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Region 2

MONTANA FISH, WILDLIFE AND PARKS
FISHERIES DIVISION
Federal Aid Job Progress Report

Date: 3/20/2001

Montana Statewide Fisheries Management

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SABHRS Project Number: 3320

Project Reporting Period: July 1, 1998 – November 30, 2000

ABSTRACT

Bitterroot River trout populations are at or near the highest numbers recorded. Westslope cutthroat and rainbow trout populations have increased since restrictive fishing regulations were imposed. The parasite associated with whirling disease, *Myxobolus cerebralis* was found in two rainbow trout in the Bitterroot River. At this time, the infection level appears to be light. Through radio telemetry, we were able to identify spawning areas used by fluvial westslope cutthroat and bull trout in the upper Bitterroot drainage. Westslope cutthroat used a variety of streams, but the Nez Perce Fork is where most from the West Fork Bitterroot and upper Bitterroot River spawned. Bull Trout from the East Fork Bitterroot River, all spawned in core areas, mostly in the upper portions of the drainage. Angler use of the Bitterroot River has been increasing steadily. About 70% of the anglers in 1999 were residents.

Fish population monitoring on the Bitterroot National Forest indicates that population trends vary throughout the drainage. No overall trend is apparent, however fishing regulation restrictions appear to be having a positive effect in some streams. The long term monitoring of water temperature in Bitterroot drainage streams continues to provide a database that is useful for comparisons between streams. A few more sites were added to the genetics database, which is primarily used to identify the locations of pure and hybridized populations of westslope cutthroat.

The stocking of Lake Como with kokanee has had mixed success. Early survival appeared to be high, however recent sampling has not identified much adult survival or spawning.

Chris Clancy -
Author

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BACKGROUND

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 (Figure 1). 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. Urbanization and associated development of the floodplain is increasing in the Bitterroot Valley (Javorsky 1994).

The Bitterroot River is an important sport fishery for anglers in western Montana. Pressure estimates from the statewide survey indicate that the Bitterroot River supported 110,931 angler days during 1999. These figures indicate an increasing trend in angling pressure on the Bitterroot River. Due to this increasing pressure, fishing regulations have become more restrictive in recent years to protect the adult fish. A creel census was conducted in 1992 and 1993 to assess these impacts. Overall, it indicated that fishing harvest was not having a serious impact on the population of trout but that monitoring should continue (Clancy 1993). Angling pressure has nearly doubled since that creel census. A Bitterroot River management plan is overdue since the original 5 year plan was written in 1991 (MFWP 1991).

Due to the importance of maintaining connections between Bitterroot River salmonids and their spawning areas we implanted radio transmitters in adult westslope cutthroat in 1998 and 1999 and bull trout in 2000, from the West Fork, East Fork and main Bitterroot River. See the attached reports.

Streams within the Bitterroot National Forest support widespread populations of native westslope cutthroat *Oncorhynchus clarki lewisi* and bull trout *Salvelinus confluentus* Due to the importance of streams within the Bitterroot National Forest (BNF), we have also monitored fish populations there. The Bitterroot National Forest encompasses 1.6 million acres, 71% of which is in Montana. Three mountain ranges, the Bitterroots to the west, the Sapphires to the east, and the Anaconda-Pintlars to the southeast comprise the Bitterroot National Forest. 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

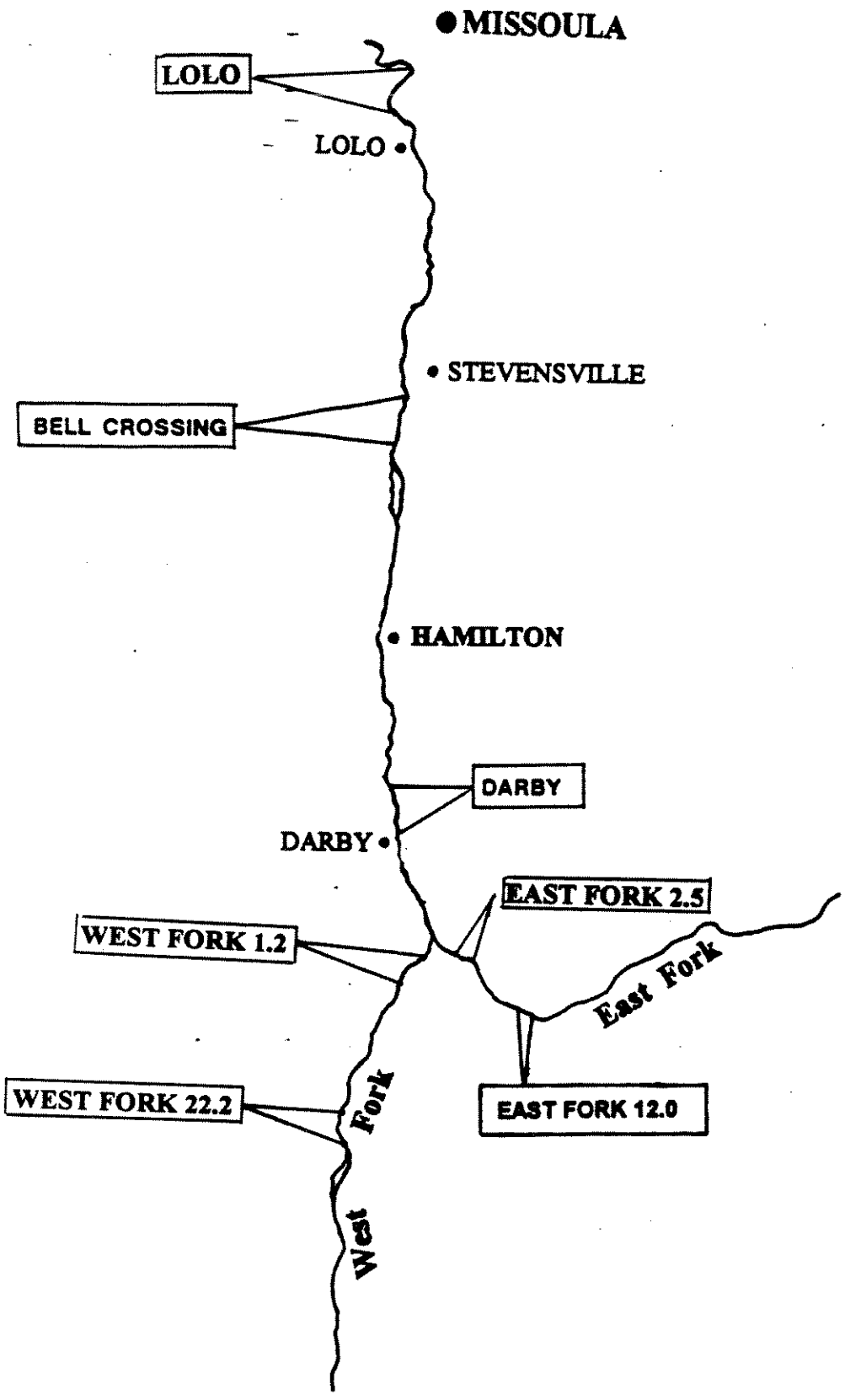


FIGURE 1. Map of electrofishing sections sampled during 1998, 1999 or 2000.

geology (Garn and Malmgren 1973). Within Montana, the BNF is the headwaters of the Bitterroot River.

During 2000, wildfires burned significant acreages in the Bitterroot drainage. It is estimated that 356,000 acres were burned. Studies of the impacts of wildfire on fisheries indicate that in healthy systems, most negative impacts are short-term (Gresswell 1999). Since wildfire impacts have been widely studied, we did not focus our work on assessing these impacts. We did, however, collect some data near reaches that had burned severely.

Historically, Lake Como has been stocked with various species of fish. In the past decade catchable and brood rainbow trout have been stocked annually. Due to the fluctuating water levels in the reservoir, growth and survival has been poor. Beginning in 1997, kokanee, *Oncorhynchus nerka,* were stocked as fingerlings, in an attempt to add some variety for the anglers and study whether kokanee would grow faster than rainbow trout.

METHODS

Bitterroot River

Fish population estimates on the Bitterroot River were collected on several reaches over the past 17 years. Study reaches were selected based on historical data, streamflow 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 system was powered by 5000-watt generator and current was modified through a Coffelt VVP-15 electrofishing unit. Smooth direct current was used to capture fish. The Peterson mark-recapture method was used to calculate population estimates as modified through the Montana Fish, Wildlife and Parks mark-recapture program. Several mark and recapture runs were required to obtain sufficient sample size to estimate fish populations in some reaches. In recent years, most of the fish collections downstream of Hamilton have 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 inflated.

Ten radio transmitters were surgically implanted into westslope cutthroat during the spring of 1998 and 1999 in the lower West Fork and main Bitterroot Rivers, respectively. During 2000, transmitters were implanted into 10 bull trout in the East Fork Bitterroot River. The transmitters and receivers were provided by Advanced Telemetry Systems (ATS). The transmitters had an external antennae that protruded anterior to the vent of the fish after surgery. The weight of the transmitters was between 8 and 11 grams for cutthroat trout and 17 grams for bull trout.

We followed the fish using an ATS 16-channel fieldmaster receiver. After the transmitters were implanted, we attempted to relocate the fish at least weekly until spawning and downstream migration ended.

Whirling Disease

During the spring of 1995, 1997 and 1999 we collected juvenile trout from 4, 5 and 5 sites, respectively, to test for the presence of *Myxobolus cerebralis* in the Bitterroot River. In Addition, sentinel cages containing juvenile rainbow trout were placed in the river at 3 sites during spring, 1998 and the fall of 1999.

Bitterroot National Forest

We monitored fish populations in some streams on the Bitterroot National Forest. Background work that went into selection of the study sites is described in previous reports (Clancy 1993, 1996). Due to the severity and large geographic scale of wildfires on the Bitterroot National Forest in 2000 we selected our sites to assess some of the future impacts. Most of the sites chosen in the past few years are long term monitoring sites established previously. Fish were captured by electrofishing using smooth direct current. On larger streams a bank electrofishing unit is used powered by 4500 watt generator and current is controlled through a Coffelt VVP-15 unit. On small streams a backpack shocker, the Coffelt Mark 10, was used. We estimated trout populations on monitoring reaches using a mark-recapture technique. Monitoring sections are usually 1000 feet long. On the marking run, fish are released as close to their capture site as possible and approximately one week is allowed between mark and recapture. Population estimates are calculated using the Montana Department of Fish Wildlife and Parks Mark-Recapture program.

Westslope cutthroat were collected at some sites for electrophoretic analysis. All fish were sent to the University of Montana for analysis.

Angling pressure data was collected through the statewide angling mail pressure survey (McFarland and Meredith 2000). The data in the most recent year (1999) was compared to angling pressure estimates from previous reports.

Water Temperature

Water temperature was monitored at a variety of sites each year. HOBO-TEMP and Optic Stowaway recorders were placed in streams in late June and early July of each year. They were removed in mid-October and the data was downloaded for analysis. We charted each data set and calculated degree days (defined as the average daily temperature in degrees centigrade summed from July 18 to October 1 each year).

Lake Como

We set gillnets overnight in Lake Como during the Fall of 1998 and 1999. We also searched for kokanee redds during the Fall of 1999 in Rock Creek upstream of Lake Como.

RESULTS AND DISCUSSION

Bitterroot River

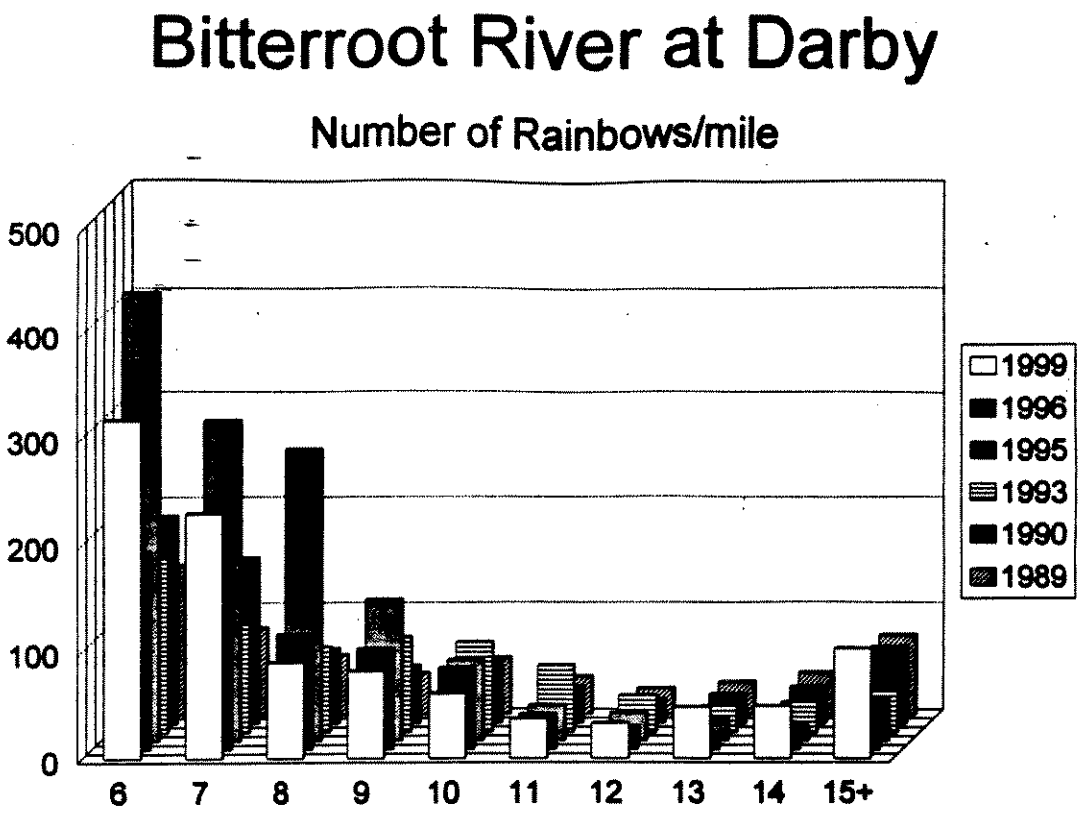
During 1998, three population estimates were collected from the East and West Forks of the Bitterroot River. During 1999, three population estimates were collected from the Bitterroot River. The Darby and Bell Crossing long term monitoring sections and a new section near Missoula were sampled. During year 2000, three population estimates were collected. Due to a large-scale landscape forest fire, two sections on the East Fork Bitterroot River were monitored. The new monitoring reach near Missoula was also sampled during 2000.

The Darby section has been sampled since 1983. Since that time, the fishing regulations have been restricted to artificial flies and lures. During the 1980's a slot limit that allowed small trout and one large fish was in effect. Since the early 1990's the Darby section has been catch-and-release for all trout. As of 1999, the trout population has been increasing (Figures 2-4). The rainbow trout population estimates for large fish indicated increasing numbers. Brown trout appeared to be stable except in the larger sizes, which were fewer than in previous years. Westslope cutthroat populations continue to increase overall, but the larger fish were slightly fewer in number than in 1995. Overall, the collective number of catchable (>7") rainbow, brown and westslope cutthroat in this reach was about 1300/mile in 1999.

The Bell Crossing section was established in 1989 and population estimates have been collected during 6 years since then. We have found that electrofishing at night is far more efficient than during the day. The 1999 population estimates indicate that large rainbow, brown and cutthroat trout populations are at or near the highest levels since sampling began (figures 5-7). Possibly, restrictive fishing regulations may be responsible for the increasing number of trout in this reach. Overall, the collective number of catchable (>7") rainbow, brown and westslope cutthroat in this reach was about 925/mile in 1999.

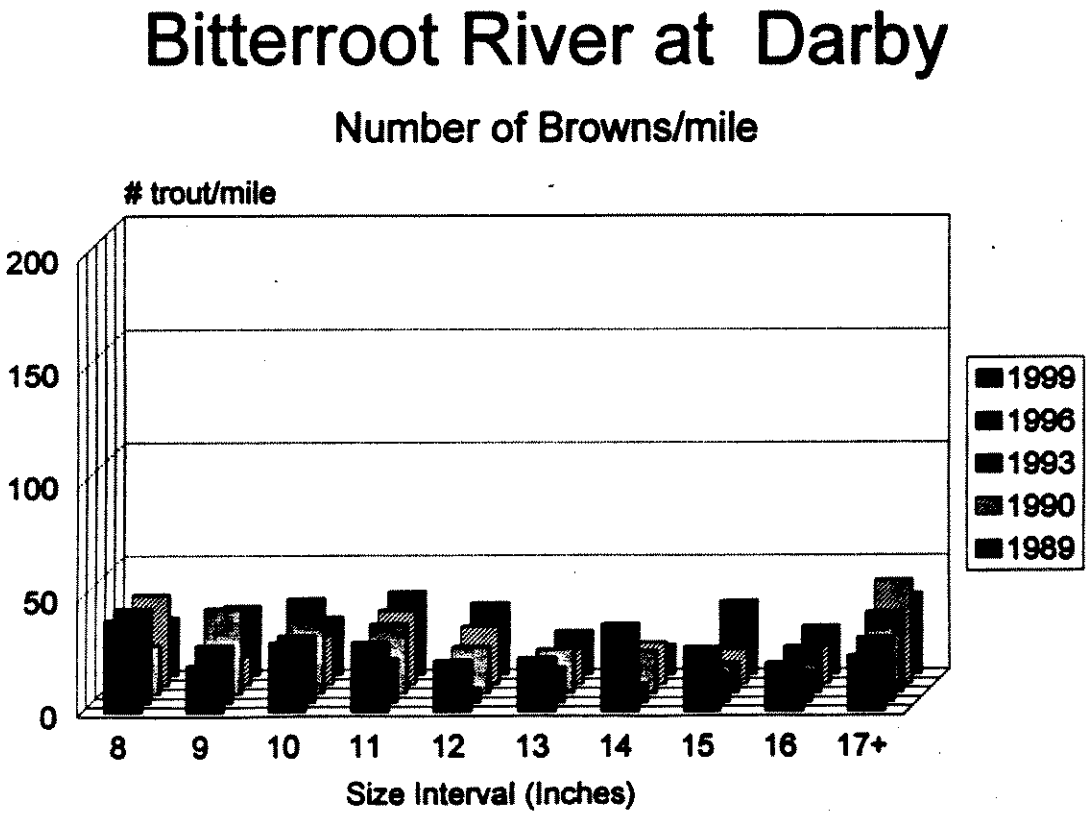
We established the Lolo section in 1999. The upstream boundary is in T12N, R20W, S22A on property owned by the Pruyn family. Access to the river is through corrals and east to the river. The downstream boundary is the last riffle upstream of the Bunkhouse Bridge (US 93). Due to the low gradient in this reach, we electrofished primarily at night.

This reach of river is typical for a lower gradient reach, supporting abundant mountain whitefish, largescale and longnose sucker and northern pikeminnow. Largemouth bass are incidental in this reach. Northern pike are known to inhabit backwaters in this area, however we did not capture any in 1999 or 2000. Other than mountain whitefish, the salmonids are dominated by rainbow trout with lesser numbers of brown and westslope cutthroat. The rainbow trout population estimates were similar during 1999 and 2000 (Figure 8). Overall, the collective number of catchable (>7") rainbow, brown and westslope cutthroat in this reach is roughly 480/mile. The number of westslope cutthroat and brown trout in this reach appears to be similar, about 32 of each over 9" per mile.



Mr 5.0 Estimates

FIGURE 2. Population estimates of rainbow trout by inch class in the Darby section during the years indicated.

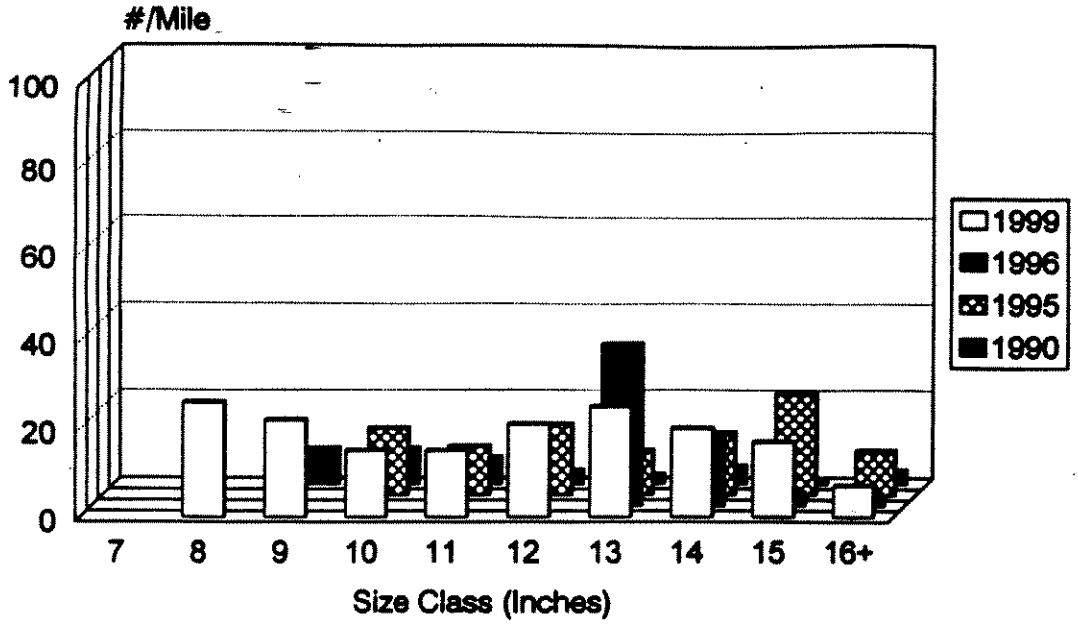


Mr 5.0 Estimates

FIGURE 3. Population estimates of brown trout by inch class in the Darby section during the years indicated.

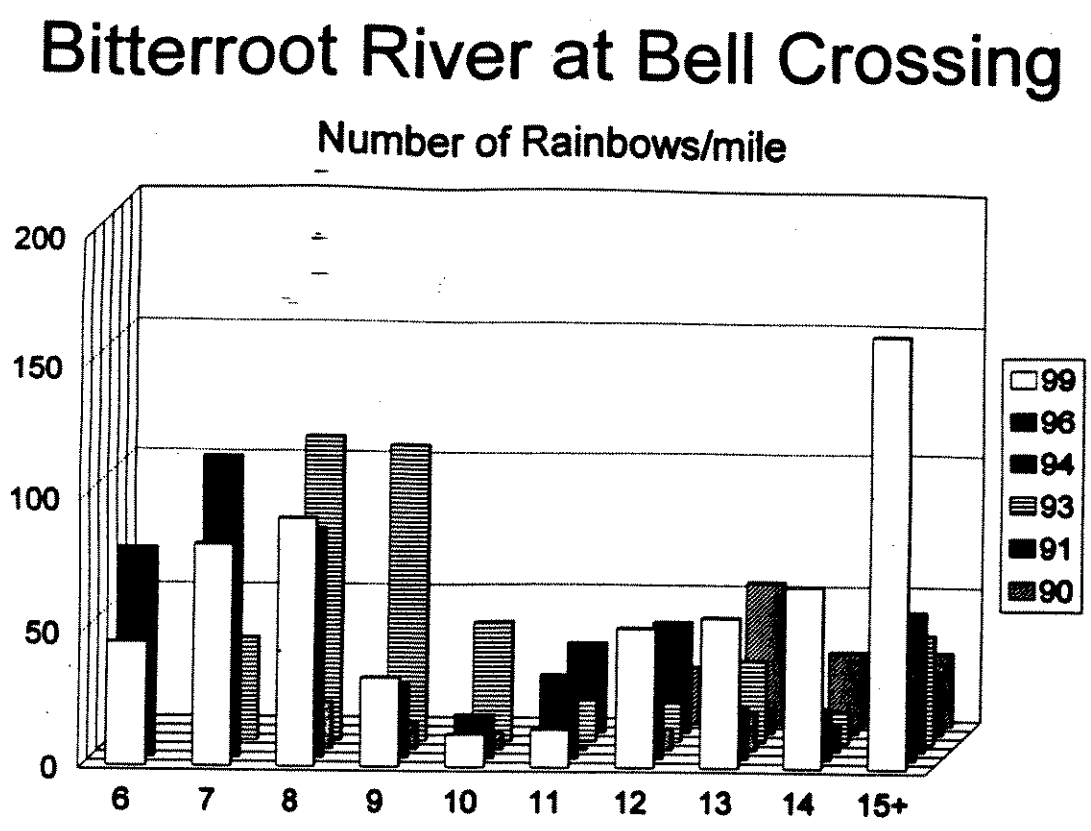
Bitterroot River at Darby

Number of Cutthroat/Mile



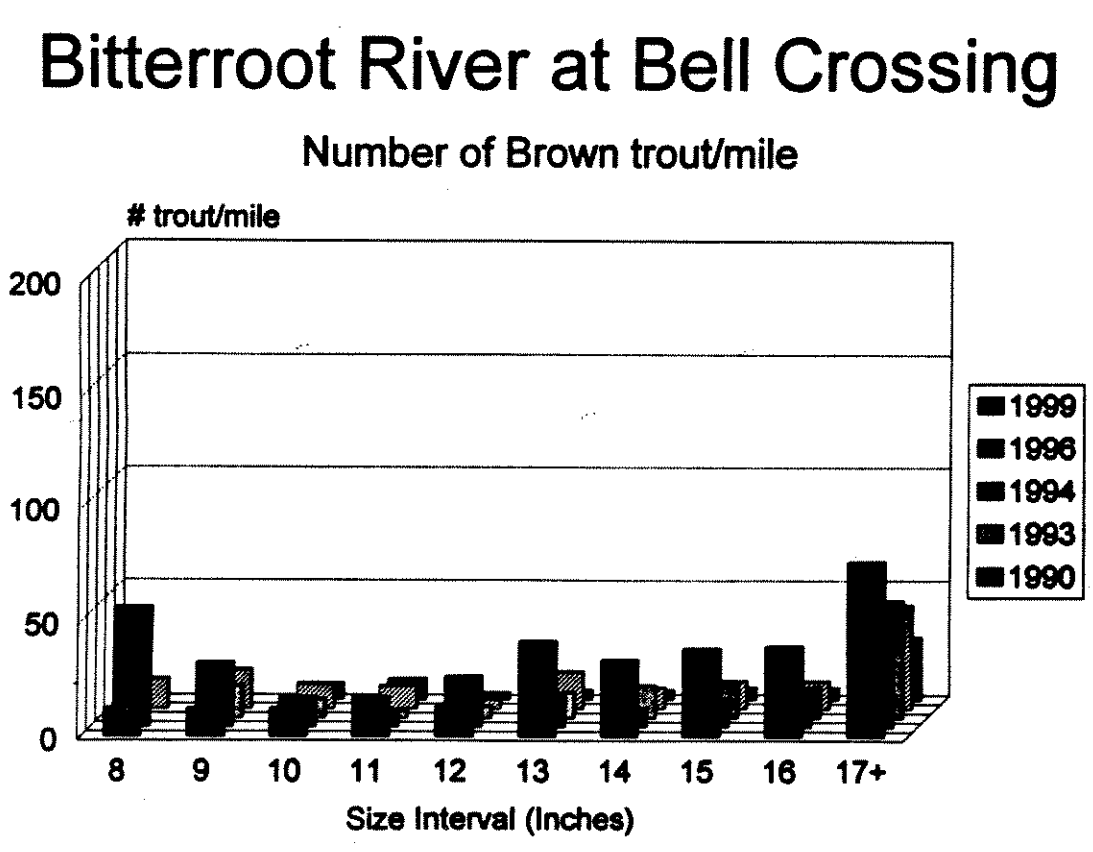
Mr 5.0 Estimates

FIGURE 4. Population estimates of westslope cutthroat by inch class in the Darby section during the years indicated.



Mr 5.0 Estimates

FIGURE 5. Population estimates of rainbow trout by inch class in the Bell Crossing section during the years indicated.



Mr 5.0 Estimates

FIGURE 6. Population estimates of brown trout by inch class in the Bell Crossing section during the years indicated.

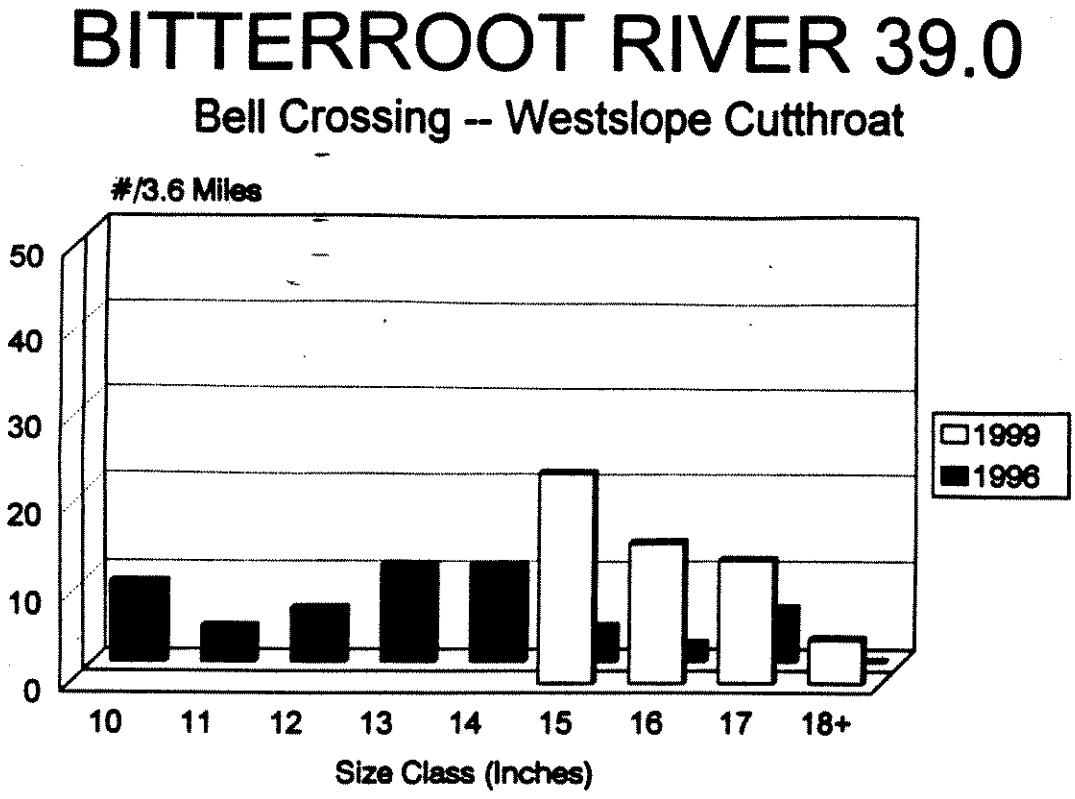
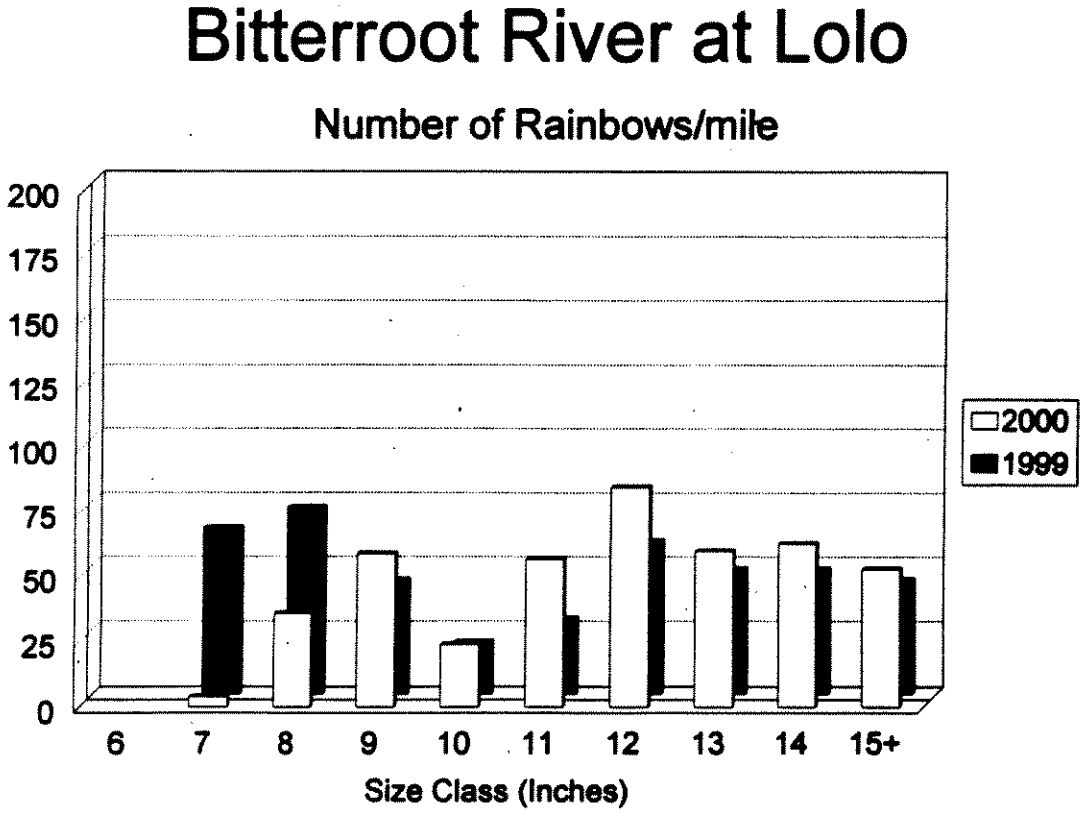


FIGURE 7. Population estimates of westslope cutthroat by inch class in the Bell Crossing section during the years indicated.



Mr 5.0 Estimates FIGURE 8. Population estimates of rainbow trout by inch class in the Lolo section during the years indicated.

We electrofished two sections of the East Fork of the Bitterroot River between Conner and Sula in year 2000 (Figure 1). Due to the landscape level forest fires that occurred in 2000, it seemed prudent to collect fish population data in reaches that have high potential for impacts associated with these fires. Prior to collection of the data, the river water had been impacted by some small slides due to rainfall events. At times, the water was black and turbid. However, these conditions did not seem to impact the trout populations we sampled. Rainbow trout population abundance was similar or above estimates from previous years in both reaches (Figures 9 and 10).

During 1998 we collected population estimates on trout in the West Fork of the Bitterroot River just downstream of Painted Rocks Reservoir and near Conner (Figure 1). The reach near Painted Rocks was 2.1 miles long. This reach is dominated by mountain whitefish. Rainbow trout, westslope cutthroat and brook trout were abundant enough for us to calculate a population estimate (Figure 11). Brown, and bull trout are also present in this reach, however, we were unable to capture enough of these species for a population estimate. This reach supports roughly 470 catchable trout per mile.

During 1973 a population estimate was collected in a 2000-foot section of the West Fork Bitterroot River in this area. At that time a large population of hatchery rainbow trout were captured. During 1973 the average size of rainbow and westslope cutthroat was smaller than in 1998, with few fish over 10 inches captured.

The Conner Reach of West Fork has been sampled previously and the trend has been an increasing number of westslope cutthroat and a stable population of rainbow trout (Figures 12 and 13). The catch-and-release regulation has been successful in producing larger westslope cutthroat trout. This reach was sampled in 1986. Since that time the proportion of westslope cutthroat handled during electrofishing has increased (Figure 14).

Fishing Pressure

Fishing pressure has been increasing in the Bitterroot River since surveys began in 1983 (Figure 15). In 1999, angler use exceeded 100,000 angler days. The Bitterroot River is divided into two reaches for the purpose of the survey. Reach 01 extends from the mouth near Missoula to Big Creek near Victor. Reach 02 extends from Big Creek to the headwaters at the confluence of the East and West Forks near Conner. Angler use varies between the two reaches (Table 1).

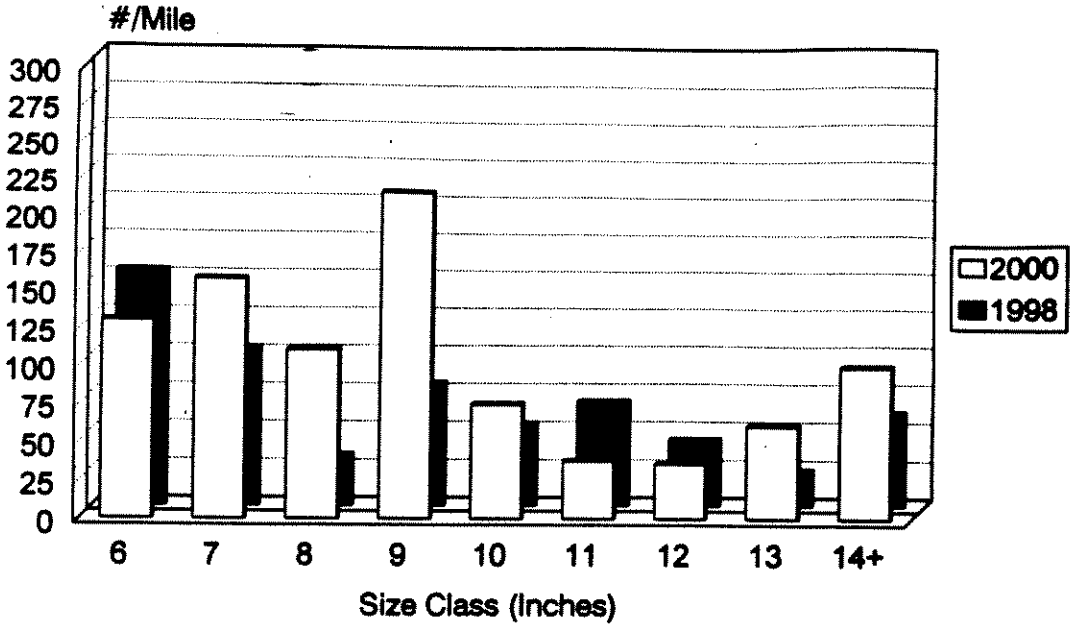
Table 1. Angler densities and percent of resident anglers fishing in the Bitterroot River in 1999.

	1999 angler days/mile	% resident
Reach 01 (Mouth – Big Cr)	1205	78
Reach 02 (Big Cr – Headwaters)	1652	65

In 1999, 70% of anglers on the Bitterroot River were residents. The lower Bitterroot River tends to have a lower density of anglers but a higher proportion of residents and

East Fork Bitterroot River 2.5

Rainbow Trout

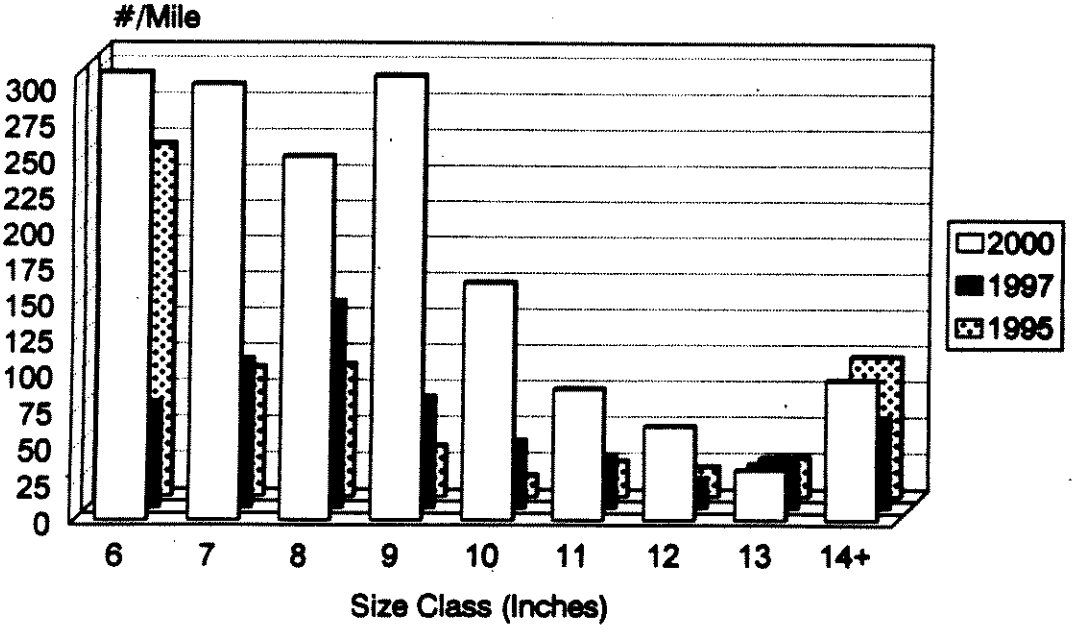


Mr 5.0 Estimates

FIGURE 9. Population estimates of rainbow trout by inch class in the East Fork Bitterroot River 2.5 during the years indicated.

East Fork Bitterroot River 12.0

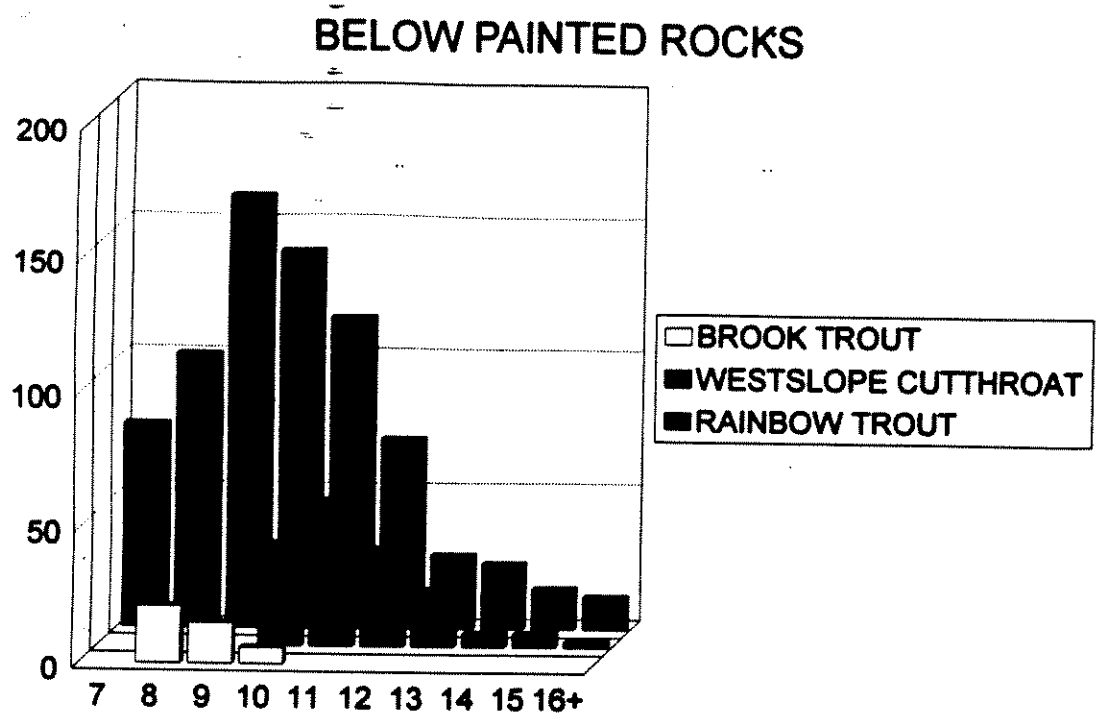
Rainbow Trout



Mr 5.0 Estimates

FIGURE 10. Population estimates of rainbow trout by inch class in the East Fork Bitterroot River 12.0 during the years indicated.

WEST FORK BITTERROOT 22.2



2.1 MILES

FIGURE 11. Population estimates by inch class in the West Fork Bitterroot River below Painted Rocks reservoir in 1998.

West Fork Bitterroot River 01.2

Rainbow Trout

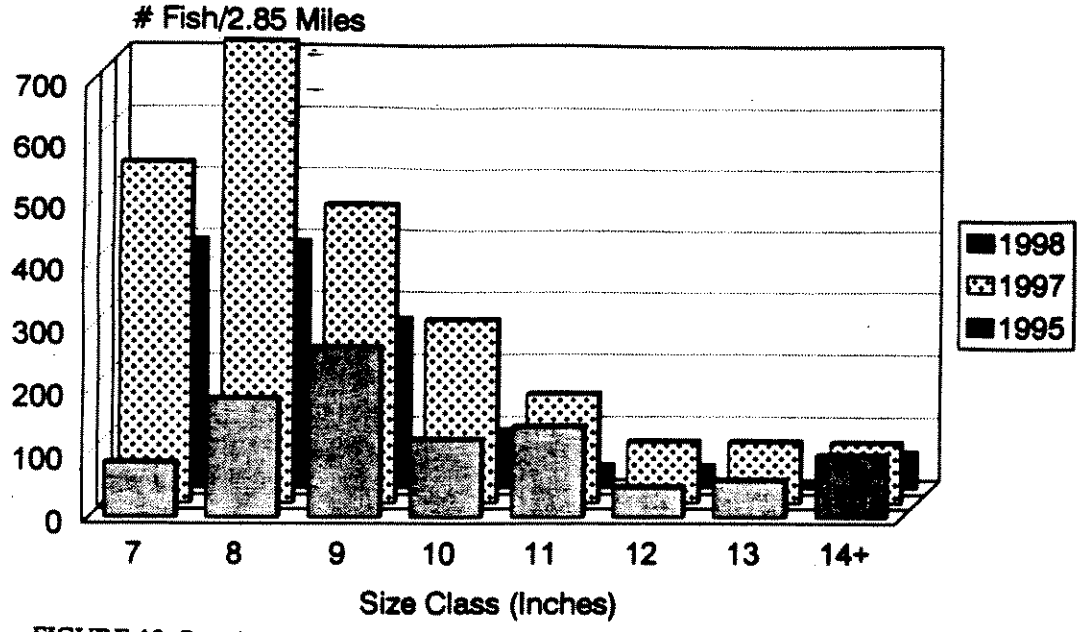


FIGURE 12. Population estimates of rainbow trout in the Conner section of the West Fork Bitterroot River during the years indicated.

West Fork Bitterroot River 01.2

Cutthroat Trout

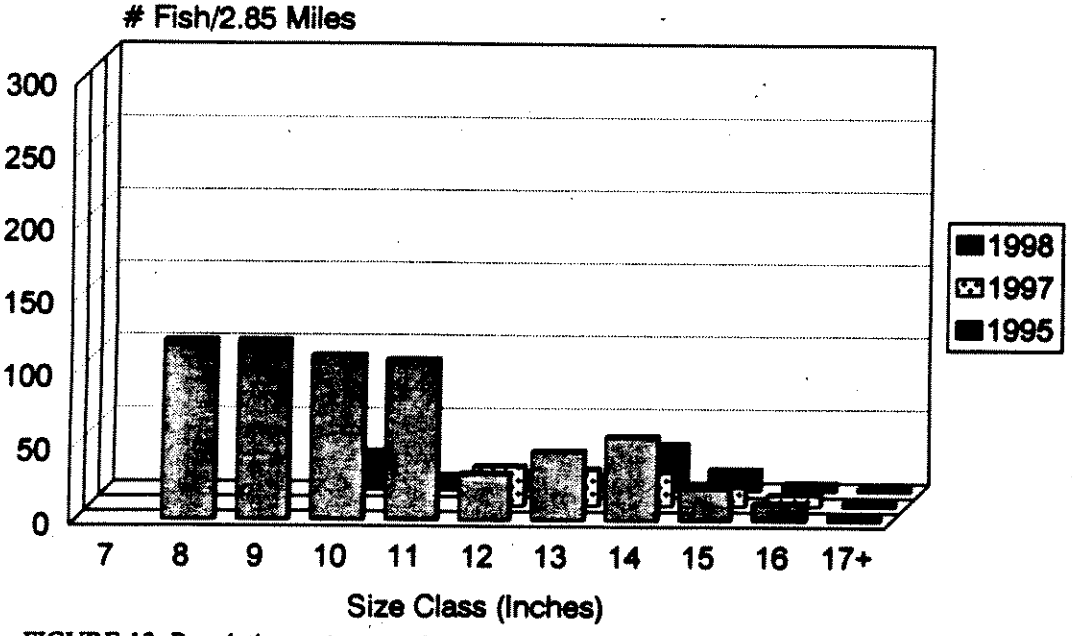


FIGURE 13. Population estimates of westslope cutthroat in the Conner section of the West Fork Bitterroot River during the years indicated.

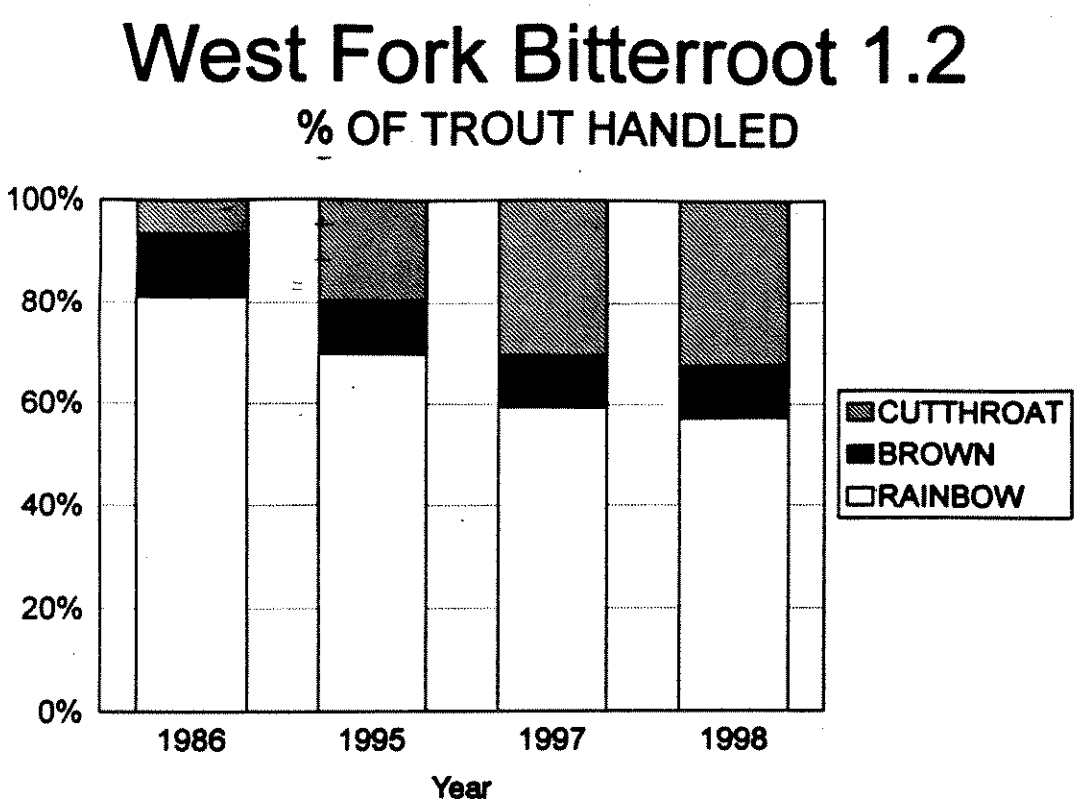


FIGURE 14. Proportion of trout of different species handled during electrofishing the Conner section of the West Fork Bitterroot river during the years indicated.

FISHING PRESSURE

BITTERROOT RIVER

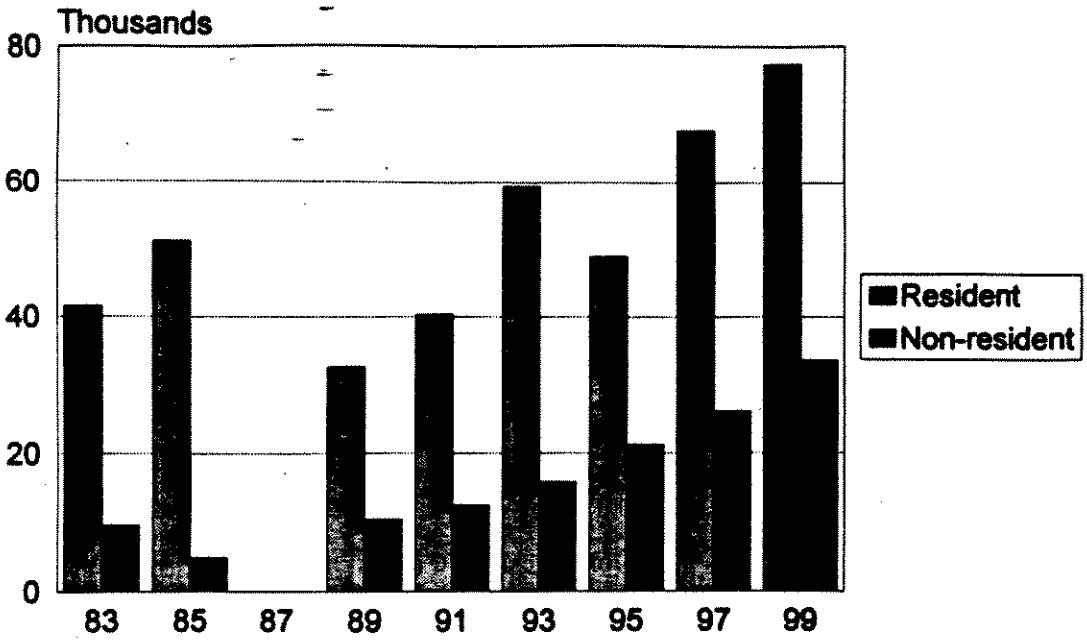


FIGURE 15. Fishing pressure estimates on the Bitterroot River during the years indicated.

conversely, the upper river supports higher densities of anglers and lower proportion of residents.

Whirling Disease

Sampling fish for the presence of *Myxobolus cerebralis* was first undertaken in the Bitterroot River in 1995. Since then, continuous sampling has occurred (Table 2). We have used a combination of grab samples and sentinel cages to assess the presence and distribution of the parasite. We have found that the parasite is present in the Bitterroot River. However, so far we have only found two fish with light infections. We will continue sampling in the future to assess any changes in this status.

Table 2. Testing for the presence of *Myxobolus cerebralis* in the Bitterroot drainage

Stream	Date	Location	Species & number	Method	Results
Bitterroot River	4/10/95	Near Darby T4N,R21W,S23	Rb - 17	Grab sample	Negative
	4/10/95	Near Hamilton T6N,R20W,S12	Rb – 19	Grab sample	Negative
	4/10/95	Near Stevensville T9N,R20W,S22	Rb - 23	Grab sample	Negative
	4/10/95	Near Lolo T12N,R20W,S26	Rb - 26	Grab sample	Negative
Hedge Ditch	10/3/96	T6N,R20W,S32	Rb - 1 Ct – 1 Mtn.Wf - 1	Grab sample	Negative
	10/3/96	T5N,R20W,S30			Negative
Republican Ditch	10/3/96	T5N,R21W,S25	LL – 11 Mtn.Wf – 1 Rb - 5	Grab sample	Negative
West Fork Bitterroot River	4/1/97	Downstream of Painted Rocks Dam T1S,R22W,S26	Eb – 7 Mtn.Wf – 5 Rb – 21 Dv – 1 Ct - 1	Grab sample	Negative
Bitterroot River	3/20/97	Near Darby T4N,R21W,S23	Rb – 14 LL – 8 Eb - 3	Grab sample	Negative
	3/20/97	Near Hamilton T6N,R20W,S12	Rb - 22	Grab sample	Negative
	3/20/97	Near Stevensville T9N,R20W,S22	Rb – 17 LL – 3 Mtn.Wf - 8	Grab sample	Negative
	3/21/97	Near Lolo T12N,R20W,S26	Rb – 9 LL - 3	Grab sample	Negative
	3/21/97	Near Missoula T13N,R20W,S35	Rb - 5	Grab sample	Negative
Bitterroot River	5/12/99-5/22/99	Near Darby T3N,R21W,S2	Rb - 60	Sentinel cage	Negative

Bitterroot River	3/31/99 3/31/99 3/31/99 3/31/99	Near Darby T4N,R21W,S23 Near Hamilton T6N,R20W,S12 Near Stevensville T9N,R20W,S22 Near Lolo T11N,R20W,S26 Near Missoula T13N,R20W,S35	Rb- 15 LL - 10 Mtn.WT - 3 Rb - 20 Rb - 23 Rb - 10 Rb - 2 LL - 1	Grab sample Grab sample Grab sample Grab sample Grab sample	1 Rb positive Negative Negative Negative Negative
West Fork Bitterroot River	4/01/99	Downstream of Painted Rocks Dam	Eb - 10 Rb - 9 LL - 1	Grab sample	Negative
Bitterroot River	11/5/99-11/15/99	Near Darby T3N,R21W,S2 Near Hamilton T6N, R20W,S12 Near Stevensville T9N,R20W,S22	Rb - 60 Rb - 60 Rb - 60	Sentinel cage Sentinel cage Sentinel cage	Negative Negative 1 Rb positive

Bitterroot National Forest

During 1998, 1999 and 2000 we continued to monitor fish populations at established sites within the Bitterroot National Forest.

Stevensville District

Burnt Fork Bitterroot River 19.2

The only long-term monitoring reach that we sampled in the past 3 years was on the Burnt Fork Bitterroot River. This section is at the end of the road near some dispersed camgrounds at the trailhead. The population estimates of westslope cutthroat have been consistent between 1994 and 2000, particularly in the larger size groups (Figure 16). Bull

BURNT FORK BITT. RIVER 19.7

Westslope Cutthroat

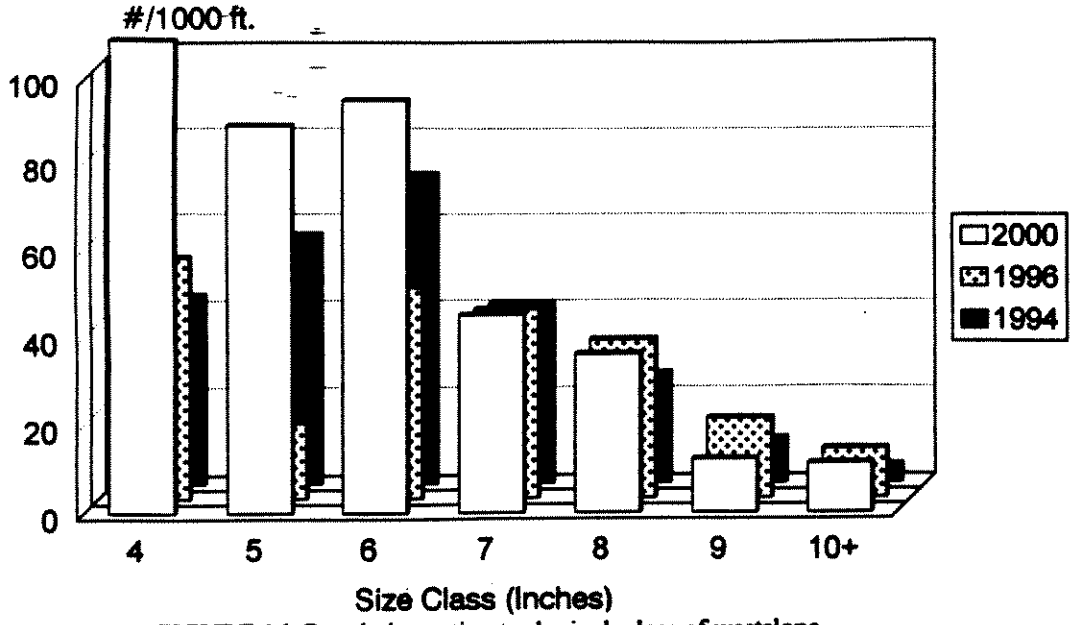


FIGURE 16. Population estimates by inch class of westslope cutthroat in Burnt Fork Bitterroot River 19.7 during the years indicated.

BURNT FORK BITT. RIVER 19.7

Bull Trout

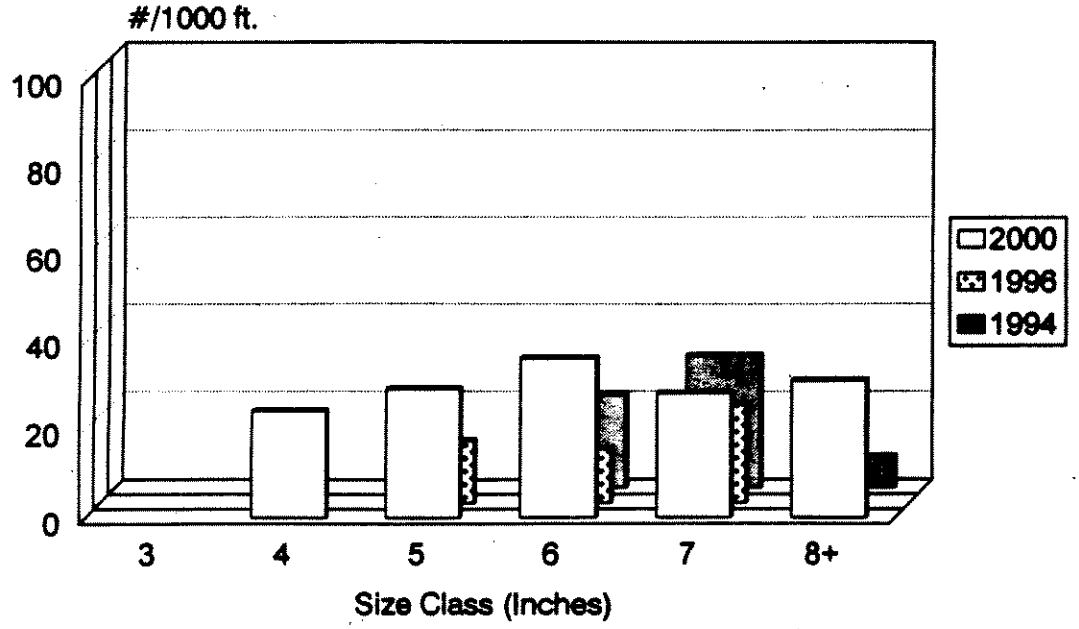


FIGURE 17. Population estimates by inch class of bull trout in Burnt Fork Bitterroot River 19.7 during the years indicated.

trout population estimates indicate an increasing trend in the larger size groups (Figure 17).

Kootenai Creek 3.5

We have also monitored a reach on Kootenai Creek since the catch-and-release regulations were instituted. Initially, we attempted to obtain population estimates by mark and recapture. In 1995 and 1998 we captured fish by angling, inserted a tag in them and then snorkeled to obtain a population estimate. In 1999 we began to assess the size of fish captured by angling as the monitoring method. When size of angler caught fish is compared between 1995 and 1999, it appears that the number of fish longer than 7 inches has increased since 1995 (Figure 18). We were unable to sample in 2000 due to fire restrictions, so we will monitor again in 2001 to assess any change in the number of larger fish.

Darby District

Some of the monitoring sites on the Darby district were sampled in 1998-2000. The trends in cutthroat populations vary by site and it is not possible to characterize them on a district wide basis, partially due to likely impacts of the fires of 2000. A more detailed discussion of individual sites follows later in this report.

Rye Creek 12.4 and North Rye Creek 1.7

Both of these sites were sampled in 2000. The number of fish of all species declined in both of these reaches between 1997 and 2000. These reaches were within areas that burned in 2000. The number of westslope cutthroat in Rye Creek 12.4 declined since 1997, however it is within the range of past estimates (Figure 19). The riparian area adjacent to the Rye Creek section was significantly burned and the fire may have caused direct mortality to some fish in this reach.

The number of westslope cutthroat and brook trout in the North Rye section was much lower in 2000 than during previous sampling (Figures 20 and 21). It is possible that direct mortality due to the 2000 fire was the cause.

Skalkaho Creek 13.1 and 16.8

Populations of westslope cutthroat in these two reaches have followed similar trends. In both sections the number of larger fish has been increasing but the number of smaller size fish has generally declined since sampling began (Figures 22-24). The catch-and-release fishing regulations may be protecting some of the larger fish, but the decline in the number of smaller fish is not understood.

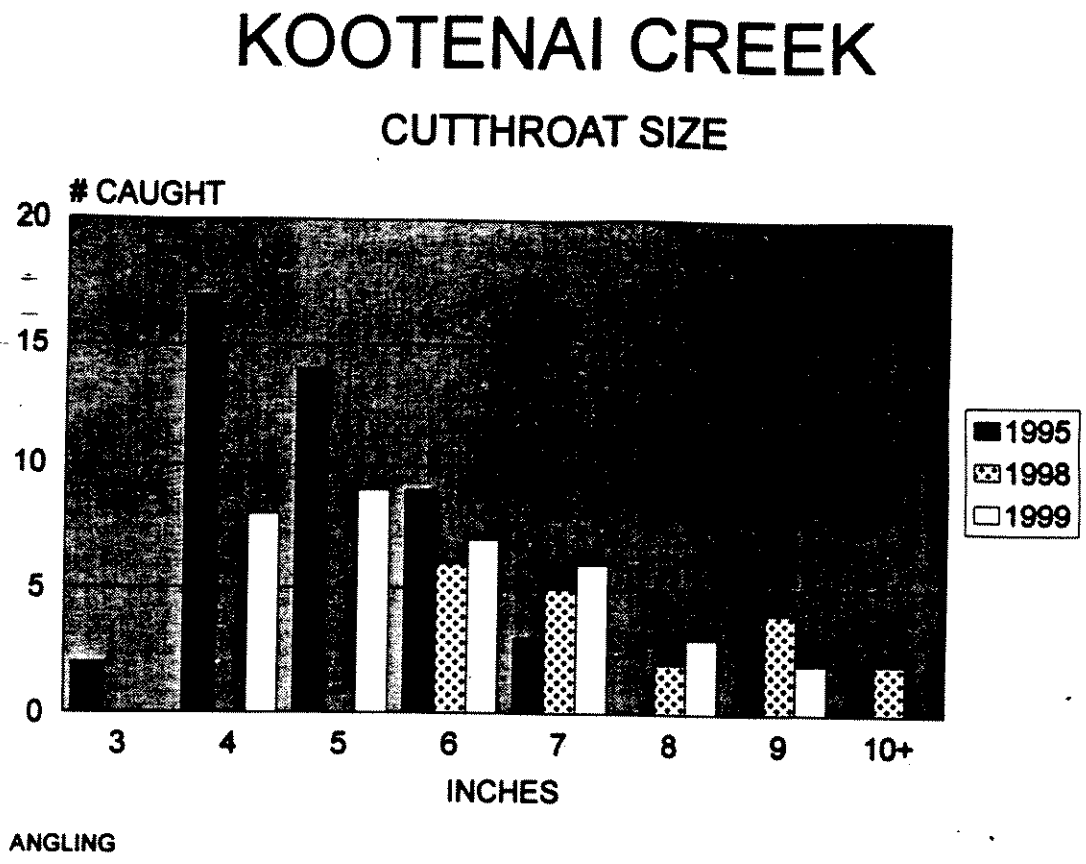
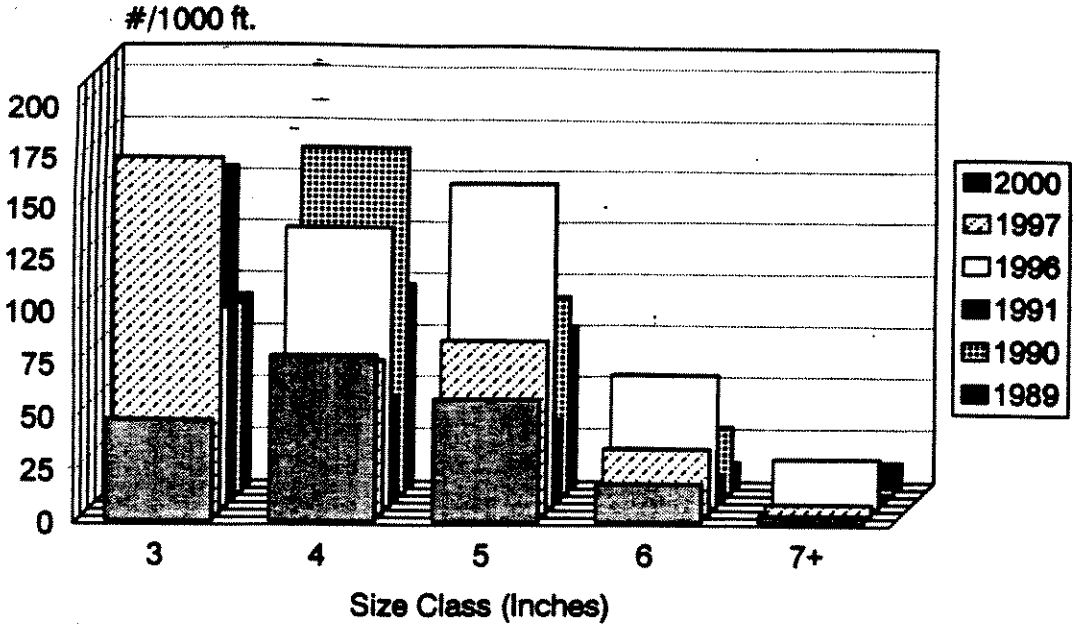


FIGURE 18. Sizes of westslope cutthroat captured by angling in Kootenai Creek during the years indicated.

RYE CREEK 12.4

Westslope Cutthroat

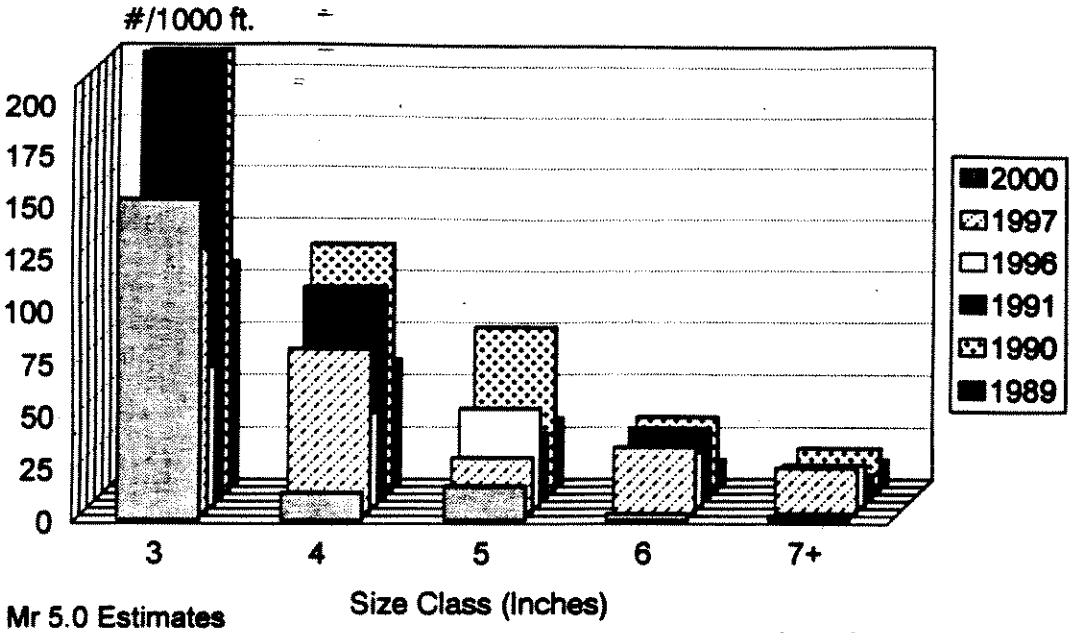


Mr 5.0 Estimates

FIGURE 19. Population estimates by inch class of westslope cutthroat in Rye Creek 12.4 during the years indicated.

NORTH RYE CREEK 1.9

Westslope Cutthroat

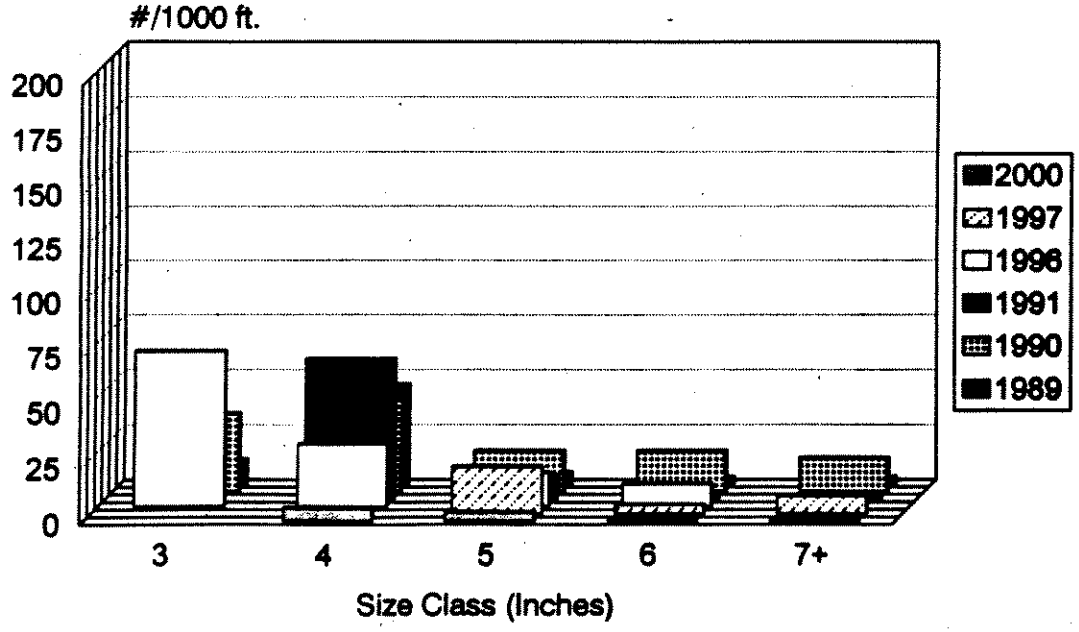


Mr 5.0 Estimates

FIGURE 20. Population estimates by inch class of westslope cutthroat in North Rve Creek 1.9 during the years indicated.

NORTH RYE CREEK 1.9

Brook Trout



Mr 5.0 Estimate

FIGURE 21. Population estimates by inch class of brook trout in North Rye Creek 1.9 during the years indicated.

SKALKAHO CREEK 13.1

WESTSLOPE CUTTHROAT

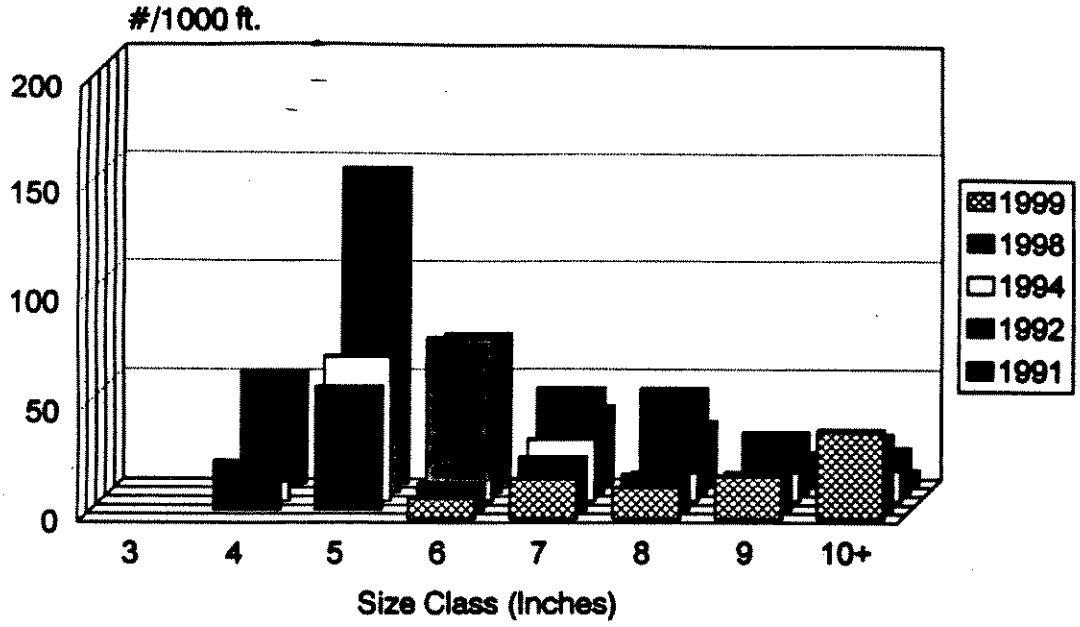
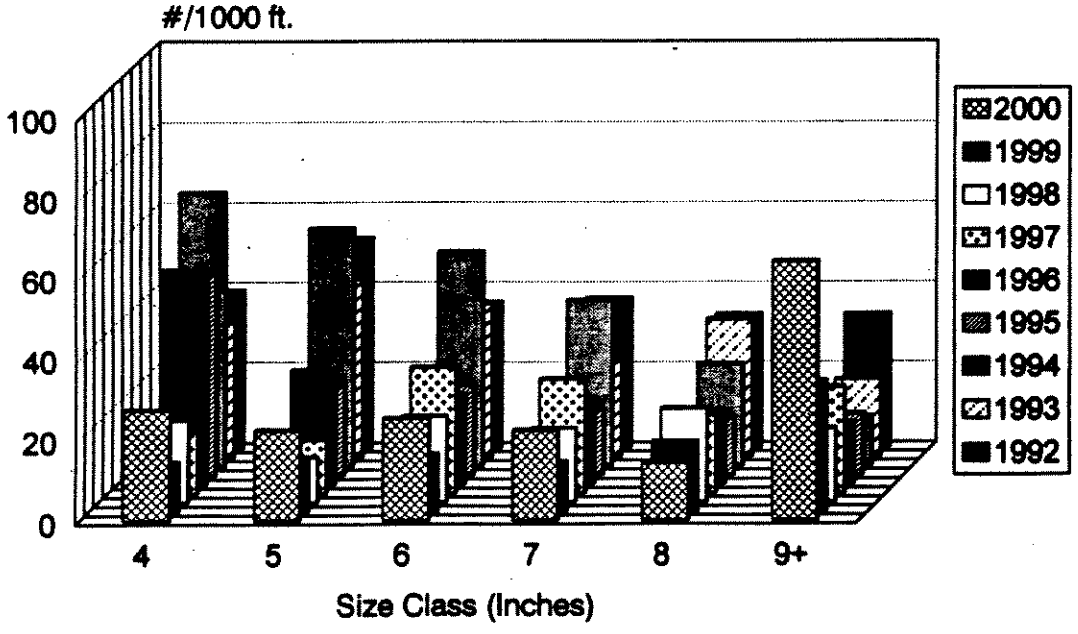


FIGURE 22. Population estimates by inch class of westslope cutthroat in Skalkaho Creek 13.1 during the years indicated.

SKALKAHO CREEK 16.8

WESTSLOPE CUTTHROAT



Mark-Recapture 4.0

FIGURE 23. Population estimates by inch class of westslope cutthroat in Skalkaho Creek 16.8 during the years indicated.

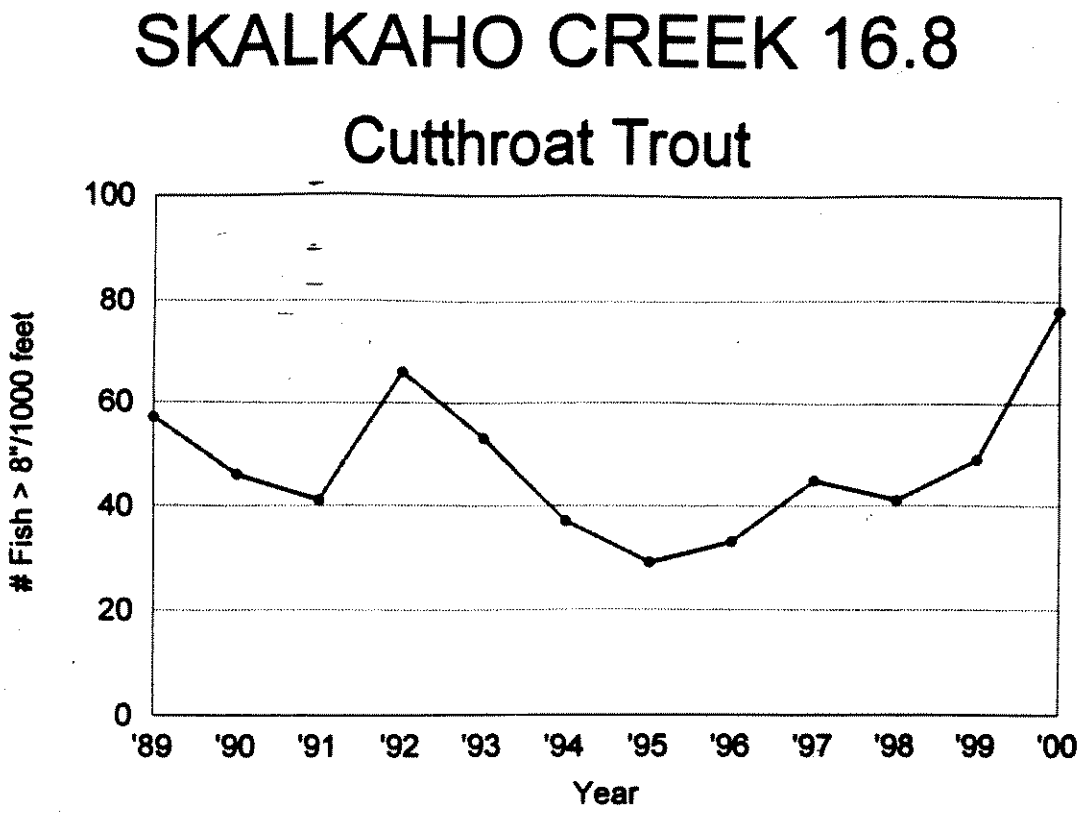


FIGURE 24. Population trend of westslope cutthroat longer than 8 inches in Skalkaho Creek 16.8 during the years indicated.

The number of larger bull trout has increased in the upper reach (16.8) but not in the lower reach (13.1) (Figures 25-27). The number of smaller bull trout (<8") is at or below past estimates.

The population estimates of westslope cutthroat in section 16.8 < 9.0 inches long have been lower after 1994 than before. Since we have electrofished this site every year since 1989, we wanted to assess whether regular electrofishing may be having an impact on juvenile westslope cutthroat. For comparison, in 2000 we collected population estimates at Skalkaho 17.2, which is within ½ mile of the long-term section. Overall, the long-term study reach had higher numbers of westslope cutthroat, but lower numbers of bull trout than the new reach (Figures 28 and 29). Fewer numbers of bull trout in the long term section were unexpected, but the similar number of juvenile westslope cutthroat in each section indicates that electrofishing may not be having serious impacts on them.

Daly Creek 0.7

During 1999, the long term monitoring section of Daly Creek was sampled. The population of larger westslope cutthroat were high compared to past sampling (Figure 30). The number of smaller westslope cutthroat is lower than past sampling. The number of bull trout is somewhat lower than in the past (Figure 31). This reach is subject to catch-and-release fishing regulations.

Sleeping Child Creek 10.2

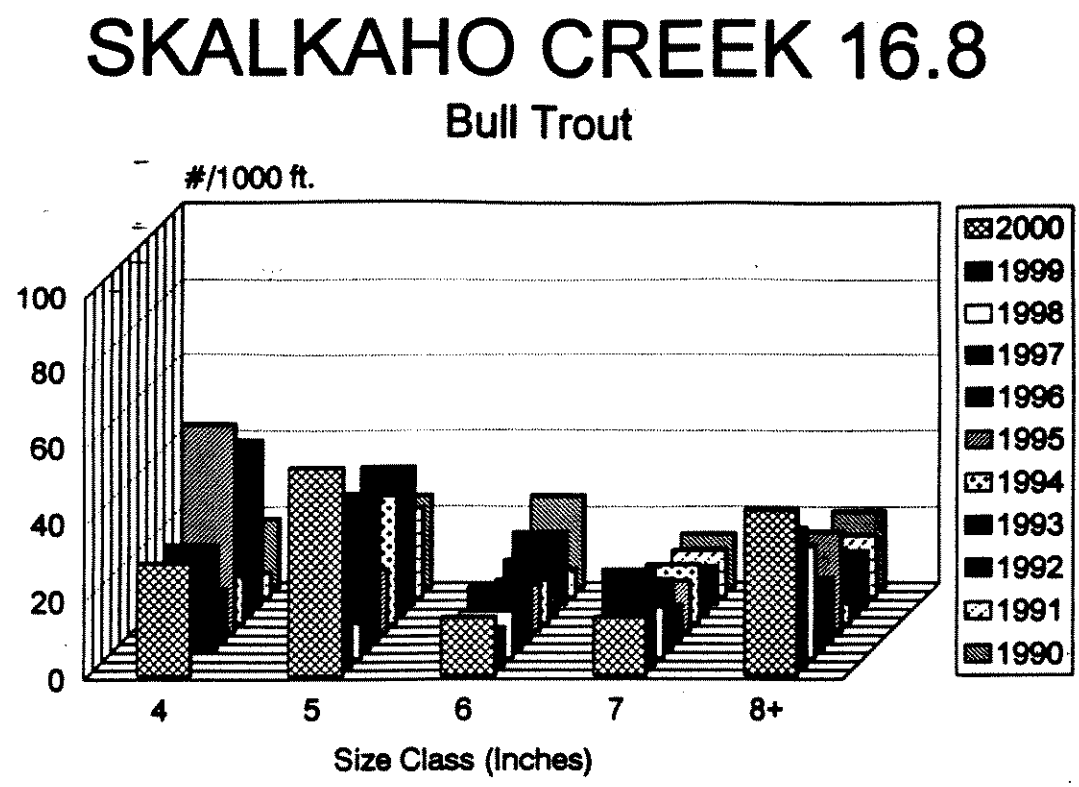
This monitoring section has been elecrofished since 1989. The population of westslope cutthroat fluctuates annually, but was within the historic range in 2000 (Figure 32). The number of larger cutthroat was higher than in the past, while the number of smaller fish was lower. This section is open to the general fishing regulations. The population of bull trout in this reach is small and difficult to enumerate.

Sula District

Some of the long-term monitoring reaches were sampled during 1999 and 2000. Most of the population estimates were within range of past data. Declines in the number of larger westslope cutthroat since the early 1990's are evident in some cases.

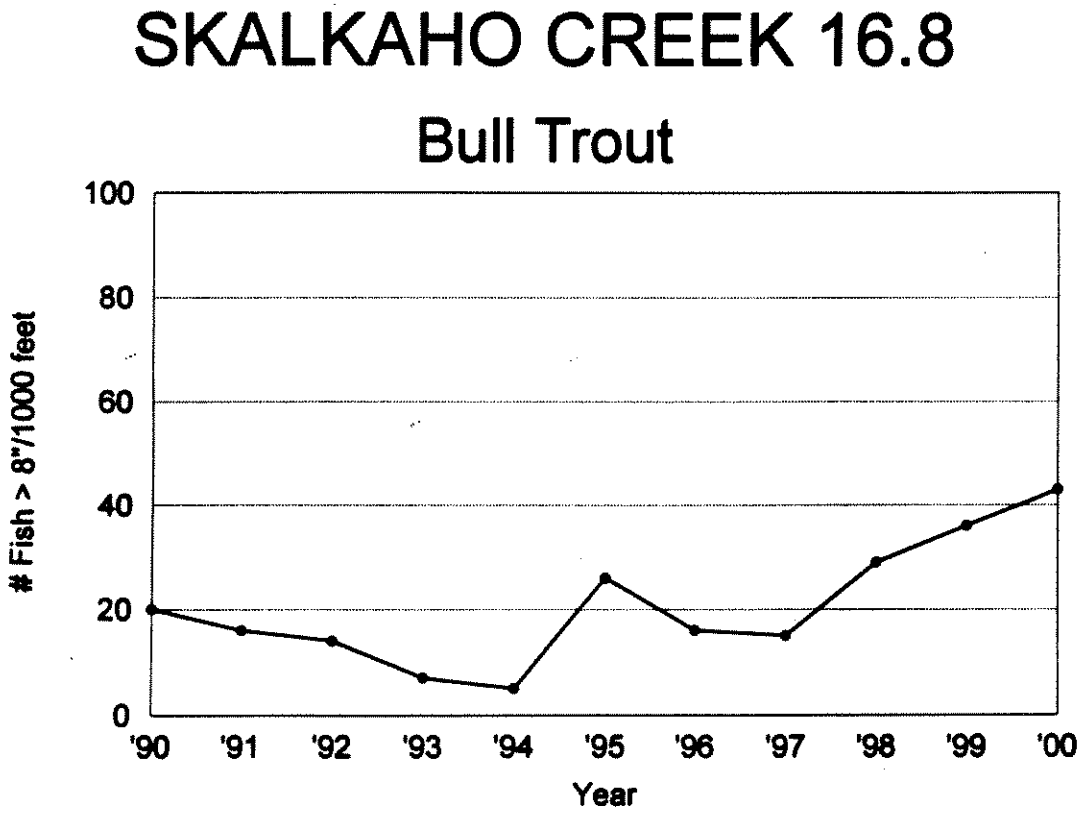
Martin Creek 1.3 and Moose Creek 1.4

This reach of lower Martin Creek was sampled in 1999 and the number of westslope cutthroat was lower than during previous estimates, particularly the larger 9-10 inch fish (Figure 33). Angler harvest may be having an impact on larger cutthroat trout since this area is easily accessible and near a public campground. Bull trout are found in this reach, in low numbers, and the number sampled was within the range of past sampling. The majority of the bull trout appeared to be hybridized with brook trout.



Mark-Recapture 5.0

FIGURE 25. Population estimates by inch class of bull trout in Skalkaho Creek 16.8 during the years indicated.



Mark Recapture 5.0 Estimates

FIGURE 26. Population trend of bull trout longer than 8 inches in Skalkaho Creek 16.8 during the years indicated.

SKALKAHO CREEK 13.1

BULL TROUT

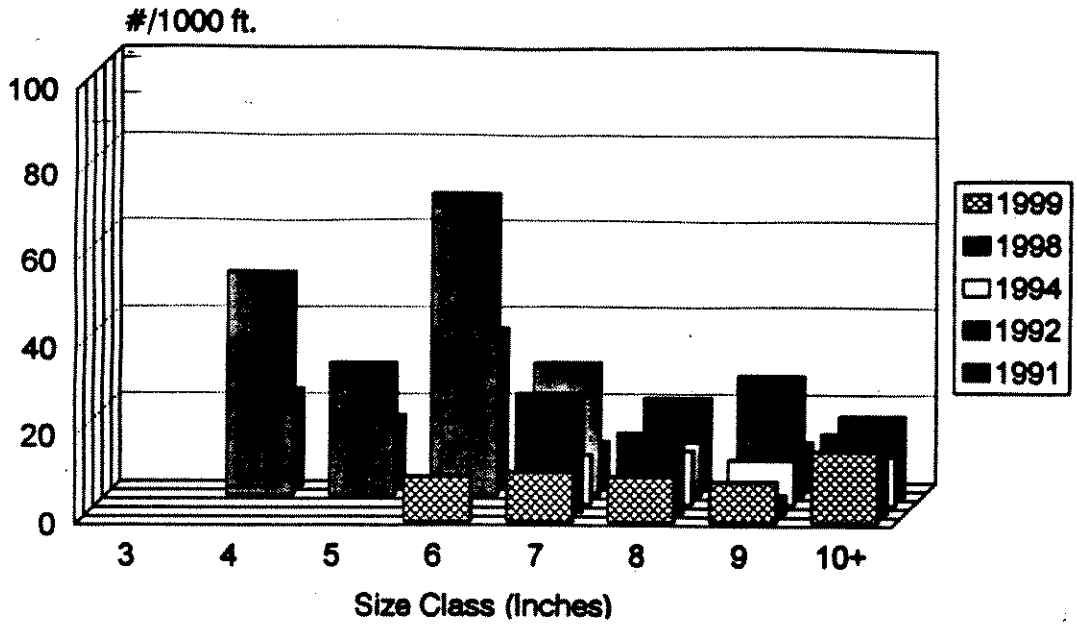
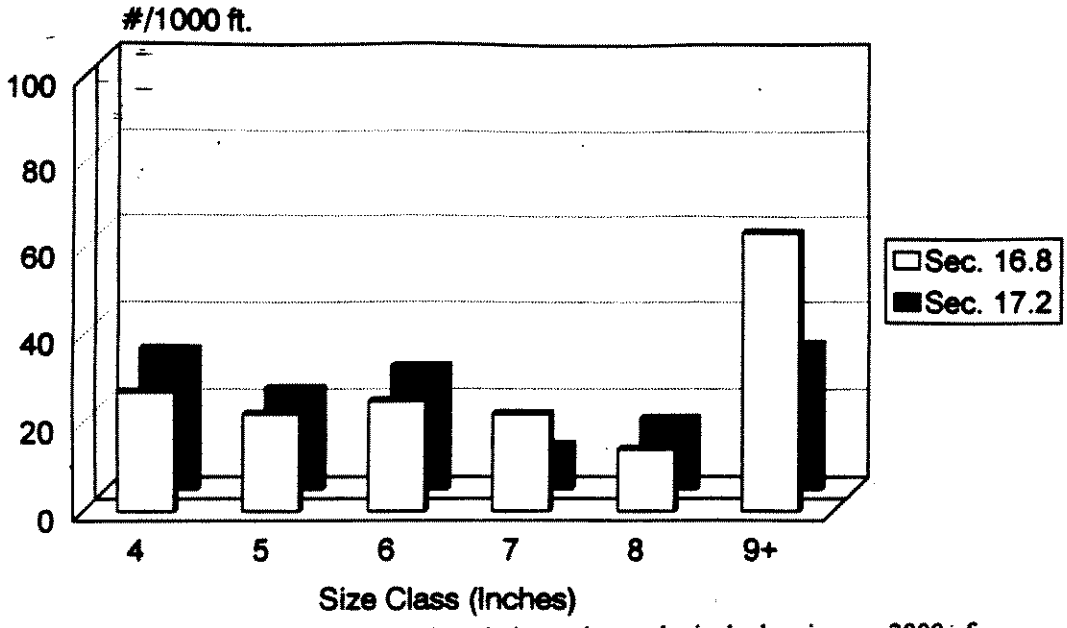


FIGURE 27. Population estimates by inch class of bull trout in Skalkaho Creek 13.1 during the years indicated.

SKALKAHO CREEK

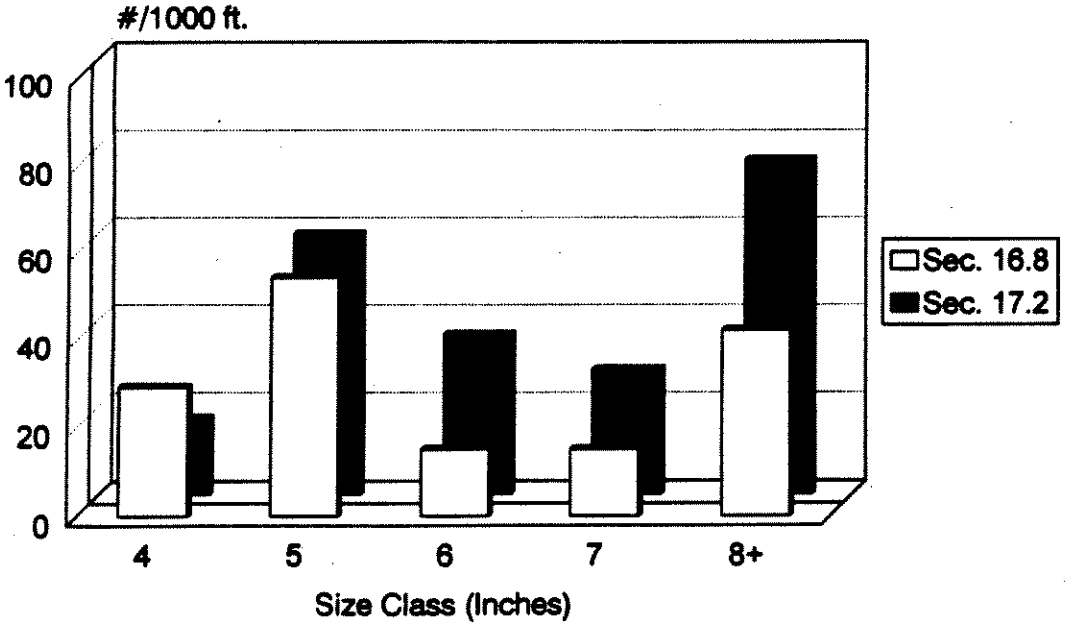
2000 Westslope Cutthroat Estimates



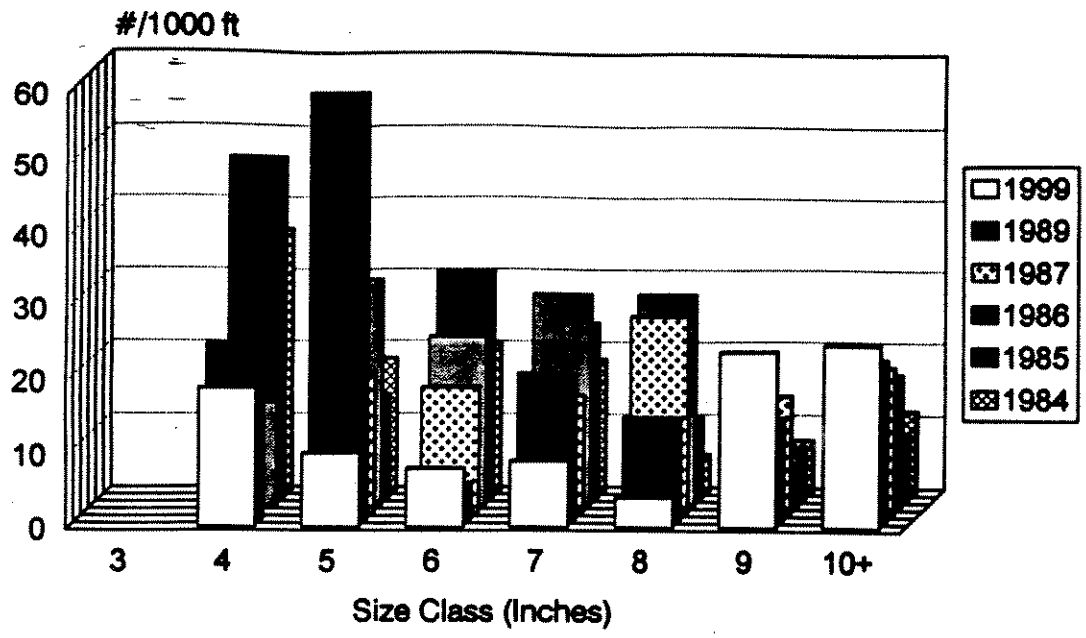
Mark-Recapture 5.0 FIGURE 28. Population estimates by inch class in year 2000 of westslope cutthroat in Skalkaho Creek 16.8 and 17.2.

SKALKAHO CREEK

2000 Bull Trout Estimates



Mark-Recapture 5.0 FIGURE 29. Population estimates by inch class in year 2000 of bull trout in Skalkaho Creek 16.8 and 17.2



Mark_Recapture 5.0 FIGURE 30. Population estimates by inch class of westslope cutthroat in Daly Creek 0.7 during the years indicated.

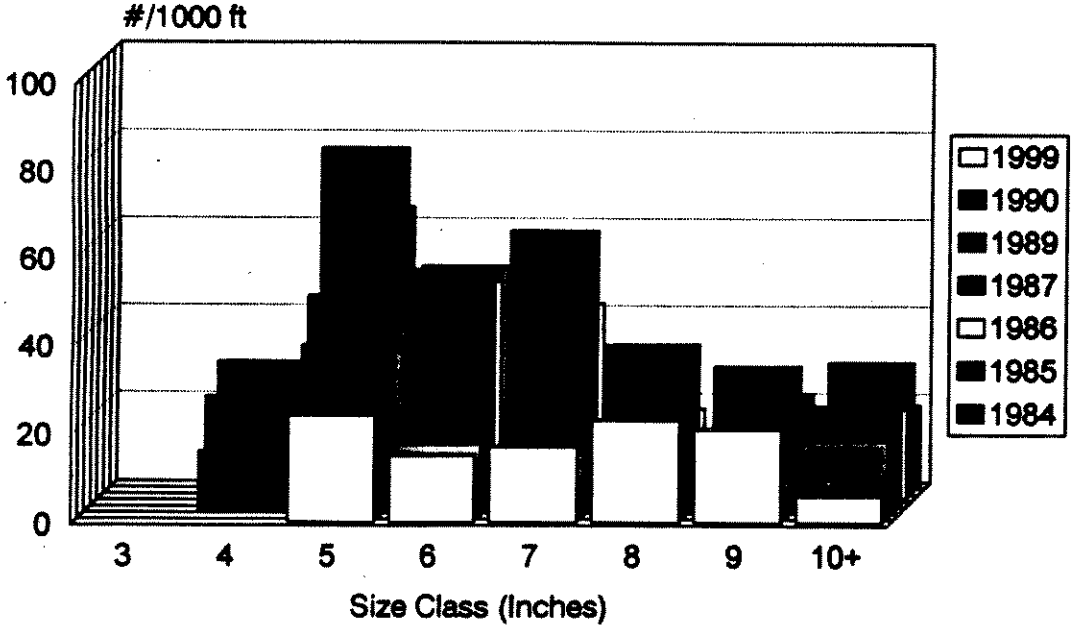
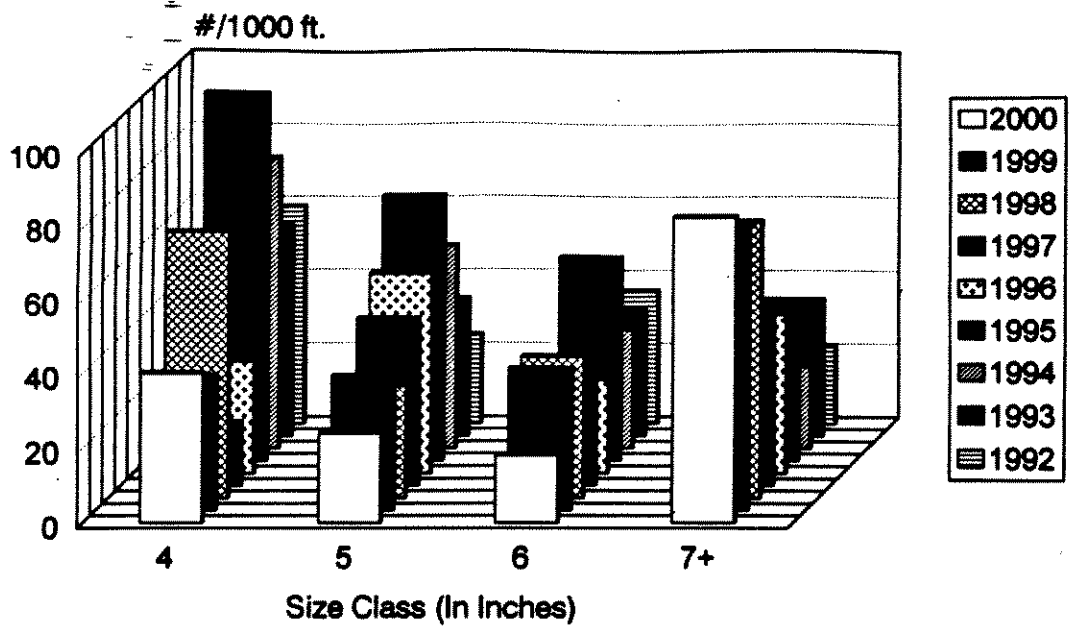


FIGURE 31. Population estimates by inch class of bull trout in Daly Creek 0.7 during the years indicated.

SLEEPING CHILD CREEK 10.2

WESTSLOPE CUTTHROAT



Mark-Recapture 5.0

FIGURE 32. Population estimates by inch class of westslope cutthroat in Sleeping Child Creek 10.2 during the years indicated.

The lower reaches of Martin and Moose Creeks support similar populations of westslope cutthroat. The 1999 population estimate of westslope cutthroat in Moose Creek was similar in number to past estimates (Figure 34). The number of bull trout has varied considerably since sampling began in 1991. The 1999 population was relatively low compared to past estimates.

Meadow Creek 5.6

This reach was sampled in 2000 and the westslope cutthroat and bull trout populations were near or slightly below past estimates (Figures 35 and 36). This area is easily accessible and there is potential that angler harvest may be impacting larger cutthroat trout. The number of larger bull trout fluctuates but no real trend is evident.

Reimel Creek 2.6 and 3.8

Reimel Creek was last sampled in 1992. Due to wildfires impacting a high proportion of the drainage, we collected population estimates on two of the study sites in 2000. Considerable stream restoration work had occurred in the drainage previous to 2000. The lower reach (2.6) had some rootwads installed and the upper site (3.8) in a meadow was intensively restored. The population estimates of larger cutthroat trout was the highest ever measured in the upper site and was slightly higher than past estimates at the lower site (Figures 37-40). The same is true of brook trout. The number of large brook trout was much higher at the upper site and slightly higher at the lower site.

Warm Springs Creek 3.5

This reach of Warm Springs Creek was sampled in 2000. The number of westslope cutthroat was similar to past sampling, with lower numbers of small fish and average numbers of larger fish (Figure 41).

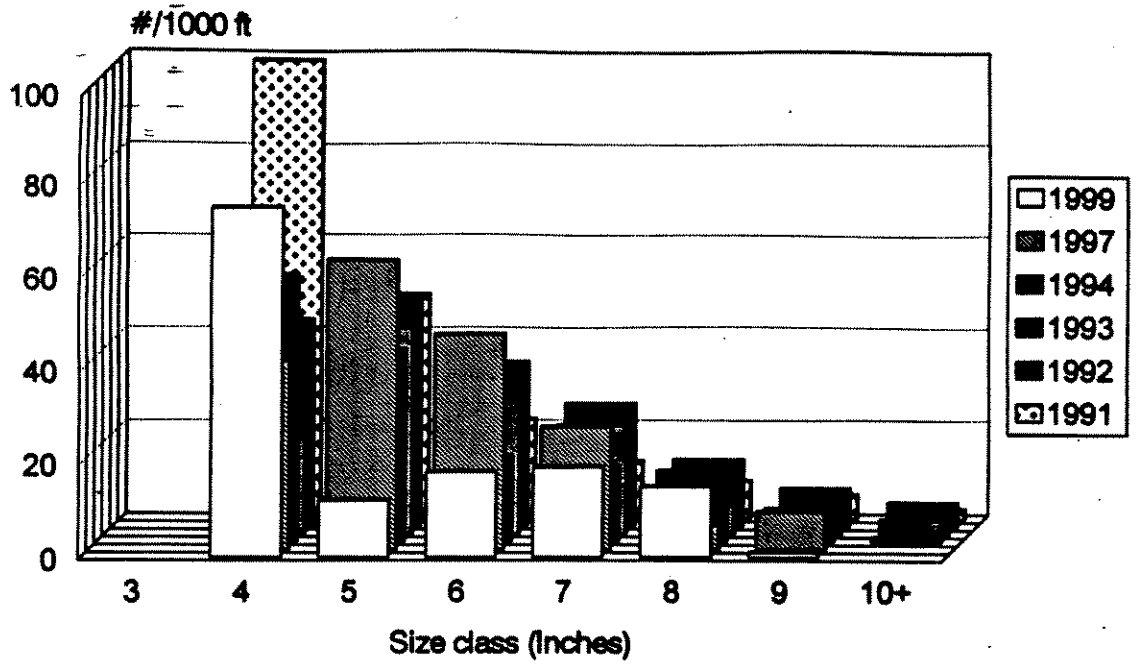
Praine Creek 1.0 and Bertie Lord 0.2

Neither of these reaches are long-term monitoring reaches, but both were sampled recently. Praine Creek 1.0 was sampled in 2000 due to the high intensity fire that passed through the study reach. This reach had only been sampled once previously. The population estimate of westlope cutthroat and brook trout was much lower in 2000 than in 1995 (Figure 42). The fire intensity in this reach was extreme, but the lower numbers of fish could be due to other factors also.

Bertie Lord 0.2 was sampled in 1999. The total number of westslope cutthroat was similar to past sampling in 1990 and 1991, but the number of larger fish was lower (Figure 43)

MARTIN CREEK 1.3

Westslope Cutthroat



Mark-Recapture 5.0

FIGURE 33. Population estimates by inch class of westslope cutthroat in Martin Creek 1.3 during the years indicated.

MOOSE CREEK 1.4

Westslope Cutthroat

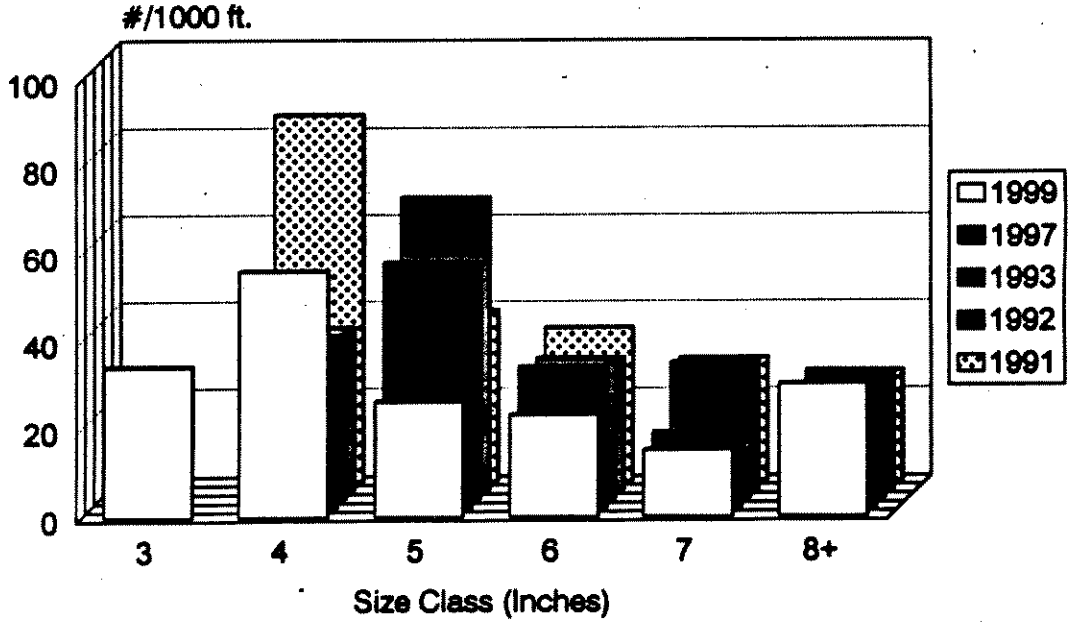
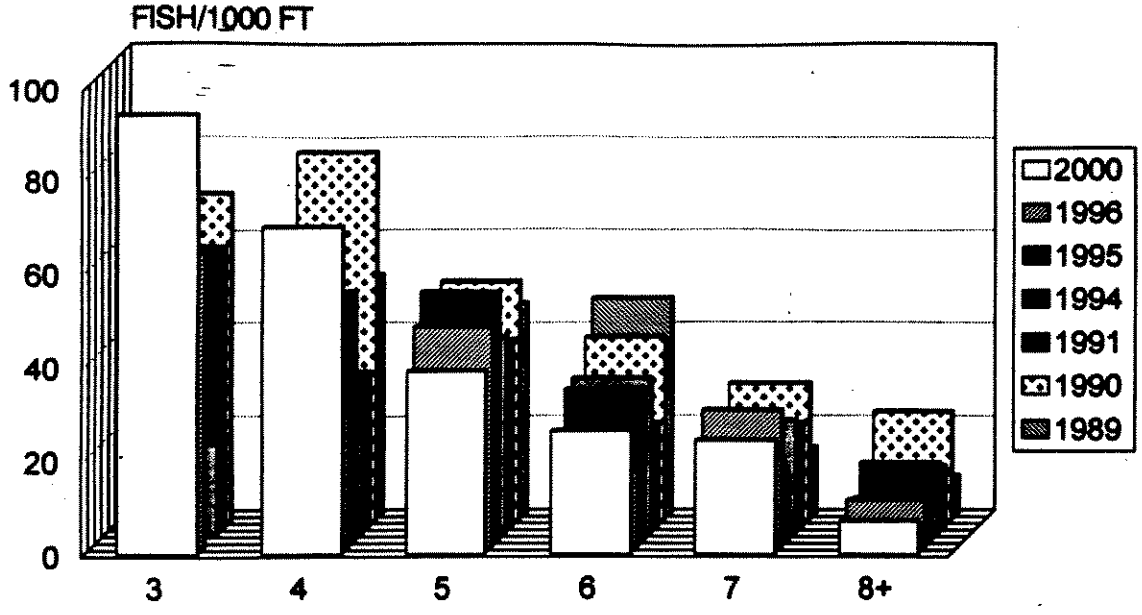


FIGURE 34. Population estimates by inch class of westslope cutthroat in Moose Creek 1.4 during the years indicated.

MEADOW CREEK 5.6

WESTSLOPE CUTTHROAT

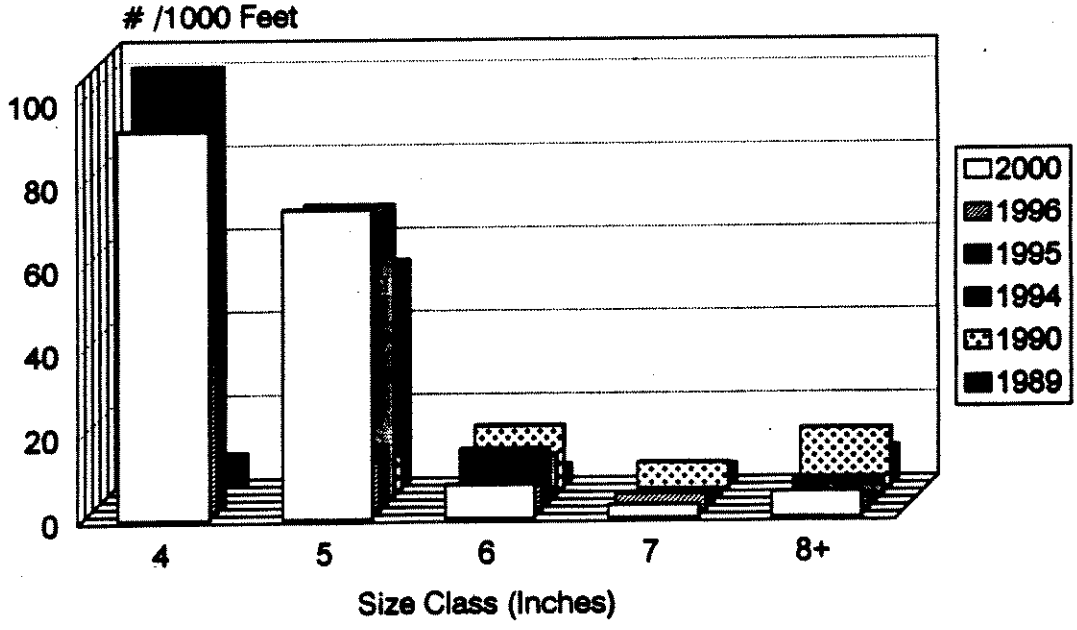


Mr 5.0 Estimates

FIGURE 35. Population estimates by inch class of westslope cutthroat in Meadow Creek 5.6 during the years indicated.

MEADOW CREEK 5.6

Bull Trout

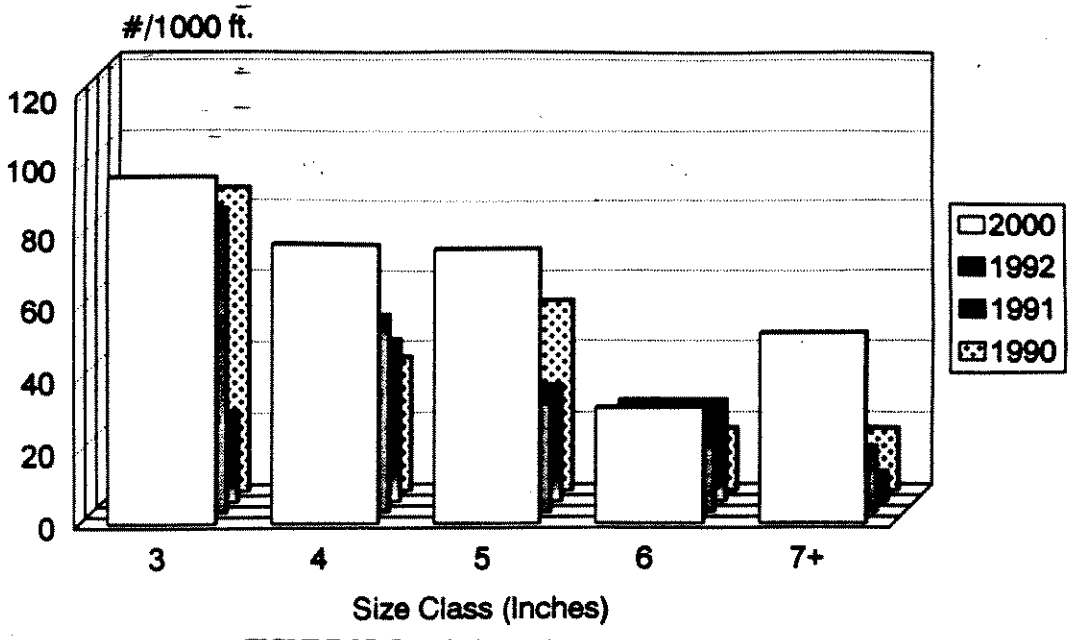


Mr 5.0 Estimates

FIGURE 36. Population estimates by inch class of bull trout in Meadow Creek 5.6 during the years indicated.

REIMEL CREEK 3.8

Westslope Cutthroat

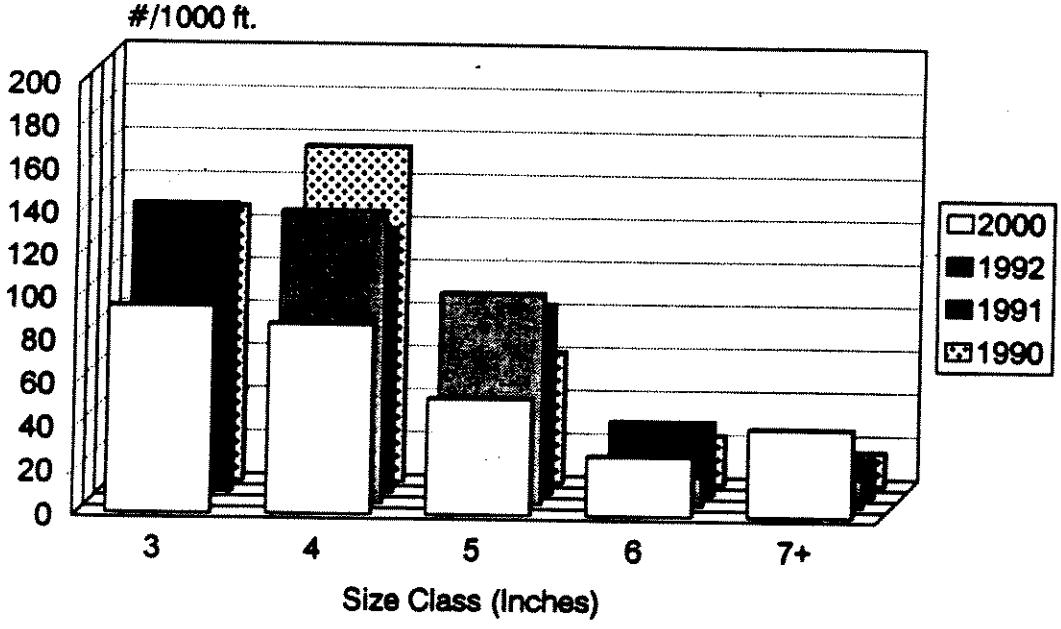


Mr 5.0 Estimates

FIGURE 37. Population estimates by inch class of westslope cutthroat in Reimel Creek 3.8 during the years indicated.

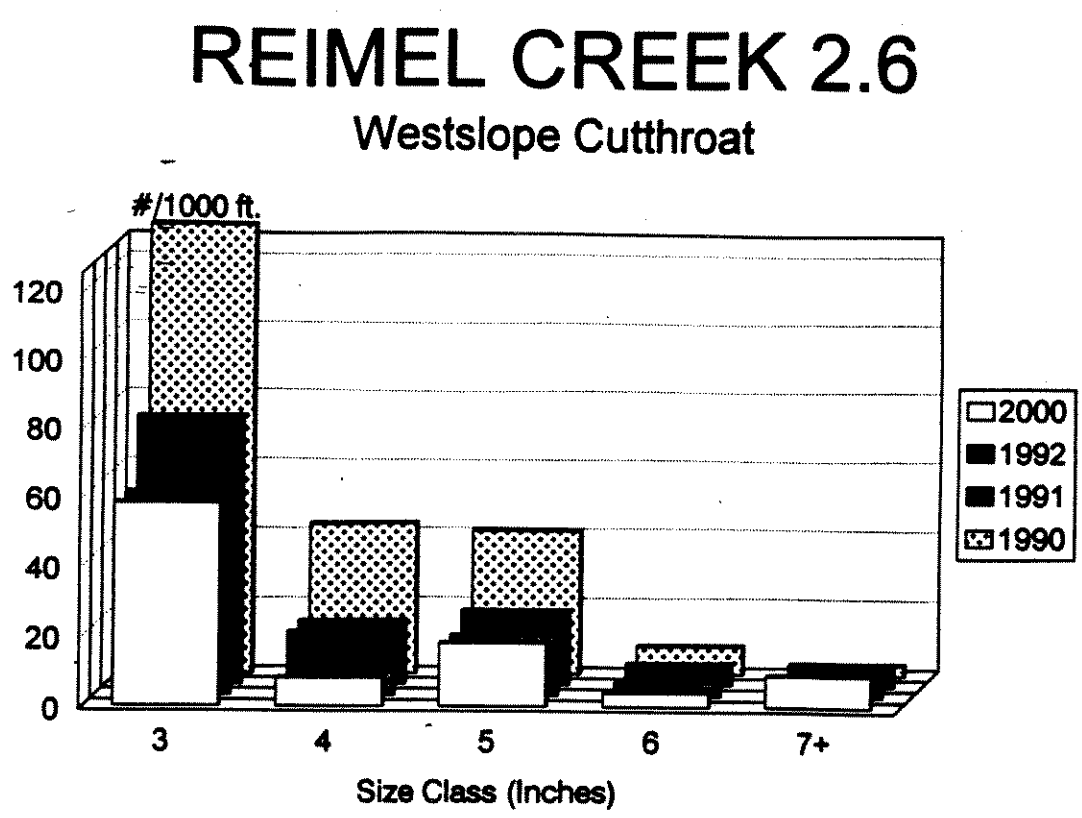
REIMEL CREEK 3.8

Brook Trout

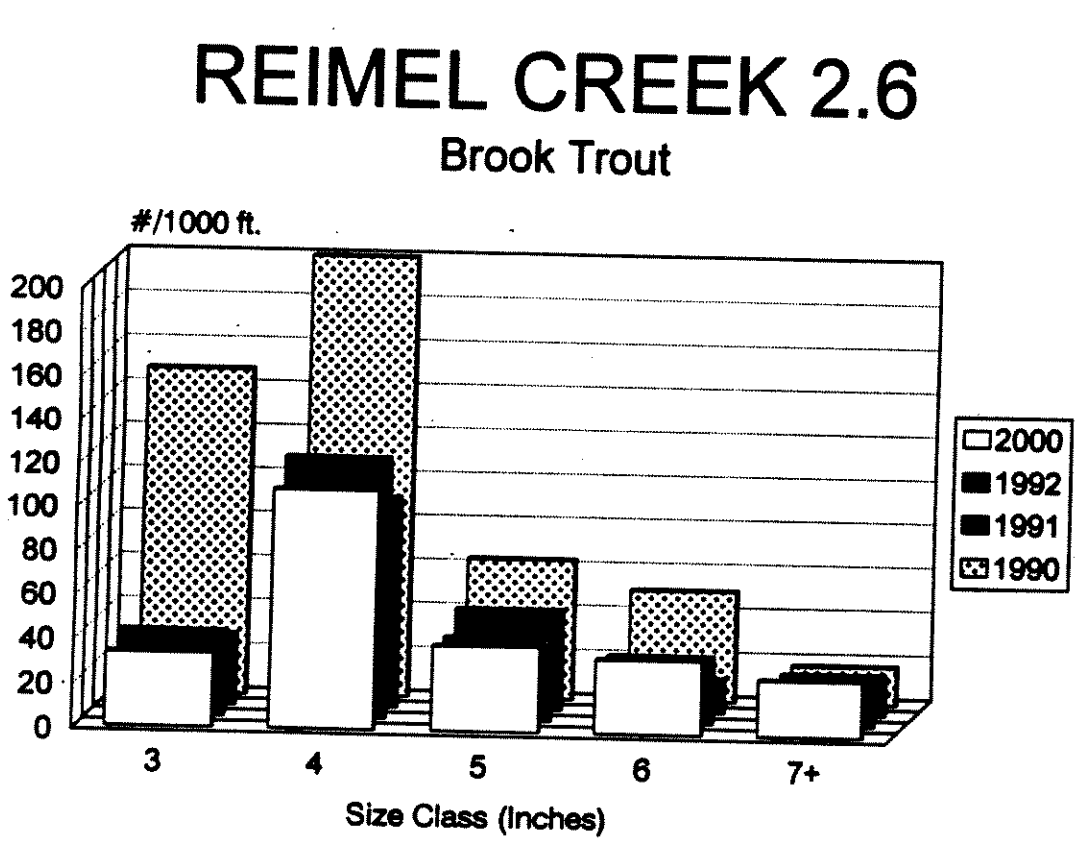


Mr 5.0 Estimates

FIGURE 38. Population estimates by inch class of brook trout in Reimel Creek 3.8 during the years indicated.



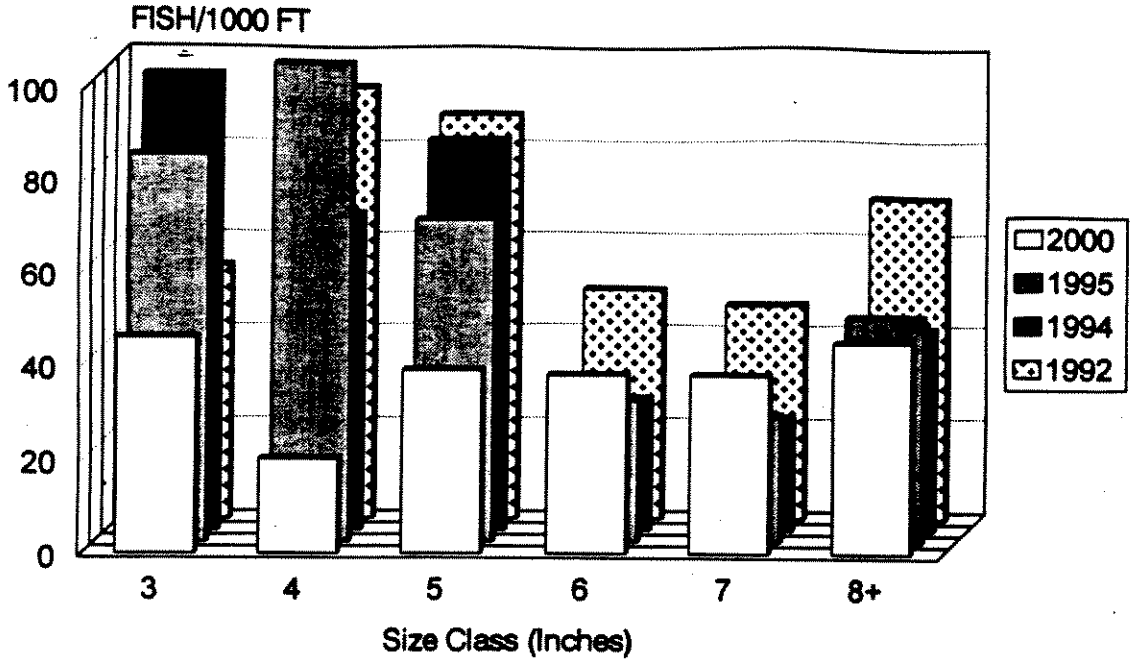
Mr 5.0 Estimates FIGURE 39. Population estimates by inch class of westslope cutthroat in Reimel Creek 2.6 during the years indicated.



Mr 5.0 Estimates FIGURE 40. Population estimates by inch class of brook trout in Reimel Creek 2.6 during the years indicated.

WARM SPRINGS CREEK 3.5

WESTSLOPE CUTTHROAT

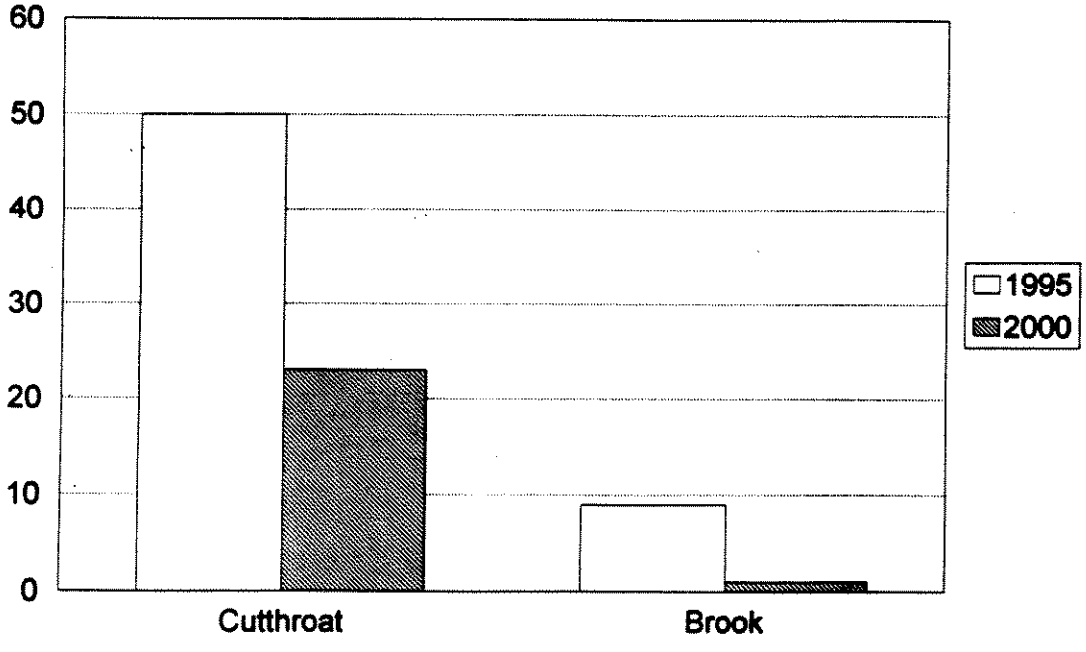


Mr 5.0 Estimates

FIGURE 41. Population estimates by inch class of westslope cutthroat in Warm Springs Creek 3.5 during the years indicated.

Praine Creek 1.0

Trout > 3" Per 400 Feet

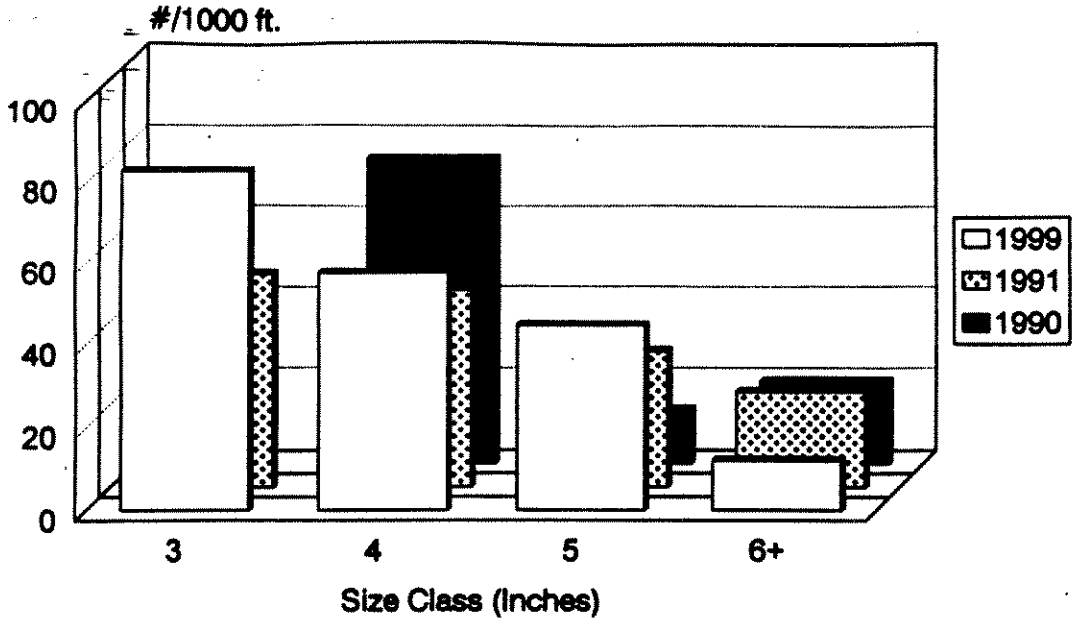


Two-Pass Estimates

FIGURE 42. Population estimates of westslope cutthroat and brook trout in Praine Creek 1.0 during 1995 and 2000.

BERTIE LORD CREEK 0.2

WESTSLOPE CUTTHROAT



Mark-Recapture 5.0

FIGURE 43. Population estimates by inch class of westslope cutthroat in Bertie Lord Creek 0.2 during the years indicated.

West Fork District

Some of the long-term monitoring sites were sampled in 1998 and 1999. The trends in the populations are variable.

Hughes Creek 9.0

This site was sampled in 1996 previous to a stream restoration project. The restoration project was undertaken in 1997 and 1998. The populations of larger westslope cutthroat and brook trout have both increased in number (Figures 44 and 45). It is too early to tell what the results of the restoration project will be.

Overwhich 2.0

This reach of stream was impacted by a landslide in 1992 that killed nearly all of the fish in the lower 5 miles of creek. Since that time, we have monitored the population of fish in a 1000-foot section of this reach. The number of westslope cutthroat has generally been increasing since 1992. The latest population estimate in 1999 indicates the number of larger westslope cutthroat is at or above the pre-slide numbers, however the 5 and 6 inch fish are below the pre-slide numbers (Figure 46). Overall, it appears that the westslope cutthroat population is similar to pre-slide numbers.

Slate Creek 1.6

The population of westslope cutthroat was sampled, most recently, in 1999. This estimate indicates that the population has declined since sampling in 1991-1993 (Figure 47). The reason for this decline is not known.

West Fork Bitterroot River 34.0

This section is upstream of Painted Rocks Reservoir. The population of westslope cutthroat has declined in all size classes since sampling began in the early 1990's (Figure 48). This section is catch-and-release yet it does not appear to be resulting in larger westslope cutthroat.

Water Temperature

We have been collecting water temperature data using HOBO-Temp and optic stowaway temperature monitors since 1993. From 1993 to 2000 we have collected between 1 and 8 years of data at 126 sites in the Bitterroot drainage (Table 3). The degree-day calculations allow a numerical comparison of different sites. Thirteen of the sites are index sites. These sites are measured every year and the sum total is used as an index for the year (Figure 49). The index can be useful at sites with occasional measurements. For example, Threemile 3.9 was measured only one year, 1994. The index comparisons indicate that 1994 was when the sites had the warmest readings recorded, therefore, this measurement at Threemile 3.9 was likely warmer than it would be most years.

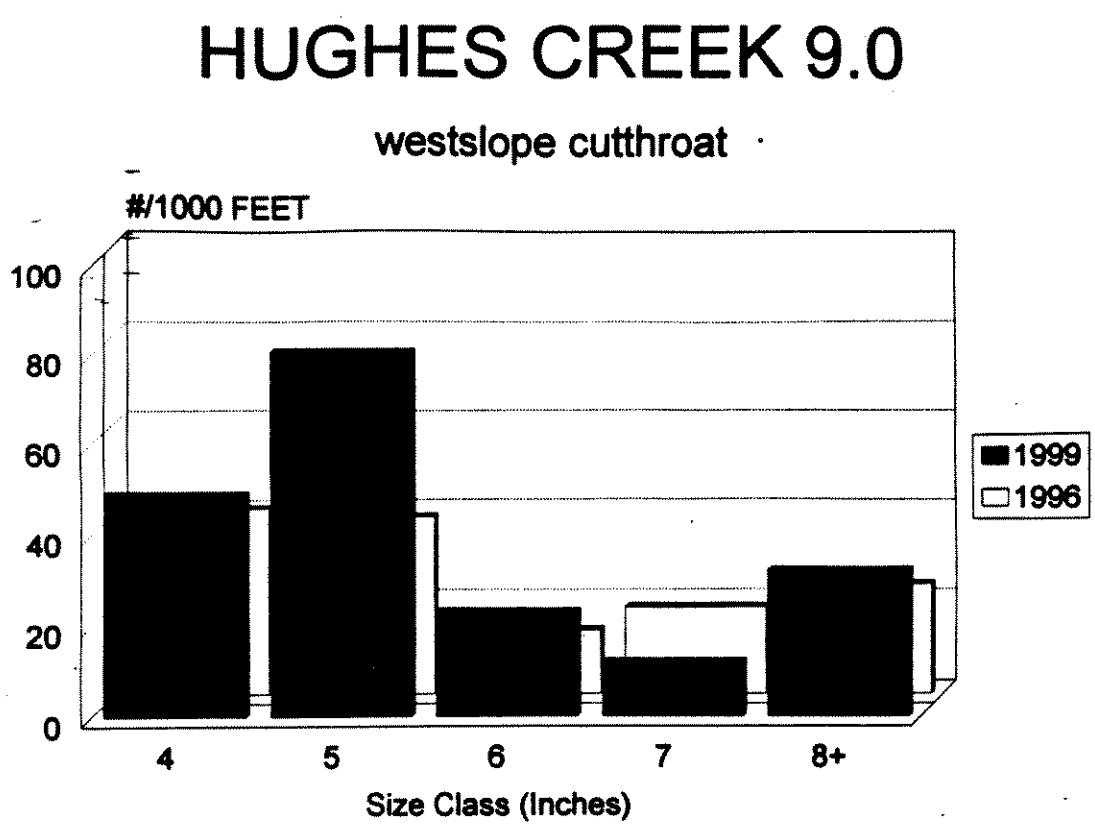


FIGURE 44. Population estimates by inch class of westslope cutthroat in Hughes Creek 9.0 during 1996 and 1999.

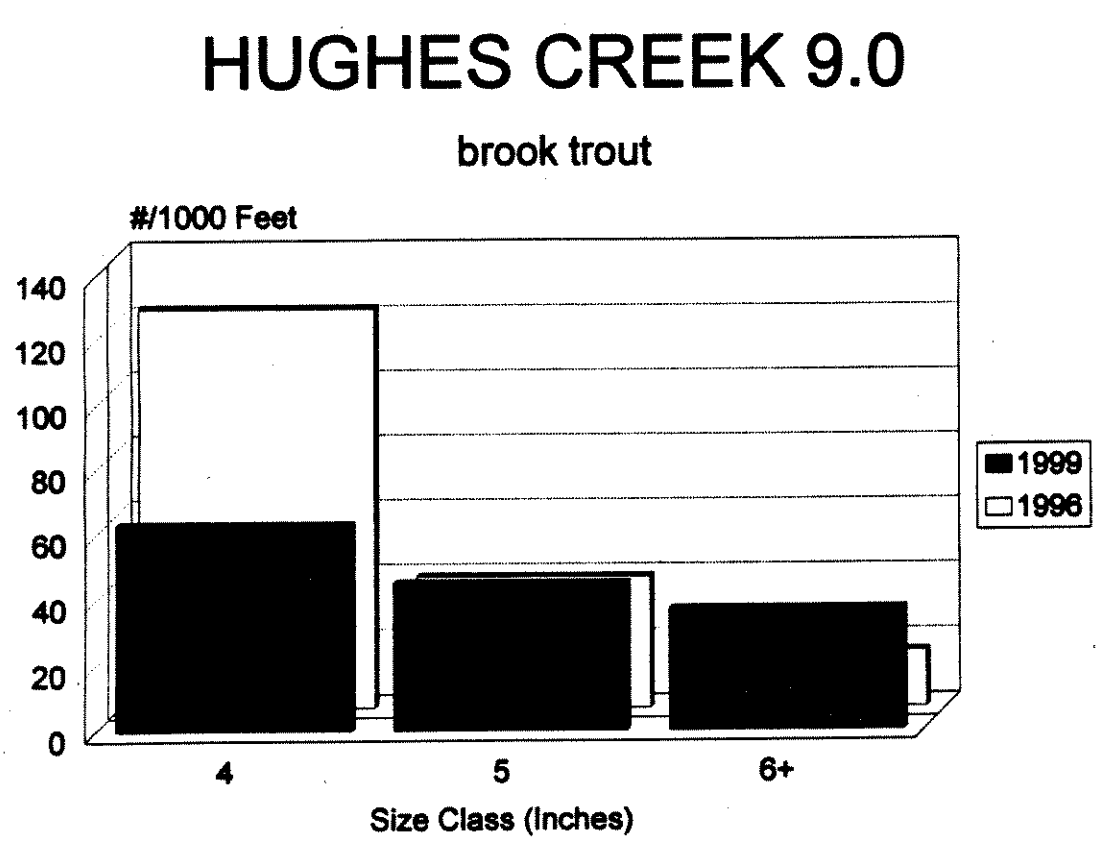
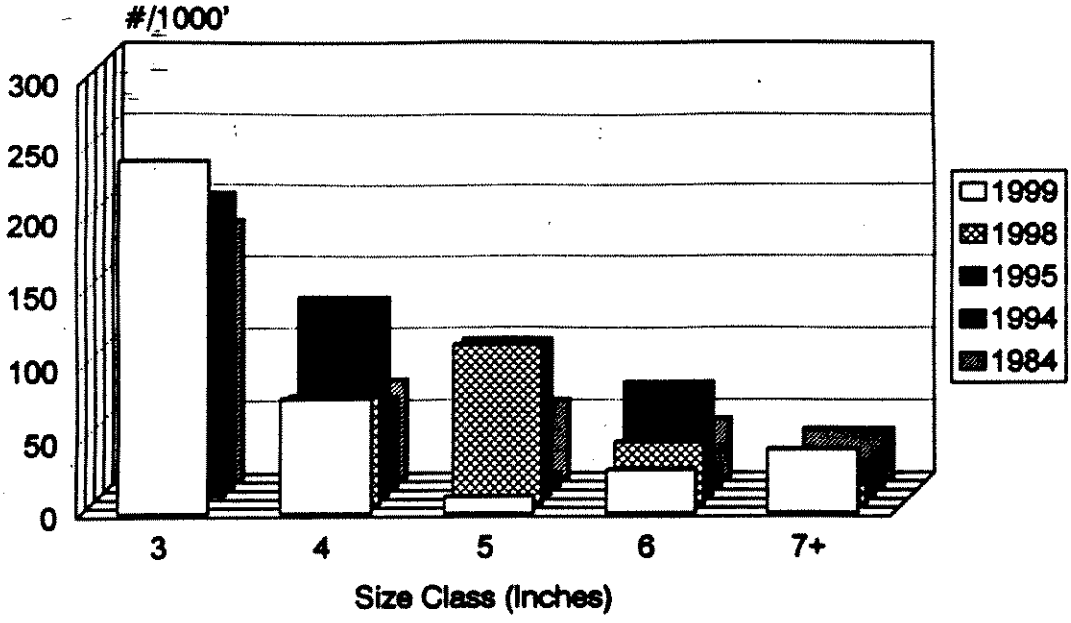


FIGURE 45. Population estimates by inch class of brook trout in Hughes Creek 9.0 during 1996 and 1999.

OVERWHICH CREEK 2.0

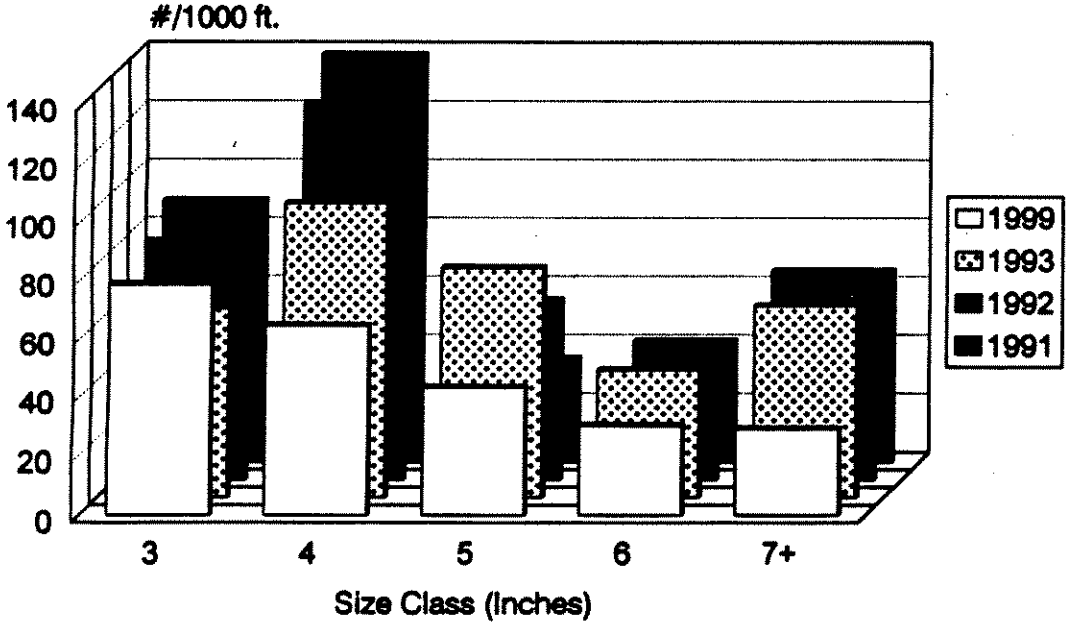
Westslope Cutthroat



Mark-Recapture 5.0 FIGURE 46. Population estimates by inch class of westslope cutthroat in Overwhich Creek 2.0 during the years indicated.

SLATE CREEK 1.6

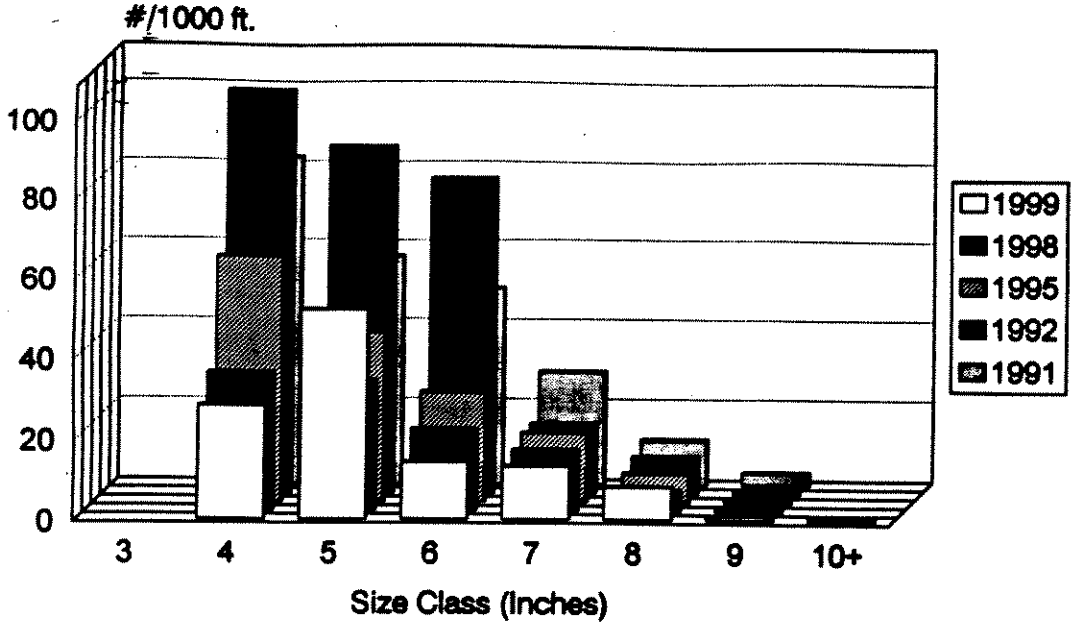
WESTSLOPE CUTTHROAT



Mark-Recapture 5.0 FIGURE 47. Population estimates by inch class of westslope cutthroat in Slate Creek 1.6 during the years indicated.

WEST FORK BITTERROOT RIVER 34.0

WESTSLOPE CUTTHROAT



Mark-Recapture 2.x

FIGURE 48. Population estimates by inch class of westslope cutthroat in West Fork Bitterroot River 34.0 during the years indicated.

Table 3. Water temperature calculated in degree days in various streams in the Bitterroot drainage.

Total Degree Days for 74 days from 7/18 to 10/1

STREAMSITE	1993	1994	1995	1996	1997	1998	1999	2000
BASS CREEK 2.1						955	816	
BASS CREEK 3.2				760		921		
BEAR CREEK 5.5								883
BEAR GULCH 0.1 (RYE)						768		
BERTIE LORD CREEK 0.2			762	707			738	
BIG CREEK 1.8						1204		
BIG CREEK 6.1				846				
BITTERROOT RIVER @ BELL XING					1208	1330		
BITTERROOT RIVER @ COMO				1056	1100	1200	1084	1079
BITTERROOT RIVER @ FLORENCE				1230	1222		1205	
BITTERROOT RIVER @ HAMILTON			1153	1038		1234	1139	1144
BITTERROOT RIVER @ MISSOULA					1249	1358	1241	
BLACKTAIL CREEK 0.1						808		
BLODGETT CREEK 0.1					1052	1059		
BLUE JOINT CREEK 05.9(INDEX)		826	739	702	774	838	737	757
BOULDER CREEK 2.0		873						
BURNT FORK BITTERROOT RIVER 11.0			709					
BURNT FORK BITTERROOT RIVER 19.7		684	564	573	632			
CAMERON CREEK 00.1								853
CAMERON CREEK 06.8						1010		
CAMERON CREEK 10.8							705	
CAMP CREEK 2.0				852	915	980		
CAMP CREEK, EAST FORK 0.1				677	717	798		
CAMP CREEK, EAST FORK 4.3					426	489		

STREAMSITE	1993	1994	1995	1996	1997	1998	1999	2000
CAMP CREEK, WEST FORK 0.1				610	662	710	623	
CATHOUSE CREEK 0.1						808		
CHAFFIN CREEK 3.1		831						
DALY CREEK 0.7(INDEX)		676	602	590	629	678	587	629
DIVIDE CREEK 0.1		718	686	593				
EAGLE POINT CREEK 0.1					581			
EAST FK BITTERROOT R. 17.8(INDEX)		998	880	828	869	947	879	892
EAST FORK BITTERROOT RIVER 00.5			1031	1012	1061	1153	1067	1069
EAST FORK BITTERROOT RIVER 31.4	608	762	674	617			692	
EIGHTMILE CREEK								860
FLAT ROCK CREEK 0.1					510			
FRED BURR CREEK 05.6						995		
FRED BURR CREEK 09.9						867		
GIRD CREEK 11.3								850
GIRD CREEK 12.6						568		
GIRD CREEK 19.5								569
GOLD CREEK 0.3					542			
GRIZZLY CREEK 0.1					581			
GUIDE CREEK 0.1							685	
HART CREEK 2.8							678	
HUGHES CREEK 01.4						934	850	
HUGHES CREEK 09.0						803	735	
JENNINGS CAMP CREEK 0.1							667	
KOOTENAI CREEK 0.4					966	1179		
KOOTENAI CREEK 3.1				796				
LAIRD CREEK 1.5								684

STREAMSITE	1993	1994	1995	1996	1997	1998	1999	2000
LAVENE CREEK 0.1								789
LICK CREEK 1.9 (DARBY RD)		871						
LITTLE BLUE JOINT CREEK 1.5			616					
LITTLE SLEEPING CHILD CREEK 4.2						822		
LITTLE WEST FORK 0.1								839
LOLO CREEK 1.2					1042	1163	1050	
LOST HORSE CREEK 01.9			995					
LOST HORSE CREEK 09.7				867			893	
LYMAN CREEK, TRIB 1.8, 0.7							683	
MARTIN CREEK 1.3(INDEX)	621	812	699	655	706	791	690	705
MARTIN CREEK 7.5		675						
MEADOW CREEK 0.3		765	671	641				
MEADOW CREEK 5.6(INDEX)		623	535	503	554	595	534	582
MILL CREEK 00.1					1134	1279		
MILL CREEK 08.4							801	
MINE CREEK 0.2							761	
MOOSE CREEK 1.4 (SULA RD)(INDEX)	593	772	658	617	678	746	664	679
NEZ PERCE FORK 01.0				789		983	864	894
NEZ PERCE FORK 11.0				682			692	733
NORTH RYE CREEK 1.9	660	816	768	742	822	887		
NOSEEUM CREEK 0.1						779		
OVERWHICH CREEK 02.0						885	793	
OVERWHICH CREEK 05.0			687					
OVERWHICH CREEK 07.0						742	602	
PIQUETTE CREEK 1.3		799						
REIMEL CREEK 3.8		756						

STREAMSITE	1993	1994	1995	1996	1997	1998	1999	2000
ROCK CREEK 0.1 (DARBY RD)					1057	1195		
ROCK CREEK 7.7 (DARBY RD)				855				
RYE CREEK 00.3					1123	1218	1125	
RYE CREEK 09.1			792		800	870		
RYE CREEK 12.4(INDEX)	561	755	655	620	700	753	653	774
RYE CREEK, TRIB 09.1, 0.1						752		
RYE CREEK, TRIB 12.3, 0.1						737		
RYE CREEK, TRIB 13.5, 0.1						730		
SAWMILL CREEK 0.9					765			
SAWMILL CREEK 1.3					722			
SAWTOOTH CREEK 0.1						1158		
SHARROTT CREEK 3.1						866		
SHEEPHEAD CREEK 0.1								750
SKALKAHO CREEK 00.6			1038	1022	1077	1168		
SKALKAHO CREEK 13.1(INDEX)	599	767	657	661	688	774	685	727
SKALKAHO CREEK 16.8(INDEX)		705	631	615	669	710	643	691
SKALKAHO CREEK 20.6	514							
SLATE CREEK 1.6		717					642	
SLEEPING CHILD CREEK 00.1					998			
SLEEPING CHILD CREEK 01.9		1118	973	938			969	
SLEEPING CHILD CREEK 10.2(INDEX)		884	757	742	801	878	749	846
SLEEPING CHILD CREEK 14.5			622	653				
SWEATHOUSE CREEK 0.1			1145	1081	1123			
SWEATHOUSE CREEK 2.3				938				
SWEATHOUSE CREEK 3.6				824				
SWEATHOUSE CREEK 4.7				748				

STREAMSITE	1993	1994	1995	1996	1997	1998	1999	2000
SWEATHOUSE CREEK 5.7		850		688				
SWEENEY CREEK 4.8				771				
SWIFT CREEK 0.1								597
TEPEE CREEK 0.9							741	
THREEMILE CREEK 0.1								1262
THREEMILE CREEK 03.9		1083						
THREEMILE CREEK 12.4			643					
TINCUP CREEK 00.1								1042
TINCUP CREEK 05.0		981		808	856	979	847	
TINCUP CREEK 16.0						1004	885	
TINCUP CREEK 16.7						1184	1017	
TOLAN CREEK 2.1		680						
TOLAN CREEK 5.1(INDEX)	449	575	500	481	546	589	514	579
TRAPPER CREEK 1.9							766	
WARM SPRINGS CREEK 03.5(INDEX)		793	687	654	727	801	704	751
WARM SPRINGS CREEK 07.4		671	603	594				
WATCHTOWER CREEK 0.1								813
WAUGH CREEK 0.7							595	
WEST FK BITTERROOT R. 40.0(INDEX)		656	563	542	602	675	571	616
WEST FORK BITTERROOT RIVER 01.2			1001	939	1018	1082	967	984
WEST FORK BITTERROOT RIVER 22.2			922	825		941		
WEST FORK BITTERROOT RIVER 34.0		912	769	699	761			
WILLOW CREEK 11.9			652					
WILLOW CREEK 14.1			556					

INDEX SITES

COMPOSITE SUM

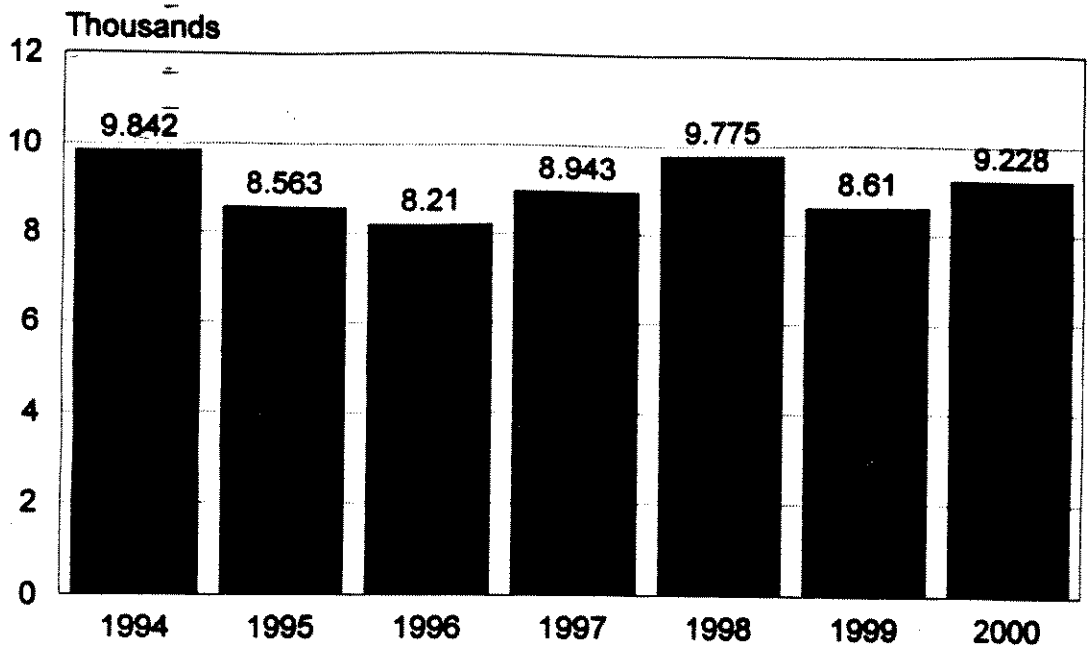


FIGURE 49. The composite sum of degree days at the 13 stream temperature index sites.

Genetic testing -

Westslope cutthroat from 92 sites on 67 streams and 1 lake have been tested for genetic purity (Table 4). The overall trend is similar to past reports, where most of the hybridization occurs in the Bitterroot Mountains, likely a result of mountain lake stocking (Clancy 1998).

Table 4. Results of electrophoretic testing of westslope cutthroat in selected streams of the Bitterroot drainage.

Stream	Location	Sample Size	Year	Status
Ambrose Creek	T9N,R18W,S18	6	1994	1
Basa Creek	T10N,R20W,S33	11	1994	3
	T10N,R21W,S34	2	1995	1,3*
Bear Creek	T7N,R21W,S34	11	1991	2
Beaver Creek	T4S,R22W,S4	2	1992	1
	T4S,R22W,S5	31	1995	1**
Big Creek	T8N,R21W,S10	5	1992	2
Bitterroot River	T4N,R20W,S35	4	1995	1**
	T3N,R21W,S2	7	1999	2*
Bitterroot R. E.Fk.	T2N,R18W,S24	6	1995	1***
Bitterroot R. E.Fk.	T2N,R17W,S22	10	1999	1
Bitterroot R. W.Fk.	T1S,R22W,S13	9	1998	2,3
	T2N,R21W,S24	6	1998	1
	T3S,R22W,S9	3	1992	1
	T3S,R22W,S9	13	1991	1
	T2S,R22W,S27	16	1994	1
Blodgett Creek	T6N,R21W,S17	6	1994	2
	T6N,R22W,S13	9	1994	2
	T6N,R22W,S16	12	1994	2
Bluejoint Creek	T2S,R23W,S2	5	1997	1
	T2S,R23W,S4	10	1994	1
		6	1994	1
Boulder Creek	T1N,R21W,S18	12	1994	1**
	T1N,R22W,S3	17	1996	1**
Burnt Fk. Bitterroot	T8N,R19W,S14	8	1994	1
	T7N,R18W,S5	14	1994	1
Camas Creek	T5N,R21W,S32	10	1998	3
Cameron Creek	T2N,R19W,S11	7	1994	1
Camp Creek	T1S,R19W,S21	5	1994	1
	T1N,R19W,S27	21	1999	2,3
Canyon Creek	T6N,R21W,S29	10	1994	1**
	T6N,R21W,S29	9	1998	1

Carlton Creek	T11N,R20W,S33	10	1998	3
Cedar Creek	T2N,R21W,S3	15	1990	1
Chicken Creek	T2S,R23W,S36	10	1995	1
Coal Creek	T2S,R22W,S16	15	1990	1
	T2S,R22W,S16	11	1994	1
Daly Creek	T5N,R18W,S19	10	1994	1
Deer Creek	T3S,R22W,S9	18	1999	1
Eightmile Creek	T10N,R21W,S2	10	1998	1
Fred Burr Creek	T7N,R21W,S21	12	1991	1
	T7N,R22W,S14	7	1991	1
Gash Creek	T8N,R22W,S32	5	1999	1
Gird Creek	T3N,R19W,S11	3	1998	1
Gold Creek	T7N,R19W,S1	30	1985, 1990	1
continued				
Stream	Location	Sample size	Year	Status
Hughes Creek	T3S,R22W,S2	12	1998	3
Kootenai Creek	T9N,R21W,S14	10	1994	1
Laird Creek	T1N,R20W,S10	8	1995	1
Lick Creek	T4N,R2W,S21	1	1992	1
Little Bluejoint Creek	T2S,R22W,S5	8	1994	1
	T2S,R22W,S4	10	1995	1
Little Boulder Creek	T1S,R22W,S26	4	1994	1
Little Rock Creek	T3N,R22W,S1	4	1998	3
Lost Horse Creek	T4N,R22W,S11	12	1994	2
Martin Creek	T2S,R17W,S16	25	1985	1
Maynard Creek	T1N,R19W,S18	10	1995	2
Meadow Creek	T1N,R18W,S10	21	1989	1
Mill Creek	T6N,R21W,S4	14	1991	2
Moose Creek	T2S,R17W,S17	25	1985	1
NelsonCreek,West Fork	T1N,R22W,S26	22	1999	2
Nez Perce Fork	T1S,R22W,S7	6	1994	1
	T1S,R22W,S18	6	1994	1
North Rye Creek	T3S,R20W,S24	8	1990	1
One Horse Creek	T10N,R20W,S9	6	1998	1
Overwhich Creek	T2S,R20W,S24	9	1998	2
Piquett Creek	T1N,R21W,S10	15	1990	1
Railroad Creek	T3N,R18W,S29	1	1992	1
Reimel Creek	T1N,R19W,S15	2	1992	1
	T1N,R19W,S35	3	1992	1

Rye Creek	T3N,R20W,S31		1985	1
	T3N,R20W,S25	10	1994	1
Schoolmarm Lake	T2N,R19W,S22	9	1998	1
Skalkaho Creek	T5N,R18W,S19	15	1991	1
	T5N,R19W,S27	10	1994	1
Sleeping Child Creek	T4N,R19W,S2	42	1985	
	T4N,R19W,S28		1989	1
Smith Creek	T8N,R21W,S22	16	1999	1
Sweathouse Creek	T8N,R21W,S19	12	1991	3
Threemile Creek	T10N,R18W,S18	10	1994	1
Tincup Creek	T3N,R21W,S17	30	1982	2
	T3N,R22W,S32	10	1992	2,3
Tincup Lake	T2N,R23W,S12	7	1998	1**
continued				
Stream	Location	Sample Size	Year	Status
Trapper Creek	T2N,R21W,S21	13	1992	2
Warm Springs Creek	T1N,R20W,S14	5	1990	2
	T1N,R20W,S27	11	1994	1
Weir Creek	T2S,R22W,S27	10	1995	1
Willow Creek	T6N,R19W,S10	5	1990	1
Woods Creek	T3S,R22W,S21	10	1995	1

Status:
1 = pure westslope cutthroat
2 = hybridized with rainbow trout
3 = hybridized with Yellowstone cutthroat
* = Bass Creek 1995 – one pure westslope and one pure Yellowstone cutthroat
* = Bitterroot River 1999 – five pure westslope, one 1st generation hybrid and one from hybrid swarm
** = 1 locus characteristic of westslope and rainbow – assume pure westslope until further sampling
*** = East Fork Bitterroot 1995 – 5 pure westslope and 1 pure rainbow

Lake Como

During spring of 1997, 1998 and 1999 kokanee were stocked in Lake Como. During the fall of 1998 and 1999 we set gillnets in Lake Como to assess the condition of the fishery. Kokanee survived in Lake Como and grew to an average length of 8.7 inches by November 1998 (Table 5). We were encouraged by this data, however sampling in 1999 captured fewer and smaller fish. Also, in 1999 we did not capture any of the 1997 cohort which we assumed would average around 10-11 inches.

In 1999 we also walked most of Rock Creek between Lake Como and the upstream falls searching for kokanee redds. We found no redds or kokanee in Rock Creek during surveys on 10/14/99 and 10/28/99.

Table 5. Results of gillnetting in Lake Como during the year indicated. Total number of each species is listed with the average length in parenthesis.

Year	Rainbow trout	Kokanee	Largescale sucker
1998	4 (8.6)	61(8.7)	25(10.1)
1999	3(10.3)	15(7.8)	13(12.0)

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Prepared by Christopher G. Clancy and Larry Javorsky
March 2001

Stream	Code Number	Key Words
Bitterroot River drainage	2-03-8865	Trout populations
		Trout habitat
		Water Temperature
		Fishing regulations
		Westslope cutthroat
		Rainbow trout
		Brown trout
		Bull trout
		Brook trout

Movement of Westslope Cutthroat trout in the upper Bitterroot River drainage

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Hamilton, Montana
March 2000

Through monitoring of trout populations in the upper reaches of the Bitterroot River and the West Fork of the Bitterroot River over the past few years, it has been found that Westslope Cutthroat (*Oncorhynchus clarki lewisi*) numbers are increasing. Since no stocking of trout is taking place in the river, it is apparent that the increase in cutthroat numbers is due to naturally reproducing stocks. It is not known, however, where and when these fish are spawning. In an effort to gain some insight into this question a 2-year radio-telemetry study was initiated by the Fish, Wildlife & Parks. Our objectives were to find out if cutthroat from the main Bitterroot and lower reaches of the West Fork migrated during spawning activities, and if so, where and when such activities occurred.

Study Area

The study area chosen was the upper Bitterroot River and all of its tributaries from Darby, Montana upstream (Figures 1 and 2), including both the East and West Forks. The Bitterroot River drainage is located at the southern end of Western Montana, and it flows in a northeasterly direction beginning at the Montana-Idaho divide.

In addition to Westslope Cutthroat trout, the Bitterroot River and its tributaries also support populations of rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*) and bull trout (*Salvelinus confluentus*). Other fish species present include mountain whitefish (*Prosopium williamsoni*), slimy sculpin (*Cottus cognatus*), largescale sucker (*Catostomus macrocheilus*), longnose sucker (*Catostomus catostomus*) , and longnose dace (*Rhinichthys cataractae*).

The majority of the tributaries of the Bitterroot River upstream of Darby are potential spawning sites, with only a couple of the smaller ones having a migrational barrier at the mouth (i.e. culvert, high gradient, low flows). There is good access to the East Fork, West Fork and all potential tributaries via a network of paved and logging roads, so we assumed that the majority of fish movement could be monitored by the radio tracking device used.

Methods

Fish to be implanted with radio transmitters were captured in late March 1998 in the lower two miles of the West Fork, and in early April 1999 in the main Bitterroot River by Darby, Montana. We used a 14-foot long aluminum drift boat fitted with a boom shocking system to capture the fish used for implantation. Two sizes of radio transmitters (8g and 11g) were surgically implanted into nine (9) westslope cutthroat in 1998, and ten (10) westslope cutthroat in 1999. Sizes ranged from 13.7 inches (350mm) to 17.5 inches (447mm), and from 0.87 pounds (395g) to 1.72 pounds (781g). The different sizes of transmitters were put into fish of different sizes so that they did not exceed 2% of the fishes' body weight (see Tables 1 and 2). Fish were released as near to their capture site as possible, and the location of the release site was recorded and used as a starting point.

Fish were then tracked using an Advanced Telemetry Systems receiver approximately once per week until water levels began to rise from runoff and any appreciable movement was observed. Once movement was detected the fish were tracked more frequently, from 2-4 times per week. Whenever a fish was located with the receiver a location was recorded using topographic maps. UTM's were also recorded from the nearest road location using a Trimble Scout GPS device. Specific river mile locations were then calculated using a Digitizing Area-Line Meter. Once water levels dropped and fish movement slowed or ceased the frequency of tracking was reduced to about 2-4 times per month.

The locations obtained were then plotted on a graph, with the y-axis being the distance the fish is located from its original starting point, and the x-axis being the date of each location obtained. The information plotted was then compared to both temperature and flow data in or near the study section to see if any relationships existed.

Temperature data were recorded both years from the West Fork Bitterroot River at stream mile 1.2 using an ONSET Optic Stowaway logging device. Temperatures were recorded approximately every 2 hours from late March through early October, encompassing the bulk of the study period.

Flow records were obtained from the US Geological Survey from the nearest site, which was in the main Bitterroot River just below the mouth of the West Fork, between Darby and Conner, Montana. Flows were recorded on a daily basis.

1998 Results

Eight of the nine cutthroat trout implanted with radio transmitters in 1998 traveled upstream (Table 3 and Figures 3 through 14). Only one, fish #4, stayed in the vicinity tagged throughout the study period. Distances traveled upstream by the eight that migrated ranged from 9.7 to 19.6 miles. As far as we could determine all of the fish either stayed in the West Fork or moved up into the Nez Perce fork, the largest tributary

to the West Fork (Figure 3A). None of the fish went upstream into the West Fork above the confluence with the Nez Perce. Since this was the case, in the graphs we've indicated that any fish that traveled above the 14.2 mile marker (which is the mouth of the Nez Perce fork) actually entered the Nez Perce fork and continued upstream (see Figure 2).

Four of the nine fish tracked (or 44%) traveled significant distances upstream and then returned to their original release site. The amount of time it took for each of these fish to move upstream and then return to their original site varied from 12 to 62 days (Table 4). Total distances traveled by these fish varied from 19.7 to 39.5 miles, with daily travel averaging from 0.6 to 2.7 miles per day.

The other four fish that traveled upstream remained at or near their uppermost location, with total distances traveled ranging from 10.9 to 18.1 miles. This upstream migration took from 5 to 24 days to complete (Table 5), and their rate of travel resembled that of the other four fish--from 0.8 to 2.2 miles per day.

The maximum distance traveled upstream by any of the eight fish in a 2-4 day period was 9.0 miles in 2 days by #7 (May 13 to May 15). The maximum downstream movement by any of the fish in a 2-4 day period was 6.5 miles in 2 days by #3 (June 8 to June 10).

When the movement data we collected was compared to temperature and flow data for the same period in 1998, no real relationship emerged (Figures 15 and 16). There was no obvious temperature change that stimulated movement either upstream or downstream. The temperature of the West Fork gradually increased from winter lows to summer highs, with no dramatic increase or decrease along the way. Similarly, there was no obvious change in flows that stimulated movement. The fish all moved after high water was in full swing and returned before it was over. They all seemed to move at different times, and especially the ones that returned to their original release site.

1999 Results

All ten of the westslope cutthroat trout implanted with radio transmitters in 1999 traveled upstream (Table 6 and Figures 17 through 28). The fish traveled to a wider diversity of sites when compared to the fish tracked in 1998 (Figure 18). Total distances traveled upstream ranged from 4.85 to 27.5 miles (Table 7). Two fish, #1A and #2A, migrated up Tincup Creek, whose mouth is located a short distance upstream (0.7 miles) from the release site. Fish #9A migrated several miles up Rye Creek, which empties into the Bitterroot River approximately 5.6 miles upstream of the release site. One fish, #10A, moved up the East Fork Bitterroot River to a point just over 12.0 miles from the confluence with the West Fork (see Figure 3).

The other six fish migrated up the West Fork. Fish #3A moved 1.7 miles into Trapper Creek, a tributary of the West Fork located 4.9 miles upstream of the confluence with the East Fork. Fish numbers 6A and 7A moved 8.7 and 14.5 miles into the West Fork, respectively, and both stayed in the mainstem of the river. The last three fish, numbers

4A, 5A and 8A migrated several miles into the Nez Perce Fork to the same area that the 1998 fish were tracked.

Total distances traveled by the ten fish in 1999 varied from 5.85 to 54.2 miles, and the dates that movement began varied from late April to mid-June (Table 6). Daily movement was similar to that of the 1998 fish, ranging from 0.68 to 1.62 miles upstream and 0.08 to 4.2 miles downstream (Table 8). Downstream movement was more sporadic and harder to follow than the upstream movement. Only three of the fish, #5A, #7A and #9A, moved downstream in such a way or timely fashion that we could track them back to the original release site. By mid-July our tracking efforts were reduced to once every two to six weeks, so the information we obtained regarding downstream movement is sketchy. Two of the fish, #4A and #10A remained at or near their uppermost point of migration, while three fish, numbers 3A, 6A and 8A made partial movements downstream.

The maximum distance traveled upstream by any of the ten fish in a 2-4 day period was 5.0 miles in 2 days by #7A (June 14 to June 16). The maximum downstream movement by any of the fish in a 2-4 day period was 15.8 miles in 4 days by #8A (June 28 to July 2).

The two fish that migrated up Tincup Creek disappeared soon after their uppermost point of movement was located. Fish #1A was the first to move, and it moved 5.85 miles up Tincup Creek before disappearing on 5/17/99. Fish #2A also traveled up Tincup Creek, to milepost 4.85, and then disappeared in like manner on 7/7/99.

When compared to temperature and flow data for the same period, our movement data for 1999 again showed no relationship to temperature changes (Figures 29 and 30). We did find that 2 of the 10 fish migrated upstream before flows from spring runoff began—both (#1A and #4A) beginning on 4/30. The other eight began their movement after runoff began, in a sporadic manner similar to the 1998 fish. Downstream movement was also sporadic, and did not seem to follow the drop in streamflow.

Four of the 1998 radio-tagged fish were still sending perceptible signals in spring and summer of 1999. Of these 4 only one, #7, exhibited any upstream movement (Figure 31). In 1998 this fish moved almost 2 miles up the Nez Perce fork, or a total of 15.9 miles upstream. In 1999 it moved 7.5 miles up the West Fork (in 6 days) and then immediately returned to its original release site in just 3 days.

Discussion

It is interesting to note that 60% of the 1998 fish and 30% of the 1999 fish that were tracked migrated into the Nez Perce fork, a tributary of the West Fork. This was the highest percentage of use out of all the tributaries available to the fish in both years, even though the Nez Perce is one of the farthest upstream tributaries for the fish to migrate to.

None of the 1998 fish released in the West Fork used any of the other tributaries that were available to them (Piquett Creek, Trapper Creek, Boulder Creek, and several tributaries of the Nez Perce fork)—they all went into the Nez Perce fork or stayed in the main West Fork. - The 1999 fish that were released in the main Bitterroot River near Darby, however, traveled upstream to several different tributaries: Trapper Creek and Nez Perce fork, both tributaries of the West Fork, Rye Creek and Tincup Creek, which are tributaries of the main Bitterroot, and the East Fork. This may indicate that further downstream in the system the fish appear to come from a wider variety of sources, which in turn indicates that a healthy population of Westslope Cutthroat depends on spawning areas in many tributaries rather than one or two primary areas.

Only one of the 19 fish implanted with a transmitter did not move from its release site, and there are a couple of factors that may have contributed to this lack of movement. This fish, #4, was the smallest of the nine (395g), and had one of the highest ratios of transmitter weight to body weight (2.0%). Tables and show the range of transmitter weight to fish weight ratios. Several studies have indicated that adverse affects on fish physiology and behavior increased as the ratio of transmitter weight to fish weight increased (Greenstreet and Morgan 1989; Marty and Summerfelt 1986). Our ratios were lower that those reported by Adams etal. 1998, and within the range suggested by the manufacturer of the transmitters. It is possible, however, that the small size of this fish caused the transmitter to adversely affect its ability to function normally.

Also, this fish was the only one of the nine that was obviously a hybrid cross between a rainbow trout (*Oncorhynchus mykiss*) and a westslope cutthroat. Rainbow trout spawn earlier than the cutthroat in the Bitterroot River system, so this fish may have had the transmitter implanted too close to its spawning time for it to spawn normally.

Four of the nine fish implanted with transmitters in 1998 and 2 of the 10 fish implanted with transmitters in 1999 stayed at or near their farthest upstream location. Several possibilities exist: 1) the fish are currently in a holding pattern, 2) the fish died naturally after spawning, and 3) the fish were caught by anglers, gutted, and the transmitters tossed back in the creek with the rest of the entrails.

The fact that eighteen of the nineteen fish we implanted with transmitters made substantial movements upstream was a good indication to us that the surgeries were successful and that there was no resultant mortality. Even fish #4 (from 1998) moved a mile upstream not long after the surgery, indicating to us that his lack of further movement was probably not due to the surgery itself. We were able to view one of our incisions later in September 1998 when we electroshocked the section that included the release sites. We recaptured the bull trout, fish #1, and its incision was fully healed and barely visible. The small hole in the fish's abdomen that the antennae protruded from showed no sign of fungus or lesion.

Despite the small sample size we had to deal with, it is apparent that the Nez Perce fork is an important spawning area for the cutthroat trout in the upper Bitterroot River system,

and as such should be given priority in management decisions. The data we collected also gives a strong indication that the cutthroat trout population in the Bitterroot River depends on successful spawning activities in *many* of its tributaries, and this, too, should be an important consideration in management decisions.

It is our intention to continue this study in subsequent years, placing radio transmitters in cutthroat farther downstream to get more information relating to the spawning habits of the cutthroat population in the mainstem of the Bitterroot River. This information will be useful in the future management of the native stocks of westslope cutthroat in the river and its tributaries.

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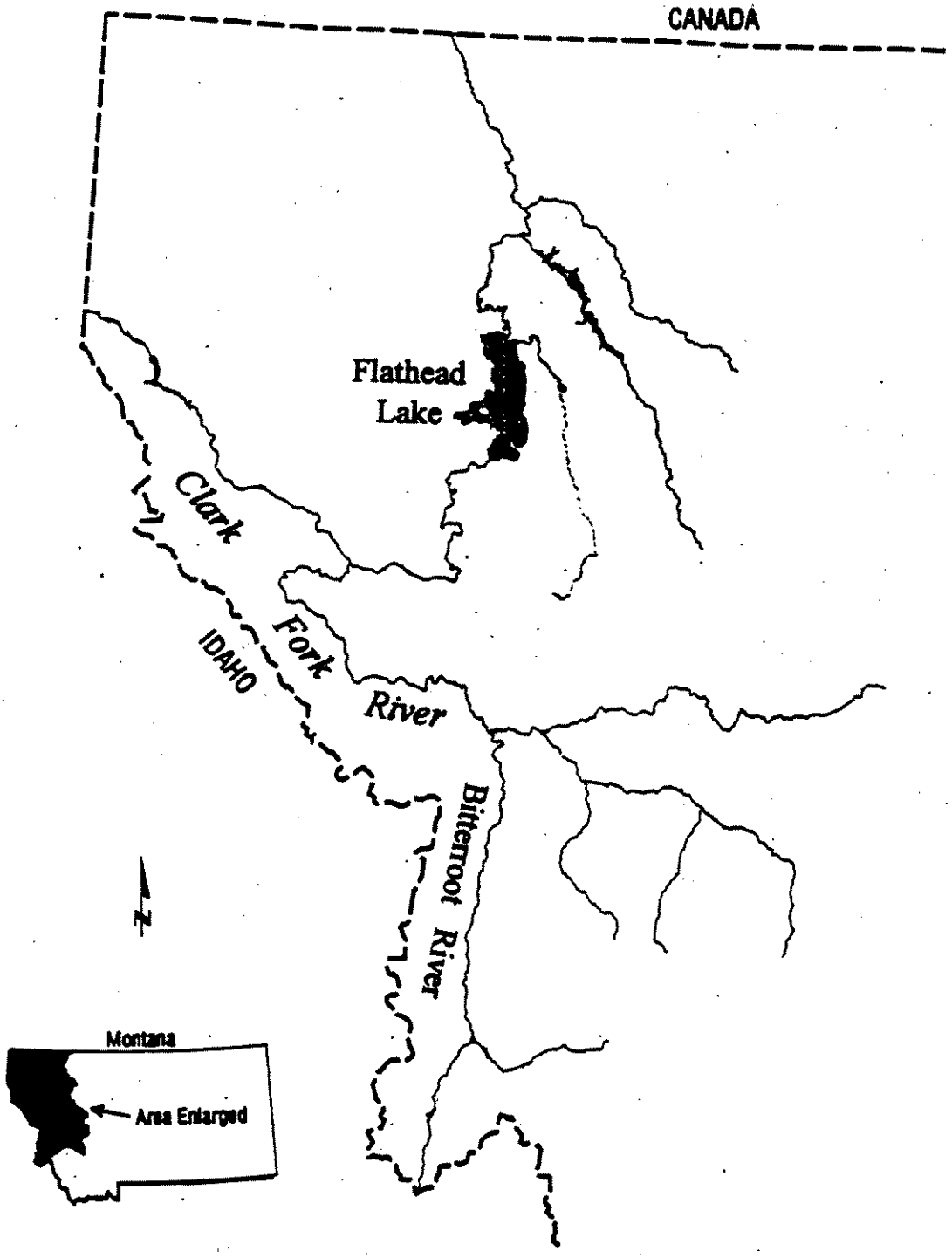
Figure 1. Map showing the general location of the study site.



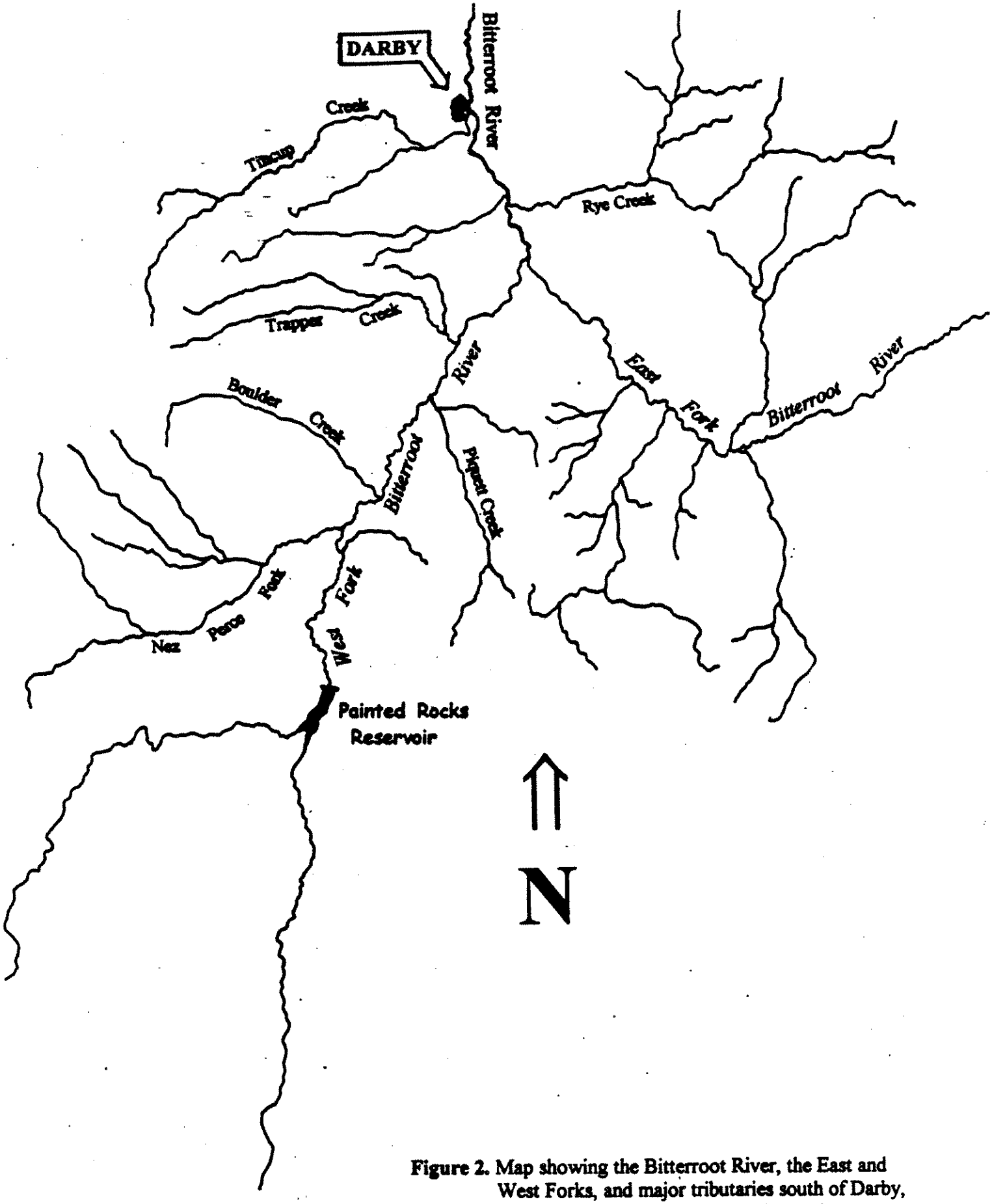


Figure 2. Map showing the Bitterroot River, the East and West Forks, and major tributaries south of Darby, Montana, which includes the entire study area.

Fish ID #	Length(mm)	Weight (g)	Transmitter Weight (g)	% Body Weight
#1	363	400	8	2.0
#2	371	481	8	1.7
#3	356	436	8	1.8
#4	348	395	8	2.0
#5	378	499	8	1.6
#6	396	581	11	1.9
#7	401	699	11	1.6
#8	386	536	11	2.1
#9	432	781	11	1.4
#10	427	781	11	1.4

Table 1. Lengths, weights, and ratios of transmitter weight to body weight (% Body Weight) for the fish implanted with transmitters in 1998.

Fish ID #	Length (mm)	Weight (g)	% Body Weight
#1A	447	916	1.2
#2A	378	499	2.2
#3A	396	590	1.9
#4A	427	785	1.4
#5A	394	626	1.8
#6A	373	472	2.3
#7A	376	508	2.2
#8A	432	767	1.4
#9A	384	626	1.8
#10A	384	544	2.0

Table 2. Lengths and weights of cutthroat trout implanted with radio transmitters in 1999. The percent body weight was based on 11g transmitters.

Fish ID #	Release Milepost	Total Upstream Movement	Total Downstream Movement
#1	03.3	??	??
#2	03.0	18.2	00.0
#3	03.3	14.5	16.0
#4	01.5	01.5	00.1
#5	02.6	11.0	00.0
#6	03.8	09.7	09.9
#7	02.4	15.9	16.3
#8	03.0	13.9	01.0
#9	02.9	19.6	20.0
#10	01.5	15.4	04.5

Table 3. Upstream and downstream distances (in miles) traveled by radio-tagged fish from April 27 to December 1, 1998. Numbers 2 through 10 are Westslope Cutthroat trout. Locations of fish #1, a Bull Trout, were not determined for much of the survey (from July 11-September 15), so no movement data were available.

Fish ID #	Begin Upstream	Return Date	# Days	Distance Traveled	Average Miles/Day
#3	6/1	6/12	12	24.4	2.0
#6	5/18	6/5	19	19.7	1.0
#7	5/15	5/26	12	32.6	2.7
#9	5/4	7/2	62	39.5	0.6

Table 4. Dates and distances (in miles) of travel for the four fish in 1998 that returned to their release sites.

Fish ID #	Begin Upstream	# Days	Distance Traveled	Average Miles/Day
#2	5/1	24	18.1	0.8
#5	6/1	5	10.9	2.2
#8	5/22	15	13.7	0.9
#10	5/11	16	15.4	1.0

Table 5. Dates and distances (in miles) of travel for upstream movement of the four fish in 1998 that remained at or near their uppermost location.

Fish ID #	Total Distance Traveled Upstream (miles)	Date Movement Began (1999)	# Days	Ave. Miles Per Day
#1A	5.85	4/30	8	0.73
#2A	4.85	5/25	4	1.21
#3A	14.6	5/31	9	1.62
#4A	26.9	4/30	19	1.42
#5A	27.1	5/25	28	0.97
#6A	16.7	6/14	18	0.93
#7A	22.5	5/19	29	0.78
#8A	27.5	5/25	30	0.92
#9A	12.9	5/13	19	0.68
#10A	19.2	6/11	15	1.28

Table 6. Upstream distances traveled for all 10 of the Westslope Cutthroat Trout implanted with transmitters in 1999, including the dates that upstream movement began.

Fish ID #	Total Distance Traveled Upstream (miles)	Total Distance Traveled Downstream (miles)	Total Distance Traveled
#1A	5.85	???	5.85?
#2A	4.85	1.5?	6.35?
#3A	14.6	8.9	23.5
#4A	26.9	1.0	27.9
#5A	27.1	27.1	54.2
#6A	16.7	8.2	24.9
#7A	22.5	22.5	45.0
#8A	27.5	16.8	44.3
#9A	12.9	12.9	25.8
#10A	19.2	1.2	20.4

Table 7. Total distances traveled by all of the 10 Westslope Cutthroat trout tracked in 1999.

Fish ID #	Total Distance Traveled Downstream - (miles)	Date Movement Began (1999)	# Days	Ave. Miles Per Day
#1A	?	–	–	–
#2A	1.5?	6/16	19	0.08
#3A	8.9	6/12	12	0.74
#4A	1.0	5/19	4	0.25
#5A	27.1	6/24	29+	0.93+
#6A	8.2	7/3	47+	0.17+
#7A	22.5	6/19	19	1.18
#8A	16.8	6/31	4	4.2
#9A	12.9	6/2	?	?
#10A	1.2	7/8	14	0.9

Table 8. Downstream distances traveled for all 10 of the Westslope Cutthroat Trout implanted with transmitters in 1999, including the dates that downstream movement began.

Spawning Movements of Fluvial Bull Trout in the upper Bitterroot River drainage, Montana

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January 2001

The migratory, fluvial life-history form of bull trout (*Salvelinus confluentus*) populations in the Bitterroot River drainage of southwestern Montana has declined in abundance and distribution over the past 150 years (Montana Bull Trout Scientific Group 1996). Resident populations of bull trout are relatively healthy in the upper reaches of a number of tributary streams to the Bitterroot River, but the connection between these populations and the fluvial life form that exists in the mainstem river and East and West forks is critical for the species' long-term persistence (Rieman and McIntyre 1993).

To better understand current abundance, distribution and movement of fluvial bull trout in the upper Bitterroot River drainage, we conducted a radiotelemetry study during the spring, summer and fall of 2000. Our objectives were to obtain information on 1.) relative size and abundance of the population, 2.) seasonal spawning movements and factors that may influence the timing of these movements, and 3.) locations of spawning areas that might be useful for future population monitoring.

Study Area

The study area chosen was the East Fork Bitterroot River and all of its tributaries from Conner, Montana upstream (Figure 1). The East Fork Bitterroot River is one of the two main tributaries to the Bitterroot River, which is located at the southern end of Western Montana. The East Fork begins in the Anaconda-Pintler Wilderness and flows in a northwesterly direction for over 40 miles before joining with the West Fork Bitterroot River to form the mainstem Bitterroot River.

In addition to bull trout, the East Fork Bitterroot River and its tributaries also support populations of rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*) and westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Other fish species present include mountain whitefish (*Prosopium williamsoni*), slimy sculpin (*Cottus cognatus*), largescale sucker (*Catostomus macrocheilus*), longnose sucker (*Catostomus catostomus*) , and longnose dace (*Rhinichthys cataractae*).

The majority of the tributaries of the East Fork Bitterroot River upstream of Conner were considered potential spawning sites, with only a couple of the smaller ones having a migrational barrier at the mouth (i.e. culvert, high gradient, low flows). There is good access to the East Fork and at least the lower portions of all potential tributaries via a network of paved and logging roads, so we assumed that the majority of fish movement could be monitored by the radio tracking device used.

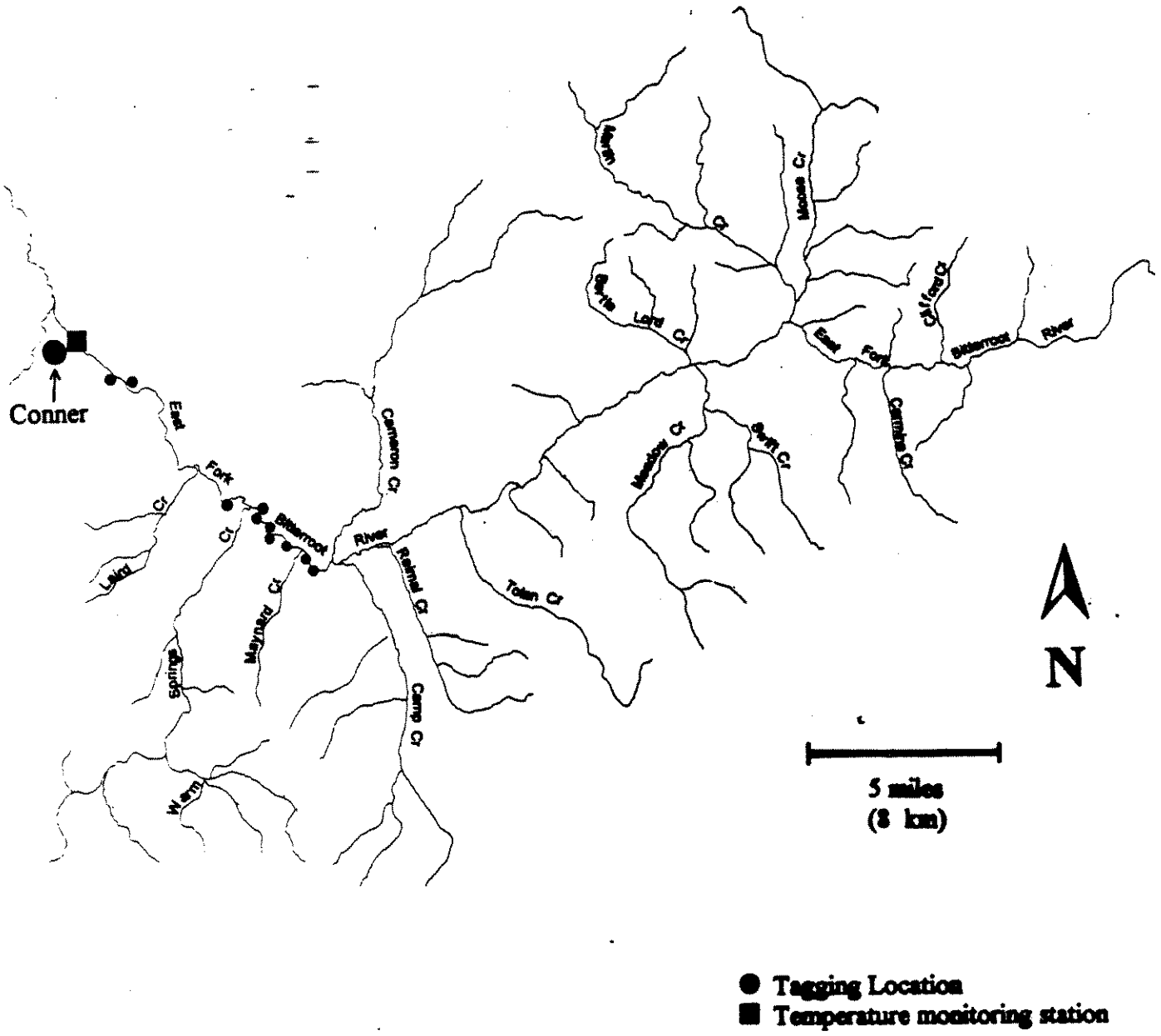

Figure 1. The East Fork Bitterroot River, Montana, showing major tributaries and locations where bull trout were implanted with transmitters in May, 2000.

Methods

Fish to be implanted with radio transmitters were captured in May 2000 in the lower, canyon section of the East Fork. We used a 14-foot long aluminum drift boat fitted with a boom shocking system to capture the fish used for implantation. The ten (10) fish implanted with transmitters took three electrochocking trips and a total of 14.8 river miles (23.8 km) to find. One 4.0 mile (6.4 km) stretch of the Bitterroot River from Hannon FAS to Darby Bridge was also electroshocked, and no large bull trout were found.

The radio transmitters we used weighed 16g. Fish implanted with the transmitters ranged in size from 15.8 inches (401mm) to 24.5 inches (622mm), and from 1.30 pounds (590g) to 4.60 pounds (2088g). With only one exception, the transmitters were placed into fish so that they did not exceed 2% of the fishes' body weight (Winter 1983) (Table 1). The one exception was a result of our uncertainty as to whether we would even find ten fish to implant. Also, Brown et. al. (1999) found that violating the 2% body weight:transmitter weight rule did not adversely affect swimming performance in fish. Fish were then released as near to their capture site as possible, and the location of the release site was recorded and used as a starting point.

Fish were tracked using a Advanced Telemetry Systems Fieldmaster 16 Channel receiver and a radial truck-top whip antennae mounted on a vehicle. One flight was taken on September 13 in an attempt to locate two of the fish whose signals had been lost for several weeks. During the flight we used a directional antennae that was mounted to the wing strut.

Fish were tracked from 1-3 times per week from the middle of May through July. Whenever a fish was located with the receiver a location was recorded using topographic maps. Specific river mile locations were then calculated using a Digitizing Area-Line Meter. Once fish movement slowed or ceased the frequency of tracking was reduced to about once per week.

Temperature data were recorded from the East Fork Bitterroot River at stream mile 0.5 using an ONSET Optic Stowaway logging device. Temperatures were recorded approximately every 2 hours 24 minutes from April through early October, encompassing the bulk of the study period (Figure 3).

Flow records were obtained from the US Geological Survey from the nearest site, which was in the main Bitterroot River just below the mouth of the East Fork, between Darby and Conner, Montana. Flows were recorded on a daily basis (Figure 4).

Results

All ten of the bull trout implanted with radio transmitters in 2000 traveled upstream (Table 2). The fish traveled to a wide diversity of sites, including Warm Springs Creek, Meadow Creek, Swift Creek, Moose Creek, and the upper East Fork (Figure 2 and Table 3). Total distances traveled upstream ranged from 4.8 to 27.8 miles (7.7 to 44.7 km), and averaged 21.5 miles (34.6 km) (Table 3).

The dates that movement began ranged from 5/31 to 6/16 (Table 2), and were close approximations since daily locations were not recorded. The bulk of the movement occurred during the descending limb of the hydrograph, when temperatures rose to a 7-day running average of 17.9 °C (Table 4). Table 5 indicates that 40% of all fish movement occurred from 6/22-6/28—the first week after this rise in temperature. A total of only 20% of all fish movement occurred before 6/22. Average miles traveled per day ranged from 0.15 to 0.83 (0.24 to 1.3 km).

There was no correlation between size of fish and date of first movement (see Table 7). There was also no correlation between size of fish and distance traveled, although the two fish that started the latest—numbers 13 and 14—traveled the fastest (0.83 and 0.77 miles per day on average, respectively).

The fish that traveled the shortest distance, #9, was released 0.6 miles (1.0 km) upstream of Warm Springs Creek, which is the tributary that it migrated into. The distance it traveled was therefore not as lengthy as its counterparts, although the fish traveled up the tributary as far as any of the fish traveled up a tributary (4.8 miles or 7.7 km—see Table 3).

The farthest upstream locations of several of the fish were not obtained due to extreme forest fire activity that began on August 1st and which prevented us from accessing the area these fish were located in until early September. The distances traveled upstream for fish numbers 3, 10, 14, and 15 were therefore not finalized, but were considered close to the general vicinity of farthest upstream movement.

Unfortunately, it was during this time period (late August and early September) that the fish apparently spawned since the locations we obtained in early September indicated that the fish were already headed downstream. For this reason we also did not obtain accurate rates of downstream movement. Only four of the fish made substantial downstream movements to holding areas at or near their release sites (Table 3). The average distance traveled downstream by these four fish was 20.5 miles (33.0 km). Cumulative distances traveled both up- and downstream varied from 9.3 to 49.6 miles (15.0 to 79.8 km), with the average being 34.3 miles (55.3 km).

Following spawning activity, four of the fish are known to be mortalities. Fish #9, which went up Warm Springs Creek, returned to near the mouth of the creek before heading down a ditch and presumably falling prey to a large bird. Its transmitter was found near a pile of bird droppings. Fish numbers 13 and 11, which migrated up Swift and Meadow Creeks, respectively, have both been tracked to large log piles. One seems to have fallen prey to a mink that resides in the log pile. The other was exposed to intense fire and may have perished during that time.

The other known fatality, fish #15, somehow ended up in a small pond near the upper reaches of the East Fork that is now dry. Possibilities include everything from being

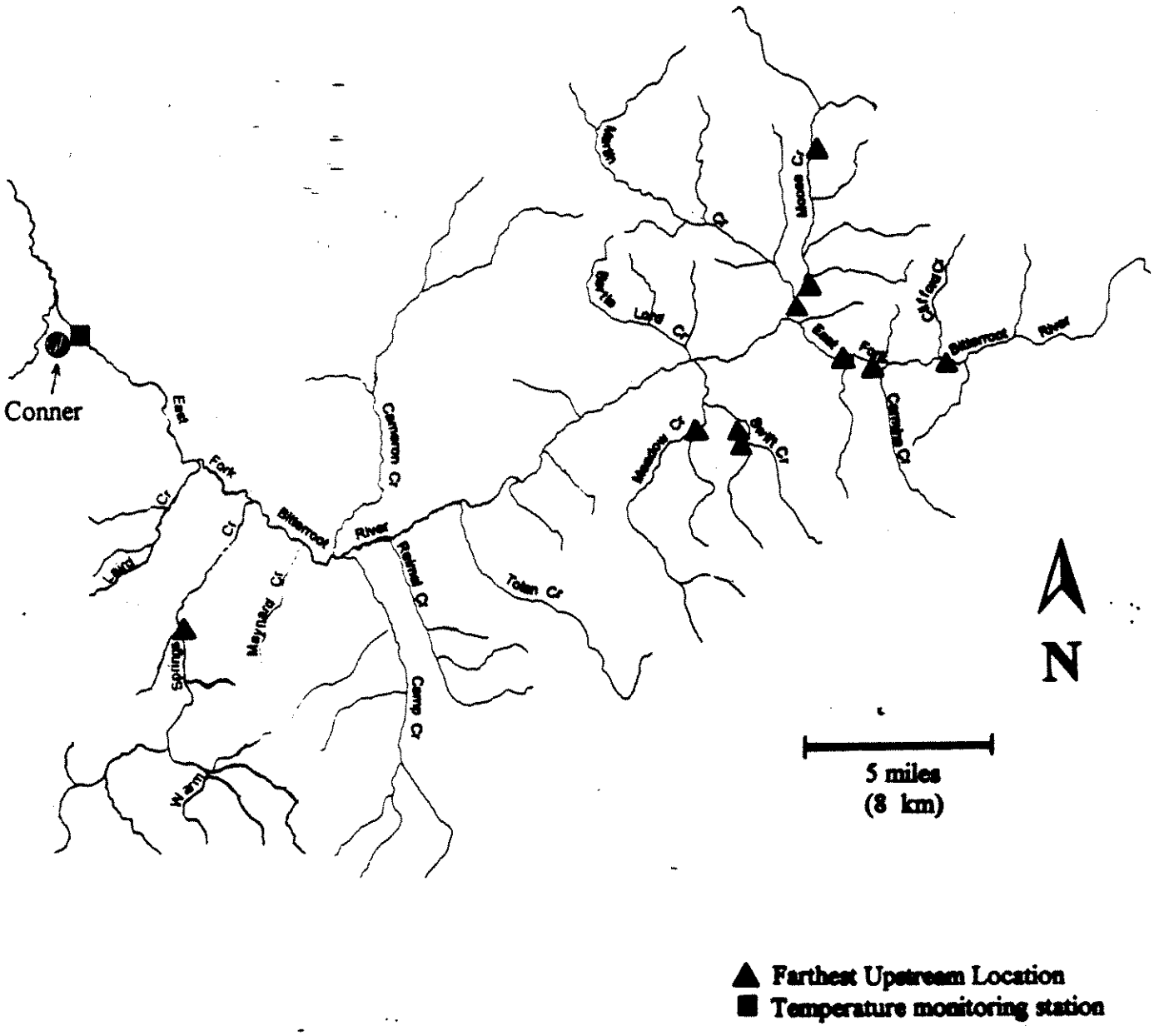

Figure 2. The East Fork Bitterroot River, Montana, showing farthest upstream locations of all 10 bull trout implanted with radio transmitters during 2000.

caught and moved there by an angler or large bird to somehow drifting into the pond via a small ditch that derives water from the East Fork to fill the pond.

Signals from two of the fish were lost during the fires and never relocated again. Fish #3 was last located up the East Fork at milepost 38.5. A flight over the area on 9/13 failed to locate the missing signal. Fish #8 had an interesting history. It was lost immediately after implantation, found in Swift Creek several days prior to the fires, and then subsequently lost again. The flight over the area failed to pick up any signal from this fish as well. With both of these fish the possibilities include transmitter failure, angler removal (although this is highly unlikely due to the fire and limited access), and the chance that these fish traveled downstream quickly and far enough that we were unable to detect them.

Discussion

The fluvial bull trout in our study began their upstream migrations as water temperatures were increasing and stream discharge was decreasing. Stream discharge was well beyond peak flow (Figure 4), suggesting that high flows did not play a significant role in the timing of bull trout migrations. Movement did coincide with an increase in the 7-day average maximum temperature beyond the 15°C threshold suggested by Rieman and McIntyre (1993). Although McPhail and Murray (1979) and Elle (1995) found migrations of fluvial bull trout to peak at 10-12°C, Swanberg (1997) recorded a mean temperature at which bull trout in the Blackfoot River system began their migrations to be 17.7°C. Our data supported the findings on the Blackfoot River.

Total distances traveled upstream by the ten fish we observed were less than those found by Swanberg (1997) in the Blackfoot River, but similar to those observed by D. Schill, R. Thurow, and P. Kline (1994) in the Rapid River, Idaho. Swanberg (1997) suggests that total distance traveled upstream by bull trout is primarily a reflection of the space available to them, and such was the case in our study. Also, forest fires prevented us from following several of the fish to their uppermost locations, which would imply that our numbers are lower than what actually occurred.

The rate of upstream movement we observed averaged 0.57 miles/day (0.9 km/day), which was again less than the rate found by Swanberg (1997), but similar to those observed by McLeod and Clayton (1994) and D. Schill, R. Thurow, and P. Kline (1994). There was a slight correlation between rate of upstream movement and size of bull trout, with the larger fish traveling at a faster rate (Table 7).

Swanberg (1997) noted in the Blackfoot River that larger fish began moving at cooler temperatures and earlier dates than smaller fish. We found no such relationship (Table 7). For example, the smallest fish we radio-tagged (#3) traveled the 3rd longest distance and was one of the first to begin migration

Ninety-four percent of the upstream migration for all 10 of the bull trout in our study occurred by July 12. Even those fish that began moving at a later date—as late as June 16—completed the bulk of their upstream movement by this date, which indicates that the later a fish begins to migrate the faster it travels. July 12 was also about the time that the hydrograph stabilized at base flows. When these fish begin their upstream migrations may not be as important as when they need to finish the bulk of their movement.

All ten of the fish we studied moved upstream to recognized core areas, presumably to spawn. In all of these core areas—Meadow Creek, upper East Fork, Moose Creek, Swift Creek, and Warm Springs Creek—there are stable, healthy populations of bull trout. What percentage of these stable, healthy resident populations are actually non-migratory residents, and what percentage are juvenile fluvial forms yet to migrate downstream is unknown.

By October only four of the ten fish we radio-tagged were to the best of our knowledge still alive and moving. Four are known mortalities, and two disappeared during the fires in August and haven't been located since. Assuming these two lost signals to be mortalities also, our mortality rate for spawning fluvial bull trout was 60%. Sources of mortality include predation by large birds and mink. D. Schill, R. Thurow and P. Kline (1994) found similarly high mortality rates for fluvial bull trout in the Rapid River in Idaho. It's unknown whether the high mortality rates we found were in some part caused by the radio transmitters, although research has indicated that radio telemetry has negligible affects on mortality (Tyus 1988; Minor 1981 as cited by Tyus).

If such mortality rates are legitimate in the fluvial population, the management implications are serious. The amount of effort it took to find 10 fluvial bull trout large enough for the study indicates a small population of such fish to begin with. If roughly 60% of them are lost each year to mortality then every mature fish capable of spawning becomes invaluable to the persistence of the subpopulation. In addition, Nelson (1999) found little likelihood of a migratory subpopulation reestablishing itself from a resident population once the migratory component was lost.

Further research is needed to establish the actual size of this fluvial component of the population in the Bitterroot River drainage, and to find actual spawning areas where redd counts can be conducted to monitor population trends. Radio telemetry was a valuable tool to establish approximately when and where these fluvial bull trout migrated to spawn, but its use in the future is questionable due to the apparent small size of the subpopulation. Other, less potentially lethal methods should be seriously considered in future research efforts.

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Fish ID #	Length (mm)	Weight (g)	% Body Weight
#3	401	590	2.7
#4	455	817	2.0
#8	462	953	1.7
#9	445	885	1.8
#10	472	1090	1.5
#11	470	1017	1.6
#12	622	2088	0.8
#13	462	953	1.7
#14	503	1249	1.3
#15	500	1253	1.3

Table 1. Lengths and weights of bull trout implanted with radio transmitters in 2000. The percent body weight was based on 16g transmitters.

Bull Trout ID #	Total Distance Traveled Upstream (miles)	Date Movement Began (2000)	# Days	Ave. Miles Per Day (km in parentheses)
#3	25.3	5/31	51	0.50 (0.80)
#4	24.0	6/1	50	0.48 (0.77)
#8	20.4	–	–	–
#9	4.8	6/12	31	0.15 (0.24)
#10	24.75	6/1	50	0.50 (0.80)
#11	26.3	5/31	40	0.66 (1.06)
#12	(>18.4)	5/31	–	–
#13	22.3	6/16	27	0.83 (1.34)
#14	20.7	6/16	27	0.77 (1.24)
#15	27.8	6/7	40	0.70 (1.13)

Table 2. Upstream distances traveled for all 10 of the Bull Trout implanted with transmitters in 2000, including the approximate dates that upstream movement began. Farthest upstream movement of fish #12 was not known.

Bull Trout ID #	Total Distance Traveled Upstream (miles)	Total Distance Traveled Downstream (miles)	Total Distance Traveled (miles)	Destination
#3	25.3	0	25.3	East Fork
#4	24.0	25.6	49.6	Moose Cr.
#8	20.4	0	20.4	Swift Cr.
#9	4.8	4.5	9.3	Warm Springs Cr.
#10	24.75	22.75	47.5	East Fork
#11	26.3	0	26.3	Meadow Cr.
#12	(>18.4)	(>14.6)	(>33.0)	Moose Cr.
#13	22.3	0	22.3	Swift Cr.
#14	20.7	19.2	39.9	East Fork
#15	27.8	1.3	29.1	Moose Cr.

Table 3. Total distances traveled by all of the 10 Bull Trout tracked in 2000. Numbers for fish #12 are not complete since farthest upstream movement of that fish was unknown.

7-Day Period	Average Daily Maximum Flow (cfs)	Average Maximum Temperature (°C)	Total Miles Traveled Upstream by all Fish (km in parentheses))	% of Total Upstream Movement of all Fish
5/18-5/24	2500	11.7	0	0
5/25-5/31	2517	10.4	0	0
6/1-6/7	2066	14.2	9.2 (14.8)	5
6/8-6/14	1913	12.7	8.6 (13.8)	5
6/15-6/21	1521	14.7	18.2 (29.3)	10
6/22-6/28	1028	17.9	73.0 (117.5)	40
6/29-7/5	737	17.8	37.6 (60.5)	20
7/6-7/12	565	18.7	26.2 (42.2)	14
7/13-7/19	452	19.7	9.8 (15.7)	5
7/20-7/26	449	21.2	2.0 (3.2)	1

Table 4. Seven-day maximum flows and temperatures in relation to Bull Trout movement during the year 2000.

Bull Trout ID #	% Traveled Before 6/21	% Traveled From 6/21 – 6/28	% Traveled After 6/28
#3	0	44	56
#4	34	38	28
#8	–	–	–
#9	42	17	41
#10	25	22	53
#11	18	49	33
#12	39	42	19
#13	29	52	19
#14	12	34	54
#15	14	26	60

Table 5. Movement of individual Bull Trout in 2000.

Bull Trout ID #	Destination	Miles traveled up Tributary (km in parentheses)
#3	East Fork	--
#4	Moose Creek	5.5 (8.8)
#8	Swift Creek	2.9 (4.7)
#9	Warm Springs Creek	4.8 (7.7)
#10	East Fork	--
#11	Meadow Creek	3.3 (5.3)
#12	Moose Creek	>1.1 (1.8)
#13	Swift Creek	2.9 (4.7)
#14	East Fork	--
#15	Moose Creek	>0.5 (0.8)

Table 6. Destinations and distances traveled up tributary streams by bull trout in 2000.

Bull Trout ID #	Weight (g)	Length (mm)	Miles traveled upstream (km in parentheses)	Date Upstream Movement Began	Average Miles traveled/day (km in parentheses)
#3	590	401	25.3 (40.7)	5/31	0.50 (0.80)
#4	817	455	24.0 (38.6)	6/1	0.48 (0.77)
#9	885	445	4.8 (7.7)	6/12	0.15 (0.24)
#8	953	462	20.4 (32.8)	5/31	–
#13	953	462	22.3 (35.9)	6/16	0.83 (1.34)
#11	1017	470	26.3 (42.3)	5/31	0.66 (1.06)
#10	1090	472	24.75 (39.8)	6/1	0.50 (0.80)
#14	1249	503	20.7 (33.3)	6/16	0.77 (1.24)
#15	1253	500	27.8 (44.7)	6/7	0.70 (1.13)
#12	2088	622	>18.4 (>29.6)	5/31	–

Table 7. Bull trout listed in order of size and compared to several parameters, including date movement began, miles traveled upstream, and average miles traveled per day.

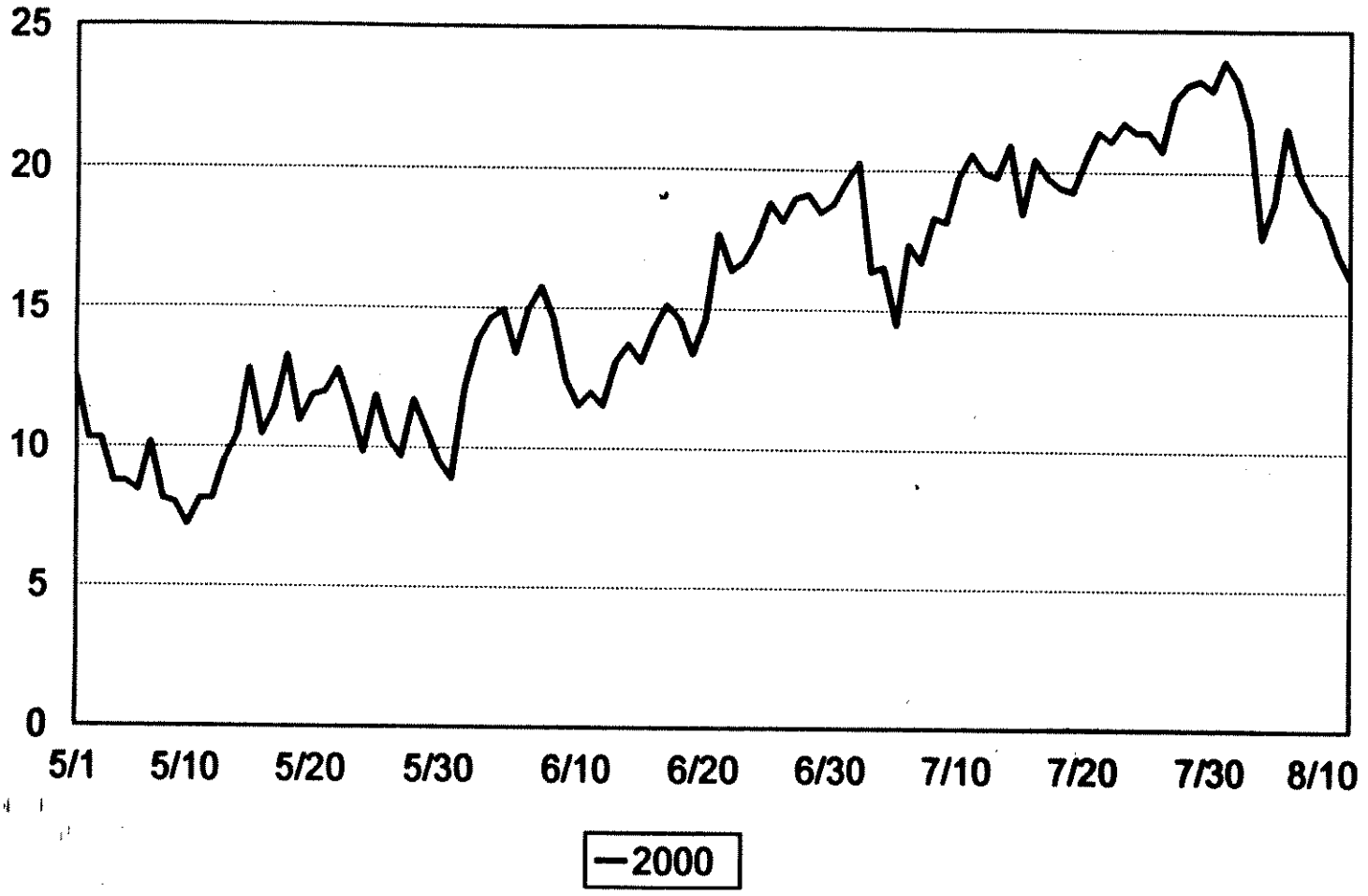

Figure 3. Daily maximum temperatures in the East Fork Bitterroot River near Conner, Montana during 2000.

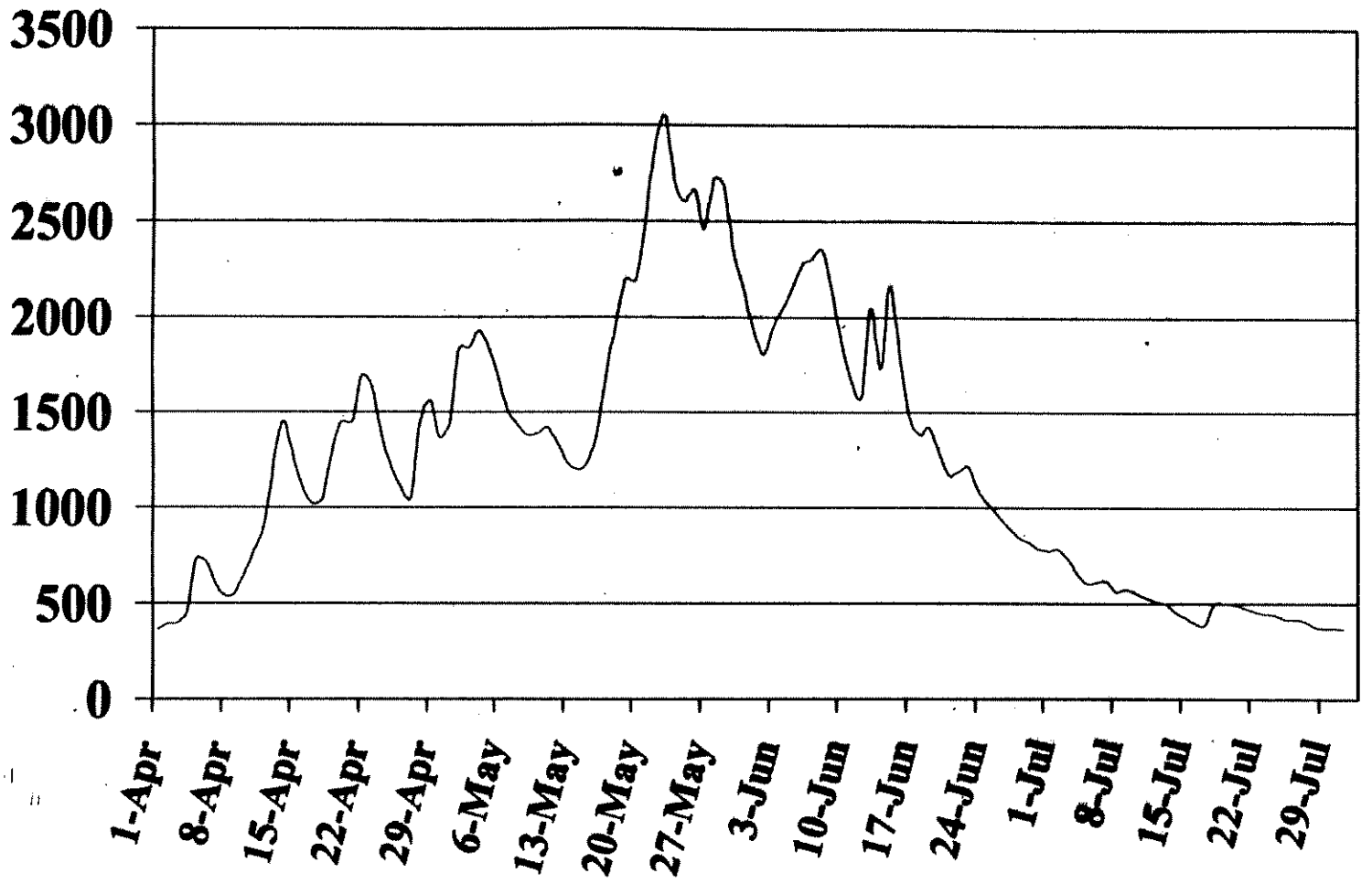

Figure 4. Mean discharge of the Bitterroot River near Darby from April 1 to July 31, 2000 (in Cubic Feet per Second—cfs)