MONTANA FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

State:	**MONTANA**	**Element 1:**	**FISHERIES MANAGEMENT**
Project No:	**F-78-R-3, 4, 5, 6**	**Job No:**	**3531**
Project Title:	**STATEWIDE FISHERIES MANAGEMENT PROGRAM**	**Job Title:**	**SOUTH CENTRAL MONTANA COLDWATER FISHERIES INVESTIGATIONS**

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 of 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 crappie have been capture during fall or spring sampling since 2001. Annual rainbow 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 their first fall has steadily declined since 2001. Sampling in 2002, 2003 and 2004 suggest that the rainbow trout population is at an all time low. Only 6 rainbow trout numbers in fall 2003 gill nets and only two were captured in 2004, both of which were > than 18 in. While the rainbow trout population is in poor condition, the walleye fishery continues to provide excellent angler opportunity for eating size and trophy-sized fish. The walleye stocking rate was reduced by half 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 have not exceeded 34% of full volume since the 2000 irrigation season, and were 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

as drought conditions became serious on the reservoir. Low water levels concentrated the prey base for the tiger muskies and they appear to have reduced sucker numbers lower than was originally hoped for. 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 were donated by local sporting groups and installed at Laurel Pond and 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 condition of fish was good. 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 fishery appears 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 predated 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, but stocked rainbows 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 musky 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 musky, 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 FWP under the Private Lands Fishing Access program. An agreement could not be made and therefore the reservoir will not currently 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. Average size of 4-year-old rainbow in the pond was 16.3 in. In fall 2003 and spring 2004 over 3500 white suckers were mechanically removed from the reservoir using trap nets. An EA was prepared to chemically treat the reservoir and 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 the Montana State University, the stream feeding the pond was fenced from livestock and a stock watering area was created. These enhancements along with future in-stream work should facilitate natural reproduction of cutthroat trout in the pond 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 the Absaroka-Beartooth Mountains in 2001, 2002 and 2003. The crew sampled lakes in the Boulder, East Rosebud, West Rosebud, Stillwater, 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.

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PROCEDURES

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, 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 to the upper Musselshell River, 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: Eagle Lake and Arlee. In an attempt to determine of one strain survived and grew better than the other a study was initiated in 2001. A combination of tetracycline marks, produced by feeding hatchery fish tetracycline laced food, and adipose clipping were performed to distinguish the two strains after stocking into the reservoir. When fish are fed with tetracycline laced feed for a period of time, the bone growth that occurs during that time will fluoresce under black light. Thus after stocking the two strains can be separated based upon the whether a mark was present or not. In addition, during 2001 31% of the Arlee rainbow trout stocked were adipose clipped before stocking. Whole heads or otoliths were removed from capture trout from 2001 to 2003 to check for the tetracycline mark. The survival of stocked trout was tested using a Chi Squared 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 collect 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 drainage) as part of a study to determine the suitability of cutthroat from Goose Lake being incorporated into the cutthroat brood stock at the Big Timber Hatchery. Eggs were collected from golden trout at Cave Lake in the Crazy Mountains for the 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. Recent improvements to roads and recreational facilities at Cooney have also contributed to increased use. In 2001 use estimates suggest that 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 and severely as the estimates suggest. Because of the drought access to other area reservoirs (Yellowtail and Deadmans Basin), particularly boat access has been limited, while Cooney 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 annual in the spring into the reservoir. Walleye were first introduced in 1984 in an effort to control the over abundant white sucker population. The high density of white suckers led to competition and retarded growth rates with stocked trout. One million fry were stocked for three consecutive years in the reservoir and within 4 years of the initial walleye plant, 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 annually at relatively high densities. Trout plants have increased from an average of 100,000 pre 1989 to 150,000 in the 1990's, which resulted in increased angler harvest of fish. The increase in stocking rate was in part to help amplify the number of fish surviving their first year and to provide for a better rainbow ice fishery. Fish plants have increased to 201,000, 277,000 and 318,000 in 2001, 2002, and 2003 in an effort to increase rainbow numbers. Fall gillnetting, however, indicates that the numbers of trout surviving their first summer in the reservoir has 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 providing 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 express high growth rates. 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.

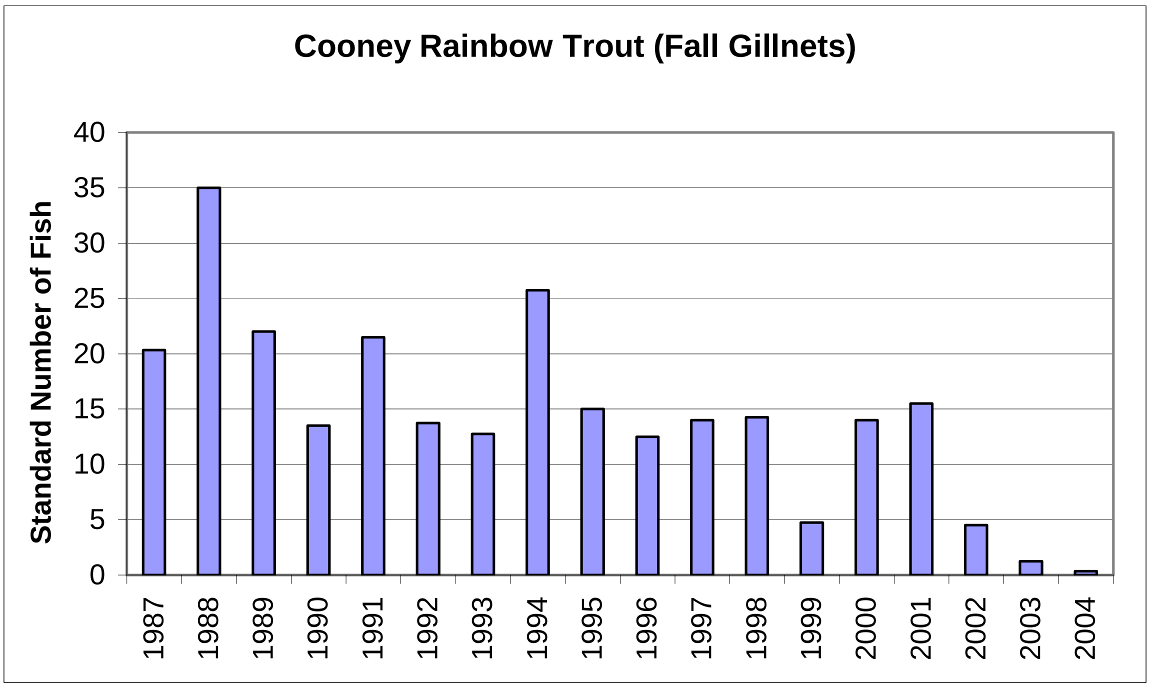


Figure 1. Standard number of fish (#fish captured/# nets set) captured in fall gillnets set in Cooney Reservoir.

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

Year	Number caught	Catch per net	Average length (in)	Average weight (lb)	Number > 14 in	Length Range (in)
			Fall Gillnetting			
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
			Spring Electrofishing			
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 provide 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 (i.e., 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 there after. High mortality of juvenile fish suggests predation from natural predators rather than over-harvest by anglers.

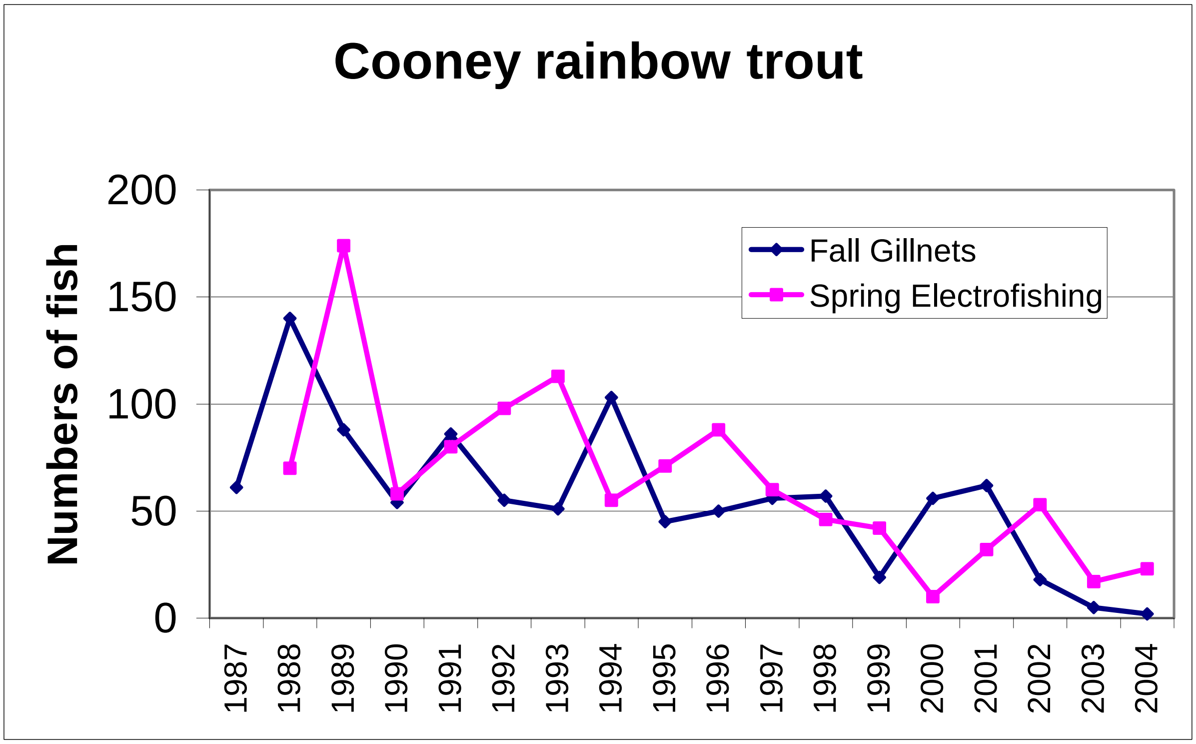


Figure 2. Total numbers of rainbow trout from spring electrofishing and fall gillnetting from Cooney Reservoir.

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 were caught between 4 gillnets ranging in size from 11.3-18.6 in. 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 survival of stocked rainbows was quite low each year.

To determine if there was a strain difference in survival and growth of Eagle Lake and Arlee strain of rainbow trout stocked into Cooney fish were marked using a tetracycline feed and adipose clipped. All Arlee rainbow trout from 2001 to 2003 were fed with tetracycline feed prior to stocking. Fish in 2001 received a single mark and fish stocked in 2002 received a double mark (fed tetracycline feed for a week, then normal feed for a week then a second week of tetracycline feed). In addition 31% of stocked Arlee rainbow were adipose fin clipped in 2001. When fish were captured in the fall using gill nets, otoliths of non-adipose 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 at least 1 year, but this was not the case 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 the thin otoliths of the trout. Unfortunately, relatively few heads were preserved making the sample size too small to determine if there were differences in survival between the strains.

In addition to the tetracycline marks, a second mark was used during 2001 by clipping the adipose fin of 31% of the 199,896 (62,000) stocked Arlee rainbows into the reservoir. 36,860 Eagle Lake rainbows were also planted in the Reservoir during 2001 for a total plant 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 rainbow 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. Because of low sample size and the disproportionate number of Arlee vs. Eagle Lake rainbow trout stocked (i.e., 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		
	Numbers	Length	Weight	Numbers	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)*		

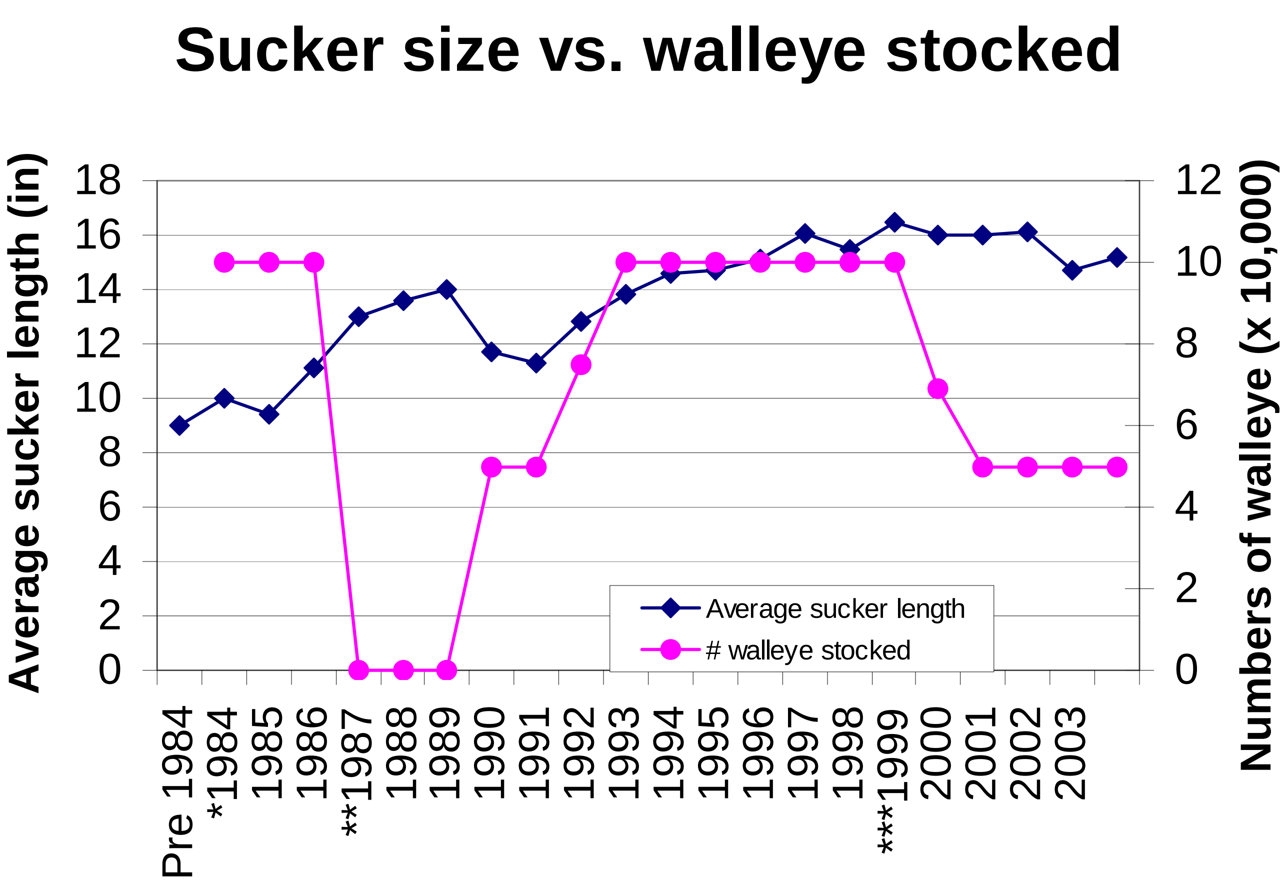
* numbers in parentheses are the p values of the Chi Squared test (numbers of clipped vs. non-clipped) and the t-tests (comparison of length and weight of clipped vs. non clipped fish).

<u>Walleye</u>

Walleye 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 walleye were performing there intended purpose and 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 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 increase sucker size is because of walleye predation on the smaller suckers. Walleye 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 double 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 and the stocking rate of walleye 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 this reductions is sufficient to allow for some 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 (see 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 6.3 4.1 in by October, which is 2.2 in below the minimum size sampled (6.3 in) during the previous four years. These data appear to suggest reduced growth of juvenile walleye during their first year. A recent decline in the crayfish population in Cooney may be responsible for reduced juvenile walleye growth. Previous diet 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 has been only minimal changes in juvenile walleye growth or relative abundance.

Figure 3. White and longnose sucker length and numbers of walleye 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

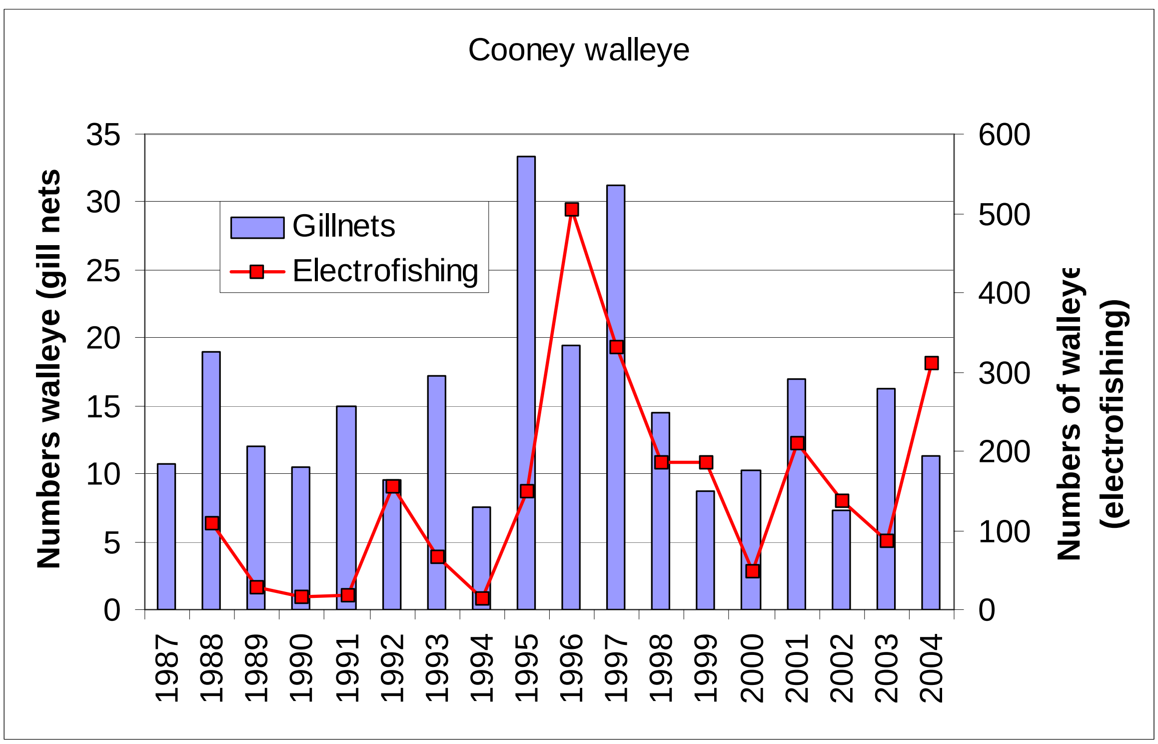


Figure 4. Fall gillnetting and spring electrofishing results for walleye from 1987 to 2004.

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 walleye are moving into shallow areas in into the mouths of the creeks to spawn. These data provide and index of the status of the adult population of fish in the reservoir. 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 tagging 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 from angler returns, the later 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 walleye and 345 fish from 11..2-31.3 in were tagged. Smaller fish were tagged during 2004 to provide some information on angler harvest and growth of smaller fish. To date, 31 tagged walleye 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, release then caught again and kept by another in May. Three fish (26.1, 27.0, 22.8) have been recaptured via electrofishing: one 368, 721, 1080, days after recaptured. These fish grew 1.1, -0.4, and 0.06 in and 0.0, 0.2, 1.4 lbs 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. However, there has been no notable increase in the walleye population or change in the size structure of the population that would suggest increased that predation rates on rainbows should be any different presently 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 have changed and walleye have switched to rainbows as their primary forage, but this theory would need to be verified through diet analysis and modeling to determine the impact of walleye on the rainbow population.

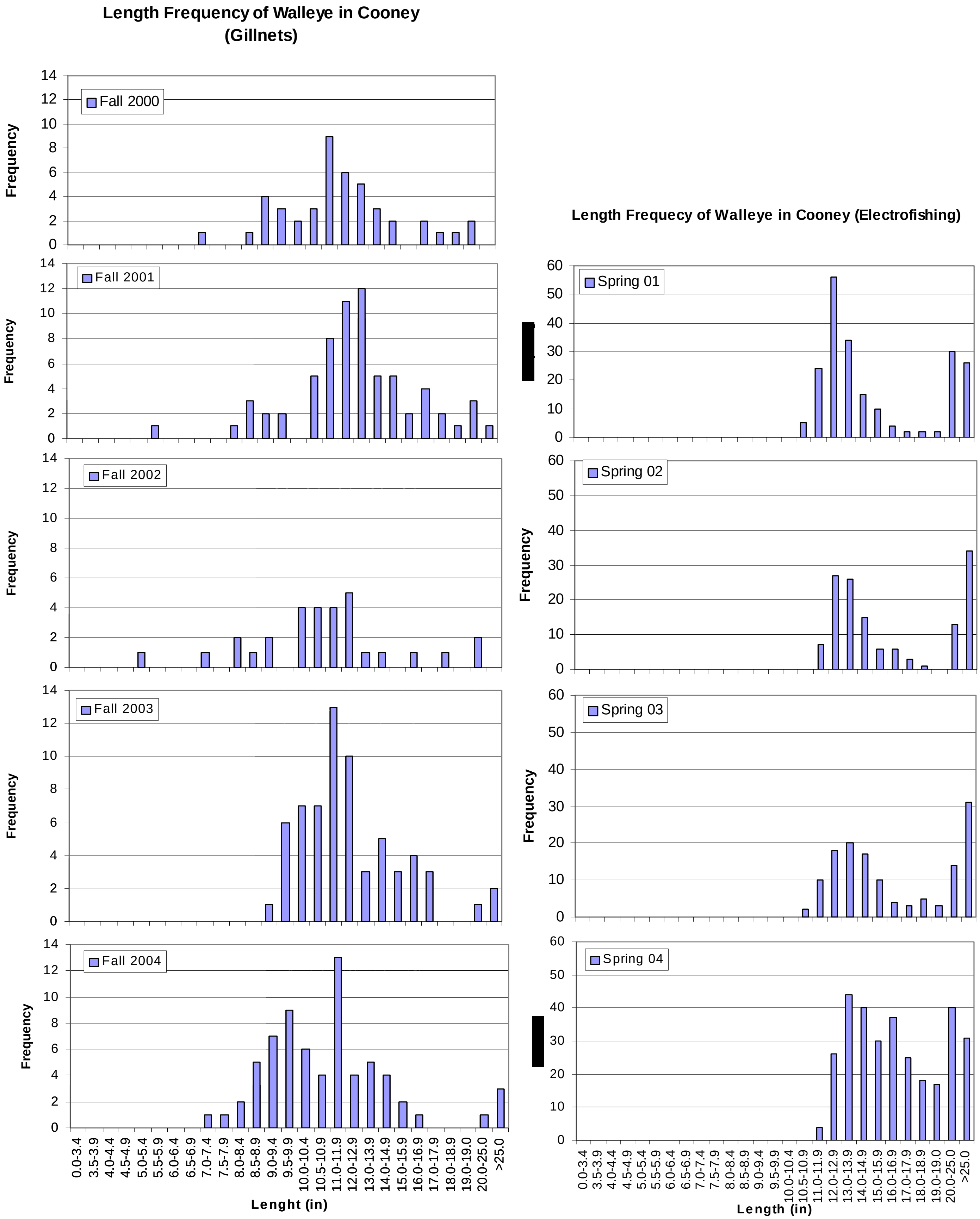


Figure 5. Length Frequency of walleye in Cooney Reservoir 2000-2004

Suckers

The foundation of Cooney Reservoir's productivity continues to be the forage provide 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 walleye were consuming all of the offspring of adult suckers 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, where as 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, and 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 and extended time period, the numbers of adult suckers captured in gill nets appears to be relatively stable (Figure 6). A single trap net was set in the fall of 2003 and 467 white suckers and 15 longnose suckers were captured 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.

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

Year/species	**# in gill net**	**#/gill net**	**#/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

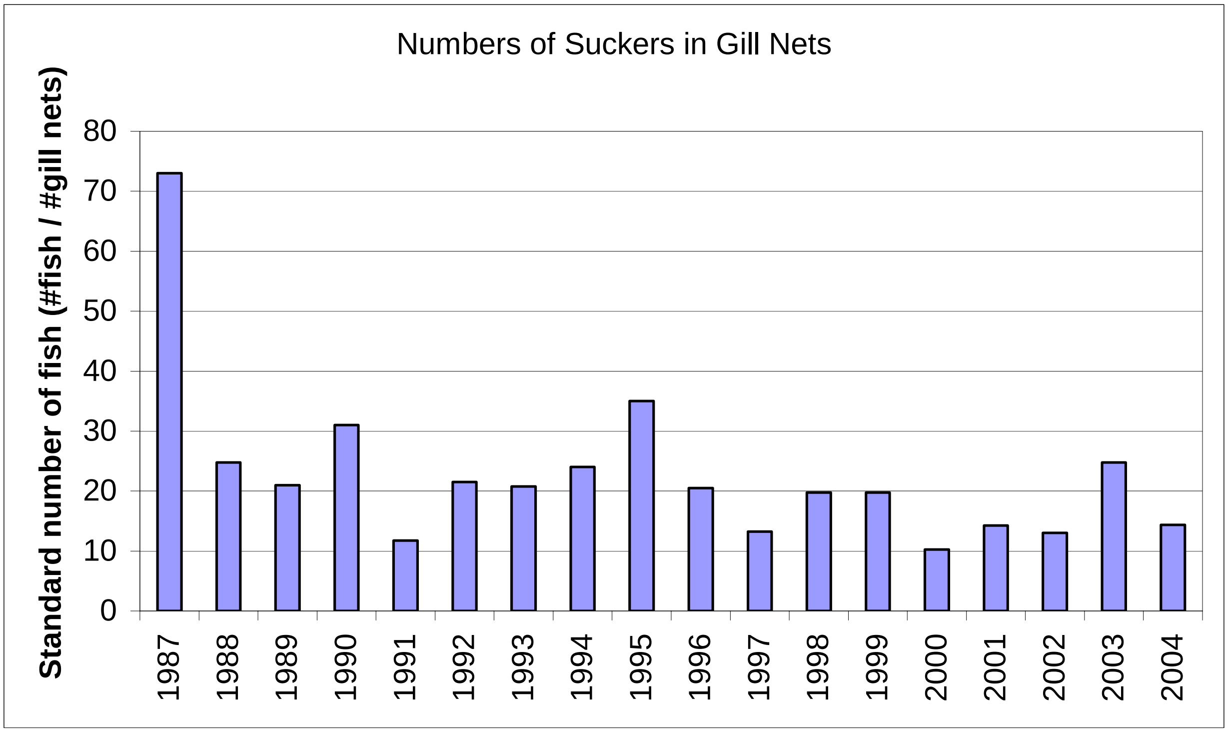


Figure 6. Standard number of white and longnose suckers gillnetted from Cooney Reservoir.

Longnose sucker populations have been slowly increasing each year in Cooney since 1995. This trend continues and 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 likely recently emigrated from the tributary stream. In 2000 average longnose sucker length was 11.0 in and has steadily increased to 15.8 in in 2004. It is unclear why the numbers of longnose suckers are increasing in the reservoir.

Over 1000 white sucker 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 gill-netted in fall 2001 so that these fish could be accurately aged. This action occurred to address the concern that most white sucker in the spawning population are in the same age-group, are very old, and thus may “age-out” of the spawning population. Such an occurrence would remove the foundation of the forage base in Cooney, and would drastically influence the fishery. Upon analysis, age determination from sucker otoliths could not be performed because 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	# caught	# 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

Brown trout, black crappie and 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 from Cooney 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 suckers 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 sampled in Cooney using all sampling methods. In the fall of 2000, 10 crappie were captured in trap nets ranging in size from 2.5-3.2 in. During 2001 14 were captured from 2.4-12.7 in. It is unclear if crappie are no longer present in Cooney Reservoir. Crappies are more susceptible to capture using trap nets in Cooney and the reservoir has not been intensively sampled using trap nets in the areas where crappie have previously been captured.

Brown trout are relatively abundant in Willow and Red Lodge creek 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. However, 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 year has compounded on the previous low water conditions. Deadmans was refilled to about 71% of full 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% of full. After another dry winter, Deadmans only contained 26,680 AF going into the 2001 irrigation season. Deadmans Basin Water Users spent considerable effort working on the outlet structure at Deadmans 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% of full. Slightly more conservative water management in 2003 left about 9,500 AF of water in Deadmans 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 Basin 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 Deadmans is filled during the winter period helped prevent any serious winterkill.

The standard net sets of 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 netting up until the spring of 2004. Spring white sucker catch rates first started to show a significant declining trend 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 white sucker catch rate reaching a record low of only 5.3 white suckers per gill net in the spring of 2004 (Table 6). At the same time the catch rate for white suckers was declining, the average size of the remaining suckers was increasing (Table 6). These data provided strong evidence that tiger muskies were impacting the white sucker population in Deadmans Basin. Another indication that the white sucker population was in trouble 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 in length have been netted in Deadmans Basin. The white sucker population appeared to maintain itself for many years with very limited recruitment of young fish. Three trap nets set in Deadmans in the spring of 2002 caught 449 small white suckers around 2.5 to 3.0 in long for a catch rate of 150 white suckers per net (Table 6). No

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

Species	NumberCaught	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	—

*Fish counted but not worked

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

Species	NumberCaught	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	—	—

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

Species	NumberCaught	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	—	—

* Numbers in brackets were fish counted but not worked.

Species	NumberCaught	Catch Per Net	Avg Length (in)	Avg Weight (lb)	Length Range (in)
			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

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

Species	NumberCaught	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 standardized fall gill net series and trap nets set in Deadmans Basin Reservoir between 2000 and 2004.

Species	NumberCaught	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

trap nets were set in Deadmans in the spring of 2003 due to bad wind conditions, but this strong year class of small white suckers was again evident 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. White sucker catch rates dropped from an average of 10.8 white suckers per gill net in the fall of 2000 down to only 2.2 white suckers per gill 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 in the fall of 2004 back up to 5.8 white suckers 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 in length were captured in all nets (Table 7).

Kokanee salmon have normally been the most common fish species captured in fall gill nets in Deadmans Basin, and this 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 kokanee per net. Kokanee were not stocked in Deadmans in 1999 due to a limited availability of fish. Indications of this missing year class were 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 kokanee numbers began a significant decline. Six gill nets set in the fall of 2003 only captured 14 kokanee for a catch rate of 2.3 kokanee 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 in half to only about 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. The kokanee plant into Deadmans 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 population in Deadmans appeared to be responding favorably to the tiger muskie introduction. Despite low water conditions that hampered access to the lake, angler use at the lake increased during this report period. The local game warden reported an increase in use at Deadmans with many nice stringers of rainbow being taken. Reports from Deadmans' anglers have been very positive during this period.

Rainbow population trends observed in the standardized netting data were quite variable. The average size of rainbow ranged around 11.5 in in spring nets and 11.0 in in fall nets before the tiger muskie stocking program was initiated in Deadmans (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 in Deadmans found that spring gill net 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 rainbow 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, and the average size of the rainbows continued to increase (Table 6). The 2001 fall net sample contained a good mix of age 0 rainbow 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 rainbows 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 2002 fall sample again contained a good mix of age zero through four-year-old rainbow, 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 rainbow age data were available for 2003 or 2004. The 2003 spring 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 rainbow per net (Table 7). Young fish from the spring plant dominated this sample, and helped keep the average size down. However, this sample also contained numerous rainbows over 17 in long 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 rainbows per net for six gill nets (Table 6). Rainbow catch rates in the fall dropped to 12 rainbows 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 tiger muskie plants was to reduce sucker numbers in Deadmans in an effort to improve the rainbow and kokanee fisheries in the lake. Tiger muskies were stocked at relatively low numbers with a goal of reducing white sucker populations in Deadmans by about 50%. The plan was to reduce the white sucker numbers enough to benefit the trout and kokanee while maintaining a reasonable sucker food base for tiger muskie. Ongoing low water conditions in Deadmans started the same year the tiger muskie program was started, and these conditions have changed the whole picture in Deadmans. Reducing the average size of Deadmans to only about 20% of full pool since the tiger muskie plants greatly increased tiger muskie predation on the reservoir's sucker population. Reducing sucker numbers to such low levels has likely increased predation on the stocked trout and kokanee populations in Deadmans.

A total of 19 tiger muskies were netted form Deadmans during this study period (Tables 6 & 7). These fished 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 fish that was netted in the spring of 2004 and weighed 17.5 lbs. Attempts to stock an additional year class of tiger muskie into Deadmans in 2004 was unsuccessful due to a lack of fish.

Normal stocking requests for Deadmans Basin have been 150,000 Arlee rainbow, 50, 000 McConaughy rainbow, and 100,000 Kokanee salmon. Due to low water levels and the limited availability of fish, kokanee plants into Deadmans were reduced in 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 Arlee rainbow. In 2004 Deadmans received approximately 38,000 Eagle Lake rainbows 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 to a large enough size to be captured in gill nets they were well represented in the 2003 fall gill nets and in both spring and fall nets in 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 in the mid-1980s. Attempts to coordinate the Afterbay stocking with the 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 lbs. 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 of these fish were probably from the 2002 plant. The high rainbow 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 a fish kill this winter. Laurel Pond is managed as a put-and-take trout fishery, with a normal stocking rate of 6000 catchable (7-11 inches) trout planted 3 times annually. However, 100 retired rainbow trout broodstock from Ennis National Fish Hatchery, averaging about four pounds, 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 Walleyes Unlimited was installed in Laurel Pond in the fall of 2003.

Two gillnets and a trap net were set in Laurel Pond on 3/22/04 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 were captured in the nets ranging in size from 7.9-11.9 in and 0.12 and 0.6 lbs. 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 species of fish. Also caught in the nets were 8 lake chubs and one goldfish. Summer time observations of the pond suggest that lake chubs are abundant in the pond; 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 gold fish 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 of the lake, making it deeper and it effectively eliminated the daily spikes and drops in stream level 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 a 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, 1 floating and two sinking gill nets were used, in 2003, 2 floating and 2 sinking gillnets were used and during 2004 2 sinking gillnets and 2 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 compared to 2003 and that actual fish population numbers are relatively similar between sampling dates. The brook trout population in the lake appears to be expanding considerably. Prior to 1994, few brook trout were sampled in the lake and in 1995 3 brook trout were sampled along with 82 brown trout (Poore and Frazer 1995). The ratio of browns to brook trout ranged from 63:4 to 11:2 from 1996 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 the brook trout numbers, but all fish in the lake appear to be in excellent condition, with no evidence of food limitation. The increase in brook trout numbers has provided additional angler opportunities in the lake. The average size of brook and brown trout averages 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 eating. 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 3000 6-inch 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 as been attempted, but has resulted in similar survival rates of current stocking practices. Brown trout prey heavily on the rainbow trout. The largest brown capture 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 and 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 2192 fish caught, 1272 are 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 migrate to the lake their survival is low.

Duirng 2004, brown, brook and rainbow trout and mountain whitefish and longnose suckers were analyzed for PCB 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 project.

Table 8. Results of standardized spring floating gill nets from 2001 and 2003 in West Rosebud Lake, where L = length (in) and W = weight (lb).

Species	# caught	Catch/h/net	Avg. L	Avg. W	Range L	Range W
			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
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, where L = length (in) and W = weight (lb).

Species	# caught	Catch/h/net	Avg. L	Avg. W	Range L	Range W
				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

Species	# caught	Catch/h/net	Avg. L	Avg. W	Range L	Range W
			2001			
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
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
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, 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 BB). Mountain whitefish and longnose sucker again appear to serve as forage base for brown trout, base on the paucity of juvenile fish and large average size (Table 8). Emerald Lake is also stocked with 6-inch rainbow trout (1800/year) but few appear to survive to the spring. No rainbows were captured in this May's sampling. Personal observations have found that many of the stocked rainbows emigrate down into West Rosebud Creek below the lake.

Table 10. Results of standardized spring netting (1 floating gill net) in Emerald Lake, 2001**,** where L = length (in) and W = weight (lb).

Species	# caught	Catch/h/net	Avg. L	Avg. W	Range L	Range W
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
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 between 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 fish in the lake and appears to regulate the numbers and species of other fish found in the lake. 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 1990's and Arlee rainbows were stocked stareing in 1996. Although survival of the stocked rainbow trout was also low, their growth was greater than that of the stocked cutthroat. Currently, the lake is stocked with 6,000 catchable size (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 student 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 9) and two sinking gillnets (Table 10). Brown trout was the most abundant species in the nets across years, followed by 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 9 and 10). 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 (# in nets: 1996= 2, 1997=2, 1998= 21, 2002=13, 2003=26). Changes in species abundance and likely influenced by brown trout predation, but may also be influenced by low water levels leading to less exchange of fish from the creek to the lake.

Table 11. Results of standardized spring floating gill nets (2 nets) in East Rosebud Lake, 2002 and 2003, where L = length (in) and W = weight (lb).

Species	# caught	Catch/h/net	Avg. L	Avg. W	Range L	Range W
	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		
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					
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, where L = length (in) and W = weight (lb).

Species	# caught	Catch/h/net	Avg. L	Avg. W	Range L	Range W
	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				
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				
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 5/30/02. Nets were pulled on the morning of 5/31/02 and fished for approximately 21 hours. The same nets were set on 9/24/02 and pulled the following morning, fishing for a total of 20 hours. Catch results are summarized in table 11 and 12.

Table 13. Total catch in four gillnets and two trap nets set in Lower Glaston Reservoir on 5/31/02.

Species	Number	Average length (in)	Average weight (lbs)	Size range (in)	Catch/hour
Tiger musky	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 9/25/02.

Species	Number	Average length (in)	Average weight (lbs)	Size range (in)	Catch/hour
Tiger musky	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	26	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 fish. One of the primary concerns when managing Lower Glaston Reservoir is the status of the white sucker population, because historically this population has attained high densities and impaired the growth of other fish and reduced angling opportunities. The data we collected during spring and fall 2002 suggest 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 is predation by tiger musky, which were stocked in the past and are still present in the reservoir. The low numbers of suckers suggest that the reservoir is currently suitable to stock salmonids (e.g., rainbow and cutthroat trout). With the sucker population currently in check, there should be little competition for food between suckers and stocked trout. Therefore, fish planted into the reservoir should experience relatively fast growth rates.

Catch data from spring and fall 2002 were very similar with two notable exceptions: (1) the absence of tiger musky in the fall nets and, (2) the increase in catch of yellow perch in the fall nets. It is likely that in the spring the musky 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 musky 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 musky may be selectively foraging on suckers, and possibly that the reduced number of suckers has lead 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 and 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, in 1999 5 rainbows were captured ranging in size from 20.8-21.3 in. The cause of reduced growth is competition from the over 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) were captured along with 6 rainbow trout. Two additional trap net sets were performed using two nets in an attempt to reduce the sucker population size. Approximately 700 suckers were removed from the reservoir. Several additional trap nets were set in the spring of 2004 and more than 3500 white suckers were removed from the pond. Past removal efforts have temporarily reduced sucker numbers and enhanced trout growth but it does not appear that mechanical removal of suckers is a viable solution for long-term population control.

Because of the chronic overpopulation by sucker in the reservoir and the desire to manage the pond for native species, an Environmental Assessment was prepared to chemically remove white suckers and rainbow trout from the pond. During the summer of 2004 the pond was lowered approximately 15 ft and on October 6, 2004 rotenone was added to the pond was treated with rotenone 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 downstream in the reservoir in the outlet stream to monitor for the presence of rotenone downstream of 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 in the spring 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 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, the spring creek that feeds Otie Reservoir was fenced off 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 crappie 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 pond. 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 crappie. Of the 29 fish captured, 27 survived transportation to the pond. The success of the stocking has not yet been evaluated, but because of the drought pond levels have been low and it is possible the pond has experienced winterkill.

Absaroka-Beartooth Mountain Lakes

The Absaroka-Beartooth 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 Absaroka-Beartooth Wilderness Area (A-B), 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 of the A-B mountain range. A four-person crew backpacked into 127 alpine lakes the Absaroka-Beartooth Mountains from 2001 to 2004. The crew sampled lakes in the Boulder, East Rosebud, West Rosebud, Stillwater, 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 and others are managed for golden trout, rainbow trout, brook trout and arctic grayling. The data from these surveys is 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. These data are summarized in Appendices 2,3 and 4.

Genetic samples were collected from Mystic and Silver Lakes in the West Rosebud drainage in 2000 and 2001 to assess the contribution of rainbow and Yellowstone cutthroat trout genetics in 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 Beartooth 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 population of fish. 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 into 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, which also contains a rainbow population was sampled instead of Diaphonous. Eggs were collected from Wounded Man and juvenile fish were tested for resistence 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 eggs were collected from over 100 females and over 200 males and sent to the Yellowstone 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 cutthroat 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 performing work 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 the lake in Icicle Lake as rainbow trout. No fish were gillnetted or observed in Second Creek Lake. The rainbow population in Icicle Lake appears health 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 in the Musselshell 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 by the end of the summer irrigation season each year. 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 of stored water that did occur ended by early summer.

A new USGS gauge was installed at the upstream end of our standardized electrofishing section upstream of Selkirk Fishing Access Site in April of 2003 and should provide valuable flow data for this site 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 help 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 down 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 populations 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-mile long 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 compared 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 lbs. 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” long 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 were unsuccessful for a couple of reasons in 2004. The Musselshell 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 one 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 walleye 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 will aid in potential management changes. As part of the creel survey, piscivorous bird counts should be done on the reservoir immediately after stocking to determine if bird predation can partly explain the reduced survival of rainbow trout.

Deadmans Basin Reservoir

Continue to monitor fish populations in Deadmans to evaluate ongoing impacts of the drought. Monitor fish population structures 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 into Deadmans in 2005 to establish another year class of muskies, and to provide predation on the strong year class of small white suckers present in the reservoir.

Afterbay Reservoir

Work closely with BOR as they continue to refine their drawdown schedule for the Afterbay Reservoir. Go back to spring plants of smaller rainbows on years when no drawdown is planned. Work with the hatchery system to try and 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 a minimum of 8 in to maintain the rainbow trout fisheries in the lakes to provide and additional harvestable fish lessen 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

The reservoir should not be actively managed until public access is secured. Although tiger musky have been effective at reducing the sucker population, making the reservoir suitable for salmonid stocking, no management can take place until public access is secured. 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 Reserovir 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 (i.e., 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 Yellowstone cutthroat trout. 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 in two ways: 1.) mechanical removal (intensive gill netting) 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 (i.e., 10 or more) and thus shift 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. The second 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 lake was found to be barren of fish in 2002. Surveys in Great Falls Creek during 2003 suggested that the stream was also barren. Lake should be restocked with Yellowstone cutthroat.

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 Bolder 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 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 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 in to Diaphonous Lake. If no resistance is found, the lake could be restocked with Yellowstone cutthroat.

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 upstream farther 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. Huckelberry, Mutt and Jeff lakes should be chemically treated and restocked with Yellowstone cutthroat trout from Goose Lake. Goose Creek should also be treated to the wilderness boundary and restocked with cutthroat trout. This would protect Goose Lake from the threat of colonization of brook trout and it would restore cutthroat to approximately 4.5 miles of stream.

Musselshell River

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

REFERENCES

FWP 1997. Montana Statewide angling pressure 1997. Montana Fish, Wildlife and Parks, Helena Montana.

FWP 1999. Montana Statewide angling pressure 1999. Montana Fish, Wildlife and Parks, Helena Montana.

FWP 2001. Montana Statewide angling pressure 2001. Montana Fish, Wildlife and Parks, Helena Montana.

Poore, M.D., and K. Frazer. 1995. South-central Montana coldwater fisheries investigations. Montana Department of Fish, Wildlife and Parks Job Progress Report F-78-R-1, Job 3531.

Poore M.D., and K. Frazer 2000. South-central Montana coldwater fisheries investigations. Montana Department of Fish, Wildlife and Parks Job Progress Report F-78-R-3,4,5,6, Job 3531.

Pacific Power and Light. 2002. 2001 Recreational use Study, Mystic Hydroelectric Project.

Stiff, R.K. 2000. Protocols for sampling alpine lakes. Montana Fish, Wildlife and Parks, Billings, Montana.

Venditti, D.A. 1994. Diet overlap and habitat utilization of rainbow trout and juvenile walleye in Cooney Reservoir, Montana. Unpublished Masters Thesis. Montana State University.

Waters Referred To

Water	Water Code	Water	Water Code
Absaroka-Beartooth Lakes			
Albino Lake	5-22-7126		
Alpine Lake	5-22-7143		
Amphitheater Lake	5-22-7146		
Bill Lake	5-22-7266		
Bob Lake	5-22-7310		
Brent Lake	5-22-7325		
Broadwater Lake	5-22-7350		
Chickadee Lake	5-22-7453		
Clover Leaf Lakes	5-22-7468		
Chrome Lake	5-22-7455		
Cradle Lake	5-22-7543		
Crater Lake	5-22-7546		
Crescent Lake	5-22-7588		
Crow Lake	5-22-7602		
Curl Lake	5-22-7630		
Daly Lake	5-22-7646		
Diaphonous Lake	5-22-7689		
Fish Lake	5-22-7896		
Fossil Lake	5-22-7924		
Gallery Lake	5-22-7963		
Golden Lake	5-22-7987		
Goose Lake	5-22-7994		
Great Falls Creek Lk.	5-22-8017		
Green Lake	5-22-8036		
Hairpin Lake	None		
Heather Lake	5-22-8058		
Horseshoe Lake	5-22-8132		
Huckleberry Lake	5-22-8148		
Island Lake	5-22-8163		
Jasper Lake	5-22-8180		
Jasper Lake	5-22-8180		
Jeff Lake	5-22-8190		
Kersey Lake	5-22-8274		
Lady of the Lake	5-22-8316		
Lake of the Clouds	5-22-8338		
Lake of the Woods	5-22-8347		
Lightning Lake	5-22-8372		
Lilly Pad Lake	5-22-8400		
Line Lake	5-22-8428		
Little Scat Lake	5-22-00CX		
Little Washtub Lake	5-22-8450		
Lower Arch	5-22-7170		
Lower Aero	5-22-8526		
Marsh Lake	5-22-8589		

Martes lake	5-22-8590
Martin Lake	5-22-8592
Martin Lake	5-22-8593
Mermaid Lake	5-22-8662
Mirror Lake	5-22-8680
Moon Lake	5-22-8708
Mutt Lake	5-22-8750
Mystic Lake	5-22-8764
North Picket Pin Lake	5-22-8880
Otter Lake	5-22-8834
Ouzel Lake	5-22-8840
Owl Lake	5-22-8849
Ovis Lake	5-22-8848
Pablo Lake	None
Peace Lake	5-22-8874
Picasso Lake	5-22-8877
Pinchot Lake	5-22-8890
Pipit Lake	5-22-8907
Production Lake	5-22-8935
Recruitment Lake	5-22-8979
Renie Lake	5-22-8994
Robin Lake	5-22-9006
Round Lake	5-22-9044
Rydberg Lake	5-22-9076
Scat Lake	5-22-9097
Silver Lake	5-22-9185
Shadow Lake	5-22-9142
Second Creek Lake	None
Sliderock Lake	5-22-9240
Smethurst Lake	5-22-9275
Snowbank Lake	5-22-9310
South Picket Pen Lake	5-22-8881
Surprise Lake	5-22-9582
Sylvan Lake	5-22-9394
Tiel Lake	5-22-00BY
Turgulse Lake	5-22-9513
Trail Lake	5-22-9480
Weasle 48	5-22-9726
Weidy Lake	None
West Boulder Lake	5-22-9730
West Fishtail Lakes	5-22-9735
Widewater Lake	5-22-9758
Wilderness Lake	5-22-00CK
Wood Lake	5-22-9799
Wounded Man Lake	5-22-9728

Crazy Mountain Lakes

Cave Lake	5-22-7449

Other Lakes

Cooney Reservoir	5-22-7518
Deadmans Basin Res.	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

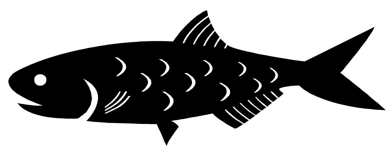
Prepared by: _Jim Olsen and Ken Frazer

Date: ______________________

Appendix 1. High Mountain Lakes Report 2002

ABSAROKA-BEARTOOTH WILDERNESS HIGH MOUNTAIN LAKES 2002

SURVEY



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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 20^{th} 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.

Slough Creek	Stillwater River	Rock Creek	East Rosebud Creek	Clarks Fork of Yellowstone River	Boulder River
2	4	1	2	18	5

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	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	
SS=SELF SUSTAINING POPULATION	ST=STOCKED 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

Additional Data on High Mountain Lakes

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

HAI Analysis

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 216	CF 216	CT	SS	33.8	A
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
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).

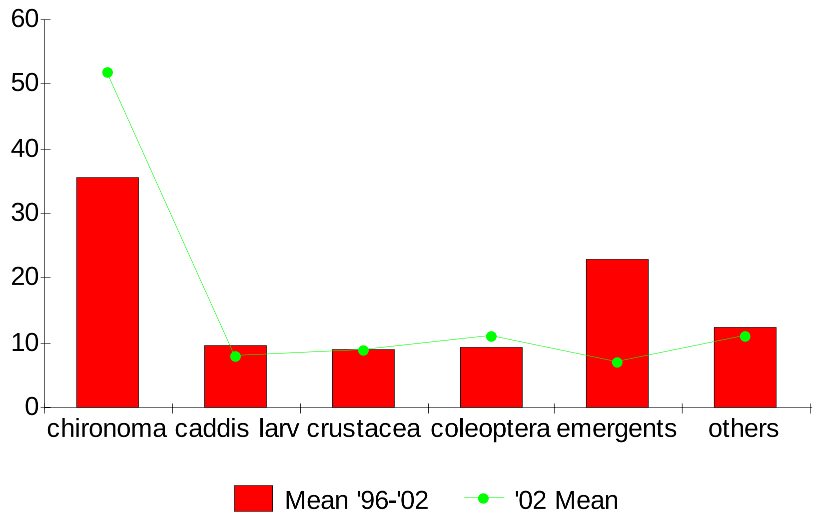
Gut Contents

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.



Appendix 2. High Mountain Lakes Report 2003

ABSAROKA-BEARTOOTH WILDERNESS HIGH MOUNTAIN LAKES

SURVEY - 2003

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	125' 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 Mountian 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.

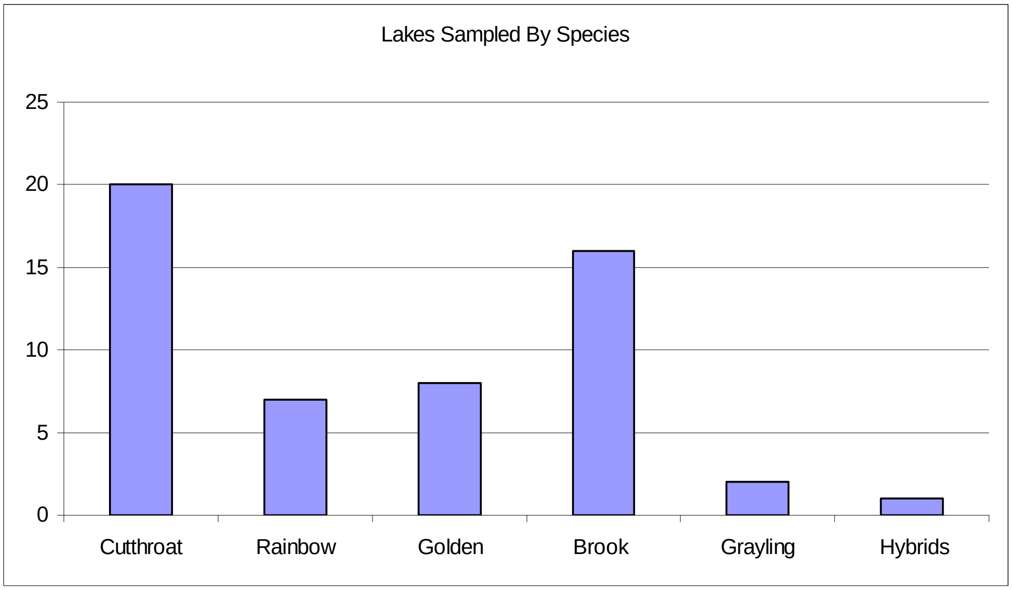


Table 2. Number of lakes sampled in 2003 by major drainage.

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

Results

Lakes with no management or status change

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

Additional Data on High Mountain Lakes

HAI Analysis

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.

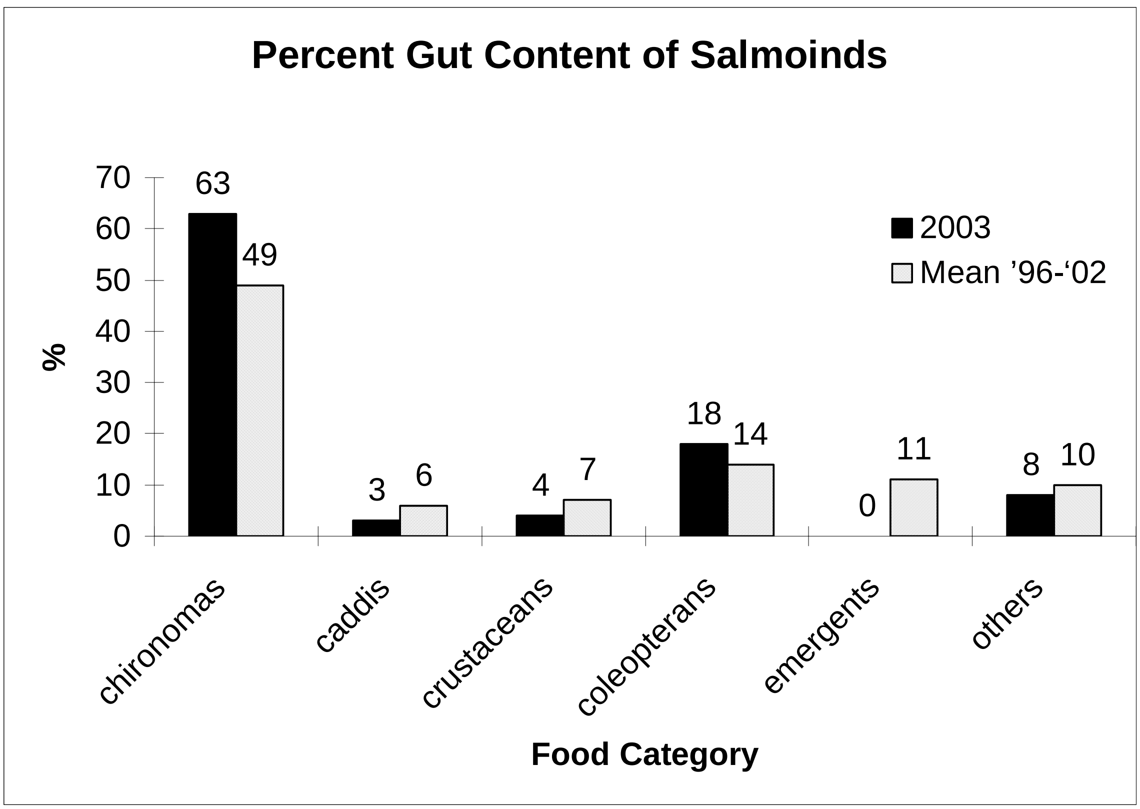
Lake	Code	Fish Species	Status	Average HAI	Health*
Golden	CF236	CT	ST	51	A
Jasper	CF237	CT	ST	16	E
Lake of the Clouds	CF93	CT	SS	26	A
Martin	CF211	EB	SS	32	A
Mirror	BR16	RB	SS	11	E
Owl	BR71	RB	SS	34	A
Pipit	SW70	CT*RB	SS	22	A
Production	CF44	EB	SS	37	A
Renie	CF228	EB	SS	8	E
Robin	CF207	RB/EB	??/SS	43	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.

Appendix 3. High Mountain Lakes Report 2004

ABSAROKA-BEARTOOTH WILDERNESS HIGH MOUNTAIN LAKES

SURVEY - 2004

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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 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

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

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	

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 team determines 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 the crew will set nets for a series of two to three hour periods when sampling trophy lakes. 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. Necropsies are done on several fish, 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 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.

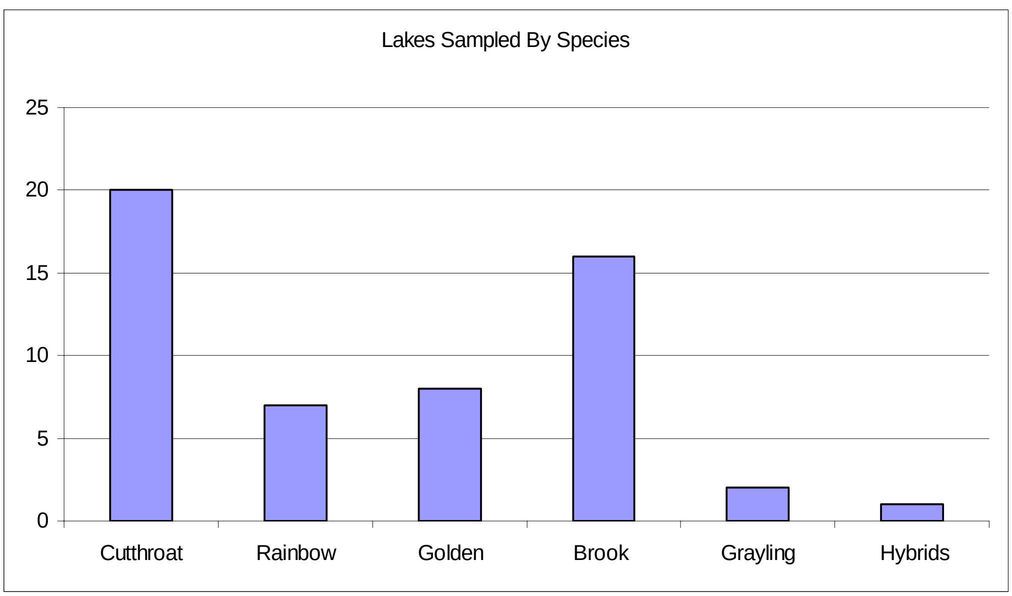

Table 1. Lakes sampled in the Absaroka-Beartooth mountain range during 2004.

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 upsidedown 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	ST	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	ST	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	WR41 A	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	CF54 A	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.

Drainage	Number of Lakes Sampled
Clarks Fork	8
East Rosebud	0
West Rosebud	9
Stillwater	3
Boulder	3
West Boulder	4
Rock Creek	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.