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

State:Montana Title:Statewide Fisheries Investigations
Project:F-78-R-2 Title:Bitterroot Forest Inventory
Job:Ij
Period Covered:July 1, 1995 to June 30, 1996

ABSTRACT

The distribution of westslope cutthroat and bull trout is fragmented in the Bitterroot drainage. Most of these fish occur as isolated resident populations in headwater streams. Brook trout are found in small streams at lower elevations. Rainbow trout populations are largely associated with the Bitterroot River and brown trout are found in the river and streams on the valley floor.

Population estimates were collected on long term monitoring streams on the Bitterroot National Forest for the seventh consecutive year. Overall, populations appeared to be stable although the larger westslope cutthroat at some sites have declined in number. Angler harvest may be responsible for low numbers of westslope cutthroat in some locations on the forest, and more restrictive fishing regulations may be proposed in the near future in some streams. Analysis of mark-recapture population estimates indicate that midsummer movement by cutthroat and bull trout is minimal, and the estimates are usually an accurate predictor of true population size. Analysis of fish habitat monitoring indicates that variablilty caused by observer bias is a problem for repeatability of some of the variables.

Electrophoretic analysis indicates that pure strain westslope cutthroat trout occur in most of the samples taken on the east side of the valley and above Painted Rocks Reservoir. However, many populations on the west side of the valley are introgressed with rainbow or Yellowstone cutthroat trout. A discussion of fish populations in some specific streams on the Bitterroot National Forest districts is included. Water temperature monitoring indicates that considerable annual variation occurs depending on air temperature, and the highest density bull trout populations are usually found in the colder streams. In tributary streams, brook trout are more common at sites with warm water temperatures, but in some locations they predominate in cold temperatures. Overall, cold water temperatures may favor bull trout over brook trout.

Bitterroot River fish populations are discussed. Large rainbow trout have declined in number in the Darby section in the past few years despite restrictive regulations. The effects of the restrictive fishing regulations near Bell Crossing are not yet conclusive, and westslope cutthroat have increased in the river since the change to a catch-and-release regulation.

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BACKGROUND

Monitoring of fish populations in the Bitterroot drainage has been accomplished through a cooperative agreement between the Bitterroot National Forest (BNF) and the Montana Fish, Wildlife and Parks (MFWP) since 1989. They agreed to fund a fisheries biologist position that would work with both agencies on fisheries issues.

Presently, the project has been focused on the following issues:

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

2. Assessing the genetic purity of westslope cutthroat and bull trout on the BNF.

3. Collecting and analyzing water temperature data throughout the Bitterroot basin.

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

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. The river flows 84 miles through irrigated crop and pastureland to it's confluence with the Clark Fork River near Missoula, Montana. Urbanization and associated development of the floodplain is increasing in the Bitterroot Valley (Javorsky 1994, addendum). 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 MFWP annually supervises the release of 15,000 acre-feet of water from

Painted Rocks Reservoir on the West Fork of the Bitterroot River and 3,000 acre-feet of water from Lake Como.

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 being studied. A creel census was conducted in 1992 and 1993 to assess these impacts. Overall, it indicated that fishing harvest is not having serious impacts on the populations, but that monitoring of fish populations should continue (Clancy 1993).

Since the waters of the BNF 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). Dewatering of tributary streams and the introduction of exotic species of trout were identified as being the highest risk to the recovery of bull trout in the Bitterroot drainage (MBTSG 1995).

Most of the work has been on or near the Bitterroot National Forest. Fish populations at the forest boundary, relationships between salmonids and habitat have all been addressed to some degree (Clancy 1991, 1993, Hoth 1979, Jakober 1995, Munther 1986, Odell 1985, Peters 1987, 1988, Vadeboncouer et al 1989).

OBJECTIVES AND DEGREE OF ATTAINMENT

1. Collect trout population estimates on at least 6 Bitterroot National Forest streams. These will be used as baseline monitoring data for future comparisons. Data included in this report.

2. Begin a basinwide inventory on one basin to learn the overall basin conditions and assess the distribution of fish. Data included in this report.

3. Collect trout population estimates on 3 sections of the Bitterroot River to assess the impacts of restrictive fishing regulations. Data included in this report.

METHODS

Bitterroot National Forest

Streams for monitoring were selected based on several factors. Basin geology and degree of human development were considered so that fish populations could be studied under different levels of land management. 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 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 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 (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). The validity of midsummer population estimates was analyzed by comparing estimates calculated in multiple sampled collections.

Movement by fish while population estimates are being collected could cause and overestimate of the true population size. Movement by trout during most of the year has historically been considered to be minimal. However, in some situations considerable movement may occur (Young 1995). To test whether extensive movement was occurring during collection of population estimates, on 6 of the study sections, we marked all fish in the upper and lower half differently during the marking run. During the recapture run, a record of the location of marked fish was used to assess whether any extensive movement had occurred within the study reach.

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

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). Observer variability can be a serious problem in classifying habitat types (Roper and Scarnecchia 1995). To minimize this, only 5 different habitat types were used in our classification and all observers were accompanied by experienced personnel.

The BNF 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. This "pulsed" monitoring technique is necessary for assessing long term changes in fish populations (Bryant 1995). Some 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). Water temperature was assessed during midsummer at numerous sites in 1993, 1994 and 1995. HOBO Temp temperature loggers were set out throughout the summer and fall months. At most monitoring sites, two or three summers of data were collected. Data was charted and summarized in degree days for comparison between sites. All of the known fish and habitat data that have been collected in the Bitterroot drainage (excluding Lolo Creek) have been summarized in computer databases on IBM compatible PC's. Fish distribution maps have been drawn based on this data.

Bitterroot River

Fish populations estimates on the Bitterroot River were collected on several reaches over the past 14 years. 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 aluminum drift boat fitted with a boom shocking system. The Petersen mark-recapture method was used to calculate population estimates (Ricker 1975). Several mark and recapture runs were required to obtain sufficient sample size to estimate fish populations. Some of the collections occurred at night to facilitate handling of more fish. The population estimates were collected during September and October each year. Brown trout may be migrating by October, therefore, their estimates may be somewhat inflated.

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 drainage fish distribution

Fish have been sampled at over 500 locations within the Bitterroot Valley. However, statistically valid population estimates, which we use to monitor the change in fish numbers over time, have only been collected at between 85 and 90 sites (Figure 1). The sites depicted by a square are monitoring sites where there is typically between 3 and 5 annual fish population estimates available. The sites depicted by a circle are sites where quantitative fish population estimates are available, however, only 1 or two years of data have been collected.

All of the fish population information that has been collected in the Bitterroot drainage has been compiled into one file. Using this information it is possible, on a broad scale, to observe fish distribution throughout the valley. With time and more data collection the distribution maps can be refined. At the present time they are adequate for observing broad distribution patterns.

Within the boundaries of the BNF, the three most common species of salmonid (trout and char) are the westslope cutthroat, bull trout and brook trout. Their distribution patterns are illustrated in Figures 2, 3 and 4. Westslope cutthroat and bull trout tend to have similar distribution patterns within the Bitterroot drainage. Both are found most commonly at higher elevations within the boundaries of the BNF. Their numbers decline at lower elevations. Neither species is abundant outside of the Bitterroot National Forest. The absence of these two species at lower elevations is thought to be a problem for future persistence of the species. Historically, migratory westslope cutthroat and bull trout left the Bitterroot River to spawn in tributary streams, however, today this connection has been lost. Although the westslope cutthroat and bull trout have similar distribution patterns, densities of bull trout are less in areas where both are found. Typically cutthroat trout are more abundant in streams that support both species and often the very smallest streams support cutthroat trout but not bull trout. Fluvial cutthroat trout still exist in manageable numbers in the Bitterroot River, while fluvial bull trout are rare downstream of Conner.

Brook trout are found in many BNF streams. However, their distribution patterns are somewhat different from westslope and very different from bull trout. In many locations, brook trout are found living with westslope cutthroat but they are seldom found in large numbers in the presence of bull trout (Clancy 1993). A competitive mechanism between bull trout and brook trout is thought to be the reason. Because of this competition, some monitoring on the BNF is focused on transition areas in streams where bull trout occur at higher elevation and brook trout at lower elevation. Monitoring these stream reaches over time should detect any encroachment of brook trout into bull trout habitat.

Rainbow and brown trout are also found within the boundaries of the BNF, but only rarely. Both species tend to be found on the

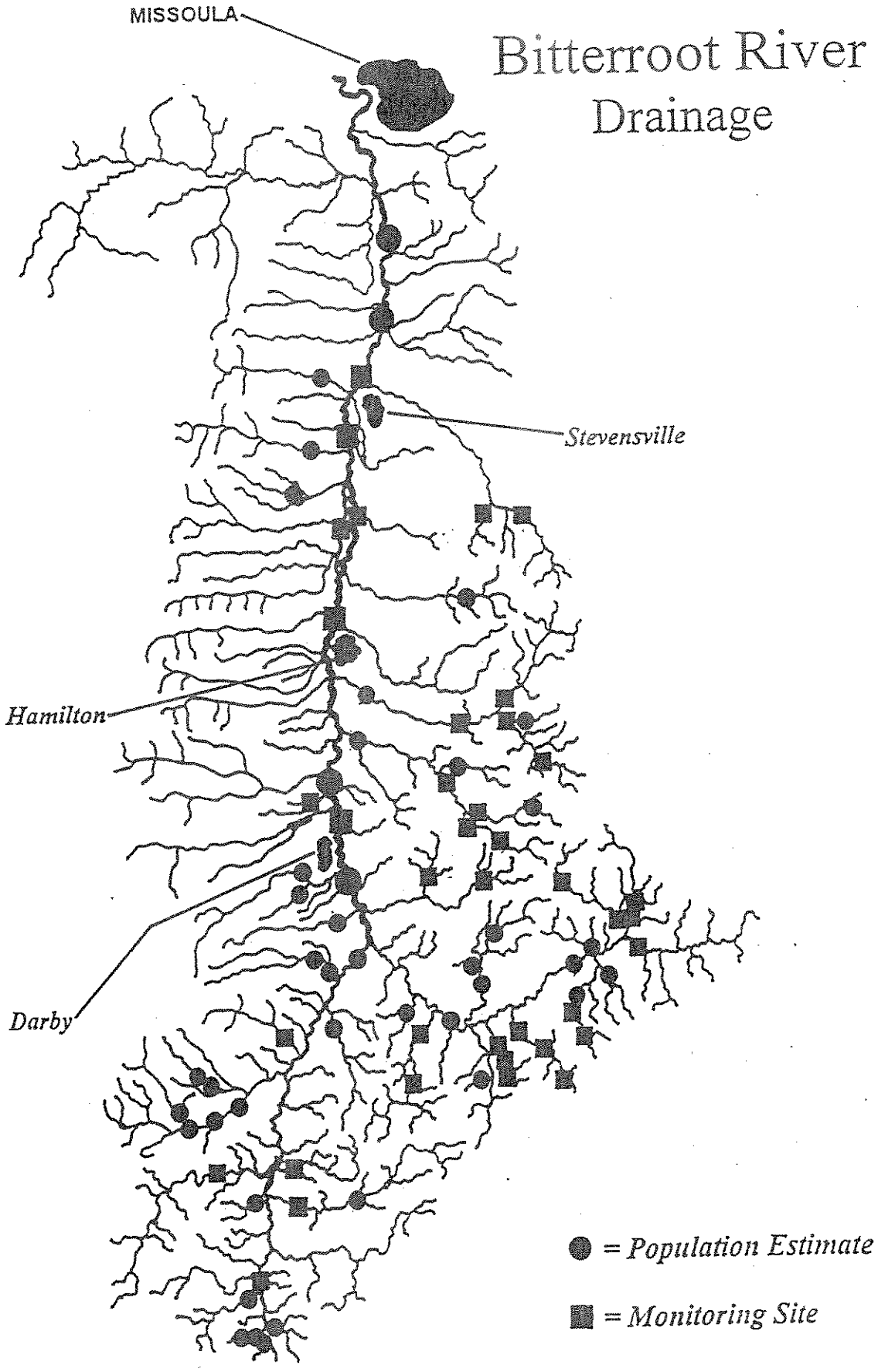


FIGURE 1. Locations of long term fish monitoring sites and population estimates in the Bitterroot drainage as of 1995.

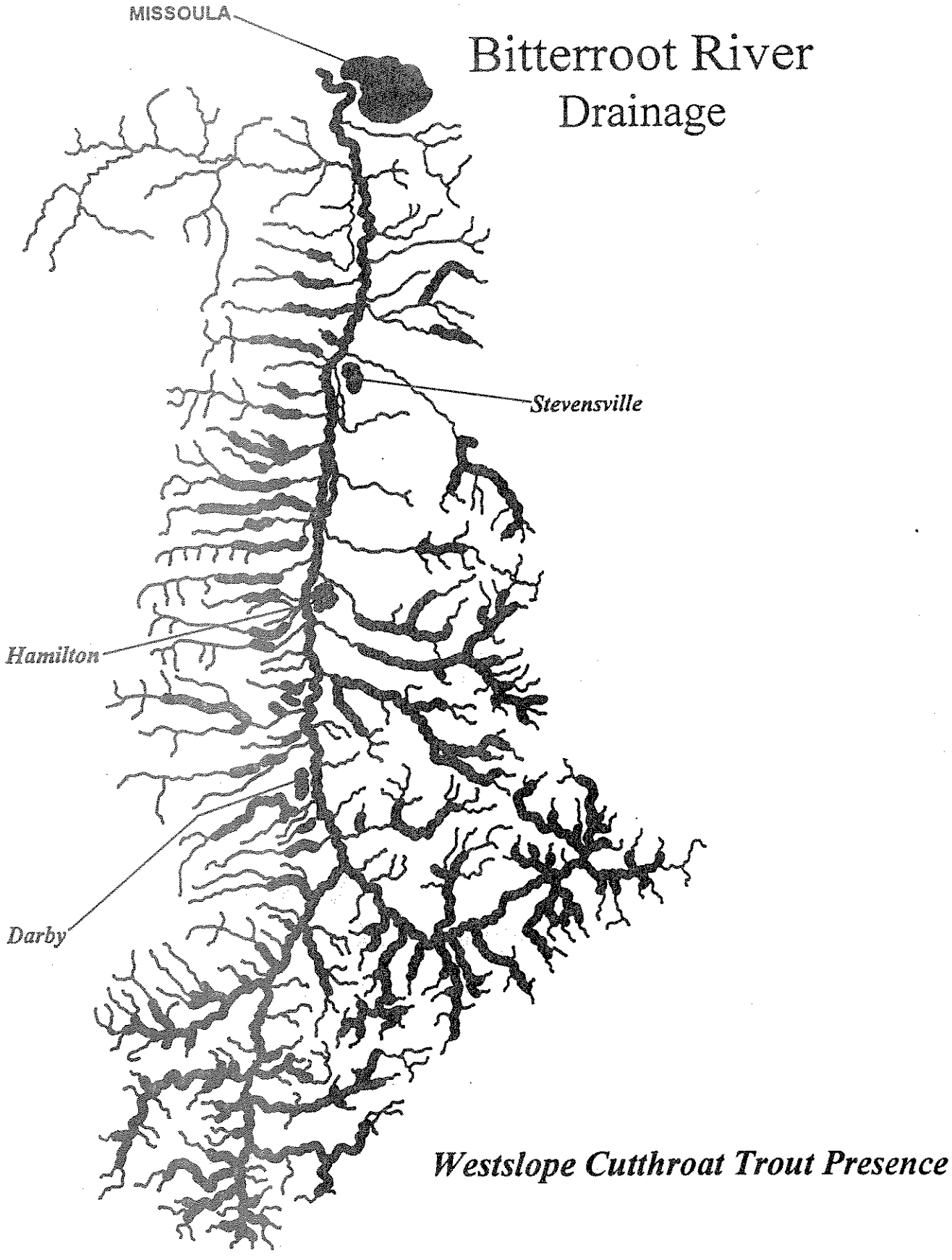


FIGURE 2. The known distribution of westslope cutthroat in the Bitterroot drainage as of 1995.

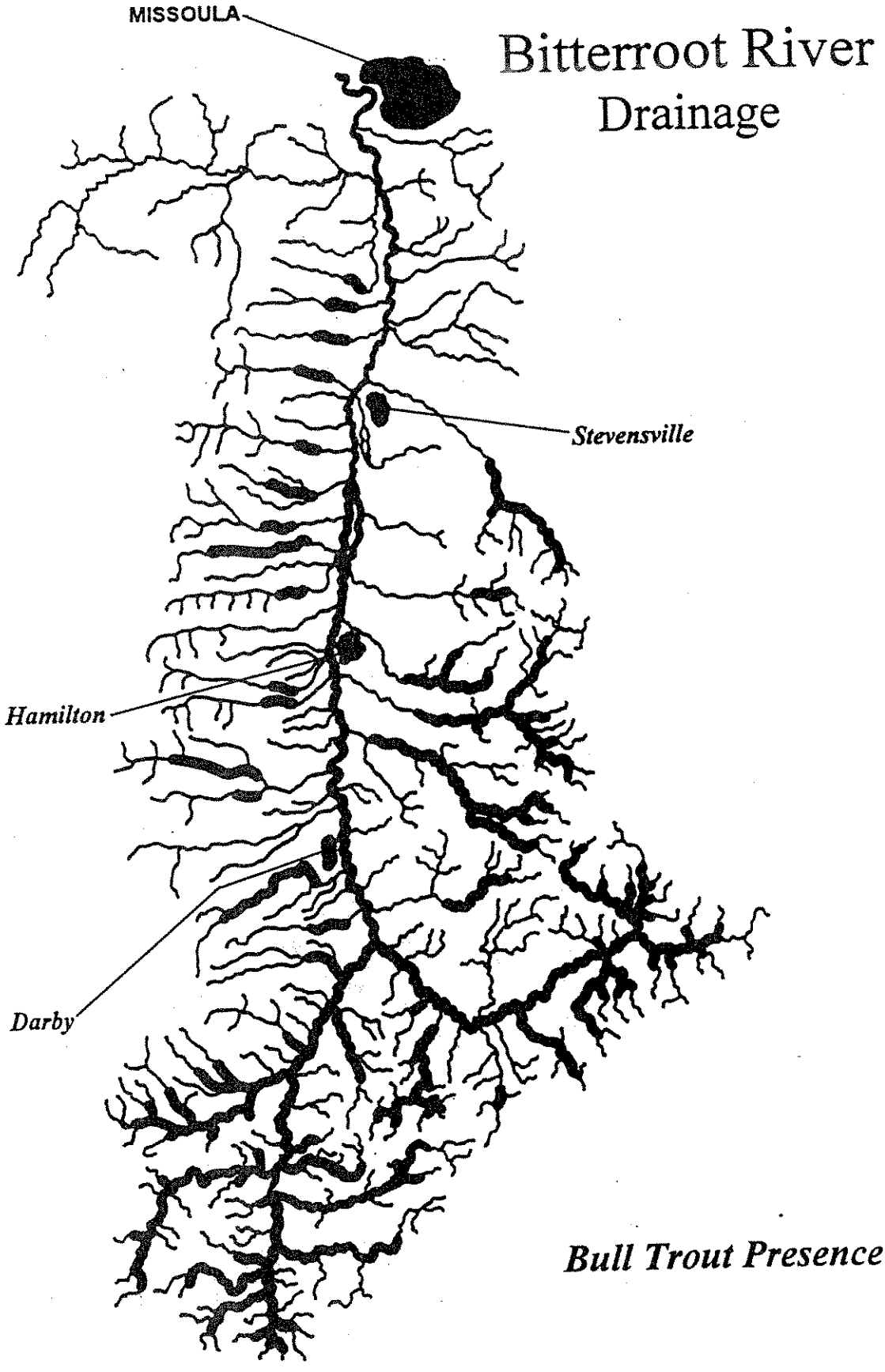


FIGURE 3. The known distribution of bull trout in the Bitterroot drainage as of 1995.

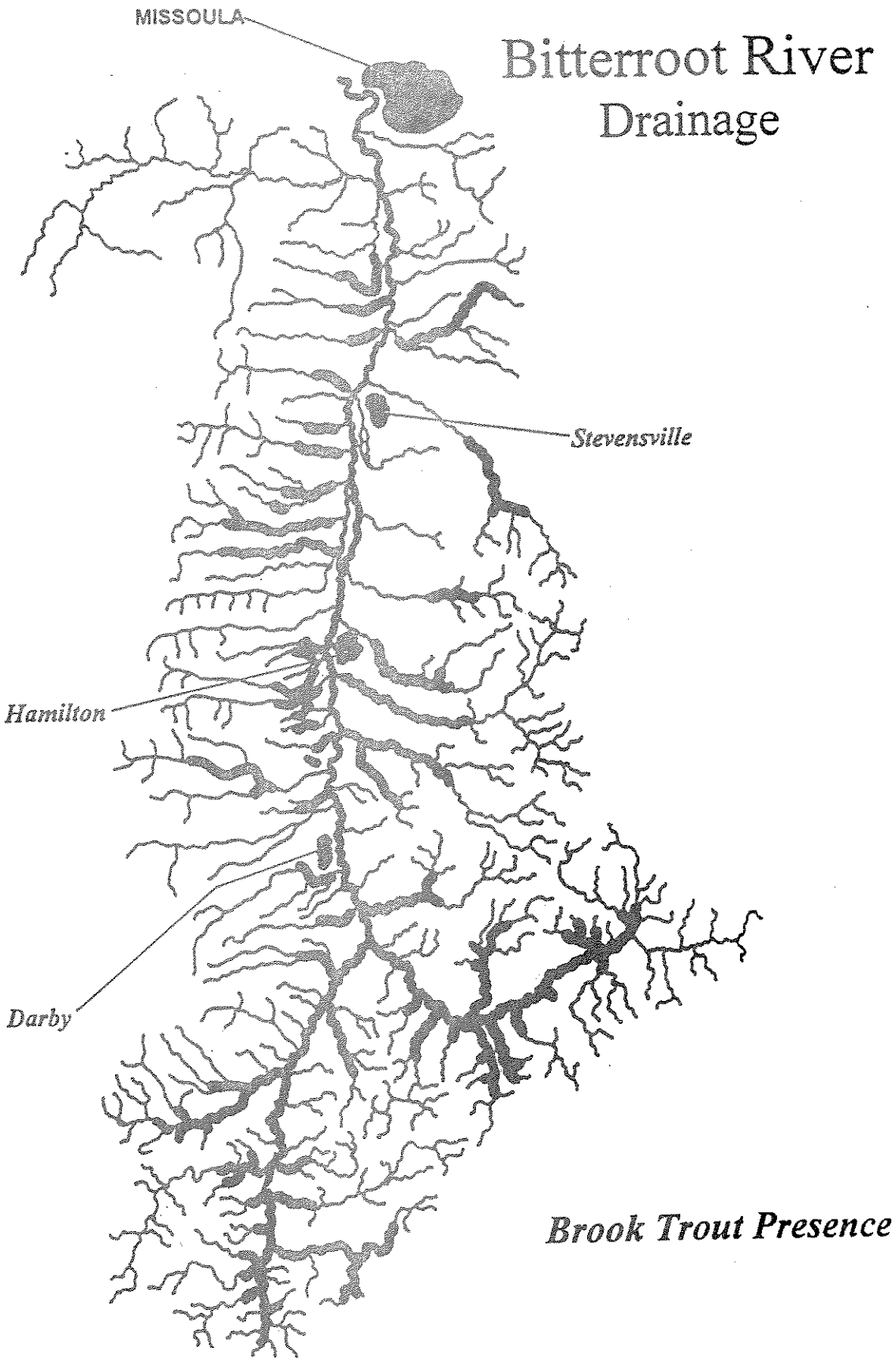


FIGURE 4. The known distribution of brook trout in the Bitterroot drainage as of 1995.

valley floor, in the lower end of tributary streams and in the Bitterroot River (Figures 5 and 6). Occasionally, both species are found on the forest, but typically they so not occur in BNF streams.

While crews are sampling fish populations at the various sites, they also observe the presence or absence of tailed frogs and sculpins (Figures 7 and 8). Both species have been observed at many different locations throughout the Bitterroot Valley and on the BNF. Tailed frogs are present at many locations on the Bitterroot National Forest however they have not been found at lower elevations on the east side of the valley. Sculpins have been found at less locations than tailed frogs, but they have been found at most elevations.

Verification of population estimates

Population estimates of westslope cutthroat trout and bull trout vary between individual years and streams. Annual fluctuations in populations of salmonids has brought into question the validity of population estimates as a monitoring tool (Platts 1988). However, the paper does not present enough detailed information to assess the findings. For monitoring purposes, it is important that fish population estimates are accurate enough for future comparison. Mark-recapture population estimates are an accepted enumeration method for trout in streams, but many factors can lead to erroneous estimates particularly improper analysis of size groups (Slaney and Martin 1987). Peterson mark-recapture is considered an accurate estimator of juvenile coho salmon (Peterson and Cederholm 1984), cutthroat trout (Slaney and Martin 1987) and in complex habitats (Rodgers et al 1992). One potential problem would be extensive movement within the stream during the period between mark and recapture. To assess this, in 1995 at 6 of the monitoring sections we marked the fish on the upper 500 feet differently than on the lower 500 feet of the section. During recapture runs, we kept a record of the location of recaptures by placing them in 6 individual nets near the point of recapture. Movement between the upper and lower half of the section was 11% and 12% for cutthroat trout and bull trout, respectively. Of that movement, most of the cutthroat trout movement was between the middle two nets, which was likely not true movement (Figure 9). Only 4 bull trout moved, but they all went upstream. This may indicate a movement pattern, but the sample size is low.

On several occasions, we returned for a second recapture trip. This allows the opportunity to calculate three separate population estimates. I calculated estimates from 1 mark and 1 recapture runs, 1 mark and 2 recapture runs, and 2 marks and 1 recapture run. Theoretically, these estimates should be the same. At the very least they should be close enough to give a good idea of how many fish are present at the time of sampling.

The difference between estimates on the same reach vary between streams. Slate Creek and Daly Creek had a higher disparity between estimates than Martin, Moose and Sleeping Child Creeks.

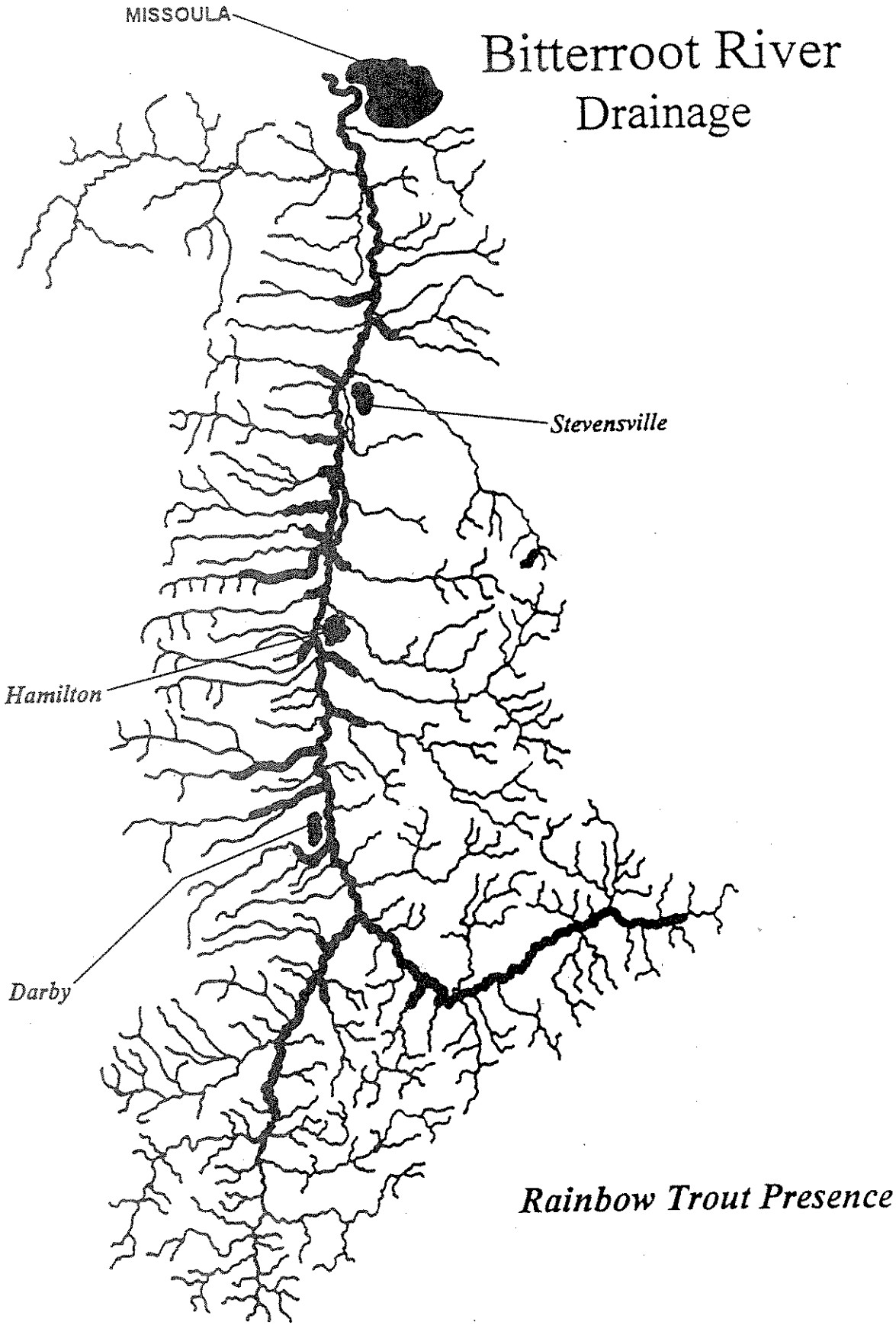


FIGURE 5. The known distribution of rainbow trout in the Bitterroot drainage as of 1995.

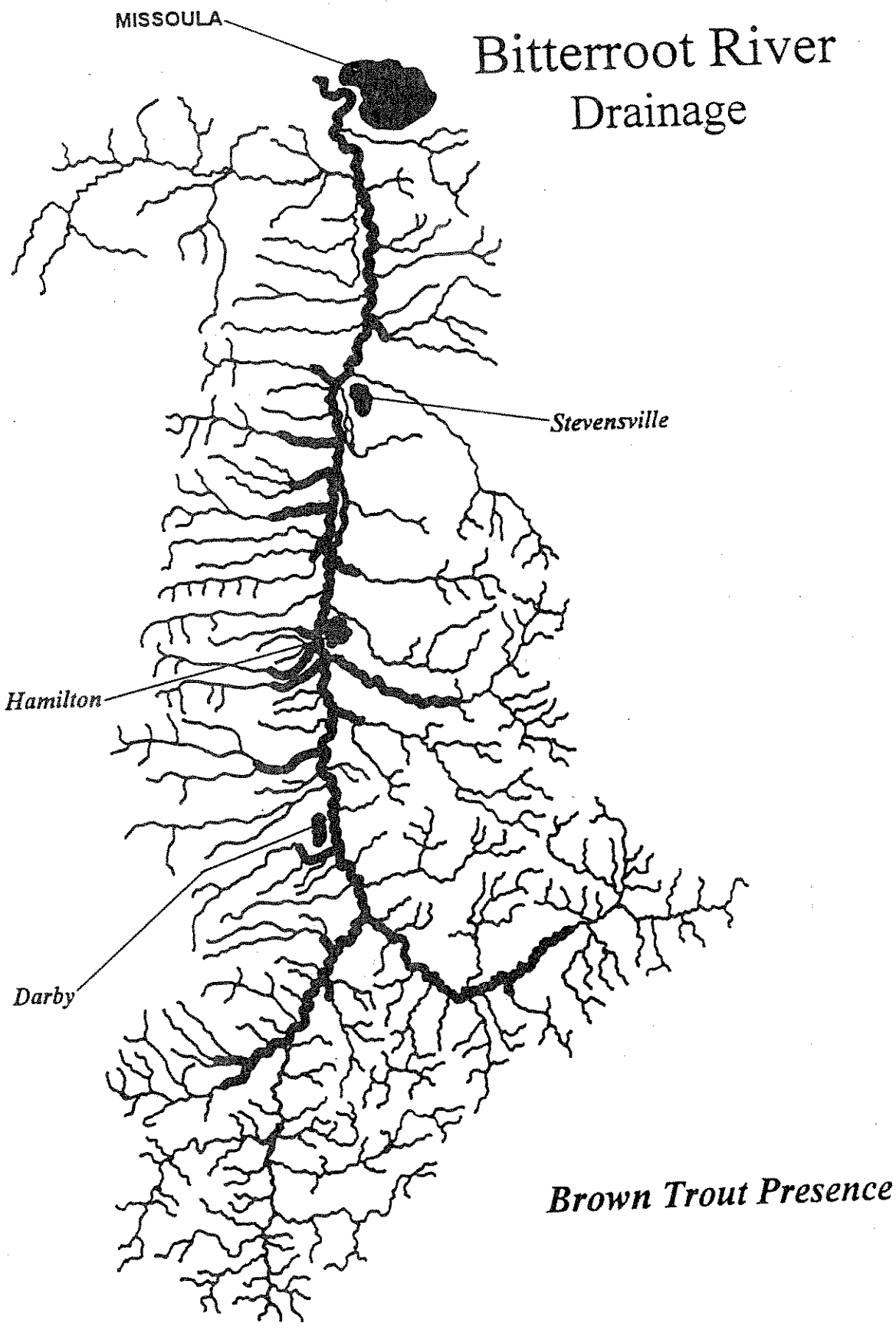


FIGURE 6. The known distribution of brown trout in the Bitterroot drainage as of 1995.

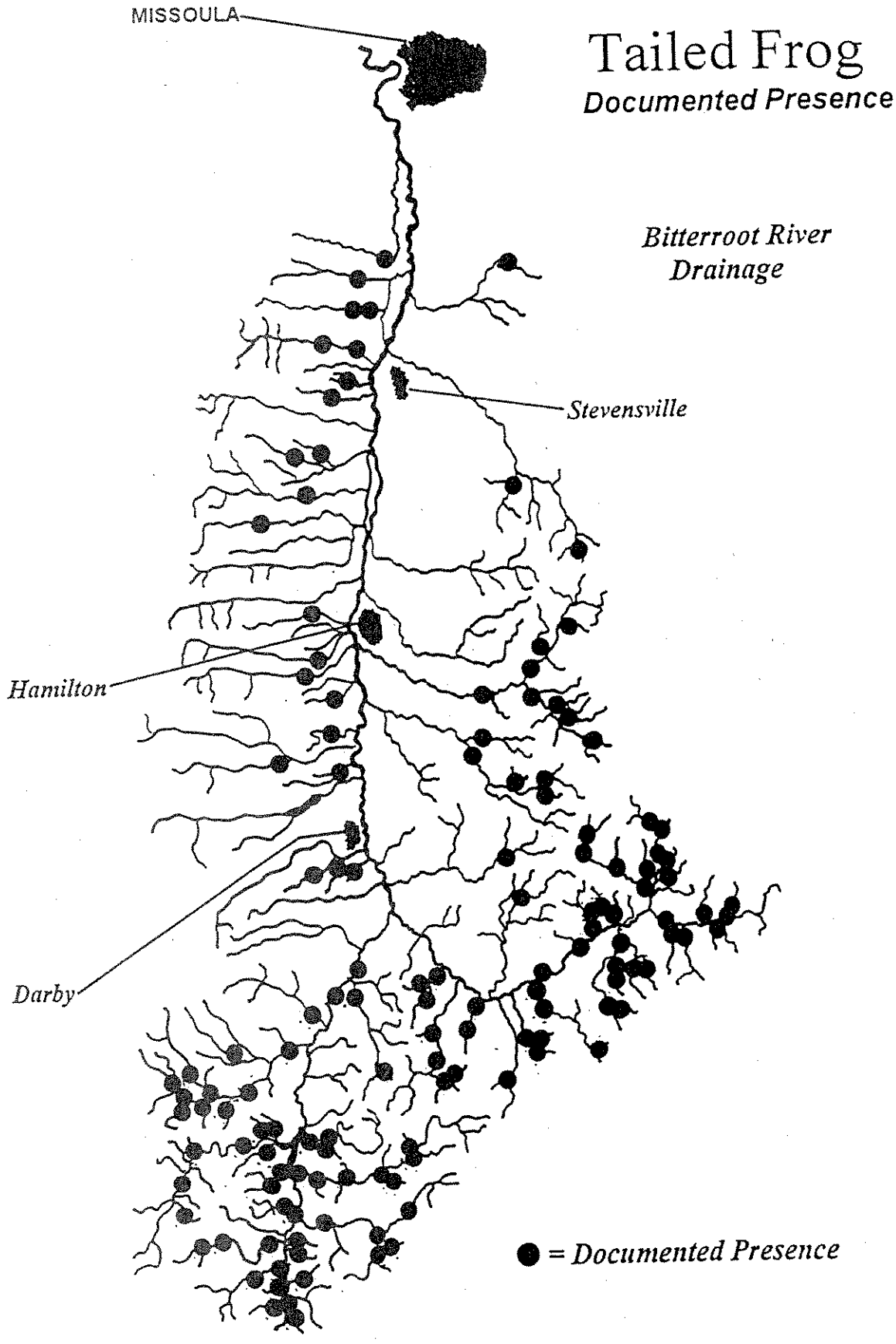


FIGURE 7. The known distribution of tailed frogs in the Bitterroot drainage as of 1995.

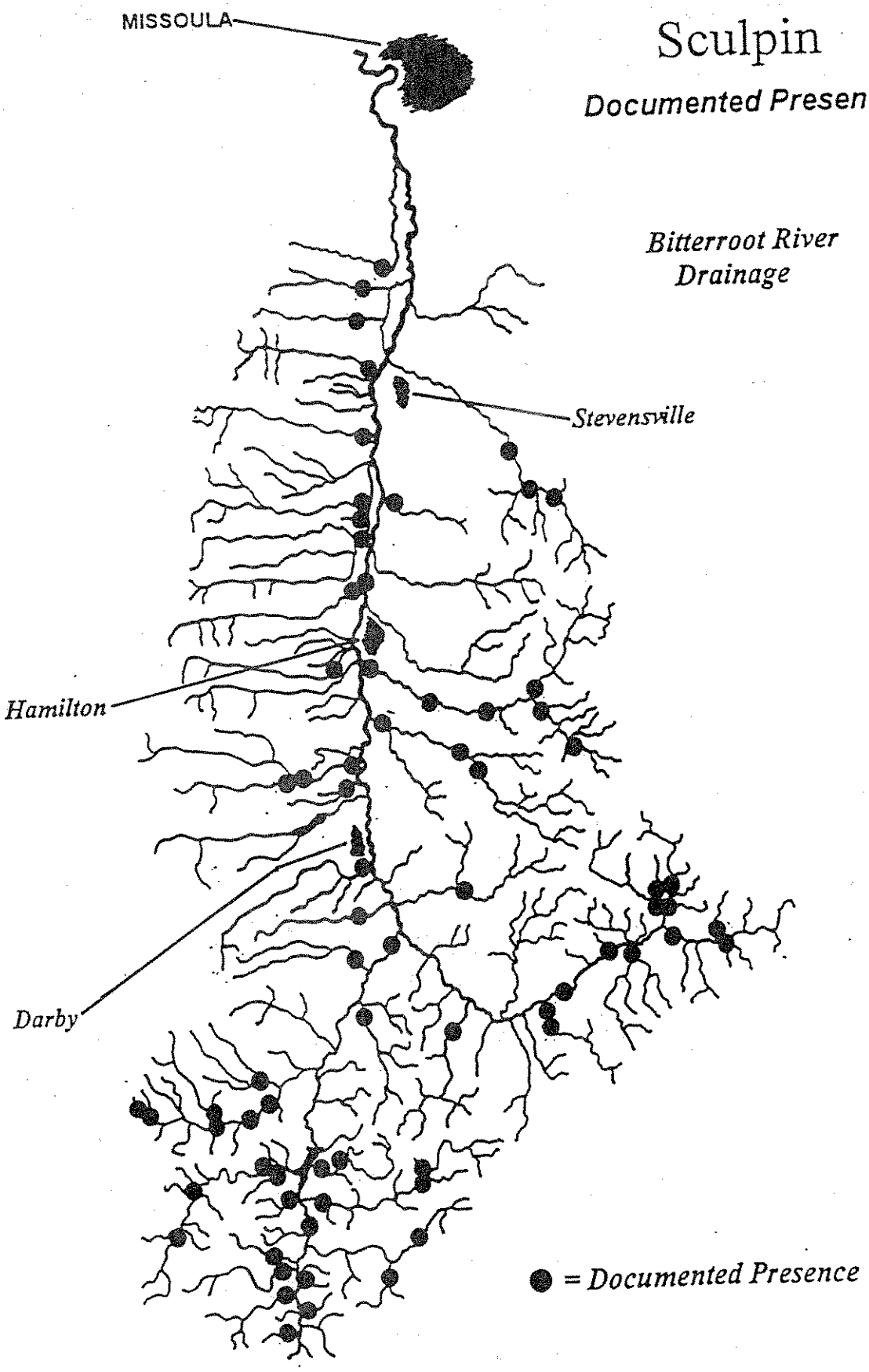


FIGURE 8. The known distribution of slimy sculpins in the Bitterroot drainage as of 1995.

TROUT MOVEMENT

WITHIN SECTION

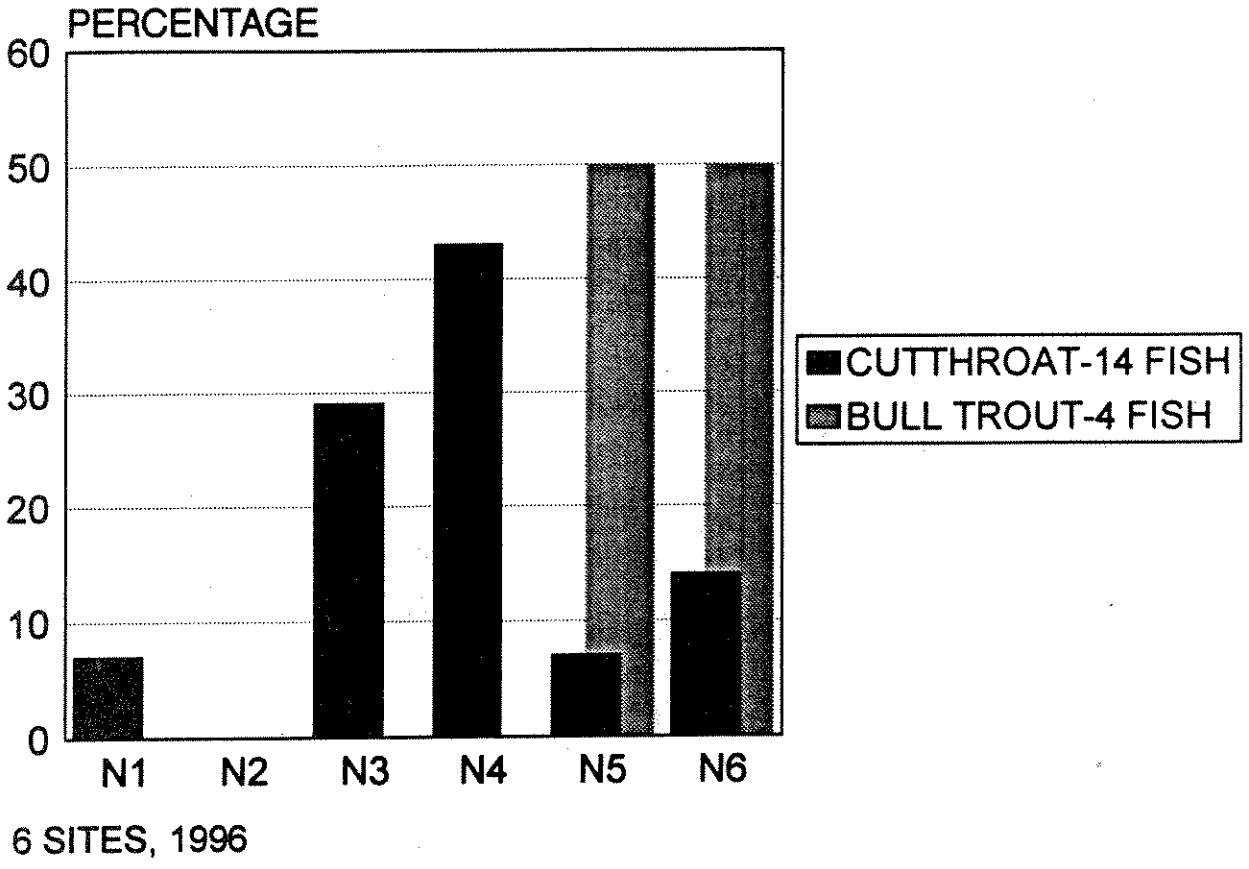


FIGURE 9. The distribution of westslope cutthroat and bull trout that moved in the six-1000 foot study sections during 1995 (N represents the six nets evenly distributed throughout the section).

Comparisons of the population estimates and their 95% confidence interval is illustrated in Figures 10-13. The explanation for the differences between streams is unknown but data that were collected earlier in the summer and had a longer time period between mark and recapture tended to have more disparity between the estimates.

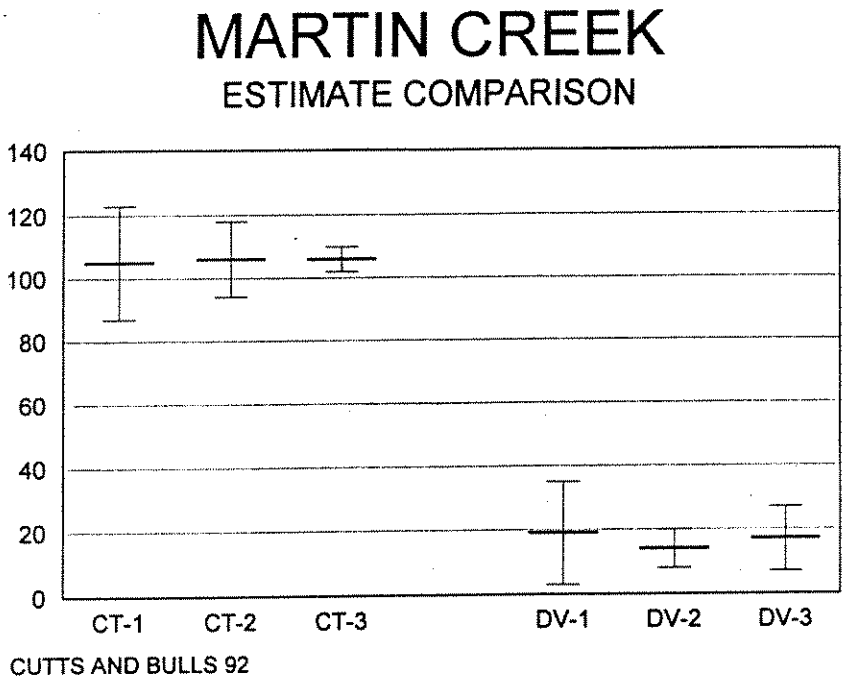
Overall, the accuracy of the population estimates appear to be good. A total of 16 estimates were checked and 9 of them were considered very accurate, 4 were fair and 3 were considered poor. Mark-recapture population estimates should be continued as a long term monitoring tool, at least until other quantitative methods can be developed.

Monitoring of physical habitat features

The physical habitat features at three sites were measured using the same method during different years. Sleeping Child Creek 9.3. and Skalkaho Creek 15.8 were measured during 1989 and 1994. Martin Creek 1.3 was measured during 1991 and 1992. These measurements were taken either by the same crew or a crew trained by MFWP.

A comparison of the data from the two years indicates that either the repeatability of some parameters is poor or that considerable change occurred. While some subtle changes have occurred, the most likely reason for the difference is poor repeatability of the methods. For example, the most obvious difference between the two years is in the percent of different habitat units (Figures 14-16). The percent of different habitat units should not change to the extent that our measurements indicate. They vary considerably at all three sites. Some variables are consistent, including streambottom composition, thalweg depth, wetwidth and substrate score. The difference between the two years is also considerable for undercut banks.

Observer variability can be a serious problem for monitoring habitat changes over time (Roper and Scarnecchia 1995). Even the method we use which relies on intensive measurements is not repeatable for some variables. Subjective measurements, varying streamflow levels and different personnel can all potentially introduce variability in measuring habitat variables.



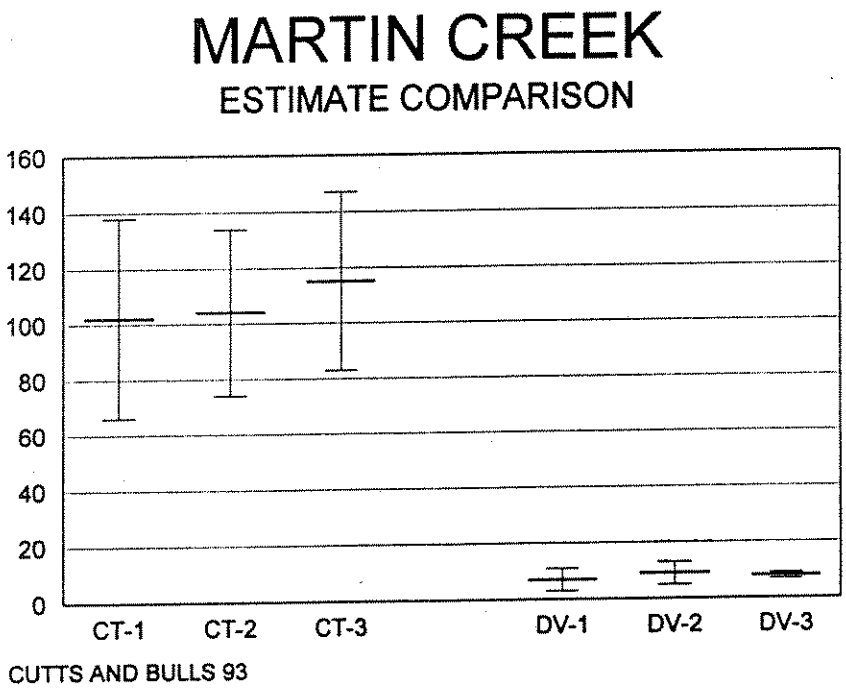
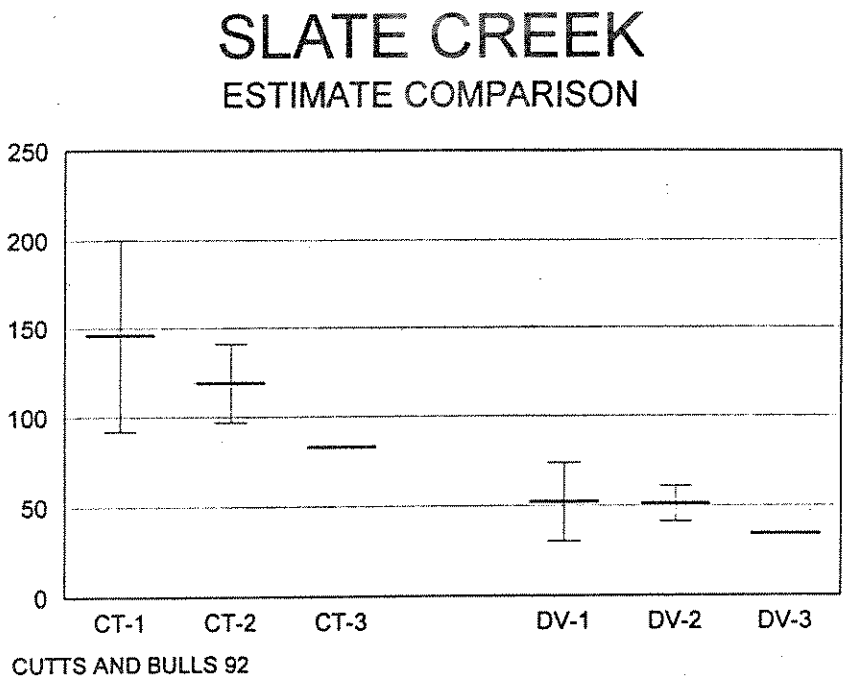


FIGURE 10. Comparison of population estimates and 95% confidence intervals calculated three different ways in lower Martin Creek during 1992 and 1993.



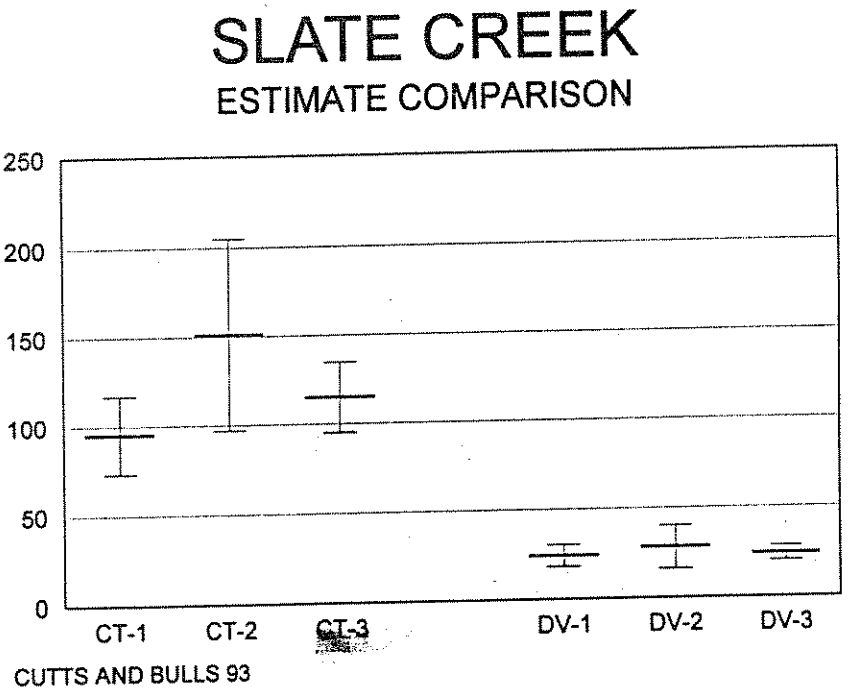
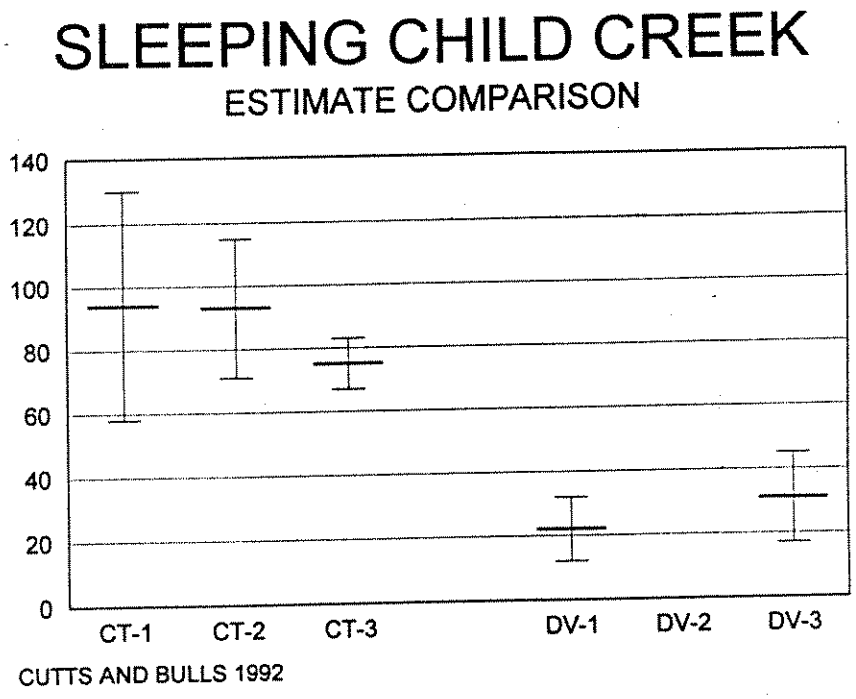


FIGURE 11. Comparison of population estimates and 95% confidence intervals calculated three different ways in Slate Creek during 1992 and 1993.



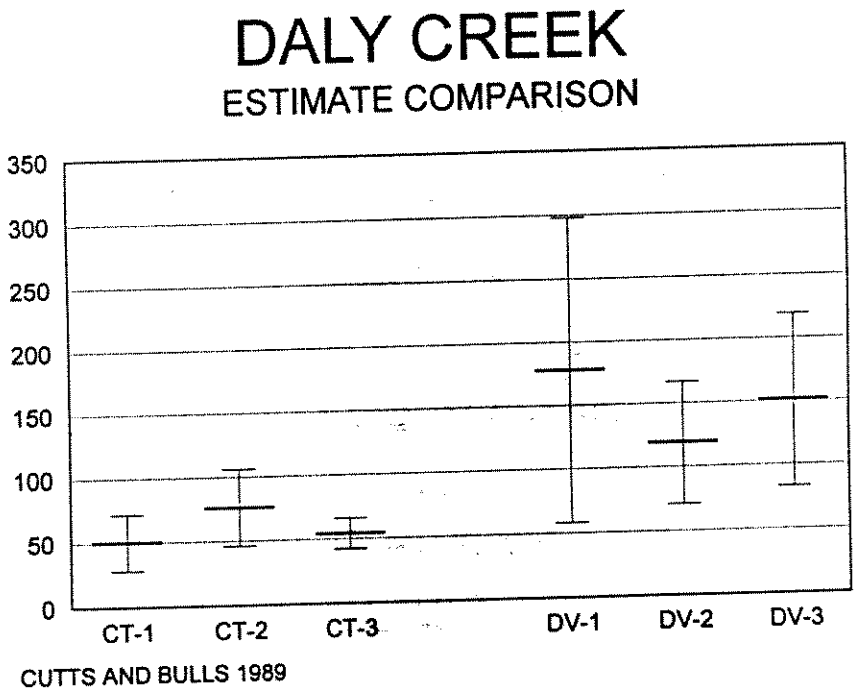
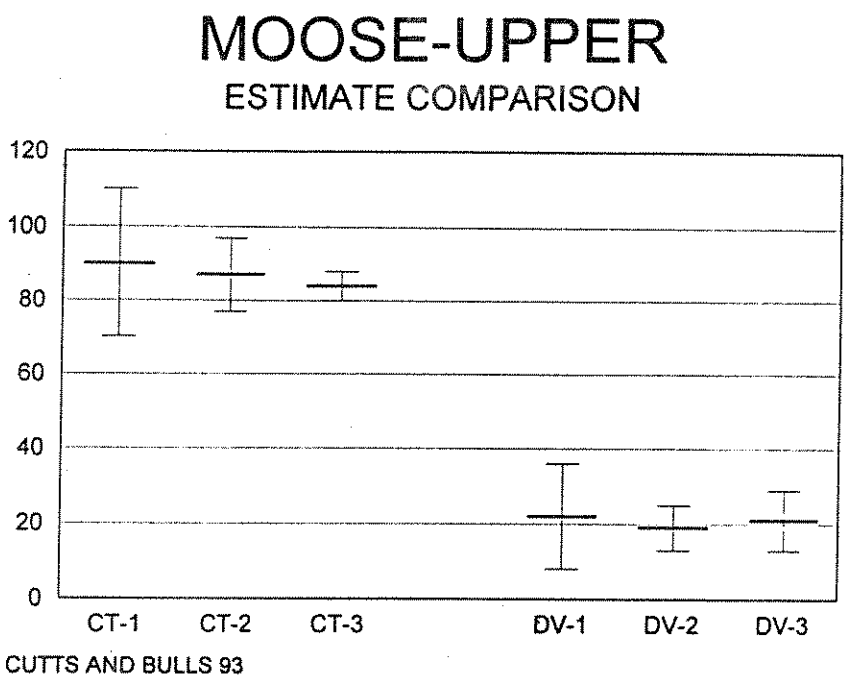


FIGURE 12. Comparison of population estimates and 95% confidence intervals calculated three different ways in Sleeping Child Creek in 1992 and Daly Creek in 1989.



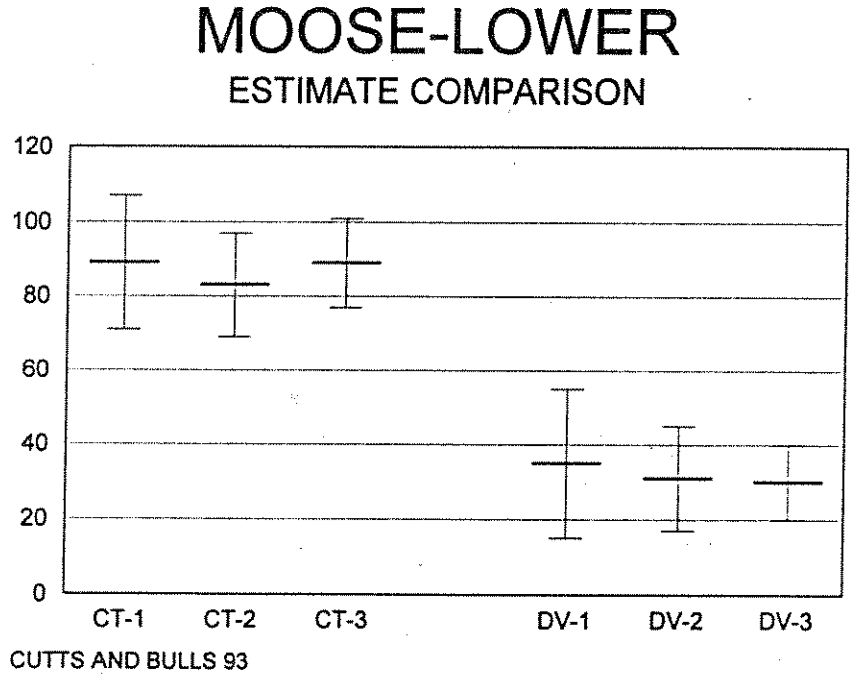
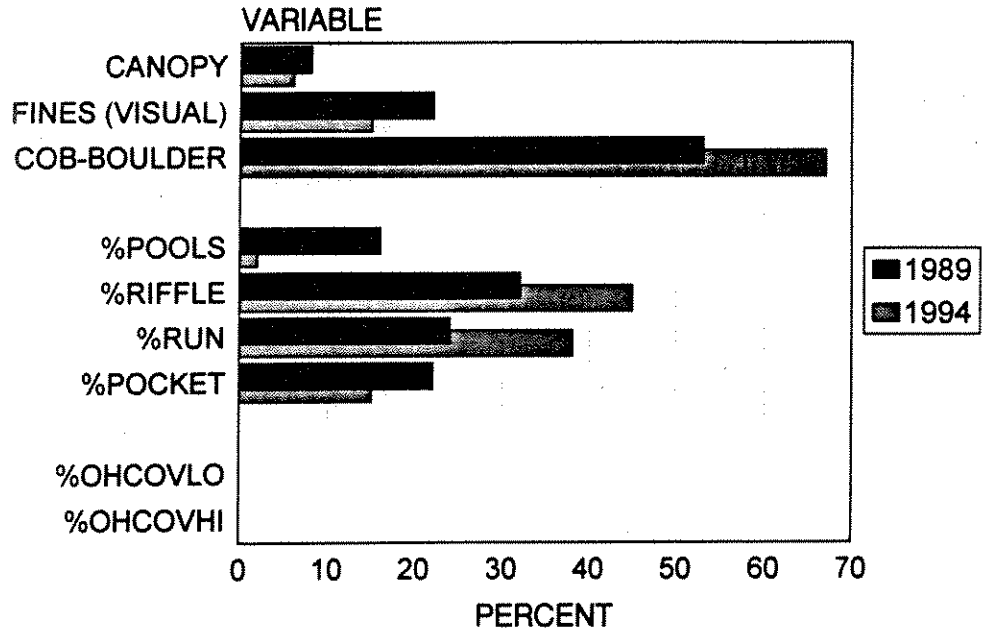


FIGURE 13. Comparison of population estimates and 95% confidence intervals calculated three different ways in two sections of Moose Creek during 1993.



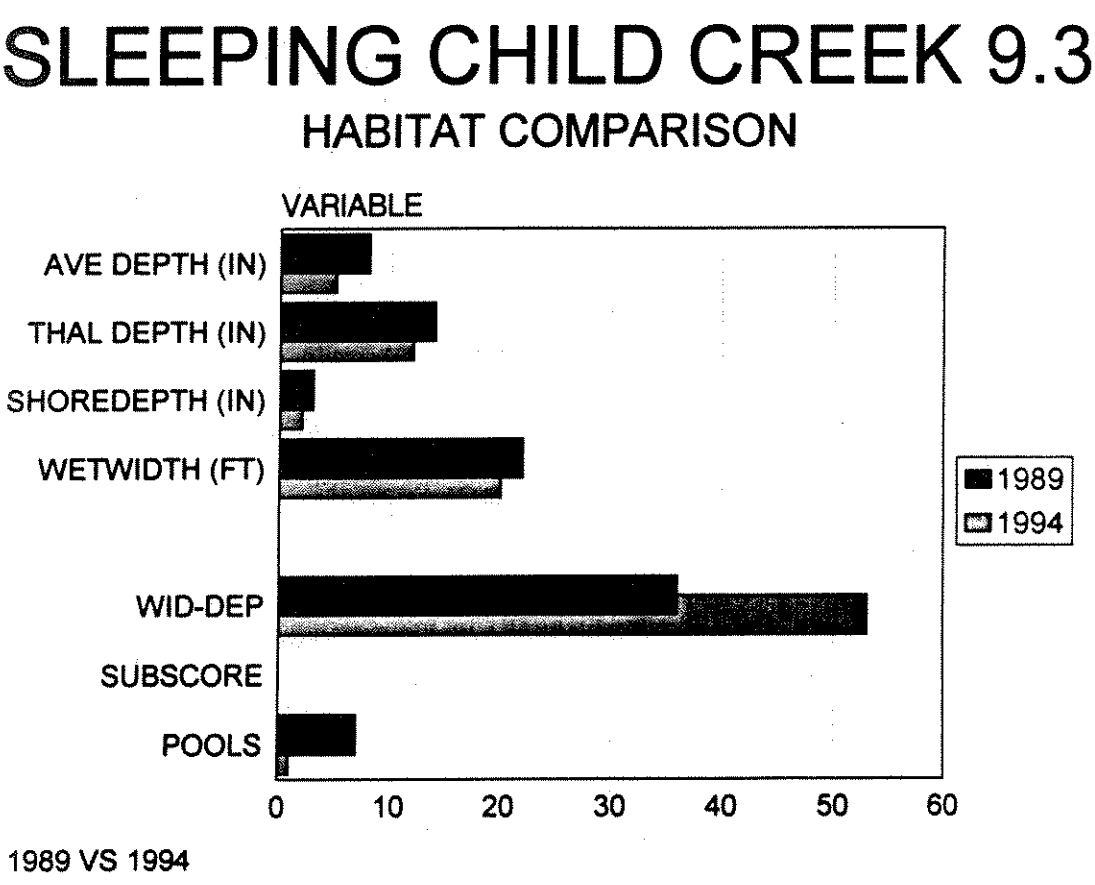
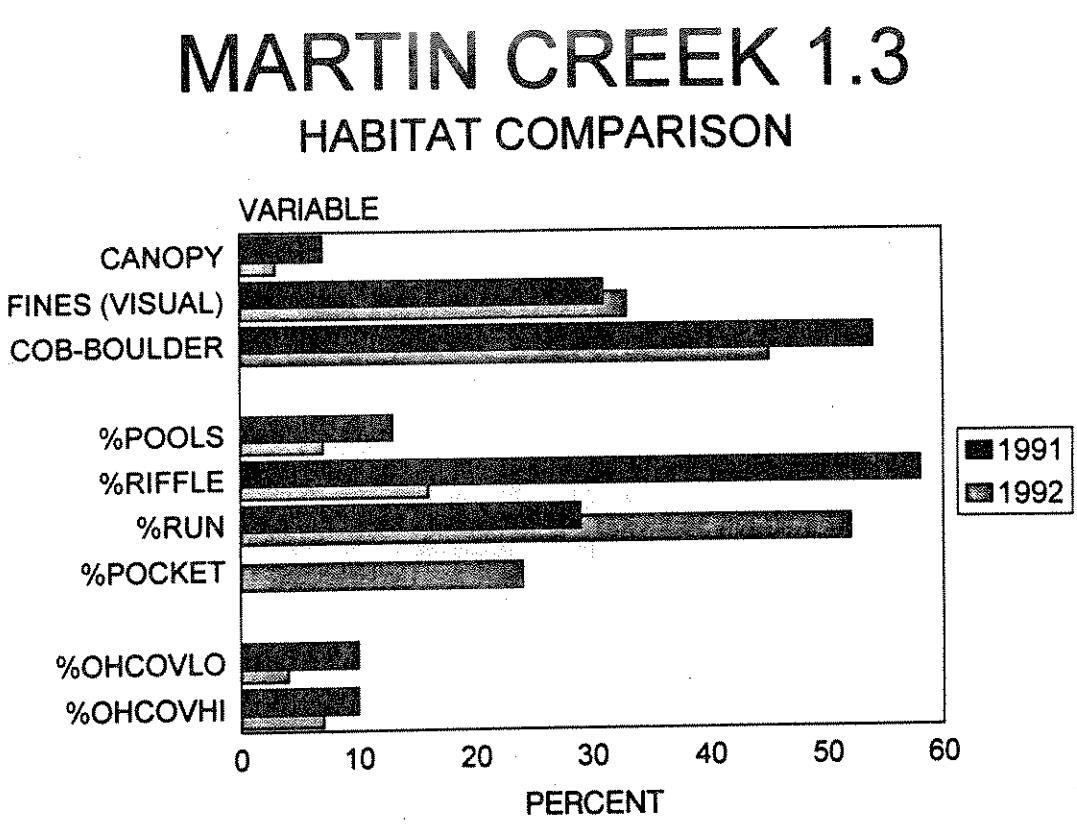


FIGURE 14. Comparison of habitat variables measured in the same reach of Sleeping Child Creek during 1989 and 1994.



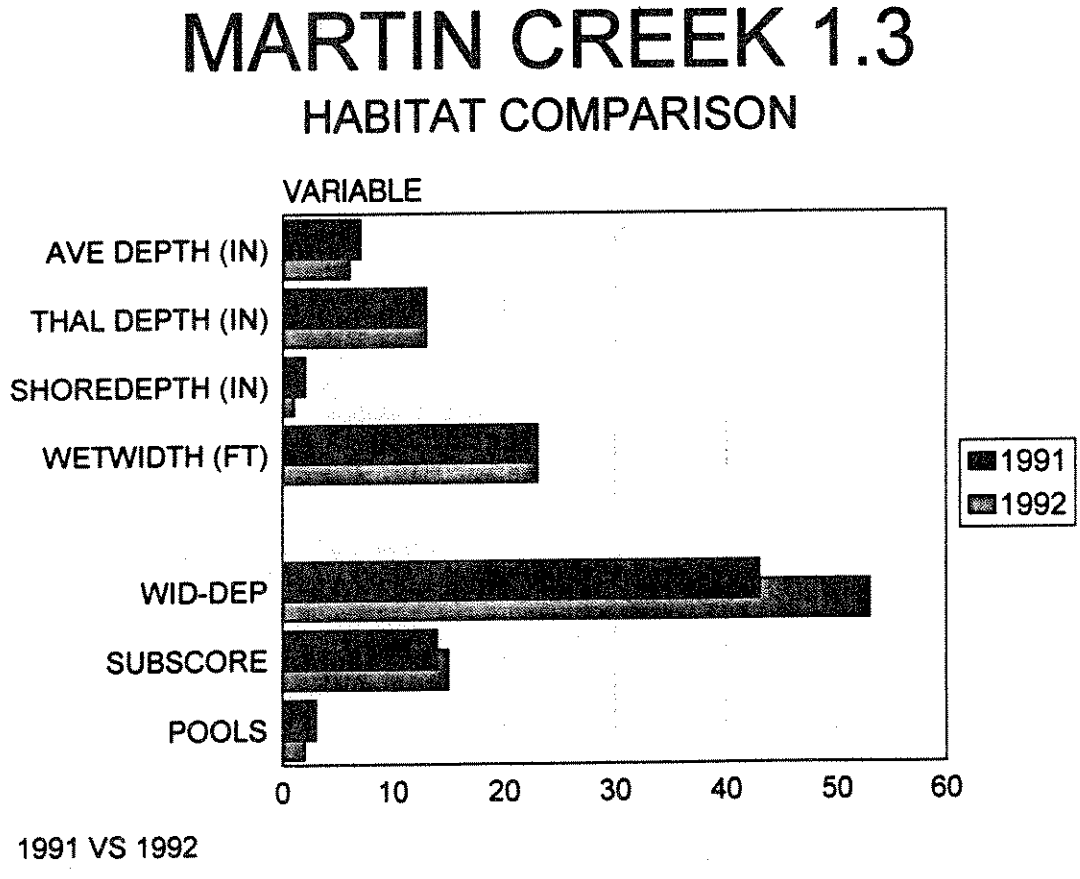
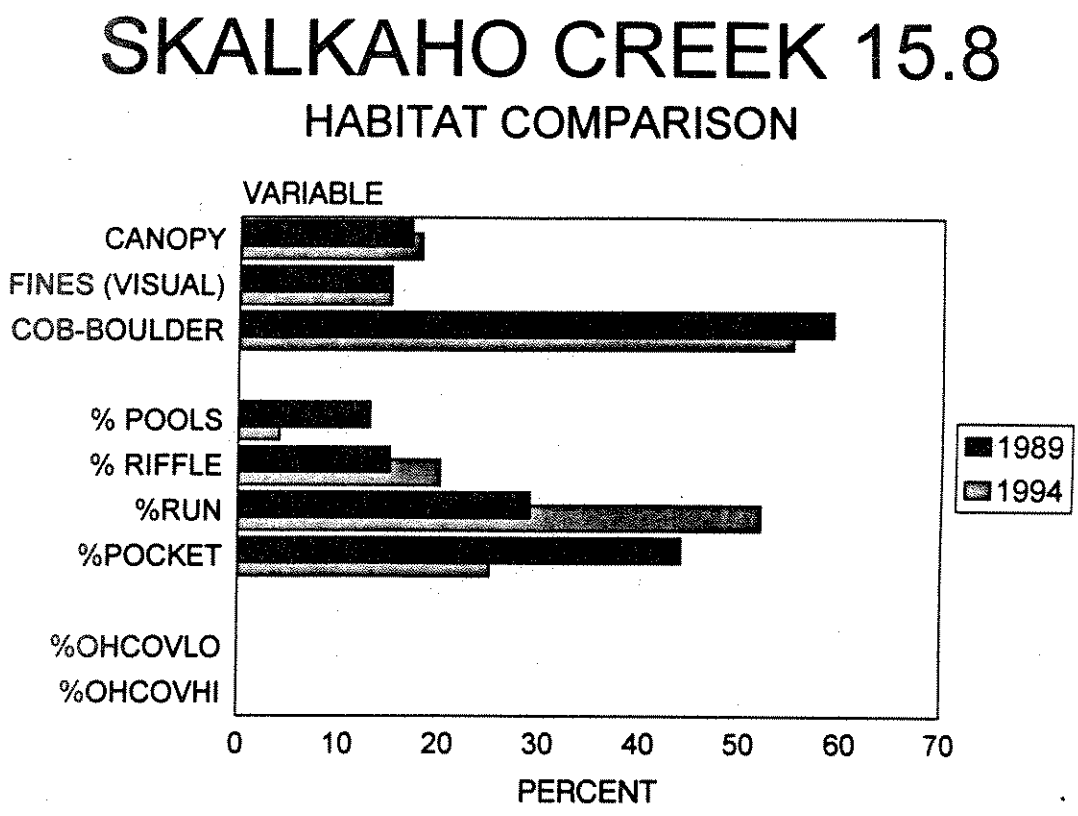


FIGURE 15. Comparison of habitat variables measured in the same reach of Martin Creek during 1991 and 1992.



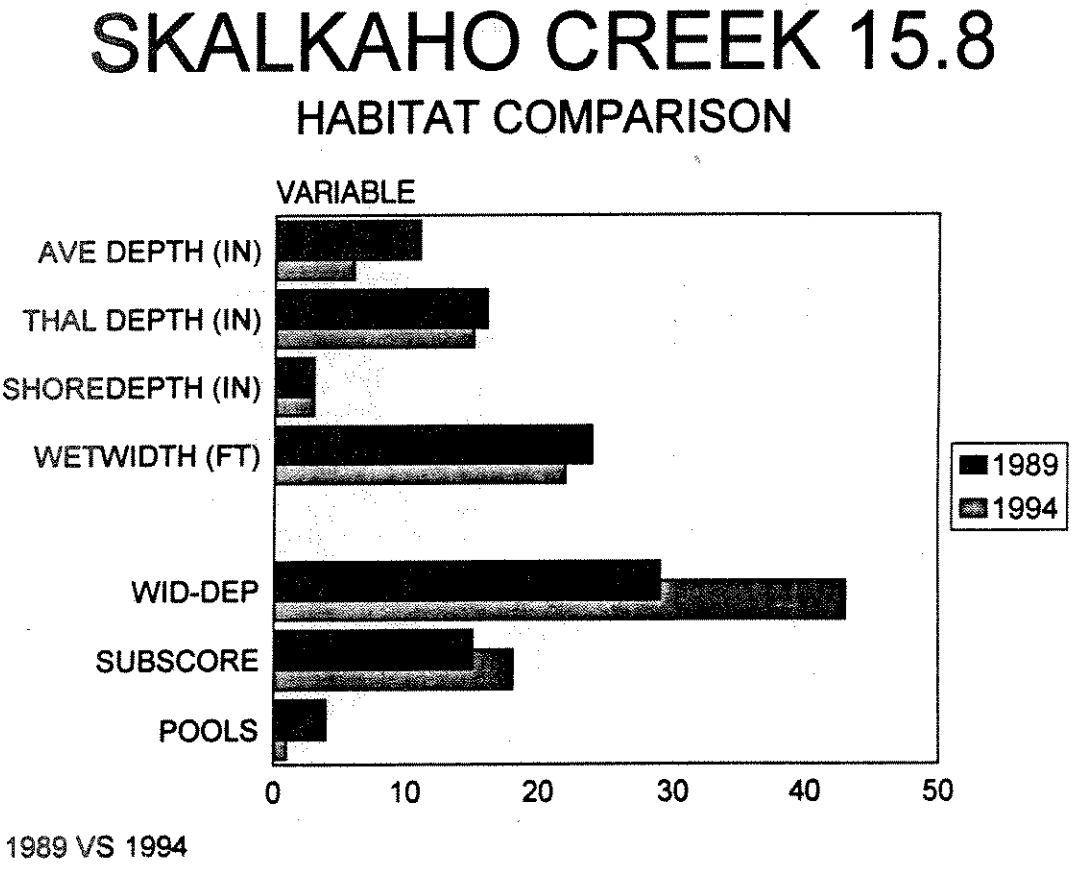


FIGURE 16. Comparison of habitat variables measured in the same reach of Skalkaho Creek during 1989 and 1994.

Bitterroot National Forest Districts

In these streams the predominant species is usually westslope cutthroat trout, with lesser numbers of bull trout. Selected habitat measurements for a comparison between streams is included in earlier reports (Clancy 1991, 1993). Water temperature throughout the Bitterroot drainage is discussed later in this report, but it is also characterized in the discussion of the specific monitoring sites.

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 BNF and MFWP 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.

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.

Stevensville District

The Burnt Fork Bitterroot River and Gold Creek have been sampled for long term monitoring purposes. In addition a population estimate was collected for westslope cutthroat trout on Kootenai Creek in 1995.

Burnt Fork Bitterroot River 19.2 and Burnt Fork Reservoir

A long term monitoring site was established at the end of the road (Burnt Fork 19.2). The first year of sampling was 1994 and a population estimate was collected for westslope cutthroat and bull trout (Figure 17). A few specimens of bull trout appeared to be hybridized with brook trout. The westslope cutthroat in this reach are pure strain (Table 3), despite the presence of rainbow trout in the headwaters.

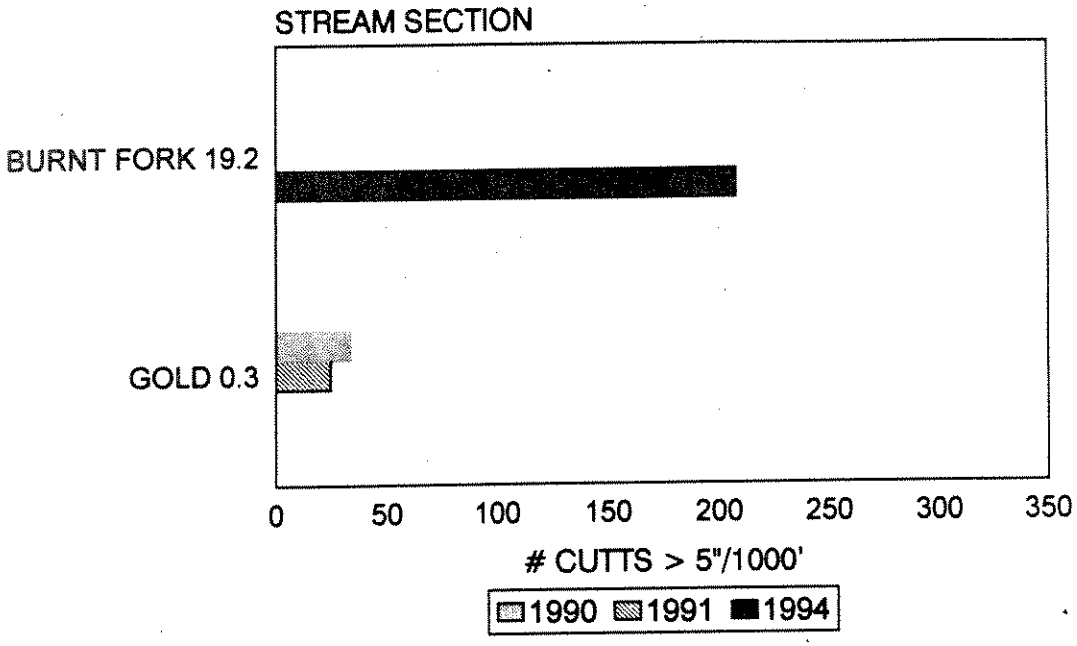
The number of fish at this site is similar to Skalkaho Creek, which is at the high range of what is typical on the BNF. This site should be monitored for at least 2 more years.

Presence-absence sampling of fish further downstream in the Burnt Fork indicated that bull trout are probably uncommon downstream of Hacke Creek and westslope cutthroat are uncommon downstream of Slocum Creek. Brook trout become more common downstream of Gold Creek and are the predominant salmonid near Slocum Creek.

During 1994, we sampled fish in Burnt Fork Reservoir and immediately downstream. In the reservoir, rainbow trout between 5 and 14" were captured and two bull trout between 10-11" inches were captured. Electrofishing in the Burnt Fork immediately below the

WESTSLOPE CUTTHROAT

STEVENSVILLE RANGER DISTRICT



BULL TROUT

STEVENSVILLE RANGER DISTRICT

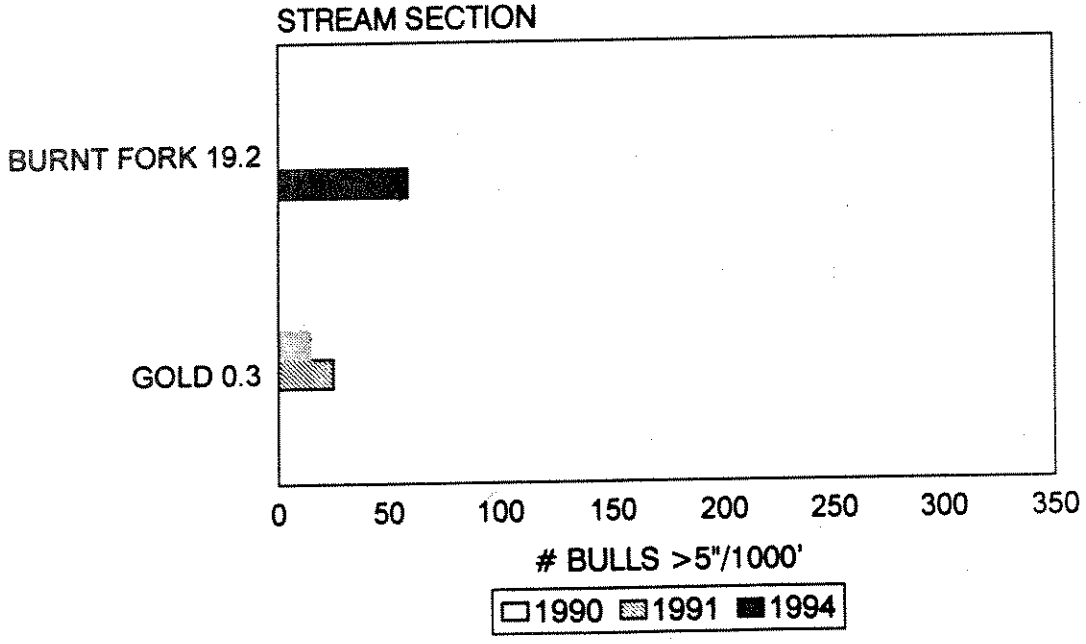


FIGURE 17. Population estimates of westslope cutthroat and bull trout collected on monitoring sections on the Stevensville District.

Dam captured westslope cutthroat (5-8"), bull trout (3-13"), and rainbow trout (2-14").

The water temperature at the monitoring site during midsummer was lower than many other sites and never exceeded 14°C and 12°C, in 1994 and 1995, respectively (Figure 18). During 1995 water temperature was monitored downstream of this site at river mile 11.3, near the junction of the North and South Forks. The maximum midsummer reading at this site was over 14°C.

Gold Creek 0.3

Gold Creek was sampled during 1990 and 1991 (Clancy 1993). Another population estimate should be collected in this reach for the third year baseline.

Kootenai Creek 3.0

In cooperation with BNF personnel a population estimate was collected during 1995 for westslope cutthroat trout in Kootenai Creek near the forest boundary. The section was 1000 feet long and the upstream end was at the diversion for the irrigation pipeline. Angling and tagging of fish was used to mark fish and snorkeling was used for the recapture run. A total of 6 angler hours was used to capture and mark 26 westslope cutthroat trout longer than 5 inches. Of the 26 westslope cutthroat tagged in the marking run, 24 were observed by night snorkeling in the recapture run. The population estimate was 102 cutthroat longer than 5 inches in this reach. This data indicate that in 6 hours of fishing 24% of the larger cutthroat trout were captured in this reach.

Other species were not captured by angling, but bull trout were commonly observed and one brook trout observed by snorkeling.

Sweathouse Creek basinwide

A basinside survey was undertaken on Sweathouse Creek which enters the Bitterroot River at Victor. Personnel from MFWP and BNF cooperated on the survey. Crews walked the mainstem of Sweathouse Creek and measured fish habitat throughout to assess the condition of the stream and the associated fishery. The stream was partitioned into 6 reaches for data analysis (Figure 19). A brief characterization of each reach is included in this report. The detailed information and summaries of the data are on file in the Supervisors Office of the BNF.

Reach 1.

This reach begins where Sweathouse Creek enters the Bitterroot River and extends upstream to Pleasant View Drive in Victor. The total length of the reach is 3612 meters (m). It is a C3 channel type with a gradient of < 1.5%. This meandering reach is dominated by low gradient riffles, runs, non-turbulent units and laterally scoured pools. The creek averages 6.0 m wide and 0.3 m deep.

The riparian area alternates between cottonwood trees and

BURNT FORK BITT. RIVER 19.2

Temperature Summaries

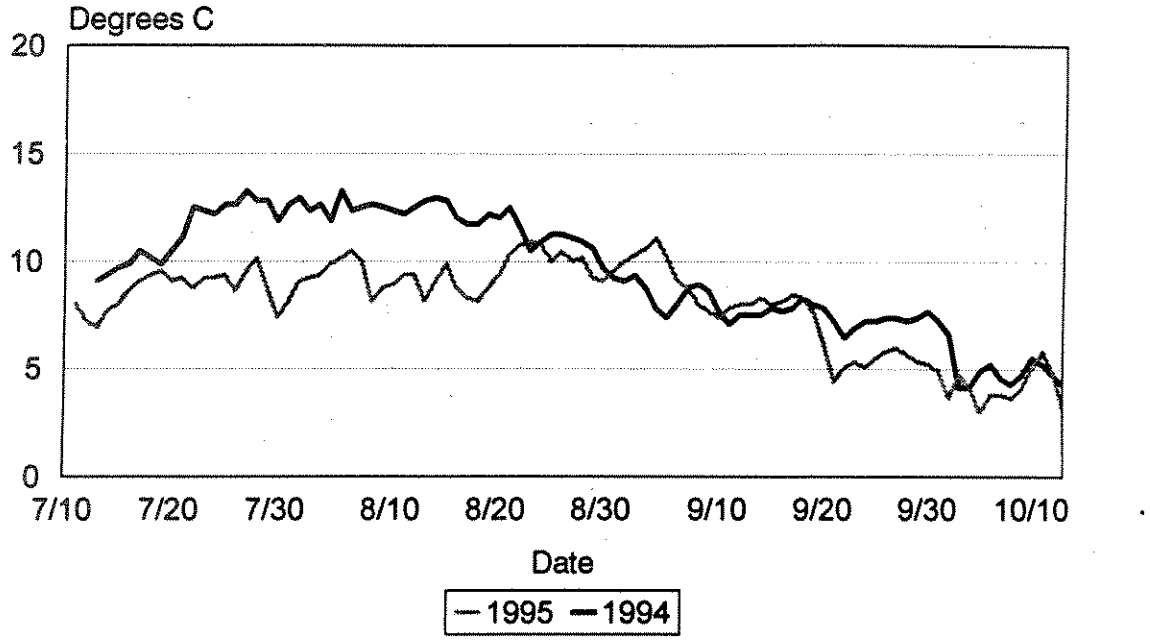


FIGURE 18. Maximum daily water temperature in the Burnt Fork Bitterroot River near the trailhead in 1994 and 1995.

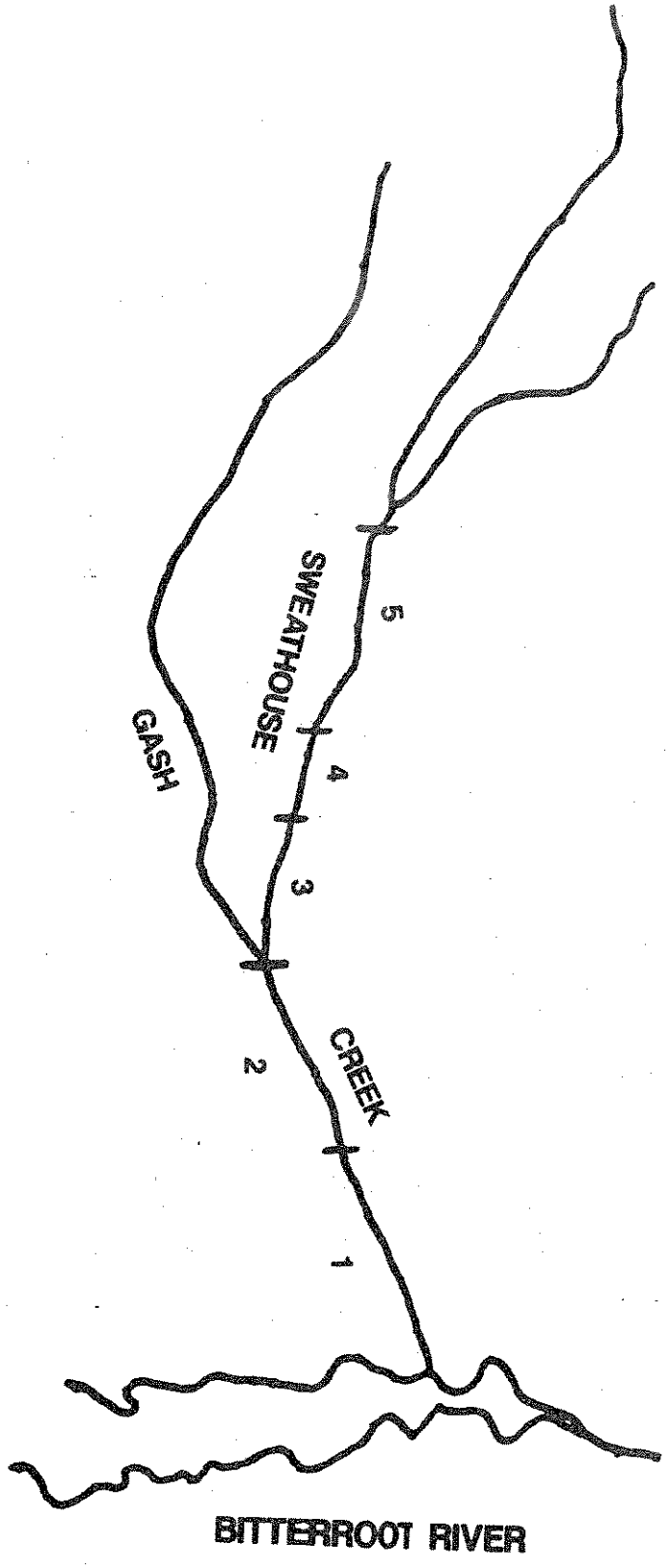


FIGURE 19. Map of the Sweathouse Creek drainage.

meadow. There are numerous areas where grazing has damaged the riparian area and streambanks. Due to unstable streambanks, rip-rap has been commonly used to reduce streambank erosion.

Brown trout were the most common species of fish captured in this reach. Brook and rainbow trout are also common. Sculpins and suckers were present. This reach supports a spawning run of rainbow trout from the Bitterroot River each spring (Clancy 1993).

Reach 2.

This reach begins at Pleasant View Drive and extends upstream to the mouth of Gash Creek. The total length of the reach is 2689 m. It is a C3 channel type with a gradient of < 2.0 %. The habitats are similar to reach 1. The creek averages 5.6 m wide and 0.2 m deep.

The riparian area alternates between meadow and cottonwood bottom. It is alternately in good condition and heavily grazed. There is some serious riparian damage from grazing in this reach and rip-rap is common.

Brown trout were the most common species of fish captured in this reach. Brook trout are also common, but no rainbow trout were captured. Suckers and sculpin are present.

Reach 3.

This reach begins at the mouth of Gash Creek and extends upstream to a small southside tributary approximately 1701 m upstream. It is a B3 channel type with a gradient of < 2.0%. The habitat units are similar to reaches 1 and 2 with less pools. The creek averages 5.8 m wide and 0.2 m deep.

The riparian area is a mix of cottonwood and coniferous trees. Some grazing damage is evident but it is not as extensive as downstream.

Brook trout are the most common species of fish captured. Brown trout are also common in this reach, and a small number of cutthroat were captured. Sculpin are present.

Reach 4.

This reach begins at the mouth of the small southside tributary and extends upstream to the twin culverts at the upper crossing in section 28. It is 810 m long. It is an A3 channel type with a gradient of 3-5%. The most common habitat types are high and low gradient riffles. The creek averages 4.5 m wide and 0.2 m deep. The riparian area is largely conifers and the streambank is stable.

Cutthroat trout are the most common species of fish captured. Brook trout are also common. Sculpins are present.

Reach 5.

This reach begins at the twin culverts at the upper crossing in section 28, and extends upstream to the lower waterfalls 3285 m upstream. It is an A2 channel type with a gradient of about 10%. The most common habitat types are high gradient riffles, step runs, and pools formed by mid channel boulders. The creek averages 4.6 m wide and 0.2 m deep. The riparian area is largely conifers and the

streambank is stable. This reach is characterized by large amounts of large woody debris in the channel.

Cutthroat trout were the most common species captured in this reach. Brook trout were captured in the lower end of the reach, but a barrier near the forest boundary appears to stop any upstream movement. Bull trout are found throughout this reach and this is the only reach where they were captured.

Reach 6.

This reach begins at the lower falls and extends to the headwaters. The entire reach was not surveyed due to time constraints. About 510 m were surveyed and high gradient riffles, pools formed by boulders and highly turbulent units were the most common habitat types. The creek averages 4.3 m wide and 0.2 m deep. The riparian area is largely coniferous and the streambank is stable. The reach is characterized by large amounts are large woody debris.

Cutthroat trout are the only species of fish captured in this reach. No sculpins were found.

Darby district

Several study sections were sampled on the Darby District during 1993, 1994 and 1995 (Figures 20 and 21). The exact locations of these sites and other monitoring sites are discussed and mapped in a previous report (Clancy 1991, 1993).

Lick Creek 1.9

A monitoring site was established by BNF biologists in Lick Creek near the forest boundary in 1990. The site is dominated by brook trout with a small population of westslope cutthroat present. The brook trout are mostly in the 4-6 inch range with an occasional individual over 10". The 1995 population estimate of brook trout was lower than the previous years, particularly in the larger sizes (Figure 22).

Water temperature was monitored at this site during 1993 and 1994. This site was warm when compared to other forest streams. During 1994 water temperature exceeded 17°C (Figure 22).

WESTSLOPE CUTTHROAT

DARBY RANGER DISTRICT

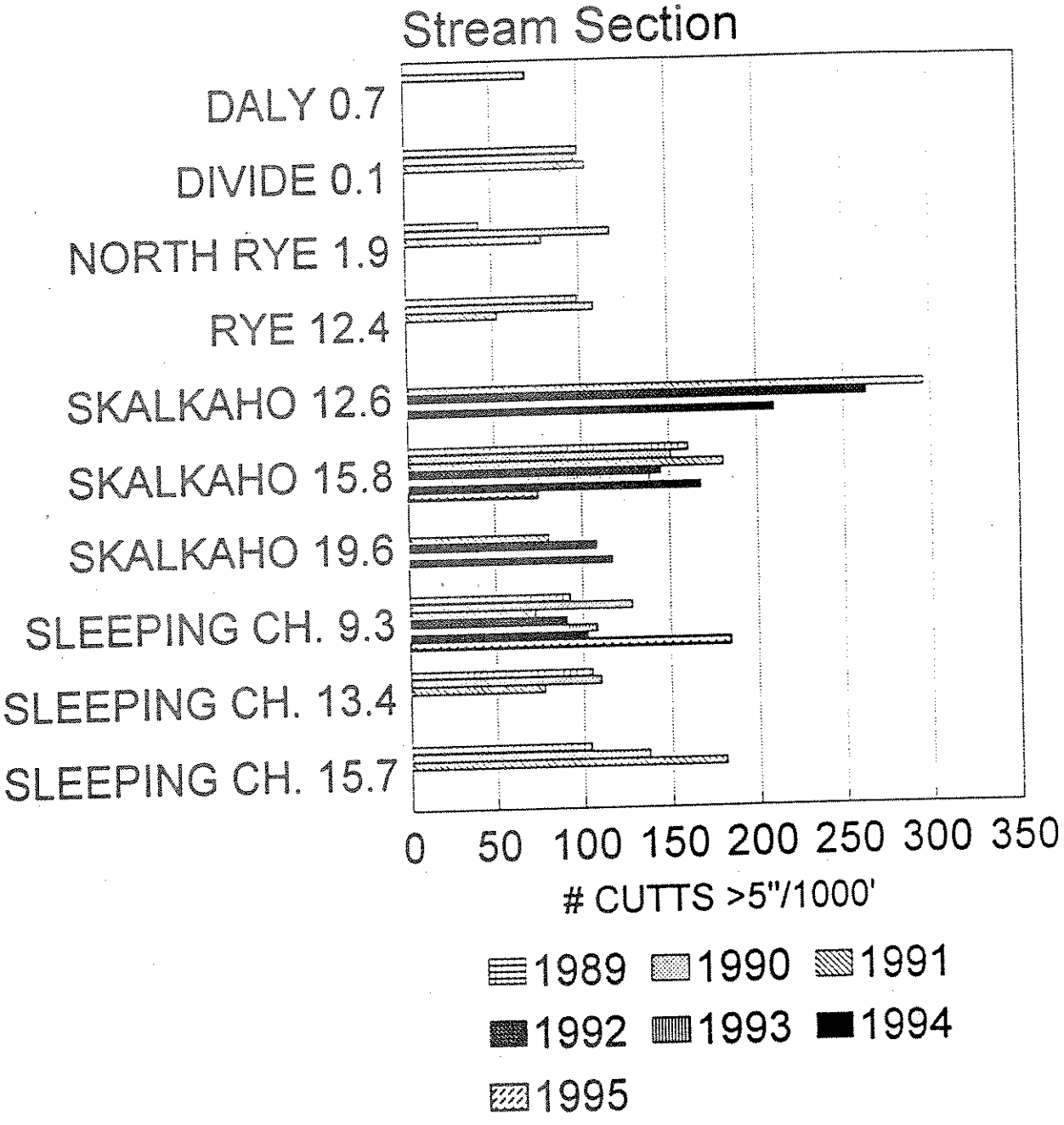


FIGURE 20. Population estimates of westslope cutthroat collected on monitoring sections on the Darby District.

BULL TROUT

DARBY RANGER DISTRICT

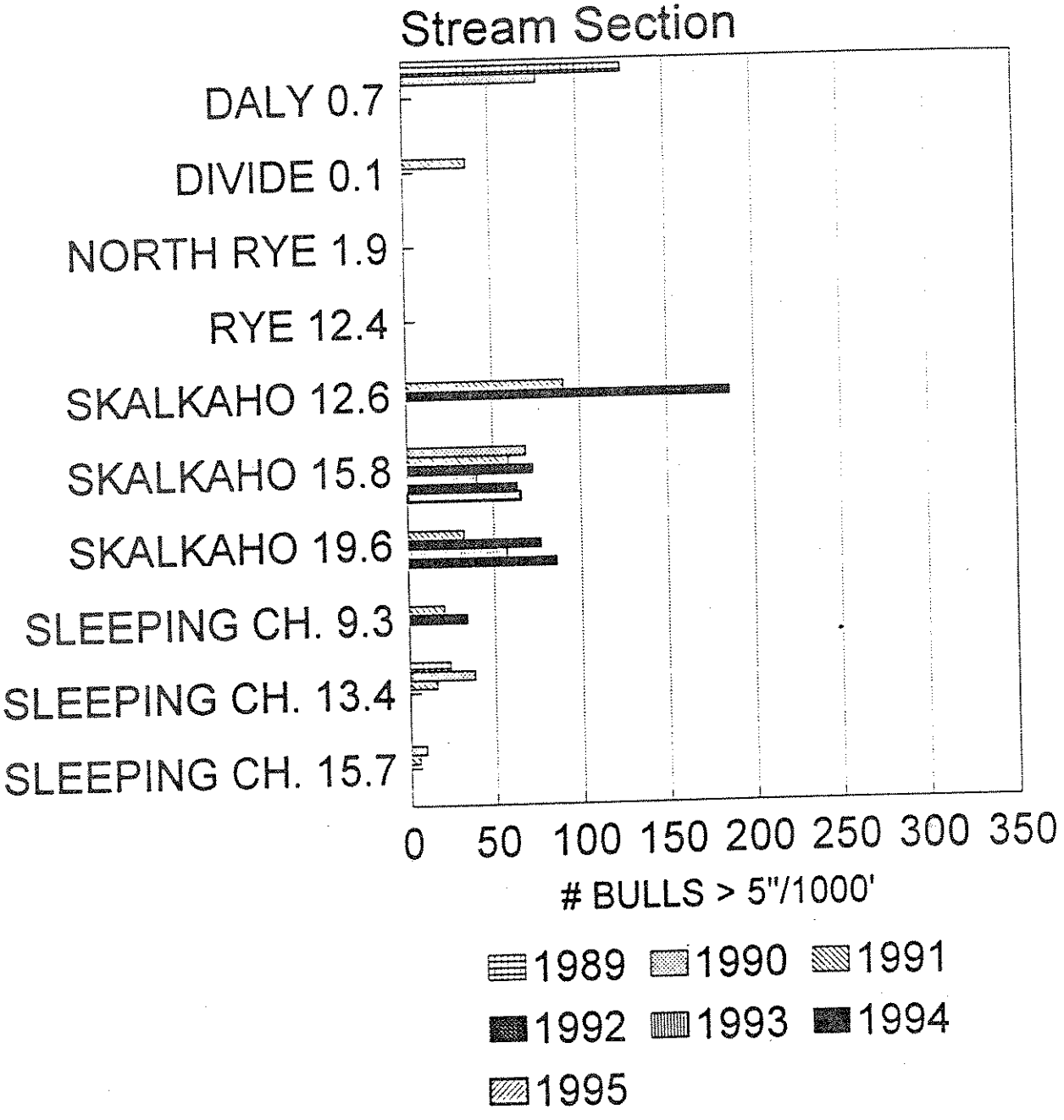
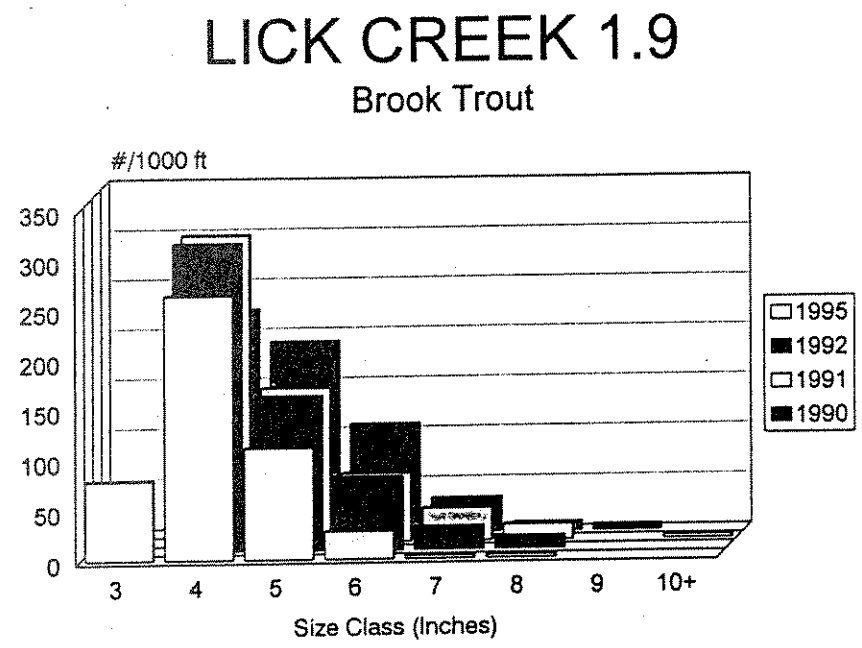


FIGURE 21. Population estimates of bull trout collected on monitoring sections on the Darby District.



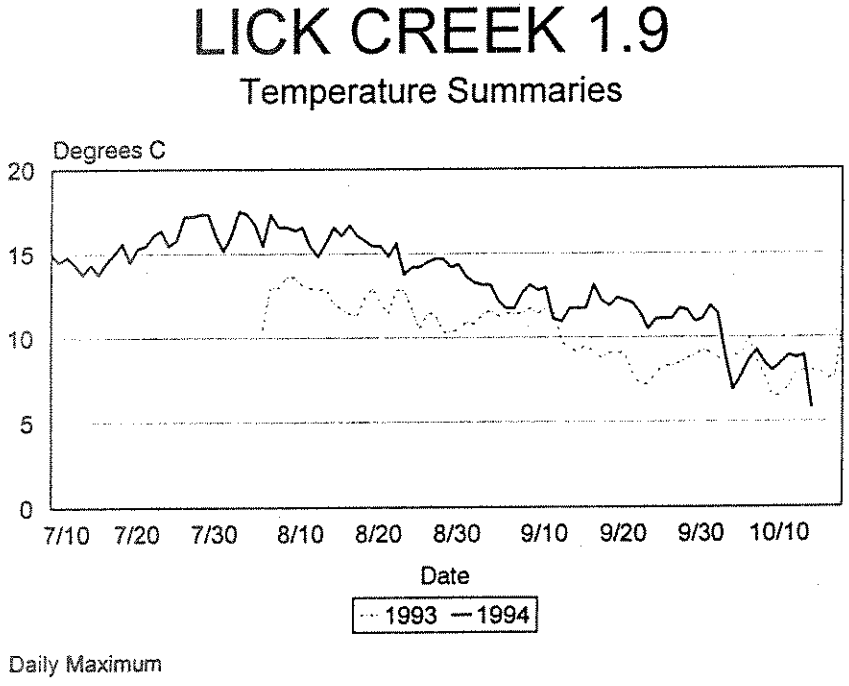


FIGURE 22. Population estimates of brook trout by size class and maximum daily water temperature in Lick Creek near the forest boundary during the years indicated.

Rye Creek 12.4 and North Rye Creek 1.7

Both of these sites were sampled for three years, from 1989-1991 (Figures 23 and 24). A temperature logger recorded water temperature at these sites in 1993, 1994 and 1995 (Figure 25). The Rye Creek site is well upstream of the North Fork, and it is dominated by westslope cutthroat. Bull trout are present but very rare and no brook trout were found in three years of sampling. The fish at this site are small with none over 7 inches. It was considerably cooler than the North Fork as it exceeded 15° C for only a few days in 1994, which was the warmest year we have recorded (Figure 25).

The North Rye Creek site is dominated by westslope cutthroat but brook trout are also abundant. This site was warmer than most other sites that we monitored as water temperature reached 18° C during 1994 and stayed above 15° C for several weeks.

Skalkaho Creek 12.6, 15.8 and 19.6 and Daly Creek 0.7

Three monitoring sites have been established on Skalkaho Creek. Skalkaho Creek is a native fishery from the headwaters downstream to near the confluence with Daly Creek. Brook trout appear in the area of Bear Gulch and the creek becomes dominated by brook and brown trout in the lower reaches (Clancy 1993).

Three years of fish population data have been collected near Bear Gulch (Skalkaho Creek 12.6). The population of cutthroat trout was highest in 1992 and the 1991 and 1994 estimates are similar (Figure 26). There is no obvious trend in cutthroat or bull trout numbers.

A long term monitoring site (Skalkaho Creek 15.8) has been established on one site in Skalkaho Creek about 1 mile above the confluence with Daly Creek. This site has been sampled since 1989 and the populations of cutthroat trout have been stable until 1995 when it was lower than any previous year (Figure 27). This site should be sampled again in 1996 and beyond.

The 7 year mean of the population estimates in this section is 151 cutthroat over 5" per 1000 feet. The 1995 estimate is below the 7 year mean. After five years, the standard deviation was below 10 in this reach. This may be a logical time period for an established baseline to be developed. This site should be monitored continuously for several more years to assess annual variations in the fish population size.

Physical habitat features were measured on this section in 1989 and 1994. The streamchannel is typically cobble-boulder dominated with lower amounts of fine materials than average for the BNF streams sampled to date (Clancy 1993).

The furthest upstream site (Skalkaho Creek 19.6) was sampled during 1991-1994 (Figure 28). This site is about 1/2 mile upstream of Weasel Creek. There was a downward trend in the larger cutthroat trout at this site, so it should be sampled again within the next few years.

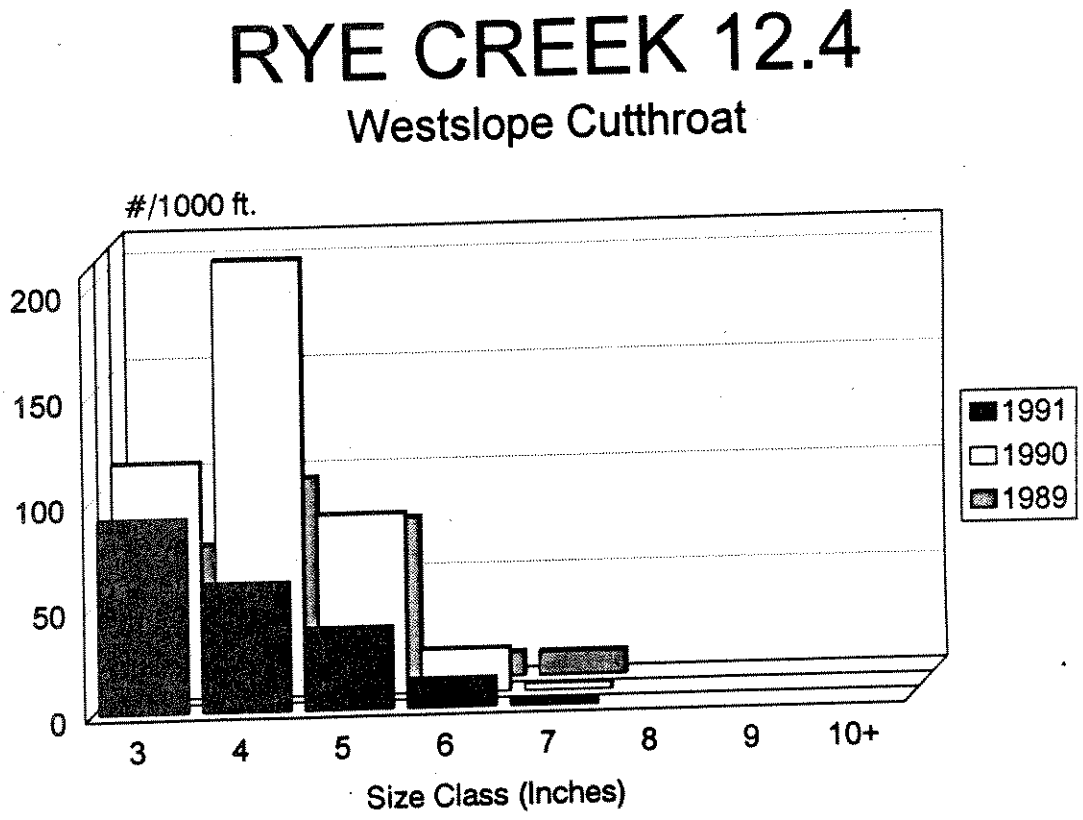
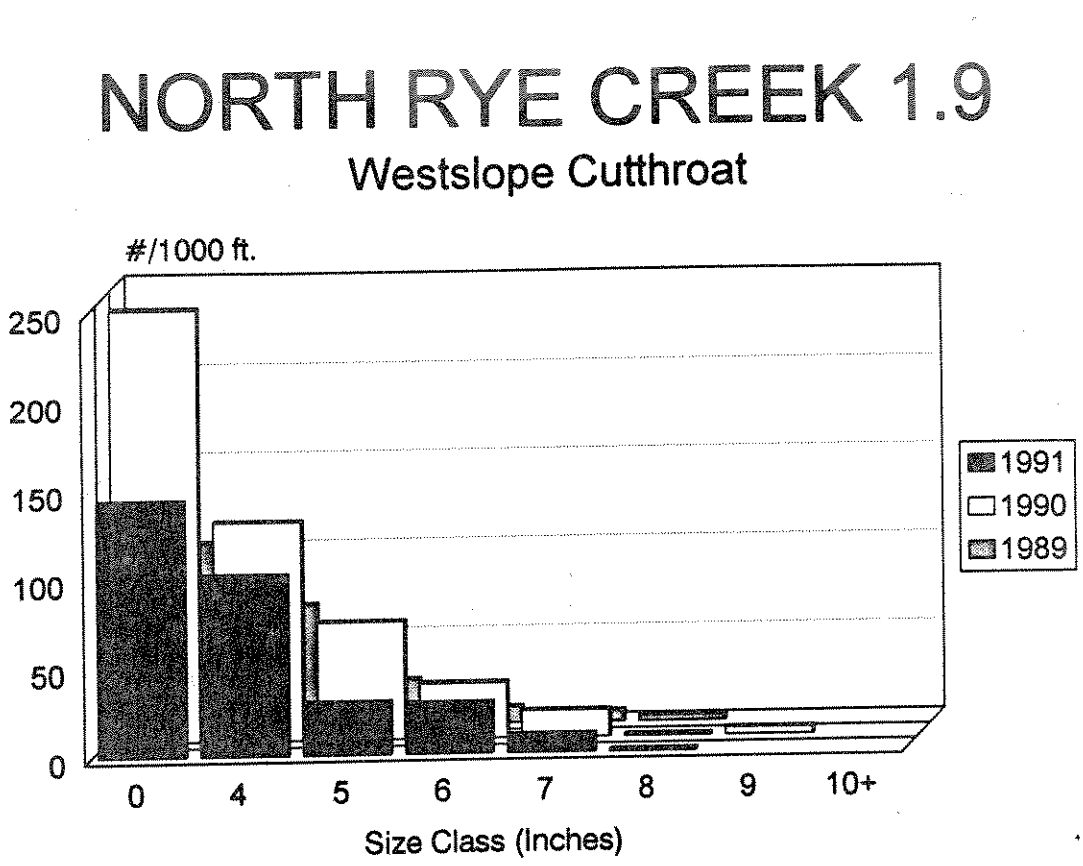


FIGURE 23. Population estimates of westslope cutthroat by size class in Rye Creek 12.4 during the years indicated.



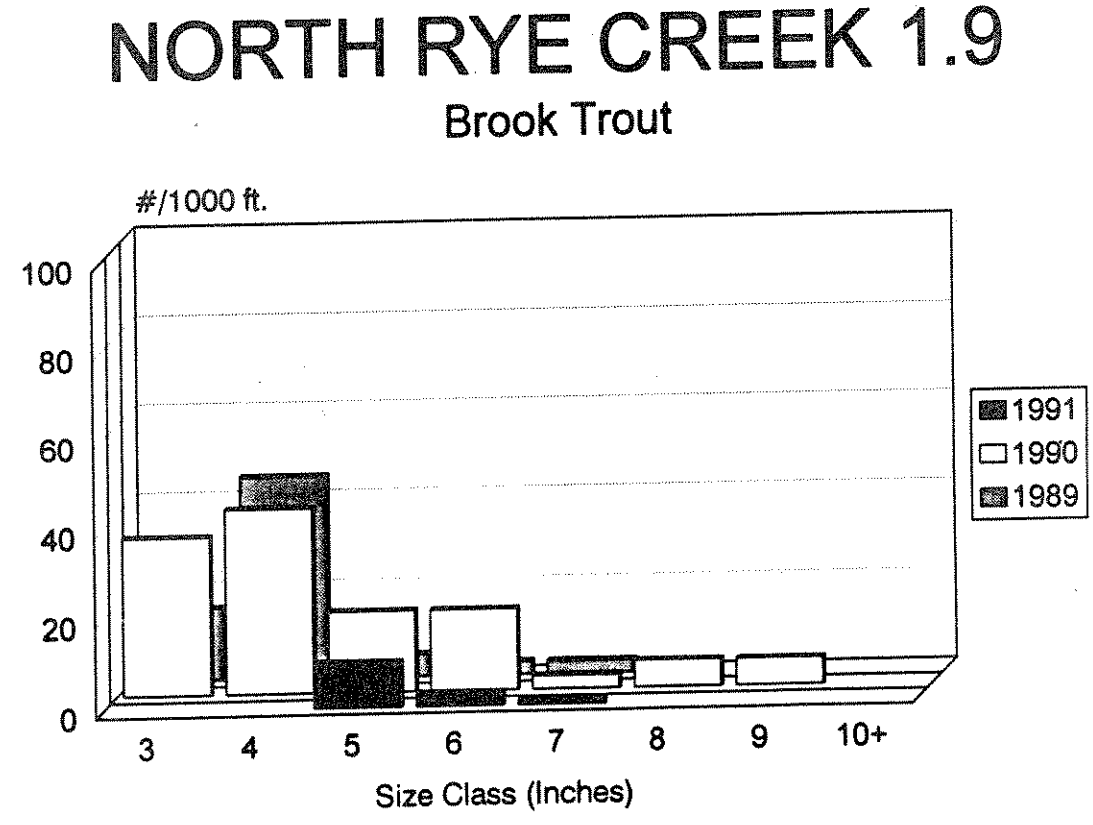
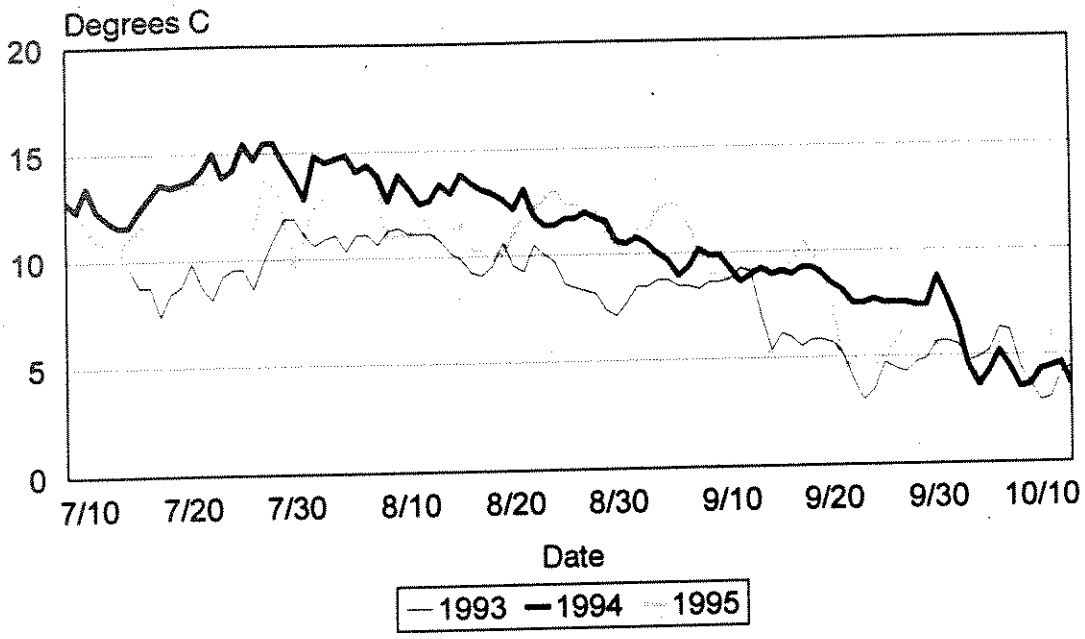


FIGURE 24. Population estimates of westslope cutthroat and brook trout by size class in North Fork Rye Creek during the years indicated.

RYE CREEK 12.4

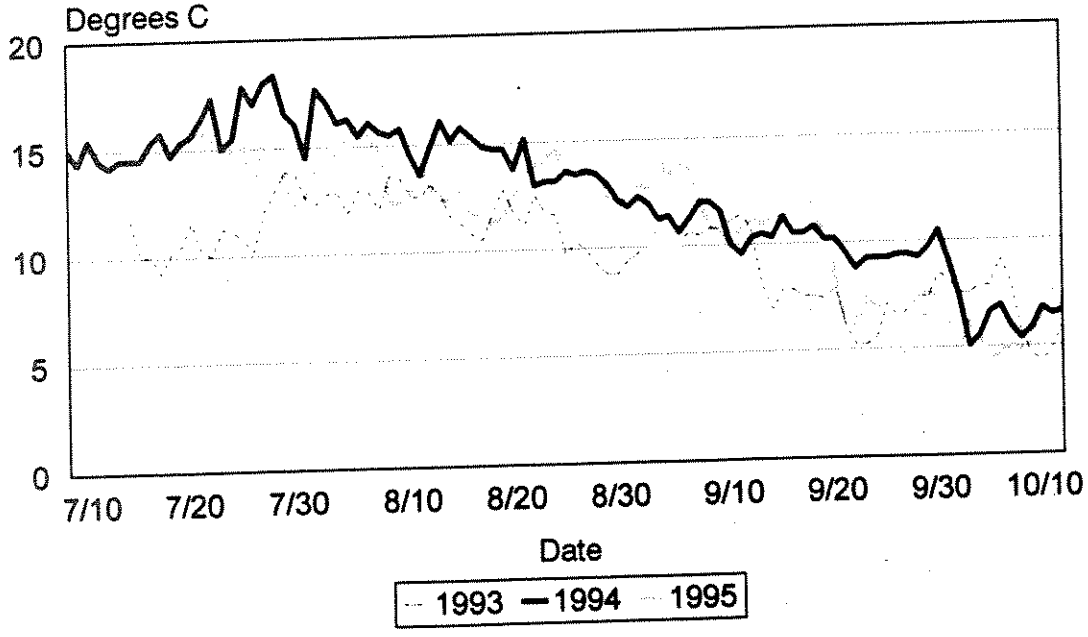
Temperature Summaries



Daily Maximum

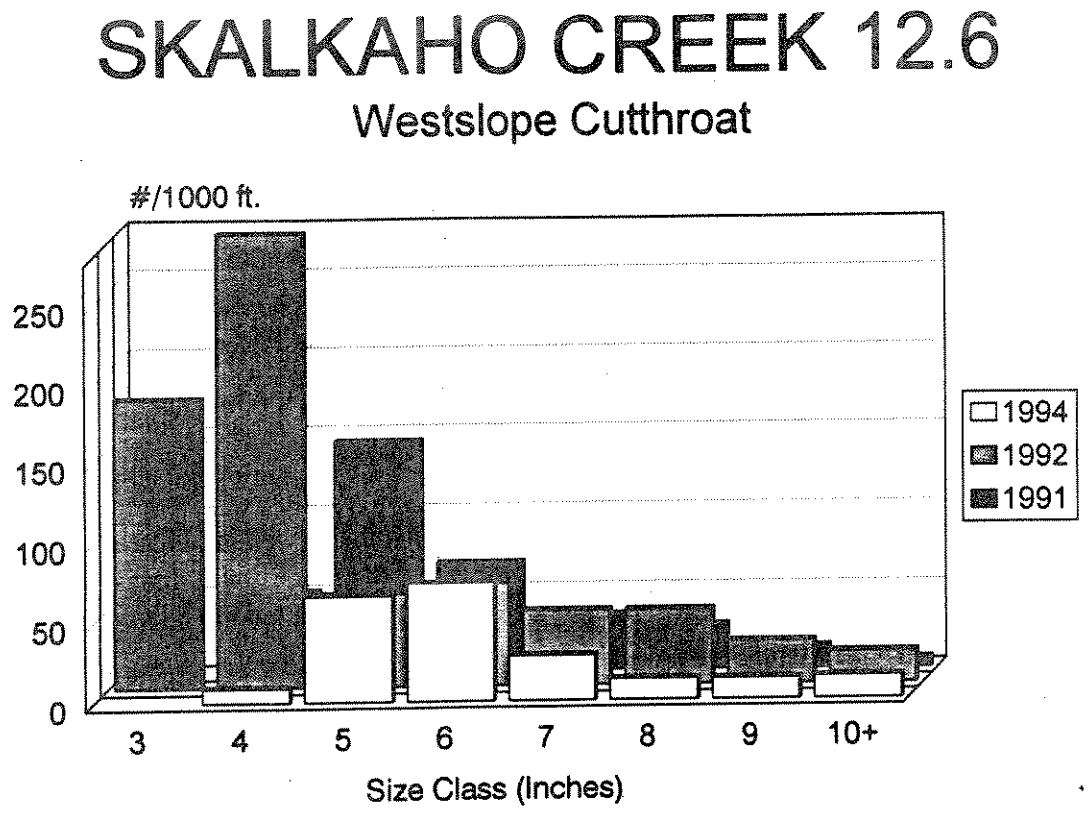
NORTH RYE CREEK 1.9

Temperature Summaries



Daily Maximum

FIGURE 25. Maximum daily water temperature in Rye Creek and North Rye Creek during the years indicated.



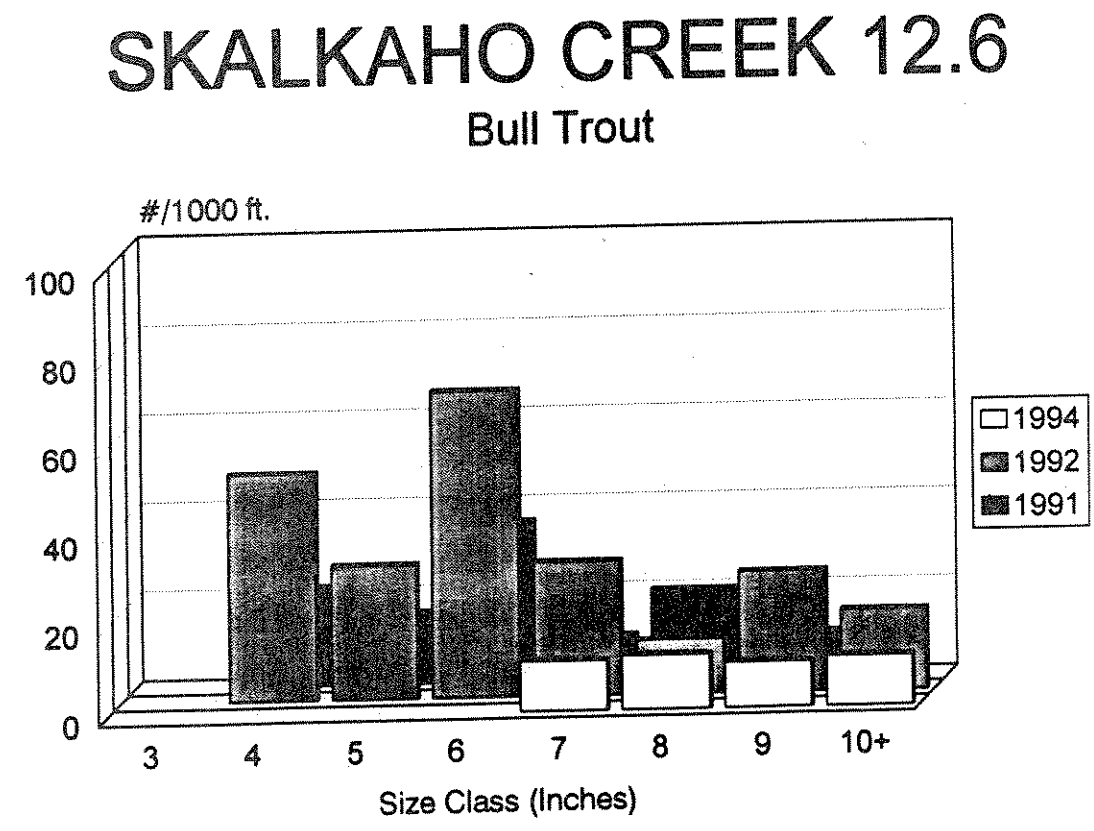
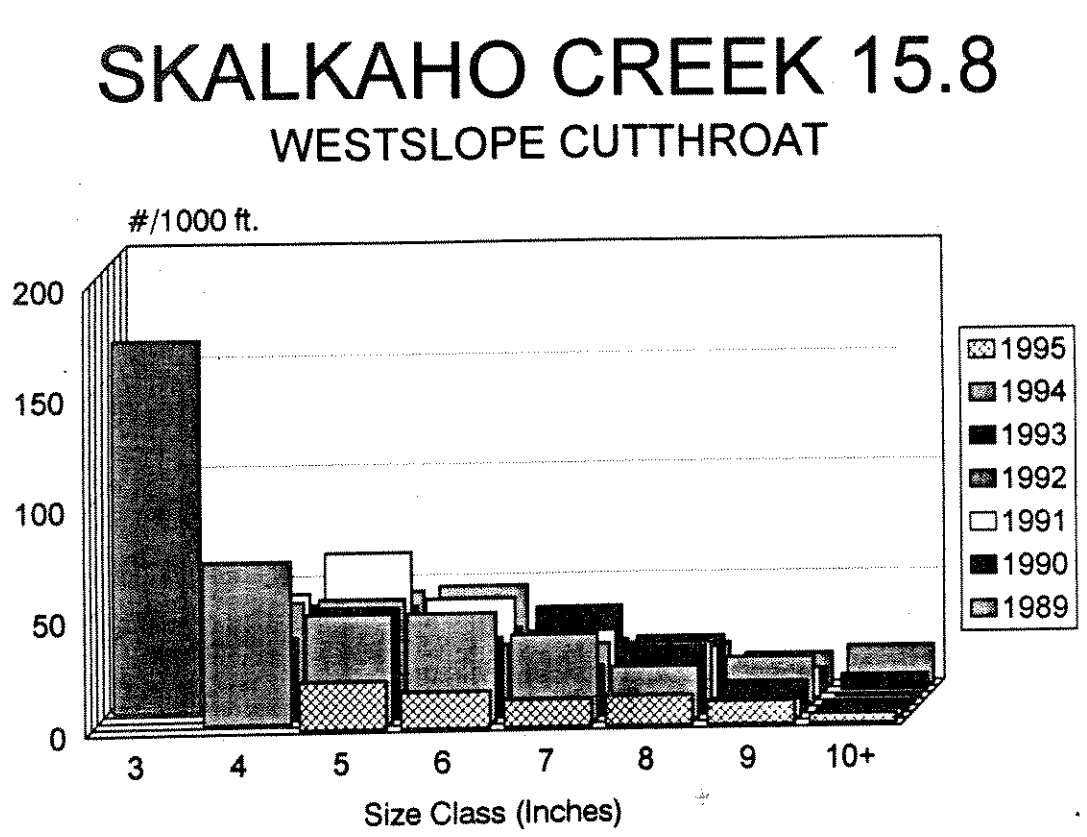


FIGURE 26. Population estimates of westslope cutthroat and bull trout in Skalkaho Creek 12.6 by size class during the years indicated.



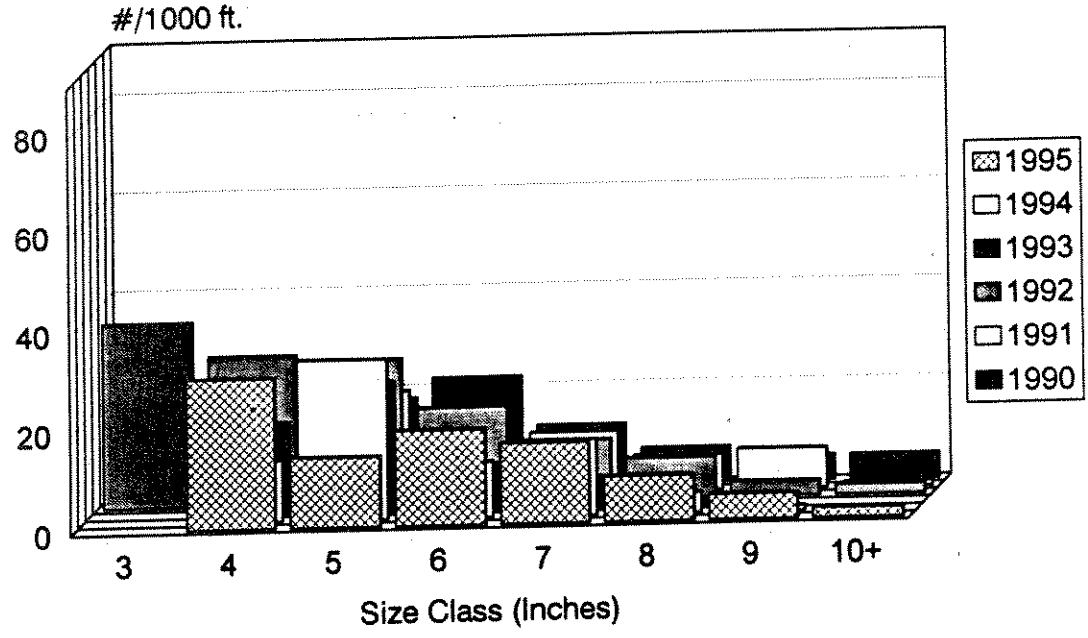
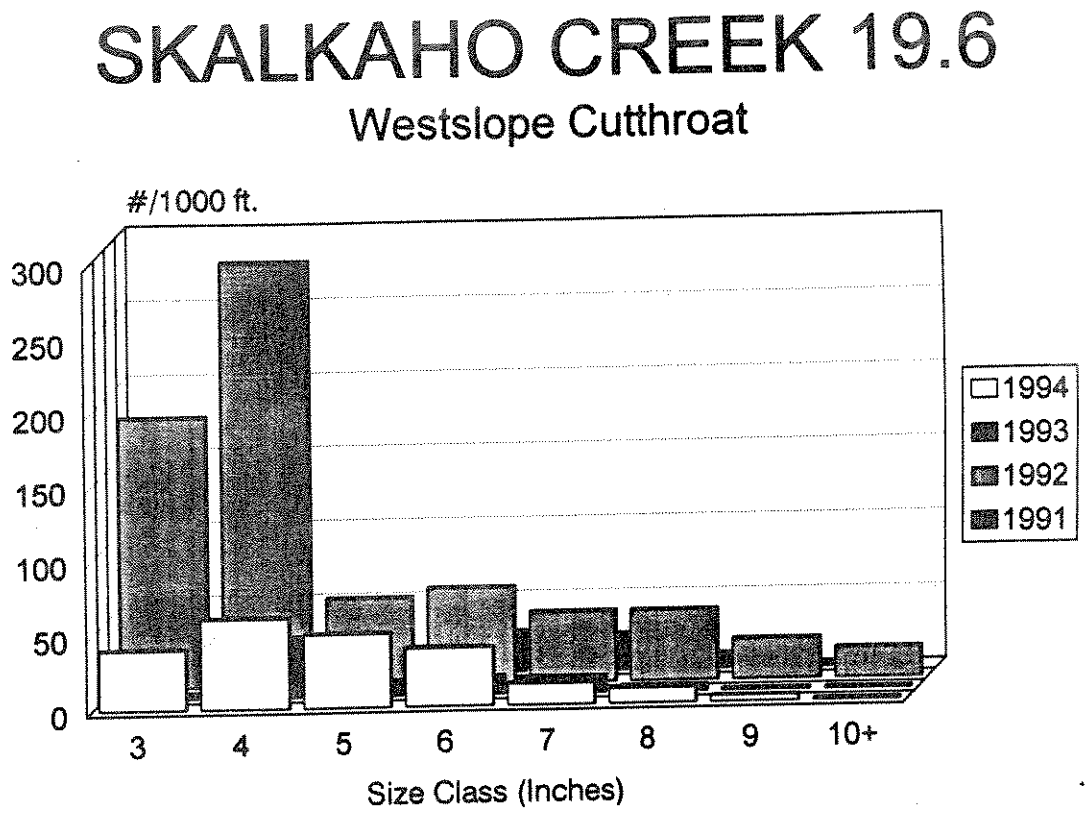


FIGURE 27. Population estimates of westslope cutthroat and bull trout in Skalkaho Creek 15.8 by size class during the years indicated.



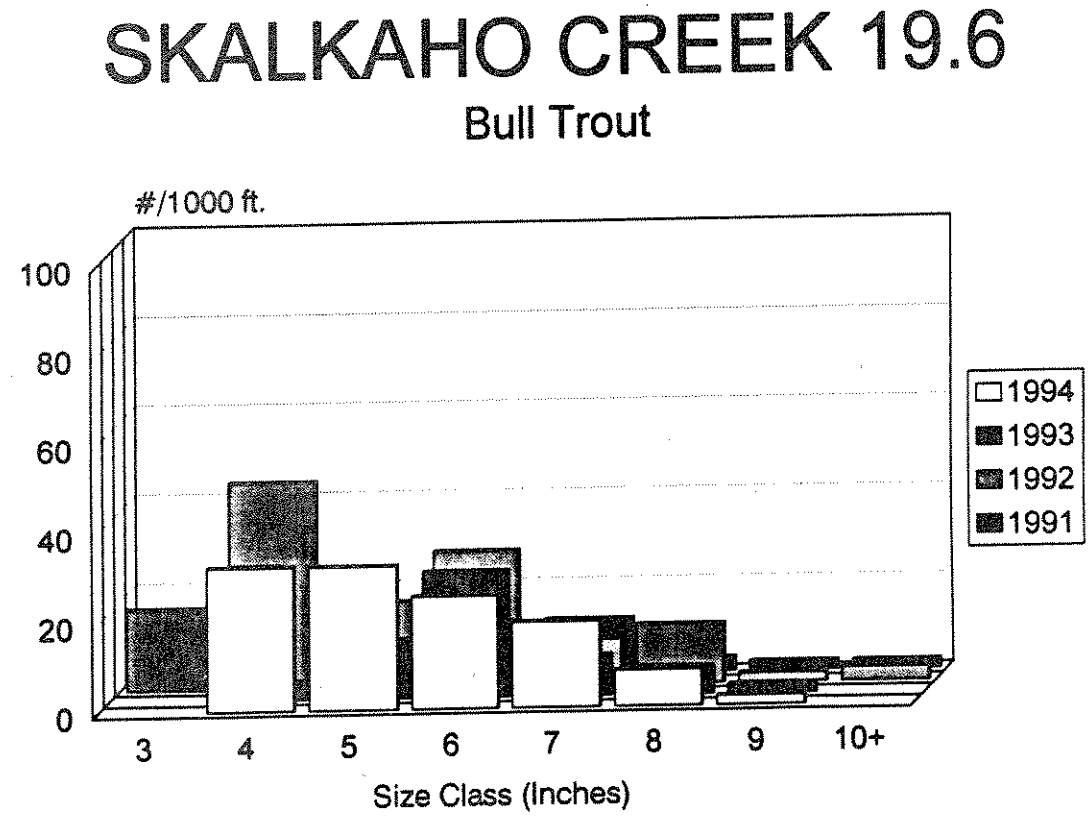


FIGURE 28. Population estimates of westslope cutthroat and bull trout in Skalkaho Creek 19.6 by size class during the years indicated.

Overall, the Skalkaho Creek drainage has some of the highest densities of westslope cutthroat and bull trout on the BNF. The cutthroat trout in the drainage above Bear Gulch are pure strain (Table 3). Daly Creek fish populations are discussed in previous reports (Clancy 1991, 1993).

In three years of sampling water temperature in the Skalkaho drainage, it has not exceeded 15° C above the confluence with Daly Creek, but maximum temperature did exceed 15° C near Bear Gulch for about 2 weeks in 1994 (Figure 29). Water temperature was recorded near the mouth of Skalkaho Creek in 1995, where maximum water temperature exceeded 18°C (Figure 30). Water temperature in Daly Creek is colder than most streams monitored and similar to Skalkaho Creek upstream of its confluence with Daly Creek (Figure 30).

Sleeping Child Creek and Divide Creek

A long term monitoring site has been established in Sleeping Child Creek immediately upstream of the hot springs (Sleeping Child 9.3). The 7 year mean of the population estimates for westslope cutthroat in this section is 111 fish over 5 inches per 1000 feet of stream. The 1995 estimate was above the 7 year mean. There has been a downward trend in the number of larger cutthroat trout in this section (Figure 31). This may be related to fishing harvest.

Due to the low number of bull trout in this reach, statistically valid population estimates have only been collected in two years, 1991 and 1992. Westslope cutthroat from this site are pure strain (Table 3).

Midsummer water temperatures were measured in 1993, 1994 and 1995. During 1994, maximum daily water temperature at this site exceeded 15° C for most of late July and early August (Figure 32). Maximum daily water temperature in lower Sleeping Child Creek during 1994 exceeded 15° C for most of the summer.

Two upstream sites in Sleeping Child Creek and one in Divide Creek are discussed in a previous report (Clancy 1991). A thermograph recorded water temperature during the summer of 1994 and 1995 in Divide Creek (Figure 33). During 1994, the water temperature did not exceed 15° C except for a short period of time in late July. During 1995 water temperature was recorded in Sleeping Child Creek immediately upstream of Divide Creek. Maximum temperature at this site was about 2°C cooler than Divide Creek in 1995 (Figures 32 and 33).

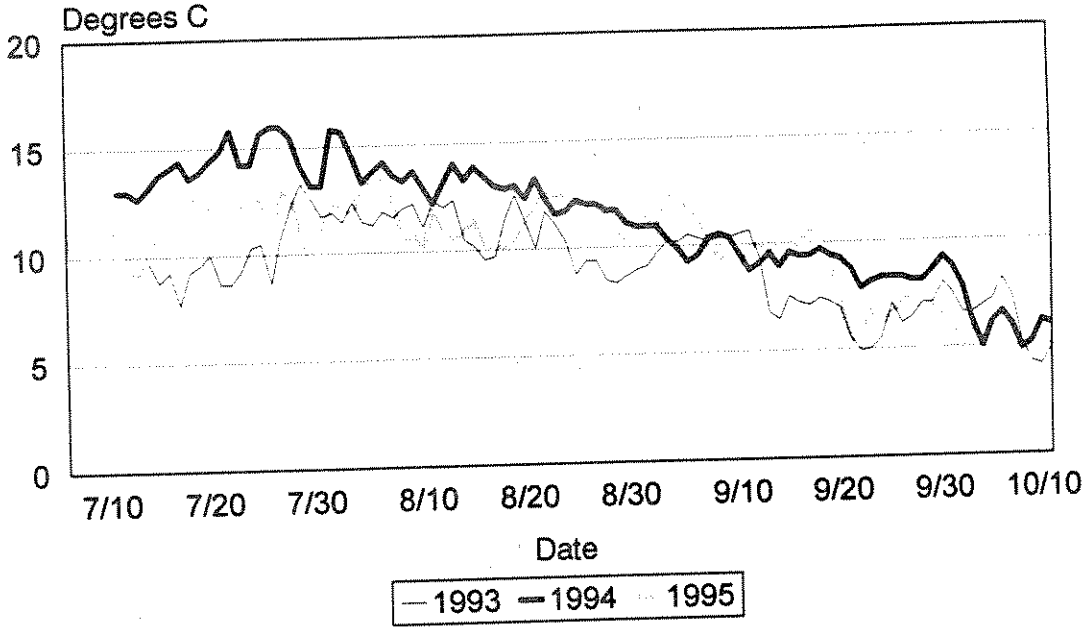
Tincup Creek 4.6

Water temperature was measured in Tincup Creek during 1993 and 1994 (Figure 34). The water temperature was warmer than expected at this site as it exceeded 18° C in 1994 and was over 15° C for most of the summer.

Fish populations have not been monitored on this creek but a single population estimate was collected at site 4.6 in 1992. It supported a mix of fish including westslope cutthroat, bull trout, brook trout, brown trout and rainbow trout. Brook trout and

SKALKAHO CREEK 12.6

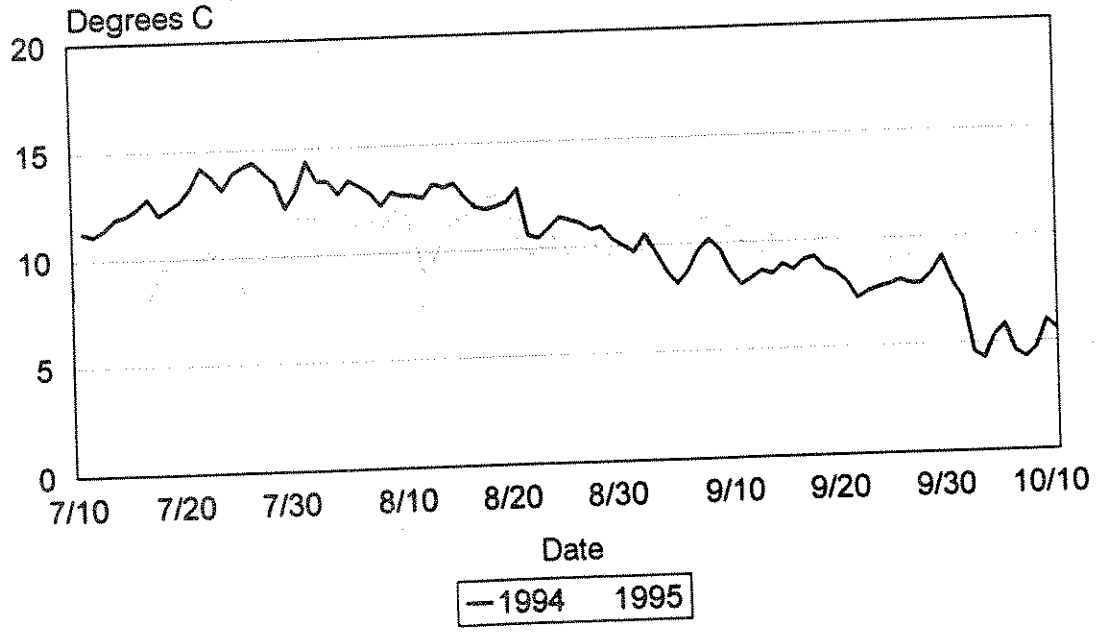
Temperature Summaries



Daily Maximum

SKALKAHO CREEK 15.8

Temperature Summaries

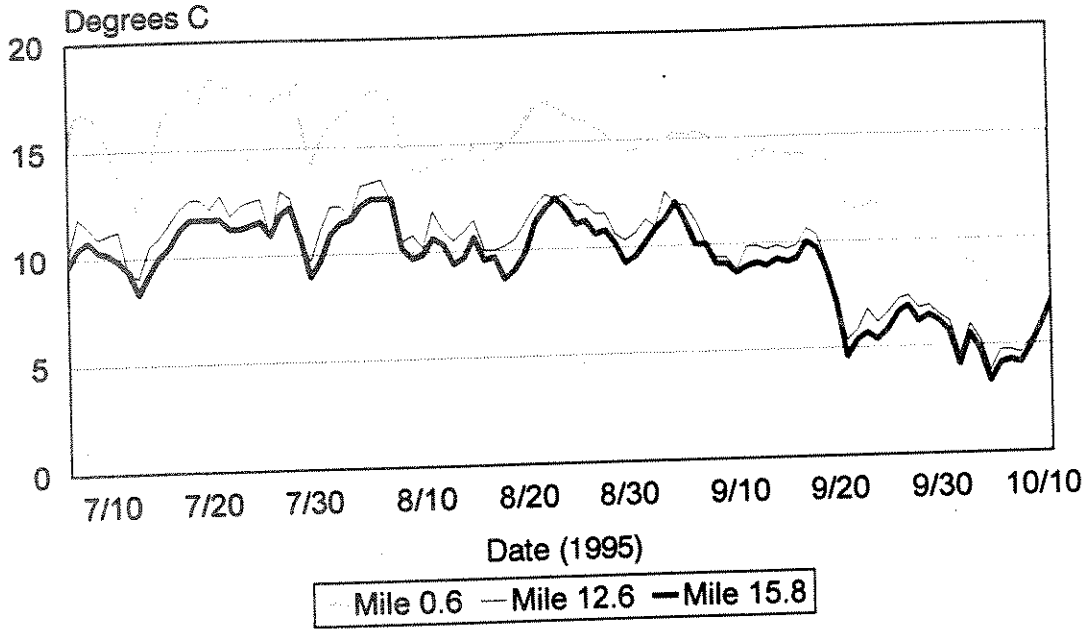


Daily Maximum

FIGURE 29. Maximum daily water temperature in Skalkaho Creek 12.6 and 15.8 during the years indicated.

SKALKAHO CREEK

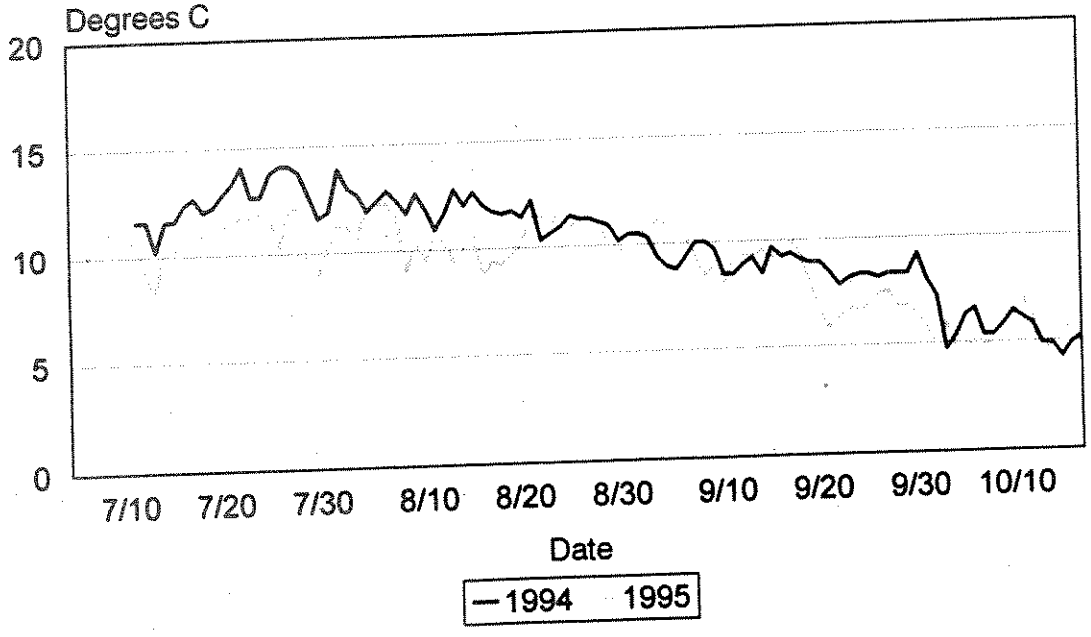
Temperature Summaries at 3 Sites



Daily Maximums

DALY CREEK 0.7

Temperature Summaries



Daily Maximum

FIGURE 30. Maximum daily water temperature at several sites in Skalkaho Creek in 1995 and Daly Creek in 1994 and 1995.

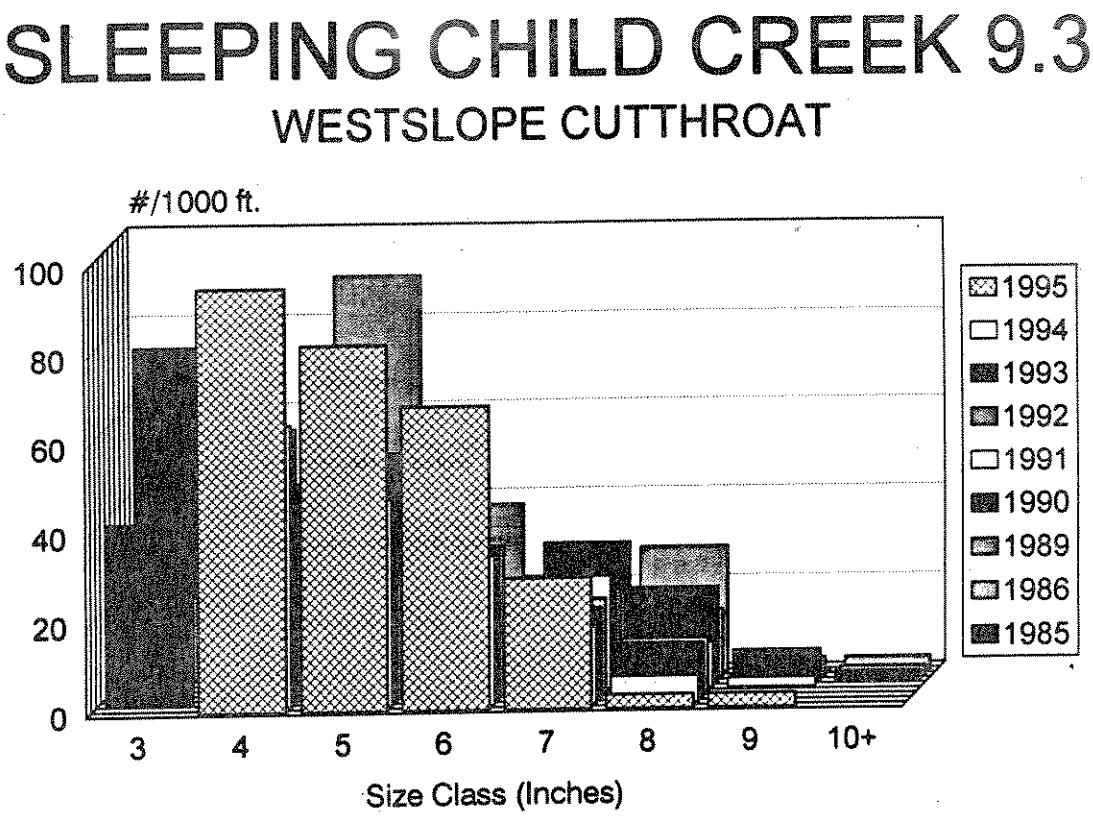
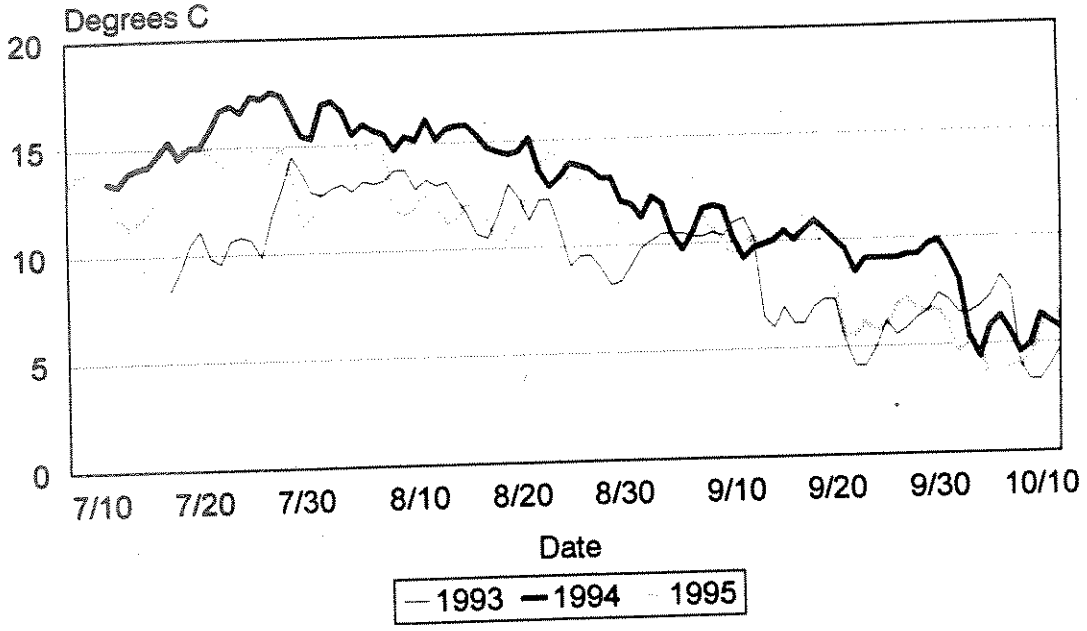


FIGURE 31. Population estimates of westslope cutthroat in Sleeping Child Creek 9.3 by size class during the years indicated.

SLEEPING CHILD CREEK 9.3

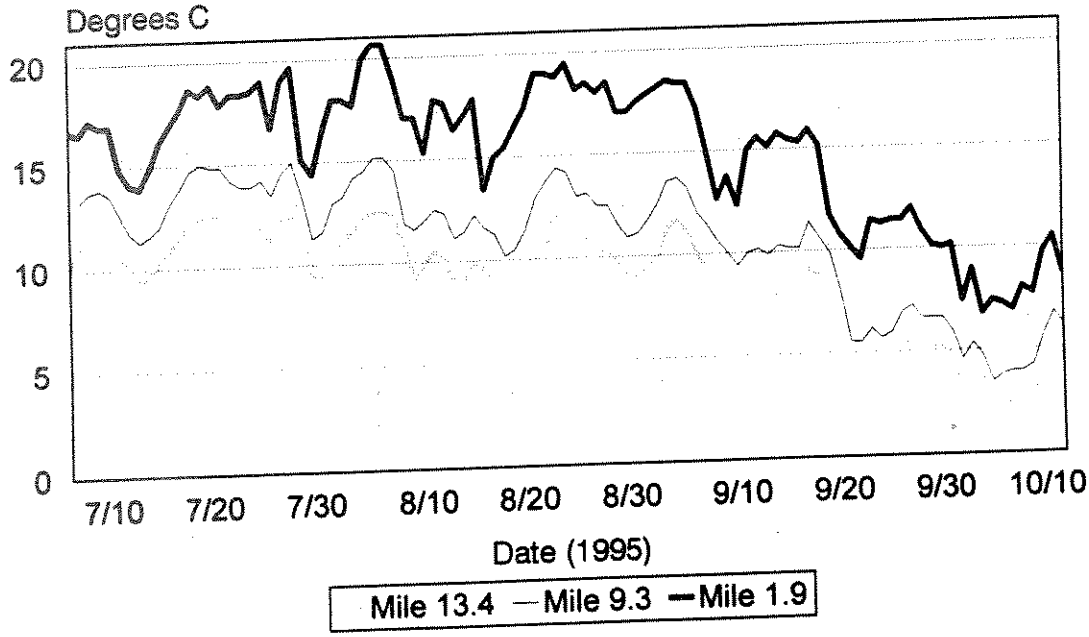
Temperature Summaries



Daily Maximum

SLEEPING CHILD CREEK

Temperature Summaries at 3 Sites

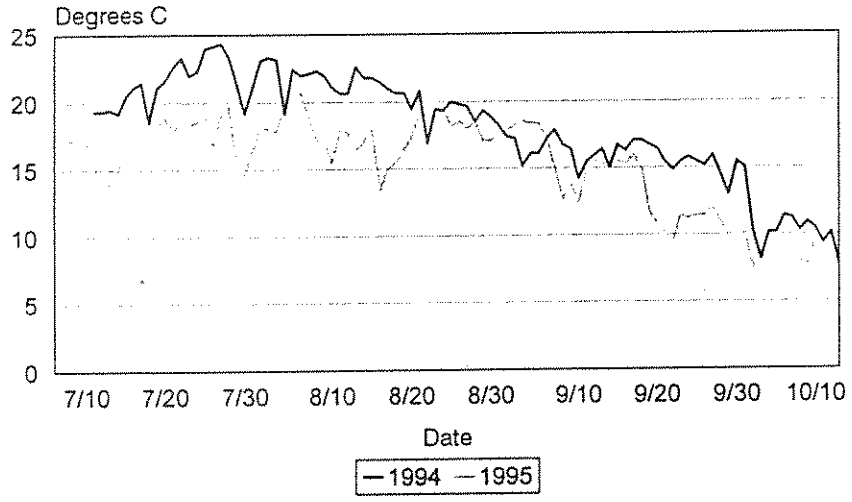


Daily Maximums

FIGURE 32. Maximum daily water temperature at several sites in Sleeping Child Creek.

SLEEPING CHILD CREEK 1.9

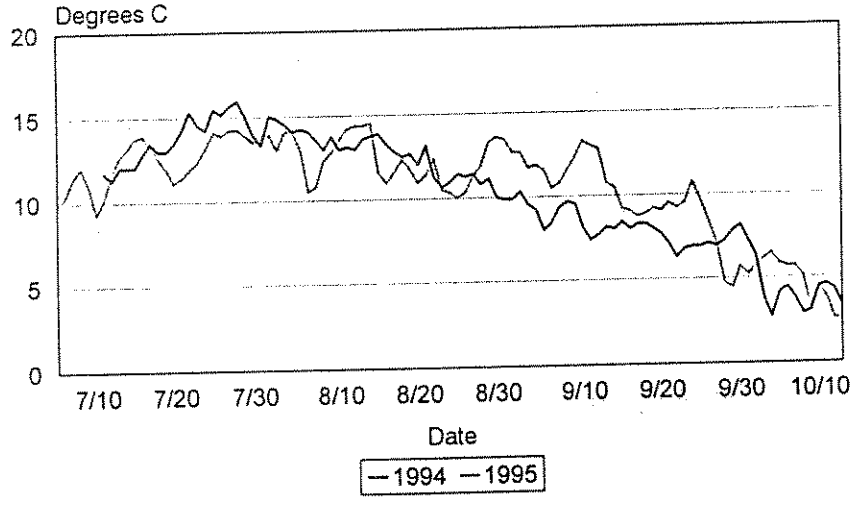
Temperature Summaries



Daily Maximum

DIVIDE CREEK 0.1

Temperature Summaries



Daily Maximum

FIGURE 33. Maximum daily water temperature in lower Sleeping Child Creek and Divide Creek during 1994 and 1995.

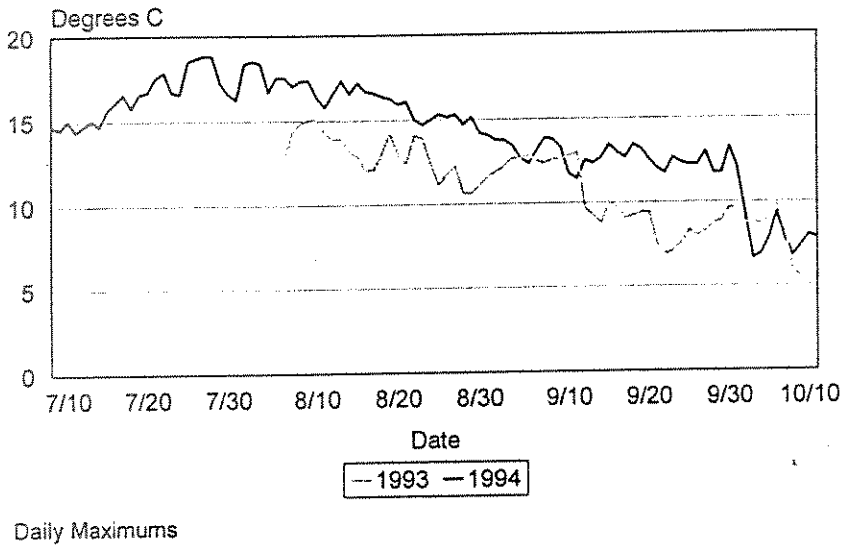


FIGURE 34. Maximum daily water temperature in Tincup Creek 4.6 during 1993 and 1994.

cutthroat trout were the predominant species.

Genetic analysis of cutthroat trout in Tincup Creek indicates they are hybridized with rainbow trout (Table 3). The lowest mile of Tincup Creek is important spawning habitat for rainbow trout from the Bitterroot River.

Sula District

Streams where fish populations were monitored during 1993, 1994 and 1995 on the Sula District were the East Fork Bitterroot River, Martin Creek, Meadow Creek, Moose Creek and Warm Springs Creek. Population estimates at these and other monitoring sites on the Sula District are summarized in Figures 35 and 36.

East Fork Bitterroot River 31.4

One monitoring site was established on the East Fork of the Bitterroot River. It was sampled in 1992 and 1994. Most of the fish at this site are in the 5-8 inch range (Figure 37). Habitat was measured at this site in 1992 (Clancy 1993). The stream is larger than most sampled and the streambottom at this site is dominated by large boulders and cobble. This site appears to be capable of supporting more large cutthroat trout than it is now. Westslope cutthroat population numbers are low for this size of stream and bull trout populations are moderate in number. This site may receive heavier fishing pressure than average which may be impacting the fish populations. Genetic analysis of fish has not been completed at this site.

Water temperature was measured at this site during midsummer and fall of 1993, 1994 and 1995. In 1994 maximum daily water temperature exceeded 15° for about 3 weeks (Figure 38). Water temperature has also been measured at two other sites on the East Fork. Downstream of the BNF it warms considerably and in 1995 it exceeded 20°C near Conner.

Population estimates have been collected at 3 other sites on the East Fork downstream of the BNF (Table 1). Cutthroat trout are the prevalent species downstream to about Tolan Creek. The average size is high but the densities are very low. Downstream of Tolan Creek rainbow trout are the dominant species and cutthroat trout are rare.

Martin Creek 1.3 and 7.5

Two monitoring sites have been established on Martin Creek. Both sites still support native fisheries. However, during sampling in 1994 one brook trout was captured at Martin Creek 1.3. At both sites the number of westslope cutthroat has been fairly stable since sampling began (Figure 39).

Both sites contain over 100 cutthroat greater than 5" per 1000 feet of stream, but low numbers of bull trout (Figure 40). Martin Creek 1.3 is characterized by cobble substrates with high amounts of fines (Clancy 1993). Martin Creek 7.5 is dominated by fine

WESTSLOPE CUTTHROAT

SULA RANGER DISTRICT

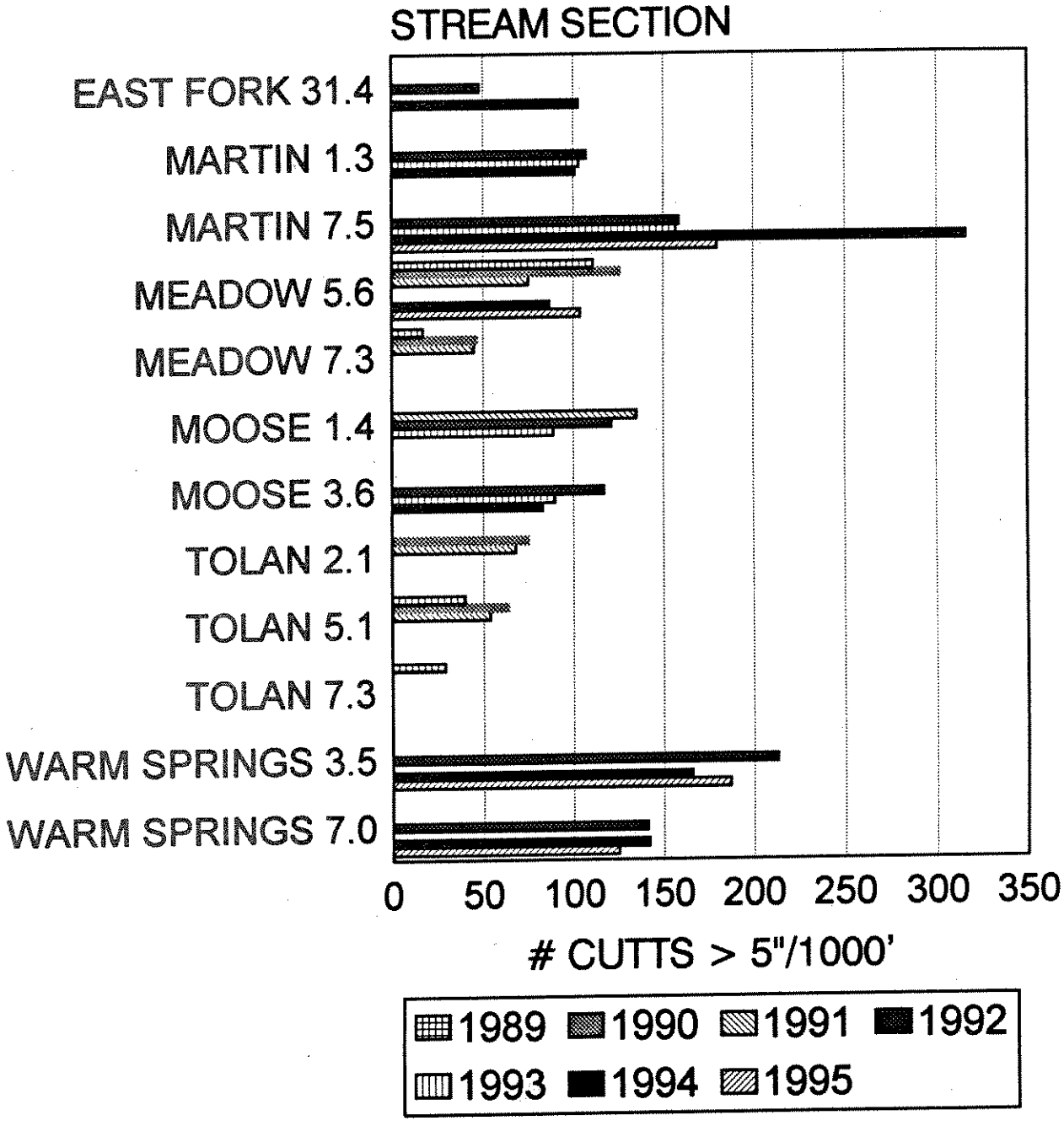


FIGURE 35. Population estimates of westslope cutthroat trout on monitoring sections on the Sula District.

BULL TROUT

SULA RANGER DISTRICT

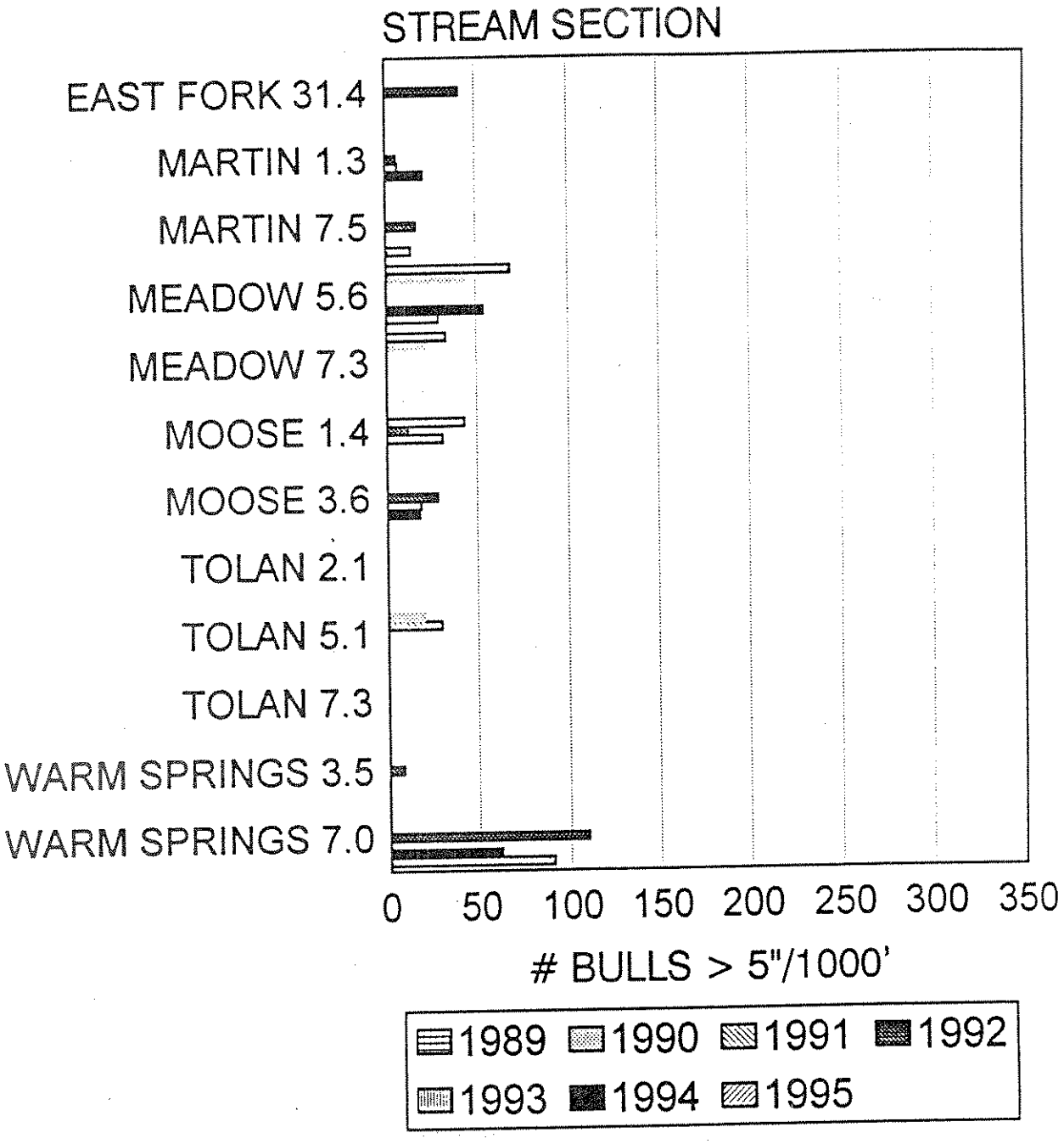


FIGURE 36. Population estimates of bull trout on monitoring sections on the Sula District.

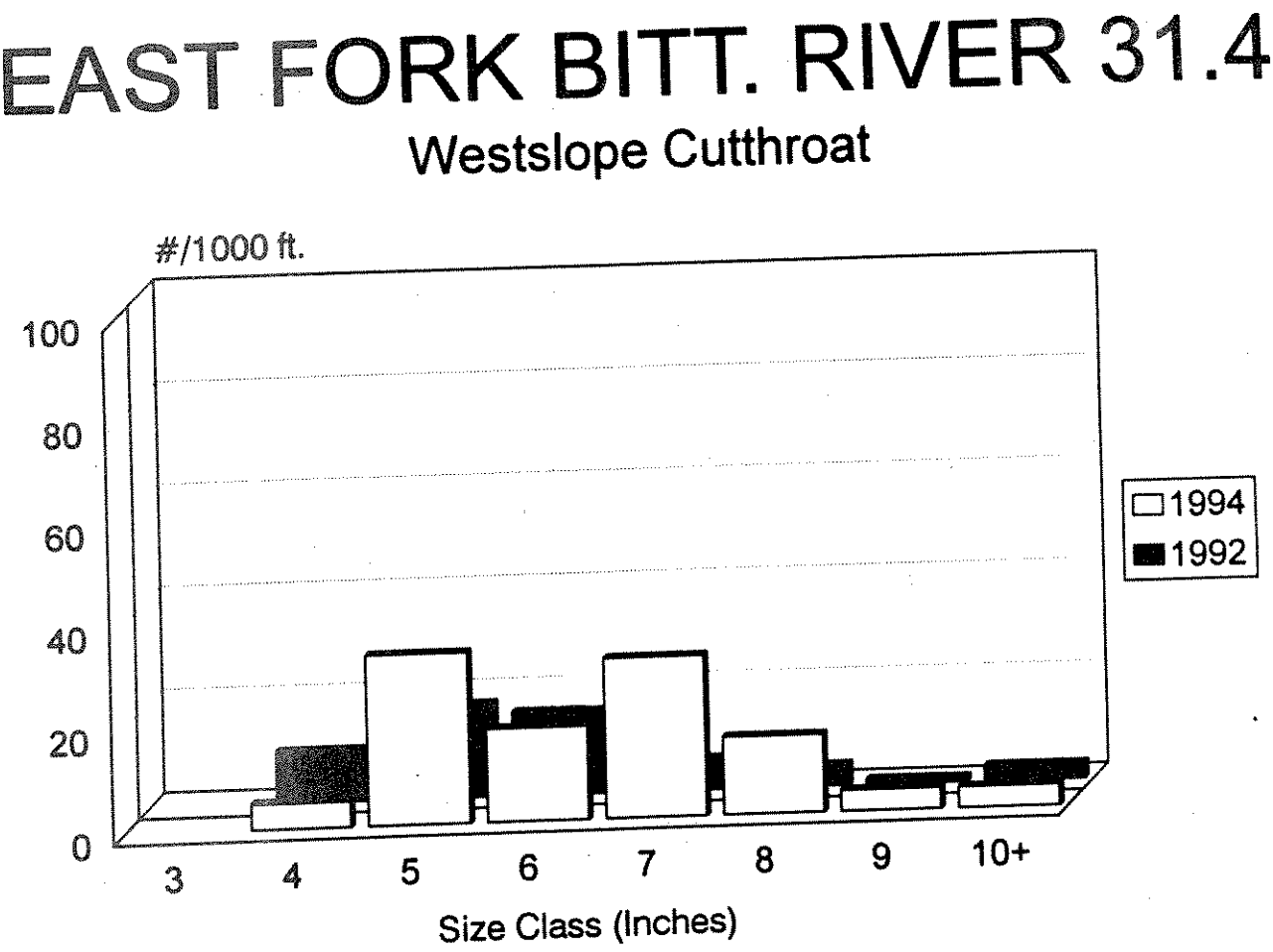
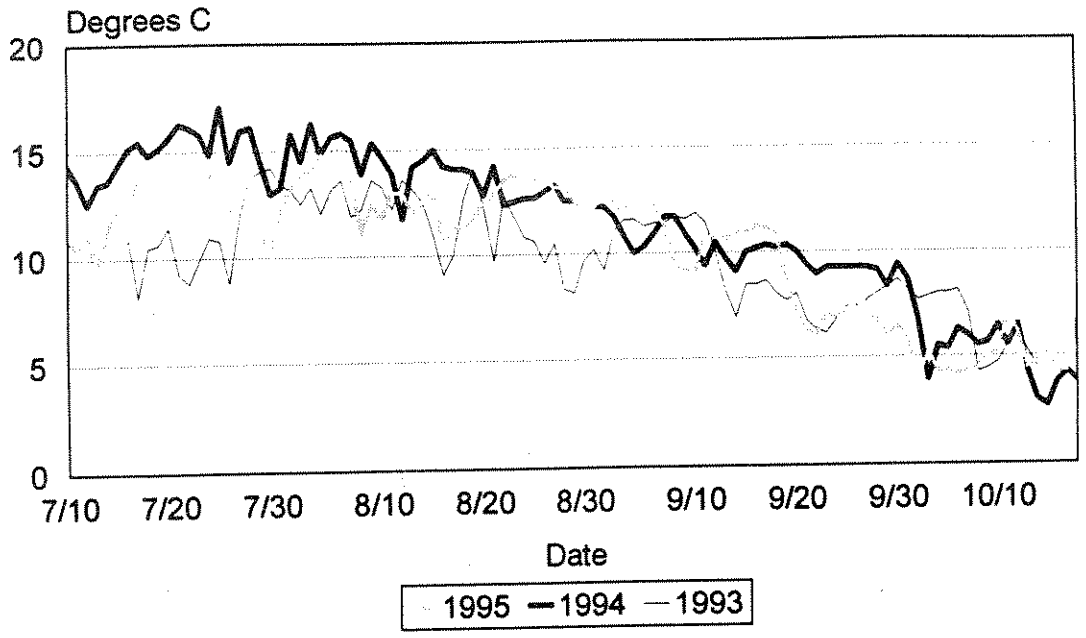


FIGURE 37. Population estimates of westslope cutthroat in the East Fork Bitterroot River 31.4 by size class during the years indicated.

EAST FORK BITTERROOT RIVER 31.4

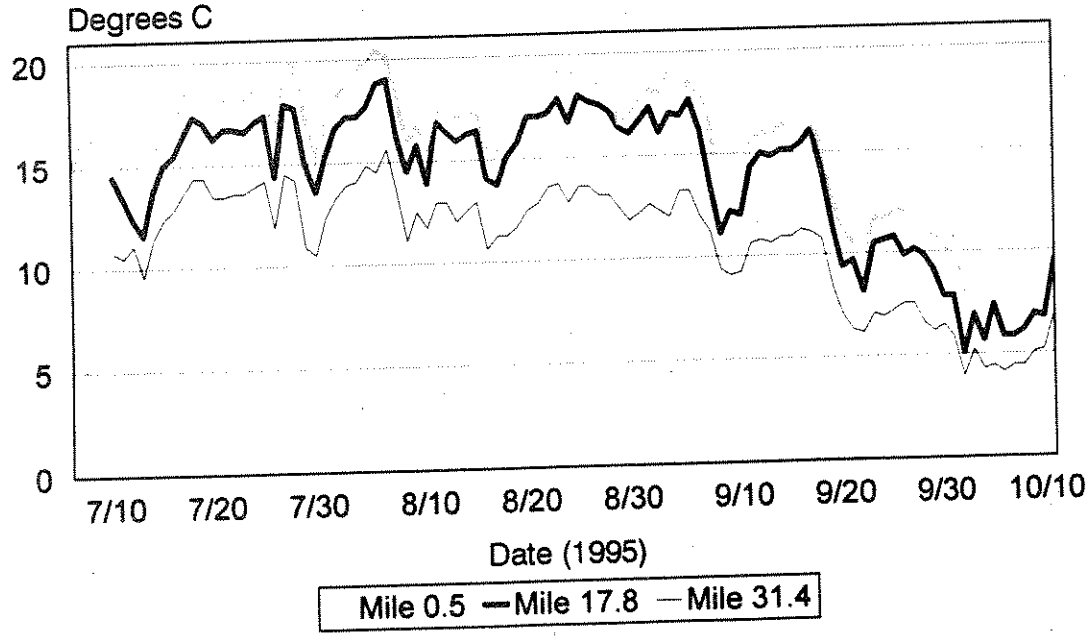
Temperature Summaries



Daily Maximums

EAST FORK BITTERROOT RIVER

Temperature Summaries at 3 Sites



Daily Maximums

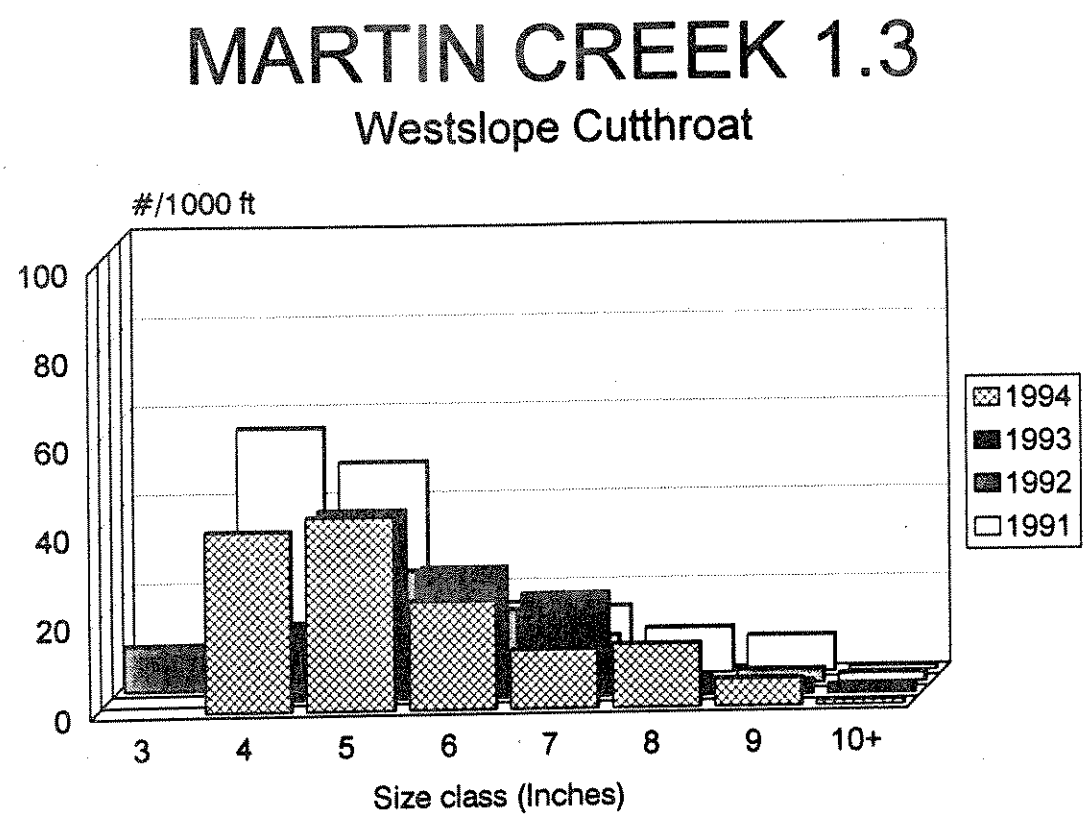
FIGURE 38. Maximum daily water temperature at several sites on the East Fork Bitterroot River.

EAST FORK BITTERROOT RIVER

Population Estimates at Several Sites (#/1000')

SECTION/Year	Rainbows > 6"	WSCutthroats > 6"	Bull Trout > 6"
East Fork 12.0 (1995)	105		
East Fork 19.1 (1992)	6	4	
East Fork 25.6 (1992)		12	8

Table 1. Population estimates of trout per 1000 feet on 3 sections of the East Fork Bitterroot River during the year indicated.



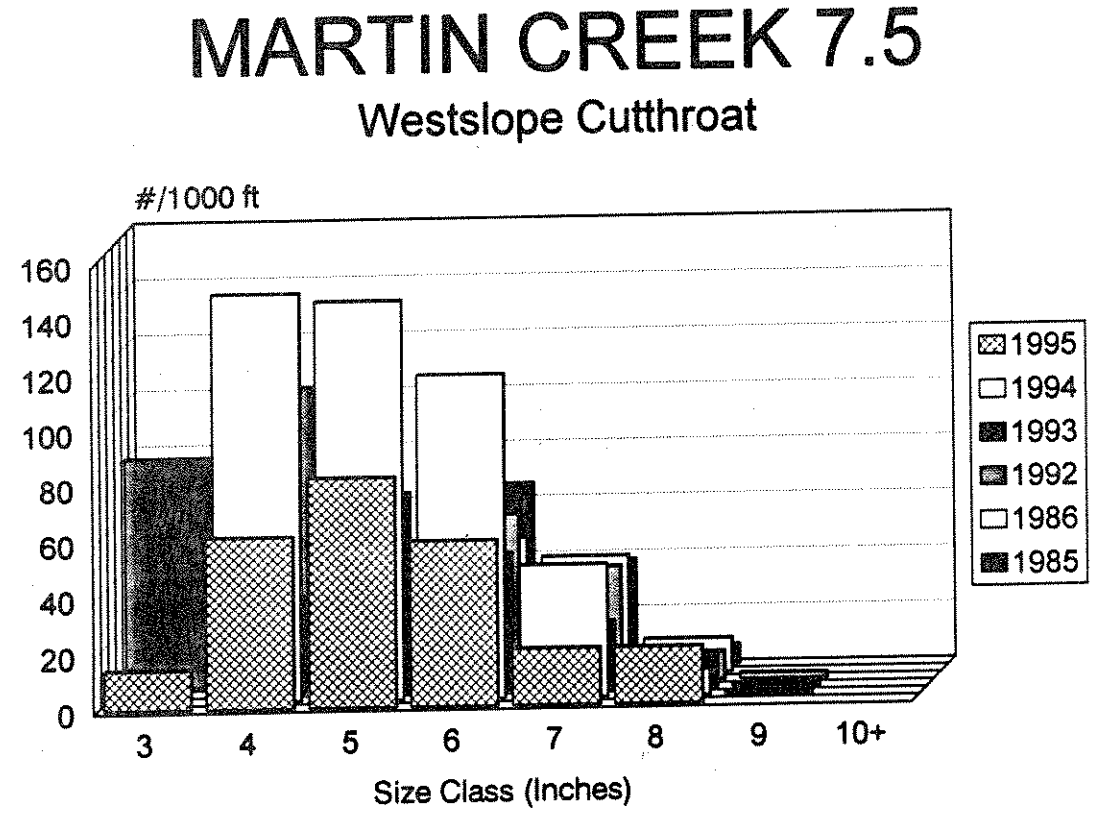
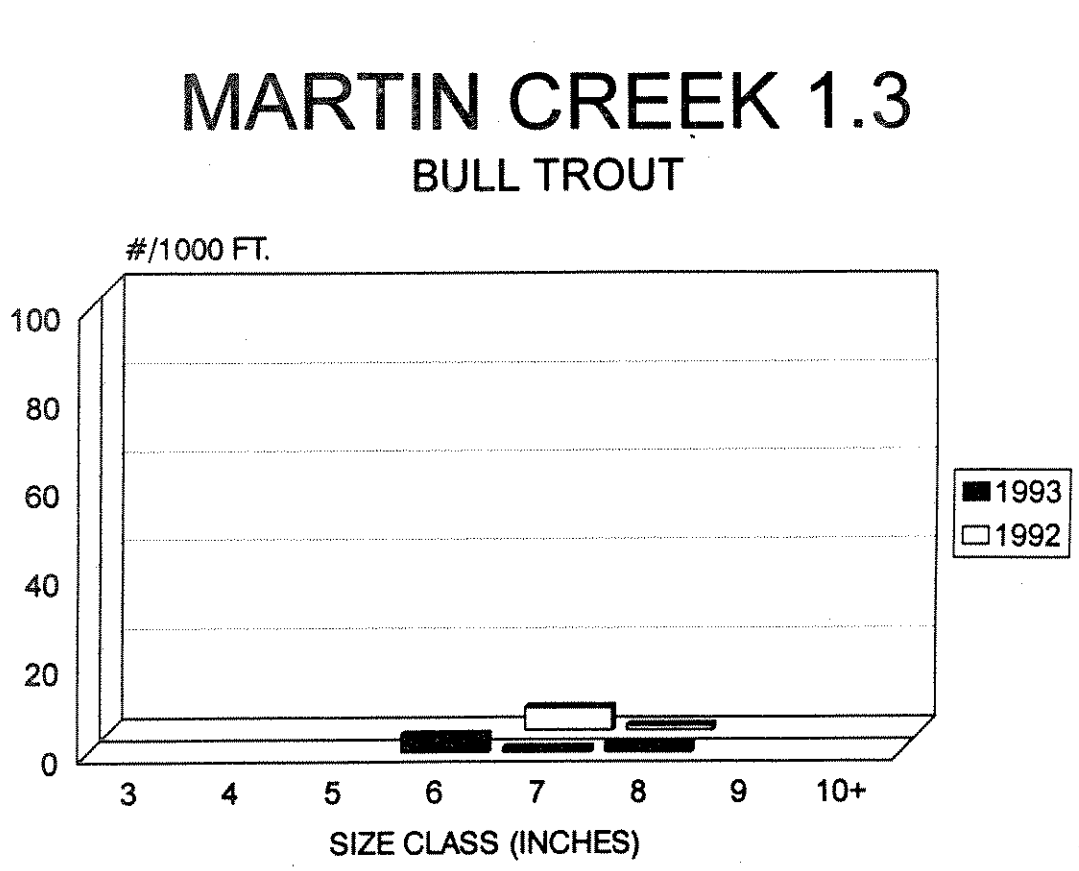


FIGURE 39. Population estimates of westslope cutthroat trout in two monitoring sections of Martin Creek by size class during the years indicated.



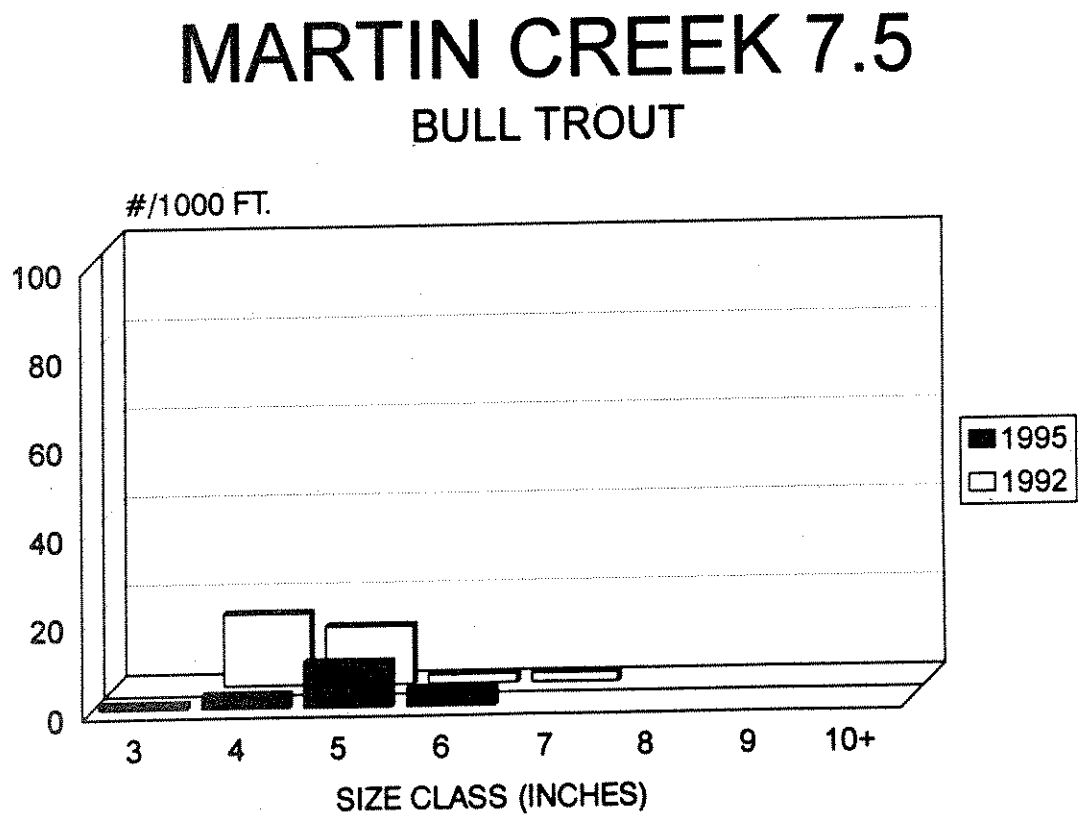


FIGURE 40. Population estimates of bull trout in two monitoring sections of Martin Creek by size class during the years indicated.

materials and contains high amounts of woody debris and instream cover from aquatic vegetation.

Water temperature is moderate in Martin Creek (Figure 41). During 1994 water temperature exceeded 18°C in one period at the lower site, but during 1993 and 1995 it exceeded 15°C for only a short period of time.

Moose Creek 1.4 and 3.6

Two monitoring sites were established on Moose Creek (Clancy 1993). Moose Creek supports a native fishery, although one brook trout was captured at the upper site in 1994. The trend in westslope cutthroat trout is downward, particularly at the upstream site (Figure 42 and 43).

The westslope cutthroat in Moose Creek are pure strain (Table 3). Water temperatures were monitored at the lower site during 1993, 1994 and 1995 and are similar to Martin Creek (Figure 43).

Meadow Creek 5.6

Meadow Creek is almost entirely a native fishery. Brook trout are found in only the lower 1/4 mile of the creek. The cutthroat trout are pure strain (Table 3).

Two monitoring sites were established on Meadow Creek (Clancy 1993). In 1994 and 1995, a fish population estimate was collected at one site (Meadow Creek 5.6). The population estimate of both westslope cutthroat and bull trout was within the range of previous estimates but both indicate a declining trend in larger fish in the past two years (Figure 44). The upper Meadow Creek site has not been sampled since 1991 and should be soon.

Water temperature in Meadow Creek has been measured at two sites (Figure 45). The upper site was cool, never exceeding 15° C during the summer, while daily maximum water temperature near the mouth exceeded 15° for at least two weeks in 1994.

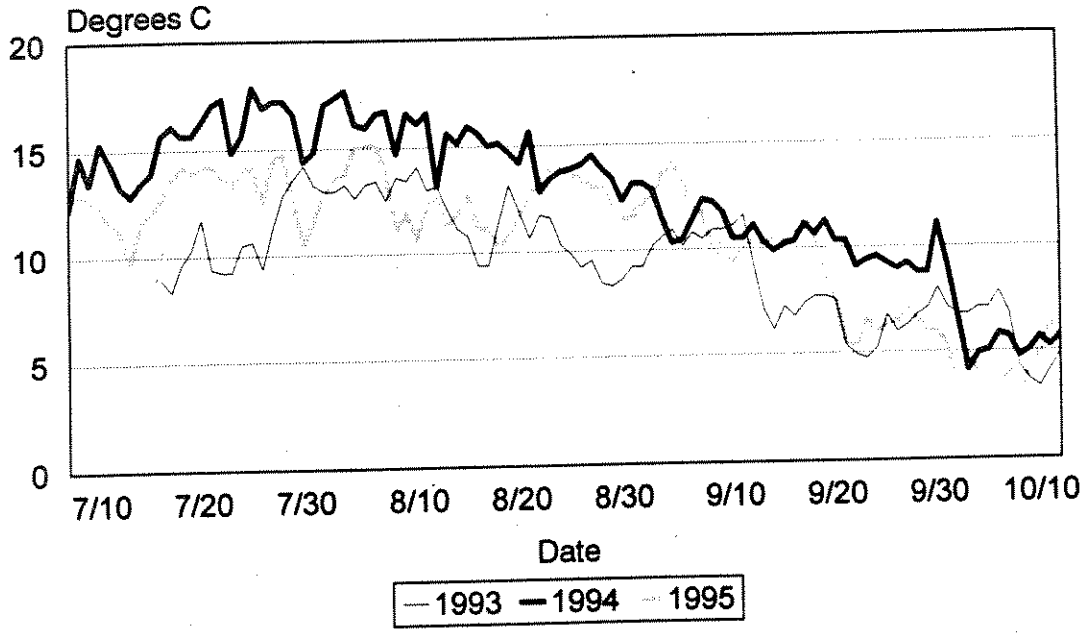
Warm Springs Creek 3.5 and 7.0

Two monitoring sites were established on Warm Springs Creek (Clancy 1993). Warm Springs Creek upstream of the meadows near Crazy Creek supports a native fishery, but the lower reaches support brook trout and rainbow trout. Cutthroat trout in the upper watershed are pure strain and in the lower watershed are introgressed with rainbow trout (Table 3).

Fish population estimates have been collected at both sites since 1992. The lower supports over 150 cutthroat longer than 5" per 1000 feet (Figure 46). The upper site has averaged about 140 per 1000 feet in three years of sampling (Figure 47). Bull trout are found in low numbers at the lower site and in high numbers at the upper site (Figure 47). Upper Warm Springs Creek supports some of the highest densities of bull trout on the Sula District. The trend in numbers of cutthroat and bull trout is stable at this time.

MARTIN CREEK 1.3

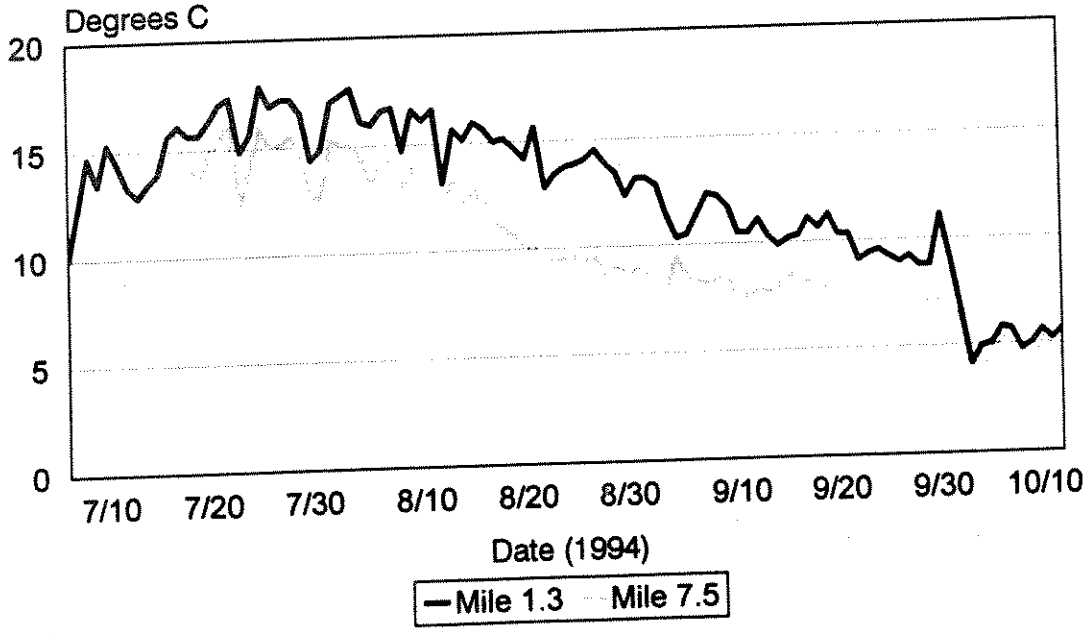
Temperature Summaries



Daily Maximum

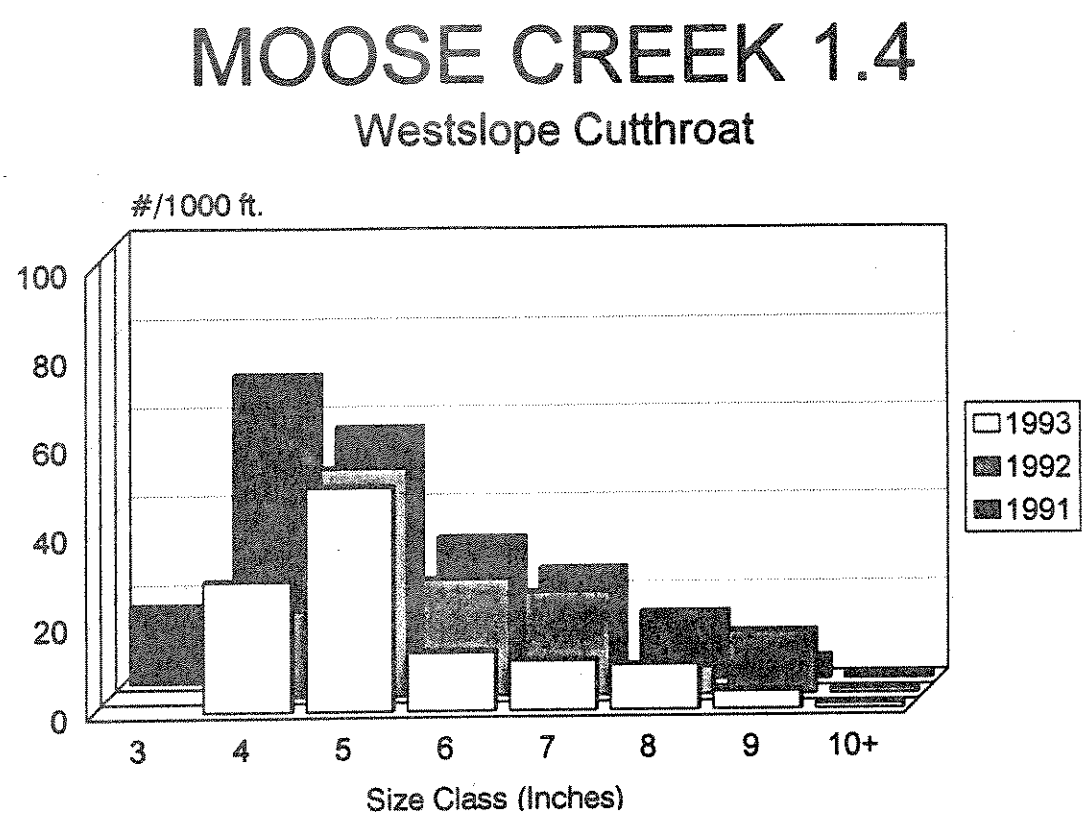
MARTIN CREEK

Temperature Summaries at 2 Sites



Daily Maximum

FIGURE 41. Maximum daily water temperature at two sites on Martin Creek.



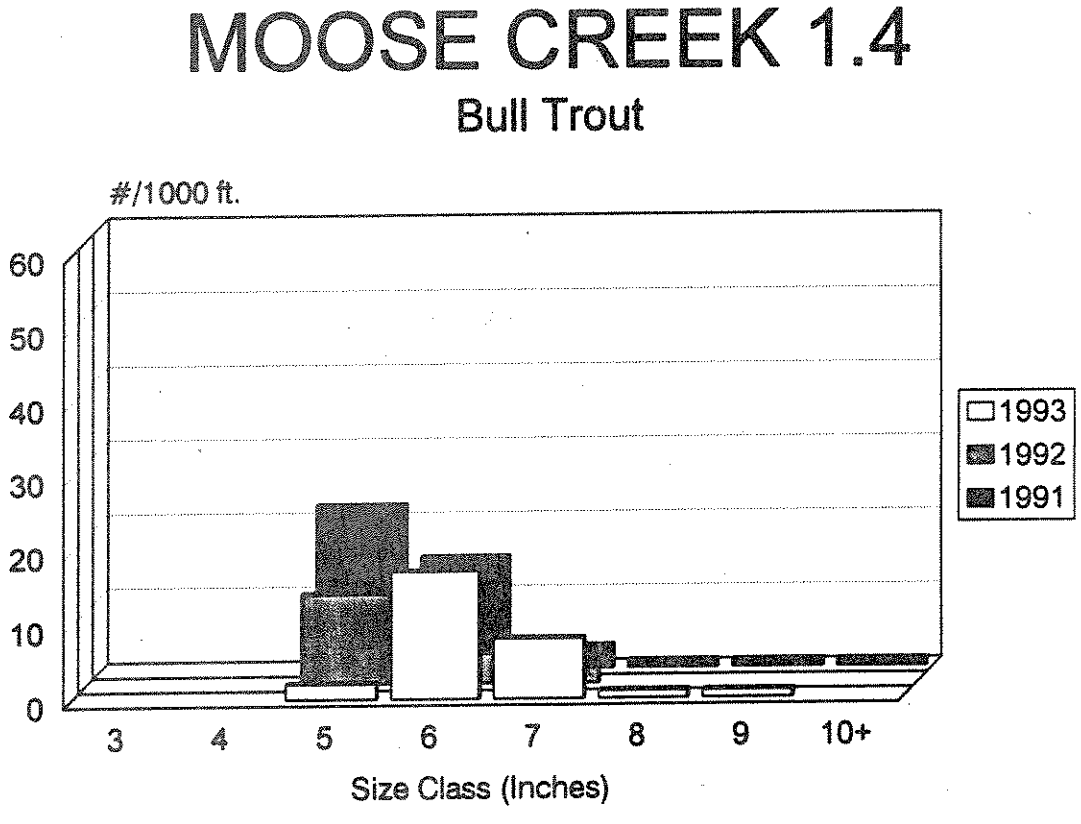
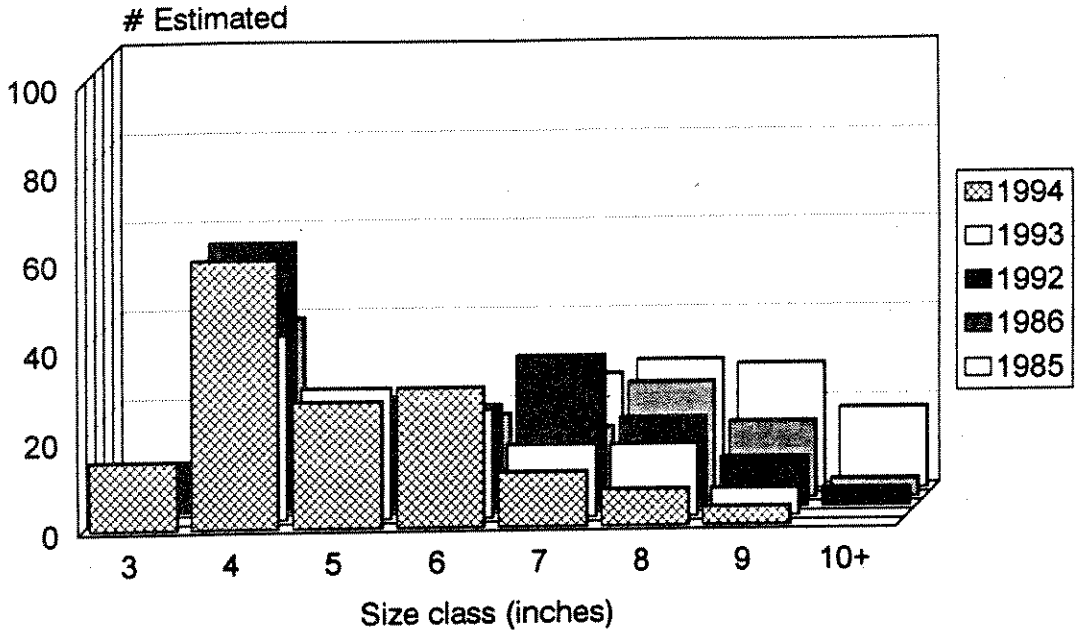


FIGURE 42. Population estimates of westslope cutthroat and bull trout at Moose Creek 1.4 by size class during the years indicated.

MOOSE CREEK 3.6

Westslope Cutthroat



MOOSE CREEK 1.4

Temperature Summaries

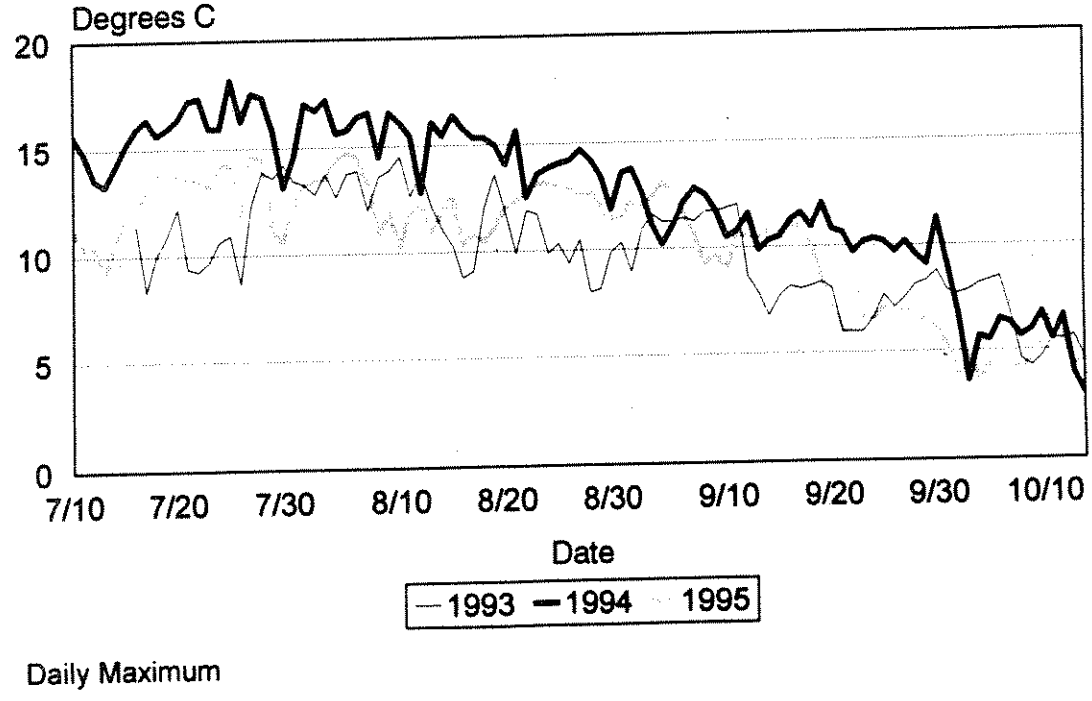
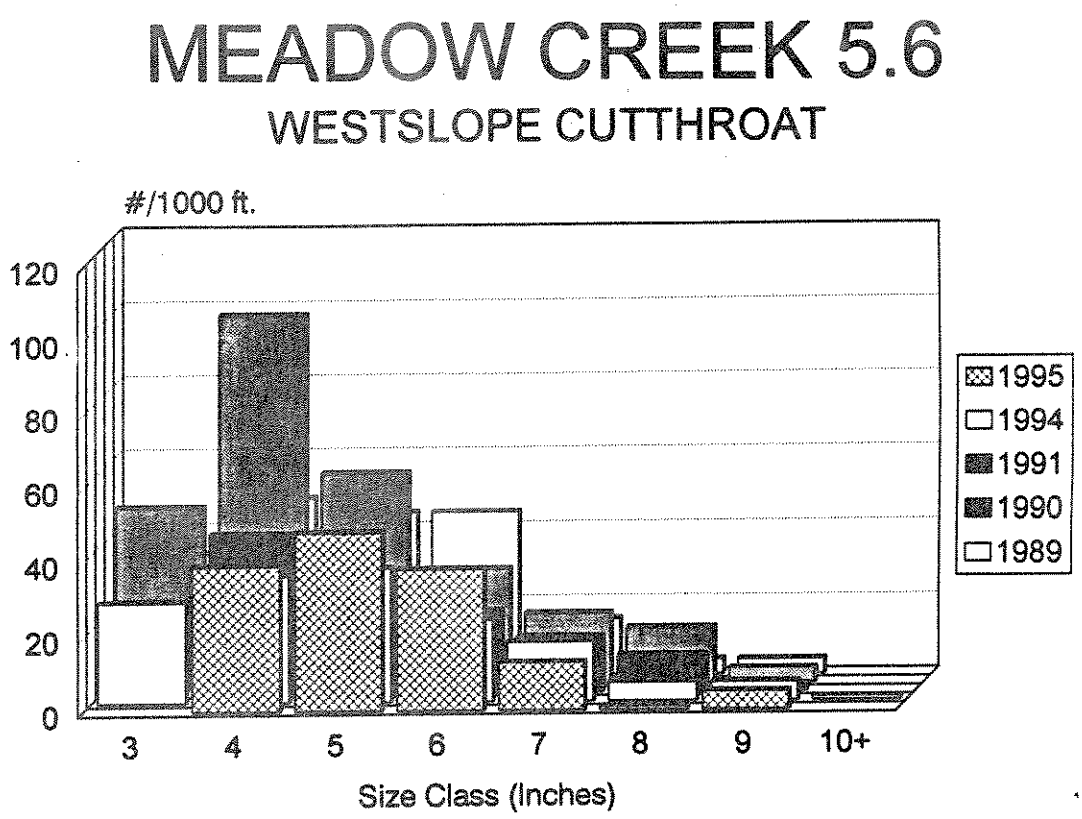


FIGURE 43. Population estimates of westslope cutthroat by size class and maximum daily water temperature in Moose Creek during the years indicated.



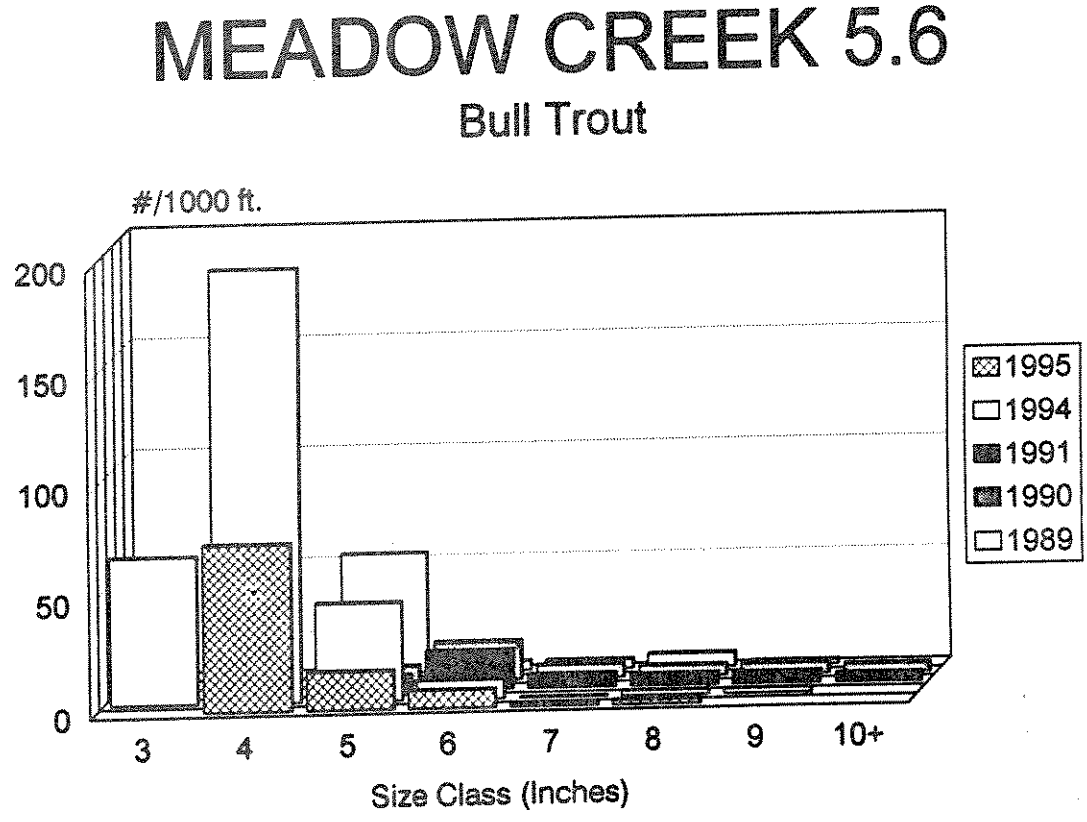
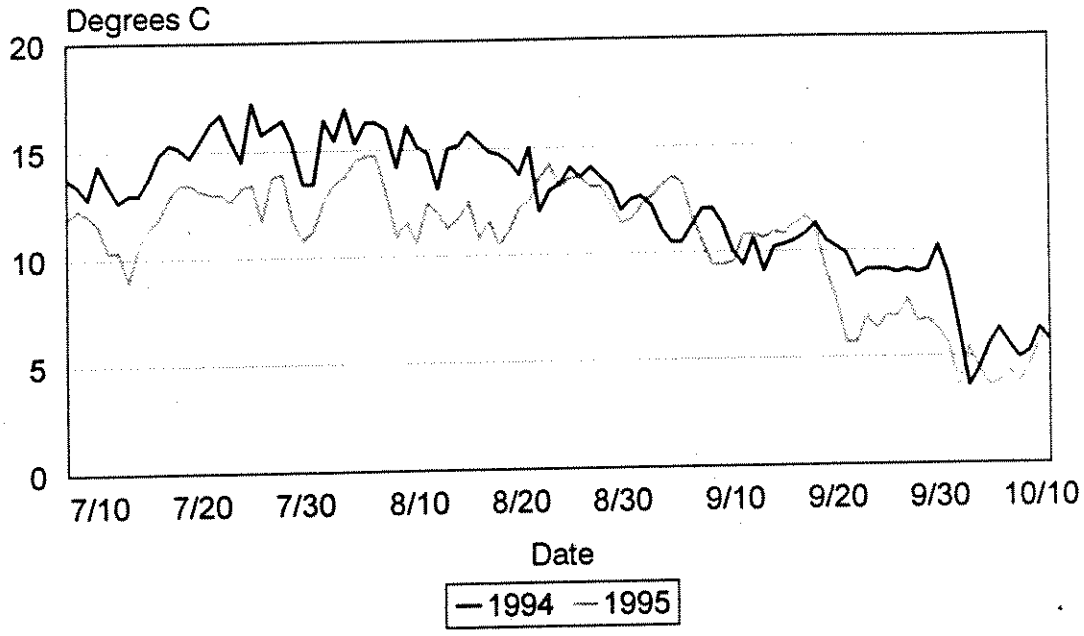
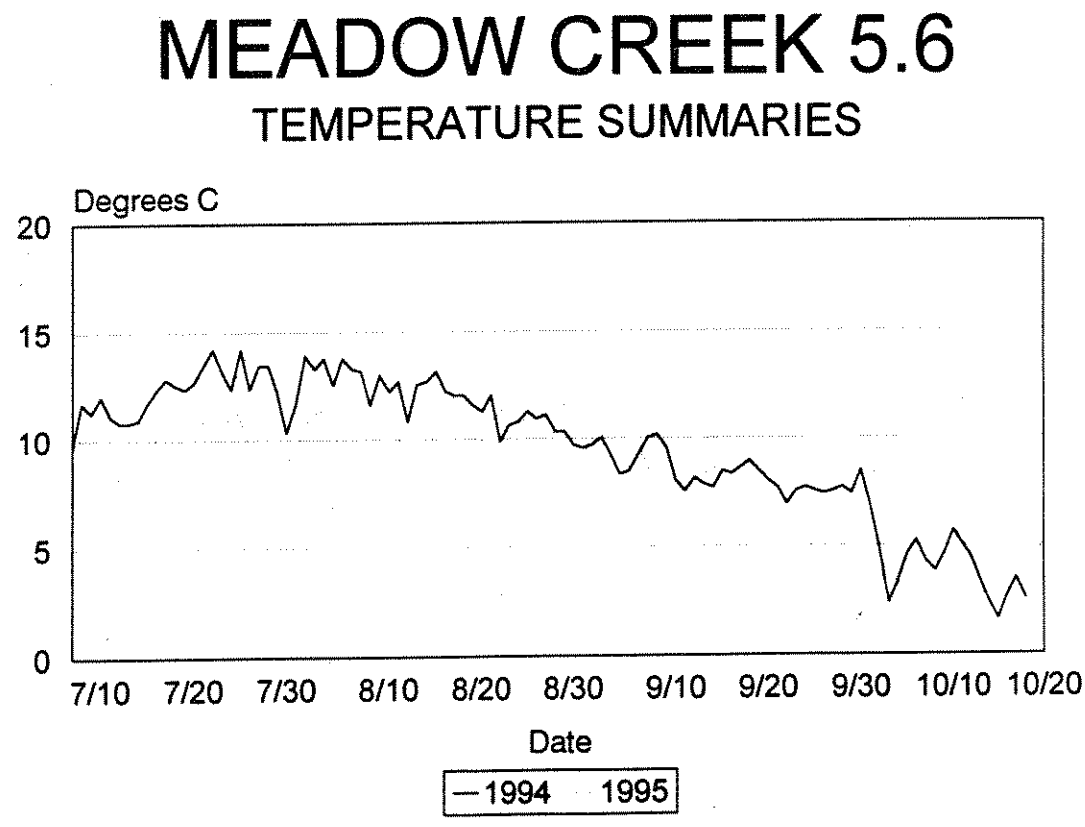


FIGURE 44. Population estimates of westslope cutthroat and bull trout in Meadow Creek 5.6 by size class during the years indicated.





DAILY MAXIMUM

FIGURE 45. Maximum daily water temperature at two sites on Meadow Creek.

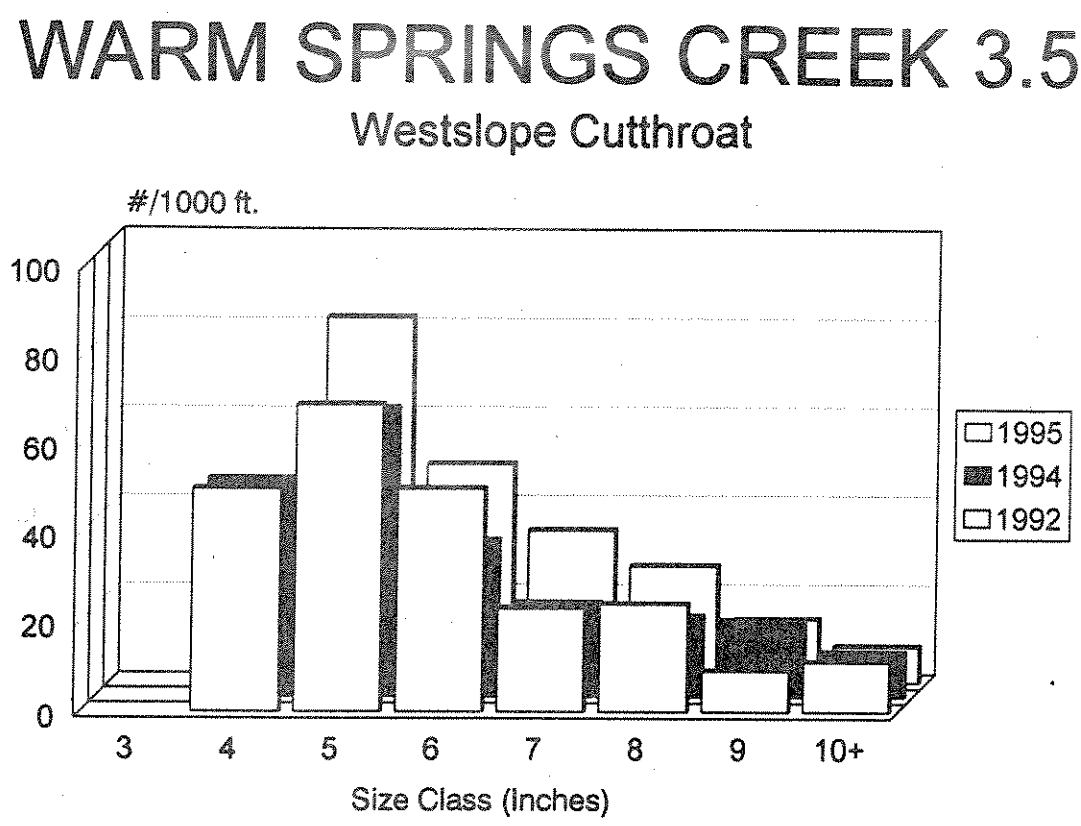
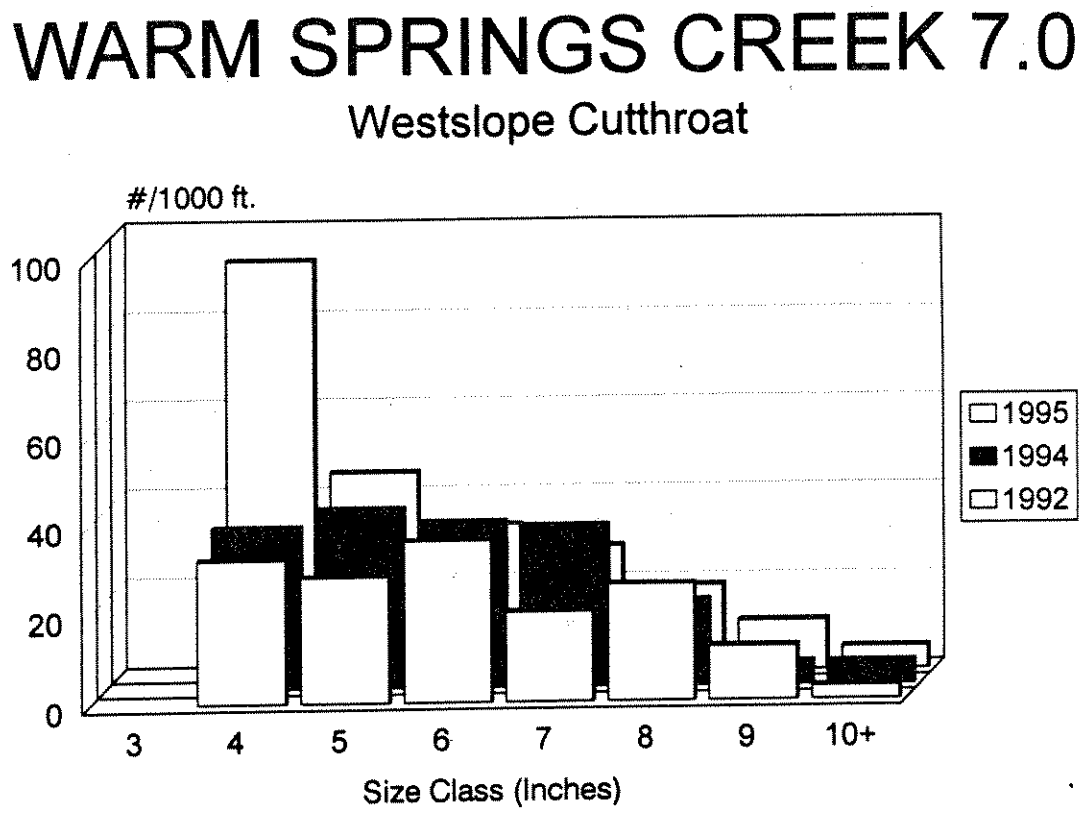


FIGURE 46. Population estimates of westslope cutthroat trout in Warm Springs Creek 3.5 by size class during the years indicated.



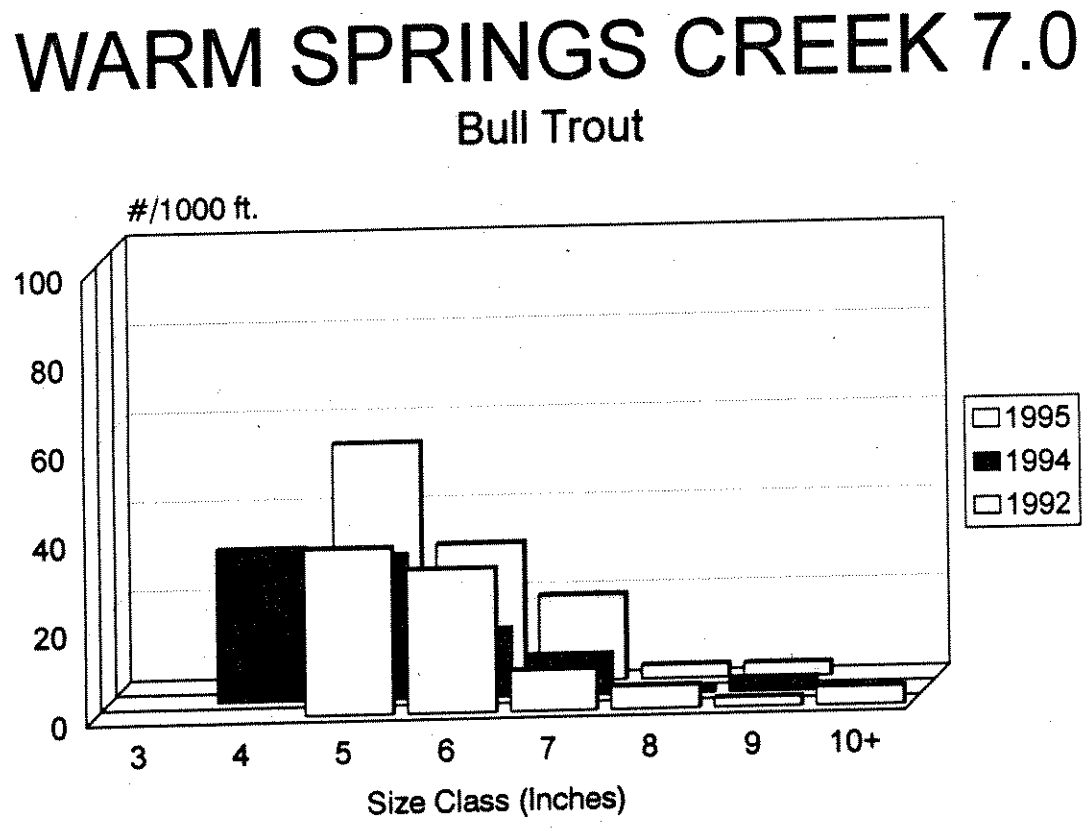


FIGURE 47. Population estimates of westslope cutthroat and bull trout in Warm Springs Creek 7.0 by size class during the years indicated.

Water temperatures in 1994 exceeded 15° C at the lower site but not at the upper site (Figure 48). Both sites are relatively cool and water temperature is not a problem at this time.

West Fork district

Four fish monitoring sites (Bluejoint Creek 4.2, Boulder Creek 2.0, Overwhich 2.0 and Slate Creek 1.2) have been established on the West Fork District (Figure 49).

Painted Rocks reservoir appears to be an upstream barrier to brown trout and rainbow trout. Neither of these species have been collected above the dam, and none of the westslope cutthroat that have been tested have been introgressed with rainbow trout.

Water temperature has been monitored at four sites on the West Fork Bitterroot River, two upstream and two downstream of Painted Rocks reservoir. Water temperature at the site above Painted Rocks reservoir (West Fork Bitterroot 30.3) exceeded 15°C in both 1994 and 1995.

Painted Rocks reservoir appears to maintain cooler water temperatures in the West Fork downstream until late summer when it appears to maintain warmer than normal water temperatures (Figures 50 and 51).

West Fork Bitterroot 30.3

This site has been monitored cooperatively by BNF and MFWP. The fishery is primarily westslope cutthroat trout with lesser numbers of brook trout and bull trout. The cutthroat trout population has been fairly stable since monitoring began in 1991, but the trend has been slightly downward (Figure 52). Brook trout are found in small numbers but the trend in 1995 was up.

Bluejoint Creek 4.2

A monitoring site was established on Bluejoint Creek in 1993. Population estimates of fish indicate that this section supports about 100 westslope cutthroat per 1000 feet of stream (Figure 49). In the three years of sampling, no trend in numbers is apparent, however, this site does appear to have habitat capable of supporting larger fish (Figure 53). Bull trout, mountain whitefish and brook trout are found in small numbers at this location. The cutthroat trout in this drainage are pure strain (Table 3). No physical habitat measurements have been taken at this site to date.

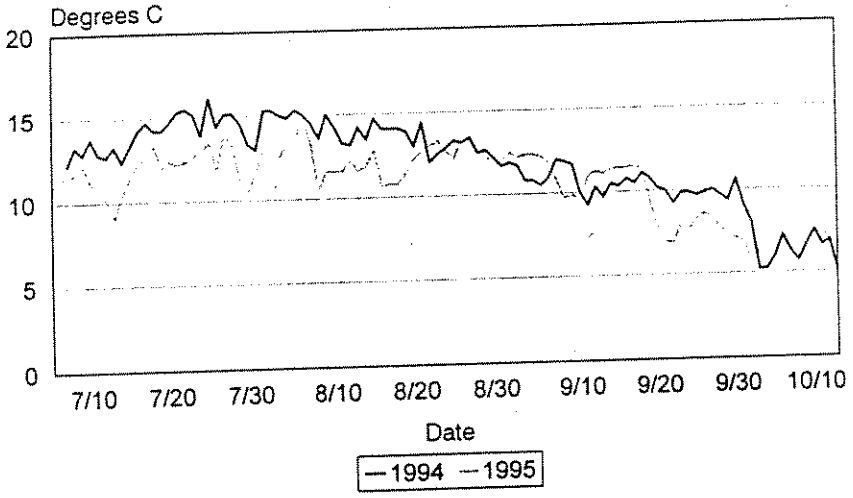
Maximum daily water temperature at this site exceeded 15° C for about 3 weeks in 1994 (Figure 53).

Boulder Creek 2.0

Fish populations were sampled once at this site in 1992 (Clancy 1993). Although a population estimate of bull trout was not collected, they were abundant in this section of stream.

WARM SPRINGS CREEK 3.5

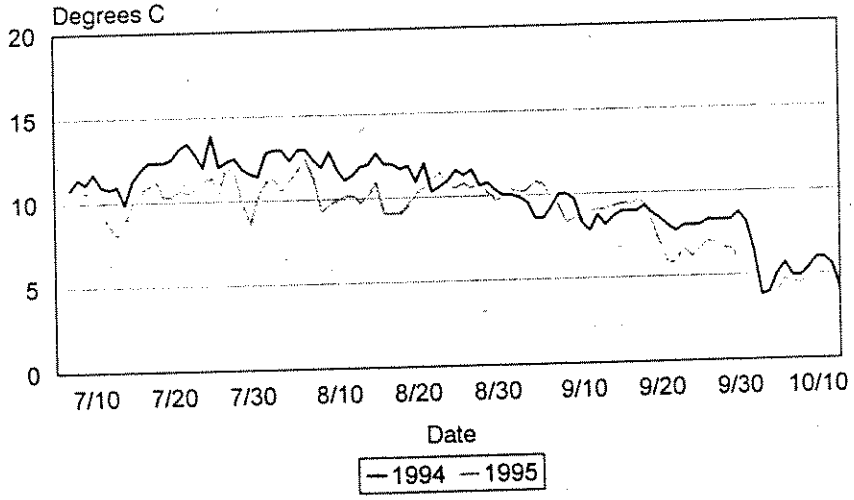
Temperature Summaries



Daily Maximum

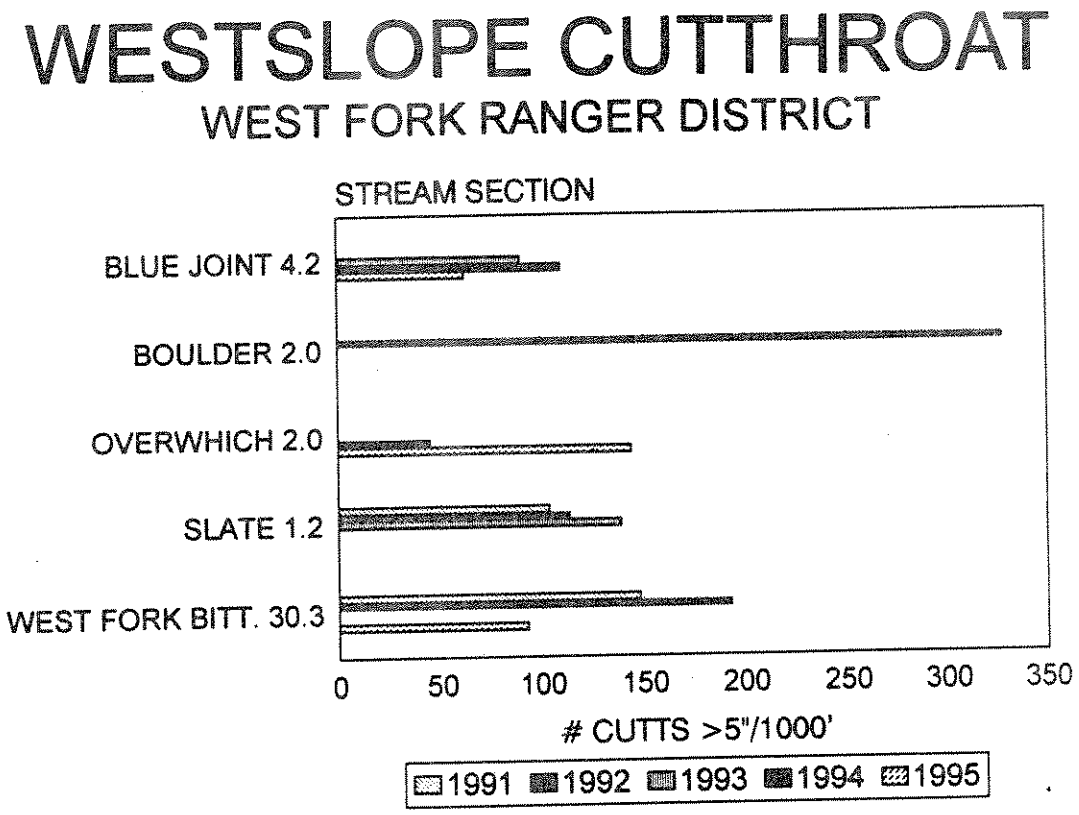
WARM SPRINGS CREEK 7.0

Temperature Summaries



Daily Maximum

FIGURE 48. Maximum daily water temperature at two sites on Warm Springs Creek.



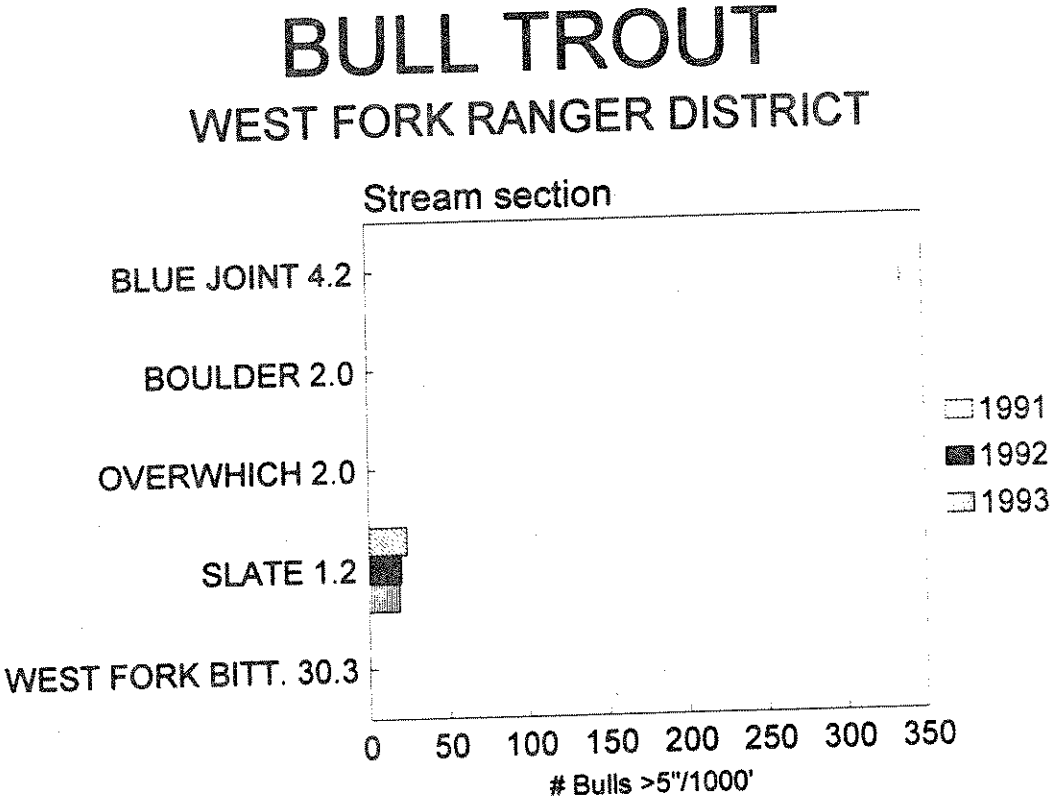
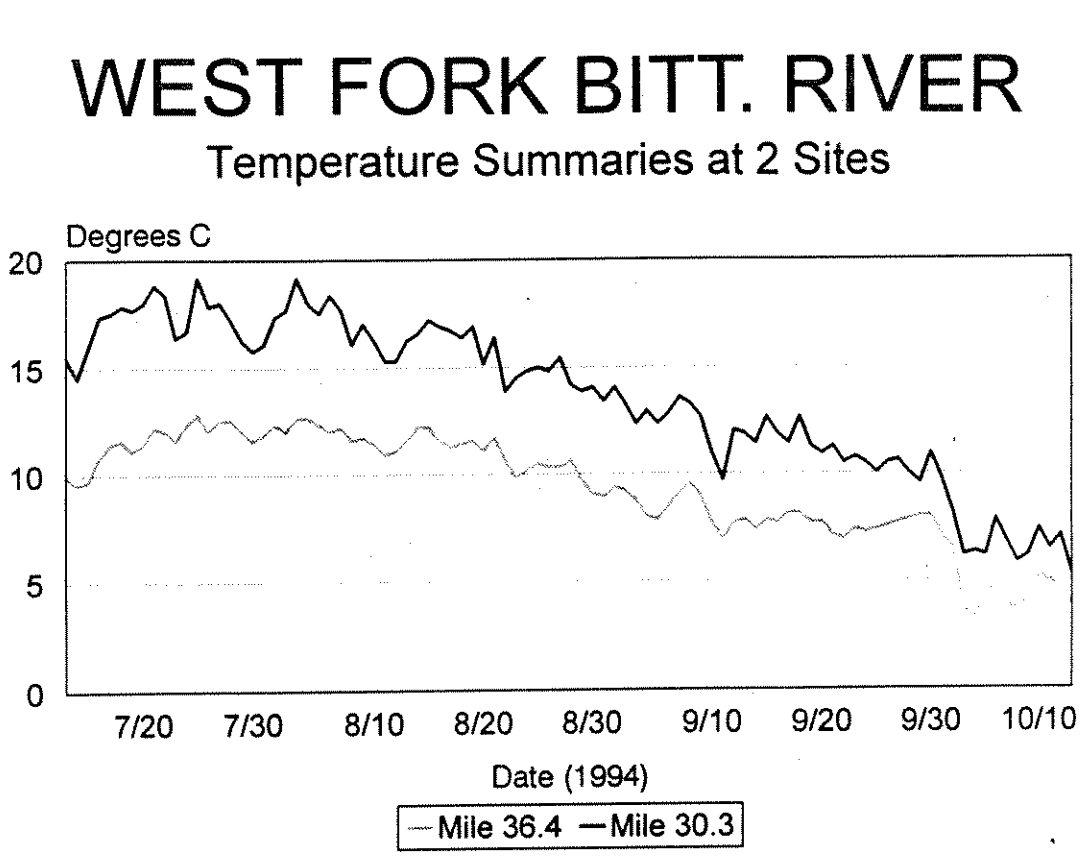


FIGURE 49. Population estimates of westslope cutthroat and bull trout on the West Fork District of the BNF.



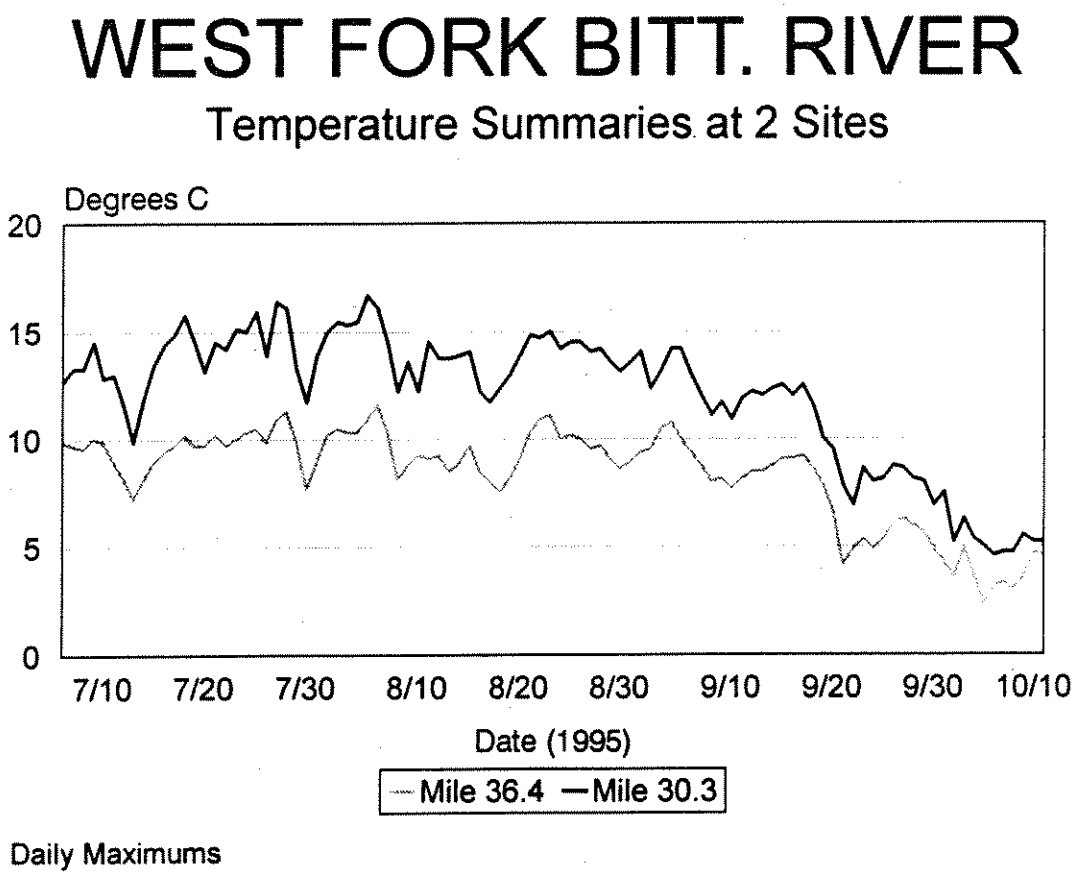


FIGURE 50. Maximum daily water temperature at the two sites on the West Fork Bitterroot River upstream of Painted Rocks Reservoir during 1994 and 1995.

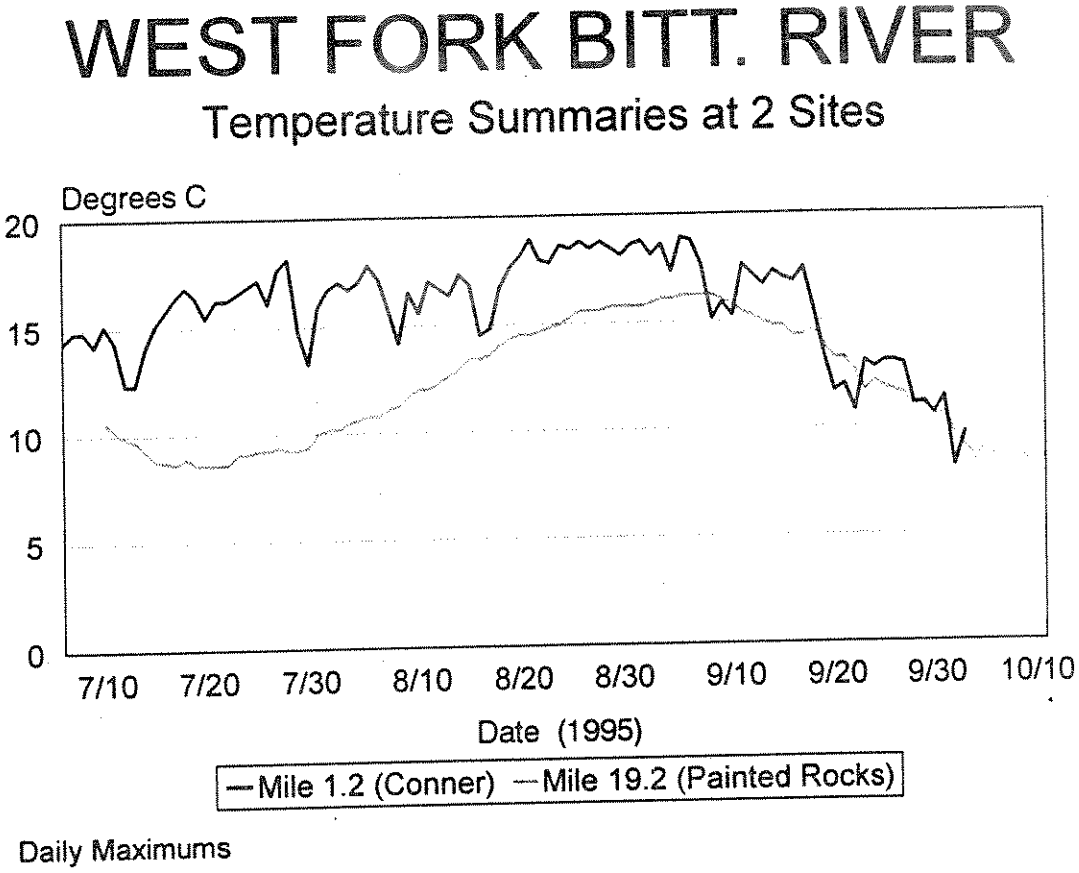
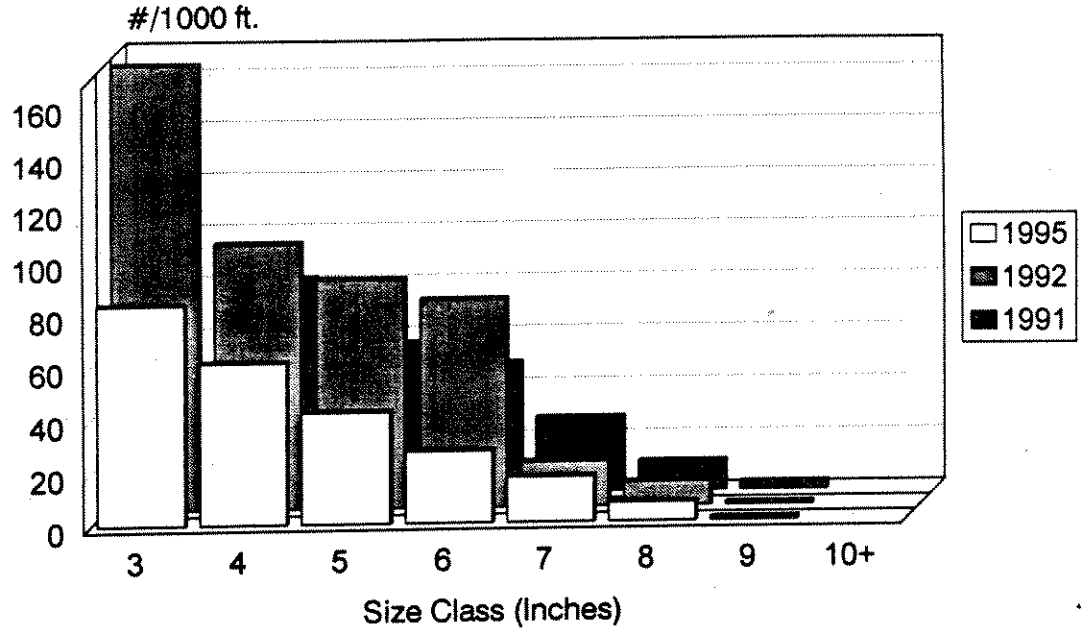


FIGURE 51. Maximum daily water temperature at two sites on the West Fork Bitterroot River downstream of Painted Rocks Reservoir during 1995.

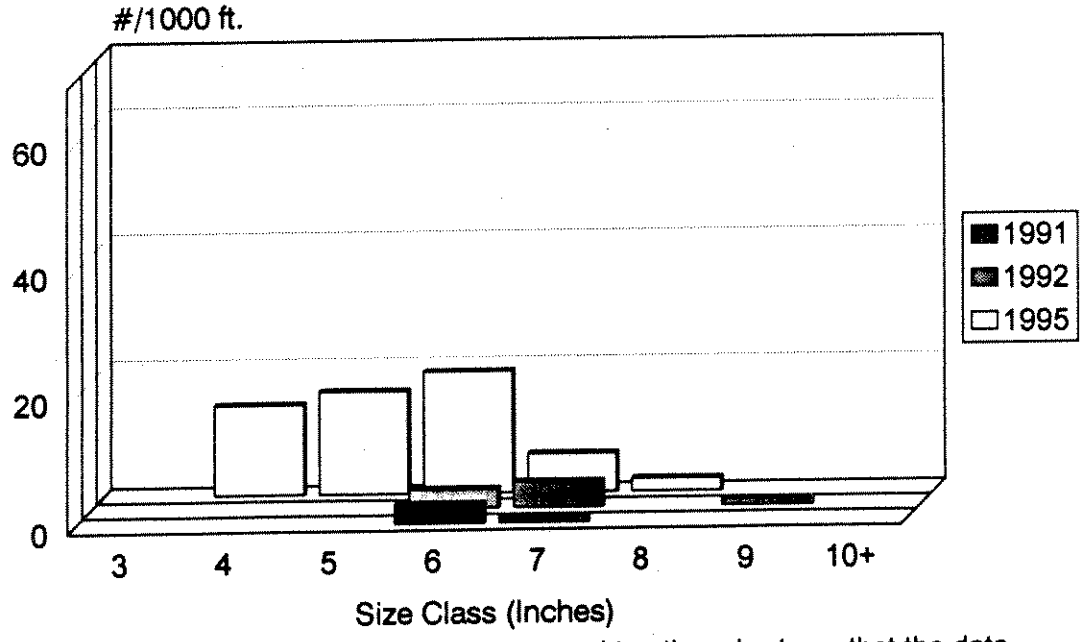
WEST FORK BITT. RIVER 30.3

Westslope Cutthroat



WEST FORK BITT. RIVER 30.3

Brook Trout

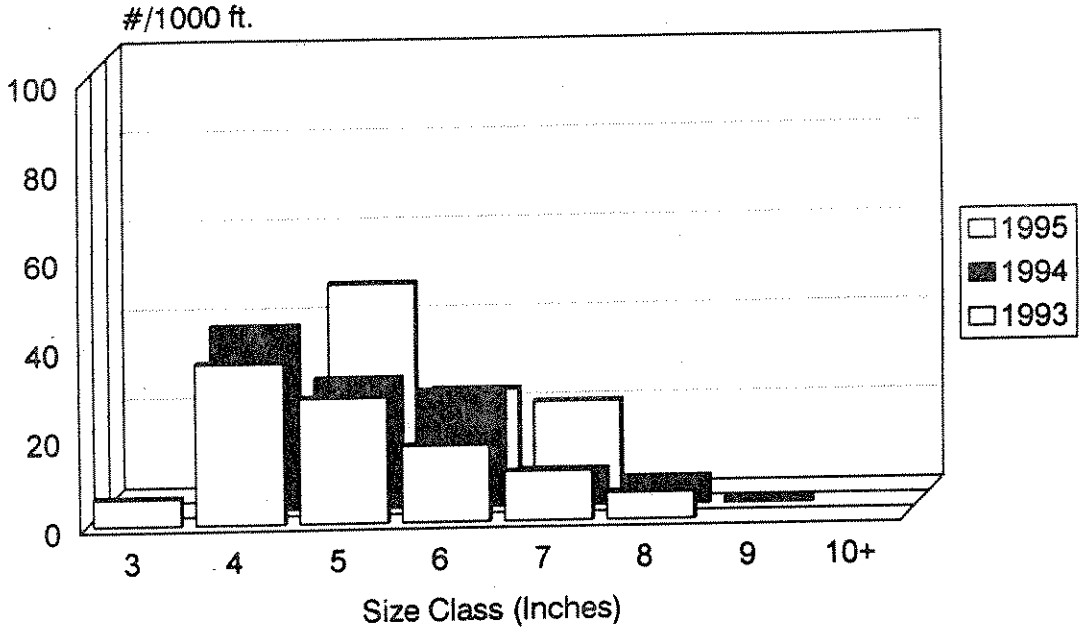


Note: Years are situated backwards compared to other charts so that the data shows more clearly.

FIGURE 52. Population estimates of westslope cutthroat and bull trout in West Fork Bitterroot River 30.3 by size class during the years indicated.

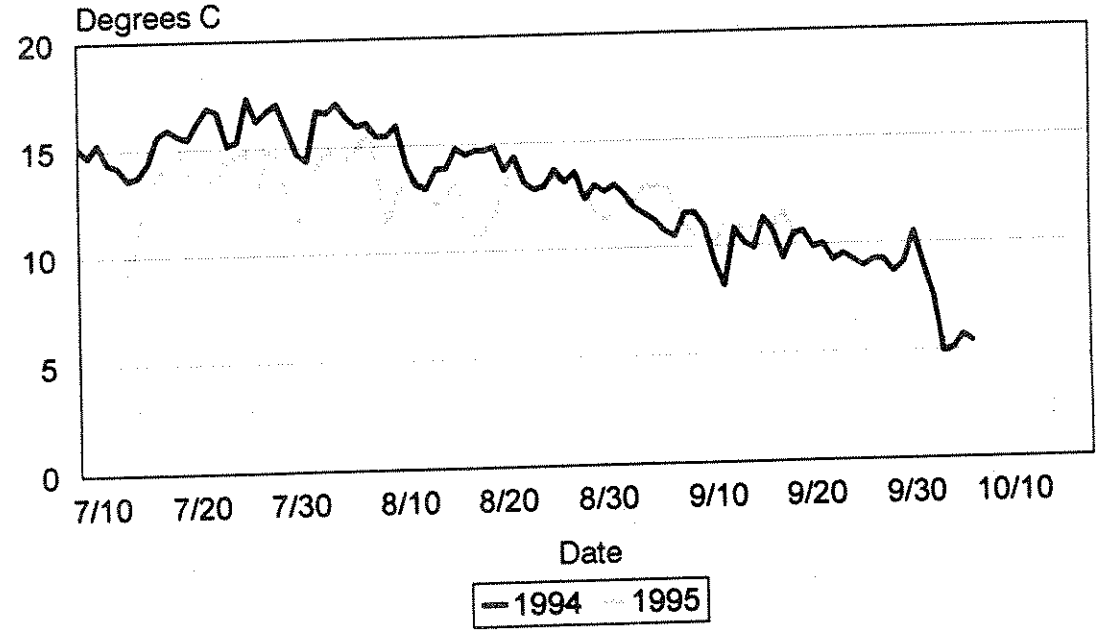
BLUE JOINT CREEK 4.2

Westslope Cutthroat



BLUE JOINT CREEK 4.2

TEMPERATURE SUMMARIES



DAILY MAXIMUM

FIGURE 53. Population estimates of westslope cutthroat by size class and maximum daily water temperature at Bluejoint Creek 4.2 during the years indicated.

Maximum daily water temperature exceeded 15° C for about 2 weeks in 1994 (Figure 54). This is one of the warmer sites that supports a high population of bull trout. There is likely a barrier on Boulder Creek downstream of this site that may be keeping brook trout from invading upstream. More cutthroat trout must be sampled before a determination can be made about their genetic purity (Table 3).

Slate Creek 1.2

A monitoring site was established on Slate Creek in 1991. Lower Slate Creek supports over 100 westslope cutthroat longer than 5" per 1000 feet of stream (Figure 49). They are pure strain (Table 3). Bull trout are also common in Slate Creek, however hybridization with brook trout is occurring. During the years of sampling, there was a slight downward trend in the number of westslope cutthroat (Figure 55). Bull trout numbers were stable.

Water temperature in lower Slate Creek are cool. It did not exceed 15° in either 1993 or 1994 (Figure 56).

Westslope cutthroat population structure

The structure of a population of fish can be useful in determining factors that are limiting the population size. In overfished populations, larger fish are often found in lesser numbers than would be expected. This can occur while the number of small fish in the population remains static or increases.

Since monitoring began in 1989 on the BNF, larger westslope cutthroat have declined at a number of sites (see discussion of individual sites). This may be related to many things, and fishing harvest is one of them. In order to look at the structure of westslope cutthroat populations, I divided the number of westslope cutthroat at each site between 4 and 7 long inches by the number of fish over 7 inches. This ratio gives an idea of the relative number of small fish to large fish at the site. The larger the number, the larger the population of small westslope cutthroat in relation to larger fish (Figure 57). Streams with a ratio over 2 may be potentially overharvested. If two sites are on the same stream and the ratio is higher at the downstream site, this may indicate overharvest of larger fish. Using these two factors in combination with a declining number of large cutthroat trout may identify streams that are candidates for more restrictive fishing regulations (Table 2).

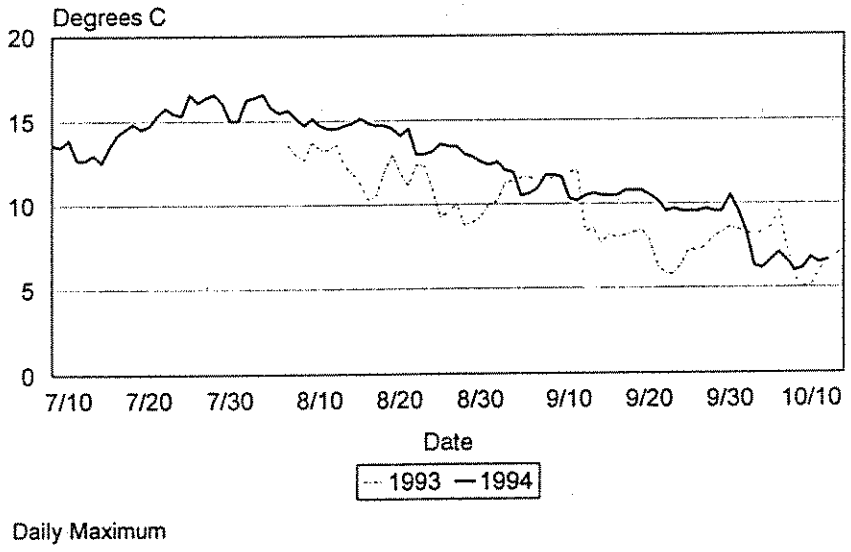
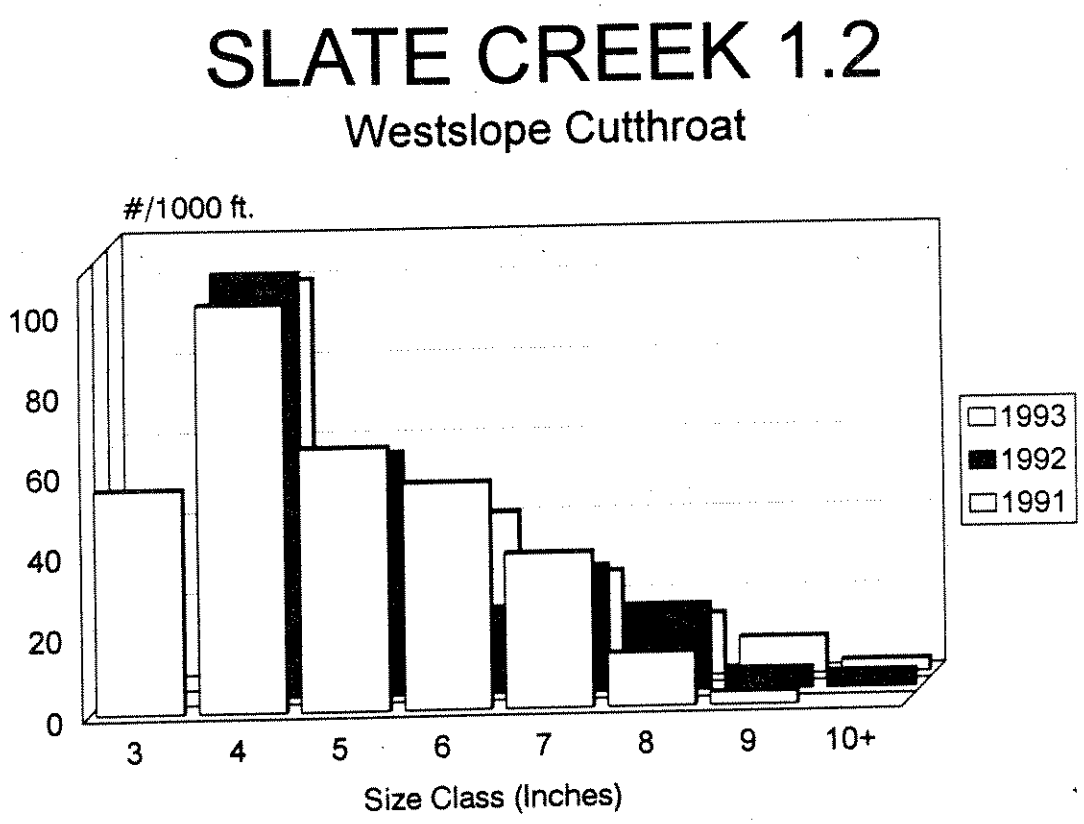


FIGURE 54. Maximum daily water temperature at Boulder Creek 2.0 during the years indicated.



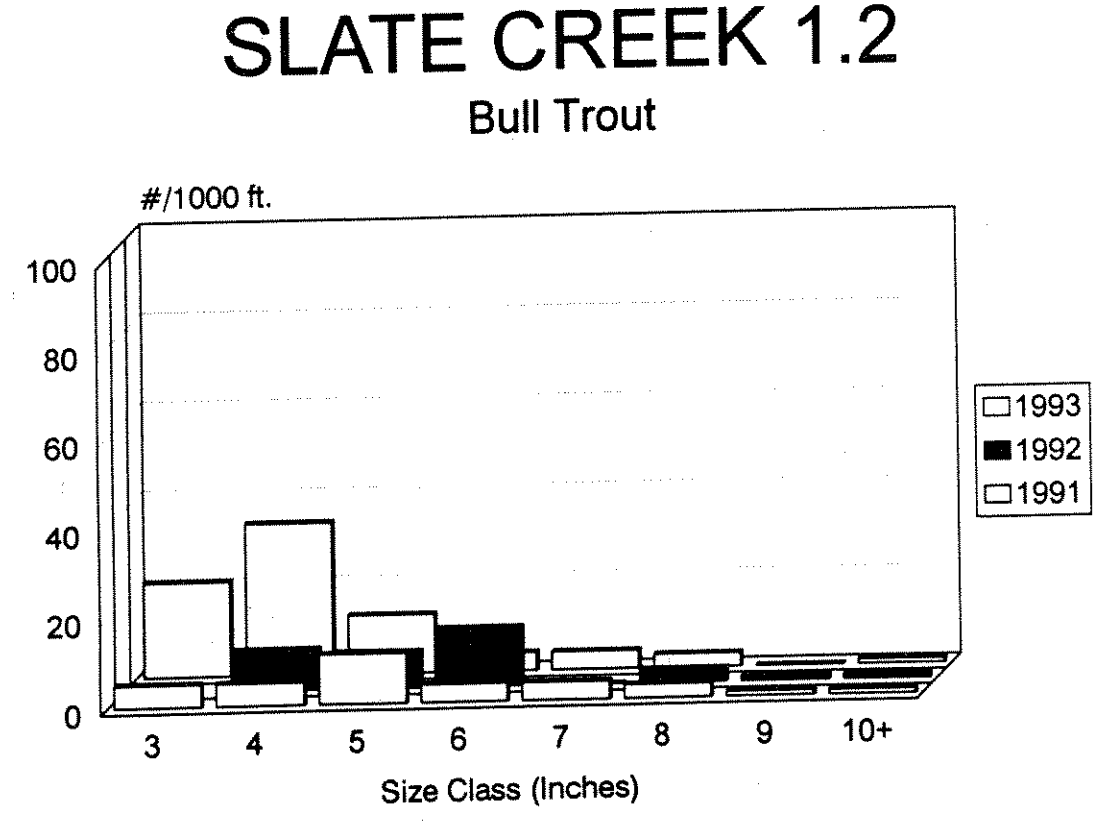


FIGURE 55. Population estimates by size class of westslope cutthroat and bull trout in Slate Creek 1.2 during the years indicated.

SLATE CREEK 1.2

Temperature Summaries

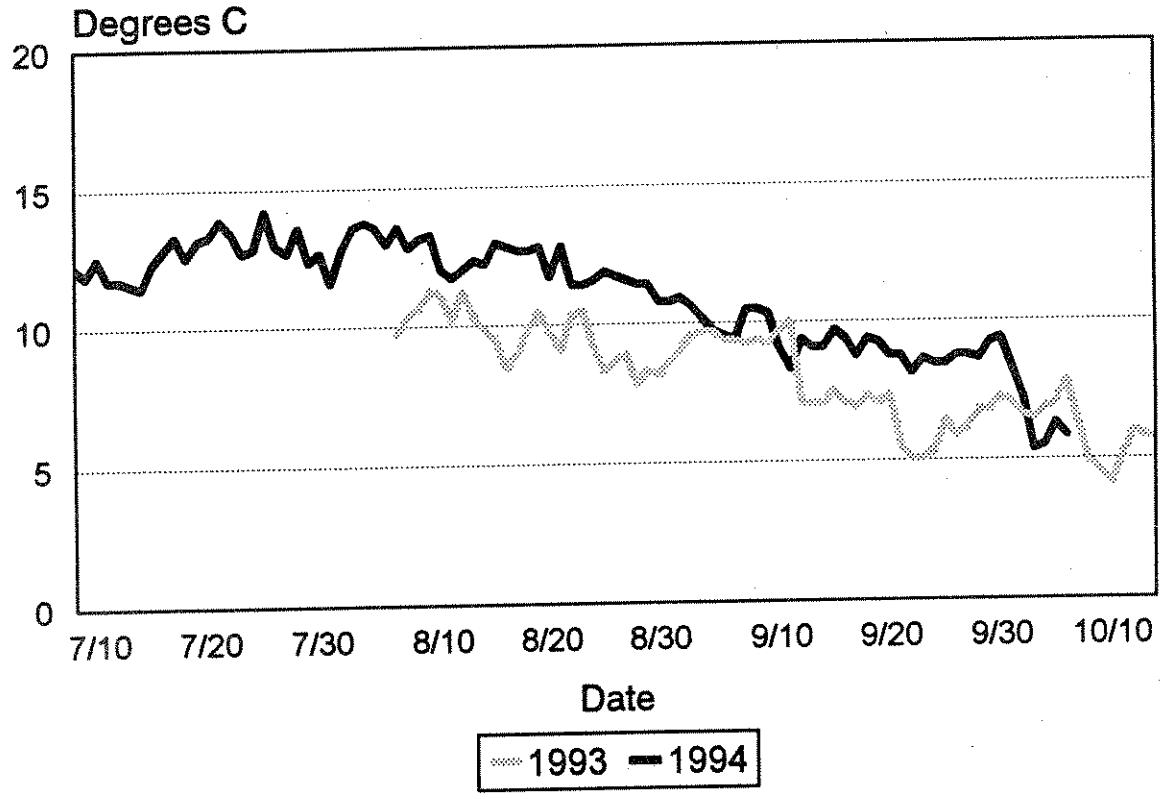


FIGURE 56. Maximum daily water temperature at Slate Creek 1.2 during the years indicated.

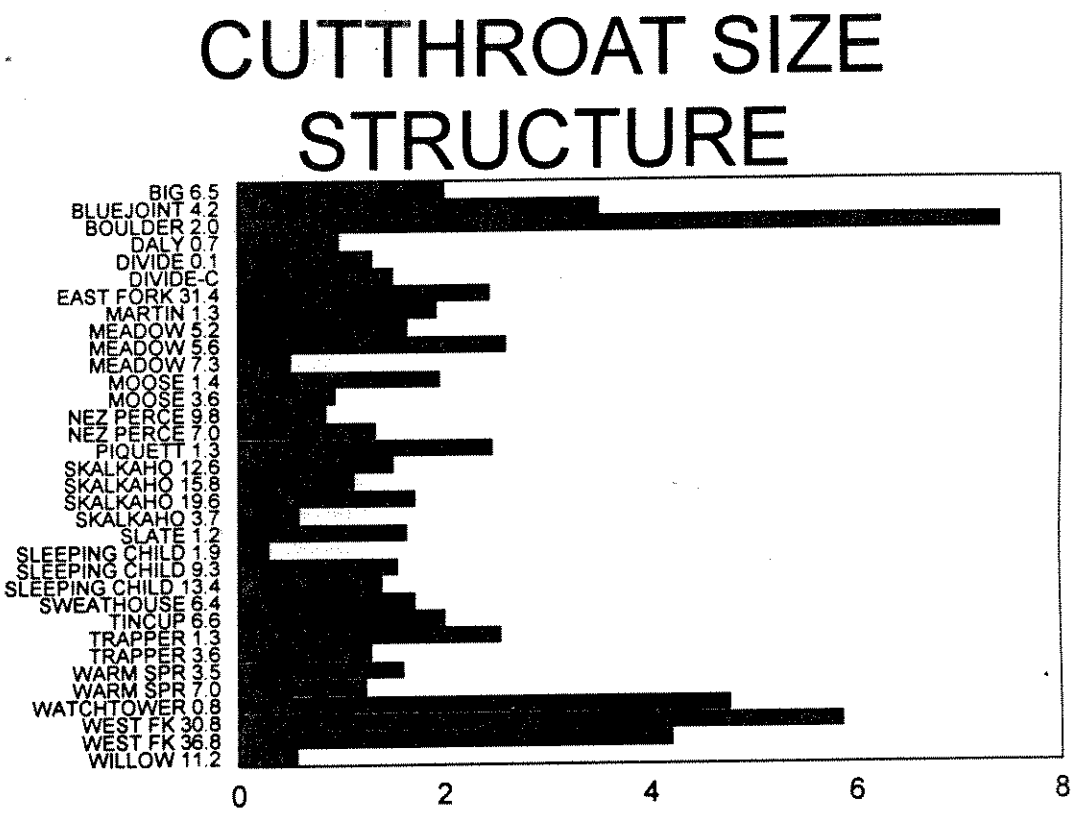


FIGURE 57. An index of westslope cutthroat population size structure derived by dividing the number of 4-7" fish by the number of fish over 7".

Table 2. Stream segments where angler harvest is potentially impacting the number of larger westslope cutthroat

Ratio over 2	Higher ratio downstream	Declining number
Bluejoint 4.2	Meadow 5.6	Skalkaho 15.8
Boulder 2.0	Moose 1.4	Skalkaho 19.6
E. Fk. Bitt 31.4	Skalkaho 12.6	Sl. Child 9.3
Meadow 5.6	Sl. Child 9.3	Moose 3.6
Piquette 1.3	Trapper 1.3	
Trapper 1.3	Warm Springs 3.5	
Watchtower 0.8	W. Fk. Bitt 30.3	
W. Fk. Bitt 30.3		
W. Fk. Bitt 36.8		

The streams that are listed in more than one category are Meadow Creek, Moose Creek, Skalkaho Creek, Sleeping Child Creek, Trapper Creek and West Fork of the Bitterroot above Painted Rocks. These are streams where restrictive fishing regulations could have potential for increasing the number of larger cutthroat trout. Factors other than angling could be limiting the number of large fish, and conversely, some other sites could be overfished and not be identified by this method, but this would be a reasonable list of streams to begin with in any discussions of more restrictive fishing regulations.

Water Temperature

During the summer of 1993, 1994 and 1995 we recorded water temperature with HOBO Temp temperature loggers at 17, 33 and 42 sites, respectively. During 1995, temperature loggers were lost at 6 of the sites. Most of the sites were on the BNF (Figure 58). During all three years temperature was monitored between mid-July and mid-October. These temperature recorders will be useful for monitoring long term trends in water temperature on the forest.

One way to compare the water temperature at the different sites is to use a measure called degree days. Degree days are calculated for each day by averaging the temperature for that day. For example, if the average temperature for a certain day is 12 degrees C, then that days measurement is 12 degree days. The degree days between July 19 and October 15 were summed and the total degree days were calculated for each site during each of the three years. This data will serve as a baseline for comparisons in the future.

It is important to understand how significant hydrological and climatological differences between years affect water temperature. For example, 1993 and 1994 were very different water years and it is reflected in the water temperatures at the monitoring sites. One year of water temperature data is only useful if it can be compared to some standard or at least discussed in the context of the water year it was collected.

Climatological data from the National Weather Service

1 Martin Creek 7.5
2 Martin Creek 1.3
3 Moose Creek 1.4
4 East Fork Bitterroot River 31.4
5 Meadow Creek 0.3
6 Meadow Creek 5.6
7 East Fork Bitterroot River 17.5
8 Tolan Creek 2.1
9 Tolan Creek 5.1
10 Divide Creek 0.1
11 Reimel Creek 2.3
12 Warm Springs Creek 3.5
13 Warm Springs Creek 7.0
14 West Fork Bitterroot River 36.4
15 West Fork Bitterroot River 30.3
16 Blue Joint Creek 4.2
17 Slate Creek 1.2
18 Boulder Creek 2.0
19 Piquette Creek 1.3
20 Chaffin Creek 3.1
21 Tincup Creek 4.6
22 Rye Creek 12.4
23 North Rye Creek 1.7
24 Lick Creek 1.9
25 Sleeping Child Creek 9.3
26 Sleeping Child Creek 1.8
27 Skalkaho Creek 15.8
28 Skalkaho Creek 12.6
29 Daly Creek 0.7
30 Roaring Lion Creek 4.3
31 Sweathouse Creek 6.4
32 Burnt Fork Bitterroot River 19.2
33 Threemile Creek 6.4
34 Bertie Lord Creek 0.1
35 East Fork Bitterroot River 0.5
36 West Fork Bitterroot River 01.2
37 West Fork Bitterroot River 19.2
38 Skalkaho Creek 0.6
39 Sleeping Child Creek 13.4
40 Sweathouse Creek 0.1
41 Burnt Fork Bitterroot River 11.3
42 Willow Creek 11.0
43 Willow Creek 13.1
44 Threemile Creek 11.7
45 Rye Creek 9.1
46 Little Blue Joint Creek 1.5
47 Overwhich Creek 5.0
48 Bitterroot River (@ Missoula)
49 Bitterroot River (@ Florence)
50 Bitterroot River (@ Bell Xing)
51 Bitterroot River (@ Hamilton)
52 Bitterroot River (@ Wally Crawford)

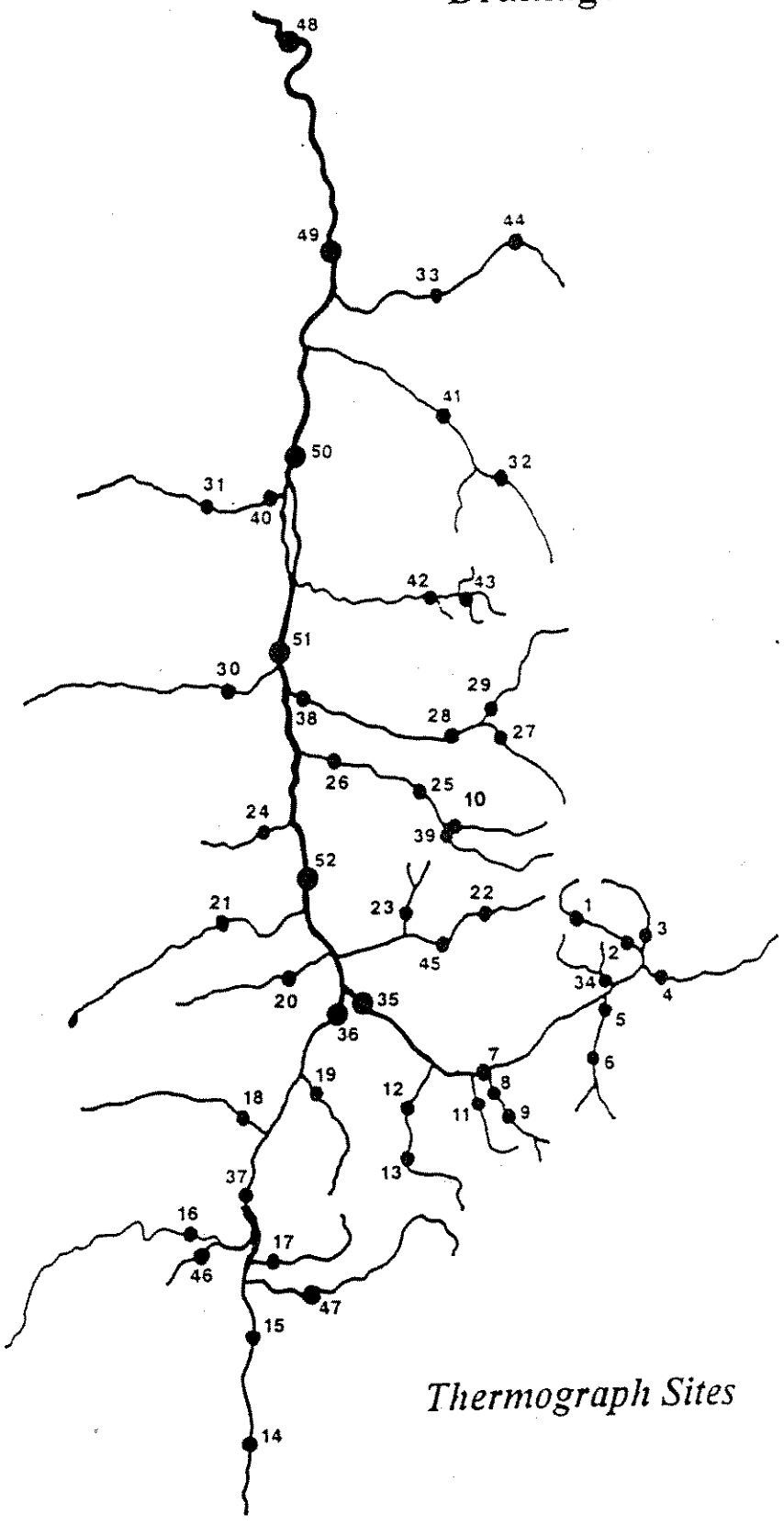


FIGURE 58. Location of HOBO Temp temperature loggers during various years in the Bitterroot drainage.

indicates how different 1993, 1994 and 1995 were (Figures 59-61). This data is important when discussing water temperature because it clearly affects it. Air temperature during the summer of 1993, 1994 and 1995 was below, above and about normal, respectively.

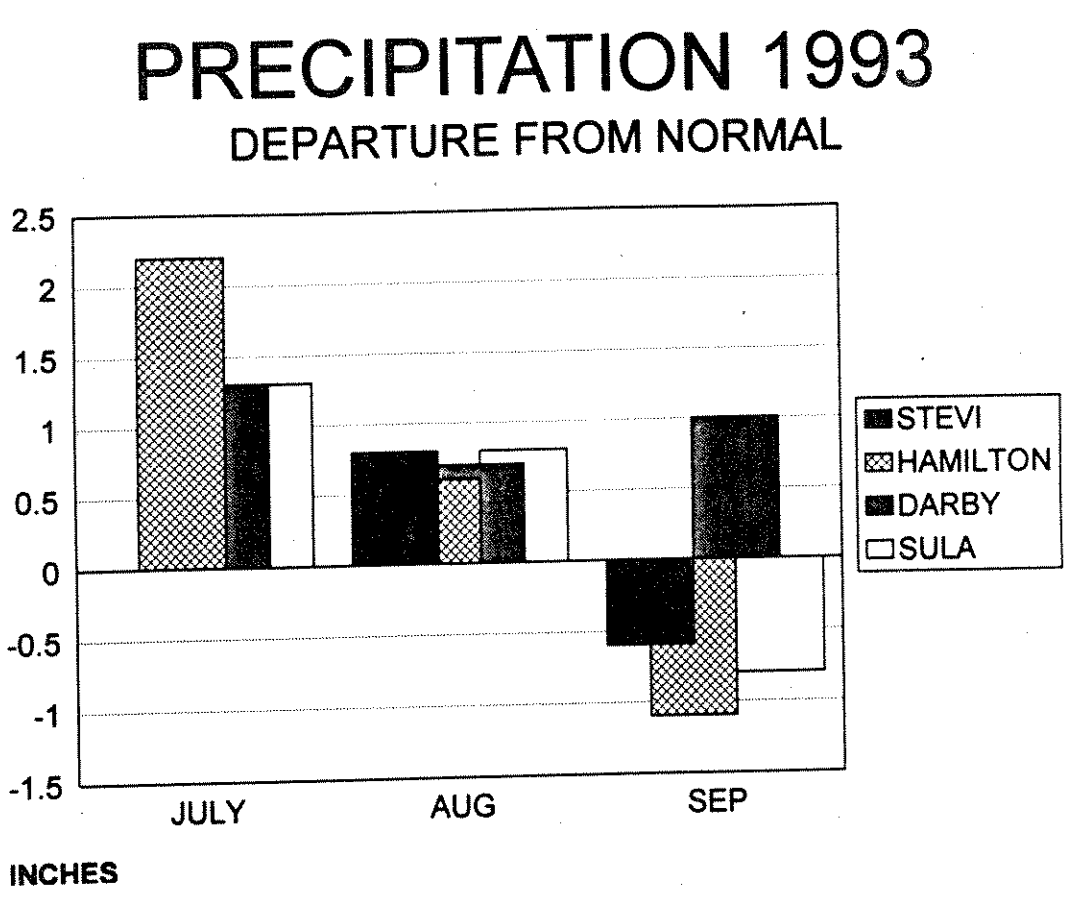
Based on the data collected in 1994 and 1995 we found that a strong correlation exists between the relative cumulative temperature units at each site between years (i.e. warm water sites in 1994 were also warm in 1995 and the same for cold sites). Linear regression showed a highly significant relationship and it allowed us to fill in data gaps for 1994 based on 1995 data. This additional data allowed us to calculate the degree day totals for 40 sites in 1994.

The relationship between water temperatures and fish densities at these locations is found in Figure 62. The relationship between westslope cutthroat and water temperature is poor. High density populations exist at warm sites and cold sites. Bull trout are thought to prefer streams with cold water temperatures. Higher density bull trout populations are seldom found in warm water temperatures on the BNF. The two sites that seem to support high bull trout densities in warm water temperatures (Sweathouse and Boulder Creeks), are both above suspected fish barriers which likely have kept brook trout from reaching them. These data support the idea that bull trout prefer colder streams.

Brook trout are found at lower elevations than bull trout (Clancy 1993). An examination of water temperature at 31 sites in 1994 that could be classified as pure bull trout, pure brook trout or a transitional area dominated by one or the other indicates that colder temperatures are preferred by bull trout (Figure 63). The mean number of degree days at pure bull trout, transitional bull trout, transitional brook trout and pure brook trout were 627, 648, 734 and 782, respectively. While the differences are statistically significant ($P<.05$), there is considerable overlap between sites. For example, one of the coldest sites is lower Tolan Creek which is a transitional brook trout site. Overall, these data indicate that cold water temperatures may give bull trout a competitive advantage over brook trout but that other factors also play a role.

Genetic testing

Westslope cutthroat trout from nearly 63 locations in the Bitterroot Valley have been tested for genetic purity at the University of Montana (Table 3). This testing will continue as we attempt to identify the locations of pure strain populations of westslope cutthroat. Bull trout are not being tested, but are identified visually (Clancy 1993). To date, westslope cutthroat trout from 45 of 63 sites have tested pure. While most of the sample sizes are too small for absolute statistical certainty, data indicates most of the populations in the Sapphire range on the east side of the valley and in the East and West Fork drainages are pure westslope cutthroat. The introgressed populations are typically located in the Bitterroot range on the west side of the valley (Figure 64). This distribution indicates that stocking of high



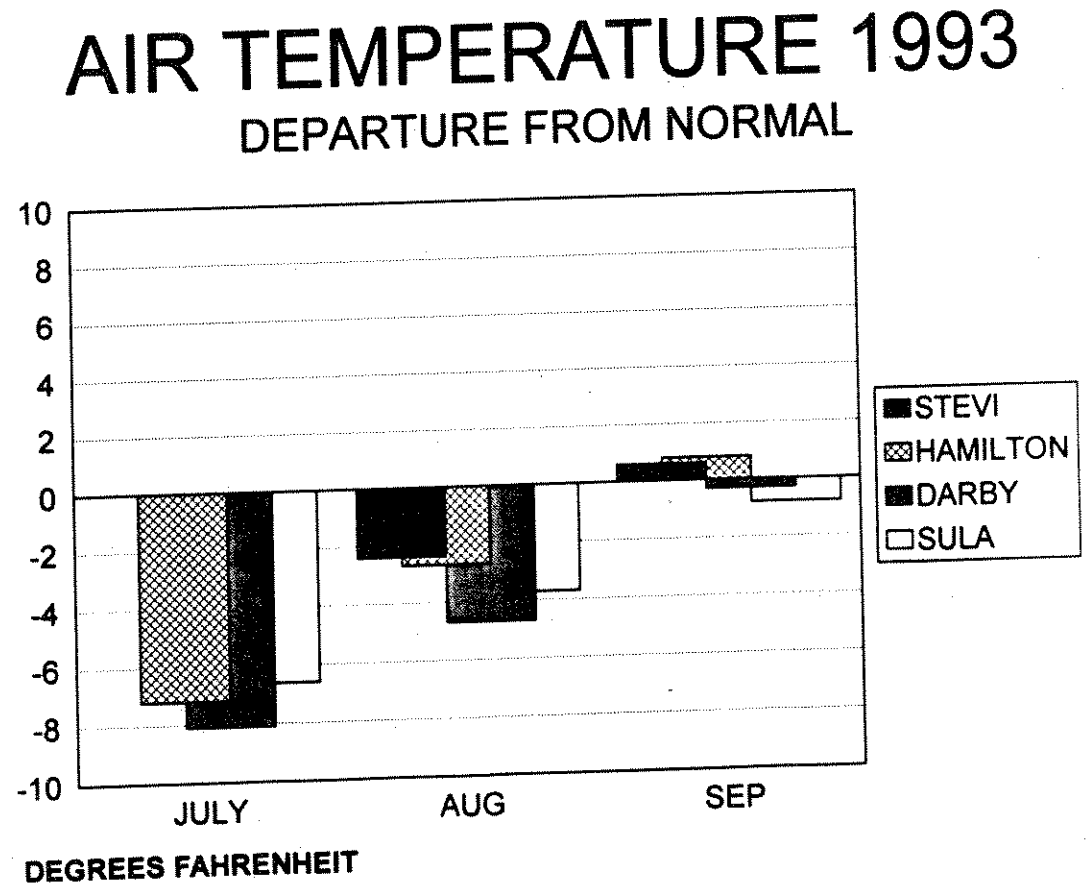
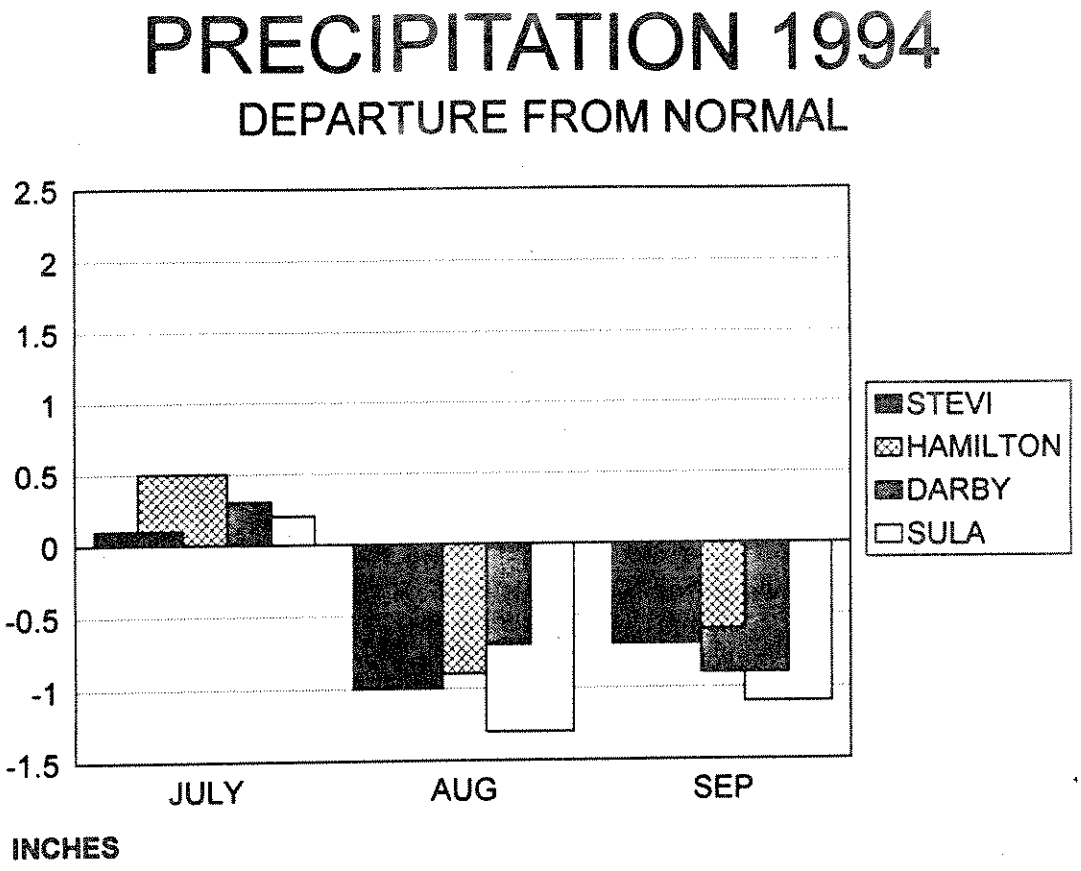


FIGURE 59. Departure from normal of monthly precipitation and monthly air temperature at National Weather Service sites in the Bitterroot drainage during 1993.



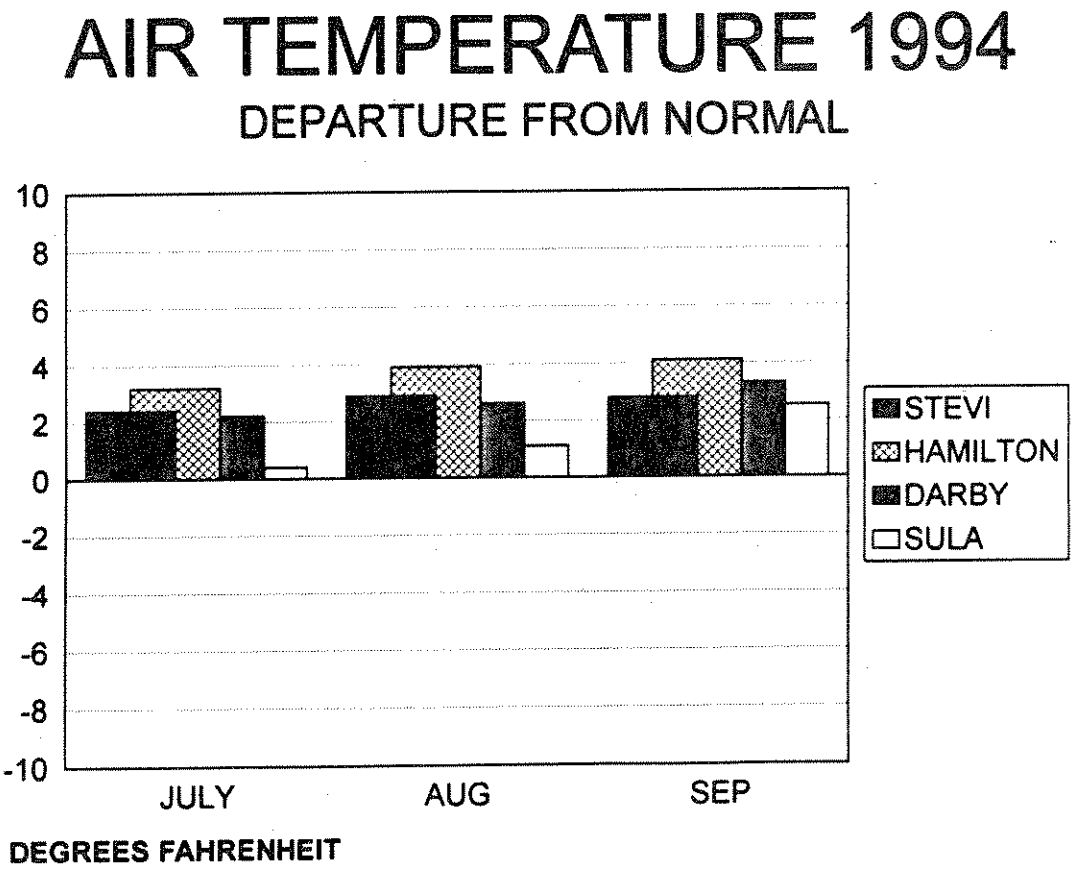
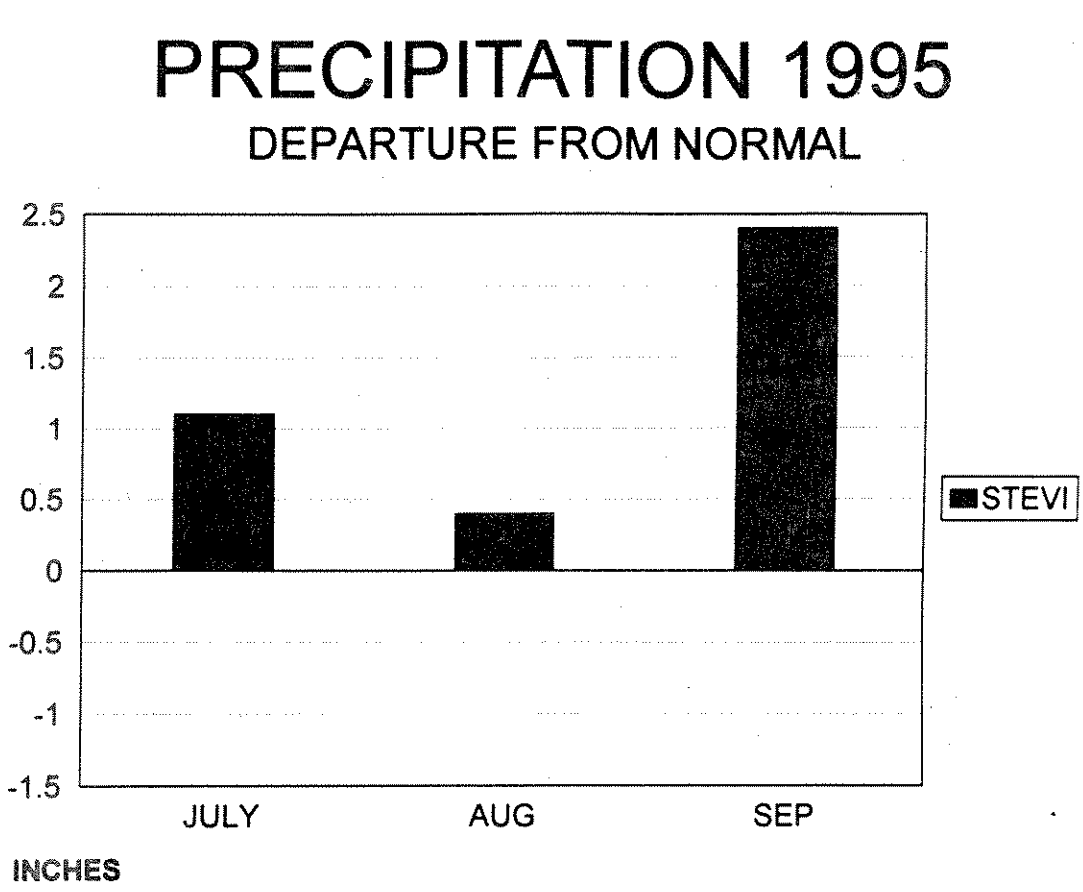


FIGURE 60. Departure from normal of monthly precipitation and monthly air temperature at National Weather Service sites in the Bitterroot drainage during 1994.



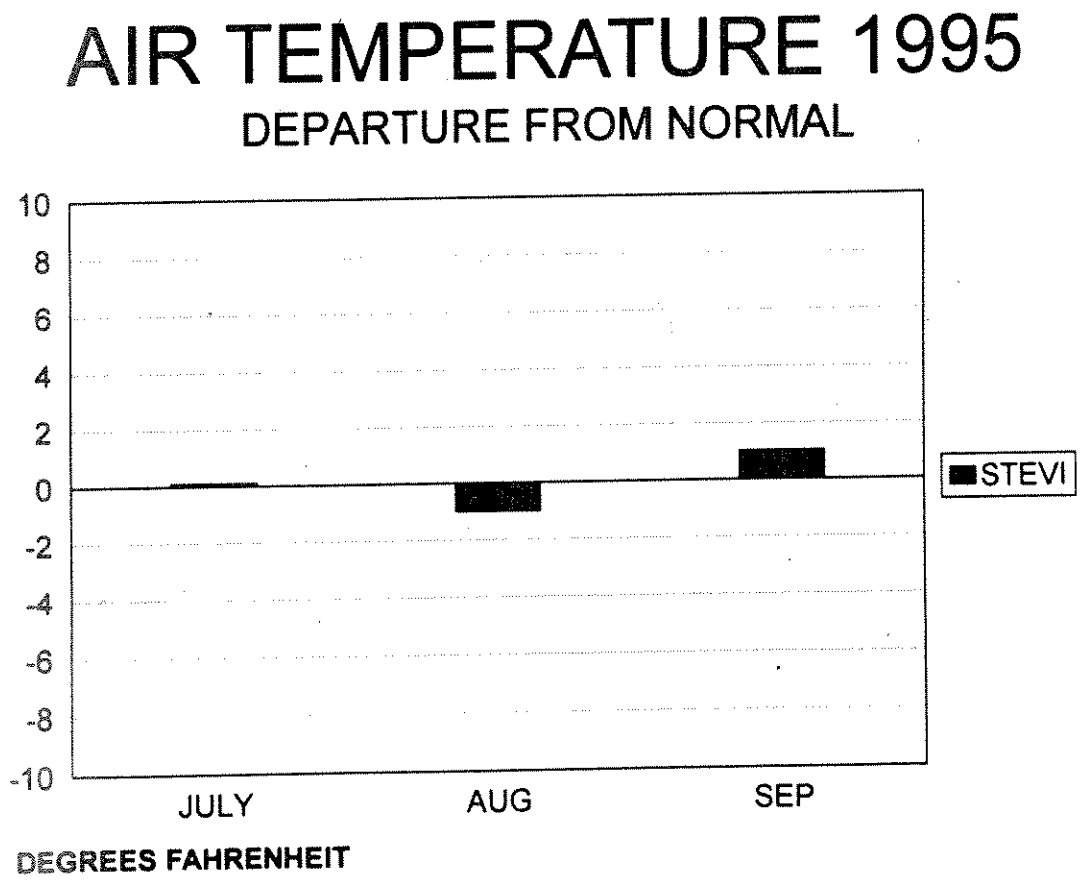
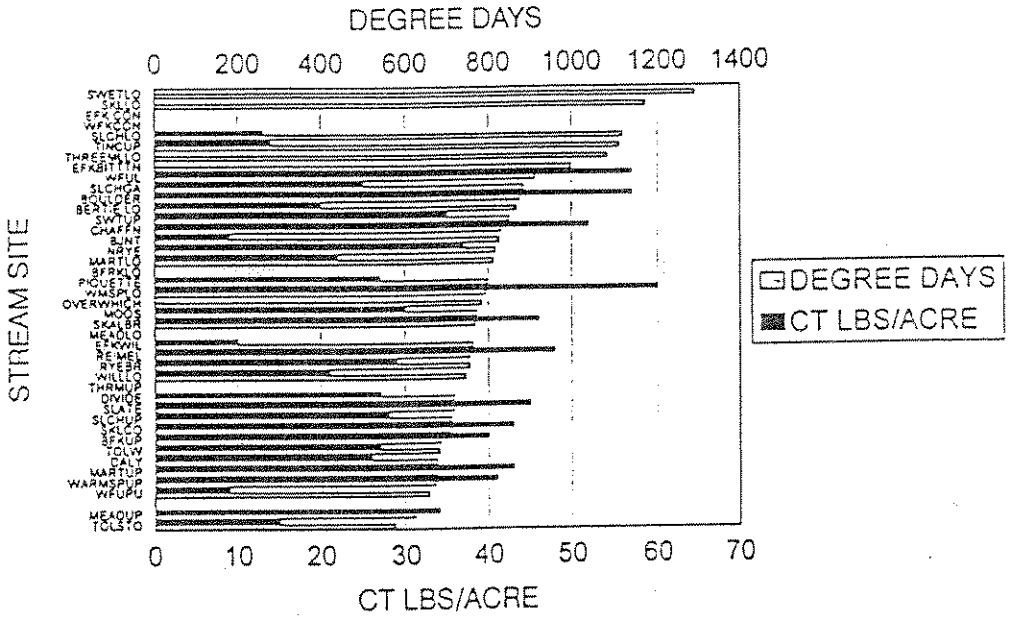
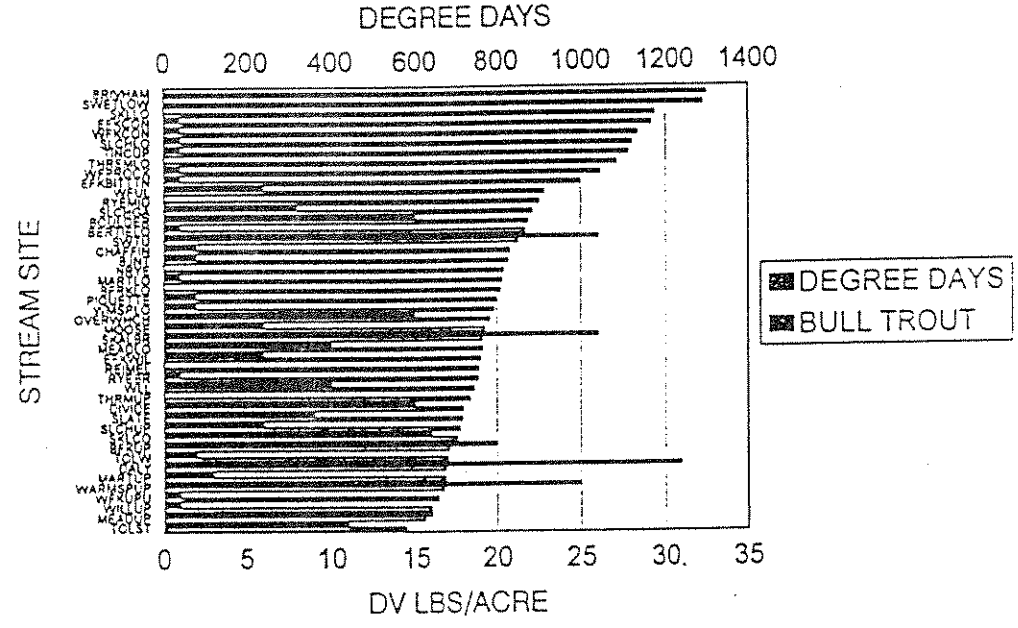


FIGURE 61. Departure from normal of monthly precipitation and monthly air temperature at the National Weather Service site at Stevensville during 1995 (data from other sites not available at the time of publication of this report).

CUTTHROAT - TEMPERATURE



BULL TROUT - TEMPERATURE



JULY 19-SEPTEMBER30

FIGURE 62. Degree days of water temperature in 1994 and westslope cutthroat and bull trout biomass in the Bitterroot drainage.

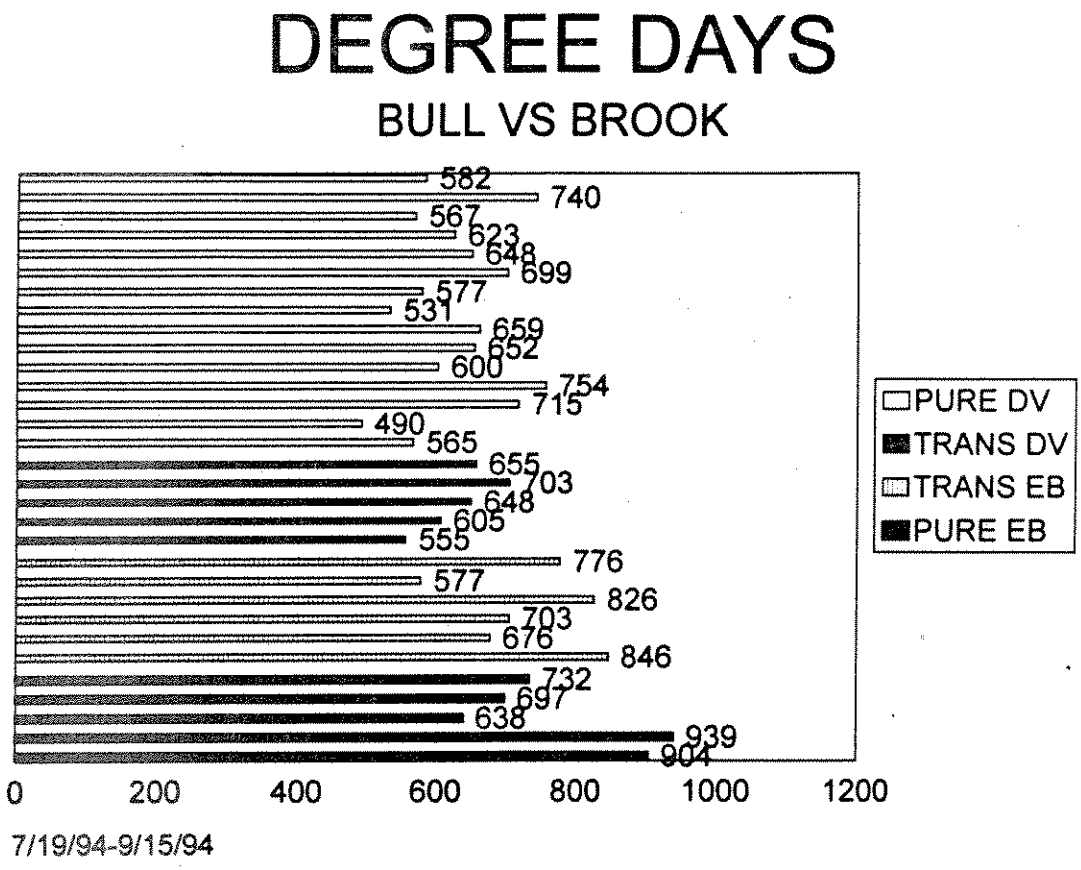


FIGURE 63. Degree days of water temperature in 1994 at sites classified as either bull trout, transition dominated by bull trout, transition dominated by brook trout and brook trout.

Table 3. Results of electrophoretic testing of westslope cutthroat trout populations in selected BNF streams.

Stream	Location	Sample Size	Year	Status
Ambrose Creek	T9N,R18W,S18	6	1994	1*
Bass Creek	T10N,R20W,S33	11	1984	3
Bear Creek	T7N,R21W,S7	11	1991	2
Beaver Creek	T4S,R22W,S4	4	1992	1*
Big Creek	T8N,R21W,S10	5	1992	2
Blodgett Creek	T6N,R21W,S17	6	1994	2
	T6N,R22W,S13	9	1994	2
	T6N,R22W,S16	12	1994	2
Bluejoint Creek		5	1987	1*
	T2S,R23W,S2	10	1994	1*
	T2S,R23W,S4	6	1994	1*
Boulder Creek	T1N,R21W,S18	12	1994	?
Burnt Fork Bitt.	T8N,R19W,S14	8	1994	1*
	T7N,R18W,S5	14	1994	1*
Cameron Creek	T2N,R19W,S11	7	1994	1*
Camp Creek	T1S,R19W,S21	5	1994	1*
Canyon Creek	T6N,R21W,S29	10	1994	?
Chaffin Creek	T2N,R21W,S3	15	1990	1*
Coal Creek	T2S,R22W,S16	15	1990	1
	T2S,R22W,S16	11	1994	1
Daly Creek	T5N,R18W,S19	10	1994	1*
Fred Burr	T7N,R21W,S21	12	1991	1*
	T7N,R22W,S14	7	1991	1*
Gold Creek	T7N,R19W,S1	30	1985, 1990	1
Hughes Creek	T3S,R22W,S2	12	1994	1*
Kootenai Creek	T9N,R21W,S14	10	1994	1*
Lick Creek	T4N,R21W,S21	1	1992	1*
Little Bluejoint Ck	T2S,R22W,S5	8	1994	1*
Little Boulder Ck	T1S,R22W,S26	4	1994	1
Lost Horse Creek	T4N,R22W,S11	12	1994	2
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
Nez Perce Fork	T1S,R22W,S7	6	1994	1*
	T1S,R22W,S18	6	1994	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*
	T1N,R19W,S35	3	1992	1*
Roaring Lion Creek	T5N,R21W,S16	11	1994	1*
Rye Creek	T3N,R20W,S31			
	T3N,R20W,S25	10	1994	1*
Sawtooth Creek	T5N,R21W,S9	10	1994	1*
Sheafman Creek	T7N,R21W,S30	21	1991	3

Skalkaho Creek	T5N,R18W,S19	15	1991	1*
	T5N,R19W,S27	10	1994	1*
Slate Creek	T2S,R22W,S1	13	1991	1*
	T2S,R22W,S1	11	1994	1*
Sleeping Child Ck.	T4N,R19W,S2			
	T4N,R19W,S28	42	1985, 1989	1
So. Fk. Lost Horse	T4N,R22W,S14	12	1994	2
Sweathouse Creek	T8N,R21W,S19	12	1991	3
Threemile Creek	T10N,R18W,S18	10	1994	1*
Tincup Creek	T3N,R21W,S17	50	1982	2
	T3N,R22W,S32	10	1992	2,3
Trapper Creek	T2N,R21W,S21	13	1992	2
Warm Springs Creek	T1N,R20W,S14	5	1990	2
	T1N,R20W,S27	11	1994	1*
West Fk. Bitt.	T3S,R22W,S9	3	1992	1*
	T3S,R22W,S9	13	1991	1*
	T2S,R22W,S27	16	1994	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 certainty

Bitterroot River

Fish populations have been monitored extensively at 3 sites in the Bitterroot River since 1989, Bell Crossing, Stevensville and Darby (Figure 65). The following discussion focuses on rainbow trout and not brown trout because population estimates are collected in September, at which time brown trout appear to be migrating. Since this migration causes inaccuracies in the estimates, I will not use them for analysis.

Bell Crossing and Stevensville

Recent fishing regulation changes include catch and release for cutthroat trout in 1990 and for all trout between Tucker Crossing and Florence in 1992. The 1992 change was enacted to attempt to take harvest pressure off of the low populations of trout in the Bell Crossing area. The Stevensville section has been under a restrictive regulation since 1982 and has some comparative value with the Bell Crossing section.

Rainbow trout populations in these two sections have followed similar trends since sampling began in 1989 (Figure 66). Rainbow trout over 14 inches increased between 1991 and 1993 at Bell Crossing and then levelled out in 1994. At Stevensville they increased between 1991 and 1993 and declined in 1994. If fishing regulations have benefitted rainbow trout in the Bell Crossing section, I would expect to see the population trend improve over

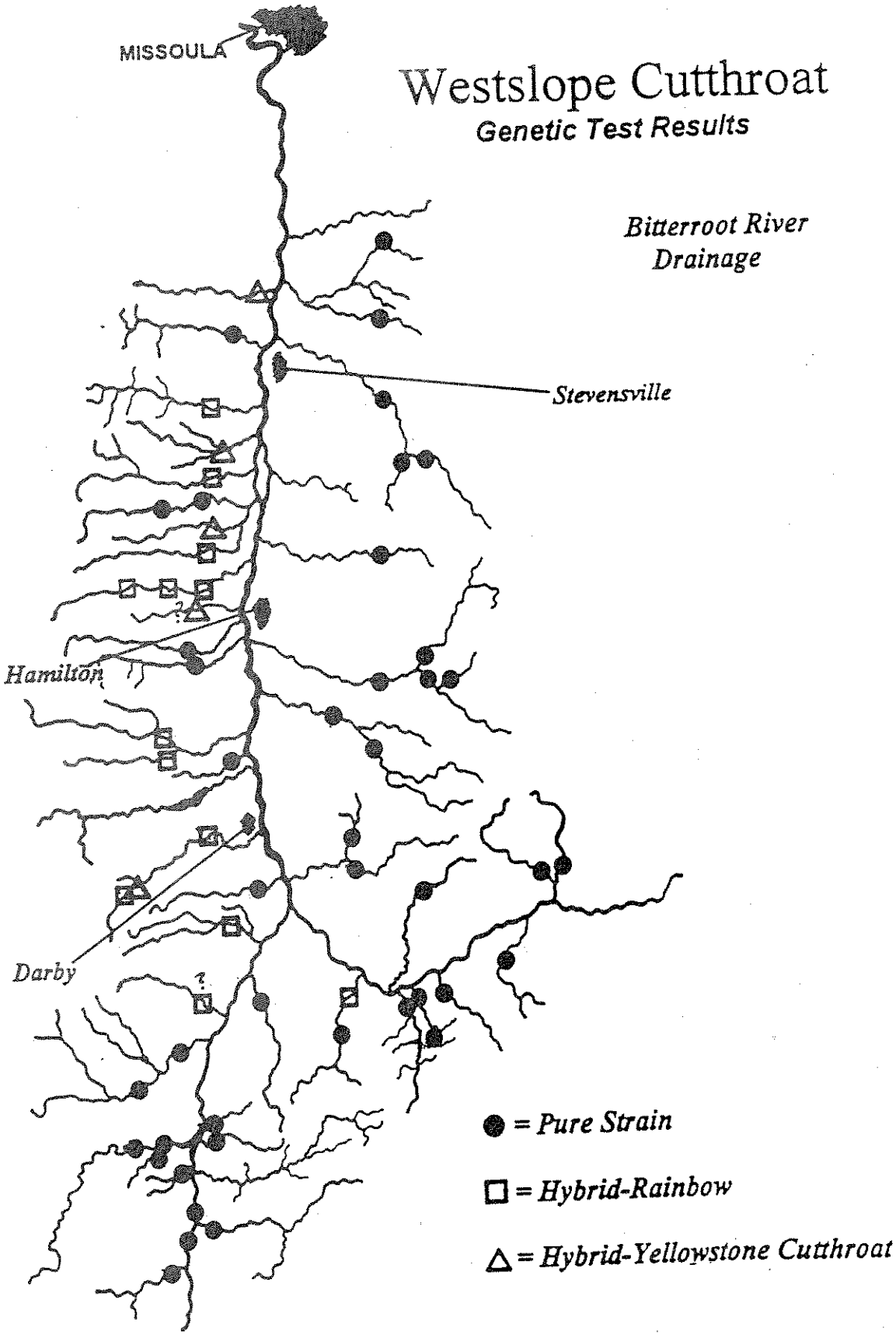


FIGURE 64. Location and result of electrophoretic testing of westslope cutthroat in the Bitterroot drainage.

mountain lakes, which are common in the Bitterroot Range, was probably a major cause for the loss of pure westslope cutthroat populations at higher elevations in the Bitterroot drainage.

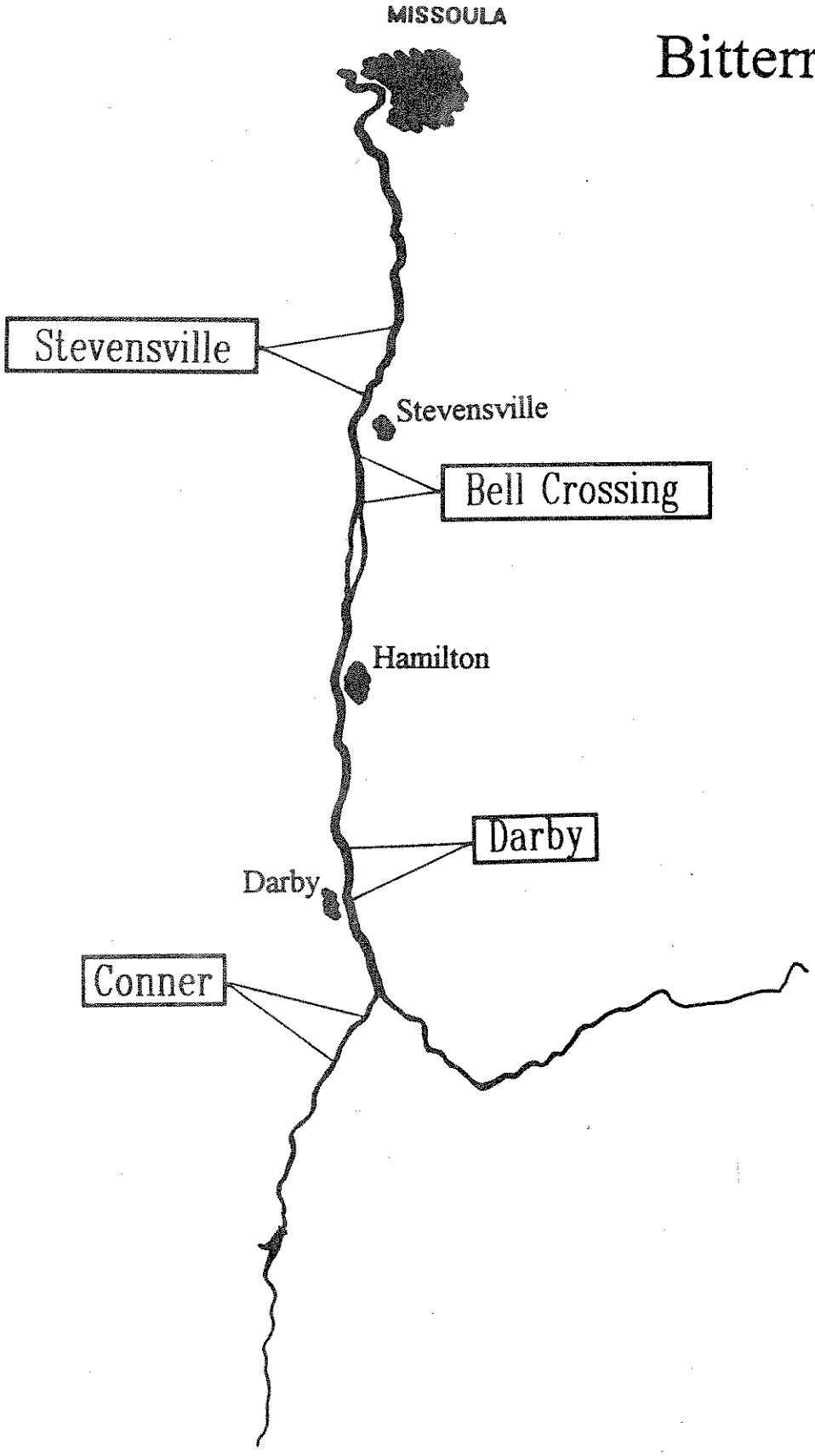
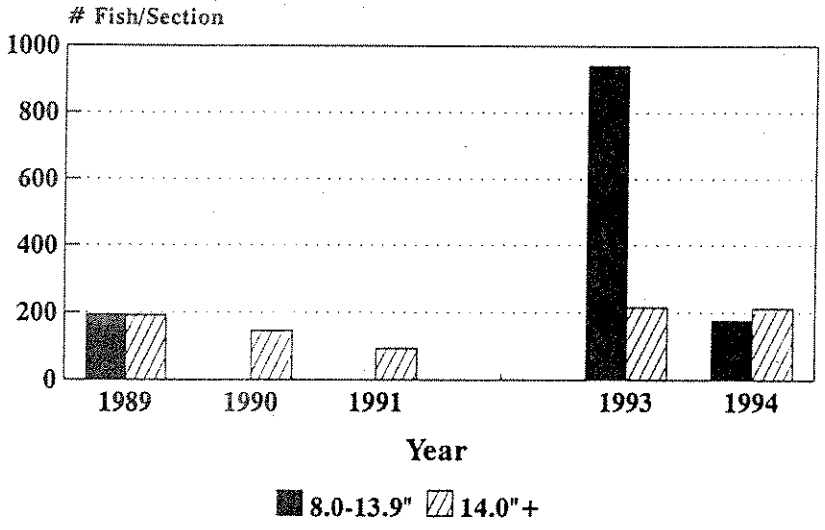


FIGURE 65. Location of long term fish monitoring reaches on the mainstem and West Fork of the Bitterroot River.

BITTERROOT RIVER
Bell Crossing Section (3.6 Miles)
Rainbow Trout



BITTERROOT RIVER
Stevensville Section (4.1 Miles)
Rainbow Trout

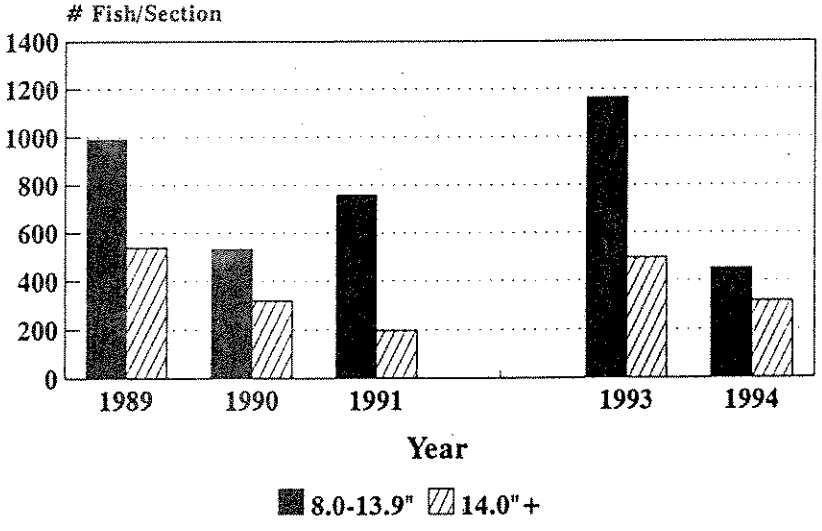


FIGURE 66. Population estimate trends for rainbow trout in the Bell Crossing and Stevensville study sections.

the Stevensville section.

At least one more year of data will have to be collected to reach a better conclusion about the effects of the regulations. At this time, the data are inconclusive.

Darby and Conner

In the Darby section, there is a long period of record for the fish populations. Large rainbow trout (over 10 inches) have decreased since 1990 even though the regulations have been very restrictive (Figure 67). The restrictive regulations do not appear to have resulted in increased numbers of large rainbow trout, however, they may have prevented further declines. To learn this, it would be necessary to compare population counts between this section and the Hannon Memorial section immediately upstream.

Westslope cutthroat trout have increased in number in the Darby section during this time period. Previous to 1990, no valid estimates were collected. During 1990 and 1995 the population of westslope cutthroat longer than 10 inches was 133 and 239, respectively.

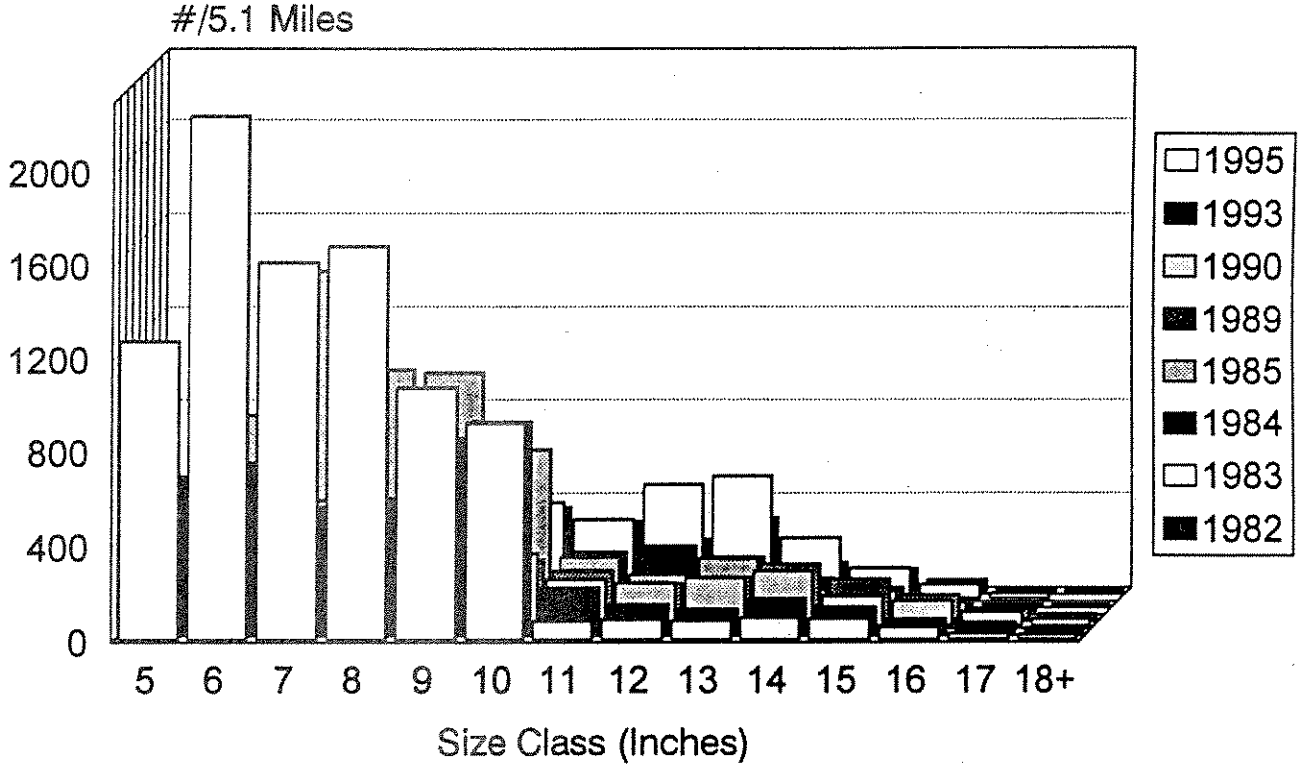
In the Conner section only two years of data have been collected and they are 9 years apart. This makes any conclusions tenuous, but the population estimate of rainbow trout in 1995 was lower than in 1986 for all size groups (Figure 68).

A valid population estimate for westslope cutthroat was not collected in 1986, so a comparison to 1995 is not possible. However, westslope cutthroat were a higher proportion of the catch in 1995 than in 1986 while the other species weres similar between the years. In 1995, a much higher proportion of 13-16" cutthroat were captured than in 1986 (Figure 69).

Overall, in the Bitterroot River south of Hamilton, westslope cutthroat trout have probably increased in number and average size since the change to a catch and release fishery. The restrictive regulation on rainbow trout does not appear to be having a significant positive effect on the population, since the population has actually been decreasing in the past few years.

BITTERROOT RIVER 72.0

Darby



RAINBOW TROUT

FIGURE 67. Population estimate trends by size group in the Darby study section.

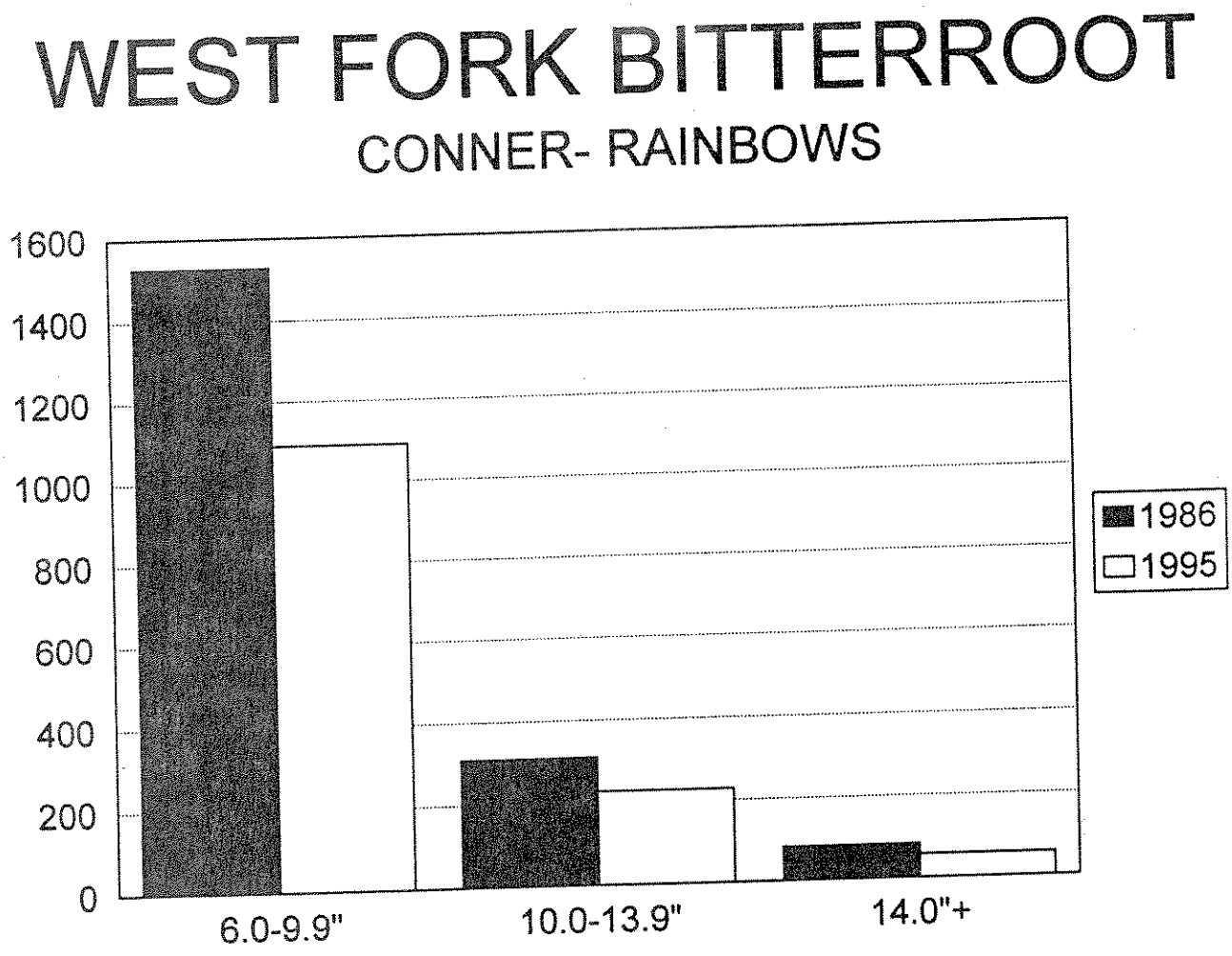
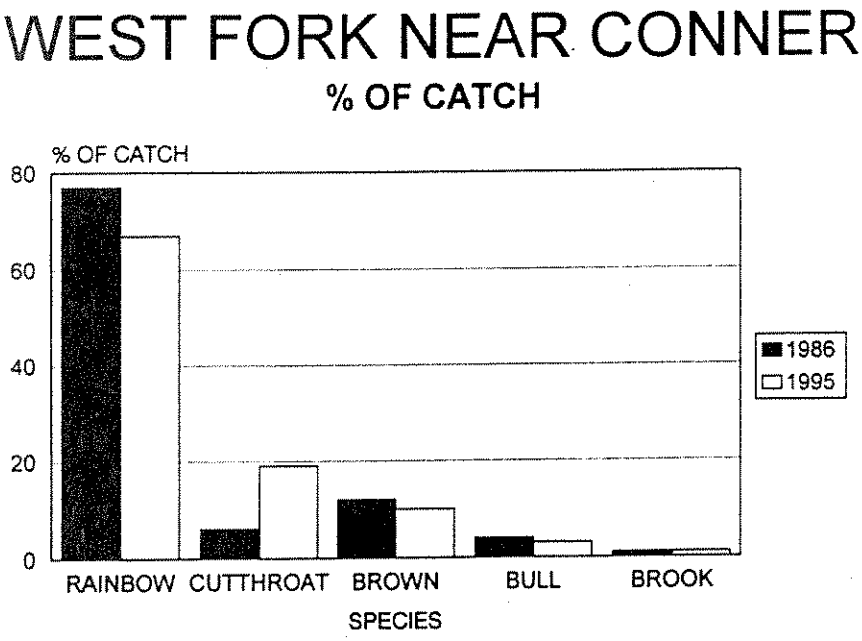


FIGURE 68. Population estimates of rainbow trout in the Conner section of the West Fork Bitterroot River during 1986 and 1995.



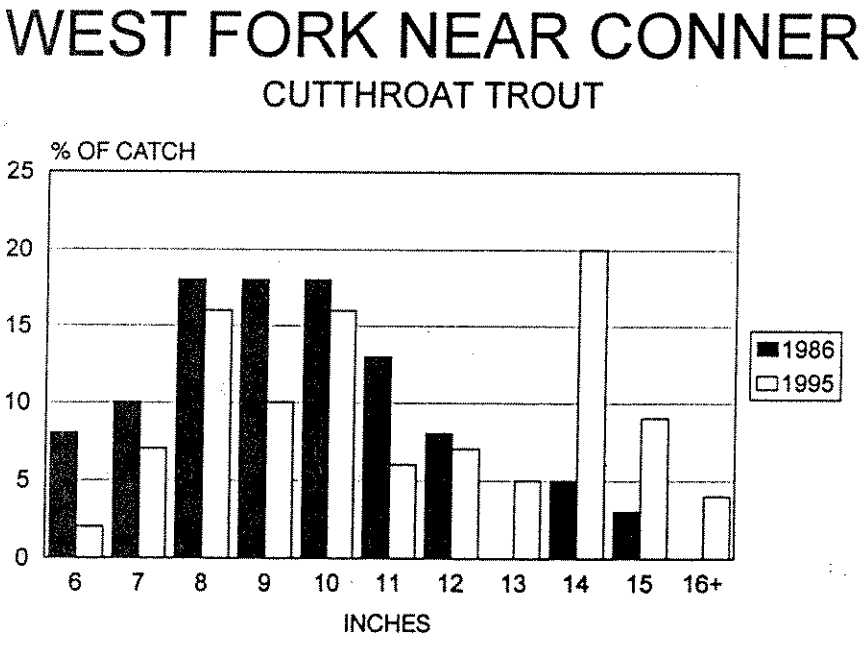


FIGURE 69. Percent of catch of various species and percent of catch by size group for westslope cutthroat during 1986 and 1995 on the Conner section of the West Fork Bitterroot River.

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Date: August 1996

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