MONTANA FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

State:	**MONTANA**	**Element 1:**	**FISHERIES MANAGEMENT**
Project No:	**F-113-R-1, 2, 3, 4, 5**	**Job No:**	**3531, 3520, 3530**
Project Title:	**STATEWIDE FISHERIES MANAGEMENT PROGRAM**	**Job Title:**	**SOUTH CENTRAL MONTANA COLDWATER FISHERIES INVESTIGATIONS**

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Project Period: July 30, 2000 – Feb 28, 2005

ABSTRACT

Cooney Reservoir is managed as a mixed trout and walleye fishery. Walleyes continue to control the sucker population through effectively cropping nearly all sub-adult suckers, thus preventing recruitment. Black crappie numbers in Cooney have been effectively controlled through walleye predation in the past, and predation may have completely eliminated the population. No black crappies have been captured during fall or spring sampling since 2001. Annual rainbow trout stocking rates have been increased from 100,000 in the late 1980's to 150,000 from 1990 through 1995, to an average of 200,000 from 1996 to 2000, and a peak of 300,000 in 2003. Despite increased stocking, survival to first fall has steadily declined since 2001. Sampling in 2002, 2003 and 2004 suggests that the rainbow trout population is at an all time low. Only 6 rainbow trout were captured in fall 2003 gill nets, and only two were captured in 2004, both longer than 18 in. While the rainbow trout population is in poor condition, the walleye fishery continues to provide excellent angler opportunity for eating-sized and trophy-sized fish. The walleye stocking rate was reduced from 100,000 to 50,000 per year in 2000. Despite lower stocking rates the population is healthy. The lower stocking rate appears to be allowing greater survival of juvenile suckers, as a slight decrease in the average sucker size was noted during 2003, and suckers under 10 in are becoming more common in the reservoir.

Deadmans Basin Reservoir has been impacted by ongoing drought conditions since the winter of 1998. Water levels in the reservoir, which have not exceeded 34% of full volume since the 2000 irrigation season, have been drawn down to around 9,000 AF (or about 11% of full pool) each summer since 2000. A three-year program of stocking tiger muskies into Deadmans Basin as a biological control on suckers was completed in 2000, just as drought conditions became serious in the reservoir. Low water levels concentrated the prey base for the tiger muskies. These

predators have reduced sucker numbers more than originally hoped. The coldwater fishery in Deadmans has responded favorably to the reduction in the sucker population. Tiger muskies are growing well, and an increasing number of Deadmans' anglers are specifically targeting these trophy fish.

Aerators donated by local sporting groups and installed at Laurel Pond have been very effective at abating the chronic fish kills that have plagued the pond. Since their installation in 2001, there has not been a fish kill. The lack of fish kills, however, has increased the number of undesirable fish species in the pond. Netting in 2004 suggested that over-winter survival and condition of stocked rainbow trout was good. Growth of stocked trout is slow, but the condition of these fish is good. This slow growth is likely related to warm summer water temperatures. Goldfish were confirmed present in the pond along with lake chubs.

East and West Rosebud and Emerald lakes were sampled from 2001 to 2004. The brook trout in East Rosebud Lake have nearly disappeared, while the brown trout appear to be thriving. The rainbow trout stocked in the lake show limited year-to-year survival, suggesting that they are either heavily harvested by anglers or eaten by large brown trout. West Rosebud Lake continues to support a relatively robust brown trout fishery. Brook trout numbers increased substantially during 2001 and 2003 to levels equal to the brown trout. Similar to East Rosebud Lake, the stocked rainbows appear to show limited year-to-year survival, yet appear to be providing a winter ice fishery in the lake.

Lower Glaston Reservoir in Sweet Grass County was sampled during 2002 to determine the status of the fishery. Tiger muskies had been stocked in the reservoir in an attempt to control the sucker population that competed with stocked trout. Sampling suggested that sucker numbers have declined substantially since the introduction of muskies, making the reservoir more suitable for salmonid growth. An attempt was made to open public access to the reservoir though an agreement between the Big Timber Boat Club and Montana Fish, Wildlife & Parks (FWP) under the Private Lands Fishing Access program. An agreement could not be reached; therefore, the reservoir will not be managed by FWP.

Otie Reservoir was sampled in 2003 and found to have a very large population of white suckers. Growth rates of rainbow trout stocked in 1999 were slow, suggesting that trout are competing with suckers for food. The average size of a 4-year-old rainbow in the pond was 16.3 in. In fall 2003 and spring 2004, over 3,500 white suckers were mechanically removed from the reservoir using trap nets. An Environmental Assessment (EA) was prepared to chemically treat the reservoir to remove white suckers and rainbow trout and restore Yellowstone cutthroat trout. The pond and inlet stream were treated in October of 2004. Further, the landowner signed a Private Lands Public Fishing Access agreement for 5 years ensuring access to the pond. Working cooperatively with Montana State University, FWP fenced the stream feeding the pond from livestock, and a stock-watering area was created. These enhancements, along with future in-stream work, should facilitate natural reproduction of cutthroat trout and eliminate the need for future stocking.

Twenty-nine black crappie were captured in Lake Josephine in Billings and transported to Nelson's Farm Pond near Luther. The success of this wild fish transfer has not yet been evaluated.

A four-person crew backpacked into 127 alpine lakes in the Absaroka-Beartooth Mountains in 2001, 2002 and 2003. The crew sampled lakes in the Boulder River, East Rosebud Creek, West Rosebud Creek, Stillwater River, Rock Creek, and Clark's Fork Yellowstone River drainages. The crew also sampled 8 lakes in the Crazy Mountains, using a combination of backpacking and helicopter transport.

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Existing Fish, Wildlife & Parks (FWP) water rights and water reservations for the Yellowstone and Missouri rivers are protected through FWP review of new water use permit applications.

Stream banks and channels are protected from poorly designed projects through FWP administration of the Stream Protection Act (124) and participation in the Natural Streambed and Land Preservation Act (310 Law).

Water discharge permits issued by the U.S. Environmental Protection Agency (EPA) and the Montana Department of Environmental Quality are reviewed, and comments are offered. Timber sale plans, grazing allotment management plans, subdivision plans, environmental assessments and environmental impact statements are also reviewed to ensure adequate protection, mitigation, and compensation of fisheries resources.

Stream-dwelling trout population densities are monitored using electrofishing methods described by Vincent (1971). Other electrofishing surveys are conducted as needed to address specific needs using standard methods. Spot creel checks are conducted to determine catch rates and angler satisfaction with regulations. Regulations are adjusted as necessary to help achieve desired fish population levels. In an effort to improve access, riverfront properties that become available for sale are investigated for potential as fishing access sites.

Lake and reservoir trout populations are monitored through standardized gillnet sets, trap netting, and electrofishing surveys. To obtain an adequate evaluation of the fishery in Cooney Reservoir, standardized electrofishing surveys are conducted in the spring, and standard gill/trap net sets are performed in the fall. Past sampling has indicated that because of differences in the distribution of age classes of fish and the distribution of different fish species, it is necessary to sample using the two methods at two different times of the year to obtain an adequate assessment of the fishery. When spring electrofishing samples have yielded few trout, gillnets have also been used to sample fish in the spring. During the winter of 2003-2004, a single gill net was set under the ice to evaluate the potential for using this technique to sample fish during the winter.

Two strains of rainbow trout are currently stocked into Cooney Reservoir, i.e. Eagle Lake and Arlee. A study was initiated in 2001 in an attempt to determine if one strain survived and grew better than the other. A combination of tetracycline marks, produced by feeding hatchery fish tetracycline-laced food, and adipose clipping were performed to distinguish the two strains after stocked into the reservoir. When fish are fed with tetracycline the ensuing bone growth will fluoresce under black light. Whole heads or otoliths were removed from captured trout from 2001 to 2003 to check for the tetracycline mark. The survival of stocked trout was tested using a chi-square tests to compare the proportion of fish captured to the expected proportion based on stocking rates and equal survival rates of both strains. Non-parametric t-tests were run to compare the length and weight of adipose- and non-adipose-clipped fish during fall 2001 and spring 2003.

Four temporary employees, working from mid-July to September, collected fisheries information from high mountain lakes using a standardized sampling protocol (Stiff, 2000) to update our lake computer database, and for periodic updates to the drainage management plans. Angler success is assessed through spot creel checks by fisheries and enforcement personnel. Genetic and disease samples were collected from Yellowstone cutthroat trout in Goose Lake (Stillwater River drainage) as part of a study to determine the suitability of incorporating cutthroat trout from Goose Lake into the brood stock at the Yellowstone River Trout Hatchery in Big Timber. Eggs were collected from golden trout at Cave Lake in the Crazy Mountains for potential use as an egg source for stocking other golden trout lakes in Montana.

RESULTS AND DISCUSSION

Cooney Reservoir

Cooney Reservoir is one of the most heavily fished waters for its size in Montana (approximately 778 surface acres at full pool). Its close proximity to Billings, Laurel and many smaller towns, along with its two-story trout/walleye fishery, draw many anglers and other recreationists. Fishing pressure estimates collected from our statewide mail survey (FWP, 1997, 1999, 2001) decreased 8%, from 42,853 angler-days in 1997, to 39,386 by 1999. In 2001, 21,083 angler days were spent at Cooney Reservoir, which is a reduction of 50% from 1997 estimates. Anecdotal observations have suggested that angling pressure may have declined, but not as severely as the estimates suggest. Because of the drought, access (particularly boat access) to other area reservoirs, such as Bighorn Lake and Deadmans Basin Reservoir, has been limited. Cooney, meanwhile, has maintained water levels sufficient for launching boats during most of the summer.

Current management of the reservoir is for a mixed trout and walleye fishery. Rainbow trout are stocked annually in the spring. Walleye were first introduced in 1984 in an effort to control the overly abundant white sucker population. The high density of white suckers led to competition with and retarded growth rates in stocked trout. Starting in 1984, one million fry were stocked for three consecutive years, and within 4 years the walleye population was large enough to effectively crop off all juvenile sucker recruitment in the reservoir. In the past, the rainbow/ walleye fishery has been surprisingly successful in providing a two-tiered fishery while controlling the numbers of white suckers. Growth rates and condition factors on stocked rainbow trout are excellent in Cooney, and there is a good fishery for average and trophy-sized walleye in the reservoir.

Rainbow trout

Rainbow trout are stocked into Cooney Reservoir annually at relatively high densities. Trout plants have increased from an average of 100,000 before 1989 to 150,000 in the 1990's, which resulted in increased angler harvest of fish. The increase in stocking rate was intended to help amplify the number of fish surviving their first year and to provide for a better ice fishery. Fish plants were increased to 201,000, 277,000 and 318,000 in 2001, 2002, and 2003 respectively, in an effort to improve rainbow return to creel. Fall gillnetting, however, indicated that the numbers of trout surviving their first summer in the reservoir had been steadily declining. In fact, of the 220,000 fish stocked in 2004, none were caught in fall gill nets (Figure 1). Two larger fish, likely from the 2002 fish plant, were captured. The number of rainbows sampled during fall has varied from 62 in 1995 to as low as 2 in 2004. The high stocking rates have not resulted in increased recruitment of fish to age 1. Despite the decrease in numbers, the mean length of age-0 rainbow trout collected in fall sampling has remained fairly consistent since 1999, varying from 11.7 to 12.2 in (Table 1). Those trout that do survive grow quickly. The average size of stocked rainbow trout in the spring (late April and early May) is 5.4 in, and by October the fish average 12.2 in and 0.80 lb.

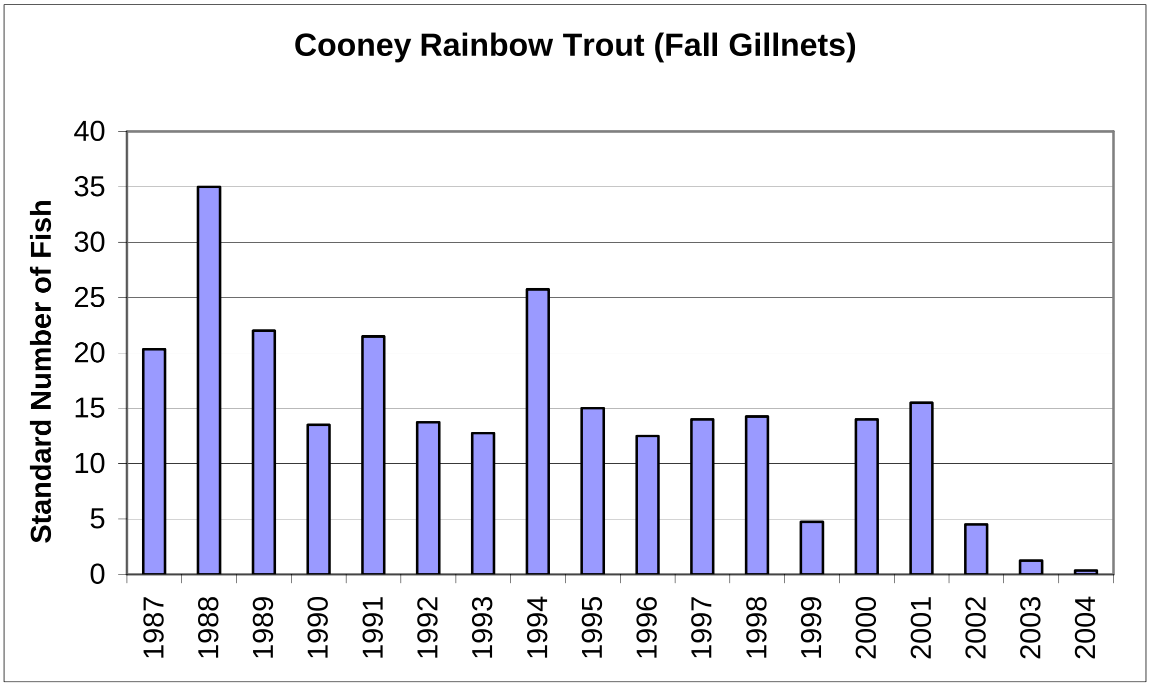


Figure 1. Standard number of fish (number of fish captured/number of nets set) captured in fall gillnets set in Cooney Reservoir.

Table 1. Rainbow trout collected in fall gillnets and during spring electrofishing in Cooney Reservoir 2000-2004.

			Fall Gillnetting			
Year	**Number caught**	**Catch per net**	**Average length (in)**	**Average weight (lb)**	**Number > 14 in**	**Length range (in)**
2000	26	6.5	13.8	1.2	7	11.8-18.9
2001	52	14.0	13.0	1.00	14	9.8-18.3
2002	18	4.5	14.4	1.32	10	11.3-18.6
2003	5	0.8	14.2	1.50	1	12.5-18.5
2004	2	0.3	18.3	2.70	2	18.0-18.5

Table 1. (Cont'd) Rainbow trout collected in fall gillnets and during spring electrofishing in Cooney Reservoir 2000-2004.

			Spring Electrofishing			
Year	**Number caught**	**Catch per net**	**Average length (in)**	**Average weight (lb)**	**Number > 14 in**	**Length range (in)**
2001	32		14.7	1.59	10	11.4-18.5
2002	53		13.7	1.23	5	9.7-18.5
2003	28		15.5	1.75	14	12.6-19.0
2004	21		13.6	1.27	6	7.6-21.1

Spring electrofishing in the reservoir and inlet streams provides an index of survival of rainbow trout through the winter. One of the objectives of increasing stocking in the reservoir is to provide a winter ice fishery. Unfortunately, higher stocking rates have not led to increased winter carryover, and spring electrofishing surveys follow the same trend as fall gillnetting (Figure 2). Winter survival appears to be good in the reservoir and fish emerge from winter in excellent condition. Sub yearling fish in Cooney grow an average of 1.7 in and 0.45 lb. from October to April.

Both gillnetting and electrofishing data suggest that the 2001 plant was the most successful plant during 2000-2004. Survival to the first fall was good, as evidenced by the large number of fish captured in gill nets in 2001 (Table 1). Those fish also survived the winter well, as shown by the high numbers captured during spring 2002 electrofishing. Of the 53 fish captured, only 5 were greater than 16 in. The same cohort of fish formed the bulk of the catch in the fall 2002 netting (10 of the 18 fish captured) and the spring 2003 catch. The spawners from the 2001 plant and their wild offspring formed all of the catch in both gill nets and electrofishing in 2004. The trend is demonstrated in Figure 2 by the decline in numbers of fish netted and electrofished from 2001. The slight increase in numbers electrofished in 2004 were juvenile wild fish captured in Red Lodge Creek. It appears that once fish reach their first fall, survival is very good in Cooney thereafter. High mortality of juvenile fish suggests predation from natural predators rather than over-harvest by anglers.

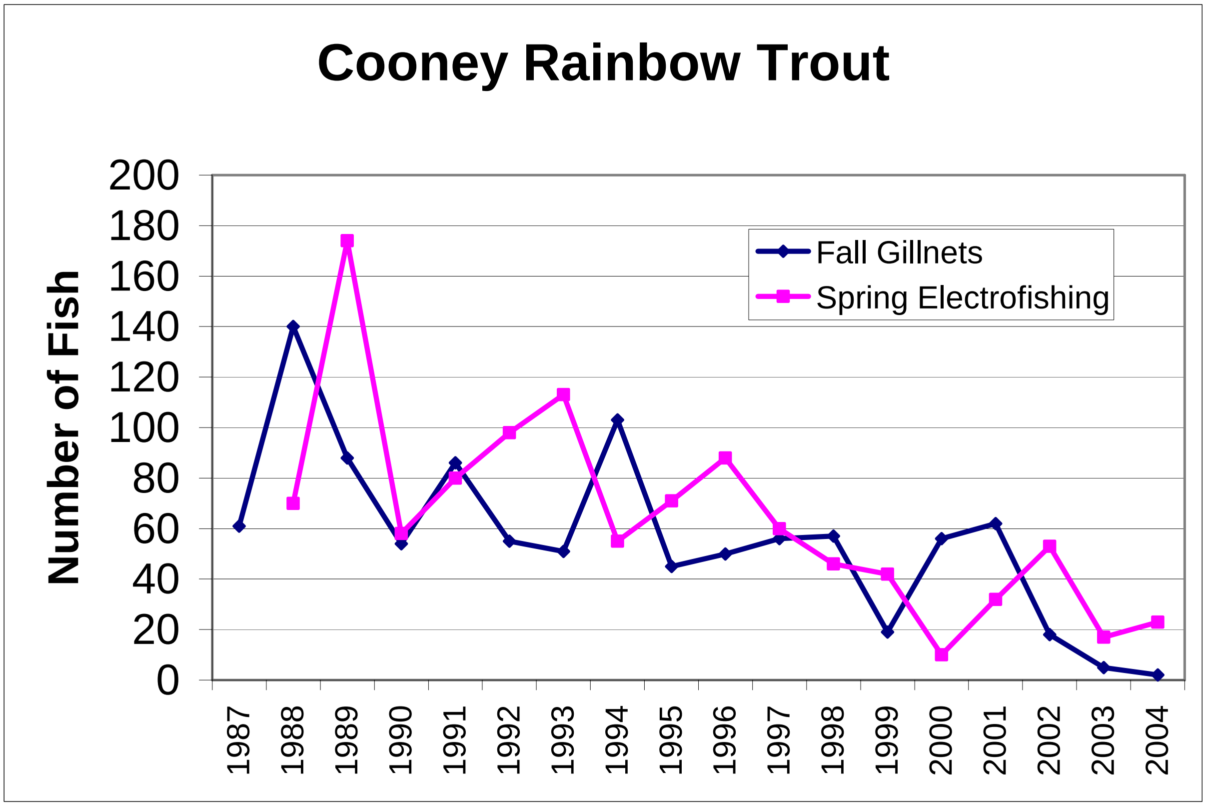


Figure 2. Total number of rainbow trout from spring electrofishing and fall gillnetting in Cooney Reservoir.

When recent fall data suggested that rainbow trout numbers were low in the fall, additional gill nets were set in the spring of 2003 and 2004 to verify the data. In 2003, 18 rainbows, ranging from 11.3-18.6 in, were caught among 4 gillnets. Only 8 of the 16 fish captured were from the spring 2002 plant. In 2004, 3 rainbows were captured ranging in size from 10.9-13.3 in (all from spring 2003 plant). Although more fish were captured in the spring than the fall in both years, it was evident from the data that survival of stocked rainbows was quite low each year.

To determine if there was a difference in survival and growth of the Eagle Lake and Arlee strains of rainbow trout stocked into Cooney, fish were marked using a tetracycline feed and an adipose clip. All Arlee rainbow trout from 2001 to 2003 were given tetracycline feed prior to stocking. Fish in 2001 received a single mark, and fish stocked in 2002 received a double mark (tetracycline feed for a week, then normal feed for a week, then a second week of tetracycline feed). In addition, 31% of stocked Arlee rainbows were adipose-fin clipped in 2001. When fish were captured in the fall using gill nets, otoliths of non-clipped fish were extracted and viewed under a black light. Tetracycline-marked trout could not be distinguished from unmarked fish using otoliths. Generally tetracycline marks are distinguishable for at least 1 year, but not in this study. Tetracycline-marks were more distinguishable from whole heads because marks could be observed in the vertebrae connecting the spine to the head more readily than in the thin otoliths. Unfortunately, relatively few heads were preserved, making the sample size too small to determine if there were differences in survival between the strains.

Of the 199,896 Arlee rainbows stocked in 2001, 31% (62,000) had their adipose fin clipped. Also, 36,860 Eagle Lake rainbows were planted for a total of 263,756 trout. So, the total proportion of adipose-clipped fish in the population was 26%. Sampling in the fall suggested that there was no difference in the expected proportion of clipped fish to non-clipped fish (22%), and that there was no difference in length or weight between clipped and non-clipped fish (Table 2). Therefore, there was no difference in the survival of Arlee vs. Eagle Lake rainbows from stocking to their first fall. By the following spring, however, there was a marginal difference (p=0.065) in the number of adipose-clipped Arlee trout to non-adipose-clipped fish, suggesting that more Arlee fish survived to reach age 1 than the Eagle Lake fish. The length of adipose-clipped Arlee fish was also greater than that of non-adipose-clipped and, the weight was marginally greater (p=0.064), suggesting that growth over the winter was greater for Arlee fish. Even though 62,000 Arlee fish were clipped, 137,000 Arlee fish were not clipped, which is 3.7 times the number of Eagle Lake fish (also not adipose-clipped) stocked into the reservoir. Therefore, it is difficult to draw any substantial conclusions from these data. One point, however, is clear from the rainbow trout data collected: the 2001 plant survived better than any other plant from 2000-2004, and 85% of fish stocked that year were Arlee rainbows.

Table 2. Results of strain evaluation between Eagle Lake and Arlee rainbow trout stocked into Cooney Reservoir.

	Fall 2001			**Spring 2002**		
	Number	**Length**	**Weight**	**Number**	**Length**	**Weight**
Not Clipped	36	11.7	0.72	30	13.1	1.10
Clipped	10	11.6	0.70	17	13.6	1.23
Total	46	(0.051)*	(0.037)*	47	(0.023)*	(0.064)*
Percent clipped	21.7 (0.89)*			36.2 (0.065)*		

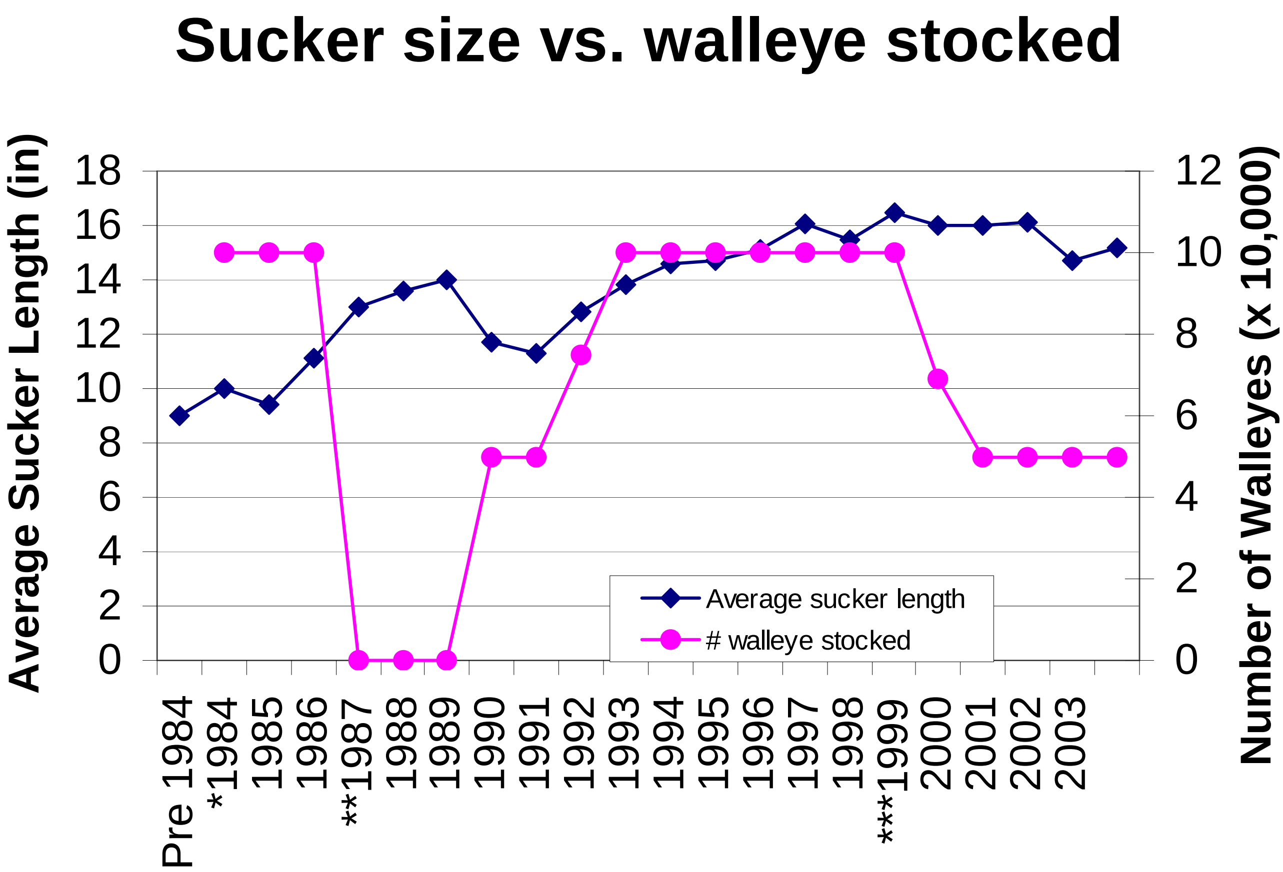
* Numbers in parentheses are the p values of the chi-square test (number of clipped vs. non-clipped) and the student's *t*-tests (comparison of length and weight of clipped vs. non-clipped fish).

<u>Walleyes</u>

Walleyes were first introduced into Cooney Reservoir in 1983 in an attempt to biologically control the white sucker population. Within a few years of introduction, the walleyes were performing their intended purpose; the numbers of smaller suckers began to decline dramatically, and the average size of suckers steadily increased (Figure 3). To determine if natural recruitment of walleye was occurring in the reservoir stocking ceased for three years from 1987-1989. Evidence of successful spawning was demonstrated by the presence of fry in the reservoir, but fry numbers were very low. There was no evidence from gill net data collected during those three years that there was any natural recruitment of walleye in the reservoir (i.e., there were no juvenile walleye 7-11 in captured in nets). It has been postulated that the high spring flows in Red Lodge and Willow creeks, and a lack of suitable-sized food in the reservoir for fry, may contribute to the observed lack of recruitment. With the lack of walleye stocking, average sucker size began to decrease. Walleye stocking resumed in 1990, and the average sucker size once again began to increase. This increase gradually reached an asymptote of average size at approximately 16 in. The increased sucker size is due to walleye predation on the smaller suckers. Walleyes are gape-limited predators, meaning they can eat almost anything they can fit in their mouth; therefore, only the larger suckers in the reservoir (> 14 in) are safe from walleye predation. Since 1987, walleyes have consumed nearly all the suckers produced each year. Even though walleyes are consuming the yearly recruitment into the sucker population, the total biomass of white suckers in Cooney has more than doubled since walleyes were introduced into the lake because average size has increased from 9 in to 16 in. A delicate balance has existed in Cooney between walleye predation on suckers and sucker recruitment from streams. Because of concern over the potential of the older, larger sucker population ageing out, the walleye stocking rate was cut in half from 2000 to 2001 to 50,000 fingerlings per year. These lower stocking rates may be leading increased sucker recruitment, as indicated by the slight decrease in average sucker size in 2003 and 2004, but it may take several years to determine if these reductions are sufficient to allow for additional recruitment of suckers.

The total number of walleye captured in gillnets varied from 30 in 2002 to 68 in 2004, with catch per net varying between 7.5 in 2002 to 16.3 in 2003. There is no discernable trend in walleye catch in gill nets or electrofishing from 2000 to 2004, and the population appears to be very similar to the past (Figure 4). Numbers of larger walleyes (fish over 16.0 in) sampled over the past five years in fall netting, usually conducted in mid-October, have varied from 4 to 12 with no consistent pattern of increase or decrease (Table 3). The increase in numbers of larger walleye captured in the spring of 2004 was related to increased electrofishing effort and the presence of more fish in the 16-22 in size range (Figure 5). Growth and survival of smaller walleyes (6.3-15.9 in) from fall sampling remains good, and the number sampled has ranged from 26 to 63, which is less than in previous years (Poore and Frazer 2000). During all five years, fingerlings planted in June at 1.2-1.4 in grew to a minimum length of 4.1 in by October, which is 2.2 in below the minimum size (6.3 in) sampled during the previous four years. These data suggest reduced growth of juvenile walleyes during their first year. A recent decline in the crayfish population in Cooney may be responsible for reduced juvenile walleye growth. Previous studies suggested that invertebrates form the majority of juvenile walleye diets during the summer (Venditti 1994). Despite slower growth, winter survival and carryover appears adequate to maintain recruitment into the adult population. Low reservoir levels, particularly during the recent drought, have undoubtedly concentrated fish and have made juvenile walleye more susceptible to predation by larger walleye. There is little cover habitat available in the reservoir, particularly at low pool elevations. Despite low water levels and the lack of habitat, there have been only minimal changes in juvenile walleye growth or relative abundance.

Figure 3. Lengths of white and longnose suckers compared to numbers of walleyes planted from 1983 to 2004.



* 1984-Walleye fry introduced into Cooney at rate of of 1 million/year (graphed numbers represent an approximation of fingerling numbers assuming 10% survival).

** 1987-Walleye stocking ceased for 3 years to evaluate natural recruitment.
1990-Walleye fingerlings were stocked rather than fry.

*** 1999-Walleye plant was reduced from 100,000 to 50,000 fingerlings.

Table 3. Walleye data from fall gillnetting and spring electrofishing in Cooney Reservoir.

Year	Number caught	Catch per net	Average length (in)	Average weight (lb)	Number > 16 in	Length range (in)
			Fall Gillnetting			
2000	41	10.3	12.5	0.75	5	8.0-33.7
2001	62	15.5	13.6	1.14	12	5.4-37.7
2002	30	7.5	11.8	0.74	4	4.9-24.4
2003	65	16.3	12.8	0.85	10	9.1-27.1
2004	68	11.3	11.7	0.83	5	6.9-27.4
			Spring Electrofishing			
2001	210		17.6	2.57	70	10.3-32.0
2002	138		20.8	3.70	55	11.2-31.4
2003	137		18.1	3.25	60	10.5-30.9
2004	312		17.5	2.49	165	11.2-31.3

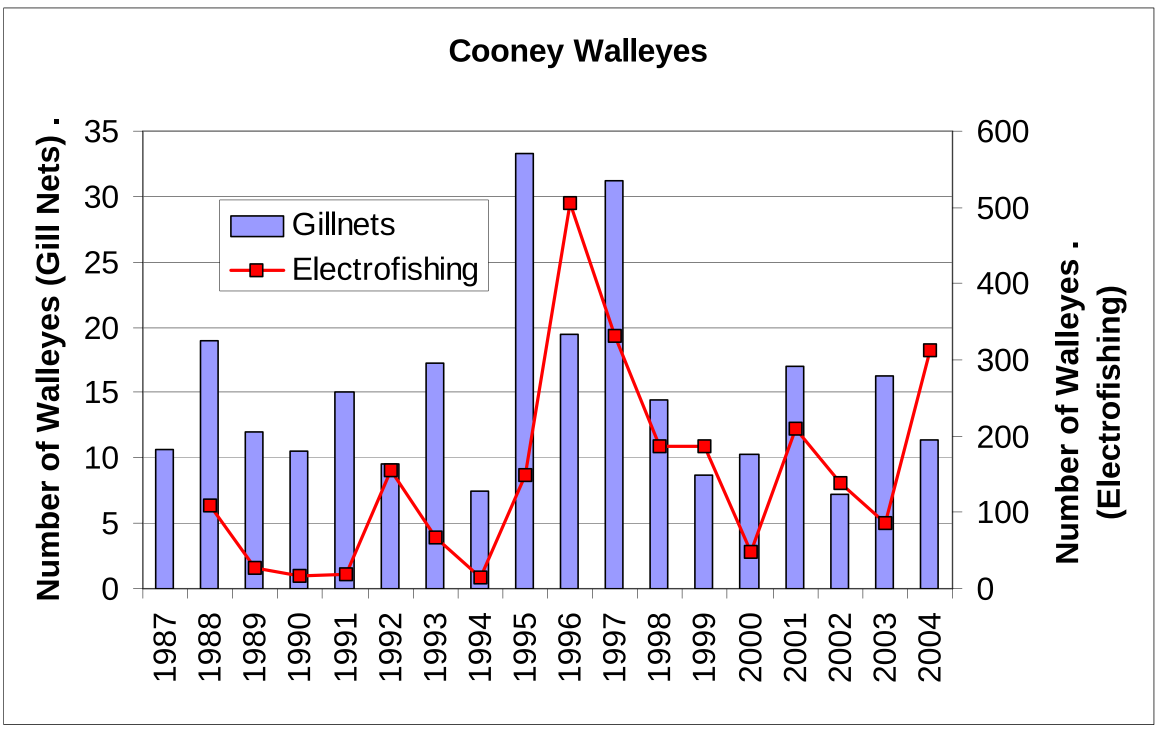
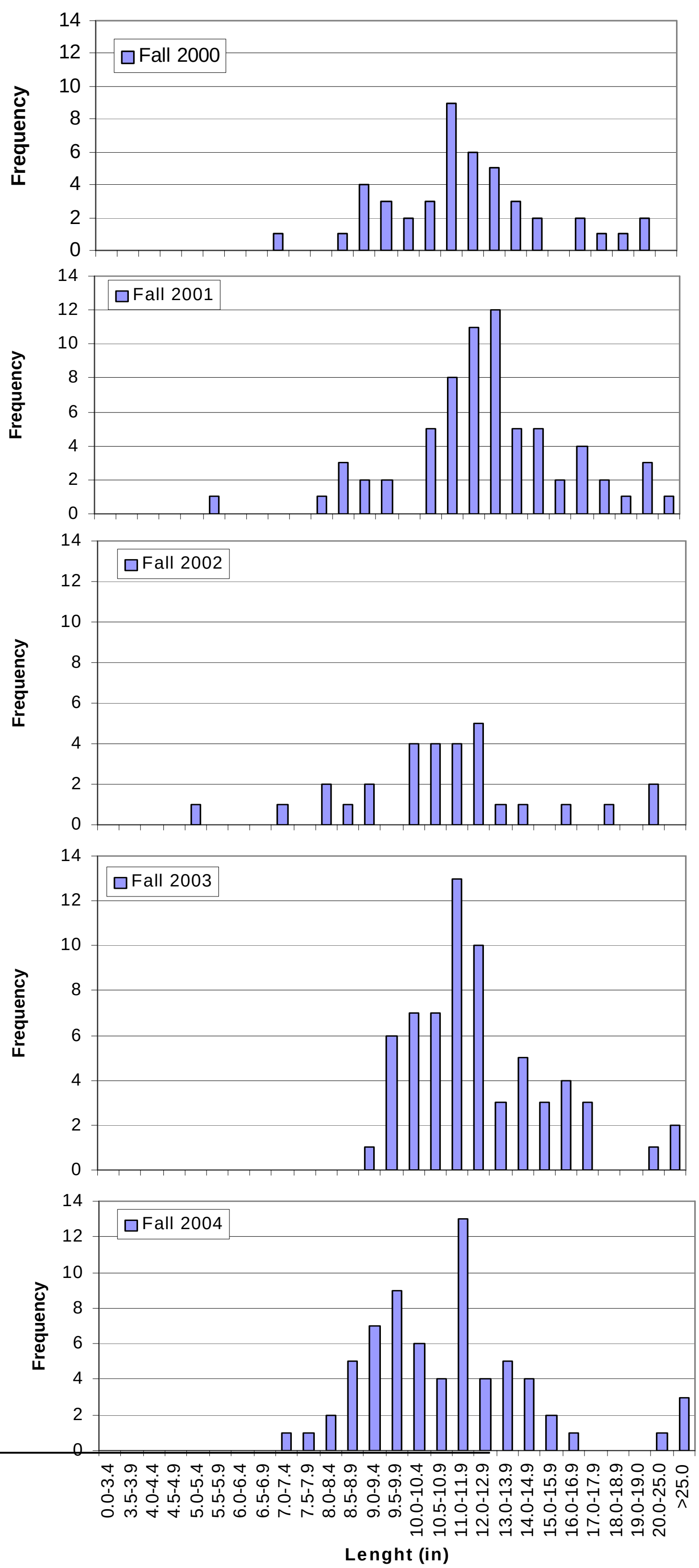


Figure 4. Fall gillnetting and spring electrofishing results for walleyes from 1987 to 2004.

Spring electrofishing and fall gillnetting provide different views of the population in the reservoir. Electrofishing done at night in the spring tends to catch larger fish because walleyes are moving into shallow areas at the mouths of the creeks to spawn. These data provide an index of the status of the adult fish population in the reservoir.

Length Frequency of Walleyes in Cooney Reservoir Fall Gillneting



Length Frequecy of Walleyes in Cooney Reservoir Spring Electrofishing

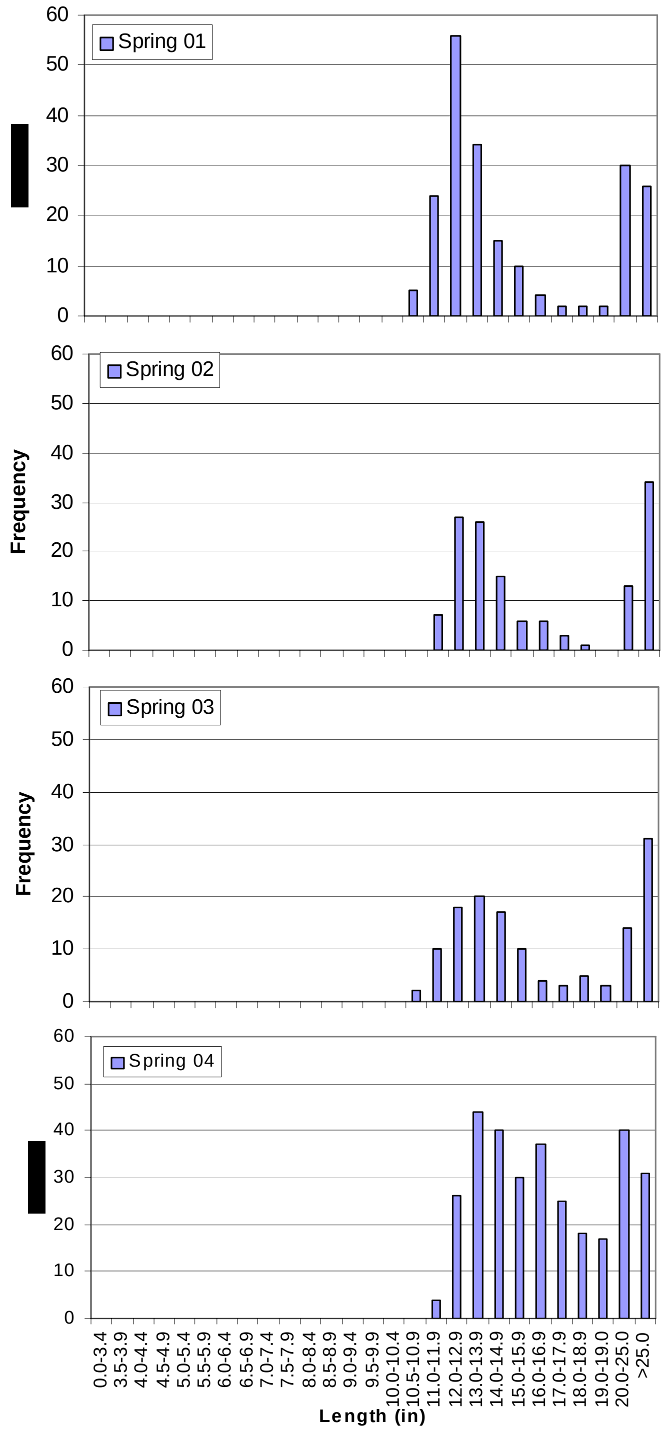


Figure 5. Length-frequency of walleyes in Cooney Reservoir from 2000 to 2004.

Gillnetting tends to catch fewer larger fish, but the data provide valuable information on the abundance of age-0 and age-1 fish (Figure 5). Electrofishing, and to a lesser extent gillnetting, data suggest the walleye population in Cooney has a bimodal structure, with good numbers of small and large walleyes but few fish between 14.0-20.0 in. This pattern has been present in the reservoir since 1994 and has continued to the present day. The cause of this population structure is unclear, but may be related to angler harvest of the 14-20 in size-range of fish. The reduction in stocking rate from 100,000 fish to 50,000 fish apparently has not affected the number of fish or the size distribution in the reservoir. In fact, more recent data from fall netting in 2003 and spring 2004 electrofishing suggest that there may be more fish in the 14-20 in range than in previous years (Figure 5).

A study was continued from 2000 to 2004 in Cooney by tagging larger walleye (generally > 16.0 in) with plastic T-type Floy tags. Retention of these tags appears to be fair; some recaptured fish were observed to have scars in the tagging location behind the second dorsal fin, but no tag present. Two fish captured had the nylon "T" part of the tag still attached, but the numbered portion of the tag had disintegrated. Tagged fish were recaptured via gillnetting, electrofishing and angler returns, with the latter providing some information on harvest rates. Five-hundred-ten walleyes averaging 19.9 in and 3.94 lb were tagged. During 2004, an intensive effort was made to tag 345 walleyes from 11.2-31.3 in. Smaller fish were tagged during 2004 to provide some information on angler harvest and growth of smaller fish. To date, 31 tagged walleyes have been recaptured, most of which came from anglers capturing fish tagged in the spring of 2004. It is difficult to determine growth from angler-returned fish because the accuracy of the length and weight measurements are generally not verifiable; however, of the 25 angler returned fish, only 3 were released. One large female was caught by an angler in April, released, then caught again and kept by another in May. Three fish (26.1 in, 27.0 in, and 22.8 in) were recaptured via electrofishing: 368, 721, and 1080 days, respectively after recapture. These fish grew 1.1, -0.4, and 0.06 in, and 0.0, 0.2, and 1.4 lb over their respective time periods. These data, although limited, suggest that adult walleye growth is slow in Cooney.

A possible reason for the decline in rainbow numbers is predation by walleye. There has been no notable increase in the walleye population or change in the size structure of the population, however, that would suggest predation rates on rainbows are any different now than in previous years when rainbow survival was good. In fact, there are fewer larger walleye now than 5 years ago. It is possible that traditional forage, such as suckers and crayfish, has changed, and walleyes have switched to rainbows as their primary forage. This theory would need to be verified through diet analysis and modeling to determine the impact of walleyes on the rainbow trout population.

Suckers

The foundation of Cooney Reservoir's productivity continues to be the forage provided by the progeny of a large, mature white sucker population. Cooney Reservoir was drained in 1981 to raise the height of the dam, and only a few large suckers remained in the lake following the completion of this project. Over the next two to three years, these large suckers produced many small suckers. By 1984, when walleyes were introduced, Cooney was again dominated by small white suckers. Three years after walleye introduction, the survival of juvenile suckers began to decline dramatically, and eventually the walleyes were consuming all of the sucker offspring in the reservoir. Since 1987, three years after walleye introduction into Cooney Reservoir, greater than 80% of the fish captured in gillnets have been over 12 in; whereas prior to walleye introduction, over 80% of the suckers captured were less than 12 in. Additionally, prior to walleye introduction, between 20% and 40% of the fish netted were less than 8 in, while from 1992 to 2003, fewer than 10 out of over 6,000 white and longnose suckers sampled have been less than 8 in (Figure 3). Despite the apparent lack of juvenile sucker recruitment into the adult population for an extended time, the numbers of adult suckers captured in gill nets appears to be relatively stable (Figure 6). A single trap net set in the fall of 2003 captured 467 white suckers and 15 longnose suckers along with one walleye. These data suggest that either mortality rates of adult suckers are extremely low, or that larger suckers emigrate from Red Lodge and Willow creeks into the reservoir and continue to supplement the adult population in the reservoir.

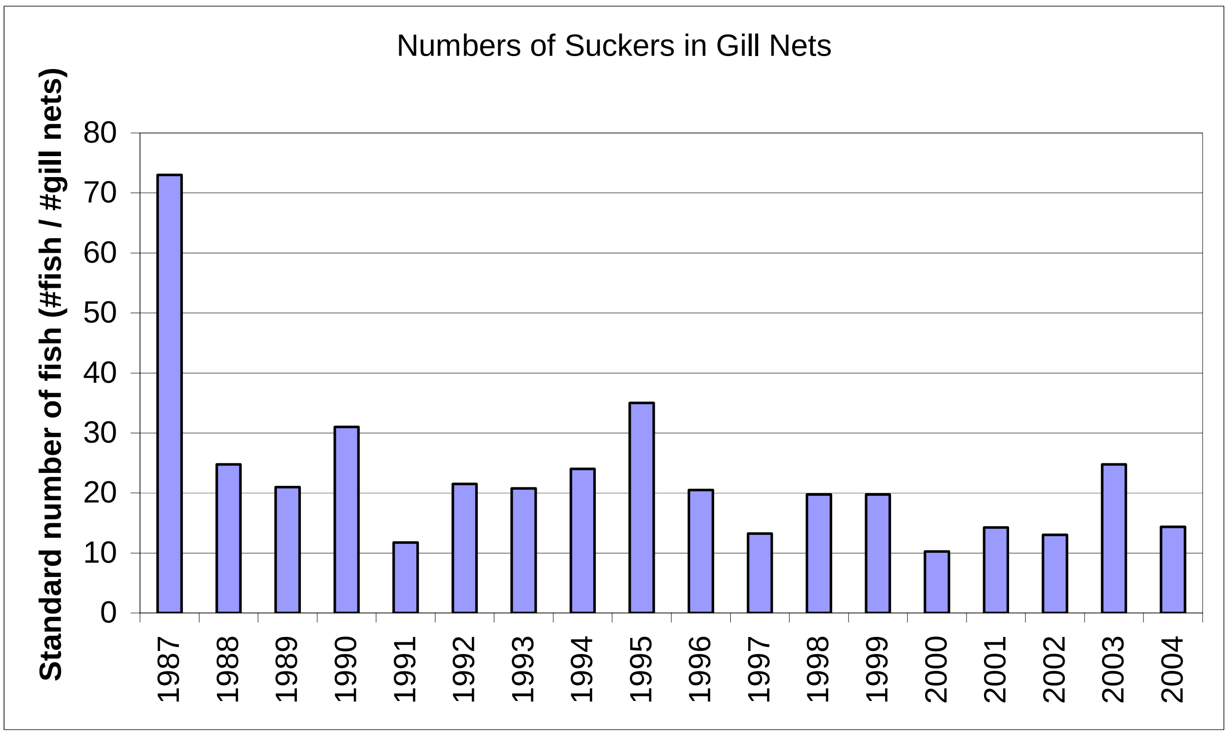


Figure 6. Standard number of white and longnose suckers gillnetted from Cooney Reservoir.

Longnose sucker populations have been slowly increasing each year in Cooney since 1995. In 2004, 36 of the 86 suckers captured (41%) were longnose suckers (Table 4). In the past, the average size of longnose suckers has been smaller than white suckers, suggesting that they recently emigrated from the tributary stream. In 2000, average longnose sucker length was 11.0 in; it has steadily increased to 15.8 in in 2004. It is unclear why the numbers of longnose suckers are increasing in the reservoir.

Table 4. Results of fall gill and trap netting in Cooney Reservoir 2000-2004.

Year/Species	No in Gill Net	No/Gill Net	No./Trap Net	Average length (in)	Average weight (lb)	Length range (in)
2000						
White sucker	29	7.3	39.8	16.0	2.00	3.4-19.9
Longnose sucker	11	2.8	3.8	11.0	0.60	8.1-15.9
2001						
White sucker	107	26.7	105	16.0	2.00	6.7-19.4
Longnose sucker	9	1.3	2.0	10.5	0.36	8.1-15.5
2002						
White sucker	47	11.8		16.1	1.84	8.3-19.4
Longnose sucker	5	1.3		11.4	0.82	7.4-16.5
2003						
White sucker	89	22.3	467	14.7	1.52	7.3-22.0
Longnose sucker	10	2.5	15	14.8	1.58	8.4-17.6
2004						
White sucker	50	8.3		14.9	1.60	11.9-18.7
Longnose sucker	36	6.0		15.8	1.70	8.7-19.5

Over 1000 white suckers were sampled by Merwin trap as they migrated into Red Lodge Creek to spawn (Table 5). Most white suckers are adult fish; only 5 of 107 white suckers (5%) measured in fall netting were less than 12 in, whereas average size remained high (15.9 in, 1.7 lb). Otoliths were removed from a subsample of white suckers gillnetted in fall 2001 so that these fish could be accurately aged. This action occurred to address the concern that most white suckers in the spawning population are in the same age-group, are very old, and thus may "age out" of the spawning population. Their disappearance would remove the foundation of the forage base in Cooney, and would impact the fishery. Unfortunately, the otolith annuli could not be accurately distinguished. Therefore, the age of adult white suckers is still unknown.

Table 5. Results of Merwin trapping in the Red Lodge Creek arm of Cooney Reservoir, 2001.

Species	No. caught	No. per hour	Average length (in)	Average weight (lb)	Length range (in)
Rainbow trout	10	0.04	13.0	1.25	9.6-18.5
Walleye	22	0.09	13.6	0.62	11.9-18.6
White sucker	1024	4.26	17.9	2.57	13.7-19.9
Longnose sucker	14	0.07	15.8	0.89	6.5-15.7
Black crappie	1	0.004	12.7	1.32	12.7

Other species

One of the primary reasons for introducing walleyes into Cooney was to help control an expanding sucker population which competes with trout for food and space. In addition to controlling suckers, walleyes have nearly eliminated lake chubs along with mountain whitefish. Chubs were abundant prior to 1984 when walleyes were introduced. One chub was captured in a trap net during the fall of 2000, but no others have been captured since. A few large whitefish have been captured in fall gillnets, but their numbers are also very low in the reservoir. Interestingly, a shorthead redhorse sucker was captured in gill nets set in May of 2004. Redhorse suckers are native to the Yellowstone Drainage, but there have been no previous records of redhorse suckers in Cooney, and it is unclear where this fish came from.

Between 1995 and 2000, a total of 112 black crappies were taken by all sampling methods combined. The crappie population structure in Cooney was bimodal with numerous 2 to 3 in fish, some 10 to 13 in fish, and few intermediate sized fish. This bimodal structure is probably due primarily to walleye predation. As with the sucker population, walleyes are eating the small crappies, thus preventing recruitment into the adult population. Spring 2001 was the last time a crappie was found in Cooney using all sampling methods. In the fall of 2000, 10 crappies ranging in size from 2.5-3.2 in were captured in trap nets. During 2001, 14 ranging from 2.4-12.7 in were captured. It is unclear if crappies are no longer present in Cooney Reservoir. Crappies are more susceptible to capture using trap nets, and the reservoir has not been intensively sampled using trap nets in the areas where crappies have previously been captured.

Brown trout are relatively abundant in Willow and Red Lodge creeks that feed Cooney Reservoir, but there are very few adult brown trout living in the reservoir. During spring electrofishing smaller fish are captured, particularly along the face of Cooney Dam, and occasionally a larger brown trout is captured in fall gill nets. The brown trout population in the reservoir appears to be highly regulated by walleye predation.

Deadmans Basin Reservoir

Drought conditions that started to affect Deadmans Basin in the winter of 1998-1999 continued and intensified during this report period. Water levels in Deadmans were drawn down to a total volume of about 32,000 AF, or only about 41% of full pool, by the end of the 2000 irrigation season. Since that time, winter inflows have been too low to allow the reservoir to refill, and each poor water year has compounded the previous conditions. Deadmans was refilled to about 71% of full pool before the start of the 2000 irrigation season. By the end of the irrigation season storage in Deadmans was down to 13,610 AF or about 18% full. After another dry winter, Deadmans only contained 26,680 AF going into the 2001 irrigation season. The Deadmans Basin Water Users Association spent considerable effort working on the outlet structure in the fall of 2001 in an effort to provide equal shares of water to all water users. The reservoir was drawn down to only 8,640 AF or about 11% of capacity by the end of September. Following another dry winter and spring, the water users started the 2002 irrigation season with Deadmans only about 25% full at 19,470 AF. Even though all water users only received about 25% of their allotted water in 2002, the basin was out of water by late summer, and the reservoir volume dropped to less than 8,900 AF by late fall. The winter of 2002-2003 was again very dry, but better precipitation in the spring reduced early irrigation demands and allowed Deadmans to continue to fill into June. Even with the slightly improved conditions, Deadmans only reached a maximum volume of 26,970 AF or 35% full. Slightly more conservative water management in 2003 left about 9,500 AF of water at the end of the irrigation season. Drought conditions continued during the winter and spring of 2003-2004, with Deadmans going into the 2004 irrigation season with less than 21,000 AF of water. A cooler summer in 2004 helped stretch the irrigation season a little longer than the previous couple of years, but the total volume of the reservoir dropped below 8,900 AF before starting to refill in late fall.

The fishery in Deadmans Basin Reservoir continued to survive despite the prolonged drought. Deadmans maintains 17 to 20 feet of depth in the deepest part of the lake even when the reservoir is drawn down as far as possible. This depth, combined with the fact that the reservoir is filled during the winter period, helped prevent any serious winterkill.

The 4 floating and 4 sinking gill nets were set in Deadmans in the fall of 2000 and the spring of 2001. Beginning in the fall of 2001, gill-net sets were reduced to only 3 floating and 3 sinking nets to compensate for the smaller volume of water being sampled. Three trap nets were also set during most netting periods.

Twelve species of fish were captured during this reporting period, including 3 fathead minnows, one lake chub, one stonecat and one longnose dace (Tables 6 & 7). White suckers were the most common species of fish captured during spring until 2004. White sucker catch rates first started to decline in the spring of 2000 after tiger muskies had been in Deadmans for two seasons. This declining trend continued through the remainder of the report period with the catch rate reaching a record low of only 5.3 white suckers per gill net in the spring of 2004 (Table 6). As the catch rate for white suckers declined, the average size of the remaining suckers increased (Table 6). These data provided strong evidence that tiger muskies were impacting the white sucker population. Another indication was a significant increase in white sucker reproduction first documented in the spring trap net samples in 2003 (Table 6). Historically, few white suckers under 8 in long have been netted in Deadmans. The population appeared to maintain itself for many years with very limited recruitment of young fish. Three trap nets set in the spring of 2002 caught 449 small white suckers (2.5 to 3.0 in long) for a catch rate of 150 per net (Table 6).

Table 6. Summary data for fish species captured in the standardized spring gillnet series and in trap nets set in Deadmans Basin Reservoir between 2001 and 2004.

Species	Number Caught	Catch Per Net	Avg Length (in)	Avg Weight (lb)	Length Range (in)
			Spring 2001 – 8 Gill Nets		
Rainbow trout	49	6.1	14.1	0.97	11.7 - 17.1
Brown trout	2	—	—	12.50, 13.35*	27.6, 29.7*
Kokanee	62	7.8	12.8	0.78	9.1 - 15.5
Tiger muskie	2	—	—	5.80, 7.50*	27.9, 29.3*
White sucker	140	17.5	13.8	1.13	6.6 - 16.1
Longnose sucker	5	0.6	14.0	1.19	10.9 - 16.3
Carp	4	0.5	23.4	7.38	22.3 - 24.3
Stonecat	1	—	7.9	—	—
			Spring 2001 – 3 Trap Nets		
Rainbow trout	72	24.0	13.9	0.85	12.1 - 17.2
White sucker	17	5.7	14.4	—	13.7 - 15.7
Shorthead redhorse	1	—	16.8	—	—
			Spring 2002 – 6 Gill Nets		
Rainbow trout	11	1.8	15.7	1.34	14.8 - 16.8
Kokanee	8	1.3	14.8	1.15	11.1 - 17.1
Tiger muskie	3	0.5	32.6	9.00	31.9 - 33.3
White sucker	102	17.0	14.3	1.24	11.5 - 16.6
Longnose sucker	5	0.8	13.7	0.96	13.1 - 14.5
Carp	1	—	21.9	4.92	—
			Spring 2002 – 3 Trap Nets		
Rainbow trout	29	9.7	15.9	1.42	14.7 - 17.1
White sucker	(44.9)**	149.7	—	—	—
Shorthead redhorse	1	—	16.8	1.60	—

* Actual weights or lengths of two fish.
** Fish counted but not worked.

Table 6. (Cont.) Summary data for fish species captured in the standardized spring gillnet series and in trap nets set in Deadmans Basin Reservoir between 2001 and 2004.

Species	Number Caught	Catch Per Net	Avg Length (in)	Avg Weight (lb)	Length Range (in)
Spring 2003 – 6 Gill Nets					
Rainbow trout	15	2.5	13.8	0.94	10.8 - 17.6
Kokanee	3	0.5	10.6	0.49	7.0 - 14.8
Tiger muskie	1	—	32.8	9.35	—
White sucker	73	12.2	15.1	1.44	12.2 - 17.5
Longnose sucker	5	0.8	14.9	1.23	13.8 - 16.3
Shorthead redhorse	4	0.5	15.1	1.32	13.6 - 15.9
Carp	1	—	6.1	0.11	—
Spring 2004 – 6 Gill Nets					
Rainbow trout	144	24	12.7	0.79	9.9 - 17.8
Brown trout	2	0.3	—	3.62, 3.74*	20.8, 22.2*
Kokanee	44	7.3	8.7	0.26	6.6 - 11.5
Tiger muskie	3	0.5	36.3	14.55	35.0 - 38.5
White sucker	32	5.3	15.1	1.61	8.2 - 16.8
Shorthead redhorse	6	1.0	15.9	1.73	15.2 - 16.5
Carp	20	3.3	10.4	—	4.7 - 28.0
Spring 2004 – 3 Trap Nets					
Rainbow trout	5	1.7	15.1	—	12.3 - 17.2
White sucker	68	22.7	15.2	1.53	3.6 - 17.5
Shorthead redhorse	4	1.3	16.7	—	15.8 - 17.7
Carp	1	—	6.9	—	—
Stonecat	1	—	7.3	—	—
Longnose dace	1	—	2.3	—	—

* Actual weights or lengths of two fish.

Table 7 . Summary data for fish species captured in the standardized fall gillnet series and in trap nets set in Deadmans Basin Reservoir between 2000 and 2004.

Species	Number Caught	Catch Per Net	Avg Length (in)	Avg Weight (lb)	Length Range (in)
Fall 2000 – 8 Gill Nets					
Rainbow trout	43	5.4	13.1	0.76	8.4 - 14.7
Brown trout	1	—	21.1	4.50	—
Kokanee	321	40.1	14.3	1.01	5.6 - 16.0
Tiger muskie	2	—	—	3.60, 5.60*	24.5, 27.5
White sucker	86	10.8	13.0	0.89	6.4 - 15.7
Longnose sucker	1	—	10.6	—	—
Shorthead redhorse	1	—	8.2	—	—
Fall 2000 – 3 Trap Nets					
Rainbow trout	1	—	14.0	—	—
Brown trout	3	1.0	28.5	10.4	25.1 - 30.5
Kokanee	11 (111)**	40.7	12.7	—	5.3 - 15.3
White sucker	98 (18)	38.7	10.2	—	5.1 - 16.0
Longnose sucker	2	—	—	—	8.4, 10.0
Lake chub	1	—	4.2	—	—
Fall 2001 – 6 Gill Nets					
Rainbow trout	31	5.2	12.5	0.79	8.0 - 16.2
Brown trout	4	0.7	19.3	4.00	14.7 - 30.1
Kokanee	211	35.2	14.6	1.01	8.4 - 17.8
Tiger muskie	2	—	—	9.20, 10.60*	30.6, 34.7
White sucker	61	10.2	14.3	1.22	8.4 - 16.1
Carp	1	—	4.3	—	—
Fall 2001 – 3 Trap Nets					
Rainbow trout	20	6.7	14.3	1.07	9.9 - 17.0
Brown trout	9	3.0	24.3	6.56	18.4 - 28.8
Kokanee	50	16.7	15.3	0.65	13.2 - 17.8
White sucker	10	3.3	14.3	1.21	13.1 - 16.1
Carp	181	60.3	2.2	—	1.0 - 4.0

* Actual weights and lengths of two fish.

** Numbers in brackets were fish counted but not worked.

Table 7. (Cont.) Summary data for fish species captured in the standardized fall gillnet series and in trap nets set in Deadmans Basin Reservoir between 2000 and 2004.

Species	Number Caught	Catch Per Net	Avg Length (in)	Avg Weight (lb)	Length Range (in)
Fall 2002 – 6 Gill Nets					
Rainbow trout	20	3.3	14.2	1.21	6.2 - 17.7
Brown trout	12	2.0	18.4	2.08	16.5 - 21.5
Kokanee	37	6.2	12.4	0.86	6.0 - 19.4
Tiger muskie	1	—	34.0	10.2	—
White sucker	26	4.3	15.3	1.47	13.0 - 16.6
Carp	1	—	8.0	0.30	—
Fall 2002 – 3 Trap Nets					
Rainbow trout	8	2.7	13.9	1.15	8.2 - 16.9
White sucker	8	2.7	15.5	1.53	1.45 - 16.6
Longnose sucker	1	—	15.9	—	—
Shorthead redhorse	1	—	15.6	—	—
Carp	1	—	7.1	—	—
Crayfish	1	—	2.1	—	—
Fall 2003 – 6 Gill Nets					
Rainbow trout	106	17.7	10.8	0.61	6.3 - 18.4
Brown trout	6	1.0	19.2	2.86	17.5 - 22.9
Kokanee	14	2.3	10.3	0.49	6.1 - 18.3
Tiger muskie	4	0.7	35.6	12.28	34.0 - 38.0
White sucker	13	2.2	15.2	1.39	14.0 - 17.1
Shorthead redhorse	1	—	16.9	1.69	—
Carp	73	12.2	7.5	—	4.2 - 28.5
Crayfish	16	2.7	3.9	—	—
Fall 2003 – 3 Trap Nets					
Rainbow trout	4	1.3	16.8	1.73	14.1 - 18.0
Kokanee	2	0.7	—	—	7.1, 15.6
White sucker	187	62.3	4.2	—	3.2 - 5.3
Shorthead redhorse	1	—	3.8	—	—
Fathead minnow	3	1.0	1.9	—	1.4 - 2.4
Crayfish	14	4.7	3.8	—	3.2 - 4.5

Table 7 . (Cont.) Summary data for fish species captured in the standardized fall gillnet series and in trap nets set in Deadmans Basin Reservoir between 2000 and 2004.

Species	**Number Caught**	**Catch Per Net**	**Avg Length (in)**	**Avg Weight (lb)**	**Length Range (in)**
			Fall 2004 – 6 Gill nets		
Rainbow trout	72	12.0	11.8	0.61	8.2 - 17.62
Brown trout	8	1.3	23.0	4.37	20.6 - 25.8
Kokanee	265	44.2	9.3	0.33	6.0 - 15.9
Tiger muskie	1	—	39.0	16.0	—
White sucker	35	5.8	8.4	0.31	6.2 - 15.6
Shorthead redhorse	3	0.5	14.7	1.24	10.8 - 17.7
Carp	15	2.5	13.6	1.38	11.7 - 23.9
Crayfish	16	2.7	3.7	—	—
			Fall 2004 – 3 Trap nets		
Rainbow trout	13	4.3	9.1	0.27	6.7 - 13.7
Kokanee	34	11.3	13.2	0.81	5.4 - 18.2
White sucker	47	15.7	7.9	0.19	6.0 - 15.6

No trap nets were set in Deadmans in the spring of 2003 due to heavy winds. This strong year class of small white suckers was again evident, however, in the fall of 2003, when three trap nets captured an average of 62 white suckers per net. These fish ranged from 3.2 to 5.3 in long (Table 6).

White sucker catch rates for fall nets showed trends similar to those observed in the spring, but even more pronounced. Catch rates dropped from an average of 10.8 per gill net in the fall of 2000 to only 2.2 per net in the fall of 2003. At the same time, the average size of the remaining suckers increased in size from 13.0 in in 2000 to 15.2 in in 2003 (Table 7). By the fall of 2004, many of the suckers from the strong 2001 year class were large enough to be captured in experimental gill nets. These small fish helped push the white sucker catch rate back up to 5.8 per net, which was still low compared to historic levels. Trap nets set in the fall of 2004 also captured numerous small suckers, but only 5 white suckers greater than 10 in were captured in all nets (Table 7).

Kokanee salmon have historically been the most common fish species captured in fall gill nets in Deadmans Basin, as was generally the case during this study period (Table 7). Fall netting in 2000 showed a very strong population of mature kokanee, with 8 gill nets catching an average of 40.1 per net. Kokanee were not stocked in Deadmans in 1999 due to a limited availability of fish. This missing year class was evident in the 2000 data, in that very few immature kokanee were netted. Kokanee catch rates remained good in the fall of 2001, and then began a significant decline. Six gill nets set in the fall of 2003 captured only 14 kokanee, for a catch rate of 2.3 per net (Table 7). The missing 1999 year class of kokanee undoubtedly contributed to the observed decline, but most of the fish from this missing year class would have aged out of the system by 2003. Beginning in 2001, the kokanee plant into Deadmans was reduced by half to only 50,000 kokanee per year. Three years of reduced plants, combined with increased predation by tiger muskies under low water conditions, contributed to the poor kokanee catch in the fall of 2003. Stocking was increased back to 101,000 fish in 2004, and the fall catch rate for kokanee jumped back up to 44.2 fish per gill net, with newly stocked fish comprising a major part of this catch (Table 7).

The rainbow trout population in Deadmans appeared to be responding favorably to the tiger muskie introduction. Despite low water conditions that hampered access, angler use at the lake increased during this report period. The local game warden reported increased use, with many nice stringers of rainbows being taken. Reports from Deadmans' anglers have been very positive during this period.

Rainbow trout population trends observed in the standardized netting data were variable. The average size of rainbow was about 11.5 in in spring nets and 11.0 in in fall nets before the tiger muskie stocking program was initiated (Poore and Frazer, 2000). Average sizes of rainbow began increasing in 2000 after tiger muskies had been in Deadmans for two years (Table 7). Age data from past netting found that spring gillnet samples were normally dominated by two-year-old fish that were normally replaced by recently stocked fish in fall samples (Poore and Frazer, 1995, 2000). Two-year-old rainbows were the dominant year class, in both spring and fall net samples in 2000, with good representation of three-year-old rainbows in the spring nets. By 2001, the spring net samples were dominated by age-3 fish, with some four-year-old fish. The average size of the rainbows continued to increase (Table 6). The fall 2001 net sample contained a good mix of age-zero rainbow trout (from the spring plant) through three-year-old fish. This sample was dominated by younger, zero- and one-year-old rainbows, which resulted in a slight decrease in average size from 2000. Very few younger rainbows were netted in the spring of 2002, when the rainbow catch rate dropped to only 1.8 per net. This sample was dominated by three- and four-year-old fish that exhibited very good growth rates and pushed the average size of gill netted rainbows to the largest size it had been in over 10 years (Table 6). The fall 2002 sample again contained a good mix of age-zero through four-year-old rainbows, but was dominated by one and two-year-old fish. All age classes again exhibited excellent growth rates, which helped keep the average size up (Table 7).

No age data for rainbow trout were available for 2003 or 2004. The spring 2003 rainbow catch rate increased slightly from 2002, but was still low (Table 6). This sample appeared to be dominated by one- and two-year-old fish, causing a decrease in average size. The rainbow catch rate took a major jump in the fall of 2003 to 17.7 per net (Table 7). Young fish from the spring plant dominated this sample, and helped keep the average size down. This sample also contained numerous rainbows over 17 in long, however, which has been rare in Deadmans in the past. The largest rainbow netted in the fall of 2003 was 18.4 in long.

The strong rainbow population from 2003 carried over to the spring of 2004, pushing the rainbow catch rate to the highest level yet at 24.0 per net for six gill nets (Table 6). Rainbow catch rates in the fall dropped to 12 per net, down from the 2003 level, but still above the long-term average.

Tiger muskies were first stocked into Deadmans Basin in 1998, with follow-up plants in 1999 and 2000. The primary goal of these plants was to reduce sucker numbers in an effort to improve the rainbow and kokanee fisheries in the lake. Tiger muskies were stocked at relatively low numbers to reduce white sucker populations by about 50%, in order to benefit the trout and kokanee while maintaining a reasonable sucker food base for tiger muskie. Low water conditions in Deadmans began the same year the tiger muskie program was started. Reducing Deadmans to an average of 20% of full pool since then has greatly increased tiger muskie predation on the sucker population. Reducing sucker numbers to such low levels has likely increased predation on the stocked trout and kokanee populations.

A total of 19 tiger muskies were netted form Deadmans during this study period (Tables 6 & 7). These fish ranged from 24.5 to 39.0 in long, with a general increase in size through the sampling period. The heaviest tiger muskie captured was a 38.5 in (17.5 lb) fish in the spring of 2004. Attempts to stock an additional year class of tiger muskies in 2004 was unsuccessful due to a lack of fish.

Traditional stocking requests for Deadmans Basin have been 150,000 Arlee rainbow trout, 50,000 McConaughy rainbows, and 100,000 kokanee salmon. Due to low water levels and the limited availability of fish, kokanee plants were reduced by half beginning in 2001 and rainbow plants were reduced in half in 2002. Rainbow plants were increased back to 2/3 of the normal request in 2003 to help compensate for expected tiger muskie predation. Hatchery problems in 2004 limited the availability of rainbows, especially the Arlee strain. In 2004, Deadmans received approximately 38,000 Eagle Lake and 70,000 McConaughy rainbows, and the kokanee plant was increased back up to just over 100,000 fish.

Carp have generally been rare in net samples collected in Deadmans Basin, but this changed in 2001 when a very strong year class of carp was produced. Small carp first showed up in trap nets set in the fall of 2001 (Table 7). As carp from this year class grew large enough to be captured in gill nets, they were well represented in the fall 2003 and in both spring and fall 2004 (Tables 6 & 7). Crayfish numbers also showed a significant increase in fall net samples in 2003 and 2004, with quite a few larger crayfish being captured.

Yellowtail Afterbay Reservoir

Management and stocking plans continued to evolve for Yellowtail Afterbay Reservoir during this report period. In an effort to keep more stocked rainbow in the Afterbay, several changes have been made in the Afterbay stocking program since switching from Arlee rainbow to wild strain rainbow trout in the mid-1980s. Attempts to coordinate the Afterbay stocking with the US Bureau of Reclamation's (BOR) program of drawing the Afterbay down in the fall to test spring seep around Yellowtail Dam have proven difficult. These drawdowns were scheduled to occur every-other-year following the 1998 drawdown. Beginning in 2000, plans were to hold 20,000 rainbows until October during drawdown years, and stock them into the Afterbay after the fall drawdowns. No rainbows would be stocked between drawdown years. However, the drawdown program has been in a state of flux since 2000 making it difficult to work with. In 2000, the BOR decided to put off the scheduled drawdown until 2001. In 2003, the BOR changed the drawdown schedule to every third year, and in 2004 the drawdown was postponed again in favor of testing other measurement techniques that could eventually lead to the elimination of the Afterbay drawdowns altogether. Approximately 16,000 5.6 in rainbows were planted, as scheduled, in October 2000 even though the drawdown had been canceled. No rainbows were stocked in 2001 prior to the scheduled drawdown. Approximately 20,000 catchable sized rainbows were stocked in the fall in both 2002 and 2003 as the planting program changed again to accommodate the proposed three year drawdown rotation. The latest 5-year stocking program calls for spring plants of smaller sized rainbows for two years in a row with no plant on the years with scheduled drawdowns. The first plant under this new schedule occurred in 2004 when 25,000 4 in rainbows were stocked in June.

Two floating and two sinking gill nets were set in the Afterbay Reservoir in the spring of 2001. No fish were caught in the floating nets, while the sinking nets caught 5 rainbows and 4 white suckers. The rainbows ranged from 16.9 to 17.6 in, and all weighed around 2 lb. No rainbows from the late fall plant in 2000 were captured, but these fish were likely too small to be effectively sampled in experimental gill nets. The four white suckers captured in 2001 ranged from 6.9 to 16.7 in long.

Two floating and two sinking gill nets set in September 2003 caught 40 rainbows, 15 white suckers and one 12.5 lb carp. The rainbows ranged from 11.8 to 16.5 in long, with an average length of 14.9 in. No age data were available for these rainbows, but most were probably from the 2002 plant. The high catch rate observed in 2003 indicated that good numbers of Eagle Lake rainbows would stay in the Afterbay Reservoir if the reservoir wasn't subjected to extreme drawdowns. The white suckers captured in 2003 were all older fish ranging from 14.5 to 17.5 in long, with an average length of 16.7 in.

Laurel Pond

Laurel Pond suffered two fish kills in 2001. The first occurred under winter ice cover and was a complete kill. The second was a partial kill that occurred in early September. In response to the problem, the Billings Chapter of Pikemasters held fundraising events throughout the summer to raise money for purchasing an aerator for the pond. A windmill aerator was installed in hopes of preventing further fish kills. Laurel Pond is managed as a put-and-take trout fishery, with a normal stocking rate of 6,000 catchable (7-11 in) trout planted 3 times annually. One hundred retired rainbow trout broodstock from Ennis National Fish Hatchery, averaging about 4 lb, were planted in early summer 2001 to provide additional fishing opportunity. Since the addition of the aerator in 2001, there has not been a fish kill on Laurel Pond. A second aerator donated by the Billings Chapter of Walleyes Unlimited, was installed in the fall of 2003.

Two gillnets and a trap net were set in Laurel Pond on March 22, 2004 to monitor the survival and growth of rainbow trout and determine the presence/absence and relative abundance of undesirable species in the pond. Fifteen rainbow trout, ranging in size from 7.9-11.9 in and 0.12 and 0.6 lb, were captured. All fish were in good condition, although it appeared that growth rates in the pond are quite slow. Slow growth is likely due to the warm water temperatures in the pond and competition for forage with other fish species. Also caught in the nets were 8 lake chubs and one goldfish. Summertime observations of the pond suggest that lake chubs are abundant; however, they are not very susceptible to passive netting techniques because of their small size. The presence of goldfish in the pond had been reported by anglers but had not been verified until 2004. Complaints have been made by fisherman about the numbers of lake chubs and the increasing numbers of goldfish in the pond. Without the periodic fish kills, the number of these undesirable species is increasing, and future management actions may be necessary to reduce their populations.

West Rosebud Lake

West Rosebud Lake is a popular destination for anglers because of its proximity to Forest Service campgrounds and other recreation areas and because of its diverse fishery. The lake supports wild populations of brown and brook trout, mountain whitefish, and longnose suckers. Six thousand Arlee rainbow trout are also stocked into the lake annually. The lake was modified in early 1980's when the reregulation dam was constructed to moderate the flows from the Mystic Lake hydroelectric facility into West Rosebud Creek. This dam raised the water elevation, making it deeper and effectively eliminating the daily spikes and drops in stream levels below the lake. The dam also precluded fish passage from downstream in West Rosebud Creek. Thus, the populations of fish in West Rosebud Lake are isolated from downstream and can only migrate upstream to near the powerhouse where they encounter natural barriers. Despite barriers being present in the system, there appears to be adequate spawning and rearing habitat upstream of the reservoir to provide ample angling opportunities while sustaining the lake's populations of fish.

The lake was sampled in May of 2001 and 2003, and in September of 2004. In 2001, one floating and two sinking gill nets were used; in 2003, two floating and two sinking gillnets were used; and during 2004, two sinking gillnets and two trap nets were used (Table 6 and 7). Catch rates in the floating gill net were nearly three times greater for brown and book trout in 2001 than 2003, while catch rates in sinking nets during 2001 were half of those observed in 2003. These data suggest that during 2001 fish may have been using the upper portions of the water column more than in 2003, and that actual fish population numbers are relatively similar between sampling dates. The brook trout population appears to be expanding considerably. Prior to 1994, few brook trout were sampled in the lake, and in 1995 three brook trout were sampled along with 82 brown trout (Poore and Frazer 1995). The ratio of brown to brook trout ranged from 63:4 in 1996 to 11:2 from to 1999. In contrast, the numbers of brook trout captured in 2001, 2003 and 2004 are equal to or slightly greater than brown trout numbers. It is unclear why there has been an increase in brook trout, but all fish in the lake appear to be in excellent condition, with no evidence of food limitation. The increase in brook trout has provided additional angler opportunities in the lake. Brook and brown trout average between 10-14 in, with many fish over 14 in and a few very large brown trout. Although more difficult to catch that the stocked rainbows, many anglers target the brown and brook trout because of their size and claimed better flavor. The brown trout population appears to use the mountain whitefish, longnose sucker and stocked trout populations as its forage base. Most captured whitefish are over 10 in, indicating that smaller whitefish are being eaten. Further, very few small trout or other species were captured in the lake, suggesting high brown trout predation rates. Because it contains adequate spawning and rearing habitat, West Rosebud creek upstream of the lake likely serves as the primary recruitment source of small fish into the lake system. It is also likely that juvenile fish rear in the inlet stream before migration to the lake.

West Rosebud Lake is stocked with 3,000 6-in trout annually; however, few of these were captured by our sampling in 2001. In 2003, only 8 were captured, but these numbers are similar to those in past years (Poore and Frazer 2000). The capture of stocked rainbows in gill nets suggests that some stocked trout are over-wintering in the lake. The stocking of other species and strains of fish into West Rosebud Lake has resulted in survival rates similar to current stocking practices. Brown trout prey heavily on the rainbow trout. The largest brown captured in 2003 had an 11 in rainbow in its stomach. In addition to competition and predation from other salmonid species, the lake receives relatively heavy fishing pressure. Even though the brown and brook trout are the most abundant species in the lake, they are also more difficult to catch than the stocked rainbow trout. Creel census data indicate that of an estimated 2,192 fish caught, 1,272 were rainbow trout, and 760 were brown and brook trout (Poore and Frazer 2000). Thus, supplementing the lake through stocking may alleviate some of the pressure on the self-sustaining stocks of brown and brook trout. West Rosebud Creek upstream of the powerhouse has a thriving population of resident rainbow trout, but it does not appear that many of the stream dwelling fish migrate to West Rosebud Lake; or, if they do, their survival is low.

During 2004, brown, brook and rainbow trout, mountain whitefish, and longnose suckers were analyzed for Polychlorinated Byphenols (PCB's) as part of the Mystic Dam relicensing process. Tissues sampled were negative for detectible levels of PCB's, and there does not appear to be any contamination of fish downstream of the hydro power project.

Table 8. Results of standardized spring floating gill nets from 2001 and 2003 in West Rosebud Lake.

Species	Number caught	Catch/h/net	Average length (in)	Average weight (lb)	Length range (in)	Weight range (lb)
			2001			
Rainbow trout	0	0.00				
Brown trout	18	0.90	13.6	0.8	11.1-15.0	0.5-1.1
Brook trout	19	0.95	12.1	0.8	8.6-14.3	0.2-1.4
Whitefish	8	0.40	13.9	1.1	9.2-18.0	0.3-2.0
Longnose sucker	0	0.00				
			2003			
Rainbow trout	4	0.10	11.4	0.5	9.8-13.0	0.3-0.8
Brown trout	11	0.26	14.4	1.5	8.3-25.7	0.2-8.0
Brook trout	16	0.38	13.0	1.0	11.1-15.5	0.5-1.8
Mountain whitefish	14	0.33	14.7	1.2	10.8-18.0	0.5-2.2
Longnose sucker	0	0.10				

Table 9. Results of standard sinking gillnets in West Rosebud Lake in 2001 , 2003 and 2004.

Species	Number caught	Catch/h/net	Average length (in)	Average weight (lb)	Length range (in)	Weight range (lb)
			2001			
Rainbow trout	5	0.11	10.7	0.5	6.9-12.9	0.1-0.7
Brown trout	25	0.53	11.8	0.6	7.0-15.9	0.1-1.3
Brook trout	23	0.48	10.4	0.4	7.0-13.6	0.1-0.9
Mountain whitefish	22	0.46	13.5	1.1	10.1-20.3	0.4-3.0
Longnose sucker	4	0.11	13.8	1.2	11.5-16.1	0.6-1.8
			2003			
Rainbow trout	4	0.10	11.7	0.8	9.5-15.0	0.4-1.5
Brown trout	46	1.10	11.5	0.5	7.3-14.1	0.1-0.9
Brook trout	53	1.26	12.1	0.7	9.0-14.9	0.2-1.4
Mountain whitefish	34	0.81	14.0	1.2	9.0-20.0	0.2-2.8
Longnose sucker	9	0.21	15.0	1.6	9.0-19.8	0.6-3.6
			2004			
Rainbow trout	2	0.04	10.8	0.57	8.8-12.8	0.24-0.90
Brown trout	28	0.62	11.8	0.62	7.1-15.3	0.16-1.18
Brook trout	25	0.55	10.9	0.59	6.6-15.1	0.11-1.21
Mountain whitefish	10	0.22	14.9	1.24	12.3-17.2	0.69-1.83
Longnose sucker	4	0.09	11.6	0.82	9.0-17.2	0.30-2.10

Emerald Lake

Emerald Lake, a very close downstream neighbor to West Rosebud Lake, also continues to support healthy brook and brown trout populations. Trout populations are similar to those in West Rosebud Lake, as brown trout average 11.8 in and 0.57 lb, and brook trout average 10.4 in and 0.43 lb (Table 10). Mountain whitefish and longnose suckers again appear to serve as the forage base for brown trout, based on the paucity of juvenile fish and large average size. Emerald Lake is also stocked with 6 in rainbow trout (1,800/year), but few appear to survive to the spring. No rainbows were captured in this May's sampling. Personal observations indicate that many of the stocked rainbows emigrate down into West Rosebud Creek below the lake.

Table 10. Results of standardized spring netting (one floating gill net) in Emerald Lake, 2001**.**

Species	Number caught	Catch/h/net	Average length (in)	Average weight (lb)	Length range (in)	Weight range (lb)
Rainbow trout	0	0.00				
Brown trout	25	1.05	11.8	0.57	7.0-15.9	0.11-1.25
Brook trout	23	0.97	10.4	0.43	7.0-13.6	0.10-0.93
Mountain whitefish	5	0.21	16.5	1.46	11.8-18.5	0.54-2.06
Longnose sucker	0	0.00				

West Rosebud River Drainage Creel Survey

A creel survey conducted by PPL Montana in the West Rosebud Creek drainage targeted use of West Rosebud, Emerald, and Mystic lakes, the stream connecting them, and the mountain lakes higher in the drainage (PPL Montana 2002). Results suggest that most people who visit the area are from Montana, and approximately 50% of the people who visit the area spend some time fishing (most fishing from shore). Of those fishing, more than half fished from the Pine Grove Campground to West Rosebud Lake, 23% fished Mystic Lake and 9% fished beyond Mystic. Two thirds of anglers reported catching fish and, of those catching fish, an average of 1.5 fish/angler was harvested (51% were rainbow, 24% brown, 12% cutthroat and 8% brook trout). The average number of fish caught per angler was 4.1, and about half of the anglers catching fish reported releasing all of their catch.

East Rosebud Lake

Through the years, East Rosebud Lake has been stocked with rainbow, brown, brook and cutthroat trout. Brown trout is the dominant predatory species in the lake, and it appears to regulate the numbers and species of other fish. From 1986-1989, McBride cutthroat trout were planted because they had shown superior reproductive performance in various other Beartooth lakes with similar physical characteristics to East Rosebud Lake; however, growth and survival of these fish was poor. DeSmet rainbow trout were stocked in the lake in the early 1990s, and Arlee rainbows were stocked starting in 1996. Although survival of the stocked rainbow trout was also low, their growth was greater than that of the stocked cutthroats. Currently, the lake is stocked with 6,000 catchable sized (8 in) Arlee rainbow trout three times during the summer to enhance the recreational fishery.

East Rosebud Lake was sampled on May 13, 2002 using floating and sinking gill nets. Columbus High School science students assisted in netting and processing fish, and they performed necropsies on the fish later at class. The lake was sampled again on April 17, 2003 with two floating (Table 11) and two sinking gillnets (Table 12). Brown trout was the most abundant species in the nets across years, followed by mountain whitefish and longnose suckers in 2002, and longnose suckers and then whitefish in 2003. Some of the differences observed in species caught and numbers of fish between 2002 and 2003 are likely due to the earlier sampling date in 2003. Rainbow trout survival beyond their first year after stocking still appears to be low, but similar to past years (Poore and Frazer 2000).

Brown trout predation on stocked trout and other fish in the lake still appears to be high. One 21 in brown trout had the remains of an approximately 10 in rainbow trout in its stomach. Another similar sized brown trout had two whitefish (approximately 8 and 10 in) in its stomach. For the first time, whitefish were not the dominant fish species in the lake. From 1990 to 2000, the numbers of whitefish captured in gillnets has exceeded that of other fish species. In 2002 and 2003, however, brown trout were the dominant fish species in nets (Table 11 and 12). In 2003, considerably more longnose suckers were captured in gillnets than whitefish. When compared to previous sampling, it appears that the longnose sucker population in the lake may be increasing (number in nets: 1996= 2, 1997=2, 1998= 21, 2002=13, 2003=26). Changes in species abundance are likely influenced by brown trout predation, but may also be influenced by low water levels leading to less exchange of fish between the creek and the lake.

Table 11. Results of standardized spring floating gill nets (2 nets) in East Rosebud Lake, 2002 and 2003.

Species	Number caught	Catch/h/net	Average length (in)	Average weight (lb)	Length range (in)	Weight range (lb)
			2002			
Rainbow trout	6	0.13	10.9	0.44	9.2-15.0	0.24-0.90
Brown trout	27	0.58	13.6	1.06	9.1-23.1	0.24-4.80
Brook trout	1	0.02	7.3	0.12		
Mountain whitefish	6	0.13	9.2	0.37	7.6-11.4	0.1-1.11
Longnose sucker	2	0.05	9.4	0.32	7.4-11.4	0.12-0.52
			2003			
Rainbow trout	1	0.03	12.5	0.56	12.5	0.56
Brown trout	2	0.06	20.9	3.66	20.0-21.8	2.84-4.48
Brook trout	0					
Mountain whitefish	1	0.03	7.7	0.12	7.7	0.12
Longnose sucker	0					

Table 12. Results of standardized spring sinking gill nets (2 nets) in East Rosebud Lake, 2002 and 2003.

Species	Number caught	Catch/h/net	Average length (in)	Average weight (lb)	Length range (in)	Weight range (lb)
			2002			
Rainbow trout	9	0.20	10.6	0.46	8.9-14.2	0.26-0.86
Brown trout	30	0.65	13.3	1.12	6.9-26.8	0.14-7.50
Brook trout	0	0.00				
Mountain whitefish	25	0.55	10.8	0.39	7.4-13.5	0.16-0.72
Longnose sucker	11	0.24	12.2	0.93	7.0-19.0	0.20-2.60
			2003			
Yellowstone cutthroat	1	0.03	8.3	0.12	8.3	0.12
Rainbow trout	3	0.8	10.3	1.35	10.0-10.8	0.28-3.44
Brown trout	23	0.62	12.4	0.67	7.0-17.6	0.10-1.82
Brook trout	0	0.00				
Mountain whitefish	9	0.24	9.9	0.27	8.0-11.5	0.12-0.42
Longnose sucker	26	0.70	11.2	0.60	7.0-17.9	0.10-2.14

Lower Glaston Reservoir

Four gill nets (two floating and two sinking) and two trap nets were set in Lower Glaston Reservoir on May 30, 2002. Nets were pulled on the morning of May 31, 2002, having fished for approximately 21 hours. The same nets were set on September 25, 2002 and pulled the following morning, fishing for a total of 20 hours. Catch results are summarized in table 13 and 14.

Table 13. Total catch in four gillnets and two trap nets set in Lower Glaston Reservoir on May 31, 2002.

Species	Number	Average length (in)	Average weight (lb)	size range (in)	Catch/hour
Tiger Muskie	5	39.7	14.48	34.0-50.0	0.23
Black crappie	2	8.6	0.27	8.2-9.0	0.09
White sucker	33	12.3	0.93	2.5-17.5	1.57
Lake chub	5	4.1	0.03	2.6-6.7	0.23
Yellow perch	1	2.1	0.01	2.1	0.05

Table 14. Total catch in four gillnets and two trap nets set in Lower Glaston Reservoir on September 25, 2002.

Species	Number	Average length (in)	Average weight (lb)	size range (in)	Catch/hour
Tiger Muskie	0	0	0	0	0
Black crappie	2	2.8	0.015	2.4-3.2	0.1
White sucker	47	9.8	0.35	4.1-17.0	2.35
Lake chub	1	4.5	0.05	4.5	0.05
Yellow perch	261	7.2	0.22	3.1-12.1	1.35

Gill and trap nets were set in Lower Glaston Reservoir during 2002 to determine the status of the fishery and establish the most appropriate species and numbers of fish to potentially stock in the future to manage the reservoir for sport fishing one of the primary concerns when managing Lower Glaston Reservoir has been the status of the white sucker population. Historically this population has attained high densities and impaired the growth of other fish, reducing angling opportunities. The data we collected during spring and fall 2002 suggested that the sucker population is much lower than it was historically. In spring 1989, 129 suckers were caught in four gill nets; only 27 suckers were captured in spring 2002 in four gill nets. The likely explanation for reduced numbers of suckers was predation by tiger muskies, which were stocked in the past and still present in the reservoir. The low numbers of suckers suggested that the reservoir was suitable to stock salmonids (e.g., rainbow and cutthroat trout).

Catch data from spring and fall 2002 were very similar, with two notable exceptions: (1) the absence of tiger muskies in the fall nets, and (2) the increase in yellow perch in the fall nets. It is likely that in the spring the muskies are concentrated in the shallower areas of the lake seeking out warmer waters, making them more vulnerable to our gill and trap nets in the spring. The lack of muskies in fall nets also suggests that there may only be a few remaining in the reservoir. The lack of perch caught in the spring may be related to the timing and location of the net sets. Perch spawn in the spring and can often become concentrated in spawning areas and be absent in the rest of the reservoir. Yellow perch numbers appear to have increased according to data collected in 1989. (Only 5 were captured in two nets in the fall compared to 26 in four nets during fall 2002.) These data suggest that muskies may be selectively foraging on suckers, and possibly that the reduced number of suckers has led to increased numbers of perch.

Otie Reservoir

Otie Reservoir is a small reservoir on an unnamed tributary of Grove Creek. The reservoir is used for irrigation and stock water and is managed by FWP under an angler access agreement with the landowner. The lake was last stocked in 1999 with rainbow trout. Sampling in fall of 2003 indicated that the growth of rainbow trout has been poor since 1999. Of the 8 rainbows captured in one floating gill net and one trap net, the largest was 17.4 in (range 14.2-17.4). In contrast, 5 rainbows were captured ranging in size from 20.8-21.3 in in 1999. The reduced growth is caused by competition from the overly abundant white sucker population. In the single trap net, 116 white suckers, ranging in size from 3.2 in to 18.5 in (average 10.1 in), were captured along with 6 rainbow trout. Two additional trap nets were set in an attempt to reduce the sucker population. Approximately 700 suckers were removed from the reservoir. Several additional trap nets were set in the spring of 2004, and more than 3,500 white suckers were removed from the pond. Past removal efforts have temporarily reduced sucker numbers and enhanced trout growth, but it did not appear that mechanical removal of suckers was a viable solution for long-term control.

To control the chronic sucker overpopulation and manage the pond for native species, an Environmental Assessment was prepared to chemically remove white suckers and rainbow trout. During the summer of 2004, the pond was lowered approximately 15 ft. On October 6, 2004, rotenone was added to the pond at a concentration of 5 parts per million (ppm). The reservoir outlet was closed before chemical was applied, and the calculated fill time of the reservoir was approximately 3 months. The inlet stream was screened off and later treated on October 16th with 1 ppm rotenone. The rotenone concentration in the reservoir was monitored using sentinel fish incubated in the reservoir. Sentinel fish were also placed in the outlet stream to monitor for the presence of rotenone downstream from the dam. On November 1, fish incubated in the reservoir showed no signs of rotenone, and the project was considered complete. No fish downstream of the reservoir died during the treatment. A trap net fished in the reservoir for three weeks after the treatment caught no live fish. Gillnets and trap nets will be set during spring 2006 to determine if the sucker and rainbow removal was successful.

A fish trap/barrier structure was installed in the stream approximately 50 yards upstream of the lake inlet. This structure is intended to preclude suckers from migrating up the creek to spawn and to potentially trap cutthroat juveniles in the future. Stream restoration on the property to the west of the pond also began in the fall of 2004. Working cooperatively with the Montana State University Foundation and the Johnson Family Foundation, FWP personnel fenced off the spring creek that feeds Otie Reservoir to preclude livestock trampling of the banks. A livestock watering area was also created at the head of the spring to allow livestock access to water without trampling banks and producing turbidity. The stream will be allowed to heal on its own for 1 or 2 years and then be evaluated for suitability for cutthroat spawning, with the goal of creating a self-sustaining population of fish in the reservoir. Future enhancements may include bank reformation, willow plantings, creation of pools and holding water, and the addition of gravels suitable for spawning.

Nelson's Farm Pond

During the summer of 2003, 29 black crappies were trap-netted from Lake Josephine in Billings and transplanted to Nelson's Farm Pond near Luther. The Nelson family had entered into an agreement with FWP to allow public access to the pond in exchange for stocking. The original plan was to stock the pond with largemouth bass to take advantage of the abundant population of lake chubs. Because of the potential for bass to escape and populate Cooney Reservoir downstream, the management of the pond was changed to stocking black crappies. Of the 29 fish captured, 27 survived transportation to the pond. The success of the stocking has not yet been evaluated, but because of drought, pond levels have been low, and it is possible the pond has experienced winterkill.

Absaroka-Beartooth Mountain Lakes

The Absaroka-Beartooth (A-B) Wilderness Area, established in 1978, encompasses 930,584 acres and contains more area over 10,000 feet in elevation than any other area in the U.S. It rates as one of the top four or five wilderness areas in the country, receiving about 320,000 visitor-days of use each year. The A-B Wilderness Area, and lands immediately adjacent, contain 948 high mountain lakes, 318 of which contain fish and 630 that are barren. Approximately 204 of these lakes have self-sustaining fisheries, and 114 are stocked. Stocking schedules vary from yearly in some of the more heavily used areas, to once every 6 to 10 years in lakes managed for trophy fisheries.

Pat Marcuson, during the time he worked for FWP out of Red Lodge, gathered a tremendous amount of information on the A-B lakes and created a massive database. He also developed fisheries management plans for each major drainage. Since that time, a computer database containing the latest information on the lakes with fisheries has been developed. Two to five temporary employees, working from mid-July to September, collect fisheries information used to update the high mountain lake computer database, and for periodic updates to the drainage management plans. Fisheries management plans originally developed in 1980 for all the A-B mountain lakes were updated with the latest information available and reissued in 1991. We are presently in the process of again updating these drainage management plans. A separate management plan is available for all the lakes located in each major drainage. A four-person crew backpacked into 127 alpine lakes in the A-B mountains from 2000 to 2004. The crew sampled lakes in the Boulder River, East Rosebud Creek, West Rosebud Creek, Stillwater River, Rock Creek, and Clark's Fork Yellowstone River drainages. The crew also sampled 8 lakes in the Crazy Mountains, using a combination of backpacking and helicopter. The majority of lakes sampled supported self-sustaining or stocked Yellowstone cutthroat trout; others are managed for golden trout, rainbow trout, brook trout and arctic grayling. The data from these surveys was used to update the high mountain lake database and to adjust stocking rates for lakes managed for fishing that lack self-sustaining populations. Our goal is to sample all 318 lakes supporting fisheries once every ten years. Survey data for 2000 through 2004are summarized in Appendix 1.

Genetic samples were collected from Mystic and Silver Lakes in the West Rosebud Creek drainage in 2000 and 2001 to assess the contribution of rainbow and Yellowstone cutthroat trout genetics to the population. Fish in Mystic Lake were identified as rainbow x cutthroat hybrids with only 13% Yellowstone genes. Fish from Silver Lake were also hybrids with a similar proportion of cutthroat genes (14%).

Three egg-taking operations occurred in the A-B and Crazy mountains. During 2003, eggs were collected from golden trout from Cave Lake in the Crazy Mountains. During this operation it was discovered that introgression from cutthroat and rainbow trout had occurred in the lake's golden trout population. It is unclear how cutthroat and rainbow got into the lake, but Cave Lake, the only golden trout lake outside the wilderness area in Regions 5, will not serve as a source of golden trout eggs in the future. Also in 2003, rainbow trout eggs were taken from Wounded Man Lake in the Stillwater River drainage. DeSmet rainbows were originally planted in Diaphonous Lake, and the egg-take was planned for Diaphonous Lake to test the progeny of the fish for resistance to whirling disease; however, the lake was found to be barren of fish. Wounded Man Lake, the next lake downstream from Diaphonous Lake, was sampled instead. Eggs and juvenile fish collected from Wounded Man were tested for resistance to whirling disease. The results of this testing is not yet available. A third egg-take occurred at Goose Lake at the head of the Stillwater Drainage. Yellowstone cutthroat trout eggs were collected from over 100 females and over 200 males and sent to the Yellowstone River Trout Hatchery in Big Timber for hatching and rearing. Because of difficulty obtaining wild gametes from McBride Lake, it is likely that Goose Lake cutthroats will replace McBride Lake cutthroats as the brood source in the hatchery system.

Icicle and Second Creek lakes in the West Boulder Drainage have been considered fishless. An amphibian survey crew working in the West Boulder during 2003 noted the presence of fish in both of these lakes. During 2004, crews gillnetted the lakes and identified the fish present in Icicle Lake as rainbow trout. No fish were gillnetted or observed in Second Creek Lake. The rainbow population in Icicle Lake appears healthy and there was evidence of natural reproduction. FWP has no stocking record for Icicle Lake, and the high gradient from the West Boulder River to the lake would likely preclude natural fish migration and colonization. Therefore, it is likely that these fish were illegally introduced into the lake.

Musselshell River

Drought conditions that began to develop in the Musselshell Drainage in 1998 were a major factor during this report period. Musselshell River flows remained well below normal for this entire period, with many sections of the lower river going completely dry each year by the end of the summer irrigation season. Late summer flows in the Musselshell are normally supplemented by releases of stored water from Martinsdale, Bair and Deadmans Basin reservoirs. With the extended drought, water levels in these reservoirs were extremely low, and any releases ended by early summer.

A new US Geological Survey gauge installed at the upstream end of our standardized electrofishing section (upstream of Selkirk Fishing Access Site) in April of 2003 should provide valuable flow data in the future. Before this gauge was installed, the gauge at Harlowton (approximately 28 miles downstream) provided the best flow data for the upper Musselshell Drainage. River flows recorded at this gauge since 2000 have helped explain the observed impacts on the trout fishery in the upper Musselshell.

River flows at the Harlowton gauge dropped below 10 cfs on July 27, 2000, and remained below this level until late September, bottoming out with a flow of only 1.9 cfs in early September. In 2001, flows at the Harlowton gauge dropped to around 10 cfs in the spring before runoff started, and then fell back below 10 cfs on August 10. Flows fell to below 1 cfs for 5 days at the end of August and remained below 10 cfs until mid-October. In 2002 flows at Harlowton fell to 14 cfs on August 22 and remained at or below this level until late September. Problems with this gauge prevented it from recording flows below 14 cfs during this period, but flows at the Roundup gauge downstream dropped below 2 cfs by mid-August, and this gauge recorded flows of 0 cfs for 23 days in September. Flows at the Harlowton gauge were probably close to 0 cfs during this time also. In 2003, flows at Harlowton dropped below 14 cfs near the end of August, and fell below 10 cfs for the first two weeks in September, with a low flow of only 1.9 cfs on September 8. Flows in the Musselshell were slightly better in 2004 due to some timely summer rains and cooler weather that helped reduce irrigation demands. Flows at Harlowton did drop to between 10 and 15 cfs in April before a limited spring runoff started. Flows dropped back down to around 10 cfs the first two weeks in September, with a low flow of 6.7 cfs recorded September 2nd.

Water commissioners appointed on the Musselshell Drainage between 2002 and 2004 helped ensure a more equitable distribution of the limited water to senior water users downstream, but did little to protect the brown trout population in the upper river. Along with the low flows, the trout in the upper Musselshell endured high summer water temperatures during this period. No long-term temperature data were available for the upper Musselshell, but incidental measurements showed surface water temperatures exceeded 80° F near Two-Dot during the summer. Beaver activities increased significantly in the upper Musselshell River with the onset of the drought. Deeper water behind beaver dams provided important refuge areas for trout during low flows. Some of the beaver ponds in the standardized electrofishing section were large enough to limit the effectiveness of the mobile electrofishing equipment used during mark/recapture efforts.

Population estimates were attempted on the 1.25 mi electrofishing section just upstream of Selkirk Fishing Access Site each spring between 2001 and 2004. In 2001, 85 brown trout and one 10.1 in rainbow were marked in this section. Sixty-six brown trout were handled during the recapture run, with 20 of these being marked fish. These data provided a fair quality brown trout estimate of 85 13 in and longer trout per mile. Thirty-nine (26 %) of the brown trout handled in 2001 were yearling fish between 3 and 5 in, and 40 brown trout were between 7 and 16 in. A statistically valid estimate could only be calculated for 13 in and longer brown trout. The 2001 estimate was comparable to a pre-drought estimate of 216 9 in and longer brown trout per mile in 1999 (Poore and Frazer, 2000). The largest brown trout captured in 2001 was 21.7 in long and weighed 3.21 lb. Five brown trout 20 in long and longer were captured in 2001.

Marking efforts in 2002 captured 69 brown trout. Seventy-five fish were handled during the recapture run, including 21 recaptures. Over 46 % of the brown trout handled in 2002 were yearling trout between 3 and 6 in long, and only 17 brown trout between 6 and 16 in were captured. As in 2001, it was only possible to calculate an estimate for brown trout 13 in and longer. The low number of recaptured fish produced a low quality estimate of 97 brown trout per mile. Although it was not possible to do a statistically valid estimate on the yearling brown trout, there were enough of these smaller trout marked and recaptured to indicate there were probably around 500 of these smaller trout per mile in this section of the Musselshell River in 2002. Despite the low flow conditions, the brown trout were still finding places to spawn successfully. There were still some nice brown trout surviving the low flows in 2002, with 4 fish over 20 in being captured.

The 2003 population structure was similar to that seen in 2002 with very poor recruitment of the strong yearling age class observed in 2002. The 2003 marking run captured 77 brown trout, with 50 being captured on the recapture run. Only 13 marked fish were recaptured during this second run. A strong age-one year-class was again evident in 2003, with 39 % of the brown trout captured measuring between 3 and 6 in. Only 12 brown trout between 6 and 16 in were handled in 2003, with only 3 recaptures in this group. Between the low recapture rate and the low number of mid-sized trout, it was not possible to calculate a valid estimate for the Selkirk section in 2003.

Mark/recapture efforts in the upper Musselshell River were unsuccessful for several reasons in 2004. The river was flowing at about 17 cfs when 64 brown trout were marked on April 20th. By May 6 when the recapture run was made on the river, flows had increased by over four fold to approximately 74 cfs. Of 48 brown trout caught during this recapture run, only 5 were marked fish, and only one of these was over 6.5 in long. No brown trout estimate could be calculated. The composition of the brown trout population in 2004 was similar to 2002 and 2003, with over 48 % of the captured brown trout from 3 to 6 in long. Most of the remaining fish were large, older fish with very few intermediate-sized trout captured. Again there was poor recruitment of the strong yearling age class observed in 2003, but successful spawning by the remaining older brown trout in the population. Ten of the brown trout handled in 2004 were over 19 in long, and the largest was 21.5 in. The brown trout population in the upper Musselshell seems to be slipping a little more each year the drought continues, but if enough older brown trout survive and continue to spawn successfully, the trout fishery could recover fairly rapidly if flows returned to normal.

MANAGEMENT RECOMMENDATIONS

Cooney Reservoir

Cooney Reservoir should continue to be stocked at 200,000 rainbow trout and 50,000 walleye during 2005 and evaluated during the fall of 2005 and spring of 2006 for rainbow survival. A study should be initiated that includes a year-round creel census and a population estimate for walleyes and suckers in the reservoir. Walleye food habits and energetic modeling should be done to predict the total predation rate of stocked rainbows by walleye in Cooney. This information, coupled with creel data on angler harvest rates, should give estimates of the mortality of the rainbows planted in the reservoir and aid in potential management changes. As part of the creel survey, piscivorous birds should be counted immediately after stocking to determine whether bird predation can partly explain the reduced survival of rainbow trout.

Deadmans Basin Reservoir

Continue to monitor fish populations in Deadmans Basin Reservoir to evaluate ongoing impacts of the drought. Monitor fish populations in the reservoir as Deadmans refills to evaluate impacts of tiger muskie predation. Adjust stocking rates for rainbows and kokanee based on available water and to compensate for apparent predation by tiger muskies. Stock a small number of tiger muskies in 2005 to establish another year class of tiger muskies, and to provide predation on the strong year class of small white suckers present in the reservoir.

Yellowtail Afterbay Reservoir

Work closely with BOR as they continue to refine their drawdown schedule for Yellowtail Afterbay Reservoir. Go back to spring plants of smaller rainbows on years when no drawdown is planned. Work with the hatchery system to obtain a sterile domestic rainbow for stocking in the Afterbay Reservoir.

East and West Rosebud Lakes and Emerald Lake

Continue to stock rainbow trout at least 8 in long to maintain the rainbow trout fisheries in the lakes to provide additional harvestable fish and reduce pressure on wild fish. Periodically monitor growth, survival, and spawning activity and adjust stocking rats to maintained the desired fishery. Monitor the increase in the brook trout population in West Rosebud Lake for possible effects on growth rates.

Lower Glaston Lake

Although tiger muskies have been effective at reducing the sucker population and made the reservoir suitable for salmonid stocking, no management can take place until public access is allowed. The department should continue to pursue opportunities to allow access at the reservoir as they arise and develop a management strategy once access is secured.

Otie Reservoir

Otie Reservoir should be monitored for the presence of white suckers and rainbow trout. If the fish kill was successful, Yellowstone cutthroat trout should be introduced into the reservoir during 2005. The riparian area of the feeder stream should be rested for a year (or possibly two) to allow natural revegetation and narrowing of the stream channel. After natural healing has occurred, the stream should be reevaluated for suitability for cutthroat spawning, and any enhancements made (e.g., introduction of spawning gravels and enhancement of rearing habitat) should be made to facilitate spawning.

Absaroka-Beartooth Lakes

Boulder River Drainage

Silver Lake. Silver Lake should be converted to a Yellowstone cutthroat trout fishery to facilitate conversion of the 4-Mile Creek Drainage to a Yellowstone cutthroat trout fishery. A pure population of Yellowstone cutthroat trout exists in Meatrack Creek, a tributary to 4-Mile Creek that is threatened by the possibility of hybridization from rainbows in 4-Mile Creek. Conversion of the lake to a cutthroat fishery could be accomplished through mechanical removal (intensive gillnetting) and subsequent high intensity stocking into the lake to swamp out many of the remaining rainbow genes. Studies in the western part of Montana suggest that genetic swamping can be effective at increasing the frequency of cutthroat alleles in rainbow and hybridized populations. Swamping refers to stocking pure cutthroats over the top of rainbows and hybridized fish over a period of several years (10 or more) and thus shifting the genetic composition of fish in the lake toward cutthroat trout. The drawbacks of swamping are that a 100% pure population would likely never be reached. Another option is to chemically remove the rainbow trout from the lake and restock it with cutthroat trout. This option has a greater likelihood of resulting in a 100% pure population of cutthroat in Silver Lake, but it is more controversial because of the use of piscicide in a wilderness area.

Great Falls Creek Lakes. Great Falls Creek Lake once contained rainbow trout but was found to be barren of fish in 2002. Surveys in Great Falls Creek during 2003 suggested that the stream was also barren. The lake should be restocked with Yellowstone cutthroat trout.

Icicle Lake and Second Creek Lake. No stocking should occur in Icicle and Second Creek lakes. Neither lake is included in the management plan for the Boulder River mountain lakes. Icicle Lakes should be monitored in 5 years to determine if the populations of fish are still present. If fish are present and populations appear to be self-sustaining, it should be added to the last of self-sustaining, fish-bearing lakes in the Boulder Drainage. Second Creek Lake should be checked a second time to verify that no fish are present in the lake. If verified, the lake should continue to be managed as a fishless lake.

Stillwater River Drainage

Diaphonous Lake. Diaphonous Lake in the Stillwater River drainage contained DeSmet rainbow trout, but has become barren following years of drought. Eggs for whirling disease testing were taken from Wounded Man Lake downstream. If the DeSmet rainbows prove to be more resistant to whirling disease, progeny of Wounded Man Lake fish could be restocked into Diaphonous Lake.

Crater Lake. Rainbow trout stocked into Crater Lake should be monitored for growth and survival in 2006. Plans to create a trail across public lands should be pursued to enhance access to the Crater and Lilly Pad lakes.

Chrome Lake. Chrome Lake should be restocked with grayling and evaluated for the capability of sustaining a mixed fishery of Yellowstone cutthroat trout and grayling.

Mutt, Jeff and Huckleberry Lakes. Mutt, Jeff and Huckleberry lakes are located at the upper end of the Goose Creek drainage near Cooke City, outside the wilderness area. All three lakes contain populations of stunted brook trout. Goose Creek also contains a population of brook trout to approximately 1 mile below Goose Lake. A small cascade has preclude brook trout from moving farther upstream in Goose Creek and from colonizing Goose Lake. Goose Lake is being considered as a source for wild gamete introduction into the Yellowstone cutthroat broodstock program. Huckleberry, Mutt and Jeff lakes should be chemically treated and restocked with Yellowstone cutthroat trout from Goose Lake. Goose Creek should also be treated up to the wilderness boundary and restocked with cutthroat trout. This effort would protect Goose Lake from the threat of colonization by brook trout and would restore cutthroats to approximately 4.5 mi of stream.

Musselshell River

Continue to monitor the brown trout population in the upper Musselshell River annually as long as the drought continues. Install a temperature recorder in the Musselshell River near Two Dot in the spring of 2005 to monitor summer water temperatures in the river.

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Waters Referred To

Water	Water Code	Water	Water Code
Absaroka-Beartooth Lakes		Martes lake	5-22-8590
Albino Lake	5-22-7126	Martin Lake	5-22-8592
Alpine Lake	5-22-7143	Martin Lake	5-22-8593
Amphitheater Lake	5-22-7146	Mermaid Lake	5-22-8662
Bill Lake	5-22-7266	Mirror Lake	5-22-8680
Bob Lake	5-22-7310	Moon Lake	5-22-8708
Brent Lake	5-22-7325	Mutt Lake	5-22-8750
Broadwater Lake	5-22-7350	Mystic Lake	5-22-8764
Chickadee Lake	5-22-7453	North Picket Pin Lake	5-22-8880
Clover Leaf Lakes	5-22-7468	Otter Lake	5-22-8834
Chrome Lake	5-22-7455	Ouzel Lake	5-22-8840
Cradle Lake	5-22-7543	Owl Lake	5-22-8849
Crater Lake	5-22-7546	Ovis Lake	5-22-8848
Crescent Lake	5-22-7588	Pablo Lake	None
Crow Lake	5-22-7602	Peace Lake	5-22-8874
Curl Lake	5-22-7630	Picasso Lake	5-22-8877
Daly Lake	5-22-7646	Pinchot Lake	5-22-8890
Diaphonous Lake	5-22-7689	Pipit Lake	5-22-8907
Fish Lake	5-22-7896	Production Lake	5-22-8935
Fossil Lake	5-22-7924	Recruitment Lake	5-22-8979
Gallery Lake	5-22-7963	Ovis Lake	5-22-8848
Golden Lake	5-22-7987	Renie Lake	5-22-8994
Goose Lake	5-22-7994	Robin Lake	5-22-9006
Great Falls Creek Lk.	5-22-8017	Round Lake	5-22-9044
Green Lake	5-22-8036	Rydberg Lake	5-22-9076
Hairpin Lake	None	Scat Lake	5-22-9097
Heather Lake	5-22-8058	Silver Lake	5-22-9185
Horseshoe Lake	5-22-8132	Shadow Lake	5-22-9142
Huckleberry Lake	5-22-8148	Second Creek Lake	None
Island Lake	5-22-8163	Sliderock Lake	5-22-9240
Jasper Lake	5-22-8180	Smethurst Lake	5-22-9275
Jasper Lake	5-22-8180	Snowbank Lake	5-22-9310
Jeff Lake	5-22-8190	South Picket Pen Lake	5-22-8881
Kersey Lake	5-22-8274	Surprise Lake	5-22-9582
Lady of the Lake	5-22-8316	Sylvan Lake	5-22-9394
Lake of the Clouds	5-22-8338	Tiel Lake	5-22-00BY
Lake of the Woods	5-22-8347	Turgulse Lake	5-22-9513
Lightning Lake	5-22-8372	Trail Lake	5-22-9480
Lilly Pad Lake	5-22-8400	Weasle 48	5-22-9726
Line Lake	5-22-8428	Weidy Lake	None
Little Scat Lake	5-22-00CX	West Boulder Lake	5-22-9730
Little Washtub Lake	5-22-8450	West Fishtail Lakes	5-22-9735
Lower Arch	5-22-7170	Widewater Lake	5-22-9758
Lower Aero	5-22-8526	Wilderness Lake	5-22-00CK
Marsh Lake	5-22-8589	Wood Lake	5-22-9799

Waters Referred To (Cont'd)

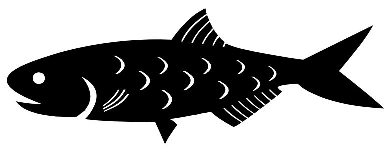
Water	Water Code	Water	Water Code
Absaroka-Beartooth Lakes (Cont'd)			
Wounded Man Lake	5-22-9728		
Crazy Mountain Lakes			
Cave Lake	5-22-7449		
Other Lakes			
Cooney Reservoir	5-22-7518		
Deadmans Basin Reservoir	5-22-7540		
East Rosebud Lake	5-22-7714		
Emerald Lake	5-22-7812		
Otie Reservoir	5-22-8833		
Yellowtail Afterbay	5-22-9834		
Yellowtail Reservoir	5-22-00BZ		
West Rosebud Lake	5-22-9744		
Musselshell River	5-18-4350		

Prepared by: _Jim Olsen and Ken Frazer

Date: __3//08_________

APPENDIX 1. High Mountain Lakes Reports From 2000 Through 2004.

Absaroka-Beartooth Wilderness
High Mountain Lakes Survey-2000



By: Richard K. Stiff
Mountain Lakes Survey Coordinator
Montana Department of Fish, Wildlife and Parks
Region 5 Fisheries
December 2000

Absaroka-Beartooth Wilderness High Mountain Lakes Survey-2000
By: Richard K. Stiff, Mountain Lakes Survey Coordinator

ABSTRACT

The High Mountain Lakes Survey was started in 1989, to monitor the fisheries of the lakes in and immediately adjacent to the Absaroka-Beartooth Wilderness. The goal of this survey is to collect fisheries data from approximately 30 lakes per year, covering approximately 300 lakes, on a rotating basis, over 10 years. These data are used in making management decisions governing the fisheries within these lakes. In 2000, the survey crew consisted of Richard Stiff, and FWP college interns John "Steve" Begley and James "Jim' Massick.

Standard age, length, weight and general health information is gathered by gill-netting fish in the lakes. A Health Assessment Index (HAI) (Adams et al. 1993) was conducted for fish when feasible, and condition factors(Ctl) are also calculated. Gut contents were also analyzed. Spawning potential was noted for inlets and outlet streams, and camping opportunities were also noted. Since 1994, the presence or absence of amphibians has also been noted.

The survey covered 37 lakes in 2000, during the months of July, August and September. By drainage in Region 5, the number of lakes surveyed were Boulder River-0, Clarks Fork of the Yellowstone-18, Crazy Mountains-0, East Rosebud Creek-3, Rock Creek-11, Slough Creek-0, Stillwater River-2, and West Rosebud Creek-3.

Current management practices and status are supported in 23 of the lakes surveyed, while changes are indicated in 14 cases (38%). Two new lakes, located in the Hellroaring Creek chain of lakes in the Rock Creek drainage need to be added to the database. Spotted frogs, *Rana pretiosa*, were noted in 3 locations, while no western chorus frogs, *Pseudacris triseriata*, were noted during the amphibian portion of this survey.

An HAI assessment was conducted on 31 of the 37 lakes surveyed, with poor health of fish noted in 9 cases. A total of 40 species populations were assessed in the 31 lakes. Problems noted in the fish were in the condition of the kidney (11.5% of fish), discoloration of the liver (7.5 % of fish), and inflammation of the intestine (6.3% of fish). Overall, 25% of the fish necropsied had parasites, usually, an intestinal nematode, *Truttaedacnitis truttae*, or tapeworm cysts of *Diphylobothrium latum*, in their body cavity. Extremely poor health was noted in both brook trout and rainbow trout in Granite Lake.

Analysis of gut contents showed that the principle food noted in 2000 was in the form of emergents (50% of contents). Chironmid larvae were the second-most frequently observed food (15%), while caddis larvae made up 13% of gut contents. Crustaceans and Coleopterans (beetles) both made up around 6% of the contents. A large number of the fish sampled had empty guts in 2000, with possible causes being the warm weather or the inexperienced crew.

Difficulty in obtaining wild-stock Yellowstone cutthroat trout (YCT) for brood stock, to refresh the genetics at the Yellowstone River Trout Hatchery prompted an

unsuccessful attempt to obtain eggs from lakes in the Slough Creek drainage in June of 2000. Subsequently, genetic and health analysis of the trout population in Goose Lake in Little Goose Lake in the Stillwater River drainage was conducted to assess its suitability for use in the hatchery. These lakes show great promise, as they harbor large populations of YCT, and are fairly accessible.

Introduction

The Absaroka-Beartooth (A-B) Wilderness straddles the Wyoming-Montana border, east and north of Yellowstone National Park and boasts the highest mountains in Montana (Figure 1). Pat Marcuson (Marcuson and Poore 1991) noted the Absaroka-Beartooth (A-B) Wilderness and area adjacent were host to over 1000 lakes. Roughly 1/3 of these lakes support fisheries (Stiff 1992). Only a few lakes in the Slough Creek drainage are thought to have originally supported fisheries, with these being host to Yellowstone cutthroat trout. All other fisheries in the A-B Wilderness are the result of introductions, or migrations of fish from the point of introduction (Stiff 1993, 1994). Lakes are currently managed by drainage due to this possibility of migration.

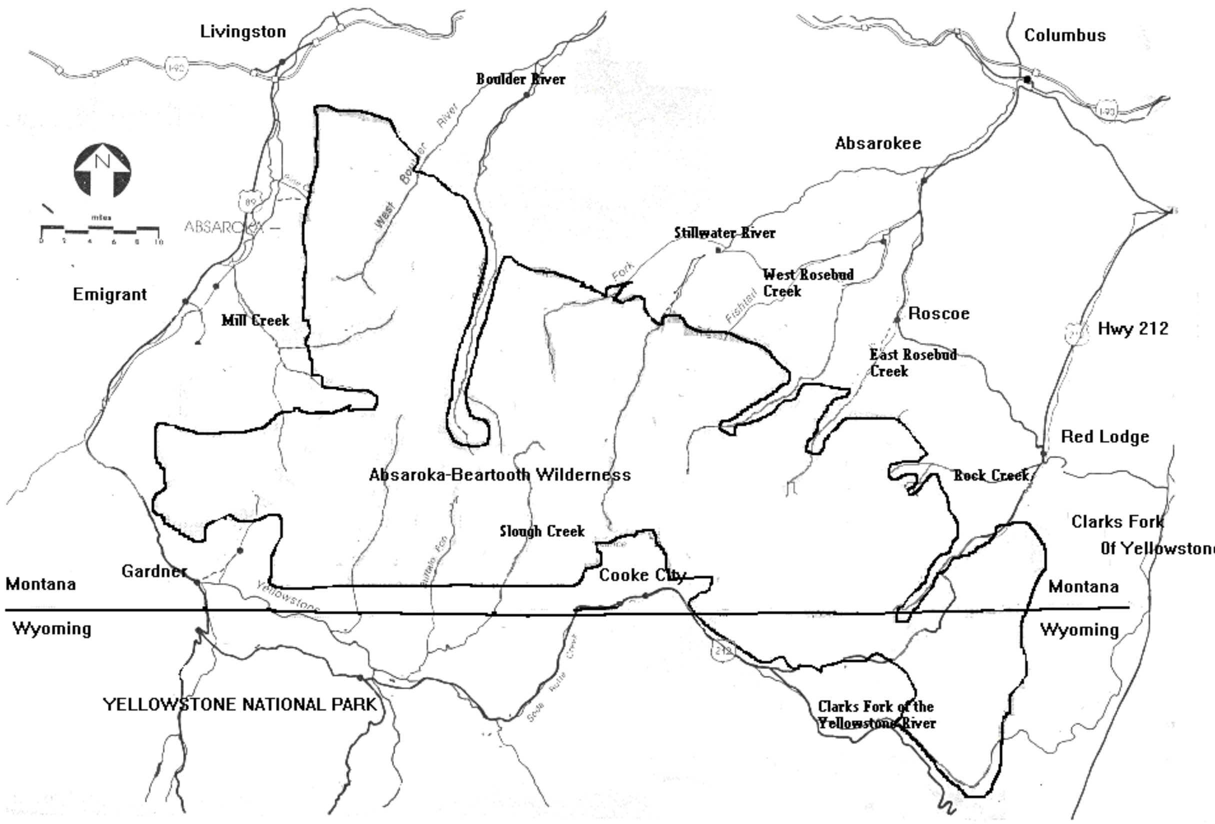


Figure 1. Absaroka-Beartooth Wilderness. Major drainages are the Clarks Fork of the Yellowstone River, the Stillwater River, Rock Creek, East Rosebud Creek, West Rosebud Creek, Slough Creek, and the Boulder River. Mill Creek is in Region 3.

There are 7 major drainages within the A-B Wilderness, with over 40% of the lakes present being located within the Clarks Fork of the Yellowstone River drainage. Other drainages are the Boulder River, East Rosebud Creek, Rock Creek, Slough Creek, the Stillwater River, and West Rosebud Creek.

The majority of the lakes in the A-B Wilderness are above 8,500 feet of elevation, with most being ice-covered until late June or early July. While the cold, clean waters of the A-B

Wilderness provide a suitable habitat for trout, growth rates are restricted by the short summer growing season, and a shortage of nutrients (Stiff 1998).

Lakes tend to have a few large fish, many medium sized fish, or a lot of small fish (Stiff 1994). Most lakes that support reproduction overpopulate resulting in smaller fish. Stocking fish in lakes without reproduction allows for a regulation of numbers, and consequently growth rates. Stocked lakes are handled as put-grow-and-take fisheries, with stocking cycles of 3, 4, 6 and 8 years.

Three and 4-year cycles are used for lakes that receive significant fishing pressure. A 6-year cycle allows for more growth of the fish, while maintaining a constant fishery. Lakes are stocked on an 8-year basis to allow the fish to age out at 7 years resulting in a fallow year in the lake so the food population can recover. In the A-B Wilderness, there are many cases where the fish surpass the 7-year age projection, and this may result in some stocking changes.

Most of the lakes being stocked are receive Yellowstone Cutthroat Trout from the Yellowstone River Trout hatchery in Big Timber, MT as the area is within their natural range. Brook trout are no longer stocked, but many populations were established during the first half of the century. There are cutthroat trout in over 100 lakes of the A-B Wilderness, while brook trout inhabit around 90. Over 20 lakes support rainbow trout fisheries and the same is true of golden trout. Fewer than 20 lakes have grayling. Lake trout and brown trout are found in several mixed fisheries, mostly outside of the wilderness boundaries.

Stream fisheries are different than lake fisheries, and streams with resident wild populations of trout are not stocked. Alpine streams, like alpine lakes, have a limited food supply. However, in a stream, the trout not only have to find food, they must also fight the stream velocity. Trout utilize feeding stations that provide refuge from the stream velocity, and the number of these stations coupled with the amount of food available limits the number of fish that may be found in a stream, and their size. A few successfully spawning fish can produce an excess of offspring to maintain the fish population.

Methods

<u>Materials</u>

gill net forms	scale envelopes	thermometer
lake data sheets	spools of tar chord	scale
HAI data sheets	125’ experimental gill nets	ruler
pencils	knife	fishing gear

Survey teams generally spend a 4-day week hiking to high mountain lakes within the A-B Wilderness, sampling lakes designated during spring meetings. The teams are free to determine own access points, and the order of the lakes sampled.

Gill nets are set by first pulling them across a bay using tar cord, and then suspending them in the lake using the same cord. Whenever possible, nets are left overnight, and pulled the following morning, although day samples with a minimum of 8 fish may be adequate. Outlet bays are the first choice of location, followed by inlet bays, and downwind bays.

The goal of gill-netting is not necessarily to establish quantities of certain age class fish, but to establish whether or not reproduction is occurring, by noting age classes of fish, and whether enough reproduction is taking place to alter management for the lake.

Fish are removed from the net, weighed, measured, and a scale sample is taken for age purposes. Scale samples are done on a maximum of 20 fish per lake, and are not taken in brook trout lakes, as the scales are often too small and annuli to close together to read. If time and weather permit, several fish are then necropsied, checking for parasites and abnormalities. An HAI assessment is done when feasible, using methods modified from those outlined by Adams et al. (1993). Gut contents are analyzed during the HAI assessment. All data are recorded on the appropriate forms.

The shoreline is walked, when possible, noting the presence or absence of fry, and the types of food organisms present. Presence or absence of amphibians is also noted. The substrate of the inlet and outlet streams is assessed for spawning potential. Camping opportunities are noted as are the presence and absence of firewood.

In 2000, Yellowstone cutthroat trout were obtained from Goose Lake and Little Goose Lake to assess health and genetic purity for refreshing genetics of the hatchery stock at the Yellowstone River Hatchery in Big Timber. Fish samples were obtained and shipped to the laboratory in Bozeman, MT for genetic analysis. In addition to HAI health assessment, MFWP fish pathologists from Great Falls subjected fish to specific pathology tests.

Results

Lakes with No Management or Status Changes

Twenty-three the 37 lakes sampled in 2000 had no change of status or management indicated (Table 1). The majority of these are self-sustaining populations.

Table 1. Lakes sampled in 2000 with no changes in management or status. Twenty-three of 37 lakes (62%) surveyed required no change.

Lake	Drainage Code	Species	Status
1. Corner Lake	CF007	CT	SS
2. Crescent Lake	RC024	CT	SS
3. Daly Lake	RC027	CT/EB	SS
4. Froze to Death Lake	ER048	CT	SS
5. Goose Lake	SR042	CT	SS
6. Granite Lake	CF147	CT/EB/RB	SS
7. Hellroaring Lake #4	RC020	CT	SS
8. Hellroaring Lake #5	RC021	CT/EB	SS
9. Hellroaring Lake #9	RC025	CT/EB	SS
10. Incisor Lake	SR018	GT	SS
11. Island Lake	WR014	CTxRB/RB	SS
12. Kersey Lake	CF060	CT/EB/LC/LT	SS
13. Lake Elaine	CF168	EB	SS
14. Little Goose Lake	SR043	CT	SS
15. Margaret Lake	CF066	CT	ST
16. Marsh Lake	CF019	CT	ST
17. Ovis Lake	CF011	CT/EB	ST/SS
18. Rock Island Lake	CF073	CT/EB	ST/SS
19. Silver Lake	WR015	RB	SS
20. Sliderock Lake	RC030	EB	SS
21. Snowbank lake	RC019	EB	SS
22. Vernon Lake	CF019	CT/EB	SS
23. Weidy Lake	CF018	CT	ST

BR=Boulder River	CT=Cutthroat Trout	
CF=Clarks Fork of the Yellowstone River	EB=Brook Trout	x=hybrids
CM=Crazy Mountains	GT=Golden Trout	/=more than 1 species
ER=East Rosebud Creek	LC=Lake Chub	
RC=Rock Creek	LT=Lake Trout	
SC=Slough Creek	RB=Rainbow Trout	
SR=Stillwater River		
WR=West Rosebud Creek	SS=Self Sustaining population	
	ST=Stocked population	

Lakes with Management and/or Status Changes

The purpose of this survey is to establish the status of fish populations in the A-B Wilderness, and to adjust management plans based on both status and observed growth rates. Fourteen of the lakes (38%) sampled in 2000 needed status or management changes (Table 2).

Flat Rock Lake is located north of Granite Lake in the Clarks Fork drainage. It can be accessed from a number of trailheads, all of which result in a long hike. It has been stocked at 100 fish per acreon an 8-year cycle, but growth of the 6-year old fish sampled in 2000 is very poor (10.9 inch average). Stocking should be dropped to 75 per acre.

Forsaken Lake is also located north of Granite Lake in the Clarks Fork drainage, immediately upstream from Flat Rock Lake. It can be accessed from a number of trailheads, all of which result in a long hike. Like Flat Rock Lake, it has been stocked at 100 fish per acre, but growth of the fish sampled in 2000 is very poor (11.8 inch average for 7 year old fish). Stocking should be dropped to 75 per acre.

Hairpin Lake is one of the Hellroaring chain of lakes in the Rock Creek Drainage. It is currently stocked at 50 fish per acre on an 8-year cycle, but reproduction is occurring. The larger fish that were taken in previous samples were not present this year, and anecdotal information from fishermen seems to confirm this. There seems to be a substantial population there (over 1.5 fish per hour in the net). Dropping this lake from stocking plans should be considered, to see if the reproduction that is occurring will support the fishery. There are plenty of other lakes in this drainage where cutthroat trout can be caught. Low reproductive rates may maintain this lake as more of a trophy fishery.

Table 2. Lakes needing adjustments in management practices and status. Fourteen of the 37 lakes sampled (38%) need their management plans/status adjusted..

Lake	Drainage Code	Species	Status	Change
1. Flat Rock Lake	CF190	CT	ST	Reduce stocking to 75/acre.
2. Forsaken Lake	CF198	CT	ST	Reduce stocking to 75/acre
3. Hairpin Lake	RC018	CT	ST/SS?	Possibly stop stocking.
4. Hellroaring Lake #12	RC029	barren	barren	Add to Dbase as confirmed fishless.
5. Hidden Lake	CF234	CT(GT)	SS	Remove GT from sheet
6. Lillis Lake	CF067	EB(CT)	SS/?? >	Remove CT from sheet for this lake.
7. Long Lake	CF010	EB(CT)	SS/ (SS)	Add CT to lake as SS.
8. Lower Snow Lake	ER004	RB	ST	Stock again with 100/acre in 2001
9. Rydberg Lake	RC028	CT/EB	SS/SS	Add new to Dbase.
10. Schoolmarm lake	CF005	CT	SS>ST	Change to a stocked lake 100/a in 2000, 50/a 2006
11. Smethurst Lake	RC026	CT/EB	SS/SS	Change abundance to R for EB.
12. Swede Lake	CF235	CT	ST>SS	Drop from stocking plans.
13. Trail Lake	CF208	CT	ST	Reduce stocking to 75/acre.
14. Upper Snow Lake	ER005	RB	ST	Stock again in 2001 at 100/acre

BR=Boulder River	CT=Cutthroat Trout	
CF=Clarks Fork of the Yellowstone River	EB=Brook Trout	x=hybrids
CM=Crazy Mountains	GT=Golden Trout	/=more than 1 species
ER=East Rosebud Creek	LT=Lake Trout	
RC=Rock Creek	RB=Rainbow Trout	
SC=Slough Creek		
SR=Stillwater River	SS=Self Sustaining population	
WR=West Rosebud Creek	ST=Stocked population	

Hellroaring Lake #12 is one of the Hellroaring chain of lakes in the Rock Creek Drainage. It is fishless, and the lake was netted in 2000 to verify this status. It should be added to the database as a fishless lake.

Hidden Lake is located north of Clay Butte and east of Granite Lake. While this lake at one time supported golden trout, and then golden trout, cutthroat trout hybrids, the fishery seems to have been taken over by cutthroat trout. The last two times this lake was sampled, none of the fish exhibited any golden trout characteristics. The reference to golden trout should be removed from the Dbase.

Lillis Lake near Cooke City had previously received an errant plant of cutthroat trout. There is no evidence of survivors from this plant. Reference to cutthroat trout in this lake should be removed from the Dbase. All that remains is the resident brook trout population.

Long Lake is located along the Goose Lake Jeep Trail. It supports a self-sustaining population of small brook trout. Cutthroat trout have worked their way downstream and in to this lake. Cutthroat trout should be added to the Dbase for this lake as SS with their abundance being R.

Lower and Upper Snow Lake are located up East Rosebud Creek. Although not far from the trail, they are fairly inaccessible due to the steep terrain. They have been stocked with rainbow trout in an attempt to establish a self-sustaining population. The fish moved from the upper lake to the lower from the previous stocking, but reproduction doesn’t seem to be taking place. Both lakes should be restocked with rainbow trout at 100 per acre.

Rydberg Lake is the lowest of the Hellroaring chain of lakes. It is very shallow and supports small brook trout and cutthroat trout. It needs to be added to the Dbase as having self-sustaining populations of both fish. Their abundance should be C (common).

Schoolmarm Lake (Upper Mud Lake) supported a small population of cutthroat trout that were established by stocking in 1977. Reproduction was and is marginal, and this resulted in a few large fish. The population seems to have died out. To reestablish a population in this shallow productive lake, it should be stocked at 100 cutthroat trout per acre in 2000/2001, and then put on a 6 year cycle at 50 per acre. This should maintain a trophy-type fishery in an area that supports a lot of small fish.

Smethhurst Lake is one of the Hellroaring chain of lakes. In this lake, the cutthroat population seems to have taken over, leaving just a few brook trout. The abundance of the brook trout should be changed from C (common) to R (rare).

Swede Lake is located in the Clarks Fork drainage, north of Clay Butte. The stocked population of cutthroat trout is now reproducing at a rate high enough to provide a good fishery. It should be removed from the stocking plans.

Trail Lake is a stocked lake right along the trail, north of Granite Lake. The 5-year old cutthroat trout in this lake only average 9.6 inches in length. In this lake 1.46 fish were sampled per hour, indicating a relatively large population hour (1.00 roughly constitutes a good fishery). As previously noted in 1993, the fish may be reproducing here. Stocking should be reduced to 75 per acre on an 8-year cycle to decrease numbers and increase growth rates.

Lakes Surveyed in 2000

There were 37 lakes surveyed during the 2000 field season (Table 3). In most cases lakes have only one species of salmonid, although in some cases one species is stocked over another. The short alpine spawning season and the similarity of some species sometimes results in the presence of hybrids. This is especially true of cutthroat trout, rainbow trout and golden trout, and the hybrids of these species are capable of reproduction. Figure 2 illustrates the number of lakes sampled by drainage, while Figure 3 notes the number of lakes sampled containing each species.

Figure 2. Number of lakes sampled in 2000 by drainage.

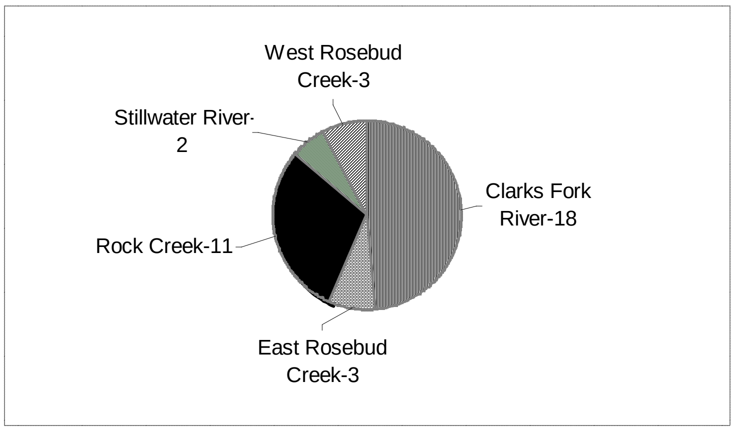


Figure 3. The number of lakes sampled in 2000 containing each species.

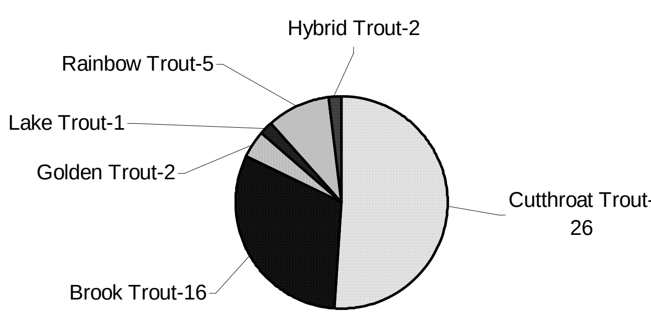


Table 3. Data on High Mountain Lakes-2000

Drainages	**Species**	**Status**
BR=Boulder River	CT=cutthroat trout	SS=self-sustaining
CF=Clark's Fork River	EB=brook trout	ST=stocked
CM=Crazy Mountains	GR=grayling	ST+=Stocked, some reproduction
ER=East Rosebud Creek	GT=golden trout	
RC=Rock Creek	LC=lake chub	**Code**=Code number used in Pat Marcuson's
SC=Slough Creek	LL=brown trout	Book "The Beartooth Fishing Guide"
SR=Stillwater River	LT=lake trout	
WR=West Rosebud Creek	RB=rainbow trout	

LAKE	DRAINAGE	CODE	SPECIES	STATUS	LAST STOCK	SAMPLE DATE	# FISH	SIZE RANGE	MEAN SIZE	COMMENTS
Corner Lake	Clarks Fork	CF007	CT	SS	1980	7/26	16	7.0-12.1	9.4	
Flat Rock Lake	Clarks Fork	CF190	CT	ST	1994	8/02	2	10.8-11.0	10.9	Reduce stocking rate
Forsaken Lake	Clarks Fork	CF198	CT	ST	1993	8/02	4	11.0-12.8	11.8	Reduce stocking rate
Granite Lake	Clarks Fork	CF147	CT	SS		8/01	0			None sampled
			EB	SS		8/01	11	5.8-10.6	8.9	Very unhealthy
			RB	SS		8/01	5	9.8-14.6	12.5	Very unhealthy
Hidden Lake	Clarks Fork	CF234	GT	??>none		8/03	0			Drop GT from Dbase
			CT	SS		8/03	22	8.4-15.1	10.7	
Kersey Lake	Clarks Fork	CF060	CT	SS		9/14	2	12.0-15.1	13.6	
			EB	SS		9/14	47	6.7-16.8	10.0	
			LC	SS		9/14	1	6.2-6.2	6.2	
			LT	SS		9/14	4	18.0-29.8	21.8	
Lake Elaine	Clarks Fork	CF168	EB	SS		8/01	7	7.6-11.2	9.6	Numbers are down
Lillis Lake	Clarks Fork	CF067	CT	??>none		7/06	0			Errant plant is gone
			EB	SS		7/06	7	6.5-12.3	9.4	
Long Lake	Clarks Fork	CF010	CT	None>SS		7/25	2	12.2-12.9	12.6	Add CT to Dbase
			EB	SS		7/25	39	6.1-10.2	8.2	
Margaret Lake	Clarks Fork	CF066	CT	ST	1996	7/06	5	16.8-20.6	18.6	
Marsh Lake	Clarks Fork	CF019	CT	ST	1997	8/17	8	10.5-12.0	11.4	
Ovis Lake	Clarks Fork	CF011	CT	ST	1997	8/16	0			Cutthroat seen
			EB	SS		8/16	10	5.0-11.0	7.9	
Rock Island Lake	Clarks Fork	CF073	CT	ST	1999	7/07	28	12.3-14.8	13.2	
			EB	SS		7/07	21	4.8-11.5	9.4	
Schoolmarm Lake	Clarks Fork	CF005	CT	SS>ST	1977	7/26	0			Need to restock(2000?)
Swede Lake	Clarks Fork	CF235	CT	ST>SS	1996	8/02	16	6.7-17.2	9.6	Stop stocking
Trail Lake	Clarks Fork	CF208	CT	ST	1995	8/02	26	8.6-10.8	9.6	Reduce stocking rate
Vernon Lake	Clarks Fork	CF068	CT	SS		7/07	5	12.0-14.8	13.2	
			EB	SS		7/07	5	6.5-15.0	11.0	
Wiedy Lake	Clarks Fork	CF018	CT	ST		8/17	6	11.9-13.0	12.5	
	XXXXX	**XXX**	**XXXXX**	**XXX**	**XXXX**	**XXX**	**XXX**	**XXXXX**	**XXX**	**XXXXX**
Froze to Death Lake	East Rosebud	ER048	CT	SS	1978	7/20	13	11.0-13.4	12.3	
Lower Snow Lake	East Rosebud	ER004	RB	ST		7/18	3	6.4-17.5	12.7	Stock on 8-yr cycle
Upper Snow Lake	East Rosebud	ER005	RB	ST	1993	7/18	0			Stock on 8-yr cycle
	XXXXX	**XXX**	**XXXXX**	**XXX**	**XXXX**	**XXX**	**XXX**	**XXXXX**	**XXX**	**XXXXX**
Crescent Lake HR8	Rock Creek	RC024	EB	SS	1941	7/12	56	6.0-9.8	8.2	
Daly Lake HR11	Rock Creek	RC027	CT	SS		7/11	9	6.5-8.0	7.4	
			EB	SS		7/11	36	6.0-9.8	8.1	
Hairpin Lake HR3	Rock Creek	RC018	CT	ST	1998	7/12	28	5.8-16.8	11.3	Reduce/stop stocking?
Hellroaring Lake #4	Rock Creek	RC020	CT	SS		7/13	49	4.5-15.3	8.8	
Hellroaring Lake #5	Rock Creek	RC021	CT	SS		7/13	4	6.9-11.3	9.3	
			EB	SS		7/13	25	7.0-13.6	10.4	
Hellroaring Lake #9	Rock Creek	RC025	CT	SS		7/11	29	6.3-9.0	8.1	
			EB	SS			5	7.5-9.5	8.1	
Hellroaring Lake #12	Rock Creek	RC029	Barren	Barren						Add to Dbase
Rydberg Lake	Rock Creek	RC028	CT	SS		7/11	13	6.5-10.8	7.7	Add to Dbase
			EB	ST		7/11	0			Observed in stream
Sliderock Lake	Rock Creek	RC030	EB	SS		1938	25	7.7-13.1	10.6	
Smethurst Lake HR10	Rock Creek	RC026	CT	SS			16	6.3-9.8	7.5	
			EB	SS			3	9.6-12.3	10.9	Change From C to R
Snowbank Lake HR3	Rock Creek	RC019	EB	SS			38	6.3-11.7	9.4	

Table 3. (Continued)

Drainages	**Species**	**Status**
BR=Boulder River	CT=cutthroat trout	SS=self-sustaining
CF=Clark's Fork River	EB=brook trout	ST=stocked
CM=Crazy Mountains	GR=grayling	ST+=Stocked, some reproduction
ER=East Rosebud Creek	GT=golden trout	
RC=Rock Creek	LC=lake chub	**Code**=Code number used in Pat Marcuson's
SC=Slough Creek	LL=brown trout	Book "The Beartooth Fishing Guide"
SR=Stillwater River	LT=lake trout	
WR=West Rosebud Creek	RB=rainbow trout	

LAKE	DRAINAGE	CODE	SPECIES	STATUS	LAST STOCK	SAMPLE DATE	# FISH	SIZE RANGE	MEAN SIZE	COMMENTS
Incisor Lake	Stillwater	SR018	GT	SS	1984	8/16	0			GT seen spawning
Little Goose lake	Stillwater	SR043	CT	SS		7/24	15	7.8-13.9	11.1	
	XXXXX	**XXX**	**XXXXX**	**XXX**	**XXXX**	**XXX**	**XXX**	**XXXXX**	**XXX**	**XXXXX**
Island Lake	West Rosebud	WR014	RB	SS	1950	7/27	14	6.0-15.6	10.5	
			RBxCT	SS		7/27	2	13.3-14.7	14.0	
Silver Lake	West Rosebud	WR015	RB	SS	4	7/26	4	6.0-15.5	10.3	

Additional Data on Fisheries

In addition to standard gill-net data gathered during this survey, a number of other parameters were noted. The Columbus, MT Field Station requested data listed in Table 3, while Table 4 contains some additional data that has been collected.

Fish Health. The HAI (Adams et al. 1993) assigns points for anatomical and physiological abnormalities. The fish of each species for each lake are averaged and the populations with the lowest scores have the healthiest fish. The average number for HAI for the fish populations sampled in the A-B Wilderness is 41 with a standard deviation of 19. Those lakes with an HAI around 60 would be considered as marginally unhealthy, while those in the low 20's would be considered very healthy. Of the 37 lakes sampled in 20000 (with 40 HAI assessments), 10 populations had excellent health with low HAI values, while 10 lakes showed relatively unhealthy populations. The remaining 20 exhibited average health using this method.

<u>Granite Lake</u> had the highest values, and unhealthiest population, noted since HAI analysis was begun in 1995. Both the brook trout and rainbow trout taken from this lake were more than two standard deviations above the mean, at values of 98 and 82 respectively. These values indicate a very unhealthy population, and a further health assessment is called for by MFWP fish pathology lab.

The main factor affecting HAI values for lakes in this year's survey seems to be kidney problems as 11.5% of the fish were affected. The most common kidney problem was the presence of white areas. Liver problems were the next most common (7.8%) with a cream colored liver being noted. The hindgut (intestine) was inflamed in 6.3% of the fish, but this may have been caused by the stress of being in a gill net.

Condition Factor. Ctl is a ratio of weight to length, calculated by the equation (weightx10000)/(length^3). The higher the number, the better the condition of the fish. Average values for Ctl are CT-3.559; and RB,EB-4.055. Of the 37 lakes sampled in 20000 (with 43 Ctl assessments), 11 lakes showed high condition factors, 12 lakes were poor and the remainder were near the average. These do not correspond directly with the lakes noted in the HAI assessment.

Catch per unit effort. FPH is fish-per-gill-net-hour. The catch per unit effort can provide relative information on the numbers of fish in the lake. A value of 1.00 FPH should provide for normal fishing while those above 1.50 would provide much better fishing, while those below 0.50 tend to have low numbers of fish, and poorer fishing. Using this method, 12 lakes surveyed should provide excellent fishing, while 6 would be rated as poor, and an additional 2 produced no fish. The remainder would provide an average fishing opportunity.

Parasites. It is very common for fish in the Absaroka Beartooth Wilderness to have parasites in their body cavity. The parasites do not pose a health problem, as they are associated with the organs, not the flesh that is eaten. Many of the fish taken have intestinal nematodes, *Truttaedacnitis truttae*, (referred to as tremadodes in earlier reports), although not to the same degree. *Diphylobothrium latum* (tapeworm cysts) are also present in the body cavity of many fish. Overall, 25% of the fish necropsied had one or the other type of parasite.

Table 4. Additional Data on High Mountain Lakes-1999

Drainages	Species	Status
BR=Boulder River	CT=cutthroat trout	SS=self-sustaining
CF=Clark's Fork River	EB=brook trout	ST=stocked
CM=Crazy Mountains	GR=grayling	ST+=Stocked, some reproduction
ER=East Rosebud Creek	GT=golden trout	
RC=Rock Creek	LL=brown trout	**Code**=Code number used in Pat Marcuson's Book "The Beartooth Fishing Guide"
SC=Slough Creek	LT=lake trout	
SR=Stillwater River	RB=rainbow trout	
WR=West Rosebud Creek	sf=spotted frogs	
	Wcf=western chorus frogs	

Ctl=Weight-length ratio(higher numbers indicate better condition)
HAI=Health Assessment Index(higher numbers indicate poorer health)
FPH=number of fish per gillnet/hour
+=good o=average -=poor

Lake	Code	Species	HAI	+o-	Ctl	+o-	FPH	+o-	Amphibians present	% of fish with parasites
Corner Lake	CF007	CT	45	o	3.78	o	0.73	o		60
Flat Rock Lake	CF190	CT	85	-	3.47	o	0.40	-		10
Forsaken Lake	CF198	CT	35	o	4.19	+	1.60	+		5
Granite Lake	CF147	EB	98	-	3.57	o	0.85	o	Spotted frogs	50
		RB	82	-	3.09	-	0.38			55
Hidden Lake	CF234	CT	39	o	3.68	o	1.35	+		20
Kersey Lake	CF060	CT			3.77	o	0.02	o		
		EB			3.53	o	0.53			
		LT			4.01	-	0.05			
Lake Elaine	CF168	EB	71	-	2.90	-	0.19	o		
Lillis Lake	CF067	EB	69	-	5.15	+	0.39	-		45
Long Lake	CF010	CT	56	-	3.05	-	0.15	+		10
		EB	14	+	3.91	o	2.89			75
Margaret Lake	CF066	CT	56	o	3.72	o	0.38	-		30
Marsh Lake	CF019	CT	20	+	4.02	+	0.70	o	Spotted frogs	0
Ovis Lake	CF011	EB	19	+	3.77	o	0.87	o		0
Rock Island Lake	CF073	CT	29	o	3.36	o	0.85	o		55
		EB	49	o	4.02	o	0.64			20
Schoolmarm Lake	CF005	CT					0.00	-		
Swede Lake	CF235	CT	33	o	3.37	o	8.00	+		20
Trail Lake	CF208	CT	15	+	4.00	+	1.46	+		0
Vernon Lake	CF068	CT	78	-	3.43	o	0.37	o		30
		EB	73	-	3.89	o	0.37			5
Wiedy Lake	CF018	CT	18	+	3.94	+	0.50	o	Spotted frogs	10
	XXX	**XXXXX**		o						
Froze to Death Lake	ER048	CT	40	o	2.95	-	4.00	+		25
Lower Snow Lake	ER004	RB	27	o	3.81	o	0.25	-		10
Upper Snow Lake	ER005	RB					0.00	-		
	XXX	**XXXXX**								
Crescent Lake HR8	RC024	EB	24	o	4.82	+	3.73	+		5

Daly Lake HR11	RC027	CT	22	o	4.29	+	0.49	+	10
		EB	31	o	3.38	-	1.97		20
Hairpin Lake HR3	RC018	CT	22	+	3.99	+	1.53	+	20
Hellroaring Lake #4	RC020	CT	33	o	3.85	+	4.90	+	10
Hellroaring Lake #5	RC021	CT	22	+	3.00	-	0.18	o	10
		EB	75	-	3.49	-	1.14		30
Hellroaring Lake #9	RC025	CT	18	+	2.24	-	.24	+	15
		EB	6	+	2.24	-	1.40		0
Hellroaring Lake #12	RC029	Barren							
Rydberg Lake	RC028	CT	50	o	4.23	+	0.81	o	25
Sliderock Lake	RC030	EB	29	o	4.00	o	1.06	o	40
Smethurst Lake HR10	RC026	CT	30	o	2.91	-	0.75	o	30
Snowbank Lake HR3	RC019	EB	67	-	3.36	-	1.71	+	10
Incisor Lake	SR018	GT					0.00	-	
Little Goose lake	SR043	CT	35	o	3.14	-	0.61	o	35
		XXXXX							
Island Lake	WR014	RB	44	o	3.97	+	0.69	o	70
		RBxCT	44	o	2.85	-	0.10		
Silver Lake		RB	18	+	3.90	+	0.20	-	20

Gut Contents

Emergents made up a larger than usual percentage of the food base in 2000 (Table 5). It is conjectured that warmer summer weather increased the number of insects emerging from the water. *Chironomas* species adults typically make up a large portion of the emergents found in the gut of the fish in these lakes, although mosquitoes are also very common. All of the emergents are lumped together as they break down quickly in the gut, and are difficult to identify. In poor years, chironomid larvae, on the bottom, serve as an alternate food source as trout are not very efficient benthic feeders. Ants, leeches and mosquito larvae dominated the category of “Other” food sources in 2000.

Table 5. Analysis of stomach contents for 2000 nearly mirrored the 5-year average. There was a shift toward the utilization of emergents.

	% *Chironomas*	% Caddis larvae	% Crustaceans	% Coleopterans	% Emergents	% Others
Mean ‘96-‘00	16.1	11.8	8.6	6.2	38.7	18.5
2000	15.0	13.0	6.0	6.0	50.0	9.0

Many of the fish necropsied had empty guts in 2000. Since the fish are active when swimming into the nets, and are often feeding one possible explanation was that the fish were regurgitating their stomach contents in the gill nets. This was supported by observations of stomach contents in the gills during necropsy. It may be that the warmer water temperatures in 2000 made these fish more stressed, resulting in their regurgitating. It is also possible that the less experienced crew utilized in 2000 may have been less meticulous in their analysis than their predecessors.

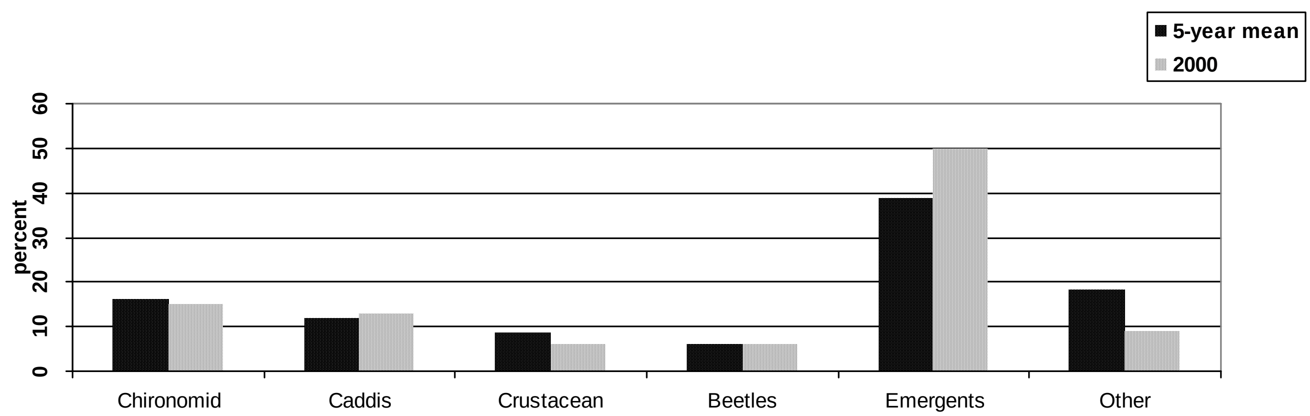


Figure 4. Gut contents for 2000 compared to the 5-year averages.

Amphibian Survey

Since 1995 the presence or absence of amphibians has been noted during the high mountain lakes survey (Table 6). This has not been a principal focus of this survey, and no specific protocols have been adopted, other than incidental observation. The late arrival of summer in the alpine setting has reduced the possibility of observing amphibians, as many of the shorelines are snow covered until mid-July.

In 1998, Dr. Nancy Butler, of Montana State University, started research into locating and identifying amphibians in relation to the presence of salmonids in the A-B Wilderness. University of Montana Ph.D. candidate, Aimee Wyrick, continued this project in 1999 as research for her dissertation. Ms. Wyrick joined the survey team in 1999 to learn fish sampling protocols fish on their way to study amphibians in an area near Sliver Lake. Sliver Lake is located in an area between the Broadwater River and Skytop Creek just south of the Aero Lakes in the Clarks Fork drainage north of Cooke City.

In 2000, spotted frogs, *Rana pretiosa* , were identified near Granite Lake, Wiedy Lake and Marsh Lake. All three of these are in the Clarks Fork drainage. Western chorus frogs, *Pseudacris triseriata,* were no encountered in 2000.

Table 6. Location of amphibians noted in surveys since 1995 (2000 sightings are in bold).

Lake	Drainage	Amphibian	Positive Sighting	Possible sighting
Anvil Lake	Stillwater	spotted frogs, western chorus frogs	X	
Broadwater Lake	Clarks Fork	spotted frogs	X	
Broadwater River	Clarks Fork	spotted frogs, western chorus frogs	X	
Burnt Gulch Lake	Boulder	spotted frogs	X	
Cliff Lake	Clarks Fork	spotted frogs	X	
Curl Lake	Clarks Fork	spotted frogs, western chorus frogs	X	
Davis Lake	Boulder	spotted frogs	X	
Fox Lake	Clarks Fork	western chorus frogs	X	
Granite Lake	**Clarks Fork**	**spotted frogs**	**X**	
Heather Lake	Boulder	spotted frogs	X	
Kaufman Lake	Boulder	spotted frogs	X	
Lake Surrender	Stillwater	spotted frogs	X	
Little Washtub Lake	Clarks Fork	spotted frogs	X	
Mariane Lake	Clarks Fork	spotted frogs	X	
Marsh Lake	**Clarks Fork**	**Spotted frogs**	**X**	
Mermaid Lake	Clarks Fork			X
Picasso Lake	Clarks Fork			X
Raven Lake	Stillwater	spotted frogs	X	
Silver Lake	Boulder			X
Sliver Lake	Clarks Fork	spotted frogs	X	
Wiedy Lake	**Clarks Fork**	**spotted frogs**		

HAI Analysis

Since 1995 HAI analysis (Adams et al. 1993) has been conducted on lakes as a part of the high mountain lakes survey, including 133 samples (Table 7). The HAI (Health Assessment Index) measures the health of fish populations by assigning point values to abnormalities observed during field necropsies. The numbers for the individual fish are averaged for the population to give an idea of the health of the fish population in each lake. The mean value for populations in the A-B Wilderness lakes for the past 6 years and 133 sample populations is a value of about 41. The standard deviation for these HAI values is 21. Populations with higher values are less healthy and an indicator of stress in the system. Those more than a standard deviation below the mean (value of 20) are extremely healthy. Those populations that are more than a standard deviation above the mean (value of 62) are unhealthy. Numbers of samples falling into each category are in Table 7. HAI samples for year 2000 are in Table 8.

Table 7. Overall HAI Values for all samples taken since 1995 compared to 2000 samples.

	# Samples	Mean Value	Standard Deviation	Healthy	Populations Normal	Unhealthy
All samples	133	41.2	20.6	22	88	22
Year 2000	39	42.1	23.4	8	22	9

Table 8. HAI analysis of A-B Wilderness Lakes 2000.

Drainages
BR=Boulder River
CF=Clark's Fork River
CM=Crazy Mountains
ER=East Rosebud Creek
RC=Rock Creek
SC=Slough Creek
SR=Stillwater River
WR=West Rosebud Creek
+=good o=average -=poor

Species
CT=cutthroat trout
EB=brook trout
GR=grayling
GT=golden trout
LL=brown trout
LT=lake trout
RB=rainbow trout

Status
SS=self-sustaining
ST=stocked
ST+=Stocked, some reproduction

Code=Code number used in Pat Marcuson's Book "The Beartooth Fishing Guide"

Lake	**Code**	**Species**	**Status**	**HAI**	**+ 0 -**
Corner Lake	CF007	CT	SS	45	0
Crescent Lake	RC024	EB	SS	24	0
Daly Lake	RC027	CT	SS	22	0
Daly Lake	RC027	EB	SS	31	0
Flatrock Lake	CF190	CT	ST	85	-
Forsaken Lake	CF198	ST	ST	35	0
Froze To Death Lake	ER048	CT	SS	40	0
Granite Lake	CF147	RB	SS	82	-
Granite Lake	CF147	EB	SS	98	-
Hairpin Lake	RC018	CT	ST	22	0
Hellroaring Lake #4	RC020	CT	SS	33	0
Hellroaring Lake #5	RC021	CT	SS	30	0
Hellroaring Lake #5	RC021	EB	SS	75	-
Hellroaring Lake #9	RC025	CT	SS	18	+
Hellroaring Lake #9	RC025	EB	SS	6	+
Hidden Lake	CF234	CT	SS	39	0
Island Lake	WR014	RB	SS	44	0
Lake Elaine	CF168	EB	SS	71	-
Lillis Lake	CF067	EB	SS	69	-
Little Goose Lake	SR	CT	SS	35	0
Long Lake	CF010	EB	SS	56	0
Long Lake	CF010	CT	SS	14	+
Lower Snow Lake	ER004	RB	ST	27	0
Margaret Lake	CF066	CT	ST	56	0
Marsh Lake	CF019	CT	ST	20	+
Ovis Lake	CF011	EB	SS	19	+
Rock Island Lake	CF073	CT	ST	29	0
Rock Island Lake	CF073	EB	SS	49	0
Rydberg Lake	RC028	CT	SS	50	0
Silver Lake	WR015	RB	SS	18	+
Sliderock Lake	RC030	EB	SS	29	0
Smethurst Lake	RC026	CT	SS	30	0
Smethurst Lake	RC026	EB	SS	67	-
Snowbank Lake	RC019	EB	SS	59	0
Swede Lake	CF235	CT	SS	33	0
Trail Lake	CF208	CT	ST	15	+
Vernon Lake	CF068	CT	SS	78	-
Vernon Lake	CF068	CT	SS	73	-
Wiedy Lake	CF018	CT	ST	18	+

When a fish is stressed, it must make metabolic adjustments to deal with the stress. These adjustments take away from normal metabolic activities and this, in turn, is expressed in a number of ways. Fish become more susceptible to parasites and disease. Livers can enlarge if fish need to detoxify agents found in the water. Even food shortages can compromise metabolic activities of the fish. In alpine lakes, stress often takes the form of extended ice cover and limited food supplies.

Since first utilized in the high mountain lakes survey in 1995, the HAI has seemed to provide a useful tool for assessing fish populations. Adopted as a part of the fish growth study being done in Kookoo Lake and Triangle Lake 1993-1997, it was necessary to assess other lakes for comparison.

It is suggested that HAI analysis continue to be included as a part of the high mountain lakes survey, and that its application be considered for other areas as a regular part monitoring fish populations. Its seems to be sensitive to problems in the fish populations, and can track improvements and declines in fish health.

Conclusions

The High Mountain Lakes Survey was started in 1989 to provide information needed to adequately manage fisheries within the Absaroka-Beartooth Wilderness. Thirty-eight percent of those lakes surveyed in 2000 required either a change in status or management. This figure has traditionally been 30-50% emphasizing the need for continued monitoring of these lakes.

The 2000 survey included 37 lakes from five of the seven major drainages of the A-B wilderness. Twenty-three of these required no change in status or management. The majority of the lakes surveyed supported cutthroat trout populations (26), while 16 supported brook trout populations. The remainder supported golden trout, rainbow, or hybrid trout.

Thirty-one of the 37 lakes surveyed in 2000 received HAI assessment, bringing the total number of indices to 133. The average HAI for all samples is 41 with a standard deviation of 21. HAI methods seem to provide a good measure of the health of fish populations, and continued use is indicated.

Gut content analysis showed for year 2000, is similar to 5-year averages. The only noteworthy changes was an increase in emergent utilization. Many of the fish necropsied in 2000 were noted to have empty stomachs, and this may have been caused by warmer water temperatures or the inexperienced crew.

Amphibians continue to be monitored with spotted frogs being noted at 3 locations, while there were no sightings of western chorus frogs. A new study has been initiated by Ph.D. candidate, Amy Wyrick, to study the impact of salmonids on the amphibian populations in the A-B Wilderness. This effort to find and identify amphibian habitats is important and should be supported and encouraged by Region 5 fisheries.

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Appendix A

Access to Absaroka-Beartooth Mountain Lakes

Sample:

Lake	**Code**			
Bridge Lake	BR036			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Bridge Creek	10	9.5	3500	100
Bridge Lake is located up the main Boulder River. The bridge Creek Trailhead is just past camp Christikon, over the river. There are 9 ½ miles of excellent trail, to just below the lake, Followed by a short scramble up some volcanic rock for ½ mile. The lake is stocked with cutthroat trout on a 4-year basis (ref. 1995), and the growth is excellent. There is little firewood near the lake, but plenty just below. There are suitable campsites ¼ mile below the lake.				

Key

Lake-common name of the lake, found in MT FW&P database and on Absaroka-Beartooth Mountains maps by Rocky Mountain Surveys.

Code-two letter abbreviation of the drainage followed by the MT FW&P lake code, originally used by Pat Marcuson, and noted in the "The Beartooth Fishing Guide: (Marcuson 1985)

- BR-Boulder river Drainage
- CF-Clark's fork of the Yellowstone River Drainage
- CM-Crazy Mountains
- ER-East Rosebud Creek Drainage
- RC-Rock Creek Drainage
- SC-Slough Creek Drainage
- SR-Stillwater River Drainage
- WR-West Rosebud River Drainage

Trailhead-most logical trailhead to access the lake, alternative may be listed

Total miles-The number of miles it is to access the lake along the route described, including both trail and cross-country miles. This is one-way distance.

Trail miles-miles of trail to get to the lake, it may be subtracted from the total miles to calculate the distance that must be traveled cross-country (no trail) to the lake.

Up elevation-this is the amount of elevation you will have to climb from the trailhead to reach the lake. Many trails include going both up and down. This is not the net elevation.

Down elevation-this is the amount of elevation you will drop or go down from the trailhead to reach the lake. Many trails include going both up and down. This is not the net elevation.

The narrative at the bottom contains information on how to reach the lake, the type of fish present, camping spots, and the amount of firewood available.

Lake	Code			
Corner Lake	CF007			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Goose Lake Jeep	.25	.25	0	0

Corner Lake is accessible by 4WD vehicle from the Goose Lake Jeep Trail, Forest Service Road #3230. It is not a road that prudent people would take their new vehicles on. An ATV can drive to the Lake. It supports a healthy population of average to small cutthroat trout. There is plenty of firewood, and it is a wonderful place to camp.

Lake	Code			
Crescent Lake	RC024			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	2	2	650	400

Crescent Lake (Hellroaring #8) is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot less than ½ mile before leaving it. Head north to the side of ridge. You can follow the line of trees down a steep grassy slope to Hellroaring Lake #12 (fishless). Head around the north side of the lake and over a saddle to Smethurst Lake. Two streams flow into this lake. Follow the one on the south side up the valley. This lake is located mid-way up the valley on the north side. It is full of average-sized brook trout. Camping is better at the lower lakes, where there is more cover and more firewood.

Lake	Code			
Daly Lake	RC027			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	2	1	300	300

Daly Lake (Hellroaring #11) is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot less than ½ mile before leaving it. Head north to the side of ridge. You can follow the line of trees down a steep grassy slope to Hellroaring Lake #12 (fishless). Head around the north side of the lake and over a saddle to Smethurst Lake. Cross the stream below Smethurst and head uphill, north to Daly Lake. This lake is located towards the lower end of the valley on the north side. It is full of average-sized brook trout and some small to average cutthroat trout. It is a great place to camp and there is a plenty of firewood.

Lake	Code			
Flat Rock Lake	CF190			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clay Butte	17	15.5	1400	1000
Muddy Creek	18	16.5	2100	200

It is a long way to Flat Rock Lake, no matter which trail you take. It is home to a stocked population of cutthroat trout that have average growth rates. It is stocked on an 8-year cycle, reference year 2002. Starting in Wyoming, from Clay Butte hike on trail 618/614 . Head north on 618 where it splits off to go to Granite Lake. The trail is very confusing where it crosses Mule Creek. Don't head down to Granite Lake here but instead cross the creek and head to Thiel Lake. As you head upstream, east, just past Thiel Lake you will meet trail #619. Hang a left and head north and then west along this trail. You will pass near Renie Lake and Kidney Lake and cross a creek between Wright Lake and Spogen Lake. Next it will be uphill to Trail Lake. Stay on the trail and head to Green Lake. A trail heads north from the north side of Green Lake uphill to Sierra Creek. Follow Sierra Creek upstream and go around Queer Lake to reach Flat Rock Lake. It's pretty rocky and it is above the tree line so there's no firewood. You'd be better off camping down below by Alp Lake or Queer Lake.

Lake	Code			
Forsaken Lake	CF198			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clay Butte	18	15.5	2000	1000
Muddy Creek	19	16.5	2500	200

It is a long way to Forsaken Lake, no matter which trail you take. It is home to a stocked population of cutthroat trout that have average growth rates. It is stocked on an 8-year cycle, reference year 2001. Starting in Wyoming, from Clay Butte hike on trail 618/614 . Head north on 618 where it splits off to go to Granite Lake. The trail is very confusing where it crosses Mule Creek. Don't head down to Granite Lake here but instead cross the creek and head to Thiel Lake. As you head upstream, east, just past Thiel Lake you will meet trail #619. Hang a left and head north and then west along this trail. You will pass near Renie Lake and Kidney Lake and cross a creek between Wright Lake and Spogen Lake. Next it will be uphill to Trail Lake. Stay on the trail and head to Green Lake. A trail heads north from the north side of Green Lake uphill to Sierra Creek. Follow Sierra Creek upstream and go around Queer Lake to reach Flat Rock Lake. It's a mile further upstream to Forsaken Lake. It's pretty rocky and it is above the tree line so there's no firewood. You'd be better off camping down below by Alp Lake or Queer Lake.

Lake	Code			
Froze To Death Lake	ER048			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Armstrong Creek	9	7	4100	0

To get to Froze to Death Lake, you start at the Armstrong Creek (Phantom Creek) trailhead, just before you get to East Rosebud Lake. It supports a population of many average sized cutthroat trout. Head up Armstrong Creek to Swamp Lake along Trail #17. When the trail changes back to switchbacks near a creek at the head of the valley, you will need to leave it and wade across the creek. From here the trail can be intermittent. Follow the trail/path south across an open slope. It will disappear near a rock slide that leads to a small saddle. Head up the rock slide, not the creek. This will top out in a saddle that leads to Phantom Lake. You should camp near Phantom Lake, as above here it is very rocky and exposed. There is firewood at Phantom Lake, but not above. Head around the west side of the lake and a mile further upstream to get to Froze to Death Lake.

Lake	Code			
Granite Lake	CF147			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clay Butte	8	8	0	1000
Muddy Creek	7	7	600	200

It is a nice backpack trip or a long day-hike way to Granite Lake. It is home to brook trout, rainbow trout and an occasional cutthroat trout. Starting in Wyoming, from Clay Butte hike on trail 618/614 . Head north on 618 where it splits off to go to Granite Lake. The trail is very confusing where it crosses Mule Creek. Be sure to head down to Granite Lake here and don't cross the creek and head to Thiel Lake. It's quite a downhill hike into Granite Lake from here. When you reach it you will be at the north end. There are a couple of flat places to camp here, and plenty of firewood. There are much nicer places to camp if you head around to Lake Creek, but the firewood is more picked over there. Muddy Creek leads right up to the south end of the lake if you go from that trailhead. It's beautiful camping here, but the firewood is very picked over. The south end of the lake is in Wyoming. The dividing line is about at Mule Creek on the east side, and Lake Creek on the west.

Lake	Code			
Hairpin Lake	RC018			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	3.5	2.5	600	200

Hairpin Lake (Hellroaring #2) is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot about 1½ miles before leaving it. Head north to the side of ridge. You can head down this slope to Snowbank Lake. From here it is a short hike, northwest and uphill to Hairpin Lake. This lake is located towards the upper end of the valley on the north side. It is stocked with cutthroat trout, some of which grow pretty large. It is currently on an 8-year stocking cycle, with a reference year of 2006, but there is some reproduction, and stocking may cease. Camping is better at the lower lakes, where there is more cover and more firewood.

Lake	Code			
Hellroaring Lake #4	RC020			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	3.5	2.5	600	200

Hellroaring #4 is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot about 1½ miles before leaving it. Head north to the side of ridge. You can head down this slope to Snowbank Lake. From here it is a short hike, northwest and uphill to Hairpin Lake. This lake is located towards the upper end of the valley on the north side. It is just downstream from Hairpin Lake. Cutthroat trout have moved downstream from Hairpin to stock this lake. It has the easiest-to-catch cutthroats in this valley, and sometimes a nice one makes it down from Hairpin Lake. Camping is better at the lower lakes, where there is more cover and more firewood.

Lake	Code			
Hellroaring Lake #5	RC021			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	2.5	2	700	200

Hellroaring #5 is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot about 1½ miles before leaving it. Head north to the side of ridge. You can head down this slope to Snowbank Lake. From here it is a short hike, northwest and uphill to Hairpin Lake. This lake is located towards the upper end of the valley on the north side. It is 2 lakes downstream from the largest lake, Hairpin Lake. It has some cutthroat trout, but mostly brook trout. The brook trout are slightly larger that most of the other Hellroaring Lakes. Camping is better at the lower lakes, where there is more cover and more firewood.

Lake	Code			
Hellroaring Lake #9	RC025			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	2.5	2	700	200

Hellroaring #9 is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot less than ½ mile before leaving it. Head north to the side of ridge. You can follow the line of trees down a steep grassy slope to Hellroaring Lake #12 (fishless). Head around the north side of the lake and over a saddle to Smethurst Lake. Two streams flow into this lake. Follow the one on the north side up to this lake which is located on the north side of the valley, between Daly Lake and Crescent Lake. It has some cutthroat trout, but mostly brook trout. The brook trout are pretty average for this area. There are a couple of pretty places to camp near the outlet, and firewood is available.

Lake	Code			
Hellroaring Lake #12	RC029			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	2.5	2	700	200

Hellroaring #12 is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot less than ½ mile before leaving it. Head north to the side of ridge. You can follow the line of trees down a steep grassy slope to Hellroaring Lake #12 (fishless). Head around the north side of the lake and over a saddle to Smethurst Lake. It is wonderful camping on the saddle between the two lakes, and there is plenty of firewood.

Lake	Code			
Hidden Lake	CF234			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clay Butte	17	15.5	1400	1000
Muddy Creek	18	16.5	2100	200

It is a good backpack trip to this lake. It is home to a population of cutthroat trout that have average growth rates. Access starts in Wyoming, from Clay Butte hike on trail 618/614 . Head north on 618 where it splits off to go to Granite Lake. The trail is very confusing where it crosses Mule Creek. Don't head down to Granite Lake here but instead cross the creek and head to Thiel Lake. As you head upstream, east, just past Thiel Lake you will meet trail #619. Keep going straight up the stream and you will encounter a trail/path that heads up to Hidden Lake. Outfitters take horses here, so it shouldn't be hard to find. Camping is great, but the firewood is pretty picked over.

Lake	Code			
Incisor Lake	SR018			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Goose Lake Jeep	3	2	250	450

Incisor Lake is best accessed by taking a 4WD vehicle from the Goose Lake Jeep Trail, Forest Service Road #3230. It is not a road that prudent people would take their new vehicles on. An ATV can easily drive to the end of the road. From here, hike up to and around Goose Lake on the east side. Cross Goose Creek just below Little Goose Lake, and head cross-country northwest up through a saddle. Incisor Lake will be ¼ mile below the saddle. It supports a population of golden trout that are reproducing. There is some of firewood, but it may be a difficult place to camp.

Lake	Code			
Island Lake	WR014			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Mystic Lake	6	6	1800	300

Island Lake is in the West Rosebud Creek drainage and is accessed from the Mystic Lake trailhead. The trail to Mystic Lake is one of the best in the Beartooths. It's about 3 miles to Mystic, and then a long hike around the south side of the lake. Island Lake is a short distance up the trail from Mystic Lake. You can wade the outlet, or take your chances trying to cross on the logjam that is always there. The lake supports a population of various sized rainbow trout. Cutthroat trout have migrated downstream from the lakes above, and it's possible to catch them and rainbow-cutthroat hybrids. Its great camping around the outlet, but lots of groups use the area and firewood has been very picked over. Head higher up the lake to get away from the people that can always be found near the outlet.

Lake	Code			
Lake Elaine	CF168			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clay Butte	10	10	1000	600

It is a nice backpack trip or a long day-hike way to Granite Lake. It's further to Lake Elaine. Lake Elaine is home to just above average brook trout. Starting in Wyoming, from Clay Butte hike on trail 618/614 . Head north on 618 where it splits off to go to Granite Lake. The trail is very confusing where it crosses Mule Creek. Be sure to head down to Granite Lake here and don't cross the creek and head to Thiel Lake. It's quite a downhill hike into Granite Lake from here. When you reach it you will be at the north end of Granite Lake. Hike around the end and down the west side to Lake Creek. Cross Lake Creek and follow a trail upstream to Lake Elaine.

Lake	Code			
Lillis Lake	CF067			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clarks Fork	2	2	300	50

It is a nice daypack trip to Lillis Lake, in the Clarks Fork drainage, not far from Cooke City. Start at the Clarks Fork Trailhead near Cooke City (Trail #3). Trail #565 splits off to the right about a mile up and winds through the timber for about a mile. The lake supports above average brook trout, that are hard to catch. There's plenty of firewood, but really no flat place to camp.

Lake	Code			
Little Goose Lake	SR043			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Goose Lake Jeep	1.5	1.5	100	0

Incisor Lake is best accessed by taking a 4WD vehicle from the Goose Lake Jeep Trail, Forest Service Road #3230. It is not a road that prudent people would take their new vehicles on. An ATV can easily drive to the end of the road. From here, hike up to and around Goose Lake on the east side. Little Goose Lake is just upstream from Goose Lake. There are nice places to camp, but there is no firewood. The lake itself is loaded with average-sized Yellowstone cutthroat trout.

Lake	**Code**			
Long Lake	CF010			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Goose Lake Jeep	0.00	0.00	0	0

Long Lake is accessible by 4WD vehicle from the Goose Lake Jeep Trail, Forest Service Road #3230. It is not a road that prudent people would take their new vehicles on. An ATV can easily drive to the Lake. It supports a healthy population of small brook trout, and an occasional cutthroat trout. It is a wonderful place to camp, but firewood is picked over.

Lake	**Code**			
Lower Snow Lake	ER004			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Alpine(East Rosebud)	5	3	3000	0

Lower Snow Lake is located up the trail from Alpine, the small community at East Rosebud Lake. It is an easy 2 to 2.5 mile hike up trail #15 to Snow Creek. From here, leave the trail and bushwack up the north(east) side of the creek. It is a very tough hike when you leave the trail. The alders are thick near the bottom, and the route is nearly hands and knees until you enter the basin that holds the two Snow Lakes. The first lake is Lower Snow Lake. Hike around the east side to reach Upper Snow Lake. The Snow Lakes are stocked with rainbow trout. It was hoped that they would reproduce here, but since that doesn't seem to be happening, these lakes will probably be placed on a stocking cycle. There aren't many good places to pitch a tent. Firewood is available.

Lake	**Code**			
Margaret Lake	CF066			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clarks Fork	2.5	2	400	100

It is a nice daypack trip or a short backpack trip to Margaret Lake, in the Clarks Fork drainage, not far from Cooke City. Start at the Clarks Fork Trailhead near Cooke City (Trail #3). Trail #565 splits off to the right about a mile up and winds through the timber for about a mile until it reaches Lillis Lake. From Lillis you may head cross-country about ¼ mile east to reach Margaret Lake, or you can continue on towards Vernon Lake. Before you get to Vernon Lake you must cross a small stream. Instead of crossing, you can head upstream about ¼ mile to find the lake. The lake is stocked on a 6-year basis with cutthroat trout, with a reference year of 2002. Growth is exceptional, but the fish are hard to catch. The only place to camp near the lake is on the bog near the outlet. Firewood is available.

Lake	**Code**			
Marsh Lake	CF019			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Lady of the Lake	4	1.5	650	500

It is a long daypack trip or a short backpack trip to Marsh Lake, in the Clarks Fork drainage, not far from Cooke City. Start at the Lady of the Lake trailhead near Cooke City (Trail #31). When you reach Lady of the Lake, cross the stream below the lake. It's cross-country heading almost straight east to reach Swamp Lake. You will probably hit a small pothole lake before you get there. Cross the outlet stream and head through the woods, once again straight east to reach Wiedy Lake. From Wiedy Lake it is ¼ mile south to reach Marsh Lake. These lakes are appropriately named so bring mosquito dope. Marsh Lake is stocked with cutthroat trout on a 6-year basis, with a reference year of 2003. Growth is good. There's plenty of fuel but you may have trouble finding a flat place for your tent.

Lake	Code			
Ovis Lake	CF011			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Goose Lake Jeep	0.5	0	250	0

Long Lake is accessible by 4WD vehicle from the Goose Lake Jeep Trail, Forest Service Road #3230. It is not a road that prudent people would take their new vehicles on. An ATV can easily drive to the Lake. From Long Lake, it is a short ½ mile hike slightly uphill to the west to get to Ovis Lake. It supports a healthy population of small brook trout, and is stocked on a 3-year cycle with cutthroat trout, with a reference year of 2000. There are few places to pitch a tent, but firewood is plentiful.

Lake	Code			
Rock Island Lake	CF073			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clarks Fork	2.5	2	400	100

It is a nice backpack trip to Rock Island Lake, in the Clarks Fork drainage, not far from Cooke City. Start at the Clarks Fork Trailhead near Cooke City (Trail #3). Stay on trial #3 around and past Kersey Lake. About a mile after you leave Kersey, Trail #566 splits off to the right and winds through the timber for about a mile until it reaches Rock Island Lake. It is a very large lake, with many places to camp, but popularity has removed available firewood from many camping areas. The lake has larger than average brook trout and it is also stocked on a 3-year basis with cutthroat trout, with a reference year of 2002. Growth of the cutthroat trout is average to above average.

Lake	Code			
Rydberg Lake	RC029			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	2.5	2	700	200

Rydberg Lake, Hellroaring #13, is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot less than ½ mile before leaving it. Head north to the side of ridge. You can follow the line of trees down a steep grassy slope to Hellroaring Lake #12 (fishless). Head around the north side of the lake and over a saddle to Smethurst Lake. Head downstream to Rydberg Lake. Rydberg doesn't have a lot of brush or trees around its shores, making it a good place to practice fly-fishing. There are small cutthroats and brook trout in this lake. It is wonderful camping on the saddle between the Hellroaring #12 and Smethurst lakes, and there is plenty of firewood.

Lake	Code			
Schoolmarm Lake	CF005			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Goose Lake Jeep	0.5	0	100	0

Schoolmarm Lake (Upper Mud Lake) is accessible by via a short walk after a 4WD drive along the Goose Lake Jeep Trail, Forest Service Road #3230. It is not a road that prudent people would take their new vehicles on. An ATV can easily drive to Lower Mud Lake. From Lower Mud Lake, it is a short ½ mile hike slightly uphill to the west to get to Schoolmarm Lake. It used to have a small population of large cutthroats, but these have disappeared. It will probably be stocked with small numbers of cutthroats on a 6-year basis to maintain the type of fishery that had been previously present. It is a beautiful place to camp, and there is plenty of firewood.

Lake	Code			
Silver Lake	WR015			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Mystic Lake	8	8	1900	300

Silver Lake is in the West Rosebud Creek drainage and is accessed from the Mystic Lake trailhead. The trail to Mystic Lake is one of the best in the Beartooths. It's about 3 miles to Mystic, and then a long hike around the south side of the lake. Island Lake is a short distance up the trail from Mystic Lake. You can wade the outlet, or take your chances trying to cross on the logjam that is always there. From here it is another 2 miles up the trail to Silver Lake. The lake supports a population of large sized rainbow trout and cutthroat-rainbow crosses. Its great camping near the outlet, but it is used heavily and firewood has been very picked over.

Lake	Code			
Sliderock Lake	RC030			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	3	2	1200	500

Sliderock Lake isn't considered one of the 13 Hellroaring Lakes, because it is located off to the south side of the same valley. This area is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot about 1½ miles before leaving it. Head north to the side of ridge. You can head down this slope to Snowbank Lake. From here it is a short hike, southwest and uphill to Sliderock Lake. This lake is located towards the upper end of the valley on the south side. It supports the largest brook trout of the Hellroaring Creek drainage. There are flat spots, but camping is better at the lower lakes, where there is more cover and firewood.

Lake	Code			
Smethurst Lake	RC026			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	1.5	1	300	500

Smethurst Lake, Hellroaring #10, is one of the 13 Hellroaring Lakes located off the along Hellroaring Creek and the Plateau of the same name. This is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot less than ½ mile before leaving it. Head north to the side of ridge. You can follow the line of trees down a steep grassy slope to Hellroaring Lake #12 (fishless). Head around the north side of the lake and over a saddle to Smethurst Lake. It is wonderful camping on the saddle between the two lakes, and there is plenty of firewood.

Lake	Code			
Snowbank Lake	RC019			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Hellroaring Plateau	3	2.5	500	200

Snowbank Lake is one of the 13 Hellroaring Lakes, and is located in the upper end of the valley. This area is a great starter hike for novices, and provides plenty of fishing for the fishing enthusiast. Take your vehicle up Forest Road #3004 to the top of Hellroaring Plateau. Even minivans can make it to the top if they're careful. From here follow the road/trail #11 on foot about 1½ miles before leaving it. Head north to the side of ridge. You can head down this slope to Snowbank Lake. It supports above average brook trout. There are flat spots, but camping is better at the lower lakes, where there is more cover and firewood.

Lake	Code			
Swede Lake	CF235			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clay Butte	7	6.5	600	300
Muddy Creek	9	8.5	1000	0

Swede Lake is a beautiful lake located within backpack distance of Clay Butte. It is home to a population of cutthroat trout that have above average growth rates. Access starts in Wyoming, from Clay Butte hike on trail 618/614 . Head north on 618 where it splits off to go to Granite Lake. The trail is very confusing where it crosses Mule Creek. Don't head down to Granite Lake here but instead cross the creek and head to Thiel Lake. As you head upstream, east, just past Thiel Lake you will meet trail #619. Turn and follow this trail ¼ mile to the north, where it crosses a very small stream. Follow this stream up to Swede Lake. There are some places to camp and firewood is available, but camping is better down below at Thiel Lake.

Lake	Code			
Trail Lake	CF208			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clay Butte	17	15.5	1400	1000
Muddy Creek	18	16.5	2100	200

It is a long one-day backpack to Trail Lake in the Clarks Fork Drainage. It is home to a stocked population of cutthroat trout that have average growth rates. It is stocked on an 8-year cycle, reference year 2003. Starting in Wyoming, from Clay Butte hike on trail 618/614 . Head north on 618 where it splits off to go to Granite Lake. The trail is very confusing where it crosses Mule Creek. Don't head down to Granite Lake here but instead cross the creek and head to Thiel Lake. As you head upstream, east, just past Thiel Lake you will meet trail #619. Hang a left and head north and then west along this trail. You will pass near Renie Lake and Kidney Lake and cross a creek between Wright Lake and Spogen Lake. Next it will be uphill to Trail Lake. There are flat places to camp and firewood is available.

Lake	Code			
Vernon Lake	CF068			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Clarks Fork	3	3	300	200

It is a long daypack trip or a short backpack trip to Vernon Lake, in the Clarks Fork drainage, not far from Cooke City. Start at the Clarks Fork Trailhead near Cooke City (Trail #3). Trail #565 splits off to the right about a mile up and winds through the timber for about a mile until it reaches Lillis Lake. From Lillis you continue on the same trail Vernon Lake. The lake harbors both brook trout and cutthroat trout. The brook trout are above average to large in size while the cutthroats are average. Camping is good at the south side of the lake, but its popularity has caused firewood to be picked over in that area.

Lake	Code			
Wiedy Lake	CF018			
Trailhead	**Total miles**	**Trail Miles**	**Up elevation**	**Down Elevation**
Lady of the Lake	4	1.5	650	500

It is a long daypack trip or a short backpack trip to Wiedy Lake, in the Clarks Fork drainage, not far from Cooke City. Start at the Lady of the Lake trailhead near Cooke City (Trail #31). When you reach Lady of the Lake, cross the stream below the lake. It's cross-country heading almost straight east to reach Swamp Lake. You will probably hit a small pothole lake before you get there. Cross the outlet stream and head through the woods, once again straight east to reach Wiedy Lake. These lakes are appropriately named so bring mosquito dope. Wiedy Lake is stocked with cutthroat trout on a 6-year basis, with a reference year of 2001. Growth is good. There's plenty of fuel but you may have trouble finding a flat place for your tent.

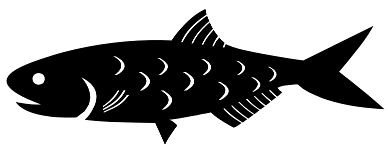
Appendix B

Future Survey Dates for Lakes Sampled in 2000

Lake	Code	Next Sample
Corner Lake	CF007	2010-2012
Crescent Lake HR8	RC024	2010-2012
Daly Lake HR11	RC027	2010-2012
Flat Rock Lake	CF190	2008-2010
Forsaken Lake	CF198	2007-2008
Froze To Death Lake	ER048	2010-2012
Granite Lake	CF147	2010-2012
Hairpin Lake	RC018	2010-2013
Hellroaring Lake #4	RC020	2010-2012
Hellroaring Lake #5	RC021	2010-2012
Hellroaring Lake #9	RC025	2010-2012
Hellroaring Lake #9	RC025	2010-2012
Hellroaring Lake #12	RC029	2010-2012
Hidden Lake	CF234	2010-2012
Incisor	SR018	2001-2002
Island Lake	WR014	2010-2012
Kersey lake	CF060	2004-2006
Lake Elaine	CF168	2010-2012
Lillis Lake	CF067	2010-2012
Little Goose Lake	SR043	2010-2012
Long Lake	CF010	2010-2012
Lower Snow Lake	ER004	2007-2008
Margaret Lake	CF066	2008-2010
Marsh	CF019	2006-2007
Ovis	CF011	2006-2007
Rock Island Lake	CF073	2008-2010
Rock Island Lake	CF073	2008-2010
Rydberg Lake	RC028	2010-2012
Schoolmarm	CF005	2005
Silver Lake	WR015	2010-2012
Sliderock Lake	RC030	2010-2012
Smethurst Lake HR10	RC026	2010-2012
Snowbank Lake	RC019	2010-2012
Swede Lake	CF235	2010-2012
Trail Lake	CF208	2008-2010
Upper Snow Lake	ER005	2007-2008
Vernon Lake	CF068	2010-2012
Weidy	CF018	2006-2007

ABSAROKA-BEARTOOTH WILDERNESS AND CRAZY MOUNTAIN HIGH

MOUNTAIN LAKES SURVEY - 2001



Dave Hergenrider

Travis Lohrenz

Montana Department of Fish, Wildlife and Parks.

Region 5 Fisheries

Introduction

The Absaroka-Beartooth (A-B) Wilderness extends East and North of Yellowstone National Park straddling the Montana-Wyoming border. The (A-B) and area adjacent holds over 1000 lakes (Marcuson and Poore 1991). Of the 1000 lakes approximately only a third of them support fisheries (Stiff 1992). The Slough Creek drainage is the only drainage thought to have supported a few lake fisheries that originally supported Yellowstone cutthroat trout. Introductions, or migration from the point of introduction account for the rest of the (A-B) fisheries (Stiff 1993, 1994). Montana fish, Wildlife and Parks currently manages the (A-B) by drainage due to the possibility of migrations.

The (A-B) contains seven major drainages, the Clarks Fork of the Yellowstone River, The Boulder River, East Rosebud Creek, Rock Creek, Slough Creek, the Stillwater River, and West Rosebud Creek. The majority of the (A-B) lakes reside in the Clark's Fork drainage with over 40% of the lakes located there.

A large portion of the lakes in the (A-B) are found at elevations over 8,500 feet in elevation. Ice out usually doesn't occur on most of these lakes until late June or early July. As a result growth rates are restricted due to the short summer season, and shortage of nutrients.

Lakes tend to have few large fish, many medium sized fish, or lots of small fish (Stiff 1994). Most lakes that support reproduction overpopulate resulting in smaller fish. Stocking fish in lakes were reproduction is absent allows for a regulation of numbers growth rates. Stocked lakes are handled as put and take fisheries, with stocking cycles 00, 4, 6 and 8 years.

Three and 4 year cycles are used for lakes that receive significant fishing pressure. Six year cycles are used to promote greater growth of the fish, and to maintain a constant fishery. Lakes are stocked on an 8-year cycle to allow the fish to age out at 7 years resulting in a fallow year in the lake in which the food population can recover. Stocking changes may be made in cases where fish surpass the 7 year age projection.

Most of the lakes are stocked with Yellowstone cutthroat trout from the Big Timber MT hatchery, as the (A-B) is within their natural range. One hundred plus lakes in the (A-B) support cutthroat trout.

Figure 2. Percent of lakes sampled by species

Brook Trout 2%   Hybrids 2%   Rainbow Trout 14%   Cutthroat Trout 64%   Golden Trout 16%

Results

Lakes with no management or status change

Twenty- eight of the 35 lakes sampled in 2001 had no management or status changes (Table 1.) Nine of these lakes are self sustaining with 21 being stocked.

Table 1.

Lake	Drainage Code		Species	Status
Big Park	ER19		GT, CT	??, SS
Billy,	ER 30		EB	SS
Blue	BR 31		CT	ST
Bowback	RC 65		CT	ST
Bramble#41	BR41		CT	ST
Cairn	ER 31		EB	5S
Cimmerian	SR 85		CT"GT"RB	SS
Crystal	CF 202		CT	ST
Dewey	ER 23		GT, CT	__, SS
Flat Rock	CF 190		CT	ST
Hipshot	CF 158		CT	ST
Huckleberry	WR5		RB	SS
Incissor	SR 18		GT	SS
Kookoo	RC 58		CT	ST
Lowe Storm	WR 110		CT	ST
Marker	RC 62		CT	ST
Medicine	ER 33		CT	ST
Narrow Escape	BR4		CT	ST
Oly				
Rainbow #5	BR 21		RB	SS
Rainbow #6	BR 22		RB	SS
Rainbow #7	BR23		RB	SS
Ram	WR35		CT	SS
Shadow	RC52		CT	ST
Squeeze	BR 5		CT	CT
Sundance	RC 50		CT	ST
Triangle	CF 110		CT	ST

BR=BOULDER RIVER
CF=CLARKS FORK
ER=EAST ROSEBUD
RC=ROCK CREEK
SR=STILLWATER
WR=WEST ROSEBUD
SS=SELF SUSTAINING POPULATION

CT=CUTTHROAT
EB=BROOK TROUT
GT=GOLDEN TROUT
RB=RAINBOW TROUT
*=HYBRIDS
___=MORE THAN ONE SPECIES
ST=STOCKED POPULATION

Brook trout populations occupy around 90 lakes. Brook trout populations were established in the first half of the century and are no longer stocked in the (A-B). Rainbow trout populations are supported in over 20 lakes. Golden trout like the rainbow occupy 20 plus lakes in the (A-B). Grayling are found in fewer than 20 lakes. Lake trout and brown trout are found mostly outside of (A-B) boundaries in several mixed fisheries.

Fish found in the streams of the (A-B) are self -supporting populations. Montana Fish, Wildlife, and Parks does not stock fish in the streams of the (A-B) wilderness. Fish found in these streams usually are smaller than those found in the mountain lakes, because of lack of nutrients, and the expenditure of energy against stream velocity.

Methods

Materials

Gill net forms	Scale envelopes	Thermometer
Ruler	Lake data sheets	HAl data sheets Pencils
Tar cord	125' experimental gill nets	Scale
GPS	knife	fishing gear

Lakes to be sampled are designated and ranked in order of priority during spring meetings. A 4-day week is usually spent by the survey crew hiking to and sampling lakes. The teams determine their own access points, and sample lakes with a priority one listing first.

Gill nets are set by first choosing the location. Outlet bays are the first choice of net location, followed by inlet bays, and down wind bays. Nets are set by pulling them across a bay using tar cord and suspended in the bay with the same cord. Nets are left overnight and pulled in the morning. Typically a day set is not used, however if a sample size of eight fish or more is obtained a day set may be sufficient.

The gill-netting is used to determine if reproduction is occurring and to what extent by noting the different age classes of fish. Lake management may be altered on the basis of this information.

Fish are removed from the net, weighed, measured, and a scale sample taken for age purposes. Scale samples are taken from a maximum number of 20 fish per lake. Scale samples are not taken from brook trout lakes, as scales are too small and annuli to close to read. Several fish are necropsied, checking for parasites and abnormalities. An HAI assessment is done using methods modified from those outlined by Adams et al. (1993). Gut contents are analyzed. All data are recorded on appropriate forms.

The shoreline is walked when possible, presence or absence fry, types of food organisms are noted. The presence or absence of amphibians is also noted. The outlet and inlet substrate is assessed for spawning potential. The availability of camping spots and fuel is noted.

Lakes surveyed in 2001

There were 34 lakes sampled in the (A-B) in 2001. Most lakes sampled held only one species of salmonid however, a small number of lakes contained hybrids. Hybrids in these lakes are the result of stocking one species over another. The short spawning season, and the similarity in some species sometimes results in the presence of hybrids. This is most commonly observed in cutthroat, rainbow, and golden trout.

The progeny of these crosses are capable of reproduction. Figure one shows the number of lakes samples by drainage, and figure 2 shows the percent of lakes by species.

Figure 1. Number of lakes sampled 2001 by drainage.

Lakes with management and/or status changes

The purpose of the high mountain lakes survey is to ascertain the status of fish populations, and adjust management plans based on status and observed growth rates.

Table 2.

LAKES IN NEED OF STATUS OR MANAGEMENT CHANGES 2001.

Lake	Drainage Code	Species	Status	COMMENTS
Anchor	CF 124	GT	??	no fish
Asteroid	SR 80	GT	??	no fish
Bramble #39	BR 39	CT	ST	no fish
Dryad	SR 84	GT	??	no fish
Forsaken	CF 198	CT	ST	no fish
Triangle	RC 60	CT	ST	no fish
Widowed	CF 123	GT	??	no fish

BR=BOULDER	CT=CUTTHROAT
CF=CLARKS FORK	EB=BROOK TROUT
ER=EAST ROSEBUD	GT=GOLDEN TROUT
RC=ROCK CREEK	RB=RAINBOW TROUT
SR=STILLWATER	*=HYBRIDS
WR=WEST ROSEBUD	___ =MORE THAN ONE SPECIES

SS=SELF SUSTAINING POPULATION
ST=STOCKED POPULATION

Additional Data on High Mountain Lakes

In addition to standard gill-net data, fish health, condition factor, parasites, gut contents were noted.

Fish Health. The HAI (Adams et al. 1993) assigns points for anatomical and physiological abnormalities. The fish of each species for each lake is averaged and the populations with the lowest scores have the healthiest fish. The average HAI for fish populations in the (A-B) is 41 with a standard deviation of 19. Those lakes with an HAI number of 60 would be considered marginally unhealthy, while those populations with a score in the low 20's would be considered very healthy. Of the 36 lakes sampled in the A-B during the 2001 field season, 25 HAI assessments were conducted. Five of the 25 had very good health with HAI numbers in the 20's, 15 showed average health, and five showed unhealthy populations with high HAI numbers. No fish were captured in the remaining 11 lakes.

Condition Factor. Ctl is a ratio of weight to length, calculated by the equation (weight* 10000)/(1ength3). The higher the number the better condition of the fish. Average Ctl values for the A-B are CT-3.559; RB, EB-4.055. Of the 36 lakes sampled in 2001 25 Ctl assessments were conducted. Fifteen lakes exhibited high condition factors, 5 showed average condition factors, 1 showed poor condition factor. Ctl was unable to be calculated on 4 lakes because lengths were unable to be obtained.

Catch per unit effort. FPH is fish- per- gill net- hour. The catch per unit effort can provide relative information on the numbers of fish in the lake. A value of 1.00 FPH should provide for normal fishing while numbers above 1.50 provide good fishing, and those lakes below 0.5 have low numbers of fish and provide for tough fishing. Of the lakes sampled this year 6 should have excellent fishing, 9 lakes should provide average fishing, and 11 would provide poor fishing.

Parasites. It is very common for fish in the A-B to have parasites associated with internal organs. Many of the fish have intestinal nematodes, *Truttaedacnitis truttae,* (referred to as trematodes in earlier reports). *Diphylobothrium latum* (tapeworm cysts) are also present in the body cavity of many fish. Of the lakes sampled 88% had parasites of on type or the other. In shadow lake a fish being necropsied was observed to have type of burrowing parasite in the psuedobranch.

Table 3.

ADDITIONAL DATA ON HIGH MOUNTAIN LAKES

LAKE NAME	CODE	SPECIES	CTL	FPH	HAI	EYE	GILL	PSE	THY	SPL	INTE	KIDNEY	LIVER	FIN	OPER
BIG PARK	ER 19	CT*GT	2.78	0.86	23	100	100	100	95	95	95	90	100	95	100
BILLY	ER30	EB	2.52	2	38	100	100	100	95	100	100	80	100	95	100
BLUE	BR31	CT	2.05	0.73	28	100	100	100	100	95	85	100	95	90	100
BOWBACK	RC85	CT	1.32	0.97	33	100	100	100	100	85	95	90	95	75	100
BRAMBLE #41	BR41	CT	1.95	1.7	22	100	100	100	100	100	100	85	95	90	100
CAIRN	ER31	EB	1.9		45	100	100	100	100	100	100	90	95	100	100
CIMMERIAN	SR85	CT*GT*RB	3.51	1.78	42	100	100	100	100	100	85	80	95	100	100
CRYSTAL	CF202	CT	3.89	0.5	31.4	100	100	100	100	85	85	100	100	100	100
DEWEY	ER23	CT	1.81	0.39	40	100	100	100	100	85	95	95	95	100	100
FLAT ROCK	CF 190	CT	2.82	1.67	38	100	100	100	100	100	100	75	100	100	100
HIPSHOT	CF 158	CT	1.8	0.12	85	100	100	100	100	100	95	95	95	100	100
HUCKLEBERRY	WR 5	RB	6.01	0.06	20	100	100	100	100	100	100	100	100	100	100
KOOKOO	RC58	CT	3.54	0.53	43	100	100	100	100	100	70	90	100	80	100
LOWER STORM	WR 10	CT	2.49	8	61	100	100	100	100	75	85	80	75	100	100
MARKER	RC82	CT	3.12	2.61	33	100	100	100	90	95	100	90	90	90	100
MEDICINE	ER33	CT	2.25	1.43	19	100	100	100	100	100	85	100	100	100	100
NARROW ESCAPE	BR4	CT	0	0.39	63.3	100	100	95	95	95	75	85	75	90	100
RAINBOW#5	BR21	RB	0	0.24	46.7	100	100	100	100	90	80	95	95	100	100
RAINBOW#6	BR22	RB	0	0.11	40	100	100	100	100	100	90	95	100	100	100
RAINBOW#7	BR23	RB	0	0.4	55	100	100	100	100	95	85	80	100	100	100
RAM	WR 35	CT	2.19	0.89	24	100	100	100	95	90	90	100	100	100	100
SHADOW	RC52	CT	3.11	1.45	31	100	100	100	100	100	95	80	100	70	100
SQUEEZE	BR5	CT	1.63	0.73	32.3	100	95	95	95	100	90	80	100	90	95
SUNDANCE	RC50	CT	2.95	0.18	43.3	100	100	100	100	100	85	100	100	85	100
TRIANGLE	CF110	CT	1.64	0.06	30	100	100	100	100	100	100	100	95	100	100

KEY

Species
Ct= Cutthroat
Eb= Eastern Brook Trout
Gt= Golden Trout
Hyb= Hybrid
Rb= Rainbow Trout

Ctl= Condition Factor (Higher # Greater Health)

Hai= Health Assessment Index (Higher # Shows Poorer Health)
Gill= Gills
Pse= Pseudobranch
Spl= Spleen
Inte= Intestine
Kidney= Kidney
Fins= Fins
Oper= Operculum

Code= Code # In Pat Marcuson's Book Fishing The Beartooths

Table 4.

DATA ON HIGH MOUNTAIN LAKES 2001

LAKE NAME	CODE	SPECIES	STATUS	LAST STOCK	SAMPLE DATE	# FISH	SIZE RANGE	MEAN SIZE	COMMENTS
ANCHOR	CF 124	GT	??		8/2	0			NO FISH RESTOCK GT
ASTERIOD	SR 80	GT		1992	8/15	0			NO FISH RESTOCK GT
BIG PARK	ER 19	GT, CT	??, SS	1955	7/10	12	6.4-14.6	8.8	
BILLY	ER 30	EB	SS			5	8.9-12.1	10.4	DRIFT FROM CAIRN
BLUE	BR 31	CT	ST	1997	7/24	12	7.2-12.3	10.3	
BOWBACK	RC 65	CT	ST	1996	7/31	17	11.9-14.6	13.3	
BRAMBLE #39	BR 39	CT	ST	1993	7/25	0			NO FISH RESTOCK
BRAMBLE #41	BR 41	CT	ST	1997	7/25	24	9.9-11.8	10.1	
CAIRN	ER 31	EB	SS	1955	7/11	2	9.9-15.9	12.9	HOOK AND LINE
CIMMERIAN	SR 85	CT*RB*GT	SS		8/15	32	6.0-15.0	8.6	
CRYSTAL	CF 202	CT	ST	1994	8/21	7	9.5-19.0	13.8	
DEWEY	ER 23	GT, CT	NONE, SS	1955, 1991	7/11	6	10.0-14.2	12.3	
DRYAD	SR 84	GT	??	1992	8/15	0			NO FISH RESTOCK GT
FLAT ROCK	CF 190	CT	ST	1994	8/21	5	9.0-12.7	11.1	
FORSAKEN	CF 298	CT	ST	1993					
HIPSHOT	CF 158	CT	ST	1995	8/22	2	14.9-15.0	15	YOY IN OUTLET POOL
HUCKLEBERRY	WR 5	RB	SS	1949	8/1	1	5.5	5.5	
INCISSOR	SR 18	GT	SS	1984	8/31	4	6.5-14.0	11.2	
JAY	SR 93	CT	SS	1977					HOOK AND LINE
KOOKOO	RC 58	CT	ST	1994	7/3	10	10.5-18.2	15.1	
LOWER STORM	WR 10	CT	ST	1995	8/6	12	9.5-16.8	14.2	
MARKER	RC 62	CT	ST	1994	8/1	43	11.1-17.8	15.5	
MEDICINE	ER 33	CT	ST	1993	7/11	30	12.5-15.2	13.8	LOOK FOR DOWNSTREAM MOVEMENT FROM BILLY
NARROW ESCAPE	BR 4	CT	ST	1989	7/4	9	8.4-14.8	12.4	
OLY	ER 28	CHECK (EB)							
RAINBOW #5	BR 21	RB	SS	1949	7/4	6	11.2-15.7	12.9	
RAINBOW #6	BR 22	RB	SS	1949	7/5	3	6.5-10.5	8.7	
RAINBOW #7	BR 23	RB	SS	1949	7/1	6	10.3-12.1	11.4	
RAM	WR 35	CT	SS	1983	8/7	12	6.6-15.4	11.6	
SHADOW	RC 52	CT	ST	1997	8/1	24	8.0-11.8	9.8	
SQUEEZE	BR 5	CT	ST	2000	7/4	16	11.1-15.3	13.7	
SUNDANCE	RC 50	CT	ST	2000	8/1	3	8.1-12.6	10.7	
TRIANGLE	RC 60	CT	ST	1994	7/31	0			NO FISH RESTOCK
TRIANGLE	CF 110	CT	ST	1995	8/20	1	14.5	14.5	

BR=BOULDER
CF=CLARKS FORK
ER=EAST ROSEBUD
RC=ROCK CREEK
SR=STILLWATER
WR=WEST ROSEBUD

CT=CUTTHROAT
EB=BROOK TROUT
GT=GOLDEN TROUT
RB=RAINBOW TROUT
*=HYBRIDS
___ =MORE THAN ONE SPECIES

CODE=CODE # USED IN PAT MARCUSON'S BOOK “F1SHING THE BEARTOOTH”

SS=SELF SUSTAINING POPULATION

ST=STOCKED POPULATION

ST+=STOCKED SOME REPRODUCTION

Gut Contents

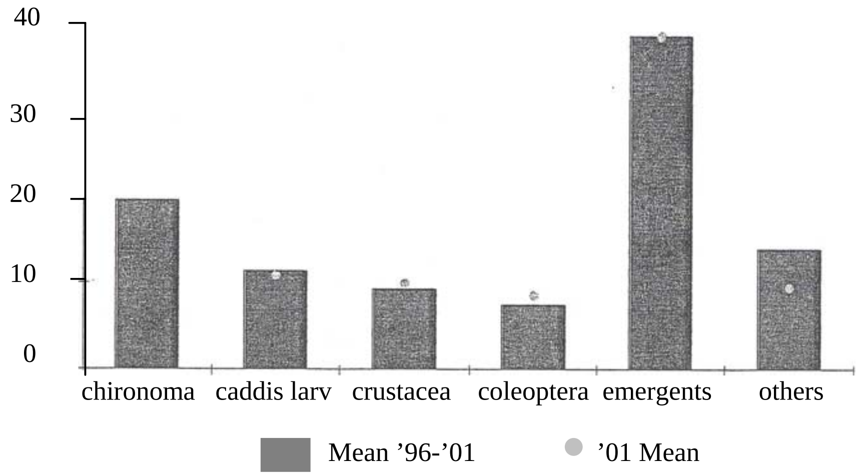
Emergents in 2001 still remained the top food source of fish in the A-B mountain lakes. However, a decrease of 11.4 % was observed when compared to the 2000 analysis. It was also evident that chironomas became a larger part of the diet in 2001, along with a increase in crustaceans. The percentage of terrestrials was down this is believed to be the result of lower lake levels.

Table 5.

ANALYSIS OF GUT CONTENT S FROM 1996-2001

	%chironornas	% caddis larvae	% crustaceans	% coleopterans	% emergents	% others
Mean '96-'01	19.45	11.35	9.35	7.4	38.65	13.99
2001	22.8	10.96	10.11	8.65	38.6	9.49

Figure 3.



HAI Analysis

Since 1995 HAl analysis (Adams et a1. 1993) has been conducted on fish sampled during the high mountain lakes survey. The HAI (Health Assessment Index) measures the health offish populations by assigning point values to abnormalities observed during field necropsies. The numbers for the individual fish are averaged for the population to give an idea of the health of the fish population in each lake. The mean value for the populations in the A-B Wilderness is a value of about 40, and the standard deviation for these HAI values is 19.88 for 159 total HAI's conducted since 1995. Populations with higher values are less healthy. Populations more than a standard deviation below the mean are extremely healthy. Populations that are more than a standard deviation above the mean are unhealthy. Numbers of samples in each category are in Table 5. HAI samples for the year 2001 are in table 6.

Table 6.

OVERALL HAI VALUES FOR ALL SAMPLES TAKEN SINCE 1995 COMPARED TO 2001 SAMPLES.

	# Samples	Mean Value	Standard Deviation	Healthy	Normal populations	Unhealthy
All samples	159	39.3	19.88	24	108	25
2001	26	37.4	13.43	4	16	4

Table 7.

HAI ANALYSIS OF A-B LAKES 2001

LAKE NAME	CODE	SPECIES	STATUS	HAI	U AE
BIG PARK	ER 19	CT*GT	??,55	23	E
BILLY	ER 30	EB	5S	36	A
BLUE	BR 31	OT	ST	28	A
BOWBACK	RC 65	CT	ST	33	A
BRAMBLE #41	BR 41	CT	ST	22	E
CAIRN	ER 31	EB	SS	45	A
CIMMERIAN	SR 85	CT*GT*RB	SS	42	A
CRYSTAL	CF 202	OT	ST	31.4	A
DEWEY	ER 23	GT, CT	1,SS	40	A
FLAT ROCK	CF 190	CT	ST	38	A
HIPSHOT	CF 158	CT	ST	65	U
HUCKLEBERRY	WR5	RB	5S	20	E
KOOKOO	RC 58	CT	ST+	43	A
LOWER STORM	WR 10	CT	ST	61	U
MARKER	RC 62	CT	ST	33	A
MEDICINE	ER 33	CT	ST	19	E
NARROW ESCAPE	BR4	OT	ST+	63.3	U
RAINBOW #5	BR 21	RB	SS	46.7	A
RAINBOW #6	BR 22	RB	SS	40	A
RAINBOW #7	BR 23	RB	SS	55	U
RAM	WR 35	OT	SS	24	E
SHADOW	RC 52	OT	ST	31	A
SQUEEZE	BR 5	CT	ST	32.3	A
SUNDANCE	RC 50	CT	ST+	43.3	A
TRIANGLE	CF110	CT	ST	30	A

KEY

DRAINAGES
BR=BOULDER RIVER
CF=CLARKS FORK RIVER
ER=EAST ROSEBUD CREEK
RC=ROCK CREEK
SR=STILLWATER RIVER
WR=WEST ROSEBUD CREEK

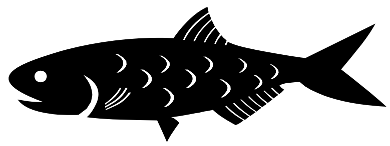
SPECIES
CT=CUTTHROAT
EB=BROOK TROUT
GR=GRAYLING
GT=GOLDEN TROUT
LL= BROWN TROUT
LT=LAKE TROUT
RB=RAINBOW TROUT

STATUS
SS=SELF-Sustaining
ST=STOCKED
ST+=STOCKED, SOME REPRODUCTION

HEALTH
U=UNHEALTHY
A=AVERAGE
E=EXCELLENT

CODE=CODE # USED IN PAT MARCUSON'S BOOK "THE BEARTOOTH FISHING GUIDE"

ABSAROKA-BEARTOOTH WILDERNESS HIGH MOUNTAIN LAKES 2002 SURVEY



Travis Lohrenz

Montana Department of Fish, Wildlife and Parks

Region 5 Fisheries

2004

INTRODUCTION

The Absaroka-Beartooth Wilderness (A-B) extends East and North of Yellowstone National Park straddling the Montana-Wyoming border. The A-B and area adjacent holds over 1000 lakes. Of the 1000 lakes approximately one- third of them support fisheries. The Slough Creek drainage is the only drainage thought to have supported native lake fisheries of Yellowstone cutthroat trout. Introductions and migration from introduction sites account for the rest of the A-B fisheries. Montana Fish, Wildlife and Parks currently manages the A-B by drainage.

The A-B contains seven major drainage's: the Clark's Fork of the Yellowstone River, the Boulder River, East Rosebud Creek, Rock Creek, Slough Creek, Stillwater River, and West Rosebud Creek. Over 40% of the A-B lakes are in the Clark's Fork drainage..

Many of the lakes in the A-B are found at elevations greater than 8,500 feet. Ice out usually doesn't occur on most of these lakes until late June or early July. As a result of the short growing season growth rates of fish inhabiting the A-B lakes are often restricted. Most lakes that have adequate spawning areas overpopulate due to the lack of angler harvest and natural predators, resulting in smaller fish. Stocking fish in lakes where reproduction is absent allows for a regulation of numbers of fish and growth rates. Stocked lakes are handled as put-grow-and-take fisheries, with stocking cycles of 3, 4, 6 and 8 years. Three and 4-year cycles are used for lakes that receive relatively high fishing pressure. Six-year cycles are used to promote greater fish growth and to maintain a constant fishery. Lakes that are stocked on an 8-year cycle lead to lower fish density and allow the fish to age out at 7 years resulting in a fallow year in the lake, in which the food population can recover. Stocking changes may be made in cases where fish surpass the 7-year age projection.

Most stocked lakes are planted with Yellowstone cutthroat trout from FWP's Yellowstone Cutthroat Trout Hatchery in Big Timber, MT. Over one hundred lakes in the A-B support Yellowstone cutthroat trout. Brook trout populations occupy approximately 90 lakes. Brook trout populations were established in the first half of the 20th century and are no longer stocked in the A-B. Rainbow trout populations are present in over 20 lakes. Golden trout also occupy over 20 lakes in the A-B. Arctic grayling are found in fewer than 20 lakes. Lake trout and brown trout are found mostly outside of A-B boundaries in a few mixed fisheries.

The purpose of the A-B lakes survey is to obtain fish presence, relative abundance, and growth data for future management decisions, and to monitor fish health, migrations, and new fish introductions. Growth and presence data are used to make management decisions such as determining and adjusting stocking rates.

METHODS

Materials

Gill net forms	Scale envelops	Thermometer
Lake data sheets	Tar cord	Scale
HAI data sheets	125' experimental gill nets	GPS
Pencils	Knife	Fishing gear
Ruler		

Lakes to be sampled are designated and ranked in order of priority during spring meetings. The survey crew hiking to and sampling lakes usually works a 4-day week. The teams determine their own access points, and sample lakes according to their priority. Gillnetting is used to determine if reproduction is occurring, and to what extent, by documenting the different age classes of fish and comparing this information to the known age of stocked fish. Gillnets are set by first choosing the location. Outlet bays are the first choice of net location, followed by inlet bays, and down wind bays. Nets are set by pulling them across a bay using tar cord. The nets are suspended in the bay with the same cord, which is tied off to a nearby tree or rock to prevent the net from drifting. Nets are left overnight and pulled in the morning. Typically a day set is not used, however if a sample size of eight fish or more is obtained a day set may be sufficient. Fish are removed from the net, weighed, measured, and a scale sample is taken for age purposes. Scale samples are taken from a maximum of 20 fish per lake. Scale samples are not taken from brook trout, as scales are too small and annuli to close to accurately read. Several fish are necropsied, checking for parasites and abnormalities. A Health and Abnormality Index (HAI) assessment is done using methods modified from those outlined by Adams et al. (1993). Gut contents are analyzed on site. All data are recorded on appropriate forms.

The shoreline is walked when possible and the presence or absence of juvenile fish amphibians, and types of fish food organisms is recorded. The outlet and inlet substrate is assessed for spawning potential. The availability of camping spots and fuel is also noted.

Lakes surveyed in 2002

In 2002, 32 lakes sampled in the A-B. Most lakes sampled held only one species of salmonid, however a small number of lakes contained hybrids. Hybrids in these lakes are the result of stocking one species over another or the migration of species between lakes. The short spawning season and the close relationship between some species sometimes results in cross breeding. Hybridization is most commonly observed between cutthroat, rainbow and golden trout. The most common cross that occurs in the A-B is between Yellowstone cutthroat and rainbow trout, however there are lakes in which Yellowstone cutthroat, rainbow trout, and golden trout genes are all present with the fish population. The progeny of these crosses are capable of reproduction. Table 1 shows the number of lakes sampled by drainage, and Table 2 shows the percent of lakes by species.

Table 1. Number of lakes sampled in 2002, by major drainage.

ugh Creek	er	k	t Rosebud Creek	; Fork of Yellowstone River	r
2			2	18	

Table 2. Percent of lakes sampled in 2002, by species.

LT/CT/EB	GR/CT	GR/EB	CT	RB	EB	EB/CT	GT	GR	HYB
3	10	3	43	10	10	6	6	3	6

RESULTS

Lakes with no management or status change

Nineteen of the 32 lakes contain self- sustaining populations of trout and the other 13 lakes contain populations sustained through stocking. Twenty-two of the 32 lakes sampled in 2002 had no management or status changes, meaning current management practices and fish status listings (presence and abundance) warranted no change. Nine of the 32 lakes sampled require management and/or management changes.

Table 3. Lakes sampled in 2002 with no management or status changes.

Lake	Drainage Code	Species	Status
Ampitheater	CF 101	EB	SS
Bill Lake	SR 076	GT*CT*RB	SS
Clover Leaf 223	CF 223	CT	SS
Clover Leaf 217	CF 217	CT	SS
Clover Leaf 216	CF 216	CT	SS
Clover Leaf 215	CF 215	CT	SS
Cradle Lake	CF 095	RB	SS
Curl Lake	CF 022	EB	ST
Gallery Lake	CF 096	RB	SS
Heather Lake	SC 006	CT	SS
Kersey Lake	CF 060	LT/EB/CT	SS/SS/SS
Lake of the Woo	SR 049	CT	SS
Line Lake	CF 246	CT	ST
Marsh Lake	CF 019	CT	ST
Martes Lake	SR 065	CT	ST
Moon Lake	RC 015	CT	ST
Otter Lake	CF 103	EB/GR	SS/??
Ouzel Lake	CF 092	CT/EB	SS
Peace Lake	SC 005	CT	SS
Pinchot Lake	SR 091	GT*RB	SS
Shadow Lake	ER 044	EB	SS
Weasel 51	BR 051	CT	SS
Weasel 48	BR 048	CT	SS
Weidy	CF 018	CT	ST

BR=BOULDER RIVER
CF=CLARKS FORK
ER=EAST ROSEBUD
RC=ROCK CREEK
SR=STILLWATER
WR=WEST ROSEBUD
ST=STOCKED POPULATION

CT=CUTTHROAT
EB=BROOK TROUT
GT=GOLDEN TROUT
RB=RAINBOW TROUT
*=HYBRIDS
SS=SELF SUSTAINING POPULATION

Table 4. Lakes with management and/or status changes.

Lake	Drainage code	Species	Status	COMMENTS
Broadwater L.	CF 023	EB/CT	SS/ST	No CT captured or observed
Great Falls L.	BR 055	RB	ST	Visual observation and angler interview revealed no presence of fish. Restock.
Lost Lake	ER 045	GR/CT	??/??	No signs of fish observed. Appears fish have died out. Restock
McKnight Lake	BR 090	GT	ST	Gill netting yielded no fish; last stocked in ’92, aged out. Restock.
Upper McKnight L.	BR 089	GT	ST	Lake is very shallow; fish would more than likely winterkill. Discontinue stocking.
Mosquito Lake	CF 18A	GR	ST	Gill netting yielded no fish; lake has a tremendous food base, Restock with CT.
Swamp Lake	CF 017	CT/GR	ST/ST	Gill netting yielded no fish; Restock
Weidy Lake	CF 018	CT/GR	ST/ST	Four larger CT were sampled; fish appear to be aging out. Restock.
Jorden Lake	CF 121	CT	SS	No fish collected due to time constraints; needs to be resampled fish observed rising.

BR=BOULDER	CT=CUTTHROATCF=CLARKS FORK	EB=BROOK TROUT
ER=EAST ROSEBUD	GT=GOLDEN TROUT	
RC=ROCK CREEK	RB=RAINBOW TROUT SR=STILLWATER	*=HYBRIDS
WR=WEST ROSEBUD	LT=LAKE TROUT	
SC=SLOUGH CREEK	SS=SELF SUSTAINING POPULATION	ST=STOCKED POPULATION

<u>Additional Data on High Mountain Lakes</u>

In addition to standard gillnet data, fish health, condition factor, parasites, gut contents were noted.

<u>HAI Analysis</u>

The HAI (Health and Abnormality Index) is used to measure the general health of fish populations in the field by assigning point values to abnormalities observed during field necropsies. Since 1995 HAI analysis has been conducted on fish sampled during the high mountain lakes survey. The HAI value for individual fish in each lake are averaged to estimate HAI value for the entire lake population. Populations with higher values are less healthy and visa versa. Populations more than a standard deviation below the mean are extremely healthy those that are more than a standard deviation above the mean are considered unhealthy. For 159 HAIs conducted since 1995, the mean value for the populations in the A-B Wilderness is approximately 40, and the mean standard deviation is 19.88. Therefore, those lakes with an HAI number of 60 would be considered marginally unhealthy, while those populations with a score in the low 20's would be considered very healthy. HAI assessments were conducted on 19 of the 32 lakes sampled in the A-B during the 2002 field season (Table 5), and 2002 HAI values were compared to 1995-200 average HAI values in Table 6. For the 2002 samples, HAI values for fish in six lakes were 29 or less, indicating very good health, while 10 populations showed average health and three showed poor health. No fish were captured in 12 of the remaining lakes, and HAI calculations could not be conducted for Cloverleaf #217. It should be noted that warmer water temperatures in the last five years could be a major contributing factor in the higher HAI values exhibited in populations. Nine of the twelve populations classified as unhealthy in 2002 are 1.5 or less standard deviations away from the "normal" population category.

Table 6. Comparison of 1995-2001 HAI values versus 2002 HAI values.

	# Samples	Mean Value	Mean Standard Deviation	Healthy	Normal populations	Unhealthy
All samples	159	39.3	19.88	24	108	25
2002	19	15.73	25.96	5	2	12

Table 5. HAI Analysis of A-B lakes in 2002.

Lake	Drainage Code	Species	Status	HAI	Health Status
Amphitheater	CF 101	EB	SS	56.7	A
Bill Lake	SR 076	GT*CT*RB	SS	51	A
Clover Leaf 223	CF 223	CT	SS		
Clover Leaf 217	CF 217	CT	SS		
Clover Leaf 216	CF 216	CT	SS	33.8	A
Clover Leaf 215	CF 215	CT	SS		
Cradle Lake	CF 095	RB	SS	80	U
Curl Lake	CF 022	EB	SS	18.8	E
Gallery Lake	CF 096	RB	SS	78.8	U
Heather Lake	SC 006	CT	SS	29	E
Kersey Lake	CF 060	LT/EB/CT	SS/SS/SS	20	E
Lake of the Woods	SR 049	CT	SS	15	E
Line Lake	CF 246	CT	ST		
Marsh Lake	CF 019	CT	ST	73	U
Martes Lake	SR 065	CT	ST	60	A
Moon Lake	RC 015	CT	ST	26	E
Otter Lake	CF 103	EB/GR	SS/??	52.5	A
Ouzel Lake	CF 092	CT/EB	SS	53	E
Peace Lake	SC 005	CT	SS	25	A
Pinchot Lake	SR 091	GT*RB	SS	51	A
Weasel 51	BR 051	CT	SS	50	A
Weasel 48	BR 048	CT	SS	54	A
Weidy	CF 018	CT	ST	52.5	A

E=Excellent Health
A=Average health
U=Unhealthy

Condition Factor

Condition factor (Ctl) is a ratio of weight to length, calculated by the equation (weight*10000)/($length^3$). Higher Ctl values suggest the fish is fatter and potentially healthier. Average Ctl values for the A-B are CT=3.559; RB=5.08, EB=4.055. Of the 32 lakes sampled in 2002, 20 Ctl assessments were conducted. Eleven lakes exhibited high condition factors, 5 showed average condition factors, and 3 showed poor condition factor (Table 7). Ctl could not be calculated for12 lakes because no fish were sampled or fish weights were not obtainable.

Table 7. Additional data on fish from high mountain lakes.

LAKE NAME	CODE	SPECIES	CTL	FPH	HAI	EYE	GILL	PSE	THY	SPL	INTE	KIDNEY	LIVER	FIN	OPER
Ampitheater	CF 101	EB	5.71	0.4	56.7	100	100	100	100	100	90	65	75	90	100
BILL LAKE	SR 076	GT*CT*RB	2.81	13	51	100	100	100	100	80	60	95	100	100	100
CLOVERLEAF 223	CF 223	CT	4.86	0.22	0	100	100	100	100	100	100	100	100	100	100
CLOVERLEAF 217	CF 217	CT		10		100	100	100	100	95	95	100	100	75	100
CLOVERLEAF 216	CF 216	CT	3.34	0.61	33.8	100	100	100	95	90	85	100	100	90	100
CLOVERLEAF 215	CF 215	CT	1.9		45	100	100	100	100	100	100	90	95	100	100
CRADLE LAKE	CF 095	RB	4.31	0.1	80	100	100	100	100	95	90	95	100	95	100
CURL LAKE	CF 022	EB	5.22	1.05	18.8	100	100	100	100	95	95	85	100	100	100
GALLERY LAKE	CF 096	RB	6.15	0.29	78.8	100	100	100	100	80	70	80	95	80	100
HEATHER LAKE	SC 006	CT	1.64	15	29	100	100	100	100	85	80	100	100	100	100
KERSEY lAKE	CF 060	CT	4.11	0.2	20	100	100	95	100	100	100	100	100	100	100
LAKE OF THE WOODS	SR 049	CT	2.59	10	15	100	100	100	100	100	80	100	100	80	95
LINE LAKE	CF 246	CT		0.08											
MARSH LAKE	CF 019	CT	3.28	0.86	73	100	100	85	95	95	80	60	100	70	100
MARTES	SR 065	CT	4.43	0.08	60	100	100	100	100	100	90	100	100	100	100
MOON LAKE	RC 051	CT	3.85	1.38	26	95	100	100	100	95	85	100	100	80	100
OTTER LAKE	CF 103	EB	7.55	2.7	52.5	100	100	100	100	90	60	70	100	100	100
OUZEL	CF 092	EB	4.89	13	53	100	100	100	100	100	50	80	100	100	100
PEACE LAKE	SC 005	CT	3.98	16	25	100	100	100	100	85	75	100	100	100	100
PINCHOT	SR 091	GT*RB	2.11	5	51	100	100	100	95	80	85	80	100	100	100
WEASEL LAKE 51	BR 051	CT	3.47	7.2	50	100	100	100	100	95	80	100	80	85	100
WEASEL LAKE 48	BR 048	CT	4.58	10	54	100	100	100	100	95	55	100	85	100	100
WEIDY		CT	4.33	0.18	52.5	100	100	100	100	100	90	90	95	100	100

KEY

CODE= CODE # IN PAT MARCUSON'S BOOK FISHING THE BEARTOOTHS
RB=RAINBOW TROUT CT=CUTTHROAT EB=EASTERN BROOK TROUT
CTL=CONDITION FACTOR FPH=FISH PER HOUR
HAI= HEALTH ASSESMENT INDEX (HIGHER # SHOWS POORER HEALTH)
NUMBERS ARE GIVEN AS % NORMAL
EYE = EYE ABNORMALITIES GILL = PARASITES OR DISEASE
PSE = PSEUDOBRANCHT SPL = SPLEEN INTE = TESTINE
KID = KIDNEY OPER = OPERCULUM

Catch Per Unit Effort

Catch per unit effort, expressed as fish-per-gill net-hour (FPH), can provide relative information on the numbers of fish in a lake. A value of 1.00 FPH should provide for normal fishing while numbers above 1.50 provide good fishing, and those lakes below 0.5 have low numbers of fish and provide for tough fishing. Applying this scale to the 2002 sampling, 10 lakes should have excellent fishing, 9 lakes should provide average fishing, and 3 would provide poor fishing (Table 7).

Parasites.

It is very common for fish in the A-B to have parasites associated with internal organs. Many of the fish have intestinal nematodes, *Truttaedacnitis truttae*, (referred to as trematodes in earlier reports). *Diphylobothrium latum* (tapeworm cysts) are also present in the body cavity of many fish. Of the lakes sampled 62% had parasites of one type or the other (Table 7).

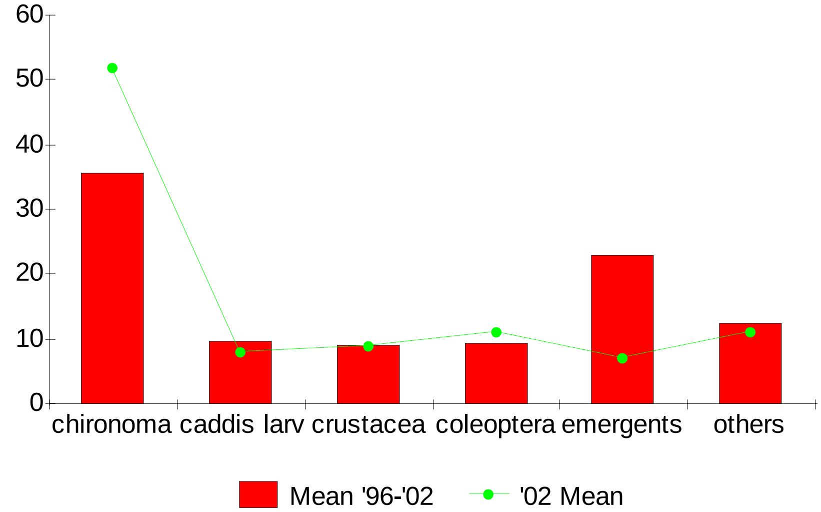
Gut Contents

Emergents and *Chironomas* remain the top food source of fish in the A-B mountain lakes in 2002 (Table 8 and Figure 1). The percentage of terrestrials was lower than in previous samples, possibly due to lower lake levels due to several consecutive years of lower than average snow pack.

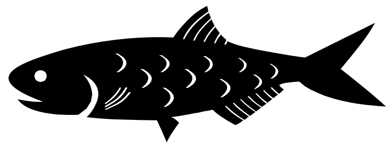
Table 8. Analysis of gut content s from 1996-2002.

	%chironomas	% caddis larvae	% crustaceans	% coleopterans	% emergents	% others
Mean '96-'02	35.7	9.6	9.1	9.2	22.8	12.5
2002	52	8	9	11	7	11

Figure 1. Percent of trout gut contents by taxa.



ABSAROKA-BEARTOOTH WILDERNESS HIGH MOUNTAIN LAKES 2003 SURVEY



Travis Lohrenz

Montana Department of Fish, Wildlife and Parks

Region 5 Fisheries

2004

Abstract

The high mountain lakes survey was started in 1989. The objective of the lakes survey was to gather fisheries data from the approximately 300 lakes in and around the Absaroka-Beartooth Wilderness (A-B) that contain fish. Current sampling scheduling calls for the collection of data from roughly 30 lakes per season, such that over a ten-year span all fish bearing lakes are surveyed. Fisheries data collected is used for fisheries management decisions concerning the high mountain lakes.

Sampling in the lakes is done by over night experimental gillnet sets, hook and line sampling, and a visual survey around the perimeter of the lake including its outlets and inlets. Fish collected are weighed, measured, and a necropsy is preformed for health analysis.

In 2003 the high mountain lakes crew sampled approximately 50 lakes. In addition, eggs were collected from Wounded Man Lake as part of a whirling disease study. Golden trout genetic samples were collected from Sylvan Lake in the East Rosebud drainage, and from Cave Lake in the Crazy Mountains to help identify a possible future Golden Trout egg donor source.

Introduction

Of the 948 lakes in the Absaroka-Beartooth Wilderness (A-B), roughly 300 of the lakes support fisheries. The majority of the fisheries within the wilderness were created as a result fish introduction into barren lakes. However, a few lakes with in the Slough Creek drainage are thought to be host to native Yellowstone cutthroat trout populations.

A number of the fisheries within the A-B are sustained through stocking. Most lakes that are stocked in the A-B do not support sufficient natural reproduction to maintain the fish populations. Three and four year stocking cycles are used for those fisheries that receive the most fishing pressure and other lakes are stocked on six to eight year cycles. It is typical for a fish in the high mountain lakes to age out about seven years of age. Thus, the six-year stocking provides an opportunity for more fish growth under low fish density conditions, while maintaining a constant fishery. An eight-year stocking cycle is used for remote and fairly unproductive lakes. Stocking fish once every eight years in these lakes allows for a fallow year in which food sources can recover. Yellowstone cutthroat trout are the primary fish species currently stocked in the A-B because the geographic location of the A-B falls with in the Yellowstone cutthroat's historic range. Many lakes in the A-B have self-sustaining fish populations. In some cases these lakes will tend to over populate and fish will exhibit slower growth rates as result of over crowding. This is very evident in many of the lakes that have populations of brook trout, as brook trout have less rigid spawning requirements than other fish species in the A-B leading to overpopulation and stunted growth rates.

Methods

<u>Materials</u>

Gill net forms	Scale envelops	Thermometer
Ruler	Lake data sheets	Tar cord Scale
HAI data sheets	25' experimental gillnets	GPS Pencils
Knife	Fishing gear	

Lakes to be sampled are designated and ranked in order of priority during spring meetings. Lake priority is determine by its stocking cycle (if it is slated to be restocked soon), amount of fishing pressure the lake receives, whether the population is self-sustaining or stocked, and the elapsed time since last sampled. The 4-person survey crew hiking to and sampling lakes usually works a 4-day workweek. The teams determine their own access points, and samples lakes with a priority 1 listing first.

Gill netting, angling and visual observations are used to as methods of collecting data at each lake. Netting and angling data are used to determine the fish species present, population status (i.e., population size and age structure and determine if there is natural reproduction occurring) and the fishery potential for each lake. Data collected at each lake is then used make management recommendations for the particular water. Gill nets are set by first choosing the location. Outlet bays are the first choice of net location, followed by inlet bays, and down wind bays. Nets are set by pulling them across a bay using tar cord and suspending the net in the bay with the same cord, which is tied off to a nearby tree or rock to prevent the net from drifting. Nets are generally left overnight and pulled the following morning. Typically a day set is not used, however if a sample size of eight fish or more is obtained a day set may be sufficient. Fish are removed from the net, weighed, measured, and a scale sample taken for age purposes. Scale samples are taken from a maximum number of 20 fish per lake. Scale samples are not taken from brook trout, as scales are too small and annuli to close to read. Several fish are necropsied, checking for parasites and physiological abnormalities. A Health and Abnormality Index (HAI) is performed using methods modified from those outlined by Adams et al. (1993). Gut contents are analyzed for fish diet information, and all data are recorded on appropriate forms.

The shoreline is walked when possible, presence or absence of fry, amphibians, and types of food organisms are noted. The outlet and inlet substrate is assessed for spawning potential and the availability of camping spots and fuel is noted.

Lakes surveyed in 2003

There were 50 lakes sampled in the A-B, and one in the Crazy Mountain Range during the 2003 season (Table 1). Most lakes sampled held only one species of salmonid, however a small number of lakes contained 2 or more salmonids and some lakes contained hybrid populations. Hybridization in the A-B is most common for spring spawning salmonids such as the cutthroat, rainbow and golden trout. The short spawning season and the similarity between these species sometimes result in crossbreeding. The progeny of these crosses are viable and capable of reproduction. The presence of hybrid fish in these lakes is generally the result of stocking one species over another or the migration of species between lakes. The most common cross that occurs in the A-B is between Yellowstone cutthroat and rainbow trout, however there are lakes in which Yellowstone cutthroat, rainbow trout, and golden trout genes are all present with in the fish population. Figure 1 shows the number of lakes sampled by drainage and table 2 shows the percent of lakes by species.

Table 1. Lakes sampled in the Absaroka-Beartooth and Crazy mountain ranges during 2003.

Lake	Code*	Species**	Status***	Date Sampled	Comments
Albino	CF245	CT	ST	7/16/2003	
Lower Aero	CF29	EB/CT	SS/ST	8/5/2003	
Upper Aero	CF/31	CT	ST	8/5/2003	
Bob	CF12	EB	SS	7/19/2003	
Brent	ER	CT		7/29/2003	
Broadwater	CF23	EB/CT	SS/??	8/19/2003	
Cave	SG	GT	SS	7/4/2003	One 4-h day gill net set in lake, no fish, many spawning fish captured in outlet stream for egg take
Chickadee	BR15	CT	SS	7/3/2003	
Crater	WR	RB	ST	9/27/03	Last stocked in 19XX. No inlet or outlet so no natural reproduction. Only lake chubs present in high numbers.
Crow	ER1	EB	SS	7/22/2003	
Curl	CF23	EB/CT	SS/??	8/19/2003	
Diaphanous	SW73	RB	SS	7/2/2003	Five days of fishing two gillnets yielded no fish/ fish have aged out.
Fossil	ER25	CT	ST	8/12/2003	Fry were observed probably not enough to support population continue to stock
Golden	CF236	CT	ST	7/16/2003	
Goose	CF42	CT	SS	7/20/2003	Netted inlet for genetic and disease sampling for possible donor source. YCT 100% pure and disease free.
Green	CF25	EB	SS	7/18/2003	
Jasper	CF237	CT	ST	7/15/2003	75% of lake covered with ice when sampled; however, fish seemed to have over wintered well and were in good shape.
Jasper	SW	CT	SS	7/11/2003	
Jeff	SW48	EB	SS	7/19/2003	
Lake of the Clouds	CF93	CT	ST	8/12/2003	
Lightning	SW102	GT	SS	7/10/2003	One of the few lakes in the AB wilderness with a pure population of GT consider for future donor source.
Lilly Pad	WR	EB	SS	9/27/03	Small population of brook trout, fish in good condition (3-13 in), many lake chubs present
Little Scat	ER15	GT	??	7/30/2003	No fish exist in this lake; lake is maybe four feet deep at the deepest point do not restock.
Little Washtub	CF51	GR	ST	8/6/2003	
Lower Arch	ER41	CT	SS	7/29/2003	
Martin Lake	ER13	GT	??	7/29/2003	Overnight net set yielded no fish; this lake is deep and contains excellent habitat. Restock with Goldens.
Martin Lake	CF211	EB	SS	7/16/2003	Brook trout are all over this lake; The fish are stunted do to over crowding.
Mermaid	CF91	CT	ST	8/12/2003	One 18" fish was caught in an over night set; Restock.
Mirror	BR16	RB	SS	7/3/2003	Fish observed spawning in outlet; At least three age classes observed.
Mutt	SW47	EB	`SS	8/18/2003	
North Picket Pin	SW105	CT	ST	8/14/2003	
Owl	BR71	RB	SS	7/4/2003	Several fish observed on redds in the inlet.
Ovis	CF11	EB/CT	SS/ST	7/19/2003	
Picasso	CF84	GT	??	8/12/2003	No fish were netted in an over night set.
Pablo	CF83	GT	SS	8/12/2003	
Pipit	SW70	RB	SS	7/2/2003	Fish spawning in outlet, several age classes of fish observed.

Table 1. (Cont.).

Lake	Code*	Species**	Status***	Date Sampled	Comments
Production	CF44	EB	SS	8/5/2003	Fish are stunted; Few fish if any would be able to make to recruitment as the outlet goes under ground in some areas due to the present drought.
Recruitment	CF45	EB	SS	8/5/2003	This lake is fed by Production; A few large fish may still be in Recruitment.
Renie Lake	CF228	EB	SS	7/15/2003	Several age classes of fish observed
Robin Lake	CF207	RB/EB	?/SS	7/15/2003	Brook trout are abundant; however, no rainbows were sampled.
Round Lake	CF8&9	EB/CT	SS/SS	7/19/2003	
Sadderbalm	SW98	GR	ST	7/22/2003	Sadderbalm lake is fishless
Scat	ER14	GT	??	7/30/2003	Lake appears to be fishless, excellent habitat spawning potential, and forage. Restock.
South Picket Pin	SW104	CT	ST	8/14/2003	
Sylvan	ER2	GT	SS	7/22/2003	Several age classes of fish observed; Genetic samples taken Sylvan may be used as a donor source.
Tiel	CF232	EB	SS	7/15/2003	Fish are stunted
Turglese	ER49	CT	SS	7/29/2003	
Trail	CF208	CT	ST	7/15/2003	Fish are small and thin
Windy	CF85	EB	SS	8/12/2003	No Changes
Wounded Man	SW	RB	SS	7/4/2003	Rainbow Gametes taken for whirling disease research, several age classes of fish observed.

* BR=BOULDER RIVER
ER=EAST ROSEBUD
RC=ROCK CREEK
SR=STILLWATER
WR=WEST ROSEBUD
CF=CLARKS FORK

** CT=CUTTHROAT
EB=BROOK TROUT
GT=GOLDEN TROUT
RB=RAINBOW TROUT

*** SS=SELF SUSTAINING POPULATION
ST=STOCKED POPULATION

Figure 1. The number of lakes sampled in 2003 by the species they contained.

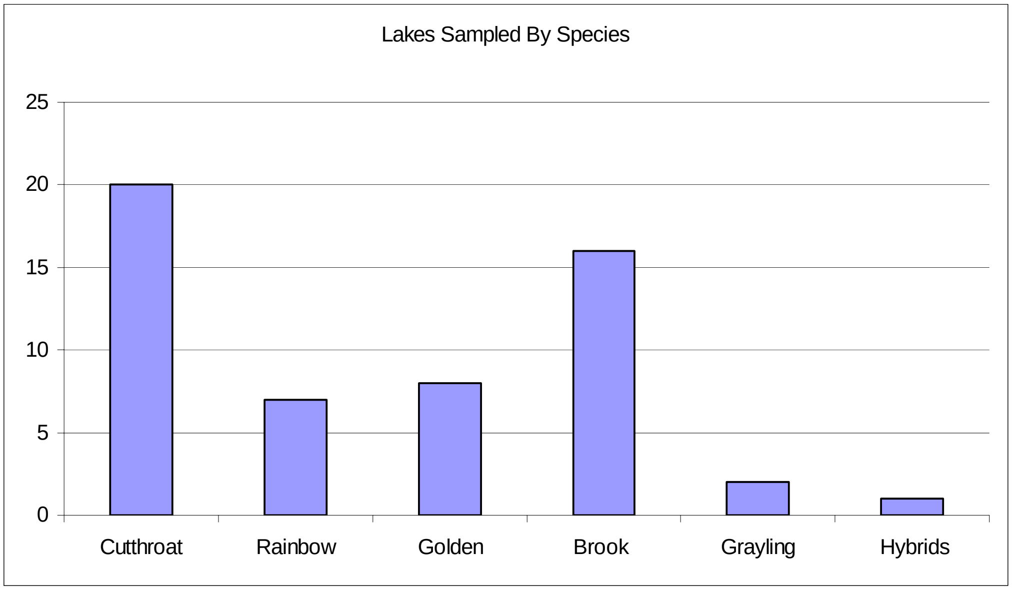


Table 2. Number of lakes sampled in 2003 by major drainage.

Drainage	Number of Lakes Sampled
Clarks Fork	25
East Rosebud	9
West Rosebud	2
Stillwater	10
Boulder	3
Sweet Grass	1
Total	50

Results

<u>Lakes with no management or status change</u>

Twenty-nine of the 50 lakes sampled in 2003 contain self-sustaining populations; the other 21 lakes contain populations sustained through stocking or some combination of natural reproduction and stocking. Forty-four of the 50 lakes sampled in 2003 had no management or status changes. Eight lakes of the 50 sampled require status and/ or management changes based upon the data collected (Table 3).

Table 3. Lakes sampled during 2003 with management and/or status changes

Lake	Code	Fish Species	Status	Date Sampled	Management Recommendation
Crater	SW	RB	ST	9/27/03	Many lake chubs present, no trout. Restock rainbows
Diaphanous	SW73	RB	SS	7/2/2003	Five days of fishing two gill nets yielded no fish. Fish have aged out.
Little Scat	ER15	GT	??	7/30/2003	No fish exist in this lake; lake is maybe four feet deep at the deepest point do not restock.
Martin Lake	ER	GT	??	7/29/2003	Overnight net set yielded no fish; this lake is deep and contains excellent habitat. Restock with Goldens.
Picasso	CF	GT	??	8/12/2003	No fish were netted in an over night set.
Robin Lake	CF207	RB/EB	??/SS	7/15/2003	Brook trout are abundant; however, no rainbows were sampled.
Sadderbalm	SW	CT		7/22/2003	Sadderbalm lake is fishless
Cave Lake	CR18	GT	SS	7/4/2003	Lake may contain golden/rainbow hybrids instead of pure goldens. Genetic samples collected for analysis

<u>Additional Data on High Mountain Lakes</u>

<u>HAI Analysis</u>

Fish Health. The HAI (Adams et al. 1993) assigns points for anatomical and physiological abnormalities observed during field necropsies. Since 1995 HAI analysis has been conducted on fish sampled during the high mountain lakes survey. . The numbers for the individual fish are averaged for the population to give an idea of the health of the fish population in each lake. The mean HAI value for the populations in the A-B Wilderness is41, and the mean standard deviation is19, calculated from 174 HAI‘s conducted since 1995. Populations more than a standard deviation below the mean are extremely healthy and those that are more than a standard deviation above the mean are unhealthy. For example, those lakes with an HAI number of 60 would be considered marginally unhealthy, while those populations with a score in the low 20’s would be considered very healthy. Of the 50 lakes sampled in the A-B during the 2003 field season, 23 HAI assessments were conducted. Four of the populations had very good health with HAI numbers in the 20's or below, 19-showed average health, and zero showed unhealthy populations with high HAI numbers. No fish were captured in 11 of the lakes, and HAI calculations were not conducted for the remaining 17 lakes because crew sampling was not familiar with HAI procedure, or because of time constraints.

Numbers of samples in each category are in table 4. HAI samples for the year 2003 are in table 5. It should be noted that warmer water temperatures in the last five years could be a major contributing factor in the lower HAI values exhibited in populations.

Table 4. Overall HAI Values for all samples taken since 1995 compared to 2003 samples. Numbers in parentheses are percent of total.

	# of samples	Mean HAI	Mean Standard Deviation	# of Healthy Populations	# of Unhealthy Populations	# of Normal Populations
1995-2003	183	33.1	19.93	28 (15)	25 (14)	119 (65)
2003	24	27.08	19.98	4 (16)	0 (0)	11 (45)

Table 5. HAI analysis of A-B lakes in 2003.

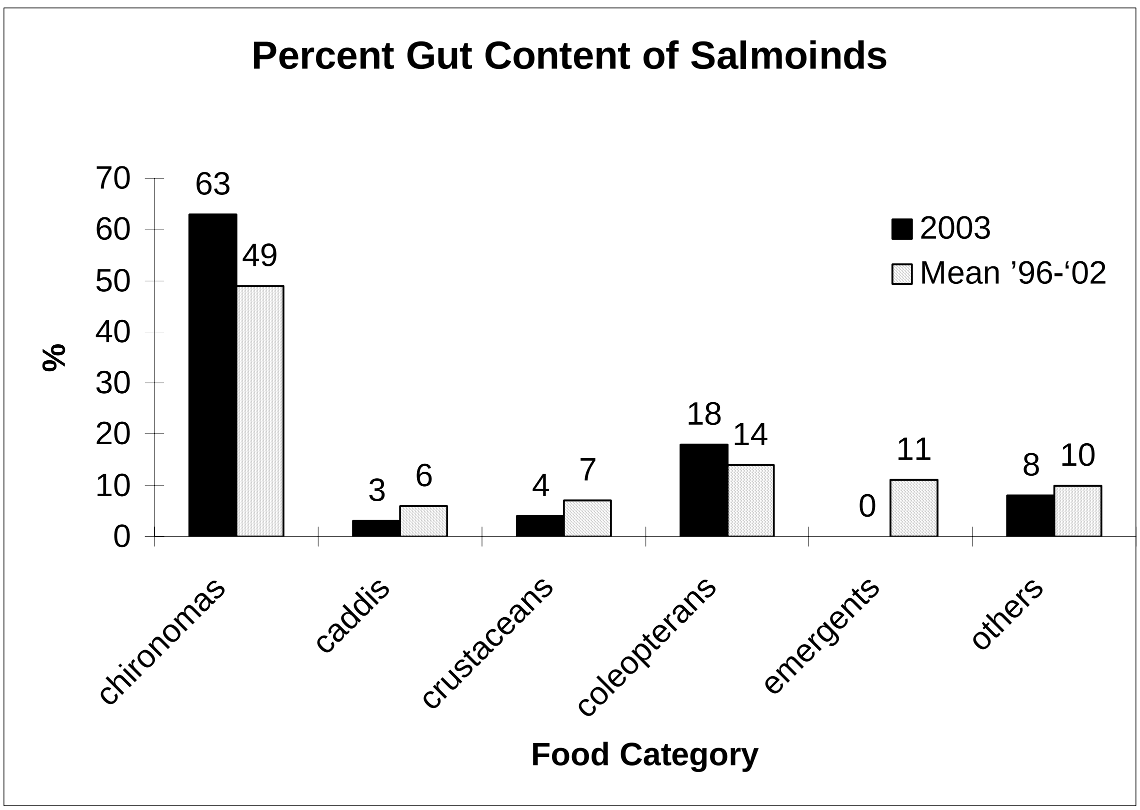
Lake	Code	Fish Species	Status	Average HAI	Health*
Golden	CF236	CT	ST	51	A
Jasper	CF237	CT	ST	16	E
Lake of the Clouds	CF93	CT	SS	26	A
Martin	CF211	EB	SS	32	A
Mirror	BR16	RB	SS	11	E
Owl	BR71	RB	SS	34	A
Pipit	SW70	CT*RB	SS	22	A
Production	CF44	EB	SS	37	A
Renie	CF228	EB	SS	8	E
Robin	CF207	RB/EB	??/SS	43	A
Sylvan	ER2	GT	SS	43	A
Tiel	CF232	EB	SS	35	A
Trail	CF208	CT	ST	29	E
Turglese	ER49	CT	SS	40	A
Wounded Man	SW72	RB	SS	37	A

* A=Average health
U=Unhealthy
E=Excellent Health

Parasites. It is very common for fish in the A-B to have parasites associated with internal organs. Many of the fish have intestinal nematodes, *Truttaedacnitis truttae,* (referred to as trematodes in earlier reports). *Diphylobothrium latum* (tapeworm cysts) are also present in the body cavity of many fish. Of the lakes sampled all fish had parasites of one type or the other (Table 6).

Gut Contents. Chironomas in 2003 still remained the top food source of fish in the A-B mountain lakes Figure (4). The percentage of terrestrials was down (where is this data, are terrestrials lumped in the other category, can you tell a terrestrial coleoptera from an aquatic?) this is believed to be the result of lower lake levels due to lower than average snow pack. Also the percent of caddis and emergents found has declined. It is possible that the lower lake levels and shallow littoral habitats normally associated with caddis and several types of emergents were left high and dry. Mollusks comprised 4% of the 2003 gut contents composition (is this something you haven't seen in past years? If so, state it).

Figure 4. Average gut contents by food category collected in 2003 and mean values for 1996-2002.



Condition Factor. Condition factor (Ctl) is a ratio of weight to length, calculated by the equation (weight*10000)/(length3). The higher the number the better condition of the fish. Average Ctl values for the A-B are: CT=3.559, RB = ?, and EB-4.055. Of the 32 lakes sampled in 2003, 21 Ctl assessments were conducted. Five lakes exhibited high condition factors, 12 showed average condition factors, and 7-showed poor condition factor (which ones were these? Table?). Ctl was not calculated on 12 lakes because no fish were sampled or lengths were not obtained.

Table 6. HAI results from fish colleted during 2003.

Lake	Code	Species	CTL	FPH	HAI	EYE	GILL	PSE	THY	SPL	INTE	KID	LIVER	FIN	OPER
Albino	CF245	CT	3.67	4	45	100	100	95	100	90	65	100	100	100	100
Brent	ER	CT	5.67	0.25	24	100	100	100	100	100	70	100	100	100	100
Chickadee	BR15	CT	2.93	5	18	100	100	100	100	100	75	100	100	100	100
Fossil	ER25	CT	3.14	2.67	36	100	100	100	100	100	60	100	100	95	100
Froze to Death	ER48	CT	5.39	2.67	40	100	100	100	100	95	60	100	95	100	100
Golden	CF236	CT	3.67	2.67	36	100	100	95	85	100	65	95	100	100	100
Jasper	CF237	CT	3.24	1.78	16	100	100	100	100	100	75	100	100	95	95
Lake of the Clouds	CF93	CT	3.07	0.42	26	95	100	100	100	100	70	95	100	100	100
Lower Arch	ER41	CT	3.25	6	38	100	100	100	100	100	75	100	100	100	100
Martin Lake	CF211	EB	4.8	8	32	100	100	100	100	100	65	95	100	100	100
Mirror	BR16	RB	2.87	5.33	11	100	100	100	100	100	95	100	100	100	100
Owl	BR71	RB	2.48	0.79	34	100	100	100	100	95	60	95	100	100	100
Pipit	SW70	RB	2.59	0.63	22	100	100	100	100	100	85	95	100	100	100
Production	CF44	EB	3.84	17	37	100	100	95	100	100	65	95	100	100	100
Renie Lake	CF228	EB	2.29	1.3	8	100	100	100	100	100	90	100	100	100	100
Robin Lake	CF207	RB/EB	4.64	2	43	100	100	100	100	100	60	95	100	100	100
Sylvan	ER2	GT	2.64	1.18	43	100	100	100	100	100	80	90	95	100	100
Tiel	CF232	EB	7.62	8	35	100	100	100	100	100	60	100	100	100	100
Turglese	ER49	CT	3.33	4	40	100	100	100	100	90	60	95	100	100	100
Trail	CF208	CT	3.96	0.87	29	100	100	100	100	95	80	90	100	100	95
Windy	CF85	EB	3.54	8											
Wounded Man	SW	RB	1.66	4	37	100	100	100	95	100	75	90	100	100	100

KEY:

CODE= CODE # IN PAT MARCUSON'S BOOK FISHING THE BEARTOOTHS
RB=RAINBOW TROUT
CT=CUTTHROAT
EB=EASTERN BROOK TROUT
CTL=CONDITION FACTOR
FPH=FISH PER HOUR
HAI= HEALTH ASSESMENT INDEX (HIGHER # SHOWS POORER HEALTH) NUMBERS ARE GIVEN AS % NORMAL
EYE = EYE ABNORMALITIES
GILL = PARASITES OR DISEASE
PSE = PSEUDOBRANCHT

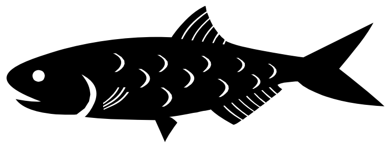
SPL = SPLEEN
INTE = TESTINE
KID = KIDNEY
OPER = OPERCULUM

Catch per unit effort. Catch per unit effort or fish per hour (FPH) can provide relative information on the numbers of fish in a given lake. A value of 1.00 FPH should provide for normal fishing while numbers above 1.50 provide good fishing, and those lakes below 0.5 have low numbers of fish and provide for tough fishing. Of the lakes sampled this year 18 should have excellent fishing, 2 lakes should provide average fishing, and 4 would provide poor fishing (which ones?).

Discussion

The 2003 high mountain lakes survey results has raised many questions with regard to A-B fish populations. 2003 marked the sixth consecutive year of drought conditions in the A-B. A comparison of data collected from 1996 to the present reveals some interesting trends in overall fish health, food availability, lake production, and recruitment back into the population. First, overall fish health seems to have gone up during the drought cycle. This may be attributed to a longer than normal growing season and increased lake productivity as a result of increased water temperature. However, in the past three years of the survey a decline in caddis, emergents, and terrestrial consumption by fish has been observed. It is hypothesized that the increased temperatures and a resulting lack of snow pack has lowered lake levels and left habitat normally inhabited by these invertebrates exposed and dry. Similarly, It has been observed that inlets and outlets used for spawning at several lakes have been reduced to a trickle or are completely dried up by mid August. Because these inlet and outlet streams are used by most fish species as spawning habitat and the late spawning time of spring spawning species (i.e., July) the eggs laid in these areas may not hatch and emerge from the gravel before the water is gone. Diaphanous Lake in the Stillwater drainage appears to be a prime example of this loss of recruitment from dry inlet and outlet streams. Diaphanous lake was host to a self-sustaining population of DeSmet rainbow trout. Over the past six years angler reports stated that larger fish were being caught, but the frequency in which fish were being captured had greatly declined. Diaphanous lake was sampled in 2003 by the high mountain lakes crew and was found to be fishless. Observation of the inlet and outlet showed that the majority of spawning gravels that would be used in a normal water year were exposed. Continued drought in the A-B could have substantial impacts on other self-sustaining populations of fish. It will be important to monitor the age class structure in self-sustaining lakes in the coming years for evidence of year class failures. This reduced recruitment of juvenile fish into the lakes could result in more lakes becoming barren and the need to restock.

ABSAROKA-BEARTOOTH WILDERNESS HIGH MOUNTAIN LAKES 2004 SURVEY



Earl Radonski and Jim Olsen

Montana Department of Fish, Wildlife and Parks

Region 5 Fisheries

2004

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In 2004 the high mountain lakes crew sampled 35 lakes. In addition, whole fish were collected from Sylvan Lake in the East Rosebud drainage as part of a study to help identify a possible future golden trout egg source.

Introduction

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Methods

Materials

Gill net forms	Scale envelops	Thermometer
Ruler	Lake data sheets	Tar cord
Scale	HAI data sheets	125' experimental gillnets
GPS	Pencils	
Knife	Fishing gear	

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The shoreline is walked when possible, presence or absence of fry, amphibians, and types of food organisms are noted. The outlet and inlet substrate is assessed for spawning potential., and the availability of camping spots and fuel is noted.

Lakes surveyed in 2004

There were 35 lakes sampled in the A-B, during the 2004 season (Table 1). Most lakes sampled held only one species of salmonid, however a small number of lakes contained two species. All of the species collected were pure stain, however the survey crew has sampled lakes in past years that hold hybrid salmonids   Hybridization in the A-B is most common for spring spawning salmonids such as the cutthroat, rainbow and golden trout. The short spawning season and the similarity between these species sometimes result in crossbreeding. The progeny of these crosses are viable and capable of reproduction. The presence of hybrid fish in these lakes is generally the result of stocking one species over another or the migration of species between lakes. The most common cross that occurs in the A-B is between Yellowstone cutthroat and rainbow trout, however there are lakes in which Yellowstone cutthroat, rainbow trout, and golden trout genes are all present with in the fish population. The number of lakes sampled by species is given in figure 1 and the number of lakes sampled by drainage is given in table 2.

Figure 1. The number of lakes sampled in 2003 by the species they contained.

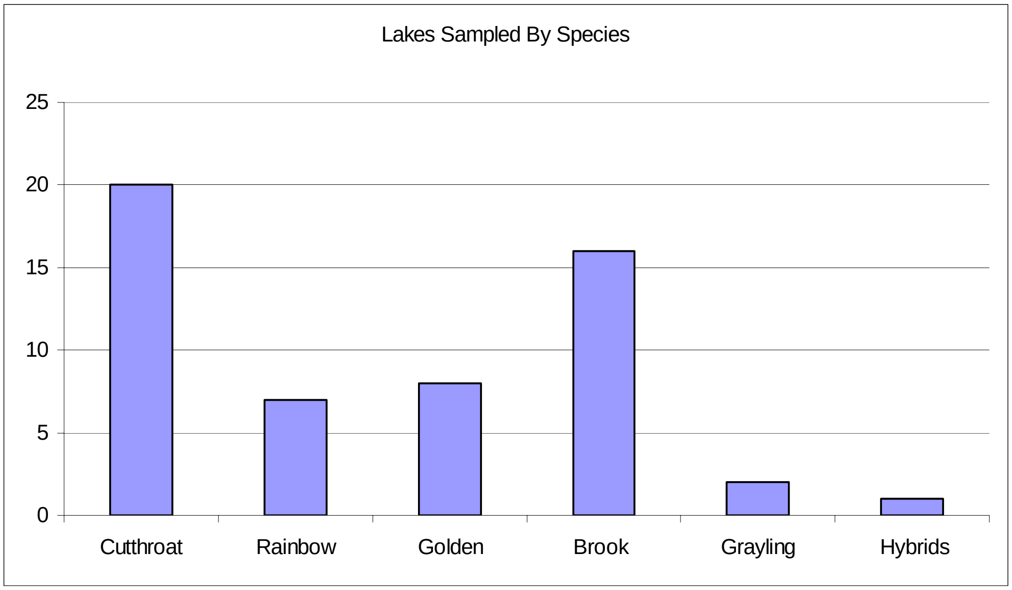

Table 1. Lakes sampled in the Absaroka-Beartooth mountain range during 2004.

Lake	Code*	Species **	Status***	Date Sampled	Comments
Lady of the Lake	CF6	EB	SS	7/7/2004	Training session for interns.
Curl	CF22	EB/CT	SS/??	7/8/2004	All fish were EB, however CT have been stocked.
Broadwater	CF23	EB/CT	SS/??	7/8/2004	All fish were EB, however CT have been stocked.
Hairpin	RC18	CT	ST	7/14/2004	
Smethurst	RC26	CT	SS	7/13/2004	Very shallow lake, spawning is best at inlet, very few fish, angled for survey.
Rydberg	RC28	CT	SS	7/13/2004	
Daly	RC27	EB	SS	7/13/2004	
Unnamed .25mi. SW of Daly	RC	CT/EB	SS	7/13/2004	Spawning best at inlet.
Cresent	RC24	EB	SS	7/14/2004	
Snowbank	RC19	EB	SS	7/14/2004	
Sliderock	RC30	EB	SS	7/14/2004	Great fishing, healthy population.
Horseshoe	BR11	CT	SS	7/20/2004	Heavily used, first lake on upside-down trail.
Alpine	WB83	CT	ST	7/20/2004	Very difficult hike, game trails helpful on North side of three creeks.
Fish	BR25	CT	SS	7/20/2004	
Chrome	SW1	GR/??	ST	7/21/2004	No fish caught or observed.
West Boulder	BR75	CT	ST	7/27/2004	Healthy population.
Kaufman	WB76	CT	SS	7/15/2003	Tough hike, fish spawning in inlet.
Icicle	WB	RB	SS	7/28/2004	Tough hike, no trail, large boulder fields beautiful lake, healthy population.
Second Creek	WB	??	??	7/28/2004	No fish caught or observed.
Weeluna	WR30	CT	SS	8/3/2004	Healthy population.
Nemidji	WR29	CT	ST	8/3/2004	Healthy population
Frenco	WR27	CT	SS	8/2/2004	Reproduction is occurring.
Beckworth	WR26	CT	SS	8/2/2004	Reproduction is occurring.
Nugget	WR25	CT	ST	8/2/2004	No reproduction, nice fish.

West Fishtail #40	WR40	GT	SS	8/11/2004	Very few fish observed no fish caught.
West Fishtail #41	WR41	GT/??	ST	8/11/2004	No fish caught or observed.
West Fishtail #41A	WR41A	GT/??	ST	8/11/2004	Very silty bottom, no fish caught or observed.
West Fishtail #43	WR43	GT	SS	8/12/2004	Beautiful area, fish are reproducing in outlet.
Widewater	CF72	RB/EB	SS	8/16/2004	Large lake, fish spawning in outlet.
Lower Aero	CF29	CT/EB	ST/SS	8/18/2004	Healthy population.
Upper Aero	CF31	CT	ST	8/18/2004	Nice healthy fish, spawning in outlet.
Weasel	CF54A	CT	ST	8/25/2004	Healthy population, one age class.
Surprise	CF54	CT	ST/SS	8/25/2004	Many age classes, reproduction is definitely occurring.
Wilderness	SW2	CT	SS	8/31/2004	Fish are plentiful, easily caught, nice size.
Wood	SW3	CT	ST	8/31/2004	Fish are chunky, only one age class.

* BR=BOULDER RIVER
ER=EAST ROSEBUD
RC=ROCK CREEK
SW=STILLWATER
WR=WEST ROSEBUD
CF=CLARKS FORK
WB=WEST BOULDER

** CT=CUTTHROAT
EB=BROOK TROUT
GT=GOLDEN TROUT
RB=RAINBOW TROUT
GR=ARCTIC GRAYLING

*** SS=SELF SUSTAINING POPULATION
ST=STOCKED POPULATION
??=MAY BE FISHLESS

Table 2. Number of lakes sampled in 2004 by major drainage.

	‹es Sampled
	8
	0
	9
	3
	3
	4
	8
Total	35

Results

Lakes with no management or status change

Twenty-two of the 35 lakes sampled in 2004 contain self-sustaining populations; the other 13 lakes contain populations sustained through stocking or some combination of natural reproduction and stocking. Twenty-nine of the 35 lakes sampled in 2004 had no management or status changes. Six lakes of the 35 sampled require status and/ or management changes based upon the data collected (Table 3).

Table 3. Lakes sampled during 2004 with management and/or status changes

Lake	Code	Fish Species	Status	Date Sampled	Management Recommendation
Curl	CF22	EB/CT	SS/ST	7/8/2004	Numerous plants of CT have not taken hold.
Broadwater	CF23	EB/CT	SS/ST	7/8/2004	Numerous plants of CT have not taken hold.
Chrome	SW1	GR	??	7/21/2004	No fish caught, restock GR or try different species.
Second Creek	WB	??	??	7/28/2004	Fish were reported in this lake. We did not catch any or see any. Leave this lake fishless.
West Fishtail #41	WR41	GT	ST	8/11/2004	No fish were caught or seen in this lake. May want to try another plant.
West Fishtail #41A	WR41A	GT	ST	8/11/2004	No fish were caught or seen. There is a lot of glacial silt. Would not recommend stocking again.

Discussion

Drought conditions have continued in south-central Montana during 2004. As noted in previous reports, the drought conditions have been having impacts on both the population dynamics of lakes and diets of fish. West Fish Tail Lake #41 appeared to be fishless, and very few fish were observed in West Fishtail Lake # 40. Both lakes are capable sustaining natural reproduction, but spawning has been limited or not present. These lakes will need to be stocked in 2011, when golden trout eggs are collected again from Sylvan Lake. Other changes in mountain lake management include the addition of Chrome Lake to the stocking plan. This lake is accessible by vehicle by way of the Benbow Road near Dean, Montana. It has been stocked with cutthroat and grayling in the past. Both species should be stocked on an alternating schedule every 3-4 years. This lake will provide anglers the only opportunity to fish for grayling at a lake accessible by 4x4 vehicles and ATV's in the Beartooth Mountains.

During 2003, FWP funded an amphibian survey in the West Boulder Drainage (Maxell 2004). Crews from the University of Montana surveyed nearly all standing-water bodies in this drainage. They also reported observing of fish in Second Creek Lake and Icicle Lake, both previously thought to be fishless. These two lakes were sampled during 2004 as part of the regular sampling. No fish were captured in Second Creek Lake, but a healthy, self-sustaining population of rainbow trout was present in Icicle Lake. The origin of this population is unknown. There are no other lakes in the West Boulder Drainage that are stocked with rainbow trout. There are rainbows present, however, in the West Boulder River and Great Falls Creek Lake (Main Boulder Drainage). It is possible that these fish were errantly stocked into the lake, but there is no record of this taking place. It is unlikely that fish intended for Great Falls Creek Lake were stocked into Icicle Lake because it lies across the mountain divide. It is possible that the fish were illegally introduced, but the hike to the lake is very difficult, and there is no trail from the West Boulder. It appears the fish have been in the lake for some time because multiple age classes were present. There are excellent spawning areas in the inlet and outlet of the lake.

Literature Cited

Maxell, B.A. 2004. Preliminary report on amphibian and aquatic reptile inventories conducted in the West Boulder River area during summer 2003. Report to Region 1 Office of the U.S. Forest Service, and the Montana Department of Fish, Wildlife, and Parks. Montana Cooperative Wildlife Research Unit and Wildlife Biology Program, University of Montana, Missoula, MT. 27 pp.