AN EXPLORATORY SURVEY OF FISHES AND AQUATIC HABITATS IN BURNS CREEK, DAWSON AND RICHLAND COUNTIES, MONTANA

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By

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INTRODUCTION

Little research has inquired into the longitudinal distribution, habitat requirements, and ecology of fishes in small prairie streams in eastern Montana. Clancey (1978) conducted a study of longitudinal distribution of aquatic habitats, aquatic invertebrates, and fishes in Sarpy Creek (Big Horn and Treasure counties) to provide baseline information against which to assess potential impacts of coal mining in the area. Barfoot (1993) studied the longitudinal distribution of fishes and habitats in Little Beaver Creek (Carter and Fallon counties, Montana, and Bowman and Slope counties, North Dakota) in order to examine the hypothesis that longitudinal zonation of fish communities in streams reflects primarily changes in stream geomorphology. His discussion included a detailed analysis of fish-habitat associations in Little Beaver Creek.

More extensive surveys have sought to develop baseline data on fish communities and habitats in eastern Montana streams in order to assess the impacts of future energy development in the region. Potential negative impacts of such development on stream fish communities include (1) degradation of water quality and alteration of streamflow regimes due to strip mining of coal and (2) decreased streamflow due to diversion of flow for on-site power generation. The results of all these studies were collected and summarized by Elser et al. (1980).

Of these extensive surveys, two generated data on fish communities in smaller prairie streams (i.e., exclusive of the Tongue, Powder, Yellowstone, and Missouri rivers). Elser et al. (1978) conducted an inventory of fishes and aquatic habitats, including physicochemical characteristics and aquatic invertebrates, in Beaver Creek, three of its tributaries (Little Beaver Creek, Hay Creek, and Lame Steer Creek), and seven north-flowing tributaries of the lower Yellowstone River (Smith Creek, Box Elder Creek, Cotton Creek, Glendive Creek, Griffith Creek, Hodges Creek, and Krug Creek). Morris et al. (1981) conducted an aquatic resources assessment of 45 tributaries of the lower Yellowstone River, generating baseline data on physicochemical characteristics, aquatic invertebrates, fishes, and aquatic habitats. A classification system was then used to assign value ratings to each stream based on (1) habitat and species value and (2) sport fishery potential.

Given the potential impacts of current land uses, including grazing and irrigated agriculture, and of future energy development on stream fish communities in eastern Montana, it would be desirable to learn more about the distribution and habitat requirements of stream fishes in the region. Moreover, from the perspective of basic ecological research, it would be interesting to further explore factors which influence longitudinal zonation of fish communities in small prairie streams.

During the summers of 1995 and 1996, I made a driving and walking tour of tributaries of the lower Yellowstone River, from the confluence of the Bighorn River to the Missouri River, in order to select a small stream for a study of longitudinal community zonation. I selected Burns Creek because it appeared to have perennial flow, better protected riparian areas, and good access. In addition, Morris et al. (1981) had rated Burns Creek among the eight most valuable of the 45 streams they surveyed in terms of habitat for fishes of special concern in Montana, aesthetics, and local value for scientific study, nature study, and recreation.

During the summer of 1997, assisted by Carol Endicott, a recent graduate of the Montana Cooperative Fishery Research Unit at Montana State University, I conducted a semi-quantitative survey of fishes and habitats in Burns Creek. The purpose of this survey was to get a general idea of longitudinal distribution of fishes, types of aquatic habitats, and sampling problems and to get access permission from landowners. Results of this initial survey could then be used to ask specific questions about the system and to design a future, quantitative study.

STUDY AREA

Burns Creek originates in northern Dawson County, Montana, and flows southeast approximately 80 km to its confluence with the Yellowstone River at river kilometer 97.8, approximately midway between Glendive and Sidney (Figure 1). Elevations range from approximately 900 m at the headwaters to 597.8 m at the mouth; the average gradient is 3.8 m/km. The major tributary of Burns Creek is its North Fork, which also originates in northern Dawson County and flows approximately 50 km to its confluence with Burns Creek about 1.5 km downstream of the Dawson County Road 549 crossing. The middle Fork of Burns Creek originates midway between the headwaters of Burns Creek and the North Fork and flows approximately 40 km to its confluence with the North Fork. The Burns Creek system drains approximately 600 km^2.

The upland terrain of the Burns Creek drainage consists of rolling hills, which have been dissected by Burns Creek and its major tributaries into colorful badlands. The upper reach of the North Fork has carved out a particularly rugged badlands terrain. Downstream of State Route 16, Burns Creek emerges onto the relatively flat floodplain of the Yellowstone River.

Geologically, the Burns Creek drainage is underlain by cretaceous and paleocene sedimentary rocks consisting primarily of sandstones and shales. The lower part of the drainage below the North Fork confluence is overlain by Wisconsin glacial till. Exposed rocks in the upper part of the drainage consist of non-marine sediments of the Fort Union formation, which contain economically extractable deposits of coal. This formation also discharges significant amounts of groundwater (Alt and Hyndman 1986, Morris et al. 1981).

The climate of eastern Montana is semiarid continental. Annual precipitation averages 33 cm with a range of 30.5-40.6 cm. Maximum precipitation occurs from late spring to early summer, with 65-85 percent of annual precipitation occurring from April to September. Snowfall accumulation is low due to periodic thaws. During January (as measured in Miles City), average minimum and maximum temperatures are -14.3°C and -2.9°C, respectively. During July, average minimum and maximum temperatures are 14.5°C and 31.1°C, respectively (Morris et al. 1981).

The flow regime of Burns Creek, as measured from 1958 to 1986 at a gauging station about 0.5 km above the State Route 16 crossing, is typical of many prairie streams in eastern Montana (Figure 2). Mean monthly discharge is slightly greater than 1.0 m^3/sec in March, declining thereafter to late summer and winter lows of 0.1-0.5 m^3/sec. Mean annual discharge is about 0.2 m^3/sec. However, annual, monthly, and daily discharge volumes are highly variable in response to long-term variations in annual precipitation and to short-term, local precipitation events, especially summer thunderstorms. Mean annual flow has ranged from 0.015 m^3/sec (1961) to 0.580 m^3/sec (1979). Zero flows frequently occurred in August and September during the period of record, and the highest recorded mean daily discharge (42.45 m^3/sec) oc-

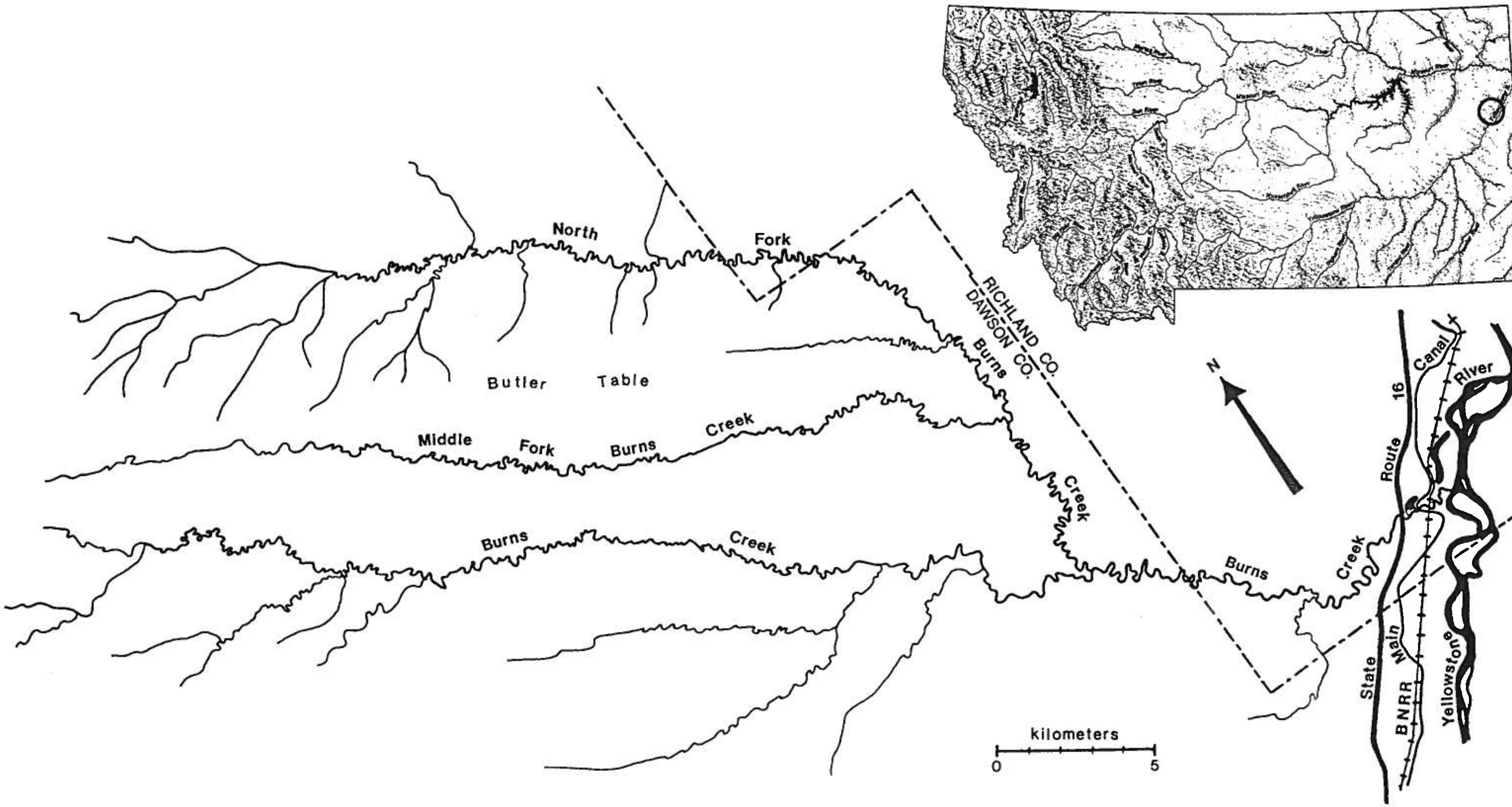

Figure 1. Map of the Burns Creek system, Dawson and Richland counties, eastern Montana (Inset map of Montana shows location of study area as a dark circle).

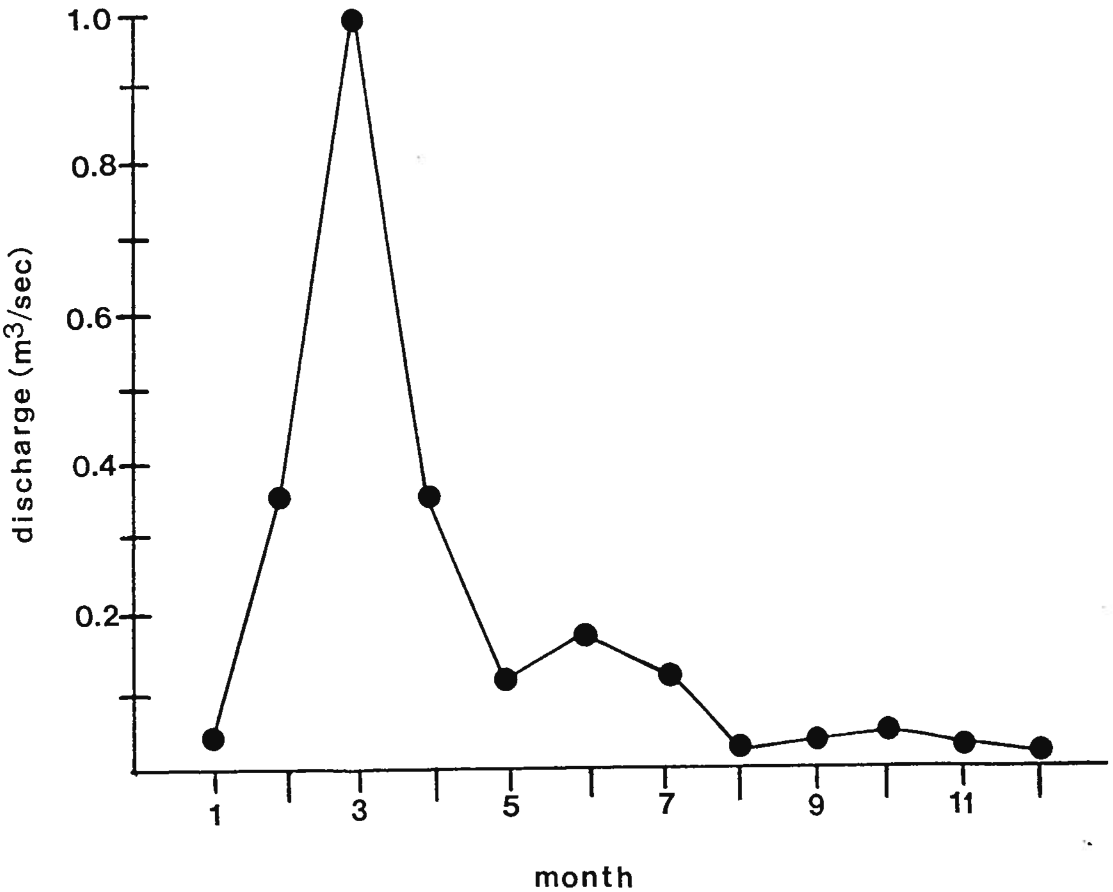

Figure 2. Mean monthly discharge (m^3/sec) of Burns Creek for period of record (1958-1967, 1976-1984, and 1986-1988)(U.S. Geological Survey 1996).

curred on 20 March 1960 and again on 26 February 1986.

Land use in the Burns Creek watershed is agricultural. Cattle grazing is the major activity upstream of the State Route 16 crossing, while irriga- crops of grains and sugar beets predominate downstream on the floodplain of the Yellowstone River. The Lower Yellowstone Project Main Canal, which originates at Intake about 12 km upstream of Burns Creek and discharges into the Missouri River at Nohly, Montana, is the principal source of irrigation water.

METHODS

Fish were sampled during 4-14 August 1997 at 12 sampling areas in Burns Creek and the North Fork (Figure 3). Sampling area 12, not shown in Figure 3, was located on the North Fork at the Dawson County Road 526 crossing. Fish were captured primarily by seining using a 1.2 x 3.5-m (9.5-mm Ace mesh) seine, but minnow traps baited with cat food were also used to capture fish in heavily vegetated areas at sampling areas 3, 7, 11, and 12. A backpack electroshocker (Mark 10, Coffelt Manufacturing, Inc., Flagstaff, Arizona) was used on one day at sampling area 3 with little success.

No attempt was made to standardize sampling effort. Rather, relatively long (250-500 m) sections of stream were seined until it was felt that additional effort in the section would not yield additional species (hence the use of the term "sampling areas" instead of "sampling stations"). Particular attention was paid to sampling interesting microhabitats, such as spring seeps, beaver ponds, undercut banks, and littoral vegetation. An effort was made to sample representative areas along the entire length of flowing stream, given landowner permission and reasonable accessibility.

During fish sampling, qualitative notes were made of habitat variables. These included water temperature, stream depth and width, lengths of pools and riffles, spring sources, turbidity, substrate types, aquatic and littoral vegetation, aquatic invertebrates, and adjacent upland vegetation and land use.

All fishes captured were identified using Holton and Johnson (1996), counted, and (except for voucher specimens) returned to the stream. Two voucher specimens of most species were retained. Due to the difficulty of differentiating between western silvery minnows (*Hybognathus argyritis*) and plains minnows (*H. placitus*) in the field, 45 specimens were retained for closer inspection in the laboratory. Several sunfishes (*Lepomis* spp.) which appeared to have hybrid characteristics were also retained for closer inspection. All specimens were preserved in 10% formalin and deposited in the Vertebrate Collection, Biology Department, Montana State University, Bozeman.

RESULTS AND DISCUSSION

Habitats

The Burns Creek system can be divided into three sections based on general habitat characteristics (Figure 3). The upper section consists of Burns Creek and the North Fork from just upstream of Dawson County 549, including sampling areas 9, 10, 11, and 12, to a point just downstream of the North Fork confluence. The middle section extends downstream from this point, including sampling areas 4, 5, 6, 7, and 8, to the crossing of the Lower Yellowstone Project Main Canal. The lower section extends downstream from the canal to the mouth, including sampling areas 1, 2, and 3.

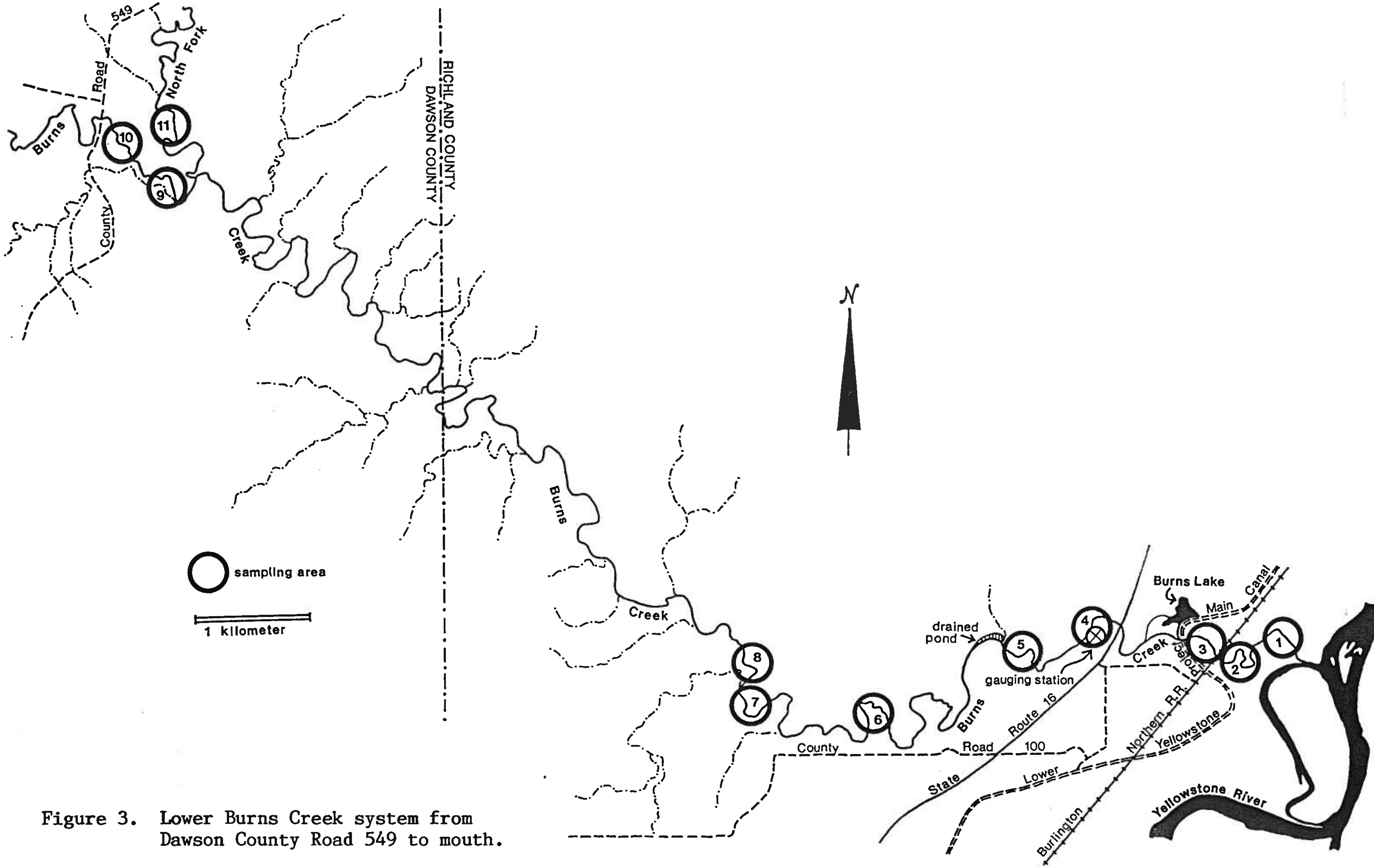

Figure 3. Lower Burns Creek system from Dawson County Road 549 to mouth.

Upper Section. Dawson County Road 549 marks the approximate upstream limit of perennial flow on both the mainstem of Burns Creek and on the North Fork. The Middle Fork drains a relatively narrow upland corridor between Butler Table and the divide separating it from the mainstem and appears to flow only in direct response to precipitation.

The main source of flow for the mainstem appears to be a large area of groundwater discharge marked by an extensive cattail (*Typha* sp.) marsh upstream of the Road 549 crossing and along tributaries flowing more or less parallel to Road 549 from the south. Unfortunately, streamflow data for Burns Creek has not been available since 1988, but discharge at the crossing appeared to be on the order of 0.1-0.2 m^3/sec. Water temperature at the crossing was 12.0°C on 13 August 1997. Turbidity was negligible, and the bottoms of deep pools were clearly visible. Channel morphology of the mainstem in the upper section consisted of long, shallow riffles and runs (about a meter wide, 10-40 m long, and 0.5-1.0 m deep) separating long, deep pools 2-10 m wide, 15-20 m long, and 0.5-1.5 m deep). Substrates consisted primarily of gravel and cobbles in riffles and runs and sand and silt in pools. Pools contained substantial beds of submerged aquatic vegetation, especially along the stream margins, undercut banks, and occasional submerged logs. However, unlike the North Fork, the mainstem was free of submerged aquatic vegetation in midchannel.

The North Fork of Burns Creek (Figure 4) was a virtually lentic habitat where the channel appeared to intersect the local water table. Water temperature was 14.5°C on 13 August 1997, and water clarity was high, although the density of submerged aquatic vegetation obscured any view of the stream bottom in most places. Morphologically, the North Fork was one long pool with no visible flow. Depth averaged about a meter, with some holes up to 1.5 m deep. The growth of submerged aquatic vegetation, predominantly *Chara* sp., was extremely dense throughout the North Fork except where it passed under Dawson County Road 526. There was a well-developed littoral plant community consisting predominantly of cattails and rushes (*Juncus* sp.) and a densely vegetated littoral community several meters wide consisting predominantly of sedges (*Carex* spp.), willows (*Salix* sp.), snowberry (*Symphoricarpos* sp.), and milkweed (*Asclepias* sp.). The substrate was deep muck and detritus over a sandy base.

Upland vegetation of the upper section of the Burns Creek system consisted predominantly of grasses (Poaceae), sagebrush (*Artemesia* spp.), and scattered stands of cottonwood (*Populus* sp.), Russian olive (*Eleagnus angustifolia*), and buffaloberry (*Shepherdia canadensis*). Although the whole area was grazed, riparian vegetation grew in dense borders several meters wide along both the mainstem and the North Fork.

Midddle Section. Downstream of the North Fork confluence was a series of beaver (*Castor canadensis*) ponds where streamflow velocity decreased, the water became more turbid, and the bottoms of pools were not visible. Water temperature also gradually increased from 14.5°C at the confluence to 23.5°C at State Route 16. We were unable to survey about six stream kilometers beginning about two kilometers below the confluence due to lack of landowner permission, but habitat characteristics seemed to be relatively uniform all the way to Route 16.

From the North Fork confluence to about two stream kilometers downstream, the creek was entrenched between undercut streambanks 2.0-5.0 m high and impounded by a series of beaver dams. Beaver were active in the area as evidenced by fresh tracks and scats. Riffles were absent, and the ponds were 5.0-10.0 m wide and 0.5-1.5 m deep. Substrates were primarily silt and deep pockets of of muck. Littoral vegetation consisted predominantly of cattails and rushes, and the riparian areas were densely vegetated in borders several meters wide with grasses, willows, snowberry, and buffaloberry.

Figure 4. North Fork of Burns Creek, T 19 N, R 56 E, Section 11, Dawson County, Montana (Sampling Area 11, 13 August 1997).

Figure 5. Burns Creek between the North Fork confluence and State Route 16, T 19 N, R 57 E, Section 32, Richland County, Montana (Sampling Area 7, 8 August 1997).

Figure 6. Burns Creek between the Lower Yellowstone Project Main Canal and the Burlington Northern Railroad, T 19 N, R 57 E, Section 26, Richland County, Montana (Sampling Area 3, 7 August 1997).

The next downstream section of the stream we were able to survey was at sampling areas 7 and 8 (Figure 5). Here the stream was still entrenched between relatively steep banks 0.5-3.5 m high. However, proceeding downstream, the banks became lower and less steep until at sampling area 4, near the abandoned gauging station, they were only 0.5-3.5 m high. No intact beaver dams were observed between sampling areas 4 and 8, although remnants of several washed-out beaver dams and a man-made rock dam (at sampling area 5) were noted. The entire section from sampling area 8 downstream to Route 16 was characterized by long, shallow pools (3.5-10.0 m wide, 20-40 m long, and 0.3-1.0 m deep) separated by long, shallow riffles and runs (about a meter wide, 20-40 m long, and less than a meter deep). Substrates consisted primarily of sand and gravel overlain by silt in pools and gravel and cobbles in riffles and runs. Littoral vegetation consisted predominantly of cattails and rushes.

Upland areas of the middle section of Burns Creek from sampling area 8 downstream to Route 16 were grazed at the time of this survey. Upland vegetation consisted predominantly of grasses and sagebrush with scattered stands of cottonwoods, Russian olive, and buffaloberry. Riparian vegetation consisted predominantly of sedges, grasses, willows, snowberry, and buffaloberry in much narrower borders (less than a meter) than those observed in the upper section. Two pools in sampling area 7 and 8 were frequently used by cattle and featured deep, mucky substrates and eroded banks. In contrast, about a kilometer of stream at sampling area 6 featured wide, densely vegetated riparian borders similar to those observed at sampling areas 9 and 10.

Lower Section. At the Lower Yellowstone Project Main Canal, Burns Creek flows over a 3.0 x 3.0-m box culvert through which the canal passes, then drops about three meters into a concrete plunge pool. This forms a vertical barrier to upstream movement by fishes from the lower section. According to landowners along the lower section of Burns Creek, construction of the canal embankment circa 1910 impounded a shallow body of water called Burns Lake, which is now essentially a marsh featuring dense submerged and floating aquatic vegetation. It appears to receive overflow from the creek during high discharge periods and to drain back into the creek along the canal embankment.

Morphology of the channel at sampling areas 2 and 3 (Figure 6) was similar to that at sampling areas 4 and 5, with long, shallow pools (3.5-10.0 m wide, 10-40 m long, and 0.3-1.0 m deep) separated by long, shallow riffles and runs (1.0-2.0 m wide, 20-40 m long, and less than a meter deep). Water temperature was 23.5°C on 4 August 1997. Turbidity was high at the beginning of the sampling period, such that the bottoms of riffles and pools were not visible, but by the end of the sampling period it had decreased sufficiently to render the bottoms of shallower pools visible. Substrates consisted primarily of sand, gravel, and silt in pools and gravel and cobbles in riffles and runs. Littoral vegetation consisted predominantly of cattails, rushes, and sedges.

We observed three small inflows of water along the creek at sampling areas 2 and 3 which at first appeared to be springs. However, their water temperatures ranged from 22.0-23.5°C, and their discharges increased toward the end of the sampling period. At that time, landowners were beginning to lay irrigation pipe and to irrigate adjacent sugar beet fields, so these inflows probably represented points of irrigation return flow.

From sampling area 1 to the mouth, the stream channel became more entrenched between steep banks 2.0-3.0 m high. This section was characterized by long, deep pools (4.0-10.0 m wide, 30-60 m long, and 0.5-1.6 m deep) separated by short, poorly defined riffles (1.0-3.0 m wide, 1.0-2.0 m long, and less than a meter deep). Water temperature was 23.5°C on 11 August 1997, and the water was very turbid. Substrates consisted of sand and deep silt in the pools and gravel and cobbles in the riffles. Remnants of several beaver dams and bank dens with fresh tracks were also observed. Littoral vegetation consisted predominantly of rushes, sedges, and cattails.

Land use adjacent to sampling area 3 consisted of grazing on the floodplain immediately adjacent to the stream and irrigated grain and sugar beet crops farther upland. Floodplain vegetation adjacent to the stream consisted predominantly of grasses and sagebrush with scattered stands of cottonwood, Russian olive, and buffaloberry. Riparian vegetation consisted of grasses, willows, sedges, and buffaloberry and was confined to a narrow strip less than a meter wide immediately adjacent to the stream channel.

Downstream of the Burlington Northern Railroad, Burns Creek flows through a parcel of BLM land (sampling area 2) for about half a kilometer. This land had apparently not been grazed for several years; grasses and other herbaceous vegetation were dense and high and continuous with riparian vegetation to the stream margin. Stands of cottonwood, willow, Russian olive, and buffaloberry were more extensive than anywhere upstream.

Burns Creek finally flows through a parcel of private land (sampling area 1 to mouth) where the owner has deliberately allowed the floodplain vegetation to grow wild for many years to encourage wildlife populations. Upland vegetation in this section resembled that on the BLM parcel, transitioning into a mature gallery forest of cottonwoods at the mouth of the stream.

Fish

Nineteen species of fishes were collected in Burns Creek from 4 to 14 August 1997 (Table 1). The most abundant species encountered in order of numbers captured were creek chub (*Semotilus atromaculatus*), white sucker (*Catostomus commersoni*), western silvery minnow (*Hybognathus argyritis*), green sunfish (*Lepomis cyanellus*), and shorthead redhorse (*Moxostoma macrolepidotum*). Forty-five *Hybognathus* were dissected in the laboratory, and all were identified as *argyritis* rather than *placitus*. Nevertheless, some of the 196 individuals collected may well have been the latter species. The largest northern pike (*Esox lucius*) was approximately 250 mm total length. The green sunfish, burbot (*Lota lota*), and yellow perch (*Perca flavescens*) were all less than 60 mm total length; most were probably young-of-the-year. Most of the carp (*Cyprinus carpio*), white suckers, and shorthead redhorse also appeared to be young-of-the-year, with the largest of each species being 150 mm, 230 mm, and 220 mm total length, respectively.

A general trend of decreasing upstream species diversity was noted, but this may reflect uneven sampling effort and inability to effectively sample certain habitats as much as actual differences in diversity. Deep water and deep, soft sediment made seining inefficient at sampling area 1 near the mouth of the stream. Only four species were encountered here, although a much greater diversity would be expected due to proximity to the Yellowstone River and intrusion of its riverine fish fauna. Morris et al. (1981) collected 12 species in this section of Burns Creek during 1979-1980, including goldeye (*Hiodon alosoides*), river carpsucker (*Carpiodes carpio*), and yellow bullhead (*Ameiurus natalis*), which were not encountered anywhere in Burns Creek during the present survey. Although they used a variety of capture methods, including seines, traps, hoop nets, gill nets, and electrofishing, their report did not specify which method or methods were used in this part of the stream.

Dense, submerged aquatic vegetation also made seining inefficient at sampling area 11 on the North Fork. Here we had better results using minnow

Table 1. Fishes collected at 12 sampling areas on Burns Creek, Dawson and Richland counties, Montana, 4-14 August 1997.

	Sampling Areas												
Species*	1	2	3	4	5	6	7	8	9	10	11	12	Σ
northern pike (*Esox lucius*)		2	1										3
common carp (*Cyprinus carpio*)		3	3	10	5							19	40
western silvery minnow (*Hybognathus argyritis*)	113	38	33	7	2		2				1		196
brassy minnow (*Hybognathus hankinsoni*)	1	2		1							1	1	6
emerald shiner (*Notropis atherinoides*)		24	33	2			1						60
sand shiner (*Notropis stramineus*)		5	5	32		3	5	2					52
fathead minnow (*Pimephales promelus*)		11	27	7		1	1					27	74
flathead chub (*Platygobio gracilis*)		14	31										45
longnose dace (*Rhinichthys cataractae*)		10	6	20	3	7	5	1					52
creek chub (*Semotilus atromaculatus*)		50	80	122	30	18	48	30	4		9	5	396
longnose sucker (*Catostomus catostomus*)		6											6
white sucker (*Catostomus commersoni*)		64	178	40	34	18	4	2	9		2		351
shorthead redhorse (*Moxostoma macrolepidotum*)	2	99											101
black bullhead (*Ameiurus melas*)		1											1
stonecat (*Noturus flavus*)		12	7	4			1						24
burbot (*Lota lota*)			1										1
brook stickleback (*Culaea inconstans*)											3	33	36
green sunfish (*Lepomis cyanellus*)	2	37	31	3	1	2	30				1		107
yellow perch (*Perca flavescens*)		1											1

*Common and scientific names based on Robins et al. (1991)

traps in terms of number of species (eight) and number of individuals captured. Morris et al. (1981) also collected eight species in the North Fork, including lake chub (*Couesius plumbeus*), which was not encountered anywhere in Burns Creek during the present survey.

An interesting habitat we were unable to sample was Burns Lake, where seining was virtually impossible due to dense vegetation and deep, soft sediments. We visually spotted one large carp moving through the vegetation near the surface. It would be interesting to get a quantitative sample of the fish fauna of the lake; winterkill may limit its diversity unless it receives regular immigrants from Burns Creek.

Another interesting habitat was the coldwater (12.0°C) section of Burns Creek between Dawson County Road 549 and the confluence of the North Fork. We did not capture any fish by seining in this section, although in shallow, warmer backwaters we observed schools of young-of-the-year minnows or suckers which passed through the siene mesh. The water was extremely clear, and we walked the banks of the whole section, alternately seining and trying to visually spot fish in the deep pools. We saw only one fish, which appeared to be an adult yellow perch. One of the landowners told us that anglers released fish caught in the Yellowstone River into Burns Creek at the Road 549 bridge. Perhaps the predominantly warmwater and coolwater fishes of Burns Creek avoid this section in the summer in favor of warmer water downstream. Conversely, the same fishes may be attracted to it in the winter when downstream water cools below 12.0°C.

The effect of the Lower Yellowstone Project Main Canal barrier on longitudinal distribution of fishes in Burns Creek is not clear from the results of this exploratory survey. Except for brook stickleback (*Culaea inconstans*), all species encountered above the canal crossing were encountered below it. In contrast, seven species, northern pike, flathead chub (*Platygobio gracilis*), longnose sucker (*Catostomus catostomus*), shorthead redhorse, black bullhead (*Ameiurus melas*), burbot, and yellow perch, were encountered below the canal but not above it. Morris et al. (1981) did collect flathead chub and black bullhead above the canal. So far, it cannot be concluded that the canal crossing forms a barrier to upstream migration of primarily riverine species like northern pike, longnose sucker, shorthead redhorse, burbot, and yellow perch. It would be interesting to do a paired stream study comparing Burns Creek and another nearby stream with a comparable drainage area which passes through a culvert under the canal and thus lacks a physical barrier to upstream migration. Fox Creek, 18.3 km downstream, would be a good candidate.

In general, as a largely perennial stream in southeastern Montana, Burns Creek exhibited a relatively diverse fish fauna. We almost certainly missed a number of species which are present, at least seasonally, between the mouth and the canal crossing. Except for the North Fork and the mouth area, aquatic habitats were fairly uniform the entire length of the stream. Although water turbidity was high during the summer of 1997, this was apparently an atypical situation due to unusually high precipitation and runoff during the spring and early summer. During the summers of 1995 and 1996, when I observed Burns Creek from the Route 16 and Road 549 crossings, water clarity was high.

The riparian areas of Burns Creek and the North Fork were in generally good condition, with wide vegetative borders and few areas of serious bank erosion. Upland vegetative cover was also reasonably good downstream of Road 549. Upstream of Road 549, the steeper badlands terrain was more sparsely vegetated, and Burns Creek probably bears a relatively high natural sediment load from the weathering of this terrain.

General Work Plan for 1998

The primary research objective of 1998 would be to standardize sampling effort at representative sites along Burns Creek so as to generate quantitative data on longitudinal distribution of fishes and aquatic habitats. Fish sampling could be based on a catch-per-unit-effort approach with standardized effort at each site or on a Delury (1947) type capture and removal approach. Habitat quantification could be similar to those methods used by Barfoot (1993) in quantifying stream substrates and shoreline cover in Little Beaver Creek.

Seining, supplemented by minnow traps in littoral areas, appears to be an effective sampling approach for most sections of Burns Creek, especially if a capture and removal method with blocking seines is used. In the mouth area, some kind of standardized trap or hoop net sampling procedure would be simplest. Electroshocking appears to be ineffective in Burns Creek due to high water conductivity; moreover, a boated-mounted unit would probably be needed in the mouth area, where deep water and sediment would inhibit the movement of a team operating a backpack unit. In the North Fork, the only feasible capture method may be minnow traps, although these obviously would be size- and species-selective. Submerged aquatic vegetation in the North Fork is too dense for any kind of net or electrofishing operation.

It would be desirable to complete three general reconnaissance tasks in 1998. First, I would like to further explore the spring sources of Burns Creek and the North Fork. I did this only cursorily in 1997 because I lacked time to talk to all the landowners concerned. Second, I would like to put one or two trap or hoop nets into Burns Lake just to see what species are in there, since the lake is a peripheral part of the Burns Creek system. Finally, I want to reconnoiter Fox Creek to see if it would be suitable for a paired stream study with Burns Creek.

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