Lake Koocanusa Creel Census 1987

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ABSTRACT

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Lake Koocanusa supported 22,370 angler days resulting in a harvest of 33,500 fish from June 17 to September 8 1987. Kokanee contributed to 88 percent of the fish harvested. The fishery was utilized primarily by residents of the Kootenays, nonresidents from Alberta contributed to 12 percent of angler effort. From 1985 to 1987 the fishery on Lake Koocanusa has tripled in terms of effort and catch. The system now provides a major fishery in both southeastern British Columbia and northwestern Montana. To effectively manage the Lake Koocanusa fishery a joint management plan should be drafted by the respective state and provincial agencies.

ACKNOWLEDGEMENTS

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Introduction

The Libby Dam was constructed on the Kootenay River as part of the Columbia River Treaty between the United States and Canada to provide hydroelectric power and flood control for the Kootenay and Columbia river basins (Columbia River Treaty 1961). Construction began in 1966; impoundment was first achieved in March 1972 and the reservoir (known as Lake Koocanusa) reached full pool for the first time in July 1974 (Shepard 1984). Lake Koocanusa at full pool extends 145 km north from the Libby Dam in Montana to Wardner, British Columbia. The reservoir in B.C. has a length of 77 km extending from the Canada/United States boundary to Wardner.

Following the filling of the reservoir in 1974 two fisheries developed both for native westslope cutthroat trout, rainbow trout, bull trout and whitefish, one on tributary streams, the other on Lake Koocanusa. Wild stocks of cutthroat were supplemented in the fisheries by the stocking of hatchery fish in Montana (May 1979). Initially the majority of angling effort was directed at stream fisheries on the lower reaches of reservoir tributaries. Ringstad and Phillips (1978) found that angler effort and catch on one stream, Gold Creek, exceeded the summer effort and catch on Lake Koocanusa. Angling effort on Lake Koocanusa in the late 1970's was less than 1500 angler days and catches did not exceed 1500 cutthroat and rainbow trout (Ringstad and Phillips 1978, Oliver 1980).

In the late 1970's kokanee salmon were accidentally released into the Koocanusa reservoir from the Kootenay Trout Hatchery. The kokanee rapidly established themselves and by 1983 the Montana Department of Fish Game and Parks estimated hydroacoustically that there were 2.5 million Kokanee in the reservoir (Shepard 1984). Associated with the dramatic increase in the abundance of kokanee the fisheries use of the reservoir increased as well.

Chisholm and Hamlin (1987) estimated the 1985 Koocanusa fishery on the Canadian portion of the reservoir to support 6,000 angler days resulting in a catch of 12,000 fish, 96% of which were kokanee.

In 1986 the Ministry of Forests and Lands, the Ministry of Environment and Parks and other provincial government agencies recognized that recreational use around the reservoir had and was continuing to increase rapidly and that this use was driven primarily by the fishery. The increasing levels of recreational effort were creating management, access and land use problems. In 1987 the Ministry of Environment and Parks, Fisheries Branch applied to the Government of British Columbia Job Trac program to conduct a creel census and recreational survey on Lake Koocanusa and the surrounding area. This proposal was funded in June 1987 and administered by the Habitat Conservation Foundation. The objective of this report is to describe the temporal and spatial distribution of angler effort and catch on the Canadian portion of the reservoir, to outline the status of the fishery and to discuss the management implications of the results.

Description of Study Area

Lake Koocanusa is located in southeastern British Columbia (Figure 1). The reservoir was formed following the construction of the Libby Dam in 1972 and has a full pool elevation of 741.5 m. A.S.L. Morphological characteristics of the reservoir are presented in Table 1.

Table 1: Morphometric data on Lake Koocanusa adapted from May 1979

Area (hectares)	18,160
Drainage (sq. km)	23,491
Average annual discharge (cu dam)	7,021,897
Shoreline (km)	360
Maximum length (km)	145
Shoreline development	7.41

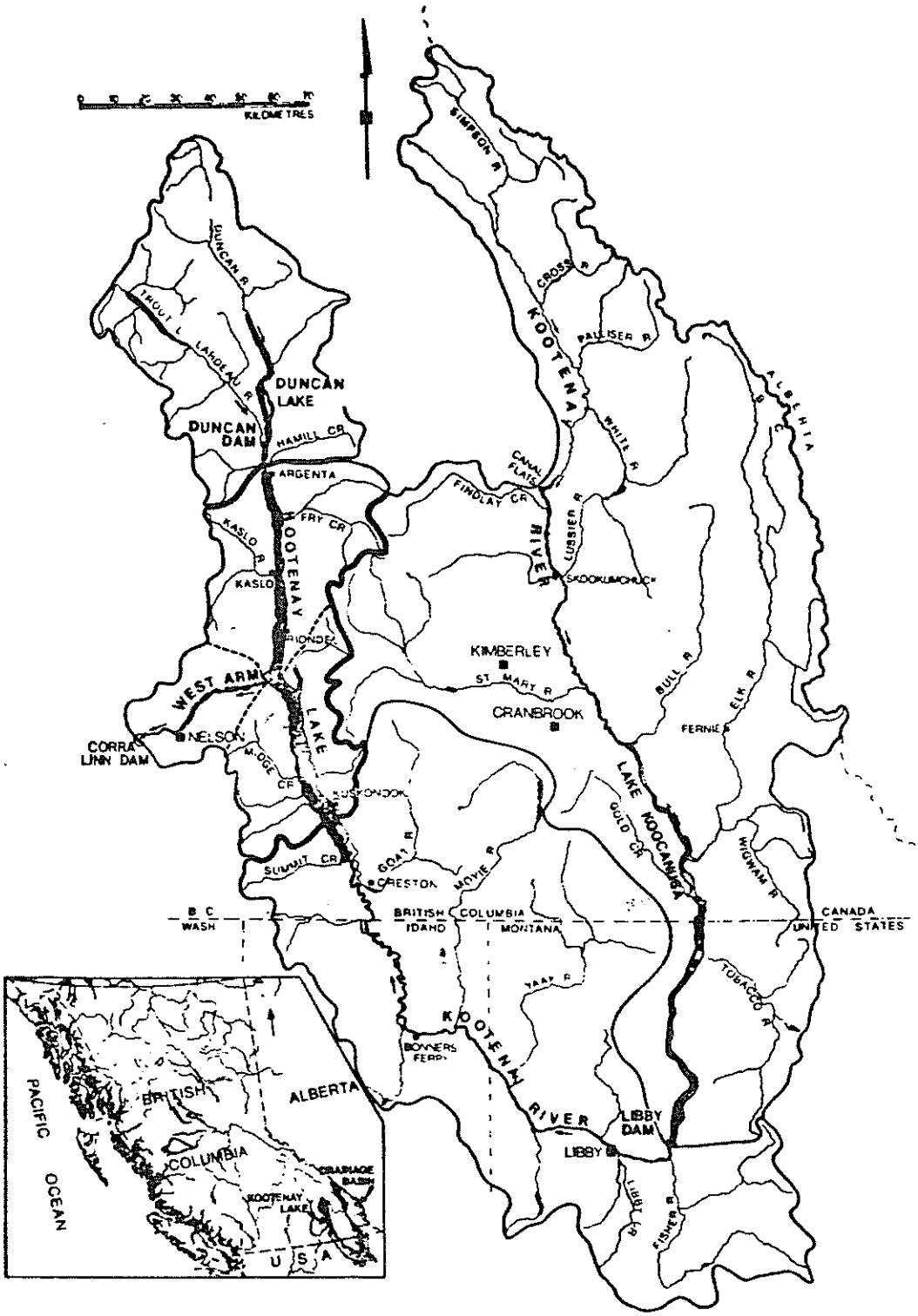

Figure . 1. Location map for the Kootenay River basin.

Maximum breadth (km)	3.86
Mean depth (m)	112.7
Maximum depth (m)	38.4
Storage capacity (cu dam)	4,711,013
Usable storage (cu dam)	4,001,216
Water retention (years)	.66
Elevation at full pool MASL	749.5
Elevation at minimum operating pool MASL	697

The 145 km long reservoir, at full pool, extends 77 km into British Columbia. The reservoir elevations are governed by the operation of the Libby Dam and vary considerably from year to year depending on the discharge of the Kootenay River. Generally the reservoir is full by late June and held there until September after which the reservoir is drawn down reaching minimum pool by late April. Annual draw downs average 30 m; longitudinally this results in the reservoir extending only 19 km into Canada, south of the Elk River. The reservoir fills rapidly from late April to June during spring freshet.

Lake Koocanusa is accessable by a network of public Forest Service access roads. A bridge is centrally located at Kikomum Creek and at the northern end of the reservoir at Wardner. The majority of land surrounding the reservoir is crown with the exception of areas at Wardner, Newgate and Jaffray. Kikomun Creek Provincial Park and a private marina are located on the eastern and western shores of the reservoir respectively, immediately south of the Kikomun Creek bridge. All other access and campsites on the reservoir are currently unregulated and unorganized. These are located primarily an old roads to the valley floor that were used prior to flooding in 1974.

Lake Koocanusa is known to contain twenty fish species. Their relative abundance and distribution from Chisholm and Hamlin (1987) are presented in Table 2. Angling regulations for common game fish in the Canadian portion of the reservoir are: trout and char, 6 fish per day of which only one rainbow and one bull trout may be over 50 cm F.L. The daily limit for kokanee is 15 and whitefish is 25. Possession limits are two daily limits.

Methods

1. Creel Census

The Koocanusa reservoir in British Columbia was divided into two areas for the creel census due to its geographical size. Area A extended from Sand Creek south to the mouth of the Elk River and Area B thence south to the Canada U.S. boundary (Figure 2). Sampling dates were stratified into weekdays and weekends/holidays. Sample dates were randomly selected from each strata. Eight survey dates per month were scheduled for each area (see Appendix 1). The creel census commenced on June 17 and was ended on September 8.

Creel census information was collected at all major access sites by interview clerks at the end of anglers fishing trips. Statistics collected were: area fished, number of persons fishing per boats, length of time spent angling, number and species of fish caught, number and species of fish released and the anglers place of residence. Information was recorded on an interview form (Appendix 2). On each sampling date instantaneous counts of the number of boats fishing in the sampling area were estimated every three hours (from 9:00 to 18:00 hrs) by creel census clerks travelling the length of the study area by boat. These counts took an average of 2 hours to complete.

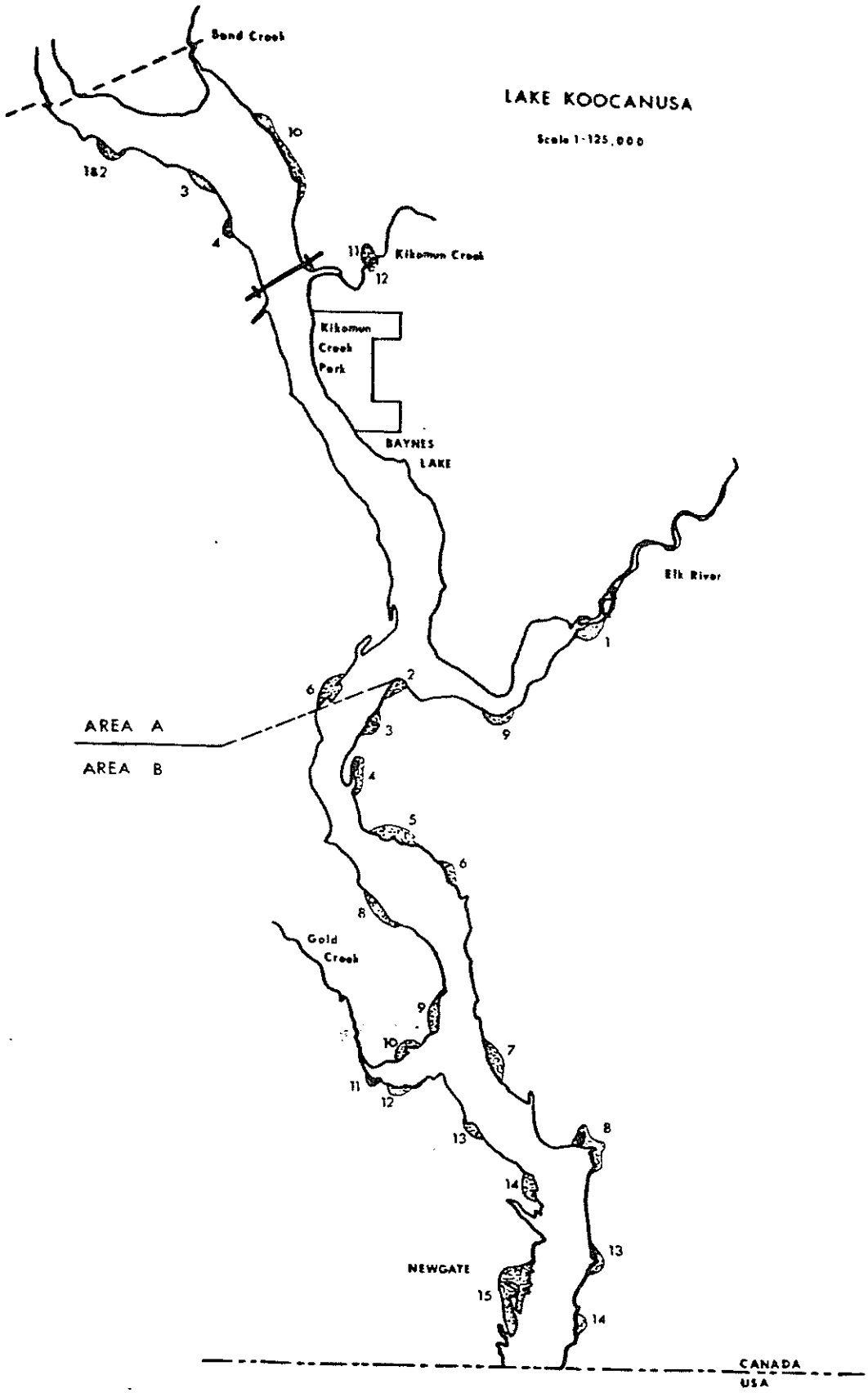

Figure 2. Lake Koocanusa Creel Census Areas in British Columbia

Table 2. 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	Salmo clarki lewisi	A	S
Rainbow trout	Salmo gairdneri	A	I
Bull trout	Salvelinus confluentus	C	S
Brook trout	Salvelinus fontinalis	R	S
Lake trout	Salvelinus namaycush	R	S
Kokanee salmon	Oncorhynchus nerka	C	I
Mountain whitefish	Prosopium williamsoni	C	D
Burbot	Lota lota	C	S
Largemouth bass	Micropterus salmoides	R	S
White sturgeon	Acipenser transmontanus	R	D[a/]
Nongame fish species			
Pumpkinseed	Lepomis gibbosus	R	S
Yellow perch	Perca flavescens	R	I
Redside shiner	Richardsonius balteatus	C	D
Peamouth	Mylocheilus caurinus	A	S
Northern squawfish	Ptychocheilus oregonensis	A	S
Largescale sucker	Catostomus macrocheilus	A	S
Longnose sucker	Catostomus catostomus	C	D
Longnose dace	Rhinichthys cataractae	R	S
Slimy sculpin	Cottus cognatus	R	S
Torrent sculpin	Cottus rhotheus	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.

The estimates of angler effort, catch and success rate were calculated using the following sampling periods: June 17-30, July 1-31, August 1-31 and September 1-8. Angler effort, catch, and success rate were calculated separately for weekdays and weekend and holidays and summed to give the total for each sampling period using the following formula:

$Ah = \bar{x}b \times \bar{x}ab \times f$

where

Ah = angler hours

$\bar{x}b$ = mean of instananeous boat counts for sample strata

$\bar{x}ab$ = mean number of anglers per boat for sample strata

f = hd (number of fishing hours per day) x ds (no fishing days per strata)

$catch = Ah \times \bar{x}CPUE$

where $\bar{x}CPUE$ = mean catch per unit effort by strata and area from interview data.

2. Fish Sampling

The species and fork lengths of fish from the anglers catch were recorded on scale envelopes by interview clerks and scales retained for analysis. Clerks attempted to collect a minimum of 30 samples per month from kokanee, cutthroat and rainbow trout. The scales were aged by counting the number of annuli when viewed using a 3M 800 Michrofiche reader at 36X magnification.

Results

From June 17 to September 8 creel census clerks interviewed 880 anglers who fished a total of 2730 hours to harvest 1100 fish on Lake Koocanusa. The average length of fishing trip was 3.1 hours. Due to the nature of the reservoir angling from boats accounted for virtually all angling effort. No attempt was made to include persons fishing from shore in the census.

Total effort was estimated to be 69,354 angler hours of effort (total effort (hrs)/ average length of fishing trip (hr) = 22,370 angler days) resulting in a harvest of 33,500 fish from June 17 to September 8, 1987. The average success rate was .48 fish per rod hour. Kokanee contributed to 88 % of the fish harvested, rainbow to 6 %, while cutthroat were caught incidentally.

Angler effort and catch was concentrated in July and August (Table 2). Greater effort occurred in area A than B in spite of higher catch success rates in the latter. Success rates in each area were similar from month to month with the exception of the June 17 to 30 sampling period in Area A.

Table 2: Summary of Angler effort, fish harvest and success rates for areas A and B, Lake Koocanusa.

	Area A			Area B		
Sampling Period	Effort hrs	Harvest fish	Success fish/hr	Effort hrs	Harvest fish	Success fish/hr
June 17-30	5920	6792	1.15	4386	2908	0.66
July 1-31	18187	6808	0.37	12938	7180	0.55
Aug.1-31	12654	3298	0.26	11776	5186	0.44
Sept.1-18	1790	481	0.27	1703	850	0.50
Total	38551	17379	0.45	30803	16124	0.52

Kokanee dominated the catch and harvest accounting for 88 percent of all fish kept by anglers. Other game fish species, rainbow, cutthroat and whitefish accounted for only 9 percent of fish harvested (Table 3). Anglers caught a high proportion of coarse fish, primarily squawfish and peamouth chub, most of which were released. Release rates for sport fish were low with the exception of whitefish.

Table 3: Total fish caught, harvested and released, by species, for all interviewed anglers.

Species	% of Total Catch (n=1944)	% of Total Harvest (n=1099)	% of Total (Released n=845)
Kokanee	53	88	6
Rainbow	4	6	1
Cutthroat	1	1	1
Whitefish	8	2	16
Other	34	3	76

The average length of Kokanee and trout captured in the reservoir was approximately 31 cm. (Table 4). No large fish (>40 cm) were recorded in the creel census samples. Kokanee caught were primarily three years old (2+). Rainbow trout captured were three or four years of age (2+ ,3+).

TABLE 4: Average length and length at age of all measured kokanee, rainbow trout and cutthroat trout harvested by interviewed anglers (June 17-September 8, 1987).

Species	x length (cm) of all measured fish (n)	x length (cm) of fish at age: 2+(n)	3+(n)	4+(n)	5+(n)
Kokanee	30.7 (106)	---	31.0(25)	---	---
Rainbow	30.4 (26)	28.3(12)	32.7(8)	34.5(1)	32.0(1)
Cutthroat	32.2 (5)	---	32.9(3)	31.1(2)	---

The Lake Koocanusa fishery was utilized primarily by local anglers. Residents of the Kootenays comprised 86 percent of all anglers. Alberta fishermen, primarily from the Lethbridge and Calgary areas, contributed to 12% of angler effort, while residents of other regions of B.C. contributed 2%.

Discussion

The increase in angler effort and catch on Lake Koocanusa has been dominated and driven by kokanee following their accidental introduction in the late 1970's. In 1985 Lake Koocanusa supported 93,500 angler days resulting in a harvest of 617,000 fish. The majority of angler effort and catch occured the American portion of the reservoir which supported 92% of all effort and 98% of all catch (Chisholm and Hamlin 1978). The reason for this discrepancy is that the reservoir fluctuates approximately 30 m vertically. In the spring two thirds of the reservoir in Canada is dry, most of its surface area and kokanee are concentrated on the Montana side of the international boundary. As the reservoir fills, the kokanee migrate north into British Columbia, as suitable reservoir habitat for them increases and the kokanee spawning season approaches. The majority of spawning streams utilized by kokanee are located at the northern end of the reservoir.

The introduction of kokanee changed the Canadian reservoir fishery from a cutthroat-rainbow fishery in the late 1970's to one dominated by kokanee. By the mid 1980's angler effort and catch had increased dramatically.

Table 6. Effort harvest and catch composition from the Lake Koocanusa Fishery 1976-1977

Year	Effort	Harvest	% Catch Composition				
			CT	RB	BT	WF	KOK
1976 [1]	890	1047	56	35	06	02	___
1979 [2]	1,330	4304	32	05	03	70	___
1985 [3]	7,500	12,500	1.5	1.5	___	02	96
1987	22,370	33,500	1	6	___	2	88

1. Ringstad and Phillips 1978
2. Oliver 1980
3. Chisholm and Hamlin 1987

CT = cutthroat WF = whitefish
Rb = rainbow KOK= kokanee
BT = bull trout

Hamlin and Chisholm (1987) found that in 1985 angling effort was 7,500 angler days resulting in a harvest of 12,500 fish, 98% of which were kokanee. Angler effort and catch from 1985 to 1987 has approximately tripled. The reduction in the proportion of kokanee in the harvest to 88% is probably a function of the weak year class.

Angling effort in British Columbia will probably continue to increase rapidly as word of relatively high success rates (.5 fish/rod hr) and large (30 cm fork length) kokanee spreads. The establishment of a commercial marina on the lake will undoubtably promote its growth. Non resident participation in the fishery is relatively low, 12% compared to other lake fisheries in the East Kootenay such as Whiteswan Lake. (19% Martin and Parkinson 1984).

The maintenance of an intensive kokanee fishery on both sides of the international boundary will be dependent on the abundance and size of kokanee available to anglers. A large reduction in abundance of kokanee from the dominant year class of 1985 and the following two weak yĕar classes did not proportionately reduce angler effort on the American portion of the reservoir. Angling effort in 1986 was only down 20 - 25 percent (Chisholm and Hamlin 1987). In British Columbia, despite the weaker year class of kokanee, angling effort increased three fold between 1985 and 1987 and catch success rates remained similiar between the two years.

The difference in response of the two fisheries to the abundance of kokanee is probably a consequence of the seasonal distribution within the reservoir. Angling effort and success rates on the American portion of the reservoir may be more sensitive to kokanee abundance than in Canada. The kokanee are probably more dispersed and therefore success rates and thus effort are more sensitive to fish abundance. As kokanee mature, the fish school and migrate north into Canada. Once anglers locate the schools, they are able to maintain similiar levels of success between years despite differences in abundance.

Kokanee abundance in Lake Koocanusa is cyclic due to the effect of a single accidental introduction in the late 1970's and the species predominantly three year life cycle. Kokanee, like other species of pacific salmon, die after spawning. As a consequence of vacant limnetic habitat the initial stocking of kokanee had very high survival. This gave rise to one dominant (abundant) year class that subsequently spawned in 1982, 1985 and will spawn again in 1988. Shepard (1984) found that 30 to 40% of male kokanee and 5% of female kokanee spawned as two year olds. This early maturation results in a moderately abundant year class of kokanee preceeding the dominant one. A weak year class follows the dominant one due to a low incedince of later (four year old) maturing fish. Increases in the abundance of the weak year class will be dependent on the early maturation at two years of age of the moderate year class preceding it and high survival of their offspring.

The cyclic abundance of kokanee in Lake Koocanusa may persist if there are strong competitive or other interactions between successive year classes . Furthermore if high levels of angler effort continue despite weak kokanee year classes the fishery itself may tend to accentuate differences in year class strength. Cyclic abundance is found in many populations of kokanee and sockeye salmon such as that of the Adams River and its causative agents are not well known.

The average size of kokanee captured in the fishery between strong and weak year classes has remained surprisingly consistent, approximately 30 cm. One would expect as the kokanee population increased in abundance the average size of kokanee would be reduced through density dependent effects. The large variations in abundance between the dominant and weak year classes has not, up to this point, appeared to have any effect on the average size of kokanee captured in the fishery. However, the catch success rates and average size of fish captured in the fishery are not accurate indicators of either abundance or average size of fish in the population.

Estimates on indices of the distribution and abundance of kokanee spawning in tributaries, the size and age at maturity and the fecundity of female fish should be collected on an annual basis. This information would be more sensitive in detecting changes in the population dynamics of kokanee within the reservoir.

The one factor which could have a large impact on the annual distribution of effort and harvest of kokanee in the Canadian portion of Lake Koocanusa is the reservoir water level. A delay in the filling of the reservoir due to low snow pack in the upper Kootenay watershed and/or operation of the Libby Dam could reduce the quantity and duration of reservoir habitat in Canada and thus availability of kokanee. This is particularly important in early summer prior to the major northward migration of mature fish to spawning streams. In addition, physical access to the reservoir would be severely restricted.

Lake Koocanusa provides a major fishery for southeastern British Columbia and sorthwestern Montana. To maintain the fishery, more intensive management of the fishery will be necessary. This will require the co-operation of both the British Columbia Ministry of Environment and Parks and the Montana Department of Fish and Wildlife and Parks. A joint fisheries management plan for Lake Koocanusa should be drafted by both agencies to deal with monitoring, regulation, stocking and other enhancement options.

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APPENDIX I

Lake Koocanusa Sampling Schedule

Date	Area	Day Type	Date	Area	Day Type
June			August		
17	a	wd	2	b	weh
20	b	weh	3	a	weh
21	b	weh	5	a	wd
22	b	wd	6	b	wd
27	a	weh	7	b	wd
28	a	weh	8	b	weh
29	a	wd	9	a	weh
30	b	wd	10	b	wd
July			12	a	wd
1	b	weh	13	a	wd
4	a	weh	14	a	wd
6	b	wd	15	a	weh
7	a	wd	18	b	wd
8	b	wd	21	b	wd
9	a	wd	26	a	wd
10	a	wd	27	b	wd
12	a	weh	September		
13	a	wd	2	b	wd
16	a	wd	4	b	wd
21	a	wd	6	b	weh
22	b	wd	7	a	weh
24	b	wd	8	a	wd
25	b	weh			
26	b	weh			
31	b	wd			

weekend or holiday = weh
weekday = wd

APPENDIX II

Creel census interview form

Koocanusa

Creel Census

Date_____

Weather_____ Clerk_____

Previously Surveyed ? (Y/N)	Area Fished (A/B)	# Anglers	Hours Fished	Species Sought	# Species Caught	# released	Place of Residence (Town, Province)

Species Code

Kokanee——K
Rainbow Trout——RBT
Cutthroat——CT
Cutthroat & Rainbow——CT•RBT

Dolly Varden——(BULL TROUT)DV
Whitefish——WF
Other——OTH

APPENDIX III

Calculation of Angler effort and harvest by Area and Sampling Period

Formula: $Ah = xb \times xab \times f$

where Ah = Angler hours

xb = Mean of instantaneous boat counts

xab= Mean number of anglers per boat

f = Number of fishing hours in sampling period, f = ds (days in strata) X hs (angling hours per day)

$H = cpue \times Ah$

where H = harvest (fish)

cpue = catch per unit effort (fish per angler hour)

APPENDIX III

AREA A	xb	xab	ds	hs	Ah	cpue	H
June 17-30							
weh	30	2.25	4	16	4320	1.45	6264
wd	5	2.0	10	16	1600	.33	528
total					5920		6792
July							
weh	26	2.13	9	15.7	7825	.38	2974
wd	15	2.0	22	15.7	10362	.37	3834
total					18187		6808
August							
weh	24	1.57	11	14.3	5927	.25	1487
wd	12	1.96	20	14.3	6727	.27	1816
total					12654		3303
Sept 1 -8							
weh	17	2.20	3	13.2	1481	.25	370
wd	3	1.56*	5	13.2	309	.36*	111
total					1790		481

* = no data, values used from wd in Area B Sept 1-8

APPENDIX III

AREA B	xb	xab	ds	hs	Ah	cpue	H
June 17-30							
weh	19	2.10	4	16	2554	.78	1992
wd	5	2.29	10	16	1832	.50	916
total					4386		2908
July							
weh	23	2.0	9	15.7	6565	.55	3610
wd	9	2.05	22	15.7	6373	.56	3569
total					12938		7179
August							
weh	17	2.2	11	14.3	5830	.40	2332
wd	11	1.89	20	14.3	5946	.48	2854
total					11776		5186
Sept 1-8							
weh	18	2.1	3	13.2	1497	.49	733
wd	2	1.56	5	13 2	206	.57	117
total					1703		850