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# INVENTORY AND SURVEY OF SELECTED STREAM FISHERIES OF THE RED ROCK, RUBY, AND BEAVERHEAD RIVER DRAINAGES OF SOUTHWEST MONTANA

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## ABSTRACT

Trout population data are presented for seven study sections on the Beaverhead River. Trout populations of the upper river tailwater environment recovered substantially from drought influenced declines of the late 1980's and early 1990's. Brown trout populations recorded observed highs in density, standing crop, and numbers of 18 inch and larger fish. Rainbow trout populations remained suppressed in association with expanding brown trout populations. Brown trout populations in mid-river environments also recovered under ample flow regimes in one study section but remained depressed in the other section. Lower river brown trout populations remained stable at low density in association with habitat limitations. Preliminary observations are presented on an Arctic grayling reintroduction effort in the lower Beaverhead River. Salmonid population data are presented for two study sections in the upper Ruby River. Trout populations recovered substantially from drought influenced flows of the 1985-1994 period under ample flow regimes in 1995-1999. Data are presented describing Arctic grayling reintroduction efforts in the upper Ruby River. Trout population data are presented for 10 study sections sampled in the lower Ruby River system. The affects of a 1994 reservoir dewatering event on a limited tailwater fishery, the acquisition of public fishing access sites, and the discovery of whirling disease are discussed among the various study sections over the period of record. The trout populations of Poindexter Slough are presented for the study period. Brown trout population declines and recovery are discussed in regard to the discovery of whirling disease in the system. Population data for four study sections on Big Sheep Creek are presented and discussed relative to the discovery of whirling disease. Westslope cutthroat trout population data are presented for Odell and Stone Creeks relative to habitat improvement projects in both drainages. Westslope cuthhroat trout sampling efforts and genetic information are presented for 83 streams within the three major river drainages covered by this report.

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## INTRODUCTION

The mainstem river fisheries of the upper Missouri River drainage of southwest Montana are nationally renowned for their wild trout populations and "blue ribbon" fisheries. These river systems, first described by the Lewis and Clark expedition, also contain smaller tributary streams which provide high quality sport fisheries or support native fish populations in isolated settings. The popular sport fisheries of these drainages support relatively high angler use which has recently undergone a relatively rapid expansion. This report details wild trout population dynamics in selected study sections of mainstem rivers and tributary streams in the Red Rock, Ruby, and Beaverhead River drainages of southwest Montana which were last described by Oswald and Brammer (1993).

The streams of southwest Montana support a relatively limited diversity of native fish species to include westslope cutthroat trout; Arctic grayling; mountain whitefish; burbot; white, longnose, and mountain sucker; longnose dace, and mottled sculpin. Concern over the future of native fluvial Arctic grayling of the upper Missouri River system has led to recent grayling reintroduction projects beginning in 1997 in the upper Ruby River and in 1999 in the lower Beaverhead River. Concern over the future persistence of native westslope cutthroat trout has resulted in numerous studies of population genetics and hybridization, competition with introduced species, and habitat limitations. These studies have resulted in recent projects which have attempted to improve habitat quality, reduce competitive factors and expand westslope cutthroat trout distribution within the upper Missouri drainage. The popular sport fisheries of southwest Montana are largely based upon wild populations of introduced salmonids including the brown, rainbow, and brook trout as well as lesser tributary contributions of Yellowstone cutthroat trout or rainbow trout and their hybrids with native westslope cutthroat trout. Introduced nongame species include the red side shiner minnow and common carp which are present at low density in lower reaches of the mainstem river systems.

The Beaverhead River supports variable populations of brown and rainbow trout dependant upon dominant habitat type, regulated flow regimes, inverted lower river hydrograph, distance from the tailwater of Clark Canyon dam, sediment loading, thermal regime, and riparian development. The sport fishery of the Beaverhead River is dominated by brown trout while limited rainbow trout populations have been supported between Clark Canyon dam and the city of Dillon, Montana. Beginning in 1999, an attempt has been made to reestablish an Arctic grayling population in the lower river between the mouth of Stodden Slough and the confluence of the Beaverhead and Big Hole Rivers. Past angler use of the Beaverhead River has been concentrated in the upper tailwater portions of the system between Clark Canyon Dam and Barretts Diversion. This concentrated use pattern has persisted to the present but estimated pressure has increased from 15,093 angler days in 1991 to 39,726 angler days in 1997 (MFWP 1991-1997) with nonresident angler use accounting for 63% of the total angler user days. Currently, the MFWP Commission and a Commission appointed citizen's advisory group are examining issues related to angler crowding in upper reaches of the Beaverhead River.

The fisheries of the Ruby River can be examined as two systems, i.e., a lower river and an upper river environment, roughly bisected by the Ruby Reservoir. The lower Ruby River supports relatively abundant populations of brown trout in habitats downstream from the Ruby Reservoir.

The size composition and abundance of these populations is dependant upon distance from the reservoir tailwater, dominant habitat type and condition, and flow release regime from the dam. Upper Ruby River fisheries are dominated by brown and rainbow trout in relatively close proximity to the reservoir while upper reaches of the river are dominated by a hybridized swarm of rainbow trout and westslope cutthroat trout. Since 1997, attempts have been made to reintroduce a fluvial Arctic grayling population in the upper Ruby River. In 1994, a complete dewatering of Ruby Reservoir occurred (Oswald 2000a) resulting in a significant fish kill in a limited reach of the Ruby River tailwater downstream from the dam. This event led to the formation of a Governor's Ruby River Task Force which investigated and recommended methods to promote adequate storage in Ruby Reservoir and adequate flow regimes for irrigation and fisheries in the Ruby River. In 1995, angler frustration over decreasing access to private lands along the lower Ruby River led to the formation of a Governor's Ruby River Fishing Access Task Force. Recommendations of this Task Force led to the formation of a Lower Ruby River Fishing Access Plan (MFWP 1996) and the ultimate acquisition of 5 public fishing access sites along the lower river corridor in 1996. Increased public access had an immediate affect on angling pressure within the lower Ruby River reach. In 1997, angling pressure on the lower Ruby was estimated at 9,458 angler days, a marked increase over the 1995 pressure estimate of 5,974 angler days (MFWP 1991-1997).

Poindexter Slough is a major spring creek fisheries resource. It is tributary to the Beaverhead River and is located in close proximity to the city of Dillon, Montana. While base flows of Poindexter Slough are maintained through accretions from numerous valley floor spring sources, a portion of the stream's summer flow consists of irrigation water diverted from the Beaverhead River. The fishery of Poindexter Slough is dominated by wild brown trout which attain extremely high density due to an abundance of favorable spawning and rearing habitat. Much of the productive fisheries reach of Poindexter Slough is located on public fishing access property maintained by MFWP. Recent angling pressure estimates indicate a use rate of approximately 3,000 angler days per year (MFWP 1997). The brown trout populations of Poindexter Slough were last described by Oswald and Brammer (1993).

Big Sheep Creek is a productive mountain tributary stream which flows into the Red Rock River near Dell, Montana. The stream enlarges markedly beyond headwater tributary inflow due to a large spring flow influence originating from a porous limestone formation. The stream has produced relatively abundant populations of large rainbow and brown trout in the recent past. Big Sheep Creek also supports limited numbers of westslope cutthroat trout which originate in headwater tributary environments. The stream supports relatively heavy angling pressure estimated at 1,661 angler days in 1997 (MFWP 1997).

In recent years, much effort has been directed at the native westslope cutthroat trout populations of the upper Missouri River drainage. The majority of these populations exist in relatively isolated first or second order mountain tributary streams. Sampling efforts have been directed at locating relict populations and determining their genetic composition to ascertain purity or degree of hybridization from introduced rainbow and Yellowstone cutthroat trout. Some effort has also been made to improve degraded habitats within discreet stream systems. Stone Creek, a Beaverhead River tributary, and Odell Creek, a Red Rock River Tributary are examples of restoration efforts. In addition to hybridization and habitat degradation, competition from introduced salmonids, particularly brook trout, has resulted in a limited distribution for the native westslope cutthroat trout in the upper Missouri River drainage.

## METHODS

Trout populations in rivers and large streams were sampled through the use of electrofishing techniques based on mark-recapture methodologies described by Vincent (1971). Electrofishing was conducted via boat mounted, mobile anode techniques which utilize a 3500 watt generator and Leach type rectifying box. A straight or continuous wave DC current is used at 1,000 to 1,500 watts. Fish captured within the field were drawn to the boat, netted, and deposited into a live car. Boats consisted of a modified Clackacraft drift boat or modified Coleman Crawdad boat depending upon stream size. Individual fish captured were anesthetized, segregated by species, measured for length and weight, marked with a small identifying fin clip, and released. Scale samples for age determination were collected from a representative subsample by length. Multiple marking runs and recaptures runs were made through each of the study sections until predetermined goals were achieved in mark and capture totals.

Trout population statistics were analyzed under a log-likelihood methodology developed and described by Montana Fish, Wildlife and Parks (1994) under guidelines presented by Brittain, Lere, and McFarland (1998). Population estimates were largely calculated for brown trout from March and April samples collected from the study sections while rainbow trout, cutthroat trout, and Arctic grayling population estimates were calculated from September and October samples. The seasonal segregation by species was applied to avoid population estimate bias due to spawning movements and migrations.

Tributaries were sampled for westslope cutthroat trout through the use of Coffelt gasoline powered or Smith Root battery powered back pack electrofishers. Back pack units used continuous DC waveforms with total output wattage determined by the specific conductance of the individual streams. Population estimates were calculated through mark - recapture or two-pass methodologies dependant upon stream size. Suspected westslope cutthroat trout collected for genetic analysis were placed immediately upon ice in the field and transferred to a freezer for storage prior to shipment to the University of Montana Genetics Lab for electrophoretic analysis. Genetic analysis was made through the use of horizontal starch gel protein electrophoresis. In general, first entry samples consisted of a collection of ten fish with a capability of detecting 1.5% Yellowstone cutthroat or 2.5% rainbow trout hybridization at the 95% confidence interval.

## RESULTS

### BEAVERHEAD RIVER

#### Hildreth Study Section

Brown trout population density and standing crop are presented in Figure 1 for the 1986 through 1999 period. Despite low winter flow regimes over the 1989-1994 period, brown trout population density and standing crop exhibited an increasing trend over prior years populations.

However, abundant flow regimes in the 1995 through 1999 period resulted in the highest observed populations in the sampling history of the study section. Populations in 1998 and 1999 exceeded 2,100 Age II and older fish per mile while standing crops exceeded 3,600 pounds per mile. High brown trout biomass in 1998 and 1999 was correlated directly with increased numbers of larger fish. Numbers of 18 inch and larger brown trout (Figure 2) soared to 693 per mile in 1998 and 832 per mile in 1999, vastly exceeding the prior observed high of 520 per mile in 1988. While total numbers of 18 inch and larger fish increased substantially in 1998-1999, their contribution as a percent of the brown trout population (Figure 3) declined from observed highs in 1986 and 1987. This would suggest that the relative abundance of 18 inch and larger brown trout has declined with burgeoning total numbers of brown trout. Similar observations can be made, in more dramatic fashion, for 20 inch and larger brown trout (Figures 4 and 5) and 22 inch and larger brown trout (Figures 6 and 7). The data strongly suggest that brown trout growth and ultimate size have declined under recorded high population density and brown trout standing crop.

Trends in rainbow trout density and standing crop over the 1986-1999 period are presented in Figure 8. While brown trout density has soared over the recent past, rainbow trout numbers have undergone a slight decline and have remained relatively constant over the recent, 1995-1999 period despite abundant flow regimes. Recent rainbow trout density has averaged approximately 25% of the observed brown trout density at approximately 500 per mile. Numbers of larger rainbow trout are exhibited in Figure 9. Relatively high numbers of 18 inch and larger rainbow trout reflect peaks in population density observed in 1986-1987, 1990, and 1998. Numbers of 20 inch and larger fish, however, have remained relatively low, with the exception of 1998, despite ample flow regimes in recent years.

Pipe Organ Study Section

Brown trout population trends are presented in Figure 10 for the 1986-1999 period of study in the Pipe Organ Section. Brown trout density declined dramatically with low flow regimes experienced in the 1990-1991 period. Beginning in 1992, populations recovered significantly to attain densities of approximately 1,500 per mile in 1998-1999. As was the case in the Hildreth Section, 1998-1999 brown trout standing crops attained observed highs approaching 2,000 pounds per mile in 1999. This was reflective of ample flow regime and high densities of larger fish in the population. The Pipe Organ brown trout standing crop, however, averaged approximately one-half that observed in the Hildreth Section in 1998-1999 due to productive differences associated with distance from the tailwater source. Numbers of larger brown trout (Figure 11) declined substantially in 1991 and remained low over the 1991-1995 period. Numbers of these 18 inch and larger fish recovered with ample flow regimes after 1995 and attained a density in excess of 250 per mile in 1999, nearly matching the prior observed high of 1988.

Fish and Game Study Section

Fish and Game Section brown trout population trends are depicted in Figure 12 for the 1988-1998 period of study. Brown trout density and standing crop declined steadily from

observed highs in 1988 in association with limited flow regimes over the 1989-1991 period. Populations recovered moderately over the 1992-1996 period with improving flow regimes and attained relatively high levels of abundance in 1998, similar to observations made in the Hildreth and Pipe Organ Sections. The 1998 standing crop in the Fish and Game Section falls far below that observed in the Hildreth and Pipe Organ Sections reflective of substantial distance from the tailwater source and more limited flow regime due to major upstream irrigation withdrawals. The strong brown trout populations of 1988 and 1989 were marked by an abundance of younger fish in the 7.0-12.9 inch and 13.0-15.9 inch length groups (Figure 13). These length groups, dominated by Age II and Age III brown trout, were also a major component of the 1998 population. In 1988 and 1989, numbers of larger brown trout, 16 inch or 18 inch and larger fish, also flourished within the population. This was also the case in 1998 which exhibited a population structure very similar to that observed in 1989 suggesting that the Fish and Game Section brown trout population was fully recovered under relatively abundant flow regimes.

Low Flow Study Section

Brown trout trends in population density and standing crop are exhibited in Figure 14 for the Low Flow Section over the 1987-1998 period of study. Brown trout density declined in 1991-1992 similar to observations made in upstream sections but appeared to recover substantially in 1993. Since 1994, density and standing crop have remained far below recorded highs and have not recovered with recent abundant flow regimes. While standing crop in the Low Flow Section has averaged slightly lower than that observed for the Fish and Game Section (Figure 12), density has generally averaged somewhat higher. Length distribution within the Low Flow brown trout population (Figure 15) indicates that the section generally supported higher densities of smaller fish than the Fish and Game Section. Recent population estimates are indicative of below average recruitment into the population despite abundant flow regimes and ample habitat availability.

Anderson Lane Study Section

Brown trout population trends for the Anderson Lane Section are presented in Figure 16 for the 1991-1999 period of study. Oswald and Brammer (1993) compared the Anderson Lane Section with prior study data within the same river reach from the 1975-1976 period with the conclusion that brown trout population density had remained relatively constant. Further study within the section revealed little change in population density or standing crop. Brown trout populations within the Anderson Lane Section have remained at low density when compared with upstream reaches. Population density approximately varied between 300 and 450 fish per mile with a standing crop of about 300 to 400 pounds per mile. Length distribution within the population (Figure 17) fluctuated dramatically with recruitment although recruitment strength remained relatively weak. Populations were reflective of relatively high percentages of larger fish at low population density.

In 1999, fluvial Arctic grayling were reintroduced to the lower Beaverhead River via plants of overwintered yearling fish totaling 18,548. One of the plant locations was the Anderson Lane Bridge which is the upstream boundary of the study section. Due to this reintroduction effort, an attempt was made to estimate the grayling population within the section in the fall of 1999. The marking run through the section resulted in the capture of 288 yearling grayling, the majority of which were in relatively close proximity to the release site. The recapture run resulted in the capture of only 20 grayling, none of which were marked fish. Two of the grayling marked in the Anderson Lane Section were recaptured downstream in the Mule Shoe Section. These results precluded the calculation of a valid population estimate and strongly suggested a downstream migration of arctic grayling in response to increasing post-irrigation season flows.

Mule Shoe Study Section

Brown trout population trends for the Mule Shoe Section are depicted in Figure 18 for the 1990-1999 period of study. Oswald and Brammer (1993) compared Mule Shoe Section populations of the early 1990's with population data from the similarly located Blaine Study Section in 1971 and 1975. Brown trout populations in the Mule Shoe study section have remained at low density and low standing crop throughout the study period. While population highs in the Mule Shoe Section have been similar to those observed in the Anderson Lane Section, low populations observed in 1991,1994, and 1998 were substantial lower than those observed in the Anderson Lane Section. Length analysis of the brown trout populations of the section (Figure 19) indicate that relatively high population densities observed in 1992 and 1993 were based on high recruitment of Age II fish into the population while most years indicate very poor recruitment. With the exception of the 1990 sample, the brown trout population of the Mule Shoe Section is not marked by a relatively high percentage of large brown trout.

Similar to the Anderson Lane Section, the Mule Shoe Section was selected as a reintroduction site for yearling fluvial Arctic grayling. Due this reintroduction effort, an attempt was made to estimate grayling density in the fall of 1999. In direct opposition to observations made at the Anderson Lane Section, the marking run in the Mule Shoe Section resulted in the capture of 36 grayling while the recapture run resulted in the capture of 101 fish. One of the recapture run grayling was a Mule Shoe Section recapture while two of the fish carried the mark from the upstream Anderson Lane Section. These results precluded calculation of a valid population estimate but confirmed a fall migration in response to increasing post-irrigation streamflows observed in the Anderson Lane Section.

Twin Bridges Study Section

Brown trout populations in the Twin Bridges Section are depicted in Figure 20 for the 1987-1999. Oswald (1990) observed that brown trout populations in the Twin Bridges averaged higher than those observed in the Anderson Lane and Mule Shoe Sections due to mitigating flow accretion from the Ruby River. Subsequent population estimates in 1995 and 1999 were indicative of populations observed in the two upstream sections averaging slightly less than 400 fish per mile. Length analysis of the brown trout populations (Figure 21) revealed that recruitment in the late 1980's generally exceeded that observed in the upstream sections and may have been associated with recruitment from the Ruby River or spring sloughs in the vicinity. Recent recruitment has been relatively low resulting in low total population density and relatively low numbers of older, larger fish within the population.

A portion of the Arctic grayling reintroduction plant was made at Silver Bow Lane, approximately 5.5 miles upstream from the Twin Bridges Section. As a result of this plant, an attempt was made to survey grayling within the section in the fall of 1999. Mark and recapture runs through the study section resulted in the capture of 14 and 16 grayling, respectively. While this effort did not result in a population estimate, it confirmed that limited numbers of the reintroduced grayling were utilizing habitats within the study section.

## UPPER RUBY RIVER

### Three Forks Study Section

The Three Forks Section typifies headwater environments of the upper Ruby River. The trout population of the Three Forks Section is composed of a hybrid swarm of rainbow trout, westslope cutthroat trout, and the hybridized progeny of both species. Due to the difficulty of visually separating individual fish, population data are analyzed as rainbow x cutthroat hybrid trout. Population data for the Three Forks Section are depicted in Figure 22 for the 1987-1999 period of study. Rainbow x cutthroat hybrid densities declined dramatically in 1989 and remained low throughout the drought influenced period which spanned 1985 through 1994 in southwest Montana. During the 1997-1999 period, population density increased markedly under favorable flow regimes. In 1999, standing crop approximated the observed high for the section which occurred in 1988. Length group analysis of the population (Figure 23) revealed that high populations of 1987, 1988 and 1999 were based largely upon high densities of 7.0-9.9 inch fish. Relationships portrayed by Oswald and Brammer (1993) indicated that the majority of fish in this length group were Ages I and II. The populations of 1997-1999 were also marked by high numbers of older, larger fish in excess of ten inches in length which contributed significantly to the increasing standing crops observed over the period. Mean condition factor of rainbow x cutthroat trout in the Three Forks Section is depicted in Figure 24 for the study period. Years marked by extremely low flow regimes such as 1987-1989, 1992, and 1994 resulted in diminished condition of the fish. Condition factor recovered with abundant flow regimes in 1995 and remained high through 1999.

In 1997, an attempt to reintroduce fluvial Arctic grayling into the upper Ruby River was initiated with a plant of 29,805 young of the year fish in late summer. These fish were very small and survival was documented into October 1997 with the capture of 31 2.0-3.3 inch fish in the Three Forks Section. Subsequent sampling documented low winter survival of these young of the year plants. In 1998 and 1999, the upper Ruby River received plants of 9,804 and 7,349 overwintered yearling grayling to increase survivability. The estimated density and standing crop of Arctic grayling in the Three Forks Section is depicted in Figure 25 for 1998 and 1999. The 1998 population estimate of 406 fish per mile was composed entirely of Age I fish and exceeded the density of the wild rainbow x cutthroat trout (Figure 22) by 104 fish per mile. The vast majority of fish in 1998 appeared to originate from the 1998 yearling plant with very few individuals suspected of being survivors of the 1997 plant. The 1999 population estimate of 292 grayling per mile represented in a decline in the number of fish planted in 1999 and was dominated by yearling fish. Standing crop in both years approximated 100 pounds per mile indicative of larger sized yearling plants in 1999 and the presence of Age II fish in the population. Mean length, weight, and condition factor for Arctic grayling in the Three Forks Section are presented in Table 1. Mean length, weight, and condition factor increased from 1998 to 1999 despite

Table 1. Mean length (inches), weight (pounds), and Condition Factor (K) for Arctic grayling collected in the Three Forks Section of the Ruby River 1998 - 1999.

| Year | Mean Length | Mean Weight | Condition Factor (K) |
|---|---|---|---|
| 1998 | 9.8 | 0.28 | 29.60 |
| 1999 | 10.5 | 0.35 | 30.06 |

the high density and standing crop impressed upon the habitat via the Arctic grayling plants. Increased size of the grayling in 1999 was related to an increase in the size of the planted grayling and the presence of Age II fish in the population. Moreover, grayling size increased as rainbow x cutthroat trout density and standing crop reached very high levels for the study section (Figure 22) while maintaining a high mean condition factor (Figure 24). This indicates that the upper Ruby habitat was previously understocked, at least under ample flow habitat conditions, in terms of total salmonid standing crop.

Greenhorn Study Section

The Greenhorn Section is typical of lower reach habitats of the upper Ruby River system. The trout populations of the reach are dominated by brown and rainbow trout. The study section was sampled in 1990 and described by Oswald and Brammer (1993). Plans to reintroduce native Arctic Grayling into the upper Ruby system led to an annual sampling program which has been adhered to since 1994.

Rainbow trout density and standing crop are depicted for the Greenhorn Section in Figure 26 for the 1990-1999 period of study. The section has supported relatively low densities of Age I and older rainbow trout which generally range between 100 and 250 fish per mile. Rainbow trout standing crop in the Greenhorn Section generally varied between 50 and slightly more than 100 pounds per mile. These standing crops were approximately equal to rainbow x cutthroat trout or Arctic grayling standing crops observed in more limited upstream environments in the Three Forks Section. Recent ample flow regimes have resulted in observed high densities and standing crops in 1998 and 1999. While density remained relatively constant between 1998 and 1999, rainbow trout standing crop increased markedly. This was reflective of increased numbers of larger rainbow trout in 1999 (Figure 27). The 1999 population, however, lacked any discernible recruitment of juvenile rainbow trout. Length analysis within the rainbow trout populations indicated limited rainbow trout recruitment in all years except 1994 and 1998.

Brown trout densities and standing crops within the Greenhorn Section are portrayed in

Figure 28. Brown trout density and standing crop substantially exceeded that observed for rainbow trout in the section. The data suggest that brown trout populations have flourished and increased markedly under recent ample flow regimes since 1995. Comparisons of standing crops with the Three Forks Section (Figures 22 and 25) indicate that the carrying capacity of the more productive habitat of the Greenhorn Section was strongly dominated by brown trout biomass. Length analysis of the Greenhorn Section brown trout populations (Figure 29) exhibited strong and consistent brown trout recruitment since 1996. This successful annual recruitment resulted in high numbers of older, larger fish in the population by 1999.

Introductions of Arctic grayling at upstream stocking locations in the upper Ruby River have not resulted in significant downstream drift of the species. Differentially marked fish have been stocked at three general locations upstream from the Greenhorn Section and have shown little propensity to move between stocking locations (Opitz 2000). The fall 1998 sampling resulted in the capture of only two yearling Arctic grayling which appeared to have originated from the 1998 plant. The 1999 sampling resulted in the capture of 7 Arctic grayling, 5 of which were confirmed to be from the 1999 yearling plant by adipose fin removal. Of four Arctic grayling captured during the 1999 recapture run, one carried the coded wire tag mark of fish planted near the Three Forks area while three carried the tag indicative of the fish planted at the lowermost location near the USFS Vigilante Station.

## LOWER RUBY RIVER

### Passamari and Maloney Study Sections

The Passamari and Maloney Sections typify the limited tailwater environment of the lower Ruby River immediately downstream from the Ruby Reservoir dam. In September 1994, Ruby Reservoir was inadvertently drained due to persistent drought conditions and high irrigation demand. Heavy sediment entrainment into the river, coupled with extremely low flow, resulted in a complete deoxygenation in the uppermost river mile and a significant fish kill numbering in the thousands for brown and rainbow trout (Oswald 2000a). The Passamari Section was established immediately following the fish kill in 1994 to monitor the affects of the kill, primarily on wild brown trout populations. The Passamari Section originated at the West Canal Diversion and Terminated at the Ruby Canyon Diversion for a distance of 6,335 feet. A fall sampling regimen was utilized in the Passamari Section to maintain consistency in the aftermath of the fish kill. In 1997, the property downstream from the Passamari reach was acquired by FWP as a public fishing access site (FAS) under the guidance of the Ruby River Access Task Force (RRATF). Beginning in 1998, Ruby River tailwater sampling was converted to a spring sampling in the Maloney Section to continue monitoring wild brown trout recovery in the aftermath of the 1994 event and to monitor the affect of public access on the fishery. The Maloney Section originated at the upstream FAS property boundary immediately upstream from the Ruby Canyon Diversion and terminated at the downstream FAS property boundary for a lineal distance of 4,792 feet. The Maloney Section is continuous with the Passamari Section with a slight overlap upstream from the Ruby Canyon Diversion.

Brown trout population trends in the Passamari and Maloney Sections are depicted in

Figure 30 for the 1994-1999 period of study. In the aftermath of the 1994 event, brown trout density was reduced to 257 Age I and older fish per mile representing a standing crop of only 227 pounds per mile. Steady increases in density and standing crop resulted in full population recovery by 1999. The 1999 population estimate of 1,397 brown trout representing 1,303 pounds of biomass per mile was indicative of a productive tailwater environment. The high 1996 ratio of brown trout standing crop to density was indicative of rapid growth and high numbers of large fish in an understocked habitat. This was exemplified buy limited expansion in numbers of 13 inch and larger brown trout (Figure 31) while numbers of 18 inch and larger fish (Figure 32) expanded very rapidly. Recruitment of juvenile brown trout (Figure 33) also remained low through 1996 but increased markedly from 1997 through 1999 with recovered numbers of large reproductive adults. Relatively high numbers of 18 inch and larger brown trout have been reflective of a very productive but limited tailwater environment associated with the reservoir. Numbers of these large trout far exceed observations in any of the downstream study sections of the lower Ruby River. The data strongly indicate that public fishing access has not diminished brown trout density, numbers of 13 inch and larger brown trout or numbers of 18 inch and larger fish. For purposes of comparison, lands surrounding the majority of the Passamari Section are under exclusive private ownership while lands surrounding the Maloney Section have been open to public fishing access since late 1996.

The rainbow trout population of the Ruby River tailwater is largely dependant upon the spill of Eagle Lake strain fish which have been stocked into Ruby Reservoir on an annual basis (Oswald 2000a). The river reach supporting these fish in significant numbers has been limited to the uppermost two to three miles of tailwater habitat. Rainbow trout density and standing crop in the Passamari Section is depicted in Figure 34 for the 1994-1997 period of study. Spring rainbow trout population estimates in the Maloney Section have been precluded by spawning movements. In the fall of 1994, rainbow trout surviving the dewatering of the reservoir impressed a very large population density and biomass on the downstream river environment. Oswald (2000a) described the relocation, back to the reservoir, of approximately 3,000 of these rainbow trout from the upper three miles of the river below the dam. The 1995 rainbow trout population of the reach reflects the affect of the spill and this relocation effort. Rainbow trout numbers increased markedly in 1996 and 1997 due to habitat recovery as demonstrated by brown trout populations and due to prolonged spillway events in the reservoir associated with abundant upper river flows and resulting abundant storage pools in the reservoir.

Stanley Study Section

As a result of the 1994 reservoir dewatering event, sampling was conducted immediately downstream from the lowermost observed fish kill. The Stanley Section originated at the Stanley Ditch Diversion and proceeded downstream to split channel complex for a lineal distance of 5,280 feet. The 1994 brown trout population estimate revealed a density of 783 fish per mile and a standing crop of 748 pounds per mile, far exceeding the density and standing crop observed in the Passamari Section in the reach of the fish kill. Population estimates for 13 inch and larger brown trout of 473 fish per mile and estimated numbers of 16 inch and larger fish of 129 per mile compared favorably with other lower Ruby River samples indicating that the fish kill was confined to upstream reaches of the tailwater. This was further confirmed by the estimated number of 253 Age I brown trout per mile in the Stanley Section versus 154 per mile in the more productive Passamari Section. Limited numbers of 18 inch and larger brown trout estimated at 18 per mile in the Stanley Section were indicative of the rapid dissipation of the limited tailwater affect of the Ruby Reservoir.

Alder Study Section

The wild brown trout population of the Alder Section was sampled in 1983 and reported by Oswald (1986a). The study section was reestablished in 1998 in response to concerns that public angling access might diminish the quality of trout populations within the reach. Public fishing access within the Alder Section reach began late in the summer of 1996 with FWP gaining a leased FAS through the assistance of RRATF. Brown trout population data are depicted for the Alder Section for 1983 and 1998-1999 in Figure 35. While brown trout density had declined between the 1983 and 1998 samples, standing crop remained approximately equal, indicative of the presence of larger fish within the population under public access in 1998. Moreover, brown trout number and standing crop increased markedly under public access between 1998 and 1999. Both the 1983 and 1999 samples were marked by substantial recruitment of juvenile fish into the population (Figure 36). Numbers of larger, 13 inch and 16 inch and larger, brown trout (Figures 37 and 38) most likely to be affected by angler induced mortality increased over 1983 levels and increased substantially between 1998 and 1999 under public access. While the productive upper tailwater habitat has diminished significantly at the Alder Section, numbers of 18 inch and larger brown trout expanded from an estimated four per mile in 1983 to 12 per mile in 1998 and 28 per mile in 1999. These numbers compare favorably with the 1994 estimate of 18 per mile in the private Stanley Section upstream. The data suggest that brown trout populations have maintained and flourished under the public angling scenario.

Guinnane Main Channel and Clear Creek Study Sections

Actions of the Ruby River Access Task Force mandated evaluation of properties as potential public FAS along the lower Ruby River corridor. As a result, The Guinnane Study Sections were established in two river channels near the town of Alder, Montana. The Guinnane Main Channel Section originated at the county road bridge at Alder and proceeded downriver to the Guinnane Ranch bridge for a lineal distance of 2,552 feet. The Guinnane Clear Creek Section also originated at the Alder county road bridge and proceeded downstream to a ranch ford for a lineal distance of 3,488 feet. While the Clear Creek channel is a natural avulsion channel of the Ruby River, its summer flows have been artificially increased via diversion for irrigation on downstream properties.

Brown trout population data for the Guinnane Main Channel and Clear Creek Sections are presented in Figure 39 for the 1996 sample. Brown trout density and biomass in the Main Channel Section far exceeded that observed in the more limited habitat of the Clear Creek Section. The total brown trout population of both channels represented 1,845 Age I and older brown trout per mile and a biomass of 1,331 pounds per mile which represent substantial population totals for the lower Ruby River. Estimated numbers of 13 inch and 16 inch and larger brown trout (Figure 40) again depict substantial differences between the two study sections but are indicative of a relatively productive sport fishery. Estimated numbers of Age I brown trout (Figure 41) exhibit relatively strong recruitment into the Guinnane Section brown trout population and, again, depict differences between the Main Channel Section and more limited habitat of the Clear Creek Section. The data suggest that the study sections could support a relatively abundant sport fishery.

Tezak and Woodson Study Sections

Two study sections were added into the lower Ruby River sampling regimen near Laurin, Montana in 1996 and 1997. The Tezak Section was selected in 1996 in order to assess property suitability as a public FAS under the guidance of the RRATF. It was also selected for analysis due to the degraded nature of the stream banks and riparian vegetation throughout the property reach. The Tezak Section originated and ended at the up and downstream property boundaries and had a length of 4,569 lineal feet. The Woodson Section was sampled in 1997 and was selected to provide companion brown trout population data in conjunction with a graduate whirling disease study conducted, in part, within the reach (Opitz 1999). The Woodson section was also selected as an appropriate proximal habitat control reach with which to compare brown trout population data from the Tezak Section. The Woodson Section originated and ended on the Woodson Ranch property and was sampled for a distance of 6,875 feet. The upstream boundary of the section was located below the mouth of Alder Creek and the section terminated at the diversion of the Schoolhouse Canal.

Brown trout density and standing crop comparisons of the two study sections are presented in Figure 42. The Woodson Section supported an observed density of 960 Age II and older brown trout per mile compared with 813 fish per mile in the Tezak section. Brown trout standing crop, however, was quite similar between the two sections with 769 pounds per mile in the Woodson Section and 751 pounds per mile in the Tezak Section. Estimated spring densities of 13 inch and larger brown trout (Figure 43) showed more fish in this length range in the Tezak Section while numbers of 16 inch and larger brown trout were virtually identical between the two sections. Estimated densities of Age II brown trout (Figure 44) showed significantly higher numbers in the Woodson Section accounting for most of the differences between the two sections in total brown trout population density. Population density and standing crop were relatively low in both sections when compared with upstream study sections in the lower Ruby River. This may have been associated with degraded bank and riparian habitat in the Tezak Section, particularly juvenile brown trout habitat, but could not be a causal factor in the Woodson Section where the riparian corridor is managed for fish and wildlife habitat and numerous habitat improvement projects have been undertaken in recent years.

Silver Spring Study Section

The brown trout populations of the Silver Spring Section were last described by Oswald and Brammer (1993). Since that time, abundant brown trout populations (Figure 45) declined substantially and unexpectedly to the lowest observed densities and standing crops for the lower Ruby River system. This rapid decline was unexpected and could not be attributed to any observed climatic, habitat, or stream flow factors or to any acute fish loss events. Populations suffered maximal decline in 1995 and 1996 but began a steady recovery in the 1997 through 1999 samples. During the 1993-1996 period of decline, recruitment to Age II (Figure 46) was extremely poor but has steadily improved through the 1997-1999 period. In January 1995, samples were collected to analyze Age I brown trout for the presence of *Myxobolus cerebralis*, the causative factor for whirling disease. Discovery of the disease in the Madison River in December 1994 provided the impetus to sample the Ruby River following the observed recruitment declines. The samples proved positive leading to speculation that whirling disease induced juvenile mortality, coupled with natural mortality of prior high numbers of older fish, was responsible for the rapid decline in brown trout density. This speculation led to the initiation of graduate study of whirling disease in the lower Ruby River (Opitz, 1999).

Length analysis of the Silver Spring brown trout populations exhibited a rapid decline in the number of 13 inch and larger brown trout (Figure 47) similar to the decline in the population. Numbers of 13 inch and larger fish approached or exceeded 500 per mile over the 1989-1992 period but declined to approximately 200 per mile over the 1994-1997 period. Some recovery within this length group was noted in 1998 and 1999 as successfully recruited Age II fish from 1997 and 1998 survived to Age III and Age IV. While low population density and biomass marked the 1993-1997 period, numbers of older 16 inch and larger fish (Figure 48) generally maintained at approximately average density and expanded rapidly from 1997-1999 to attain observed high densities for the study section. Numbers of these larger fish appeared to flourish at below average brown trout population densities.

<u>Sailor Study Section</u>

The Sailor Section has been sampled sporadically since 1979 and was last reported on by Oswald (1984). A single sample was collected in 1986 following a lower river dewatering event near Sheridan, Montana in May 1985. In the early 1990's a new property owner purchased the land surrounding the Sailor Section and began management of the property for the fish and wildlife resources. This management included a large investment in bank and channel habitat restoration to improve brown trout populations in the reach. Brown trout population declines in the Silver Spring Section resulted in renewed interest in the population dynamics of the downstream Sailor Section.

Brown trout population statistics are presented in Figure 49 for the 1979-1998 period of study. The 1986 sample exhibited a relatively high brown trout density and biomass for the section indicating that the 1985 dewatering event was not particularly deleterious to brown trout populations in the Sailor Section reach. The 1995-1998 samples, however, revealed population densities far below expected levels for the section. Despite river corridor management techniques calculated to improve fisheries, brown trout populations remained near 500 per mile over the 1995-1997 period and improved slightly to 638 per mile in 1998. Again, it was speculated that whirling disease induced mortality of juvenile brown trout may have been the causative factor triggering graduate research in that area (Opitz 1999). As was the observed case in the Silver

Spring Section, recruitment to Age II (Figure 50) was weak over the 1995-1997 period but improved slightly in 1998 following improved recruitment of Age I fish in 1997. The 1998 recruitment of Age I fish was relatively high suggesting that population density should have improved in 1999 although no sampling was conducted that year. Spring densities of 13 inch and larger brown trout (Figure 51) remained low from 1995 through 1997 but improved slightly in 1998. Numbers of 16 inch and larger brown trout (Figure 52) maintained consistently at approximately 30 per mile over the 1995-1997 period but increased substantially in 1998 as was the observed case in the Silver Spring Section.

## POINDEXTER SLOUGH

### Section Three

Poindexter Slough is a popular spring creek type fishery with ample public access located approximately three miles south of the city of Dillon, Montana. The brown trout populations of Poindexter Slough were last described by Oswald and Brammer (1993). Trends in brown trout population density and standing crop are depicted in Figure 53 for the 1989-1999 period of study. Poindexter Slough has traditionally supported the highest observed brown trout densities within the study area, however, standing crop has been proportionately lower, reflective of smaller average fish size at extremely high density. Following the extremely high peak density of 1992, brown trout density declined to below average levels and, with the exception of 1994, remained low through 1997. High population density in Poindexter Slough resulted primarily from strong cohorts of Age I fish (Figure 54) recruited into the population. The vast majority of the peak population observed in 1992 was based upon high numbers of Age I fish which composed 79% of the brown trout population in that year. Similarly, low populations of 1991, 1993, and 1995-1997 were all associated with poor survival of fish to Age I. Concern over sub-average population density and poor juvenile recruitment led to testing for and the discovery of whirling disease in the Poindexter Slough brown trout population in February 1995. As a result, intensive graduate research was conducted on the affects of whirling disease on brown trout populations in both Poindexter Slough and the lower Ruby River (Opitz 1999) over the 1996-1998 period. In 1998 and 1999, Poindexter Slough brown trout density recovered dramatically with strong recruitment of Age I fish into the population.

The affect of decreased population density and limited recruitment on larger brown trout numbers in Poindexter Slough can be discerned from Figures 55 and 56. Numbers of 13 inch and larger brown trout (Figure 55) actually exhibited an increasing trend with densities approaching 150 per 1,000 feet by 1998 and 1999. These were the highest observed densities for these larger fish over the 1989-1999 period of study. This numeric increase was virtually linear, with the exception of 1996, over the 1995-1999 period. Numbers of 15 inch and larger fish (Figure 56) increased markedly and remained high over the 1994-1999 period exceeding 50 per 1,000 feet in 1995, 1998, and 1999. The data, similar to the observed situation in lower reaches of the lower Ruby River, indicate that numbers of larger brown trout increased under reduced population density.

# BIG SHEEP CREEK

## Shearing Pen Study Section

The trout populations of Big Sheep Creek have been studied sporadically over the 1980-1996 period. The Shearing Pen Section is located on lands administered by the BLM and is bounded on the up and downstream ends by bridges spanning the county road. The 4,065 foot section is a relatively high gradient reach marked by a limestone canyon with abundant spring flow accretions. Trout populations in Big Sheep Creek were first studied in 1980 in order to determine in stream flow requirements for aquatic life (MFWP 1989). The recent discovery of whirling disease in 1996 in Big Sheep Creek has led to concern over the future of rainbow trout populations in the system.

The brown trout populations of the Shearing Pen Section are depicted in Figure 57 for the three years of sampling. The 1980 and 1986 samples revealed population densities of 23 and 50 fish per 1,000 feet while the 1996 sample revealed a much increased population of 109 per 1,000 feet. Recruitment of juvenile brown trout (Figure 58) appeared limited in all of the sample years but increased in a linear manner over the sample period. Numbers of 13 inch and larger fish (Figure 59) appeared to dominate the sampled populations and increased markedly in the 1996 sample while numbers of 16 inch and larger brown trout appeared relatively static approaching 10 fish per 1,000 feet.

Population trends for rainbow trout in the Shearing Pen Section (Figure 60) have declined substantially over the period of study. While differences between 1980 and 1986 could be attributed to normal population fluctuation, the 1996 population represented a substantial decline from the previous estimates. Numbers of juvenile rainbow trout (Figure 61) also declined substantially over the period with an estimated population of only 4 per 1,000 feet observed in 1996. Estimated densities of larger rainbow trout (Figure 62) peaked in 1986 but had declined to only five 13 inch and larger and two 15 inch and larger fish per 1,000 feet by 1996.

## Canyon Study Section

The Canyon Section of Big Sheep Creek lies immediately downstream from a meandered meadow complex and represents a low gradient reach slightly back watered by a natural rock hydraulic control at the head of an elongated high gradient canyon. The low gradient reach is marked by deposits of fine sediments and the growth of aquatic macrophytes and is influenced by dispersed spring inflow. The study section lies within lands administered by USBLM. The section originates at the BLM boundary downstream from the mouth of Muddy Creek and proceeds downstream to the canyon grade control for a lineal distance of 3,050 feet.

Brown trout densities and standing crops are presented in Figure 63 for the Canyon Section over the 1982-1996 period of study. Brown trout populations in the Canyon Section exceeded those observed in the Shearing Pen Section by a substantial amount. Similar to limited observations in the Shearing Pen Section, brown trout populations in the Canyon Section increased markedly in 1996. In contrast with the 1986 Shearing Pen sample, the 1987 brown trout population of the Canyon Section was abundant. This was probably indicative of better brown trout cover in the lower gradient habitat of the Canyon Section. The abundance of juvenile brown trout in the Canyon Section (Figure 64) far exceeded that observed for the Shearing Pen Section and increased markedly in the 1987 and 1996 samples. Numbers of larger brown trout (Figure 65) increased substantially in 1987, reflective of the high population biomass observed in the sample. While numbers of 13 inch and larger fish increased in the 1987 and 1996 samples, numbers of 16 inch and larger brown trout have remained relatively constant at all population densities.

Rainbow trout densities and standing crops are presented in Figure 66 for the Canyon Section over the period of study. In the 1982 and 1983 samples, rainbow trout outnumbered brown trout in the Canyon Section and exceeded brown trout standing crop in the 1983 sample. Rainbow trout standing crop was maximized in 1987 at a density of 122 fish per 1,000 feet. In the 1996 sample, however, rainbow trout density had declined significantly to only 7 fish per 1,000 feet. Numbers of juvenile rainbow trout (Figure 67) recruited into the population were extremely erratic in the 1982-1987 samples, however, the 1996 sample revealed no yearling rainbow trout in the limited population. Numbers of larger rainbow trout in the Canyon Section (Figure 68) were maximized in 1987 at relatively high density but decreased significantly under the extremely low population density observed in 1996.

### Partnership and Surgical Study Sections

Single entry samples were collected in the Partnership and Surgical Sections in 1986 and 1990. This was done in order to assess trout populations on private lands along the stream, assess populations under management strategies calculated to improve fish habitat, and to assess populations typical of meandered meadow complexes which are limited to private lands along Big Sheep Creek. Both study sections lie on lands under relatively exclusive private ownership and both stream reaches have employed management strategies which have eliminated or restricted livestock grazing and have employed modern methods of streambank and channel stabilization. The Partnership Section was wholly contained on the Big Sheep Creek Partnership ranch and incorporated 4,750 feet of stream length. The Surgical Section was contained within the ownership of the Canyon Ranch and incorporated 3,570 lineal feet of stream.

The rainbow trout populations of both study sections are presented in Figure 69. While the Partnership Section supported a high density and standing crop of rainbow trout in 1986, the population totals were slightly lower than those observed in the Canyon Section in 1987. Similarly, rainbow trout density in the Surgical Section was far lower than high densities observed in the Canyon Section and similar to those observed in the Shearing Pen Section although standing crop far exceeded that observed for the Shearing Pen Section at similar density. Numbers of larger rainbow trout (Figure 70) observed in both sections far exceeded observations for the Shearing Pen Section but did not attain highs observed in the Canyon Section.

## ODELL CREEK

### Taft Study Section

Odell Creek is a tributary of Lower Red Rock Lake originating in the Centennial

Mountains of southwest Montana. The lower reaches of the stream and Lower Red Rock Lake are contained within the Red Rock Lakes National Wildlife Refuge. The stream has been studied for its spawning migrations of adfluvial Arctic grayling from Lower Red Rock Lake (Boltz 1999) but also supports resident populations of native westslope cutthroat trout and introduced brook trout. Limited genetic samples from lower reaches of the stream have revealed hybridization with the introduced Yellowstone strain of cutthroat trout. The average genetic purity of the westslope cutthroat trout population of Odell Creek has been calculated as 95% from a ten fish sample collected immediately upstream from the Taft Section. An unnamed tributary to Odell Creek in proximity to the Taft Section revealed a genetically pure population of westslope cutthroat trout. In 1994, the U.S. Fish and Wildlife Service Partners for Wildlife program entered into an agreement with a private property owner to mechanically improve channel stability and cutthroat trout habitat within a reach of Odell Creek located upstream from the Centennial Valley Road. The length of the Taft Section has not been provided by USFWS to date so population estimates were calculated for the entire section. Population estimates were provided in order to compare future population response to habitat improvement techniques.

Estimated numbers and standing crops of westslope cutthroat trout and brook trout are depicted in Figure 71 for the Taft Section in 1994. Westslope cutthroat trout density and standing crop far exceeded that of brook trout in the section. Although the length of the study section is currently unknown, westslope cutthroat density appeared relatively high when compared with other westslope cutthroat trout populations in the area while the brook trout population density appeared relatively low. Length analysis within the populations (Figure 72) revealed a westslope cutthroat trout population with apparently ample recruitment and relatively high numbers of larger fish for the habitat type.

## STONE CREEK

Stone Creek is a small first and second order tributary system which originates in the Ruby Mountains and flows into the Beaverhead River. Irrigation practices and natural geology generally have isolated the upper system from the Beaverhead River via intermittent flow regimes near the Beaverhead and Madison County boundary. This isolation has maintained a single species fishery in the form of a population of genetically pure westslope cutthroat trout. An active talc mine is located at the headwaters of the Left Fork of Stone Creek and a heavily used county road accesses the mine. The road is composed of dirt and is heavily used and maintained by a contracted trucking company which hauls talc ore to a mill south of Dillon, Montana. In 1986, concern over negative affects of the haul road on stream channel stability, heavy sedimentation, trout habitat, and the persistence of the westslope cutthroat trout population led to study of the westslope cutthroat trout and habitat improvement projects. In 1995, the mining company abandoned and reclaimed the road in the Left Fork in favor of a high road relocation on a ridge top to the west. The reclaimed road also incorporated many features to trap and control sediment input into the Left Fork. In 1996, a coalition of interested parties from government agencies and the private sector entered into a stream channel restoration project which included stream channel and bank reconstruction, vegetative plantings, riparian fencing, and beaver dam removal in the Left Fork, Middle Fork, and upper mainstem of Stone Creek (Oswald 1999). Stream improvement projects were endeavored from 1996 through 1998 in an attempt to improve channel stability, westslope cutthroat trout habitat, and water quality in the Stone Creek system.

Left Fork Study Section

Studies on the westslope cutthroat trout of the Left Fork of Stone Creek began in 1986 due to concern over habitat degredation associated with the haul road. The Left Fork Study Section has been located upstream from the Middle Fork Road and has reached a maximum length of 3,333 lineal feet of stream with the exception of the 1995 sample which included the entire 1.67 miles of Left Fork below the talc mine. Westslope cutthroat trout population density in the Left Fork is presented in Figure 73 for the 1986 - 1998 study period. Prior to stream channel reclamation, densities of Age I and older cutthroat trout remained at or below 10 fish per 1,000 feet. The population rapidly responded to habitat reclamation techniques attaining a density in excess of 100 fish per 1,000 feet by 1998. Cutthroat trout standing crop (Figure 74) increased rapidly also, rising from a pre-reclamation biomass of approximately 2 pounds per 1,000 feet to nearly 20 pounds per 1,000 feet in 1998. Despite these large increases in density and standing crop, cutthroat condition factor (Figure 75) declined only slightly, attesting to vastly improved carrying capacity within the reconstructed habitat.

Length frequency analysis of the 1994 and 1998 samples (Figures 76 and 77) suggested that reproduction was much improved following reclamation. The 1994 sample (Figure 76) exhibited very limited contribution of Age I fish and Age 0 fish were lacking in the sample. The 1998 sample (Figure 77) indicated strong recruitment of Ages 0 through II with a probable overlap between Age II and Age III fish. All of these cohorts were recruited since road reclamation occurred in 1995 and all of the fish Age II and younger were recruited following stream reclamation in 1996.

Mainstem Study Section

Studies on the mainstem of Stone Creek have also been conducted since 1986. The Mainstem Section consists of the 1,000 foot reach immediately downstream from the confluence of the Left and Middle Forks of Stone Creek. Estimated Mainstem Section cutthroat trout densities are depicted in Figure 78 for the period of study. In 1986, the Mainstem Section supported approximately 30 westslope cutthroat trout per 1,000 feet due to relatively abundant populations in the Middle Fork at that time. By 1994, cutthroat trout density had declined to three fish per 1,000 feet and sampling efforts in 1995 resulted in the capture of no fish. The post reclamation population of 1998 approached 200 westslope cutthroat trout per 1,000 feet of stream. The 1998 westslope cutthroat trout standing crop was estimated at 37.3 pounds of biomass per 1,000 feet. This standing crop was one of the highest observed among westslope cutthroat trout populations in southwest Montana streams (MFWP Unpub. Data).

Middle Fork Study Section

The Middle Fork of Stone Creek has been sampled upstream from the lowermost county county road crossing of the creek since 1986. The section was established as a control because the stream was not impacted by the heavily used haul road from the talc mine. The estimated density of Age I and older cutthroat trout in the Middle Fork Section is exhibited in Figure 79 for the 1986-1998 period of study. In 1986, numbers of westslope cutthroat trout in the Middle Fork were extremely abundant and the Middle Fork appeared to be a refuge for the westslope cutthroat trout of the Stone Creek drainage. In 1994 and 1995, however, westslope cutthroat trout numbers declined dramatically with the establishment of extremely numerous beaver dams. One count estimated the number of dams to be in excess of 80 on approximately two miles of stream (USBLM Unpub. Data). It was felt that fragmentation of the habitat via beaver dam barriers and fluvial habitat impoundment was related to declining westslope cutthroat trout numbers. In 1997, selected beaver dams were notched in order to reconnect habitat and reestablish a fluvial component in the system. In 1998, the cutthroat trout population of the Middle Fork increased dramatically to exceed 100 fish per mile.

Length frequency analysis of the 1986 Middle Fork Section sample (Figure 79) revealed a population composed largely of Age I fish suggesting that the Middle Fork was an important spawning and rearing habitat for Stone Creek. The 1998 length frequency analysis (Figure 81) revealed a population dominated by Age I and Age II fish similar to those observed in the Left Fork and Mainstem. The 1998 sample contained only one young of the year fish suggesting that the two dominant cohorts may have accessed the Middle Fork from the Left Fork and Mainstem after selected beaver dams had been notched.

Mainstem Distribution Study Sections

In August 1995, attempts were made to find downstream populations of westslope cutthroat trout in the Stone Creek mainstem. Five study sections of varying length between the confluence of the Left and Middle Forks and the mouth of Winnipeg Creek were electrofished for the presence and relative abundance of fish. The 1995 sampling effort resulted in the capture of no cutthroat trout in any of the five sample sections. This effort was repeated in September 1999 following the 1998 documentation of westslope cutthroat trout population recovery in upstream environments. Results of the 1999 sampling are portrayed in Figure 82. The 1999 sampling revealed the collection of westslope cutthroat trout in all five of the previously unoccupied study reaches. Moreover, the cutthroat trout were present at relatively high collection densities ranging between 71 and 82 fish per 1,000 feet in four of the five study reaches. The low densities observed at study Station 4 were associated with habitats that were previously sediment laden to the point at which the stream channel was filled with fine sediments which obliterated all niche diversity and resulted in a very wide shallow channel. In 1999, the sediment was in the process of mobilization as exemplified by numerous migrating headcuts and limited niche diversity was beginning to provide a cutthroat trout habitat niche component. Cutthroat trout collected in the mainstem in 1999 consisted of largely of Age I through Age IV fish in all of the sample reaches except Station 2. At Station 2, limited grade and streambank stabilization performed in 1997 apparently resulted in the creation of favorable spawning and rearing habitat as indicated by the collection of relatively high numbers of Age 0 fish. Results of the 1999 sampling indicate that westslope cutthroat trout had expanded their range of distribution a minimum of 3.5 miles down the mainstem of Stone Creek post reclamation.

## WESTSLOPE CUTTHROAT TROUT GENETIC SAMPLING STREAMS

Recent interest in relict native stocks of westslope cutthroat trout and the availability of modern genetic analytic techniques has resulted in sampling efforts in small headwater tributary streams known or suspected to support populations of cutthroat trout. Methods generally incorporated the selection of readily accessible sampling reaches for electrofishing with a back pack unit. Random selection of a 10 fish sample of fish which visually appeared to be of cutthroat trout descent was followed by electrophoretic analysis at the University of Montana Genetics Laboratory. Because streams on the Beaverhead National Forest have been sampled for westslope cutthroat genetics through cooperative efforts between the Forest Service and MFWP, streams selected for study under this project were limited to lands under private, USBLM, or State of Montana ownership in the Red Rock, Ruby, and Beaverhead River drainages. Virtually all of the streams in the Big Hole River drainage originate on the National Forest.

Streams sampled for the presence and genetic purity of westslope cutthroat trout are indexed in Table 2. For the 1992-1999 period of study. Additional data including study section location and length, numbers of salmonids collected per lineal unit, fish length and weight data, and habitat notes have been summarized in more extensive data files for each stream (MFWP Unpub. Data). Information summarized in Table 2 should not be considered definitive for several reasons. Genetic purity, as reported, represents an estimate of the average heterozygosity within the population of each stream sampled and was based on a limited sample, usually 10 fish, from each population. The reported genetic purity does not preclude the existence of pure individuals within the population. For example, Cabin Creek in the Big Sheep Creek drainage is reported at a purity of 98% for the population while 9 of the 10 individual fish within the sample exhibited genetic characteristics of pure westslope cutthroat trout. Also, samples limited to readily accessible reaches may not have attained stream reaches occupied by pure westslope cutthroat trout as was the observed case in the two samples from Cottonwood Creek in the Blacktail Deer Creek drainage. Finally, higher habitats on the National Forest or reaches of difficult accessibility in some of the streams listed in Table 2 could support unsampled westslope cutthroat trout populations. This was the case in Kate Creek which is listed in Table 2 as lacking cutthroat trout but revealed a pure population of westslope cutthroat trout in a subsequent National Forest sample in upstream reaches.

The data in Table 2 represent sampling reaches in 83 headwater tributary streams. The streams were generally first or second order tributary systems. Of the 83 streams that were sampled, 48 or 57.8% yielded some form of westslope cutthroat trout population, whether it was pure or hybridized to some extent. Hybridization, where it occurred, resulted from crosses with rainbow trout, Yellowstone cutthroat trout, or both in combination. All of the hybridized fish in the samples carried a westslope cutthroat trout genetic component.

Twenty-two of the 83 streams sampled (26.5%) yielded pure populations of westslope cutthroat trout. Of these pure native westslope cutthroat streams, 14 supported only westslope cutthroat trout while 3 were sympatric with other native species such as mottled sculpin. Five of the pure westslope cutthroat trout streams also supported populations of introduced salmonids, primarily brook trout. The data suggest that most of the pure populations were secured by environments that limited entry of exotic species and precluded hybridization.

Table 2. Index of tributary streams in the Red Rock, Ruby and Beaverhead River drainages sampled for the presence and genetic integrity of native westslope cutthroat trout populations 1992-1999.

| STREAM | YEAR | SPECIES | GENETIC ANALYSIS |
|---|---|---|---|
| Blacktail Deer Cr. Drainage - Snowcrest Mtns. | | | |
| Alkali Creek | 95 | MS | NA |
| Taylor Creek | 95 | EB,MS | NA |
| Swamp Creek | 95 | NONE | NA |
| Rock Creek | 95 | WCT | 100% |
| Blacktail Cr. Drainage - Sweetwater Hills | | | |
| Elk Gulch Creek | 92 | EB,MS | NA |
| Blacktail Cr. Drainage - Blacktail Mtns. | | | |
| Teddy Creek | 92 | WCTxRBxYCT | 94% |
| Price Creek | 92 | WCTxYCT,MS | 85% |
| Cottonwood Creek | 92 | WCT | 98% |
| Cottonwood Creek | 99 | WCT | 100% |
| Jake Canyon Creek | 92 | WCT | 100% |
| Riley Creek | 92 | NONE | NA |
| Red Rock River Drainage - Blacktail Mtns. | | | |
| Sage Creek | 93 | EB,MS | NA |
| Sage Creek | 98 | WCT | 100% |
| Basin Creek | 93 | WCT,MS | 99% |
| Little Basin Creek | 93 | WCTxRBxYCT,MS | 92% |
| Little Sage Creek | 93 | EB,MS | NA |
| East Creek | 93 | EB,MS | NA |
| Bull Creek | 93 | EB,MS | NA |
| Beech Creek | 93 | WCTxRB,EB,MS | 73% |
| Long Creek | 93 | EB,MS | NA |

Table 2. Continued.

| | | | |
|---|---|---|---|
| Long Creek | 99 | WCT,EB,MS | 98% |
| Pistol Creek | 93 | NONE | NA |
| Divide Creek | 93 | WCTxRBxYCT,EB,MS | 88% |
| Ruby River Drainage - Greenhorn Mtns. | | | |
| Idaho Creek | 94 | WCT | 100% |
| N.F. Greenhorn Creek | 94 | WCTxRB,EB,MS | 98% |
| Ruby River Drainage - Snowcrest Mtns. | | | |
| Spring Brook | 95 | NONE | NA |
| Ledford Creek | 94 | LL,EB,MS | NA |
| Robb Creek | 94 | WCT,EB,MS | 98% |
| Ruby River Drainage - Ruby Mtns. | | | |
| Sweetwater Creek | 92 | RB,RBxCt,MS | NA |
| N.F. Sweetwater Creek | 94 | WCT,MS | 100% |
| N.F. Sweetwater Creek | 95 | WCTxRB,MS | 95% |
| W.F. Sweetwater Creek | 94 | WCT,MS | 100% |
| Cottonwood Creek | 92 | CT,RB,RBxCT,EB,MS | 75% |
| Garden Creek | 92 | RB,MS | NA |
| Hinch Creek | 92 | WCTxRBxYCT,MS | 84% |
| Beaverhead River Drainage - Ruby Mtns. | | | |
| McHessor Creek | 92 | RBxCT | 66% |
| Trout Creek | 92 | WCTxYCT,MS | 94% |
| Spring Creek | 92 | WCT | 100% |
| Middle Fork Stone Creek | 92 | WCT | 100% |
| Winnipeg Creek | 95 | WCT | 100% |
| Horse Prairie Creek Drainage - Beaverhead Mtns. | | | |
| Frying Pan Creek | 92,93 | WCTxRB,MS | 95% |
| Trapper Creek | 93 | WCTxRB,EB,MS | 94% |
| Bear Creek | 93,94 | WCT,EB,MS | 99% |
| North Fork Everson Creek | 92 | WCT,EB,MS | 100% |
| South Fork Everson Creek | 93 | WCT | 100% |
| Nip and Tuck Creek | 92 | EB,MS | NA |

Table 2. Continued.

| | | | |
|---|---|---|---|
| North Fork Divide Creek | 92,94 | WCT,MS | 99% |
| South Fork Divide Creek | 93,94 | WCT,MS | 99% |
| Horse Prairie Creek | 93 | EB,MS | NA |
| Shenon Creek | 93 | EB,MS | NA |
| Rape Creek | 93 | WCT | 100% |
| Barrett Creek | 94 | WCT | 100% |
| Poole Creek | 94 | EB,MS | NA |
| Medicine Lodge Creek Drainage - Beaverhead Mtns. | | | |
| Erickson Creek | 93 | EB,MS | NA |
| Morrison Creek | 93 | EB,MS | NA |
| Schwartz Creek | 93 | EB,MS | NA |
| Medicine Lodge Creek Drainage - Tendoy Mtns. | | | |
| Kate Creek | 93 | EB,MS | NA |
| Big Sheep Creek Drainage - Beaverhead Mtns. | | | |
| Cabin Creek | 92 | WCT,MS | 98% |
| Indian Creek | 92 | WCTxRB | 82% |
| Simpson Creek | 92 | WCT | 100% |
| Tex Creek | 93 | NONE | NA |
| Coyote Creek | 93 | NONE | NA |
| Little Deadman Creek | 93 | WCTxRBxYCT | 90% |
| Unnamed ? Creek | 93 | WCTxRBxYCT | 50% |
| Pine Creek | 93 | WCTxRB | 82% |
| Big Sheep Creek Drainage - Tendoy Mtns. | | | |
| Muddy Creek | 92 | WCT,LL,MS,LNSU | 100% |
| Red Rock River Drainage - Centennial Mtns. | | | |
| West Fork Corral Creek | 93 | EB,MS | NA |
| Peet Creek | 92 | WCTxYCT,MS | 88% |
| Bean Creek | 92 | WCT | 100% |
| Bear Creek | 93 | WCT | 100% |
| Jones Creek | 92 | WCT,LND | 100% |
| Winslow Creek | 94 | CT | 88% |

Table 2. Continued.

| | | | |
|---|---|---|---|
| Tipton Creek | 94 | NONE | NA |
| Curry Creek | 93 | NONE | NA |
| Matsingale Creek | 93 | NONE | NA |
| Odell Creek | 94 | WCTxYCT,EB,MS | 95% |
| Unamed Trib. Odell Cr. | 94 | WCT | 100% |
| Red Rock River Drainage - Snowcrest Mtns. | | | |
| First Wolverine Creek | 93 | EB,MS | NA |
| Second Wolverine Creek | 93 | NONE | NA |
| Little Sandy Creek | 93 | NONE | NA |
| East Fork Clover Creek | 93 | EB,MS | NA |
| Grasshopper Creek Drainage - Pioneer Mtns. | | | |
| West Fork Dyce Creek | 93 | WCT,EB,MS | 100% |
| East Fork Dyce Creek | 94 | WCT,EB,MS | 100% |
| Scudder Creek | 93 | EB | NA |
| Divide Creek | 94 | EB,MS | NA |
| Grasshopper Creek Drainage - Big Hole Divide | | | |
| Ames Creek | 94 | EB | NA |
| Harrison Creek | 94 | NONE | NA |

Key to Species: WCT = westslope cutthroat trout; YCT = Yellowstone cutthroat trout; RB = rainbow trout; EB = brook trout; LL = brown trout; MS = mottled sculpin; LND = longnose dace; LNS = longnose sucker; (* x denotes hybridization)

Eight other streams supported near pure populations of westslope cutthroat with estimated average genetic purities of 98% or 99%. All of these streams supported other fish species in addition to the cutthroat trout. Four of the streams supported sympatric native species other than salmonids while four supported populations of introduced salmonid species.

Thirteen of the 83 stream samples did not reveal populations of salmonids. One of these streams supported an extremely abundant population of mottled sculpin while the remainder of the streams appeared fishless. While many of the streams did not appear to provide sufficient habitat to support fisheries, seven of the streams appeared to provide sufficient fish habitat. Of these seven, Alkali, Harrison, and Tex Creeks appeared to hold a high potential for attempts to reintroduce native westslope cutthroat trout.

## DISCUSSION

### BEAVERHEAD RIVER

Upper River Study Sections

Brown trout populations in the upper tailwater reach of the Beaverhead River emerged from drought limited nonirrigation flow regimes and flourished under ample flow regimes in the 1995-1999. Oswald and Brammer (1993) described substantial losses of larger brown trout in association with severely limited over winter flow regimes in the Hildreth Section and overall brown trout population decline in the Pipe Organ Section. Oswald (2000b) noted declines of large brown trout in the Big Hole River over a prolonged period of drought reduced flow regimes and observed similar increases in numbers of large fish under ample flow conditions.

While numbers of 18 inch and larger brown trout increased to observed highs in the Hildreth Section, numbers of 20 inch and larger brown trout and, particularly, 22 inch and larger brown trout lagged below historic levels as a percentage of the population. Total brown trout density and biomass have far exceeded prior highs suggesting that brown trout populations are near carrying capacity resulting in reduced growth and ultimate size. Conversely, numbers of larger brown trout increased in the lower Ruby River and Poindexter Slough as brown trout density decreased. Following the severe drought year of 1988, regulations restricted anglers to the harvest of 3 trout, only one of which could exceed 18 inches and only one of which could be a rainbow trout. Based upon recent observed highs in brown trout density and standing crop, brown trout harvest was returned to the standard 5 fish limit while maintaining the one rainbow trout restriction in the 2000 license year. Based upon comparative data from restrictive regulations study sections on the Big Hole River, Oswald (2000b) concluded that little, if any, differences in trout populations could be attributed to restrictive regulations and the prevailing catch and release philosophy of most large river anglers has precluded significant harvest despite the application liberal or restrictive regulations.

Extremely high brown trout density and biomass has been a recent phenomenon related to very abundant flow regimes dominating the system since 1995. It is quite probable that current high densities, particularly those of older, larger fish, will decline dramatically when releases from Clark Canyon Dam become more restrictive. This affect was described by Oswald and Brammer (1993) and is apparent in the data presented in this report. It is also possible that a more acute factor, such as disease, will become a vector for population reduction in lieu of significant harvest. Oswald (1986b) attributed outbreaks of and subsequent fish kills from the disease, bacterial furunculosis, when July flows were reduced to a 400 to 620cfs range. It is possible that the flow and stress thresholds for disease outbreaks have become altered at recent high population densities. That is, disease outbreak might occur at higher discharges than previously observed due to higher habitat demands of extremely dense populations. It is also possible that higher population density could result in more traumatic kills than previously observed.

Rainbow trout density has continued a trend of slowly declining populations in association with expanded brown trout population density and standing crop. This decline has occurred while regulations restricting anglers to the harvest of only one rainbow trout have been in place since 1989, suggesting that factors other than angler harvest have been controlling rainbow trout abundance.

Mid River Study Sections

Brown trout populations in the Low Flow and Fish and Game Sections declined under drought influenced flows in the early 1990's. Oswald and Brammer (1993) presented a detailed comparison of the two sections determining that the Low Flow Section was better adapted to lower flow regimes through the production of higher densities of smaller fish. This was apparent in the brown trout population response through 1993. Trout populations in the Fish and Game Section appeared to recover with ample flow regimes since 1995, however, brown trout densities in the Low Flow Section have remained low. Trout populations in the Low Flow Section declined following a similar decline in population associated with the discovery of whirling disease in Poindexter Slough. The Low Flow Section is located downstream from the mouth of Poindexter Slough which has since exhibited a full recovery in brown trout recruitment. It was speculated that whirling disease had influenced brown trout recruitment in Poindexter Slough and downstream in the Low Flow Section. Opitz (1999), however, felt that population declines in Poindexter Slough were within the range of normal brown trout population dynamics and did not attribute the low populations to whirling disease.

Lower River Study Sections

Brown trout populations in the Anderson Lane, Mule Shoe, and Twin Bridges Sections have remained at low density since the 1970's with very little, if any significant change. Oswald and Brammer (1993) listed habitat problems characteristic of the lower river including altered flow regime, heavy bedload transport associated with an inverted hydrograph, channel atrophy, high summer temperatures, and bank instability associated with poor woody riparian vegetative development. While brown trout density remained low throughout the reach, relatively high percentages of larger fish marked some of the samples.

Due to low brown trout density, favorable length of river reach available, and active alluvial processes, the lower Beaverhead River was selected by MFWP as an Arctic grayling recovery area and received its first plants of overwintered grayling in 1999. Preliminary observations suggest that the grayling have distributed throughout the reach and a fall migration in a downstream direction was triggered by the rising limb of the inverted hydrograph. Future sampling will determine the success or failure of the reintroduction effort.

## UPPER RUBY RIVER

The data strongly suggest that populations of rainbow x cutthroat hybrids, rainbow trout, and brown trout have all recovered from drought influenced flow regimes of the 1985-1994 period. Recovery in terms of highs in density, standing crop, recruitment and condition factor were all observed as populations flourished. The 1999 rainbow trout population of the Greenhorn Section, however, showed little evidence of recruitment success. Further study will be required to determine if other factors, such as whirling disease, are affecting rainbow trout recruitment in the section.

Arctic grayling reintroduction efforts in the upper Ruby River have met with limited success to date. While stocked populations of grayling have demonstrated an affinity for the fluvial environment and maintained high population density throughout the stocked reach (Opitz 2000) winter survival has appeared to be a limiting factor. Questions still remain as to whether the surviving grayling will be capable of successfully spawning and rearing progeny in the upper Ruby River environment. These questions should be answered as planted grayling attain Ages III and IV and become fully mature adults. Surprisingly, the artificial placement of a large standing crop of grayling into the apparently limited environment of the Three Forks Section has not resulted in deleterious affects on the wild rainbow x cutthroat hybrid population which occupied the reach. Density and standing crop of these wild fish remained high in spite of the high density grayling population and their mean condition factor remained high as well. This may be symptomatic of ample habitat niche at high flow or may be due to differential niche occupation by the species.

## LOWER RUBY RIVER

The complete dewatering of the Ruby Reservoir in 1994 resulted in a substantial fish kill and heavy losses in the wild brown trout population of the productive tailwater environment. Oswald (2000a) described rainbow trout population recovery after 1995 in the Ruby Reservoir. Data presented in this report clearly depict a full recovery of brown trout populations in the affected river reach. Actions taken via the establishment of a Governor's Ruby River Task Force in 1994 and 1995 included a program to mobilize and transport sediments into canals in the aftermath of the 1994 event. Other Task Force actions called for the establishment of a drought emergency flow relief plan, a minimum flow release of 25cfs from the dam, and the establishment of stream gages to gather data upon which to establish minimum flow requirements by river reach. Sampling of sections in the aftermath of the 1994 event and in association with public fishing access acquisition have led to a definitive description of a lower Ruby River tailwater fishery. The Passamari, Maloney, Stanley, Alder, and Guinnane Sections define a rapidly diminishing productive tailwater habitat that is extremely productive in close proximity to the dam.

Concern over dwindling public access to the fishery of the lower Ruby River led to the formation of the Governor's Ruby River Access Task Force in 1995 which resulted in the development of a lower Ruby River access plan (MFWP 1996) and the ultimate acquisition of five public fishing access sites (FAS). Concern over the potential negative affects of unlimited public access to discreet reaches of the river led, in turn, to the implementation of special restrictive fishing regulations on the lower Ruby. Former regulations maintained a year around angling season with a daily bag limit of five trout, one of which could exceed 18 inches in length. The restrictive regulation called for catch and release angling with artificial lures from December 1 to the third Saturday in May and a limited harvest of three trout, only one of which could exceed 15 inches in length through November 30. Data strongly indicate that angler use was not detrimentally affecting trout populations before or following the implementation of the restrictive regulations. Data from the Maloney, Alder, and Silver Spring study sections under public access can be compared with prior estimates from those sections or with data from the Passamari, Stanley, Woodson, Tezak, or Sailor Sections under exclusive management to adequately demonstrate that public angling pressure has not diminished brown trout populations in terms of abundance, standing crop, recruitment, or ultimate size of the fish. Oswald (Vincent et al. 1989) suggested that restrictive regulations on the Big Hole River had little discernible affect after eight years of implementation and further suggested (Oswald 2000b) that the prevailing angler practice of catch and release angling was maintaining brown trout mortality within natural annual rates.

Dramatic decreases in brown trout populations were noted in the Silver Spring Section over the 1993-1996 period and observed, in a more limited manner, in the Sailor Section downstream. These population decreases were not associated with traumatic loss or disruption in habitat quality or quantity via physical alteration, substantial flow reduction, or major climatic shift. They also were not associated with any known acute fish kill event. Angler harvest should not have been a factor because both study sections were managed under limited access catch and release scenarios entered into by the landowners and a local outfitter. In fact, the Silver Spring Section had shifted from an unlimited public access scenario to one of restricted outfitted access in 1993. While the population declines were directly correlated with significant decline in brown trout recruitment, no explanation for the substantial decline in juvenile brown trout populations could be offered until whirling disease was discovered in February 1995. The discovery of whirling disease triggered companion graduate research on the affects of the disease on brown trout in the lower Ruby River and Poindexter Slough. While the study could not directly confirm that whirling disease was the causative vector of declining recruitment in both streams, Opitz (1999) suggested that the disease may have been the cause of the decline in the lower Ruby River. Brown trout recruitment of Age I and Age II cohorts improved markedly in the Ruby River in the 1997-1999 samples suggesting that the study had not been undertaken in the worst years of recruitment loss (Opitz 1999). Poor recruitment of Age II brown trout dominated the 1993 through 1996 samples suggesting that poor recruitment to Age I dominated the 1992-1995 samples while the Opitz (1999) study spanned the 1996-1998 period when recruitment of Age I, and subsequently, Age II fish improved markedly. Brown trout generally demonstrate a resistance to whirling disease although populations can be affected under favorable conditions for *Myxobolus cerebralis* (Walker and Nehring 1995). It is possible, however, that more than 100 years of wild brown trout recruitment in the absence of the disease in Montana may have resulted in a population composed of individuals naive to the disease and a loss of some of this resistance. Conversely, many, if not most, of the juveniles surviving to adulthood may have retained this natural resistance to the disease and subsequently passed it on to their progeny. This possibility was also discussed by Opitz (1999) in explanation of improving recruitment following the four year period of decline prior to his study. It is interesting to note that four years is generally the period of time required to attain full reproductive maturity for most brown trout in southwest Montana. More observation will be required to observe the response of wild brown trout to the presence of whirling disease in the lower Ruby River system.

## POINDEXTER SLOUGH

Poindexter Slough has generally supported extremely abundant wild brown trout populations exceeding any other water in the project area in lineal density. Due to an abundance of high quality spawning and rearing habitat, the preponderance of the brown trout populations has typically consisted of Age I fish. Similar to observations in the lower Ruby River, brown trout population density and juvenile recruitment declined dramatically in the early 1990's and remained low until recruitment of Age I fish recovered in 1998 and 1999 resulting in populations approximating former abundance. Again, no plausible explanation could be offered for the declining recruitment until 1995 samples confirmed the presence of whirling disease in the brown trout population. The declining recruitment in association with whirling disease resulted in the initiation of intensive graduate research in the lower Ruby River and Poindexter Slough. Opitz (1999) could not attribute the observed declines in recruitment in Poindexter Slough to whirling disease and suggested that the declines were within the range of natural population dynamics for brown trout in the stream. He also acknowledged, however, that the research was conducted in the aftermath of the severe population declines and that population recovery may have been associated with the reproductive maturation of fish which had survived exposure to the disease. These fish would have exhibited a natural brown trout resistance to the disease and presumably passed it on to their progeny. Poindexter Slough provides excellent habitat for *Tubifex tubifex*, an intermediate host for *Myxobolus cerebralis*, and may provide for "hot spots" for the disease (Opitz 1999). Such hot spots have been identified in the upper Colorado River (Walker and Nehring 1995) in association with declines in brown trout recruitment. As was the case in the lower Ruby River, recovery in brown trout recruitment in Poindexter Slough closely mimicked the length of time required for reproductive maturation of cohorts recruited in the aftermath of the severe population declines. Further observation will be required over time in order to determine what, if any, affects whirling disease will have on Poindexter Slough brown trout populations.

While brown trout recruitment declines in Poindexter Slough resulted in low population density, brown trout standing crop remained relatively stable. This was due to population compensation in the form of increased numbers of larger fish at low density. This suggested that growth rates and ultimate size for individual fish in the population were improved by the decreased density and further suggested that Poindexter Slough brown trout standing crops have been maintained at, or very close to, carrying capacity. Similar observations were made for larger fish as density declined in the lower Ruby River while brown trout ultimate size has been reduced in the upper Beaverhead River under burgeoning population density and standing crop.

## BIG SHEEP CREEK

Big Sheep has long been recognized as a popular tributary sport fishery for wild brown and rainbow trout of relatively large size and strong abundance. The stream incorporates features of a high gradient mountain tributary and a productive spring creek due to its limestone batholith and abundant spring flow accretions. Trout population sampling in Big Sheep Creek has been sporadic over the years but several observations can be made from the data. The data suggest that differences can be discerned among different habitat types represented in the sampling but little difference can be discerned between sections under public land management and exclusive private land management. Moreover, the data suggest that habitat improvement strategies employed by private landowners have not resulted in any significant differences in trout populations from reaches under public land management.

The presence of whirling disease was confirmed in rainbow and brown trout collected from Big Sheep Creek in 1996. Whirling disease is known to have a profound affect on rainbow trout while brown trout usually are capable of surviving the disease. The most recent samples from Big Sheep Creek have exhibited declining rainbow trout populations with reduced recruitment while brown trout populations and recruitment have flourished. Data suggest that whirling disease could be responsible for the rainbow trout decline, however, additional sampling will be required to confirm that.

## WESTSLOPE CUTTHROAT TROUT RESTORATION PROJECTS

Concern over the persistence of native westslope cutthroat trout stocks has led to various experimental habitat improvement projects designed to insure perpetuation of the species. Habitat improvement projects have often revolved around livestock grazing management strategies and riparian fence construction, mine reclamation projects, altered timber harvest strategies, or improved road management techniques. Some projects have involved construction of barriers and incorporated removal of nonnative species of salmonids to prevent hybridization or reduce competition. Other endeavors, such as the Odell and Stone Creek projects have involved major reconstruction of unstable stream channels and stream banks in addition to the incorporation of strategies mentioned above.

The Odell Creek project incorporated the 1994 sample immediately following construction efforts in the experimental reach. The sample demonstrated a relatively abundant westslope cutthroat trout population with limited encroachment by the introduced brook trout. Future sampling must be endeavored to determine if the channel stabilization strategies resulted in improvement of the cutthroat trout population.

The Stone Creek project was extremely successful in improving native westslope cutthroat trout populations and markedly reduced the risk of extinction of the species in the drainage. Reduction of sediment loading and the restoration of stream function has resulted in significant improvement in habitat quality and quantity. The improvements produced rapid results with substantial increases in westslope cutthroat trout density and standing crop in the Left Fork and mainstem of Stone Creek observed by 1998 and significant increases in westslope cutthroat trout distribution down the mainstem by 1999. The Stone Creek westslope cutthroat trout population could currently be used as a donor population for reintroduction efforts within the native range in the upper Missouri drainage. The Stone Creek project can be used as a template for successful westslope cutthroat trout habitat restoration techniques in degraded stream systems.

## WESTSLOPE CUTTHROAT TROUT GENETIC SAMPLING

Data presented in Table 2 are indicative of the limited status of native westslope cutthroat trout distribution in the Missouri River headwaters. Native species such as westslope cutthroat trout, Yellowstone cutthroat trout, Arctic grayling, bull trout, and lake trout have risen to a status of concern due primarily to competition from and hybridization with introduced salmonid species elimination of access to critical habitats, and habitat degradation. The data presented in Table 2 suggest that the present day westslope cutthroat trout resource has largely become isolated in small headwater habitats which afford some level of protection from invasion by nonnative salmonids. This results in small satellite populations which are genetically unique and important but occupy limited habitats which are highly susceptible to stochastic elimination.

Table 2 also identifies populations which bear some form of hybridization. It is important to consider that, while a population may exhibit characteristics of hybridization, many, if not most, of the individual fish in the population may be genetically pure. It is also important to consider that, in the majority of cases, sources of hybridization through the stocking of introduced salmonids ceased many years ago. Thus, it could be important to monitor levels of hybridization in some of the populations over time to determine trends.

Finally, Table 2 identifies streams which represent potential sites for westslope cutthroat trout reintroduction and expansion of distribution. More intensive research will be required to determine the suitability of these streams as reintroduction sites but some of them appear to hold abundant potential upon preliminary review. Due to the unique genetic status of the existing westslope cutthroat trout populations and the limited number which currently support enough individuals to serve as donor populations, careful planning and evaluation should accompany any reintroduction proposal.

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Report Prepared By: Richard A. Oswald, MFWP, Region 3, Bozeman June 2000

All Work Included in this Report in Conjunction with Federal Aid in Fish and Wildlife Restoration Acts:
Project Numbers: F-78-R-1; F-78-R-2; F-78-R-3; F-78-R-4; and F-78-R-5

Montana Fish, Wildlife & Parks Project Number 3304

## APPENDIX OF FIGURES

Figure 1. Estimated spring density and standing crop of brown trout in the Hildreth Section of the Beaverhead River, 1986 - 1999.

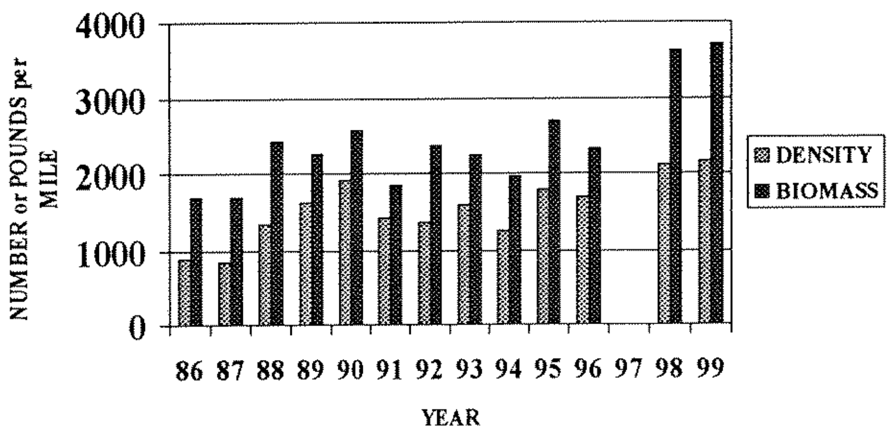


Figure 2. Estimated spring density of 18 inch and larger brown trout in the Hildreth Section of the Beaverhead River, 1986 - 1999.

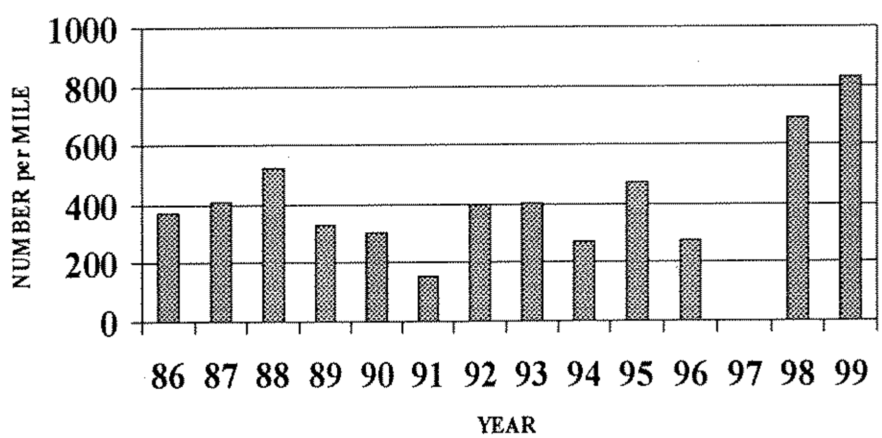

Figure 3. Density of 18 inch and larger brown trout as a percentage of the total spring brown trout population in the Hildreth Section of the Beaverhead River; 1986 - 1999.

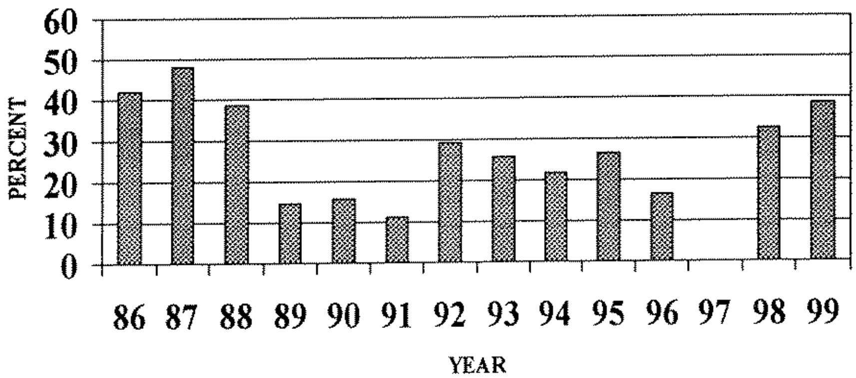


Figure 4. Estimated spring density of 20 inch and larger brown trout in the Hildreth Section of the Beaverhead River, 1986 - 1999.

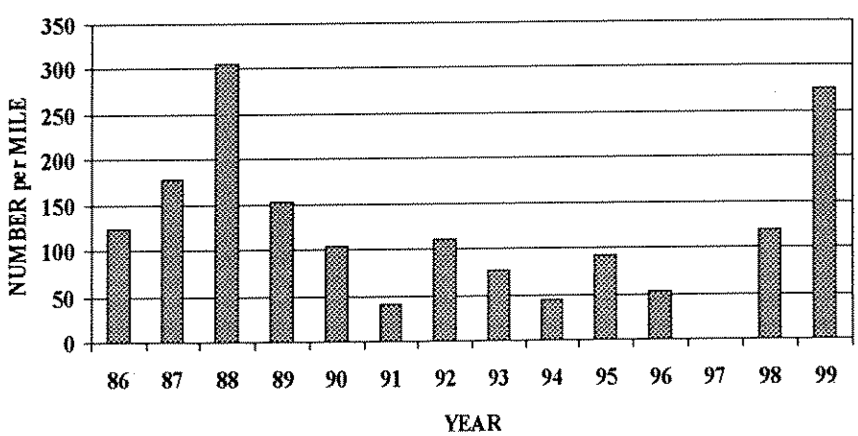

Figure 5. Density of 20 inch and larger brown trout as a percentage of the 18 inch and larger segment of the brown trout population in the Hildreth Section of the Beaverhead River, 1986-1999.

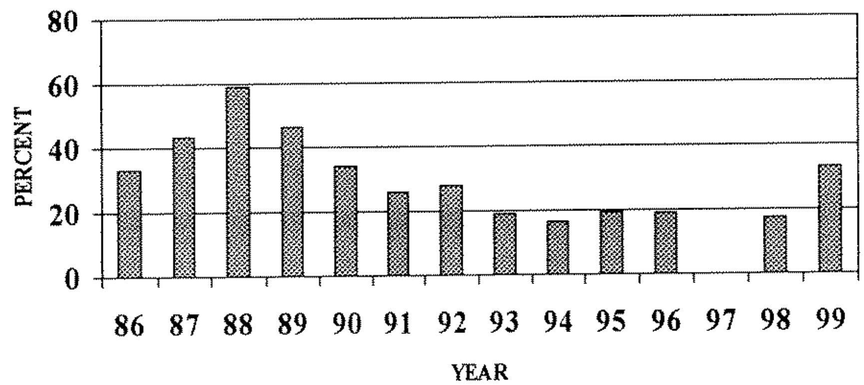


Figure 6. Estimated spring density of 22 inch and larger brown trout in the Hildreth Section of the Beaverhead River, 1986 - 1999.

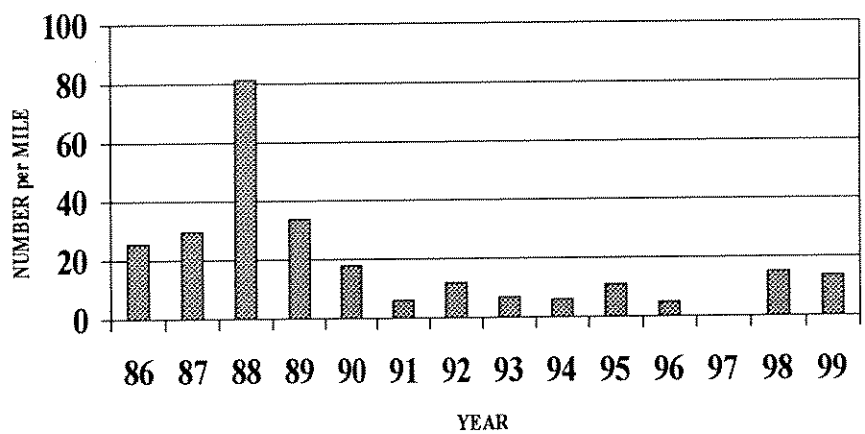

**Figure 7. Density of 22 inch and larger brown trout as a percentage of the 18 inch and larger segment of the brown trout population in the Hildreth Section of the Beaverhead River, 1986 - 1999.**

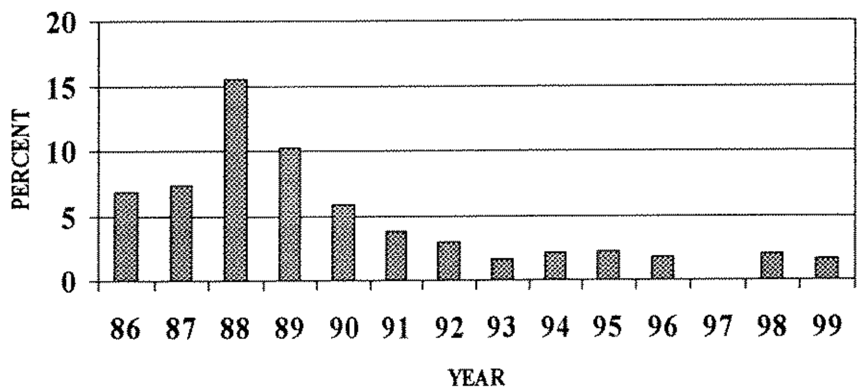


**Figure 8. Estimated fall density and standing crop of Age I and older rainbow trout in the Hildreth Section of the Beaverhead River 1986 - 1999.**

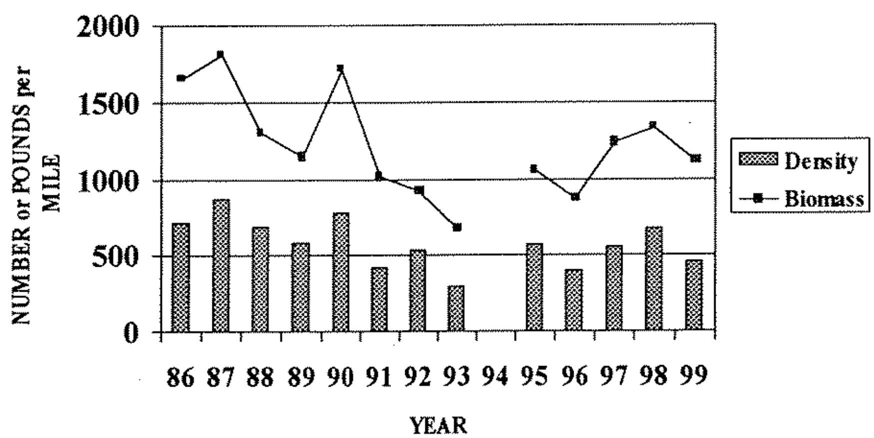

**Figure 9. Estimated fall density of 18 inch and larger and 20 inch and larger rainbow trout in the Hildreth Section of the Beaverhead River, 1986 - 1999.**

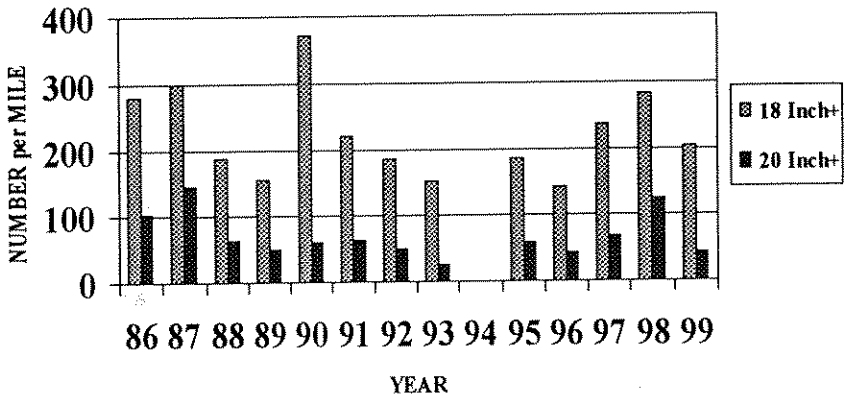


**Figure 10. Estimated spring density and standing crop of Age II and older brown trout in the Pipe Organ Section of the Beaverhead River, 1986 - 1999.**

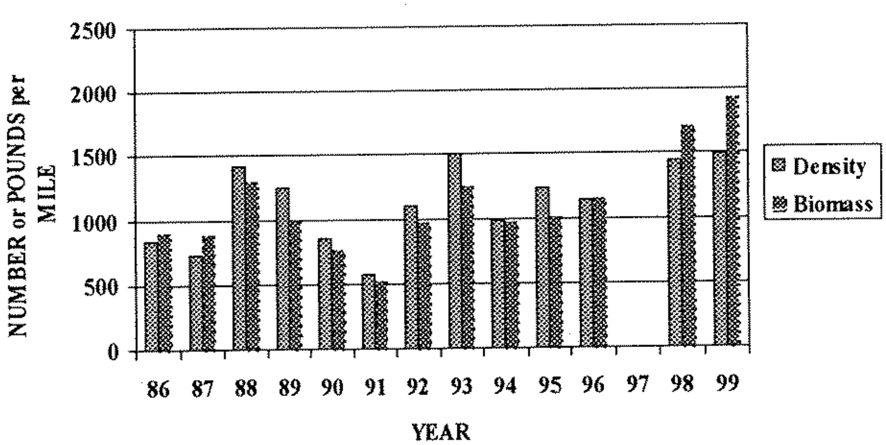

Figure 11. Estimated spring density of 18 inch and larger brown trout in the Pipe Organ Section of the Beaverhead River, 1986 - 1999.

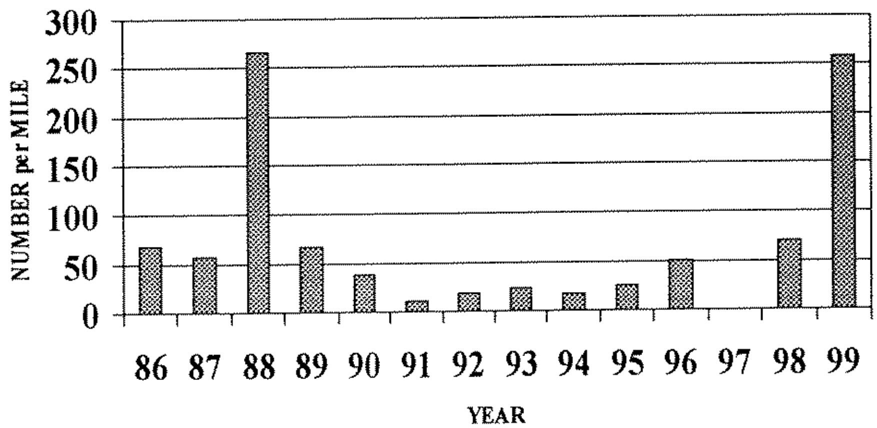


Figure 12. Estimated spring density and standing crop of Age II and older brown trout in the Fish and Game Section of the Beaverhead River, 1988 - 1999.

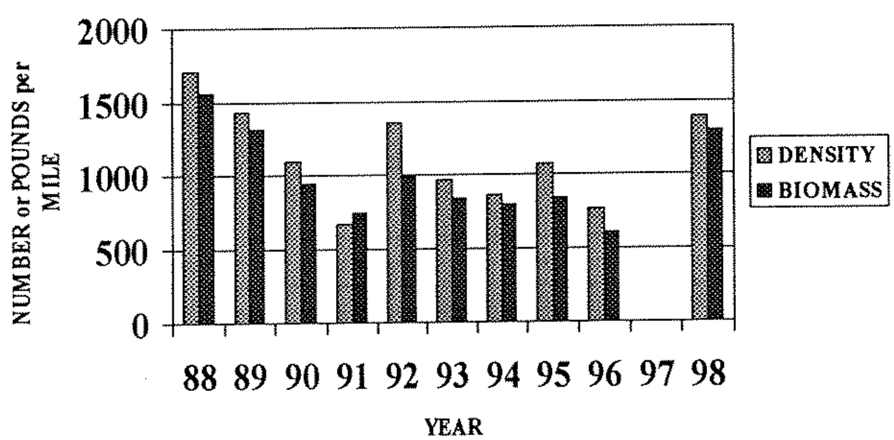

Figure 13.Estimated spring densities, by length group, of Age II and older brown trout in the Fish and Game Section of the Beaverhead River, 1988 - 1998.

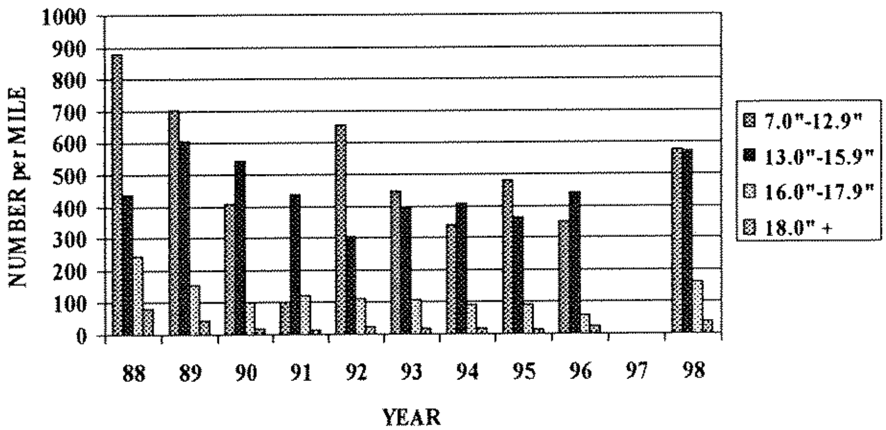


Figure 14. Estimated spring density and standing crop of Age II and older brown trout in the Low Flow Section of the Beaverhead River, 1987 - 1998.

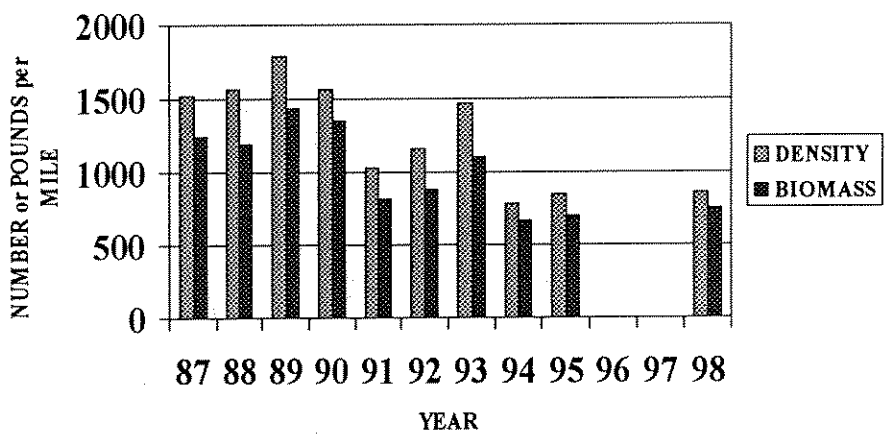

Figure 15. Estimated spring densities, by length group, of Age II and older brown trout in the Low Flow Section of the Beaverhead River, 1987 - 1998.

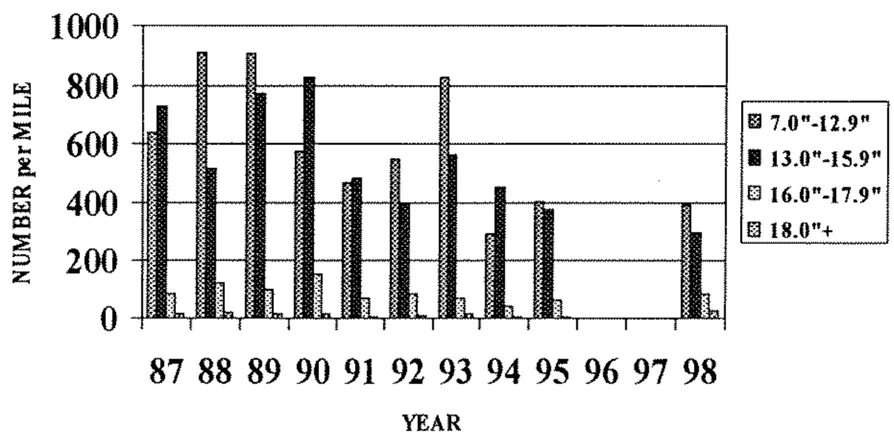


Figure 16. Estimated spring density and standing crop of Age II and older brown trout in the Anderson Section of the Beaverhead River, 1991 - 1999.

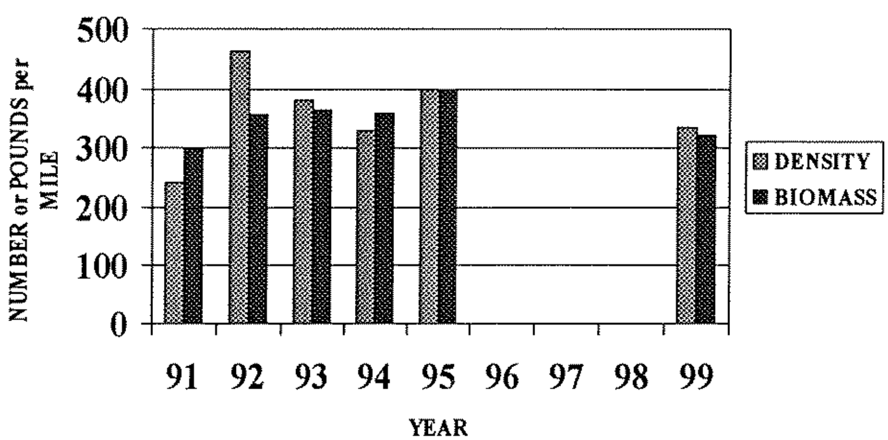

**Figure 17. Estimated spring densities, by length group, of Age II and older brown trout in the Anderson Section of the Beaverhead River, 1991 - 1999.**

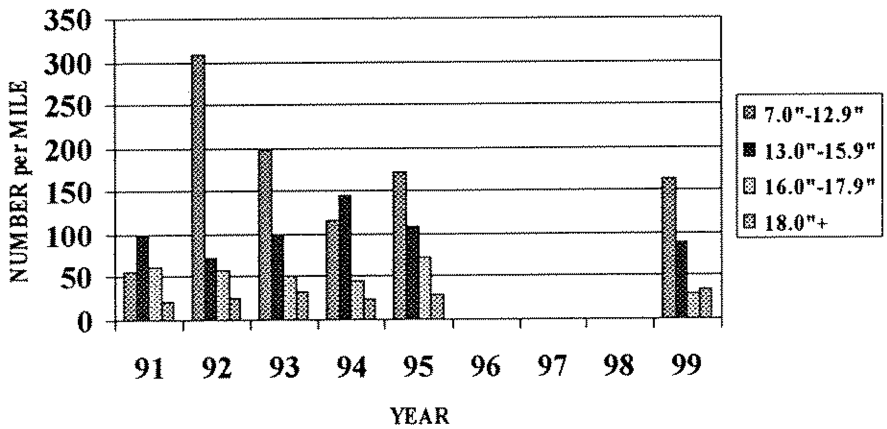


**Figure 18. Estimated spring density and standing crop of Age II and older brown trout in the Mule Shoe Section of the Beaverhead River, 1990 - 1999.**

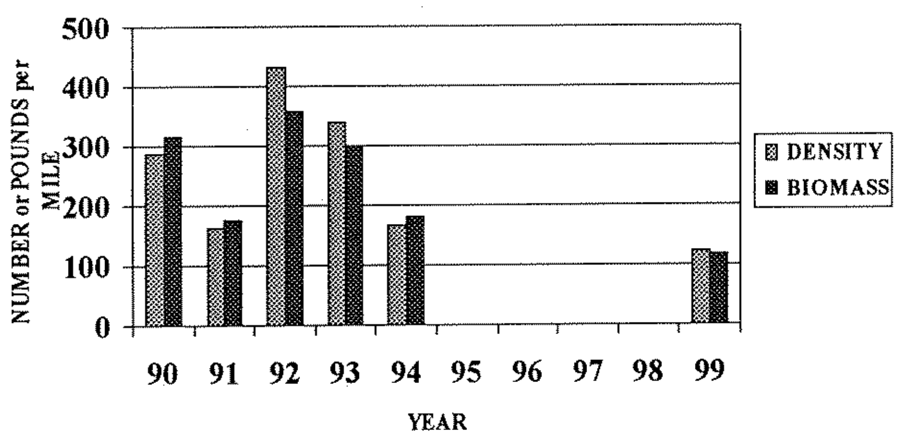

Figure 19. Estimated spring densities, by length group, of Age II and older brown trout in the Mule Shoe Section of the Beaverhead River, 1990 - 1999.

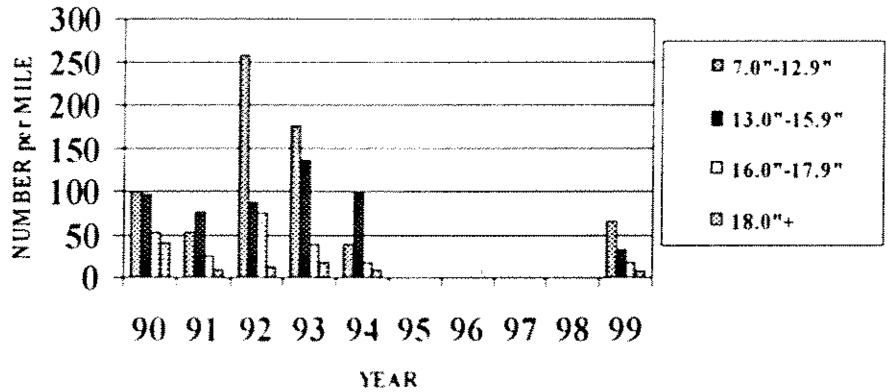


Figure 20. Estimated spring density and standing crop of Age II and older brown trout in the Twin Bridges Section of the Beaverhead River, 1987 - 1999.

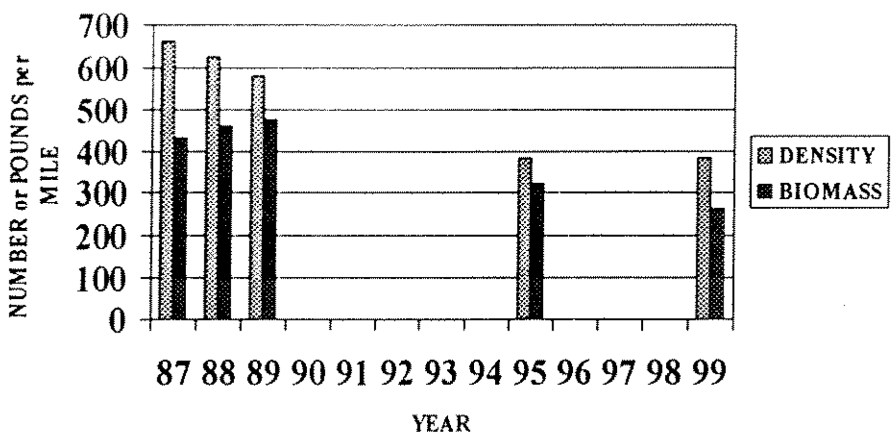

Figure 21. Estimated spring densities, by length group, of Age II and older brown trout in the Twin Bridges Section of the Beaverhead River, 1987 - 1999.

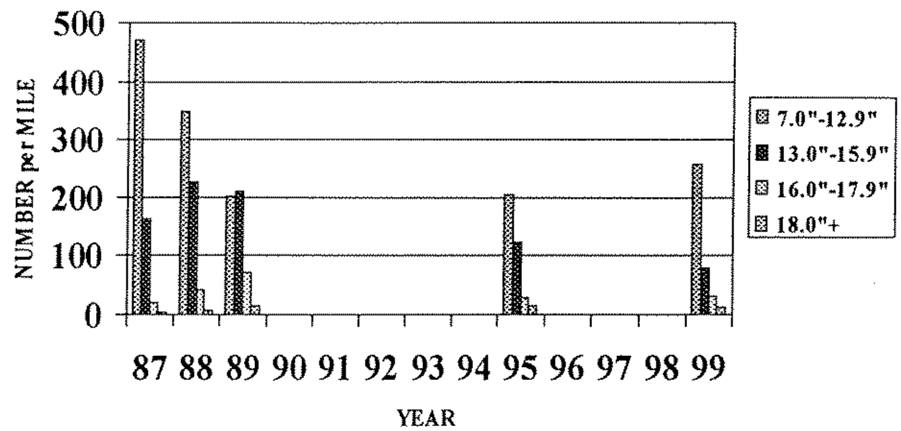


Figure 22. Estimated fall density and standing crop of Age I and older rainbow x cutthroat hybrid trout in the Three Forks Section of the Ruby River, 1987 - 1999.

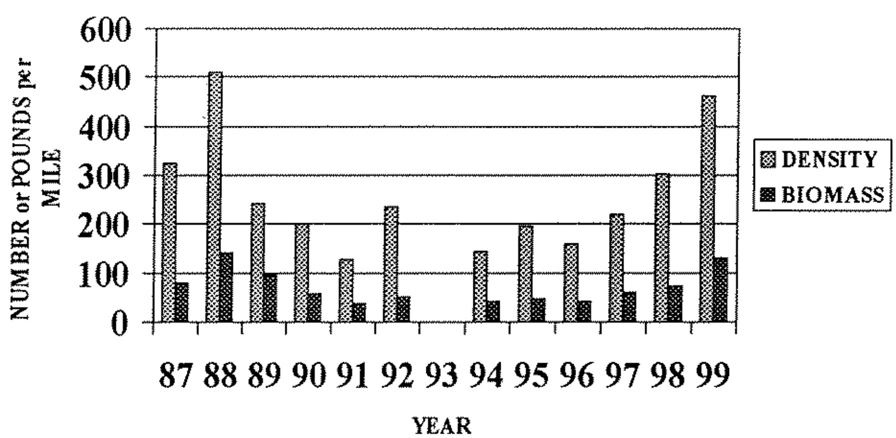

Figure 23. Estimated fall density, by length group, for Age I and older rainbow x cutthroat hybrid trout in the Three Forks Section of the Ruby River, 1987 - 1999.

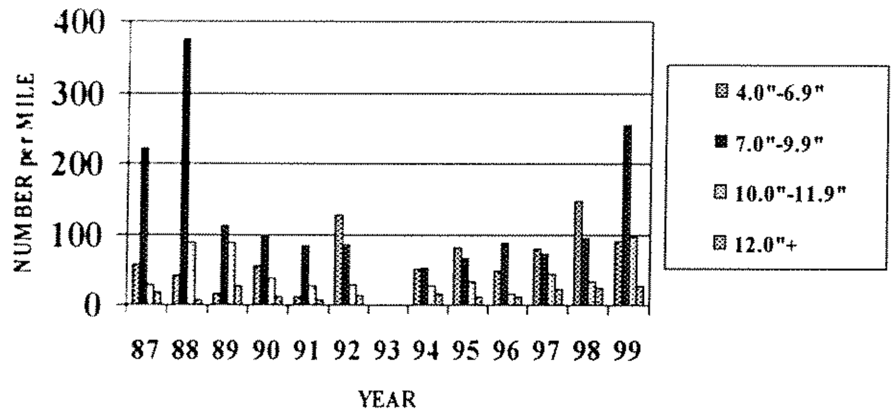


Figure 24. Mean fall Condition Factor (K) for Age I and older rainbow x cutthroat hybrid trout in the Three Forks Section of the Ruby River, 1987 - 1999.

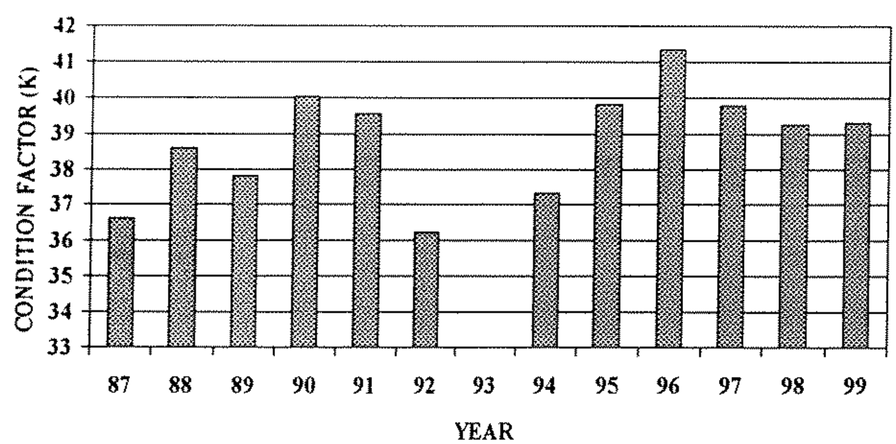

Figure 25. Estimated fall density and standing crop for Age I and Age II arctic grayling in the Three Forks Section of the Ruby River 1998 and 1999.

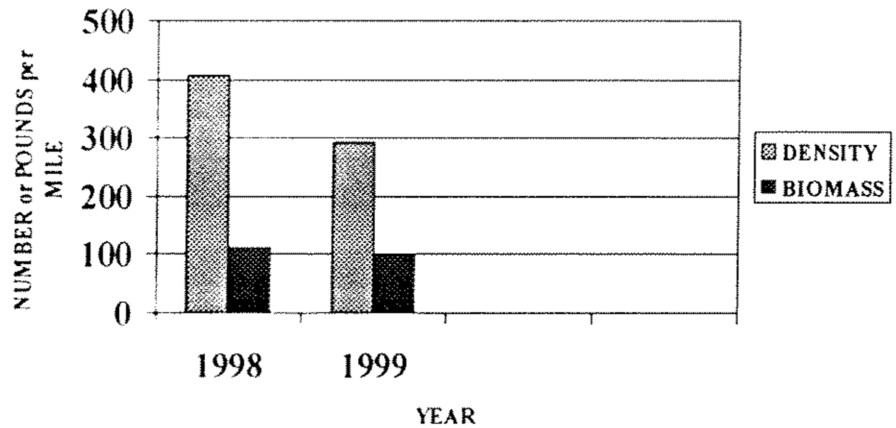


Figure 26. Estimated fall density and standing crop of Age I and older rainbow trout in the Greenhorn Section of the Ruby River, 1990 - 1999.

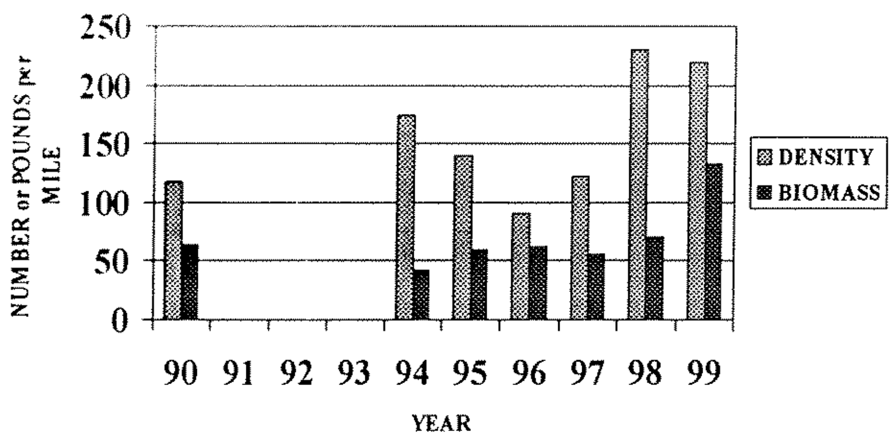

Figure 27. Estimated fall densities, by length group, of Age I and older rainbow trout in the Greenhorn Section of the Ruby River 1990 -1999.

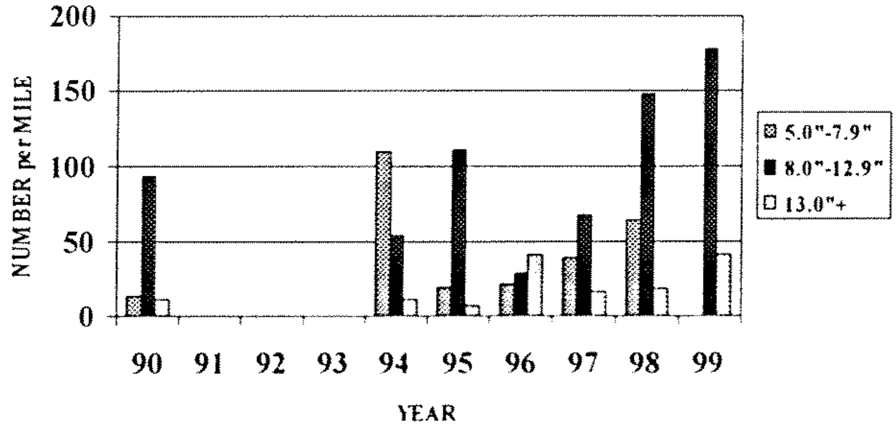


Figure 28. Estimated fall density and standing crop of Age I and older brown trout in the Greenhorn Section of the Ruby River, 1990 - 1999.

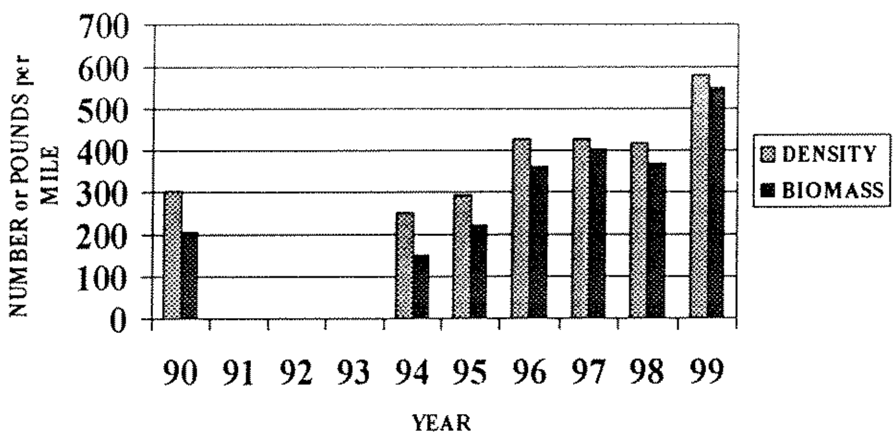

**Figure 29. Estimated fall densities, by length group, of Age I and older brown trout in the Greenhorn Section of the Ruby River, 1990 - 1999.**

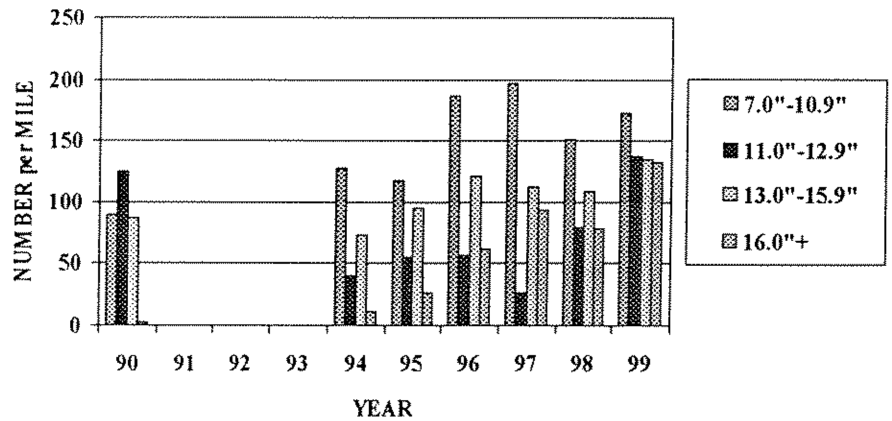


**Figure 30. Estimated density and standing crop of fall Age I and older brown trout in the Passamari (PASS) Section and spring Age II and older brown trout in the Maloney (MAL) Section of the Ruby River 1994 - 1999.**

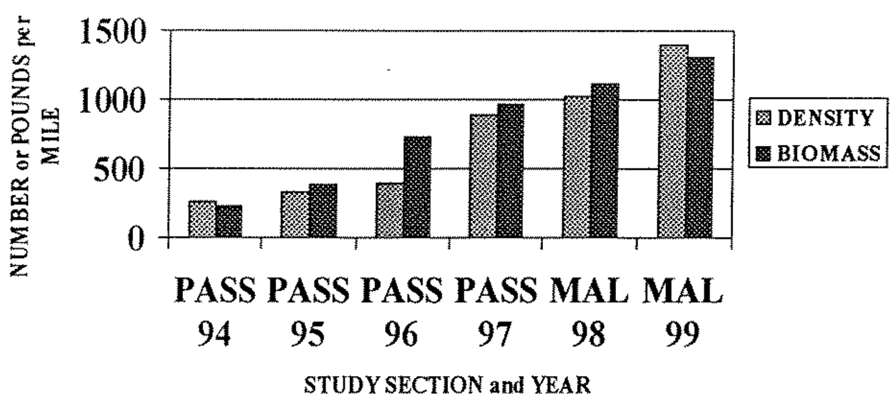

Figure 31. Estimated densities of 13 inch and larger brown trout from fall samples in the Passamari (PASS) Section and spring samples in the Maloney (MAL) Section of the Ruby River, 1994 - 1999.

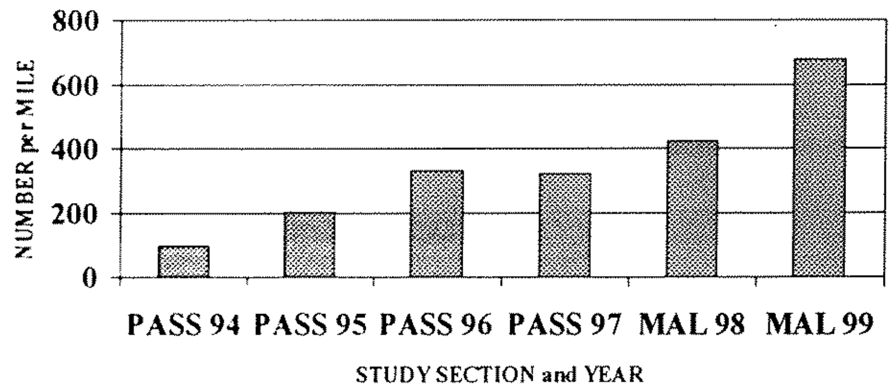


Figure 32. Estimated densities of 18 inch and larger brown trout from fall samples in the Passamari (PASS) Section and spring samples in the Maloney (MAL) Section of the Ruby River, 1994 - 1999.

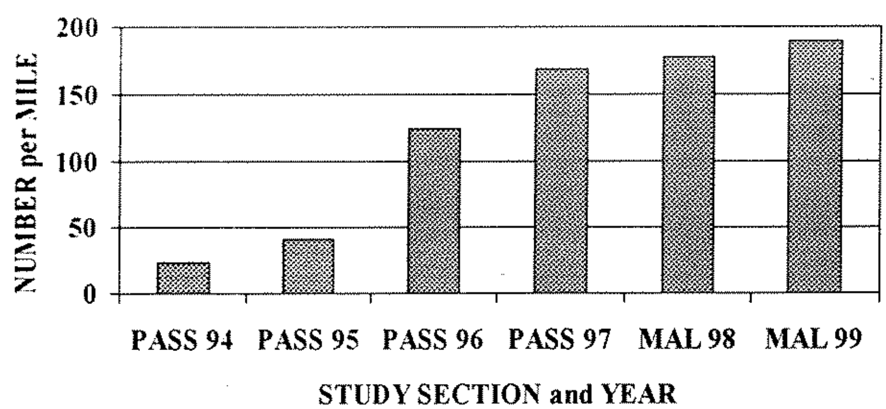

Figure 33. Estimated densities of juvenile brown trout from fall samples of Age I fish in the Passamari (PASS) Section and spring samples of Age II fish in the Maloney (MAL) Section of the Ruby River, 1994 - 1999.

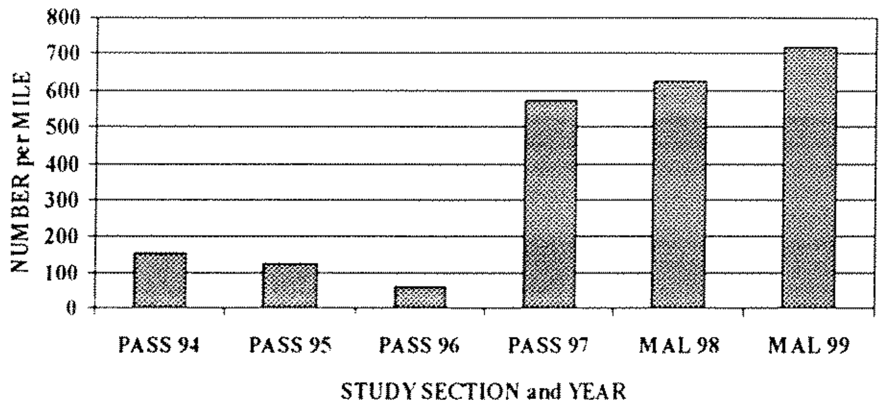


Figure 34. Estimated fall density and standing crop of Age I and older rainbow trout in the Passamari Section of the Ruby River 1994 - 1997.

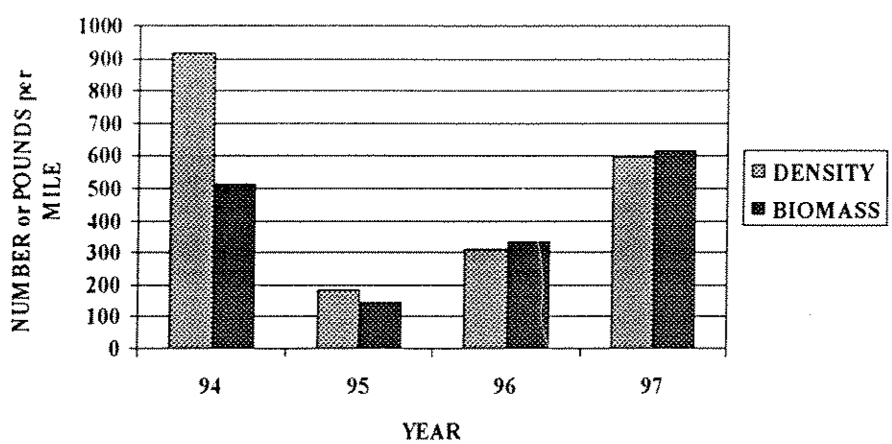

**Figure 35. Estimated spring density and standing crop of Age II and older brown trout in the Alder Section of the Ruby River 1983, 1998, and 1999.**

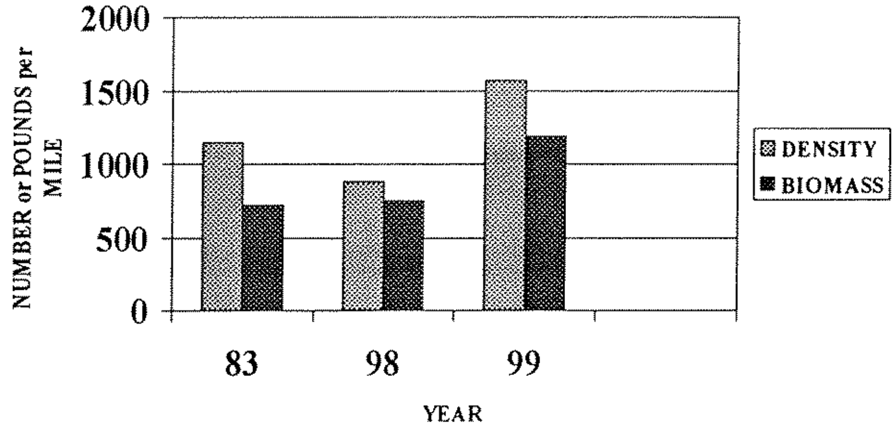


**Figure 36. Estimated spring density of juvenile (Age II) brown trout in the Alder Section of the Ruby River; 1983, 1998, and 1999.**

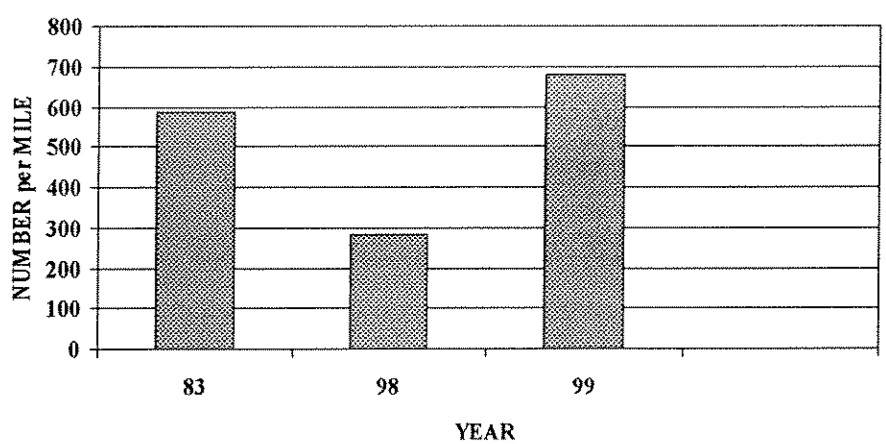

**Figure 37. Estimated spring density of 13 inch and larger brown trout in the Alder Section of the Ruby River 1983, 1998, and 1999.**

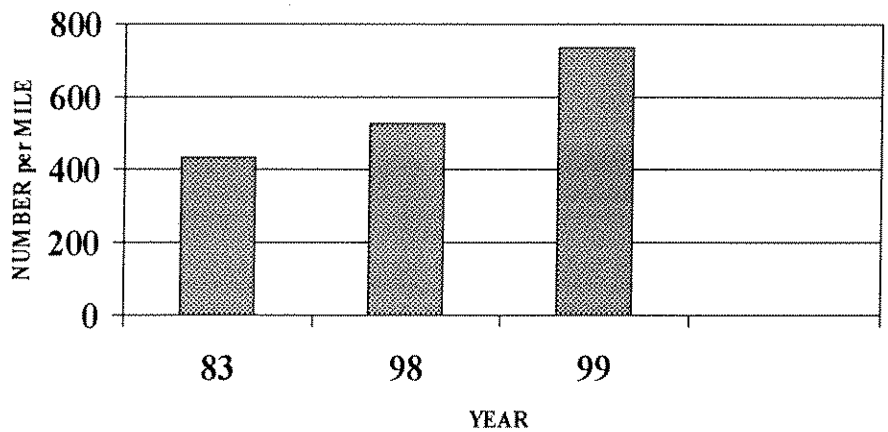


**Figure 38. Estimated spring density of 16 inch and larger brown trout in the Alder Section of the Ruby River; 1983, 1998, and 1999.**

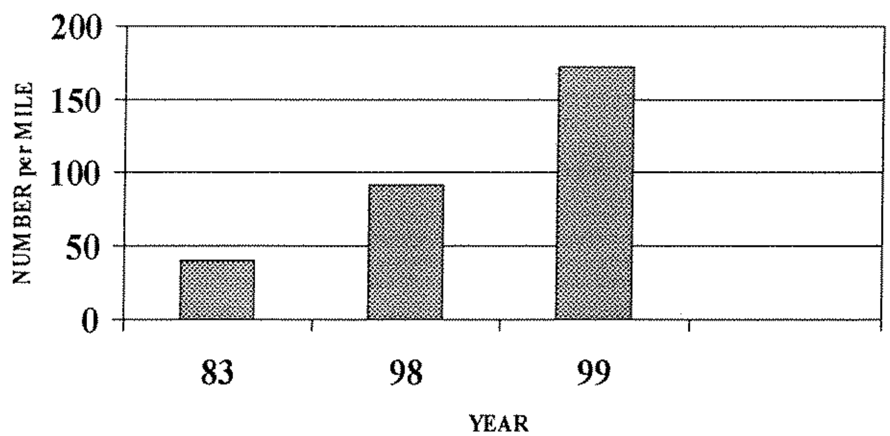

**Figure 39. Estimated fall density and standing crop of Age I and older brown trout in the Guinnane Main Channel and Clear Creek Sections of the Ruby River, 1996.**

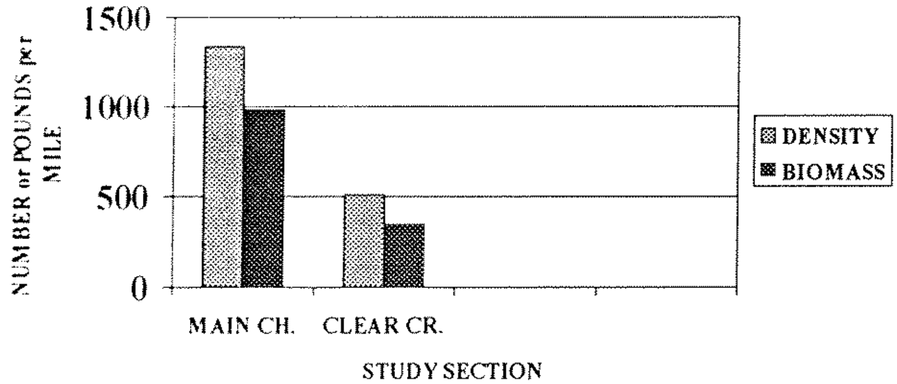


**Figure 40. Estimated fall densities of 13 inch and larger and 16 inch and larger brown trout in the Guinnane Main Channel and Clear Creek Sections of the Ruby River, 1996.**

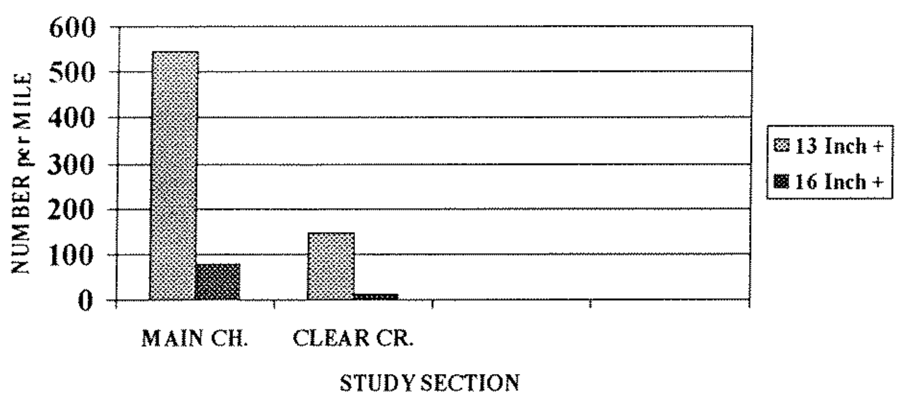

Figure 41. Estimated fall density of Age I brown trout in the Guinnane Main Channel and Clear Creek Sections of the Ruby River, 1996.

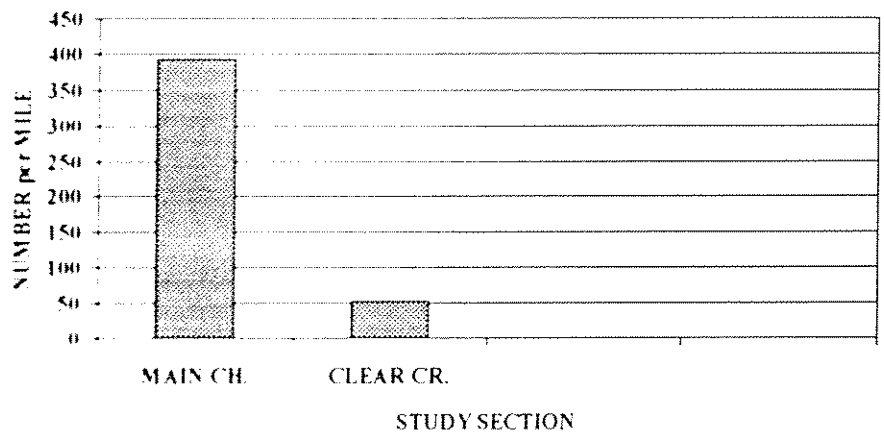


Figure 42. Estimated spring density and standing crop of Age II and older brown trout in the Tezak and Woodson Sections of the Ruby River, 1996 - 1997.

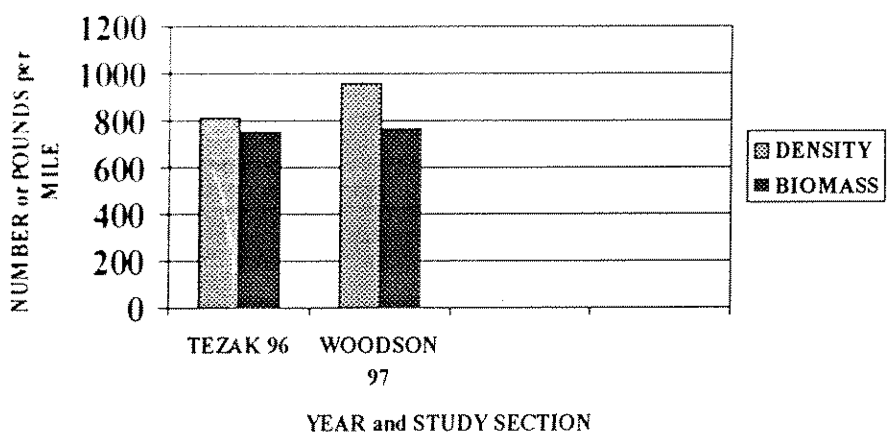

Figure 43. Estimated spring densities of 13 inch and larger and 16 inch and larger brown trout in the Tezak and Woodson Sections of the Ruby River, 1996 - 1997.

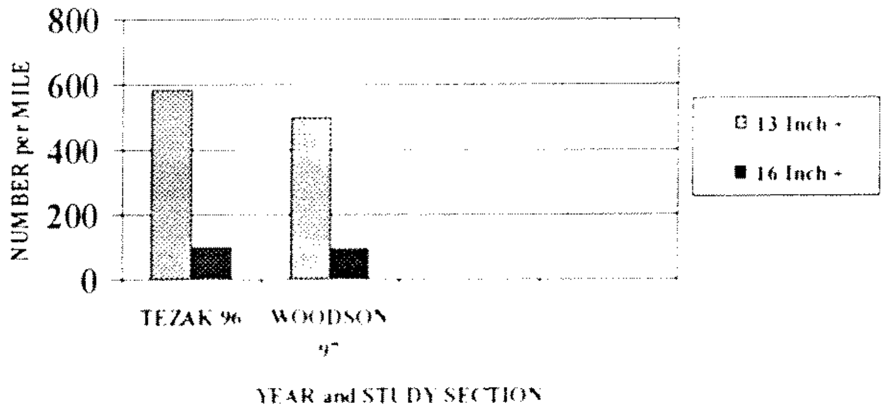


Figure 44. Estimated spring density of Age II brown trout in the Tezak and Woodson Sections of the Ruby River, 1996 - 1997.

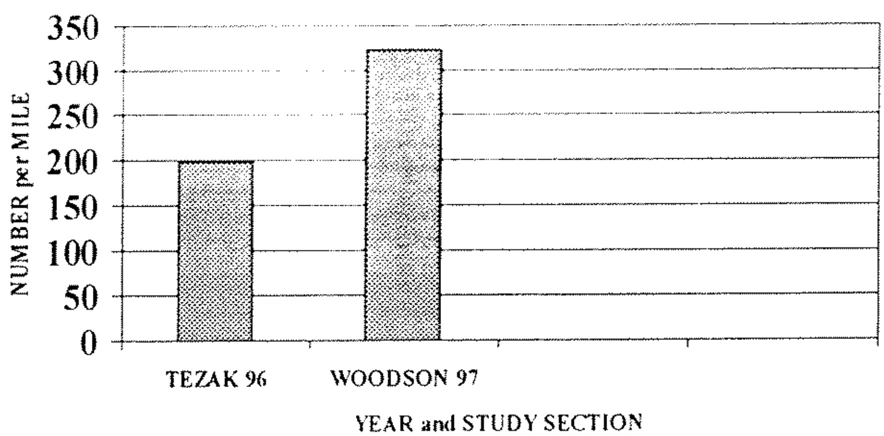

**Figure 45. Estimated spring density and standing crop of Age II and older brown trout in the Silver Spring Section of the Ruby River, 1989 - 1999.**

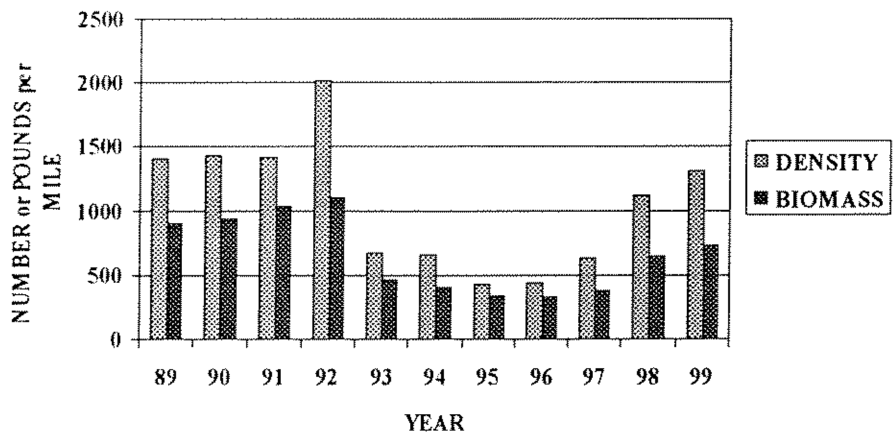


**Figure 46. Estimated spring densities of juvenile (Age I and Age II) brown trout in the Silver Spring Section of the Ruby River, 1989 - 1999.**

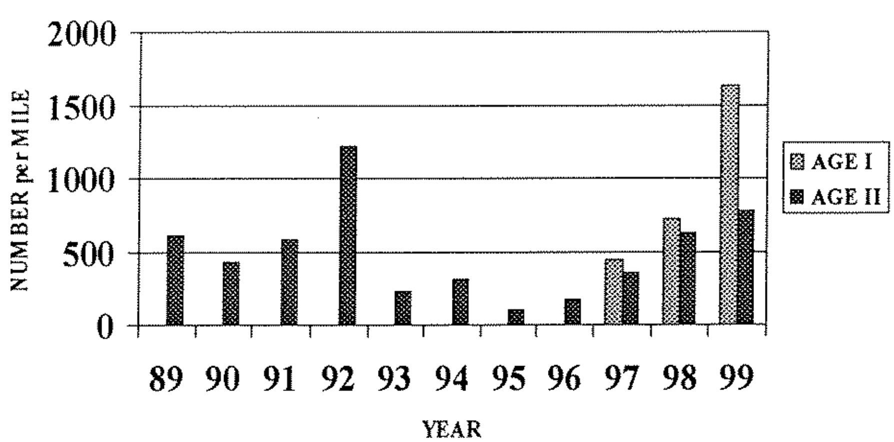

Figure 47. Estimated spring density of 13 inch and larger brown trout in the Silver Spring Section of the Ruby River, 1989 - 1999.

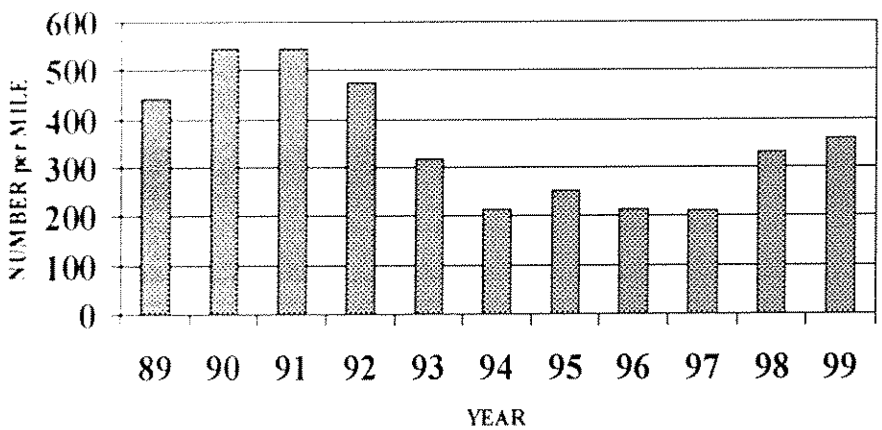


Figure 48. Estimated spring density of 16 inch and larger brown trout in the Silver Spring Section of the Ruby River, 1989 - 1999.

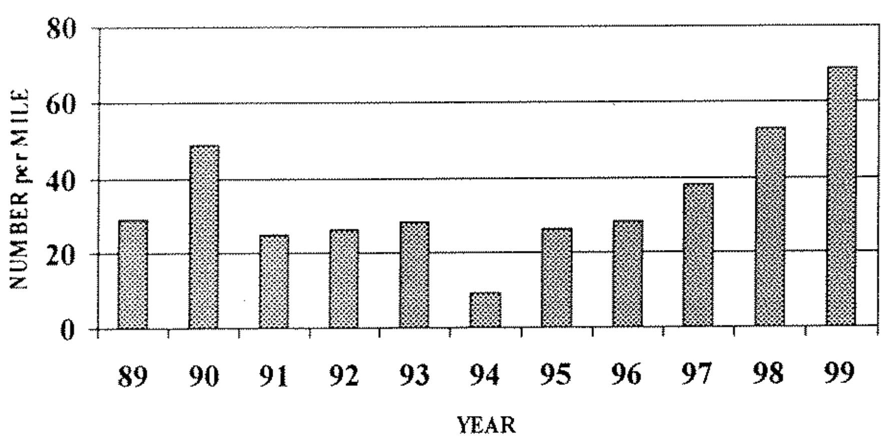

Figure 49. Estimated spring density and standing crop of Age II and older brown trout in the Sailor Section of the Ruby River, 1979 - 1998.

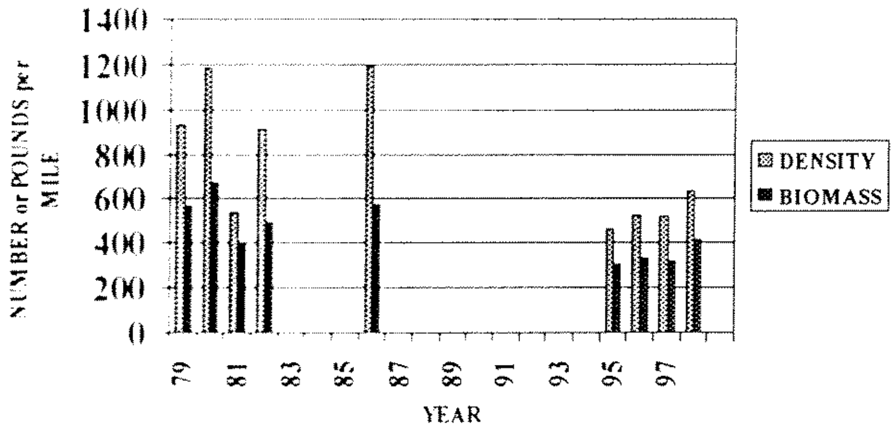


Figure 50. Estimated spring densities of juvenile (Age I and Age II) brown trout in the Sailor Section of the Ruby River, 1995 - 1998.

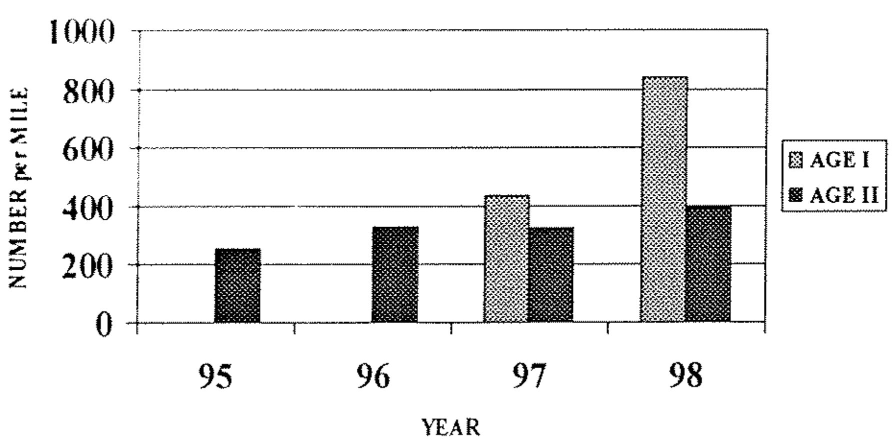

Figure 51. Estimated spring density of 13 inch and larger brown trout in the Sailor Section of the Ruby River, 1995 - 1998.

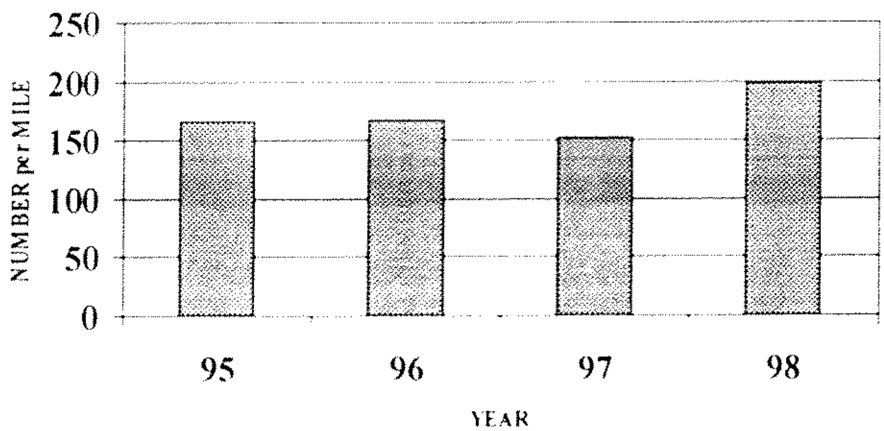


Figure 52. Estimated spring density of 16 inch and larger brown trout in the Sailor Section of the Ruby River, 1995 - 1998.

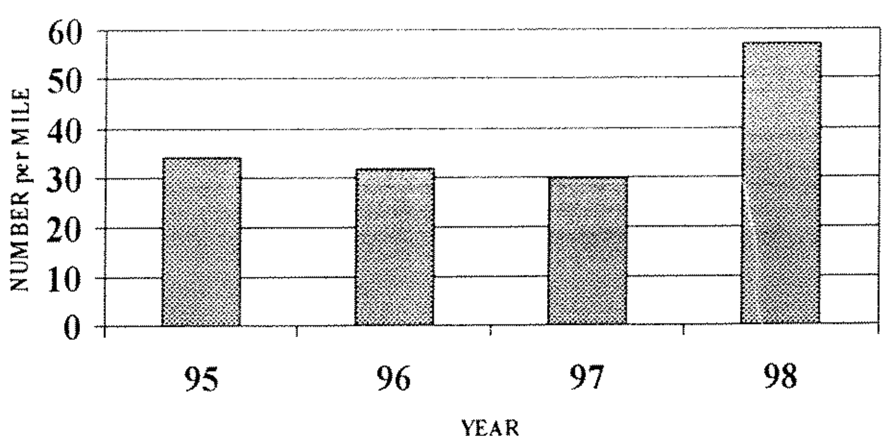

Figure 53. Estimated spring density and standing crop of Age I and older brown trout in Section Three of Poindexter Slough, 1989 - 1999.

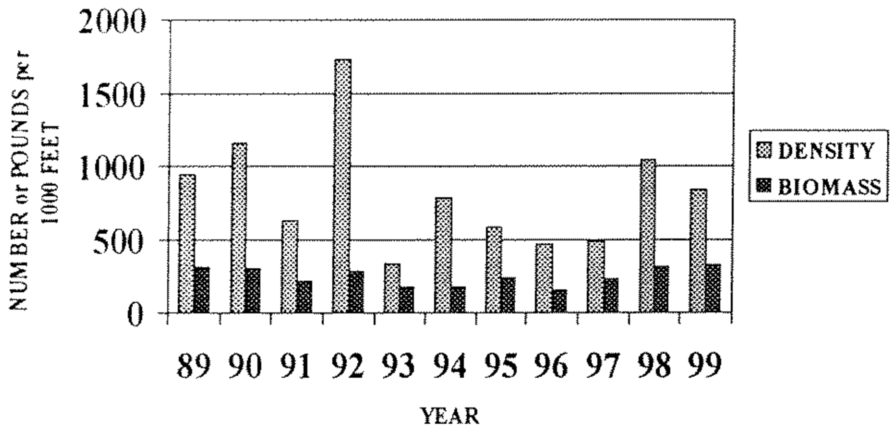


Figure 54. Estimated spring density of Age I brown trout in Section Three of Poindexter Slough, 1989 - 1999.

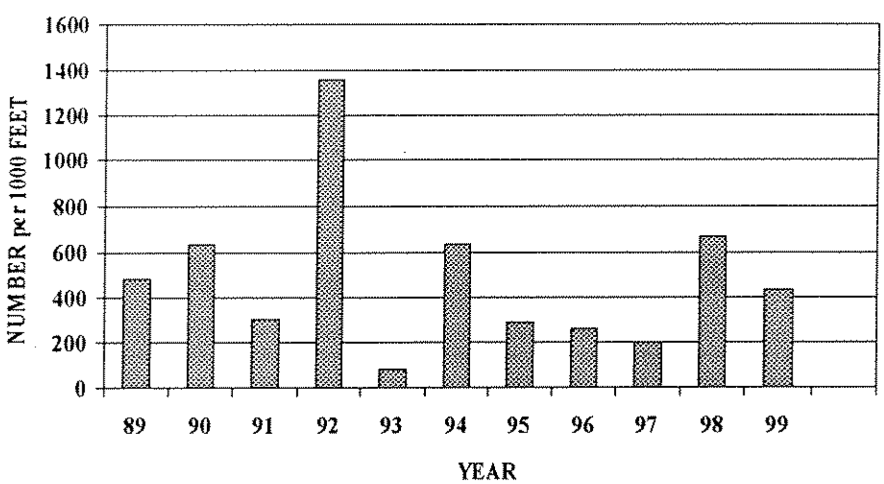

Figure 55. Estimated spring density of 13 inch and larger brown trout in Section Three of Poindexter Slough, 1989 - 1999.

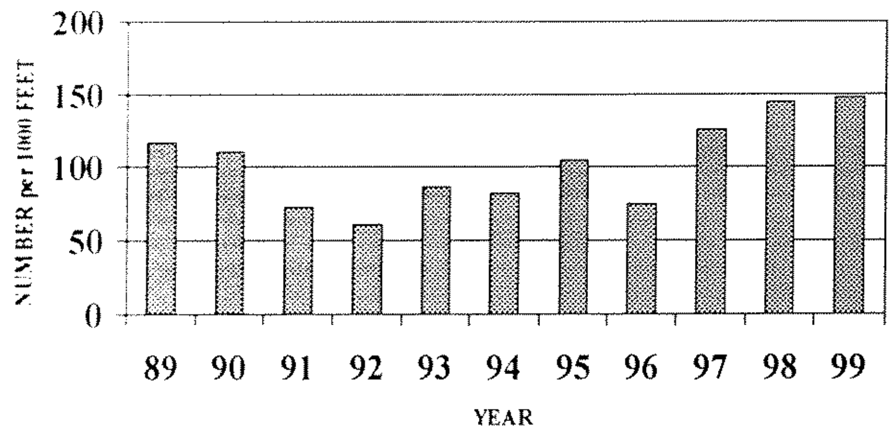


Figure 56. Estimated spring density of 15 inch and larger brown trout in Section Three of Poindexter Slough, 1989 - 1999.

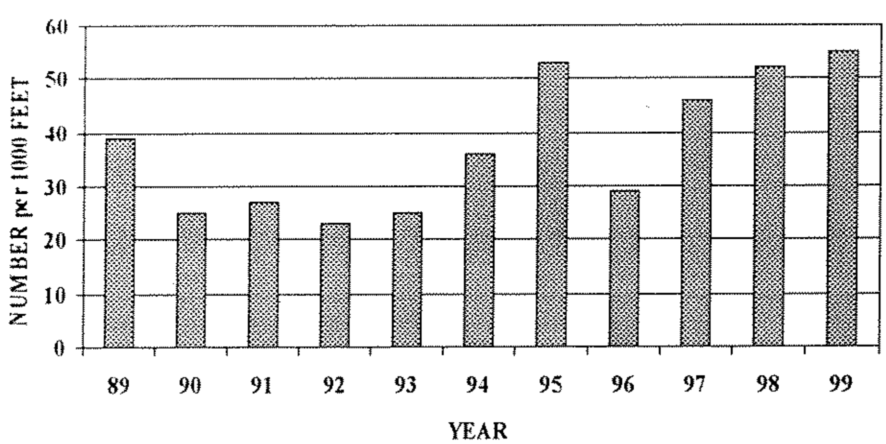

Figure 57. Estimated spring or fall density and standing crop of brown trout in the Shearing Pen Section of Big Sheep Creek, 1980, 1986, and 1996.

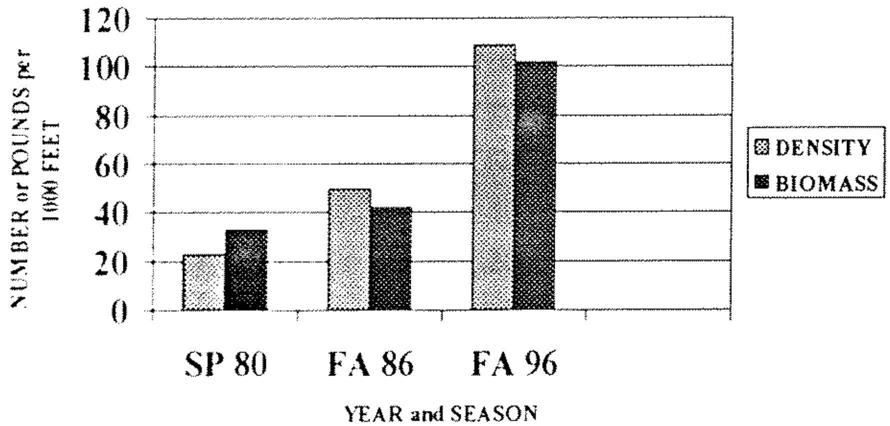


Figure 58. Estimated density of juvenile (fall Age I or spring Age II) brown trout in the Shearing Pen Section of Big Sheep Creek, 1980, 1986, and 1996.

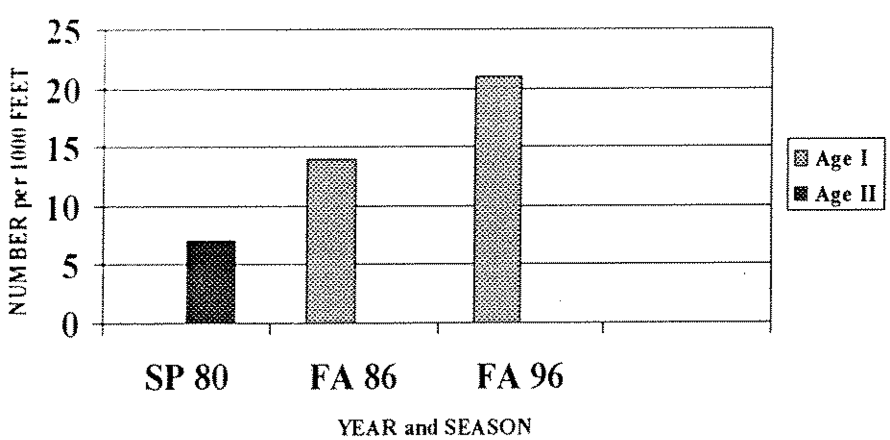

Figure 59. Estimated spring or fall densities of 13 inch and larger and 16 inch and larger brown trout in the Shearing Pen Section of Big Sheep Creek, 1980, 1986, and 1996.

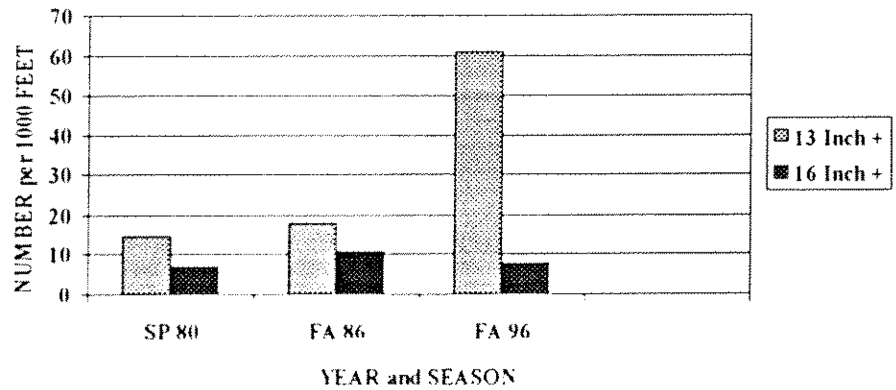


Figure 60. Estimated spring or fall density and standing crop of rainbow trout in the Shearing Pen Section of Big Sheep Creek; 1980, 1986, and 1999.

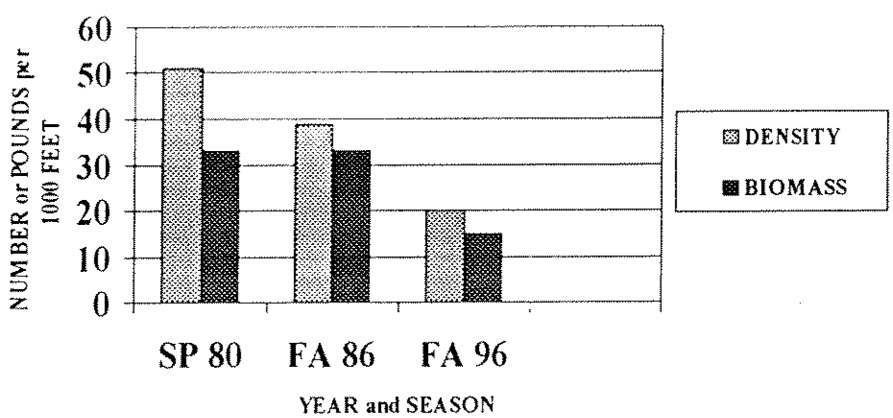

Figure 61. Estimated density of juvenile (fall Age I or spring Age II) rainbow trout in the Shearing Pen Section of Big Sheep Creek; 1980, 1986, and 1996.

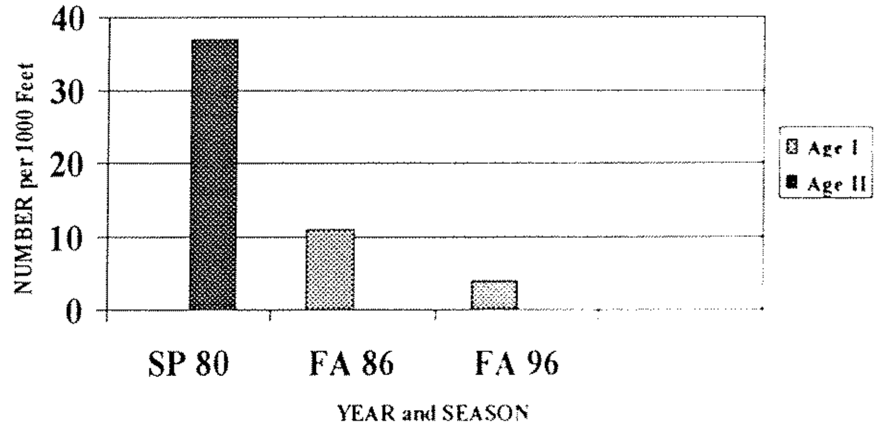


Figure 62. Estimated spring or fall densities of 13 inch and larger and 15 inch and larger rainbow trout in the Shearing Pen Section of Big Sheep Creek; 1980, 1986, and 1996.

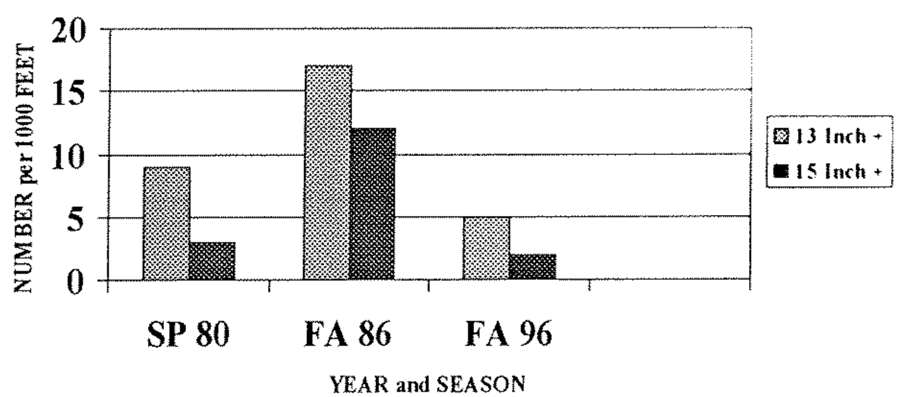

Figure 63. Estimated spring or fall density and standing crop of brown trout in the Canyon Section of Big Sheep Creek; 1982, '83, '87, and 1996.

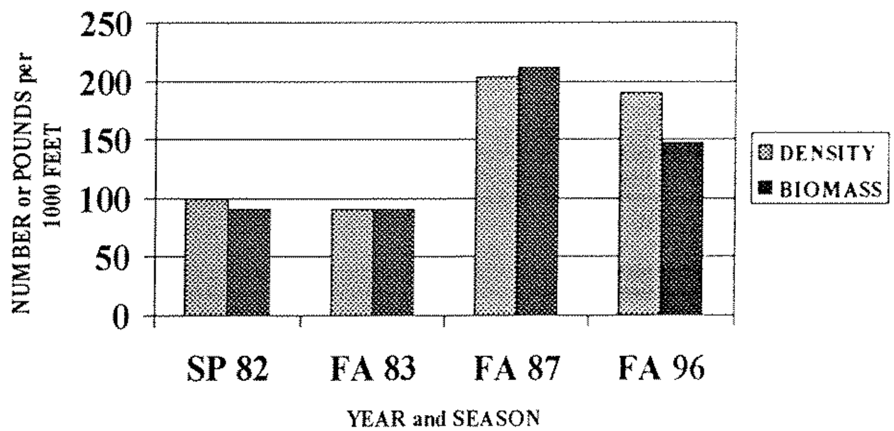


Figure 64. Estimated spring or fall density of juvenile (fall Age I or spring Age II) brown trout in the Canyon Section of Big Sheep Creek; 1982, '83, '87, and 1996.

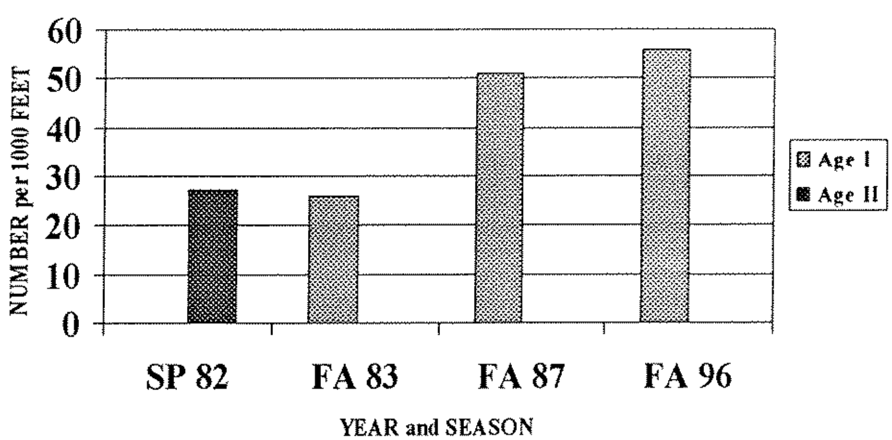

Figure 65. Estimated spring or fall densities of 13 inch and larger and 16 inch and larger brown trout in the Canyon Section of Big Sheep Creek; 1982, '83, '87, and 1996.

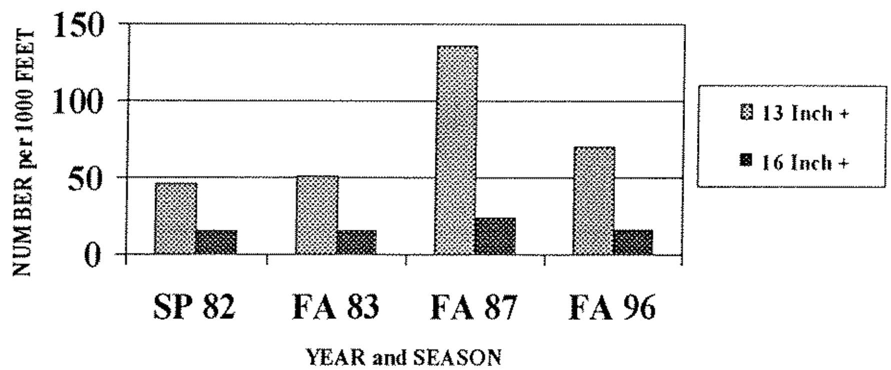


Figure 66. Estimated spring or fall density and standing crop of rainbow trout in the Canyon Section of Big Sheep Creek; 1982, '83, '87, and 1996.

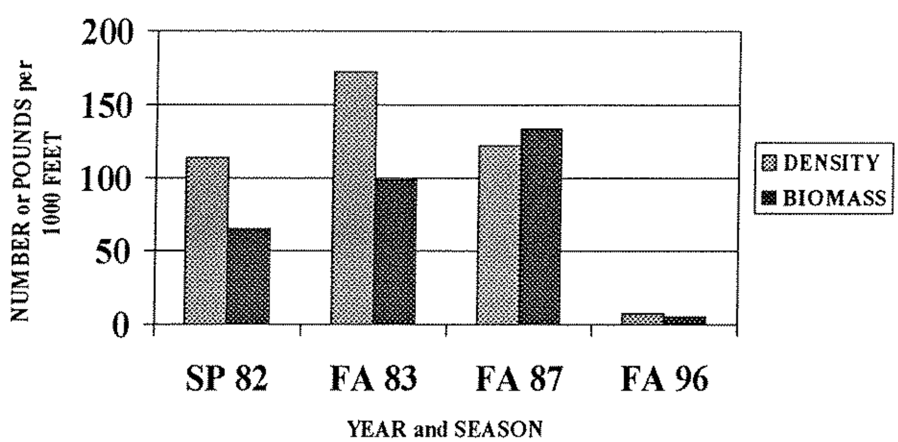

Figure 67. Estimated density of juvenile (fall Age I or spring Age II) rainbow trout in the Canyon Section of Big Sheep Creek; 1982, '83, '87, and 1996.

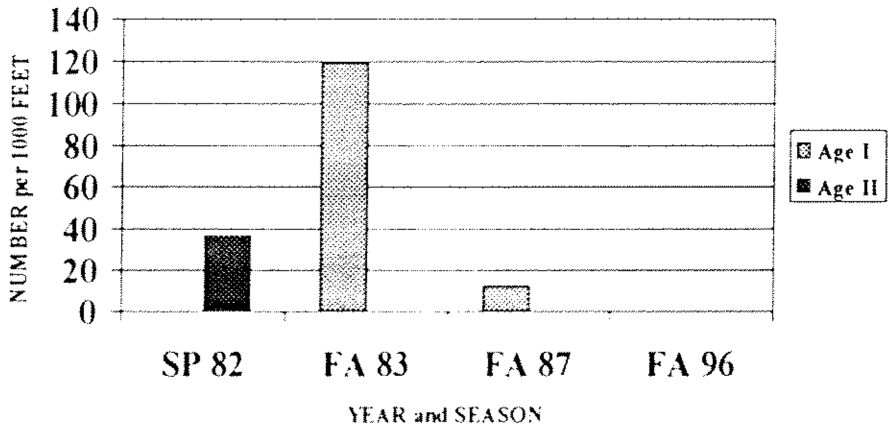


Figure 68. Estimated spring or fall densities of 13 inch and larger and 15 inch and larger rainbow trout in the Canyon Section of Big Sheep Creek; 1982, '83, '87, and 1996.

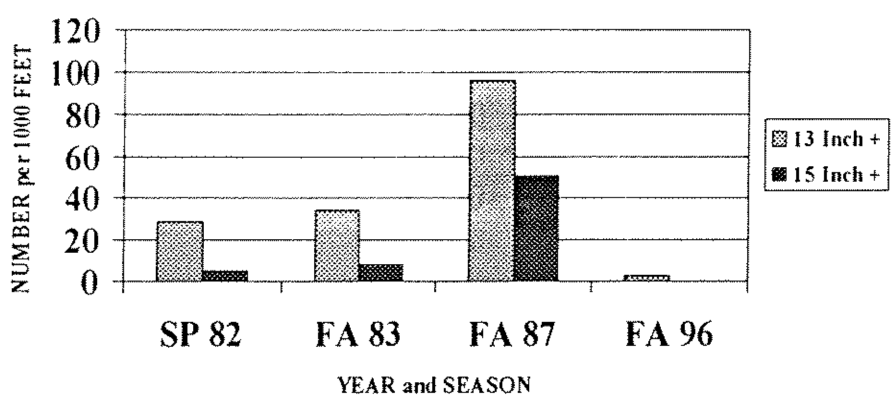

Figure 69. Estimated fall density and standing crop of Age I and older rainbow trout in the Partnership and Surgical Sections of Big Sheep Creek, 1986 and 1990.

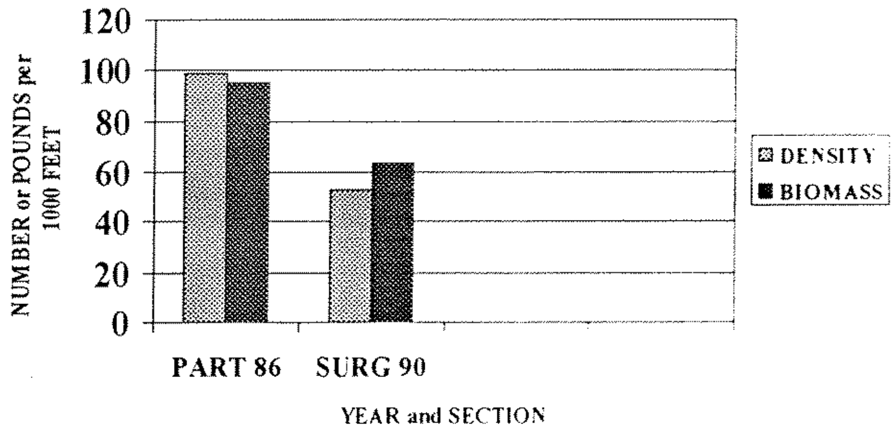


Figure 70. Estimated fall densities of 13 inch and larger and 15 inch and larger rainbow trout in the Partnership and Surgical Sections of Big Sheep Creek, 1986 and 1990.

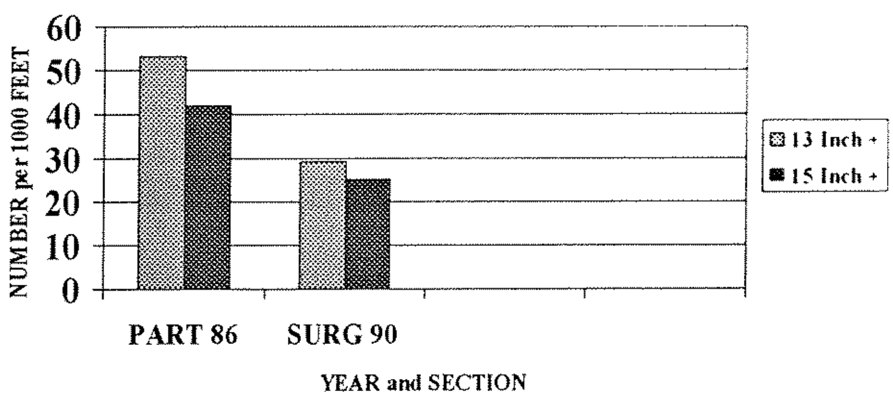

Figure 71. Estimated fall number and standing crop of westslope cutthroat trout and brook trout in the Taft Section of O'Dell Creek, 1994.

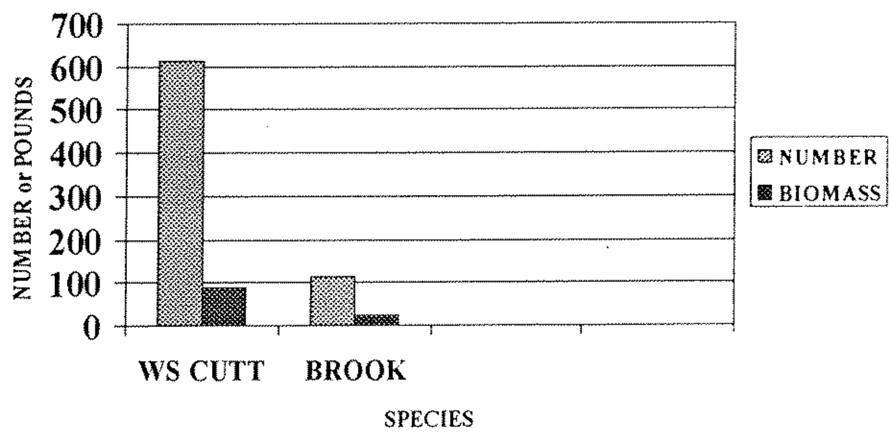


Figure 72. Estimated fall numbers, by length group, of westslope cuttroat trout and brook trout in the Taft Section of O'Dell Creek, 1994.

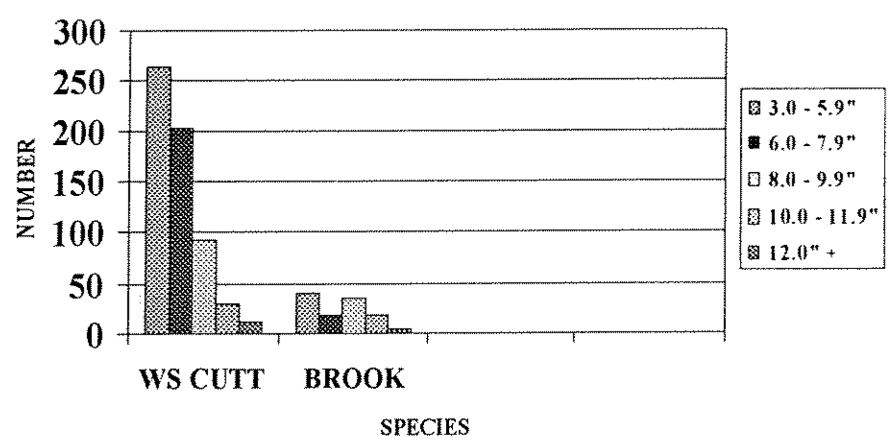

**Figure 73. Estimated Density of Age I and older Westslope Cutthroat Trout in the Left Fork of Stone Creek 1986 - 1998.**

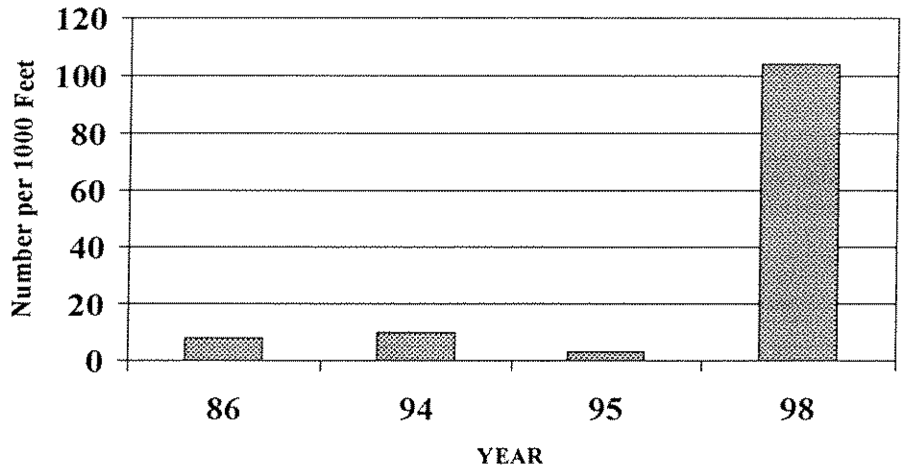


**Figure 74. Estimated Standing Crop of WCT in the Left Fork of Stone Creek Pre- and Post-Reclamation in 1994 and 1998.**

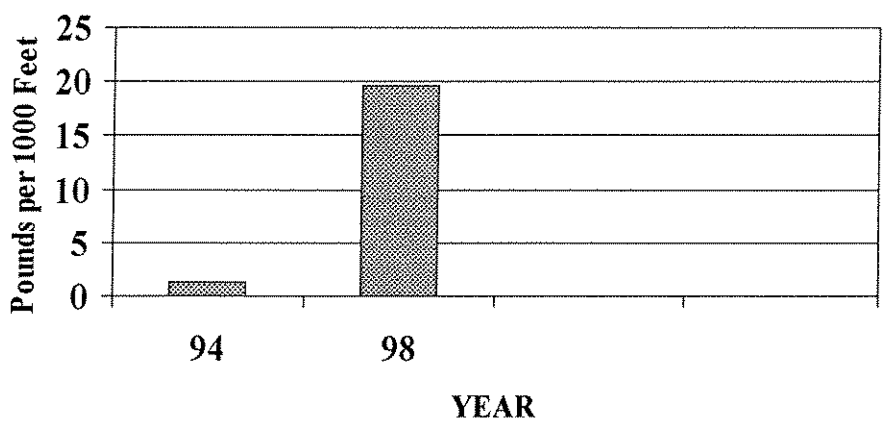

Figure 75. Mean Condition Factor (K) for WCT collected in the Left Fork of Stone Creek Pre- and Post- Reclamation 1994 - 1998.

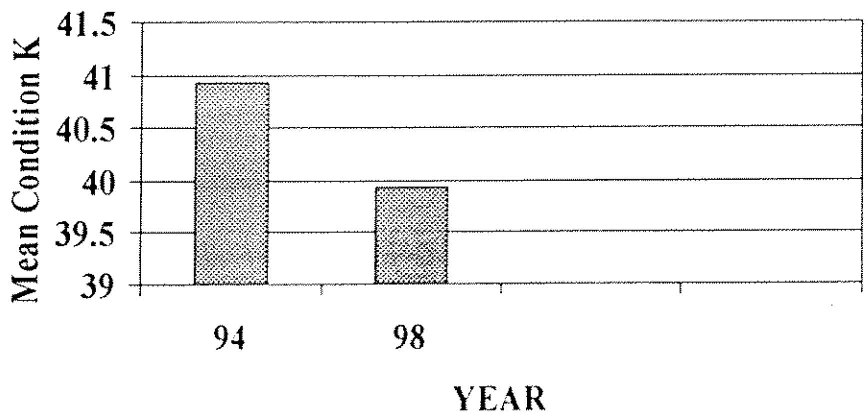


Figure 76. Length - Frequency Distribution of WCT collected in the Left Fork of Stone Creek in July 1994.

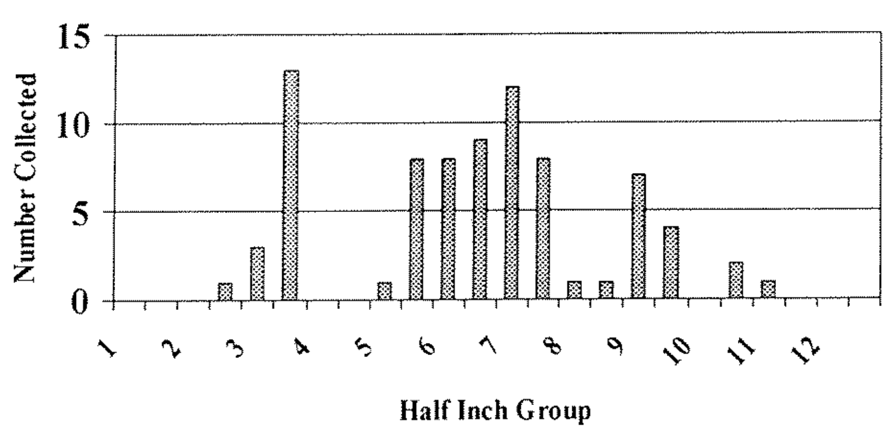

Figure 77. Length - Frequency Distribution of WCT collected in the Left Fork of Stone Creek in September 1998.

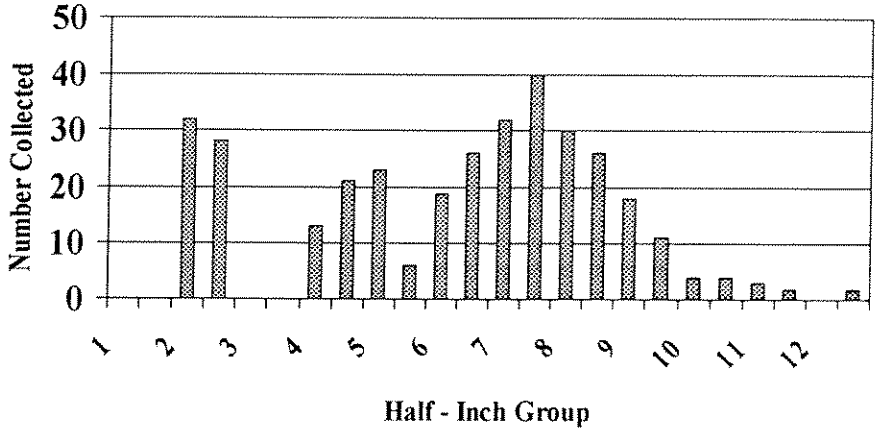


Figure 78. Estimated Density of Age I and older Westslope Cutthroat Trout in the upper Mainstem of Stone Creek 1986 - 1998.

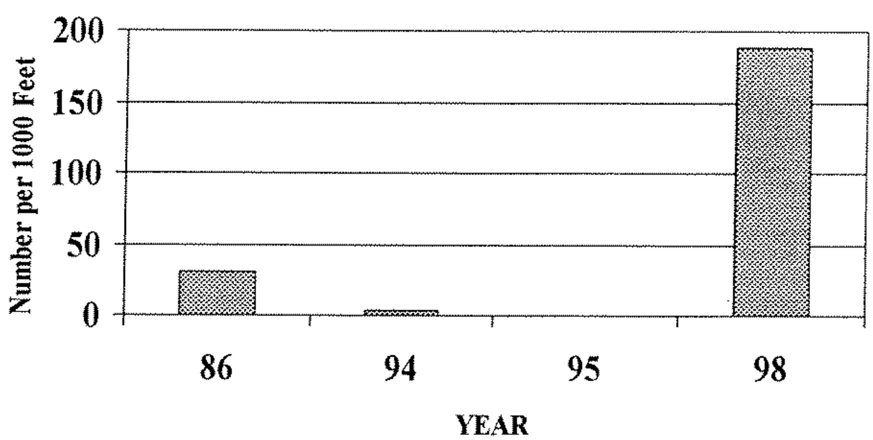

Figure 79. Estimated Density of Age I and older Westslope Cutthroat Trout in the Middle Fork of Stone Creek 1986 - 1998.

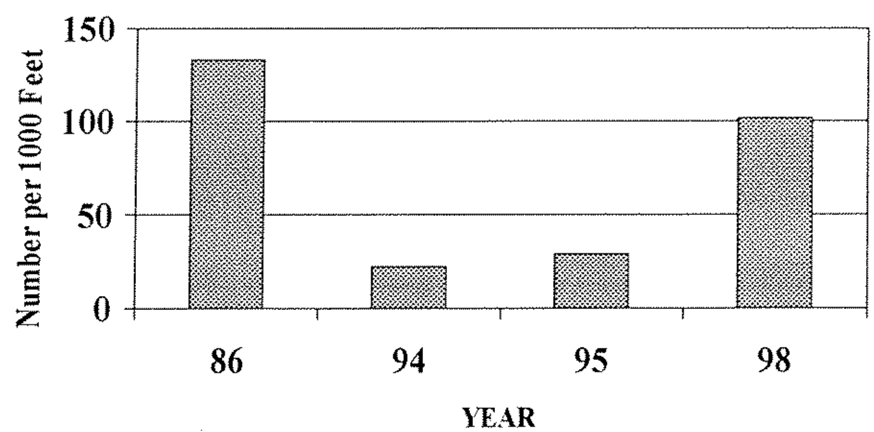


Figure 80. Length frequency distribution of westslope cutthroat trout collected in May 1986 in the Middle Fork of Stone Creek.

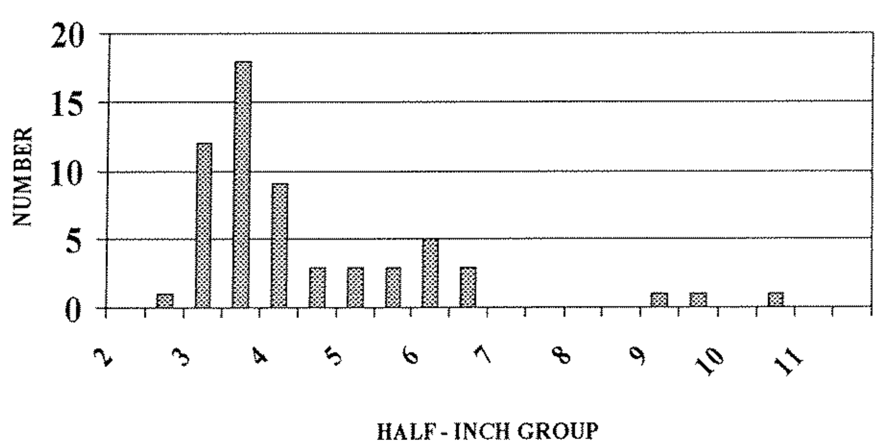

Figure 77. Length - Frequency Distribution of WCT collected in the Left Fork of Stone Creek in September 1998.

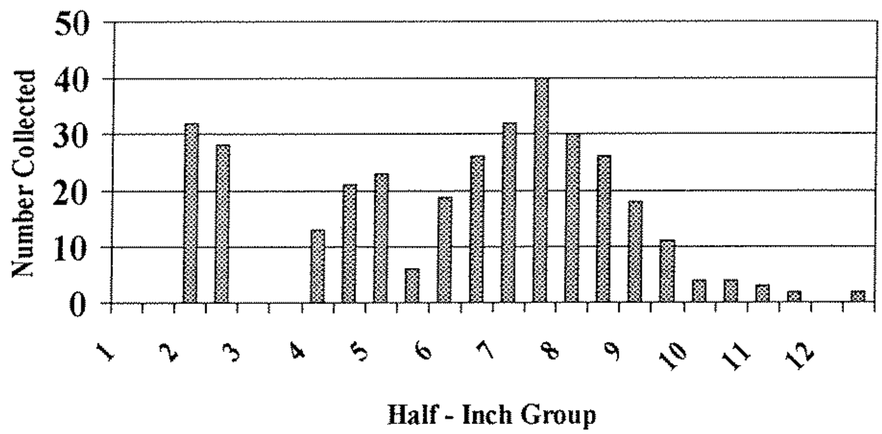


Figure 78. Estimated Density of Age I and older Westslope Cutthroat Trout in the upper Mainstem of Stone Creek 1986 - 1998.

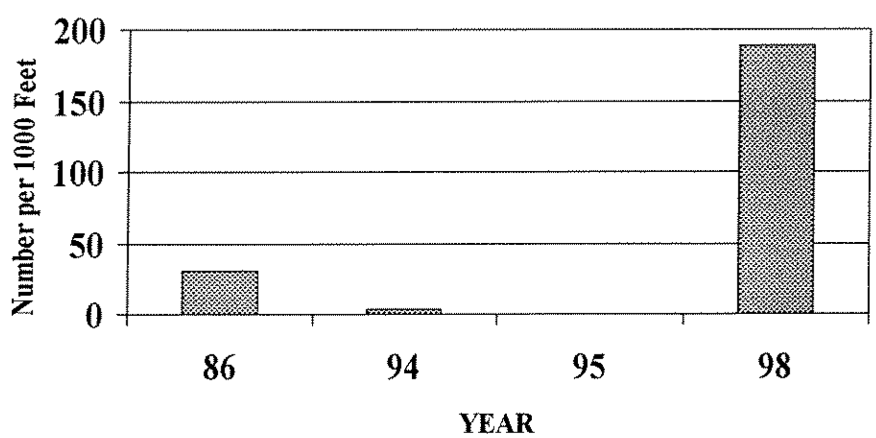

Figure 79. Estimated Density of Age I and older Westslope Cutthroat Trout in the Middle Fork of Stone Creek 1986 - 1998.

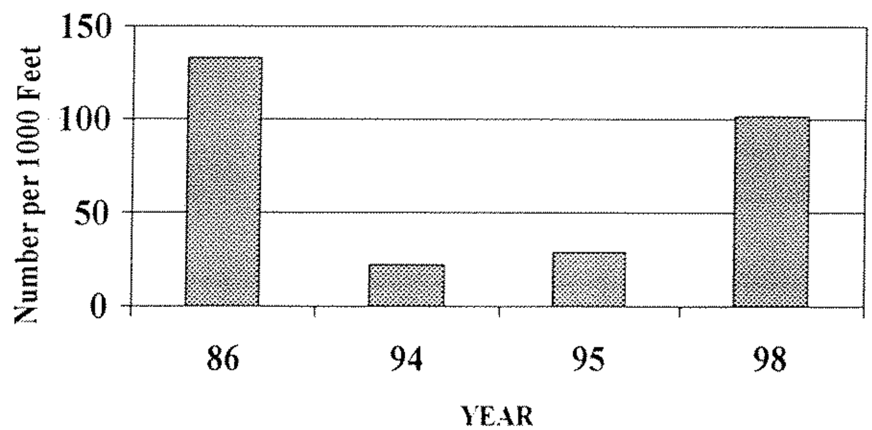


Figure 80. Length frequency distribution of westslope cutthroat trout collected in May 1986 in the Middle Fork of Stone Creek.

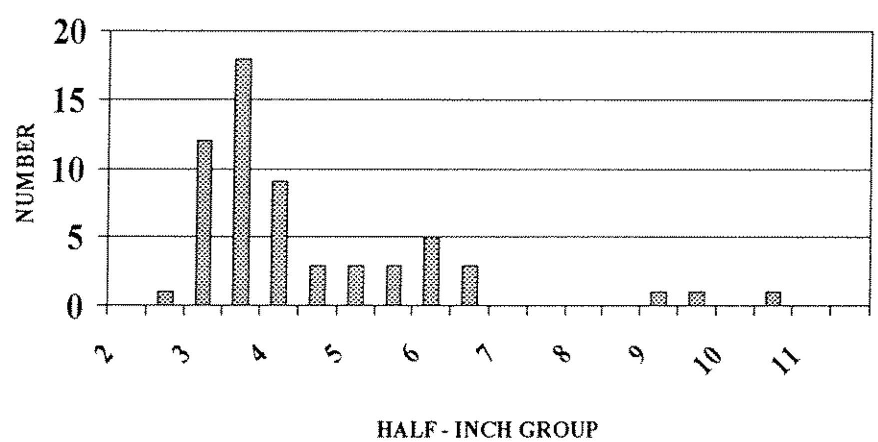

Figure 81. Length frequency distribution of westslope cutthroat trout collected in September 1998 in the Middle Fork of Stone Creek.

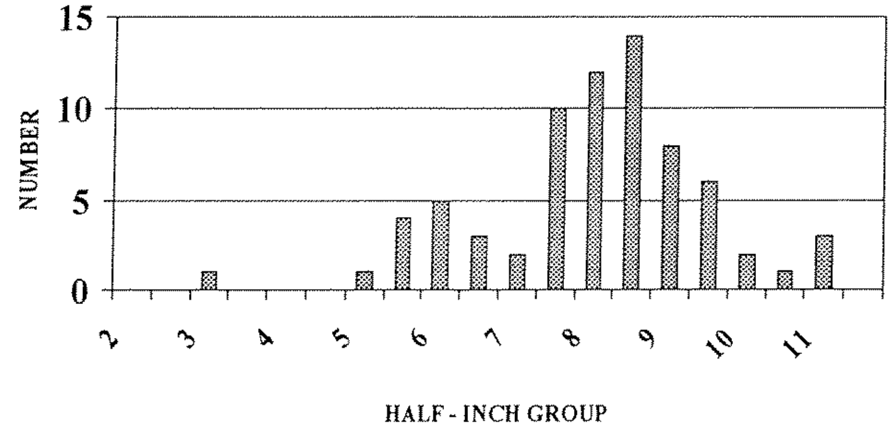


Figure 82. Expansion of WCT down Stone Creek Mainstem depicting 1999 collection density per 1000 feet of stream.