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MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana

Title: Southwest Montana Fisheries Study

Project No.: F-9-R-34

Title: Inventory and Survey of the Waters of the Big Hole, Beaverhead and Ruby River Drainages

Job No.: I-b

Project Period: July 1, 1985 through June 30, 1986

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ABSTRACT

Water year 1984 was marked by higher than average flows in the Big Hole River and represented the third consecutive year of high flow regimes. Populations of wild brown and rainbow trout responded to ample summer flow regimes by attaining high densities. Data indicate a link between the amplitude of summer flow and survival of Age IV and older brown and rainbow trout and recruitment of Age I rainbow trout into the population.

Populations of large (18 inch +) brown trout have increased dramatically in the Maiden Rock section of the Big Hole River in response to the implementation of a slot limit in 1981. Despite protection afforded to 13 to 22 inch trout, numbers of 16 inch and larger brown trout have increased while fish less than 16 inches have decreased in number. Populations of rainbow trout under special regulation have shown no discernible difference in percentage rate of increase of protected fish from populations outside of the regulated area. Analysis of the effect of special regulations on rainbow trout may be obscured at present by rapid expansion of rainbow trout populations and extreme differences in rainbow trout density between the study sections.

Populations of arctic grayling in the upper Big Hole River could not be estimated due to out-migration of fish from study areas to over winter habitat. Fall sampling will have to be rescheduled to avoid migration in the future.

Continued return of tags from brown trout confirm that brown trout from the Jefferson River migrate into the Ruby River to spawn. Sampling of brown trout in the Ruby River tailwater indicate populations similar to those sampled in downstream reaches.

Sample data are presented for numerous other waters within the project area.

BACKGROUND

The Big Hole River is one of Montana's premier trout streams and sustains heavy angling pressure from resident and non-resident fishermen. Fishing pressure on the Big Hole River during the 1983-84 season was estimated at 61,880 angler-days and second only to the Madison River among southwest Montana streams in terms of non-resident use.

Irrigation demands, in association with hay and cattle ranches, represent another use of Big Hole River water. Irrigation withdrawals generally peak in late summer when normal streamflows approach the annual minimum and water temperatures approach maximum levels. Low summer flows have been shown to have adverse effects on Big Hole River trout populations (Wells and Decker-Hess 1980 and 1981, Oswald 1984).

Special regulations designed to increase numbers of large trout were implemented in 1981 on a reach of the Big Hole River between Divide and Melrose. The "slot limit" regulations allow fishermen to harvest three trout under 13 inches and one trout over 22 inches in length. All trout between 13 and 22 inches must be released; anglers have also been restricted to the use of artificial lures and flies to reduce hooking mortality of released fish.

The upper reaches of the Big Hole River support the last native fluvial arctic grayling population of significance in the contiguous United States. The grayling is a species of special concern in Montana (Deacon et al. 1978) and represents a unique angling opportunity in the Big Hole. Fisherman harvest of grayling was restricted from five per day to one per day in 1982. In 1983, the limit was further restricted to one per day in excess of 13 inches based on information on grayling densities and population age structure.

The lower Ruby River has been identified as an important spawning stream for migratory Jefferson River brown trout. The Ruby River also supports a good fishery for resident brown trout and provided 9,293 angler-days of recreation downstream from Ruby Reservoir in 1982-83.

In addition to its major river fisheries, the project area supports numerous other trout fisheries of significance. Poindexter Slough, a tributary of the Beaverhead River, is a spring creek brown and rainbow trout fishery of national renown which supported an estimated 2153 days of fishing pressure in 1982-83. Ruby and Clark Canyon Reservoirs provide lentic fisheries for brown and rainbow trout. Clark Canyon Reservoir is known for exceptional trout growth, especially in hatchery stocked rainbow trout. The Centennial Valley, at the headwaters of the Missouri River, contains numerous lakes and ponds, some of which produce trophy sized trout. Culver Pond, MacDonald Pond and Elk Lake provide a mixed angling opportunity for brook, rainbow, cutthroat and lake trout and arctic grayling. The Beaverhead National Forest boundaries contain a total of 254 mountain lakes, many of which support fisheries. Most of these lakes are managed through the stocking of cutthroat trout while some are capable of supporting natural reproduction and wild populations of cutthroat or rainbow trout.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. To determine spring and fall trout population estimates in two sections of the Big Hole River. Data are presented for 1984. Data for 1985 have been collected but will be presented in a subsequent report due to a reorganization of the data processing system.

2. To assess the effect of special angling regulations on the trout population of one section of the Big Hole River. Data are presented for 1984. Data for 1985 will be presented in a subsequent report for reasons stated above.

3. To monitor daily discharge and water temperature at one location on the Big Hole River. Data are presented.

4. To monitor fisheries throughout the drainages. As part of this objective, the following specific tasks were completed:

   a. To determine fall arctic grayling populations in the upper Big Hole River. Data are presented.

   b. To determine fall spawning migrations of Jefferson River brown trout in the lower Ruby River. Final data are presented.

   c. To determine spring trout populations in two sections on Poindexter Slough. Data are presented.

   d. To assess lentic trout populations in Clark Canyon and Ruby Reservoir, Elk Lake, and Culver and MacDonald Ponds. Data are presented.

   e. To assess mountain lake trout populations in eleven lakes on the Beaverhead Forest. Data are presented.

5. To mitigate or enhance habitat alterations due to agricultural, residential, mining and industrial development. Data are presented.

PROCEDURES

Discharge and water temperature data were collected at a USGS gage site on the Big Hole River near Melrose. Data were computer analyzed and adjusted by the USGS.

Fish populations were censused through the use of boat-mounted mobile anode electrofishing equipment. Fish were aged by the scale method. Population and standing crop estimates were made using methods described by Vincent (1971, 1974 and 1985) and adapted for computer analysis (Holton et al. 1981).

Lentic fish populations were sampled by using overnight sets of 125' x 5' monofilament gill nets. Each experimental gill net consisted of five 25 foot panels measuring 0.75 in., 1.0 in., 1.25 in., 1.50 in. and 2.0 in. bar mesh. Floating gill net sets were employed in lower elevation waters while sinking sets were used in mountain lakes. Mountain lakes were sampled from a helicopter fitted with inflatable pontoons.

FINDINGS

Big Hole River

Discharge

Summer flows were markedly above average in water year 1984. The 1984 season represented the third successive year of exceptionally high summer flows in the Big Hole River. Analysis of mean August-September flows (Oswald 1984) in water years 1982, 1983 and 1984 rank these years as the eighth, fifth and seventh highest flow regimes recorded for the twenty-two year period of record 1964-1985. Respective August-September flows for water years 1982, 1983 and 1984 averaged 9%, 32% and 18% higher than the mean for the 1964-1985 period. The mean August flow of 724 cfs exceeded the 600 cfs identified as the instream flow required to maintain high levels of aquatic habitat potential, while a mean September flow of 510 cfs was markedly above the 300 cfs identified to maintain low levels of aquatic habitat potential (MDFWP 1979) in 1984. August-September flow regimes for the Big Hole River near Melrose are depicted in Figure 2. Summer flows in 1984 generally followed patterns similar to the prior high flow years of 1982 and 1983 (Oswald 1984). Minimum summer flows of 333 cfs in 1982, 465 cfs in 1983 and 416 cfs in 1984 represent a favorable trend for recruitment and survival of Big Hole River trout.

The 1985 water year represented a sharp contrast to the 1982-1984 period. Mean August-September flows of 392 cfs averaged 25% below the period average 1964-1985. August flow in 1985 averaged 322 cfs, barely exceeding the minimum flow criterion of 300 cfs, and averaged less than 300 cfs, to a minimum of 204 cfs, on twelve days during the month. September flows in 1985 exhibited a marked increase over those observed in August and averaged 465 cfs. Flows during the first week of September, however, still remained below 300 cfs, to an observed minimum of 204 cfs. Summer flow regimes in 1985 deviated sharply from normal patterns in the Big Hole River (Figure 2). While the annual minimum was reached in late August-early September conforming to normal patterns, this period was bracketed by discharge peaks in early August and September which resulted from prolonged periods of heavy precipitation. July is not considered to be a critical low flow month on the Big Hole River with average flows generally exceeding 1000 cfs and minimum flows rarely dropping below 300 cfs (Table 1). In 1985, however, stream flow during July ranged between 452 and 221 cfs and averaged 322 cfs. Mean July streamflow in 1985 was 81% lower than the average for 1964-1985 and represented the lowest average flow during the twenty-two year period of record.

Flows in the Big Hole River during the critical month of August have been linked to the abundance of Age IV and older brown trout in the fall. A significant relationship ($P \leq .05$) between minimum August flow and estimated numbers of Age IV and older brown trout has been demonstrated through linear regression analysis (Wells and Decker-Hess 1980 and 1981). Expansion of this relationship (Oswald 1984) indicated a continuation of the trend under which low August flows in 1981 were followed by low numbers of Age IV+ brown trout, while higher flows in 1982 and 1983 resulted in a greater fall abundance of the Age IV+ fish. High August flows in 1984 (minimum 470 cfs) again resulted in high numbers of Age IV+ brown trout in the Melrose section (Table 2). The 1984 estimate of 871 Age IV+ brown trout was the highest in the sampling history of the Melrose section and may be more reflective of three consecutive high flow years rather than the direct product of the 1984 flow regime.

Because fall brown trout estimates can be subject to error introduced through spawning movements (Vincent 1985), it may be more advantageous to assess the effect of summer flows on the more stable fall rainbow trout populations. This has not been done in the past due to expanding wild rainbow trout populations (McMullin 1982) and a lack of sufficient data. Fall rainbow trout data from the Melrose and Maiden Rock sections (Table 9) suggest a link between critical summer flows and fall rainbow trout numbers. In the Melrose section, numbers of Age IV and older rainbow trout were low following low flow summers in 1979 and 1981. Numbers of these older fish were high in 1980 following a near average summer flow and maintained high and expanding densities through the 1982-1984 high flow years. A similar trend was evidenced in the Maiden Rock section. The data further suggest a link between low summer flows and survival of young of the year trout. Years following the low flow summers of 1979 and 1981 in the Melrose section and 1981 in the Maiden Rock section resulted in low estimated densities of Age I rainbow trout, while years following high summer flows in 1978, 1980 and 1982-83 exhibited high densities of these young fish.

Water Temperature

Summer water temperatures at the Melrose gage site are presented in Figure 3 for 1984. No temperature data were recorded in 1985 due to a loss of funding sources. Seasonal temperature variation in 1984 followed normal patterns with the attainment of summer maxima in early August followed by a cooling trend from mid-August through September. The summer maximum recorded temperature of 69.8°F occurred on August 9, 1984, resulting in the third consecutive summer in which temperatures rarely exceeded 70°F. The overall thermal regime during the summer of 1984 was excellent for trout growth and survival.

While collection of temperature data did not occur at the USGS gage in 1985, a limited amount of data was collected near Wisdom in July and August. Thermograph data showed that temperatures reached or exceeded 70°F, to a maximum of 72°F, between July 9 and August 6, 1984. Night temperatures over the same period ranged between 55 and 59°F. Cooling trends after August 6, 1984 resulted in maximum temperatures which never exceeded 65°F despite continued low streamflow. USGS gage site temperature data collected near Wise River (1979-1983) suggest that temperatures commonly exceed 70°F in the upper Big Hole River in late July and early August.

Fish Populations

Melrose Section

This study section was established in 1969 (Elser and Marcoux 1972) and its trout population described by numerous investigators, most recently Wells and Decker-Hess (1981), McMullin (1982) and Oswald (1984). Population and standing crop estimates of brown and rainbow trout in the section are presented in Table 2 for spring and fall 1984.

Spring numbers of Age II and older brown trout exhibited an increase of 23% over numbers observed in 1983 (Oswald 1984). This increase appears to represent an upward trend in brown trout abundance since 1981 (Table 5). The increased brown trout density was entirely accounted for by Age II and III fish while Age IV and older brown trout underwent a 16% decline. The standing crop of Age II and older brown trout in 1984 increased by 15% over the estimated standing crop for 1983.

Fall numbers of Age I and older rainbow trout in 1984 exhibited a 23% increase in abundance over 1983 levels. While the 1984 rainbow trout density attained the highest observed level in the sampling history of the Melrose section, the population growth was not linear, as was the case in brown trout, over the 1981-1984 period (Table 5). The increased rainbow trout density in 1984 was accounted for by increases in Age I, II and IV+ fish while Age III fish underwent a 16% decline from 1983. The standing crop of rainbow trout in 1984 was the highest observed in the sampling history of the Melrose section and increased 33% over 1983.

Spring brown trout and fall rainbow trout estimates are emphasized to describe stable population data and minimize error associated with spawning movements of mature fish (Vincent 1985).

Maiden Rock Section

The Maiden Rock section was established in March 1981 and its trout populations were described by McMullin (1982) and Oswald (1984). The study section was initiated to monitor the effect of special "slot limit" fishing regulations which were instituted in 1981 to increase numbers of large (13-22 inch) trout. The special regulations requires the release of all trout between 13 and 22 inches in length and restricts angler method to the use of artificial flies and lures. Population and standing crop estimates of brown and rainbow trout are presented in Table 3 for spring and fall 1984.

Spring numbers of Age II and older brown trout underwent a 10% decline from 1983 levels. This decline in the overall population has been consistent, on an annual basis, since institution of the special regulations in 1981 (Table 5). The numerical decline between 1983 and 1984 occurred in Age II (-13%) and Age III (-22%) fish while Age IV+ brown trout increased (6%) in number. The standing crop of brown trout in 1984 represented a decline from the 1983 level and, like brown trout density, has undergone an annual decline since 1982 following an increase in standing crop between 1981 and 1982 (Oswald 1984).

The effects of special regulations on brown trout are demonstrated in Table 4 through a comparison of numbers of 13 inch and larger and 18 inch and larger brown trout per mile in the Maiden Rock and Melrose sections. Thirteen inch and larger brown trout numbers increased rapidly after one year of regulation but have since declined in 1983 and 1984 for a net increase of 18% over pre-regulation numbers in the Maiden Rock section. Over the same period, 13 inch and larger brown trout have undergone a net increase of 42% in the Melrose section without special regulations. A different pattern, however, is evident for eighteen inch and larger brown trout. In the Maiden Rock section, the eighteen inch and larger fish have undergone a steady annual increase from 40 to 145 per mile for a net gain of 263%. The large brown trout (18 in. +) in the Melrose section have fluctuated in number and have increased from 28 per mile to 37 per mile over the 1981 to 1984 period. The data suggest that the special regulations have had little comparative effect on numbers of brown trout greater than 13 inches but have been extremely effective in increasing numbers of 18 inch and larger brown trout.

A close inspection of the effect of the special regulations on numbers of brown trout in excess of 13 inches is provided in Table 6. Analysis of numbers of fish per mile, by inch group, reveals that the special regulations has been effective in increasing numbers of 16 inch and larger brown trout, while numbers of 13 to 15 inch fish have actually declined in the Maiden Rock section. In the Melrose section increases have occurred through all length groups of brown trout between 13 and 18 inches; however, 19 inch and 20 inch + brown trout have declined. While most inch groups of brown trout in the Melrose section have shown a numerical increase over the 1981-84 period, these increases have not been of a magnitude similar to the Maiden Rock section. For example, 18 inch brown trout in the Melrose section increased from 14 to 30 per mile, while fish of the same size increased from 16 to 89 per mile in the Maiden Rock section between 1981 and 1984. Moreover, numbers of 13 through 18 inch brown trout in the Melrose section increased an average 39% over the period, while the overall estimated population increased 40%. The data suggest that numbers of larger brown trout (13 in. +) in the Melrose section have increased as a result of increased brown trout density, while numbers of 16 inch and larger brown trout in the Maiden Rock section have increased in response to special regulations, independent of overall brown trout density.

Oswald (1984) demonstrated that one effect of the special regulations on the brown trout population was a shift in biomass distribution under which 18 inch and larger brown trout accounted for an increasing percentage of the brown trout standing crop. Data collected in 1984 (Table 7) indicate that this trend has continued. Under special regulations in the Maiden Rock section, 18 inch + brown trout accounted for 31.6% of the standing crop in 1984. This represents the third annual increase from 1981 when 18 inch + brown trout accounted for 11.3% of the standing crop prior to special regulations. In the Melrose section, the 18 inch + brown trout have accounted for 8.8% to 10.1% of the standing crop of brown trout over the 1981-1984 period.

Fall numbers of Age I and older rainbow trout (Table 3) underwent a slight (7%) decline from 1983 levels of abundance. This decline was mainly accounted for by Age III fish and is reflective of poor recruitment from the low flow year of 1981. While numbers declined between 1983 and 1984, rainbow trout density remained extremely high; reflective of a strong trend of increasing abundance over the 1981-1984 period (Table 5). The 1984 standing crop of rainbow trout in the Maiden Rock section also declined (13%) from the 1983 sample.

The effects of special regulations on rainbow trout are shown in Table 4 through a comparison between the Maiden Rock and Melrose sections. Thirteen inch and larger rainbow trout in the Maiden Rock section have declined in numbers in 1983 and 1984 following a rapid increase between 1981 and 1982. This is the same pattern exhibited by 13 inch + brown trout in the section. Numbers of 13 inch + rainbow trout in the Melrose section have exhibited a general trend of increased density over the period. Numbers of 15 inch and larger rainbow trout have generally increased in both sections over the 1981-1984 period as has overall rainbow trout density (Table 5). Net percentage increases for 13 inch plus (61%) and 15 inch plus (87%) rainbow trout in the Maiden Rock section between 1981 and 1984 can be compared with increases of 53% (13 inch +) and 102% (15 inch +) in the Melrose section. While the data, at this point of study, show little discernible effect of special regulations on the rate of increase of larger rainbow trout, total rainbow trout density has increased by 421 fish per mile in the Maiden Rock section compared with an increase of 65 fish per mile in the Melrose section over the special regulation period. Furthermore, analysis of net rates of increase (percent gain) of 13 inch + and 15 inch + rainbow trout for the Melrose section may not be directly comparable with results from the Maiden Rock section because of relatively low per mile densities of these larger fish in the Melrose section.

Further analysis of thirteen inch and larger rainbow trout is provided for both sections in Table 8 by inch group. In contrast to the situation with brown trout, this data does not provide a distinct difference between the sections in terms of rate of increase. Fifteen and 16 inch + rainbow trout numbers have increased at similar rates in both sections over the period. While the data suggest that numbers of 13 and 14 inch rainbow trout have been afforded a more favorable rate of increase in the Maiden Rock section, numbers of these fish declined in 1983 and 1984 from maximum observed levels of abundance in 1982. Again, analysis of rates of increase between the two sections may be clouded by distinct differences in per mile density which indicate that densities across all analyzed inch groups (Table 8) in the Maiden Rock section are approximately double those observed in the Melrose section.

Data presented in Table 9 provide for analysis of rainbow trout population dynamics in the Maiden Rock and Melrose sections on a comparable (number per mile) basis. As previously discussed, the data suggest that low flow years (1979 and 1981) could limit rainbow trout density through adverse effects on survival of Age IV+ fish and recruitment of young fish into the population. The data further demonstrate that rainbow trout populations in the Melrose section have maintained a fluctuating growth trend (11% increase) over the 1981-1984 period while populations in the Maiden Rock section have demonstrated exceptional growth (56% increase). Finally, the data demonstrate a marked increase in rainbow trout density in the Maiden Rock section when compared with the Melrose section. Rainbow trout densities in the Maiden Rock section were approximately two to three times higher than densities observed in the Melrose section over the 1981-1984 period. This might be indicative of the existence of better rainbow trout habitat in the Maiden Rock section as well as protection afforded through special regulation.

Wisdom Section

The Wisdom section was established in the fall of 1983 to gather information on the status of arctic grayling populations in the upper Big Hole River. The section and its arctic grayling and trout populations were described by Oswald (1984). Because the primary purpose of the study is to investigate grayling population dynamics, sampling is conducted in fall to avoid error interjected by spawning movements.

Estimated numbers and standing crop of arctic grayling in the Wisdom section are presented in Table 10 for 1984. While the 1984 data suggest a significant decline from a density of Age II and older grayling of 683 estimated in 1983, the 1984 estimate is not believed to be reliable due to out-migration of grayling from the section. During 1984 sampling, a total of 121 4.3 to 14.4 inch grayling were marked in three passes through the Wisdom section. During the recapture, which also consisted of three passes through the section, only 57 grayling were captured, 14 of which were recaptures from the marking trips. The period between mark and recapture trips was marked by the onset of severe cold and winter conditions in the upper Big Hole Valley. These climatic conditions had not occurred in 1983 when a more reliable estimate was calculated through a more balanced sample. As was the case in 1983, only 13 Age 0 and Age I grayling were collected in the Wisdom section in 1984. Brook trout density, subject to spawning movements, was estimated at 261 per mile and rainbow trout were estimated to be present at a density of 10 per mile in 1984.

The Wisdom section was re-sampled in fall 1985. Again, a reliable estimate was prevented due to an even more dramatic out-migration of grayling from the section than was observed in 1984. Due to a channel alteration, only one of the two major river channels composing the section could be electrofished in 1985. Despite this restriction, a total of 71 7.6-13.7 inch grayling were captured during two passes through the section. During the recapture sampling, only 12 grayling were captured, three of which were recaptured marked fish. Again, the period between mark and recapture trips was marked by the onset of severe winter climatic conditions. In a manner similar to 1983 and 1984, only 11 Age I grayling were captured in 1985.

Ruby River

Alder Section

Sampling was discontinued in the Sailor section of the Ruby River after 1982 with adequate descriptions of the relatively stable brown trout populations through the 1979-1982 period (Oswald 1984). In the spring of 1984, the Alder section (7920 ft.) was established to compare the current status of the fishery in the tailwater of Ruby Reservoir with past data from 1983 and with the current status of the downstream (Sailor section) fishery. The Alder section originates at the county bridge south of Alder and ends at a private bridge at the site of the old Madison County Farm. The present Alder section contains segments of the old Brown, Miller and Hacker series of study sections (Peterson 1974) used to compare habitat alterations in 1973.

Estimated populations and standing crops of Age II and older brown trout are presented in Table 11 for the Alder section, 1984. The Alder section supported relatively dense populations of brown trout (1147 per mile) in 1984. Most of these fish were Age III and ranged between ten and fourteen inches in length. Mean length at age was comparable to that observed in the Sailor section (Oswald 1984). Brown trout density in the Alder section in 1984 compared favorably with the 1973 estimate in the Miller section (Table 12), indicating that the fishery has not declined over the period. Peterson (1974) compared brown trout in bulldozer altered (Brown), rock rip-rap altered (Hacker) and unaltered (Miller) sections of the Ruby River (Table 12). The present Alder section is located within the 1973 section series and compares closely with the unaltered channel habitat of the Miller section. Size distribution of brown trout in the Alder section showed densities of 13 inch and larger brown trout at 435 per mile and 15 inch and larger brown at 38 per mile. Comparative data from the Sailor section (1979-1982) showed that downstream reaches of the Ruby River supported 179 to 225 13 inch + brown trout per mile and 28-68 15 inch + brown trout per mile.

Documentation of the importance of the lower Ruby River as a spawning stream for migratory Jefferson River brown trout has been accomplished through tag return information (McMullin 1982, Oswald 1984). This practice was continued in 1985 and the recent data are presented in Table 13. While relatively low numbers of fish were tagged in 1985, a high rate of tag returns was observed. To date, 30 out of 37 tag returns came from the Jefferson River. Of the seven tag returns which were not from the Jefferson River, one came from the Ruby River and four were returned from the Beaverhead River between the mouth of the Ruby and the origin of the Jefferson.

Poindexter Slough

Poindexter Slough is a spring-fed meadow tributary which enters the Beaverhead River south of Dillon, Montana. While Poindexter Slough is extremely popular with resident and non-resident anglers as a spring creek fishery, it receives some of its flow via diversion from the Beaverhead River. The trout populations of Section Three were first described by Peterson (1975). Intensive sampling in Section Three was resumed in 1981 and continued in the spring season through the present. A second section, the Gary section, was instituted in 1982 and sampled in spring from 1982 through 1984. The Gary section is located on private land and is subject to very light fishing pressure, while Section Three is on public land and is heavily fished. The brown trout populations of the Gary section and Section Three, over the 1981-1984 period, are presented in Table 14.

The 1981 and 1984 samples indicate that Poindexter Slough supports extremely high densities (in excess of 670 per 1,000 ft.) of brown trout. Peterson (1975) presented data indicating a brown trout density (Age I+) of 554 per 1,000 ft. for the 1974 sample. While brown trout densities in 1981 and 1984 were high, the 1981-1983 period was marked by a severe (52%) decline in numbers. This decline was almost wholly accounted for among Age I fish and was indicative of poor recruitment from the 1980 and 1981 spawning seasons. The brown trout sample of 1984 represented a reversal of the declining trend in the form of excellent recruitment from the 1982 spawning season evidenced by an abundance of Age I fish. The same trends in brown trout numbers that occurred in Section Three were apparent in the Gary section.

While fall estimates on stable rainbow trout populations are not conducted on Poindexter Slough, trend information from spring rainbow trout populations is available (Table 15). Rainbow trout numbers have declined 88% from 1981 to 1984 in Section Three and have undergone a 76% decline from 1982-1984 in the Gary section. This decline has occurred almost entirely as a result of very poor recruitment into Age I and Age II ranks over the period.

Fluctuations in brown trout reproductive success and a severe decline in rainbow trout recruitment over the 1981-1984 period in Poindexter Slough are not understood at the present. Continued monitoring should provide more information on factors influencing brown and rainbow trout population dynamics in the system.

Clark Canyon Reservoir

Clark Canyon Reservoir supports populations of wild brown trout and receives an annual stocking of hatchery rainbow trout. Prior to 1983, the reservoir was stocked with Arlee strain rainbow trout. The Arlee rainbow trout were characterized by rapid growth in Clark Canyon Reservoir with Age I fish averaging 14.9 inches and 1.57 lbs. in May following May plants in the prior year. Wells (1980) discussed increased survival of planted Arlee rainbow trout as a result of a modified stocking program in Clark Canyon Reservoir. Beginning in 1982, Clark Canyon Reservoir received fall plants of Age 0 DeSmet strain rainbow trout in addition to continued spring plants of Arlee strain fish. Brown and rainbow trout trend data from overnight sets of experimental gill nets (5 to 15 sets per year) are presented in Table 16 for Clark Canyon Reservoir, 1979-1985.

Brown trout numbers appear to be relatively stable in Clark Canyon Reservoir after undergoing somewhat of a decline from pre-1981 levels (Wells 1980). Brown trout number per net set averaged 2.9 per net over the 1965-1980 period versus 2.0 per net over the 1981-1985 period. This decline in brown trout capture coincided with an increase in the numbers of rainbow trout captured per net. DeSmet strain rainbow trout were introduced into Clark Canyon Reservoir in the fall of 1982. Permanent fin clips on 10% of the DeSmet rainbow stocked in September 1984 resulted in the identification of ten DeSmet yearlings in the 1985 sample. No identifiable survivors of the 1982 or 1983 DeSmet plants have been collected in subsequent samples. The fall planted DeSmet rainbow collected in 1985 averaged 10.9 inches in length while spring planted Arlee rainbow, which composed 86% of the Age I rainbow trout collected, averaged 14.4 inches in length. While Age I DeSmet rainbow composed only 14% of the 1985 sample of Age I rainbow trout, the 1984 DeSmet plant represented 63% of the rainbow trout stocked in the reservoir. The data suggest a low survival rate among fall planted DeSmet rainbow when compared with survival rates of spring planted Arlee strain fish. Establishment of a wild population of DeSmet rainbow trout in Clark Canyon Reservoir may require spring stocking of yearling fish.

Ruby River Reservoir

Ruby Reservoir supports populations of wild brown trout and received annual plants of hatchery rainbow trout through 1980. In 1980, the planting of hatchery rainbow trout was abandoned in favor of the stocking of McBride strain Yellowstone cutthroat trout. This program continued through the 1980-1983 period. Through an error in communication, the last Arlee strain rainbow plant coincided with the first McBride strain cutthroat plant in 1980. Trend information from overnight sets of experimental gill nets in early May (5 sets per sample) are presented for brown, rainbow and cutthroat trout in Ruby Reservoir, 1979-1985, in Table 17. Trend information specific to rainbow trout populations in Ruby Reservoir are summarized in Table 18.

The data indicate that the introduction of cutthroat trout to Ruby Reservoir has met with very limited success while rainbow trout have responded to the cessation of stocking with the establishment of a growing wild population. While the last (1980) plant of Arlee rainbow trout moved through the system resulting in high numbers of Age IV+ fish in 1983 and 1984, a growing number of wild Age II rainbow trout have appeared in the sample each year. All stocking of hatchery trout in Ruby Reservoir will be discontinued until a full evaluation of the growth of the wild rainbow trout population can be accomplished.

Elk Lake

Elk Lake is located north of the Red Rock Lakes National Wildlife Refuge in the Centennial Valley. Elk Lake contains wild populations of arctic grayling and lake trout and has received annual hatchery stocking of cutthroat trout since 1965. Since 1977, the stocking of cutthroat trout has consisted of McBride strain Yellowstone cutthroat trout. Trend data, collected in overnight sets of experimental gill nets, are summarized for cutthroat and lake trout and arctic grayling in Elk Lake, 1979-1985, in Table 19. Grayling numbers, reflected in number per gill net set, appear to be relatively stable, averaging 9.3 per net set over the period. The Elk Lake grayling population is dependent on spawning period streamflow in Narrows Creek, a small tributary to Elk Lake (Lund 1974). The data suggest a decline in lake trout numbers over the period; however, this may be sampling error associated with the exclusive use of floating gill net sets. Cutthroat plants, prior to 1982, were marked by varying degrees of survival. In 1982 and 1983 Elk Lake was stocked with yearling McBride cutthroat and survival increased markedly. Lund (1974) noted that the cutthroat trout spawning runs into Narrows Creek were dominated for two successive seasons by a year class of fish that were planted as yearlings. No stocking of cutthroat trout occurred in Elk Lake after 1983. The rapid downturn in number per net in the 1985 sample indicates that fisherman harvest, along with natural mortality, may necessitate stocking of yearling cutthroat on a biennial basis.

MacDonald Pond

MacDonald Pond is located on the Red Rock Lakes National Wildlife Refuge and has been characterized by the presence of trophy sized wild rainbow trout (Wells 1980). Trend information, collected in overnight sets of experimental gill nets, is presented for rainbow trout in MacDonald Pond for 1971-1985 in Table 20. The trend data from MacDonald Pond indicate a steady decline in rainbow trout numbers over the years. The scarcity of Age I fish (only two individuals collected over the 5 sample seasons), coupled with an inspection of Elk Springs Creek after rainbow spawning, indicate that recruitment may be limiting the fishery. Trophy regulations, limiting fishermen to the harvest of one rainbow trout in excess of 20 inches and the use of artificial flies and lures, will be implemented in 1986.

Culver Pond

Culver Pond is also located in the Red Rock Lakes National Wildlife Refuge and has supported a trophy brook trout fishery of prominence (Wells 1980). The sampling history of Culver Pond, 1971-1986, is presented in Table 21. The data indicate that brook trout numbers in Culver Pond have increased markedly in the 1980's over numbers collected in the 1970's. Recruitment of brook trout has been excellent since 1979, but average length of the brook trout has declined without any significant loss in growth rate. This suggests that fisherman harvest of the larger fish is responsible for declining average length. Samples collected in October 1985 still revealed the presence of brook trout in excess of five pounds (USFWS 1985). Trophy regulations, limiting fisherman harvest to four fish less than 12 inches and one in excess of 18 inches and limiting angler method to the use of artificial flies and lures, will be implemented in 1986.

Mountain Lakes

A series of eleven alpine lakes were sampled in 1983 in the Pioneer Mountains within Beaverhead National Forest boundaries. Results of water chemistry and gill net sampling are compared with fish stocking information for these lakes in Appendix A.

DISCUSSION

Summer flows in the Big Hole River were well above average during the summer of 1984 and marked the third consecutive summer (1982-1984) of flow and temperature regimes conducive to excellent trout survival and recruitment. Both brown and rainbow trout populations in the Melrose section attained the highest observed densities in the sampling history of the section in 1984. Kozakiewicz (1979) and Wells and Decker-Hess (1981) emphasized the necessity of adequate summer flows in maintaining high-level trout populations in the Big Hole River.

While fall numbers of Age IV and older brown trout have been linked to minimum summer flows (Wells and Decker-Hess 1981, Oswald 1984), inspection of rainbow trout population data suggest a strong link with summer flow regimes. The data indicate that both recruitment of Age I rainbow trout and survival of Age IV and older rainbow trout are closely linked to the magnitude of summer flow. Rainbow trout density-flow relationships could be preferable to analysis of similar brown trout data because fall rainbow trout population estimates are relatively stable and not subject to estimate inflation from spawning movements.

Special angling regulations, designed to increase numbers of larger (13 to 18 inch) trout in the Big Hole River, have been in effect since 1981. While Kozakiewicz (1979) indicated that fisherman harvest was not a limiting factor for Age IV+ brown trout in the Big Hole River, Wells and Decker-Hess (1980) suggested that angler harvest may have been limiting the larger segment (18 inch +) of this age group. Selective fisherman harvest of larger fish was cited as the major factor in limiting numbers of large brown trout in central Wisconsin streams (Avery and Hunt 1981) and has been suggested as the primary factor in determining differences in numbers of large brown trout between two sections on the Beaverhead River in Montana (Oswald 1986). Since the inception of the "slot limit" on the Big Hole River, numbers of 18 inch + brown trout have increased 263% in the special regulations section while comparatively little increase was observed in the control section. An overall analysis of 13 inch + brown trout numbers, however, showed little difference between the sections. Closer analysis of size groups revealed that the slot limit has been effective in increasing numbers of 16 inch + brown trout, while fish under 16 inches have actually declined in number. Moreover, total brown trout numbers and standing crop of brown trout have declined significantly since the inception of the "slot limit." While brown trout standing crop has decreased, the standing crop of 18 inch + brown trout has increased and presently accounts for almost one-third of the brown trout biomass. Clark and Alexander (1984) observed a similar decline in total brown trout density and numbers of fish protected by the range of the slot limit (12 to 16 inches) in the Au Sable River, but did not observe a concomitant increase in numbers of large brown trout. Other factors, however, such as declining recruitment and increased angler harvest, prevent direct comparison with this study. Clearly, the special regulations have been effective in markedly increasing numbers of larger brown trout. Due to unmeasured factors, such as competition and predation, the increases in larger fish have resulted in a decline in the numbers of brown trout less than sixteen inches, suggesting that gains in large brown trout density have occurred at the expense of the smaller fish.

While the effect of the special regulation on brown trout is quite clear, less difference, in terms of percent increase of sizes of rainbow trout affected by the slot limit, is apparent between the two study sections. Rainbow trout populations in the Maiden Rock section exhibited much higher density and much more rapid expansion than populations in the Melrose section. This could be indicative of better rainbow trout habitat in the Maiden Rock section in conjunction with protection afforded by the special regulation. Moreover, rainbow trout recruitment has fluctuated with summer streamflow over the period, but has undergone expansion with favorable flow regimes since 1982. McMullin (1982) suggested that rapid expansion of wild rainbow trout populations could confound analysis of special regulations between the two study sections. High rainbow trout densities, coupled with rapidly expanding populations and possible differences in rainbow trout habitat, may delay or prevent the manifestation of the effect of the slot limit on rainbow trout between the existing study section. Earlier suggestions (Oswald 1984) that special regulation had increased numbers of 13 inch + and 15 inch + rainbow have since been modified due to a recalculation of estimates based on efficiency curve analysis (Vincent 1985).

The upper reaches of the Big Hole River support the last native fluvial grayling population of significance in the contiguous United States. Data collected in 1983 indicated that grayling were present in low densities (105 Age II and older per mile) and restricted to pool habitats marked by laminar flows (Oswald 1984). This habitat conforms closely to fluvial grayling habitat descriptions presented by Hulbert et al. (1985).

Sample seasons in 1983, 1984 and 1985 were marked by the collection of low numbers of Age 0 and Age I grayling. Both grayling fry and juveniles have been known to occupy tributary streams as summer habitat and return to the mainstem river for winter habitat (Craig and Poulin 1975). Juvenile grayling generally ascend tributary streams after adults have completed spawning. In the upper Big Hole drainage, Liknes (1981) made collections of grayling fry in seven tributary streams.

Reliable grayling estimates were confounded in both 1984 and 1985 due to out-migration of grayling from the study section between mark and recapture sampling. It is believed that these out-migrations were triggered by the onset of severe cold and winter-like conditions that did not occur in 1983. Migration of fluvial grayling to winter habitats has been documented by numerous authors (Yoshihara 1972, Kratt and Smith 1977, Tuck 1980) and generally occurs in a downstream direction when water temperatures approach 32°F (Yoshihara 1972). Hulbert et al. (1985) define over winter habitat as a critical component for fluvial grayling and define this habitat as deep pools (1.2 meter minimum) that do not freeze to the bottom and provide current velocities less than .15 m/s and dissolved oxygen saturations greater than 1.0 mg/1.

Prolonged drought conditions during the summer of 1985 resulted in low flows in the Big Hole River. Temperature elevations concomitant with low flow conditions produced water temperatures which attained or exceeded 70°F on twelve days during the month of July. Despite the elevated temperatures, numbers of grayling marked in 1985 compared favorably with the 1983 and 1984 sample, which suggested that no major loss of adult or sub-adult grayling had occurred. Existing data indicate that various stages in the life cycle of fluvial grayling are capable of withstanding temperatures in excess of 70°F (La Perrier and Carlson 1973).

To date, studies of the fluvial grayling of the Big Hole River have indicated a population of low density which is restricted to a specific habitat type in summer. This population coexists with introduced brook and rainbow trout as well as native mountain whitefish burbot and several species of sucker. The habitat of Age 0 and Age I fish apparently differs from that of the adults and may include tributary streams. Specific spawning areas in the tributaries and mainstem are unknown at present. The onset of winter triggers an out-migration of grayling from the upper Big Hole River near Wisdom; however, the location and description of the over winter habitats are unknown at present. It is obvious that much more information is needed to understand the life history of the fluvial grayling in the Big Hole River. Further study of the Big Hole River grayling should include a rescheduling of fall sampling to avoid winter migration, tagging of all captured grayling and radio-telemetry study to follow movements and define habitats.

Good stream bank and channel management are essential to the maintenance of stream trout fisheries. An ongoing effort to enforce stream protection laws, through the inspection of proposed projects, has been continued in the Big Hole, Beaverhead and Ruby River drainages. Through the report period, a total of 30 projects in Beaverhead County and 33 projects in Madison County were inspected under the Natural Streambed and Land Preservation Act of 1975. An additional 26 projects were inspected under the Stream Protection Act of 1963.

RECOMMENDATIONS

This project should be continued. Evaluation of the response of wild brown and rainbow trout populations to critical summer flows in the Big Hole River should continue. Effects of special regulations should continue to be monitored as numbers of larger trout increase and changes in population dynamics occur. The status of the native fluvial grayling population of the upper Big Hole River should continue to be monitored as a species of special concern. Fisheries of significance throughout the study area should be monitored to assess the effects of management direction, fishing pressure and habitat changes.

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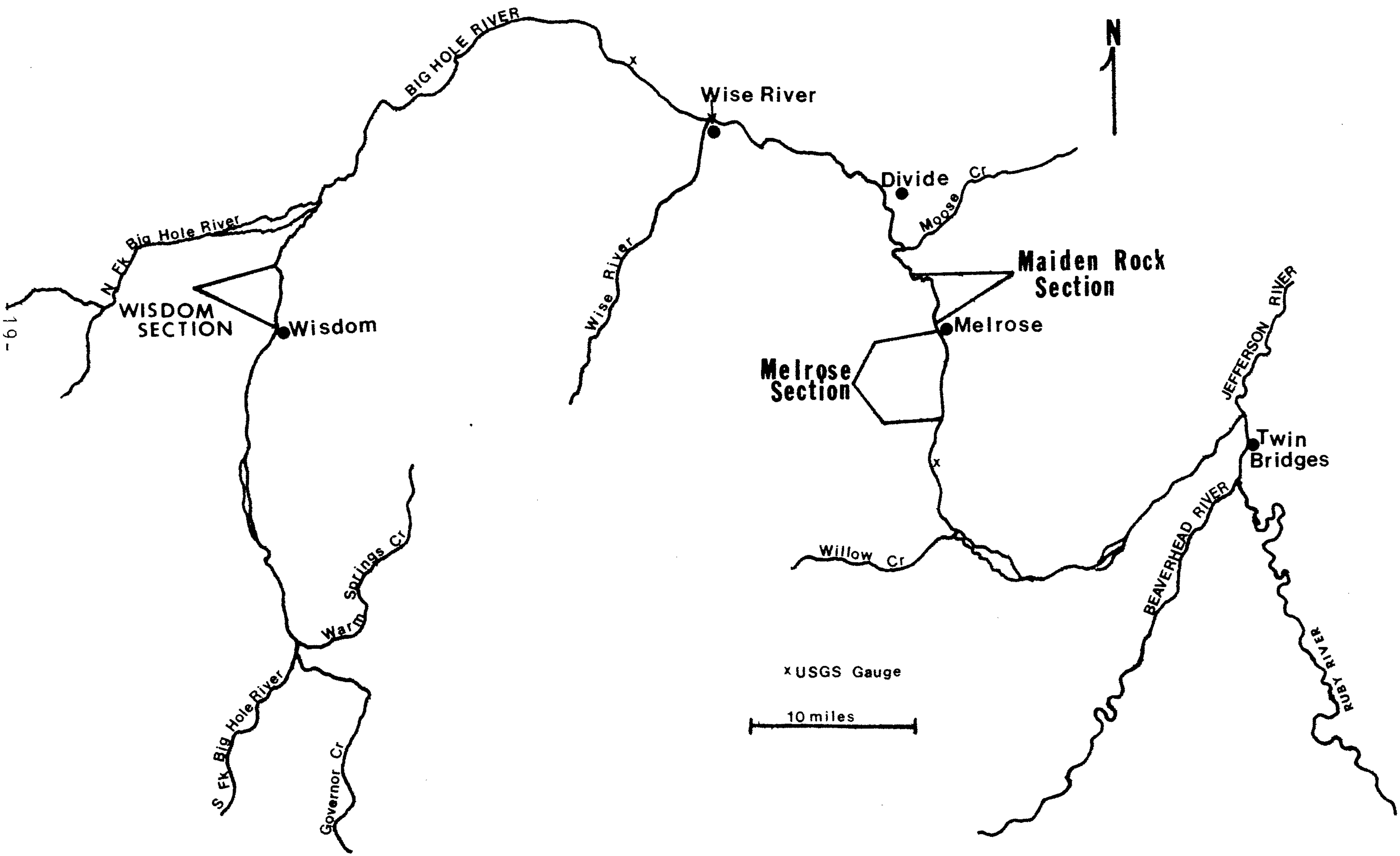
Date: August 5, 1986

Waters Referred To:	Big Hole River, Section 01	3 02 0425 01
	Big Hole River, Section 03	3 02 0475 01
	Ruby River, Section 01	3 01 6360 01
	Poindexter Slough	301 5890 01
	Clark Canyon Reservoir	3 01 8610
	Ruby River Reservoir	3 01 9440
	Elk Lake	3 01 8780
	Culver Pond	3 01 8680
	McDonalds Pool	3 01 9100

Key Words: Flow Regime; Trout Population Dynamics; Trout Standing Crop; Special Regulations; Grayling Populations; Migration; Lake Fisheries

Figure 1. The Big Hole River drainage.



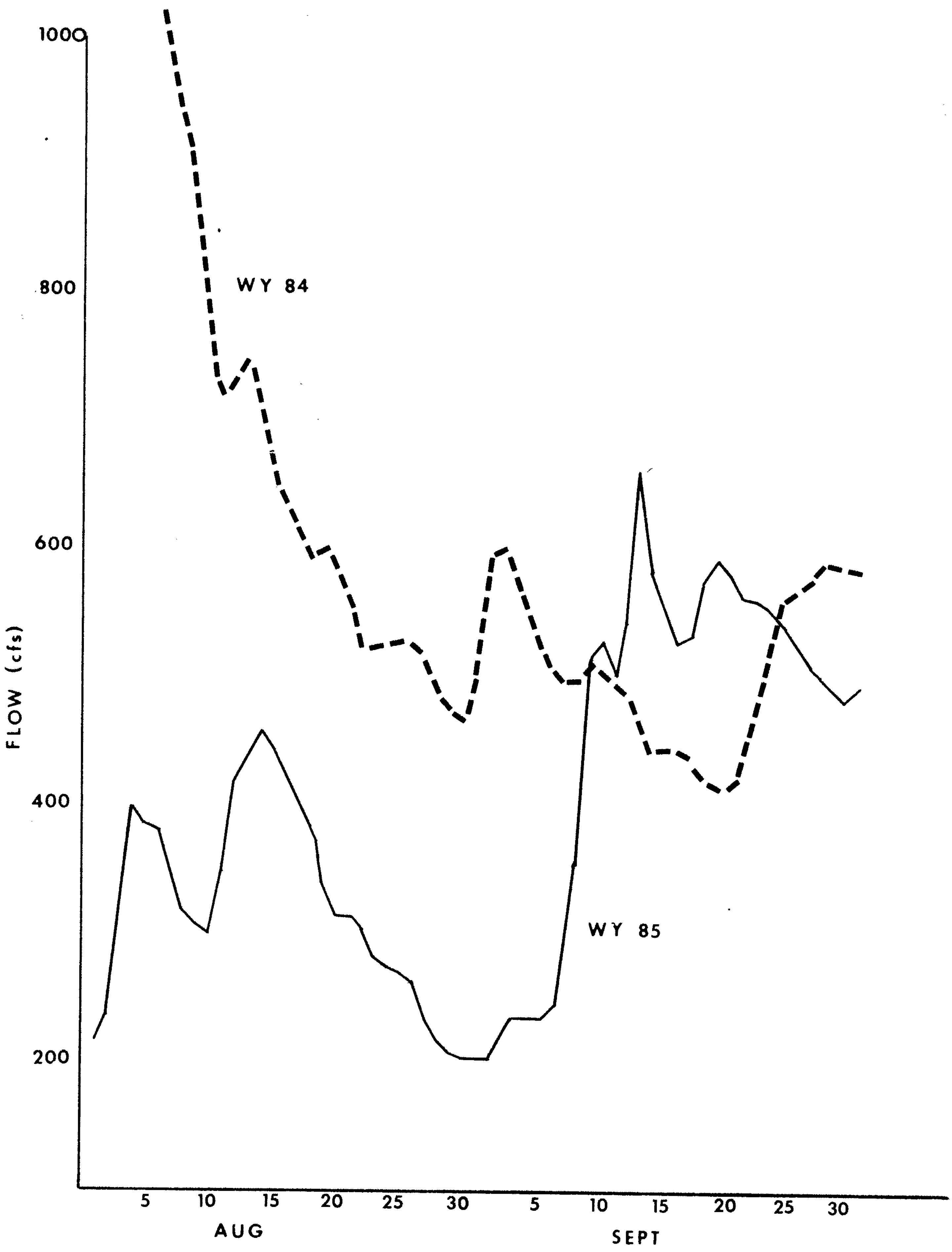


Figure 2. Mean daily discharge at the USGS gage on the Big Hole River near Melrose, Montana, August-September 1984 and 1985.

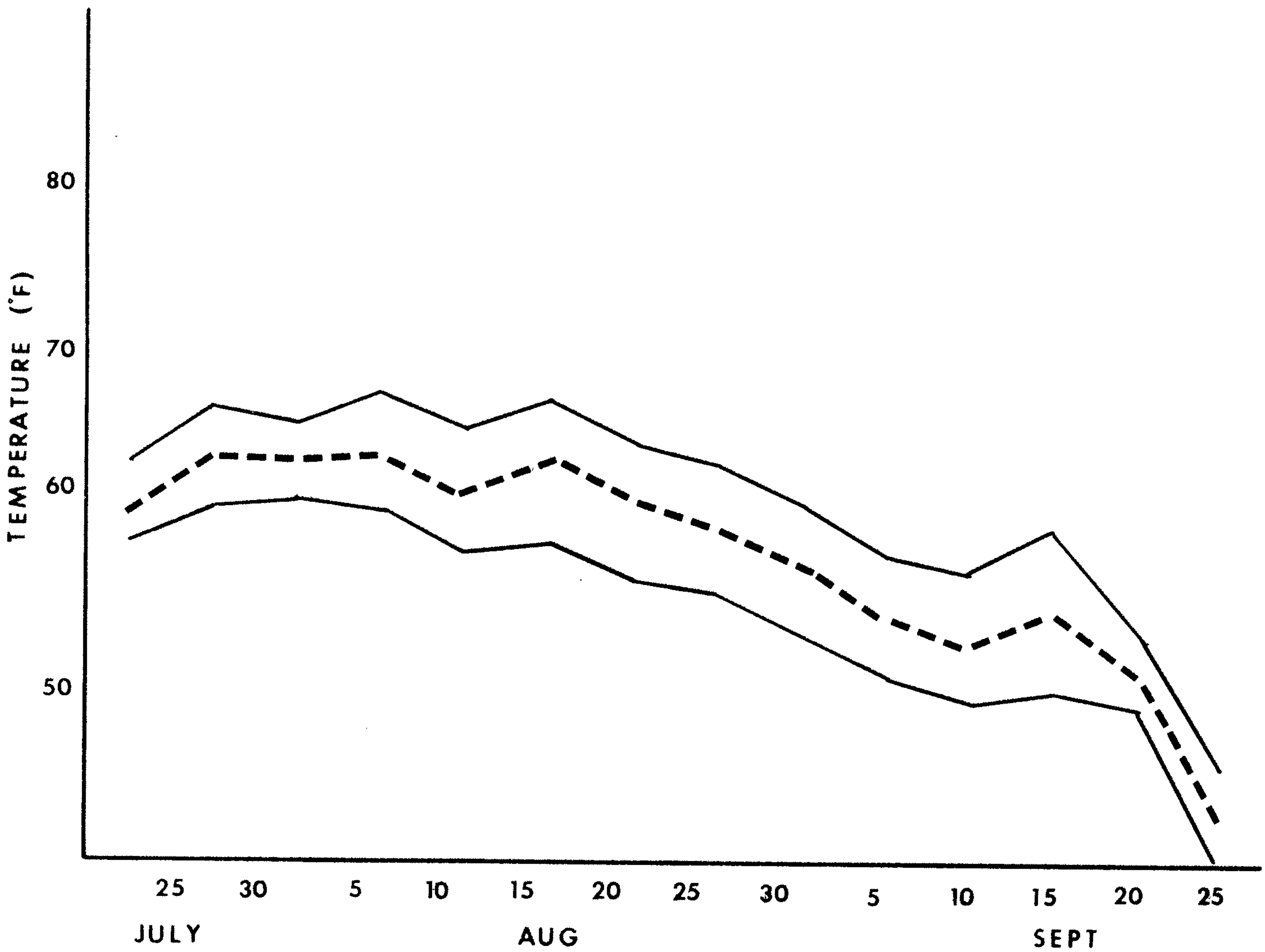


Figure 3. Five-day average maximum, minimum and mean water temperatures measured at the USGS gage near Melrose on the Big Hole River, summer 1984.

Table 1. Mean and minimum July discharge of the Big Hole River near Melrose for the 1964-1985 period.

Water Year	Mean (cfs)	Minimum (cfs)
1964	2019	821
1965	2881	1460
1966	359	222
1967	1816	915
1968	1301	616
1969	1695	853
1970	2119	1000
1971	1735	970
1972	1501	878
1973	430	160
1974	1474	450
1975	4120	1590
1976	1811	1030
1977	688	497
1978	2385	1090
1979	681	441
1980	1628	638
1981	1251	657
1982	2750	1210
1983	2249	906
1984	1845	1080
1985	322	221
Average	1685	805

Table 2. Estimated populations, biomass and mean length of brown and rainbow trout in the Melrose section (22,500 ft.) of the Big Hole River, 1984 (standard deviations [80% confidence interval] are in parentheses).

	March, 1984				September, 1984		
Age	Mean Length (in)	Number	Biomass (lbs)	Age	Mean Length (in)	Number	Biomass (lbs)
			Brown Trout				
I	6.4	--	--	I	8.7	2014	542
II	9.4	1485	451	II	12.3	1831	1359
III	13.6	1868	1781	III	15.2	2226	3010
IV+	16.5	990	1606	IV+	17.4	871	1746
		4343 (±700)	3838 (±348)			6942 (±736)	6657 (±814)
			Rainbow Trout				
I	--	--	--	I	8.7	1108	312
II	9.8	934	336	II	11.8	840	563
III	12.7	628	475	III	14.0	500	545
IV+	14.9	486	608	IV+	15.9	365	576
		2048 (±311)	1419 (±148)			2813 (±312)	1996 (±195)

Table 3. Estimated populations, biomass and mean length of brown and rainbow trout in the Maiden Rock section (15,500 ft.) of the Big Hole River, 1984 (standard deviations [80% confidence interval] are in parentheses).

March, 1984				September, 1984			
Age	Mean Length (in)	Number	Biomass (lbs)	Age	Mean Length (in)	Number	Biomass (lbs)
Brown Trout							
I	--	--	--	I	8.8	1238	347
II	10.0	468	171	II	12.1	729	518
III	13.9	932	956	III	15.4	2123	3044
IV+	17.5	1066	2015	IV+	18.6	646	1546
		2466 (±301)	3142 (±354)			4736 (±701)	5455 (±814)
Rainbow Trout							
I	--	--	--	I	8.2	2696	611
II	9.2	1877	564	II	11.2	1446	787
III	11.9	1515	941	III	14.1	742	790
IV+	15.3	597	788	IV+	15.7	503	738
		3989 (±1107)	2293 (±426)			5387 (±1045)	2926 (±348)

Table 4. Estimated numbers per mile of selected sizes of brown (spring estimates) and rainbow (fall estimates) trout in Maiden Rock and Melrose sections 1981-1984.

Size	1981	1982	1983	1984
		Maiden Rock Brown Trout		
13 inch +	506	773	657	597
18 inch +	40	70	110	145
		Melrose Brown Trout		
13 inch +	390	570	475	552
18 inch +	28	36	29	37
		Maiden Rock Rainbow Trout		
13 inch +	250	567	471	403
15 inch +	89	111	174	166
		Melrose Rainbow Trout		
13 inch +	140	179	150	212
15 inch +	43	64	57	87

Table 5. Estimated spring numbers of Age II and older brown trout and fall numbers of Age I and older rainbow trout in the Melrose and Maiden Rock sections of the Big Hole River, 1981-1984.

	Year			
Section	1981	1982	1983	1984
		Brown Trout		
Melrose	3104	3750	3535	4343
Maiden Rock	3011	2809	2739	2465
		Rainbow Trout		
Melrose	2537	2262	2282	2813
Maiden Rock	3444	4161	5765	5387

Table 6. Estimated spring numbers (per mile) of thirteen inch and larger brown trout, by inch group, in the Melrose and Maiden Rock sections, 1981-1984.

	Inch Group							
Year	13	14	15	16	17	18	19	20+
				Maiden Rock				
1981	131	135	113	47	39	16	10	14
1982	200	145	133	112	113	37	16	16
1983	104	143	120	121	77	57	30	23
1984	85	93	79	102	93	89	34	23
Percent Change 1981-1984	(-35%)	(-31%)	(-30%)	(+117%)	(+138%)	(+456%)	(+240%)	(+64%)
				Melrose				
1981	117	91	64	55	34	14	7	8
1982	137	161	113	81	40	20	10	7
1983	84	114	94	97	56	15	9	6
1984	145	119	85	87	54	30	5	2
Percent Change 1981-1984	(+24%)	(+31%)	(+33%)	(+58%)	(+59%)	(+114%)	(-29%)	(-75%)

Table 7. Estimated total spring brown trout biomass, estimated spring biomass accounted for by 18 inch and larger brown trout, and percentage of total biomass accounted for by 18 inch and larger brown trout (parentheses) for the Maiden Rock and Melrose sections, 1981-1984.

	1981	1982	1983	1984
		Maiden Rock		
Total Biomass (lbs)	2793	3499	3201	3142
18 inch + Biomass (lbs)	315	566	743	994
Percent of Total	(11.3)	(16.2)	(23.0)	(31.6)
		Melrose		
Total Biomass (lbs)	2801	3802	3342	3841
18 inch + Biomass (lbs)	283	368	295	352
Percent of Total	(10.1)	(9.7)	(8.8)	(9.2)

Table 8. Estimated fall numbers (per mile) of thirteen inch and larger rainbow trout, by inch group, in the Melrose and Maiden Rock sections, 1981-1984.

Year	Inch Group 13	14	15	16+
Maiden Rock				
1981	84	77	52	38
1982	196	261	63	48
1983	165	132	94	81
1984	111	126	93	73
Percent Change 1981-1984	(+32%)	(+64%)	(+79%)	(+92%)
Melrose				
1981	50	46	28	15
1982	57	59	43	20
1983	48	45	29	28
1984	43	58	51	36
Percent Change 1981-1984	(-14%)	(+26%)	(+82%)	(+140%)

Table 9. Estimated fall numbers of rainbow trout per mile in the Melrose and Maiden Rock sections of the Big Hole River, 1979-1984.

Year	Age Group I	II	III	IV+	Total
Melrose					
1979	388	145	55	31	619
1980	170	193	84	59	506
1981	258	204	118	15	595
1982	120	229	135	47	531
1983	233	107	140	56	536
1984	260	197	117	86	660
Maiden Rock					
1981	562	349	209	51	1171
1982	383	421	403	156	1363
1983	975	423	436	127	1961
1984	917	492	252	171	1832

Table 10. Estimated fall populations, biomass and mean length of arctic grayling in the Wisdom section of the Big Hole River, 1984 (standard deviations [80% confidence interval] are in parentheses.

Age	Mean Length (in)	Number	Biomass (lbs)
0		--	--
I	8.9	30	7
II	10.4	65	24
III	11.5	221	108
IV+	12.8	139	90
		455	229
		(±125)	(±58)

Table 11. Estimated spring populations, biomass and mean length of brown trout in the Alder section of the Ruby River, 1984 (standard deviations [80% confidence interval] are in parentheses).

Age	Mean Length (in)	Number	Biomass (lbs)
II	9.3	584	181
III	12.7	885	623
IV+	15.3	251	251
		1720	1086
		(±233)	(±107)

Table 12. Estimated spring numbers per mile of Age II and older brown trout in the Brown, Miller and Hacker sections (1973), the Sailor section (1982) and the Alder section (1984) of the Ruby River.

Section	Number/Mile
Brown	425
Miller	1341
Hacker	610
Sailor	869
Alder	1147

Table 13. Numbers of brown trout tagged in fall in the lower Ruby River and numbers of tag returns from the Jefferson River and other upper Missouri River tributaries, 1981-1985.

Year	Number Tagged	Tag Returns Jefferson River	Tag Returns Other Streams[1]
1981	115	3	1
1982	317	19	3
1983	173	4	0
1985	85	4	3

[1] Ruby River, Beaverhead River, Madison River.

Table 14. Estimated spring numbers of Age I and older brown trout in Section Three (3200 feet) and the Gary section (2700 feet) of Poindexter Slough, 1981-1984.

Year	I	II	III	IV+	Total
		Section Three			
1981	1539	354	155	108	2156
1982	593	558	352	133	1636
1983	322	452	209	49	1032
1984	1507	349	238	59	2153
		Gary Section			
1982	344	182	203	85	814
1983	148	333	197	39	717
1984	627	218	203	59	1107

Table 15. Estimated spring numbers of rainbow trout in Section Three (3200 feet) and the Gary section (2700 feet) of Poindexter Slough, 1981-1984.

	Year			
Section	1981	1982	1983	1984
Three	920	518	210	103
Gary	--	296	182	70

Table 16. Brown and rainbow trout trend information from 125 foot experimental floating gill nets set overnight in late April or early May in Clark Canyon Reservoir.

		Brown Trout		Rainbow Trout			
Year	Number of Nets Set	Number Per Net Set	Length Range (in)	Number Per Net Set	Length Range (in)	Mean Length (in) at Age I	Mean Weight (lbs) at Age I
1979	12	3.7	9.2-22.2	1.2	6.2-18.5	13.6	1.25
1980	11	1.6	6.2-23.2	3.3	12.7-16.0	14.8	1.60
1981	5	3.0	6.5-23.3	5.2	12.4-21.5	15.0	1.68
1982	10	1.3	8.5-21.6	4.4	13.6-21.0	14.9	1.71
1983	5	2.0	14.5-20.1	4.8	13.9-27.6	14.9	1.57
1984	5	2.0	14.7-21.8	4.2	13.4-23.3	14.9	1.65
1985*	15	1.9	7.2-24.2	6.3	9.0-20.7	13.9	1.42

* Rainbow trout data includes both Arlee and DeSmet strains.

Table 17. Brown, rainbow and cutthroat trout trend information from 125 foot experimental gill nets (5 nets per sample year) set overnight in early May in Ruby River Reservoir.

	Brown Trout		Rainbow Trout		Cutthroat Trout	
Year	Number Per Net Set	Length Range (in)	Number Per Net Set	Length Range (in)	Number Per Net Set	Length Range (in)
1979	4.6	11.5-20.0	3.2	9.0-17.4	--	--
1981	6.0	9.6-18.5	17.2	9.7-16.5	0.4	7.5-10.5
1982	1.8	12.8-14.7	14.0	9.1-16.7	2.4	12.7-14.8
1983	3.8	13.0-22.8	12.4	10.7-18.3	0.8	10.9-17.5
1984	2.6	6.2-19.5	9.6	7.8-18.4	2.2	12.3-14.9
1985	5.2	9.2-18.0	14.0	8.8-18.2	0.8	12.3-13.3

Table 18. Rainbow trout trend information by age group from 125 foot experimental gill nets (5 nets per sample year) set overnight in early May in Ruby River Reservoir.

Year	Age II			Age III			Age IV+		
	Number Per Net Set	Percent of Sample	Average Length (in)	Number Per Net Set	Percent of Sample	Average Length (in)	Number Per Net Set	Percent of Sample	Average Length (in)
1979	1.6	50%	12.6	1.2	38%	15.1	0.4	12%	17.1
1981	13.8	80%	12.2	--	--	--	--	--	--
1982	5.6	40%	11.9	8.2	59%	15.3	0.2	1%	16.7
1983	2.4	20%	12.6	5.0	40%	15.0	5.0	40%	16.6
1984	3.4	35%	11.1	2.2	23%	14.2	3.8	40%	16.2
1985	10.2	73%	11.6	2.8	20%	14.4	1.0	7%	17.0

Table 19. Cutthroat trout, arctic grayling and lake trout trend information from 125 foot experimental gill nets (one to 5 nets per sample year) set overnight in late May in Elk Lake (1979-1986).

	Cutthroat Trout		Arctic Grayling		Lake Trout	
Year	Number Per Net Set	Length Range (in)	Number Per Net Set	Length Range (in)	Number Per Net Set	Length Range (in)
1979	2.4	14.3-19.5	6.8	6.7-17.3	2.2	10.9-17.5
1981	12.8	12.7-19.3	12.4	12.0-17.5	1.4	14.7-17.5
1982	10.5	13.0-17.5	11.5	13.0-16.7	1.0	14.0-17.2
1983	45.8	9.4-17.6	5.8	11.2-17.0	1.5	13.2-16.0
1984	121.0	11.6-15.2	10.0	11.8-16.6	0.0	--
1985	25.7	14.1-17.0	9.7	13.8-17.7	0.3	15.1
1986	6.5	10.7-19.4	1.8	7.1-17.0	0.0	--

Table 20. Rainbow trout trend information from 125 foot experimental gill nets set overnight in late May in MacDonald Pond, 1971-1986.

Year	Number Per Net Set	Length Range (in)	Average Length (in)
1971	11.0	9.7-18.8	13.7
1979	9.0	8.4-17.6	13.8
1980	7.0	13.9-22.0	17.0
1985	1.0	13.8-14.6	14.2
1986	1.5	16.5-24.7	20.0

Table 21. Brook trout trend information from 125 foot experimental gill nets set overnight in late May in Culver Pond, 1971-1986.

Year	Number Per Net Set	Length Range (in)	Average Length (in)
1971	8.0	9.1-17.0	13.0
1979	13.0	9.2-17.8	13.8
1980	60.0	7.0-18.5	12.0
1982	41.0	7.5-19.4	12.4
1985	23.0	6.8-18.0	11.4
1986	27.0	6.1-15.9	10.9

APPENDIX A

INTRODUCTION

The Beaverhead National Forest contains 254 lakes which support a significant proportion of the estimated 48,700 fisherman-days of recreation expended on the forest in 1980 (USFS 1982). The Pioneer Mountains contain 86 (34%) of the lakes of the Beaverhead Forest, primarily within the boundaries of the Dillon and Wise River Ranger Districts. These mountain lakes represent a valuable recreational resource because of their alpine settings, spectacular scenery, isolation and sport fisheries.

Most of the lakes (62) of the Pioneer Mountains support sport fisheries. These fisheries are the result of hatchery plants which began as early as the 1930's. Many lakes have established naturally reproducing self-sustaining fish populations while others require regular hatchery plants to maintain fisheries due to lacking or inadequate spawning habitat. Pioneer lakes have received introductions and currently support populations of cutthroat, rainbow, brook and golden trout as well as arctic grayling. Some lakes, which have received introductions of cutthroat and rainbow trout in the presence of spawning habitat, hold populations of rainbow X cutthroat hybrid trout.

Since 1976, the Montana Department of Fish, Wildlife and Parks (MDFWP) has emphasized the stocking of McBride Yellowstone cutthroat trout in mountain lakes. The McBride strain, which originated in McBride Lake in Yellowstone National Park, is particularly well adapted to alpine lake habitats. They grow rapidly because of their ability to efficiently use the dominant food base of alpine lakes which consists of zooplankton and midges (Chironomidae). They are also able to reproduce successfully in most lakes which have suitable spawning habitat.

Fisheries and habitat data were collected from many Beaverhead Forest lakes in 1967 and 1973-73 in order to determine fisheries status and potential. In an effort to gather more recent management data, the Beaverhead National Forest and MDFWP entered a cooperative survey of mountain lakes in 1981. Under this survey, 16 West Big Hole lakes in the Wisdom Ranger District were studied in 1981 (Wells, 1982) and 13 Pioneer Mountain lakes in the Wise River Ranger District were studied in 1982 (McMullin 1983). As the final phase of the cooperative survey, 11 Pioneer Mountain lakes in the Wise River (6) and Dillon (5) Ranger Districts were inventoried in 1983. The project was designed to gather data necessary to develop management recommendations for the inventoried lakes and to evaluate the success of McBride cutthroat trout introductions in some of the lakes in 1976 and 1979. The necessity of the development of management objectives for these lakes is imperative because a portion of the East Pioneer Mountains has been recommended for wilderness designation.

STUDY AREA

The Pioneer Mountains, located in the Beaverhead National Forest in southwest Montana lay within the boundaries of three ranger districts. The 428,840 acres within the Dillon and Wise River Ranger Districts represent eighty percent of the Beaverhead Forest Pioneer Planning Unit. Lands within this unit are managed for timber harvest, grazing, mining and many forms of dispersed and non-dispersed recreation including fishing. The Dillon Ranger District contains 48 lakes, 34 of which support fisheries while the Wise River Ranger District contains 67 lakes, 42 of which support fisheries. Collectively, the Dillon and Wise River Districts hold forty-five percent of the lakes and forty-nine percent of the lake fisheries of the Beaverhead Forest.

Lakes sampled in 1983 were located on the east slope of the East Pioneer Mountains. The six Wise River District lakes were located in the Big Hole River drainage and included Lion, Grayling, Vera, Crescent, Canyon and Abundance Lakes. The five Dillon District lakes included North and South Gorge, Waukena and Tendoy Lakes in the Big Hole River drainage and Scott Lake in the Beaverhead River drainage.

METHODS

Eleven lakes were sampled August 22-24, 1983 by using a helicopter mounted on inflatable pontoons. A single monofilament experimental mesh gill net was fished approximately 24 hours as a sinking set in each lake. Each gill net measured 125 feet by 5 feet and consisted of five panels measuring .75 in., 1.0 in., 1.25 in., 1.50 in. and 2.0 in. bar mesh. Fish collected were measured for length (.1 in.), weighed (.01 lb.) and aged by the scale method. Fish condition was calculated as:

$$K = \frac{100,000\ W}{L^3}$$

where K = Coefficient of condition
W = Weight in lbs. (nearest .01)
L = Length in inches (nearest .1)

Water samples were collected from each lake to determine water quality and relative potential productivity. Water samples were analyzed by Dr. Gordon Pagenkopf, Department of Chemistry, Montana State University, Bozeman. Depth profiles and contours were not determined due to a malfunction in the helicopter power source and weather conditions that prevented land soundings.

RESULTS

Water Quality

Selected water quality parameters for the eleven lakes sampled in 1983 are presented in Table 1. All of the lakes sampled were calcium-bicarbonate waters with near-neutral pH (6.80-7.51). Calcium was the dominant anion in all lakes generally followed by magnesium in more productive lakes (specific conductance greater than 20 umhos/cm) and sodium in less productive waters

Table 1. Selected Water Quality Parameters for Pioneer Mountain Lakes Sampled in 1983.

Lake	Specific Conductance (umhos/cm)	Total Alkalinity (mg/l)	pH	Major Ions (mg/l)						
				Ca	Mg	Na	K	Cl	SO_4	NO_3
Canyon	42.8	26.1	7.30	3.9	1.7	0.4	<.10	<.5	1.3	<1.0
Crescent	17.1	8.8	6.92	1.4	0.4	0.4	<.10	<.5	1.4	<1.0
Gorge (North)	18.9	9.7	6.90	1.6	0.3	0.6	<.10	<.5	1.6	<1.0
Gorge (South)	12.6	6.5	6.90	1.2	0.2	0.3	<.10	<.5	1.1	<1.0
Grayling	36.1	20.8	7.10	3.3	0.9	0.4	0.10	<.5	1.4	<1.0
Lake Abundance	11.0	4.5	7.51	0.6	0.2	0.3	0.15	0.9	<1.0	<1.0
Lion Lake	31.5	19.7	7.32	3.3	0.9	0.3	<.10	<.5	1.4	<1.0
Scott Lake	39.8	22.1	6.97	3.7	0.9	0.8	0.15	0.7	2.2	<1.0
Tendoy Lake	16.0	8.4	6.80	1.5	0.3	0.5	<.10	<.5	<1.0	<1.0
Vera Lake	25.3	16.2	6.99	2.6	0.7	0.5	<.10	<.5	1.7	<1.0
Waukena Lake	21.8	12.3	7.10	2.1	0.4	0.4	<.10	1.0	1.0	<1.0
Averages	24.8	14.1	7.07	2.3	0.6	0.4	-	-	-	-

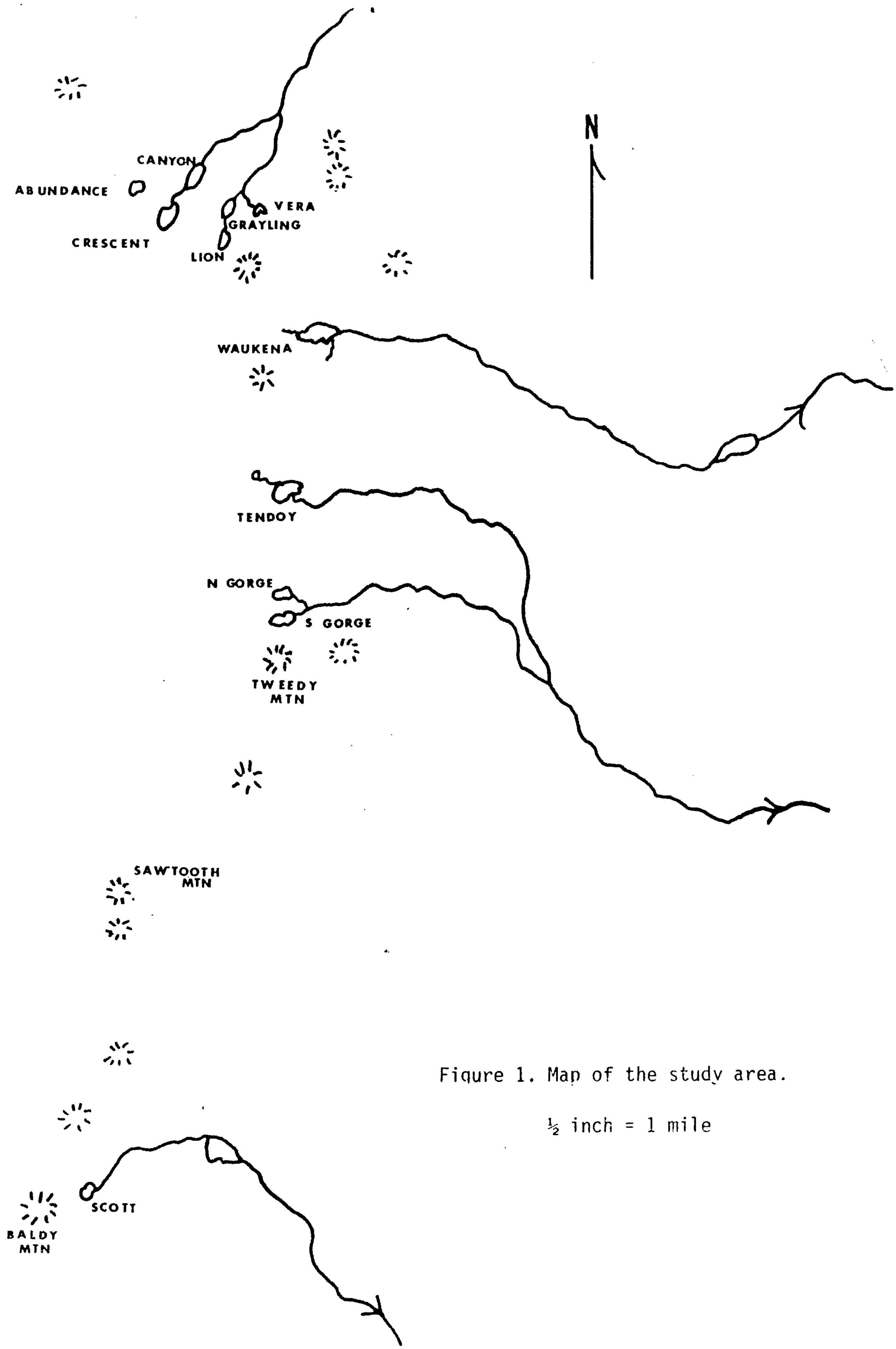


Figure 1. Map of the study area.

½ inch = 1 mile

(specific conductance less than 20 umhos/cm). The bicarbonate ion was the dominant cation in all waters surveyed. Sulphate exceeded 2.0 mg/l in Scott Lake.

A relative index of lake productivity can be obtained from specific conductance and bicarbonate alkalinity. Specific conductance ranged from 11.0 umhos/cm in Lake Abundance to 42.8 umhos/cm in Canyon Lake. The average value of 24.8 umhos/cm observed in 1983 compares favorable with values observed by McMullin (1983) in 13 other Pioneer Mountain Lakes (28.4 umhos/cm) and exceeds those observed by Wells (1982) in 15 West Big Hole Lakes (ave. = 17.4 umhos/cm). Bicarbonate alkalinity values ranged 4.54 to 26.10 mg/l and averaged 14.1 mg/l in the surveyed lakes. By comparison, lakes in the West Big Hole exhibited an alkalinity range of 2.0 to 16.0 mg/l and averaged 8.7 mg/l. Dissolved nitrate was present at concentrations of less than one milligram per liter in all of the lakes surveyed. All of the lakes studied in 1983 would be classified as oligotrophic.

Fisheries

The status of the lake fisheries surveyed in 1983 is presented by individual lake. The planting history of each lake is summarized. Parameters such as species composition, sample number, fish size, growth and reproduction are compared with past samples. Management suggestions, based on evaluation of existing data, are presented for each lake.

Canyon Lake

Planting History

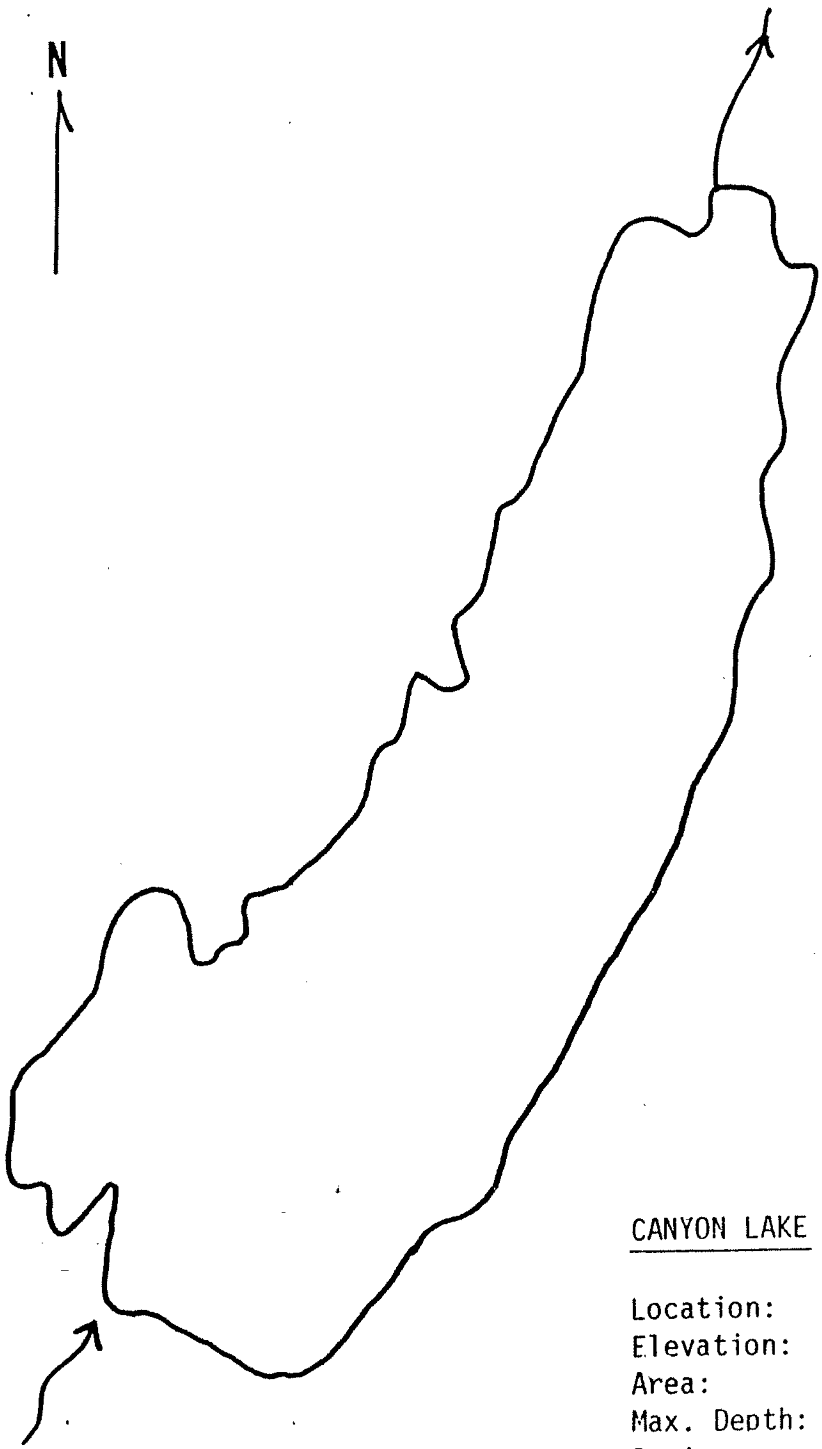
Year	Species	Number	Size
1936	Rb	19,200	2"
1945	Rb	8,640	2"
1948	YCt	8,320	2"

Description and Fish Population

Canyon Lake is a relatively shallow lake located near the head of the Canyon Creek drainage. The entire lake is classified as littoral. This, coupled with the highest specific conductance (42.8 umhos/cm) and bicarbonate alkalinity (26.1 mg/l) of the surveyed lakes, indicates a relatively high productivity for mountain lakes.

The 1983 sample indicated that Canyon Lake supports an abundant trout population. Comparisons with 1967 data show that average size of cutthroat trout has remained stable while the population has shifted from a dominance of rainbow X cutthroat hybrids to a dominance of cutthroat trout over the hybrids.

The presence of a range of age groups in the cutthroat trout sample indicated good reproductive success. Age I cutthroat trout averaged 6.7 in. while age II fish averaged 8.6 in., age III fish averaged 9.8 in. and age IV and older fish averaged 12.0 in. in length, indicative of relatively slow



CANYON LAKE

Location:	T3S R11W S8
Elevation:	8392'
Area:	14 acres
Max. Depth:	9'
Drainage:	Canyon Creek
Scale:	1 in. = 220'

growth. Condition of both cutthroat and hybrid trout was well below averages for the respective species in Pioneer Lakes. This observation was somewhat surprising in light of the potential productivity of Canyon Lake and may be indicative of overpopulation.

Canyon Lake supports a relatively popular fishery. The lake is utilized by a local guest ranch for fishing pack trips. Fisherman log reports from 1966-69 indicate catch rates as high as 2.0 fish per hour for cutthroat trout.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Condition
1967	YCt	7	9.3 - 10.4	9.9	0.32	32.7
	Rb X Ct	14	8.3 - 14.0	9.8	0.30	30.1
1983	YCt	27	6.5 - 16.0	9.9	0.35	32.6
	Rb X Ct	2	8.0 - 9.2	8.6	0.23	34.9

Management Suggestions

Canyon Lake should be managed as a wild trout fishery. Reproduction is adequate in the two inlet streams to stock the lake. Data suggest that reproductive success may be limiting trout growth in very productive environment. Increased harvest in Canyon Lake could result in a better balance between reproduction and standing crop and further result in faster growth rates for cutthroat trout.

Crescent Lake

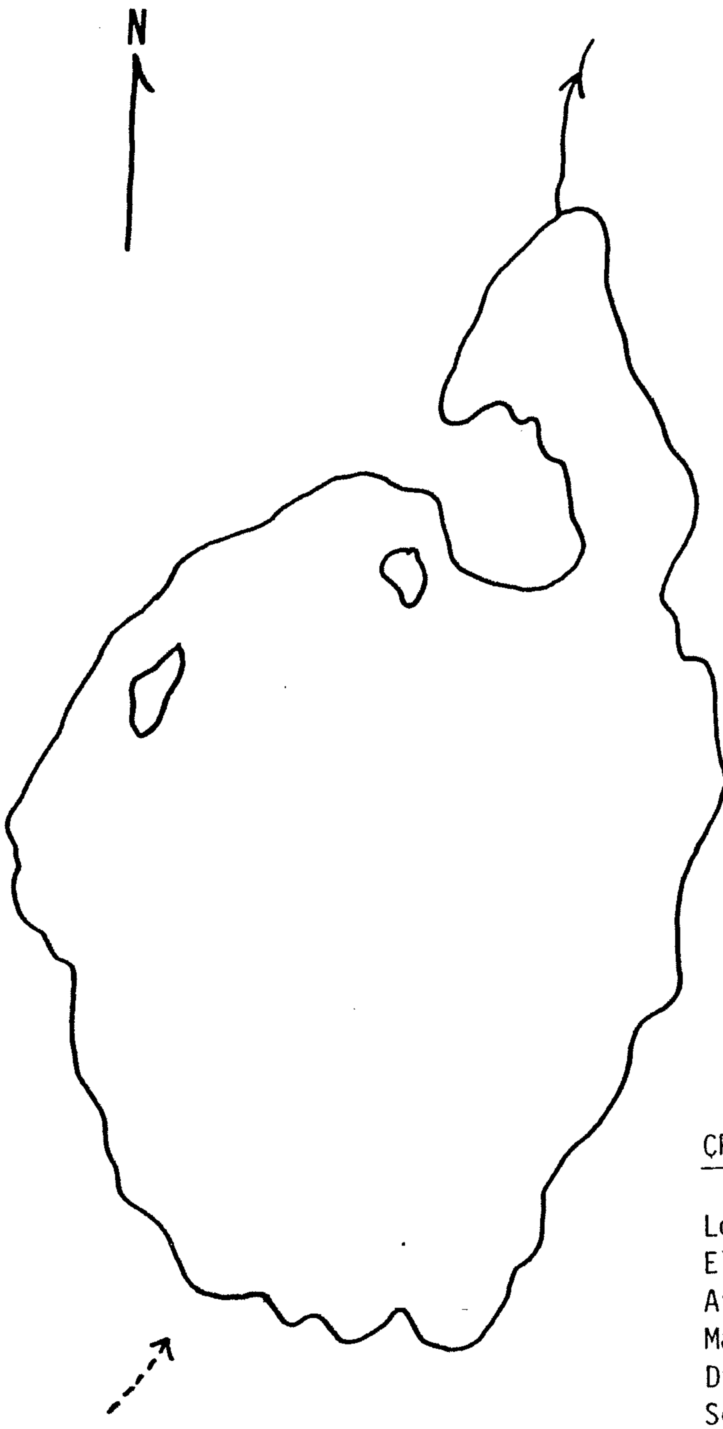
Planting History

Year	Species	Number	Size
1946	YCt	12,160	1"
1947	YCt	2,400	Fry
1948	YCt	8,320	2"
1949	YCt	16,600	1"
1976	MYCt	1,513	2"
1979	MYCt	1,000	2"

Description and Fish Population

Crescent Lake is a relatively large (24 acre) alpine lake located at the head of the Canyon Creek drainage. The lake exhibits a maximum depth of 22 feet and its sturcture is composed of about 50 percent littoral zone. Below average specific conductance and bicarbonate alkalinity suggest limited productivity.

Crescent Lake was heavily planted with cutthroat trout in the late 1940's. While no record of a rainbow trout introduction exists, a 1967 sample revealed



CRESCENT LAKE

Location: T3S R11W S18
Elevation: 8600'
Area: 24 acres
Max. Depth: 22'
Drainage: Canyon Creek
Scale: 1 in. = 330'

the presence of rainbow X cutthroat hybrid trout aged II, III, IV and older. In 1976 and 1979, Crescent Lake received introductions of McBride Yellowstone cutthroat trout.

The 1983 sample resulted in the capture of eight McBride cutthroat which were age IV fish from the 1979 plant and averaged 13.9 inches in length. Condition was good and near average for Pioneer Lakes. Somewhat perplexing was the presence of three apparently pure rainbow trout in the sample. The rainbow trout were age III and IV fish indicating that some limited reproduction is possible in the outlet stream or near springs along the lake shore.

Crescent Lake supports a relatively popular fishery. The lake is used by a local guest ranch for fishing pack trips and supported an estimated 150 angler-days in 1975-76 (MDFWP data). Fisherman logs reported catch rates as high as 2.8 fish per hour for cutthroat trout averaging 12-13 inches in 1981-82.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave./ Length (in.)	Ave./ Wt.(lbs.)	Condition
1967	Rb X Ct	4.0	8.5 - 15.6	12.3	0.84	35.8
1983	MYCt	8.0	13.0 - 15.1	13.9	0.97	35.4
	Rb	3.0	10.2 - 13.0	11.5	0.52	34.0

Management Suggestions

Crescent Lake should be restocked with McBride Yellowstone cutthroat trout every five years at a rate of 50-100 per acre. While some natural reproduction of rainbow or rainbow X cutthroat trout does occur, it is probably not adequate to sufficiently stock the lake. Furthermore, the McBride cutthroat exhibited a growth rate and average size far superior to the wild trout. Crescent Lake should be re-sampled in four or five years to determine whether the McBride cutthroat can establish a naturally reproducing population.

Gorge Lake (North)

Planting History

Year	Species	Number	Size
1976	MYCt	1,018	2"
1979	MYCt	1,000	2"

Description and Fish Population

The Gorge Lakes are among the highest elevation fisheries in the Pioneer Mountains. Both are located over 9,100 feet in elevation. North Gorge Lake is a relatively small deep body of water located at the head of Gorge Creek. The lake exhibited below average specific conductance (18.9 umhos/cm) and bicarbonate alkalinity (9.74 mg/l) indicative of relatively low productivity.

North Gorge Lake was sampled in 1967 and found to be barren of fish. In 1976 and 1979, McBride Yellowstone cutthroat trout were introduced to establish a fishery.

The 1983 sample revealed that North Gorge Lake currently supports an abundant fishery for McBride cutthroat trout. Age IV fish, probably survivors from the 1979 plant, averaged 13.5 inches and 0.86 lbs.; good growth for the trophic state and elevation of the lake. The survey further revealed that 68% of the sample (13 fish) was composed of age I, II and III fish. The 1967 inventory determined that spawning habitat was lacking in North Gorge Lake. Results from the present study indicate that McBride cutthroat have found suitable spawning habitat, possibly outlet or a short portion in inlet, and are reproducing naturally. Growth of the wild trout is good with age II fish averaging 10.0 inches. No apparent survivors of the 1976 plant were collected.

Fisherman logs from 1979-83 reported catch rates of less than one fish per hour in 1979-80 which increased to 1.7 fish per hour in 1982-83. The reported catch consisted of 12 to 15 inch McBride cutthroat trout.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Condition
1967	--	0.0	--	--	--	--
1983	MYCt	19.0	7.2-13.8	11.4	0.58	36.7

Management Suggestions

North Gorge Lake should be re-surveyed in two to three years. It is apparent that McBride cutthroat trout are successfully reproducing in the lake, however, it is not presently known if the natural reproduction will be sufficient to adequately stock the lake in the future. If natural reproduction proves to be sufficient, the lake should be managed as a wild cutthroat trout fishery. If natural reproduction is insufficient to meet harvest demands, the lake should be stocked every 5 years with 50-100 McBride cutthroat trout per acre.

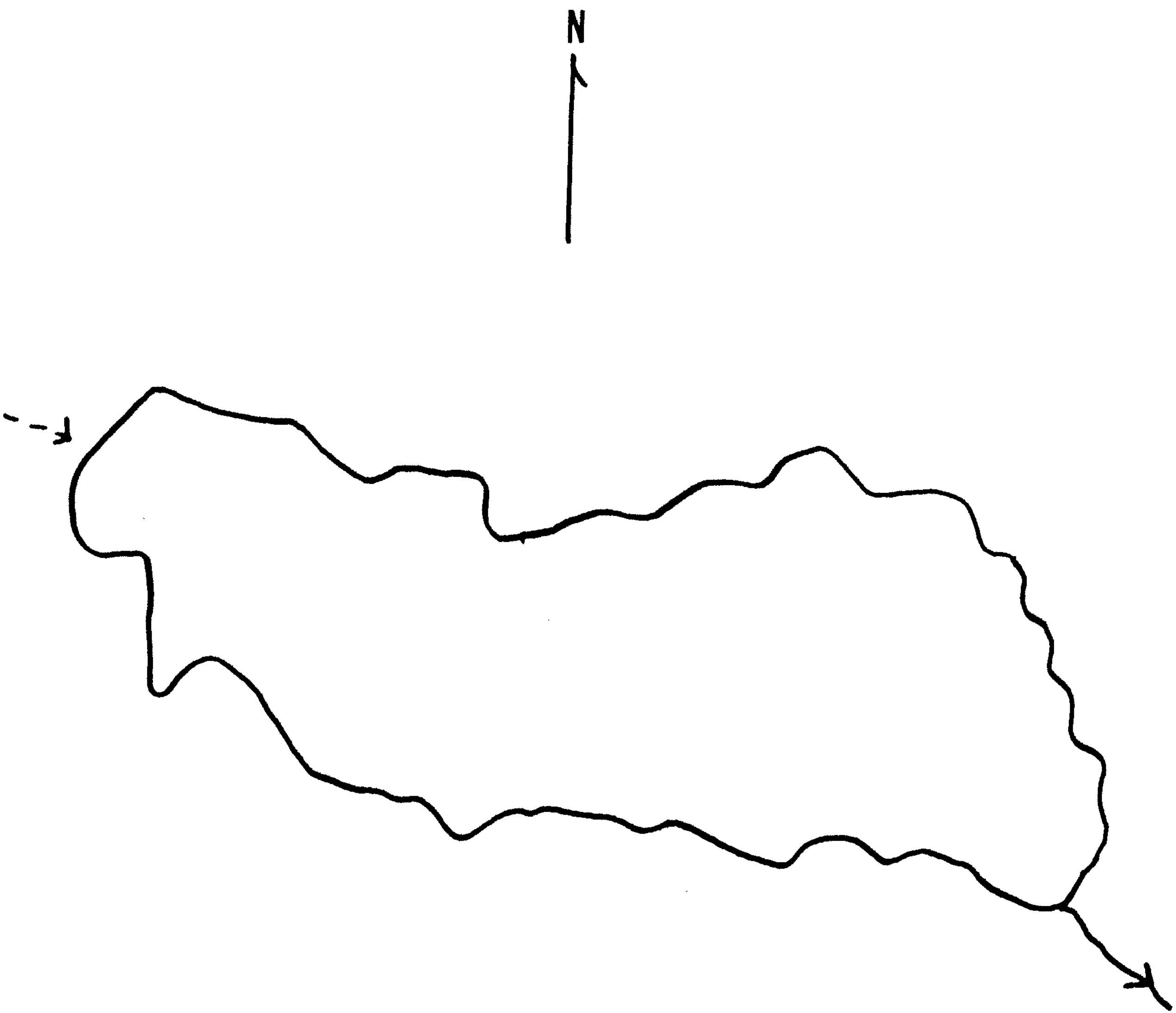
Gorge Lake (South)

Planting History

Year	Species	Number	Size
1976	MYCt	1,018	2"
1979	MYCt	1,000	2"

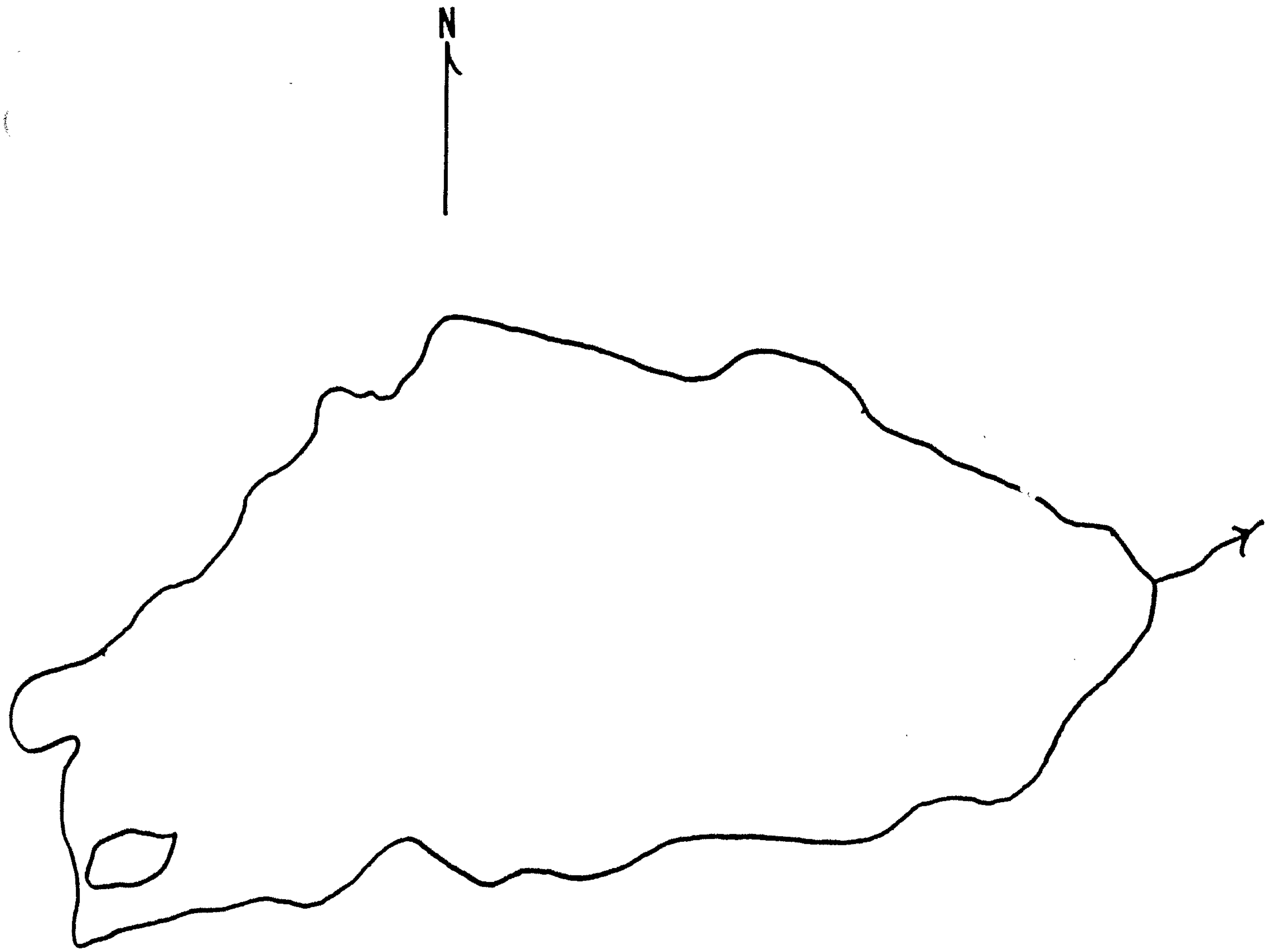
Description and Fish Population

South Gorge Lake represents one of the highest altitude fisheries in the Pioneer Mountains at 9,185 feet. The twelve acre lake is relatively



GORGE LAKE (NORTH)

Location:	T4S R11W S9
Elevation:	9140'
Area:	9 acres
Max. Depth:	30'
Drainage:	Gorge Creek
Scale:	1 in. = 220'



GORGE LAKE (SOUTH)

Location: T4S R11W S16
Elevation: 9185'
Area: 12 acres
Max. Depth: 43'
Drainage: Gorge Creek
Scale: 1 in. = 220'

deep (43 ft.) and is located at the head of Gorge Creek. Potential productivity as indicated by specific conductance (12.6 umhos/cm) and bicarbonate alkalinity (6.50 mg/l) is low; classifying South Gorge Lake as one of the most oligotrophic in the Pioneer Mountains.

South Gorge Lake was surveyed in 1967 and found to be barren. The study further indicated that suitable trout spawning habitat was lacking. In 1976 and 1979, South Gorge Lake was planted with McBride Yellowstone cutthroat trout.

The 1983 survey revealed that the McBride cutthroat have established an abundant population in South Gorge Lake. Age III fish, probably survivors from the 1979 plant, averaged 13.8 inches and 0.96 lbs. Fish condition was average for Pioneer lakes which was somewhat surprising in the absence of much chemical enrichment. As was the case in North Gorge, McBride cutthroat have reproduced naturally in South Gorge Lake. Fifty-three percent (nine fish) of the 1983 sample was composed of wild progeny (ages I, II and III) from the McBride cutthroat introductions. These wild progeny exhibited good growth with age II fish averaging 9.4 inches. No apparent survivors of the 1976 plant were collected.

Fisherman Logs from 1980-82 report catch rates ranging from 0.5 fish per hour in 1980 to 1.7 fish per hour in 1982. McBride cutthroat averaging 12 to 14 inches comprised the catch.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Condition
1967	--	0.0	--	--	--	--
1983	MYCt	17.0	6.2 - 14.3	11.2	0.62	37.6

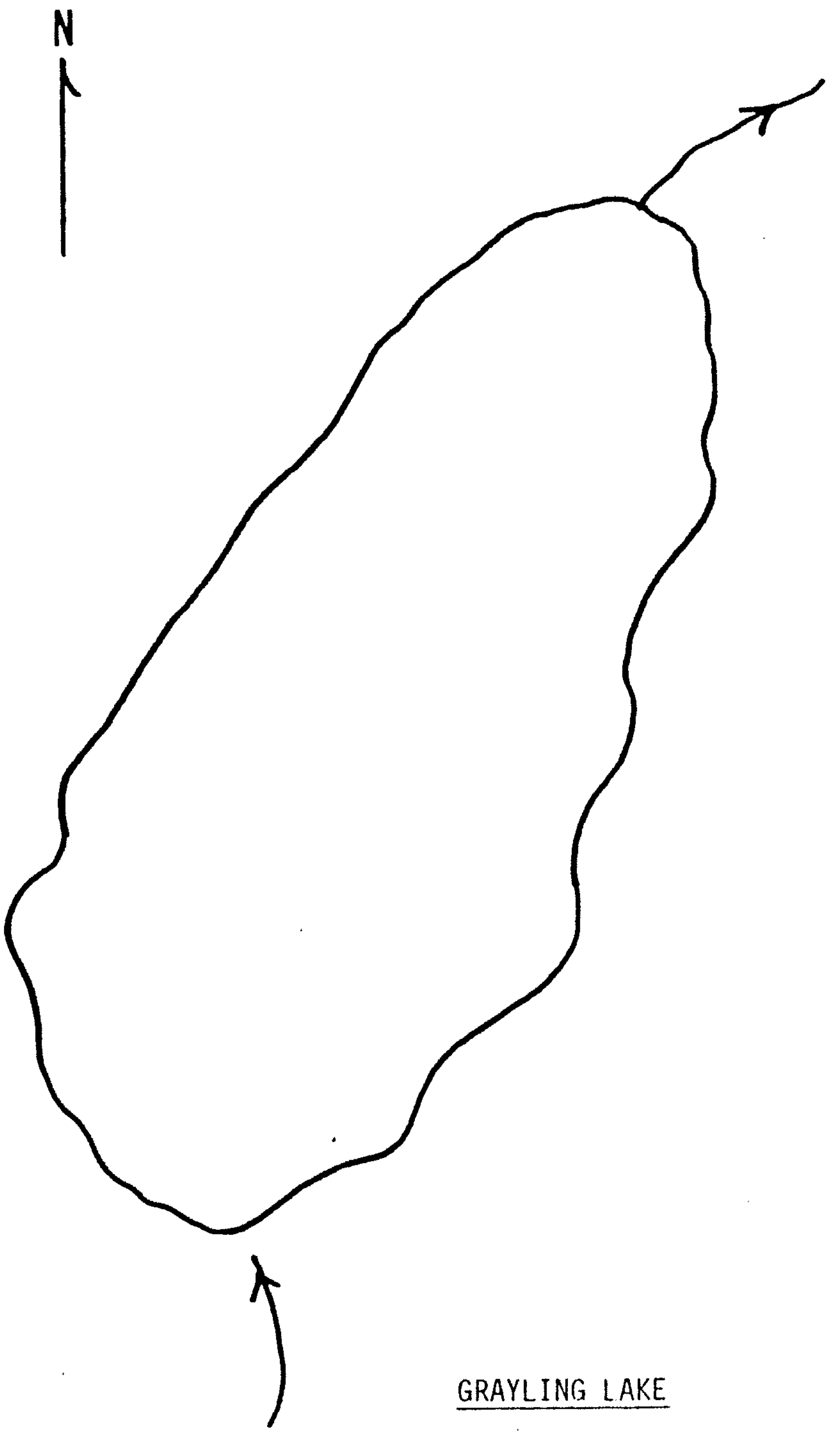
Management Suggestions

South Gorge Lake should be re-surveyed in two to three years. It is apparent that the McBride cutthroat trout are successfully reproducing in the lake, however it is not presently known if the natural reproduction will be sufficient to adequately stock the lake in the future. If natural reproduction proves to be sufficient, the lake should be managed as a wild cutthroat trout fishery. If natural reproduction is insufficient to meet harvest demands, the lake should be stocked every five years with 50-100 McBride cutthroat trout per acre.

Grayling Lake

Planting History

Year	Species	Number	Size
1942	Gr	100,000	Fry
	Gr	420	4"
1950	Gr	100,000	Fry



GRAYLING LAKE

Location: T3S R11W S17
Elevation: 8700'
Area: 18 acres
Max. Depth: 33'
Drainage: Lion Creek
Scale: 1 in. = 220'

Description and Fish Population

Grayling Lake, located in the Lion Creek drainage, has a surface area of 18 acres and a maximum depth of 33 feet. The lake exhibits a specific conductance of 36.1 umhos/cm and bicarbonate alkalinity of 20.8 mg/l, both well above average for Pioneer lakes and indicative of relatively high potential productivity.

Grayling Lake was rated as having substantial grayling habitat and adequate grayling spawning habitat. Planting records show that arctic grayling were introduced to the lake in 1942 and re-stocked in 1950. No arctic grayling have been collected in subsequent samples.

Although no record of cutthroat or rainbow trout plants exist for Grayling Lake, a 1967 sample yielded rainbow, rainbow X cutthroat hybrid and Yellowstone cutthroat trout. It is probable that Grayling Lake was stocked with these species by downstream drift from Lion Lake (see Lion Lake) and has since established naturally reproducing populations.

The 1983 sample resulted in the capture of 30 trout, 25 of which appeared to be pure rainbow trout averaging 9.0 inches in length. Scale analysis revealed a good age distribution, ages I through IV and older present, indicative of adequate natural reproduction. Rainbow trout condition was below average for Pioneer Lakes and growth was relatively slow e.g., age I = 6.1 in., age II = 7.0 in., age III = 9.0 in. and age IV and older = 10.8 in.

Grayling Lake supported an estimated 186 angler-days of fishing pressure in 1975-76 (MDFWP data). Fisherman logs from 1975-81 reported exceptional catch rates of 2.3 to 6.0 fish per hour.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Ave. Condition
1967	Rb	7.0	8.6 - 12.1	10.0	0.28	27.6
	YCt	5.0	9.3 - 12.6	10.5	0.37	31.6
	Rb X Ct	11.0	7.3 - 12.2	9.5	0.28	29.7
1983	Rb	25.0	6.0 - 12.9	9.0	0.28	34.7
	Rb X Ct	5.0	8.1 - 12.2	10.5	0.38	31.8

Management Suggestions

Grayling Lake should be managed as a wild trout fishéry. Reproduction is adequate to stock the lake. Data suggest that reproductive success may be limiting rainbow trout growth and average size in a relatively productive environment. Increased harvest in Grayling Lake could provide a better balance between reproduction and standing crop resulting in faster growth rates and larger average size in the population.

Lake Abundance

Planting History

Year	Species	Number	Size
1948	YCt	8,320	2"
1980*	MYCt	2,000	2"
1981	MYCt	2,015	2"

Description and Fish Population

Lake Abundance is a relatively small (7 acre) but deep (35 ft) lake located in the upper Canyon Creek drainage. Abundance exhibited the lowest specific conductance (11.0 umhos/cm) and bicarbonate alkalinity (4.5 mg/l) observed in 24 Pioneer Lakes. Spawning habitat appears inadequate or extremely limited at both outlet and inlet.

While no record of a rainbow trout introduction exists for Lake Abundance, a 1967 sample captured three rainbow X cutthroat hybrid trout ages II through IV. In 1980 an attempt was made to plant McBride Yellowstone cutthroat trout in the lake, however, this plant apparently did reach Lake Abundance. A successful introduction of McBride cutthroat was made in 1981.

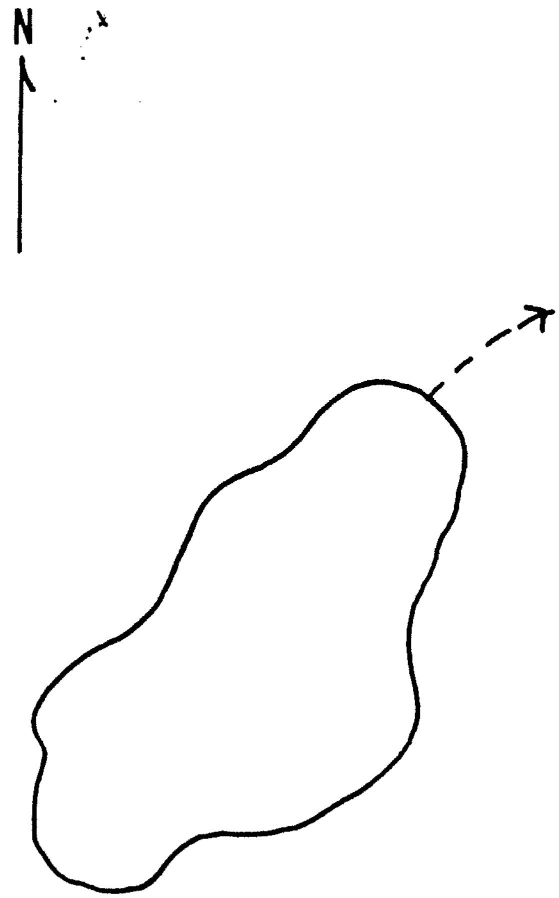
The 1983 sample consisted entirely of McBride cutthroat from the 1981 plant. These age II fish averaged 9.3 inches and one-fourth pound. Trout condition was well below average for Pioneer Lakes. While cutthroat trout growth in Lake Abundance is slow, it is comparable to many other lakes in the area and probably reflective of the low productivity of the water.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave./ Length (in.)	Ave./ Wt. (lbs.)	Condition
1967	Rb X Ct	3.0	10.1 - 15.4	12.8	0.75	34.3
1983	MYCt	7.0	9.0 - 9.7	9.3	0.25	31.4

Management Suggestions

Lake Abundance should be stocked with McBride Yellowstone cutthroat trout every five years at a rate of 50-100 per acre. Care must be taken, owing to the low productivity of the lake, to avoid overstocking. The lake should be re-surveyed in five years to evaluate gorwth rate and average size relative to the numbers of fish planted.



LAKE ABUNDANCE

Location:	T3S R11W S7
Elevation:	8600'
Area:	7 acres
Max. Depth:	35'
Drainage:	Canyon Creek
Scale:	1 in. = 220'

Lion Lake

Planting History

Year	Species	Number	Size
1934	Rb	27,000	Fry
1946	Rb	5,280	2"
	YCt	4,480	1"
1949	YCt	7,260	1"

Description and Fish Population

Lion Lake is a small relatively deep lake located at the head of the Lion Creek drainage. Specific conductance (31.5 umhos/cm) and bicarbonate alkalinity (19.7 mg/l) were both above average and indicative of a relatively productive environment. Spawning habitat appeared adequate in both inlet and outlet streams.

Lion Lake received introductions of rainbow and cutthroat trout in the 1930's and 1940's. In 1946, both species were stocked in the lake. Despite this high potential for hybridization, a 1967 sample collected trout which apparently were unhybridized rainbow.

The 1983 sample collected both rainbow trout and rainbow X cutthroat hybrids, however, the sample was dominated by rainbow. Rainbow trout of all age groups were collected indicative of adequate natural reproduction. Rainbow trout growth, maximum size and condition were good, although not exceptional, compared with other lakes in the vicinity. Age I fish averaged 5.4 inches while age II = 8.2 in., age III = 10.5 in. and the age IV and older fish averaged 13.9 inches. The relatively slow growth of the age I fish compared to the other age groups may be due to late spawning dates at high altitude.

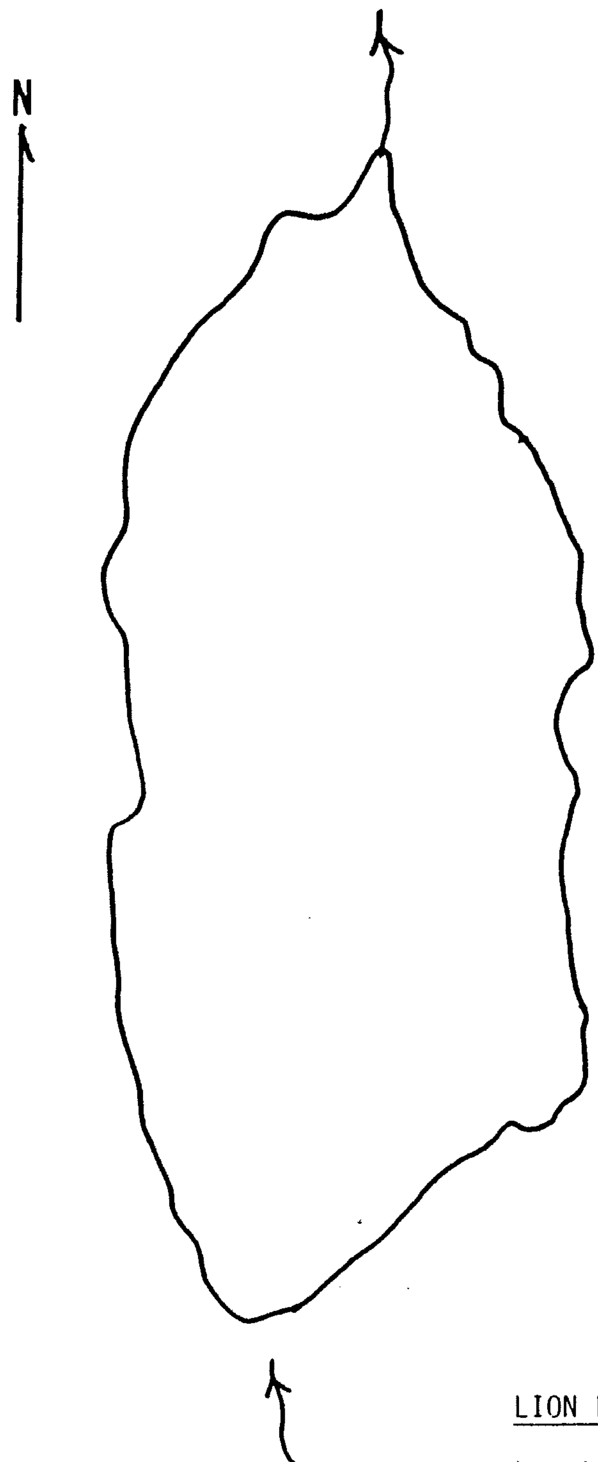
Fisherman logs in 1975 and 1980 reported good catch rates of 1.3-3.0 fish per hour. The reported catch consisted of fish averaging 10.5-11.0 inches in length.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Condition
1967	Rb	4.0	10.2 - 14.4	12.3	0.64	34.2
1983	Rb	17.0	5.1 - 14.7	10.3	0.50	38.7
	Rb X Ct	2.0	7.9 - 15.5	11.7	0.79	38.8

Management Suggestions

Lion Lake should be managed as a wild rainbow trout fishery. Natural reproduction is adequate to stock the lake at current harvest levels. The population exhibited good growth and condition and appeared to maintain a good balance between recruitment and mortality.



LION LAKE

Location: T3S R11W S17
Elevation: 8840'
Area: 10 acres
Max. Depth: 32'
Drainage: Lion Creek
Scale: 1 in. = 220'

Scott Lake

Planting History

No record of any fish plants exists for Scott Lake.

Description and Fish Population

Scott Lake is a small (8 acre) lake located at the head of Estler Creek. It was the only Pioneer Lake surveyed that is located in the Beaverhead River drainage. Water chemistry analyses indicated that Scott Lake is a relatively productive water with specific conductance (39.8 umhos/cm) and bicarbonate alkalinity (22.1 mg/l) well above average for Pioneer lakes.

While no planting record exists for Scott Lake, it supports low numbers of large rainbow trout of unknown origin. Fisherman logs from 1971-73 reported catch rates of 0.2 to 0.3 fish per hour for 14 to 16 inch rainbow trout. Log summaries from 1978-79 and 1982 reported catch rates of 0.0 fish per hour.

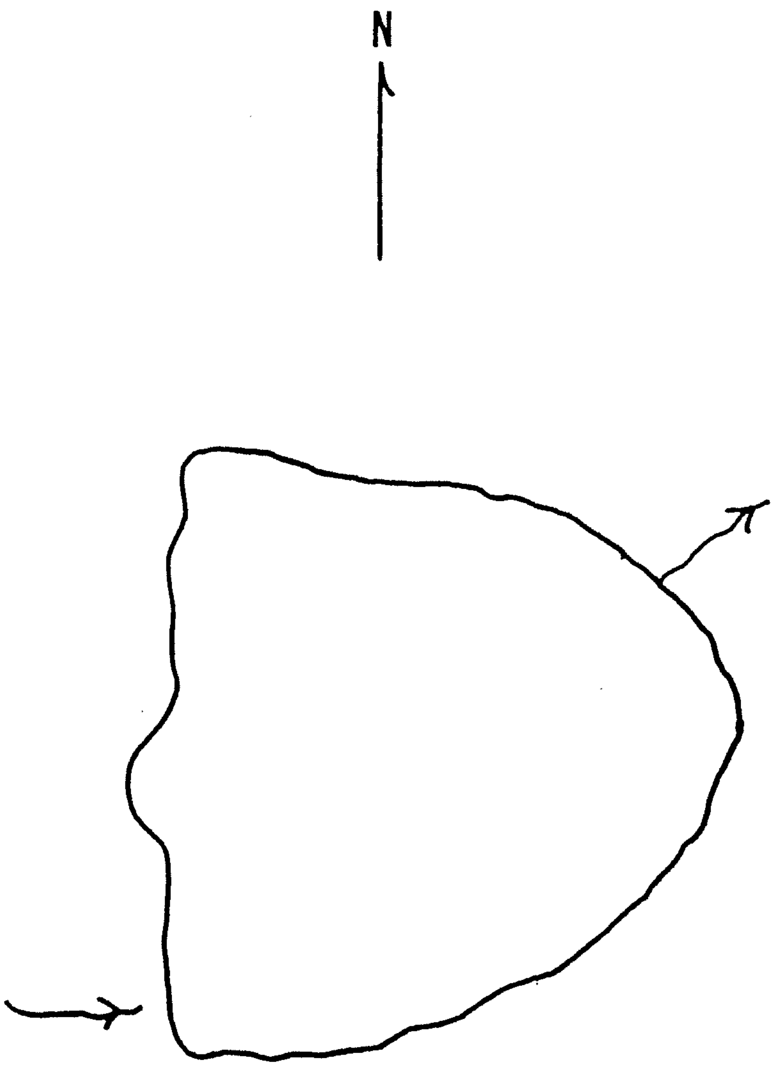
The 1983 survey yielded one large rainbow trout which weighed nearly 4¼ pounds. Apparently some natural reproduction in an extremely limited portion of the inlet or outlet is possible in Scott Lake. This reproduction, however, does not appear adequate to stock Scott Lake to its productive potential or to support a sport fishery. A recent landslide observed during the 1983 survey may have further restricted and spawning habitat in the inlet stream.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Condition
1983	Rb	1.0	21.2	21.2	4.24	44.5

Management Suggestions

Scott Lake should be planted with rainbow trout every five years. Due to its productivity and capability of producing large rainbow trout, Scott Lake should be managed as a trophy fishery. As such, the lake should be stocked at a rate of 50-60 fish per acre to insure continued good growth and avoid overcrowding.



SCOTT LAKE

Location:	T5S R11W S30
Elevation:	8700'
Area:	8 acres
Max. Depth:	Unknown
Drainage:	Estler Creek
Scale:	1 in. = 220'

Tendoy Lake

Planting History

Year	Species	Number	Size
1968	MYCt	2,120	3"
1971	MYCt	2,028	3"
1976	MYCt	2,062	2"
1981	MYCt	1,007	2"

Description and Fish Population

Tendoy Lake is a relatively large (21 acres) and extremely deep (98 ft.) lake located at the head of the Willow Creek drainage. At an elevation of 9,240 feet, it is the highest lake fishery in the Pioneer Mountains and one of the highest fisheries on the Beaverhead Forest. A dam was constructed on the lake for irrigation pruposes but was breached and is currently inactive. Specific conductance (16.0 umhos/cm) and bicarbonate alkalinity (8.4 mg/l) were below average for Pioneer Lakes.

Tendoy Lake received its first introduction of McBride Yellowstone cutthroat trout in 1968 and has been exclusively stocked with the strain to the present. A 1972 survey collected 20 age I McBride cutthroat from the 1971 plant. These fish exhibited excellent growth averaging 9.2 inches. A 1971 creel check revealed age III McBride cutthroat from the 1968 introduction which averaged 14.4 inches, again indicative of excellent growth.

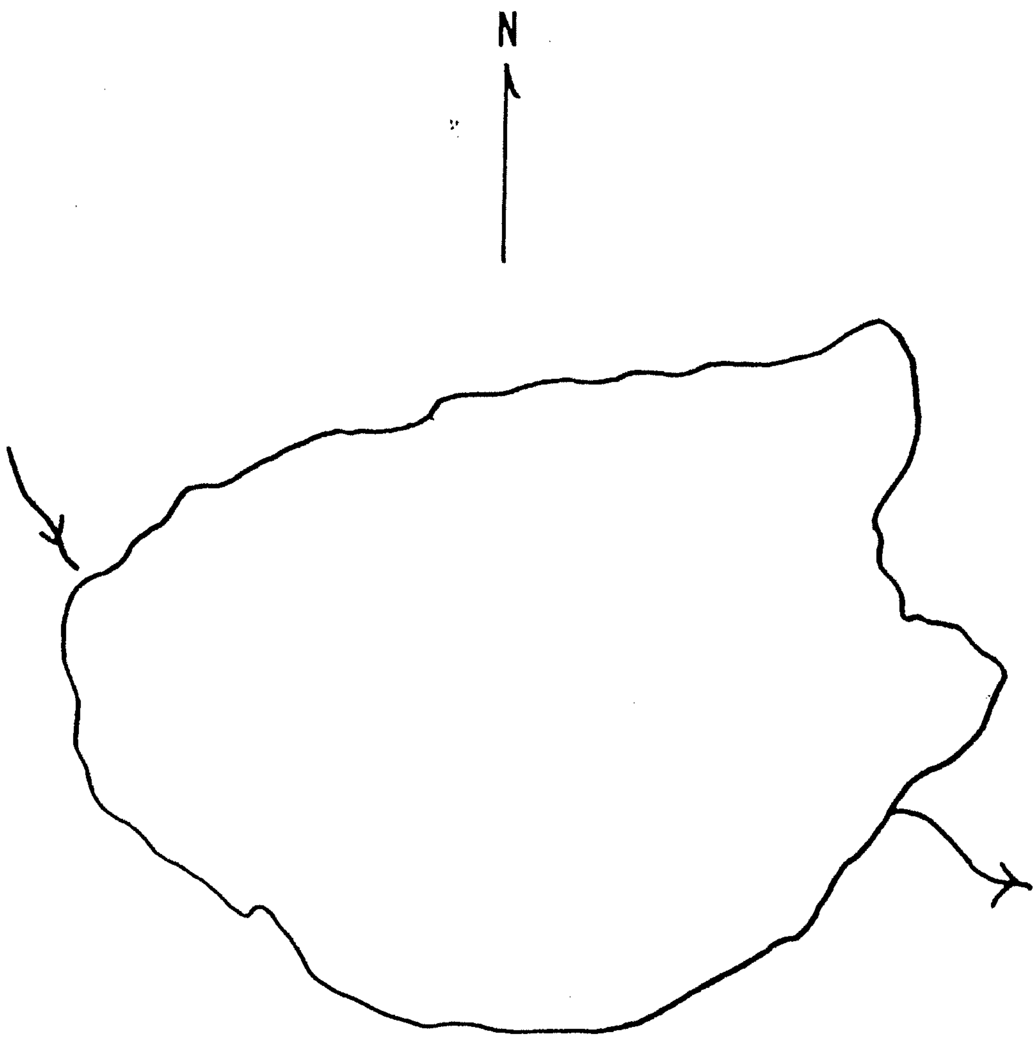
The 1983 survey resulted in the collection of a sample dominated by age II McBride cutthroat from the 1981 plant. These fish averaged 10.0 inches and were in above average condition relative to other Pioneer Lakes. The sample also contained one large (16.6 inch) fish which may have been a survivor from the 1976 plant and an age III fish (13.9 inch) apparently the result of natural reproduction. While some natural reproduction may occur in Tendoy Lake, the spawning habitat appears extremely limited due to steep inlet gradient. Natural reporduction does not appear adequate to sustain the fishery.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Condition
1972	MYCt	10.0	7.0 - 10.7	9.2	0.28	34.4
1983	MYCt	12.0	8.6 - 16.6	10.9	0.59	40.2

Management Suggestions

Tendoy Lake should be planted with McBride Yellowstone cutthroat trout every five years at a rate of 50-100 per acre. The lake should provide excellent fishing in 1985.



TENDOY LAKE

Location:	T4S R11W S4
Elevation:	9240'
Area:	21 acres
Max. Depth:	98'
Drainage:	Willow Creek
Scale:	1 in. = 330'

Vera Lake

Planting History

Year	Species	Number	Size
1949	YCt	7,260	1"

Description and Fish Population

Vera Lake is a small (5 acre) shallow (10 ft.) lake located in the Lion Creek drainage. The lake is surrounded by timber and has no perennial inlet. Water analysis revealed slightly above average specific conductance (25.3 umhos/cm) and bicarbonate alkalinity (16.2 mg/l) for Pioneer Lakes.

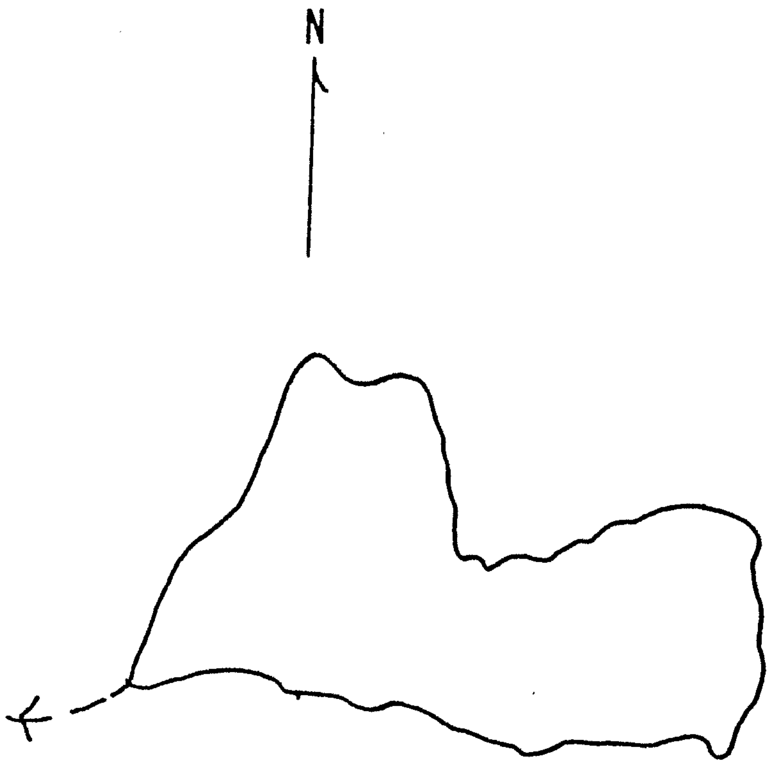
Vera Lake received a single plant of cutthroat trout in 1949. A 1967 sample revealed the presence of rainbow X cutthroat hybrid trout in relatively low numbers. These fish were age I, II and III indicating that natural reproduction was possible. The 1983 sample resulted in the capture of no fish which may indicate that Vera Lake is presently barren.

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Condition
1967	Rb X Ct	4.0	6.1 - 12.9	8.7	0.33	36.6
1983	--	0.0	--	--	---	--

Management Suggestions

It is not presently known if Vera Lake can sustain a viable fishery. Its shallow depth and lack of a good flowing inlet stream may make it susceptible to winter kill. Vera Lake should be examined on the ground to ascertain whether rainbow trout from Grayling Lake could reach Vera Lake via outlet streams. If this is possible, Vera Lake should be stocked on a trial basis with rainbow trout at a rate of 50 per acre. If a barrier exists between Grayling and Vera Lakes, then Vera Lake should be stocked with McBride cutthroat trout, on a trial basis, at a rate of 50 per acre. If either species is planted, immediate followup sampling should occur in two-three years to ascertain the success or failure of the introduction. If such a plant fails, Vera Lake should be abandoned as a fishery.



VERA LAKE

Location:	T3S R11W S16
Elevation:	8700'
Area:	5 acres
Max. Depth:	10'
Drainage:	Lion Creek
Scale:	1 in. = 220'

Waukena Lake

Planting History

Year	Species	Number	Size
1959	Rb	6,000	1"
1960	Rb	6,000	1"
1963	Rb	1,500	2"
1965	Rb	1,500	4"
1976	MYCt	1,513	2"
1979	MYCt	1,000	2"

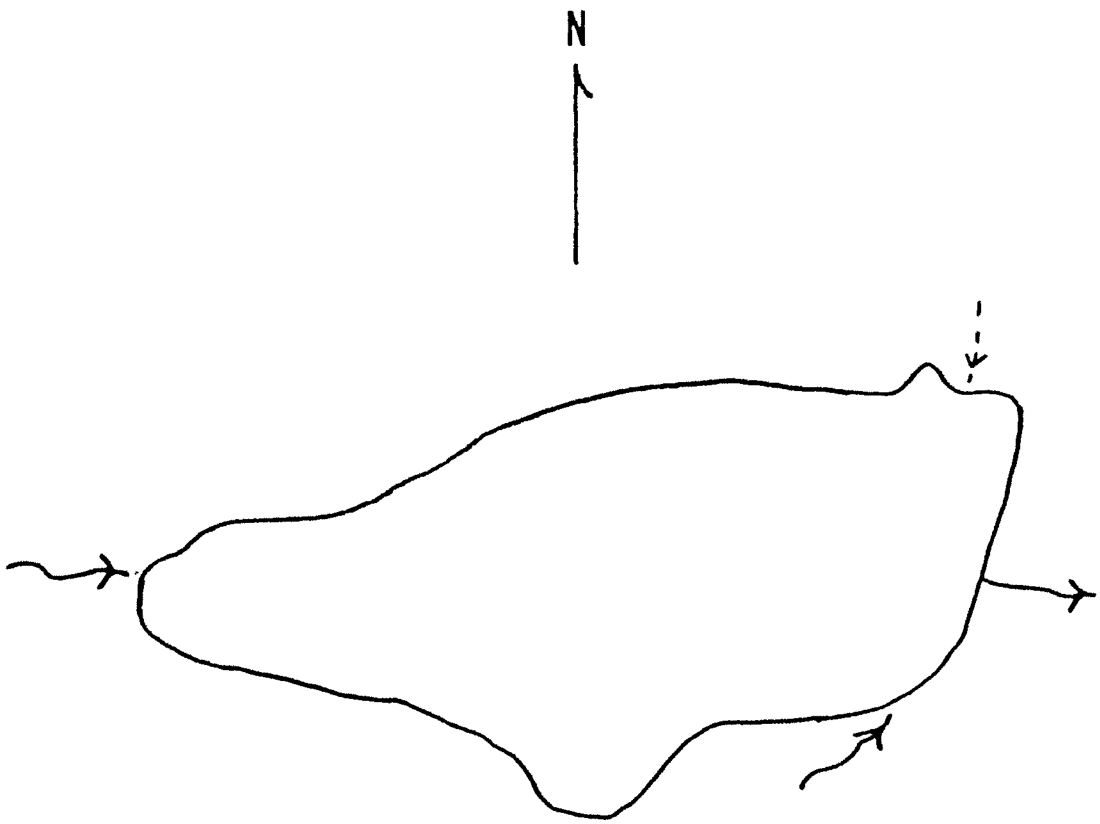
Description and Fish Population

Waukena Lake is a large (35 acre) body of water located at the head of the Rock Creek drainage. The lake holds a relatively large percentage of littoral zone, indicative of good productivity, and has a maximum depth of 35 feet. Specific conductance (21.8 umhos/cm) and bicarbonate alkalinity (12.3 mg/l) were slightly below average for Pioneer Lakes. An active dam, built for irrigation purposes, forms the lower boundary of the lake. Waukena Lake is fed by two major inlets which appear to have suitable gravels and gradient for spawning although this habitat is confined to relatively short reaches of the streams. Adult trout have been observed in both streams during the spawning season.

Waukena Lake was sampled in 1958 and found to be barren of fish. In the period spanning 1959-1965, Waukena Lake was stocked with rainbow trout. In 1976 and 1979, the lake received introductions of McBride Yellowstone cutthroat trout. It is interesting to note that a 1972 sample, prior to the introduction of cutthroat trout, collected a single 16.1 inch fish identified as a cutthroat.

The 1983 survey documented the survival and growth of McBride cutthroat in Waukena Lake. Four McBride cutthroat from the 1979 plant were captured. These fish exhibited excellent growth averaging 16.2 inches and nearly two pounds at age IV. Condition of the fish was superior ranking among the highest observed in Pioneer Lakes. The sample also contained two rainbow X cutthroat hybrids age I and II, indicative that some natural reproduction occurs in Waukena Lake.

Waukena Lake supports a popular sport fishery with frequent reports of catches of trophy trout. Fisherman Logs for 1966 and 1980 reported catch rates as high as 1.0 fish per hour for McBride cutthroat averaging 15.8 inches and rainbow trout averaging 12.0 inches.



WAUKENA LAKE

Location: T3S R11W S22
Elevation: 8666'
Area: 35 acres
Max. Depth: 35'
Drainage: Rock Creek
Scale: 1 in. = 500'

Sampling History

Year	Species	No./ Net	Length Range (in.)	Ave. Length (in.)	Ave. Wt. (lbs.)	Ave. Condition
1958	--	0.0	--	--	--	--
1972	Ct	1.0	16.1	16.1	1.74	41.7
1983	MYCt	4.0	15.0 - 17.1	16.2	1.94	45.5
	Rb X Ct	2.0	6.3 - 13.8	10.1	0.57	43.4

Management Suggestions

Waukena Lake should be restocked with McBride Yellowstone cutthroat trout every five years at a rate of 50-100 per acre. The lake should be managed as a trophy cutthroat trout fishery. An on-the-ground survey of the two major inlet streams should be conducted to determine if anything can be done to improve spawning habitat or conditions. The lake should be sampled periodically to monitor interactions between stocked McBride cutthroat and wild populations, effects of fishing pressure, stocking rates and possible natural reproduction of McBride cutthroat. Waukena Lake should provide excellent cutthroat trout fishing in 1984 and 1985.

LITERATURE CITED

McMullin, S. L. 1983. Wise River District Mountain Lake Survey, 1982. USFS Rpt., Bvhd. Nat. Forest. 31 pp.

Wells, J. D. 1982. West Big Hole Mountain Lake Survey, 1981. USFS Rpt. Bvhd. Nat. Forest. 44 pp.

USFS, 1982. Beaverhead National Forest Proposed Land Management Plan. USDA, USFS, Bvhd. Nat. Forest. 216 pp.

Interagency Lake Database

Water Codes

Canyon Lake	3-02-7550	Lion Lake	3-02-8400
Crescent Lake	3-02-7663	Scott Lake	3-01-9500
Gorge Lake (North)	3-02-7915	Tendoy Lake	3-02-9575
Gorge Lake (South)	3-02-7916	Vera Lake	3-02-9550
Grayling Lake	3-02-7975	Waukena Lake	3-02-9625
Lake Abundance	3-02-7100		