MONTANORE PROJECT
Continued Interim
Aquatic Biological Monitoring
1994

For:

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I. INTRODUCTION

A. Purpose

Pre-mine inventory of streams in the Montanore Project area was conducted in 1988-89 (McGuire, et al., 1989). Those studies were compiled into a draft environmental impact statement (DEIS) released to the public in October 1990 (U.S.F.S., et al., 1990). A supplement to the DEIS (U.S.F.S., et al., 1991) made recommendations for future aquatic monitoring and subsequently, an interim aquatic biological monitoring program was designed after discussions with state and federal agencies (Water Quality Bureau, Department of State Lands and Kootenai National Forest). The interim biological monitoring program was implemented in 1990, 1991, 1992 and 1993 (Farmer, 1991, 1992b, 1993 and Farmer et al., 1993).

Nitrate levels in Libby Creek, as the result of mine exploration activities, exceeded recommended state levels in the summer and fall of 1991 and mining operations were discontinued while the effects of the nitrate increase on stream biota was being ascertained (Farmer 1992a). Pre-mine monitoring of all of the Montanore Project stream sites was continued in 1992 (Farmer, 1993) but was confined to the four Libby Creek stations in 1993 (Farmer et al., 1994).

At the request of the Montana Water Quality Bureau (WQB), monitoring of only three of the Libby Creek stations was conducted in October 1994 in an effort to "document the relationship between ambient nitrate levels and biological community response". Those data are the subject of the report contained herein.

B. Acknowledgements

The 1994 interim aquatic biological monitoring program for the Montanore Project was funded by Noranda, Inc. Doug Parker coordinated the program from the Missoula office. Mark Petersmeyer administered the program from the Libby office. Lynn Hagarty provided surface water quality information from the Libby office.

Erich Weber, PhycoLogic, Helena performed the periphyton analysis and wrote that section of this report. Kim Rieser assisted with field work and the cleaning of the samples in the lab. Maria Newcomb analyzed the samples, performed the initial data analysis and provided some assistance with this report. Dr. Carlene Farmer collected the periphyton and macroinvertebrate samples, assisted with macroinvertebrate sample analysis and data compilation, reviewed and edited the periphyton report and wrote this report.

II. DESCRIPTION OF SAMPLING STATIONS

The reader is referred to all of the previously mentioned reports for a thorough description of the project area and the sampling stations. Table 1 lists all of the samples which have been collected from the project area since 1988. The location of all of the sampling stations relative to the proposed operation are shown in Figure 1.

Physical characteristics and nitrogen concentrations for the stations sampled in 1994 are presented in Table 2. Figure 2 compares the nitrate concentrations at the three Libby Creek stations from 1989-1994. Because L1 (LB-3000) was not sampled in October 1990, the nitrate reading for L3 (LB-2000), which is 4.2 miles downstream of

Table 1. Aquatic biological sampling conducted in the Montanore Project area, 1988-1994 (surface water station numbers in parentheses).

DATE	STATION	SAMPLES COLLECTED
August 1988	L11(?)	1 composite periphyton and 3 Hess (170 microns) macroinvertebrate samples
	L10(LB-200)	Same As In Previous Sample Set (spss)
	L9(LB-300)	No Samples (ns)
	L8(?)	spss
	L5(?)	spss
	L4(?)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra1(?)	ns
	Ra2(RA-500)	spss
	Ra3(?)	spss
	Ra4(?)	spss
	Po1(PM-1000)	spss
	Po2(PM-1000)	spss
	LC1((LC-800)	spss
	LC2(LC-800)	spss
	Be1(?)	spss
	Be2(BC-500)	spss
	Be3(?)	spss
October 1988	L11(?)	spss
	L10(LB-200)	spss
	L9(LB-300)	ns
	L8(?)	spss
	L5(?)	spss
	L4(?)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra1(?)	ns
	Ra2(RA-500)	spss

Table 1. (Continued).

DATE	STATION	SAMPLES COLLECTED
	Ra3(?)	spss
	Ra4(?)	spss
	Po1(PM-1000)	spss
	Po2(PM-1000)	spss
	LC1(LC-800)	spss
	LC2(LC-800)	spss
	Be1(?)	spss
	Be2(BC-500)	spss
April 1989	L11(?)	spss
	L10(LB-200)	spss
	L9(LB-300)	ns
	L8(?)	spss
	L5(?)	spss
	L4(?)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra1(?)	ns
	Ra2(RA-500)	spss
	Ra3(?)	spss
	Ra4(?)	spss
	Po1(PM-1000)	spss
	Po2(PM-1000)	spss
	LC1((LC-800)	spss
	LC2(LC-800)	spss
	Be1(?)	spss
	Be2(BC-500)	spss
	Be3(?)	spss
April 1990	L11(?)	Discontinued (dc)
	L10(LB-200)	5 Hess (500 micron) macroinvertebrate samples
	L9((LB-300)	spss

Table 1. (Continued).

DATE	STATION	SAMPLES COLLECTED
	L8(?)	dc
	L5(?)	dc
	L4(?)	dc
	L3(LB-1000)	ns
	L1(LB-3000)	5 Hess (500 micron) macroinvertebrate samples
	Ra1(?)	spss
	Ra2(RA-500)	ns
	Ra3(?)	dc
	Ra4(?)	dc
	Po1(PM-1000)	spss
	Po2(PM-1000)	dc
	LC1((LC-800)	spss
	LC2(LC-800)	dc
	Be1(?)	ns
	Be2(BC-500)	ns
	Be3(?)	ns
August 1990	L10(LB-200)	5 Hess (500 micron) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra1(?)	spss
	Ra2(RA-500)	ns
	Po1(PM-1000)	spss
	LC1((LC-800)	ns
	Be1(?)	ns
	Be2(BC-500)	ns
	Be3(?)	ns
October 1990	L10(LB-200)	5 Hess (500 micron) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss

Table 1. (Continued).

DATE	STATION	SAMPLES COLLECTED
	L1(LB-3000)	spss
	Ra1(?)	spss
	Ra2(RA-500)	ns
	Po1(PM-1000)	spss
	LC1((LC-800)	spss
	Be1(?)	ns
	Be2(BC-500)	ns
	Be3(?)	ns
April 1991	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra1(?)	dc
	Ra2(RA-500)	ns
	Po1(PM-1000)	spss
	LC1((LC-800)	1 composite periphyton, 4 Hess (500 micron) macroinvertebrate samples
	Be1(?)	dc
	Be2(BC-500)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	Be3(?)	dc
August 1991	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra2(RA-500)	spss
	Po1(PM-1000)	spss
	LC1((LC-800)	1 composite periphyton, 1 kick (500 micron) macroinvertebrate samples
	Be2(BC-500)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples

Table 1. (Continued).

DATE	STATION	SAMPLES COLLECTED
October 1991	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra2(RA-500)	spss
	Po1(PM-1000)	spss
	LC1((LC-800)	spss
	Be2(BC-500)	spss
April 1992	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra2(RA-500)	spss
	Po1(PM-1000)	spss
	LC1((LC-800)	spss
	Be2(BC-500)	spss
August 1992	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra2(RA-500)	spss
	Po1(PM-1000)	spss
	LC1((LC-800)	spss
	Be2(BC-500)	spss
October 1992	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss

Table 1. (Continued).

DATE	STATION	SAMPLES COLLECTED
	Ra2(RA-500)	spss
	Po1(PM-1000)	spss
	LC1((LC-800)	spss
	Be2(BC-500)	spss
March 1993	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
	Ra2(RA-500)	dc
	Po1(PM-1000)	dc
	LC1((LC-800)	dc
	Be2(BC-500)	dc
August 1993	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
October 1993	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	spss
	L1(LB-3000)	spss
October 1994	L10(LB-200)	1 composite periphyton/4 Hess (500 micron) and 1 kick (500 microns) macroinvertebrate samples
	L9(LB-300)	spss
	L3(LB-1000)	dc
	L1(LB-3000)	spss

Table 1. (Continued).

	ANNUAL TOTALS		
	Periphyton	Macroinvertebrate-Hess	Macroinvertebrate-kick
1988-89	50	150	0
1990	0	95	0
1991	23	88	22
1992	24	96	24
1993	12	48	12
1994	4	16	4
Totals	113	493	62

L9 and 5.5 mile upstream of L1, was used.

Although the nitrate levels in L9 in 1994 were still slightly higher than for the other two stations, they have decreased significantly since their peak in 1991 and were only slightly higher than the "normal" levels observed in 1989 and 1990.

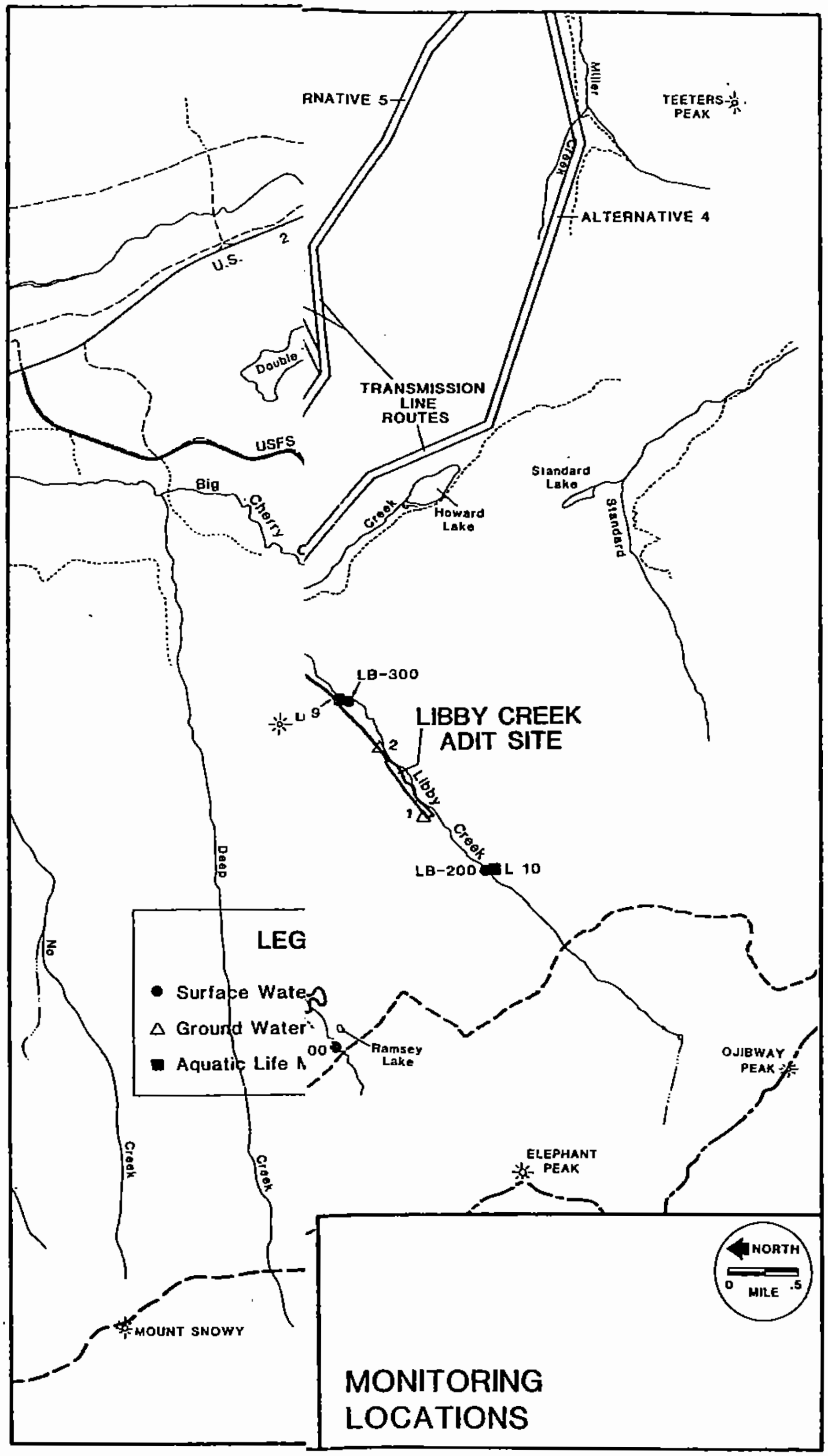


Figure 1. Aquatic biological sam

Table 2. Physical and chemical features of the Libby Creek biological sampling stations in the Montanore Project area, October 1994.

	Time	Air Temp. °F	Water Temp.°F	Width'(Mean')	Maximum Depth"(Mean")	Embedd.	Ammonia*	Nitrate/Nitrite*
L10(LB-200	08:00	36	41	6-18(11)	21(7)	0-5%	0.05	0.22
L9(LB-300)	10:15	39	37	15-20(12)	19(6)	0-5%	<0.05	0.48
L1(LB-3000)	14:10	49	46	18-80(28)	14(8)	0-5%	<0.05	0.06

*mg/L, data courtesy Noranda Minerals, March 1995

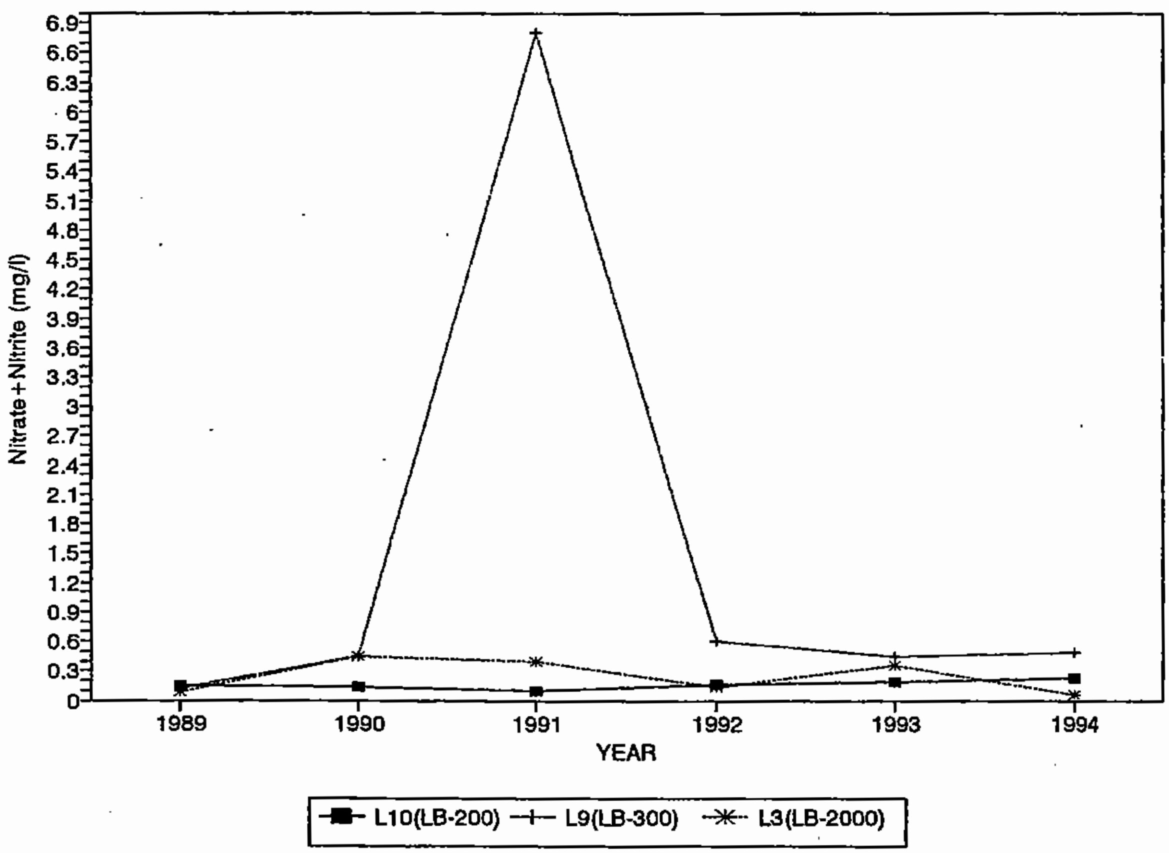


Figure 2. October nitrate concentrations in Libby Creek, 1989-1994.

Figures 3-5 show the three stations as they appeared in October 1994. Water levels were typical for October.

Figure 6 illustrates the substrate conditions at the three stations. Very little accumulated sediment was noticed at all three sites but the fine, stringy, green algae, observed in Libby Creek in previous years, was once again most abundant at the upper station, L10. Very little of the algae was observed at L9 compared to previous years and it was difficult to even find it at the lower station, L1. The gelatinous, brown, "apple butter-type" algae was again noticeable at L9, but in general, the substrate seemed much "cleaner" at this site than in previous years. A green-brown gelatinous film coated the substrate at the lower station, L1.

III. PERIPHYTON

A. Introduction

Periphyton is the assemblage of small, often microscopic organisms (invertebrates, bacteria, fungi and algae) that live attached to or in close association with submerged substrates. Benthic algae typically dominate the periphyton community in freshwater streams. They can be conveniently divided into two major groups: the diatoms, which possess rigid, siliceous cell walls called frustules, and the non-diatom or soft-bodied algae which, as the name implies, lack a siliceous cell wall.

This section examines the structure and composition of non-diatom and diatom algae associations in the periphyton from the three Libby Creek sites. It assesses similarities

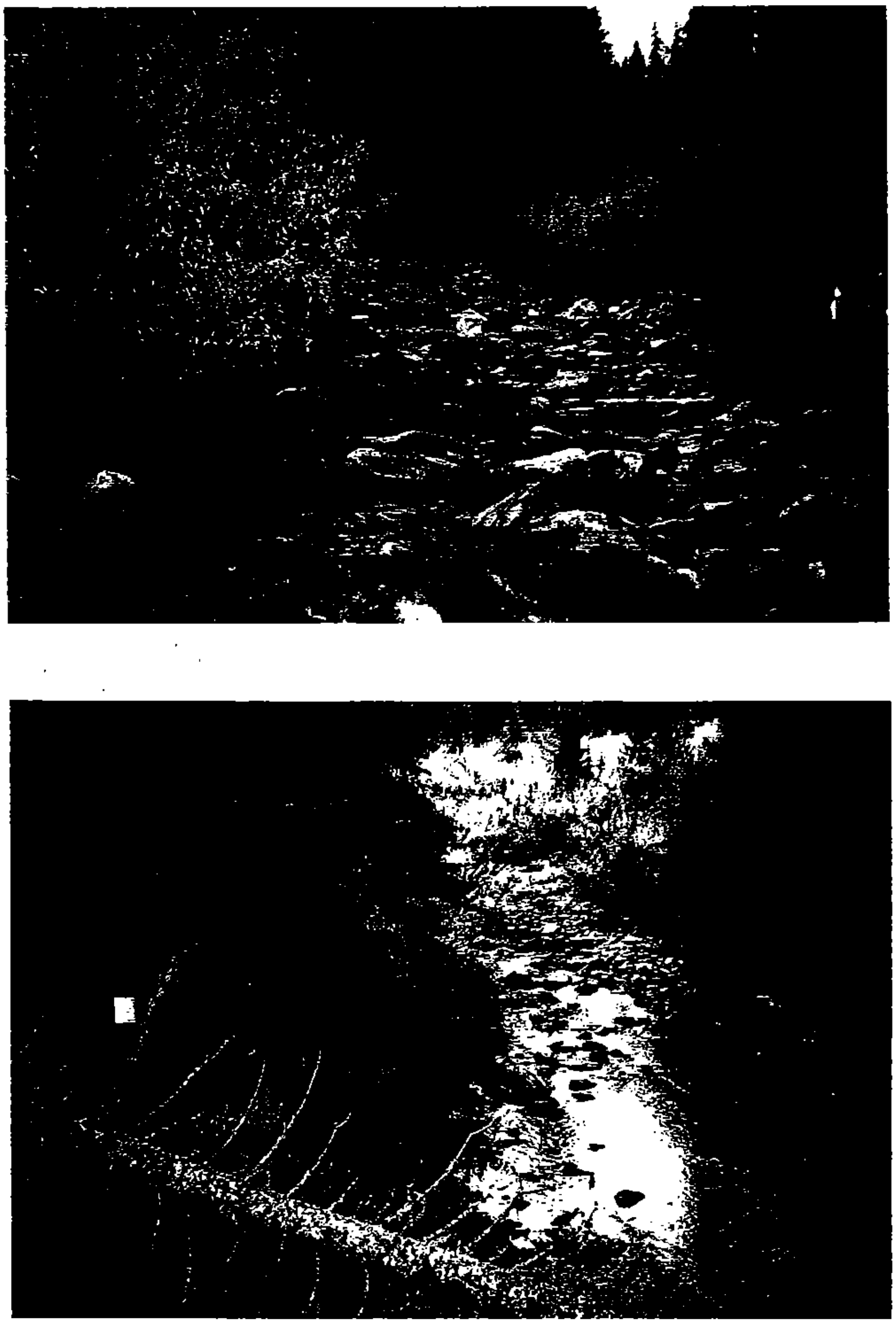


Figure 3. *Upper Libby Creek, L10 (LB-200), October 1994 (both views are downstream).*

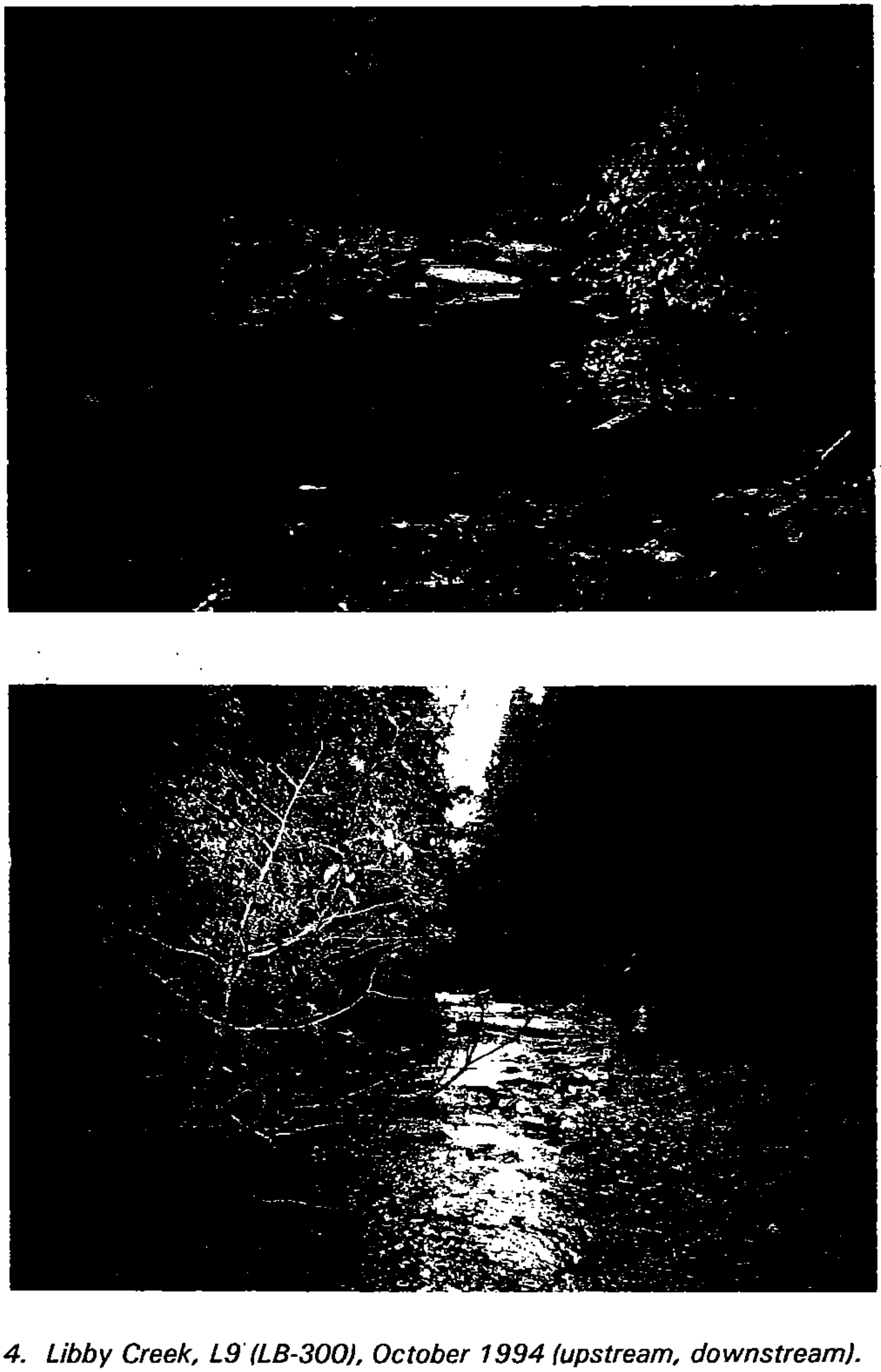


Figure 4. Libby Creek, L9 (LB-300), October 1994 (upstream, downstream).

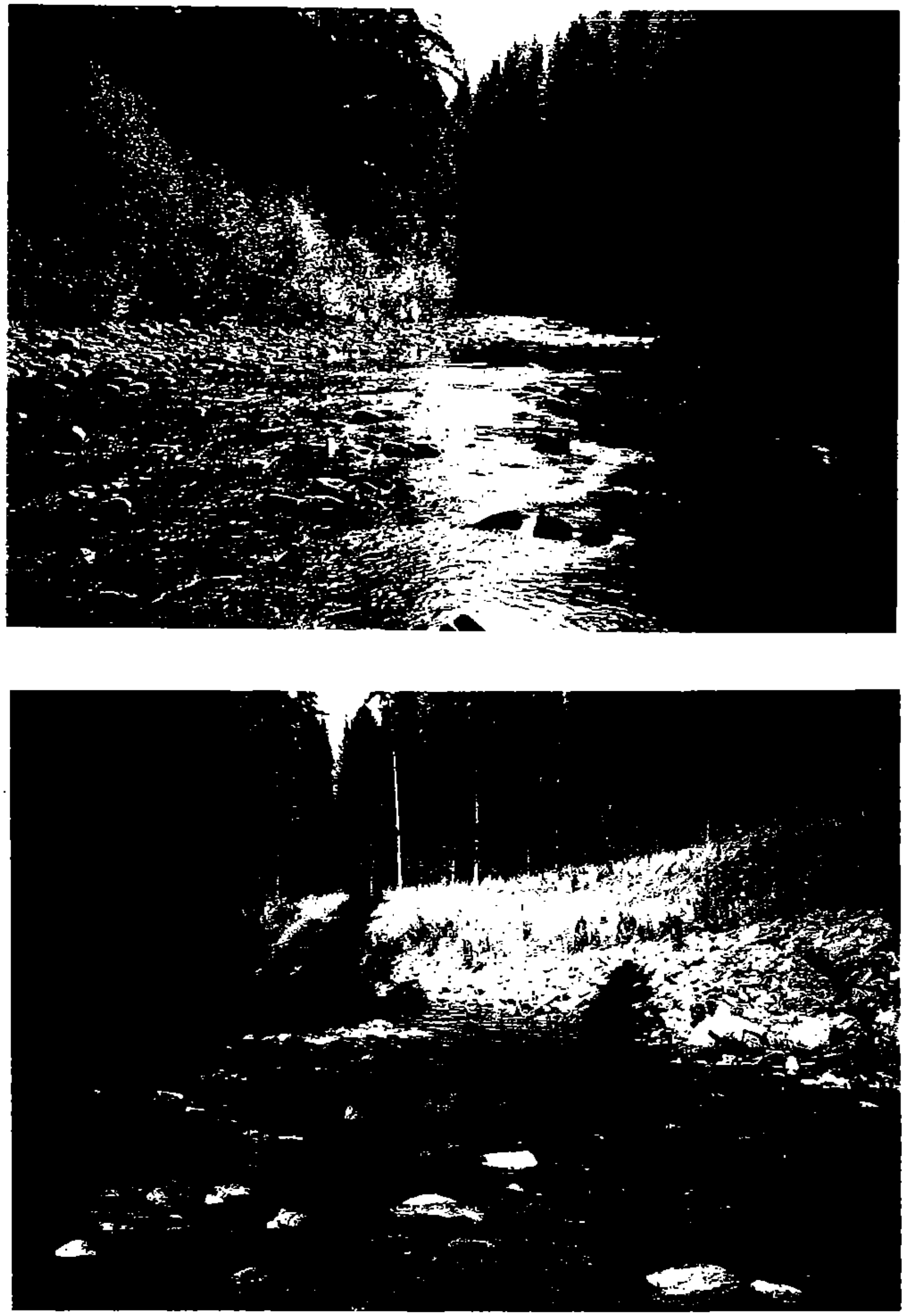
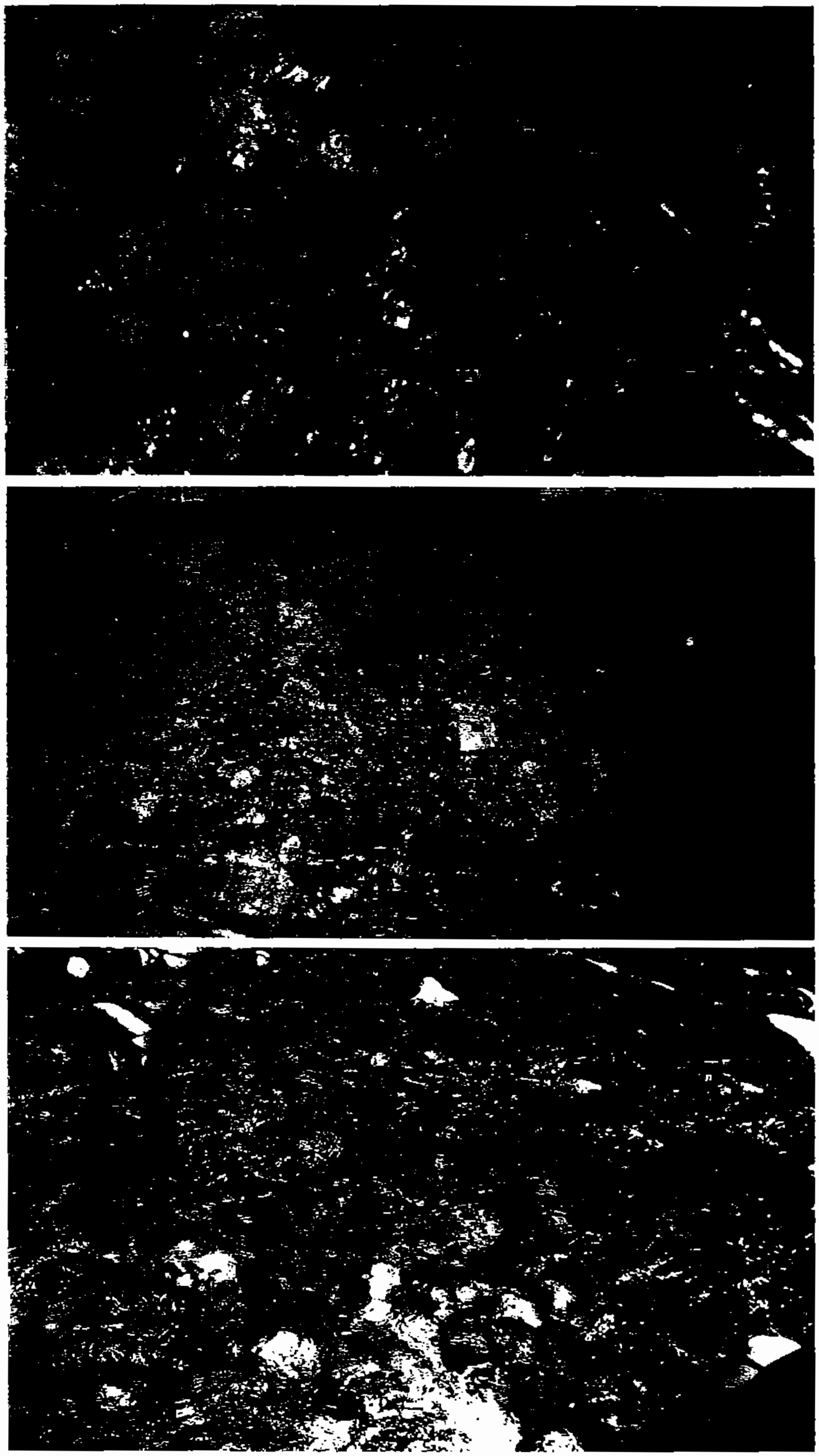


Figure 5. Lower Libby Creek, L1 (LB-3000), October 1994 (upstream, downstream).



L10

L9

L1

Figure 6. A view of the substrate at L10, L9, and L1 in October 1994.

and differences between the sites during October 1994, and applies two protocols (Bahls 1993) to assess biological integrity and impairment of aquatic life. It also compares October 1994 results with the same period during monitoring years 1991, 1992 and 1993 (Weber 1992, 1993, 1994).

B. Methods

Composite periphyton samples were collected from the three Libby Creek sites by Westech personnel following methods described by Bahls (1993). An effort was made to sample all forms of algae present in approximately the same proportion to one another as they occurred in stream. Samples were preserved with Lugol's solution and kept cold until the time of analysis.

A subsample of the periphyton from each station was thoroughly scanned with an Olympus BHT compound microscope under 200X and 400X, and all non-diatom algae present were identified to genus. The relative abundance of cells of each genus was estimated using the following system:

- R (Rare): fewer than one cell per microscope field at 200X, on the average;
- C (Common): at least one, but fewer than five cells per field of view;
- VC (Very Common): between 5 and 25 cells per field of view;
- A (Abundant): greater than 25 cells per field, but numbers within limits reasonably counted;
- VA (Very Abundant): number of cells per field too numerous to count.

The abundance of diatom algae (all genera considered collectively) relative to the non-diatom genera was also estimated for comparative purposes.

Each dominant (common or greater in relative abundance) non-diatom genus, (as well as the diatom component if it met this criterion), was also ranked according to its estimated contribution to the **total algal biovolume** present in the sample. The genus estimated to have the greatest biovolume was ranked number 1; the second most number 2, and so on. These rankings were used to calculate the **dominant non-diatom phylum** (see Non-Diatom Algae Metrics, below).

Following non-diatom analyses, all organic matter was chemically oxidized from each sample as described by Bahls (1993), and a permanent diatom strewn mount was prepared for each station according to Standard Methods (APHA et al. 1980). Each permanent mount was thoroughly scanned with a high-numerical aperture oil immersion objective at 1000X, and all diatoms encountered identified to species. A proportional count of approximately 400 diatom frustules was performed on each diatom mount. Diatoms that were identified during the floristic scan but not tallied during the count were denoted as present with the letter "p".

The percent relative abundance of diatom species and diatom association metrics were calculated for each sample from the raw count data. Each species was assigned to one of three pollution tolerance (PT) groups as originally determined by Lange-Bertalot (1979). Simply stated, group 1 taxa are most tolerant to pollution, group 2 less tolerant, and group 3 are sensitive to pollution. Bahls (1993) published expanded autecological criteria for assigning diatom taxa to PT groups, along with an extensive listing of diatom taxa reported from Montana. A number of unlisted taxa were assigned PT group numbers by the author, based on autecological data published in references by Krammer and Lange-Bertalot (1986, 1988, 1991a, 1991b) and Lange-Bertalot (1993). Default PT group assignments, determined by Bahls (1993) for most freshwater genera and intended for use when sufficient autecological data is lacking, were used only as a last resort.

1. non-diatom algae metrics

Metrics applied to non-diatom (soft-bodied) algae included: **number of dominant genera** and **dominant phylum**, and **indicator taxa**, as recommended by Bahls (1993).

The number of common non-diatom genera generally is inversely proportional to the degree of pollution in mountain and foothill streams in Montana. However, because mountain streams tend to be naturally nutrient-poor, an increase in inorganic nutrients may actually cause an increase in the number of non-diatom genera (Bahls 1993). In 21 least-impaired reference streams from combined mountain and foothill ecoregions in Montana, Bahls (1993) found from 1 to 10 common non-diatom genera, with a mean value of 5.

The dominant non-diatom phylum was determined by calculating the cumulative weighted rank of genera within each phylum based on estimated biovolume, as described by Bahls (1993). Diatoms were not included in this metric. Briefly, in a sample with x number of common or greater non-diatom genera, the genus ranking highest in biovolume scored x points, second highest, x-1 points, and so on. The scores of all genera in each phylum were summed for each site to determine the dominant non-diatom phylum based on estimated relative biovolume.

Bahls et al. (1992) found that blue-green algae (phylum Cyanophyta) dominated the non-diatom flora of reference streams in the Northern Rockies ecoregion, which includes northwestern Montana and the Libby Creek drainage. He hypothesized that dominance by blue-green algae may be a function of relatively low inorganic nitrogen levels, and that higher nitrogen concentrations tend to favor dominance by green algae (phylum Chlorophyta).

2. diatom metrics

Metrics calculated for each diatom association include **species richness** (number of species counted), **Shannon diversity index** (Weber 1973), **pollution index** and **siltation index**. The percent relative abundance of the **dominant diatom species** is also considered. Diatom associations from the three sampling locations are compared to one another using the **percent similarity index** of Whittaker and Fairbanks (1958).

Species richness is probably the most basic indicator of community health and, as a general rule correlates directly to water quality: as water quality declines, so does the number of species. However, naturally austere conditions in some mountain streams may limit species richness. In reference streams from mountain and foothill ecoregions in Montana, between 23 and 51 (mean 33) diatom species were counted (Bahls 1993).

The percent relative abundance (PRA) of the dominant diatom taxon generally displays an inverse relationship to water quality, with a high value indicating elevated environmental stress that may be due to pollution. Again, low species richness in some pristine mountain streams will result in higher PRA values for those taxa present. The relative abundance of the dominant diatom taxon in mountain and foothill reference streams averaged 31.6 percent, with a range of 11.1 to 67.0 (Bahls 1993).

The Shannon diversity index considers the distribution of individuals among the species present (equitability) along with species richness. High diversity values occur in diatom communities where no taxa are strongly dominant in numbers, which is generally the case in healthy, unimpaired streams. Diatom communities under environmental stress, either natural or man-caused, will have a relatively small number of taxa that account for most of individuals present, resulting in lower diversity index values. Diatom species diversity values of between 2.16 and 4.50 were found in 21 least-impaired reference streams from mountain and foothill ecoregions, with a mean value of 3.58 (Bahls 1993).

The pollution index was proposed by Bahls (1993) as a shorthand method of summarizing the information contained in the three pollution tolerance groups of Lange-Bertalot (1979). The index is derived from the decimal fraction of the total percent relative abundance (PRA) value of diatom taxa in each pollution tolerance group, multiplied by the respective group number. The sum of these three products is the pollution index. The index will range from 1.00 (all most tolerant taxa) to 3.00 (all most sensitive taxa). Pollution index values of between 2.45 and 2.94 (mean 2.72) were determined by Bahls (1993) for diatom communities in 21 reference streams from mountain ecoregions.

The siltation index is defined as the sum of the percent relative abundance values of diatom taxa belonging to the genera *Navicula, Nitzschia and Surirella* (Bahls 1993). These genera were chosen because they are highly motile biraphidean diatoms well adapted to existence on unstable substrates. Values can range from 0 to 100; in mountain reference streams the index ranged from 0.0 to 50.3 (mean 14.5).

The percent similarity index is simply the sum of the smaller of the two percent relative abundance values for each species that is common to both sites being compared. Theoretically, values for this will range from 0 (totally different communities) to 100 (identical communities).

3. bioassessment protocol

Two protocols employing diatom metrics to assess biological integrity and aquatic life impairment in streams were proposed by Bahls (1993):

Protocol I compares metric values from a study site to metric values derived from least-impaired reference streams in the same physiographic province (ecoregion), and is intended for use when a local reference or control site is not available. Protocol I uses up to three of the diatom association indexes: Shannon diversity index, pollution index, and siltation index. Protocol I was developed with, and is recommended for use with, data collected during the summer months only. For this reason, it is not certain how well Protocol I can be applied to data collected during other times of the year. Table 9 (p. 39) contains the criteria used to establish impairment ratings and scores for each of the diatom association indexes used with Protocol I. The **lowest** score establishes the overall biological integrity and impairment rating for the aquatic community at that site.

Protocol II compares metric values from a study site to metric values from a local upstream or sidestream control site. The control site must be of the same stream order as the study site. The same three diatom association indexes used in Protocol I, plus the percent similarity index of Whittaker and Fairbanks (1958), are used in Protocol II. Criteria used to establish impairment ratings and scores are contained in Table 11 (p. 42). Again, the **lowest** score establishes the overall biological integrity and impairment rating. Because it compares against local reference conditions, Protocol II is more sensitive than Protocol I, and can be applied to data collected year-round.

Protocol II recognizes a possible two-way response by diatom diversity to different causes and degrees of impairment. As discussed under the Shannon diversity section, this is due to the **increase** in diversity known to occur in some mountain streams with an increase in sediment and/or nutrients. No intrinsic value is placed on this higher diversity, as it is a deviation from the undisturbed condition for that site.

The siltation rating method in Protocol II, which uses the ratio of the reference site siltation index to the study site index x 100, puts a greater penalty on sediment increases at the lower end of the siltation scale. An hypothetical increase of 0.25 units over a reference site siltation index of 0.00 results in a value of 0%, which is rated as a heavy siltation increase at the study site. However, the same increase (0.25 units) over a reference site value of 1.00 gives a value of 80%, which rates as **no** increase in siltation.

C. Results and Discussion

1. <u>non-diatom algae</u>

A total of 17 genera of non-diatom algae were identified from the three Libby Creek stations in October 1994 (Table 3). This compares to 15 in October 1993, 17 in 1992, and 13 in 1991, all from Libby Creek stations L10, L9, and L1 only (Weber 1992, 1993, 1994). The estimated relative abundance values for all non-diatom genera found at the three Libby Creek stations in October 1994 are listed in Appendix A.

Overall, there were 10 "dominant" non-diatom genera (those common or greater in estimated relative abundance) identified at Libby Creek stations in October 1994 (Table 4). This compares to 11 genera in October 1993, 11 in 1992, and 8 in 1991, again for stations L10, L9 and L1 only (Weber 1992, 1993, 1994). Stations L10 and L9 shared three of four dominant genera of green algae (phylum Chlorophyta) found at the upstream stations in 1994, while downstream station L1 had only a single genus in common with either stations L10 or L9. There were no dominant genera of blue-green algae (phylum Cyanophyta) present at station L10 in October 1994, while three genera were present at station L9, and two at station L1 (Table 4). Dominant blue-green algae were all but absent from station L10, but were relatively important at stations L9 and

Table 3. Genera of non-diatom algae identified in periphyton samples from Libby Creek stations in the Montanore Project area, October 1994.

Phylum Chlorophyta
- Order Tetrasporales
  - Family Tetrasporaceae
    - ***Tetraspora***
- Order Chlorococcales
  - Family Chlorococcaceae
    - ***Trebouxia***
  - Family Microsporaceae
    - ***Microspora***
- Order Chaetophorales
  - Family Chaetophoracaea
    - ***Gongrosira***
    - ***Stigeoclonium***
- Order Zygnematales
  - Family Zygnemataceae
    - ***Mougeotia***
    - ***Spirogyra***
    - ***Zygnema***
  - Family Desmidiaceae
    - ***Closterium***
    - ***Cosmarium***
    - ***Staurastrum***

Phylum Chrysophyta
- Sub-Phylum Chrysophyceae
  - Order Chromulinales
    - Family Hydruraceae
      - ***Hydrurus***

Phylum Rhodophyta
- Order Nemalionales
  - Family Chantransiaceae
    - ***Audouinella***

Phylum Cyanophyta
- Order Chroococcales
  - Family Chroococcaceae
    - ***Merismopedia***
    - ***Microcystis***
- Order Oscillatoriales
  - Family Oscillatoriaceae
    - ***Oscillatoria***
    - ***Phormidium***

L1 during October of all three previous monitoring years (Weber 1992, 1993, 1994).

Chlorophyta was the dominant phylum at all three Libby Creek stations in October 1994, although the blue-green algae (phylum Cyanophyta) ranked a close second at stations L9 and L1 (Table 5, Appendix A). This was also the case at the three Libby Creek stations during October of the previous three years, with the single exception of station L1 in 1993. The relative importance of the green algae in Libby Creek is somewhat of a departure from Northern Rockies reference streams, where blue-green algae generally are dominant in the nutrient-poor waters (Bahls et al. 1992). The green and blue-green algae at the Libby Creek stations, in nearly every instance, can be

Table 4. Dominant non-diatom algae[a] at three Libby Creek stations in the Montanore Project area, October 1994.

Algal Genus	Libby Creek Station L10	L9	L1
Bacillariophyta (diatoms)			
All genera collectively	C	VC	A
Chlorophyta (green algae)			
Gongrosira			VC
Microspora	VC	C	
Mougeotia			A
Spirogyra	C	C	C
Staurastrum			C
Tetraspora		VC	
Zygnema	VA	VC	
Cyanophyta (blue-green algae			
Microcystis		A	
Oscillatoria		VA	VA
Phormidium		VC	VC

[a]Defined as common or greater in estimated relative abundance.
C = common; VC = very common; A = abundant; VA = very abundant

considered co-dominant phyla. This relationship suggests the possibility of elevated instream levels of dissolved inorganic nitrogen above, as well as below, the Montanore Project adit.

The dominant non-diatom taxon at each station, based on the highest biovolume ranking, is listed in Table 5 for October 1994, as well as the previous three monitoring years. The filamentous green alga *Zygnema* was dominant at station L10 in 1994, and during all other years except 1993, when it was a close second to the filamentous green alga *Microspora*. The blue-green alga *Oscillatoria* had the greatest estimated

Table 5. Dominant phylum, dominant non-diatom taxon, and number of dominant non-diatom algal genera at three Libby Creek stations in the Montanore Project area, October 1991-94.

Station:	Libby Creek L10	Libby Creek L9	Libby Creek L1
Dominant Phylum			
October 1994:	**Chlorophyta**	**Chlorophyta**	**Chlorophyta**
October 1993:	Chlorophyta	Chlorophyta	Cyanophyta
October 1992:	Chlorophyta	Chlorophyta	Chlorophyta
October 1991:	Chlorophyta	Chlorophyta	Chlorophyta
Dominant Taxon			
October 1994:	***Zygnema***	***Oscillatoria***	***Oscillatoria***
October 1993:	*Microspora*	*Zygnema*	*Oscillatoria*
October 1992:	*Zygnema*	*Oscillatoria*	*Ulothrix*
October 1991:	*Zygnema*	*Ulothrix*	*Oscillatoria*
Number of Genera			
October 1994:	**3**	**7**	**6**
October 1993:	5	8	4
October 1992:	7	8	2
October 1991:	3	5	4

biovolume of non-diatom algae present at stations L9 and L1 in October of 1994. *Oscillatoria* also ranked first at station L9 in 1992 and at station L1 in 1991 and 1993 (Table 5). During the remainder of the years, *Oscillatoria* was second only to the filamentous green algae *Zygnema* or *Ulothrix* at stations L9 and L1 (Table 5; Weber 1992, 1993, 1994). *Zygnema* is typically found in western Montana in cold, well-oxygenated flowing water, and generally prefers moderately low levels of inorganic nitrogen and low amounts of suspended sediment. The genus *Oscillatoria* contains many species, and tolerates a wide range of environmental conditions. *Oscillatoria* occurs as a dominant form in waters having moderately low to high levels of algal nutrients.

The number of dominant non-diatom genera in Libby Creek in October 1994, and during the previous three years in general, increased from station L10 downstream to station L9, then decreased again at station L1 (Table 5). The number of dominant genera at the three Libby Creek stations during October of all four monitoring years fell within the range of 1 to 10 determined for least-impaired reference streams in western Montana (Bahls 1993).

2. **diatom algae**

The estimated abundance values of diatoms (all genera considered collectively) relative to non-diatom algal genera at the three Libby Creek stations in October 1994 are listed in Appendix A. Diatoms as a group are also ranked with non-diatom genera according to the estimated contribution each made to the total periphyton biovolume in each sample (Appendix A). Diatoms were "dominant algae" (common or greater in estimated relative abundance) at all three sites in October (Table 4). They ranked second in estimated biovolume relative to dominant non-diatom algae at station L9, third at station L1, and fourth at station L10 (Appendix A).

A total of 54 species of diatom algae belonging to 17 genera were identified in periphyton samples from the three Libby Creek stations in the Montanore Project area in October 1994 (Table 6). This compares to 67 species and 19 genera in 1993, 73

Table 6. Diatom species (Phylum Chrysophyta: Class Bacillariophyceae) identified in periphyton samples from Libby Creek stations in the Montanore Project area, October 1994.

Order Centrales
Family Cosciniodiscaceae
Aulacoseira alpigena
A. distans
Melosira varians

Order Pennales
Family Fragilariaceae
Diatoma anceps
D. hyemalis
D. mesodon
Fragilaria capucina
F. construens
F. ulna
Hannaea arcus

Family Eunotiaceae
Eunotia minor
E. musicola
E. praerupta
E. subarcuatoides

Family Achnanthaceae
Achnanthes biasoletiana
A. bioretii
A. chlidanos
A. daonensis
A. kriegeri
A. marginulata
A. minutissima
A. subatomoides
Cocconeis placentula

Family Naviculaceae
Amphora pediculus
Cymbella affinis
C. cesatii
C. cistula
Cymbella gracilis
C. lata
C. microcephala
C. minuta
C. silesiaca
C. sinuata
C. turgidula
Frustulia rhomboides
Gomphonema acuminatum
G. bipunctatum
G. clavatum
G. micropus
G. minutum
G. parvulum
G. pumilum
G. rhombicum
G. truncatum
Navicula gallica
N. heimansioides
N. reichardtiana
Pinnularia microstauron

Family Bacillariacea
Nitzschia dissipata
N. fonticola
N. inconspicua
N. pura

Family Epithemiaceae
Denticula tenuis

Family Surirellceae
Stenopterobia delicatissima

species and 21 genera in 1992, and 18 genera and 44 species in 1991, again at Libby Creek stations L10, L9 and L1 during October of each year (Weber 1991, 1992, 1993). All diatom species present at Libby Creek stations in October 1994 are listed in Appendix B, along with proportional count results and percent relative abundance (PRA) values for each species.

The primary and secondary dominant diatom species at each Libby Creek station during October 1994, with corresponding PRA values, are listed in Table 7. Data from October of the previous three years are also presented for comparison (Weber 1992, 1993, 1994).

Diatoma mesodon was the primary, and *Achnanthes minutissima* the secondary dominant diatom species at station L10 in October 1994. *Achnanthes minutissima* was the primary dominant at station L10 during October of all three previous years, with *Diatoma mesodon* the secondary dominant during two of those years (Table 7). The same two diatom taxa were dominant forms at station L9 during October 1994, as well as in 1993 and (in reverse order) 1992. Together, these taxa always accounted for over 30 percent relative abundance at both stations L10 and L9, and on occasion have made up over 65% of the diatom numbers present (Table 7).

Achnanthes minutissima has a relatively broad environmental amplitude, but is most often strongly dominant in smaller, well-oxygenated streams with higher quality, somewhat acidic water. *Diatoma mesodon* is found almost exclusively in smaller mountain streams, and is a good indicator of high quality, well-oxygenated water.

Table 7. Primary and secondary dominant diatom taxa, and corresponding percent relative abundance (PRA) values at Libby Creek stations in the Montanore Project area during October of 1991 through 1994.

Station		Primary Dominant (PRA)	Secondary Dominant (PRA)
Libby Creek L10			
	October 1994:	***Diatoma mesodon* (35.1)**	***Achnanthes minutissima* (30.2)**
	October 1993:	*Achnanthes minutissima* (30.8)	*Diatoma mesodon* (14.7)
	October 1992:	*Achnanthes minutissima* (30.0)	*Hannaea arcus* (25.1)
	October 1991:	*Achnanthes minutissima* (16.7)	*Diatoma mesodon* (16.7)
Libby Creek L9			
	October 1994:	***Achnanthes minutissima* (28.4)**	***Diatoma mesodon* (26.4)**
	October 1993:	*Achnanthes minutissima* (28.4)	*Diatoma mesodon* (21.9)
	October 1992:	*Diatoma mesodon* (45.6)	*Achnanthes minutissima* (22.8)
	October 1991:	*Eunotia subarcuatoides* (35.9)	*Diatoma mesodon* (20.4)
Libby Creek L1			
	October 1994:	***Achnan. biasolettiana* (37.8)**	***Achnanthes minutissima* (33.7)**
	October 1993:	*Achnanthes minutissima* (47.6)	*Cymbella cistula* (21.5)
	October 1992:	*Achnanthes minutissima* (49.8)	*Achnan. biasolettiana* (16.9)
	October 1991:	*Achnanthes minutissima* (79.5)	*Achnan. biasolettiana* (7.2)

Gomphonema parvulum approached a relative abundance of 20% at station L9 in October 1994. This taxon is important because it often occurs in large numbers in waters with high levels of organic nutrients from biogenic wastes (mesosaprobic to polysaprobic conditions), and was assigned a pollution tolerance (PT) number of 1 (most tolerant) by Lange-Bertalot (1979). However, Krammer and Lange-Bertalot (1986, 1991b) indicate that large populations of *G. parvulum*, that might be considered a separate variety of the species, have been found in waters with relatively low (oligosaprobic) nutrient levels. This certainly is more in line with what would be expected in Libby Creek, even assuming the possibility of nutrient enrichment due to inorganic nitrogen inputs above station L9. The presence of significant numbers of pollution sensitive (PT group 3) diatom taxa at station L9 must also be considered. The fact that sensitive forms were not precluded is probably more indicative of the actual water quality at station L9. Nevertheless, with the PT rating of 1, *G. parvulum* had a significant effect on the pollution index at station L9, which subsequently affected the results of bioassessment Protocols I and II. Both will be discussed with this in mind in the next section.

Achnanthes biasolettiana and *A. minutissima* were the dominant diatom taxa at station L1 in October 1994, where each was present in about the same percent relative abundance. During the previous three years, *A. minutissima* was always strongly dominant at station L1, with *A. biasolettiana* the secondary dominant during two of the years (Table 7). *Achnanthes biasolettiana* is a mountain form that prefers high quality, calcium-poor water.

Several species belonging to the genera *Cymbella* and *Gomphonema* were also relatively important at station L1 in October 1994, but were all but absent from upstream stations L10 and L9 (Appendix B). This was also observed during October of all three previous years of monitoring (Weber 1992, 1993, 1994). All of these taxa are attached forms that require moderately low levels of nutrients and suspended sediment, and are indicators of generally good water quality. They also indicate the significantly different conditions present at station L1, where Libby Creek is a much larger stream, and is less enclosed by forest canopy than at either station L10 or L9. The total PRA of diatom species in each of the three pollution tolerance groups of

Lange-Bertalot (1979) during October 1994, as well as the three previous years, are presented in Figure 7 for Libby Creek stations L10, L9 and L1. Pollution sensitive (group 3) taxa dominated at all three Libby Creek stations during October of all four years considered. Only station L9 in 1994 had a PRA value for PT group 3 diatoms of less than 80. The relatively low PT group 3 total at station L9 (70%) was offset by the relatively high total relative abundance for PT group 1 taxa of about 20% (Figure 8). This was entirely due to the presence of significant numbers of *Gomphonema parvulum* that, rightly or wrongly, is assigned to PT group 1. Interestingly, in October of all three years prior to 1994, *G. parvulum* was present in higher numbers (over five times the relative abundance in 1991) at station L10 than at station L9 (Weber, 1992, 1993, 1994). This is clearly reflected in the PT group 1 values in Figure 7. Total PRA values for the most tolerant (group 1) taxa were well below 10% at all other stations over all four years.

Values for diatom community structure parameters (species richness, Shannon diversity index, pollution index and siltation index) for 1994 are tabulated in Appendix B, following the diatom species list. Diatom species richness, Shannon diversity index and pollution index values for the three Libby Creek stations during October 1994, as well as the previous three years, are presented graphically in Figure 8.

Species richness and Shannon diversity index values at all three Libby Creek stations were generally lower than those determined in October 1993 and, with few exceptions, were at or near all-time lows for October when compared to the previous monitoring years (Figure 8). The relatively low diversity index values were due in part to

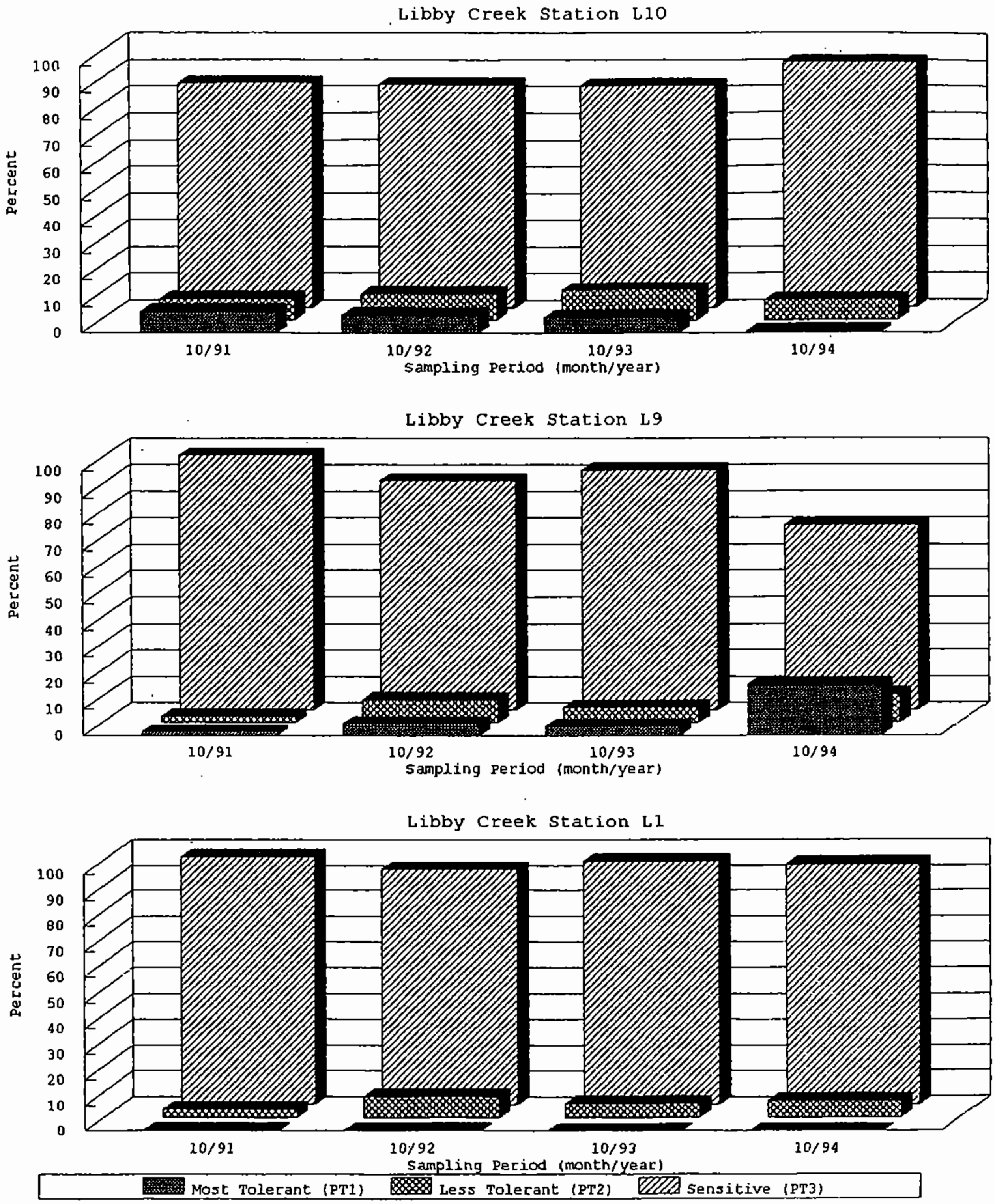


Figure 7. *Total percent relative abundance of diatom taxa in three pollution tolerance groups (Lange-Bertalot, 1979) at Libby Creek stations, October 1991-1994.*

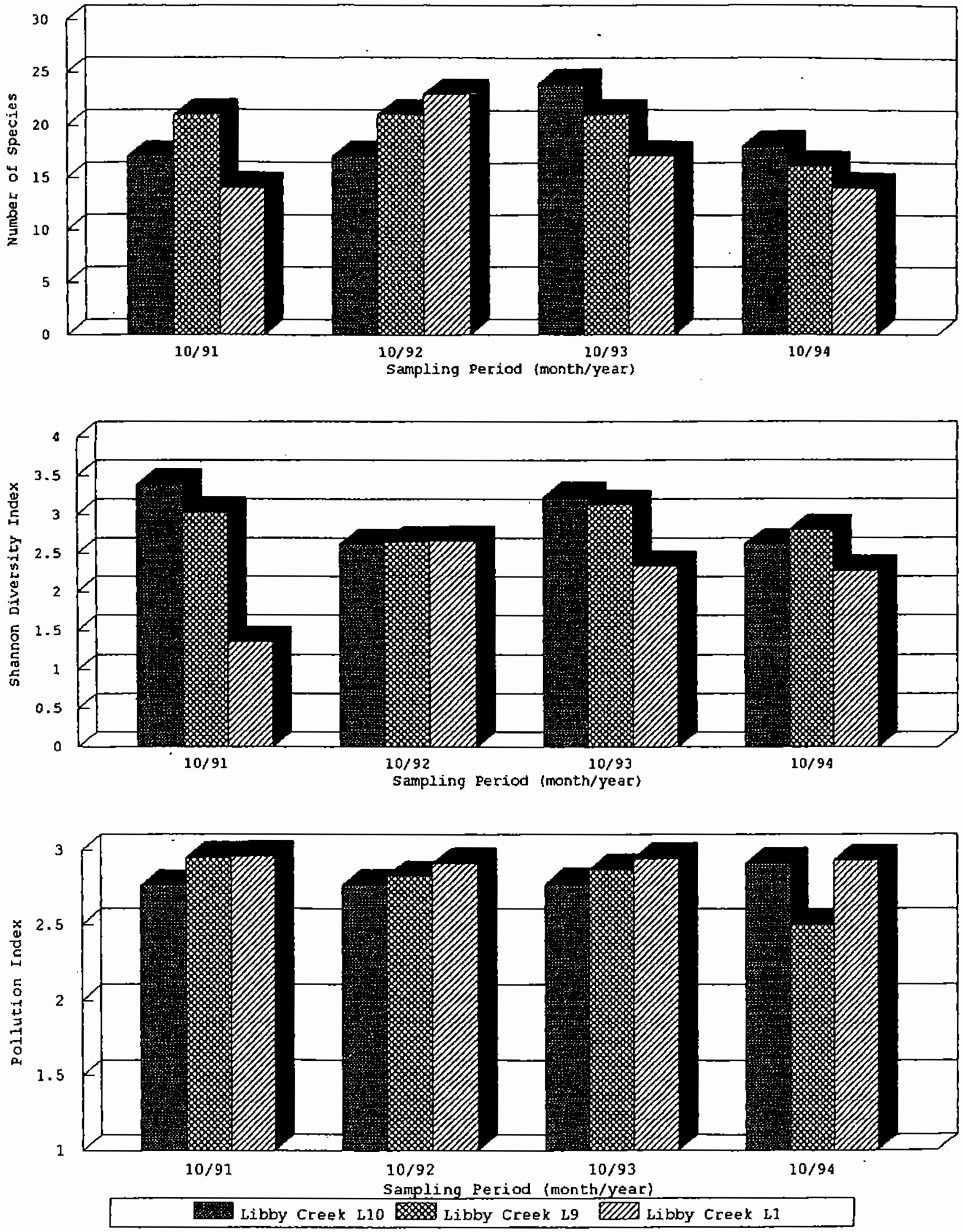


Figure 8. Diatom species richness, Shannon diversity index and pollution index values at three Libby Creek stations, October 1991-1994.

the low species richness values found at all three Libby Creek stations during October 1994. However, both metrics were still within the range determined by Bahls et al. (1992) for least-impaired reference streams in Montana. The other factor that influences the Shannon diversity index is how evenly diatom numbers are distributed amongst the species present. The moderately high relative abundances of the primary and secondary dominant diatom species (Table 7), which together accounted for 55 to 70 percent of the individuals present in October 1994, indicate a fairly uneven distribution between species at all three Libby Creek stations. This likely is indicative of stress on the diatom community, possibly related to seasonal flow and/or temperature extremes due to drought, or the naturally austere conditions found in mountain streams in northwestern Montana.

The pollution index value at station L10 reached an all-time high for October in 1994, indicating very good water quality, while station L9 dipped to an all-time low value, suggesting a significant decline in water quality when compared to station L10, and to data from previous years (Figure 8). As was previously discussed, the effect of moderate numbers of the pollution "tolerant" diatom *Gomphonema parvulum* present at station L9 on the pollution index is readily apparent.

Station L1 had the highest pollution index value of the three Libby Creek stations monitored in 1994, and was virtually unchanged from 1993 and the previous two years (Figure 8). This suggests relatively stable conditions at station L1, with consistently good water quality.

Values for the siltation index from the three Libby Creek stations in October 1994 were very low, as they typically have been during October of the previous three years (Table 8). This indicates that sedimentation is not a problem in Libby Creek, at least during the autumn season.

3. bioassessment protocols

As was discussed under **Methods**, bioassessment Protocol I was developed with data collected during the summer months, and the validity of applying Protocol I to diatom association indexes calculated with data from autumn is largely untested. With this in mind, diatom metrics for the three Libby Creek stations monitored in October 1994 were assessed using the Protocol I criteria (Table 9) to determine biological integrity and overall impairment of aquatic life. Additionally, index values for the three stations during October of the previous three years were assessed for comparison with 1994 results (Table 8).

In October 1994, station L10 had excellent biological integrity with no impairment of aquatic life, while station L9 was rated as having good biological integrity with minor impairment due to a borderline pollution index rating (Table 8). Both stations L10 and L9 were rated as having excellent biological integrity with no overall impairment of aquatic life during October of the previous three years. At downstream station L1, biological integrity was also rated as good with minor impairment of aquatic life during 1994, due to a slightly depressed diversity index score. Almost exactly the same conditions were seen at station L1 in October 1993, while a very low diversity index value in October of 1991 suggested only fair integrity with moderate impairment of

Table 8. Biological integrity and impairment ratings[a] for Libby Creek stations in the Montanore Project area during October for the years 1991 - 1994.

Station	Sampling Period	Diversity Index (score)	Pollution Index (score)	Siltation Index (score)	Biological Integrity	Overall Impairment
Libby Creek L10						
	October 1994	**2.62 (4)**	**2.91 (4)**	**0.00 (4)**	**Excellent**	**None**
	October 1993	3.22 (4)	2.77 (4)	0.24 (4)	Excellent	None
	October 1992	2.62 (4)	2.76 (4)	0.25 (4)	Excellent	None
	October 1991	3.39 (4)	2.76 (4)	0.00 (4)	Excellent	None
Libby Creek L9						
	October 1994	**2.80 (4)**	**2.50 (3)**	**0.00 (4)**	**Good**	**Minor**
	October 1993	3.12 (4)	2.87 (4)	0.24 (4)	Excellent	None
	October 1992	2.64 (4)	2.82 (4)	0.25 (4)	Excellent	None
	October 1991	3.03 (4)	2.95 (4)	0.60 (4)	Excellent	None
Libby Creek L1						
	October 1994	**2.28 (3)**	**2.93 (4)**	**1.47 (4)**	**Good**	**Minor**
	October 1993	2.34 (3)	2.94 (4)	0.24 (4)	Good	Minor
	October 1992	2.66 (4)	2.91 (4)	0.72 (4)	Excellent	None
	October 1991	1.36 (2)	2.96 (4)	0.00 (4)	Fair	Moderate

[a]based on diatom association indexes using bioassessment Protocol I (Bahls 1993); see Table 9 for criteria.

Table 9. Criteria for establishing impairment ratings and scores for diatom association indexes from mountain streams under bioassessment Protocol I (Bahls, 1993).

Score	Rating	Diversity Index	Pollution Index	Siltation Index
1	high stress	< 1.00		
	severe pollution		< 1.50	
	heavy siltation			> 60
2	moderate stress	1.00-1.75		
	moderate pollution		1.50-2.00	
	moderate siltation			40-60
3	minor stress	1.76-2.50		
	minor pollution		2.01-2.50	
	minor siltation			20-39
4	no stress	> 2.50		
	no pollution		> 2.50	
	no siltation			< 20

Lowest Score	Biological Integrity	Overall Impairment
1	poor	severe
2	fair	moderate
3	good	minor
4	excellent	none

aquatic life at station L1 (Table 8). The data from October 1992 indicated the best conditions at station L1 since the inception of Libby Creek monitoring.

Bioassessment Protocol II was applied to diatom association indexes from Libby Creek stations L10 and L9 during October of 1994, as well as for October of the previous three years (Table 10). Station L10 served as the "upstream control" for station L9 which, because of its location downstream of the Montanore Project exploratory adit, was of primary interest as the "study site". Because Protocol II uses a local control for comparison, it is more sensitive than Protocol I, and can be applied year round. Protocol II requires that the control site be of the same stream order as the site(s) being assessed. Libby Creek at station L10 is of lower stream order than downstream station L1, and therefore is not a valid control site under Protocol II.

Table 10. Application of diatom bioassessment Protocol II (Bahls 1993) to establish biological integrity and overall impairment of aquatic life[a] at Libby Creek station L9 during October for the years 1991 - 1994.

Monitoring Year:	1991	1992	1993	1994
Diversity Index Ratio: (Score)	90% (4)	101% (4)	97% (4)	107% (4)
Pollution Index Ratio: (Score)	107% (4)	102% (4)	104% (4)	86% (3)
Siltation Index Ratio: (Score)	0% (1)	100% (4)	100% (4)	100% (4)
Similarity Index: (Score)	51% (3)	67% (4)	67% (4)	72% (4)
Low Score:	1	4	4	3
Biological Integrity:	Poor	Excellent	Excellent	Good
Overall Impairment:	Severe	None	None	Minor

[a]Libby Creek station L10 was used as the upstream control for each assessment; see Table 11 for criteria.

The criteria used to establish ratings and scores for diatom association indexes under Protocol II are presented in Table 11. In addition to the three indexes used with Protocol I, a percent similarity index was calculated for the control and study sites (see **Methods**). The system used to rate the Shannon diversity index provides for two possible responses (Table 11), which is explained in greater detail under **Methods.** Results returned by bioassessment Protocol II for October 1994, as well as for October of the previous three years, are presented in Table 10.

In October of 1994, Libby Creek station L9 was rated as having good biological integrity with minor impairment of aquatic life when compared to station L10. This was slightly worse than the ratings of excellent with no impairment returned for October of 1992 and 1993, and was due to the lower pollution index ratio in 1994 (Table 10). The moderately high PRA of the diatom species *Gomphonema parvulum* that has been placed in PT group 1, was responsible for the apparent decline in biological integrity and increase in overall impairment at station L9. As was discussed under **diatom algae**, the extreme PT rating for *G. parvulum*, at least as it occurs in Libby Creek, is probably inappropriate. Evidence exists in the literature that populations of this taxon thrive in waters that are relatively nutrient-poor. A PT rating of 2 for *G. parvulum* would acknowledge some tolerance of elevated nutrients, which is probably true, and would have resulted in a biological integrity rating of excellent at station L9, with no overall impairment. These changes are strongly supported by the fact that during October of all three years prior to 1994, *G. parvulum* occurred at a significantly greater relative abundance at station L10 than at station L9, and therefore was not favored by the elevated nitrogen levels documented at station L9 (Weber

Table 11. Criteria for establishing impairment ratings and scores for diatom association indexes when a local reference or control site is available and used (bioassessment Protocol II; Bahls 1993).

Score	Rating	Diversity Index[a]	Pollution Index[a]	Siltation Index[b]	Similarity Index[c]
1	high stress	<40%			
		>160%			
	severe pollution		<50%		
	heavy siltation increase			<20%	
	very dissimilar communities				<20%
2	moderate stress	40-60%			
		140-160%			
	moderate pollution		50-70%		
	moderate siltation increase			20-40%	
	somewhat dissimilar communities				20-40%
3	minor stress	61-80%			
		120-139%			
	minor pollution		71-90%		
	small siltation increase			41-60%	
	somewhat similar communities				41-60%
4	no stress	>80%			
		<120%			
	no pollution		>90%		
	no siltation increase			>60%	
	very similar communities				>60%

[a]Value is ratio of study site index to reference site index x 100.
[b]Value is ratio of reference site index to study site index x 100.
[c]Percent community similarity (Whittaker and Fairbanks 1958).

Lowest Score	Biological Integrity	Overall Impairment
1	poor	severe
2	fair	moderate
3	good	minor
4	excellent	none

1992, 1993,1994).

In October of 1991, the ratings for biological integrity / overall impairment plunged to poor / severe as the result of a siltation index ratio of 0%, which returned a score of 1 (Tables 10 and 11; Weber 1994). The relatively minor increase in siltation index at station L9 (0.25) over that at station L10 (0.00) was considered to be indicative of a "heavy siltation increase" by the Protocol II criteria. However, in reality the 0.25 represents a relative abundance value for silt-tolerant diatom genera of 1/4 of one percent, while the remaining 99.75% of the diatoms present at station L9 apparently were silt-intolerant. It appears that the siltation index ratio may suffer from a mathematical quirk when the control site siltation index value equals 0. The mean siltation index value for mountain reference streams in Montana was 14.5 (Bahls 1993). It seems reasonable to assume that the integrity/impairment ratings at station L9 in October 1991 were at least good/minor.

With the exception of the October 1991 results, Protocol I and Protocol II assessments of biological integrity and overall impairment of aquatic life at Libby Creek station L9 in October show complete agreement (Tables 8 and 10).

D. Conclusions

1. There were only minor differences between non-diatom and diatom algae associations at Libby Creek stations L10 and L9 in October 1994, based on community structure and composition metrics. The greater number of non-diatom genera, and the greater importance of blue-green algae and the diatom *Gomphonema parvulum* may be indicative of some nitrogen enrichment at station L9 over levels at station L10,

although the evidence is less than conclusive.

2. Considerably greater differences in non-diatom and diatom algae associations were seen in October 1994 between Libby Creek station L1 and either stations L10 or L9, than between the latter two stations. These differences are probably related more to the larger size and different physical nature of Libby Creek at station L1 than to major differences in water quality.

3. Results of two bioassessment protocols developed by the Montana Water Quality Division utilizing diatom association metrics were in generally good agreement. Protocol I indicated that biological integrity was excellent at Libby Creek stations L10 and L1, with no impairment of aquatic life in October 1994, but decreased to good with minor impairment at station L9, with least-impaired reference streams for comparison. Under Protocol II, with station L10 considered as the unimpaired control, station L9 was again rated as having good biological integrity with only minor impairment of aquatic life during October 1994.

4. Reassessment of data from October of the three previous monitoring years under Protocol I revealed that biological integrity remained excellent, with no impairment of aquatic life at Libby Creek station L10 from 1991 to 1994. At station L9, biological integrity in October of 1991, 1992 and 1993 also rated as excellent, with no impairment of aquatic life indicated under both Protocols I and II. Libby Creek station L1 was somewhat more variable than either upstream station L10 or L9 under Protocol 1, but generally had at least good biological integrity during October of all four years.

IV. MACROINVERTEBRATES

A. Introduction

Macroinvertebrate refers to organisms inhabiting the bottom substrate consisting of sediments, debris, macrophytes, filamentous algae, etc., of freshwater habitats for at least part of their life cycle. Macroinvertebrates are those organisms retained by a mesh of $\geq$200 to 500 microns (Rosenberg, et al., 1993 and Loeb, et al., 1994).

Data on macroinvertebrate populations can be an integral part of a biomonitoring program which systematically uses biological responses to evaluate changes in the environment. The most common type of biomonitoring is surveillance which includes surveys conducted prior and subsequent to project completion.

Of the two groups most often used for assessing water quality, i.e., algae and macroinvertebrates, the latter group is the most commonly used. Benthic macroinvertebrates are advantageous for biomonitoring because: they are ubiquitous and thus, can be used to monitor environmental characteristics in a variety of aquatic ecosystems; the group contains a large number of taxa offering a wide range of responses to environmental changes; they are sedentary, thereby allowing spatial analyses of ecosystem characteristics; macroinvertebrates have relatively long life cycles which provide for documentation of temporal changes. Thus, benthic macroinvertebrates act as continuous monitors of the water they inhabit (Rosenberg, et al., 1993 and Loeb, et al., 1994).

B. Sampling

The Libby Creek stations were sampled for macroinvertebrates using the same methods as in previous years. A Hess net (500 microns) with a Dolphin plankton bucket (65 microns) attached to the end of the net was used to collect four replicates. Samples were collected from the thalweg of the riffle/run area in a non-random fashion so as to collect from the best available habitat at each station. Each succeeding sample was collected upstream of the previous sample.

The Hess net was used as outlined by Klemm et al. (1990). The net was placed in an area with a substrate of gravel and small to medium cobbles (0.6-6.0 inches in diameter). All removable rocks within the Hess frame were scrubbed free of organisms and then deposited outside the net frame. Then, the remaining substrate was stirred to a depth possible with the hands and a heavy screwdriver to capture organisms in the upper hyporheic zone. The collector then stood, dipped the net in the stream, and raised it quickly to flush macroinvertebrates into the Dolphin bucket. This washing technique was repeated until no visible organisms remained in the main Hess net. The Dolphin bucket was then unscrewed and its contents emptied into a labelled collection jar.

Because benthic communities in the Montanore Project area tend to be sparse, a fifth sample was again collected using a 500 micron mesh bottom kick net. The net was held in place downstream of a gravel/cobble/small boulder area by one biologist while a second biologist overturned and rubbed the substrate to dislodge organisms for 20 seconds. The process was then repeated twice more at two other spots for a total of

60 seconds of collecting time. Attention was given to sampling consistency so the kick samples could be treated quantitatively relative to each other. All five samples were preserved with 10% formalin and transported to the Westech lab for processing.

During each collecting period, notes on air and water temperature, substrate composition, streambank condition, stream width and depth, sediment embeddedness, and any other noteworthy characteristics were made. In addition, photographs were taken of each site during the collection period.

C. Identification and Analysis

In the lab, macroinvertebrate samples were stained with rose bengal to facilitate the sorting process. The organisms acquired a bright pink color from the dye making them much more readily visible within the sample debris. The samples were poured into a white nalgene pan and all organisms, visible first to the naked eye and then with an illuminated magnifying (.75x) lens, were separated from the debris and stored in 70% ethanol.

The organisms were later placed in a watch glass, examined under a Bausch and Lomb StereoZoom 7 microscope, identified, and counted. The entire sample was counted to eliminate subsampling which can overlook taxa and potentially add a source of undesirable data variation.

Specimens were identified to the lowest taxon possible depending on the stage of development and physical condition of the organisms. A number of keys, listed in the

References section, were used in the identification process. Representatives of questionable taxa were sent to taxonomic experts for verification. A reference collection from the samples was stored in the Westech lab.

Raw counts of macroinvertebrate taxa found in each sample were used in a Quatro (5.0) program for several statistical calculations. Those metrics are presented in the Appendices and/or Tables of this report. Richness was measured by the number and relative percentage of taxa, and number and relative percentage of the major groups (E = Ephemeroptera, P = Plecoptera, T = Trichoptera, and Other).

Community diversity was measured with the Shannon-Weaver Index (SDI) (Weber, 1973). The community loss index was derived from the calculations presented in Courtemanch, et al. (1987). Enumerations included the total number of individuals at each station for each sampling period, the ratio of EPT to the total number of individuals, the ratio of EPT individuals to Chironomidae individuals, and the ratio (SR) of pollution sensitive taxa, based on Winget et al.'s Tolerance Quotient (U.S.D.A., 1979), to the total number of individuals.

Functional measures included the ratio of collector-filterers to the total, ratio of collector-gatherers to the total, ratio of shredders to the total, ratio of scrapers to the total, ratio of omnivores to the total, and ratio of scrapers to collector-filterers.

A stream rating score was given to each site by combining the SDI, EPT/C, and SR. This score for integrity/impairment was used to compare all sites sampled in 1994.

Dual site comparisons were made between control/reference and impact sites in 1994 and between previous years using several metrics including the community loss index and Pearson et al.'s (1983) method of data analysis based on log-normal distribution of individuals among species.

D. Results and Discussion

1. population composition and density

Table 12 lists all of the macroinvertebrates collected from the Montanore Project area in 1994. Specific organisms collected with each replicate at each station are listed in Appendix C.

Table 13 shows the group composition and total abundance for the Hess and kick samples from each station. The twelve Hess samples collected 11,695 organisms (975/replicate) from 70 taxa while the three kick samples gathered another 2,988 organisms (996/replicate) from 67 taxa. Overall, the Hess samples collected slightly more mayflies (Ephemeroptera) than the kick samples while the kick samples gathered a few more stoneflies (Plecoptera) and caddisflies (Trichoptera).

Highest abundance per sample set was at the L9 station. This station also had the highest diversity (number of taxa) with the Hess samples but had the lowest diversity of the kick samples. And, the L9 samples were most evenly divided between the four groups (Ephemeroptera, Plecoptera, Trichoptera, Other).

Table 12. Aquatic macroinvertebrates collected from the Libby Creek stations in the Montanore Project area in October 1994.

ORDER	FAMILY	GENUS/SPECIES
EPHEMEROPTERA	Baetidae	*Baetis* sp.
	Ephemerellidae	*Caudatella* sp.
		Drunella doddsi
		Drunella grandis
		Serratella sp.
		Immature
	Hepatgeniidae	*Cinygmula* sp.
		Epeorus sp.
		Rhithrogena sp.
	Leptophlebiidae	*Paraleptophlebia* sp.
	Siphlonuridae	*Ameletus* sp.
PLECOPTERA	Capniidae	Immature
	Chloroperlidae	*Sweltsa/Suwallia* sp.
	Leuctridae	*Despaxia augusta*
		Immature
	Nemouridae	*Visoka cataractae*
		Zapada cinctipes
		Zapada columbiana
	Peltoperlidae	*Yoraperla brevis*
	Perlidae	*Doroneuria theodora*
		Immature
	Perlodidae	*Isoperla* sp.
		Megarcys sp.
		Setvena bradleyi
		Skwala sp.
		Immature
	Taeniopterygidae	*Taenionema* sp.
TRICHOPTERA	Brachycentridae	*Brachycentrus* sp.
		Micrasema sp.
		Immature
	Glossosomatidae	*Anagapetus* sp.
		Glossosoma sp.
	Hydropsychidae	*Arctopsyche grandis*
		Hydropsyche sp.
		Parapsyche elsis
		Immature
	Hydroptilidae	*Agraylea* sp.
	Limnephilidae	*Apatania* sp.
		Chyrandra centralis
		Ecclisomyia sp.
	Uenoidae	*Neophylax* sp.
		Neothremma alicia
		Oligophlebodes sp.
	Rhyacophilidae	*Rhyacophila Angelita* grp.
		Rhyacophila Betteni grp.
		Rhyacophila Brunnea grp.
		Rhyacophila hyalinata
		Rhyacophila iranda
		Rhyacophila Sibirica grp.
		Rhyacophila vaccua

Table 12. (Continued).

ORDER	FAMILY	GENUS/SPECIES
		Rhyacophila vepulsa
		Rhyacophila Verrula grp.
		Rhyacophila sp.
	Pupae	
DIPTERA	Ceratopogonidae	
	Chironomidae	
	Empididae	*Chelifera* sp.
		Clinocera sp.
		Oreogeton sp.
	Psychodidae	
	Simuliidae	
	Tipulidae	*Antocha* sp.
		Dicranota sp.
		Hexatoma sp.
		Pedicia sp.
COLEOPTERA	Elmidae	*Dubiraphia* sp.
		Heterlimnius sp.
		Lara sp.
		Immature
MISCELLANEOUS	Annelida (Oligochaeta)	
	Hydracarina	
	Nematoda	
	Turbellaria	

Table 13. Composition of macroinvertebrates from the Libby Creek samples, October 1994*.

Station	Total Organisms	Total Taxa	Ephemeroptera %	Plecoptera %	Trichoptera %	Other %
L10	3211(2603)	49(50)	30.0(38.3)	15.3(23.5)	17.4(20.4)	37.3(17.8)
L9	5106(2858)	52(41)	24.6(30.9)	28.0(28.6)	22.3(23.8)	25.0(16.7)
L1	3378(2662)	48(42)	66.8(70.2)	11.1(8.1)	17.1(13.1)	5.1(8.5)
Totals	11695(2988)	70(67)	38.2(33.4)	19.7(23.9)	19.5(24.6)	22.6(18.1)

* Hess organisms(kick organisms)

Table 14. Relative abundance of the most common macroinvertebrates in the combined Libby Creek samples, October 1994.

Taxa	Group	No.	% of Total	Samples*
Cinygmula sp.	E	Hess = 3024 kick = 2621	25.9 32.3	12 3
Chironomidae	D	Hess = 2264 kick = 785	19.4 9.7	12 3
Glossosoma sp.	T	Hess = 892 kick = 618	7.6 4.8	12 3
Taenionema sp.	P	Hess = 889 kick = 627	7.6 7.7	11 3
Zapada columbiana	P	Hess = 351 kick = 389	3.0 4.8	8 2
Agraylea sp.	T	Hess = 364 kick = 218	3.1 2.7	8 2

*out of 12 Hess and 3 kick samples

For the Hess samples, mayflies (Ephemeroptera) were the dominant group (67%) at lower Libby Creek (L1), stoneflies (Plecoptera) were dominant (28%) at middle Libby Creek (L9) and the Other group (37%), consisting mostly of the Dipteran Chironomidae, predominated at L10. For the kick samples, mayflies were the dominant group at all three stations.

The mayfly, *Cinygmula* sp., was the single most common organism and was relatively more abundant in the kick samples than in the Hess samples (Table 14). The second most frequently collected taxa, Chironomidae, was relatively more abundant in the Hess samples. The caddisfly, *Glossosoma* sp., was relatively more common in Hess samples. The stoneflies, *Taenionema* sp. and *Zapada columbiana* and the caddisfly, *Agraylea* sp., were of nearly equal relative abundance in the Hess and kick samples. The 10 most abundant taxa at the three stations (Hess samples) were:

L10	L9	L1
1--Chironomidae(34%)	Chironomidae(21%)	*Cinygmula* sp.(44%)
2--*Cinygmula* sp.(20%)	*Cinygmula* sp.(17%)	*Hydropsyche* sp.(11%)
3--*Glossosoma* sp.(8%)	*Taenionema* sp.(16%)	*Paraleptophlebia* sp.(7%)
4--*Sweltsa/Suwallia* sp.(5%)	*Glossosoma* sp.(12%)	*Rhithrogena* sp.(6%)
5--*Agraylea* sp.(5%)	*Zapada columbiana*(5%)	Ephemerellidae(5%)
6--*Baetis* sp.(4%)	*Agraylea* sp.(4%)	*Sweltsa/Suwallia* sp.(4%)
7--*Zapada columbiana*(3%)	*Zapada* sp.(3%)	*Baetis* sp.(4%)
8--*Rhithrogena* sp.(3%)	*Sweltsa/Suwallia* sp.(2%)	Capniidae(3%)
9--*Taenionema* sp.(3%)	*Rhithrogena* sp.(2%)	Chironomidae(2%)
10-*Anagapetus* sp.(2%)	Ephemerellidae(2%)	*Zapada cinctipes*(2%)

Mountain streams in good condition contain macroinvertebrate populations that consist of 51% Ephemeroptera, 9% Plecoptera, and 10% Trichoptera with the six most dominant taxa being mayflies (Bahls et al., 1992). The L1 samples most closely met these reference criteria in 1994.

The relative abundance of the major groups and numbers of taxa as well as ratios of certain groups or taxa are compared in Table 15. EPT Total is the number of Ephemeroptera, Plecoptera, and Trichoptera in the sample set. EPT% is the total percent of each of those groups in the sample set. EPT taxa is the number of taxa in the sample set for each of those three groups. Baet/Ephem is the ratio of the number of Baetidae compared to the total number of Ephemeroptera in the sample set. Chir% refers to the percentage of Chironomidae in the sample set. EPT/Chir is the ratio of the number of EPT compared to the number of Chironomidae in the sample set.

The presence of a large proportion of EPT taxa compared to the number of Chironomidae is generally indicative of "healthy" waters while an abundance of Chironomidae is usually characteristic of some degree of impairment. Also, baetid mayflies are considered to be more pollution tolerant than other mayflies and the ratio of baetids to the total number of Ephemeroptera can help characterize water quality. The higher the Baet/Ephem ratio, the greater the preponderance of Baetidae in the sample (Plafkin et al., 1989, Wisseman, 1991, Bahls et al., 1992).

All of the sample sets, regardless of the method used, had an EPT% of over 50%. The sample set with the lowest EPT% (62.7%) was the Hess set from L10 and the highest (94.9%) was the Hess set from L1. The sample sets with the highest diversity were the L9 Hess set and the L10 kick (43 and 40, respectively). The lower station, L1, had the lowest diversity with 34 and 31 taxa from the Hess and kick sample sets, respectively but was the only station with over 50% of the organisms being mayflies (Ephemeroptera).

Table 15. Relative composition of Libby Creek macroinvertebrate sample sets, October 1994.

STATION	EPT Total	EPT%	EPT Taxa	Baet/Ephem	Chir%	EPT/Chir
L10-Hess	2013	62.7	38	0.13	34.1	1.84
L10-kick	2139	82.2	40	0.18	11.7	7.04
L9-Hess	3827	75.0	43	0.06	21.4	3.49
L9-kick	2380	83.3	32	0.04	13.3	6.26
L1-Hess	3207	94.9	34	0.06	2.2	43.34
L1-kick	2435	91.5	31	0.03	3.8	24.11

Table 16. Relative percent abundance of macroinvertebrate functional feeding groups and their dominant taxa in the Libby Creek samples, October 1994 (see p. 56 of text).

STATION	SC	SH	CG	CF	OM	P	UNK
L10-Hess	32.9	6.8	49.1 Chironomidae	1.5	0.1	9.6	0.2
L10-kick	36.3 *Cinygmula*	14.3 *Zapada* ssp.	35.7 Chironomidae	1.8	0.1	11.7 sev. taxa	0.1
L9-Hess	45.8 *Cinygmula/ Taenionema*	9.0	34.6 Chironomidae	2.4	0.0	8.0	0.3
L9-kick	59.8 *Cinygmula/ Taenionema*	8.0	21.2 Chironomidae	1.8	0.0	8.7	0.6
L1-Hess	47.5 *Cinygmula*	6.1	26.7 sev. taxa	12.0 *Hydropsyche*	0.1	6.5	1.1
L1-kick	49.2 *Cinygmula*	5.1	30.8 sev. taxa	7.1	0.2	5.9	1.6
Total-Hess	**42.7** ***Cinygmula***	**7.5**	**36.3** **Chironomidae**	**4.9**	**0.1**	**8.0**	**0.5**
Total-kick	**48.8** ***Cinygmula***	**9.1**	**29.0** **sev. taxa**	**3.5**	**0.1**	**8.7**	**0.8**

Chir% was highest in the L10 Hess sample set (34.1%) and lowest in the L1 Hess samples (2.2%). The EPT/Chir ratio ranged from 1.84 in the L10 Hess samples to 43.34 in the L1 Hess samples. The EPT/Chir ratio for the L9 Hess set was slightly higher than for the L10 Hess samples while the ratio for the L10 and L9 kick samples were similar but much lower than the L1 kick sample.

The Baet/Ephem ratio ranged from 0.03 in the L1 kick sample to 0.18 in the L10 kick sample. Both the L10 Hess and kick sample sets had a higher Baet/Ephem ratio than any of the other sample sets.

2. functional feeding groups

Functional feeding group designations are based on the morphological structures and behaviors responsible for food acquisition (Merritt et al., 1978 and Cummins, 1988). Benthic taxa can be labeled as one of six possible trophic designations (Merritt et al., 1978 and Wisseman, 1991): shredders which are large particle detritivores, scrapers which feed on deposited detritus, filtering collectors which feed on particles in suspension, gathering collectors which feed on deposited detritus, predators which feed on other invertebrates, and omnivores which feed on a variety of materials. Organisms which do not fit one of these designations are grouped as an "unknown" feeder.

The relative abundance of some of the functional feeding groups can be useful in characterizing a stream's condition within the limits of those metrics (Cummins, 1988). A diverse and abundant scraper community is usually indicative of good water quality.

Shredders and their microbial food base are sensitive to toxicants and modifications of the riparian zone (Plafkin et al., 1989) so abundance usually increases with increasing water quality. An increase in collector/filterers, such as Simuliidae, may be indicative of organic enrichment (Rosenberg et al., 1993), although some c/f, such as the caddisfly *Parapsyche elsis,* are highly sensitive to pollution. Collector/gatherers ingest organically enriched fine sediment and an increase in abundance of c/g taxa is [usually] indicative of a negative trend in habitat/water quality (Wisseman, 1991). However, once again there are some fairly pollution intolerant c/g such as the Dipteran Psychodidae.

Table 16 (p. 55, see also Appendices) separates the macroinvertebrates collected from Libby Creek in 1994 according to percentage of functional feeding group. Scrapers are macroinvertebrates which survive by scraping diatom and organic film off the substrate. At least 10% of the fauna in least impacted montane streams are usually scrapers which consist mostly of mayflies and caddisflies. High abundance of scrapers is generally a positive water quality sign (Wisseman, 1994). Scrapers were the predominant functional feeding group in the L10-k, L9-H, L9-k, L1-H and L1-k samples. The most abundant scraper *Cinygmula* sp. (family Heptageniidae), is a widespread, common group in western montane streams. When this family is abundant at a site, habitat complexity and integrity are usually high and summer water temperatures are low. Although listed as a scraper, the stonefly, *Taenionema* sp., can exist as a shredder and collector/gatherer as well and is a relatively intolerant taxa that can rapidly proliferate at sites with an abundance of algae, leaves and/or organic matter.

Members of the collector/gatherer group feed on fine organic particles in the substrate. Although a normal constituent of all aquatic ecosystems, high numbers in riffles is generally indicative of stressed habitat since many of the cg's are "weed" type, tolerant taxa that can proliferate in streams having few intolerant forms. Cg's, dominated by Chironomidae, were the predominant functional feeding group only in the L10 Hess sample set.

Shredders (sh) were most abundant in the L10 kick sample and consisted primarily of the stonefly genus, *Zapada*, a relatively intolerant taxa that prefers cool water and is intolerant to fine sediment and winter scouring of the substrate.

Collector/filterers (cf) were abundant only in the L1 Hess samples and were represented by the caddisfly, *Hydropsyche* sp., a relatively tolerant taxa that tends to appear in significant numbers when shading decreases and water temperature and algae production increases.

In addition to relative percentages, ratios of functional feeding groups can further characterize water quality (Rosenberg et al., 1993). Table 17 compares several functional group ratios.

The sc/cf ratio ranged from 3.95 in the L1 Hess sample set to 33.49 in the L9 kick sample (higher numbers = better water quality). The sc/(sc + cf) ratio was very similar for the L10 and L9 Hess and kick sample sets (0.951-0.971) and lowest (0.798) for the L1 Hess sample set (higher number = better water quality). The sc/total ratio was

Table 17. Functional feeding group ratios for macroinvertebrate samples from Libby Creek, October 1994.

STATION	SC/CF	SC/(SC+CF)	SC/TOTAL	CG/TOTAL	SH/TOTAL	CF/TOTAL
L10-Hess	22.49	0.957	0.329	0.491	0.068	0.015
L10-kick	19.67	0.952	0.363	0.357	0.143	0.018
L9-Hess	19.47	0.951	0.458	0.346	0.090	0.024
L9-kick	33.49	0.971	0.598	0.212	0.080	0.018
L1-Hess	3.95	0.798	0.475	0.267	0.061	0.120
L1-kick	6.97	0.875	0.492	0.308	0.051	0.071

lowest (0.329) in the L10 Hess samples and highest (0.598) in the L9 kick sample (higher number = better water quality). The cg/total ratio was lowest (better water quality depending on the taxa present) in the L9 kick sample (0.212) and highest in the L10 Hess sample set (0.491).

The sh/total ratio was highest (better water quality) in the L10 kick sample (0.143) and lowest in the L10 Hess sample set (0.068). Having the highest and lowest numbers at both stations is the result of the two different sampling methods. Shredders can exist in the L10 site because of the abundant riparian deciduous vegetation, the leaves of which form extensive packs behind large cobbles and boulders in the fall. This larger substrate is sampled by the kick net but not by the Hess net.

The cf/total ratio was highest for the L1 Hess samples (0.120), suggesting at least a slight decrease in water quality at this station, and lowest (0.015) in the L10 Hess sample sets.

3. diversity/pollution sensitivity values

The Tolerance Quotient (TQ) (Winget et al., 1979 and Wisseman, 1991) and the Tolerance Value (TV) (Hilsenhoff, 1987) are presented with each taxa in Appendices C. The TQ is a rating (2-110) of the relative tolerance of a taxon to levels of total alkalinity, substrate composition, sulfate concentration and percent gradient. TV's are intended to indicate a taxon's sensitivity to organic and nutrient pollution with a scale of 0-11.

The Shannon Diversity Index (SDI) is a measure of community diversity which combines richness (number of taxa) and enumerations (abundance of each taxa), but not tolerance values, in a statistical summary (Rosenberg et al., 1993). Originally calculated for large streams, a SDI of less than 3.00 is considered indicative of organic pollution (Platts et al., 1983 and Worf, 1980). Although relative comparisons of the SDI can have value in smaller streams which may be subjected to degradation other than organic pollution, discrepancies have been noted by the senior author (Farmer, 1994) and other investigators (Rosenberg et al., 1993). Therefore, in some cases, particularly for sample sets with low numbers of organisms, it is important to use the SDI judiciously.

The Sensitivity Ratio (SR) is arrived at simply by dividing the total number of sensitive organisms by the total number of organisms in the sample set (Farmer et al., 1994). Sensitive organisms are those taxa with a TQ of 48 or less. Ideally, the higher the percentage of sensitive organisms in the sample, the higher the quality of water from which the sample is retrieved.

The Shannon Diversity Index, Sensitivity Ratio and the EPT/Chir ratio were combined to give a numerical Biological Quality (BQ) score and a rating for biological integrity and overall impairment of the Libby Creek samples (Table 18). Biological integrity is the ability of an aquatic ecosystem to support and maintain a community of organisms having a species composition, diversity and functional organization comparable to that of the natural [undisturbed] habitats within a region (Karr et al., 1981). Impairment is the degree to which a stream will support beneficial uses as described in the Montana Surface Water Quality Standards (Bahls et al., 1992).

Table 19 compares the 1990-1994 Montanore Project's October sample sets using the above impairment rating scheme. All of the sample sets except for the L10-Hess set, had a lower sensitivity ratio in 1994 than in 1993 although the difference was slight. All of the stations except L9-k had a higher SDI in 1994. The EPT/C ratio was significantly lower in all of the sample sets in 1994 than in 1991 and 1992 and was mostly similar to 1993 except in the L1 sets where it was higher in 1994. The overall scores, compared to 1993, were the same or one point higher or lower for all of the sites in 1994.

4. dual site comparisons

This section is intended to compare the stations sampled in 1994 and to also evaluate possible reference sites for the Libby Creek stations downstream of the Montanore Project area.

The upper Libby Creek station, L10, and the Bear Creek station, Be2, were originally

Table 18. Biological integrity and overall impairment rating scheme used for the Libby Creek biological sampling stations, October 1994.

SDI	EPT/CHIR	SR	SCORE
<1.50	<1.00	0.00-0.20	1
1.50-2.25	1.00-10.00	0.20-0.50	2
2.25-3.00	10.00-15.00	0.50-0.70	3
3.00-3.75	15.00-25.00	0.70-0.85	4
>3.75	>25.00	>0.85	5

SDI = Shannon Diversity Index (Weber, 1973)

EPT/Chir = total number of Ephemeroptera, Plecoptera, Trichoptera divided by the total number of Chironomidae

SR = total number of sensitive organisms (TQ = <49) divided by the total number of organisms

SCORE = numbers arbitrarily assigned based on unpublished data (Farmer, 1993)

COMBINED SCORE	BIOLOGICAL INTEGRITY (BI)	OVERALL IMPAIRMENT (OI)
3-5	poor	severe
6-9	fair	moderate
10-12	good	minor
13-15	excellent	none

Table 19. Diversity and sensitivity values for the Libby Creek stations, October 1990-1994.

YEAR	SDI	EPT/C	SEN.RATIO	SCORE	BIOL.INTEG.	OVERALL IMPAIR.
L10-Hess						
1994	3.46	1.84	0.540	9	fair	moderate
1993	3.05	1.12	0.464	8	fair	moderate
1992	3.73	10.05	0.765	11	good	minor
1991	3.58	80.26	0.868	14	excellent	none
1990	3.12	35.6	0.807	13	excellent	none
L10-kick						
1994	4.04	7.04	0.666	10	good	minor
1993	3.59	7.40	0.713	11	good	minor
1992	3.70	9.45	0.748	10	good	minor
1991	3.30	370.0	0.851	14	excellent	none
1990	--	--	--	--	--	--
L9-Hess						
1994	3.74	3.49	0.673	9	fair	moderate
1993	3.62	4.56	0.792	10	good	minor
1992	3.01	49.44	0.907	14	excellent	none
1991	1.93	2432.0	0.923	12	good	minor
1990	3.44	17.75	0.873	13	excellent	none
L9-kick						
1994	3.44	6.26	0.802	10	good	minor
1993	3.58	8.17	0.826	10	good	minor
1992	3.06	77.00	0.926	14	excellent	none
1991	2.32	2001.0	0.872	13	excellent	none
1990	--	--	--	--	--	--
L1-Hess						
1994	3.21	43.34	0.792	12	good	minor
1993	3.10	10.67	0.863	12	good	minor

Table 19. (Continued).

YEAR	SDI	EPT/C	SEN.RATIO	SCORE	BIOL.INTEG.	OVERALL IMPAIR.
1992	3.57	16.84	0.596	11	good	minor
1991	2.66	685.3	0.892	13	excellent	none
1990	2.88	296.7	0.877	13	excellent	none
L1-kick						
1994	3.14	24.11	0.837	12	good	minor
1993	3.13	9.52	0.862	12	good	minor
1992	3.77	21.80	0.650	12	good	minor
1991	2.88	788.3	0.753	12	good	minor
1990	--	--	--	--	--	--

established as control and reference sites, respectively. Based on physical characteristics alone, both sites are quite similar to each other and to L9 but are substantially different from the downstream Libby Creek stations.

Dual site comparisons using the 1994 macroinvertebrate data were made between L10/L9 and L10/L1 (Table 20). The October 1992 data was used to compare Be2 and L10 to the downstream stations (Table 21). The community loss index in the comparisons was taken from Courtemanch et al. (1987). The index is the ratio of the number of taxa lost between an unaffected reference community and a pollution affected community, to the total number of taxa found in the affected community. The value of the index is determined by both the observed change in community richness as well as change in taxonomic similarity. The index produces values that can range from zero, indicating no harmful change, to infinity where there is complete loss of a community.

The higher the community loss index the greater the dissimilarity between the two sites. The dissimilarity may be the result of increased stress (Rosenberg et al., 1993), assuming the two sites have the same potential for equal biological quality based on the physical attributes of the sites, or the dissimilarity may be due to inherent physical characteristics. Values exceeding 0.8 are indicative of excessively harmful changes in the communities (Courtemanch et al., 1987).

Table 20. Dual site comparisons for the Libby Creek Hess sample sets, October 1993-1994.

Project: Montanore Date: 13 October 1994

Reference Site: Upper Libby Creek (L10)

Comparison Site: Middle Libby Creek (L9)

A-REFERENCE SITE--L10	B-COMPARISON SITE--L9
Total abundance = 3211	Total abundance = 5106
Total number of taxa = 49	Total number of taxa = 52
Number of EPT taxa = 38	Number of EPT taxa = 43

AB = total taxa in common = 40

EPT taxa in common = 32

Community loss index (A taxa - AB taxa)/B taxa = 0.173

Shannon Diversity Index A = 3.46	Shannon Diversity B = 3.74
Biological Quality A = 9	Biological Quality B = 9

DOMINANT TAXA:

Reference Site--L10:	Comparison Site--L9
1-Chironomidae	1-Chironomidae
2-*Cinygmula* sp.	2-*Cinygmula* sp.
3-*Glossosoma* sp.	3-*Taenionema* sp.
4-*Sweltsa/Suwallia* sp.	4-*Glossosoma* sp.
5-*Agraylea* sp.	5-*Zapada columbiana*
6-*Baetis* sp.	6-*Agraylea* sp.
7-*Zapada columbiana*	7-*Zapada* sp.
8-*Rhithrogena* sp.	8-*Sweltsa/Suwallia* sp.
9-*Taenionema* sp.	9-*Rhithrogena* sp.
10-*Anagapetus* sp.	10-Ephemerellidae

DOMINANTS IN COMMON:

Among 5 most abundant = 3

Among 10 most abundant = 8

Table 20. (Continued).

Project: Montanore **Date:** 13 October 1994

Reference Site: Upper Libby Creek (L10)

Comparison Site: Lower Libby Creek (L1)

A-REFERENCE SITE--L10	**B-COMPARISON SITE--L1**
Total abundance = 3211	Total abundance = 3378
Total number of taxa = 49	Total number of taxa = 48
Number of EPT taxa = 38	Number of EPT taxa = 34

AB = total taxa in common = 30

EPT taxa in common = 23

Community loss index (A taxa - AB taxa)/B taxa = 0.396

Shannon Diversity Index A = 3.46	Shannon Diversity B = 3.21
Biological Quality A = 9	Biological Quality B = 12

DOMINANT TAXA:

Reference Site--L10:	Comparison Site--L1
1-Chironomidae	1-*Cinygmula* sp.
2-*Cinygmula* sp.	2-*Hydropsyche* sp.
3-*Glossosoma* sp.	3-*Paraleptophlebia sp.* sp.
4-*Sweltsa/Suwallia* sp.	4-*Rhithrogena* sp.
5-*Agraylea* sp.	5-Ephemerellidae
6-*Baetis* sp.	6-*Sweltsa/Suwallia* sp.
7-*Zapada columbiana*	7-*Baetis* sp.
8-*Rhithrogena* sp.	8-Capniidae
9-*Taenionema* sp.	9-Chironomidae
10-*Anagapetus* sp.	10-*Zapada cinctipes*

DOMINANTS IN COMMON:

Among 5 most abundant = 1

Among 10 most abundant = 5

Table 20. (Continued).

Project: Montanore **Date:** 20 October 1993

Reference Site: Upper Libby Creek (L10)

Comparison Site: Middle Libby Creek (L9)

A-REFERENCE SITE--L10	B-COMPARISON SITE--L9
Total abundance = 1269	Total abundance = 2077
Total number of taxa = 33	Total number of taxa = 41
Number of EPT taxa = 27	Number of EPT taxa = 31

AB = total taxa in common = 30

EPT taxa in common = 24

Community loss index (A taxa - AB taxa)/B taxa = 0.073

Shannon Diversity Index A = 3.59	Shannon Diversity B = 3.47
Biological Quality A = 8	Biological Quality B = 10

DOMINANT TAXA:

Reference Site--L10	Comparison Site--L9
1-*Cinygmula* sp.	1-*Taenionema* sp.
2-*Sweltsa/Suwallia* sp.	2-*Cinygmula* sp.
3-Chironomidae	3-*Glossosoma sp.*
4-*Taenionema* sp.	4-*Sweltsa/Suwallia* sp.
5-*Rhithrogena* sp.	5-*Zapada columbiana*
6-*Baetis* sp.	6-*Rhithrogena* sp.
7-Leuctridae	7-*Baetis* sp.
8-*Agraylea* sp.	8-Chironomidae
9-*Zapada columbiana*	9-*Rhyacophila Verrula* sp.
10-*Rhyacophila* sp.	10-Hydropsychidae

DOMINANTS IN COMMON:

Among 5 most abundant = 3

Among 10 most abundant = 7

Table 21. Dual site comparisons for the Libby Creek and Bear Creek Hess sample sets, October 1991-1992.

Project: Montanore **Date:** 21 October 1992

Reference Site: Bear Creek (Be2)

Comparison Site: Upper Libby Creek (L10)

A-REFERENCE SITE--Be2	B-COMPARISON SITE--L10
Total abundance = 2720	Total abundance = 1657
Total number of taxa = 43	Total number of taxa = 34
Number of EPT taxa = 35	Number of EPT taxa = 27

AB = total taxa in common = 25

EPT taxa in common = 21

Community loss index (A taxa - AB taxa)/B taxa = 0.529

Shannon Diversity Index A = 3.62	Shannon Diversity B = 3.73
Biological Quality A = nn	Biological Quality B = nn

DOMINANT TAXA:

Reference Site--Be2:	Comparison Site--L10:
1-*Cinygmula* sp.	1-*Cinygmula* sp.
2-*Glossosoma* sp.	2-*Rhithrogena* sp.
3-*Baetis* sp.	3-*Baetis* sp.
4-Chironomidae	4-*Taenionema* sp.
5-*Rhithrogena* sp.	5-Chironomidae
6-*Taenionema* sp.	6-*Sweltsa/Suwallia* sp.
7-*Sweltsa/Suwallia* sp.	7-*Zapada columbiana*
8-*Zapada columbiana*	8-*Epeorus* sp.
9-*Drunella doddsi*	9-*Rhyacophila Betteni* grp.
10-*Despaxia augusta*	10-Hydropsychidae

DOMINANTS IN COMMON:

Among 5 most abundant = 4

Among 10 most abundant = 7

Table 21. (Continued).

Project: Montanore **Date:** 21 October 1992

Reference Site: Bear Creek (Be2)

Comparison Site: Middle Libby Creek (L9)

A-REFERENCE SITE--Be2	**B-COMPARISON SITE--L9**
Total abundance = 2720	Total abundance = 2208
Total number of taxa = 43	Total number of taxa = 34
Number of EPT taxa = 35	Number of EPT taxa = 29

AB = total taxa in common = 28

EPT taxa in common = 25

Community loss index (A taxa - AB taxa)/B taxa = 0.441

Shannon Diversity Index A = 3.62	Shannon Diversity B = 3.01
Biological Quality A = nn	Biological Quality B = nn

DOMINANT TAXA:

Reference Site--Be2:	Comparison Site--L9:
1-*Cinygmula* sp.	1-*Taenionema* sp.
2-*Glossosoma* sp.	2-*Glossosoma* sp.
3-*Baetis* sp.	3-*Cinygmula* sp.
4-Chironomidae	4-*Rhithrogena* sp.
5-*Rhithrogena* sp.	5-*Baetis* sp.
6-*Taenionema* sp.	6-*Sweltsa/Suwallia* sp.
7-*Sweltsa/Suwallia* sp.	7-*Rhyacophila Betteni* grp.
8-*Zapada columbiana*	8-Chironomidae
9-*Drunella doddsi*	9-*Drunella doddsi*
10-*Despaxia augusta*	10-*Megarcys* sp.

DOMINANTS IN COMMON:

Among 5 most abundant = 4

Among 10 most abundant = 8

Table 21. (Continued).

Project: Montanore **Date:** 21 October 1992

Reference Site: Bear Creek (Be2)

Comparison Site: Lower Libby Creek (L1)

A-REFERENCE SITE--Be2	B-COMPARISON SITE--L1
Total abundance = 2720	Total abundance = 2156
Total number of taxa = 43	Total number of taxa = 38
Number of EPT taxa = 35	Number of EPT taxa = 27

AB = total taxa in common = 27

EPT taxa in common = 21

Community loss index (A taxa - AB taxa)/B taxa = 0.421

Shannon Diversity Index A = 3.62	Shannon Diversity B = 3.57
Biological Quality A = nn	Biological Quality B = nn

DOMINANT TAXA:

Reference Site--Be2:	Comparison Site--L1:
1-*Cinygmula* sp.	1-Hydropsychidae
2-*Glossosoma* sp.	2-*Rhithrogena* sp.
3-*Baetis* sp.	3-*Baetis* sp.
4-Chironomidae	4-*Cinygmula* sp.
5-*Rhithrogena* sp.	5-*Sweltsa/Suwallia* sp.
6-*Taenionema* sp.	6-Chironomidae
7-*Sweltsa/Suwallia* sp.	7-*Oligophlebodes* sp.
8-*Zapada columbiana*	8-*Drunella* sp.
9-*Drunella doddsi*	9-Capniidae
10-*Despaxia augusta*	10-*Arctopsyche grandis*

DOMINANTS IN COMMON:

Among 5 most abundant = 3

Among 10 most abundant = 5

Table 21. (Continued).

Project: Montanore **Date:** 21 October 1992

Reference Site: Upper Libby Creek (L10)

Comparison Site: Middle Libby Creek (L9)

A-REFERENCE SITE--L10	B-COMPARISON SITE--L9
Total abundance = 1657	Total abundance = 2208
Total number of taxa = 34	Total number of taxa = 34
Number of EPT taxa = 27	Number of EPT taxa = 29

AB = total taxa in common = 27

EPT taxa in common = 23

Community loss index (A taxa - AB taxa)/B taxa = 0.206

Shannon Diversity Index A = 3.73	Shannon Diversity B = 3.01
Biological Quality A = 11	Biological Quality B = 10

DOMINANT TAXA:

Reference Site--10:	Comparison Site--L9:
1-*Cinygmula* sp.	1-*Taenionema* sp.
2-*Rhithrogena* sp.	2-*Cinygmula* sp.
3-*Baetis* sp.	3-*Glossosoma* sp.
4-*Taenioneme* sp.	4-*Rhithrogena* sp.
5-Chironomidae	5-*Baetis* sp.
6-*Sweltsa/Suwallia* sp.	6-*Sweltsa/Suwallia* sp.
7-*Zapada columbiana*	7-*Rhyacophila Betteni* grp.
8-*Epeorus* sp.	8-Chironomidae
9-*Rhyacophila Betteni* grp.	9-*Drunella doddsi*
10-Hydropsychidae	10-*Megarcys* sp.

DOMINANTS IN COMMON:

Among 5 most abundant = 4

Among 10 most abundant = 6

Table 21. (Continued).

Project: Montanore **Date:** 22 October 1991

Reference Site: Upper Libby Creek (L10)

Comparison Site: Middle Libby Creek (L9)

A-REFERENCE SITE--L10	**B-COMPARISON SITE--L9**
Total abundance = 1937	Total abundance = 2457
Total number of taxa = 35	Total number of taxa = 30
Number of EPT taxa = 26	Number of EPT taxa = 25

AB = total taxa in common = 25

EPT taxa in common = 20

Community loss index (A taxa - AB taxa)/B taxa = 0.333

Shannon Diversity Index A = 3.58	Shannon Diversity B = 1.93
Biological Quality A = 14	Biological Quality B = 12

DOMINANT TAXA:

Reference Site--L10:	Comparison Site--L9:
1--*Rhithrogena* sp.	1-*Taenionema* sp.
2-*Cinygmula* sp.	2-Hydropsychidae
3-*Taenionema* sp.	3-*Epeorus* sp.
4-*Sweltsa/Suwallia* sp.	4-*Rhithrogena* sp.
5-*Rhyacophila vaccua*	5-*Zapada columbiana*
6-*Baetis* sp.	6-*Rhyacophila vaccua*
7-*Epeorus* sp.	7-*Drunella doddsi*
8-*Zapada columbiana*	8-*Cinygmula* sp.
9-Hydropsychidae	9-*Sweltsa/Suwallia* sp.
10-Oligochaeta	10-*Megarcys* sp.

DOMINANTS IN COMMON:

Among 5 most abundant = 2

Among 10 most abundant = 7

Table 21. (Continued).

Project: Montanore	**Date:** 25 October 1990
Reference Site: Upper Libby Creek (L10)	
Comparison Site: Middle Libby Creek (L9)	

A-REFERENCE SITE--L10	**B-COMPARISON SITE--L9**
Total abundance = 187	Total abundance = 481
Total number of taxa = 23	Total number of taxa = 33
Number of EPT taxa = 19	Number of EPT taxa = 28

AB = total taxa in common = 16

EPT taxa in common = 14

Community loss index (A taxa - AB taxa)/B taxa = 0.212

Shannon Diversity Index A = 3.12	Shannon Diversity B = 3.44
Biological Quality A = 14	Biological Quality B = 12

DOMINANT TAXA:

Reference Site--L10:	Comparison Site--L9:
1-*Cinygmula* sp.	1-*Cinygmula* sp.
2-*Baetis* sp.	2-*Taenionema* sp.
3-*Ameletus* sp.	3-*Sweltsa/Suwallia* sp.
4-*Sweltsa/Suwallia* sp.	4-*Ameletus* sp.
5-*Rhithrogena* sp.	5-*Baetis* sp.
6-*Zapada columbiana*	6-*Rhithrogena* sp.
7-Chironomidae	7-*Dicranota* sp.
8-*Visoka cataractae*	8-*Zapada columbiana*
9-*Neothremma alicia*	9-*Lepidostoma* sp.
10-*Rhyacophila vaccua*	10-*Drunella coloradensis/flavilinea*

DOMINANTS IN COMMON:

Among 5 most abundant = 4

Among 10 most abundant = 6

The community loss indexes for the Libby Creek comparisons (Tables 20 and 21) are:

Reference/Comparison Site		Community Loss Index
1994:		
	L10/L9	0.173
	L10/L1	0.396
1993:		
	L10/L9	0.073
1992:		
	Be2/L10	0.529
	Be2/L9	0.441
	Be2/L1	0.421
	L10/L9	0.206
1991:		
	L10/L9	0.333
1990:		
	L10/L9	0.212

These site comparison data indicate that L10 and L9 are similar enough that L10 is an adequate control/reference site for L9. But, the L10 and Be2 sites are not very good reference stations for lower Libby Creek, L1. However, one of the advantages of consecutive annual sampling prior to project operation is that a previous year's data can be used in comparison to a following year as reference data for the same site in succeeding years. For example, Table 22 presents dual site comparisons on an annual basis for the lower Libby Creek station since none of the other stations are analogous enough to L1 to serve as its reference.

Because this is one site being compared to itself each year, we can assume the same potential for biological quality was present each year. The 1988 and 1990 data were not compared because of the difference in sampling methods.

Table 22. Annual dual site comparisons for the Libby Creek (L1) station Hess samples, October 1990-1994.

Project: Montanore **Date:** October 1990/1991

Reference Site: Lower Libby Creek (L1)--1990

Comparison Site: Lower Libby Creek (L1)--1991

A-REFERENCE SITE--L1(1990)	B-COMPARISON SITE--L1(1991)
Total abundance = 910	Total abundance = 2072
Total number of taxa = 33	Total number of taxa = 29
Number of EPT taxa = 26	Number of EPT taxa = 25

AB = total taxa in common = 19

EPT taxa in common = 15

Community loss index (A taxa - AB taxa)/B taxa = 0.483

Shannon Diversity Index A = 2.88	Shannon Diversity Index B = 2.66
Biological Quality A = 13	Biological Quality B = 13

DOMINANT TAXA

Reference Site--L1('90)	Comparison Site--L1('91)
1-*Cinygmula* sp.	1-*Taenionema* sp.
2-*Taenionema* sp.	2-*Cinygmula* sp.
3-*Baetis* sp.	3-*Rhithrogena* sp.
4-*Rhithrogena* sp.	4-*Baetis* sp.
5-*Sweltsa/Suwallia* sp.	5-*Sweltsa/Suwallia* sp.
6-*Drunella coloradensis/flavilinea*	6-Hydropsychidae
7-*Drunella doddsi*	7-*Drunella doddsi*
8-*Oligophlebodes* sp.	8-*Serratella* sp.
9-*Arctopsyche grandis*	9-*Zapada columbiana*
10-*Zapada cinctipes*	10-*Parapsyche elsis*

DOMINANTS IN COMMON:

Among 5 most abundant = 5

Among 10 most abundant = 6

Table 22. (Continued).

Project: Montanore **Date:** October 1990/1992

Reference Site: Lower Libby Creek (L1)--1990

Comparison Site: Lower Libby Creek (L1)--1992

A-REFERENCE SITE--L1(1990)	B-COMPARISON SITE--L1(1992)
Total abundance = 910	Total abundance = 2156
Total number of taxa = 33	Total number of taxa = 38
Number of EPT taxa = 26	Number of EPT taxa = 27

AB = total taxa in common = 22

EPT taxa in common = 16

Community loss index (A taxa - AB taxa)/B taxa = 0.289

Shannon Diversity Index A = 2.88	Shannon Diversity Index B = 2.57
Biological Quality A = 13	Biological Quality B = 11

DOMINANT TAXA

Reference Site--L1('90)	Comparison Site--L1('92)
1-*Cinygmula* sp.	1-Hydropsychidae
2-*Taenionema* sp.	2-*Rhithrogena* sp.
3-*Baetis* sp.	3-*Baetis* sp.
4-*Rhithrogena* sp.	4-*Cinygmula* sp.
5-*Sweltsa/Suwallia* sp.	5-*Sweltsa/Suwallia* sp.
6-*Drunella coloradensis/flavilinea*	6-Chironomidae
7-*Drunella doddsi*	7-*Oligophlebodes* sp.
8-*Oligophlebodes* sp.	8-*Drunella* sp.
9-*Arctopsyche grandis*	9-Capniidae
10-*Zapada cinctipes*	10-*Arctopsyche grandis*

DOMINANTS IN COMMON:

Among 5 most abundant = 4

Among 10 most abundant = 6

Table 22. (Continued).

Project: Montanore **Date:** October 1990/1993

Reference Site: Lower Libby Creek (L1)--1990

Comparison Site: Lower Libby Creek (L1)--1993

A-REFERENCE SITE--L1(1990)	B-COMPARISON SITE--L1(1993)
Total abundance = 910	Total abundance = 2543
Total number of taxa = 33	Total number of taxa = 53
Number of EPT taxa = 26	Number of EPT taxa = 40

AB = total taxa in common = 25

EPT taxa in common = 18

Community loss index (A taxa - AB taxa)/B taxa = 0.151

Shannon Diversity Index A = 2.88	Shannon Diversity Index B = 3.93
Biological Quality A = 13	Biological Quality B = 12

DOMINANT TAXA

Reference Site--L1('90)	Comparison Site--L1('93)
1-*Cinygmula* sp.	1-*Cinygmula* sp.
2-*Taenionema* sp.	2-*Rhithrogena* sp.
3-*Baetis* sp.	3-Hydropsychidae
4-*Rhithrogena* sp.	4-*Baetis* sp.
5-*Sweltsa/Suwallia* sp.	5-*Glossosoma* sp.
6-*Drunella coloradensis/flavilinea*	6-Capniidae
7-*Drunella doddsi*	7-Chironomidae
8-*Oligophlebodes* sp.	8-*Neophylax* sp.
9-*Arctopsyche grandis*	9-*Sweltsa/Suwallia* sp.
10-*Zapada cinctipes*	10-*Serratella* sp.

DOMINANTS IN COMMON:

Among 5 most abundant = 3

Among 10 most abundant = 4

Table 22. (Continued).

Project: Montanore	Date: October 1990/1994
Reference Site: Lower Libby Creek (L1)--1990	
Comparison Site: Lower Libby Creek (L1)--1994	

A-REFERENCE SITE--L1(1990)	B-COMPARISON SITE--L1(1994)
Total abundance = 910	Total abundance = 3378
Total number of taxa = 33	Total number of taxa = 48
Number of EPT taxa = 26	Number of EPT taxa = 34

AB = total taxa in common = 21

EPT taxa in common = 15

Community loss index (A taxa - AB taxa)/B taxa = 0.250

Shannon Diversity Index A = 2.88	Shannon Diversity Index B = 3.21
Biological Quality A = 13	Biological Quality B = 12

DOMINANT TAXA

Reference Site--L1('90)	Comparison Site--L1('94)
1-*Cinygmula* sp.	1-*Cinygmula* sp.
2-*Taenionema* sp.	2-*Hydropsyche* sp.
3-*Baetis* sp.	3-*Paraleptophlebia* sp.
4-*Rhithrogena* sp.	4-*Rhithrogena* sp.
5-*Sweltsa/Suwallia* sp.	5-Ephemerellidae
6-*Drunella coloradensis/flavilinea*	6-*Sweltsa/Suwallia* sp.
7-*Drunella doddsi*	7-*Baetis* sp.
8-*Oligophlebodes* sp.	8-Capniidae
9-*Arctopsyche grandis*	9-Chironomidae
10-*Zapada cinctipes*	10-*Zapada cinctipes*

DOMINANTS IN COMMON:

Among 5 most abundant = 2

Among 10 most abundant = 5

Table 22. (Continued).

Project: Montanore **Date:** October 1991/1994

Reference Site: Lower Libby Creek (L1)--1991

Comparison Site: Lower Libby Creek (L1)--1994

A-REFERENCE SITE--L1(1991)	B-COMPARISON SITE--L1(1994)
Total abundance = 2072	Total abundance = 3378
Total number of taxa = 29	Total number of taxa = 48
Number of EPT taxa = 25	Number of EPT taxa = 34

AB = total taxa in common = 22

EPT taxa in common = 18

Community loss index (A taxa - AB taxa)/B taxa = 0.146

Shannon Diversity Index A = 2.66	Shannon Diversity Index B = 3.21
Biological Quality A = 13	Biological Quality B = 12

DOMINANT TAXA

Reference Site--L1('91)	Comparison Site--L1('94)
1-*Taenionema* sp.	1-*Cinygmula* sp.
2-*Cinygmula* sp.	2-*Hydropsyche* sp.
3-*Rhithrogena* sp.	3-*Paraleptophlebia* sp.
4-*Baetis* sp.	4-*Rhithrogena* sp.
5-*Sweltsa/Suwallia* sp.	5-Ephemerellidae
6-Hydropsychidae	6-*Sweltsa/Suwallia* sp.
7-*Drunella doddsi*	7-*Baetis* sp.
8-*Serratella* sp.	8-Capniidae
9-*Zapada columbiana*	9-Chironomidae
10-*Parapsyche elsis*	10-*Zapada cinctipes*

DOMINANTS IN COMMON:

Among 5 most abundant = 2

Among 10 most abundant = 4

Table 22. (Continued).

Project: Montanore Date: October 1992/1993

Reference Site: Lower Libby Creek (L1)--1992

Comparison Site: Lower Libby Creek (L1)--1993

A-REFERENCE SITE--L1(1992)	B-COMPARISON SITE--L1(1993)
Total abundance = 2156	Total abundance = 2543
Total number of taxa = 38	Total number of taxa = 53
Number of EPT taxa = 27	Number of EPT taxa = 40

AB = total taxa in common = 31

EPT taxa in common = 20

Community loss index (A taxa - AB taxa)/B taxa = 0.132

Shannon Diversity Index A = 3.57	Shannon Diversity B = 3.93
Biological Quality A = 11	Biological Quality B = 12

DOMINANT TAXA:

Reference Site--L1('92):	Comparison Site--L1('93):
1-Hydropsychidae	1-*Cinygmula* sp.
2-*Rhithrogena* sp.	2-*Rhithrogena* sp.
3-*Baetis* sp.	3-Hydropsychidae
4-*Cinygmula* sp.	4-*Baetis* sp.
5-*Sweltsa/Suwallia* sp.	5-*Glossosoma* sp.
6-Chironomidae	6-Capniidae
7-*Oligophlebodes* sp.	7-Chironomidae
8-*Drunella* sp.	8-*Neophylax* sp.
9-Capniidae	9-*Sweltsa/Suwallia* sp.
10-*Arctopsyche grandis*	10-*Serratella* sp.

DOMINANTS IN COMMON:

Among 5 most abundant = 4

Among 10 most abundant = 6

Table 22. (Continued).

Project: Montanore **Date:** October 1993/1994

Reference Site: Lower Libby Creek (L1)--1993

Comparison Site: Lower Libby Creek (L1)--1994

A-REFERENCE SITE--L1(1993)	**B-COMPARISON SITE--L1(1994)**
Total abundance = 2543	Total abundance = 3378
Total number of taxa = 53	Total number of taxa = 48
Number of EPT taxa = 40	Number of EPT taxa = 34

AB = total taxa in common = 36

EPT taxa in common = 26

Community loss index (A taxa - AB taxa)/B taxa = 0.354

Shannon Diversity Index A = 3.93	Shannon Diversity B = 3.21
Biological Quality A = nn	Biological Quality B = nn

DOMINANT TAXA:

Reference Site--L1('93):	Comparison Site--L1('94):
1-*Cinygmula* sp.	1-*Cinygmula* sp.
2-*Rhithrogena* sp.	2-*Hydropsyche* sp.
3-Hydropsychidae	3-*Paraleptophlebia* sp.
4-*Baetis* sp.	4-*Rhithrogena* sp.
5-*Glossosoma* sp.	5-Ephemerellidae
6-Capniidae	6-*Sweltsa/Suwallia* sp.
7-Chironomidae	7-*Baetis* sp.
8-*Neophylax* sp.	8-Capniidae
9-*Sweltsa/Suwallia* sp.	9-Chironomidae
10-*Serratella* sp.	10-*Zapada cinctipes*

DOMINANTS IN COMMON:

Among 5 most abundant = 2

Among 10 most abundant = 6

The community loss index for each L1 comparison was:

Reference/Comparison Site	Community Loss Index
1990/1991	0.483
1990/1992	0.289
1990/1993	0.151
1990/1994	0.250
1991/1994	0.146
1992/1993	0.132
1993/1994	0.354

Remembering that the closer to zero the community loss index is the more similar are the two sample sets being compared, we see that the L1 sample sets were most dissimilar in the 1990/1991 comparison. That dissimilarity decreased in the 1990/1992 comparison and again in the 1990/1993 comparison but increased in the 1990/1994 comparison. The sample sets were most similar in 1992/1993.

Although some dissimilarities, i.e., shifts in biological communities, have occurred at L1 in the last five years, the changes were most dramatic from 1990 to 1991 and were relatively slight from then on. These annual changes were as much illustrative of normal inter-annual variation at this station as due to effects of nutrient loading at the L9 site. The L1 site is far enough downstream (about nine miles) of the Montanore adit and large enough not to have been noticeably affected by the nutrient loading at L9.

5. indicator species

Monitoring water quality changes by the use of indicator organisms has proven useful when the perturbations are known and understood (Rosenberg et al., 1993). Indicator species or assemblages can also be used by establishing a baseline data set which objectively identifies the indicator taxa for a particular stream site (Pearson et al., 1983). This method of selection of the indicator organisms is based on a recognizable pattern of distribution of individuals within a species: a few species are represented by many individuals, many species are represented by few individuals, and some species are intermediate in abundance. This expected log-normal distribution of individuals among species is shown in Figure 9.

The indicator taxa are those of intermediate abundance. Rare species cannot be used as indicators because they may be rare for reasons other than pollution such as emigration, immigration, competition, etc. At the same time, very abundant taxa cannot be used because they may have opportunistic characteristics, such as high reproductive capacity and good dispersal mechanisms, rather than being pollution tolerant (Pearson et al., 1983).

The abundance classes used by Pearson et al. (1983) and applied to the Montanore Project data are:

Class I = 1 individual per species
Class II = 2 to 3 individuals per species
Class III = 4 to 7 individuals per species
Class IV = 8 to 15 individuals per species
Class V = 16 to 31 individuals per species
Class VI = 32 to 63 individuals per species
Class VII = 64 to 127 individuals per species
Class VIII = 128 to 255 individuals per species
Class IX = 256 to 511 individuals per species
Class X = 512 to 1023 individuals per species

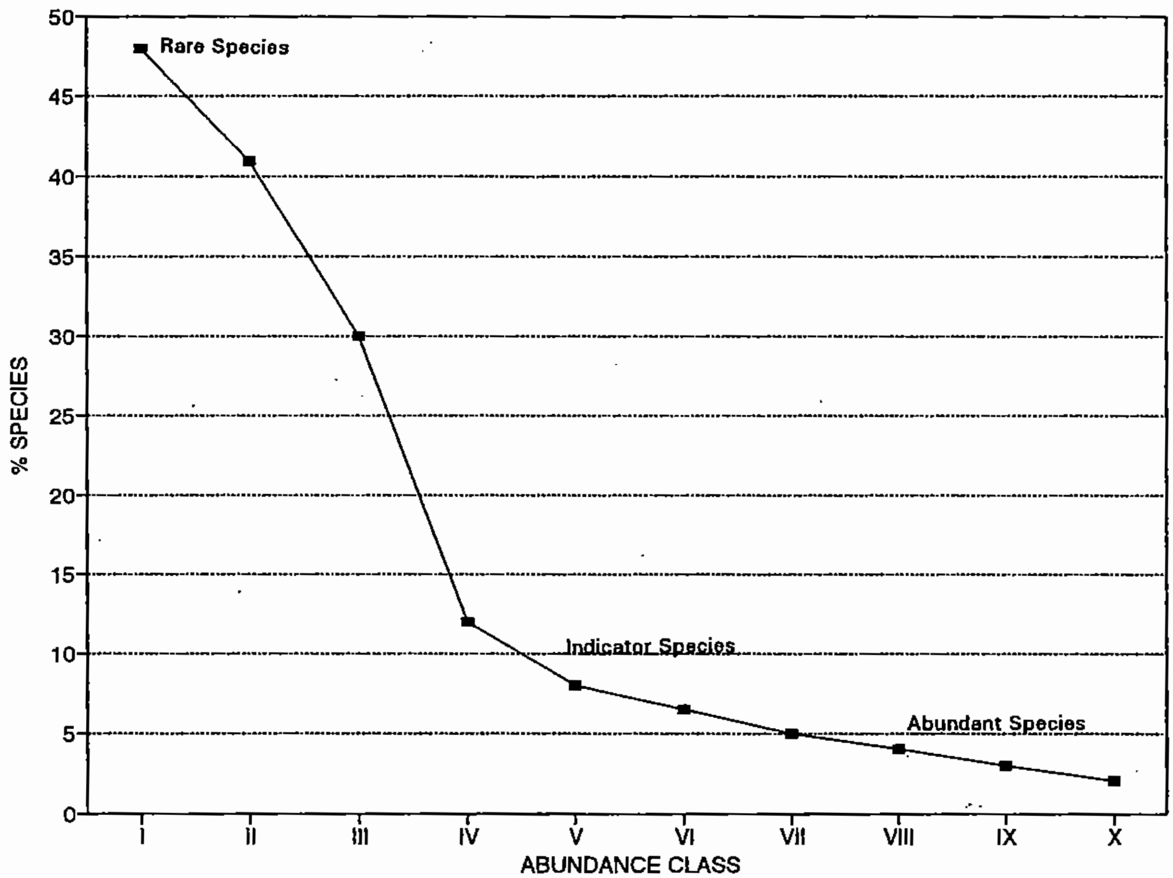


Figure 9. Expected log-normal distribution of individuals among different species (Pearson et al., 1983).

The number of individuals per species is based on the mean number of organisms per replicate. Species present in the intermediate abundance classes V and VI are considered to be good indicators of change and generally either increase or decrease markedly following disturbance to the community (Pearson et al., 1983).

With disturbance, the smooth, bell-shaped log-normal distribution becomes distorted with peaks, an excess of 50% for Class I, and/or an absence of higher classes (Ugland et al., 1982). The log-normal distribution of individuals among species for each of the three Libby Creek stations Hess sampled in October 1988, 1990-1994 are presented in Figures 10-15. In 1988 (Figure 10), all three sites exhibited a distorted curve indicating a less than "normal" situation existed at the sites. Of the three sites, L10 was the most normal in 1988. A similar distortion of species distribution occurred again in 1990 (Figure 11).

But, in 1991, the distribution curves at all three stations became more normal with the L9 and L1 curves fitting Pearson's normal curve slightly better than did L10's. These more normal species curves were repeated again in 1992 with the L9 curve fitting Pearson's curve the best.

In 1993, the L10 and L1 curves were about the same as in 1992. But, the L9 curve began to show some distortion indicating that conditions had become less than desirable for support of a "normal" biological population at L9. Again in 1994, the L10 and L1 curves remained about the same but the L9 curve showed more distortion

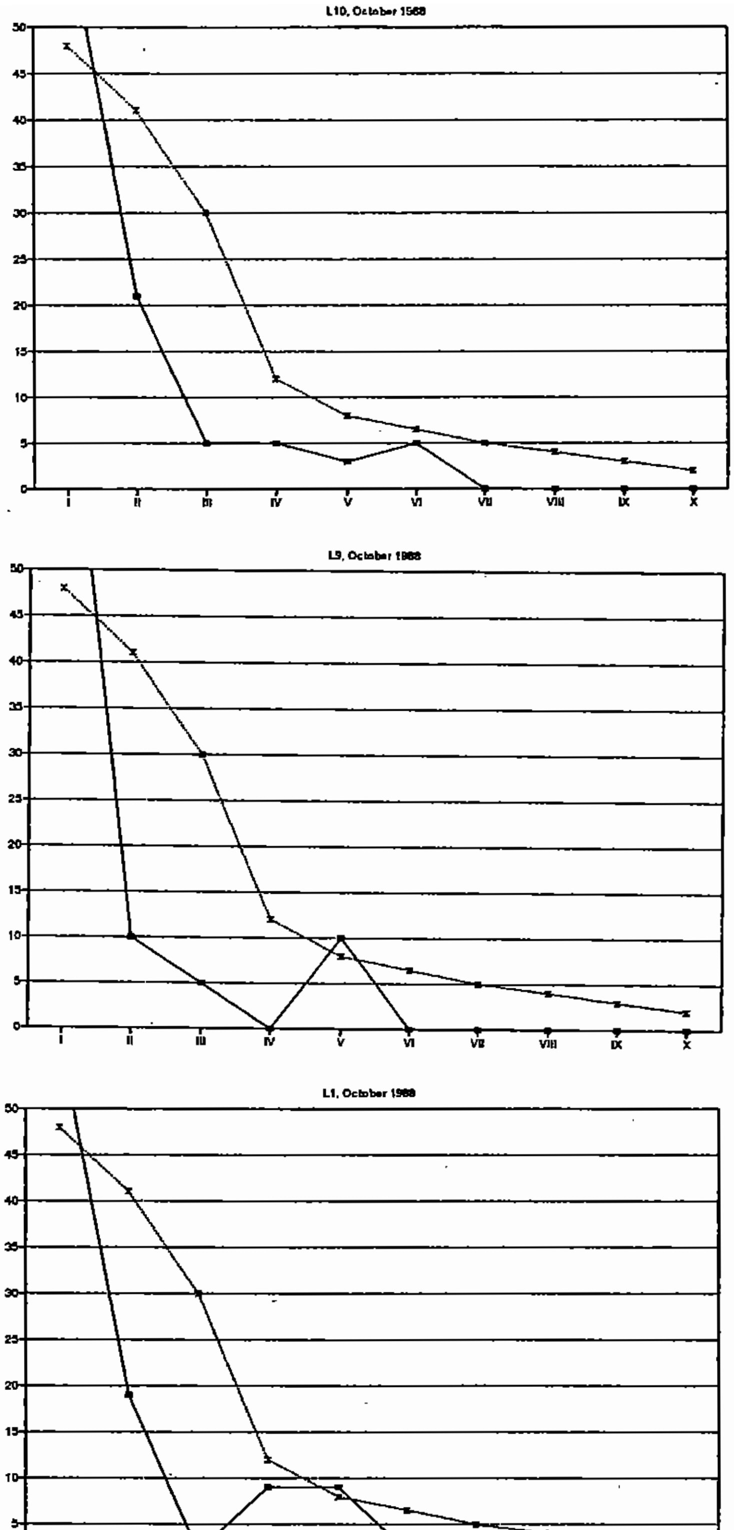


Figure 10. Log-normal distribution of species at Libby Creek stations, October 1988 (dotted line is Pearson's (et al., 1983) ideal distribution).

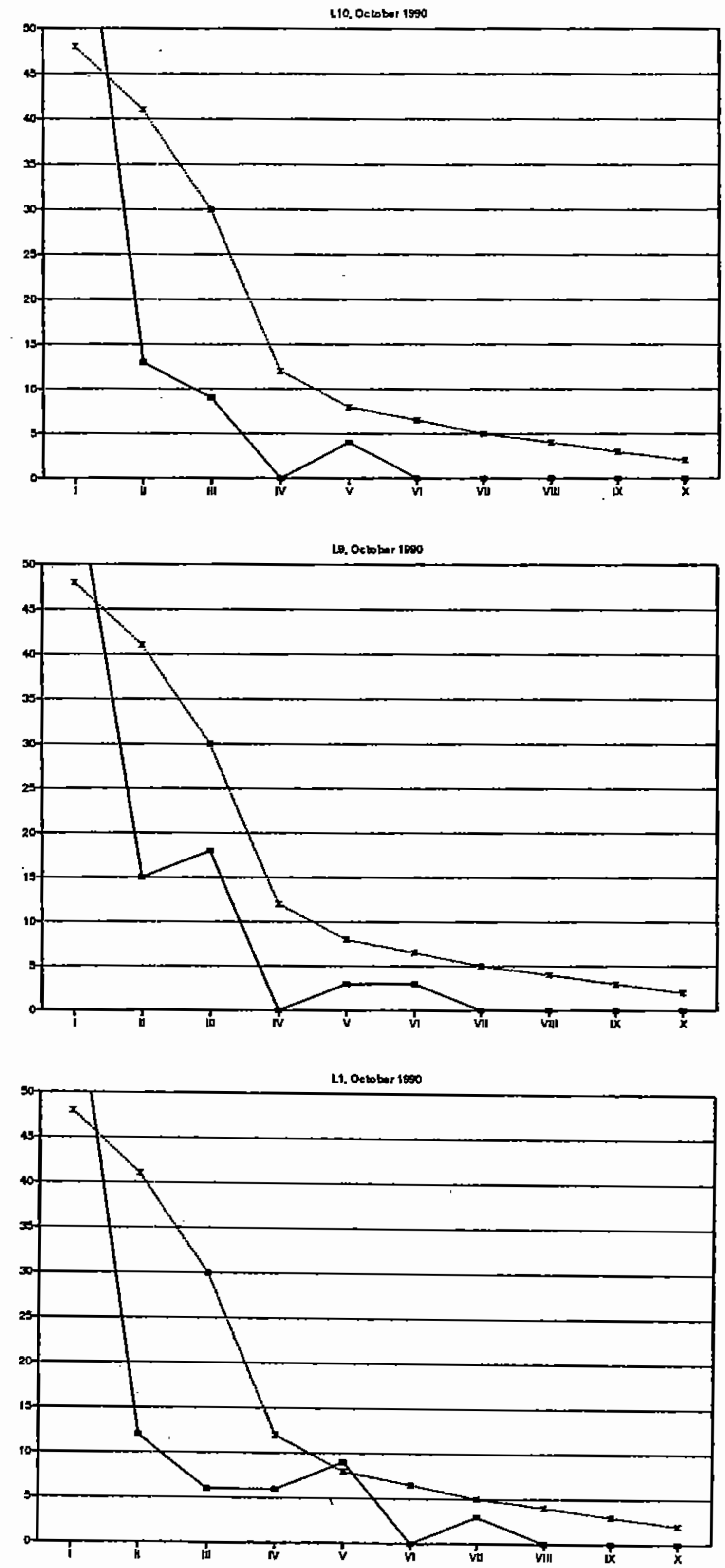


Figure 11. Log-normal distribution of species at Libby Creek stations, October 1990 (dotted line is Pearson's (et al., 1983) ideal distribution).

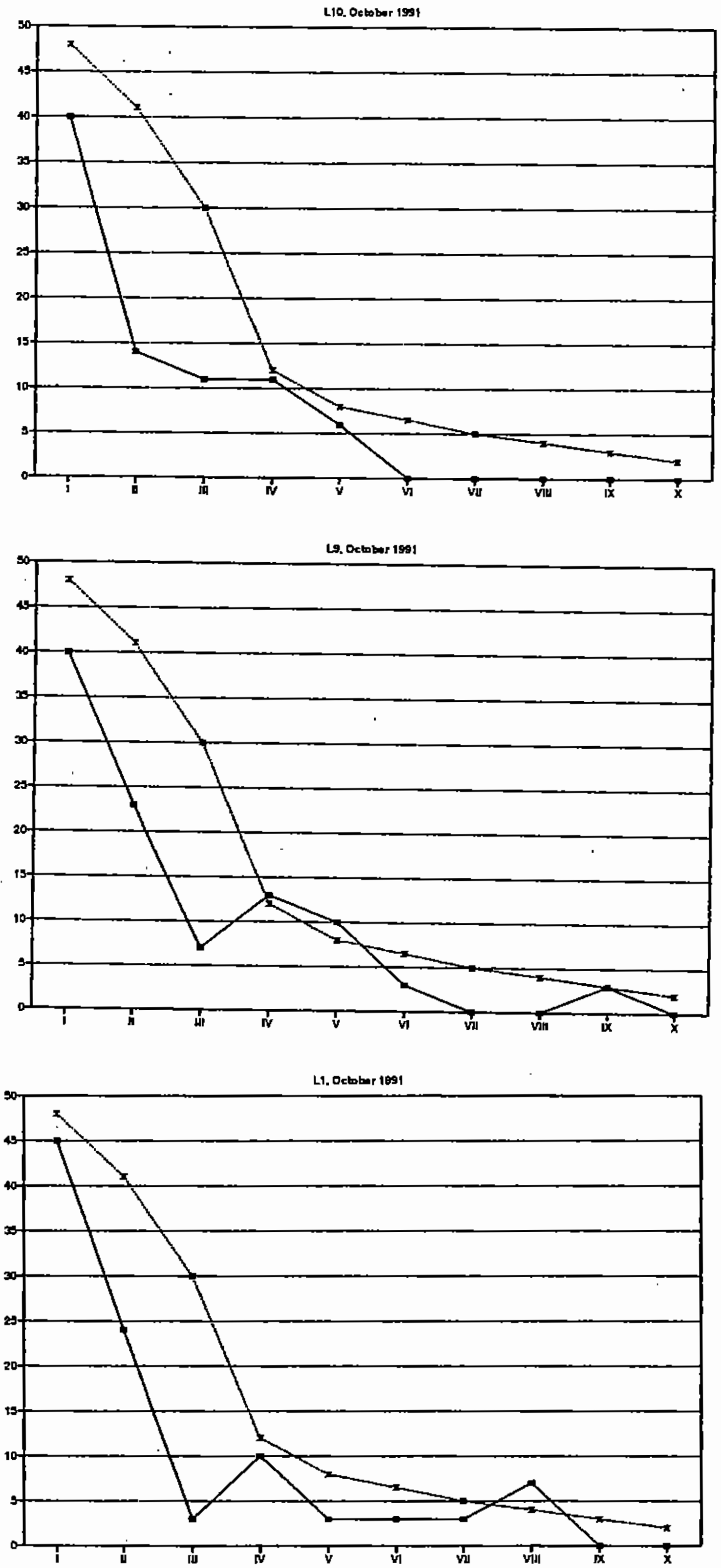


Figure 12. Log-normal distribution of species at Libby Creek stations, October 1991 (dotted line is Pearson's (et al., 1983) ideal distribution).

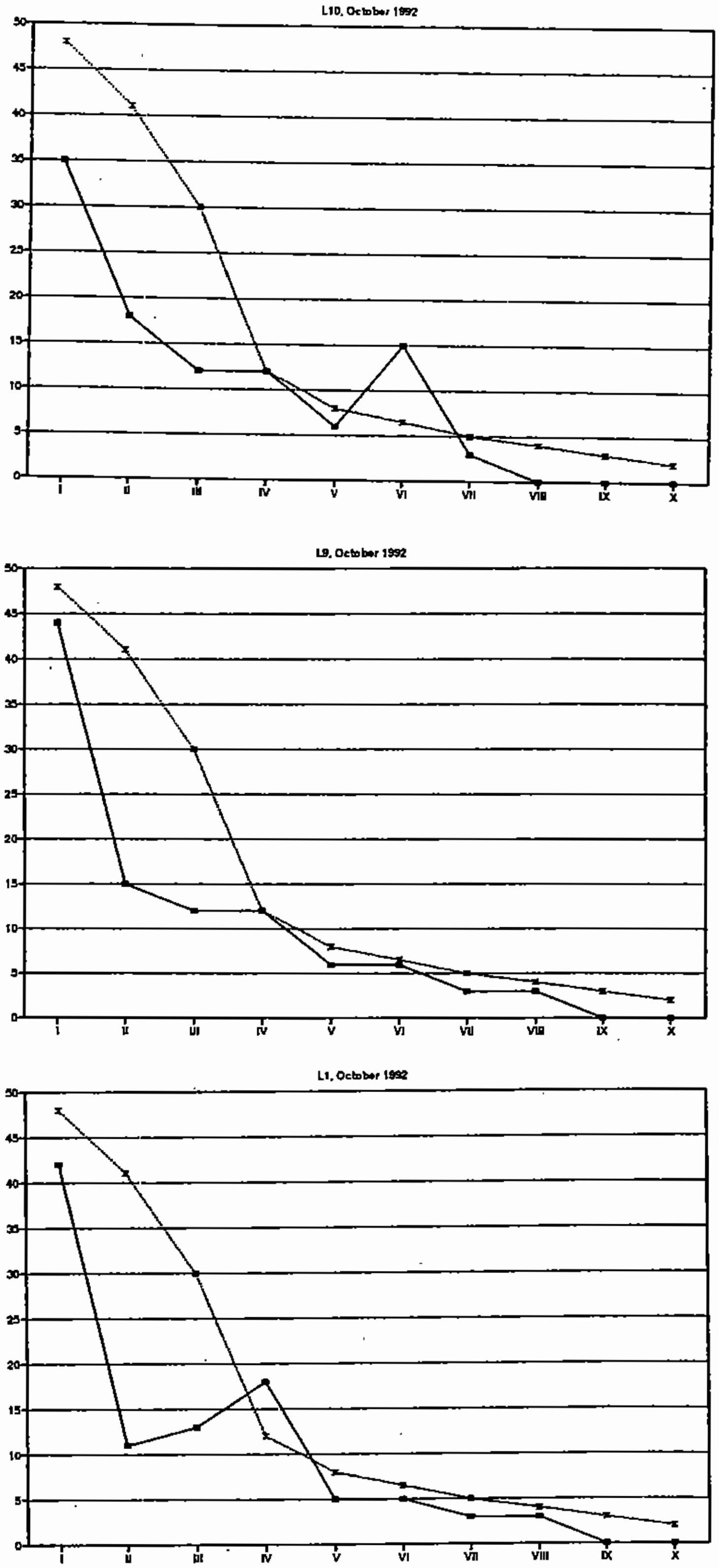


Figure 13. Log-normal distribution of species at Libby Creek stations, October 1992 (dotted line is Pearson's (et al., 1983) ideal distribution).

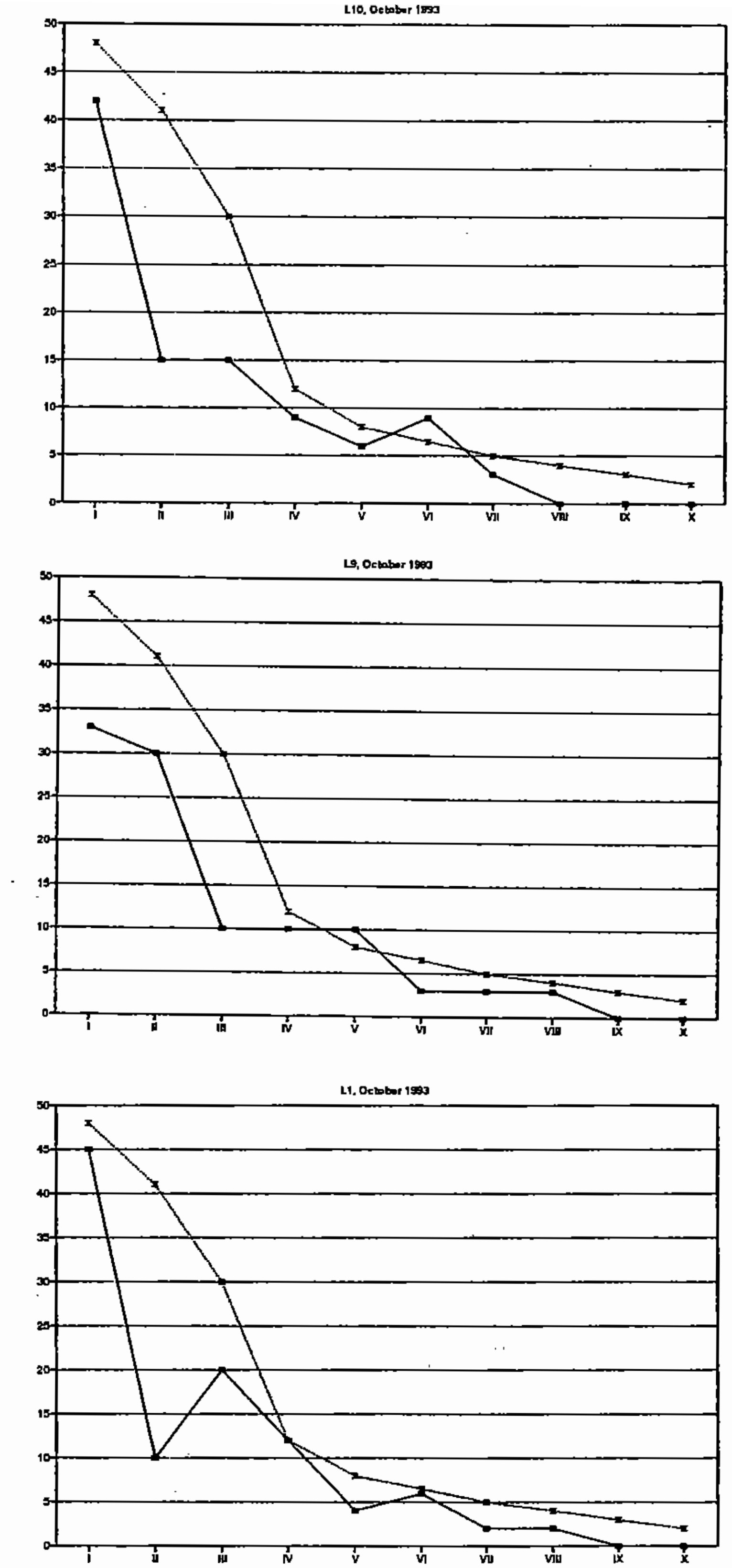


Figure 14. Log-normal distribution of species at Libby Creek stations, October 1993 (dotted line is Pearson's (et al., 1983) ideal distribution).

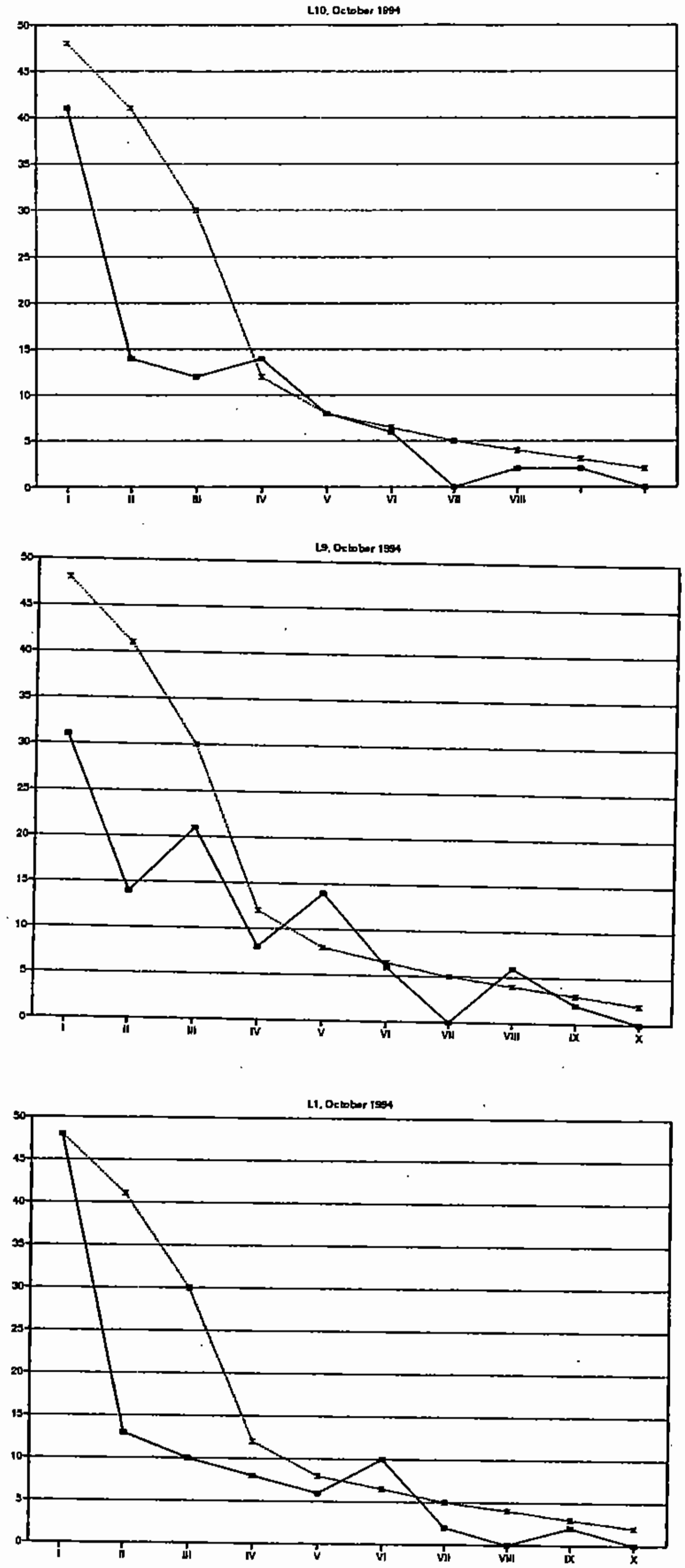


Figure 15. Log-normal distribution of species at Libby Creek stations, October 1994 (dotted line is Pearson's (et al., 1983) ideal distribution).

Indicator taxa, those in abundance classes V and VI, for the three Libby Creek sites for the last six years are listed in Table 23. Again, it is these taxa which increase or decrease markedly following a disturbance. If a taxa is not present for a particular site, it has either become a rare or an abundant taxa.

It is particularly interesting to notice which taxa were present at L10 in 1991 and 1992 but not present at L9 and vice versa. For example, *Baetis* sp. was an indicator species at L10 in 1991 and 1992 but was absent as an indicator from L9 in 1991. Chironomidae was an indicator at L10 in 1992 and 1993 but only in 1992 at L9. And, the stonefly, *Taenionema* sp., which proliferated at L9 as a result of the nutrient loading (Farmer et al., 1994), was present as an indicator at L10 in 1991-94 but was an abundant taxa at L9.

Figures 16 and 17 graphically illustrate the annual shift in the mean number of organisms and the total number of organisms present at each station during each sampling period from 1988 through 1994. Figure 17 shows the relative abundance of the four major groups at the three stations for the 16 sampling episodes conducted in the Montanore Project area since 1988. The species distribution curves and these population graphs illustrate the shifts in concentrations of macroinvertebrate populations that have occurred at L10 due to natural conditions and at L9 due to natural variations and to the anthropogenic addition of nutrients below the Montanore adit, and at L1 due mostly to natural conditions.

The mean number of organisms per sample was highest at L9 in 1994 and about the

Table 23. Station occurrence of species in abundance classes V and VI in the Libby Creek macroinvertebrate Hess samples, October 1988-1994.

L10

TAXA	1988	1990	1991	1992	1993	1994
Baetis bicaudatus	x	-	-	-	-	-
Baetis sp.	-	-	x	x	x	x
Ephemerellidae	-	-	-	-	-	-
Cinygmula sp.	x	-	-	-	-	-
Epeorus sp.	-	-	x	x	-	-
Rhithrogena sp.	-	-	-	x	x	x
Paraleptophlebia sp.	-	-	-	-	-	-
Ameletus sp.	-	-	x	-	-	-
Capniidae	-	-	-	-	-	-
Sweltsa/Suwallia sp.	-	-	x	x	x	x
Chloroperlinae	x	-	-	-	-	-
Perlomyia sp.	-	-	-	-	-	-
Zapada cinctipes	-	-	-	-	-	-
Zapada columbiana	-	-	-	x	-	x
Zapada sp.	-	-	-	-	-	-
Doddsia sp.	-	-	-	-	-	-
Taenionema sp.	-	-	x	x	x	x
Hydropsyche sp.	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-
Glossosoma sp.	-	-	-	-	-	x
Agraylea sp.	-	-	-	-	-	x
Neophylax sp.	-	-	-	-	-	-
Oligophlebodes sp.	-	-	-	-	-	-
Rhyacophila Betteni grp.	-	-	-	-	-	-
Rhyacophila vaccua	-	-	x	-	-	-
Chironomidae	-	-	-	x	x	-
Turbellaria	-	-	-	-	-	-

Table 23. (Continued).

L9

TAXA	1988	1990	1991	1992	1993	1994
Baetis bicaudatus	-	-	-	-	-	-
Baetis sp.	-	-	-	x	x	x
Ephemerellidae	-	-	-	-	-	x
Cinygmula sp.	x	x	-	x	-	-
Epeorus sp.	-	-	x	-	-	-
Rhithrogena sp.	-	-	x	x	-	x
Paraleptophlebia sp.	-	-	-	-	-	-
Ameletus sp.	-	-	-	-	-	-
Capniidae	-	-	-	-	-	-
Sweltsa/Suwallia sp.	-	-	-	x	x	x
Chloroperlinae	x	-	-	-	-	-
Perlomyia sp.	-	-	-	-	-	-
Zapada cinctipes	-	-	-	-	-	-
Zapada columbiana	-	-	x	-	x	x
Zapada sp.	-	-	-	-	-	x
Doddsia sp.	x	-	-	-	-	-
Taenionema sp.	-	x	-	-	-	-
Hydropsyche sp.	-	-	-	-	-	-
Hydropsychidae	-	-	x	-	-	x
Glossosoma sp.	-	-	-	-	x	-
Agraylea sp.	-	-	-	-	-	x
Neophylax sp.	-	-	-	-	-	-
Oligophlebodes sp.	-	-	-	-	-	-
Rhyacophila Betteni grp.	-	-	-	-	-	x
Rhyacophila vaccua	-	-	-	-	-	-
Chironomidae	-	-	-	-	x	-
Turbellaria	-	-	-	-	-	x

Table 23. (Continued).

L1

TAXA	1988	1990	1991	1992	1993	1994
Baetis bicaudatus	-	-	-	-	-	-
Baetis sp.	-	x	x	x	x	x
Ephemerellidae	-	-	-	-	-	x
Cinygmula sp.	x	-	-	x	-	-
Epeorus sp.	-	-	-	-	-	-
Rhithrogena sp.	-	x	-	-	-	x
Paraleptophlebia sp.	-	-	-	-	-	x
Ameletus sp.	-	-	-	-	-	-
Capniidae	-	-	-	-	x	x
Sweltsa/Suwallia sp.	-	-	-	x	x	x
Chloroperlinae	x	-	-	-	-	-
Perlomyia sp.	x	-	-	-	-	-
Zapada cinctipes	-	-	-	-	-	x
Zapada columbiana	-	-	-	-	-	-
Zapada sp.	-	-	-	-	-	-
Doddsia sp.	x	-	-	-	-	-
Taenionema sp.	-	-	-	-	-	-
Hydropsyche sp.	x	-	-	-	-	-
Hydropsychidae	-	-	-	-	x	-
Glossosoma sp.	-	-	-	-	x	-
Agraylea sp.	-	-	-	-	-	-
Neophylax sp.	-	-	-	-	x	-
Oligophlebodes sp.	-	-	-	x	-	-
Rhyacophila Betteni grp.	-	-	-	-	-	-
Rhyacophila vaccua	-	-	-	-	-	-
Chironomidae	-	-	-	x	x	x
Turbellaria	-	-	-	-	-	-

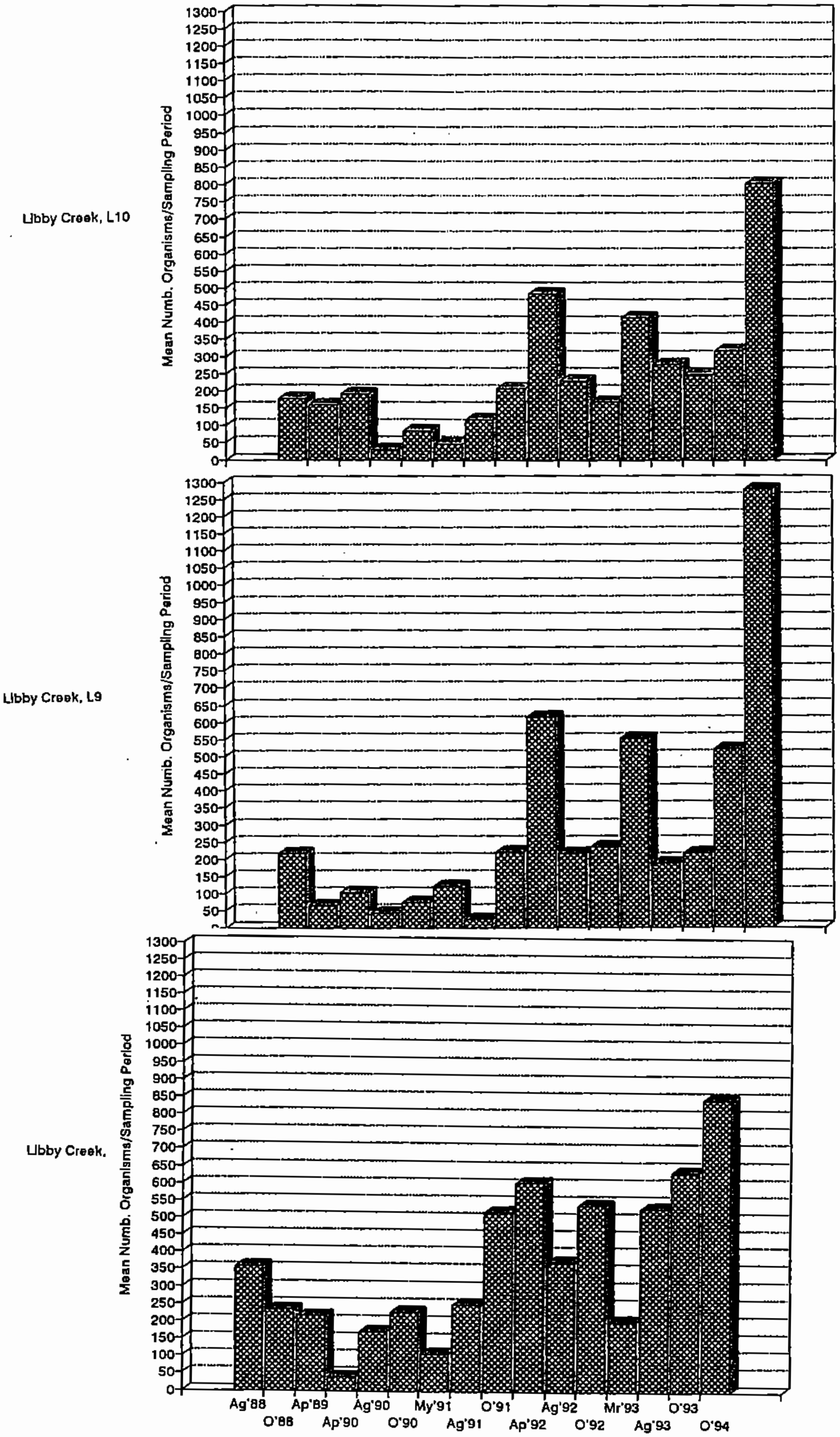


Figure 16. Mean number of organisms present at the three Libby Creek stations during each sampling period from 1988 through 1994.

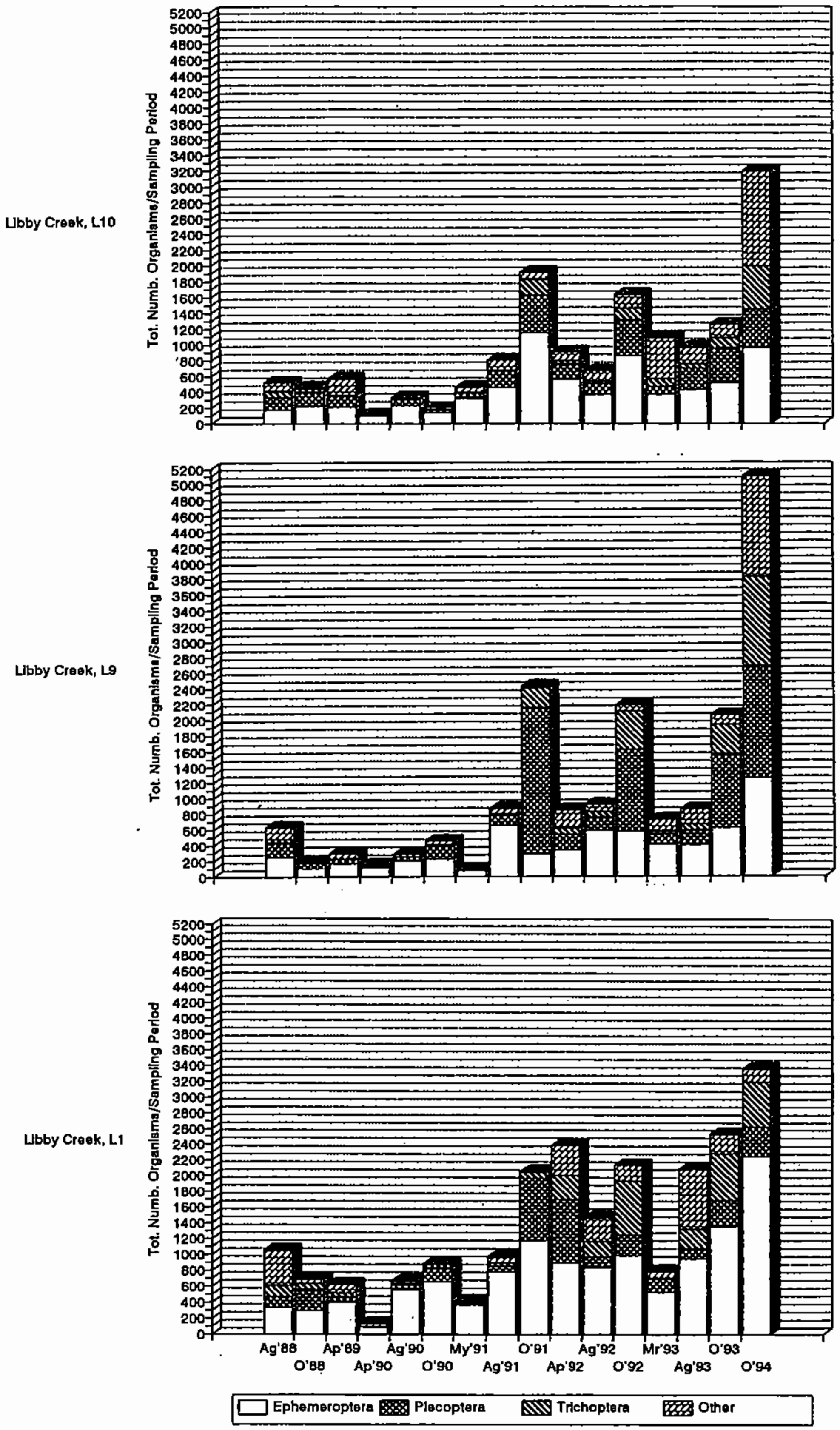


Figure 17. Relative group abundance of macroinvertebrates at the three Libby Creek stations during each sampling period from 1988 through 1994.

same for L10 and L1 (Figure 16). In October 1994, all three stations produced the highest number of organisms per replicate for all of the years sampled (Figure 17).

6. statistical comparison of the 1994 data

The mean and standard deviation for each replicate set are presented in Appendix C. The mean, standard deviation, % coefficient of variation (%CV) and % standard error of the mean (%SE) for the 1994 samples appear in Table 24.

The coefficient of variation indicates whether or not the sampling technique is adequate. The percent standard error of the mean indicates when a sufficient number of samples have been taken to account for community variability. EPA recommends the coefficient of variation should be under 50 percent and the standard error of the mean should be under 20 percent (Winget et al., 1979).

The 1994 Hess sample sets all easily met the recommended %CV and %SE demonstrating the adequacy of the sampling program and the homogeneous nature of the sample sites thus permitting the collection of four relatively similar replicates from each site.

E. Conclusions

1. The 1994 macroinvertebrate data collected from three Libby Creek stations continued to document the inter-annual variations possible in Libby Creek and its relatively rapid response to natural and anthropogenic influences.

Table 24. Statistical comparison of the October 1994 Libby Creek macroinvertebrate Hess sample sets.

STATION	SAMPLE	TOTAL	MEAN	STAND. DEV. (n-1)	%CV	%SE
L10	1	801				
	2	894				
	3	566				
	4	950				
	Total	3211	803	169.4	21.1	12.4
L9	1	1760				
	2	1260				
	3	835				
	4	1251				
	Total	5106	1277	378.4	29.7	17.4
L1	1	966				
	2	1009				
	3	790				
	4	613				
	Total	3378	845	181.1	21.4	12.6

2. Data from the last several years have shown that station L10 above the mine area is an adequate reference for the L9 station, just below the adit, but is not a suitable reference station for the lowest station, L1. However, the several years of pre-mine data for L1 can be used for reference during any future mine operation.

3. Water quality conditions at L10 have been compromised during several of the sampling episodes since 1988. Because L10 is in a pristine area, at least from the standpoint of human impacts, its periods of diminished water quality are obviously the result of natural limiting factors such as temperature, fluctuations in annual flow, spring scouring, nutrient concentration, etc.

4. Biological conditions at L9 are affected by conditions at L10 as well as impacts related to the Montanore adit.

5. Nitrate loading in 1991 to Libby Creek below the Montanore adit enabled the macroinvertebrate populations at L9 to compensate for natural limiting factors and to achieve their most enhanced condition in all of the years sampled. That heightened water quality at L9 subsequently diminished, in 1993 and 1994, to "normal" conditions, which are determined by the influence of the upstream station, L10, and by the natural limiting effects of shading, lower temperature, nutrient levels at L9.

6. The nutrient loading at L9 did not significantly affect macroinvertebrate populations at the lowest Libby Creek station, L1 which was protected from any effects by virtue of the distance of L1 from the adit and the size of Libby Creek at L1.

F. Future Monitoring

Noranda does not plan to conduct any additional monitoring of the Montanore Project area until the operational phase of the project begins.

V. SUMMARY

Biological monitoring of the three Libby Creek stations, L10, L9 and L1, was conducted in October 1994 in an effort to determine the residual effects, if any, of the nutrient loading to Libby Creek from the Montanore adit area in 1990. Periphyton and macroinvertebrate samples were collected in a fashion identical to the previous years.

The periphyton samples collected 17 non-diatom algae, dominated by Chlorophyta, and 54 species of diatoms dominated by *Diatoma mesodon* and *Achnanthes minutissima* at L10 and L9 and by *Achnanthes biasolettiana* and *Achnanthes minutissima* at L1.

The periphyton data revealed that:

- there were only minor differences between non-diatom and diatom algae associations at Libby Creek stations L10 and L9 in October 1994, based on community structure and composition metrics. The greater number of non-diatom genera, and the greater importance of blue-green algae and the diatom *Gomphonema parvulum* may be indicative of some nitrogen enrichment at station L9 over levels at station L10, although the evidence is less than conclusive;

- considerably greater differences in non-diatom and diatom algae associations were seen in October 1994 between Libby Creek station L1 and either stations L10 or L9, than between the latter two stations. These differences are probably related more to the larger size and different physical nature of Libby Creek at station L1 than to major differences in water quality;

- results of two bioassessment protocols developed by the Montana Water Quality Division utilizing diatom association metrics were in generally good agreement. Protocol I indicated that biological integrity was excellent at Libby Creek stations L10 and L1, with no impairment of aquatic life in October 1994, but decreased to good with minor impairment at station L9, with least-impaired reference streams for comparison. Under Protocol II, with station L10 considered as the unimpaired control, station L9 was again rated as having good biological integrity with only minor impairment of aquatic life during October 1994;

- reassessment of data from October of the three previous monitoring years under Protocol I revealed that biological integrity remained excellent, with no impairment of aquatic life at Libby Creek station L10 from 1991 to 1994. At station L9, biological integrity in October of 1991, 1992 and 1993 also rated as excellent, with no impairment of aquatic life indicated under both Protocols I and II. Libby Creek station L1 was somewhat more variable than either upstream station L10 or L9 under Protocol 1, but generally had at least good biological integrity during October of all four years.

The macroinvertebrate samples collected over 900 organisms/replicate, the highest mean number of organisms collected since 1988. The 70 taxa consisted mostly of the mayfly, *Cinygmula* sp. and the Dipteran Chironomidae. Mayflies were the predominant group at L1, stoneflies were the most abundant group at L9 and the Other group was most significant at L10.

The 1994 macroinvertebrate data demonstrated that:

- macroinvertebrate data collected from three Libby Creek stations continued to document the inter-annual variations possible in Libby Creek and its relatively rapid response to natural and anthropogenic influences;

- data from the last several years have shown that station L10 above the mine area is an adequate reference for the L9 station, just below the adit, but is not a suitable reference station for the lowest station, L1. However, the several years of pre-mine data for L1 can be used for reference during any future mine operation;

- water quality conditions at L10 have been compromised during several of the sampling episodes since 1988. Because L10 is in a pristine area, at least from the standpoint of human impacts, its periods of diminished water quality are obviously the result of natural limiting factors such as temperature, fluctuations in annual flow, spring scouring, nutrient concentration, etc.;

- biological conditions at L9 are affected by conditions at L10 as well as impacts related to the Montanore adit;

- nitrate loading in 1991 to Libby Creek below the Montanore adit enabled the macroinvertebrate populations at L9 to compensate for natural limiting factors and to achieve their most enhanced condition in all of the years sampled. That heightened water quality at L9 subsequently diminished, in 1993 and 1994, to "normal" conditions, which are inherently less than excellent because of the natural limiting effects of upstream influences, shading, lower temperature, nutrient levels at L9;

- although the L9 samples produced the most organisms of the three stations sampled in 1994, population composition was that of a stressed system;

- the nutrient loading at L9 did not significantly affect macroinvertebrate populations at the lowest Libby Creek station, L1 which was protected from any effects by virtue of the distance of L1 from the adit and the size of Libby Creek at L1;

- of the three Libby Creek stations sampled in 1994, the lowest one, L1, exhibited the best water quality.

Overall, the nutrient loading of Libby Creek in 1990 via the Montanore Project appeared to have the greatest impact on the L9 station. The effects on the biota at L9 were initially, positive in terms of enhancing the overall population numbers and diversity of taxa. These positive effects of the increased nutrient load continued to diminish in 1993 and 1994 as Libby Creek at L9 continued to rebound to its "normal" conditions.

Noranda plans to conduct no additional pre-mine aquatic biological monitoring in the Montanore Project area.

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VII. APPENDICES

Appendix A

Estimated relative abundance and biovolume contribution rank (in parentheses) of diatoms and genera of non-diatom algae in periphyton samples from 1994 Montanore Project biological monitoring.

R=rare; C=common; VC=very common; A=abundant; VA=very abundant

SAMPLING PERIOD: October 1994

STREAM:	Libby Cr.	Libby Cr.	Libby Cr.
STATION NO.:	L10	L9	L1
SAMPLE NO.:	P004J	P003J	P001J
Bacillariophyta (diatoms)			
All genera collectively	C(4)	VC(2)	A(3)
Chlorophyta (green algae)			
Closterium			R
Cosmarium		R	
Gongrosira			VC(4)
Microspora	VC(2)	C(7)	
Mougeotia	R		A(2)
Spirogyra	C(3)	C(5)	C(7)
Staurastrum			C(6)
Stigeoclonium			R
Tetraspora		VC(6)	
Trebouxia	R		
Zygnema	VA(1)	VC(3)	
Chrysophyta (yellow-green algae)			
Hydrurus		R	
Cyanophyta (blue-green algae)			
Merismopedia			R
Microcystis		A(4)	
Oscillatoria		VA(1)	VA(1)
Phormidium	R	VC(8)	VC(5)
Rhodophyta (red algae)			
Audouinella		R	
moss	C	A	

Appendix B

Diatom proportional count data, 1994 Montanore Project biological monitoring.

PT = Pollution Tolerance Group number (Lange-Bertalot 1979); PRA= Percent Relative Abundance.

A letter "p" indicates species encountered during floristic scan but not during count.

SAMPLING PERIOD: October 1994

STREAM:		Libby Cr.	Libby Cr.	Libby Cr.
STATION NO.:		L10	L9	L1
SAMPLE NO.:		P004J	P003J	P001J
SPECIES	PT	PRA	PRA	PRA
Achnanthes biasolettiana	3	p	1.44	37.84
A. bioretii	3	0.24	0.00	0.00
A. chlidanos	3	0.00	p	0.00
A. daonensis	3	p	0.00	0.00
A. kriegeri	3	2.93	p	p
A. marginulata	3	p	0.00	0.00
A. minutissima	3	30.24	28.37	33.66
A. subatomoides	3	p	p	0.00
Amphora pediculus	3	0.00	p	0.00
Aulacoseira alpigena	3	0.73	0.72	0.00
A. distans	3	p	0.00	0.00
Cocconeis placentula	3	0.00	0.00	p
Cymbella affinis	3	0.00	0.00	0.25
C. cesatii	3	0.24	p	0.00
C. cistula	3	0.00	0.00	0.98
C. gracilis	3	0.24	0.24	0.00
C. lata	3	p	0.00	0.00
C. microcephala	2	0.00	0.00	0.49
C. minuta	2	0.00	3.37	4.42
C. silesiaca	3	0.24	p	0.49
C. sinuata	3	0.00	0.00	0.74
C. turgidula	3	0.00	0.00	p
Denticula tenuis	3	0.00	0.00	p
Diatoma anceps	3	0.49	0.00	0.00
D. hyemalis	3	7.32	2.64	0.00
D. mesodon	3	35.12	26.44	p
Eunotia minor	3	2.20	4.81	0.00
E. muscicola	3	0.49	0.72	0.00
E. praerupta	3	p	0.00	0.00
E. subarcuatoides	3	1.95	1.68	0.00
Fragilaria capucina	2	7.32	6.49	0.49
F. construens	3	0.00	p	0.00
F. ulna	2	0.00	0.00	0.25

Appendix B (continued)

SAMPLING PERIOD: October 1994

STREAM:		Libby Cr.	Libby Cr.	Libby Cr.
STATION NO.:		L10	L9	L1
SAMPLE NO.:		P004J	P003J	P001J
Frustules Counted:		410	416	407
Total Species:		29	25	27
Species Counted:		18	16	14
Shannon Diversity:		2.62	2.80	2.28
Pollution Index:		2.91	2.50	2.93
Siltation Index:		0.00	0.00	1.47
G. pumilum	3	0.00	0.00	8.11
G. rhombicum	3	0.00	0.00	p
G. truncatum	3			p
Hannaea arcus	3	8.54	0.96	p
Melosira varians	2	0.00	0.00	p
Navicula gallica	2	p	0.00	0.00
N. heimansioides	3	0.00	0.00	p
N. reichardtiana	2	0.00	0.00	p
Nitzschia dissipata	3	0.00	p	0.00
N. fonticola	3	0.00	0.00	0.49
N. inconspicua	2	0.00	0.00	p
N. pura	2	0.00	0.00	0.98
Pinnularia microstauron	2	p	0.00	0.00
Stenopterobia delicatissima	3	p	0.00	0.00
Total PRA PT Group 1:		0.73	19.47	0.00
Total PRA PT Group 2:		7.56	10.58	6.63
Total PRA PT Group 3:		91.71	69.95	93.37

No.1--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L10, 4 Hess samples)

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Ephemeroptera												
Baetis sp.	49	22	34	16	121	3.8	30.3	14.6	48%	V	72	cg
Diphetor sp.					0	0.0	0.0	ERR	ERR		72	cg
Caudatella sp.					0	0.0	0.0	ERR	ERR		48	cg
Caudatella edmundsi					0	0.0	0.0	ERR	ERR		48	cg
Caudatella hystrix					0	0.0	0.0	ERR	ERR		48	cg
D. coloradensis/flavilinea					0	0.0	0.0	ERR	ERR		18	cg
Drunella doddsi	3	5	7	5	20	0.6	5.0	1.6	33%	III	4	cg
Drunella grandis					0	0.0	0.0	ERR	ERR		24	cg
Drunella spinifera	1	0	0	0	1	0.0	0.3	0.5	200%	I	24	pr
Drunella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp./Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerellidae	15	1	4	3	23	0.7	5.8	6.3	109%	III	48	cg
Cinygma sp.					0	0.0	0.0	ERR	ERR		48	sc
Cinygmula sp.	186	124	139	191	640	19.9	160.0	33.5	21%	VIII	21	sc
Epeorus sp.	6	2	9	15	32	1.0	8.0	5.5	68%	IV	21	sc
Heptagenia sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp.					0	0.0	0.0	ERR	ERR		48	sc
Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp./Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Rhithrogena sp.	16	47	1	29	93	2.9	23.3	19.5	84%	V	21	cg
Heptageniidae					0	0.0	0.0	ERR	ERR		48	sc
Paraleptophlebia sp.	1	0	0	0	1	0.0	0.3	0.5	200%	I	24	cg
Ameletus sp.	6	2	24	0	32	1.0	8.0	11.0	137%	IV	48	cg
Plecoptera												
Capniidae					0	0.0	0.0	ERR	ERR		32	sh
Kathroperla perdita					0	0.0	0.0	ERR	ERR		24	cg
Sweltsa/Suwallia sp.	39	35	53	46	173	5.4	43.3	7.9	18%	VI	24	pr
Chloroperlidae					0	0.0	0.0	ERR	ERR		nn	pr
Despaxia augusta	3	15	4	6	28	0.9	7.0	5.5	78%	III	18	sh
Paraleuctra sp.					0	0.0	0.0	ERR	ERR		18	sh
Perlomyia sp.					0	0.0	0.0	ERR	ERR		18	sh
Leuctridae					0	0.0	0.0	ERR	ERR		18	sh
Capniidae/Leuctridae					0	0.0	0.0	ERR	ERR		32	sh
Amphinemura sp.					0	0.0	0.0	ERR	ERR		6	sh
Malenka sp.					0	0.0	0.0	ERR	ERR		36	sh
Nemoura sp.					0	0.0	0.0	ERR	ERR		24	sh
Visoka cataractae	0	6	2	0	8	0.2	2.0	2.8	141%	II	36	sh
Zapada cinctipes					0	0.0	0.0	ERR	ERR		16	sh
Zapada columbiana	20	77	4	8	109	3.4	27.3	33.8	124%	V	16	sh
Zapada sp.	22	16	6	4	48	1.5	12.0	8.5	71%	IV	16	sh
Nemouridae					0	0.0	0.0	ERR	ERR		36	sh
Yoraperla brevis	12	4	0	7	23	0.7	5.8	5.1	88%	III	12	sh
Acroneuria abnormis					0	0.0	0.0	ERR	ERR		6	pr
Claassenia sabulosa					0	0.0	0.0	ERR	ERR		6	pr
Doroneuria theodora	0	2	1	0	3	0.1	0.8	1.0	128%	I	18	pr
Hesperoperla pacifica					0	0.0	0.0	ERR	ERR		18	pr
Perlidae	0	3	0	5	8	0.2	2.0	2.4	122%	II	24	pr
Cultus sp.					0	0.0	0.0	ERR	ERR		12	pr
Isoperla sp.	0	0	1	0	1	0.0	0.3	0.5	200%	I	24	pr
Kogotus modestus					0	0.0	0.0	ERR	ERR		18	pr
Megarcys sp.	3	1	0	1	5	0.2	1.3	1.3	101%	I	24	pr
Setvena bradleyi					0	0.0	0.0	ERR	ERR		48	pr
Skwala sp.					0	0.0	0.0	ERR	ERR		18	pr
Perlodidae	2	5	0	0	7	0.2	1.8	2.4	135%	II	48	pr
Pteronarcella sp.					0	0.0	0.0	ERR	ERR		24	sh
Pteronarcys sp.					0	0.0	0.0	ERR	ERR		24	sh
Doddsia occidentalis					0	0.0	0.0	ERR	ERR		24	sc
Taenionema sp.	26	28	0	25	79	2.5	19.8	13.2	67%	V	48	sc
Taeniopterygidae					0	0.0	0.0	ERR	ERR		48	sh
Trichoptera												
Amiocentrus sp.					0	0.0	0.0	ERR	ERR		24	cg
Brachycentrus sp.	1	0	0	0	1	0.0	0.3	0.5	200%	I	24	cf
Brachycentridae					0	0.0	0.0	ERR	ERR		24	unk
Micrasema sp.	0	1	0	0	1	0.0	0.3	0.5	200%	I	24	sh
Agapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Anagapetus sp.	17	24	0	14	55	1.7	13.8	10.1	73%	IV	24	sc
Glossosoma sp.	69	88	1	85	243	7.6	60.8	40.7	67%	VI	24	sc
Glossosomatidae					0	0.0	0.0	ERR	ERR		24	sc
Arctopsyche grandis					0	0.0	0.0	ERR	ERR		18	cf
Hydropsyche sp.					0	0.0	0.0	ERR	ERR		108	cf
Parapsyche elsis	1	27	1	4	33	1.0	8.3	12.8	152%	IV	6	cf
Hydropsychidae	2	8	1	2	13	0.4	3.3	3.2	99%	II	108	cf
Agraylea sp.	82	16	35	11	144	4.5	36.0	32.4	90%	VI	108	cg
Hydroptila sp.					0	0.0	0.0	ERR	ERR		108	cg
Ochrotrichia sp.					0	0.0	0.0	ERR	ERR		108	cg

Taxa	Total Number In Each Replicate: Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Oxyethira sp.					0	0.0	0.0	ERR	ERR		108	cg
Lepidostoma sp.					0	0.0	0.0	ERR	ERR		18	sh
Apatania sp.					0	0.0	0.0	ERR	ERR		18	sc
Chyrandra centralis					0	0.0	0.0	ERR	ERR		18	sh
Cryptochia sp.					0	0.0	0.0	ERR	ERR		108	sh
Dicosmoecus sp.					0	0.0	0.0	ERR	ERR		24	om
Ecclisomyia sp.	0	0	1	0	1	0.0	0.3	0.5	200%	I	108	om
Hesperophylax sp.					0	0.0	0.0	ERR	ERR		108	om
Limnephilus sp.					0	0.0	0.0	ERR	ERR		108	sh
Onocosmoecus sp.					0	0.0	0.0	ERR	ERR		18	om
Psychoglypha sp.					0	0.0	0.0	ERR	ERR		24	om
Pycnopsyche guttifer					0	0.0	0.0	ERR	ERR		72	sh
Limnephilidae	3	1	0	1	5	0.2	1.3	1.3	101%	I	108	unk
Neophylax sp.	0	5	1	0	6	0.2	1.5	2.4	159%	II	24	sc
Neothremma alicia	2	0	0	0	2	0.1	0.5	1.0	200%	I	8	sc
Oligophlebodes sp.					0	0.0	0.0	ERR	ERR		24	sc
Dolophilodes sp.					0	0.0	0.0	ERR	ERR		24	cf
Wormaldia sp.					0	0.0	0.0	ERR	ERR		24	cf
Philopotamidae					0	0.0	0.0	ERR	ERR		24	cf
Rhyacophila acropedes					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Alberta grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Angelita grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Betteni grp.	6	22	3	8	39	1.2	9.8	8.4	86%	IV	18	pr
Rhyacophila Bifila grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Brunnea grp.	1	1	0	0	2	0.1	0.5	0.6	115%	I	18	pr
Rhyacophila Coloradensis grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila hyalinata	1	0	0	1	2	0.1	0.5	0.6	115%	I	18	pr
Rhyacophila iranda	0	7	0	0	7	0.2	1.8	3.5	200%	II	18	pr
Rhyacophila Sibirica grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila tucula					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vaccua					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vepulsa	1	0	0	0	1	0.0	0.3	0.5	200%	I	18	pr
Rhyacophila Verrula grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila sp.	3	0	0	0	3	0.1	0.8	1.5	200%	I	18	pr
Trichopteran pupae					0	0.0	0.0	ERR	ERR		nn	unk
Other												
Diptera												
Atherix sp.					0	0.0	0.0	ERR	ERR		24	pr
Agathon sp.					0	0.0	0.0	ERR	ERR		2	sc
Dioptopsis sp.					0	0.0	0.0	ERR	ERR		2	sc
Blephariceridae					0	0.0	0.0	ERR	ERR		2	sc
Ceratapogonidae					0	0.0	0.0	ERR	ERR		108	pr
Chironomidae	185	250	213	447	1095	34.1	273.8	118.5	43%	IX	108	cg
Culicidae					0	0.0	0.0	ERR	ERR		108	cg
Dixidae					0	0.0	0.0	ERR	ERR		108	cg
Chelifera sp.					0	0.0	0.0	ERR	ERR		95	pr
Clinocera sp.	1	0	0	3	4	0.1	1.0	1.4	141%	I	95	pr
Oreogeton sp.	0	4	2	0	6	0.2	1.5	1.9	128%	II	95	pr
Limnophora sp.					0	0.0	0.0	ERR	ERR		108	pr
Glutops rossi					0	0.0	0.0	ERR	ERR		110	pr
Psychodidae					0	0.0	0.0	ERR	ERR		36	cg
Simuliidae					0	0.0	0.0	ERR	ERR		108	cf
Antocha sp.					0	0.0	0.0	ERR	ERR		24	cg
Dicranota sp.	0	1	2	0	3	0.1	0.8	1.0	128%	I	24	pr
Hexatoma sp.	0	0	0	1	1	0.0	0.3	0.5	200%	I	36	pr
Pedicia sp.					0	0.0	0.0	ERR	ERR		72	pr
Molophilus sp.					0	0.0	0.0	ERR	ERR		72	unk
Pedicia sp.					0	0.0	0.0	ERR	ERR		36	om
Tipula sp.					0	0.0	0.0	ERR	ERR		36	om
Limnophila sp.					0	0.0	0.0	ERR	ERR		72	pr
Tipulidae					0	0.0	0.0	ERR	ERR		72	unk
Coleoptera												
Curculionidae					0	0.0	0.0	ERR	ERR		nn	sh
Hydaticus sp.					0	0.0	0.0	ERR	ERR		72	pr
Dytiscidae					0	0.0	0.0	ERR	ERR		72	pr
Cleptelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Dubiraphia sp.					0	0.0	0.0	ERR	ERR		104	cg
Heterlimnius sp.	1	0	0	1	2	0.1	0.5	0.6	115%	I	104	cg
Lara sp.	0	1	0	0	1	0.0	0.3	0.5	200%	I	104	cg
Narpus sp.					0	0.0	0.0	ERR	ERR		104	cg
Optioservus sp.					0	0.0	0.0	ERR	ERR		104	cg
Rhizelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Stenelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Zaitzevia sp.					0	0.0	0.0	ERR	ERR		104	cg
Elmidae					0	0.0	0.0	ERR	ERR		104	cg
Brychius sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplus sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplidae					0	0.0	0.0	ERR	ERR		54	unk

No.1--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L10, 4 Hess samples)

Taxa	Total Number In Each Replicate				Sum of							
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Hydrophilidae					0	0.0	0.0	ERR	ERR		72	pr
Miscellaneous												
Corixidae					0	0.0	0.0	ERR	ERR		108	unk
Gerridae					0	0.0	0.0	ERR	ERR		72	pr
Hemiptera					0	0.0	0.0	ERR	ERR		72	unk
Lepidoptera					0	0.0	0.0	ERR	ERR		nn	sh
Annelida(Oligochaeta)	3	4	6	3	16	0.5	4.0	1.4	35%	III	108	cg
Annelida(Hirudinea)					0	0.0	0.0	ERR	ERR		108	pr
Mollusca-Sphaeridae					0	0.0	0.0	ERR	ERR		108	cg
Pelecypoda					0	0.0	0.0	ERR	ERR		108	cf
Lymnaea sp.					0	0.0	0.0	ERR	ERR		108	cg
Helisoma sp.					0	0.0	0.0	ERR	ERR		108	sc
Physa sp.					0	0.0	0.0	ERR	ERR		108	cg
Gastropoda					0	0.0	0.0	ERR	ERR		108	sc
Hydracarina	11	16	9	6	42	1.3	10.5	4.2	40%	IV	108	pr
Nematoda	0	1	0	0	1	0.0	0.3	0.5	200%	I	108	om
Ostracoda					0	0.0	0.0	ERR	ERR		108	cg
Turbellaria	1	22	2	2	27	0.8	6.8	10.2	151%	III	108	cg
TOTALS	801	894	566	950	3211							

TOTAL NUMBER =	3211
TOTAL TAXA =	49
MEAN NO. =	803
STD (N-1) =	169.4
%COEF.VAR. =	21.10%
% SE MEAN =	12.41%
SHANNON DIV. =	3.46
SEN.RATIO =	0.540
EPT ABUND =	2013
EPT % =	62.7%
EPT TAXA TOTAL =	38
BAET/EPHEM =	0.13
EPT/CHIRON =	1.84
SC TOTAL =	1057
SC % =	32.9%
SH TOTAL =	217
SH % =	6.8%
CG TOTAL =	1575
CG % =	49.1%
CF TOTAL =	47
CF % =	1.5%
PR TOTAL =	308
PR % =	9.6%
OM TOTAL =	2
OM % =	0.1%
UNK TOTAL =	5
UNK % =	0.2%
SC/CF =	22.49
SC/(SC+CF) =	0.957
SC/TOTAL =	0.329
SH/TOTAL =	0.068
CG/TOTAL =	0.491
CF/TOTAL =	0.015

EPHEM TOTAL=	963
EPHEM %=	30.0%
PLEC TOTAL=	492
PLEC %=	15.3%
TRIC TOTAL=	558
TRIC %=	17.4%
OTHER TOTAL=	1198
OTHER %=	37.3%

DOMINANT TAXA:
1--Chironomidae--34.1%
2--Cinygmula sp.--19.6%
3--Glossosoma sp.--7.6%
4--Sweltsa/Suwallia sp.--5.4%
5--Agraylea sp.--4.5%
6--Baetis sp.--3.8%
7--Zapada columbiana--3.4%
8--Rhithrogena sp.--2.9%
9--Taenionema sp.--2.5%
10--Anagapetus sp.--1.7%

ABUNDANCE CLASS TOTALS:

I--	40.8%
II--	14.3%
III--	12.2%
IV--	14.3%
V--	8.2%
VI--	6.1%
VII--	0.0%
VIII--	2.0%
IX--	2.0%
X--	0.0%
total=	100%

No.2--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L10, 1 Kick sample)

Taxa	Total Number In Each Replicate				Sum of							
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Ephemeroptera												
Baetis sp.	177				177	6.8	177.0	ERR	ERR	VIII	72	cg
Diphetor sp.					0	0.0	0.0	ERR	ERR		72	cg
Caudatella sp.	2				2	0.1	2.0	ERR	ERR	II	48	cg
Caudatella edmundsi					0	0.0	0.0	ERR	ERR		48	cg
Caudatella hystrix					0	0.0	0.0	ERR	ERR		48	cg
D. coloradensis/flavilinea					0	0.0	0.0	ERR	ERR		18	cg
Drunella doddsi	24				24	0.9	24.0	ERR	ERR	V	4	cg
Drunella grandis					0	0.0	0.0	ERR	ERR		24	cg
Drunella spinifera	7				7	0.3	7.0	ERR	ERR	III	24	pr
Drunella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp./Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerellidae	20				20	0.8	20.0	ERR	ERR	V	48	cg
Cinygma sp.					0	0.0	0.0	ERR	ERR		48	sc
Cinygmula sp.	644				644	24.7	644.0	ERR	ERR	X	21	sc
Epeorus sp.	6				6	0.2	6.0	ERR	ERR	III	21	sc
Heptagenia sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp.					0	0.0	0.0	ERR	ERR		48	sc
Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp./Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Rhithrogena sp.	46				46	1.8	46.0	ERR	ERR	VI	21	cg
Heptageniidae					0	0.0	0.0	ERR	ERR		48	sc
Paraleptophlebia sp.	2				2	0.1	2.0	ERR	ERR	II	24	cg
Ameletus sp.	69				69	2.7	69.0	ERR	ERR	VII	48	cg
Plecoptera							0.0					
Capniidae	39				39	1.5	39.0	ERR	ERR	VI	32	sh
Kathroperla perdita					0	0.0	0.0	ERR	ERR		24	cg
Sweltsa/Suwallia sp.	86				86	3.3	86.0	ERR	ERR	VII	24	pr
Chloroperlidae					0	0.0	0.0	ERR	ERR		nn	pr
Despaxia augusta	10				10	0.4	10.0	ERR	ERR	IV	18	sh
Paraleuctra sp.					0	0.0	0.0	ERR	ERR		18	sh
Perlomyia sp.					0	0.0	0.0	ERR	ERR		18	sh
Leuctridae	3				3	0.1	3.0	ERR	ERR	II	18	sh
Capniidae/Leuctridae					0	0.0	0.0	ERR	ERR		32	sh
Amphinemura sp.					0	0.0	0.0	ERR	ERR		6	sh
Malenka sp.					0	0.0	0.0	ERR	ERR		36	sh
Nemoura sp.					0	0.0	0.0	ERR	ERR		24	sh
Visoka cataractae	9				9	0.3	9.0	ERR	ERR	IV	36	sh
Zapada cinctipes					0	0.0	0.0	ERR	ERR		16	sh
Zapada columbiana	237				237	9.1	237.0	ERR	ERR	VIII	16	sh
Zapada sp.	29				29	1.1	29.0	ERR	ERR	V	16	sh
Nemouridae					0	0.0	0.0	ERR	ERR		36	sh
Yoraperla brevis	43				43	1.7	43.0	ERR	ERR	VI	12	sh
Acroneuria abnormis					0	0.0	0.0	ERR	ERR		6	pr
Claassenia sabulosa					0	0.0	0.0	ERR	ERR		6	pr
Doroneuria theodora	3				3	0.1	3.0	ERR	ERR	II	18	pr
Hesperoperla pacifica					0	0.0	0.0	ERR	ERR		18	pr
Perlidae	9				9	0.3	9.0	ERR	ERR	IV	24	pr
Cultus sp.					0	0.0	0.0	ERR	ERR		12	pr
Isoperla sp.					0	0.0	0.0	ERR	ERR		24	pr
Kogotus modestus					0	0.0	0.0	ERR	ERR		18	pr
Megarcys sp.	15				15	0.6	15.0	ERR	ERR	IV	24	pr
Setvena bradleyi	3				3	0.1	3.0	ERR	ERR	II	48	pr
Skwala sp.					0	0.0	0.0	ERR	ERR		18	pr
Perlodidae	14				14	0.5	14.0	ERR	ERR	IV	48	pr
Pteronarcella sp.					0	0.0	0.0	ERR	ERR		24	sh
Pteronarcys sp.					0	0.0	0.0	ERR	ERR		24	sh
Doddsia occidentalis					0	0.0	0.0	ERR	ERR		24	sc
Taenionema sp.	111				111	4.3	111.0	ERR	ERR	VII	48	sc
Taeniopterygidae					0	0.0	0.0	ERR	ERR		48	sh
Trichoptera							0.0					
Amiocentrus sp.					0	0.0	0.0	ERR	ERR		24	cg
Brachycentrus sp.					0	0.0	0.0	ERR	ERR		24	cf
Brachycentridae					0	0.0	0.0	ERR	ERR		24	unk
Micrasema sp.					0	0.0	0.0	ERR	ERR		24	sh
Agapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Anagapetus sp.	26				26	1.0	26.0	ERR	ERR	V	24	sc
Glossosoma sp.	144				144	5.5	144.0	ERR	ERR	VIII	24	sc
Glossosomatidae					0	0.0	0.0	ERR	ERR		24	sc
Arctopsyche grandis					0	0.0	0.0	ERR	ERR		18	cf
Hydropsyche sp.					0	0.0	0.0	ERR	ERR		108	cf
Parapsyche elsis	29				29	1.1	29.0	ERR	ERR	V	6	cf
Hydropsychidae	19				19	0.7	19.0	ERR	ERR	V	108	cf
Agraylea sp.	211				211	8.1	211.0	ERR	ERR	VIII	108	cg
Hydroptila sp.					0	0.0	0.0	ERR	ERR		108	cg
Ochrotrichia sp.					0	0.0	0.0	ERR	ERR		108	cg

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Oxyethira sp.					0	0.0	0.0	ERR	ERR		108	cg
Lepidostoma sp.					0	0.0	0.0	ERR	ERR		18	sh
Apatania sp.					0	0.0	0.0	ERR	ERR		18	sc
Chyrandra centralis	2				2	0.1	2.0	ERR	ERR	II	18	sh
Cryptochia sp.					0	0.0	0.0	ERR	ERR		108	sh
Dicosmoecus sp.					0	0.0	0.0	ERR	ERR		24	om
Ecclisomyia sp.	2				2	0.1	2.0	ERR	ERR	II	108	om
Hesperophylax sp.					0	0.0	0.0	ERR	ERR		108	om
Limnephilus sp.					0	0.0	0.0	ERR	ERR		108	sh
Onocosmoecus sp.					0	0.0	0.0	ERR	ERR		18	om
Psychoglypha sp.					0	0.0	0.0	ERR	ERR		24	om
Pycnopsyche guttifer					0	0.0	0.0	ERR	ERR		72	sh
Limnephilidae	3				3	0.1	3.0	ERR	ERR	II	108	unk
Neophylax sp.	7				7	0.3	7.0	ERR	ERR	III	24	sc
Neothremma alicia	6				6	0.2	6.0	ERR	ERR	III	8	sc
Oligophlebodes sp.					0	0.0	0.0	ERR	ERR		24	sc
Dolophilodes sp.					0	0.0	0.0	ERR	ERR		24	cf
Wormaldia sp.					0	0.0	0.0	ERR	ERR		24	cf
Philopotamidae					0	0.0	0.0	ERR	ERR		24	cf
Rhyacophila acropedes					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Alberta grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Angelita grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Betteni grp.	65				65	2.5	65.0	ERR	ERR	VII	18	pr
Rhyacophila Bifila grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Brunnea grp.	3				3	0.1	3.0	ERR	ERR	II	18	pr
Rhyacophila Coloradensis grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila hyalinata	3				3	0.1	3.0	ERR	ERR	II	18	pr
Rhyacophila iranda	7				7	0.3	7.0	ERR	ERR	III	18	pr
Rhyacophila Sibirica grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila tucula					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vaccua					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vepulsa	2				2	0.1	2.0	ERR	ERR	II	18	pr
Rhyacophila Verrula grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila sp.	2				2	0.1	2.0	ERR	ERR	II	18	pr
Trichopteran pupae					0	0.0	0.0	ERR	ERR		nn	unk
Other							0.0					
Diptera							0.0					
Atherix sp.					0	0.0	0.0	ERR	ERR		24	pr
Agathon sp.					0	0.0	0.0	ERR	ERR		2	sc
Dioptopsis sp.					0	0.0	0.0	ERR	ERR		2	sc
Blephariceridae					0	0.0	0.0	ERR	ERR		2	sc
Ceratopogonidae					0	0.0	0.0	ERR	ERR		108	pr
Chironomidae	304				304	11.7	304.0	ERR	ERR	IX	108	cg
Culicidae					0	0.0	0.0	ERR	ERR		108	cg
Dixidae					0	0.0	0.0	ERR	ERR		108	cg
Chelifera sp.					0	0.0	0.0	ERR	ERR		95	pr
Clinocera sp.	1				1	0.0	1.0	ERR	ERR	I	95	pr
Oreogeton sp.	15				15	0.6	15.0	ERR	ERR	IV	95	pr
Limnophora sp.					0	0.0	0.0	ERR	ERR		108	pr
Glutops rossi					0	0.0	0.0	ERR	ERR		110	pr
Psychodidae					0	0.0	0.0	ERR	ERR		36	cg
Simuliidae					0	0.0	0.0	ERR	ERR		108	cf
Antocha sp.					0	0.0	0.0	ERR	ERR		24	cg
Dicranota sp.	6				6	0.2	6.0	ERR	ERR	III	24	pr
Hexatoma sp.	1				1	0.0	1.0	ERR	ERR	I	36	pr
Pedicia sp.	2				2	0.1	2.0	ERR	ERR	II	72	pr
Molophilus sp.					0	0.0	0.0	ERR	ERR		72	unk
Pedicia sp.					0	0.0	0.0	ERR	ERR		36	om
Tipula sp.					0	0.0	0.0	ERR	ERR		36	om
Limnophila sp.					0	0.0	0.0	ERR	ERR		72	pr
Tipulidae					0	0.0	0.0	ERR	ERR		72	unk
Coleoptera							0.0					
Curculionidae					0	0.0	0.0	ERR	ERR		nn	sh
Hydaticus sp.					0	0.0	0.0	ERR	ERR		72	pr
Dytiscidae					0	0.0	0.0	ERR	ERR		72	pr
Cleptelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Dubiraphia sp.					0	0.0	0.0	ERR	ERR		104	cg
Heterlimnius sp.	1				1	0.0	1.0	ERR	ERR	I	104	cg
Lara sp.					0	0.0	0.0	ERR	ERR		104	cg
Narpus sp.					0	0.0	0.0	ERR	ERR		104	cg
Optioservus sp.					0	0.0	0.0	ERR	ERR		104	cg
Rhizelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Stenelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Zaitzevia sp.					0	0.0	0.0	ERR	ERR		104	cg
Elmidae					0	0.0	0.0	ERR	ERR		104	cg
Brychius sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplus sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplidae					0	0.0	0.0	ERR	ERR		54	unk

No.2--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L10, 1 Kick sample)

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Hydrophilidae					0	0.0	0.0	ERR	ERR		72	pr
Miscellaneous							0.0					
Corixidae					0	0.0	0.0	ERR	ERR		108	unk
Gerridae					0	0.0	0.0	ERR	ERR		72	pr
Hemiptera					0	0.0	0.0	ERR	ERR		72	unk
Lepidoptera					0	0.0	0.0	ERR	ERR		nn	sh
Annelida(Oligochaeta)	35				35	1.3	35.0	ERR	ERR	VI	108	cg
Annelida(Hirudinea)					0	0.0	0.0	ERR	ERR		108	pr
Mollusca-Sphaeridae					0	0.0	0.0	ERR	ERR		108	cg
Pelecypoda					0	0.0	0.0	ERR	ERR		108	cf
Lymnaea sp.					0	0.0	0.0	ERR	ERR		108	cg
Helisoma sp.					0	0.0	0.0	ERR	ERR		108	sc
Physa sp.					0	0.0	0.0	ERR	ERR		108	cg
Gastropoda					0	0.0	0.0	ERR	ERR		108	sc
Hydracarina	60				60	2.3	60.0	ERR	ERR	VI	108	pr
Nematoda					0	0.0	0.0	ERR	ERR		108	om
Ostracoda					0	0.0	0.0	ERR	ERR		108	cg
Turbellaria	39				39	1.5	39.0	ERR	ERR	VI	108	cg
TOTALS	2603	0	0	0	2603							

TOTAL NUMBER =	2603
TOTAL TAXA =	50
MEAN NO. =	2603
STD (N-1) =	1301.5
%COEF.VAR. =	50.00%
% SE MEAN =	50.00%
SHANNON DIV. =	4.04
SEN.RATIO =	0.666
EPT ABUND =	2139
EPT % =	82.2%
EPT TAXA TOTAL =	40
BAET/EPHEM =	0.18
EPT/CHIRON =	7.04
SC TOTAL =	944
SC % =	36.3%
SH TOTAL =	372
SH % =	14.3%
CG TOTAL =	930
CG % =	35.7%
CF TOTAL =	48
CF % =	1.8%
PR TOTAL =	304
PR % =	11.7%
OM TOTAL =	2
OM % =	0.1%
UNK TOTAL =	3
UNK % =	0.1%
SC/CF =	19.67
SC/(SC+CF) =	0.952
SC/TOTAL =	0.363
SH/TOTAL =	0.143
CG/TOTAL =	0.357
CF/TOTAL =	0.018

EPHEM TOTAL=	997
EPHEM %=	38.3%
PLEC TOTAL=	611
PLEC %=	23.5%
TRIC TOTAL=	531
TRIC %=	20.4%
OTHER TOTAL=	464
OTHER %=	17.8%

DOMINANT TAXA:
1--Cinygmula sp.--24.7%
2--Chironomidae--11.7%
3--Zapada columbiana--9.1%
4--Agraylea sp.--8.1%
5--Baetis sp.--6.8%
6--Glossosoma sp.--5.5%
7--Taenionema sp.--4.3%
8--Sweltsa/Suwallia sp.--3.3%
9--Ameletus sp.--2.7%
10--Rhyacophila Betteni Grp.--2.5%

ABUNDANCE CLASS TOTALS:

I--	8.0%
II--	26.0%
III--	12.0%
IV--	12.0%
V--	12.0%
VI--	12.0%
VII--	8.0%
VIII--	8.0%
IX--	2.0%
X--	2.0%
total=	100%

No.3--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L9, 4 Hess samples)

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Ephemeroptera												
Baetis sp.	36	12	11	14	73	1.4	18.3	11.9	65%	V	72	cg
Diphetor sp.					0	0.0	0.0	ERR	ERR		72	cg
Caudatella sp.	0	0	0	1	1	0.0	0.3	0.5	200%	I	48	cg
Caudatella edmundsi					0	0.0	0.0	ERR	ERR		48	cg
Caudatella hystrix					0	0.0	0.0	ERR	ERR		48	cg
D. coloradensis/flavilinea					0	0.0	0.0	ERR	ERR		18	cg
Drunella doddsi	11	31	14	4	60	1.2	15.0	11.5	76%	IV	4	cg
Drunella grandis					0	0.0	0.0	ERR	ERR		24	cg
Drunella spinifera	10	1	0	10	21	0.4	5.3	5.5	105%	III	24	pr
Drunella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp.	4	0	0	0	4	0.1	1.0	2.0	200%	I	48	cg
Serratella sp./Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerellidae	71	4	4	13	92	1.8	23.0	32.3	140%	V	48	cg
Cinygma sp.					0	0.0	0.0	ERR	ERR		48	sc
Cinygmula sp.	391	158	121	219	889	17.4	222.3	119.5	54%	VIII	21	sc
Epeorus sp.	2	0	4	0	6	0.1	1.5	1.9	128%	II	21	sc
Heptagenia sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp.					0	0.0	0.0	ERR	ERR		48	sc
Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp./Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Rhithrogena sp.	8	41	25	17	91	1.8	22.8	14.0	62%	V	21	cg
Heptageniidae					0	0.0	0.0	ERR	ERR		48	sc
Paraleptophlebia sp.	0	2	0	0	2	0.0	0.5	1.0	200%	I	24	cg
Ameletus sp.	14	1	0	1	16	0.3	4.0	6.7	167%	III	48	cg
Plecoptera												
Capniidae	19	7	2	2	30	0.6	7.5	8.0	107%	IV	32	sh
Kathroperla perdita					0	0.0	0.0	ERR	ERR		24	cg
Sweltsa/Suwallia sp.	32	31	16	23	102	2.0	25.5	7.5	29%	V	24	pr
Chloroperlidae					0	0.0	0.0	ERR	ERR		nn	pr
Despaxia augusta	2	10	4	4	20	0.4	5.0	3.5	69%	III	18	sh
Paraleuctra sp.					0	0.0	0.0	ERR	ERR		18	sh
Perlomyia sp.					0	0.0	0.0	ERR	ERR		18	sh
Leuctridae					0	0.0	0.0	ERR	ERR		18	sh
Capniidae/Leuctridae					0	0.0	0.0	ERR	ERR		32	sh
Amphinemura sp.					0	0.0	0.0	ERR	ERR		6	sh
Malenka sp.					0	0.0	0.0	ERR	ERR		36	sh
Nemoura sp.					0	0.0	0.0	ERR	ERR		24	sh
Visoka cataractae	0	4	0	0	4	0.1	1.0	2.0	200%	I	36	sh
Zapada cinctipes	15	1	0	4	20	0.4	5.0	6.9	138%	III	18	sh
Zapada columbiana	38	95	32	79	242	4.7	60.5	31.3	52%	VI	16	sh
Zapada sp.	60	38	8	23	129	2.5	32.3	22.2	69%	VI	16	sh
Nemouridae					0	0.0	0.0	ERR	ERR		38	sh
Yoraperla brevis	1	1	2	10	14	0.3	3.5	4.4	125%	III	12	sh
Acroneuria abnormis					0	0.0	0.0	ERR	ERR		6	pr
Claassenia sabulosa					0	0.0	0.0	ERR	ERR		6	pr
Doroneuria theodora					0	0.0	0.0	ERR	ERR		18	pr
Hesperoperla pacifica					0	0.0	0.0	ERR	ERR		18	pr
Perlidae	1	0	2	1	4	0.1	1.0	0.8	82%	I	24	pr
Cultus sp.					0	0.0	0.0	ERR	ERR		12	pr
Isoperla sp.	2	0	0	0	2	0.0	0.5	1.0	200%	I	24	pr
Kogotus modestus					0	0.0	0.0	ERR	ERR		18	pr
Megarcys sp.	8	2	5	5	20	0.4	5.0	2.4	49%	III	24	pr
Setvena bradleyi					0	0.0	0.0	ERR	ERR		48	pr
Skwala sp.					0	0.0	0.0	ERR	ERR		18	pr
Perlodidae	13	7	0	22	42	0.8	10.5	9.3	89%	IV	48	pr
Pteronarcella sp.					0	0.0	0.0	ERR	ERR		24	sh
Pteronarcys sp.					0	0.0	0.0	ERR	ERR		24	sh
Doddsia occidentalis					0	0.0	0.0	ERR	ERR		24	sc
Taenionema sp.	103	269	181	249	802	15.7	200.5	75.1	37%	VIII	48	sc
Taeniopterygidae					0	0.0	0.0	ERR	ERR		48	sh
Trichoptera												
Amiocentrus sp.					0	0.0	0.0	ERR	ERR		24	cg
Brachycentrus sp.	0	0	1	0	1	0.0	0.3	0.5	200%	I	24	cf
Brachycentridae					0	0.0	0.0	ERR	ERR		24	unk
Micrasema sp.					0	0.0	0.0	ERR	ERR		24	sh
Agapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Anagapetus sp.	12	5	14	9	40	0.8	10.0	3.9	39%	IV	24	sc
Glossosoma sp.	104	104	85	289	582	11.6	148.0	94.1	64%	VIII	24	sc
Glossosomatidae					0	0.0	0.0	ERR	ERR		24	sc
Arctopsyche grandis	2	2	0	0	4	0.1	1.0	1.2	115%	I	18	cf
Hydropsyche sp.	1	0	0	0	1	0.0	0.3	0.5	200%	I	108	cf
Parapsyche elsis	2	9	6	7	24	0.5	6.0	2.9	49%	III	6	cf
Hydropsychidae	2	47	17	23	89	1.7	22.3	18.7	84%	V	108	cf
Agraylea sp.	155	20	10	35	220	4.3	55.0	67.5	123%	VI	108	cg
Hydroptila sp.					0	0.0	0.0	ERR	ERR		108	cg
Ochrotrichia sp.					0	0.0	0.0	ERR	ERR		108	cg

No.3--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L9, 4 Hess samples)

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Oxyethira sp.					0	0.0	0.0	ERR	ERR		108	cg
Lepidostoma sp.					0	0.0	0.0	ERR	ERR		18	sh
Apatania sp.					0	0.0	0.0	ERR	ERR		18	sc
Chyrandra centralis					0	0.0	0.0	ERR	ERR		18	sh
Cryptochia sp.					0	0.0	0.0	ERR	ERR		108	sh
Dicosmoecus sp.					0	0.0	0.0	ERR	ERR		24	om
Ecclisomyia sp.					0	0.0	0.0	ERR	ERR		108	om
Hesperophylax sp.					0	0.0	0.0	ERR	ERR		108	om
Limnephilus sp.					0	0.0	0.0	ERR	ERR		108	sh
Onocosmoecus sp.					0	0.0	0.0	ERR	ERR		18	om
Psychoglypha sp.					0	0.0	0.0	ERR	ERR		24	om
Pycnopsyche guttifer					0	0.0	0.0	ERR	ERR		72	sh
Limnephilidae	4	7	1	2	14	0.3	3.5	2.6	76%	III	108	unk
Neophylax sp.					0	0.0	0.0	ERR	ERR		24	sc
Neothremma alicia					0	0.0	0.0	ERR	ERR		8	sc
Oligophlebodes sp.	2	3	1	1	7	0.1	1.8	1.0	55%	II	24	sc
Dolophilodes sp.					0	0.0	0.0	ERR	ERR		24	cf
Wormaldia sp.					0	0.0	0.0	ERR	ERR		24	cf
Philopotamidae					0	0.0	0.0	ERR	ERR		24	cf
Rhyacophila acropedes					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Alberta grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Angelita grp.	0	3	4	0	7	0.1	1.8	2.1	118%	II	18	pr
Rhyacophila Betteni grp.	13	34	21	21	89	1.7	22.3	8.7	39%	V	18	pr
Rhyacophila Bifila grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Brunnea grp.	0	0	0	1	1	0.0	0.3	0.5	200%	I	18	pr
Rhyacophila Coloradensis grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila hyalinata					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila iranda	2	1	1	8	12	0.2	3.0	3.4	112%	II	18	pr
Rhyacophila Sibirica grp.	0	1	1	2	4	0.1	1.0	0.8	82%	I	18	pr
Rhyacophila tucula					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vaccua	0	2	0	0	2	0.0	0.5	1.0	200%	I	18	pr
Rhyacophila vepulsa	3	2	1	7	13	0.3	3.3	2.6	81%	II	18	pr
Rhyacophila Verrula grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila sp.	1	0	8	10	19	0.4	4.8	5.0	105%	III	18	pr
Trichopteran pupae	0	0	2	0	2	0.0	0.5	1.0	200%	I	nn	unk
Other												
Diptera												
Atherix sp.					0	0.0	0.0	ERR	ERR		24	pr
Agathon sp.					0	0.0	0.0	ERR	ERR		2	sc
Dioptopsis sp.					0	0.0	0.0	ERR	ERR		2	sc
Blephariceridae					0	0.0	0.0	ERR	ERR		2	sc
Ceratopogonidae					0	0.0	0.0	ERR	ERR		108	pr
Chironomidae	561	248	182	104	1095	21.4	273.8	200.3	73%	IX	108	cg
Culicidae					0	0.0	0.0	ERR	ERR		108	cg
Dixidae					0	0.0	0.0	ERR	ERR		108	cg
Chelifera sp.					0	0.0	0.0	ERR	ERR		95	pr
Clinocera sp.	1	1	0	1	3	0.1	0.8	0.5	67%	I	95	pr
Oreogeton sp.	5	5	11	8	29	0.6	7.3	2.9	40%	III	85	pr
Limnophora sp.					0	0.0	0.0	ERR	ERR		108	pr
Glutops rossi					0	0.0	0.0	ERR	ERR		110	pr
Psychodidae					0	0.0	0.0	ERR	ERR		36	cg
Simuliidae	0	1	0	0	1	0.0	0.3	0.5	200%	I	108	cf
Antocha sp.					0	0.0	0.0	ERR	ERR		24	cg
Dicranota sp.	7	1	0	1	9	0.2	2.3	3.2	142%	II	24	pr
Hexatoma sp.					0	0.0	0.0	ERR	ERR		36	pr
Pedicia sp.					0	0.0	0.0	ERR	ERR		72	pr
Molophilus sp.					0	0.0	0.0	ERR	ERR		72	unk
Pedicia sp.					0	0.0	0.0	ERR	ERR		36	om
Tipula sp.					0	0.0	0.0	ERR	ERR		36	om
Limnophila sp.					0	0.0	0.0	ERR	ERR		72	pr
Tipulidae					0	0.0	0.0	ERR	ERR		72	unk
Coleoptera												
Curculionidae					0	0.0	0.0	ERR	ERR		nn	sh
Hydaticus sp.					0	0.0	0.0	ERR	ERR		72	pr
Dytiscidae					0	0.0	0.0	ERR	ERR		72	pr
Cleptelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Dubiraphia sp.					0	0.0	0.0	ERR	ERR		104	cg
Heterlimnius sp.	0	1	2	1	4	0.1	1.0	0.8	82%	I	104	cg
Lara sp.					0	0.0	0.0	ERR	ERR		104	cg
Narpus sp.					0	0.0	0.0	ERR	ERR		104	cg
Optioservus sp.					0	0.0	0.0	ERR	ERR		104	cg
Rhizelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Stenelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Zaitzevia sp.					0	0.0	0.0	ERR	ERR		104	cg
Elmidae					0	0.0	0.0	ERR	ERR		104	cg
Brychius sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplus sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplidae					0	0.0	0.0	ERR	ERR		54	unk

No.3--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L9, 4 Hess samples)

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Hydrophilidae					0	0.0	0.0	ERR	ERR		72	pr
Miscellaneous												
Corixidae					0	0.0	0.0	ERR	ERR		108	unk
Gerridae					0	0.0	0.0	ERR	ERR		72	pr
Hemiptera					0	0.0	0.0	ERR	ERR		72	unk
Lepidoptera					0	0.0	0.0	ERR	ERR		nn	sh
Annelida(Oligochaeta)	2	4	4	3	13	0.3	3.3	1.0	29%	II	108	cg
Annelida(Hirudinea)					0	0.0	0.0	ERR	ERR		108	pr
Mollusca-Sphaeridae					0	0.0	0.0	ERR	ERR		108	cg
Pelecypoda					0	0.0	0.0	ERR	ERR		108	cf
Lymnaea sp.					0	0.0	0.0	ERR	ERR		108	cg
Helisoma sp.					0	0.0	0.0	ERR	ERR		108	sc
Physa sp.					0	0.0	0.0	ERR	ERR		108	cg
Gastropoda					0	0.0	0.0	ERR	ERR		108	sc
Hydracarina	15	7	5	2	29	0.6	7.3	5.6	77%	III	108	pr
Nematoda					0	0.0	0.0	ERR	ERR		108	om
Ostracoda					0	0.0	0.0	ERR	ERR		108	cg
Turbellaria	27	37	17	15	96	1.9	24.0	10.1	42%	V	108	cg
TOTALS	1760	1260	835	1251	5106							

TOTAL NUMBER = 5106
TOTAL TAXA = 52
MEAN NO. = 1277
STD (N-1) = 378.4
%COEF.VAR. = 29.65%
% SE MEAN = 17.44%
SHANNON DIV. = 3.74
SEN.RATIO = 0.673
EPT ABUND = 3827
EPT % = 75.0%
EPT TAXA TOTAL = 43
BAET/EPHEM = 0.06
EPT/CHIRON = 3.49
SC TOTAL = 2336
SC % = 45.8%
SH TOTAL = 459
SH % = 9.0%
CG TOTAL = 1767
CG % = 34.6%
CF TOTAL = 120
CF % = 2.4%
PR TOTAL = 408
PR % = 8.0%
OM TOTAL = 0
OM % = 0.0%
UNK TOTAL = 16
UNK % = 0.3%
SC/CF = 19.47
SC/(SC+CF) = 0.951
SC/TOTAL = 0.458
SH/TOTAL = 0.090
CG/TOTAL = 0.346
CF/TOTAL = 0.024

EPHEM TOTAL= 1255
EPHEM %= 24.6%
PLEC TOTAL= 1431
PLEC %= 28.0%
TRIC TOTAL= 1141
TRIC %= 22.3%
OTHER TOTAL= 1279
OTHER %= 25.0%

DOMINANT TAXA:
1--Chironomidae--21.4%
2--Cinygmula sp.--17.4%
3--Taenionema sp.--15.7%
4--Glossosoma sp.--11.6%
5--Zapada columbiana--4.7%
6--Agraylea sp.--4.3%
7--Zapada sp.--2.5%
8--Sweltsa/Suwallia sp.--2.0%
9--Rhithrogena sp.--1.8%
10--Ephemerellidae--1.8%

ABUNDANCE CLASS TOTALS:
I-- 30.8%
II-- 13.5%
III-- 21.2%
IV-- 7.7%
V-- 13.5%
VI-- 5.8%
VII-- 0.0%
VIII-- 5.8%
IX-- 1.9%
X-- 0.0%
total= 100%

No.4--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L9, 1 Kick sample)

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Ephemeroptera												
Baetis sp.	32				32	1.1	32.0	ERR	ERR	VI	72	cg
Diphetor sp.					0	0.0	0.0	ERR	ERR		72	cg
Caudatella sp.					0	0.0	0.0	ERR	ERR		48	cg
Caudatella edmundsi					0	0.0	0.0	ERR	ERR		48	cg
Caudatella hystrix					0	0.0	0.0	ERR	ERR		48	cg
D. coloradensis/flavilinea					0	0.0	0.0	ERR	ERR		16	cg
Drunella doddsi	14				14	0.5	14.0	ERR	ERR	IV	4	cg
Drunella grandis					0	0.0	0.0	ERR	ERR		24	cg
Drunella spinifera	1				1	0.0	1.0	ERR	ERR	I	24	pr
Drunella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp./Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerellidae	20				20	0.7	20.0	ERR	ERR	V	48	cg
Cinygma sp.					0	0.0	0.0	ERR	ERR		48	sc
Cinygmula sp.	730				730	25.5	730.0	ERR	ERR	X	21	sc
Epeorus sp.	4				4	0.1	4.0	ERR	ERR	III	21	sc
Heptagenia sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp.					0	0.0	0.0	ERR	ERR		48	sc
Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp./Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Rhithrogena sp.	66				66	2.3	66.0	ERR	ERR	VII	21	cg
Heptageniidae					0	0.0	0.0	ERR	ERR		48	sc
Paraleptophlebia sp.					0	0.0	0.0	ERR	ERR		24	cg
Ameletus sp.	17				17	0.6	17.0	ERR	ERR	V	48	cg
Plecoptera							0.0					
Capniidae	4				4	0.1	4.0	ERR	ERR	III	32	sh
Kathroperla perdita					0	0.0	0.0	ERR	ERR		24	cg
Sweltsa/Suwallia sp.	33				33	1.2	33.0	ERR	ERR	VI	24	pr
Chloroperlidae					0	0.0	0.0	ERR	ERR		nn	pr
Despaxia augusta	8				8	0.3	8.0	ERR	ERR	IV	18	sh
Paraleuctra sp.					0	0.0	0.0	ERR	ERR		18	sh
Perlomyia sp.					0	0.0	0.0	ERR	ERR		18	sh
Leuctridae					0	0.0	0.0	ERR	ERR		18	sh
Capniidae/Leuctridae					0	0.0	0.0	ERR	ERR		32	sh
Amphinemura sp.					0	0.0	0.0	ERR	ERR		6	sh
Malenka sp.					0	0.0	0.0	ERR	ERR		36	sh
Nemoura sp.					0	0.0	0.0	ERR	ERR		24	sh
Visoka cataractae	3				3	0.1	3.0	ERR	ERR	II	36	sh
Zapada cinctipes	3				3	0.1	3.0	ERR	ERR	II	16	sh
Zapada columbiana	152				152	5.3	152.0	ERR	ERR	VIII	16	sh
Zapada sp.	58				58	2.0	58.0	ERR	ERR	VI	16	sh
Nemouridae					0	0.0	0.0	ERR	ERR		36	sh
Yoraperla brevis					0	0.0	0.0	ERR	ERR		12	sh
Acroneuria abnormis					0	0.0	0.0	ERR	ERR		6	pr
Claassenia sabulosa					0	0.0	0.0	ERR	ERR		6	pr
Doroneuria theodora	2				2	0.1	2.0	ERR	ERR	II	18	pr
Hesperoperla pacifica					0	0.0	0.0	ERR	ERR		18	pr
Perlidae	8				8	0.3	8.0	ERR	ERR	IV	24	pr
Cultus sp.					0	0.0	0.0	ERR	ERR		12	pr
Isoperla sp.					0	0.0	0.0	ERR	ERR		24	pr
Kogotus modestus					0	0.0	0.0	ERR	ERR		18	pr
Megarcys sp.	14				14	0.5	14.0	ERR	ERR	IV	24	pr
Setvena bradleyi					0	0.0	0.0	ERR	ERR		48	pr
Skwala sp.					0	0.0	0.0	ERR	ERR		18	pr
Perlodidae	19				19	0.7	19.0	ERR	ERR	V	48	pr
Pteronarcella sp.					0	0.0	0.0	ERR	ERR		24	sh
Pteronarcys sp.					0	0.0	0.0	ERR	ERR		24	sh
Doddsia occidentalis					0	0.0	0.0	ERR	ERR		24	sc
Taenionema sp.	513				513	17.9	513.0	ERR	ERR	X	48	sc
Taeniopterygidae					0	0.0	0.0	ERR	ERR		48	sh
Trichoptera							0.0					
Amiocentrus sp.					0	0.0	0.0	ERR	ERR		24	cg
Brachycentrus sp.					0	0.0	0.0	ERR	ERR		24	cf
Brachycentridae	1				1	0.0	1.0	ERR	ERR	I	24	unk
Micrasema sp.					0	0.0	0.0	ERR	ERR		24	sh
Agapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Anagapetus sp.	13				13	0.5	13.0	ERR	ERR	IV	24	sc
Glossosoma sp.	448				448	15.7	448.0	ERR	ERR	IX	24	sc
Glossosomatidae					0	0.0	0.0	ERR	ERR		24	sc
Arctopsyche grandis					0	0.0	0.0	ERR	ERR		18	cf
Hydropsyche sp.					0	0.0	0.0	ERR	ERR		108	cf
Parapsyche elsis	17				17	0.6	17.0	ERR	ERR	V	6	cf
Hydropsychidae	33				33	1.2	33.0	ERR	ERR	VI	108	cf
Agraylea sp.	7				7	0.2	7.0	ERR	ERR	III	108	cg
Hydroptila sp.					0	0.0	0.0	ERR	ERR		108	cg
Ochrotrichia sp.					0	0.0	0.0	ERR	ERR		108	cg

No.4--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L9, 1 Kick sample)

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Oxyethira sp.					0	0.0	0.0	ERR	ERR		108	cg
Lepidostoma sp.					0	0.0	0.0	ERR	ERR		18	sh
Apatania sp.					0	0.0	0.0	ERR	ERR		18	sc
Chyrandra centralis					0	0.0	0.0	ERR	ERR		18	sh
Cryptochia sp.					0	0.0	0.0	ERR	ERR		108	sh
Dicosmoecus sp.					0	0.0	0.0	ERR	ERR		24	om
Ecclisomyia sp.					0	0.0	0.0	ERR	ERR		108	om
Hesperophylax sp.					0	0.0	0.0	ERR	ERR		108	om
Limnephilus sp.					0	0.0	0.0	ERR	ERR		108	sh
Onocosmoecus sp.					0	0.0	0.0	ERR	ERR		18	om
Psychoglypha sp.					0	0.0	0.0	ERR	ERR		24	om
Pycnopsyche guttifer					0	0.0	0.0	ERR	ERR		72	sh
Limnephilidae	17				17	0.6	17.0	ERR	ERR	V	108	unk
Neophylax sp.					0	0.0	0.0	ERR	ERR		24	sc
Neothremma alicia					0	0.0	0.0	ERR	ERR		8	sc
Oligophlebodes sp.					0	0.0	0.0	ERR	ERR		24	sc
Dolophilodes sp.					0	0.0	0.0	ERR	ERR		24	cf
Wormaldia sp.					0	0.0	0.0	ERR	ERR		24	cf
Philopotamidae					0	0.0	0.0	ERR	ERR		24	cf
Rhyacophila acropedes					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Alberta grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Angelita grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Betteni grp.	65				65	2.3	65.0	ERR	ERR	VII	18	pr
Rhyacophila Bifila grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Brunnea grp.	13				13	0.5	13.0	ERR	ERR	IV	18	pr
Rhyacophila Coloradensis grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila hyalinata					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila iranda	2				2	0.1	2.0	ERR	ERR	II	18	pr
Rhyacophila Sibirica grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila tucula					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vaccua					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vepulsa	10				10	0.3	10.0	ERR	ERR	IV	18	pr
Rhyacophila Verrula grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila sp.	53				53	1.9	53.0	ERR	ERR	VI	18	pr
Trichopteran pupae					0	0.0	0.0	ERR	ERR		nn	unk
Other							0.0					
Diptera							0.0					
Atherix sp.					0	0.0	0.0	ERR	ERR		24	pr
Agathon sp.					0	0.0	0.0	ERR	ERR		2	sc
Dioptopsis sp.					0	0.0	0.0	ERR	ERR		2	sc
Blephariceridae					0	0.0	0.0	ERR	ERR		2	sc
Ceratapogonidae					0	0.0	0.0	ERR	ERR		108	pr
Chironomidae	380				380	13.3	380.0	ERR	ERR	IX	108	cg
Culicidae					0	0.0	0.0	ERR	ERR		108	cg
Dixidae					0	0.0	0.0	ERR	ERR		108	cg
Chelifera sp.					0	0.0	0.0	ERR	ERR		95	pr
Clinocera sp.	3				3	0.1	3.0	ERR	ERR	II	95	pr
Oreogeton sp.	16				16	0.6	16.0	ERR	ERR	V	95	pr
Limnophora sp.					0	0.0	0.0	ERR	ERR		108	pr
Glutops rossi					0	0.0	0.0	ERR	ERR		110	pr
Psychodidae					0	0.0	0.0	ERR	ERR		36	cg
Simuliidae	1				1	0.0	1.0	ERR	ERR	I	108	cf
Antocha sp.					0	0.0	0.0	ERR	ERR		24	cg
Dicranota sp.	1				1	0.0	1.0	ERR	ERR	I	24	pr
Hexatoma sp.					0	0.0	0.0	ERR	ERR		36	pr
Pedicia sp.					0	0.0	0.0	ERR	ERR		72	pr
Molophilus sp.					0	0.0	0.0	ERR	ERR		72	unk
Pedicia sp.					0	0.0	0.0	ERR	ERR		36	om
Tipula sp.					0	0.0	0.0	ERR	ERR		36	om
Limnophila sp.					0	0.0	0.0	ERR	ERR		72	pr
Tipulidae					0	0.0	0.0	ERR	ERR		72	unk
Coleoptera							0.0					
Curculionidae					0	0.0	0.0	ERR	ERR		nn	sh
Hydaticus sp.					0	0.0	0.0	ERR	ERR		72	pr
Dytiscidae					0	0.0	0.0	ERR	ERR		72	pr
Cleptelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Dubiraphia sp.					0	0.0	0.0	ERR	ERR		104	cg
Heterlimnius sp.	1				1	0.0	1.0	ERR	ERR	I	104	cg
Lara sp.					0	0.0	0.0	ERR	ERR		104	cg
Narpus sp.					0	0.0	0.0	ERR	ERR		104	cg
Optioservus sp.					0	0.0	0.0	ERR	ERR		104	cg
Rhizelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Stenelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Zaitzevia sp.					0	0.0	0.0	ERR	ERR		104	cg
Elmidae					0	0.0	0.0	ERR	ERR		104	cg
Brychius sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplus sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplidae					0	0.0	0.0	ERR	ERR		54	unk

No.4--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L9, 1 Kick sample)

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Hydrophilidae					0	0.0	0.0	ERR	ERR		72	pr
Miscellaneous							0.0					
Corixidae					0	0.0	0.0	ERR	ERR		108	unk
Gerridae					0	0.0	0.0	ERR	ERR		72	pr
Hemiptera					0	0.0	0.0	ERR	ERR		72	unk
Lepidoptera					0	0.0	0.0	ERR	ERR		nn	sh
Annelida(Oligochaeta)	3				3	0.1	3.0	ERR	ERR	II	108	cg
Annelida(Hirudinea)					0	0.0	0.0	ERR	ERR		108	pr
Mollusca-Sphaeridae					0	0.0	0.0	ERR	ERR		108	cg
Pelecypoda					0	0.0	0.0	ERR	ERR		108	cf
Lymnaea sp.					0	0.0	0.0	ERR	ERR		108	cg
Helisoma sp.					0	0.0	0.0	ERR	ERR		108	sc
Physa sp.					0	0.0	0.0	ERR	ERR		108	cg
Gastropoda					0	0.0	0.0	ERR	ERR		108	sc
Hydracarina	8				8	0.3	8.0	ERR	ERR	IV	108	pr
Nematoda					0	0.0	0.0	ERR	ERR		108	om
Ostracoda					0	0.0	0.0	ERR	ERR		108	cg
Turbellaria	65				65	2.3	65.0	ERR	ERR	VII	108	cg
TOTALS	2858	0	0	0	2858							

TOTAL NUMBER =	2858
TOTAL TAXA =	41
MEAN NO. =	2858
STD (N-1) =	1429.0
%COEF.VAR. =	50.00%
% SE MEAN =	50.00%
SHANNON DIV. =	3.44
SEN.RATIO =	0.802
EPT ABUND =	2380
EPT % =	83.3%
EPT TAXA TOTAL =	32
BAET/EPHEM =	0.04
EPT/CHIRON =	6.26
SC TOTAL =	1708
SC % =	59.8%
SH TOTAL =	228
SH % =	8.0%
CG TOTAL =	605
CG % =	21.2%
CF TOTAL =	51
CF % =	1.8%
PR TOTAL =	248
PR % =	8.7%
OM TOTAL =	0
OM % =	0.0%
UNK TOTAL =	18
UNK % =	0.6%
SC/CF =	33.49
SC/(SC+CF) =	0.971
SC/TOTAL =	0.598
SH/TOTAL =	0.080
CG/TOTAL =	0.212
CF/TOTAL =	0.018

EPHEM TOTAL=	884
EPHEM %=	30.9%
PLEC TOTAL=	817
PLEC %=	28.6%
TRIC TOTAL=	679
TRIC %=	23.8%
OTHER TOTAL=	478
OTHER %=	16.7%

DOMINANT TAXA:
1--Cinygmula sp.--25.5%
2--Taenionema sp.--17.9%
3--Glossosoma sp.--15.7%
4--Chironomidae--13.3%
5--Zapada columbiana--5.3%
6--Rhithrogena sp.--2.3%
7--Rhyacophila Betteni Grp.--2.3%
8--Turbellaria--2.3%
9--Zapada sp.--2.0%
10--Rhyacophila sp.--1.9%

ABUNDANCE CLASS TOTALS:

I--	12.2%
II--	14.6%
III--	7.3%
IV--	19.5%
V--	14.6%
VI--	12.2%
VII--	7.3%
VIII--	2.4%
IX--	0.0%
X--	0.0%
total=	90%

No.5--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L1, 4 Hess samples)

Taxa	Total Number In Each Replicate				Sum of							
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Ephemeroptera												
Baetis sp.	68	44	4	18	132	3.9	33.0	27.5	83%	VI	72	cg
Diphetor sp.					0	0.0	0.0	ERR	ERR		72	cg
Caudatella sp.	0	0	0	1	1	0.0	0.3	0.5	200%	I	48	cg
Caudatella edmundsi					0	0.0	0.0	ERR	ERR		48	cg
Caudatella hystrix					0	0.0	0.0	ERR	ERR		48	cg
D. coloradensis/flavilinea					0	0.0	0.0	ERR	ERR		18	cg
Drunella doddsi	2	0	0	0	2	0.1	0.5	1.0	200%	I	4	cg
Drunella grandis					0	0.0	0.0	ERR	ERR		24	cg
Drunella spinifera					0	0.0	0.0	ERR	ERR		24	pr
Drunella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp./Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerellidae	59	41	38	43	181	5.4	45.3	9.4	21%	VI	48	cg
Cinygma sp.					0	0.0	0.0	ERR	ERR		48	sc
Cinygmula sp.	218	463	487	327	1495	44.3	373.8	125.5	34%	IX	21	sc
Epeorus sp.	3	1	2	2	8	0.2	2.0	0.8	41%	II	21	sc
Heptagenia sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp.					0	0.0	0.0	ERR	ERR		48	sc
Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp./Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Rhithrogena sp.	81	76	36	24	217	6.4	54.3	28.5	53%	VI	21	cg
Heptageniidae					0	0.0	0.0	ERR	ERR		48	sc
Paraleptophlebia sp.	50	58	57	54	219	6.5	54.8	3.6	7%	VI	24	cg
Ameletus sp.					0	0.0	0.0	ERR	ERR		48	cg
Plecoptera												
Capniidae	37	32	19	13	101	3.0	25.3	11.1	44%	V	32	sh
Kathroperla perdita					0	0.0	0.0	ERR	ERR		24	cg
Sweltsa/Suwallia sp.	36	58	39	13	146	4.3	36.5	18.4	51%	VI	24	pr
Chloroperlidae					0	0.0	0.0	ERR	ERR		nn	pr
Despaxia augusta	5	6	15	6	32	0.9	8.0	4.7	59%	IV	18	sh
Paraleuctra sp.					0	0.0	0.0	ERR	ERR		18	sh
Perlomyia sp.					0	0.0	0.0	ERR	ERR		18	sh
Leuctridae					0	0.0	0.0	ERR	ERR		18	sh
Capniidae/Leuctridae					0	0.0	0.0	ERR	ERR		32	sh
Amphinemura sp.					0	0.0	0.0	ERR	ERR		6	sh
Malenka sp.					0	0.0	0.0	ERR	ERR		36	sh
Nemoura sp.					0	0.0	0.0	ERR	ERR		24	sh
Visoka cataractae	1	0	0	0	1	0.0	0.3	0.5	200%	I	36	sh
Zapada cinctipes	53	13	1	0	67	2.0	16.8	24.9	149%	V	16	sh
Zapada columbiana					0	0.0	0.0	ERR	ERR		16	sh
Zapada sp.					0	0.0	0.0	ERR	ERR		16	sh
Nemouridae					0	0.0	0.0	ERR	ERR		36	sh
Yoraperla brevis					0	0.0	0.0	ERR	ERR		12	sh
Acroneuria abnormis					0	0.0	0.0	ERR	ERR		6	pr
Claassenia sabulosa					0	0.0	0.0	ERR	ERR		6	pr
Doroneuria theodora					0	0.0	0.0	ERR	ERR		18	pr
Hesperoperla pacifica					0	0.0	0.0	ERR	ERR		18	pr
Perlidae	3	1	0	0	4	0.1	1.0	1.4	141%	I	24	pr
Cultus sp.					0	0.0	0.0	ERR	ERR		12	pr
Isoperla sp.					0	0.0	0.0	ERR	ERR		24	pr
Kogotus modestus					0	0.0	0.0	ERR	ERR		18	pr
Megarcys sp.					0	0.0	0.0	ERR	ERR		24	pr
Setvena bradleyi					0	0.0	0.0	ERR	ERR		48	pr
Skwala sp.	1	0	5	2	8	0.2	2.0	2.2	108%	II	18	pr
Perlodidae	4	3	0	2	9	0.3	2.3	1.7	76%	II	48	pr
Pteronarcella sp.					0	0.0	0.0	ERR	ERR		24	sh
Pteronarcys sp.					0	0.0	0.0	ERR	ERR		24	sh
Doddsia occidentalis					0	0.0	0.0	ERR	ERR		24	sc
Taenionema sp.	4	2	0	2	8	0.2	2.0	1.6	82%	II	48	sc
Taeniopterygidae					0	0.0	0.0	ERR	ERR		48	sh
Trichoptera												
Amiocentrus sp.					0	0.0	0.0	ERR	ERR		24	cg
Brachycentrus sp.	1	1	1	0	3	0.1	0.8	0.5	67%	I	24	cf
Brachycentridae					0	0.0	0.0	ERR	ERR		24	unk
Micrasema sp.	3	0	0	1	4	0.1	1.0	1.4	141%	I	24	sh
Agapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Anagapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Glossosoma sp.	28	6	2	21	57	1.7	14.3	12.3	86%	IV	24	sc
Glossosomatidae					0	0.0	0.0	ERR	ERR		24	sc
Arctopsyche grandis	2	1	0	0	3	0.1	0.8	1.0	128%	I	18	cf
Hydropsyche sp.	206	100	21	38	365	10.8	91.3	83.7	92%	VII	108	cf
Parapsyche elsis					0	0.0	0.0	ERR	ERR		6	cf
Hydropsychidae	25	9	0	0	34	1.0	8.5	11.8	139%	IV	108	cf
Agraylea sp.					0	0.0	0.0	ERR	ERR		108	cg
Hydroptila sp.					0	0.0	0.0	ERR	ERR		108	cg
Ochrotrichia sp.					0	0.0	0.0	ERR	ERR		108	cg

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Oxyethira sp.					0	0.0	0.0	ERR	ERR		108	cg
Lepidostoma sp.					0	0.0	0.0	ERR	ERR		18	sh
Apatania sp.	2	4	5	0	11	0.3	2.8	2.2	81%	II	18	sc
Chyrandra centralis					0	0.0	0.0	ERR	ERR		18	sh
Cryptochia sp.					0	0.0	0.0	ERR	ERR		108	sh
Dicosmoecus sp.					0	0.0	0.0	ERR	ERR		24	om
Ecclisomyia sp.					0	0.0	0.0	ERR	ERR		108	om
Hesperophylax sp.					0	0.0	0.0	ERR	ERR		108	om
Limnephilus sp.					0	0.0	0.0	ERR	ERR		108	sh
Onocosmoecus sp.					0	0.0	0.0	ERR	ERR		18	om
Psychoglypha sp.					0	0.0	0.0	ERR	ERR		24	om
Pycnopsyche guttifer					0	0.0	0.0	ERR	ERR		72	sh
Limnephilidae	7	14	6	6	33	1.0	8.3	3.9	47%	IV	108	unk
Neophylax sp.	0	10	8	6	24	0.7	6.0	4.3	72%	III	24	sc
Neothremma alicia					0	0.0	0.0	ERR	ERR		8	sc
Oligophlebodes sp.	0	0	1	0	1	0.0	0.3	0.5	200%	I	24	sc
Dolophilodes sp.					0	0.0	0.0	ERR	ERR		24	cf
Wormaldia sp.					0	0.0	0.0	ERR	ERR		24	cf
Philopotamidae					0	0.0	0.0	ERR	ERR		24	cf
Rhyacophila acropedes					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Alberta grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Angelita grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Betteni grp.	3	1	1	0	5	0.1	1.3	1.3	101%	I	18	pr
Rhyacophila Bifila grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Brunnea grp.	9	10	6	2	27	0.8	6.8	3.6	53%	III	18	pr
Rhyacophila Coloradensis grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila hyalinata	1	0	0	0	1	0.0	0.3	0.5	200%	I	18	pr
Rhyacophila iranda					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Sibirica grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila tucula					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vaccua	3	0	0	0	3	0.1	0.8	1.5	200%	I	18	pr
Rhyacophila vepulsa					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Verrula grp.	1	0	0	0	1	0.0	0.3	0.5	200%	I	18	pr
Rhyacophila sp.	0	1	0	0	1	0.0	0.3	0.5	200%	I	18	pr
Trichopteran pupae	1	0	0	2	3	0.1	0.8	1.0	128%	I	nn	unk
Other												
Diptera												
Atherix sp.					0	0.0	0.0	ERR	ERR		24	pr
Agathon sp.					0	0.0	0.0	ERR	ERR		2	sc
Dioptopsis sp.					0	0.0	0.0	ERR	ERR		2	sc
Blephariceridae					0	0.0	0.0	ERR	ERR		2	sc
Ceratapogonidae	0	4	2	0	6	0.2	1.5	1.9	128%	II	108	pr
Chironomidae	21	28	10	15	74	2.2	18.5	7.8	42%	V	108	cg
Culicidae					0	0.0	0.0	ERR	ERR		108	cg
Dixidae					0	0.0	0.0	ERR	ERR		108	cg
Chelifera sp.	1	0	0	1	2	0.1	0.5	0.6	115%	I	95	pr
Clinocera sp.					0	0.0	0.0	ERR	ERR		95	pr
Oreogeton sp.					0	0.0	0.0	ERR	ERR		95	pr
Limnophora sp.					0	0.0	0.0	ERR	ERR		108	pr
Glutops rossi					0	0.0	0.0	ERR	ERR		110	pr
Psychodidae	1	0	1	2	4	0.1	1.0	0.8	82%	I	36	cg
Simuliidae	1	0	0	0	1	0.0	0.3	0.5	200%	I	108	cf
Antocha sp.	13	8	6	0	27	0.8	6.8	5.4	80%	III	24	cg
Dicranota sp.					0	0.0	0.0	ERR	ERR		24	pr
Hexatoma sp.	0	2	1	2	5	0.1	1.3	1.0	77%	I	36	pr
Pedicia sp.					0	0.0	0.0	ERR	ERR		72	pr
Molophilus sp.					0	0.0	0.0	ERR	ERR		72	unk
Pedicia sp.					0	0.0	0.0	ERR	ERR		36	om
Tipula sp.					0	0.0	0.0	ERR	ERR		36	om
Limnophila sp.					0	0.0	0.0	ERR	ERR		72	pr
Tipulidae					0	0.0	0.0	ERR	ERR		72	unk
Coleoptera												
Curculionidae					0	0.0	0.0	ERR	ERR		nn	sh
Hydaticus sp.					0	0.0	0.0	ERR	ERR		72	pr
Dytiscidae					0	0.0	0.0	ERR	ERR		72	pr
Cleptelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Dubiraphia sp.	0	0	0	1	1	0.0	0.3	0.5	200%	I	104	cg
Heterlimnius sp.	4	4	10	4	22	0.7	5.5	3.0	55%	III	104	cg
Lara sp.					0	0.0	0.0	ERR	ERR		104	cg
Narpus sp.					0	0.0	0.0	ERR	ERR		104	cg
Optioservus sp.					0	0.0	0.0	ERR	ERR		104	cg
Rhizelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Stenelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Zaitzevia sp.					0	0.0	0.0	ERR	ERR		104	cg
Elmidae	0	2	1	0	3	0.1	0.8	1.0	128%	I	104	cg
Brychius sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplus sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplidae					0	0.0	0.0	ERR	ERR		54	unk

No.5--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L1, 4 Hess samples)

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Hydrophilidae					0	0.0	0.0	ERR	ERR		72	pr
Miscellaneous												
Corixidae					0	0.0	0.0	ERR	ERR		108	unk
Gerridae					0	0.0	0.0	ERR	ERR		72	pr
Hemiptera					0	0.0	0.0	ERR	ERR		72	unk
Lepidoptera					0	0.0	0.0	ERR	ERR		nn	sh
Annelida(Oligochaeta)	2	1	0	1	4	0.1	1.0	0.8	82%	I	108	cg
Annelida(Hirudinea)					0	0.0	0.0	ERR	ERR		108	pr
Mollusca-Sphaeridae					0	0.0	0.0	ERR	ERR		108	cg
Pelecypoda					0	0.0	0.0	ERR	ERR		108	cf
Lymnaea sp.					0	0.0	0.0	ERR	ERR		108	cg
Helisoma sp.					0	0.0	0.0	ERR	ERR		108	sc
Physa sp.					0	0.0	0.0	ERR	ERR		108	cg
Gastropoda					0	0.0	0.0	ERR	ERR		108	sc
Hydracarina	0	1	0	2	3	0.1	0.8	1.0	128%	I	108	pr
Nematoda	4	0	0	1	5	0.1	1.3	1.9	151%	I	108	om
Ostracoda					0	0.0	0.0	ERR	ERR		108	cg
Turbellaria	4	4	5	1	14	0.4	3.5	1.7	49%	III	108	cg
TOTALS	966	1009	790	613	3378							

TOTAL NUMBER =	3378
TOTAL TAXA =	48
MEAN NO. =	845
STD (N-1) =	181.1
%COEF.VAR. =	21.44%
% SE MEAN =	12.61%
SHANNON DIV. =	3.21
SEN.RATIO =	0.792
EPT ABUND =	3207
EPT % =	94.9%
EPT TAXA TOTAL =	34
BAET/EPHEM =	0.06
EPT/CHIRON =	43.34
SC TOTAL =	1604
SC % =	47.5%
SH TOTAL =	205
SH % =	6.1%
CG TOTAL =	901
CG % =	26.7%
CF TOTAL =	406
CF % =	12.0%
PR TOTAL =	221
PR % =	6.5%
OM TOTAL =	5
OM % =	0.1%
UNK TOTAL =	38
UNK % =	1.1%
SC/CF =	3.95
SC/(SC+CF) =	0.798
SC/TOTAL =	0.475
SH/TOTAL =	0.061
CG/TOTAL =	0.267
CF/TOTAL =	0.120

EPHEM TOTAL=	2255
EPHEM %=	66.8%
PLEC TOTAL=	376
PLEC %=	11.1%
TRIC TOTAL=	576
TRIC %=	17.1%
OTHER TOTAL=	171
OTHER %=	5.1%

DOMINANT TAXA:
1--Cinygmula sp.--44.3%
2--Hydropsyche sp.--10.6%
3--Paraleptophlebia sp.--6.5%
4--Rhithrogena sp.--6.4%
5--Ephemerellidae sp.--5.4%
6--Sweltsa/Suwallia sp.--4.3%
7--Baetis sp.--3.9%
8--Capniidae sp.--3.0%
9--Chironomidae--2.2%
10--Zapada cinctipes--2.0%

ABUNDANCE CLASS TOTALS:

I--	47.9%
II--	12.5%
III--	10.4%
IV--	8.3%
V--	6.3%
VI--	10.4%
VII--	2.1%
VIII--	0.0%
IX--	2.1%
X--	0.0%
total=	100%

No.6--Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L1, 1 Kick sample)

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Ephemeroptera												
Baetis sp.	53				53	2.0	53.0	ERR	ERR	VI	72	cg
Diphetor sp.					0	0.0	0.0	ERR	ERR		72	cg
Caudatella sp.					0	0.0	0.0	ERR	ERR		48	cg
Caudatella edmundsi					0	0.0	0.0	ERR	ERR		48	cg
Caudatella hystrix					0	0.0	0.0	ERR	ERR		48	cg
D. coloradensis/flavilinea					0	0.0	0.0	ERR	ERR		18	cg
Drunella doddsi					0	0.0	0.0	ERR	ERR		4	cg
Drunella grandis					0	0.0	0.0	ERR	ERR		24	cg
Drunella spinifera	1				1	0.0	1.0	ERR	ERR	I	24	pr
Drunella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp./Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerellidae	222				222	8.3	222.0	ERR	ERR	VIII	48	cg
Cinygma sp.					0	0.0	0.0	ERR	ERR		48	sc
Cinygmula sp.	1247				1247	46.8	1247.0	ERR	ERR	VI	21	sc
Epeorus sp.	4				4	0.2	4.0	ERR	ERR	III	21	sc
Heptagenia sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp.					0	0.0	0.0	ERR	ERR		48	sc
Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp./Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Rhithrogena sp.	106				106	4.0	106.0	ERR	ERR	VII	21	cg
Heptageniidae					0	0.0	0.0	ERR	ERR		48	sc
Paraleptophlebia sp.	236				236	8.9	236.0	ERR	ERR	VIII	24	cg
Ameletus sp.	1				1	0.0	1.0	ERR	ERR	I	48	cg
Plecoptera							0.0					
Capniidae	25				25	0.9	25.0	ERR	ERR	V	32	sh
Kathroperla perdita					0	0.0	0.0	ERR	ERR		24	cg
Sweltsa/Suwallia sp.	50				50	1.9	50.0	ERR	ERR	VI	24	pr
Chloroperlidae						0.0	0.0	ERR	ERR		nn	pr
Despaxia augusta	7				7	0.3	7.0	ERR	ERR	III	18	sh
Paraleuctra sp.					0	0.0	0.0	ERR	ERR		18	sh
Perlomyia sp.					0	0.0	0.0	ERR	ERR		18	sh
Leuctridae					0	0.0	0.0	ERR	ERR		18	sh
Capniidae/Leuctridae					0	0.0	0.0	ERR	ERR		32	sh
Amphinemura sp.					0	0.0	0.0	ERR	ERR		6	sh
Malenka sp.					0	0.0	0.0	ERR	ERR		36	sh
Nemoura sp.					0	0.0	0.0	ERR	ERR		24	sh
Visoka cataractae	2				2	0.1	2.0	ERR	ERR	II	36	sh
Zapada cinctipes	89				89	3.3	89.0	ERR	ERR	VII	16	sh
Zapada columbiana					0	0.0	0.0	ERR	ERR		16	sh
Zapada sp.					0	0.0	0.0	ERR	ERR		16	sh
Nemouridae					0	0.0	0.0	ERR	ERR		36	sh
Yoraperla brevis					0	0.0	0.0	ERR	ERR		12	sh
Acroneuria abnormis					0	0.0	0.0	ERR	ERR		6	pr
Claassenia sabulosa					0	0.0	0.0	ERR	ERR		6	pr
Doroneuria theodora	5				5	0.2	5.0	ERR	ERR	III	18	pr
Hesperoperla pacifica					0	0.0	0.0	ERR	ERR		18	pr
Perlidae					0	0.0	0.0	ERR	ERR		24	pr
Cultus sp.					0	0.0	0.0	ERR	ERR		12	pr
Isoperla sp.					0	0.0	0.0	ERR	ERR		24	pr
Kogotus modestus					0	0.0	0.0	ERR	ERR		18	pr
Megarcys sp.					0	0.0	0.0	ERR	ERR		24	pr
Setvena bradleyi					0	0.0	0.0	ERR	ERR		48	pr
Skwala sp.	11				11	0.4	11.0	ERR	ERR	IV	16	pr
Perlodidae	23				23	0.9	23.0	ERR	ERR	V	48	pr
Pteronarcella sp.					0	0.0	0.0	ERR	ERR		24	sh
Pteronarcys sp.					0	0.0	0.0	ERR	ERR		24	sh
Doddsia occidentalis					0	0.0	0.0	ERR	ERR		24	sc
Taenionema sp.	3				3	0.1	3.0	ERR	ERR	II	48	sc
Taeniopterygidae					0	0.0	0.0	ERR	ERR		48	sh
Trichoptera							0.0					
Amiocentrus sp.					0	0.0	0.0	ERR	ERR		24	cg
Brachycentrus sp.	2				2	0.1	2.0	ERR	ERR	II	24	cf
Brachycentridae					0	0.0	0.0	ERR	ERR		24	unk
Micrasema sp.	14				14	0.5	14.0	ERR	ERR	IV	24	sh
Agapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Anagapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Glossosoma sp.	26				26	1.0	26.0	ERR	ERR	V	24	sc
Glossosomatidae					0	0.0	0.0	ERR	ERR		24	sc
Arctopsyche grandis	6				6	0.2	6.0	ERR	ERR	III	18	cf
Hydropsyche sp.	167				167	6.3	167.0	ERR	ERR	VIII	108	cf
Parapsyche elsis					0	0.0	0.0	ERR	ERR		6	cf
Hydropsychidae	13				13	0.5	13.0	ERR	ERR	IV	108	cf
Agraylea sp.					0	0.0	0.0	ERR	ERR		108	cg
Hydroptila sp.					0	0.0	0.0	ERR	ERR		108	cg
Ochrotrichia sp.					0	0.0	0.0	ERR	ERR		108	cg

	Total	Number	In Each	Replicate	Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Oxyethira sp.					0	0.0	0.0	ERR	ERR		108	cg
Lepidostoma sp.					0	0.0	0.0	ERR	ERR		18	sh
Apatania sp.	2				2	0.1	2.0	ERR	ERR	II	18	sc
Chyrandra centralis					0	0.0	0.0	ERR	ERR		18	sh
Cryptochia sp.					0	0.0	0.0	ERR	ERR		108	sh
Dicosmoecus sp.					0	0.0	0.0	ERR	ERR		24	om
Ecclisomyia sp.					0	0.0	0.0	ERR	ERR		108	om
Hesperophylax sp.					0	0.0	0.0	ERR	ERR		108	om
Limnephilus sp.					0	0.0	0.0	ERR	ERR		108	sh
Onocosmoecus sp.					0	0.0	0.0	ERR	ERR		18	om
Psychoglypha sp.					0	0.0	0.0	ERR	ERR		24	om
Pycnopsyche guttifer					0	0.0	0.0	ERR	ERR		72	sh
Limnephilidae	40				40	1.5	40.0	ERR	ERR	VI	108	unk
Neophylax sp.	19				19	0.7	19.0	ERR	ERR	V	24	sc
Neothremma alicia					0	0.0	0.0	ERR	ERR		8	sc
Oligophlebodes sp.	10				10	0.4	10.0	ERR	ERR	IV	24	sc
Dolophilodes sp.					0	0.0	0.0	ERR	ERR		24	cf
Wormaldia sp.					0	0.0	0.0	ERR	ERR		24	cf
Philopotamidae					0	0.0	0.0	ERR	ERR		24	cf
Rhyacophila acropedes					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Alberta grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Angelita grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Betteni grp.	1				1	0.0	1.0	ERR	ERR	I	18	pr
Rhyacophila Bifila grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Brunnea grp.	46				46	1.7	46.0	ERR	ERR	VI	18	pr
Rhyacophila Coloradensis grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila hyalinata					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila iranda					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Sibirica grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila tucula					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vaccua					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vepulsa					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Verrula grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila sp.	1				1	0.0	1.0	ERR	ERR	I	18	pr
Trichopteran pupae	3				3	0.1	3.0	ERR	ERR	II	nn	unk
Other							0.0					
Diptera							0.0					
Atherix sp.					0	0.0	0.0	ERR	ERR		24	pr
Agathon sp.					0	0.0	0.0	ERR	ERR		2	sc
Dioptopsis sp.					0	0.0	0.0	ERR	ERR		2	sc
Blephariceridae					0	0.0	0.0	ERR	ERR		2	sc
Ceratapogonidae	1				1	0.0	1.0	ERR	ERR	I	108	pr
Chironomidae	101				101	3.8	101.0	ERR	ERR	VII	108	cg
Culicidae					0	0.0	0.0	ERR	ERR		108	cg
Dixidae					0	0.0	0.0	ERR	ERR		108	cg
Chelifera sp.					0	0.0	0.0	ERR	ERR		95	pr
Clinocera sp.					0	0.0	0.0	ERR	ERR		95	pr
Oreogeton sp.					0	0.0	0.0	ERR	ERR		95	pr
Limnophora sp.					0	0.0	0.0	ERR	ERR		108	pr
Glutops rossi					0	0.0	0.0	ERR	ERR		110	pr
Psychodidae	1				1	0.0	1.0	ERR	ERR	I	36	cg
Simuliidae					0	0.0	0.0	ERR	ERR		108	cf
Antocha sp.	64				64	2.4	64.0	ERR	ERR	VII	24	cg
Dicranota sp.					0	0.0	0.0	ERR	ERR		24	pr
Hexatoma sp.	3				3	0.1	3.0	ERR	ERR	II	36	pr
Pedicia sp.					0	0.0	0.0	ERR	ERR		72	pr
Molophilus sp.					0	0.0	0.0	ERR	ERR		72	unk
Pedicia sp.					0	0.0	0.0	ERR	ERR		36	om
Tipula sp.					0	0.0	0.0	ERR	ERR		36	om
Limnophila sp.					0	0.0	0.0	ERR	ERR		72	pr
Tipulidae					0	0.0	0.0	ERR	ERR		72	unk
Coleoptera					0		0.0					
Curculionidae					0	0.0	0.0	ERR	ERR		nn	sh
Hydaticus sp.					0	0.0	0.0	ERR	ERR		72	pr
Dytiscidae					0	0.0	0.0	ERR	ERR		72	pr
Cleptelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Dubiraphia sp.					0	0.0	0.0	ERR	ERR		104	cg
Heterlimnius sp.	24				24	0.9	24.0	ERR	ERR	V	104	cg
Lara sp.	2				2	0.1	2.0	ERR	ERR	II	104	cg
Narpus sp.					0	0.0	0.0	ERR	ERR		104	cg
Optioservus sp.					0	0.0	0.0	ERR	ERR		104	cg
Rhizelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Stenelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Zaitzevia sp.					0	0.0	0.0	ERR	ERR		104	cg
Elmidae	4				4	0.2	4.0	ERR	ERR	III	104	cg
Brychius sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplus sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplidae					0	0.0	0.0	ERR	ERR		54	unk

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Hydrophilidae					0	0.0	0.0	ERR	ERR		72	pr
Miscellaneous							0.0					
Corixidae					0	0.0	0.0	ERR	ERR		108	unk
Gerridae					0	0.0	0.0	ERR	ERR		72	pr
Hemiptera					0	0.0	0.0	ERR	ERR		72	unk
Lepidoptera					0	0.0	0.0	ERR	ERR		nn	sh
Annelida(Oligochaeta)					0	0.0	0.0	ERR	ERR		108	cg
Annelida(Hirudinea)					0	0.0	0.0	ERR	ERR		108	pr
Mollusca-Sphaeridae					0	0.0	0.0	ERR	ERR		108	cg
Pelecypoda					0	0.0	0.0	ERR	ERR		108	cf
Lymnaea sp.					0	0.0	0.0	ERR	ERR		108	cg
Helisoma sp.					0	0.0	0.0	ERR	ERR		108	sc
Physa sp.					0	0.0	0.0	ERR	ERR		108	cg
Gastropoda					0	0.0	0.0	ERR	ERR		108	sc
Hydracarina	16				16	0.6	16.0	ERR	ERR	V	108	pr
Nematoda	4				4	0.2	4.0	ERR	ERR	III	108	om
Ostracoda					0	0.0	0.0	ERR	ERR		108	cg
Turbellaria	7				7	0.3	7.0	ERR	ERR	III	108	cg
TOTALS	2662	0	0	0	2662							

TOTAL NUMBER =	2662
TOTAL TAXA =	42
MEAN NO. =	2662
STD (N-1) =	1331.0
%COEF.VAR. =	50.00%
% SE MEAN =	50.00%
SHANNON DIV. =	3.14
SEN.RATIO =	0.837
EPT ABUND =	2435
EPT % =	91.5%
EPT TAXA TOTAL =	31
BAET/EPHEM =	0.03
EPT/CHIRON =	24.11
SC TOTAL =	1311
SC % =	49.2%
SH TOTAL =	137
SH % =	5.1%
CG TOTAL =	821
CG % =	30.8%
CF TOTAL =	188
CF % =	7.1%
PR TOTAL =	158
PR % =	5.9%
OM TOTAL =	4
OM % =	0.2%
UNK TOTAL =	43
UNK % =	1.6%
SC/CF =	6.97
SC/(SC+CF) =	0.875
SC/TOTAL =	0.492
SH/TOTAL =	0.051
CG/TOTAL =	0.308
CF/TOTAL =	0.071

EPHEM TOTAL=	1870
EPHEM %=	70.2%
PLEC TOTAL=	215
PLEC %=	8.1%
TRIC TOTAL=	350
TRIC %=	13.1%
OTHER TOTAL=	227
OTHER %=	8.5%

DOMINANT TAXA:
1--Cinygmula sp.--46.8%
2--Paraleptophlebia sp.--8.9%
3--Ephemerellidae--8.3%
4--Hydropsyche sp.--6.3%
5--Rhithrogena sp.--4.0%
6--Chironomidae--3.8%
7--Zapada cinctipes--3.3%
8--Antocha--2.4%
9--Baetis sp.--2.0%
10--Sweltsa/Suwallia sp.--1.9%

ABUNDANCE CLASS TOTALS:

I--	14.3%
II--	16.7%
III--	16.7%
IV--	9.5%
V--	14.3%
VI--	11.9%
VII--	9.5%
VIII--	7.1%
IX--	0.0%
X--	0.0%
total=	100%

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Ephemeroptera												
Baetis sp.	151	78	49	48	326	2.8	27.2	48.4	178%	V	72	cg
Diphetor sp.					0	0.0	0.0	ERR	ERR		72	cg
Caudatella sp.	0	0	0	2	2	0.0	0.2	1.0	600%	I	48	cg
Caudatella edmundsi					0	0.0	0.0	ERR	ERR		48	cg
Caudatella hystrix					0	0.0	0.0	ERR	ERR		48	cg
D. coloradensis/flavilinea					0	0.0	0.0	ERR	ERR		18	cg
Drunella doddsi	16	36	21	9	82	0.7	6.8	11.4	167%	III	4	cg
Drunella grandis					0	0.0	0.0	ERR	ERR		24	cg
Drunella spinifera	11	1	0	10	22	0.2	1.8	5.8	316%	II	24	pr
Drunella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp.	4	0	0	0	4	0.0	0.3	2.0	600%	I	48	cg
Serratella sp./Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerellidae	145	46	46	59	296	2.5	24.7	47.7	193%	V	48	cg
Cinygma sp.					0	0.0	0.0	ERR	ERR		48	sc
Cinygmula sp.	795	745	747	737	3024	25.9	252.0	26.4	10%	VIII	21	sc
Epeorus sp.	11	3	15	17	46	0.4	3.8	6.2	162%	III	21	sc
Heptagenia sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp.					0	0.0	0.0	ERR	ERR		48	sc
Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp./Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Rhithrogena sp.	105	164	62	70	401	3.4	33.4	46.4	139%	VI	21	cg
Heptageniidae					0	0.0	0.0	ERR	ERR		48	sc
Paraleptophlebia sp.	51	60	57	54	222	1.9	18.5	3.9	21%	V	24	cg
Ameletus sp.	20	3	24	1	48	0.4	4.0	11.7	292%	III	48	cg
Plecoptera												
Capniidae	56	39	21	15	131	1.1	10.9	18.6	170%	IV	32	sh
Kathroperla perdita					0	0.0	0.0	ERR	ERR		24	cg
Sweltsa/Suwallia sp.	107	124	108	82	421	3.6	35.1	17.3	49%	VI	24	pr
Chloroperlidae					0	0.0	0.0	ERR	ERR		nn	pr
Despaxia augusta	10	31	23	16	80	0.7	6.7	9.1	136%	III	18	sh
Paraleuctra sp.					0	0.0	0.0	ERR	ERR		18	sh
Perlomyia sp.					0	0.0	0.0	ERR	ERR		18	sh
Leuctridae					0	0.0	0.0	ERR	ERR		18	sh
Capniidae/Leuctridae					0	0.0	0.0	ERR	ERR		32	sh
Amphinemura sp.					0	0.0	0.0	ERR	ERR		6	sh
Malenka sp.					0	0.0	0.0	ERR	ERR		36	sh
Nemoura sp.					0	0.0	0.0	ERR	ERR		24	sh
Visoka cataractae	1	10	2	0	13	0.1	1.1	4.6	422%	I	36	sh
Zapada cinctipes	68	14	1	4	87	0.7	7.3	31.3	432%	III	16	sh
Zapada columbiana	56	172	36	87	351	3.0	29.3	60.0	205%	V	16	sh
Zapada sp.	82	54	14	27	177	1.5	14.8	30.2	205%	IV	16	sh
Nemouridae					0	0.0	0.0	ERR	ERR		36	sh
Yoraperla brevis	13	5	2	17	37	0.3	3.1	6.9	225%	II	12	sh
Acroneuria abnormis					0	0.0	0.0	ERR	ERR		6	pr
Claassenia sabulosa					0	0.0	0.0	ERR	ERR		6	pr
Doroneuria theodora	0	2	1	0	3	0.0	0.3	1.0	383%	I	18	pr
Hesperoperla pacifica					0	0.0	0.0	ERR	ERR		18	pr
Perlidae	4	4	2	8	18	0.1	1.3	1.6	122%	I	24	pr
Cultus sp.					0	0.0	0.0	ERR	ERR		12	pr
Isoperla sp.	2	0	1	0	3	0.0	0.3	1.0	383%	I	24	pr
Kogotus modestus					0	0.0	0.0	ERR	ERR		18	pr
Megarcys sp.	11	3	5	6	25	0.2	2.1	3.4	163%	II	24	pr
Setvena bradleyi					0	0.0	0.0	ERR	ERR		48	pr
Skwala sp.	1	0	5	2	8	0.1	0.7	2.2	324%	I	18	pr
Perlodidae	19	15	0	24	58	0.5	4.8	10.3	214%	III	48	pr
Pteronarcella sp.					0	0.0	0.0	ERR	ERR		24	sh
Pteronarcys sp.					0	0.0	0.0	ERR	ERR		24	sh
Doddsia occidentalis					0	0.0	0.0	ERR	ERR		24	sc
Taenionema sp.	133	299	181	276	889	7.6	74.1	78.4	106%	VII	48	sc
Taeniopterygidae					0	0.0	0.0	ERR	ERR		48	sh
Trichoptera												
Amiocentrus sp.					0	0.0	0.0	ERR	ERR		24	cg
Brachycentrus sp.	2	1	2	0	5	0.0	0.4	1.0	230%	I	24	cf
Brachycentridae					0	0.0	0.0	ERR	ERR		24	unk
Micrasema sp.	3	1	0	1	5	0.0	0.4	1.3	302%	I	24	sh
Agapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Anagapetus sp.	29	29	14	23	95	0.8	7.9	7.1	90%	IV	24	sc
Glossosoma sp.	201	198	98	395	892	7.6	74.3	124.3	167%	VII	24	sc
Glossosomatidae					0	0.0	0.0	ERR	ERR		24	sc
Arctopsyche grandis	4	3	0	0	7	0.1	0.6	2.1	353%	I	18	cf
Hydropsyche sp.	207	100	21	38	366	3.1	30.5	84.2	276%	V	108	cf
Parapsyche elsis	3	36	7	11	57	0.5	4.8	14.9	313%	III	6	cf
Hydropsychidae	29	64	18	25	136	1.2	11.3	20.5	181%	IV	108	cf
Agraylea sp.	237	36	45	46	364	3.1	30.3	97.4	321%	V	108	cg
Hydroptila sp.					0	0.0	0.0	ERR	ERR		108	cg
Ochrotrichia sp.					0	0.0	0.0	ERR	ERR		108	cg

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Oxyethira sp.					0	0.0	0.0	ERR	ERR		108	cg
Lepidostoma sp.					0	0.0	0.0	ERR	ERR		18	sh
Apatania sp.	2	4	5	0	11	0.1	0.9	2.2	242%	I	18	sc
Chyrandra centralis					0	0.0	0.0	ERR	ERR		18	sh
Cryptochia sp.					0	0.0	0.0	ERR	ERR		108	sh
Dicosmoecus sp.					0	0.0	0.0	ERR	ERR		24	om
Ecclisomyia sp.	0	0	1	0	1	0.0	0.1	0.5	600%	I	108	om
Hesperophylax sp.					0	0.0	0.0	ERR	ERR		108	om
Limnephilus sp.					0	0.0	0.0	ERR	ERR		108	sh
Onocosmoecus sp.					0	0.0	0.0	ERR	ERR		18	om
Psychoglypha sp.					0	0.0	0.0	ERR	ERR		24	om
Pycnopsyche guttifer					0	0.0	0.0	ERR	ERR		72	sh
Limnephilidae	14	22	7	9	52	0.4	4.3	6.7	154%	III	108	unk
Neophylax sp.	0	15	9	6	30	0.3	2.5	6.2	250%	II	24	sc
Neothremma alicia	2	0	0	0	2	0.0	0.2	1.0	600%	I	8	sc
Oligophlebodes sp.	2	3	2	1	8	0.1	0.7	0.8	122%	I	24	sc
Dolophilodes sp.					0	0.0	0.0	ERR	ERR		24	cf
Wormaldia sp.					0	0.0	0.0	ERR	ERR		24	cf
Philopotamidae					0	0.0	0.0	ERR	ERR		24	cf
Rhyacophila acropedes					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Alberta grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Angelita grp.	0	3	4	0	7	0.1	0.6	2.1	353%	II	18	pr
Rhyacophila Betteni grp.	22	57	25	29	133	1.1	11.1	16.1	145%	IV	18	pr
Rhyacophila Bifila grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Brunnea grp.	10	11	6	3	30	0.3	2.5	3.7	148%	II	18	pr
Rhyacophila Coloradensis grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila hyalinata	2	0	0	1	3	0.0	0.3	1.0	383%	I	18	pr
Rhyacophila iranda	2	8	1	8	19	0.2	1.6	3.8	236%	II	18	pr
Rhyacophila Sibirica grp.	0	1	1	2	4	0.0	0.3	0.8	245%	I	18	pr
Rhyacophila tucula					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vaccua	3	2	0	0	5	0.0	0.4	1.5	360%	I	18	pr
Rhyacophila vepulsa	4	2	1	7	14	0.1	1.2	2.6	227%	I	18	pr
Rhyacophila Verrula grp.	1	0	0	0	1	0.0	0.1	0.5	600%	I	18	pr
Rhyacophila sp.	4	1	8	10	23	0.2	1.9	4.0	210%	II	18	pr
Trichopteran pupae	1	0	2	2	5	0.0	0.4	1.0	230%	I	nn	unk
Other												
Diptera												
Atherix sp.					0	0.0	0.0	ERR	ERR		24	pr
Agathon sp.					0	0.0	0.0	ERR	ERR		2	sc
Dioptopsis sp.					0	0.0	0.0	ERR	ERR		2	sc
Blephariceridae					0	0.0	0.0	ERR	ERR		2	sc
Ceratapogonidae	0	4	2	0	6	0.1	0.5	1.9	383%	I	108	pr
Chironomidae	787	526	405	566	2284	19.4	188.7	150.5	80%	VIII	108	cg
Culicidae					0	0.0	0.0	ERR	ERR		108	cg
Dixidae					0	0.0	0.0	ERR	ERR		108	cg
Chelifera sp.	1	0	0	1	2	0.0	0.2	0.6	346%	I	95	pr
Clinocera sp.	2	1	0	4	7	0.1	0.6	1.7	293%	I	95	pr
Oreogeton sp.	5	9	13	8	35	0.3	2.9	3.3	113%	II	95	pr
Limnophora sp.					0	0.0	0.0	ERR	ERR		108	pr
Glutops rossi					0	0.0	0.0	ERR	ERR		110	pr
Psychodidae	1	0	1	2	4	0.0	0.3	0.8	245%	I	36	cg
Simuliidae	1	1	0	0	2	0.0	0.2	0.6	346%	I	108	cf
Antocha sp.	13	8	6	0	27	0.2	2.3	5.4	239%	II	24	cg
Dicranota sp.	7	2	2	1	12	0.1	1.0	2.7	271%	I	24	pr
Hexatoma sp.	0	2	1	3	6	0.1	0.5	1.3	258%	I	36	pr
Pedicia sp.					0	0.0	0.0	ERR	ERR		72	pr
Molophilus sp.					0	0.0	0.0	ERR	ERR		72	unk
Pedicia sp.					0	0.0	0.0	ERR	ERR		36	om
Tipula sp.					0	0.0	0.0	ERR	ERR		36	om
Limnophila sp.					0	0.0	0.0	ERR	ERR		72	pr
Tipulidae					0	0.0	0.0	ERR	ERR		72	unk
Coleoptera												
Curculionidae					0	0.0	0.0	ERR	ERR		nn	sh
Hydaticus sp.					0	0.0	0.0	ERR	ERR		72	pr
Dytiscidae					0	0.0	0.0	ERR	ERR		72	pr
Cleptelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Dubiraphia sp.	0	0	0	1	1	0.0	0.1	0.5	600%	I	104	cg
Heterlimnius sp.	5	5	12	6	28	0.2	2.3	3.4	144%	II	104	cg
Lara sp.	0	1	0	0	1	0.0	0.1	0.5	600%	I	104	cg
Narpus sp.					0	0.0	0.0	ERR	ERR		104	cg
Optioservus sp.					0	0.0	0.0	ERR	ERR		104	cg
Rhizelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Stenelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Zaitzevia sp.					0	0.0	0.0	ERR	ERR		104	cg
Elmidae	0	2	1	0	3	0.0	0.3	1.0	383%	I	104	cg
Brychius sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplus sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplidae					0	0.0	0.0	ERR	ERR		54	unk

No.7-Macroinvertebrate Data--Montanore Project, October 1994, Libby Creek (L10, L9, L1--12 Hess samples)

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Hydrophilidae					0	0.0	0.0	ERR	ERR		72	pr
Miscellaneous												
Corixidae					0	0.0	0.0	ERR	ERR		108	unk
Gerridae					0	0.0	0.0	ERR	ERR		72	pr
Hemiptera					0	0.0	0.0	ERR	ERR		72	unk
Lepidoptera					0	0.0	0.0	ERR	ERR		nn	sh
Annelida(Oligochaeta)	7	9	10	7	33	0.3	2.8	1.5	55%	II	108	cg
Annelida(Hirudinea)					0	0.0	0.0	ERR	ERR		108	pr
Mollusca-Sphaeridae					0	0.0	0.0	ERR	ERR		108	cg
Pelecypoda					0	0.0	0.0	ERR	ERR		108	cf
Lymnaea sp.					0	0.0	0.0	ERR	ERR		108	cg
Helisoma sp.					0	0.0	0.0	ERR	ERR		108	sc
Physa sp.					0	0.0	0.0	ERR	ERR		108	cg
Gastropoda					0	0.0	0.0	ERR	ERR		108	sc
Hydracarina	26	24	14	10	74	0.6	6.2	7.7	125%	III	108	pr
Nematoda	4	1	0	1	6	0.1	0.5	1.7	346%	II	108	om
Ostracoda					0	0.0	0.0	ERR	ERR		108	cg
Turbellaria	32	63	24	18	137	1.2	11.4	20.0	175%	IV	108	cg
TOTALS	3527	3163	2191	2814	11695							

TOTAL NUMBER = 11695
TOTAL TAXA = 70
MEAN NO. = 975
STD (N-1) = 568.7
%COEF.VAR. = xxx
% SE MEAN = xxx
SHANNON DIV. = xxx
SEN.RATIO = xxx
EPT ABUND = 9047
EPT % = 77.4%
EPT TAXA TOTAL = 52
BAET/EPHEM = 0.07
EPT/CHIRON = 4.00
SC TOTAL = 4997
SC % = 42.7%
SH TOTAL = 881
SH % = 7.5%
CG TOTAL = 4243
CG % = 36.3%
CF TOTAL = 573
CF % = 4.9%
PR TOTAL = 937
PR % = 8.0%
OM TOTAL = 7
OM % = 0.1%
UNK TOTAL = 57
UNK % = 0.5%
SC/CF = 8.72
SC/(SC+CF) = 0.897
SC/TOTAL = 0.427
SH/TOTAL = 0.075
CG/TOTAL = 0.363
CF/TOTAL = 0.049

EPHEM TOTAL= 4473
EPHEM %= 38.2%
PLEC TOTAL= 2299
PLEC %= 19.7%
TRIC TOTAL= 2275
TRIC %= 19.5%
OTHER TOTAL= 2648
OTHER %= 22.6%

DOMINANT TAXA:
1--Cinygmula sp.--25.9%
2--Chironomidae--19.4%
3--Glossosoma sp.--7.6%
4--Taenionema sp.--7.6%
5--Sweltsa/Suwallia sp.--3.6%
6--Rhithrogena sp.--3.4%
7--Hydropsyche sp.--3.1%
8--Agraylea sp.--3.1%
9--Zapada columbiana--3.0%
10--Baetis sp.--2.8%

ABUNDANCE CLASS TOTALS:
I-- 45.7%
II-- 15.7%
III-- 12.9%
IV-- 8.6%
V-- 8.6%
VI-- 2.9%
VII-- 2.9%
VIII-- 2.9%
IX-- 0.0%
X-- 0.0%
total= 100%

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Ephemeroptera												
Baetis sp.	262				262	3.2	87.3	ERR	ERR	VII	72	cg
Diphetor sp.					0	0.0	0.0	ERR	ERR		72	cg
Caudatella sp.	2				2	0.0	0.7	ERR	ERR	I	48	cg
Caudatella edmundsi					0	0.0	0.0	ERR	ERR		48	cg
Caudatella hystrix					0	0.0	0.0	ERR	ERR		48	cg
D. coloradensis/flavilinea					0	0.0	0.0	ERR	ERR		18	cg
Drunella doddsi	38				38	0.5	12.7	ERR	ERR	IV	4	cg
Drunella grandis					0	0.0	0.0	ERR	ERR		24	cg
Drunella spinifera	9				9	0.1	3.0	ERR	ERR	II	24	pr
Drunella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp.					0	0.0	0.0	ERR	ERR		48	cg
Serratella sp./Ephemerella sp.					0	0.0	0.0	ERR	ERR		48	cg
Ephemerellidae	262				262	3.2	87.3	ERR	ERR	VII	48	cg
Cinygma sp.					0	0.0	0.0	ERR	ERR		48	sc
Cinygmula sp.	2621				2621	32.3	873.7	ERR	ERR	X	21	sc
Epeorus sp.	14				14	0.2	4.7	ERR	ERR	III	21	sc
Heptagenia sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp.					0	0.0	0.0	ERR	ERR		48	sc
Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Leucrocuta sp./Nixe sp.					0	0.0	0.0	ERR	ERR		48	sc
Rhithrogena sp.	218				218	2.7	72.7	ERR	ERR	VII	21	cg
Heptageniidae					0	0.0	0.0	ERR	ERR		48	sc
Paraleptophlebia sp.	238				238	2.9	79.3	ERR	ERR	VII	24	cg
Ameletus sp.	87				87	1.1	29.0	ERR	ERR	V	48	cg
Plecoptera					0		0.0					
Capniidae	68				68	0.8	22.7	ERR	ERR	V	32	sh
Kathroperla perdita					0	0.0	0.0	ERR	ERR		24	cg
Sweltsa/Suwallia sp.	169				169	2.1	56.3	ERR	ERR	VI	24	pr
Chloroperlidae					0	0.0	0.0	ERR	ERR		nn	pr
Despaxia augusta	25				25	0.3	8.3	ERR	ERR	IV	18	sh
Paraleuctra sp.					0	0.0	0.0	ERR	ERR		18	sh
Perlomyia sp.					0	0.0	0.0	ERR	ERR		18	sh
Leuctridae	3				3	0.0	1.0	ERR	ERR	I	18	sh
Capniidae/Leuctridae					0	0.0	0.0	ERR	ERR		32	sh
Amphinemura sp.					0	0.0	0.0	ERR	ERR		6	sh
Malenka sp.					0	0.0	0.0	ERR	ERR		36	sh
Nemoura sp.					0	0.0	0.0	ERR	ERR		24	sh
Visoka cataractae	14				14	0.2	4.7	ERR	ERR	III	36	sh
Zapada cinctipes	92				92	1.1	30.7	ERR	ERR	V	16	sh
Zapada columbiana	389				389	4.8	129.7	ERR	ERR	VIII	16	sh
Zapada sp.	87				87	1.1	29.0	ERR	ERR	V	18	sh
Nemouridae					0	0.0	0.0	ERR	ERR		36	sh
Yoraperla brevis	43				43	0.5	14.3	ERR	ERR	IV	12	sh
Acroneuria abnormis					0	0.0	0.0	ERR	ERR		6	pr
Claassenia sabulosa					0	0.0	0.0	ERR	ERR		6	pr
Doroneuria theodora	10				10	0.1	3.3	ERR	ERR	II	18	pr
Hesperoperla pacifica					0	0.0	0.0	ERR	ERR		18	pr
Perlidae	17				17	0.2	5.7	ERR	ERR	III	24	pr
Cultus sp.					0	0.0	0.0	ERR	ERR		12	pr
Isoperla sp.					0	0.0	0.0	ERR	ERR		24	pr
Kogotus modestus					0	0.0	0.0	ERR	ERR		18	pr
Megarcys sp.	29				29	0.4	9.7	ERR	ERR	IV	24	pr
Setvena bradleyi	3				3	0.0	1.0	ERR	ERR	I	48	pr
Skwala sp.	11				11	0.1	3.7	ERR	ERR	III	18	pr
Perlodidae	56				56	0.7	18.7	ERR	ERR	V	48	pr
Pteronarcella sp.					0	0.0	0.0	ERR	ERR		24	sh
Pteronarcys sp.					0	0.0	0.0	ERR	ERR		24	sh
Doddsia occidentalis					0	0.0	0.0	ERR	ERR		24	sc
Taenionema sp.	627				627	7.7	209.0	ERR	ERR	VIII	48	sc
Taeniopterygidae					0	0.0	0.0	ERR	ERR		48	sh
Trichoptera					0		0.0					
Amiocentrus sp.					0	0.0	0.0	ERR	ERR		24	cg
Brachycentrus sp.	2				2	0.0	0.7	ERR	ERR	I	24	cf
Brachycentridae	1				1	0.0	0.3	ERR	ERR	I	24	unk
Micrasema sp.	14				14	0.2	4.7	ERR	ERR	III	24	sh
Agapetus sp.					0	0.0	0.0	ERR	ERR		24	sc
Anagapetus sp.	39				39	0.5	13.0	ERR	ERR	IV	24	sc
Glossosoma sp.	618				618	7.6	206.0	ERR	ERR	VIII	24	sc
Glossosomatidae					0	0.0	0.0	ERR	ERR		24	sc
Arctopsyche grandis	6				6	0.1	2.0	ERR	ERR	II	18	cf
Hydropsyche sp.	167				167	2.1	55.7	ERR	ERR	VI	108	cf
Parapsyche elsis	46				46	0.6	15.3	ERR	ERR	IV	6	cf
Hydropsychidae	65				65	0.8	21.7	ERR	ERR	V	108	cf
Agraylea sp.	218				218	2.7	72.7	ERR	ERR	VII	108	cg
Hydroptila sp.					0	0.0	0.0	ERR	ERR		108	cg
Ochrotrichia sp.					0	0.0	0.0	ERR	ERR		108	cg

	Total Number In Each Replicate				Sum of							
Taxa	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Oxyethira sp.					0	0.0	0.0	ERR	ERR		108	cg
Lepidostoma sp.					0	0.0	0.0	ERR	ERR		18	sh
Apatania sp.	2				2	0.0	0.7	ERR	ERR	I	18	sc
Chyrandra centralis	2				2	0.0	0.7	ERR	ERR	I	18	sh
Cryptochia sp.					0	0.0	0.0	ERR	ERR		108	sh
Dicosmoecus sp.					0	0.0	0.0	ERR	ERR		24	om
Ecclisomyia sp.	2				2	0.0	0.7	ERR	ERR	I	108	om
Hesperophylax sp.					0	0.0	0.0	ERR	ERR		108	om
Limnephilus sp.					0	0.0	0.0	ERR	ERR		108	sh
Onocosmoecus sp.					0	0.0	0.0	ERR	ERR		18	om
Psychoglypha sp.					0	0.0	0.0	ERR	ERR		24	om
Pycnopsyche guttifer					0	0.0	0.0	ERR	ERR		72	sh
Limnephilidae	60				60	0.7	20.0	ERR	ERR	V	108	unk
Neophylax sp.	26				26	0.3	8.7	ERR	ERR	IV	24	sc
Neothremma alicia	6				6	0.1	2.0	ERR	ERR	II	8	sc
Oligophlebodes sp.	10				10	0.1	3.3	ERR	ERR	II	24	sc
Dolophilodes sp.					0	0.0	0.0	ERR	ERR		24	cf
Wormaldia sp.					0	0.0	0.0	ERR	ERR		24	cf
Philopotamidae					0	0.0	0.0	ERR	ERR		24	cf
Rhyacophila acropedes					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Alberta grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Angelita grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Betteni grp.	131				131	1.6	43.7	ERR	ERR	VI	18	pr
Rhyacophila Bifila grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila Brunnea grp.	62				62	0.8	20.7	ERR	ERR	V	18	pr
Rhyacophila Coloradensis grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila hyalinata	3				3	0.0	1.0	ERR	ERR	I	18	pr
Rhyacophila iranda	9				9	0.1	3.0	ERR	ERR	II	18	pr
Rhyacophila Sibirica grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila tucula					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vaccua					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila vepulsa	12				12	0.1	4.0	ERR	ERR	III	18	pr
Rhyacophila Verrula grp.					0	0.0	0.0	ERR	ERR		18	pr
Rhyacophila sp.	56				56	0.7	18.7	ERR	ERR	V	18	pr
Trichopteran pupae	3				3	0.0	1.0	ERR	ERR	I	nn	unk
Other					0		0.0					
Diptera					0		0.0					
Atherix sp.					0	0.0	0.0	ERR	ERR		24	pr
Agathon sp.					0	0.0	0.0	ERR	ERR		2	sc
Dioptopsis sp.					0	0.0	0.0	ERR	ERR		2	sc
Blephariceridae					0	0.0	0.0	ERR	ERR		2	sc
Ceratapogonidae	1				1	0.0	0.3	ERR	ERR	I	108	pr
Chironomidae	785				785	9.7	261.7	ERR	ERR	IX	108	cg
Culicidae					0	0.0	0.0	ERR	ERR		108	cg
Dixidae					0	0.0	0.0	ERR	ERR		108	cg
Chelifera sp.					0	0.0	0.0	ERR	ERR		95	pr
Clinocera sp.	4				4	0.0	1.3	ERR	ERR	I	95	pr
Oreogeton sp.	31				31	0.4	10.3	ERR	ERR	IV	85	pr
Limnophora sp.					0	0.0	0.0	ERR	ERR		108	pr
Glutops rossi					0	0.0	0.0	ERR	ERR		110	pr
Psychodidae	1				1	0.0	0.3	ERR	ERR	I	36	cg
Simuliidae	1				1	0.0	0.3	ERR	ERR	I	108	cf
Antocha sp.	64				64	0.8	21.3	ERR	ERR	V	24	cg
Dicranota sp.	7				7	0.1	2.3	ERR	ERR	II	24	pr
Hexatoma sp.	4				4	0.0	1.3	ERR	ERR	I	36	pr
Pedicia sp.	2				2	0.0	0.7	ERR	ERR	I	72	pr
Molophilus sp.					0	0.0	0.0	ERR	ERR		72	unk
Pedicia sp.					0	0.0	0.0	ERR	ERR		36	om
Tipula sp.					0	0.0	0.0	ERR	ERR		36	om
Limnophila sp.					0	0.0	0.0	ERR	ERR		72	pr
Tipulidae					0	0.0	0.0	ERR	ERR		72	unk
Coleoptera					0		0.0					
Curculionidae					0	0.0	0.0	ERR	ERR		nn	sh
Hydaticus sp.					0	0.0	0.0	ERR	ERR		72	pr
Dytiscidae					0	0.0	0.0	ERR	ERR		72	pr
Cleptelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Dubiraphia sp.					0	0.0	0.0	ERR	ERR		104	cg
Heterlimnius sp.	26				26	0.3	8.7	ERR	ERR	IV	104	cg
Lara sp.	2				2	0.0	0.7	ERR	ERR	I	104	cg
Narpus sp.					0	0.0	0.0	ERR	ERR		104	cg
Optioservus sp.					0	0.0	0.0	ERR	ERR		104	cg
Rhizelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Stenelmis sp.					0	0.0	0.0	ERR	ERR		104	cg
Zaitzevia sp.					0	0.0	0.0	ERR	ERR		104	cg
Elmidae	4				4	0.0	1.3	ERR	ERR	I	104	cg
Brychius sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplus sp.					0	0.0	0.0	ERR	ERR		54	sc
Haliplidae					0	0.0	0.0	ERR	ERR		54	unk

Taxa	Total Number In Each Replicate Rep. 1	Rep. 2	Rep. 3	Rep. 4	Sum of Rep.	%RA	Mean	St.Dev.	%CV	AC	TQ	FFG
Hydrophilidae					0	0.0	0.0	ERR	ERR		72	pr
Miscellaneous					0		0.0					
Corixidae					0	0.0	0.0	ERR	ERR		108	unk
Gerridae					0	0.0	0.0	ERR	ERR		72	pr
Hemiptera					0	0.0	0.0	ERR	ERR		72	unk
Lepidoptera					0	0.0	0.0	ERR	ERR		nn	sh
Annelida(Oligochaeta)	38				38	0.5	12.7	ERR	ERR	IV	108	cg
Annelida(Hirudinea)					0	0.0	0.0	ERR	ERR		108	pr
Mollusca-Sphaeridae					0	0.0	0.0	ERR	ERR		108	cg
Pelecypoda					0	0.0	0.0	ERR	ERR		108	cf
Lymnaea sp.					0	0.0	0.0	ERR	ERR		108	cg
Helisoma sp.					0	0.0	0.0	ERR	ERR		108	sc
Physa sp.					0	0.0	0.0	ERR	ERR		108	cg
Gastropoda					0	0.0	0.0	ERR	ERR		108	sc
Hydracarina	84				84	1.0	28.0	ERR	ERR	V	108	pr
Nematoda	4				4	0.0	1.3	ERR	ERR	I	108	om
Ostracoda					0	0.0	0.0	ERR	ERR		108	cg
Turbellaria	111				111	1.4	37.0	ERR	ERR	VI	108	cg
TOTALS	8123	0	0	0	8123							

TOTAL NUMBER =	8123
TOTAL TAXA =	67
MEAN NO. =	2708
STD (N-1) =	xxxx
%COEF.VAR. =	xxxx
% SE MEAN =	xxxx
SHANNON DIV. =	xxxx
SEN.RATIO =	xxxx
EPT ABUND =	6954
EPT % =	85.6%
EPT TAXA TOTAL =	50
BAET/EPHEM =	0.07
EPT/CHIRON =	8.86
SC TOTAL =	3963
SC % =	48.8%
SH TOTAL =	737
SH % =	9.1%
CG TOTAL =	2356
CG % =	29.0%
CF TOTAL =	287
CF % =	3.5%
PR TOTAL =	710
PR % =	8.7%
OM TOTAL =	6
OM % =	0.1%
UNK TOTAL =	64
UNK % =	0.8%
SC/CF =	13.81
SC/(SC+CF) =	0.932
SC/TOTAL =	0.488
SH/TOTAL =	0.091
CG/TOTAL =	0.290
CF/TOTAL =	0.035

EPHEM TOTAL=	3751
EPHEM %=	46.2%
PLEC TOTAL=	1643
PLEC %=	20.2%
TRIC TOTAL=	1560
TRIC %=	19.2%
OTHER TOTAL=	1169
OTHER %=	14.4%

DOMINANT TAXA:
1–Cinygmula sp.–32.3%
2–Chironomidae–9.7%
3–Taenionema sp.–7.7%
4–Glossosoma sp.–7.6%
5–Zapada columbian–4.8%
6–Ephemerellidae–3.2%
7–Baetis sp.–3.2%
8–Paraleptophlebia sp.–2.9%
9–Rhithrogena sp.–2.7%
10–Agraylea sp.–2.7%

ABUNDANCE CLASS TOTALS:

I–	28.4%
II–	10.4%
III–	9.0%
IV–	14.9%
V–	16.4%
VI–	6.0%
VII–	7.5%
VIII–	4.5%
IX–	1.5%
X–	1.5%
total=	100%