MONTANA DEPARTMENT OF FISH WILDLIFE AND PARKS
FISHERIES DIVISION
JOB COMPLETION REPORT

State: Montana Title: Statewide Fisheries Investigations
Project: F-46-R-4 Title: Bitterroot Forest Inventory
Job: Ij
Period Covered: July 1, 1991 to June 30, 1992

ABSTRACT

Population estimates were collected on long term monitoring streams on the Bitterroot National Forest for the fourth consecutive year. Overall, populations appeared to be stable and the consistency between years indicate that electrofishing should be an effective monitoring tool. Since Brook trout and bull trout do not coexist in large numbers they appear to be incompatible in most forest streams. Most brook trout populations are found in locations that have historically had road access. However, some exceptions exist, and it is not clear whether brook trout invaded from other areas or were stocked near the location they are found presently. Bull trout populations tend to be found in higher elevation streams than brook trout. The highest density bull trout populations appear to exist in watersheds that are considered healthy. Brook trout are found in healthy as well as high risk drainages.

Electrophoretic analysis indicates that pure strain westslope cutthroat trout exist in most of the samples taken and that bull trout x brook trout hybrids may be visually distinguishable in the field. A discussion of fish populations in some specific streams on the Bitterroot National Forest districts is included.

Analysis of relationships between trout populations and habitat on the Bitterroot National Forest indicate that cutthroat trout seem to be adaptable to a variety of habitat types, but bull trout are more numerous in streams that have low amounts of fine sediment.

Bitterroot River fish populations are discussed. Rainbow trout populations in the dewatered section of the Bitterroot River are very low. Redd counts in Bitterroot River tributaries indicate that westside streams are heavily used by spawning rainbow trout from the Bitterroot River and that the timing and number of redds varies considerably between years. Fry trapping indicates that dewatering and diversion of water for irrigation from tributary streams is impacting the survival of young-of-the-year rainbow and brown trout.

The 1992 creel census indicates that most harvest of trout is by shore anglers and that anglers appear to be following the strict harvest regulations on the catch and release sections. Harvest is light overall in the Bitterroot River, but is moderate on a couple of reaches.

BACKGROUND

Public interest in land management activities on public lands has increased in recent years, and more emphasis is being placed on protection of fish and wildlife. At the same time, demand for information concerning outdoor activities on private land continues to increase.

To meet the demand for more information on the fisheries of the Bitterroot drainage on public and private land, the Bitterroot National Forest (BNF) and the Montana Department of Fish, Wildlife and Parks entered into a cooperative agreement to study fisheries issues. They agreed to fund a fisheries biologist position that would work with both agencies on fisheries issues of importance. Presently, the project has focused on the following issues:

1. Trout and habitat relationships on the BNF, with emphasis on the effects of land management activities on sedimentation of streams and it's effect on BNF fisheries.

2. Building a long term monitoring program for the fisheries of the BNF.

3. Studying the trout populations of the Bitterroot River and assessing the effects of fishing regulations.

4. Studying the early life history of rainbow trout populations in the Bitterroot River and assessing the loss of trout fry into irrigation ditches.

The Bitterroot National Forest (BNF) encompasses 1.6 million acres, 71% of which lies in Montana. Three mountain ranges, the Bitterroots to the west, the Sapphires to the east and the Anaconda-Pintlars to the southeast comprise the BNF. Water flowing within the BNF is excellent in quality and most is considered soft, a result of basin geology. Streams originating from the Bitterroot Mountains are unusually low in hardness and dissolved solids because of the resistant igneous and metamorphic rocks. The streams draining the Sapphire range tend to have higher dissolved solids because of slightly less resistant and more soluble background geology (Garn and Malmgren 1973). Within Montana, the BNF contains streams which are the headwaters of the Bitterroot River.

The Bitterroot River flows in a northerly direction from the confluence of the East and West Forks near Conner, Montana. It flows 84 miles through irrigated crop and pastureland to it's confluence with the Clark Fork River near Missoula, Montana. Five major diversions and numerous smaller canals remove substantial quantities of water from the river during the irrigation season (Spoon 1987). In addition, many of the tributaries which originate on the BNF are diverted for irrigation during the summer months and contribute little streamflow to the river during that time. Therefore, many tributaries and the mainstem of the Bitterroot River are chronically dewatered during the irrigation season.

Streamflow characteristics vary along the Bitterroot River with the most critically dewatered reach between Hamilton and Stevensville (Spoon 1987). To help alleviate the mainstem dewatering, the Montana Department of Fish, Wildlife and Parks annually supervises the release of 15,000 acre-feet of water from Painted Rocks Reservoir on the West Fork of the Bitterroot River.

The Bitterroot River is an important sport fishery for trout fishermen in Western Montana. Pressure estimates from the statewide survey indicate that angling pressure on the Bitterroot River during 1991 was 52,776 fisherman days (McFarland 1992). Fishing regulations on the Bitterroot River have become more restrictive in recent years because of concern for the quality of the fishery. A five year management plan was written in 1991 to guide fishing regulations until 1996 (MDFWP 1991).

The impact of fishing on the populations of trout in the Bitterroot River is an issue with many anglers. A creel census was conducted in 1992 and 1993 to assess these impacts.

Since the waters of the Bitterroot National Forest are so important to the Bitterroot River, this project was initiated to study fisheries throughout the drainage without regard to administrative boundary.

Fisheries information within the Bitterroot valley is available from a variety of sources. The Bitterroot River has been studied in relation to dewatering and the impacts of releases of Painted Rocks Reservoir water (Spoon 1987). Some midvalley tributaries that have dewatering problems, and spawning runs by Bitterroot River fish have been studied (Good 1985, Good et al 1984, Clancy 1991).

Most of the work has been on or near the Bitterroot National Forest. Fish populations at the forest boundary, relationships between salmonids and sedimentation, and woody debris counts have all been addressed to some degree (Hoth 1979, Odell 1985, Munther 1986, Peters 1987, 1988, Vadeboncouer et al 1989, Clancy 1991).

The relationship between trout and different habitat components has been studied extensively. Sediment, particularly sand, can be detrimental to salmonid fisheries (Alexander and Hansen 1983, 1986, Bianchi 1963, Bjornn et al 1977, Crouse et al 1981, Irving and Bjornn 1984, Klamt 1976, Reiser and White 1988, Saunders and Smith 1965, Sowden and Power 1985, Stowell et al 1983, Tappel and Bjornn 1983, Young 1989). Most of the sediment that is introduced from human related activities is a result of roadbuilding, and to a lesser degree, logging practices (Bilby et al 1989, Burns 1972, Duncan and Ward 1985, Johnson et al 1986, Megahan and Kidd 1972, Moring 1982, Yee and Roelofs 1980). In recent years more work is being done to control erosion from these sources (Burroughs and King 1989, Yee and Roelofs 1980). While the negative relationship between fine sediment and salmonid populations is generally accepted, disagreements about the amounts, timing and the methods of measurement are common (Chapman 1988, Chapman and McLeod 1987, Everest et al 1986, Harvey 1989, Levinski 1986, Lotspeich and Everest 1981, Platts et al 1979, Vadeboncouer et al 1989).

Large woody debris (LWD) is recognized as benefitting salmonid populations in many areas (Dolloff 1986, Elliott 1986, Heifetz et al 1986, Lestelle 1978, Lisle 1986, Marston 1982, Sedell et al 1988). Overhead cover has also been positively correlated with salmonid populations (Wesche et al 1987a, 1987b).

This study will attempt to define the relationships of salmonids and their habitat on the BNF, and understand the relationship between recruitment, fishing regulations and trout populations on the Bitterroot River. This report discusses the data collected between 1989 and 1992.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. Collect fish habitat information from selected Bitterroot River tributaries, enter data on computer and maps. Data included in this report.

2. Electrofish selected Bitterroot River tributaries to determine trout population numbers in relation to habitat. Collect trout samples for genetic sampling. Data included in this report.

3. Collect sediment data from the same stream sections identified for the work in the previous two tasks. Data included in this report.

4. Electrofish 3 sections of the main Bitterroot River to determine trout population numbers. Data included in this report.

5. Monitor spawning tributaries for emigration of young-of-the-year trout to the main river. Monitor losses of young trout to irrigation ditches. Data included in this report.

METHODS

Bitterroot National Forest

Selection of streams for long term monitoring was based on several factors. Basin geology and degree of human development were considered so that fish populations could be studied under different scenarios. Several streams were selected from an earlier study and were included in this study (Peters 1987, 1988, Munther 1986).

Before any fieldwork was completed the stream gradient and order were mapped from USGS 1:24,000 contour maps. Based on gradient, the general area of study was selected and approximately a 1 mile reach of this area was surveyed in the field on most but not all streams. This primary survey consisted of counting habitat types and woody debris. Based on this survey, an 800 or 1000 foot section was selected for further intensive fish population and habitat measurements. All surveys were completed between July 15 and September 15.

When the final survey sections were selected, fish populations were enumerated on sections of either 800 or 1000 feet in length. Early in the study, electrofishing was conducted on some streams with a Coffelt Mark-10 backpack electrofisher, but a bank electrofishing unit was used on larger streams. Beginning with the 1991 field season, bank electrofishing was the primary method used since the pulsed waveform of the backpack electrofisher can be damaging to trout (Sharber and Carothers 1988). A mark-recapture method was used, with the recapture run occurring within 7-14 days following marking. Mark-recapture was selected as the population estimator since it generally is more accurate than the removal method and we were unable to capture a large percentage of the population in our first sample (Peterson and Cederholm 1984, Riley and Fausch 1992). Individual fish were measured, weighed and marked, and larger fish were tagged with individually numbered dart tags in some streams.

Population estimates were calculated using the Mark-Recapture program which is based on the Chapman modification of the Petersen estimate (Ricker 1975).

General habitat features were measured by a method similar to that used on the Beaverhead National Forest (Shepard 1987, Platts et al 1983, 1987). Specific habitat types were classified according to generally accepted methods (American Fisheries Society 1985). In addition to the overhead cover measurements taken in the standard survey, a second method was devised during 1991. At each cross section in the transects, the mean distance of overhang from the streambank for a distance of 1 yard upstream and downstream of the tape was measured for low and high overhead cover. Also the quality, or shading potential of the overhead cover was ranked. The ranking was on a numeric basis of 1 through 4 based on the density of the cover. Number 1 was sparse, up to 25% of the water under the cover would be shaded and number 4 was dense, with over 75% of the water under the cover being shaded. Numbers 2 and 3 were intermediate. This intensive overhead cover measurement was discontinued in 1992. Individual woody debris pieces were counted and estimates of their length were recorded. The sizes of woody debris were separated into three diameter classes (0-6", 6-12", and over 12") and two location classes (in water or out of water). While ocular measures of sediment are included in the general habitat measurements, two other methods were used in 1990 and 1991. Whitlock-Vibert boxes filled with marbles were placed in areas that appeared to be similar habitat to westslope cutthroat spawning areas (Reiser et al 1987, Shepard et al. 1984, Wesche et al 1989). Artificial redds were built and the boxes were placed in pits that were excavated by plunging with a bathroom plunger. They were buried flush with the streambottom, and in 1990 covered with material that was excavated immediately upstream by plunging. The plunger was used to simulate redd building activity of cutthroat trout. During 1991 the boxes were not covered with streambottom materials. Boxes were placed in the stream during early June and collected during late August, which is considered to be the incubation period of westslope cutthroat on the BNF.

Upon removal from the stream, the W-V boxes were emptied of their contents, the marbles were separated from the sediments and a volumetric measure of sediment was calculated with Imhoff cones. The sediment was then placed in double ziploc bags and kept for further analysis.

McNeil hollow core samples were collected on selected streams (McNeil and Ahnell 1964) during 1990 and 1991. The core sampler had a 6 inch deep tube with a 6 inch diameter. On most of the streams which were easily accessible, samples were collected adjacent to a W-V sample which was considered to be a good set. Hollow core samples were collected at the same time that W-V boxes were removed. Sediment samples from the W-V boxes and McNeil cores were dried at 130 degrees F, sieved and weighed. Due to large amounts of organic matter and clay in the W-V samples they were washed before drying. The size of sieves used with the W-V boxes was standard sieve sizes number 10, 20, 40, 100, 200 and pan. In addition to these sizes the McNeil core samples were sieved through standard sieve sizes 3 inch, 2 inch, 1 inch, 3/4 inch, 1/2 inch, 3/8 inch and 1/4 inch. After sieving, the sample retained in each sieve was weighed to the nearest gram. All of the smaller fractions from the McNeil cores were subsampled because the entire sample was too large for analysis.

Westslope cutthroat and bull trout were collected for electrophoretic analysis on some streams. All fish were sent to the University of Montana for analysis.

The Bitterroot National Forest Plan recommends monitoring 6 streams annually to meet the Forest objectives (USDA 1987). We have set a goal of monitoring trout populations for at least 3 years in each stream we select, to serve as a baseline for future population studies.

During 1991 and 1992 additional stream characteristics were measured on the study sites. Wolman pebble counts and T-Walks were completed on all study sites (Wolman 1954, and Ohlander 1993).

Bitterroot River

Fish population estimates on the Bitterroot River were collected on several stream reaches over the past 10 years (Figure 1). Study reaches were selected based on historical data, flow patterns and fishing regulations. The reaches are 2.2-5.1 miles in length. Electrofishing was conducted from a 14-foot long steel drift boat fitted with a boom shocking system. The Petersen mark-recapture method was used to calculate population estimates (Ricker 1975). The population estimates were collected during September and October each year. Several sampling runs are necessary to collect enough fish for a statistically valid sample. Brown trout may be migrating by October, therefore, their estimates may be somewhat inflated.

A creel census was conducted during 1992 and 1993 to assess the impacts of fishermen on the trout fishery of the Bitterroot River. The creel census was conducted from the mouth of the Bitterroot River to the confluence of the East and West Forks near Conner, Montana. The River was divided into 5 subsections for the purposes of the study. Pressure estimates were based on aerial counts of four flights a week over the entire reach. The flights were stratified by day of week, weekend or weekday and hour of day. Interviews were taken during the rest of the time available.

Rainbow trout redd counts were made on 20 streams during the Spring of 1990, 1991 or 1992. Starting at the mouth of the stream, redds in the lowest one mile were counted and measured once a week. All of the disturbed area of the redd was measured, including the pit and tailspill. A painted rock was placed at the upstream edge

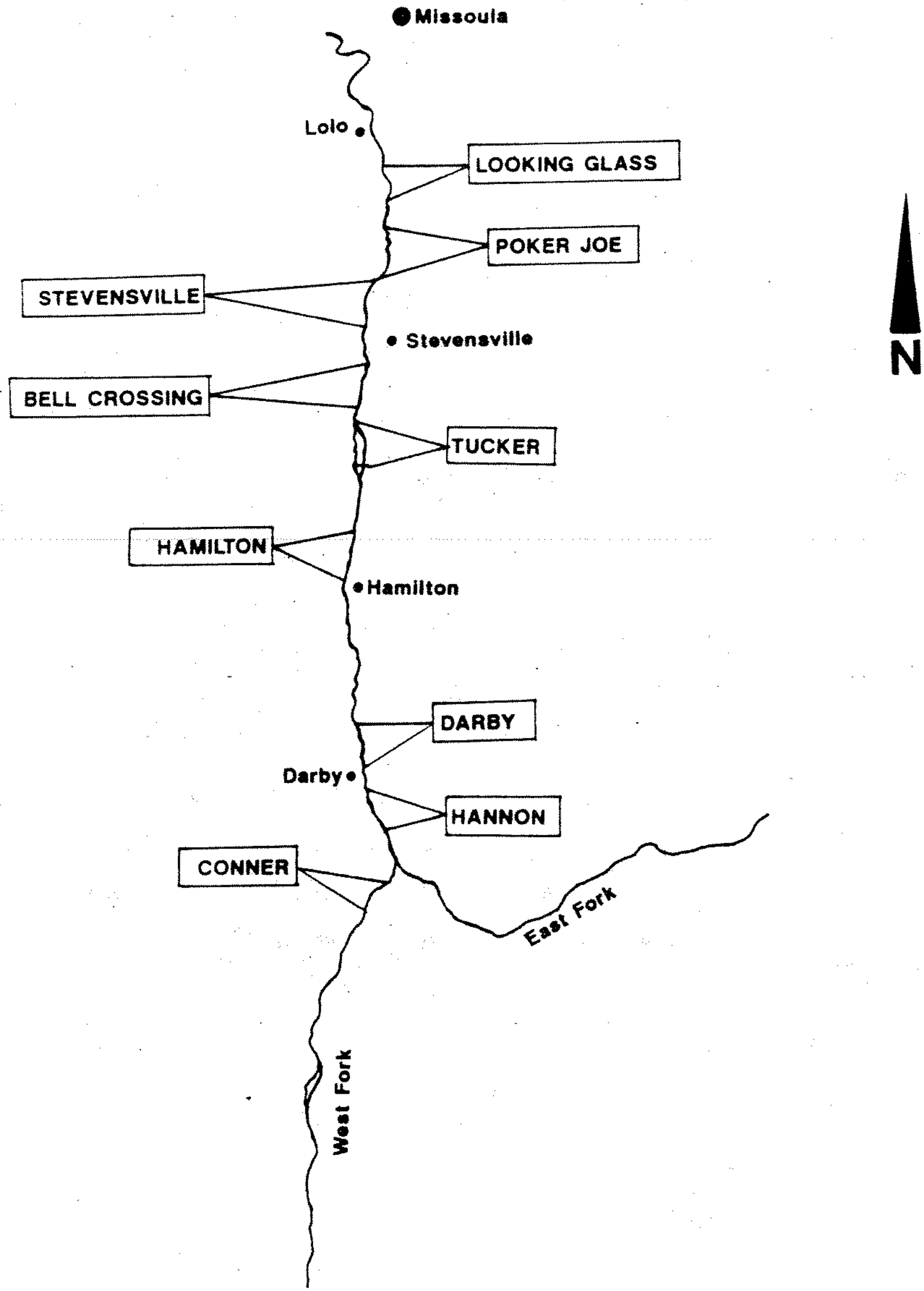


Figure 1. Map of the Bitterroot River Study Sections

of each redd so that each redd was counted only once. Areas where several redds were present or were reworked between counts presented a problem. If a large area was disturbed, the counter judged how many redds were present based on how many pits were easily seen. Any new area of disturbance between weeks was considered a new redd. If the painted rock had been moved into the redd, the area upstream of the rock was considered a new redd. Counting began the first week of March and ended in mid-May, when spring runoff precluded further studies. A short period of high water during 1990 and an early runoff in 1992 probably caused some redds to be missed.

Emerging fry were trapped with downstream frytraps in 9 of the streams during 1990. During 1991 three streams which support large irrigation diversions were trapped. During 1992 two of the same streams were trapped and Tincup Creek was added since negotiations on a water lease had commenced. At the diversions, a trap was placed both upstream and downstream of the diversion and one trap was placed in the ditch. The trap opening was a 9 square foot frame composed of reinforcing bar 3 ft in length on each side, and it funnelled down into a catch basin constructed of PVC pipe and net material. The main body of the trap was constructed of 1/4" and 1/8" mesh hardware cloth. The 1/4" mesh cloth encompassed the upstream half of the cone and the 1/8" mesh cloth encompassed the cod end of the trap. Trapping began in late May or early June and proceeded until mid-July when most of the downstream drift had ended. Trout fry were counted and a subsample was measured each day.

We attempted to calculate the trap efficiency by measuring streamflow in each stream, and streamflow through the trap to calculate the percentage of flow passing through the trap. The fish were captured and classified to species (Martinez 1984).

All data was compiled and analyzed on PC compatible computers. The software we used was DBase IV, Mark-Recapture, Harvard Graphics 2.1, WordPerfect 5.1 and Statgraphics 5.0 Plus.

RESULTS AND DISCUSSION

Bitterroot National Forest trout populations

The location of each of the study sites is indicated on the maps (Figures 2-17).

Population estimates of westslope cutthroat trout were consistent on most streams during 1989 through 1992 (Figures 18-21). The overall consistency of population estimates between years indicate that the mark-recapture procedure is probably an appropriate enumeration method. Bull trout population estimates are more difficult to collect (Figures 18-21). Consistency between years does seem to be fairly good for bull trout population estimates but more data is needed to assess this. Annual fluctuations in populations of salmonids has brought into question the validity of population estimates as monitoring tools (Platts 1988), however, the paper does not present enough detailed information to assess the findings. For monitoring purposes, we will collect population estimates for a minimum of three years at each site.

In these streams the predominant species is usually the westslope cutthroat trout, with lesser numbers of bull trout. Of the streams we sampled, Skalkaho Creek supports the highest number of westslope cutthroat trout and Daly Creek supports the highest number of bull trout (Figure 19). Selected habitat measurements for a comparison between streams is included (Table 1). Since streambottom condition and sediment are of particular interest, those measurements are included separately (Table 2).

The discussion of individual streams is included in the report under Forest Service Districts and a discussion of fish and habitat relationships is contained in a separate section of the report.

Bitterroot National Forest Districts

It is important to note that the following discussion pertains only to those streams that are being sampled for long term monitoring purposes. Many more streams have been sampled by Bitterroot National Forest fisheries crews, primarily for project related activities. Data on those streams is contained in various project specific reports and on file in the Supervisors office in Hamilton.

The naming convention for these sites has changed since the last report. Study site locations are reflected in the names of the study sites. The name reflects the number of river miles from the mouth of the stream that the study site is located. For example, Gold Creek 0.3 is a study site located on Gold Creek, 0.3 river miles from it's confluence with the Burnt Fork of the Bitterroot.

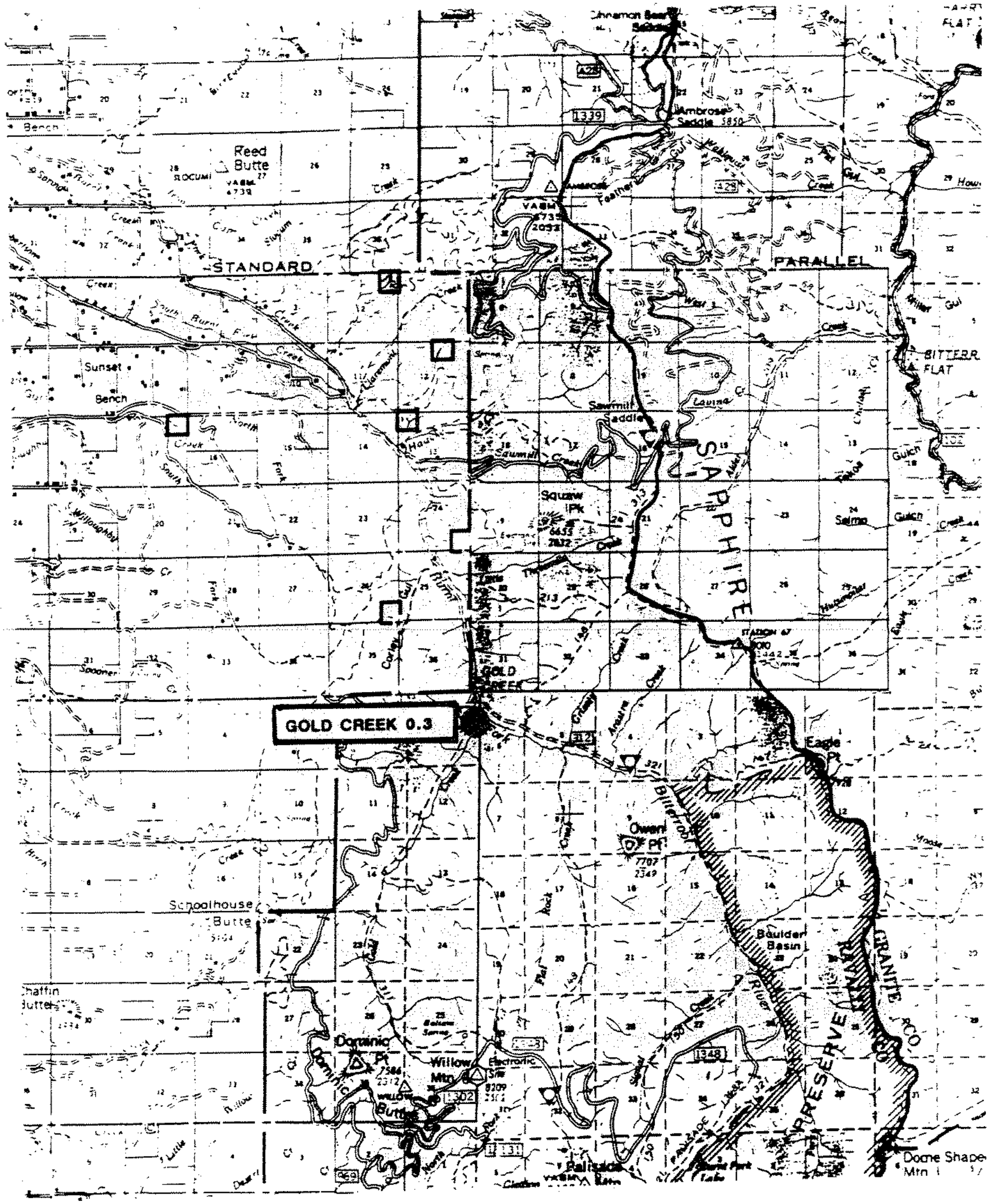


Figure 2. Map of Study Site on Gold Creek

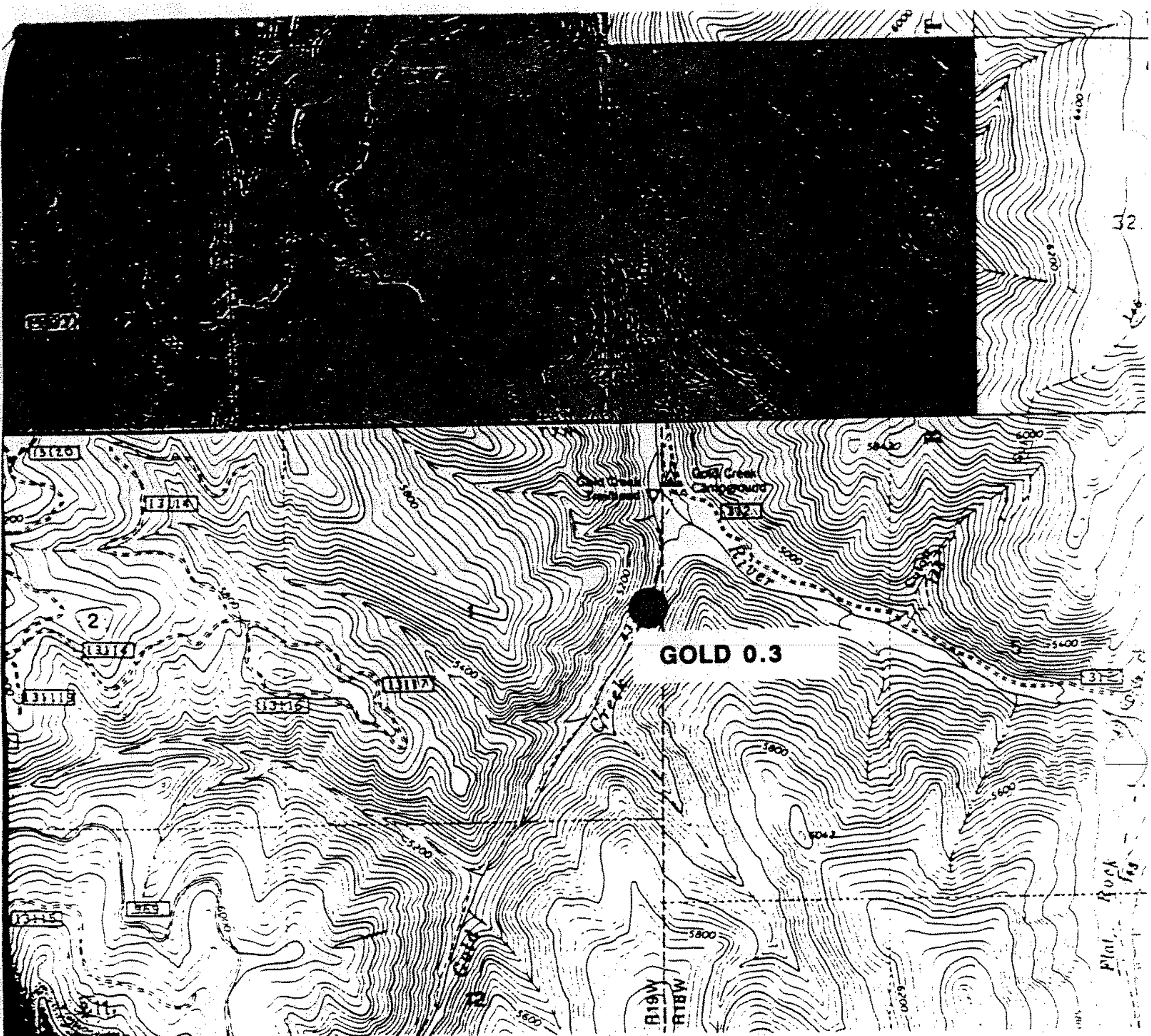


Figure 3. Detailed Map of Gold Creek Study Site

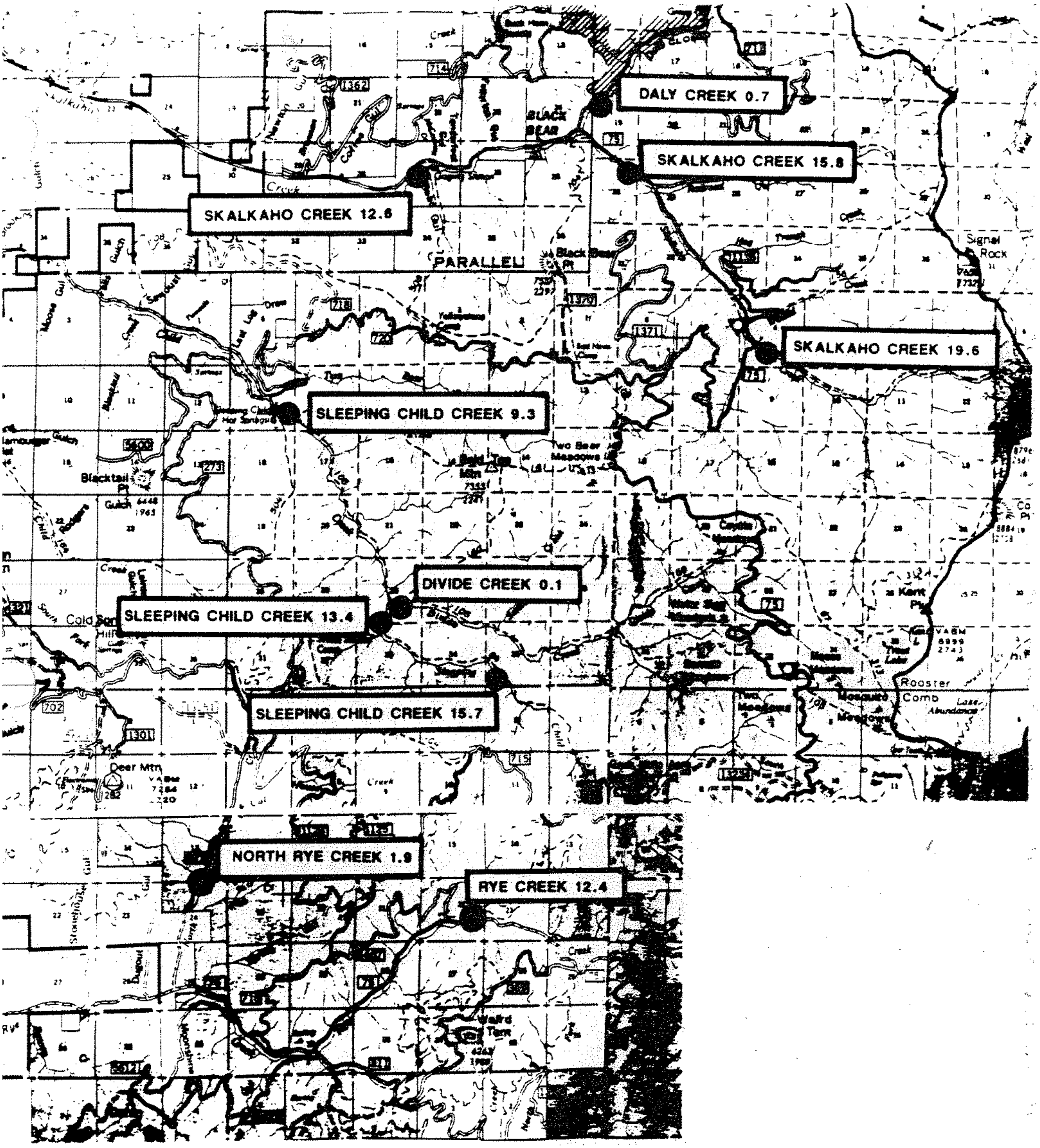


Figure 4. Map of Study Sites on Darby District

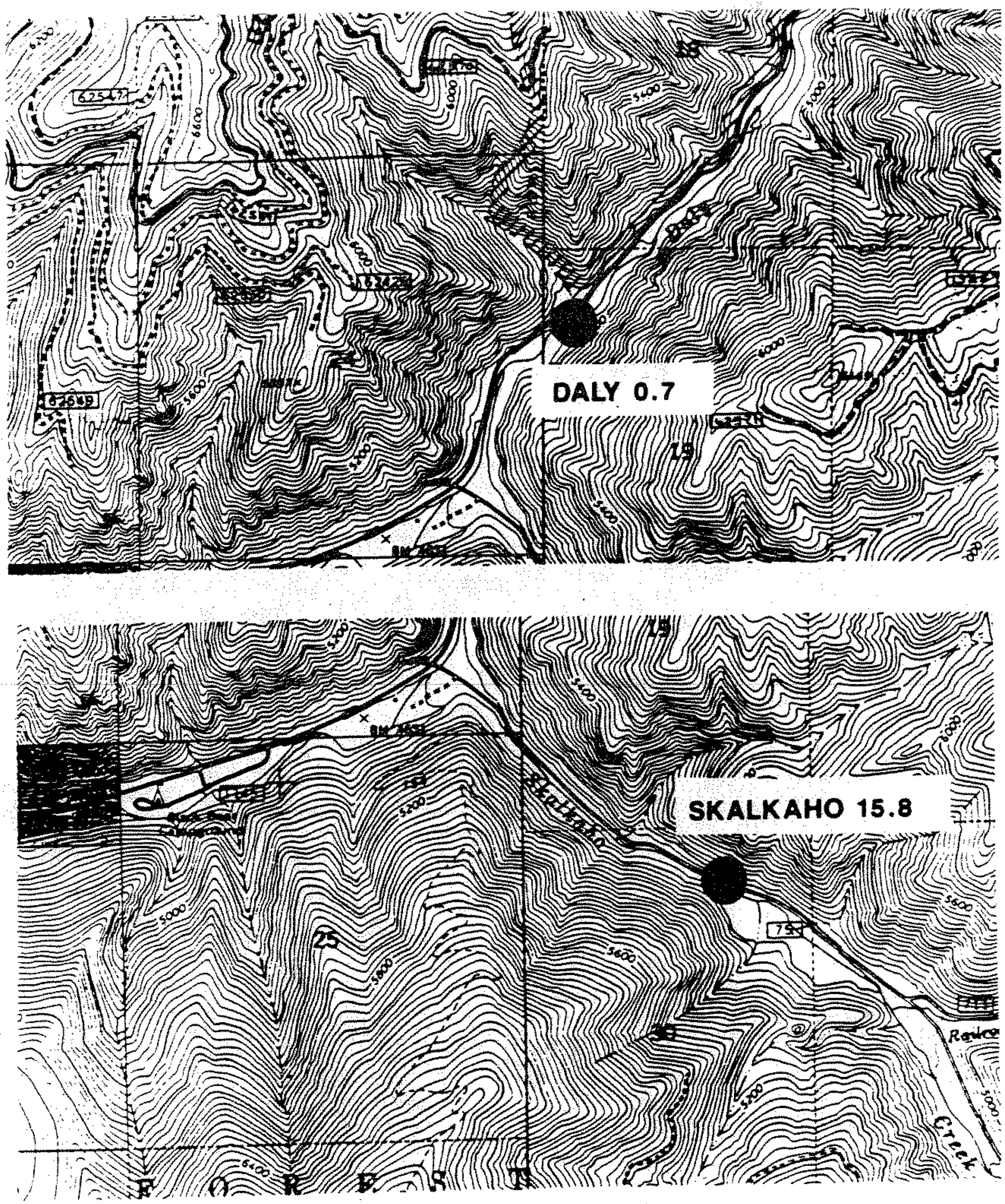


Figure 5. Map of Daly Creek and Skalkaho Creek Study Sites

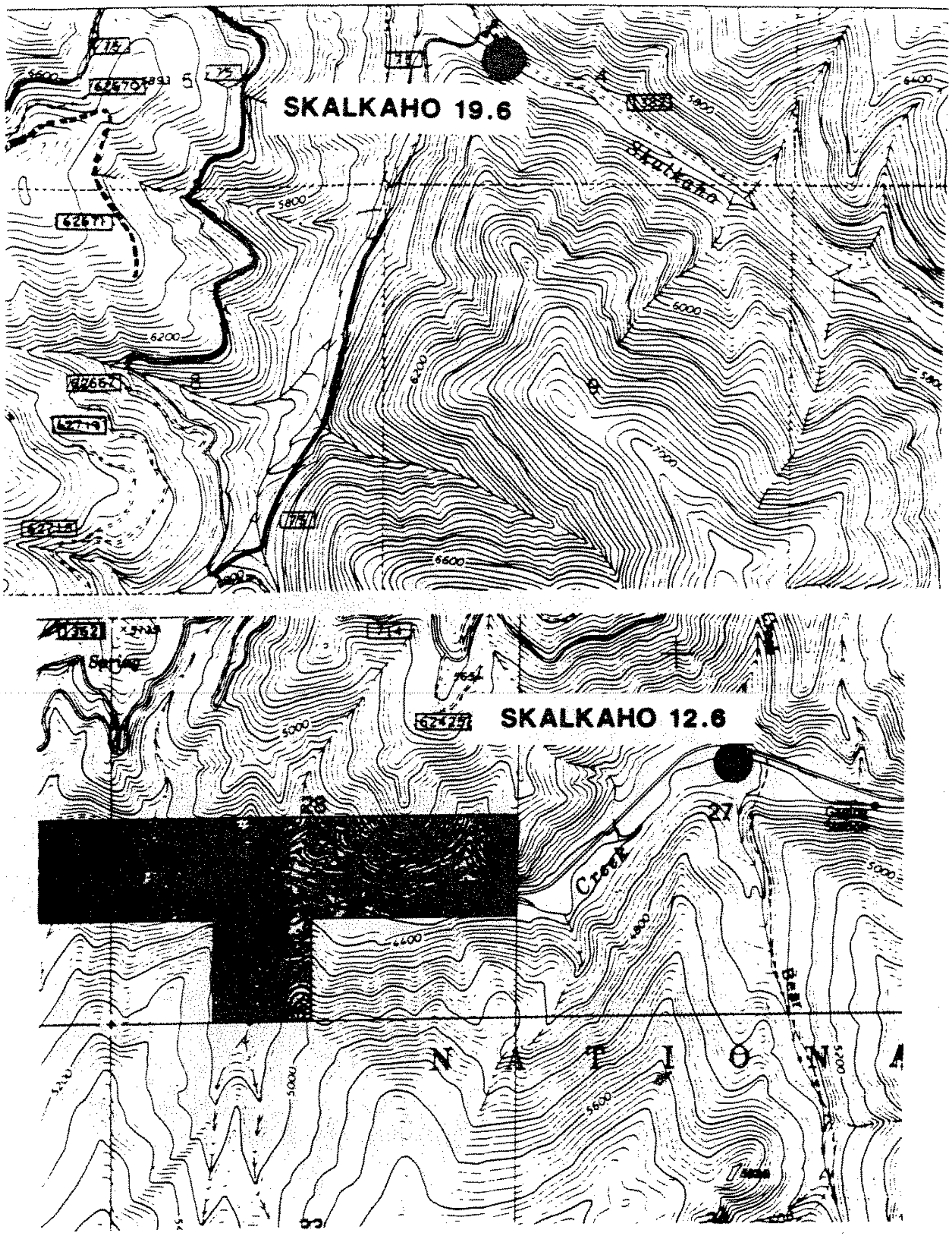


Figure 6. Map of Skalkaho Creek Study Sites

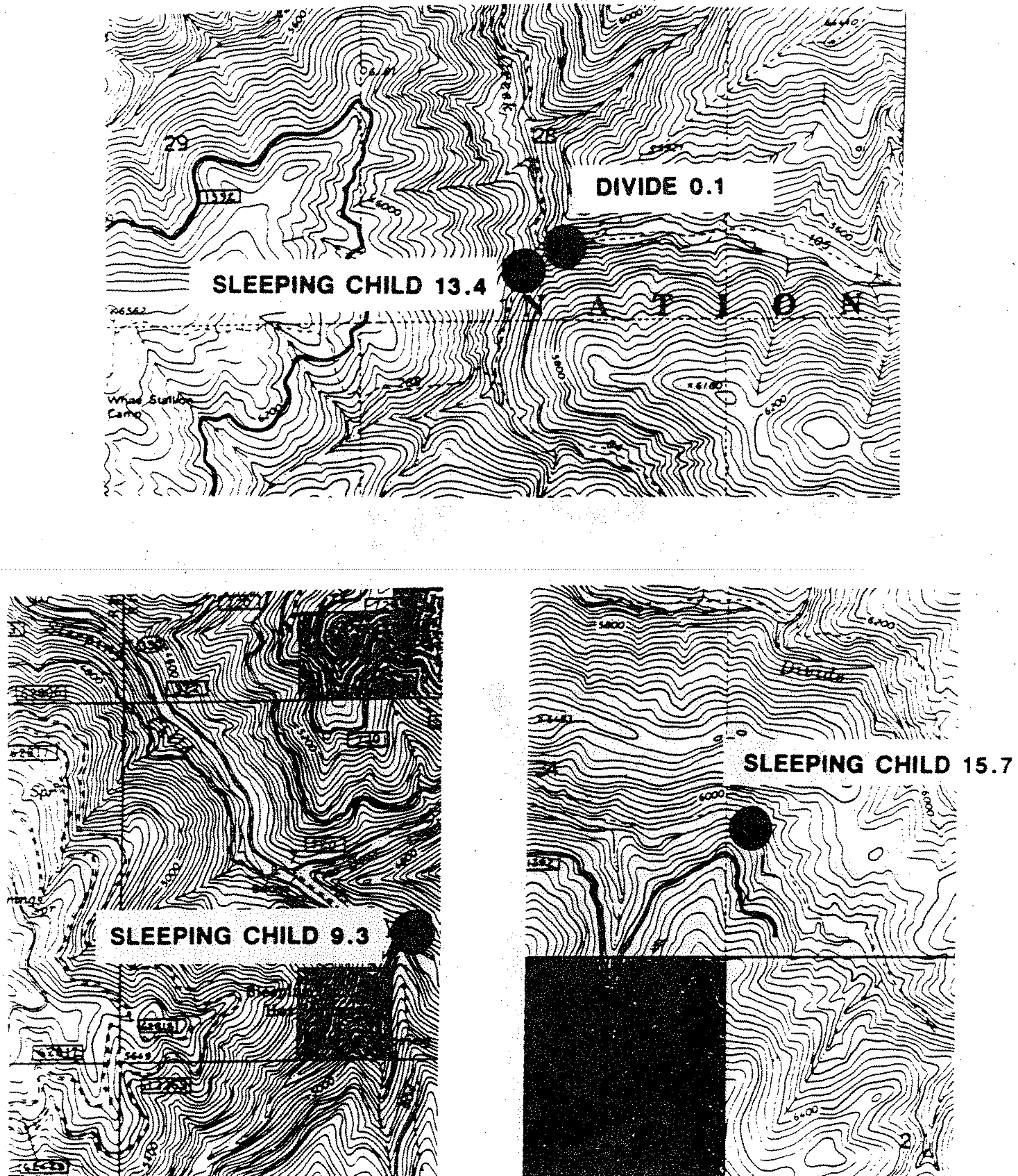


Figure 7. Map of Sleeping Child and Divide Creek Study Sites

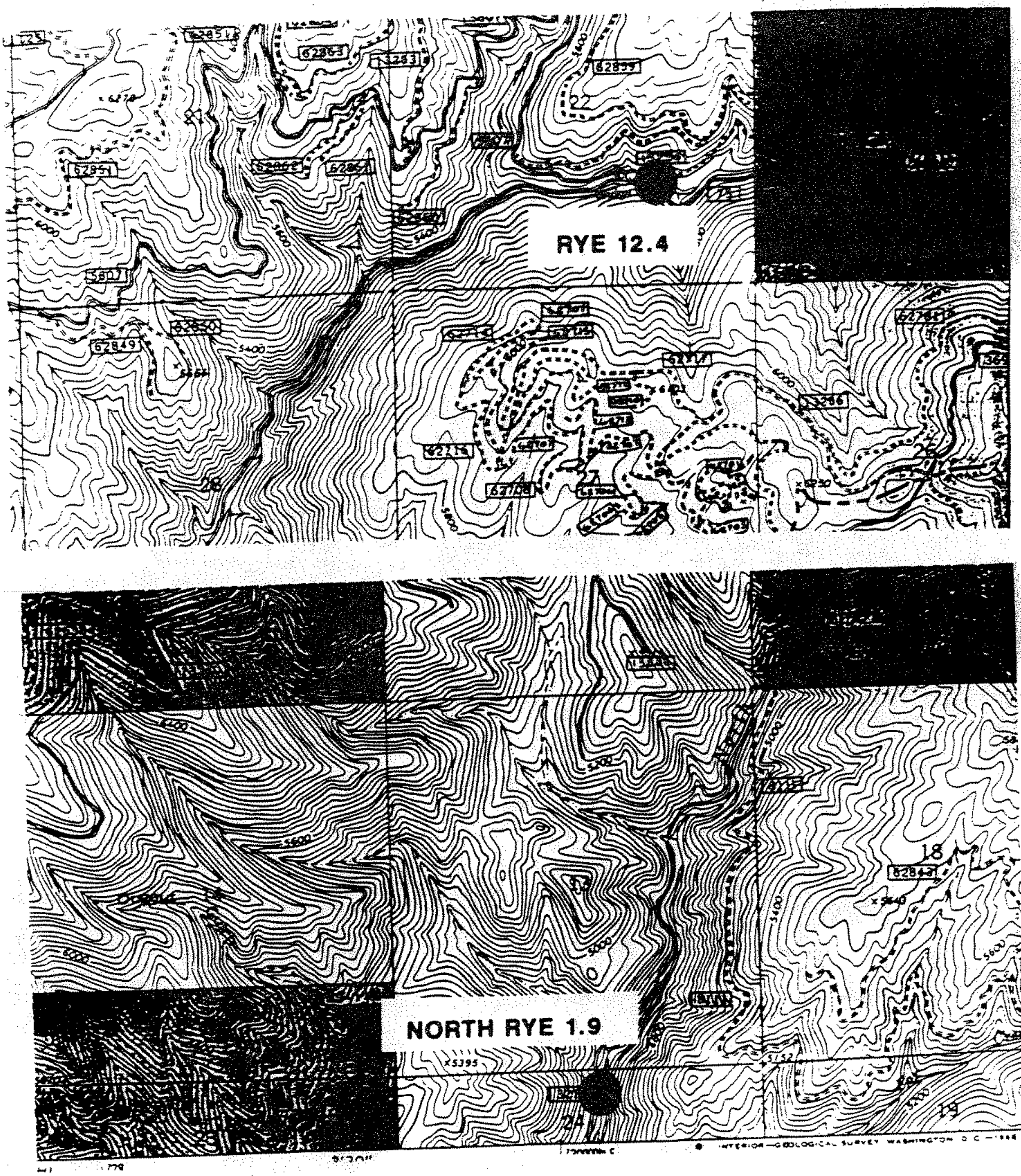


Figure 8. Map of North Rye Creek and Rye Creek Study Sites

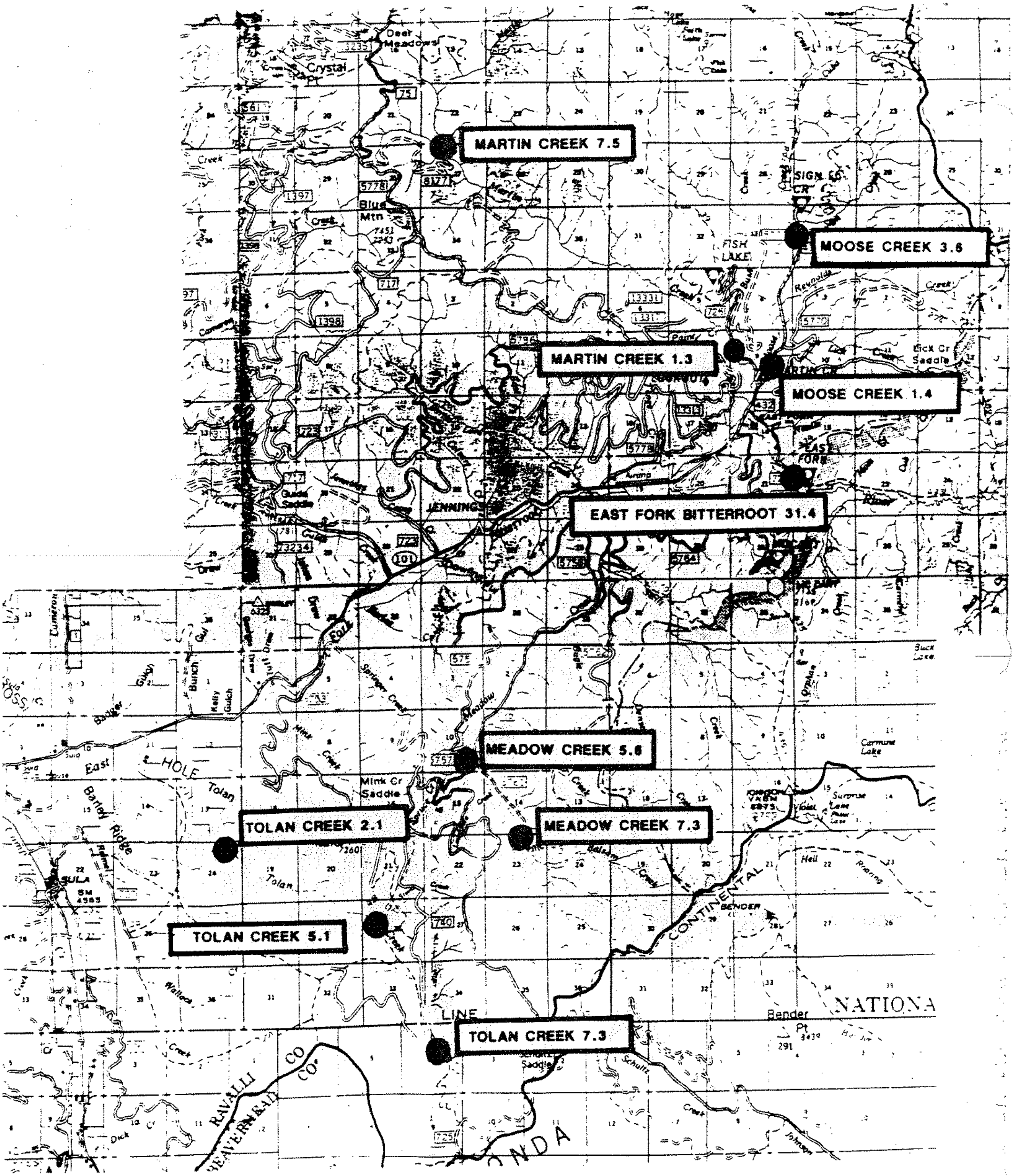


Figure 9. Map of Study Sites on the Sula District

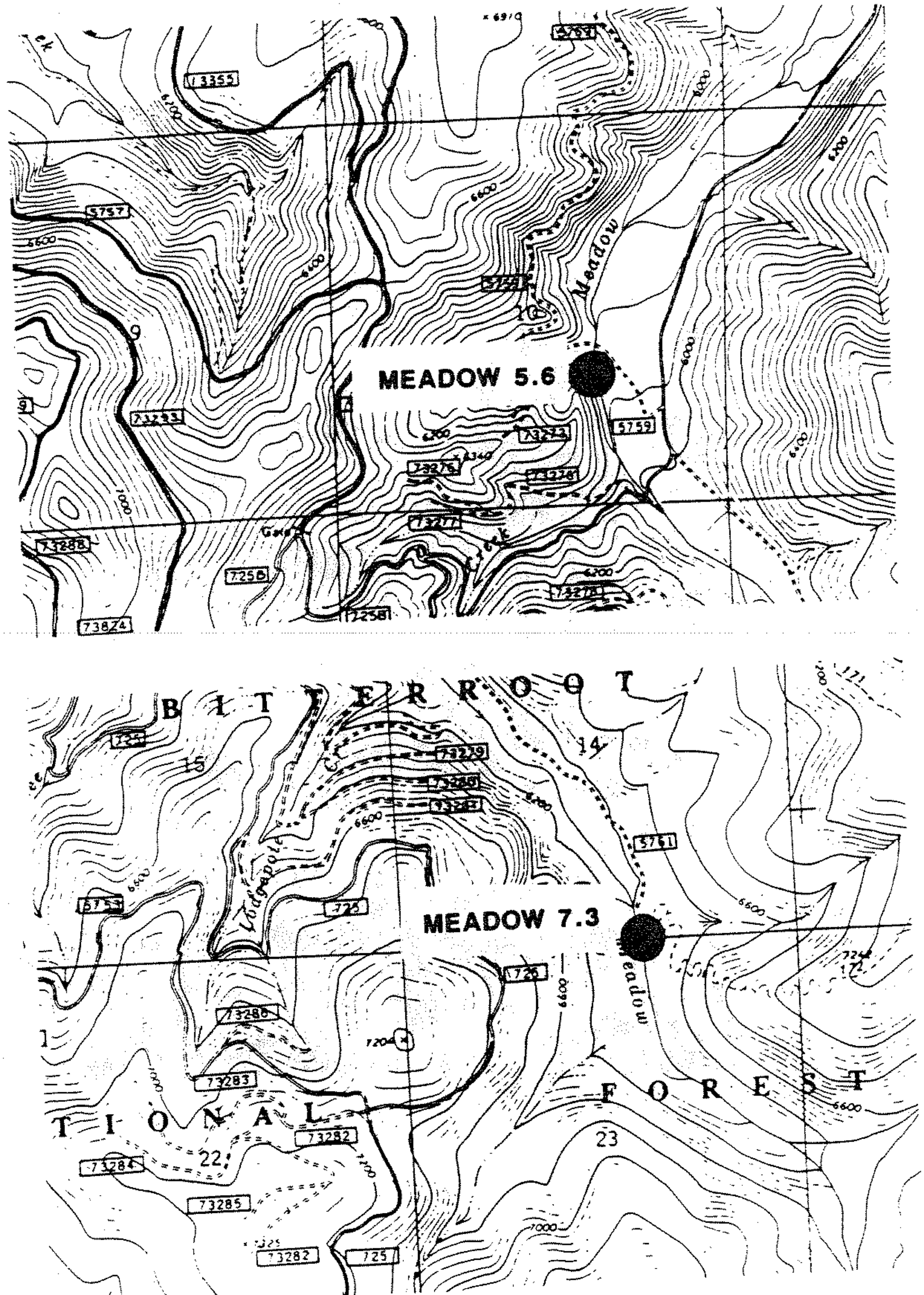


Figure 10. Map of Meadow Creek Study Sites

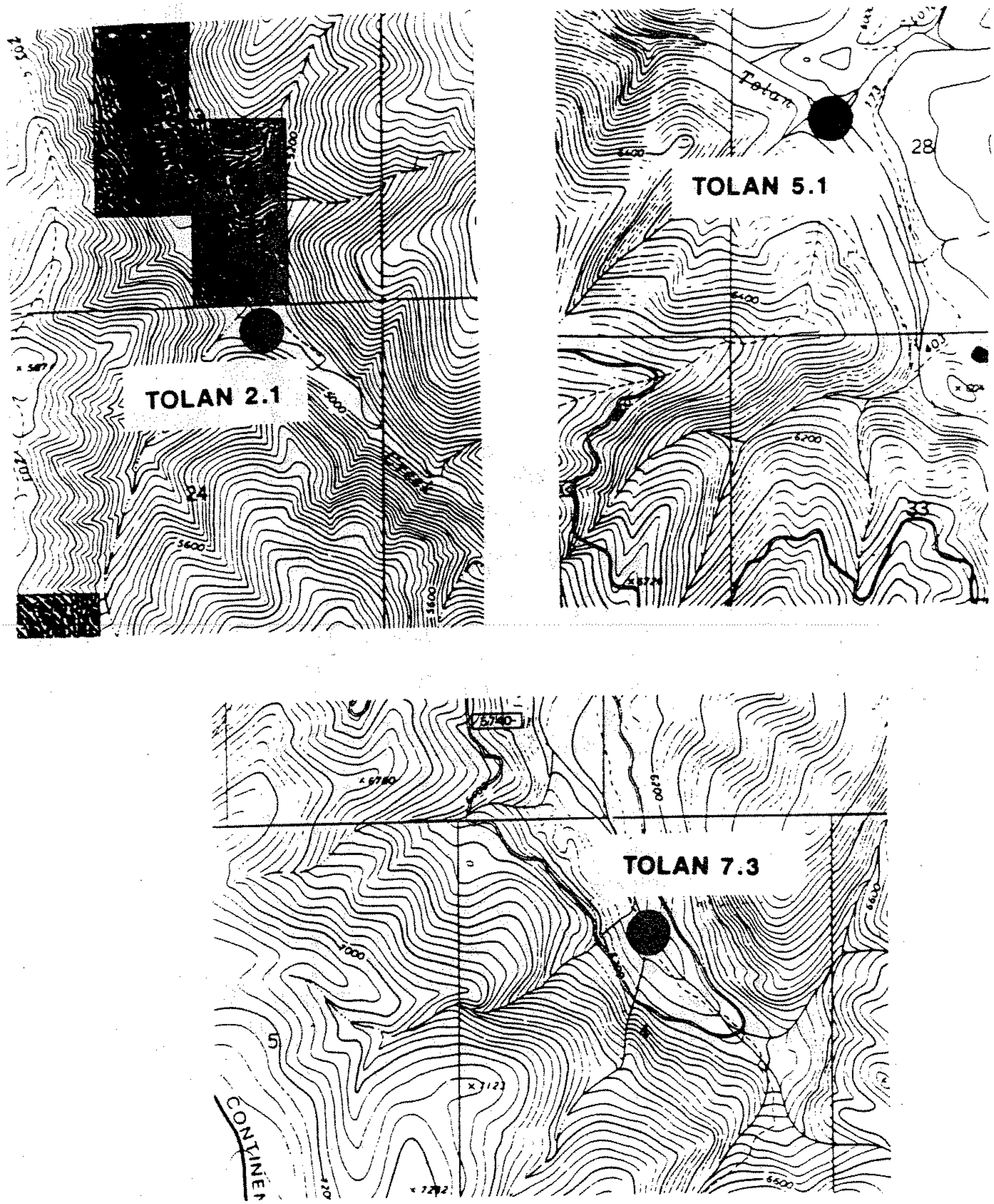


Figure 11. Map of Tolan Creek Study Sites

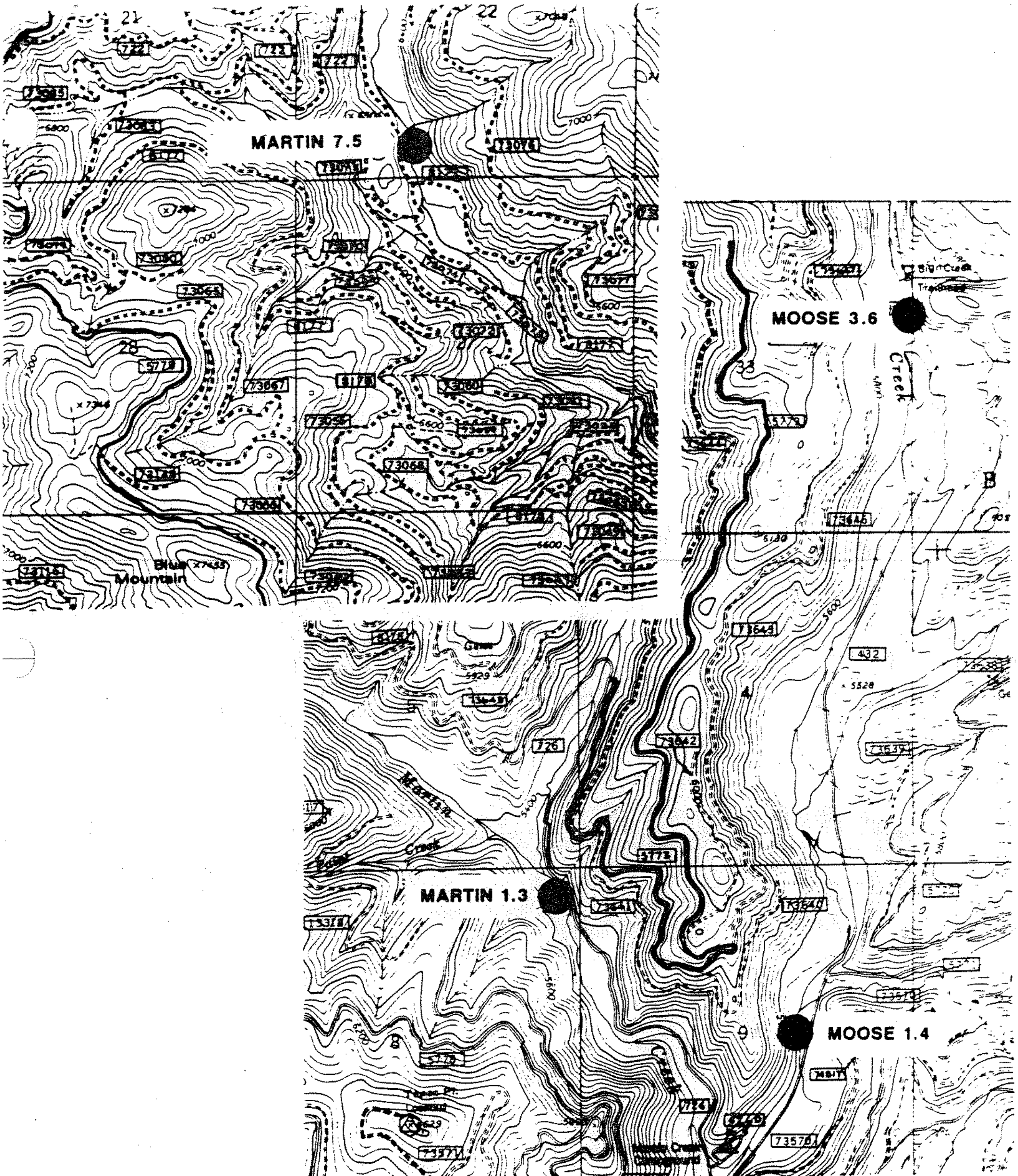


Figure 12. Map of Meadow Creek and Moose Creek Study Sites

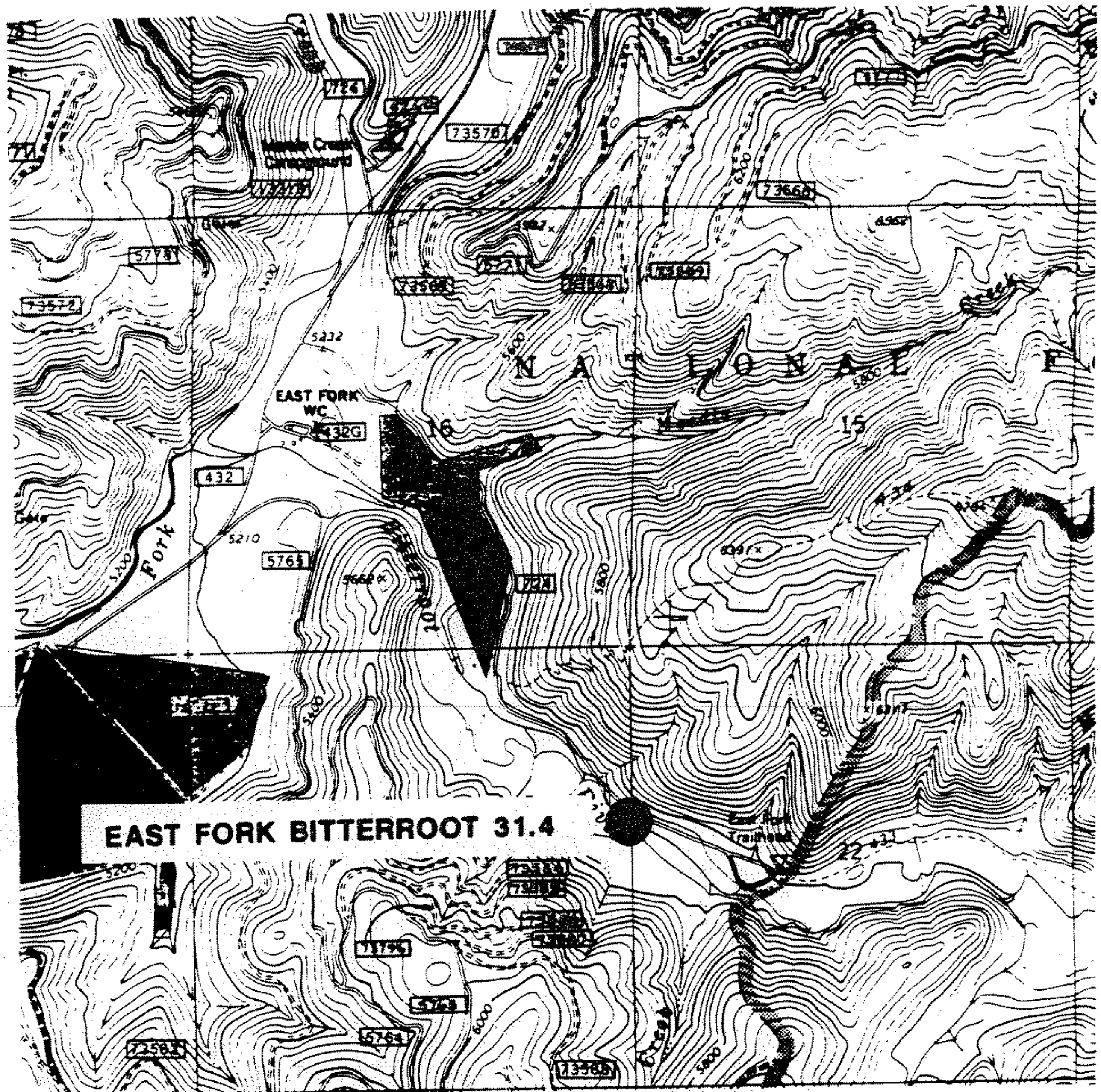


Figure 13. Map of East Fork Bitterroot River Study Site

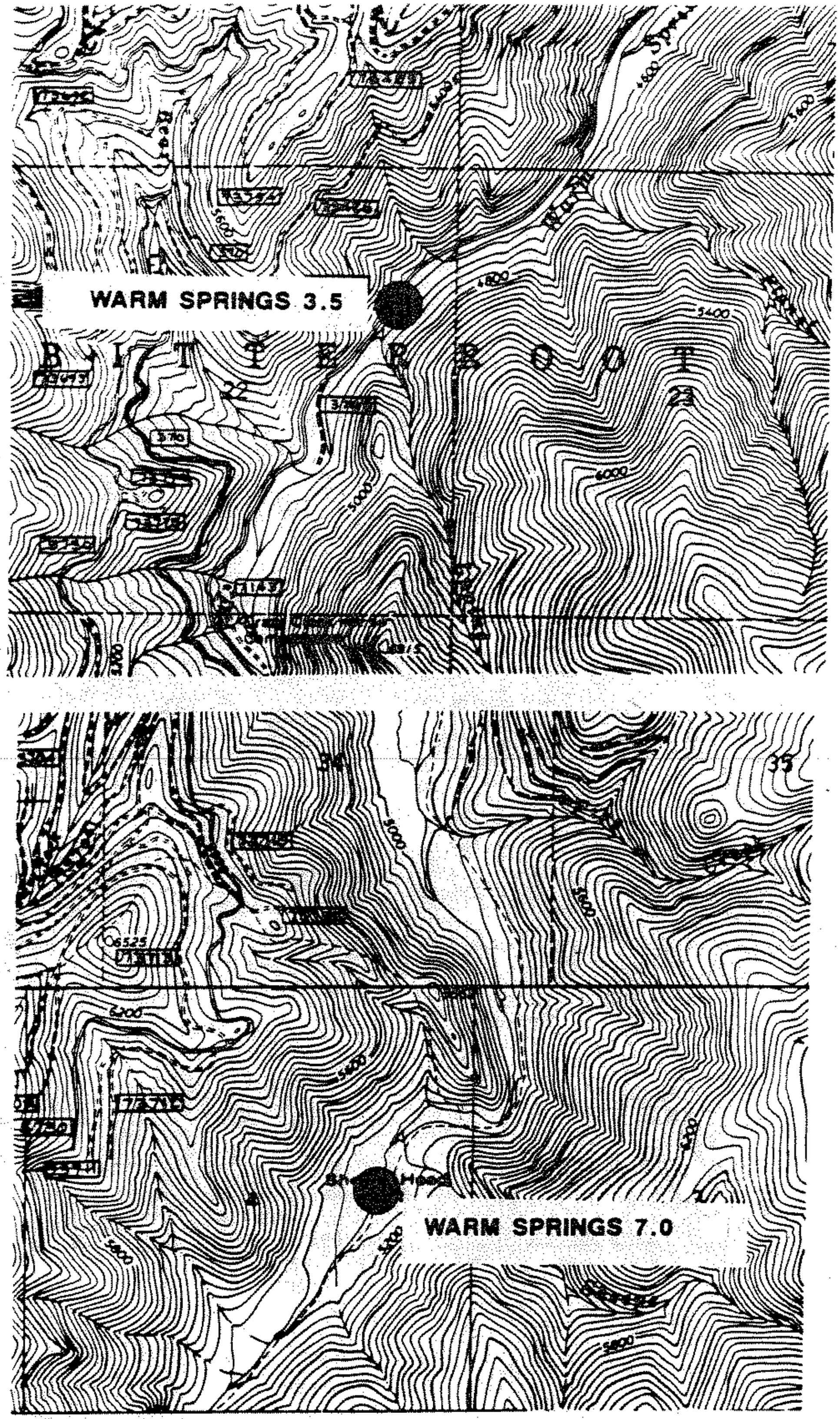


Figure 14. Map of Warm Springs Creek Study Sites

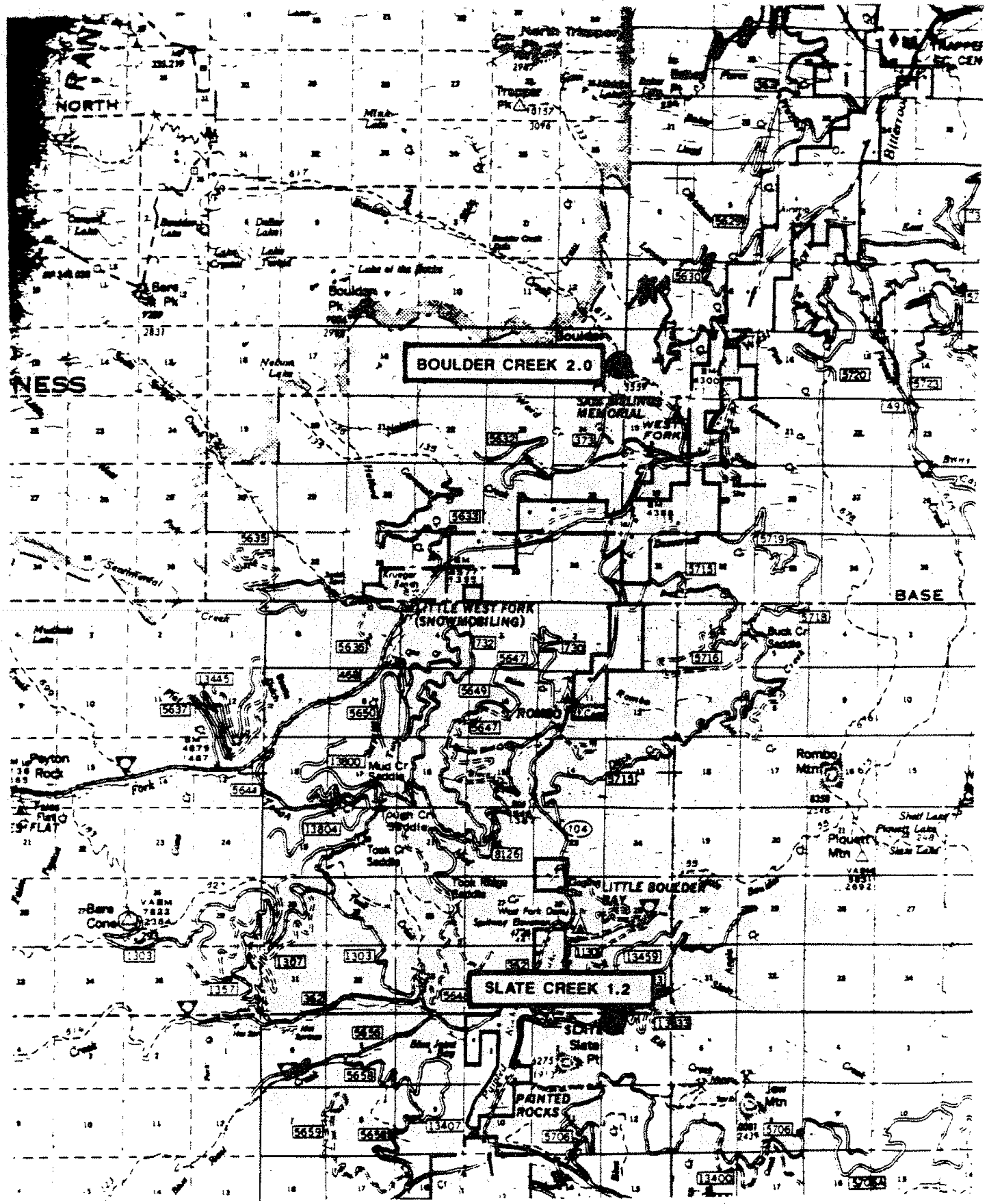


Figure 15. Map of Study Sites on the West Fork District

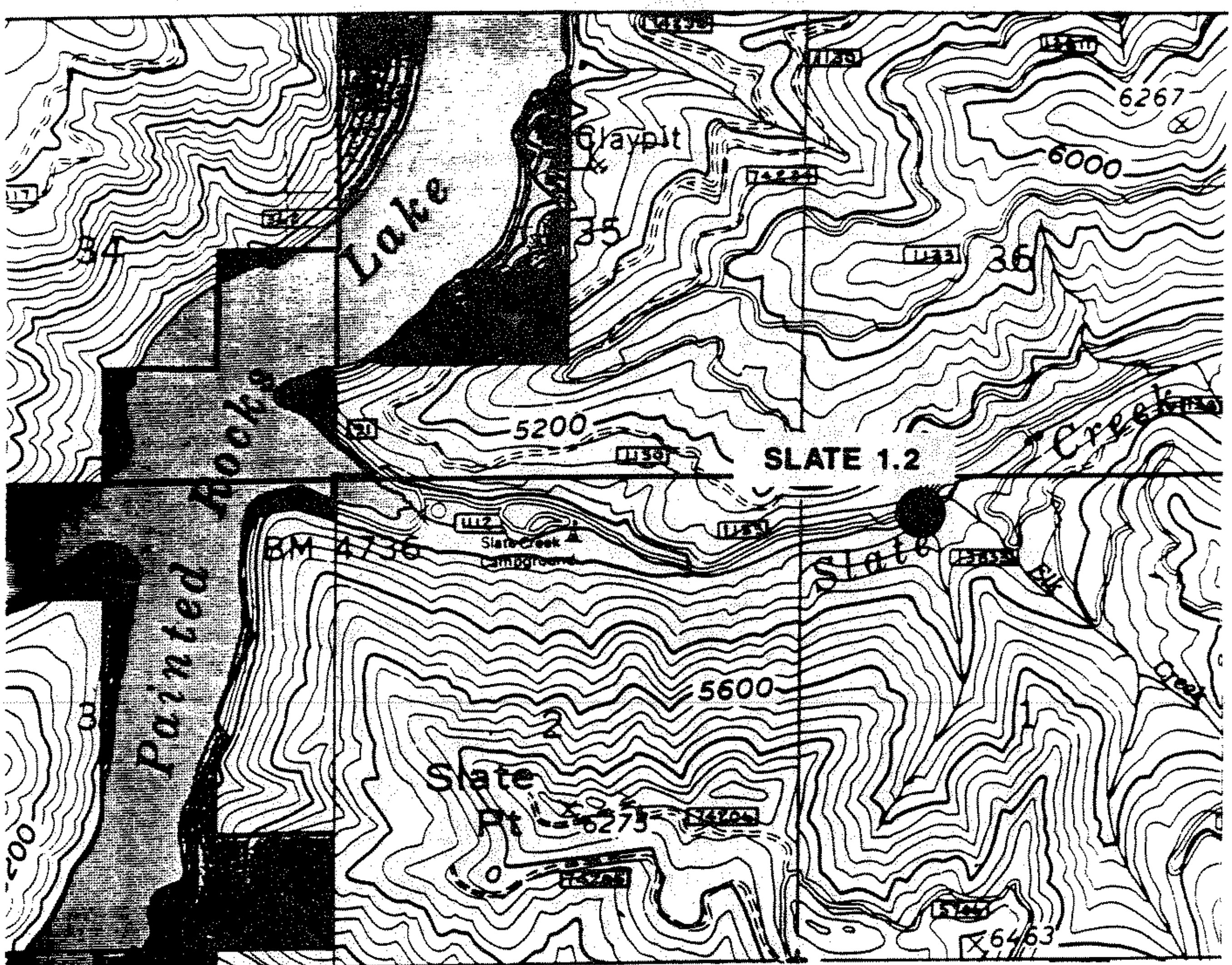


Figure 16. Map of Slate Creek Study Sites

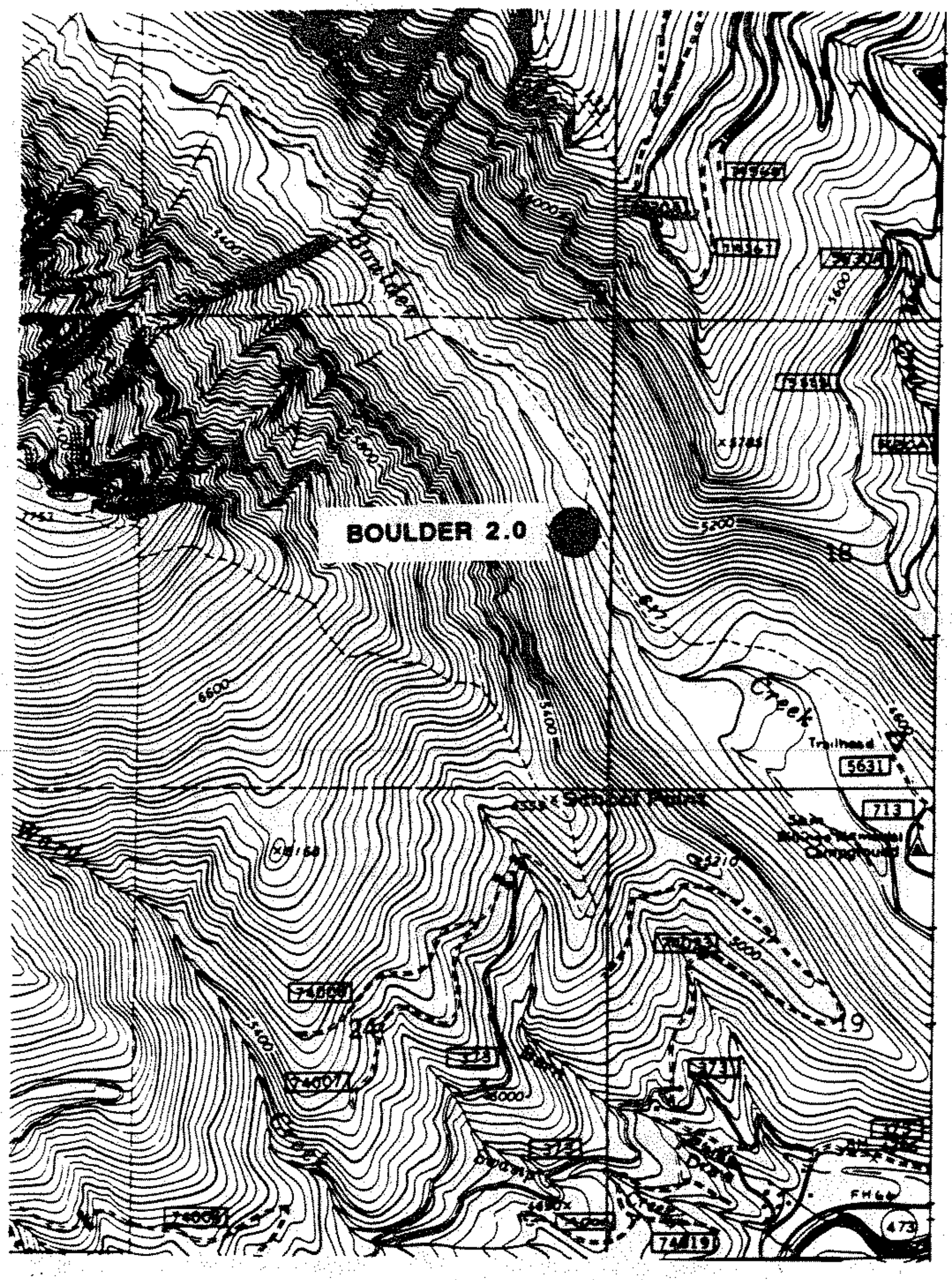


Figure 17. Map of Boulder Creek Study Site

TABLE 1-1
SELECTED HABITAT VARIABLES FOR MONITORING STREAMS.

STREAM NAME	YEAR	UNDERCUT LENGTH (FT)	CANOPY COVER (%)	AVERAGE DEPTH (IN)	AVERAGE THALWAG DEPTH (IN)	AVERAGE SHORE DEPTH (IN)	WIDTH DEPTH RATIO
BOULDER CREEK 2.0	92	304	10	7	15	3	49
DALY CREEK 0.7	89	367	1	11	18	3	31
DIVIDE CREEK 0.1	89	366	8	10	14	4	27
EAST FORK BITTERROOT RIVER 31.4	92	122	3	6	16	1	67
GOLD CREEK 0.3	90	872	21	8	11	6	17
MARTIN CREEK 1.3	92	384	3	6	14	1	54
MARTIN CREEK 7.5	92	613	3	7	14	5	33
MEADOW CREEK 5.6	89	692	8	7	11	4	29
MEADOW CREEK 7.3	89	823	8	7	11	4	29
MOOSE CREEK 1.4	91	474	6	5	12	1	58
MOOSE CREEK 3.6	92	324	1	5	11	2	63
NORTH RYE CREEK 1.9	89	316	14	6	9	2	22
RYE CREEK 12.4	89	489	5	5	8	2	27
SKALKAHO CREEK 12.6	91	526	11	11	18	3	60
SKALKAHO CREEK 15.8	89	427	15	11	16	4	30
SKALKAHO CREEK 19.6	91	446	24	8	13	3	31
SKALKAHO CREEK 3.7	91	213	18	5	13	1	59
SLATE CREEK 1.2	91	422	10	6	11	3	44
SLEEPING CHILD CREEK 09.3	89	343	9	9	15	3	34
SLEEPING CHILD CREEK 13.4	89	106	5	8	13	3	30
SLEEPING CHILD CREEK 15.7	89	545	7	10	15	4	25
TOLAN CREEK 2.1	90	135	14	6	10	1	30
TOLAN CREEK 5.1	89	766	9	8	12	2	25
TOLAN CREEK 7.3	89	704	8	7	10	4	26
WARM SPRINGS CREEK 3.5	92	76	6	7	15	3	39
WARM SPRINGS CREEK 7.0	92	296	5	6	14	2	48
AVERAGE FOR ALL STREAMS		429	9	7	13	3	38

TABLE 1-2
SELECTED HABITAT VARIABLES FOR MONITORING STREAMS

STREAM NAME	SUBSTRATE SCORE	DEPTH UNDERCUT BANK (IN)	BANK ANGLE (DEG)	SILT SAND SMALL GRAVEL (%)	COBBLE BOULDER (%)	WET WIDTH (ft)	POOLS (NO)
BOULDER CREEK 2.0	16	6	129	19	58	23	4
DALY CREEK 0.7	17	5	121	14	63	27	7
DIVIDE CREEK 0.1	14	7	113	36	50	20	5
EAST FORK BITTERROOT RIVER 31.4	16	2	140	15	53	34	1
GOLD CREEK 0.3	13	23	72	34	19	10	9
MARTIN CREEK 1.3	15	5	124	31	46	24	2
MARTIN CREEK 7.5	13	8	112	33	18	17	6
MEADOW CREEK 5.6	12	8	106	24	44	15	8
MEADOW CREEK 7.3	14	15	98	31	38	14	12
MOOSE CREEK 1.4	15	6	135	25	54	24	2
MOOSE CREEK 3.6	16	6	125	21	47	21	2
NORTH RYE CREEK 1.9	12	5	117	39	46	9	9
RYE CREEK 12.4	11	4	112	53	32	10	14
SKALKAHO CREEK 12.6	18	5	117	9	70	39	1
SKALKAHO CREEK 15.8	15	7	118	17	57	25	4
SKALKAHO CREEK 19.6	14	7	130	18	51	18	3
SKALKAHO CREEK 3.7	17	5	136	2	65	21	4
SLATE CREEK 1.2	14	6	127	31	36	17	7
SLEEPING CHILD CREEK 09.3	15	5	108	23	53	22	7
SLEEPING CHILD CREEK 13.4	16	3	120	22	64	19	3
SLEEPING CHILD CREEK 15.7	13	13	100	42	27	18	6
TOLAN CREEK 2.1	13	1	130	27	43	14	2
TOLAN CREEK 5.1	11	11	97	56	14	14	13
TOLAN CREEK 7.3	14	17	91	21	37	13	7
WARM SPRINGS CREEK 3.5	17	1	136	15	62	21	2
WARM SPRINGS CREEK 7.0	15	4	140	20	56	21	1
AVERAGE FOR ALL STREAMS	14	7	117	26	46	20	5

TABLE 1-3
SELECTED HABITAT VARIABLES FOR MONITORING STREAMS

STREAM NAME	POOL AREA (SQFT)	PERCENT POOLS	PERCENT RIFFLE	PERCENT RUN	PERCENT POCKET WATER	PERCENT LOW OVER HEAD COVER	PERCENT HIGH OVER HEAD COVER
BOULDER CREEK 2.0	2572	14	14	59	13	8	8
DALY CREEK 0.7	3800	16	8	18	57	0	0
DIVIDE CREEK 0.1	3697	18	27	5	48	0	0
EAST FORK BITTERROOT RIVER 31.4	837	3	12	38	47	3	3
GOLD CREEK 0.3	1373	16	28	31	22	0	0
MARTIN CREEK 1.3	1825	7	16	52	24	5	6
MARTIN CREEK 7.5	4063	24	6	55	15	11	6
MEADOW CREEK 5.6	2479	18	25	23	34	0	0
MEADOW CREEK 7.3	3842	24	15	28	34	0	0
MOOSE CREEK 1.4	1750	6	17	29	48	6	10
MOOSE CREEK 3.6	510	4	23	45	26	8	13
NORTH RYE CREEK 1.9	1310	17	14	19	50	0	0
RYE CREEK 12.4	3536	42	39	3	16	0	0
SKALKAHO CREEK 12.6	782	2	10	49	33	9	13
SKALKAHO CREEK 15.8	3248	13	15	29	44	0	0
SKALKAHO CREEK 19.6	1683	9	54	37	0	13	21
SKALKAHO CREEK 3.7	3941	20	30	36	13	5	9
SLATE CREEK 1.2	3184	16	35	37	10	21	25
SLEEPING CHILD CREEK 09.3	3686	16	32	24	22	0	0
SLEEPING CHILD CREEK 13.4	555	3	9	7	80	0	0
SLEEPING CHILD CREEK 15.7	4470	27	17	28	27	0	0
TOLAN CREEK 2.1	250	3	44	23	28	0	0
TOLAN CREEK 5.1	4679	31	36	2	31	0	0
TOLAN CREEK 7.3	1667	18	59	0	23	0	0
WARM SPRINGS CREEK 3.5	807	4	0	42	55	5	7
WARM SPRINGS CREEK 7.0	340	2	3	50	39	5	11
AVERAGE FOR ALL STREAMS	2342	14	23	30	32	4	5

TABLE 2-1
SELECTED STREAM BOTTOM MEASURES ON MONITORING STREAMS

STREAM NAME	SUSTRATE SCORE	SILT SAND SMALL GRAVEL (%)	COBBLE BOULDER (%)	INFILL (%)	TARZWELL SUBSTRATE RATIO	CORE SAMPLE (%<1/4")
BOULDER CREEK 2.0	16	19	58	10	39	
DALY CREEK 0.7	17	14	63	8	36	49.1
DIVIDE CREEK 0.1	14	36	50	28	59	
EAST FORK BITTERROOT RIVER 31.4	16	15	53		117	
GOLD CREEK 0.3	13	34	19	40	28	49.9
MARTIN CREEK 1.3	15	31	46	40	78	
MARTIN CREEK 7.5	13	33	18	22	81	
MEADOW CREEK 5.6	12	24	44	42	39	45.9
MEADOW CREEK 7.3	14	31	38	48	33	49.7
MOOSE CREEK 1.4	15	25	54	46	16	
MOOSE CREEK 3.6	16	21	47			
NORTH RYE CREEK 1.9	12	39	46	84	15	60.5
RYE CREEK 12.4	11	53	32	58	25	57.6
SKALKAHO CREEK 12.6	18	9	70	18	40	
SKALKAHO CREEK 15.8	15	17	57	32	25	46.5
SKALKAHO CREEK 19.6	14	18	51			
SKALKAHO CREEK 3.7	17	2	65	8	34	
SLATE CREEK 1.2	14	31	36	36	32	
SLEEPING CHILD CREEK 09.3	15	23	53		44	
SLEEPING CHILD CREEK 13.4	16	22	64	48	25	
SLEEPING CHILD CREEK 15.7	13	42	27	38	42	
TOLAN CREEK 2.1	13	27	43	42	27	55.7
TOLAN CREEK 5.1	11	56	14	74	18	
TOLAN CREEK 7.3	14	21	37	36	17	
WARM SPRINGS CREEK 3.5	17	15	62	6	39	
WARM SPRINGS CREEK 7.0	15	20	56	2	32	
AVERAGE FOR ALL STREAMS	14	26	46	35	39	46.1

TABLE 2-2
SELECTED STREAM BOTTOM MEASURES ON MONITORING STREAMS

STREAM NAME	D15	D84	W-V BOXES 1990	W-V VISUAL FINES 1990	W-V BOXES 1991	W-V VISUAL FINES 1991
BOULDER CREEK 2.0	1.7	186.8				
DALY CREEK 0.7	1.3	112.8	324	31	167	48
DIVIDE CREEK 0.1	3.8	229.2	292	48	232	36
EAST FORK BITTERROOT RIVER 31.4	13.7	329.2				
GOLD CREEK 0.3	0.6	83.6	176	39	138	47
MARTIN CREEK 1.3	8.1	229.1				
MARTIN CREEK 7.5	0.0	55.8				
MEADOW CREEK 5.6	4.5	99.9	173	44	115	41
MEADOW CREEK 7.3	0.4	83.2	199	37	105	33
MOOSE CREEK 1.4	5.0	198.5				
MOOSE CREEK 3.6	42.9	256.6				
NORTH RYE CREEK 1.9	1.4	181.0	251	74	215	60
RYE CREEK 12.4	0.6	112.8	259	67	147	36
SKALKAHO CREEK 12.6	26.3	211.7				
SKALKAHO CREEK 15.8	8.5	252.2	167	41	148	40
SKALKAHO CREEK 19.6	3.4	224.0				
SKALKAHO CREEK 3.7	22.4	252.3				
SLATE CREEK 1.2	0.2	61.4				
SLEEPING CHILD CREEK 09.3	12.2	265.1				
SLEEPING CHILD CREEK 13.4	0.3	259.8	257	36	237	29
SLEEPING CHILD CREEK 15.7	1.4	99.9	303	52	219	57
TOLAN CREEK 2.1	1.2	116.4	172	50	168	39
TOLAN CREEK 5.1	1.5	44.6	133	51	136	54
TOLAN CREEK 7.3	1.8	62.7	97	26	96	37
WARM SPRINGS CREEK 3.5	12.6	337.3				
WARM SPRINGS CREEK 7.0	5.0	305.6				
AVERAGE FOR ALL STREAMS	7.0	178.9	216	46	160	42

Stevensville district

The only stream where fish populations have been sampled for monitoring purposes is Gold Creek (Figures 2,3). Gold Creek contains westslope cutthroat, bull trout and bull trout x brook trout hybrids (Figure 18). Population estimates were collected in 1990 and 1991. The population and habitat variables are discussed in a previous report (Clancy 1991).

Threemile Creek

The Threemile Creek drainage has historically contributed large amounts of sediment to the Bitterroot River. At the present time, the Soil Conservation Service is involved with a project to stabilize the drainage. It involves, better water management by two large ditch companies that have historically used Threemile Creek as a relief, stabilizing streambanks on private land in the lower drainage, and stabilizing sediment sources on state land in the upper drainage. Five study sections were electrofished in 1991 and 1992 to collect baseline data on fish populations in Threemile Creek (Figure 22).

Threemile Creek is dominated by eastern brook trout in most reaches (Figure 23). Section 1.8, which lies at the upper boundary of the Lee Metcalf Wildlife Refuge supports a small number of rainbow and brown trout, and little else. Eastern brook trout were found in the highest numbers in the section upstream of Wheelbarrow Creek. The most significant decline in trout number occurs downstream of the Supply Ditch in section 3.6. Water management of the Supply Ditch appears to be introducing large amounts of sand into Threemile Creek downstream of the creek crossing.

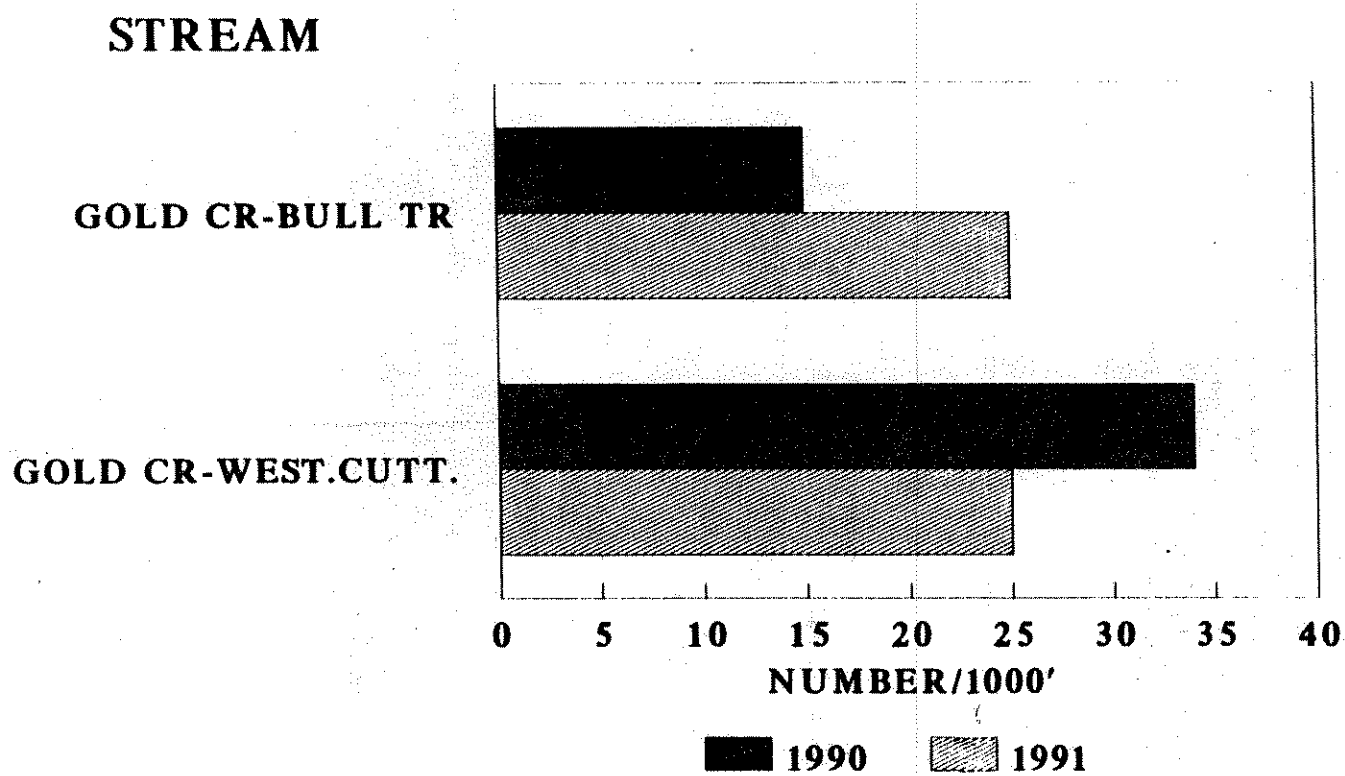
If the project by the Soil Conservation Service is successful in controlling sediment in the Threemile drainage, it will probably be beneficial to the creek and the Bitterroot River.

Darby district

Several study sections have been sampled on the Darby district. The locations are mapped in this report (Figures 4-8). Skalkaho Creek supports the highest number of westslope cutthroat of all the sites studied to date on the Darby district (Figure 19). The highest number of bull trout is found in the Daly Creek-Skalkaho Creek area (Figure 19). Upper Skalkaho Creek is a native fishery but below the confluence with Daly Creek, we have captured a few brook trout in study site Skalkaho Creek 12.6. Below the National Forest, the fishery is made up of more species and native species become less abundant (Figure 24).

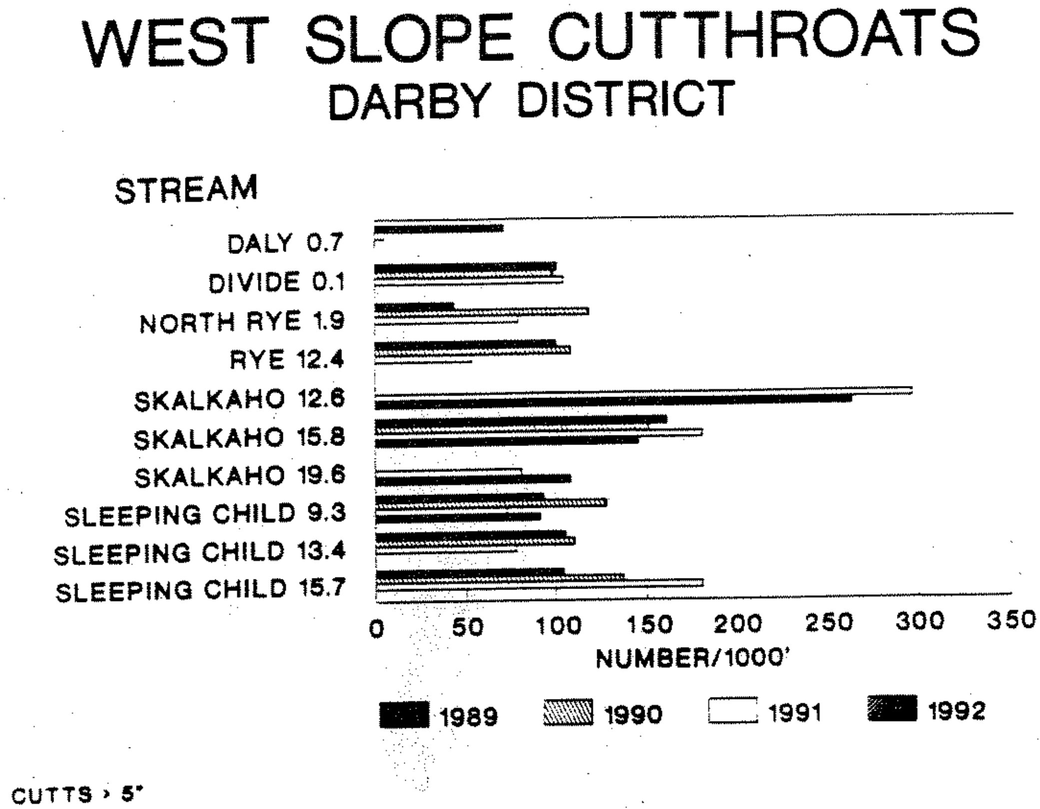
One notable drainage on the district is the Rye Creek drainage. Westslope cutthroat numbers are within the range of the other sections on the district, however, bull trout numbers are very low in the Rye Creek drainage. The section on the North Fork contains large numbers of brook trout but no bull trout and the

TROUT POPULATIONS
STEVENSVILLE DISTRICT



FISH > 5"

Figure 18. Westslope Cutthroat and Bull Trout Population Estimates on Gold Creek during 1990 and 1991



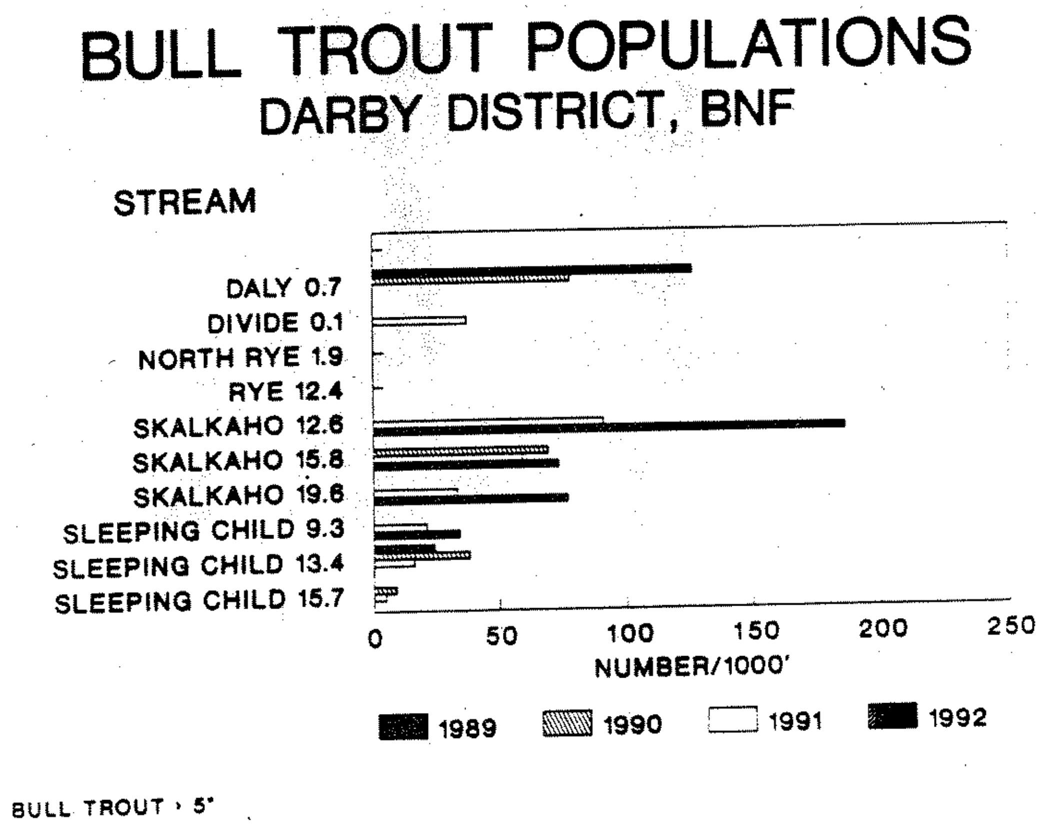


Figure 19. Westslope Cutthroat and Bull Trout Population Estimates on the Darby District During 1989-1992

section on upper Rye Creek contains no brook trout and only a very small number of bull trout. The reason for the absence of bull trout on upper Rye Creek is not clear. It does contain higher amounts of fine sediment than other streams (Table 2).

Sleeping Child and Divide Creeks are discussed in a previous report (Clancy 1991).

Sula district

Several sections have been sampled on the Sula district (Figure 20). Warm Springs Creek has the highest number of westslope cutthroat and bull trout of the study sites sampled to date. The highest number of westslope cutthroat trout is in section 3.5 and the highest number of bull trout is in section 7.0, which is located nearly 2.0 miles upstream of the Crazy Creek trailhead. Brook trout have been captured in Warm Springs Creek in the vicinity of the Crazy Creek campground. At the present time, the upstream limit of brook trout is unknown. Brook trout have also been found in the lower reaches of Meadow Creek. During the 1993 field season we will attempt to locate the upstream limit of these fish.

One notable stream on the district is Martin Creek. It supports a healthy population of westslope cutthroat but has a low population of bull trout, particularly in the lower reaches. The drainage has been heavily logged and roaded, and the sediment measures indicate slightly higher levels of fine sediment than average. However the very low numbers of bull trout may be related to other factors, also. Future study, including water temperature analysis may indicate why these populations are so low.

Tolan and Meadow Creeks were discussed in a previous report (Clancy 1991)

West Fork district

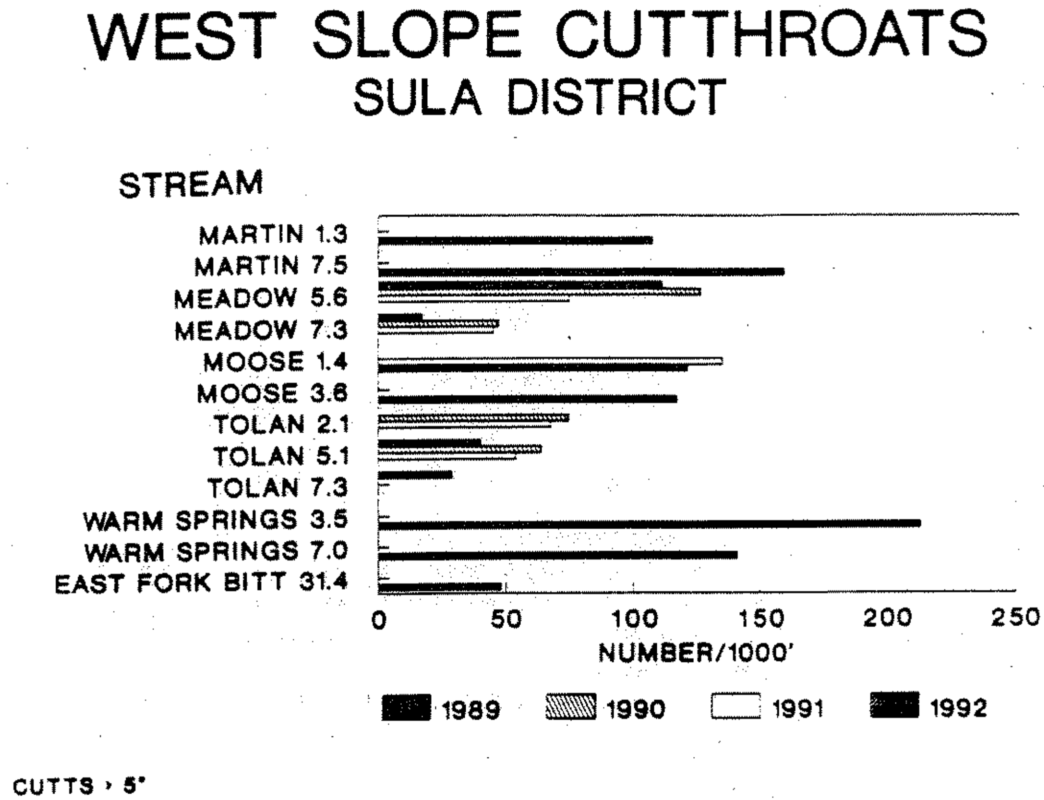
Slate Creek and Boulder Creek are the only streams that have been sampled for long term monitoring purposes on the West Fork district (Figures 15-17).

The Boulder Creek study site is within the Boulder Creek Research Natural Area and it supports a healthy population of westslope cutthroat and bull trout. The bull trout population is not illustrated on the figure because a statistically valid estimate was not collected because of sampling inefficiency.

Slate Creek is a tributary of Painted Rocks Reservoir. It supports an average population of westslope cutthroat and a small population of bull trout, brook trout and hybrids (Figure 21).

Bull trout-brook trout interactions

While bull trout are native to the Bitterroot drainage, brook trout are not. Little work has been done to assess interactions



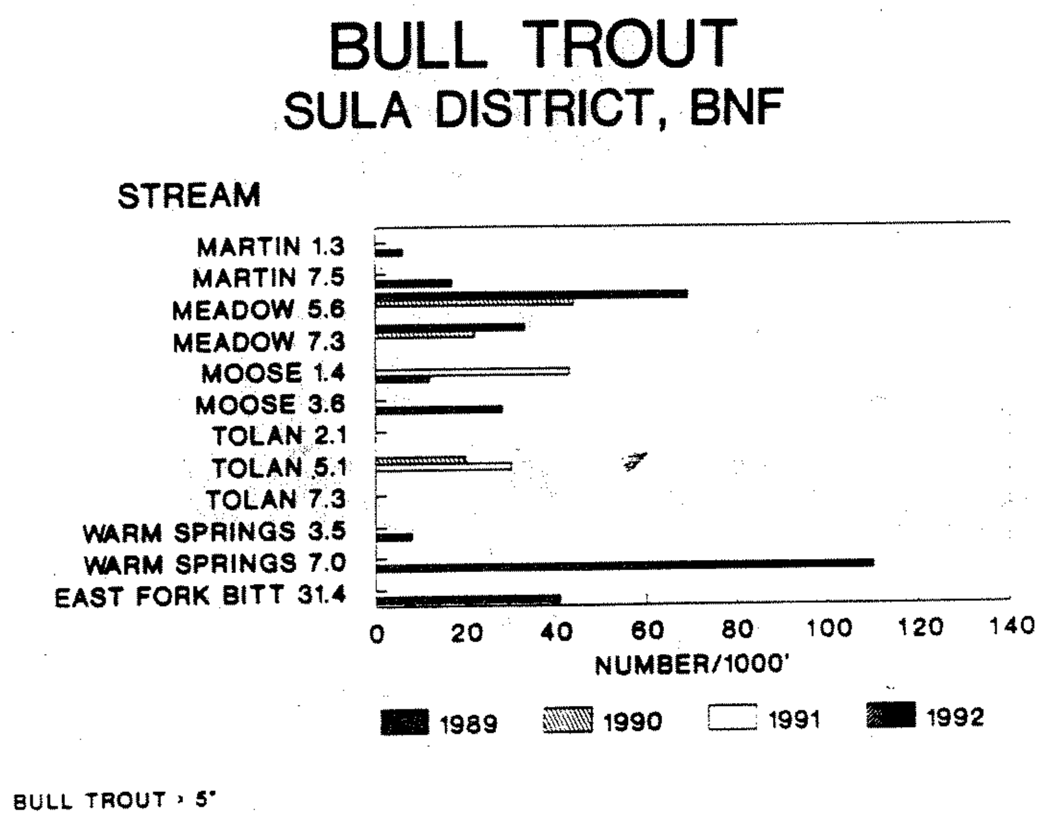
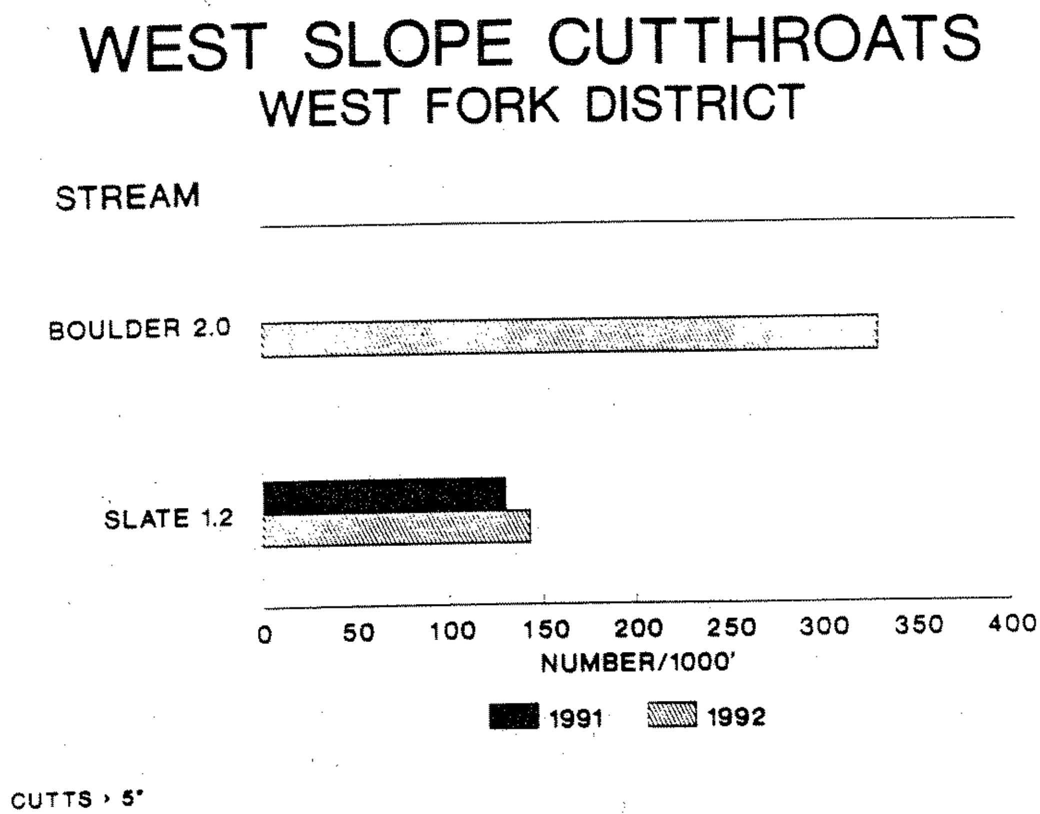


Figure 20. Westslope Cutthroat and Bull Trout Population Estimates on the Sula District During 1989-1992



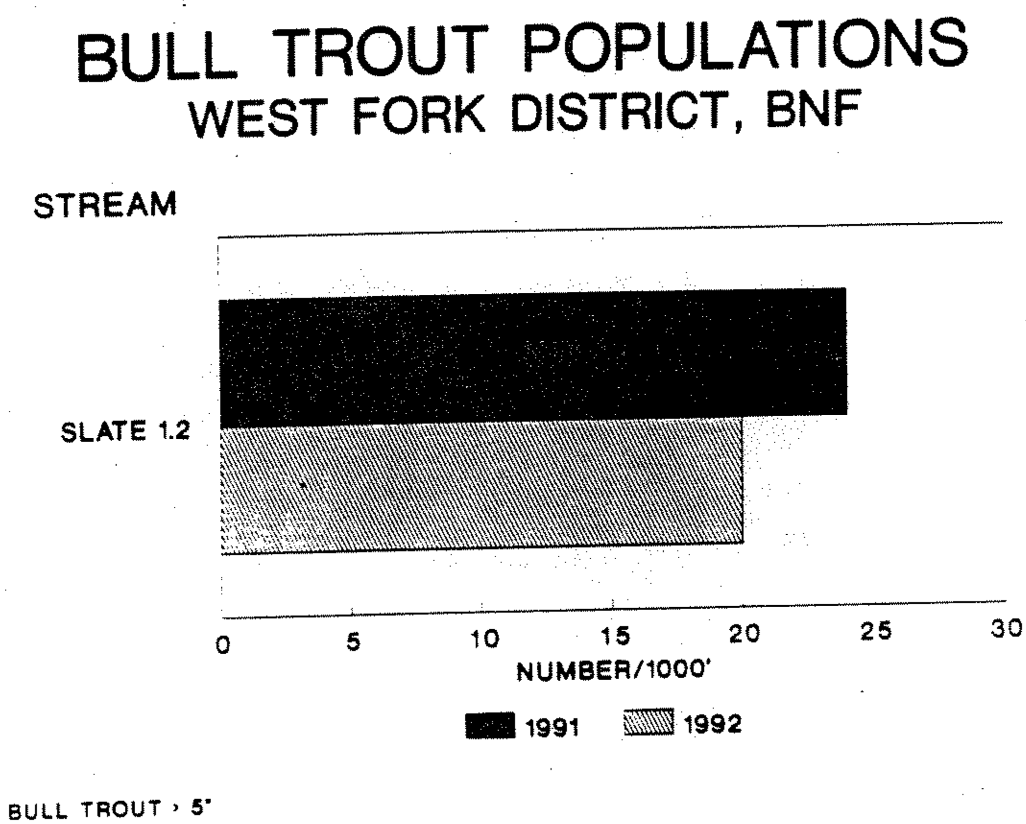


Figure 21. Westslope Cutthroat and Bull Trout Population Estimates on West Fork District During 1991 and 1992

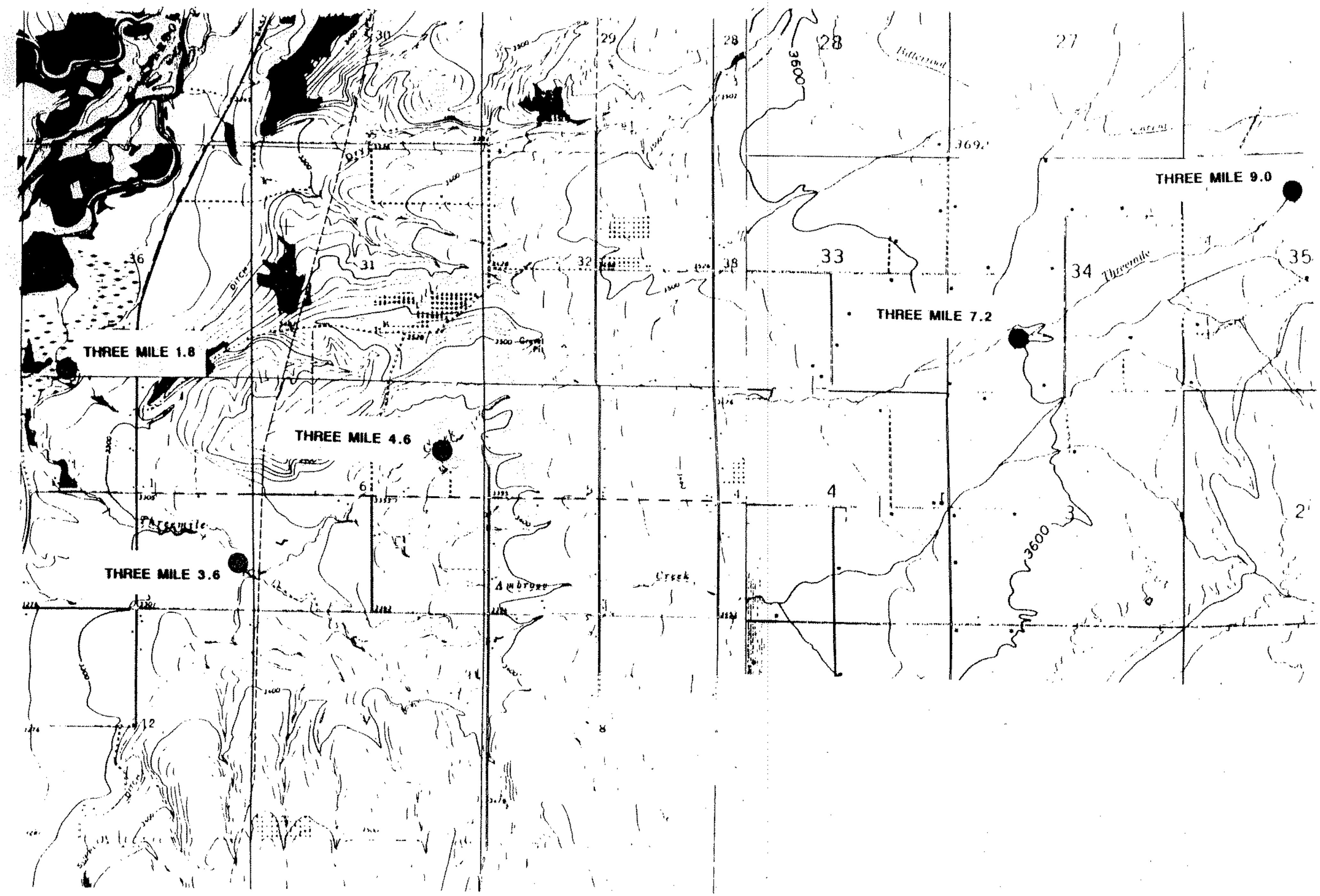


Figure 22. Map of Study Sections on Threemile Creek

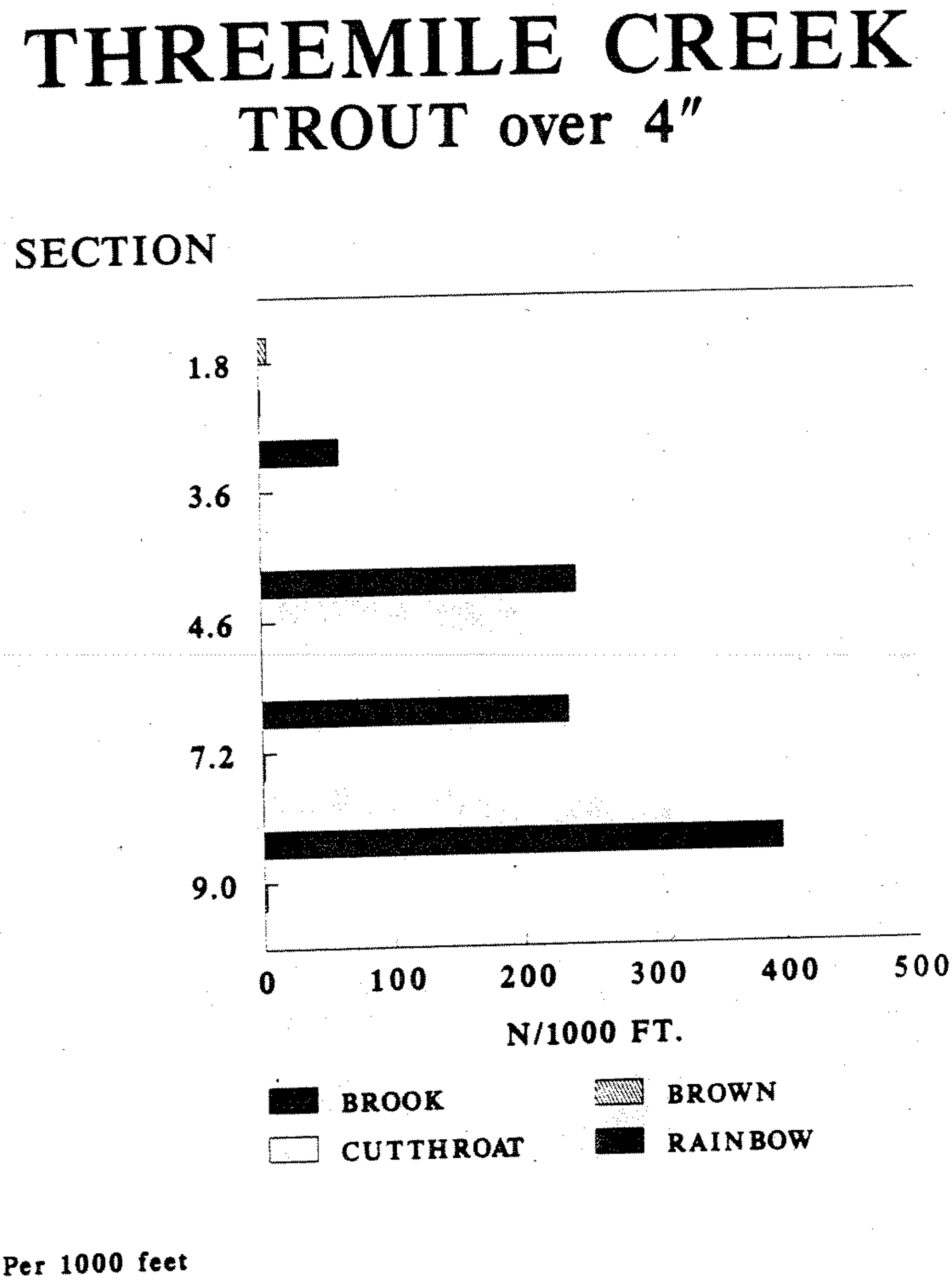
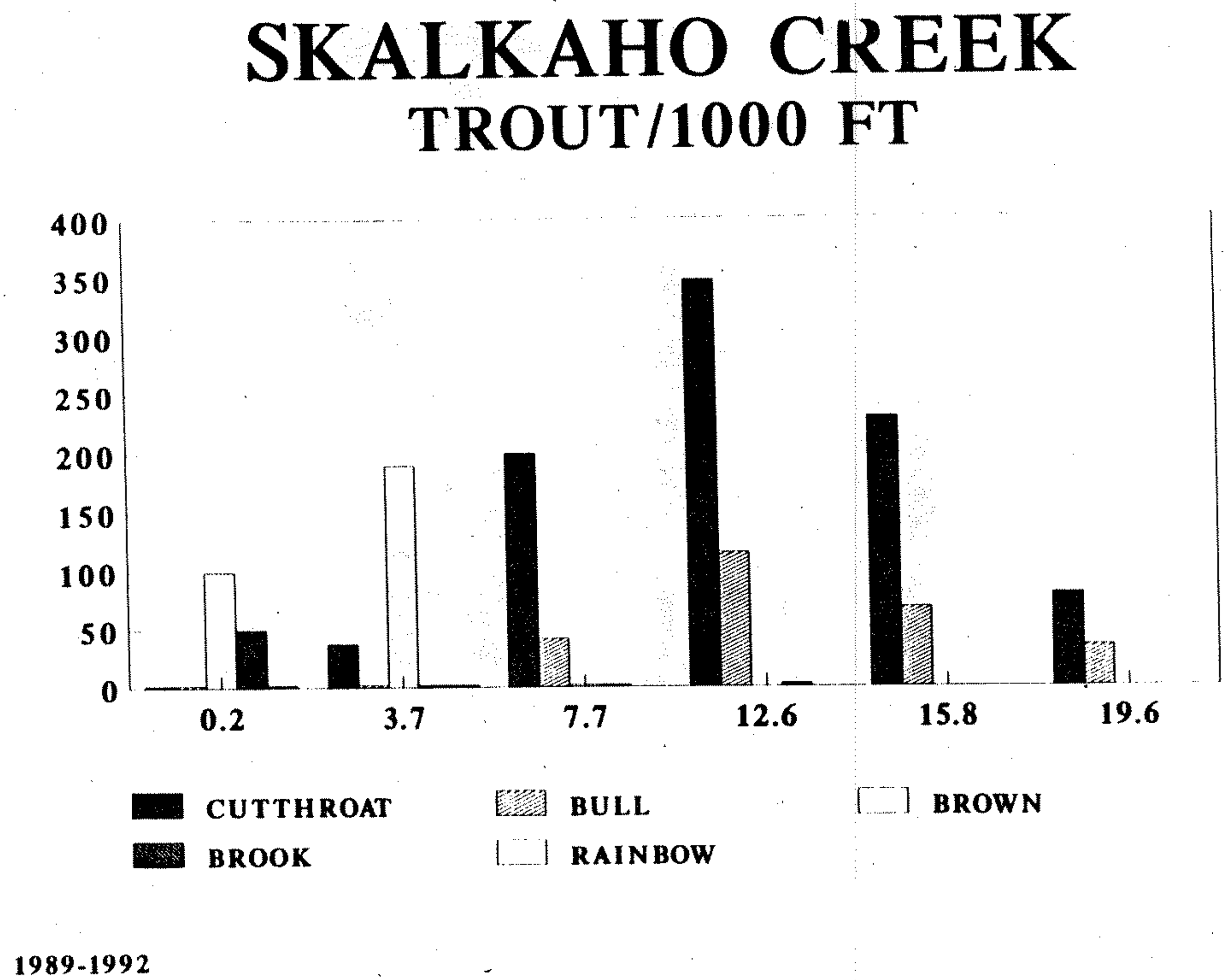


Figure 23. Trout Population Estimates in Threemile Creek During 1990 and 1992



Figur^ 24. Trout Population Estimates in Skalkaho Creek Betwwen 1989 and 1992 between the two species, but they are known to hybridize, and usually produce an infertile offspring (Leary et al 1983). Data collection on the BNF indicates that brook trout may be replacing bull trout populations in some streams. Analysis of fisheries data on the Bitterroot National Forest indicates that the two species never coexist in large numbers (Table 3). A majority of streams contain one species and not the other (Figure 25).

There is concern that brook trout may be able to outcompete bull trout in some habitats particularly those containing more sediment and higher temperatures. Brook trout tend to have higher survival to emergence than cutthroat trout and probably bull trout in high sediment habitats (Hausle and Coble 1976, Irving and Bjornn 1984, Weaver and Fraley 1991).

On the Bitterroot National Forest, watershed condition has been classified into three categories, healthy, sensitive and high risk (USDA 1993). Bull trout populations with significant (10 or more fish longer than 5 inches per 1000 feet) numbers of individuals have only been found in healthy and sensitive drainages (Figure 26). Brook trout populations with significant numbers of individuals have been found in all three categories. Furthermore, only 20% of high risk drainages have been found to support bull trout while 85% of them contain brook trout (Figure 26). This distribution indicates that brook trout may be more competitive in drainages that have been impacted by development.

The watershed relationship is clouded by the unknown distribution of brook trout in the early 20th century. Most of the brook trout were stocked in the early part of the 20th century. They were stocked by many individuals and no records exist of stocking dates and locations of most of these fish. This information is important because bull trout probably, historically, had all of the Bitterroot drainage below barriers available to them. Since the brook trout were not stocked in all waters, their distribution may be related to the locations of their introductions.

A map of road locations in 1923 was consulted to identify roads present at that time. We assumed that brook trout were stocked wherever roads were present in 1923 and may have potentially been stocked along trails that led to mountain lakes. If brook trout are invading into areas where they were not introduced, we would expect to find them today some distance from their likely stocking locations. In general, brook trout are found in streams near a 1923 road location (Table 4). However, there are some populations that are far from a 1923 road location. Six of these sites do not lead to a mountain lake. It is possible that small roads that were not on the map led to some of these sites and brook trout were stocked in some of these locations, however the evidence does indicate that brook trout may be invading some areas on their own. Continued monitoring of forest streams is the only way to definitely conclude if brook trout are still moving into new habitats.

Brook trout may be able to outcompete bull trout in some habitats. Brook trout appear to be replacing bull trout in the

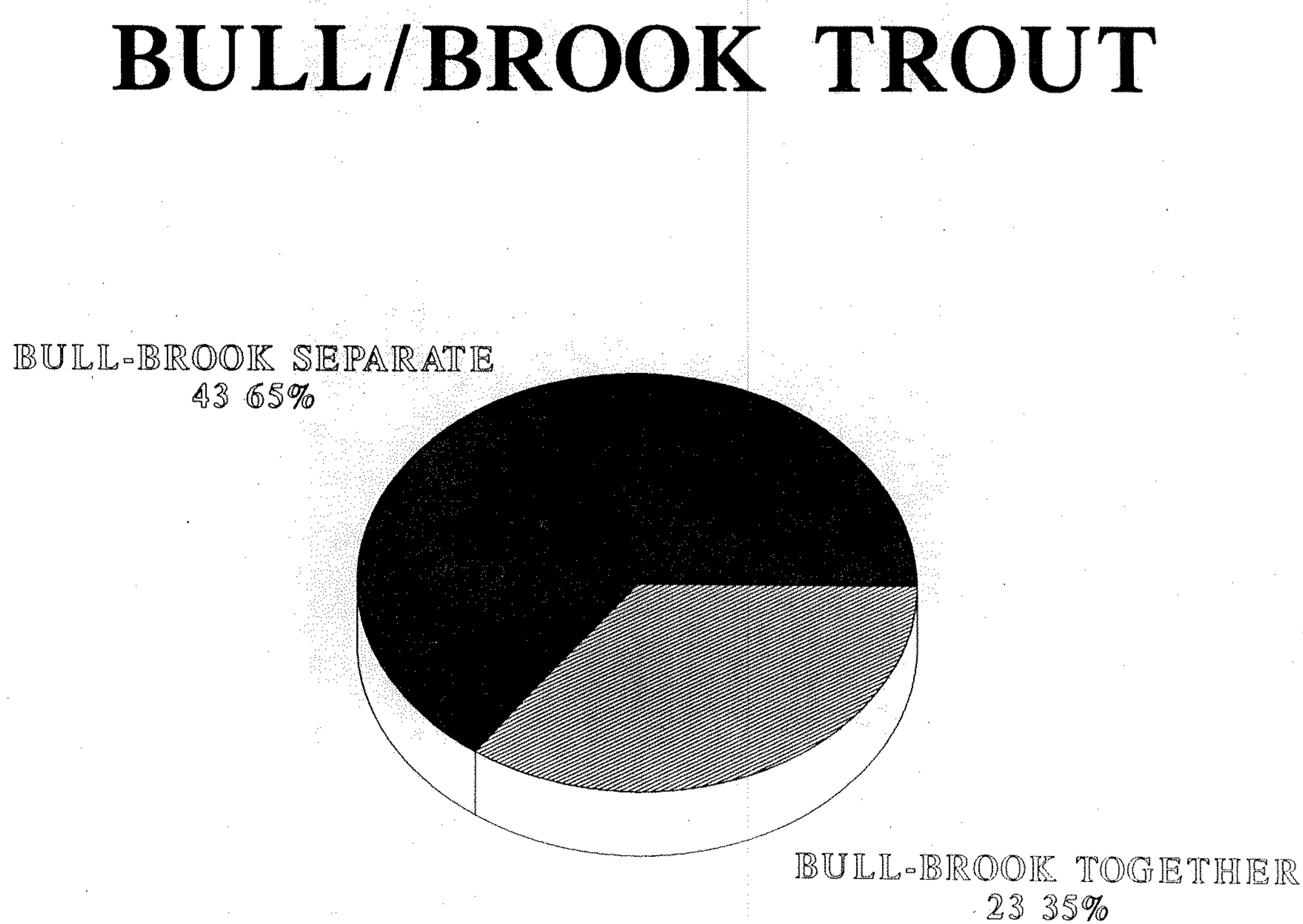
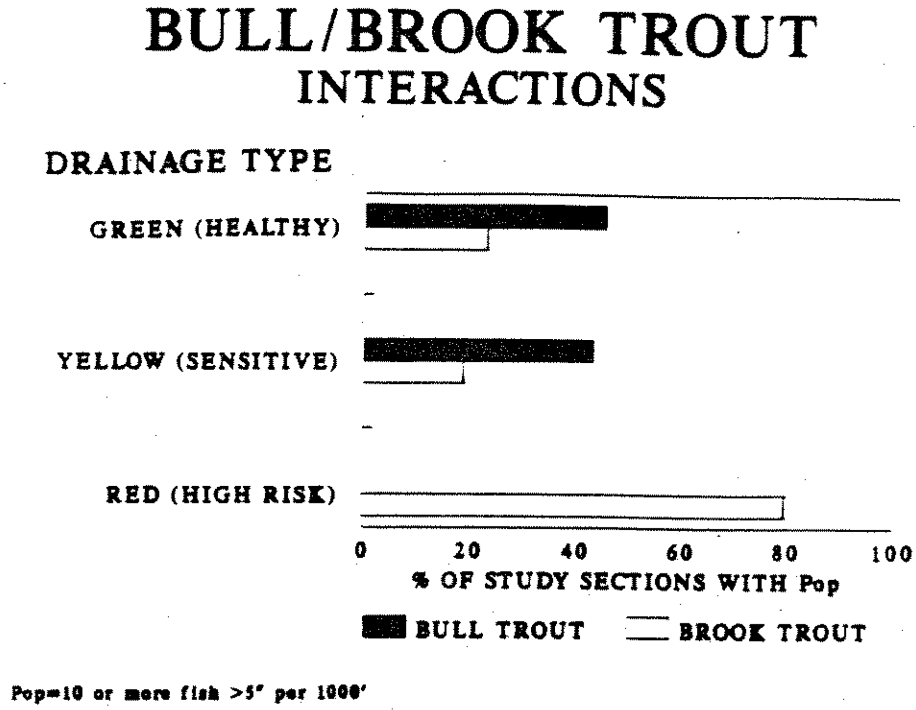


Figure 25. Bull-brook trout interaction.



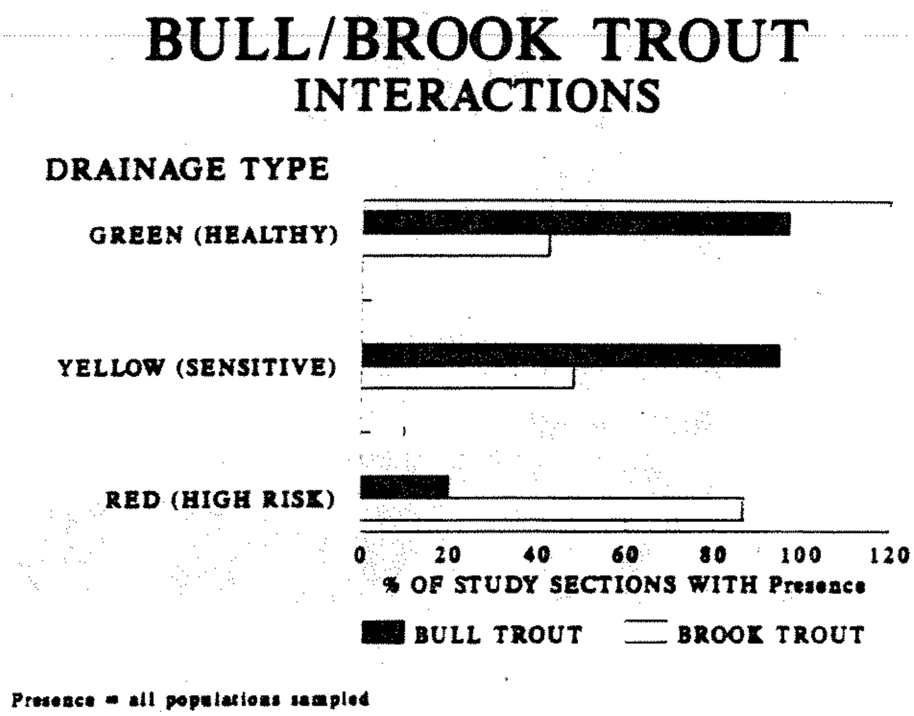


Figure 26. Bull Trout and Brook Trout Population in Different Watersheds During 1989-1992

South Fork of Lolo Creek (Leary et al 1991). If this relationship does occur, the populations of bull trout in Meadow Creek and Warm Springs Creek may be vulnerable to competition from brook trout.

Table 3. The status of westslope cutthroat, bull trout and brook trout on some streams on the Bitterroot National Forest in 1989-1992.

STREAM SECTION	WS CUTTHROAT	BULL TROUT	BROOK TROUT
Bass 3.5	Pop	0	Pop
Bear 6.0	Pop	1	Pop
Beaver 0.3	Pop	1	0
Bertie Lord 0.2	Pop	1	Pop
Big 6.5	Pop	1	1
Boulder 2.0	Pop	Pop	0
Cameron 15.4	Pop	0	Pop
Chaffin 3.1	Pop	1	Pop
Chaffin 3.2	Pop	0	1
Coal 1.3	Pop	0	0
Daly 0.7	Pop	Pop	0
Divide 0.1	Pop	Pop	0
East Fork Bitterroot 19.1	Pop	1	0
East Fork Bitterroot 25.6	Pop	Pop	0
East Fork Bitterroot 31.4	Pop	Pop	0
Gold 0.3	Pop	Pop	0
Johnson 0.7	Pop	1	0
Laird 1.4	Pop	0	Pop
Lick 1.9	Pop	0	Pop
Little West Fork 1.3	Pop	1	1
Little West Fork 3.1	Pop	1	0
Martin 1.3	Pop	1	0
Martin 7.5	Pop	Pop	0
Meadow 5.2	Pop	Pop	0
Meadow 5.6	Pop	Pop	0
Meadow 7.3	Pop	Pop	0
Moose 1.4	Pop	Pop	0
Moose 3.6	Pop	Pop	0
Nez Perce Fork 7.0	Pop	1	1
Nez Perce Fork 9.8	Pop	1	Pop
Nez Perce Fork 11.8	Pop	1	1
North Fork Rye 1.9	Pop	0	Pop
Piquett 1.3	Pop	1	Pop
Railroad 1.4	Pop	Pop	0
Reimel 2.6	Pop	0	Pop
Reimel 2.9	Pop	0	Pop
Reimel 3.8	Pop	0	Pop
Rye 12.4	Pop	1	0
Sheep 0.2	Pop	1	0

Pop = 10 or more fish >5" per 1000', or if less than 10, large number of fish <5"
1 = species present, but in small numbers
0 = species not present

Table 3 (continued)

STREAM SECTION	WS CUTTROAT	BULL TROUT	BROOK TROUT
Skalkaho 3.7	Pop	1	Pop
Skalkaho 7.7	Pop	1	1
Skalkaho 12.6	Pop	Pop	1
Skalkaho 15.8	Pop	Pop	0
Skalkaho 19.6	Pop	Pop	0
Slate 1.2	Pop	Pop	Pop
Sleeping Child 9.3	Pop	Pop	1
Sleeping Child 13.4	Pop	Pop	0
Sleeping Child 15.7	Pop	Pop	0
Sweathouse 6.4	Pop	Pop	0
Threemile 3.5	0	0	Pop
Threemile 7.2	1	0	Pop
Threemile 9.1	1	0	Pop
Tincup 6.6	Pop	1	Pop
Tolan 2.1	Pop	1	Pop
Tolan 5.1	Pop	Pop	0
Tolan 7.3	Pop	1	0
Trapper 1.3	Pop	1	Pop
Trapper 3.6	Pop	1	Pop
Warm Springs 3.5	Pop	1	Pop
Warm Springs 5.6	Pop	1	0
Warm Springs 7.0	Pop	Pop	0
Watchtower 0.8	Pop	1	1
Waugh 0.7	Pop	0	1
West Fork Bitterroot 30.3	Pop	1	1
West Fork Bitterroot 36.4	Pop	1	0
Willow 11.2	Pop	1	1
Woods 0.4	Pop	1	1

Pop = 10 or more fish >5" per 1000', or if less than 10, large number of fish <5"
1 = species present, but in small numbers
0 = species not present

Table 4. Present location of brook trout and bull trout in relation to roads present in 1923 or other likely stocking locations.

	brook trout	bull trout
Within 1 mile of 1923 road	25	19
Further than 1 mile from 1923 road	6*	20

* Streams and their distance from a 1923 road are: North Rye 1.7, Cameron 2.5, Reimel 1.3, Reimel 2.0, Tolan 1.5, and Slate 1.6.

Bull trout-brook trout habitats

Using discriminant analysis, habitat measurements from streams that contain bull trout were compared to streams that contain brook trout. We classified study sites according to the number and type of char that are present. Since most streams either support bull trout or brook trout, we were able to classify most streams as "bull trout" streams or "brook trout" streams. To qualify as the appropriate stream class, a study site had to support greater than 1 pound per acre of that species. Study sites that contain greater than 1 pound per acre of both species were placed in a third category of stream classified as "both".

Three habitat variables, in combination, identified bull, brook and "both" streams 86%, 82% and 100% of the time, respectively. These habitat variables are elevation, wetted width, and high overhead cover. Streams that met the classification as "bull trout" streams were wider streams, at higher elevations that had less high overhead cover (Table 5).

It appears that these three variables discriminate the habitat types of these species (Figure 27). However, sampling bias plays a role in the effectiveness of the variables. The data indicates that bull trout are found in larger, high elevation streams which have less overhead cover. Bull trout are present in other high elevation streams that are small and have high overhead cover percentages, but we do not have sampling data from many of these streams. Also, larger streams will tend to have smaller values for high overhead cover, since it is rated on a percent basis. A wide stream with the same amount of overhead cover as a narrow stream will have a lower percentage of overhead cover. Elevation is probably a valid indicator of bull trout habitat. Of the sites sampled so far, bull trout have been collected at elevations between 4300 ft and 6300 ft, averaging 5385 ft. Brook trout have been found at elevations between 3800 ft and 5100 ft, averaging 4600 feet. The sites containing a mix of both species have been found between 4200 ft and 5900 ft, averaging 4800 ft. Although this is not a random sample, it does demonstrate that brook trout are presently found at lower elevations than bull trout. The width of the stream may also be important, but we have not sampled a wide variety of stream widths.

While these three variables clearly demonstrate a difference between bull and brook trout streams, other variables may play a role when the sample size of streams is larger. For example, streambottom composition, by itself, identified bull trout, brook trout and "both" streams 64%, 45% and 25% of the time. However, in combination with other measurements, it did not make a significant contribution.

For the discriminant analysis to be more complete we will sample more streams to add to the database.

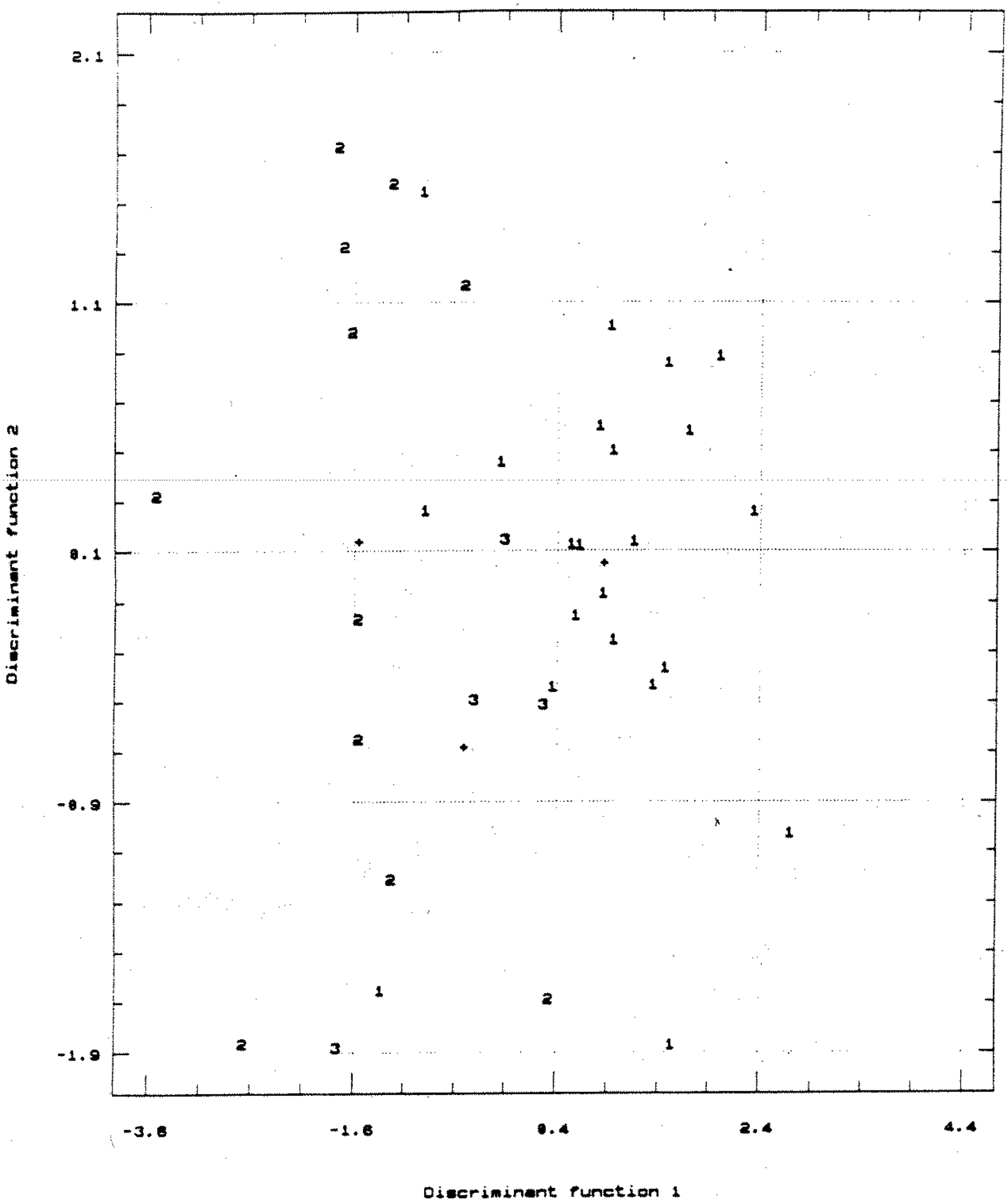


Figure 27. Discrimination Analysis of Bull Trout, Brook Trout and "Both" Streams

1 = Bull Trout, 2 = Brook Trout, 3 = "Both"

Table 5. Discriminant analysis for streams containing bull trout, brook trout and both. The variables used to make the predictions are elevation, wetted width, and high overhead cover.

	1	2	3
Actual streams	22	11	4
Predicted streams	19 (86%)	9 (82%)	4 (100%)

1-greater than one lb/acre of bull trout
2-greater than one lb/acre of brook trout
3-greater than one lb/acre of both species

The distribution of bull trout and brook trout on the BNF is clearly related to the location of roads. Streams sites that are near historic roads have a higher tendency to contain brook trout than sites that are unroaded (previous discussion). It is likely that brook trout were stocked in the areas that historically were roaded. Also, brook trout tend to be found in streams characterized by lower elevations, narrower widths, finer substrates and more overhead cover. Attempting to separate the distribution of brook trout from bull trout based on historic stocking and habitat variables is difficult. Without historic fish distribution information, any conclusions would be speculative. It is likely that stocking patterns and habitat variables have both affected the distribution of brook trout.

<u>Genetic testing</u>

Trout from several streams have been tested for genetic purity at the University of Montana (Table 6). This testing will continue as we attempt to identify the locations of pure strain populations of westslope cutthroat and bull trout. To date, 22 of 31 populations of westslope cutthroat that have been tested, have been pure. However, most of the sample sizes are too small for statistical validity.

The bull trout analysis is part of a study to attempt to field identify bull trout from brook trout and hybrids of the two species. The numbers and composition of fish analyzed in each creek have no significance.

During 1991 and 1992 samples of bull trout, brook trout and their hybrids were sent to the University of Montana for genetic analysis. The fish were field identified and compared to the electrophoretic analysis. The results indicate that, in most cases, field identification is accurate to determine whether fish are bull trout, brook or their hybrids, but it is not foolproof. One hybrid was misidentified as a bull trout.

More samples will be analyzed in the future, but this study indicates that the list of fish species present in each stream is probably accurate.

Table 6. Results of electrophoretic testing of trout populations in selected BNF streams.

Westslope cutthroat

Stream	Location	Sample Size	Year	Status
Bass Creek	T10N,R20W,S33	11	1984	3
Bear Creek	T7N,R21W,S7	11	1991	2
Beaver Creek	T4S,R22W,S4	4	1992	1*
Bluejoint Creek		5	1987	1*
Chaffin Creek	T2N,R21W,S3	15	1990	1*
Coal Creek	T2N,R22W,S16	15	1990	1*
Fred Burr	T7N,R21W,S21	12	1991	1*
Fred Burr	T7N,R22W,S14	7	1991	1*
Gold Creek	T7N,R19W,S1	30	1985, 1990	1
Lick Creek	T4N,R21W,S21	1	1992	1*
Martin Creek	TN2,R17W,S16	25	1985	1
Meadow Creek	T1N,R18W,S10	21	1989	1
Mill Creek	T6N,R21W,S4	14	1991	2
Moose Creek	T2N,R17W,S17	25	1985	1
North Rye Creek	T3N,R20W,S24	8	1990	1*
Piquett Creek	T1N,R21W,S10	15	1990	1*
Railroad Creek	T5N,R18W,S29	1	1992	1*
Reimel Creek	T1N,R19W,S15	2	1992	1*
Reimel Creek	T1N,R19W,S35	3	1992	1*
Rye Creek	T3N,R20W,S31			
Sheafman Creek	T7N,R21W,S30	21	1991	3
Skalkaho Creek	T5N,R18W,S19	15	1991	1*
Slate Creek	T2S,R22W,S1	2	1991	1*
Sleeping Child Ck.	T4N,R19W,S28	42	1985, 1989	1
Sweathouse Creek	T8N,R21W,S19	12	1991	3
Tincup Creek	T3N,R21W,S17	50	1982	2
Tincup Creek	T3N,R22W,S32	10	1992	2,3
Trapper Creek	T2N,R21W,S21	13	1992	2
Warm Springs Creek	T1N,R20W,S14	5	1990	2
West Fk. Bitt.	T3S,R22W,S9	3	1992	1*
West Fk. Bitt.	T3S,R22W,S9	13	1991	1*
Willow Creek	T6N,R19W,S10	5	1990	1*

1 = pure westslope cutthroat
2 = hybridized with rainbow trout
3 = hybridized with Yellowstone cutthroat
* = sample too small for statistical validity

bull trout-brook trout

Stream	Location	Sample Size	Year	Status
Bear Creek	Same as above	2	1991	bull-brook hybrid
		9	1991	brook trout

Divide Creek	T4N,R19W,S28	4	1991 bull trout
Fred Burr Creek	T7N,R22W,S14	12	1991 brook trout
Gold Creek	Same as above	2	1991 bull trout
		2	1991 brook trout
		1	1991 bull-brook hybrid
Meadow Creek	Same as above	9	1989, 1991 bull trout
North Rye Creek	Same as above	5	1991 brook trout
Skalkaho Creek	T5N,R19W,S27	9	1991 bull trout
		1	1991 brook trout
Slate Creek	T2S,R22W,S1	1	1991 bull trout
		1	1991 bull-brook hybrid
		2	1991 brook trout
Sleeping Child Cr	T4N,R19W,S7	8	1991 bull trout
		1	1991 brook trout
Tolan Creek	T1N,R19W,S24	3	1991 bull trout
		4	1991 brook trout
West Fk. Bitt. R.	T3S,R22W,S9	3	1991 brook trout
Woods Creek	T3S,R22W,S20	2	1991 bull trout
		1	1991 bull-brook hybrid
		2	1991 brook trout

Trout-habitat relationships

We are attempting to understand the relationship between trout populations and habitat on the BNF. Habitat variables that are recognized as important to trout are being measured on the monitoring reaches (Table 7). Several different measurements of streambottom composition have been used on each reach since studies have indicated that it is particularly important to bull trout (Leathe and Enk 1985, Weaver and Fraley 1991, Pratt, 1992).

Water temperature, which is also considered to be very important to bull trout is difficult to collect over a broad area. During the 1993 field season thermographs will be placed at several study sites for comparison purposes.

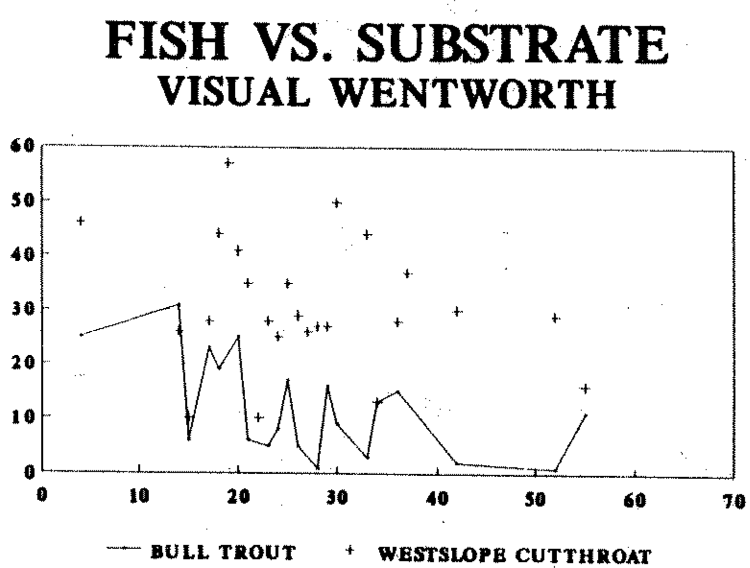
Table 7. Habitat variables measured on the long term monitoring reaches of the Bitterroot National Forest.

habitat types	wetwidth
pool depth	channel width
residual pool volume	average depth
source of pool	maximum depth
type of pool	mean shoredepth
quality of pool	substrate score
canopy	depth of undercut
length of undercut bank	mean bankangle
overhead cover	woody debris
streambottom composition(wentworth)	sinuosity
surface fines in riffles(grid)	elevation
pebble counts	gradient
t-walk	

Correlation matrices were run between cutthroat trout, bull trout and these habitat variables. Most of the relationships were not significant (p>.05). Correlation matrices were calculated on small streams (<20 feet wetted width) and on large streams (>20 feet wetwidth) (Tables 8 and 9). These correlations are not interactive, they are simple correlations between the fish and each habitat variable. The simple regressions indicate that on all size streams the streambottom variables are important for bull trout. Also bull trout are significantly correlated to deeper streams. On small streams the two most important variables are streambottom fines and canopy cover. On large streams, streambottom and depth are important variables. Stepwise multiple regression also selected streambottom as the most important variable for bull trout in most cases. On small streams the canopy cover is significant, which may indicate that higher canopy cover, maintains lower water temperatures that are considered important to bull trout.

In general, bull trout populations tended to be higher where the streambottom materials were larger. In areas with high amounts of fines, bull trout populations tend to be low (Figure 28).

Several different methods of measuring streambottom substrate have been used. Most of them indicate a negative relationship between bull trout populations and fine streambottom materials, or conversely, a positive relationship between bull trout and large streambottom materials (i.e. cobble and boulders). While this relationship appears to occur, there are likely circumstances where it will not be consistent. Unpublished data from the Bitterroot National Forest has identified at least one stream which has high amounts of fines and a significant bull trout population. These specific instances should be looked at to attempt to understand the relationship further.



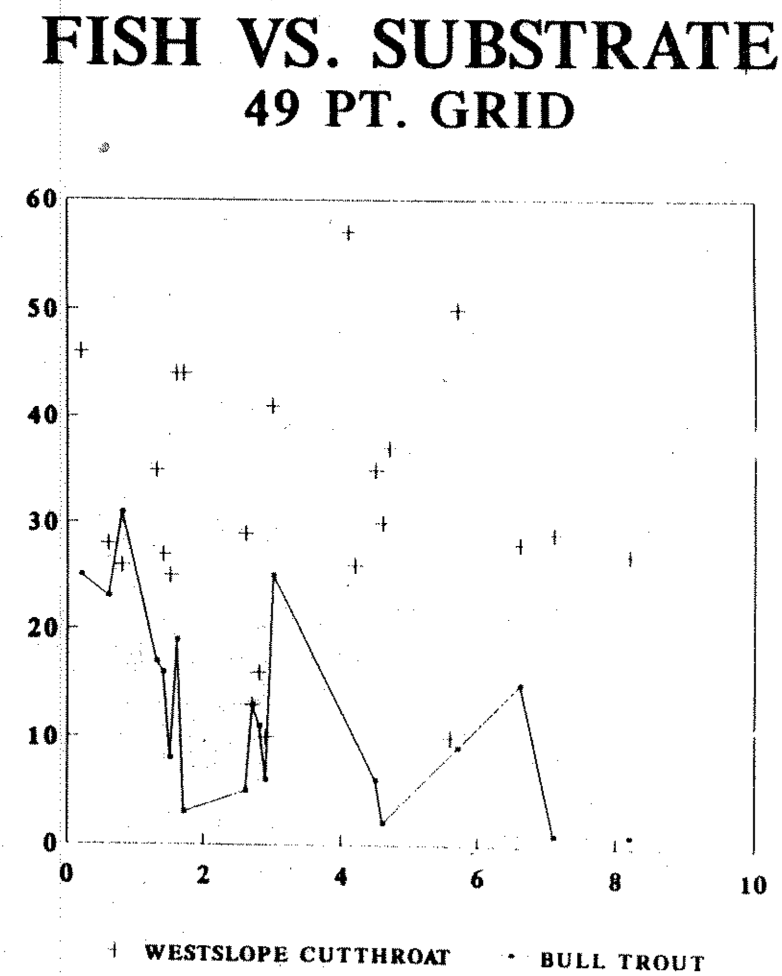


Figure 28. Bull Trout and Westslope Cutthroat Densities, Visual Fines and 49-Point Grid Readings on Study Sites of the Bitterroot National Forest

Table 8. Some significant relationships between bull trout populations and habitat variables measured on long term monitoring reaches of the Bitterroot National Forest.

Variable	Corr.	R^2	P-value
ALL STREAMS			
Percent fines (grid)	-.62	38%	.005
Wentworth fines	-.52	28%	.018
Cobble-Boulder	+.46	21%	.043
Pct_infill	-.46	21%	.06
Subscore-riffle	+.48	23%	.03
Average depth	+.53	28%	.02
Thalweg depth	+.44	19%	.05

Stepwise multiple regression selected Wentworth fines and cobble-boulder as the two most significant variables accounting for 87% of the variability of populations.

Variable	Corr.	R^2	P-value
SMALL STREAMS (<20 FEET WETTED WIDTH)			
Canopy	+.68	47%	.02
Wentworth fines	-.65	42%	.03

Stepwise multiple regression selected canopy as the most significant variable accounting for 47% of the variability of populations.

Variable	Corr.	R^2	P-value
LARGE STREAMS (>20 FEET WETTED WIDTH)			
Percent riffle	-.63	40%	.07
Average depth	+.69	48%	.04
Thalweg depth	+.67	45%	.05
Shoredepth	+.64	41%	.06
Substrate score riffle	+.77	60%	.01
Wentworth fines	-.71	51%	.03
Wentworth fines riffle	-.82	66%	.007
Cobble-Boulder	+.82	66%	.007

Stepwise multiple regression selected cobble-boulder as the most significant variable accounting for 67% of the variability of populations.

Table 9. Some significant relationships between westslope cutthroat populations and habitat variables on long term monitoring reaches of the Bitterroot National Forest.

Variable	Corr.	R^2	P-value
ALL STREAMS			
Depth undercut	-.42	18%	.03
Bankangle	+.46	21%	.02
Percent riffle	-.48	23%	.02
Percent run	+.56	32%	.003
Overhead cover low	+.51	26%	.009
Overhead cover high	+.45	21%	.02
Wentworth fines	-.40	16%	.05

Stepwise multiple regression selected percent run as the most significant variable accounting for 32% of the variability of populations.

Variable	Corr.	R^2	P-value
SMALL STREAMS (<20 FEET WETTED WIDTH)			
Percent riffle	-.44	20%	.10
Percent run	+.57	33%	.03
Overhead cover low	+.63	40%	.01
Overhead cover high	+.51	26%	.06
Width-Depth ratio	+.70	49%	.005
Depth undercut	-.56	32%	.03
Bankangle	+.63	40%	.02

Stepwise multiple regression selected percent riffle and width-depth ratio as the most significant variables accounting for 73% of the variability of populations.

Variable	Corr.	R^2	P-value
LARGE STREAMS (>20 FEET WETTED WIDTH)			
Percent riffle	-.55	30%	.06
Shoredepth	+.66	43%	.02

Stepwise multiple regression selected shoredepth as the most significant variable accounting for 43% of the variability of populations.

The comparison between westslope cutthroat and habitat variables has not produced relationships that are consistent (Table 9). Overhead cover appears to be important to cutthroat trout, but some of the other relationships are not easily understood. For example, the positive relationship between westslope cutthroat and bankangle and the negative relationship between westslope cutthroat and depth of undercut are unexpected and not understood. While there are relationships between westslope cutthroat and their habitat, we have not identified consistently important variables.

Many of the variables are related to channel shape and configuration, but the relationships are not easy to understand. If we were looking at a wider variety of streams including low gradient, meandering streams and high gradient, high elevation streams, we would probably see more significant relationships.

Bitterroot River Fish Populations

During the past two years, trout population estimates have been collected on four study sections including Hamilton, Bell Crossing, Stevensville and Looking Glass (Figure 1).

A comparison of averages of all of the population estimates on the Bitterroot River during the 1980's and 1990's indicates some notable trends in the trout populations throughout the River (Figure 29).

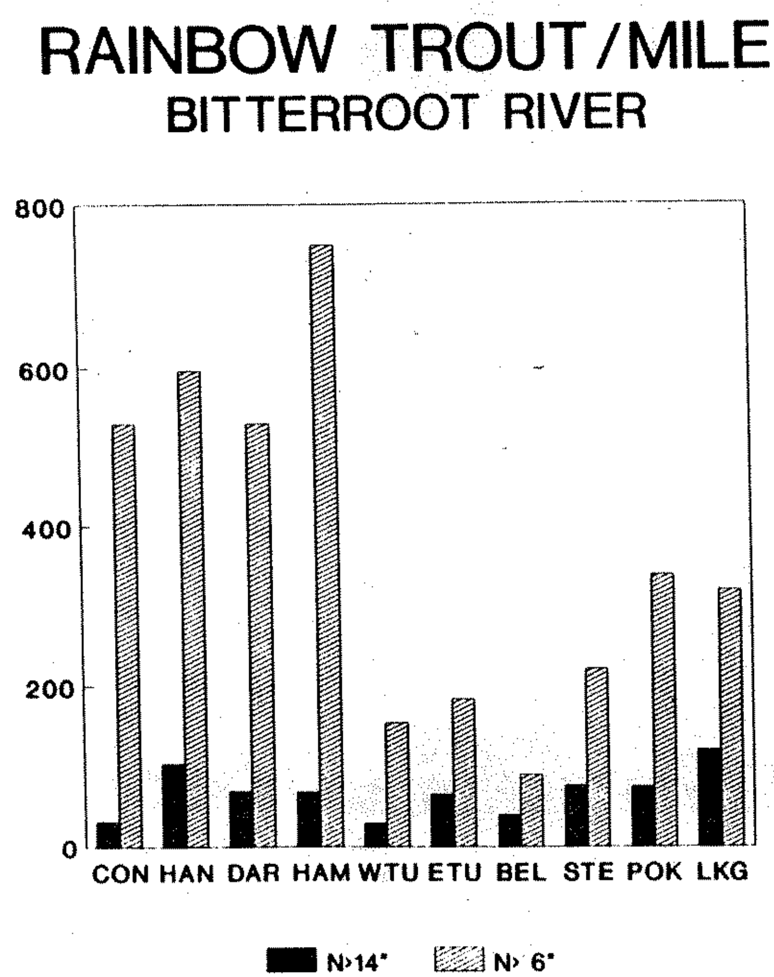
Brown trout populations are highest in the upper Bitterroot River near Darby, and decline in a downstream direction. Looking Glass, the furthest downstream study section, supports very few brown trout (the numbers on Figure 29 for Looking Glass are an estimate since the population is so low that a valid population estimate was not available). The reasons for this declining trend in a downstream direction are not understood.

Rainbow trout populations are also highest in the upper River near Darby. The population remains stable downstream to the Hamilton section and declines in the area of Bell Crossing. Study sections in the Tucker channels are difficult to assess since they are parallel to each other and carry a split flow of the River. The rainbow trout population increases in the Stevensville area and remains stable to Looking Glass.

The most likely reason for the declining population of rainbow trout in the Bell Crossing area is dewatering of the mainstem of the River (Spoon 1987). Summer flows in that section of River become very low during July and August of most years, even with the additional water from Painted Rocks Reservoir (Figures 30,31 and 32).

The low streamflows in the River appear to affect the population of rainbow trout. Several tributaries contribute large numbers of rainbow trout fry to the River in this area, but survival in the River must be low since the trout populations in the dewatered area are low. Irrigation returns and groundwater inflows downstream between Bell Crossing and Stevensville appear to alleviate some of this problem, as there is some recovery in the Stevensville area. The impact of fishing regulation differences between the sections is difficult to document because of habitat differences between sections.

Beginning with the 1992 fishing season, between Tucker Crossing and Florence, the regulations became catch and release with artificial lures only. This was enacted to attempt to take harvest pressure off of the low populations of trout in the Bell Crossing area.



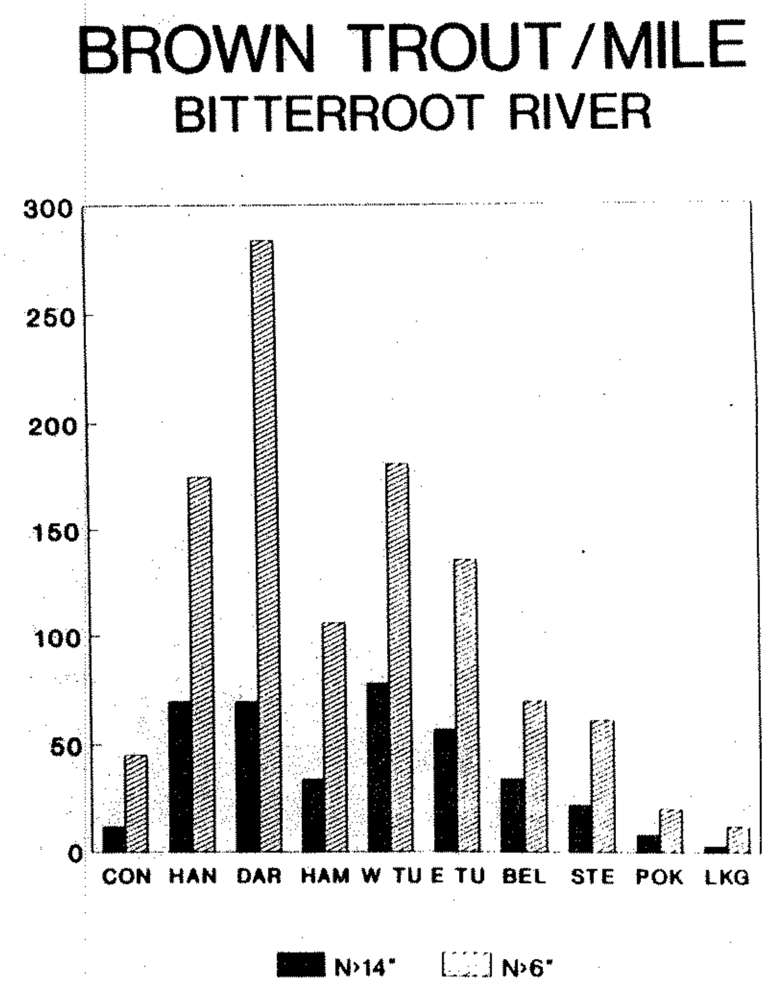


Figure 29. Mean Values of Fish Population Estimates on Study Sections of the Bitterroot River Between 1984 and 1992

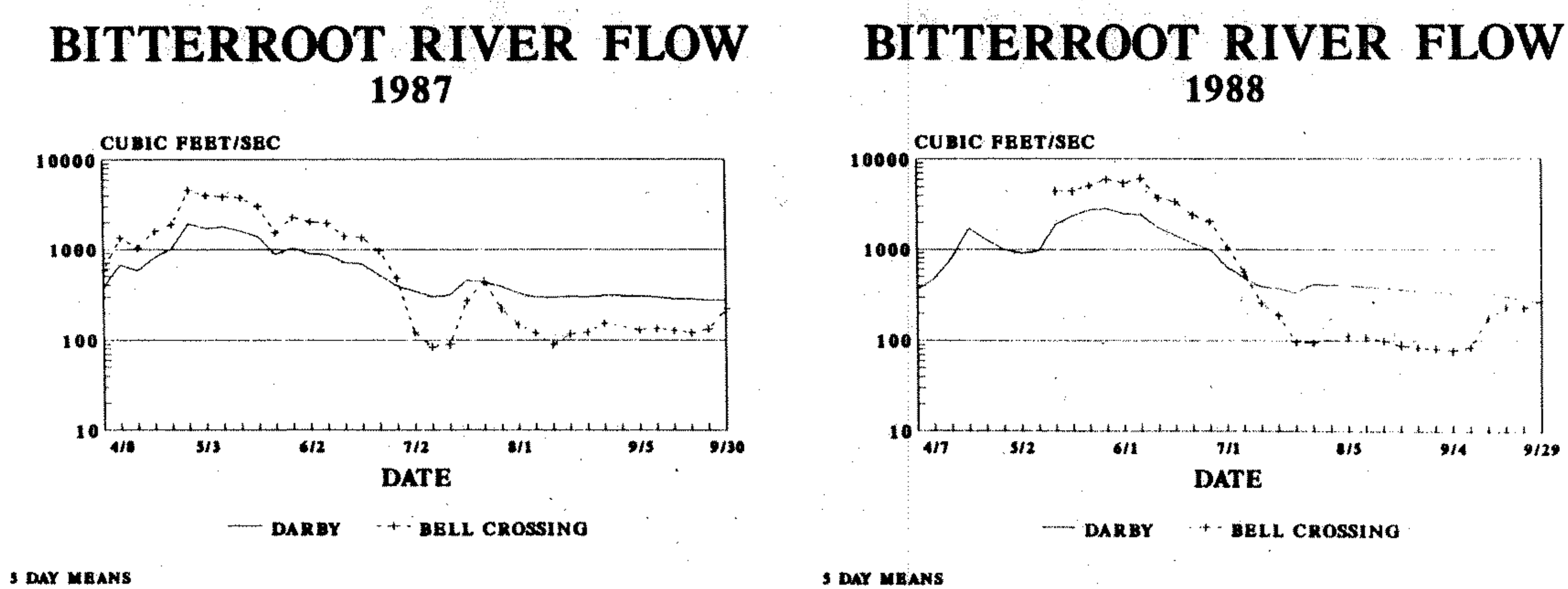
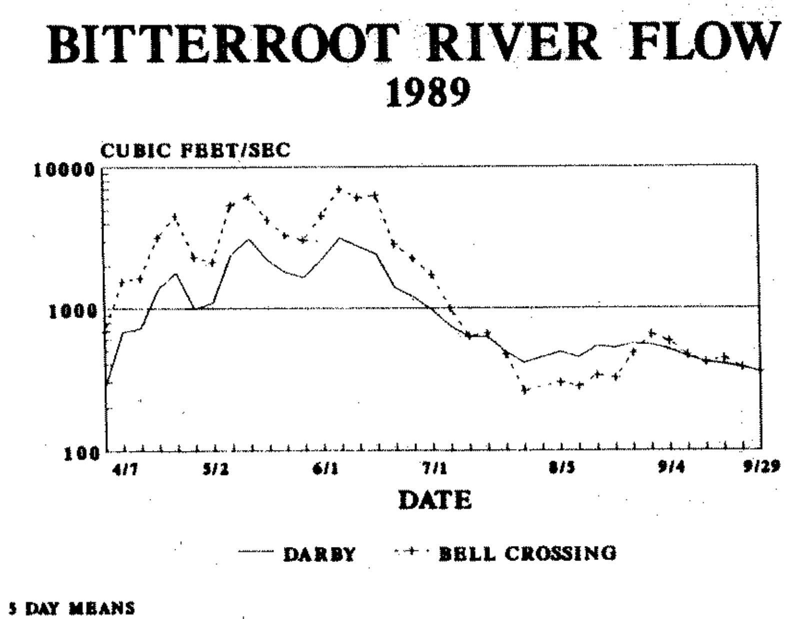


Figure 30. 5 Day Mean Streamflows at the Darby and Bell Crossing Gages on the Bitterroot River During 1987 and 1988 (USGS Data)



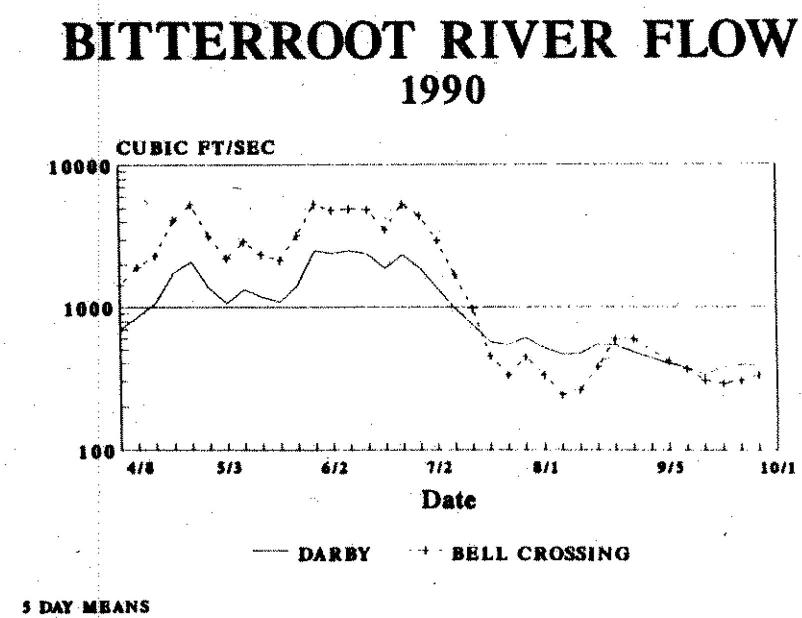


Figure 31. 5 Day Mean Streamflows at the Darby and Bell Crossing Gages on the Bitterroot River During 1989 and 1990 (USGS Data)

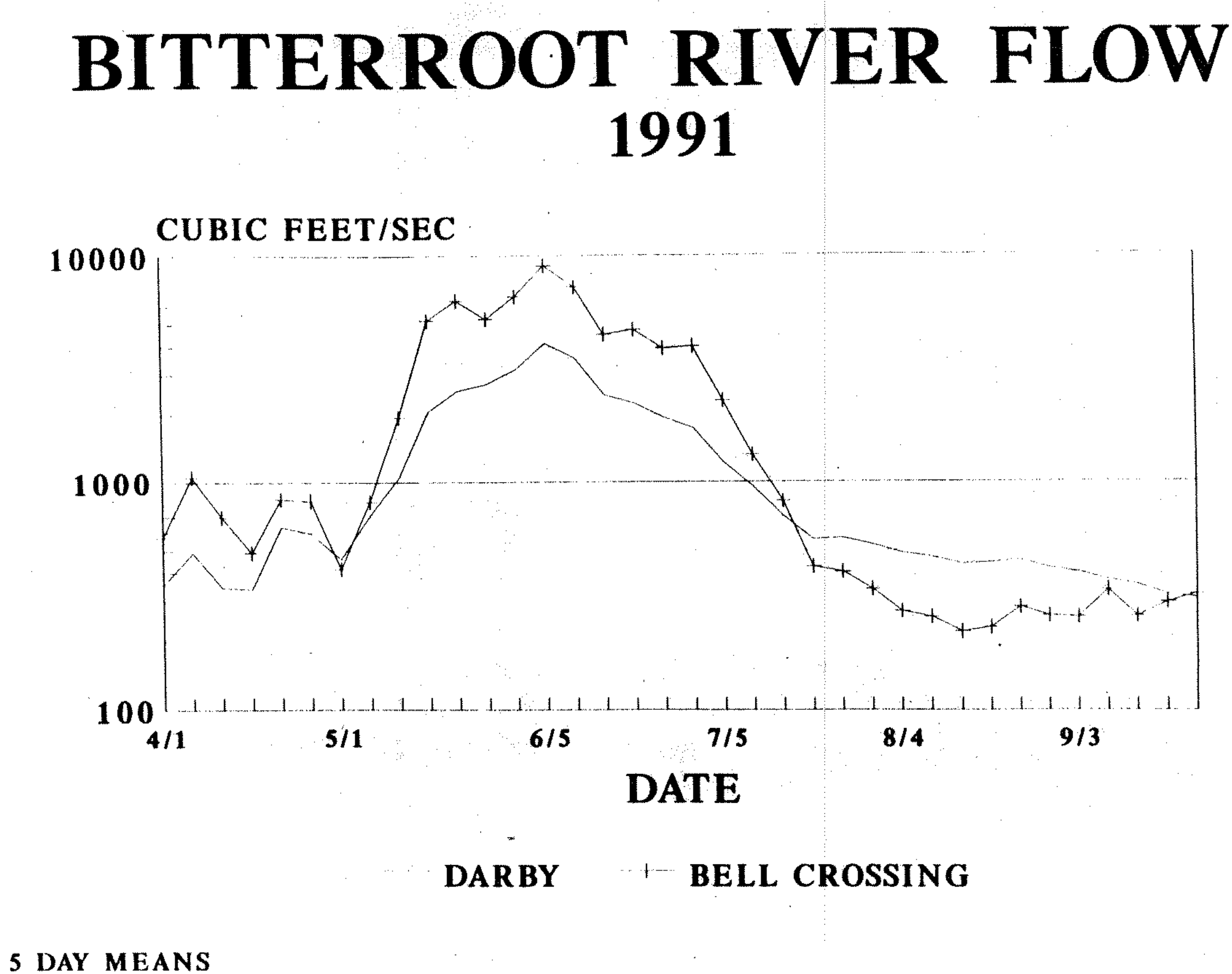


Figure 32. 5 Day Mean Streamflows at the Darby and Bell Crossing Gages on the Bitterroot River During 1991 (USGS Data)

Bitterroot River creel census

During 1992 and 1993 a creel census was conducted on the Bitterroot River from the mouth to the confluence of the East and West Forks. Two weekend flights and two weekday flights were made from fixed wing aircraft to assess pressure for the duration of the census. Based on pressure counts, anglers were classified as either shore or boat anglers.

Anglers were interviewed, and information was recorded about their angling technique and how many fish they had caught. A total of 853 anglers were interviewed during the census. Ninety percent (762) of the anglers were male.

Overall, there was more fishing pressure from shore anglers than boat anglers (Table 10). The reach receiving the highest pressure from both shore and boat anglers was between Tucker Crossing and Como Bridge. This is partly explained by the fact that this is a long reach of river with good access and it flows through the city of Hamilton. It is also open to fishing with bait. The reach between Florence and Tucker Crossing is a catch and release section where no live bait is allowed. It supported slightly less fishing pressure. The catch and release section near Darby supported more fishing pressure than the section immediately upstream which is open to the use of bait (Table 10).

The highest fishing pressure was during the Spring before high water. This is probably a result of the excellent fishing available during the Spring hatches which have become very popular in the past few years. Most of the whitefishing is over by then and this high pressure would be from catch and release trout fishing.

Overall the harvest is low when compared to the actual number of fish in the River (Table 11). The calculations of trout populations in the reaches is a conservative figure, the populations are probably higher. There is no harvest on the catch and release sections, and less than 5.0% harvested in the other sections except for the reach from the mouth to Florence where the rainbow trout and brown trout harvest was about 18.0% and 32.0%, respectively, of the population. The only other reach where harvest for a species exceeded 5.0% was the reach from Tucker to Como Bridge where brown trout harvest was 21.0% of the population. Overall, the harvest for rainbow and brown trout was 6.0 and 7.0%, respectively.

Table 10. Fishing pressure stratified by reach and time period on the Bitterroot River during February 1993 to February 1993.

Total Pressure (hours):

	Shore	Boat	Total
Mouth to Florence Bridge (22 mi)	11620	4873	16493
Florence Br. to Tucker Cr (24 mi)*	15149	9943	25093
Tucker Cr. to Como Br.(21 mi)	19883	12336	32220
Como Br. to Darby Br.(7 mi)*	2313	5802	8116
Darby Br. to Forks (6 mi)	2682	2682	5365
Total	51649	35639	87288

* catch and release, artificial flies and lures only

Total Pressure (hours):

	Shore	Boat	Total
March 1 - May 15	12825	16187	29012
May 16 - June 30	9732	9039	18771
July 1 - August 31	10381	6954	17335
September 1 - October 31	7191	3121	10312
November 1 - February 28	11519	337	11856
Total	51648	35638	87286

Table 11. Harvest of fish by anglers compared to fish present in the Bitterroot River during February 1992 through February 1993.

Total Harvest (fish kept) by time period:

Species	Rb	LL	Ct	Mwf
March 1 - May 15	176	0	0	8361
May 16 - June 30	716	144	46	83
July 1 - August 31	556	361	0	0
September 1 - October 31	580	0	0	0
November 1 - February 28	17	0	0	17881
Total	2046	506	46	26325

Total Harvest (fish kept) by reach:

Species	Rb	LL	Ct	Mwf
Mouth to Florence Bridge	1206	70	0	2038
Florence Br. to Tucker Cr.	0	0	0	7513
Tucker Cr. to Como Br.	668	435	46	6837
Como Br. to Darby Br.	0	0	0	2801
Darby Br. to Forks	172	0	0	7135
Total	2046	506	46	26325

Trout longer than 6.0 inches in each reach (Extrapolated from Figure 29). These figures are very rough estimates for comparison purposes only.

Species	Rb	LL	Ct	Mwf
Mouth to Florence Bridge	6600	220	-	-
Florence Br. to Tucker Cr.	4800	1800	-	-
Tucker Cr. to Como Br.	14700	2100	-	-
Como Br. to Darby Br.	3500	1750	245	-
Darby Br. to Forks	3600	900	-	-
Total	33200	6770		

Most of the anglers interviewed were from Missoula or Ravalli Counties, but 28% were from out of state. Anglers that were with an outfitter made up only 10% of the total and 34% of the boat anglers. Almost all outfitted anglers were using flies while private anglers used a variety of baits.

Table 12. Various information about the anglers interviewed during the creel census from February 1992 to February 1993.

Angler origin: Ravalli county 46%
Missoula county 22%
Out of state 28%

Outfitted and private anglers:

	Private	Outfitted
All anglers	90%	10%
Boats only	66%	34%

Bait type:	Outfitted:		Private:	
	Live	0%	Live	37%
	Flies	98%	Flies	47%
	Lures	2%	Lures	16%

Start time:		
	Before 10 a.m.	10%
	10 a.m. to 3 p.m.	75%
	After 3 p.m.	15%

Bitterroot River tributaries

The early life history of rainbow trout in the Bitterroot drainage is being studied because recruitment appears to be poor in the dewatered portion of the River. A study to assess the relative importance of Bitterroot River tributaries to the mainstem was initiated. During March, April and May of 1990, 1991 and 1992 we walked the lower 1 mile of 12 tributaries of the Bitterroot River once a week and counted rainbow trout redds (Table 13).

Table 13. Streams where Spring redd counts and Summer fry trapping occurred in 1990, 1991 and/or 1992.

Redd counts	Fry trapping
Miller Creek	Big Creek and ditch
Sweeney Creek	Blodgett Creek and ditch
Threemile Creek	Lost Horse Creek and ditch
Kootenai Creek	Kootenai Creek
Big Creek	Big Creek
Sweathouse Creek	Sweathouse Creek
Bear North Channel	Bear North Channel
Bear South Channel	Bear South Channel
Mill Creek	Mill Creek
Blodgett Creek	Blodgett Creek
Tincup Creek	Tincup Creek
Fern Creek	Fern Creek
Skalkaho Creek	

Table 13. continued

<u>Redd counts</u>
Warm Springs Creek
Tolan Creek
Bass Creek
Larry Creek
Lost Horse Creek
Rock Creek
Canyon Creek

Some streams were sampled only one year while others have been sampled all three years (Figure 33).The total number of redds varies substantially between years on the same creeks. This is probably due to many factors that are not understood. However, it is also due to Spring runoff patterns. When the creeks rise early in the Spring, the redd counts tend to be low, because many redds are obscured by the high water. Since this variability between years may be causing annual counts to be in question, only Kootenai, Big, Blodgett and Tincup Creeks are being used for annual monitoring of rainbow trout redds. The redds in these streams are easy to distinguish and they are probably the best monitoring streams we have identified to date.

Spawning is initiated in early March, peaks in mid-April in most streams, and is generally tapering off by mid May. Spawning in higher elevation streams such as Tincup and Fern Creek is later than in the other streams. Big and Kootenai Creeks have been documented as important spawning tributaries previously (Good et al 1984). They also found that Rye Creek supports very little rainbow trout spawning and in Sleeping Child Creek none was documented. The streams with the highest number of redds are Big, Blodgett, Kootenai, Mill and Tincup Creeks.

Once the spawning ended, incubation of the eggs takes place. Emergence and downstream drift of young-of-year (YOY) rainbow trout began in late June and most is completed by mid-July (Figure 34). Enumeration of drifting YOY is difficult so we selected the streamflow method for enumerating fry drift. Streamflows are measured in the creek and in the trap, and the proportion of water going through the trap is considered the same proportion of fry that are being captured.

Loss of young of the year trout is considered to be a major problem in the Bitterroot River (Spoon 1987). Dewatering of the mainstem by irrigation withdrawals is suspected as a problem for survival of young trout in the River. South Bear, North Bear, Sweathouse, and Big Creeks all contribute large numbers of YOY rainbow trout to the dewatered section of the Bitterroot River, yet adult populations in the Bell Crossing area are very low. Additional data collection is necessary to understand this relationship.

During 1991 and 1992, tributaries with major diversion

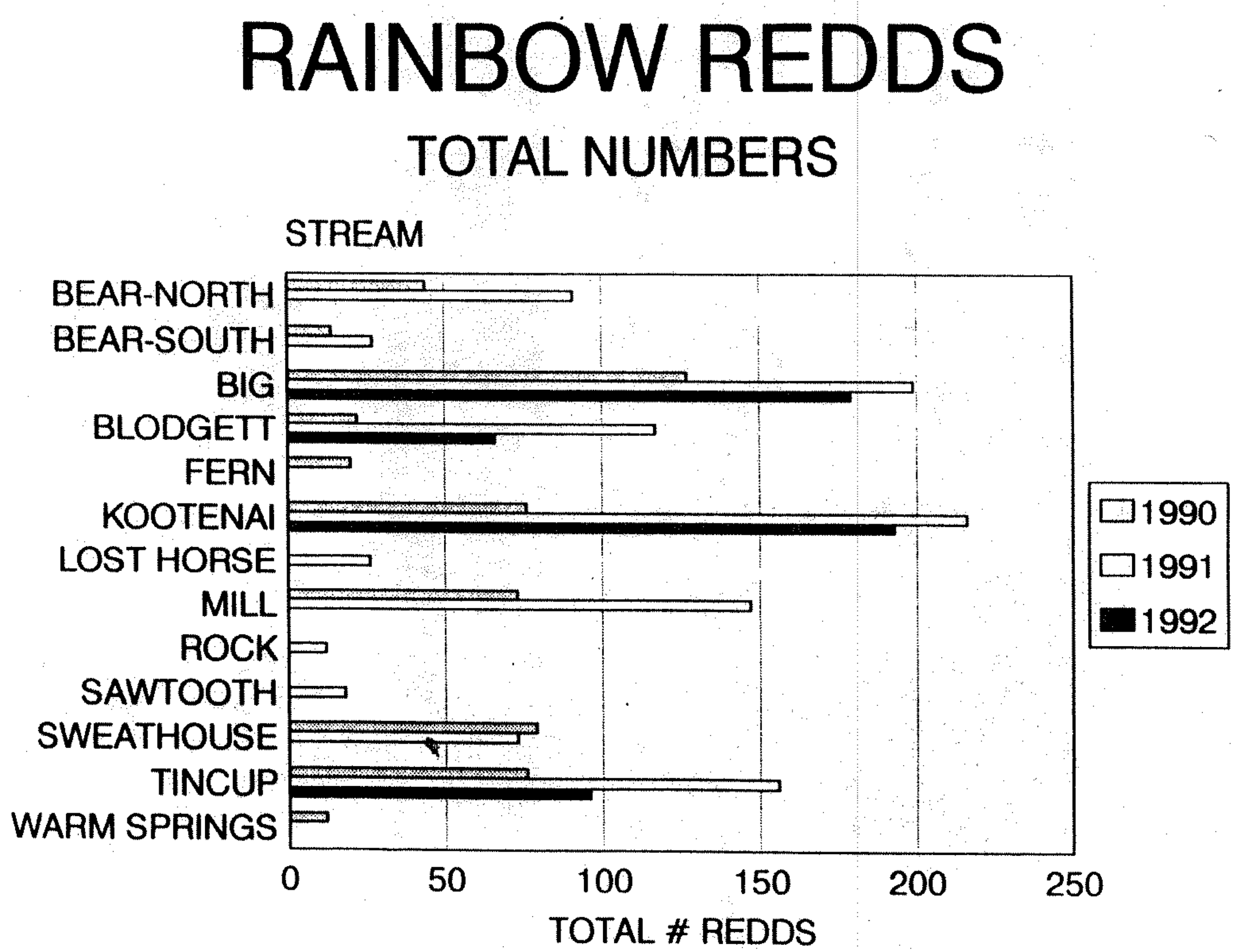


Figure 33. Total Number of Rainbow Trout Redds Counted in the Lower Mile of Bitterroot River Tributaries, 1990-1992

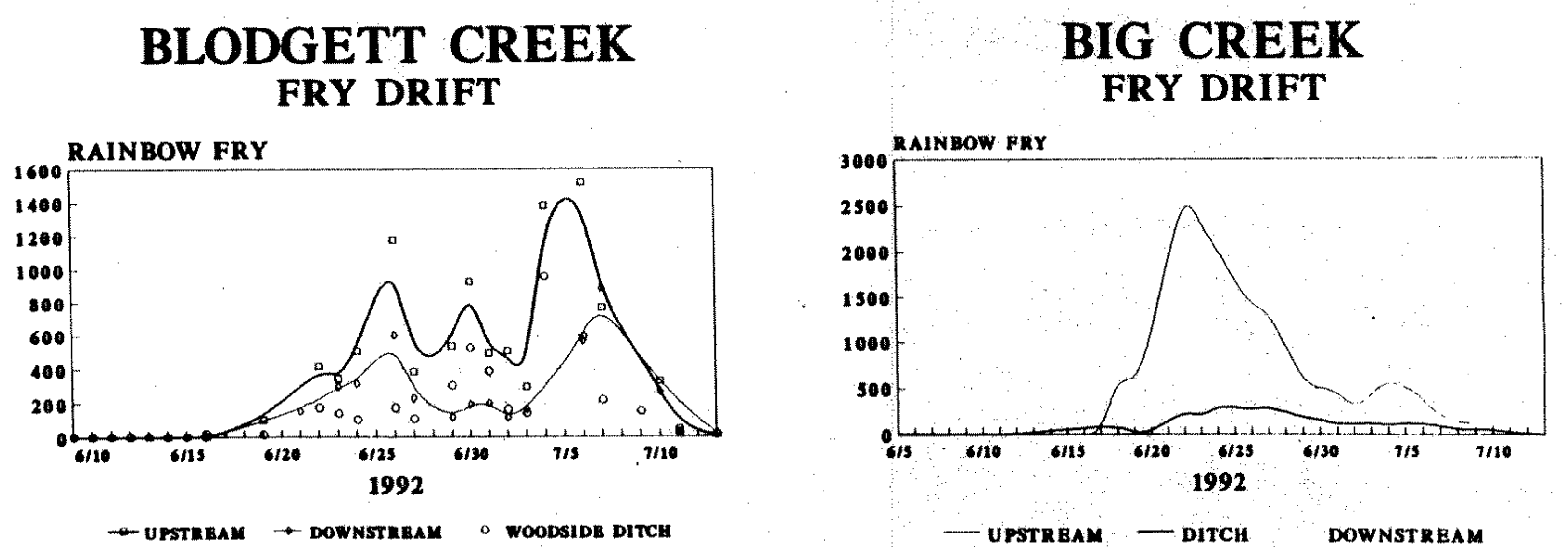


Figure 34. Timing and Duration of Rainbow Trout Fry Drifting in Blodgett Creek During 1992

structures were sampled. Big, Blodgett and Lost Horse Creeks were sampled during 1991 and Big and Blodgett Creeks were sampled in 1992. Each of these streams supports a large diversion ditch in the lower reaches which potentially diverts drifting trout fry from the stream. The Brinkerhoff, Woodside and Ward ditches were sampled on Big, Blodgett and Lost Horse Creeks, respectively. A trap was placed in the ditch and in the stream above and below the ditch.

Our sampling indicated that the Brinkerhoff ditch diverted 31% and 19% of the fry passing the headgate in Big Creek in 1991 and 1992, while the Woodside ditch diverted 20% and 41% of the fry passing the headgate in Blodgett Creek in 1991 and 1992 (Figure 35). The Ward ditch on Lost Horse Creek did not significantly divert trout fry because of very little production in the Creek in 1991. The trout fry we caught in the Ward ditch appeared to be mostly brook trout and a few rainbow trout that spawn in the ditch. We discontinued sampling the Ward ditch in 1992.

The number of fry lost into the ditches is related to the total production of fry in the creek, streamflows during the drift period, and diversion practices at the headgate. One more year of data will be collected at each headgate to assess the loss of fry over a three year period, which should provide enough data, collected under different conditions, to make recommendations to minimize the loss.

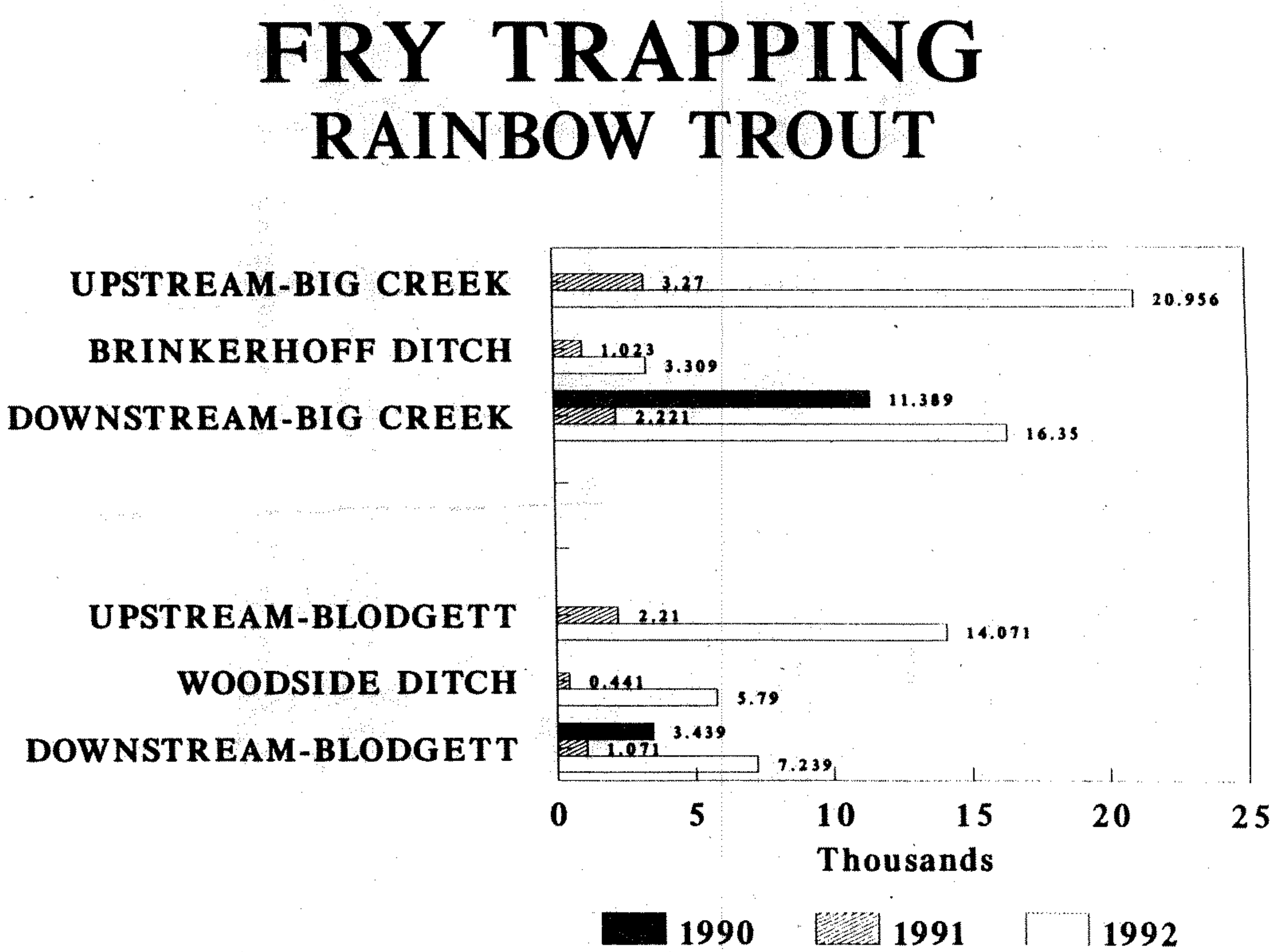


Figure 35. Estimates of Rainbow Trout Fry Drifting in Blodgett and Big Creeks and Their Ditches During 1990-1992

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Prepared by Christopher G. Clancy
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Stream	Code Number	Key Words
Bitterroot River drainage	2-03-8865	Trout populations Trout habitat Sediment Dewatering Creel Census Fishing regulations Westslope Cutthroat Rainbow Trout Brown Trout Bull Trout Brook Trout Fry Trapping Redd Counts