MONTANA DEPARTMENT OF FISH AND GAME

AQUATIC HABITAT INVENTORY OF THE BEAVER CREEK DRAINAGE AND SELECTED TRIBUTARIES OF THE YELLOWSTONE RIVER

FINAL REPORT

APRIL 1, 1977 - SEPTEMBER 30, 1978

PREPARED FOR AND SUBMITTED TO

BUREAU OF LAND MANAGEMENT
YS-512-CT7-74

BY:

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CHRIS CLANCEY
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INTRODUCTION

Historically, agriculture has been the most important industry of the Northern Great Plains. In 1975, over 40% of the primary employment in Montana was provided by agriculture (Montana Dept. of Community Affairs 1976). Irrigated agriculture is also the largest consumer of water in the Great Plains region. But another industry looms on the horizon, threatening not only land but water, and that industry is coal development. In 1971, the North Central Power Study (North Central Power Study Coordinating Committee, 1971) described 42 potential power plant sites in the five-state Northern Great Plains region. These plants fired by Northern Great Plains coal, would generate 200,000 megawatts of electricity, consume 3.4 million acre-feet of water annually and result in a large population increase.

Strip mining itself involves little use of water. How important the energy industry becomes as a water user depends on: 1) how much of the coal mined in the region is exported, and by what means, and 2) by what process and to what end product the remainder is converted within the region. If conversion follows the patterns project by the Old West Regional Commission Study (Elser, et al. 1977), the energy industry will use from 48,350 to 326,740 acre feet of water annually by the year 2000.

Coal reserves are plentiful in the Beaver Creek drainage and from the earliest days, the outcroppings were common and easily recognizable by early explorers. Small mines were opened in several vicinities during the homestead era. The coal was used for fuel, blacksmithing and other activities requiring the use of heat. But lack of transportation delayed the mining of coal on a large scale. In 1972, Tenneco, Inc. realized the great potential in these vast coal deposits and began buying coal leases from landowners along Beaver Creek. In addition to private coal, federal coal reserves also exist, with over 43,000 acres of federal coal present in the Wibaux-Beach coal field.

Presently, Intake Water Company, a subsidiary of Tenneco, is interested in constructing reservoirs and pipelines to serve the industrialization expected to take place in the Beaver Creek drainage. Mining and possible gasification of the Wibaux-Beach coal reserves will surely have a great environmental impact.

The objectives of this study were:

(1) To inventory the aquatic resources of Beaver Creek to determine species composition, diversity, distribution and relative abundance of aquatic invertebrates and fishes to assist in predicting impacts of proposed water storage projects and coal development; and

(2) to collect identical information in selected Yellowstone River and Beaver Creek tributaries located in Federal Coal Lease Nomination areas.

Funding for the study was provided by the Bureau of Land Management (BLM), U.S. Department of Interior (USDI). Field seasons extended from May 1 through October 15, 1977 and from March 1 through September 29, 1978.

DESCRIPTION OF STUDY AREA

Beaver Creek is a meandering prairie stream which primarily flows in a northeast direction through the Fort Union Coal Fields of Montana and North Dakota. The stream rises in the table land of the Beaver Creek divide in northern Fallon County, and flows diagonally across Wibaux County into North Dakota, emptying into the Little Missouri River. From its headwaters to its confluence, it flows about 220 km, of which, 131 km are in Montana (Figure 1). It drains an area of over 2050 km^2. Most of the Beaver Creek Valley's early industrial history was dependent on the creek; first because of its rich hunting and trapping resources and as an easy travel route; and later, because of the grazing and abundant water it supplied for range livestock. Agricultural activities now rank high in importance in the Beaver Creek basin.

Topography of the basin varies from rolling hills to the flat lands along the stream bottom, ranging in elevation from nearly 975 to about 671 m at the creeks mouth. Climatic conditions are influenced by topography, with the higher sections along the Dakota border being wetter. Annual average precipitation runs around .36 m. The climate is characterized by warm and humid summers with cold winters.

Soil materials of the Beaver Creek basin consist of weathered sandstones and shales of Cretaceous Age, a few terrace remnants of old alluvial deposits and recent alluvium in the stream bottoms. Soils are mostly within the loam to clay loam texture range, but there are significant areas of sandy loam and loamy sand soils and local areas of dense clay soils. These soil conditions are evident in the silty nature of the stream substrate. Relief is deeply rolling to broken intersected by several sub-drainages. The major Beaver Creek tributaries; Little Beaver Creek, Hay Creek, and Lame Steer Creek, flow through similar terrain (Figure 2).

North-flowing tributaries of the lower Yellowstone, while not contributing much to the Yellowstone River in terms of flow, are still important to the Yellowstone Basin. Smith Creek, Box Elder Creek, Cotton Creek, Glendive Creek and its tributaries; Griffith Creek, Krug Creek and Hodges Creek rise in the rolling uplands on the Yellowstone-Beaver Divide (Figure 3). These stream flow through soils derived from glacial till and alluvial deposits much of which lies over economically strippable coal. Box Elder Creek is being considered by Intake Water Company as the site for an off-channel reservoir site. Diversion facilities will be constructed on the Yellowstone River, and the water pumped to a proposed reservoir on Box Elder Creek.

Habitat conditions of Beaver Creek are similar to other prairie stream environments. The headwater reaches of the spring-fed stream consists of small pools, with thick mats of aquatic vegetation. Velocities are generally slow with few defined riffles. Vegetative growth along the stream banks consists mainly of grasses. The long meandering middle stretch is characterized by higher, brush-covered banks. Deep pools and channels are common with a firm, rocky substrate. In the lower reaches, the creek widens

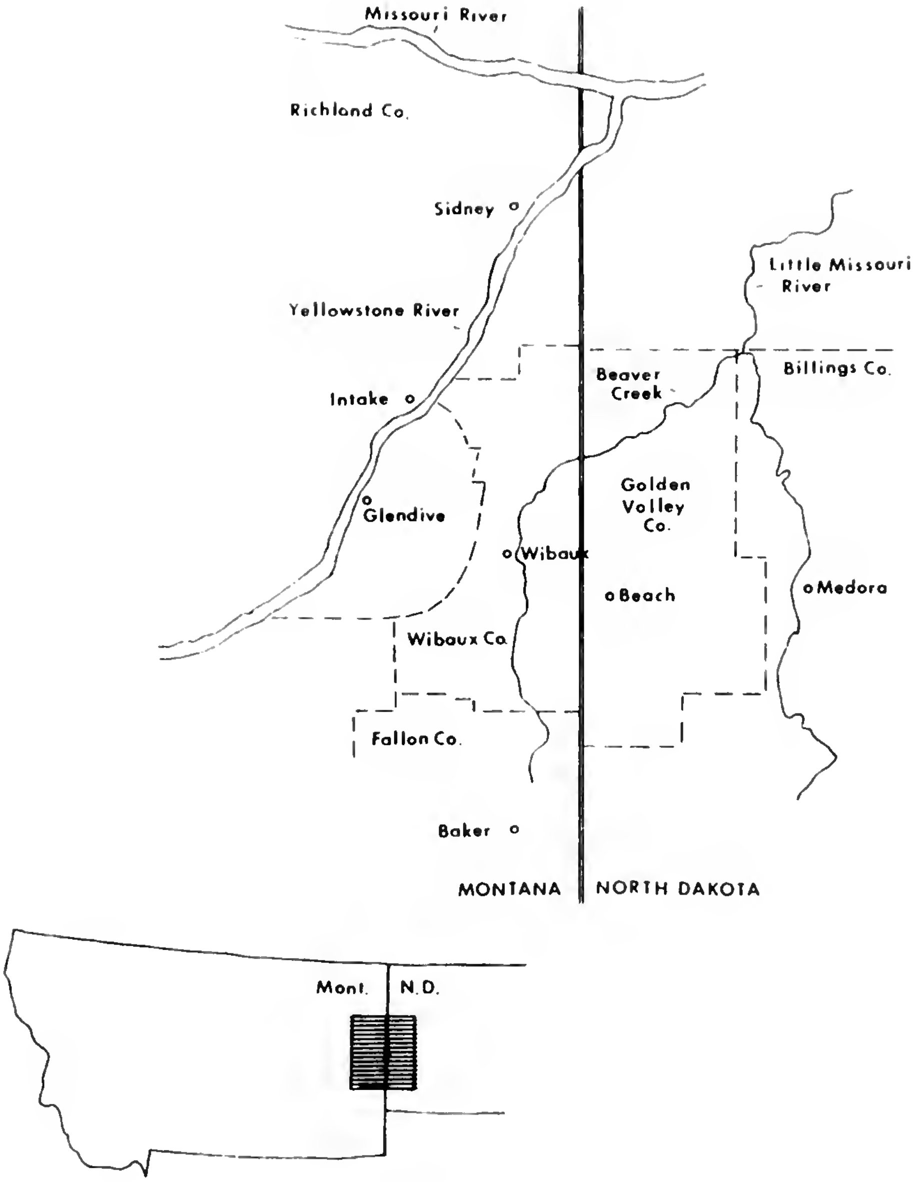


Figure 1. Map of study area .

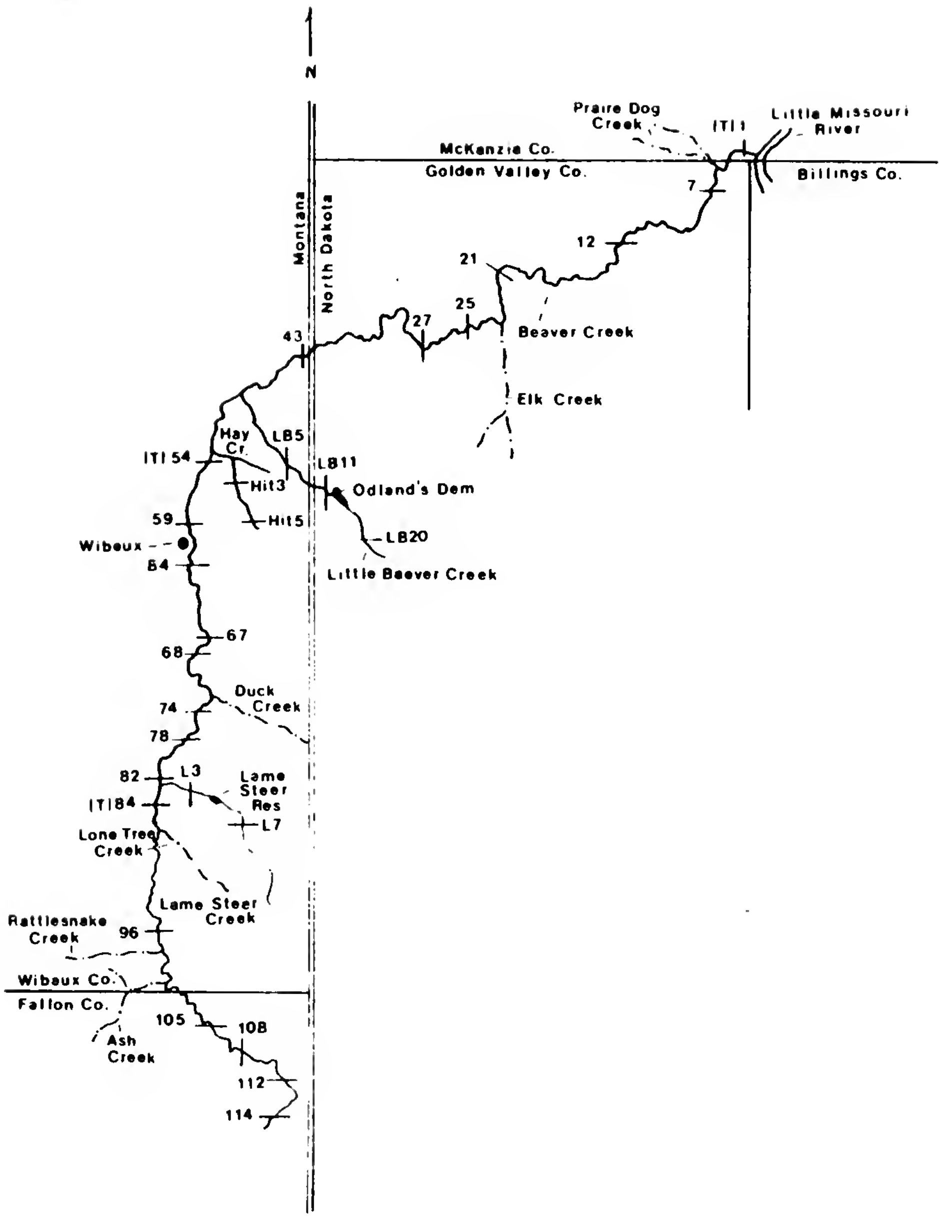


Figure 2. Map of Beaver Creek drainage showing study sections. (T) indicates thermograph locations. Streams which were intermittent and not included are shown by broken lines.

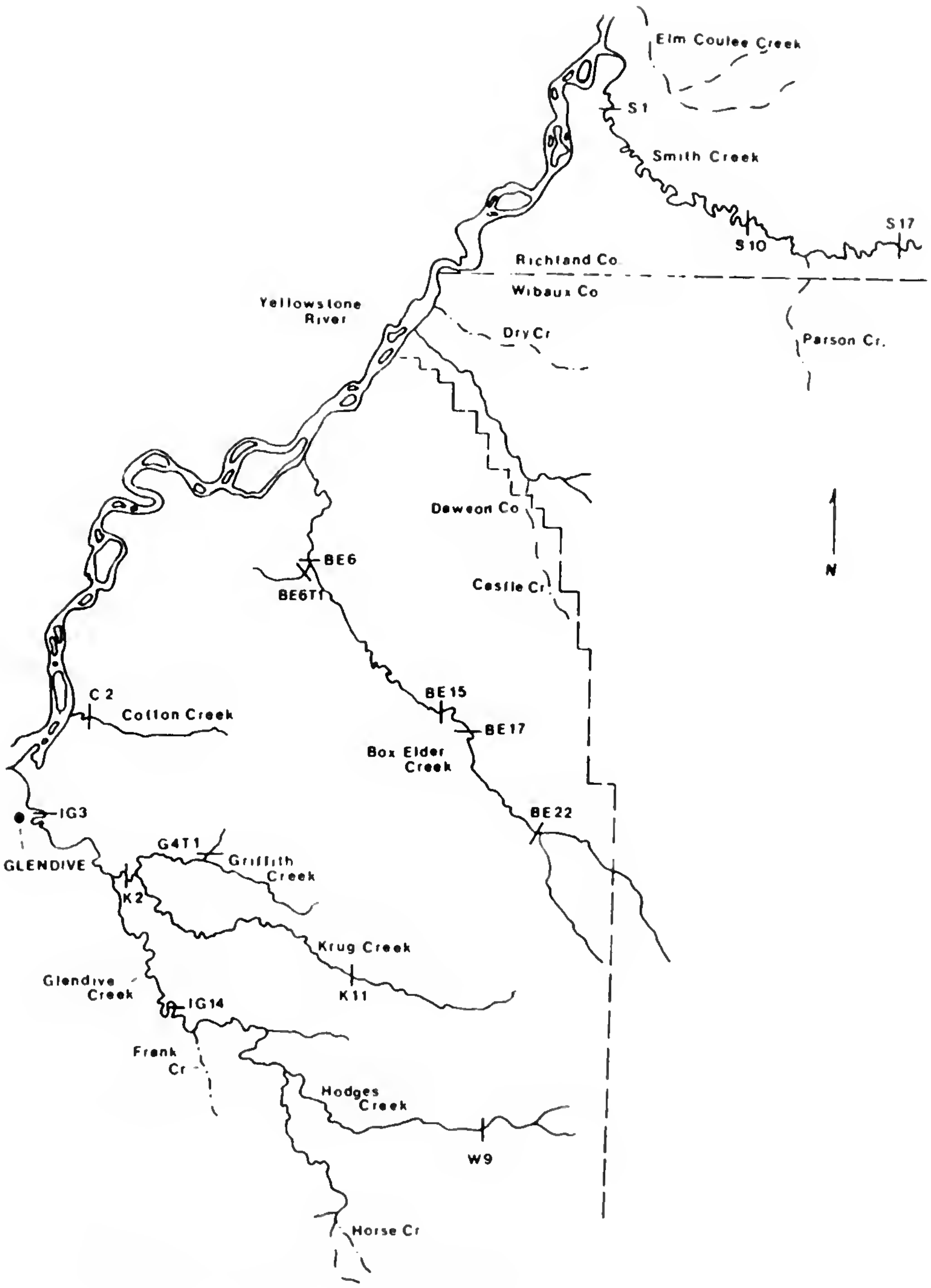


Figure 3. Map of Yellowstone River triutaries, showing study sections. Streams which were intermittent and not included are shown by broken lines.

to form deep pools with more frequent riffle areas. Steep, eroded banks line the lower reach, resulting in an extremely silt-laden substrate. The change in elevation from source to mouth was 324.0 m (Figure 4). Habitat conditions of the tributaries were similar to those noted for Beaver Creek. Substrate of most study streams was muddy.

A total of 24 intensive sampling stations were established on Beaver Creek. The number corresponding to the number of the section that the creek flowed through was assigned to the station. Physical parameters were measured, aquatic invertebrates and fish populations were sampled at each site. Specific locations for each section are shown in Appendix I. Each named tributary was given an alphabetical designation and sampled as follows: Little Beaver Creek (LB), 3 sections; Hay Creek (H), 2 sections; Lame Steer Creek (L), 2 sections; Smith Creek (S), 3 sections; Box Elder Creek (BE), 5 sections; Cotton Creek (C), 1 section; Glendive Creek (IG), 2 sections; Griffith Creek (G), 1 section; Krug Creek (K), 2 sections; and Hodges Creek (W), 1 section. Specific locations for each sampling section are presented in Appendix II.

METHODS

A visual survey was conducted on all tributaries to Beaver Creek and all west flowing tributaries to the Yellowstone River between Glendive Creek and Smith Creek. Streams which did not contain a steady flow were eliminated from the study. These streams are shown on Figures 2 and 3 as broken lines. Base maps (BLM Surface Management Quads, 1:126,720; USGS topographic quads, 1:24,000) and rectified aerial photos (1:24,000) were used to identify possible study reaches. Each section through which each creek flowed was consecutively numbered starting at the mouth. Study sites were selected for each stream based on habitat conditions (inclusion of variety of habitat types) and access.

Physical parameters were measured at each study section according to stream survey methods outlined in BLM Manual 6671. Field data were recorded on stream habitat survey field form number 6671-1. Water temperatures were recorded at two sections in 1977 (Sections 54 and 84) with Partlow 31 Day Recording Thermographs and at three sections in 1978 (Sections 1, 54 and 84) with Taylor 31-Day Recording Thermographs (Figure 2). Temperatures were recorded in ^{o}F and converted to ^{o}C. Limited chemical analyses were run using a Hach DR-EL 2 and Hach Model AL-36-P. Conductivity and dissolved oxygen were recorded using a YSI model S-C-T meter and a YSI Model 57 oxygen meter, respectively.

Aquatic invertebrates were sampled by a variety of methods. Initial plans for quantitative sampling were abandoned early in the study when it became evident that most sites did not have adequate flowing water for use of either Water's Round or Surber samplers. Organic debris and rocks eliminated the use of a dredge at most sites. Most samples were modified kick samples, and many were taken by digging up the stream bottom with a dip net. A few Water's Round samples were collected. Adult Odonata were collected with an adult net and/or by shooting with a .22 birdshot.

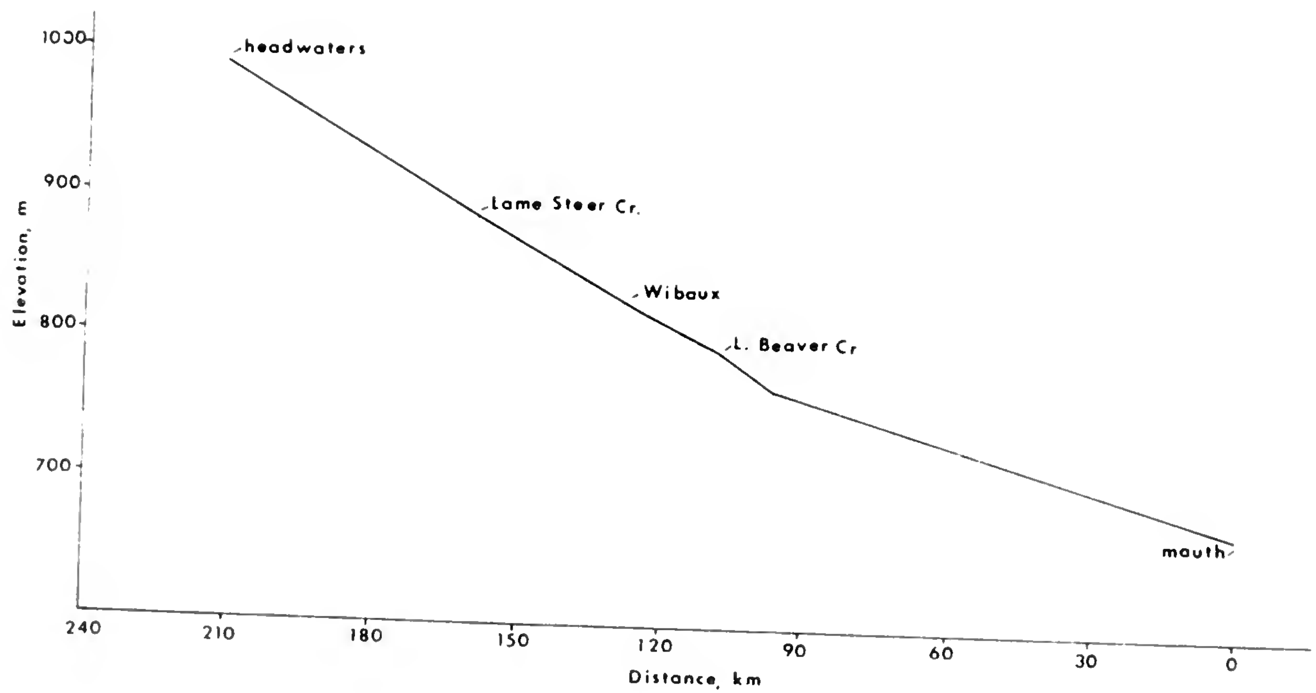


Figure 4. Longitudinal profile of Beaver Creek.

All habitat types at each section were sampled for aquatic invertebrates. Samples from any one site on any one day were combined to give an overall qualitative analysis of the sampling. All samples were fixed in the field in a formalin solution. In the laboratory, bottom samples were washed through a US Series 30 mesh screen and all organisms picked and sorted to the lowest taxa possible without the aid of magnification. Specimens were then preserved in 50 percent alcohol solutions and saved for further identification. The Nematoda, Oligocheata and Diptera were identified by Richard Oswald of Bozeman, Montana, while all other organisms were identified by Barbara Marback Roth of Hillsboro, Oregon.

Several sampling techniques were used to collect and sample fish populations. Electrofishing gear using a mobile positive from the bank or a stationary boom positive on a small fiberglass boat was used during early sampling periods. Seining was conducted with a 25-foot, 1/4 inch mesh bag seine and a 10', 1/4 inch mesh seine. A fine mesh dip net was utilized when sample site consisted of a small trickle of water. Gill nets (125' experimental and 100', 2-inch bar mesh gill nets) were either drifted through deep holes or dead-set. Traps made of reinforcing bar and covered with chicken wire were baited and fished for channel catfish. Setlines were fished overnight during early spring of 1978, however, they were unsuccessful in capturing any game fish.

All game fish were weighed, measured, fin clipped (walleye and sauger) and marked with numbered Floy tags. Scale samples were taken beneath the pectoral fin from the left side. The number of fish of each species was recorded for most samples but when this was not done, relative abundance of each species was recorded. Lengths and weights were not measured on all fish since many of them, particularly cyprinids, are small. Length frequency analyses were completed for those species where such data was taken. Species diversity indicies were calculated for each season according to Newell (1977).

RESULTS

Physical and Chemical Parameters

The runoff pattern of Beaver Creek is typical of a prairie stream, with a bi-modal discharge (Figure 5). Peak runoff occurs in March , followed by a smaller peak in June. Flows then taper off to minimal for the remainder of the year. Maximum discharge for the thirty-year (1938-1968) period of record at Wibaux was 107 m^3/sec (3780 cfs). Historic records indicated flood stages in 1929 and 1872 reaching about 850 m^3/sec (30,000 cfs) . Periods of no flow occur regularly. Mean flow at Wibaux (1938-1968) was 0.63 m^3/sec (22.3 cfs).

General chemical features of the Beaver Creek drainage are shown in Table 1, which summarizes measurements taken during the field study. Alkalinity was high in comparison to other streams, averaging 240 mg/l at the three stations, reflecting the chemical nature of the drainage. Specific conductance increased with progression downstream, from an

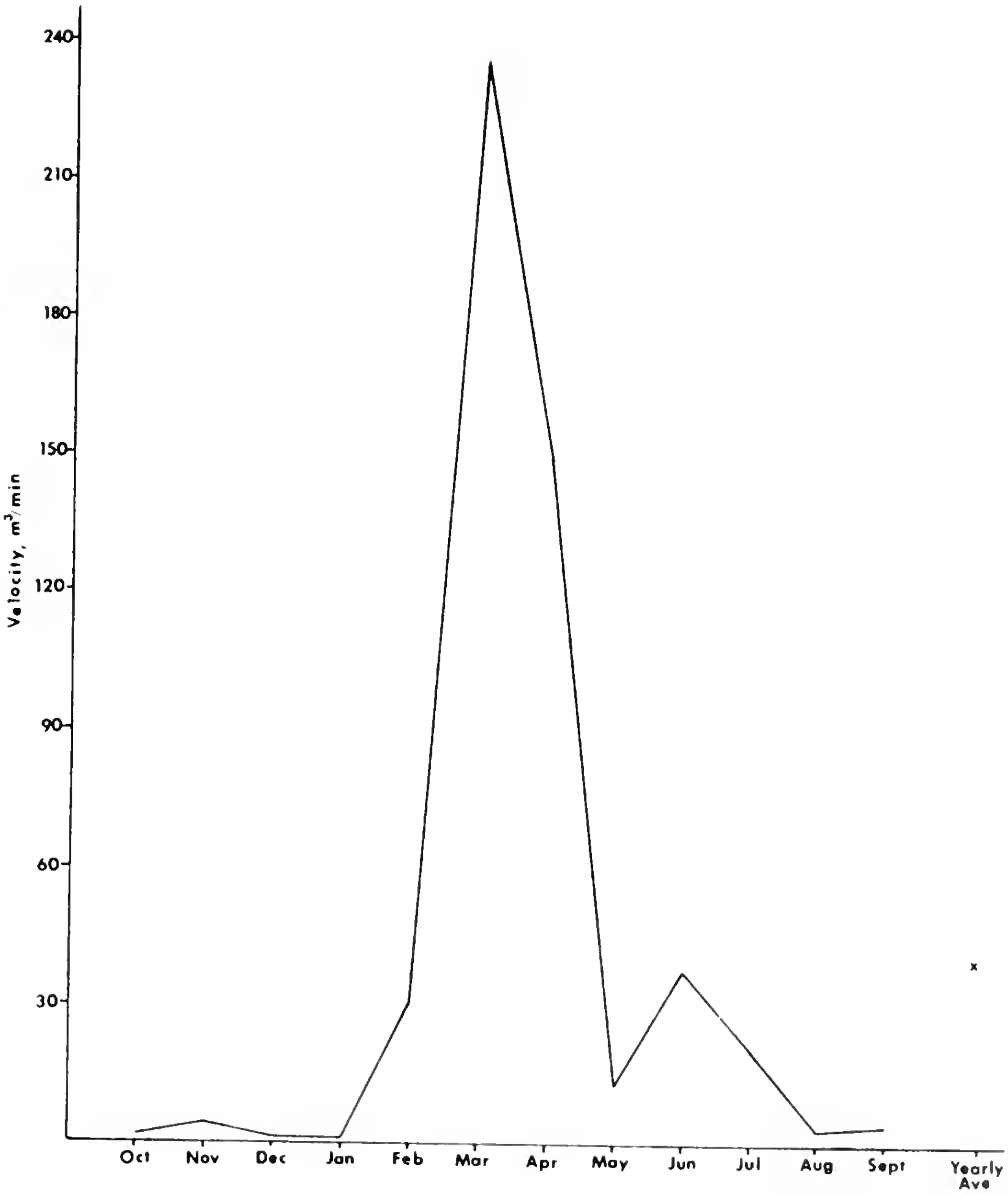


Figure 5. Mean monthly flows for Beaver Creek near Wibaux, for period of record (1938-1968).

average of 1288 umhos/cm at Station 84, to an average of 1922 umhos/cm at Station 1. Turbidities were generally low for a prairie stream reflecting local runoff as a result of storms. The pH ranged from 6.9 to 8.5 while dissolved oxygen levels were considered good. Chemical features of the tributaries were similar to those of the main stem. The Yellowstone tributaries showed similar water chemistries except alkalinities which were considerably higher.

Five day average maximum and minimum water temperatures for April-September, 1977 and 1978 are summarized in Figures 6, 7, 8, and 9. Temperatures exhibited the same general trends with peaks in May and August. The August peak being the yearly maximum. Temperatures declined steadily through late August and September. Maximum temperatures recorded in 1978 were: Section 1 (mouth) 24.3°C; Section 54, 25.0°C; and Section 84, 26.2°C.

Stream Habitat Analysis

Stream habitat conditions were measured at 5 Beaver Creek stations, 2 stations on Little Beaver Creek and 7 lower Yellowstone tributary stations. On Beaver Creek, riffles averaged 10.3 cm in depth as compared to 57.4 cm for pools (Table 2). Widths averaged 3.0 m for riffles and 9.3 m for pools. Habitat conditions were analyzed in terms of optimum conditions for pool frequency, pool quality, substrate materials, bank cover and bank stability as outlined in BLM manual 6671 (Duff and Cooper 1976). These parameters are considered "priority A limiting factors." Pool riffle ratios of 50:50 is considered ideal or optimum. Each pool is rated in terms of width, depth and fish shelter and class 1, 2 or 3 pools are considered good quality pools. Substrate materials are important in terms of fish spawning and aquatic invertebrate production. The amount of each type of substrate material is determined and a ratio of suitable:unsuitable is calculated. Judgements are made concerning bank cover and bank stability. Points are given on each transect, totaled and divided by the total possible to determine the class for the stream reach. Points are totaled, divided by total possible and the percent of optimum obtained. Optimum is considered ideal habitat or 100 percent

All sections measured on Beaver Creek showed habitat conditions ranging between 60 and 85 percent of optimum. The best habitat rating was Beaver 59 with a value of 84.7 percent of optimum. Bank cover and bank stability was considered excellent and showed very little ungulate damage. This reach of stream appeared to be very stable and in good shape. The results of the Beaver Creek habitat analysis suggests that physical conditions on the stream are above average (50% of optimum). Little Beaver Creek had significantly lower habitat conditions than Beaver Creek.

Tributary stream results are shown in Table 3. The best habitat conditions were found on Glendive Creek at Station 14 at 93.7 percent of

Table 1. General chemical parameters measured at three sections on Beaver Creek, 1977 and 1978.

Date	°C Temp	m³/s Discharge	mg/l Alkalinity	Conductance	D.O.	Turbidity	pH
			Section 1				
8/18/77	20.6		250	400	4.5	-	-
4/578	6		110	340	11.8	-	7.0
4/10/78	-		130	700	11.3	-	8.0
4/25/78	13.3	1.88	130	1300	12.0	85	8.5
5/9/78	13.3	2.08	250	1700	11.2	500	8.0
5/25/78	19.0	0.99	230	1900	9.4	40	8.5
6/5/78		3.66	240	1900	9.8	-	8.0
6/14/78	24.0		-	2200	8.6	70	8.5
7/6/78	23.0	4.73	210	1600	8.5	500	8.0
7/17/78	24.0	0.98	150	1750	7.8	120	8.5
7/31/78	24.0	0.47	210	2200	7.5	30	8.0
8/9/78	24.0	0.32	410	2250	8.9	30	7.5
8/21/78	21.0	0.17	400	2110	8.4	15	8.5
8/31/78	18.0	0.05	410	2030	8.4	0	8.5
			Section 54				
8/12/77	16.7		400	-	6.5	60	-
9/22/77	15.6		380	600	7.5	-	-
3/29/78	3.3		65	150	11.2	-	7.5
4/6/78	5.6		100	490	11.2	-	7.5
4/17/78	5.6	1.53	160	950	11.8	30	6.9
4/25/78	10.0		200	1010	12.5	-	7.5
5/5/78	10.0	0.92	210	1250	10.8	10	8.0
5/18/78	15.6	0.89	240	1750	10.9	20	8.0
6/1/78	11.0	1.57	240	1550	11.1	30	7.5
6/20/78	20.0	0.48	220	1800	10.2	10	7.5
7/7/78	21.0	3.73	120	1100	8.0	500	8.0
7/18/78	23.0	0.62	210	1700	9.1	105	8.5
8/1/78	24.0	0.20	380	1850	8.5	30	8.0
8/11/78	21.0	-	250	1700	8.0	20	8.5
8/18/78	14.0	0.02	440	1250	7.4	40	8.5
8/30/78	16.5	T	430	1600	7.1	0	8.0
			Section 84				
8/29/77	14.4		360	1100	6.8	50	8.6
3/14/78	1.0	-	220	990	8.8	-	7.5
3/23/78	0.0	-	-	150	-	-	
3/30/78	0.0	-	60	130	11.8	-	-
4/25/78	7.0	0.36	200	1000	12.5	-	7.5
5/5/78	10.0	-	220	1300	9.1	-	8.5
5/18/78	14.4	0.43	220	1570	9.8	-	8.0
6/1/78	9.4	1.74	220	1300	10.6	50	8.0
6/20/78	16.0	0.13	260	1850	8.4	60	8.0
						10	7.5

Table 1 Continued.

Date	°C Temp.	m^3/s Discharge	mg/l Alkalinity	Conductance	D.O.	Turbidity	pH
			Section 84 continued				
7/7/78	20.0	0.40	140	1200	6.9	210	7.5
7/17/78	23.0	0.28	150	1400	6.0	90	7.5
7/31/78	19.0	0.07	160	1250	4.8	45	7.5
8/9/78	20.0	0.02	410	2250	5.6	10	7.5
8/21/78	18.0	0.02	390	1600	6.2	10	8.5
9/3/78	24.0	0.01	460	2050	6.2	10	7.5

optimum, while the poorest was 27.7 percent at Station 3 on Glendive Creek. The upper reaches of Glendive Creek show good bank cover, stability and very little ungulate use resulting in a high rating. However, the lower reaches of the creek have been altered and the habitat condition rating of 27.7 percent of optimum reflects the stream stability. Box Elder Creek rated good as did Krug Creek, while Cotton Creek and a tributary to Griffith Creek rated fair.

Hydrophytes

Aquatic plants are an important source of food for waterfowl, muskrats and herbivorous fish and insects, forming the food chain base for game fish and water birds. Cover for fish and aquatic invertebrates is also provided by hydrophytes. A list of hydrophytes found in the Beaver Creek and Yellowstone tributary streams is presented in Table 4. The species of hydrophytes in the study area tend to be widespread in geographic affinities. This is indicative of a wide ecological tolerance. Representatives of the other four geographical affinities for the United States constitute approximately 15 percent of this list. Most of the species have in common a tolerance of fluctuating water levels, more specifically, a tolerance to low water. As the margins of the creeks gradually recede, the emergent zone has produced a luxuriant growth of grasses, sedges and rushes, literally, a sedge meadow or fen. Representatives of both lotic and lentic waters were identified in compliance with the diversity of the creek habitats. In lieu of the limited soil types in the study drainages, the overall plant community is surprisingly diverse.

AQUATIC INVERTEBRATES

A list of the aquatic invertebrates found in the Beaver Creek and Yellowstone drainages is shown in Table 5; and their approximate distribution throughout Beaver Creek and the Yellowstone River tributaries is presented in Figures 10 and 11. These do not represent a complete distributional list. They do, however indicate predominate forms.

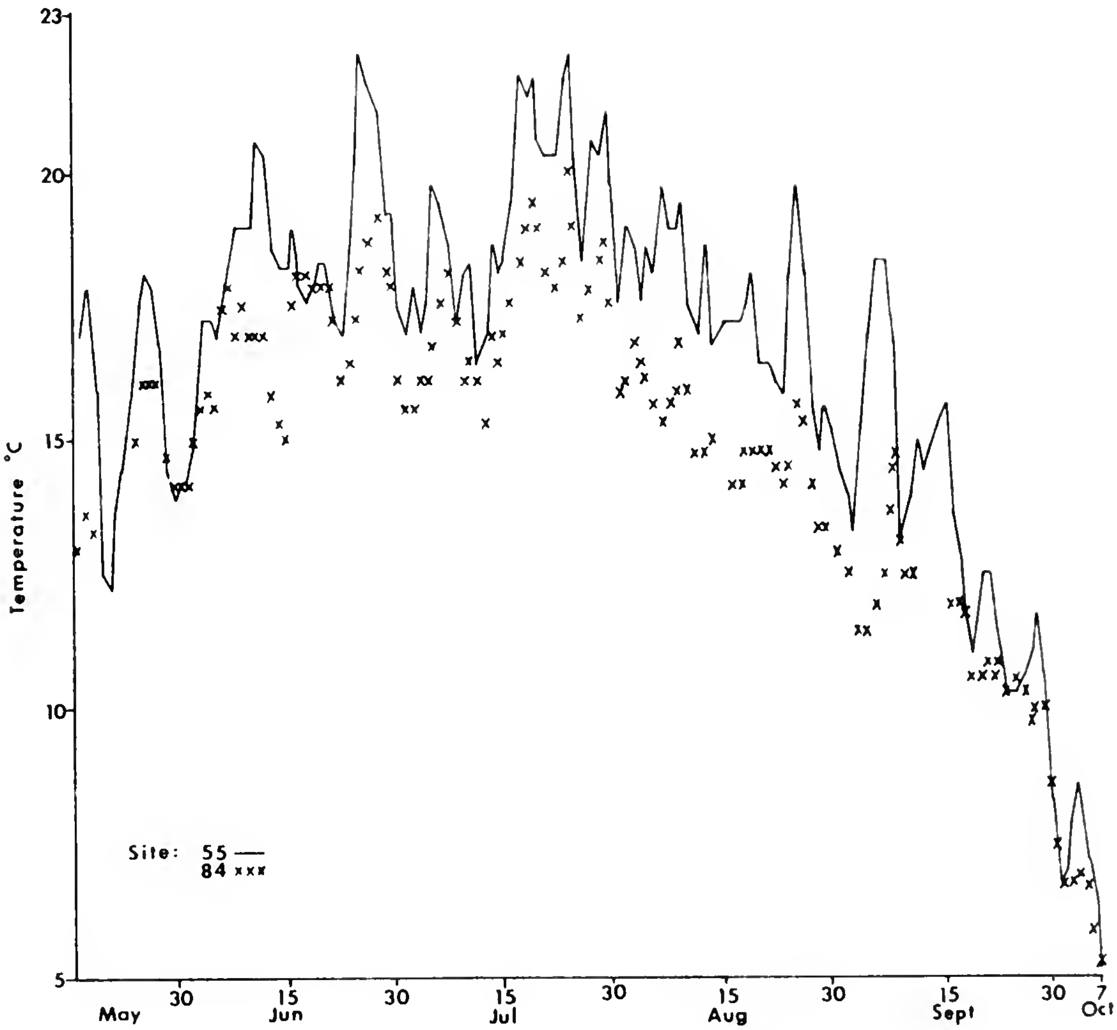


Figure 6. Daily mean water temperatures for sections 55 and 84, Beaver Creek, 1977.

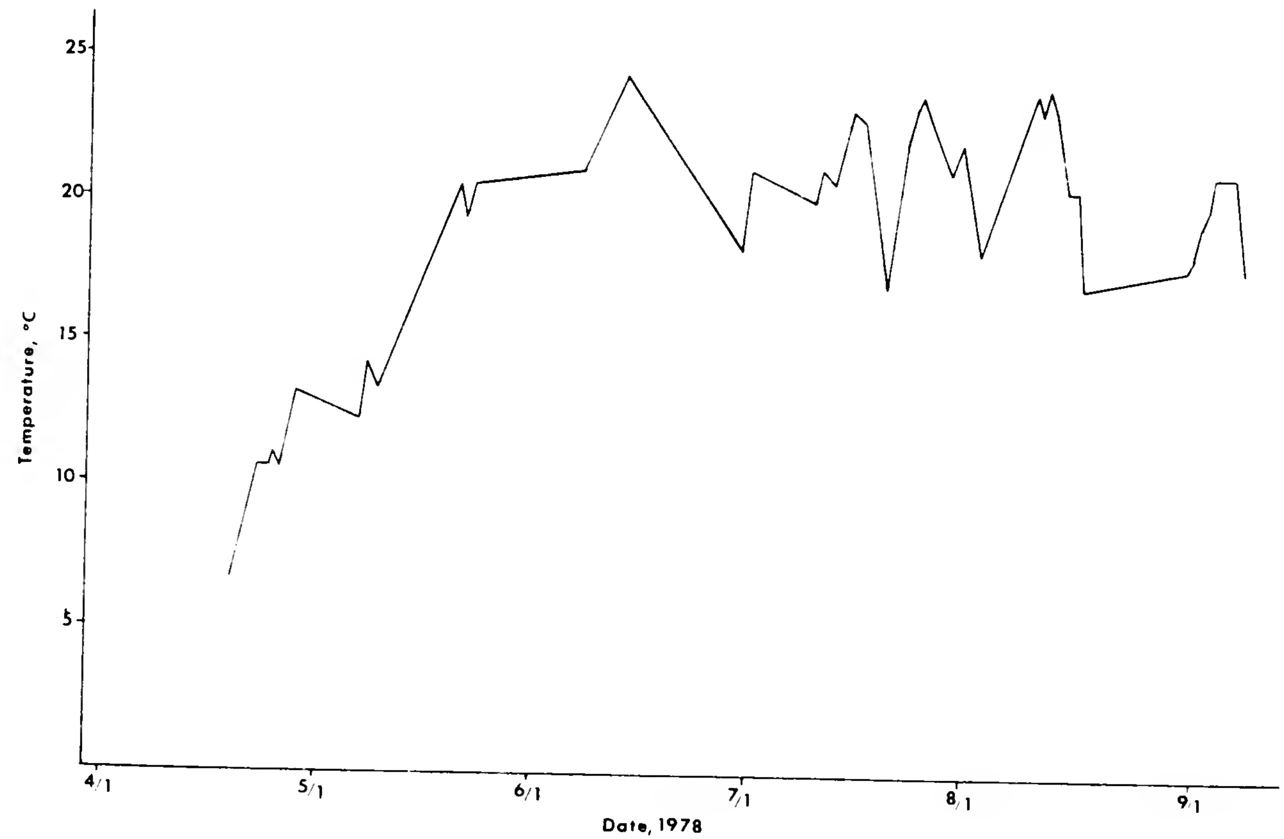


Figure 7. Daily mean water temperatures for section 1, Beaver Creek, 1978.

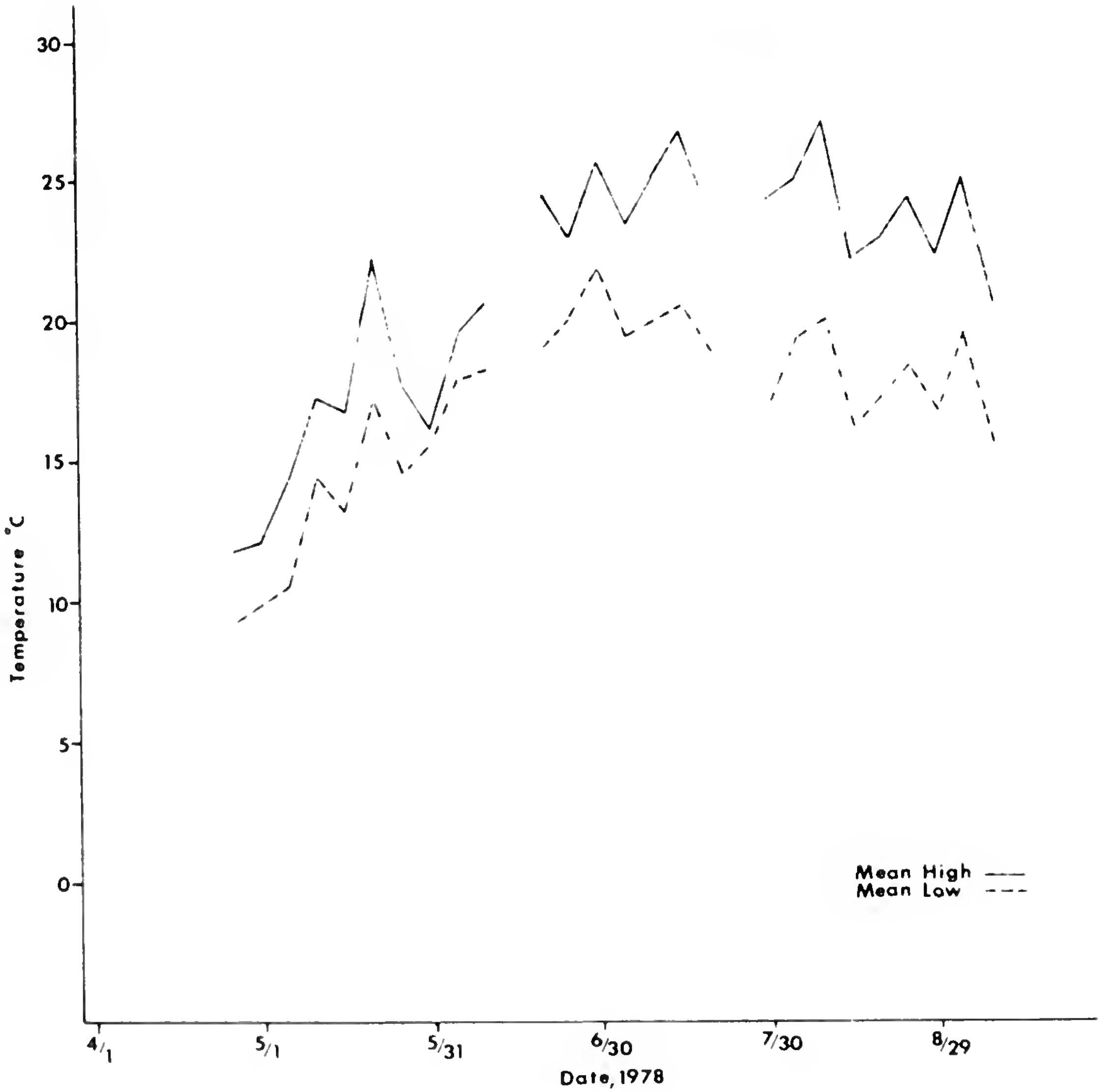


Figure 3. Five-day mean-maximum and minimum water temperatures, section 54, Beaver Creek, 1978.

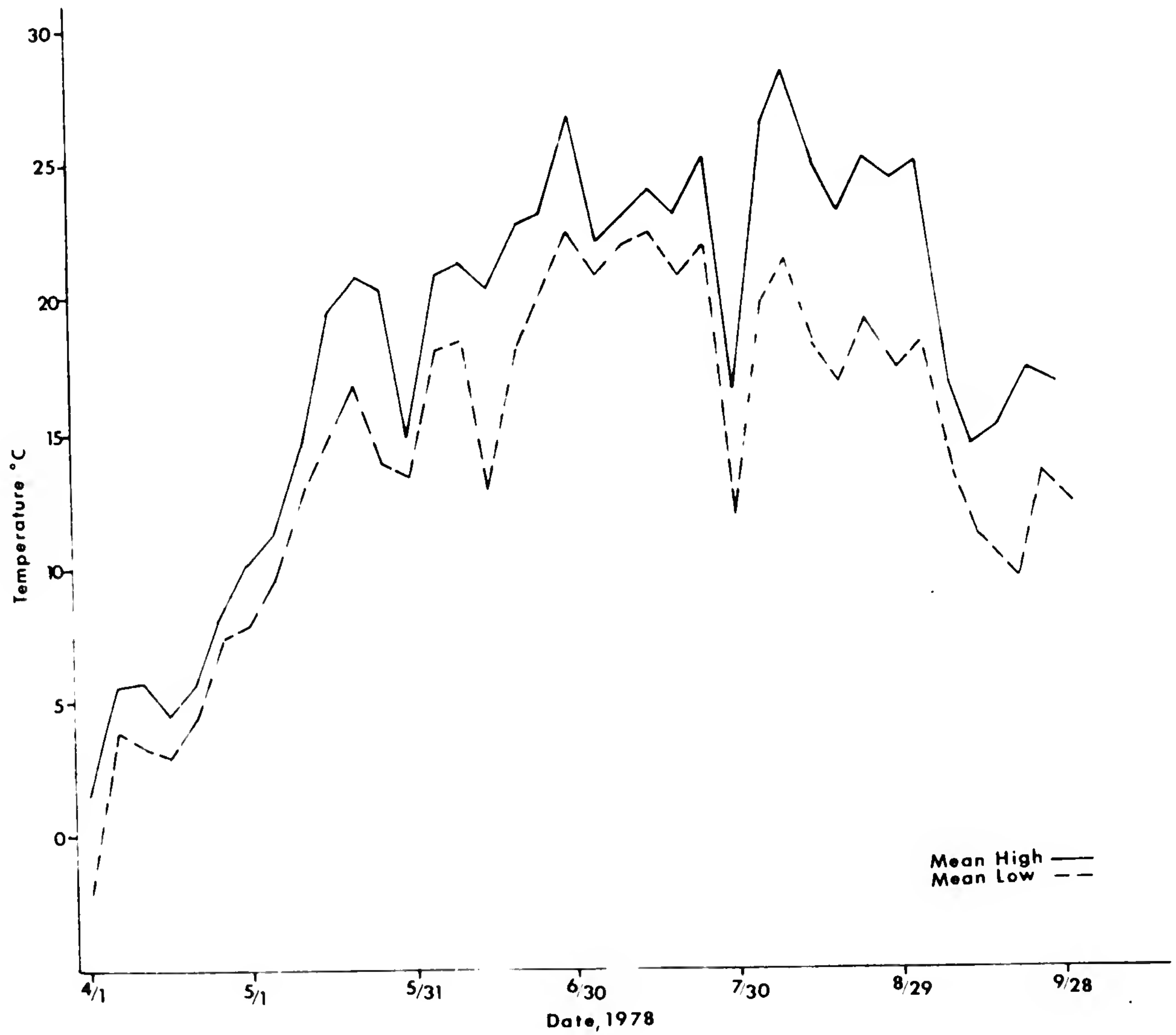


Figure 9. Five-day mean-maximum and minimum water temperatures, section 84, Beaver Creek, 1973.

Table 2. Summary of physical measurements and habitat conditions of Beaver Creek and Little Beaver Creek, 1977.

Section	Distance Above Mouth (km)	Riffles Mean Depth (m)	Riffles Mean Width (m)	Pools Mean Depth (m)	Pools Mean Width (m)	Habitat Conditions (% Optimum)
Beaver 7	14.4	0.04	7.5	0.12	10.1	71.8
Beaver 35	74.0	-	-	0.52	4.9	60.5
Beaver 59	117.5	0.40	5.0	0.54	8.9	84.7
Beaver 84	165.7	0.04	1.5	1.30	9.3	68.2
Beaver 108	201.1	0.04	0.9	0.40	13.4	65.8
Lt. Beaver 5	6.4	0.11	2.1	0.34	4.4	46.0
Lt. Beaver 11	12.9	0.05	1.1	0.40	12.3	42.3

Table 3. Summary of physical measurements and habitat conditions of lower Yellowstone tributaries.

Stream Sec.	Distance Above Mouth (km)	Riffles Mean Depth (m)	Riffles Mean Width (m)	Pools Mean Depth (m)	Pools Mean Width (m)	Habitat Conditions (% Optimum)
Glendive 3	3.2	0.03	3.9	-	-	27.7
Glendive 14	22.5	0.04	2.2	0.08	5.0	93.7
Box Elder 1	1.6	0.06	1.6	0.23	3.9	87.1
Box Elder 6	9.7	0.01	2.6	0.16	7.5	72.7
Krug 11	19.3	0.02	0.1	0.27	6.3	65.4
Cotton 2	1.6	0.04	2.0	-	-	40.0
Griffith 1	1.6	0.02	0.4	0.07	2.9	38.2

Acroneuria sp is the only species of stonefly collected in Beaver Creek and its tributaries. The substrate and flow patterns of these creeks are not conducive to stonefly development. Intermittence of the creek coupled with sluggish current, shifting and mucky substrates are limiting this group. Stoneflies are most successful in cobble and gravel substrates of permanent streams (Hynes 1976).

Caenis sp and *Callibaetis* sp are the two most widely distributed mayflies in Beaver Creek. These two genera are tolerant of a wide variety of environmental conditions but seem to prefer productive, slow moving waters. *Caenis* sp. and *Callibaetis* sp. are the dominant mayflies in Sarpy Creek which is similar to Beaver Creek in many respects (Clancey 1977).

Table 4. List of hydrophytes for the Beaver Creek Aquatic Study.

Submersed Hydrophytic Species	Yellowstone	Beaver Creek
Potamogeton pectinatus	C	C
P. foliosus	F	F
Zannichellia palustris	C	C
Ceratophyllum demersum	C	C
Myriophyllum exalbescens	F	F
Vallisneria americana	NF	R
Ranunculus longirostris	UC	UC

Emersed Hydrophytic Species	Yellowstone	Beaver Creek
Glycyrrhiza lepidota	C	C
Scirpus americanus	C	C
S. paludosus	R	R
Juncus torreyi	NF	R
J. nodosus	NF	R
J. balticus	NF	UC
J. effusus	C	C
Spartina pectinata	C	C
Bouteloua gracilis	F	F
Hordeum jubatum	C	C
Elymus sp.	UC	F
Solidago missouriensis	C	C
S. canadensis	C	C
Asclepias speciosa	C	C
Xanthium sp.	C	C
Ranunculus glaberrimus	F	C
Potentilla anserina	F	F
Typha latifolia	NF	F
T. angustifolia	R	F
T. angustifolia x latifolia	NF	R
Alisma subcordatum	NF	UC
Sagittaria cuneata	UC	UC
Triglochin sp.	R	R
Mentha arvensis	C	C
Lycopus americanus	C	C
Eleocharis acicularis	C	C
E. palustris	C	C
Cyperus sp.	C	C
Carex sp.	C	C
Polygonum persicaria	F	C
P. natans	R	F
Rumex sp.	C	C
Echinocloa crus-gali	F	F
Panicum sp.	F	F
Equisetum kansanum	F	F
E. arvense	F	F
Ratibidia columnifera	C	C
Lychnis sp.	NF	R

Table 4. Continued

Emersed Hydrophytic Species Continued	Yellowstone	Beaver Creek
Cirsium arvense	C	C
C. undulatum	C	C
Clematis ligusticifolia	F	C
Sonchus uliginosus	F	F
Plantago patagonica	R	NF
Agropyron sp.	C	C
Andropogon sp.	C	C
Rosa woodsii	C	C
Distichlis stricta	C	C

* C - Common
F - Frequent
UC - Uncommon
R - Rare
NF - Not Found

Damselflies and dragonflies are abundant in Beaver Creek. This group is generally associated with sluggish waters in which they cling and climb among the plant forms. *Ishnura* sp. and *Enallagma* sp. appear to be distributed throughout the creek.

Cheumatopsyche sp. is the most common caddisfly in the creek. This genus seems to be tolerant of severe environmental conditions such as warm temperatures, intermittence, low dissolved oxygen levels and shifting substrates which limit other caddisflies.

Hyalella azteca is found predominately in the upper reaches of the stream. This amphipod is closely tied to sluggish water and a high density of plant materials (Eggleton 1952). The downstream portions of the creek are more lotic and contain fewer aquatic macrophytes which are preferred by *Hyalella azteca*.

Diptera is the most common group of invertebrates in Beaver Creek (Figure 11). Their numbers increase steadily from the mouth up to a point near Section 84 and then decrease. This may be due to intermittence in the upper most sections which eliminates some forms.

The chironomid fauna is typical of a warm, slow moving stream. The subfamilies Tanypodinae and Chironominae are widely distributed while the Orthocladiinae are rare. In South Dakota streams Hudson (1971) found Tanypodinae and Chironominae most commonly in slow waters of warm climates. These two groups are tolerant of low oxygen stress (Oliver 1971). The Orthocladiinae are common under a wide range of conditions but in general prefer cooler waters (Hudson 1971). They generally decrease in numbers as water temperatures increase (Oliver 1971).

Table 5. Relative abundance of organisms found in each drainage.

Taxa	DRAINAGE Beaver Creek	Yellowstone
Nematoda	XR	XR
Nematomorpha		
Paragordius	XR	R
Annelida		
Oligochaeta		
Tubificidae		
Limnodrilus claparedianus	R	XR
L. hoffmeisteri	R	XR
L. spiralis	XR	A
L. udekemianus	C	C
Limnodrilus (immatures)	C	C
Hirudinea		
Glossiphoniidae	R	A
Erpobdellidae	R	A
Piscicolidae	R	XR
Arthropoda		
Arachnoidea		
Eylais	R	C
Crustacea		
Cladocera		
Polyphemus	XR	XR
Isopoda		
Lirceus	XR	A
Amphipoda		
Hyalella azteca	VC	VC
Decapoda		
Astacidae	XR	A
Insecta		
Diptera		
Tipulidae		
Hexatoma	XR	XR
Tipula	XR	XR
Tabanidae	R	R
Stratiomyidae		
Eulalia	XR	A
Nemotelus	A	XR
Stratiomyia	R	A
Dolichopodidae		
Hydrophorous	XR	XR
Ephydridae		
Ephydra	R	XR
Sciomyzidae		
Sepedon	XR	XR
Culicidae (pupae)	XR	A
Culex	R	C
Anopheles	XR	A
Chaoboridae		
Chaoborus	XR	XR

Table 5. continued

Taxa	Beaver Creek	Yellowstone
Simuliidae		
Simulium	C	C
Ceretopogonidae		
(Tribe) Stilobezziini	R	R
Chironomidae (pupae)	C	R
(sub-family) Tanypodinae		
Ablabesmyia	XR	XR
Procladius	R	R
Tanypus	R	C
Theinemannimyia (group)	R	XR
(sub-family) Chironominae		
Chironomus	VC	VC
Cladotanytarsus	C	R
Cryptochironomus	R	R
Cryptocladopelma	XR	A
Dicrotendipes	C	C
Endochironomus	C	C
Glyptotendipes	R	A
Leptochironomus	R	A
Micropsectra	R	R
Parachironomus	XR	A
Paralauterborniella	XR	A
Paratendipes	XR	XR
Paratanytarsus	XR	A
Pharnopsectra	XR	A
Polypedilum	XR	XR
Pseudochironomus	C	A
Rheotanytarsus	XR	A
Stictochironomus	XR	A
Tanytarsus	C	R
Saetheria tylus	XR	A
(sub-Family) Orthocladiinae		
Acricotopus	R	R
Cardiocladius	A	XR
Cricotopus	R	A
Hydrobaenus	A	XR
Orthocladius	XR	XR
Parametriocnemus	XR	A
Trichocladius	A	XR
Plecoptera		
Acroneuria	XR	XR
Ephemeroptera		
Baetidae		
Caenis	VC	C
Callibaetis	C	C
Centroptilum	C	R
Leptophlebia	A	XR
Tricorythodes	XR	A

Table 5. continued

Taxa	Beaver Creek	Yellowstone
Ephemeridae		
Hexagenia	R	A
Heptageniidae		
Heptagenia	XR	A
Stenonema	XR	A
Odonata		
Aeschnidae		
Aeshna	R	R
Anax	A	XR
Calopterygidae		
Calopteryx	XR	A
Coenagrionidae		
Argia	XR	XR
Amphiagrion	XR	XR
Enallagma	C	C
Ischnura	C	C
Lestes	C	C
Gomphidae		
Gomphus	R	R
Libellulidae		
Libellula	XR	R
Pantala	XR	A
Perithemis	A	R
Sympetrum	XR	XR
Tarnetrum	XR	C
Plathemis	A	XR
Hemiptera		
Corixidae		
Graptocorixa	VC	VC
Belostomatidae		
Belostoma	XR	A
Gerridae		
Gerris	R	R
Naucoridae		
Ambrysis	XR	A
Nepidae		
Ranatra	XR	XR
Notonectidae		
Notonecta	R	R
Trichoptera		
Hydropsychidae		
Cheumatopsyche	C	XR
Hydropsyche	C	A
Leptoceridae		
Arthripsodes	XR	A
Limnephilidae		
Limnephilus	XR	A
Psychomyiidae		
Psychomyia	XR	XR

Table 5. continued

Taxa	Beaver Creek	Yellowstone
Phryganeidae		
Ptilostomis	XR	A
Coleoptera		
Dytiscidae		
Bidessus	XR	A
Colymbetes	XR	XR
Dytiscus	XR	XR
Hydaticus	XR	R
Hydroporus	XR	R
Hydrovatus	XR	XR
Laccodytes	XR	XR
Notomicrus	XR	A
Oreodytes	R	A
Rhantus	A	XR
Elmidae	XR	A
Dubiraphia	C	C
Haliplidae		
Haliplus	XR	R
Peltodytes	R	R
Hydrophilidae		
Berosus	R	XR
Helophorus	XR	XR
Hydrochara	XR	A
Hydrochus	XR	A
Hydrophilus	XR	XR
Phaenonotum	A	XR
Tropisternus	XR	R
Lampyridae	XR	A
Mollusca		
Gastropoda (unknown)	C	R
Lynmaeidae	C	C
Physidae	VC	VC
Planorbidae	VC	R
Pelecypoda		
Margaritanidae		
Magaritifera	C	A

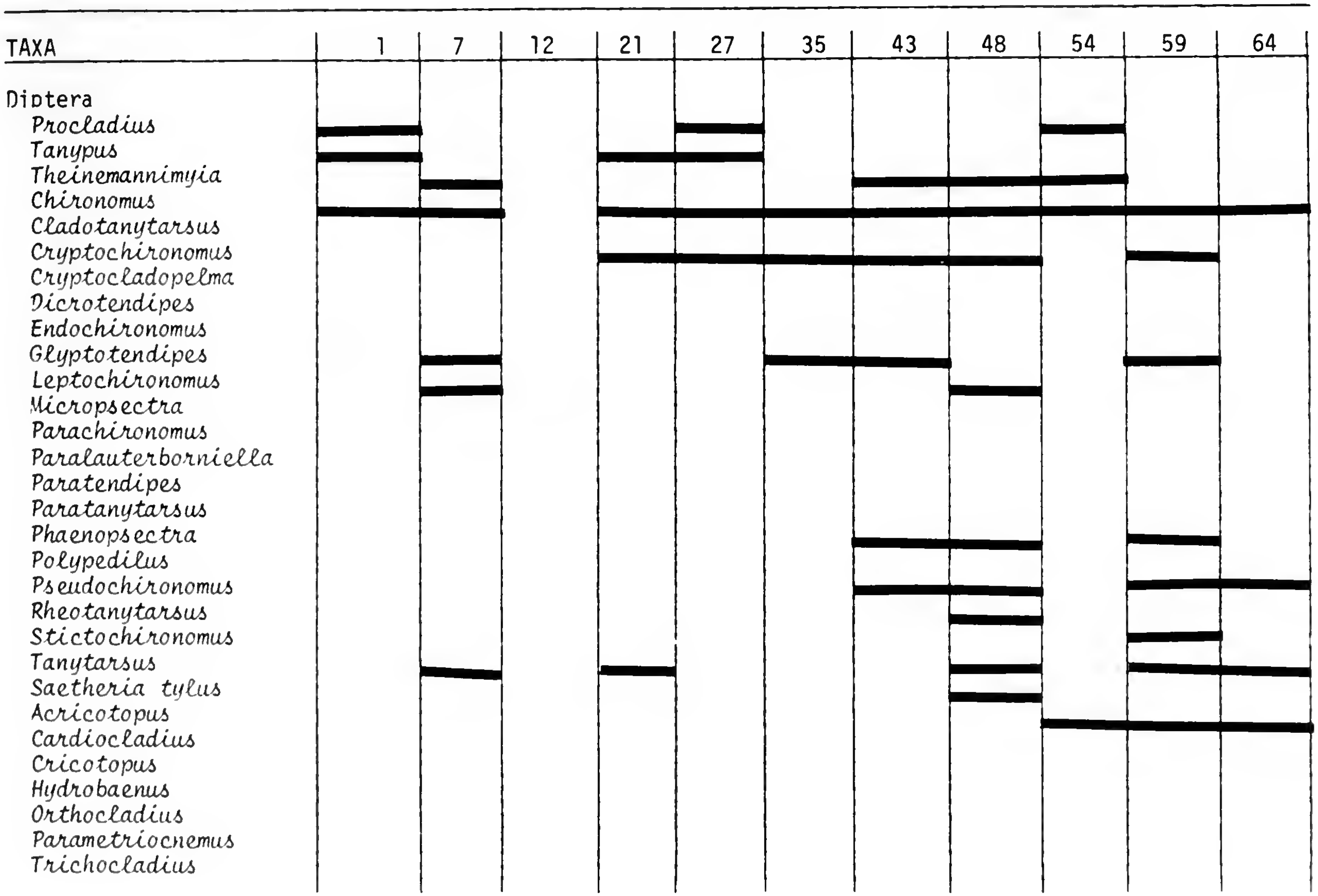
Key:

A - absent;
XR - extremely rare - <50 individuals collected and found in <10% of the sites, or all individuals (number not significant) collected at one site;
R - Rare - <50 individuals but found at >10% of the sites;
C - common - 50 to 400 individuals, or >400 individuals but found at <50% of the sites;
VC - very common - >400 individuals and found at >50% of the sites, or individuals found at >75% of the sites.

Figure 10. Distribution of taxa at all sites in the Beaver Creek Drainage.

TAXA	SITE 1	7	12	21	27	35	43	48	54	59	64
Nematoda										X	
Paragordius											X
Oligochaeta											
Limnodrilus claparedianus											
Limnodrilus hoffmeisteri	X	X					X			X	
Limnodrilus spiralis											
Limnodrilus udekemianus		X					X	X	X	X	X
Limnodrilus (immatures)		X					X	X	X	X	X
Hirudinea											
Glossiphoniidae							X				
Erpobdellidae										X	X
Piscicolidae										X	
Acari											
Eylais											
Cladocana											
Polyphemus											
Isopala											
Lirceus										X	X
Amphipoda											
Hyalella azteca									X	X	X
Decapoda											
Astacidae											
Diptera											
Hexatoma											X
Tipula					X						
Tabanidae		X						X		X	X
Eulalia											
Nemotelus											
Stratiomyia						X					
Hydrophorous				X							
Ephydra										X	
Sepedon											
Culicidae (pupae)											
Culex										X	
Anopheles											
Chaoborus											
Simulium		X			X	X		X			
Stilobezziini											
Chironomidae (pupae)		X				X	X			X	X
Ablabesmyia							X				

Figure 10. Continued



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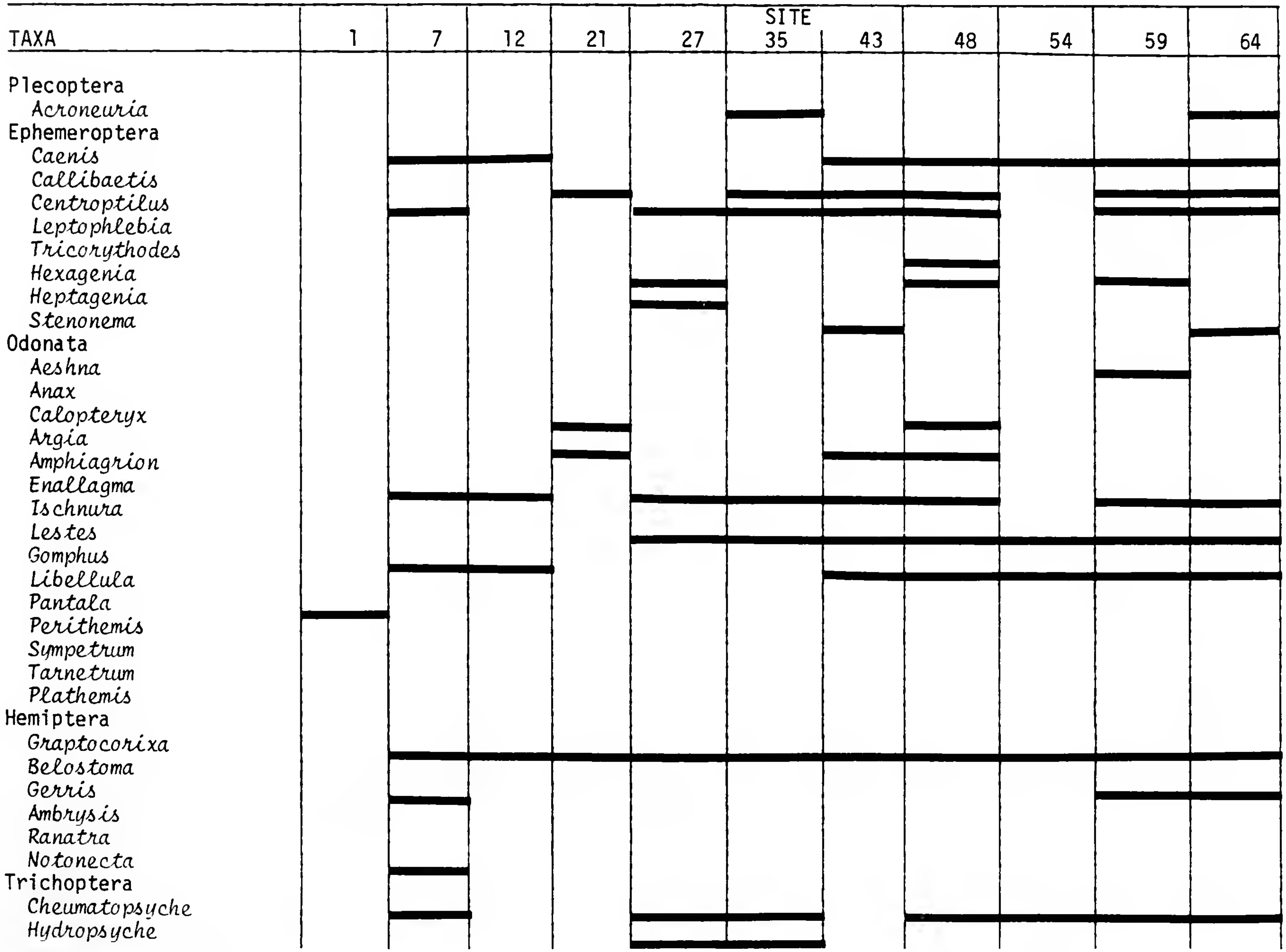

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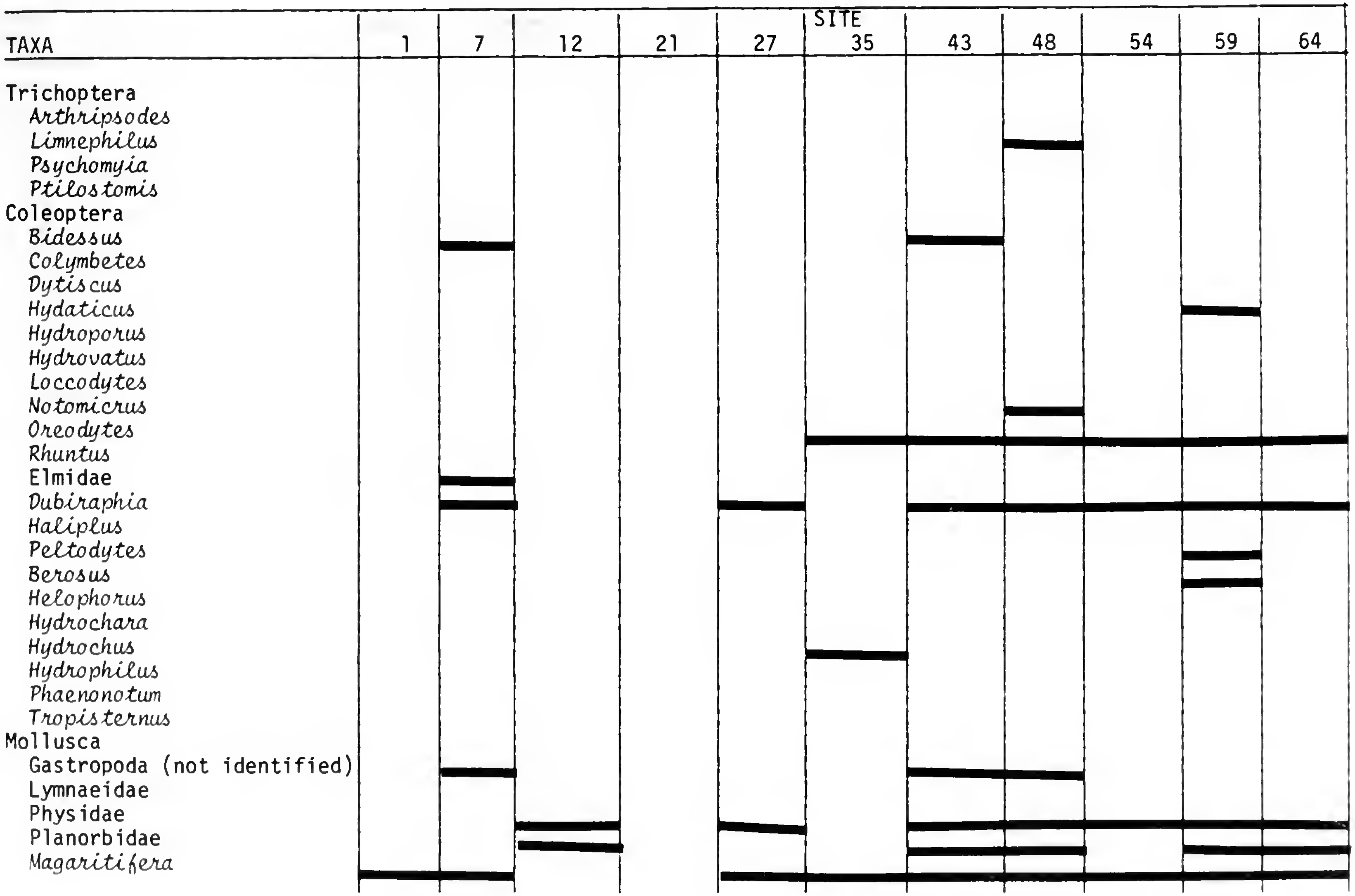

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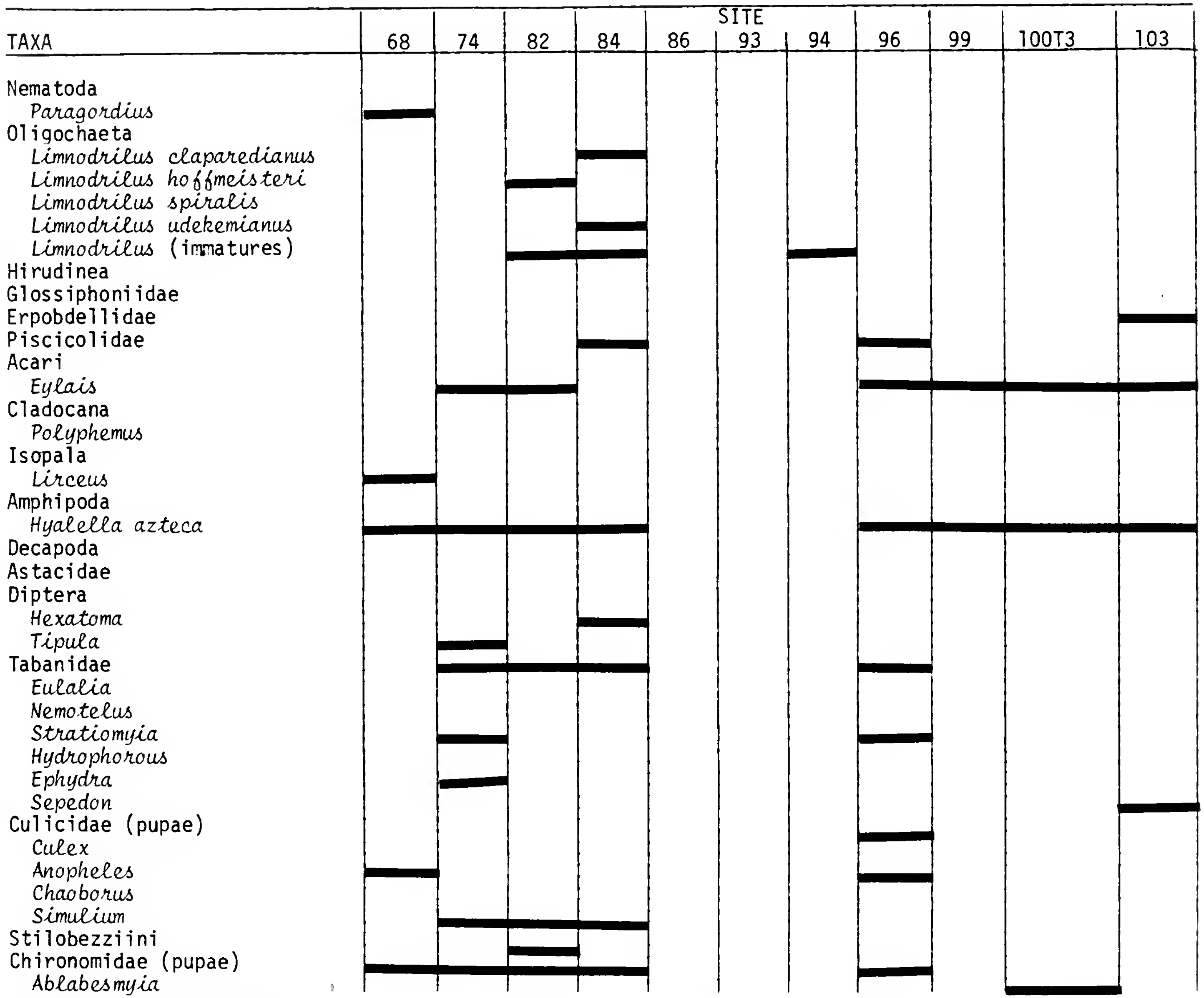

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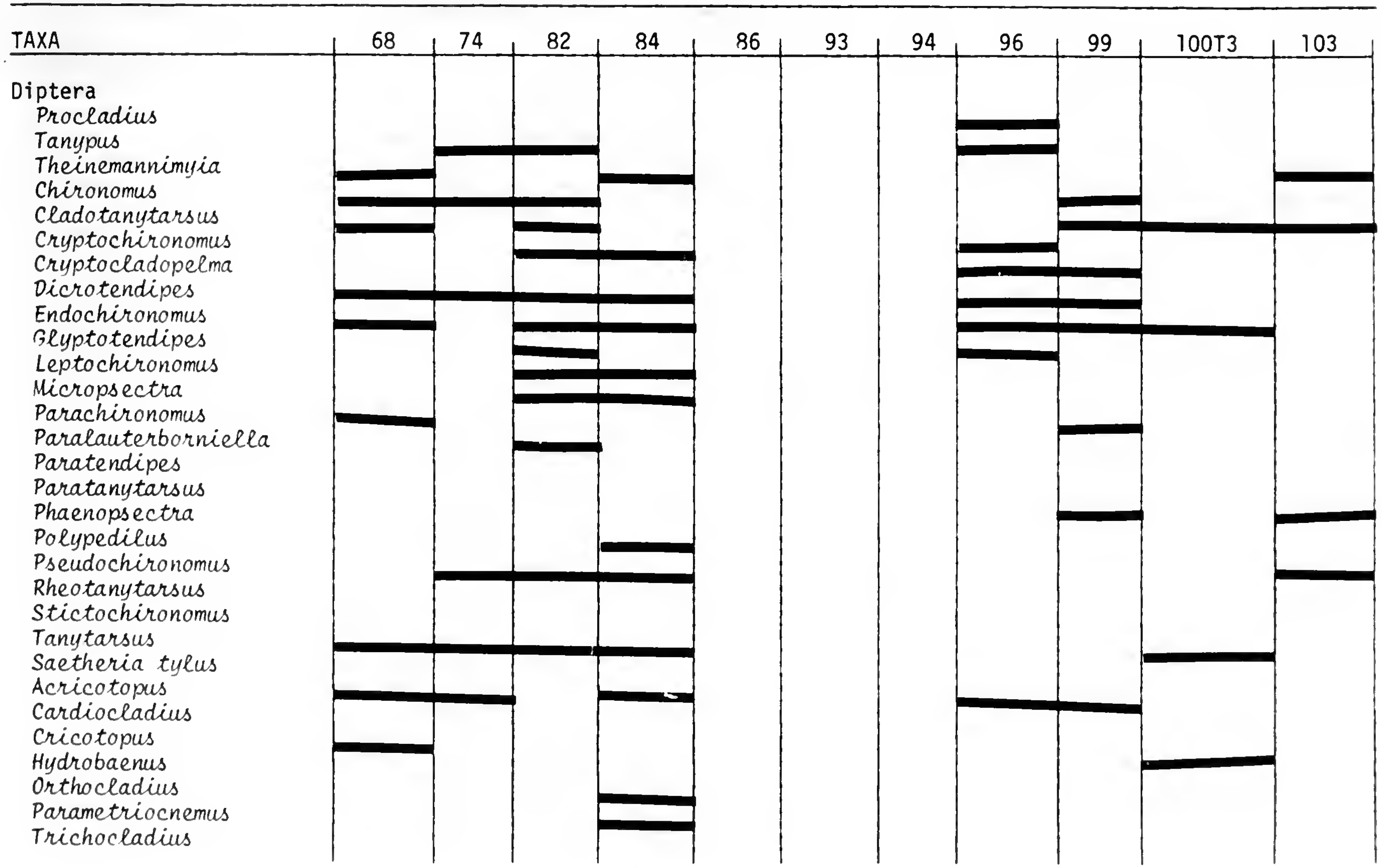

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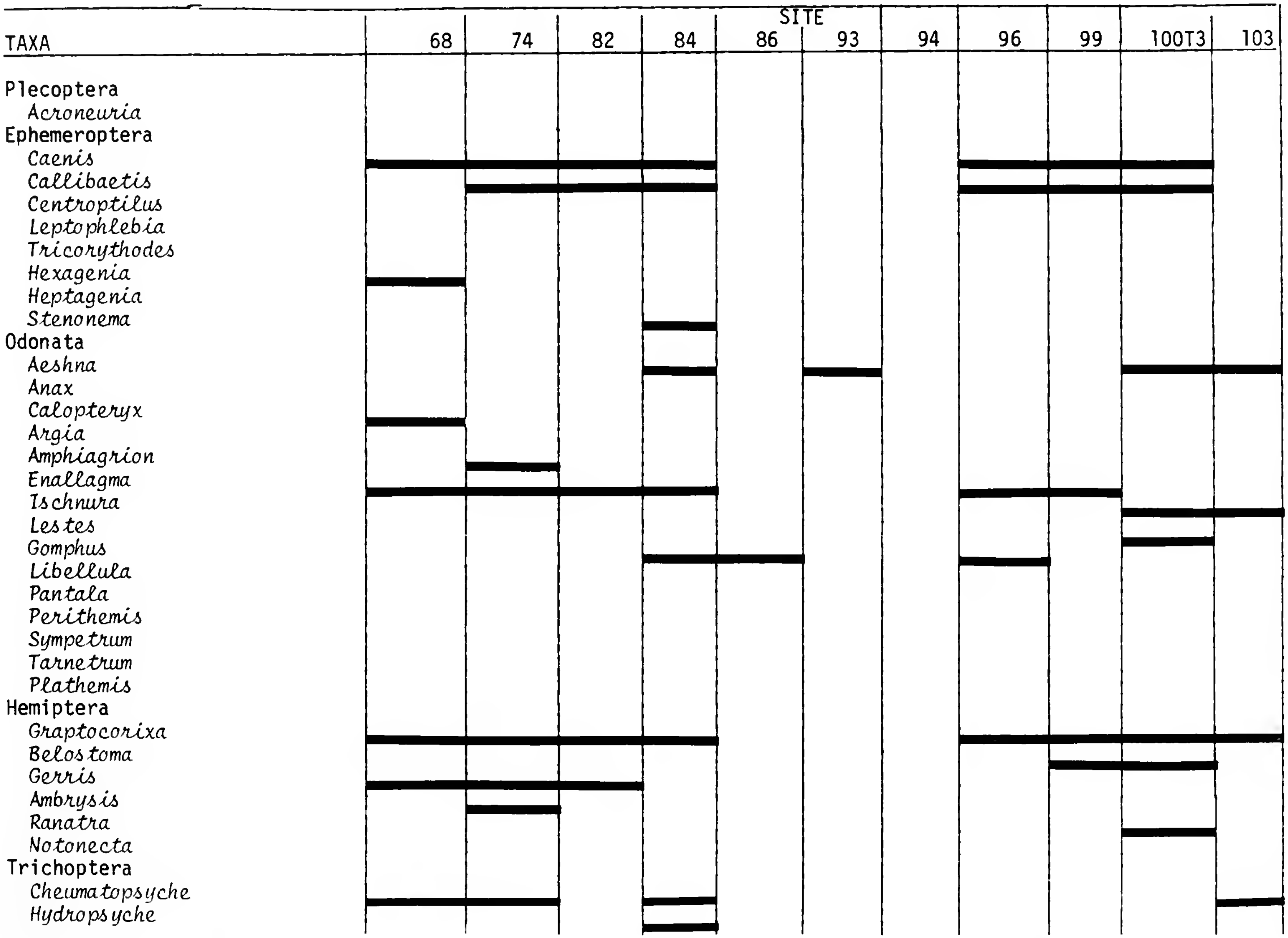

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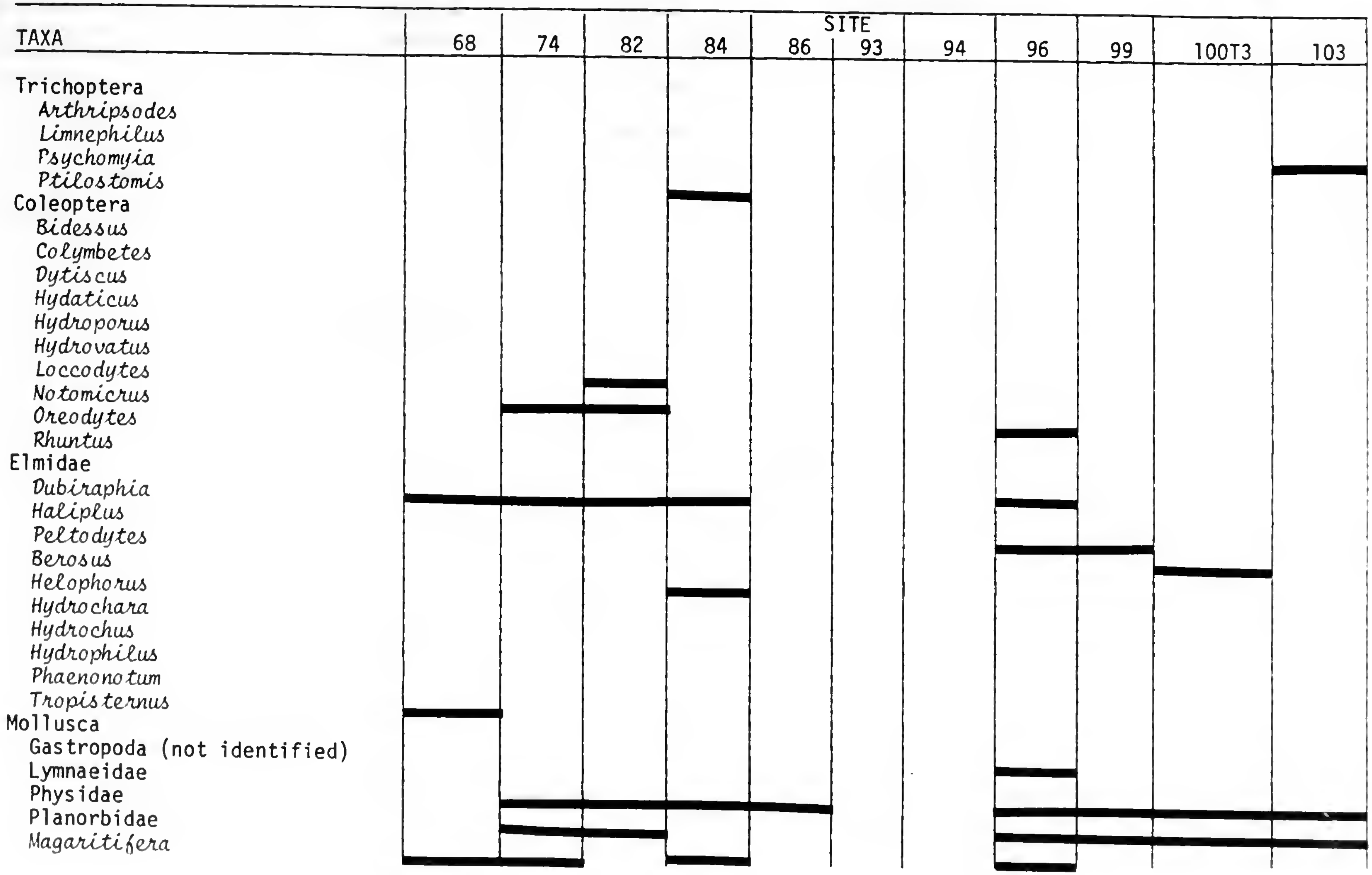

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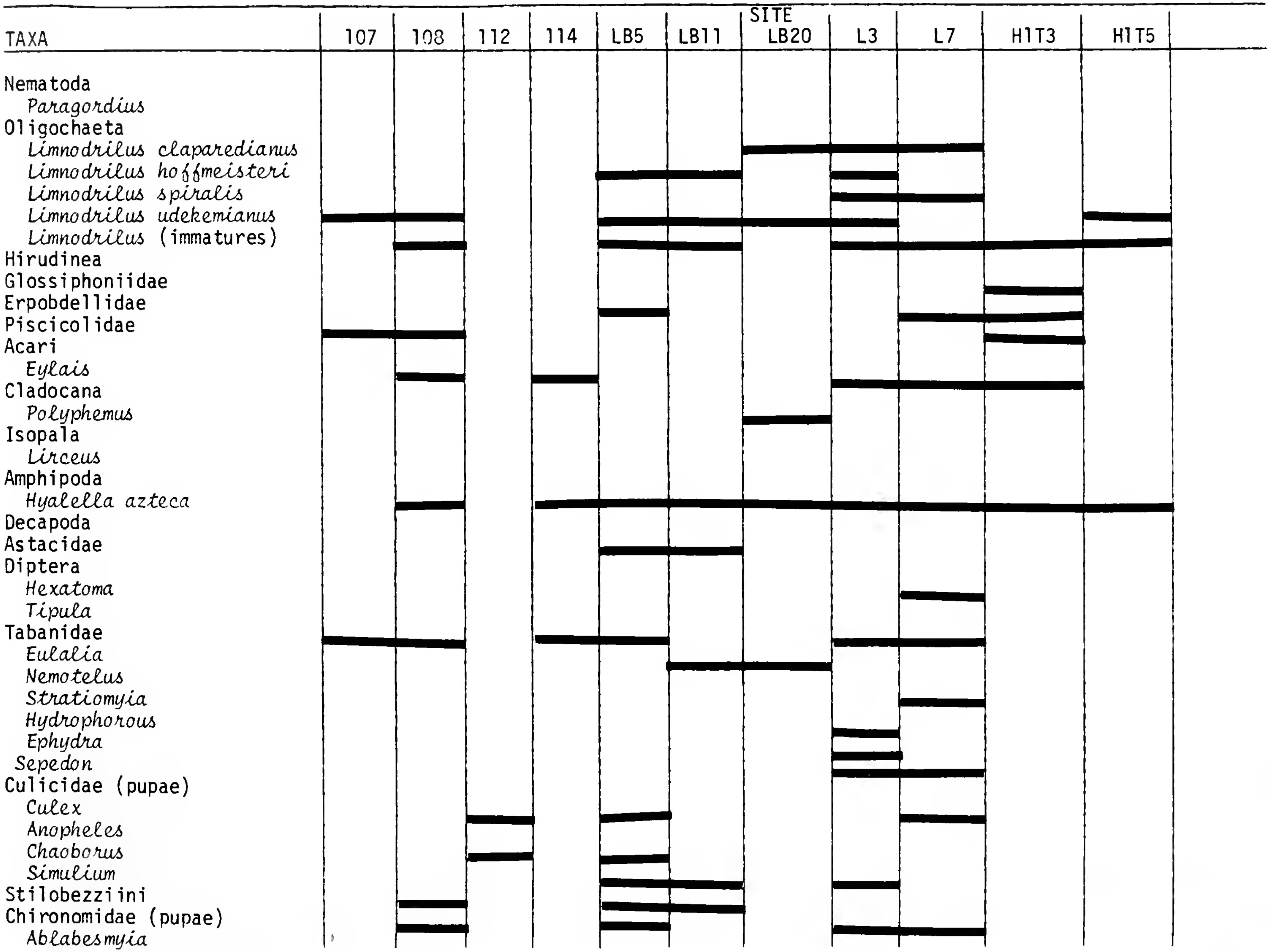

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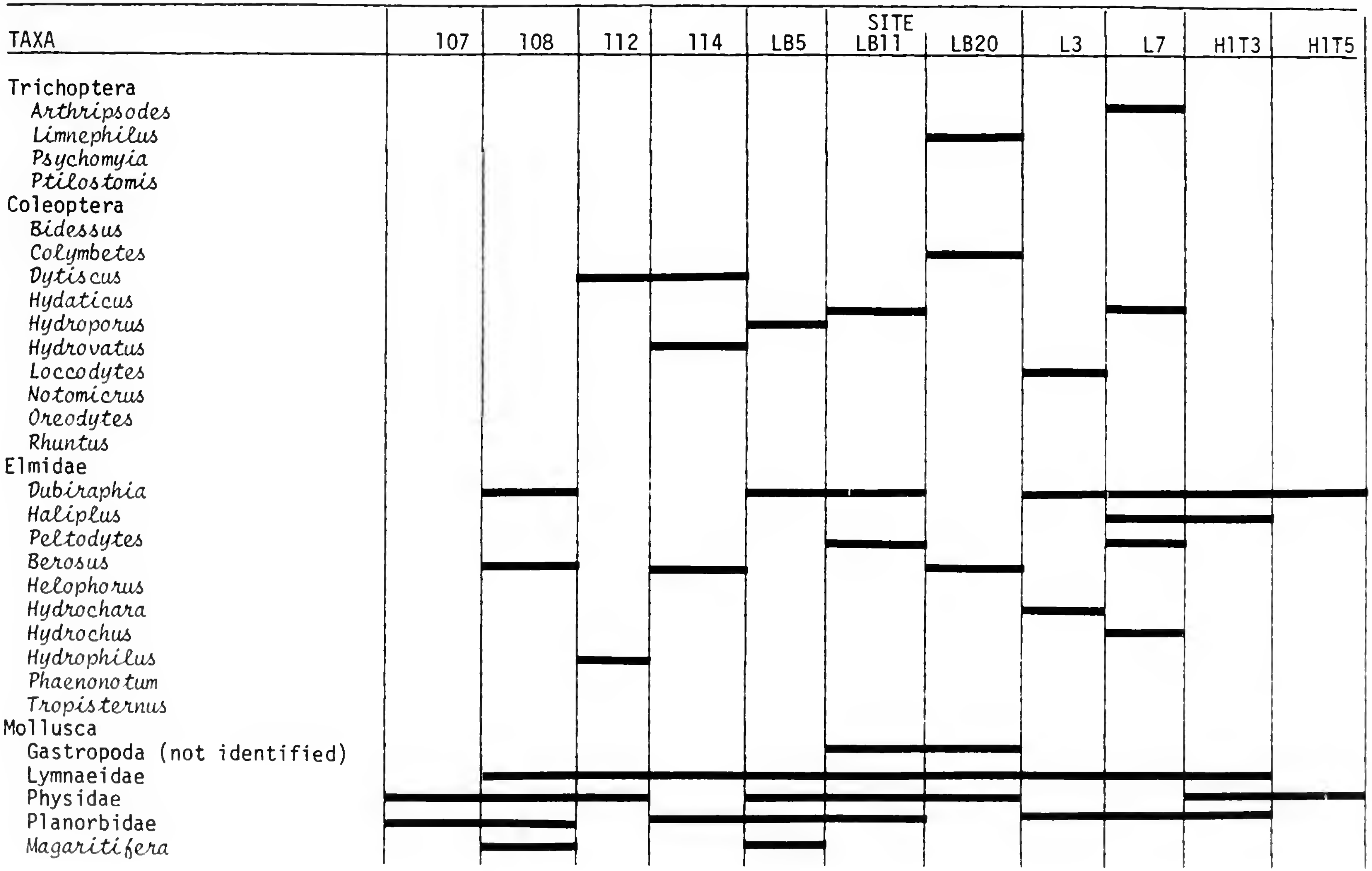

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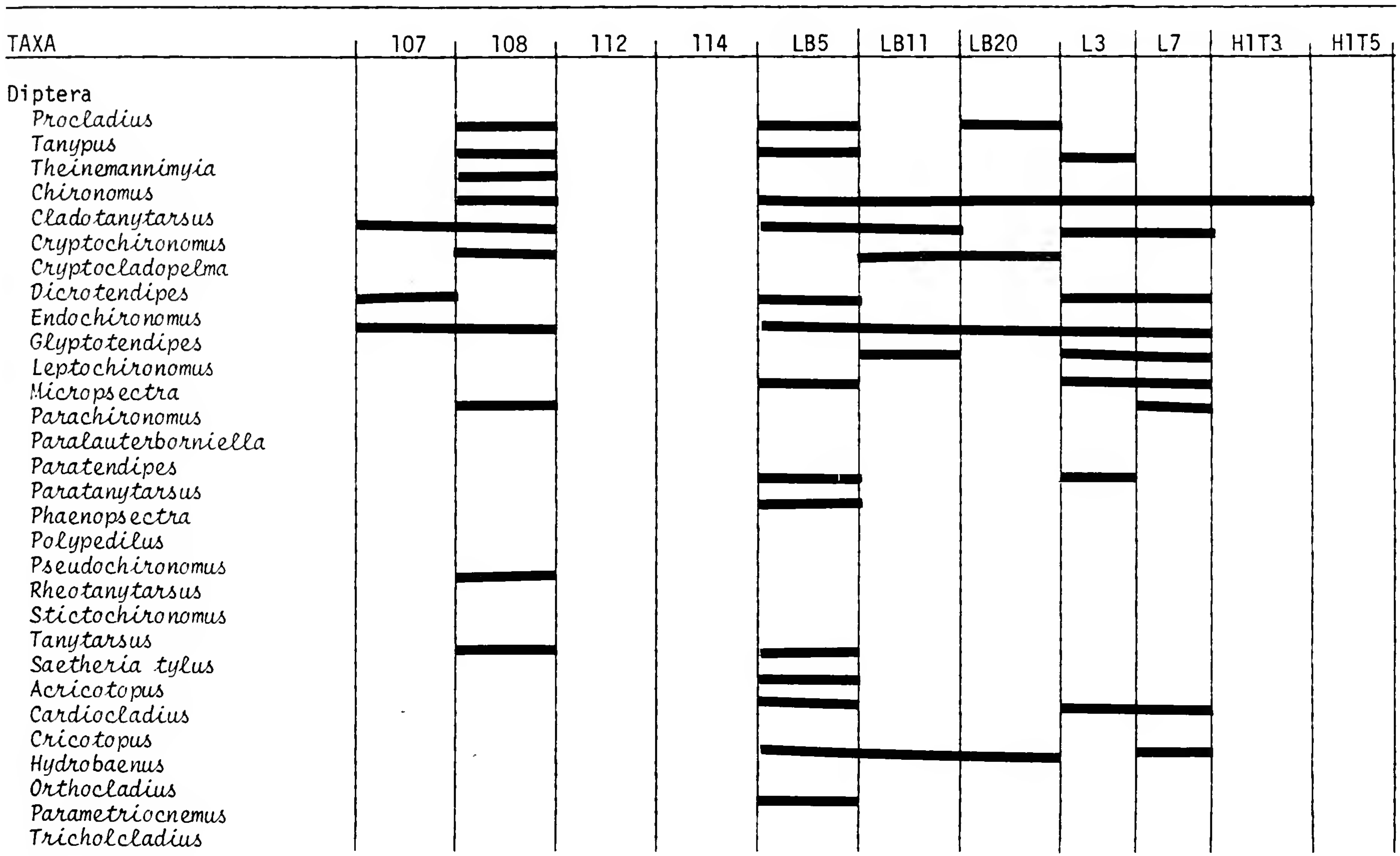

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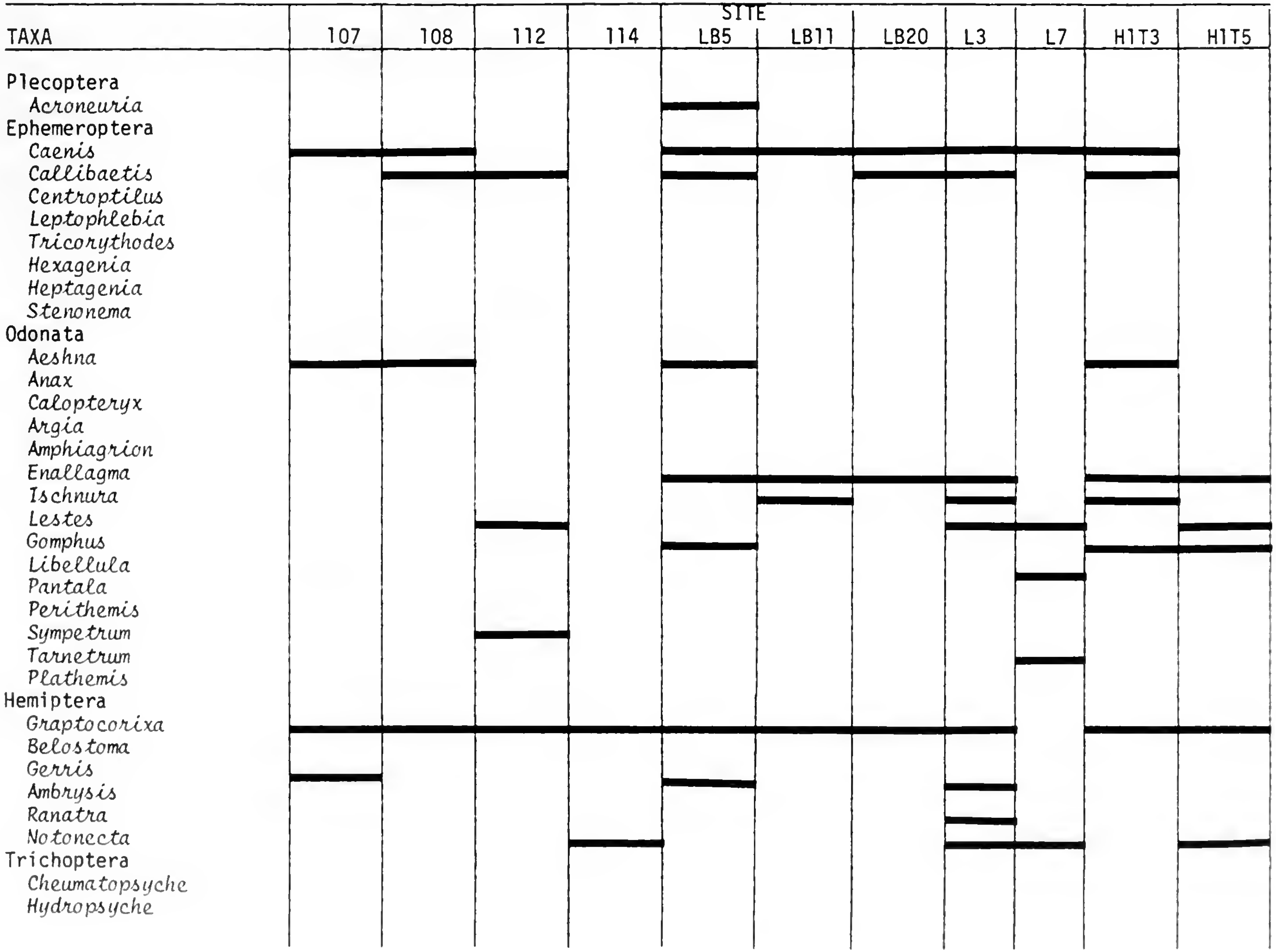
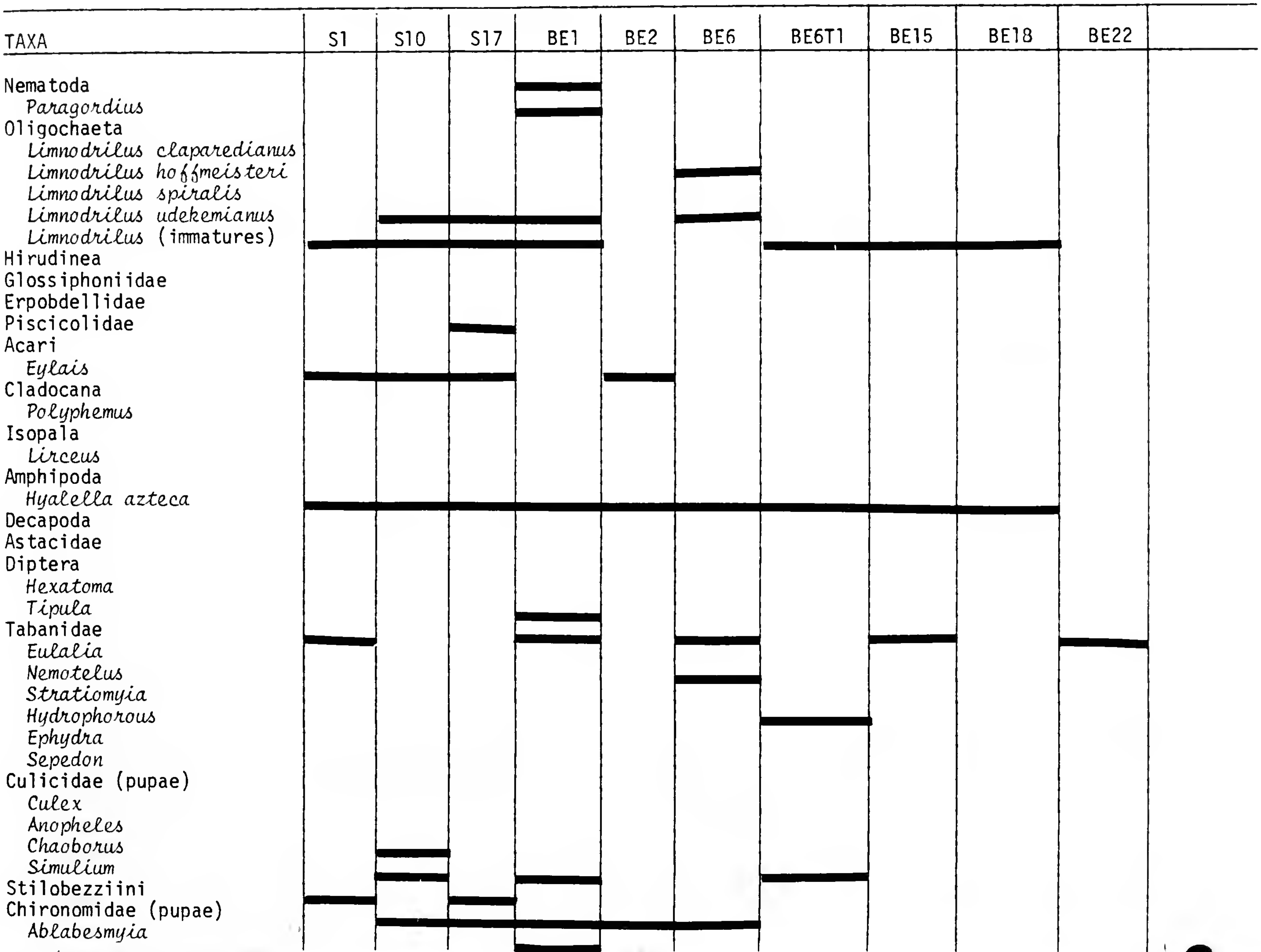


Figure 11. Distribution of taxa at all sites in the Yellowstone Drainage .



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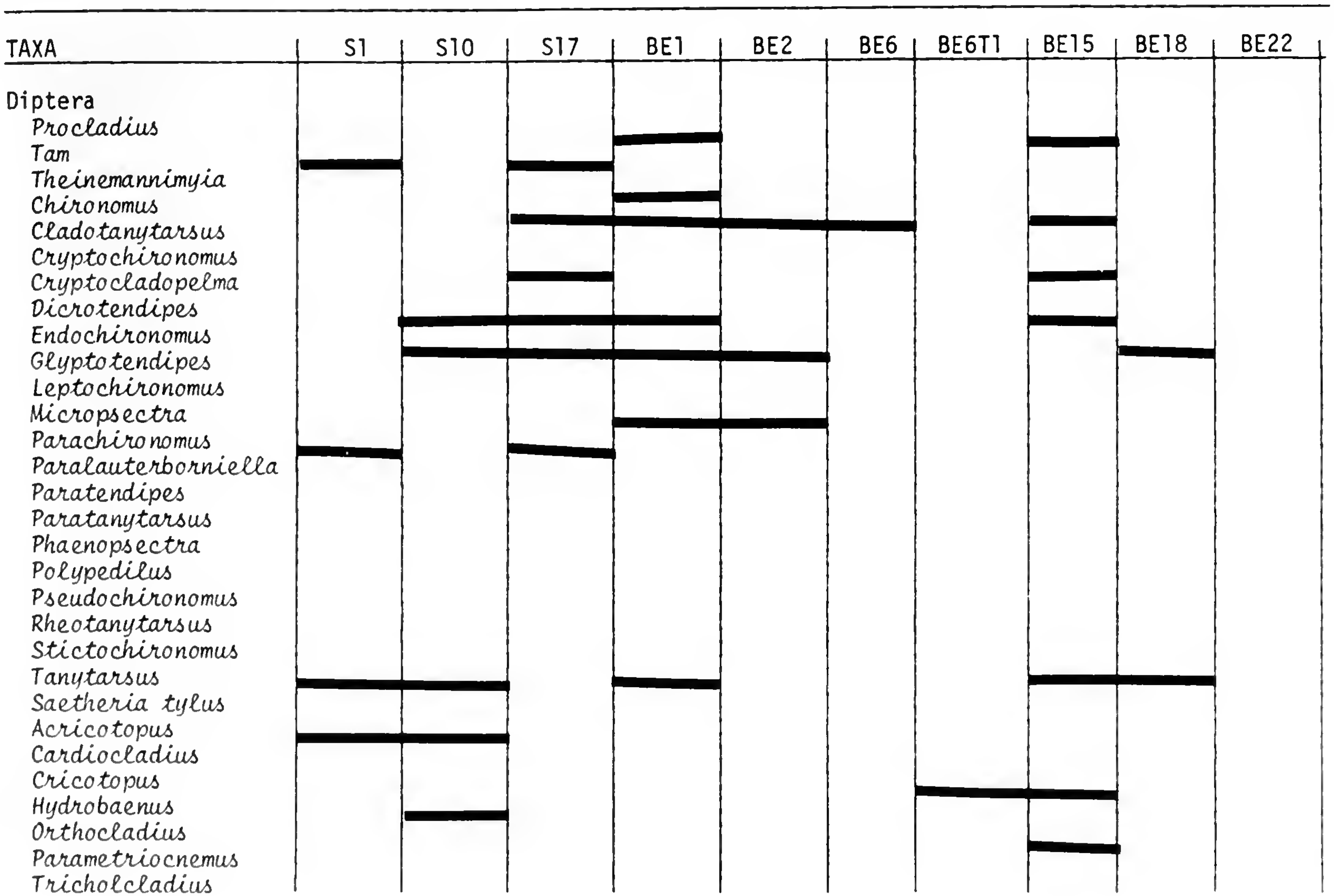

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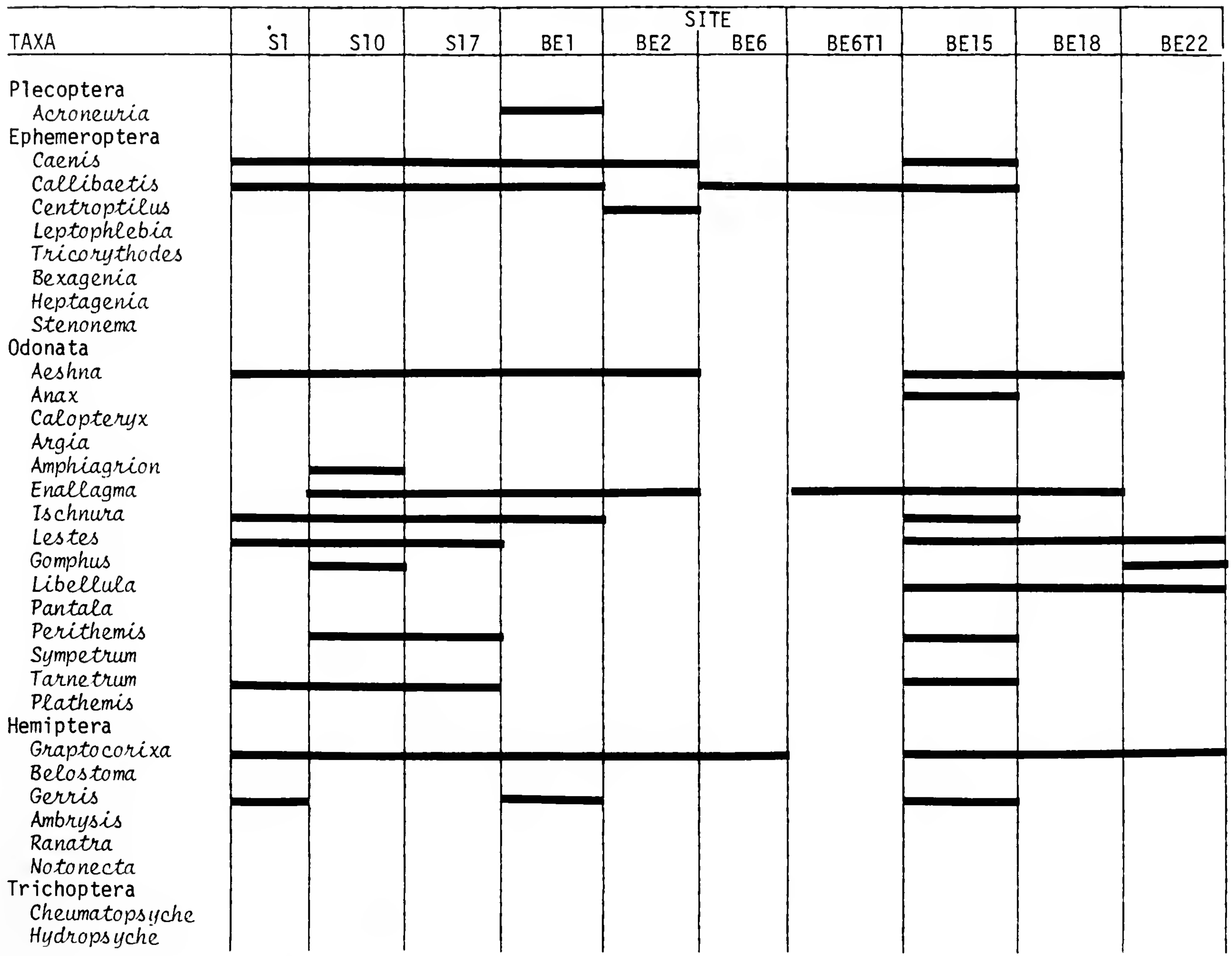

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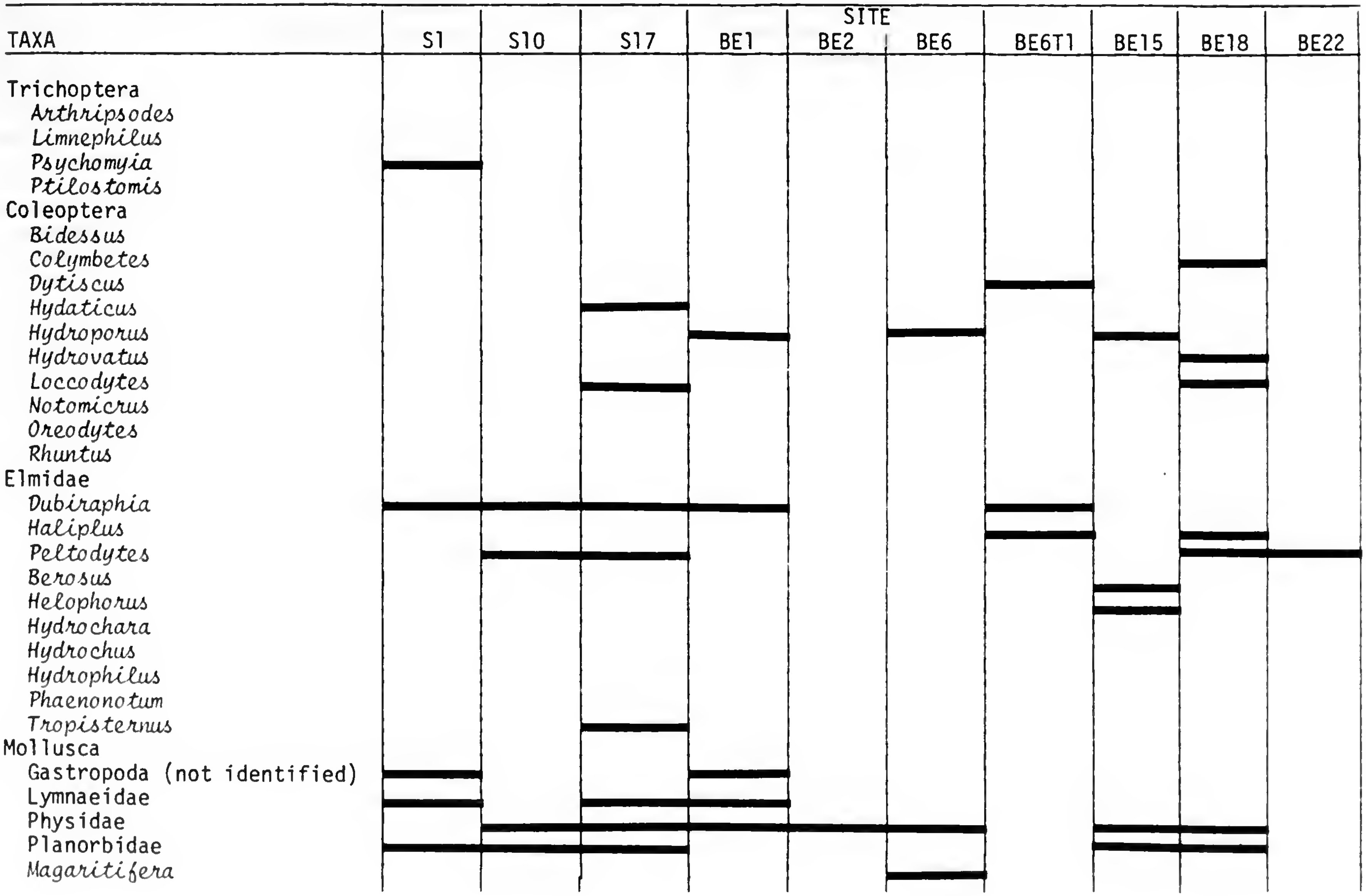

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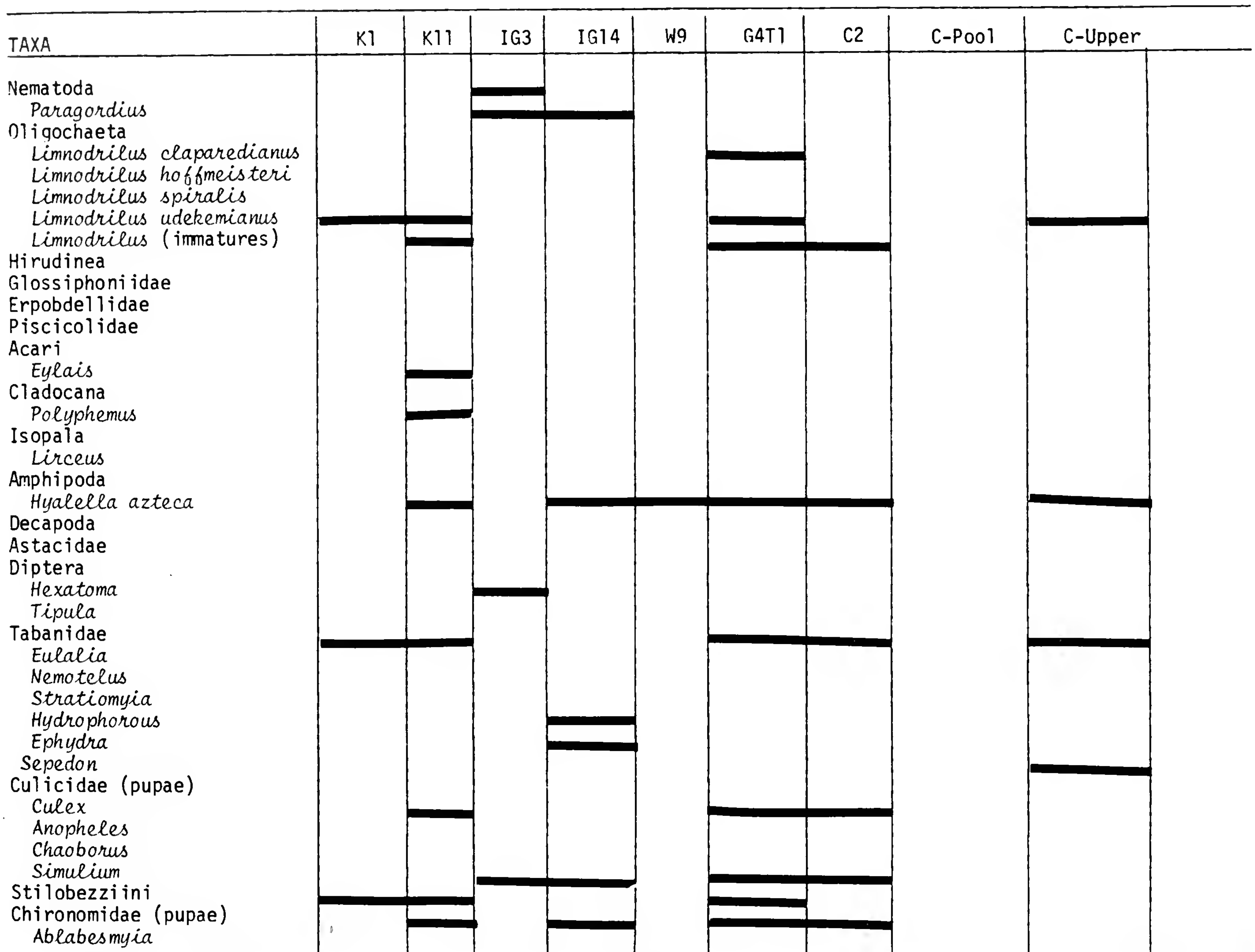

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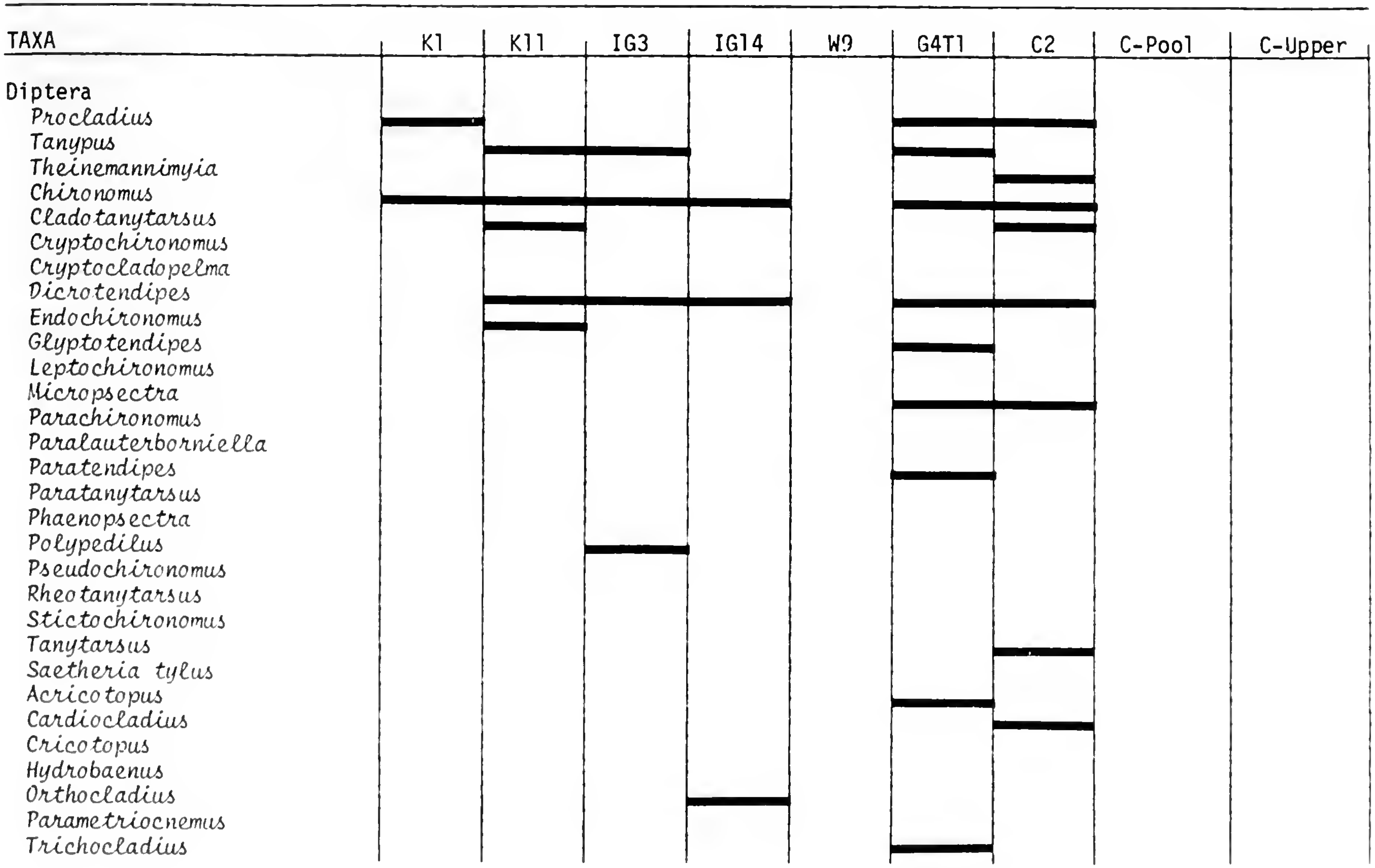

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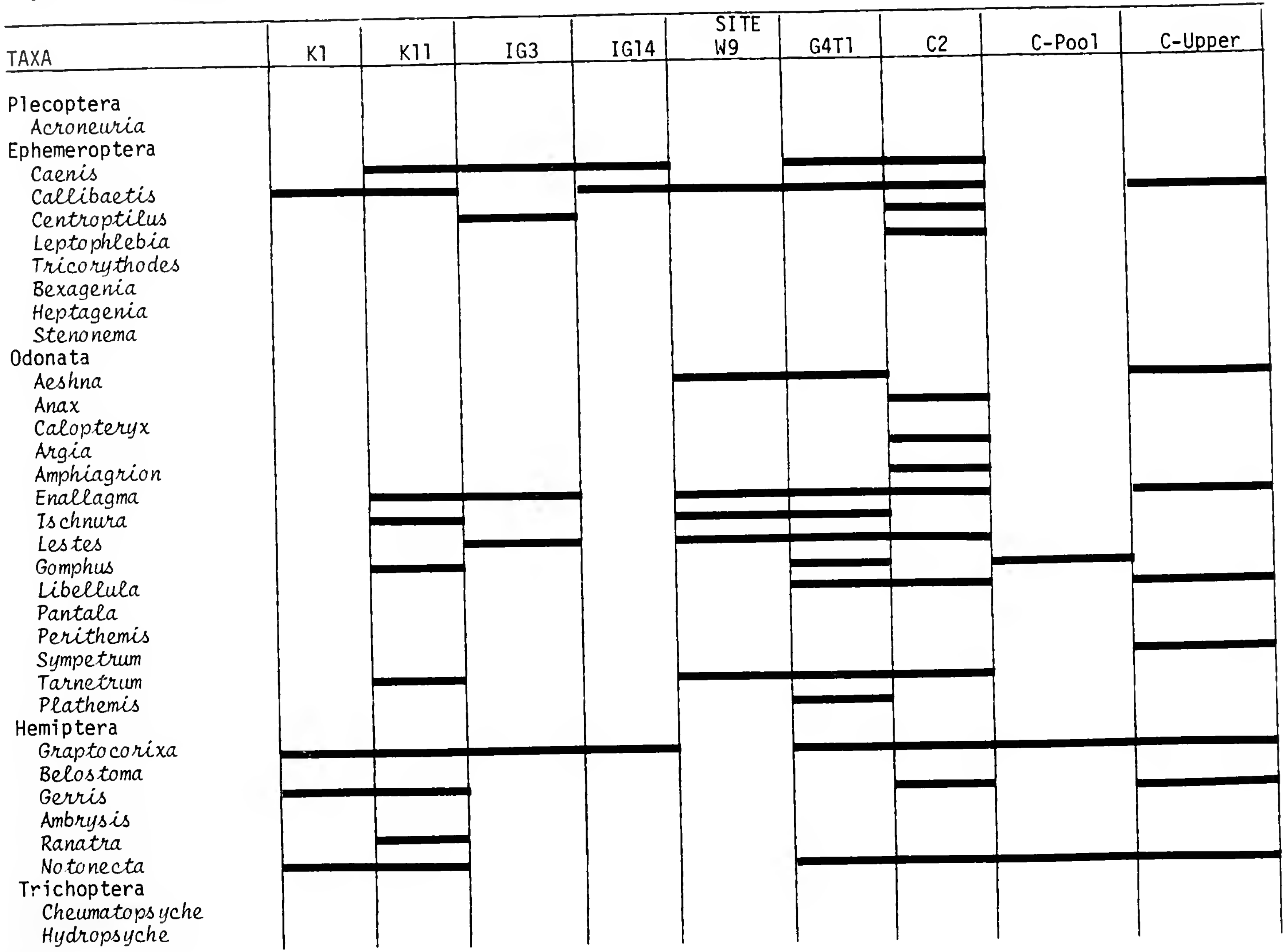

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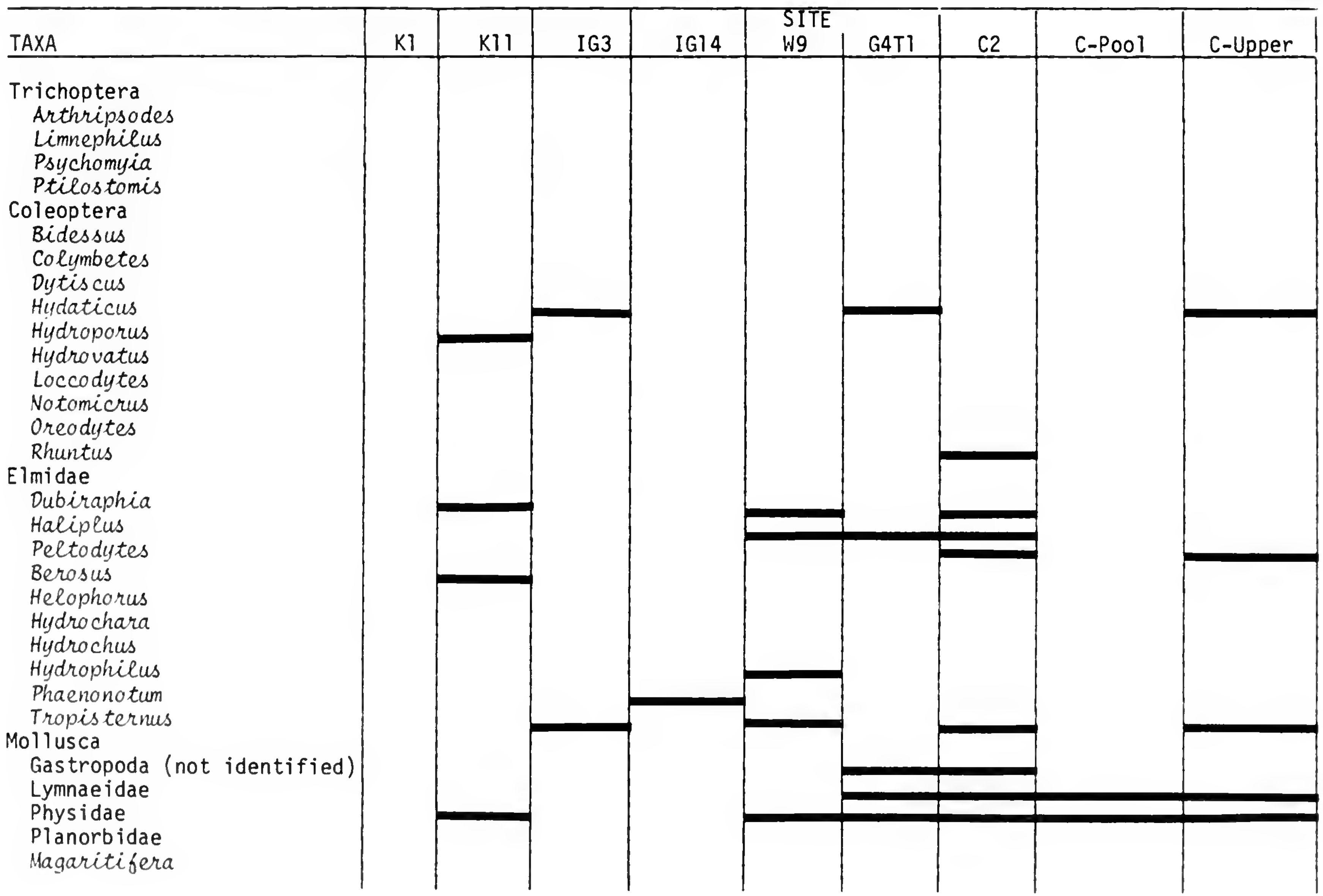

Chironomus sp., *Endochironomus* sp., and *Tarytarsus* sp., are the most prevalent Chironomidae in Beaver Creek. All three prefer slow to standing water, low to medium oxygen concentrations, and eutrophic waters (Beck 1977).

Limnodrilus udekemianus is a common oligochaete throughout the system. Hiltenun (1970) and Brinkhurst (1974) both state that this species is found under a very wide variety of conditions from extremely productive to oligotrophic.

Hilsenoff (1977) has used invertebrates to evaluate the water quality of Wisconsin streams. Each species was assigned a biotic index value on the basis of the quality of streams from which they were collected. 0 values were assigned to species collected only in unaltered streams of very high water quality and values of 5 assigned to species known to occur in severely polluted or disturbed streams. Intermediate values were assigned to species known to occur in streams with various degrees of disturbance or pollution. Hilsenoff's values were applied to the most dominant groups (*Cheumatopsych* *Chironomus* sp., *Hyalella azteca* and *Caenis* sp.) resulting in an average value of 4.25. This does not necessarily indicate that Beaver Creek is altered or polluted since very adaptable forms can be assigned high values as a result of the fact that they can adapt to many situations and they are tolerant of severe environmental stresses which are common in intermittent streams.

Diversity indices have been calculated for the invertebrates in Beaver Creek and they are presented in Table 6.

The presence of certain aquatic organisms often provides a good indication of the condition of a stream (Goodnight 1973). However, Wilhm (1970) states that "associations or populations of benthic macroinvertebrates provide a more reliable criterion of organic enrichment than mere occurrence of a given species." Diversity indices have been used to analyze biological communities and provide insight into community structure. Goodman (1975) suggested that diversity does not necessarily indicate stability and Herlbert (1971) and Hilsenoff (1977) question the validity of diversity indices. The attempt to summarize population diversity by two indices (diversity and redundancy) does not seem to have been successful thus far (Hamilton 1975). However, diversity and redundancy included with number of taxa and total number of individuals generally presents valuable information.

With the limitations of diversity indices in mind, these values along with redundancy have been presented in Table 6. These values can probably be used as a valuable tool in "before and after" studies. They will generally show an effect of severe perturbations on an aquatic community.

Intermittent prairie streams often support similar invertebrate faunas. The sluggish water of Beaver Creek, coupled with intermittence during dry years (1977) limits the range of invertebrates. Patrick (1959) found that organisms with a shorter life span are the quickest to establish natural populations. Harrel and Dorris (1968) found that during drought, community structures of several Oklahoma streams were similar. In general, it appears that species which complete their life cycle in one year or less are predominant and species which require more than one year to complete their life cycle are limited to pool dwelling forms.

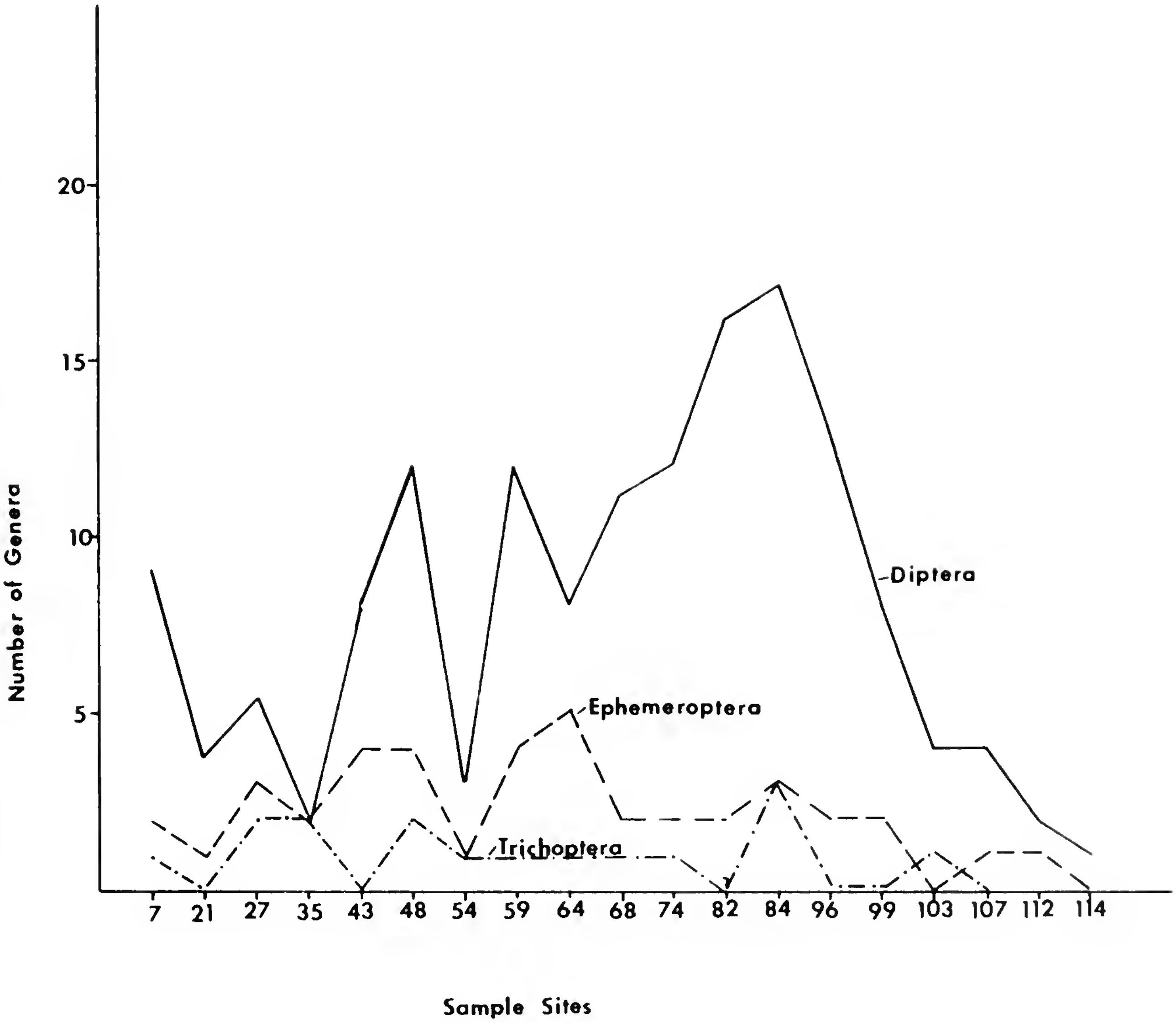

Figure 12. Number of genera of the three major orders of aquatic invertebrates found at each sampling site on Beaver Creek, 1977.

Table 6. Species diversity ($\bar{d}$), redundancy (R), and equitability (Em) of aquatic invertebrates of Beaver Creek, Beaver Creek tributaries and Yellowstone River tributaries, 1977.

Site	$\bar{d}$	R	Em
1	1.09	0.707	0.171
7	2.38	0.579	0.281
12	2.22	0.283	0.498
21	2.23	0.434	0.428
27	2.02	0.518	0.237
35	1.95	0.558	0.220
43	3.01	0.448	0.358
54	1.73	0.678	0.232
59	3.34	0.404	0.338
64	2.96	0.471	0.338
68	2.60	0.539	0.315
74	2.68	0.502	0.286
82	2.30	0.583	0.227
84	3.46	0.371	0.380
96	2.57	0.518	0.285
99	2.88	0.374	0.352
103	3.11	0.240	0.558
107	3.10	0.243	0.558
108	2.79	0.453	0.300
112	2.26	0.395	0.328
114	2.91	0.311	0.550
LB5	3.63	0.344	0.360
LB11	3.02	0.392	0.322
LB20	2.58	0.445	0.274
L3	4.08	0.263	0.489
L7	3.44	0.442	0.451
HIT3	1.54	0.730	0.184
HIT5	2.05	0.453	0.253
S1	2.55	0.498	0.304
S10	3.44	0.316	0.375
S17	3.25	0.379	0.344
BE1	3.159	0.429	0.359
BE2	2.40	0.433	0.357
BE6	2.02	0.505	0.263
BE15	3.21	0.451	0.434
BE18	1.36	0.730	0.159
BE22	1.24	0.686	0.212
C2	3.55	0.365	0.366
IG3	2.94	0.561	0.527
IG14	2.48	0.480	0.393
G4T1	3.17	0.409	0.309
K1	0.90	0.827	0.121
K11	3.42	0.325	0.362
W9	2.75	0.318	0.422

FISH

Beaver Creek

Species Composition and Distribution

A total of 30 species of fish were collected in Beaver Creek. Estimates of the relative abundance of each species was based mostly on the actual numbers counted, and to a lesser degree on the frequency of occurrence in collections. Those species occurring in half or more of the samples were considered abundant, in more than a third of the collections but less than half, are common; in more than a tenth, but less than a third, are uncommon; and in fewer than a tenth, rare. A list of the fish and their distribution in Beaver Creek for 1977 and 1978 are shown in Figures 13 and 14. A kite diagram (Figure 15) shows the distribution and relative abundance of major species in the creek.

Three species of fish, fathead minnow (*Pimephales promelas*), creek chub (*Semotilus atromaculatus*) and white sucker (*Catostomus commersoni*) are widely distributed throughout the Beaver Creek system. Fathead minnows and white suckers are commonly distributed in other small eastern Montana streams. Elser and Schrieber (1978) found white suckers throughout Rosebud Creek and Clancey (1977) found white suckers and fathead minnows to be the two dominant species in Sarpy Creek.

The creek chub, while native to Montana, maintains a limited distribution; being restricted to the Yellowstone and Little Missouri River systems in the extreme east-central portion of the state. It is considered quite rare in Montana (Brown 1971). In Wyoming, the creek chub is common throughout many drainages, inhabiting small streams (Baxter and Simon 1970). The creek chub is also common in Missouri, preferring small streams which cease to flow in dry weather (Pflieger 1975). Beaver Creek appears to meet habitat requirements for the creek chub, which do not thrive in streams that maintain strong flows. A length frequency distribution of 390 creek chubs collected from Beaver Creek in 1978 is shown in Figure 16. Fish ranged in length from 30 to 218 mm . Prior to this study, the largest specimen reported in Montana was 147 mm (Brown 1971). The dominant size group was from 41 to 70 mm, making up 43.6 percent of the sample (170 of 390).

Several other species found in Beaver Creek also have limited distributions in Montana. The sand shiner (*Notropis stramineus*) is described as a hardy species (Scott and Crossman 1973) which is able to withstand highly variable flows (Summerfelt and Minckley 1969). Erratic flows are common in Beaver Creek and the sand shinner is common throughout the drainage.

The brook stickleback (*Culaea inconstans*) is native to Montana, but is limited to the eastern part of the state, found primarily in tributaries of the Missouri River. While the stickleback is considered tolerant of high salinities common in intermittent streams (Nelson 1968), its preferred habitat is small, clear streams rich in aquatic vegetation. Distribution of stickleback in Beaver Creek was limited to the upper reaches (above station 74) which meets its habitat requirements.

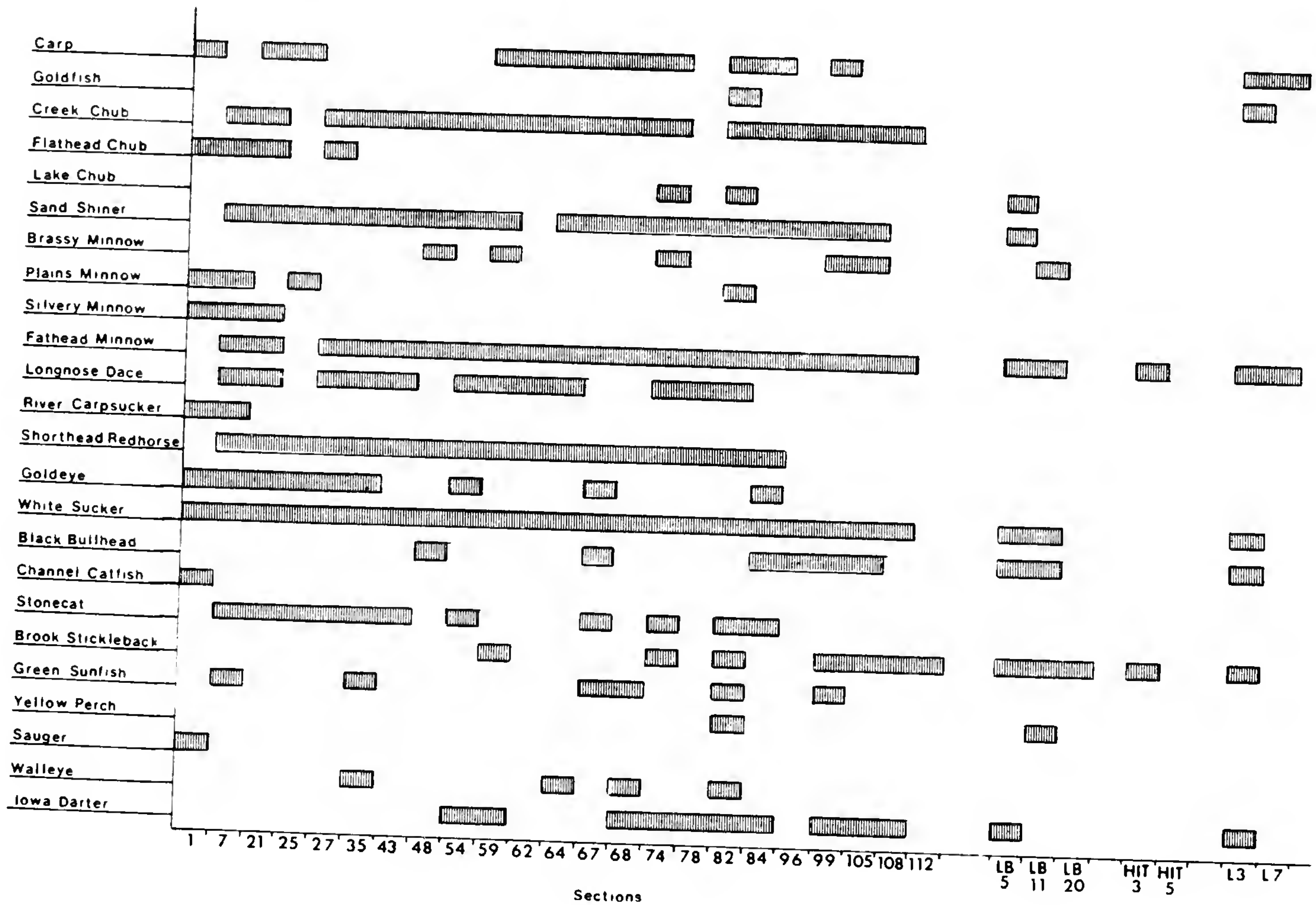

Figure 13. Distribution of fishes found in the Beaver Creek drainage, 1977.

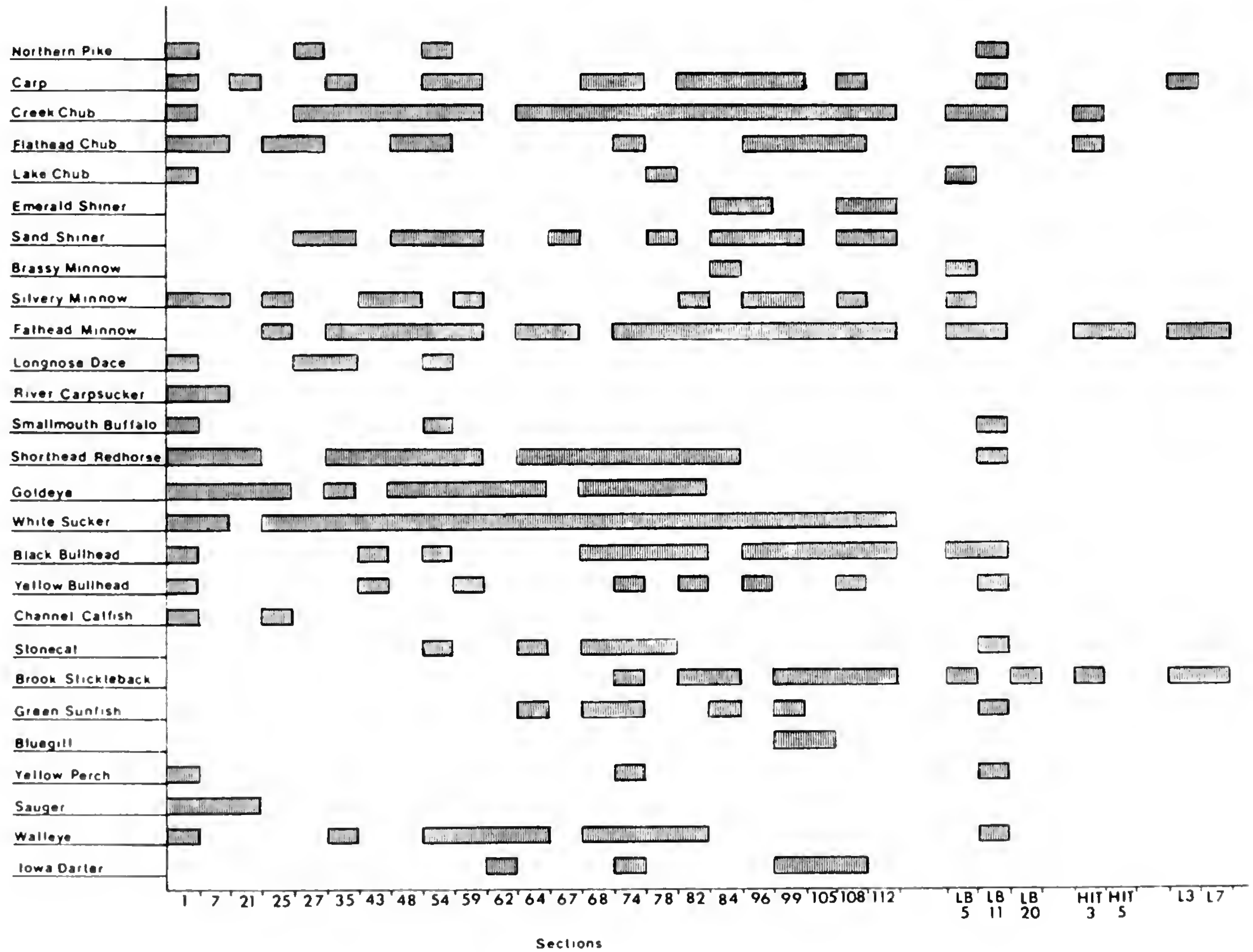

Figure 14. Distribution of fishes in the Beaver Creek drainage, 1973.

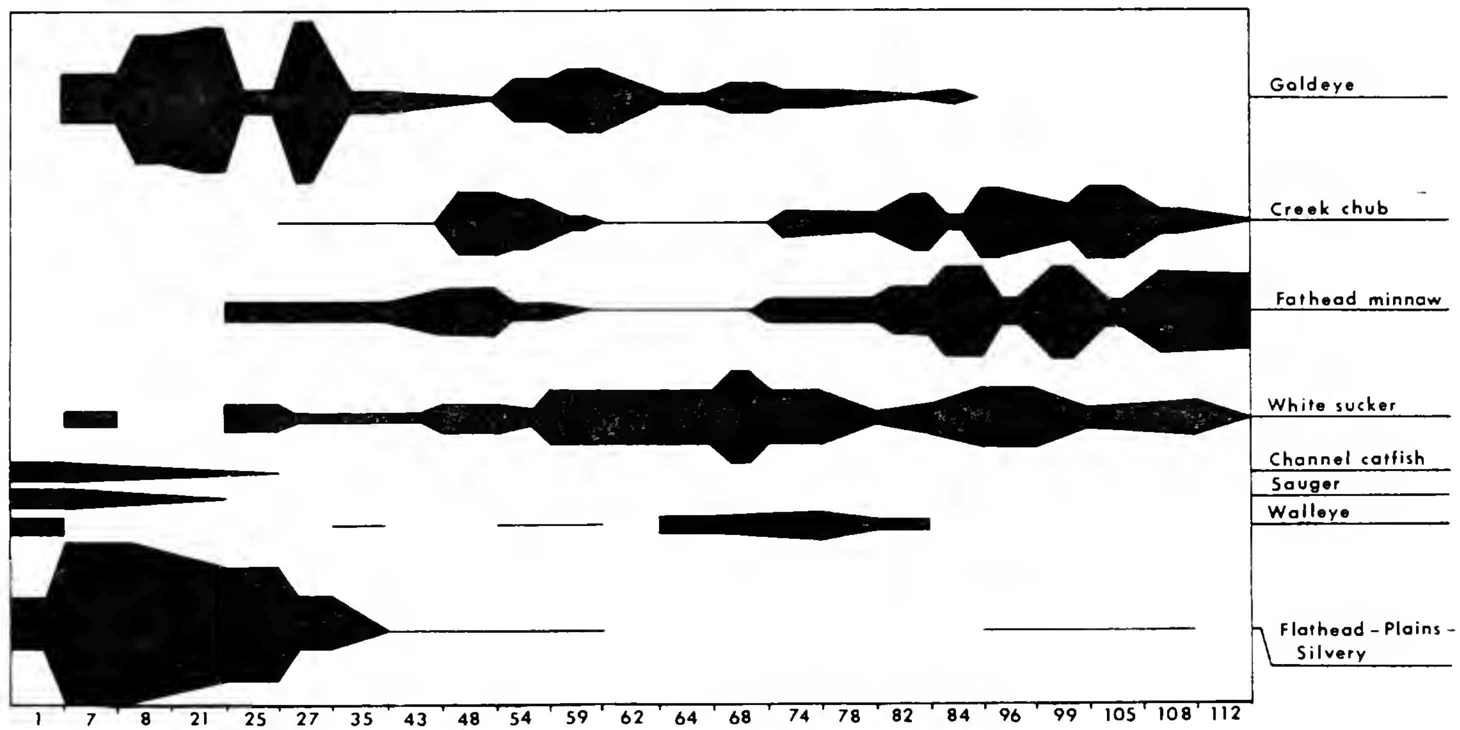

Figure 15. Kite diagram showing distribuiton and relative abundance of major fish species in Beaver Creek. Width of kite at each site is proportional to the number of that species caught.

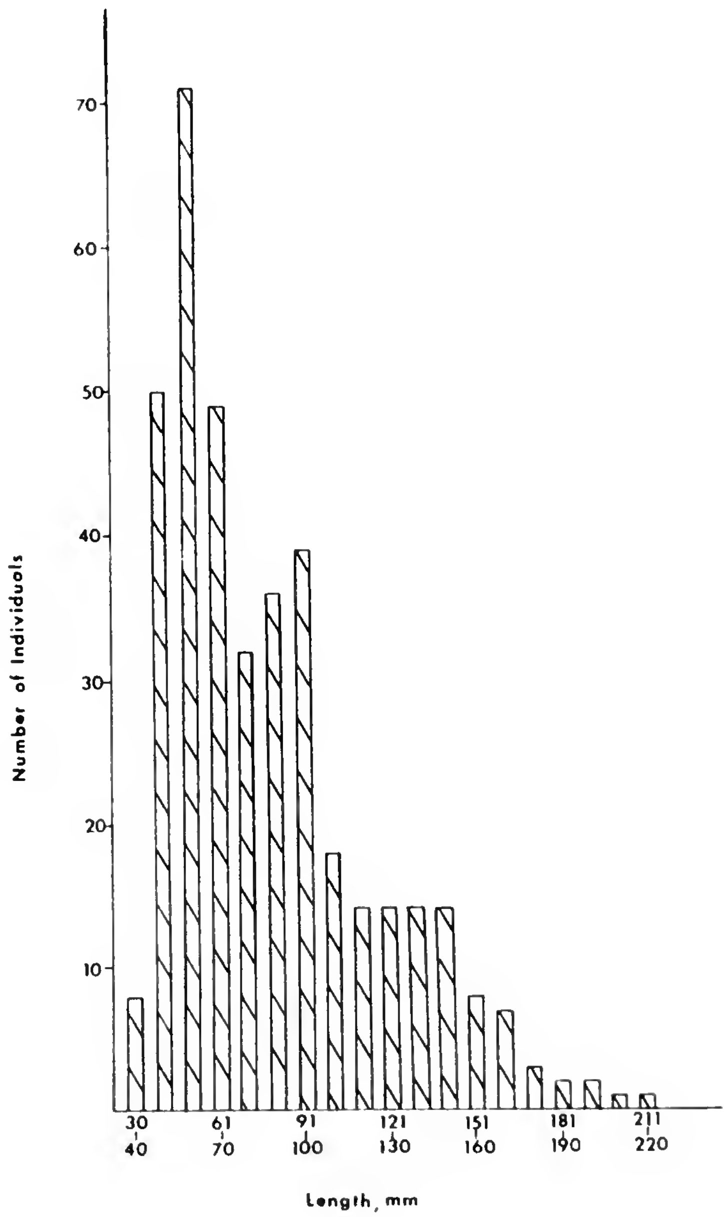

Figure 16. Length-frequency distribution of creek chubs taken in Beaver Creek, 1973.

Yellow bullheads (*Ictalurus natalis*) were collected sporadically in Beaver Creek. This species is not native to Montana and previously was reported only from reservoirs (Brown 1971). When found in streams, it is generally associated with gravel substrates and aquatic vegetation.

The Iowa darter (*Etheostoma exile*) is native to Montana in the lower Missouri River and Little Missouri River drainages. Habitat preferences of the Iowa darter is generally slow-moving clear water streams with abundant rooted vegetation (Scott and Crossman, 1973). In Beaver Creek, this species was collected mostly in the upstream sections (primarily above section 68). Habitat conditions in these reaches meet the Iowa darters requirements.

Distribution of the river carpsucker (*Carpiodes carpio*) and the smallmouth buffalo (*Ictiobus bubalus*) was restricted to the lower reaches of the stream. Both species prefer pools or quiet backwaters, suggesting that their occurrence in Beaver Creek was the result of movements out of the Little Missouri River.

Four species of game fish inhabit Beaver Creek. Walleye (*Stizostedion vitreum*), sauger (*Stizostedion canadense*), channel catfish (*Ictalurus punctatus*) and northern pike (*Esox lucius*) were collected during 1977 and 1978.

Walleye - Walleye is the most popular sportfish in the creek. They were collected as far upstream as section 84. This section seems to be a transition zone on the creek. Upstream of section 84 appears to be too harsh for walleye and also supports low numbers of invertebrates (Figure 10).

Walleye may have been introduced into Beaver Creek when they were stocked into Lame Steer Reservoir which drains into Beaver Creek on sampling section 82. The walleye is generally distributed downstream from this site. Walleye are rare in the Little Missouri River (Durre 1977) and are probably rare in lower Beaver also.

During the spring of 1978, 13 ripe male walleye were collected in Beaver Creek. No ripe females were collected. These fish ranged between 3 and 6 years old and were captured between April 18 and May 16 when water temperatures varied from 5-17°C (41-62°F) (Figure 7). This corresponds to the temperatures at which ripe male walleye were collected in Lake Winnebago (Priegel 1970). Other studies have shown that female walleye are present only during the actual spawning period which often occurs during one night (Ellis and Giles, 1965). This probably explains the absence of ripe females in our sampling on Beaver Creek. Length-frequency distribution for walleye collected in 1978 is shown in Figure 17. Walleyes ranged in length from 93 to 672 mm with the size class of 441 to 470 mm making up 12.9 percent. The average length and weight for walleye was 417 mm and 563 grams, respectively. The largest walleye collected weighed 2500 grams.

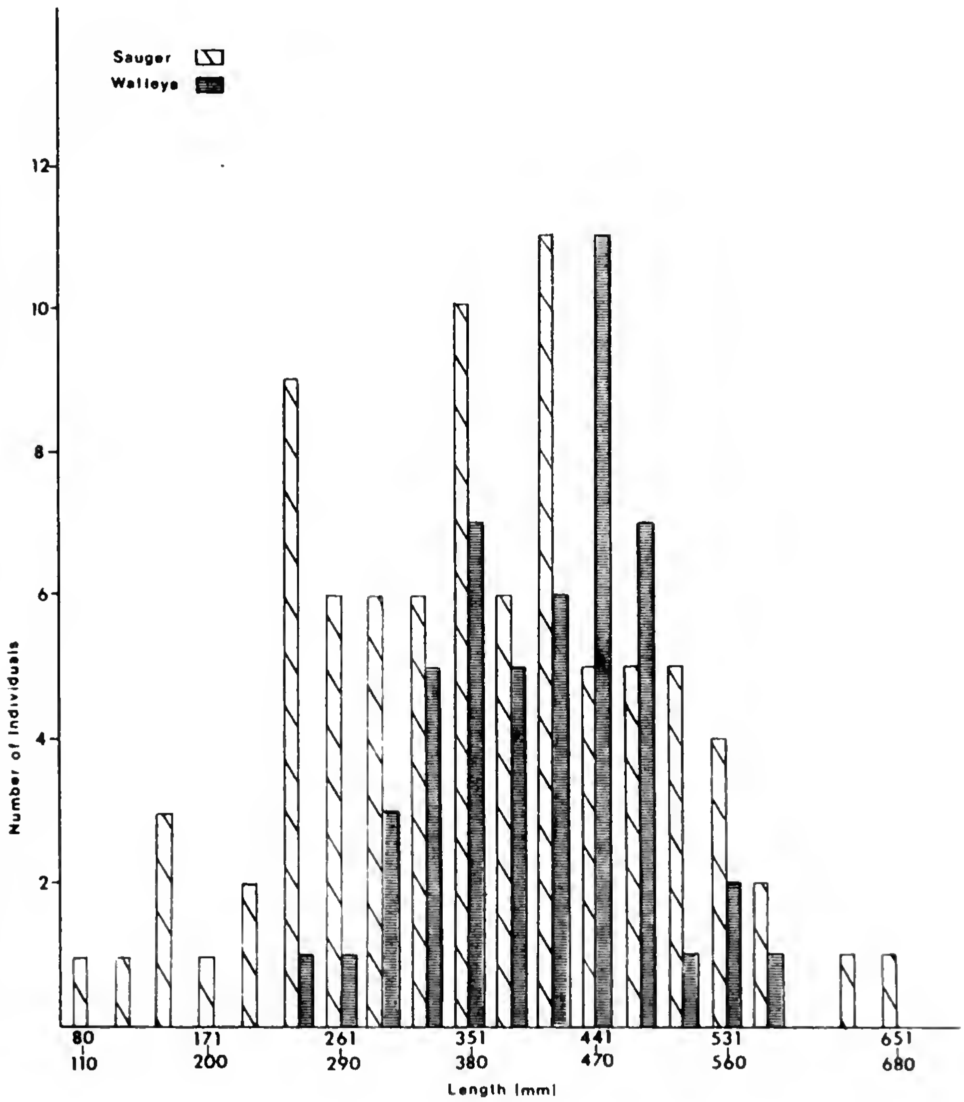

Figure 17. Length-frequency distribution of sauger and walleye collected spring, 1978, in Beaver Creek.

Local fisherman have expressed interest in the possibilities of stocking walleye in Beaver Creek. This creek would probably only support a put and take fishery due to limited spawning substrate. Gravel-rubble substrate seems to be preferred by walleye (Johnson 1961). Gradually warming water temperatures during spring also appear to be important to strong years classes of walleye (Busch et al. 1975). Rapid fluctuations in water temperatures and flows were common in Beaver Creek as a result of spring time storms and would probably severely reduce reproductive potential of the creek. In Escanaba Lake, Wisconsin, stocked walleye fingerlings added little to the angler harvest in following years (Kempinger and Churchill, 1972), however, in a small lake in Iowa, stocked walleye added significantly to the year class strength (Carlander et al. 1960) in subsequent years.

Fishing pressure at the present time would have to be considered light in Beaver Creek. Few fishermen were seen, and of 43 walleye that were tagged in 1978 no fisherman tag returns were reported. Stocking of catchable size fish would increase public interest, possibly to the point that the fishing harvest would be adequate for future stocking.

Sauger. Sauger do not maintain a continuous distribution throughout Beaver Creek. This species was collected only as far upstream as section 21 (Figure 13). Most of the larger sauger were collected in spawning condition between April 21 - May 24.

Ripe female sauger were collected between April 28 - May 3, corresponding to the period when the highest concentration of sauger was encountered (Figure 14). Water temperatures during this period ranged between 11-12^{o}C (52-54^{o}F). In Lake Winnebago, Priegel (1969) found sauger spawning activity to occur between April 24 and May 9 while water temperatures ranged between 43-52^{o}F. He concluded that spawning was essentially complete in less than two weeks. Eschmeyer and Smith (1943) reported that sauger below Norris Dam, Tennessee did not spawn when water temperatures were below 50^{o}F. Spawning may have been initiated earlier in Beaver Creek than April 28 but high spring runoff precluded any sampling before this date.

After May 4, sauger numbers dropped off drastically (Figure 18). Although sampling efforts remained essentially constant, subsequent catches were low. This probably indicates that the spawning sauger returned to the Little Missouri River. Durre (1977) indicates that the Little Missouri River is important to the sauger populations of Lake Sakakawea. The spawning migration into Beaver Creek probably contributes to this population.

Sauger ranged in length from 233 to 561 mm, with 22.0 percent of the sample falling into size class from 411 to 440 mm (Figure 17). The average length was 421 mm and the average wieght was 614 g. The largest sauger collected weighed 1290 g.

A total of 41 sauger were tagged and released in Beaver Creek during the spring of 1978. No tags were returned by fishermen indicating that the sauger harvest is light.

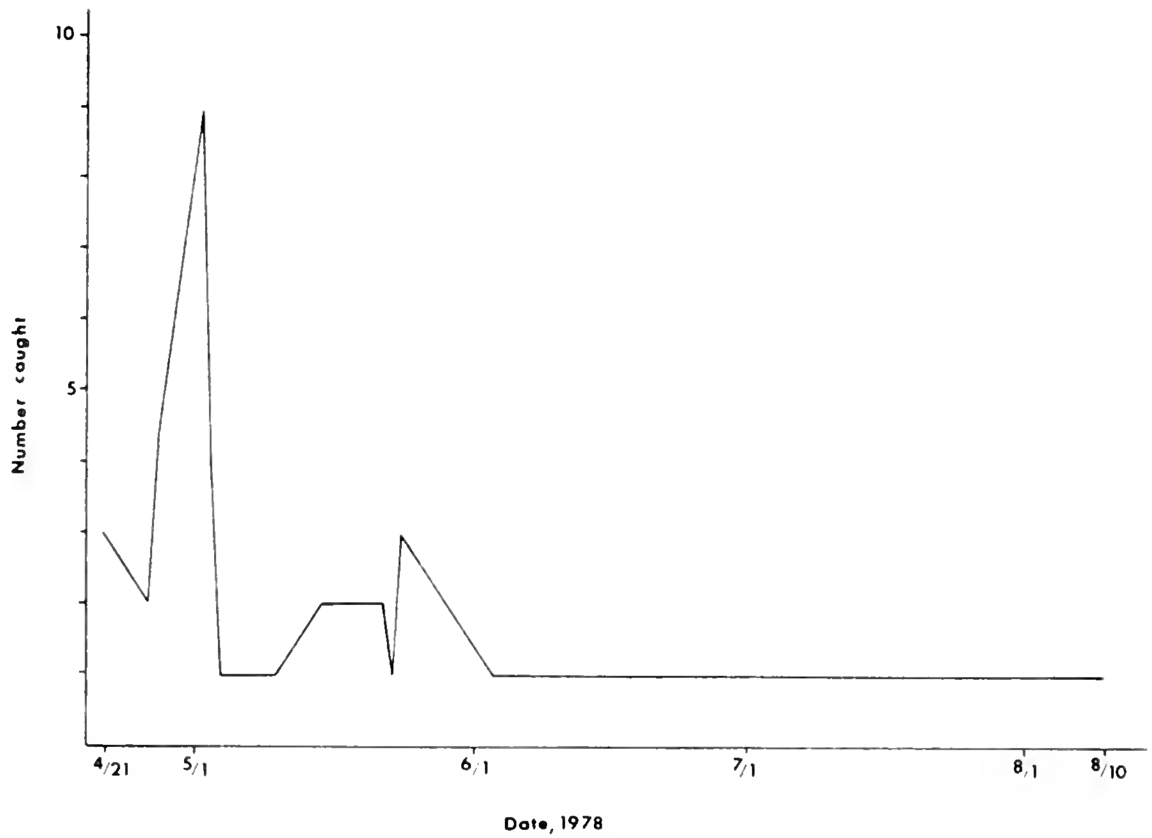

Figure 13. Number of sauger caught per sampling effort, Beaver Creek, 1978.

Lower Beaver Creek is distant from any population center and access is extremely poor in wet weather, explaining the low level of exploitation.

Age and Growth. The length-weight relationship of fish can be represented by the formula: $w = al^b$ ($\log w = \log a + b (\log l)$). where w = weight, l = length, b = regression coefficient and log a = y intercept.

The functional regression value b = 3 describes isometric growth, such as would characterize a fish having an unchanging body form and unchanging specific gravity. b values greater or less than 3 characterize allometric growth: if b= 3, the fish becomes "heavier for its length" as it grows larger. There are sometimes marked differences between different populations of the same species or between the same population in different years presumably associated with their nutritional condition.

A total of 68 walleye were captured during 1978 in Beaver Creek and figure 19 illustrates the length-weight relationship of these fish. The growth rate of walleye in Beaver Creek is generally slower than walleye in the Tongue River Reservoir (Riggs 1978), however, Beaver Creek walleye have a faster growth rate than walleye in the Yellowstone River and Columbia River drainage in Montana (Peters 1964).

The length-weight relationship (Figure 20) was derived from the measurement of 48 sauger captured during 1978. The growth rate of sauger in Beaver Creek is similar to sauger in the Tongue River Reservoir (Riggs 1978) and generally higher than sauger in the Yellowstone River, Fort Peck Reservoir, Milk River, Missouri River (Peters 1964) and Lake Winnebago (Priegel 1969).

Channel catfish. Channel catfish are also present in the lower reaches of Beaver Creek near its confluence with the Little Missouri River. A total of 14 individuals were captured in section 1 during May of 1978 when water temperatures ranged from 12-20°C (54-68°F). This species was observed as far upstream as section 25 and fishermen reported an occasional catfish caught at Wibaux.

Spawning of channel catfish generally occurs at temperatures between 70 and 85°F (21-29°C) (Clemens and Snead 1957). Those temperatures were common during late June in 1978, however, runoff from rainstorms precluded any sampling during this period (Figure 21). Young of the year channel catfish were collected in section 1 during August and September and section 25 in September indicating that channel catfish utilize lower Beaver Creek for spawning and rearing.

Channel catfish probably move up Beaver Creek from the Little Missouri River. After the spawning season is over and the water levels in Beaver Creek reach summer lows, they probably return to the Little Missouri River. McCammon (1956) found downstream movement of catfish in the lower Colorado River in the fall. Other studies have concluded that channel catfish move long distances upstream and downstream from the point of capture (Harrison 1953, Hubley 1963, Muncy 1958 and Messman 1973). Van Eeckhout (1974) found that flows delineate when and how much catfish move

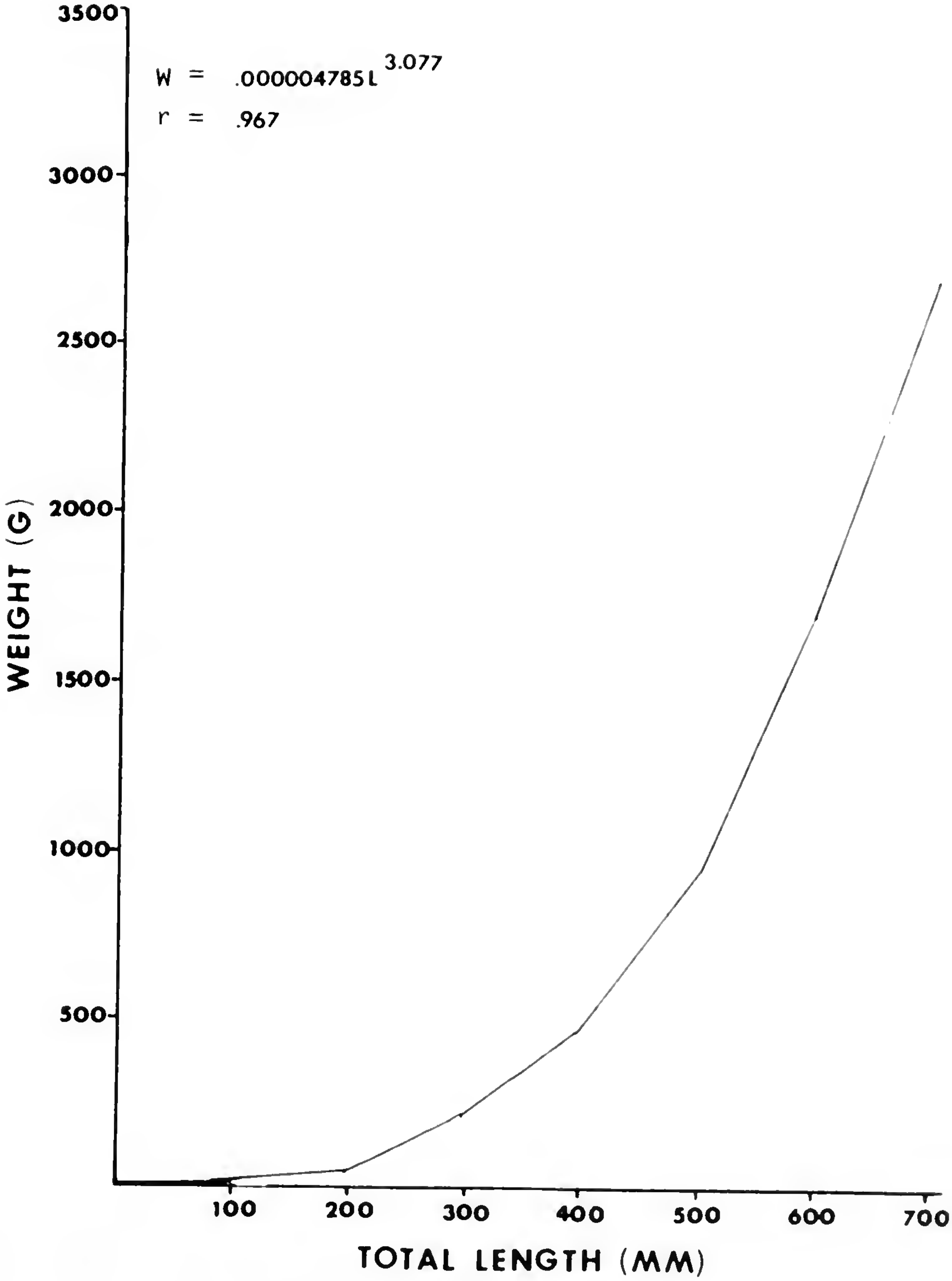

Figure 19. Length-weight relationship of walleye from Beaver Creek, 1978.

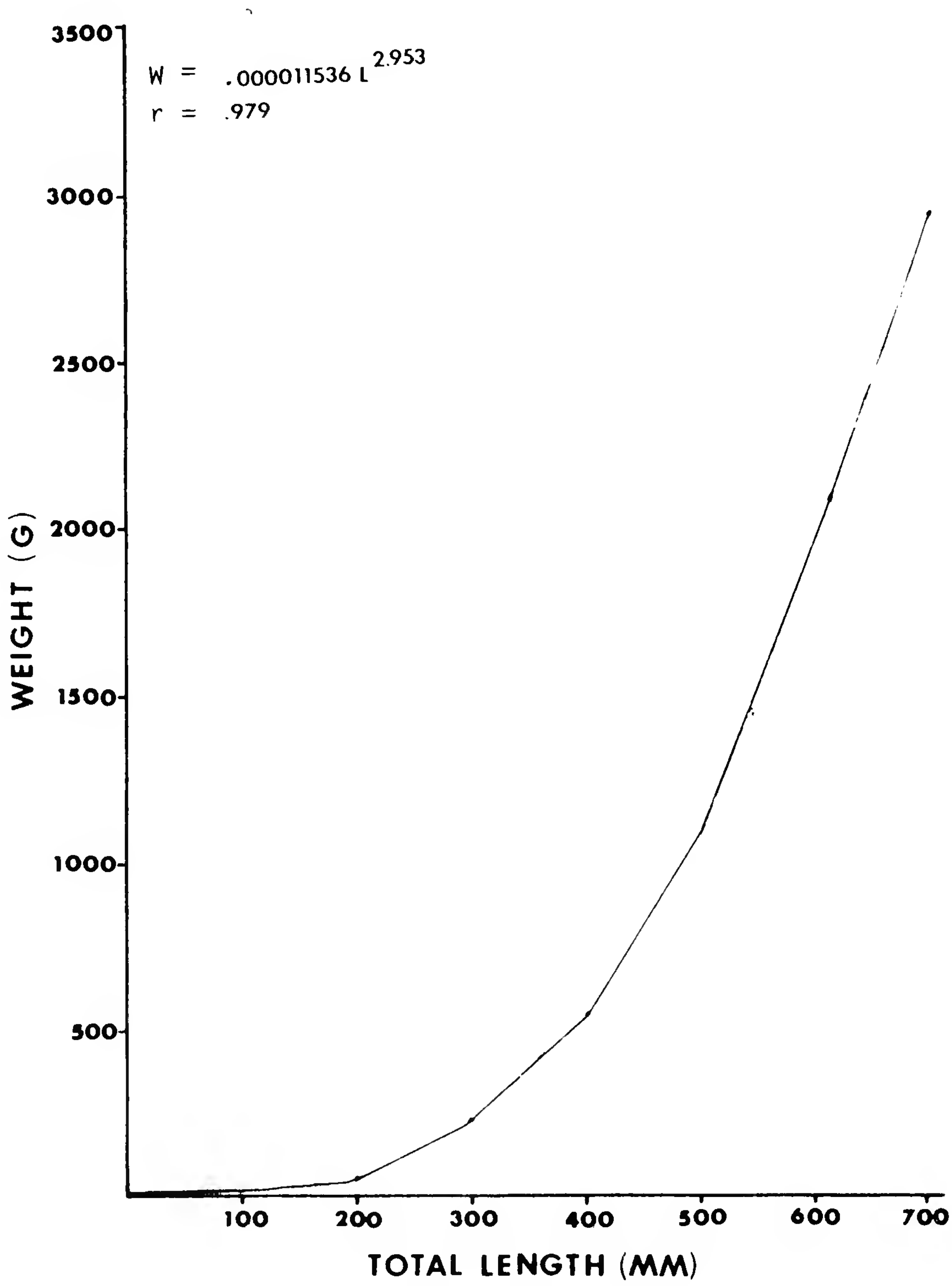

Figure 20. Length-weight relationship of sauger from Beaver Creek, 1978.

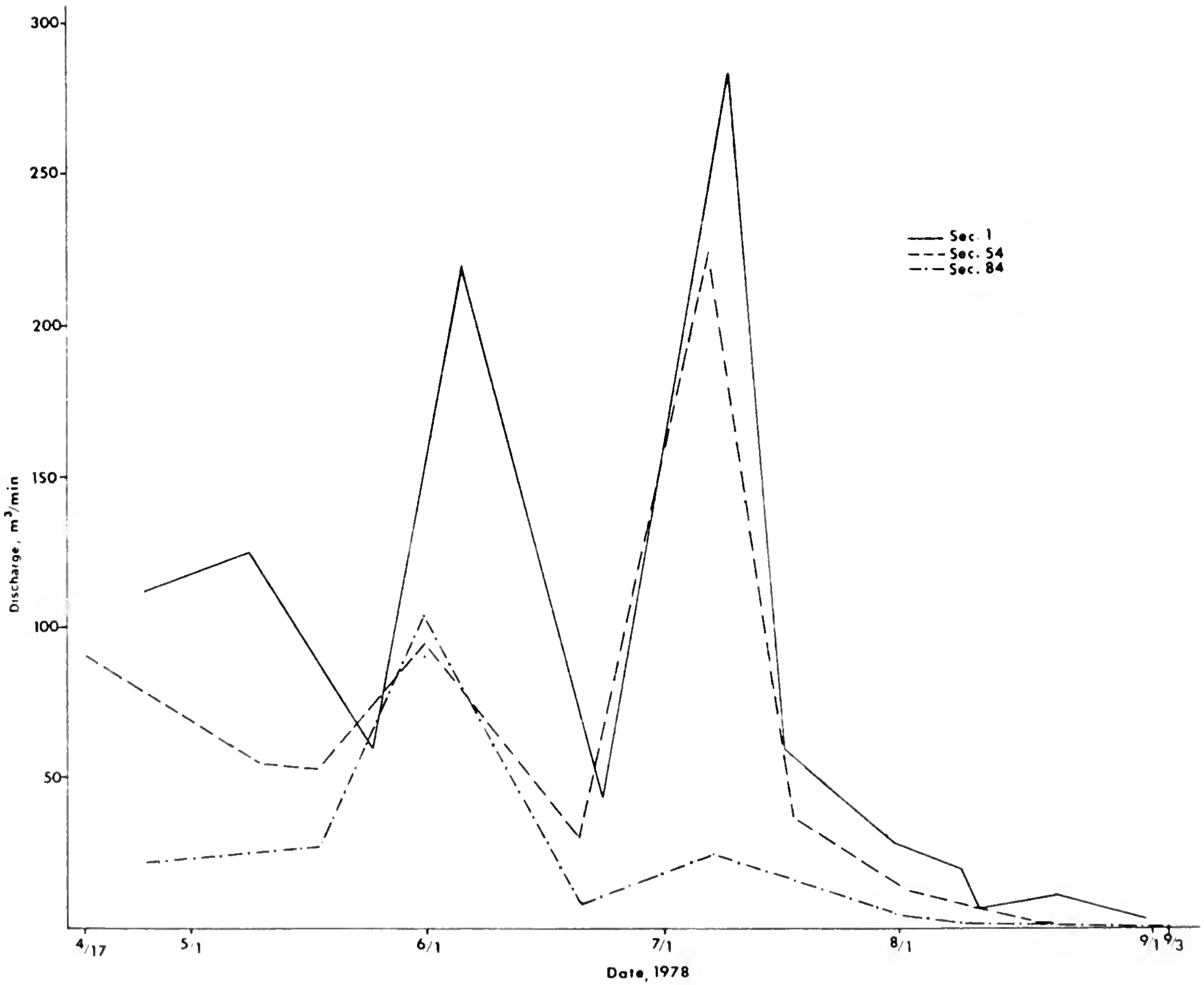

Figure 21. Discharge of Beaver Creek, sections 1, 54, and 84, 1978.

and that in July and August catfish moved downstream with increased flow levels in the Little Missouri River. He also indicates that constant stream discharge from mid-June to July will generally result in successful reproduction. Droughts and flash floods will result in poor reproduction, poor survival of young and brood stock reductions. While rapid fluctuations in discharge were common in Beaver Creek during this period (Figure 21), successful reproduction did occur. However, reproduction may have been reduced through environmental fluctuations.

Northern pike. Only four northern pike were collected in Beaver Creek, one at section 1 and the other three taken in the middle reaches of the stream. There were at least two age-classes represented in the sample. The northerns ranged in length from 427 to 693 mm and in weight from 500 to 2268 g. Since very few northerns were taken in Beaver Creek, it is possible that they are in the creek as the result of stocking a stock-water reservoir. Northerns do not contribute to the recreational fishery of the stream.

Species Diversity. Measures of species diversity are another tool for the quantitative and qualitative description of fishery. Investigations of longitudinal zonation in stream fishes reveal that, in relatively unpolluted systems, diversity increases downstream (Sheldon 1968), meaning the number of species increases with proximity to the river's mouth. Factors which determine the upstream limits of particular species also apparently contribute to the regulation of species diversity. A study by Tramer and Rogers (1973) found that variations in water quality upset the normal pattern of longitudinal zonation of fishes. Where streams are undergoing stress from pollution, species diversity may remain at levels similar to those in the headwaters throughout the entire system. The disappearance of some of the headwaters species is balanced by the appearance of others, and gains in the abundance of one species are canceled out by losses in another. Therefore, from baseline data, a change in water quality can be reflected by a change in species diversity. It is a generally accepted concept that a large-scale environmental stress exerted upon a diverse biological community results in a reduction in species diversity (Cairns 1969).

While species-diversity indices have been used extensively with benthic macroinvertebrates to evaluate degradational environmental conditions, they have only recently been applied to fish populations (Sheldon 1968, Jackson and Harp 1973, and Harima and Mundy 1974). Shannon-Weaver diversity indices were calculated for the 1977 and 1978 samples (Table 7). In 1977, d ranged from 1.519 to 2.70 as compared to 0.996 to 3.022 in 1978. No trend in d from source to mouth was noted in Beaver Creek similar in magnitude to those calculated on other Montana prairie streams.

Table 7. Species diversity (d), redundancy (R) and equitability (Em) of fish samples from Beaver Creek, Beaver Creek tributaries and Yellowstone River tributaries for 1977 and 1978

Site	1977			1978		
	$\bar{d}$	R	Em	$\bar{d}$	R	Em
1	1.79	0.603	0.295	2.79	0.361	0.313
7	2.24	0.402	0.289	1.51	0.500	0.234
21	1.84	0.545	0.263	1.00	0.784	0.215
25	2.23	0.140	0.645	1.68	0.488	0.372
27	2.28	0.363	0.303	1.90	0.426	0.266
35	2.43	0.314	0.333	1.31	0.619	0.166
48	1.83	0.401	0.258	2.13	0.227	0.358
54	2.19	0.364	0.304	2.90	0.264	0.344
59	2.36	0.279	0.288	2.33	0.371	0.387
64	2.70	0.237	0.403	2.30	0.201	0.496
67	1.81	0.427	0.329	2.05	0.148	0.343
68	2.38	0.256	0.362	2.52	0.304	0.319
74	1.91	0.509	0.223	3.02	0.268	0.435
78	2.25	0.220	0.292	2.28	0.353	0.294
82	2.46	0.377	0.267	2.43	0.340	0.361
84	2.17	0.318	0.300	1.95	0.454	0.197
96	1.59	0.384	0.259	2.08	0.331	0.251
99	1.65	0.427	0.245	1.97	0.455	0.214
105	1.79	0.413	0.247	2.20	0.163	0.281
108	1.66	0.248	0.334	2.37	0.313	0.285
LB 5	1.84	0.380	0.237	1.89	0.431	0.374
LB11	1.59	0.490	0.215	2.69	0.289	0.348
L3	1.55	0.566	0.444	1.27	0.444	0.213
L7	1.08	0.629	0.137	0.13	0.906	0.017
S1	1.50	0.493	0.277	2.96	0.181	0.430
S10	1.78	0.339	0.344	0.85	0.228	0.599
S17	1.09	0.709	0.156	3.03	0.141	0.531
BE1	1.85	0.486	0.380	1.96	0.486	0.298
BE15	1.26	0.602	0.160	0.85	0.677	0.107
IG3	0.30	0.941	0.050	1.22	0.440	0.178
IG14	1.05	0.360	0.137	0.11	0.947	0.016
K2	0.45	0.602	0.160	0.16	1.000	0.030
K11	2.05	0.245	0.310	2.29	0.251	0.262

Species Interactions

Two minnow complexes were identified and compared in Beaver Creek. The creek chub complex consisted of the creek chub, fathead minnow and sand shiner, while the flathead chub complex consisted of the flathead chub (*Hybopsis gracilis*), silver minnow (*Hybognathus argyritis*) and the plains minnow (*H. placides*). The percent composition of these two complexes in Beaver Creek for 1977 and 1978 is shown in figures 22 and 23, respectively.

Although the percentages of each complex vary somewhat between years, the association between the two is similar. The flathead chub complex dominates the lower portions of the creek while the creek chub complex is dominant in the upper reaches. Section 24 appears to be the transition zone for the complexes with the creek chub complex showing dominance upstream from this section. Together, the complexes generally dominate the fish numbers throughout the creek. In areas not dominated by the complexes, goldeye tend to be abundant in the lower reaches, replaced by white suckers upstream. The flathead chub complex prefers turbid waters which flow over silty, pebbly substrates and the creek chub complex chooses clearer water and can withstand mucky habitats with extensive rooted vegetation (Brown 1971 and Baxter and Simon 1970).

Sauger show close association with the flathead chub complex but walleye are associated with both complexes. Sauger are found as far upstream as section 21, which is about where the flathead chub complex begins to lose dominance. Considering the piscivorous nature of sauger and walleye, these complexes probably represent important forage bases.

Goldeye (*Hiodon alosoides*) are abundant in Beaver Creek. Although little information is available concerning competition of goldeye, walleye and sauger for food, space, shelter, and spawning sites, the possibility may exist and may limit walleye and sauger numbers. Spawning for goldeye occurs at temperatures between 10-12.8°C (50-55°F), corresponding to the spawning period of sauger and walleye. Although goldeye generally spawn in pools and backwaters, competition for space is likely to occur. Goldeye feed extensively on the water surface for insects so competition for food is unlikely. Large numbers of goldeye could prey heavily on walleye fry. Creek chubs are the only other piscivore present in large numbers in Beaver Creek.

The goldeye and flathead chub complex are predominantly downstream. In contrast, the creek chub and fathead minnow are generally most common in the upstream sections. The white sucker is common throughout the drainage. Game fish compose a small percent of fish species present.

<u>Beaver Creek Tributaries</u>

Aquatic invertebrates and fish populations were sampled in three tributaries to Beaver Creek (Figure 2). Water chemistry measurements are

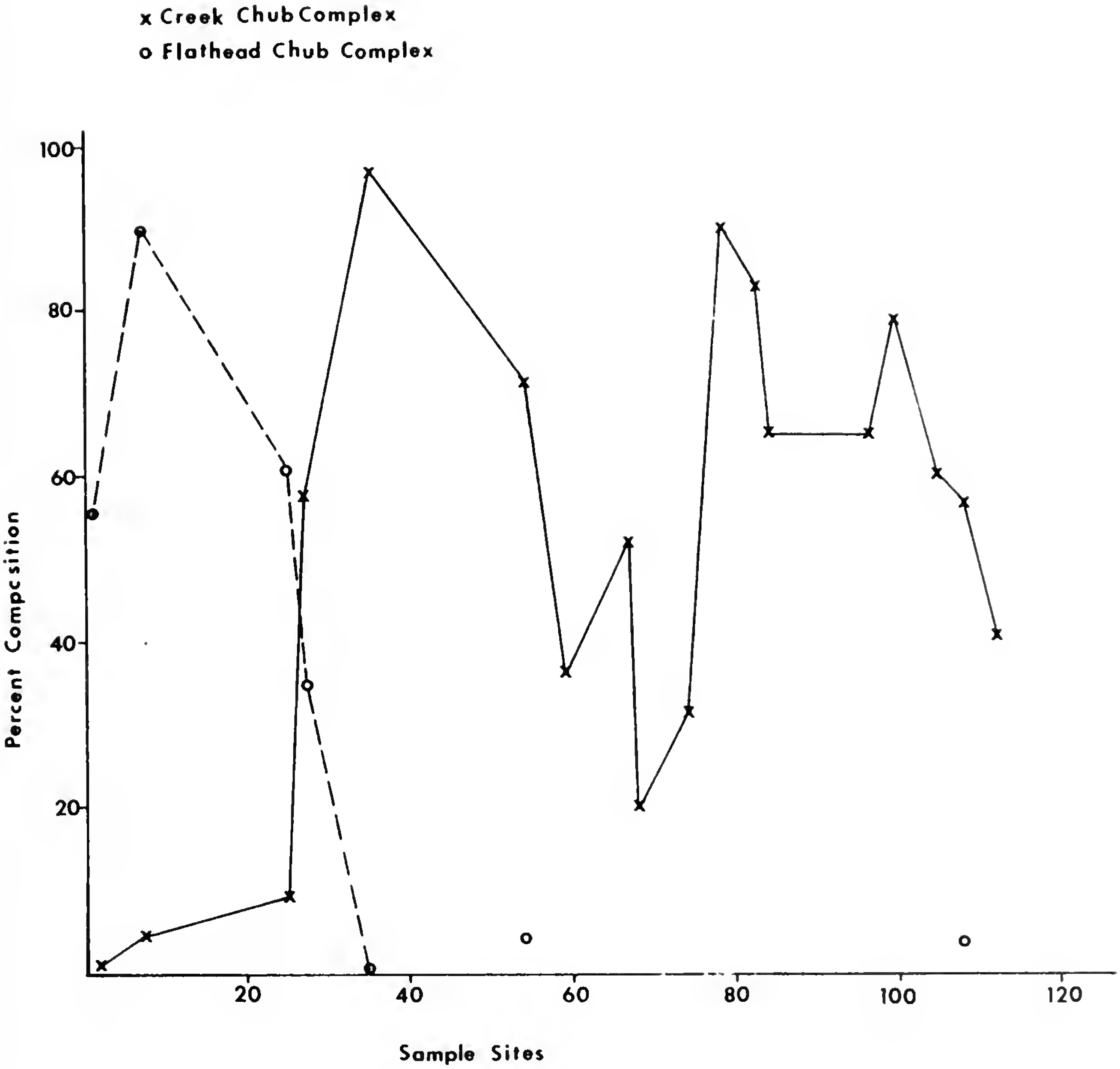

Figure 22. Comparison of minnow complexes, Beaver Creek, 1978.

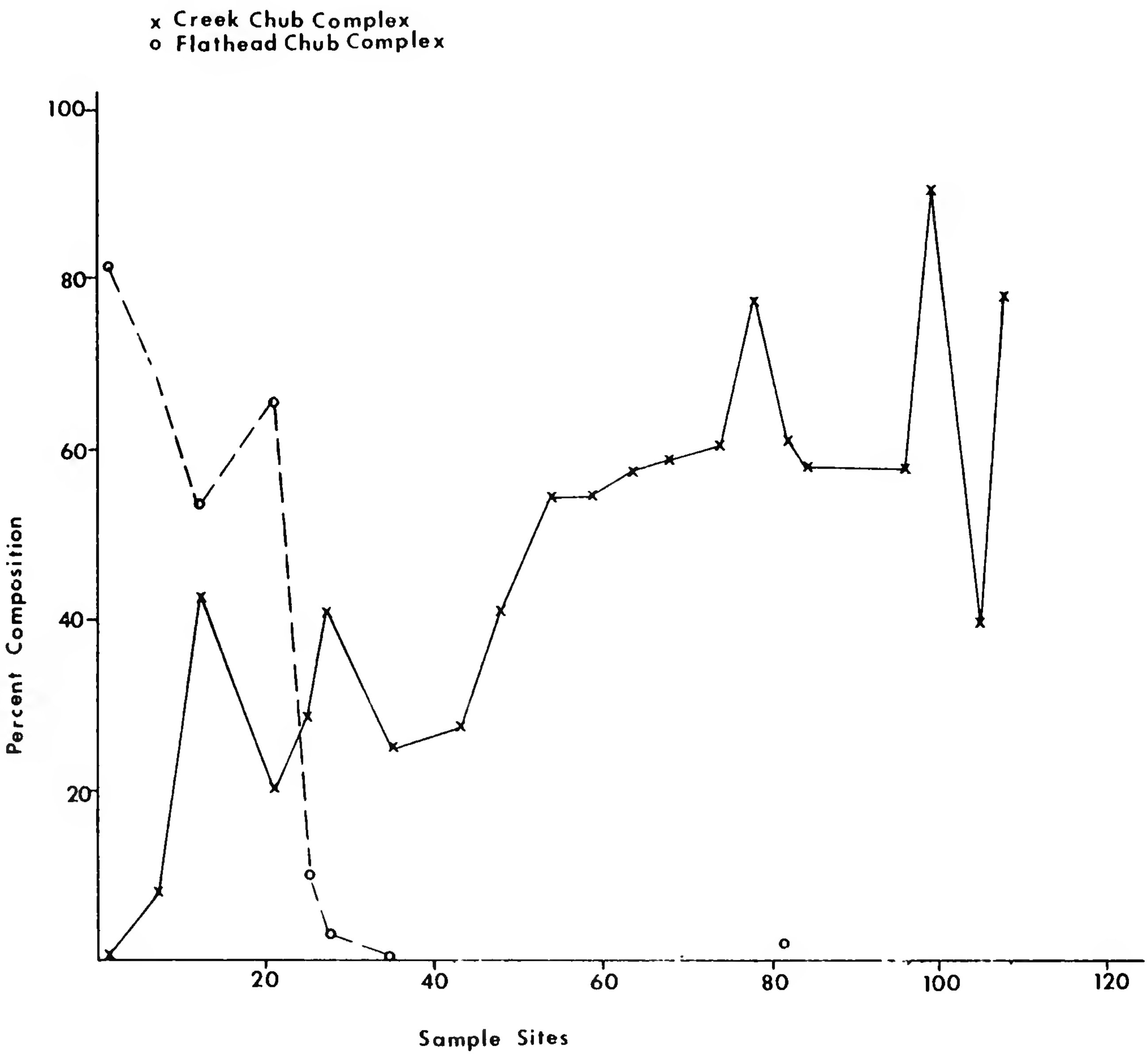

Figure 23. Comparison of minnow complexes, Beaver Creek, 1978.

summarized in Table 8. The assemblage of aquatic invertebrates was very similar to the collections made in Beaver Creek. Figure 10 shows the aquatic invertebrates collected in Beaver Creek tributaries and their distribution.

Little Beaver Creek. A total of 20 species of fish were collected in Little Beaver Creek (Table 9). Distribution and relative abundance of the major species is shown in Figure 24. Only the brook stickleback was distributed throughout the stream, representing the only species found in the headwaters. Walleye, northern pike, yellow bullhead, goldeye, yellow perch and shorthead redhorse were found only in the middle reach. The creek chub dominated the lower section.

Hay Creek. Seven species of fish were taken in Hay Creek, with fathead minnows being the dominant species, found in both sample sites (Table 9). Other species found were similar to species found in Beaver Creek.

Lame Steer Creek. Table 9 shows the fish distribution of Lame Steer Creek. Two species, fathead minnows and carp ranged throughout the stream. The remaining five species were found near the mouth and approximate the fish populations of Beaver Creek.

Lame Steer Lake. The fish populations of Lame Steer Lake were sampled as a probable source of the walleye found in Beaver Creek. Lame Steer Reservoir was built by W.P.A. in 1938 to create a resting area for migrating waterfowl. A flood in 1952 washed out the spillway which was rebuilt in 1953. In 1954, 50,000 walleye pike were stocked in the lake. Two gill nets fished in 1956 took 253 crappie, 90 suckers, 1 carp, 2 walleye, 1 bullhead, and 1 bluegill. In 1957, a gill net tool 46 suckers and 23 crappies (Alvord 1959). Recommendations in 1959 were against rehabilitation of the fish population until fishing pressure warranted such action.

Gill nets were again fished in 1977 to check on the walleyes. A total of 12 walleyes were taken, ranging in length from 185 to 505 mm. The inclusion of several size classes indicates that walleyes are reproducing in the lake. Other fish taken were 187 carp, 28 white suckers, 4 carp and 4 black bullheads.

Since walleyes have maintained themselves in Lame Steer Reservoir naturally since 1954, it is probable that this is the source of walleye in Beaver Creek. Early correspondence about Lamesteer Reservoir suggested that fish had easy access to the reservoir via the spillway during spring runoff. It is also possible then that fish spill out into the stream via the spillway.

Table 8. General water chemistry parameters measured on Beaver Creek tributaries, 1977 and 1978.

Date	Temp. °C	Alkalinity mg/l	Conductance umhos/cm	D.O. ppm	Turbidity JTU's	pH
			-LB11-			
6/7/77	34.4	-	-	4.8	-	8.7
9/22/77	10.0	500	1300	6.3	75	8.8
7/21/78	17.0	160	1800	10.8	115	7.5
			-HIT3-			
7/12/77	18.9	100	-	-	-	9.8
9/22/77	11.1	270	650	8.3	5	8.5
7/25/78	25.0	170	3100	12.0	<10	8.5
			-L3-			
7/25/77	18.9	137	-	-	25	10.0
7/19/78	22.0	150	1700	2.4	90	8.5

Table 9. Distribution of fishes in Beaver Creek tributaries, 1977-1978. Montana species of special concern underlined.

	Streams		
Species	Little Beaver	Hay	Lame Steer
Carp	*		*
<u>Creek chub</u>	*	*	*
Flathead chub		*	
Lake chub	*		
Brassy minnow	*		
Silvery minnow	*		
Fathead minnow	*	*	*
Smallmouth buffalo	*		
Shorthead redhorse	*		
White sucker	*	*	*
Goldeye	*		
Black bullhead	*	*	*
Yellow bullhead	*		
Stonecat	*		
Brook stickleback	*	*	*
Green sunfish	*		
Yellow perch	*		
Walleye	*		
Iowa darter	*	*	*
Northern pike	*		

Yellowstone River Tributaries

Seven north flowing tributaries to the Yellowstone River were sampled in 1977 and 1978 (Figure 3). Chemical parameters for each stream are shown in Table 10. The invertebrate fauna of these tributaries is similar to that of Beaver Creek. *Hyalella azteca*, *Chironomus*, *Endochironomus*, and *Daphnia* are very common throughout the lower Yellowstone basin. A list of the aquatic invertebrates collected in each tributary is presented in Figure 10.

Smith Creek. A total of 21 species of fish were collected in Smith Creek (Table 11). The downstream sections near the mouth of the creek are dominated by creek chubs, brassy minnows (*Hybagnathus hankinsoni*), white suckers and brook sticklebacks. Young-of-the-year northern pike and channel catfish were collected during the fall of 1978, suggesting that adults of these species migrated into Smith Creek from the Yellowstone River in the spring and summer of 1978 to spawn. While adults were not taken, the presence of young-of-the-year fish indicate the importance of this tributary.

Box Elder Creek. A kite diagram of the fish distributions and relative abundance of fish in Box Elder Creek is presented in Figure 26. A total of 19 species were found in the stream (Table 11). The flathead chub, silvery minnow and river carpsucker dominate the lower sections of the creek. These species are common near the mouth of creeks which run into the Yellowstone River. The lake chub (*Covesius plumbeus*) and plains killifish become abundant about midway in the creek. The creek chub is by far the dominant species throughout most of the creek. The white sucker is common except for the headwaters. Lake chubs, fathead minnows, emerald shiner (*Notropis atherinoides*) and sand shiner appear to be headwater species. These four species dominate the upper portions of the creek because of their tolerances to extreme habitat fluctuations. The sturgeon chub (*Hybopsis gelida*) was collected during 1977. This species is rare in Montana and has only been collected in the lower Yellowstone and it's tributaries. Habitat preference of the sturgeon chub is turbid water over gravel substrate with moderate to strong current, restricted the species to the turbid prairie streams. The presence of the northern redbelly dace (*Phoxinus eos*) in Box Elder Creek is the first occurrence of this species outside of the Missouri River drainage. They were probably introduced into the drainage as a bait fish by anglers.

Cotton Creek. Five species of fish were collected in Cotton Creek (Table 11). The plains killifish (*Fundulus kansae*) is abundant in this stream. Prior to 1971, known distribution of this species in Montana was limited to the Big Horn River drainage (Brown 1971). It has now been collected downstream in the Yellowstone River where it has established itself in small feeder streams. Killifish seem to prefer shallow sandy bottomed streams which vary greatly in their thermal and chemical features (Minckley and Klaassen 1969). Pflieger (1975) suggests that the distribution of this species is limited by it's requirements for high salinity or by inability to complete in the more diverse populations found in a typical stream situation.

Glendive Creek. Ten species of fish were collected in Glendive Creek (Table 11). All of these species are commonly distributed throughout the lower Yellowstone system. Game fish were not collected in Glendive Creek.

Table 10. General chemistry measurements from Yellowstone River tributaries, 1977-1978.

Date	Temp. °C	Alkalinity mg/l	Conductance umhos/cm	D.O. ppm	Turbidity JTU's	pH
			-S10-			
6/9/77	-	-	-	4.5	-	9.5
8/4/77	17.8	340	-	10.5	15	9.6
9/14/77	15.6	540	1100	7.0	100	9.1
7/14/78	25.0	210	2050	8.0	150	8.5
			-BE1-			
6/6/77	22.2	350	-	7.3	-	9.2
7/28/77	21.1	400	-	8.0	-	-
9/15/77	15.0	440	350	8.8	65	8.4
6/21/78	21.1	270	2700	8.4	92	9.5
			-C2-			
6/10/77	-	-	450	10.5	-	8.4
8/2/77	22.8	400	180	-	5	6.8
9/15/77	18.9	430	500	12.0	15	8.5
3/16/78	2.0	120	610	12.8	-	7.5
			-IG3-			
6/6/77	28.3	880	-	5.3	-	9.5
7/19/77	-	125	-	-	250	9.4
9/15/77	18.9	500	400	8.5	4500	-
3/16/78	1.0	70	220	12.5	-	8.5
7/12/78	20.0	280	1650	9.5	>500	8.0

Griffith Creek. Six species of fish were collected in Griffith Creek (Table 11). These species are common throughout the area.

Hodges Creek. Two species were collected in this small tributary of Glendive Creek (Table 11). Sandshiners and fathead minnows are common throughout the area.

Krug Creek. Thirteen species of fish were collected in Krug Creek during 4 sampling dates (Table 11). These species are all commonly distributed throughout the study area.

Table 11. Distribution of fishes in tributary streams of the Yellowstone River 1977-78. Montana species of special concern underlined.

Species	Streams						
	Smith	Box Elder	Cotton	Glendive	Griffith	Krug	Hodges
Carp	*	*				*	
Creek chub	*	*	*		*	*	
Sturgeon chub		*					
Flathead chub	*	*		*	*	*	
Lake chub	*	*			*	*	
Brassy minnow	*	*					
N. redbelly dace		*					
Plains minnow				*		*	
Silvery minnow	*	*		*	*	*	
Fathead minnow	*	*		*	*	*	*
Emerald shiner	*	*		*			
Longnose dace	*	*	*		*	*	
Sand shiner	*	*		*			*
Smallmouth buffalo	*			*			
River carpsucker		*		*			
Shorthead redhorse	*						
White sucker	*	*	*	*		*	
Channel catfish	*						
Black bullhead	*	*				*	
Yellow bullhead	*					*	
Stonecat	*	*					
Brook stickleback	*	*	*	*		*	
Bluegill		*					
Green sunfish	*						
White crappie	*						
Northern pike	*						
Plains killifish		*	*			*	

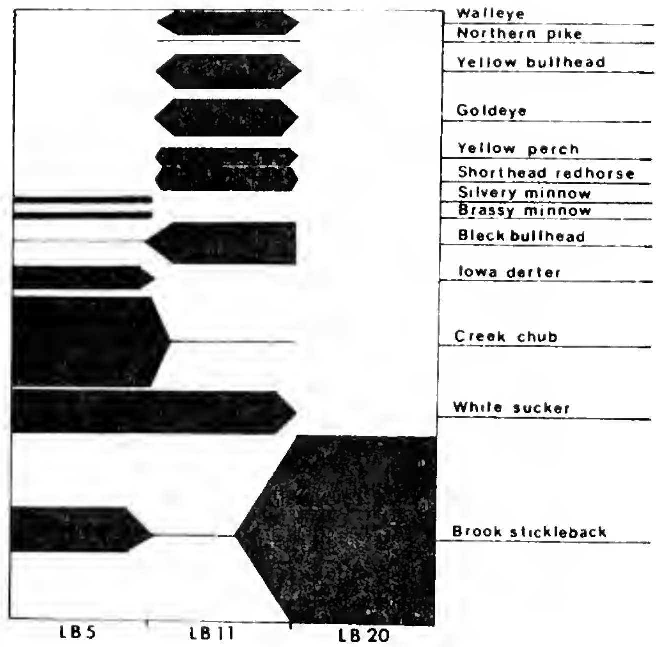

Figure 24. Kite diagram showing distribution and relative abundance of fishes in Little Beaver Creek. Width of kite at each station represents number of individuals taken.

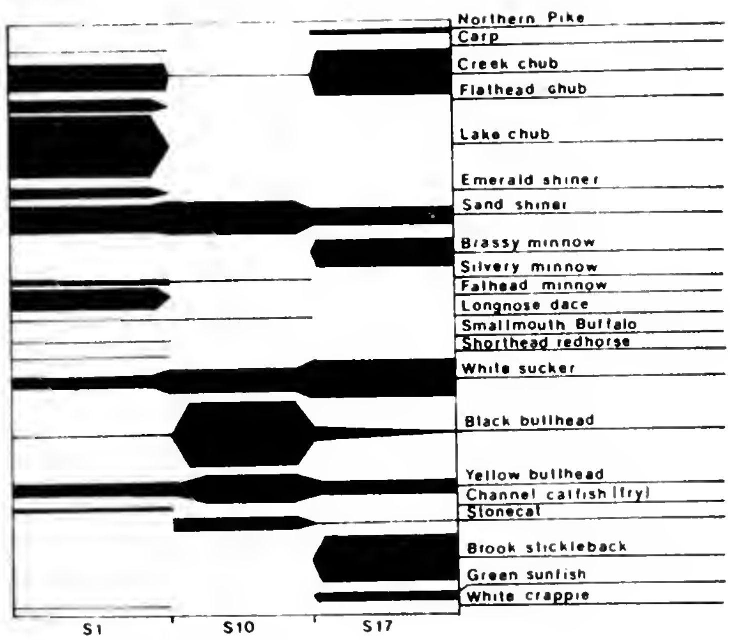

Figure 25. Kite diagram showing distribution and relative abundance of fishes taken in Smith Creek. Width of kite at each section is proportional to the number of individuals taken.

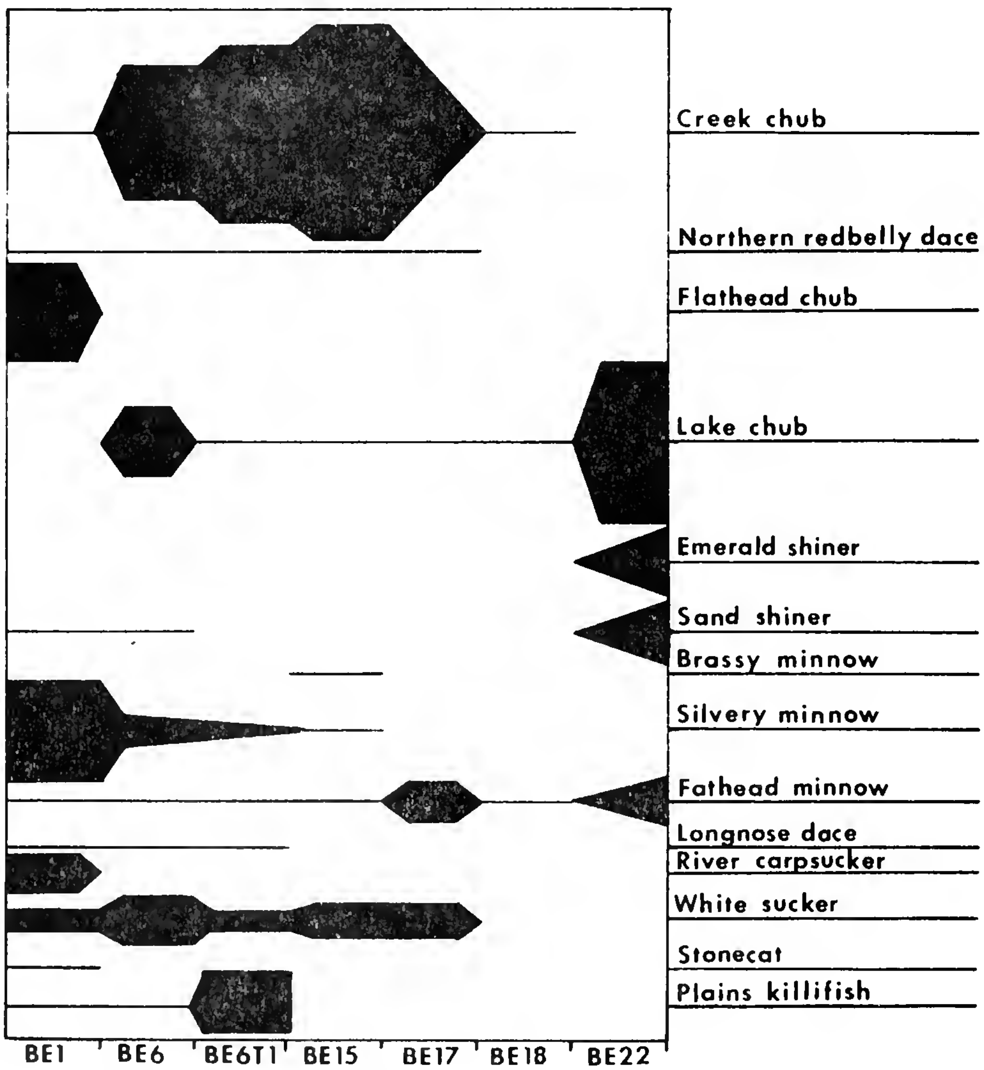

Figure 26. Kite diagram showing distribution and relative abundance of fishes in Box Elder Creek. Width of kite is proportional to the number of individuals collected.

CLASSIFICATION OF STREAMS

Each stream in the study area was classified and ranked to assist the Federal agencies with making the decision concerning leasing of federal coal reserves. The importance of the aquatic resources in relation to surface coal mining is therefore recognized. A rating procedure developed by Holton and McFarland (1978) was utilized to assign each stream a species and habitat value and a sport fishery potential value. The fish resource value was then assigned.

The value assigned for species and habitat was determined by a point system in which most points were awarded for important habitats of fish species of special concern. Native species found in limited numbers and/or limited waters were considered of special concern. Fewer points were awarded to less important habitats of species of special concern and for widespread species occurring in large numbers. Least points were awarded for non-indigeneous species considered of minimal value. Points were also given for esthetics and for importance to local community for scientific study, nature study and/or recreation. The procedure for the rating system is included in Appendix III.

Sport fishery potential was based on a point system in which points were awarded for (1) productivity as indicated by biomass or numbers and sizes of game or sport fish, (2) legal rights of the public to fish or willingness of a landowner to permit fishing, (3) esthetics and, (4) use by fishermen (fishing pressure).

Six value classes were established and a stream was rated according to its score as follows:

Value Class	Class Identification
1	Highest valued fishery resource
2	High priority fishery resource
3	Substantial fishery resource
4	Limited fishery resource
5	Low value fishery resources
6	Negligible fishery resource or not classified

The value and subsequent rating for each stream covered by this study is summarized in Table 12. Computer printouts for each stream reach are in Appendix III.

Beaver Creek received the highest rating of the streams under consideration, with a value class of 2. Habitat for the creek chub, a class C species of special concern was considered to be substantial in Beaver Creek. Since Beaver Creek is the only perennially flowing stream in the area, it was given special consideration as being important to the community. Points accumulated from the remaining species brought the total to 10.9. A class 2 stream is considered to have a high priority fishery resource and should be protected. Activities planned for the Beaver Creek drainage should be carefully reviewed to insure that this unique aquatic resource is protected. The water storage project planned for Beaver Creek will undoubtedly affect this resource. Instream flows necessary to maintain the integrity of Beaver Creek must be identified and maintained.

Box Elder Creek also received a high rating with a value class of 2. The creek was considered to have high priority habitat for the creek chub and killifish, both class C species of special concern. Limited habitat for the sturgeon chub, a class B species of special concern also increased the rating. The points accumulated from the remaining 16 species placed the value rating at 10.0. Sport fishery value was only 5, receiving a class 4 rating, which is not surprising considering the scarcity of game and sport fish. Since this class is considered to have a high priority fishery resource, activities which may affect the aquatic resources should be discouraged. Coal lease applications for Box Elder Creek drainage should not be considered until further research has shown that the quality and richness of this resource is not jeopardized. Water resource development projects being considered for this drainage should be reviewed very carefully to insure that the integrity of the system is maintained.

Table 12. Stream classification values for Beaver Creek, Beaver Creek tributaries and Yellowstone River tributaries.

	Species and Habitat		Sport Fishery Potential	
	Value	Class	Value	Class
Beaver Cr.	10.9	2	7	4
Box Elder Cr.	10.0	2	5	4
Smith Cr.	8.3	3	8	4
Little Beaver Cr.	7.7	3	8	4
Krug Cr.	6.3	3	5	4
Griffith Cr.	4.8	4	5	4
Cotton Cr.	4.1	4	6	4
Hodges Cr.	3.8	4	7	4
Lamesteer Cr.	3.6	4	6	4
Hay Cr.	3.3	4	6	4
Glendive Cr.	2.6	4	5	4

Three streams, Smith Creek, Little Beaver Creek and Krug Creek, were rated as class 3 streams on the basis of species and habitat values. Habitat values for the creek chub and plains killifish accounted for the classification. Class 3 streams have a substantial fishery resource. Resource development activities in these drainages should be reviewed to protect the aquatic resources. Guidelines should be established and followed, however, to prevent substantial riparian damage.

DISCUSSION

Flow regime, physical characteristics, chemical parameters and stream morphology of Beaver Creek, it's tributaries and the small tributaries to the lower Yellowstone River were found to be similar to other southeastern Montana prairie streams. Runoff in Beaver Creek is usually characterized by two high-water periods. The first, and largest, occurs during late winter or early spring and represents lowland snowmelt runoff, while the second occurs in later spring and coincides with the spring rains. Flows for the streams in the study area in 1977 represent an extremely low flow, while 1978 is considered above average.

Diptera is the most abundant and widely distributed group of aquatic invertebrates in the Beaver Creek drainage. The invertebrate fauna found in Beaver Creek and the tributaries are characteristic of intermittent prairie streams. Distribution patterns in these streams are influenced by the sluggish water and their intermittent nature. Species which complete their life history in one season appeared to dominate the invertebrate fauna.

Fishes found in the Beaver Creek drainage are similar to those found in other eastern Montana streams (Elser et al. 1978, Elser and Schrieber 1978, Clancey 1977). Some exceptions particularly creek chub, Iowa darter, brook stickleback and plains killifish were noted and their distribution identified. In general most species were distributed in Beaver Creek in one of three ways: i.e. found only near the mouth, present only in the headwaters, or distributed throughout (Figures 13 and 14). Those species found only near the mouth were likely migrants from the Little Missouri River. Water temperatures, water quality and substrate in the upper reaches favored those fishes found in this area. Other species existing throughout the creek are obviously tolerant of the entire range of conditions and habitats existing there.

Comparisons of fish numbers between stations were difficult to make because sampling conditions between stations varied greatly. However, for a given station, the numbers of each species sampled probably indicate their relative densities. In addition, the abundance or scarcity of certain species at a given station probably reflects the suitability of habitat for those species involved. There seemed to be little uniformity in species diversity of the ichthyofauna within the study area. Diversity was greater above the Montana-North Dakota boundary than below. Samples were not taken frequently enough nor were they of adequate size to allow a completely quantitative assessment.

Observations suggest that sauger, walleye and channel catfish utilize Beaver Creek for spawning. The importance of this stream to maintaining the fish populations of Lake Sakakawea and the Little Missouri River is unanswered. The lack of angler returns of tagged fish indicates an under-utilized resource. This is not unexpected since fishing pressure is low reflecting the sparse human population density of the area.

Young-of-the-year sport fish taken in the Yellowstone River tributaries indicates the importance of these streams for maintaining the integrity of the lower Yellowstone. While it is difficult to evaluate the relative importance of these streams to the reproductive potential of lower Yellowstone fish populations, it demonstrates that these streams do provide spawning and nursery areas. When resource development decisions are made, the importance of these tributaries should be considered. Channel catfish and northern pike were collected in Smith Creek, but may also utilize other streams as well.

Classification of streams in the study area indicates that these prairie streams are important from the standpoint of species and their habitat values. A serious problem in the preservation of aquatic habitat is the measurement of the total worth of a stream. A fishery (either recreational or scientific) does not lend itself to conventional means of measurement and is too often sold short in comprehensive planning that involves water resources. Two streams inventoried in this study, Beaver Creek and Box Elder Creek, were placed in resource value class which is considered high priority resource fisheries. Decisions concerning resource development in these drainages should be made only after the potential impacts are carefully considered.

Among the primary concerns about leasing Federal coal reserves and the subsequent energy devleopment are the effects of coal extraction on water quality, the influences of water withdrawals for coal combustion and the impacts of water storage projects for marketing the water in other basins. In a strip mine operation, topsoil and overburden are removed and set aside, sections of a coal seam removed and consumed, and eventually the void is refilled with overburden (spoils) and recovered with the stored topsoil. As a result of this operation, the normal flow of the aquifer and of surface water is disturbed. Natural chemical and biological processes are altered, hastened or retarded. These may affect the quality of water passing through the mine site area, and in turn alter the biological structure of the subsequent receiving waters - the nearby streams, rivers, ponds and lakes.

Studies on the influences of coal mining on subsurface and surface water quality have suggested major impacts (Thurston, et al. 1976). Ground and ground water disturbances associated with mining activity enhances mineralization processes and thereby increases the rates of dissolution of many ionic substances in natural waters (VanVoast and Hedges, 1975). Therefore, it appears likely that coal mining operations in the Beaver Creek or lower Yellowstone basins would alter the water quality and impact the aquatic system. Discharge waters from the West Decker mine have been shown to contain higher concentrations of certain ions than the receiving waters (Whalen, et al. 1976). Water running over mine overburden and spoils result in relatively large amounts of soluble sulfate and carbonate compounds being leached from the overburden and spoils, resulting in an increase in salinity. Beaver Creek, Little Beaver Creek, Box Elder Creek, Smith Creek and Krug Creek all were classed as substantial or better fishery resources and should be protected from environmental degradation.

Mercury enrichment of mine water is another problem associated with coal mining. Phillips (1978) has found higher concentrations in Decker mine discharge water; however dilutional rates were high enough so that the mine does not appear to have a detectable influence on the mercury content of the Tongue River or Tongue River Reservoir. Heavy metal contamination of streams in the Beaver Creek drainage and lower Yellowstone River tributaries is however, a possible impact of coal development in this area.

Intake Water Company, a wholly owned subsidiary of Tenneco, Inc., has proposed construction of an off channel reservoir on Box Elder Creek, and a mainstem reservoir on Beaver Creek. An appropriation for 80,650 acre-feet of Yellowstone River water per year was filed by Intake Water Company. This water will be pumped to the detention reservoir on Box Elder Creek. An impoundment on Box Elder Creek would have a negative effect on the diverse biota of this stream, unless measures are taken to provide adequate instream flow values. Several native Montana species which are of special concern are found in Box Elder Creek: creek chub, sturgeon chub and plains killifish; and their integrity must be maintained.

Water will then be pumped into the reservoir on Beaver Creek and marketed in industrial areas. However, Intake Water Company is currently involved in a legal battle to obtain permission to transport Yellowstone basin water into the Little Missouri Basin. Not only questions involving states rights, but also questions concerning the Yellowstone Compact are involved. Several locations for the reservoir have been discussed. Depending on the final site and future irrigation demands in the area, the downstream fishery will be dependent on releases from the reservoir. The fishery in Beaver Creek is also diverse and adequate flows must be maintained below the dam if the integrity of the fishery is to be maintained. Instream flows adequate to provide habitat must be maintained.

It is doubtful if a quality recreational fishery could be maintained in the reservoir. Lamesteer Reservoir has not been able to provide a sustained quality fishery and there is no reason to believe that a mainstem reservoir would be any better . Additionally, the Beaver Creek Reservoir would be subjected to large fluctuations in water levels due to industrial use of the water.

Baseline information on the current aquatic invertebrate and fish species composition, distribution, and abundance in Beaver Creek, its tributaries and tributaries to the Yellowstone is important and necessary to detect any future changes in the aquatic communities resulting from coal leasing, mining and energy conversion. Additional studies to monitor the aquatic populations should be planned so future effects can be detected and remedial action taken if and where necessary.

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APPENDIX I

BEAVER CREEK DRAINAGE SAMPLING SITES

BEAVER CREEK

North Dakota

Sites			
1.	T 145 N,	R 102 W.	Sec. 34
2.			Sec. 33
3.	T 144 N,	R 103 W,	Sec. 1
4.			Sec. 2
5.			Sec. 11
6.			Sec. 10
7.			Sec. 15
8.			Sec. 22
9.			Sec. 23
10.			Sec. 26
11.			Sec. 27
12.			Sec. 28
13.			Sec. 29
14.			Sec. 32
15.	T 143 N,	R 103 W,	Sec. 5
16.	T 144 N,	R 103 W,	Sec. 31
17.	T 143 N,	R 103 W,	Sec. 6
18.	T 143 N,	R 104 W,	Sec. 1
19.	T 144 N,	R 104 W,	Sec. 36
20.	T 143 N,	R 104 W,	Sec. 2
21.			Sec. 3
22.			Sec. 10
23.			Sec. 11
24.			Sec. 15
25.			Sec. 16
26.			Sec. 21
27.			Sec. 20
28.			Sec. 17
29.			Sec. 19
30.			Sec. 30
31.	T 143 N,	R 105 W,	Sec. 24
32.			Sec. 25
33.			Sec. 23
34.			Sec. 26
35.			Sec. 27
36.			Sec. 34
37.			Sec. 33
38.			Sec. 28
39.			Sec. 32
40.	T 142 N,	R 105 W,	Sec. 5
41.	T 143 N,	R 105 W,	Sec. 31
42.	T 142 N,	R 105 W,	Sec. 6

Montana

Sites			
43.	T 16 N,	R 61 E,	Sec. 18
44.	T 16 N,	R 60 E,	Sec. 13
45.			Sec. 14
46.			Sec. 23
47.			Sec. 22
48.			Sec. 27
49.			Sec. 28
50.			Sec. 33
51.			Sec. 32
52.	T 15 N,	R 60 E,	Sec. 5
53.			Sec. 8
54.			Sec. 17
55			Sec. 18
56.	T 15 N,	R 59 E,	Sec. 24
57.			Sec. 25
58.			Sec. 26
59.			Sec. 36
60.			Sec. 35
61.	T 14 N,	R 59 E,	Sec. 1
62.			Sec. 12
63.			Sec. 13
64.			Sec. 24
65.			Sec. 25
66.			Sec. 36
67.	T 14 N,	R 60 E,	Sec. 31
68.	T 13 N,	R 60 E,	Sec. 6
69.	T 13 N,	R 59 E,	Sec. 1
70.			Sec. 12
71.			Sec. 13
72.	T 13 N,	R 60 E,	Sec. 18
73.			Sec. 19
74.	T 13 N,	R 59 E,	Sec. 24
75.	T 13 N,	R 60 E,	Sec. 30
76.	T 13 N,	R 59 E,	Sec. 25
77.	T 13 N,	R 60 E,	Sec. 31
78.	T 13 N,	R 59 E,	Sec. 36
79.			Sec. 35
80.	T 12 N,	R 60 E,	Sec. 5
81			Sec. 6
82.			Sec. 7
83.			Sec. 18
84.			Sec. 19
85.			Sec. 30
86.	T 12 N,	R 59 E,	Sec. 25
87.	T 12 N,	R 60 E,	Sec. 31

BEAVER CREEK continued

Site	Montana	
88.	T 12 N, R 59 E,	Sec. 36
89.	T 11 N, R 59 E,	Sec. 1
90.	T 11 N, R 60 E,	Sec. 6
91.		Sec. 7
92.	T 11 N, R 59 E,	Sec. 12
93.		Sec. 13
94.	T 11 N, R 60 E,	Sec
95.		Sec. 19
96.		Sec. 30
97.		Sec. 31
98.	T 10 N, R 60 E,	Sec. 6
99.		Sec. 5
100.		Sec. 8
101.		Sec. 9
102.	T 10 N, R 60 E,	Sec. 16
103.		Sec. 15
104.		Sec. 22
105.		Sec. 23
106.		Sec. 26
107.		Sec. 25
108.		Sec. 36
109.	T 10 N, R 61 E,	Sec. 31
110.		Sec. 30
111.	T 9 N, R 61 E,	Sec. 5
112.		Sec. 4
113.		Sec. 9
114.		Sec. 8
115.		Sec. 17
116.		Sec. 18
117.	T 9 N, R 60 E,	Sec. 13

LONE TREE CREEK

LT1.	T 12 N, R 60 E,	Sec. 30
LT2.		Sec. 31
LT3.		Sec. 32
LT4.		Sec. 33

LAME STEER CREEK

L1.	T 12 N, R 60 E,	Sec. 7	
L2		Sec. 8	
L3.		Sec. 9	
L4.		Sec. 16	
L5.		Sec. 15	(Lame Steer
L6.		Sec. 14	Lake, LS)
L7.		Sec. 23	
L8.		Sec. 24	

LAME STEER CREEK continued

Site		
L9.		Sec. 25
L10.		Sec. 36
L11.	T 12 N, R 61 E,	Sec. 31
L12.	T 11 N, R 61 E,	Sec. 6

HAY CREEK

H1.	T 15 N, R 60 E,	Sec. 17
H2.		Sec. 16
H3.		Sec. 21
H4.		Sec. 22
H1T1.	T 15 N, R 60 E,	Sec. 17
H1T2.		Sec. 20
H1T3.		Sec. 21
H1T4		Sec. 28
H1T5.		Sec. 33
H1T6.		Sec. 34
H1T7.	T 14 N, R 60 E,	Sec. 3

LITTLE BEAVER CREEK

LB1.	T 16 N, R 60 E,	Sec. 33
LB2.		Sec. 34
LB3.	T 15 N, R 60 E,	Sec. 3
LB4.		Sec. 10
LB5.		Sec. 11
LB6.		Sec. 14
LB7.		Sec. 13
LB8.		Sec. 24
LB9.	T 15 N, R 61 E,	Sec. 19

North Dakota

LB10.	T 141N, R105W,	Sec. 7	
LB11.		Sec. 18	
LB12.		Sec. 8	(Odland
LB13.		Sec. 17	Dam)
LB14.		Sec. 20	
LB15.		Sec. 21	
LB16.		Sec. 28	
LB17.		Sec. 27	
LB18.		Sec. 34	
LB19.		Sec. 33	
LB20.	T 140N, R 105W,	Sec. 6	
LB21.		Sec. 7	

ELK CREEK

E1. T 143N, R 104W, Sec. 11

PRAIRIE DOG CREEK

T 144N, R 103W, Sec. 2

SIX CREEK

T 145N, R 102W, Sec. 26

APPENDIX II

YELLOWSTONE DRAINAGE SAMPLING SITES

GLENDIVE CREEK

Site		
1G1.	T 16 N, R 56 E,	Sec. 18
1G2.		Sec. 19
1G3.		Sec. 20
1G4.		Sec. 29
1G5.		Sec. 30
1G6		Sec. 28
1G7.		Sec. 33
1G8.	T 15 N, R 56 E,	Sec. 4
1G9.		Sec. 3
1G10.		Sec. 10
1G11.		Sec. 11
1G12.		Sec. 14
1G13.		Sec. 23

KRUG CREEK

K1.	T 16 N, R 56 E,	Sec. 33
K2.		Sec. 34
K3.	T 15 N, R 56 E,	Sec. 3
K4.		Sec. 2
K5.		Sec. 11
K6.		Sec. 12
K7.	T 15 N, R 57 E,	Sec. 7
K8.		Sec. 8
K9.		Sec. 9
K10.		Sec. 15
K11.		Sec. 14
K12.		Sec. 13

GRIFFITH CREEK

G1.	T 16 N, R 56 E,	Sec. 34
G2.		Sec. 35
G3.		Sec. 36
G4.	T 16 N, R 57 E,	Sec. 31
G5.		Sec. 30
G4T1.	T 16 N, R 57 E,	Sec. 31

COTTON CREEK

C1.	T 16 N, R 56 E,	Sec. 5
C2.		Sec. 4
C3.		Sec. 3
C4.		Sec. 10
C5.		Sec. 11

BOX ELDER CREEK

Site		
BE1.	T 18 N, R 57 E,	Sec. 31
BE2.	T 17 N, R 57 E,	Sec. 6
BE3.		Sec. 5
BE4.		Sec. 8
BE5.		Sec. 7
BE6.		Sec. 18
BE7.		Sec. 19
BE8.		Sec. 20
BE9.		Sec. 29
BE10.		Sec. 32
BE11.		Sec. 28
BE12.		Sec. 33
BE13.		Sec. 34
BE14.	T 16 N, R 57 E,	Sec. 1
BE15.	T 16 N, R 58 E,	Sec. 6
BE16.		Sec. 7
BE17.		Sec. 8
BE18.		Sec. 17
BE19.		Sec. 16
BE20.		Sec. 21
BE21		Sec. 22.
BE22.		Sec. 27
BE6T1.	T 17 N, R 57 E,	Sec. 18

SMITH CREEK

S1.	T 19 N, R 58 E,	Sec. 3
S2.		Sec. 10
S3.		Sec. 11
S4.		Sec. 14
S5.		Sec. 23
S6.		Sec. 24
S7.	T 19 N, R 59 E,	Sec. 19
S8.	T 19 N, R 58 E,	Sec. 25
S9.	T 19 N, R 59 E,	Sec. 30
S10.		Sec. 29
S11.		Sec. 20
S12.		Sec. 28
S13.		Sec. 33
S14.		Sec. 27
S15.		Sec. 34
S16.		Sec. 35
S17.		Sec. 36
S18.	T 19 N, R 60 E,	Sec. 31
S19.		Sec. 32
S20.		Sec. 29

PARSON CREEK

T 19 N, R 59 E, Sec. 34

HODGES CREEK 21-0420

W9. T 14 N, R 58 E, Sec. 9

APPENDIX III

Stream Rating Procedures and Classification Sheets

APPENDIX III

MONTANA DEPARTMENT OF FISH AND GAME

PROCEDURE FOR RATING MONTANA STREAMS

December 1978

GENERAL

Six value classes were established:

VALUE CLASS	CLASS DEFINITION
1	Highest-valued fishery resource
2	High priority fishery resource
3	Substantial fishery resource
4	Limited fishery resource
5	Low value fishery resource
6	Negligible fishery resource or not classified.

Each stream reach was placed in a value class for each of the two criteria below. The final classification, the fish resource value, was the higher class given for criterion 1 or 2.

Criterion 1 - Species and Habitat Value of Stream Reach

The class of each reach was determined by a point system in which most points were awarded for important habitats of fish species of special concern (native species found in limited numbers and/or limited waters). Fewer points were awarded to less important habitats of species of special concern and for the occurrence of widespread species found in substantial numbers. Least points were awarded for occurrence of non-indigenous species considered of minimal value. Additional consideration was given to tributaries that are important sources of trout recruitment. Points were also given for spring streams; outstanding esthetics; and for local community value where the stream, being one of few or the only one in the immediate area, is important to a community for scientific study, nature study, and/or recreation.

Criterion 2 - Sport Fishery Potential of Stream Reach

The class of each reach was based on a point system in which points were awarded for (1) productivity as indicated by biomass or numbers and sizes of game or sport fish, (2) ingress (legal rights of the public to fish the reach or willingness of landowner to permit fishing), (3) esthetics and (4) use by fishermen (fishing pressure).

DETAILED PROCEDURE FOR ASSIGNING VALUE CLASSES

A. Procedure for Criterion I - Species and Habitat Value of Stream Reach

1. Standards and Associated Points

Points[1/]	Standard	
15	I	Highest-valued habitat[2/] for class A species of special concern[3/].
10	II	High priority habitat for class A species of special concern. or Highest-valued habitat for class B species of special concern.
5	III	Substantial habitat for class A soecies of special concern. or High priority habitat for class B species of special concern. or Highest-valued habitat for class C species of special concern.
3	IVA	Substantial habitat for class B species of special concern. or High priority habitat for class C species of special concern.
1.5	IVB	Substantial habitat for class C special of special concern.
.4	V	Limited habitat for any species of special concern. or Abundant[4/] population of: (1) native not species of special concern[5/] or (2) non-native game or sport species[5/].
.3	VIA	Common abundance of: (1) native not species of special concern or (2) non-native game or aport species.
.2	VIB	Same as VIA only abundance rating is uncommon or unknown.
.1	VII	Same as VIA only abundance is rated as rare, M (species absent but might be present if habitat problem corrected) or E (species expected but not verified). or Presence of any non-native non-sport species.
3	VIII	Esthetics is 3 or higher (on a scale of 1 lowest to 5 highest).
3	IX	Stream is one of few streams or only one in the immediate area and is important to community for scientific study, nature study and/or recreation.
3	X	Stream is a spring stream or spring creek.

1/ Points are awarded for each species meeting a standard.

2/ Habitat designations: highest-valued, high priority, substantial, and limited are based on judgement decisions of fisheries managers.

3/ See list of species of special concern in Appendix.

5/ See list of Montana fish species in Appendix.

II. Assignment of class

Points	Species and Habitat Value Class
15 or more	1
10 to less than 15	2
5 to less than 10	3
.3 to less than 5	4
Greater than zero to less than .1	5
0.	6

Important tributaries for trout recruitment are advanced one class but not higher than class 3.

NOTE: If no fish are present stream reach is automatically in class 6; exception, if no fish present but stream has local community importance (standard IX above) class 5 is assigned.

B. Procedure for Criterion 2 - Sport Fishery Potential of Stream Reach

I. Productivity - Award of Points and Assignment of Grade

a. Points for productivity of all trout species combined[1/]

Biomass (Kg) per 300 m	Points
70 and over	9
12 to less than 70	5
5 to less than 12	3
Greater than 0 to less than 5	1

If trout present but biomass is unknown:
Each species with abundance A,B,C or D[2/] is assigned 1
Each species with abundance U,V, or Z is assigned .5

b. Points for productivity of class A non-trout game and sport fish[1/]

Abundance Rating[2/]	Points
A	2
B	1
C	1
D	2
U, V and Z	.5

Note: Maximum for mountain whitefish is 2 points.

c. Assignment of productivity grade

Points (sum of points from a and b above)	Grade
9 and over	4
6 to less than 9	3
3 to less than 6	2
Greater than 1 to less than 3	1
1 or less	0

II. Assignment of Ingress Grade

Ingress rating [2/]	Grade
1	4
2	3
3	3
4	2
5	1
6 and 7	0

1/ For species designations see list of Montana fishes in Appendix.
2/ See explanation of ratings in Appendix.

III. Assignment of Esthetics Grade

Esthetics rating[1/]	Grade
5	4
4	3
3	2
2	1
1	0

IV. Assignment of Use (Fishing Pressure) Grade

Fisherman days/10 km	Grade
1250 and over	4
310 to less than 1250	3
65 to less than 310	2
Greater than 0 to less than 65	1
0 (none or unknown)	0

V. Computation of Sport Fishery Potential Score and Assignment of Class.

A. Score = Sum of (grade for each component x multiplier[2/]).

B. Assignment of Class

	Score	Conditions	Sport fishery potential class
1.	17 and over	Fish production based on natural reproduction. Paddlefish or bragging-size[3/] trout present and ingress rating of 1, 2 or 3 and esthetics rating of 3, 4 or 5 and overall use of 5000 or more[4/]	1
2.	17 and over	Ingress rating of 1, 2 or 3 and at least one condition in 1 above not met.	2
3.	17 and 18	Ingress rating of 4 to 7	3
4.	15 to less than 17	Ingress rating of 1, 2 or 3	2
5.	15 to less than 17	Ingress rating of 4 to 7	3
6.	Greater than 11 to less than 15		3
7.	Greater than 4 to 11		4
8.	Greater than 0 to 4		5
9.	0		6

Note: If no fish are present stream reach is automatically in class 6.

1/ See explanation of ratings in Appendix
2/ Multiplier for productivity is 2; for other components (ingress, esthetic and use) the multiplier is 1.
3/ See Appendix for bragging sizes
4/ For this purpose the stream reach will be a composite of adjoining reaches that meet all other conditions for Class 1.

C. Assignment of Fish Resource Value Class

The fish resource value class is simply the higher class given for criterion 1 or 2 above.

APPENDIX

INGRESS RATING. As used here ingress means the legal right to enter.

Code

1 - Stream section bordered almost entirely by public lands which insure ingress by anglers (exclude state school sections).

2 - A stream section bordered by a mix of private and public land where the public land is distributed in such a way that no significant portion of the stream is unavailable by vehicle and/or walking. Floating may also be a major means of access.

3 - A stream section bordered by mostly private land where ingress is uncontrolled or readily available by permission. This portion may be available by floating or through navigability laws. Also includes corporate lands - these are currently open but could go to individual ownership in the future or company policy regarding ingress could change.

4 - A stream section bordered mostly by private land where ingress is limited but some fishing is allowed. May include minor portions where public land or road crossing may provide limited ingress. The portion through private land may be available by floating or through navigability laws.

5 - A stream section bordered entirely by private land where public fishing is available for a fee or where a small group has leased exclusive rights. Legality may be in question on some streams but this category identifies the current "fee" or "lease" fishing areas.

6 - A stream section bordered mostly by private land where little or no ingress by permission is allowed. Floating precluded by stream size or other physical limitation (no road or public land to reach stream).

7 - A stream or stream segment bordered by public land that is unavailable because of posting on private land or locked gates on private roads.

FISH ABUNDANCE RATINGS. Abundance of fish refers only to adult fish, or in case game and sport fish to keeper size (7" minimum for trout; exception 6" minimum for trout populations which spawn when shorter than 7"). By nature abundance ratings are subjective. Since trout command the most interest of Montana fishes, the abundance ratings for all fishes were geared to trout. The abundance graph (Figure 1) is a guide to numbers associated with abundant, common, uncommon and rare. The ratings reflect the peak abundance during the year, e.g., when migratory spawners are present.

A = Abundant
B = Abundant with proportional number of bragging size (see appendix)
C = Common
D = Common with proportional number of bragging size (see appendix)
U = Uncommon
V = Uncommon with proportional number of bragging size (see appendix)
R = Rare
E = Presence not verified but expected
M = Species absent but could be present if habitat problems corrected
N = Not present
P = Species absent, but might be present if introduced (e.g., potential habitat in a barren stream)
Z = Abundance unknown

Special codes entered in abundance column to indicate habitat value of reach for species of special concern.

G = Highest-valued

H = High priority

S = Substantial value

L = Limited value

CODES FOR FISHES' USE OF REACH

Codes indicating single use or dominant use:

L = Resident throughout life cycle

A = Spawning elsewhere (includes hatchery fish) -- spends part or most of life in reach

H = Spawning and hatching -- young promptly move downstream

J = Spawning and nursery to subadult

C = Passing through -- species uses reach as a corridor to migrate upstream and return downstream

F = Feeding run

N = No use (in connection with abundance codes M, N and P)

Z = Use undetermined

Codes that are combinations of the above codes to indicate more than one population of a species.

R = L plus H or J

P = C plus L, A, H or J

S = H and J combined

Any other combination: Code entered for dominant use

ESTHETICS RATINGS. Esthetics were rated 1 (low) through 5 (high). Features that detract from esthetics include: pollution, dewatering, channelization, riprap (particularly car bodies and discarded building materials), mine tailings, a busy highway along stream and severe land abuse. As a guide:

1 - A stream with low esthetic qualities.

2 - A stream and area with fair esthetics qualities.

3 - A water with natural beauty but of a more common type that listed under 4 and 5. A clean stream in an attractive setting.

4 - A water comparable to 5 except that it may lack pristine characteristics. Presence of human development such as roads, farms, etc., usually comprise the difference between 4 and 5.

5 - A water of outstanding natural beauty in a pristine setting.

MONTANA FISHES IN FAMILY SEQUENCE
(Also see species of special concern list)

MT F&G Code	
□ 27 −	Sturgeon*
□ 90 −	White sturgeon
□ 91 −	Pallid sturgeon
□ 92 −	Shovelnose sturgeon
□ 28 −	Paddlefish
38 −	Shortnose gar
34 −	Goldeye
> 01 ‡	Rainbow trout* (See 122)
> 02 −	Cutthroat trout*
> 03 ‡	Brook trout
> 04 ‡	Brown trout
> 05 −	Dolly Varden
> 06 −	Lake trout
> 07 ‡	Golden trout
□ 08 ‡	Kokanee
09 ‡	Coho salmon
□ 10 −	Arctic grayling
> 11 ‡	Rainbow x cutthroat trout hybrid
> 12 −	Westslope cutthroat trout (pure)
> 13 −	Yellowstone cutthroat trout (pure)
14 −	Whitefish*
15 ‡	Lake whitefish (May be native in St Mary's Lake)
□ 85 −	Mountain whitefish
86 −	Pygmy whitefish
87 ‡	Chinook salmon
88 ‡	Splake
□ 89 ‡	Salmon*
>118	Trout*
119	Trout/Salmon*
>120 ‡	Rainbow trout x golden trout hybrid
>121 −	Upper Missouri cutthroat trout (pure)
>122 −	Native rainbow trout
□ 23 ‡	Northern pike (Native only in Saskatchewan River Drainage)
29 −	Peamouth
30 ·	Goldfish
32 ·	Carp
33 −	Northern squawfish
35 ·	Utah chub
37 −	Minnow*
39 −	Longnose dace
41 −	Northern redbelly/Finescale dace*
42 −	Brassy minnow
43 −	Silvery/Plains minnow*
44 −	Flathead chub
45 −	Lake chub
46 −	Sturgeon chub
47 −	Emerald shiner
48 −	Sand shiner
49 −	Redside shiner
50 −	Creek chub
51 −	Pearl dace
52 −	Fathead minnow
53 ·	Golden shiner (May be native in eastern Montana)
140 −	Silvery minnow
141 −	Plains minnow
142 −	Finescale dace
143 −	Northern redbelly dace

MT F&G Code	
11 −	Sucker*
40 −	Buffalo*
55 −	River carpsucker
56 −	Longnose sucker
57 −	White sucker
58 −	Largescale sucker
59 −	Blue sucker
60 −	Bigmouth buffalo
61 −	Smallmouth buffalo
62 −	Shorthead redhorse
63 −	Mountain sucker
□ 24 −	Channel catfish
25 ‡	Bullhead*
64 −	Stonecat
65 ‡	Black bullhead
66 ‡	Yellow bullhead
100 −	Trout-perch
□ 26 −	Burbot
103 −	Plains killifish (Probably native)
106 ·	Mosquitofish
109 ·	Shortfin molly
112 ·	Variable platyfish
115 ·	Green swordtail
71 −	Brock stickleback
17 ‡	Largemouth bass
18 ‡	Bass*
19 ‡	Sunfish*
21 ‡	Crappie*
□ 73 ‡	Smallmouth bass
74 ‡	Bluegill
75 ‡	Pumpkinseed
76 ‡	Green sunfish
77 ‡	Black crappie
78 ‡	White crappie
79 ‡	Rock bass
20 ‡	Yellow perch
□ 22	Sauger/Walleye*
□ 81 −	Sauger
□ 82 ‡	Walleye
83 −	Iowa darter
36 −	Freshwater drum
16 −	Sculpin*
130 −	Mottled sculpin
131 −	Slimy sculpin
132 −	Torrent sculpin
133 −	Shorthead sculpin
134 −	Spoonhead sculpin

CODES:
- > Trout species
- − Native fish, i.e., indigenous
- ‡ Non-native game or sport fish
- · Non-native non-game or sport fish
- □ Stream class A non-trout game or sport fish
- * Undesignated as to species or strain

MONTANA FISH SPECIES OF SPECIAL CONCERN* As of November 1978.

CLASS A - Gene pool insecure and/or limited habitats in Montana and elsewhere in North America.

White sturgeon
Pallid sturgeon
Paddlefish
Yellowstone cutthroat trout
Arctic grayling

CLASS B - Intermediate between class A and class C

Westslope cutthroat trout
Upper Missouri cutthroat trout
Sturgeon chub
Shorthead sculpin

CLASS C - Limited number and/or limited distribution in Montana, at least fairly widespread and abundant elsewhere in North America, gene pool not in jeopardy if extirpated from Montana

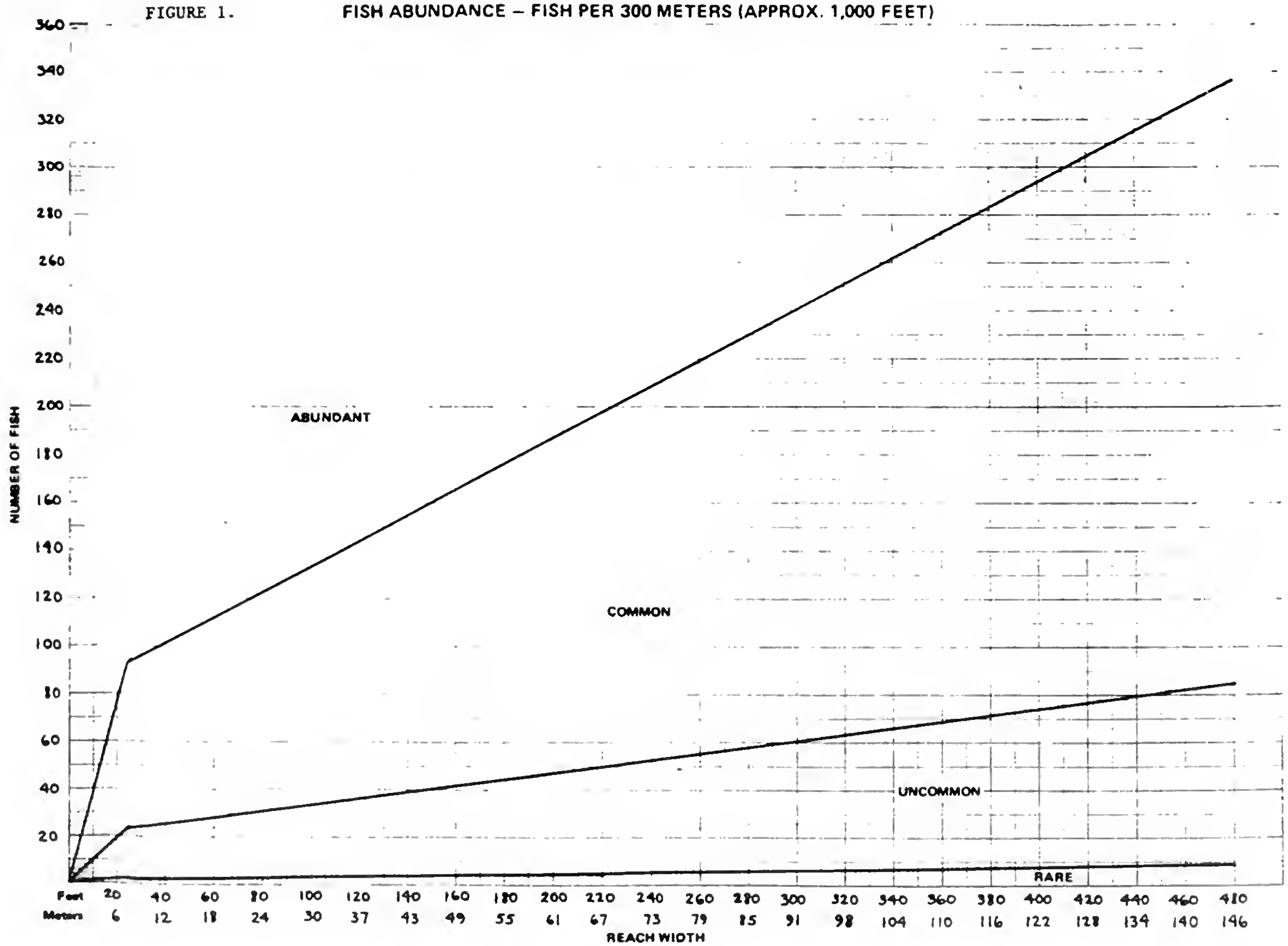
Shortnose gar
Native rainbow trout
Creek chub
Finescale dace
Trout-perch
Plains killifish
Spoonhead sculpin

BRAGGING-SIZE FISH

Species	Kg	Lbs.	Species	Kg	Lbs
Shovelnose sturgeon	2.7	6	Northern Pike	6.8	15
Paddlefish	34.0	75	Bullhead - black & yellow	.3	.7
Mountain whitefish	.9	2	Channel catfish	3.6	8
Kokanee	.9	2	Burbot	2.7	6
Cutthroat trout	.7	1.5	Smallmouth bass	.9	2
Rainbow trout	1.4	3	Largemouth bass	1.8	4
Brown trout	1.4	3	Crappie, black & White	.5	1
Brook trout	.5	1	Yellow perch	.5	1
Dolly Varden	4.5	10	Sauger	.9	2
Lake trout	6.8	15	Walleye	1.8	4
Arctic Grayling	.9	2			
Golden trout	.5	1			

*All are native with possible exceptions of plains killifish and finescale dace which are assumed to be.

FIGURE 1. FISH ABUNDANCE – FISH PER 300 METERS (APPROX. 1,000 FEET)



APPENDIX IV

1742

STREAM: BEAVER CREEK 120100 2 0 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T12NR60E07 -LAMESTEER CREEK SERIAL : 786
LOWER REACH BOUNDARY: T16NR61E18 -NORTH DAKOTA BNDRY
LENGTH (KM): 95.00
COUNTY AT LOWER BOUNDARY: WIBAUX
TRIBUTARY TO: MISSOURI RIVER

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
VIB	WALLEYE	V	L	.2
VIB	SAUGER	U	L	.2
VII	CHANNEL CATFISH	E	L	.1
VIA	BROOK STICKLEBACK	C	L	.3
VIA	IOWA DARTER	C	L	.3
VII	CARP	C	L	.1
VIA	LAKE CHUB	C	L	.3
VIA	PLAINS MINNOW	C	L	.3
VIA	SHORTHD REDHORSE	C	L	.3
VIA	WHITE SUCKER	C	L	.3
VIA	GREEN SUNFISH	C	L	.3
IVB	CREEK CHUB	S		1.5
VIB	NORTHERN PIKE	U	L	.2
VIA	GOLDEYE	C	L	.3
VIA	FLATHEAD CHUB	C	L	.3
[illegible]	EMERALD SHINER	U	L	.2
V	SAND SHINER	[illegible]	L	.4
VIB	BRASSY MINNOW	U	L	.2
VIA	SILVERY MINNOW	C	L	.3
VIA	FATHEAD MINNOW	C	L	.3
VIA	LONGNOSE DACE	C	L	.3
VII	SMALLMOUTH BUFF.	R	L	.1
VIA	YELLOW BULLHEAD	C	L	.3
VIA	BLACK BULLHEAD	C	L	.3
VII	STONECAT	R	L	.1
VIB	BLUEGILL	U	L	.2
VII	YELLOW PERCH	R	L	.1
VII	RIVER CARPSUCKER	R	L	.1

TX ---------------------------IMPORTANT TO LOCAL COMMUNITY 3.0

TOTAL 10.9

SPECIES & HABITAT VALUE CLASS 2

SPORT FISHERY POTENTIAL

COMPONENT		GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)-			
	TROUT, .00KG/300M POINTS : .0			
	NONTROUT POINTS : 1.5			
	TOTAL POINTS : 1.5	1	2	2
II	IN-LESS RATING-3	3	1	3
III	ESTHETICS RATING-2	1	1	1
IV	USE-FMD/10KM: 39. ,OVERALL: 331.5	1	1	1
			TOTAL	7

SPORT FISHERY POTENTIAL CLASS 4

F I S H R E S O U R C E V A L U E C L A S S 2

1750

STREAM: BOXELDER CREEK 210088 2 1 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T16NR59E27 -COUNTY ROAD SERIAL : 877
LOWER REACH BOUNDARY: T18NR57E30 -MOUTH
LENGTH (KM): 32.00
COUNTY AT LOWER BOUNDARY: DAWSON
TRIBUTARY TO: YELLSTONE RIVER

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
VIB	BLACK BULLHEAD	U	R	.2
V	FATHEAD MINNOW	A	L	.4
V	SAND SHINER	A	L	.4
V	FLATHEAD CHUB	A	R	.4
VIA	LONGNOSE DACE	C	L	.3
VIB	LAKE CHUB	U	L	.2
VIB	FNSCALE/REDBELLY	U	L	.2
VII	STONECAT	R	L	.1
VII	BLUEGILL	R	L	.1
VIB	WHITE SUCKER	U	L	.2
VIB	BRASSY MINNOW	U	L	.2
IVA	CREEK CHUB	H		3.0
IVA	PLAINS KILLIFISH	H		3.0
V	STURGEON CHUB	L		.4
VIB	EMERALD SHINER	U	L	.2
VII	CARP	U	L	.1
VIA	SILVERY MINNOW	C	L	.3
VII	RIVER CARPSUCKER	R	L	.1
VIB	BROOK STICKLEBACK	U	L	.2
			TOTAL	10.0

SPECIES & HABITAT VALUE CLASS X 2

Shouldn't this be a class 2 ?

SPORT FISHERY POTENTIAL

COMPONENT		GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)-			
	TROUT, .[illegible]KG/300M POINTS : .[illegible]			
	NONTROUT POINTS : .[illegible]			

						1751
	TOTAL POINTS	: .0	0	2	0	
II	INGRESS RATING-3		3	1	3	
III	ESTHETICS RATING-1		0	1	0	
IV	USE-FMD/10KM: 0. ,OVERALL: .0		0	1	0	
				TOTAL	3	

SPORT FISHERY POTENTIAL CLASS 5

F I S H R E S O U R C E V A L U E C L A S S 3

STREAM: LITTLE BEAVER CREEK 210480 2 0 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T15NR61E19 -NORTH DAKOTA BORDER SERIAL : 884
LOWER REACH BOUNDARY: T16NR6 E33 -MOUTH
LENGTH (KM): [illegible]
COUNTY AT LOWER BOUNDARY: WIBAUX
TRIBUTARY TO: BEAVER CREEK

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
V	FATHEAD MINNOW	A	L	.4
VIA	SAND SHINER	C	L	.3
V	LAKE CHUB	A	L	.4
VIA	IOWA DARTER	C	L	.3
VIA	BLACK BULLHEAD	C	L	.3
V	WHITE SUCKER	A	L	.4
V	BROOK STICKLEBCK	A	L	.4
IVA	CREEK CHUB	H		3.0
VIA	GOLDEYE	C	L	.3
VII	NORTHERN PIKE	R	L	.1
VII	CARP	U	L	.1
VII	BRASSY MINNOW	F	L	.1
VII	SILVERY MINNOW	R	L	.1
VII	SMALLMOUTH BUFF.	R	L	.1
VIA	SHORTHD REDHORSE	C	L	.3
VIA	YELLOW BULLHEAD	C	L	.3
VIB	STONECAT	U	L	.2
VII	GREEN SUNFISH	R	L	.1
VIB	YELLOW PERCH	U	L	.2
VIA	WALLEYE	C	L	.3
			TOTAL	7.7

SPECIES & HABITAT VALUE CLASS 3

SPORT FISHERY POTENTIAL

COMPONENT		GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)- TROUT, .0)KG/300M POINTS : .0			

1763

	NONTROUT POINTS	: 1.0			
	TOTAL POINTS	: 1.0	0	2	0
II	INGRESS RATING-3		3	1	3
III	ESTHETICS RATING-2		1	1	1
IV	USE-F[illegible]D/1[illegible]KM: [illegible]. ,OVERALL: .[illegible]		0	1	0
				TOTAL	4

SPORT FISHERY POTENTIAL CLASS 5

F I S H R E S O U R C E V A L U E C L A S S 3

STREAM: SMITH CREEK 210998 2 0 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T19NR60E31 -C.S. CREEK SERIAL : 885
LOWER REACH BOUNDARY: T20NR58E34 -MOUTH
LENGTH (KM): 32.0
COUNTY AT LOWER BOUNDARY: RICHLAND
TRIBUTARY TO: YELLOWSTONE RIVER

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
V	FATHEAD MINNOW	A	L	.4
V	SAND SHINER	A	L	.4
VII	CARP	C	L	.1
VIA	BRASSY MINNOW	C	L	.3
VIA	PLAINS MINNOW	C	L	.3
VIA	FLATHEAD CHUB	C	L	.3
VIB	LAKE CHUB	U	L	.2
V	BLACK BULLHEAD	A	L	.4
V	WHITE SUCKER	A	L	.4
VIA	BROOK STICKLEBACK	C	L	.3
IVA	CREEK CHUB	F		3.0
VIA	NORTHERN PIKE	C	L	.3
VIA	EMERALD SHINER	C	L	.3
VIA	SILVERY MINNOW	C	L	.3
VII	LONGNOSE DACE	R	L	.1
VII	SMALLMOUTH BUFF.	R	L	.1
VIB	SHORTHEAD REDHORSE	U	L	.2
VIB	YELLOW BULLHEAD	U	L	.2
VIA	CHANNEL CATFISH	C	L	.3
VII	STONECAT	R	L	.1
VIB	GREEN SUNFISH	U	L	.2
VII	WHITE CRAPPIE	R	L	.1
			TOTAL	8.3

SPECIES & HABITAT VALUE CLASS 3

SPORT FISHERY POTENTIAL

COMPONENT	GRADE	MULTIPLIER	SCORE

I	FISH PRODUCTIVITY (SPECIES ABOVE)-				
	TROUT, .00KG/300M POINTS	: .0			
	NONTROUT POINTS	: 2.0			
	TOTAL POINTS	: 2.0	1	2	2
II	INGRESS RATING-3		3	1	3
III	ESTHETICS RATING-1		0	1	0
IV	USE-FMD/10KM: 0. ,OVERALL: .0		0	1	0
				TOTAL	5

SPORT FISHERY POTENTIAL CLASS 4

F I S H R E S O U R C E V A L U E C L A S S 3

STREAM: KRUG CREEK 210425 2 0 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T15NR57E39 -KRUG CR SCHOOL RD. SERIAL : 882
LOWER REACH BOUNDARY: T16NR56E33 -MOUTH
LENGTH (KM): 17.0
COUNTY AT LOWER BOUNDARY: DAWSON
TRIBUTARY TO: GLENDIVE CREEK

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
V	FATHEAD MINNOW	A	L	.4
V	PLAINS MINNOW	A	L	.4
VIA	FLATHEAD CHUB	C	L	.3
V	LAKE CHUB	A	L	.4
VIA	BLACK BULLHEAD	C	L	.3
VIA	WHITE SUCKER	C	L	.3
V	BROOK STICKLEBACK	A	L	.4
IVB	PLAINS KILLIFISH	S		1.5
VIA	YELLOW BULLHEAD	C	L	.3
VII	LONGNOSE DACE	P	L	.1
VIA	SILVERY MINNOW	C	L	.3
IVB	CREEK CHUB	S		1.5
VII	CARP	C	L	.1
			TOTAL	6.3

SPECIES & HABITAT VALUE CLASS 3

SPORT FISHERY POTENTIAL

COMPONENT		GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)-			
	TROUT, .00KG/300M POINTS : .0			
	NONTROUT POINTS : .0			
	TOTAL POINTS : .0	0	2	0
II	INGRESS RATING-3	3	1	3
III	ESTHETICS RATING-1	0	1	0
IV	USE-FMD/10KM: 0. ,OVERALL: .0	0	1	0
			TOTAL	3

SPORT FISHERY POTENTIAL CLASS 5

FISH RESOURCE VALUE CLASS 3

STREAM: GRIFFITH CREEK 210340 2 1 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T16NR56E36 -INTERSTATE 94 SERIAL : 881
LOWER REACH BOUNDARY: T16NR56E34 -MOUTH
LENGTH (KM): 6.00
COUNTY AT LOWER BOUNDARY: DAWSON
TRIBUTARY TO: KRUG CREEK

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
V	FATHEAD MINNOW	A	L	.4
V	LAKE CHUB	A	L	.4
VIB	LONGNOSE DACE	U	L	.2
IVA	CREEK CHUB	H		3.0
V	SILVERY MINNOW	A	L	.4
V	FLATHEAD CHUB	A	L	.4
			TOTAL	4.8

SPECIES & HABITAT VALUE CLASS 4

SPORT FISHERY POTENTIAL

COMPONENT			GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)-				
	TROUT, .00KG/300M POINTS	: .0			
	NONTROUT POINTS	: .0			
	TOTAL POINTS	: .0	0	2	0
II	INGRESS RATING-3		3	1	3
III	ESTHETICS RATING-1		0	1	0
IV	USE-FMD/10KM: 0. ,OVERALL: .0		0	1	0
				TOTAL	3

SPORT FISHERY POTENTIAL CLASS 5

F I S H R E S O U R C E V A L U E C L A S S 4

STREAM: COTTON CREEK　　210120 2 1　　F&G REGION 7　　1753 NOVEMBER 22,1978

UPPER REACH BOUNDARY: T16NR56E10ADD -2MI.ABOVE MOUTH　　SERIAL : 879

LOWER REACH BOUNDARY: T16NR56E05 -MOUTH

LENGTH (KM): 3.00

COUNTY AT LOWER BOUNDARY: DAWSON

TRIBUTARY TO: YELLOWSTONE RIVER

SPECIES & HABITAT VALUE

(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)

(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
VIB	BROOK STICKLEBACK	U	L	.2
IVA	PLAINS KILLIFISH	H		3.0
VIA	WHITE SUCKER	C	L	.3
VIB	LONGNOSE DACE	U	L	.2
V	CREEK CHUB	L		.4
			TOTAL	4.1

SPECIES & HABITAT VALUE CLASS 4

SPORT FISHERY POTENTIAL

COMPONENT		GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)-			
	TROUT. .00KG/300M POINTS : .0			
	NONTROUT POINTS : .0			
	TOTAL POINTS : .0	0	2	0
II	ACCESS RATING-3	3	1	3
III	ESTHETICS RATING-2	1	1	1
IV	USE-MD/10KM: 0. ,OVERALL: .0	0	1	0
			TOTAL	4

SPORT FISHERY POTENTIAL CLASS 5

F I S H R E S O U R C E V A L U E C L A S S 4

STREAM: HODGES CREEK 210410 2 0 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T14NR58E24 -SOURCE SERIAL : ACH
LOWER REACH BOUNDARY: T15NR57E33BDD -MOUTH
LENGTH (KM): 22.0
COUNTY AT LOWER BOUNDARY: DAWSON
TRIBUTARY TO: GLENDIVE CREEK

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
V	SAND SHINER	A	L	.4
V	FATHEAD MINNOW	A	L	.4
VIII	-------------------------ESTHETICS: 3			3.0
			TOTAL	3.8

SPECIES & HABITAT VALUE CLASS 4

SPORT FISHERY POTENTIAL

COMPONENT			GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)-				
	TROUT, .00KG/300M POINTS	: .0			
	NONTROUT POINTS	: .0			
	TOTAL POINTS	: .0	0	2	0
II	INGRESS RATING-3		3	1	3
III	ESTHETICS RATING-3		2	1	2
IV	USE-[illegible]		0	1	0
				TOTAL	5

SPORT FISHERY POTENTIAL CLASS 4

FISH RESOURCE VALUE CLASS 4

STREAM: LAMESTEER CREEK 210460 2 1 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T12NR61E31 -COUNTY ROAD SERIAL : 883
LOWER REACH BOUNDARY: T12NR60E27 -MOUTH
LENGTH (KM): 11.00
COUNTY AT LOWER BOUNDARY: WIBAUX
TRIBUTARY TO: BEAVER CREEK

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS	
V	FATHEAD MINNOW	A	L	.4	Elk Creek chub should
V	IOWA DARTER	A	L	.4	be put into standard
V	BLACK BULLHEAD	A	L	.4	
V	WHITE SUCKER	A	L	.4	
IVA	CREEK CHUB	H		3.0	— 1.5
VII	CARP	U	L	.1	
V	BROOK STICKLEBCK	A	L	.4	
			TOTAL	5.1	

SPECIES & HABITAT VALUE CLASS ~~3~~ 4 3.6

SPORT FISHERY POTENTIAL

COMPONENT		GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)-			
	TROUT, .00KG/300M POINTS : .0			
	NONTROUT POINTS : .			
	TOTAL POINTS : . .	0	2	0
II	THOREST RATING-3	3	1	3
III	ESTHETICS RATING-2	1	1	1
IV	USE-FMD/10KM: 0. ,OVERALL: .0	0	1	0
			TOTAL	4

SPORT FISHERY POTENTIAL CLASS 5

F I S H R E S O U R C E V A L U E C L A S S 3

1746

STREAM: HAY CREEK 120250 2 0 F&G REGION 7 NOVEMBER 22, 1978
UPPER REACH BOUNDARY: T15NR60E36 -SOURCE SERIAL : ACG
LOWER REACH BOUNDARY: T15NR60E17BAP -MOUTH
LENGTH (KM): 9.5
COUNTY AT LOWER BOUNDARY: FIBAUX
TRIBUTARY TO: BEAVER CREEK

SPECIES & HABITAT VALUE
(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
IVB	CREEK CHUB	S		1.5
VIA	FLATHEAD CHUB	C	L	.3
V	FATHEAD MINNOW	A	L	.4
VIA	WHITE SUCKER	C	L	.3
VIB	BLACK BULLHEAD	U	L	.2
V	BROOK STICKLEBCK	A	L	.4
VIB	IOWA DARTER	U	L	.2
VIII	------------------------ ESTHETICS: 3			~~3.0~~

TOTAL 6.3 3.3

SPECIES & HABITAT VALUE CLASS ~~X~~ 4

SPORT FISHERY POTENTIAL

COMPONENT			GRADE	MULTIPLIER	SCORE
I	FISH PRODUCTIVITY (SPECIES ABOVE)-				
	TROUT, .0KG/300M POINTS	: .0			
	NONTROUT POINTS	: .0			
	TOTAL POINTS	: .0	0	2	0
II	INGRESS RATING-3		3	1	3
III	ESTHETICS RATING-3		2	1	2
IV	USE-FMD/10KM: 0. ,OVERALL: .0		0	1	0
				TOTAL	5

SPORT FISHERY POTENTIAL CLASS 4

F I S H R E S O U R C E V A L U E C L A S S 3

1754

STREAM: GLENDIVE CREEK 210275 2 1 F&G REGION 7 NOVEMBER 22,1978
UPPER REACH BOUNDARY: T15NR56E24 -ALLARD SERIAL : 880
LOWER REACH BOUNDARY: T16NR55E24 -MOUTH
LENGTH (KM): 16.00
COUNTY AT LOWER BOUNDARY: DAWSON
TRIBUTARY TO: YELLOWSTONE RIVER

SPECIES & HABITAT VALUE

(IMPORTANCE OF FISH HABITAT WITH EMPHASIS ON SPECIES OF SPECIAL CONCERN)
(SEE RATING PROCEDURE FOR EXPLANATION OF ABUNDANCE & USE)

STANDARD	SPECIES	ABUN.	USE	POINTS
V	FLATHEAD CHUB	A	L	.4
V	PLAINS MINNOW	A	L	.4
VIA	FATHEAD MINNOW	C	L	.3
VII	RIVER CARPSUCKER	R	J	.1
VIA	WHITE SUCKER	C	L	.3
VIA	BROOK STICKLEBCK	C	L	.3
VII	SMALLMOUTH BUFF.	R	L	.1
VIA	SILVERY MINNOW	C	L	.3
VIA	SAND SHINER	C	L	.3
VII	EMERALD SHINER	R	L	.1
			TOTAL	2.6

SPECIES & HABITAT VALUE CLASS 4

SPORT FISHERY POTENTIAL

COMPONENT			GRADE	MULTIPLIER	SCORE
1	FISH PRODUCTIVITY (SPECIES ABOVE)-				
	TROUT, .00KG/300M POINTS	: .0			
	NONTROUT POINTS	: .0			
	TOTAL POINTS	: .0	0	2	0
II	INGRESS RATING-3		3	1	3
III	ESTHETICS RATING-1		0	1	0
IV	USE-FMD/1 KM: 0. ,OVERALL: .0		0	1	0
				TOTAL	3

SPORT FISHERY POTENTIAL CLASS 5

F I S H R E S O U R C E V A L U E C L A S S 4