MONITORING KOKANEE SALMON ESCAPEMENT AND SPAWNING IN THE FLATHEAD RIVER SYSTEM

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FLATHEAD RIVER KOKANEE MONITORING
ACTIVITY SCHEDULE

PRIORITY 1

ACTIVITY	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	MAN-DAYS
REDD COUNTS		4	12										16
SNORKEL COUNT	6	6	3										15
FISH SAMPLES		2	1	1									4
MAN-DAYS	6	12	16	1									35
													TOTAL

PRIORITY 2

CREEL SURVEY	5	5											10
FRY SAMPLING							5	4	5	1			15
MAN-DAYS	5	5					5	4	5	1			25
													TOTAL

PRIORITY 3

EGG & ALEVIN SAMPLING					4								4
MAN-DAYS					4								4
													TOTAL

Summary of activities and man-day requirements outlined in the Flathead River system kokanee monitoring report

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INTRODUCTION

Studies of kokanee salmon in the Flathead River system were conducted by the Montana Department of Fish, Wildlife and Parks (MDFWP) from 1979-1982 with funding provided by the Bureau of Reclamation (Graham et al. 1980, McMullin and Graham 1981, Fraley and Graham 1982). These studies resulted in flow recommendations in the Flathead River of 3500-4500 cfs, measured at Columbia Falls, during the kokanee spawning period (15 October-15 December). A minimum flow of 3500 cfs was recommended during the incubation period (15 December-30 April). These flows were designed to eliminate the heavy incubation mortality which had occurred in kokanee redds dewatered by past Hungry Horse Dam operations. These flows were recommended through the Northwest Power Planning Council (NWPPC 1982) and were provided by the Bureau of Reclamation during 1982-83 and 1983-84. Preliminary study flows were provided by the Bureau of Reclamation during 1980-81 and 1981-82.

The study continued in 1982 under Bonneville Power Administration funding with the purpose of evaluating and fine tuning the flow recommendations. This report outlines a monitoring program to evaluate kokanee escapement and spawning in the Flathead River system. The report is organized by activity. Priority one activities include: 1) kokanee redd counts, 2) snorkel counts of spawners, and 3) fish samples for age and length data. Priority two activities are presented in Appendix C; fry sampling and creel census. Egg sampling is a priority three activity and is also presented in Appendix D. Under each activity, a "procedures" section presents methods, background and justification. A "sample site" section give specific instruction and results format for each particular area.

Priority one activities are considered essential for a clear, long-term picture of kokanee escapement and population trends in the river system. Continued monitoring of kokanee escapement will allow generation of a stock-recruitment curve for the river system. Priority one activities are designed as the minimum monitoring program, while priority two and three activities would be desirable if time and resources permit.

This monitoring program will be initiated during the 1984-85 season and will be continued through 1987, at least partly under Bonneville Power Administration funding. At that time, the monitoring program should be reevaluated and combined into a drainage-wide kokanee monitoring plan. Reevaluation would be necessary to integrate kokanee monitoring of other areas of the drainage as well as taking into account major population changes.

KOKANEE REDD COUNTS

PROCEDURE

Kokanee redd counts are a reliable indicator of the number of successful spawners in a particular area of the river system. Escapement can be estimated from redd counts by applying a ratio of the number of spawners associated with a completed redd. The number of kokanee spawners per completed redd ranged from 1.8 to 3.2 and averaged 2.4 in the Flathead River system spawning areas (Table 1). Additional data will be collected in 1984-85. Similar methods were used to estimate bull trout spawning runs in the Flathead River system from redd counts. (Fraley et al. 1981, Shepard et al. 1982).

Table 1. Kokanee spawner counts and redd counts in Flathead River system spawning areas.

Site	Number of kokanee	Number of redds	Spawners/ redd
Brenneman's Slough (1982)	471	156	3.0
Beaver Creek (1982)	45	14	3.2
Brenneman's Slough (1983)	314	174	1.8
TOTAL	830	344	2.4

A long-term index of kokanee population trends in the river system will be provided by counting redds in specific areas each year. Redd counts should be conducted near the end of the spawning period at each river system area. Counts made too early will result in incomplete data, while counts made too long after spawning has been completed will be low due to redd siltation.

Kokanee redds can be identified by their cleaned appearance, the presence of a depression, and a mound or tailspill (Figure 1). Only redds with these recognizable features should be counted. Very large redds which appear to have two or three distinguishable depressions and mounds are probably "community redds", where several pairs of fish have spawned (Figure 1). A large redd with two recognizable depressions and mounds should be counted as two redds. In some heavily used spawning areas where areas of gravel are totally spawned over several times, it may be impossible to recognize individual redds. In these areas, it is necessary to visually fit in an appropriate number of redds, based on the size

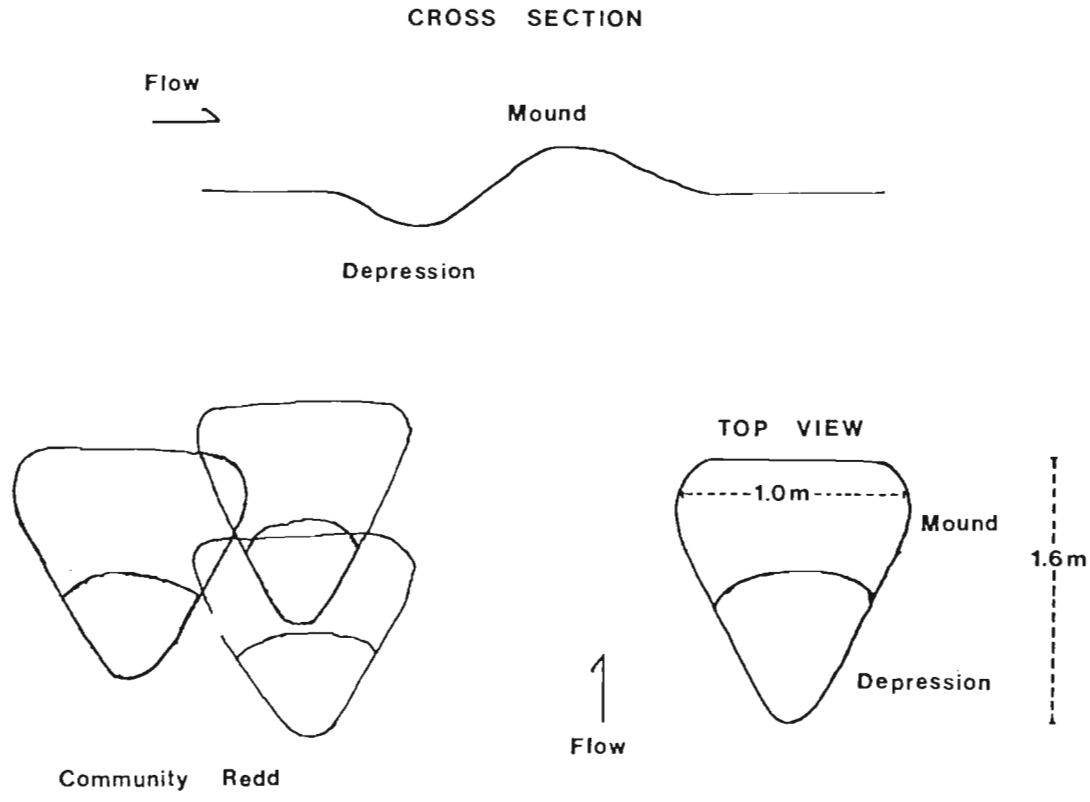

Figure 1. Diagrams of typical kokanee redds in the Flathead River system. The community redd would appear as one average sized redd and one very large redd, but the presence of three depressions would identify it as three redds.

of other recognizable redds in the area. A sample of 70 redds measured in mainstem Flathead River spawning areas averaged 1.6 m in length by 1.0 m in width (Fraley and Graham 1982).

Redd counts to monitor kokanee population trends are proposed for major spawning sites in the mainstem Flathead River, South Fork of the Flathead River, Whitefish River, Beaver Creek and Deerlick Creek. All redd counts described are rated Priority 1, and are considered essential in monitoring kokanee population trends in the river system.

SAMPLE SITES

Mainstem Flathead River

Redd counts to monitor yearly trends in mainstem kokanee spawning runs are proposed for areas 1, 17, 20-21, 25, 27, 29, 32, 34, 35-37, 36, 38 and 39 (Fraley and Graham 1981). These 12 spawning areas contained 72% of the total number of redds counted in all 47 spawning areas of the Flathead River from 1979-1983 (Table 2). Counts for these 12 areas and for all 47 areas indicated similar yearly trends in the mainstem kokanee spawning run from 1979-1983 (Figure 2).

Complete descriptions and detailed map locations of these spawning areas are presented in Appendix A.

Prior to total redd counts in these areas, two reconnaissance checks should be made. The first check should be made during one of the first several days after the spawning flow request takes effect. Presently the flow restriction of 3500-4500 cfs begins on 15 October. During this preliminary count, watered and dry redds should be counted at areas 25, 27, 29, 32, 34, 35-37, 38 and 39. This count will provide an index of the timing of the spawning run as well as an indication of spawning loss due to redd construction before the flow restriction was in effect. These eight areas are the most subject to redd dewatering and could be surveyed in one day by two people from the jet boat. Shallow areas are counted by wading, deeper areas are cruised and counted from the deck of the boat.

The second reconnaissance check should be made on the first work day in November. This check is designed to provide information on the status and timing of the spawning run for public information purposes as well as for biological information. All 12 areas should be checked from the jet boat by two people

A total redd count in the 12 mainstem areas should be made on one day during the period 20-25 November. It would be desirable for three people to participate in this count, so two observers can be stationed on the front deck of the jet boat. Shallow areas can be counted by wading, while deeper areas should be cruised in the jet boat. Two observers could finish any areas not counted the

Table 2. Redd counts for the 12 mainstem Flathead River spawning areas proposed for monitoring, 1979-1983.

Area description	Area number	Number of redds					
		1979	1980	1981	1982	1983	Total
Brenneman's Slough	1	425	136	341	180	278	1,360
Fairview	17	359	0	118	0	0	477
Pressentine Side Channel	20-21	55	13	830	0	154	1,052
Bucks	25	290	5	363	0	124	782
Hoerner	27	150	0	494	0	368	1,012
Kokanee Bend	29-30	275	0	469	22	300	1,066
Columbia Falls Bridge	32	---[1]	---[1]	735	0	199	934
Spring above Taylors	34	20	0	160	67	123	370
Columbia Falls Slough	36	330	231	0	0	0	561
Mouth of Slough and upstream bank	35-37	150	0	641	0	1,327	2,118
Anaconda Bar Spring	38	100	0	288	0	260	648
House of Mystery	39	---[1]	---[1]	1,083	560	1,852	3,495
TOTAL, 12 areas		2,154	385	5,522	829	4,985	13,875
TOTAL 45 areas		2,802	467	7,853	1,528	6,680	19,330
% TOTAL		77	82	70	54	73	72

[1] Area not checked.

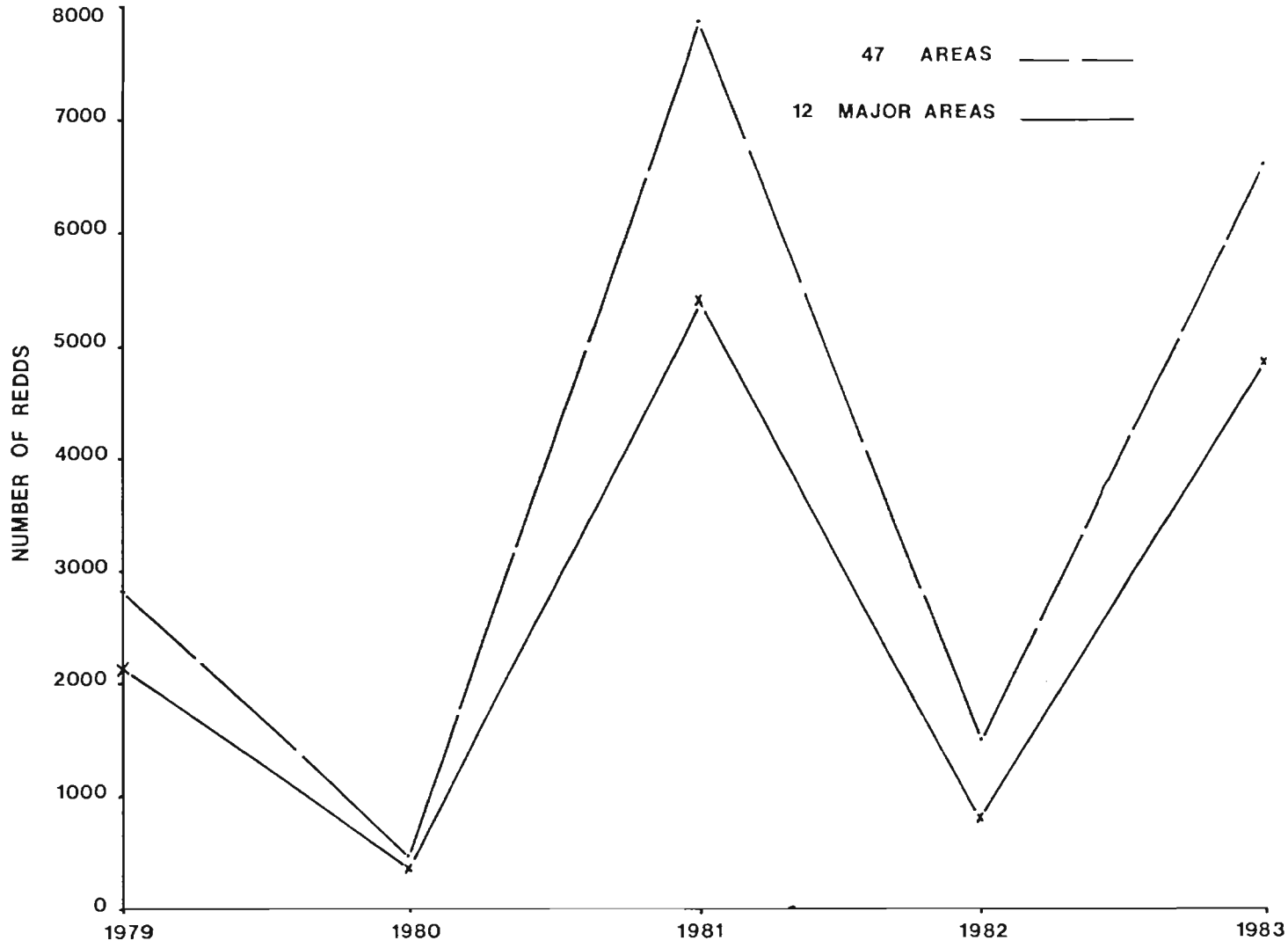

Figure 2. Yearly trends in kokanee spawner abundance in the mainstem Flathead River as indicated by total redd counts in 47 areas (dotted line) and redd counts in 12 proposed monitoring areas (solid line).

following day. Directions for counting each site is contained in the area descriptions (Appendix A).

Results should be reported in the manner shown in Table 2. Each years data could be added to the table, and a short description of findings during the reconnaissance checks could be included. The total redd count of all mainstem spawning areas could be estimated by dividing the count for the 12 major areas by 0.72, which is the average proportion of redds contained in the 12 areas from 1979-1983.

South Fork Flathead River

Redd counts in the South Fork of the Flathead River should be conducted by canoe or small boat and outboard. Spawning should be virtually complete by the second week in November. If possible, make the count with three people during the second week of November from Devil's Elbow to the Highway 2 Bridge. Appendix A contains descriptions and map locations of the spawning sites on the South Fork. Redd counts should be reported separately for each area and totaled (Appendix A). The lowest flow possible in the South Fork that will not violate the flow restrictions in the mainstem Flathead River should be requested from the Bureau of Reclamation at Hungry Horse Dam.

Whitefish River

Redd counts on the Whitefish River should be conducted by canoe, from Hodgson's Bridge to Rose Crossing Bridge, preferably by three people in one long day. Shallow areas and side channels should be waded, while deeper areas are counted by observation from the canoe. The count should be as close to 22 October as possible (after the majority of spawning has taken place in the past). Descriptions and map locations for the specific spawning sites on the river are given in Appendix A.

Beaver-Deerlick Creeks

These small, spring fed creeks represent the farthest upstream point of kokanee spawning in the river system. They should be counted during the last week of November to ensure spawning is complete. One person could shuttle two observers to the upstream end of each stream and to pick them up at the downstream end at completion of the count. Descriptions and map locations for the spawning sites on the creek and landowner contacts, are given in Appendix A.

River System Summary

Redd count activities in the Flathead River system will require a total of 16 man-days during the period of 15 October - 1 December (Table 3). The procedures will require two-three people and seven working days. Data summation will be minimal, requiring

Table 3. Summary of redd count activities proposed for monitoring in the Flathead River system.

Area	Activity	Timing	Number days	Number people	Number man-days
Mainstem Flathead River	Mid October check	15-19 October	1	2	2
	Early November check	1-5 November	1	2	2
	Final redd count	20-25 November	2	3	6
South Fork Flathead River	Final redd count	5-15 November	1	2	2
Whitefish River	Final redd count	20-28 October	1	2	2
Beaver/Deerlick Creeks	Final redd count	25 Nov-1 Dec.	1	2	2
TOTAL			7	---	16

only a tally of the redd counts and short written descriptions of the status and timing of the kokanee run.

Redd counts for each area should be tallied and added to Table 4. Descriptions and observation of the timing and status of the spawning run should be included in the short monitoring report prepared each year.

SNORKEL COUNTS OF KOKANEE SPAWNERS

PROCEDURE

Snorkel counts of kokanee spawners in lower McDonald Creek should be conducted five times from early September through early November to determine timing of the spawning run and to reduce the chance of missing the peak number of spawners. The counts are conducted on the 4 km of stream from McDonald Lake to the Middle Fork of the Flathead River. Two snorkelers should begin at the top of each run, riffle or pool and slowly swim downstream, both counting all kokanee which pass upstream between them. When a school is encountered, the snorkelers should drive the fish to the end of the run or pool and count them as they file back upstream between them.

Snorkelers should count the fish by the smallest practical unit; medium-large schools will require the snorkelers to count by 20's, while a very large school may require the counts to be made by 50's. Smaller groups can be counted by 10's or individual fish. The unit of counting will have to be adjusted according to the speed and density at which the kokanee file upstream between the snorkelers. Snorkelers may have to count fish while wading through very shallow areas.

Each snorkeler reports the count to a data recorder, who follows the snorkelers down the stream in a canoe. The data recorder notes the location in the stream and the counts given to him by the two snorkelers. The two counts given by the snorkelers for each school of fish represent the high and low estimates. The estimates for all schools are summed for the total high, low and mean estimate for the creek. Snorkelers should also estimate the number of dead fish encountered and give this information to the data recorder. An example of the data format for a snorkel count is given in Appendix B.

The counts must be coordinated with Glacier National Park officials due to the sensitive nature of the associated bald eagle concentration. To reduce disturbance of the bald eagles feeding along McDonald Creek, the counts are made on Wednesdays, beginning at the same time as the eagle count conducted by research biologist Riley McClelland. Plans for each count should be made a week in advance through Resource Specialist Gary Gregory located at park headquarters, and Research Biologist Riley McClelland. The Region 1 Montana Department of Fish, Wildlife and Parks Information Officer, will act as the liason between the Department, Glacier National

Table 4. Kokanee redd counts for proposed monitoring areas in the Flathead River system.

Area	Number of redds				
	1979	1980	1981	1982	1983
Mainstem Flathead River	2,154	385	5,522	829	4,985
South Fork Flathead River[2]	---[1]	---[1]	300	200	1,872
Whitefish River	---[1]	426	416	765	530
Beaver-Deerlick Creeks	0	---[1]	718	42	1
TOTAL	2,154	811	6,956	1,836	7,388

[1] No count.

[2] Count from Devil's Elbow to Highway 2.

Park, and the media. He will also act as the data recorder and canoe operator on the snorkel counts. Timing of the counts is designed for repeatability and comparison with previous years, as well as covering the normal spawning period of the kokanee in McDonald Creek (Table 5). The five counts should be recorded similar to Table 6 and included in the short monitoring report prepared each year. The maximum mean count for the year will be used for the trend number for comparison between years. The total number of spawners in the creek for the year would be somewhat higher.

After redd counts and snorkel counts have been completed, an estimate of the total river system escapement can be compiled (Table 7). This table should also be included in the short yearly monitoring report.

FISH SAMPLES FOR LENGTH AND AGE

PROCEDURE

Important aspects of the river system kokanee population that should be part of any monitoring program are the length and age structure of each year's spawning run. These parameters have been monitored for the kokanee spawning run in McDonald Creek (1970-1983), Flathead River, spring (1974-1983), Flathead River nonspring (1974-1983) and Whitefish River (1972, 1974, 1980, 1982, 1983).

A collection of adults on the spawning grounds should be made at each area near the middle portion of the spawning period. Collections should consist of a minimum of 25 fish of each sex, if possible. Return the fish to the lab and remove both otolith bones with tweezers after sectioning the head midway between the eye and the front edge of the operculum. Store the otoliths in a scale envelope and record area, date, sex, length and weight (optional). Examine otoliths suspended in water on a small blackened watchglass under 15x magnification with a dissecting microscope. Record length, sex and otolith measurement data on standard FIRE I format sheets (Appendix B) and enter into a computer file on the Region 1 Discovery computer. Consult Delano Hanzel for data entry and summary.

Summarize by sex and age groups for each individual site (Appendix B) and summarize all sites for the total river system (Table 8). Include both tables in the yearly monitoring report.

SAMPLE SITES

Mainstem Flathead River, Non-spring

Collections of kokanee for age and length determinations from mainstem Flathead River non-spring areas were made from 1974-1979 at mainstem Area 27 (Hoerner-Bucks side channel) and from 1981-1983 at mainstem Area 39 (House of Mystery). Future collections of

Table 5. Schedule for snorkel counts of kokanee spawners in McDonald Creek.

Count No.	Count date	Number[1] days	Number people	Number man-days
1	Wednesday nearest 7 September	1	3	3
2	Wednesday nearest 20 September	1	3	3
3	First Wednesday in October	1	3	3
4	Wednesday nearest 20 October	1	3	3
5	First Wednesday in November	1	3	3
	TOTAL	5	---	15[2]

[1]Field counts take approximately 0.8 days including travel time, remainder of day for data summary.

[2]Five of the man-days will be supplied by the Region 1 Information Officer.

Table 6. Snorkel counts of kokanee in McDonald Creek during 1983.

Date	Number of kokanee				Total mean
	Low count	High count	Mean (live)	Dead	
9/7/83	4,845	6,390	5,618	0	5,618
9/21/83	11,092	12,677	11,885	10	11,895
10/5/83	30,360	37,995	34,178	128	34,306
10/19/83	22,327	25,427	23,877	2,213	26,090
11/2/83	6,370	7,540	6,955	2,870	9,825
11/16/83	377	414	396	---[1]	396

[1] No count due to decomposition.

Table 7. Estimated numbers of post-harvest kokanee spawners in the Flathead River system, 1979-1983. The percent contribution for each area is in parentheses.

Year	McDonald Creek[1]	Mainstem Flathead R.[2]	Whitefish River[2]	South Fork Flathead R.[2]	Beaver-Deerlick Creeks[2]	Middle Fork Flathead R.	Total
1979	65,000 (90)	6,785 (10)	---	---[3]	0	---[3]	71,785
1980	49,500 (96)	1,121 (2)	1,022 (2)	---[3]	---[3]	---[3]	51,643
1981	103,500 (79)	19,073 (15)	988 (<1)	720 (<1)	1,723 (1)	5,520 (4)	131,534
1982	30,965 (80)	3,720 (10)	1,836 (5)	480 (1)	101 (<1)	1,802 (4)	38,904
1983	34,306 (60)	16,279 (28)	1,272 (2)	4,493 (8)	2 (<1)	1,330 (2)	57,681

[1] Snorkel count of spawners.
[2] Estimated by multiplying redd counts by 2.4.
[3] No count.

Table 8. Length and age data for kokanee salmon collected in Flathead River system spawning areas from 1970-1983. Data are from Hanzel and Rumsey, Progress Reports F-7-R-33, 1970-83.

	No. fish			Average length [1]			% Age II+ [2]			% Age III+			% Age IV+		
Year	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb
1983	116	140	256	376	361	369	3	1	2	88	96	92	9	3	6
1982	107	106	213	381	367	374	2	1	2	79	89	84	19	10	14
1981	85	120	205	373	356	364	0	0	0	82	95	89	18	5	11
1980	47	69	116	371	343	357	0	0	0	36	65	51	64	35	49
1979	92	102	194	345	328	336	0	0	0	85	98	92	15	2	8
1978	175	143	318	333	312	321	0	0	0	85	95	90	15	5	10
1977	321	309	630	323	310	316	4	1	2	89	94	92	7	5	6
1976	253	145	398	312	300	306	6	6	6	81	71	76	13	23	18
1975	114	123	237	315	302	308	0	0	0	56	69	63	44	31	37
1974 [3]	114	78	192	315	302	308	0	0	0	60	72	66	40	28	34
1973	44	22	66	305	292	298	2	14	8	82	73	78	16	13	14
1972	49	27	76	333	318	325	0	0	0	32	37	34	68	63	66
1971	99	112	211	333	320	327	0	23	11	29	69	49	33	8	20
1970	74	83	157	325	310	318	0	0	0	34	31	33	66	69	67

[1] Combined length is an average of the mean male and mean female lengths.
[2] Combined age structure is an average of the mean male and mean female age structure.
[3] Figures from 1970-1973 are McDonald Creek fish only.

kokanee should be made at Area 39. This area supported the greatest number of fish and redds in 1981, 1982 and 1983, and should best represent the age and length structure of the mainstem non-spring spawning run. The peak spawning period ranged from early to mid-November during the 1981-1983 period, so collections should be attempted during the first two weeks of November. The timing of the spawning run will be determined during the mid-October and early November reconnaissance checks, and collection time can be adjusted based on yearly variations in timing. If insufficient numbers of spawners enter Area 39 the collection should be made in Area 27. If both areas have insufficient numbers of fish, the collection should be made in Area 37, 25, or 32, in that order of priority.

The best method for collection in Area 39 is shocking with a Coffelt gasoline powered backpack shocker in the shallow portion of the area. A gill net can also be drifted through the area.

Mainstem Flathead River, Spring

Collections in Brenneman's Slough (mainstem Area 1) have been made from 1974-1983. This spawning area has had a significant kokanee spawning run each year since at least the early 1960's. The spawning period is relatively late at this site, usually beginning in early November and extending into early January. Kokanee should be collected sometime during the peak of the run, which could range from mid-November to mid-December. There should always be sufficient spawners present for a collection during the last week of November. If a trap is not operated on the slough, the best collection method is drifting a gill net through groups of spawners. Contact Betty and Bob Rose (755-0852) or Tom Siderius (755-0598).

McDonald Creek

The spawning period in McDonald Creek usually extends from Mid-September through late November. Peak numbers of kokanee are usually present in the Creek in mid-October. The best collection method for the McDonald Creek sample is to coordinate with Flathead Hatchery egg taking operations if they will be made that particular year. Otherwise, place a gill net across the creek at the Apgar Bridge at night and force a number of kokanee into it by throwing rocks. The collection could also be made by drifting a gill net or by dip netting along the creek during the mid-October snorkel survey. Contact Gary Gregory (888-5441) of Glacier National Park for permission to make the collection.

Whitefish River

The peak period of kokanee spawning in the Whitefish River is generally late September - mid-October. The spawning period is of short duration in this stream, so a few checks of spawning activity should be made in late September and early October. The collec-

tions should be made within one km upstream or downstream of Rose Crossing Bridge, as this area usually has some spawning activity. Another site which usually has spawners is 0.5 km above Tetrault Bridge (see map in Appendix A). The best method for collection is backpack shocking in confined areas or drifting a gill net downstream through groups of spawners. Contact Robin Street (1414 Rose Crossing, 755-1926), before making the collection.

Kokanee Collection Summary

Enter all age and length data in individual tables for each site (Appendix B) and in the river system summary (Table 8). Plan the work schedule to accommodate the approximate dates in the sampling schedule (Table 9).

Table 9. Sampling schedule for kokanee collections in river system spawning areas. Time requirements are for fish collection and otolith removal.

Site	Collection period		Number days	Number people	Number man-days
Flathead River, non-spring	1-15 Nov	Back pack shocker, gill net	1	2	2
Flathead River, spring	15 Nov - 15 Dec	Gill net	1	2	2
McDonald Creek	5 Oct - 25 Oct	Gill net, dip net	Do in conjunction with mid-October snorkel counts		
Whitefish River	1 Oct - 20 Oct	Back pack shocker, gill net	Do in conjunction with October redd count		
TOTAL			2	---	4[1]

[1] One additional manday will be required for data entry and analysis.

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APPENDIX A

Descriptions and map locations of spawning areas
where kokanee redd counts are suggested for monitoring.
Areas where redds have been found are enclosed in dotted lines.
Sample data form for McDonald Creek snorkel counts.

DESCRIPTIONS OF MAINSTEM FLATHEAD RIVER SPAWNING AREAS

1. **Brenneman's Slough (RK 37.0)**

A spring slough area that enters the main river from the east side in the vicinity of the Salmon Hole (just upstream from the mouth of the Stillwater River) and extends about 3 km north. The spawning area is in the upper end of the slough in the northeast corner of Section 15, Township 28 North, Range 21 West. The main area is above the culvert near the Robert and Betty Rose residence, although some spawning occurs in the first 200 m below the culvert. Gravel in the area is covered with silt but is of high quality with numerous associated springs. The water level is affected by Flathead Lake, and the slough carries flow from the main river during peak runoff which enters at the upper end. Land owners, Bob and Betty Rose (1066 Steel Bridge Road, 755-0852) and Tom Siderius (1007 Steel Bridge Road, 755-0598), should be contacted prior to any work in the area. The area can be reached by vehicle on Steel Bridge Road and then on a secondary access road past the Rose house.

17. **East Fairview Area (near old shack) (RK50.0)**

One km up the east channel above a large pool at RK50 is a medium size spawning area. This area is in the northwest corner of Section 30, Township 29 North, Range 21 West. Just downstream of where this channel makes a bend to the north, there is a large, deep hole containing spawning gravel with a log jam along the east bank. There is an old shack just upstream from this log jam above a cut bank on the east side. Near this shack there are several small channels containing spawning gravel. Spawning has also occurred along the channel between the large pool and the shack. This area is best reached by jet boat to the large pool, then by wading upstream through the east channel to the shack.

20-21. **Lower Pressentine Side Channel (21) (small east channel between Reserve and Pressentine, and mouth of the channel (20) (RK52.4).**

A small east channel leaves the main channel approximately 2.4 km below Pressentine access on a bend with a high bank on the east side. There is a house visible on top of this high bank. There are stretches of spawning gravel along the center the full length of this channel. Where this channel re-enters the river is a pool area and log jam. This area contains good spawning gravel and is best reached and counted from the jet boat.

25. **Bucks Garden Area (RK59.7)**

Approximately one-third of the distance up the east channel behind the island below Buck's Gardens, two channels converge at a large gravel flat. This flat is composed of good spawning gravel. There are also pockets of gravel along both channels upstream from

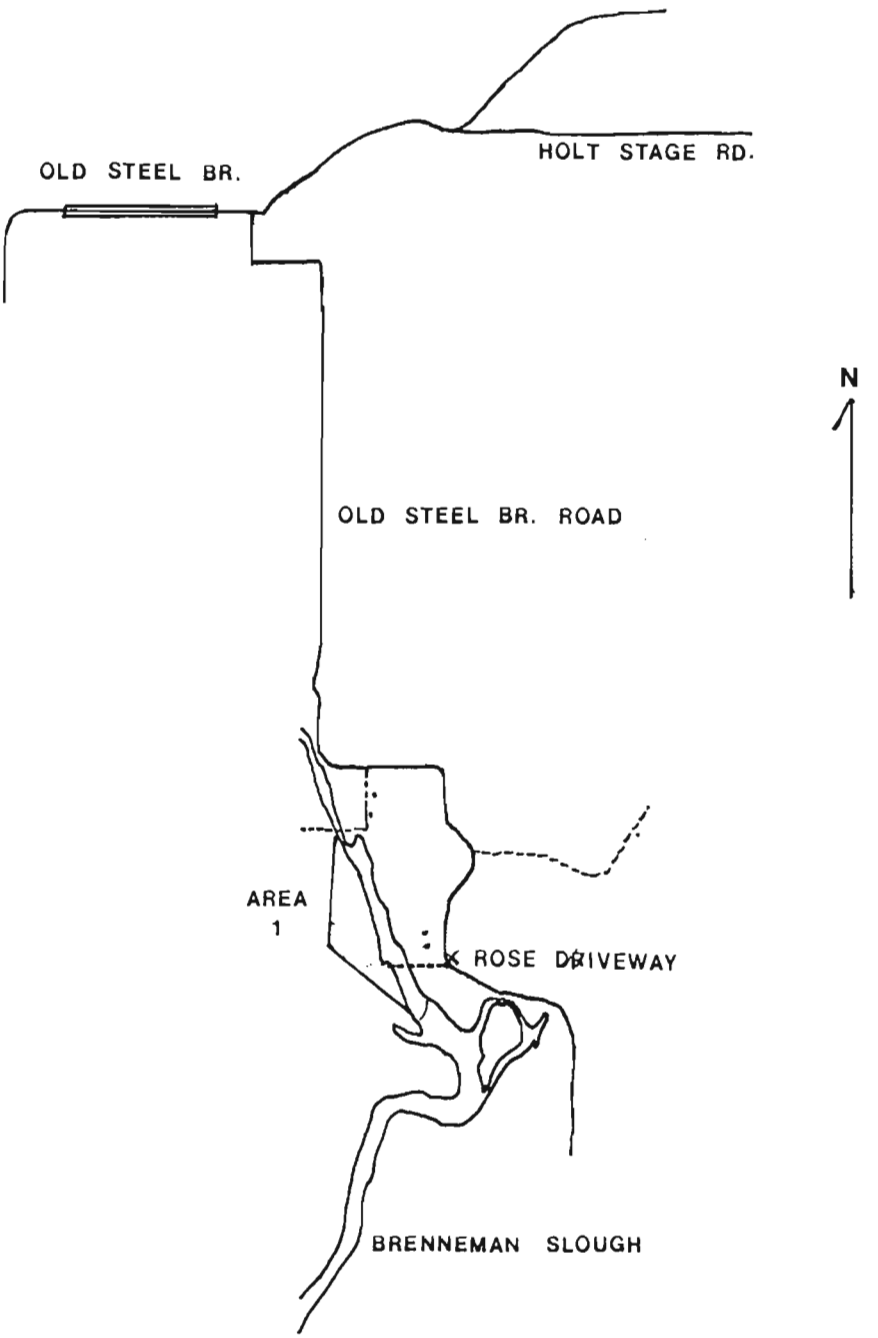


Figure 1. Location of Brenneman's Slough spawning area (1).

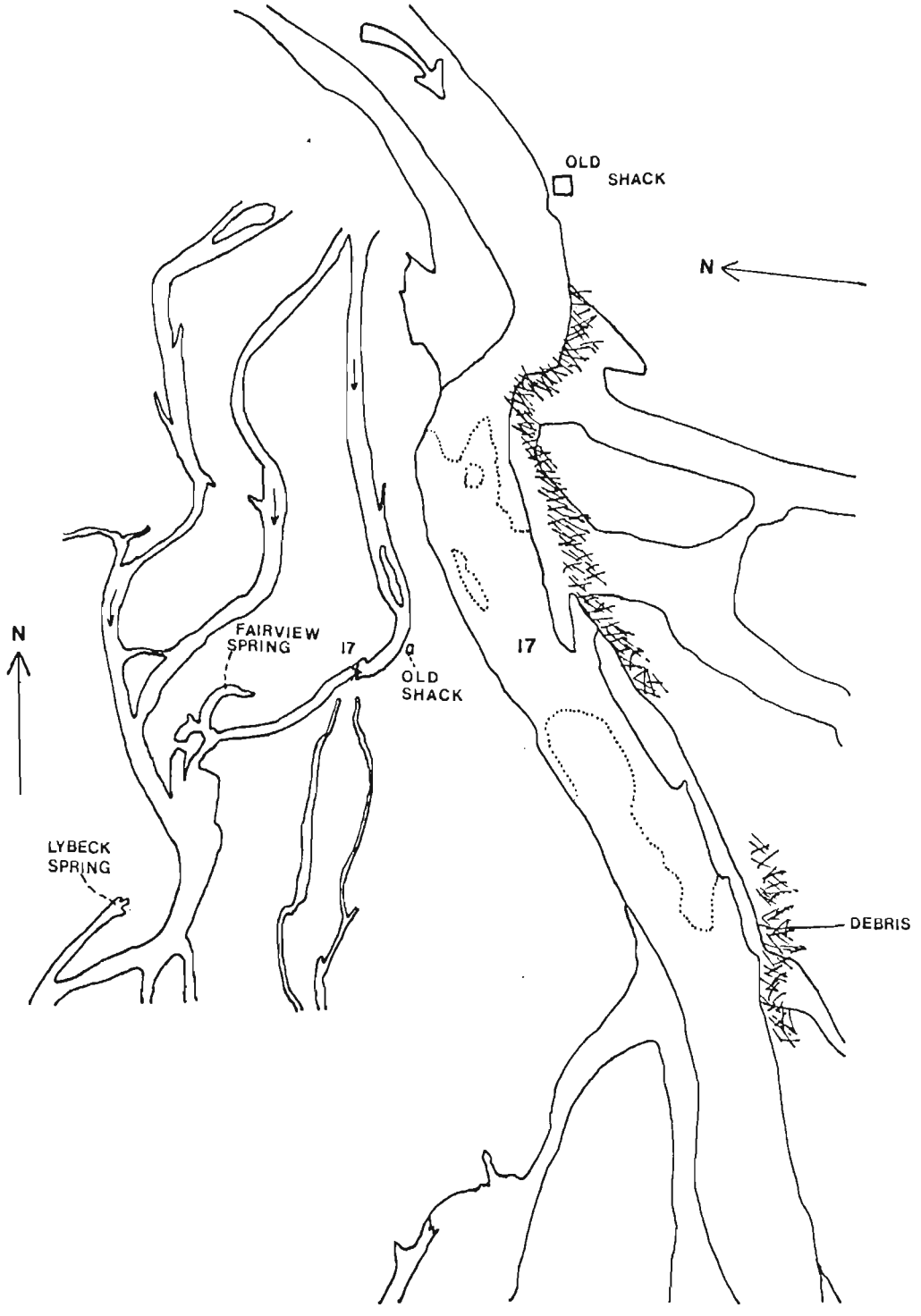


Figure 2. Location of Fairview Spring spawning area (17).

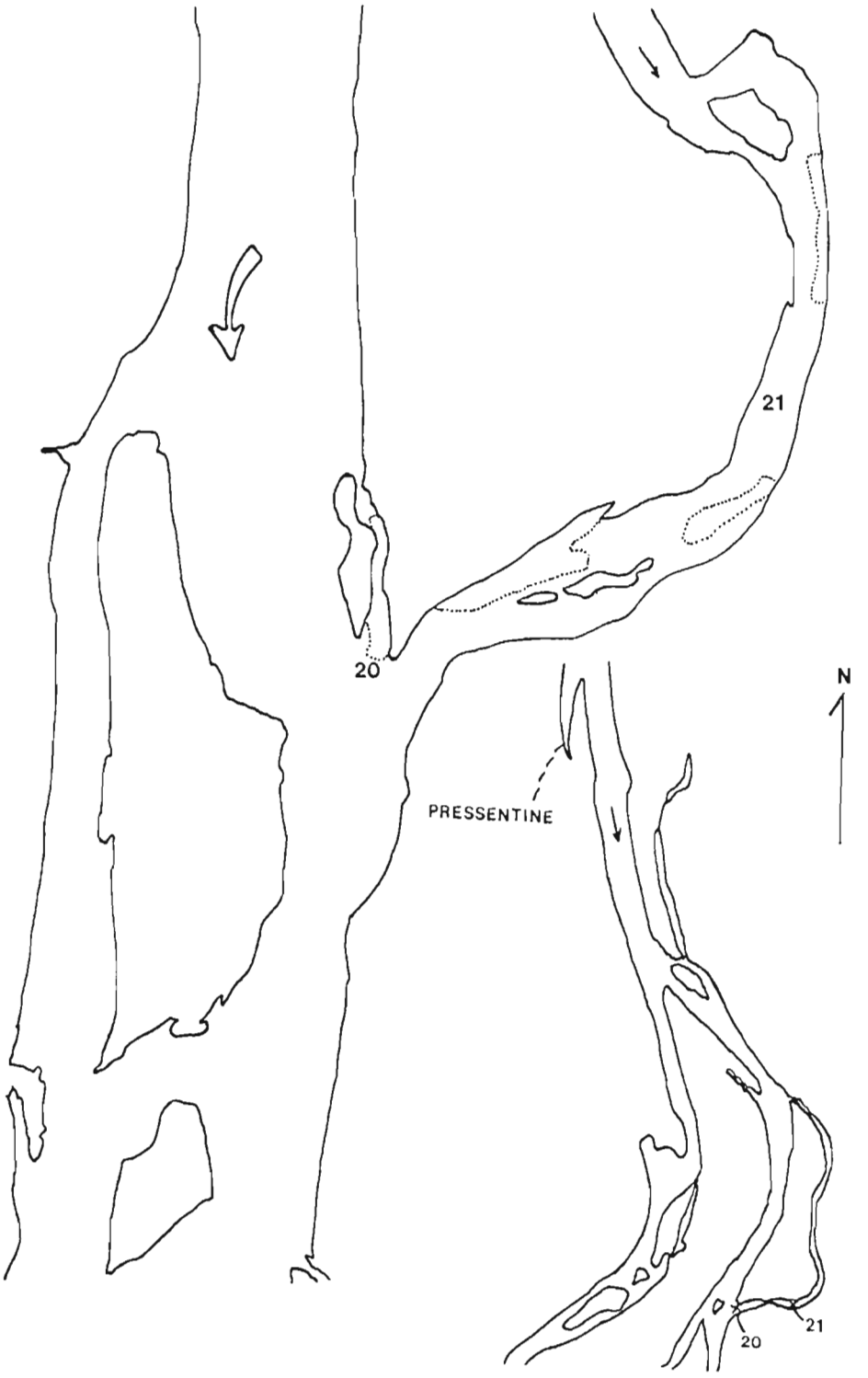


Figure 3. Location of Pressentine side channel spawning areas (20, 21).

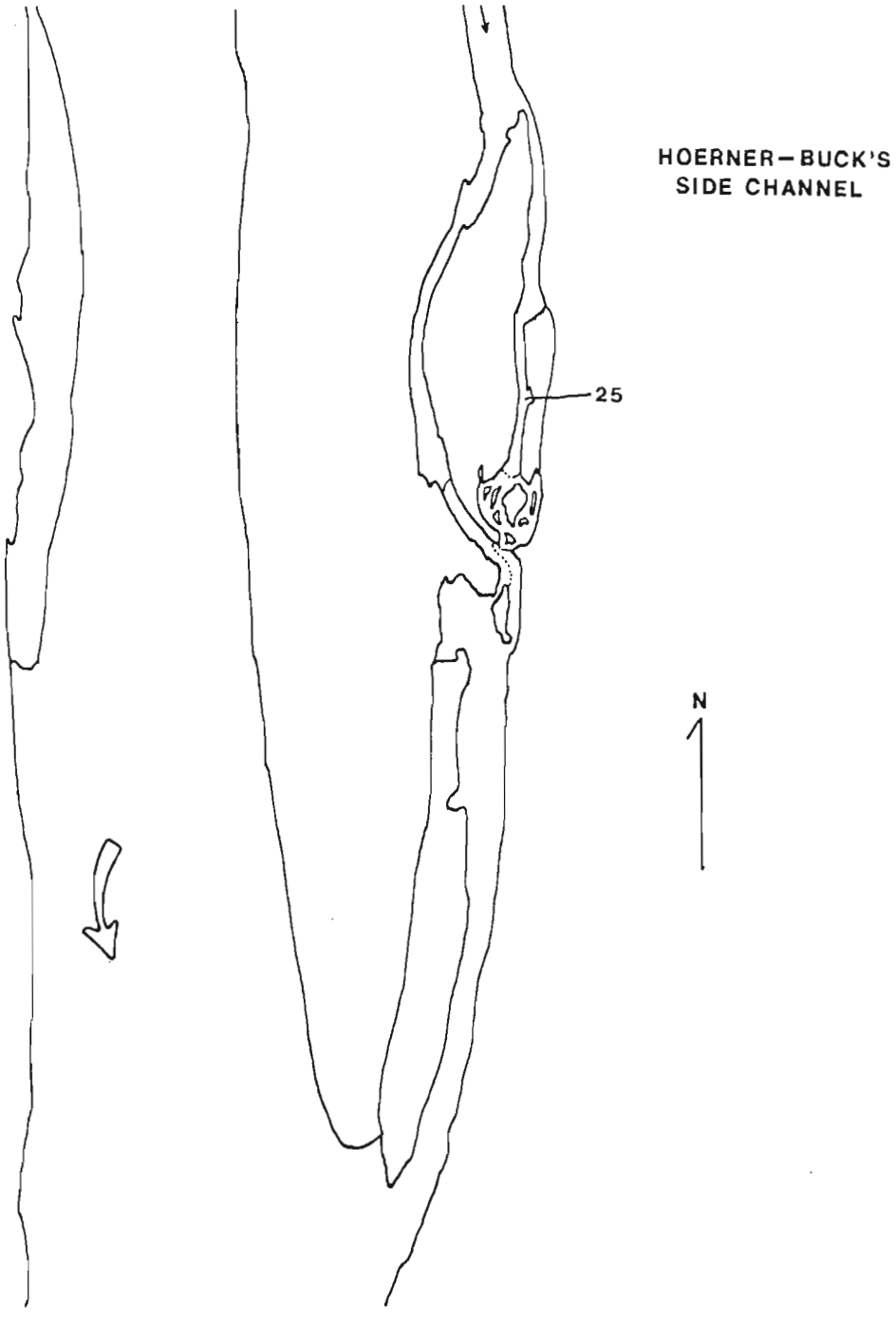


Figure 4. Location of Buck's spawning area (25).

this flat. Just upstream of the split channels along the east bank is an area of spawning gravel. The area is best reached by jet boat to the mouth of the small east channel, then by wading upstream to Area 27 to count the kokanee redds.

27. **Hoerner Spawning Area - Head End of Buck's (RK60.3)**

At the head of the channel along the east side of Buck's Island is a large area of spawning gravel along the east river bank. Some of the gravel is watered by a small channel cut. Areas of gravel extend into the main river channel. Redds in the channel cut are best counted on foot while redds off the gravel bar in the main river channel must be counted from the jet boat.

29-30. **Kokanee Bend - Large Bend Below Access (29, RK60.8) and Mouth of Side Channel (30, RK61.0)**

Between Buck's Island and Kokanee Bend access, the east channel makes a big bend with a steep cut east bank. From the large rock field at the lower end of the bend upstream part way around the bend, there is marginal gravel along the east bank. This area is in the main river channel but the redds are along the bank where velocities are moderate. There is ground water coming in along the bank. Kokanee redds are constructed in large substrate in this area. Redds should be counted upstream to the mouth of the Kokanee Bend side channel where an area of spring-fed gravel exists.

32. **Highway 2 (Old Hwy. 40) Bridge (RK65.8)**

On the southeast side of the river, 200 m below the Highway 2 Bridge, is a large deposit of good spawning gravel which extends for 200 m downstream along the bank and out in the channel around a small island. The area is located across and just downstream from the Teakettle Access on the Flathead River in Columbia Falls.

34. **Large Gravel Bar Above Highway 40 Bridge (RK66.5)**

Approximately 0.8 km above the Highway 2 (Old Hwy 40) Bridge at Columbia Falls is a large gravel bar along the east side of the river. During high flow, water runs behind it creating an island. There is some good gravel along the outside of the point at the downstream end of this bar just above the steep cut east bank. This area has some spring influence. Best reached by jet boat and counted by wading.

35-37. **Mouth Columbia Falls Slough and East Bank Above (RK67.7)**

A spring slough converges with the main river on the east side approximately 200 m upstream from the upper end of the above mentioned gravel bar. The mouth of this slough is in the northeast corner of Section 9, Township 30 North, Range 20 West. There is some good gravel at the mouth of this slough along the south shore-

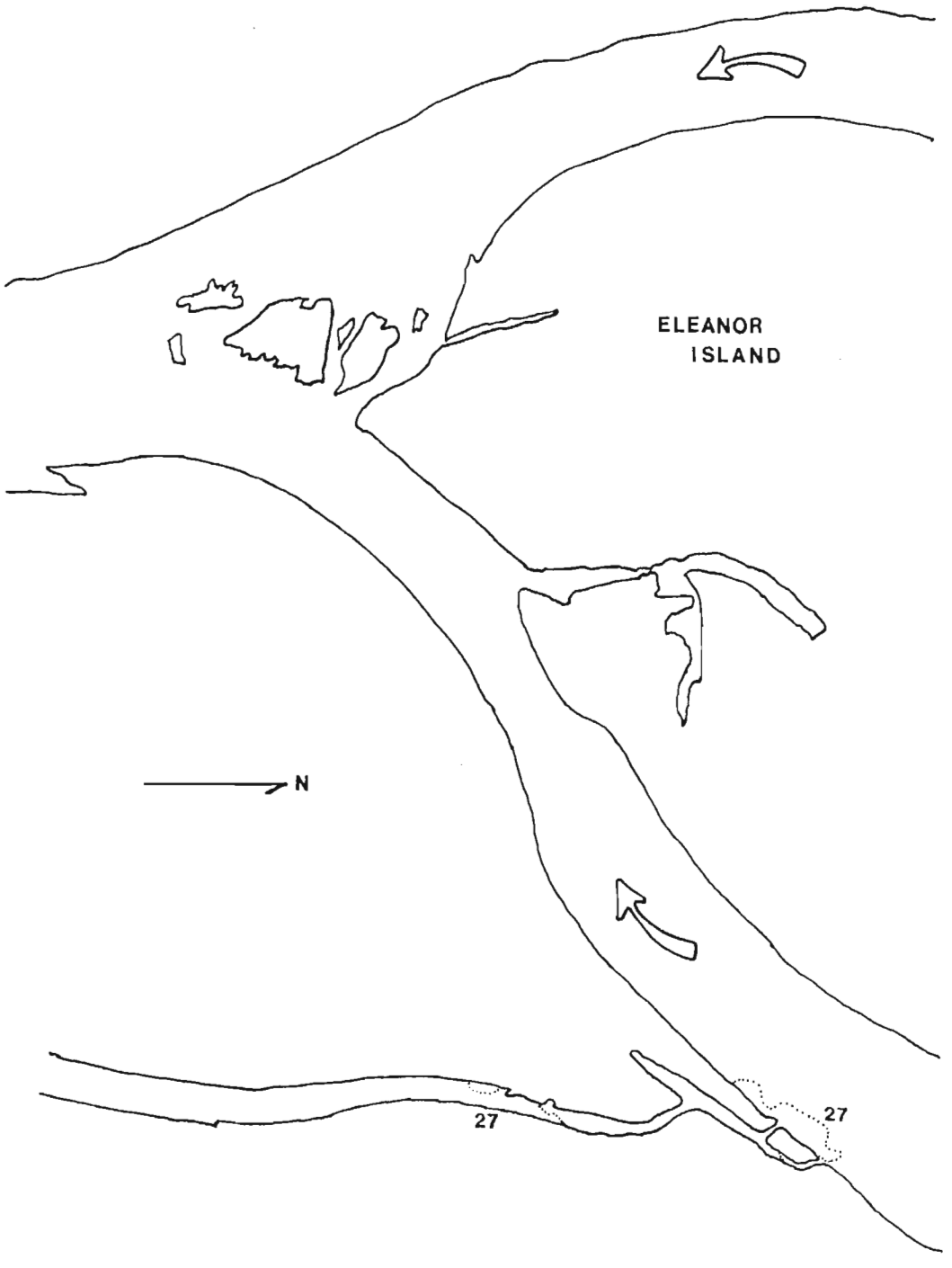


Figure 5. Location of Hoerner spawning area (27).

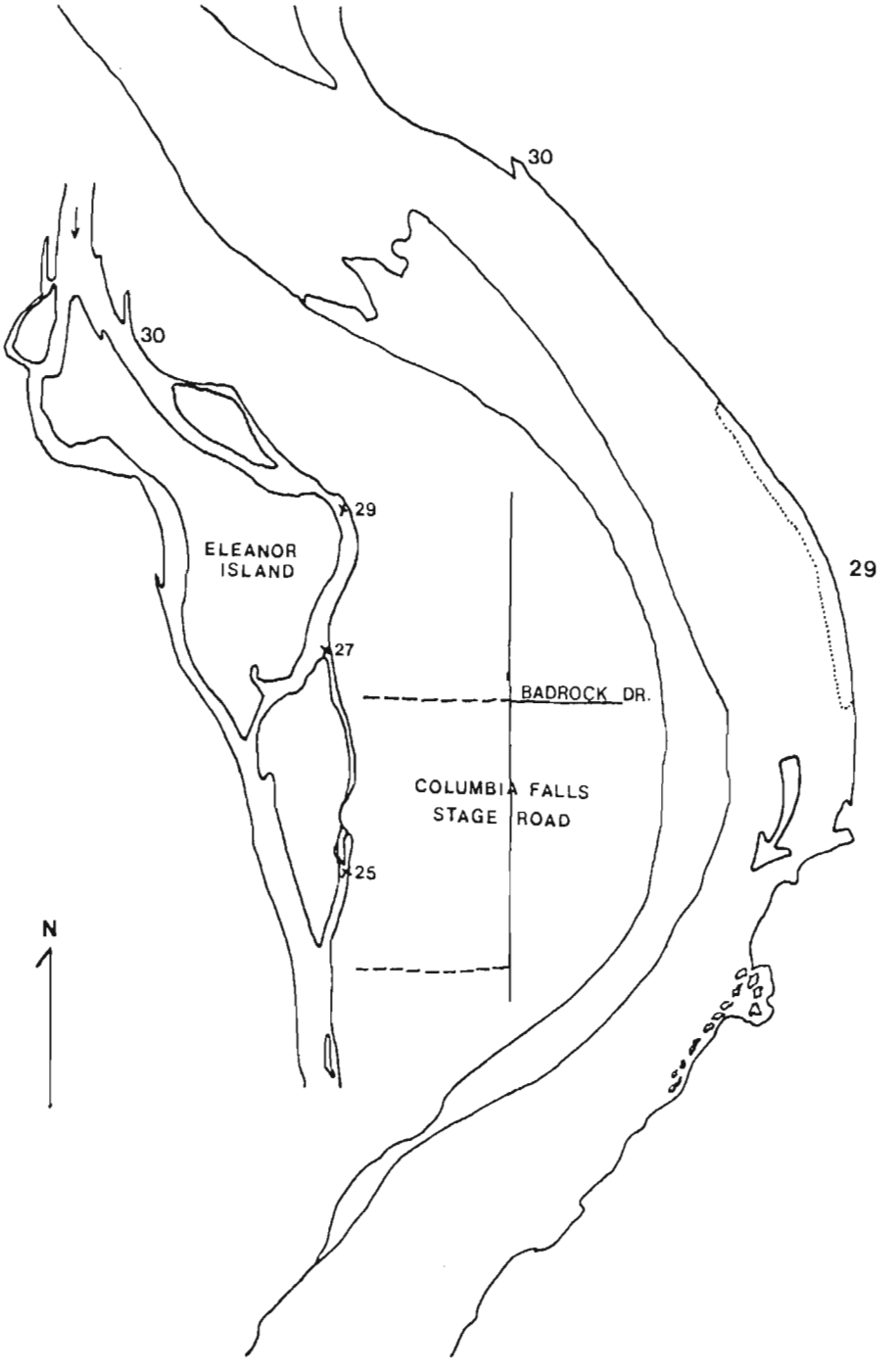


Figure 6. Location of Kokanee Bend spawning areas (29, 30).

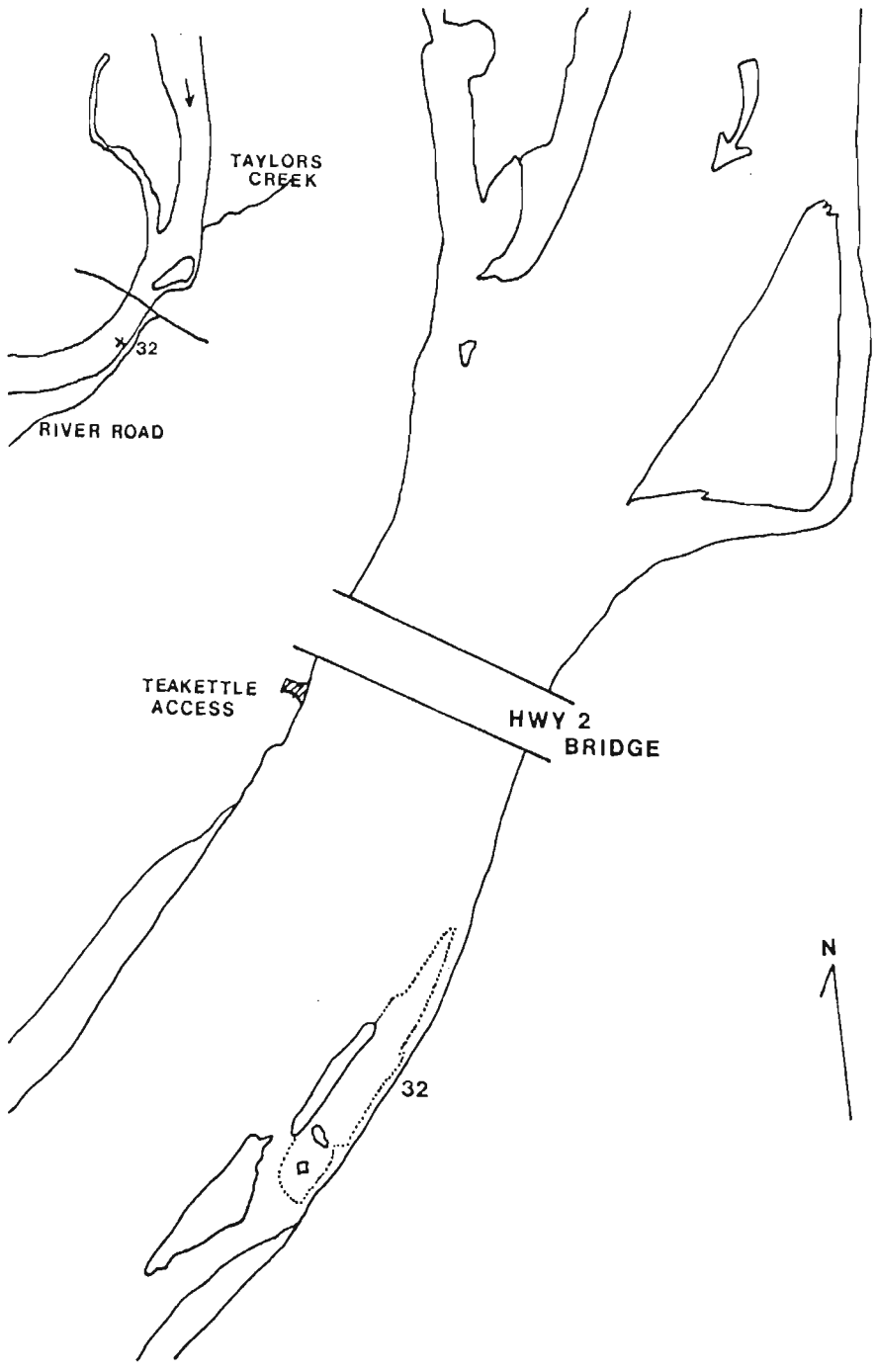


Figure 7. Location of Highway 2 Bridge (Columbia Falls) spawning area (32).

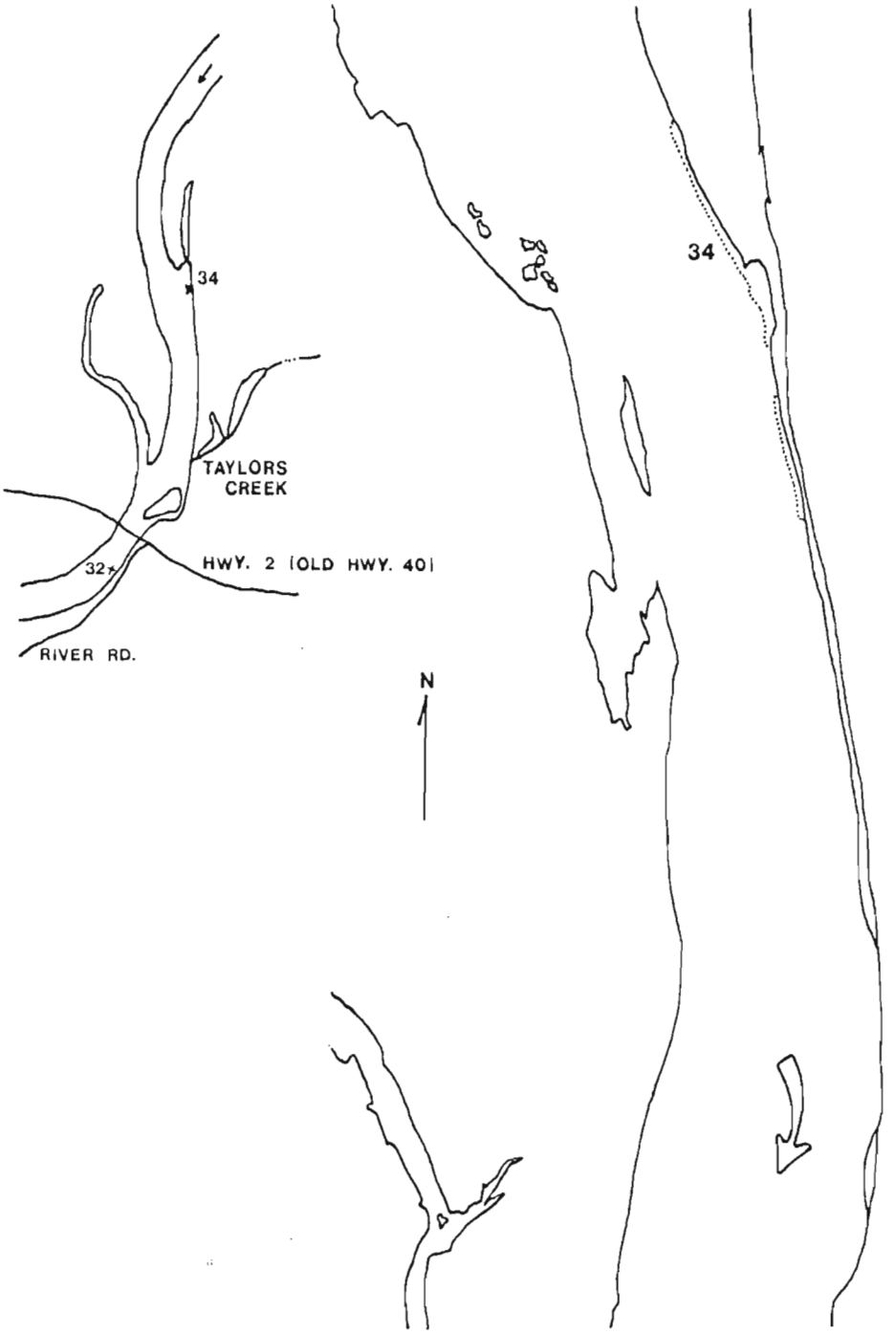


Figure 8. Location of spring gravel bar above Taylors spawning area (34).

line. During high flows, the main river cuts across the point but most of the current is broken by the fallen trees. There is also some flow coming from the slough itself.

Just upstream from the mouth of the slough, the river splits around a large gravel bar. At the downstream end of the south channel, just before the convergence is a hole by a boulder along the south bank. There are gravel areas along the steep bank extending all the way up from the mouth of the slough.

Both areas are best reached by jet boat. The shallow portions are best counted from foot while the deeper or swifter portions of the area should be cruised and counted from the front of the jet boat.

36. Columbia Falls Slough (RK68.5)

The slough mentioned above extends approximately 1 km to the east. Approximately one-half way up this slough, just below where a road crosses it, the bottom changes from silt to gravel and cobble. From the road to the end of the slough there is a large quantity of good spawning gravel. This slough is fed mostly by springs and is affected little by fluctuating river levels. Redds were present in the slough in 1979 and 1980, but not in 1981, 1982 or 1983.

38. Lower Anaconda Bar (RK68.5)

At the head end of the south channel mentioned above there is an area of good gravel along the south bank. It is across and just downstream from a large slide area on the north river bank. Most of the current flows along the north bank so the velocity over these redds is slow. This area is spring influenced.

39. House of Mystery (RK69.5)

There is an island in the river channel directly below the House of Mystery tourist shop. On the southeast side of the island in the channel along the south bank is a large amount of good spawning gravel extending for approximately 300 m. This area contained the largest number of redds of any area in 1981, 1982 and 1983. There is some ground water influence in the area.

The area can be reached through the House of Mystery tourist shop but is best reached by jet boat from downstream. Much of the area is shallow, but the deeper portions along the island must be counted from the jet boat. Check with the owner of the House of Mystery before accessing from Highway 2.

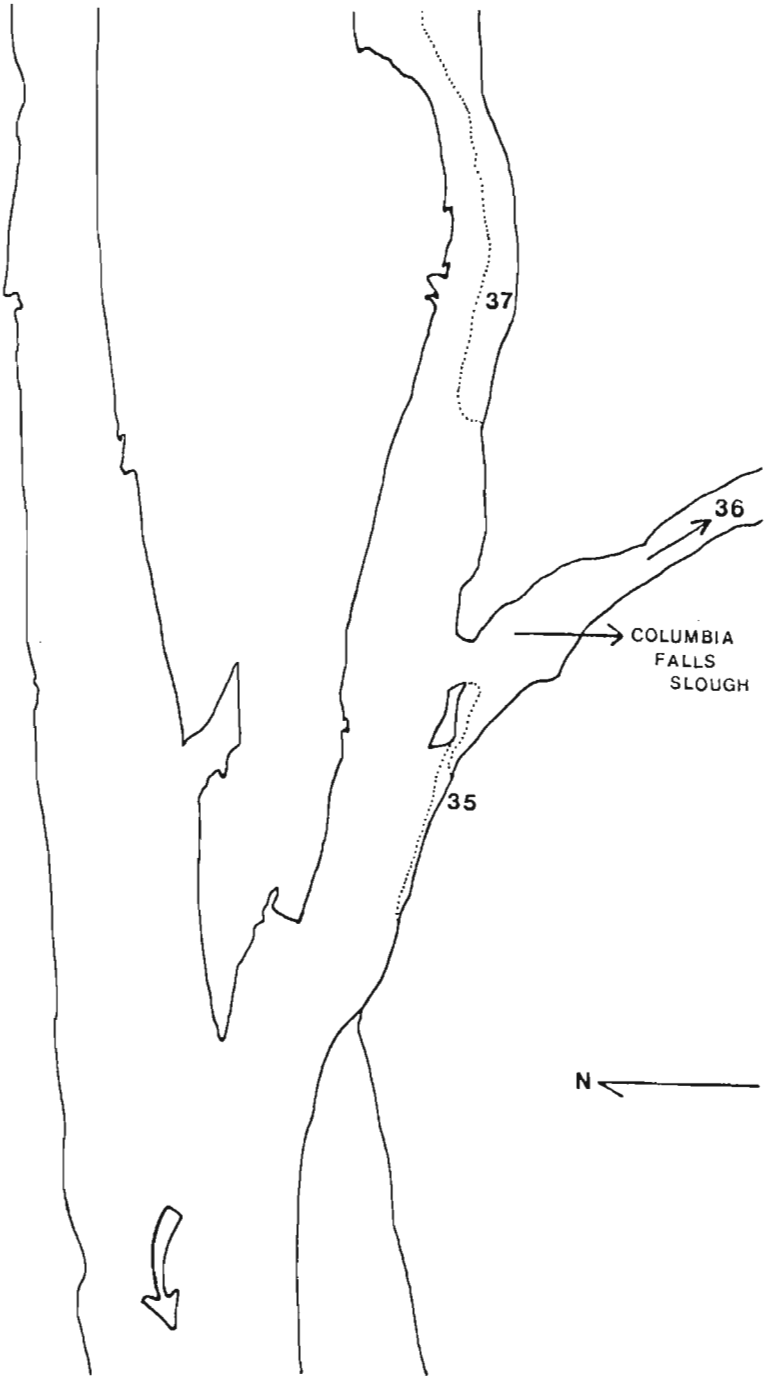


Figure 9. Location of Columbia Falls slough spawning areas (35, 36, 37).

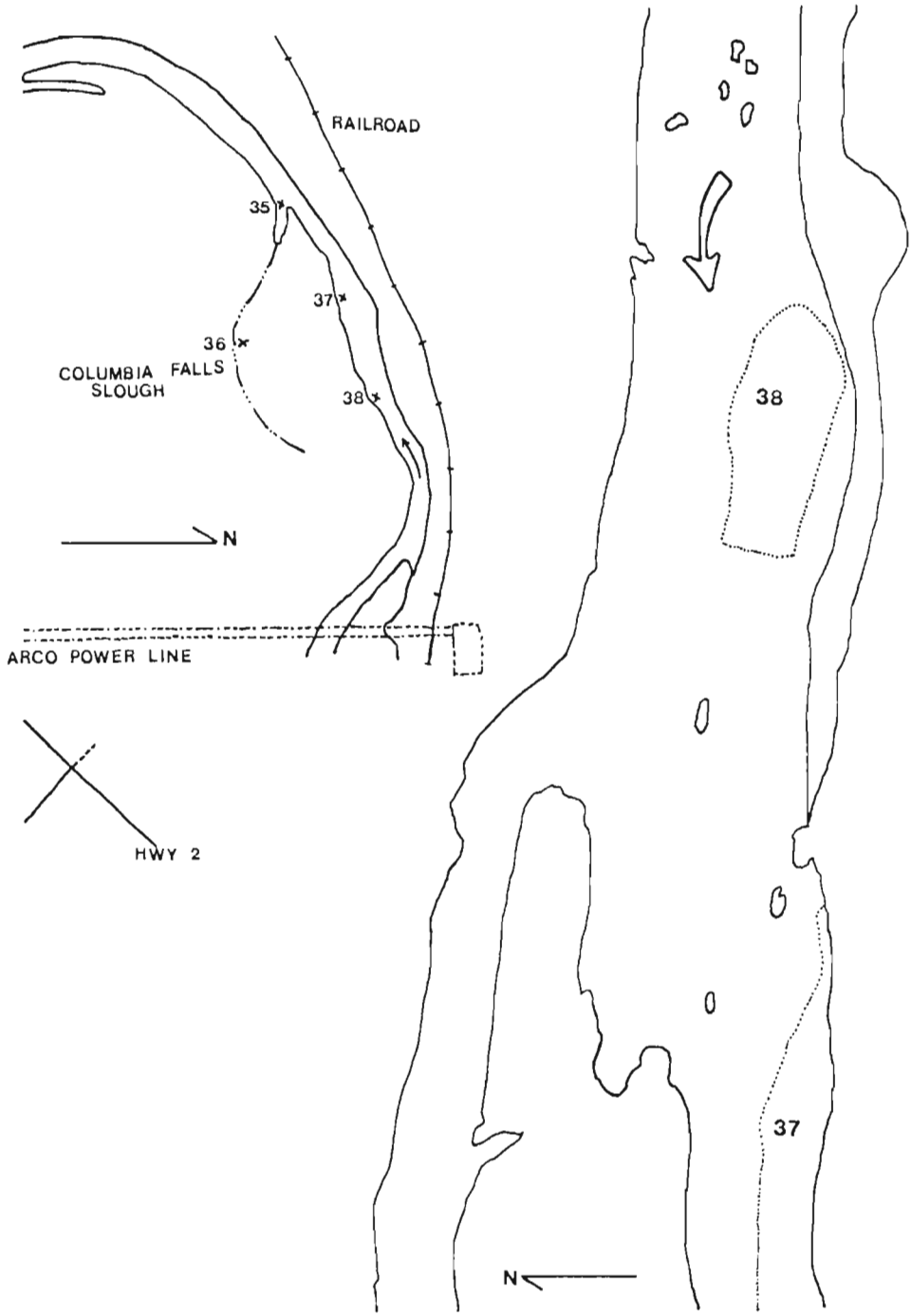


Figure 10. Location of Anaconda Bar Spring spawning area (38).

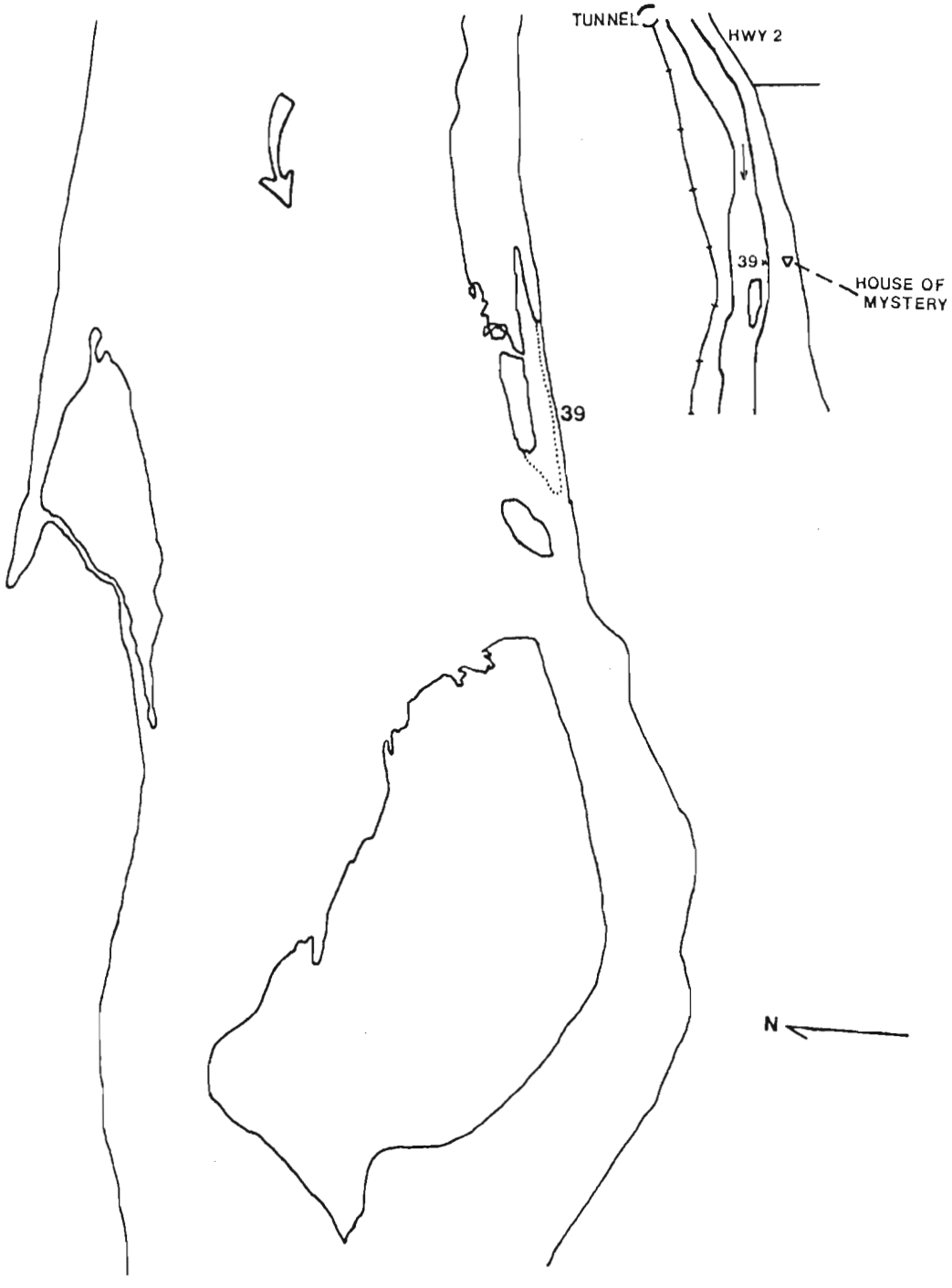


Figure 11. Location of House of Mystery spawning area (39).

Suggested final redd count procedure:

Day 1 Put jet boat in at Teakettle Access. Run downstream to Area 17. Proceed back upstream, count areas 20-21, 25, 27, 29-30, 32, 34, 35-37, 36, 38 and 39. If large numbers of redds are encountered, it may not be possible to count all areas on day 1.

Day 2 Count any areas not finished on day 1. Finish redd count by driving to Area 1 (Brenneman's Slough) after unloading jet boat and loading the canoe at headquarters.

Table 1. Number of kokanee redds in the South Fork of the Flathead River from Devil's Elbow to Highway 2 on 29 October 1981, 12 November 1982 and 7 November 1983.

Spawning area description	Area	River km	Number of redds 1981	1982	1983
300-400 m above Highway 2	1	1.5	45	100[1/]	805
Whelp Creek area	2	2.6	90	0	0
Left bank of big bend across from Whelp Creek	3	3.2	140	25	9
U.S.G.S. gauge area (left and right banks)	4	5.5	2	43	859
Devil's Elbow	5	6.3	---[2/]	32	184
TOTALS			277	200	1857

1/ Redds found after November count.
2/ No count.

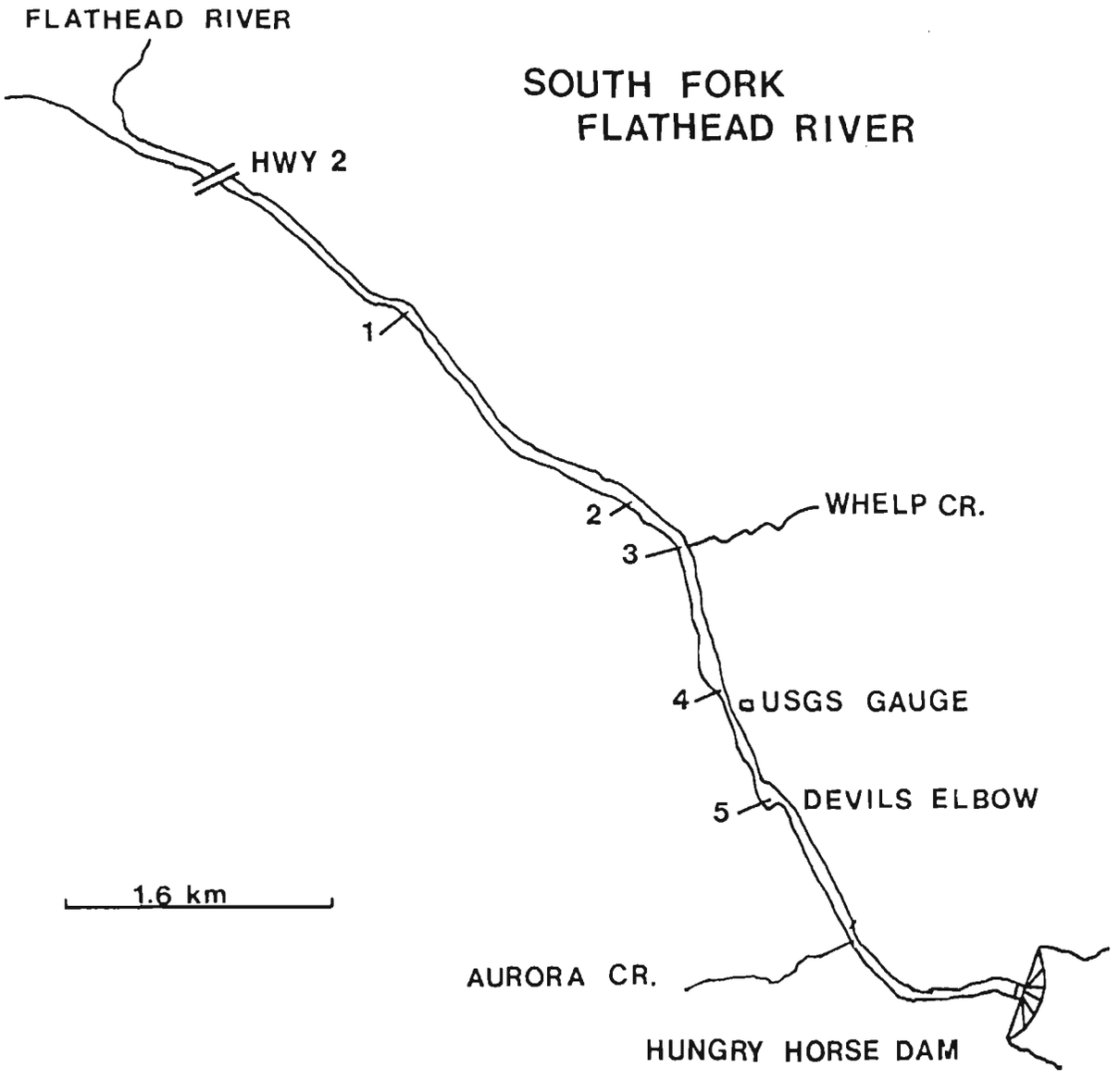


Figure 12. Spawning area locations on the South Fork of the Flathead.

Table 2. Number of redds counted in Beaver and Deerlick creeks on 4 December 1981, 3 December 1982, and 5 December 1983.

Spawning area description	Area	Creek km	Number of redds 1981	1982	1983
Deerlick Creek					
Mouth of Deerlick Creek to Moccasin Creek river access	1	0-.5	48	9	1
Hwy 2 Bridge to Dalimata Bridge	2	1.0-1.5	11	1	0
Gas line crossing to Hwy Dept. shed	3	2.0-3.0	143	14	0
Beaver Creek					
Run below ford crossing to beginning of creek (including side channel by ford)	1	3.0-4.0	516	18	0
TOTAL			718	42	1

Table 3. Number of kokanee redds counted in the Whitefish River on 19 October 1981, 22 October 1982, and 24 October 1983.

Spawning area description	Area	River km	Number of redds 1981	1982	1983
Rose Crossing to Birch Grove Bridge	1	6.0-9.5	265	289	103
Birch Grove Bridge to Tetrault Bridge	2	9.5-13.0	48	421	272
Tetrault Bridge to Hodgson Crossing	3	13.0-15.0	41	127	118
Above Hodgson Crossing	4	15.0-15.5	59	36	37
TOTAL			413	873	530

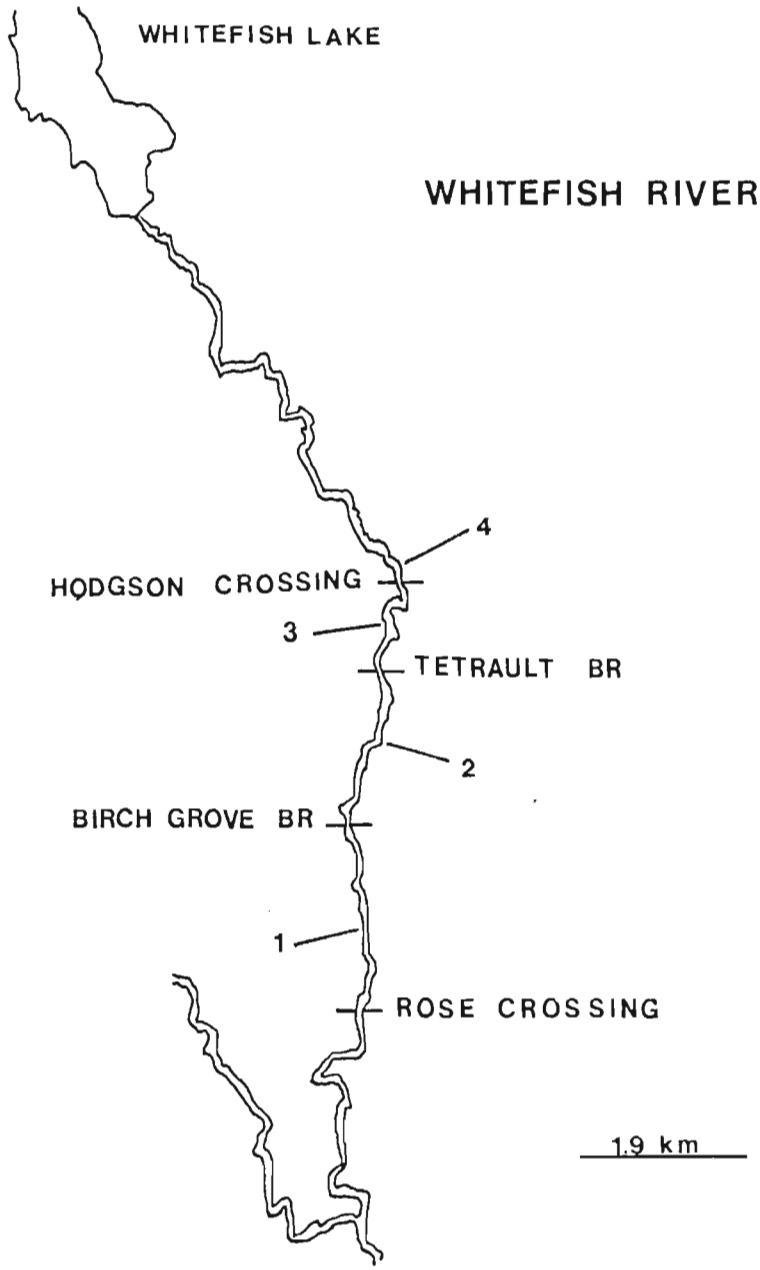


Figure 13. Spawning area locations on the Whitefish River. Numbers indicate areas between road crossings.

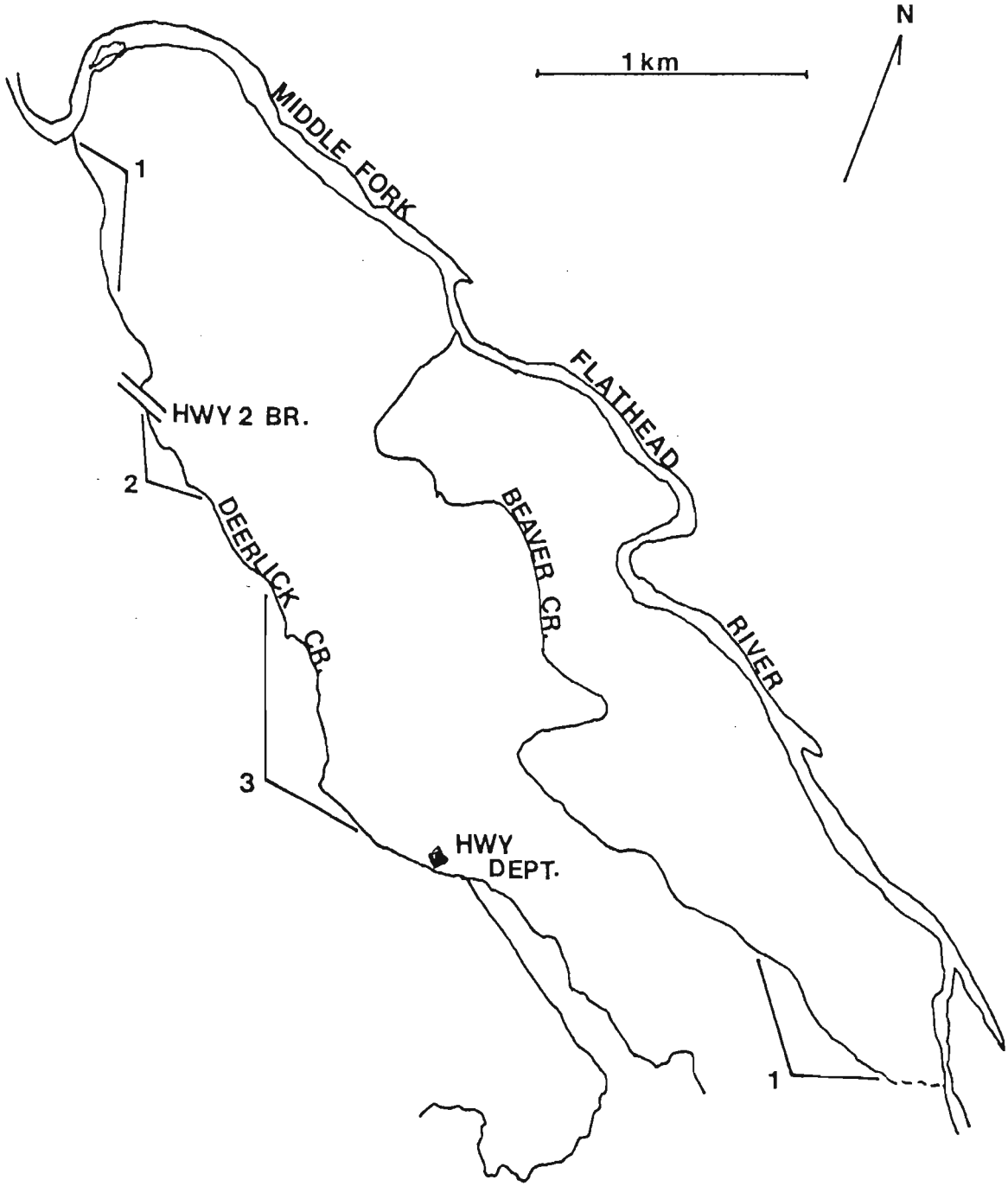


Figure 14. Spawning area locations on Beaver and Deerlick creeks in the Middle Fork of the Flathead drainage.

McDONALD CREEK - SNORKEL COUNT OF KOKANEE SPAWNERS

DATE: 10/19/83 AIR TEMP: 36°F WATER TEMP: 51°F

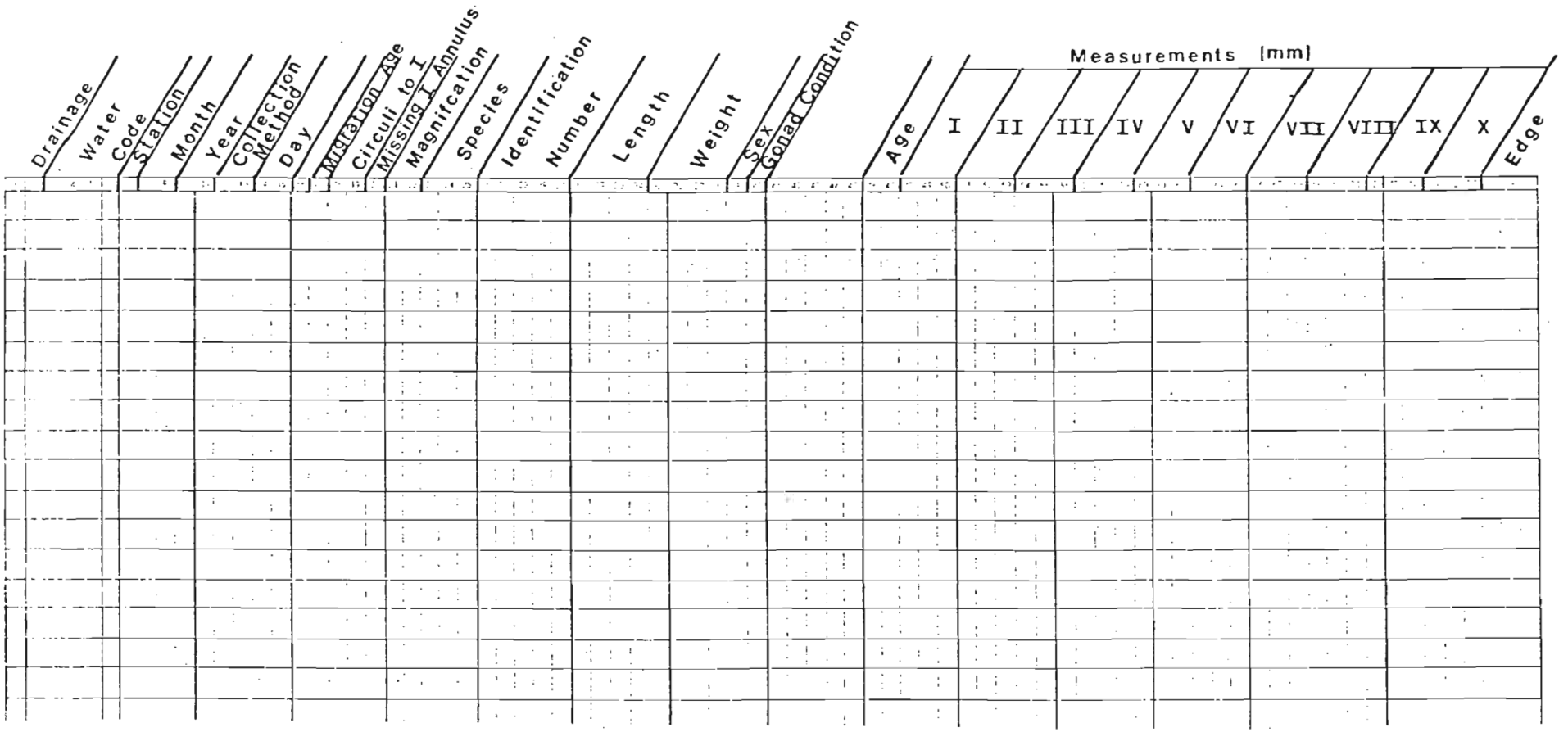
START TIME: 0815 COMMENTS: morning fog - cleared
END TIME: 1330 SNORKELERS: Fraley, Gaub, Cavigli
RECORDER: Aderhold

Stream location	Low count (live)	High count (live)	Dead count
First pool below McDonald Lake	300	350	6
Run to Apgar Bridge	200	225	38
Apgar Bridge Pool	180	220	---
	4,400	4,700	---
Run below Apgar	1,900	2,300	75
	2,800	3,200	8
Big Bend pool	70	80	289
Run after big bend	410	420	120
	650	750	---
	300	375	---
	1,000	1,200	---
	400	425	43
Deep pool	2,100	2,200	---
Run after deep pool	300	375	352
	600	775	---
	550	650	---
Riffle before channel split	375	450	---
Channel split	750	850	150
Right channel away from blind	350	400	---
Left channel near blind	---	---	10
Run after blind	340	400	430
Riffle after blind	275	320	---
	400	500	---
Run to wagon wheel	100	125	---
Run to split No. Two	375	550	275
Riffle near split No. Two	875	975	---
Last pool	660	710	220
Last run to Quarter Circle Bridge	17	17	---
	40	40	---
	30	30	---
	10	10	187
Quarter Circle Bridge	180	185	10
TOTAL	22,327	25,427	2,213
MEAN, live		23,877	

APPENDIX B

Form for entering age and length data on Discovery computer system and data tables for individual river system sites.

FORM FOR ENTRY OF AGE-GROWTH DATA



Collection method: "1" boat shocking, "2" tow nets, "3" beach seine, "4" purse seine, "5" drift net, "6" electrofishing stream, "7" gill nets, "8" Dept. angling, "9" river trap, "10" mid-water trawl, "11" Rotenone, "12" creel census.
Age at out migration: "1"-I+, "2"-II+, "3"-III+ ....."9"-0+.
Missing annulus: "1" missing annulus, blank no missing annulus.
Sex: "1" males, "2" females.
Gonad condition: "0" undetermined, "1" egg size 1-3, "2" egg size 4-5, "3" egg size 6-7, "4" egg size 8-9, "5" egg size 10-11, "6" egg size 12-14, "7" male red, "8" male pink, "9" male white.
Age: "99" fish was not aged or no scales.

Form FMD-D

Table 1. Length and age data for kokanee salmon collected in Flathead River system spawning areas from 1970-1983.

Year	No. Fish			Average Length			% Age II+			% Age III+			% Age IV+		
	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb
Flathead River, Spring (Brenneman's Slough)															
1983	29	51	80	381	366	374	0	0	0	100	98	99	0	2	1
1982[1]	168	225	393	388	369	378	6	3	4	83	97	90	11	0	6
1981	29	29	58	384	361	372	0	0	0	64	93	79	36	7	21
1980	32	40	72	372	343	358	0	0	0	30	61	46	70	39	54
1979	51	48	99	345	329	337	0	0	0	81	96	88	19	4	12
1978	36	18	54	335	317	326	0	0	0	89	94	91	11	6	9
1977	53	49	102	323	315	319	8	0	4	77	96	87	15	4	9
1976	51	35	86	320	307	314	0	8	4	82	52	67	18	40	29
1975	27	25	52	323	310	316	0	0	0	59	83	71	41	17	29
1974	33	11	44	325	310	318	0	0	0	79	91	85	21	9	15
Flathead River, Non-spring (Eleanor Island 1974-1979, House of Mystery 1981-1983)															
1983	36	31	67	373	353	363	0	0	0	100	93	97	0	7	3
1982	31	24	55	377	362	369	0	0	0	89	96	93	11	4	7
1981	27	27	54	358	345	351	0	0	0	96	96	96	4	4	4
1980	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1979	15	21	36	348	323	336	0	0	0	79	100	90	21	0	10
1978	49	49	98	329	310	320	0	0	0	84	96	90	16	4	10
1977	35	41	76	318	302	310	3	3	3	91	91	91	6	6	6
1976	50	47	97	302	295	298	10	2	6	82	84	83	8	14	11
1975	50	50	100	310	302	306	0	0	0	48	62	55	52	38	45
1974	50	43	93	305	297	301	0	0	0	56	60	58	44	40	42

Table 1. (Continued)

Table 1. (Continued).

Year	No. Fish			Average Length			% Age II+			% Age III+			% Age IV+		
	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb	Male	Female	Comb
McDonald Creek															
1983	31	32	63	371	358	365	14	4	9	72	93	83	14	3	8
1982	26	24	50	389	369	379	0	0	0	54	76	65	46	24	35
1981	29	64	93	381	361	371	0	0	0	89	97	93	11	3	7
1980	11	24	35	368	345	357	0	0	0	40	71	56	60	29	44
1979	26	33	59	348	330	339	0	0	0	96	0	48	4	100	52
1978	20	17	37	328	318	323	0	0	0	84	94	89	16	6	11
1977	41	50	91	315	305	310	0	0	0	96	83	90	4	17	10
1976	152	63	215	315	300	308	4	12	8	76	64	70	20	24	22
1975	37	48	85	312	300	306	0	0	0	65	71	68	35	29	32
1974	32	26	58	318	305	311	0	0	0	53	81	67	47	19	33
1973	64	22	86	305	292	299	2	14	8	82	73	77	16	14	15
1972	49	27	76	333	318	325	0	0	0	32	37	34	68	63	66
1971	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1970	74	83	157	325	310	318	0	0	0	34	31	33	66	69	67
Whitefish River															
1983	20	26	46	384	363	374	0	0	0	78	96	87	22	4	13
1982	12	17	29	383	362	373	0	0	0	100	77	88	0	23	12
1980	4	5	9	375	339	357	0	0	0	75	75	75	25	25	25
1974	3	3	6	315	300	307	0	0	0	67	100	84	33	0	16
1972	28	12	40	284	338	311	0	0	0	65	74	69	26	35	31

1/ Aging based on 36 males, 35 females.

APPENDIX C

- Priority Two Activities

- Priority Three Activities

FRY SAMPLING

PROCEDURE

Estimating the numbers and timing of emigrating fry could be a valuable method of monitoring yearly kokanee spawning success. Numbers of fry are estimated by expanding numbers of fry captured in drift nets by the total water volume in the stream.

SAMPLE SITES

McDonald Creek

McDonald Creek is the major source of kokanee to Flathead Lake and is suggested as the primary monitoring site. Weekly drift net samples from the water column from March 1 through mid-June (for a total of 14) would be sufficient to roughly estimate emigration numbers and timing.

Sample McDonald creek from the Quarter Circle Bridge using three to four $0.5m^2$ drift nets, depending on water depth, in a vertical stack (Figure 1). Weight both sides of the bottom net and tie additional nets at the corners extending to the top of the water column. Set the nets in the afternoon, recording water velocity at the mouth of each net and the gauge reading at Apgar Bridge. Pull the nets the following morning , again recording velocities and gauge height. Count the kokanee fry and record total for each net. Calculate the amount of water filtered by each net by multiplying the velocity (m/sec) by the surface area ($0.5m^2$) and then by the number of seconds the nets were in place. Divide the number of kokanee in each net by the total amount of water filtered. Extrapolate this figure to a total estimate for that night by expanding it relative to the total water passing the sampling point during the sampling period (m^3 x total seconds nets were in place). Interpolate between sampling dates to obtain the total emigration estimate. Back calculate emigration to zero before sampling began and after the termination of sampling (Fraley and Graham 1982).

Report the figures for each sampling date, (Figure 2) and the total estimate for the year (Table 1) in the yearly monitoring report. Each sampling date would require two half days for one person, for a total of 16 man days. Access to Quarter Circle Bridge during March and April is on foot on the Quarter Circle Bridge Road. The road is usually opened sometime in May. Check with Park Service officials before scheduling sampling dates.

Brenneman's Slough

Fry emigration can be estimated by netting the culvert outlet from Brenneman's slough spawning area. Sampling this area would require more travel during the McDonald Creek sampling period, but would not increase man day requirements. Follow the same schedule described for McDonald Creek. Add a fry holding box (Figure 3) to

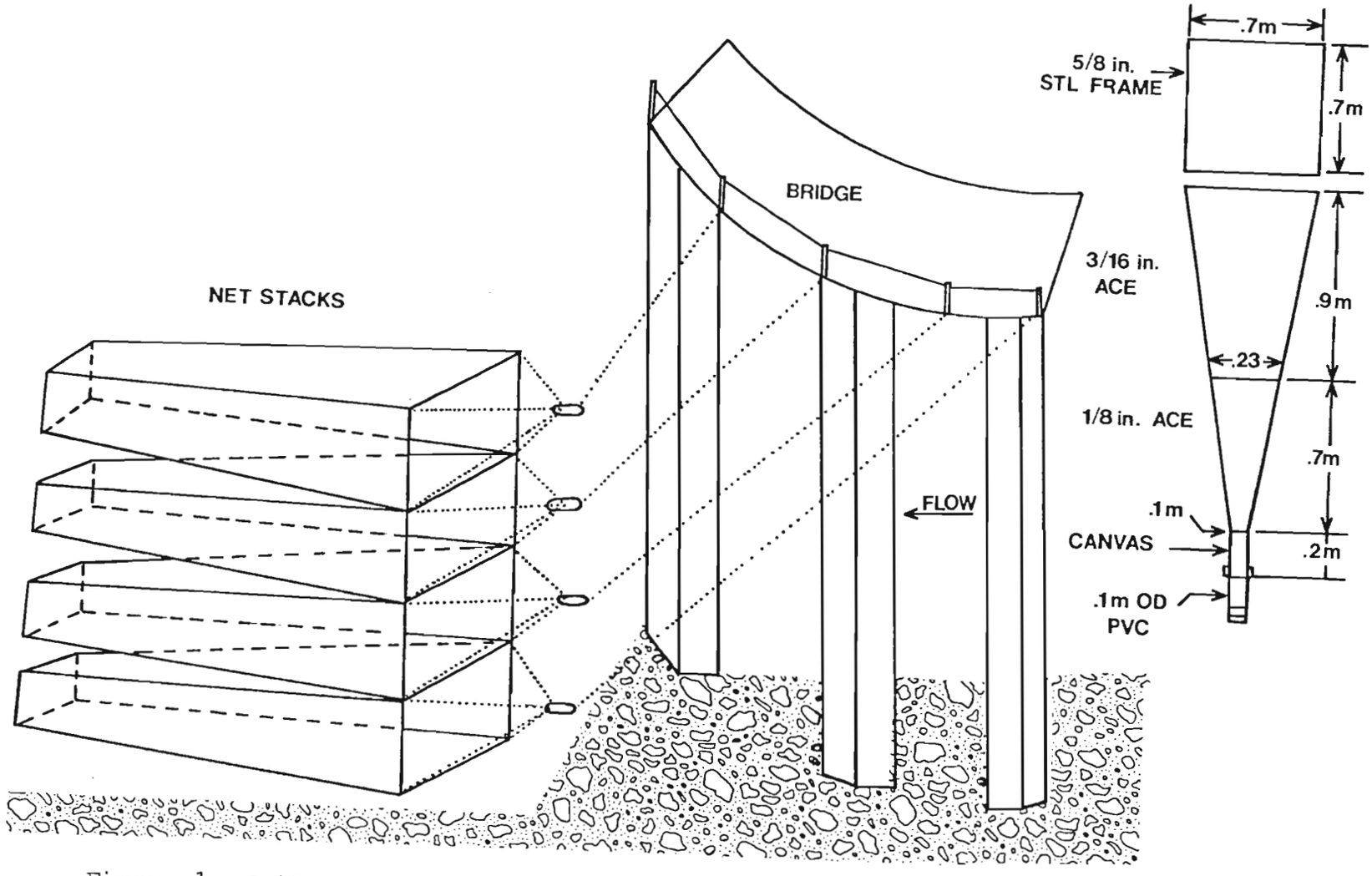


Figure 1. Drift net design and sampling procedure for estimating kokanee fry outmigration from McDonald Creek.

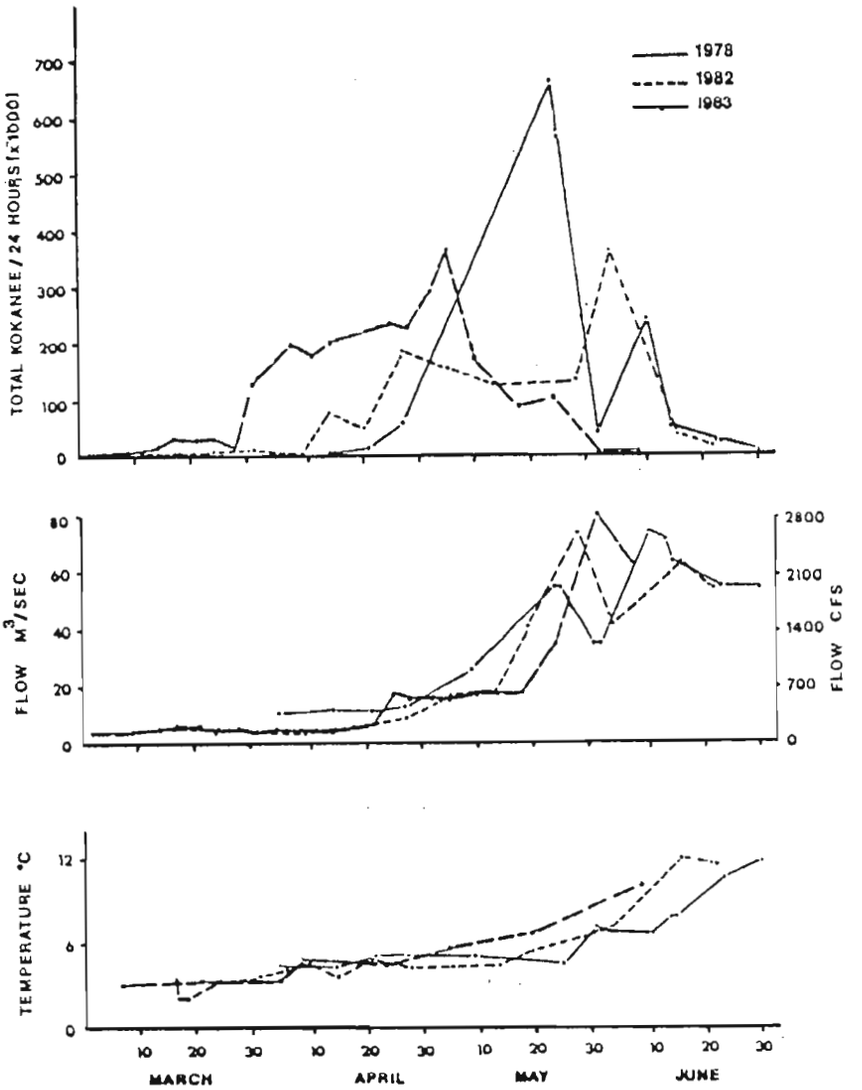


Figure 2. Estimated number of kokanee fry emigrating, flow and water temperature in McDonald Creek during 1982 and 1983. 1978 comparison data are from Hanzel and Rumsey (unpublished).

Table 1. Kokanee fry sampling data for McDonald Creek for 1983, 1982 and 1978.

	1983	1982	1978
Sampling Period	3 Feb-8 Jun	11 Mar-22 Jun	4 Apr-30 Jun
No. Sampling Dates	27	16	14
Mean Flow (m^3/sec)1/	16.1	25.0	41.0
No. Samples	67	21	10
Total No.Fry Sampled	72,122	18,584	6,885
Mean No. Fry/100m^3 Water Filtered	14.3	8.4	7.2
Total Estimated Fry Emigration	12,404,568	11,696,821	15,041,746

1/ Lower mean flows in 1982 and 1983 resulted partly from sampling dates in the early spring before snow melt began.

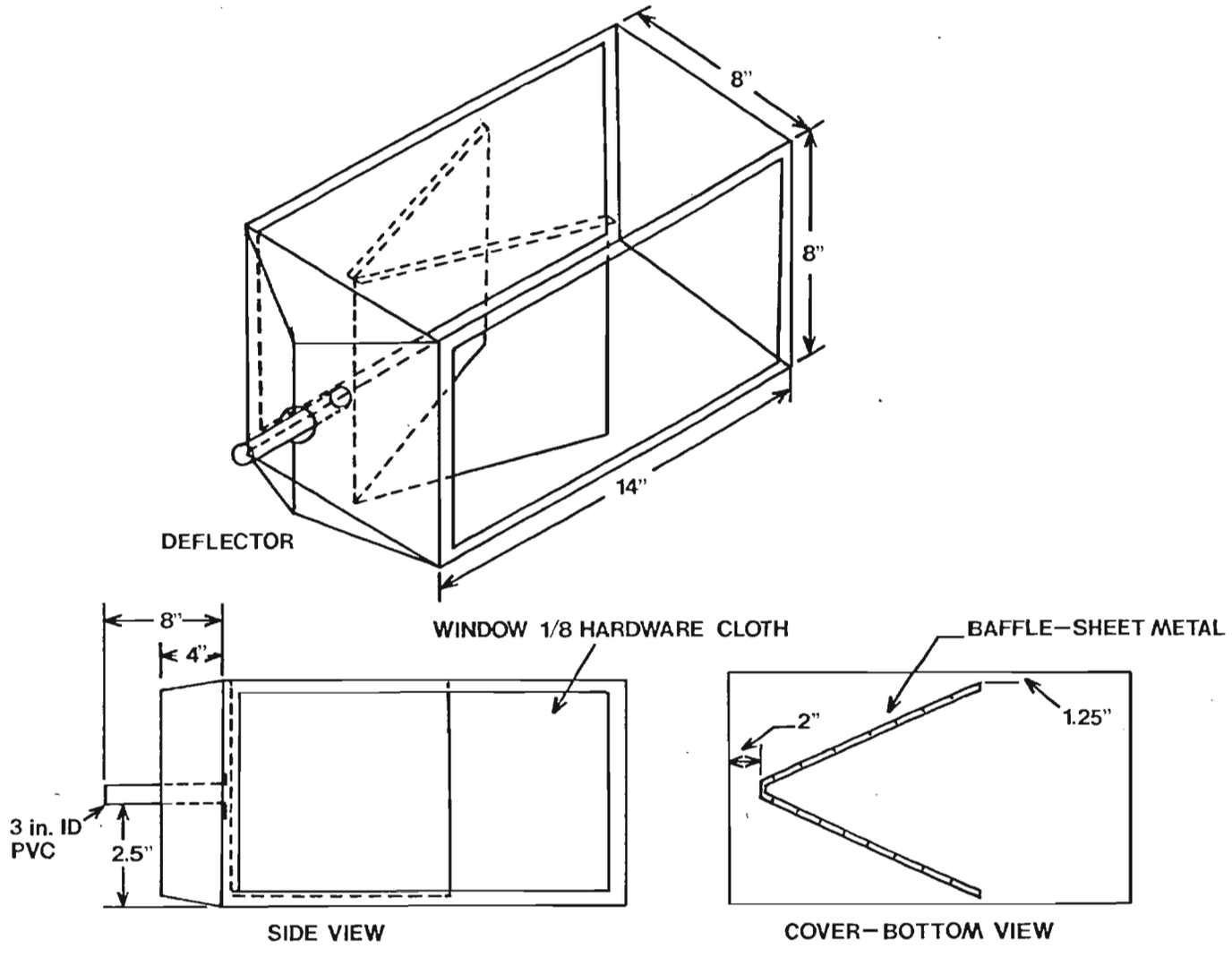


Figure 3. Fry holding box for drift net. Construction is 1/2 inch plywood with 1/8 inch hardware cloth windows which were given several coats of paint to reduce mesh size. Hinged top is made of 1/2 inch plywood, baffle and deflector are sheet metal.

the end of the drift net to prevent fry mortality. Position the net at the lower end of the culvert and calculate the amount of water (m^3) filtered by multiplying wetted net area by velocity by the total set time. Measure discharge in the slough below the culvert with a price current meter. Expand the number of fry captured to a total estimate for that night based on the percent of flow filtered through the net. Report trend and summarized data (Figure 4).

CREEL SURVEY

PROCEDURE

Angler catch rate has been a reasonable indicator of the strength of the kokanee spawning run in the mainstem Flathead River during past years (Table 2). Catch rates during the odd numbered years when mainstem runs were relatively strong were 1.99, 1.94, 2.02 and 1.38 during 1975, 1979, 1981 and 1983, respectively. Catch rates were only 0.40 and 0.48 during 1980 and 1982 when the mainstem kokanee run was weak (Hanzel 1977, Fredenberg and Graham 1982, Fraley and Graham 1982, Fraley and McMullin 1983).

Angler interviews are also important in gaining an overall assessment of the mainstem kokanee run and angler utilization of that run as the population recovers. When the population builds to levels similar to previous years, angler catch rates will increase, particularly in October. In recent years, catch rates in October have been nil due to the absence of a strong late run of kokanee spawners. A total of 10 days of angler interviews is recommended for monitoring on the mainstem and Middle Fork of the Flathead River.

When conducting angler interviews, direct the questions to one member who will represent the fisherman party. Request the following information: 1) residence of the majority of the party, 2) the terminal tackle type, 3) the number of anglers in the party, 4) how long the party has fished (total fisherman hours), 5) how many fish of each species were caught (kept and released), and 6) whether or not the party is done fishing for the day. Record the location and date of the interview. Measure any kokanee that are kept (as time allows). Enter all information on the standard Montana Creel Forms. An example of the form and specific instructions for each item follow this discussion.

Conduct the interviews on four weekend days and two weekdays in September, and three weekend days and one weekday in October, for a total of 10 days. Choose the survey days so they are evenly spaced within each period. Morning and evening hours are generally the most productive, and all sites should be visited at least twice. The sites suggested for survey extend from the Columbia Falls area to West Glacier and cover a total road distance of approximately 20 miles.

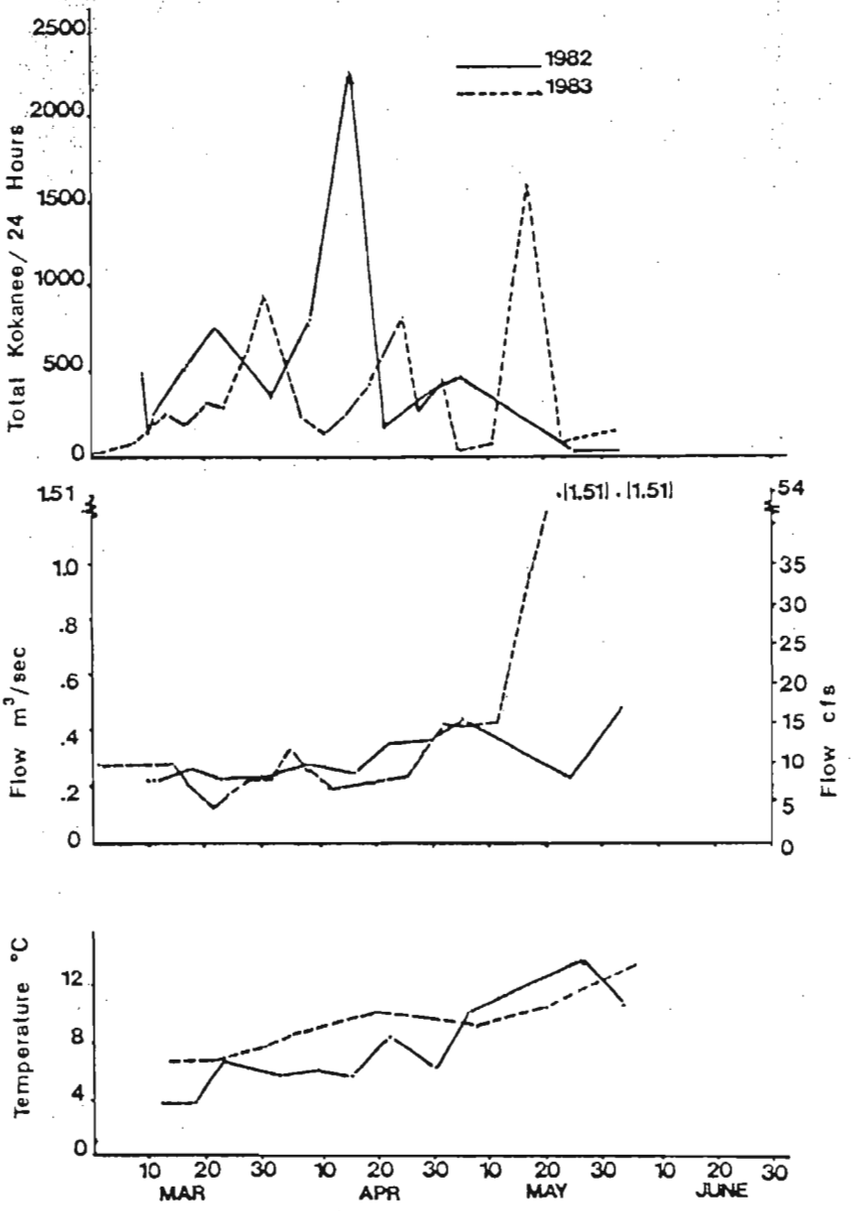


Figure 4. Number of kokanee fry emigrating, flow and water temperatures in Brenneman's Slough in the lower Flathead River, 1982 and 1983.

Table 2. Creel survey data for the mainstem Flathead River kokanee fishery from 1979-83. Figures do not include the early fall lure fishery in the Salmon Hole area below Kalispell.

Month	Hours effort	No. Kokanee caught	Catch rate
1983[1/]			
September	79	112	1.41
October	11	13	1.18
TOTAL	90	115	1.38
1982[2/]			
September	1,201	592	0.49
October	85	25	0.29
TOTAL	1,286	617	0.48
1981[2/]			
September	672	1,115	1.66
October	362	975	2.69
TOTAL	1,034	2,090	2.02
1980[2/]			
September	---	---	---
October	61	24	0.40
TOTAL	61	24	0.40
1979[2/]			
September	1,278	2,417	1.89
October	768	1,557	2.02
TOTAL	2,046	3,974	1.94
1975			
September	---	---	---
October	1,135	2,260	1.99
TOTAL	1,135	2,260	1.99

1/ Lure fishing only, no snagging in 1983.

2/ Snag fishing

ANGLER SURVEY FORM INSTRUCTIONS

COLUMN 1 YEAR (Last digit 8 "4" etc.)

COLUMN 2-5 ID Number - Optional

COLUMNS 6-7 Area
- 41 Flathead Lake to mouth of the Stillwater
- 42 Mouth of Stillwater to Pressentine
- 43 Pressentine Access to Highway 2 Bridge Columbia Falls
- 44 Highway 2 Bridge - Blankenship Bridge
- 21 Middle Fork Flathead River

COLUMNS 8-9: Day

COLUMNS 10-11: Month

COLUMN 12: Day of Week

1: Monday	5: Friday
2: Tuesday	6: Saturday
3: Wednesday	7: Sunday
4: Thursday	8: Holiday

COLUMN 14: Kokanee angler (enter "1") Not kokanee angler (enter "2). Enter 1 if Angler is fishing partly or only for kokanee.

COLUMNS 40-41: Origin. Origin of party is recorded for the following locations using thse one digit codes. If party contains anglers from more than one origin, code them based on where the majority are from.

1: Kalispell
2: Other Flathead County
3: Lake County
4: Missoula County
5: Other Western Montana (west of Continental Divide)
6: Eastern Montana (East of Continental Divide)
7: Nonresident (USA)
8: Foreign

COLUMNS 42-43: Number of people fishing/party

COLUMN 44: Fish from shore or boat

1 - Shore
2 - Boat
3 - Ice

COLUMN 45: Type of bait

1 - Bait (Worms, etc)

2 - Flies
3 - Lures
4 - Snagging hooks
5 - Any combination of the above

COLUMNS 46-48: Hours fished. This is the toal 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 11/2 hours, the total would be (2 x 5) = (2 x 3) + (1 x 1.5) = 17.5 hours. For more accuracy, ask them specifically when they started and stopped fishing and if all people in the party fished the entire time.

COLUMN 49: Is fishing trip for that day complete?

1 - Trip over
2 - Not Over
3 - Don't know

ENTER DATA for designated species

COLUMNS 50-51: Number of kokanee kept

COLUMNS 52-53: Number of kokanee released

COLUMNS 54-55: Total of columns 50-51 and 52-53

REPEAT FOR EACH SPECIES

COLUMN 74: Other Species code - enter one digit code. If game species not on this list are caught, enter in the comments section.

1 - Rainbow
2 - Cutthroat
3 - Brook Trout
4 - Arctic Grayling
5 - Bull Trout
6 - Lake Trout
7 - Yellow Perch
8 - Kokanee
9 - Bass

COLUMNS 75-76: Number of "Other Species" kept

COLUMNS 77-78: Number of "Other Species" Returned

COLUMNS 79-80: Total of columns 75-76 and 77-78
(Insert 2 different tables at this point)

SAMPLE SITES

Mainstem Flathead River

It is suggested that angler interviews be conducted at four general sites in the mainstem Flathead River: Columbia Falls Bridges, Berne Memorial Park on Highway 2, Monegans Hole at the mouth of the South Fork and Blankenship Bridge near the junction of the Middle and North Forks. A total of 10 days of angler census is suggested as sufficient to yield a representative catch rate for kokanee. In 1979, 11 days of survey would have resulted in catch rate data which was very similar to results obtained in 22 days of survey (Table 3).

Table 3. Comparison of kokanee catch rates based on 22 days of survey and 11 days of survey (every other day omitted) during September and October, 1979.

Month	Number days surveyed	Number fisherman hours	Number kokanee caught	Catch rate
September	10	1,278	2,417	1.84
	5	522	964	1.85
October	12	768	1,557	2.02
	6	441	879	2.00
TOTAL	22	2,046	3,974	1.94
	11	963	1,843	1.91

Middle Fork

The majority of angler pressure and harvest during the fall kokanee fishery on the Middle Fork is concentrated in one small area. The run at the mouth of McDonald Creek and 0.5 km above and below it should be censused once in the morning hours and once in the evening hours during each of the 10 survey days. Catch rates were 1.92 and 2.94 kokanee/hour during the relatively strong McDonald Creek kokanee spawning runs of 1981 and 1980. Kokanee runs were poor in 1982 and 1983 and catch rates were lower, 0.97 and 1.24 kokanee/hour, respectively (Table 4).

Creel Survey Summary

Record total number of fisherman hours, total number of kokanee caught and catch rate for the mainstem fishery and Middle Fork fishery in the format of Tables 2 and 4 and include in the short monitoring report prepared for each year. Schedule the sample days evenly as described above during September and October (Table 5).

Table 4. Creel survey data for the Middle Fork kokanee fishery from 1979-1983. Most of the data is from the Golf Course area near the Mouth of McDonald Creek.

Month	Hours effort	No. kokanee caught	Catch rate
1983[1/]			
September	78	101	1.29
October	3	0	0
TOTAL	81	101	1.24
1982[2/]			
September	1,794	1,920	1.07
October	1,145	1,363	0.84
TOTAL	3,065	3,157	0.97
1981[2/]			
September	879	1,743	1.98
October	1,686	3,191	1.89
TOTAL	2,565	4,934	1.92
1980[2/]			
September	---	---	---
October	103	303	2.94
TOTAL	103	303	2.94

1/ Lure and corn fishery.

2/ Snag fishing.

Table 5. Angler survey schedule for the kokanee fishery on the mainstem Flathead River and Middle Fork.

Period	Number days	Number people	Number man-days
15 September-30 September	5	1	5
1 October-15 October	5	1	5
TOTAL	10	1	10

EGG AND ALEVIN SAMPLING

PROCEDURE

Sampling kokanee eggs and alevins in spawning gravels provides data on survival and development that can be compared between years at a particular site. It is recommended that egg and alevin sampling be conducted during late January in McDonald Creek to monitor development level (percent hatched alevins) and survival. McDonald Creek was selected because of its critical importance as a spawning area, and because five years of comparative data are available.

The sampling area extends 0.5 km from the outlet at McDonald Lake to the first large bend and pool below the Apgar Bridge. Three samples should be collected from each of three gravel areas. These areas are the narrow run by the cabins near the lake outlet, the riffle below Apgar Bridge, and the riffle above the previously mentioned large pool at the bend. These areas typically support heavy concentrations of spawning kokanee.

The 0.11 m^2 hydraulic egg and alevin sampler should be used to collect the samples. (Graham et al 1980, McNeil 1963). Place the sampler with collecting bucket over the selected gravel area and turn it into the substrate. Position a kick net with collecting bucket below the sampler. Bubble the eggs and alevins out of the gravel by working the water jet into the substrate with circular motions. Sample five minutes, then empty collecting buckets. Count live and dead eggs, live and dead sac fry alevins and record on a data sheet (Figure 5). All live eggs should be eyed by mid January-early February. Re-attach the collecting buckets, sample an additional five minutes to complete the sample, and count and record live and dead eggs and alevins. If no eggs or alevins were collected during the first five minutes record zero and consider the sample complete. Report results for each sample and summarize all samples for yearly survival and development trends (Table 6). These trend data will indicate yearly changes in development and emergence timing. Large changes in survival levels related to superimposition, ice scouring or some other factor may be detected.

DATE: _____ MCDONALD CREEK EGG AND ALEVIN SAMPLES WATER TEMP: _____

Sample No.	Location	Eggs		Sac Fry Alevins		Total Live	% Survival	% Hatched
		Live	Dead	Live	Dead			
1								
2								
3								
4								
5								
5								
7								
8								
9								
10								
11								
12								

Figure 5. Form for entry of egg and alevin sampling data.

Table 6. Analysis of egg and alevin samples taken in McDonald Creek in the Apgar area from 1980-1984.

Sampling dates	No. Samples	No. Live Eggs and Alevins	% Survival	% Alevins
1/18-1/23/84	18	1,127	92	29
2/1-2/2/83	13	1,181	88	25
2/8-2/9/82	14	1,424	78	12
1/13/81	3	311	94	< 1
1/14/80-2/1/80	10	1,801	85	7

The proposed egg and alevin sampling and data analysis would take two people two days to complete, for a total of four man-days, and would be conducted from 15 January - 1 February.