SALMON RIVER HABITAT ENHANCEMENT

ANNUAL REPORT
FY 1986

PART1 OF 2

BY

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PREFACE

This project, No. 83-359, was funded by the Bonneville Power Administration (BPA) under contract No. DE-A179-84BP14383.

This report has two volumes: a tribal project annual report (Part I) and a report prepared for the Tribes by their engineering contractor J.M. Montgomery, Consulting Engineers, Inc. of Boise (Part II). The tribal project annual report contains reports for four subprojects within Project 83-359. Subproject I involved fish inventories (during enhancement treatment in 1586) in Bear Valley Creek, Idaho, that will be used in conjunction with 1984 and 1985 fish and habitat pre-treatment (baseline) data to evaluate effects of habitat enhancement on the habitat and fish community in Bear Valley Creek overtime. 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 in the upper-Salmon River basin (traditional Treaty fishing areas of the Shoshone-Bannock Tribes, Fort Hall Indian Reservation, Idaho). Subproject III involved fish inventories (pre-treatment) in the Yankee Fork drainage of the Salmon River, and habitat problem identification on Fivemile and Ramey Creek (tributaries to the Yankee Fork). Subproject IV involved baseline habitat and fish inventories on the East Fork of the Salmon River, Herd Creek and Big-Boulder Creek (major tributaries to the East Fork).

SUBPROJECT I

Bear Valley Creek:
Enhancement and Inventory

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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 habitat of chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Salmo gairdneri) in the stream from the mid-1950's to 1986. Habitat enhancement efforts via a project funded by Bonneville Power Administration have begun to decrease sediment recruitment from reaches within the mined area. The effects of reduced sediment recruitement will be evaluated by monitoring aquatic habitat and fish communities over time. Physical (1 time/year 1984 and 1985) and biological (2 times/year 1984, 1985 and 1986) variables were measured in seven sites within each of seven strata along the length (55 km) of Bear Valley Creek. In 1986 fish species present in Bear Valley Creek were chinook salmon, mountain whitefish (Prosopium williamsoni), steelhead/rainbow trout, brook trout (Salvelinus fontinalis), cutthroat trout (S. clarki), bull trout (S. confluentus) and shorthead sculpin (Cottus confusus). Significantdifferences in densities were observed in July and August among strata with age 0+ chinook salmon, adult whitefish and brook trout. Age 0+ chinook salmon exhibited significant differences in density between sample sessions. Mean total fish density (all species combined) was greatest in stratum three during both sample sessions. Age 0+ chinook salmon densities ranged from 0.00 to 0.13 fish/m^2 pool. Length, weight and condition of age 0+ chinook salmon was greatest in the most downstream stratum and decreased in an upstream direction (ranges: 55 to 71.7 mm, 1.5 to 4.0 g, .90 to 1.1, respectively). This corresponds to general trends in stream temperature. Significant differences in densities among years were observed in, age 1+ chinook salmon, steelhead trout age 0 + and 2+, whitefish age 0+ and bulltrout. A significant association between years and strata was noted in the distribution of age 0+ chinook salmon. The largest shift was in 1986 when no fish were found in the uppermost strata. This contrasts with 1985 and 1984 when 40% and 12% respectively were found in stratum 6 and 15% and 18% were found in stratum 5. During 1986 the relative composition of age 0+ chinook salmon ranged from 0 to 80% among strata. The abundance of age 0+ chinook salmon in July and August of 1986 was 15,850 and 6,275 respectively. Most fish were located in strata 2 and 3. In 1986, 28 redds were counted via helicopter and ground survey.

INTRODUCTION

Bear Valley Creek, a major tributary of the Middle Fork of the Salmon Kiver, 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 tile 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 the late 1950's) of sediment into the stream. Bear Valley Creek has downcut 2 to 5 km through 2.3 km of unconsolidated overburden in the mined area. 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. An additional 200,000 to 400,000 cubic meters of mining overburden could be added to the stream if a 50- or 100-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 valuable ore body (euxenite, tantalum, columbium, thorium, and uranium). The strategic nature of the metals in the ore body and scarcity of such ore bodies 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 Kivers Act although the intent of the 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 Brider '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 Tribes 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 Kiver Basin Fish and Wildlife Program (Northwest Power Planning Council 1982). The Planning Council was aware of the Shoshone-Bannock 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 off-site 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 techincal 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, 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 recommmended 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. These efforts continued through the 1986 construction season (July-October). At least two more years will be required to complete the project.

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 on the habitat and fish community throughout Bear Valley Creek. The objective of this study was to make pre-treatment and during treatment, habitat and fish inventories during 1984, 1985, and 1986 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 in this project is limited to 638 ha of patented land (Bear Valley Minerals, Inc.,

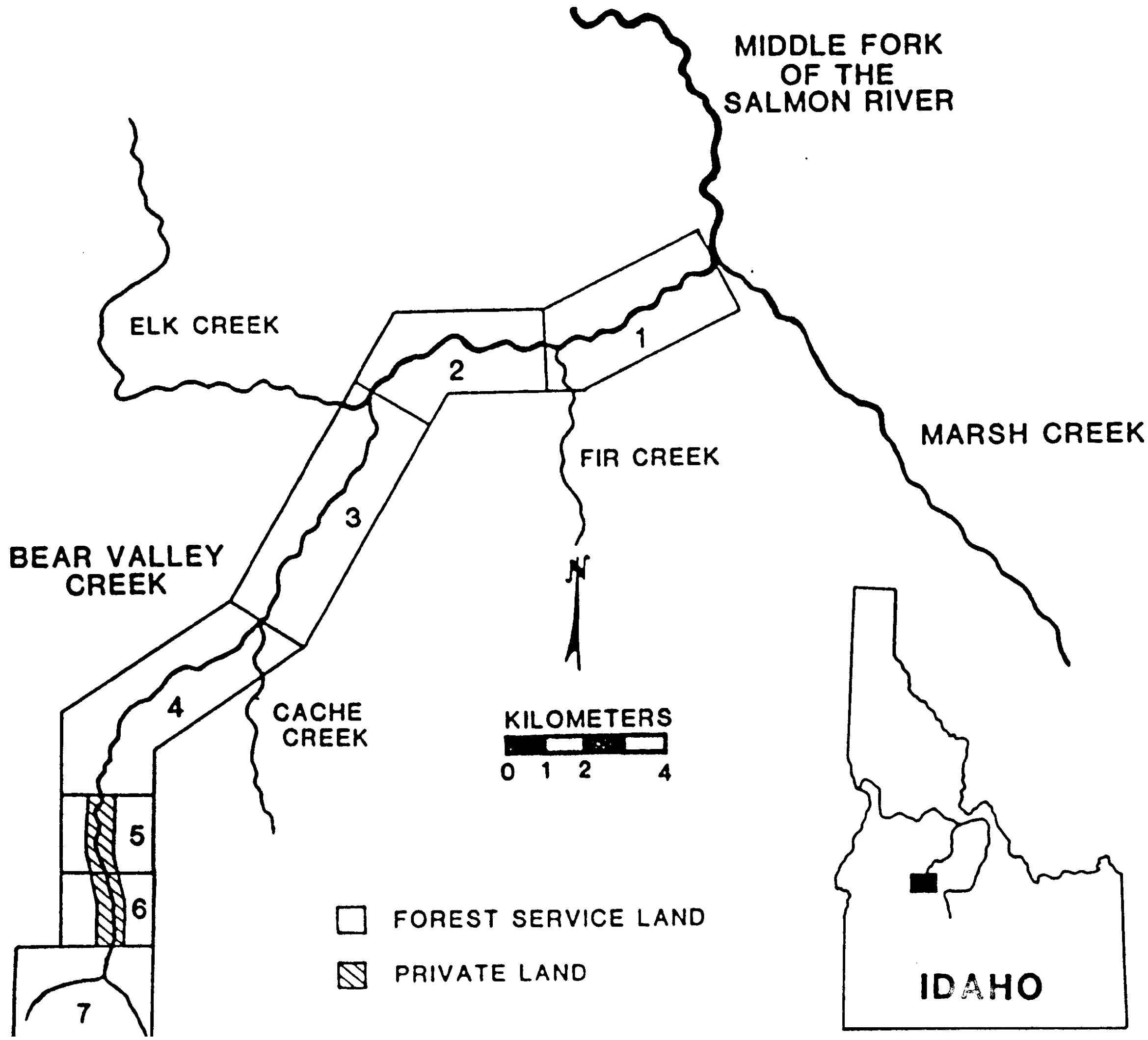


Figure 1. Bear Valley Creek, Idaho, study area and strata location.

portions of Sections 10, 15, and 22, Township 11 North, Range 8 East, Boise Meridian) near the headwaters of the stream.

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 shorthead sculpin (Cottus confusus).

METHODS

Habitat and Fish Community Inventories

The biological variables measured in 1986 are listed in Table 1.

Variable Measurement

Variables were measured in one riffle-pool sequence (experimental unit) at seven systematically determined sites (replicates) within each of seven strata (plots) (Fig. 1). Riffle-pool sequences were the same as those utilized in previous years (Konopacky et al. 1985, 1986). Stratification was based on stream size, valley width, gradient, land use associated with the stream, and land ownership (Table 2).

Fish were counted and ages (0+, l+, 2+ and older based on length) estimated of all salmonid species in each pool by underwater snorkel observations. When pool widths were narrow enough to allow visibility of both banks (Strata 7, 6, and 5) from the center of the stream, one diver would approach the downstream end of the pool and slowly crawl upstream noting presence and age of each salmonid fish. In wider stream segments (Strata 4, 3, 2, and 1) two divers would approach the downstream end of the pool and crawl or pull themselves upstream close to their assigned bank. After both banks were observed, the divers would both float downstream side by side each counting fish found towards their assigned bank. All snorkle observations were conducted between 1100-1500 hours and when water turbidity was deemed by tribal biologist to be low enough for accurate counts.

Chinook salmon were differentiated into two groups: age 0+ fish and age l+ residualized males. Steelhead trout (which 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 l+ and older fish. Due to the difficulty of identifying cutthroat par, only adult cutthroat were noted. Shorthead sculpin and adult sea-run chinook salmon were noted but not included in any analysis. 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^2 pool) of each species class was calculated as the abundance of fish in each size-class divided by pool area.

Lengths (mm) and weights (+0.01g) were measured on 40 to 50 age 0+ chinook salmon collected per stratum via electrofishing (DC). All habitat types along

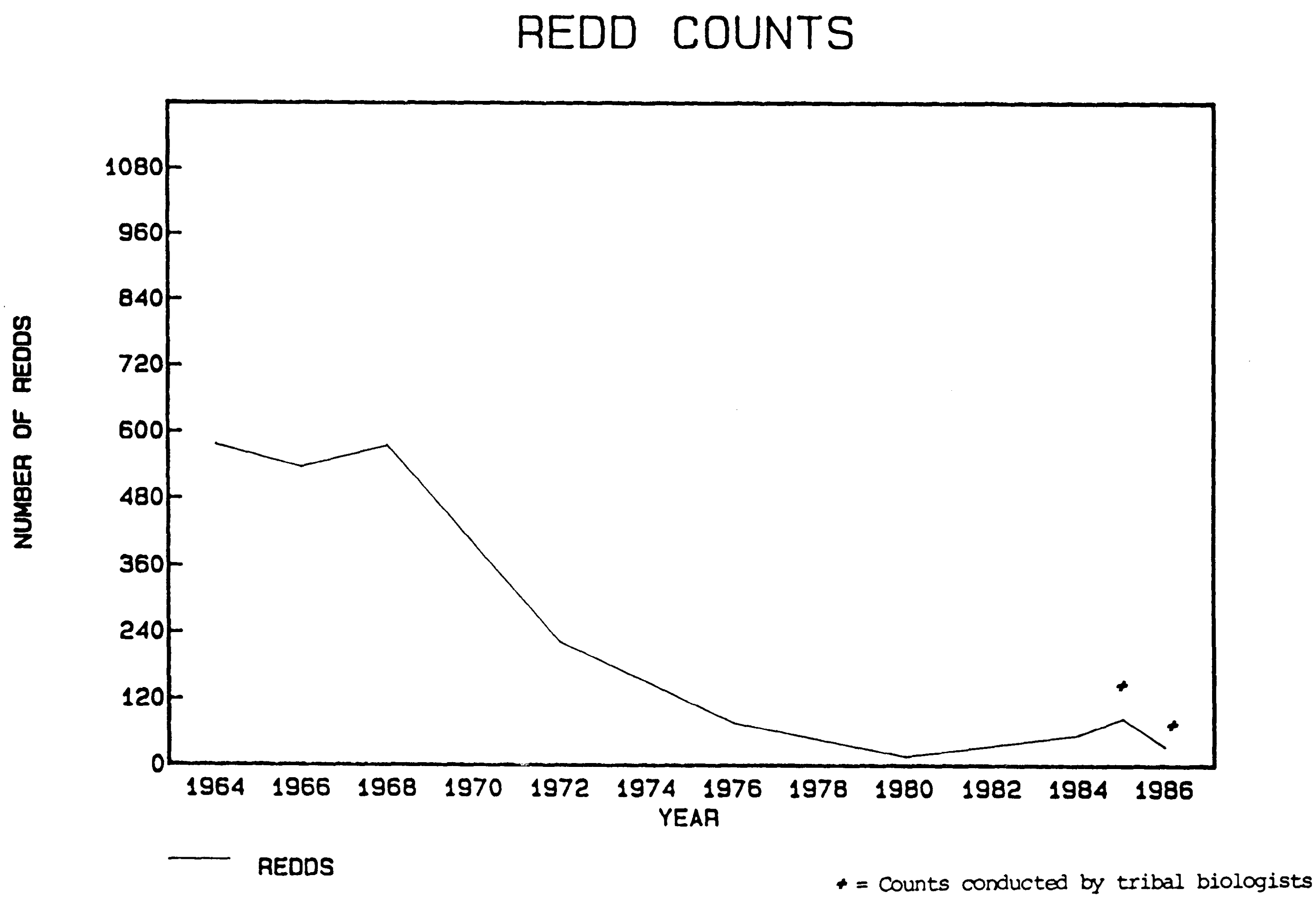


Figure 2. Counts of spring chinook salmon redds in Bear Valley Creek, Idaho, 1964-1986.

Table 1. Variables monitored in Bear Valley Creek, Idaho, 1986.

Variables
Temperature
Species Composition
Relative Abundance
Density
Population size
Chinook length
Chinook weight
Chinook condition
Chinook redd count

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

Stratum	Length	Gradient (%)	Land type	Land ownership	Land use
1[a]	7.7[b]	.2-1.45	Narrow, forested valley	USFS[c]	Non-consumptive
2	11.1	.01-.31	Wide valley, meadow/forest	USFS	Grazing[d]
3	12.7	.12-.61	Wide valley, meadow/forest	USFS	Grazing
4	11.2	.01-.37	Wide valley, meadow/forest	USFS	Grazing
5	4.0	.05-.19	Wide valley, meadow	BVM	Grazing
6	2.3	.25-1.0	Wide valley, mine/meadow	BVM[e]	Mined (1950's)
7[f]	5.5	.66-1.9	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.

the majority of stream length in each strata were shocked to account for potential fish size variability. Fish were anesthesized with MS-222 prior to measurements. Condition of age 0+ chinook salmon was calculated using length and weight data (Carlander 1979).

Water temperature (C) was monitored with one Taylor Maximum Minimum thermometer in each stratum each week between 16 June and 29 August 1986. Total degree-days (1C x 24 hours) were estimated for each stratum based on weekly maximum-minimum readings. Each weekly max-min temperature reading was averaged and multiplied by 7 to generate degree-days per week. These degree-days were than totaled by stratum to estimate cumulative degree-days for each stratum for the entire field season.

Abundances of age 0+ chinook salmon were estimated in July and August from mean and variance values derived from snorkeling surveys using techniques outlined in Sheaffer et al. (1979).

Redd counts were made on 28 August by two counters from a helicopter. Water visibility as well as flying conditions were excellent. Air speed was held below 20 km/hr at low air heights to insure accurate counts. The two counts were recorded and the average of the two counts was used as a final redd count estimate. Following aerial counts, a ground survey of the stream section containing the highest number of redds was conducted. This survey was conducted to establish the validity of the aerial count.

Biological variables were compared in August among 1984, 1985, and 1986 and between July and August in 1986. Unless otherwise stated, main effect hypotheses were analyzed through a two-way analysis of variance (alpha=0.05) using the Statistical Analysis System (SAS) computer package (Helwig and Council 1979). Significant differences among strata were determined with Duncan's New Multiple Range Test (Ott 1977). Significant interaction hypotheses required the calculation of least significant difference (LSD) (Steele and Torrie 1960) to delineate differences between/among and within interaction terms. Proportional distribution (expressed as a percent) of age 0+ chinook salmon, steelhead trout, and whitefish was compared among strata and among years with a Chi-square test of association. Normality and homogeneity of variance were tested and appropriately monotonically transformed, when necessary prior to using parametric statistics (Helwig and Council 1979).

RESULTS

Temperature

Water temperature ranged from 0.5 to 16.6C during June, 1.1 to 19.4C in July, and 0.0 to 21.1C in August. Degree-days (C x 24 hours) ranged from 610 in strata 7 to Y63 in stratum 2 during 16 June through 25 August. More degree-days were accumulated in downstream strata than in upper strata (Fig. 3).

Densities

Individual species densities among strata were not significantly different between the July and August sampling periods with all species age classes except O+ chinook. Fish densities (all species and age classes

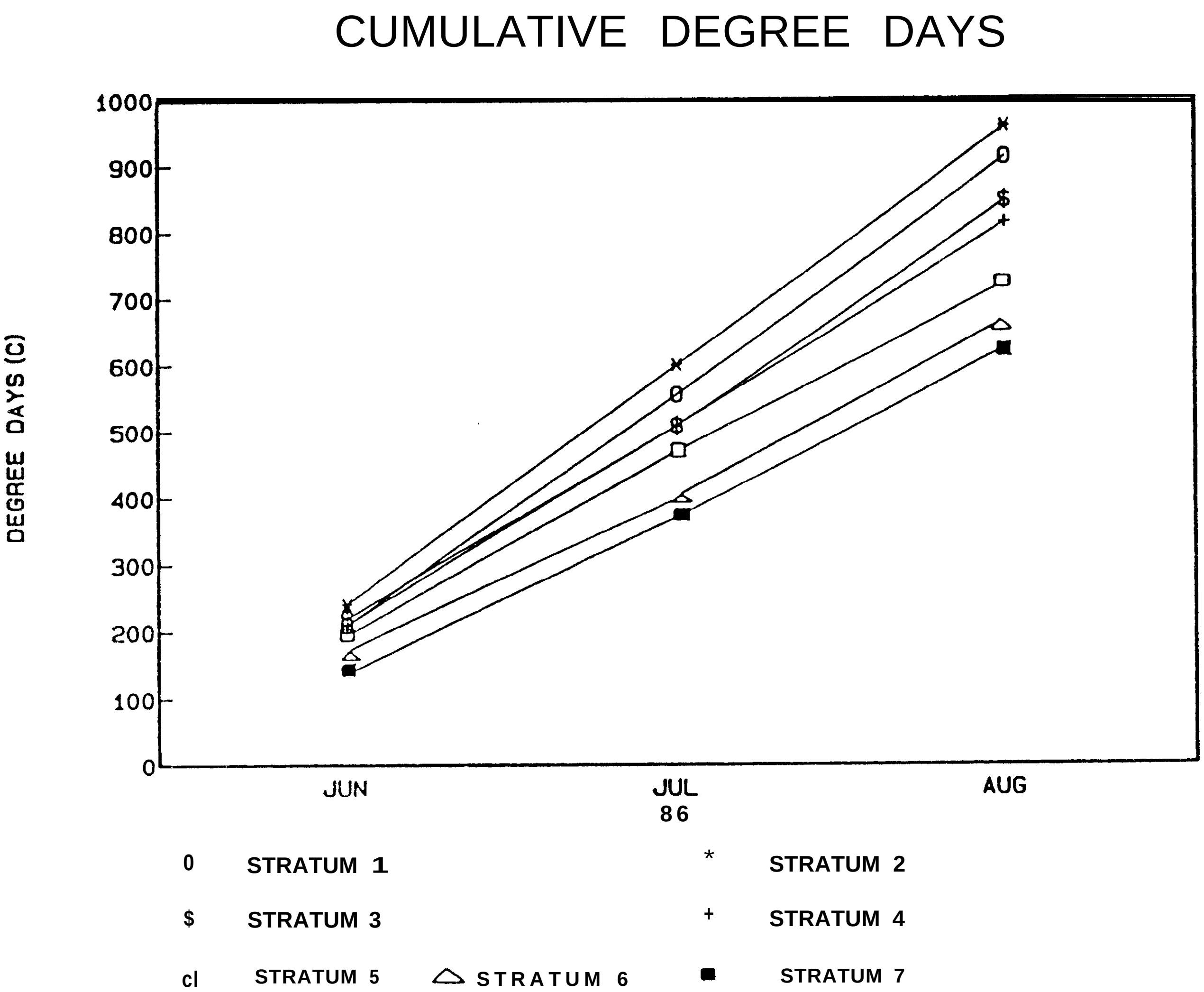


Figure 3. Cumulative degree-days during the period of 16 June to 29 August, Bear Valley Creek, Idaho, 1986.

combined) were highest in stratum 3 during July and August (Fig. 4). In July no fish species were found in stratum 6 (area of enhancement project). In August the highest mean fish density occurred in strata 2,3 and 4, with a trend of decreasing density moving upstream from stratum 4. No fish were found in the uppermost strata. All fish species densities and associated analysis of variance are compiled in table 3 and 4, respectively.

Age 0+ Chinook Salmon in July and August 1986.
The density of age 0+ chinook salmon among strata was significantly different between sampling periods. However, general patterns were the same. The greatest densities occurred in stratum 3 in both periods with significantly smaller densities being found in the other downstream strata (1, 2, 4) (Fig. 5A). No age 0+ chinook were found in any of the uppermost strata in either of the sampling periods.

Age 0+ Steelhead Trout in July and August 1986.
Densities did not differ among strata or between July and August. The greatest densities occurred in the middle to lower stream sections (Strata 2, 3 and 5) in July and strata 2 and 3 in August. No fish were found in either of the uppermost strata in either of the sampling periods (Fig. 5B).

Age 1+ Steelhead Trout in July and August 1986.
Densities did not differ among strata or between July and August. No 1+ steelhead were found in the uppermost section of the stream (Stratum 7) in either sampling period. Stratum 5 in July and stratum 6 in August had the overall greatest densities (Fig. 6A).

Age 2+ Steelhead Trout in-July and August 1986.
The density of age 2+ steelhead trout among strata did not differ significantly between sampling periods. No fish were found in the upper sections of the stream in July, but there seems to be an upstream movement of steelhead 2+ fish between sample periods (Fig. 6B).

Age 0+ Whitefish in July and August 1986.
The density of age 0+ whitefish among strata did not differ significantly between sampling periods. Similar distributions among strata were found when comparing observation periods, with highest densities found in the section of stream directly downstream of the old mined area (Stratum 5). As with most other fish species no age 0+ whitefish were found in the uppermost stream sections (Fig. 7A).

Juvenile Whitefish in July and August 1986.
The density of juvenile whitefish among strata did not differ significantly; and were extremely low. Distribution among strata did however differ significantly between sampling periods. Juvenile whitefish found in the July session were located in the downstream most section of the stream (Strata 1, 2, and 3). No fish were found in the August session (Fig. 7B).

Adult Whitefish in July and August 1986.
The density of adult whitefish differed among strata (Fig. 8A). Fish densities were highest in the downstream section of the stream during both sampling periods with a slight upstream movement of fish occurring between sample periods. No fish were found in the most upstream sections of the stream (Strata 6 and 7) in either sample period.

Adult Cutthroat Trout in July and August 1986.
Densities did not differ among strata or between July and August. Cutthroat trout densities were highest in the upper most section of stream (Stratum 7) in July, while no cutthroat were found in this section in August, No fish were observed in the middle stream sections (Strata 3, 4, 5 and 6) during either sampling period (Fig. 8B).

MEAN TOTAL FISH DENSITY

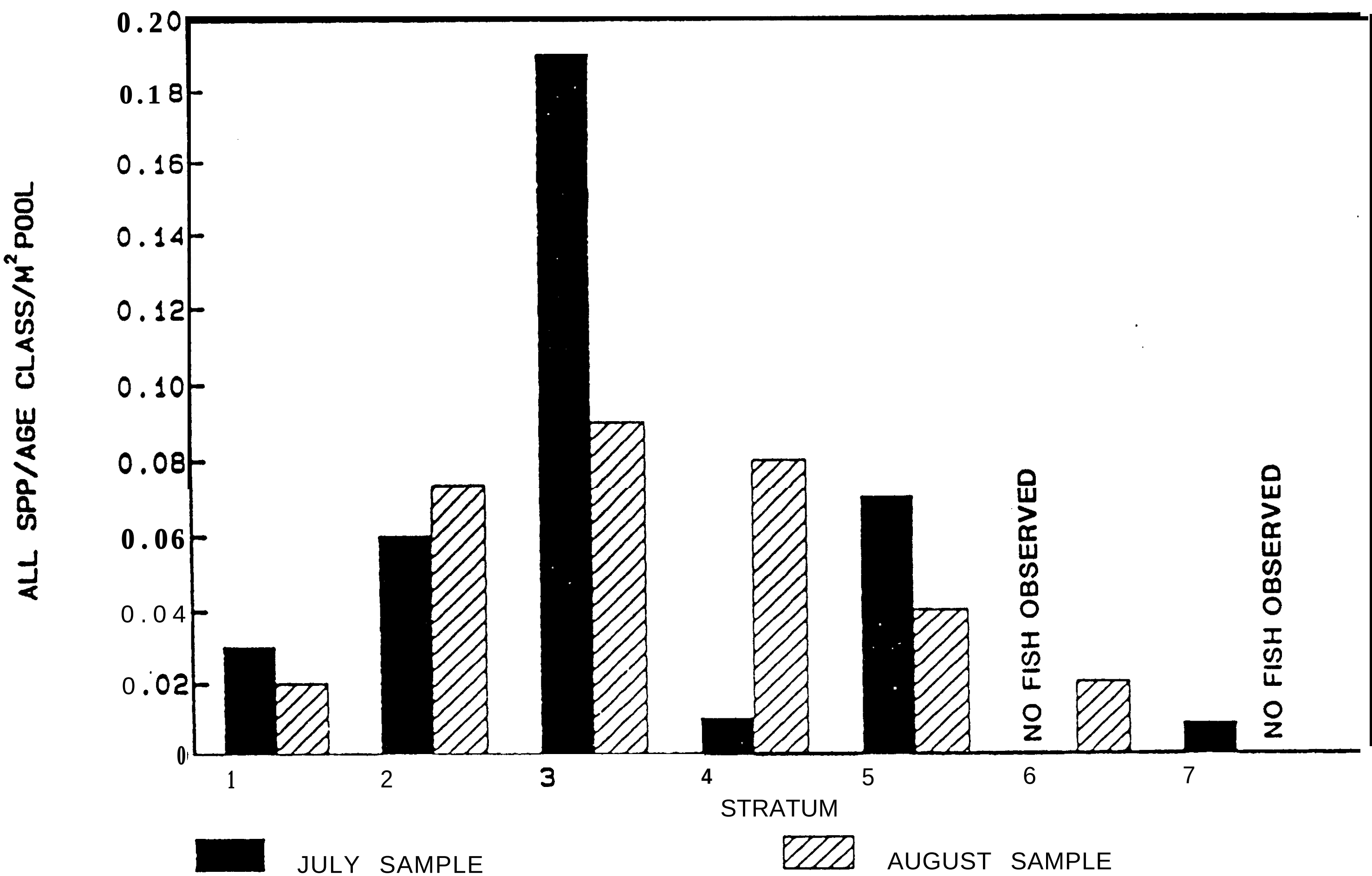


Figure 4. Fish density (all species and age classes combined) by sample session, Bear valley Creek, Idaho, 1986.

Table 3. Mean total fish densities by session and stratum, on Bear Valley Creek, Idaho 1986.

SESSION 1

STRATUM	I	2	3	4	5	6	7
CHS YOY	.01181	.03484	.13307	**.00344**	0	0	0
WHF YOY	.00048	.00965	.00545	.00604	.02063	0	0
WHF JUV	.00246	.00216	.00111	0	0	0	0
WHF ADULT	.00306	.00888	.01461	0	0	0	0
STT YOY	.00041	.00060	.00523	.00145	.03581	0	0
STT ADULT	.00548	.00035	.00768	0	.00794	0	0
CUT 2 ADULT	.00068	0	0	0	0	0	.00420
BKTD	.00038	0	.00256	.00023	0	0	0
OTHER	.00128	0	.00256	-000223	0	0	.00420
TOTAL	.02604	.05648	.17227	.01139	.06438	0	.00840

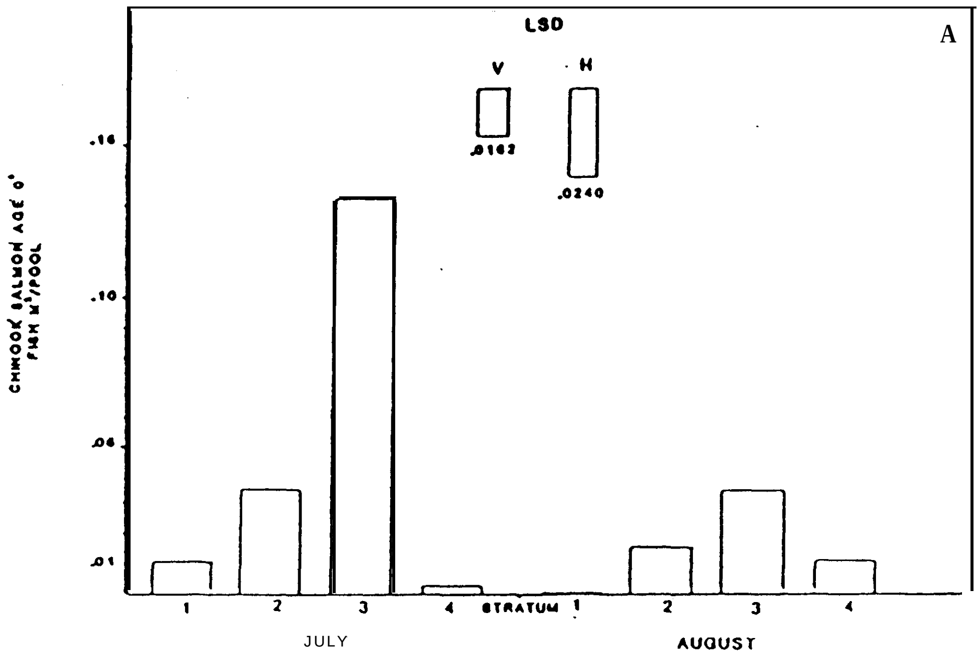
SESSION 2

STRATUM	1	2	3	4	5	6	7
CHS YOY	.00129	.01536	.03552	.01430	0	0	0
WHF YOY	.00018	.00502	.01331	.00621	.02065	0	0
WHF JUV	0	0	0	0	0	0	0
WHF OLDER	.01268	.01782	.00112	.00012	.00694	0	0
STT YOY	.00095	.01717	.00523	.00097	0	0	0
STT ADULT	.00018	.00008	.00102	.00085	0	.00734	0
CUT 2 ADULT	.00048	.00015	0	0	0	0	0
BKTD	.00006	0	.01739	.03267	.00699	.00454	0
OTHER	.00054	.00015	.01739	.03267	.00699	.00454	0
TOTAL	.01636	.05575	.09098	.08779	.04157	.01642	0

Table 4. Analysis of variance for fish species by age class, Bear Valley Creek, Idaho 1986.

Species by Age Class	Source	DF	F Value	PR> F
CHS 0+	Stratum	3	10.06	.0002
	Site (Stratum)	24	1.55	.1503
	Session	1	6.08	.0215
	Session * Stratum	3	4.29	.0166
STH 0+	Stratum	4	.31	.8655
	Site (Stratum)	30	1.05	.4518
	Session	1	.72	.4033
	Session * Stratum	4	2.11	.1075
STH 1+	Stratum	5	.44	.8198
	Site (Stratum)	36	1.02	.4815
	Session	1	1.77	.1922
	Session * Stratum	5	1.67	.1685
STH 2+	Stratum	4	.44	.5677
	Site (Stratum)	30	.93	.5764
	Session	1	.32	.5738
	Session * Stratum	4	1.84	.1473
WHF 0+	Stratum	4	.70	.5999
	Site (Stratum)	30	.74	.7859
	Session	1	.01	.9052
	Session * Stratum	4	.18	.9444
WHF JUV	Stratum	2	.39	.6831
	Site (Stratum)	18	.94	.5487
	Session	1	8.12	.0111
	Session * Stratum	2	.39	.6831
WHF 2+	Stratum	4	3.5	.0200
	Site (Stratum)	30	1.43	.1755
	Session	1	.22	.6413
	Session * Stratum	4	2.09	.1101
CUT 2+	Stratum	6	.87	.5228
	Site (Stratum)	42	.94	.5783
	Session	1	.86	.3607
	Session * Stratum	6	.90	.5021
BKT (All Age Classes)	Stratum	4	2.82	.0438
	Site (Stratum)	30	1.00	.5005
	Session	1	10.37	.0032
	Session * Stratum	4	2.61	.0567

AGE 0+ CHINOOK SALMON



AGE 0+ STEELHEAD TROUT

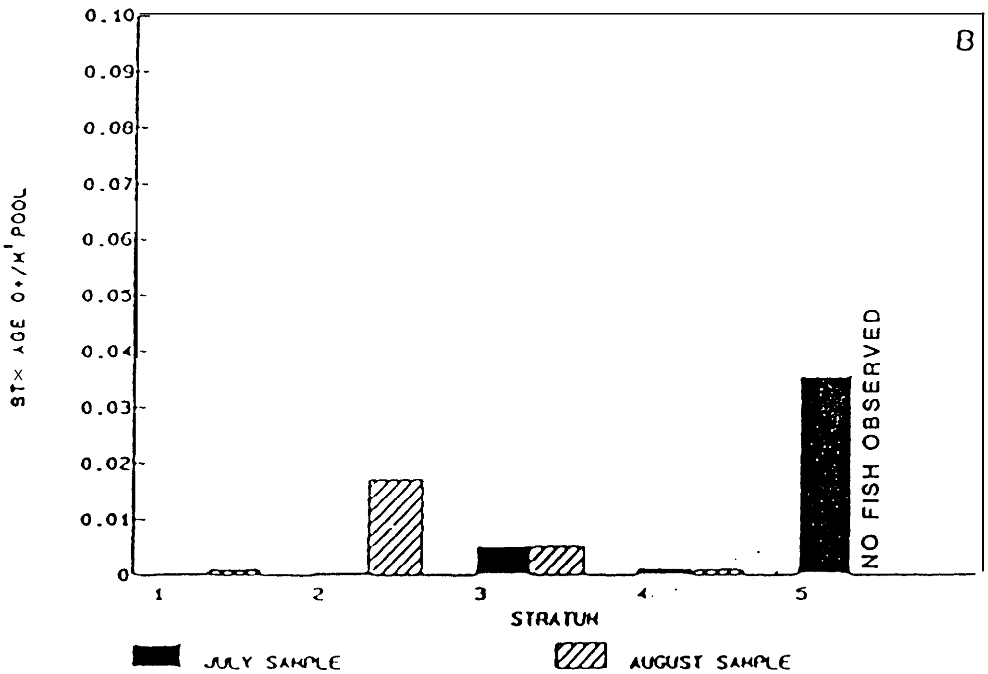
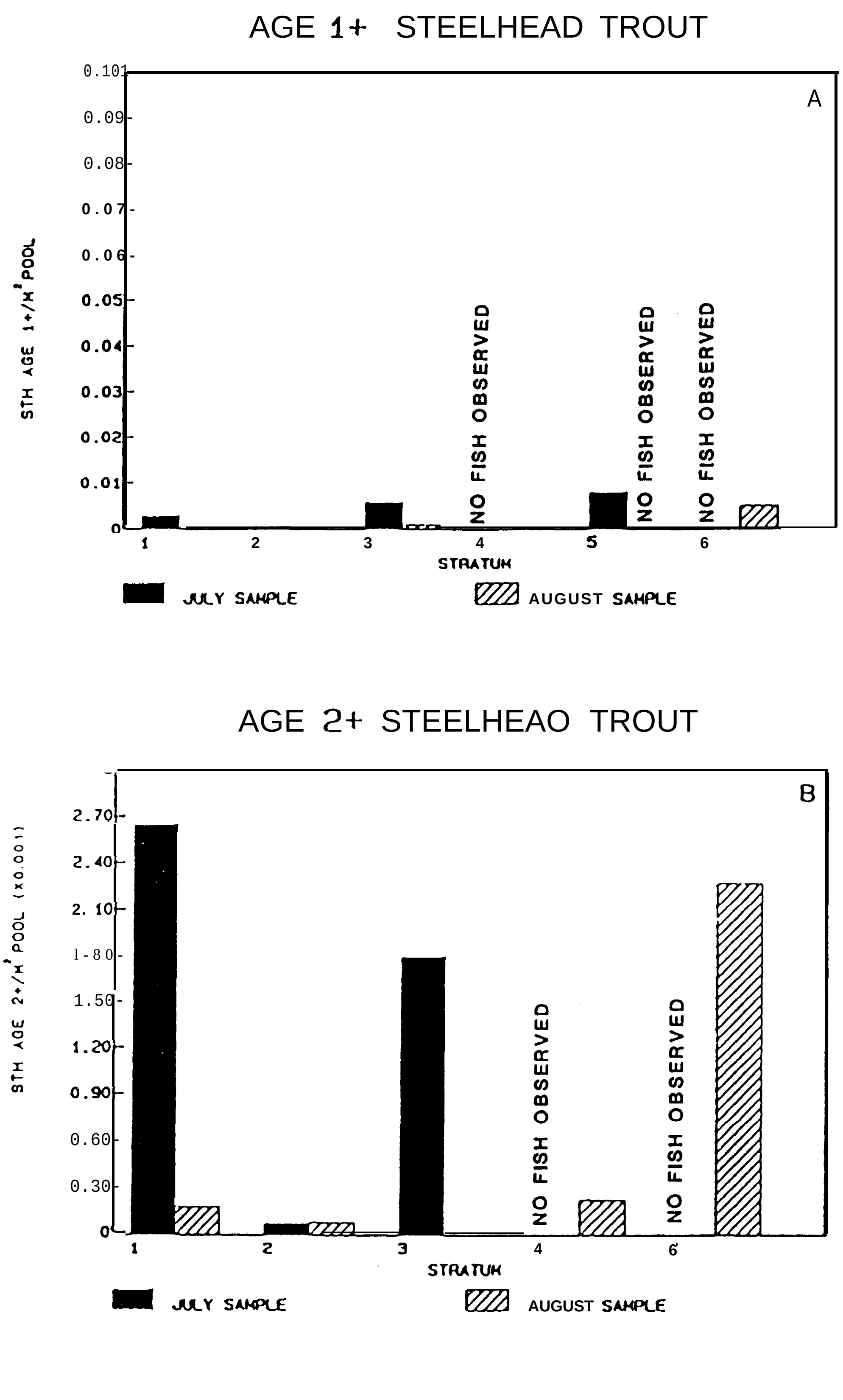


Figure 5. Mean (n=7 per stratum) densities of age 0+ chinook salmon (A) and age 0+ steelhead trout (B) by stratum. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's respectively, indicate significant ($P<0.05$) differences between those means (A). No significant ($P>0.05$) difference occurred among strata or between sampling periods (B), Bear Valley Creek, Idaho, 1986.



Figure& Mean (n=7 per stratum) densities of age l+ and 2+ steelhead trout (A and B, respectively), Bear Valley Creek, Idaho, 1986. No significant (P.>0.05) differences occurred in either set of means among strata or between sampling periods.

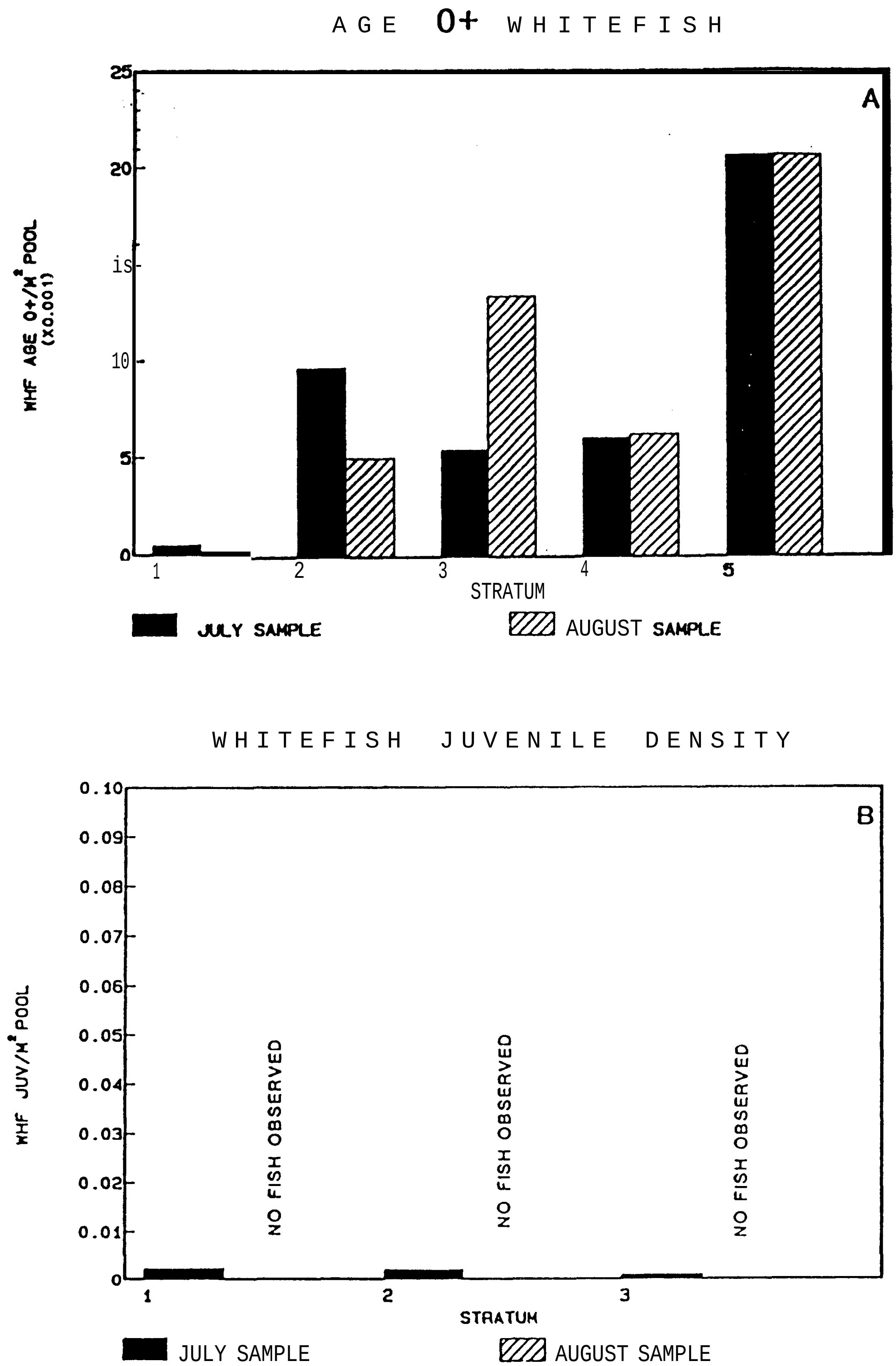
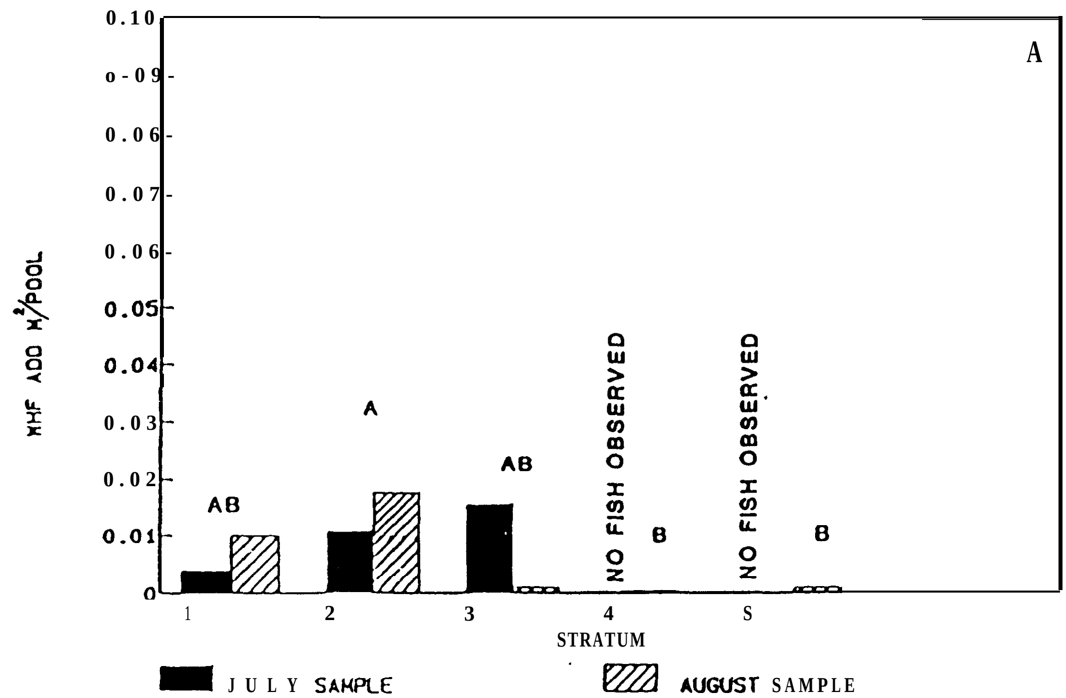
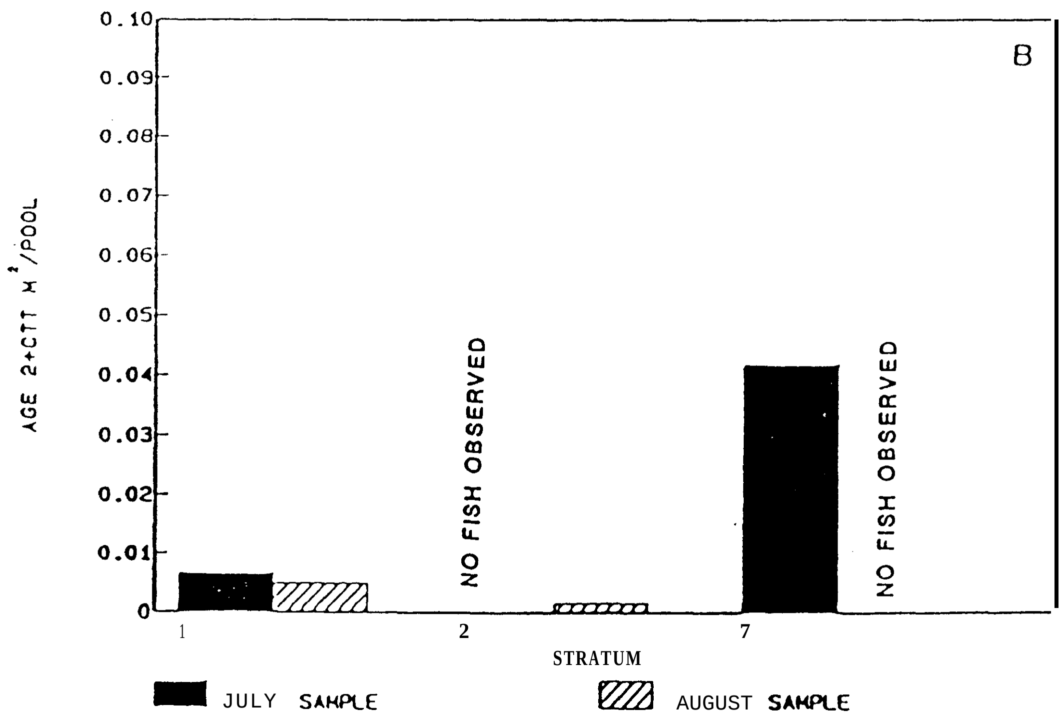


Figure 7 . Mean (n=7 per stratum) densities of age 0+ and juvenile whitefish (A and B, respectively) among strata, Bear Valley Creek, Idaho, 1986. No significant difference ($P > 0.05$) occurred in either set of means.

AOULT WHITEFISH



AGE 2+ CUTTHROAT TROUT



igure 8, Mean (n=7 per stratum) densities of adult whitefish and cutthroat rout (A and 8, respectively), Bear Valley Creek, Idaho, 1986, A common etter above means indicates non-significant (P>0.05) differences between 11 pairs of means with that letter (Fig. 8A). No significant differences ccurred in Fig, 88 strata means.

Brook trout all ages combined in July and August 1986. Densities differed among strata and between July and August. brook trout densities were greatest in strata 3 and 4. No brook trout were found in strata 2 or 7 during both sample sessions. Higher densities were observed in August (Fig. 9).

Relative Abundance

During July 1986, relative composition of age 0+ chinook salmon ranged from 0 to 51.5% among strata (Fig. 10). The most abundant species-age class group by stratum were; whitefish (all ages) in the most downstream sections (Strata 1 and 2) and stratum 5; age 0+ and older steelhead trout in stratum 6; age 0+ chinook in stratum 3; other species in stratum 4. No fish were found in the uppermost stream section (Stratum 7).

During August 1986, relative composition of age 0+ chinook ranged from 0 to 80% among strata (Fig. 11). The most abundant species-age class group by stratum were: age 0+ chinook salmon in strata 1, 2, and 3; age 0+ older whitefish in stratum 4; age O+ and older steelhead trout in stratum 5; and other species in the most upstream section of Bear Valley Creek (Stratum 7). No fish were observed in stratum 6 in August.

Densities, Comparison Among Years

Densities of individual species were compared with those reported in 1984 and 1985 (Konopacky et al. 1986) (Table 5). Overall chinook YOY densities were similar to those reported in 1985 but lower than 1984. Steelhead YOY densities exhibited a similar pattern. Older aged steelhead densities did not differ greatly from previous years. Whitefish YOY densities were lower than those found in 1985 and juvenile and adult densities were not significantly different than previous years. Other species (Bull trout, Brook trout, Cutthroat) were infrequent in all three years and difficult to compare.

Distribution Among Years

A Chi-square contingency table was used to examine whether there was a significant difference in the distribution of age 0+ chinook salmon among strata between years. This test essentially standardizes the differences in abundance among years so that differences in distribution can be examined without the complicating influence of year to year absolute differences in abundance. A significant association between years and strata was noted (X = 702.502, n=1877, P<O.OOl). The largest shift in proportion distribution was 1986 when no fish were found in the uppermost strata. This contrasts with 1985 and 1984 when 40% and 12% respectively of chinook salmon were found in stratum 6 and 15% and 18% were found in stratum 5 (Fig. 12).

Length/Weight Relationships (Age 0+ Chinook Salmon) 1986

Total length in July and August. There was a significant difference in fish length between July and August and among strata (Table 6). Length ranged from 54.7 to 62.0 mm and 63.8 to 71.7 mm in July and August, respectively (Fig. 13A). Mean fish length were significantly larger in the lowest section of Bear Valley Creek (Stratum 1) than in all other strata. No age 0+ chinook salmon were found in the uppermost 3 strata.

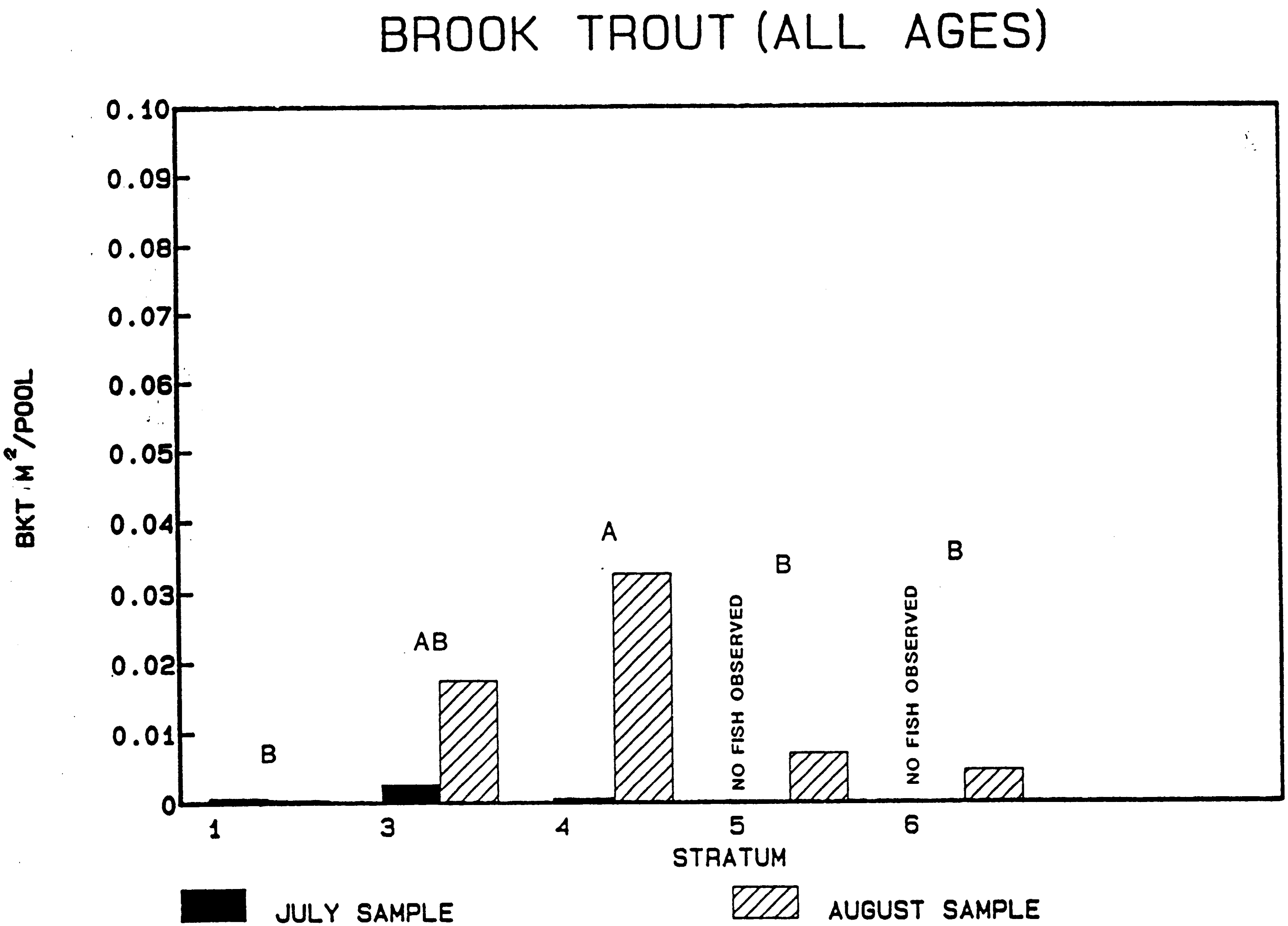


Figure 9. Mean (n=7 per stratum) densities of Brook Trout (all age classes combined), Bear Valley Creek, Idaho, 1986. A common letter above means indicates non-significant differences (P>0.05) between all pairs of means with that letter.

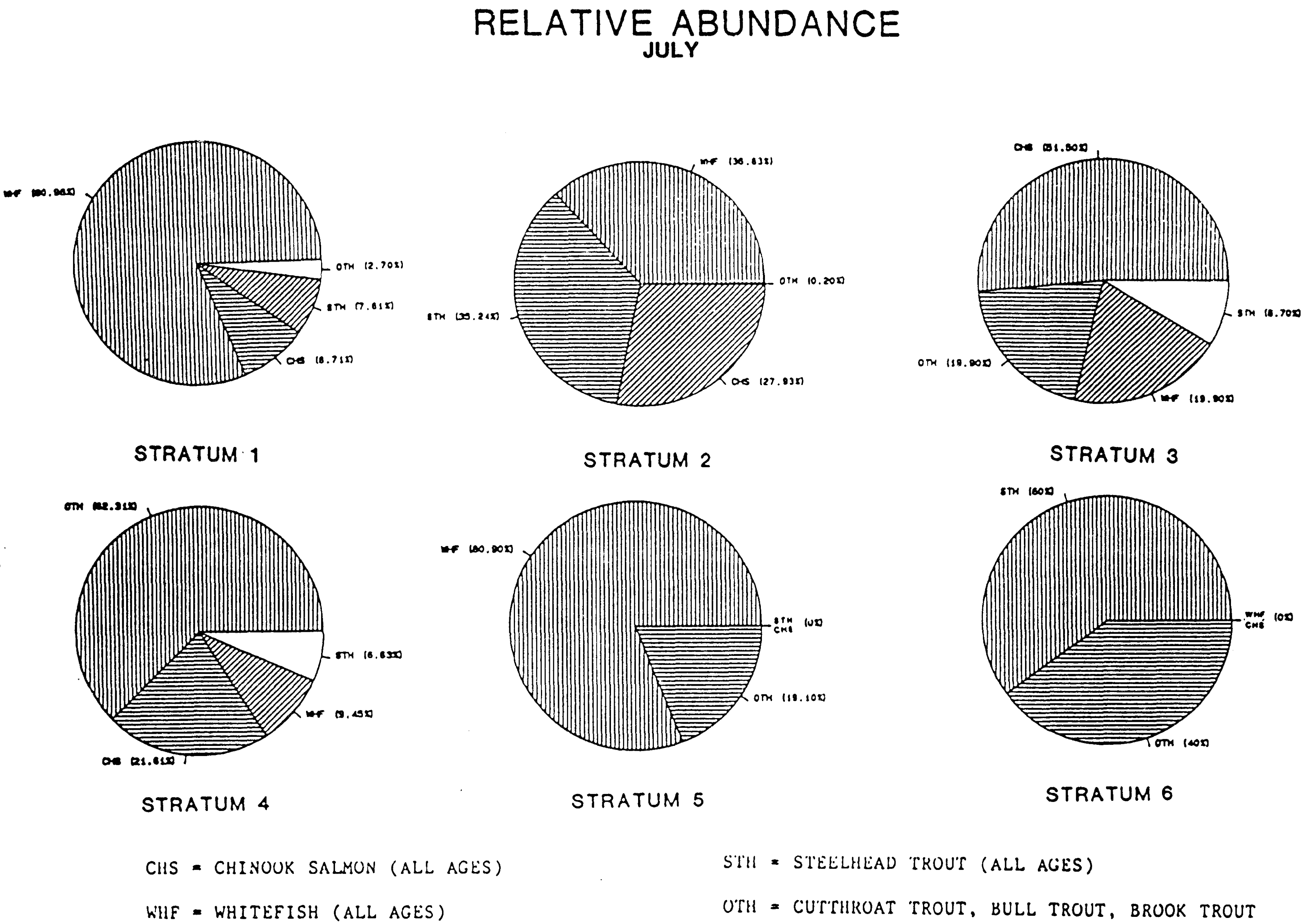


Figure . Relative abundance (percent) of fish species (combined age classes) Bear Valley Creek, Idaho, July, 1986.

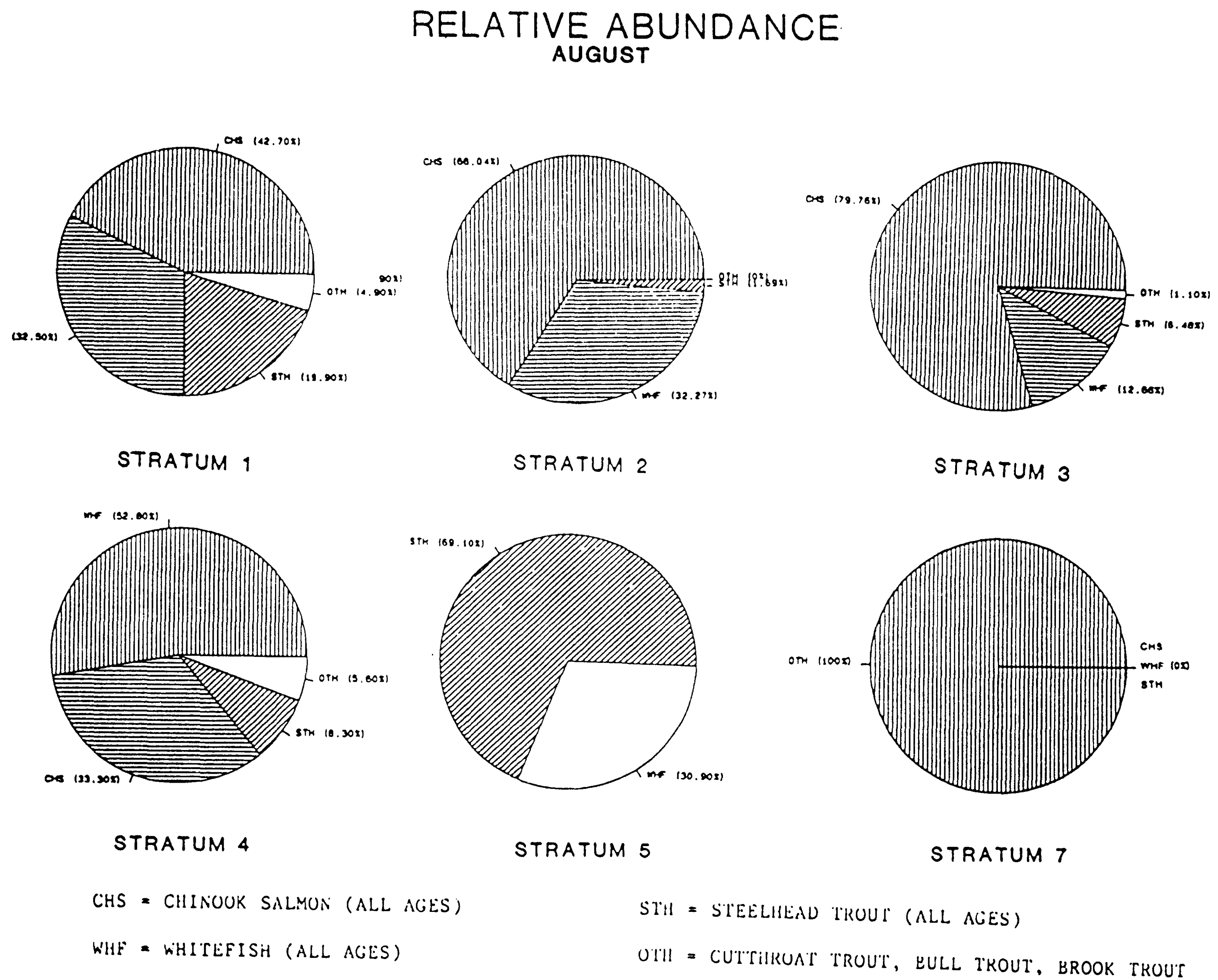


Figure 11. Relative abundance (percent) of fish species (combined age classes) Bear Valley Creek, Idaho, August, 1986.

Table 5 . Analysis of variance for species/age classes, Bear Valley Creek, Idaho, 1984, 1985 and 1986.

Species by Age Class	Source	DF	F Value	PR> F
CHS YOY	Stratum	6	1.86	0.0928
	Site (Stratum)	7	1.43	0.1988
* A B B	Year	2	20.88	0.0001
4 5 6	Year * Stratum	12	4.22	0.0001
	Stratum	6	0.55	0.7711
CHS 1+	Site (Stratum)	7	0.41	0.8932
A A B B	Year	2	3.53	0.0324
45 6	Year * Stratum	12	2.24	0.0140
	Stratum	6	2.59	0.0216
STH YOY	Site (Stratum)	7	2.64	0.0145
A A B B	Year	2	3.77	0.0259
4 5 6	Year * Stratum	12	2.36	0.0094
	Stratum	6	3.01	0.0089
STH 1+	Site (Stratum)	7	1.36	0.2301
A A A	Year	2	1.64	0.1981
4 5 6	Year * Stratum	12	1.19	0.2965
	Stratum	6	0.91	0.4880
STH 2+	Site (Stratum)	7	1.05	0.4002
A A A	Year	2	0.37	0.6890
5 4 6	Year * Stratum	12	1.93	0.0373

* = Duncan Multiple Range Comparison Test

4 = 1984 5 = 1985 6 = 1986

(Table 5. Continued)

Species by	Source	DF	F Value	PR > F
WHF YOY	Stratum	6	3.07	0.0080
A B B	Site (Stratum)	7	1.29	0.2586
5 4 6	Year	2	15.46	0.0001
	Year * Stratum	12	6.74	0.0001
WHF Juveniles	Stratum		0.86	0.5300
A A A	Site (Stratum)		2.35	0.0277
5 4 6	Year		1.15	0.3209
	Year * Stratum		1.16	0.3206
WHF Adult	Stratum	6	5.67	0.0001
A A A	Site (Stratum)	7	2.30	0.0301
5 4 6	Year	2	0.42	0.6593
	Year * Stratum	12	0.81	0.6376
CUT 2+	Stratum	6	4.60	0.0003
A B B	Site (Stratum)	7	2.76	0.0110
5 4 6	Year	2	3.38	0.0374
	Year * Stratum	12	1.07	0.3880
BULL TROUT	Stratum	6	1.17	0.3260
A AB B	Site (Stratum)	7	4.89	0.0001
4 5 6	Year	2	7.69	0.0007
	Year * Stratum	12	5.37	0.0001
BROOK TROUT YOY	Stratum	6	6.70	0.0001
B ABA	Site (Stratum)	7	2.43	0.0234
6 5 4	Year	2	0.73	0.4827
	Year * Stratum	12	1.36	0.1953

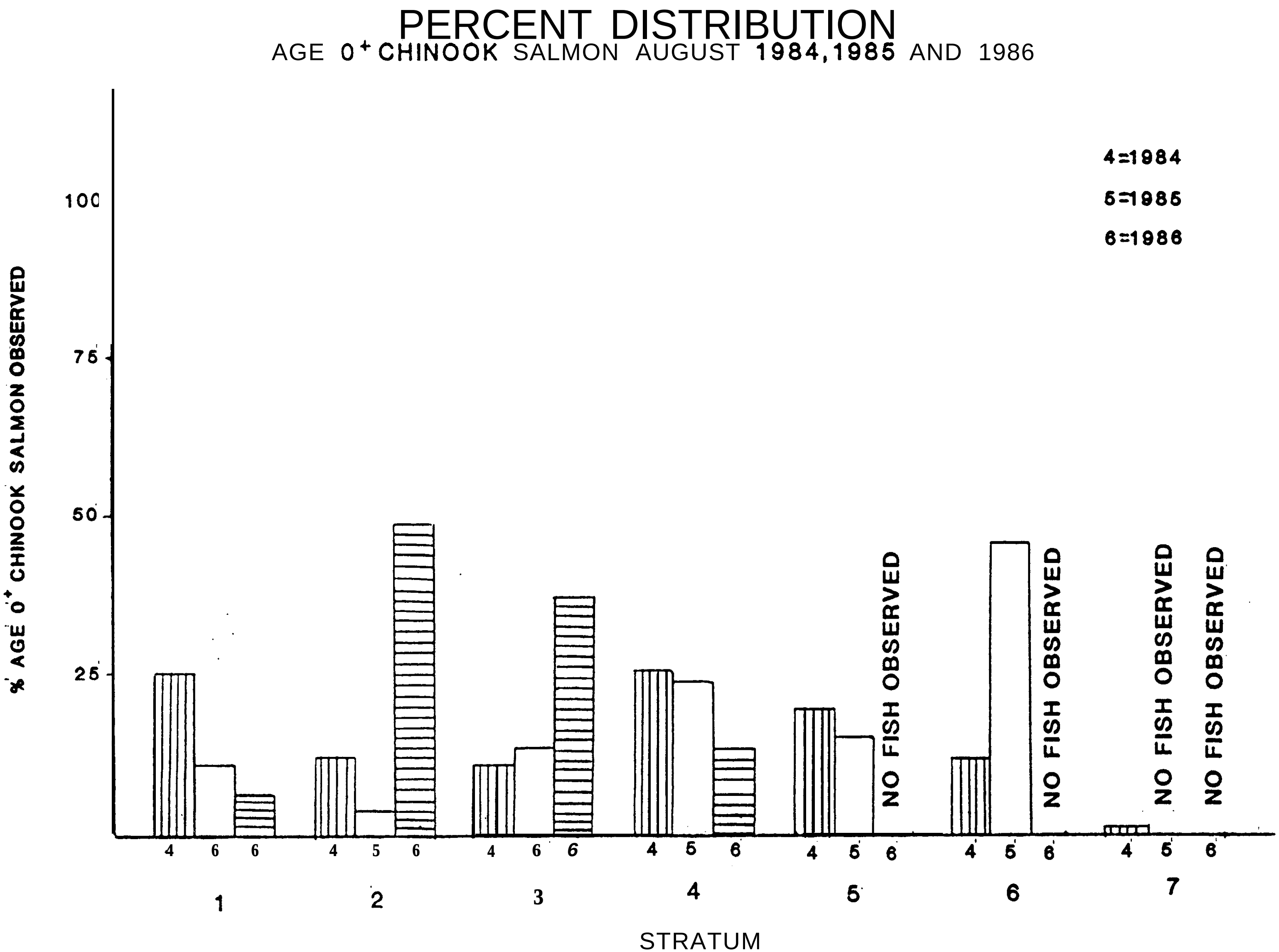


Figure 12. Percent distribution of age 0+ chinook salmon during August in 1984, 1985 and 1986, Bear Valley Creek, Idaho.

Table 6 . Analysis of variance for age 0+ chinook salmon length, weight, and condition factor, Bear Valley Creek, Idaho, 1986.

Variable	Source	DF	F Value	PR > F
CHS YOY Length	Session	1	213.55	0.0001
	Stratum	3	23.32	0.0001
	Session * Stratum	3	0.41	0.7474
CHS YOY Weight	Session	1	252.42	0.0001
	Stratum	3	31.16	0.0001
	Session * Stratum	3	1.87	0.1320
CHS YOY Condition	Session	1	40.37′	0.0001
	Stratum	3	14.48	0.0001
	Session * Stratum	3	8.26	0.0001

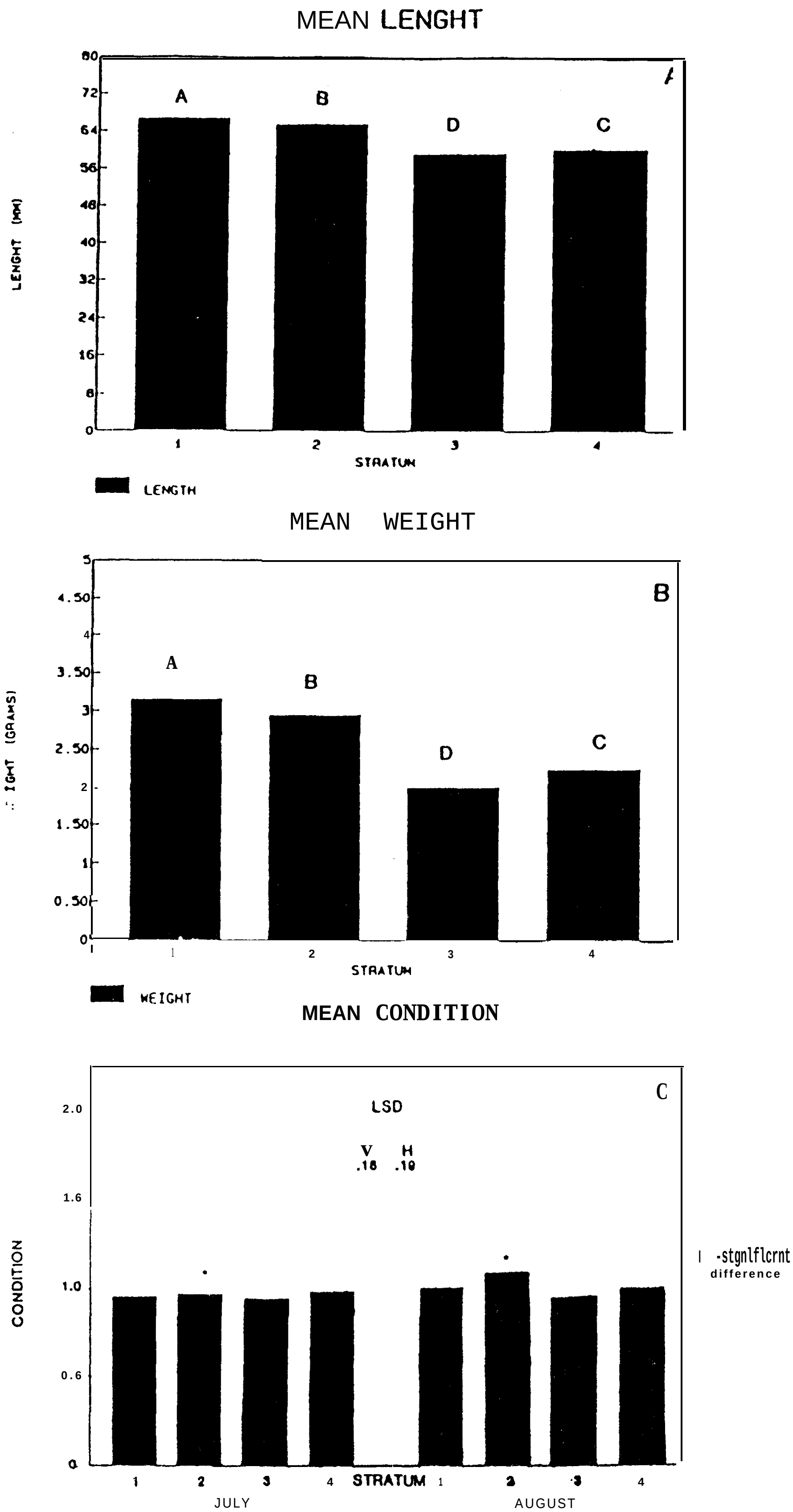


Figure 13. Mean length, weight and condition (Figs. A, B and C, respectively) of age 0+ chinook salmon, among strata, Bear Valley Creek, Idaho, 1986. A common letter above means indicates non-significant (P>0.05) differences between ail pairs of means with that letter (Figs. A+B). Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's respectively, indicate significant (PL0.05) differences between those means.

Live weight in July and August.
There was a significant difference in weight between sessions and among strata (Table 6). Fish weight ranged from 1.5 to 2.3 grams and 2.5 to 4.0 grams in July and August, respectively (Fig. 13B). Mean fish weight was significantly greater in the lowest section of stream (Stratum 1) than in all other strata. No age 0+ chinook salmon were found in the uppermost three strata.

Condition in July and August.
Fish condition differed significantly among strata between July and August 1986 (Table 6). Mean fish condition ranged from .90 to .97 and from .909 to 1.13 in July and August, respectively. Mean fish condition was significantly lower in stratum 3 than in all other strata. In August, densities were significantly different in stratum two, than in stratum two during July. No fish were found in the uppermost 3 strata (Fig. 13C).

Length/Weight Relationships (Age 0+ Chinook Salmon) Comparison Among Years

Total length in August 1984, 1985, and 1986.
Fish length differed significantly among strata between August 1984, August 1985 and August 1986 (Table 7). Mean fish length was greatest in the lower portion of the stream and ranged from 68.1 to 78.6 mm (Strata 1 and 2) with a trend of decreasing fish length upstream. Overall mean fish length was greatest in 1985 and least in 1986.

Live weight in August 1984, 1985, and 1986.
Fish weight differed significantly among strata between August 1984, 1985, and 1986. (Table 7). Mean fish weights were greatest in the lower portion of the stream (Strata 1 and 2) and ranged from 2.89 g to 4.97 g. As with total length, there is a trend of decreasing mean weight further upstream where samples were collected. Mean fish weight was greatest in 1985 and least in 1986.

Condition in August 1984, 1985, and 1986.
Fish condition differed significantly among strata between August 1984, 1985, and 1986 (Table 7) and ranged from .88 to 1.03. Mean fish condition was greatest in the most downstream sections (Strata 1 and 2) of stream, while mean fish condition was lowest in the uppermost stream reaches (Strata 6 and 7). Mean fish condition was significantly greater in 1986 than in 1985 and 1984.

Chinook Abundance and Kedds

Abundance of age 0+ chinook salmon in July and August 1986
In July, total number of age 0+ chinook salmon was 15,850+2086 (95% bounds). Highest numbers were observed in the lower to middle stream strata (Strata 2 and 3). No fish were found in the upstream three strata. In August, total number of fish was 6,275+1,850, as in July, the highest numbers were observed in the lower to middle strata (Strata 2 and 3) and no fish were found in the upstream areas of the stream (Strata 5, 6 or 7) (Fig. 14).

Redd Count in 1986
Total number of redds on 27 August 1986 was 28. A majority of the redds were located in stratum 2 (Table 8). A ground verification confirmed the accuracy of these counts.

Table 7. Mean length, weight and condition of age 0+ chinook salmon, Bear Valley Creek, Idaho 1984, 1985 and 1986. A common letter above yearly means indicate a non-significant (P> 0.05) difference among means.

Variable and Species	Source	DF	F Value	PR >F
	Stratum	6	65.26	0.0001
CHS YOY	Year	2	238.76	0.0001
LENGTH	Year * Stratum	8	4.09	0.0001
*B A C 84 85 86				
	Stratum	6	63.47	0.0001
CHS YOY	Year	2	185.94	0.0001
WEIGHT	Year * Stratum	8	7.17	0.0001
*B A C 84 85 86				
	Stratum	6	12.65	0.0001
CHS YOY	Year	2	116.63	0.0001
CONDITION	Year * Stratum	8	11.77	0.0001
*C B A 84 85 86				

* = Duncan's New Multiple Range Test

84 = 1984

85 = 1985

86 = 1986

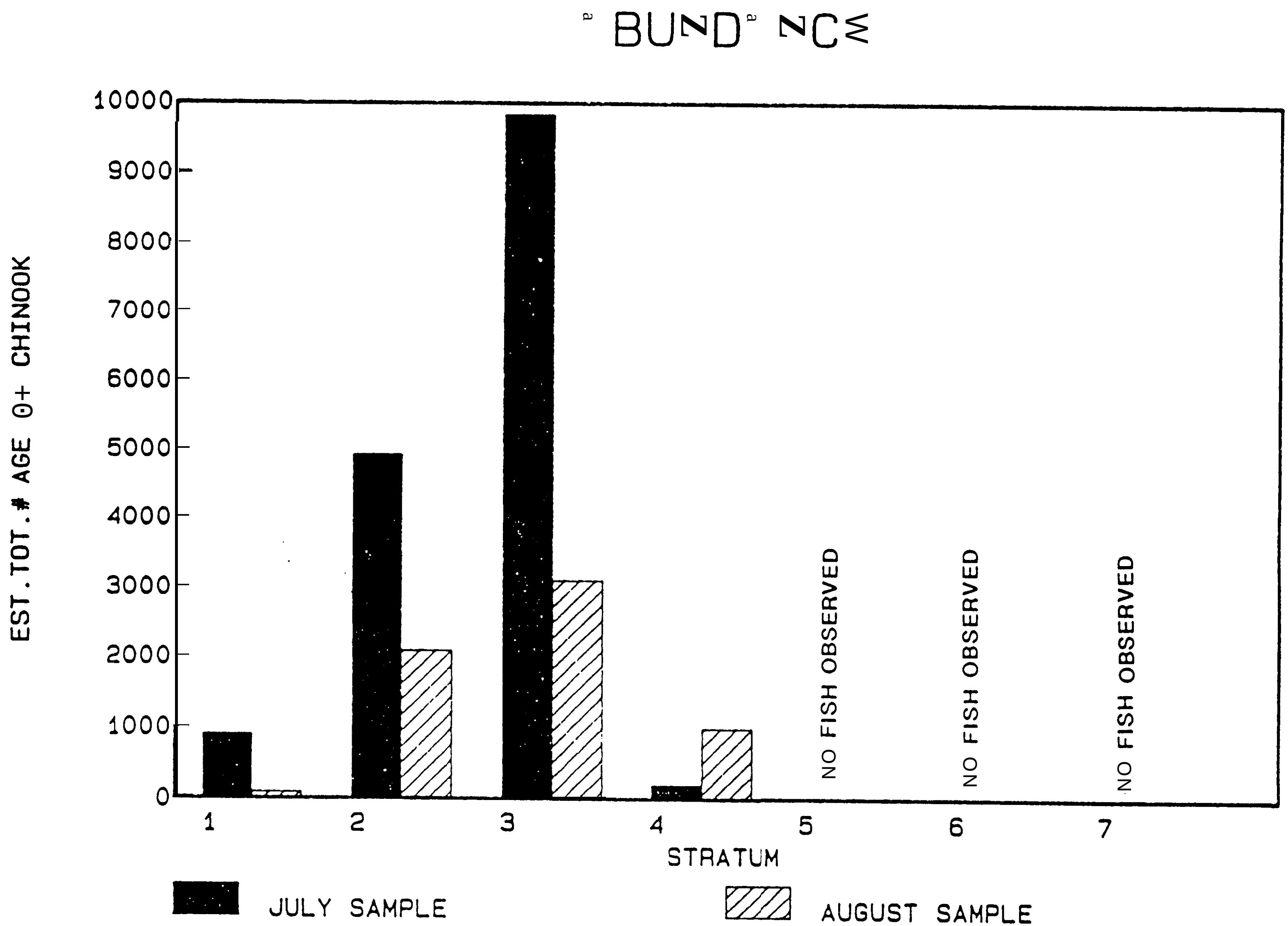


Figure **14.** Estimated abundance of age 0+ chinook salmon by session and stratum during 1986, Bear Valley Creek, Idaho.

Table 8. Distribution of Redds found in Bear Valley Creek, Idaho, 1986.

STRATUM	REDDS COUNTED	% OF TOTAL
1	0	0
2	23	82.2
3	4	14.3
4	1	3.5
5	0	0
6	0	0
7	0	0
Total	28	100

DISCUSSION

Fish community composition within Bear Valley Creek in 1986 was similar to that reported in previous years by Konopacky et al. (1985, 1986). Young of the year chinook salmon, steelhead trout and whitefish dominated the fish community in most strata. As in previous years, brook trout, cutthroat trout, and bull trout represented a small proportion of the total community. These species were represented by a few individuals of various age groups that were present in localized areas. Age 0+ chinook densities ranged from 0 to 0.14 fish/m^2 pool. These densities are far below the rearing potential of Idaho streams (0.3 to 1.7 fish/m^2 pool; Schulich and Bjornn 1977, Bjornn 1978) and are similar to those found in 1985 and 1984.

The greatest difference in fish distribution among years was in the lack of chinook salmon and steelhead trout in the uppermost strata in the vacinity of the mined area in 1986. In 1984 and 1985, age 0+ chinook were found in the upper strata except for stratum 7 in 1985. Age 0+ steelhead trout were found in all strata in both years. The reasons for the absence of fish in the mined area (stratum 6) in 1986 are not known. Although chinook and steelhead were found in the upper strata in 1984 and 1985, densities were very low and the lack of fish in 1986 may correspond to natural fluctuations in population densities or may be due to an inadequancy of the sampling program in current use. It is possible that construction activities in the mined area also influenced chinook and steelhead habitat utilization, although, water quality monitoring in the construction area indicated no signficant increases in sediment transport or other water quality parameters (Construction report 1987).

In 1986, significant differences were found among strata on Bear Valley Creek in relation to length and weight of chinook salmon. In general, lengths and weights increased with increasing downstream distance from the headwaters of the stream. Similar trends were observed in 1984 and 1985 (Konopacky et al. 1986). These patterns correspond to temperature trends also observed in Bear Valley Creek in which temperatures and accumulated degree-days increased in a downstream direction. Length and weight relationships among strata may be largely attributable to water temperature and its influence on growth. It is also likely that differences in length and weight relationships among years may be due to annual differences in ambient temperatures.

The total estimated number of chinook salmon presmolts in August 1986 was 6,274. The total number of redds counted in August in 1985 was 85. Assuming that 3,500 fertilized eggs were deposited per redd, an egg to presmolt survival rate of 2.11% was observed between August 1985 and August 1986. This rate is lower than the survival estimates of 9.4% and 8.1% that were observed in 1984 and 1985 respectively (Konopacky et al. 1986). All of these survival values are considerably lower than would be expected under pristine conditions. Egg to presmolt survival rates are dependent on the survival from egg to alevin within spawning gravels and survival of fry and presmolts in rearing habitat. Both of these types of habitat in Bear Valley Creek continue to be severly impacted by sediment deposition and survival rates to presmolts are probably strongly affected by the negative influence of this sediment. The redd and juvenile distribution in Bear Valley Creek is concentrated in areas which have relatively low amounts of fine sediment, however, these area contain larger proportions of fine sediments than is typical of pristine streams. Movements of juveniles downstream to areas not included in our surveys may also influence our calculations of low survival rates.

A significant portion of the sediment input to Bear Valley Creek has been arrested due to the completion of some stabilization measures within the mined property. A full range of stream physical habitat assessments will again be measured in 1987 to begin establishing a post-treatment record for evaluation of project success within Bear Valley Creek. Measures of physical habitat and juvenile densities will continue to be the best means to document benefits attributable to this project. Future monitoring will emphasize measuring changes in specific habitat parameters impacted by sediment and examining fish response to these changes.

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SUBPROJECT II

Middle Fork/Upper Salmon River:
Planning and Coordination

Carl Richards, Project Leader (PL) of BPA Project No. 83-359 and his predecessor, Richard C. Konopacky (January-February), consulted with Bonneville Power Administration (BPA), Idaho Department of Fish and Game (IFG), the Boise National Forest (BNF), Sawtooth National Recreation Area (SNRA), the Challis National Forest (CNF) and private landowners concerning ongoing and proposed habitat enhancement projects in the Upper Salmon River and Middle Fork of the Salmon River drainages. The majority of the PL's time was spent in conjunction with BPA project No. 84-24; Marsh, Elk, Bear Valley, Valley and Upper Salmon River, Idaho. The Fort Bridger Treaty of 1868 entitles tribal members to fish in the Salmon River drainage and was used as the criteria for Tribal involvement in project coordination efforts and the cooperative management of anadromous fish resources within Treaty areas.

On January 15 and February 6-7 the PL met with BNF, SNRA, and IFG representatives to discuss work statement changes to the contract between the BNF and their contractor OEA Research concerning project No. 84-24. Discussions centered on clarifications and additions to the existing work statement that were needed to satisfy the intent of the BPA funded stream habitat inventory. On May 22, the PL met with the same steering committee to review an early draft of inventory results and treatment recommendations that was submitted by OEA to the BNF. Specific recommendations were made to the contractor regarding report format and interpretation of results. An on-site review of major problems and treatment recommendations in Upper Salmon and Middle Fork tributaries by the PL, steering committee members and OEA representatives was conducted on June 6. Priority streams and specific remediation alternatives were examined. On July 31, the PL met with steering committee members to review the second half of the draft OEA report that contained data summaries and statistical analysis. A critique of statistical methods and interpretation was submitted to the contractor.

The PL also participated on a selection committee comprised of representatives of BNF, Salmon National Forest and BPA to select an andromous fish coordinator who will oversee BPA funded projects under Project 84-24. Several applicants were evaluated and a recommendation was made to the Forest Service as to the most qualified applicants. On September 25, the PL attended a meeting of members of IFG, SNRA, CNF and private landowners groups to discuss management alternatives and their relationship to proposed enhancement work on the Upper Salmon River in the Stanley Basin. Alternatives and relative benefits were examined.

On April 15, the PL met with BNF representatives to discuss Forest Service management and anadromous fisheries. Specific management practices and their relation to tribal and other BPA funded enhancement programs on the BNF were reviewed.

The PL also participated in developments relating to BPA Project No. 83-415, Alturas Lake Creek and Upper Salmon River Flow Augmentation. On January 15, the PL met with IFG and BPA representatives to discuss development of alternatives on this project. The PL was in telephone contact with all effected parties during the year in relation to the status of the Alturas Lake project.

On May 23, the PL attended a meeting with IFG representatives to coordinate evaluation and monitoring efforts in the Salmon River drainage. An agreement was reached whereby tribal and IFG monitoring efforts under tribal sponsored projects and BPA Project No. 83-7, Idaho Habitat Evaluation, will complement one another and eliminate duplication of efforts. The PL also attended two meetings of the Idaho Habitat Enhancement Coordination Committee on April 16 and November 5. This committee consists of all tribal, Federal and State agencies within the state that are involved in BPA funded habitat enhancement work. Both meetings concerned the review of ongoing and proposed enhancement projects within the state. Specific recommendations were made by committee members on development and evaluation of individual projects.

SUBPROJECT III

Yankee Fork of the Salmon River: Inventory, Problem Identification and Enhancement Feasibility

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ABSTRACT

Extensive dredge mining has degraded chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (Salmo *gairdneri*), and resident salmonid habitat in the Yankee Fork drainage of the Salmon River. An ongoing feasibility study will determine the feasible alternatives for enhancing salmonid habitat, which will, influence production throughout the drainage. Subsequent negotiations with an interagency task force will produce a preferred alternative addressing the potential for enhancement of the Yankee Fork to increase critically needed habitat. A construction easement will then be needed from private landowners prior to implementation. Aquatic habitat of fish communities were inventoried in the Yankee Fork of the Salmon River, Jordan Creek and the West Fork of the Yankee Fork of the Salmon River (the latter two streams are tributaries to the Yankee Fork) during 1984 and 1985 for use as pre-treatment data to evaluate anticipated habitat enhancement. Physical (1 time/year, 1984 and 1985) and biological (2 times/year 1984, 1985 and 1986) variables have been measured in six sites within seven strata of the Yankee Fork drainage. Fish data were collected via snorkel-observations and electrofishing. Salmonid species present in the Yankee Fork drainage include: chinook salmon, steelhead/rainbow trout, mountain whitefish (*Prosopium williamsoni*), brook trout (*Salvelinus* fontinalis), cutthroat trout (S. *clarki*), and bull trout (S. *confluentus*). Shorthead sculpin (Cottus *confusus*) were also present. In 1986: Significant differences in densities were observed among strata in age 0+ chinook salmon, age 1+ and older steelhead trout, whitefish juveniles and adults. Significant differences in densities were also observed in age 1+ and older steelhead trout between sample sessions. Mean total fish density was greatest in stratum 5 (upper Yankee Fork proper) during both sample sessions. During 1986 the relative composition of age 0+ chinook salmon ranged from 0 to 97% among strata. Significant differences occurred among strata in mean length and condition of age 0+ chinook salmon in 1986, Age 0+ chinook salmon condition was greater in 1985 than in 1986. The total abundance of age 0+ chinook salmon. in July and August of 1986 was 37,288 and 38,084, respectively. The total number of redds counted by helicopter on 31 August 1986 was three, Ground surveys indicated far more redds were present and were located primarily between Fivemile and MacKay Creeks. Densities of age 0+ steelhead and whitefish were significantly different between years. A significant association between years and strata was noted in the distribution of age 0+ chinook salmon. 'The largest shift occurred during 1986 when 73% of age 0+ chinook salmon were found in stratum 5. This contrasts with 1985 when no age 0+ chinook salmon were found in the same stratum. Salmonid habitat and passage problem areas were identified and prioritized for remediation on Fivemile and Ramey Creeks (tributaries of the Yankee Fork). Major sedimentation problem types in descending order of potential sediment input, include: dredge tailings, open slopes, roading adjacent to the stream, washouts, sloughing stream banks. Passage problems included beaver dams, log jams, and waterfalls.

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 River 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. 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. A considerable put-and-take rainbow trout fishery has also been developed by the Idaho State Fish and Game in the old dredge/settling pond adjacent to Yankee Fork proper.

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

The Yankee Fork of the Salmon River 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 on natural and wild stocks since 1978. In 1985 and 1986, the Tribes held a ceremonial fishery in the upper Yankee Fork on surplus hatchery chinook salmon. Through BPA funding, the Tribes undertook pre-treatment biological and habitat inventories consistent with inventories conducted on the Yankee Fork drainage in 1984 and 1985 (Konopacky et al. 1985,1986). Habitat problems affecting fish and their habitats in the Yankee Fork drainage were identified and prioritized relative to sediment recruitment and other problems.

Objectives of the current study were: 1) continue pre-treatment inventories of fish populations in the Yankee Fork system to establish baseline conditions; 2) to identify on-site problems in Fivemile Creek and Kamcy Creek (tributaries to Yankee Fork) affecting fish populations and their habitats; and 3) determine feasible alternatives for enhancement of critical habitat.

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, Fivemile, Ramey, Lightning and Eightmile Creeks. The Yankee Fork of the Salmon River is a low to medium gradient system which flows through narrow canyons and moderately wide valleys of lodgepole pine (Pinus contorta) forests. 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 private landowners.

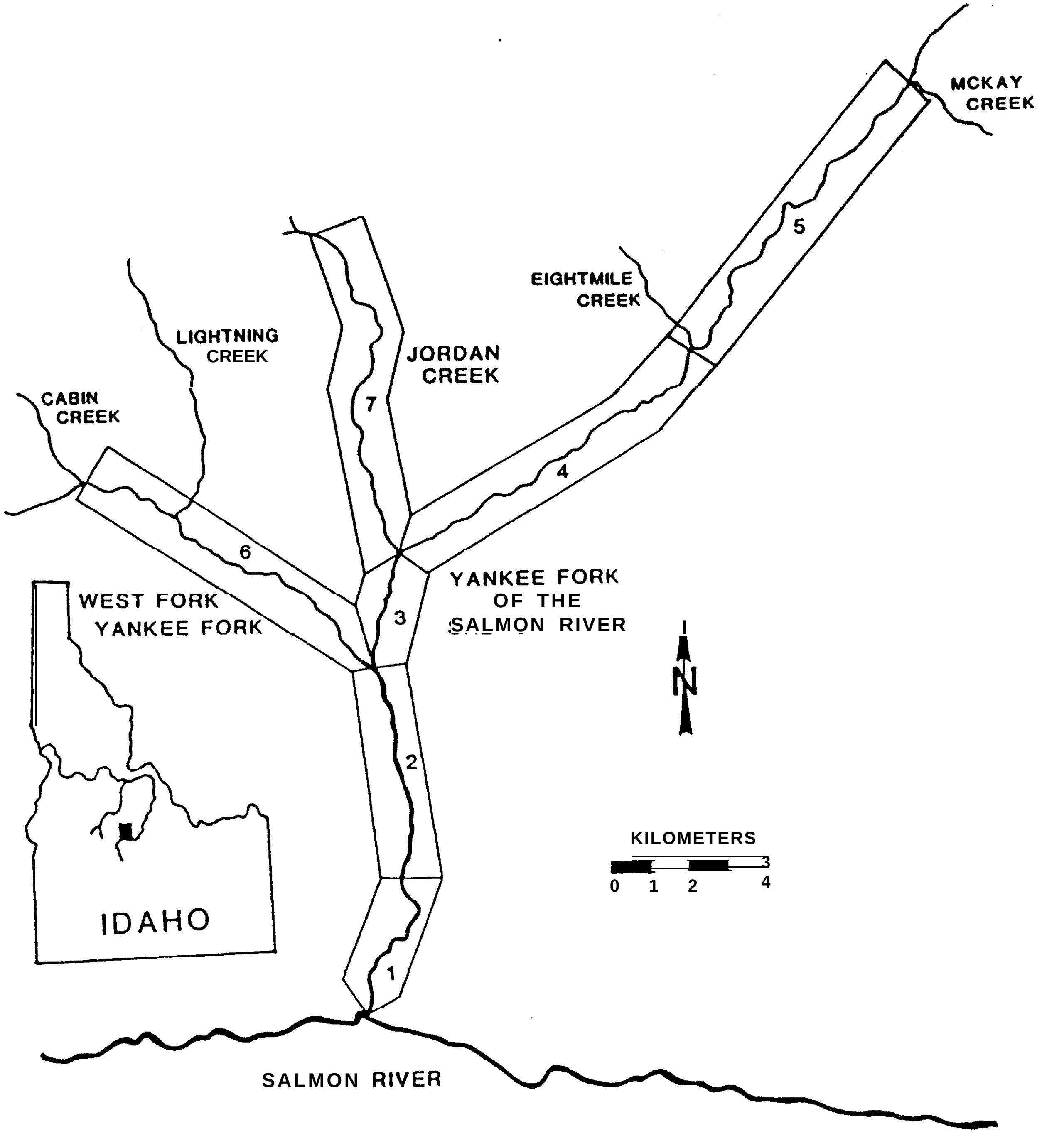


Figure 1. Yankee Fork drainage of the Salmon River, Idaho, study area and strat location.

The biological and physical inventory 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. Problem identification studies address Fivemile Creek and Ramey Creek moving from their confluence with Yankee Fork upstream approximately 5.0 km on each stream.

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, deep rock, and open pit mines continue to operate in upper Yankee Fork and Jordan Creek drainage. 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 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*).

METHODS

Selection of Feasibility Study Subcontractor

Approximately 35 organizations were contacted, given a general overview of the project scope, and asked whether they would be interested in receiving a request-for-proposal (RFP) for the feasibility study portion of the Yankee Fork Habitat Enhancement Project. Nineteen organizations requested the RFP. These RFP's were sent out on June 16 and a deadline of July 11 for receipt of proposals was set. The RFP contained a general statement of work and a request for technical proposals including biological feasibility/fish production potential and engineering feasibility/engineering preliminary design. Appendices of potential problems in the creek, maps and a preliminary NEPA checklist were included. A profile of organization experience with similar projects and qualification of key personnel or subcontractors was also required. A separate proposal for projected costs which included details of all personnel and other costs was requested.

Eight complete proposals were received in Tribal offices by July 11. A meeting was convened in Boise on July 24 to select a contractor for the project. Representatives of Idaho Fish and Game, the Challis National Forest, Bonneville Power Administration and the Tribes evaluated proposals in terms of: quality and detail of the study plan (30%), qualifications and experience of the offeror and subcontractors (30%), extent to which offeror had experience with NEPA (20%), and competitiveness of total cost and rates (20%). Bechtel National Inc. (BNI) of San Francisco received the highest rankings and were awarded the contract August 4th.

BNI began the feasibility study in coordination with the Tribes, IFG, CNF and BPA in September. The feasibility study for the Yankee Fork Habitat Enhancement project will be completed in March 1987. The study will identify limiting habitat for anadromous fishes and suggest appropriate remedial enhancement techniques.

REDD COUNTS

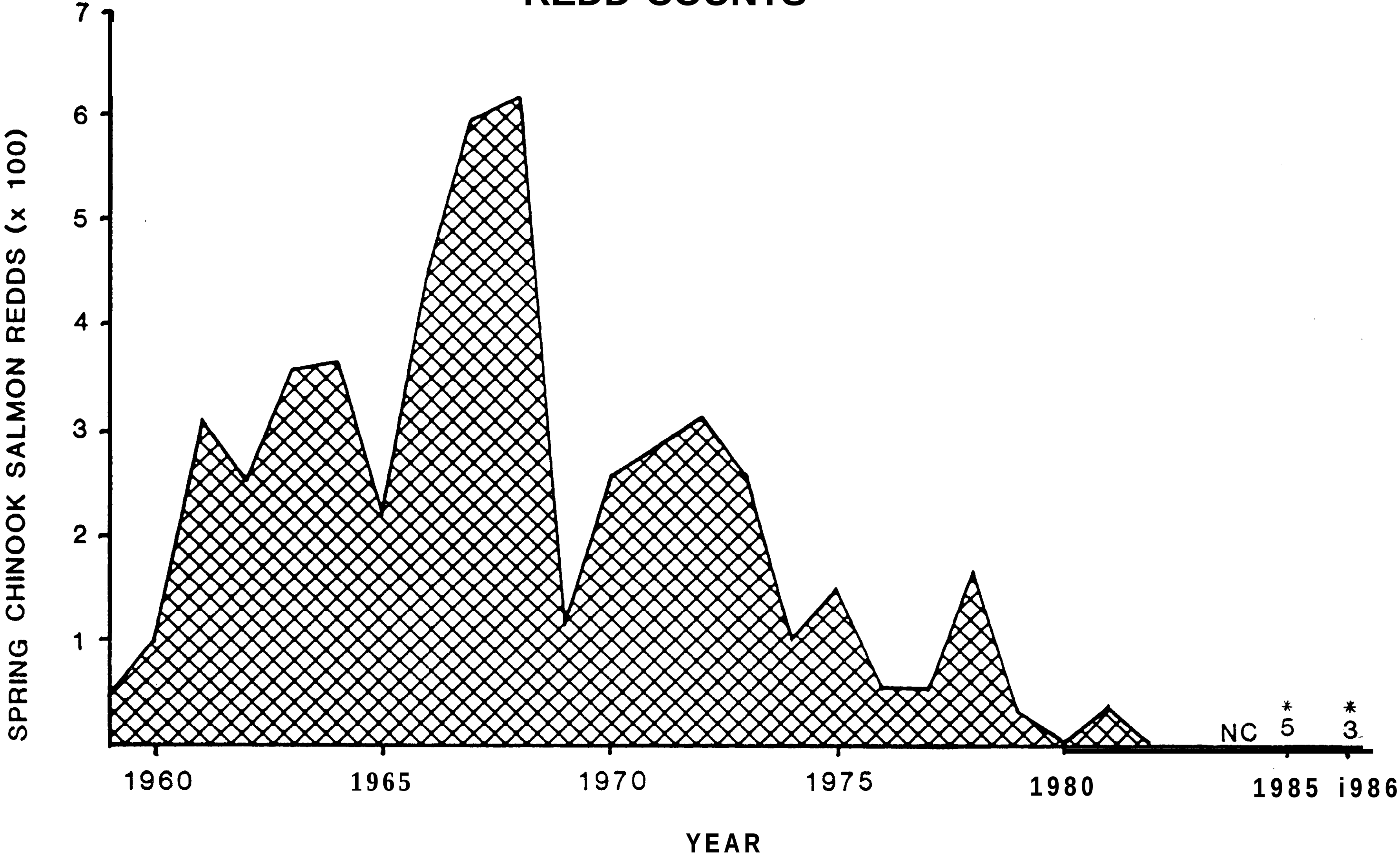


Figure 2. Counts of spring chinook salmon redds in the Yankee Fork drainage of the Salmon River, Idaho, 1986. Pre-1960 counts were made by walking the stream while counts in later years were made from the air, Counts with an asterisk above them were made by tribal biologists.

Habitat and Fish Community Inventories

Variables

Biological variables measured in this study are listed in table one.

Variable Measurement

Measurement of biological variables in Yankee Fork followed methodologies used in Bear Valley Creek during 1986 (Methods, Sub-Project 1). Study sites (6 per stratum) and strata (7 total) were the same as in 1985. Biological variable means were compared in August and between July and August in 1986. Statistical analysis followed procedures used in Sub-Project 1.

Problem Identification

During 1984 and 1985 tribal biologists separated the Yankee Fork drainage into five separate reaches (one or more strata) on the basis of mining activities (past and present), stream size, valley width, and location in the drainage (Table 2). In 1986, two more reaches were added (Fig. 3) to the overall problem identification walkthrough to help better isolate point and non-point sediment inputs (major cause of habitat deterioration) as well as other problems affecting fish and their habitats. Reach F includes Ramey Creek (From it's confluence with Yankee Fork upstream approximately 3 km). Reach G includes the lowest 4 km of Fivemile Creek. The entire length of reach F and G was walked and the physical characteristics of the reach and problem areas were described.

Data from reaches A,B,C,D and E can be obtained from (Konopacky et al. 1985 and 1986). Reach characteristics included: stream, size and gradient; riffle-pool type; extent and quality of spawning and rearing habitat; stream bank type and stability; 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 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

Temperature

Water temperature ranged from 0.0 to 17.8C during June 0.0 to 20.0C during July and 0.0 to 20.6C in August.

Degree-days (C X 24 hours) ranged from 160.8 in stratum 3 to 254.4 in stratum 1 between 16 and 30 June. Degree-days ranged from 153.6 in stratum 7 to 273.6 in stratum 4 between 1 July and 30 July. Degree-days ranged from 166.8 in stratum 5 to 321.6 in stratum 3 between 1 and 25 August. Cumulative degree-days for the period of 16 June through 25 August was greatest in stratum 1 (the most downstream stratum of Yankee Fork proper) and least in

Table 1. Variables monitored in the Yankee Fork drainage of the Salmon River, Idaho during 1986.

Variables
Temperature
Species composition
Relative abundance
Density
Population size
Chinook length
Chinook weight
Chinook condition
Chinook redd counts

Table 2 . Reach characteristics for habitat problem identification, Yankee Fork drainage of the Salmon River, Idaho, 1986.

Reach	Length (km)	Gradient (%)	Land Type	Land Ownership	Land Use
A	5.50	.45-2.3	Narrow forested steep sided valley	USFS	Non-consumptive
B	9.80	.6-1.0	Wide valley, sparse forest tailing area	USFS, J.R.S.	Mining-recreational
C	23.2	.7-1.1	Moderately wide valley, forest	USFS, Private	Mining-grazing recreational
D	12.7	.34-1.5	Moderately wide valley, forest/ meadow	USFS	Non-consumptive
E	9.60	l-8-2.7	Narrow forested valley	USFS, J.R.S.-Private	Mining-recreational
F	4.00	*	Narrow forested valley	USFS, Private	Mining-recreational
G	4.00	*	Narrow forested valley	USFS	Grazing-recreational

J.R.S. = J.R. Simplot

USFS = United States Forest Service (Challis district)

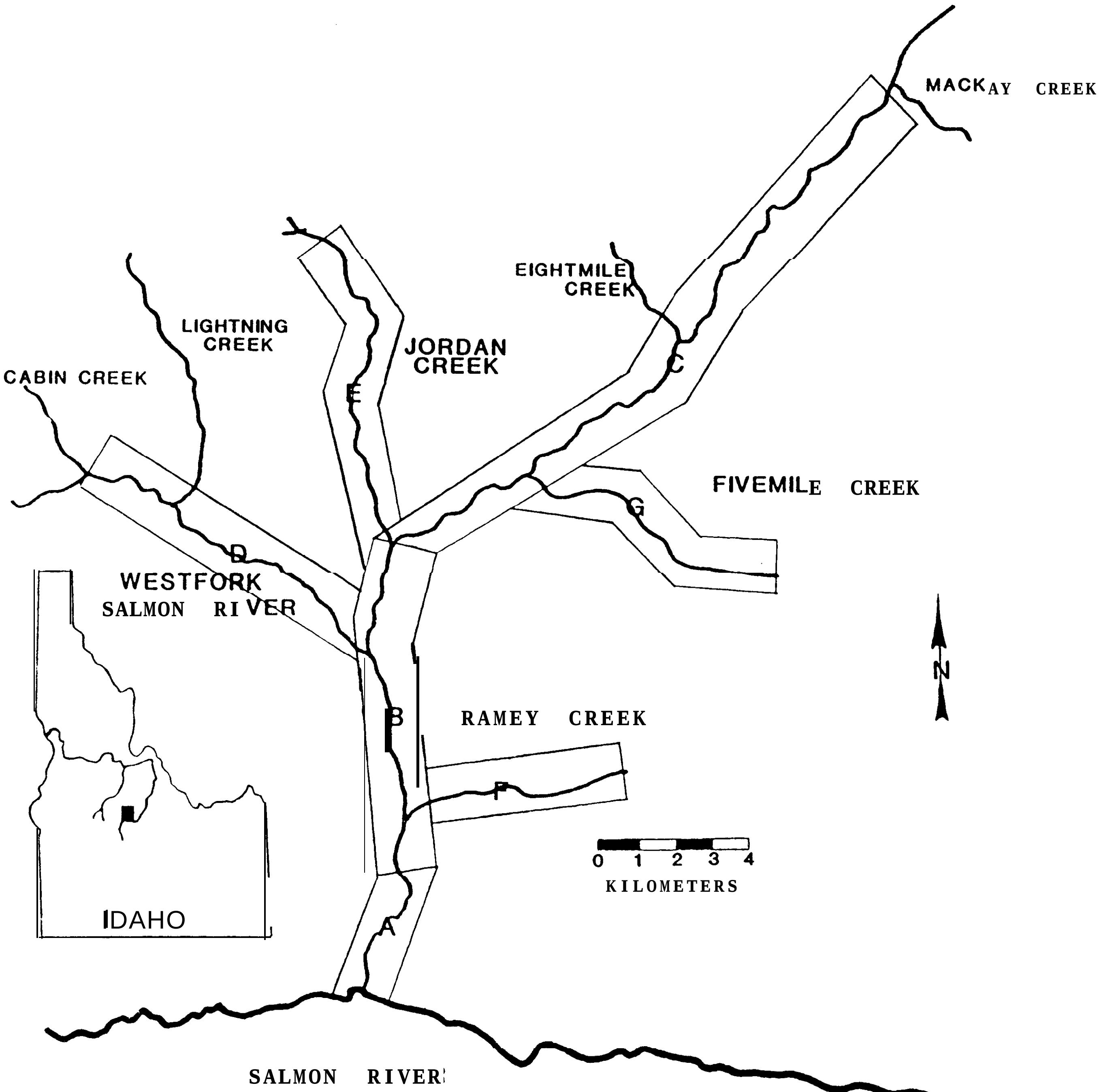


Figure 3. Yankee Fork of the Salmon River drainage, Idaho, reach locations for habitat problem identification.

stratum 7 (Jordan Creek) during the same period of time in 1986. Due to inaccessibility, temperature data was not collected at the most upstream section of Yankee Fork proper in July (stratum 5) consequently, this stratum was excluded from cumulative degree-days computations (Fig. 4).

Reach Description and Problem Identification of Reach G and F

Problems characteristics 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 thin buffer of vegetation next to the water's edge. Sloughing streambanks were classified as low (< lm), medium (1-2m) or high (>2m) 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 vegetative cover or exposed soil. Washouts occurred in roaded sections, stream tributaries, and as a result of poorly designed culvert passages. Barriers to fish passage (adult chinook salmon) included log jams, waterfalls and low flows.

Reach F

Reach F (lower Ramey Creek) extends from the confluence of Ramey Creek with the Yankee Fork of the Salmon River upstream approximately 3 kilometers (Fig. 3). Throughout most of this reach, the stream flows with moderate to high gradient and moderate sinuousity through a fairly narrow valley. Upland areas have moderate to steep slopes of dense lodgepole forest or expansive open slopes either vegetated with grass and sage or not vegetated.

Stream habitat is dominated by small pools and high gradient riffles with some small cascades in areas of downed timber. Riffles are small and fast and contain good quality gravels for spawning but substrate in the lower section of stream is highly,embedded with silt. Pools are small but have excellent instream and riparian cover for rearing salmonids. Instream cover is in the form of boulders, turbulence, undercut banks and downed trees. Riparian cover is excellent and is provided by willows and alders. Dense root systems help maintain fair to good bank stability. Grazing has occurred in the past but has created no adverse impacts on riparian cover or bank stability.

Problems in reach F which affect fish habitat include: sloughing stream banks (825 m); open slopes adjacent to stream (800 m); stream running through unvegetated dredge tailing (30 m); road washout (1); beaver dam (1); log dam (1); irrigation diversion without proper screening (1); stream crossings (1); riprap needed along road (1) (Table 3).

Reach G

Reach G (Fivemile Creek) begins at the confluence of Fivemile Creek with the Yankee Fork of the Salmon River and continues up Fivemile Creek approximately 4 km (Fig. 3). Throughout most of the reach, the stream flows with moderate gradient and sinuosity through a forested valley. Upland areas have moderate to steep slopes of lodgepine forest or grass and sagebrush. The average width of floodplain is approximately 30 meters.

Stream habitat is primarily composed of small riffle and pool micro-habitats with intermittent sections of pocketwater. Riffles have a low to moderate embeddedness with a thin coating of silt on all substrate. Pools are

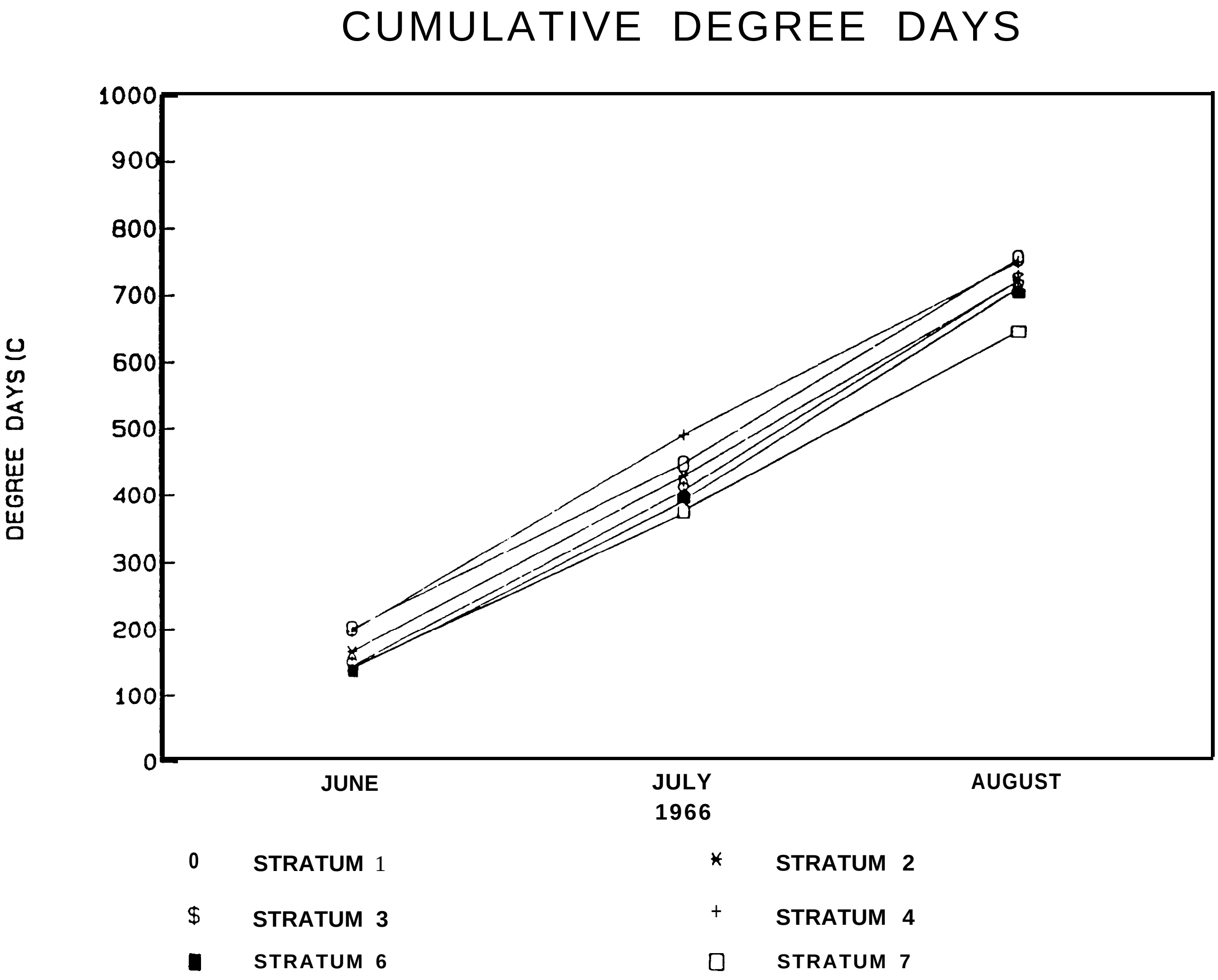


Figure 4. Cumulative degree-days during the period of 16 June through 25 August, Yankee Fork drainage of the Salmon River, Idaho, 1986.

Table 3. Identification, extent, sediment input (relative to other reaches), and priority for remediation of habitat problems in Reach F (Ramey Creek), tributary to Yankee Fork of the Salmon River, Idaho, 1986.

Priority for Problem Type Kemediation	Length (m)	Percent of Total Length (4022)	Ranking of Potential Sediment Input	Priority of Remediation
Sloughing banks				
medium natural	550	13.7	1	5
high natural	275	6.8	2	6
Open slopes				
exposed soil	100	2.5	3	8
sparse vegetation	700	17.4	7	9
Dredge tailings				
without vegetation	30	0.7	8	NA
Washouts				
road	1[b]	NA	5	1
tributary stream	1[b]	NA	4	7
Barriers				
beaver dams	1[b]	NA	NA	4
log dams	1[b]	NA	NA	3
Irrigation diversion	1[b]	NA	NA	NA
Road adjacent to stream needing ripra	1[b]	NA	6	2

NA = Not Applicable

1 = highest priority

b = occurrence

fairly shallow and have adequate instream cover (boulders, turbulence, downed logs and undercut banks). Approximately 1 km upstream of the mouth, a narrow waterfall/cascade creates a total barrier to fish movement. The riparian zone is thick and consists of willows and alders. The soil on the flood plain is deep and has an excellent riparian root system which enhances bank stability. At present cattle grazing effects are light and have limited effects on habitat quality.

Problems in reach G which affect fish habitat include: s 1 oughing banks (748 m); ioeb skioes adhacebt ti strean (440m); passage restriction (1); and avalanche shoots entering stream (1) (Table 4).

Fish Community Inventory

Densities

Individual species densities among strata were not significantly different between the July and August sampling periods with all species age classes except age 1+ and older steelhead trout (Table 5). Total fish densities (all species and age classes combined) were highest in stratum 5 (the most upstream stratum on Yankee Fork proper) during July and August (Fig. 5). Total density was similar between sampling periods in all strata except stratum 6 (West Fork) and stratum 4 where greater densities were found in August. During July and August, there was a general trend of lower fish densities in the downstream strata (strata :,3,2 and 1) in Yankee Fork proper. Individual species densities and associated analysis of variance are compiled in tables 5 and 6, respectively.

Age 0+ chinook salmon in July and August 1986. There was a significant difference in age 0+ chinook salmon densities among strata. Highest densities occurred in the most upstream section of Yankee Fork proper (stratum 5) in both sampling sessions. No age 0+ chinook were found in Jordan Creek (stratum 7) (Fig. 6A).

Age 0+ steelhead trout in July and August 1986. There was no difference in density of age 0+ steelhead trout among strata or between sampling periods. No fish were found in strata 4,5 or 7 during either session (Fig. 6B).

Age 1+ and older steelhead trout in July and August 1986. There was a significant difference in densities of age 1+ and older steelhead trout between months and among strata. Strata 1,3,4 and 7 had significantly greater densities in August than in July. Stratum 7 (Jordan Creek) had a greater density than all other strata. Strata 5 and 6 had the lowest densities. Fish densities were greatest in August (Fig. 7A).

Juvenile whitefish in July and August. 1986. There was a significant difference in densities of juvenile *whitefish among strata. Stratum 6 (West Fork of Yankee Fork) had a greater density than other strata. Strata 4, 5 and 7 did not have any fish during either sample session (Fig. 7B).

Adult whitefish in July and August 1986. There was a significant difference in densities of adult whitefish among strata. Strata 1, 3 and 6 had greater mean densities than stratum 7. Stratum 1 (most downstream section) had the greatest mean density. No adult whitefish were found in stratum 5 (Fig. 8).

Table 4. Identification, extent, sediment and input (relative to other reaches), and priority for remediation of habitat problems in Reach G (Fivemile Creek), Yankee Fork of the Salmon River drainage, Idaho, 1986.

Priority for Problem Type Remediation	Length (m)	Percent of Total Length (8000)	Ranking of Potential Sediment Input	Priority of Remediation
Sloughing banks				
low cut bank				
natural	12	.1	6	3
medium cut bank				
natural	70	1.8	5	2
high cut bank				
natural	396	5.0	1	1
Avalanche chutes	20	.25	3	4
Open slopes				
raw	90	1.1	2	5
sparsely vegetated	350	4.4	4	6
Passage restriction	lb	NA	NA	7

b = occurrances

NA = Not Applicable

1 = highest priority

Table 5. Mean Total Fish Densities by Session and Stratum, Yankee Fork drainage of the Salmon River, Idaho, 1986.

SESSION 7

Stratum	1	2	3	4	5	6	7
CHS YOY	.00029	.00010	.00151	0	.43719	.00457	0
WHF YOY	0	0	0	0	0	0	0
WHF JUV	.00202	.00135	0	0	0	.00457	0
WHF ADD	.01326	.00765	.00972	.01024	0	.01534	.00358
STT YOY	.00071	0	0	0	0	0	0
STT OLDER	.00784	.00094	.00078	.00122	.00196	.00079	.03333
CUT 2 AD	0	0	0	0	0	0	0
BKT	0	0	0	0	0	0	0
OTHER	.00025	.00006	0	0	.00826	0	0
TOTAL	.02698	.OlOl	.0120	.01146	.44937	.02527	.0369

SESSION 2

Stratum	1	2	3	4	5	6	7
CHS YOY	.00149	.00171	.00466	.00442	.43889	.11041	0
WHF YOY	0	0	0	0	0	0	0
WHF JUV	0	0	.00031	0	0	.00190	0
WHF ADD	.01443	.00752	.00875	.00496	0	.00643	0
STT YOY	.00227	.OOOYl	.00022	0	0	.00047	0
STT OLDER	.01870	.00607	.01059	.02052	.00354	.00413	.05356
CUT 2 AD	0	0	0	0	0	0	0
BKT	0	0	0	0	0	.00047	0
OTHER	.00048	0	.00030	0	.00480	.00237	0
TOTAL	.03737	.016210	.02483	.02990	.44723	.12618	.05356

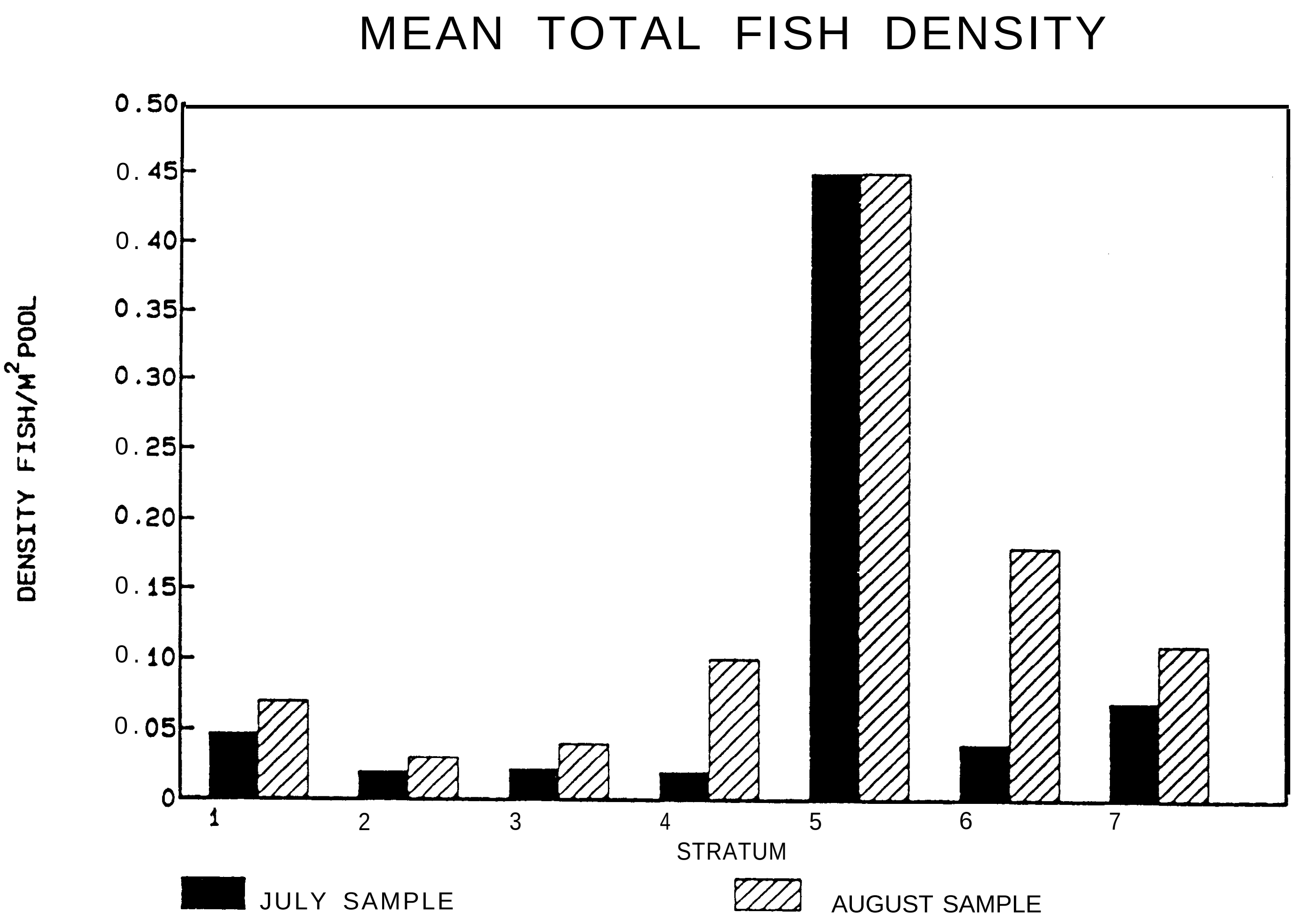


Figure 5. Fish-densities (all species and age classes combined) by sample session, Yankee Fork drainage of the Salmon River, Idaho, 1986.

Table 6 . Analysis of variance for fish species by age class, Yankee Fork drainage of the Salmon River, Idaho, 1986.

Species by Age Class	Source	DF	F Value	PR> F
	Stratum	5	35.49	0.0001
CHS o+	Site (Stratum)	30	22.43	0.0001
	Session	1	2.15	0.1537
	Session * Stratum	5	0.94	0.4683
	Stratum	3	2.60	0.0825
STH O+	Site (Stratum)	20	0.49	0.9379
	Session	1	3.97	0.0609
	Session * Stratum	3	0.57	0.6445
STH l+	Stratum	6	41.48	0.0001
and Older	Site (Stratum)	35	27.62	0.0001
	Session	1	38.27	0.0001
	Session * Stratum	6	3.01	0.0181
	Stratum	3	17.99	0.0001
WHF Juv	Site (Stratum)	20	9.71	0.0001
	Session	1	0.28	0.6041
	Session * Stratum	3	2.41	0.0989
	Stratum	5	3.20	0.0202
WHF 2+	Site (Stratum)	30	2.37	0.0113
	Session	1	3.62	0.0672
	Session * Stratum	5	1.05	0.4058

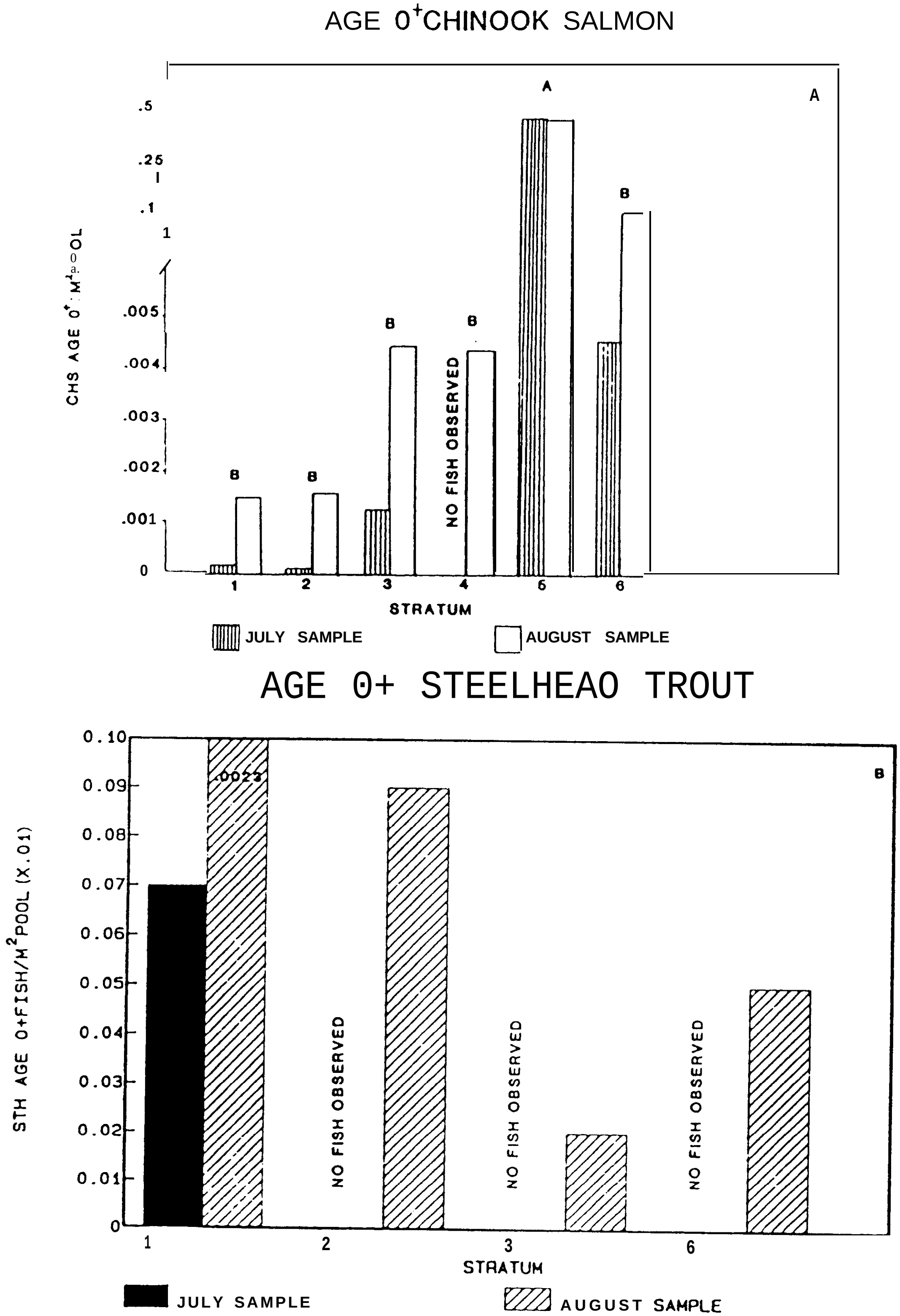
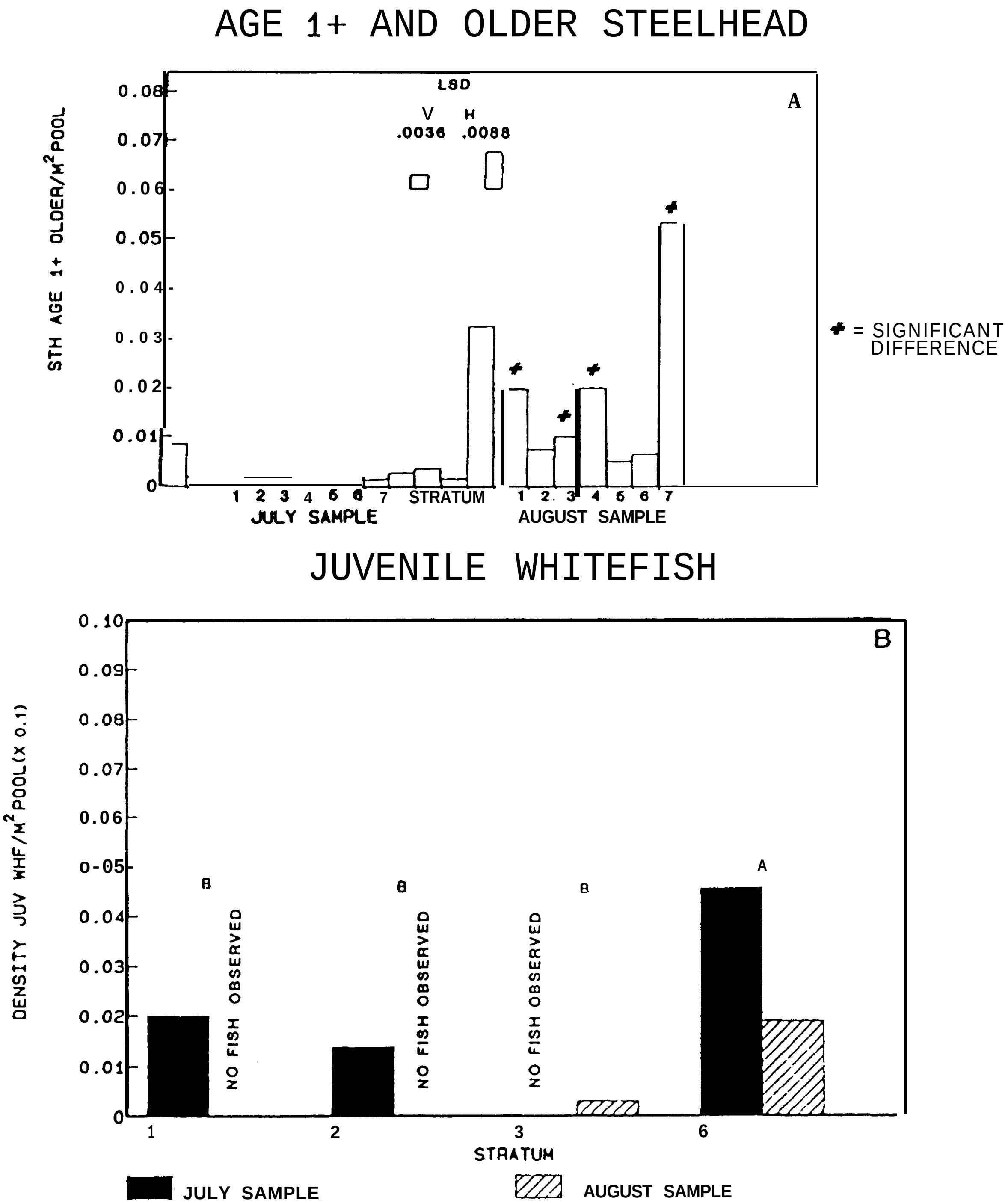


Figure 6. Mean (n=6 per stratum) densities of age 0+ chinook salmon(A). A common letter above means indicates non-significance (P>0.05) between all pairs of means with that letter. Mean densities of age 0+ steelhead trout among strata(B). No significant differences occurred between strata means. All densities from the Yankee Fork drainage of the Salmon River, Idaho, 1986.



Figure' 7, Mean (n=6 per stratum) densities of age l+ and older steelhead by stratum (A), and juvenile whitefish by stratum (B), Yankee Fork drainage of the Salmon River, Idaho, 1986. Mean differences within or between months that are greater than vertical (V) or horizontal (H) LSD's respectively indicate significant (Pr0.05.) differences between those means of figure A. A common letter above means (Fig. B) 'indicate a non-significant (P>O.O5) difference among strata means.

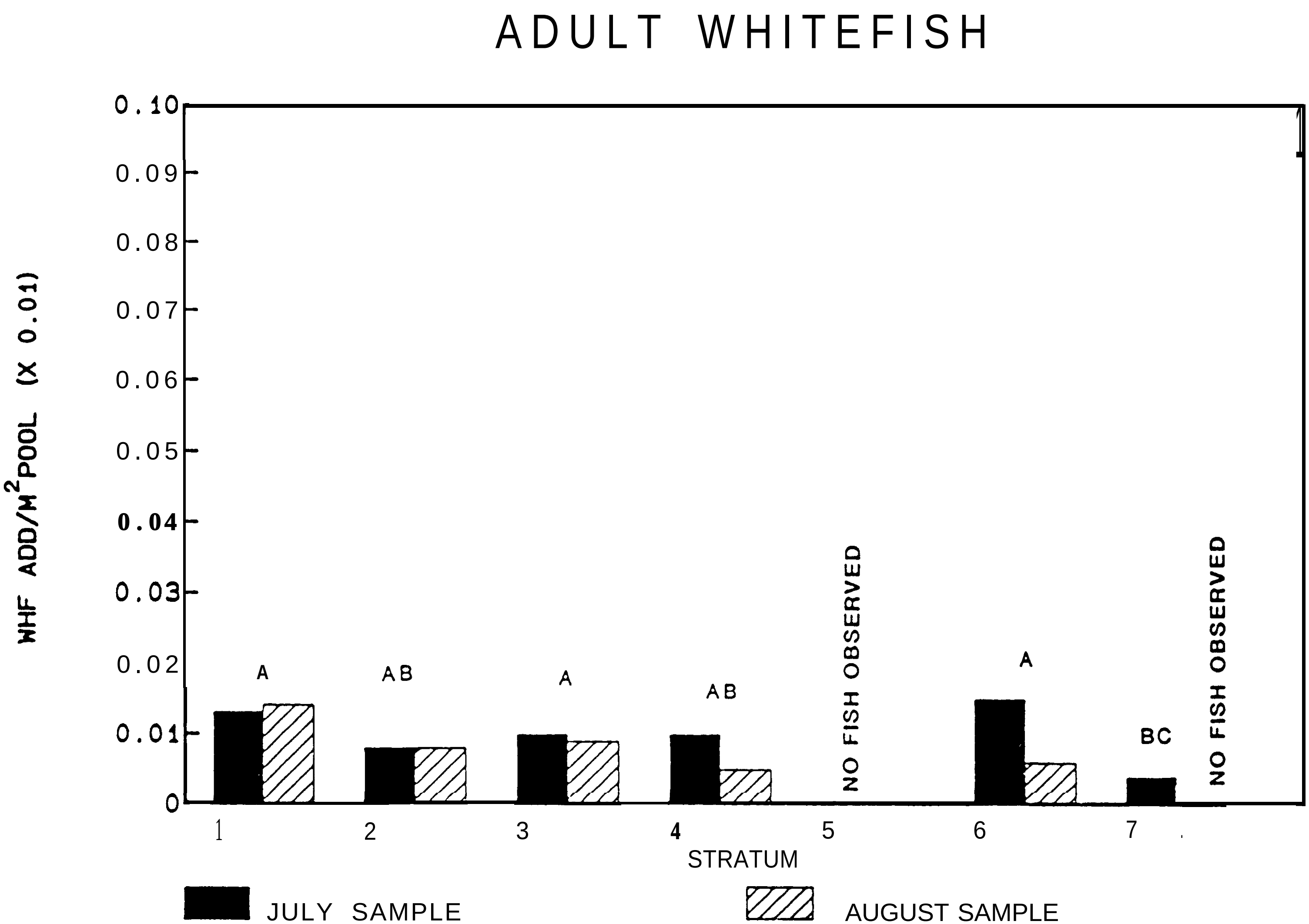


Figure 8. Mean (n=6 per stratum) fish densities of adult whitefish, Yankee Fork drainage of the Salmon River, Idaho, 1986, A common letter above means indicate a non-significant (P>0.05) difference among strata means.

Relative Abundance

The relative composition of the fish community was similar between July and August in strata 1, 5 and 7. In strata 2, 3 and 4, steelhead trout comprised a greater proportion of the fish community in August then was observed in July (Figs. 9 and 10). During July 1986, relative composition of age 0+ chinook salmon ranged from 0 to 97%. The most abundant species age class group by stratum were: age 0+ and older whitefish in strata 1,2,3,4 and 6; age 0+ chinook salmon in stratum 5; and steelhead trout age l+ and older in stratum 7.

During August 1986, age 0+ chinook salmon ranged from 0 to 97% among strata. The most abundant species age class group by stratum were; steelhead trout age 0+ and older in strata 1,3,4, and 7; whitefish age 0+ and older in stratum 2; chinook salmon age 0+ in stratum 5 (uppcrmosr section of Yankee Fork proper) and stratum 6 (West Fork of Yankee Fork). The abundance of age 0+ chinook increased during August in stratum 6 (West Fork).

Densities, Comparisons Among Years

Densities of individual species were compared with those reported in 1984 and 1985 (Konopacky et al. 1986) (Table 7). Overall densities of: age 0+ and age l+ chinook salmon; age l+ and 2+ steelhead trout; and juvenile and adult whitefish did not differ significantly among sampling years. Significantly greater densities of age 0+ steelhead and whitefish occurred in 1984 than in 1985 and 1986 (Duncans, $P<0.05$).

Distribution Among Strata Among Years

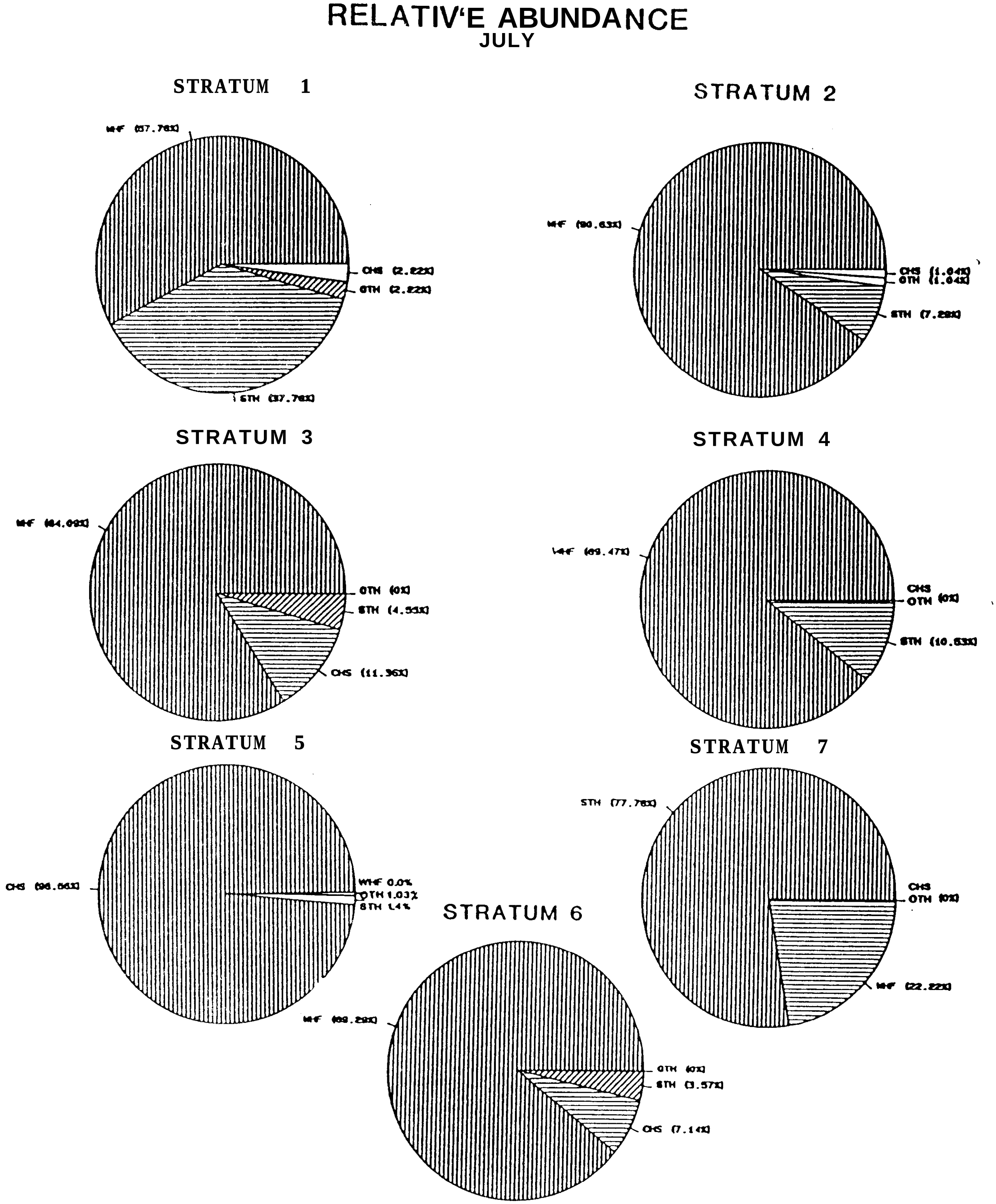
A Chi Square contingency table was used to examine whether there was a significant difference in the distribution of age 0+ chinook salmon among strata between years. A significant association between years and strata was noted and (n=51578, $X^2=45823.5$ and Pc. 0.0001). A shift in distribution was observed during 1986 when 72.8% of age 0+ chinook were found in stratum 5 (most upstream section of Yankee Fork proper) and 1.4% were found in stratum 4. This contrasts with 1985 when 0% of age 0+ chinook were found in the same stratum and 56.4X in stratum 4 (Fig. 11).

Length/Weight Relationships (Age 0+ Chinook Salmon) 1986

Total Length in July and August. Total fish length differed significantly among strata ($F=6.21$, $P<0.0001$). Mean fish lengths ranged from 52.0 to 74.3 and 66.6 to 77.3 in July and August, respectively. In July and August, mean fish length was greatest in strata 3 and 5. During both sampling sessions, stratum 6 (West Fork of the Yankee Fork) and stratum 4 had the smallest medn fish length. No fish were collected in stratum 4 or in stratum 7 during both sample sessions (Fig. 12A).

Live weight in July and August. Fish weight did not differ significantly among strata ($F=1.20$, $P=O.3106$). Mean fish weight ranged from 2.0 to 4.0 grams and from 4.0 to 5.3 grams in July and August, respectively. No age 0+ chinook salmon were found in stratum 7 (Jordan Creek) during either session (Fig. 12B).

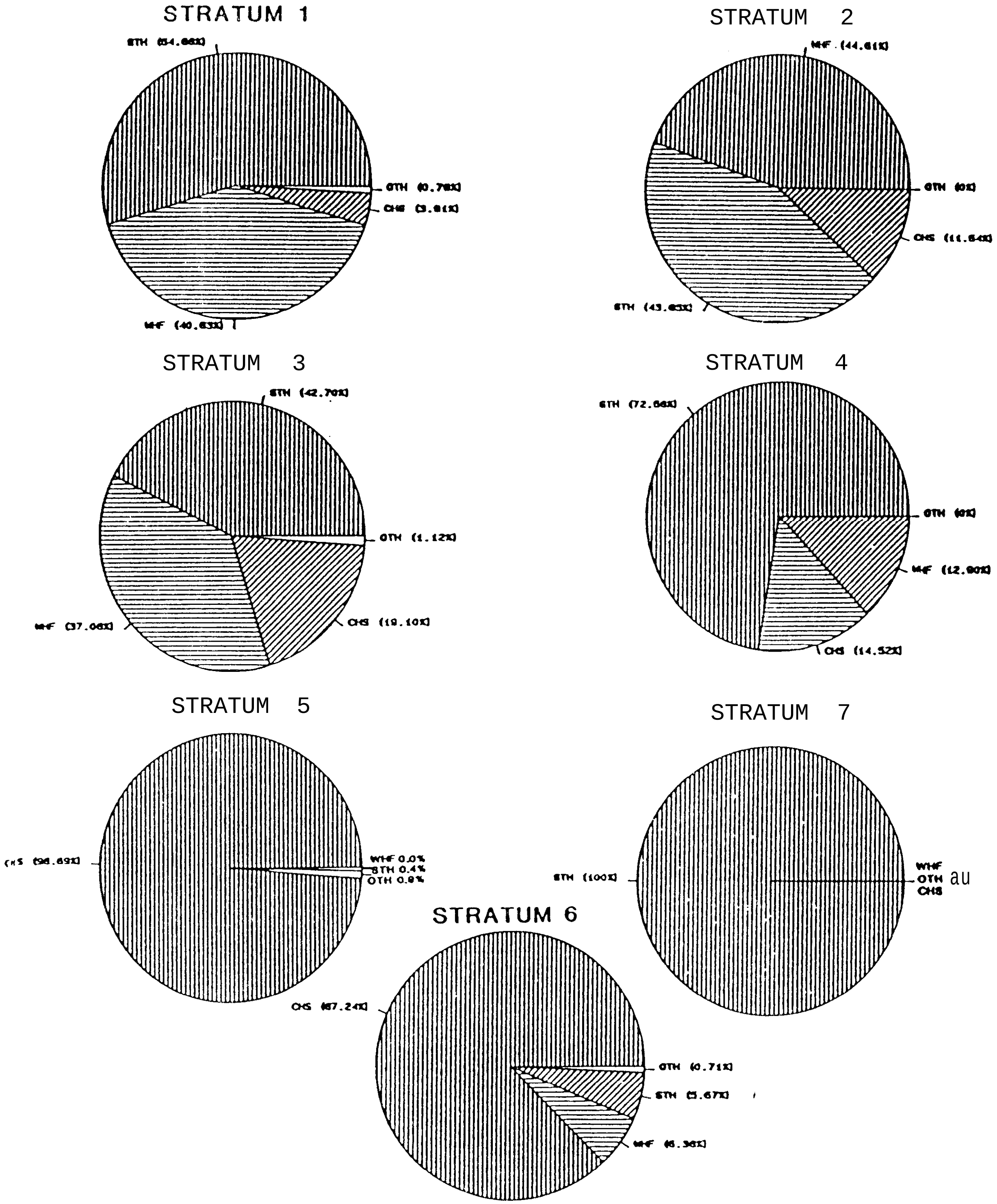
Condition in July and August. Fish condition differed significantly among strata ($F=5.31$, $P<0.0001$). Condition ranged from .92 to 1.03 and .92 to 1.1 in July and August, respectively. Fish condition was highest in strata 2,3 and 6 and the lowest in strata 4 and 5 (The most upstream strata sampled



CHS=CHINOOK SALMON(ALL AGES) STH=STEELHEAD TROUT(ALL AGES)
WHF=WHITEFISH(ALL AGES) OTH=CUTTHROAT,BULL,BROOKTROUT(ALL AGES)

Figure 9. Relative abundance (percent) of fish species (combined age classes) Yankee Fork of the Salmon River, July, 1986.

RELATIVE ABUNDANCE
AUGUST



CHS=CHINOOK SALMON(ALL AGES) STH=STEELHEAD TROUT(ALL AGES)
WHF=WHITEFISH(ALL AGES) OTH=CUTTHROAT,BULL,BROOKTROUT(ALL AGES)

FigurelQ Relative abundance (percent) of fish species (combined age classes) Yankee Fork of the Salmon River, August, 1986.

Table 7. Analysis of variance for species/age classes, Yankee Fork drainage of the Salmon River, Idaho 1984, 1985 and 1986.

Species by Age Class	Source	DF	F Value	PR F
CHS YOY	Stratum	6	1.43	0.2126
	Site (Stratum)	7	6.09	0.0001
	Year	2	1.13	0.3258
	Year * Stratum	11	1.78	0.0712
CHS l+	Stratum	6	0.15	0.9885
	Site (Stratum)	7	0.59	0.7656
	Year	2	0.82	0.4428
	Year * Stratum	11	0.43	0.9372
STH YOY	Stratum	6	1.20	0,3126
	Site (Stratum)	7	2.66	0.0159
	Year	2	9.28	0.0002
	Year * Stratum	11	1.49	0.1516
STH l+	Stratum	6	1.47	0.2003
	Site (Stratum)	7	2.26	0.0372
	Year	2	0.54	0.5822
	Year * Stratum	11	3.52	0.0005
STH 2+	Stratum	6	0.29	0.9406
	Site (Stratum)	7	0.53	0.8087
	Year	2	1.26	0.2890
	Year * Stratum	11	0.29	0.9847
WHF YOY	Stratum	6	4.31	0.0008
	Site (Stratum)	7	2.29	0.0090
	Year	2	5.12	0.0081
	Year & Stratum	11	2.80	0.0040
WHF Juveniles	Stratum	6	1.03	0.4091
	Site (Stratum)	7	1.23	0.2965
	Year	2	1.40	0.2532
	Year * Stratum	11	1.94	0.0461
WHF Adult	Stratum	6	3.00	0.0106
	Site (Stratum)	7	4.98	0.0001
	Year	2	0.79	0.4567
	Year * Stratum	11	1.14	0.3426

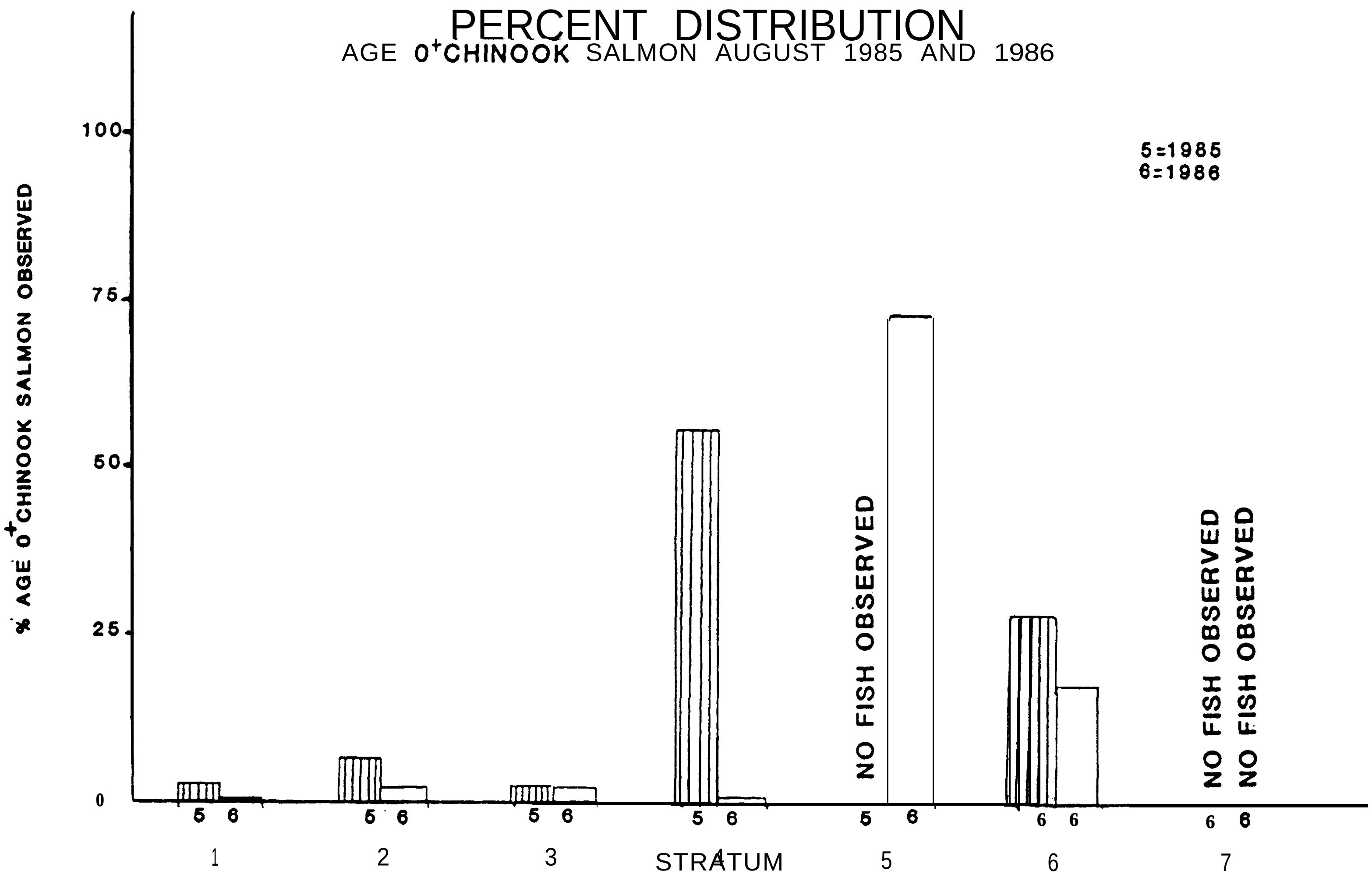


Figure 11. **Percent distribution of age 0+ chinook salmon during August in 1985 and 1986, Yankee Fork drainage of the Salmon River,** Idaho.

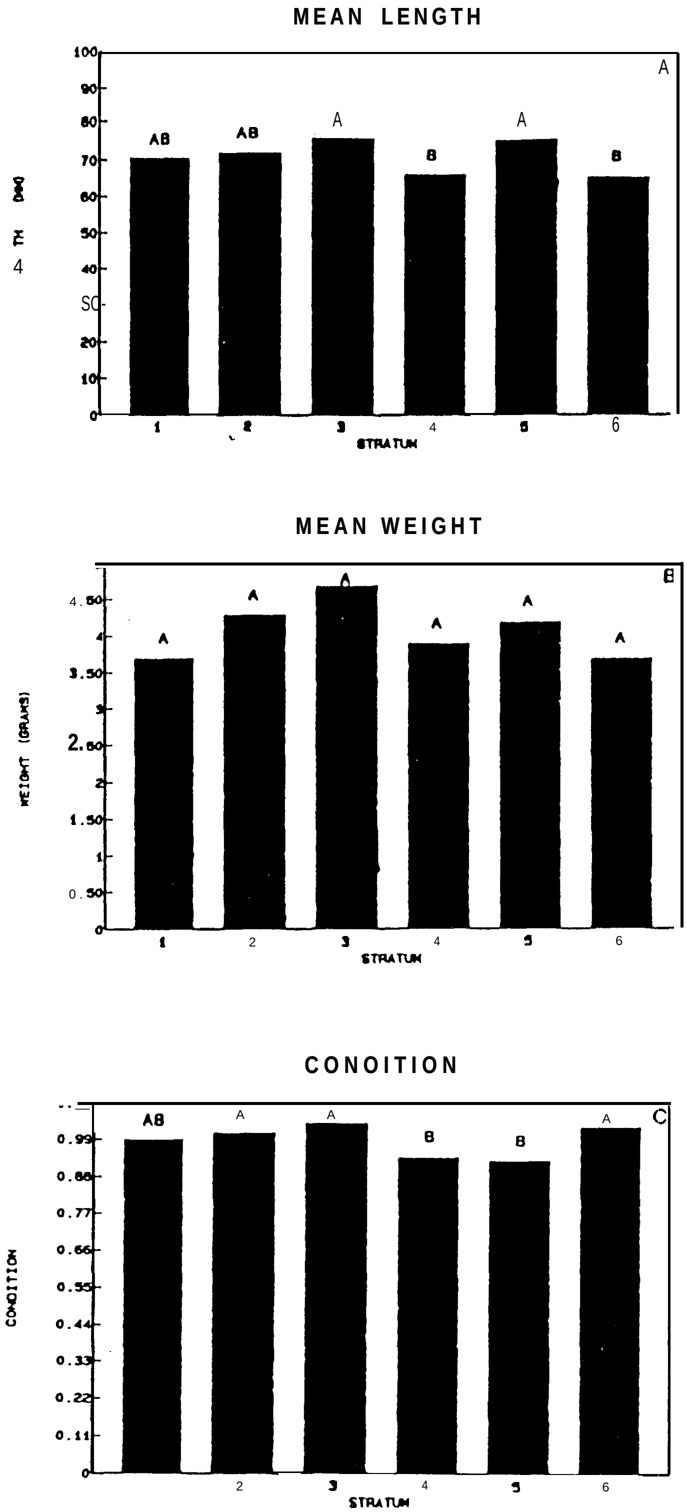


Figure 12, Mean length, weight and condition (A, B and C respectively) of age 0+ chinook salmon, among strata, Yankee Fork drainage of the Salmon River, Idaho, 1986. A common letter above means indicates non-significant(PW.05) differences between all pairs of means with that letter.

on Yankee Fork proper). No age 0+ chinook salmon were found in stratum 7 (Jordan Creek) during either session (Fig. 12C).

Length/Weight Relationships (Age 0+ Chinook Salmon) Comparison Between Years

No significant difference was observed in mean total length or weight between 1385 and 1986. A significantly greater fish condition was observed in August 1985 then in August 1986 (Table 9).

Chinook Abundance and Kedds

Abundance age 0+ chinook salmon in July and August 1986. In July, the total number of age O+ chinook salmon was 37,288 + 4997 (95% bounds).

In August, total number of fish was 38,084 + 4684. Distribution patterns observed in July were similar to those in August (Fig. 13).

Aerial Redd Count in 1986. The total number of redds counted on 31 August 1986 was 3. One week after the aerial redd count was completed a ground redd count survey was conducted starting at the confluence of Fivemile Creek and walking upstream approximately one mile. In this survey 35 redds were observed.

DISCUSSION

Fish community composition within the Yankee Fork of the Salmon River in 1986 was similar to that reported in previous years by Konopacky et al. (1985, lY86). Steelhead trout, whitefish and young of the year chinook salmon dominated the fish community in all strata. Brook trout, cutthroat trout and bull trout represented a small proportion of the total community and were represented by a few individuals in localized areas.

The greatest differences in fish distribution between years were: the lack (.002 fish/m^2 pool) of age O+ chinook salmon during 1986 in stratum 4, as compared to approximately .l fish/m^2 pool in 1984 and 1985; the absence of young of the year chinook salmon in stratum 7 (Jordan Creek) during 1985 and 1986; and the large amounts of age O+ chinook present during 1986 in stratum 5 as compared to a total absence of this species/age class in 1984 and 1985. Excluding stratum 5 (Upper stratum of Yankee Fork proper), age 0+ chinook densities ranged from 0 to .11 fish/m^2 pool. These densities are far below the rearing potential of Idaho streams (0.3 to 1.7 fish/m^2; Schulich and Bjornn 1977, Bjornn 1978). The reason for the lack of age 0+ chinook salmon in stratum 4 in 1986 is not known, but probably reflects natural fluctuations in habitat use. Densities of age 0+ chinook salmon in stratum 5 were .44 fish/m^2 pool during July and August of 1986. The reason for the large increase of age 0+ chinook salmon in stratum 5 seems to reflect successful spawning of the adult chinook salmon (Rapid River stock) that were planted by IDFG above Fivemile Creek for the Shoshone-Bannock tribal ceremonial fishery in 1985.

The absence of age 0+ chinook salmon in Jordan Creek may be the result of insufficient flow (0.15m^3/sec and 0.08m^3/sec in September during 1984 and 1985, respectively) in the lower section of the stream. A portion of the upper Jordan Creek flows are lost as ground/water within the extensively dredge mined section of the stream. Low flows compounded by the presence of a long (1 kilometer) homogenous section of stream with shallow depths (≈6 inches) and little or no pool habitat provide less than adequate adult passage for chinook salmon. Conditions are poorest in late summer and early fall when

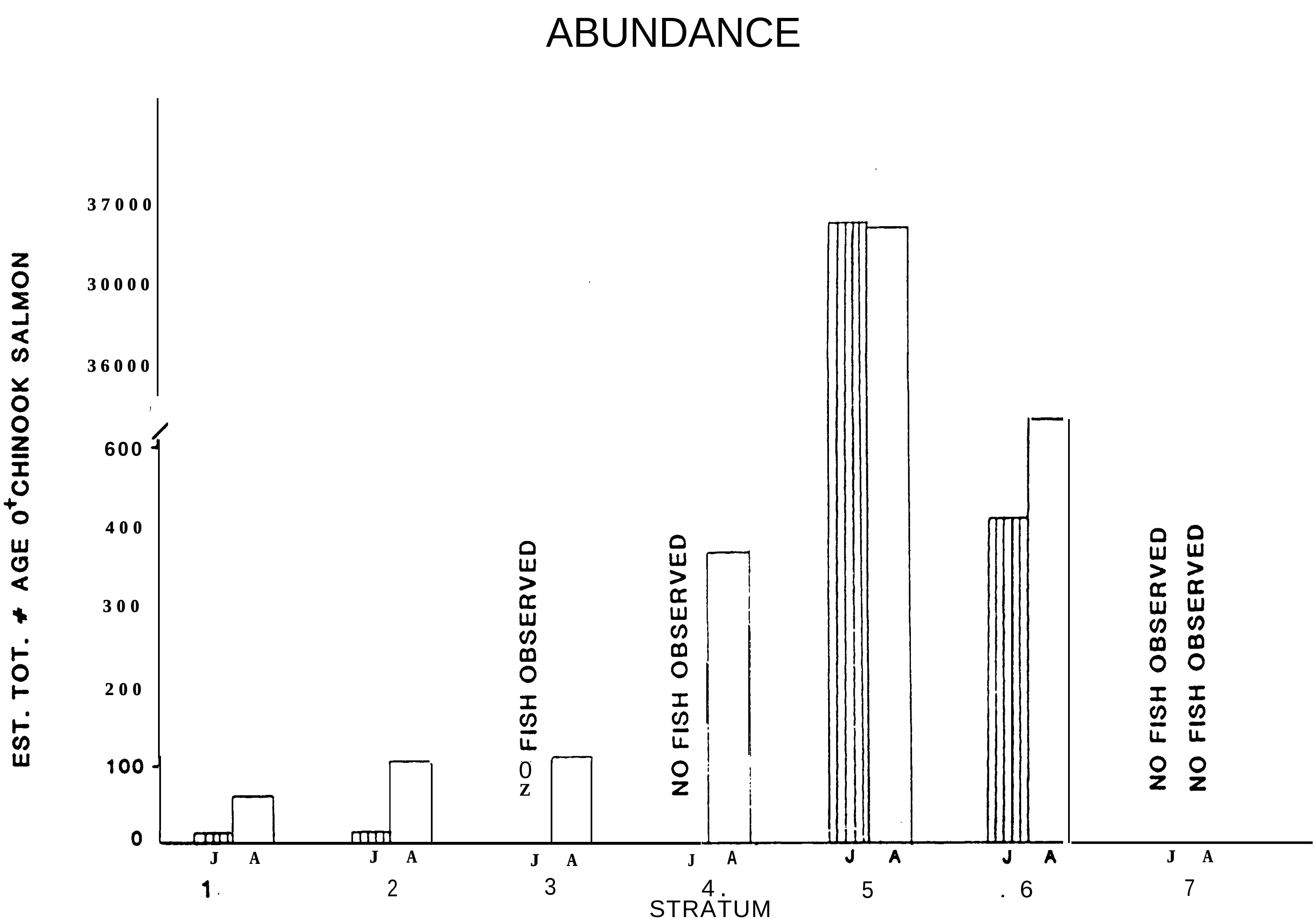
Table 8. Analysis of variance for age 0+ chinook salmon length, weight and condition factor, Yankee Fork drainage of the Salmon River, Idaho, 1985 and 1986.

Variable	Source	DF	F Value	PR > F
CHS YOY Length *A A 85 86	Stratum Year Year * Stratum	6 1 3	16.02 0.48 9.88	0.0001 0.4900 0.0001
CHS YOY Weight *A A 85 86	Stratum Year Year * Stratum	6 1 3	7.48 0.12 5.91	0.0001 0.7345 0.0008
CHS YOY Condition *A B 85 86	Stratum Year Year * Stratum	6 1 3	1.64 14.44 1.36	0.1367 0.0002 0.2557

* = Duncan's New Multiple Range Test

85 = 1985

86 = 1986



Figurel3. Estimated abundance of age 0+ chinook salmon by session and stratum during 1986, Yankee Fork drainage of the Salmon River, Idaho.

salmon stocks native to the area are returning to tributaries for spawning. It is likely that existing conditions often preclude adult passage. Movement of juvenile chinook salmon into Jordan Creek from the Yankee Fork may also be hindered by habitat problems. Lack of passage and habitat degradation due to recent sediment inputs from washouts of small tributaries have reduced suitability of habitat.

The greatest difference in fish distribution between July and August 1986 were: the increase in densities of young of the year chinook salmon in strata 6 (West Fork) in August; and the general increase of age l+ and older steelhead trout in all strata. The reason for the density differences in the West Fork could possibly be the result of inherent error in the sampling design currently in use or the possibility that fish were distributed upstream of the uppermost sample site (since excellent spawning and rearing habitat exists as far upstream as the confluence of Cabin Creek) during July and downstream movement of the fish occurred before the August sample. Steelhead densities increased in all strata as a result of the outplanting of catchable size steelhead by IDFG during late July.

Habitat inventories conducted in 1984 and 1985 (Konopacky et al. 1986) indicate that, the quality of habitat in *the* Yankee Fork drainage of the Salmon Kiver is extremely diverse and ranges from almost pristine spawning and rearing habitat (West Fork and upper Yankee Fork proper) to highly embedded rearing pools, limited quality spawning gravels and channelized un- vegetated stream banks (strata 2 and 3). Juvenile survival rates in the high quality habitats (strata 5 and 6) can be assumed to be near those expected under pristine conditions. Due to the adverse land use practices in *the lower* section of Yankee Fork proper and Jordan Creek survival rates are assumed to be depressed from those above. Rearing habitat has been recognized to be the habitat type most limiting in the Yankee Fork drainage (strata 2 and 3). Future habitat enhancement effort will be developed to address this concern.

Reach Description and Problem Identification

In the past, Five Mile Creek (reach G) and Ramey Creek (reach F) have run extremely turbid during storm events (personal communication IDFG). These events have added to the overall sediment input of Yankee Fork proper, and to the streams decline of quality spawning and rearing habitat.

Five Mile Creek is a mountain stream that enters the Yankee just upstream of the old geologic landslide. The major problems associated with this stream are naturally caused steep, open slopes (which are responsible for large amounts of sediment input) and a series of waterfalls which create a barrier for migrating adult salmon. Since no chinook salmon can spawn above the waterfalls most of the problems in this reach are of low priority for enhancement , at least at this time, than other areas of the drainage.

Ramey Creek enters the Yankee Fork near Preacher's Cove (in the old dredge tailings area). The greatest problem type is naturally occurring medium height (1-2m) cut banks. Since this problem type is naturally created and no chinook salmon are currently spawning in this stream, enhancement efforts in this area are also of low priority.

Both of these tributaries do occasionally input large amounts of fine sediments into the Yankee Fork of the Salmon River, however, these problems are overshadowed by other habitat problems within the drainage. It does not appear that major enhancement efforts in Fivemile and Ramey Creek would be cost effective at this time given the non-point nature of the problems within these tributaries.

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SUBPROJECT IV

East Fork Salmon River: Habitat and Fish Inventory, 1986

and

Herd Creek: Fish Inventory, 1986

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East Fork Salmon River

ABSTRACT

Ranching and agricultural practices have altered a substantial portion of the aquatic habitat in the East Fork of the Salmon River drainage. The East Fork is an important spawning stream for wild spring and summer chinook salmon (Oncorhynchus tshawytscha) in the Salmon River drainage. The East Fork project is listed in section 700 of the Northwest Power Planning Council's Fish and Wildlife Program. Aquatic habitat and fish community of East Fork and Big Boulder Creek, a tributary to the East Fork, were inventoried for use in identifying habitat problems fbr anticipated habitat enhancement. Biological inventories continued to be monitored on Herd Creek, as part of the problem identification inventory initiated in 1985. Physical and biological variables were measured in six sites within six strata along most of East Fork (46.7 km) during July and August 1986. Fish data were collected via snorkel-observations and electrofishing. Minimum and maximum water temperatures ranged from 3 to 21C, between 21 July and 22 August. Riffle area, pool area, stream width, pool depth, and gradient, differed significantly among strata A significantly higher frequency of fine (<8 mm diameter) sediments occurred in Herd Creek (stratum 2) than in all other strata. In decreasing order of abundance, salmonid species in the East Fork of the Salmon River included: chinook salmon, mountain whitefish (Prosopium williamsoni), steelhead/rainbow trout (Salmo gairdneri), and bull trout (Salvelinus confluentus). Estimated abundance of age 0+ chinook salmon was 9,274 fish in August. Density was highest (0.62 fish/m^2 pool) in stratum 2 and lowest (0.00/m^2 pool) in stratum 4. 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 0.00 to 0.15 and 0.00 to 0.31 fish/m^2 pool, respectively. Age 0+ steelhead/rainbow trout densities ranged from 0 fish/m^2 in the stratum 4 in July to 0.34 fish/m^2 pool in stratum 2 in August.

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 (Schwartzberg and Rogers. 1986) 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 were 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 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 ranching operations. Grazing and other land use practices have caused decreased bank stability and damaged riparian communities. Both point and non-poiut sources of sedimentation have increased siltation and reduced the quality of spawning and rearing habitat.

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. In 1986 tribal biologists conducted habitat and fish inventories on the East Fork of the Salmon River and Big Boulder Creek (a major tributary to the East Fork) and continued monitoring fish densities on Herd Creek.

Objectives of this study were: 1.) inventory the fish community and their habitat on the East Fork proper and Big Boulder Creek to establish baseline data; 2.) continue monitoring fish densities on Herd Creek while developing habitat enhancement alternatives for the only private ranch on Herd Creek; 3.) conduct a feasibility study on the East Fork to formulate enhancement alternatives to remediate habitat problems.

STUDY AREA

The East Fork of the Salmon River is located in Custer County, Idaho (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 lodgepine pine (*Pinus contorta*) forest, 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.

Intensive biological and physical inventories addressed 46.7 km of the East Fork system which extended from the mouth to the U.S. Forest Service guard station at Bowery and Big Boulder Creek from its confluence with the

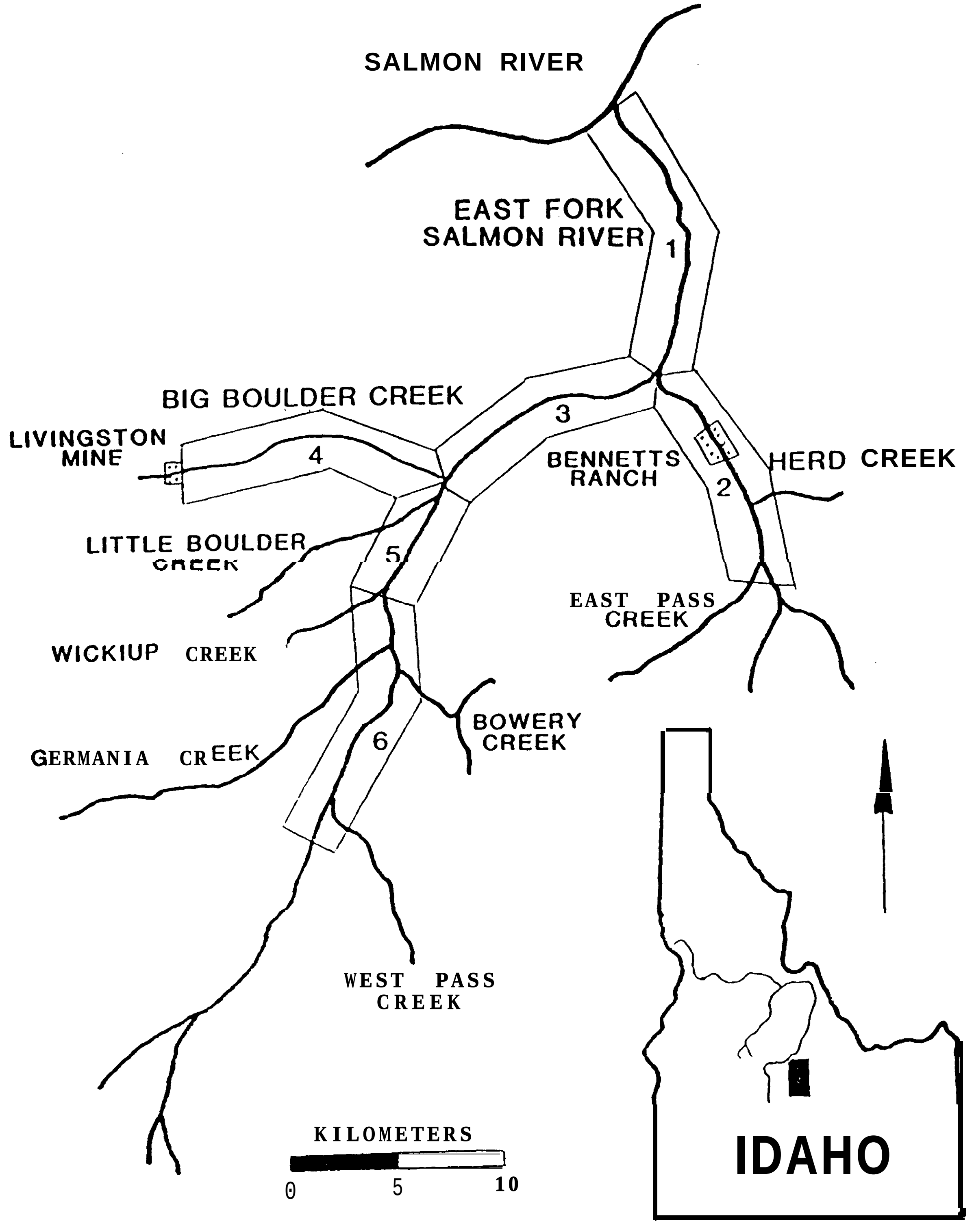


Figure 1. East Fork of the Salmon River, Idaho, study area and strata location.

East Fork up to the Livingston mine (7 km). 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 a distance of Herd Creek (2.4 km) pass through pastures and grazed forests. Roads parallel almost all of the East Fork, Big Boulder Creek and Herd Creek.

The East Fork system is an important spawning and rearing stream for spring and summer chinook salmon, spawning 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), mountain whitefish (Prosopium williamsoni), and short head sculpin (Cottus confusus)

METHODS

Habitat and Fish Community Inventories

Variables

Habitat and biological variables measured in the East Fork of the Salmon River (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 biological and physical variables in East Fork of the Salmon River followed methodologies used in Bear Valley during 1986 (Methods, Sub-project 1, BPA Project 83-359, FY 1986 Annual Report) with the following exceptions: 1.) water temperature (C) was monitored with one Taylor maximum/minimum thermometer in each stratum. Water temperature extremes were recorded for each stratum one time per week from 21 July to 22 August. Maximum and minimum temperature from each week per stratum were averaged to generate an average weekly temperature per stratum. These weekly averages were multiplied by 7 days to generate degree-days.

Experimental Design

Physical variables were measured once in one riffle-pool sequence (experimental unit) at six systematically determined sites (replicates or subsamples) for strata 1,3,4,5, and 6. Strata 2 (Herd Creek) was intensively inventoried in 1985 (6 sites within 4 strata). In 1986, six of the 24 sites in strata 2 (encompassing the total length of the study area) were selected to be used in comparison with the other East Fork strata. Stratification was based on stream size, valley width, gradient, land use, and land ownership (Table 2.)

RESULTS

Variables in the habitat inventory of the East Fork, Idaho were measured in early August during 1986 and were only compared among strata. Variables in the biological 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. During July, strata 1 and 3 were not inventoried due to extremely high flows.

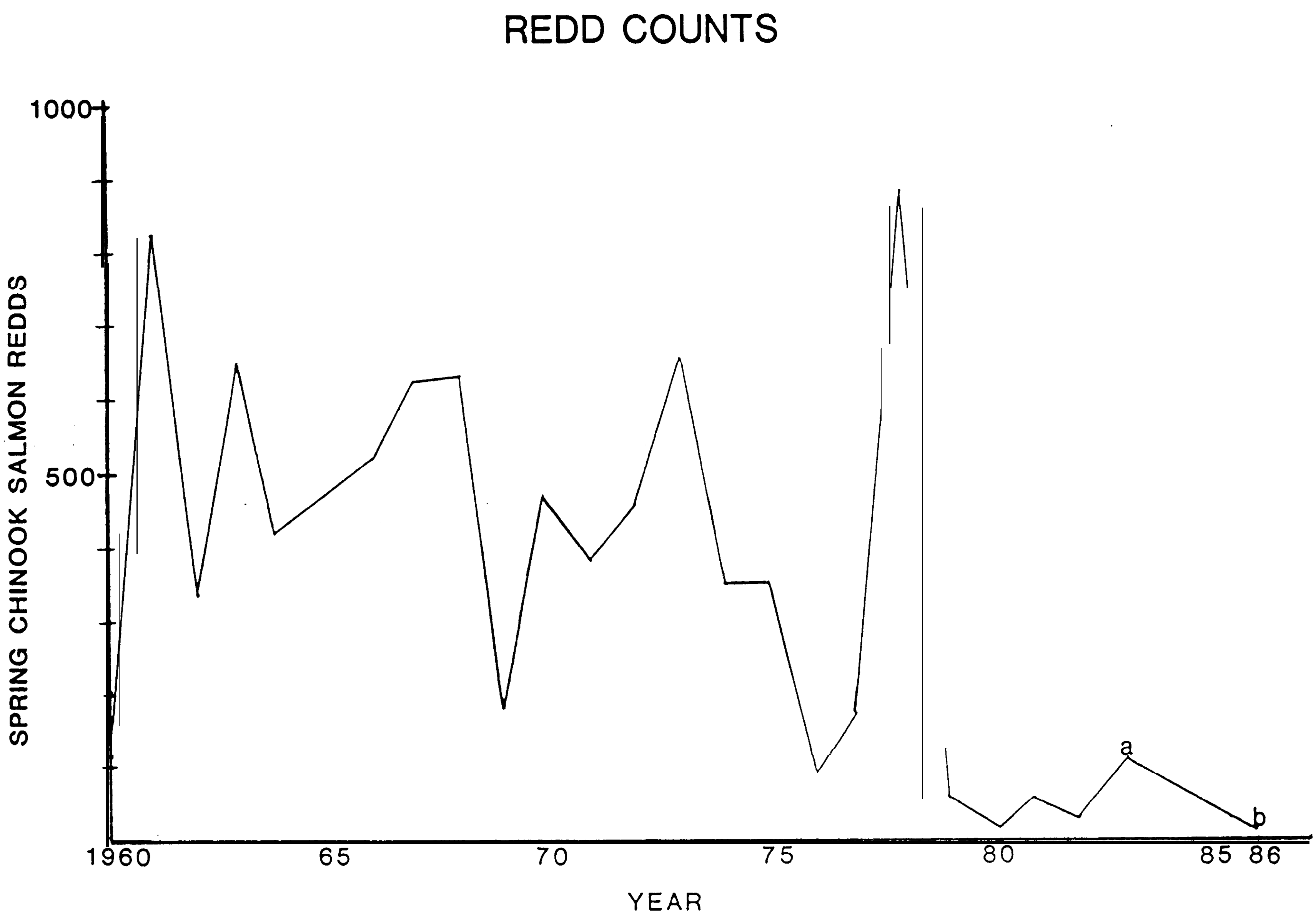


Figure 2. Counts of spring chinook salmon redds in East Fork of the Salmon River, 1960-1986.

a=Bowery Guard Station to 3.5 mi. below Big Boulder Creek (10.0 mi.).
b=Count done by Tribal Biologist (excludes lowest 2 miles of stream).
Before 1983, index area was 21.0 miles

Table 1. Habitat and biological variables monitored in the East Fork of the Salmon River, Idaho, 1986.

habitat	Biological
Temperature	Species Composition
Flow (discharge)	Relative abundance
Surface area	Density
Stream width	Population number
Stream depth	chinook length
Stream gradient	chinook weight
Kiparian cover (available to fish)	chinook condition
Stream substrate	Chinook redd counts

Table 2. Strata characteristics, East Fork drainage of the Salmon River, Idaho, 1986.

Stratum	Length (km)	Gradient (%)	Land Type	Land Ownership	Land Use
1[a]	15.6	.06-.72	Narrow sagebrush valley moderately wide ranchland	BLM[c]	Farming, grazing
2[b]	15.5	0.0-1.6	Narrow sagebrush valley moderately wide ranchland	USFS[d] Private	Grazing
3	13.2	.01-.74	Wide valley, ranchland	BLM Private	Farming, grazing
4[e]	7.2	2.0-3.3	Narrow forested valley	USFS	Grazing
5	7.1	.13-.86	Moderately-wide sparsely forested floodplain	Private	Farming, grazing
6	10.2	.57-1.3	Moderately wide, forested floodplain	USFS	Grazing

a= stream mouth
b= Herd Creek
c= Bureau of Land Management
d= United States Forest Servive, Challis National Forest
e= Big Boulder Creek

Habitat Inventory

Water temperature ranged from 3.3 to 21.1C during July and August. Cumulative degree-days ranged from 323.4 in stratum 4 (Big Boulder Creek) to 458.8 in stratum 1. A greater number of degree-days were accumulated in the downstream strata of the East Fork of the Salmon River proper than in the upstream strata (Fig. 3).

Late August flows in the East Fork of the Salmon River ranged from 2.21 m^3/s in stratum 6 to 6.45 m^3/s in stratum 1. Flow ranged from .91 m^3/s to .94 m^3/s in Big Boulder Creek and Herd Creek respectively. As expected, flow was greatest in the downstream strata of East Fork Proper (Table 3).

Riffle and pool areas in the East Fork generally decreased from downstream to upstream. Mean combined riffled-pool area ranged from 923.4 m in stratum 6 (upstream) to 1675.5 m in stratum 3 (downstream). Mean combined riffle-pool area in Big Boulder Creek and Herd Creek (tributaries to the East Fork) were significantly smaller and ranged from 212.7 m and 275.4 m respectively (Table 3). (Note Table 4 for all riffle-pool analysis of variance information.)

As was expected, mean pool width increased with downstream strata. Both tributary streams (Herd Creek and Big Boulder Creek) had the narrowest mean pool widths (Table 3).

All East Fork proper strata had similar maximum pool depths. Stratum 2 (Herd Creek) and stratum 4 (Big Boulder Creek) had the lowest maximum pool depths (Table 3).

Gradient was highest on Big Boulder Creek and Herd Creek. On the East Fork of the Salmon River proper highest gradients were found in the upper headwater section (stratum 6). The section of the East Fork that flows through most of the private pastureland had the lowest gradient (stratum 3).

The percent of pool bottom covered with fines (pool embeddedness) differed significantly among strata and ranged from 36.7% embeddedness in stratum 2 (Herd Creek) to 5.8% embeddedness in the most upstream section (Stratum 6) of the East Fork of the Salmon River. All strata in the East Fork proper had a similarly low percent of pool embeddedness. Herd Creek had a significantly higher pool embeddedness than all other strata (Tables 3 and 4).

Size-frequency (%) distributions of riffle substrate particles differed ($Q=563.93$ $P<0.0001$) among strata within the East Fork Basin. Distributions differed significantly between all pairs of strata except strata 1 and 3. (Both downstream sections of East Fork Proper.) Highest frequency of large (>128 mm diameter) riffle substrate occurred in strata 1 and 3. When percent frequency of small (<4 or <8 mm diameter) riffle substrate in all strata of the East Fork as well as Herd Creek and Big Boulder Creek was compared, Herd Creek had the highest frequency of small substrate (Fig. 4).

Absolute cover (undercut banks and overhanging vegetation) available to fish did not differ significantly among strata and ranged from 59 cm in stratum 6 to 263 cm in stratum 1. Pool cover (available to fish) expressed as percent of stream width, did not differ significantly among strata and ranged from 4.5% in stratum 6 to 22.17% in stratum 2. Downstream strata have a greater percent of riparian cover when compared to stream width than does the upper East Fork strata. Herd Creek had the greatest cover available for fish habitat of all strata sampled (Table 3).

CUMULATIVE DEGREE DAYS

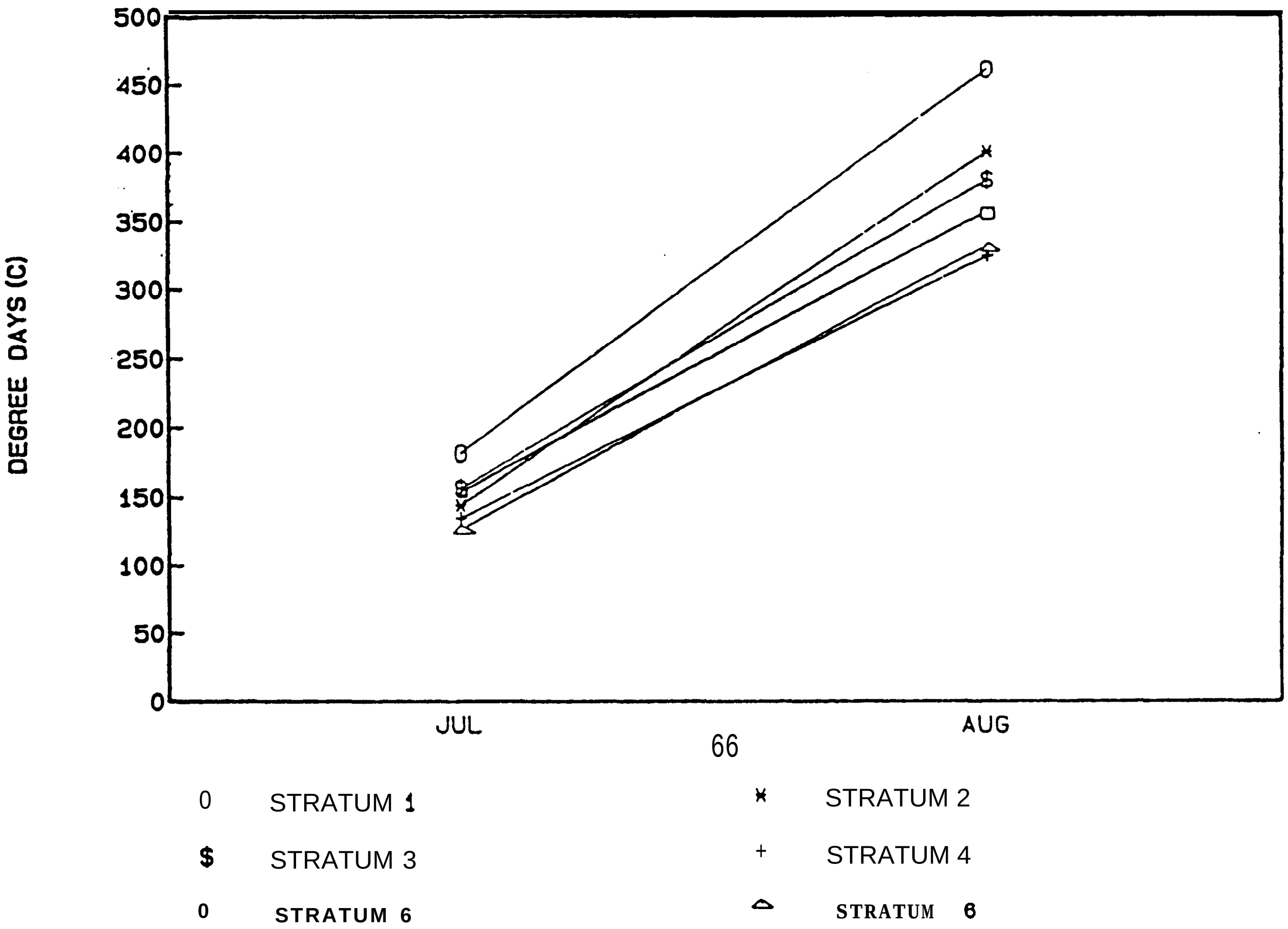


Figure 3. Cumlative degree-days during the period of2 1July to 22 August, East Fork of the Salmon River and major tributaries, Idaho, 1986.

Table 3. East Fork of the Salmon River Drainage, riffle-pool measurements.

Variable	STRATUM 1	2	3	4	5	6
Flow (cms)	6.45	0.94	4.6	0.91	2.81	2.21
Rif + Pool Area (m) X/SE	1532.1 / 155.8	275.4 / 95.4	1675.0 / 320.6	212.7 / 74.7	1169.3 / 177.5	923.4 / 174.1
Pool Width (m) X/SE	18.3 / 0.6	5.19 / 2.4	15.4 / 1.0	5.48 / 0.2	14.14 / --i-x--	13.11 / 0.9
Gradient (X) Range/X	.06-.7 / .49	1.1-1.6 / .91	.01-.3 / .26	1.9-3.3 / 2.5	.13-.86 / .58	.6-1.3 / 1.1
Pool Embed (%) X/SE	13.3 / 2.47	36.7 / 11.95	15.0 / 1.29	15.8 / 3.27	13.3 / 1.05	5.83 / .8
Pool cov (cm) X/SE	260 / 130	153 / 035	124 / 76	75 / 21	111.2 / 45.3	59 / 13
Pool cov (%) X/SE	11 / 7.1	23 / 5.8	7.5 / 4.7	13.6 / 2.3	7.2 / 2.5	4.5 / .13
Maximum Pool Depth (cm) X/SE	119.7 / 14.4	81 / 11	111.7 / 9.8	85 / 8.9	124 / 12	116 / 7
% Silt X/SE	.033 / .013	19.5 / 8.7	6.4 / --XT--	0.1 / .007	.024 / -- .01	.02 / .005
% 4mm X/SE	.008 / .008	10.8 / 2.5	1.3 / .84	.004 / .003	.002 / .002	.002 / .002
% 8mm X/SE	.008 / .008	12.7 / 3.5	1.1 / .87	.006 / .005	0.0 / 0.0	.004 / .007

SE = Standard error of mean X = Variable mean

Table 4. Analysis of variance for riffle/pool measurements of the East Fork of the Salmon River and major tributaries, Idaho, 1986.

Variable	Source	DF	F value	Pr> F
Pool Area	Stratum	5	9.21	.0001
Rif/Pool Area	Stratum	5	6.21	.0005
Rif Area	Stratum	5	11.26	.0001
Pool Width	Stratum	5	19.56	.0001
Pool Cov (cm)	Stratum	5	1.19	.3360
Pool cov %	Stratum	5	2.17	.0840
Pool Max Depth	Stratum	5	2.81	.0333
Pool Embedd	Stratum	5	4.0	.0067
% Gradient	Stratum	5	31.42	.0001
2 Silt	Stratum	5	4.55	.0032
% < 4mm	Stratum	5	34.04	.0001
% < 8mm	Stratum	5	11.9	.0001

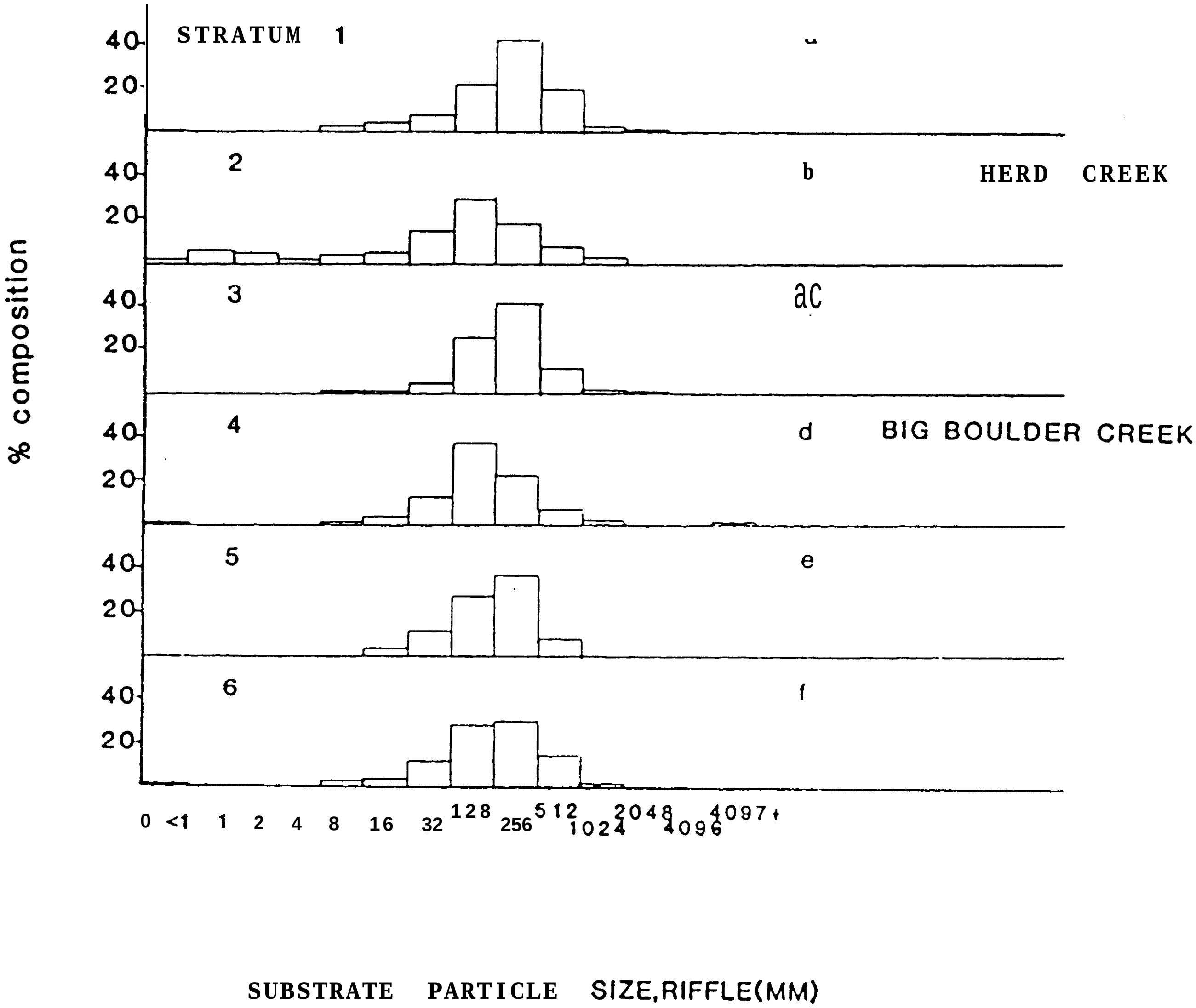


Figure 4. Substrate particle size distribution, East Fork of the Salmon River, and major tributaries, Idaho 1986. A common letter next to individual stratum distributions indicates non-significance(P<0.05) between strata.

Fish Community Inventory

Densities

Fish densities (all species and age classes combined) were highest in stratum 2 (Herd Creek) during July. The two most downstream strata on East Fork proper (strata 1 and 3) were not sampled during July due to high spring flows and low water visibility. During August, stratum 2 (Herd Creek) also had the highest combined total fish density. Fish densities were highest in stratum 3 of the East Fork proper strata (Fig. 5). All fish densities by species/age class and associated analysis of variance are presented in table 5 and 6, respectively.

Age 0+ chinook salmon. Densities did not differ between months. Significant differences did exist among strata. Densities ranged from 0.00 to .060 fish/m^2 pool among strata in July and from 0.0 to .061 fish/m^2 pool among strata in August (Fig. 6a). In July and August, no fish were found in stratum 4 (Big Boulder Creek). Stratum 2 (Herd Creek) had the greatest age 0+ chinook salmon density.

Age 0+ mountain whitefish. No significant differences occurred between months or among strata. Densities ranged from 0.0 to .001 fish/m^2 pool in July and from 0.0 to .016 fish/m^2 pool in August. Stratum 2 (Herd Creek) had the greatest density of age 0+ mountain whitefish in both July and August sample sessions (Fig. 6b).

Juvenile and older mountain whitefish. Densities did not differ among strata and ranged from 0.90 to .031 fish/m^2 pool. Stratum 1 (The most downstream section of East Fork proper) had the greatest density of juvenile and older mountain whitefish (Fig. 7a). Densities did not differ between July and August.

Age 0+ steelhead troyt. Densities did not differ among strata and ranged from 0.0 to 0.034 fish/m' pool. Stratum 2 (Herd Creek) had the greatest density of fish. Densities did not differ between July and August. During July densities were greatest in stratum 2 compared to stratum 5 in August (Fig. 7b).

Age 1+ and older steelhead trout. Densities differed among strata and ranged from 0.0018 to 0.0562 fish/m^2 pool. Stratum 2 had a significantly greater density than all other strata (Fig. 7c). Densities did not differ between July and August.

Relative Abundance

During August, percent relative abundance of age 0+ chinook salmon ranged, by strata, from 0 to 68.5% (Fig. 8). Age 0+ chinook salmon were the most abundant species-age class in stratum 5. Age 0+ and older steelhead/rainbow trout were most abundant in stratum 6. Relative abundances of mountain whitefish were highest in strata 1 and 3 (57% and 46% respectively). Other species (cutthroat trout, bull trout and brook trout) constituted the greatest percent of the fish community in stratum 4 (Big Boulder Creek).

Length Weight Relationships

Total Length in July and August 1986. Fish length differed among strata ($F=6.74, P<0.0001$) and ranged from 65.0 to 72 mm. Fish lengths in stratum 1 (most downstream stratum of East Fork proper) were significantly longer than in all other strata (Fig. 9a).

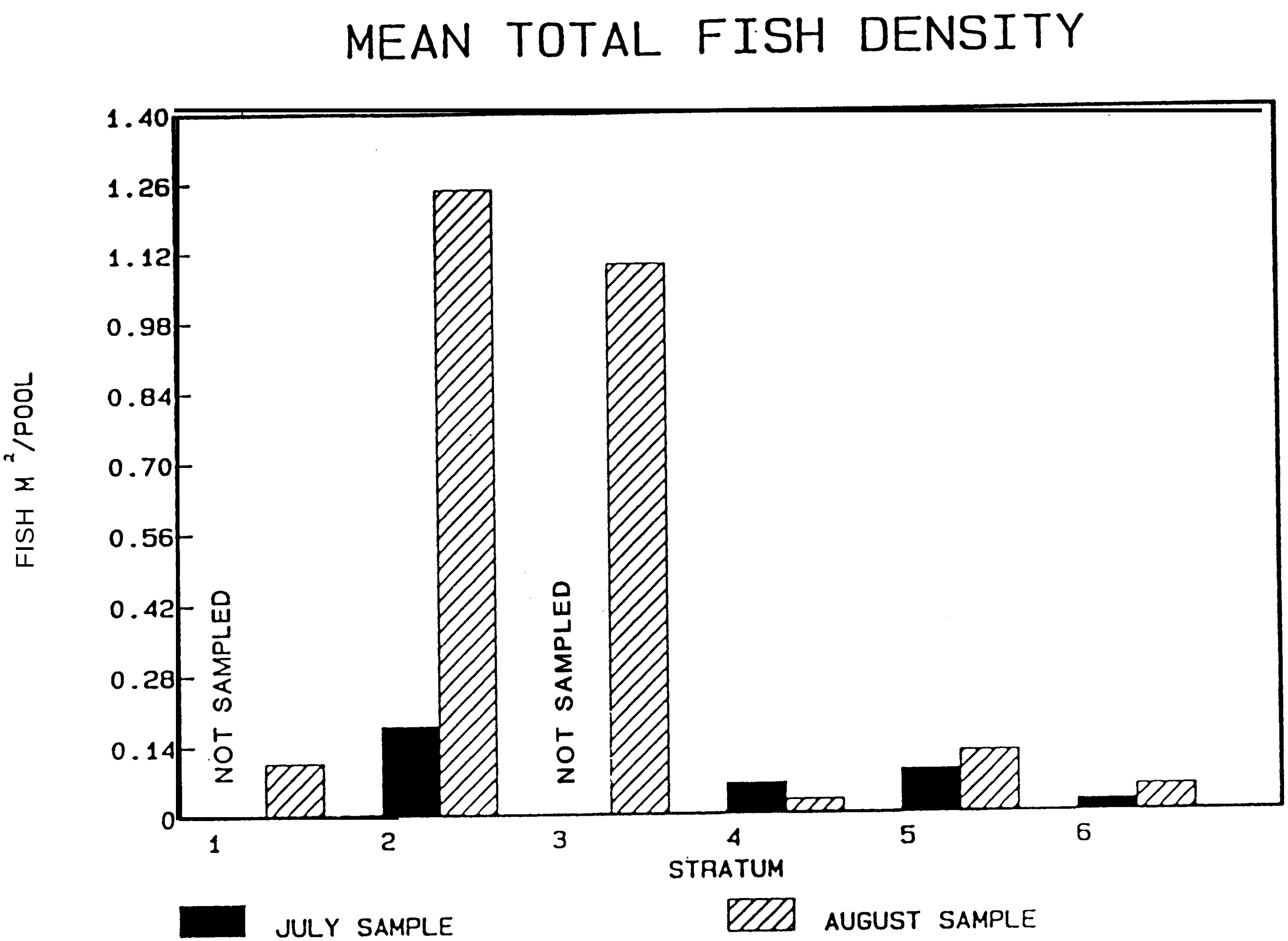


Figure 5. Fish density (all species and age classes combined) by sample session, East Fork of the Salmon River and major tributaries, 1986.

Table 5. Mean total fish densities by session and stratum, on the East Fork of the Salmon River, and major tributaries, Idaho 1986.

SESSION 1

	HERD CREEK			BIG BOULDER CR.		
STRATUM	1	2	3	4	5	6
CHS YOY	NOT COLLECTED	.06039	NOT COLLECTED	0	.03860	.00031
WHF YOY		.00109		0	0	.00017
WHF Juv		0		0	0	.00017
WHF ADD		.00586		0	.01665	.00870
STT YOY		.03400		0	.00149	0
STT OLDER		.03671		.03080	.00712	.00217
CUT 2 AD		0		0	0	0
BKTD		0		0	0	0
OTHER		0		.00088	0	.00238
TOTAL	0	**.13805**	0	.03168	.06386	.01390

SESSION 2

STRATUM	1	2	3	4	5	6
CHS YOY	.01841	.06194	.01973	0	.05572	.00330
WHF YOY	0	.01567	.00186	0	.00053	0
WHF JUV	.00323	0	0	0	0	0
WHF ADD	.02802	.01339	.02900	0	.01520	.01580
STT YOY	.00064	.00357	.00030	0	.00499	.00456
STT OLDER	.01254	.05618	.00661	.01271	.01600	.00634
CUT 2+	0	0	.00015	0	0	0
BKT	0	0	.00044	0	0	0
OTHER	.00062	.02685	.00161	.00338	0	0
TOTAL	.06346	.17760	.05970	.01609	.09244	.03000

Table 6. Analysis of Variance for Fish Species by Age Class. East Fork of the Salmon River and major tributaries, Idaho, 1986.

Species by Age Class	Source	DF	F Value	PR > F
CHS 0+	Stratum	2	8.15	.0040
	Site (Str)	15	2.41	.0498
	Sess	1	0.34	.5669
	Sess * Str	2	0.14	.8695
STH 0+	Stratum	2	1.09	.3624
	Site (Str)	15	1.57	.1948
	Sess	1	0.49	.4966
	Sess * Str	2	1.27	.3088
STH 1+ and Older	Stratum	3	6.34	.0034
	Site (Str)	20	3.48	.0038
	Sess	1	0.18	.6796
	Sess * Str	3	1.10	.3707
WHF 0+	Stratum	2	2.59	.1083
	Site (Str)	15	0.98	.5155
	Sess	1	2.14	.1645
	Sess * Str	2	1.99	.1713
WHF Juv. and Older	Stratum	2	1.30	.3016
	Site (Str)	15	2.64	.0348
	Sess	1	1.81	.1986
	Sess * Str	2	0.79	.4707

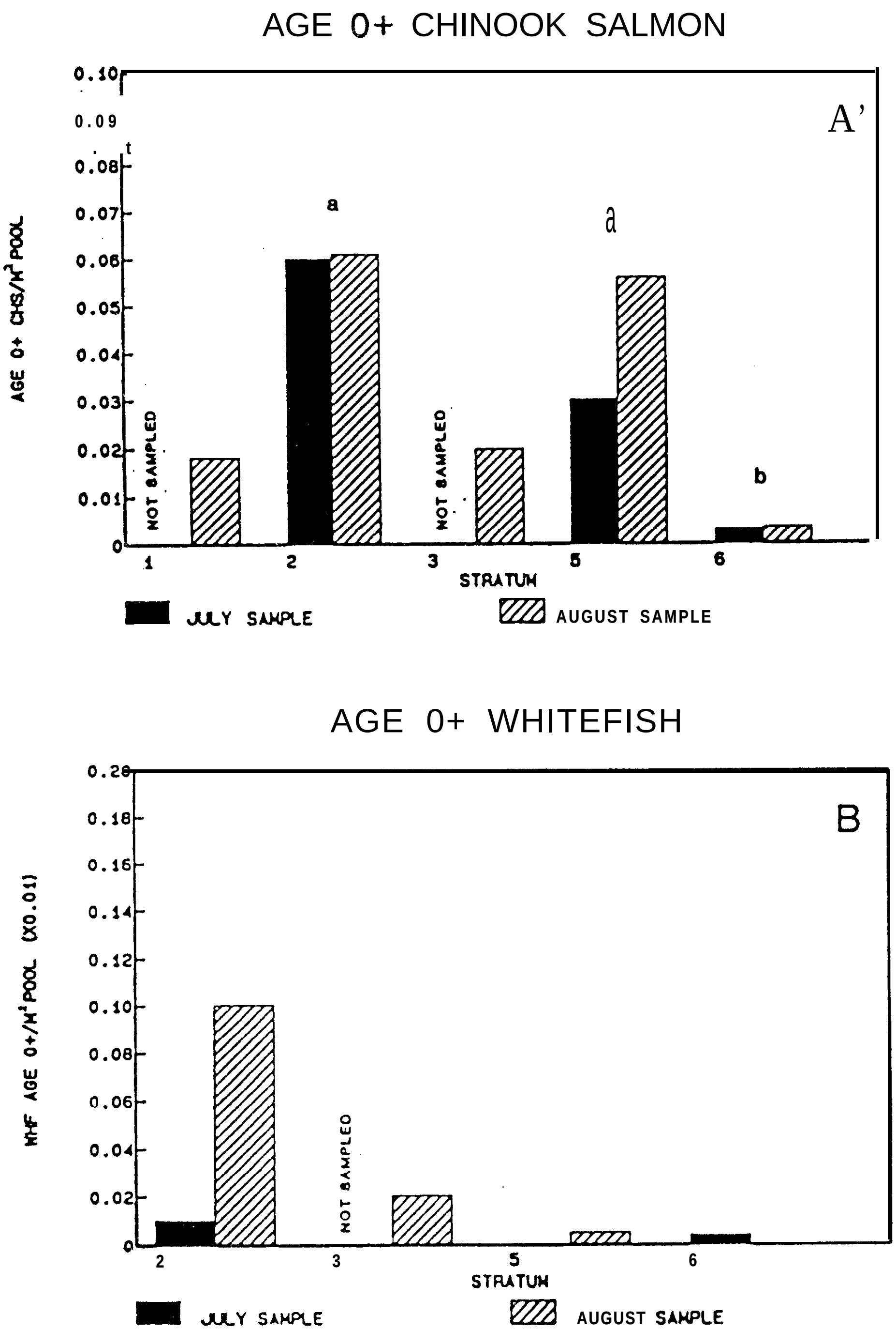


Figure 6. Mean (n=6 per stratum) densities of age 0+ chinook salmon among strata (A). A common letter above means indicate non-significant (P>0.05) difference among strata. Mean densities of age 0+ whitefish among strata (B). No significant (P>0.05) differences occurred between means (68). All densities from the East Fork of the Salmon River and major tributaries, Idaho, 1986.

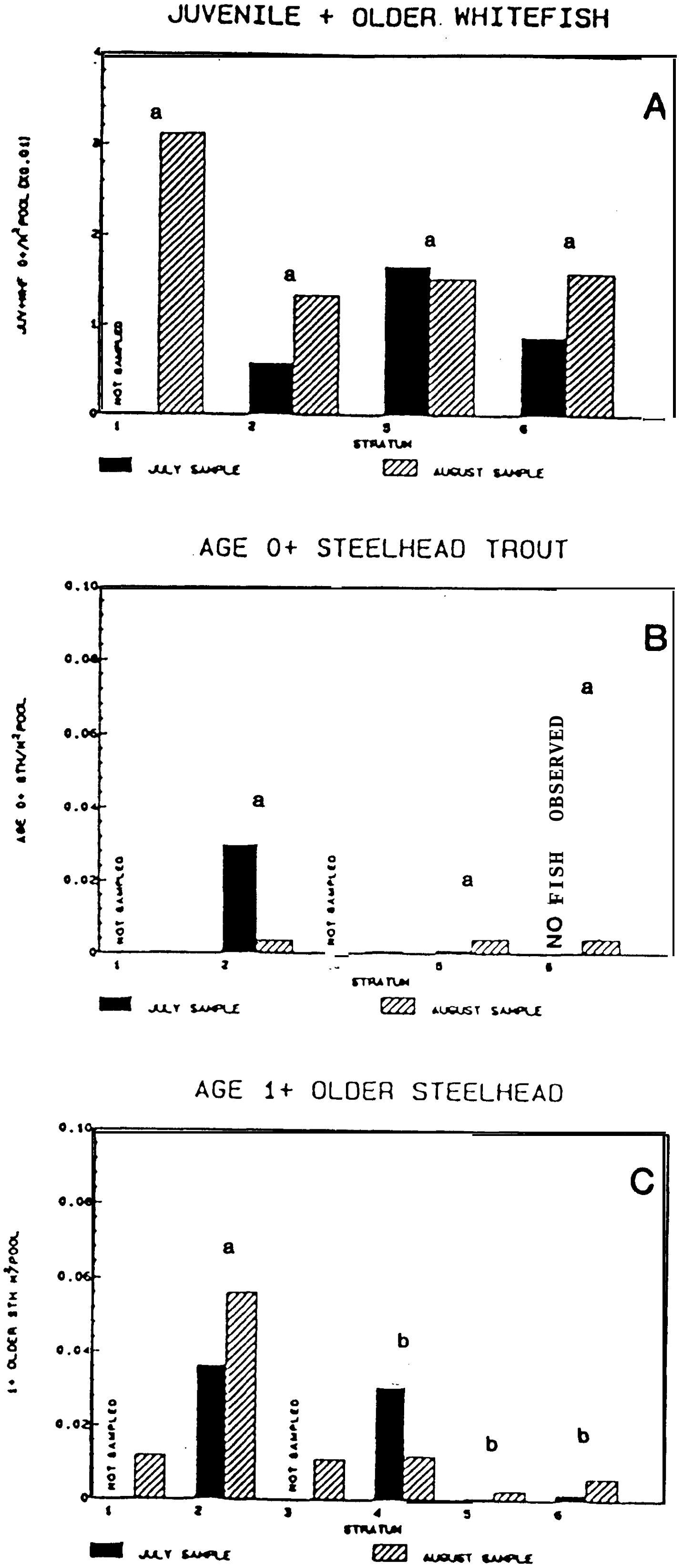
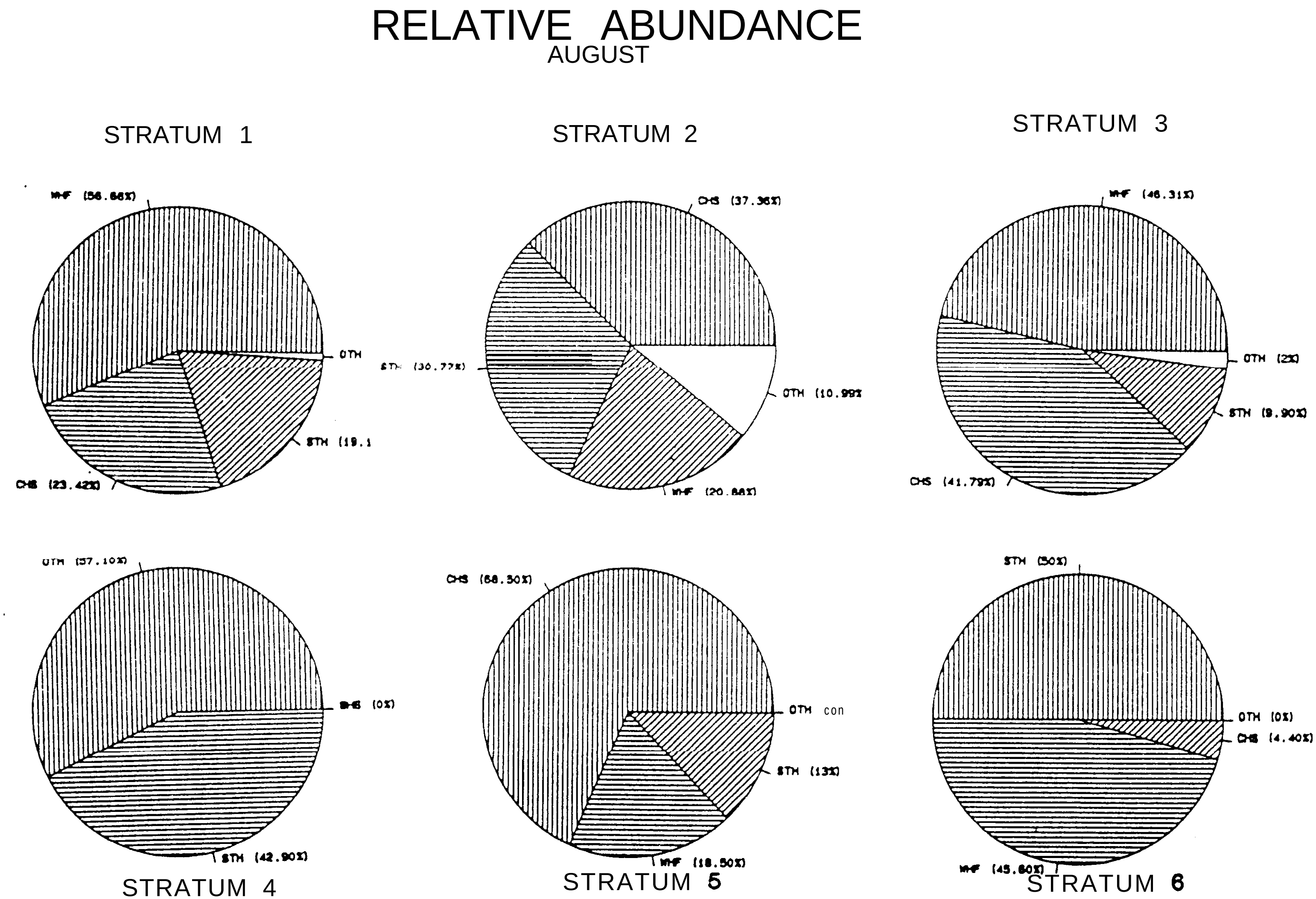


Figure **7**. Mean (n=6 per stratum) densities of juvenile+ whitefish, age 0+ steelhead trout, age 1+ steelhead trout (A, B, and C respectively) among strata, East Fork of the Salmon River and major tributaries, Idaho, 1986. A common letter above means indicate non-significant (P>0.05) difference among strata.



CHS = CHINOOK SALMON (ALL AGES) STH = STEELHEAD TROUT (ALL AGES)

WHF = WHITEFISH (ALL AGES) OTH = CUTTHROAT TROUT, BULL TROUT, BROOK TROUT

Figure 8. Relative abundance (percent) of fish species (combined age classes) East Fork of the Salmon River and major tributaries, Idaho, August, 1986.

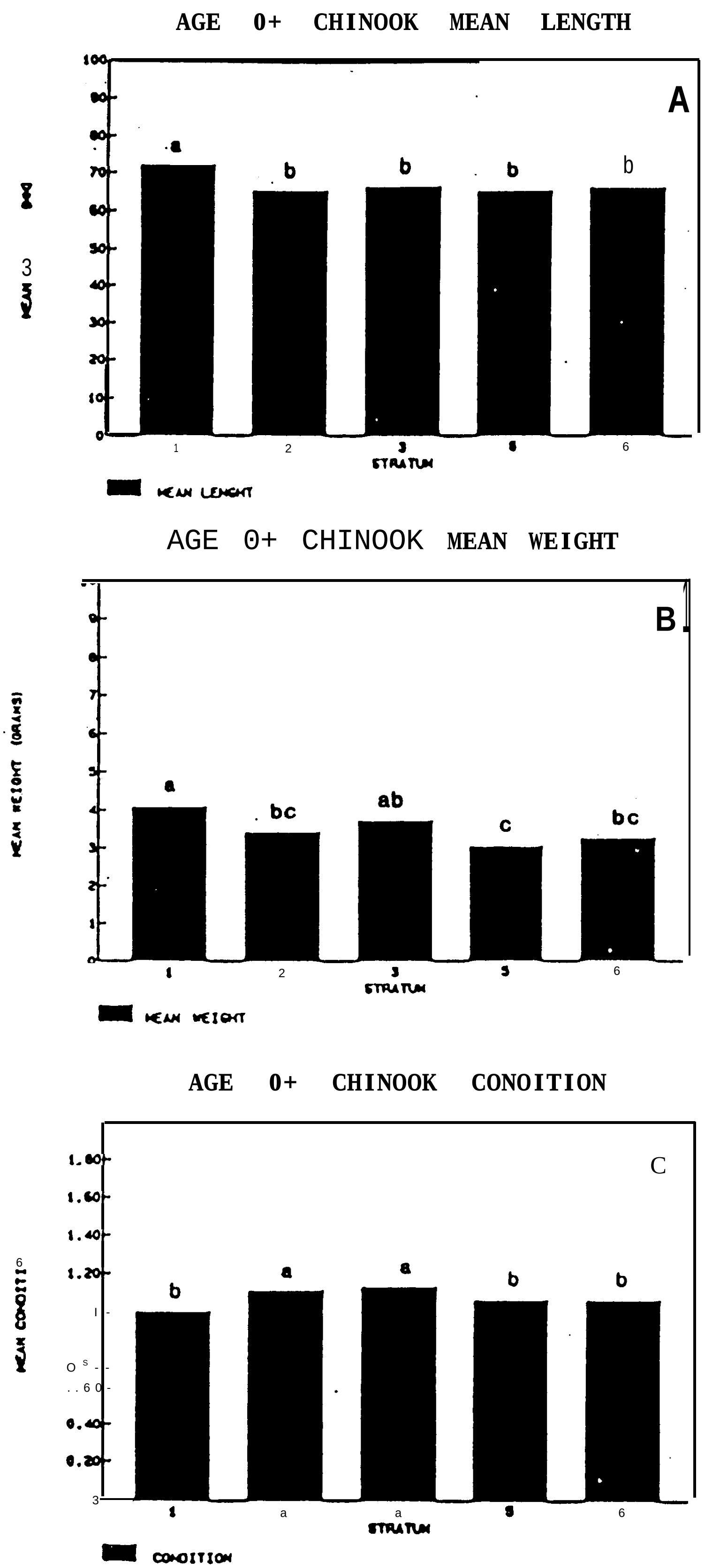


Figure 9. Mean (n=6 per stratum) length, weight and condition factor (A, B and C respectively) of age 0+ chinook salmon among strata, East Fork drainage of the Salmon River, Idaho, 1986. A common letter above means indicates non-significance (P> 0.05) between all pairs of means with that letter.

Live weight in July and August 1986. Fish weight differed among strata ($F=7.16$, $P<0.0001$) and ranged from 3.03 to 4.08 grams. Fish weights in stratum 1 were significantly greater than all other strata. Stratum 5 had significantly smaller fish weights than all other strata (Fig. 9b).

Condition in July and August 1986. Fish condition differed among strata ($F=9.28$, PhO.OOO1) and ranged from 1.002 to 1.13. Fish condition was highest in strata 2 and 3 and significantly lower in strata 1,5 and 6 (Fig. 9c).

Chinook Abundance and Redds

Abundance age 0+ chinook salmon in August 1986. Estimated total number of fish in August was 9274 + 2039 (95% confidence interval). Greatest numbers (3146 + 252) were observed in stratum 2 (Herd Creek). No age 0+ chinook salmon were observed in strata 4 (Big Boulder Creek)(Fig. 10).

Adult spring chinook salmon

Aerial Redd Counts in 1986. The total number of redds on 31 August was nine. This aerial redd count was flown from Bowery Guard Station downstream to approximately one mile upstream of the confluence of the East Fork with the mainstem Salmon River.

DISCUSSION

In general, salmonid densities within the East Fork of the Salmon River drainage are low, regardless of the large amount of salmonid habitat available. Total fish densities were lowest in Boulder Creek and in the most upstream reaches of the East Fork proper and greatest in Herd Creek. Age 0+ chinook densities were also highest in Herd Creek and lowest in upstream reaches of East Fork. Age 0+ chinook comprised a large portion of the fish community in all reaches they were present except the most upstream areas of the East Fork. Chinook densities were well below rearing potential (0.3 to 1.7 fish/m^2) typical of Idaho streams (Schulich and Bjornn 1977; Bjornn 1978). Herd Creek chinook densities were similar to those found in 1985 by Monopacky et al. (1986). Densities above the trapping facility operated by Idaho Fish and Game are considerably lower than those observed below the facility and in Herd Creek. Under current operations, one-third of adults returning to the facility are allowed to pass upstream.

Steelhead/rainbow trout and whitefish also comprised a large portion of the fish community. Age 0+ steelhead/rainbows were found in low densities throughout the East Fork drainage except Boulder Creek, indicating that some natural spawning may be occuring in most reaches. Older steelhead/rainbow trout were considerably more abundant then young of the year primarily due to the outplanting of steelhead within the drainage by Idaho Fish and Game. Although no significant differences were noted, whitefish young of the year were most abundant in Herd Creek and adults were found throughout the drainage except in Boulder Creek.

Cutthroat trout, brook trout and bull trout were found in very low densities throughout the drainage. These species were only found in a few localized riffles and pools within each stratum which makes generalizations on their distribution difficult.

Water temperature in the East Fork of the Salmon drainage ranged from 3.3 to 21.2C during July and August. Temperature extremes probably occurred for only short periods of time during a die1 cycle and did not appear to limit survival of age O+ chinook salmon. Preferred range of water temperature for

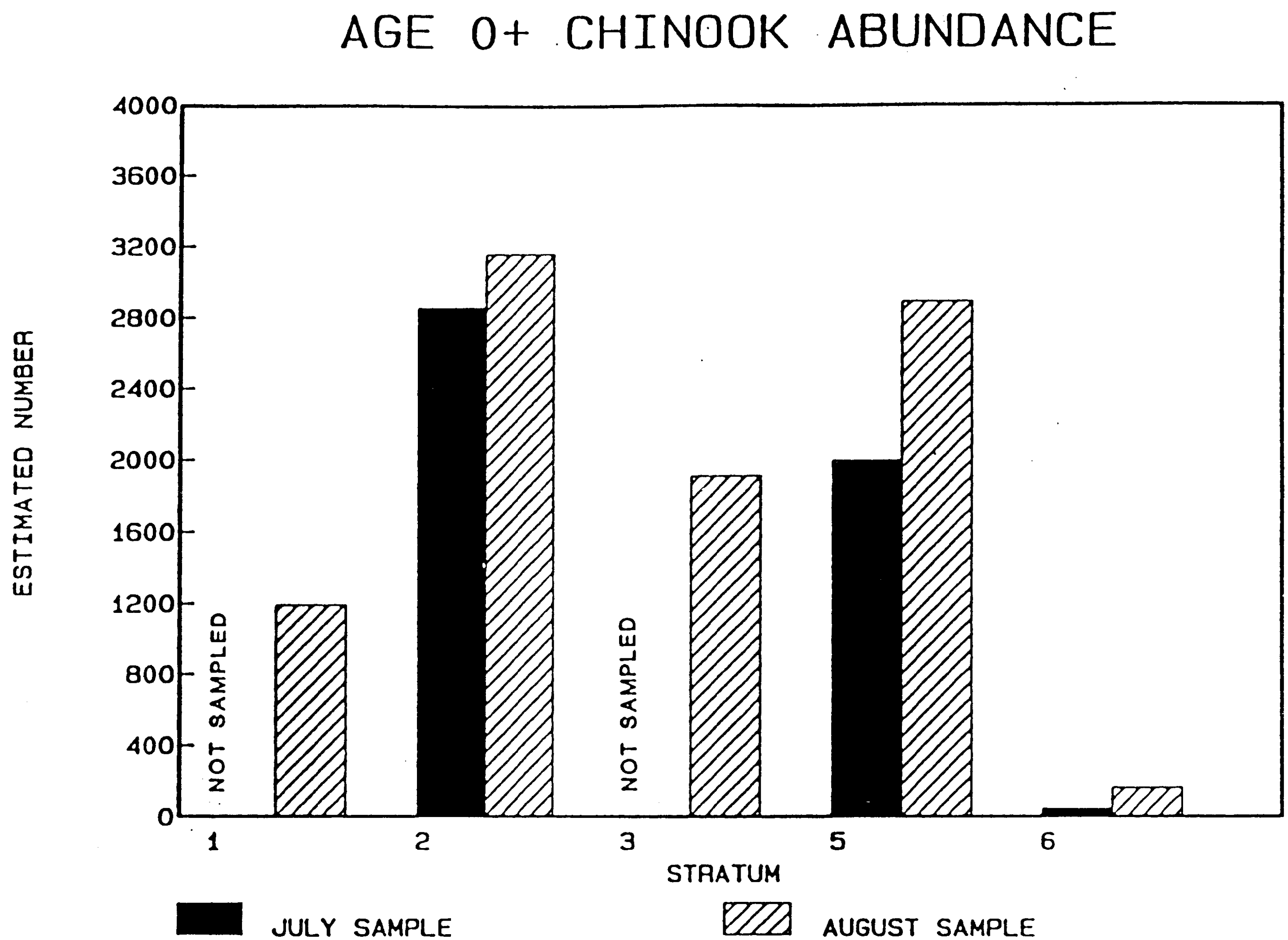


Figure 10. Estimated abundance of age 0+ chinook salmon by session and stratum, East Fork of the Salmon River and major tributaries, Idaho, 1986.

juvenile chinook salmon is 7 to 15C, with an upper lethal temperature of 25C (Reiser and Bjornn 1979). No strong relationships between temperature and length and growth of age 0+ chinook were observed, although length and weights were greatest at the lowermost portion of the East Fork which was also the warmest portion of the river.

Flow did not appear to limit chinook salmon passage or survival depths in the East Fork during August, however no chinook salmon were observed in stratum 4 (Big Boulder Creek). Flow during late August ranged from .906 m^3/second in stratum 4 (Big Boulder) to 6.45 m^3/second in stratum 1. Average riffle depths were adequate for fish passage and ranged from 50.1 to 57.0 cm in strata 5 and 1 respectively. Adult spring chinook require water depths of at least 24 cm for adequate passage (Thompson 1972). Absence of chinook salmon in Big Boulder Creek is probably a result of non-use by adults for spawning. The lower 4 miles of Big Boulder Creek is a high gradient narrow stream which has little to no habitat for spawning chinook salmon, but offers no true barrier to Salmon Passage. Spawning habitat is however, available upstream near the old Livingston Mine. This lack of use by salmon may have resulted from some type of adverse land use practice which displaced the Salmon run downstream into the East Fork.

The amount of riffle and pool area in the East Fork of the Salmon River, Herd Creek and Big Boulder Creek does not appear to limit present levels of chinook salmon numbers. In the 1960's up to 800 redds were recorded (Schwatzberg & Rogers. 1986) in the East Fork proper. Approximately 20 redds were observed in 1986 (Fig. 2). Thus, although the overall spawning and rearing quality of the East Fork drainage has deteriorated due to continued adverse land-use practices since the 1960's the potential spawning area far exceeds the amount currently utilized. Low escapement may be the prevailing factor determining under utilization of quality habitat by chinook salmon.

Bank instability and loss of riparian communities along stream banks continues to be a problem that negatively influences fisheries habitat in the East Fork of the Salmon River particularly below the Idaho Fish and Game trapping facility (Konopacky, et al. 1986). Pools have large proportions of fine materials and available cover in the form of overhanging banks and vegetation is minimal in several reaches. Sedimentation within stream riffles and pools was greatest in Herd Creek. High sediment in this section probably resulted from a substantial input of fines into Herd Creek from the lake creek blow out in 1983 (Mel Reingold, IDFG, personal communication). The flows and gradient associated with Herd Creek have a low capacity for natural rejuvenation thus the blow out of Lake Creek continues to effect Herd Creek. Fine sand has partially filled in most rearing pools in stratum 2 (Herd Creek)(Fig. 4) which results in loss of depth and, subsequently, rearing space. The highest percent of sand as pool substrate occurs below the Lake Creek confluence on Herd Creek. This area also has the lowest gradient (0.73%)(Konopacky et al., 1986) and acts like a sediment trap. No great differences were noted among other areas in the East Fork drainage. However, the sampling program used only estimates surface particle size distributions and may not truly indicate conditions existing within riffle substrates. Tribal biologists observed several hundred meters of banks collapse into various sections of the stream during the 1986 high flow periods. Boulder Creek contributed a large amount of sediment to East Fork due to a large active scarp located downstream of Livingston. Future monitoring programs will include core sampling to further delineate substrate composition within the East Fork. Herd Creek has the highest potential for sediment related impacts to growth and survival of anadromous fishes.

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