KOOTENAI FALLS WILDLIFE INVENTORY [1/]

AND IMPACT ANALYSIS

[1/] Final Report

For the period

January 1, 1978 - September 1, 1979

Montana Department of Natural Resources and Conservation
Energy Division
32 South Ewing
Helena, Montana 59601

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INTRODUCTION

BACKGROUND

Northern Lights, Inc. (NLI), a rural electric cooperative based in Sandpoint, Idaho, agreed on February 3, 1978, to fund a study of the fish and wildlife resources of the Kootenai Falls area in Lincoln County, Montana. This study, coordinated by the Montana Department of Natural Resources and Conservation (DNRC), was designed to provide information relevant to the analysis of impacts of the proposed Kootenai Falls hydroelectric project on fish and wildlife resources, information which could be used by NLI in its application to the Federal Energy Regulatory Commission (FERC) and by DNRC in its ultimate evaluation of the facility required under the Major Facility Siting Act.

THE KOOTENAI FALLS PROJECT

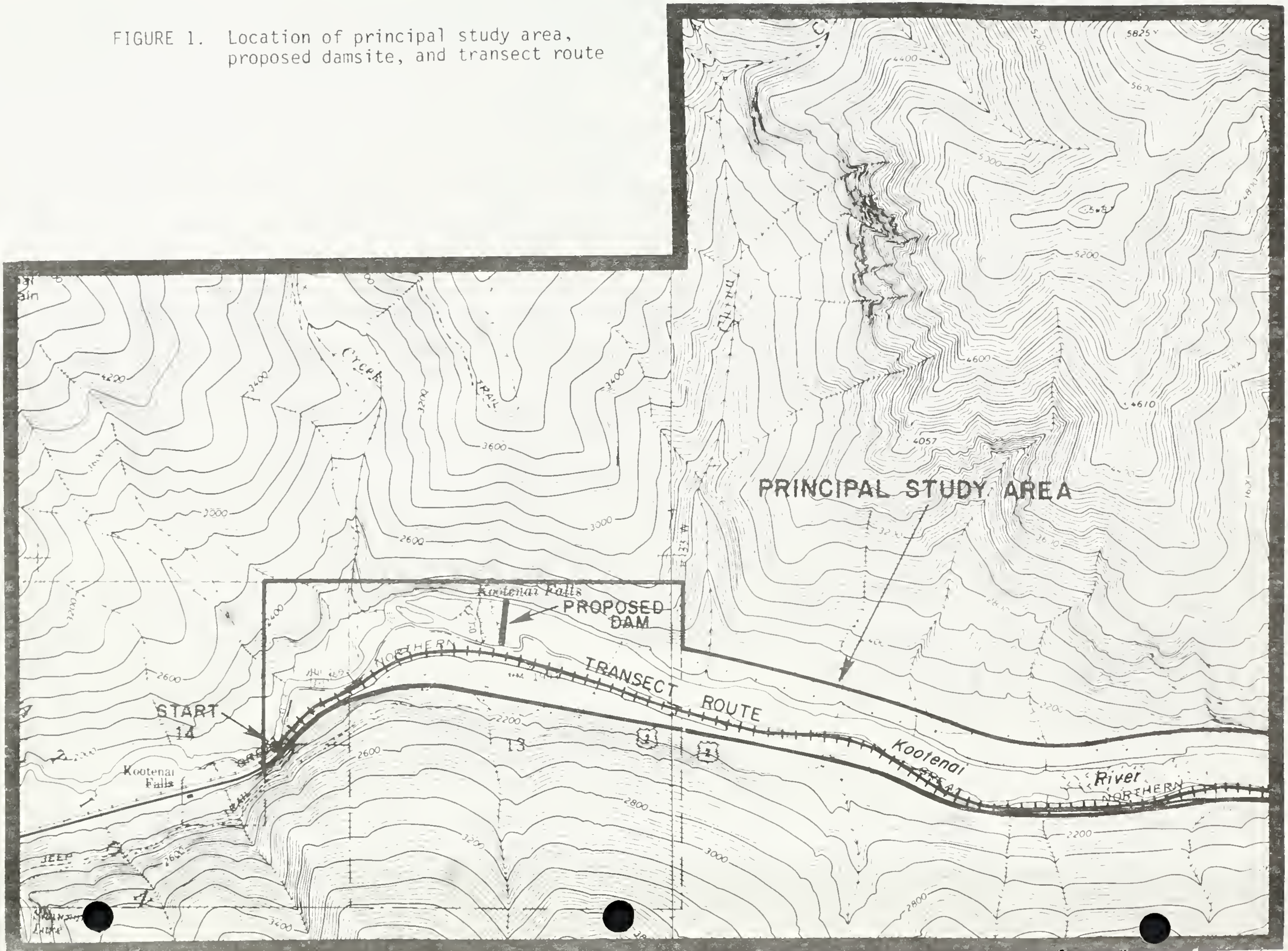
The proposed Kootenai Falls hydroelectric project has been described in detail by NLI (1978) and will only be briefly described here. Figure 1 shows the location and Figure 2 illustrates the design of the proposed dam. The dam structure would be approximately 9.1 m (30 ft) high, impounding the river and inundating associated riparian habitat at least to the 609.6 m (2,000 ft) contour for approximately 4.8 km (3 mi). It would be utilized for peak power periods commensurate with flows released from dams upriver. Water would be diverted from above the dam into an underground powerhouse, which would have the capacity to utilize 672 cms (24,000 cfs) or the entire flow of the river. The water would return to the river through two 11.9 m (39 ft) tunnels approximately 1.6 km (1.0 mi) below the Falls. The bypassed portion of the canyon would be nearly dewatered, passing as little as 21 cms (750 cfs) of water.

OVERALL STUDY SCOPE AND OBJECTIVES

The DNRC's approach in designing and carrying out this study was one which emphasized impacts analysis and identification of possible means whereby impacts may be mitigated or compensated. Since the budget for the study was small, an effort was made to limit the collection of inventory data to that directly useful in impact assessment and mitigation. Emphasis was placed on habitats and species most likely to be affected by hydroelectric development, particularly those dependent upon riparian and falls environments.

The wildlife inventory was largely carried out by the Montana Department of Fish, Wildlife and Parks (MDFWP) under contract with DNRC, entered into on February 15, 1978. Some limited field work was carried

FIGURE 1. Location of principal study area, proposed damsite, and transect route



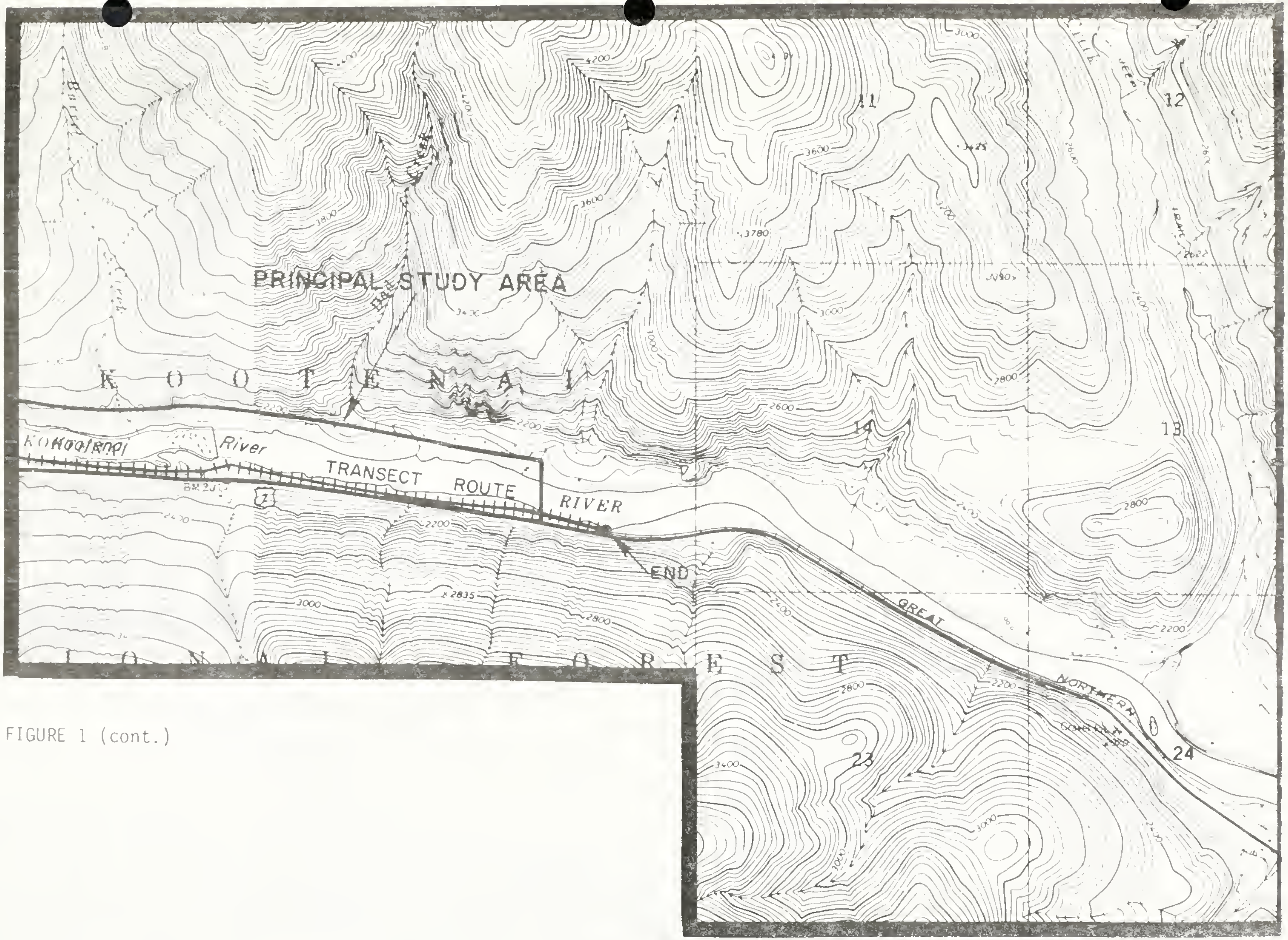


FIGURE 1 (cont.)

FIGURE 2. Location of proposed dam, powerhouse, and diversion tunnels (SOURCE: NLI 1978).

out by the DNRC and MDFWP prior to this date. Field work after July, 1978 was conducted by DNRC personnel and a private contractor. Much of the material presented herein was previously published by MDFWP (Joslin, 1978).

Realizing the need for continuous monitoring of the wildlife resource and updating of the baseline data, NLI agreed, on January 19, 1979, to fund a long-term wildlife monitoring study. The monitoring study was designed to concentrate on certain key species and habitats which would most likely be affected by the proposed developments and to supplement the original wildlife study.

At the time this study was made, Northern Lights, Inc. had not applied to DNRC for a certificate under the Major Facility Siting Act (MFSA), and the only other studies under way were the vegetation and fisheries studies. Therefore, the impact analysis presented here was not prepared in conjunction with the DNRC's analysis of engineering visual, recreation, and other concerns, as is the usual procedure with evaluation of major facilities. In the event that Northern Lights, Inc. submits an application under the MFSA, the results of this study and of the monitoring studies will be integrated into the complete evaluation required by the MFSA, the Montana Environmental Policy Act (MEPA), and other applicable statutes. The impact analysis and recommendations for mitigation and compensation presented in this report are thus tentative and subject to refinement as the DNRC's evaluation of the overall impact of the facility proceeds. Final conclusions and recommendations will be developed only after public and professional comment has been received, and will be presented in the DNRC's final environmental impact statement on the project.

THE STUDY AREA

The study area for this project extends along the Kootenai River, roughly from the proposed outlet structure to the head of the proposed pool, and includes a strip of upland habitats of variable width adjacent to the river (Figure 1). The Falls area received the greatest intensity of study throughout the report period. At the beginning of this study, the project design differed considerably from that described in NLI's application to FERC (NLI 1978). This early design called for extensive vegetation clearing of the bench between the damsite and the footbridge (Figure 2); therefore, the study initially focused on this area until the latest design was received in late 1978. Information on proposed pool levels did not become available to DNRC until July 9, 1979, and consequently a detailed vegetation map was not available until September 19, 1979. The emphasis of study within the overall study area thus shifted as new information about the project was received.

HABITATS OF THE STUDY AREA

THE KOOTENAI RIVER AND KOOTENAI FALLS

The Kootenai River originates in southeast British Columbia, flows south into Montana, then west into Idaho and turns north to enter Canada once again. Kootenai Falls is located in Lincoln County between the northwest Montana communities of Libby and Troy, 48 km (30 mi) down river from Libby Dam. Libby Dam impounds 80.5 km (50 mi) or approximately half of the Kootenai River in the state and backs water into Canada for another 80.5 km (50 mi). Currently, Libby Dam is a baseload facility, but a proposal has been made to convert the dam to a peak load facility by employment of four additional generators. Conversion to a power-peaking dam would require construction of a reregulating dam to avoid flooding of downstream settlements. The Libby Additional Units and Reregulating Dam (LAURD) would impound another twenty percent of the free-flowing Kootenai River in Montana. The Kootenai Falls Dam would be located approximately 32 km (20 mi) below the proposed reregulating dam.

Kootenai Falls is the last major falls on a Montana river not yet dammed or impounded. The Falls is composed of a complex series of cascades falling over shelf rock which occur between and on either side of three islands located in mid-river. The Falls mark the entry to the rugged 1.9 km (1.2 mi) Kootenai Canyon. Water depths in the canyon are as much as 30 m (99 ft), providing habitat for tne only white sturgeon fishery within the state (Graham 1979a). Even though the Falls cannot be seen from Highway 2, the area receives up to 55,000 visitor days of use per year (NLI 1978), making it a popular natural scenic attraction.

The all-time low flow recorded on the Kootenai was 28 cms (1000 cfs). Historic flows usually ranged from 112 to 1288 cms (4000 to 46,000 cfs), depending upon the season with highest flows during spring runoff. With installation of Libby Dam, seasonal flow regimes were reversed and flows now range from 56 to 560 cms (2,000 to 20,000 cfs). Northern Lights, Inc. (1978) proposes to divert all but 21 cms (750 cfs) for power generation.

PRELIMINARY COVER AND TERRAIN CLASSIFICATION

A map (scale = 1:24,000) of forest habitat types (Pfister et al. 1977) for the area, provided by the Kootenai National Forest (Olson-Elliott & Associates 1976), served as the basis for more detailed field mapping of cover and terrain types within the study area (Figure 3). Four natural cover types were recognized: timber, shrub, grass, and rock (or bare). Eight terrain types were mapped on 7.5- minute topographic maps, using ocular estimates and infrared color photographs. The following four terms describe rocky terrain types: bluffs, benches with rocky drop-offs, often in step-like series; cliffs, rock faces one or more meters in height; talus, masses of shale or boulders, generally not capable of supporting vegetation to climax stage due to instability or poor edaphic features; broken, those areas which are not bluffs, cliffs, or talus,

FIGURE 3. Map of terrian types.

1 = Bluff	5 = Flood Plain
2 = Broken	6 = Park
3 = Cliff	7 = Cutting Unit
4 = Talus	No Number = Timbered

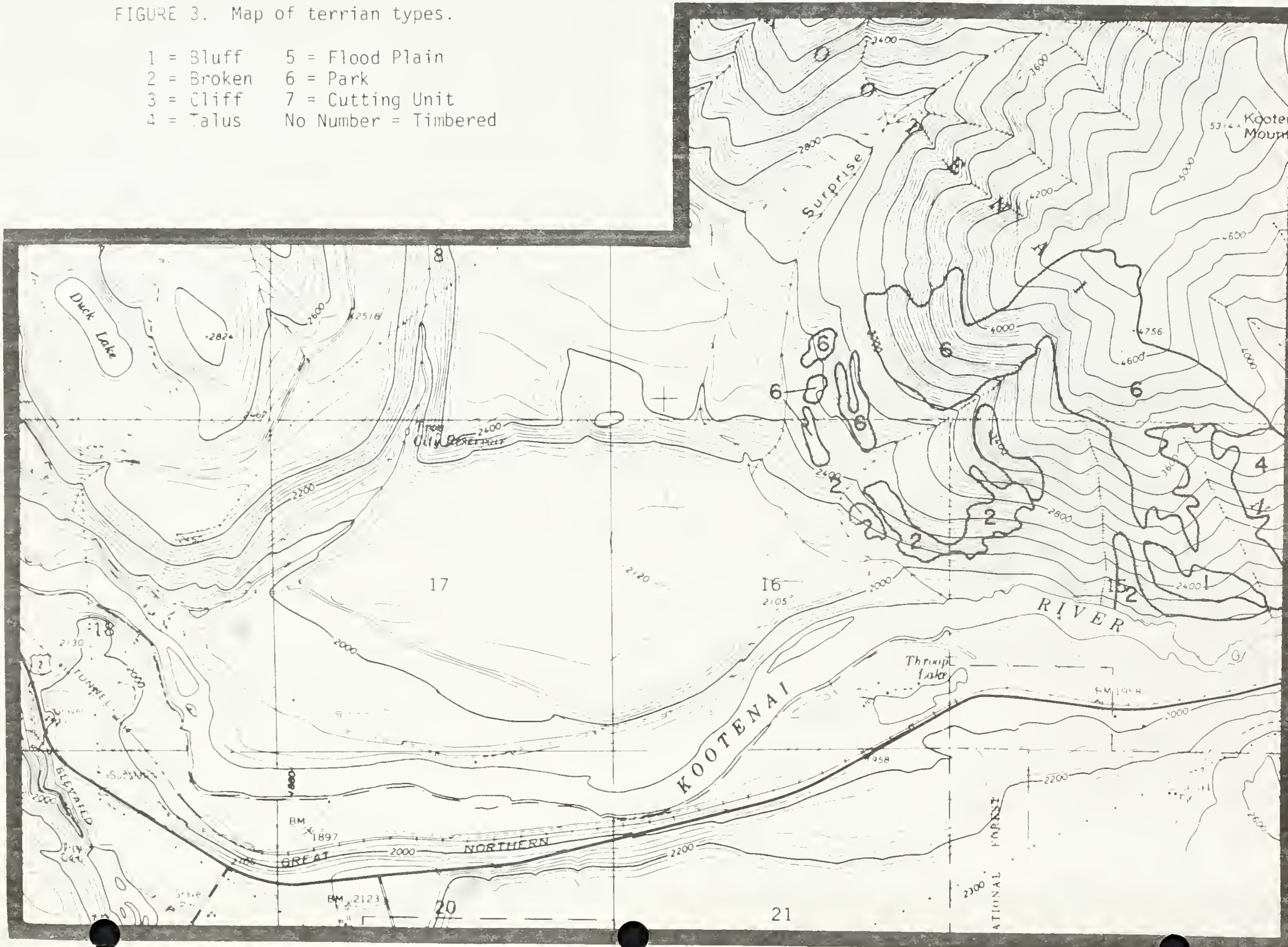
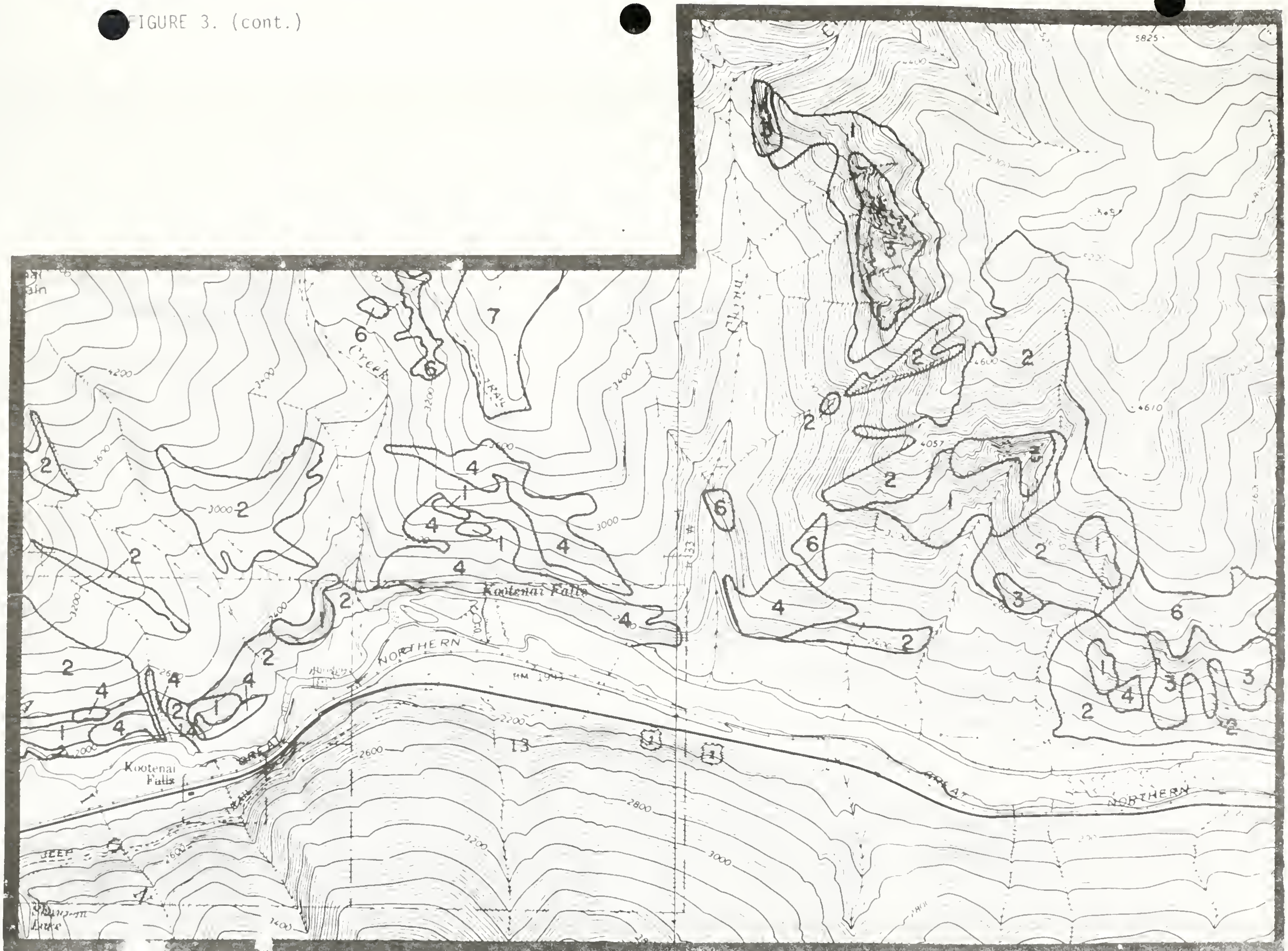


FIGURE 3. (cont.)



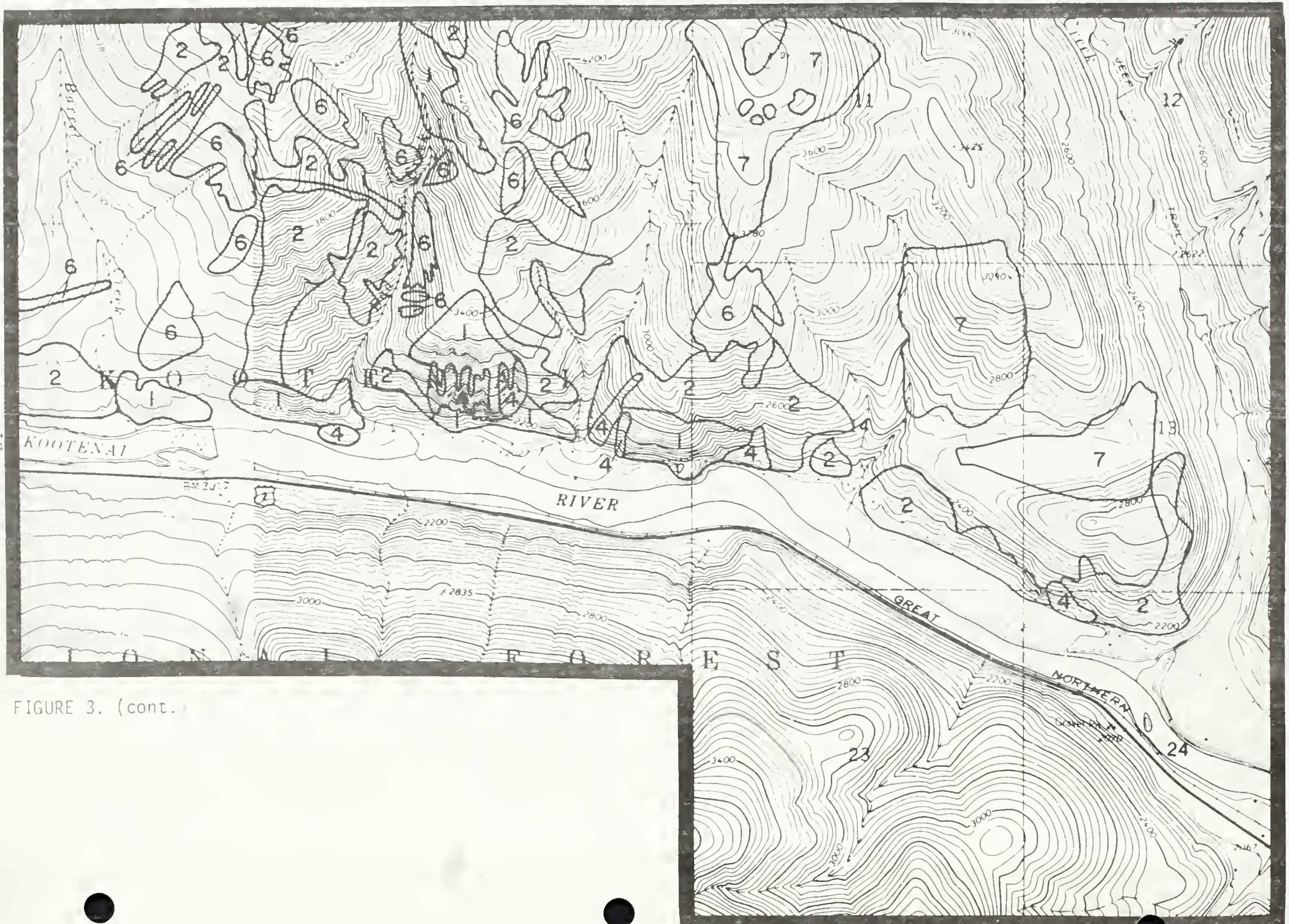


FIGURE 3. (cont.

but which were obviously difficult to traverse because of rocky substrate. If an area could not be defined as one of the rocky terrains, then it was classified as one of the four remaining terrain types, including: ridge, the line of land separating two drainages; floodplain, the low-lying, flat or gently sloping land adjacent to a water course; park, a nontimbered flat or sloping area; sidehill, a catchall term used to categorize any nonrocky area which would not fit any of the other terrain types. The cliff, talus and park types by definition are not timbered, but the five remaining terrain types could support any cover type. A map of terrain types is shown in Figure 3.

The area south of the river in the vicinity of Kootenai Falls is heavily timbered and falls within the relatively moist western red cedar/ queencup beadlily and western hemlock/queencup beadlily habitat types, while the area to the north falls primarily within the much drier Douglas fir/ninebark, Douglas fir/bluebunch wheatgrass and Douglas fir/snowberry habitat types. Rocky outcrops, grassy meadows, and scree slopes are much more prevalent north of the river.

HABITAT CATEGORIES

Habitat categories were defined based on the above classification and on the 1:1200 vegetation map prepared as part of the vegetation study (Olson-Elliott & Associates 1979). Table 1 lists the habitat categories used in this study, their abbreviations, their component vegetation community types, and dominant vegetation. More detailed descriptions of the vegetation types and a map showing their distribution in the study area has been presented in the vegetation report (Olson-Elliott & Associates 1979).

INVENTORY

METHODS

General

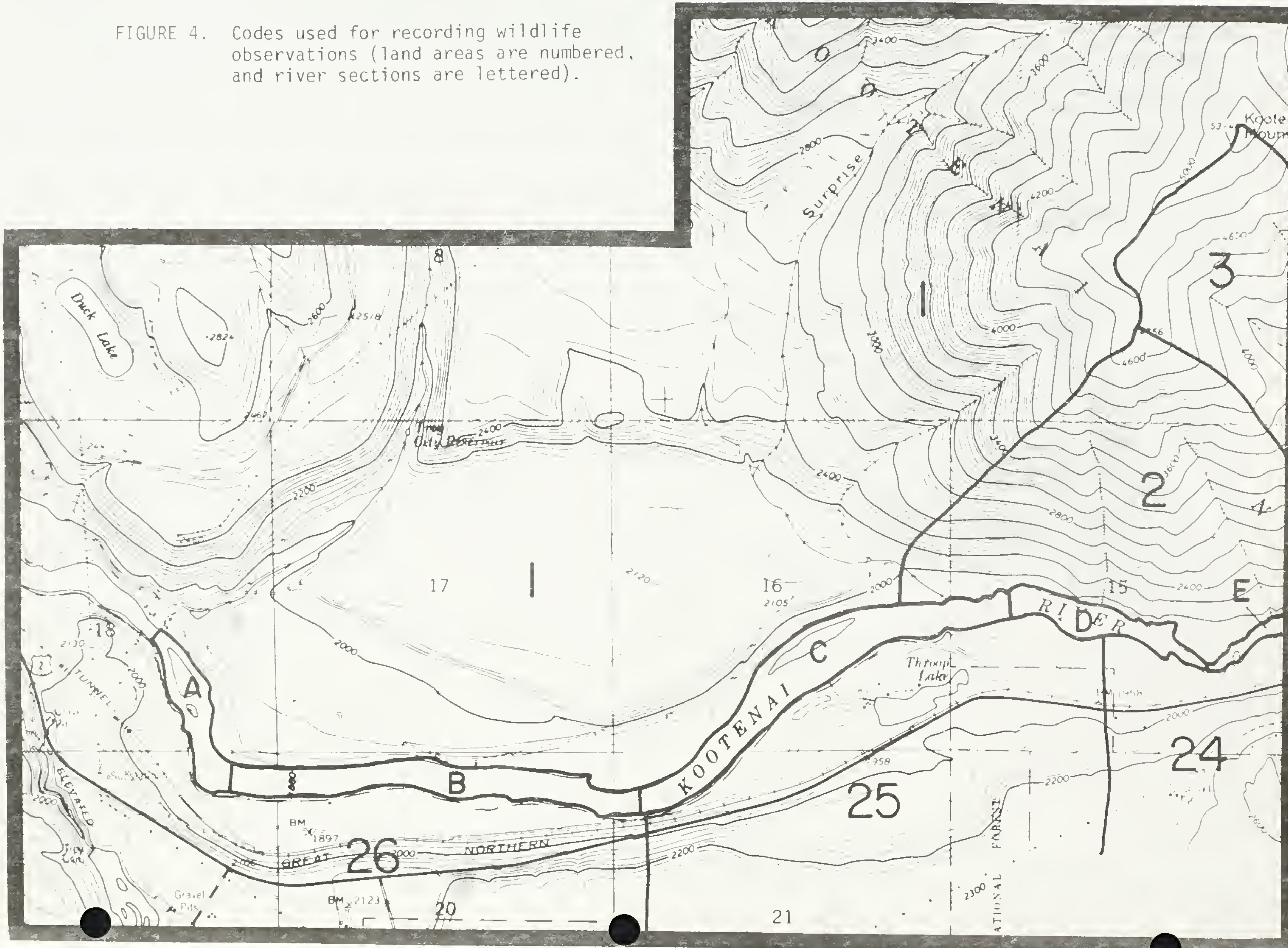
Field work was intermittent throughout the study period; Appendix A summarizes the schedule of field work. Observations were aided by the use of a 7 x 35 power binocular and a 15 to 60 variable power spotting scope. Field data were recorded on standard data sheets (Appendix B and C) which are on file with the DNRC. For purposes of this study, winter was defined as the period January 1 to March 15, spring as March 16 to May 30, summer as June 1 to August 31, and fall as September 1 to December 31. Systematic inventories were made as described below; observations of species which were made during reconnaissance and incidental to the systematic surveys were recorded and were used in compiling the species list. Locations of animals observed in terrestrial habitats were plotted on field maps and also recorded on data sheets using the number codes shown in Figure 4. Locations of waterfowl and other aquatic animals were recorded using the letter code shown in Figure 4. Habitat preferences were recorded on standard data sheets using forest habitat types (Pfister *et al*. 1977) and the cover types and terrain types described earlier. Since the vegetation study did not begin until July of 1979, more precise habitat information was not available for most of the field work, and habitat categories (Table 1) were assigned to wildlife species *a posteriori*.

Large Mammal Survey

Data were recorded on standard data sheets for each observation of a carnivore or ungulate, and included the following information: date, time of day, observer, mode of transportation, cloud cover, precipitation, percent snow cover, temperature, wind speed, number of animals, group composition, activity, slope, aspect, elevation, forest habitat type, general cover type, terrain type (see Appendix B). Eight aerial surveys were made over the study area in 1978, including three helicopter and five fixed-wing flights. Locations of each animal or group observed were plotted on field maps and were also recorded on data sheets using the location codes shown in Figure 4. As shown in this figure, the land area was coded using numerals from Surprise Gulch (1) to east of Pipe Creek (15) on the north side of the river, and from west of Cedar Creek (16) to the junction of Highway 2 and Highway 202 (26) south of the river.

Monthly bighorn sheep surveys were conducted from Lynx Flats to Quartz Creek from January through July, 1978, and incidental observations were collected during the remainder of the study period. The surveys were conducted from Highway 2 during early morning or late afternoon and evening.

FIGURE 4. Codes used for recording wildlife observations (land areas are numbered, and river sections are lettered).



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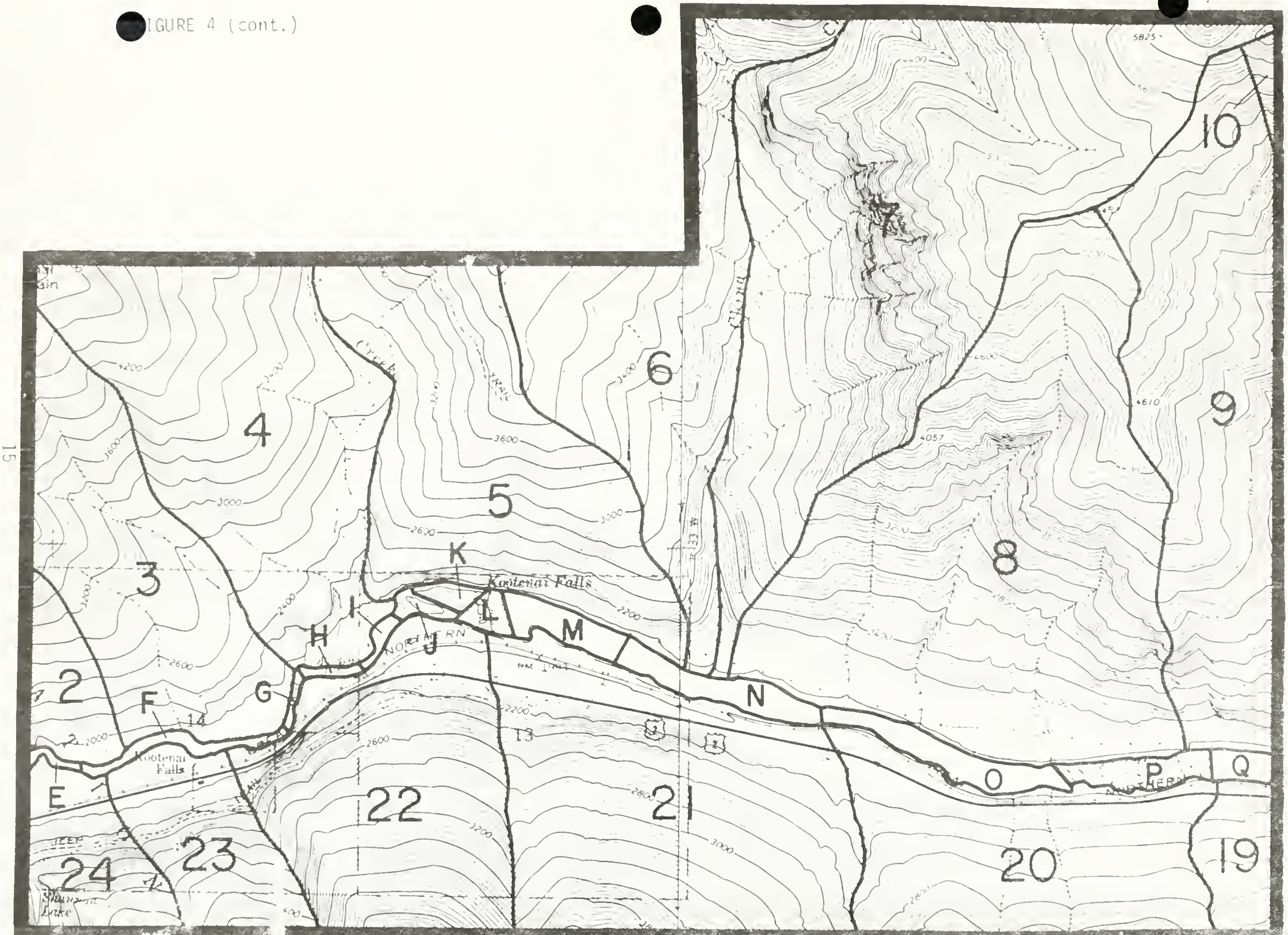

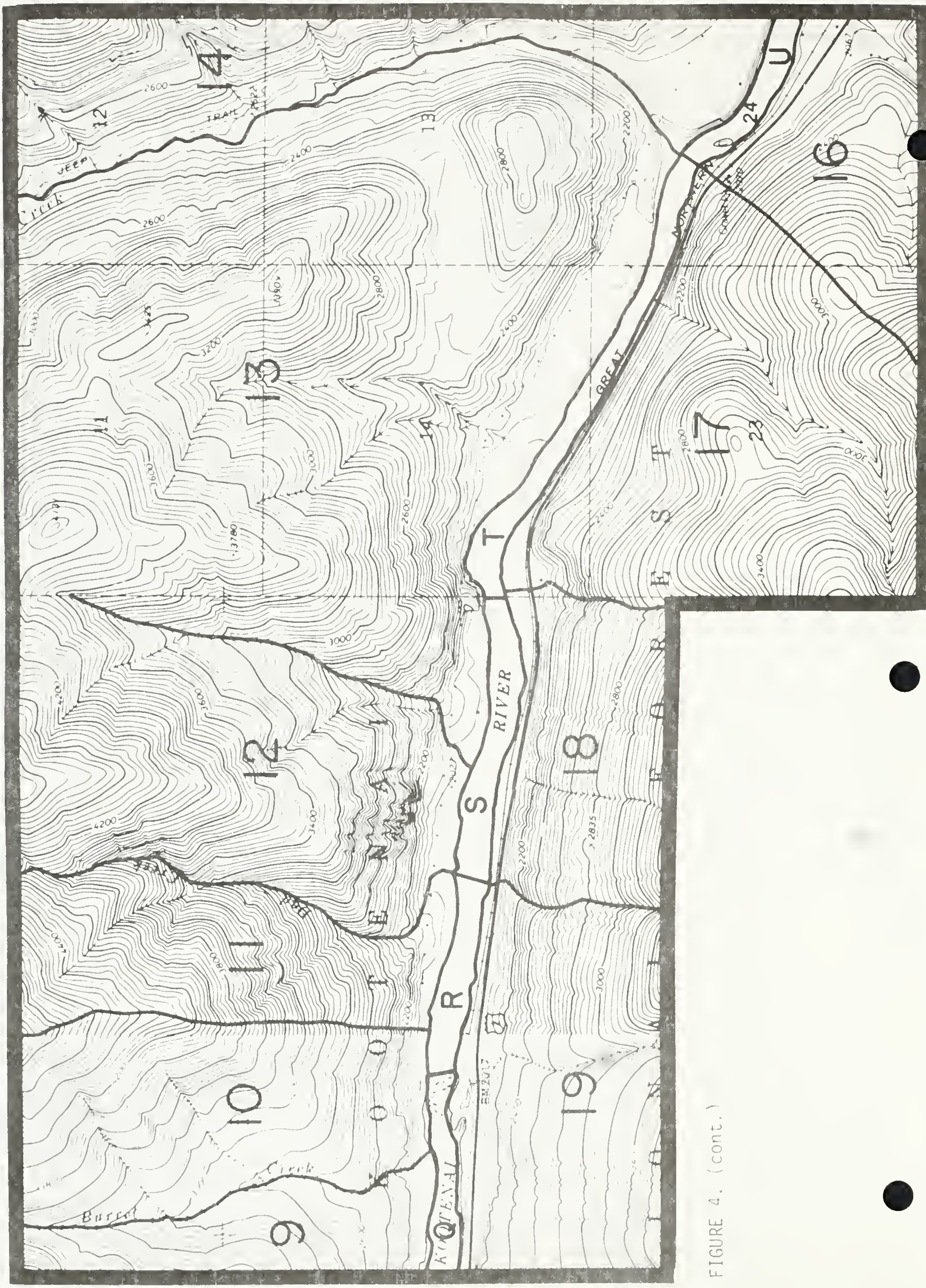

FIGURE 4. (cont.)

TABLE 1. Summary of habitat categories used in the wildlife study

Habitat Category	Abbr.	Component Community Types 1/	Dominant Vegetation
WATER HABITATS			
Rapids	RA	-	None--includes fast water broken by shallow rocks
Falls	FA	-	None--includes fast water falling over falls, fast water above and below falls
Slow Water	SW	-	None--includes relatively smooth, wide river sections, mostly upstream of Falls, with no white water
Fast Water	FW	-	None--includes narrowly constricted sections of river, mostly below falls having no white water
Aquatic Vegetation (Rooted)	AV	17	*Ranunculus aquatilus*, *Elodea canadensis*
SPARSELY VEGETATED HABITATS			
Exposed Rock or Logjams (in River)	ER	R	None--includes exposed rock in river surrounded by water as well as logjams
Bare Rock (Upland)	BR	R	None--includes scoured rock along river canyon not surrounded by water
Gravel Bar	GB	12	*Tanacetum vulgare*, *Agrostis alba*, *Equisetum arvense*
Scree and Talus	ST	S	None--includes steep rockslides adjacent to river
Rocky Outcrops (Upland)	RO	15	*Festuca scabrella*, *Physocarpus malvaceus*, *Philadelphus lewisii*
GRASSLAND AND MARSH HABITATS			
Riparian Grassland and Hayfields	RG	14,20,25	*Phleum pratensis*, *Poa pratensis*, *Bromus inermis*, *Agropyron repens*
Fescue Grassland	FG	16	*Festuca scabrella*, *Agropyron spicortum* *Balsamorhiza sagittata*
Cattail Marsh	CM	13	*Typha latifolia*
SHRUB HABITATS			
Willow	WI	24	*Salix* spp., *Tanacetum vulgare*, *Agrostis alba*
Birch-Alder-Dogwood	BA	21	*Betula occidentalis*, *Alnus incana*, *Cornus stolonifera*
Alder-Dogwood	AD	11	*Alnus incana*, *Cornus stolonifera*

Table 1: Cont.

Habitat Category	Abbr.	Component Community Types[1/]	Dominant Vegetation
FOREST HABITATS			
Riparian Cottonwoods[2/]	RC	10	Populus trichocarpa, Almus incana, Betula occidentalis
Snags (Deciduous)	SD	10,9,23	Populus trichocarpa (usually)
Cottonwood-Conifers[3/]	CC	9.23	Populus trichorcarpa, Pseudotsuga menziesii, Thuja plicata
Ponderosa Pine-Douglas Fir[4/]	PD	4,5	Pinus ponderosa, Pseudotsuga menziesii
Douglas Fir/Shrub[3/]	DS	6,8	Pseudotsuga menziesii, Pinus ponderosa, Calamagrostis rubescens
Douglas Fir/Ninebark[4/]	DN	2,3	Pseudotsuga menziesii, Physocarpus malvaceus
Douglas Fir-Western Red Cedar[4/]	DW	1,7	Pseudotsuga menziesii, Thuja plicata
Snags (Coniferous)	SC	1-9,23	Variable
OTHER			
Powerline Right-of-Way	PR	18	Betula occidentalis, Rubus parviflorus, Acer glabrum
Railroad Right-of-Way	RR	19	Berberis repens, Rubus parviflorus, Sambucus cerulea
Orchard	OR	22	Pyrus malus
Open Air	OA	-	None--includes open air of river canyon

1/See DNRC 1979

2/Early Succession

3/Mid Succession

4/Late Succession

Riparian Habitat Transects

In order to determine the extent of use of riparian habitats by vertebrates, transects were established along the railroad right-of-way which parallels Highway 2 in the study area. All transects began at the retaining wall along Highway 2, but the length of the transects was increased as further information on pool extent was obtained (Figure 1). The first eight transect runs were made between January 20, 1978, and March 2, 1978, and extended to the mouth of China Creek. Seven additional runs of this same route were made between April 24, 1978 and May 9, 1978. The route was later extended upstream to a point 2 km (1.6 mi) upstream from the head of the Falls (Figure 1) and was run nine times between May 11, 1978 and July 8, 1978. In 1979, the route was extended to a point approximately 4 km (3 mi) above the Falls and was run an additional fourteen times between January 20 and June 30, 1979. Methods were modified from those of Emlen (1977). Transects were generally run starting 0.25 hr before local sunrise except during winter, when runs began somewhat later. Only birds were recorded during 1978 transect runs, but both birds and mammals were recorded in 1979. During transect runs, the southern- facing slope of mountains across the river were scanned with the aid of binoculars or power spotting scope. Approximately 2.5 hours were required for each transect run. Information obtained during transect runs was used to compare the relative use by vertebrates of upland coniferous forest habitats and the riparian deciduous forest/shrub habitats.

Water Bird Survey and Census

Use of the Kootenai River in the study area by waterfowl and other water birds was investigated during riparian habitat transects and general reconnaissance. Because much of the river from Libby to near the junction of U.S. Highway 2 and State Highway 202 is not navigable, observations along the river, other than in those areas already mentioned, were made incidental to other activities, usually while en route between Libby and Troy on Highway 2. Locations of waterfowl observed on the river were recorded on standard data sheets (Appendix C) using letter codes from the mouth of O'Brien Creek (A) to Pipe Creek (W, Figure 4).

Waterfowl censuses of the Kootenai River in the study area were made on fourteen different days in 1979 (Appendix A). These censuses attempted to determine the minimum numbers of each species present in the project area each day. Censuses were conducted along the river from the proposed outlet to the upper end of the pool (area codes G-N, P-S, and Z in Figure 4). During winter, parts of the river canyon below the Falls (areas G-K in Figure 4) were inaccessible because of ice and snow and censuses were not taken here (Appendix A). Censuses of the river section above the Falls were made during transect runs; at the conclusion of a transect run, the section below the Falls was censused.

Bald Eagle Survey

Locations of eagles observed were recorded on maps, and habitat preferences were recorded on standard data sheets. Observations made during fall, 1978, were made incidental to the fisheries study. Winter observations were made during transect runs along the railroad tracks and incidental to travel through the area. The Kootenai river was censused for bald eagles as part of the National Wildlife Federation's nationwide Bald Eagle survey during the report period. Information gathered by Meyer (1979) during regular ground and aerial surveys of the Kootenai River and by Craighead and Craighead's (1979) LAURD study provided additional information on Bald Eagle use of the study area.

Bird Censuses

Bird populations of a portion of the study area (Figure 5) were censused in winter (January 20 - March 2, 1978) and during the breeding season (May 7 - June 30, 1978) using standard methods (Hall 1964; Van Velzen 1972; Kolb 1965). The schedule of the breeding bird census is given in Appendix D. Monthly occurrence, location, and habitat type were noted for each bird species. The upland portions of the census area were defined on the basis of NLI's original plan for construction of the powerhouse between the damsite and the footbridge; since this area would not be affected by NLI's revised proposal, no censuses were made in 1979.

Small Mammal Trapping

Small mammal populations were sampled in September of 1978, using a combination of snap and pitfall traps. September was chosen as the trapping period in an effort to sample populations near the peak of their annual cycle. The locations of all trapping sites and their code numbers are shown in Figure 5. Four snap trap lines, each consisting of twenty-five stations (2 traps/station, for a total of fifty traps per line) located at fifteen m (45 ft) intervals, were operated for three consecutive nights (September 3-5, 1978). Two of these trap lines (Nos. 1 and 2) were set in typical riparian grassland habitats in an area likely to be inundated should the project be implemented. The two remaining lines (Nos. 3 and 4) were set in typical nonriparian Douglas fir-western red cedar coniferous forest habitats or forest edge habitats adjacent to the railroad right-of-way. Total trapping effort for these lines was 600 trap-nights (200 traps x 3 nights). In addition to snap trap lines, four additional lines, each consisting of four sunken-can ("pitfall") traps at 15 m (45 ft) intervals, were run during the same period. These lines sampled typical forest-edge shrub (No.5), stream-side within Douglas fir-western red cedar forest (No.6), shrubby Douglas fir-dominated forest (No.7), and scree habitats (No.8). All traps were removed at the end of the trapping period. Animals captured were weighed, measured, sexed, and identified to species. Standard study skins and

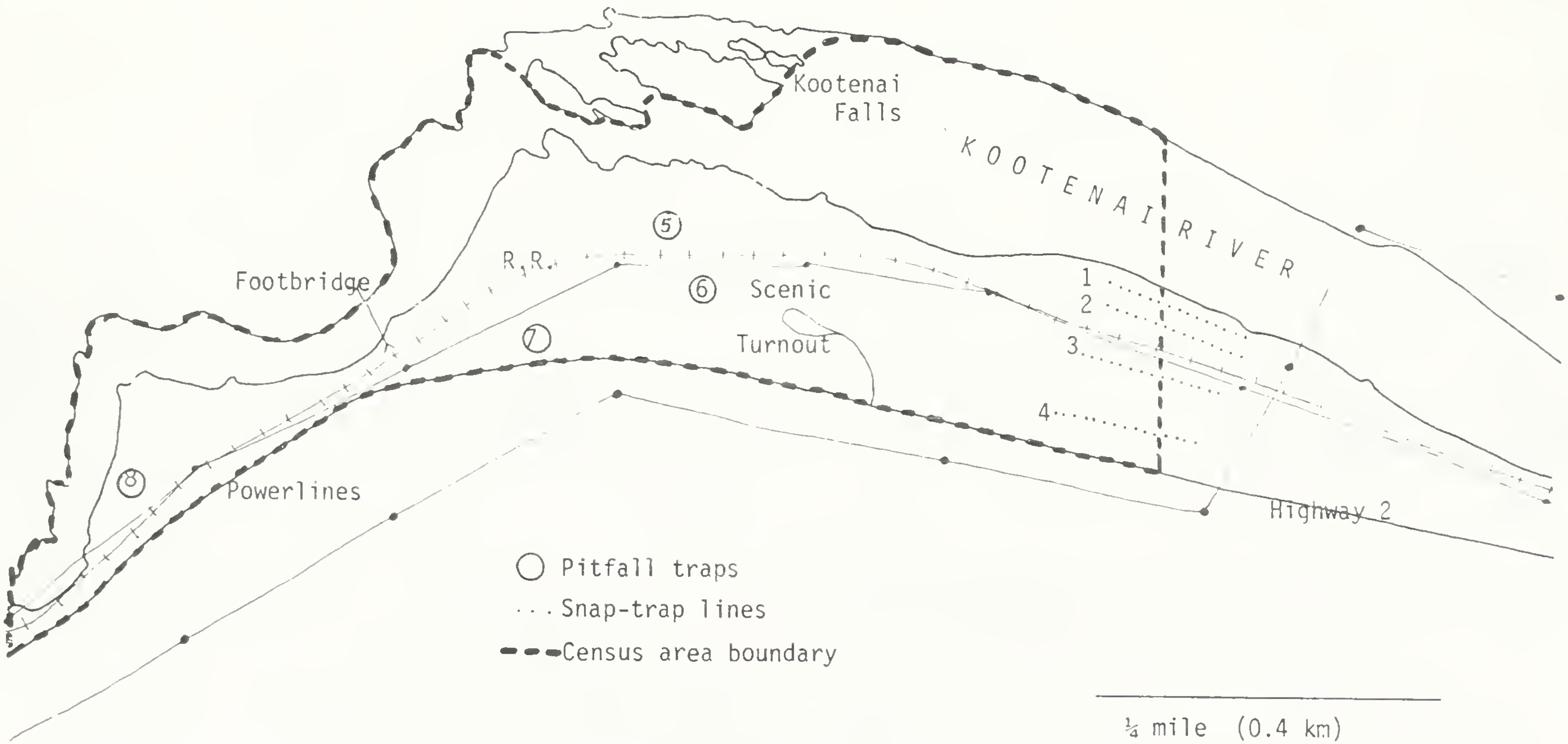

FIGURE 5. Location of breeding bird census area and small mammal trapping sites.

skulls were prepared of all species except the deer mouse. (See Appendix E for sample data sheet.)

Reptile and Amphibian Survey

No systematic surveys of reptiles or amphibians were conducted during this survey, although all observations made incidental to other field work were recorded and occasional searches of likely habitat were made during both summers.

RESULTS

Summary of Fauna Observed

The information presented below is based on work conducted by MDFWP as reported by Joslin (1978) for the period January, 1978 to July, 1978, and on work conducted by DNRC through August 1, 1979. Lists of vertebrates which occur or probably occur in northwestern Montana near the project area may be obtained from the reports of: Hall and Kelson (1979), Hoffmann and Pattie (1968), and Hoffmann *et al.* (1969a and b) for mammals; Davis (1961) and Skaar (1975) for birds; Black (1970a) for amphibians; and Black (1970b) and Davis (1963) for reptiles (see also Flath 1979). These data are readily available and need not be repeated in this document; only information on vertebrates actually encountered during the study is included in this report. Inventory data for 72 species of birds and 28 of mammals encountered during this study are summarized in Tables 2 and 3, respectively.

The only reptiles observed were a group of nine western garter snakes (*Thamnophis elegans vagrans*) found beneath discarded sheet metal in riparian grassland near the head of Kootenai Falls, and an unidentified snake (possibly a racer) observed in the understory of Douglas fir forest near the head of the Falls in June of 1979. No amphibians were found during the present study, despite a search of likely habitat. However, a Couer d'Alene Salamander (*Plethodon vandykei*) was reportedly collected on the south side of Highway 2 above the retaining wall at the western border of the project area (Elliott 1979). This species is considered a non-game species of "special interest" by the MDFWP (Flath 1979). It is likely that the wide fluctuations in discharge and shoreline of the Kootenai River presently limit amphibian populations in the area by rendering the entire river unsuitable as breeding habitat.

According to Skaar (1975), over 211 species of birds occur in the Kootenai Basin, 84% of which breed there. Over 50 of these species are directly dependent upon water, and many others are directly dependent upon riparian habitat.

Of the 72 bird species observed during this study, 15 (21%) were classified as permanent residents in the Falls area, 49 (63%) as summer

TABLE 2 - Summary of data collected on bird species observed on the Kootenai Falls study area, January 1978 through July 1979.

Species	Habitat 1/	Where Observed 2/	Status and Abundance 3/ This Study	Status and Abundance 3/ Skaar (1979) 4/	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Great Blue Heron Ardea herodias	GB,SW,ER	C.D.F,J,H.L.M.N	s-U	BW	-	-	-	-	-	J	J	A	-	O	-	-
Canada Goose Branta canadensis	SW,GB,RG	C,D,E,M,N	B-C	BW	-	-	M	A	M	J	-	-	-	-	-	-
Mallard Anas platyrhynchos	SW,FW,GB,FA,ER,AV,CM	D.F,H.L.M.N.P,Q.R S,T,Z	W-A, b-A	BW	J	F	M	A	M	J	J	-	S	-	N	-
American Wigeon Anas americana	SW,GB	M	sm-R	BW	-	-	-	A	M	-	-	-	-	-	-	-
Common Goldeneye Bucephala clangula	SW,ER,FW,GB,FA	E,F,H,M,N,P,Q,R,S, T,Z	W-A, b-A	BW	J	F	M	A	M	J	-	-	-	-	-	-
Barrow's Goldeneye Bucephala islandica	SW,ER	M	b-U	BW	-	-	-	A	M	-	-	-	-	-	-	-
Harlequin Duck Histrionicus histrionicus	FA,FW,ER,BR,SW	F,G,H,J,L,M,N	b-U	B	-	-	-	A	M	J	J	A	-	-	-	-
Common Merganser Mergus merganser	FW,GB,SW,AV,ER	D,F,G,H,M,N,P,Q,R, S,Z	W-C, b-A	BW	J	F	M	A	M	J	J	-	S	O	N	-
Red-tailed Hawk Buteo jamaicensis	PD,OA	2,4,6	w-R, S-U	B	-	F	-	-	M	J	-	-	-	O	-	-
Golden Eagle Aquila chrysaetos	PD	6,20	s-R	BW	-	-	-	A	-	-	-	-	-	-	-	-
Bald Eagle Haliaeetus leucocephalus	SD,RC,DS,SC,CC,PD,OA	B,D,E,F,H,M,V 8,9,13,21	W-U, s-U	BW	J	F	M	-	-	J	J	-	-	O	N	-
Osprey Pandion haliaetus	OA,SW,FW,SD,CC	D,E,M,N,P,Q,Z, 7,19,20,21,22,24	b-C	B	-	-	M	A	M	J	J	A	S	-	-	-
Merlin Falco columbarius	RO,DS	22	w-U, b-U	BW	J	-	-	-	-	J	-	-	-	-	-	-
American Kestrel Falco sparverius	SC,RC,CC,DS,SD	21,22	B-U	BW	-	-	-	-	M	J	J	-	-	-	-	-
Ruffed Grouse Bonasa umbellus	DW,DS	8,16,21,22,23	b-U, w-U	BW	-	F	-	A	M	J	-	-	-	O	-	-
Killdeer Charadrius vociferus	GB	D,25	B-U	BW	-	-	-	-	M	-	-	-	-	-	-	-
Spotted Sandpiper Actitus macularia	GB,ER,FA	F,J,K,L,M,N,Z	b-	B	-	-	-	-	M	J	J	-	-	-	-	-

TABLE 2 - Summary of data collected on bird species observed on the Kootenai Falls study area, January 1978 through July 1979.

Species	Habitat 1/	Where Observed 2/	Status and Abundance 3/ This Study	Status and Abundance 3/ Skaar (1979) 4/	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
California Gull *Larus californicus*	SW,OA	M	s-U	w	-	-	-	-	-	J	J	-	-	-	-	-
Ring-billed Gull *Larus delawarensis*	SW,OA,ER	I,L	t-U, fm-R	tw	-	-	-	-	-	-	J	-	-	O	-	-
Mourning Dove *Zenaida macroura*	RR,DS	21,20	w-R, b-U	bW	-	F	-	-	M	J	-	-	-	-	-	-
Black Swift *Cypseloides niger*	OA	L	s-R	b	-	-	-	-	-	-	J	-	-	-	-	-
Vaux's Swift *Chaetura vauxi*	OA	L,M	sm-U	b	-	-	-	-	M	-	-	-	-	-	-	-
Calliope Hummingbird *Stellula calliope*	PR,RR,RO,DS	22	s-r	B	-	-	-	-	-	-	J	-	-	-	-	-
Rufous Hummingbird *Selasphorus rufus*	DS	21	s-U	B	-	-	-	-	M	J	J	-	-	-	-	-
Belted Kingfisher *Megaceryle alcyon*	SW	D,N	w-R, s-U	BW	-	F	-	-	M	-	J	-	-	-	-	-
Common Flicker *Colaptes auritus*	RC,CC,SD,DW,DN	21	B-U	BW	-	-	-	-	M	J	J	-	-	O	-	-
Pileated Woodpecker *Dryocopus pileatus*	DW	18,22	W-R, s-R	bW	J	-	-	-	-	J	-	-	-	-	-	-
Hairy Woodpecker *Dendrocopos villosus*	DW,RC,CC,SD	18,21	W-R, s-R	BW	J	-		-	M	-	-	-	-	-	-	-
Willow Flycatcher *Empidonax traillii*	WI, BA	10,21	b-U	b	-	-	-	-	M	J	-	-	-	-	-	-
Flycatcher (sp. undeterm.) *Empidonax* sp.	DW,AD,DS,DN	17,19,21,22	b-U		-	-	-	-	M	J	-	-	-	-	-	-
Violet-green Swallow *Tachycineta thalassina*	OA,PR,BR	F,G,H,I,J,K,L,M 21	b-A	B	-	-	-	A	M	J	J	-	-	-	-	-
Tree Swallow *Iridoprocne bicolor*	OA,SD	L,M,21	B-U	B	-	-	-	-	M	J	J	-	-	-	-	-
Rough-winged Swallow *Stelgidopteryx ruficollis*	OA,BR	F,G	B-U	B	-	-	-	-	M	J	J	-	-	-	-	-
Steller's Jay *Cyanocitta stellaria*	DW	22	fm-R	bW	-	-	-	-	-	-	-	-	-	O	-	-

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Species	Habitat 1/	Where Observed 2/	Status and Abundance 3/: This Study	Status and Abundance 3/: Skaar (1973) 4/	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Common Raven *Corvus corax*	DW,PD,RO,DS,DN,OA,RC,CC	M,8,10,26,25,22,21, 20	W-C, B-C	BW	J	-	-	A	M	J	J	-	-	O	-	-
Common Crow *Corvus brachyrhynchos*	DW,PD,DS,DN,OA,ER,RC,CC	L,8,17,18,19,20,21, 22,23,24	W-A, b-A	bW	J	F	M	A	M	J	J	A	-	O	-	-
Black capped Chickadee *Parus atricapillus*	DW,DS,CC,BA,SD,DN	19,20,21,22,23,24	W-A, B-A	BW	J	F	M	A	M	J	J	A	-	O	-	-
Mountain Chickadee *Parus gambeli*	DW	22	fm-R	BW	-	-	-	-	-	-	-	-	-	O	-	-
Chestnut-backed Chickadee *Parus rufescens*	DS	21	w-U	bW	J	-	-	-	-	-	-	-	-	-	-	-
Red-breasted Nuthatch *Sitta canadensis*	DW,DS	22	w-R, s-R	BW	-	-	M	-	-	J	-	-	-	O	-	-
Brown Creeper *Certhia familiaris*	DW	22	w-R	BW	-	F	-	-	-	-	-	-	-	-	-	-
Dipper *Cinculus mexicanus*	RA,FA,ER,GB,FW	F,H,I,J,L,P,Q,21	W-C, b-C	BW	J	F	M	A	M	J	J	A	-	O	N	-
Winter Wren *Troglodytes torglodytes*	DW	22	s-R	BW	-	-	-	-	M	J	-	-	-	-	-	-
Gray Catbird *Dumetella carolinesis*	BA,AD	19,21	b-U	B	-	-	-	-	-	J	-	-	-	-	-	-
American Robin *Turdus migratorius*	DW,DS,CC,RC,PD,DN,BA,BR, OA	I,N,5,8,13,20,21,22,	b-C	BW	-	-	-	A	M	J	J	A	-	-	-	-
Varied Thrush *Ixoreus naevius*	DW,DN	8,20,21,22	b-c	Bw	-	-	-	A	M	-	-	-	-	-	-	-
Swainson's Thrush *Catharus ustulatus*	DS,DW,DN	3,4,13,20,21,22	B-C	B	-	-	-	-	-	J	J	-	-	-	-	-
Townsend's Solitaire *Myadestes townsendi*	PD,RO	4,21	w-U, s-U	Bw	-	-	M	-	-	J	-	-	-	O	-	-
Golden-crowned Kinglet *Regulus satrapa*	DW	3,4,18,17,20,21,22, 23,24,25	W-A, b-A	BW	J	F	M	A	M	J	J	-	-	O	-	-
Ruby-crowned Kinglet *Regulus calendula*	DW,CC	21	b-U	B	-	-	-	-	M	-	-	-	-	-	-	-
Cedar Waxwing *Bombycilla cedrorum*	DS,PD,BA	20,22	s-U	B	-	-	-	-	-	J	J	-	-	-	-	-

TABLE 2 - Summary of data collected on bird species observed on the Kootenai Falls study area, January 1979 through July 1979.

Species	Habitat [1/]	Where Observed [2/]	Status and Abundance [3/]: This Study	Status and Abundance [3/]: Skaar (1979) [4/]	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Red-eyed Vireo *Vireo olivaceus*	DS,DW,DN,BA	9,20,21	b-U	B	-	-	-	-	-	J	J	-	-	-	-	-
Warbling Vireo *Vireo gilvus*	AD,CC,RR,DW,BA	21,22	b-U	B	-	-	-	-	-	J	J	-	-	-	-	-
Orange-crowned Warbler *Vermivora celata*	BA,CC,PR,DS	22	b-R	b	-	-	-	-	-	-	J	-	-	-	-	-
Nashville Warbler *Vermivora ruficapilla*	BA,CC,DS	20,21,22	b-C	3	-	-	-	-	M	J	-	-	-	-	-	-
Yellow Warbler *Dendroica petechia*	DS,WI,BA,CC	20,21,22,23	b-U	B	-	-	-	A	M	J	-	-	-	-	-	-
Yellow-rumped Warbler *Dendroica coronata*	DW,DS,CC,DN	3,4,5,20,21,22	b-A	B	-	-	-	A	M	J	J	-	-	-	-	-
Townsend's Warbler *Dendroica townsendi*	DW	21,22	b-U	B	-	-	-	-	-	J	J	-	-	-	-	-
MacGillivray's Warbler *Oporornus tolmiei*	DW,RR,BA,CC	18,20,21,22	b-C	B	-	-	-	A	M	J	J	-	-	-	-	-
American Redstart *Setophaga ruticilla*	BA,DW,CC	22	b-U	B	-	-	-	-	-	J	J	-	-	-	-	-
Brown-headed Cowbird *Molothrus ater*	PR,ER,DS,CC	L,M,20,21	b-C	3	-	-	-	-	M	J	J	-	-	-	-	-
Western Tanager *Piranga ludoviciana*	DW,DN,DS,PR,CC	20,21,22	b-U	B	-	-	-	-	-	J	J	-	-	-	-	-
Lazuli Bunting *Passerina amoena*	CC,DW,DS	21	s-R	b	-	-	-	-	-	J	-	-	-	-	-	-
Pine Siskin *Spinus pinus*	PD,DW,DN,CC	21,20	b-C	bW	-	-	-	A	M	J	-	-	-	-	-	-
American Goldfinch *Spinus tristis*	CC,RG,DS,OA	M	s-R	bW	-	-	-	.	-	J		-	-	-	-	-
Red Crossbill *Loxia curvirostra*	DS,DW,CC,DN	19	B-C	bW	-	-	-	-	-	J	-	-	S	O	-	-
Rufous-sided Towhee *Pipilo erythrophthalmus*	BA	21	b-U	bw	-	-	-	A	-	-	-		-	-	-	-
Dark-eyed Junco *Junco hyemalis*	DW,DN,PD,DS,CC	3,4,19,20,[illegible] 22 23	B-C	BW	-	-	-	-	M	J	J	[illegible]	-	-	-	-

TABLE 2 - Summary of data collected on bird species observed on the Kootenai Falls study area, January 1979 through July 1979.

Species	Habitat 1/	Where Observed 2/	Status and Abundance 3/: This Study	Status and Abundance 3/: Skaar (1979) 4/	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Chipping Sparrow *Spizella passerina*	DS,DW,CC,DW	4,19,20,21,22	B-C	B	-	-	-	-	M	J	J	-	-	-	-	-
Lincoln's Sparrow *Melospiza lincolnii*	DW,DS	21,22	s-R	b	-	-	-	-	M	-	J	-	-	-	-	-
Song Sparrow *Melospiza melodia*	RR,RG,DS,PR,WI,BA	10,18,19,20,21, 22	W-U, B-A	BW	J	F	M	A	M	J	J	-	-	O	N	-
Snow Bunting *Plectrophenax nivalis*	PR	21	w-U	w	J	-	-	-	-	-	-	-	-	-	-	-

1/ Habitat categories are listed in approximate decreasing order of preference or intensity of use. Abbreviations as in Table 1.

2/ See Figure 4 for location codes of river stretches (letters) and upland areas (numbers).

3/ Status: W - Overwinters in area (at least one record each during January and February).

w - Transient in winter.

sm - Spring migrant.

fm - Fall migrant.

B - Breeds on area (nest or dependent young located).

b - Probably breeds on area (territorial males or pairs, located).

s - Summers on area in small numbers but no evidence of breeding.

t - Occurs but no evidence of breeding.

Abundance: A - Abundant, found in large numbers in appropriate habitats.

C - Common, found in moderate numbers in appropriate habitats, 15 to 50 registrations

U - Uncommon, small numbers in appropriate habitats, 2 to 15 registrations.

R - Rare, few sightings, 1 or 2 registrations.

4/ Indicates status of species in latilong No. 1 as reported by Skaar (1975).

5/ Months when seen are indicated by letter abbreviations in sequence, January through December (Note: very little field work was carried out in August, September, and November; none was carried out in December).

TABLE 3. Summary of data collected on general habitat use and local distribution of mammals observed on the Kootenai Falls study area.

Common Name	Scientific Name	General Habitat Description[1/]	Where Observed[2/]
Masked shrew	(Sorex cinereus)	Trapped in western red cedar forest (DW)	21
Vagrant Shrew	(Sorex vagrans)	Riparian grassland; Douglas fir and western red cedar forest (RG, DW, DN)	21
Mountain Cottontail	(Sylvilagus nuttallii)	Railroad right-of-way (RR)	21
Snowshoe hare	(Lepus americanus)	Railroad right-of-way (RR)	21
Golden-mantled squirrel	(Spermophilus lateralis)	Open, Douglas-fir/ponderosa pine forest and scree on north side of river (PD, ST)	4
Columbian ground squirrel	(Spermophilus columbianus)	Banks in open areas along railroad tracks; north of river in open Douglas-fir-ninebark forest (RR, RG, DN)	3,4,20,21,22
Red-tailed chipmunk	(Eutamias ruficaudis)	Dense shrubs along railroad tracks; cedar and fir forests (RR, DW)	4,21,22
Yellow pine chipmunk	(Eutamias amoenus)	Railroad right-of-way; talus (RR, ST, PD)	21,22,19
Red squirrel	(Tamiasciurus hudsonicus)	Conifers; several middens in Section 21 (DW, DS, DN)	3,4,5,6,20,21,22,23,24
Northern flying squirrel	(Glaucomys sabrinus)	Remains discovered in conifers (DW)	22
Beaver	(Castor canadensis)	Undercut banks along south shore of river above the falls and observed in calm water below the falls (W1, SW)	M,N,D,E
Northern pocket gopher	(Thomomys talpoides)	Riparian grassland (RG)	
Deer mouse	(Peromyscus maniculatus)	Coniferous forest, talus (DW, DS, ST, DN)	21
Red-backed vole	(Clethrionomys gapperi)	Western red cedar forest (DW)	21
Meadow vole	(Microtus pennsylvanicus)	Riparian grassland (RG)	21
Long-tailed vole	(Microtus longicaudus)	Riparian grassland and shrubbery (RG, RC)	21
Muskrat[3/]	(Ondatra zibethica)	Below the falls in calm water (SW)	E
Meadow jumping mouse	(Zapus princeps)	Riparian grassland (RG)	21
Bushy-tailed woodrat	(Neotoma cinerea)	Steep sidehill, large rocks in timber, railroad right-of-way (RD, RR)	22
Mink[4/]	(Mustela vison)	Remains discovered on highway 2	21
River otter	(Lutra canadensis)	Dense, deciduous bank vegetation and river (SW, AV, EN)	M-N
Coyote	(Canis latrans)	Conifer forests, deciduous vegetation, meadows, shore (DW, RG,	21

Black Bear[3/]	(*Ursus americanus*)	Trail through dense vegetation leading to river; apparently regularly used	18
White-tailed deer	(*Odocoileus virginianus*)	Often associated with water and dense brush but also observed in dry rocky habitats, railroad right-of-way (PD, DS, RR, DW)	- 5/
Mule deer	(*Odocoileus hemionus*)	Often observed on steep timbered hillsides but also occurring on the flood plain (PD, DN)	- 5/
Elk	(*Cervus canadensis*)	One set of tracks in cedar forest (DW)	21
Moose	(*Alces alces*)	River floodplain and cedar forest (RC, DW)	17,19
Bighorn sheep	(*Ovis canadensis*)	Primarily in Douglas-fir habitat types and associated bluffs, broken terrain, cliffs and parks north of the river (RO, DN, DS, RG, PD, ST)	- 6/

1/ Habitat categories are listed in approximate decreasing order of preference or intensity of use. Abbreviations as in Table 1.

2/ See Figure 4 for location codes of river (letters) and upland (numbers) portions of the study area.

3/ Observed by Pat Graham, fisheries biologist.

4/ Collected by Bill Martin, fisheries biologist assistant.

5/ See Figure 7, distribution map of deer observations.

6/ See Figure 8, distribution map of bighorn sheep observations.

residents only, 3 (4%) as winter residents only, and 5 (7%) as visitors or transients. A total of 46 species were designated breeding species, 14 of which were confirmed breeders (active nests or dependent young observed). Evidence for overwintering was encountered for 11 species (if a species was encountered during both January and February, it was considered an overwintering bird).

Skaar's (1975) data indicate that 50 of the 72 species encountered in this study are confirmed breeders in this area of the state and another 17 are circumstantial breeders; also, 35 of these species are known to winter in this region of the state.

Winter transients were defined as those species which were observed on one occasion sometime during the period from January to March 15. Although seven species were classified as winter transients, Skaar (1975) indicates that all but the snow bunting actually spend the winter in northwest Montana.

It should be noted that very little field work was conducted during the late summer and fall months (August through November); the observations listed in Table 2 for these months were casual observations made incidental to other work. Therefore, the low numbers of species reported in Table 2 for these months are likely due to a lack of intensive field work rather than to a low diversity of birds. No field work was conducted in December.

Water Bird Survey and Census

Table 4 lists the number of waterfowl observations recorded each month in the study area, January through July, 1978. Since individual birds were often seen and recorded more than once during a given month, the figures given by no means represent a census of the number of birds present; they do, however, give an indication of relative abundances in the study area.

Table 5 presents the results of the 1979 census of waterfowl populations of sections G-N, P-S, and Z, Figure 4. In this table, the minimum number of birds known to be present below the Falls, above the Falls, and along the entire stretch are presented.

During the March through May, 1978 spring migration period, seven species of waterfowl were observed in the Kootenai Falls study area. Common goldeneye was the most prevalent species followed by mallard, common merganser, Canada goose, harlequin duck, Barrow's goldeneye, and American wigeon.

Of the seven species observed in 1978 during spring migration, three species were known to breed in the study area, including common merganser, mallard, and Canada goose. Territorial pairs of harlequin ducks and common goldeneye were observed on the study area, which indicate that breeding probably occurred (Dzubin 1969).

T .E 4. Number of waterfowl observations recorded each month on the Kootenai Falls study area, January - July, 1978

	January	February	March	April	May	June	July
C on goldeneye	24(72)[1/]	196(71)	222(66)	27(29)	51(19)	36(17)	-
M ard	9(28)	82(29)	29(9)	37(39)	96(36)	29(14)	-
C on merganser	-	-	21(6)	7(8)	32(12)	90(44)	9(100)
C ada goose	-	-	1(tr)	18(19)	33(13)	2(1)	-
H lequin duck	-	-	-	1(1)	38(14)	49(24)	-
E row's goldeneye	-	-	-	2(2)	13(5)	-	-
A rican wigeon	-	-	-	2(2)	2(1)	-	-
U dentified duck	-	-	64(19)	-	1(tr)	-	-

1/ Number of waterfowl observations (percent of total waterfowl observations made during the month.

TABLE 5. Census results for waterfowl and other water birds, sections G-N, P-S, and Z of the Kootenai River.

	Jan 20	Feb 10	Feb 11	Feb 12	Apr 18	Apr 19	Apr 20	Apr 21	Jun 13	Jun 14	Jun 27	Jun 28	Jun 29	Jun 30	Aug 1
Great Blue Heron	-(0)-[1]	-(0)-	-(0)-	-(0)-	0(0)0	0(0)0	0(0)0	0(0)0	0(1)1	0(0)0	0(0)0	0(0)0	0(1)1	0(0)0	2(-)-
Canada Goose	-(0)-	-(0)-	-(0)-	-(0)-	0(1)1	0(2)2	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(-)-
Mallard	-(0)-	-(21)-	-(8)-	-(11)-	2(13)15	0(14)14	0(12)12	0(6)6	5(12)17	4(2)6	10(0)10	13(0)13	26(10)36*	15(0)15	0(-)-
Common Goldeneye	-(58)-	-(142)-	-(77)-	-(58)-	0(10)10	0(7)7	0(11)11	0(8)8	0(0)0	0(0)0	0(14)14	0(0)0	0(20)20	0(0)0	0(-)-
Harlequin Duck Males	-(0)-	-(0)-	-(0)-	-(0)-	0(1)1	0(0)0	0(0)0	1(1)1[2]	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(-)-
Harlequin Duck Females	-(0)-	-(0)-	-(0)-	-(0)-	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(-)-
Common Merganser	-(0)-	-(0)-	-(8)-	0(3)-	-(1)1	0(1)1	0(4)4	0(2)2	0(2)2	0(2)2	0(8)8*	0(8)8*	0(3)3	0(1)1	0(-)-
Bald Eagle	-(2)-	-(4)-	-(1)-	-(2)-	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(0)0	0(-)-
Osprey	-(0)-	-(0)-	-(0)-	-(0)-	0(0)0	0(0)0	0(0)0	0(0)0	0(1)1	0(0)0	0(1)1	0(0)0	0(0)0	0(1)1	1(-)-
Spotted Sandpiper	-(0)-	-(0)-	-(0)-	-(0)-	0(0)0	0(0)0	0(0)0	0(0)0	1(0)1	0(0)0	1(0)1	1(0)1	1(0)1	1(0)1	0(-)-
Dipper	-(0)-	-(2)-	-(2)-	-(2)-	0(0)0	0(0)0	0(0)0	0(0)0	2(0)2	0(0)0	1(0)1	0(1)1	1(0)1	1(0)1	3(-)-

* Includes broods.

1/ Below falls, (above falls) total.
2/ The same individual may have been seen above and below the falls.

NOTE: A dash indicates that no census was conducted.

Wintering waterfowl included the mallard, common goldeneye, and common merganser. The highest number of mallards observed in 1978 was 42 on February 24, and a high of 47 common goldeneye was observed on February 15.

Riparian Habitat Transects

Results of the 1978 riparian habitat transect runs are presented in Table 6, along with data on the number of bird registrations made at times other than transect runs. Fifty-nine species of birds were registered a total of 1277 times according to sight or song. Forty-five species were observed during transect runs. Sixty percent of the total number of registrations were recorded in the riparian type paralleling the river. This riparian floodplain area is the site of the proposed reservoir and construction area. The remaining registrations were noted in the coniferous forest sloping upward from the floodplain. The riparian type was used by 76 percent of the species observed while the conifer type was used by 51 percent of the species observed. Mapping of the territories of 26 bird species revealed that 85 percent of the species used the riparian type exclusively or in combination with the coniferous type. Only 15 percent of the species utilized the coniferous type exclusively. A total of 122 territories were identified on the transect for the 26 species. Eighty-seven percent of the territories occurred in the riparian type or ecotone; 77 percent of these occurred exclusively in the riparian type.

In 1979, 40 species of birds and 6 species of mammals were recorded during the 14 transect runs (Table 7). Of the total number of registrations, 6 percent were in conifers, 77 percent in riparian, and 17 percent in ecotone areas; if waterfowl are excluded, the percentages are 17, 30, and 53, respectively. These percentages indicate the importance of ecotonal areas in terms of numbers of birds (other than waterfowl). However, the relative number of species is greater in riparian habitat where 28 species or 68 percent (23 species or 64 percent, excluding waterfowl) were observed. This is due to the fact that larger numbers of fewer species were recorded in ecotones, while smaller numbers of more species were recorded in riparian habitats. The lowest number of species, 14, was recorded in the coniferous areas of the transect; this may be due in part to reduced detectability of birds using this dense forest habitat. Of the 28 species utilizing riparian habitat, nine also used coniferous and nine used ecotonal habitat. Seventeen species were found in riparian habitat exclusively, while only four species were found exclusively in coniferous areas.

The yellow-pine chipmunk was very abundant on the railroad embankment, and was the most commonly observed mammal on the transect runs. The highest densities were in areas where coniferous forest graded into tall shrubs on the south of the tracks and shrubs bordered the north side of the tracks. In more open areas, the chipmunks were not as common. Columbian ground squirrels were the next most commonly seen mammal, and a concentration of burrows was found along the south side of the railroad

Table 6. Number of registrations and number of territories recorded for each bird species on the Kootenai Falls study area during sixteen transect runs and general reconnaissance, January 20 - July 8, 1978.

	Number of Resistrations 1/					Number of Indicated Breeding Territories 2/		
	During Transect Runs		During Other Times					
Species	Conifers 3/	Riparian 4/	Conifers	Riparian	Total	Conifers	Riparian	Ecotone
Canada goose		28		26	54			
Mallard		239		43	282		1	
American wigeon		2		2	4			
Common goldeneye		313		243	556			
Barrow's goldeneye		13		2	15			
Harlequin duck		75		13	88		1	
Common merganser		105		45	150		2	
Red-tailed hawk			2		2			
Bald eagle				8	8			
Osprey		4		45	49			2
American kestrel		3		1	4		1	
Ruffed grouse	1		1	2	4			
Killdeer				6	6			
Spotted sandpiper		21		10	31		3	
California gull				8	8			
Ring-billed gull				1	1			
Band-tailed pigeon 5/				1	1			
Mourning dove	4	2			6			1
Vaux's swift		2		1	3			
Calliope hummingbird				1	1			
Rufous hummingbird		2		2	4			
Belted kingfisher		1		3	3			
Common flicker		3		1	4		1	
Pileated woodpecker	1		2		3			
Hairy woodpecker			1		1			
Willow flycatcher				3	3		1	
Flycatcher (Empidonax sp.)			2		2			
Violet-green swallow		38		21	59		3	
Tree swallow		9		3	12		1	
Rough-winged swallow		4		8	12			
Steller's jay			1		1			
Common raven	9	12	21		42			5
Common crow	77	85	35	15	212			13
Black-capped chickadee	27	23	32	16	98		2	4
Mountain chickadee			1		1			
Chestnut-backed chickadee				8	8			
Red-breasted nuthatch			1		1			
Brown creeper				1	1			
Dipper		10		59	69		4	
Winter wren			2		2			
Gray catbird		2		1	3			
American robin	17	25			42			10
Varied thrush	16	1			17	3		
Swainson's thrush	21		11		32			1
Townsend's solitare	1		2		3			
Golden-crowned kinglet	28		72		100	4		
Ruby-crowned kinglet	12				12	4		
Cedar waxwing			1		1			
Red-eyed vireo		7			7		2	
Warbling vireo				1	1			
Orange-crowned warbler				1	1			
Nasnville warbler	9	6	1	1	17			5
Yellow warbler		12		1	13		1	
Yellow-rumped warbler	41	13		1	55			12
Townsend's warbler	2				2			
MacGillivray's warbler	2	16	1		19		3	3
American redstart				1	1			
Brown-headed cowbird	2	22			24		4	1
Western tanager	2	2		2	6			
Lazuli bunting		2			2			
Pine siskin	8	6			14			
Dark-eyed junco	21	2	1		24	5		
Chipping sparrow	11	4	5		20			3
Lincoln's sparrow	1			1	2			
Song sparrow		184		1	185		20	
Snow bunting				8	8			

1/ Registrations = observations or song (call).
2/ Territories determined from breeding season transect information only. A minimum of three registrations recorded on different days were used in defining a territory.
3/ Conifer = the western red cedar, douglas-fir, western larch, lodge pole pine forest. This area would not be flooded by the proposed project and little area would be disturbed.
4/ Riparian = deciduous forest and floodplain grassland, an area which is likely to be disturbed or flooded as a result of the proposed project.
5/ Unconfirmed.

TABLE 7. Number of registrations recorded for bird and mammal species during 14 transect runs, January 20 - June 30, 1979.

Species	Number of registrations[1]			
	Conifers[2]	Riparian[3]	Ecotone[4]	Total
BIRDS				
Canada Goose	-	3	-	3
Mallard	-	147	-	147
Common Goldeneye	-	364	-	364
Harlequin Duck	-	3	-	3
Common Merganser	-	38	-	38
Red-tailed Hawk	1	-	-	1
Bald Eagle	1	6	1	8
Golden Eagle	1	-	-	1
Osprey	1	4	-	5
American Kestrel	-	2	-	2
Merlin	1	-	-	1
Ruffed Grouse	-	-	1	1
Great Blue Heron	-	2	-	2
Spotted Sandpiper	-	1	-	1
Mourning Dove	-	-	5	5
Common Flicker	-	5	-	5
Willow Flycatcher	-	1	-	1
Flycatcher (*Empidonax* sp.)	-	2	1	3
Violet-Green Swallow	-	-	57	57
Common Raven	2	2	3	7
Common Crow	9	6	10	25

Table 7: Continued

Black-Capped Chickadee	10	-	1	11
Dipper	-	8	-	8
Gray Catbird	-	-	3	3
American Robin	2	5	2	9
Swainson's Thrush	3	1	-	4
Golden-crowned Kinglet	11	12	2	25
Cedar Waxwing	-	-	6	6
Red-eyed Vireo	1	3	2	6
Warbling Vireo	-	1	-	1
Yellow Warbler	-	4	-	4
Yellow-rumped Warbler	2	-	1	3
MacGillivray's Warbler	-	1	1	2
Brown-headed Cowbird	-	-	4	4
American Goldfinch	-	4	-	4
Pine Siskin	-	1	-	1
Red Crossbill	-	-	20	20
Dark-eyed Junco	1	-	-	1
Chipping Sparrow	-	1	3	4
Rufous-sided Towhee	-	2	-	2
Song Sparrow	-	5	19	24
TOTAL SPECIES	14	28(23)[6/]	19	
TOTAL INDIVIDUALS (Excluding Waterfowl)	46	634(79)	142	822(267)

Table 7: Continued

MAMMALS				
Columbian Ground Squirrel	-	-	7	7
Yellow-pine Chipmunk	-	-	80[5/]	80[5/]
Red Squirrel	1	-	-	1
Mountain Cottontail	-	-	1	1
Snowshoe Hare	-	-	1	1
Bighorn Sheep	-	-	2	2
TOTAL SPECIES	1	0	5	6
TOTAL INDIVIDUALS	1	0	91	92

[1/]Registrations = Observations or song (call).

[2/]Conifer = Forests dominated by western red cedar, Douglas fir, or western larch.

[3/]Riparian = Deciduous forest, shrub, and floodplain grassland.

[4/]Ecotone = Railroad right-of-way, an area of disturbed vegetation, mixed conifers, and riparian shrubs.

[5/]Estimated abundance.

[6/]Percent of total.

tracks east of the switching station below the power line crossing. These squirrels appeared to prefer the more open habitat next to the railroad tracks.

Winter Bird Survey and Breeding Bird Census

Fourteen species were encountered during the 1978 winter bird survey on 8 counts averaging 107 minutes each, as follows (numbers in parentheses indicate average number seen per trip (+ = less than 0.5), indicated density per 100 ha, and indicated density per 100 acres): Mallard (2, 5, 2), Common Goldeneye (10, 22, 9), Common Merganser (+, +, +), Mourning Dove (+, +, +), Belted Kingfisher (+, +, +) Pileated Woodpecker (+, +, +), Hairy Woodpecker (+, +, +), Common Raven (+, +, +), Common Crow (1, 1, +), Black-capped Chickadee (4, 9, 4), Brown Creeper (+, +, +), Dipper (6, 13, 6), Golden-crowned Kinglet (5, 12, 5), and Song Sparrow (1, 1, 1).

Results of the 1978 breeding bird census are presented in Appendix D and summarized in Table 8. A total of 33 breeding species were encountered on the plot, with a total of 91 territorial males or females. The overall density of birds for the plot, including the water area, was found to be 410 individuals/km^2 (166/100 acres); for the land are alone, density was 684/km^2 (278/100 acres)(each territory was assumed to represent two individuals). These latter figures are within the range reported by Beidleman (1978) for cottonwood-willow communities in Colorado, but are somewhat lower than typical densities of eastern deciduous woodland, Rocky Mountain coniferous forest, and floodplain forests (Beidleman 1978, Fitzgerald 1978).

Small Mammal Trapping

A summary of small mammal trapping data is presented in Table 9. Eight species of mammals were captured during the trapping program; a song sparrow was also taken in a snap trap. Snap trap data indicated that the total number of captures, total number of species, and total biomass of captures were lower in the riparian grassland than in adjacent coniferous forest. A large percentage of all captures and biomass in the coniferous forest were of deer mice, which were not taken in riparian grassland. Voles of the genus *Microtus* and meadow jumping mice were taken only in riparian grassland, while the masked shrew, red-tailed chipmunk, and red-backed vole were taken only in conifers during the snap trapping program.

Furbearer Harvest Data

Trapping of furbearers is a locally important type of recreation and also contributes to the local economy. MDFWP estimates of fur harvest by licensed trappers in Hunting District 100, which includes the

TABLE 8. Census data for breeding birds of the Kootenai Falls study area, 19...

SPECIES	Preferred habitat in census area	No. of Breeding Pairs	No. of Nests Located	Overall Density 2/ 3/	Adjusted Density 4/
Mallard	Open water, shores	2	-	-	-
Common Goldeneye	Open water	+ 1/	-	-	-
Harlequin Duck	Fast water, rocky peninsulas	1	-	-	-
Common Merganser	Open water	+	-	-	-
Osprey	Open water, adjacent forest	+	-	-	-
American Kestrel	Open conferous forest with snags	1	-	-	-
Spotted Sandpiper	Shores	1.5	-	-	-
Common Flicker	Riparian cottonwoody	1	1	-	-
Empidonax Flycatcher	Douglas fir - western larch	1	-	-	-
Violet-green Swallow	River canyon	12	-	27,11	27,11
Tree Swallow	Open water and adjacent forest	1	1	-	-
Rough-winged Swallow	River canyon	4	4	9,4	9,4
Common Raven	Coniferous forest, rocky cliffs	+	nest near plot	-	-
Common Crow	Coniferous forest, RR right-of-way	1	-	-	-
Black-capped Chickadee	Coniferous forest	3.5	1	8,3	13,5
Dipper	Shores	4	-	9,4	23,10
American Robin	Coniferous forest	4.5	2	10,4	17,7
Varied Thrush	Dense conifers	+	-	-	-
Swainson's Thrush	Coniferous forest	5.5	-	12,5	20,8
Golden-crowned Kinglet	Dense conifers	6	-	13,5	22,8
Red-eyed Vireo	Mixed forest	4	-	9,4	15,7

Warbling Vireo	Mixed forest	2	-	-	-
Nashville Warbler	Deciduous groves	2	-	-	-
Yellow Warbler	Open shrubbery	4.5	-	10,4	17,7
Yellow-rumped Warbler	Mixed forest	7	-	16,6	27,10
Townsend's Warbler	Coniferous forest	5.5	-	12,5	20,8
MacGillivray's Warbler	Low shrubbery	2	-	-	-
American Redstart	Moist mixed forest	2	-	-	-
Brown-headed cowbird	Mixed forest	2	-	-	-
Western Tanager	Coniferous forest	1	-	-	-
Pine Siskin	Coniferous forest	2	-	-	-
Dark-eyed Junco	Coniferous forest	4.5	-	10,4	17,7
Song Sparrow	Open shrubbery	3.5	-	8,3	13,5

1/ Species with partial territories (less than 0.5) are indicated by a +.

2/ Active nests only.

3/ First figure is breeding pairs/km^2; second figure is breeding pairs/100 acres. Density over the entire plot, including both terrestrial and aquatic habitats, is shown here. Density estimates are given only for species having more than two breeding pairs per plot.

4/ These figures represent densities in terrestrial or aquatic habitats only for terrestrial and aquatic species, respectively.

TABLE 9. SUMMARY OF KOOTENAI FALLS SMALL MAMMAL TRAPPING PROGRAM
SEPTEMBER 3-5, 1973.

	Snap Traps							Pitfall Traps					
	Floodplain Grassland			Coniferous Forest			Total	5 (Shrub)	6 (Streamside)	7 (Douglas fir)	8 (Rocks)	Total	Grand Total
	1	2	1&2	3	4	3&4							
Total Number of Captures	6	11	17	16	16	33	50	2	6	4	1	13	63
Total Number of Species	2	3	4	2	4	5	8	2	2	2	1	3	8
Total Biomass (grams)	110	253	363	284	335	619	982	30	101	57	14	202	1184
Masked Shrew (*Sorex cinereus*)	-	-	-	-	1	1	1	-	-	-	-	-	1
Vagrant Shrew (*Sorex vagrans*)	4	1	5	1	-	1	6	1	-	1	-	2	8
Red-tailed Chipmunk (*Eutamias ruficaudus*)	-	-	-	-	2	2	2	-	-	-	-	-	2
Deer Mouse (*Peromyscus maniculatus*)	-	-	-	15	9	24	24	-	4	3	1	8	32
Red-backed Vole (*Clethrionomys gapperi*)	-	-	-	-	4	4	4	-	-	-	-	-	4
Meadow Vole (*Microtus pennsylvanicus*)	2	-	2	-	-	-	2	-	-	-	-	-	2
Long-tailed Vole (*Microtus longicaudus*)	-	8	8	-	-	-	8	1	2	-	-	3	11
Meadow Jumping Mouse (*Zapus princeps*)	-	2	2	-	-	-	2	-	-	-	-	-	2

study area, indicate that the marten (Marties americana) was the most important furbearer during the 1977-1978 season, both in terms of number of pelts and value of pelts. In terms of total value of pelts, coyote and bobcat ranked second and third, while the key aquatic furbearers -- beaver, muskrat, and mink -- ranked fourth, fifth, and seventh, respectively (Weckwerth and Cross 1979).

Species Accounts -- Birds

A summary of inventory data for bird species for which additional data were obtained (primarily riparian species) is presented below. Location codes, as defined in Figure 4, are used to describe locations where appropriate.

Canada Goose. In 1978, Canada geese were first observed March 7. They were seen on or flying over the river from Williams Creek (N) to near Throops Lake (C). Geese were most often observed while in flight although loafing geese were observed on several occasions just up from Kootenai Falls at the boundary of section M and N. Broods of three and eight were reported on April 26 and May 15, respectively, upstream from Throops Lake (D). In 1979, geese were first encountered April 18, the first day of spring observations, when a pair of geese was seen on the south river bank at the Falls. A pair was also seen on the river near Throops Lake. No nests or broods were discovered in 1979.

Mallard. Mallards are year-long residents of the Kootenai River in the Falls area. They were seen along the river from Bobtail Creek (U) to below the Falls south of Kootenai Mountain (F). Mallards were seen in the same sections of river as common goldeneye (M and N); however, on several occasions they were noted standing and feeding in the white water and on a fallen log just above the crest of the Falls (L). During winter, sheltered areas on the shore on the south side of the river were preferred, while beaches on either side of the river were preferred in spring. The Mallards were associated with shallow water and shoreline more often than any other duck observed on the study area. A favorite loafing site of Mallards was the point of land east of the boundary between section M and N. A class I-a (Gollop and Marshall 1954) mallard brood of 6 was observed on May 18, 1978, directly across from China Creek (N); a brood of 4 was seen on June 29, 1979, swimming among rocks in the cattail marsh just above the Falls on the south side of the river (M).

American Wigeon. American wigeon were observed on April 30, 1978, and once more on May 25, 1978, in the bay area immediately above the Falls (M). They were apparently using the area as a stopover during migration.

Common Goldeneye. Common goldeneye were observed at all seasons and should be considered year-long residents. In 1978, they were seen along the river from near the city limits of Libby to the vicinity of the only island in the river below the Falls (E), but they were most often seen in the section of river (M and N) from Williams Creek to the head of the Falls. Common goldeneye usually nest in cavities in deciduous trees (Bellrose 1976). Along the Kootenai River this type of habitat occurs in the riparian zone. An unverified brood was reportedly seen June 12, 1978, by fisheries biologist Brad Shepard. In 1979, Common Goldeneye were often seen in fast water and, in winter, in large pools sheltered by rocks. They were observed courting in winter and spring when their numbers were highest. By June, observations of Common Goldeneyes ranked behind those of Mallards (Table 5). It appears that the project area is more heavily utilized by the common goldeneyes as a wintering area than a breeding area. This could be due to the availability of fast-flowing ice-free water and resultant available food in winter. During spring and summer, numbers decreased but the common goldeneye remained on the study area during the nesting season.

Barrow's Goldeneye. In 1978, Barrow's goldeneye were first observed April 30 and were last observed June 5. No more than two birds were observed on any one occasion although at least two males and one female were present and used the bay area immediately above the Falls (M). These birds were apparently transients. Nesting habits of the Barrow's goldeneye are similar to those of the Common goldeneye. None were seen in 1979.

Harlequin Duck. One of the most unusual species encountered in this study was the harlequin duck. Rare and local in its distribution throughout Montana (Skaar 1975), this species is a highly stenotopic "K-selected" species, and is restricted to turbulent, fast-flowing mountain stream habitat. According to Kuchel (1976), the harlequin duck's "precise ecological requirements and extreme sensitivity to human intrusion limit breeding activities to remote, pristine areas." While not formally recognized as a threatened or endangered species, the Harlequin duck is rare throughout its range, and became extinct in Colorado in the early 1800's (Kuchel 1976), although a breeding population has recently become re-established there (Nelson and Parkes 1976). A small population, consisting of at least 7 individuals in 1978 and 3 in 1979, was found to be closely associated with the Falls (Table 10). In 1978, the population consisted of one pair, a lone female, and four bachelor males; while observations were made in river sections G, H, I, J, L, M, and N, most birds were seen feeding in swift water at the head of the Falls (L) or loafing on exposed rocks at or just above the head of the Falls (M). All 7 birds were seen loafing together, forming a "club" of both paired and unpaired birds as described by Bengtson (1966:84). The rushing water at the head of the Falls, where the river first begins to break over the rocky benches, was a preferred feeding site. Harlequins feed almost exclusively on aquatic insect larvae (Bengtson and Ulfstrand 1971, Bengtson 1972, Kuchel 1976). Simuliidae (Diptera) were the major food source in Iceland, and while Orthocladiinae were found to be much more abundant dipterans in bottom samples taken in the Kootenai Falls area, Simuliidae were dominant in substrate basket samples (Graham 1979) and are probably abundant in the

TABLE 10. Harlequin duck observations in the Kootenai Falls area, 1978-1979.

Date	Minimum number known present: Males	Females	Pairs	Total	Location (River Section)
1978					
April 29	1	-	-	1	L
May 1	1	1	1	2	L
May 2	2	1	1	3	M
May 7	1	1	1	2	J,L
May 8	2	1	-	3	L
May 9	3	2	2	5	L
May 11	1	1	1	2	L,M,N
May 21	1	1	1	2	F,I,L,M,N
May 22	1	1	1	2	H
May 29	1	-	-	1	M
June 2	1	-	-	1	M
June 5	4	2	1	6	J,L,M
June 6	5	2	1	7	L,M
June 7	5	2	1	7	L,M
June 8	5	2	1	7	L,M
June 9	5	2	1	7	M
June 16	-	1	-	1	L
1979					
April 18	1	-	-	1	L
April 21	1	-	-	1	H,L
June 13	1	1	-	2	G,H
July 31	-	2	-	2	L
August 1	-	2	-	2	L

preferred feeding sites which are characterized by laminar rather than turbulent flow (Hynes 1970). Harlequin ducks nest in tree cavities, fissures in rocks, or on the ground near turbulent water (Peterson 1961, Bellrose 1976, Bengtson 1966); the majority of broods hatch during the first week of July and do not feed in fast water for two weeks. A search of the Falls area on June 29-30, 1978 failed to reveal either adult birds or young.

Fewer harlequin ducks were present at the Falls in 1979 than in 1978; only 8 or 9 observations were made during the report period. The first individual encountered in 1979, a lone male, was seen at the head of the Falls on April 18. On April 21, 1979, a male was seen below the footbridge and another (possibly the same individual) on rocks just above the Falls. According to Kuchel (1976), non-breeding males arrive in Montana in mid-April, two or three weeks before the rest of the population; it is therefore likely that these April observations represent non-breeding individuals. Harlequins were next seen on June 13, 1979, when a female was seen swimming along the shoreline near the bend in the river between sections G and H. It was only observed for a few minutes before it disappeared among the rocks. A male was also seen flying back and forth in this same area, but there was no indication that the two were paired (Smith 1979). An intensive search was made of the Falls area for harlequins on June 13-14 and 27-30, but no birds were seen. Two females were seen together at the head of the Falls on July 31 and again on August 1, 1979; a careful search of river section G-L for broods on August 1 failed to yield additional observations. Kuchel (1976) reports that, in Glacier Park, pairs dissolve and all males usually leave the breeding grounds in mid-June. Non-breeding females may depart as the final males leave the area, while females with broods remain until August. While it is therefore possible that the June 13, 1979 observations represent a nesting pair, and the females seen in August were breeding individuals which had lost either nests or broods, it is also likely that the 1979 Falls area population is simply a non-breeding aggregation, as described by Bengtson (1972). Breeding populations may occur in larger tributaries of the Kootenai River (such as China Creek), although none have yet been reported. The nearest known breeding population is at Grave Creek, a tributary of Fortine Creek (Weydemeyer 1979).

Common Merganser. Common mergansers were observed during all seasons, and were observed more universally along the river than any other duck species. They were seen on the river from near the city limits of Libby to near Throops Lake (D). Second only to harlequin ducks, common mergansers used the fast water of the Falls for feeding and security (I, J, L). Common mergansers nest in cavities of deciduous trees, usually near water. At least two broods (probably creches) having an average brood size of 11.5 were seen in 1978 between Williams Creek and China Creek (N and Z). A brood of 7 was seen on June 27 and 28, 1979, in river section M and P.

Bald Eagle. The bald eagle was classified as an endangered species in Montana in March of 1978. During this study, bald eagles were observed on 8 occasions during the winter of 1977-1978, at the following locations: directly over the Falls (J); immediately below Kootenai Falls over the footbridge (H); downriver from this location approximately 0.8 km (0.5 mi) (F); on two occasions at the lower entrance of the river gorge (D); near the junction of Highways 2 and 202 (two perched in conifers along the river); and one perched in a conifer near the town of Libby. Observations made during the winter of 1978-1979 are summarized in Table 11, and locations of birds seen are shown in Figure 6. Most use of the area by bald eagles occured from October through March. No active nests have been found in the area (Kichura and Ruediger 1978; Meyer 1979), although observations made in the Falls area in June and July of 1978 indicate possible breeding. The nearest known active nest on the Kootenai River in Montana is located along Lake Koocanusa, near the Canadian border (Craighead and Craighead 1979). Wintering bald eagle populations of the Kootenai River have been the subject of recent study in connection with the proposed Libby reregulating dam (LAURD)(Craighead and Craighead 1979) and the proposed BPA 230-kV Libby Integration and Northwest Montana/North Idaho Support Project (Meyer 1979). Kichura and Ruediger (1978) also collected nesting data in the area as part of an osprey survey.

According to Craighead and Craighead (1979), fall migration through the LAURD area occurs from early September to early December, overwintering from early December through late February, and spring migration from late February to mid-April. The LAURD area was found to be more important as a stopover for migrating eagles (an estimated 350 eagles pass through on the southward migration) than as a wintering area (only 12 or fewer were known to overwinter). Craighead and Craighead (1979) estimate the overwintering population on the Kootenai River from Porthill to Libby Dam to be about 40. Meyer (1979) obtained a high count of 14 for the Yaak River - Libby section of the Kootenai River in early December, 1978, but only about 7-10 eagles winter on this section (Meyer 1979, Craighead and Craighead 1979). The area of heaviest concentration was between Kootenai Falls and Quartz Creek, which contained 40 percent of the eagles observed in this river section. Overall, the Kootenai River near Kootenai Falls appears to be less important as a wintering area for bald eagles than other major rivers of northwestern Montana; estimates of eagle density obtained by the National Wildlife Federation's national midwinter bald eagle survey (conducted January 13-27, 1979) for the lower Flathead, Clark Fork, and Kootenai rivers were 1.80, 6.73, and 8.56 river kilometers/eagle (1.12, 4.18, and 5.32 river miles/eagle), respectively. Use of the Kootenai River as a wintering area appears to be limited by food availability; fish are apparently the major winter food source in the Kootenai Falls area, and there is no concentrated food source (such as a fish spawning run) available (Meyer 1979). Meyer (1979) found that tall cottonwoods and Douglas fir received the greatest use as perch trees, and that most perch trees were located 15.2 m (50 ft) or less from the river. Similar findings were obtained by Craighead and Craighead (1979) and this study.

TABLE 11. Minimum numbers of bald eagles seen along the Kootenai River, October 1978-February 1979.

Location	Oct. 16	Oct. 18	Oct. 20	Oct. 23	Nov. 21	Jan. 20	Feb. 10	Feb. 11	Feb. 12
Above Falls	-	-	-	-	4	2	4	1	2
Below Falls	4	1	1	1	-	-	-	-	-

FIGURE 6. Locations of fall and winter 1978-1979 bald eagle observations, Kootenai Falls area.

X = Fall 1978 (October-November)
0 = Winter 1979 (January-February)

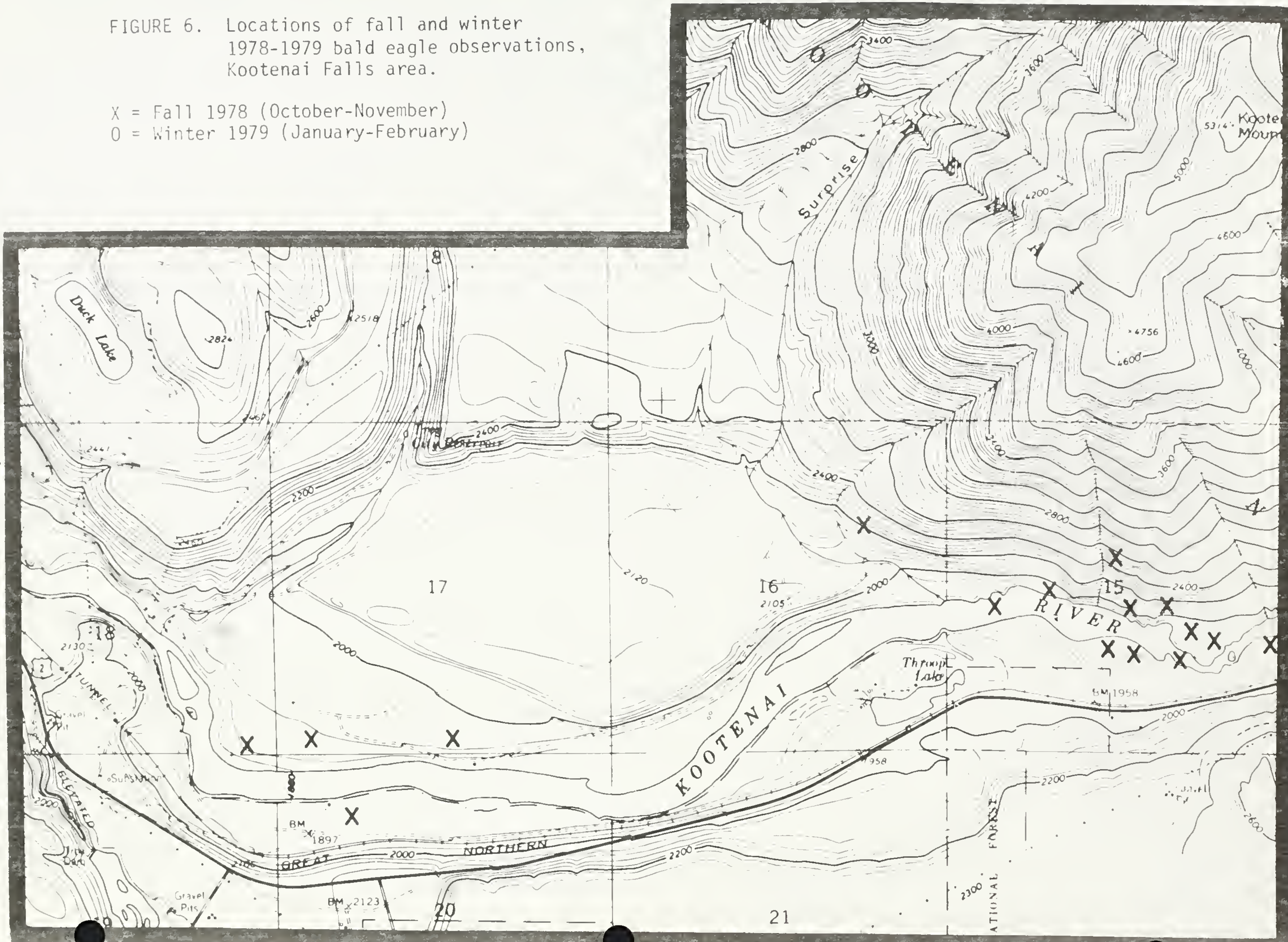
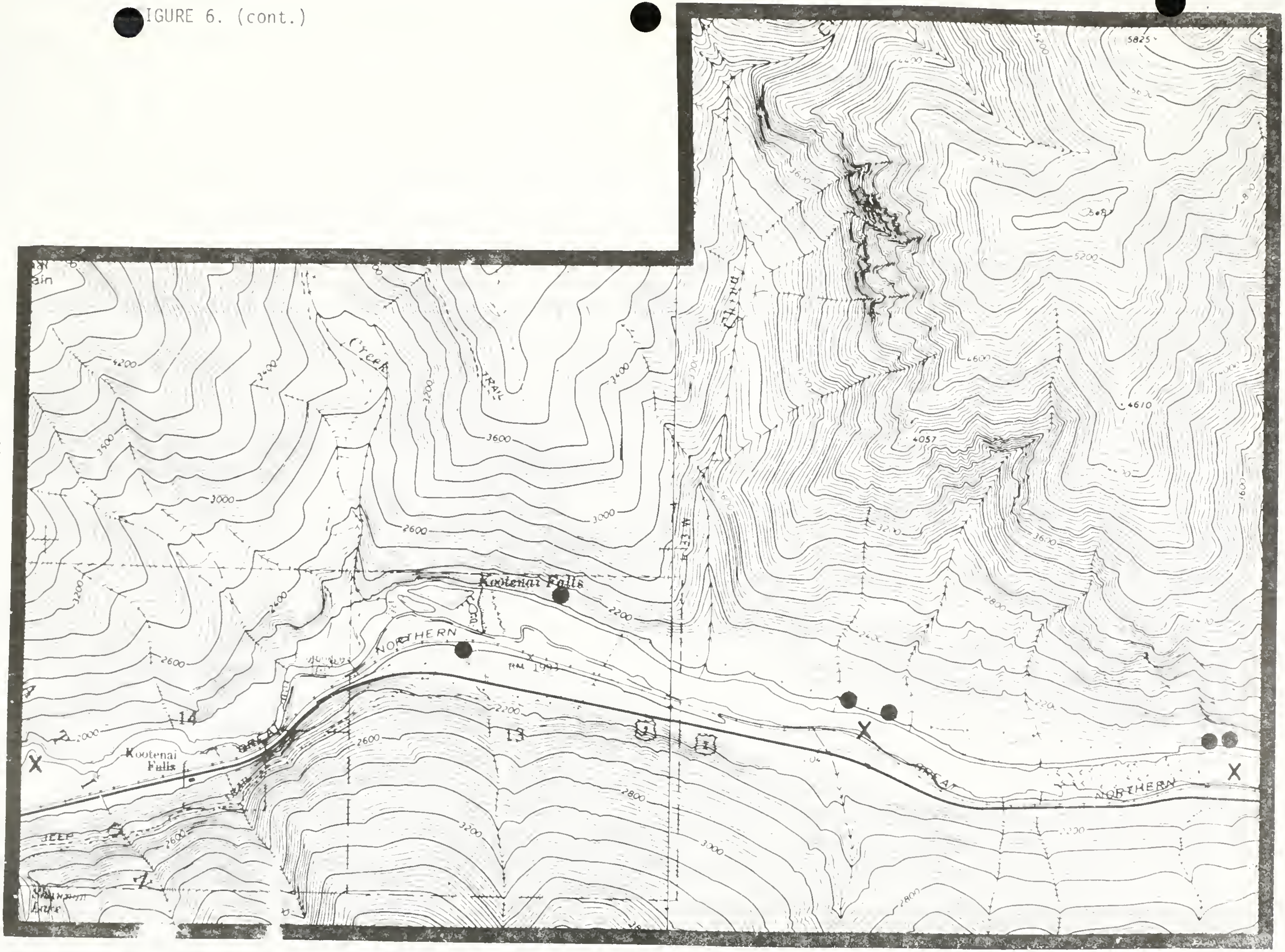


FIGURE 6. (cont.)



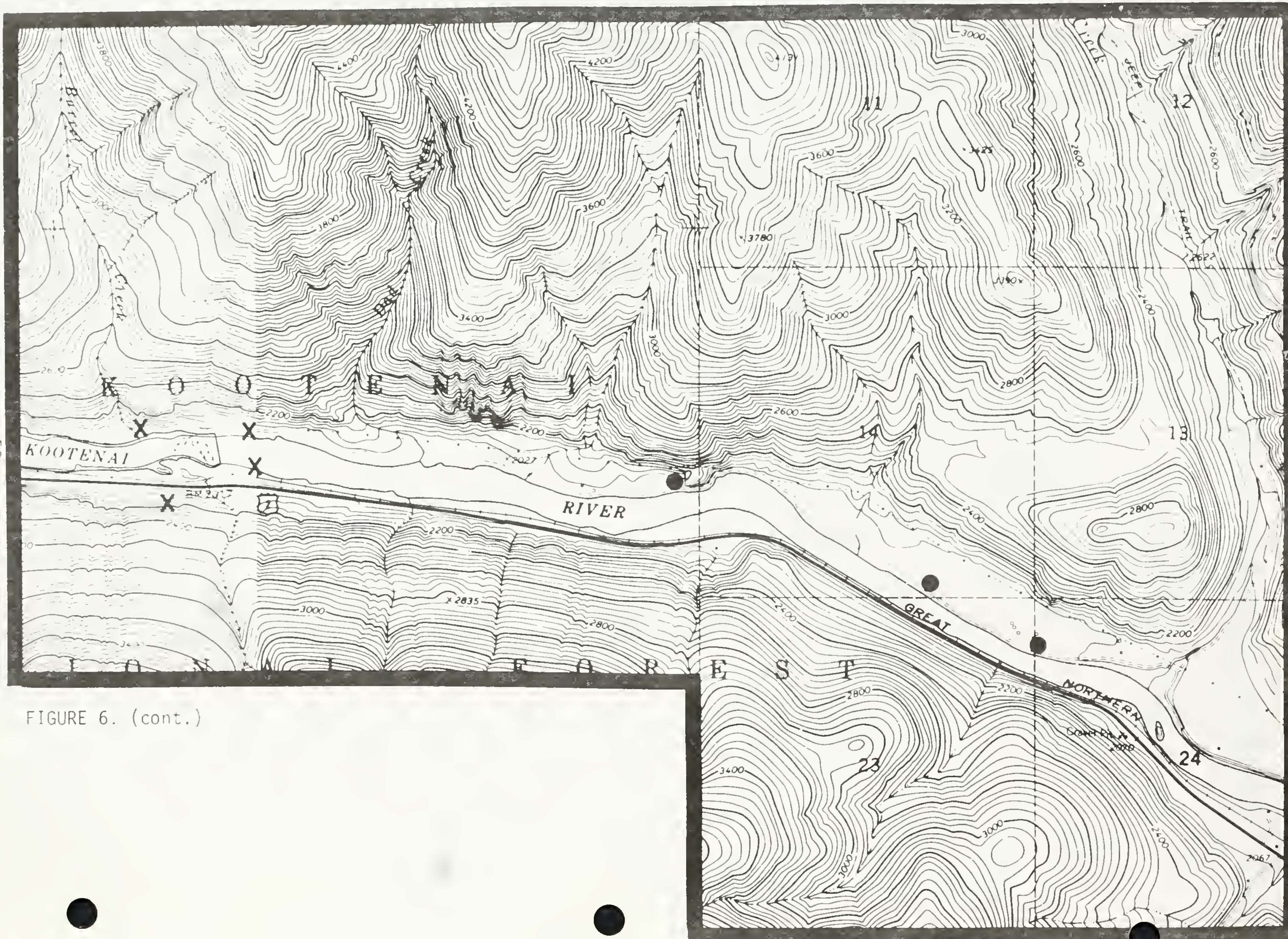


FIGURE 6. (cont.)

Osprey. Osprey were frequently observed in the Falls area in the summer and fall and were usually seen fishing in the stretch of river between the Falls and the transmission line crossing (section M, Figure 4). This area is fairly shallow, offering easy fishing. On two occasions, successful fishing bouts were witnessed in which the Ospreys caught fairly large mountain whitefish, then flew off upstream and out of sight into drainages on the south side of the river. The Osprey appear to use the river and Falls area as a preferred feeding area. The Kootenai River supports a healthy, and apparently stable or growing, breeding osprey population (Craighead and Craighead 1979). The nearest known nest site is located near Throops Lake, area code 25 (Kichura and Ruediger 1978; Meyer 1979). Although no nests were located in the Falls area, it is believed that one pair nested up Williams Creek (area code 21-22), and another pair might have nested on or near Lynx Flats (1). A pair was reportedly observed going through the motions of building a nest above the highway retaining wall midway down the gorge (22), but since the activity occurred in mid-June and was not completed, it is likely this pair was either immature or was engaging in an unsuccessful renesting attempt.

American Kestrel. The nest of an American kestrel was located in an abandoned woodpecker hole in a cottonwood snag immediately upriver from the Falls (21). The nesting kestrel and a nesting common flicker in an adjacent snag were observed harassing each other on several occasions. Success of the kestrel nest was not determined.

Dipper. Dippers were present in the Falls area throughout the study period. They were observed feeding in fast water on the Falls in the winter, when tributary streams are frozen or snowbound. They were also observed feeding in rapids on rocks upstream from the Falls. Kootenai Falls provides suitable habitat for nesting (Bakus 1959), although fluctuating water levels probably make nesting hazardous. No nests were located during this study. Many small streams feed into the river on the north and south shore, providing additional habitat for Dippers. Table 5 presents census data for Dippers; the greatest number seen on a single day in 1979 was nine on August 1, when newly fledged young were abundant. Dippers appeared to be concentrated near the Falls during all seasons, probably because of increased food density. Worthy of special note is the Dipper population which winters at the Falls. On one occasion 11 Dippers were observed feeding in the rushing water. The average number of Dippers observed during 11 winter trips to the Falls (sections J, K, L, and the downstream third of M) was 6.25. Dippers move to lower elevations to find fast water during winter; they do not undertake long-distance migrations. Because of this, the few available stretches of free-flowing white water become critical wintering areas. Kootenai Falls constitutes such an area.

Species Accounts -- Mammals

A summary of inventory data for mammal species for which additional data were obtained is presented below.

Beaver. An active beaver lodge was discovered on the river's south shore, upriver from the Falls, below the powerline crossing, on the boundary of river sections M and N (Figure 4). Den openings were in an undercut bank protected by a flexible barricade of cut branches and shrubs which allowed secure access to and from the den regardless of river fluctuation.

River Otter. Only one verified sighting of a river otter was made during this study. On June 29, 1979, one individual, probably a transient, was observed swimming, fishing, and climbing on rocks just above the Falls (section M). An unverified sighting by a fisherman was reportedly made in this same area in 1978.

White-tailed Deer. White-tailed deer were infrequently seen during this study and are apparently uncommon in the Falls area, probably due to limited security and railroad and highway related disturbance. Only 11 observations were recorded in 1978 and 1 (a male seen near the Falls September 2) in 1979. Locations of sightings and sign are shown in Figure 7. Monthly distribution of sightings for the period January - July, 1978, is shown in Table 12, and the distribution of all deer observations (mule and white-tailed, including sign) among habitat types and elevation categories is shown in Table 13. MDFWP harvest estimates indicate a 1978 harvest of 945 deer, of which 65 percent were white-tailed deer, in hunting district 100, which includes the study area (Weckwerth et al. 1979).

Mule Deer. Mule deer also appear to be uncommon in the study area; 18 observations were made in 1978 and none in 1979 (Figure 7; Tables 12 and 13).

Elk. A single set of elk tracks was observed in the study area in 1978 (Figure 7); no additional evidence of elk use of the area was obtained.

Moose. Two sets of moose tracks were observed in the study area in 1978 (Figure 7). A cow and calf were reportedly seen near the Lion's Club turnout in early June, 1979 (McGrady 1979).

Bighorn Sheep. Bighorn sheep were the most frequently observed ungulate in the Kootenai Falls study area. Twenty-one bighorns were transplanted along the Kootenai River between Libby and Troy in 1954, 1955, and 1963. Sporadic observations have been made by MDFWP personnel (K. Knoche and B. Campbell) since 1974. Only the information collected since June 1977 was utilized in the following analysis.

From June 1977 through July 1978, 109 groups totaling 522 sheep observations were recorded (Table 14). These consisted of 91 rams, 247 ewes, 102 lambs, and 82 unclassified sheep. Monthly censuses were conducted from February through June,1978, and the number observed during any one census represented a minimum number of sheep present on the visible portion of the study area. During the February census, 40

FIGURE 7. Location of elk, moose, mule deer and white-tailed deer sign and observations, November 1977 - August 1979.

• = sign
E = Elk
M = Moose
○ = Mule Deer
□ = White-Tailed Deer
(Numbers within symbols indicate group size for mule and white-tailed deer).

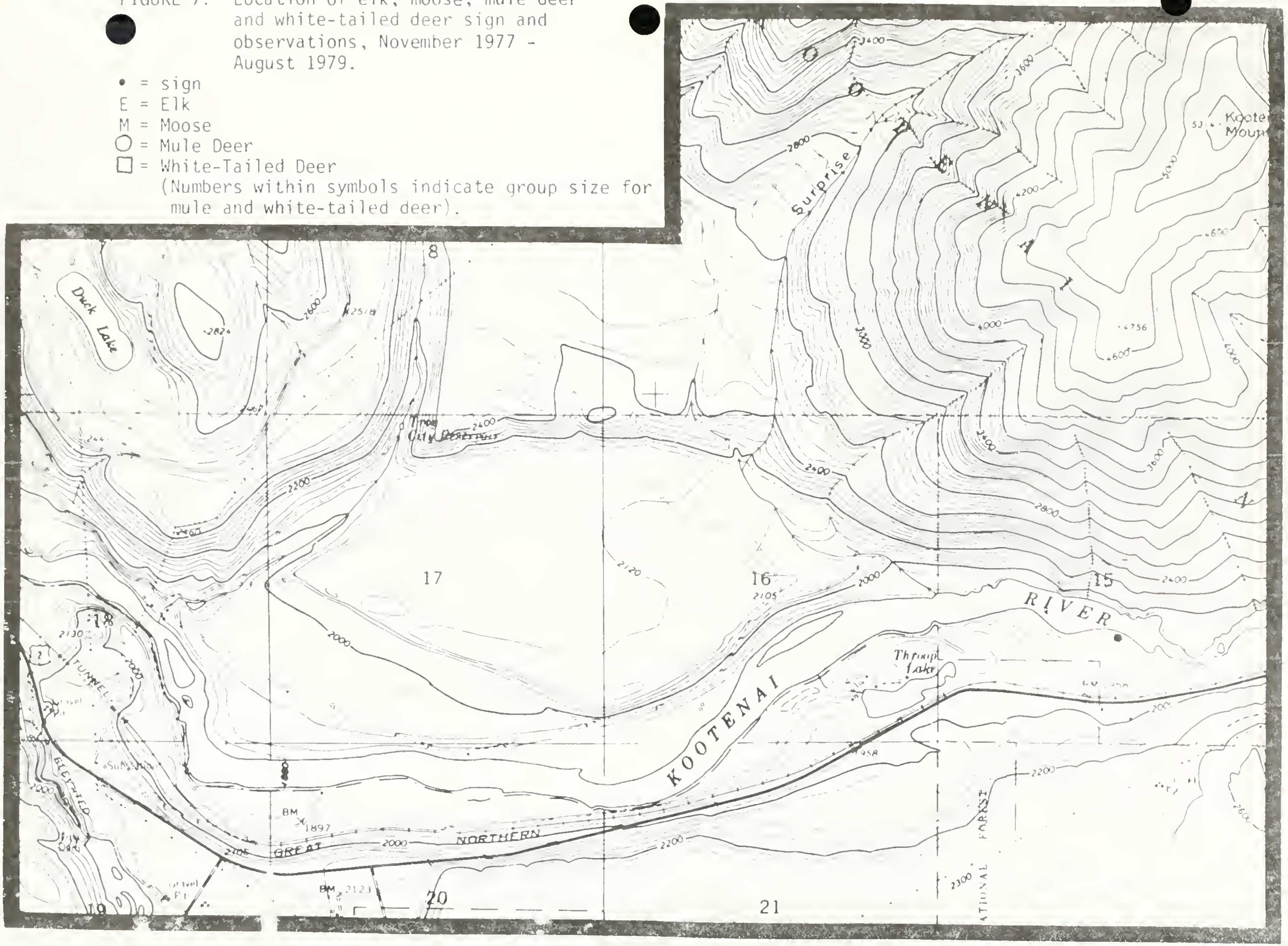
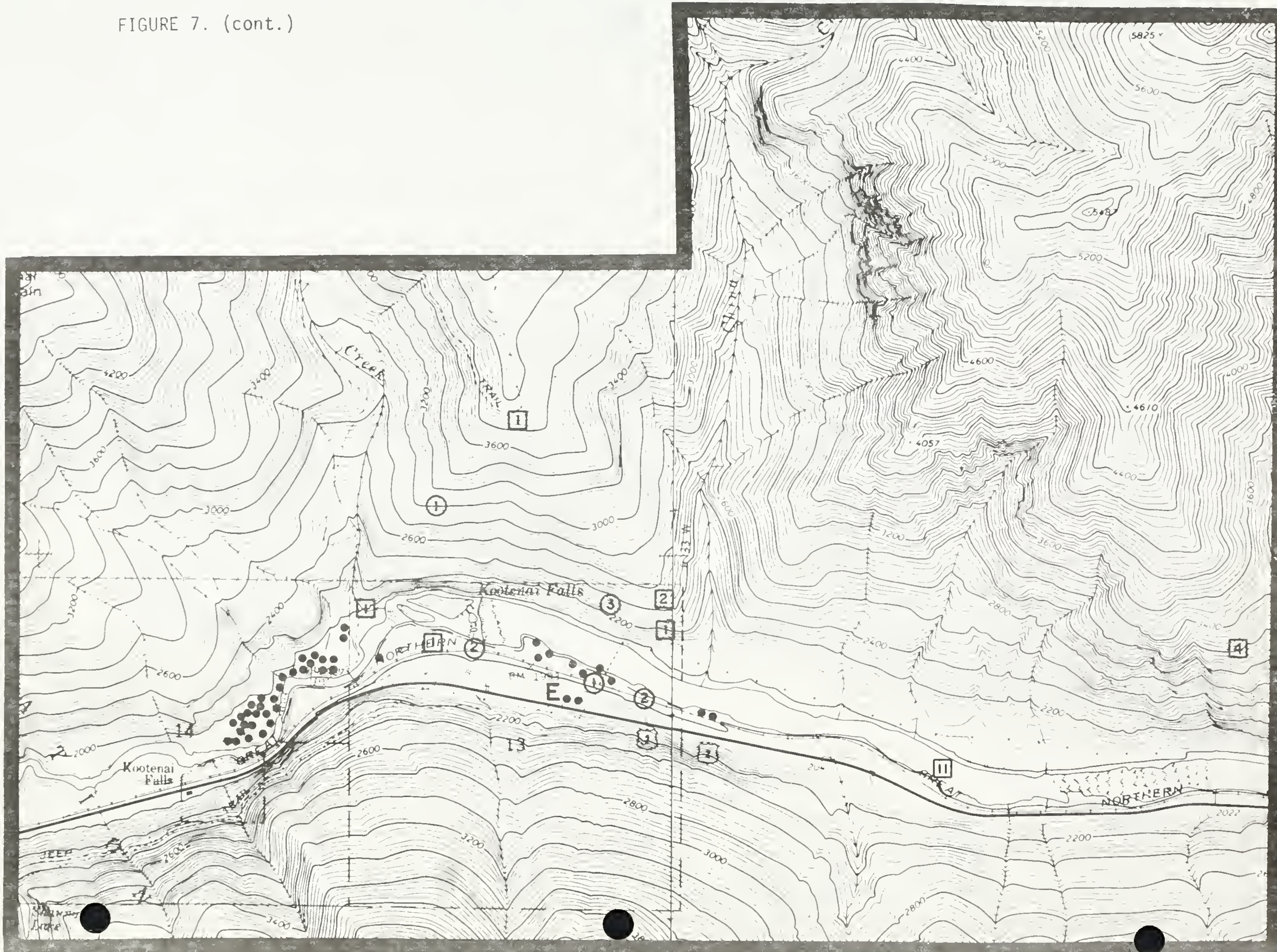


FIGURE 7. (cont.)



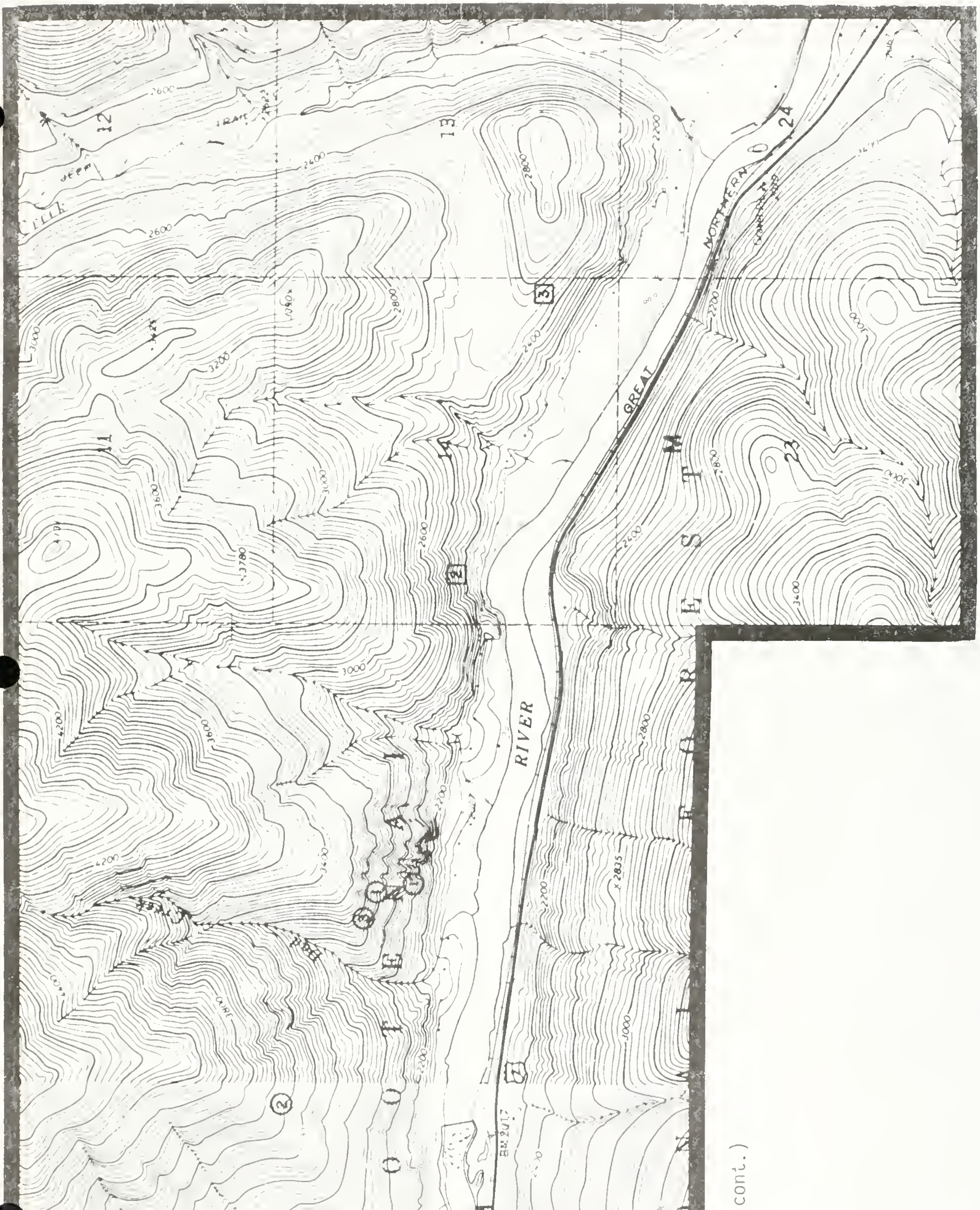


FIGURE 7. (cont.)

TABLE 12. Mule deer and white-tailed deer observations and sign recorded on the Kootenai Falls study area, January through July, 1978.[1/]

Observations	Sample Size	Percent of Total	Number					
			January	February	March	May	June	July
Mule deer	18	24.0	5	8	2	-	3	-
White-tailed deer	11	14.7	1	7	3	-	-	2
Sign								
Tracks	21	28.0	8	5	-	-	-	-
Droppings	11	14.7	9	-	-	3	5	-
Beds	14	18.6	12	-	-	2	2	-
Total	75	100.0	35	20	5	5	10	2

1/ No records during April.

TABLE 13. Deer observations and sign recorded on the Kootenai Falls study area according to habitat type and elevation, January through July, 1978 [1/]

Category	Sample Size	Percent of Total	Percent of Observations					
			January	February	March	May	June	July
Habitat Type								
THPL/CLUN	21	27	4.8	23.8	4.8	19.0	47.6	-
PSME/AGSP	8	10	-	75.0	-	-	-	25.0
PSME/PHMA	43	56	69.8	20.9	6.9	2.3	-	-
PSME/SYAL	5	7	80.0	-	20.0	-	-	-
Elevation								
≤609m (2000 ft)	49	63	61.2	6.1	2.1	10.2	20.4	-
610-670m (2001-2200 ft)	6 -	8	-	100.0	-	-	-	-
671-853m (2201-2800 ft)	10	13	-	50.0	30.0	-	-	20.0
7853m (2800 ft)	12	16	41.7	50.0	8.3	-	-	-

1/ No records during April.

TABLE 14. Number of groups and number of bighorn sheep observations made each month on the Kootenai Falls study area, June 1977 - July 1978.

Date	Number of Groups Observed	Number of Sheep				
		Total	Male	Female	Lambs	Unclassified
1977						
June	1	17	1	8	7	1
November	4	13	3	6	-	4
December	1	1	1	-	-	-
1978						
January	5	11	4	3	4	-
February	10	40	12	14	9	5
March	29	121	35	48	21	17
April	16	92	15	45	24	8
May	28	113	12	70	7	29
June	8	58	1	26	17	14
July	7	51	7	27	13	4
Total	109	522	91	247	102	82

sheep were observed, followed by 76 in March, 74 in April, 46 in May, and 35 in June. These figures represent the maximum number of sheep observed during any one census. Observability of sheep was hampered by dense timber, rugged terrain, and ground censusing from one elevation along the highway. Aerial surveys were limited due to dangerous flying conditions in the narrow canyon. A capture and mark program would be necessary to obtain population estimates or yearly trends.

Bighorn ewes do not normally breed until 2.5 years of age (Smith 1954). It was difficult to separate the yearling ewe component and the 1/2 to 3/4 year old rams from adult ewes depending upon the date of observation. The unclassified portion of the herd consisted of this faction and possibly some adult ewes. Sheep classified as lambs in April were considered yearlings in May, since two newborn lambs were observed May 7. The lamb/ewe ratio (primary age ratio) based on classified animals for the February through April period was 50.5/100. This figure may be high if adult ewes were inadvertently unclassified. The ratio is 39.4/100 when the unclassified segment is incorporated. The true primary age ratio falls within this range (11 percent). Stelfox (1976) indicates that the average primary age ratio of four Canadian bighorn herds during the winter period was 45.6 lambs/100 ewes, which compares closely with these findings; however Brown (1974) found an 82 percent ratio for the February through April period in the nearby Thompson Falls herd. Age ratios cannot be used to interpret herd vigor (Caughley 1974) because the population may be exploding or crashing while the age ratio is doing the opposite, depending upon other demographic factors. The 1978 ram/ewe ratio for all months combined was 36.8/100. During a May 3, 1979, helicopter survey of the Kootenai Falls area, MDFWP personnel observed 80 sheep and obtained ratios of 33 lambs: 100 ewes and 58 rams: 100 ewes (Weckwerth et al. 1979).

The activity or behavior of all observed bighorns was recorded according to one of five activity patterns (Table 15). Seasonal changes did not seem to influence activities, although walking and running were observed more often during the summer months. The sheep observed showed no apparent reaction to the presence of train work crews or other human presence on the south side of the river. Trains pass through the area fairly regularly and the sheep are probably habituated to the noise created. Highway 2 is clearly visible from the north bluffs, but auto traffic had no apparent effect on the sheep.

Habitat use on the Kootenai Falls bighorn sheep range is summarized in Tables 16 through 20. As previously mentioned, an observability bias was present which likely influenced the data. A radio-tracking program would be necessary to alleviate this type of bias. Table 16 and Figure 8 reveal where bighorns were observed, by season. From November through March, most bighorns were observed from just below the Falls (area 3), across Kootenai Mountain (areas 1 and 2). During spring and summer (except for June) the majority of sheep were found on other portions of the study area, upriver from the Falls. During November through March the majority of sheep were observed using the broken terrain type (Table 17)

TABLE 15. Monthly activity of bighorn sheep on the Kootenai Falls study area, June 1977 through July 1978.

Date	Activity						
	Feeding	Bedded	Walking	Standing	Running	Tracks	Unknown
Nov. 1977 - Jan. 1978	30/32 1/	-	10/4	50/56	-	10/8	-
February 1978	70/48	10/40	10/10	-	-	-	10/2
March 1978	69/85	25/13	-	3/1	-	-	3/1
April 1978	28/30	72/70	-	-	-	-	-
May 1978	38/47	26/31	7/3	25/17	-	-	4/2
June 1977 - 1978 2/	11/8	22/20	22/28	44/44	-	-	-
July 1978 3/	29/28	29/45	-	28/7	14/20	-	-
Total	41/45 4/	27/33	5/5	18/13	1/2	1/1	3/1

1/ Percentage of groups observed during the month/percentage of sheep observations during the month.

2/ June, 1977 and 1978 data combined.

3/ July 1978 data only.

4/ Percentage of total groups/percentage of total sheep observations.

TABLE 16 Monthly distribution of bighorn sheep on each area of the Kootenai Falls study area, June 1977 through July 1978.

Date	Area Codes [1]												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Nov. 1977 - Jan. 1978	20/12[2]	20/20	20/12	-	10/12	-	10/20	10/20	-	-	10/4	-	-
February 1978	-	10/10	20/50	10/13	10/2	-	-	30/15	-	-	-	-	20/10
March 1978	3/11	28/13	10/5	-	10/7	-	-	3/3	7/14	-	-	21/32	18/15
April 1978	-	-	31/33	-	6/5	-	-	13/18	-	6/2	-	38/34	6/8
May 1978	-	11/3	21/22	-	-	-	-	14/8	22/28	-	4/4	21/24	7/11
June 1977 - 1978 [3]	-	-	45/50	-	-	-	-	22/27	11/4	-	-	11/16	11/3
July 1978 [4]	-	14/4	14/10	-	-	-	29/25	14/18	-	-	-	-	14/43
Total	3/3[5]	13/6	21/25	1/1	6/3	-	3/3	13/14	8/11	1/tr	2/1	17/21	12/12

1/ See Figure 9 for upland area codes.

2/ Percentage of groups observed during the month/percentage of sheep observations during the month.

3/ June 1977 and 1978 data combined.

4/ July 1973 data only.

5/ Percentage of total groups/percentage of total sheep observations.

FIGURE 8. Location of bighorn sheep observations November 1977 - July 1978.

○ = November 1977-March 1978.
□ = April 1978-July 1979
△ = April and June 1979
Numbers within symbols indicate group size.
Black areas are riparian grasslands or hay-fields adjacent to bighorn sheep habitat.

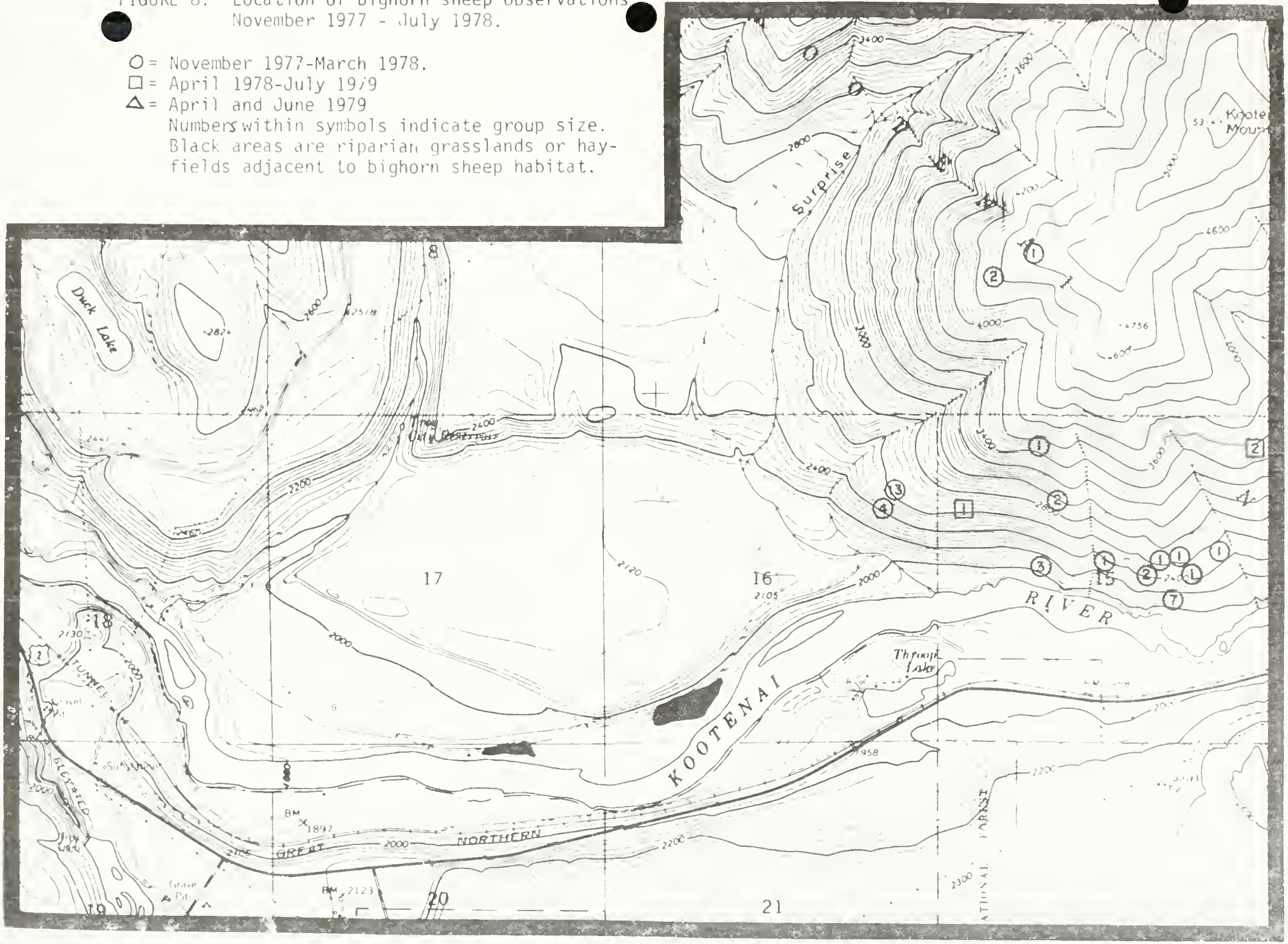
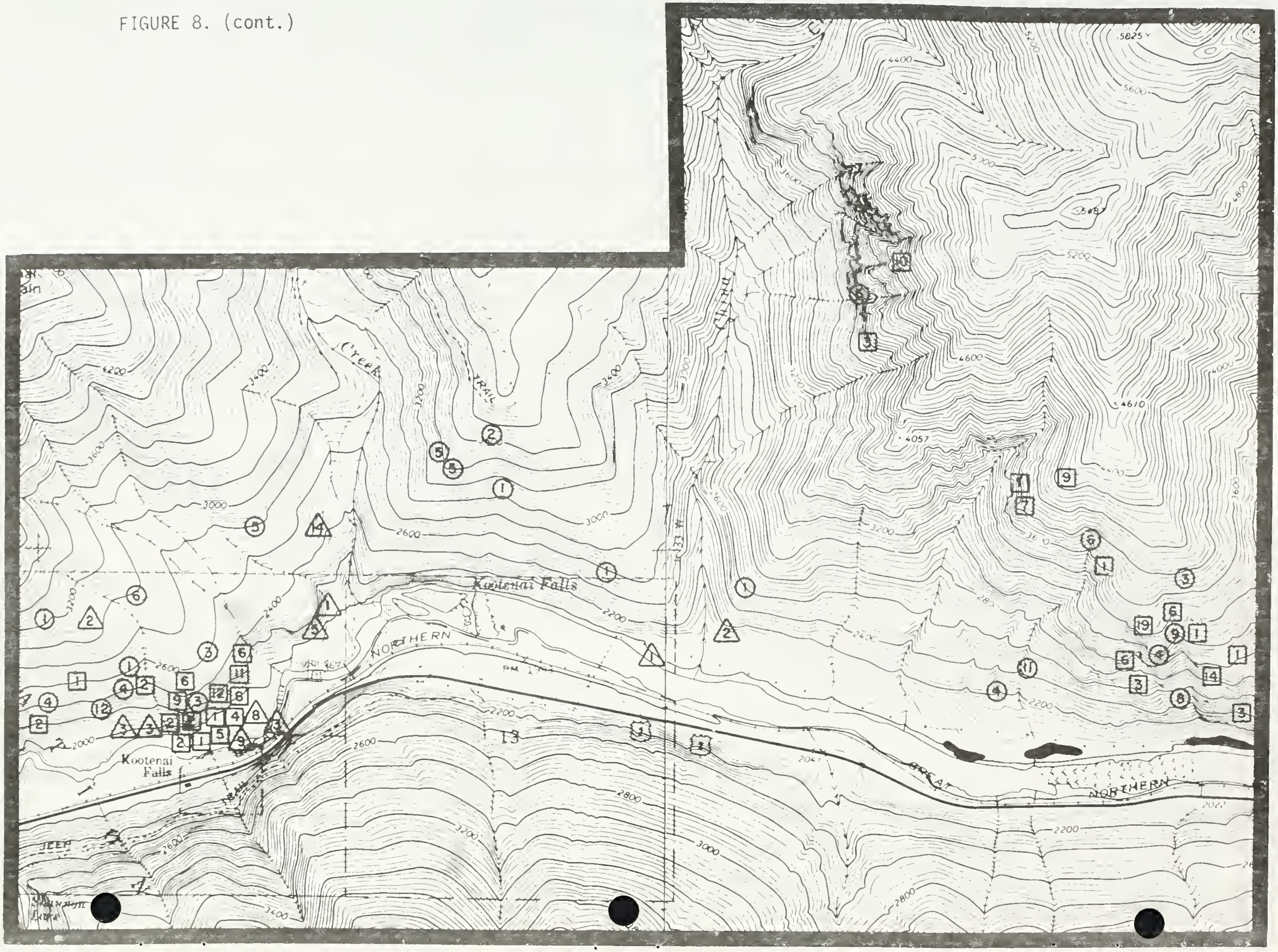


FIGURE 8. (cont.)



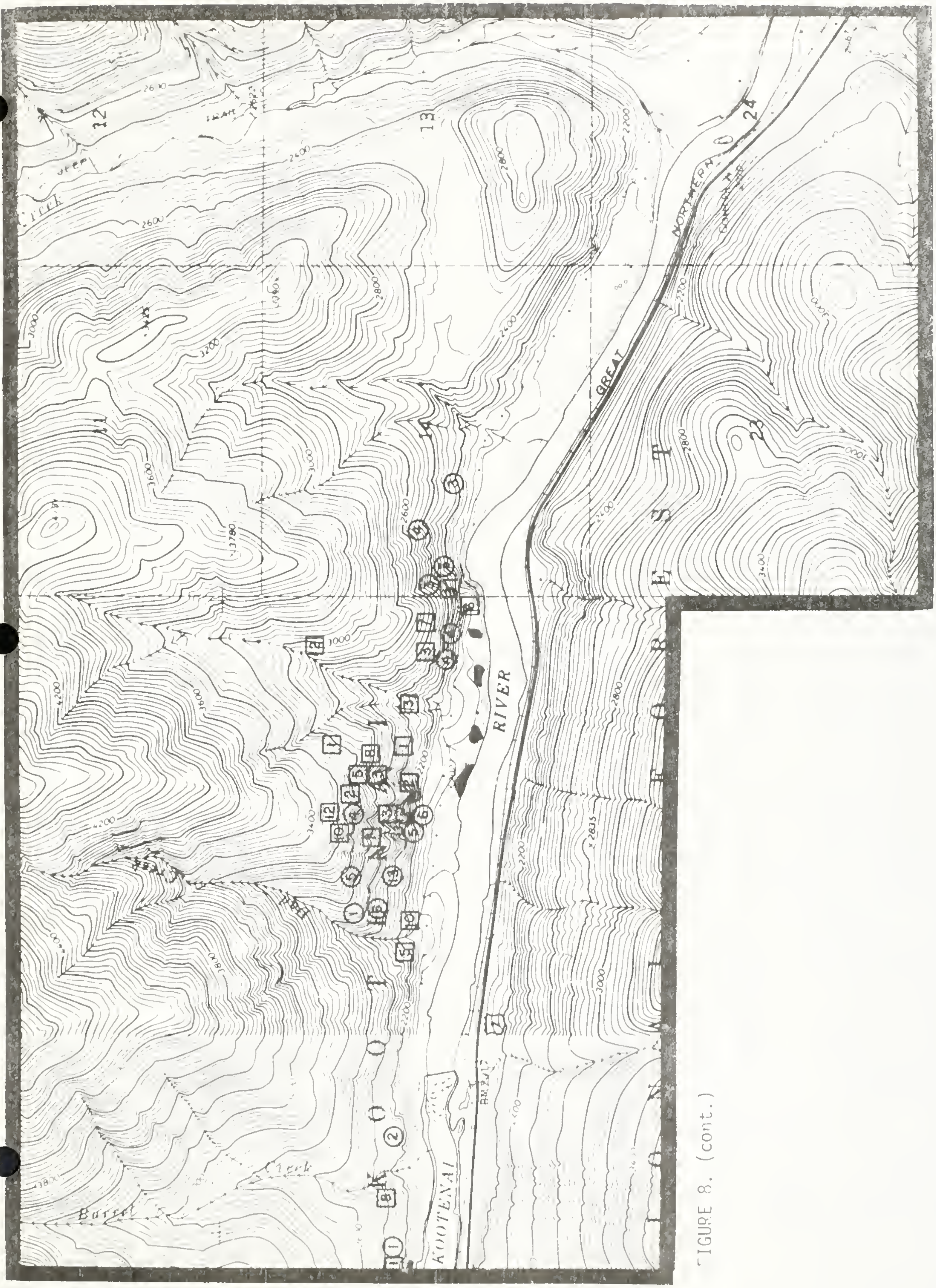


FIGURE 8. (cont.)

TABLE 17. Monthly observations of bighorn sheep according to terrain type on the Kootenai Falls study area, June 1977 through July 1978.

Date	Terrain Type					
	Bluff	Sidehill	Cliff	Broken	Talus	Ridge
Nov. 1977 - Jan. 1978	-	20/12 1/	10/20	70/68	-	-
February 1978	-	10/3	10/10	70/85	10/3	-
March 1978	34/32	7/2	3/7	38/40	14/13	-
April 1978	44/51	-	-	25/26	31/23	3/4
May 1978	54/70	-	11/8	32/21	4/1	-
June 1977 - 1978 2/	78/72	-	11/3	11/25	-	-
July 1978 3/	29/51	14/17	14/20	29/10	14/2	-
Total	38/48 4/	5/2	7/11	38/30	11/8	1/1

1/ Percentage of groups observed during the month/percentage of sheep observations during the month.

2/ June 1977 and 1978 data combined.

3/ July 1978 data only.

4/ Percentage of total groups/percentage of total sheep observations.

but from April through July sheep were most commonly observed on the bluff terrain type. Although bighorns have occasionally been observed south of the highway, for purposes of this survey, the sheep range was considered the north side of the canyon. Because of this survey, sheep were predominantly observed on south aspects during all months (Table 18). During November through March the majority of sheep were observed using slopes between 10 and 35 degrees (Table 19), while during April through July sheep were observed on all slopes. Through April, the majority of sheep observed were at elevations between 670 m (3300 ft) and 835 m (2800 ft). After April, sheep appeared to be dispersed at all observable elevations (Table 20). Habitat use in 1979 was generally similar to that observed in 1978, although no quantitative analyses were made.

A partially paralyzed bighorn lamb captured on June 8, 1978, was suffering from a large infestation of ticks and secondary afflictions including wounds, pneumonia, and dehydration. Efforts to improve his condition were unsuccessful so he was dispatched on June 18. The carcass was sent to the veterinary clinic in Bozeman for autopsy.

During 1979 winter transects, no sheep were seen. The weather during that time made visibility extremely poor with fog limiting the view considerably. A major blizzard and ice storm came through the area on January 21, 1979, and rain and snow prevailed on other transect days in winter. Any sheep present on visible portions of the study area during that time were probably in sheltered areas.

In 1979, the largest number of sheep were observed in April when the sheep were at or near the lowest portions of their range. A total of 41 observations were made during the four days spent in the field that month. The largest single group totaled 14 and was observed feeding in a fairly open area on the forested southeast slope of Kootenai Mountain. The largest group sizes (2-14) were seen during April. Most of the sheep observed were on exposed rock and in open areas in the forest on the north side of the river. The majority of observations were made west of the Falls, between the retaining wall and the Falls. The talus slopes directly north of the Falls seemed to act as a barrier to movement of large groups upstream. Sheep were observed upstream in grassy areas near the water's edge, but in much lower numbers. Such riparian grassland is normally an important component of bighorn sheep spring range, but most use during the study period probably occurred at night.

During spring and summer of 1979, sheep were observed feeding along the north shore near the water's edge in the area where the powerline crosses the river (area code N). This area is considered important for spring forage and MDFWP is trying to purchase some of the grassy benches in this area for sheep habitat (Christensen 1979). Bluffs across from the retaining wall were utilized fairly regularly in spring and summer, 1979. This area is accessible by a footbridge, but does not appear to be heavily utilized by people.

TABLE 18. Monthly distribution of bighorn sheep according to aspect on the Kootenai Falls study area, June 1977 through July 1978.

Date	Aspect					
	East	Southeast	South	Southwest	West	Unknown
Nov. 1977 - Jan. 1978	10/20 1/	30/32	40/36	20/12	-	-
February 1978	-	10/12	70/75	20/13	-	-
March 1978	-	3/2	90/83	7/15	-	-
April 1978	-	13/10	81/84	6/6	-	-
May 1978	-	36/49	43/39	14/8	-	7/4
June 1977 - 1978 2/	-	22/20	67/79	11/1	-	-
July 1978 3/	-	14/41	43/16	14/18	29/25	-
Total	1/1 4/	18/23	65/63	12/10	2/2	2/1

1/ Percentage of groups observed during the month/percentage of sheep observations during the month.

2/ June 1977 and 1978 data combined.

3/ July 1978 data only.

4/ Percentage of total groups/percentage of total sheep observations.

TABLE 19. Monthly distribution of bighorn sheep according to slope on the Kootenai Falls study area, June 19‑ through July 1978.

Date	Slope in Degrees								
	0-5	5-10	10-15	15-25	25-35	35-45	45-60	60+	known
Nov. 1977 - Jan. 1978	10/8 1/	10/4	50/48	-	30/40	-	-	-	
February 1978	10/3	20/10	10/10	40/73	-	-	-	-	/5
March 1978	-	7/2	14/14	24/25	10/20	10/9	31/29	3/1	
April 1978	-	6/1	6/5	25/40	6/8	13/5	44/41	-	
May 1978	-	21/36	7/2	21/12	25/17	7/7	4/2	4/5	/19
June 1977 - 1978 2/	-	22/31	-	22/20	-	-	11/3	45/46	
July 1978 3/	-	14/10	-	-	43/49	14/17	-	29/24	
Total	1/tr 4/	14/15	12/8	22/25	15/16	7/6	16/15	8/10	

1/ Percentage of groups observed during the month/percentage of sheep observations during the month.

2/ June 1977 and 1978 data combined.

3/ July 1978 data only.

4/ Percentage o' total groups/percentage of total sheep observations.

TABLE 20. Monthly distribution of bighorn sheep according to elevation on the Kootenai Falls study area, June 1977 through July 1978.

Date	Elevation [1/]					
	≤ 609m (2000 ft)	610-670 m (2001-2200 ft)	611-853 m (2201-2800 ft)	854-1036 m (2801-3400 ft)	1037-1219 m (3401-4000 ft)	>1219 m (4000 ft)
Nov. 1977 - Jan. 1978	10/8 [2/]	20/20	30/20	-	20/40	20/12
February 1978	-	20/10	80/90	-	-	-
March 1978	-	21/23	45/54	24/16	10/7	-
April 1978	6/1	19/31	44/40	19/16	12/12	-
May 1978	7/6	25/28	36/27	26/37	7/2	-
June 1977 - 1978 [3/]	22/35	22/16	11/4	34/44	11/1	-
July 1978 [4/]	-	29/51	14/2	-	28/10	29/37
Total	5/7 [5/]	22/26	40/35	18/21	11/7	4/4

1/ The elevation of Kootenai Falls is 609 m (2000 ft)

2/ Percentage of groups observed during the month/percentage of sheep observations during the month.

3/ June 1977 and 1978 data combined.

4/ July 1978 data only.

5/ Percentage of total groups/percentage of total sheep observations.

In 1978, 5 ram permits and 10 ewe permits were issued for Hunting District 100, which includes the Kootenai Falls herd. Hunter success was 100 percent for rams and 75 percent for ewes (Weckwerth and Cross 1979, Weckwerth et al. 1979).

SUMMARY OF HABITAT RELATIONS

The Kootenai Falls area is a complex mosaic of many different habitats, each harboring its own assemblage of animals. Figure 9 shows the pattern of distribution of selected vertebrates among habitats of three generalized cross-sections of the Kootenai River Valley (at the Falls, at the gorge below the Falls, and upstream from the Falls). Typical vertebrate species associated with each of the habitat categories listed in Table 1 are discussed below.

Water Habitats

Rapids. The only species which was observed to use rapids extensively was the dipper. Aquatic insects associated with rapids provided an important food source for the dipper, and wintering dippers concentrated at major rapids.

Falls. Kootenai Falls is the only remaining unimpounded falls of a major river in Montana, and as such provides a unique habitat. The Falls of the Yaak River, located north of Troy, is smaller and of lower gradient than Kootenai Falls and does not provide a comparable habitat. Kootenai Falls actually consists of several very different habitats, which receive different levels of use by different wildlife species. The thalweg (deepest part) of the river channel is located near the north bank of the river at the Falls, and -- at all flows -- most of the water volume descends the Falls through this channel. Water velocity is high in this constricted channel, and flow is very turbulent. A large island separates the main flow into north and south channels just below the head of the Falls. The only species observed to use the crashing, turbeulent water and spray of the main channels was the dipper. The head of the Falls and the minor channels below are a highly variable environment, depending on the pattern of discharge from Libby Dam. A series of relatively flat rock benches occur at the head of the Falls, south of the main channel and form a stairstep pattern leading to the sheer rock dropoffs of the Falls itself. These rock benches are densely covered with periphyton the river's southern bank. At low flows of 112 to 168 cms (4,000 - 6,000 cfs), most of this rock is dry and exposed or supports a gentle trickle of water from the relatively calm pool upstream; relatively little water descends over the Falls here, and the minor channels downstream are essentially calm pools. At high flows of 168 cms (6,000 cfs) and higher, a much larger volume of water cascades in a turbulent manner over the rock benches and the edge of the Falls, and the minor channels are turbulent as well, producing considerable spray and white water. At nearly all discharges, water flow across the benches between "stairsteps" is laminar rather than turbulent somewhere near the center of the Falls, and provides preferred feeding habitat for the harlequin ducks, the most distinctive and characteristic species of the Falls habitat. Harlequins are presumably feeding on diptera larvae (probably Simuliidae) in this swift water. Dippers feed in the same general area, but competition with the harlequins for food resources is avoided, as dippers feed in shallower water, closer to the rocks, and

FIGURE 9. Generalized distribution of selected vertebrate species among habitats of three cross-sections of the Kootenai River Valley.

A. Cross-section above falls near old homestead.

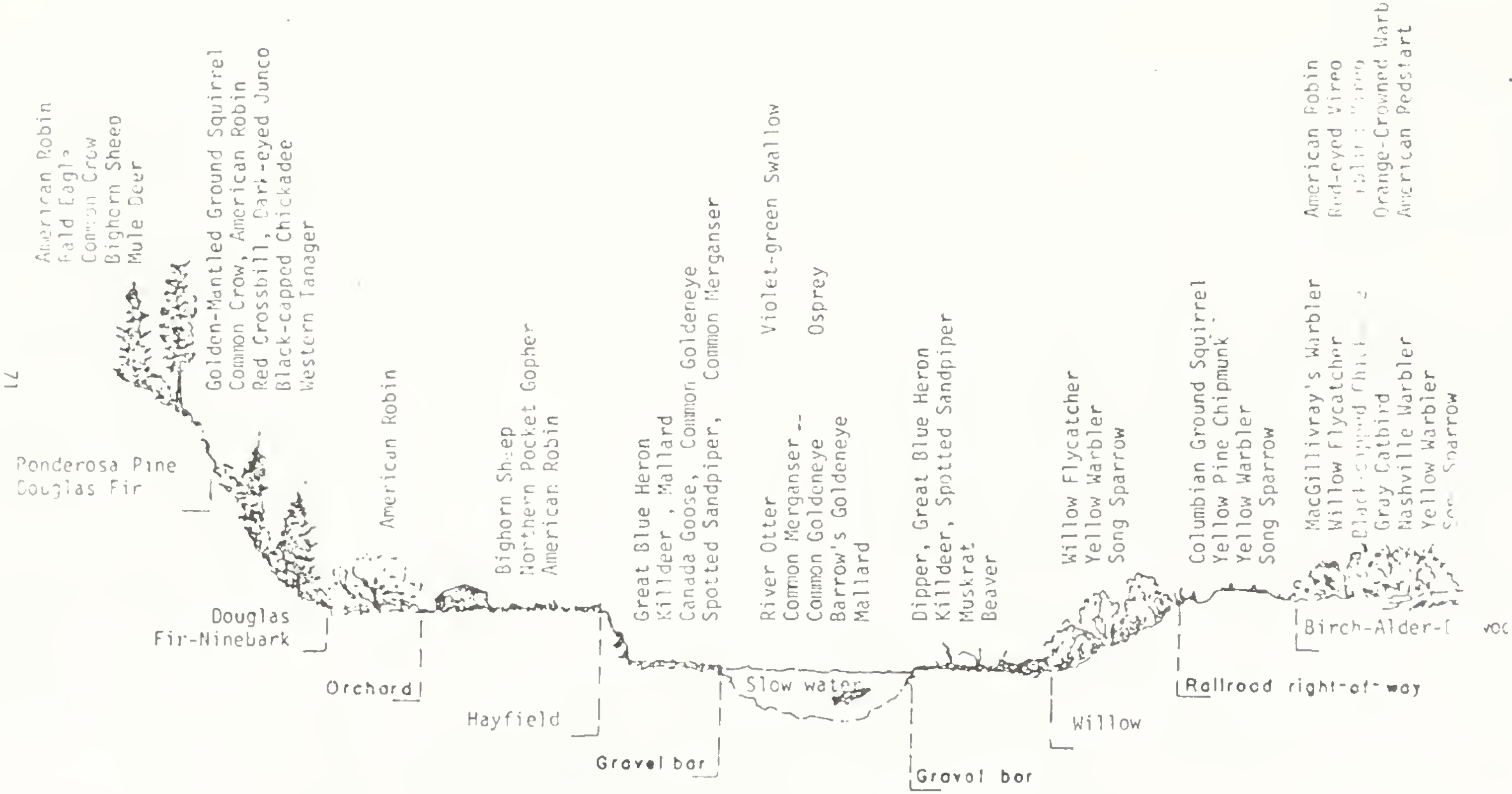


FIGURE 9. (Cont.)

B. Cross-section at Kootenai Falls.

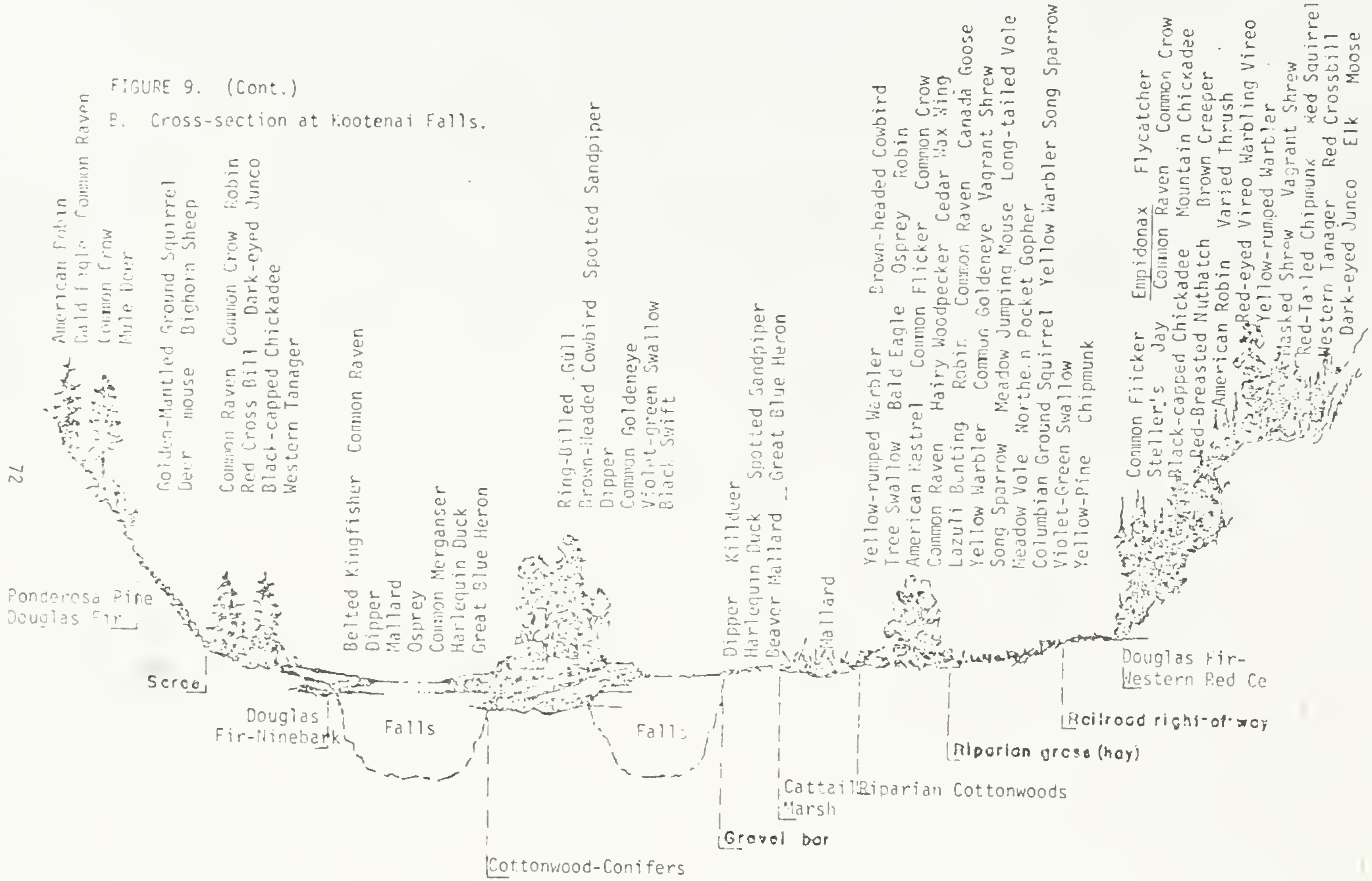
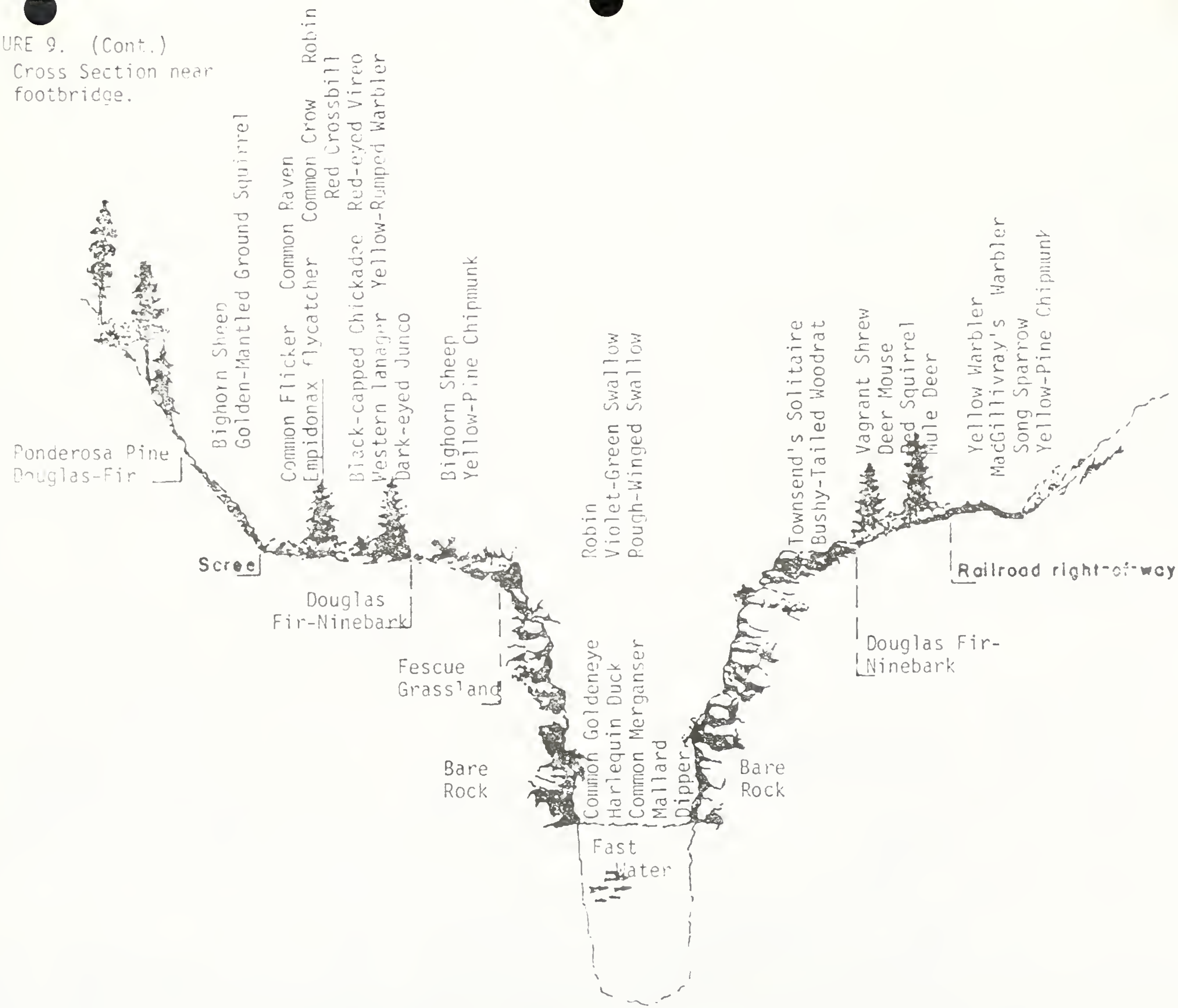


FIGURE 9. (Cont.)
C. Cross Section near footbridge.



select different prey (primarily Ephemeroptera, Trichoptera, and Diptera, with very few Simuliidae) (Mitchell 1968). Mallards, common goldeneye, spotted sandpipers, a river otter were observed in the relatively slow water between rock benches at the head of the Falls. A beaver was seen along a minor channel on the south bank of the river at a time when discharge was relatively low. Common ravens and common crows were occasionally seen on exposed rocks at the head of the Falls, presumably drinking or scavenging on carrion trapped on the exposed rocks or logjams. Harlequin ducks were also observed in fairly quiet side channels just below the Falls or perched on rocks adjacent to the main channel.

Slow Water. Relatively slow, deep water occurs both above and below the Falls; its distribution and extent are controlled largely by the pattern of discharge from Libby Dam. Large flocks of mallards, common goldeneye, and common mergansers were frequently seen swimming in this habitat; harlequin ducks, Canada geese, Barrow's goldeneye, American wigeon, belted kingfishers, and ring-billed and California gulls were seen less frequently. Spotted sandpipers, great blue herons, and dippers used shoreline areas for feeding. Osprey and (presumably) bald eagles use these relatively slow and deep stretches of the river for feeding. Otter, muskrat, and beaver were also observed in slow water.

Fast Water. Constricted areas, especially the main river channel in the gorge below the Falls, are characterized by fast, turbulent flows and are used by a few species, including mallards, common goldeneye, harlequin ducks, common mergansers, and dippers.

Aquatic Vegetation (Rooted). The mallard, common merganser, and river otter were the only species seen using this very limited habitat, which occurs only in a relatively quiet backwater-like area at the head of the Falls on the south bank of the river. A mallard brood used this area extensively, and it apparently provides the only suitable brood-rearing habitat for puddle ducks in the Falls area.

Sparsely Vegetated Habitats

Exposed Rock or Logjams (in River). A peninsula of boulders and rocky rubble extends into the river from the south bank just upstream from the head of the Falls; when cut off from shore by high discharges, these rocks were preferred loafing habitat for "clubs" of harlequin ducks, and were used also by spotted sandpipers, dippers, ring-billed gulls, mallards, and Barrow's and common goldeneye. Small islands of exposed rock and the log and debris jams at the head of the Falls were extensively used as loafing habitat (or as perching areas between feeding bouts) by great blue herons, mallards, harlequin ducks, common mergansers, ring-billed gulls, dippers, common crows, and brown-headed cowbirds. Dippers were the most characteristic species on exposed rock surrounded by water below the Falls.

Bare Rock (Upland). The nearly vertical rock cliffs forming the river gorge between the footbridge and the concrete retaining wall were used as nesting sites by rough-winged swallows, robins, and possibly violet-green swallows.

Gravel Bars. Spotted sandpiper breeding territories were typically associated with gravel bars along the river; great blue herons, Canada geese, mallards, American wigeon, common goldeneye, common mergansers, and killdeer also used this habitat.

Scree and Talus. Rockslides and talus slopes were most common on the steep hillside to the north of the Falls; they were used occasionally by bighorn sheep, and provided cover for golden-mantled ground squirrels and yellow pine chipmunks. A single deer mouse was the only mammal taken in pitfall traps set in loose rock, but both masked and vagrant shrews probably occur there as well. Pikas have been reported to use this habitat at unusually low elevations along the Fisher River near the study area (Hoffman et al. 1979a), but none were observed during this study.

Rocky Outcrops (Upland). A raven nest was located on a steep rock outcrop above Highway 2. On the north side of the river, sparsely vegetated cliffs and rocky bluffs were used extensively by bighorn sheep, and also by merlin, Townsend's solitaire, and bushy-tailed woodrat.

Grassland and Marsh Habitats

Riparian Grasslands and Hayfields. While these habitats were used occasionally for feeding or loafing by a variety of birds from adjacent tree and shrub habitats (e.g., American robins, common ravens, song sparrows) and by Canada geese and common goldeneye, they supported no typical grassland species (such as savannah sparrow or western meadowlarks), probably because of their limited extent. Nevertheless, such habitats are characterized by relatively high primary productivity, and are a prime food source for grazing herbivores, particularly voles (*Microtus* spp.) and bighorn sheep. Figure 8 shows where relatively flat, grassy slopes of this habitat occur adjacent to rocky areas used heavily by bighorn sheep on the north side of the river. In these areas, bighorn sheep occupy the lowest elevations in late March and early April; these highly productive grasslands provide a key food source. Small mammals taken during the trapping effort in this habitat include the vagrant shrew, meadow vole, long-tailed vole, and meadow jumping mouse. Burrows of northern pocket gophers and Columbian ground squirrels were observed in this habitat, and western garter snakes were found only in this habitat.

Fescue Grassland. This grassland type is also an important source of forage for bighorn sheep. It is occupied by yellow-pine chipmunks and probably deer mice and vagrant shrews, as well as various birds using adjacent timber and shrub habitats.

Cattail Marsh. Mallards were the only vertebrates observed using the small patch of cattails located on the south bank of the river adjacent to the head of the Falls, but it is likely used by voles and deer mice. The area is too small and isolated to provide suitable breeding habitat for such characteristic species as the red-winged blackbird, long-billed marsh wren, and sora.

Shrub Habitats

Willow. Riparian willows at the head of the Falls provided food for beaver and breeding habitat for the willow flycatcher. Yellow warbler and song sparrows also used this habitat occasionally.

Birch-Alder-Dogwood. Common birds in this habitat include: willow flycatcher, black-capped chickadee, gray catbird, American robin, cedar waxwing, red-eyed vireo, warbling vireo, orange-crowned warbler, Nashville warbler, yellow warbler, McGillivray's warbler, American redstart, rufous-sided towhee, and song sparrow.

Alder-Dogwood. This type was quite limited in extent and was not investigated regularly. Species composition is probably similar to the birch-alder-dogwood type.

Forest Habitats

Riparian Cottonwoods. The shrub layer of this habitat supports a group of species similar to that of the birch-alder-dogwood type. Additional species using the tall cottonwoods are the bald eagle, osprey, American kestrel, common flicker, hairy woodpecker, common raven, common crow, American robin, yellow-rumped warbler, and brown-headed cowbird.

Snags (Deciduous). Snags of cottonwood and (to a lesser degree) birch and aspen provide perch sites for bald eagles, American kestrels, and osprey; cavities within snags provide nesting habitat for American kestrel, common flicker, hairy woodpecker, tree swallow, and black-capped chickadee; cavity-nesting ducks (common goldeneye, harlequin duck, common merganser) may also use deciduous snags for nesting (see discussion on p.7.

Cottonwood - Conifers. This habitat is apparently a mid-succession type in which riparian cottonwoods are being successfully invaded by conifers. Characteristic bird species of this habitat are: bald eagle, osprey, American kestrel, common flicker, hairy woodpecker, common raven, common crow, black-capped chickadee, American robin, Swainson's thrush, golden-crowned kinglet, ruby-crowned kinglet, cedar waxwing, warbling vireo, orange-crowned warbler, Nashville warbler, yellow warbler, yellow-rumped warbler, MacGillivray's warbler, American redstart, brown-headed cowbird, western tanager, lazuli bunting, pine siskin, American goldfinch, red crossbill, dark-eyed junco, and chipping sparrow.

Ponderosa Pine-Douglas Fir. This type occurs on the dry, steep south-facing slopes on the north side of the river, and was not investigated with the same level of intensity as the riparian types. Birds seen in this habitat were the American kestrel, golden eagle, bald eagle, common raven, common crow, American robin, Townsend's solitaire, cedar waxwing, pine siskin, and dark-eyed junco; mammals using this type include the yellow-pine chipmunk, golden-mantled ground squirrel, white-tailed deer, mule deer, and bighorn sheep.

Douglas Fir-Shrub. Bird species using this mid-succession habitat are similar to those of the cottonwood-conifer habitat. Those observed include the bald eagle, merlin, American kestrel, ruffed grouse, mourning dove, rufous hummingbird, calliope hummingbird, Empidonax flycatcher, common raven, common crow, black-capped chickadee, chestnut-backed chickadee, red-breasted nuthatch, American robin, Swainson's thrush, cedar waxwing, red-eyed vireo, orange-crowned warbler, Nashville warbler, yellow warbler, yellow-rumped warbler, brown-headed cowbird, western tanager, lazuli bunting, American goldfinch, red crossbill, dark-eyed junco, chipping sparrow, Lincoln's sparrow, and song sparrow. Mammals observed in this type include the red squirrel, deer mouse, white-tailed deer, and bighorn sheep.

Douglas Fir-Ninebark. Characteristic species of this late-successional type are common flicker, Empidonax flycatcher, common raven, common crow, black-capped chickadee, American robin, varied thrush, Swainson's thrush, red-eyed vireo, yellow-rumped warbler, western tanager, pine siskin, red crossbill, dark-eyed junco and chipping sparrow. The vagrant shrew and deer mouse were taken during limited trapping in this type; also seen were Columbian ground squirrel, red squirrel, mule deer, and bighorn sheep.

Douglas Fir-Western Red Cedar. Bird species using this type include ruffed grouse, common flicker, pileated woodpecker, hairy woodpecker, Empidonax flycatcher, Steller's jay, common raven, common crow, black-capped chickadee, mountain chickadee, red-breasted nuthatch, brown creeper, winter wren, American robin, varied thrush, Swainson's thrush, golden-crowned kinglet, ruby-crowned kinglet, red-eyed vireo, warbling vireo, yellow-rumped warbler, Townsend's warbler, MacGillivray's warbler, American redstart, western tanager, lazuli bunting, pine siskin, red crossbill, dark-eyed junco,chipping sparrow, and Lincoln's sparrow. Mammals observed, trapped, or leaving signs in this habitat are the masked shrew, vagrant shrew, red-tailed chipmunk, red squirrel, northern flying squirrel, deer mouse, red-backed vole, coyote, white-tailed deer, elk, and moose.

Snags (Coniferous). Cavities in coniferous snags provide important nest sites for cavity-nesting birds as well as the red squirrel and northern flying squirrel. Large western red cedar snags between the head of the Falls and Highway 2 showed evidence of extensive feeding use by pileated woodpeckers. Such snags were frequently used as perches by bald eagles and American kestrels.

Other

Powerline Right-of-Way. This habitat is extremely variable, and is typically used by species of adjacent habitats, as well as shrub and edge-loving species such as the yellow warbler, MacGillivray's warbler, and song sparrow. Wires on the distribution line were often used as perches by violet-green swallows and brown-headed cowbirds.

Railroad Right-of-Way. Like the powerline right-of-way, the railroad right-of-way is used by species of adjacent habitats for travel and feeding. In the vicinity of the head of the Falls, shrubs along the right-of-way produce berries abundantly which are used extensively by birds and small mammals. Columbian ground squirrel burrows are common on the right-of-way at the head of the Falls, and yellow pine chipmunks are abundant on the right-of-way in summer and fall.

Orchard. The scattered apple orchards along the Kootenai River were used by species of adjacent habitats and did not support a characteristic group of species. Black bears from adjacent coniferous habitats are likely to feed on fallen apples in the fall, although none were observed in this study.

Open Air. The open air above the river is of course traversed by many bird species (especially raptors and waterfowl) which are crossing the river or moving-up or down river. A number of species, however, use this habitat for feeding on the flying insects which are abundant in summer above the river; these include the black swift, Vaux's swift, violet-green swallow, tree swallow, and rough-winged swallow. Violet-green swallows were especially abundant in the Falls area.

ANALYSIS OF POTENTIAL IMPACTS AND MITIGATING MEASURES

In the following section, potential impacts of the proposed Kootenai Falls project on the wildlife resource are discussed, along with possible means of mitigating these impacts and the overall potential effectiveness of mitigation.

Potential impacts are described in terms of their ultimate effect on population size and/or the carrying capacity of the environment (that is, the optimum number of animals which the environment can support over a long period of time). In this sense, an adverse or negative impact may be defined as an environmental change which (1) temporarily reduces population size below carrying capacity, (2) increases population size above carrying capacity, or (3) reduces an area's carrying capacity. Similarly, a beneficial or positive impact is a change which (1) restores a depleted or oversize population to carrying capacity, or (2) increases an area's carrying capacity. For the purposes of this report, potential impacts were grouped according to the four primary mechanisms by which populations or carrying capacity may be affected: (1) habitat alteration, (2) displacement, (3) changes in mortality or natality rates, and (4) physiological stress. The relationships among these mechanisms of impact are complex, but this categorization is nevertheless useful for purposes of impact analysis.

The overall significance of an impact may be viewed from either a social or a biological perspective (Sharma et al. 1975). Social significance is dependent upon the degree to which a given impact affects the public's sensibilities or system of values; thus, while destruction of a brood of ducklings may not be biologically significant, it may outrage people and assume a social significance that cannot be ignored. Biological significance is best thought of in terms of measurable, long-term changes in carrying capacity. Thus, if 100 tree squirrels should be destroyed, the impact to the total population would be short-term (lasting a few years at most) and hence not significant (sensu Sharma et al. 1975) -- the population would recover relatively quickly, and carrying capacity would not be affected. If ten osprey or five bighorn sheep were destroyed, the impact would be more long-lasting and hence more significant, since these species are relatively scarce and have lower recovery rates, but carrying capacity would still not be affected. If nesting habitat for five pair of osprey or winter-spring habitat for five bighorn sheep were destroyed, however, the impact to the population would be long-term (lasting more than a few years) and carrying capacity would be reduced -- a significant impact.

Possible mitigating measures are discussed in this section; compensation and enhancement management are dealt with in a later chapter. It should be emphasized that the mitigating measures discussed below are not necessarily those which will ultimately be recommended by DNRC; selection of appropriate mitigating measures in many cases requires tradeoffs with other concerns as well as consideration of cost-effectiveness. For example, loss of riparian habitat can be very effectively reduced by lowering forebay elevation from 610 to 606 m (2000 to 1990 feet), but this would affect many other features of the project and such a recommendation is beyond the scope of this report. A final set of mitigating measures, construction guidelines, and stipulations can be arrived at only after DNRC has completed its multidisciplinary review of the project, and after public comment has been received as required by the Major Facility Siting Act.

HABITAT ALTERATION

The habitat of an animal species may be defined as a type of area where the species can generally be found, and which provides for all life requirements of the species. Although carrying capacity is determined by a great many environmental features, such as colonization rates, competitive milieu, etc., habitat quality is often considered the principal determinant of carrying capacity: if habitat is altered in such a way that it no longer meets the life requirements of a population, carrying a capacity is reduced. Species differ considerably in their ability to adapt to different habitats. Some species are very stenotopic, that is, restricted to a narrowly-defined range of environmental conditions. "K-selected" species (MacArthur and Wilson 1967), such as the harlequin duck, pileated woodpecker, and wolverine, are usually very stenotopic and are especially vulnerable to habitat alteration. Such species are often restricted to late-successional habitats. Eurytopic species are those which can tolerate wide extremes in environmental conditions. These are often "R-selected" species, such as most rodents and many songbirds, which have high reproductive rates and the ability to quickly colonize vacant habitats. Eurytopic species are generally characteristic of early successional stages and occupy a wide range of habitats.

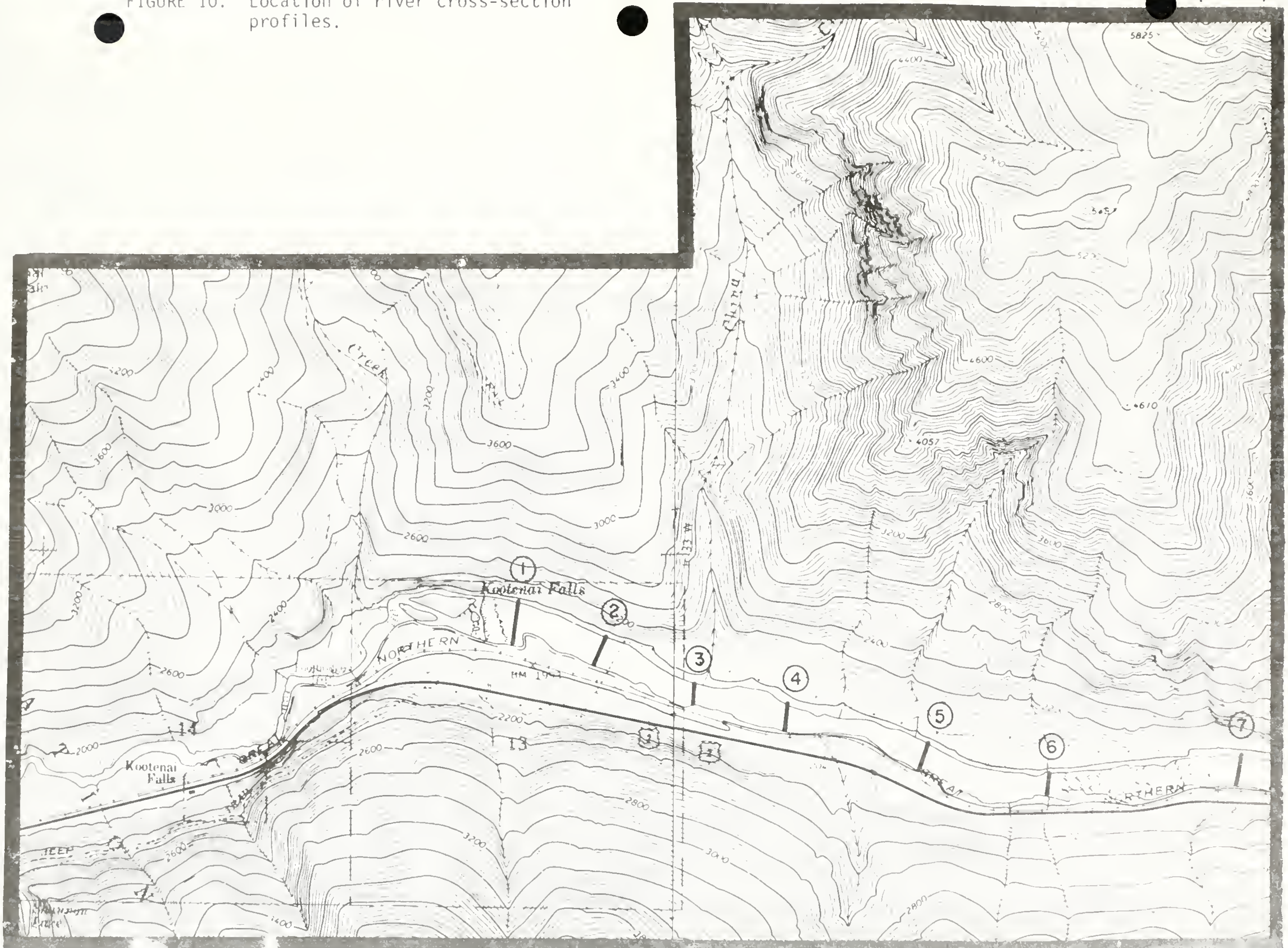
The proposed Kootenai Falls project would affect a variety of species through changes in aquatic and riparian habitats. These habitat changes would result primarily from impoundment of the Kootenai River and relocation of the railroad, and are discussed in detail below.

Changes in Riparian Habitats Due to Impoundment and Railroad Relocation

The construction of Libby Dam has had a profound effect on the downstream riparian environment of the Kootenai River. Prior to impoundment in 1972, the pattern of discharge of the Kootenai River was typical of that of large montane rivers: high flows occurred with spring runoff, and low flows occurred in winter. Libby dam reversed that pattern, and now peak flows generally occur in winter (Figure 11). Furthermore, the frequency of extremely high (flood) runoff has been reduced and the daily variation in flows is extreme. Flows often vary by 424 cms (15,000 cfs) or more from morning until evening each day in winter. This alteration in flow regimes has undoutedly influenced the pattern of succession in riparian plant communities, both by eliminating the "flood disclimax" successional pattern and by allowing relatively high flows to scour a portion of the riverbanks almost any day of the year. The proposed Kootenai Falls project would superimpose further changes on those brought about by Libby Dam, as discussed below.

Littoral Habitats. The term "littoral" is used here as in marine ecology i.e., to refer to the zone between high and low water marks. In order to adequately assess potential effects of the proposed dam on littoral habitats (which are largely limited in the project area to gravel bars and bare rock), it is

FIGURE 10. Location of river cross-section profiles.



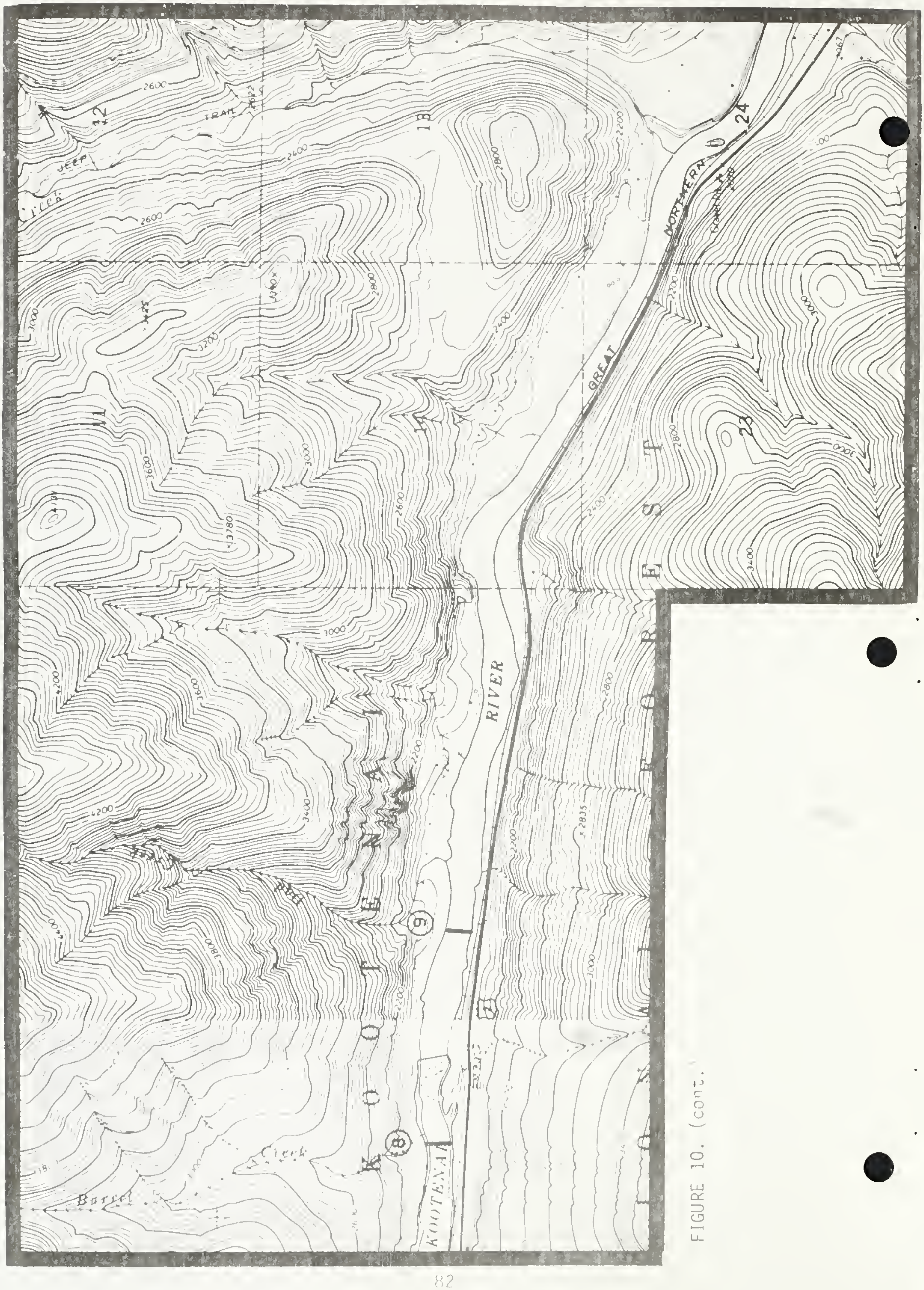


FIGURE 10. (cont.)

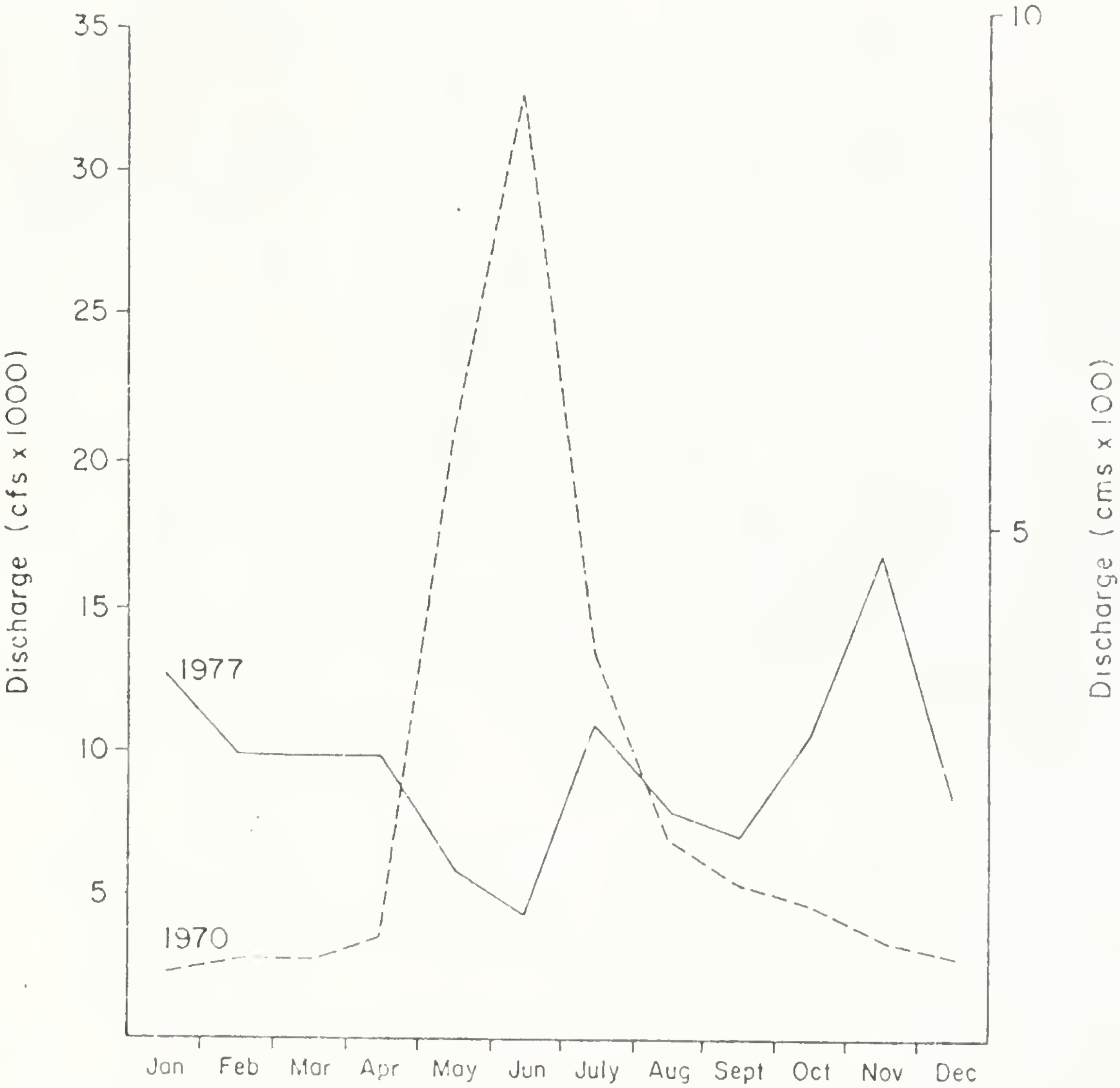


FIGURE 11. Monthly averages of mean daily discharge downstream from the Libby Dam site prior to impoundment (1970) and following impoundment (1977) (SOURCE: Graham 1979a).

necessary to examine certain features of the current discharge regime from Libby Dam.

Figure 12 shows the typical seasonal pattern of discharge of the Kootenai River at Kootenai Falls, as controlled by Libby Dam. It is evident from this figure that, during a "typical" year, lowest flows occur April through June, with relatively little daily variation, while highest flows occur in November through January with considerable daily variation. NLI's proposal would not affect this discharge regime, but would moderate its effects in the pool area. Figure 13 shows the impact of the project on the pattern of seasonal variation in surface elevations of the Kootenai River, and Figure 14 shows the impact on the pattern of seasonal variation in width of the wetted perimeter (and hence of the littoral zone) at three river cross sections. Pool elevations would remain fairly constant at 609.6m (2000 feet), regardless of discharge, for a distance of roughly 2.4 km (1.5 mi) upstream from the dam (NLI 1978; HA-25), in contrast to the present regime of drastic year-long fluctuations in elevation shown in Figure 13. Correspondingly, width of the littoral zone would be drastically reduced should the project be constructed (Figure 14). At the upper end of the pool (cross section 9, Figure 10), pool elevations range from 609.7m (2000.2 ft) at a discharge of 56 cms (2000 cfs) to 614.1m (2014.6 ft) at 1400 cms (50,000 cfs) (NLI 1978:HA-17). Natural river elevations at these same discharges would be 608.1 m (1995.2 ft) and 614 m (2014.3 ft), respectively. While all terrestrial vegetation would be lost due to permanent inundation below the 609.6 m (2000 ft) contour, some flood-tolerant riparian vegetation may be able to persist below the 1400 cms (50,000 cfs) pool level along the upper end of the pool, where it would only be inundated part of the time (during very high flows). Actually, flows can be expected to be below 672 cms (24,000 cfs) 93 percent or more of the time (NLI 1978:H-2). Plant species which can tolerate this much inundation, for example cottonwood and willow (Teskey and Hinckley 1978), can thus be expected to survive along a portion of the pool. If clearing is not carried out in this portion of the littoral zone, as proposed by NLI, both living and dead vegetation which persists will provide useful wildlife cover; construction costs will be reduced as well (Nelson et al. 1978).

These changes in the characteristics of the littoral zone would have important consequences for wildlife. It is likely that all gravel bar, logjam, exposed rock, and bare rock habitats would be eliminated from along the proposed pool; woody vegetation or grasses would probably colonize any bare surfaces that remained along the new, stable shoreline. Scouring by very high discharges would occur very infrequently, as the 100-year flood from Libby Dam is only 1456 cms (52,000 cfs) (NLI 1978:H-2). This would eliminate much feeding habitat for dippers and spotted sandpipers, and would also eliminate gravel bars which are important loafing habitat for waterfowl (Taber and Raedeke 1976), and which would otherwise lead to seral willow communities important to beaver (Martin 1977). Willows presently established in the uppermost littoral zone would probably be replaced by cottonwoods as sediments are deposited (Martin 1977), and no new gravel bars or willow stands would be produced since high discharges would occur so rarely.

Stabilization of pool elevation, and consequent reduction in the littoral zone, could have beneficial effects on a number of wildlife species. Violent fluctuations in shoreline elevation and the resultant wide littoral zone create

FIGURE 12. Typical seasonal pattern of discharge of the Kootenai River at Libby, based on July 1976-June 1979 hourly discharge data (SOURCE: Sewell and Associates 1979).

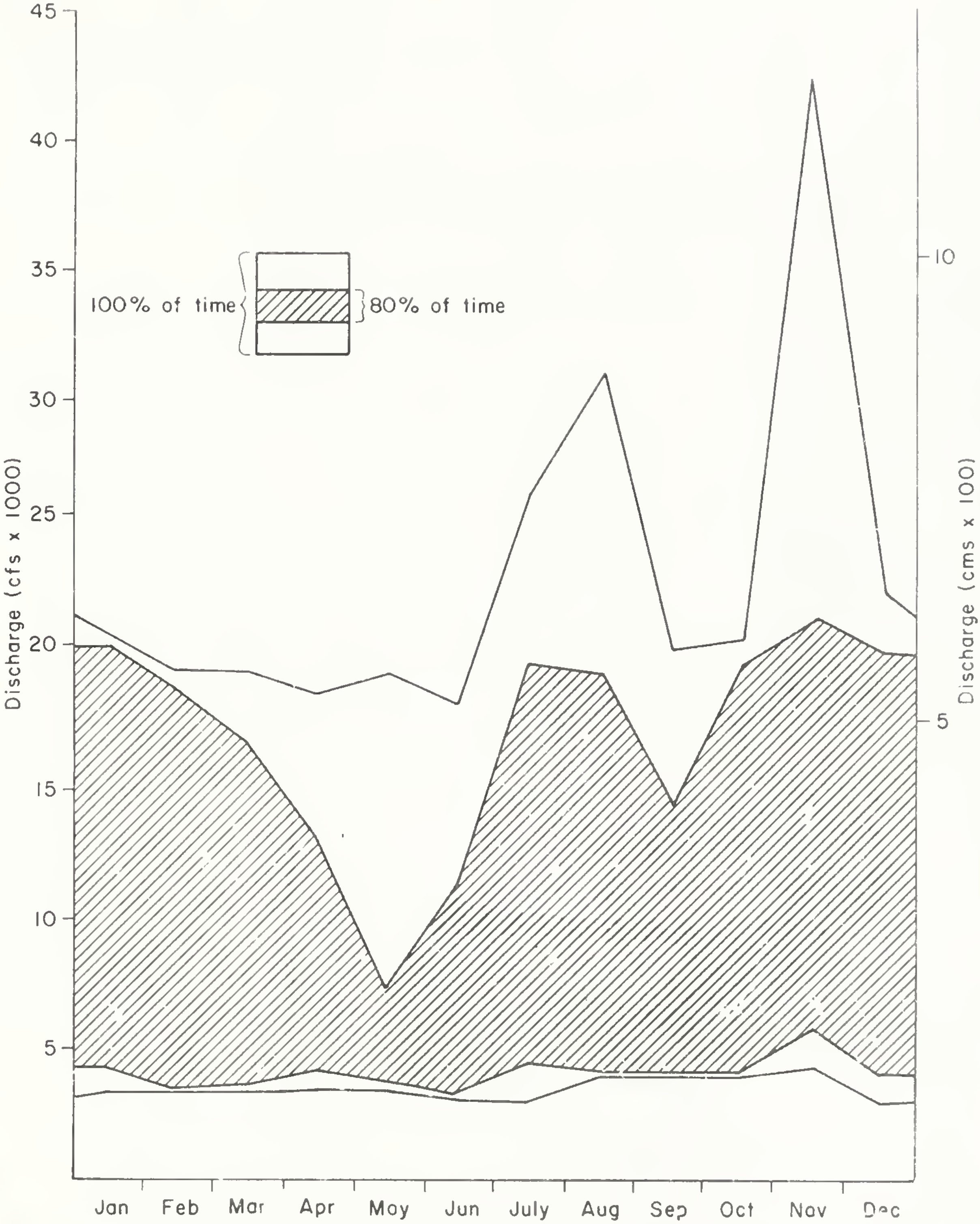


FIGURE 13. Typical seasonal variation in surface elevation of the Kootenai River at three river cross sections, with and without the proposed dam assuming a forebay elevation of 610m (2,000 ft) and the pattern of discharge shown in Figure 12 (SOURCE: Sewell and Associates 1979).

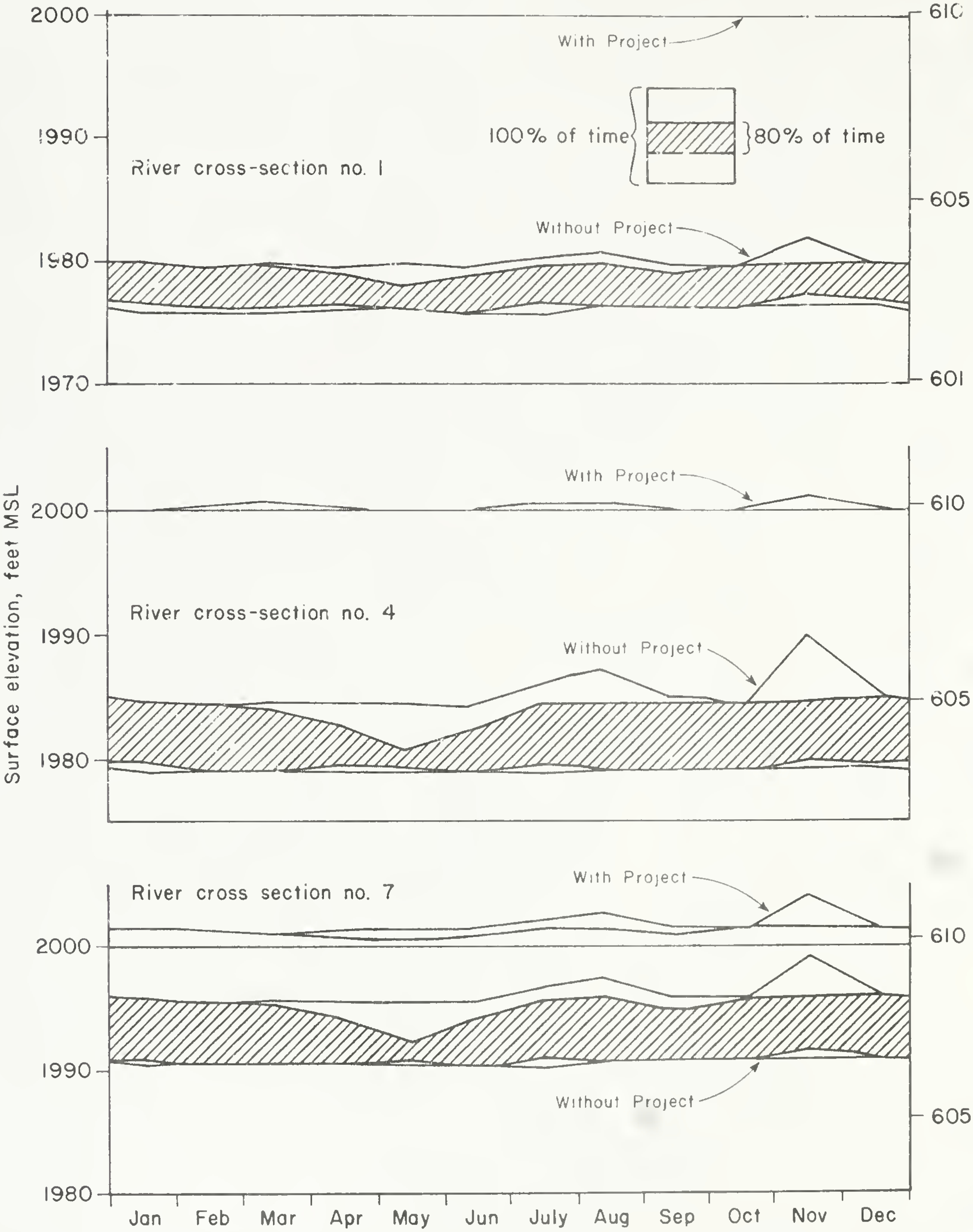
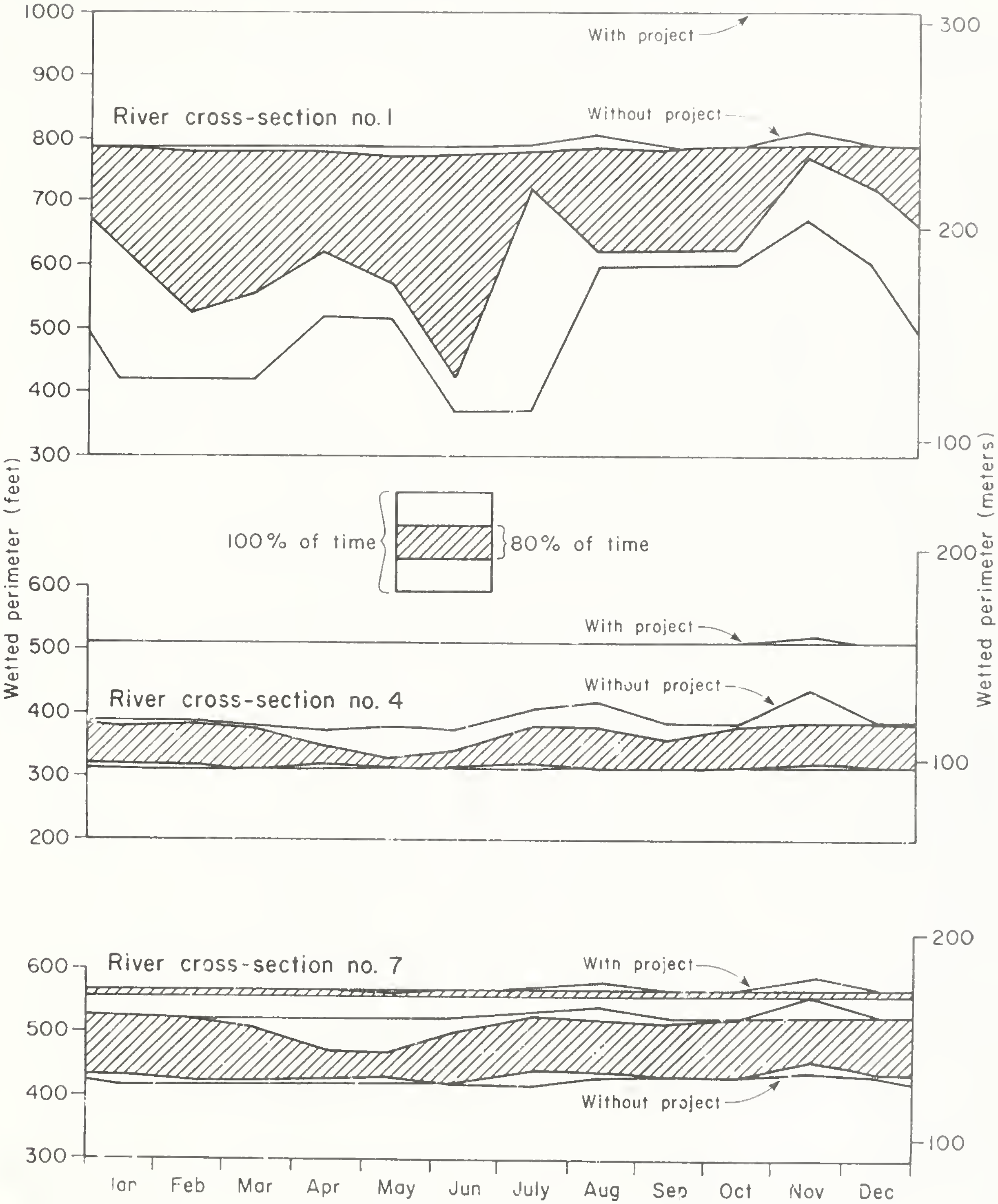


FIGURE 14. Typical seasonal variation in wetted perimeter and width of littoral zone (area between daily high and low water marks) of the Kootenai River at three river cross sections, with and without the proposed dam, assuming a forebay elevation of 610 m (2000 ft) and the pattern of discharge shown in Figure 12 (SOURCE: Sewell and Associates 1979).



an inhospitable environment for benthic macroinvertebrates, since few local organisms are adapted for a "freshwater intertidal" life (Hanson and Eberhardt 1971:8-9, Payne, et al. 1976). Stranding of benthic insects on a wide littoral zone can be lethal during exposure periods of 24-28 hours; Ephemeroptera, a key food source of the dipper (Mithcell 1968), are especially intolerant to short-term exposure (Brusven et al. 1974). A stabilized river shoreline would probably be more productive of aquatic insects than the present fluctuating shoreline, although species composition would change drastically; net effects on availability of suitable food for waterfowl broods are uncertain. Shoreline stabilization could also result in increased production of rooted aquatic vegetation, which is important to diving ducks, once siltation establishes suitable substrate (McKern 1976). Shoreline stabilization and eventual siltation could increase breeding and estivation habitat for riparian amphibians such as the leopard frog (<u>Rana pipiens</u>) and spotted frog (<u>Rana pretiosa</u>), both of which were consipicuously absent from both the Kootenai Falls study area and from the widely fluctuating Columbia River (McKern 1976). Creation of a muddy-bottomed riverbank via sedimentation could create habitat for mud-probing shorebirds, which were also conspicuously rare in the Kootenai and Columbia River study areas (Payne et al., 1976). Stabilization of shoreline elevations could also benefit furbearers by preventing the exposure of dens with young to drowning (due to sudden high discharges) or predation (due to exposure of den entrances at low water), and possibly increasing food supply (Taber and Raedeke 1976; Martin 1977).

<u>Terrestrial (Supralittoral) Habitats</u>. At a river discharge of 1400 cms (50,000 cfs), the project as proposed (forebay at 610 m (2,000 ft) would inundate roughly 24.5 ha (60.6 acres) of riparian habitats which would otherwise be exposed. An additional 4.6 ha (11.4 acres) of land would be disturbed for railroad relocation, bringing the total amount of riparian habitat which would be altered at the project site to roughly 29.1 ha (72 acres) (table 21). An unknown amount of additional habitat would be disturbed off-site to provide housing for construction workers and to produce the fuel and materials necessary for construction of the project. This loss of habitat represents a reduction in carrying capacity for all species presently dependent upon the affected terrestrial habitats (see pages for a list of species for the individual habitats listed in table 21).

Of the 29.1 ha (72 acres) of habitat affected, 9.8 ha (24.3 acres) (34%) are dominated by trees and/or shurbs (including the willow, birch-alder-dogwood, riparian cottonwood, cottonwood-conifer, and conifer-dominated types). Trees and/or shrubs dominate 6.8 ha (16.8 acres) (28%) of the 24.5 ha (60.6 acres) which would be inudated at a forebay elevation of 610 m (2,000 ft), and 3.0 ha (7.5 acres) (66%) of the 4.6 ha (11.4 acres) which would be disturbed by railroad relocation. Most of this latter area would represent a permanent, long-term loss since the new railroad right-of-way would be kept clear of trees and tall shrubs. Loss of riparian trees and shrubs is especially significant, since these riparian habitats are not only highly diverse and productive, but also increasingly rare.

Due to various human developments, riparian vegetation has been reduced in the United States to 70 - 90 percent of its original extent, and remaining riparian habitat continues to be destroyed at approximately 6 percent per year (McCormick 1968). Realizing the value of this diminishing resource, the U.S. Forest Service recently conducted two national symposia dealing with the importance, protection,

TABLE 21. Amounts of habitat which would be inundated by the proposed Kootenai Falls dam at a discharge of 1400 cms (50,000 cfs) or disturbed by railroad relocation.

Habitat	Area Flooded at a Discharge of 1400 cms (50,000 cfs)[2/]			
	Forebay at 605.5 m (1,990 ft)	Forebay at 609.6 m (2,000 ft)	Area Disturbed by Railroad Relocation	Total Area Disturbed with Forebay at 609.6m (2,000 ft)
Aquatic Vegetation (Rooted)	.06(.16)[1/]	.06(.16)	0	.06(.16)
Gravel Bar (incl. exposed rock)	6.37(15.73)	14.6(36.06)	0	14.6(36.06)
Scree and Talus	.06(.16)	.11(.25)	0	.11(.26)
Rocky Outcrops (Upland)	0	0	0	0
Riparian Grasslands and Hayfields	1.17(2.88)	1.17(2.88)	0	1.17(2.88)
Fescue Grassland	0	0	0	0
Cattail Marsh	.01(.02)	.01(.02)	0	.01(.02)
Willow	.50(1.23)	.50(1.23)	0	.50(1.23)
Birch-Alder-Dogwood	.12(.29)	.41(1.02)	0	.41(1.01)
Alder-Dogwood	0	0	0	0
Riparian Cottonwoods	.03(.08)	1.78(4.40)	0	1.78(4.40)
Cottonwood-Conifers	.53(1.31)	2.69(6.64)	.72(1.77)	3.40(8.41)
Ponderosa Pine-Douglas Fir	.31(.77)	.53(1.30)	0	.53(1.30)
Douglas Fir-Shrub	0	0	.34(.85)	.34(.85)
Douglas Fir-Ninebark	0	0	.22(.55)	.22(.55)
Douglas Fir-Western Red Cedar	0	.89(2.19)	1.75(4.32)	2.64(6.51)
Powerline Right-of-way	.01(.02)	.21(.52)	.36(.89)	.57(1.41)
Railroad Right-of-way	.44(1.08)	1.60(3.96)	1.21(2.98)	2.8[illegible](6.94)
Orchard	0	0	0	0
TOTAL	9.51(23.73)	24.54(60.63)	4.60(11.36)	29.14(71.99)

1/ ha (acres).

2/ Land area presently exposed at a flow of 396.2 ± 84.9 cms (14,000 ± 3,000 cfs).

SOURCE: Olson-Elliott and Associates 1979.

and management of riparian ecosystems (Johnson and Jones 1977, Johnson and McCormick 1978), and a similar symposium was recently held in Colorado (Graul and Bissell 1978). While the cottonwood-willow riparian ecosystem is "unquestionably the most productive and highly diversified ecosystem in the west" (Beidleman 1978), it is also our most endangered habitat (Mustard 1978).

Many studies have documented that the high structural diversity and horizontal patchiness of multi-layered riparian forests contributes not only to greater numbers of birds, but also to a greater diversity (both of species and guilds) than most other temperate habitats (Walcheck 1969, 1970, Carothers et al. 1974, Thompson 1978, Meslow 1978, Anderson, et al. 1977). In the present study, both the breeding bird census and riparian habitat transects showed that riparian trees and shrubs support both more individual birds and a greater variety of birds than any other habitat studied.

Riparian forests and shrubbery are highly productive, and those in the study area probably have a net primary productivity on the order of 5-10 tons/acre (Golden et al. 1979). Much of the production is in the form of browse available to white-tailed deer, and loss of this habitat would probably reduce white-tailed deer carrying capacity. Deer security within the riparian habitats which would be flooded along the south bank of the river is presently limited by existing disturbances in the area, notably traffic on the twin railroad tracks, the unimproved road paralleling the tracks, Highway 2, and fishermen and sight-seer traffic. In fact, few deer were seen in this area during the study.

Both the riparian deciduous forests and the coniferous forests provide perch sites and potential nest support structures for osprey and bald eagles. The trees that would be removed do not appear to be preferred or specially selected by these birds. Available data indicate that wintering bald eagles use whatever tall trees are available close to the river's edge (especially within 15.2 m (50 ft)), and that after impoundment the availability of suitable roosting or nesting trees would not be reduced.

The forest types which would be inundated or cleared are a source of snags and dead or decaying trees, which are important as nest sites or feeding sites for a variety of species. Many recent studies have shown the importance of snags and old growth to cavity-nesting birds and mammals (Meslow 1978, Bull 1978, McClelland 1977, Jackman 1974); cavity-nesting species found in or near the study area are listed in table 22. Loss of existing snags, and of a source for future snags, would represent a significant, long-term loss for these species.

A total of 1.2 ha (2.9 acres) of riparian grasslands and hayfields would be inundated assuming a forebay of 610 m (2,000 ft). These habitats are relatively scarce in the area, and support relatively high densities of rodents. Of the 1.2 ha (2.9 acres) affected, almost none occur on the north bank of the river adjacent to bighorn sheep concentration areas (Figure 8). However, the rise in water table brought about by the pool is likely to encourage establishment and growth of hydrophilic shrubs over a much larger grassland area, thus reducing further the amount of forage available to bighorn sheep. Bighorns use these low-elevation grasslands most heavily in spring, preferring such grass species as Festuca scabrella, Festuca idahoensis, Agropyron spicatum, Koeleria cristata, and Stipa comata in the nearby

TABLE 22. Cavity-nesting species known to occur in the Kootenai Falls Area

Common Goldeneye	Black-capped Chickadee
Barrow's Goldeneye	Mountain Chickadee
Common Merganser	Chestnut-backed Chickadee
Merlin	White-breasted Nuthatch 1/
American Kestrel	Red-breasted Nuthatch 1/
Common Flicker 1/	Brown Creeper
Pileated Woodpecker 1/	Winter Wren
Hairy Woodpecker 1/	Red Squirrel
Violet-green Swallow	Northern Flying Squirrel
Tree Swallow	

1/ Primary cavity nesters (excavate own cavity)

SOURCE: Bull 1978, Scott et al., McClelland 1977.

Lake Koocanusa area (Brown 1979).

The cattail marsh and rooted aquatic vegetation stands which would be inundated by the project are the only representatives of these types found in the study area (Olson-Elliott and Associates 1979). Although small in extent, these types are at least seasonally important to dabbling ducks.

All tree, shrub, and grassland-dominated types, as well as the existing railroad and powerline rights-of-way, support considerable small mammal populations. This prey base is used by a number of predators in the area, notably the raven, coyote, red-tailed hawk, American kestrel and possibly one or more species of owl. Except for the raven, these predators do not appear to heavily use these habitats at present, and effects of loss of a portion of the prey base would likely be small.

Mitigating Measures and Their Effectiveness. One of the most effective measures for reducing the amount of riparian habitat lost would be lowering of the forebay elevation. Since the banks of the river are gently sloping, a small change in forebay elevation could lead to a substantial decrease in area inundated (Table 21). For example, lowering the forebay from 610 m (2,000 ft) to 606.5 m (1990 ft) would reduce the amount of habitat flooded from 24.5 ha (60.6 acres) to 9.6 ha (23.7 acres); this would reduce the amount of riparian forests flooded even more dramatically, from 5.9 ha (14.5 acres) to 0.9 ha (2.2 acres). Also, since the railroad would not have to be relocated as high upslope, the amount of new right-of-way clearing and the lateral extent of fill slopes would be reduced as well. Such a lowering of pool level would have important effects on other aspects of the project (especially economics, visual impact, and power generation capability), and optimum pool elevation can only be determined by careful consideration of costs and benefits of the tradeoffs involved. These tradeoffs are beyond the scope of this analysis, and can only be made after DNRC's full evaluation of the facility under the MFSA and analysis of public comment.

Prior to the commencement of any clearing operations, NLI should submit for FERC and state review and approval a clearing plan, specifying the timing and extent of vegetation removal along the shoreline. Specific trees to be removed, and those allowed to remain, should be identified in this plan. NLI plans to allow some of the larger conifers which would be inundated to remain as snags in the pool; this would provide attractive perching and possibly nesting sites for eagle and osprey. The amount of vegetation cleared should be the minimum necessary to allow construction to proceed, and clearing should be postponed as long as possible during construction (Regan 1979, Fielder 1977). Clearing should be done in stages rather than all at once; the earliest construction stages would require the earliest clearing. Riparian trees surrounding the construction area at the head of the Falls should be allowed to remain until just prior to final inundation. As mentioned earlier, flood-tolerant shrubs and/or trees should not be cleared from the littoral zone at the upper end of the pool if the extent of inundation does not exceed their tolerances.

Assuming a forebay elevation of 610 m (2,000 ft), it is possible to partially mitigate some habitat loss by restoration of riparian habitats along the shoreline and relocated railroad right-of-way. NLI (1978) proposes to use a portion of the approximately 650,250 m^3 (850,000 yd^3) of the material excavated during project construction as fill for railroad relocation, access roads, and a construction plant area to be placed on the south bank of the river near the intake structure at the head of the Falls. Once construction is completed, approximately 4.5 ha (11 acres) would be restored and revegetated as wildlife habitat. NLI's proposed habitat restoration plan is as follows:

> Appropriate fill materials will be used to raise the level of the construction plant and spoil disposal areas above the project pool level, and to provide a gradual slope extending from the relocated railroad embankment into the reservoir. The area thus treated and revegetated with appropriate species will provide terrestrial riparian habitat and shallow water habitat along the new shoreline. Creation of small coves along this shoreline will restore waterfowl and shorebird areas. If deemed appropriate, the gradual slope could be extended into the reservoir with underwater placement of rubble and boulders in order to provide suitable substrate for benthic insects.
>
> The area for the proposed habitat restoration will extend along the left embankment from the dam to approximately 1,219 m (4,000 ft) upstream. The average width will be about 19.8 m (65 ft) and the total surface area will be 4.5 ha (11 acres) (Figure W-32). Prior to placement of spoil material in the construction plant and spoil disposal areas, the sandy topsoil will be stripped and stockpiled. After dam construction is completed, sufficient spoil material will be placed to form a gradual slope from near the top of the left embankment to the water surface. The new shoreline essentially will follow the original shoreline contour but at a higher elevation. An effort will be made to create as many small sheltered bay areas as possible. The stockpiled topsoil will then be placed over the spoil, graded, and stabilized against erosion.
>
> Once the topsoil is in place, the area initially will be seeded in native grasses. Deciduous trees and shrubs will be planted in strips, shelterbelt fashion, at the higher elevations. The overall objective is to restore a habitat similar to the riparian grasslands and thickets lost through construction and impoundment. In order to maximize the area's usefulness and attractiveness to local wildlife and to enhance habitat diversity in the conifer-dominated general Project Area, recommendations concerning suitable plant species, planting, and management requirements will be solicited from appropriate state and federal agencies such as MDNRC, USFWS, and USFS. Potentail candidate tree and shrub species are black cottonwood, willows, alders, birches, elderberry, and wild rose. To enhance waterfowl and furbearer habitat, semi-aquatic plants, such as cattails and reeds could be established in the small bays along the new undulating shoreline.
>
> After the initial plants have become established, natural secondary successional processes will result in the introduction of additional species. Sufficient riparian habitat exists both upstream and downsteam to insure the transportation by wind, water, and animals of seeds and other plant propagation material into the area. Depending on the vegetation established and recommended habitat management techniques,

periodic cutting and thinning may be required to maintain the proper balance between trees, shrubs, grasses, and herbs for providing maximum wildlife food and cover.

In addition, several of the larger-sized conifers such as ponderosa pine will not be removed from along the 610 m (2,000 ft) contour level. Inundation will kill these trees and their dead snags could be attractive to osprey and eagles for nesting and perching. (NLI 1978: W4-2,3)

Prior to certification, NLI should submit to FERC and DNRC for review, and to FERC and the Montana Board of Natural Resources and Conservation for approval, a detailed reclamation and restoration plan spelling out the precise goals, location, and methods of habitat restoration. A map (scale = 1:400) should accompany the plan, showing the new shoreline, surface contours, locations of transplanted trees and shrubs, and the type of treatment (fertilization, mulching, etc.) to be employed in different areas. A series of cross-section profiles, showing depth of water table, depth of fill, depth of topsoil, etc. should also accompany the plan. The plan should specify the timetable of restoration, as well as species of plants to be used, sources of seeds, sod, and nursery stock, types of mulch and/or fertilizer to be used, time sequence of topsoil removal and replacement, sources of additional topsoil, and methods and season of planting (Olson-Elliott and Associates 1979). It should also include long-term management and monitoring specifications, possibly including plans for maintaining a disclimax cottonwood-dominated community by control of invading conifers.

Before such a habitat restoration plan is prepared, it is necessary to identify the "target species" for which the area is to be managed; this can only be done after analysis of public comment on the proposal. Creation of shallow ponds and sheltered coves in the reclaimed area which would support rooted aquatic vegetation and cattail marshes would benefit dabbling ducks. The more stable river elevations along the pool (Figure 13) would probably allow cattails and emergent vegetation to eventually become established along the shore-line. Permanent ponds could also be created near the upper end of the pool, where river level fluctuations are relatively great, by construction of sandbagged dikes to retain water during low flows (Figure 15) or to trap water from the many springs and small streams which enter the river in the Falls area. Establishment of dense grass cover would benefit small mammals (especially voles) and, if accomplished in certain areas along the north river shore, possibly bighorn sheep as well. Aquatic furbearers (especially beaver, muskrat, and mink) would benefit from establishment of willows, cottonwood saplings, and cattail marshes along the shoreline. Bird diversity and abundance would likely be increased by creating a three-layered habitat with grasses and forbs, mixed shrubs, and tall deciduous and coniferous trees. Taller trees and snags would benefit cavity-nesting birds and provide perch sites for bald eagles and other large birds. Abundant browse could benefit white-tailed deer.

The best habitat restoration strategy would probably be aimed at creating a complex mosaic of many habitats with high vertical layering and horizontal patchiness, similar to that which exists in the area today. Management of the south bank of the river for big game is not advisable, since the railroad and Highway 2 would create the risk of mortality for animals attracted to the reclaimed habitats, and since heavy big game use could impede reclamation. The restored land should slope gently from the railroad fill slopes into shallow

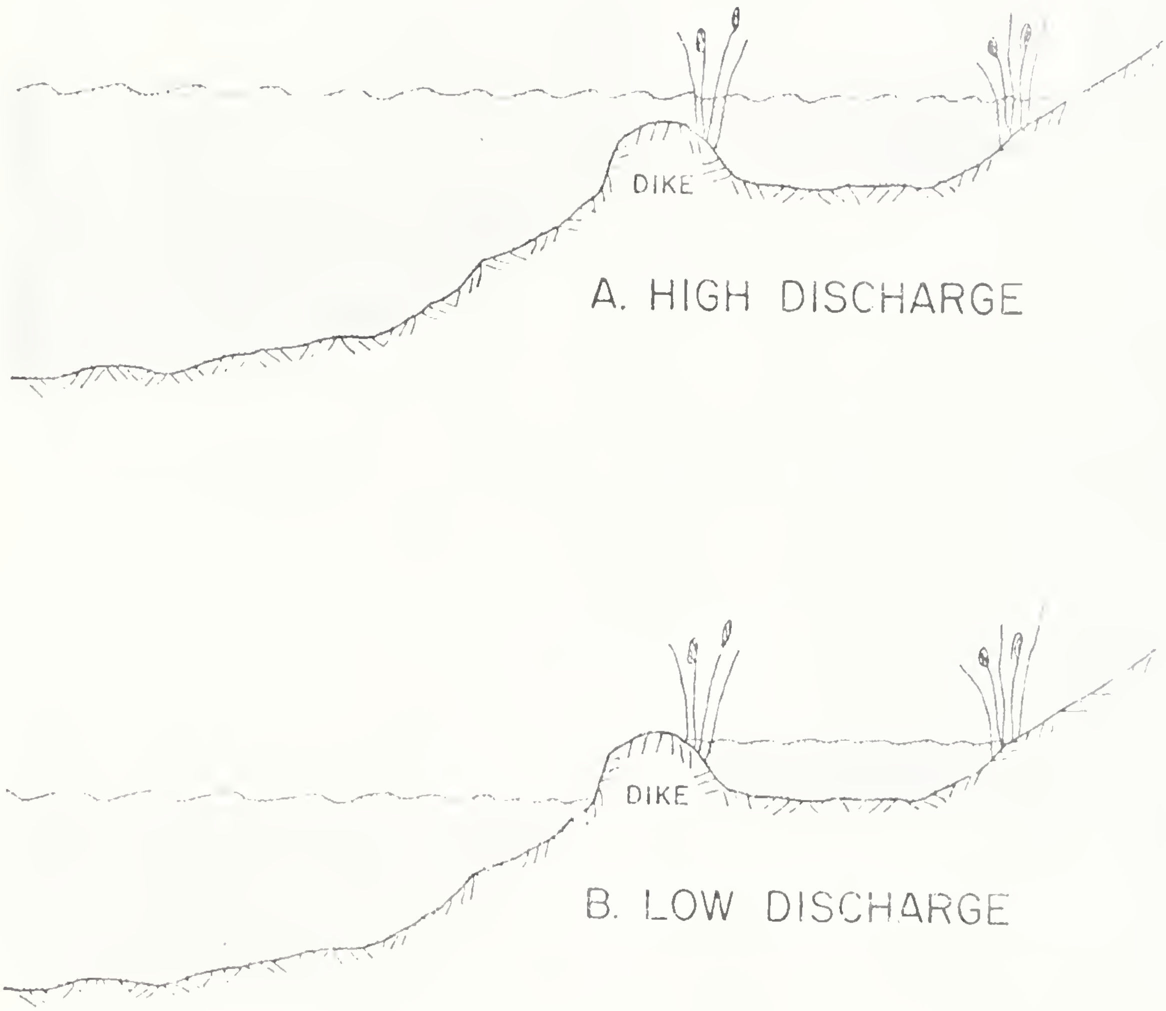


FIGURE 15. Possible method of creating permanent diked shallow wetlands along the pool perimeter.

water, allowing fishermen access to the shoreline and allowing tree and shrub roots to reach the water table. The new shoreline should be wide enough to allow tree and shrub establishment between the railroad grade and the river. Shoreline length should be maximized by the creation of peninsulas and sheltered downstream coves (Stoecker 1978). A few large boulders left protruding above the pool some distance from shore would provide roosting and loafing areas for waterfowl and other bird species. In no case should a steep riprap or fill slope extend from the railroad bed to the river bottom.

It is likely that a well-planned and executed habitat restoration program will eventually be effective in restoring a portion of the riparian habitats lost as a result of the project. However, assuming only 4.5 ha (11 acres) is restored (as proposed by NLI 1978), there will be an unmitigated net loss of at least 2.3 ha (5.8 acres) of riparian tree and shrub habitat. While it would be possible to restore an area greater than the 4.5 ha (11 acres) proposed by NLI, it is unlikely that sufficient fill is available to restore the entire area inundated, or that costs of such extensive restoration would be justified in light of the benefits. Reducing the volume of the pool while maintaining constant forebay elevation would not affect the power generating capability of the project, since the head would remain unchanged, so there is the possibility that somewhat more than 4.5 ha (11 acres) could be restored.

Construction of the project is scheduled to take place over 4.5 yr (NLI 1978), and it is likely that 15 to 20 yr might be required to restore riparian habitats and the railroad right-of-way to a condition similar to that found today. The wildlife losses -- including not only population losses but lost viewing or hunting opportunities -- which would accrue during this period are both significant and irretrievable.

Changes in Upstream Aquatic Habitat

Impoundment of Kootenai River by the proposed dam would create a relatively deep, slow-moving pool extending roughly 4.8-8.0 km (3-5 mi) upstream from the Falls. This could affect a number of aquatic species, especially waterfowl and furbearers (effects on littoral habitats and associated wildlife species have been discussed previously). Furbearers, such as beaver and muskrat, would probably benefit from the project, as pool elevations would be relatively stable and favorable vegetation would probably thrive along the more stable shoreline. Use of the pool area by waterfowl for feeding would probably decrease with impoundment. Harlequins, common goldeneyes, and common mergansers prefer rapidly moving shallow water areas in which to feed, areas which would be inundated by impoundment. The proximity of very swift, turbulent water to such feeding areas is essential to harlequins (Bengtson 1966). Both mallards and Canada geese prefer rocky sheltered areas and streamside areas for loafing and resting; submergence of rocks and gravel bars would eliminate these areas. Mallards were seen consistently on shore in winter on both sides of the river. All of these shores would be lost in the pool area after impoundment. Suitability of the area as brood-rearing habitat might also be affected by the project. Broods of most species of waterfowl using the area survive almost exclusively on macroinvertebrates during the first two weeks of life, and -- depending on shoreline configuration of the restored habitats -- impoundment of the river and altered flow regimes would likely affect availability of this food source. Eventual siltation of rock interstices on the pool bottom would change production of invertebrates used by waterfowl. Migrating, wintering, and other nonbreeding waterfowl would probably continue to use the pool as a loafing area (provided the pool effect does not cause the river to ice over in winter).

Bald eagles and osprey would probably continue to use the pool area for feeding, although it is probable that impoundment will reduce fish density (Graham 1978b). Inundation of China Rapids would reduce the winter carrying capacity of the river for dippers, which use the rapids for feeding in winter.

Mitigation of possible waterfowl production losses could be accomplished by providing suitable brood-rearing habitat along the restored shoreline. Present levels of waterfowl production are relatively low in the pool area, and it is unlikely the project would have a significant effect on production (with the exception of the harlequin duck, as discussed elsewhere).

Changes in Microclimate

It is possible that the presence of the reservoir would alter the microclimate of the Kootenai River canyon. In a study in western Washington, Taber and Raedeke (1976) found that the presence of reservoirs created a "warm bowl" effect, raising the temperature in the vicinity of the reservoir and increasing the rate of snowmelt adjacent to the reservoir. This effect, if it does occur in the project area, is not likely to significantly affect wildlife populations. Impoundment of the river could result in ice formation, but the extent of ice-over is not known.

Downstream Dewatering

NLI's proposal calls for reduction of flows over Kootenai Falls to 21 cms (750 cfs) roughly 98-100 percent of the time (NLI 1978:H-1; Figure 16). Most of this flow would be diverted to trickle over the Falls, essentially dewatering the north channel of the river. Much of the area below the Falls which is now under water at lowest discharges would be exposed, and high discharges would flush the area very infrequently. The almost constant flow of 21 cms (750 cfs) over the Falls and through the canyon would contrast dramatically with the present flow regime, which is much higher and which is characterized by wide daily and seasonal variation (Figure 12).

The most significant impact of this dewatering would be elimination of feeding areas for harlequin ducks. Harlequins presently use the fast water at the head of the Falls as a preferred feeding site, presumably feeding on dipteran larvae. This area is presently characterized by swift, laminar flow, and the change to a meager, turbulent flow would alter the suitability of the area for feeding. The harlequin duck is a "K-selected" species, having highly specialized habitat requirements, a high suseptibility to changes in flow regimes, and a strong dependence on aquatic insects of fast-flowing waters as a food source (Kuchel 1976). A change in flow regime of the Falls and the gorge downstream, coupled with a change in insect production, would be highly detrimental to this population.

Feeding habitat -- and winter carrying capacity -- for dippers would be reduced as well, although dippers would probably continue to use the Falls to some extent. Harlequins, goldeneyes and dippers were seen between the Falls and future outlet area, both feeding and loafing. The canyon offers protection from disturbance and evidently a good food resource. This will be changed by the drastic reduction in water coming over the Falls. Dewatering could also affect the bighorn sheep which can reach the river easily below

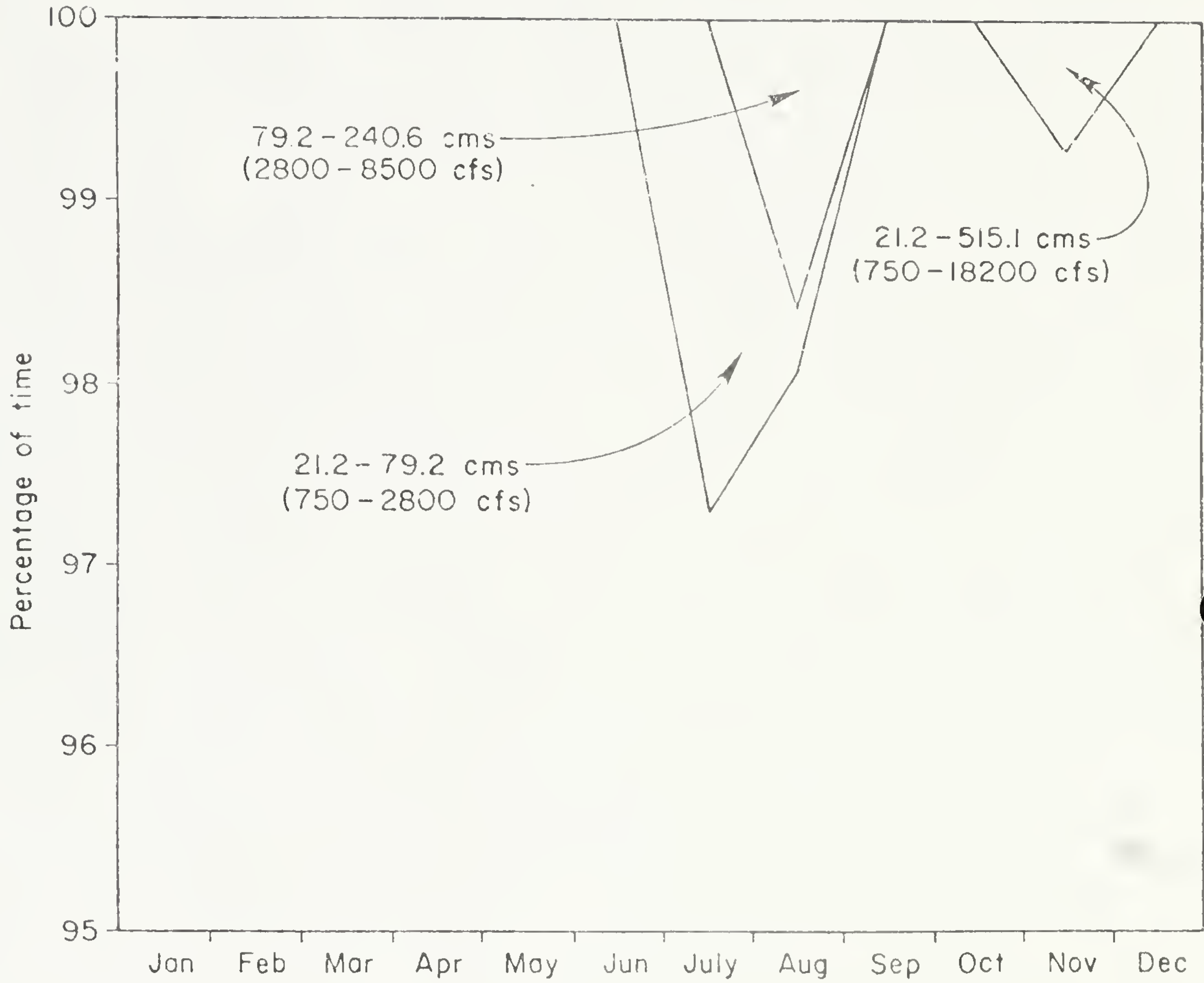


FIGURE 16. Percent of time that different flows would be allowed to pass over the Kootenai Falls Dam. (SOURCE: Sewell and Associates 1979).

the Falls. The area north of the canyon is used by bighorn sheep in spring; access to free-flowing water could be restricted somewhat by dewatering of the gorge.

Considerable daily fluctuations in flow, and occasional great daily summer discharges, presently limit the suitability of the gorge area as nesting habitat for birds which nest on rock ledges or cavities (e.g., harlequin duck, dipper, Canada goose, common goldeneye). Nests which are constructed during periods of low, relatively constant spring or summer flows are destroyed during the occasional high discharges from Libby Dam (Figure 12). The change to a constant flow regime brought about by the proposed Kootenai Falls Dam may thus allow increased nest success for species not otherwise affected by the project, although some high flows may occur over the dam briefly during the breeding season (Figure 16).

Low, constant flows through the channels below the Falls would encourage the growth of algae (probably Spirogyra or Ulothrix (May and Huston 1975), which is presently abundant at the head of the Falls) and possibly vascular plants along the shoreline. These changes would probably not significantly affect wildlife populations, other than possibly increasing suitability as amphibian breeding habitat and increasing production of certain invertebrates.

Effects of low flows on the harlequin duck could be mitigated only by relocating the damsite upstream from the rocky area used as a loafing area and by providing minimum discharges of 112 cms (4,000 cfs) or more over the dam. Since this would probably not be entirely effective and would also greatly affect overall design of the project, its feasibility as a mitigating measure cannot be evaluated at this time. Such an evaluation can only be made after DNRC's full evaluation of the facility under the MFSA and analysis of public comment.

Discharge Impacts at the Outlet Structure

NLI (1978) proposes to divert the entire river flow (except for 21 cms (750 cfs) allowed to pass over the dam) up to discharges of 672 cms (24,000 cfs), and to return these flows to the river gorge roughly one mile below the Falls. It is likely that, at high flows, discharge at the outlet structure would cause backflows of water upstream into the canyon, perhaps forming a pool of relatively still water. This pool would probably be used by waterfowl, especially during migration. If detritus (such as dead fish which were killed by passage through the powerhouse) accumulate at this pool and near the outlet structure, bald eagles and ravens are likely to be attracted to the area, although few suitable perch sites for bald eagles exist in the steep canyon area. Since the amount of fish mortality caused by passage through the powerhouse depends largely on the effort toward mitigation of entrainment impact (Graham 1978b), it is impossible to predict at this time whether or not bald eagles will find a concentrated food source near the outlet.

DISPLACEMENT

Displacement, or population redistribution resulting from disturbances or other environmental change, is a special case of habitat alteration that causes animals to avoid an otherwise suitable area. Extended displacement is equivalent to a reduction in carrying capacity, since the amount of habitat available to the population is reduced.

The project-related features which would most likely cause displacement of animals are: (1) the presence of up to 500 construction workers in the project area; (2) construction activity in the dam area, outlet area, and the work area at the head of the Falls; (3) blasting noise during excavation; (4) noise created by transport and unloading of excavated material; (5) noise created by clearing machinery, earth-moving machinery, concrete plants, and other on-site machinery. Construction would extend over a 4.5 yr period, with most of the excavation and railroad relocation taking place during the first 18 months (NLI 1978). Estimates of noise levels to be created by this project are not available from NLI, but similar types of activities can be expected to produce noise levels of 78 - 88 dB with occasional peaks of 110dB at a distance of 15.2 m (50 ft) (Golden et al. 1979).

The wildlife species of the project area which would be most sensitive to construction noise and human activity are waterfowl, large raptors (especially the bald eagle), and ungulates. Waterfowl would probably avoid the entire pool area during construction and dumping of fill along the south shoreline. Harlequin ducks are particularly sensitive to human disturbance (Kuchel 1976), and would be displaced from the Falls during dam construction. Wintering bald eagles are also very sensitive to human activity (Craighead and Craighead 1979, Meyer 1979), and would probably avoid the stretch of river from the outlet to near the pool head during construction. At present, the Falls area is the portion of the Libby-Troy section of the river most heavily used by bald eagles (Meyer 1979). Bighorn sheep would initially avoid the Falls area during construction, probably moving into less suitable habitat farther upslope, but would probably eventually become habituated to some extent and return at least partway. Bighorns are apparently able to habituate readily to constant or regular disturbances, and presently occupy the area in spite of noise from the Falls, the railroad, and from traffic on Highway 2. The few white-tailed and mule deer present in the project area would be displaced during construction.

With the exception of the harlequin duck, all species displaced by construction disturbances would probably return following completion of the project (to the extent that suitable habitat remains), and are unlikely to suffer long-term population-level effects as a result of displacement. Little opportunity exists for mitigation of noise and construction related displacement, other than seasonal curtailment of construction, as mentioned below.

CHANGES IN MORTALITY AND NATALITY RATES

Minor variations in the natural mortality rate of a population are normally balanced by over-production of young or, in many cases, by an increase in the natality rate, with the result that most animal populations are maintained at or near carrying capacity. Thus, increased mortality rates or decreased natality rates have a serious significant impact on populations only when they exceed the potential of the population to recover. If mortality rates increase or natality rates decrease for long periods of time, a population can become locally extinct. Small mammals and other r-selected species have high reproductive potentials and high natural mortality rates; very high mortality in populations of these species can often be compensated for in a few months or years. Species most likely to exhibit population-level effects of increased mortality are those with a low reproductive potential, those which are already rare or in danger of extinction, and those living in small, isolated habitats. Of the species inhabiting the study area, the bald eagle, osprey, and harlequin duck are most vulnerable to mortality-induced population declines.

The work force would peak at about 500 construction workers for a period of about 20 months during this project (NLI 1978). Of these 500 workers, 200 would be hired locally and 300 would move into the area. Many of the latter would bring their families to the area. The presence of this many people in the project area increases the likelihood of illegal off-hours shooting of wildlife, both on-site and off-site. The magnitude of this man-caused mortality is impossible to predict, but such shooting could nonetheless result in a significant impact, especially in the case of the bald eagle. Local harvest of game animals, both legal and illegal, would probably increase during construction. In recent years, five bighorn sheep ram permits have been issued annually for the Kootenai River herd located near the project area; poaching by construction workers could limit the number of permits which could be issued in future years, thereby limiting hunter opportunities. The impacts of illegal shooting can be mitigated somewhat by strict enforcement of regulations in the project area, by posting notices near construction areas, or by closing the area to hunting of bighorns.

The possibility exists for entrainment of waterfowl and other water birds in the intake structure; should this occur, it is unlikely that populations will be significantly affected by the resultant mortality.

Project construction could decrease natality rates by (1) destroying nests during clearing, thus inhibiting or halting reproductive activities; (2) displacing bighorn sheep during lambing (in late May or early June); or (3) producing physiological stress as described elsewhere in this report. As discussed earlier, the project could increase nest success of birds nesting along the dewatered section. (Such changes in natality are not expected to significantly affect populations of species found in the project area.)

PHYSIOLOGICAL STRESS

The effects of stress are sublethal, difficult to identify, and may not result in immediate observable population changes. Stress on a population may increase as a result of displacement, which can indirectly affect mortality and natality rates. For example, repeated displacement of bighorn sheep from winter-spring range into areas of deep snow or other suboptimal habitat would not kill animals directly, but it could cause abortion of fetuses or predispose animals to mortality through other causes, such as predation, disease, starvation, or hypothermia. Even slight increases in stress and the expenditure of stored energy (such as would result from displacement and harassment) are important during winter, when most animals are already under severe stress.

Creation of dust during construction could create slight increases in stress by coating forage, irritating eyes, or impairing visibility, but rainfall is generally high in this area and dust is expected to have little or no effect on wildlife.

Mitigation of displacement-related stress to bighorn sheep or bald eagles could be accomplished by restricting noise-producing construction activities during late winter and spring.

COMPENSATION OF UNMITIGATED IMPACT

Even with the most successful habitat restoration and other mitigation, a certain amount of adverse wildlife impact would be unavoidable should the project be built (see discussion on adverse impacts which cannot be avoided, p. 107). In the words of Pengelly (1973), mitigation implies an admission that "some loss will occur and that you will try to do as little harm as possible. Unfortunately for wildlife, this is a decision that is being increasingly made with inevitable long-term results -- a one-way attrition." However, unmitigated wildlife losses need not -- and should not -- be written off as an unavoidable cost of development. Loss or degradation of wildlife or habitats, which are public resources, may be considered to be part of the cost of development, and there is no reason the public should be required to bear this cost any more than the public should bear more direct costs such as cost of materials and labor. Compensation of development-related losses of private property is standard practice, and compensation of losses of public resources -- such as wildlife -- is no less valid. The legal framework for compensation of unavoidable impact is provided at the national level by NEPA, which requires federal agencies to consider the following means by which developer would ultimately bear all project-related costs (including losses of public resources):

a) Avoiding the impact altogether by not taking a certain action or parts of an action.

b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

c) Rectifying the impact by repairing, rehabilitating or restoring the affected environment.

d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

e) Compensating for the impact by replacing or providing substitute resources or environments.

It will be noted that (a), (b), and (c) above deal with mitigation of impact as defined earlier, while (d) and (e) deal with compensation of impact. Cost-effectiveness should be an important consideration in determining the optimal strategy for dealing with project-related losses; in some cases, compensation or related strategies may yield greater and more cost-effective benefits than mitigation alone (Thompson 1979). Two possible strategies for compensating unmitigated impact are described below; the conceptual basis for these strategies is presented in Appendix G.

Compensation by Enhancement

Unmitigated short-term losses could be compensated by enhancement management, either on-site or off-site. Compensation by enhancement involves management to produce gains in carrying capacity in one area to make up for impact-related losses in carrying capacity in another area. Thus, unmitigated losses are accepted, and an attempt is made to recoup these losses through intensive enhancement elsewhere. Compensation may be in-kind (e.g., lost harlequin duck habitat is compensated by increased harlequin duck management) or out-of-kind (e.g., lost harlequin duck habitat is compensated by increased bighorn sheep management). The latter approach creates considerable problems, as it necessitates quantification of the relative value or importance of the different species.

Intensive habitat improvement is often the most feasible means of increasing wildlife numbers (Oliver and Barnett 1966, Remington 1971). Compensation of riparian habitat losses by off-site enhancement has recently been applied to several hydroelectric projects in the northwest. The U.S. Army Corps of Engineers was required to partly compensate for inundation of bighorn sheep winter habitat by Libby Dam through purchase of sheep habitat along the Kootenai River near Kootenai Falls. This settlement would result in only partial compensation, however, since 3500 acres were inundated and only 107 were purchased. Loss of whooping crane migration habitat due to construction of the Grayrocks Dam in Wyoming was compensated by establishment of a $7 million Whooping Crane Trust Fund, the annual interest of which (c.$500,000) will be used to manage habitat elsewhere (Bowen 1979). In perhaps the classic compensation settlement to date, riparian habitat lost due to inundation by the Wells Project in Washington is to compensated by a $1.25 million program, which includes not only long-range relief from damage (restoration and off-site enhancement), but immediate interim relief as well (including release of pen-reared game birds to offset decreased availability to hunters). Overall, nearly 2996 ha (7,400 acres) of off-site lands were made available for intensive enhancement management, as compared to losses of about 1903 ha (4,700 acres) due to inundation (Oliver 1974). Utilities often enter into voluntary wildlife compensation agreements, recognizing the considerable public relations value provided by such programs (Burgess and Huber 1979).

Some possible means of compensating unmitigated losses of the Kootenai Falls project via enhancement are discussed below.

Riparian Habitat Enhancement. Riparian habitat along the Kootenai River upstream or downstream from the project area could be intensively managed to partly offset project-related losses. Possible techniques would involve control of conifer invasion, artificial propagation of cottonwoods, enhancement of browse species important to white-tailed deer, management to ensure long-term production of old growth cottonwood and snags (perhaps by girdling of live trees), and management to ensure a high structural diversity of tree and shrub habitats. Another possibility is restoration of cleared riparian forest habitats in the Libby-Troy area. Such management would probably be costly and of limited effectiveness in substantially increasing carrying capacity of target species.

Bighorn Sheep Habitat Enhancement. Bighorn sheep production could be enhanced in the Libby-Troy area by acquisition and management of key habitat (especially winter-spring range). Possible habitat improvements include vegetation manipulation, controlled burning, nitrogen fertilization, and seeding and planting of preferred forage plants (Bailey 1978). However, much grassland habitat along the Kootenai River has already been acquired by MDFWP as part of the Libby Dam compensation effort, and a greater opportunity for enhancement through habitat acquisition might exist outside the Libby-Troy area. Enhancement management of existing MDFWP lands would probably be more cost-effective. (NOTE: Control of shrub invasion of riparian grasslands used by bighorn sheep has been discussed previously as a mitigating measure).

Harlequin Duck Habitat Enhancement. Little opportunity exists for compensation of harlequin duck habitat losses. It is reasonable to assume that all suitable habitat in the vicinity is occupied, and that any habitat changes of such areas would only be detrimental to populations. Investigation of the Yaak Falls as possible compensation habitat is recommended as part of the monitoring program presented below.

Enhancement of Habitat of Other Waterfowl. Nesting habitat of Canada geese and cavity-nesting ducks could possibly be enhanced along the Kootenai River by installation and maintenance of nest boxes, nesting platforms and/or nesting islands. However, as discussed by Nelson et al. (1978), such increases in nest site availability are effective only where nest sites are limiting and where habitat is otherwise suitable to support a larger population. There is some evidence that breeding populations in the Kootenai Falls area are limited by the availability of brood-rearing habitat and food for young ducks (especially aquatic macroinvertebrates) rather than by nest site availability, and new nesting structures would probably provide but minor increases in an already minor production, unless impoundment were to substantially increase availability of food along the shoreline. Use of the area by migrating field-feeding waterfowl could possibly be enhanced by creation of grainfields adjacent to the river but suitable areas are lacking and cost-effectiveness would probably not be great enough to justify such land use change. Creation of shallow permanent pools along the shoreline using sandbags or dikes has been discussed previously.

Installation of Raptor Nest Structures. As was the case with waterfowl, breeding populations of osprey, bald eagle, and red-tailed hawks in the area appear to be limited by factors other than nest-site availability (probably food availability and relative security). An abundance of potential nest sites presently exist in the area, and creation of new sites would probably do little to increase nesting populations or production of young.

Compensation by Protection of Threatened Habitat

Another strategy for compensating unmitigated losses is to prevent future impact, which would otherwise occur, by protecting threatened habitat off-site.

The rate of loss of quality wildlife habitat due to development is increasing nationwide, and the loss of riparian habitat is especially acute, with annual losses approaching 6 percent (McCormick 1968). Nearly all habitat presently available can be considered threatened or endangered over the long-term, as man's exploitation of other resources continues (Mustard 1978). Long-term protection of habitat, then, can provide substantial future benefits, benefits which may actually increase in unit value over time.

Protection of habitat can be afforded via fee simple purchase, which is often prohibitively expensive, or via long-term dedication or easement. The legal framework for the latter is provided at the state level by the Montana Open Space Land and Conservation Act of 1975, which provides for maintenance of lands in perpetuity of their natural condition (MDFWP and USDI no date). Specifically, loss of riparian habitat, harlequin duck habitat or other losses could be partly compensated by the establishment of easements which would assure maintenance of similar habitats in perpetuity elsewhere in the area. For example, easements obtained on riparian habitat between Libby and Troy would contain provisions allowing present uses, but prohibiting future timber clearing, subdivision, inundation, or other activities detrimental to wildlife. Federal easements would be more desirable than state easements, since the former could not be overturned by state action, and since much riprian habitat between Libby and Troy is presently owned by the U.S. Forest Service. Such easements are an especially attractive form of compensation, since the cost (Cp, page 144) may be very low compared to outright purchase, and protection is afforded regardless of future ownership status. The benefits of this form of compensation may not be felt for years or decades, and therefore some environmental costs (i.e., unmitigated impact) would continue to accrue. However, as protected habitat becomes increasingly scarce, the benefits of long-term protection would not only accrue but increase over time, and total benefits over the long-term could eventually be far greater -- even if discounted -- than those to be obtained by mitigation. Also, since initial costs are small and costs do not accrue (as do costs of long-term enhancement), the cost-effectiveness of this strategy would probably be much higher over the long-term than that of either mitigation or enhancement compensation.

Recommendations

Prior to certification, NLI should submit to DNRC and FERC for review, and to FERC and the Board of Natural Resources and Conservation for approval a detailed plan for mitigation and for compensation of unmitigated losses. Such a plan should accompany the reclamation and restoration plan mentioned earlier, and should employ the most cost-effective mix of strategies -- mitigation, enhancement, and long-term protection of off-site habitats. Means should be provided to provide immediate interim relief as well as long-term relief from damage. It appears likely that the best strategy for long-term relief would involve protective easements on habitats similar to those affected by the project; a reasonable plan would probably afford in-kind protection in perpetuity for an area 20-25 times that of each affected habitat. A map (scale = 1:24,000) should accompany the plan, and show the location and dominant vegetation of enhancement lands as well as land ownership and proposed easements. NLI shoudl be required to negotiate purchase of land or acquisition of easements before final certification of the project. The plan should specify methods of cost-benefit analysis and of estimating the requirements for habitat losses; the habitat evaluation procedures of Schamberger and Farmer (1978) or Fielder (1977) merit consideration for the latter. A procedure for long-term monitoring of the success of mitigation, compensation, and enhancement should be outlined, and should be capable of ensuring that all mitigating measures are enforced and of discerning unmitigated losses.

OVERALL SIGNIFICANCE OF IMPACTS TO MONTANA'S WILDLIFE RESOURCE

Overall, the impact to the wildlife resource which would result from the proposed Kootenai Falls project is not exceptional, in comparison with many other energy facilities which have been sited in Montana. NLI is to be commended for a sincere effort toward making the proposal as environmentally compatible as possible, as evidenced by the drastic changes in project design which were made during evolution of the final proposal. However, project-related losses should certainly not be considered unimportant, as they involve a number of significant long-term effects which cannot be avoided. Piecemeal erosion of habitat is proceeding statewide at an ever-increasing rate, and irreversibly affects the future abundance and distribution of animals. Mustard (1978) has termed this attrition "incremental extinction." Losses which appear relatively small at the present time will thus assume a greater importance in the future, when supply is scarcer and demand is higher.

Adverse Effects Which Cannot Be Avoided

As discussed previously, there are certain impacts associated with the project which could not be completely mitigated should the project be carried out; these include loss of riparian and "rapids" habitat and associated wildlife species due to inundation; loss of the harlequin duck feeding and loafing habitat; restriction of flows between the damsite and the discharge tunnel; possible reduction of bald eagle prey availability; displacement and associated stress due to construction noise and human activity; and increased mortality of various species due to legal or illegal shooting. It appears that little opportunity exists for compensation of these losses through enhancement, and long-term protection of off-site habitats -- although an attractive strategy -- would not be entirely effective in preventing net losses over time.

Irreversible and Irretrievable Commitment of Resources

All long-term impacts which would result from construction of the project would be irreversible, assuming the dam would remain in place and in operation indefinitely. The unmitigated net losses which would accrue over time represent an irretrievable loss of viewing and/or hunting opportunities in this scenic area; such losses assume special importance in light of projected growth in the area and the probable future demand for recreational use the area will consequently receive, and of the probable future decline in supply of quality wildlife viewing and hunting opportunities. No extinctions of species or gene pools are expected to result from the facility.

Short-Term v. Long-Term Impacts

Displacement, stress, and increased mortality rates due to construction noise and the presence of construction crews would in most cases be a short-term impact; most species affected would probably re-establish in the area (insofar as habitat alteration allows) following completion of the project. Habitat alteration, however, would be a long-term impact, and would continue to affect populations as long as the project exists.

Summary of Major Impacts

The most significant impacts which are likely to result from the proposed facility are summarized below.

Loss of the Harlequin Duck Population. The destruction of feeding and loafing habitat, as well as two or more years of construction-related disturbance, is expected to eliminate the present harlequin duck population from the area. No effective methods of mitigation or in-kind compensation of this impact have been identified. The harlequin duck is very rare in Montana, and the study area represents the only readily accessible viewing area outside a national park. Observing a harlequin duck in Montana is an uncommon experience, and the importance of the viewing opportunity provided by the Falls is likely to increase with time.

Loss of Riparian Habitat and Associated Wildlife Populations. Even with the most successful restoration and reclamation, a net loss of riparian shore, tree, and shrub habitats would result from the proposed facility. These habitats are unusually diverse and productive, and their continuing attrition has recently become a matter of national concern. Approximately half of the Kootenai River in Montana has been impounded by Libby Dam, and another 20 percent would be impounded by the proposed LARUD project; the little riparian habitat remaining thus assumes key importance.

Bighorn Sheep Losses. The bighorn sheep population located near the project area could be affected by (1) shrub invasion of grasslands on winter-spring range due to raised water table; (2) increased stress due to construction-related displacement; and (3) increased mortality due to illegal shooting by construction workers. These effects taken together could be expected to at least temporarily reduce the harvestable surplus -- and hence the number of permits issued for the herd. Bighorn sheep are one of the most highly prized game animals in Montana, and the number of permits applied for greatly exceeds the number issued. Any losses in hunting or viewing opportunities for this species are thus of relatively great concern.

RECOMMENDATIONS FOR MONITORING

RATIONALE

The inventory reported in this document was designed to provide a description of the wildlife resource of the project area as it exists before construction of the proposed Kootenai Falls project. Another objective of this inventory was to allow a priori predicition of potential impacts which may result from the proposed facility. A long-term monitoring program of the project area is necessary to document the nature and magnitude of actual impacts (including unexpected impacts), as well as to determine the success of habitat restoration, compensation programs, and mitigation in general. Also, long-term monitoring provides an essential continuation and refinement of the original inventory in light of year-to-year changes in wildlife communities and unforseen human developments of activities in the area. The long-term monitoring program presented below was designed to meet these objectives (NOTE: This program will be expanded to include off-site mitigation and compensation lands once they have been identified).

PLAN OF STUDY

General

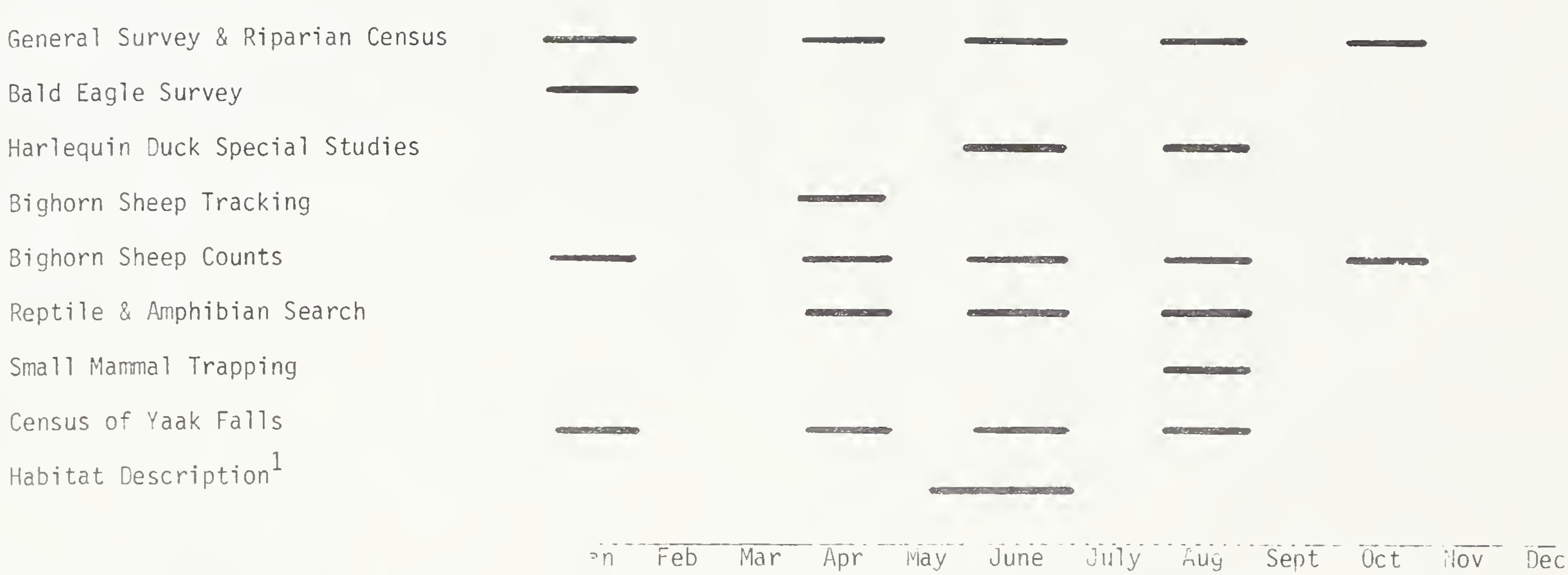
Each year, until the second year following project completion, field work will take place for five consecutive days during each of five months. Specifically, field work will take place within the following time period each year: January 1-15, April 1-10, June 1-15, August 1-10, and October 1-15.

Following the second year after construction, this schedule will be followed every third year, while field work will take place June 1-15 only during other years. All observations of mammals (exclusive of sciurid rodents), upland game birds, waterfowl, and raptors made in the project area and elsewhere between Libby and Troy will be recorded on 1:24,000 field maps and on standard data sheets (see Appendix B and C). All bird nests located will be described on standard nest record cards and locations plotted on a separate set of maps. A journal shall be kept by all field investigators throughout the study, and will include itinerary, species lists, detailed species accounts (including field marks for rare or unusual species, habitat preferences, food habitats, etc.), and other appropriate information. Figure 17 shows the schedule of field work and the timing of special studies as described below.

Riparian Wildlife Census

This census is designed to produce data allowing comparisons of wildlife use of the project area between months and between years. The general methodology is patterned after standard winter bird study (Kolb 1965) and breeding bird census (Hall 1964, Van Velzen 1972) techniques used in the original inventory, but has been extended to include all vertebrate species. The census area includes: the entire Kootenai River and its shorelines from 50 m (164 ft) below the proposed outlet to the upper end of the proposed pool; the land area which would be inundated at a forebay elevation of 610 (2,000 ft); the land area would be affected by the railroad relocation; and a "control" area, including all remaining land between Highway 2 and the Kootenai River. The entire area is to be censused on three consecutive days during each month in the field following the instructions

FIGURE 17. Schedule of Field work for monitoring program.



[1] Two years only

outlined in Appendix F. Results will be analyzed separately for the project area and the control area.

Bald Eagle Survey

The Kootenai River between Libby and Troy will be surveyed from Highway 2 for bald eagles three times in Janaury, following the methods of Meyer (1979). These data will be treated separately from bald eagle information obtained during general surveys and riparian habitat censuses.

Harlequin Duck Special Studies

In addition to surveys made during riparian habitat censuses, special searches of the Falls area for harlequin ducks will be carried out each day in the field in June and August. In June, emphasis will be placed on determination of total population size and the number of pairs present; in August, emphasis will be placed on search of likely brood-rearing habitat for broods.

Bighorn Sheep Counts

One day each month, a special search of the cliffs north of the River between Libby and Troy will be made from strategic viewpoints along Highway 2 using a spotting scope. An estimate of the minimum number of sheep known to be present will be recorded. All oberservations will be recorded on field maps and data sheets.

Bighorn Sheep Tracking

On two different days each April, the north shore of the Kootenai River adjacent to known bighorn sheep range will be walked and searched for tracks or other evidence of bighorn sheep use. These data will be recorded on standard field maps and data sheets.

Amphibian and Reptile Search

At least four hours will be spent each month during April, June, and August in a search of likely habitat for amphibians and reptiles.

Small Mammal Trapping

Two snap-trap lines (each consisting of 25 stations of two traps each) will be run for three consecutive nights in August (beginning in 1980), one in riparian cottonwoods at the head of the Falls and one in adjacent riparian grassland. Capture data will be recorded on standard data sheets (Appendix E).

Census of Yaak Falls

Water and shoreline habitats of Yaak Falls and c. 100 m (328 ft) of river upstream and downstream will be censused for vertebrates in January, April, June, and August (one visit each month) in an effort to determine its suitability as a possible future control study area or as a compensation area.

Species List Updated

The species lists presented in this report as Table 2 and 3 will be updated each year; emphasis will be placed on refining data on habitat preferences, distribution, and breeding status, and upon recording new species (particularly migrants).

Habitat Description

Six vegetation plots 0.04 ha (0.1 acre) in size will be permanently staked and sampled in May or June of 1980 and again the year prior to project construction using the methods of James and Shugart (1970) in each of the following three riparian habitats: riparian cottonwood, cottonwood-conifers, and birch-alder. Foliage height diversity measurements will be made at each plot.

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LITERATURE CITED

Anderson, B.S., and R.D. Ohmart. 1977. Vegetation structure and bird use in the lower Colorado Valley. In Importance, preservation management of riparian habitat: a symposium. pp. 23-34. R.R. Johnson and D.A. Jones (tech. coord.) U.S.D.A. Forest Service General Technical Report RM-43.

Bailey, J.A. 1978. Trickle Mountain bighorn sheep study. Colorado State University, Fort Collins.

Bakus, G.J. 1959. Territoriality, movements and population density of the dipper in Montana. Condor 61:410-425.

Beidleman, R.G. 1978. The cottonwood-willow riparian ecosystem as a vertebrate habitat, with particular reference to birds. In Lowland river and stream habitat in Colorado: a symposium. pp. 192-195. Graul, W.D., and S.J. Bissell (tech. coord.) Colorado Chapter Wildl. Soc. and Colorado Audubon Council.

Bellrose, F.C. 1976. Ducks, geese and swans of North America. Wildlife Management Institute and Illinois National Historical Surveillance. Stackpole Books. 544pp.

Bengtson, S.A. 1966. Field studies on the harlequin duck in Iceland. Wildfowl Trust Ann Rep. 17:79-94.

Bengtson, S.A. 1972. Breeding ecology of the Harlequin duck (Histrionicus histrionicus) in Iceland. Ornis Scand. 3:1-19.

Bengtson, S.A. and S. Ulfstrand. 1971. Food resources and breeding frequency of the harlequin duck (Histrionicus histrionicus) in Iceland. Oikos 22:235-239.

Black, J.H. 1970a. Amphibians of Montana. Number 1 of Animals of Montana Series. Montana Wildlife, January 1970: 1-32.

Black, J.H. 1970b. Turtles of Montana. Number 2 of Animals of Montana Series. Montana Wildlife, November 1970: 26-32.

Bowen, C.M. 1979. Grayrocks -- a new approach to mitigation. In The mitigation symposium: a national workshop on mitigating losses of fish and wildlife habitats. pp. 434-438. G.A. Swanson (tech. coord.) U.S.D.A. Forest Service General Technical Report RM-65.

Brown, G.W. 1974. Distribution and population characteristics of bighorn sheep near Thompson Falls in Northwestern Montana. M.S. Thesis. University of Montana, Missoula. 134pp.

Brown, G.W. 1979. Ural-Tweed bighorn sheep investigation. Montana Department of Fish, Wildlife & Parks, Helena.

Brusven, M.A., C. MacPhee, and R. Biggam. 1974. Effects of water fluctuations on benthic insects. In Anatomy of a river. pp. 67-79. Pacific Northwest River Basins Commission. Vancouver, Washington.

Bull, E.L. 1978. Specialized habitat requirements of birds: snag management, old growth, and riparian habitat. In Proceedings of the workshop on non-game bird habitat management in the coniferous forests of the western United States. pp. 79-82. R.M. DeGraaf (tech. coord.) U.S.D.A. Forest Service General Technical Report PNW-64.

Burgess, R., and E. Huber. 1979. Biological monitoring on rights-of-way. Presented at the Second Symposium on Environmental Concerns in Rights-of-Way Management. Ann Arbor, Michigan, October 16-18, 1979.

Burt, W.H., and R.P. Grossenheider. 1964. A field guide to the mammals. Houghton-Mifflin Co. Boston. 284pp.

Carothers, W.W., R.R. Johnson, and S.W. Aitchison. 1974. Population structure and social organization of southwestern riparian birds. Amer. Zool. 14:97-108.

Caughley, G. 1974. Interpretation of age ratios. J. Wildl. Manage. 38(3): 557-562.

Christensen, A. 1979. Telephone conversation with Pat Nichols, Department of Natural Resources & Conservation, July 1979.

Craighead, J.J., and L. Craighead. 1979. An assessment of the ecological impacts of the Libby additional units and reregulating dam (LAURD) project and Libby Dam on the American bald eagle. U.S. Army Corps of Engineers Contract # DACW67-78-C-0109. Final Report.

Davis, C.V. 1961. A distributional study of the birds of Montana. Ph.D. Thesis Oregon State University, Corvallis.

Davis, C.V. 1963. Montana snakes. Montana Department of Fish & Game. Helena. 10pp.

Elliott, J. 1979. Personal communication. Olson-Elliott and Associates, Helena, Montana.

Dzubin, A. 1969. Assessing breeding populations of ducks by ground counts. In Saskatchewan wetland Seminar. pp. 178-230. Canadian Wild . Service Printing Serial Number 6. Department of Indian Affairs and Northern Division. Ottowa.

Emlen, J.T. 1977. Estimating breeding season bird densities from transect counts. Auk 94:455-468.

Fielder, P.C. 1977. An assessment of Chief Joseph Dam-units to 27 project impacts and their mitigation and compensation by means of the habitat unit evaluation procedure. Washington Department of Game, Applied Research Bull. No. 14.

Fitzgerald, J.P. 1978. Vertebrate associations in plant communities along the South Platte River in northeastern Colorado. In Lowland river and stream habitat in Colorado: a symposium. pp. 73-88. Graul, W.D., and S.J. Bissell (tech. coords.) Colo. Chap. Wildl. Soc. and Colo. Audubon Council.

Flath, D. 1979. Nongame species of special interest or concern. Montana Department of Fish, Wildlife & Parks.

Golden, J., R.R. Quellette, S. Saair, and P.N. Cheremisoff. 1979 Environmental impact data book. Ann Arbor Science Publ., Inc., Ann Arbor, Michigan.

Gollop, J.B., and W.H. Marshall. 1954. A guide for aging broods in the field. Mississippi Flyway County Technical Section.

Graham, P.J. 1979a. Kootenai Falls aquatic environment study. Final Report. Montana Department of Fish, Wildlife & Parks, Helena.

Graham, P.J. 1979b. Kootenai Falls aquatic environment study-impact assessment. Montana Department of Fish, Wildlife & Parks, Helena.

Graul, W.D., and S.J. Bissell (tech. coord.) 1978. Lowland river and stream habitat in Colorado: a symposium. Colo. Chap. Wildl. Soc. and Colo. Audubon Council, 195pp.

Hall, G.A. 1964. Breeding bird censuses -- why and how. Audubon Field Notes. 18:413-416.

Hall, E.R., and K.R. Kelson. 1979. The mammals of North America (2nd Edition). Ronald Press, New York.

Hanson, W.C., and L.L. Eberhardt. 1971. A Columbia River Canada goose population 1950-1970. Wildl. Monogr. No. 28:1-61.

Hoffmann, R.S., and D.L. Pattie. 1968. A guide to Montana mammals. University of Montana, Missoula. 133pp.

Hoffmann, R.S., D.L. Pattie, and J.F. Bell. 1969. The distribution of some mammals in Montana. II. Bats. J. Mamm. 28:737-741.

Hoffman, R.S., P.L. Wright, and F.E. Newby. 1969. The distribution of some mammals in Montana. I. Mammals other than bats. J. Mamm. 50:579-604.

Hynes, H.B.N. 1970. The ecology of running waters. University of Toronto Press, Waterloo, Ontario, Canada. 555pp.

Jackman, S. 1974. Cavity nesting birds - can we ever leave enough snags? Technical Paper 3873, Oregon Ag. Expt. Sta.

James, F.C., and H. Shugart, Jr. 1970. A quantitative method of habitat description. Audubon Field Notes. 24:727-736.

Johnson, R.R., and D.A. Jones. 1977. Importance, preservation and management of riparian habitat: a symposium. U.S.D.A. Forest Service General Technical Report RM-43.

Johnson, R., and J. McCormick. 1978. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. U.S.D.A. Forest Service, General Technical Report WO-12.

Joslin, G. 1978. Kootenai Falls wildlife inventory. Montana Department of Fish, Wildlife, & Parks. Helena.

Kichura, T., and B. Ruediger. 1978. 1978 osprey/eagle nesting inventory. U.S.D.A. Forest Service, Kootenai National Forest.

Kolb, H. 1965. The Audubon winter bird population study. Audubon Field Notes. 19:432-434.

Kuchel, C.R. 1976. Aspects of breeding ecology of the harlequin duck (*Histrionicus histrionicus*) in Glacier National Park. M.S. Thesis, University of Montana, Missoula.

MacArthur, R.H., and E.O. Wilson. 1967. The theory of island biogeography. Princeton Univ. Press. Princeton, N.J.

McClelland, B.R. 1977. A study of forest snags and hole-nesting birds. Ph.D. Thesis, University of Montana, Missoula.

McCormick, J.R. 1968. An initiative for preservation and management of a wetland habitat. A position paper in support of a proposal for a national program for the protection and management of riparian ecosystems. U.S.D.I. Fish and Wildlife Service, Office of Biological Services. 27pp.

McGrady, D. 1979. Personal communication to Pat Nichols, Department of Natural Resources & Conservation. June, 1979.

McKern, J.L. 1976. Inventory of riparian habitats and associated wildlife along Columbia and Snake Rivers. Vol. I: Summary. U.S. Army Corps of Engineers, North Pacific Division.

Martin, P.R. 1977. The effect of altered stream flow on furbearing mammals of the Yellowstone River Basin, Montana. Yellowstone Impact Study Technical Report No. 6. Montana Department of Natural Resources & Conservation, Helena.

May, B., and J.E. Huston, 1975. Status of fish populations in the Kootenai River below Libby Dam following regulation of the river. Montana Department of Fish & Game, Job final report. Contract No. DACW 67-73-C-003.

May, B., and J.E. Huston. 1979. Status of fish populations in the Kootenai River below Libby Dam following regulation of the river. Montana Department of Fish, Wildlife & Parks, Helena. Contract No. DACW 67-73-C-0055.

Meslow, E.C. 1978. The relationship of birds to habitat structure - plant communities and successional stages. In Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the western United States. De Graaf, R.M. (tech. coord.) U.S.D.A. Forest Service Technical Report PNW-64.

Meyer, J.R. 1979. Northwest Montana/North Idaho transmission corridor - bald eagle study. Bonneville Power Administration. Portland, Oregon.

Mitchell, P.A. 1968. The food of the dipper (Cinclus mexicanus Swainson) on two western Montana streams. M.S. Thesis, University of Montana, Missoula.

Montana Department of Fish, Wildlife & Parks and the U.S. Department of the Interior. No date. Conservation easements in Montana. Helena, Montana.

Mustard, E.W. 1978. Lowland river and stream habitat in Colorado -- a pictorial review. In Lowland river and stream habiatat in Colarado: a symposium. W.D. Graul and S.J. Bissell (tech. coords.) Colo. Chap. Wildl. Soc. and Colo. Audubon Council.

Nelson, C.H., and K. C. Parkes. 1976. A definite Colarado breeding record for the harlequin duck. Auk 93:846-847.

Nelson, R.W., and G.C. Horak and J.E. Olson. 1978. Western reservoir and stream habitat improvements handbook. U.S.D.I. Fish and Wildlife Service FWS/OBS--78/56.

Northern Lights, Inc. 1978. Kootenai River hydroelectric project No. 2752. Application for license. Before the Federal Energy Regulatory Commission. Sandpoint, Idaho.

Oliver, W.H. 1974. Wildlife problems associated with reservoirs used for electrical power generation (with special emphasis on Wells Hydroelectric Project Wildlife Study). Washington Department of Game, Bulletin No. 3.

Oliver, W.H. and Barnett, D.C. 1966. Wildlife studies in the Wells hydroelectric project area. FPC license No. 2149. Columbia River, Washington. Wash. Dept. Game, Olympia.

Olson-Elliott and Associates. 1976. Unpublished forest habitat type maps prepared for Bonneville Power Administration Libby Integration Project. Helena, Montana.

Olson-Elliott and Associates. 1979. Kootenai Falls project - vegetation impacts assessment and inventory. Prepared for Montana Department of Natural Resources & Conservation, Helena.

Payne, N.F., G.P. Munger, J.W. Matthews, and R.D. Taber. 1976. Inventory of riparian habitats and associated wildlife along Columbia and Snake Rivers. Vol. IV: Mid-Columbia River. U.S. Army Corps of Engineers, North Pacific Division.

Pengelly, W.L 1973. Letter to Richard Strong, U.S.F.S., Hamilton, Montana, January 5.

Peterson, R.T. 1961. A field guide to Western birds. Houghton Mifflin Co., Boston. The Riverside Press, Cambridge. 366pp.

Pfister, R., B. Kovalchik, and S. Arno. 1977. Forest habitat types of Montana. Intermountain Forest and Range Experimental Station. U.S.D.A. Forest Service, General Technical Report INT-34.

Regan, D.M. 1979. Letter to J.A. Poteat. U.S. Army Corps of Engineers. June 11, 1979.

Remington, J.D. 1971. An analysis of the report - wildlife studies in the hydroelectric project area - with recommendations. J.D. Remington, Wildlife Consultant, Portland, Oregon.

Robbins, C.S. 1970. Recommendations for an international standard for a mapping method in bird census work. Audubon Field Notes 24:723-726.

Schamberger, M., and A. Farmer. 1978. The habitat evaluation procedures, their application in project planning and impact evaluation. U.S. Fish and Wildlife Service, Division of Ecological Services, Project Impact Evaluation, Fort Collins, Colorado.

Sewell, J.A., and Associates. 1979. Letter to Larry S. Thompson, Department of Natural Resources & Conservation, of October 12.

Sharma, R.K., J.D. Buffington, and J.T. McFadden (eds.) 1976. Proceeding of the workshop on the biological significance of environmental impacts. NR-Conf-002 U.S. Regulatory Commission, Washington, D.C. 327pp.

Skaar, P.D. 1975. Montana bird distribution. P.D. Skaar, 501 South Third, Bozeman, Montana. 56pp.

Smith, D.R. 1954. The bighorn sheep in Idaho -- its status, life history and management. Wildlife Bull. No. 1. Federal Aid to Wildlife Restoration Act, Idaho Project 99-R. 154pp.

Smith, J. 1979. Telephone conversation with Pat Nichols, Department of Natural Resources & Conservation, August 1979.

Stelfox, J.G. 1976. Range ecology of Rocky Mountain bighorn sheep in Canadian National Parks. Can. Wildl. Serv. Rep. Ser. 39:1-50.

Stoecker, R.E. 1978. The importance of shoreline length to improving wildlife habitat at gravel ponds. In Lowland river and stream habitat in Colorado: a symposium. pp. 172-176. W.D. Graul and S.J. Bissell (tech. coords.) Colo. Chap. Wildl. Soc. and Colo. Audubon Council.

Sullivan, J.O. 1973. Ecology and behavior of the dipper: adaptations of a passerine to an aquatic environment. Ph.D. Thesis, University of Montana, Missoula. 212pp.

Taber, R.D., and K.Ra edeke. 1976. Biotic survey of Ross Lake Basin report for July 1, 1975 - June 30, 1976. College of Forest Resources. Institute of Forest Products, University of Washington, Seattle.

Thompson, L.S. 1978. Species abundance and habitat relations of an insular montane avifauna. Condor 80:1-14.

Thompson, L.S. 1979. Mitigation as management: strategy and some alternatives. In The mitigation symposium: a national workshop on mitigating losses of fish and wildlife habitats. pp.222-228. G.A. Swanson (tech. coord.) U.S.D.A. Forest Service General Technical Report RM-65.

Teskey, R.O., and T.M. Hinckley. 1978. Impact of water level changes on woody riparian and wetland communities. Vol. VI: Plains grassland region. U.S.D.I. Fish and Wildlife Service, Biological Services Program FWS/OBS-78/89.

APPENDIXES

Appendix A. Schedule of 1977-1979 field work, Kootenai Fall Wildlife Study

Date	Observer[1/]	Type of Field Work	Waterfowl Census Above Falls	Waterfowl Census Below Falls	Riparian Habitat Transects
1977					
Oct. 13	LT	Reconnaissance	-	-	-
Nov. 30	GJ	Reconnaissance	-	-	-
Dec. 20	GJ	Reconnaissance	-	-	-
1978					
Jan. 11	GJ	General Inventory	-	-	-
Jan. 18	GJ	General Inventory	-	-	-
Jan. 20	GJ	General Inventory	-	-	X
Jan. 24	GJ	General Inventory	-	-	X
Jan. 30	GJ	General Inventory	-	-	-
Feb. 9	GJ	General Inventory	-	-	X
Feb. 10	GJ	General Inventory	-	-	-
Feb. 11	GJ	General Inventory	-	-	X
Feb. 13	GJ	General Inventory	-	-	-
Feb. 15	GJ	General Inventory	-	-	X
Feb. 16	GJ	General Inventory	-	-	X
Feb. 24	GJ	General Inventory	-	-	-
Feb. 28	GJ	General Inventory	-	-	X
Mar. 1	GJ	General Inventory	-	-	-
Mar. 2	GJ,LT	General Inventory	-	-	X
Mar. 3	GJ	General Inventory	-	-	-
Mar. 6	GJ	General Inventory	-	-	-
Mar. 7	GJ	General Inventory	-	-	-
Mar. 10	GJ	General Inventory	-	-	-
Mar. 11	GJ	General Inventory	-	-	-
Mar. 12	GJ	General Inventory	-	-	-
Apr. 13	GJ	General Inventory	-	-	-
Apr. 17	GJ	General Inventory	-	-	-
Apr. 24	GJ	General Inventory	-	-	-
Apr. 25	GJ	General Inventory	-	-	-
Apr. 26	GJ	General Inventory	-	-	-
Apr. 27	GJ	General Inventory	-	-	-
Apr. 29	GJ	General Inventory	-	-	X
Apr. 30	GJ	General Inventory	-	-	X
May 1	GJ	General Inventory	-	-	X
May 1	GJ	General Inventory	-	-	X
May 4	GJ	General Inventory	-	-	X
May 6	LT	General Inventory	-	-	-
May 7	GJ,LT	General Inventory	-	-	-
May 8	GJ,LT	General Inventory	-	-	X
May 9	GJ,LT	General Inventory	-	-	X

Appendix A. (Cont)

May 10	GJ	General Inventory	-	-	-
May 11	GJ	General Inventory	-	-	X
May 12	GJ	General Inventory	-	-	-
May 13	GJ	General Inventory	-	-	X
May 15	PG	Incidental Observations	-	-	-
May 18	GJ	General Inventory	-	-	X
May 19	GJ	General Inventory	-	-	-
May 21	GJ	General Inventory	-	-	X
May 22	GJ	General Inventory	-	-	-
May 25	GJ	General Inventory	-	-	-
June 2	GJ	General Inventory	-	-	X
June 5	GJ,LT	General Inventory	-	-	-
June 6	PG,LT	General Inventory	-	-	-
June 7	LT	General Inventory	-	-	-
June 8	GJ,LT	General Inventory	-	-	X
June 9	LT	General Inventory	-	-	-
June 11	GJ	General Inventory	-	-	-
June 12	PG	Incidental Observations	-	-	-
June 13	GJ	General Inventory	-	-	-
June 15	GJ	General Inventory	-	-	-
June 16	GJ	General Inventory	-	-	X
June 18	GJ	General Inventory	-	-	-
June 20	GJ	General Inventory	-	-	X
June 21	GJ	General Inventory	-	-	-
June 29	LT	General Inventory	-	-	-
June 30	LT	General Inventory	-	-	-
July 6	GJ	General Inventory	-	-	-
July 8	GJ	General Inventory	-	-	X
July 9	BM	Incidental Observations	-	-	-
July 11	GJ	General Inventory	-	-	-
July 13	GJ	General Inventory	-	-	-
July 14	GJ	General Inventory	-	-	-
July 15	GJ	General Inventory	-	-	-
July 16	GJ	General Inventory	-	-	-
July 17	GJ	General Inventory	-	-	-
July 31	PG	Incidental Observations	-	-	-
Sept 2	PN	Small Mammal Trapping	-	-	-
Sept 3	PN	Small Mammal Trapping	-	-	-
Sept 4	PN	Small Mammal Trapping	-	-	-
Oct. 11	LT	Reconnaissance	-	-	-
Oct. 16	PG	Incidental Observations of Bald Eagles	-	-	-
Oct. 18	PG	Incidental Observations of Bald Eagles	-	-	-
Oct. 20	PG	Incidental Observations of Bald Eagles	-	-	-

Oct. 23	PG	Insidental Observations of Bald Eagles	-	-	-
Nov. 2	LT	Reconnaissance	-	-	-
Nov. 21	PG	Incidental Observations of Bald Eagles	-	-	-
1979					
Jan. 20	PN	Waterfowl and Riparian Surveys	X	-	X 2/
Feb. 10	PN	Waterfowl and Riparian Surveys	X	-	X
Feb. 11	PN	Waterfowl and Riparian Surveys	X	-	X
Feb. 12	PN	Waterfowl and Riparian Surveys	X	-	X
April 18	PN	Waterfowl and Riparian Surveys	X	X	X
April 19	PN	Waterfowl and Riparian Surveys	X	X	X
April 20	PN	Waterfowl and Riparian Surveys	X	X	X
April 21	PN	Waterfowl and Riparian Surveys	X	X	X
June 13	PN	Waterfowl and Riparian Surveys	X	X	X
June 14	PN	Waterfowl and Riparian Surveys	X	X	X 2/
June 27	PN	Waterfowl and Riparian Surveys	X	X	X
June 28	PN	Waterfowl and Riparian Surveys	X	X	X
June 29	PN	Waterfowl and Riparian Surveys	X	X	X
June 30	PN	Waterfowl and Riparian Surveys	X	X	X
July 31	LT	Reconnaissance	-	-	-
Aug 1	LT	Reconnaissance	-	X	-

1/ GJ=Gayle Joslin, PG=Pat Graham, PN=Pat Nichols, BM-Bill Martin, LT=Larry Thompson.

2/ Bad weather may have affected results on these dates.

APPENDIX B

KOOTENAI FALLS WILDLIFE STUDY WILDLIFE OBSERVATION DATA SHEET: INSTRUCTIONS FOR USE

1. Level. Leave Blank

2. Date.* List only for first observation, or for observations listed at top of data sheet.

3. Observers.* Indicate two initials of two principal observers; e.g., RP = Richard Prodgers alone; RPLR = Richard Prodgers, Lamar Rose, and Joe Elliott.

4. Vehicle.*

   SC - Stationary car

   MC - Moving car

   FT - Foot

   AP - Airplane

   BT - Boat

   SK - Skiis

5. Cloud Cover.** Estimate percent cloud cover.

6. Precipitation.** Indicate type (R - rain, H - hail or sleet, S - snow, N - none) and rate (N - none, L - light, M - moderate, H - heavy).

7. Temperature.** Use Fahrenheit scale; indicate whether estimated (e.g., E 50) or measured (M50). For below zero temperatures, indicate with B or X (e.g., 10B = ten below, estimated; 10X = ten below, measured).

8. Wind Speed.** Use Beaufort Numbers:

Number	Wind Speed MPH	Indicators
0	Less than 1	Smoke rises vertically
1	1 to 3	Wind direction felt by smoke drift
2	3 to 7	Wind felt on face; leaves rustle
3	8 to 12	Leaves, small twigs in constant motion
4	13 to 18	Raises dust and loose paper
5	19 to 24	Small trees in leaf sway; crested wavelets
6	25 to 31	Large branches in motion
7	32 to 38	Whole trees in motion, inconvenience in walking against wind
8	39 to 46	Breaks twigs off trees, impedes progress
9	above 47	Structural damage

9. Observation Number. Begin with one for each day.

10. Time. Military (e.g., 0535, 1721)

11. Species. Use common names as listed in Skaar (1975) and Burt & Grossenheider (1964). If common name consists of one word, list first four letters (e.g., Beaver - BEAV). If two words, list first two letters of each word (e.g., Bighorn Sheep = BISH). If three or more words, list

first letter of first two words, first two letters of last word (e.g., White-tailed Deer = WTDE). For unusual species or ambiguous names, it is best to list full name under "Remarks".

12. Number of Animals. Make sure the sum of adult males, adult females, young, and unclassified equals the total. Each distinct group of animals should be given a separate observation number.

13. Activity. List first two letters of word; for example:

BE = Bedded	SO = Soaring
ST = Standing	DR = Drinking
FE = Feeding	CO = Courtship
WA = Walking	MA = Mating
RU = Running	SB = Standing and bedded (in same group)
FL = Flying	BF = Bedded and feeding (in same group)
SW = Swimming	RK = Roadkill
PE = Perched	SC = Scat
NE = Nesting	TR = Tracks

14. Slope. Estimate degrees from horizontal.

15. Aspect. N. NE. E. SE. S, SW, W, NW

16. Percent of Snow. Estimate overall snow cover for area.

17. Vegetation. Indicate two-letter wildlife habitat category code (See Table 1 of Final Report) in appropriate column. Dominant plant species (e.g., *Pseudotsuga menziesii* and *Symphoricarpos alba* = PSMESYAL) may also be listed under "dominants."

If additional dominants need be listed, list under "Remarks."

18. Topography. Classify according to terrain type categories described on Page ____ of the Final Report.

19. Elevation. Record first two digits of elevation in feet (e.g., 2317 = 23).

20. Remarks. Indicate such observations as associated species, food items, catalogue numbers of specimens taken, etc.

*List only for observation number one for each day, for observations list at top of data sheet, or when changing observers, vehicles, or level.

** May be listed only at beginning and end of trip.

SHEET NO ____________

KOOTENAI FALLS WILDLIFE STUDY
Wildlife Observation Data Form

ENERGY PLANNING DIVISION
Montana Department of Natural Resources and Conservation

DATE____________19____

	DATE						PPT							NUMBER OF ANIMALS									VEGETATION				
LEVEL	YEAR	MONTH	DAY	OBSERVERS	VEHICLE	CLOUD COVER	TYPE	RATE	TEMPERATURE	WIND SPEED	OBS NO	TIME	SPECIES	TOTAL	ADULT MALES	ADULT FEMALES	YOUNG	UNCLAS ADULTS	ACTIVITY	SLOPE °	ASPECT	% SNOW	DOMINANTS	CODE	TOPOGRAPHY	ELEVATION (ft)	REMARKS

APPENDIX C

KOOTENAI FALLS WILDLIFE STUDY WATERFOWL OBSERVATION DATA SHEET: INSTRUCTIONS FOR USE

OBJECTIVES OF STUDY:

(1) For All Species. To determine dates of earliest arrival, peak of movement, and end of movement for spring and fall migrations.

(2) For Breeding Species. To determine the importance of waters in the study area as nesting habitat; size of breeding populations in the study area; nesting habitat requirements; dates of nesting; clutch and brood sizes; productivity.

(3) For Migrants. To determine the importance of waters in the study area as resting or feeding habitat.

CATEGORIES OF DATA:

(1) Level. Leave Blank.

(2) Date. List only for the first observation of the day, or at the top of a new data sheet.

(3) Observers. Abbreviate as on Wildlife Observation Data Sheet.

(4) Time. Military (e.g., 0535, 1721)

(5) Area Code. Locations of waterfowl observations will be coded in the "Area Code" column. This will eliminate the need for plotting waterfowl observations on base maps. Use letter codes as shown in Figure ____ of the Final Report; use column 54 only (the right-hand column).

(6) Species. Use four-letter abbreviations of common names as listed by Skaar (1975). If common names consists of one word, list first four letters (e.g., Pintail = PINT). If two words, list first two letters of each word (e.g., Canada Goose = CAGO). If three or more words, list first letter of first two words and first two letters of last word (e.g., Ring-necked Duck = RNDU; Blue-winged Teal = BWTE, Great Blue Heron = GBHE), etc.) Identify birds to species if possible; if this cannot be done, indicate UNDU (=Unident. Ducks); UNGE (="Unident. Geese"); UNKN (="Unknown"); etc. Where several species occupy a given water area, it may be necessary to use several rows to record the data, or even several rows for one species.

(7) Census. An X in this column indicates that all water birds occupying the water area in question were recorded; this includes waterfowl, shorebird, kingfishers, herons, etc.

(8) Activity: List first two letters of word; for example:

FL - Flying	CO = Courtship
SW = Swimming	MA = Mating
FE = Feeding	NE = Nesting
ST = Standing	PE = Perched

(9) Number of Birds. Indicate number of individuals of each sex and age class observed. If sex and age cannot be determined, leave these columns blank.

(10) Number of Pairs. Of the birds listed under "number of birds", how many obvious pairs were seen?

(11) Brood Size. Up to two broods per species can be listed under "A" and "B", if more than two broods per species are seen in the same water area, another row must be used.

(12) Notes. An X under "Search?" indicates an active search for nests was made. Indicate the number of nests located whether or not a search was made. For each nest recorded, additional data (location, construction, number of eggs, vegetation, exposure, evidence of predation, etc.) should be recorded in the field journal.

GENERAL. Several days' data may be recorded on the same page, but one page should not have data from different months.

SHEET NO. ______

KOOTENAI FALLS WILDLIFE STUDY
Waterfowl Observation Data Form

ENERGY PLANNING DIVISION
Montana Department of Natural Resources and Conservation

DATE __________ 19____

FILE	DATE: YEAR	DATE: MONTH	DATE: DAY	OBSERVERS	TIME	LOCATION AND DESCRIPTION OF WATER AREA	AREA CODE	SPECIES	CENSUS	ACTIVITY	NUMBER OF BIRDS: ADULT MALE	NUMBER OF BIRDS: ADULT FEMALE	NUMBER OF BIRDS: UNCL ADULT	NUMBER OF BIRDS: YNG	NUMBER OF PAIRS	BROOD SIZE: A	BROOD SIZE: B	NEST

APPENDIX D

CENSUS OF RIVER FALLS AND ADJACENT WESTERN RED CEDAR-DOUGLAS FIR FOREST

Location: Montana; Lincoln County; located between the Kootenai River and U. S. Highway #2, about 19 km (12 miles) WNW of Libby; 48^{o} 27' N, 115^{o} 47' W, Kootenai Falls Quadrangle, U.S.G.S. Continuity: New. Size: 44.5 ha = 110 acres (oblong, paced). Description of Plot: Approximately 40% of the plot is water, including a 1500 m (= 4921 ft) stretch of the Kootenai River. Kootenai Falls, the major falls of the Kootenai River, is located in this stretch, and river elevation drops 17 m (= 55 ft) between the eastern and western edges of the plot. Flows of the Kootenai River are controlled by the pattern of discharge from Libby Dam (located approximately 40 km = 25 miles upstream), and varied from 113 m^3/sec (= 4,000 ft^3/sec) to 566 m^3/sec (= 20,000 ft^3/sec) during the study. Width of the river within the plot was approximately 250 m (820 ft) at its widest point and 45 m (= 111 ft) at its narrowest, where it flows through a steep, rocky canyon. A number of islands, the largest of which is less than 2 ha (= 5 acres) in size, are found in the 400 m (= 1,312 ft) stretch of the river immediately below the falls; these islands, as well as all water areas to the north of them, were excluded from the plot. A footbridge spans the river at its narrowest point, approximately 500 m (= 1,640 ft) from the western boundary of the plot. The land area included in this plot is that between the southern bank of the Kootenai River and U.S. Highway #2 to the south. This strip of land is 300 m (= 984 ft) wide at its widest point and 70 m wide (= 230 ft) at its narrowest point. A two-track Burlington Northern railroad roughly bisects this land area lengthwise; these tracks were used by approximately one train/hour during census runs. A telephone line and a 34.5 kilovolt powerline parallel this railroad, resulting in a cleared corridor roughly 40 m (=131 ft) in width. Most of the remainder of the plot is forested. A Lion's Club picnic area with a spring, wooden tables, garbage receptacles, and outhouses is located along Highway 2 near the center of the plot, and a 150 m (= 492 ft) loop road enters into the plot from Highway 2 300 m (= 984 ft) from the eastern edge of the plot. Both areas were heavily used by picnickers, fishermen, and sightseers throughout the summer. An abandoned forest road connects U.S. #2 and the railroad right-of-way near the eastern edge of the plot. At the western edge of the plot, the highway, railroad, and telephone lines come together at the base of a steep, rocky cliff, and pass over a nearly vertical concrete embankment which extends to the riverbank. Rocky outcrops are common within the plot north of the railroad right-of-way. A number of very small streams bisect the plot. Elevations range from 588 m (= 1,930 ft) to 640 m (= 2,100 ft). A fairly steep bank rises between the railroad right-of-way and the relatively flat bench to the south in the eastern 2/3 of the plot. Forests to the north of this bank are fairly open and shrubby, with few large trees; forests to the south are much more dense, with many tall trees and little understory vegetation. The study area falls primarily within the western red cedar/queencup beadlily (*Thuja plicata/Clintonia uniflora*) habitat type (Pfister et al. 1977, Forest Habitat Types of Montana, U.S.D.A. Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah), although a gradation to the Douglas fir/ninebark (*Pseudotsuga menziesii/Physocarpus malvaceus*) habitat type is indicated along drier, exposed ridges near the water's edge. The dominant canopy trees are Douglas fir, western larch (*Larix occidentalis*), and western red cedar, and the most prominent shrubs are Canadian buffaloberry (*Shepherdia canadensis*), chokecherry (*Prunus virginiana*), common snowberry (*Symphoricarpos albus*), creambush oceanspray (*Holodiscus discolor*), elderberry (*Sambucus* spp.), mountain alder (*Alnus incana*), ninebark, quaking aspen (*Populus tremuloides*), red-osier dogwood (*Cornus stolonifera*), redstem ceanothus (*Ceanothus sanguineus*), Rocky Mountain maple (*Acer glabrum*), syringia (*Philadelphus lewisii*), thimbleberry (*Rubus parviflorus*), western serviceberry (*Amelanchier alnifolia*), and willow (*Salix* spp.). Much of the more densely forested portion of the plot south of the railroad tracks has little or no ground cover, and the soil in these areas is covered with a mat of needles and with scattered logs and branches. A quantitative survey of the vegetation gave the following results: trees, 3 in. (= 7.6 cm) diameter and over, based on five 0.1 acre (=0.04 ha) circular samples, 2421/ha (= 980/acre); total basal area 37 m^2/ha (= 160.1 ft^2/acre). Species of trees (figures after each give number of trees/ha, number of trees/acre, relative density (%), relative dominance, and frequency, in that sequence): Douglas fir 760, 338, 34, 48, 100; western larch 716, 318, 32, 27, 100; western red cedar 414, 184, 19, 13, 80; lodgepole pine (*Pinus contorta*) 86, 38, 4, 5, 40; water birch (*Betula occidentalis*) 158, 70, 7, 3, 80; Rocky Mountain maple (*Acer glabrum*) 9, 4, tr (= trace, or less than 0.5%), tr, 20; ponderosa pine (*Pinus ponderosa*) 5, 2, tr, tr, 20; Rocky Mountain juniper (*Juniperus scopulorum*) 5, 2, tr, tr, 20. A few small Engelmann spruce (*Picea engelmannii*), western hemlock (*Tsuga heterophylla*) and grand fir (*Abies grandis*) were also found in the plot. Trees by diameter size class (figures after each class given number of trees/ha, number of trees/acre, relative density (%), basal area in m^2/ha, basal area in ft^2/acre, relative dominance): A(8-15 cm = 3-6 in) 1278, 568, 58, 13.0, 56.8, 18; B(15-23 cm = 6-9 in) 540, 240, 24, 16.5, 72.0, 22; C(23-78 cm = 9-15 in) 315, 140, 14, 65.7, 112.0, 35; D(38-53 cm = 15-27 in) 41, 18, 2, 7.4, 32.4, 10; E(53-69 cm = 21-27 in) 27, 12, 1, 8.5, 37.2, 12; F(69-84 cm = 27-33 in) 5, 2, tr, 2.3, 9.8, 3. Shrub stems/ha, 5265; shrub stems/acre, 2340; ground cover 26%; canopy cover 66%; average canopy height 22 m = 72 feet (range 18-30 m = 60-100 feet). Plant names follow Hitchcock and Cronquist's (1973) Flora of the Pacific Northwest. Edge: bordered on the north by the steep north bank of the Kootenai River and the slopes of the Purcell Mountains, characterized near the plot by Douglas fir/ninebark forests and relatively dry rocky outcrops; bordered to the south by U.S. Highway 2 south of which rise the lower slopes of the Cabinet Mountains, characterized near the plot by the relatively moist western red cedar/queencup beadlily and western hemlock/queencup beadlily habitat types. A steep, rocky cliff rises above the highway just south of the western third of the plot. Weather: the spring of 1978 was relatively moist and followed a severe winter; plant phenology was thus several days behind the normal. Rain was occasionally experienced during census runs, but weather for the most part was clear to cloudy and dry. Coverage: May 7, 8, 9, 22, 25; June 5, 6, 7, 8, 9, 29, 30. All trips between 0515 and 2130 hours. Total person-hours: 34.6. Census: violet-green swallow, 12(27, 11); yellow-rumped warbler, 7 (16, 6); golden-crowned kinglet, 6(13, 5); Swainson's thrush, 5.5 (12, 5); Townsend's warbler, 5.5 (12, 5); American robin, 4.5 (10, 4); yellow warbler, 4.5 (10, 4); dark-eyed junco, 4.5 (10, 4); rough-winged swallow, 4 (9, 4); dipper, 4 (9, 4); red-eyed vireo, 4 (9, 4); black-capped chickadee, 3.5 (8, 3); song sparrow, 3.5 (8, 3); mallard, 2; warbling vireo, 2; Nashville warbler, 2; MacGillivray's warbler, 2; American redstart, 2; brown-headed cowbird, 2; pine siskin, 2; spotted sandpiper, 1.5; harlequin duck, 1; American kestrel, 1; common flicker, 1; Empidonax flycatcher (Hammond's or Dusky), 1; tree swallow, 1; common crow, 1; western tanager, 1; common goldeneye, +; common merganser, +; osprey, +; common raven, +; varied thrush, +. Total: 33 species, 91 territorial males or females (205/km^2, 83 per 100 acres). Visitors: Canada goose, American wigeon, Barrow's goldeneye, mourning dove, rufous hummingbird, calliope hummingbird, belted kingfisher, hairy woodpecker, willow flycatcher, Townsend's solitaire, cedar waxwing, orange-crowned warbler, lazuli bunting, Lincoln's sparrow. Remarks: Five nests were located: common flicker, 1; tree swallow, 1; black-capped chickadee, 1; robin, 2. Rough-winged swallows nested in crevices in the steep concrete retaining wall at the extreme western edge of the plot, and a raven nest was located on a steep rock cliff facing Highway 2 just outside the plot. An active osprey nest was found several km downstream from the plot. Although pileated woodpeckers were not observed during the census, one was seen on the plot February 9, 1978, by G. Joslin, and feeding excavations were fairly common in old-growth western red cedar. A brood of 12 common mergansers was seen on June 2 by G. Joslin near the eastern boundary of the plot, and a possible but unverified brood of 7 harlequin ducks was seen June 12 by B. Shepard just downstream from the plot. At least seven harlequin ducks were present on the plot; these appeared to represent one pair, one lone female, and four bachelor males. All preferred the head of the falls as a feeding area and the rocky promontory just upstream from the falls as a nesting area, although the entire stretch of river within the plot was used at some time. The first harlequin (a male) was seen in the plot April 29, and the last (a female) was seen June 16. Of the 33 breeding species encountered during the census, the following were restricted to the Kootenai River and/or its shores: mallard, common goldeneye, harlequin duck, common merganser, spotted sandpiper, and dipper. The remaining species, with the exception of the swallows, were primarily restricted to terrestrial habitats, which comprised only 60% of the plot. More meaningful density estimates for these species in terrestrial habitats may thus be obtained by multiplying the density figures reported above by 1.67. The varied thrush, golden-crowned kinglet, Townsend's warbler, yellow-rumped warbler, and western tanager occupied primarily tall, dense, western red cedar and Douglas fir forests south of the railroad right-of-way; the warbling vireo, yellow warbler, MacGillivray's warbler, and song sparrow occupied open, shrub-dominated habitats along the right-of-way. Other vertebrates seen on the plot: wandering garter snake, (*Thamnophis elegans*), beaver (*Castor canadensis*), chipmunk (*Eutamias* spp.), tree squirrel (*Tamiasciurus hudsonicus*), Columbian ground squirrel (*Spermophilus columbianus*), northern flying squirrel (*Glaucomys sabrinus*), mule deer (*Odocoileus hemionus*). This study was part of a wildlife inventory related to a proposed hydroelectric facility, and was funded by Northern Lights, Inc.

Appendix E

FIELD DATA SHEET - VERTEBRATE TRAPPING

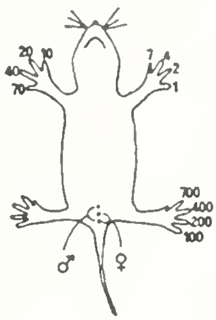
DATA TYPE	LOCATION		INITIALS			DAY		MONTH		YEAR		TREATMENT	REPLICATE	GENUS		SPECIES		CONDITION	MARK	NUMBER			MALE	FEMALE	WEIGHT			ROW OR TRAP NO.		COLUMN		TIME
2	3	4	5	6	7	8	9	10	11	12	13	14	16	19	20	21	22	24	25	26	27	28	29	30	33	34	35	37	38	39	40	47

DATA TYPE

1-Trap Grid
2-Live Trapline
3-Snap Trapline

TIME

1-Morning
2-Afternoon



TREATMENT

1-Control
2-Experiment

CONDITION

0-Normal
1-Escaped
2-Torpid
3-Dead
4-Injured

MARK

0-Normal
1-Unmarked
2-Ear Tag
3-Toe Clip
4-2 & 3
5-Nat. Amp.

TRAP NUMBER

00 to 100

MALE

0-Ad. Non-Breed
1-SAd. Non-Breed
2-J. Non-Breed
3-Ad. Breed?
4-SAd. Breed?
5-J. Breed?
6-Ad. Breed
7-SAd. Breed
8-J. Breed
9-Undeterm.

FEMALE

0-Ad. Non-Breed
1-SAd. Non-Breed
2-J. Non-Breed
3-Ad. Breed?
4-SAd. Breed?
5-J. Breed?
6-Ad. Breed
7-SAd. Breed
8-J. Breed
9-Undeterm.

APPENDIX F

KOOTENAI FALLS

RIPARIAN WILDLIFE CENSUS

INSTRUCTIONS

Objectives

The objective of this census is to document the seasonal pattern of use of the Kootenai Falls project area by wildlife before, during, and after construction. All vertebrate species using the area are to be investigated--reptiles, amphibians, birds, and mammals.

Materials Needed

Binoculars, spotting scope, clipboard, field maps, field data sheets, summary sheets, nest record cards, colored pencils, rain gear, field guides.

Methods

This census is designed to produce data allowing comparisons of wildlife use between months and between years. The general methodology is patterned after the standard winter bird study (Kolb 1965) and breeding bird census (Hall 1964, Van Velzen 1972) techniques, but is extended to include all vertebrate species. The study area is to be censused on three consecutive days each month during January, April, June, August, and October along a standardized route. Censuses will begin precisely at local sunrise except in April, June, and August, when they will begin one-half hour before local sunrise each day. The same route will be followed each time (although starting point and direction will be changed randomly from day to day), and will be such that all points of the studyarea come under direct observation, including the interior of forests and the north shore of the river. The species, location, sex (if known), age (adult or immature, if known), and movements of each animal seen will be recorded precisely in relation to habitat categories on field maps using colored pencil or ball point pen; special notation shall be used to denote simultaneous observations and evidence of territoriality (singing males, chasing, etc.). All vertebrates seen, even those not identified, will be recorded; if not identified to species, animals will be identified as precisely as possible: "unknown gull", "unknown frog or toad," "unknown chipmunk," "unknown passerine," etc. Starting points and direction of runs will be varied randomly to ensure that all portions of the project area receive at least one day's early-morning observation. The exact route taken, starting and ending points, and direction of travel will be recorded directly on the field maps. Pertinent data regarding starting time, weather conditions, etc. will be recorded at the start and end of each route on the field data sheets (a different set of maps and one or more field data sheets will be used each day). Record time as military time (e.g., 0820, 1916); use Beaufort wind speed code numbers.

At the end of each day's run, the minimum estimate of the number of animals of each species known to be present for each of two areas (the project area and the control area) and the total census area will be recorded on field data sheets for each of the four sections of the map. (NOTE: If an animal is seen in both areas (control and project), its will be assigned to the area where first observed.) It is important that this analysis be performed immediately after conclusion of each day's census run. Species will be listed in phylogenetic order; unkowns will be listed at the end of the appropriate taxonomic group (e.g., "unknown hawk" will follow those hawks identified to species;("unknown bird" will fall between the last identified bird and the first identified mammal.) Under the column entitled "entire plot," the minimum number of each species present within the entire plot will be estimated. Note that the numbers in this column will not necessarily be the totals of the four map sections. For example, a bald eagle may have been seen on section 1 and also on section 3, but unless there is firm evidence that two individuals were actually seen (e.g., simultaneous observations or separate observations of one adult and one immature), only one will be entered under the "entire plot" column. Also, if four mallards (one male, three females) were seen on section 1, five mallards (three males, two females) on section 2, seven unidentified ducks on section 3, and six unidentified ducks in section 4, and if it was uncertain that these groups did not mix during the census, the entries would be as follows:

	Section 1	Section 2	Section 3	Section 4	Entire Plot
Mallard	4	5	-	-	6
Unidentified Duck	-	-	7	6	1

This represents the minimum estimate of the total population present. If, on the other hand, there was a reasonable certainty that the sightings represented all different ducks (perhaps two groups were seen simultaneously, or perhaps the river was in view the full time of the census and no ducks were seen flying between sections), 9 mallards and 13 unidentified ducks would be recorded in the "entire plot" column. Once this is done for all species, the number of birds seen in the entire plot divided by the total number of hours of observation (minus any breaks) will be entered in the last column (to the nearest hundredth).

At the end of the week data from all plots will be transferred to the summary sheets, also in phylogenetic order, and the average minimum number present and number seen per hour will be calculated. Each month, then, three field data sheets and three summary sheets will be preapred.

April, June, and August data will be used to determine breeding bird territories according to the criteria listed by Robbins (1970).

Species seen or heard outside the census boundary will be listed on the field sheet, but not included in the census results. All observations of waterfowl, raptors, and large mammals made during census runs will be recorded on standard waterfowl or wildlife data sheets as well. Details of any nests located will be recorded on nest record cards, and locations of nests will be marked on a separate set of maps each year.

APPENDIX G

Conceptual Basis for Compensation of Unmitigated Impact

Strategies of mitigation and compensation may be considered conceptually by examination of Figure 18. In this figure, carrying capacity (K) is shown as a function of time (with seasonal, successional, and other variations smoothed out) under various management strategies. Carrying capacity with management is shown by dashed lines; that which would be the case if the management technique were not applied is shown by solid lines. Carrying capacity may be considered proportional to the "habitat units" of the U.S. Fish and Wildlife Service Habitat Evaluation Procedures (Schamberger and Farmer 1978); thus, similar figures may be constructed based on actual field data.

In Figure 18-I, a solid curve is shown which represents, as a function of time f(t), the change in K resulting form an unmitigated, short-term impact. The dashed curve in this same figure shows how mitigation might serve to lessen the reduction in K over time according to a different function of time, m(t). The benefits B_m to the population which could be obtained by mitigation, represented as the shaded area in Figure 18-I, would thus be

$$B_m = \int_0^t \left[m(t) - f(t) \right] dt.$$

If the costs of mitigation are C_m, the benefit per unit cost (expressed as habitat unit days or a similar measure) is simply $B_m/C_m = E_m$, which is a measure of the cost-effectiveness of mitigation. Note that, in this figure, some losses accrue over time even with mitigation.

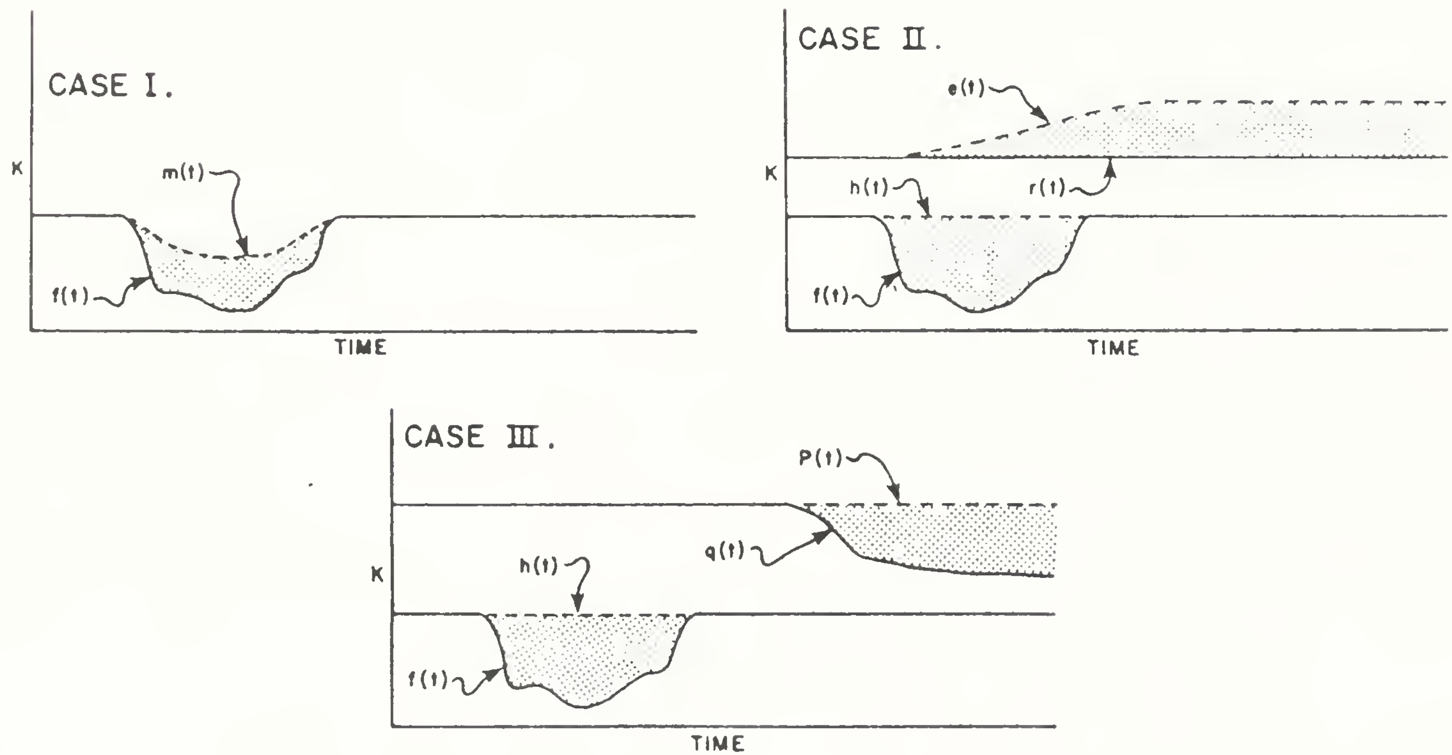
Two strategies for compensating this unmitigated impact are described below. If justified on the basis of cost-effectiveness, such strategies may even be considered as substitutes for mitigation in certain cases. Figures 18-II and 18-III show these two alternatives. In both cases, the impact curve f(t) is the same as in figure 18-I, but the impacts are not mitigated and simply accepted as they are. The impact-related losses L to the resource are thus equal to the difference between the situation if the impact did not occur (represented by a dotted line) and the function h(t) and f(t), or

$$L = \int_0^t \left[m(t) - f(t) \right] dt.$$

Compensation by Enhancement

In figure 18-II, the carrying capacity of enhancement land is represented by the solid line r(t). Long-term enhancement of this area may increase the

FIGURE 18. Three possible strategies for mitigating or compensating for a short-term impact.



incremental value of K only slightly each year (as shown by curve e(t)), but over many years the total gains of such enhancement

$$G_e = \int_0^t \left[e(t) - r(t) \right] dt$$

properly discounted, may very well exceed the unmitigated losses L. It is clear that the longer enhancement can be applied, even if enhancement is very slight, the more substantial the long-term benefits that accrue over time. (NOTE: Unless discounted, any long-term compensation, however slight, would turn out to be the best strategy for dealing with a short-term impact.) In this case, the overall net benefits of compensation B_c are equal to G_e - L. Assuming costs of enhancement equal C_e, the benefit per unit cost of compensation is $B_c/C_e = E_c$. This value can be contrasted to that of mitigation, E_m, to determine which strategy would be most cost-effective.

Compensation by Protection of Threatened Habitat.

In figure 18-I, the solid line described by the function q(t) shows that change in K which would occur if nothing is done about the impending impact, and p(t) describes the situation if this impact is prevented. The total gains

$$G_p = \int_0^t \left[p(t) - q(t) \right] dt$$

discounted over time, may in fact exceed long-term unmitigated losses L, in which case the overall net benefits are $B_p = G_p - L$. Assuming costs of prevention are C_p, the benefit per unit cost is $B_p/C_p = E_p$, which again may be compared to corresponding values for mitigation and enhancement compensation.