biodegradable nylon mesh. The erosion control blanket functions as a mulch, retains moisture, traps soil particles, and reflects sunlight, all of which help promote vegetation growth. The erosion control blanket was installed in an overlapping manner and secured to the ground with metal U-shaped clips nine inches long. The edge of the erosion control blanket next to the stream was buried in a trench throughout the length of the stabilization floodplain. Floodplain stabilization using this method is shown in Figure 3-3 (Photo B).

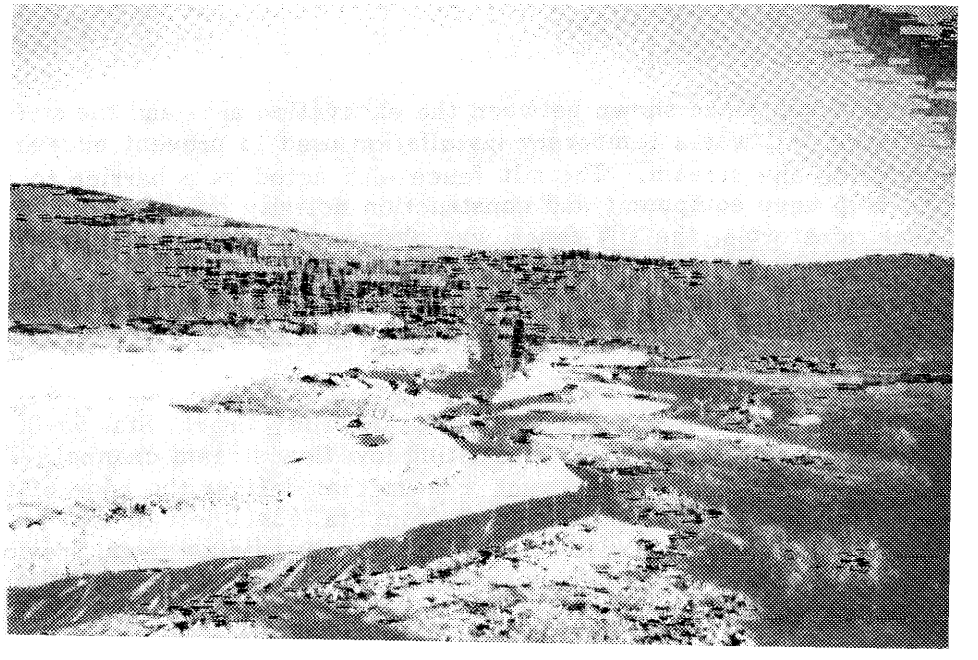


Photo A

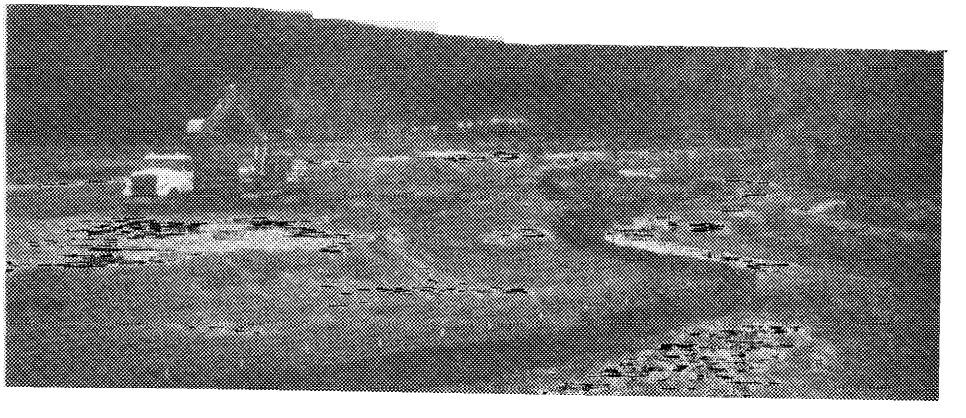


Photo B

Figure 3-2. Photo A: Bear Valley Creek meanders past an eroded section of an earthen dike at Sta. 64+00. The dike was originally constructed as part of the 1950's mining operation.
Photo B: The eroded section of earthen dike at Sta. 64+00 has been excavated as part of the floodplain construction. The meander pattern of Bear Valley Creek has not been modified by the construction activity, however, the stream is more visible because of the floodplain excavation.

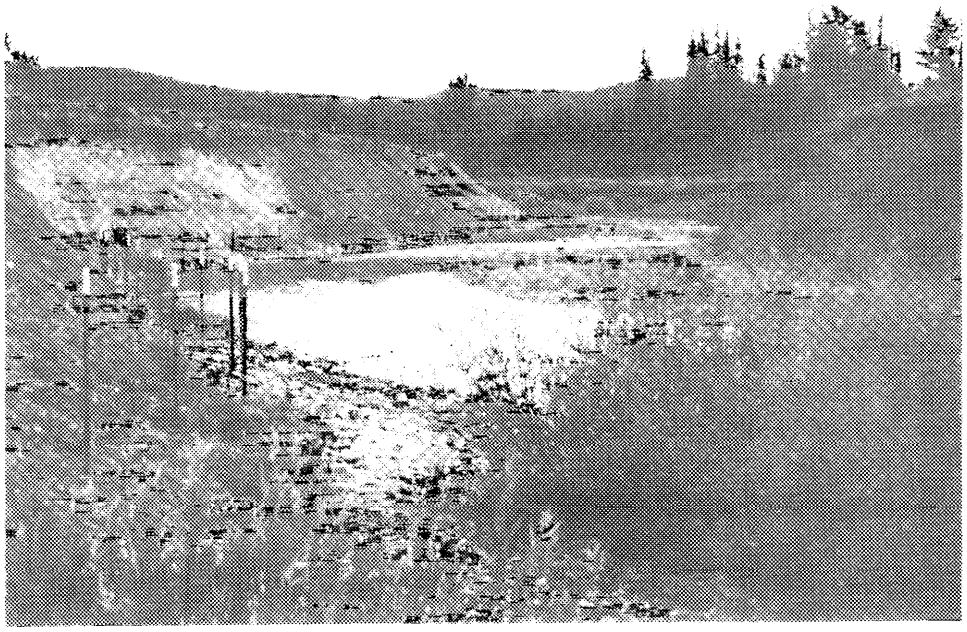


Photo A

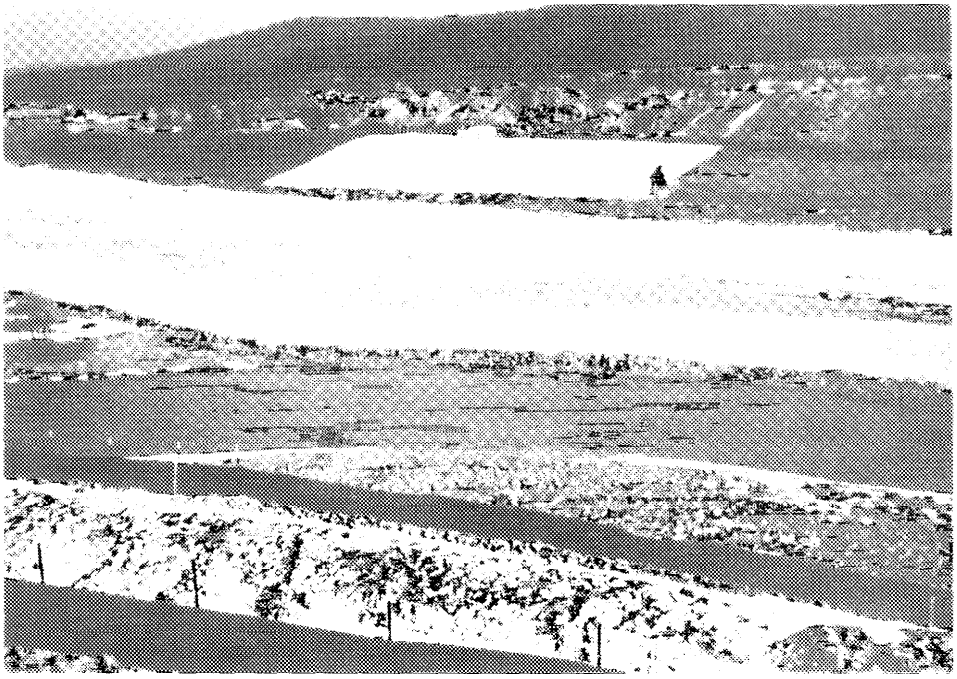


Photo B

Figure 3-3, Photo A: Upstream (south) view of Bear Valley Creek at Sta, 60+00 left before start of construction, Note willow bushes in foreground.
Photo B: View across Bear Valley Creek (booking east) at Sta, 60+00 left near end of 1985 construction activity. Biodegradable erosion control blanket (light tan color) is installed over seeded and fertilized soil on new floodplain, Slope at outside edge of floodplain is seeded and stabilized with erosion control blanket (center) and geotextile matting (black material at left), Layer of riprap installed at toe of 3:1 slope extends underneath floodplain for protection against bank erosion from potential stream meandering and flooding during the peak flow of snowmelt runoff, Willow bushes at far left are same as in Photo A,

The 3:l slope above the floodplain and riprap layers was seeded, fertilized, and stabilized with the erosion control blanket. An additional layer of geotextile matting was applied to help prevent erosion of the 3:l slope. The geotextile matting is comprised of flexible monofilament nylon formed into an open mesh. The geotextile matting was applied directly over the erosion control blanket and secured with 24 inch long wooden stakes. The top edges of the geotextile matting and erosion control blanket were buried in a trench along the crest of the 3:l slope. A one inch layer of topsoil was spread over the top of the geotextile matting and the area was reseeded to help promote revegetation. The geotextile matting functions as a substrate for holding roots into the soil and also allows water to flow freely out of the soil. The application of geotextile matting as part of the 3:l slope stabilization is shown in Figure 3-3.

Special problems encountered during the construction included naturally deposited fine sediments forming muck within the constructed floodplain, and temporary failure of the berm due to pumping of the fill by loaded heavy equipment. The muck was excavated to a maximum depth of eight feet below the invert of the stream channel and refilled with the granular, well drained soils found in adjacent areas of the floodplain. The mucked out area was approximately 40 feet wide and 200 feet long. The fill provided a solid base for the construction equipment, and any future meanderings of the stream into this area will encounter only sand, gravel, and cobble materials instead of muck and fine sediments. The berm failure was treated in a similar manner as the area of deposited fine sediments. The "pumped" area was excavated and the mud and saturated soil materials were disposed of out away from the stream. The excavated area was filled with fresh granular material, and then overlayed with filter fabric. Additional lifts of granular material were placed over the filter fabric and the fill was wheel compacted resulting in stabilization of the berm.

The soil stabilization measures employed in Bear Valley during 1985 are considered by JMM to be state-of-the-art, however, their use is experimental. JMM conducted numerous telephone interviews and researched applications of the soil stabilization materials prior to the 1985 construction. All information provided to JMM by manufacturers and their previous clients indicate that the Bear Valley project has employed proper use of the soil stabilization materials. Soil stabilization through use of these materials has not yet been proven in Bear Valley, and until further observations can be made, these erosion control measures are not recommended for blanket use on other similar projects without careful consideration. JMM will monitor the success (or failure) of the 1985 soil stabilization measures throughout 1986 and may make adjustments in future construction at the Bear Valley project based on field observations.

CONSTRUCTION QUANTITIES

The construction quantities resulting from the 1985 work on the Bear Valley Creek project are summarized in Table 3-l. Each construction item shown in Table 3-l is numbered and described, and the quantity of work is reported with the appropriate unit of measurement. The primary construction activity was conducted on the left bank of the project area (see record drawings, Chapter 4) from Sta. 56+OO to Sta. 74+00.

The nonrecoverable owner-furnished materials installed at the Bear Valley Creek project site during the 1985 construction season are summarized in Table 3-2.

TABLE 3-l

SUMMARY OF 1985 CONSTRUCTION QUANTITIES
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Item	Description	Quantity	Unit of Measurement
1.	Equipment mobilized	25	load
2.	Equipment demobilized	25	load
3.	Stream site area cleared	4.5	acre
4.	Area of initial riprap exploration	0.5 ±	acre
5.	Area cleared of timber for riprap road and production site	4.5	acre
6.	New road construction for riprap production and transport	1.1	mi
7.	Riprap produced and transported to stockpile	3,900 ±	cu yd
8.	Excavation of granular soils from floodplain	17,500 ±	cu yd
9.	Excavation, salvage, and stockpile of topsoil	3,000 ±.	cu yd
10.	Excavation and disposal of muck	1,000 ±	cu yd
11.	Silt fence installed with posts at five foot centers	3,700	lin ft
12.	Silt fence removed (fabric and posts)	1,650	lin ft
13.	Silt fence removed (fabric only; post left in place)	1,500	lin ft
14.	Silt fence fabric reinstalled (posts already in place)	200	lin ft
15.	Material placed in berm and site roadways	17,000	cu yd
16.	12 in. diameter CMP installed for site drainage	80	lin ft
17.	12 in. diameter CMP removed from site	20	lin ft
18.	Excavation for riprap installation	1,500	cu yd
19.	Filter fabric installed in riprap trench	4,200	sq yd
20.	Riprap installed at toe of 3:l slope defining floodplain	1,650	cu yd
21.	Length of riprap installation at edge of floodplain	1,175	lin ft
22.	Floodplain and 3: 1 slope seeded	4.0	acre
23.	Floodplain and 3:l slope fertilized	3.5	acre
24.	Erosion control blanket installation on floodplain and 3:l slope (net)	12,400	sq yd
25.	Edge of erosion control blanket buried along stream	1,890	lin ft
26.	Geotextile matting installation on 3:l slope (net)	2,390	sq Yd
27.	Edge of geotextile matting and erosion control blanket buried along top of 3:l slope	925	lin ft
28.	Topsoil spread 1 in. to 2 in. deep over geotextile matting	2,400	sq yd

These materials include seed, fertilizer, filter fabric, erosion control blanket and anchoring staples, and geotextile matting and wood anchoring stakes. The summary provided in Table 3-2 includes the description, quantity, and unit of measurement for each of the materials. Additional quantities of the materials listed in Table 3-2 were purchased in anticipation of installation during 1985. These materials were transported to Boise at the close of the 1985 construction season and are in temporary storage at a Boise warehouse until they can be used during summer 1986 construction at the Bear Valley Creek project site.

The 1985 construction quantities completed represent approximately 60 percent of the work required to stabilize both sides of Bear Valley Creek from Sta. 56+00 to Sta. 74+00 (see record drawings, Chapter 4). Approximately 27 percent of the currently defined construction work from Sta. 37+00 to Sta. 74+00 was completed during the 1985 construction effort.

CONSTRUCTION COSTS

Construction costs for the 1985 work performed at the Bear Valley Creek project site are summarized in Table 3-3. The project elements shown in Table 3-3 are numbered and referenced to items in Tables 3-1 and 3-2. Each project element listed in Table 3-3 is described, and total cost of the element is presented with the unit cost and unit of measurement. The total cost of 1985 construction including contractor's charges, materials purchase, and JMM field engineering/construction management was $321,003. JMM purchased additional construction materials during 1985 that will be used in 1986 construction activities at the Bear Valley Creek project site. These additional materials, including erosion control blanket, geotextile matting, and filter fabric, were purchased at a total cost of $30,176.

The unit costs for the 1985 construction work were affected by the weather and site conditions experienced in Bear Valley during September, October and November. Snowfall in excess of 12 inches was observed from four separate storms during the 1985 construction season. The snowfall and below freezing temperatures slowed the enhancement work by decreasing construction efficiency. Project elements with higher unit costs resulting from decreased construction efficiency include riprap production and transport, excavation, riprap installation, and erosion control blanket installation. Unit costs for these project elements are expected to improve during the 1986 construction season, provided the work begins in mid-July and ends in mid-October.

The 1985 unit costs for construction (Table 3-3) were all within 20 percent of the estimated pre-construction unit costs presented in Table 5-2 of the Preferred Alternative Report (JMM, June 1985). Some of the estimated pre-construction unit costs were calculated using different units of measurement than shown in Table 3-3. The estimated pre-construction unit costs also include the materials costs. The 1985 unit costs presented in Table 3-3 are broken out for labor (construction, installation, etc.) and materials. However, calculation of the unit costs for the same unit of measurement and to include materials indicates that the 1985 actual unit costs were in the range of pre-construction estimates of unit costs. Differences between the actual and estimated unit costs may be attributed to the late start of construction, the short construction period, unknown construction conditions, and severe weather conditions.

TABLE 3-2

SUMMARY OF NONRECOVERABLE OWNER*-FURNISHED MATERIALS
INSTALLED DURING 1985 CONSTRUCTION SEASON
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Item	Description	Quantity	Unit of Measurement
1.	Seed mixture (high altitude, wet condition)	250	lb
2.	Fertilizer (16-N, 16-P, 16-Potash)	2,000	lb
3.	Filter fabric beneath riprap (544 sq yd/roll)	7.75	rolls
4.	Filter fabric in berm (166 sq yd/roll)	0.50	rolls
5.	Erosion control blanket (80 sq yd/roll)	177	rolls
6.	Staples for anchoring erosion control blanket (1,000/box)	16	boxes
7.	Geotextile matting (173 sq yd/roll)	16	rolls
8.	Wood stakes for anchoring geotextile matting (100/bundle)	18	bundles

*Owner is the Shoshone-Bannock Tribes. These materials were purchased by JMM for the Shoshone-Bannock Tribes.

TABLE 3-3

SUMMARY OF 1985 CONSTRUCTION COSTS
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Item	Item Reference to Table 3-l	Description of Project Element	Element Cost ($)	Unit of Measurement	Unit Cost ($)
1.	1,2	Mobilization/Demobilization	$ 11,825	load	237
2.	3	Site clearing	3,264	acre	725
3.	4	Riprap exploration initial site, recontour, reclamation	2,134	acre	4,268
4.	5,6	Riprap roadway development	16,273	mi	14,794
5.	7	Riprap production and transport to stockpile	61,006	cu yd	15.64
6.	8,9,10,15	Excavation (incl. placement, stockpile, disposal)	56,997	cu yd	2.65
7.*	11,12,13,14	Silt fence (install, remove, partial re-install)	4,378	lin ft	1.18
8.**	18,19,20,21	Riprap installation	41,030	cu yd	24.87
9.**	22,23	Seeding and fertilization (floodplain and 3: 1 slope)	1,144	acre	286
10.**	24,25	Erosion control blanket installation	8,888	sq yd	0.72
11.**	26,27	Geotextile matting installation	4,554	sq yd	1.91
12.	28	Topsoil spreading	917	sq yd	0.38
13.	incl. 16,17	General site maintenance, security, night	30,382	ls	30,382
14.	—	Project superintendence (contractor)	8,621	day	187
15.	-	Temporary stabilization measures	3,269	ls	3,269
		Subtotal A	$254,682		
	Item Reference to Table 3-2				
17.	1	Seed mixture	$ 381	lb	1.52
18.	2	Fertilizer	412	lb	0.21
19.	3	Filter fabric (riprap)	3,018	roll	389
20.	4	Filter fabric (berm)	248	roll	496
21.	596	Erosion control blanket and staples.	6,855	roll	38.73
22.	778	Geotextile matting and stakes	11,702	roll	731
23.***	-	Silt fence fabric, posts, ties	3.666	lin ft	0.99
		Subtotal B	$ 26,282		
24.	-	JMM field engineering/construction management and monitoring	$ 37,247	day	810
25.	-	Other JMM direct costs for project	2,792	ls	2,792
		Subtotal C	$ 40,039		
		TOTAL A,B,C	$321,003		

*Does not include recoverable/reusable materials.
**Does not include nonrecoverable materials.
***Reusable materials, unit cost for 1985.

CHAPTER 4

CHAPTER 4

PROJECT RECORD DRAWINGS

This chapter provides a copy of the record drawings (see pocket) for Phase I Construction of the Bear Valley Creek Fish Habitat Enhancement Project. The record drawings were adapted from the plans developed for the 1985 construction season. All construction work completed during 1985 is indicated on the record drawings. The presently defined remaining construction activities also are shown on the record drawings as plans for future phases of the project. The Phase I plans were incorporated into the agreement for services (subcontract) between JMM and the construction subcontractor. The plans (and specifications provided in Chapter 5) served to define the construction work for the Bear Valley Creek project.

There are eight sheets included in the record drawings for the Phase I construction. Sheet 1 contains the title, location map, general notes, summary of quantities, and sheet index. The project key map comprising Sheet 2 shows the coverage of Sheets 4, 5, 6, and 7, and provides general locations of access routes and stockpile, spoil, contractor's staging, and riprap source areas. Sheet 3 is a base map for the bridge and dike modifications, which were not designed as part of Phase I. Sheets 4 and 5 are the plans for construction of the floodplain from Sta. 37+00 to Sta. 56+00. The 1985 construction activity did not include any of the work shown on Sheets 4 and 5. The primary work effort conducted in 1985 was directed to the areas shown on Sheets 6 and 7, Sta. 56+00 to Sta. 74+00 (left). The construction activities completed in 1985 are indicated with notes and graphics on Sheets 6 and 7. Typical construction details are included on Sheet 8 of the record drawings. The entire set of record drawings for the 1985 construction of the Bear Valley Creek project are included in the pocket following this page.

CHAPTER 5

CHAPTER 5

PROJECT SPECIFICATIONS

Specifications for the 1985 construction of the Bear Valley Creek Fish Habitat Enhancement Project are presented in this chapter. The specifications are comprised of the General Conditions (sections 1.01 - 6.12), the Technical Provisions (sections 101.01 - 190.03), and the Technical Specifications (sections 200-2O3). The General Conditions include sections on definitions, specifications and drawings. engineer-owner-contractor relations, materials and Iworkmanship, progress and payment, and bonds, insurance, legal responsibility, and public safety. The Technical Provisions include sections on general requirements, mobilization, contractor submittals, quality control, temporary construction facilities, site access, environmental controls, field office facilities, protection and restoration of existing facilities, and project closeout. The Technical Specifications include sections on site preparation, earthwork, riprap, and erosion control fabrics. The Technical Specifications have been modified based on 1985 project experience. These modifications to the Technical Specifications are shown in bold type and represent a refinement of the 1985 technical specifications for use in construction during 1986 and subsequent years.

The specifications were incorporated into the agreement for services (subcontract) between JMM and the construction subcontractor. The specifications (and plans provided in Chapter 4) served to define the construction work for the Bear Valley Creek project. The remainder of this chapter is comprised of the specifications developed for the Bear Valley Creek project.

CONDITIONS OF THE CONTRACT

GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS

1.01 OWNER

The word 'Owner" shall mean the Shoshone-Bannock Tribes, and who are referred to throughout the Contract Documents as singular in number and masculine in gender. The term Owner shall mean the Owner or his authorized representative, James M. Montgomery, Consulting Engineers, Inc. All necessary action by Owner pertaining to the Contract will be taken by the Owner representative empowered to act on behalf of the Owner.

1.02 ENGINEER

The word "Engineer" shall mean the individual or individuals authorized by the Owner to oversee the field execution of the work of this Contract. The responsibility of the Engineer under this Contract shall be limited and does not include responsibility for the superintendence of construction processes, site conditions, operations, equipment, personnel, or the maintenance of a safe place to work or any safety in, on, or about the site of the work.

1.03 CONTRACTOR

The word 'Contractor" shall mean the party entering into Contract with the Owner as his authorized representative for performance of the work called for in the Contract Documents, including the Contractor's authorized agents.

1.04 SUBCONTRACTOR

The word "Subcontractor" shall mean any person, firm, or corporation entering into agreement with a Contractor who has a contract with the Owner or the authorized representative for performance of any part of the Contractor's obligation under the Contract, and whose contractual obligations are with the Contractor and not with the Owner.

1.05 CONTRACT

The word "Contract" shall mean the agreement between the Owner and the Contractor and the subcontractor for the satisfactory performance of the construction work indicated on the drawings and specified herein and the consideration therefor, all as evidenced by the Contract Documents.

1.06 CONTRACT DOCUMENTS

The Contract Documents shall comprise the following documents: Agreement, Payment Bond, General Conditions, Technical Provisions, Drawings, Construction Specifications, and all addenda pursuant to the provisions of the Contract.

1.07 SPECIFICATIONS

The word 'Specifications' shall mean that portion of the Contract Documents comprising the General Conditions, Technical Provisions, Construction

Specifications and all addenda and change orders executed pursuant to the provisions of the Contract.

1.08 DRAWINGS; CONTRACT DRAWINGS

The words "Drawings" or "Contract Drawings" shall mean that portion of the Contract Documents comprising all drawings, plans, maps, profiles, diagrams, or other graphic representation delineating the location, nature, extent, and form of the work, together with applicable details and all addenda executed pursuant to the provisions of the Contract.

1.09 NOTICE TO PROCEED

The words "Notice to Proceed" shall mean the written notice issued by the Owner to the Contractor authorizing him to proceed with the work.

ARTICLE 2 - SPECIFICATIONS, DRAWINGS, AND RELATED DATA

2.01 INTENT OF CONTRACT DOCUMENTS

The intent of the Contract Documents is that the Contractor furnish labor, materials, equipment, and services, except as may be specifically noted otherwise, which are required or necessary to fully complete the work.

2.02 MATERIALS

Specific Owner-furnished materials for completing this project will include and be limited to the following:

geotextile fabric (enkamat)
erosion control blanket (curlex)
filter fabric
silt fencing (complete)
seed
fertilizer
project signs

2.03 SPECIFICATIONS AND DRAWINGS COMPLEMENTARY

The Specifications and Drawings are complementary and what is called for in one shall be as binding as if called for in both.

2.04 DISCREPANCIES IN THE CONTRACT DOCUMENTS

Any discrepancies, conflicts, errors, or omissions found in the Contract Documents shall be promptly reported to the Engineer who will issue a correction in writing. The Contractor shall not take advantage of any such discrepancies, conflicts, errors, or omissions, but shall comply with any corrective measures regarding the same prescribed by the Engineer.

2.05 ORDER OF PRECEDENCE OF CONTRACT DOCUMENTS

In resolving conflicts resulting from conflicts, errors, or discrepancies in any of the Contract Documents, the order of precedence after the direction of the engineer shall be as follows:

1. Agreement
2. Specifications
3. Drawings

Within the Specifications the order of precedence is as follows:

1. Addenda
2. General Conditions
3. Technical Provisions
4. Construction Specifications

With reference to the Drawings the order of precedence is as follows:

1. Figures govern over scaled dimensions
2. Detail drawings govern over general drawings
3. Addenda govern over Contract Drawings

ARTICLE 3 - ENGINEER-OWNER-CONTRACTOR RELATIONS

3.01 ENGINEER'S AUTHORITY

(a) The Engineer shall have final technical authority on matters concerning (1) the quality and acceptability of materials and equipment furnished to meet the provisions of the Contract Documents; (2) acceptability of the rate of progress of the work; and (3) review of quantities of work performed by the Contractor for pay purposes.

3.02 LEGAL ADDRESS OF CONTRACTOR

The Contractor shall designate the place to which all notices, letters, and other communications to the Contractor will be mailed or delivered. The mailing or delivering to said address of any notice, letter, or other communication shall be deemed sufficient service thereof upon the Contractor. The date of such service shall be the date of such mailing or delivery. Said address may be changed at any time by a written notice signed by the Contractor and delivered to the Engineer.

3.03 CONTRACTOR'S DAILY REPORTS

Except where otherwise provided, the Contractor shall complete a daily report indicating manpower, major equipment, subcontractors, etc., 'involved in the performance of the work. The daily report shall be completed on forms prepared by the Contractor and approved by the Engineer, and shall be submitted to the Engineer at the conclusion of each work day.

3.04 RIGHTS-OF-WAY

(a) Lands or rights-of-way for the work to be constructed under the Contract will be provided by the Owner as shown on the Drawings. Nothing contained in the Contract Documents shall be interpreted as giving the Contractor exclusive occupancy of the lands or rights-of-way provided. The Owner shall not be liable for any claims or damages resulting from the Contractor's unauthorized trespass or use of any other properties.

(b) The Contractor shall not do any work that would affect any fence; or any other structure, nor shall the Contractor enter upon the rights-of-way involved until notified by the Engineer that authority therefor has been secured from the proper party. After authority has been obtained, the Contractor shall give said party due notice of his intention to begin work.

(c) Lands to be furnished by the Owner for construction operations, rip rap production, roads, and other purposes will be specifically shown on the drawings or provided for in the Technical Provisions. Should the Contractor find it necessary to use any additional land for his or for other purposes during the construction of the work, he shall provide for the use of such lands at his own expense.

3.05 CONTRACTOR'S OBLIGATIONS

(a) The Contractor shall perform all labor and services and furnish all the materials, tools, and appliances, except as hereinafter otherwise definitely

provided, necessary or proper for performing and completing the work required by the Contract Documents, in the manner and within the time stipulated in the Technical Provisions. He shall furnish, erect, maintain, and remove the construction plant and such temporary works as may be required. The Contractor alone shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods, and for any damage which may result from their failure or their improper construction, maintenance, or operation. All the labor and materials shall be performed and furnished strictly pursuant to and in conformity with the Contract Documents, the lines and grades and other directions of the Engineer as given from time to time during the progress of the work under the terms of the Contract, and in accordance with working drawings to be furnished from time to time as provided herein. The Contractor shall complete the entire work in accordance with the Contract Documents and at the prices fixed in the Contract.

(b) A technically qualified supervisor or superintendent, shall be designated in writing as the Contractor's representative at the site, and who shall supervise or superintend the work and shall provide competent supervision of the work until its completion. The supervisor or superintendent shall have full authority to act in behalf of the Contractor; and all directions given by the Engineer to said supervisor or superintendent shall be considered as having been given to the Contractor. If said supervisor or superintendent is not present on that part of the work where the Engineer desires to give instructions, such instructions may be given by the Engineer to the foreman in charge of the particular work to which the instructions apply. Such instructions given to a foreman likewise shall be considered given to the Contractor. Such instructions given by the Engineer to the said supervisor or superintendent or to a foreman, will be confirmed in writing. All instructions and directions given by the Engineer will be limited to matters properly falling within the Engineer's authority as specified in Paragraph 3.01, herein.

(c) The Contractor's supervisor or superintendent shall be present at the site of the work at all times while work under the Contract is in progress. Failure to observe this requirement may be considered as suspension of the work by the Contractor, until such time as such supervisor or superintendent is again present at the site. No additional payment will be allowed for any costs to the Contractor of slowdown, delays, idled equipment, or any other costs incurred by the Contractor as the direct or indirect result of such suspension. If in the normal conduct of the business of the Contractor it may become necessary for the designated supervisor or superintendent to leave the site of the work for any reason, the Contractor shall provide an authorized alternate, and a written notice thereof shall be provided to the Engineer prior to any such absence.

3.07 INSPECTION AND TESTING

(a) All materials furnished and all work performed under the Contract shall be subject to review by the Engineer. The Engineer shall be permitted access to all parts of the work, and shall be furnished with such materials, information and assistance by the Contractor and his subcontractors and suppliers as is required to make a complete and detailed inspection.

(b) Work done in the absence of prescribed inspection may be required to be removed and replaced under the proper inspection, and the entire cost of removal and replacement, including the cost of all materials which may be furnished by the Owner and used in the work thus removed, shall be borne by the Contractor, regardless of whether the work removed is found to be defective or not. Work covered up without the authority of the Engineer, shall, upon order of the Engineer, be uncovered to the extent required, and the Contractor shall similarly bear the entire cost of performing all the work and furnishing all the materials necessary for the removal of the covering and its subsequent replacement.

(c) Except as otherwise provided herein, the cost of review and inspection will be paid by the Owner. All inspection fees imposed by the U.S. Forest Service shall be paid by the Contractor and reimbursed by the Owner.

(d) The Engineer will make, or have made, such inspections and tests as he deems necessary to see that the work is being accomplished in accordance with the requirements of the Contract. In the event such inspections or tests reveal non-compliance with the requirements of the Contract, the Contractor may be required to bear the cost of such corrective measures deemed necessary by the Engineer, and shown to be the result of improper workmanship on the part of the Contractor as well as the cost of subsequent reinspection and retesting.

3.08 ASSIGNMENT FORBIDDEN

The Contractor shall not assign, sublet, sell, transfer, or otherwise dispose of the Contract or any portion thereof, or his right, title, or interest therein, or his obligations thereunder, without the written consent of the Owner. If the Contractor violates this provision, the Contract may be terminated at the option of the Owner. In such event, the Owner shall be relieved of all liability and obligations to the Contractor and to his assignee or transferee , growing out of such termination.

3.09 SUBCONTRACT LIMITATIONS

(a) Pursuant to the Supplemental General Conditions, subcontracts will be permitted to such extent as shall be shown to be necessary or advantageous to the Contractor in the prosecution of the work and without injury to the Owner's interests. Each subcontractor shall be properly licensed for the type of work which he is to perform.

(b) A copy of each subcontract, if in writing (or if not in writing, then a written statement signed by the Contractor giving the name of the subcontractor and the terms and conditions of each subcontract), shall be filed promptly with the Engineer upon the Engineer's request. Each subcontract shall contain a reference to the Agreement and the General and Supplemental General Conditions of the Contract between the Owner and the Contractor, and the terms of said agreement and conditions of the Contract shall be made a part of each subcontract insofar as applicable to the work covered thereby. Each subcontract shall provide for annulment of same by the Contractor upon written order of the Engineer, if, in the Engineer's opinion, the Subcon-

tractor fails to comply with the requirements of the prime Contract insofar as the same may be applicable to this work.

(c) The Contractor shall be responsible for the acts and omissions of his subcontractors and their employees to the same extent as he is responsible for the acts and omissions of his own employees. Nothing contained in this Section shall create any contractual relationship between any subcontractor and the Owner nor relieve the Contractor of any liability or obligation under the prime Contract.

3.10 TEMPORARY SUSPENSION OF WORK

(a) GENERAL. The Owner may, by written notice to the Contractor, temporarily suspend the work, in whole or in part, for such period or periods as Owner may deem necessary. Suspended work shall be resumed by the Contractor within 10 calendar days of receipt of written notice to proceed.

(b) EFFECTIVE DATE. Such suspension shall be effective upon receipt by the Contractor of the written order suspending the work and shall be terminated upon receipt by the Contractor of the written order terminating the suspension.

(c) PAYMENT FOR DELAY. The Contract Price(s) paid for the work shall include full compensation for all costs incurred by reason of any delay to the work, except as otherwise provided in this Article. No payment will be made for delay caused by failure on the part of the Contractor to carry out the provisions of the Contract, including failure to provide materials and workmanship meeting the requirements of the Contract Documents, or failure to provide a supervisory representative at the site at all times while 'work is in progress. In the event of a delay caused by suspension of the work for the sole convenience and benefit of the Owner, or by the failure of the Owner to furnish within Contract time requirements, access to the work, right-of-way, utility relocation, drawings, materials, or equipment for which the Owner is responsible under the Contract: and, provided that the Owner has notified the Contractor in accordance with Paragraph 3.10(a), hereof, the Contractor will be entitled to payment of the following cost subject to the succeeding provisions:

(1) Those actual necessary costs of idle time of construction equipment, idle time of workers, moving of construction equipment, and hauling of materials and equipment which are incurred solely by reason of the delay and which could not have been avoided by the judicious handling of forces,. construction equipment and plant, with allowance for overhead and profit.

(2) Costs incurred, with the written approval of the Engineer, to mitigate the foregoing costs, with allowance for overhead and profit.

The Contractor shall maintain complete and accurate daily records of all such costs, clearly distinguishing them from the costs of other portions of the work, and shall submit a detailed written report of such costs to the Engineer. In addition, the Contractor shall submit evidence of any cause of

delay specified hereinabove. As soon as practicable, following receipt of such report and evidence, if required, the Engineer will determine the nature and extent of such costs. If the Engineer determines that payment is not due, he will so advise the Contractor in writing. Should the Contractor disagree with such finding, he may submit a notice of protest to the Engineer. The Contractor shall provide the Engineer with access to his daily cost records or certified copies thereof as requested. All such records shall be retained by the Contractor and opened to inspection and audit by the Owner and his authorized representatives. Except for the additional compensation provided hereinbefore, the Contractor shall have no claim for damage or compensation for any delay or hindrance whether or not contemplated by the Contract.

3.11 DELAY DUE TO EXCUSABLE INCLEMENT WEATHER

(a) The Contractor will be eligible for payment for delay according to paragraph 3,10(d) for as many calendar days as the Contractor is specifically required under the provisions of the Technical Provisions to suspend construction operations, or as many calendar days as the Contractor is prevented by excusable inclement weather, or conditions resulting immediately therefrom, from proceeding with the labor and equipment force engaged on the operation.

(b) Excusable inclement weather shall mean any weather condition sufficient to prevent all construction from safely proceeding or at the direction of the Engineer.

3.12 TERMINATION OF CONTRACT BY OWNER (CONTRACTOR NOT AT FAULT)

(a) The Owner may terminate the Contract immediately upon written notice to the Contractor, if it is found that reasons beyond the control of either the Owner or Contractor make it impossible or against the Owner's interests to complete the work. In such a case, the Contractor shall have no claims against the Owner except: (1) for the value of work performed up to the date the Contract is terminated; and, (2) for the cost of materials and equipment on hand, in transit, or on definite commitment, as of the date the Contract is terminated, which would be needed in the work and which meet the requirements of the Contract Documents. The value of work performed and the cost of materials and equipment delivered to the site, as mentioned above, shall be determined in accordance with the procedure prescribed for the making of the final estimate and payment under Paragraph 5.06.

(b) When written notice to discontinue work as provided for in Paragraph 3.10, herein, is served upon the Contractor after the work has been damaged by an act of God or other causes as defined in said Paragraph 3.10, the Owner or the Contractor, before work other than investigative work is resumed, may terminate the Contract. Upon such termination the Contractor shall be paid for work performed to the time of occurrence of said act of God or other named causes.

3.13 TERMINATION OF CONTRACT BY OWNER (CONTRACTOR DEFAULT)

(a) In the event of default by the Contractor, the Owner may either suspend the work under the provisions of Paragraph 3.10, herein, immediately upon written notice to the Contractor may terminate the Contract as provided herein. It shall be considered a default by the Contractor whenever he shall: (1) declare bankruptcy, become insolvent, or assign his assets for the benefit of his creditors: (2) fail to provide materials or workmanship meeting the requirements of the Specifications; (3) disregard or violate important provisions of the Contract Documents or Engineer's instructions, or fail to prosecute the work according to the approved progress schedule; or, (4) fail to provide a qualified superintendent, competent workmen, or subcontractors, or materials or equipment meeting the requirements of the Contract Documents.

(b) In the event the Contract is terminated in accordance with Paragraph 3.13(a), herein, the Owner may take possession of the work and of all materials of the Contractor, which have been provided in connection with the work, and may complete the work by whatever method or means he may select. The cost of completing the work shall be deducted from the balance which would have been due the Contractor had the Contract not been terminated and the work completed in accordance with the Contract Documents.

3.14 TERMINATION OF CONTRACT BY CONTRACTOR

The Contractor may terminate the Contract upon 10 calendar days written notice to the Owner, whenever: (1) the entire work has been suspended under the provisions of Paragraph 3.10, herein, for more than 30 consecutive calendar days through no fault or negligence of the Contractor, and notice to resume work or to terminate the Contract has not been received from the Owner within this time period; or, (2) the Owner should fail to pay the Contractor any substantial sums due him in accordance with the terms of the Contract and within 40 calendar days after presentation to the Owner by the Contractor of a proper claim therefor, unless within said lo-day period the Owner shall have remedied the condition upon which the payment delay was based. In the event of such termination, the Contractor shall have no claims against the Owner except for those claims specifically enumerated in Paragraph 3.12, herein, and as determined in accordance with the requirements of said Paragraph.

3.15 LINES AND GRADES

(a) The Engineer will provide bench marks, near or on the site of the work, and will provide lines and grades as shown on the drawings for proper execution of the work.

(b) The Contractor shall preserve all bench marks, stakes, and other survey marks, and in case of their removal or destruction by his own employees or by his subcontractor's employees, he shall be liable for the cost of their replacement.

ARTICLE 4 - MATERIALS AND WORKMANSHIP

4.01 MATERIALS AND EQUIPMENT - GENERAL

(a) Unless otherwise specified, shown, or agreed, any materials incorporated in the work shall be new and of current manufacture. The Engineer may request the Contractor to furnish manufacturer's certificates to this effect.

(b) All packaged manufactured products for use on the work shall be delivered to the work in their original, unopened packages, bearing thereon the manufacturer's name and the brand name of the product.

(c) Wherever any product or material is selected to be used on the work, all such products or materials shall be of the same brand and manufacture throughout the work.

4.02 SAFEGUARDING OF EQUIPMENT, MATERIALS, AND WORK

The Contractor shall properly safeguard all equipment, materials, and work against loss, damage, malicious mischief, or tampering by unauthorized persons until acceptance of the work by the Owner. Locked and covered storage or other suitable measures shall be provided as necessary to accomplish this purpose.

4.03 CONTRACTOR'S UTILITIES

(a) The Contractor shall provide telephone and all electric power required in performance of the work under the Contract.

4.04 TITLE TO MATERIALS FOUND ON THE WORK

The Owner reserves the right to retain title to all soils, stone, sand, gravel, and other materials developed and obtained from excavations and other operations connected with the work. Unless otherwise specified in the Contract Documents, neither the Contractor nor any subcontractor shall have any right, title, or interest in or to any such materials. The Contractor will be permitted to use in the work, without charge, any such materials which meet the requirements of the Contract Documents.

4.05 DEFECTIVE EQUIPMENT, MATERIALS, OR WORK

(a) Inspection of the work shall not relieve the Contractor of any of his obligations under the Contract. Even though equipment, materials, or work required to be provided under the contract have been inspected, accepted, and estimated for payment, the Contractor shall, at his own expense, replace or repair any such equipment, materials, or work found to be defective or otherwise not to comply with the requirements of the Contract up to the end of the maintenance and guarantee period as provided in Paragraph 6.04.

(b) Any equipment or materials brought upon the job site by the Contractor and subsequently rejected by the Engineer as not complying with the requirements of the Contract shall be removed immediately by the Contractor from the job site.

(c) If the Contractor shall fail to repair or replace unsatisfactory equipment, materials, or work, or to remove unsatisfactory equipment or materials from the job site, within 5 calendar days after being ordered to do so by the Engineer, the Engineer may make the ordered repairs or remove the condemned equipment or materials and the Owner will deduct the cost thereof from any monies due or to become due the Contractor.

4.06 CHARACTER OF WORKERS

None but skilled workers shall be employed on work requiring special qualifications. When required in writing by the Engineer, the Contractor or any subcontractor shall discharge any person who is, in the opinion of the Engineer, incompetent, disorderly, or otherwise unsatisfactory, and shall not again employ such discharged person on the work except with the consent of the Engineer. Such discharge shall not be the basis of any claim for damages against the Owner or any of his agents.

5.01 GENERAL

(a> EQUIPMENT. The Contractor will be paid for the use of equipment at the rental rate listed for such equipment specified in the current edition of the "Rental Rate Blue Book" as published by Dataquest Incorporated, 1290 Ridder Park Drive, San Jose, California 95131, phone (408) 971-9100. Such rental rate will be used to compute payments for equipment whether the equipment is under the Contractor's control through direct ownership, leasing, renting, or another method of acquisition. The rental rate to be applied for use of each item of equipment shall be the rate resulting in the least total cost to the Owner for the total period of use. If it is deemed necessary by the Contractor to use equipment not listed in the foregoing publication, an equitable rental rate for the equipment will be established by the Engineer. The Contractor may furnish cost data which might assist the Engineer in the establishment of the rental rate.

(1) The rental rates paid, as above provided, shall include the cost of fuel, oil, lubrication supplies, small tools, necessary attachments, repairs and maintenance of all kinds, depreciation, storage, insurance, and all incidentals. Operators of equipment will be separately paid for as provided in Paragraph 5.02(b), herein.

(2) All equipment shall, in the opinion of the Engineer, be in good working condition and suitable for the purpose for which the equipment is to be used.

(3) Before construction equipment is used on the work, the Contractor shall plainly stencil or stamp an identifying number thereon at a conspicuous location, and shall furnish to the Engineer, in duplicate, a description of the equipment and its identifying number.

(4) Unless otherwise specified, manufacturer's ratings and manufacturer approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment which has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer.

(5) Individual pieces of equipment or tools having a replacement value of $100 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made therefor.

(6) Rental time will not be allowed while equipment is inoperative due to breakdowns.

(b) EQUIPKENT ON THE WORK. The rental time to be paid for equipment on the work shall be the time the equipment is in productive operation on the extra work being performed and, in addition, shall include the time required to move the equipment to the location of the extra work and return it to the original location or to another location requiring no more time than that required to return it to its original location, except that moving time will not be paid if the equipment is used on other than the extra work, even though located at the site of the extra work. Loading and transporting costs

will be allowed, in lieu of moving time, when the equipment is moved by means other than its own power, except that no payment will be made for loading and transporting costs when the equipment is used at the site of the extra work on other than the extra work. The following shall be used in computing the rental time of equipment on the work.

5.02 PROGRESS SCHEDULES

Within 5 calendar days after start of work, or at such times as may be required by the Engineer, the Contractor shall submit construction schedules showing the order in which he proposes to carry on the work and the dates when the various parts are to be begun and completed. Schedules shall be subject to the approval of the Engineer and if, in his opinion, a submitted schedule is inadequate to secure the completion of the work in the time agreed upon, or is otherwise not in accordance with the requirements of the Contract Documents, he may require the Contractor to submit a new schedule which will assure timely completion of the work. Schedules shall conform to the requirements of the Technical Provisions.

5.03 MONTHLY ESTIMATES AND PAYMENTS

(a) On or about the 30th of each month, the Contractor shall prepare and submit to the Engineer, an estimate of the cumulative amount and value of work performed by the Contractor up to that date. Said amount will include 80 percent of the value of all acceptable materials for the Contract that have been delivered and suitably stored at the project site but not yet used in the work, provided any such individual item has a value of more than $5000 and will become a permanent part of the improvement. To this figure will be added all amounts due or paid the Contractor for performance of extra work in accordance with change orders.

(b) Upon verification and approval by the Engineer, such estimates shall be prepared in the form directed by the Engineer and delivered to the Engineer not later that the 30th day of each calendar month for approval and submittal to the Owner for payment.

(c) The monthly payments may be withheld or reduced if, in the Engineer's opinion, the Contractor is not diligently or efficiently endeavoring to comply with the intent of the Contract, or if the Contractor fails to pay his labor and material bills as they become due.

5.04 FINAL PAYMENT TERMINATES LIABILITY OF OWNER

Final payment is defined as the last progress payment made to the Contractor for earned funds. The acceptance by the Contractor of the final payment shall be a release of the Owner and its agents from all claims of liability to the Contractor for anything done or furnished for, or relating to, the work or for any act or neglect of the Owner or of any person relating to or affecting the work.

ARTICLE 6 - BONDS, INSURANCE, LEGAL RESPONSIBILITY, AND PUBLIC SAFETY

6.01 PAYMENT BOND

The Contractor shall secure with a corporate surety or sureties satisfactory to the Owner, a bond or irrevocable letter of credit in the amount of $75,000 in the amount at least equal to the Contract Price as security to guarantee payment of claims of laborers and materialmen under the Contract.

6.02 ADDITIONAL SURETY

If, during the life of the performance bond, any of the sureties named in said bond become insufficient in the opinion of the Owner, he may require the Contractor to furnish additional sufficient sureties within 10 calendar days of receipt of written order to do so. In the event the Contractor fails or neglects to furnish sufficient additional sureties, when ordered, within the prescribed time period, the Owner may suspend the work or terminate the Contract, and the Contractor shall have no claim for damages.

6.03 INSURANCE

(a) GENEPAL. After receipt of Notice of Award and pprior to execution of the Agreement by the Owner, the Contractor shall obtain all the insurance required under this Paragraph and submit said insurance policies to the Engineer for review. In addition, the Contractor shall provide the Engineer with corresponding certificates of insurance. The Contractor shall not allow any subcontractor to commence work on it's subcontract until the insurance required of the subcontractor has been so obtained and reviewed. Unless otherwise specified, all insurance required under this Paragraph shall be maintained continuously during the life of the Contract up to the date of acceptance of the work by the Owner, but Contractor's liabilities under this Contract shall not be deemed limited in any way to the insurance coverage required.

(b) WORKERS' COMPENSATION INSURANCE. The Contractor shall procure and maintain Workers' Compensation Insurance as required by applicable State law for all of his employees to be engaged in work at the site of the project under this Contract and, in case of 'any such work sublet, the Contractor shall require the subcontractor similarly to provide Workers' Compensation Insurance for all of the latter's employees to be engaged in such work unless such employees are covered by the protection afforded by the Contractor's Workers' Compensation Insurance. In case any class of employees engaged in hazardous work on the project under this Contract is not protected under the Workers' Compensation Statute, the Contractor shall provide and shall cause each subcontractor to provide adequate employer's liability insurance for the protection of such of his employees as are not otherwise protected.

(c) CONTRACTOR'S PUBLIC LIABILITY AND PROPERTY DAMAGE INSURANCE AND VEHICLE LIABILITY INSURANCE. The Contractor shall procure and maintain Contractor's Public Liability Insurance, Contractor's Property Damage Insurance and Vehicle Liability Insurance in the amounts specified in the Supplemental General Conditions.

(d) SUBCONTRACTOR'S PUBLIC LIABILITY AND PROPERTY DAMAGE INSURANCE AND VEHICLE LIABILITY INSURANCE. The Contractor shall either: (1) require each of his subcontractors to procure and to maintain Subcontractor's Public Liability and Property Damage Insurance and Vehicle Liability Insurance of the type and in the amounts specified in the Supplemental General Conditions; or, (2) insure the activities of his subcontractors in his own policy, in like amount.

(e) SCOPE OF INSURANCE. The insurance required under Paragraph 6.05(c) and (d), herein, shall provide adequate protection for the Contractor and his subcontractors, respectively, against damage claims which may arise from operations under this Contract, whether such operations be by the insured or by anyone directly or indirectly employed by him. In addition, the insurance required under Paragraphs 6.03(c), (d), and (e), herein, shall name the Owner, the Engineer, and their officers, agents, and employees as "additional insured& under the policies.

(f) PROOF OF INSURANCE. The Contractor shall furnish the Engineer with certificates showing the type, amount, class of operations covered, effective dates and dates of expiration of policies. Such certificates shall also contain substantially the following statement: "The insurance covered by this certificate will not be cancelled or materially altered, except after 30 days written notice has been received by the Owner."

6.04 INDEMNIFICATION OF OWNER AND ENGINEER

(a) To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, the Engineer, and their officers, agents, and employees, against and from all claims and liability arising under or by reason of the Contract or any performance of the work, but not from the sole negligence or willful misconduct of the Owner and/or the Engineer. Such indemnification by the Contractor shall include but not be limited to the following:

(1) Liability or claims resulting directly or indirectly from the negligence or carelessness of the Contractor or his agents in the performance of the work, or in guarding or maintaining the same, or from any improper act or omission of the Contractor or his agents:

(2) Liability or claims arising directly or indirectly from or based on the violation of any law, ordinance, regulation, order, or decree, whether by the Contractor or his agents;

(3) Liability or claims arising directly or indirectly from the breach of any warranties, whether express or implied, made to the *Owner by the Contractor or his agents;

(4) Liabilities or claims arising directly or indirectly from the willful misconduct of the Contractor or his agents; and,

(5) Liabilities or claims arising directly or indirectly from any breach of the obligations assumed herein by the Contractor.

(b) The Contractor shall reimburse the Owner, and the Engineer for all costs and expenses, including attorney's fees, incurred by said Owner, and the Engineer in enforcing the provisions of this Paragraph.

6.05 LAWS AND REGULATIONS

The Contractor shall observe and comply with all Federal, State, and local laws, ordinances, codes, orders, and regulations which in any manner affect those engaged or employed on the work, the materials used in the work, or the conduct of the work. If any discrepancy or inconsistency should be discovered in this Contract in relation to any such law, ordinance, code, order, or regulation, the Contractor shall report the same in writing to the Engineer. The Contractor shall indemnify and hold harmless the Owner, the Engineer, and their officers, agents, and employees, against all claims or liability arising from violation of any such law, ordinance, code, order, or regulation, whether by himself or by his employees or subcontractors. Any particular law or regulation specified or referred to elsewhere in these Contract Documents shall not in any way limit the obligation of the Contractor to comply with all other provisions of Federal, State, and local laws and regulations.

6.06 PERMITS AND LICENSES

(a) Within 10 calendar days of the commencement date stated in the Notice to Proceed, the Contractor shall submit a complete list of all permits he will obtain indicating the Agency required to grant the permit and the expected date of submission for the permit and required date for receipt of the permit.

(b) The Contractor shall obtain all permits and licenses required for prosecution of the work beyond those obtained by the Owner as listed in the Technical Provisions, and shall pay all taxes properly assessed against his equipment or property used in connection with the work.

6.07 SALES AND USE TAXES

The Contractor shall pay all sales and use taxes assessed by Federal, State or local authorities on materials furnished by the Contractor in performance of the work.

6.08 LABOR DISCRIMINATION

No discrimination shall be made in the employment of persons upon the work by the Contractor or by any subcontractor under him, because of the race, color, sex, or religion of such persons, and there shall be full compliance with the provisions of applicable State and Federal laws in this regard.

6.09 PUBLIC SAFETY AND CONVENIENCE

(a) The Contractor shall at all times conduct his work so as to assure the least possible obstruction to traffic and inconvenience to the general public, and adequate protection of persons and property in the vicinity of the work.

6.10 SANITARY PROVISIONS

The Contractor shall provide and maintain such sanitary accommodations for the use of it's employees and those of it's subcontractors as may be necessary to comply with the requirements of State and local health departments.

6.11 FEDERAL SAFETY AND HEALTH REGULATIONS

(a) Contractors and subcontractors shall comply with the provisions of the "Safety and Health Regulations for Construction," as promulgated by the Secretary of Labor under Section 107 of the "Contract Work Hours and Safety Standards Act", as set forth in Title 29 CFR Part 1926.

(b) Contractors and subcontractors shall comply with the provisions of the Occupational Safety and Health Standards, promulgated by the Secretary of Labor under the "Occupational Safety and Health Act of 1970", as set forth in 29 CFR 1926. Where an individual State act on occupational safety and health standards has been approved by Federal authority, then the provisions of said State act shall control.

6.12 CONTRACTOR'S RESPONSIBILITY FOR LOSSES AND DAMAGE

(a) MATERIALS AND FACILITIES. The Contractor shall be responsible for materials and facilities as hereinafter provided and in the event of his failure to carry out said responsibilities.

(1) The Contractor shall be responsible for any material furnished him and for the care of all work until its completion and final acceptance, and he shall at his own expense replace damaged or lost material and repair damaged parts of the work.

(2) The Contractor shall protect Owner facilities from damage resulting from his work. Owner facilities damaged by or as a result of the Contractor's work under this Contract shall be repaired or replaced, as directed by the Engineer, at the Contractor's expense.

- END OF GENERAL CONDITIONS -

TECHNICAL PROVISIONS

DIVISION 100 - GENERAL

SECTION 101 - GENERAL REQUIREMENTS

101.01 THE REQUIREMENT

The Contractor shall furnish, in accordance with the Specifications and Drawings, all plant, labor, equipment, and materials required for flood plain development and fish habitat enhancement along designated portions of Bear Valley Creek about 20 miles northeast of Lowman in Valley County, Idaho.

101.02 DESCRIPTION OF WORK

The work includes excavation of natural ground and dredge-mine tailings to create an approximately 180-foot wide flood plain; construction of a stream channelization berm: filling and/or surface grading of excavated dredge tailings areas adjacent to Bear Valley Creek; preparations and installation of erosion control materials along the stream channel and flood plain; and seeding and plantings within the project area.

101.03 SITE OF THE WORK

The site of the work is located in and around a 3500-foot (±) reach of Bear Valley Creek running north-south between sections 22 and 15; T. 8E., R. 11 N., BM in the southwest corner of Valley County, Idaho.

101.04 BEGINNING AND COMPLETION OF THE WORK

The Contractor shall begin work on or before the commencement date stated in the Notice to Proceed from the Owner, and shall complete all work under the Contract within approximately 60 calendar days after said commencement date. The time stated for completion shall include final cleanup of the premises.

101.05 CONTRACT DRAWINGS

Contract drawings applicable to the work to be performed under the Contract are listed in the Table of Contents.

101.06 MAINTENANCE OF PLANT OPERATION

(a) The Contractor will be performing work along an active mountain valley stream. Under these conditions, extra precautions will be necessary to assure that no damage or extra sedimentation occurs. Beyond the silt fencing materials provided by the Owner and the applicable details presented in the drawings, all construction procedures and any temporary facilities, materials, equipment and labor required to achieve this objective shall be provided by the Contractor. At the completion of work, all such temporary facilities, materials and equipment remaining shall be removed from the site.

101.07 ORDER OF THE WORE

The work shall be carried on at such places on the project and also in such order or precedence as may be found necessary by the Engineer to expedite the completion of the project. After work has begun on any portion of designated part of the project, it shall be carried forward to its final completion. All work shall conform to the provisions of the approved Contractor's schedule as specified under Paragraph "Contractor's Schedules" of Section entitled "Contractor Submittals" of the Technical Provisions.

101.08 INTERFERENCE WITH ADJACENT WORK

The Contractor shall cooperate fully with any other contractors, the forces of the Owner, or the forces of other public or private agencies which may be engaged in project-related work or otherwise performing activities which may interfere with the progress of the work, and shall schedule the work so as to minimize interference with said forces.

101.09 SEQUENCE OF CONSTRUCTION

(a) Work under the Contract shall be scheduled and performed according to a construction schedule covering the entire work. The Contractor shall submit the schedule to the Engineer before any work is commenced. The schedule shall be in the form specified under Paragraph "Contractor's Schedules"' of Section entitled "Contractor Submittals" of the Technical Provisions.

(b) The following construction constraints should be used as a guideline in preparing the scheduling.

(1) Work directly within the active Bear Valley Creek stream shall not be permitted unless positive measures are provided to prevent immediate sedimentation and also prevent conditions that would be readily succeptible to erosion and/or sedimentation at subsequent periods of higher stream flow.

(2) Equipment crossings of the active stream shall not be permitted except at permanent bridges or approved temporary bridges/culverts constructed of materials and procedures approved by the Engineer and the public agencies having jurisdiction.

(3) Unless otherwise approved, equipment travel, circulation, and storage shall be confined to public roadways, designated temporary roadways, and to' those areas on the project site which must be disturbed in the course of the prescribed project work. Existing vegetation shall be preserved in all areas not being regraded or otherwise designated for modification work.

(4) The Contractor shall be required to adhere to all constraints or stipulations imposed by permits and clearances which will be secured from public agencies prior to and during the course of the project. The provisions of these permits, including U.S. Fish and Wildlife Service permit relative to the Grey Wolf and U.S. Forest Service permit relative

to development of riprap on Forest Service land, shall be provided to the Contractor by the Engineer at or before the start of work.

101.10 SALVAGE

It shall be the Owner's perogative to salvage certain items of existing equipment which are to be dismantled and removed during the course of construction. Prior to removal of any existing equipment from the site of the work, the Contractor shall ascertain from the Engineer whether or not the particular item or items are to be salvaged. Items to be salvaged shall be stockpiled on the site in a location as directed by the Engineer. All other items of equipment shall be disposed of off-site by the Contractor.

- END OF SECTION -

SECTION 110 - MOBILIZATION

110.01 DEFINITION AND SCOPE

Mobilization shall include the obtaining of all transportation related permits, insurance, and bonds; moving onto the site of all plant and equipment; furnishing and erecting construction facilities; all as required for the proper performance and completion of the work. Mobilization shall include but not be limited to the following principal items:

(a) Moving on to the site of all Contractor's plant and equipment required for first month operations.

(b) Providing field office trailer(s) for the Contractor and the Engineer, complete with all specified furnishings and utility services including access to a telephone.

(c) Providing on-site sanitary facilities and potable water facilities as required.

(d) Arranging for and erection of Contractor's work and storage yard.

(e) Submittal of all required subcontractor insurance certificates and bonds and/or letter of credit.

(f) Obtaining all required permits.

(g) Posting all OSHA required notices and establishment of safety programs.

(h) Have the Contractor's superintendent at the job site full time.

- END OF SECTION -

SECTION 130 - CONTRACTOR SUBMITTALS

130.01 GENERAL

Wherever submittals are required hereunder, all such contractor submittals shall be submitted to the Engineer at the construction site for recording and forwarding to the Owner.

130.02 CONTRACTOR'S SCHEDULE

(a) SCHEDULE. Within 5 calendar days after start of work, the Contractor shall furnish to the Engineer a schedule for the work showing his plan for orderly completion of the work and showing in detail his planned mobilization of plant and equipment, sequence of early operations, and timing of procurement of materials. The Contractor shall assist the Engineer in reviewing and evaluating such schedule.

130.03 SHORING, BRACING, AND SLOPING OF TRENCHES

Prior to commencement of any trench excavation, 5 feet or greater in depth, the Contractor shall submit to the Engineer a detailed plan showing the design of shoring, bracing and sloping, and shall be in receipt of the Engineer's acceptance of same prior to commencing the excavation.

- END OF SECTION -

SECTION 140 - QUALITY CONTROL

140.01 SITE INVESTIGATION AND CONTROL

(a) The Contractor shall verify all dimensions in the field and shall check field conditions continuously during construction. The Contractor shall be solely responsible for any inaccuracies built into the work due to his failure to comply with this requirement.

(b) The Contractor shall inspect related and appurtenant work and shall report in writing to the Engineer any conditions which will prevent proper completion of the work.

140.02 INSPECTION OF THE WORK

(a) The work shall be conducted under the general observation of the Engineer and shall be subject to inspection by representatives of the Engineer acting on behalf of the Owner to insure compliance with the requirements of the Contract Documents. The Engineer shall be permitted reasonable access to all parts of the work.

(b) No work shall be backfilled, buried, cast in concrete, hidden or otherwise covered until it has been inspected by the Engineer or his authorized representative. Any work so covered in the absence of inspection shall be subject to uncovering. Where uninspected work cannot be uncovered, such as in concrete cast over reinforcing steel, all such work shall be subject to demolition, removal, and reconstruction under proper inspection, and no addition payment will be allowed therefor.

140.0140.03 RIGHT OF REJECTION

(a) The Engineer shall have the right, at all times and places, to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of these Specifications, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the work at the site. If the Engineer or inspector, through an oversight or otherwise, has accepted materials or work which is defective or which is contrary to the Specifications, such material, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected by the Engineer.

(b) The Contractor shall promptly remove rejected articles or materials from the site of the work after notification of rejection.

(c) All costs of removal and replacement of rejected articles or materials as specified herein shall be borne by the Contractor.

- END OF SECTION -

SECTION 150 - TEMPORARY CONSTRUCTION FACILITIES

150.01 CONTRACTOR'S PLANT AND EQUIPMENT

(a) GENERAL. It shall be the Contractor's responsibility to provide plant and equipment that is adequate for the performance of the work under this Contract within the time specified. All plant and equipment shall be kept in satisfactory operating condition, shall be capable of safely and efficiently performing the required work, and shall be subject to approval by the Owner's representative at any time within the duration of the Contract. All work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.

(b) CONSTRUCTION LIGHTING. All work conducted at night or under conditions of deficient daylight shall be suitably lighted to insure proper work and to afford adequate facilities for inspection and safe working conditions.

(c) CONSTRUCTION WIRING. All wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. All electrical facilities shall conform to the requirements of Subpart K of the OSHA Safety and Health Standards for Construction.

(d) SEPARATION OF CIRCUITS. Unless otherwise permitted by the Engineer, circuits separate from lighting circuits shall be used for all power purposes.

150.02 UTILITIES

(a) TELEPHONE SERVICES. The Contractor shall provide and maintain at all times during the progress of the work, at his own expense, not less than one telephone in good working order, at his own field construction office. Each such telephone shall be connected to an established exchange for toll service.

(b) TELEPHONE USE. The Contractor shall permit the Engineer, or the Owner's authorized representatives or employees free and unlimited use of said telephone facilities for all calls that do not involve published toll charges. Calls originated by the Engineer, the Owner, their authorized representatives or employees which involve toll or message unit charges shall be billed to the Owner by the Contractor at the rates charged him by the telephone company.

150.03 SAFETY

(a) GENERAL. Appropriate first aid facilities and supplies shall be kept and maintained by the Contractor at the site of the work. All persons within the construction area shall be required to wear protective helmets. In addition, all employees of the Contractor and his subcontractors shall be provided with, and required to use, personal protective and life saving equipment as set forth in Subpart E of the OSHA Safety and Health Standards for Construction (29CFR 1926).

(b) PUBLIC SAFETY. During the performance of the work the Contractor shall erect and maintain temporary fences, bridges, railings, and barriers and

shall take all other necessary precautions and place proper guards for the prevention of accidents.

- END OF SECTION -

SECTION 152 - SITE ACCESS

152.01 HIGHWAY AND ROADWAY LIMITATIONS

The Contractor shall make his own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the work. It shall be the Contractor's responsibility to construct and maintain any haul roads required for his construction operations.

- END OF SECTION -

SECTION 154 - ENVIRONMENTAL CONTROLS

154.01 EXPLOSIVES AND BLASTING

(a) The use of explosives on the work will be subject to the approval of the Engineer. All operations involving the handling, storage, and use of explosives shall be conducted in accordance with the requirements of Subpart U of the OSHA Standards for Construction, and in accordance with applicable U.S. Forest Service regulations and with all local laws and regulations.

(b) Only competent, reliable men working under experienced supervision shall be permitted to use explosives. The Contractor will be held responsible for and shall make good any damage caused by blasting or otherwise resulting from his possession or use of explosives on the work.

154.02 DUST ABATEMENT

The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent his operation from producing dust in amounts damaging to the vicinity. The dust abatement measures shall be continued until the Contractor is relieved of further responsibility by the Engineer.

154.03 RUBBISH CONTROL

During the progress of the work, the Contractor shall keep the site of the work and other areas used by him in a neat and clean condition, and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the work site, and shall establish regular intervals of collection and disposal of such materials and waste. He shall also keep his haul roads free from dirt, rubbish, and unnecessary obstructions resulting from his operations. Equipment and material storage shall be confined to areas approved by the Engineer. Disposal of all rubbish and surplus materials shall be off the site of construction, at the Contractor's expense, all in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Subpart H, Section 1926.252 of the OSHA Safety and Health Standards for Construction.

154.04 SANITATION

(a) TOILET FACILITIES. Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to therequirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction.

(b) SANITARY AND OTHER ORGANIC WASTES. The Contractor shall establish a regular collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of away from the site in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto.

154.05 PROJECT SIGN

If so required, the Contractor shall install two Engineer provided project signs as provided by the Owner. Signs will be 4 feet by 8 feet in size and constructed of 5/8-inch exterior grade plywood. The sign shall be erected on two 4-inch by 4-inch posts in location as directed by the Engineer.

- END OF SECTION -

SECTION 156 - FIELD OFFICE FACILITIES

156.01 GENERAL FIELD OFFICE REQUIREMENTS

(a) All required field offices, equipped as specified herein, shall be provided at the site(s) indicated, ready for use by the Engineer within 10 working days after receipt by the Contractor of written Notice to Proceed. The Contractor's attention is directed to the condition that no payment for mobilization, or any part thereof, will be approved for payment under the contract until all field office facilities specified herein, have been provided as specified.

(b) Unless released earlier by the Engineer in writing, the field office(s) shall be maintained in full operation until final Notice of Completion has been executed and recorded. Upon recordation of final Notice of Completion, or upon early release of the field office(s) by the Engineer, the Contractor shall remove the field office(s) within 10 working days from said date, and shall restore the site occupied by said field office(s) to the condition specified or indicated on the Contract Documents for the subject area.

156.02 FIELD TELEPHONE SERVICE

Within 10 working days after receipt by the Contractor of written Notice to Proceed, the Contractor shall provide one telephone, in good order. Requirements pertaining to telephones are specified in Section entitled "Temporary Construction Facilities."

156.03 OFFICE FACILITIES

(a) GENERAL. The Contractor shall furnish and install all necessary electrical wiring, and heating equipment, and shelving, and shall furnish all necessary light, heat, and janitorial services in connection with all field offices specified herein, for the duration of the work; and shall remove said offices and appurtenant facilities within 10 calendar days after the filing and recording of the final Notice of Completion.

(b) FIELD OFFICE. The Contractor shall provide and maintain for the joint use of the Engineer and Contractor at a point convenient to the construction operations, one well lighted, electrically heated field office. The office shall be provided with an outside door lock. The area of said field office shall be approximately 128 square feet. Said office shall be of the portable trailer type unless otherwise specifically authorized by the Engineer in writing and shall be a separate unit, not attached or connected to any other structures.

156.04 FIELD OFFICE EQUIPMENT

(a) The Contractor shall provide the following listed items in good condition for the field office:

1 each - Standard 30 x 60-inch desk or equivalent working space.

1 each - Plan table 36 x 72-inch top; 36 inches high.

1 each - Office chair(s), standard arm rest type, adjustable, swivel, tilt-back with casters.

1 each - Office chair(s), stiff-leg type, no arm rest.

1 each - Waste basket(s).

1 each - Potable water dispenser unit and potable water.

156.06 FIELD OFFICE SERVICES

(a) Each field office required hereunder shall be provided with sufficient lighting to provide not less than 50 foot-candles at desk top height at each desk location. Exterior lighting shall be provided over the entrance door.

- END OF SECTION -

SECTION 160 - PROTECTION AND RESTORATION OF EXISTING FACILITIES

160.01 GENERAL

(a) The Contractor shall protect all existing structures and improvements not designated for removal and shall restore damaged or temporarily relocated improvements to a condition equal to or better than they were prior to such damage or temporary relocation.

(b) COSTS BORNE BY OWNER. All costs of locating, repairing damage not due to failure of the Contractor to exercise reasonable care, and removing or relocating such utility facilities not indicated in the plans and specifications with reasonable accuracy, and for equipment on the project which was actually working on that portion of the work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessarily idled during such work will be paid for by the Owner.

(c) APPROVAL OF REPAIRS. All repairs to a damaged improvement shall be inspected and approved by an authorized representative of the improvement owner before being concealed by backfill or other work.

160.02 TREES WITHIN ROAD RIGHTS-OF-WAY AND PROJECT LIMITS

(a) GENERAL. The Contractor shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the Engineer and the jurisdictional agency or Owner.

- END OF SECTION -

SECTION 190 - PROJECT CLOSEOUT

190.01 FINAL CLEANUP

The Contractor shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the work by the Owner will be witheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

190.02 FINAL SUBMITTALS

The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Engineer for transmittal to the Owner:

(a) Certificates of inspection and acceptance by local governing agencies having jurisdiction.

(b) Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

190.03 MAINTENANCE AND GUARANTEE

(a) The Contractor shall comply with the maintenance and guarantee requirements contained in Article 6.04 of the General Conditions.

(b) Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work.

(c) The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the work and the Contractor and his surety shall be liable to the Owner for the cost thereof.

- END OF SECTION -

TECHNICAL SPECIFICATIONS

SECTION 200 - SITE PREPARATION

1. DESCRIPTION OF WORE

A. This specification Section covers all work required to prepare the site, or portions thereof, for the measures described in other sections of the Contract Documents. Work items for which site preparation is specified herein shall include earthwork, fencing, riprap, and seeding and fertilizing.

B. The work under this Section shall include, but not be limited to: silt fence installation; site clearing, grubbing, and debris disposal: topsoil stripping and stockpiling; spreading topsoil; dewatering: and temporary roads.

c. Reference Points Preservation: During all site preparation operations, as for other work items under this Contract, the Contractor shall carefully maintain bench marks, monuments and other reference points, and shall be responsible for costs associated with their replacement if they are disturbed or destroyed. The replacement of disturbed or damaged points shall be performed by qualified professionals acting under the authorization and according to requirements which will be prescribed by the Engineer.

2. SILT FENCING

A. Requirement

1. Silt fencing shall be installed, complete, as shown and specified prior to the commencement of adjacent work. Silt fencing shall be maintained until erosion control measures have been completed unless the fence conflicts with their installation.

2. Silt fencing shall be installed as shown on the drawings and as specified herein at all locations where construction activity such as clearing, stripping, excavating, filling, and etc. could cause rock or earth material to enter either the active stream channel or wet areas contiguous with the active stream.

B. Materials. Silt fence installation shall be performed by the Contractor using materials supplied by the Owner including metal posts, fencing fabric, and wire or plastic ties and clips.

c. Installation.

1. The fabric shall be layed to closely follow the existing ground line in order to serve as barrier to runoff from areas behind the fencing and to prevent soil and rock from falling or being pushed into the stream.

2. Support posts shall not be driven in the active stream. There shall be a minimum one foot offset or separation between the posts and the water's edge of Bear Valley Creek.

3. The bottom one foot + of the fencing fabric shall be secured or anchored by hand-placed soil as shown on the Drawings.

4. During installation, and at all times thereafter, the Contractor shall take necessary precautions to avoid overloading of the fabric or supporting elements. Such measures should include periodic removal of material impinging on the fence during construction activity.

5. Wire ties shall be used for all silt fencing designated to remain in-place beyond the end of the current construction season.

3. SITE CLEARING, GRUBBING, AND DEBRIS DISPOSAL

A. Site Clearing.

1. Generally, the entire site shall be cleared of all abandoned or pre-existing, manmade debris, equipment, pipe, and other man-made items not being a part of nor contributing to the project.

2. All trees, brush, stumps, logs I and roots of downed trees shall be cleared from the construction areas of excavations, embankments, rip-rap sources, temporary roadways, and fences as specified herein, as shown on the Drawings, or as directed by the Engineer.

3. Spoil areas shall be cleared only to the extent described herein, or as directed by the Engineer.

B. Clearing Limits.

1. Unless otherwise directed by the Engineer, clearing limits for excavations and embankments shall be a line 15-feet beyond the slope (cut or fill) intercepts.

2. Clearing limits in spoil areas shall coincide with the edges of spoil desposition.

3. Within floodplain areas designated to remain undisturbed, clearing or selective cutting shall be as designated by the Engineer.

C. Clearing and Grubbing Requirements.

1. Within limits of excavations and structural embankments, all trees, brush, deadfall, and all associated root masses shall

be cleared and all stumps, roots, and other organic material larger than 3-inch diameter shall be grubbed to a minimum depth of one foot.

2. Within the limits of non-structural embankments, clearing shall be limited to trees, brush, and deadfall having a diameter larger than **3-inches** in diameter at a level which is three feet off the ground. Grubbing shall be limited to stumps (including their associated root mass) which are larger than 12 inches diameter at ground level. Cleared tree and brush shall be cut off within 12 inches of the ground surface.

3. Within spoil areas, clearing shall be limited to trees and brush which are larger than three inches diameter at three feet above ground. Larger material may be left uncleared if approved by the Engineer. No grubbing will be required. Cleared trees and brush shall be cut off within 12 inches of the ground surface.

4. Trees or brush designated for selective clearing within an otherwise undisturbed floodplain area shall be cut off as near as possible to ground surface.

D. Debris Disposal

1. All man-made items removed from the site shall be disposed of off-site by the Contractor unless otherwise approved by the Engineer.

2. All cleared trees and brush shall be piled on-site in designated areas for disposal by burning subject to applicable ordinances and regulations, or other method as designated by the Engineer.

3. Grubbed materials shall be disposed of as applicable to cleared trees, brush, roots, etc.

4. STRIPPING AND STOCKPILING TOPSOIL

A. The Contractor shall salvage and stockpile available fine-grained surface soil and topsoil from all portions of construction areas specifically identified for excavation or embankment construction.

B. The Contractor shall strip available topsoil up to a depth of 12-inches or to greater depths as the Engineer directs. Soft spots encountered during topsoil stripping shall be excavated unless these spots occur in areas where deeper excavation will be required later during construction.

C. Topsoil shall be segregated and stockpiled in Engineer-designated areas for subsequent use in landscaping and/or reclamation activities. Stockpiles shall be located in well-drained areas where the topsoil can be placed and stored as loosely as possible. Topsoil stockpile slopes shall be no greater than 2:1. It shall be deposited in such a manner as will facilitate the measurement of volume.

5. TEMPORARY ROADS

A. The Contractor shall construct temporary roads at locations approved by the Engineer to serve as a means of access during construction activities. Unless otherwise directed, new temporary roads shall be one-lane wide (maximum 12-feet) and shall remain unsurfaced.

B. No temporary road shall be constructed across any active portion of Bear Valley Creek without the prior written consent of the Owner. Any temporary creek crossing shall be subject to approval of the Owner and shall comply with requirements specified by the Engineer.

The Contractor shall provide temporary culvert piping as required for crossing all active or potentially active drainage courses.

c. Upon completion of the work, all new temporary roads shall be ripped or otherwise obliterated. Temporary culverts shall be removed and the drainage ways restored to original contour at the temporary crossings.

6. DEWATERING

A. The Contractor shall provide the necessary pumps, piping, and any other dewatering equipment, supplies or materials necessary to keep the excavations for the placement of riprap or other erosion control materials free from standing water during preparation, placement, and inspection operations.

B. Dewatering shall also include all required removal or exclusion of water from excavations and from existing depresssed areas which are designated for embankement construction or filling with spoil materials.

c. Water removed from excavations shall not be pumped into Bear Valley Creek. Water shall be disposed to depressed areas in the vicinity which can drain to Bear Valley Creek only via ground seepage.

7. SURFACE DITCHES AND DIVERSIONS

A. The Contractor shall construct surface ditches or other diversions as required or as directed by the Engineer, to provide positive continuous drainage for all existing water courses and areas where drainage route(s) are interrupted by the work without the intent of impoundment. Ditches and diversions shall be constructed so as to convey the diverted water without an increase in turbidity or pollutant contribution to Bear Valley Creek.

8. SPREADING TOPSOIL

A. Topsoil shall be spread to a uniform depth of 1 to 2 inches on the finish-graded 3:l slopes of the constructed Bear Valley Creek floodplain after the application of seed, fertilizer, erosion control blanket and enkamat stabilization blanket (geotextile matting).

B. Unless otherwise directed by the Engineer, topsoil shall not be spread upon the actual constructed floodplain between the left and right station lines which define the approximately flat floodplain surface.

C. Outside the limits of the constructed floodplain, topsoil shall be spread in the areas and to the depths designated by the Engineer. Unless otherwise directed in these specifications, on the Drawings, or by the Engineer, a uniform layer of topsoil 4 to 6 inches in thickness shall be applied wherever topsoil spreading is specified or required.

SECTION 201 - EARTHWORK

1. DESCRIPTION OF THE WORK

A. The work of this Section shall include, but not be limited to, the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the floodplain development work specified in the Contract Documents. Earthwork shall include the excavation and backfill of all necessary trenches and pits; the disposal of excess excavated materials; borrow of materials to make up deficiencies for fills and embankments; the shaping or trading required to produce finished sections and surfaces specified or shown; and all other incidental earthwork, all in accordance with the requirements of the Contract Documents.

B. No classification of excavated materials will be made. The work shall include the removal and subsequent handling of all earth, loose or cemented gravel, loose rock, and other materials of whatever nature excavated or otherwise removed in the performance of the contract work.

2. EXCAVATING REQUIREMENTS

A. General.

1. Excavation shall be performed to the lines and grades shown and specified on the Drawings except as otherwise directed by the Engineer.

2. Grades and/or temporary ditches shall be maintained to promote water drainage of the construction area to the maximum practical extent without permitting surface runoff to enter Bear Valley Creek.

3. Generally, finish grades shall be achieved within plus or minus 0.3 foot of those shown on the Drawings.

B. Constraints.

1. No earthwork operations shall be permitted adjacent to the Bear Valley Creek or wet areas contiguous with the active water course until silt fencing has been installed, complete, as specified elsewhere in these specifications.

2. The Contractor shall confine his earthwork operations and equipment travel corridors to the disturbed areas within the designated clearing limits as shown on the plans.

3. To the extent necessary, equipment selection, construction procedures, and sequence of operations shall be dictated by the obligation to protect and preserve the quality of the waters and environs of Bear Valley Creek within the project area.

3. SPOIL AREAS

A. Spoil materials shall be deposited only in the locations designated in the field by the Engineer. The various spoil areas such as those shown on the Drawings shall be utilized in the order or sequence directed by the Engineer.

B. Spoil areas shall be cleared only to the extent directed by the Engineer. Grubbing shall not be performed for any designated spoil area.

c. Spoil material shall be placed in maximum 18-inch deep lifts. No compaction of spoil material shall be provided beyond normal, incidental circulation of earth moving equipment over the area. End dumping of spoil materials into deep spoil deposits may be applied at the discretion of the Engineer.

D. Spoil material shall not be deposited into moving water. Spoil areas shall be dewatered as required prior to placement of spoil material in order to prevent any displaced or turbid water from entering, or otherwise contributing to the turbidity of, Bear Valley Creek.

E. The finished surfaces of spoil areas shall be sloped and shaped to a contour blending naturally with the surrounding ground surface and as designated by the Engineer.

4. EMBANKMENT CONSTRUCTION

A. The floodplain containment berm shall be constructed to the lines and grades shown on the Drawings and as specified herein.

B. The necessary embankment material shall be excess material excavated from adjacent reaches of the constructed floodplain.

c. Proof Rolling.

1. All cleared areas designated to receive compacted embankment fill shall be proof-rolled with one pass of a heavily-loaded truck or scraper prior to placement of fill material. The object of the proof rolling shall be to indicate the stability of the embankment foundation materials. At the Engineer's request, or with his approval, proof-rolling may be performed with any suitable unit of loaded, rubber-tired equipment of minimum 20 tons gross weight.

2. Proof-rolling shall be performed in the presence of the Engineer. The Contractor shall give the Engineer at least four (4) hours advance notice of his intent to proof roll so that the required observation can be provided without delaying the progression of the work.

D. Placement.

1. Fill material shall be placed for compaction in level, horizontal lifts of maximum 14-inch loose depth. As directed by the Engineer, the lift depths shall be reduced as required such that the specified embankment density can be achieved with a single pass of the designated compactor.

2. The embankment fill may be constructed progressively from base to crest beginning with a minimum 60-foot wide base and minimum 3:l side slopes at both sides of berm.

   Subsequent fill material placed on the outside (away from the stream) of the berm to achieve the specified 10:1 slope may be bladed, bull-dozed, or dumped into place without full compaction.

E. Compaction.

1. Embankment compaction shall be performed as soon as necessary after lift placement and shaping in order to minimize any required water application as an aid to compaction.

2. Compaction shall be performed progressively across the full width of the minimum section described in 4.D.(2) above and shall be applied full height of the berm.

3. Embankment compaction may be applied either by the normal circulation of the earthmoving equipment or by a single pass of a minimum lo-ton, self-propelled, vibratory drum compactor. The minimum acceptable density of the compacted berm shall be 90% of maximum ASTM D-698 (Standard Proctor) density.

SECTION 202 - RIPRAP

1. DESCRIPTION OF WORK

A. This specification Section covers the furnishing of all equipment, labor, materials and performance of work for production of riprap from the Owner-designated source(s), transport of riprap to the temporary stockpile or the installation site, and for construction of riprap courses where riprap protection is shown or specified.

B. The production of riprap shall be subject to review of the U.S. Forest Service and shall comply with U.S.F.S. requirements. Forest road construction, maintenance, and site reclamation measures shall be included in the work and shall comply with applicable Forest Service requirements.

c. All permits, except blasting and roadway usage permits, for the riprap production will be obtained by the Engineer. The Engineer will pay the U.S. Forest Service fees for the removal of rock from Forest Service lands.

2. MATERIAL REQUIREMENTS

A. Stone Quality. Stone shall be hard, angular, durable, natural or quarried andesite rock free of overburden and organic material and suitable in all other respects for the intended purpose.

B. Individual stones shall, in general, be free of weak laminations and discernible seams or cracks.

c. Gradation. The median particle size shall be approximately 16 inches. Stones shall be as nearly cubical as practical. The ratio of the greatest to the least dimensions shall not exceed three. Rock shall generally conform to the following gradation:

Size of Stone	Percentage Smaller (Weight)
24"	100
14"	30
8"	10

3. RIPRAP PRODUCTION AND TRANSPORT

A. As required, vegetation shall be cleared, access shall be developed, and riprap shall be produced from mountainside deposits of andesite rock existing in a surficial matrix of earth and stone fragments.

B. All andesite fragments larger than 8 inches shall be reclaimed from the earth/stone matrix by means of segregation operations conducted at the production site. Mountainside disposal of soil and waste shall be performed as directed by the Engineer.

c. Available andesite rock shall be produced first from all areas already disturbed for riprap production, and thereafter from adjacent uncleared or undisturbed areas designated by the Engineer.

D. Excavation for rock production shall not extend down into deposits of granite or other unsuitable rock which may underlie the andesite/soil matrix.

E. Over-size andesite fragments shall be segregated for further breakage either at the production site or at the temporary riprap stockpile area located at the stream site.

F. Riprap transport shall be performed by minimum 12 cubic yard capacity trucks or other conveyances equipped with 2-way radios. No more than six such vehicles shall be employed at any given time in the transport of rock from production site to stream site.

4. GENERAL CONSTRUCTION REQUIREMENTS

A. Riprap protection shall be constructed according to the lines and grades shown on the drawings. Where low areas are encountered, they shall be backfilled and thoroughly compacted in advance of laying the riprap slope protection.

B. Receiving slopes shall be shaped or excavated to accept the full riprap blanket thickness. No placement of riprap shall proceed until the Engineer has approved the line and grade of the riprap excavation including cutoff trenches.

C. Cutoffs shall be provided at the leading and trailing edges of riprap protected areas whether or not such cutoffs are shown on the plans. The depth and bottom width of riprap cutoffs shall be a minimum of two times the course thicknesses shown on the drawings. After completion of cutoffs, excavations at the riprap perimeter shall be backfilled and mechanically tamped to finish grade.

D. Placement of slope protection shall proceed from the lowest elevation to the highest. The joint pattern shall be broken as much as practical. The full blanket thickness shall be placed as a single course or layer. At the Engineer's discretion, larger or slightly oversize stones may be placed at the base or toe of the riprap zone.

E. The top or finish surface shall be relatively smooth and as dense as practicable.

F. There shall be no large accumulations of either larger or smaller stones. Control of gradation shall be by visual inspection. If requested by the Engineer, the Contractor shall assist with labor and equipment for riprap gradation tests.

G. Backfill soils or gravels placed over the completed riprap blanket shall be deposited to a level approximately six to 12 inches above the design elevation of the constructed floodplain to allow for some subsidence of backfill materials into riprap voids.

5. RESTRICTIONS

A. Dewatering. No riprap shall be placed until all water entering the space to be filled has been properly cut off or has been diverted by pipes, or other means, and carried clear of the work. No riprap shall be deposited under water without the explicit permission of the Engineer, and then only in strict accordance with his directions. Pumping or other necessary dewatering operations for removing groundwater will be required.

B. Rock Placement. Riprap shall be carefully placed onto the prepared surface which shall include a properly anchored layer of filter fabric material as specified elsewhere in these specifications. In order to minimize damage and disturbance of the fabric, the riprap material shall be dropped from the minimum practicable height onto the filter fabric-prepared surface. In no case shall the distance of drop exceed 2 feet. Care shall be taken not to puncture, snag, or displace the fabric material during the riprap placing operation.

c. Rip-rap placement shall commence as soon as practicable after the excavation or other slope preparation of area to receive riprap is completed. In the case of riprap installation at the toe of an embankment, the riprap trench shall be excavated into compacted material after completion of the fine grading. Any required remedial compaction work shall be completed and approved by the Engineer prior to the start of riprap installation.

D. At the site of riprap rock placement, positive measures shall be applied to keep rock free of soil or gravel during handling and

placement, and to prevent loss or scatter of rock fragments at the stream site. Grizzlies, bins, or other devices shall be utilized to keep rock clean, prevent loss, and simplify its handling by the machine which actually places the rock into the riprap blanket.

SECTION 203 -EROSION CONTROL FABRICS

1. DESCRIPTION OF WORE

A. The work of this Section shall include the temporary storage and subsequent installation of erosion control fabrics as specified herein and as shown on the Drawings.

B. Erosion control fabrics covered by this Section shall include silt fencing, filter fabric, excelsior erosion control blanket, and "Enkamat" stabilization blanket (geotextile matting).

c. Erosion control fabrics and installation supplies shall be Owner-supplied as specified herein. Owner-supplied materials will be delivered in unopened containers and packages to the Contractor's project staging area for storage and subsequent handling by the Contractor.

2. MATERIALS

A. Silt Fencing. Silt fencing materials shall consist of 36" wide woven geotextile fabric (such as Permea Tex 5200 Stabilization and Drainage Fabric), 5-foot steel fencing posts, and 7-inch plastic ties and/or ductile tying wire for securing fabric to the support posts.

B. Filter Fabric. Filter fabric shall be general-purpose, spun polypropylene geotextile fabric such as Dupont's Typar #3401 or Mirafi Type 140 fabric supplied in 15 to 16-foot roll widths.

c. Excelsior Erosion Control Blanket ("Curlex"). Erosion control blanket shall be curlex blanket as manufactured by American Excelsior Company. Curlex rolls will be approximately as follows:

Roll Width	48"
Roll Length	180'
Roll Weight	78#
Roll Area	80 sy

Anchorage devices will be two-legged steel staples furnished by the Owner for the curlex blanket material.

D. Geotextile Matting ("Enkamat'). Geotextile matting shall be Type 7010 Enkamat as manufactured by American Excelsior Company. Anchoarage devices shall be pine stakes or metal staples as supplied by the Owner. Geotextile matting rolls will be approximately as follows:

Roll Width	36 "
Roll Length	490'
Roll Weight	8 #
Roll Diameter	46"
Roll Area	173 sy

3. INSTALLATION REQUIREMENTS

A. Silt Fencing. Silt fencing shall be installed as shown on the Drawings and as specified in Section 200 entitled "Site Preparation."

B. Filter Fabric.

1. Filter fabric shall be installed as shown on the drawings and as specified herein beneath all stone riprap which is designated to be placed at the edges of the constructed flood plain.

2. Prior to layout of fabric, receiving slopes shall be cleared of any objects which could puncture or tear the material. The

ground shall be reasonably smooth and uniform, free of clumps and sharp mounds.

3. Adjoining strips of fabric shall be overlapped two feet. The fabric layout shall proceed from downstream toward upstream such that each upstream edge of a sheet is protected or covered as shown on the Drawings.

4. The Contractor shall conduct operations in a manner to protect the exposed fabric from abrasion, cuts, tears, or ruptures. Any fabric torn or punctured during the laydown and covering process shall be patched with an extra layer of undamaged fabric extending at least 2-feet beyond the extreme limits of any tear or hole or fabric injury. Patch material shall be attached as recommended by the manufacturer.

5. At the limits of fabric-covered areas, the edges of the fabric shall be anchored all around in a trench at Ieast one-foot deep. Beneath riprap, at the streamward edge of the riprap blanket, the fabric may be considered to be anchored by the riprap in the riprap trench.

6. Work shall be organized to prevent any equipment from working directly on exposed fabric.

7. Fabric shall not be exposed to sunlight for any period exceeding 3 days. Care shall be taken to lay out only as much fabric as can be anchored and covered within two working days.

8. The placement of riprap upon the prepared, fabric-covered slope shall be performed according to the restrictions specified in Section 202 entitled "Riprap."

c. Curlex Blanket.

1. The curlex blanket shall be spread only on prepared, fertilized, and seeded surfaces. The curlex shall be rolled out such that the plastic netting is on top of the fibre mat.

2. On slopes, the curlex shall be layed up-and-down the slope.

3. Ends and sides of adjoining pieces of material shall be overlapped 6 inches and 4 inches respectively and stapled as specified herein. Four anchors shall be installed across ends. A common row of staples shall be used at side joints.

4. Within the constructed floodplain, the edges of the curlex mats shall be buried in a 6-inch deep trench as follows: a) along the streamward edge of the curlex mat nearest the stream: and b) at the unlapped ends of mats where curlex coverage is not continuous. Otherwise, no anchorage dikes or trenches will be required for curlex erosion control blanket.

5. Anchorage shall be by means of g-inch long, two-legged, steel staples driven vertically and full-length into the ground. The legs shall be spread 3 inches to 4 inches apart at the ground surface to improve resistance to pull-out.

6. Staple spacing criteria shall be as follows:

   a) On 3:l slopes and other surfaces which will not be exposed to the active flaw of Bear Valley creek, anchors shall be installed at 6-foot alternating spacing down the edges and the center of the 4-foot wide curlex mats.

   b) Within the constructed floodplain where the curlex mats could be exposed to the active flow of Bear Valley Creek, a 4-foot alternating spacing shall be applied.

c) The spacing of edge staples shall be reduced to 2-feet wherever the curlex mat is buried in a 6-inch deep trench. The 2-foot spacing is applicable also for the five strips of curlex fabric nearest Bear Valley Creek at locations where, at high flow rate, Bear Valley Creek water will flow out of the main channel and onto the floodplain.

7. Waste of curlex material shall be minimized by limiting overlaps as specified above: by utilizing the full length of netting at roll ends: and by permitting small coverage gaps at the intersections of non-parallel strips of matting.

8. Curlex material shall not be rolled out onto ground containing frost within the g-inch penetration zone of the anchorage staples. Further, -no stapling shall be undertaken while any frost exists within the staple penetration zone.

D. Geotextile Matting.

1. Geotextile matting shall be installed peak-side-down as shown on the Drawings and specified herein on slope surfaces which have been prepared with curlex erosion control blanket.

2. The geotextile matting shall be installed on 3:l slopes from top to bottom and anchored as shown on the Drawings by riprap at the bottom and an anchorage trench at the top of the protected slope.

3. Adjoining strips of geotextile matting shall be overlapped 3 inches and staked at 5-foot intervals with a common stake situated at least 1 inch from the edges of the lapped fabric. The overlap at end joints shall be I.2 inches with the anchorage stake situated at the center of the lap.

4. Wooden anchorage stakes provided for the geotextile matting shall be oriented with their broad side along the contour line or perpendicular to the slope.

5. Anchorage stakes shall be driven perpendicular to the sloping ground surface. No more than 5 inches of wooden anchor stake shall be left exposed above the ground surface.

6. The bottom and top rows of stakes shall be situated beneath the riprap anchorage and in the anchorage trench respectively.

CHAPTER 6

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

CHAPTER 6

1985 MONITORING STUDIES

INTRODUCTION

This chapter describes the 1985 monitoring studies conducted for the Bear Valley Creek project and provides an analysis of monitoring results where appropriate. The monitoring studies were conducted to establish baseline data on pre-construction conditions and also to gather information about the project site that could affect design and/or construction of the enhancement and stabilization measures. Some of the monitoring studies were conducted during the 1985 construction activity to determine what, if any, short term effects the stabilization and enhancement work was having on Bear Valley Creek. The 1985 monitoring studies included the following activities.

- Water Quality Sampling
- Stream Flow Measurements
- Botanical Assessment
- Soils Evaluation
- Cross Section Surveying

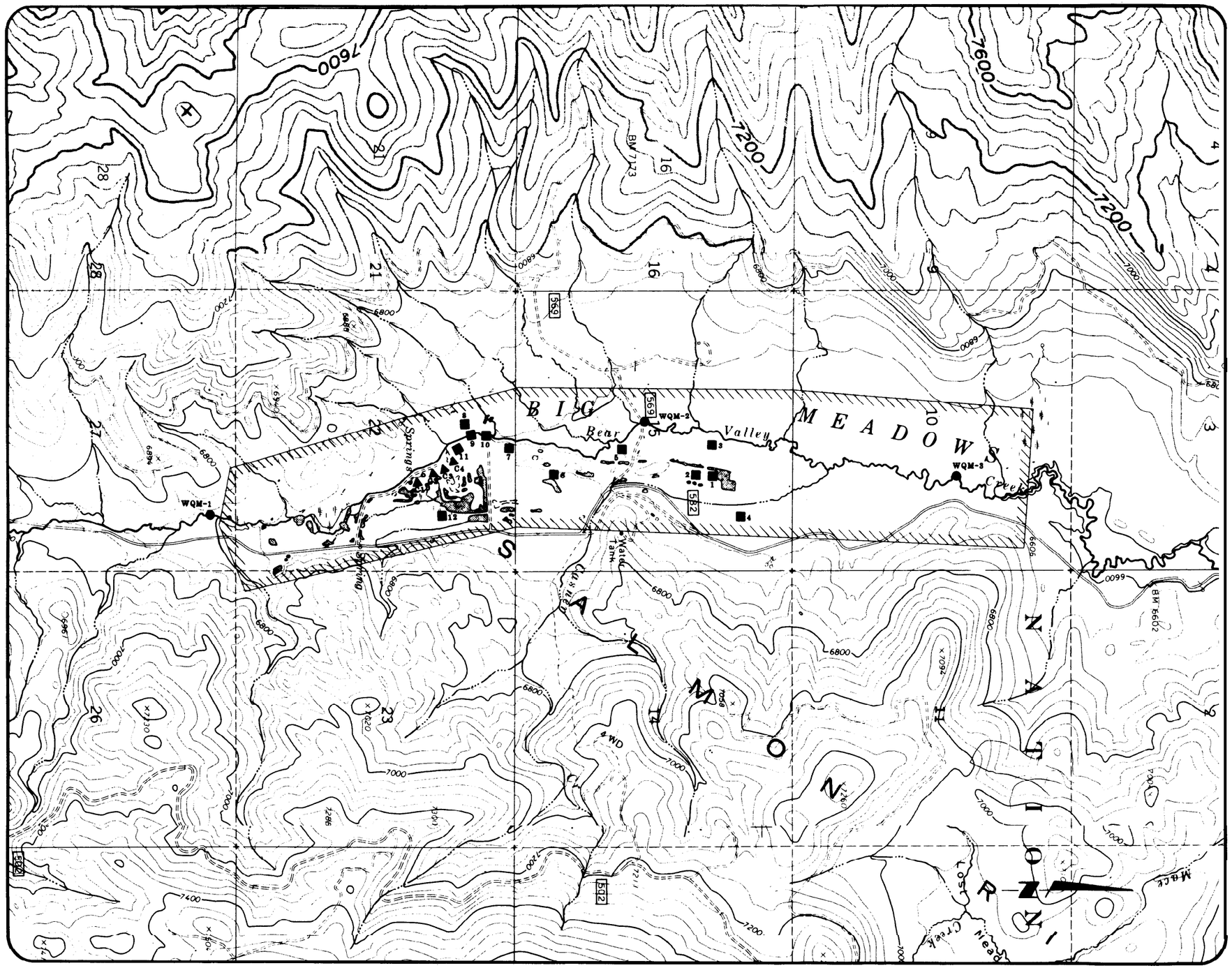
The data collected from these activities are presented, analyzed and discussed as appropriate in the sections below.

WATER QUALITY SAMPLING

The water quality sampling program was conducted as a baseline monitoring and construction monitoring study. Water quality sampling sites were established at six locations on the patented land in Bear Valley for baseline monitoring. Three water quality sampling sites were located on Bear Valley Creek: 1) WQM-1, at the southern upstream patented land boundary; 2) WQM-2, at the bridge crossing Bear Valley Creek in the middle of Section 15; and 3) WQM-3, at the northern downstream boundary of the patented land (Figure 6-l). The remaining three water quality sampling sites were located at ponds within the patented land boundaries: 1) WQMP-1, at the outlet to the large pond near soil test pit location Cl; 2) WQMP-2, at the sediment pond east of Bear Valley Creek near soil nutrient sampling site 6; and 3) WQMP-3 at the outlet to the largest dredge pond on the patented land, north of the bridge and west of Forest Route 582 near soil nutrient sampling site 1 (Figure 6-l).

The six water quality sampling sites were each visited four times during 1985 to collect water samples for analysis by a Boise laboratory. The schedule included sampling prior to the peak spring runoff, during the spring runoff, following spring runoff at the base flow condition, and during the low flow period. The first sampling trip was made by helicopter due to snowpack covering roads to the site. The remaining three sampling trips were made using a four wheel drive vehicle.

The water quality parameters monitored for each site and the monitoring results are presented in Tables 6-1, 6-2, 6-3, and 6-4. The data presented in Table 6-l are the results of water quality analyses from samples collected prior to the peak spring runoff. The results for the stream sampling sites indicate good



BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

FIELD STUDIES'

SAMPLING AND MONITORING SITES

FIGURE 6-1

LEGEND

	PATENTED LAND BOUNDARY
●WQM-2	WATER QUALITY AND STREAM FLOW MONITORING SITE
■10	SOIL NUTRIENT SAMPLING SITE
▲C2	SOIL TEST PIT LOCATIONS

0 1000 2000 4000

SCALE FEET

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

TABLE 6-l

RESULTS OF WATER QUALITY MONITORING MAY 6, 1985
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

		Results By Station					
Parameter	units	WQM-1	WQM-2	WQM-3	WQMP-1	WQMP-2	WQMP-3
Temperature	°F	38.5	40.0	35.5	39.0	32.0	38.0
Turbidity	FTU	1.5	3.0	2.9	14.0	4.8	5.0
pH	units	7.0	6.6	6.6	6.5	6.5	6.5
Total Suspended Solids	mg/l	8.0	8.0	2.0	4.0	2.0	2.0
Total Dissolved Solids	mg/l	26.0	34.0	30.0	48.0	20.0	42.0
Sulfate	mg/l	0.67	1.0	1.3	--*	--	--
Specific Conductance	µmho	20.0	30.0	18.0	--	--	--
NH_3-N	mg/l	<0.1	<0.1	<0.1	--	--	--
$N0_3$-N	mg/l	<0.1	<0.1	<0.1	--	--	--
Total Kjeldahl Nitrogen	mg/l	0.67	1.7	2.2	--	--	--
Total Phosphorus	mg/l	0.014	0.049	0.022	--	--	--
Total Coliform	#/l00 ml	16.0	2.2	16.0	--	--	--

*Results represented with (-) indicate no monitoring for parameter at this sampling site.

TABLE 6-2

RESULTS OF WATER QUALITY MONITORING JUNE lo,1985
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

		Results By Station					
Parameter	units	WQM-1	WQM-2	WQM-3	WQMP-1	WQMP-2	WQMP-3
Temperature	°F	40.0	39.0	38.5	40.0	40.0	38.5
Turbidity	FTU	0.50	1.0	1.6	5.5	20.0	5.4
pH	units	7.0	6.8	6.7	6.5	6.7	6.6
Total Suspended Solids	mg/l	2.0	8.0	12.0	6.0	12.0	6.0
Total Dissolved Solids	mg/l	40.0	42.0	28.0	40.0	40.0	36.0
Sulfate	mg/l	0.33	1.0	0.67	--*	--	--
Specific Conductance	µmho	18.0	28.0	16.0	--	--	--
NH_3-N	mg/l	<0.1	<0.1	<0.1	--	--	--
$N0_3$-N	mg/l	<0.1	<0.1	<0.1	--	--	--
Total Kjeldahl Nitrogen	mg/l	1.1	0.57	0.46	--	--	--
Total Phosphorus	mg/l	0.040	0.081	0.036	--	--	--
Total Coliform	#/100 ml	9.2	>16.0	>16.0	--	--	--
Arsenic	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/l	1.90	1.85	2.08	6.12	3.15	4.93
Copper	mg/l	<0.002	<0.002	<0.002	<0.002	0.003	<0.002
Iron	mg/l	0.13	0.12	0.11	1.11	0.42	0.12
Magnesium	mg/l	0.208	0.213	0.209	0 .536	0.420	0.530
Potassium	mg/l	0.203	0.202	0.211	0.340	0.733	0.261
Sodium	mg/l	3.24	3.04	3.28	3.28	3.14	3.18
Zinc	mg/l	<0.010	<0.010	<0.010	<0.010	0.015	<0.010
Radioactivity							
Alpha	pCi/l	--	--	--	0.1	2.9	0.3
2Sigma	pCi/l	--	--	--	0.3	1.0	0.4
Beta	pCi/l	--	--	--	0.6	3.3	-0.1
2Sigma	pCi/l	--	--	--	0.8	1.1	0.8

*Results represented with (-) indicate no monitoring for parameter at this sampling site.

TABLE 6-3

RESULTS OF WATER QUALITY MONITORING SEPTEMBER 9, 1985
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

		Results By Station					
Parameter	units	WQM-1	WQM-2	WQM-3	WQMP-1	WQMP-2	WQMP-3
Temperature	°F	43.0	46.0	44.0	54.0	49.0	
Turbidity	FTU	2.6	4.9	3.7	0.64	<100.0	
pH	units	6.7	6.7	6.8	6.8	6.8	
Tot al Suspended Solids	mg/1	10.0	2.0	8.0	4.0	64.0	
Total Dissolved Solids	mg/1	24.0	38.0	44.0	56.0	122.0	
Sulfate	mg/1	1.3	1.3	1.3	--*	--	
Specific Conductance	µmho	24.0	24.0	24.0	--	--	
NH_3-N	mg/1	<0.1	<0.1	<0.1	--	--	
$N0_3$-N	mg/1	<0.1	<0.1	<0.1	--	--	
Total Kjeldahl Nitrogen	mg/1	1.7	1.5	3.3	--	--	
Total Phosphorus	mg/1	0.310	0.093	0.040	--	--	
Total Coliform	#/100 ml	>16.0	>16.0	>16.0	--	--	

*Results represented with (-) indicate no monitoring for parameter at this sampling site.

TABLE 6-4

RESULTS OF WATER QUALITY MONITORING OCTOBER 16, 1985
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

		Results By Station					
Parameter	Units	WQM-1	WQM-2	WQM-3	WQMP-1	WQMP-2	WQMP-3
Temperature	OF	36.0	39.0	40.0	43.0	45.0	43.0
Turbidity	FTU	1.4	2.0	2.0	2.4	27.0	4.4
pH	units	7.0	7.0	7.0	7.0	7.1	7.1
Total Suspended Solids	mg/l	2.0	1.0	1.0	2.0	1.0	2.0
Total Dissolved Solids	mg/l	28.0	35.0	39.0	52.0	47.0	38.0
Sulfate	mg/l	1.0	1.3	3.0	--*	--	--
Specific Conductance	µmho	28.0	24.0	20.0	--	--	--
NH3-N	mg/l	x0.1	co.1	<0.1	--	--	--
N03-N	mg/l	x0.1	x0.1	<0.1	--	--	--
Total Kjeldahl Nitrogen	mg/l	1.7	0.68	1.5	--	--	--
Total Phosphorus	mg/l	0.358	0.032	0.028	--	--	--
Total Coliform	#/100 ml	9.2	16.0	16.0	--	--	--

*Results represented with (-) indicate no monitoring for parameter at this sampling site.

water quality within the parameters tested. The results for the pond sampling sites indicate good water quality and no apparent influence on the stream. The results of water quality -monitoring during the spring runoff are presented in Table 6-2. The data for the stream sampling sites indicate good water quality conditions during runoff for the parameters monitored. The data for the pond sampling sites indicate good water quality and no apparent influence on the stream. Radioactivity levels in the ponds were at or below background concentrations for waters exposed to sunlight. Results of the water quality monitoring at the base flow condition (following spring runoff) are presented in Table 6-3. The weather conditions were rainy when water quality samples were collected on September 9, 1985, and the results from site WQMP-2 indicate high turbidity, high total suspended solids, and high total dissolved solids, relative to the other sampling sites. Site WQMP-2 is a settling pond with no surface outlet and it is surrounded by fine clay sediments. The data for the stream sampling sites indicate good water quality conditions and no apparent influence from the ponds. The data presented in Table 6-4 are the results of water quality analyses collected during the low flow period. The water quality samples were collected on October 16, 1985, during active construction along Bear Valley Creek. The data for the stream and pond sampling sites indicate good water quality, except for higher turbidity in the pond at WQMP-2.

The results from analysis of water samples collected for Bear Valley Creek during 1985 indicate a good baseline water quality condition throughout the spring and summer months. The parameters monitored for Bear Valley Creek indicate the 1985 construction did not affect the water quality of the stream. Comparison of the 1985 water quality data with results from 1977 samples collected in Bear Valley Creek indicate similar conditions for the same parameters.

In addition to the baseline water quality monitoring program, turbidity was monitored during the 1985 construction activity in September and October. The turbidity samples were collected at WQM-1, WQM-2, and at random locations between these two sampling sites. A portable Hach Turbidimeter was used to measure the turbidity. The results of turbidity measurements collected from Bear Valley Creek during the 1985 construction activity are presented in Table 6-5. The turbidity measurements are evaluated on a point in time basis, upstream results compared to downstream results, for determining compliance with State of Idaho water quality standards. Samples collected on October 10, 14, and 21, 1985, indicated excessive turbidity in Bear Valley Creek between upstream and downstream sites. Bear Valley Creek was completely frozen over on these three dates, and as daily temperatures increased, the ice fractured and broke up. JMM engineers working on the site observed and recorded that the turbidity was caused by the ice pulling sediments out of the stream banks and by ice chunks tumbling over the stream bed gravels. There was no input of fine or colloidal materials to Bear Valley Creek from the construction activity during the ice breakup events. The remaining turbidity data (Table 6-5) collected from Bear Valley Creek during the 1985 construction demonstrates that the project had no significant affect on the turbidity of the stream between upstream and downstream monitoring sites.

STREAM FLOW MEASUREMENTS

The stream flow measurements were conducted using crest gauge and in-stream flow methods in Bear Valley Creek. The crest gauge method of stream flow

TABLE 6-5

RESULTS OF 1985 TURBIDITY MONITORING
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Sampling Date	TURBIDITY (FTU) WQM-1 (above project construction)	Random sites in construction zone	WQM-2 (below construction at bridge)	Comments
7/19/85	0.50	--*	2.0	Weather cool, overcast
9/16/85	0.90	1.2	1.0	Weather clear, cool
9/23/85	0.57	0.87	0.95	Weather sunny, warm
9/25/85	0.59	0.63	0.69	Weather sunny, warm
9/27/85	0.37	1.6	2.0	Weather sunny, warm
9/30/85	0.52	1.0	0.95	Weather clear, cool
10/2/85	0.86	0.95	0.97	Weather fair, partly sunny
10/4/85	0.95	1.1	1.2	Weather cool a.m., warm p.m.
10/10/85	1.4	—	37	Stream frozen over a.m., ice breakup loosened fines
10/14/85	1.9	8.3	36	Stream frozen over a.m ., ice breakup loosened fines
10/16/85	1.4	—	2.0	Weather clear, cool, no ice in stream
10/21/85	15	29	78	Stream frozen over a.m., ice breakup loosened fines
10/23/85	4.0	4.8	5.2	Weather snowy, cold
11/7/85	3.1	3.8	3.9	Weather snowy, cold

*Results represented with (-) indicate no sample collected at this site.

measurement involved installation of a graduated staff contained in a PVC pipe at the bridge across Bear Valley Creek. This site is the same as water quality monitoring site WQM-2 (Figure 6-l). The crest gauge pipe has perferations that allow the water to contact the graduated staff. Cork dust placed in the pipe floats to the surface of the water and records the highest stage of the stream flowing through a known cross section. The WQM-2 site was selected for crest gauge measurement of stream flow because the cross section is relatively stable and unchanging compared to the rest of Bear Valley Creek. The crest gauge method of flow measurement provides an estimate of peak stream flow during spring runoff. The Bear Valley Creek crest gauge was installed to help estimate peak stream flows as part of monitoring for the habitat enhancement project.

The crest gauge was installed at WQM-2 during the May 6, 1985 monitoring trip, prior to the peak of spring runoff. JMM subcontractor Howard Myers surveyed the cross section in July 1985. The crest gauge graduated staff was read in July 1985. The estimated peak flow at WQM-2 during 1985 was 164 cfs, as determined using Manning's equation for open channel flow. This estimated flow occurred in late May or early June 1985.

The in-stream flow measurements were made at each of the water quality monitoring sites on the same day as water quality sampling. The method of in-stream flow measurement involved recording water velocity and depth at one foot increments across Bear Valley Creek. The water velocity was measured at 0.6 times the stream depth using a digital hand-held meter mounted on a top-setting rod. Each incremental area was multiplied by the recorded velocity to yield a flow for the increment. Summation of the incremental flows resulted in our estimate of the stream flow at the monitoring site. The in-stream flows as estimated by this method are presented in Table 6-6. The highest recorded stream flow was at WQM-3 during the relay 1985 monitoring trip. This flow was higher than the flow recorded at WQM-3 during the June 1985 monitoring trip, however, flows at WQM-1 and WQM-2 were highest during the June 1985 monitoring trip. The data suggest that the snowpack melted earlier in portions of the drainage basin tributary only to WQM-3 as compared to the upstream drainage areas. Stream flow measurements taken in September and October 1985 indicate a base flow condition in Bear Valley Creek.

BOTANICAL ASSESSMENT

A botanical assessment was conducted for the project area during 1985 to characterize existing vegetation and provide data on plant communities. The botanical assessment was used to help plan the revegetation strategy for the project. JMM subcontracted with Smithman Consulting Services of Boise, Idaho to conduct the botanical assessment and revegetation plan. Smithman Consulting Services performed the field work at Bear Valley Creek in June, July, and August 1985, and their report was completed in September 1985. This section of the chapter presents the report as submitted by Smithman Consulting Services.

The botanical assessment and revegetation plan as presented by Smithman Consulting Services included recommendations for vegetation stabilization of the constructed floodplain and other areas disturbed during construction and historic mining. The JMM project team, comprised of two biologists, a landscape architect, a soil scientist, and several engineers with extensive experience in land reclamation, did not concur with the recommendations of the revegetation plan

TABLE 6-6

RESULTS OF 1985 IN-STREAM FLOW MEASUREMENTS
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Stream Flow Measurement Site	Estimated lb-stream Flows (cfs)			
	5/6/85	6/10/85	9/9/85	10/16/85
WQM-l*	25.6	50.3	20.4	18.1
WQM-2**	48.1	62.4	29.9	26.8
WQM-3***	85.8	81.9	49.2	44.2

*Site is located upstream of project area at south boundary of patented land (Figure 6-l).

**Site is located immediately downstream of project area at bridge in center of Sec. 15, T.llN., R.8E. on patented land (Figure 6-l).

***Site is located downstream of project area at north boundary of patented land (Figure 6-l).

as submitted by Smithman Consulting Services. In summary, the plan recommended natural seeding of disturbed areas and revegetation with no fertilization. JMM identified seeding and fertilization of disturbed areas for revegetation as a high priority because of potential downstream effects of sediment which could be recruited from the construction area in future years. Immediate stabilization with vegetation would help prevent sediment recruitment into the stream and protect spawning habitat in downstream reaches. The 1985 construction included seeding of the constructed floodplain with a mixture of high altitude seeds that grow well in wet soils. The constructed areas above the floodplain were seeded with a mixture of high altitude seeds that grow well in dry soil conditions. JMM's revegetation plan emphasizes establishment of introduced plants that can eventually be dominated by native plants in order to achieve stabilization of the soils. Researchers with the USDA-Forest Service, Intermountain Forest and Range Experiment Station were in concurrence with JMM on the approach to stabilization of soils through use of introduced species. Site visits by these researchers with JMM helped verify that introduced plant species were already present in Bear Valley. The researchers recommended seeding with introduced species and application of fertilizer to promote revegetation and soil stabilization that could eventually lead to establishment of native species in the constructed areas.

The 1985 construction included seven-10 square foot test plots that were not seeded or fertilized to help test each revegetation strategy. Five of the test plots were located in the constructed floodplain, and two test plots were located on the 3 to 1 slopes defining the floodplain. The revegetation of areas constructed in 1985 will be closely monitored in 1986.

The botanical assessment and revegetation plan by Smithman Consulting Services is presented in the following pages.

BOTANICAL ASSESSMENT

and

REVEGETATION PLAN

BEAR VALLEY FISH HABITAT ENHANCEMENT PROJECT

for

SHOSHONE-BANNOCK INDIAN TRIBES

and

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

September 1985

by

Patricia L. Packard

and

Lynda C. Smithman

Smithman Consulting Services
819 North 18th Street
Boise, Idaho 83702

(208) 344-2650

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INTRODUCTION

The Bear Valley Fish Habitat Enhancement Project is sponsored by the Shoshone-Bannock Tribes with funds from the Bonneville Power Administration and with cooperation from Bear Valley Minerals, Inc. , owners of the patented land on Bear Valley Creek. Patricia L. Packard and Lynda C. Smithman were requested under contract with James M. Montgomery, Consulting Engineers, Inc., to conduct field reconnaissance and to review pertinent literature regarding revegetation of the patented lands in Bear Valley. The literature review and the evaluation of existing data began in February 1985. Field studies were initiated in July 1985 for development of the revegetation plan.

The following report includes an overview of the Bear Valley habitat and a discussion of problems in adaptation of subalpine plants. A detailed description of Bear Valley plant associations, their potential for revegetation, proposed actions and recommendations for revegetation is provided in Appendix B. An analysis of past revegetation efforts and an evaluation of selected treatments also is included. The appendix contains a check list of Bear Valley plant species which includes the habitat preferences and the reproductive capabilities for each taxon.

GENERAL ADAPTATIONS OF SUBALPINE FLORA TO SUBALPINE CLIMATE

Bear Valley lies in the Idaho Batholith and is composed of granite, quartz monzonite and granodiorite rocks (Kline et al. 1953). Soils derived from these rocks ordinarily are acidic and infertile. Plants native to the soils are adapted and flourish but plants introduced from other regions are usually not adapted to such conditions.

Boggy areas within subalpine regions are often somewhat alpine in character. This is apparently true in Bear Valley, one of the coldest areas in the state (Cole 1972)) which supports a subalpine-alpine flora with a very short growing season.

The short, cool growing season and infertile soil are probably the two main factors to which subalpine plants must be adapted and these must be taken into consideration in management of subalpine habitats. Late seasons and cold air drainage delay plant growth in the spring. Cole (1972) says runoff begins in March but in years with heavy snow pack, runoff doesn't begin to recede until June. In years with 14 feet of snow in Bear Valley (Kline et al. 1953)) the growing season must be greatly delayed. Late season drought causes plants to brown-off, often by the first of August. In this short time, there must be sufficient photosynthesis to provide daily maintenance of the plants, occasional maturation of seeds and storage of sufficient carbohydrate to support leaf growth before photosynthesis begins in the spring so full photosynthetic use may be made of all time suitable for photosynthesis in the short season.

There are a number of adaptations tending to maximize photosynthesis during a brief growing season but plants with only partial sets of adaptations will not be competitive with plants having full sets. Partially adapted plants will be replaced by fully adapted plants. Once a plant acquires a full set of adaptations, seed set, with the accompanying sexual reproduction process, is a disadvantage because sexual reproduction breaks up sets, of adaptive

genes. Asexual reproduction retains the adaptive gene sets so there is strong selection for systems of asexual reproduction. A minimum of 42% of the Bear Valley plants are known to have some form of asexual reproduction; rhizomes, sprouting root stalks or apomixis. The actual figure is probably much higher.

Reproduction by seeds has a second big disadvantage in subalpine habitats. Seed set in a short season is unreliable and may not occur every year. This, too, places a premium on vegetative reproduction, e.g., rhizomes or sprouting rootstalks. Annuals rarely reproduce asexually and are obliged to set seed every year so they are infrequent in subalpine habitats. Only 7 (8%) annual species were found on the patented land in Bear Valley, all in very low frequency. This seems to be unusually high for a subalpine region. Two of these species were introduced weeds and three were confined to margins of ponds in the clay basin area of the dredge tailings, a habitat that does not, exist here under normal circumstances. Annual species comprise an estimated <3% of the species of undisturbed vegetation, the higher figure probably representing effects of disturbance. In all cases, annuals were infrequent and confined to special habitats.

Adaptations to maximize photosynthesis are to be expected in subalpine floras. Photosynthesis is a photochemical reaction, independent of temperature, but it is linked to temperature-dependent chemical reactions. This means that lowland plants cannot photosynthesize at low temperatures. Tundra species, however, are able to photosynthesize down to the freezing point (Daubermire 1978). Subalpine species, especially in locations such as Bear Valley, can be expected to have similar abilities. In some alpine species this is inherent. In others rapid acclimatization is a phenotypic response, ultimately depending on genetic capacity. Respiration, too, is comparatively rapid at low temperatures in high altitude plants (Billings 1974).

Scott and Billings (1964) found alpine tundra plants to have higher light saturation values than lowland plants. High light intensities ordinarily decrease photosynthetic efficiency. But in high altitudes, where light intensity is high, low temperatures and short seasons make it necessary to

utilize all possible photosynthetic time. Alpine plants have adapted to utilizing the light intensities efficiently. Introduced plants without this ability are not able to photosynthesieze efficiently during brief periods of suitable temperature, and so loose out to adapted natives. Subalpine plants can be expected to have similar abilities to slightly lesser degrees.

Products of photosynthesis are stored immediately as starch or other complex carbohydrates in leaves or shoots and are translocated at night to underground parts for long term storage. Low night time temperatures, as occur almost any summer night in Bear Valley, inhibit conversion and translocation of photosynthetic products. High altitude plants have to be adapted to proceeding with this reaction at low temperatures. Casual field observation suggests lowland plants are typically unable to do this.

Photoperiod in high altitude plants usually triggers onset of at least dormancy and flowering and possibly several other processes. High altitude plants often bloom before lowland ecotypes of the same species so as to complete the life cycle before winter or browning-off. This requires a long photoperiod in high altitude plants and a shorter photoperiod in lowland plants (Chabot and Billings 1972). If flowering is not induced early enough to occasionally complete seed set, reproduction and adaptation may not occur. Similarly, if dormancy is not triggered at the right time, plants winter kill.

Seed germination in alpine plants is fine-tuned to alpine conditions, generally requiring oscillating, comparatively high temperatures and moist soil. This combination of characteristics prevents fall germination and restricts germination to the time of year in which seedlings have a chance of making it (Chabot and Billings 1972; Billings 1974). Again, this can be extrapolated to subalpine conditions, similar to alpine conditions but to a slightly lesser degree. Field observations suggest germination at higher temperatures is characteristic of Bear Valley plants but a drought year was not the appropriate time to study this. Lowland species, especially of European origin, are frequently adapted for fall germination to take advantage of fall rains. Fall germination apparently leads to winter kill at high

altitudes. This may explain the apparent non-germinating habits of some revegetation seedings we have seen in subalpine areas.

In summary, in the unlikely event that introduced lowland material germinates in subalpine areas and the more unlikely event that it photosynthesizes sufficiently to produce a carbohydrate surplus and thus is able to reproduce, there is little possibility that it will have the correct photoperiod to induce flowering or that it can go dormant and live through the winter. Survival of introduced seedlings in subalpine areas is a “snowball in hell” situation.

These are only a few of the largest adaptations that make life possible in subalpine areas. Without doubt, the complete catalogue would be extensive. It needs to be re-emphasized that in order to survive, a plant needs a full set of adaptations.

POTENTIAL FOR REVEGETATION

Considerable species diversity is found on the mined property in Bear Valley. The check list of 89 species contained in Appendix B is comparable in size with other Central Idaho subalpine areas with which the consultants are familiar. It is particularly noteworthy that a flora of this magnitude was detected during a drought year. A few more species could be expected in a more moist field season, particularly if such a season coincided with the rest cycle in the Big Meadows grazing allotment.

An abundance of propagules exists throughout the mined property. Naturally revegetated areas also were observed in each plant community which serve as on-site centers of distribution. There is substantial evidence that seeds, pieces of root and other propagules continue to be blown and wash from the surrounding areas. For example, Abies lasiocarpa (subalpine fir) and Picea engelmannii (Engelmann spruce) seeds have been flown or washed into the patented lands from considerable distances upstream and/or upslope. Extensive colonies of Artemisia ludoviciana var. latiloba (western mugwort) and Penstemon attenuatus var. militaris (taper-levaed penstemon), which provide excellent sources of seed as well as have the ability to reproduce vegetatively were observed. Mat-forming perennials such as Sagina saginoides (alpine pearlwort) were frequently noted on newly-formed gravel bars. Rhizomatous sedges and rushes were found along moist streambanks and ponds; these plants have the ability to form aggressive colonies. Several species of Salix (willow), each adapted for slightly different habitats, also were collected on the patented land.

The large number of rhizomatous and stoloniferous species, at least 42%, of the plants found on the mined property, demonstrates that the local flora has excellent capabilities for use in stabilization projects. These capabilities used in combination with proposed fencing, modification of steep slopes, creation of wider floodplains, geotextile fiber and erosion control blankets further increase the likelihood of success for the Fish Habitat Enhancement Project.

Tests conducted by James M. Montgomery, Consulting Engineers, Inc., during 1985 indicate that Bear Valley soils tend to be more acidic than alkaline, which is to be expected in the subalpine environment. Data gathered from sedge meadow, floodplain, clay basin and rocky tailings soils suggest that these soils may be rather basic or neutral. Higher levels of acidity were noted in the former sedge meadows and in the "resoiled" tailings. Significant levels of released nitrogen were found in the sedge meadow and former sedge meadow soils.

Since the native plants of Bear Valley are adapted for these rather typical subalpine conditions, the test results do not indicate any special problems for revegetation. Non-native plants, however, would probably not be adapted for these conditions. The higher levels of acidity detected in the former sedge meadow soil and the "resoiled" tailings may require further investigation, if there are problems with restoring vegetation on these soils. Fortunately most of the proposed construction will not involve former sedge meadows and the consultants have recommended burying any excess sedge meadow soil acquired through excavation.

RESULTS OF PAST REVEGETATION EFFORTS

In 1957, approximately , the dredge tailings were leveled. Top soil, excavated elsewhere on the property, was placed on a portion of the tailings near the large dredge pond in Section 15 and at least 32 acres were seeded with the following introduced plants according to an article published in Mining World, January, 1985:

Alsike clover
Meadow foxtail
Smooth brome
Timothy
Intermediate wheatgrass

During the 1985 field season the consultants observed only small numbers of these introduced plants in the leveled tailings.

Tailings on the margins of the clay basin and the basin itself still contain some remnants of this original seeding, but these remnants are rather sparse. For example, a few Phleum pratense (common timothy) were observed. Alopercurus pratense (meadow foxtail), although a little more numerous than the common timothy, are quite depauperate when compared to low elevation specimens. Trifolium hybridum (alsike clover) also has persisted, but seems rather small in diameter (approximately 5-6 cm) and appears to be somewhat solitary. A sterile coarse grass was observed on the leveled tailings near the big dredge pond which had been reclaimed with a top soil cover. This grass possibly could be a remnant of this original seeding; no other introduced species were observed on the top soil cover.

During the fall of 1969 the U.S. Forest Service recommended, in a letter from W. Pavlat, Bear Valley District Ranger, that the owners of the patented lands seed the former diversions with the following introduced species :

Phleum pratense	Common timothy
Alopecurus pratense	Meadow foxtail
Agropyron subsecundum	Bearded wheatgrass

Virtually no evidence of these introduced grasses which were seeded on the former diversions could be found during the 1985 field season. The low moist diversion banks on the patented lands have naturally revegetated with Carex spp. (sedges) and Juncus balticus var. montanus (Baltic rush).

There are several possible explanations for the apparent absence of introduced species along the former diversions in sedge meadow communities. Untimely germination in the fall, which is typical of low-elevation grasses, may have resulted in freezing. The water-saturated habitat, although conducive to the germination of sedges and rushes, does not favor the germination of grass seeds. There also is the possibility that the aggressive rhizomatous sedges and rushes may have swamped any introduced grasses which were able to survive the subalpine environment.

The effectiveness of these treatments, which were visionary in 1958 and still considered standard practice in 1969, is now questioned by reclamation specialists. Consequently, practitioners are more frequently using native species in revegetation planning. Although standard seed mixes have been used extensively at lower elevations where the local flora has collapsed, their effectiveness in high altitude habitats has yet to be demonstrated. It appears that in Bear Valley the introduced species drop out rather rapidly along saturated stream and canal banks. In less saturated portions of the patented lands, where they are barely able to persist, their depauperate growth does not seem to be vigorous enough to provide the desired sod building function which is considered essential for soil stabilization.

BEAR VALLEY PLANT ASSOCIATIONS

Subalpine Forest

The slopes surrounding Bear Valley are covered by subalpine forest. This community is not included in the study area but the constant rain of seeds from this forest strongly influences the study area.

This area includes both terminal and lateral glacial morains composed of raw, immature glacial soils. This immature soil is even more infertile than ordinary granitic-derived soils and supports a lodgepole pine (Pinus contorta) forest almost entirely. Lodgepole pine, known as a serotinous species, is adapted for coming in after fire. However, the Central Idaho ecotype is not markedly serotinous and lacks serotinous cones. It is adapted to raw, granitic, glacial soil and forms an edaphic climax on this soil that will not support other forest vegetation.

Mature soils on high slopes surrounding Bear Valley are covered with Abies lasiocarpa (subalpine fir) and Picea engelmannii (Engelmann spruce) and their associated species. Bare ridges are prominent and support low mounds of subalpine-alpine plants,

Conifer seeds are distributed by winds as are seeds of some other species. Birds, mammals and flowing water are known or suspected to distribute seeds of other species. There is a constant rain of subalpine forest seeds on the wet sedge meadows of Bear Valley. These seeds can not germinate in the highly saturated soils of undisturbed meadow, but where the water table has dropped, or especially on the conditions created by dredge tailings, these seeds find suitable habitat for germination and growth. The raw tailings of the Bear Valley dredge are not far different from the native raw glacial till and infertile granitic soils of the local subalpine forests.

Sedge Meadow

The floor of Bear Valley is occupied largely by sedge meadow. The main species found here are:

Carex aquatilis	Water sedge
Carex canescens	Gray sedge
Carex illota	Small-headed sedge
Juncus balticus	Small-winged sedge
Juncus mertensiana	Merten's rush
Luzula hitchcockii	Smooth woodrush
Calochortus sp.	Sego lily
Salix drummondiana	Drummond's willow
Salix wolfii	Wolf's willow
Polygonum bistortoides	American bistort
Delphinium depauperatum	Dwarf larkspur
Ranunculus alismaefolius	Dwarf plantain-leafed buttercup
Saxifraga oregana	Box saxifrage
Trifolium lineines	Long-stalked clover
Ligusticum tenuifolium	Slender-leaved ligusticum
Gentiana calycosa	Mountain gentian
Castilleja cusickii	Cusick's Indian paintbrush
Pedicularis groenlandica	Elephantella
Penstemon globosus	Globe penstemon
Veronica serpyllifolia	Thyme-leaved Veronica
Aster foliaceus	Leafy aster
Haploppapus uniflorus	One-flowered aster
Senecio foetidus	Sweet marsh butterweed

Sedge meadows are essentially flat but there are occasional slight elevations, sparsely vegetated with:

Eriogonum flavum	Yellow eriogonum
Spragea umbellata	Pussypaws
Antennaria corymbosa	Meadow pussytoes

The first two species are derived from bare areas in alpine-subalpine ridges, the last species from better drained dry meadow surrounding the wet sedge meadow.

Sedges and most species occupying the wet sedge meadow have seeds capable of germinating in highly saturated soil. Grasses and any other species

requiring any degree of drainage in the soil are virtually excluded from these meadows. The seeds of sedges are distributed by running water.

Sedge meadow plants are markedly low in stature. Lowland ecotypes of Bear Valley willow species are medium to tall shrubs, but no sedge meadow willow reached two feet. This adaptation probably plays two main rolls. Low stature and flat tops insure that no part of the plant will be exposed above the snow cover to ice blast damage. More importantly, summer air temperatures tend to be slightly higher at ground level and the low, even vegetation of sedge meadows acts as a unit with ground level. Temperature is the factor that limits photosynthesis in subalpine areas, a factor especially critical in a valley subject to cold air drainage. Short plants in the comparatively warm air at ground level photosynthesize more efficiently than taller plants, so have a competetive edge. In time, taller plants are eliminated. Low stature is a characteristic phenotypic response of plants on infertile soil but this does not seem to hold here because willows protected by trees in Bear Valley are markedly taller than willows in exposed sedge meadows.

Former Sedge Meadow

Interactions between soil, climate and plants of sedge meadows result in a dark gray soil, well adapted to sedge meadow species but poorly suited to other species. As Bear Valley Creek cuts down through the sedge meadow, the water table, once at or near the soil surface, is lowered some feet below the surface. The dry soil will not support plant growth in the later part of the season and life cycles for many species can not be completed. The following species form a scanty cover over the dark gray surface:

Pinus contorta	Lodgepole pine - sparse
Luzula hitchcockii	Smooth woodrush
Calochortus sp.	Sego lily
Potentilla gracilis	Cinquefoil
Trifolium hybridum	Alsike clover
Trifolium longipes	Long-stalked clover

Epilobium angustifolium	Fireweed
Gentiana calvcosa	Mountain bog gentian
Penstemon attenuatus	Taper-leafed penstemon
Penstemon globosus	Globe penstemon
Symphoricarpos sp.	Snowberry
Achillea millefolium	Yarrow
Antennaria corymbosa	Meadow pussytoes
Artemisia ludoviciana	Western mugwort
Aster integrifolius	Thick-stemmed aster
Cirsium sp.	Thistle
Haplopappus uniflorus	One-flowered goldenweed

Elevations in the former sedge meadow were quite bare. Species found there include:

Eriogonum flavum	Yellow eriogonum
Spragea umbellata	Pussytoes
Arenaria congesta	Capitate sandwort
Cymopterus glaucus	Grayish cymopterus
Haplopappus langinosus	Wooly goldenweed
Wyethia amplexicaulis x helianthoides	Mule's ears

Only five of the sedge meadow species persist here, and one species found on elevations in sedge meadows, occurs in the former sedge meadow. Two species growing on elevations in the sedge meadow also occur on elevations in the former sedge meadow. All other species have entered the former sedge meadow since the water table dropped. They appear to be mostly species of dry meadow lying between sedge meadow and the surrounding forest, or of dry open spots on ridges above the subalpine forest. Willows and sedges that dominated the wet sedge meadows have disappeared since the stream cut the deep channel through the meadow. Sedges require a water table at the surface for most of the season. Willows seem to require a water table no more than 3.5 feet (eyeball measurement) below the surface during the driest season.

In instances, species occuring on sedge meadow have been replaced by a similar species in the same genus, but having different adaptations. This illustrates how critical precise adaptation is to the habitat.

Grasses are virtually absent, although drainage has been improved and some germination would be expected. The dark color of the soil may cause

excessive soil temperatures during a critical season for the establishment of some plants, but other factors must be present because lodgepole pine, a rather aggressive species, is stunted on this soil, even long after passing through the sensitive seedling stage.

Bare habitats can be expected to support annuals, but no annuals were found on this soil. Browning off had occurred sometime before completion of the checklist. Since annuals tend to self-destruct after browning off, their apparent absence may not be significant.

Rocky Tailings

Vegetation forms a sparse cover over tailings containing an amount of rocky material. A number of species was involved:

Abies lasiocarpa	Subalpine fir
Picea engelmannii	Engelmann spruce
Pinus contorta	Lodgepole pine
Bromus inermis	Smooth brome
Deschampsia elongata	Slender hair grass
Sitanion hystrix	Bottlebrush
Luzula hitchcockii	Smooth woodrush
Salix drummondiana	Drummond's willow
Salix exigua	Riverbank willow
Salix rigida	Watson's willow
Salix scouleriana	Scouler's willow
Eriogonum flavum	Yellow eriogonum
Rumex acetosella	Sheep sorrel
Spragea umbellata	Pussypaws
Arenaria congesta	Capitate sandwort
Spergularia rubra	Red sandspurry
Arabis drummondii	Drummond's rockcress
Frageria virginiana	Wild strawberry
Potentilla gracillis	Cinquefoil
Trilfolium hybridum	Alsike clover
Viola sp.	Violet
Gayophytum nuttallii complex	Dwarf gayophytum
Lomatium leptocarpum	Slender-fruited lomatium
Vaccinium caespitosum	Dwarf huckleberry
Collomia tinctoria	Yellow-staining collomia
Penstemon attenuatus	Taper-leaved penstemon
Penstemon globosus	Globe penstemon
Achilles millefolium	Yarrow
Agoseris glauca	Mountain dandelion

Anaphalis magaritacea	Pearly everlasting
Artemisia ludoviciana	Western mugwort
Eriophyllum lanatum	Eriophyllum
Halopappus lanceolatus	Wooly goldenweed
Taraxicum offinale	Common dandelion

Dredge tailings appear to be an inhospitable habitat but actually are very similar to the raw glacial till, bare alpine and subalpine slopes and eroded streambanks of the normal subalpine scene. Subalpine plants are preadapted to sterile, rocky dredge tailings and rapidly move in. This area was formerly wet sedge meadow, but dredging increased the volume of the tailings resulting in a well-drained elevation with raw mineral soil which can not be expected in any way to support sedge meadow. A good lodgepole pine stand is forming, as could be expected, and has progressed to the point that associated species, e.g., Vaccinium caespitosum, Potentilla gracillis, Frageria virginiana and Viola sp., are appearing in the accumulating duff beneath the trees.

A few introduced weeds and an occasional, but probably statistically insignificant relict of former seeding attempts are found on the tailings, but essentially, the plants becoming established are of local origin. Because they are of local origin, they have the adaptations to the Bear Valley climate, as well as being preadapted to the raw tailings.

Willows on the dredge tailings are especially interesting. They were difficult to classify, seeming to sometimes involve characteristics of more than one species and sometimes representatives of one of the other sex being infrequent or lacking. Willows are well known (and roundly cursed by taxonomists) for hybridizing. Hybrid willow are probably produced constantly, but normally the new combinations of characteristics do not fit any existing soil types in the valley and they are selected against. Dredging created new combinations of soil characteristics, some apparently matching the hybrid willows. Because willows produce vegetatively, these new sets of adaptive genes persist. Several other species on the tailings are known to have this same ability and possibly they too are inventing their own new ecotypes to fit the new habitat offered by the tailings.

There appeared to be a clay layer or some other feature, resulting in a water table in the rocky tailings, usually higher than that of the original meadow. This probably accounts for the good growth of willows in some areas.

These tailings have been leveled, possibly delaying revegetation, which is usually enhanced by providing a variety of microhabitats. The Bear Valley floor was essentially flat before removal of the cover, but flattening of the surface will not induce seral vegetation. Observation of dredge tailings throughout Central Idaho indicates that providing a flat, uniformly watered, drained and windswept surface, e.g. , as is produced by leveling tailing piles, generally delays revegetation because it does not provide the hollows necessary for wind protection of seedlings or for accumulation of litter, water and seeds. The pattern left by the steps and swings of the dredge is conducive to revegetation without modification. In places on the Bear Valley tailings, tracks of the cat that did the leveling are still visible, outlined by plants that established nowhere but in the slight depressions left by the cat treads.

The churning and settling effects of lodgepole pine roots in tailings, combined with settling by gravity and water, will tend to level tailing piles with time. The older Idaho City tailings demonstrate the natural leveling effect of deep rooted vegetation.

Clay Basin

One area of the tailings is composed of a peculiar yellow material showing clay cracks. Clay is an unusual soil type in this area and apparently has developed few species able to cope with it. This area was sparsely vegetated by:

Pinus contorta	Lodgepole pine
Alopercurus pratensis	Meadow foxtail
Phleum alpinum	Alpine timothy
Phleum pratense	Common timothy
Salix Scouleriana ?x *drummondiana*	Willow, possibly hybrids

Polygonum aviculare	Knotweed
Polygonum minimum	Polygonum
Rorippa obtusa	Blunt-leaved yellowcress
Potentilla gracillis	Cinquefoil
Trifolium hybridum	Alsike clover
Epilobium angustifolium	Fireweed
Cymopterus glaucus	Grayish cymopterus
Plagiobothrys scouleri	Scouler's plagiobothrys
Veronica serpyllifolia	Thyme-leaved Veronica
Agoseris glauca	Mountain dandelion
Cirsium sp.	Thistle
Haplopappus lanceolatus	Lance-leafed goldenweed
Taraxicum offinale	Common dandelion

Frequency was very low for some of these species; they were present but could not be said to be established. There are more introduced species here than at any other site, reflecting the virtual absence of clay soil in subalpine regions and the lack of preadapted species to this habitat.

There were indications of hybridization between the introduced timothy, probably part of a revegetation effort, and the native species. This is a potentially dangerous situation. Recombination of the adaptive characteristics of the native species with the lowland adapted characteristics of introduced species can not be expected to produce any superior ecotypes. Fortunately, the introduced plants are infrequent and probably can not swamp the native population.

Plants established in the clay are accumulating a surrounding ring of duff in which other species, unable to tolerate bare clay soil, are establishing. Revegetation of this area is slow but is proceeding. It appears that the rate of revegetation will increase as revegetation progresses.

Flattened and Resoiled Tailings

Attempts at rehabilitation had been made at this site: the results were unfortunate. Margins of the site, left as raw tailings rubble, are revegetating nicely, forming two long lines of lodgepole pine forest outlining what appears to be a bare landing strip for 747's.

In this area, tailings were leveled and dark gray sedge meadow soil applied to the surface. The soil was not appropriate to well-drained situations and is suitable habitat only for the rhizomatous Penstemon attenuatus. Rhizomes may have been present in the soil at the time it was deposited there and they form virtually a monoculture of penstemon. Since that species has a short season, it is probably a spectacular carpet of purple for something like 10 days, and a barren mess the rest of the year until mercifully covered by snow.

Present in low frequency with the penstemon on the "reclaimed" tailings are these pitiful few species:

Juncus sp.	Rush, cowed off
a coarse grass, possibly introduced, cowed off too badly to identify	
Rorippa obtusa	Blunt-leaved yellowcress
Achilles millefolium	Yarrow
Artemisia ludoviciana	Western mugwort

This area needs help. The vegetational cover is more solid than on other tailings but is essentially composed of a single species and there is little indication of further vegetational development. The combination of wet meadow soil and well-drained, elevated dredge tailings created a habitat unknown to man or nature. Until this unnatural habitat is removed, revegetation efforts will be a waste of money because neither the producers of seed mixtures nor "01' Ma Nature" has yet produced a plant with these soil requirements.

Stream Areas

Vegetation along the new channel of Bear Valley Creek has progressed to a fair stage of maturity. Species found along the stream and on gravel bars are:

Equisetum pratense	Shady horsetail
Alopercurus pratensis	Meadow foxtail
Agrostis scabra	Rough hairgrass

Phleum alpinus	Alpine timothy
Carex aquatilis	Water sedge
Carex canescens	Gray sedge
Carex illota	Small-headed sedge
Carex microptera	Small-winged sedge
Juncus balticus	Baltic rush
Juncus mertensiana	Merten's rush
Rumex acetocella	Sheep sorrel
Montia cordifolia	Broadleaved montia
Saginia saginoides	Alpine pearlwort
Stellaria longipes	Longstalked starwort
Lupinus polyphyllus	Large-leaved lupine
Hypericum anagalloides	Bog St. John's wort
Epilobium alpinum	Alpine epilobium
Gavonhytum nuttallii	Dwarf gayophytum
Gentiana calvcosa	Mountain bog gentian
Mimulus primuloides	Primrose monkeyflower
Veronica americana	American Veronica
Achilles millifolium	Yarrow
Artemisia ludoviciana	Western mugwort

About 30% of the sedge meadow species also grow along the immediate stream banks. Seed sources for revegetating this area are located in adjacent sedge meadows and in upstream areas. Many of these species are adapted for distribution of seeds by running water. Revegetation is an inherent characteristic of streamside plant communities. Streams are a constantly eroding and changing habitat and will tolerate only seral species with good powers of dissemination and revegetation.

Some of the floodplain and banks are not as well revegetated. In places, the new floodplain, because of original design faults and deposition of erosional materials on the floodplain, is elevated above the water table. Localized areas of the floodplain substrate appear not to have the capacity to deliver water to plant roots that the loose dredge tailings have. Where the surface of the floodplain approaches the water table, or where the substrate has the proper composition, the area has, revegetated well. These areas are being dominated by willows and sod-forming graminoids. Where these conditions do not hold, revegetation is not satisfactory.

Some banks are so steep that the rate of erosion exceeds the rate of revegetation. Vegetation on the banks is similar to that of the adjacent

meadows or the tailings. The only species of any note is the Eriophyllum lanatum (eriophyllum) which reached its highest abundance on the steepest banks.

PROPOSED ACTIONS AND RECOMMENDATIONS

Sedge Meadow

No actions are planned in the undisturbed sedge meadows as part of the Bear Valley Fish Habitat Enhancement Project Preferred Alternative. However, an alternative route for placing a stream diversion has been identified should the owners of the patented lands decided to resume mining in Bear Valley.

Restoration of the sedge meadow association is an integral component of the Preferred Alternative. Return of sedge meadow species is desired along the newly constructed streambanks in Reaches D, E, and part of F. This association also will be desirable in parts of G and GG, where the banks of tributaries need to be stabilized.

The existing nearly vertical banks will be excavated to provide a floodplain with 3 to 1 sloped banks, which will be more amenable to revegetation than the former steep and highly eroded slopes, typical of the western part of Reach D. Fencing and the use of geotextile fabric and erosion control blankets are proposed to facilitate plant growth.

Propagules appear to be abundant in the soils along the stream. Additional propogules are blown and washed into the patented lands throughout the year. Restoration of the streamside habitat should provide the water-saturated conditions necessary for the germination of sedge meadow species, particularly *Carex* spp. (sedges) and *Juncus* spp. (rushes). *Salix wolfii* (Wolff's willow) also can be expected to re-establish itself along the low moist streambanks. Existing sedge meadow species in the southern part of Reach D will not be disturbed during construction.

Fencing will greatly enhance the success for restoration of native sedge meadow vegetation. The use of geotextile fabric and erosion control blankets will be beneficial not only for retention of seeds and other

propagules already present, but also for capturing material which will wash or blow in. Fertilization is not recommended as it might suppress the growth of native species which are preadapted for the site. Fertilization would favor the growth of introduced species of grass, which have proven unsuccessful in past stabilization efforts. Seeding and other lower elevation reclamation practices do not seem appropriate as there are numerous propagules already present in the streambank soils. Hand planting, if necessary, selected species in identified problem areas would be more effective than applying treatments uniformly regardless of need.

A plan for establishing container-grown cuttings of Salix spp. (willows) could be initiated this year, so that these native shrubs would be available for future transplanting if persistant problem areas are identified along the new banks. In the first year the goal of establishing centers of distribution should be met. Monitoring should be done to identify any problem areas which might need further enhancement. If such problem areas are identified, then a program for broadcasting native seed, transplanting willow cuttings directly or using established container-grown cuttings could be implemented. The type of problem, the habitat involved and the requirements of the desired species would influence the design for corrective action as there could be considerable variation in timing and procedures.

It is expected that the use of fencing, geotextile fabric and erosion control blankets will greatly increase the establishment of centers of distribution for native species during the first year. Such centers would be able to expand due to the number of rhizomatous and stoloniferous species found in Bear Valley. Restoration of low moist streambanks will result in the return of sedge meadow species along Bear Valley Creek. Small amounts of excavated meadow could be used as top soil along these low moist streambanks, but the use of the meadow soils should be avoided in arid areas. Initially, the sedge meadow species will form a narrow border along the stream. The parameters of this border will be related to available moisture. In the areas where the stream bed has cut below the valley floor, the sedge meadow species may be restricted to the margins of

the stream and possibly to the floodplain since the upper banks and the adjacent meadows appear to be rather arid.

Former Sedge Meadow

New construction to stabilize the west streambanks in Reach D and E will affect the former sedge meadow associations. Several minor components of the Preferred Alternative also may involve former sedge meadow vegetation. These soft gray soils in areas which are now arid can no longer support the desired sedge meadow species and are suitable only for supporting rather sparse cover. Once disturbed, these soils appear difficult to revegetate.

Former sedge meadow vegetation can be expected to re-invade the upper portions of the newly stabilized streambanks, particularly in Reach D, where the stream has downcut severely. It is anticipated that the upper l/2 to l/3 of these banks will not have enough moisture for the germination of sedge meadow species. Consequently, species which are more tolerant of arid conditions will colonize the upper banks.

The post-construction slopes will be less steep and consequently more conducive to establishment of Penstemon attenuatus var. militaris (taper-leaved penstemon) and Achilles millefolium ssp.. lanulosa var. alpicola (yarrow) which can provide excellent cover. Several minor species such as gayophytum nutallii (dwarf gayophytum) can be expected to re-invade barren areas. The use of the geotextile fabric and the erosion control blankets will be extremely important for the retention of seeds, rhizomes and other propagules in these difficult-to-manage areas.

Fertilization, hydromulching and other lower elevation practices are not recommended as they may conflict with the return of native species. Achieving centers of distribution should be a feasible goal during the first year. If problem areas are detected, species specific distribution of native seeds and rhizomes can be initiated to increase vegetative cover on these arid upper streambanks. Penstemon and yarrow, which already have

demonstrated their ability to colonize these soils would be excellent choices, if further enhancement is needed. These two taxa have the additional benefit of being aesthetically pleasing as well as have the ability to contribute to the stability of the banks.

These rather arid areas may have a tendency to support discontinuous vegetation. Thus, fencing will be essential for restoring stability. The use of geotextile fabric also will play a critical role in facilitating the restoration of native vegetation. It is expected that the fabric will help retain propagules which are already present in the soil. If discontinuity persists as a problem along the upper and rather arid streambanks a monoculture of pentsemon can be encouraged. These aggressive plants have woody rhizomatous roots and reproduce vegetatively as well as by seed. When established, they should greatly increase the stability of the upper banks in Reach D.

Rocky Tailings

The proposed stabilization of streambanks in Reach D, E and part of F will involve the the rocky tailings plant associations. Establishment of the proposed new floodplain will occur almost entirely within this community. Coarse soils similar to the rocky tailings support -many of the same species are found in Stabilization Area I which is slated for further study.

Although the rocky tailings have a very severe appearance, they are reasonably stable and have good potential for revegetation. Fencing will hasten successful revegetation of native plant species in the tailings. The use of geotextile fabric and erosion control blankets will not be as critical in the tailings as they are in the sedge meadows and the former sedge meadows.

Nat-forming pioneer species such as Sagina saginoides (alpine pearlwort) and Stellaria longipes var. longipes (longstalked starwort) can be expected to bind together rock on the moist floodplain. They will be

joined by rhizomatous and somewhat stoloniferous species such as Cardamine cordifolia var. cordifolia (large mountain bittercress) and Epilobium alpinum var. nutans (alpine willow-herb). Small colonies of Carex spp. (sedges) and Juncus mertensiana (Merten's rush) can be expected to return. Where there is sufficient moisture, Juncus balticus var. montanus (Baltic rush) will be able to form extensive populations. Various Salix spp. (willows) can be expected to colonize the floodplain and its 3 to 1 sloped banks.

Terracing the eastern margin of the floodplain would provide wind-sheltered areas with an adequate water table for supporting the growth of S. drummundiana (Drummond's willow), S. rigida var. watsonii (Watson's willow) and S. scouleriana (Scouler's willow). Field observations indicate that there is a relationship between sheltered habitats and increased height among the willows in Bear Valley.

Continued revegetation of the rocky tailings by Pinus contorta (lodgepole pine) can be expected. Where established, these trees have created a layer of duff which supports Vaccinium caespitosum (dwarf huckleberry) and other forest associates. An area in the southern portion of Reach D will be staked during construction to preserve these species for future distribution in the project area.

Establishing centers of distribution for rocky tailings species would be a feasible first year goal for the newly-constructed floodplain. Ample propagules were observed on the site for insuring successful revegetation. Since many of the species present are rhizomatous, distribution will be facilitated by heavy equipment working in the area. Salix spp. (willows) often reproduce vegetatively so their distribution may be increased by the breaking and the spreading of twigs and roots during the construction phase of the stabilization project.

Cuttings to be container-grown can be collected this season for future use in case any problem areas occur. Direct cuttings could also be used for enhancing stability if problem areas are identified. Since there seems to

be a direct relationship between the amount of moisture available and the success rate for transplanted willow, it would be advisable not to plant any willows until next year when the new drainage patterns will be more apparent.

Clay Basin

Clay basin plant associations would be affected by the stabilization and the revegetation measures proposed for Area FF. Excess material from the proposed streambank and flood plain excavation would be used as fill for improving portions of Area FF. Deposition of excess excavation material has been proposed in the southernmost portion of Area FF as this region appears to be poorly vegetated and quite flat. It also appears to be lower in elevation than the surrounding area and could be contributing to the sedimentation problems of Bear Valley Creek. The northern portion of Area FF also appears rather barren and it too would be an ideal candidate for disposal of excess material. Revegetation of the excavated tailings would be expected to follow the same successful pattern that is already in process on the rocky tailings.

The soft gray sedge meadow soils should be buried after excavation as they are rather impossible to revegetate in arid settings with either native or introduced plants. A cover of coarse rocky dredge tailings, however, has good potential for revegetation. The proposed creation of terraces and depressions will supply the various microhabitats necessary for successful revegetation of the tailings.

Where the clay basin would be covered with excess dredge tailings stands of Pinus contorta (lodgepole pine) and its associated species would be expected to return. In more severe areas on the excavated tailings a stable but widely spaced cover composed of alpine/subalpine species such as Eriogonum flavum var. piperi (yellow eriogonum), Spragea umbellata (pussy-paw) and Arenaria conqesta (capitate sandwort) would be expected to re-invade the area. Anaphalis margaritacea (pearly everlasting) and Artemisia ludoviciana var. latiloba (western mugwort) which tend to form

mosaics on the tailings can be expected to contribute to the stability and diversity of these enhanced areas.

Several rather deep depressions which appear to be former dredge ponds will be removed when the floodplain is excavated. However, other ponds, both deep and shallow ones will be left intact. Wet-site vegetation is becoming established around these ponds. Not only are they important for wildlife, but also they serve as centers of distribution for the re-establishment of sedge meadow species. These ponds have an integral role in facilitating the return of the desired sedge meadow species on the patented land.

An extensive centrally located portion of the clay basin in Area FF appeared to be rather barren during the drought. However, after the mid-summer rains, numerous lower elevation native plants germinated in this area. Although this vegetative cover is rather sparse, it has become a rather unique habitat which should be permitted to continue evolving. Several of the native species found at this site are associated with long distance dispersal.

Where necessary, fencing the newly constructed areas in the clay basin will hasten the regeneration of native species both on the clay and on the excavated tailings. Adequate propagules are present which should be favorably distributed by the heavy equipment involved in the stabilization project. Geotextile fabric and erosion control blankets would probably not be needed unless specific problem areas are identified. There is considerable evidence that wind and water routinely bring additional seeds, rhizomes and other propagules into Area FF. Fertilization should be avoided as these species seem to be preadapted for their respective habitats in the clay or the tailings.

Flattened and Resoiled Tailings

This site is located approximately in the center of the patented lands just south of the big dredge pond. Stabilization and revegetation are

proposed as a minor component of the Bear Valley Fish Enhancement Project Preferred Alternative.

Restoration could be accomplished by covering the resoiled area with excess coarse dredge tailings from the newly excavated floodplain. The coarse tailings would facilitate expansion of the surrounding lodgepole stand. Since this site appears to be higher in elevation than the remainder of the patented lands, it would become an attractive forested knoll. The understory duff would support a rather dense cover of dwarf huckleberry and native violets as well as other conifer-associated species which would enhance not only the diversity, but also the aesthetics of Bear Valley.

Stream Areas

Reconstructed stream areas and floodplains in the Bear Valley Fish Habitat Enhancement Project will involve sedge meadow, former sedge meadow and rocky tailings plant associations. All of these associations are expected to revegetate the construction area. The location and the extent of these associations will be related to the soil types and the amounts of moisture available after construction has been completed.

Opportunities for the return of sedge meadow species and other wet-site vegetation will be enhanced along the reconstructed streambanks and floodplain. Some vegetative discontinuity is expected along the more arid upper streambanks. Additional enhancement as described in the discussion of former sedge meadow plants may be needed if there are persistent problem areas.

The former floodplain also exhibited discontinuous patterns of vegetation, possibly due to lack of uniform moisture delivery throughout the floodplain. If dry areas recur on the floodplain after construction, further investigation may be warranted. As long as these arid sites are restricted to rocky tailings, then the additional enhancement would probably not be needed. Excavated lodgepole pine could be deposited along the streambanks and the floodplain. While this would only be a temporary measure, it might alter the velocity of the stream and hasten revegetation.

ANALYSIS OF REVEGETATION ALTERNATIVES

Introduced Species

Pioneer efforts in reclamation involved the use of introduced species of grasses and legumes. Many of these plants which originated in Europe and/or Asia have been cultivated along with selected species from the western hemisphere for introduction in areas designated as improvement projects. Early research in seed technology often was oriented for range improvement to benefit livestock grazing. Legumes were included in the mixtures of cultivated grass seed for their nitrogen-fixing capabilities which presumably would help meet the fertilization requirements of the grasses. Reclamation specialists began adopting the range improvement technology for soil stabilization projects as grass and legume seeds were available commercially.

Treatments composed of introduced species have been used extensively at low elevations. This strategy may be appropriate where the local flora has collapsed, particularly near urban and agricultural areas.

Where reasonably successful, the sod-building capabilities of the cultivated grasses have been useful in stabilizing soils. There is considerable expense incurred with site preparation, fertilization and purchase of seed mixes. Repeated treatments are sometimes necessary. Not all such projects have been unqualified successes, even at low elevations.

Revegetation strategies which utilized introduced seed at high elevation sites have had rather dubious results. Data collected in a recently completed 6-year study of upper montane road cuts in Montana demonstrate that there is no statistical significance between plots with native vegetation and plots treated with introduced grasses and legumes (Hungerford 1984). Moreover, field observations at Bear Valley also indicated that introduced species of grasses do not appear to function as soil stabilizers in such a severe habitat.

The appropriateness of using introduced species of grasses and legumes depends on several considerations which must be carefully weighed along with the convenience of obtaining readily available supplies. The expense of using introduced grasses and legumes can best be justified in low elevation disturbed sites which are devoid of native flora since the establishment of these introduced species is usually more successful where conditions are not so severe. When native species are lacking and when the habitat is suitable for supporting introduced grasses, this treatment can be a cost-beneficial strategy.

Anytime non-native materials are introduced there is a possibility of inadvertently contaminating native vegetation with exotic weedy species which may have been accidently included in seed mixes. In some cases, there is also taxonomic confusion over which species are actually in the mixes. For example, several different Siberian species often are recognized as "crested wheatgrass". Agropyron cristatum does not usually escape, but its closely related ally, A. pectiniforme, frequently escapes (Cronquist et al. 1977).

Care should also be taken to rule out the possibilities of accidental introduction of species which could hybridize with the local flora. Such hybridization could result in the loss of adaptive sets of genes. There is some evidence in Bear Valley that the introduced Phleum pratense (common timothy) has hybridized with the native P. alpinum (alpine timothy). While hybridization is a naturally-occurring phenomenon among the native species, weaker plants are usually selected against and do not persist. Large numbers of introductions could swamp the gene pool of the native flora . This would allow the survival of the weakened hybrids. In extreme cases these kinds of accidents can lead to the collapse of the local flora and the creation of wastelands devoid of productive vegetative cover.

"Native" Species From Commercial Suppliers

In response to reclamation specialists' need for native species in revegetation projects, commercial suppliers have begun to provide native seed

and nursery stock. The use of the term "native" in supply catalogues usually refers to plants which are native to the general region e.g., Purshia tridentata (bitterbrush) is a native in the Pacific Northwest while Trifolium repens (Dutch clover) is introduced from Eurpoe. These services have expanded the spectrum of treatments available for solving reclamation problems. Exemplary results can be achieved where commercially-provided native species have replaced diversity and stabilized soils in areas which lack healthy local flora.

The potential of this innovative industry is currently limited to selected geographic areas and ecosystems. Demand for native species is not usually sufficient in remote areas to warrant an available supply of seed and nursery stock. For example, virtually none of the species which occur in Bear Valley are listed in the catalogues of several major suppliers in the region.

Commercially-supplied native plants have the greatest chance for success if they are used in their appropriate habitat. Using plants or seeds obtained from out-of-state which are not adapted for the Central Idaho subalpine habitat can be expected to have less that satisfactory results as they probably would not be adapted for such a severe climate. The results could be quite disappointing considering the expenses involved. However, commercially-obtained plants and seeds utilized in a reclamation project near their place of origin would be much more successful and therefore more cost-beneficial than the use of such materials in Bear Valley.

The demand for greater species diversity in reclamation is a positive trend. Native species offer a wide array of adaptations useful in many different habitats. Care does need to be taken in selecting appropriate seeds and nursery stock as many commercial suppliers often do not segregate their seed according to variety or ecotype. For example, Achillea millefolium ssp. lanulosa var. alpicola, the alpine variety of yarrow, was collected only as Achilles millefolium. Utilization of foreign ecotypes or genotypes could lead to loss of the adaptive sets of genes in the local

flora. Moreover, the results would not be as effectve as using the appropriate ecotypes for the site.

Revegetation plans should be thoroughly evaluated in order to avoid the possibility of introducing “foreign” native taxa which might hybridize with the local native plants. A number of taxa are interfertile but do not ordinarily hybridize due to geographic barriers. The availability of commercially-supplied native plants, which adds many welcome dimensions to revegetation planning, also removes some of the barriers that prevent hybridization. Thus, caution is needed in planning appropriate commercial purchases so that genetic accidents do not occur. Preservation of adaptive sets of genes should not be overlooked in developing reclamation projects. The use of commercially-supplied native materials can be beneficial if carefully planned for sites near the sources of supplies and for areas which lack a healthy local flora.

Enhancement With Local Native Species

Numerous strategies are available for making use of local native species in reclamation projects. These strategies often include excavating and replanting native species within the same area. Other common techniques include gathering native seed for broadcasting as well as directly transplanting cuttings of adventitious species. These efforts have the greatest likelihood for success if the propagules are collected on the reclamation site so that the correct adaptive sets of genes are used. Collections may be either species specific or habitat specific, depending on the exact nature of the reclamation problems to be solved. The revegetation design should attempt to replicate successful natural processes. Appropriate methods and timing can be determined through field observation of the selected species in the project area.

Revegetation of easily eroded areas may require working with established stock. Raising cuttings in containers for a couple of years may be necessary for acquiring an adequate supply of established plants for revegetating difficult-to-manage slopes of streambanks. Container-grown plants

cared for on-site retain the desired acclimatization and are quite likely to be successful transplants. When on-site care is not feasible, the containers may be taken to a nursery. If there is considerable difference in elevation between the nursery and the reclamation site, then special treatment will be needed to retain the appropriate acclimatization for the cuttings. Although off-site storage and care for container-grown cuttings can still be successful, there will be some losses when these cuttings are transplanted.

The patented lands at Bear Valley are ideal in many respects for implementing enhancement techiques which utilize local native species. There are excellent sources on this site which are available for collecting seeds or cuttings. This is particularly fortunate because appropriately adapted seeds and nursery stock for Bear Valley are not available from commerical suppliers.

Since there is considerable evidence that numerous native species have returned in the mined area, it probably is unnecessary to save any excavated species for transplanting. Several areas within the construction zone, however, will be staked and preserved as centers of distribution of native species. Establishment of container-grown cuttings could be initiated this season so that they will be available, if needed, in a couple of years.

Collecting seed for broadcasting and directly transplanting cuttings should probably not be undertaken until specific problem areas, if any, are identified next field season. Natural revegetation of the project construction zone is expected to minimize the need for widespread use of these specialized enhancement techniques. Reserving these strategies for future use would not only be a more cost-beneficial use of resources, but would also enable revegetation specialists to design a species specific or habitat specific approach for revegetating any difficult-to-manage areas which might occur.

Familiarity with the reclamation site and its native vegetation enables reclamation specialists to develop cost-effective strategies for using native vegetation in stabilization projects. These enhancement techniques, if used selectively, should be less costly than those strategies which require purchased seed and nursery stock. Although these techniques appear to be labor intensive, they usually do not involve extensive use of heavy equipment if their application is confined to problem areas. Enhancement with native plants is a useful strategy for stablilizing sensitive areas which otherwise would be difficult to manage. Careful timing may be needed for collecting the desired native seed or for taking cuttings. Establishing an adequate supply of containerized cuttings requires advance planning, which may not always be convenient.

Habitat Restoration

Habitat restoration can be a very successful method for achieving stabilization and revegetation of disturbed areas. This approach requires an understanding of the reclamation site's ecology and its relationship to the surrounding area. Reclamation specialists can identify the desired habitats for creating maximum stability and thus, plan for reconstructing these habitats so that the appropriate native vegetation can return.

A healthy, diverse native flora is a prerequisite for successful use of this approach. Projects on the margins of urban or agricultural areas which are not surrounded by native vegetation probably would not be suitable for this type of treatment. Bear Valley, however, has a healthy, diverse flora which is well-stocked with rhizomatous species essential for stabilization.

Once the ecology of the site is understood then construction strategies can focus on recreating the desired habitats for restoring stability to the area. On the patented lands in Bear Valley, several areas have been identified in which the desired sedge meadow species will be able to return. Areas such as the rocky tailings and the less moist portions of the clay basin which are not suitable for reclamation as sedge meadow, are

being colonized by other plant communities in the vicinity. Identification of the habitat preferences of these various communities enables the specialist to reconstruct a variety of ecological niches for successfully stabilizing and revegetating the reclamation site.

This strategy is probably the least costly to implement. Risks can be minimized by conducting preliminary ecology studies to determine the feasibility of using the restoration approach. The cost of time spent in the field is offset by eliminating the need for purchasing commercial seed and nursery stock as well as specialized supplies for site preparation.

Land managers sometimes seem reluctant to rely on habitat restoration as a reliable strategy for revegetation. Perhaps this hesitation stems from unfortunate comparisons of unrestored disturbances, which are not suitable for revegetation, with successful lower elevation grass seedings. Brown and Johns ton, in their study of high elevation mine disturbances, have found that native species can be successfully used to establish plant cover during the first growing season (1978). Megahan concludes that deep-rooted vegetation such as ponderosa pine reduces surface erosion and offers additional benefit over conventional grass seeding because mass erosion hazards are lessened (1974). Through the use of native species in Bear Valley many different growth forms such as mats, deep roots and woody rhizomes can be employed for soil stabilization..

The risks involved with habitat restoration are minimized by preliminary field studies which give direction for sound revegetation planning. Field observations are instrumental in predicting the success of the proposed interventions. Consequently, habitat restoration is more predictable and less risky than other currently available alternatives for revegetation. This alternative is particularly appropriate for Bear Valley since there is ample evidence of a healthy native flora as well as documentation of past failures with introduced species.

Additional Treatment Alternatives

Fencing is planned for the reconstruction areas on the patented lands in Bear Valley. This measure will protect the area from livestock use, which will be beneficial for revegetation efforts. Studies by Platts and Nelson (1985) show that cattle graze riparian vegetation more heavily than upland vegetation. The elimination of grazing and trampling will result in more extensive plant regeneration in the project area along Bear Valley Creek. This measure will be essential for achieving the goals of the Fish Habitat Enhancement Project.

The use of geotextile fabric and erosion control blankets also are specified in the Preferred Alternative. These materials will interface appropriately with the concept of habitat restoration. The fabric and the blanket can be expected to help retain propagules already in the soil during the spring runoff. In addition, these materials will provide catchment areas for propagules which are washed or blown into the project area. The manufacturer's specifications state that site preparation and seeding are neceesary for obtaining the desired results. The need for seeding can be eliminated because there are ample amounts of propagules already present in the soil. Thus, natural processes currently in place in Bear Valley can be relied upon for meeting the manufacturer's directives for use of geotextile fabric and erosion control blankets. Furthermore, these materials can be expected to subsequently reduce erosion while the plants are becoming established during the first growing season.

The use of fertilizers in high elevation projects remains controversial. Many revegetation manuals list suggested fertilization practices for both native and introduced species. However, Laycock cautions practitioners that the conditions for success with fertilization at high altitudes are neither well understood nor consistent (1982). Furthermore, he believes that it is best to start with small scale plots before making widespread applications since even when success is achieved the economic feasibility can be questionable or negative.

SUMMARY

Implementation of the Bear Valley Fish Habitat Enhancement Project includes a revegetation component for achieving stabilization of the patented land. Field studies undertaken for the preparation of the revegetation plan clearly indicate that, in spite of the harsh climate and prior disturbance, a diverse and healthy flora is re-invading the patented land.

The majority of the taxa--more than 90x--found on the patented land are perennial. Moreover, at least 42% of the species included on the preliminary check list contained in Appendix B are known to be rhizomatous or stoloniferous. The presence of numerous adapted native species with excellent regeneration potential increases the likelihood for successful stabilization of previously disturbed sites.

Restoration of habitat for Bear Valley plant associations will be the most effective revegetation strategy since high altitude sites are not usually conducive to the establishment of introduced species. Past efforts utilizing introduced species for soil stabilization have been less than successful in Bear Valley. Commercial supplies of plants native to Bear Valley are unavailable.

The proposed construction in Bear Valley Fish Habitat Enhancement Project Preferred Alternative is expected to increase the rate of colonization in selected difficult-to-manage areas. Several reaches of Bear Valley Creek have been designated for streambank modification and floodplain construction which is expected to facilitate the revegetation and subsequently the stabilization of these problem areas.

Monitoring should be initiated for several years to insure that an adequate number of centers of distribution become established for revegetating the reconstruction areas. Specific enhancements utilizing native flora can be designed, if necessary, for any difficult-to-manage sites

detected during the monitoring process. Adequate vegetative cover for controlling erosion is expected throughout most of the project area by the end of the first growing season. The arid former sedge meadow soils may require some additional effort to achieve satisfactory cover. An ample supply of seed and other propagules are available for initiating any corrective actions that might be needed.

The proposed use of geotextile fabric and erosion blankets will aid in the retention in these reconstructed areas. Protecting the reconstructed area with a fence will be essential for achieving stabilization. Fertilization of this high elevation site is not recommended as there is evidence that the flora is adapted for rather sterile conditions. Past use of introduced species which often require fertilization has not produced the desired stabilization. Thus, the most effective strategy for stabilizing the patented land focuses on the restoration of appropriate habitat so that adapted native species can colonize the project area.

APPENDIX A

PUBLICATIONS CITED

Anonymous. January 1958. Idaho Placer is Source of 99 Percent of U.S. Columbium-Tantalum Output. Mining World. Volume 20; No. 1.

Billings. W. 1974. Adaptations and Origins of Alpine Plants. Arctic and Alpine Research. 6:129-142.

Brown, R. and R. Johnston. 1978. Rehabilitation of a High Elevation Mine Disturbance. IN: Proceedings. High Altitude Revegetation Workshop No. 3. Edited by S. Kenny. Colorado Water Resources Research Institute, Information Series No. 28. Colorado State University. Fort Collins, Colorado. 1978. pp.116-130.

Cabot, F. and W. Billings. 1972. Origins and Ecology of the Sierran Alpine Flora and Vegetation. Ecological Monographs. 42:163-199.

Cole, G. 1972. The Hydrology of the Bear Valley Creek Drainage.

Cronquist, A., A. Holmgren, N. Holmgren, J. Reveal and P. Holmgren. 1977. Intermountain Flora: Vascular Plants of the Intermountain West. Volume 6. Columbia University Press. New York, New York.

Daubenmire, R. 1978. Plant Geography. Academic Press. New York, New York

Hungerford, R. 1984. Native Shrubs: Suitability for Revegetating Road Cuts in Northwestern Montana. Intermountain Forest and Range Experiment Station. U.S.D.A. Forest Service. Ogden, Utah.

Kline, M., E. Carlson, R. Starch and A. Robertson. 1953. Bear Valley Radioactive Mineral Placers, Valley County Idaho. Technical Information Service Extension. Oak Ridge, Tenn., U.S. Atomic Energy Commission, Bureau of Mines. Washington, D.C.

Laycock, W. 1982. Seeding and Fertilizing to Improve High Elevation Rangelands. Intermountain Forest and Range Improvement Station. U.S.D.A. Forest Service. Ogden, Utah.

Megahan, W. 1974. Deep-rooted Plants for Erosion Controil on Granitic Road Fills in the Idaho Batholith. Intermountain Forest and Range Experiment Station. U.S.D.A. Forest Service. Ogden, Utah.

Pavlat, W. 1969. Letter from Bear Valley Ranger District to Robert Porter of Porter Borthers Co. 6 August 1969. Lowman, Idaho.

Platts, W. and R. Nelson. 1985. Will the Riparian Pasture Build Good Streams? Rangelands. 7:7-10.

Scott, D. and W. Billings. 1964. Effects of Environmental Factors on Standing Crop and Productivity of an Alpine Tundra. Ecological Monographs. 34:243-270.

U.S.D.A. Forest Service. 1979. User Guide to Vegetation: Mining and Reclamation in the West. Intermountain Forest and Range Experiment Station. Ogden, Utah.

APPENDIX B

BEAR VALLEY CHECK LIST

EQUISETACEAE
Equisetum pratense L. - Shady horsetail
Native
Circumboreal: streambanks, wet gravel bars
Rhizomatous perennial

PINACEAE
Abis lasiocarpa (Hook.)Nutt. - Subalpine fir
Native
Subalpine: tailings
Tree

Picea engelmannii Parry - Engelmann spruce
Native
Subalpine: tailings
Tree

Pinus contorta Dougl. - Lodgepole pine
Native
Montane to subalpine in our area: rocky tailings, sparse on clay basin, former sedge meadow, absent on resoiled tailings
Tree

TYPHACEAE
Typha latifolia L. - Common cattail
Native
Widespread: margins of dredge ponds
Rhizomatous perennial

POTAMOGETONACEAE
Potamotgeton sp. - Pondweed
Native
Aquatic perennial in dredge ponds

GRAMINEAE
Alopercurus pratensis L. - Meadow foxtail
Introduced
Sparse and stunted on gravel bars, clay basin
Perennial grass

Agrostis scabra Willd. Rough hairgrass
Native
Lowland to subalpine: stream margins, gravel bars
Perennial grass

Bromus ineris Leys ss. inermis - Smooth brome
Introduced
Widespread to subalpine: sparse on tailings
Rhizomatous perennial grass

Deschampsia caespitosa (L.)Beauv. - Tufted hairgrass
Native
Alpine to montane: sedge meadows and tailings
Perennial grass

Deschampsia elongata (Hook.)Munro - Slender hair-grass
Native
Widespread to alpine: tailings and former sedge meadows
Perennial grass

Phleum alpinum L. - Alpine timothy
Native
Montane to subalpine: streambanks, clay basin
Somewhat rhizomatous perennial grass

Phleum pratense L. - Common timothy
Introduced: sparse and stunted on clay basin
Perennial grass

? Poa - senescent
Perennial grass

Sitanion hystrix (Nutt.)J.G.Smith - Bottlebrush
Native
Widespread to alpine: tailings
Perennial bunch grass

CYPERACEAE
Carex aquatilis Wahl. - Water sedge
Native
Lowland to subalpine; streambanks, margins of ponds, sedge meadows
Rhizomatous graminoid

Carex canescens L. - Gray sedge
Native
Lowland to subalpine: streambanks, gravel bars, sedge meadows
Rhizomatous graminoid

Carex illota L.H.Bailey - Small-headed sedge
Native
Subalpine to alpine: streambanks, sedge meadow
Tufted graminoid

Carex microptera MacKenzie - Small-winged sedge
Native
Lowland to montane: streambanks, gravel bars, sedge meadows
Tufted graminoid

JUNCACEAE
Juncus balticus Willd. var. montanus Engelm. - Baltic rush
Native
Montane to alpine: streambanks, gravel bars, sedge meadows
Rhizomatous graminoid

Juncus mertensiana Bong. - Merten's rush
Native
Montane to alpine: sedge meadow, streambanks
Rhizomatous perennial graminioid

Luzula hitchcockii Hamt-Ahtal - Smooth woodrush
Native
Montane to alpine: sedge meadow, former sedge meadow, ?tailings
Rhizomatous perennial graminoid

LILIACEAE
Calochortus sp. - immature - Sego lily
Native
Sedge meadow, former sedge meadow
Bulbous perennial forb

SALICACEAE
Salix drummondiana Barrat - Drummond's willow
Native
Montane: sedge meadow, tailings
Shrub
Staminate plants infrequent or lacking in Bear Valley so pistillate plants possibly apomictic. Some plants sterile.
Hybridizes with S. scouleriana, apparent hybrids on clay basin

Salix exiqua Nutt.ssp. exiqua - Slender willow; Riverbank willow
Native
Mostly lowland: few and stunted on tailings. All plants observed were staminate.
Shrub spreading by underground organs

Salix rigida Muhl. var. watsonii (Bebb)Cronq. - Watson's willow
Native
Lowland to montane: sedge meadow, tailings, margins of ponds
Shrub

Salix scouleriana Barratt - Scouler's willow
Native
Lowland to montane: sedge meadow, tailings
Shrub

Salix wolfii Bebb var. idahoensis Ball - Wolf's willow
Native
Montane to subalpine: sedge meadows
Shrub

POLYGONACEAE
Erigonum flavum Nutt. car. piperi (Greene)Jone - Yellow eriogonum
Native
Lowland to alpine: tailings, elevations in former sedge meadow
Mat-forming, taprooted perennial forb

Polygonum aviculare L. - Knotweed
Introduced weed
Widespread: clay basin near ponds
Annual

Polygonum bistoroides Purch - American bistort
Native
montane to alpine: sedge meadow
Rhizomatous perennial forb

Polygonum minimum Wats. - Polygonum
Native
Alpine to subalpine in barren soil: clay basin
Annual forb

Rumex acetosella L. - Sheep sorrel; sour weed
Introduced weed
Ubiquitous in disturbed, acid soil: tailings, roadside, steep streambanks
Perennial forb with spreading rootstalks

Rumex salicifolius Weinm. ssp. triangulivalvus var. montigenitus Jeps. - Willow dock
Native
Widespread: near water, margins of ponds
Taprooted perennial forb

PORTULACACEAE
Montia cordifolia (Wats.)Pax-Hoffm. - Broadleafed montia
Native
Lowland to montane: near water, streambanks
Perennial forb with rhizome-like rootstalk

Spragea umbellata Torr. var. umbellata - Pussypaws
Native
Lower forest zones to subalpine in bare soil: bare soil on elevations in sedge meadows, elevation in former sedge meadow, tailings
Annual or perennial forb

CARYOPHYLLACEAE
Arenaria conqesta Nutt. var. conqesta - Capitate sadnwort
Native
Lowland to alpine: dry meadow near forest, elevations in former sedge meadow, tailings
Mat-forming, perennial forb

Sagina saginoides (L.)Britt. - Alpine pearlwort
Native
Circumpolar: streamside gravel bars
Perennial or biennial forb

Spergularia rubra (L.)Pres. - Red sandspurry
Introduced weed
Montane in our area: tailings, roads, trampled areas
Annual forb

Stellaria longipes Goldie var. longipes - Longstalked starwort
Native
montane: streamside gravel bars
Rhizomatous perennial forb

RAUNCULACEA
Delphinium depauperatum Nutt. - Dwarf larkspur
Native
Lowland to subalpine: sedge meadow
Perennial forb

Ranunculus alismaefolius Geyer var. alismellus Gray - Dwarf plantain-leaved buttercup
Native
Widespread to timberline: sedge meadow
Perennial forb

Ranunculus aquatillis L. - White water-buttercup
Native
Widespread: Tributary streams and diversions in quiet water
Aquatic perennial forb rooting at nodes

CRUCIERAE
Arabis drummondii Gray - Drummond's rockcress
Native
Montane to subalpine: tailings
Perennial forb

Cardamine cordifolia Gray var. cordifolia - Large mountain bittercress
Native
Montane to alpine: margins of streams
Rhizomatous perennial forb

Rorippa obtusa (Nutt.)Britt. - Blunt-leaved Yellowcress .
Native
Widespread: clay basin
Annual

SAXIFRAGACEAE
Saxifragea oregana Howell var. mnotanensis (Small)C.L.Hitchc. - Bog saxifrage
Native
Montane to subalpine: sedge meadow
Perennial forb

ROSACEAE
Frageria virginiana Duchesne - Wild strawberry
Native
Montane : forest and adjacent well-drained meadow, tailings
Stoloniferous perennial forb

Potentilla sp. - immature - Cinquefoil

Potentilla gracillis Doug1 - Cinquefoil
Native
Widespread to subalpine: former sedge meadow and tailings, sparse on clay basin with other vegetation
Perennial forb

LEGUMINOSAE
Lupinus polyphyllus Lindl. var. burkei (Wats.)Hitchc. - Large-leaved lupine
Native
Lowland to montane: gravel bar
Perennial forb

Trifolium hybridum L. - Alsike clover
Intoduced weed
Widespread : tailings, former sedge meadow, sparse on clay basin
Somewhat stoloniferous perennial forb

Trifolium longipes Nutt. var. pedunculatum (Rydb.)C.L.Hitchc. - Longstalked clover
Native
Widespread: sedge meadow, former sedge meadow
Rhizomatous or stoloniferous perennial forb

HYPERICACEAE
Hypericum anagalloides C.&S. - Bog St. John's wort
Native
Widespread to montane: streambanks, gravel bars
Mat-forming perennial forb with rooting leaves

VIOLACEAE
Viola sp. -sterile - Violet
Under Pinus contorta, on and near tailings
Forb

ONAGRACEAE
Epilobium alpinum var. nutans (Hornem.)Hook. - Alpine willow-herb
Native
Montane to alpine: streambanks
Rhizomatous and stoloniferous perennial forb

Epilobium angustifolium L. - Fireweed
Native
Montane mostly in our area: former sedge meadow, tailings, clay basin
Perennial forb with rhizome-like roots

Gayophytum nuttallii complex - Dwarf gayophytum (=Gayophytum humile Juss.)
Native
Lower montane: tailings, steep streambanks
Annual forb

UMBELLIFERAE

Cymopterus glaucus Nutt. - Grayish cymopterus
Native
Lower montane to alpine: elevations in former sedge meadow, margin of clay basin on tailings
Taprooted perennial forb

Liguisticum tenuifolium Wats - Slender-leaved ligusticum
Native
Montane: sedge meadow
Taprooted perennial forb

Lomatium leptocarpum (T.&G.)Coult.&Rose - Slender-fruited lomatium
Native
Lowlands to montane: former sedge meadows, tailings
Perennial forb

ERICACEAE

Vaccinium caespitosum Michx. - Dwarf huckleberry
Native
Montane: tailings under Pinus contorta
Mat-forming shrub with spreading rootstalks

GENTIANACEAE

Gentiana calycosa Griseb. var. asepala (MacGuire)C.L.Hitchc. - Mountain Bog Gentian
Native
Subalpine to alpine: streambanks, sedge meadows, former sedge meadows
Perennial forb

POLEMONIACEAE

Collomia tinctoria Kell. - Yellow-staining collomia
Native
Foothills to montane in bare soil: tailings
Annual forb

BORAGINACEA

Plagiobothrys scouleri (H.&A.)Johnst. var. penicillatus (Greene)Cronq. - Soucler's plagiobothrys
Native
Lowlands to montane near ephemeral water: clay basins around ponds
Annual forb

SCROPHULARIACEA

Castilleja cusickii Greenm. - Cusick's Indian paintbrush
Native
Montane to subalpine in our area: sedge meadow
Perennial forb

Mimulus primuloides Benth - Primrose monkeyflower
Native
Montane: streambanks, gravel bars
Rhizomatous perennial forb

Pedicularis groenlandica Retz. - Elephant's head; Elephantella
Native
Montane to subalpine: streambanks, gravel bars

Penstemon attenuatus Dougl. var. militaris (Greene)Cronq. - Taper-leaved penstemon
Native
Montane: former sedge meadow, tailings, abundant on resoiled tailings
Rhizomatous perennial forb

Penstemon globosus (Piper)Pennel & Keck - Globe penstemon
Native
Montane to subalpine: sedge meadow, former sedge meadow, tailings
Rhizomatous perennial

Veronica americana Schwein. - American Veronica
Native
Lowland to montane: edges of streams, gravel bars
Rhizomatous perennial forb rooting at nodes

Veronica serpyllifolia L. - Thyme-leaved Veronica
Native
Lowland to subalpine: sedge meadow, sparse in clay basin
Rhizomatous perennial forb

CAPRIFOLIACEAE
Lonicera utahensis Wats. - Twinberry
Native
Montane to subalpine: infrequent in meadows
Shrub

? Symphoricarpos sp. - sterile - Snowberry
Native
Infrequent in sedge and former sedge meadows
Shrub

COMPOSITAE
Achillae millifrolium L. ssp. lanulosa (Nutt.)Piper var. alpicola (Rydb.) Garrett - Yarrow
Native
Circumboreal: former sedge meadows, streambanks, tailings, sparse on resoiled tailings
Rhizomatous perennial forb

Agoseris glauca Raf. var. dasycephala (T.&G.)Jeps. - Mountain dandelion
Native
Widespread: clay basin, tailings
Perennial forb

Anaphalis magaritacea L.)B.H. - Pearly everlasting
(= A. margaritacea (L.)B.H. var. subalpina Gray)
Native
High altitutde form of widespread species: tailings
Rhizomous perennial forb

Antennaria corvmbosa E.Nels. - Meadow pussytoes
Native
Montane : former sedge meadow, elevations in sedge meadow
Mat-forming, rhizomatous perennial forb

Artemisia ludoviciana Nutt. car. latiloba Nutt. - Western mugwort
Native
Widespread: former sedge meadow?, streambanks, abundant on some tailings, absent from resoiled tailings
Rhizomatous perennial forb

Aster foliaceus Lindl. var. apricus Gray - Leafy aster
Native
Alpine to subalpine: sedge meadow
Rhizomatous forb

Aster integrifolius Nutt. - Thick-stemmed aster
Montane : former sedge meadow, clay basin
Rhizomatous perennial forb

Cirsium sp. - immature - Thistle
Tailings, clay basin, former sedge meadow

Eriophyllum lanatum (Pursh)Forbes var. integrifolium (Hook.)Smiley - Eriophyllum
Native
Widespread, mostly lowland: steep slopes of tailings
Perennial forb

Haplopappus lanceolatus (Hook.)T.&G. var. tenuicaulis Gray - Lance-leafed goldenweed
Native
Lowland to montane: clay basin
Perennial forb

Haplopappus lanuginosus var. lanuginosus - Wooly goldenweed
Native
Lowland to subalpine ridgetop species: tailings, elevations in former sedge meadows
Perennial

Haplopappus uniflorus (Hook.)T.&G. - One-flowered goldenweed
Native
Mostly lowland: sedge meadows, former sedge meadows
Taprooted perennial forb

Senecio foetidus Howell var. hvdrophvlloides (Rydb.)T.Y.Barkley - Sweet marsh butterweed
Native
Foothills to montane: sedge meadows
Perennial forb

Taraxicum offinale Weber - Common dandelion
Introduced weed
Widespread: tailings, clay basin
Taprooted perennial forb
Native species may also be present

Wyethia amplexicaulis Nutt. x helianthoides Nutt. - Mule's ears
Native
Montane : former sedge meadow on elevations
Taprooted perennial forb

SOILS EVALUATION

The soils evaluation included two separate activities. Soil nutrient testing was conducted in August 1985 prior to construction. Soil test pits were excavated during 1985 construction in September and October.

Soil Nutrient Testing

The soil nutrient testing involved collecting soil samples at various locations on the patented property and testing the samples for nutrients. Twelve samples were collected from representative soils on the patented land (Figure 6-l). The soil sample sites were excavated using a shovel and the samples were collected by hand. Nutrient testing was conducted by Western Laboratories of Parma, Idaho using state-of-the-art methods for soil evaluation. The results of the soil nutrient testing are presented in Table 6-7.

Results of the soil testing indicate low available nutrients and acidic soil conditions. Analysis of the samples for pH indicated a range of 4.6 to 6.1 pH units. These pH values are lower than pH values recorded for the water quality samples collected in 1985. Macro and micro nutrients in the soil samples were generally limiting for revegetation with exception to iron and calcium. The nutrient recommendations made by Western Laboratories for a pasture type condition in Bear Valley are presented in Table 6-8.

TABLE 6-8

NUTRIENT RECOMMENDATIONS FOR REVEGETATION*
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Revegetation Area Description	Recommended Nutrients (pounds per acre)							
	N	P_2O_5	K_2O	SO_4-S	Mn	Cu	Mg	Zn
Dredge Tailing - Dry Seed Mixture	55	120	100	20	2	2	10	2
Floodplain - Wet Seed Mixture	57	120	100	20	2	2	10	5
Wet Meadow Areas	40	160	100	20	2	2	10	5

*Recommendations based on production of pasture.

Soil Test Pits

Soil test pits were excavated during the 1985 construction at the locations shown in Figure 6-l. The test pits (C1-C4) were located along the berm alignment and conducted to investigate soil conditions in areas to be filled with granular soils. Excavation of the test pits was accomplished using a 1.25 cubic yard bucket on a tracked excavater. The four test pits were each excavated to a depth of eight

TABLE 6-7

RESULTS OF 1985 SOIL NUTRIENT TESTING
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Soil Sampling Site (#)	Description of Sampling Site*	pH (units)	Texture**	Soluble Salts (µmhos)	Lime $CaCO_3$ (%)	Organic Matter (%)	Soil Nutrients (ppm)											
							NO_3	P	K	Ca	Mg	Na	Zn	Fe	Mn	Cu	SO_4	B
1	Dredge Tailing	5.4	LOSN	0.2	0	0.1	2	10	42	545	160	108	0.9	20.4	6.6	0.3	1.0	0.1
2	Reclaimed Dredge Tailing	4.6	SICL	0.4	0	9.0	7	15	56	1605	235	124	2.4	21.2	1.7	0.1	4.0	0.1
3	Wet Meadow	5.1	LOSN	0.2	0	8.3	7	4	34	335	50	118	2.6	45.1	1.0	0.2	4.0	0.1
4	Wet Meadow	5.4	SICL	0.2	0	9.0	6	2	39	640	105	126	0.7	37.8	2.2	0.2	3.0	0.1
5	Dredge Tailing	5.3	SN	0.2	0	0	1	8	32	370	60	112	0.9	39.9	1.0	0.1	1.0	0.1
6	Dredge Tailing, Sediment Pond	5.5	SICLLO	0.2	0	0.2	5	20	70	2445	365	120	0.6	12.0	7.1	0.2	3.0	0.1
7	Dredge Tailing	5.6	SN	0.2	0	0	2	7	37	565	70	111	0.3	5.2	4.5	0.1	1.0	0.1
8	Wet Meadow	4.9	SNLO	0.2	0	3.2	3	2	43	1080	160	123	0.7	40.3	2.2	0.2	3.0	0.1
9	Floodplain	6.1	SN	0.2	0	0	1	3	32	540	75	113	0.4	7.3	5.0	0.2	2.0	0.1
10	Floodplain	5.8	SN	0.2	0	0	1	5	34	425	80	110	0.3	9.6	1.9	0.1	2.0	0.1
11	Dredge Tailing	5.3	SN	0.2	0	0.1	2	10	35	325	60	108	0.5	9.1	5.1	0.2	1.0	0.1
12	Reclaimed Wet Meadow	5.9	LO	0.3	0	4.6	6	4	58	1575	195	128	1.4	48.3	4.1	0.5	4.0	0.1

*See Figure 6-l for location of soil sampling sites.

**Texture classifications: ST, Silt; SN, Sand; LO, Loam; CL, Clay.

feet below the ground surface. The observations of the test pits indicated similar soil and water conditions in all four locations. The soil conditions were characterized by sand, gravel, and small cobbles with fine silt and clay particles mixed into the alluvium throughout its depth. Water flows freely into the test pits from the granular soils at depths ranging from 1.5 to 4.5 below existing grade. The ground water elevation was generally the same as the stream water surface elevation throughout the test pit locations. A registered professional engineer examined each pit before it was backfilled with the granular soils. The soils were determined to be capable of bearing the fill associated with the berm and compatible with the project design.

CROSS SECTION SURVEYING

Bear Valley Creek was surveyed for cross sections and horizontal/vertical control in July 1985. The surveying was performed by Howard Myers, Registered Land Surveyor. The cross section surveying was conducted to collect data for input into the Corps of Engineers HEC-2 backwater profile computer model. The HEC-2 model was run as part of the design to help project hydraulic conditions for the peak flow design event in Bear Valley Creek. The cross sections also were used to estimate excavation volumes for the 1985 construction. The cross sections were surveyed at intervals of approximately 100 feet from downstream to upstream at 56 locations along Bear Valley Creek. The cross section data cover a reach extending from downstream of the bridge in Section 15 to upstream of Reach B (Preferred Alternative Report, JMM, June 1985).

Horizontal and vertical control also was established by Howard Myers during the July 1985 surveying. Existing USGS benchmarks, section corners, and mineral patent corners were used to survey and locate a permanent reference point in the project area. The reference point is located in the centerline of the bridge at the east abutment, Section 15, T.llN., R.8E., Boise Meridian, N. 12,947.26, E. 9,546.96 (Mineral Patent Coordinates), elevation 6,623.90 MSL. An elevation bench mark was established at a bolt on the southwest bridge curb, elevation 6624.70. This surveying data will be used throughout the Bear Valley Creek project for reference and vertical/horizontal control with existing mapping, bench marks, and other surveyed points.

CHAPTER 7

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

CHAPTER 7

PROJECTIONS FOR COMPLETION OF THE PROJECT

INTRODUCTION

Projections for completion of the Bear Valley Creek Fish Habitat Enhancement Project, as presently defined by the plans presented in Chapter 4, may be considered in terms of construction quantities and costs. Future project needs include reapplication for permits, submittal of amendments to existing permits, and design of the log fence around the enhancement site. The undefined work in Reach B (Preferred Alternative Report, JMM, June 1985) has been established as a priority for construction in 1986 by the Tribes, BPA, and Interagency Task Force. The projected construction quantities and costs, permitting and design needs, and undefined work in Reach B are discussed below.

PROJECTED CONSTRUCTION QUANTITIES

The projected construction quantities for the planned 1986 and 1987 work in Bear Valley are summarized in Table 7- 1. The estimated quantities shown in Table 7-1 are only for presently defined work and do not include quantities of Reach B construction which could be started in 1986. The 1986 construction as presently planned would include completion of the work on Sheets 6 and 7 (left) that was started in 1985 (see record drawings, Chapter 4), completion of the work on Sheets **6** and 7 (right), stabilization of adjacent area GG (Preferred Alternative Report, JMM, June 1985) and perimeter fencing around the entire project area. The 1986 construction quantities also include production and transport of all remaining riprap required for the project as presently defined. The 1987 construction would include completion of the work on Sheets 4 and 5, stabilization of adjacent area FF (Preferred Alternative Report, JMM, June 1985), and stabilization of the areas near the bridge across Bear Valley Creek.

PROJECTED CONSTRUCTION COSTS

The projected construction costs are based upon completion of the Bear Valley Creek project as defined by the plans (see record drawings, Chapter 4) and quantities presented in Table 7-l. The projected 1986 construction costs are $558,000 including contractor's labor and equipment, materials, and JMM construction monitoring and field engineering. The projected costs also include all remaining riprap production and transport required to complete the project as presently defined. The perimeter fencing costs also are included in the 1986 projected construction costs. The projected 1987 construction costs are $672,000 including contractor's labor and equipment, materials, and JMM construction monitoring and field engineering. The 1986 and 1987 projected construction costs do not include any work that may be conducted in Reach B of the Bear Valley Creek project. The projected construction costs also do not include the riparian revegetation work because of uncertainty in how successful the willow planting trial program will be during 1986 and subsequent years. The willow planting trial program could be expanded in future years if the plants survive and help stabilize the constructed floodplain. All of the projected construction costs include an inflation increase of six percent per year and ten percent profit on the construction.

TABLE 7-l

PROJECTED CONSTRUCTION QUANTITIES FOR 1986 AND 1987*
BEAR VALLEY CREEK FISH HABITAT ENHANCEMENT PROJECT

Item	Description of Construction Element	Unit of Measurement	Total Projected Quantity 1986	Total Projected Quantity 1987
1.	Site Clearing	acre	2.0	3.3
2.	Grading/Leveling	acre	2.5	5.0
3.	Excavation/Earthwork	cu yd	16,350	44,200
4.	Overhaul	cu yd	1,000	0
5.	Geotextile Matting Installation	sq Yd	5,810	8,280
6.	Topsoil Spreading Over Geotextile Matting	sq Yd	5,810	10,580
7.	Erosion Control Blanket Installation	sq Yd	18,540	32,550
8.	Seeding and Fertilization	acre	7.5	25
9.	Floodplain Reseeding	acre	5.5	6.0
10.	Silt Fencing (Install and Remove)	lin ft	2,070	2,620
11.	Riprap Production and Transport	cu yd	5,9 50	0
12.	Riprap Installation	cu yd	3,740	4,460
13.	Temporary Crossings BVC	each	1	0
14.	Temporary Tributary Diversions	each	5	1
15.	Topsoil Spreading/Disposal	cu yd	0	4,000
16.	Perimeter fencing, gates, crossings	lin ft	13,000	0

*Projected construction quantities do not include potential, undefined work in Reach B.

FUTURE PROJECT NEEDS

There are a number of future needs for the Bear Valley Creek project in 1986 and subsequent years. The future project needs are presented below.

- The perimeter fence planned for construction in 1986 must be designed and the specifications need to be developed before May 1986. The fence design will have to include stream crossings and access gates, and have enough detail to estimate quantities of materials required for construction. Trees for the log poles will be supplied by the USFS -Boise National Forest, Lowman Ranger District. The Tribes must give the USFS enough lead time to locate the pole source. After the pole source is located, costs for cutting, limbing, and transporting the poles will be estimated by JMM. An overall estimated cost of perimeter fence construction also will be developed by JMM. A separate fence construction contract will be awarded to a qualified contractor, and JMM will have to conduct the contractor selection process before July 1, 1986. An unresolved item regarding the perimeter fence is funding for long term maintenance.

- A monitoring program is recommended for the 1986 and 1987 construction seasons. The monitoring program should be consistent with the monitoring conducted in 1985, including water quality sampling, and analysis, streamflow measurement, and soil nutrient sampling on the constructed floodplain. The water quality and streamflow monitoring are proposed for six sites and four times during the year. The soil nutrient sampling would be a one-time sampling effort. An additional item recommended for the 1986 season is geotechnical evaluation of soil stability in the planned construction zones. 'Mater in the soils may cause stability problems during certain periods of the construction activity, and the geotechnical evaluation may result in prescriptive measures that could alleviate potential stability problems. The Tribes also suggested that JMM monitor the snowmelt runoff with a field person during spring 1986 to observe what, if any, flooding effects there are on the areas stabilized in 1985, This monitoring effort would be expensive and difficult because of early season access to the site and uncertainty about when and how long the peak runoff period will occur.

- Permitting for the 1986 construction activity will include applying for new permits and amending 1985 permits. The biological evaluation on the gray wolf will have to be updated and resubmitted to the USFWS. The acquisition of log poles from the USFS will require a special use permit. The application will have to identify the diameter, height, and quantity of timber required for the fence. The riprap special use permit will have to be renewed with the USFS. The existing riprap site may not contain the rock volume required to complete the project as presently defined, and new riprap sites must be explored as part of a contingency plan for the project. Any development of a new riprap site will have to be permitted by the USFS. The planned work for 1986 will require amendment to the IDWR stream channel alteration permit. A new application for the COE 404 permit must be prepared because of the need for constructing a temporary

crossing in Bear Valley Creek. All of these permits must be in place by July 15, 1986 in order to allow construction to begin. A minimum of 60 days should be allowed for agency review of the permit applications, and JMM will require 30 days for preparation of permit applications. JMM will need authorization from the Tribes by April J 5, 1986 to begin preparing permit applications and prevent delays in the construction scheduled for 1986.

- The riparian revegetation planned as part of the project will have to be conducted in stages. In 1985, the USFS agreed to root 150 willow cuttings on a trial basis for planting in the constructed floodplain during 1986. The success of this trial program for riparian revegetation will be monitored throughout 1986. Additional willow cuttings will be rooted for planting in 1987 if the trial willows planted in 1986 have reasonable survival. The goal of the riparian revegetation program is to help stabilize the floodplain and provide bank cover and overhang of the stream throughout the enhancement reaches. The riparian revegetation program could potentially continue through 1989, depending on success of the plantings and the number of willows that can be rooted each year.

- The lodgepole pine revegetation program is initially scheduled for 1987 and will involve planting seedlings in the non-floodplain areas affected by construction activity to provide additional long term stabilization. The availability of lodgepole pine seedlings will depend on USFS needs for trees, however, the Bear Valley Creek project will probably be able to acquire 5000 trees for planting in 1987. Additional lodgepole pine seedlings may be acquired for planting in 1988 and 1989, depending on stabilization needs for the project.

- Bear Valley Minerals, Inc. will require a preconstruction report for the 1986 season, as provided by their easement with the Tribes. The pre-construction report will include plans, specifications, and photographs of existing conditions in the area scheduled for enhancement and stabilization in 1986. The pre-construction report must be completed by May 15, 1986 in order to give Bear Valley Minerals, Inc. enough time to review and approve the construction activity. JMM will need 30 days to prepare the pre-construction report and will need authorization from the Tribes by April 15, 1986 to begin this effort. JMM also will prepare any modifications or changes to the plans or specifications during the preparation of the pre-construction report. Any changes or modifications to the plans and specifications will be based on 1985 construction experience and 1986 projected construction needs.

- The contractor selection process will have to be completed by July 1, 1986. JMM will need 30 days to contact contractors, collect labor and equipment unit prices, and prepare the contractor anlaysis and recommendation package for the Tribes and BPA. JMM will need authorization from the Tribes by June 1, 1986 to proceed with the contractor selection, however, earlier authorization for this task may help ensure response from many contractors before they are committed to summer projects. The goal of the contractor selection

process is to recommend the contractor with the best qualifications and lowest unit prices for labor and equipment to construct the Bear Valley Creek project in 1986.

- The stabilization of Reach B (Preferred Alternative Report, JMM, June 1985) has been identified by the Interagency Task Force as a priority reach for construction during 1986. Two alternatives have been proposed for stabilizing Reach B. The first alternative involves constructing a diversion channel that would bypass the unstable areas of Reach B. The second alternative would be directed at stabilizing the existing streambanks of Reach B. An Interagency Task Force meeting has been tentatively scheduled for mid to late June 1986 in the field to decide which alternative would be endorsed. The design of stabilization for Reach B could require up to 30 days, irregardless of which alternative is selected. The permitting is dependent upon completion of the design, and permit preparation would require a minimum of ten days. Permit application reviews by the agencies will potentially require another 60 days. The permits for construction of Reach B could be granted by October 1, 1986 if a decision on the alternatives is made by June 30, 1986, however, there is little possibility that any construction work would be completed because the season is scheduled to end October 15, 1986. Construction of either alternative in Reach B will require a significant quantity of riprap, and a new rock source would have to be developed for this portion of the project. Utilizing the schedule presented above, design of Reach B improvements would have to begin in early April 1986 in order to start construction in July and complete the season's work in October. If any construction is to take place during 1986 in Reach B, we would recommend that a 10 percent level design be completed on both options by the third week of April. Based upon the 10 percent design a decision would have to be made by the end of the first week in May as to what alternative to pursue. This would require review with the Interagency Task Force and approval of the selected alternative for Reach B by Bear Valley Minerals, Inc. before the design could be finalized. Unless this schedule can be met, JMM would recommend that construction work on Reach B be delayed until 1987 in order to allow the Interagency Task Force and Bear Valley Minerals, Inc. to select a mutually agreeable alternative for stabilization and enhancement of this portion of Bear Valley Creek.

The future project needs for 1986 and subsequent years as described above are necessary for successful completion of the Bear Valley Creek Fish Habitat Enhancement Project. Monitoring, permitting, design, and other key activities need to be started by the indicated dates in order to maximize the construction season and keep unit costs for construction in control. The July 15, 1986 date is a realistic goal for starting the construction activity, but any delays will result in a shortened construction season, less progress toward overall completion of the project, and potentially higher costs to perform the construction work.

REFERENCES

REFERENCES

Bear Valley Minerals, Inc. 1985. Topographic Mapping of the Big Meadows Area of Bear Valley. Includes Bear Valley Creek and Disturbed Area. 5 sheets, 42" x 64". Scale 1" = 100', 2 foot contours.

JMM. November 1984. Project Work Plan, Bear Valley Creek, Idaho, Fish Habitat Enhancement Project. Prepared for the Shoshone-Bannock Tribes. 50 pages.

JMM. March 1985. Draft Feasibility Report, Bear Valley Creek, Idaho, Fish Habitat Enhancement Project. Prepared for the Shoshone-Bannock Tribes. 150 pages.

JMM. April 1985. Selected Alternative Report, Bear Valley Creek, Idaho, Fish Habitat Enhancement Project. Prepared for the Shoshone-Bannock Tribes. 50 pages.

JMM. June 1985. Preferred Alternative Report, Bear Valley Creek, Idaho, Fish Habitat Enhancement Project. Prepared for the Shoshone-Bannock Tribes. 65 pages.

Shoshone-Bannock Tribes. June 1985. FY 1984 Annual Report, BPA Project No. 83-359, Salmon River Habitat Enhancement. Prepared for the Bonneville Power Administration, division of Fish and Wildlife. 105 pages.

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

Argonaut Building, Suite 210, 1301 Vista Avenue, Boise, Idaho 83705 / (208) 345-5865

713.0050

April 30, 1986

Shoshone-Bannock Tribes
P.O. Box 306
Fort Hall, ID 83203

Attention: Mr. Phillip Cernera, Fisheries Biologist

Subject: Bonneville Power Administration Project No. 83-359
Herd Creek Fish Habitat Enhancement Project

Gentlemen:

We are pleased to submit 15 copies of the Feasibility Report for the Herd Creek Fish Habitat Enhancement Project. This report is the output for our October 31, 1985 contract. At your instruction, copies of this report have been sent directly to Mr. James R. Bennetts and Bonneville Power Administration.

James M. Montgomery, Consulting Engineers, Inc. (JMM) wishes to express its appreciation for the technical input and information provided by Dr. Richard Konopacky and Mr. Cernera in completing this project. The JMM project team also wishes to express their gratitude for the patient assistance of Mr. James Bennetts, owner of the private lands comprising the study area, the Bonneville Power Administration, the USDI - Bureau of Land Management, the USDA - Forest Service, and the Idaho Department of Fish and Game.

This report presents a description of the Herd Creek study area, development and analysis of preliminary alternatives for stabilizing the stream banks and protecting fish habitat, and provides recommended alternatives for the six stream problem reaches. The study area description includes a detailed analysis of surface water hydrology. The recommended alternatives were developed and analyzed based on the Shoshone-Bannock Tribes objectives for the Herd Creek project, compatibility with existing grazing activities, and general engineering criteria applicable to the study area. Institutional alternatives also were listed in the feasibility report for consideration by the involved entities.

We would like to point out that the information contained in this report may be subject to modification based on further investigation and verification of field conditions. All written comments on this report should be directed to the Shoshone-Bannock Tribes, Fisheries Department.

Again, we appreciate all of the assistance and cooperation provided to JMM in conducting this study. We would look forward to working with the Shoshone-Bannock Tribes, Bonneville Power Administration, Mr. James Bennetts, and federal and state resource management agencies should this project be implemented in Herd Creek. Please call me at (208) 345-5865 if you have any questions regarding this report.

Very truly yours,

Brian D. Liming

Brian D. Liming
Project Engineer/Scientist

Enc.

BPA PROJECT NO. 83-359

FY 1985 ANNUAL REPORT

PART 4 OF 4

FEASIBILITY REPORT

HERD CREEK, IDAHO

FISH HABITAT ENHANCEMENT PROJECT

Prepared by:

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

Prepared for:

SHOSHONE-BANNOCK TRIBES
FISHERIES DEPARTMENT

Submitted to:

BONNEVILLE POWER ADMINISTRATION
DIVISION OF FISH AND WILDLIFE

APRIL 1986

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CHAPTER 1

CHAPTER 1

SUMMARY

The Feasibility Report for the Herd Creek Fish Habitat Enhancement Project provides a characterization of the study area, and also includes development and analysis of preliminary alternatives for stabilizing stream banks and protecting chinook salmon spawning and rearing habitat. Chapter 2 presents an introduction to the report and includes a statement of the problem, purpose and background, report utilization discussion, and authorization for the study. The study area is characterized in terms of physical and biological components in Chapter 3 and includes an evaluation of the existing data base, a detailed discussion of surface water hydrology, and the identification and analysis of specific problem reaches in Herd Creek. Surface water hydrology is a primary environmental feature and influence on the study area. Preliminary alternatives for the problem reaches are developed and analyzed in Chapter 4 based on the objectives of the Shoshone-Bannock Tribes, compatibility with existing livestock grazing operations, and general engineering criteria. Chapter 5 presents the recommended alternatives for the Herd Creek study area. The overall recommended alternative emphasizes non-structural stream bank stabilization measures consisting of riparian revegetation, construction of intermittent fencing to limit livestock access to Herd Creek, construction of stabilized livestock crossings of the stream, and no action for the remaining areas. Implementation of the recommended alternative components to any of the problem reaches will require additional engineering analysis and design.

CHAPTER 2

CHAPTER 2

INTRODUCTION

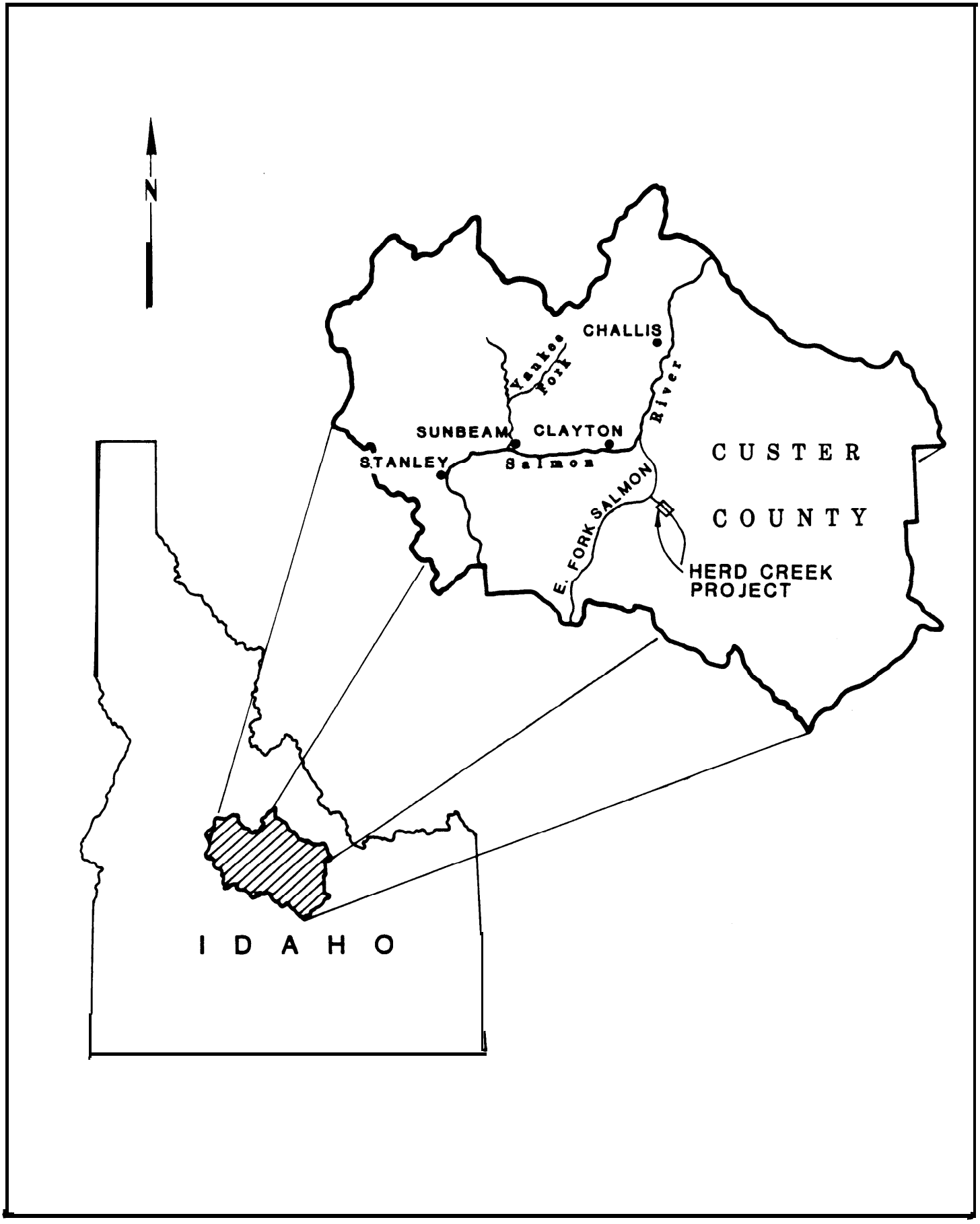
STATEMENT OF PROBLEM

The past thirty years have shown a significant decline in the return of chinook salmon and steelhead trout to their natural spawning areas in Idaho. There are several significant reasons for the loss of this important resource, including the dams on the lower Columbia and Snake and Clearwater Rivers, increased fishing pressures by commerical sport and subsistence fishermen, reduced flows during critical migration periods, water quality problems, and the continuing destruction of spawning and rearing habitat by natural and human accelerated modification of watersheds, stream channels and bed substrate. Numerous studies and reports have attempted to quantatively and qualitatively assess the impacts of the various reported reasons for the observed decline in natural anadromous fish spawning. This document is limited to one very specific aspect of the overall problem. The problem addressed by this report is the protection of spawning and rearing habitat, and stabilization of sediment production areas, believed to be affecting downstream spawning and rearing habitat. This problem area is the privately held, presently grazed lands in the Herd Creek, Idaho drainage (Figure 2-l). The project study area includes portions of Sections 7 and 18, Township 9 North, Range 19 East, Boise Meridian. Herd Creek is the largest tributary to the East Fork of the Salmon River. It is considered the most important tributary stream for spawning and rearing of chinook salmon in the East Fork drainage. The private land includes approximately 2.5 stream miles of Herd Creek. These private ranch lands are grazed by livestock throughout the season. Livestock access to the stream is believed to be one activity affecting spawning and rearing habitat within the private land boundaries and also contributing sediment to the downstream publicly owned and managed reaches of Herd Creek.

The problem this report addresses is the identification of erosion and sedimentation areas contained within the private land in the Herd Creek drainage. This report provides an analysis and evaluation of alternatives for eliminating or ameliorating the problems delineated.

PURPOSE AND BACKGROUND

The purpose of this report is to provide the Shoshone-Bannock Tribes with a feasibility level study that will permit the evaluation of alternative protection, enhancement, and mitigation measures that could be implemented in order to protect existing spawning and rearing habitat areas presently undergoing degradation. The Herd Creek, Idaho Fish Habitat Enhancement Project has been undertaken in conjunction with other concurrent studies, and those yet to be performed, that fall under the Salmon River Habitat Enhancement Program funded by the Bonneville Power Administration (BPA). This program provides offsite enhancement as partial compensation for fish habitat damage and migration problems related to hydroelectric power projects in the Columbia River Basin. The project is listed in program measure 704(d)(l), Table 2 of the Northwest Power Planning Council's 1984 Columbia River Basin Fish and Wildlife Program.



HERD CREEK
FISH HABITAT ENHANCEMENT PROJECT
LOCATION MAP
FIGURE 2-1

The Tribes are sponsoring this project because the East Fork system is an important anadromous fishing area, as provided in the Treaty with the Eastern Band Shoshoni and Bannock, 1868 and its amendments. The Tribes have invested significant manpower and resources into various studies and management programs for the protection and enhancement of anadromous fish in the Salmon River drainage. The Herd Creek Fish Habitat Enhancement Project is one of several habitat protection efforts undertaken by the Tribes in the Salmon River drainage.

Portions of the Herd Creek drainage have been used for livestock grazing and agricultural purposes during most of the past 100 years. Wild ungulates (deer, elk) are found within the drainage during specific seasons throughout the year. The Bureau of Land Management (BLM) and USDA-Forest Service (USFS) jointly manage the Herd Creek Grazing Allotment which covers 45,409 acres of federal lands upstream and downstream of the private land. In 1979, approximately 1.25 miles of Herd Creek on BLM lands were fenced to exclude all livestock from the upstream end of the private land to the boundary of the USFS lands (Challis National Forest). The BLM and USFS have been attempting to limit livestock access to Herd Creek on the federal lands in order to protect stream banks and anadromous fish habitat. Similar protection measures have been suggested for the private land on Herd Creek, however, livestock access continues to contribute to bank instability and habitat disruption, affecting the stream throughout the private land and also in downstream reaches. The overall purpose of this project is to develop alternatives that could reduce the erosion and sedimentation, enhance the fish habitat, and allow for continued livestock grazing on the private lands in the Herd Creek drainage.

REPORT UTILIZATION

This report considers the preliminary feasibility of controlling and reducing erosion and sedimentation arising from the private land in the Herd Creek drainage with an overall objective to enhance fish habitat. Although care has been taken to assure the reliability of the information set forth in this report, the scope of work has limited detailed study of the private land. Data and factual information obtained from third parties have not been independently verified. Therefore, for these and other reasons, the possibility of error or misinterpretation of information supplied by third parties cannot be entirely ruled out, although care has been taken to assure the greatest reliability possible under the circumstances. Nevertheless, all findings, conclusions, data, and information expressed in this report should be regard as preliminary and subject to further refinement and development, if the design of recommended modifications is actually undertaken.

AUTHORIZATION

The Herd Creek, Idaho, Fish Habitat Enhancement Feasibility Study is being performed by James M. Montgomery, Consulting Engineers, Inc. (JMM) for the Shoshone-Bannock Tribes (Tribes), under Bonneville Power Administration (BPA) contract number 83-359. The project is funded by BPA's Division of Fish and Wildlife as part of the overall effort to protect, mitigate, and enhance fish habitat and resources impacted by hydroelectric development and operation in the Columbia River Basin. Mr. James R. Bennetts has granted an easement to the Tribes for conducting the feasibility study on the private land in the Herd Creek drainage.

ABBREVIATIONS

In order to conserve space and improve readability, the following abbreviations have been used throughout this report:

BLM.....	Bureau of Land Management
BPA.....	Bonneville Power Administration
cfs.....	cubic feet per second
COE.....	U.S. Army Corps of Engineers
cu ft....	cubic feet
cu yd....	cubic yard
cu yd/yr	cubic yards per year
°C.....	degree centigrade
°F.....	degree Fahrenheit
USFS..	USDA-Forest Service
ft	foot (feet)
fps..	feet per second
USFWS	USDI-Fish and Wildlife Service
HEC.....	Hydrologic Engineering Center
IDFG....	Idaho Department of Fish and Game
IDWR....	Idaho Department of Water Resources
JMM.....	James M. Montgomery, Consulting Engineers, Inc.
lin ft...	linear foot (feet)
mi....	mile(s)
MSL....	mean sea level
SCS....	U.S.D.A. - Soil Conservation Service
sq ft....	square feet
sq mi..	square mile(s)
sq yd....	square yard
Sta....	stations
tons/sq mi/yr	tons per square mile per year
tons/yr..	tons per year
Tribes	The Shoshone-Bannock Tribes
USGS....	U.S.D.I. - Geological Survey
yr.....	year

CHAPTER 3

CHAPTER 3

CHARACTERIZATION OF THE STUDY AREA AND PROBLEM IDENTIFICATION

INTRODUCTION

This chapter provides an evaluation of the existing data base, a description of the study area, and an identification of the problems on the private land in the Herd Creek drainage. The evaluation of the existing data base provides a summary of the available information compiled from all sources on Herd Creek. The project study area is described in terms of general physical and biological characteristics and environmental features related to the erosion and sedimentation problems within the Herd Creek drainage. The primary environmental feature is the surface water hydrology of the study area. The last section of this chapter includes an identification and analysis of the specific problem reaches within the private land boundary.

EVALUATION OF EXISTING DATA BASE

The existing data and information base was compiled from various agency sources. These sources include:

- The Shoshone-Bannock Tribes
- USDA-Forest Service, Challis National Forest (USFS)
- USDI-Bureau of Land Management (BLM)
- USDA-Soil Conservation Service, Snow Survey (SCS)
- USDI-Geological Survey (USGS)
- Idaho Department of Fish and Game
- Idaho Department of Water Resources

In addition to the data and information evaluated from the sources listed above, other information and reference materials from JMM's library were included in the data base for consideration by the project team. The JMM project team visited the study area on two separate dates to take photographs, examine problem reaches, and collect data on the private land and surrounding watershed. The following subsections present summaries of the existing data base.

Water Quality

There are no available records of water quality data on Herd Creek. The Tribes monitored water temperature in Herd Creek during 1985 to characterize the fish habitat, however, no other physical or chemical data on the water quality of Herd Creek was located by JMM.

Hydrology and Hydrologic Analysis

Surface water hydrology data for the project study area are limited. The USGS installed a recording stream flow gage in Herd Creek during 1979. Stream flows were measured in Herd Creek from October 1979 to September 1984, when the gage operation was discontinued. The IDWR has records of three water rights on Herd Creek totaling 3.3 cfs. Two of the water rights, granted in 1885 and 1900, are decreed. The third water right was granted in 1960 to Mr. James Bennetts.

The hydrologic analysis was performed using the Corps of Engineers HEC-1 computer model which simulates surface runoff response of river basins to precipitation events. An explanation of the HEC-1 model functions and the results of the hydrologic modeling are presented later in this chapter. Data requirements and assumptions necessary to run the HEC-1 model include:

- Watershed Data
- Soils Data
- Management Activities
- Routing Reach Data
- Snowpack/Snowmelt Data
- Runoff Data

The existing data base for modeling surface runoff characteristics of the Herd Creek project area was sufficient for some of the model parameters, but was lacking or insufficient in others for providing a high degree of reliability. The physical characteristic data obtained from maps and soil surveys was sufficient for modeling purposes. Data was lacking for soil infiltration and vegetative cover characteristics. Data for these areas were assumed using best engineering and scientific judgement. Site specific climatological data required for modeling purposes were not available and were interpolated from a representative climatological station near the study area.

The parameters assumed for modeling the study area such as infiltration characteristics, snowpack equivalent water content, and estimated runoff per square mile should be adequate for the feasibility level of alternative evaluation and recommendation. Modeling parameters such as the snowmelt coefficient that influence the rate of snowmelt runoff were optimized based on calibration of the model using known snowmelt-generated stream flows recorded at the Herd Creek gage.

Aerial Photographs and Maps

The Tribes provided aerial photographs of the project area. The aerial photographs were taken in August 1985 and have an approximate scale of one inch equals 100 feet. USGS topographic maps (7.5 minute, one inch equals 2,000 feet) of the entire Herd Creek drainage basin were used in the hydrologic modeling and characterization of the project vicinity.

Cross Section Surveying

Cross section surveying was performed throughout the length of Herd Creek on the patented land. A total of 23 cross sections were surveyed by JMM subcontractor Howard Myers Company in July 1985. The cross section data was used in the hydrologic modeling, hydraulic analysis, and problem identification on the private land.

Vegetation

The vegetation data base evaluation involved review of existing federal and state resource reports, examination of aerial and ground level photographs, and field reconnaissance of plant communities in the study area. The existing literature, maps, photographs, and field data are limited but adequate to identify problems and analyze alternatives for this feasibility study.

DESCRIPTION OF THE STUDY AREA

This section describes the existing physical and biological environment of the study area as presented in Figure 3-l. The project study area contains approximately 440 acres. The intent of this section is to provide general information about the existing environment in terms of the erosion and sedimentation processes occurring in and adjacent to Herd Creek within the private land boundary. The primary environmental feature, surface water hydrology, is addressed in a later section of this chapter.

Physical Components of the Study Area

The physical components of the study area may be described in terms of topography, geology, and soils. These physical components are described below as they relate to the erosion and sediment delivery process.

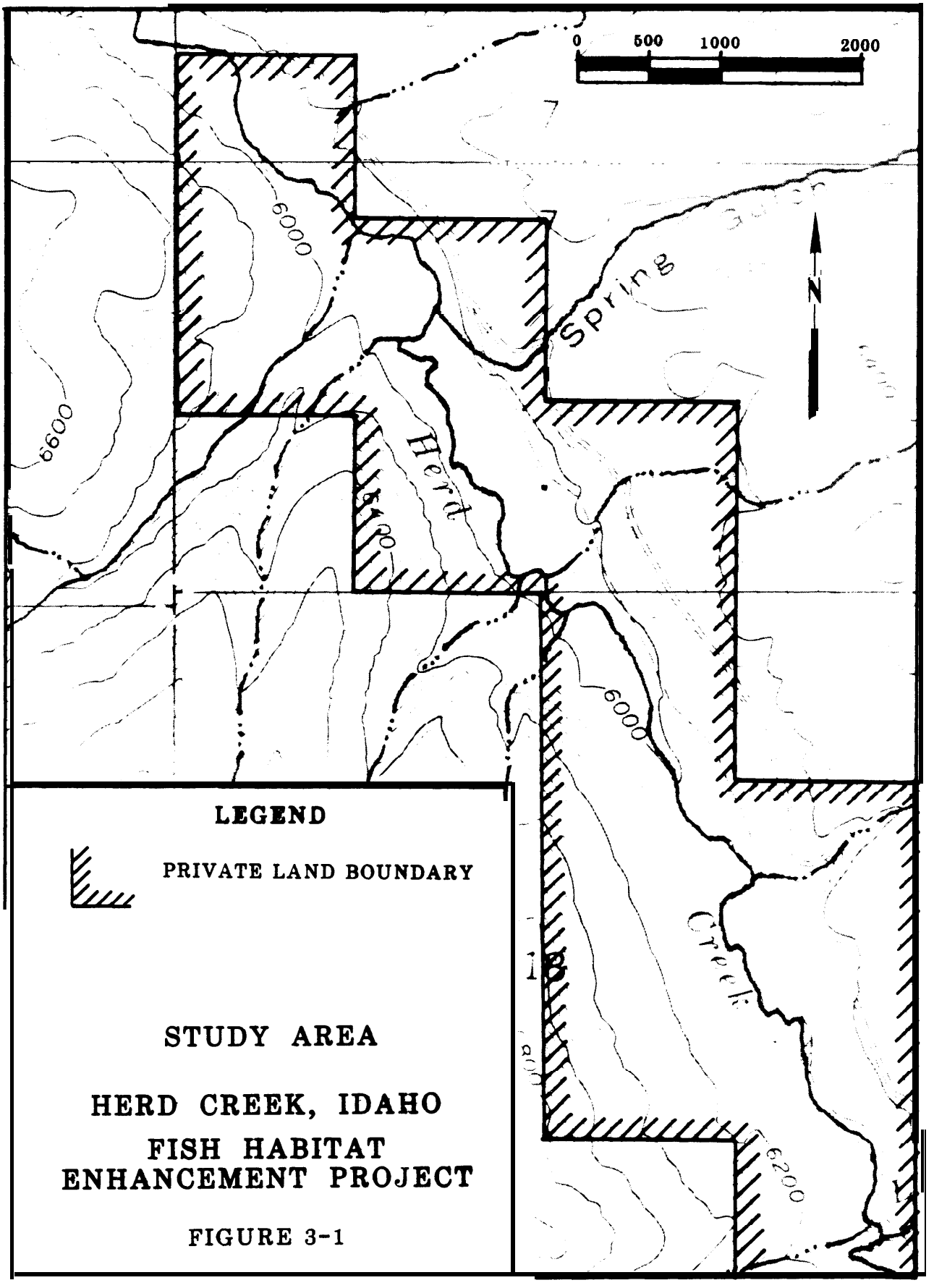
Topography. The topography of the Herd Creek project study area is primarily comprised of a high mountain, narrow meadow valley with an elevation ranging from approximately 5,820 to 6,080 feet above mean sea level. The narrow meadow valley is surrounded by steep slopes with the highest peak having an approximate elevation of 8,300 feet on the eastern side of the valley. The highest point on the west side of the study area is at an elevation of 7,858 feet. The mountains in the project vicinity have slopes ranging from 15 to 80 percent.

The Herd Creek valley in the study area has slopes ranging from less than one percent to one and one-half percent. Faulting and uplifting, natural erosion, fluvial action and cryoplanation contributed to the shaping of the topography. Natural erosion rates of the study area are estimated as moderate.

Geology. Herd Creek is located within an area of Idaho dominated by volcanic rocks. The surface geology of the study area vicinity is characterized by a thick layer of rock called the Challis Volcanics. These rocks are comprised of volcanic flows and ash deposits derived from the extensive Challis volcanic field over 40 million years ago. This volcanic field covers much of central Idaho. The volcanic rocks in the project area are moderately to highly erodable, depending on the amount of mineralization in weak areas of the bedrocks. Structural geology of the study area is characterized by local faulting and fracture zones.

The meadow portion of the valley along Herd Creek is comprised primarily of sediments naturally eroded from the tributary drainage over millions of years. The sediments are deposited in an unconsolidated alluvium that forms the floodplain of Herd Creek. Fluvial action from normal and peak flow runoff continually modifies the floodplain (essentially the entire valley-meadow area), depositing, eroding, and redepositing sediments into downstream reaches. The natural erosion processes of the entire watershed have an affect on the downstream reaches of Herd Creek including the study area.

Soils. The soils of the study area are generally classified into two landtypes. The mountain slopes comprise the dominant landtype of the study area. Soils on the mountain slopes are generally shallow and poorly developed at the surface, with deeper and more uniform subsoils. The soils and subsoils are primarily derived from the Challis Volcanics which include andesite, rhyolite, latite, and tuff as parent materials. Soil textures observed throughout the mountain slope landtype are



STUDY AREA

HERD CREEK, IDAHO
FISH HABITAT
ENHANCEMENT PROJECT

FIGURE 3-1

loams, silts, and clays. Soils of the project vicinity are subject to erosion from snowmelt runoff, precipitation events (rainstorms and thunderstorms), frost action, and wind.

The second landtype of the study area consists of depositional soils. The depositional landtype contains the soils of primary interest within the study area. This landtype occurs in the narrow valley along Herd Creek and consists of shallow soils on the surface with unconsolidated alluvium comprising the subsoils. The soils and subsoils are derived from the parent volcanic materials typical of the mountain slopes. The depositional landtype soil textures include loams, silts, clays, sands, and gravels. These soils are susceptible to erosion from fluvial action, precipitation events, and frost action.

Erosion of soils from the mountain slope and depositional landtypes can be accelerated due to human activities. These human activities include road building, road use, land management for livestock grazing, and irrigation. Each of these activities have contributed to accelerating natural erosion processes within the study area.

Biological Components of the Study Area

The significant biological components of the study area include vegetation types, livestock grazing, wildlife utilization, and aquatic biology. The influence of past land management activities and related biological characteristics of the study area are discussed in the following sections.

Vegetation Types. The study area is comprised of three predominant vegetation types that have been identified and characterized. These vegetation types are scrub/shrub, riparian, and irrigated pasture. The valley/floodplain portion of the study area contains all three of these vegetation types. The scrub/shrub vegetation type occurs on the mountain slopes and fringes of the valley floodplain. The scrub/shrub vegetation type contains little or no overstory. Scrub/shrub species include common juniper and mountain sagebrush. The riparian vegetation type is located in a narrow zone along both sides of Herd Creek except where rock outcrops are adjacent to the stream. The riparian vegetation within the study area is disrupted and non-continuous in some reaches. Riparian species include alder, cottonwood, willow, wild rose, and various types of grasses. The riparian vegetation type is characterized by overstory, shrub, and understory species where little or no disruption has occurred. The irrigated pasture vegetation type occurs mostly on the floodplain between the riparian and scrub/shrub vegetation types. A portion of the scrub/shrub vegetation type above the floodplain has been converted into irrigated pasture. The irrigated pasture species are primarily introduced grasses and basic crops that provide food value for livestock. The irrigated pasture has replaced the riparian vegetation type in some places along Herd Creek within the study area. The density of riparian vegetation immediately upstream and downstream of the study area suggests that the riparian zone within the study area has been mostly replaced by irrigated pasture.

Livestock Grazing. Livestock grazing occurs throughout the Herd Creek drainage and much of the study area during the late spring, summer, and early fall months. The federal lands surrounding the study area contain approximately 4,000 AUM's in three allotments that are managed by the BLM and USFS under a rest rotation system. The private lands within the study area are grazed by livestock, and a 1980 BLM Land Management Plan indicates that the private landowner, Mr. James

Bennetts, agreed to exclude livestock from one pasture to help improve fish habitat (BLM, 1980). Records available to JMM indicate livestock have grazed in the Herd Creek drainage for nearly a century.

Wildlife Utilization. Reported wildlife utilization of the study area includes elk, deer, small game, and raptors. Elk and deer may use the study area during different seasons than the livestock. Riparian vegetation can be damaged and disrupted by any hoofed animal, including wild ungulates and livestock. Deer use of the Herd Creek drainage was estimated in 1977 to be less than one livestock use equivalent per acre. Livestock use of the same area was estimated at 265 cattle use days per acre (IDFG, 1979).

Aquatic Biology. Herd Creek contains both resident and anadromous species of fish, in addition to aquatic macroinvertebrates. Diversity of aquatic macro-invertebrates sampled in 1977 within the Herd Creek drainage was excellent, according to an IDFG study (1979). Resident fish species recorded in the study area include rainbow trout, bull trout, mountain whitefish, and cutthroat trout. Anadromous fish species recorded in the study area include chinook salmon and steelhead trout. Herd Creek is considered the most important stream in the East Fork Salmon River drainage for spawning and rearing of chinook salmon. A recent inventory of fish species and habitat components in Herd Creek was completed by the Shoshone-Bannock Tribes (1986).

SURFACE WATER HYDROLOGY

This section describes the existing hydrologic conditions of the Herd Creek study area. The results of surface water hydrology modeling studies conducted for the drainages flowing into the study area in Herd Creek are presented in this section. The general climatic conditions and physical characteristics of the Herd Creek study area related to surface water hydrology are also discussed. The objectives of this section are: 1) to provide an evaluation through modeling of the surface water hydrology and to estimate the stream flow characteristics of Herd Creek and its tributaries within the project area; 2) to provide a hydrology summary of the estimated runoff generated from various snowmelt runoff events.

Surface Water Resources

The study area includes approximately 2.5 miles of Herd Creek and portions of contributing surface streams such as Lake Creek and numerous small unnamed tributaries. Herd Creek is the largest tributary to the East Fork Salmon River. The Herd Creek drainage comprises approximately 73,880 acres of watershed, and the main stream is approximately 9.4 miles long. The boundaries of the private land are at stream mile 3.25 and stream mile 5.75. The tributary creeks originate due to snowmelt, precipitation, subsurface flows, and/or surface storage.

Stream Channel Characteristics

Herd Creek is primarily a meandering stream in a narrow valley surrounded by steep mount ain slopes. The average slope of the water surface is 1.1 percent through the study area. The' small tributaries to Herd Creek in the study area have mostly intermittent flows. These tributary channels are characterized by steep channel gradients with generally straight reaches and few meanders.

The average stream depth of Herd Creek before and after spring runoff is 14 inches, withsome pools up to six feet deep. The average channel width in the study area is 19 feet under base flow conditions. The average amplitude of the stream meanders within the study area is 150 feet, and the average meander belt width is 350 feet.

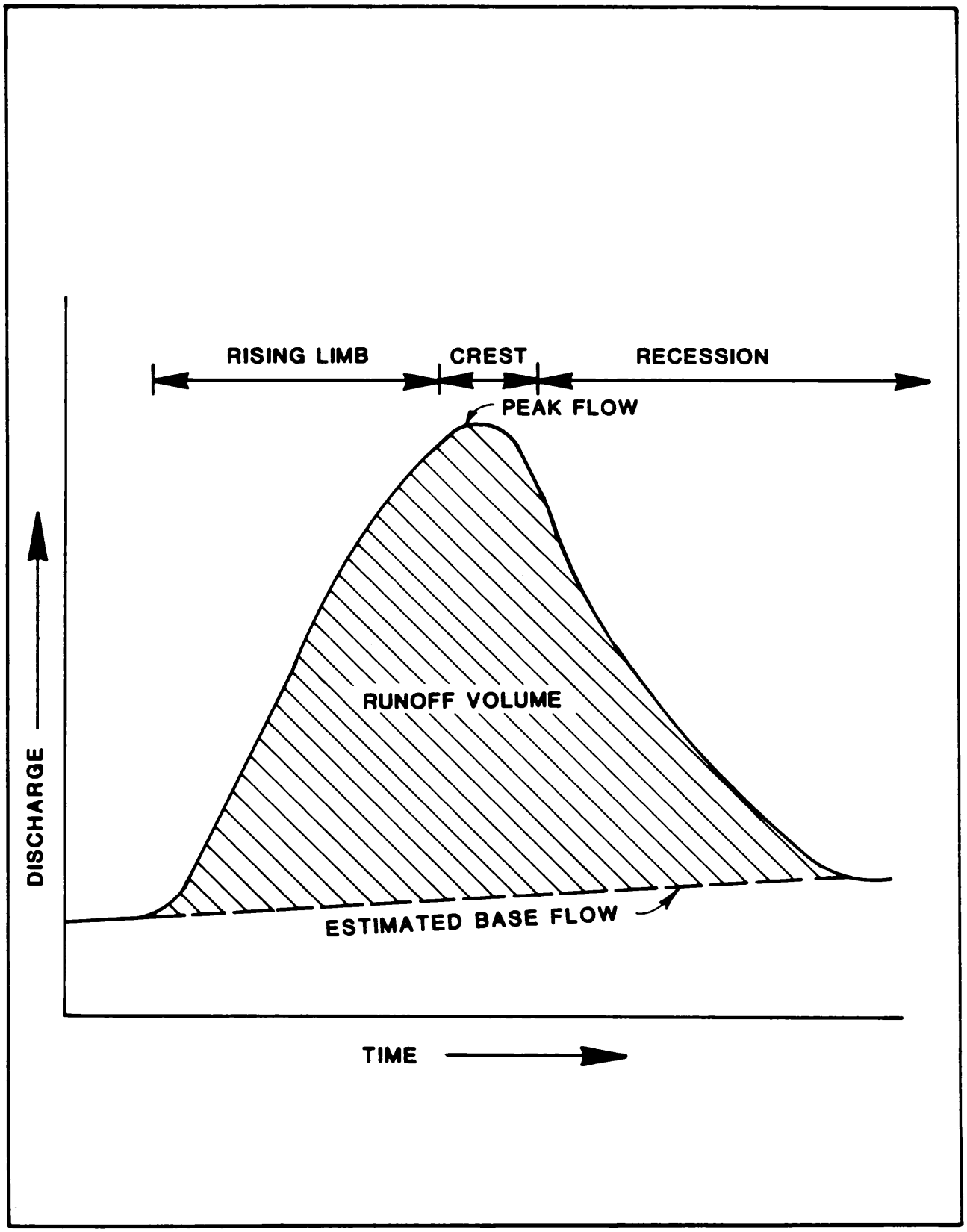
The valley bottom through which Herd Creek flows is a floodplain built by natural erosion and sedimentation processes over millions of years. The path of Herd Creek is continually changing within the floodplain as the stream attempts to reach an equilibrium state. These changes in the stream channel are evident from aerial photographs showing the past meanders of Herd Creek. Some oxbow ponds (previous meanders) exist within the study area. The natural erosion and sedimentation processes in the floodplain actively occur throughout the year, however, changes in the stream's channel are most likely to happen during the spring snowmelt runoff when flows reach an annual maximum. During spring runoff, the flows can increase to the point where the stream exceeds its low flow banks and inundates the floodplain. As the water enters the floodplain, the overall stream velocity decreases, however, the main channel flow velocities will generally remain higher than floodplain flow velocities.

Disturbed stream banks are generally more susceptible to erosion than vegetated, undisturbed stream banks. The spring runoff flows in Herd Creek may exceed the low flow channel capacity, and when the flood waters some into contact with disturbed stream banks in the study area, the process of erosion is accelerated. The eroded material is transported downstream as bed load and suspended sediments until it reaches an area with reduced flow velocity and is deposited in the floodplain or stream bed. The deposition may change the capacity of the channel or the profile of the stream bottom and further modify the stream course. This cycle is continuous and self-perpetuating in streams like Herd Creek. Contact between the stream and disturbed stream bank areas speeds up the process of erosion and sedimentation.

Hydrological Modeling

The Herd Creek drainage basin was modeled for surface water runoff from snowmelt events using the HEC-1 hydrologic computer model. The input data for the HEC-1 model were collected from various sources, and the data are summarized in the following subsections. The model provides an efficient -method of analyzing flood flows under a variety of precipitation/runoff conditions. The output hydrographs from the model can be used to help plan and design facilities and improvements for a selected runoff event.

A hydrograph is a graph of discharge versus time, and an example hydrograph of runoff streamflow is shown in Figure 33. The runoff hydrograph consists of a rising limb, crest segment, and recession curve. The rising limb reflects the increase in streamflow during a runoff event. The crest segment of the hydrograph characterizes the period during which streamflow is greatest, and ends at an inflection point on the falling side of the hydrograph. The recession curve represents the withdrawal of water from storage within the drainage basin. The estimated base flow is the contribution from groundwater. The runoff volume may be calculated by integrating the area under the curve of the hydrograph. The peak flow occurs during the crest segment and is the maximum discharge of the runoff event. The runoff hydrographs developed for the Herd Creek study area are considerably more complex than the example presented in Figure 3-2.



EXAMPLE HYDROGRAPH
OF RUNOFF STREAMFLOW
FIGURE 3-2

A summary of the HEC-1 model functions is presented below. Background information sources, physical characteristics of the study area drainage basin, input data and assumptions, and discussion of the results obtained from the HEC-1 model are included in the discussion.

Summary of HEC-P Model Functions. The HEC-1 computer model was originally developed in 1967 for the U.S. Army Corps of Engineers by the Hydrologic Engineering Center (HEC) at Davis, California. After several major revisions, the model is now a powerful analysis tool for simulating rainfall or precipitation/runoff events and computing flood hydrographs. The version of HEC-1 used to evaluate the drainage characteristics of the Herd Creek basin was published in March, 1981. The HEC-1 model requires a number of input data variables to simulate actual conditions within the basin under analysis. These following variables are discussed later in this section.

- Subbasin area
- Precipitation quantity
- Precipitation distribution
- Exponential precipitation loss rate
- Impervious area
- Subbasin runoff lag time
- Stream channel reach length
- Stream channel reach slope
- Manning's coefficients for right and left bank, center of channel
- Base streamflow
- Cross section coordinates (x and y)

The input data variables are arranged by order of occurrence in each subbasin from upstream to downstream areas. The subbasins are characterized in terms of area, initial and uniform precipitation losses into the soil, impervious area, and lag times for runoff to collect at subbasin design points. The design storm or snowpack is applied to the subbasin area, a portion of the precipitation or snowmelt is lost into the soil, and the remaining rainfall is combined with runoff from impervious areas to produce a hydrograph at the subbasin design point. The subbasin hydrograph is then routed to the next downstream design point through a simulated open channel. The input data for hydrograph routing include vertical and horizontal coordinates of a typical cross section of the stream reach, Manning's roughness coefficient for the stream channel and each stream bank, and the channel slope and reach length. The routed hydrograph is combined with the runoff hydrograph from the subbasin area collected at the downstream design point, and the combined hydrograph is then routed to a further downstream design point. Subsequent routing and combining of hydrographs through downstream reaches and subbasins to the most downstream design point yields a total outflow hydrograph.

The HEC-1 model has a snowfall/snowmelt option which requires additional input data for simulation of runoff from snowmelt. The additional data variables for the snowfall/snowmelt model are presented below and discussed later in this section.

- Subbasin area by snowmelt zone
- Snowpack water equivalent by snowmelt zone
- Annual precipitation by snowmelt zone

- Temperature lapse rate
- Snowmelt coefficient
- Melting temperature of snowpack
- Exponential loss rate of snowmelt
- Rate of change of precipitation
- Exponent of precipitation for loss rate function
- Rate of change of snowmelt loss
- Air temperature

The snowfall/snowmelt option combines these additional variables with the runoff modeling sequence described above. Each subbasin that collects winter snowpack is characterized in terms of area by elevation zone. The annual precipitation and snowpack in terms of water content for each elevation zone provide the model with precipitation storage data, and the design storm is applied to the snowpack to compute the amount of melt and runoff. The model computes snowfall/snowmelt for each elevation zone using the degree-day method with temperature as the input data. The runoff produced from snowmelt is collected at the subbasin design point, and the hydrograph is routed to the downstream design point as described earlier.

The HEC-1 model has limitations which must be considered in its use and interpretation of the modeling results. The HEC-1 model does not account for surface water recharge from groundwater except by input of base flow at specific points in the model. Surface water which enters the soil and flows subsurface to a stream channel may only be input using the base flow variable. The HEC-1 model does not efficiently handle runoff and routing calculations for small subbasin areas. Specific stream channel reaches are assumed to be homogeneous by the model. The HEC-1 model calculates a stream stage for computed stream flows in specific reaches, however, this model does not account for any backwater effect due to downstream constrictions or flooding. A separate computer model named HEC-2 calculates backwater and flooding effects using cross section data at various points in an area of interest. Use of the HEC-2 model would be recommended for any design conducted for the Herd Creek project.

Background Information Sources. Sources of background information for computer modeling of surface water hydrology within the project study area were obtained from various state and federal agencies. Topographic maps utilized to delineate the overall drainage basin and individual subbasins were obtained fro-m the USGS (1967). The limited soils data were used in conjunction with various hydrologic equations from the USDA-Soil Conversation Service (SCS, 1964), USDI -Bureau of Reclamation (1977) and Chow (1964) to estimate infiltration losses of precipitation and surface runoff rates. Additional soils data on soil moisture content were obtained from a more recent SCS (1974) publication. Impervious and high runoff surfaces including rock outcrops and roads in the drainage basin were delineated using aerial photographs and USGS topographic maps. Stream channel slopes and lengths were estimated based on measurements made using USGS topographic maps and field survey data. Streamflow data utilized to estimate base and peak stream flows for Herd Creek in the study area were published by the USGS (1979). Snowpack depth and equivalent water content data compiled by Berg (1980) were used in the snowmelt runoff modeling effort. Climatological data were extrapolated from nearby National Oceanic and Atmospheric Administration (NOAA) stations for use in the snowmelt runoff modeling.

Physical Characteristics of the Herd Creek Drainage Basin. The modeling of surface water hydrology initially involved delineation of the total drainage basin which is tributary to the USGS gage near the confluence of Herd Creek with the East Fork. The overall drainage basin was then divided into individual subbasins where more precise topographical and hydrological evaluations could be applied. Within these subbasins, physical characteristics were defined using USGS data, Forest Service data, NOAA publications, and observations made by the study team during field sessions in the project area.

The subbasins were delineated by analyzing surface water drainage patterns in the study area. Each subbasin contains a tributary stream and/or a portion of Herd Creek. The subbasin boundaries were determined by following the higher topographical features surrounding Herd Creek and its tributary streams. The area of each subbasin is presented in Table 3-1, and the overall area of the project drainage basin is 115.44 square miles.

The subbasins within the overall project drainage basin were characterized and evaluated in terms of the following physical features:

- Topography;
- Soils characteristics;
- Infiltration characteristics;
- Open impervious areas;
- Floodplains;
- Precipitation features; and
- Climatological characteristics.

The primary runoff event. in the Herd Creek drainage is from annual snowmelt, as indicated by USGS stream flow gaging records collected from October 1979 to September 1984. Precipitation data from regional climatological recording stations indicate that approximately 70 percent of the annual precipitation occurs from November through April.

Site specific snowpack data for the Herd Creek drainage is nonexistent. The estimated snowpack data was interpolated from eight separate snow courses due to their close proximity and similar topographical attributes with the study area. Record snowpack depths and water content were recorded at most of these snow courses on or about May 1, 1974. The highest gaged stream flow from snowmelt runoff in Herd Creek during the period of record (1979-1984) was in May 1983. The snowpack depth and water content data collected on May 1, 1983 at the same eight snow courses provided a means for calibrating the HEC-1 model based on the snowmelt runoff flows recorded at the Herd Creek gage. The May 1, 1983 snow course data was used to simulate the runoff from snowmelt and the HEC-1 model was calibrated to produce the peak flow at the gaging station. Then the 1974 snow course data was applied to the model to generate the design peak flow of Herd Creek. The snow course data for May 1, 1983 and May 1, 1974 at each of the recording stations is presented in Table 3-2.

The temperature characteristics for the study area were extrapolated from measurements recorded at the nearest climatological station. The Challis climatological station records for June 1974 and May 1983 were examined during and prior to the periods of peak runoff from snowmelt. These temperature data are presented in Table 3-3. Both of the snowmelt runoff events evaluated using the HEC-1 model occurred during high temperature, non-precipitation events.

TABLE 3-l

HERD CREEK FISH HABITAT ENHANCEMENT PROJECT
HYDROLOGIC SUBBASIN AREAS

Subbasin Number*	Subbasin Area (mi^2)
1	12.03
2	12.18
3	17.06
4	8.70
5	20.53
6	8.39
7	21.82
8	14.73
TOTAL AREA	115.44

*The design point of Subbasin 1 is the USGS gaging station. The design point of Subbasin 2 is the upstream end of the study area (south boundary of Bennetts Ranch). Subbasin 3 is the Lake Creek drainage. Subbasins 4 and 5 include most of the East Pass Creek drainage. Subbasin 6 is the Middle Canyon drainage. Subbasin 7 includes the West Fork Herd Creek drainage. Subbasin 8 includes the East Fork Herd Creek drainage.

TABLE 3-2

RECORDED SNOWPACK DATA NEAR HERD CREEK
FISH HABITAT ENHANCEMENT PROJECT STUDY AREA*

Snow Course Name and Location	Elevation (ft MSL)	May 1, 1974 Snowpack Depth (inches)	May 1, 1974 WaterContent (inches)	May 1, 1983 Snowpack Depth (inches)	May 1, 1983 Water Content (inches)
Banner Summit T.llN., R.10E., Sec. 11	7040	--* *	-	84	35.3
Stickney Mill T.6N., R.19E., Sec. 9	7430	-	--	40	14.8
Galena (old) T.6N., R.15E., Sec. 4	7440	55	25.1	54	23.1
Galena (new) T.6N., R.15E, Sec. 4	7470	-	-	67	28.3
Galena Summit T.6N., R.l5E., Sec. 7	8780	91	40.5	88	35.2
Lost-Wood Divide T.6N., R.l8E., Sec. 25	7900	90	39.5	74	30.0
Mill Creek Summit T.13N., R.17E., Sec. 8	8800	84	37.4	71	28.6
Vienna Mine T.5N., R.13E., Sec. 1	8960	128	62.5	108	47.6

*Location of Herd Creek study area is T.9N., R.19E.

* * - indicates data not recorded or snow course not established as of this date.

Source: Summary of Snow Survey Measurements for Idaho, UDSA-Soil Conservation Service, and State of Idaho Dept. of Water Resources, 1979; and Updated Reports.

TABLE 3-3

MAXIMUM AND MINIMUM AIR TEMPERATURES AT THE CHALLIS WEATHER STATION NEAR THE HERD CREEK STUDY AREA

AIR TEMPERATURES (OF)

1974	Maximum	Minimum	1983	Maximum	Minimum
June 14	92	49	May 21	82	43
June 15	93	52	May 25	83	45
June 16	93	53	May 26	84	47
June 17	93	52	May 27	87	44
June 18	91	54	May 28	86	46
June 19	91	52	May 29	85	48

Source: NOAA Records for Idaho, 1983 and 1974.

Hydrologic Model Input Data and Assumptions. The input parameters for the HEC-1 model may be separated into three distinct groups of data: 1) precipitation and snowmelt characteristics; 2) runoff characteristics; and 3) stream channel characteristics. Portions of the input data were assumed using best engineering judgement where field investigations were not performed or actual climatic data were not available.

Precipitation and Snowmelt Characteristics. The precipitation and snowmelt characteristics include the snowfall and snowpack data that is input into the HEC-1 computer model. The design snowpack water content for the Herd Creek drainage basin was estimated using an elevation projection method with the data for 1974 presented in Table 3-2. The 1983 data from Table 3-2 was used to calibrate the unknown model parameters. The 1974 snowmelt runoff has been estimated to represent a design level or "worst case" flood in terms of design for potential stream bank stabilization measures. The estimated snowpack water content for the range of elevations in the Herd Creek drainage is presented in Table 3-4.

The snowmelt option of the HEC-1 model divides the subbasins in the drainage into 1000 foot elevation zones for application of the corresponding snowmelt water content data shown in Table 3-4. The snowmelt zone areas within each subbasin are presented in Table 3-5. The air temperature data (Table 3-3) were adjusted to the Herd Creek subbasin elevations using the adiabatic lapse rate (3.8°F decrease in air temperature per 1000 foot increase in elevation). Each snowmelt event was modeled over a six day period, and the temperature data were divided into 90 minute intervals to more closely resemble actual conditions throughout each day.

Runoff Characteristics. Runoff input data include: 1) the subbasin area; 2) soil water loss information; 3) consideration of impervious areas; and 4) subbasin lag time. The subbasin areas were determined using 7.5 minute USGS maps of the drainage. The subbasin areas were presented earlier in Table 3-l. Soil infiltration losses were estimated using SCS hydrologic soil cover complex numbers determined after completing inspection of the drainage basins. The HEC-1 model input utilizes an exponential loss rate function that simulates infiltration into the soil under wet conditions. The impervious areas within each subbasin were estimated based on field inspection and examination of photographs. Roads were assumed to be 90 percent impervious. The subbasin lag time (L) was estimated using the hydrologic soil cover complex number, greatest flow length, and the average watershed slope in the following equation:

$$L = \frac{\ell^{0.8}(S+1)^{0.7}}{1900\ Y^{0.5}}$$

Where:
- L = lag time in hours
- ℓ = greatest flow length in feet
- S = 1000/CN - 10
- CN = hydrologic soil-cover complex curve number
- Y = average watershed slope in percent

(equation from SCS National Engineering Handbook, Section 4)

TABLE 3-4

ESTIMATED SNOWPACK WATER CONTENT AT SELECTED ELEVATIONS IN THE HERD CREEK DRAINAGE FOR 1974 AND 1983 (BASED ON SCS DATA)

Year	Elevation Zone (feet MSL)	Estimated Herd Creek Snowpack Water Content (inches)
1974	5800-6900	17.5
	6900-7900	28.5
	7900-8900	40.5
	8900-9900	52.0
	9900-10,900	63.5
1983	5800-6900	13.5
	6900-7900	23.5
	7900-8900	33.5
	8900-9900	43.5
	9900-10,900	53.5

TABLE 3-5

AREAS OF HERD CREEK SNOWMELT ZONES WITHIN HYDROLOGIC SUBBASINS

	Area (sq mi) of Snowmelt Zones					
Subbasin	5800-6900 ft MSL	6900-7900 ft MSL	7900-8900 ft MSL	8900-9900 ft MSL	9900-10,900 ft MSL	Total Area (sq mi)
1	5.95	5.05	1.03	0	0	12.03
2	3.62	6.44	2.07	0.05	0	12.18
3	1.66	5.45	6.39	3.56	0	17.06
4	0.56	3.71	3.19	0.96	0.28	8.70
5	0.09	3.06	6.85	8.21	2.32	20.53
6	0.03	1.20	4.25	2.66	0.25	8.39
7	0.51	4.68	10.42	5.73	0.49	21.82
8	0.35	4.53	7.53	2.32	0	14.72
						115.44

Stream Channel Characteristics. The stream channel characteristics include: 1) Manning's roughness coefficient for left and right overbank areas and the center of the channel; 2) reach length between subbasin design points; 3) slope of the representative reach; and 4) x and y coordinates of the cross section representative of each reach. The Manning's roughness coefficients were selected following field inspection of the streams. The reach lengths between design points were determined from USGS maps. The slope of each subbasin channel was determined by computing an average slope over the entire subbasin channel length using USGS topographic maps. The cross sections were selected following field inspection of the streams and from cross section survey data. Each cross section is representative of the reach between two design points, and the data is entered into the model as x and y coordinates.

In addition to the stream channel characteristics discussed above, base flow for Herd Creek was input into the HEC-1 model. The base flow is the amount of water discharged from the ground water system to sustain stream flow between the annual periods of snowmelt runoff. Base flow was estimated to range from 10 cfs to 23 cfs during the period of record (1979-1984).

Significance of Design Points. The design points for the snowmelt runoff modeling were selected using several criteria. Each design point represents the confluence of a subbasin with another subbasin or Herd Creek. This may include the cumulative discharge of one or more upstream hydrographs from subbasins routed through a stream channel to that design point. The design points were selected considering the following criteria:

- Location of design point at the confluence of major tributaries with the main stream channel.
- Relationship of design point to the drainage from the study area.
- Design point is representative of adjacent upstream and downstream channel reaches.
- Location of bridges, roads, and other features which could be affected by runoff.
- Correlation with streamflow and potential alternative selections.

Results of HEC-1 Modeling. The results of modeling the snowmelt runoff events for the Herd Creek hydrologic basin are in the form of quantitative flood hydrographs with peak flows. The 1983 snowmelt runoff event generated peak flows of 437 cfs at the gaging station (Subbasin 1 design point) and 418 cfs at the upstream boundary of the study area (Subbasin 2 design point). The simulated 1974 snowmelt runoff resulted in flows of 458 cfs at the Subbasin 1 design point and 432 cfs at the Subbasin 2 design point. The 1974 snowmelt runoff event as modeled provides a conservative design peak flow for use in developing and evaluating alternatives for stabilizing stream banks in the study area.

Extreme Hydrologic Events

Extreme hydrologic events (hazardous events) could produce higher flows than the design flow as estimated by modeling the 1974 snowmelt runoff. These extreme

events could include the probable maximum precipitation (PUP) or heavy rainfall on deep snowpack. In mountainous locations, the existence of deep snowpacks, high temperatures leading to maximum melting rates, and rain on snow events present conditions that could produce extreme runoff flows. Generally the PMP and snow-related extreme hydrologic events are considered when designing dams and other structures that may cause a substantial risk of loss of human life if failure occurs. However, the Herd Creek study area is not directly tributary to areas of human occupation, and the potential failure of stabilization structures and measures that could be constructed within the study area would not pose a threat to human life.

IDENTIFICATION AND ANALYSIS OF PROBLEM AREAS

The identification and characterization of specific problem reaches within the study area was completed in order to identify significant and potential causes of aquatic habitat degradation associated with the available habitat throughout Herd Creek. Through this identification and analysis procedure, priority areas were identified for development of preliminary alternatives.

The private land comprising the study area was evaluated and analyzed using color aerial photographs, topographic maps, color photographs and slides, and stream channel cross sections in order to delineate specific problem areas along the main stream channel. Various other data including background reports and hydrologic data were used in the problem identification effort.

The procedure for evaluation of the problems involved the following steps:

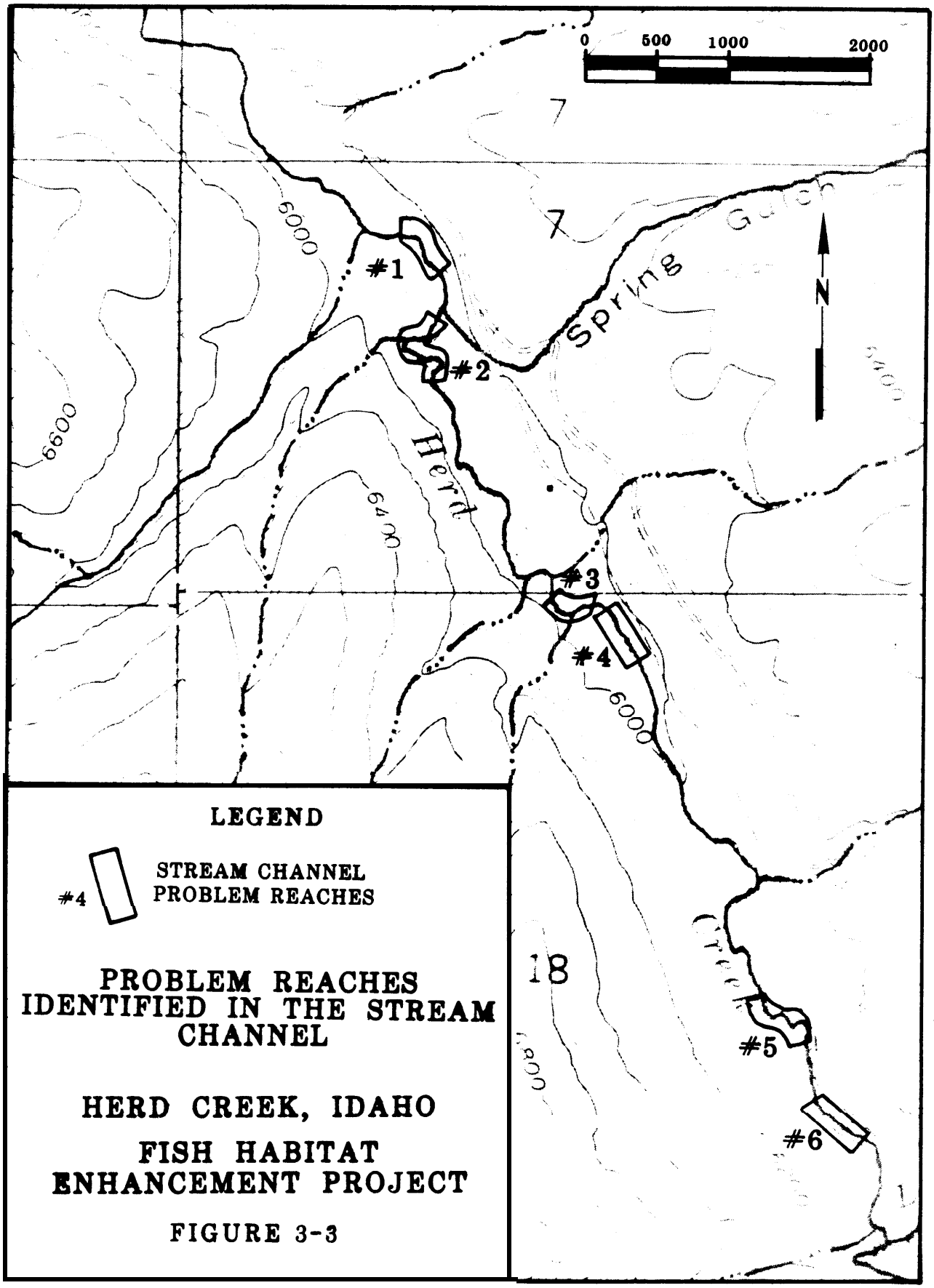
- delineate specific problem reaches along Herd Creek within the boundaries of the private land;
- identify the specific problems within each reach; and
- assign a rating to the severity of the problems in each reach based on the objectives established for this study.

Identification of the specific problems provides for systematic development of a range of preliminary alternatives for correcting any significant problems. The development of preliminary alternatives may be based on the overall objectives for the project study area. Preliminary objectives established by the Shoshone-Bannock Tribes to enhance the fish habitat within the project study area are listed below in order of importance.

1. Stabilize streambanks and stream channel.
2. Maintain, protect and improve chinook salmon spawning and rearing habitat.
3. Reduce deposition and downstream transport of sediment.
4. Re-establish suitable riparian vegetation.

Problem Area Analysis Procedure

Identification of the problem areas was initiated by analyzing individual stream channel reaches. Six problem reaches were identified from downstream to up-stream within the study area. The six problem reaches were labeled Reach 1 through 6 as shown on Figure 3-3. The stream reaches were analyzed based on the following criteria:



PROBLEM REACHES IDENTIFIED IN THE STREAM CHANNEL

HERD CREEK, IDAHO

FISH HABITAT ENHANCEMENT PROJECT

FIGURE 3-3

- Streambank stability;
- Meander sequencet/straight channel runs;
- Riparian (vegetation) cover;
- Stream channel gradient;
- Hydraulic conditions at design flow;
- Position in floodplain and floodplain width;
- Livestock interaction with stream.

Rating of Problem Severity

The problems in each reach were rated as to what percent of the total problem, within the entire private land area, that reach contributed, using the objectives described earlier in this section as guidelines. The intent of this rating procedure was to identify those areas with the most severe problems and to distinguish them from the areas that constitute only a minor impact. This ensures that reaches with the most severe and/or complex problems receive the -most attention during the alternative formulation process. It also helps eliminate considering corrective actions that may not be practical or cost effective to implement.

The rating of problems in stream reaches considered all of the preliminary objectives for the Herd Creek Project as discussed earlier in this section. The objectives are restated for the rating of problems, in order of importance, as follows:

1. Contribution to stream erosion problem.
2. Disruption of salmon spawning and rearing habitat.
3. Contribution to sediment deposition problem.
4. Contribution to riparian vegetation problem.

The rating method utilized a combination of subjective assignment and an objective analysis based on the evaluation of existing data concerning the severity of problem in individual stream reaches. Those problem reaches that were determined to have a 10 percent or less severity rating (contributing 10 percent or less of the total problem) were not considered further in the development and analysis of alternatives for corrective action unless a specific and readily correctable problem could be defined.

Analysis of Stream Channel Problem Reaches

The problem stream channel reaches are characterized in this section. Each reach is analyzed and described in terms of existing conditions identified in July 1985, and/or potential problems. The stream channel reaches are delineated on Figure 3-3.

Reach 1. Reach 1 is characterized by a visibly eroding stream bank along the west side of Herd Creek. The stream makes a set of two angular turns (greater than 90 degrees) in a short distance and is actively eroding the stream bank to lengthen its course and become more stable through the reach. The cut bank is approximately 200 feet long and up to 8 feet high. A middle channel depositional island is located immediately downstream of the cut bank at the first of the two 90 degree plus turns. A minor cut bank is located on the east bank just downstream of the second 90 degree plus turn. This cut bank is approximately 40 feet

long and 5 feet high. The west bank at the downstream end of Reach 1 is unvegetated but is not visibly eroding. The floodplain width varies from 400 feet to over 700 feet wide throughout Reach 1. The average slope through Reach 1 is 0.014 feet per feet. Riparian cover is non-existent throughout Reach 1. The hydraulic calculations of Reach 1 under the design flow of 432 cfs indicate an average velocity of 4.2 fps, a depth of 0.7 feet, and a width of approximately 145 feet, including the entire stream channel and a portion of the floodplain. There does not appear to be major interaction of livestock with the stream in Reach 1.

Reach 2. Reach 2 is characterized by one and one half meanders of the stream. Depositional bars are located on the inside corners of the curves, with some vegetation growing on the bars. Reach 2 includes a livestock crossing in the upstream portion, and the north stream bank is trampled and slightly eroded. This crossing does not appear to be a major contribution to stream sediments. In the middle of Reach 2, a cutbank area extends along the west side for approximately 80 feet. The cut bank height ranges from approximately two to six feet, however, there is vegetation (sagebrush) growing in part of the cut. At the downstream end of Reach 2, the east bank is eroding for approximately 30 feet with a maximum 8 foot cut bank. This cut bank appears to be actively eroding which is probably a result of natural forces. The cut bank is located immediately below a rock outcrop. The floodplain width is approximately 400 feet wide. The average slope through Reach 2 is 0.015 feet per feet. Riparian vegetation is non-existent throughout Reach 2. The hydraulic calculations of Reach 2 under the design flow of 432 cfs indicate Herd Creek has an average velocity of 4.6 fps, a depth of 0.85 feet, and a width of approximately 110 feet. The design flow width of Herd Creek inundates the stream channel and a portion of the floodplain.

Reach 3. Reach 3 is characterized by a large meander of the stream. The channel is braided, with small islands of depositional materials in the middle of the stream. A six foot deep cut bank extends for approximately 170 feet along the west side of Herd Creek upstream of the bridge. Immediately upstream of the cut bank, a large depositional bar has formed on the outside of the stream meander, followed by smaller mid-channel deposits of gravels and sands. There is a livestock crossing between pasture areas split by the stream in Reach 3, however, the crossing area does not appear to contribute large quantities of sediment. The livestock crossing is located across prime spawning habitat. The average slope through Reach 3 is 0.008 feet per feet. The floodplain is approximately 500 feet wide throughout Reach 3. The hydraulic calculations of Reach 3 under the design flow of 432 cfs indicate an average velocity of 3.2 fps, a depth of 1.3 feet, and a width of approximately 180 feet, including a significant portion of the floodplain. There is some riparian vegetation along Reach 3. Approximately 50 percent of the bank areas are vegetated with grasses and have no shrub or overstory cover.

Reach 4. Reach 4 is characterized by active stream channel meandering with two complete existing meanders. Depositional bars are located on the inside corners of the meanders in Reach 4. Eroding cut banks two to three feet high in Reach 4 appear to be partly due to natural dynamics of the stream system. The eroding banks are disturbed further by livestock access to the stream. The extent of eroding banks is estimated at approximately 400 feet along the west side of the stream in two sections. Past meander tracks are clearly visible in the meadow to the west of the stream. The east bank is more stable with trees and

dense brush established next to the stream. Herd Creek could be re-cutting a meander across the low meadow areas west of the existing channel. The west bank has no riparian vegetation and is covered only with low growing plants. The average slope through Reach 4 is 0.008 feet per feet. The floodplain is approximately 600 feet wide throughout Reach 4. Hydraulic calculations of Reach 4 under the design flow of 432 cfs indicate an average velocity of 2.9 fps, a depth of approximately 0.65 feet, and a width of approximately 230 feet, including a significant portion of the floodplain. Reach 4 and Reach 3 are close together and the instability problems noted here may be related.

Reach 5. Reach 5 is characterized by two meanders through the problem area, with a clearly defined riffle-pool-riffle sequence. Gravel depositional bars are located on the inside curve of each meander. The primary problem area is approximately 400 feet long and includes two livestock crossings of the stream. Near the upstream end of Reach 5, livestock cross Herd Creek to gain access to pasture land further upstream. Downstream from this livestock crossing, Herd Creek makes a 90 degree turn to the north. The stream bank is slightly eroded on the outside of the 90 degree meander. The west stream bank is steep and lies below a road along the bottom of the upper irrigated pasture. Approximately 160 feet downstream from the 90 degree corner, a major livestock crossing of the stream is evident. The stream bank is eroded on both sides with two foot high cut banks, and a number of cattle trails are visible on the hillside up to the upper irrigated pasture. The floodplain is approximately 350 feet wide at Reach 5. The average slope through Reach 5 is 0.010 feet per feet. Hydraulic calculations of Reach 5 under the design flow of 432 cfs indicate an average velocity of 4.3 fps, a depth of one foot, and a width of approximately 90 feet. The floodplain is partially inundated by the design stream flows. Approximately 50 percent of the banks with Reach 5 have riparian vegetation.

Reach 6. Reach 6 is characterized by a meander with a riffle-pool-riffle sequence and gravel depositional bar on the inside curve of the meander. The southwest stream bank is unstable and eroding for approximately 250 feet. The eroding cut bank is approximately four feet high, and the disruption of the stream bank appears to be aggravated by livestock access. There is minimal riparian vegetation throughout Reach 6. The floodplain is approximately 250 feet wide in Reach 6 due to topographical constrictions caused by the mountain slopes and resistant rock outcrops. The average slope through Reach 6 is 0.010 feet per feet. Hydraulic calculations of Reach 6 under the design flow of 432 cfs indicate an average velocity of 3.4 fps, a depth of 0.8 feet, and a width of approximately 150 feet. Under the design flow conditions, over half of the floodplain is inundated by water from Herd Creek.

Rating of Stream Reach Problems

The ratings of stream reach problems based on the previously identified objectives are presented in Table 3-6. The six stream channel reaches were rated according to the severity of the problems. Reaches 1, 2, 3, and 5 were found to contribute 80 percent of the erosion problems within the study area. Reaches 2, 3, 4, and 5 were observed to contain 100 percent of the habitat disruption, primarily due to livestock access across the stream. Sediment deposition was progressively more noticeable from upstream to downstream reaches. Reaches 1, 2, and 4 accounted for 65 percent of the riparian cover problem areas. Reach 2 is the only stream reach with problems in all four of the objectives. The

TABLE 3-6

RATING OF PROBLEMS IN STREAM REACHES

Stream Reach	Contribution to Stream Erosion Problem (%)*	Disruption of Salmon Propagation Habit at (%)*	Contribution to Sediment Deposition Problem (%)*	Contribution to Riparian Vegetation Problem (%)*
1	30	0	30	25
2	20	25	30	20
3	15	30	15	10
4	10	15	15	20
5	15	25	10	10
6	10	0	0	15
Total	100	100	100	100

*Percent of problems within the entire private land area, equivalent to percent of importance of the problem within each of the four objectives.

reaches with the higher erosion problem ratings have the highest priority for potential stabilization measures. Reaches in which salmon rearing and spawning habitat have been disrupted by livestock activity have the next highest priority for potential implementation measures.

SUMMARY

This chapter has presented an evaluation of the existing data base and a description of the general physical and biological characteristics of the study area as they relate to the erosion and sedimentation processes. The surface water hydrology also was described and modeled to obtain a design peak flow for the study area. This chapter also has identified and analyzed the specific stream channel problem reaches. The procedure utilized for analyzing the problem reaches involved characterizing the physical and biological conditions of the study area in terms of known and potential erosion and sedimentation, based on the information collected. The problem areas were analyzed using criteria and objectives developed by the Tribes. The individual problem reaches were then subjectively and objectively rated based upon their relative significant problems in relation to the contribution of the entire study area. This information provided the basis for developing the potential preliminary alternatives presented in Chapter 4.

CHAPTER 4

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

CHAPTER 4

ALTERNATIVE DEVELOPMENT AND ANALYSIS

INTRODUCTION

This chapter presents the development and analysis of alternatives for the Herd Creek Fish Habitat Enhancement Project. The alternatives have been developed based on the objectives established by the Tribes for the project, and compatibility with existing livestock grazing activities within the study area (private land). The alternatives include both physical and institutional measures for stabilization of the streambanks and limiting livestock access to Herd Creek. The physical alternatives have been analyzed in terms of general engineering criteria. The result of the analysis is a list of feasible physical alternatives for implementation in the problem reaches. The institutional alternatives are listed but not analyzed because their criteria for screening and potential implementation must be developed and agreed on by the Tribes, BPA, other federal agencies, and the private landowner.

DESCRIPTION OF ALTERNATIVES

The alternatives for potential stabilization and protection of stream problem reaches have been developed based on the objectives established by the Tribes and compatibility with existing (and projected) livestock grazing activities. The physical alternatives all involve leaving the stream channel in its existing alignment and stabilizing eroding banks utilizing various construction and revegetation measures. The institutional alternatives consider various land ownership and use arrangements that could be negotiated between the involved parties.

The development of physical alternatives for the Herd Creek study area was constrained by the hydrologic and hydraulic characteristics of the private land. The design peak runoff flow of 432 cfs inundates portions of the floodplain in the study area as determined by calculating basic hydraulic equations given known and assumed data. The floodplain of Herd Creek is gently sloped and productive when irrigated because of the natural fluvial processes occurring over the past 40 million years. Some of the specific stream reach problems are actually occurring naturally due to the dynamic process of stream meandering. These problem reaches may be aggravated by existing livestock grazing activities. Nature has repeatedly demonstrated that the physical forces of water cannot be permanently altered by man-made structures without continued maintenance. Eventually, diverted or otherwise altered streams in environments such as the Herd Creek study area will find the most stable channel, irregardless of the position, composition or integrity of the structure. The physical alternatives must consider the dynamic forces of the stream and account for future meanders throughout the width of the floodplain. Essentially, the surface water hydrology and hydraulics of the stream are in conflict with the existing land use of the study area. The changes in the stream channel are more apparent in the study area because of the lack of riparian vegetation and the impacts of livestock access to Herd Creek. These and other related physical and biological characteristics have constrained development of the alternatives. Most of the physical alternatives are oriented to short term stabilization and protection of the problem reaches but offer no guarantees for long term stabilization of the

floodplain. In contrast, the institutional alternatives are oriented toward long term natural stabilization but offer no short term protection and stabilization of the problem reaches.

Physical Alternatives

There are four primary physical alternatives that have been developed for application in various combinations to the six stream problem reaches. These primary physical alternatives are listed below.

1. Stabilize eroding stream banks by utilizing various physical and biological erosion control measures. Such measures -nay include use of engineered riprap installation, gabions, geotextiles, erosion control blankets, and vegetation.

2. Construct fences (either continuous or intermittent) along Herd Creek to limit livestock access to the stream and adjacent bank areas.

3. Construct livestock crossings (either elevated or submerged) to provide specific access corridors across Herd Creek. An elevated livestock crossing would be a bridge structure. A submerged livestock crossing would be constructed using a gabion mattress or similar structure. The submerged structure would extend up both stream banks to prevent bank erosion.

4. No action alternative. This alternative allows the physical and biological systems to continue in their present states, along with existing or modified land use.

The individual alternatives may be used at some of the sites in combination with other alternatives. The following subsections briefly describe the specific potential physical alternatives for each problem reach. The no action alternative may be used at any or all of the stream problem reaches, and is not repeated below.

Reach 1 Alternatives.

a. Stabilize the two eroding banks. At the upstream bank, excavate out the eroded soils to speed up the meandering process, stabilize the slopes with riprap or gabion mattresses, geotextile fabrics and riparian vegetation. At the downstream bank, excavate the bank and stabilize with riprap and riparian vegetation.

b. Establish riparian vegetation throughout the reach by transplanting shrubs and trees from within the Herd Creek drainage.

Reach 2 Alternatives.

a. Stabilize the three eroding banks by excavating out soils, installing riprap or gabions, geotextile matting and transplanting riparian vegetation. Construct fences on both sides of the stream reach to limit livestock access, and develop a submerged or elevated crossing for livestock access to pastures.

b. Construct fences on both sides of the stream to limit livestock access, and develop a submerged or elevated crossing for livestock access to pastures.

Reach 3 Alternatives.

a. Stabilize eroding west bank with riprap, geotextiles, and riparian vegetation. Fence both banks at the existing livestock crossing, utilize existing bridge for livestock crossing or construct submerged crossing between Reaches 3 and 4.

b. Establish more woody, riparian vegetation on both stream banks. Construct fences on both sides of stream to limit livestock access to the existing bridge or a new submerged stream crossing for livestock.

Reach 4 Alternatives.

a. Construct a fence along west bank of Reach 4, and revegetate with woody, riparian vegetation.

b. Construct fences along both banks of Reach 4, and revegetate with woody, riparian vegetation.

Reach 5 Alternatives.

a. Construct a fence along both sides of the stream to limit livestock access to a bridge crossing or submerged crossing. Revegetate both banks with transplanted riparian shrubs and trees.

b. Revegetate both stream banks with transplanted riparian shrubs and trees.

Reach 6 Alternatives.

a. Stabilize the eroding bank by excavating out soils, installing riprap or a gabion mattress, geotextile installation, and vegetation. Construct a fence to limit livestock access to the reach.

b. Construct a fence along the outside curve of the eroding bank to limit livestock access, revegetate with riparian vegetation.

All of these potential physical alternatives effectively decrease the amount of available pasture in the study area, with exception to the “revegetation only” alternatives and the no action alternatives. The loss of pasture land resulting from implementing any of these alternatives is difficult to estimate because of design considerations for the hydrologic and hydraulic characteristics of the stream. The potential physical alternatives are analyzed later in this chapter.

Institutional Alternatives

The potential institutional alternatives for the Herd Creek study area are numerous, complex and do not apply to specific problem reaches. Several of the potential institutional alternatives are listed below for consideration by the involved parties.

1. Sale of the private land. The land could potentially be purchased by a Federal agency, the Tribes, or an environmental land trust group. Acquisition of the land under a sale/purchase agreement would probably result in removing livestock grazing from the study area.

2. Sale of the private land as in 1. above with lease back to the livestock operation under specific stipulations regarding livestock access to the stream.

3. Lease of the property (long term or short term) to a Federal agency, the Tribes, or an environmental land trust group. The private land owner would retain title to the property.

1. Donation of the private land to a Federal agency or State institution, in return for tax deduction for assessed value of property.

5. Grant of permanent easement or right of way to Federal agencies or Tribes to manage the stream and floodplain areas in a manner consistent with hydrologic conditions and fishery objectives.

There are many other possible institutional alternatives for the Herd Creek study area in addition to those listed above, however it is beyond the scope of this report to conduct further research and present all such alternatives. The listed alternatives may provide a starting point for discussions and negotiations between the Tribes, Federal agencies, and the private landowner. The potential institutional alternatives are not discussed further in this report.

ANALYSIS OF PHYSICAL ALTERNATIVES

The potential physical alternatives have been analyzed in terms of general engineering criteria and compatibility with existing livestock grazing activity. This section presents a summary of the analysis of potential physical alternatives for stabilizing and protecting the stream problem reaches in the Herd Creek study area.

The general engineering criteria used in the analysis include the following:

- engineering feasibility and constructibility;
- reliability and effectiveness;
- implementation considerations (permitting, easements, etc.);
- environmental effects; and
- preliminary cost estimates.

Additional criteria which were considered include:

- compatibility with existing livestock grazing activities (private landowner); and

- full construction implementation which requires no commitment to future operation and maintenance of improvements (BPA and Tribes).

The analysis is presented in terms of the four primary physical alternatives listed earlier in this chapter. The primary physical alternatives are related to the problem reaches as necessary in the analyses that follow.

Construct Stream Channel Stabilization Measures

The construction of stream channel stabilization measures in the study area problem reaches are generally feasible from an engineering standpoint but would be difficult to construct because of access limitations and restricted working space. The engineering design of stabilization measures would generally involve use of existing floodplain areas (pasture) and possibly berms or dikes to help retain flood flows. Loss of pasture land to stream bank stabilization measures would be in conflict with existing livestock grazing activities, however, pasture loss is now occurring naturally in several of the reaches without any implementation. The reliability and effectiveness of stabilization measures may be high in the short term, but long term natural changes of the stream channel alignment in the floodplain could result in low reliability and effectiveness or creation of other stream problem reaches. Riparian revegetation may be one exception because once established, the plant roots would hold the soil and help stabilize eroding stream banks. Establishment of riparian vegetation is sometimes difficult and not too successful. Implementation considerations would be most extensive for the stabilization alternative because of requirements for a stream channel alteration permit, a Corps of Engineers 404 permit, and other potential permits. The environmental effects of the stabilization measures would be mostly positive in the short term, but could be detrimental with respect to the long term hydrologic aspects of the drainage. Construction of stabilization measures would have to be conducted during the period of minimum impact on chinook salmon and other fish in the stream. The preliminary cost estimates of the stabilization measures would probably range from $5000 at Reach 4 (revegetation only) to $30,000 at Reach 2 or Reach 1 (full stabilization). The stabilization measures would generally conflict with the livestock grazing operation because of lost pasture land. The stabilization alternatives also would not be assured of maintainence free structures.

The most promising stabilization measure would be revegetation with riparian plants, shrubs, and trees, if good survival rates can be attained. The riparian revegetation also would be less costly to implement, however, there would be no immediate response in Herd Creek because of the time factor involved in plant establishment.

Construct Fences Along Herd Creek

This primary alternative could be implemented with either continuous fencing along one or both sides of the stream as necessary, or intermittent fencing along problem reaches. Any combination of fencing would have high engineering feasibility and constructability. The reliability and effectiveness of any type of fence may be questioned, however, a fence would probably limit livestock access to the stream. The reliability and effectiveness of fencing might be questionable if the stream channel changes alignment into the fence line, or if the fence is damaged during a high runoff event because it was installed too close to the stream. Implementation considerations and environmental effects would be negligible with the fencing alternative. The fence also would limit deer and elk access to the stream. Installation of a fence would help promote stabilization and protection of the stream banks and fish habitat. These positive environmental effects are among the objectives of the Tribes. The preliminary cost estimates of fencing for the study area range from $4,000 for partial fencing to $66,000 for continuous fencing (both sides of Herd Creek).

The continuous fencing alternative would be in conflict with existing grazing activities, particularly with a setback from the stream to account for flood flows. Intermittent fencing may be more compatible with the existing livestock grazing activities.

The fencing alternative would be required with most of the stabilization measures to protect them from damage by livestock access. The fencing alternative also would be accompanied by the livestock stream crossing alternative.

Construct Livestock Stream Crossings

This primary alternative would be somewhat questionable in terms of engineering feasibility and constructibility for the submerged crossing. Elevated crossings would have to be designed to conduct the design peak flow plus enough freeboard to allow for debris passage. The reliability of both types of crossings would be questionable in the long-term because of potential changes in the stream channel alignment . The crossings would probably be effective as long as the channel alignment remained unchanged. The most promising aspect of the submerged crossing would be the bank stabilization. Implementation considerations would include an IDWR stream channel alteration permit and other potential permits or requirements. The environmental effects of constructing either crossing would probably be negative during the short-term but result in net positive long-term impacts due to bank stabilization. The preliminary cost estimates would probably range from $8,000 to $12,000 per crossing (elevated or submerged). The livestock stream crossings would probably be marginally compatible with existing livestock activities, however, a minimum number of constructed crossings would probably be preferred.

No Action Alternative

The no action alternative would not be affected by engineering or construction, and allows for the greatest amount of variation for the natural stream system in terms of reliability and effectiveness. There are no significant implementation considerations associated with the no action alternative. The environmental effects of the no action alternative include continued erosion and sedimentation accelerated by livestock interactions with the stream, direct disruption of fish spawning and rearing habitat, and lack of riparian cover or even loss of existing riparian vegetation along Herd Creek. There are no dollar costs associated with the no action alternative except for the value of the affected fish resources.

The no action alternative is the most compatible of the four primary alternatives with existing livestock grazing activities. However, the no action alternative does not meet any of the Tribes objectives for the Herd Creek Fish Habitat Enhancement Project.

SUMMARY

The potential physical and institutional alternatives have been developed and described in this chapter. The potential physical alternatives also have been analyzed in terms of general engineering criteria applied to the Herd Creek study area and compatibility with existing and projected future livestock grazing activities. The potential physical alternatives are constrained by the conflicts between the surface water hydrology of Herd Creek and the existing livestock operations on the private land. The recommended alternatives of each reach and the overall study area are presented in Chapter 5.

CHAPTER 5

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

CHAPTER 5

RECOMMENDED ALTERNATIVES

INTRODUCTION

The recommended alternatives for the Herd Creek Fish Habitat Enhancement Project are a combination of all four primary physical alternatives presented in Chapter 4. The overall recommended alternative for the study area is briefly discussed, and the specific recommended alternatives for the six stream problem reaches are presented. Implementation of any one of the alternatives for the steram problem reaches will require additional engineering analysis and design.

OVERALL RECOMMENDED ALTERNATIVE

The overall recommended alternative for the Herd Creek study area is to: 1) revegetate the problem reaches with riparian plants, shrubs, and trees; 2) construct intermittent fencing throughout the revegetated areas to limit livestock access to current problem areas; 3) construct several livestock stream crossings; and 4) allow natural fluvial processes to continue in the study area (no action alternative). The non-structural aspects of this overall recommended alternative would promote riparian revetetation, the most effective means of long-term stabilization, as the primary component in reducing erosion and improving fish habitat through establishment of stream cover. The riparian revegetation component will require additional pasture land along the stream for implementation, but the area required would be much less than that necessary for structural stabilization measures. Riparian vegetation is adaptable to flood conditions and contributes to stability of the channel and bank areas.

The intermittent fence component would minimize the loss of use of existing pasture land along specific problem reaches. A semi-movable fence may be the most useful livestock access control measure. The fence could be moved when its alignment is encroached upon by the natural stream channel meandering, or when a specific problem reach is stabilized and other livestock access problem reaches have developed. A disadvantage of the semi-removable fence, or any fence, is that it requires long-term maintenance.

The livestock stream crossings would have to be carefully planned, designed, and constructed in conjunction with the intermittent fence placement. The crossings also would have to be installed in relatively stable reaches of the stream so that they are not left dry in the middle of a future pasture area after the stream channel alignment has changed. Use of the existing bridge along with one or two other strategically placed crossings would help protect the banks and valuable habitat areas of Herd Creek within the study area.

The no action alternative would be applied to most of the area within the private land boundaries. The natural erosion and sedimentation processes of Herd Creek and its floodplain would be allowed to continue because control of the problems would only be a short-term solution. The no action alternative, in conjunction with limiting livestock access at key points, encouraging livestock crossing at stabilized reaches, and revegetation with riparian plants, provides the least impact on the existing grazing operation and meets the long-term objectives of the Tribes.

SPECIFIC RECOMMENDED ALTERNATIVES

The specific application of the recommended alternatives to the six problem reaches is summarized in Table 5-l. Some of the alternative measures should not be implemented until the stream system becomes more stabilized by natural processes within the reach. Other alternative measures could be implemented as soon as feasible, given agreement between all of the involved entities. All of the recommended alternative measures would require an additional level of engineering analysis and design before being implemented.

An additional set of alternatives should be considered for the study area. These are the institutional alternatives listed in Chapter 4. The institutional alternatives may offer some opportunities for long-term benefit of all involved entities. Some of the institutional alternatives could also complement the recommended physical alternatives for stabilization and protection of Herd Creek.

TABLE 5-l

SPECIFIC RECOMMENDED ALTERNATIVES
FOR THE SIX PROBLEM REACHES IN THE HERD CREEK
STUDY AREA

Problem Reach Number	Recommended Alternatives			
	Riparian Revegetation	Intermittent Fence Construction	Livestock Stream Crossing	No Action
1	Both stream banks with emphasis on establishing larger trees and shrubs.	Short distance along west bank to protect revegetation efforts.	None.	Remainder
2	Both stream banks with emphasis on establishing larger trees and shrubs.	Short distance along east bank to protect revegetation efforts; Longer distance along west bank to protect banks and revegetation efforts. Fences would direct livestock to new crossing.	Construct one crossing to provide access between pastures.	Remainder
3	Both stream banks, especially west bank. Emphasis on larger trees and shrubs.	Short distance along east bank to redirect livestock crossing to bridge; longer distance along west bank, tie into fence along Reach 4.	Utilize existing bridge, may have to get approval from agencies because of entry onto public lands.	Remainder
4	Both stream banks, mostly west bank. Emphasis on establishing larger trees and shrubs.	Short distance along east bank near irrigation ditch; longer distance along west bank, tie into fence along Reach 3.	None.	Remainder
5	East stream bank only, fill in bare areas with riparian vegetation.	Short distance along southwest bank to limit access to existing crossing; longer distance along east bank to limit crossing access.	Construct one crossing to provide access to upper irrigated pasture and south pasture.	Remainder
6	Primarily on west stream bank. Emphasis on establishing larger trees and shrubs.	Short distance along west bank.	None.	Remainder

REFERENCES

REFERENCES

Beard, J. 1986. Updated Reports, Snow Survey Measurements for Idaho. USDA-SCS, and IDWR. 1983 Data. 15 pages.

Berg, N.A. 1980. Summary of Snow Survey Measurements for Idaho. USDA-SCS, and IDWR. 1921-1979. 393 pages.

Chow, V.T. 1959. Open Channel Hydraulics. McGraw-Hill Publishers, New York, N.Y.

Chow, V.T. 1964. Handbook of Hydrology. McGraw-Hill Publishers, New York, N.Y.

IDFG, 1979. Report on Stream Characteristics and Habitat Limitations of Herd Creek, in _____. 5 pages.

IDWR, 1985. Water Rights in the Herd Creek Drainage, Idaho. 1 page.

NOAA, 1983 and 1979. Climatological Data for Idaho.

USDA - Forest Service. Herd Creek Allotment, data and map, by Wayne Somes, Yankee Fork Ranger District, Challis National Forest. 2 pages.

Shoshone-Bannock Tribes. 1985. Color Aerial Photos of Herd Creek, Scale: 1" = 100'. 18 photos.

Shoshone-Bannock Tribes. 1986. BPA Project No. 83-359, FY 1985 Annual Report, Part 1 of 4, Salmon River Habitat Enhancement, Subproject IV: East Fork Salmon River/Herd Creek. 54 pages.

USDA - Soil Conservation Service. 1974. Water Supply outlook for Idaho, Water Year 1974. Soil Conservation Service, Snow Survey Division. 10 pages.

USDA - Soil Conservation Service. 1964. National Engineering Handbook, Section 4 - Hydrology. Soil Conservation Service.

USDI - Bureau of Reclamation. 1980. Anadromous Habitat Management Plan, ID-040-WHA-Al-AF. Salmon, Idaho. pages 13-15.

USDI - Bureau of Reclamation. 1977. Design of Small Dams, A Water Resources Technical Publication. U.S. Government Printing office, 816 pages.

USDI - Geological Survey. 1980. Water Resources Data for Idaho, Water Year 1979. ID-79-2. p. 198.

USDI - Geological Survey. 1981. Water Resources Data for Idaho, Water Year 1980. ID-80-2. p. 212.

USDI - Geological Survey. 1982. Water Resources Data for Idaho, Water Year 1981. ID-81-2. p. 171.

USDI - Geological Survey. 1983. Water Resources Data for Idaho, Water Year 1982. ID-82-2. p. 276.

USDI - Geological Survey. 1984. Water Resources Data for Idaho, Water Year 1983. ID-83-2. p. 271.

USDI - Geological Survey. 1967. Topographic Maps of the Herd Creek Area, with the following titles:

1)	Herd Peak, Idaho	7.5 min. series, 40' contours, 1" = 2000'
2)	Meridian Peak, Idaho	7.5 min. series, 40' contours, 1" = 2000'
3)	Ryan Peak, Idaho	7.5 min. series, 40' contours, 1" = 2000'
4)	Jerry Peak, Idaho	7.5 min. series, 40' contours, 1" = 2000'
5)	Herd Lake, Idaho	7.5 min. series, 40' contours, 1" = 2000'
6)	Bowery Peak, Idaho	7.5 min. series, 40' contours, 1" = 2000'
7)	Bowery Creek, Idaho	7.5 min. series, 40' contours, 1" = 2000'
8)	Horse Basin, Idaho	7.5 min. series, 40' contours, 1" = 2000'
9)	The Paint Pot, Idaho	7.5 min. series, 40' contours, 1" = 2000'
10)	Ziegler Basin, Idaho	7.5 min. series, 40' contours, 1" = 2000'