East Boulder River
Fisheries Monitoring, 2001

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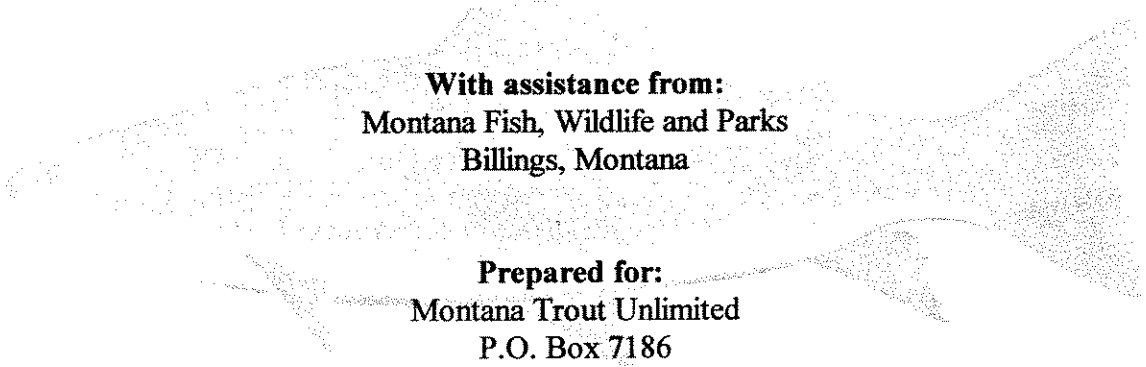

With assistance from:
Montana Fish, Wildlife and Parks
Billings, Montana

Prepared for:
Montana Trout Unlimited
P.O. Box 7186
Missoula, Montana 59807

For compliance with:
Good Neighbor Agreement

Between:
Northern Plains Resource Council
Cottonwood Resource Council
Stillwater Protective Association
Stillwater Mining Company

December 2001

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Executive Summary

The Stillwater Mining Company (SMC) is constructing a platinum/palladium mine in the East Boulder River drainage in the Gallatin National Forest, Montana. In May 2000, Stillwater Mining Company signed a Good Neighbor Agreement with Northern Plains Resource Council (NPRC), Cottonwood Resource Council, and the Stillwater Protective Association. The Agreement is a contract between NPRC and SMC that provides for specified activities to protect natural resources and involve citizens in decision-making regarding SMC's activities. Among other activities, the Agreement provides funding for a Fisheries Study and Monitoring Plan for the Boulder River drainage.

A Fisheries Evaluation and Monitoring Plan was developed in April 2001 that will guide research and monitoring activities during the first five years of implementation of the Good Neighbor Agreement. Included in this plan was a detailed work plan that specified the research to be done in the first year. This report is a summary of the results of the first year of fisheries monitoring efforts under the Good Neighbor Agreement.

The objectives of the study were to: 1) determine the best methods for sampling fish in this drainage, 2) determine the abundance and distribution of fish in the drainage, and 3) determine ages and growth rates of brown and rainbow trout, 4) compare results to past fish population estimates, and 5) prepare a written report with the findings of the project.

In September 2001 field activities were completed in the East Boulder River drainage. A total of five sites were sampled. All sites were sampled using electrofishing equipment. Fish population estimated were calculated at all sites using the two-pass methodology.

Results indicate that fish populations are similar to, or higher than, they have been during previous sampling. Species composition is the same as has been found in the past except at site B-6, where brook trout were found for the first time. Sites B-5 and B-6 have the highest densities of game fish of the five sites sampled. Elk Creek has the lowest density of game fish of the five sites sampled.

Sampling will be repeated at two year intervals to monitor potential impacts of the East Boulder Mine on fish populations in the East Boulder River.

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1. Introduction

The Stillwater Mining Company (SMC) is constructing a platinum/palladium mine in the East Boulder River drainage in the Gallatin National Forest, Montana. In May 2000, Stillwater Mining Company signed a Good Neighbor Agreement with Northern Plains Resource Council (NPRC), Cottonwood Resource Council, and the Stillwater Protective Association. The Agreement is a contract between NPRC and SMC that provides for specified activities to protect natural resources and involve citizens in decision-making regarding SMC's activities. Among other activities, the Agreement provides funding for a Fisheries Study and Monitoring Plan for the Boulder River drainage.

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2. Methods and Study Site Descriptions

Estimates of fish abundance were made at five sites within the drainage; Elk Creek, B-4, B-5, B-6 and B-11 (Placer Basin) (Figures 2-1 and 2-2). Electrofishing sample sites were selected in coordination with Montana Fish, Wildlife and Parks (FWP) and were located to correspond to past sample sites. Personnel involved in data collection were FWP staff (Scott Barndt, David Hergenrider, and Travis Lorenz); Trout Unlimited staff (Bruce Farling and Bruce Rehwinkel), as well as Ginger Gillin (Apex Aquatics), Carol Endicott (Confluence Consulting), Sarah Zuzulock (Center for Science in Public Participation) and Scott Bosse (Greater Yellowstone Coalition).

2.1 Site B-4

Site B-4 is on the East Boulder River at the confluence of Elk Creek (T3S R13 E section10). The site was 700' in length and was sampled on September 19, 2001. Water temperature was 58°F. The upstream end of the site was just upstream of the confluence with Elk Creek, the downstream end was a site at the fence just downstream of Elk Creek. This site is in the same location as was sampled by FWP in the past.

Sampling was done by electrofishing with the use of a "crawdad" boat set up with a Coffelt electrofishing unit and generator. The two-pass method of population estimation was used. In this method, two thorough electrofishing passes are made, starting at the upstream end of the site. Fish collected during the first pass are held until the second pass is complete. Fish were anesthetized and all trout were weighed and measured. Fish were returned to the stream after sampling was completed.

2.2 Site B-5

Site B-5 is on the East Boulder River at the U.S. Forest Service campground (T3S R13E section 32). The site was 1000' in length and was sampled on September 18, 2001. Water temperature was 46°F. The upstream end of the site is at the campground. The downstream end of the site is at the end of the concrete retaining wall adjacent to the East Boulder Road. This site is in the same location as was sampled by FWP in the past.

This site was sampled by Beak (1982). They found the site had an average elevation of 5,779'; a gradient of 2% and an average width of 39'.

The same sampling method used at site B-4 was used at this site. However, additional data collected included scale samples from a sample of ten trout from every 0.5" length group.

2.3 Site B-6

Site B-6 is on the East Boulder River just downstream of the confluence with Dry Fork Creek. The site is 500' in length and was sampled on September 18, 2001. Water temperature was 52°F. The upstream end of the site is at the bridge just downstream of the entrance to the East Boulder Mine at T4S R13E section 2. The downstream end of the site is 500' downstream of the bridge. This site is a short distance downstream of the previous Site B-6. The decision was made to move the site because of a proposal by Stillwater Mining Co. to discharge groundwater from the mine into the East Boulder River. If approved, groundwater would be discharged just upstream of the bridge. Therefore, this site is well situated to detect any fisheries impacts from this potential discharge.

This site was sampled by Beak (1982). They found the site had an average elevation of 6,199'; a gradient of 3%, and an average width of 32.5'.

The same sampling method used at site B-4 was used at this site.

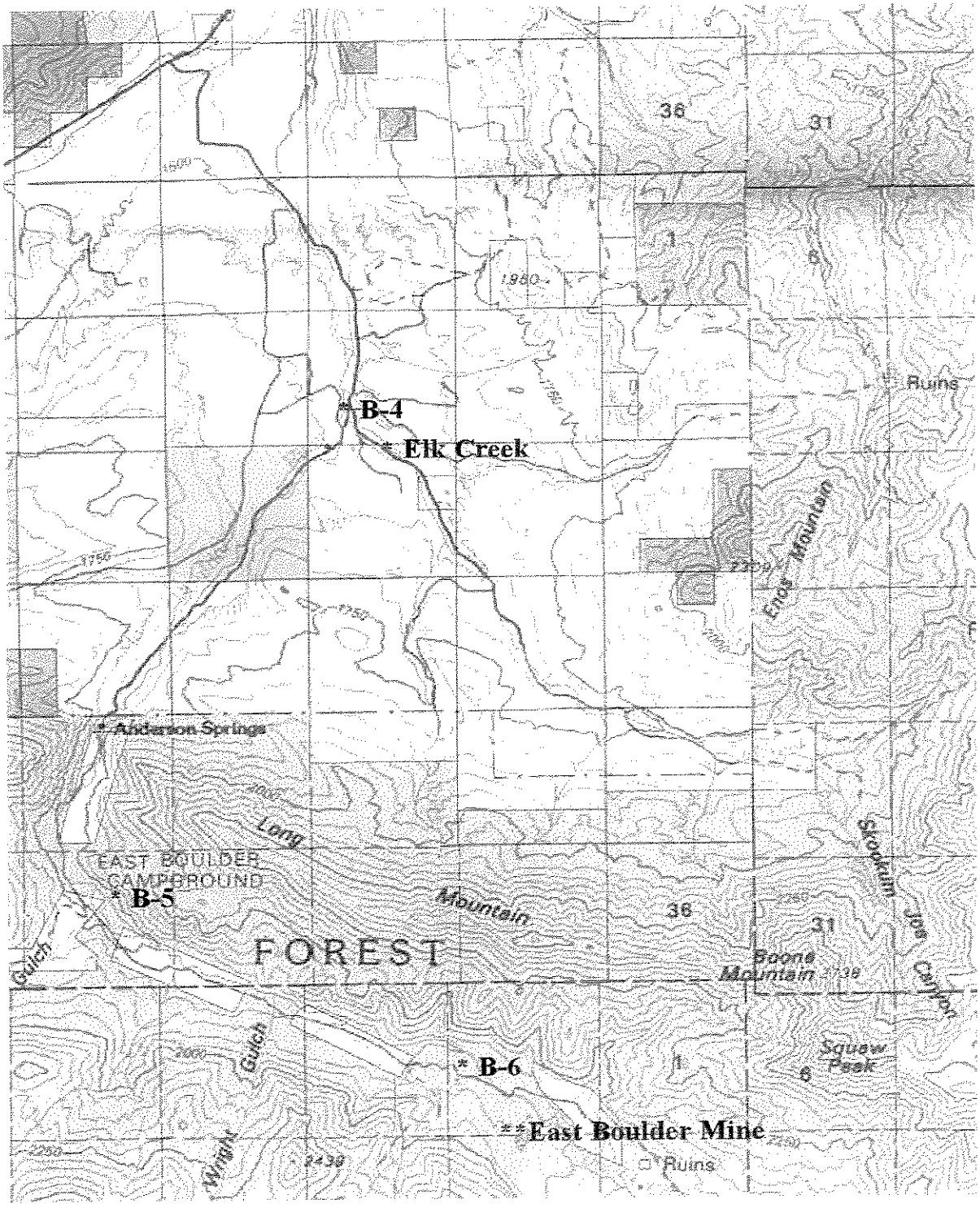

Figure 2-1. Map of study area showing Sites B-4, B-5, B-6, and Elk Creek. Source: 1:100,000 scale topographic map, BLM Edition, Livingston, Montana.

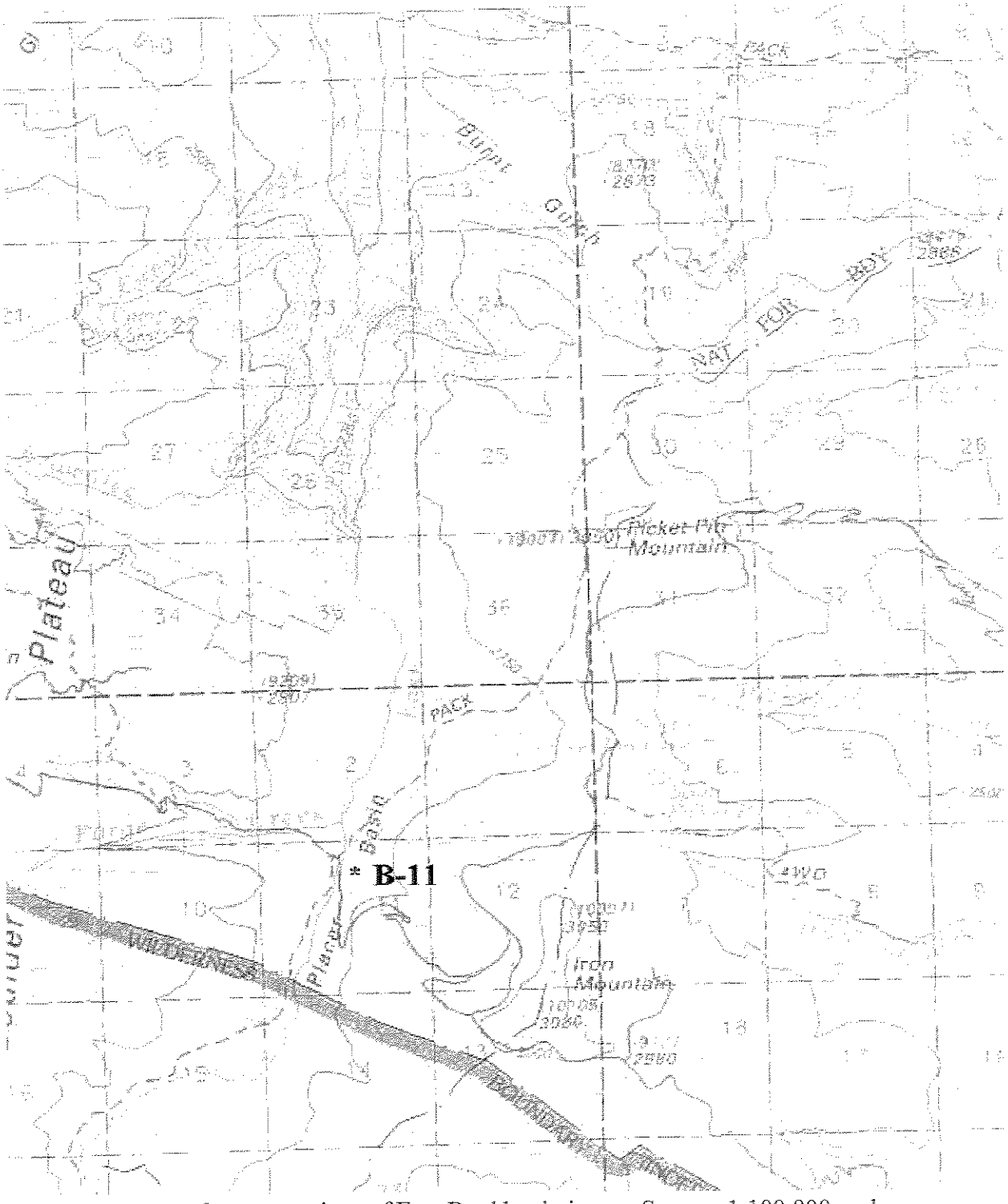

Figure 2-2. Map of upper portions of East Boulder drainage. Source: 1:100,000 scale topographic map, BLM Edition, Gardiner, Montana.

2.4 Site B-11

Site B-11 is site on the East Boulder River in the Placer Basin, upstream of the East Boulder mine. This site is about 1500' above the confluence with Forge Creek in T5S R13E section11, approximately 1 mile downstream of the Absaroka Beartooth Wilderness. Note that this is upstream of the site labeled B-11 during the 1981 - 1982 fisheries study. This site is site above natural waterfalls that are a fish passage barrier. The site is 1000' in length and was sampled on September 5, 2001. Water temperature was 59°F. The downstream end of the site was site just upstream of the road crossing and the upstream end was site 1000' upstream. This site has been sampled qualitatively by FWP in the past. However this was the first quantitative fish sampling that has been conducted at this location. Approximately 60 fish were taken from this site for fish disease studies. Results of disease studies will be reported by FWP at a later time.

The same sampling method used at site B-3 was used at this site, except that a Coffelt backpack electrofishing unit was used instead of a "crawdad" boat set up. Electrofishing began at the downstream end of the section and moved upstream. Scale samples were collected from a sample of 10 trout from every 0.5" length group.

2.5 Elk Creek

The Elk Creek site is just upstream of the East Boulder Road bridge at T3S R13 E section 10. The site is 350' in length and was sampled on September 19, 2001. The downstream end of the site is just upstream of the bridge and the upstream end of the site is site at the fence crossing 350' upstream. Water temperature was 57°F at 1440 hours. Although other qualitative samples of Elk Creek have been taken in the past, this was the first quantitative sample.

This site was sampled by Beak (1982). They found the site had an average elevation of 5,199'; a gradient of 6%, and an average width of 9.8'.

The same sampling method used at site B-11 was used at this site. Scale samples were collected from all of the trout.

2.6 Data analysis

Fish population estimates were calculated using standard fisheries methods and equations. An estimated population size (by species and size group) with confidence intervals was calculated at each site. Specifically, population estimates were calculated using the equation:

$$\hat{N} = \frac{(n_1)^2}{n_1 - n_2}$$

$$\text{Standard deviation (s.d.)} = \frac{(n_1\, n_2)(\text{SQRT}(n_1 + n_2))}{(n_1 - n_2)^2}$$

$$95\%\ \text{confidence interval} = \hat{N} \pm (1.96)(\text{s.d.})$$

Where n_1 = the number of fish caught in the first pass, n_2 = the number of fish caught in the second pass and SQRT = square root.

However, when the population estimate minus the confidence interval was less than the total number of fish collected, the lower boundary of the confidence interval was assumed to be the total number of fish collected ($n_1 + n_2$). The range for the confidence interval was rounded to the nearest whole number, to reflect the reality that there are no 'partial' fish.

In some cases, it was not possible to calculate a valid population estimate for the smaller size classes of fish because there was not sufficient depletion between the first and second passes. In these situations, there was only a minimum estimate of the number of fish present, based on the total number of fish

collected. Fish population estimates were calculated by species and size class (< 4", ≥ 4" < 8", and ≥ 8"). Total fish population estimates for the site were calculated by adding together the population estimates for each size class.

In addition, average and range of length and weight of fish collected was calculated by species at each site. Relative weight was calculated as (Anderson and Neumann, 1996):

$$W_r = (W/W_s) \text{ X } 100$$

Where W is the weight of the individual and W_s is a length-specific standard weight predicted by a length-weight regression constructed to represent the species. The formulas used for each species (brook, brown, rainbow, and cutthroat trout) described in Table 2-1. The formula takes the form of (Anderson and Neumann, 1996):

$$\log_{10} W_s = a + b(\log_{10} (L))$$

Table 2-1. Parameters for standard weight equations and minimum total lengths applied.

Species	Intercept (a)	Slope (b)	Minimum length	Source
Brook trout	-3.467	3.043	5.4"	Whelan and Taylor (1984)
Brown trout	-3.366	2.96	5.6"	Milewski and Brown (1994)
Cutthroat trout	-3.492	3.099	5.4"	Kruse and Hubert cited in Anderson and Neumann (1996)
Rainbow trout	-3.432	3.024	4.7"	Simpkins and Hubert cited in Anderson and Neumann (1996)

When W_r values are well below 100 for and individual or size group, problems may exist in food or feeding conditions. When W_r values are well above 100, fish may not be making best use of surplus prey (Anderson and Neumann, 1996). Since weight measurements are difficult to gather accurately under field conditions, particularly for small fish, the statistic is only applied to larger fish. It is of most use as a comparison between other sites or within sites over time.

Length-frequency histograms were prepared for each species of trout at each site.

In order to more fully explore the implications of the data, the raw data from 1989 was entered into spreadsheets and analyzed in the same method as the 2001 data. This information was available for Sites B-4, B-6, and B-11. This year (1989) was selected because it was the most recent year that had available data.

Trout length at age shall be calculated, to the degree possible, from the scale samples at Sites B-4, B-5, B-11, and Elk Creek after FWP completes scale mounting and reading. This information will be included in an addendum to this report at a later date.

3. Results

3.1 Site B-4

3.1.1 Summary of September 2001 sampling

Three species of fish were found at site B-4, rainbow trout (*Oncorhynchus mykiss)*, brown trout (*Salmo trutta*) and mottled sculpin (*Cottus bairdi*). Population estimates of the two trout species are displayed in Table 3-1. Of the game fish, rainbow trout were 45% of the fish collected and brown trout were 55%.

Table 3-1. Summary of trout population statistics, Site B-4, September 2001

	# 1st pass	# 2nd pass	Total caught	Pop. Estimate (per 700')	standard deviation	95% confidence interval (range)	# per 1000' (95% C.I.)
Rainbow ≥ 8"	11	1	12	12.1	0.4	± 0.7 (12 - 13)	17 (17-19)
Rainbow ≥ 4" < 8"	47	6	53	53.9	1.2	± 2.4 (53 - 56)	77 (76-80)
Rainbow < 4"	24	26	50	50*	N.A.	(50 - ?)	71* (71-?)
Brown ≥ 8"	23	4	27	27.8	1.3	± 2.6 (27 - 30)	40 (39-43)
Brown ≥ 4" < 8"	46	12	58	62.2	3.6	± 7.1 (58 - 69)	89 (83-98)
Brown < 4"	36	18	54	72	14.7	± 28.8 (54 - 101)	103 (77 -144)
TOTAL	187	67	254	278*		(254 -319+)	397* (363-456+)

* There was insufficient depletion between passes to calculate a population estimate for the rainbow trout ≤ 4". Therefore the number of fish caught is assumed to be the minimum number of fish present.

The average length of rainbow trout in this site was 4.6" (range from 1.8" to 12.1") and the average weight was 0.08 lbs. The average length of brown trout in this site was 5.8" (range from 1.7" to 14.4") and the average weight was 0.15 lbs (Table 3-2). This is the smallest average size for rainbow trout of any of the sites sampled. The only site that had a smaller average size for brown trout was Elk Creek. However, there were trout of catchable (≥ 8") size present in this section.

Both rainbow trout and brown trout had a wide range of sizes present in the section. The presence of fish 2"- 3" and less indicates that reproduction is taking place in the section or in nearby portions of the river.

For both species, fish 2" or less were almost certainly young-of-the-year (YOY), hatched from eggs this season. Fish of this size are not strong swimmers and are highly vulnerable to predation. For these reasons they generally do not migrate long distances, unless they are moving downstream with the current. Therefore, they probably emerged from redds that were located within this section or in areas upstream.

Table 3-2. Comparison of lengths and weights of game fish between sections

	B-4	B-5	B-6	B-11	Elk Ck
Ave. length RB (inches) (range)	4.6 (1.8 -12.1)	5.5 (1.5 - 12.9)	5.8 (1.7 -9.7)	N.A	5.4 (4.3 - 6.4)
Ave. weight RB (lbs) (range)	.08 (.01-.65)	.10 (.01 - .08)	.09 (.01 - .29)	N.A.	.07 (.03 - .10)
Ave. relative weight RB	97.7	104.5	93.2	N.A.	105.8
Ave. length LL (inches) (range)	5.8 (1.7-14.4)	7.2 (2.0 - 17.1)	6.5 (2.1 - 15.4)	N.A	5.2 (2.6 - 8.8)
Ave. weight LL (lbs) (range)	0.15 (.01-1.02)	.22 (.01 - 2.0)	.14 (.01 - 1.26)	N.A.	.08 (.01 - .26)
Ave. relative weight LL	102.6	100.2	84.7	N.A.	105.0
Ave. length EB (inches) (range)	N.A	6.0 (4.4 - 8.5)	6.0 (3.9 - 8.7)	N.A	N.A
Ave. relative weight EB	N.A.	115.8	100.4	N.A.	N.A.
Ave. weight EB (lbs) (range)	N.A.	.11 (.03 - .25)	.10 (.03 - .22)	N.A.	N.A.
Ave. length YCT (inches) (range)	N.A	9.4 (9.4 - 9.4)	8.6 (8.6 - 8.6)	5.1 (1.7 -8.7)	N.A
Ave. weight YCT (lbs) (range)	N.A.	.30 (.30 - .30)	.22 (.22 - .22)	.08 (.01 - .22)	N.A.
Ave. relative weight YCT	N.A.	N.A.	N.A.	117.7	N.A.

RB = rainbow trout, LL = brown trout, EB = brook trout, YCT = Yellowstone cutthroat trout. N.A. = Not applicable, species not found at this site.

As can be seen in Figure 3-1, the rainbow 2" size class was the most abundant in this section. As described

above, these fish are YOY. Ages of the rest of the fish will be determined from scale samples at a later date.

Brown trout spawn in the fall so their young emerge earlier in the year than rainbow trout young. As can be seen in Figure 3-2, brown trout YOY were generally 2-3" in length, larger than rainbow YOY. Brown trout had a larger average size and a greater number of fish larger than 8" than rainbow trout. Since brown trout are fall spawners, there was some concern during study planning that brown trout numbers might be inflated as a result of spawning migrations into the study site. There were brown trout present in the study site that were large enough to be sexually mature, but no ripe brown trout were found in any of our study sites. The length frequency histogram does not indicate an influx of larger fish. It appears that our sampling took place early enough in the fall (mid-September) that we were primarily sampling fish that were resident at that site.

3.1.2 Comparison to previous years sampling

Population estimates of brown and rainbow trout over 3" were calculated for this site to allow for direct comparison to previous year's data. Numbers of both brown and rainbow trout were higher in September 2001 than in previous sampling (Figure 3-3). Rainbow trout were a higher percentage of the game fish population in 2001 than in any previous sampling.

As shown in Table 3-3, the number of trout over 8" was approximately the same in both 1989 and 2001. The higher population estimate in 2001 is a result of a larger number of rainbow trout in the 4" - 8" length group. In addition, the 1989 sampling was not successful in capturing trout less than 4". In 2001 we collected a large number of both brown and rainbow trout in the smallest size group, although it was not possible to calculate a population estimate for the rainbow trout < 4" group.

Table 3-3 . Comparison of population estimates, by length group, from 1989 and 2001 at B-4. Source: FWP file data.

	2001 # per 1000' (95% C.I.)	1989 # per 1000' (95% C.I.)
Rainbow ≥ 8"	17 (17-19)	16 (15 - 20)
Rainbow ≥ 4" < 8"	77 (76-80)	24 (23 - 28)
Rainbow < 4"	71* (71-?)	N.A.
Brown ≥ 8"	40 (39-43)	56 (54 - 61)
Brown ≥ 4" < 8"	89 (83-98)	74 (56 - 109)
Brown < 4"	103 (77 -144)	N.A.
TOTAL	397* (363-456+)	170 (148 - 218)

* There was insufficient depletion between passes to calculate a population estimate for the rainbow trout ≤ 4". Therefore the number of fish caught is assumed to be the minimum number of fish present. N.A. = No data available. Fish smaller than 4" were present in the section, but only one brown trout and no rainbow trout in this size group was collected.

During the 1981-1982 fish sampling, rainbow trout were found to average 7.3" in length (Wiedenheft, 1982). In 1989, rainbow trout averaged 7.6" in length. This compares to an average rainbow trout length of 4.6" in 2001. The smaller average length in 2001 is probably due to greater effectiveness in capturing small fish in 2001 (Figure 3-1). Evidence for this is the field notes from 1989 that state, "small yearling rainbows 2.5" - 3.5" are common". Yet the smallest rainbow collected during the 1989 sampling was 5".

No rainbow trout over 12" were found in 1981 - 1982 or in 1989 in spite of the fact that the 1982 sampling was conducted during the spring when spawning rainbows were believed to be present at the site (Wiedenheft, 1982). One rainbow over 12" was found in this site in 2001.

In 1981 -1982, brown trout averaged 7.1" - 7.8" in length. In 1989, brown trout averaged 8.2" in length. Brown trout averaged 5.8" in 2001. Fish over 12" in length made up 28% of the population in fall 1981, 13% of the population in August 1989, but only 1% of the population in spring 1982 (Wiedenheft, 1982). Brown trout over 12" in length made up 6% of the population in 2001. This size distribution indicates that larger brown trout may have moved into this section in the fall of 1981 for spawning. The 2001 sampling was conducted early in the fall, perhaps before brown trout had started spawning migrations.

However, the 1989 sampling was conducted at very near the same time of year as the 2001 sampling, and

yet the average length of brown trout was much larger in 1989, and the percentage of fish of 12" was also larger in 1989 (Figure 3-2). It may be that we were more effective in capturing small (< 3") brown trout in 2001 than in 1989. The higher proportion of large fish in 1989 may have been due to earlier migrations, perhaps as a result of weather conditions.

3.2 Site B-5

3.2.1 Summary of September 2001 sampling

Five species of fish were collected at Site B-5, rainbow and brown trout, brook trout (*Salvelinus fontinalis*), Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), and mottled sculpin. Population estimates were attempted for rainbow, brown, and brook trout. Only one Yellowstone cutthroat trout was collected so no population estimate was possible. Rainbow trout composed 71% of the sample, brown trout were 24%, brook trout were 4%, and Yellowstone cutthroat trout were < 1%.

Site B-5 had the largest average size brown trout of any of the sites sampled at 7.2" (Table 3-2). It also had the largest brown trout overall, 17.1". It had the second largest average size for rainbow trout (5.5"). Site B-6 had a larger average size for rainbow trout. However, the largest rainbow trout overall was found at this site, 12.9" (Table 3-2).

Table 3-4. Summary of trout population statistics, Site B-5, September 2001

	# 1st pass	# 2nd pass	Total caught	Pop. Estimate (#/1000')	standard deviation	95% confidence interval (range)
Rainbow ≥ 8"	29	5	34	35.0	1.5	±2.9 (34 - 38)
Rainbow ≥ 4" < 8"	136	73	209	294	36.1	± 70.9 (223 - 364)
Rainbow < 4"	28	52	80	80*	N.A.	(80 - ?)
Brown ≥ 8"	34	9	43	46	3.2	± 6.3 (43 - 52)
Brown ≥ 4" < 8"	32	24	56	128	89.8	± 176 (56 -304)
Brown < 4"	6	6	12	12*	N.A.	(12 - ?)

	# 1st pass	# 2nd pass	Total caught	Pop. Estimate (#/1000')	standard deviation	95% confidence interval (range)
Brook ≥ 8"	1	2	3	3*	N.A.	(3-?)
Brook ≥ 4" < 8"	8	9	17	17*	N.A.	(17-?)
Brook < 4"	0	0	0	0*	N.A.	(0-?)
TOTAL	274	180	454	615*		(468 - 870*)

* There was insufficient depletion between passes to calculate a population estimate for several size groups. Therefore the number of fish caught is assumed to be the minimum number of fish present.

Both rainbow trout and brown trout had a wide range of sizes present in the section. The presence of fish 2"- 3" and less indicates that reproduction is taking place in the section or in nearby portions of the river. For both species, fish 2" or less were almost certainly YOY.

For rainbow trout, the number of 2" fish was much smaller than at Site B-4, downstream (Figure 3-4). It is possible that rainbow trout grow faster at Site B-5 than in Site B-4 and that the 3" fish collected were YOY. Or there may simply be less fry habitat in Site B-5 or less spawning taking place in or near Site B-5. Scale samples, when they are processed, will allow estimation of length at age.

Although the largest brown trout was about 4.5" larger than the largest rainbow, there was only one fish collected that was this large (Figure 3-5). For the most part, the range of sizes of brown trout were not much different than rainbow trout. However, there were more brown trout in the 8 - 10" size class, resulting in a larger average size.

Brook trout were present in the site at a limited range of sizes (Figure 3-6). The absence of any small fish may indicate a lack of YOY brook trout in the site. Two of the brook trout collected were ripe males (6.6" and 7.2"), indicating that brook trout were entering their spawning season at the time of sampling.

3.2.2 Comparison to previous years sampling

Population estimates of brown and rainbow trout over 3" were calculated for this site to allow for direct comparison to previous year's data. Numbers of both brown and rainbow trout have fluctuated wildly in previous sampling, particularly in the spring and fall of 1982 (Figure 3-7). The numbers of trout in Site B-5 in September 2001 appear to be comparable to previous year's estimates, with the exception of the 1982 samples.

3.3 Site B-6

3.3.1 Summary of September 2001 sampling

Four species of fish were collected at Site B-6, rainbow, brook, Yellowstone cutthroat, and brown trout, and longnose dace (*Rhinichthys cataractae*). Population estimates were attempted for rainbow, brown, and brook trout. Only one Yellowstone cutthroat trout was collected so no population estimate was possible. Rainbow trout composed 75% of the sample; brown trout were 21%, brook trout were 4% and Yellowstone cutthroat trout were < 1% (Table 3-4).

Site B-6 had the second largest average size brown trout of any of the sites sampled at 6.5" (Table 3-2). It also had the second largest brown trout overall, 15.4". It had the largest average size for rainbow trout (5.8"). However, the largest rainbow trout was found at this site was a relatively small 9.7" (Table 3-2).

Table 3-5. Summary of trout population statistics, Site B-6, September 2001

	# 1st pass	# 2nd pass	Total caught	Pop. Estimate (per 500')	standard deviation	95% confidence interval (range)	# per 1000' (95% C.I.)
Rainbow ≥ 8"	17	2	19	19.3	.6	± 1.3 (19 - 21)	38 (38 - 42)
Rainbow ≥ 4" < 8"	89	31	120	136.6	8.9	± 17.6(120 - 154)	273 (240 - 308)
Rainbow < 4"	30	16	46	64	16.6	± 32.5 (46 - 96)	128 (92 - 192)
Brown ≥ 8"	9	3	12	13.5	2.6	± 5.1 (12 -19)	27 (24 - 38)
Brown ≥ 4" < 8"	21	12	33	49	17.9	± 35 (33 - 84)	98 (66 - 168)
Brown < 4"	3	3	6	6*	N.A.	(6*-?)	(12*-?)

	# 1st pass	# 2nd pass	Total caught	Pop. Estimate (per 500')	standard deviation	95% confidence interval (range)	# per 1000' (95% C.I.)
Brook ≥ 8"	1	0	1	1	0	± 0 (1-1)	2 (2-2)
Brook ≥ 4" < 8"	8	0	8	8	0	±0 (8-8)	16 (16-16)
Brook < 4"	2	0	2	2	0	±0 (2-2)	4 (4-4)
TOTAL	180	67	247	299.3*			598 (494 - 782)

* There was insufficient depletion between passes to calculate a population estimate for brown trout ≤ 4". Therefore the number of fish caught is assumed to be the minimum number of fish present.

A range of sizes of rainbow and brown trout in the site indicate that reproduction is taking place in the section, or nearby (Figure 3-8).

Although the rainbow population estimate for trout ≥ 8" is higher than the brown trout population estimate for this size group (Table 3-4), there were no rainbow trout present in the 10" - 15" size group. There were brown trout in the site that large (Figure 3-9).

Brook trout were present in a limited range of sizes (Figure 3-10). None of these fish were ripe at the time of sampling.

3.3.2 Comparison to previous years sampling

The population estimates of brown and rainbow trout over 3" were calculated for this site to allow for direct comparison to previous year's data. The numbers of trout in Site B-6 in September 2001 are higher than previous year's estimates (Figure 3-11). Brook trout have not been found in previous samples at this site. The percentage of the game fish that were composed of rainbow trout was comparable to previous year's sampling.

Table 3-6 compares the 1989 sample with the 2001, by length group. The number of brown and rainbow trout over 8" in length was slightly higher in 1989 than in 2001. The number of rainbow trout smaller than 8" was larger in 2001 than in 1989, resulting in an overall increase in the number of rainbow trout

estimated to be present at the site. The overall number of brown trout was very similar during the two sample periods.

Table 3-6 . Comparison of population estimates, by length group, from 1989 and 2001 at B-6. Source: FWP file data.

	2001 # per 1000' (95% C.I.)	1989 # per 1000' (95% C.I.)
Rainbow ≥ 8"	38 (38 - 42)	44 (44 - 46)
Rainbow ≥ 4" < 8"	273 (240 - 308)	155 (138 - 175)
Rainbow < 4"	128 (92 - 192)	52 (36 - 93)
Brown ≥ 8"	27 (24 - 38)	46 (46 - 48)
Brown ≥ 4" < 8"	98 (66 - 168)	99 (97 - 104)
Brown < 4"	(12*-?)	23 (21 - 28)
Brook ≥ 8"	2 (2-2)	0
Brook ≥ 4" < 8"	16 (16-16)	0
Brook < 4"	4 (4-4)	0
TOTAL	598 (494 - 782)	419 (382 - 494)

The average length of rainbow trout did not vary much between the two sample periods, 5.8" in 2001 and 6.1" in 1989. The average length of brown trout did not vary much either, 6.5" in 2001 and 6.6" in 1989. The overall distribution of trout among size groups was similar in both years (Figure 3-8 and Figure 3-9).

3.4 Site B-11 (Placer Basin)

3.4.1 Summary of September 2001 sampling

One species of fish was collected at Site B-11, Yellowstone cutthroat trout (Table 3-5).

Table 3-7. Summary of trout population statistics, Site B-11, September 2001

	# 1st pass	# 2nd pass	Total caught	Pop. Estimate (#/1000')	standard deviation	95% confidence interval (range)
Yellowstone cutthroat (YCT) < 3"	20	8	28	33	5.9	± 11.5 (28-45)
YCT > 3" < 6"	97	30	127	140	7.3	± 14.3 (127 -155)
YCT > 6"	51	21	72	87	10.1	± 19.8 (72 - 106)
TOTAL	168	59	227	260		(227 - 306)

The length-frequency histogram for this site (Figure 3-12) indicates that growth rates are probably quite slow at this location. About 5% of the fish collected were under 2" in length in spite of the late summer sampling. This is almost certainly an underestimate of the numbers of fry actually present because the mesh size of the nets that were used were ineffective in capturing very small fish. In addition, no fish were collected that were over 8.7". Given the high elevation of this site (over 8,700'), slow growth rates are expected.

3.4.2 Comparison to previous years sampling

This was the first quantitative sampling that has been done at this location. It is believed that the Yellowstone cutthroat trout in this area are the progeny of a hatchery plant that was made in the 1971 from Yellowstone cutthroat trout kept at the Big Timber Fish Hatchery. This reach of stream was fishless prior to this plant (Stewart, 1977 and Hergenrider, FWP, personal communication, September 5, 2001).

Sampling in 1972 and 1974 indicated that Yellowstone cutthroat trout were present, but in low numbers (Stewart, 1977). These were qualitative samples of 1500 feet of stream in the same location as Site B-11. In 1972, four Yellowstone cutthroat trout were found. In 1974, only one Yellowstone cutthroat trout was found. Stewart (1977) concluded that a few fish from the original hatchery plant were still present in the system but there was no evidence of reproduction. In 1981-1982, surveys of this reach of stream continued to find few fish (Weston, 1989). By 1989 fish abundance had increased to the point where it was possible

to take a sample of 29 trout from this reach for genetic analysis. All of these fish were between 3 - 4" in length, except for one fish 7.1" (Figure 3- 12). This sampling found the fish to be pure Yellowstone cutthroat trout (Weston, 1989). It appears that fish abundance has gradually increased in this reach since the original hatchery planting. In addition, the size range of cutthroat trout has increased, indicating that the population is successfully reproducing and surviving in the available habitat.

Waterfalls downstream of this site prevent the upstream movement of brown, brook, and rainbow trout into this reach of the East Boulder River. However, the two Yellowstone cutthroat trout that were caught in Site B-5 and B-6 may have been downstream migrants from above these barriers.

3.5 Elk Creek

3.5.1 Summary of September 2001 sampling

Three species of fish were found in Elk Creek, rainbow trout, brown trout, and mottled sculpin. Population estimates of the two trout species are displayed in Table 3-6. Of the game fish, rainbow trout were 18% of the fish collected and brown trout were 82%.

Table 3-8. Summary of trout population statistics, Elk Creek, September 2001

	# 1st pass	# 2nd pass	Total caught	Pop. Estimate (per 350')	standard deviation	95% confidence interval (range)	# per 1000' (95% C.I.)
Rainbow ≥ 8"	0	0	0	0	0	0	0
Rainbow ≥ 4" < 8"	6	2	8	9	2.1	± 4.1(8 - 13)	26 (23 -37)
Rainbow < 4"	0	0	0	0	0	0	0
Brown ≥ 8"	1	0	1	1	0	0 (1-1)	3 (3 - 3)
Brown ≥ 4" < 8"	17	3	20	20.6	1.1	± 2.3 (20 - 23)	59 (57 - 66)
Brown < 4"	11	5	16	20.1	6.1	± 12 (16 - 32)	57 (46 - 91)
TOTAL	35	10	45	50.7		(45 - 68)	145 (129 - 194)

The average length of rainbow trout was 5.4", which was larger than the average length of rainbow trout in Site B-4. However, the largest rainbow trout collected was only 6.4" (Table 3-2). No rainbow trout less than 4" in length were collected, explaining the relatively large average size. The average length of brown trout was 5.2", smaller than any other site. The largest brown trout was 8.8" (Table 3-2). Elk Creek is quite a small stream so the small sizes of the trout found are not surprising.

Rainbow trout were few in number and of a narrow size range in Elk Creek (Figure 3-13). This may indicate that rainbow trout use Elk Creek as seasonal habitat, or for subadult habitat. The East Boulder River is in close proximity to the sampling site so it would be a short migration for fish to move between one stream and the other. Brown trout had a wider range of sizes present in Elk Creek (Figure 3-14). Several age classes were present, including fish small enough to be YOY and fish large enough to potentially be sexually mature.

3.5.2 Comparison to previous years sampling

Elk Creek was sampled during the fall of 1981. No population estimate was made due to insufficient recapture of tagged fish. Species composition consisted of 60% brook trout (mean length 4.6"), 20% rainbow trout (mean length 8.6"), and 20% brown trout (mean length 5.4"). A few redds were observed in Elk Creek in the fall of 1981 (Wiedenheft, 1982).

This sample was apparently collected further upstream in Elk Creek than the 2001 sample. No brook trout were collected in 2001, however, it is known that brook trout are present in areas further upstream (Barndt, FWP, personal communication, September 19, 2001). It appears that species composition in this stream changes rapidly along its course, making comparisons from other samples in the past difficult. However, the large average length of rainbow trout found in the 1981 sample is surprising given the small size of this tributary.

3.6 Summary

Table 3-2 lists average relative weights for each species at each site. Sites B-5, Elk Creek, and B-11 had the highest average relative weights. The high relative weight for cutthroat trout in B-11 is surprising given the high elevation of this site. Apparently food supply for cutthroat trout is abundant at this site, perhaps because of the lack of stream shading, potentially resulting in high primary productivity. Site B-6 had the lowest average relative weights.

Figure 3-15 depicts a comparison of fish populations for the five sites surveyed. Although the point estimate for Site B-5 is higher than for Site B-6, their 95% confidence intervals overlap to a large degree. The same is true for the confidence intervals for B-4 and B-11. However, the confidence intervals for B-5 and B-6 do not overlap with the estimates for B-4 and B-11, indicating that populations are significantly smaller at the latter sites. The estimate for Elk Creek is significantly less than for any of the other sites.

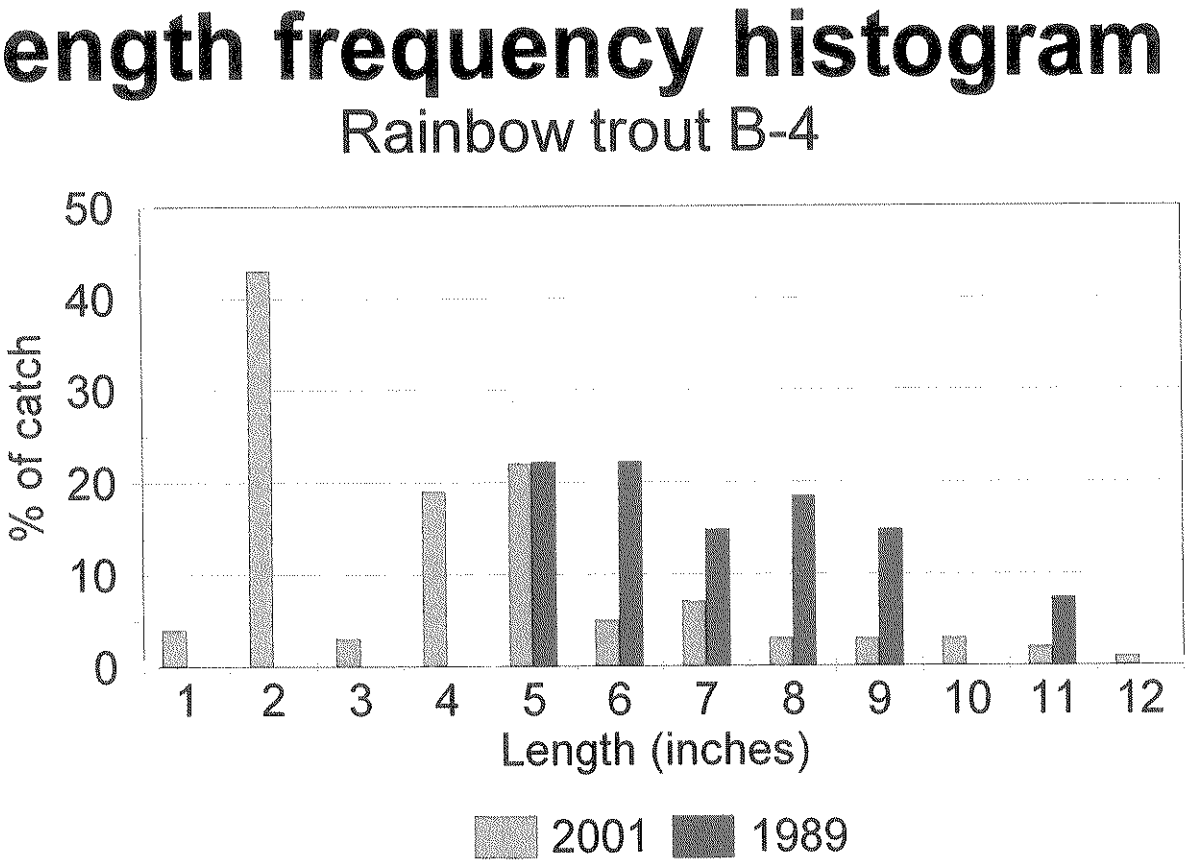

Figure 3-1. Data collected on the East Boulder River August 1989 and September 2001.

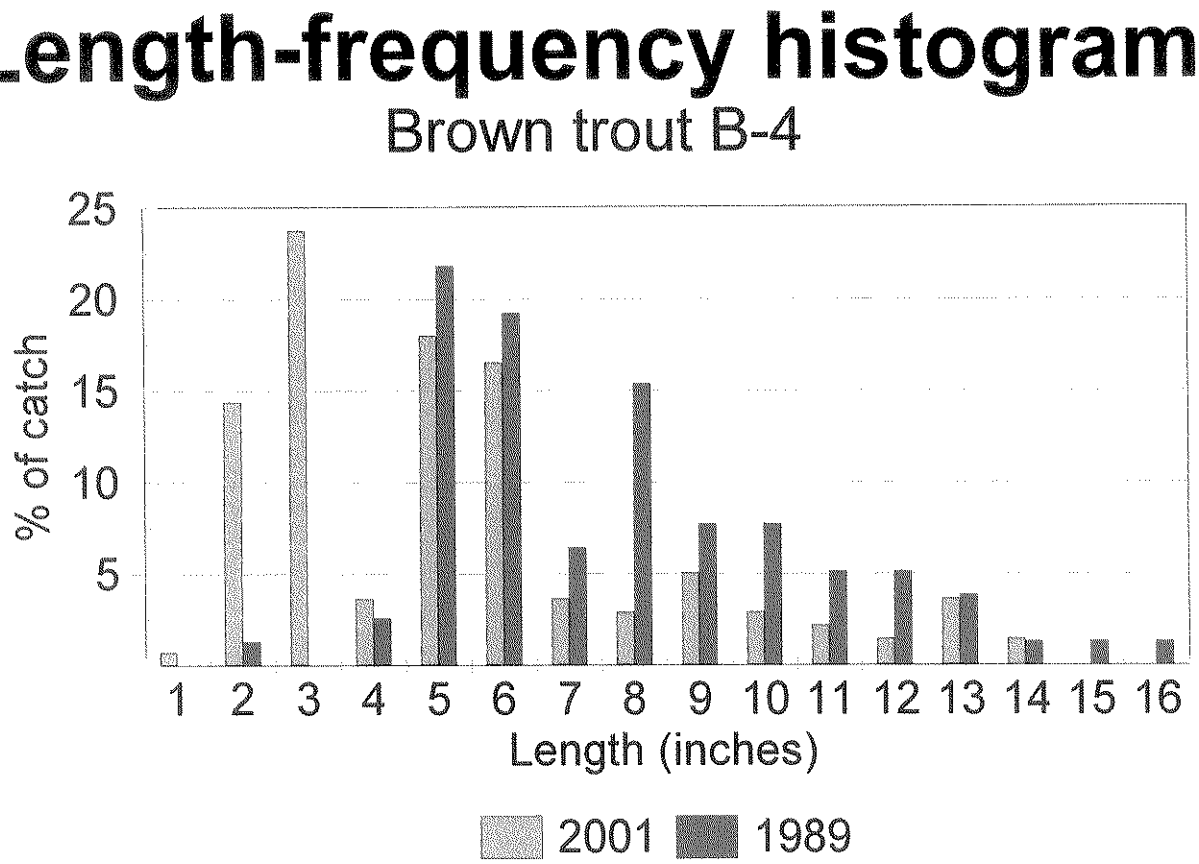

Figure 3-2. Data collected East Boulder River August 1989 and September 2001.

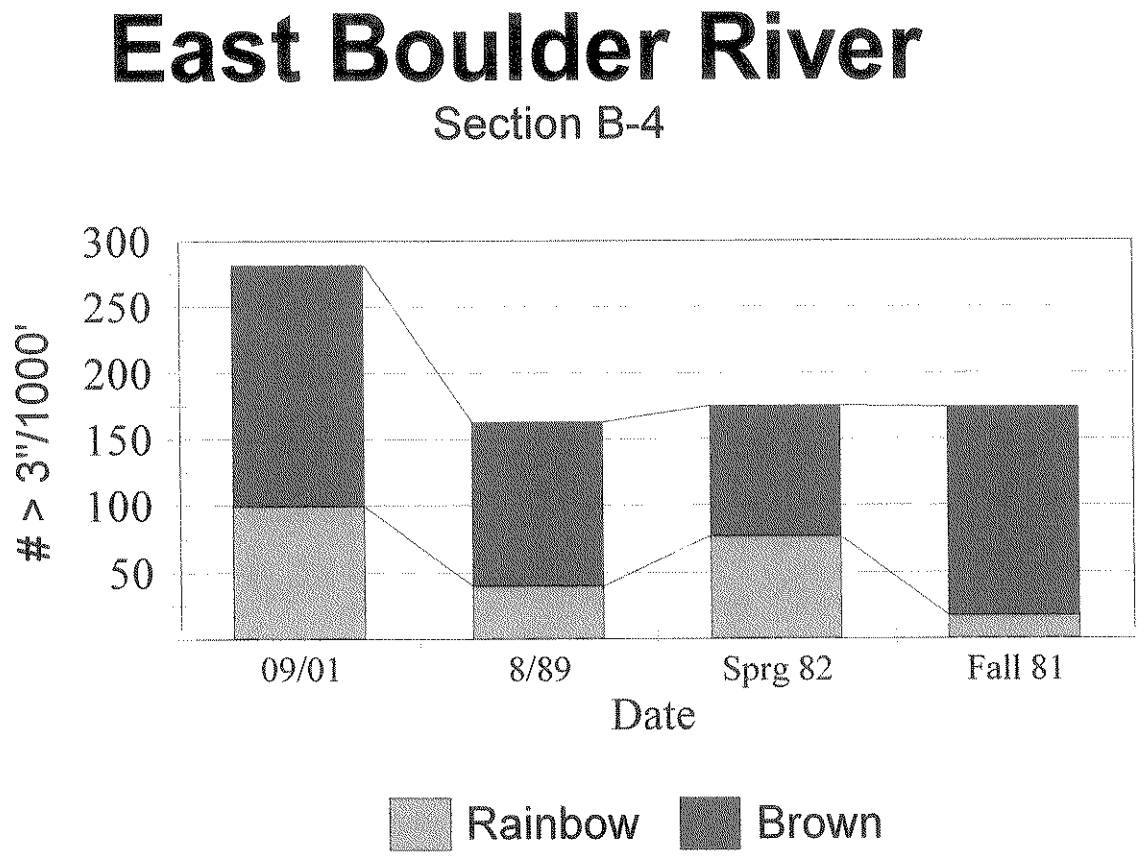

Figure 3-3. Comparison of fish population estimates over time.

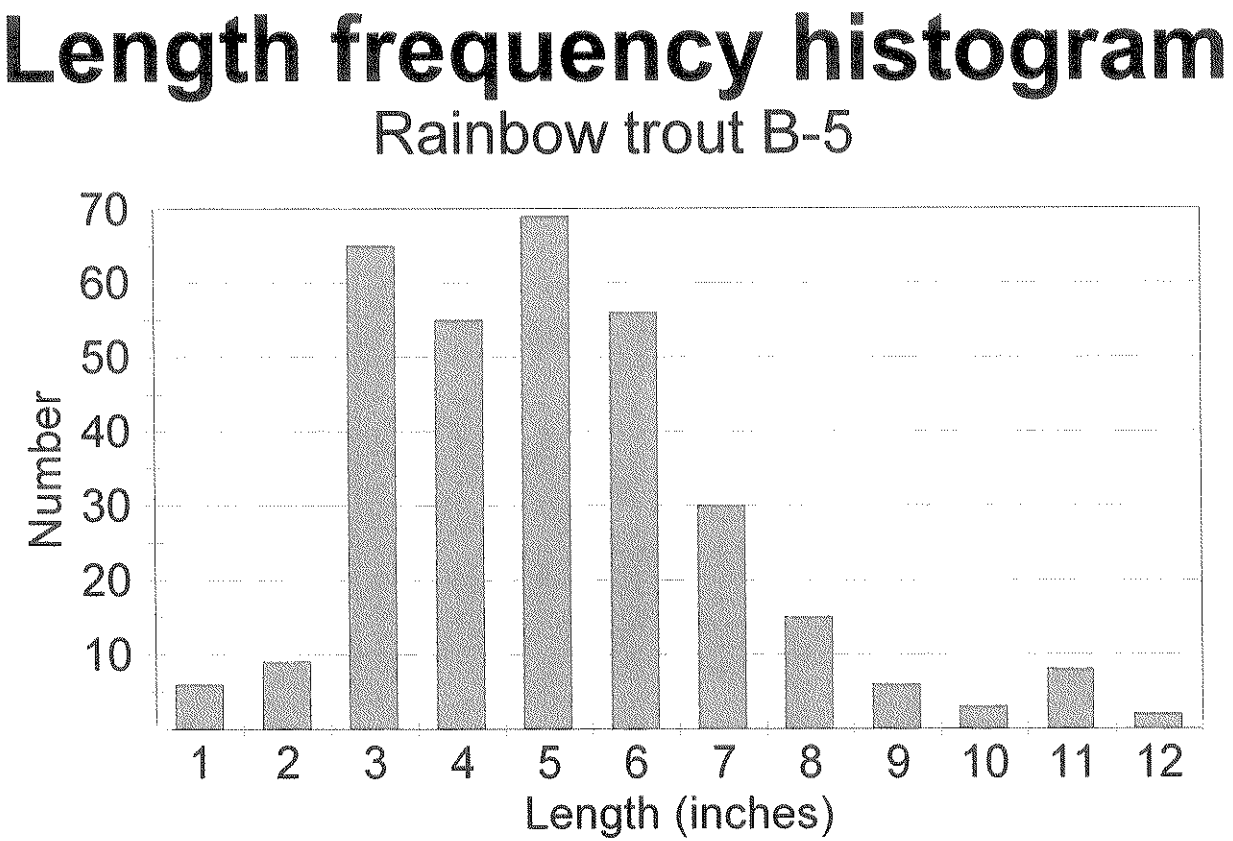

Figure 3-4. East Boulder River, September 18, 2001.

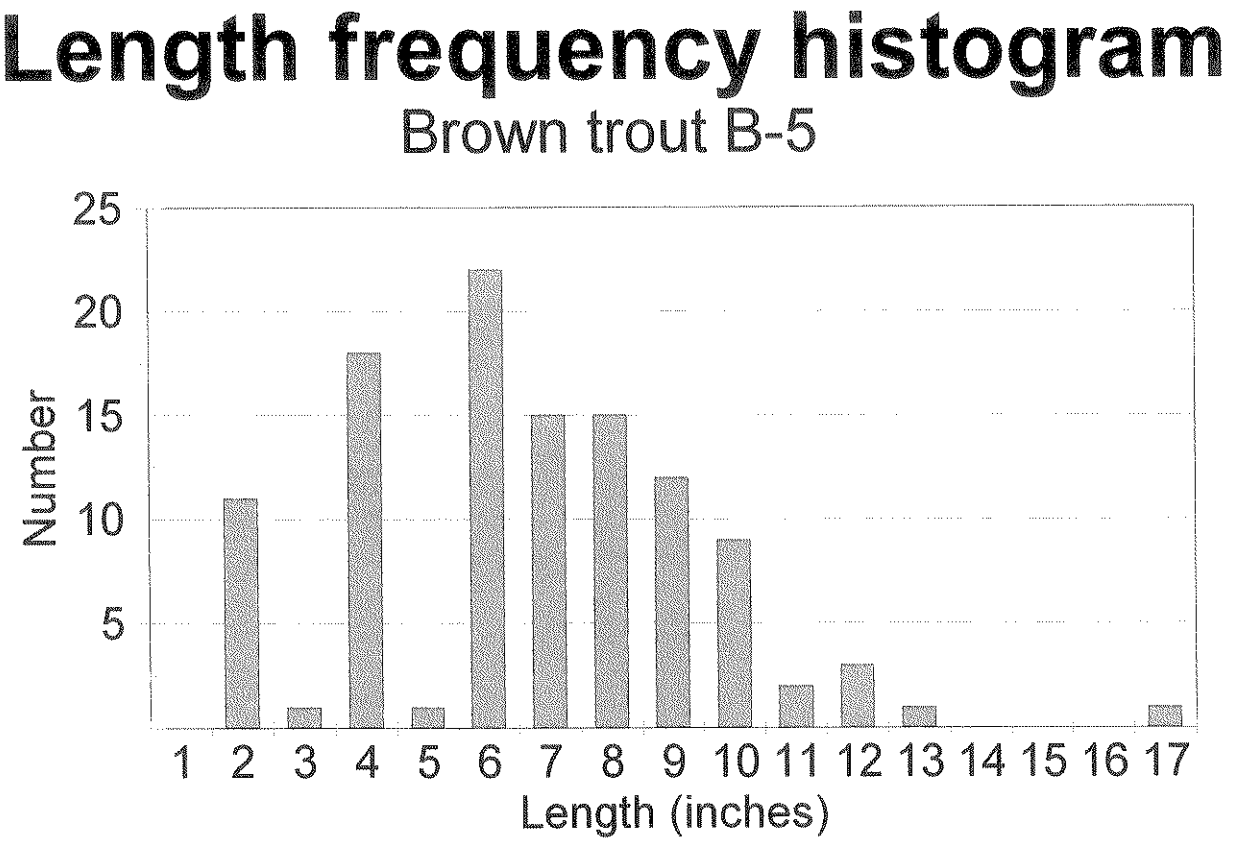

Figure 3-5. East Boulder River, September 18, 2001.

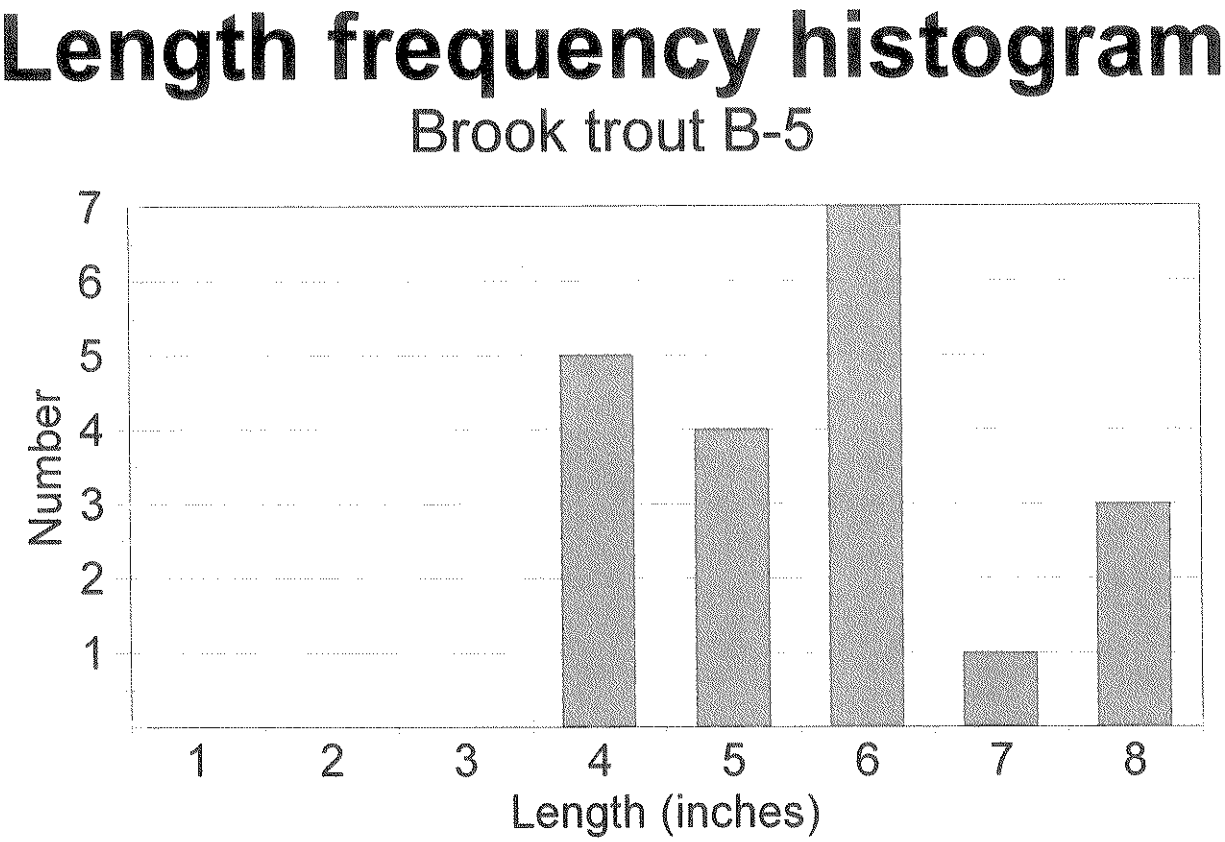

Figure 3-6. East Boulder River, September 18, 2001

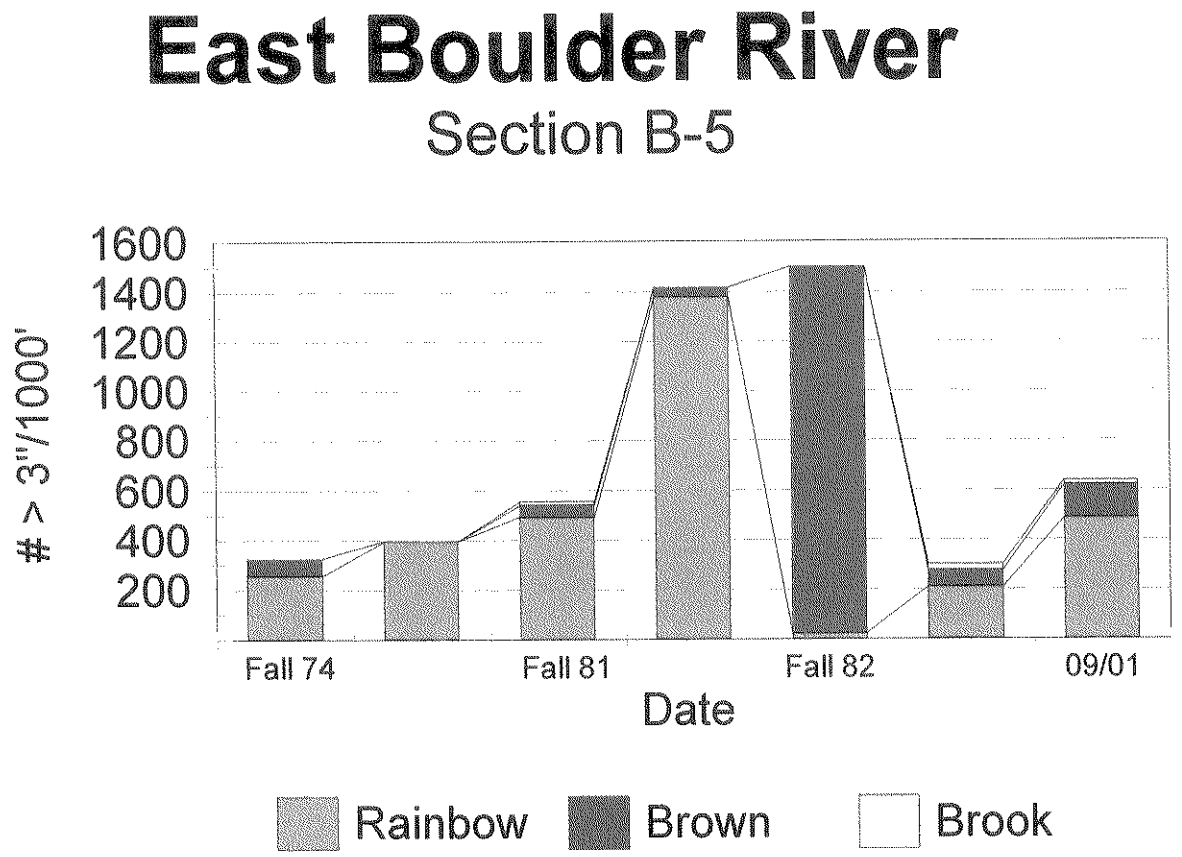

Figure 3-7. Data collected September 18, 2001.

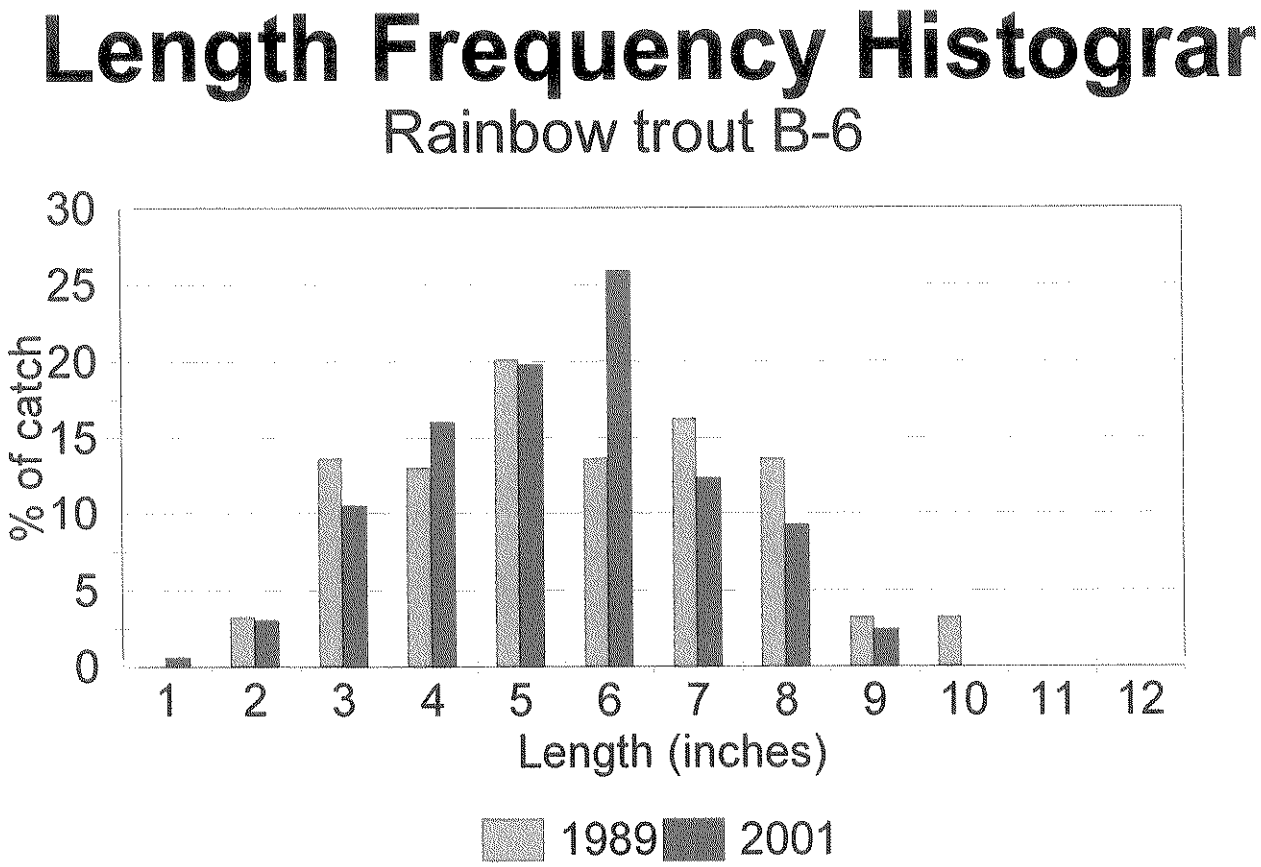

Figure 3-8. Data collected East Boulder River, August 1989 and September 2001.

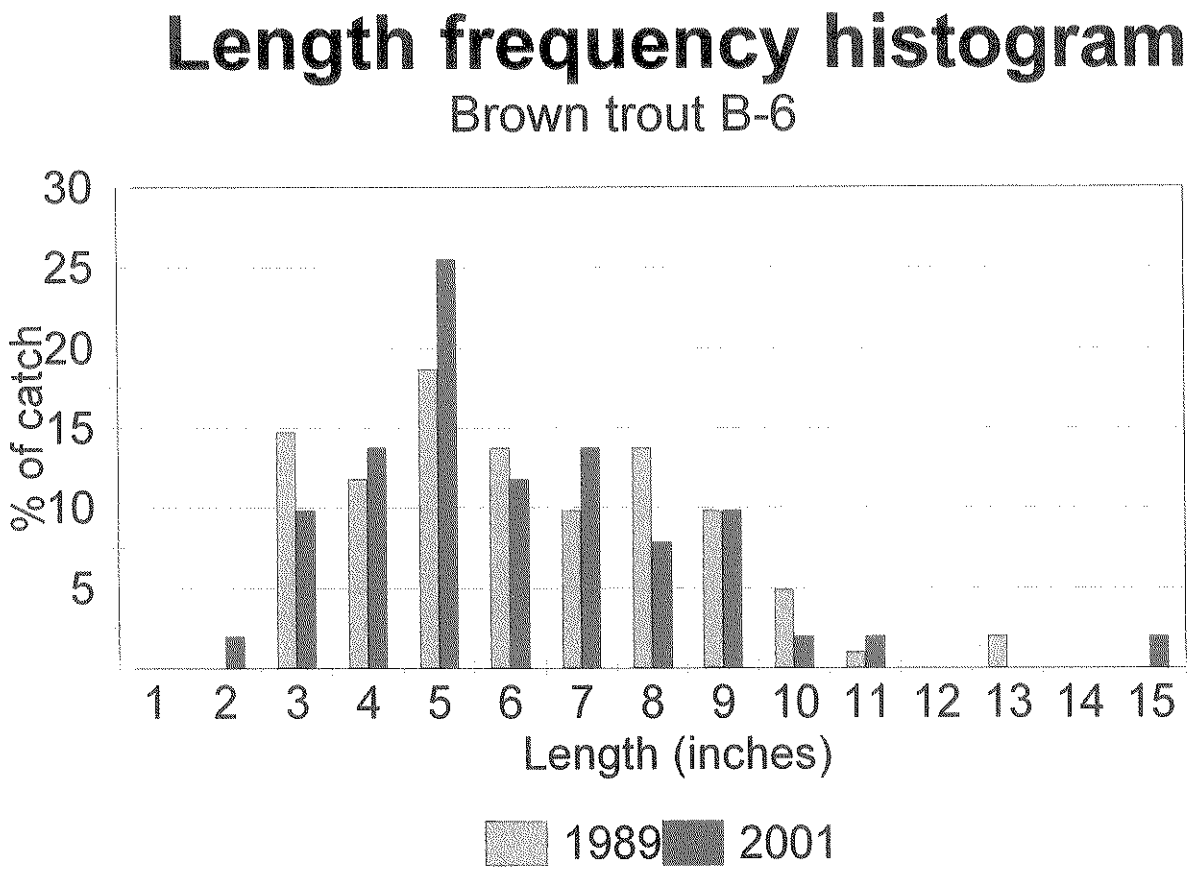

Figure 3-9. Data collected East Boulder River, August 1989 and September 2001.

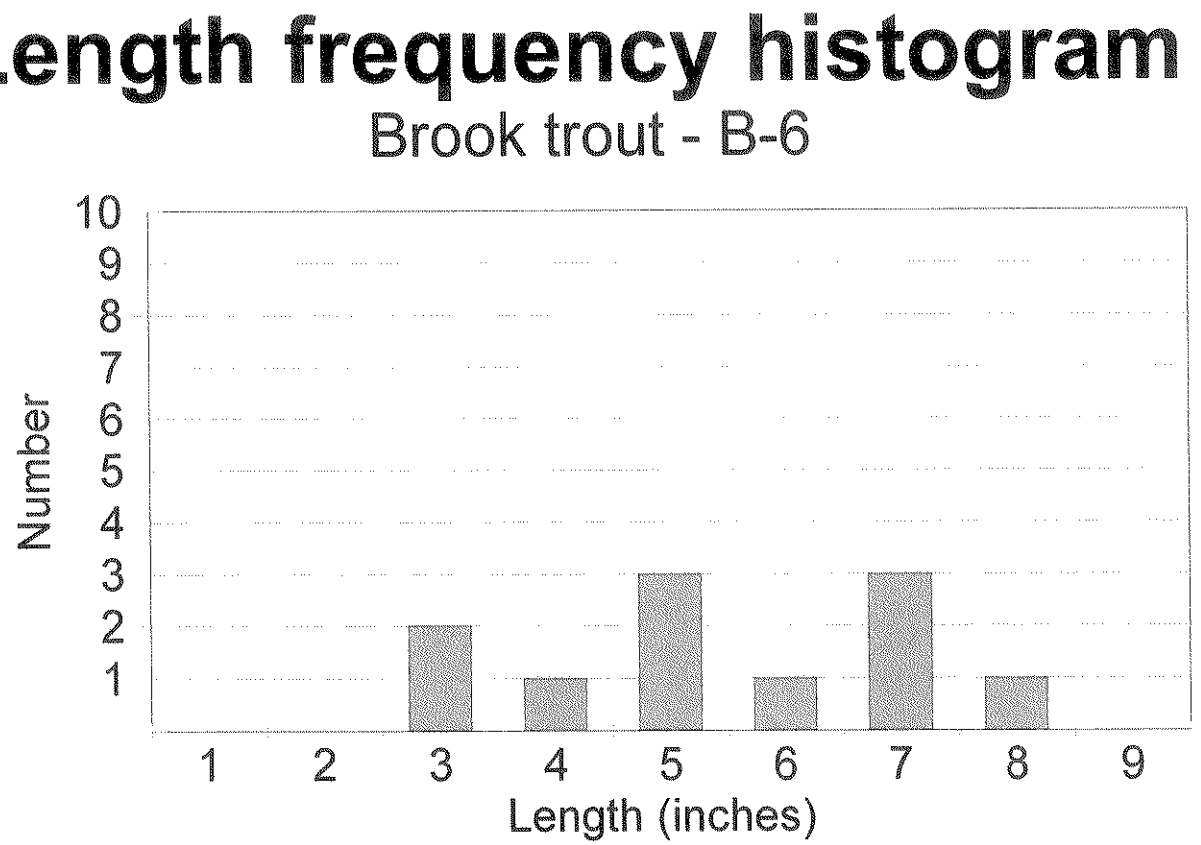

Figure 3-10. East Boulder River, September 18, 2001

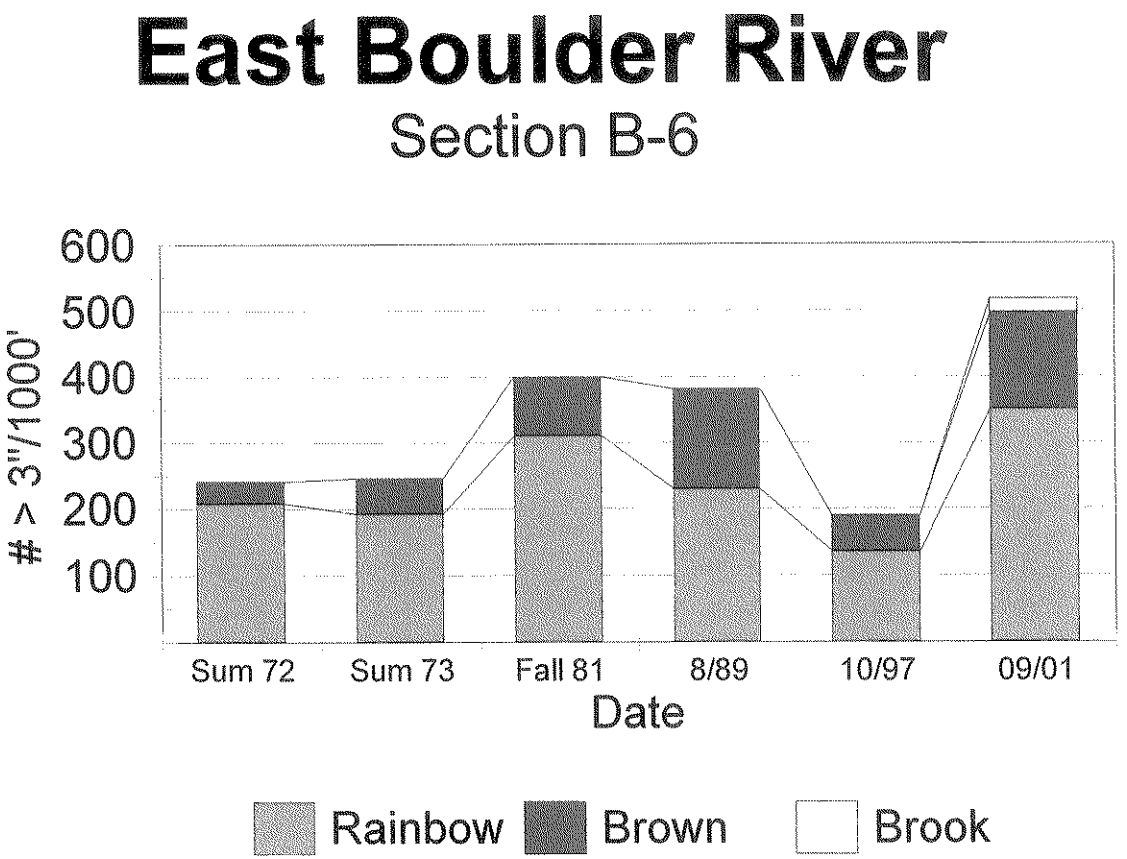

Figure 3-11. Comparison of population estimates over time.

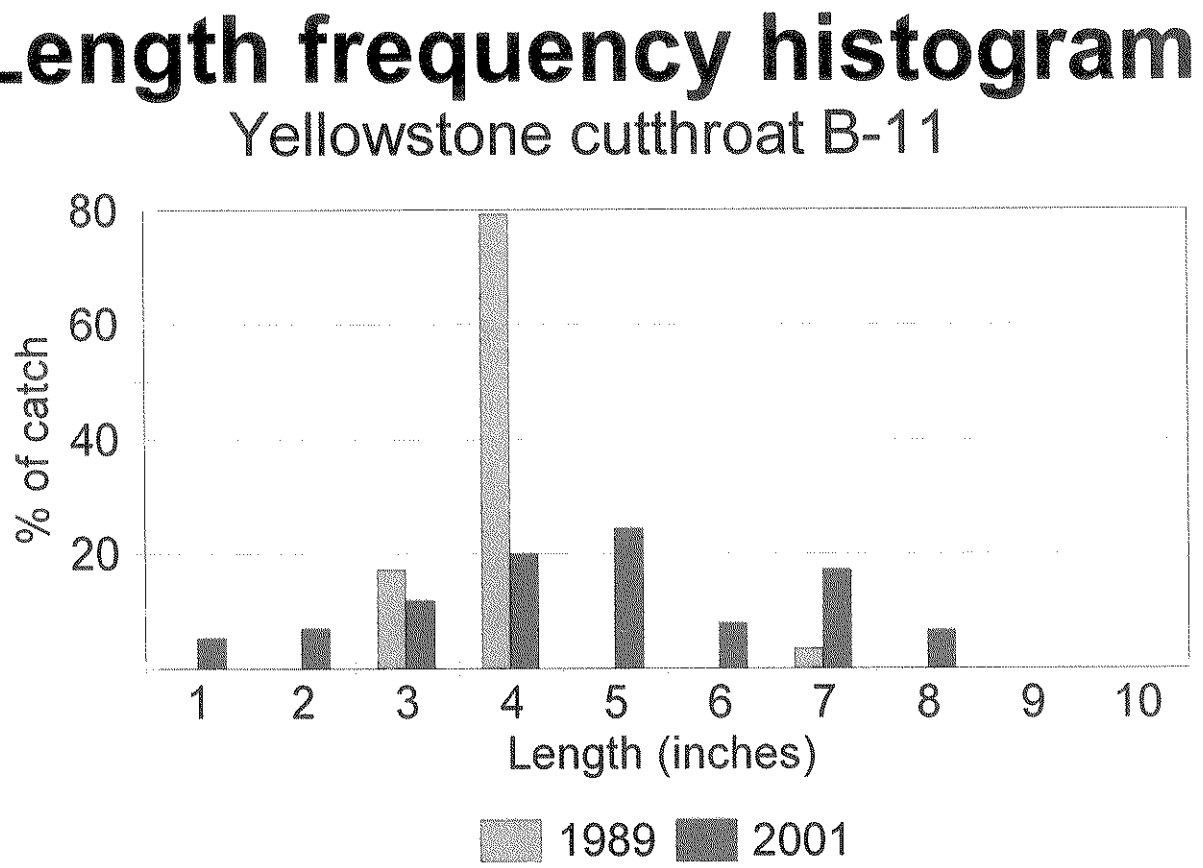

Figure 3-12. Data collected East Boulder River, August 1989 and September 2001

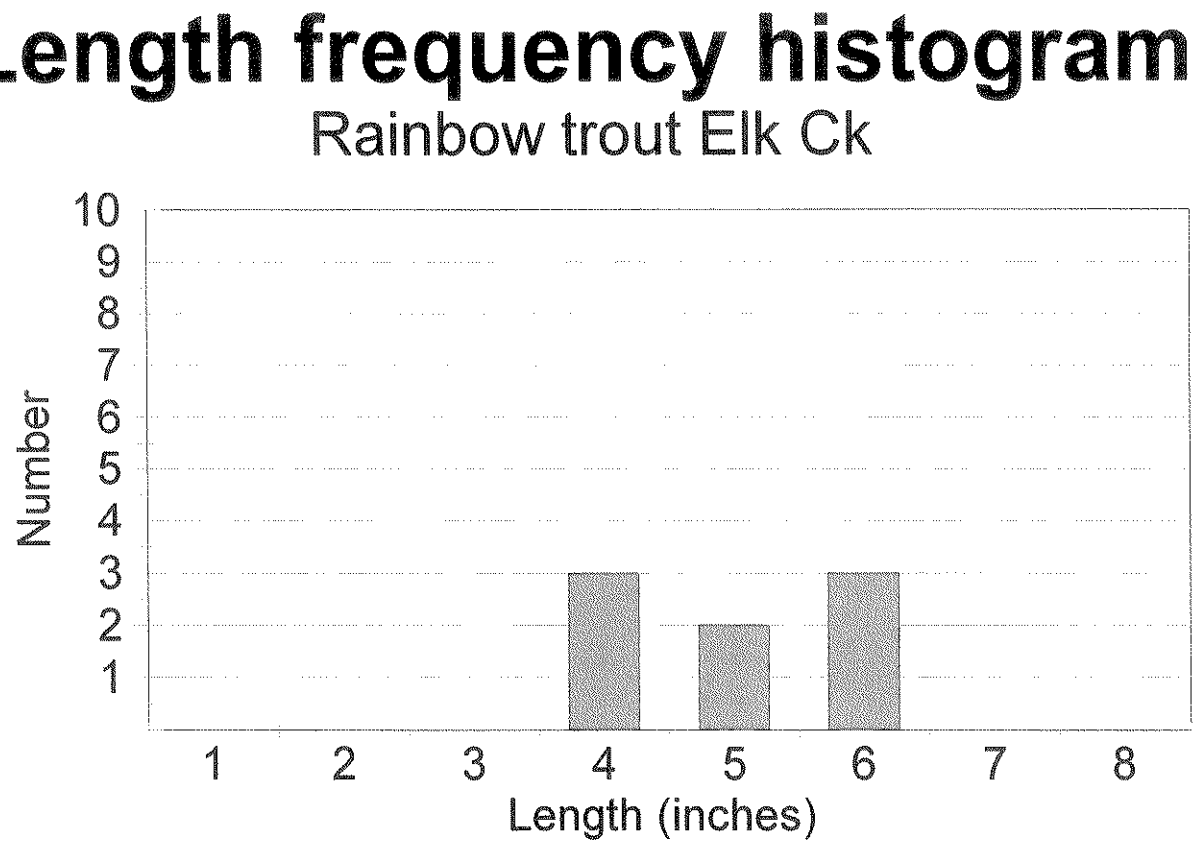

Figure 3-13. Elk Creek, tributary to East Boulder River, September 19, 2001

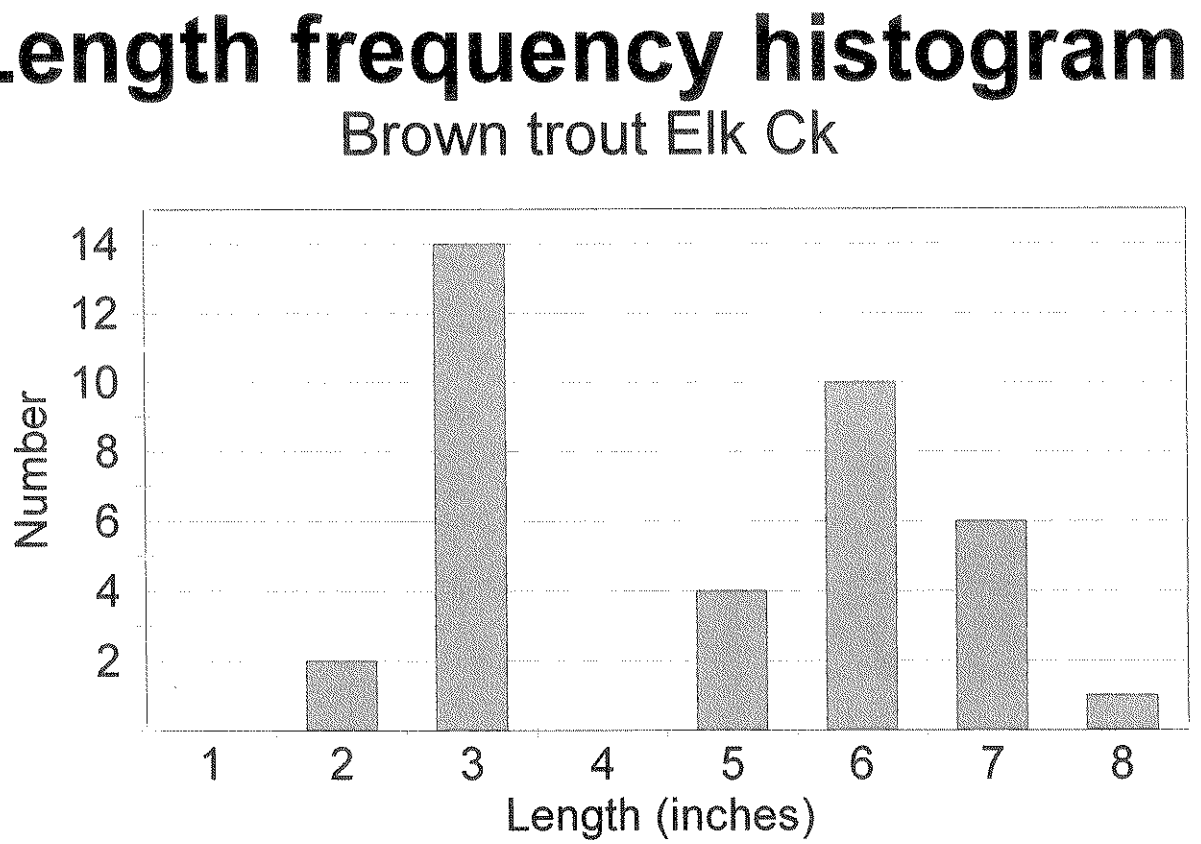

Figure 3-14. Elk Creek, tributary to East Boulder River, September 19, 2001

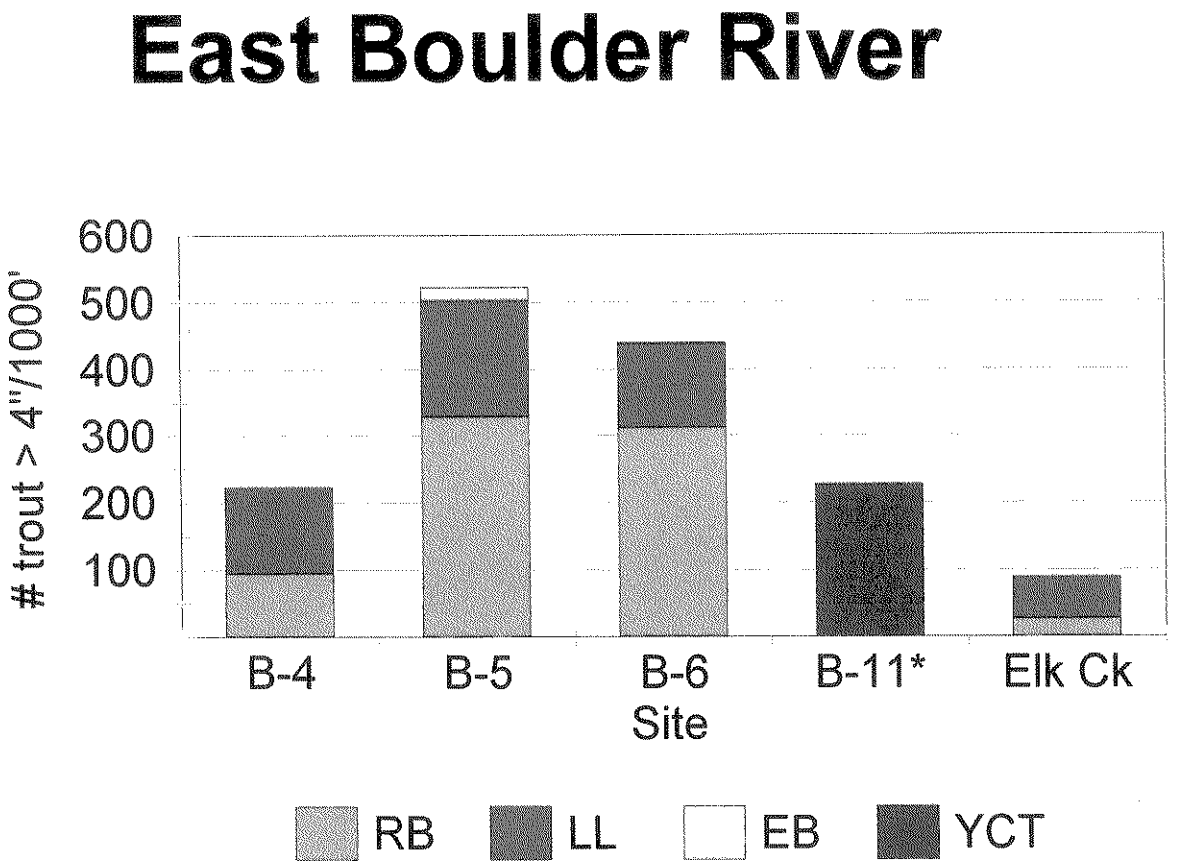

Figure 3-15. Comparison of fish populations, September 2001. * Estimate for Site B-11 is trout > 3". RB = rainbow, LL = brown, EB = brook, and YCT = Yellowstone cutthroat trout.

Discussion

Overview of objectives

As described in the introduction, the objectives of the study were to: 1) determine the best methods for sampling fish in this drainage, 2) determine the abundance and distribution of fish in the drainage, and 3) determine ages and growth rates of brown and rainbow trout, 4) compare results to past fish population estimates, and 5) prepare a written report with the findings of the project.

With regard to the first objective, we had originally intended to use both snorkeling and electrofishing to sample fish in order to determine which method was best. As a result of budget constraints, we decided to only use electrofishing. The summer of 2001 was a time of very low streamflows in Montana in general, and the Boulder River specifically. Water clarity was excellent at all study sites except for Elk Creek. However, conditions would not have been amenable to snorkeling because low flows and large substrate would have greatly limited underwater visibility. In fact, after observing habitat conditions in the study sites, it is apparent that snorkeling would be ineffective for quantitative sampling in the East Boulder River.

While our electrofishing efforts provided satisfactory results, we did learn some lessons that should improve future efforts. We underestimated the time required for sampling at almost all of the sites, but particularly Sites B-5 and B-11. At Site B-5, future samplers should expect to spend a full day at the site. Allowing extra time would make it possible to use a third electrofishing pass if needed to improve confidence intervals. In addition, it may be possible to make an estimate of sculpin abundance if more time were allotted. At Site B-11, a solid population estimate could be gathered using a shorter section (500' rather than 1000'). This would allow extra time for making a third electrofishing pass if needed, without requiring an overnight stay in the field.

The "crawdad" set up worked well at Sites B-4, B-5 and B-6. Backpack electroshockers were adequate at Elk Creek and B-11. However, it should be noted that the battery electroshocker was ineffective at Site B-11, necessitating the use of the gasoline generator backpack unit.

We were very successful in meeting objective 2. We completed quantitative sampling at five sites within the East Boulder drainage, a larger number of sites than we expected to be able to complete with the available budget. This was accomplished with the help of several assistants from Trout Unlimited, Greater Yellowstone Coalition, and Center for Science and Public Participation and the excellent cooperation of Montana Fish, Wildlife, and Parks. Without their generous help we could not have accomplished so much in so little time.

While we have not accomplished objective 3 as yet, scale samples were collected from trout in Sites B-4, B-5, Elk Creek and B-11. When mounted and read, these samples will help us establish age and growth information for these fish.

Current information was compared to past samples, when this information was available. Therefore we accomplished objective 4 to the extent possible.

Objective 5 is this report.

Conclusions

All sites sampled contained apparently healthy populations of trout. Young-of-the year were present at every site, indicating trout reproduction within the East Boulder River drainage. Where quantitative data were available from the past, it appears that numbers of trout are comparable to, or greater than, has been present in the past. Yellowstone cutthroat trout, a Montana Species of Special Concern, are only present in significant numbers upstream of fish passage barriers in the upper East Boulder River. At all other sites, trout populations consisted primarily of non-native populations of rainbow and brown trout, with lesser numbers of brook trout present at some locations. The only abundant non-game species found in the East Boulder River was mottled sculpin. One longnose dace was also found.

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