

BPA

**1985 Libby Reservoir Angler Census:
May 13 - October 31, 1985**

U.S. Department of Energy
Bonneville Power Administration
Division of Fish & Wildlife

Montana Department of
Fish, Wildlife and Parks

August 1987



**Interim
Report**

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**Bonneville Power Administration
Division of Fish and Wildlife - PJ
P. O. Box 3621
Portland, OR 97208**

1985 LIBBY RESERVOIR ANGLER CENSUS:

MAY 13 - OCTOBER 31, 1987

INTERIM REPORT

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Prepared By

Ian Chisholm, Project Biologist
Paul Hamlin, Fisheries Technician
Montana Department of Fish, Wildlife and Parks
P.O. Box 67
Kalispell, Montana 59903

Funded by

Dale E. Johnson, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, Oregon 97208
Project No. 84-52

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EXECUTIVE SUMMARY

An intensive creel and economic survey was conducted on Libby Reservoir from May 13 through October 31, 1985. This research was part of a larger effort to quantify the existing reservoir fishery and the effects of dam operation on this fishery. Census techniques incorporated direct interviews and electronic car counters installed at all established boat ramp access sites. A total of 4,243 angling party interviews, 2,379 car counter interviews and 719 economic surveys were conducted on Libby Reservoir.

Interviewed anglers fished for 52,146 hours. Estimated pressure was 518,916 hours or 93,500 angler days equivalent to 2.10 angler days per acre. Eight percent of the total estimated angler days or 7,436 fishing trips occurred on the Canadian portion of the reservoir. Boat anglers expended over 96 percent of the total effort.

Anglers caught an estimated 617,097 fish during the creel period, 97 percent (597,380 fish) of which were kokanee. The majority (98 percent) of the kokanee harvested were caught on the U.S. portion of the reservoir. Harvest of Salmo spp. was estimated at 15,334 fish. Whitefish and brook trout harvest was estimated at 1,273 and 48 fish, respectively. Nongame fish species were almost nonexistent in the creel and estimated harvest was less than 0.5 percent of the total harvest.

Average size of harvested fish was 314 mm for kokanee, 271 mm for cutthroat trout, 298 mm for rainbow trout, and 411 mm for bull trout.

The overall harvest rate of game fish was 1.15 fish per hour. During the creel period, kokanee were harvested at 1.11 fish per hour and Salmo spp. were creeled at 0.03 fish per hour. Kokanee were caught most successfully by boat anglers (1.14 c/h) and shore anglers creeled Salmo spp. more successfully (0.33 c/h).

Boat fishermen comprised 95 percent of all anglers, fished an average of 5.3 hours per trip and harvested over 99 percent of the kokanee. Shore angler trips fished an average 3.8 hours per trip and accounted for 23 percent of the total Salmo catch. Boat anglers fished most successfully with lures and a combination of lure types while shore fishermen primarily used bait.

Nonresidents made up 55 percent of the total number of anglers fishing in the Montana portion of the reservoir, and they harvested 66 percent of all kokanee creeled. In Canada, anglers tended to be of more local origin. Eighty-three percent of all completed trip interviews on the Canadian portion of the reservoir were residents of East Kootenay.

Comparison of 1985 and 1986 counter crossings at boat ramps on Libby Reservoir indicated that despite a drop in kokanee numbers, angling pressure remained high. Overall 1986 ramp use was 71 percent of that in 1985 and angler-use patterns for individual boat ramps were similar. This suggested that angling pressure was fairly stable between the two years and is indicative of a strong growing fishery.

Applicable creel results will be incorporated into our modeling effort of dam operation effects on the reservoir fishery. This will provide a basis to evaluate potential costs and benefits of management decisions. The primary value of the creel study in the modeling effort will result from the refinement of recruitment, mortality rates, and standing estimates. The economic analysis, which will be presented in a separate report, will provide a foundation for examining resource trade-offs.

INTRODUCTION

In 1983, the Montana Department of Fish, Wildlife and Parks (MDFWP) began a Bonneville Power Administration (BPA) funded study on Libby Reservoir. This work was directed by the Northwest Power Planning Council's resident fish and wildlife plan pursuant to program measure 804(b)(1). Libby Reservoir study goals are to quantify the effects of dam operation on the existing fishery and recommend reservoir levels needed to maintain or enhance this fishery (Chisholm and Fraley 1985). The study is unique in that it was designed to address its goal by gathering detailed information on every trophic level in the reservoir system and integrate this information into a predictive computer model.

Since impoundment in 1972 and the introduction of kokanee by 1982, the fishery of Libby Reservoir has been in a state of flux. Shapiro and Associates (1985) reported a 860 percent increase in recreational use on Libby Reservoir from 1974 to 1984. The dynamic nature of Libby Reservoir's fish community has been well documented (Huston et al. 1984, Shepard and McMullin 1983, Shepard 1984). In light of the stated project goals and the growing fishery in Libby Reservoir, an intensive creel and economic survey was conducted in 1985. This research was part of the larger effort to quantify the status and importance of the reservoir fishery and major influences on fish community structure.

Statewide angling surveys, conducted in 1975-1976 and annually since 1982, provided partial estimates of pressure (47 percent of the reservoir's full pool length is in Canada) but do not provide complete harvest information. Direct interview census of Libby Reservoir anglers conducted by Huston et al. (1984) provided catch characteristics for the U.S. portion of the reservoir, but did not estimate overall pressure.

This survey was designed to census angling parties during late spring, summer, and fall, and estimate pressure, fish harvest and economic value(s) for the entire reservoir. In addition to providing a basis to evaluate potential costs and benefits of management decisions, applicable creel results will be incorporated directly into the fish population component of our computer model.

DESCRIPTION OF THE STUDY AREA

Libby Reservoir (Lake Koocanusa) was formed on the Kootenai River following completion of Libby Dam in 1972. The dam is located in Lincoln County, northwest Montana, approximately 27 km upstream from the city of Libby. Average annual discharge of 868 m³/sec (30,650 cfs) makes the Kootenai River the second largest tributary to the Columbia River. Libby Reservoir receives runoff from 47 percent of the 49,987 sq km (19,300 sq mi) drainage basin.

At the full pool elevation of 741.5 m (2,459 ft mean sea level), the reservoir extends 145 km northward with 68 km of its length located in southeast British Columbia. Libby Reservoir has a maximum surface area of 18,801 hectares (46,456 acres) and a volume of 7.16 cubic kilometers (5.869 million acre-feet). Average reservoir depth is 38.5 m (126.4 ft) with a maximum depth of 107 m (350 ft) (Storm et al. 1982).

The Montana portion of the reservoir is situated between the Purcell and Salish mountains in a steep, narrow conifer-dominated valley. The valley broadens in the Tobacco Plains area near Rexford, Montana. A forest development road spans the length of the reservoir's west side, and U.S. Highway 37 parallels much of the east bank (Figure 1). One bridge connects these roads approximately 12 miles south of the U.S.-Canadian border. Koocanusa is bordered mainly by Forest Service land with the majority of private land located near the town of Rexford. Important tributaries include the Tobacco River, Young Creek, Pinkham Creek, Big Creek, Fivemile Creek, Bristow Creek, Cripple Horse Creek, Barron Creek and Canyon Creek. Six developed access sites have been established in the United States section of Libby Reservoir (Figure 1). The McGillivray and Tobacco Plains sites are high water ramps, whereas Barron Creek, Cripple Horse, Peck Gulch and Rexford Bench are usable to drawdown depths over 30 m (100 ft). There is one marina on Libby Reservoir, located near the mouth of Cripple Horse Creek. Other access points are available, but are limited to shore angling and small boat launching.

The Canadian portion is bordered by the McGillivray Range to the west and the Galton and Lizard Ranges to the east. This segment lies in an open valley created by glacial activity. The area is flanked by a network of private and Forest Service roads with a bridge crossing near Kikomun Creek Park and another near the northern end at Wardner, British Columbia. Private land bordering Lake Koocanusa increases in this segment, but the majority lies under Crown control. Major tributaries include the main stem Kootenai (spelled Kootenay in Canada), Elk River, Bull River, Kikomun Creek, Sand Creek and Gold Creek. Developed access sites are scarce, with one centrally located campground and boat launching facility located at Kikomun Creek Provincial Park. Other access points are available through Forest Service roads but trailered boat access is limited. Depending on drawdown level and

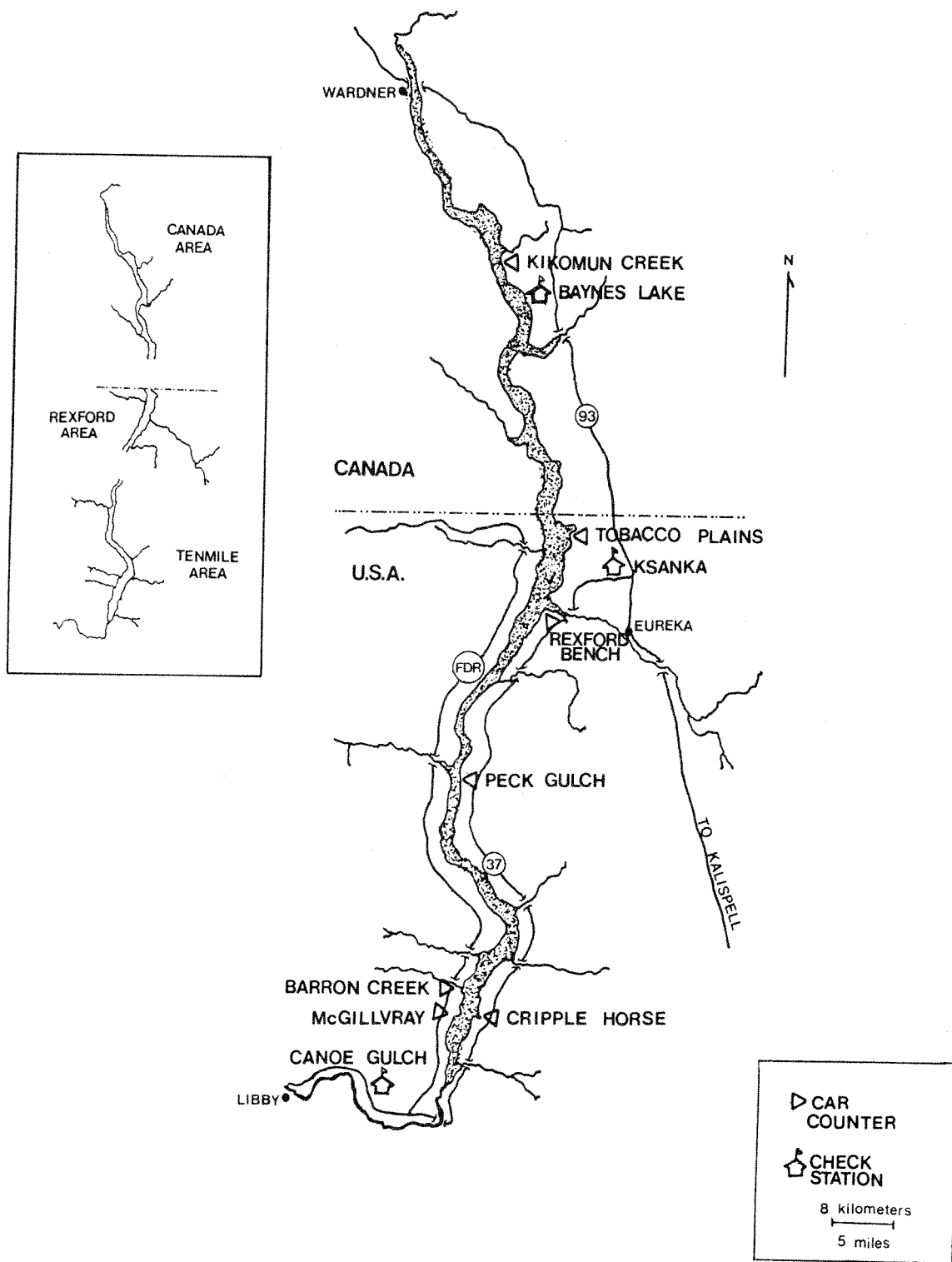


Figure 1. Map of Libby Reservoir illustrating car counter sites and creel check stations. Inset delineates geographic study areas.

lake fill rates, the Canadian area is usually inundated from June through December.

Twenty species of fish are known to exist in the Libby Reservoir drainage. Their relative abundance and abundance trends are shown in Table 1.

Each angler on Libby Reservoir was allowed the following limits during the 1985-1986 season:

MONTANA:

1. Trout - ten pounds and one fish, or ten fish, whichever is reached first. Two fish could always be taken, regardless of weight. Possession limit equals the daily limit. A separate brook trout limit of ten pounds not to exceed 20 fish daily and 20 in possession was in effect;
2. Kokanee - Twenty fish daily and forty in possession. Snagging season for kokanee was open from September 15 through December 31 during 1985;
3. Whitefish - One hundred fish daily and 100 in possession;
4. Burbot - Five fish daily and five fish in possession;
5. Bass - Five fish daily and five fish in possession.

It was unlawful to take or possess any sturgeon of the genus Acipenser. There were no limits on nongame species such as yellow perch.

BRITISH COLUMBIA:

1. Trout - Six fish, of which only one rainbow over 50 cm (20 inches, fork length) and one bull trout over 50 cm (FL) may be taken. Possession limit equals two daily limits;
2. Kokanee - Fifteen fish daily and thirty in possession. No snagging season exists in British Columbia;
3. Whitefish - Twenty-five fish daily and fifty in possession;
4. Burbot - Fifteen fish daily and thirty in possession;
5. Bass - Eight fish daily and sixteen in possession;
6. Sturgeon - One fish over 100 cm (FL) may be taken under authority of a free sturgeon permit.

Table 1. Present relative abundance (A=abundant, C=common, R=rare) and abundance trend from 1975 to 1982 (I=increasing, S=stable, D=decreasing) of fish species present in Libby Reservoir.

Common Name	Scientific Name	Relative Abundance	Abundance Trend
Game fish species			
Westslope cutthroat trout	<u>Salmo clarki lewisi</u>	A	S
Rainbow trout	<u>Salmo gairdneri</u>	A	I
Bull trout	<u>Salvelinus confluentus</u>	C	S
Brook trout	<u>Salvelinus fontinalis</u>	R	S
Lake trout	<u>Salvelinus namaycush</u>	R	S
Kokanee salmon	<u>Oncorhynchus nerka</u>	C	I
Mountain whitefish	<u>Prosopium williamsoni</u>	C	D
Burbot	<u>Lota lota</u>	C	S
Largemouth bass	<u>Micropterus salmoides</u>	R	S
White sturgeon	<u>Acipenser transmontanus</u>	R	D ^{a/}
Nongame fish species			
Pumpkinseed	<u>Lepomis gibbosus</u>	R	S
Yellow perch	<u>Perca flavescens</u>	R	I
Redside shiner	<u>Richardsonius balteatus</u>	C	D
Peamouth	<u>Mylocheilus caurinus</u>	A	S
Northern squawfish	<u>Ptychocheilus oregonensis</u>	A	S
Largescale sucker	<u>Catostomus macrocheilus</u>	A	S
Longnose sucker	<u>Catostomus catostomus</u>	C	D
Longnose dace	<u>Rhinichthys cataractae</u>	R	S
Slimy sculpin	<u>Cottus cognatus</u>	R	S
Torrent sculpin	<u>Cottus rhotheus</u>	R	S

^{a/} Five white sturgeon were relocated from below Libby Dam to the reservoir. At least one of these fish moved up-river out of the reservoir and two were reported caught by anglers.

METHODS

An intensive creel and economic census was conducted on Libby Reservoir from May 13, 1985 (the opening day of general fishing season), through October 31, 1985. Census techniques incorporated direct interviews and electronic car counters installed at all established boat ramps. Car counters were chosen in lieu of plane flight instantaneous counts for reasons of cost, coverage, and political boundaries. Interview data were collected at car counter sites, check stations on major access roads, and on the reservoir by boat using methods described by Graham and Fredenberg (1983). Car counter data were collected and analyzed following methods presented by Mischon and Wyatt (1979).

Creel sampling was scheduled by two-week blocks, stratified into weekend (and holidays) and weekday periods (Best and Boles 1956, Neuhold and Lu 1957). Holidays sampled included Monday, May 27 (Memorial Day), Thursday, July 4 (Independence Day), Monday, September 2 (Labor Day), and Monday, October 4 (Columbus Day). Three creel clerks worked seven to eight 10-hour days during each two-week stratum (Table 2). Two clerks surveyed the U.S. portion and one clerk surveyed the Canadian portion of the reservoir.

Interviews were conducted during boat surveys, at car counter locations (six in U.S. portion, one in Canada), and at check stations (Table 2, Figure 1). The reservoir was stratified into three geographic areas for boat interviews (Figure 1). A roving boat survey was conducted along the shoreline of the reservoir to help determine the percent of anglers using established access points and the ratio of shore to boat fishermen. The boat survey sampling area was randomly chosen in the United States portion of the reservoir. Sample days and beginning times were selected randomly without replacement within each two-week period. Creel clerks interviewed anglers on a party basis with emphasis on completed trip interviews.

Car counter interviews were conducted for four hours at two different access sites on each sample day. Site selection was determined by random sampling with replacement in the United States portion of the reservoir. Creel clerks monitored the car counter at the start and end of each scheduled car counter interview. The primary purpose of these data was to enable accurate estimates of the proportion of angling parties crossing a particular counter. In addition, all seven car counters were read every Friday evening and Monday morning to provide site specific, gross counts for people using the boat ramps during the weekday and weekend periods of each two-week stratum.

Data obtained from interviews and car counters were recorded directly on coding forms for computer entry and analysis. A

Table 2. Sample design for Libby Reservoir creel census from May 13 through October 31, 1985.

Area	Number of days per two-week period					
	Car Counter		Check Station		Boat	
	WD	WE ^{a/}	WD	WE	WD	WE
Tenmile						
Rexford	4	4	1	2	2	2
Canada	2	2	1	1	1	1

Starting Times ^{b/}		
Car Counter	Check Station	Boat
7:00 am	10:00 am	7:00 am
11:00 am	11:00 am	8:00 am
3:00 pm	12:00 noon	9:00 am
7:00 pm	1:00 pm	10:00 am
		11:00 am
		12:00 noon
		1:00 pm
		2:00 pm

^{a/} WD=weekday, WE=weekend days and holidays

^{b/} Starting times were based on leaving the field station which was 0.5 to 1.5 hours from survey sites. All shifts were 10 hours long.

complete listing of all creel forms used, including questions, instructions, and suggested changes, is presented in Appendix A. Creel data were analyzed using SPSS computer programs (Nie et al. 1975). Analysis methodology followed that presented by Graham and Fredenberg (1983) and is described in detail in Appendix B. The economic census data were analyzed by MDFWP personnel at the Research Bureau in Bozeman, Montana, and will be presented in an addendum to this report.

RESULTS

Angler Creel Statistics

A total of 4,243 angling party interviews, 2,379 car counter interviews and 719 economic surveys were conducted on Libby Reservoir from May 13 to October 31, 1985. Completed trip interviews comprised 78 percent (3,323) of all interviewed anglers (4,243). Three thousand seventeen creel interviews (80.5 percent) were conducted in the U.S. portion and 826 creel interviews (19.5 percent) were held in the Canadian portion. Despite an apparent skew toward the U.S. portion, every attempt was made to interview fishermen in proportion to pressure.

Representative coverage of the reservoir's access points and stratified sample design ensured that all areas and types of fishermen were well represented. Therefore, the results presented here should accurately reflect the angler population.

DISTRIBUTION OF PARTY INTERVIEWS AND INTERVIEW HOURS

Libby Reservoir is primarily a weekend/holiday fishery. Sixty-nine percent of all angling interviews were conducted on weekends (and holidays) and 31 percent on weekdays. This pattern was consistent through all areas (Appendix Table C1).

Cripple Horse and Rexford boat ramps received the highest use. Forty-six percent of the interviewed anglers accessed the reservoir at these two ramps (Table 3). The popularity of these sites probably resulted from the marina and campground fishing development and their proximity to the towns of Libby and Eureka. Fishing activity peaked over the Memorial Day (May 27) and Independence Day (July 4) holidays. Use remained high through mid September and dropped sharply thereafter, corresponding to the beginning of kokanee spawning season. The McGillivray and Tobacco Plains boat ramps were used least. Both are highwater ramps; usable only after the reservoir has filled to within 12 m of full pool. Higher use at the highwater ramp at McGillivray is probably a result of the campground development there.

The majority of party interviews (86 percent) were conducted with boat fishermen that used the access ramps (Table 4). Shore fishermen comprised only 4.58 percent of all interviewed anglers. Eighty-seven percent of the interviewed anglers used the established ramps (and crossed counters) to access the reservoir. Ramp use was the most common method of reservoir access, but was variable; ranging from 63.3 to 93.2 percent of all interviewed angling parties during the creel survey (Appendix Table C2). Of the 12 percent of angling parties not crossing car counters, three percent (144 interviewed parties) were shore anglers and nine percent (385 interviewed parties) boat anglers (Table 4).

Table 3. Distribution of completed trip angler interviews for each car counter by two-week periods for Libby Reservoir from May 13 through October 31, 1985.

Period	Unknown	McGillivray	Barron Creek	Cripple Horse	Peck Gulch	Rexford	Tobacco Plains	Kikomun Creek	Undesig-nated		Total
									Other	8	
May 13 - May 26	9		95	206	76	160	3	--	19		568
May 27 - Jun 9	57	16	307	707	117	81	--	--	159		1444
Jun 10 - Jun 23	47	32	33	237	183	161	4	22	29		748
Jun 24 - Jul 7	5	90	67	345	243	260	22	22	270		1324
Jul 8 - Jul 21	--	28	54	131	80	73	30	76	48		520
Jul 22 - Aug 4	4	128	29	123	92	155	25	176	33		765
Aug 5 - Aug 18	5	78	57	245	122	222	18	124	68		939
Aug 19 - Sep 1	2	43	17	86	88	191	40	257	32		756
Sep 2 - Sep 15	2	1	12	74	62	158	41	231	106		687
Sep 16 - Sep 29	--	5	6	26	40	32	2	46	50		207
Sep 30 - Oct 13	--	--	3	3	1	4	--	11	11		33
Oct 14 - Oct 31	--	--	6	1	--	19	--	6	2		34
	131	421	686	2184	1104	1516	185	971	827		8025

Table 4. Breakdown of fishing category for 4,237 angling party interviews conducted on Libby Reservoir from May 13 through October 31, 1985.

Fishing Category	Ramp Use	Number of Angling Parties	Percent of Total
Shore	Yes	50	1.18
Shore	No	144	3.39
Boat	Yes	3,664	86.35
Boat	No	385	9.07
Total		4,243	100.00

Interviewed anglers fished a total of 52,146 hours during the creel period. Sixty-four percent of these hours occurred in the Tenmile area and 13.5 percent were expended in Canada (Appendix Table C3). Generally, the Tenmile area accounted for the greatest percentage of fishing time spent on the reservoir through the summer months. Hours fished peaked over the Memorial and Independence Day holidays. After mid September, fishing pressure declined most dramatically in the U.S. portion of the reservoir (Appendix Table C3). The similarity of car counter use and angler interview trends is evidence that proportional sampling of pressure was achieved.

LENGTH OF FISHING TRIPS

The average fishing trip lasted 5.2 hours (Table 5). However, trip length varied over the creel period and with angler category and origin. Anglers fished longest during the spring period (\bar{x} = 6.3 hours); trip length dropped to an average 3.5 hours in early October. Boat anglers fished longer than shore fishermen (Appendix Table D1), averaging 5.3 hours versus 3.8 hours, respectively. U.S. anglers fished an average 5.7 hours and Canadians fished an average of 4.3 hours (Appendix Table D2). Trip duration was a function of distance traveled (Tables 6 and 7). Idaho and Washington anglers fished an average of 6.4 hours; Eureka/Rexford residents fished an average of 4.3 hours.

FISHING PARTY SIZE

Mean party size was 2.0 anglers. Party size was largest (\bar{x} = 2.8 anglers) during the two-week period encompassing the Independence Day holiday, probably reflecting family vacationing (Table 5). Weather and low success rates probably contributed to the low average party size (\bar{x} = 1.9 anglers) recorded for October 14 through October 31. With the exception of the above mentioned periods, party size was fairly consistent, ranging from an average of 2.1 to 2.6 anglers per party. Canadian anglers tended to fish in smaller parties than anglers fishing the U.S. portion (Appendix Table D2). Average party size for the creel period was 2.1, 2.5, and 2.5 anglers per party for the Canada, Rexford, and Tenmile areas, respectively. Party size was generally higher but more variable in the U.S. portion, ranging from an average of 1.8 to 2.8 anglers per party.

ANGLER ORIGIN

Libby Reservoir is a regionally important fishery. In the U.S. portion, anglers from outside of Lincoln County, Montana, made up 78 percent of all fishermen (Table 6). Of the total, approximately 52 percent came from Idaho and Washington to fish. Montana anglers comprised 45 percent, Idaho anglers 28 percent,

Table 5. Fishing effort expended by all completed trip anglers interviewed for each two-week period from May 13 through October 31, 1985.

Period	Number of Parties	\bar{x} Anglers per Party	Mean Hours Fished	Total Hours
May 13 - May 26	217	2.6	6.3	3556.3
May 27 - Jun 9	612	2.4	5.7	8292.5
Jun 10 - Jun 23	303	2.5	5.5	4129.1
Jun 24 - Jul 7	477	2.8	5.6	7386.0
Jul 8 - Jul 21	220	2.4	5.6	2916.5
Jul 22 - Aug 4	314	2.4	5.3	4071.0
Aug 5 - Aug 18	401	2.3	5.9	5566.6
Aug 19 - Sep 1	329	2.3	5.4	4090.4
Sep 2 - Sep 15	317	2.2	4.9	3355.0
Sep 16 - Sep 29	99	2.1	4.2	872.6
Sep 30 - Oct 13	16	2.1	3.5	116.5
Oct 14 - Oct 31	18	1.9	4.2	142.7
Grand Mean		2.4	5.2	
Totals	3323			44495.7

Table 6. Breakdown of fishing effort by angler origin for all completed trip interviews conducted in the U.S. portion of Libby Reservoir from May 13 through October 31, 1985.

USA Angler Origin	Total Number Fishermen	Total Hours Fished	Average Hours per Fisherman
Libby	1090 (16%)	5295.7 (14%)	4.9
Eureka or Rexford Area	228 (4%)	989.0 (3%)	4.3
Other Lincoln County	143 (2%)	805.1 (2%)	5.6
Flathead County	862 (13%)	4467.0 (11%)	5.2
Sanders County	219 (3%)	1385.5 (4%)	6.3
Other Western Montana (west of continental divide)	402 (6%)	2059.5 (5%)	5.1
Other Eastern Montana (east of continental divide)	74 (1%)	424.5 (1%)	5.7
Idaho	1844 (28%)	11836.5 (30%)	6.4
Washington	1617 (24%)	10362.1 (27%)	6.4
Other nonresidents (USA)	140 (2%)	675.0 (2%)	4.8
Canadian	71 (1%)	380.5 (1%)	5.4

Table 7. Breakdown of fishing effort by angler origin for all completed trip interviews conducted in the Canadian portion of Libby Reservoir from May 13 through October 31, 1985.

CANADA Angler Origin	Total Number Fishermen	Total Hours Fished	Average Hours per Fisherman
Wardner	84 (6%)	337.8 (6%)	4.0
Other East Kootenays	996 (77%)	4398.0 (78%)	4.4
Other B.C.	65 (5%)	244.5 (4%)	3.8
Alberta	137 (11%)	565.5 (10%)	4.1
Other Canada	0	0.0	0.0
Foreign	17 (1%)	88.0 (2%)	5.2

and Washington anglers 24 percent of all interviewed anglers fishing the U.S. portion of the reservoir. Anglers from Rexford and Eureka, the two U.S. towns closest to the reservoir, accounted for only four percent of the total number of interviewed anglers.

In Canada, anglers tended to be of more local origin. Eighty-three percent of all completed trip interviews on the Canadian portion of the reservoir were residents of East Kootenay, which surrounds the reservoir (Table 7). Only 11 percent of the anglers came from a province outside British Columbia. Similar to the Rexford/Eureka towns in the U.S., anglers from the river town of Wardner, B.C., comprised only six percent of completed trip interviews.

FISHING TACKLE USE

Lure use varied seasonally and with angler category. Boat anglers spent more time fishing with lures in May, switching to a combination of bait types (predominantly lures and bait) through the remainder of the survey (Table 8). Bait varied in importance of use for boat fishermen through the creel period. In May, seven percent of the fishing time was spent using bait. Bait use increased to 12 percent of the boat fisherman hours in August, and 29 percent in September. Bait was most commonly used by shore anglers throughout the creel period (Table 8).

With minor exceptions, lure success followed lure use patterns. Shore fishermen used bait most often and the majority of the shore-creeled trout and kokanee were caught on bait (Table 9). However, 37 percent and 24.9 percent of the kokanee were caught on lures and a combination of lures and bait, respectively. Boat anglers fished most successfully with the combination lure type. Fifty percent of the kokanee and hybrid trout creeled were caught using a combination of lures and bait. Lures alone were also productive for boat anglers fishing for trout and kokanee (Table 9). Interviewed parties accounted for 12,131 kokanee (44 percent of the catch) using lures alone.

Species Composition and Size of Creeled Fish

SPECIES COMPOSITION OF THE CATCH

The Libby Reservoir fishery is currently dominated by a single fish species. A total of 51,372 fish were creeled by the 3,323 anglers interviewed who had completed trips on Libby Reservoir. Kokanee salmon comprised 96 percent (49,448 fish) of the total angler harvest during the creel period (Table 10). Nongame species made up less than one percent of the total catch. Few anglers reported harvesting whitefish (106 fish), peamouth (53 fish), northern squawfish (167 fish), and suckers (29 fish). Kokanee salmon composed from 40 to 99 percent of the game fish

Table 8. Monthly distribution of fisherman hours by lure type for all angler parties interviewed on Libby Reservoir from May 13 through October 31, 1985.

Month	Lure Type	Shore	Boat	Total Hours Fished
MAY	Bait (worms, maggots, etc.)	189.5	451.0	640.5
	Flies	--	--	--
	Lures	106.8	3,833.0	3,989.8
	Any comb. of above	92.0	1,948.5	2,040.5
JUNE	Bait	227.0	359.5	586.5
	Flies	22.5	40.0	62.5
	Lures	107.5	4,561.1	4,668.6
	Any combination	149.0	5,579.4	5,728.5
JULY	Bait	--	714.5	714.5
	Flies	--	100.5	100.5
	Lures	--	4,324.0	4,324.0
	Any combination	32.0	5,609.5	5,641.5
AUG	Bait	19.0	1,186.0	1,205.0
	Flies	--	8.0	8.0
	Lures	2.0	2,776.5	5,778.5
	Any combination	16.5	5,706.1	5,722.6
SEPT	Bait	24.5	1,512.5	1,537.0
	Flies	2.0	20.0	22.0
	Lures	6.0	847.5	853.5
	Any combination	40.0	2,800.6	2,840.6
OCT	Bait	6.0	22.0	28.0
	Flies	--	--	--
	Lures	--	84.7	84.7
	Any combination	--	109.5	109.5
TOTAL	Bait	466.0	4,245.5	4,711.5
	Flies	24.5	168.5	193.0
	Lures	222.3	16,476.8	16,699.1
	Any combination	329.5	21,753.7	22,098.2

Table 9. Number of fish caught (and percent by species) by 3,323 completed trip shore and boat fishermen for each bait type from May 13 through October 31, 1985.

Bait Type	WCT	RBT	HYB	KOK	BULL
SHORE FISHERMEN					
Bait (worms, maggots, etc.)	70 (67.2)	98 (66.7)	78 (82.1)	72 (38.1)	3 (21.4)
Flies	1 (1.0)	3 (2.0)	0	0	0
Lures	8 (7.8)	17 (11.6)	5 (5.3)	70 (37.0)	5 (35.7)
Any combination of the above	25 (24.0)	29 (19.7)	12 (12.6)	47 (24.9)	6 (42.9)
BOAT FISHERMEN					
Bait	43 (12.6)	155 (26.5)	12 (6.0)	2965 (6.1)	5 (31.3)
Flies	2 (0.6)	9 (1.5)	1 (0.5)	150 (0.3)	0
Lures	177 (51.9)	229 (39.1)	85 (42.7)	21131 (43.7)	8 (50.0)
Any combination of the above	119 (34.9)	192 (32.8)	101 (50.8)	24091 (49.9)	3 (18.7)

Table 10. Species composition of the angler harvest from Libby Reservoir from May 13 through October 31, 1985.

Species	Number	(Percent)
Kokanee salmon	49,448	(96)
Rainbow trout	775	(1.5)
Westslope cutthroat trout	450	(0.9)
Rainbow x cutthroat hybrid	303	(0.6)
Northern squawfish	167	(0.3)
Mountain whitefish	106	(0.2)
Peamouth	53	(0.1)
Bull trout	31	(0.06)
Longnose suckers	29	(0.06)
Largescale suckers	5	(0.01)
Brook trout	4	(<0.01)
Perch	1	(<0.01)

catch during the creel period (Appendix Table E1). From mid May to mid September, kokanee comprised over 95 percent of the catch. Simple linear regression between hours fished and percent of catch comprised of kokanee and rainbow trout (Appendix Table E1) yielded correlation values of $R=0.74$ ($N=12$) and $R=-0.78$ ($N=12$), respectively. The positive relationship of effort expended with kokanee and the negative relationship between effort and rainbow trout suggests that kokanee were the species fished for and that rainbow trout were caught incidental to kokanee fishing. The marked increase in percentage of trout in the catch after September 15 does indicate a shift in angler emphasis, concurrent with kokanee spawning migrations.

SIZE OF HARVESTED GAME FISH

KOKANEE

Overall mean total length of all measured kokanee harvested during the creel period was 314 mm (Table 11). Lengths of harvested kokanee varied with month and area, reflecting seasonal changes in growth and distribution of fish (Appendix Table F1). Except for the month of August, mean lengths were highest (312-330 mm) in the Canada area. This may be related to greater food resource, early homing to spawning grounds, a reflection of angler ability, or an artifact of smaller sample sizes and sampling bias. A decrease in mean length in Canada from 332 mm in July to 305 mm in August, and a concomitant increase in Tenmile mean lengths to 324 mm probably reflects a genuine movement to the deeper, more thermally stable waters closer to the dam. Subsequent September increase of mean lengths in Canada and a decrease in Tenmile reflect redistribution of mature kokanee toward their natal spawning streams. Average size of harvested fish generally increased from early to late summer as fish grew. Total average lengths of harvested kokanee increased from 310 mm in June to 319 mm in August and 328 mm in September (Appendix Table F1). The drop in length of kokanee to an overall average of 303 mm after September is a result of the larger, mature fish becoming unavailable to the fishery as spawning is initiated. Limited data shows the average weight of 334-mm length harvested kokanee was 490 grams (Appendix Table F2).

SALMO SPP.

Rainbow were the trout species most often creeled and the average length of 193 measured fish was 298 mm (Table 11). The average weight of 16 trout averaging 312 mm long caught in Libby Reservoir during the creel period was 348 g (Appendix Table F2). Cutthroat trout were the smallest game fish creeled from Libby Reservoir. The average length of 87 angler harvested cutthroat was 271 mm and the average length for hybrid trout measured 299 mm

Table 11. Average length for all measured game fish harvested by interviewed anglers from Libby Reservoir from May 13 through October 31, 1985.

Species	Average Length (mm)	Number Measured
Cutthroat	271	87
Rainbow	298	193
Cutthroat x Rainbow Hybrids	299	92
Bull Trout	411	11
Kokanee	314	1132

(Table 11). Bull trout are currently the largest salmonids in the reservoir and 11 measured harvested fish averaged 411 mm.

Libby Reservoir anglers creeled smaller fish on the average than those present, as measured by gill net catches during the same time period. Average lengths of gill netted kokanee, rainbow, cutthroat and hybrid trout were 332, 329, 289, and 310 mm, respectively (Appendix Table F3). The only exception to this was bull trout. Gill net captured bull trout averaged 382 mm, while angler catch averaged 411 mm. Comparison and causal interpretation of these data is confounded by the disparity of harvest techniques, sampling times and sizes, and possible bias introduced by creel clerk sampling, of the angler catch. Mean lengths of creeled kokanee were larger for Canadian anglers than gill net catches on a month-to-month basis until the spawning season began in September (Appendix Tables F1 and F3).

Harvest Rates

The overall mean harvest rate of game fish was 1.15 fish per hour (c/h) (Table 12). Harvest rates are essentially catch rates, because anglers on Libby Reservoir returned only 0.4 percent of the kokanee they caught. During 1985, kokanee were harvested at 1.11 c/h, while salmo (trout) species were creeled at 0.03 fish per hour. Kokanee have become the major game fish sought in Libby Reservoir with Salmo species being creeled seasonally or incidental to kokanee fishing.

Mean kokanee harvest rates were high during the spring-summer period and declined in the fall. Harvest rates ranged from a high of 1.47 c/h during June to the low of 0.22 c/h in October coincidental to the spawning season (Table 13). Overall harvest rates were lowest in the Canada area with a mean rate of 0.46 fish per hour. The high rates of 0.55 and 0.60 in Canada were reached during August and September, respectively. This reflects the movement of kokanee toward their primary spawning grounds in Canada, and coincides with periods of stable water levels, moderating water temperature and increasing plankton densities. The Tenmile area received the highest harvest rate (1.25 c/h) for the U.S. segment with a similar rate in the Rexford Area (1.08 c/h). In the U.S. area, rates remained high (>1.00 c/h) from May through August with one exception of 0.87 fish per hour during July in the Tenmile area. Rates declined to 0.28 c/h in Tenmile and 0.12 c/h in Rexford during October.

Kokanee were caught most successfully by boat anglers at an average rate of 1.14 fish per hour. The harvest rate by shore anglers was 0.18 c/h, 84 percent lower than the overall kokanee harvest rate. A total of 49,254 (99.6 percent) kokanee were creeled by interviewed boat anglers (Table 14).

Table 12. Harvest of kokanee salmon, rainbow, cutthroat, rainbow x cutthroat hybrid, and bull trout catch (percent) and catch per hour (c/h) for 3,323 completed trip interviews on Libby Reservoir by two-week time periods from May 13 through October 31, 1985.

Period	Number Caught (percent) and C/H									
	KOK		RB		WCT		RBxWCT		DV	
	No.	c/h	No.	c/h	No.	c/h	No.	c/h	No.	c/h
May 13 - May 26	4,828 (96)	1.36	89 (2)	0.03	73 (1)	0.02	58 (1)	0.02	3 ($<.1$)	--
May 27 - Jun 9	13,339 (96)	1.61	211 (2)	0.03	180 (1)	0.02	176 (1)	0.02	17 ($<.5$)	--
Jun 10 - Jun 23	4,923 (98)	1.19	60 (1)	0.01	34 (1)	0.01	8 ($<.5$)	--	4 ($<.1$)	--
Jun 24 - Jul 7	6,892 (99)	0.93	47 (1)	0.01	15 ($<.5$)	--	6 ($<.1$)	--	2 ($<.1$)	--
Jul 8 - Jul 21	2,324 (99)	0.80	17 (1)	0.01	8 ($<.5$)	--	3 ($<.5$)	--	1 ($<.1$)	--
Jul 22 - Aug 4	4,525 (99)	1.11	39 (1)	0.01	13 ($<.5$)	--	11 ($<.5$)	--	1 ($<.1$)	--
Aug 5 - Aug 18	6,991 (99)	1.26	37 (1)	0.01	17 ($<.5$)	--	9 ($<.5$)	--	2 ($<.1$)	--
Aug 19 - Sep 1	3,221 (96)	0.79	75 (2)	0.02	33 (1)	0.01	13 ($<.5$)	--	0	--
Sep 2 - Sep 15	2,128 (95)	0.63	79 (4)	0.02	29 (1)	0.01	11 ($<.5$)	--	0	--
Sep 16 - Sep 29	222 (67)	0.25	72 (2.2)	0.08	34 (10)	0.04	4 (1)	--	0	--
Sep 30 - Oct 13	37 (64)	0.32	15 (26)	0.13	6 (10)	0.05	0	--	0 (2)	--
Oct 14 - Oct 31	18 (40)	0.13	14 (31)	0.10	8 (18)	0.06	4 (9)	0.03	1 (2)	0.01
TOTAL	49,448 (97)	1.11	775 (2)	0.02	450 (1)	0.01	303 ($<.1$)	0.01	31 ($<.1$)	<0.01

Table 13. Monthly kokanee salmon harvest and harvest rates (in parentheses) for 3,323 completed trip angler interviews for each area of Libby Reservoir during 1985.

MONTH	Numbers of Kokanee Caught (Catch-Rates per Hour)			
	TENMILE	REXFORD	CANADA	TOTAL
MAY	7,988(1.46)	1,318(1.14)	-----	9,306(1.39)
JUN	13,917(1.63)	2,281(1.13)	131(0.24)	16,329(1.47)
JUL	7,186(0.87)	1,904(1.16)	234(0.21)	9,324(0.85)
AUG	6,963(1.23)	3,365(1.29)	1,005(0.55)	11,333(1.13)
SEP	712(0.45)	1,175(0.64)	1,214(0.61)	3,101(0.57)
OCT	21(0.28)	10(0.12)	24(0.25)	55(0.22)
TOTAL	36,787(1.25)	10,053(1.08)	2,608(0.46)	49,448(1.11)

Table 14. Harvest and harvest rates by interviewed shore and boat anglers for the five major fish species caught in Libby Reservoir from May 13 through October 31, 1985.

	Hours Fished	Number of fish (fish per hour)				
		Wct	Rbt	Hyb	Kok	Bull
Shore	1,059.8	104 (0.10)	150 (0.14)	95 (0.09)	189 (0.18)	15 (0.01)
Boat	43,402.4	346 (0.01)	605 (0.01)	208 (0.01)	49,254 (1.14)	16 (<0.01)

Overall harvest rates in the U.S. portion were similar for most residence categories (Table 15). Eight of the 11 residence categories exceeded harvest rates of 1.00 fish per hour. Idaho anglers were most successful, harvesting kokanee at a rate of 1.37 c/h. Libby, eastern Montana and Canada angler harvest rates were lower: 0.90, 0.70 and 0.63 kokanee per hour, respectively. Six categories of angler origin were examined in the Canada portion of Libby Reservoir (Table 16). Harvest rates were similar among angler origins with the low of 0.40 salmon per hour by Wardner, B.C., residents and the high of 0.57 c/h from foreign anglers.

Average kokanee per trip for all residences of anglers fishing the U.S. portion is provided in Table 15. The highest number of kokanee per completed trip (8.8) was reached by Idaho anglers, followed by Washington anglers at 8.3 fish per trip. Canadian anglers had the lowest success, catching 3.4 fish per completed trip. As expected, numbers of fish per trip was directly related to harvest rates. Fish per trip is often used to assess the effects of number limits on harvest. All angler categories were well below the 20 fish per day limit allowed. In the Canadian area, kokanee per trip ranged from 2.94 for foreign anglers to 1.60 per trip by Wardner, B.C., residents (Table 16). These values are also below the 15 daily salmon limit.

Total kokanee caught by angler origin for completed trip reflected harvest rates, number of anglers, and hours fished. Idaho and Washington anglers creel 16,195 (34.8 percent) and (28.9 percent) of the fish examined in the U.S. respectively (Table 15). In Canada, the majority of kokanee were taken by other East Kootenay (local) residents (2,069, 79.3 percent) corresponding with the highest number of anglers and total hours expended (Table 16).

Overall harvest rates for rainbow trout, cutthroat trout and rainbow x cutthroat trout hybrids were low (0.03 c/h). Of the Salmo spp., rainbow trout catch rates were highest (0.05 c/h) in the Canada area (Appendix Tables G1, G2 and G3). This higher rainbow harvest rate could be a result of problems associated with the determination of hybrids in Lake Koocanusa. Due to this identification problem and overall low harvest rates, trout species were combined and presented as Salmo species (Table 17). The harvest rate for Salmo species remained low throughout much of the creel period with higher rates during early spring and fall. The Canada area had the highest overall rate of 0.06 and high monthly rates of 0.34 c/h and 0.16 c/h occurred during May and June, respectively. Average harvest rates in the Tenmile section were 0.03 Salmo per hour while a rate of 0.02 c/h occurred in the Rexford area. The highest monthly rate in the U.S. of 0.46 fish per hour was reached in the Tenmile area during October. The lower Salmo harvest rates during the 1985 census when compared to catch rates in the 1981 census are likely a result of the shift from a trout fishery to primarily a kokanee fishery. Gill net trend data for Salmo species between 1980 and 1985 shows similar

Table 15. Harvest and harvest rate from completed trip interviews by angler origin for kokanee salmon caught in the U.S. portion of Libby Reservoir from May 13 through October 31, 1985.

USA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Libby	4750 (10.2%)	4.4	0.90
Eureka or Rexford Area	1144 (2.5%)	5.0	1.16
Other Lincoln County	914 (2.0%)	6.4	1.13
Flathead County	4414 (9.5%)	5.1	1.00
Sanders County	1530 (3.3%)	7.0	1.10
Other Western Montana (west of continental divide)	2750 (5.9%)	6.8	1.33
Eastern Montana (east of continental divide)	297 (0.6%)	4.0	0.70
Idaho	16195 (34.8%)	8.8	1.37
Washington	13456 (28.9%)	8.3	1.30
Other nonresidents (USA)	821 (1.8%)	5.9	1.22
Canadian	240 (0.5%)	3.4	0.63

Table 16. Harvest and harvest rate by angler origin for kokanee salmon caught in the Canadian portion of Libby Reservoir from May 13 through October 31, 1985.

CANADA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Wardner, B.C.	134 (5.1%)	1.60	0.40
Other East Kootenays	2069 (79.3%)	2.08	0.47
Other B.C.	123 (4.8%)	1.89	0.50
Alberta	232 (8.9%)	1.69	0.41
Other Canada	0	0.00	0.00
Foreign	50 (1.9%)	2.94	0.57

Table 17. Monthly Salmo spp. harvest and harvest rates (in parentheses) for 3,323 completed trip angler interviews for each area of Libby Reservoir during 1985.

MONTH	Numbers of <u>Salmo</u> spp. Caught (Catch Rates per Hour)			
	TENMILE	REXFORD	CANADA	TOTAL
MAY	323(0.06)	69(0.06)	22(0.34)	414(0.06)
JUN	371(0.04)	40(0.02)	86(0.16)	497(0.04)
JUL	36(<.01)	16(0.01)	68(0.06)	120(0.01)
AUG	65(0.01)	21(0.01)	84(0.05)	170(0.02)
SEP	129(0.08)	31(0.02)	100(0.05)	260(0.05)
OCT	35(0.46)	7(0.08)	5(0.05)	47(0.19)
TOTAL	959(0.03)	184(0.02)	365(0.06)	1508(0.03)

catches of 6.0 and 4.9 fish per net night (Chisholm and Fraley 1985).

Salmo species were creeled more successfully (0.33 c/h) by shore anglers. Shore anglers creeled rainbow, cutthroat and hybrid trout at 0.14, 0.10, and 0.09 fish per hour, respectively. The overall harvest rate of trout by boat anglers was 0.03 per hour nine percent of the overall shore angling rate (Table 14). Interviewed boat anglers caught 1,159 Salmo species while interviewed shore anglers creeled 349 (23.1 percent of the total Salmo catch).

Rainbow trout, cutthroat trout and hybrid trout harvest rates in the U.S. were similar and low (<0.01 to 0.04 c/h) for all categories of angler origin (Appendix Tables G5, G6 and G7). Other Lincoln county residents creeled rainbow at 0.04 fish per hour for the highest rate of all trout species. Local residents appear to have better success at catching trout in the U.S. portion of the reservoir. Lincoln county residents fish per trip rates ranged from 0.04 to 0.24 Salmo per trip while anglers from outside Lincoln County caught Salmo at rates ranging between 0.01 to 0.10 fish per angling trip (Appendix Tables G5, G6, G7). In the Canadian portion of the reservoir harvest rates by angler origin were low and varied little. Rainbow trout were the most often creeled trout species with a high of 0.26 fish per trip from other East Kootenay residents. Local anglers and other B.C. residents appear more successful with higher numbers of trout per angler trip and better harvest rates (Appendix Tables G9 through G11).

The harvest rate of bull trout (char) was very low (<0.01 c/h) for the entire creel period (Appendix Table G4). The highest rate of 0.05 fish per hour was reached during May in the Canada area.

Bull trout were creeled by shore anglers at 0.01 fish per hour. Boat anglers caught bull trout incidental to kokanee fishing with less than 0.01 fish taken per hour. Shore anglers caught 15 of the 31 bull trout examined (Table 14).

The breakdown of bull trout harvest rates by angler origin for the U.S. and Canadian portions of the reservoir are shown in Appendix Tables G6 through G12, respectively. Bull trout harvest rates of 0.02 c/h or less were observed in all angler origin categories in both U.S. and Canada. A total of 14 bull trout were checked in the U.S. portion, of which six were creeled by Idaho anglers. In Canada, 14 of the total 17 creeled were taken by other East Kootenay residents.

Fishing Pressure

An estimated 518,916 hours were spent fishing on Libby Reservoir between May 13 and October 31, 1985 (Table 18). Boat

Table 18. Estimated pressure (hours) on Libby Reservoir by angler category for each two-week period from May 13 through October 31, 1985.

Period	Boat hours Fished	Shore Hours Fished	Total Pressure
May 13 - May 26	37,258	752	38,010
May 27 - Jun 9	36,756	823	37,579
Jun 10 - Jun 23	60,550	1,184	61,734
Jun 24 - Jul 7	73,645	1,396	75,041
Jul 8 - Jul 21	49,379	1,118	50,497
Jul 22 - Aug 4	60,526	1,180	61,706
Aug 5 - Aug 18	59,263	1,414	60,677
Aug 19 - Sep 1	91,819	1,648	93,467
Sep 2 - Sep 15	25,869	652	26,521
Sep 16 - Sep 29	6,431	238	6,669
Sep 30 - Oct 13	5,114	86	5,200
Oct 14 - Oct 31	1,742	73	1,815
TOTAL	508,353	10,563	518,916

anglers expended 96 to 98 percent of the total effort during the creel period (Table 18). Overall fishing effort peaked in late August at 93,467 hours (Table 18, Figure 2). Pressure dropped significantly after this peak, to an estimated 26,251 hours over the next two-week period. Anglers fished an estimated 31,484 hours on the Canadian portion of the reservoir and 487,431 hours (94 percent of the total) on the U.S. portion (Table 19). Highest pressure (hours) occurred in Canada during the first two weeks of August and on the U.S. portion of the reservoir during the last two weeks of August. Total pressure was lowest during October, following the kokanee spawning run.

Total estimated angler-days spent on Libby Reservoir from May 13 through October, 1985, was 93,560 (Table 20). The pressure estimate is equivalent to 0.52 angler-days per square km of reservoir surface area or 2.10 angler-days per surface acre.

Shore anglers accounted for approximately three percent (2,924) of the total estimated angler-days on Libby Reservoir, and approximately two percent of the fishing time. This discrepancy is explained by the shorter average fishing trip duration logged by shore anglers. The pressure trend in angler-days was similar to that for total hours (Figure 2). Two fishing pressure peaks occurred: the first a two-week block encompassing the Independence Day holiday; and the second over a two-week period in late August. Eight percent of the total estimated angler-days or 7,436 fishing trips occurred on the Canadian portion of the reservoir (Table 21). Distribution and timing of angler pressure differed on the two portions of the reservoir, probably a result of reservoir drawdown effects and interrelated fish distribution patterns and angler success rates. Figure 3 illustrates the gradual increase and decline of angler pressure in Canada which accompanies reservoir fill and drawdown patterns. The U.S. portion of the reservoir is less affected by reservoir operation, and fishing pressure increases rapidly in the spring from a two-week value of 6,534 angler-days in late May to 13,536 angler-days pressure during the two-week period encompassing July 4 (Table 21, Figure 3). Estimated two-week angler-pressure peaked at 15,013 days on the U.S. portion, and declined by 71 percent in the two-week period following this peak.

Harvest

An estimated 617,097 fish were harvested from Libby Reservoir during the creel period, May 13 through October 31, 1985 (Table 22). Of this total, 99.3 percent were kokanee and *Salmo* spp. Estimated harvest of kokanee was 597,380 fish or 96.8 percent of the total. The second most commonly caught fish was rainbow trout (8,305 fish) which accounted for 1.3 percent of the total harvest. Westslope cutthroat, rainbow x cutthroat hybrid and bull trout estimated harvest was 4,390, 2,383 and 256 fish, respectively.

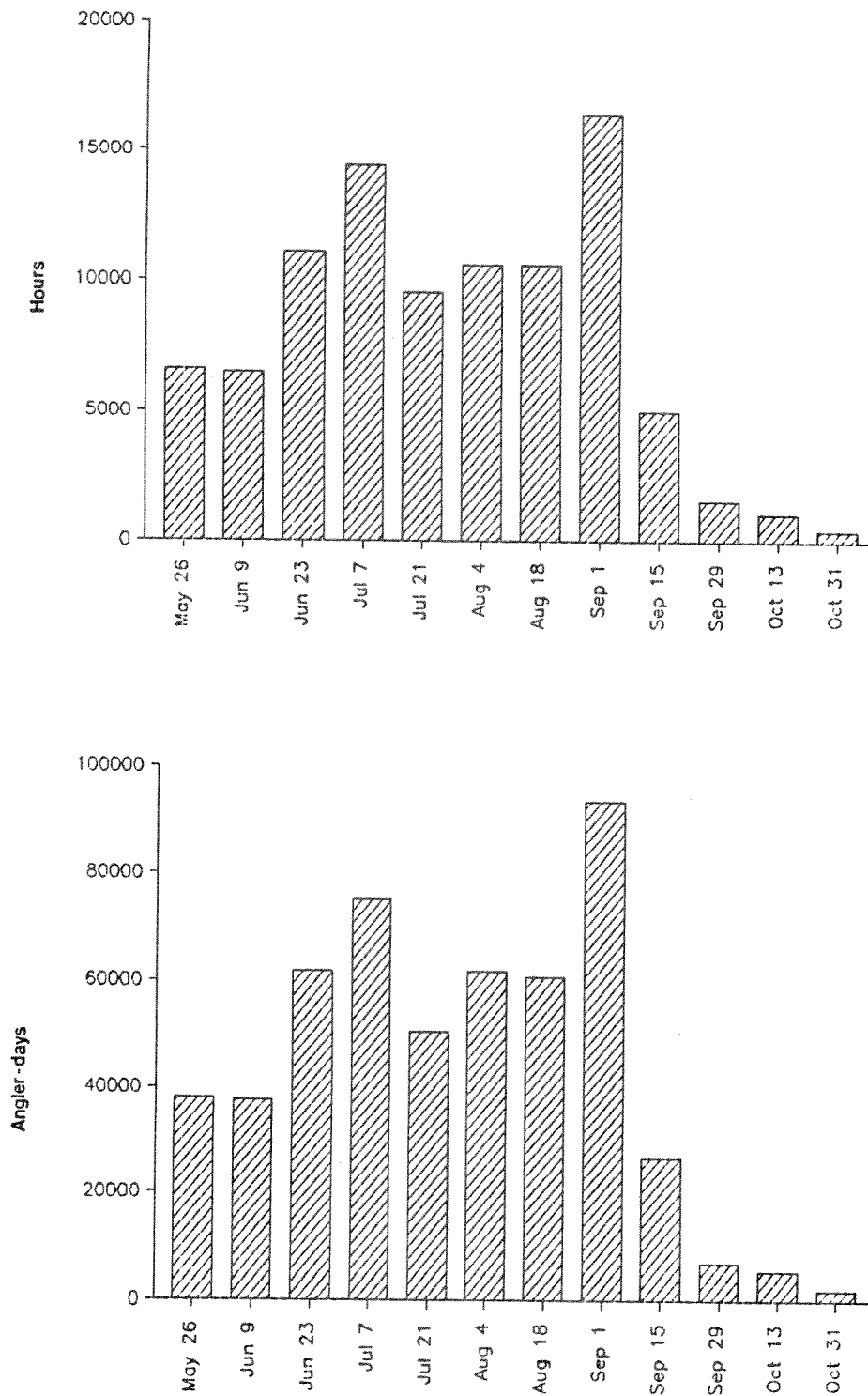


Figure 2. Estimated pressure (top) and estimated angler-days (bottom) on Libby Reservoir by two-week periods, May 13 through October 31, 1985. The date listed represents the last day of each period.

Table 19. Estimated pressure (hours) for the two portions of Libby Reservoir during the creel survey for each two-week period from May 13 through October 31, 1985.

Period	United States	Canada
May 13 - May 26	37,732	278
May 27 - Jun 9	37,060	519
Jun 10 - Jun 23	60,267	1,467
Jun 24 - Jul 7	72,327	2,714
Jul 8 - Jul 21	46,299	4,198
Jul 22 - Aug 4	57,414	4,292
Aug 5 - Aug 18	54,109	6,568
Aug 19 - Sep 1	87,390	6,078
Sep 2 - Sep 15	23,396	3,125
Sep 16 - Sep 29	5,256	1,412
Sep 30 - Oct 13	4,811	388
Oct 14 - Oct 31	1,370	445
Totals	487,431	31,484

Table 20. Estimated angler-days on Libby Reservoir by two-week periods from May 13 through October 31, 1985.

Period	Boat Angler Days	Shore Angler Days	Total Angler Days
May 13 - May 26	6,430	173	6,603
May 27 - Jun 9	6,285	206	6,491
Jun 10 - Jun 23	10,670	386	11,056
Jun 24 - Jul 7	13,977	405	14,382
Jul 8 - Jul 21	9,246	298	9,544
Jul 22 - Aug 4	10,251	315	10,566
Aug 5 - Aug 18	10,182	377	10,559
Aug 19 - Sep 1	15,881	484	16,365
Sep 2 - Sep 15	4,823	174	4,997
Sep 16 - Sep 29	1,480	63	1,544
Sep 30 - Oct 13	1,030	23	1,053
Oct 14 - Oct 31	381	20	401
TOTAL	90,636	2,924	93,560

Table 21. Estimated angler-days for the two portions of Libby Reservoir during the creel survey from May 13 through October 31, 1985.

Period	United States	Canada
May 13 - May 26	6,534	69
May 27 - Jun 9	6,366	125
Jun 10 - Jun 23	10,790	266
Jun 24 - Jul 7	13,536	845
Jul 8 - Jul 21	8,716	828
Jul 22 - Aug 4	9,532	1,034
Aug 5 - Aug 18	8,961	1,599
Aug 19 - Sep 1	15,013	1,353
Sep 2 - Sep 15	4,283	714
Sep 16 - Sep 29	1,200	343
Sep 30 - Oct 13	911	142
Oct 14 - Oct 31	283	118
Totals	86,125 (92.1%)	7,436 (7.9%)

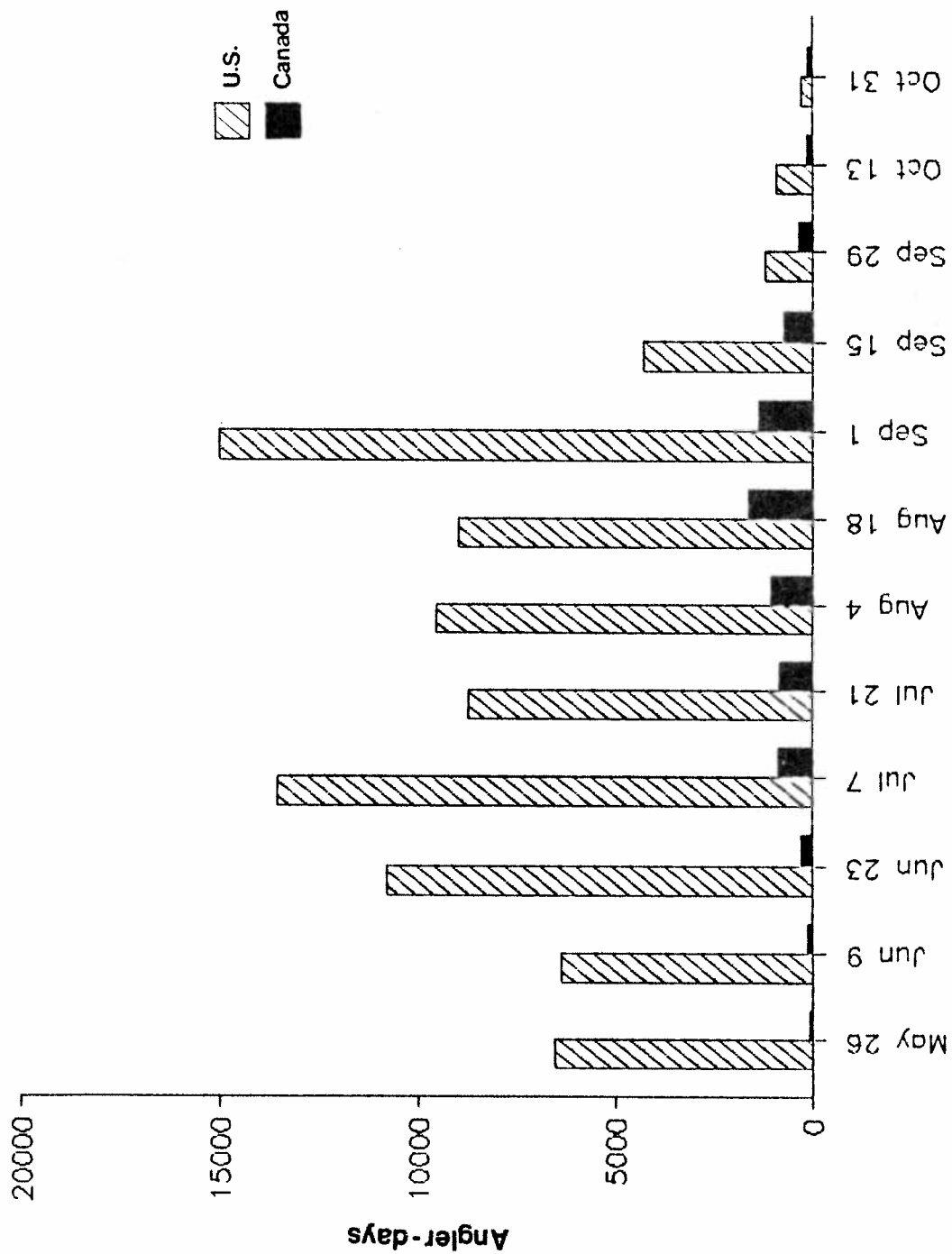


Figure 3. Estimated angler-days for the U.S. and Canadian portions of Libby Reservoir by two-week periods from May 13 through October 31, 1985. The date listed represents the last day of each period.

Table 22. Estimated total number of fish harvested by species from Libby Reservoir from May 13 through October 31, 1985.

Species	Number	(percent of total)
Kokanee salmon	597,380	(96.8)
Rainbow trout	8,305	(1.3)
Westslope cutthroat trout	4,390	(0.7)
Rainbow x cutthroat hybrid	2,383	(0.4)
Northern squawfish	2,006	(0.3)
Mountain whitefish	1,273	(0.2)
Peamouth	636	(0.1)
Bull trout	256	(0.1)
Largescale suckers	348	(0.1)
Longnose suckers	60	(0.1)
Brook trout	48	(<0.1)
Perch	12	(<.01)
TOTAL	617,097	

Combined harvest of kokanee and genus *Salmo* is illustrated in Figure 4. Largest numbers of trout were caught during the late spring and fall months, while kokanee harvest peaked in early July and late August. Trends of kokanee harvest and fishing pressure were similar, reflecting the interrelated nature of angler effort and success. More variable trout harvest probably reflects similar distribution patterns of trout and salmon in spring and fall and incidentally higher catch rates. Also, shore anglers fishing tributaries have high success rates during spring and fall when trout are closely associated with the shoreline. Sixty-six percent of the bull trout harvest occurred by June 23 (Appendix Table H1).

Evidence for 'kokanee fishermen' catching rainbow trout is provided by Appendix Table H1. Estimated rainbow trout harvest peaked at 1,714 fish during the last two weeks in August, at the same time of peak kokanee harvest (87,709 fish). Highest numbers of cutthroat and hybrid trout were caught in late spring with 48 percent and 67 percent of their respective total harvest occurring by June 23 (Appendix Table H1).

Anglers harvested the greatest percentage of the kokanee on the U.S. portion of the reservoir. Ninety-eight percent of the estimated kokanee harvested (585,056 fish) were caught by anglers fishing in the U.S. (Table 23). Anglers fishing on the Canadian portion accounted for 12,323 fish, with 68 percent of these fish being taken from August 5 through October 31 (Table 23). Conversely, 68 percent of the kokanee harvested on the U.S. portion (403,610 fish) were creel prior to August 5.

Over 99 percent of the kokanee harvested were creel by boat anglers (Appendix Table H2). Total kokanee harvest by shore anglers was estimated to be 1,792 fish.

The estimated total harvest of mountain whitefish on Libby Reservoir was 1,273 fish (Table 22). The only other game fish creel by anglers was brook trout, with an estimated 48 fish being harvested. Nongame fish species were almost non-existent in the creel and estimated harvest was less than 0.5 percent of the total harvest. Harvest of squawfish, peamouth, largescale and longnose suckers, and perch were estimated at 2,006, 636, 408 and 12 fish, respectively (Table 22).

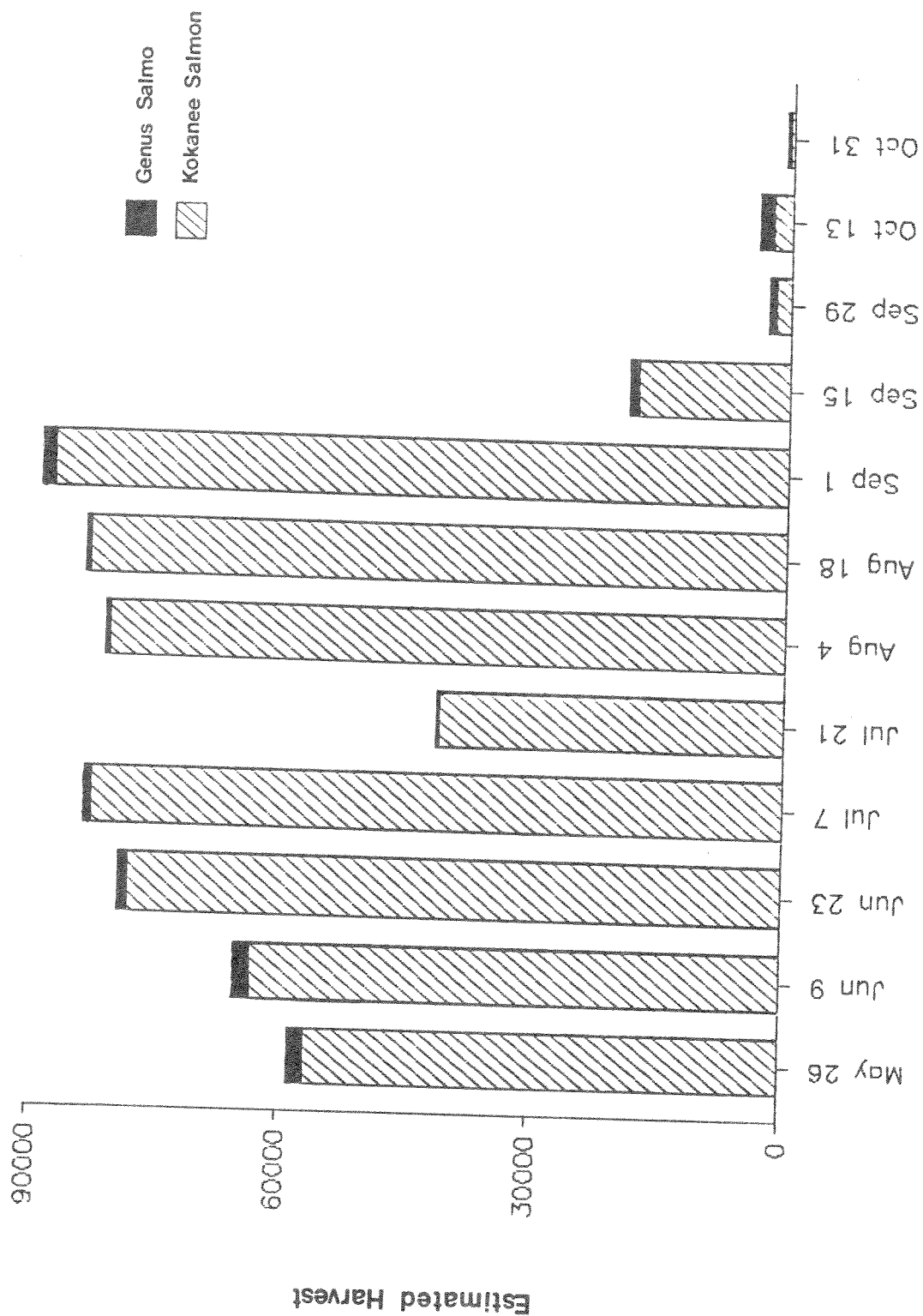


Figure 4. Estimated harvest of Genus Salmon and kokanee salmon on Libby Reservoir by two-week periods, May 13 through October 31, 1985. The date listed represents the last day of each period.

Table 23. Summary of estimated kokanee harvest for the two portions of Libby Reservoir during the creel survey from May 13 through October 31, 1985.

Period	United States	Canada
May 13 - May 26	56,674	88
May 27 - Jun 9	63,165	165
Jun 10 - Jun 23	77,494	745
Jun 24 - Jul 7	82,076	823
Jul 8 - Jul 21	40,635	763
Jul 22 - Aug 4	79,639	1,343
Aug 5 - Aug 18	81,132	2,400
Aug 19 - Sep 1	83,718	3,991
Sep 2 - Sep 15	16,481	1,605
Sep 16 - Sep 29	1,519	277
Sep 30 - Oct 13	2,114	98
Oct 14 - Oct 31	409	25
Totals	585,056 (97.9%)	12,323 (2.1%)

DISCUSSION

The structure of the Libby Reservoir fishery has changed significantly since last quantified by Huston et al. (1984). In 1981, kokanee comprised 14 percent of the total catch, and were being caught at a rate of 0.04 fish per hour. During the same year, cutthroat and rainbow trout made up 28 and 55 percent of the catch and were being caught at an overall catch rate of 0.26 fish per hour. By 1985, kokanee comprised over 96 percent of the total harvest, and kokanee catch rates had climbed to an average 1.11 fish per hour for May through October. Similar kokanee catch rates (0.97 fish per hour) were reported for Flathead Lake during the 1981 license year (Graham and Fredenberg 1983). We estimated nearly 600,000 kokanee were harvested from Libby Reservoir from May through October 1985.

Concurrent with the increase in kokanee population size has been an increase in angling pressure on Libby Reservoir. According to statewide angling survey estimates, fishing pressure has increased by over 500 percent since the 1975 license year (Table 24). The largest increase in pressure occurred from 1984 to 1985, when survey estimates rose from 39,392 to 114,229 angler days. Montana's statewide angling survey estimate for license year 1985 (114,229 angler days) compares favorably with our estimate of 93,560 angler days use on the entire reservoir (May through October 1985). Given the disparity of analysis techniques and incomplete sample year of the creel estimate, the two estimates agree closely.

The increasing trend of non-resident angler use first noted by Huston et al. (1984) continues as the kokanee fishery establishes itself. From 1976 to 1978, non-resident anglers made up less than 12 percent of the angler population. Non-resident angler use increased to 41 percent of all anglers in 1981. By 1985, non-residents comprised 55 percent of the total anglers. In addition to the excellent kokanee fishing, other probable factors affecting this increase are the campground facilities, and the relative remoteness and beauty of the Kootenai drainage.

A cyclic pattern of every third kokanee year class being "strong" has occurred on Libby Reservoir and will continue until the kokanee spawning population stabilizes. The 1983 year class (1985 spawners) was the strongest year class of kokanee since their introduction in 1979-1981. Angler pressure was accordingly high. From their installation in May to the end of October in 1985, the car counters logged 102,709 crossings (Appendix Table II).

However, despite a subsequent drop in kokanee numbers in 1986 to an estimated 10 to 15 percent of 1985 levels, angling pressure appeared to remain high. Comparison of boat ramp use for identical time periods in 1985 and 1986 illustrates this point

Table 24. Summary of estimated fishing pressure (angler-days) from Statewide Angling Surveys for the Montana portion of Libby Reservoir.

Period	Total	Resident	Non-resident
May 1975 - April 1976	18,568	16,003	2,564
May 1982 - April 1983	35,245	20,173	15,072
May 1983 - April 1984	34,330	25,379	8,950
March 1984 - Feb. 1985	39,932	30,598	9,334
March 1985 - Feb. 1986	114,229	33,855	80,373

(Appendix Table I1). When the 1985 Kikomun Creek crossings are disregarded to enable equitable comparison (Kikomun Creek was not monitored in 1986), total crossings in 1986 (66,308) are 71 percent of those recorded in 1985 (93,756). Actual 1986 crossings were higher; three car counters malfunctioned due to rain and missed counts for four to six weeks. At the McGillivray, Cripple Horse and Rexford boat ramps, where complete data existed for both years, 1986 crossings were 89, 73, and 87 percent of those recorded in 1985, respectively.

Angler use patterns between the two years were also similar. Graphs of 1985 and 1986 ramp use for the McGillivray, Cripple Horse and Rexford boat ramps show distinct use patterns among the three boat ramps, but very similar use patterns between years for each location (Appendix Tables I1, I2 and I3). This suggests fishing pressure on Libby Reservoir was fairly stable between the two years. The dramatic increase in fishing pressure since 1975, the high angling pressure and harvest experienced in 1985, and the apparent stability of angling pressure in 1986 are indicative of the growing importance of the Libby Reservoir fishery.

On a regional basis, pressure on Libby Reservoir is comparatively high. Survey pressure estimates for the 1985 license year on Flathead Lake and Lake Mary Ronan, two popular regional fisheries, were 75,964 and 18,398 angler days, respectively. Our pressure estimate on Libby Reservoir for May through October 1985 was 93,560 angler days. Estimated pressure on Libby Reservoir is equivalent to 2.10 angler-days per surface acre. This is lower than Lake Mary Ronan, with estimated angler density of 12.2 angler days per acre and higher than Flathead Lake, which experienced 1.34 angler-days per surface acre in 1985.

Creel information will be used in the fishery component of the computer model being developed by this project. The creel results will help define seasonal mortality more clearly, especially the angler component (fishing mortality). Creel results will also help refine our standing crop estimates. In conjunction with age and growth analysis, seasonal harvest rates will also allow assessment of differential fishery recruitment.

Data from the economic survey, conducted as part of our creel research, is being analyzed and will be presented in an addendum to this report. This analysis will provide site-specific net economic value for the Libby Reservoir fishery. We are aware of only one other study (Leathe 1984) that substantiated the economic value of a Montana fishery. Economic valuation is a critical step in cost-benefit analysis of resource tradeoffs.

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Appendix A

Complete listing of all creel and economic survey forms and instructions used by Libby Reservoir creel survey in 1985. Asterisk (*) indicates a suggested inclusion or modification of form. The suggestions are provided for clarity and to facilitate data processing.

FORM A

CREEL CENSUS INSTRUCTIONS

Suggested Introduction

I am an employee of the State of Montana Department of Fish, Wildlife and Parks and I'd like to ask you a series of questions. The purpose of this survey is to gather information on fisherman harvest rates and the economic value of the sport fishery of Lake Koocanusa. Please be as specific as possible in your answers and also, please keep in mind that you will remain anonymous.

In question 1 on the economic survey, the zip code of the party leader's primary residence is requested. Occasionally, confusion results when a party leader's primary residence is out of state but he/she spends the summer in Montana. As a rule of thumb, if a person maintains a residence of any sort (motel, cabin, campground, RV park, house, etc.) in a fixed location in Montana for two months or more, then use that Montana zip code as their residence and consider their trip(s) as having originated from that location (i.e., for questions 3,5,10b and 10c). Otherwise, use their out of state zip code as their point of origin in answering subsequent questions.

Detailed Instructions - Creel Interview

This information must be filled out for parties interviewed for economic information.

Interview only parties that have fished for at least one half hour on the census day. If you plan to remain in a limited area, or if it doesn't look like a busy day ask parties that have yet to complete their fishing "how long do they plan to fishing today?" Then plan on returning to interview them later. Go ahead and fill out data then, but keep track of that data form and revise it when you return to re-interview that party. Interview only [heads of parties (one person per party)], but collect fish information from the entire party. Look closely for tags, clipped fins, and potential signs of tag loss (holes or scars near the dorsal fin). Record all this information. Be sure to look at all creeled fish.

NOTE: When conducting boat interviews - ask at least questions #84 and #85.

- COLUMN 1: Year
- COLUMNS 2-5: Party identification number: One number per party. This number is unique and is used to identify party that fish data corresponds to.
- COLUMNS 6-7: Area of reservoir: 1 = Dam up to bridge; 2 = Bridge up to border; 3 = Border to head of reservoir; 4 = Tributary to reservoir.
- COLUMNS 8-9: Day of month.
- COLUMNS 10-11: Month of year
- COLUMN 12: Day of week:
 1=Monday 2=Tuesday 3=Wednesday 4=Thursday
 5=Friday 6=Saturday 7=Sunday
- COLUMN 13:
- COLUMNS 14-15: Number of anglers in party.
- COLUMN 16: Fish from shore or boat: 1=Shore; 2=Boat; 3=Ice.
- COLUMN 17: Type of bait: 1=Bait (worms, etc.); 2=Flies; 3=Lures; 4=Snagging hooks; 5=Any combination of above.
- COLUMNS 18-20: Hours fished.
- This is the total hours for the entire party in tenths of hours. If five people fished and two fished 5 hours, 2 fished 3 hours, and one fished 1-1/2 hours, the total would be $(2 \times 5) + (2 \times 3) + (1 \times 1.5) = 17.5$ hours. For more accuracy, ask them specifically when they started and stopped fishing and if all the people in the party fished the entire time.
- COLUMN 21: Is fishing trip for that day completed?
- 1=Yes; 2=No; 3=Don't know;
 4=Done fishing for day, but trip not over.
- COLUMNS 22-23: Origin. Origin of party is recorded for the following locations using these one digit codes. If party contains anglers from more than one origin code then based on where the majority are from.

For USA

- 1: Libby
- 2: Eureka or Rexford area
- 3: Other Lincoln county

For Canada

- 1: Wardner, B.C.
- 2: Other West Kootenay
- 3: Other B.C.

4: Flathead county (7)	
5: Saunders county (35)	
6: Other Western Montana	
7: Other Eastern Montana	7: Alberta
8: Idaho	
9: Washington	
10: Other USA nonresidents	10: Other Canada
11: Canadian	
12: Other Foreign	12: Foreign

COLUMN 24: Number of cutthroat kept.

COLUMNS 25-26: Number of cutthroat landed. This is the total catch, and includes fish that were kept as well as those that were released.

COLUMNS 29-30: Number of cutthroat examined for marks.

COLUMNS 31-32: Number of cutthroat marked.

Repeat for each species

COLUMNS 73-75: Other species - enter three digit code only for species not listed previously. Use code below:

Rainbow trout	=W001	Peamouth	= W029
Cutthroat trout	=W012	Northern Squawfish	= W033
hatchery	=H012	Redside shiner	= W049
Bull trout	=W005	Longnose sucker	= W056
Hybrid (WCTxRB)	=W011	Largescale sucker	= W058
Kokanee	=W008		
Mountain whitefish	=W085	RARE species:	
Yellow perch	=W020	Brook trout	= W003
Burbot	=W026	Lake trout	= W006

COLUMNS 76-77: Number of "Other Species" kept.

COLUMNS 78-79: Number of "Other Species" landed (kept and released).

COLUMNS 80-81: Number of "Other Species" examined for marks.

COLUMNS 82-83: Number of "Other Species" marked.

COLUMN 84: Where did you access the reservoir?

1=McGillivray; 2=Barron Creek; 3=Cripple Horse Marina;
 4=Peck Gulch; 5=Rexford Campground; 6=Tobacco Plains;
 7=Kikomun Creek; 8=Other.

COLUMN 85: Did you use the boat ramp? This applies to launching a boat or driving down the ramp to park - will usually be boat launch.

0=don't know; 1=yes; 2=no.

* Suggested modification: Columns 22-23: Origin. Use discreet numbers for all locations regardless of political boundaries.

FORM B

Car Counter Recording Instructions

Check the car counter every Friday evening after 6:00 pm and every Monday morning before 9:00 am. Try to check counter on Tuesday morning before 9:00 am following a three-day weekend (Monday Holiday) and after 6:00 pm on days preceding mid-week holidays and before 9:00 am on days following a mid-week holiday. Record the following:

Column 1: Location code:
1 = McGillivray 5 = Rexford
2 = Barron Creek 6 = Tobacco Plains
3 = Cripple Horse 7 = Kikomun Creek
4 = Peck Gulch 8 = Other

Columns 2-7: Date (month/day/year)

Columns 8-11: Military time counter was checked. Record to nearest half hour. Midnight is 0000, noon is 12000, 3:30 pm is 1530, etc.

Column 12: Day of Week Code:
1=Monday 2=Tuesday 3=Wednesday 4=Thursday
5=Friday 6=Saturday 7=Sunday

Columns 13-17: Car counter record at time of previous count check.

Columns 18-22: Car counter reading at present. Carry this total forward to next reading date columns 13-17.

Column 23: Was car counter operation checked?

1 = YES 2 = NO

Column 24: Was the counter working properly when checked.

0 = not checked
1 = yes
2 = no
3 = not checked, but seems to be recording improperly.

Comments: Write down if counter O.K. and anything important, such as battery change.

*Note: This form should not be used for car counter interviews.

FORM C

**CAR COUNTER INTERVIEWS
INSTRUCTIONS**

This form is to be used when stationed at a car counter on a boat ramp. This data will be important in determining the number of anglers crossing the car counter. This form must be completed for all vehicles crossing the counter during the survey period. If you are so busy with large numbers of people arriving or leaving make sure you at least collect these data, but you can skip the creel census angler interviews. When possible, complete all three forms: car counter interview; creel census and economic interview; and collect individual fish information. Interview each party crossing the counter only once - as they are leaving. If you are working an early shift (7:00 am to 11:00 am), and can keep track of people putting in, go ahead and complete this form as they put in, but be sure you don't interview them again as they leave.

Record the following for each vehicle that crosses the counter (Note: If there are people that don't drive across the counter, but go out fishing, or whatever, with a boat that does - include them in as part of the interview with the party that crosses the counter):

Column 1: Counter location code.

1 = McGillivray	5 = Rexford
2 = Barron Creek	6 = Tobacco Plains
3 = Cripple Horse	7 = Kikomun Creek
4 = Peck Gulch	8 = Other

Columns 2-7: Date (month/day/year)

Column 8: Day of week.

1=Monday	2=Tuesday	3=Wednesday	4=Thursday
5=Friday	6=Saturday	7=Sunday	

Columns 9-12: Military time to nearest half hour. Midnight is 0000 hrs, noon is 1200 hrs, 3:30 pm is 1530 hrs.

Columns 13-14: Total number in party (whether they are fishing or not).

Columns 15-16: Total number of anglers in party. Ask this question.

Columns 17: Are they using a boat or shore fishing. Ask and record predominant type of fishing.

1 = Shore
2 = Boat
3 = Ice

Columns 18-19: Origin of majority of party.

For USA Counters

- 1: Libby
- 2: Eureka or Rexford area
- 3: Other Lincoln county
- 4: Flathead county (7)
- 5: Saunders county (35)
- 6: Other Western Montana
- 7: Other Eastern Montana
- 8: Idaho
- 9: Washington
- 10: Other USA nonresidents
- 11: Canadian
- 12: Other Foreign

For Canadian Counters

- 1: Wardner, Bull River,
Jaffray, Bayres Lake,
Newgate area
- 2: Fernie or Cranbrook
- 3: Other West Kootenay
- 4:
- 5:
- 6: Other East B.C.
- 7: Other West B.C
- 8: Other West Alberta
- 9: Other East Alberta
- 10: Other Canadian
- 11: USA
- 12: Other Foreign

Columns 20: Parked above or below car counter while out in boat?
 1 = above
 2 = below
 0 = don't know
 3 = sightseers or multiple crossings by a fishing
 party.

Column 21-22: Days boat was left in reservoir (without trailering
 again)?

* Suggested modification: Origin of majority of party. Use
 discreet numbers for all locations
 regardless of political boundaries.

* Suggested Inclusion: Car counter reading at the start of
 interview shift.

 Car counter reading the the end of
 interview shift.

FORM D
CREEL CENSUS - Fish Form Instructions

When time permits (and minimum of 10 parties or 10 % of the parties contacted per day) take fish measurements. Use I.D. number from Creel Census Form (columns 2-5) for each fish measured. Chances are you will be measuring lots of kokanee. It is o.k. to limit yourself to measuring 50 to 100 kokanee a day. Please try to measure and examine all trout and at least look at the kokanee to see if any are adipose clipped or tagged. We are trying to make a mark-recapture estimate, so we must have an accurate account of the number of fish examined and number tagged. If fish were caught in some other area than you are presently censusing, it's o.k. to measure them. If they were caught in another body of water - ignore them. Fill out the form using the following procedure:

COLUMNS 2-5: Party I.D. Number (from Creel Census Form)

COLUMNS 6-9: Species code (see below) with the first space a W=wild or H=hatchery (cutthroat only will be hatchery)

Rainbow trout	=W001	Peamouth	= W029
Cutthroat trout	=W012	Northern Squawfish	= W033
hatchery	=H012	Redside shiner	= W049
Bull trout	=W005	Longnose sucker	= W056
Hybrid (WCTxRB)	=W011	Largescale sucker	= W058
Kokanee	=W008		
Mountain whitefish	=W085	RARE species:	
Yellow perch	=W020	Brook trout	= W003
Burbot	=W026	Lake trout	= W006

COLUMNS 10-13 Length in mm (if you only have an English scale, please note it is in inches)

COLUMNS 14-17: Weight in grams (only if there is lots of time, or for large fish) - not necessary.

COLUMN 18: Fish tagged or obviously fin-clipped (0=unsure, 1=tagged, 2=fin-clipped, 3=possible lost tag)

COLUMNS 19-20: Tag type or fin clip type (see below)

Tag types:
 1=spaghetti
 2=flag (colored - no number)
 3=dangler (plastic disc with number)

Fin clips

10=adipose clip
11=upper caudal
12=lower caudal
13=caudal punch
14=anal clip
15=anal punch
16=dorsal punch
17=left pelvic (rear paired fin)
18=right pelvic (rear paired fin)
19=left pectoral (front paired fin)
20=right pectoral (front paired fin)

COLUMN 21:

Tag Color

1=Dark blue
2=Light blue
3=Green
4=Red
5=Yellow
6=Orange
7=White
8=Black

COLUMNS 22-26: Tag number (last five numbers)

* Suggested Inclusion: DATE

FORM E
Economic Survey

Be sure to collect economic data from party leader (any member of each party). The purpose of interviewing party leaders is to be sure we are collecting this data by party and not by individual. Ask the party leader if his party has answered the economic portion of the interview before. If the party has previously supplied economic information do not ask the economic questions again. No repeat interviews on economic questions - please. If things are jammed up at car counters you may skip the economic questions.

Date:

Party ID:

Questions:

1. What is the zip code of your residence?
2. If from Montana, what is the county (vehicle license number designation)?
3. Is fishing from Lake Koocanusa the main purpose of your trip?
If no, skip to question 9.

1 = Yes 2 = No

4. How many individuals in your party, including yourself, traveled here to fish today?
5. How many days will you spend on Lake Koocanusa fishing during this trip from your home?
6. What were the main species (specific kinds) of fish you fished for today? Rank in order or priority. (See species codes - next page)
7. How many years in your life (average for party) have you been fishing?
8. On average, how many days per year do you fish?
9. Would you come to Lake Koocanusa if you could not have fished?

1 = Yes 2 = No

10. How many miles (one way) did you drive from your home to Lake Koocanusa?
11. Did you use any other transportation besides auto or truck (i.e., plane, train, etc.) to reach Lake Koocanusa? If so,

approximately how much did that transportation cost you (one way)?

12. If Lake Koocanusa wasn't your primary destination, how many extra miles did you drive to reach Lake Koocanusa?
13. What other destinations have you, and do you plan on visiting this trip?

Species Codes: Economic Questions

- 1 = Rainbow trout
- 2 = Cutthroat trout
- 3 = Bull trout
- 4 = Any trout
- 5 = Kokanee
- 6 = Burbot
- 7 = Mountain whitefish
- 8 = Other
- 9 = Anything

APPENDIX B

Creel Census Analysis Methodology

APPENDIX B

A detailed explanation of the analysis methodology employed by this study is presented. As stated in the Methods section, study design and analysis were modeled after Graham and Fredenberg (1983), but significant modifications were incorporated in our analysis and are explained for reference and clarification.

Step 1. DERIVING ANGLERS PER VEHICLE. Vehicle counts were obtained from all car counters every Friday night and Monday morning to separate total weekday and weekend day counts. Location-specific car counter data were segregated by weekend day-weekday for each two-week period originally used to randomly select sample days. Using the car counter interviews, we determined average counts per angling party for each category (two-week period, weekend-weekday), at each location. All cars crossing a car counter were interviewed as they left the boat ramp, ensuring that non-fishing traffic was accounted for and only completed trip anglers were represented. As it was impossible to conduct car counter interviews for every counter location on a representative weekday and weekend day, we used two mathematical methods to calculate missing counts per angling party data. Simple linear regression was performed using existing counts per angling party and associated total counts. If the correlation coefficient was above $R=0.50$, the regression equation (and the appropriate total counts value) was used to estimate the counts per angling party. If the correlation was below $R=0.50$, the mean counts per angling party for all existing values at that location were used to estimate missing values. Total counts were then divided by counts per angling party to determine the total number of angling parties crossing each car counter during that weekday-weekend category and two-week period.

Step 2. CALCULATING TOTAL ANGLING PARTIES. Because the resulting numbered angling parties represents only those crossing car counters, this figure was expanded to total angling parties by dividing by the percentage of angling parties that used boat ramps. Use and non-use of ramps was calculated directly from the creel interview data form (See Appendix A). Angling party figures for each counter location were expanded by the percentage of non-ramp users fishing in the reservoir area that counter was located in. Creel interview data were also used to split estimated total angling parties into shore and boat angling parties in each area. All percentages used are provided in Table 1. Unlike Graham and Fredenberg (1983), we did not apply a 'camping' factor which increases the estimate to account for the number of anglers camping on the reservoir and therefore not crossing the ramps for every fishing trip. Since five of the seven car counter ramps were associated with campgrounds, our estimates should be conservative. A 'camping' factor was not used because the bias associated with its derivation and application was unknown.

Step 3. CALCULATING TOTAL ANGLER DAYS. Average overall number of boat and shore anglers were determined by using car counter and creel interview data. Average size of boat and shore parties were separated by day of week, two-week period, and car counter location. Average party size was multiplied by the total number of angling parties for each appropriate angler category (boat and shore), and class (weekend day - weekday, two-week period, and car counter location) to determine angling days.

Step 4. DETERMINING PRESSURE. Average hours fished were multiplied by the total number of angling days for each angling category (boat and shore), two-week period, and car counter location and summed to determine total pressure estimates (angling hours). Retention of data within the above classes and categories through this step was done to minimize the variability that occurred at each level.

Appendix Table B1. Breakdown of creel interviews used to estimate boat, shore, and total pressure.

Area Fished	Shore or Boat	Ramp use	Number Angling Parties	Percent of Area Total
Area 1 Tenmile	shore	yes	38	6.42
	shore	no	39	3.60
	boat	yes	594	88.25
	boat	no	155	7.73
Area 2 Rexford	shore	yes	2	0.20
	shore	no	19	1.85
	boat	yes	959	93.56
	boat	no	45	4.39
Area 3 Canada	shore	yes	10	4.60
	shore	no	86	4.72
	boat	yes	2,111	71.91
	boat	no	185	18.77

APPENDIX C

Distribution of Party Interviews and Interview Hours

Appendix Table C1. Distribution of party interviews by two-week periods for each area of Libby Reservoir, May 13 through October 31, 1985.

Wave	Tenmile		Rexford		Canada	
	Week-day	Week-end	Week-day	Week-end	Week-day	Week-end
May 13 - May 26	25	148	12	99		9
May 27 - Jun 9	124	493	26	17	13	21
Jun 10 - Jun 23	73	156	30	53	16	31
Jun 24 - Jul 7	118	273	63	119	9	46
Jul 8 - Jul 21	30	144	31	33	30	30
Jul 22 - Aug 4	79	125	56	45	32	78
Aug 5 - Aug 18	72	192	46	75	35	72
Aug 19 - Sep 1	89	68	62	103	35	120
Sep 2 - Sep 15	55	49	28	87	71	93
Sep 16 - Sep 29	29	36	8	19	11	49
Sep 30 - Oct 13	3	3	4	--	5	14
Oct 14 - Oct 31	5	3	2	7	3	3
TOTALS	702	1,690	368	657	260	566
	29.4%	70.6%	35.9%	64.1%	31.5%	68.5%
Overall						
		weekday = 31.4%				
		weekend = 68.7%				

Appendix Table C2. Distribution of ramp use by two-week periods for Libby Reservoir from May 13 through October 31, 1985.

Period	Used Ramp		Didn't use ramp		TOTAL Angling Parties
	Angling Parties	%	Angling Parties	%	
May 13 - May 26	257	88.3	34	11.7	291
May 27 - Jun 9	582	86.6	90	13.4	672
Jun 10 - Jun 23	311	93.1	23	6.9	334
Jun 24 - Jul 7	530	83.2	107	16.8	637
Jul 8 - Jul 21	261	85.3	45	14.7	306
Jul 22 - Aug 4	386	91.9	34	8.1	420
Aug 5 - Aug 18	452	90.4	48	9.6	500
Aug 19 - Sep 1	441	93.2	32	6.8	473
Sep 2 - Sep 15	318	80.9	75	19.1	393
Sep 16 - Sep 29	111	70.3	47	29.7	158
Sep 30 - Oct 13	19	63.3	11	36.7	30
Oct 14 - Oct 31	20	87.0	3	13.0	23
	<u>3,688</u>	<u>87.04</u>	<u>549</u>	<u>12.96</u>	<u>4,237</u>

Note: An additional six angling parties were uncategorized.

Appendix Table C3. Number of anglers and hours fished for 4,243 interviewed angling parties for each area of Libby Reservoir by two-week periods, May 13 through October 31, 1985.

Period	Tenmile		Rexford		Canada	
	Number Anglers	Hours	Number Anglers	Hours	Number Anglers	Hours
May 13 - May 26	463	2923.5	273	1039.5	20	46.8
May 27 - Jun 9	1448	8141.8	109	479.5	69	208.0
Jun 10 - Jun 23	566	3095.1	219	1045.0	97	368.5
Jun 24 - Jul 7	1119	6206.0	477	2089.0	117	417.5
Jul 8 - Jul 21	420	2239.8	146	797.2	126	555.5
Jul 22 - Aug 4	512	2773.0	248	1082.6	249	930.5
Aug 5 - Aug 18	637	3768.1	300	1646.8	218	914.5
Aug 19 - Sep 1	364	1796.2	403	2148.5	336	1516.5
Sep 2 - Sep 15	261	1577.0	262	1285.5	331	1444.5
Sep 16 - Sep 29	137	563.4	53	213.6	126	444.5
Sep 30 - Oct 13	12	38.5	10	26.0	41	141.5
Oct 14 - Oct 31	12	43.7	19	82.5	15	55.5
TOTALS	5951	33166.1	2519	11935.7	1745	7043.8

Overall Total Number Anglers	10,215
Total Hours Fished	52,145.6

APPENDIX D

Length of Fishing Trips

Appendix Table D1. Average hours fished by completed trip boat and shore anglers on Libby Reservoir for each two-week period from May 13 through October 31, 1985.

Period	Average Hours Boat Anglers	Average Hours Shore Anglers
May 13 - May 26	5.4	4.3
May 27 - Jun 9	5.4	4.2
Jun 10 - Jun 23	5.5	3.5
Jun 24 - Jul 7	4.9	3.6
Jul 8 - Jul 21	5.3	3.8
Jul 22 - Aug 4	5.7	3.8
Aug 5 - Aug 18	5.5	3.8
Aug 19 - Sep 1	6.0	3.5
Sep 2 - Sep 15	5.4	3.8
Sep 16 - Sep 29	4.4	3.8
Sep 30 - Oct 13	4.6	3.7
Oct 14 - Oct 31	4.9	3.6
AVERAGE	5.3	3.8

APPENDIX E

Species Composition of the Catch

Appendix Table E1. Total hours fished and catch (percent) of kokanee (KOK), rainbow (RB), westslope cutthroat (WCT), rainbow x cutthroat hybrid, and bull trout (DV) for 3,323 completed trip interviews on Libby Reservoir by two-week periods, May 13 through October 13, 1985.

Period	Hours Fished	KOK	RB	WCT	RBxWCT	DV
May 13 - May 26	3,556.3	95.6	1.8	1.4	1.1	0.1
May 27 - Jun 9	8,292.5	95.8	1.5	1.3	1.3	0.1
Jun 10 - Jun 23	4,129.1	97.8	1.2	0.7	0.2	0.1
Jun 24 - Jul 7	7,386.0	98.9	0.7	0.2	0.1	<.1
Jul 8 - Jul 21	2,915.5	98.8	0.7	0.3	0.1	<.1
Jul 22 - Aug 4	4,071.0	98.6	0.8	0.3	0.2	<.1
Aug 5 - Aug 18	5,566.6	99.1	0.5	0.2	0.1	<.1
Aug 19 - Sep 1	4,090.4	96.4	2.2	1.0	0.4	0.0
Sep 2 - Sep 15	3,355.0	99.4	0.4	0.1	0.1	0.0
Sep 16 - Sep 29	872.6	66.9	21.7	10.2	1.2	0.0
Sep 30 - Oct 13	116.5	63.8	25.9	10.3	0.0	0.0
Oct 14 - Oct 31	142.7	40.0	31.1	17.8	8.9	2.2

APPENDIX F

**Size of the Harvested Game Fish and Size of Gillnetted Game Fish
during May through October 1985**

Appendix Table F1. Monthly average length (mm) of harvested kokanee for each area of Libby Reservoir. Number measured in parentheses.

Month	Area			Total ^{a/} Length
	Tenmile Length	Rexford Length	Canada Length	
May	--	--	--	--
June	310 (122)	309 (37)	316 (7)	310 (181)
July	319 (236)	321 (81)	332 (28)	321 (351)
August	324 (87)	319 (40)	305 (34)	319 (178)
September	321 (9)	321 (4)	330 (48)	328 (61)
October	310 (5)	-- (0)	312 (5)	303 (23)
Grand Mean	317 (459)	318 (162)	322 (122)	318 (794)

^{a/} Includes some tributary caught fish

Appendix Table F2. Average lengths and weight for measured game fish harvested by interviewed anglers from Libby Reservoir during May 13 through October 31, 1985.

Species	Average Length (mm)	Average Weight (g)	Number Measured
Cutthroat	294	305	8
Rainbow	312	348	16
Cutthroat x Rainbow Hybrids	370	537	5
Bull Trout	396	615	3
Kokanee	334	490	4

Appendix Table F3. Average lengths from gill net catches on Libby Reservoir from May through October, 1985.

Month	RB	HB	WCT	KOK	DV
May	(37) 361	(10) 352	(14) 348	(168) 294	(7) 405
Jun	(48) 339	(26) 290	(15) 283	(169) 314	(41) 354
Jul	--	--	--	(114) 328	--
Aug	(68) 342	(34) 334	(26) 253	(377) 338	--
Sep	--	--	--	(40) 337	--
Oct	(123) 309	(43) 294	(71) 291	(356) 354	(12) 465
Grand Mean	(276) 329	(113) 310	(126) 289	(1224) 332	(60) 382

APPENDIX G

Breakdown of Harvest Rates by Month, Area and Angler Origin for Game Fish

Appendix Table G1. Monthly rainbow trout harvest and harvest rates (in parentheses) for 3,323 completed trip angler interviews for each area of Libby Reservoir during 1985.

MONTH	Numbers of Rainbow Trout (Catch Rates per Hour)			
	TENMILE	REXFORD	CANADA	TOTAL
MAY	119(0.02)	27(0.02)	15(0.23)	161(0.02)
JUN	134(0.02)	23(0.01)	55(0.10)	212(0.02)
JUL	17(<0.1)	8(<.01)	54(0.05)	79(0.01)
AUG	23(<.01)	12(0.01)	66(0.04)	101(0.01)
SEP	72(0.05)	21(0.01)	80(0.04)	173(0.03)
OCT	18(0.24)	7(0.08)	4(0.04)	29(0.11)
TOTAL	383(0.01)	98(0.01)	274(0.05)	755(0.02)

Appendix Table G2. Monthly westslope cutthroat trout harvest and harvest rates (in parentheses) for 3,323 completed trip angler interviews for each area of Libby Reservoir during 1985.

MONTH	Numbers of Cutthroat Trout Caught (Catch Rates per Hour)			
	TENMILE	REXFORD	CANADA	TOTAL
MAY	133(0.02)	18(0.02)	7(0.11)	158(0.02)
JUN	97(0.01)	15(0.01)	22(0.04)	134(0.01)
JUL	11(<.01)	6(<.01)	12(0.01)	29(<.01)
AUG	26(<.01)	4(<.01)	16(0.01)	46(<.01)
SEP	44(0.03)	7(<.01)	18(0.01)	69(0.01)
OCT	13(0.17)	---	1(0.01)	14(0.06)
TOTAL	324(0.01)	50(0.01)	76(0.01)	450(0.01)

Appendix Table G3. Monthly rainbow x cutthroat trout hybrid harvest and harvest rates (in parentheses) for 3,323 completed trip angler interviews for each area of Libby Reservoir during 1985.

MONTH	Numbers of Rainbow x Cutthroat Trout Caught (Catch Rates per Hour)			
	TENMILE	REXFORD	CANADA	TOTAL
MAY	71(0.01)	24(0.02)	---	95(0.01)
JUN	140(0.02)	2(<.01)	9(0.02)	151(0.01)
JUL	8(<.01)	2(<.01)	2(<.01)	12(<.01)
AUG	16(<.01)	5(<.01)	2(<.01)	12(<.01)
SEP	13(0.01)	3(<.01)	2(<.01)	18(<.01)
OCT	4(0.05)	---	---	4(0.02)
TOTAL	252(0.01)	36(<.01)	15(<.01)	303(0.01)

Appendix Table G4. Monthly bull trout harvest and harvest rates (in parentheses) for 3,323 completed trip angler interviews for each area of Libby Reservoir during 1985.

MONTH	Numbers of Bull Trout Caught (Catch Rates per Hour)			
	TENMILE	REXFORD	CANADA	TOTAL
MAY	5(<.01)	1(<.01)	3(0.05)	9(<.01)
JUN	5(<.01)	1(<.01)	11(0.02)	17(<.01)
JUL	---	---	1(<.01)	2(<.01)
AUG	1(<.01)	---	1(<.01)	2(<.01)
SEP	---	---	---	---
OCT	---	1(0.01)	---	1(<.01)
TOTAL	11(<.01)	3(<.01)	16(<.01)	31(<.01)

Appendix Table G5. Harvest and harvest rate by angler origin for rainbow trout caught in the U.S. portion of Libby Reservoir from May 13 through October 31, 1985.

USA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Libby	133 (28.1%)	0.12	0.03
Eureka or Rexford Area	22 (4.6%)	0.10	0.02
Other Lincoln County	34 (7.2%)	0.24	0.04
Flathead County	66 (13.9%)	0.08	0.02
Sanders County	19 (4.0%)	0.09	0.01
Other Western Montana (west of continental divide)	18 (3.8%)	0.04	0.01
Other Eastern Montana (east of continental divide)	6 (1.3%)	0.08	0.01
Idaho	84 (17.7%)	0.05	0.01
Washington	83 (17.5%)	0.05	0.01
Other non residents (USA)	2 (0.4%)	0.01	<0.01
Canadian	7 (1.5%)	0.10	0.02

Appendix Table G6. Harvest and harvest rate by angler origin for westslope cutthroat trout caught in the U.S. portion of Libby Reservoir from May 13 through October 31, 1985.

USA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Libby	96 (25.7%)	0.09	0.02
Eureka or Rexford Area	18 (4.8%)	0.08	0.02
Other Lincoln County	15 (4.0%)	0.10	0.02
Flathead County	55 (14.7%)	0.06	0.01
Sanders County	15 (4.0%)	0.07	0.01
Other Western Montana (west of continental divide)	6 (1.6%)	0.02	<0.01
Other Eastern Montana (east of continental divide)	3 (0.08%)	0.04	0.01
Idaho	105 (28.1%)	0.06	0.01
Washington	58 (15.5%)	0.04	0.01
Other non residents (USA)	2 (0.5%)	0.01	<0.01
Canadian	1 (0.3%)	0.01	<0.01

Appendix Table G7. Harvest and harvest rate by angler origin for hybrid trout (westslope cutthroat x rainbow) caught in the U.S. portion of Libby Reservoir from May 13 through October 31, 1985.

USA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Libby	91 (31.9%)	0.08	0.02
Eureka or Rexford Area	8 (2.8%)	0.04	0.01
Other Lincoln County	7 (2.5%)	0.05	0.01
Flathead County	44 (15.4%)	0.05	0.01
Sanders County	8 (2.8%)	0.04	0.01
Other Western Montana (west of continental divide)	5 (1.7%)	0.01	<0.01
Other Eastern Montana (east of continental divide)	3 (1.1%)	0.04	0.01
Idaho	83 (29.1%)	0.05	0.01
Washington	32 (11.2%)	0.02	<0.01
Other non residents (USA)	3 (1.1%)	0.02	<0.01
Canadian	1 (0.4%)	0.01	<0.01

Appendix Table G8. Harvest and harvest rate by angler origin for bull trout caught in the U.S. portion of Libby Reservoir from May 13 through October 31, 1985.

USA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Libby	3	<0.01	<0.01
Eureka or Rexford Area	0	0.00	0.00
Other Lincoln County	2	0.01	<0.01
Flathead County	1	<0.01	<0.01
Sanders County	1	0.01	<0.01
Other Western Montana (west of continental divide)	0	0.00	0.00
Other Eastern Montana (east of continental divide)	1	0.01	<0.01
Idaho	6	<0.01	<0.01
Washington	0	0.00	0.00
Other non residents (USA)	0	0.00	0.00
Canadian	0	0.00	0.00

Appendix Table G9. Harvest and harvest rate by angler origin for rainbow trout caught in the Canadian portion of Libby Reservoir from May 13 through October 31, 1985.

CANADA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Wardner, B.C.	17 (6.2%)	0.20	0.05
Other East Kootenays	224 (81.8%)	0.23	0.05
Other B.C.	11 (4.0%)	0.17	0.05
Alberta	22 (8.0%)	0.16	0.04
Other Canada	0	0.00	0.00
Foreign	0	0.00	0.00

Appendix Table G10. Harvest and harvest rate by angler origin for westslope cutthroat trout caught in the Canadian portion of Libby Reservoir from May 13 through October 31, 1985.

CANADA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Wardner, B.C.	3 (4.0%)	0.04	0.01
Other East Kootenays	65 (85.5%)	0.07	0.02
Other B.C.	0	0.00	0.00
Alberta	8 (10.5%)	0.06	0.01
Other Canada	0	0.00	0.00
Foreign	0	0.00	0.00

Appendix Table G11. Harvest and harvest rate by angler origin for hybrid trout (westslope cutthroat x rainbow) caught in the Canadian portion of Libby Reservoir from May 13 through October 31, 1985.

CANADA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Wardner, B.C.	0	0.00	0.00
Other East Kootenays	13 (86.6%)	0.01	<0.01
Other B.C.	1 (6.7%)	0.02	<0.01
Alberta	1 (6.7%)	0.01	<0.01
Other Canada	0	0.00	0.00
Foreign	0	0.00	0.00

Appendix Table G12. Harvest and harvest rate by angler origin for bull trout caught in the Canadian portion of Libby Reservoir from May 13 through October 31, 1985.

CANADA Angler Origin	Total No. of Fish Caught	Number per Angler	Fish per Hour (c/h)
Wardner, B.C.	1 (5.9%)	0.01	0.00
Other East Kootenays	14 (82.4%)	0.01	0.00
Other B.C.	0	0.00	0.00
Alberta	2 (6.7%)	0.02	0.02
Other Canada	0	0.00	0.00
Foreign	0	0.00	0.00

APPENDIX H

Harvest of Game Fish

Appendix Table H1. Distribution of the estimated harvest of all primary game fish creeled from Libby Reservoir for each two-week period from May 13 through October 31, 1985.

Period	Kok	Rb	Wct	RbxWct	Dv	TOTAL
May 13 - May 26	56,762	951	780	620	32	59,145
May 27 - Jun 9	63,330	956	816	798	77	65,977
Jun 10 - Jun 23	78,239	897	508	120	60	79,824
Jun 24 - Jul 7	82,899	478	152	61	20	83,610
Jul 8 - Jul 21	41,398	294	139	52	17	41,900
Jul 22 - Aug 4	80,982	591	197	168	15	81,953
Aug 5 - Aug 18	83,532	403	185	98	22	84,240
Aug 19 - Sep 1	87,709	1,714	754	297	--	90,474
Sep 2 - Sep 15	18,086	624	229	87	--	19,026
Sep 16 - Sep 29	1,796	550	260	31	--	2,637
Sep 30 - Oct 13	2,213	669	268	--	--	3,150
Oct 14 - Oct 31	434	178	102	51	13	778
TOTAL	597,380	8,305	4,690	2,383	256	612,714

Appendix Table H2. Summary of kokanee boat and shore harvest on Lake Kooacanusa for each two-week period May 13 through October 31, 1985.

Period	Kokanee Boat Harvest	Kokanee Shore Harvest	Total Harvest
May 13 - May 26	56,591	170	56,762
May 27 - Jun 9	63,140	190	63,330
Jun 10 - Jun 23	78,004	235	78,239
Jun 24 - Jul 7	82,651	249	82,899
Jul 8 - Jul 21	41,274	124	41,398
Jul 22 - Aug 4	80,739	243	80,982
Aug 5 - Aug 18	83,281	251	83,532
Aug 19 - Sep 1	87,446	263	87,709
Sep 2 - Sep 15	18,031	54	18,086
Sep 16 - Sep 29	1,791	5	1,796
Sep 30 - Oct 13	2,206	7	2,213
Oct 14 - Oct 31	433	1	434
TOTAL	595,588	1,792	597,379

APPENDIX I

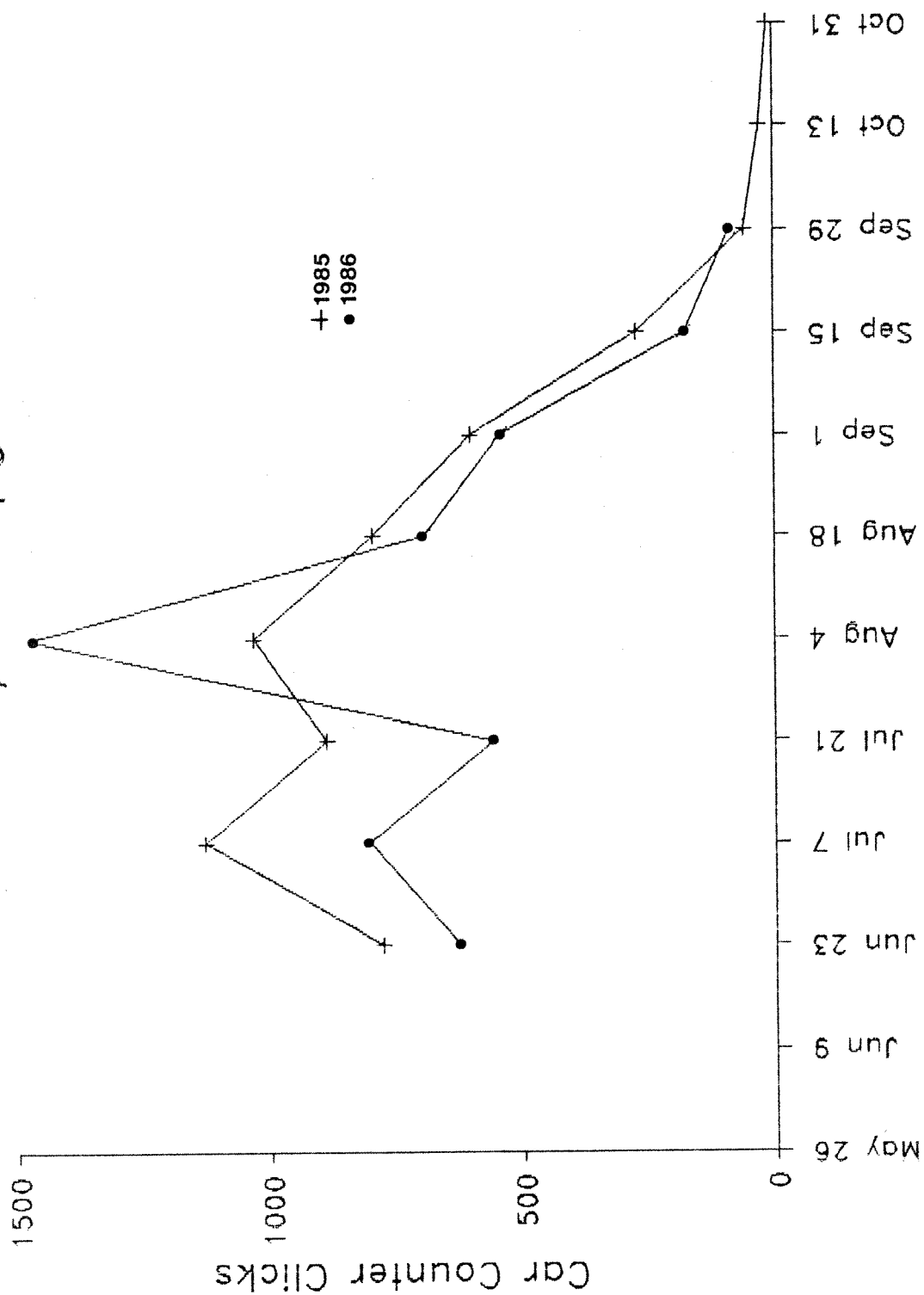
**Comparison of Boat Ramp use on Libby Reservoir
during Identical Time Periods in 1985 and 1986**

Appendix Table 11. Comparison of ramp use for identical time periods in 1985 and 1986 for the seven established boat ramp access points on Libby Reservoir.

Period	McGillivray		Barron		Cripple		Peck		Rexford		Tobacco		Kikoman		Total	
	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986
May 13 - May 26	closed	closed	448	580	2398	1776	1519	586	2747	2036	closed	closed	closed	--	7112	4978
May 27 - Jun 9	*		1654	800	4170	3218	1157	1539	1151	2342	closed	closed	closed	--	8132	7899
Jun 10 - Jun 23	777	625	1688	--	3130	2379	3004	--	2960	2635	53	closed	136	--	11748	5639
Jun 24 - Jul 7	1127	803	963	--	2445	1226	2546	--	3369	1924	601	--	1128	--	12179	3953
Jul 8 - Jul 21	887	557	643	210	1619	1003	2128	--	4264	2402	875	--	1101	--	11517	4172
Jul 22 - Aug 4	1030	1473	404	542	1344	1454	1951	2236	4453	5066	782	--	1298	--	11262	10771
Aug 5 - Aug 18	794	692	481	923	1514	927	2327	2461	5036	5485	880	429	1865	--	12897	10917
Aug 19 - Sep 1	600	541	432	215	2028	840	3721	1746	6404	4133	1772	1544	1762	--	16719	9019
Sep 2 - Sep 15	271	177	167	148	558	366	1611	617	2961	1999	949	323	906	--	7123	3630
Sep 16 - Sep 29	57	86	101	215	316	447	412	229	1036	1465	257	120	415	--	2594	2562
Sep 30 - Oct 13	28	closed	49	255	71	397	81	253	244	763	39	100	173	--	685	1768
Oct 13 - Oct 31	11	closed	55	348	92	277	59	145	309	206	46	24	169	--	741	1000
TOTAL	5582	4954	7085	4236	19685	14310	20516	9812	34934	30456	5954	2540	8953	--	102709	66308

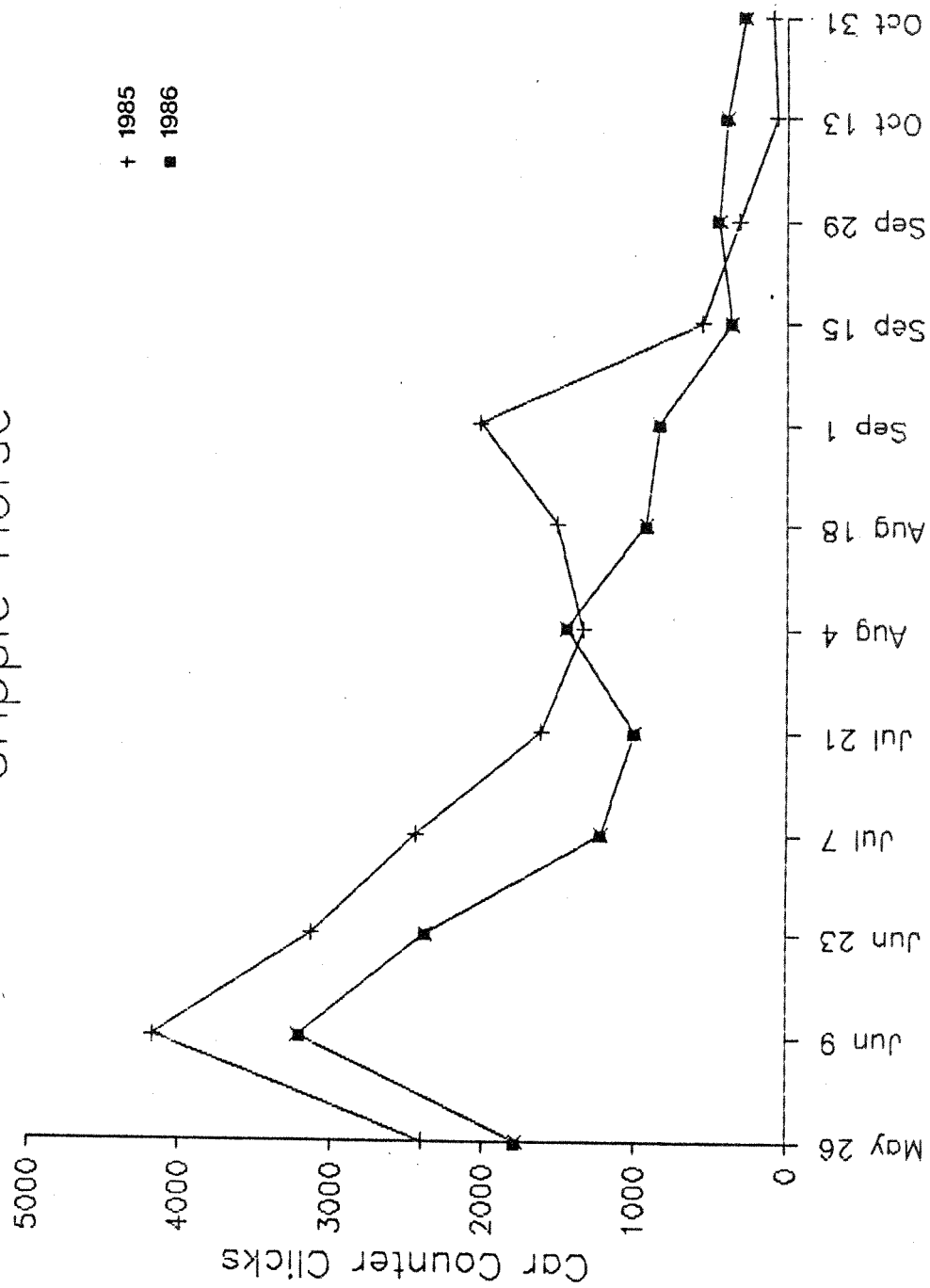
*Indicates incomplete data due to counter malfunction.

McGillivray Campground



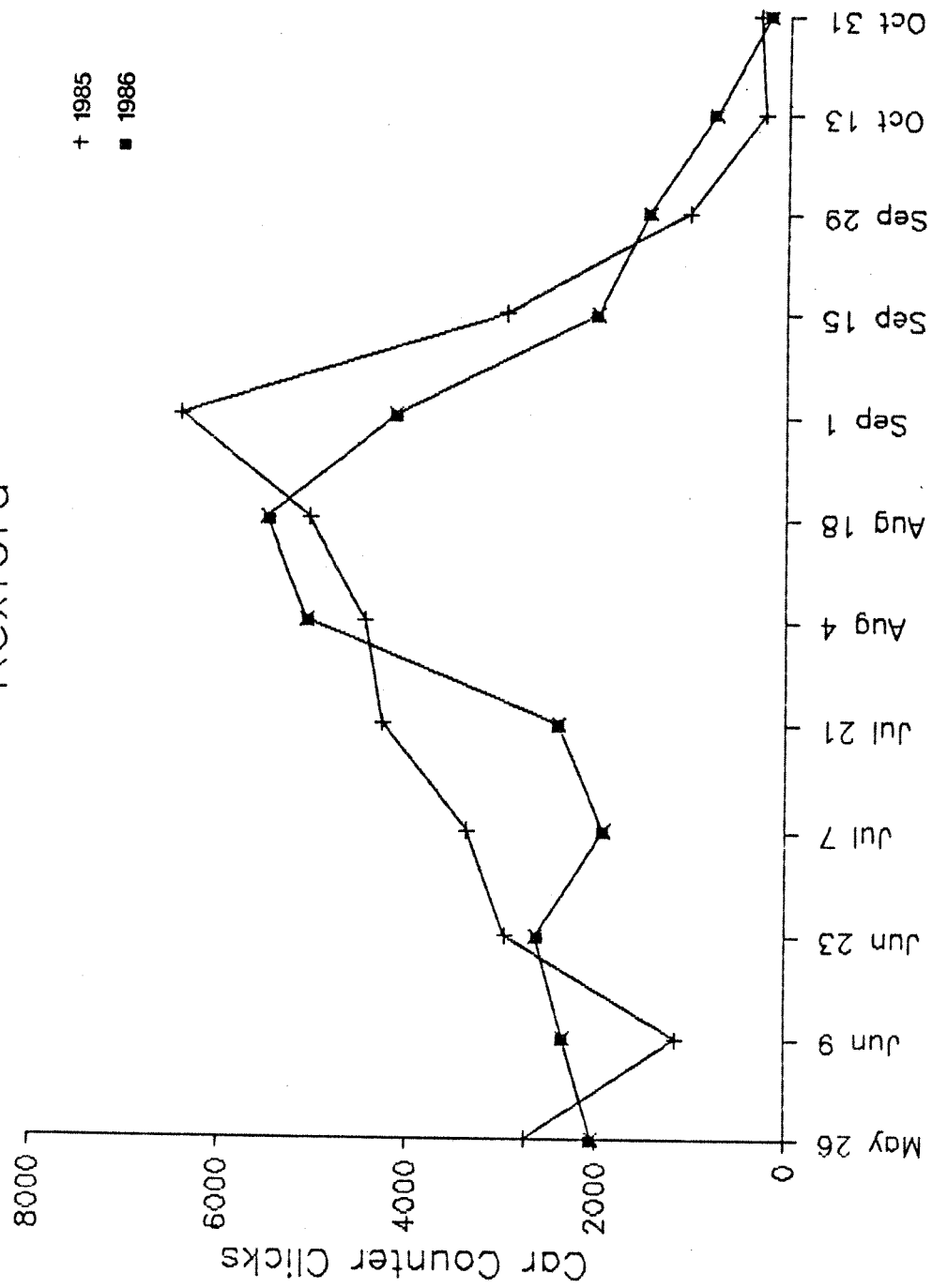
Appendix Figure I1. Total number of counter crossings for McGillivray campground boat ramp, May 26 through October 31, 1985 and May 26 through October 31, 1986.

Cripple Horse



Appendix Figure I2. Total number of counter crossings for Cripple Horse Marina boat ramp, May 26 through October 31, 1985, and May 26 through October 31, 1986.

Rexford



Appendix Figure I3. Total number of counter crossings at Rexford Bench boat ramp, May 26 through October 31, 1985, and May 26 through October 31, 1986.

