Effects of a Crude Oil Spill on the Benthic Invertebrate Community of the Gasconade River, Missouri

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Introduction

The Gasconade River originates in Wright County in southern Missouri and flows north about 400 km until it enters the Missouri River near Gasconade, Mo. On December 24, 1988, a ruptured pipeline released about 863,000 gallons of crude oil into Shoal Creek, a tributary of the Gasconade River near Vienna, Mo. The pipeline reportedly ruptured at about 16:30 and members of the Missouri Department of Natural Resources (MDNR) Emergency Response Team were on site to assess the incident within 6 hours.

The 0.56 m diameter pipeline that transported oil from Texas to Illinois had a fracture about 2.5 cm wide that extended for 12 m. The oil, classed as West Texas Intermediate Sweet Crude Oil, entered Shoal Creek about 0.4 km east of its confluence with the Gasconade River. Booms deployed at public accesses on the Gasconade River were unable to contain the oil and by December 27, oil reached the Missouri River. Water samples collected in the Missouri River below the Gasconade River showed no levels of petroleum products exceeding drinking water quality standards. Oil removal continued in the Gasconade River and by January 24, 1989, Shell reported that approximately 50% of the oil had been recovered.

The first samples collected to determine possible effects on the benthic macroinvertebrate community were collected by the MDNR in March 1989. A one-year study was initiated in July 1989 by National Fisheries Contaminant Research Center in cooperation with personnel from MDNR. The purpose of this report is to summarize findings from the study.

Methods of Study

Study Area

The Gasconade River study area covered about 90 river miles and included a total of nine sample locations above and below the oil spill site (Figure 1). Sample sites were selected in cooperation with the MDNR to maintain continuity with sampling efforts completed by the State prior to the initiation of this study. Locations of sample sites are as follows:

Site #	MDNR Zone	Location (relative to spill)	River Mile	County	Access Point
1	1a	upstream	103-106	Phelps	Jerome Public Access
2	1b	upstream	86-89	Maries	Belle Chute Access
3	1c	upstream	81-84	Maries	near U.S. Rt.63 Bridge
4	2	downstream	74	Maries	1 km below Rt.42 Bridge
5	3	downstream	68	Maries	Paydown Public Access
6	3a	downstream	51	Osage	Rollins Ferry Access
7	4	downstream	43	Osage	Pointers Creek Access
8	4a	downstream	30-32	Osage	2 km below Rt.50 Bridge
9	5	downstream	16-18	Gasconade	Helds Island Access

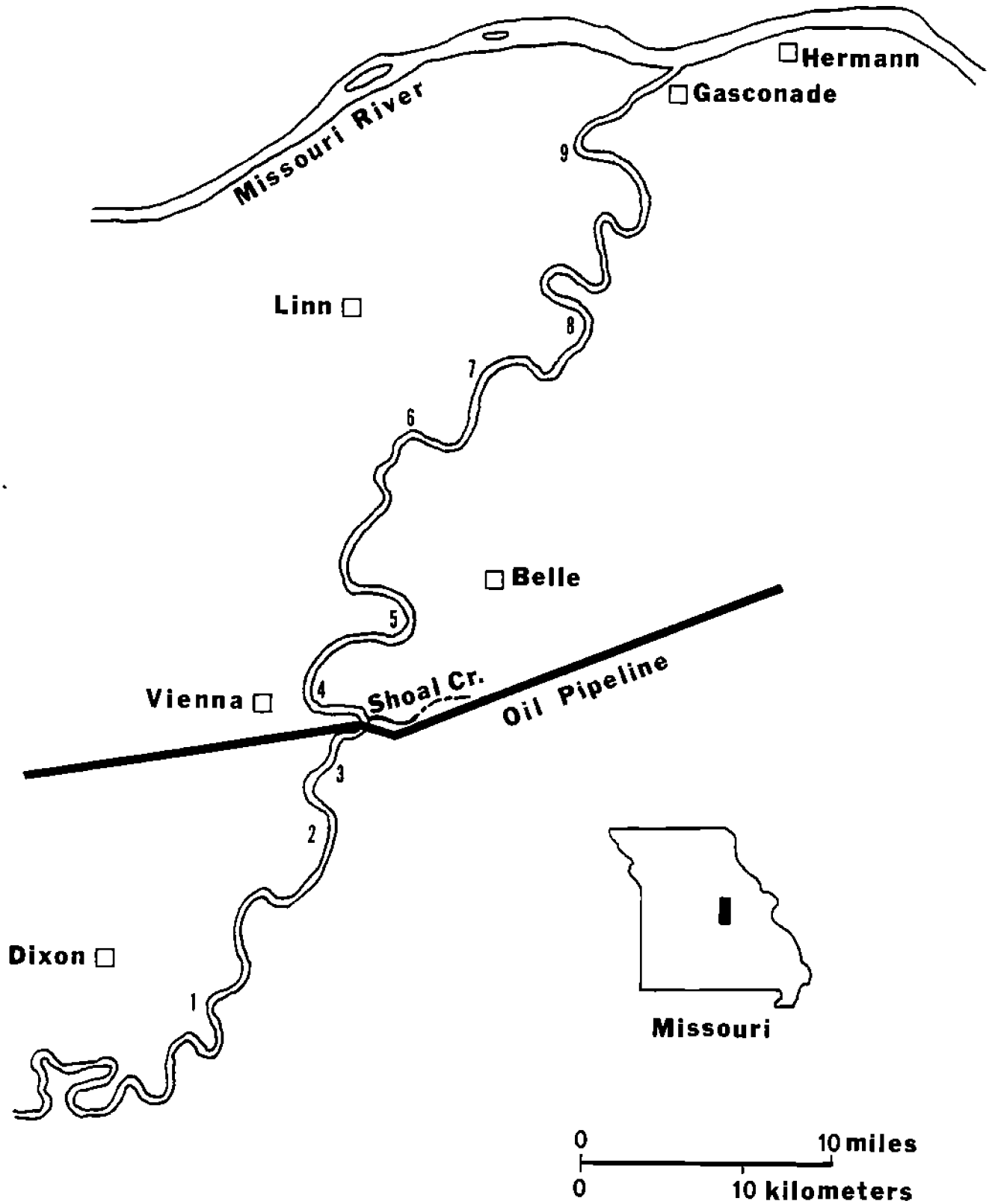


Figure 1. Map of Gasconade River study area.

Field Methods

Macrobenthos samples were collected from each location in July 1989 (Period 4), October-November 1989 (Period 5), January-February 1990 (Period 6), March-April, 1990 (Period 7) and June 1990 (Period 8). Sequential numbering of sample periods begins with "4" to accomodate previous sample collection periods (1-3) by MDNR. Riffle habitats with gravel/cobble substrate and current velocities of greater than 0.3 m/sec were sampled at depths of 0.2-0.8 m. All samples were collected from the head of island shoals or the upstream end of side channels. To characterize the benthic composition of each riffle, five replicate samples were taken from a 0.3 m area with a 0.5 m wide D-Frame kicknet containing 800 x 900 um mesh net. Each replicate was a composite of 4 to 5 kicks in substrate approximately 0.6 m in front of the net; replicates were collected in a downstream to upstream direction to minimize substrate disturbance. In addition, one composite sample consisting of 5 sweeps with a D-frame kicknet was collected from adjacent nearshore areas of sand, gravel, and vegetation. These qualitative samples were collected to provide supplemental information on taxa present in the riffles. All samples were initially inverted and washed onto a 0.3 X 0.5 m pan and concentrated with a small rubber squeegee. Macroinvertebrates and associated debris were then placed in labeled 0.5-L glass jars with plastic lids and preserved in a mixture of 10% formalin and 0.5 mg/L Rose Bengal dye.

Site 6 contained no suitable riffle habitat, therefore no samples were collected from that location during any sample period. In addition, high water prevented sampling of riffle

habitats at some sites during January (Sites 1, 2, and 8) and March (Sites 2 and 9). The scheduled June 1990 collection trip also revealed that severe flooding during May had completely scoured all riffle habitats in the study area and little recolonization had occurred. Therefore, no riffle samples were collected from any location for the final June sample period. Individuals from MDNR were consulted on all decisions that involved deletion of a sample site.

Macrobenthos were also sampled from backwater habitats that contained muck/detritus substrates and maintained standing water during normal river stages. Five grab samples of bottom substrate were collected from water depths of 0.6 to 2.0 m with a Petite ponar sampler. Samples were individually emptied into a 20-L stainless steel bucket and then transferred into a 500-um, screen-bottom bucket for washing. In addition, a qualitative sample consisting of 5 sweeps with a D-frame kicknet was collected from the margins of each backwater area to provide additional information on taxa present.

Site 4 contained no suitable backwater habitat, therefore no samples were collected from this location during our study. In addition, high water in January prevented the collection of samples from Sites 2 and 8. All other backwater sites were sampled successfully.

Depth, current velocity, water temperature, dissolved oxygen, and specific conductivity were measured at each location. A subsurface water sample collected from riffle areas at each site was acidified with sulfuric acid and returned to the

laboratory for determination of hardness, alkalinity, pH, total NH3, total P, NO2 + NO3, and total Kheldahl nitrogen. A separate sample was also collected for later measurement of total petroleum hydrocarbons, total organic carbon, and total toxic organics .

Laboratory Methods

All macroinvertebrate samples were washed from each sample through a U.S. Standard #30 sieve to remove formalin and dye preservative. Large fragments of debris, sticks, and leaves were washed through the sieve and removed. Each sample was sorted with an illuminated dissecting microscope at 10X magnification. Organisms were counted and placed in labeled glass vials of 70% ethanol, and initially separated into 5 general groupings:

1) Ephemeroptera/Plecoptera
2) Mollusca
3) Oligochaeta and other worms
4) Midges
5) Other taxa

Each group of 5 glass vials for each sample were placed together in storage boxes for later taxonomic identification.

After each sample was sorted, the sample number, sort date, and technicians initials were recorded consecutively on a standard list. Every tenth sample on the list was resorted by the MDNR Quality Assurance Officer to verify that at least 95% of the organisms had been removed. If this procedure indicated less than 95% removal, this sample and the preceding nine (all samples sorted since the last check) were resorted.

Literature Review

Knowledge of the effects of freshwater oil spills on aquatic ecosystems is limited compared to the wealth of information available on the impacts of oil entering the marine environment. In the past, marine spills have been highly publicized and often received international attention. Concern over lack of interest in research on inland spills prompted the National Academy of Sciences (1973) to state:

> Problems of oil pollution have received considerably more attention in the marine environment than in the freshwater environment; however, the consequences of a large oil spill in a confined area such as a river or lake would be far more serious than those of a spill in open waters. The likelihood of such a disaster is increasing because of the increased use of oil as a substitute for coal. Continuous or intermittent release of lesser quantities of petroleum products to inland water as a result of refining, transportation, and use can be equally important and merits special attention in freshwater ecosystems.

Fortunately, public awareness of inland spills has increased and scientists are now focusing attention on the fate and effects of oil in freshwater. In several recent reviews information on effects of oil spills in freshwater systems has been summarized (Academy of Natural Sciences of Philadelphia 1983, Cairns and Buikema 1984, Muller 1987, Vandermeulen and Hrudey 1987, and Green and Trett 1989).

Inland spills have occurred relatively often in the past. In the United States, 179 freshwater oil spills were reported between 1979 and 1986 and spills exceeding 50,000 gallons occurred 25 times between 1974 and 1980 (Cronk et al. 1990). Petroleum releases into the aquatic environment were a leading

cause of fish kills in this country and Crunkilton (1984) reported that one third of all pollution incidents in water in the state of Missouri were petroleum related. The recent large volume spills of 705,000 gallons into the Ohio River (Cronk et al. 1990) and 863,000 gallons into the Gasconade River have highlighted the importance of understanding the effects of oil on freshwater systems.

The extent of injury to an aquatic system caused by an oil spill is dependent on the type of oil, the hydrological conditions of the river, and the speed and efficiency of the clean up. Oil discharges are complex mixtures of aliphatic, cycloaliphatic, olefinic, cyclic and polycyclic aromatic hydrocarbons. The solubility and volatility of these components can vary with water temperature and velocity. Depending on the source, crude oil may also contain up to 2% sulfur in an inorganic form as well as a large number of organic sulfur compounds (Monticello and Finnerty 1985). Refinery oil wastes may contain metals including vanadium, nickel, lead, zinc and copper (Petrakis and Weiss 1980, Shailubhai 1986). Therefore, the threat afforded by a spill into the aquatic environment is highly dependent on the chemical characterization of the oil.

The toxicity of oil can result from direct contact with an organism, from exposure to the water soluble fraction and its immediate degradation products, or from exposure to oil residues sorbed to the aquatic sediments. Because of the numerous routes of exposure, almost any macroinvertebrate may be affected by oil. Exposure may result in immediate mortality or sublethal effects that may affect reproduction and successful recolonization.

Studies on the exposure of invertebrates to oil have focused on the evaluation of lethal responses of single species (often daphnids or protozoans) under laboratory conditions and on the benthic macroinvertebrate community response under natural conditions when challenged with an accidental release. Laboratory tests have often been conducted with individual phenolic and polycyclic aromatic hydrocarbon components. Several studies have suggested that the toxicity and bioaccumulation of these individual components increases with increasing ring numbers (Millemann et al. 1984) or with increasing molecular weight (Lu et al. 1977; Southworth et al. 1978, Bobra et al. 1983, and Trucco et al. 1983). Green and Trett (1989) offer a reasonable review of the toxicity of several individual constitutents of oil to laboratory organisms.

Relatively few studies have evaluated the effects of an oil spill on the invertebrate community in their natural environment. Of these studies, several have reported contradictory information on the effects of spills on macroinvertebrate communities (Ryck and Duchrow 1974, Schultz and Tebo 1974, Masnik 1976, Rosenberg and Wiens 1976, Guiney et al. 1987). A survey of a benthic community in a Pennsylvania watershed contaminated by a kerosene spill indicated that rapid recolonization occurred shortly after the spill (Guiney et al. 1987). Measurements of species diversity indicated that most stations recovered within 6 to 8 months. Similarly, Masnik et al. (1976) observed minimal effects on the benthic community of a fourth order stream that received 15,000 L of No. 2 fuel oil. In a group of artificial ponds exposed to a

range of concentrations of synthetic crude oil, pond invertebrates began to recover within three months, even at the highest doses (Cushman and Goyert 1984). In contrast, a benthic community exposed to a 25,000 L crude oil spill in a small Texas stream had not recovered after 26 months (Harrel 1985). Crunkilton and Duchrow (1990) also indicated an extended recovery period for Asher Creek, a southwestern Missouri stream that received 1.5 million L of domestic crude oil. Functional feeding groups were also selectively altered by exposure to oil. During the 532 d study, effects were recorded for all functional groups except shredders. The most severely affected taxa were Ephemeroptera, Plecoptera, and Trichoptera. These three taxa were also significantly reduced in an experimental spill of oil sands tailings in a 30m stretch of the Muskeg River in Northern Alberta (Barton and Wallace 1979). These taxa are very sensitive to many types of pollution and their presence or absence represents a good measure of condition of a stream. In the diverse examples reported above, it is likely that the type of oil spilled and the dilution water available to mediate the spill, play a major role in recovery of the aquatic systems.

Comparisons of the tolerance of different organisms to oil exposure is difficult because responses of those organisms are highly dependent on the chemical nature of the oil. Relatively few tests have been conducted in which many species have been exposed to the same oil. Buikema et al.(1976) compared 18 freshwater species to a synthetic mixture derived from No. 2 fuel oil (Table 1). Daphnids were the most sensitive species tested in this series. However, similar to many other studies, actual

Table 1. Comparative tolerance of selected freshwater invertebrates and fish exposed to an arbitrary reference mixture (ARM). The LC50 data are expressed as multiples and fractions of the ARM (From Buikema et al. 1976).

Organism	LC50		
	24h	48h	96h
Snail			
Physa sp.	9.2-22.0	7.8-20.0	6.4-19.0
Helisoma sp.	7.4	7.4	---
Nitocris sp.	3.7	1.9	1.8
Gonobasis sp.	4.6-7.4	4.5-4.9	0.37-3.3
Amphipod			
Gammarus sp.	5.6	3.2	1.3
Crayfish			
Cambarus sp.	7.5	---	---
Water flea			
Daphnia pulex	0.11	0.07	0.03
Daphnia magna	0.16	0.06	---
Worms			
Dero sp.	5.6	5.6	5.6
Tubifex sp.	1.8-5.6	1.8	0.21-0.56
Stylaria sp.	6.0	---	6.0
Aeolosoma headleyi	8.3	3.0	4.0
Planaria			
Dugesia tigrina	4.9-6.3	2.0	1.6-2.0
Rotifer *			
Philodina acuticornis	1.0,6.0	1.0,6.0	1.0,6.0
Mosquito larvae			
Aedes aegypti			
3rd instar	2.3	---	1.8
1st instar	0.5-0.8	---	---
Fish			
Rainbow trout	4.0	4.0	----
Bluegill sunfish	7.4	---	5.6
Goldfish (ORSANCO)	7.8	7.0	6.4

* Two levels of effect

measured exposure concentrations in this comparison were not documented.

In general, research is needed on the toxicity of oil to freshwater invertebrates, particularly to organisms existing in the aquatic sediments. In addition, environmental consequences of oil spills require attention. All case histories cited in this review highlight the need for detailed, integrated, long-term assessments following oil spills. When an accidental spill occurs, it is often difficult to allocate funding in an expedient manner in order to begin immediate assessment of spill-related effects. In such cases, valuable information is lost as was the case in this study, which was not initiated until 6 months after the oil spill. Our current understanding of oil-related problems does not allow accurate predictions of fate and effects of oil in a freshwater system. Similarly, the rates of ecosystem recovery to previous levels of diversity, dominance, and abundance have not been adequately studied. The available data suggests that this may range from three months to several years. As petroleum and petroleum products continue to enter the freshwater environment, studies on fate, effects, and recovery will be of critical importance.

Results and Discussion

Benthic Community Analyses

As with many large rivers, the Gasconade is a complex ecological system containing over 300 benthic species identified during this study and the earlier reconnaissance studies of MDNR (Appendix B). From the 389 samples collected during this study from July 1989 through June 1990, 247 species were identified. To evaluate potential adverse effects from the oil spill, information was assessed both descriptively by summary of ecological indices and statistically through the use of log-linear models. Total number of organisms, species composition, relative abundance, diversity, and several other indices of environmental perturbation were examined separately for backwater areas and riffles. Effects of the oil spill on five functional feeding groups as well as on 13 major taxonomic categories were investigated. Four of the functional groups --- categories of Shredders, Scrapers, Predators, and Collectors --- were observed in a sufficient number of samples for statistical treatment. Major taxonomic categories were defined as Annelida, Mollusca, Crustacea, Ephemeroptera, Plecoptera, Hemiptera, Odonata, Megaloptera-Lepidoptera-Neuroptera, Tricoptera, Coleoptera, Chironomidae, other Diptera, and other Taxa.

No effects related to the oil spill were evident in samples collected from riffles during our study. Shannon Diversity Index of samples from riffle habitats ranged from 1.3 to 3.2 with no consistent differences between upstream and downstream locations (Appendix C). Organisms in taxonomic groups such as Mollusca,

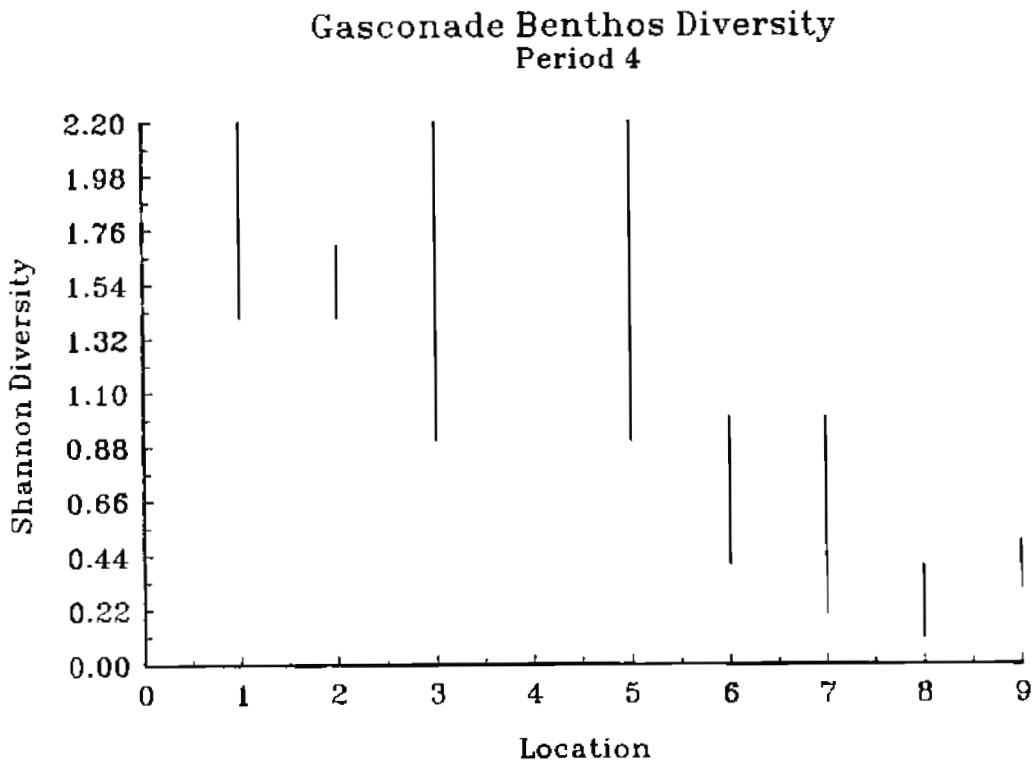
Ephemeroptera, Tricoptera, and Coleoptera were most abundant (Appendix D). The EPT Index included in Appendix C represents the total number of distinct taxa within the orders Ephemeroptera, Tricoptera, and Plecoptera and summarizes taxa richness within these insect orders, which are generally considered to be sensitive to pollution. For all riffles, this EPT index ranged from 8 to 27 and did not differ consistently among locations. Furthermore, the ratio of EPT to Chironomidae abundances, which represents a measure of community balance, indicated that riffle communities at all locations were dominated by the pollution-sensitive groups (Ephemeroptera, Tricoptera, and Plecoptera) and not the more tolerant Chironomidae (Appendix C).

The functional groups of Shredders, Scrapers, Predators, and Collectors were present in the riffles at all locations. Organisms in the Scraper and Collector groups were most abundant (Appendix E). Analysis of functional group data with log-linear models did not suggest any significant effects from the spill.

Backwater areas were generally dominated by the taxanomic groups Annelida, Mollusca, Chironomidae, and Other Diptera (Appendix D). These four groups accounted for about 90% of the organisms collected in the backwater areas. Because of the low relative abundance of other taxonomic groups, effects related to location were not immediately apparent. A log-linear analysis similar to those described in Appendix B was used to assess the number of taxonomic groups and number of organisms in the backwater areas. The analysis revealed that the probability of collecting a sample with a small number of taxa and a small

number of organisms was significantly greater at sites 6 and 7 (below the spill) than at other sites. For sites 8 and 9, however, there was a high probability of collecting a large number of organisms, but not a large number of taxa. That the high probability of observing a large number of organisms for sites 8 and 9 was caused by great abundances of only a few taxa is illustrated in plots of the ranges of Shannon diversity indices for these sites during each sample period (Figures 2-4). Although the probability of collecting a large number of organisms may have been greater at locations 8 and 9 than other locations, diversity was extremely low. As Figures 2 and 3 clearly indicate, diversity was consistently lower during Period 4, 5, and 6 in sites 6, 7, 8, and 9 than in any other locations. Sites 7, 8, and 9 also remained low in Period 7.

The general relationship of higher diversities in upstream as compared to downstream locations (8 and 9) appears to hold in Figure 4, however, maximum values of diversity indices for all locations are greatly reduced as compared to values in previous sample periods (Figures 2 and 3). These values reflect the effects of severe flooding in May on the backwater communities. Flooding completely scoured riffle habitats in May and because of lack of recolonization, riffles were not sampled during June. It is apparent that the number of species in backwater areas were also greatly reduced. Unfortunately, June 1990 was the final sample period of our study. Because of the persistent effects on diversity documented at downstream sites in previous sample periods, additional samples to determine rates of recolonization in these areas would have been informative.



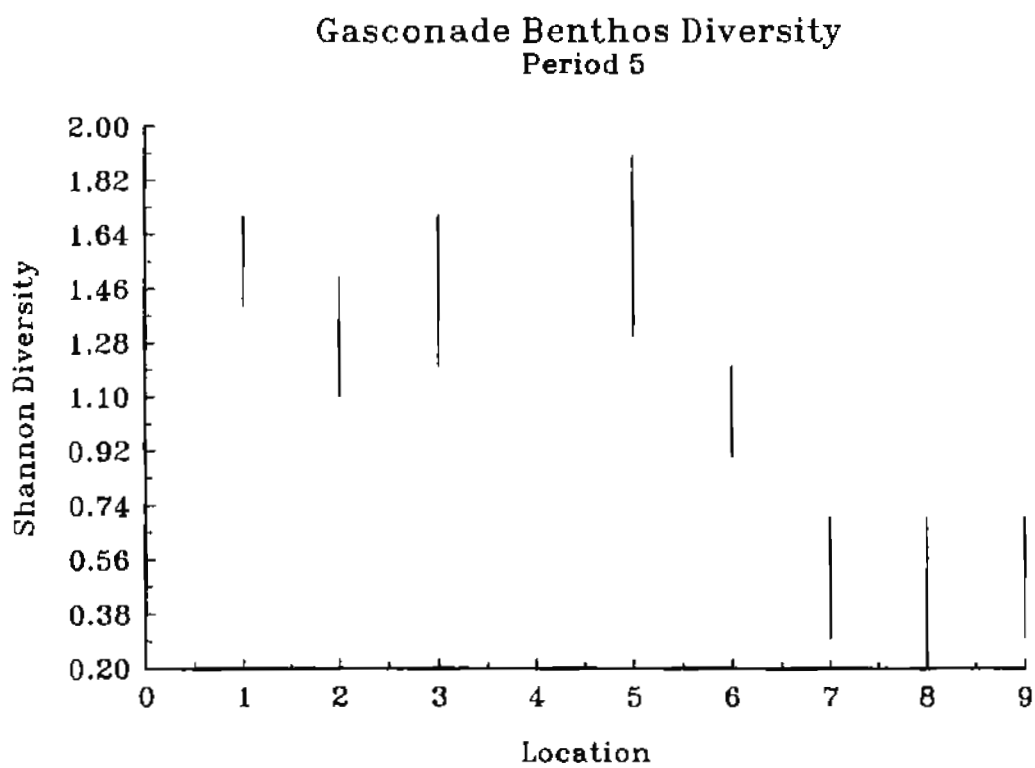
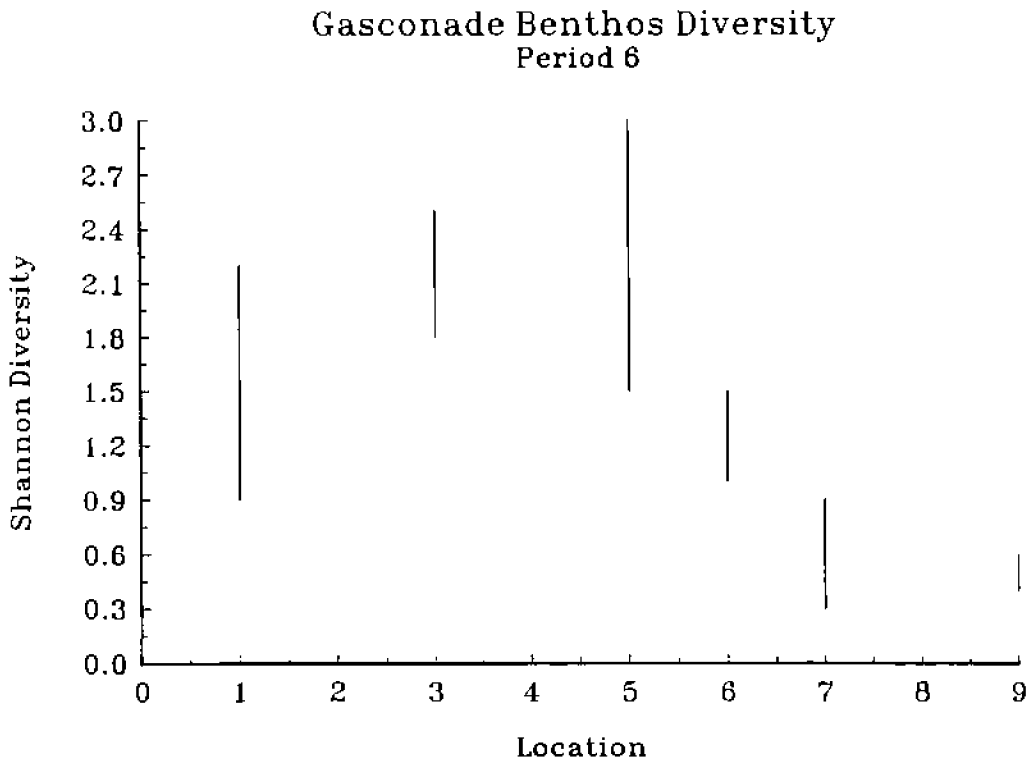


Figure 2. Range of values for Shannon Diversity Index for locations 1-9 on the Gasconade River during Period 4 (July 1989) and 5 (October-November 1990).



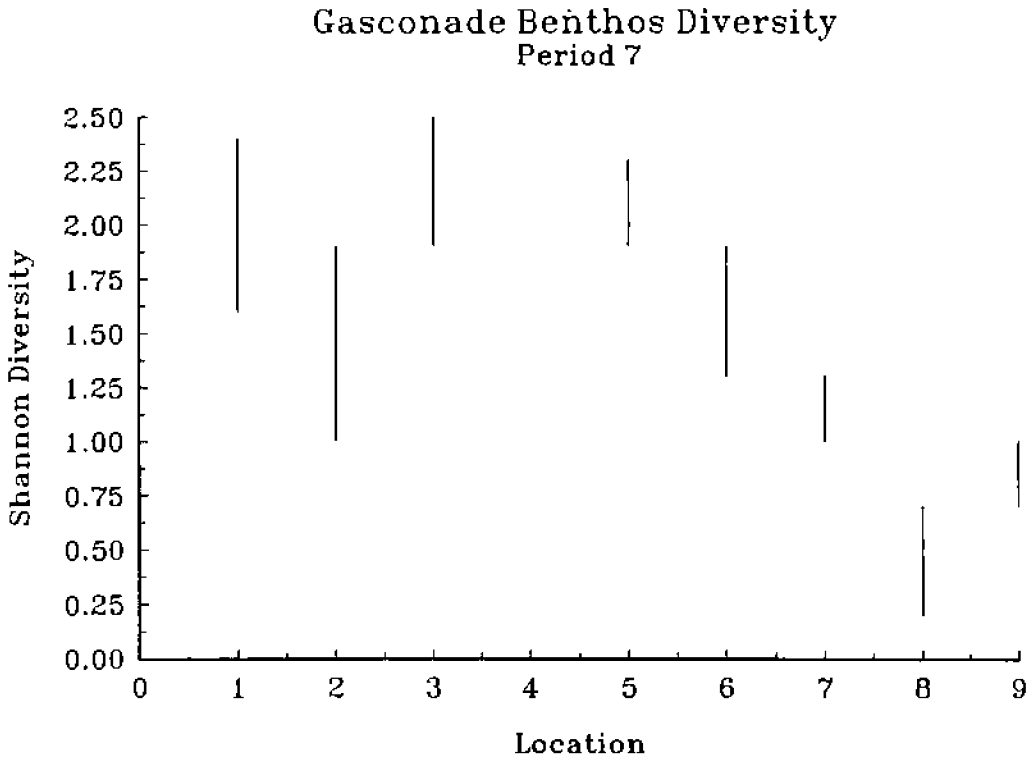


Figure 3. Range of values for Shannon Diversity Index for locations 1-9 on the Gasconade River during Period 6 (January-February 1990) and 7 (March-April 1990).

BACKWATER AREA

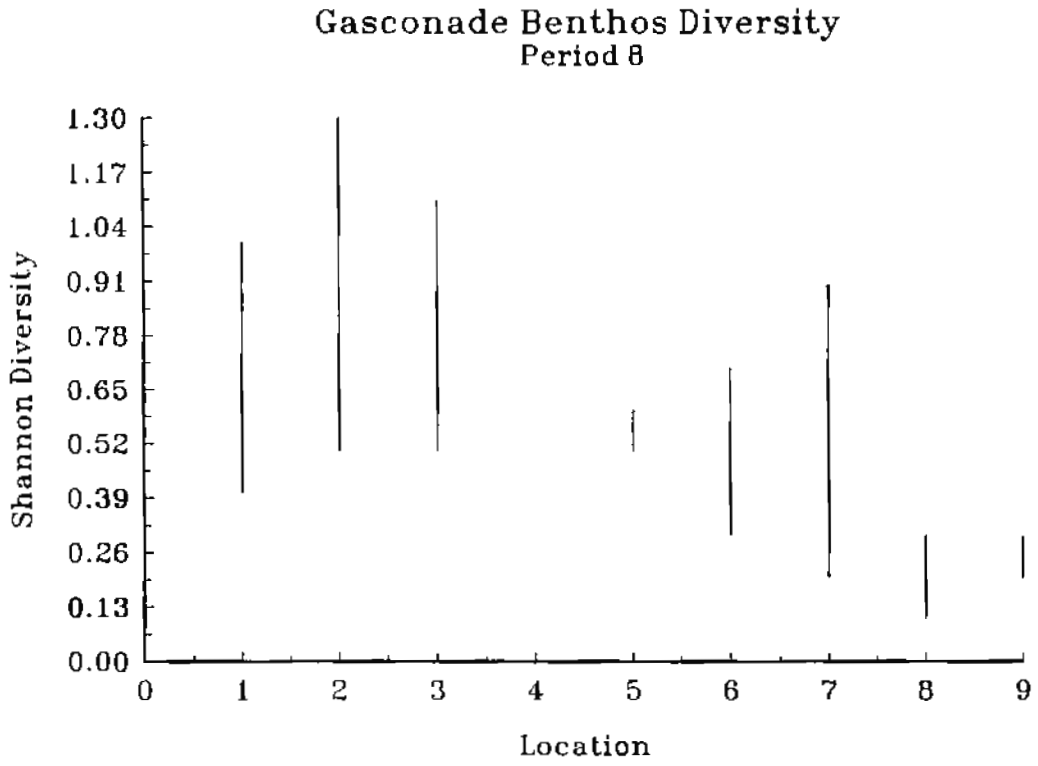


Figure 4. Range of values for Shannon Diversity Index for locations 1-9 on the Gasconade River during Period 8 (June 1990).

Statistical analysis of Shredder and Scraper functional groups in the backwater areas showed significant effects related to the oil spill. Abundance categories used in log-linear models were zero organisms, a small number of organisms, and a large number of organisms. These analyses indicated that the probability of obtaining a sample containing no shredders was significantly higher for locations 7, 8, and 9 than for other locations (Table 2); there was also a high chance of collecting a small number of organisms from this functional group at site 6. Analysis of the abundance of the functional group Scrapers also indicated effects consistent with a hypothesis of lasting damage from the oil spill. The probabilities of obtaining a large number of organisms were high for locations 2 and 5 and significantly reduced for locations 6 and 7 (Table 3). Parameter estimates for location 5 were consistently similar to those for upstream locations and consistently disimilar to those for downstream locations. Values calculated for the Shannon Diversity Index also exhibited this pattern, indicating that samples from location 5 were more similar to samples from sites above the spill than to those from other sites below the spill (Figure 2-4).

Information from reconnaissance studies conducted by MDNR are included in Appendix F, but are difficult to interpret based on the lack of replication of samples. These numbers do represent the only information available on the spill prior to initiation of our study in July. Total number of organisms and taxa richness in riffles were lower in the most downstream

Table 2. Log-linear analysis for Shredders from backwater areas.

Functional Group 1
(Shredders)

Location	Zero	Small	Large	Main Effects Location
1	-0.644	-0.633	1.278**	-0.223
2	-0.221	-0.165	0.386	0.147
3	-0.668*	0.262	0.406	0.053
5	-0.833*	0.025	0.808**	-0.034
6	0.345	0.524*	-0.869*	-0.022
7	0.832**	0.025	-0.857*	-0.034
8	0.607*	0.171	-0.778*	0.011
9	0.583*	-0.210	-0.373	0.101
Period				**Main Effects Period**
4	0.395*	-0.390*	-0.005	0.025
5	-0.417*	0.238	0.179	0.003
6	0.157	-0.384*	0.227	0.028
7	-0.503*	0.210	0.293	-0.016
8	0.368*	0.326	-0.694**	-0.040
Main effects Organism	-0.102	0.168	-0.066	

* if estimate/standard error > 1.96
** if estimate/standard error > 3.00

Table 3. Log-linear analysis for Scrapers from backwater areas.

	Functional Group 2 (Scrapers)			
Location	Zero	Small	Large	Main Effects Location
1	-0.507	0.019	0.488	-0.043
2	-0.250	-0.265	0.515*	0.041
3	0.116	-0.498*	0.382	0.122
5	-0.017	0.541*	0.558*	0.054
6	1.247*	0.154	-1.402**	-0.040
7	0.133	0.626*	-0.758*	-0.096
8	-0.211	0.350	-0.139	0.002
9	-0.510	0.154	0.356	0.040
Period				Main Effects Period
4	0.026	0.285	-0.310	-0.009
5	-0.240	-0.051	0.291	-0.031
6	-0.243	-0.025	0.268	-0.022
7	0.004	-0.366	0.361*	0.013
8	0.453*	0.157	-0.610**	0.049
Main effects Organism	-0.683	0.495	0.188	

* if estimate/standard error > 1.96
** if estimate/standard error > 3.00

location, Zone 5 (our Site 9) during the early and late March sample periods. In addition, values for community loss coefficients generally increase in downstream locations. However, similar effects did not occur in backwater samples. The inability to assess the relative variability of these numbers within and among locations greatly limits the interpretation of this information.

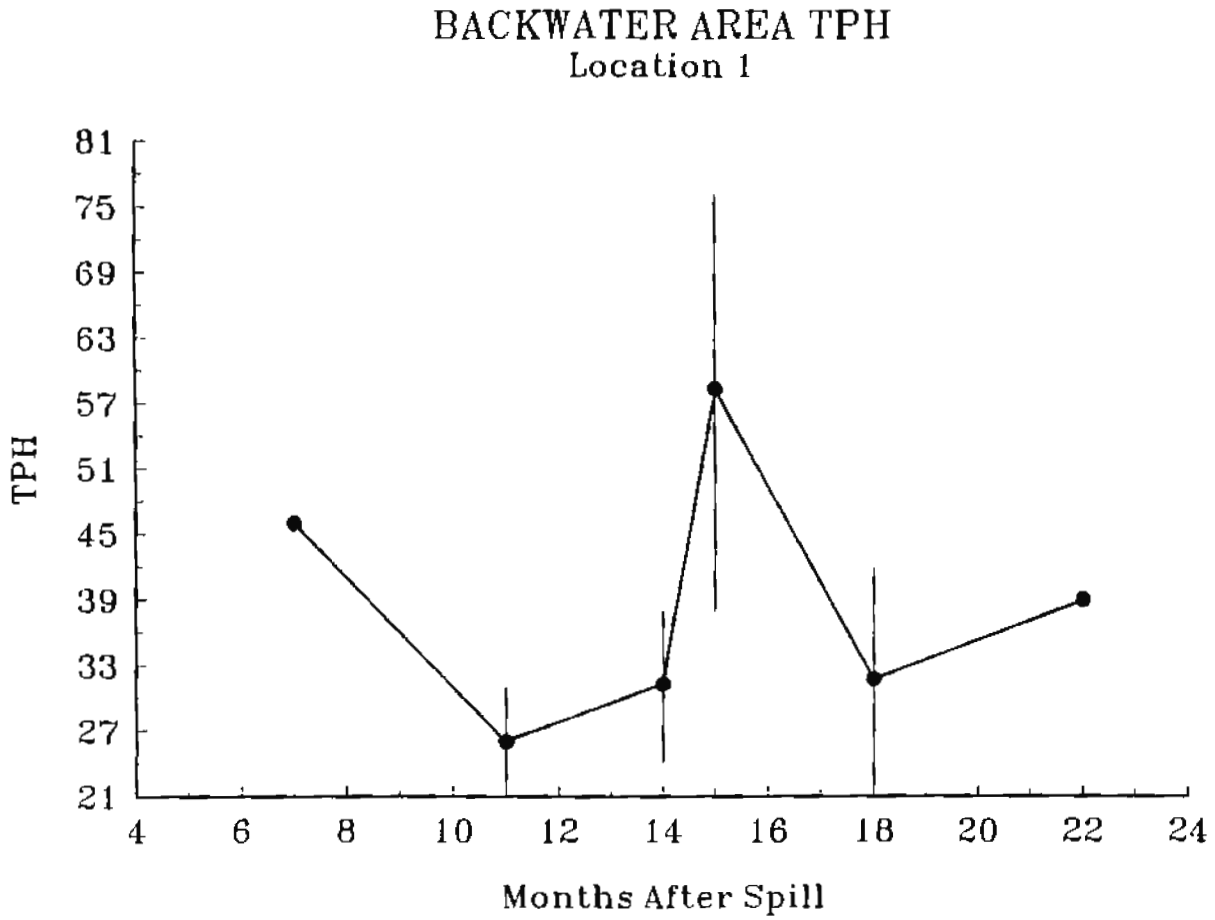
Water Quality and Contaminants

Similar to many other Missouri streams, the Gasconade is a moderately hard, well buffered river with pH ranging from 8.0-8.6. During our study, hardness ranged from 170-200 mg/L as $CaCO_3$ and alkalinity ranged from 160-180 mg/L as $CaCO_3$ with no differences among locations. Although some seasonal effects were evident in levels of nitrogen and phosphorus, no differences existed among locations. In most cases, concentrations of nitrogen and phosphorus remained at or below detection limits during our study (MDNR database).

Concentrations of total petroleum hydrocarbons (TPH) in the sediments were variable within locations (Figures 5-9), but during the year following the spill concentrations were generally higher in the backwater locations downstream from the spill than in the upstream sites. TPH concentrations in backwater locations upstream of the spill were less than 80 mg/kg while concentrations as high as 9500 mg/kg (site 8) were recorded downstream.

A general decrease in TPH concentrations over time occurred in backwater areas (Figures 5-9). Declines in TPH concentrations at sites 6, 7, and 8 were evident 7 to 10 months after the spill, however, TPH levels at these three locations were not

Figures 5-9. Means and ranges of TPH concentrations (mg/kg) for replicated samples (●) and individual TPH values for unreplicated samples (▲) collected from backwater locations after the oil spill. Values included in these figures represent samples collected as a part of this study as well as additional samples collected by MDNR. A summary of total number of replicates and actual maximum and minimum values are included in Appendix G.


BACKWATER AREA TPH
Location 1
TPH
81
75
69
63
57
51
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10
12
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16
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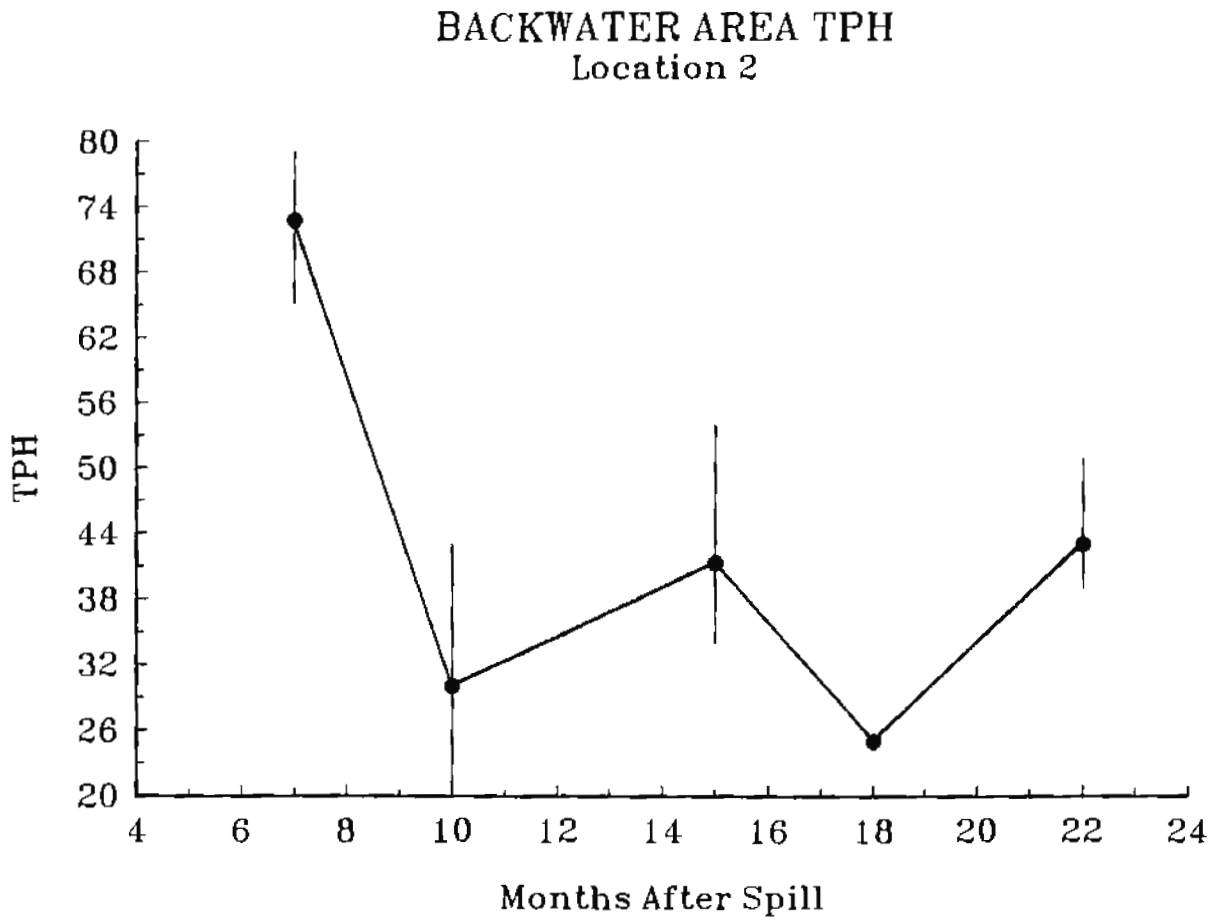
22
24
Months After Spill


BACKWATER AREA TPH
Location 2
TPH
80
74
68
62
56
50
44
38
32
26
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14
16
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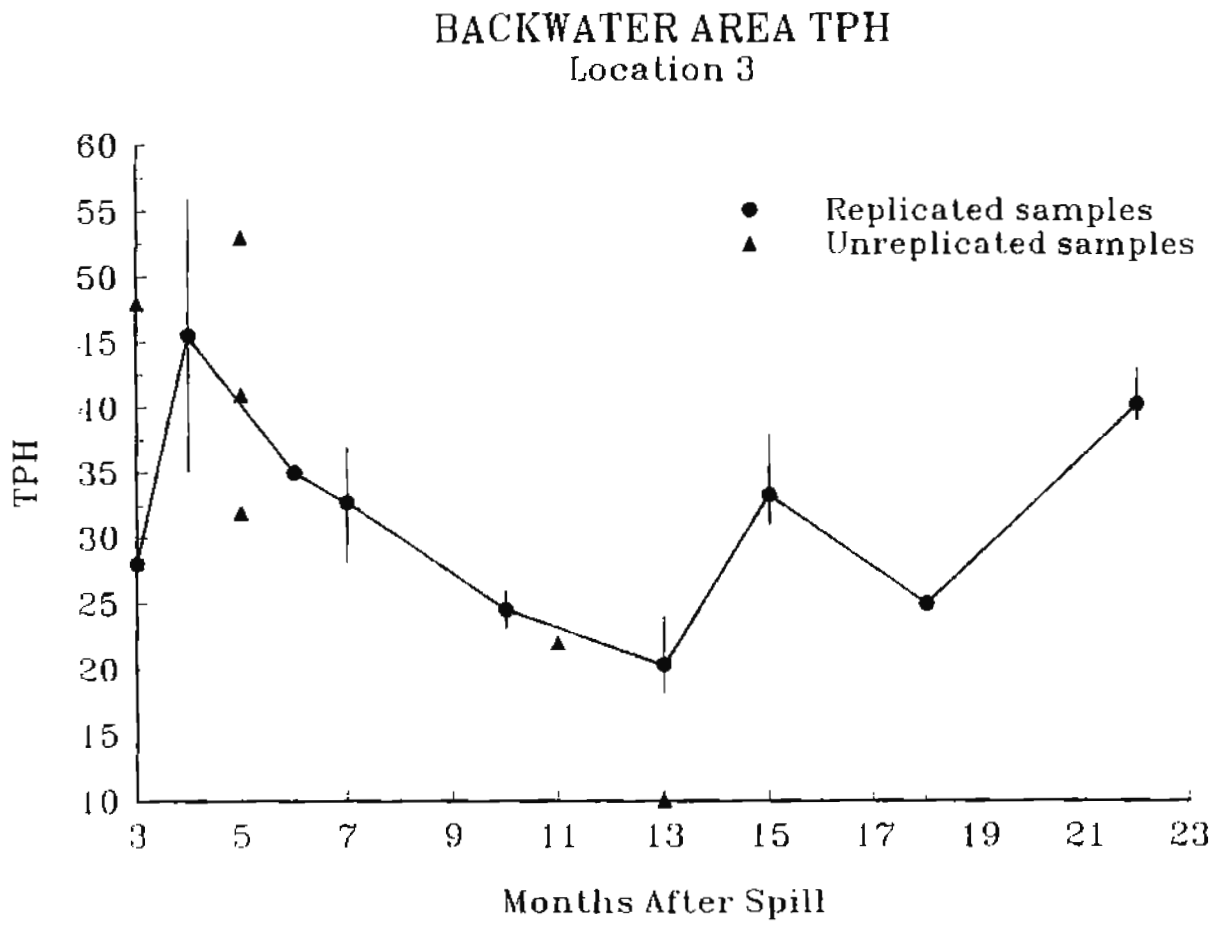
24
Months After Spill

Figure 5.


BACKWATER AREA TPH
Location 3
Replicated samples
Unreplicated samples
TPH
60
55
50
45
40
35
30
25
20
15
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3
5
7
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23
Months After Spill

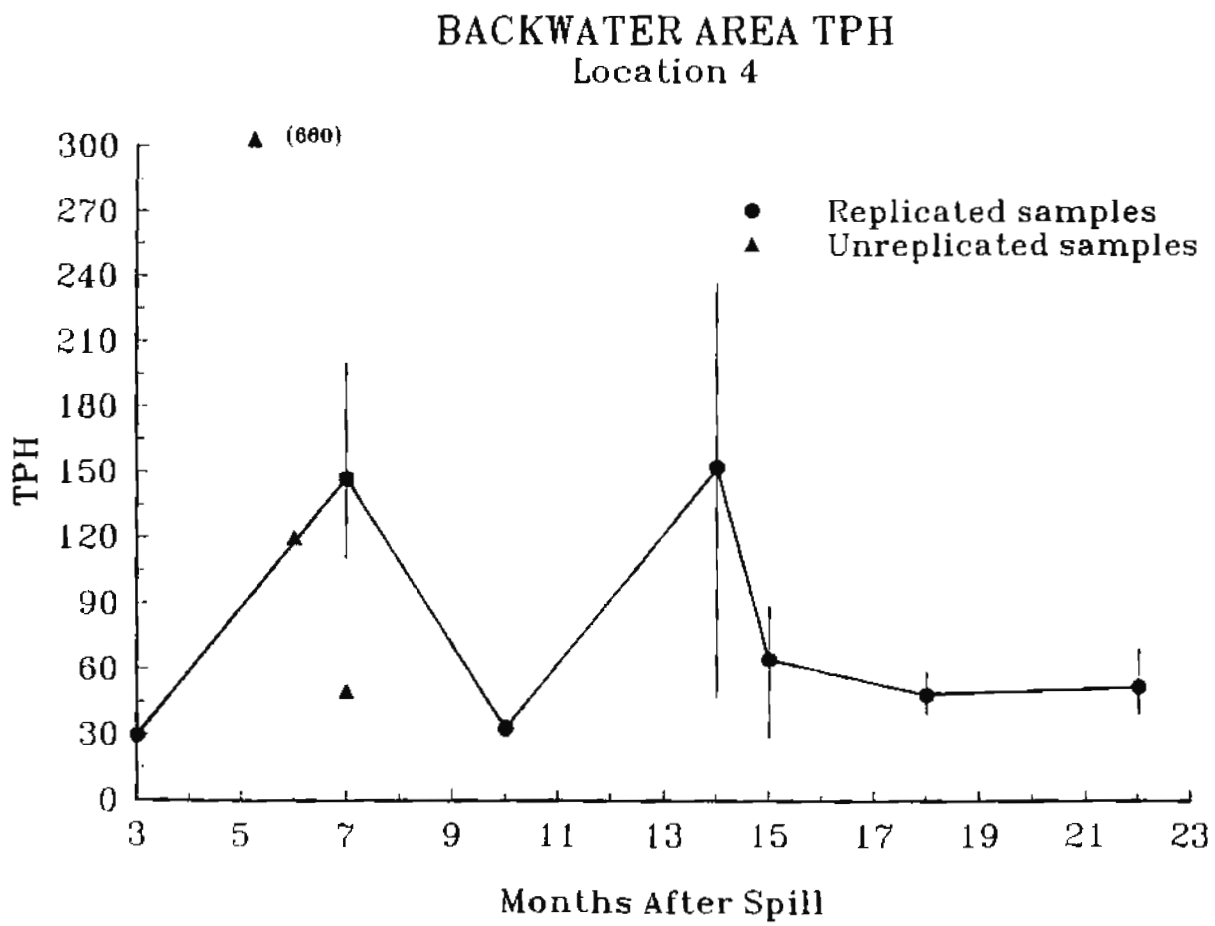
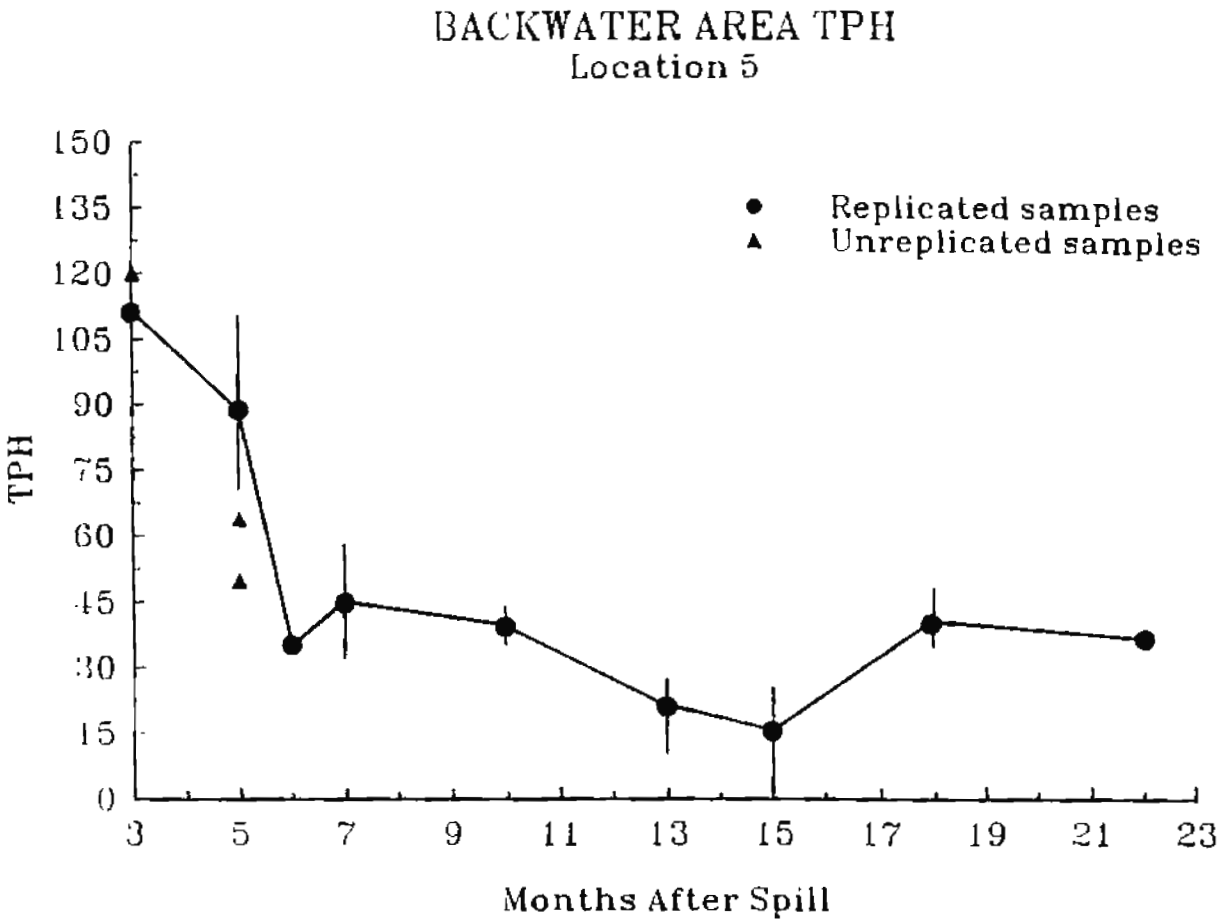

BACKWATER AREA TPH
Location 4
(660)
Replicated samples
Unreplicated samples
TPH
300
270
240
210
180
150
120
90
60
30
0
3
5
7
9
11
13
15
17
19
21
23
Months After Spill

Figure 6.


BACKWATER AREA TPH
Location 5
Replicated samples
Unreplicated samples
TPH
150
135
120
105
90
75
60
45
30
15
0
3
5
7
9
11
13
15
17
19
21
23
Months After Spill

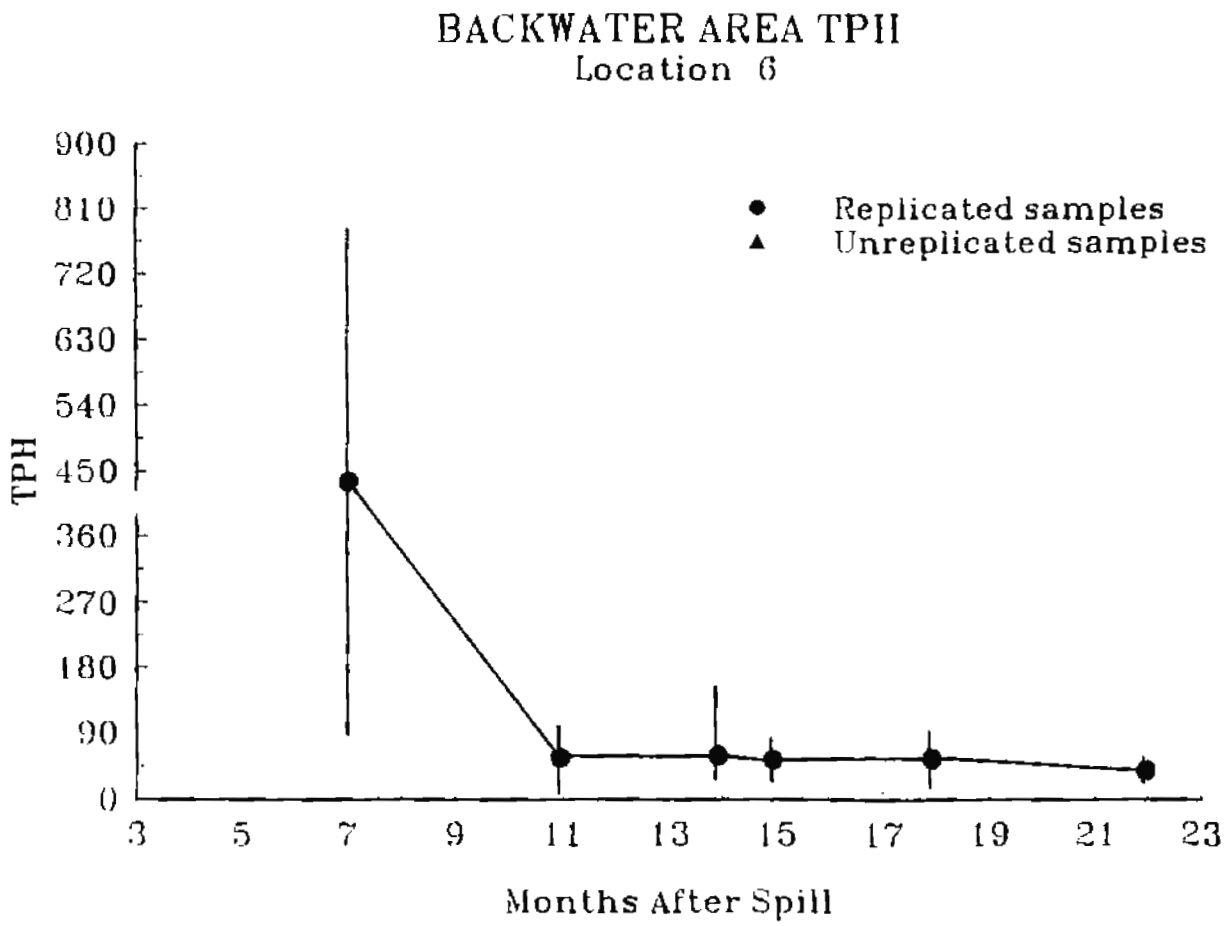
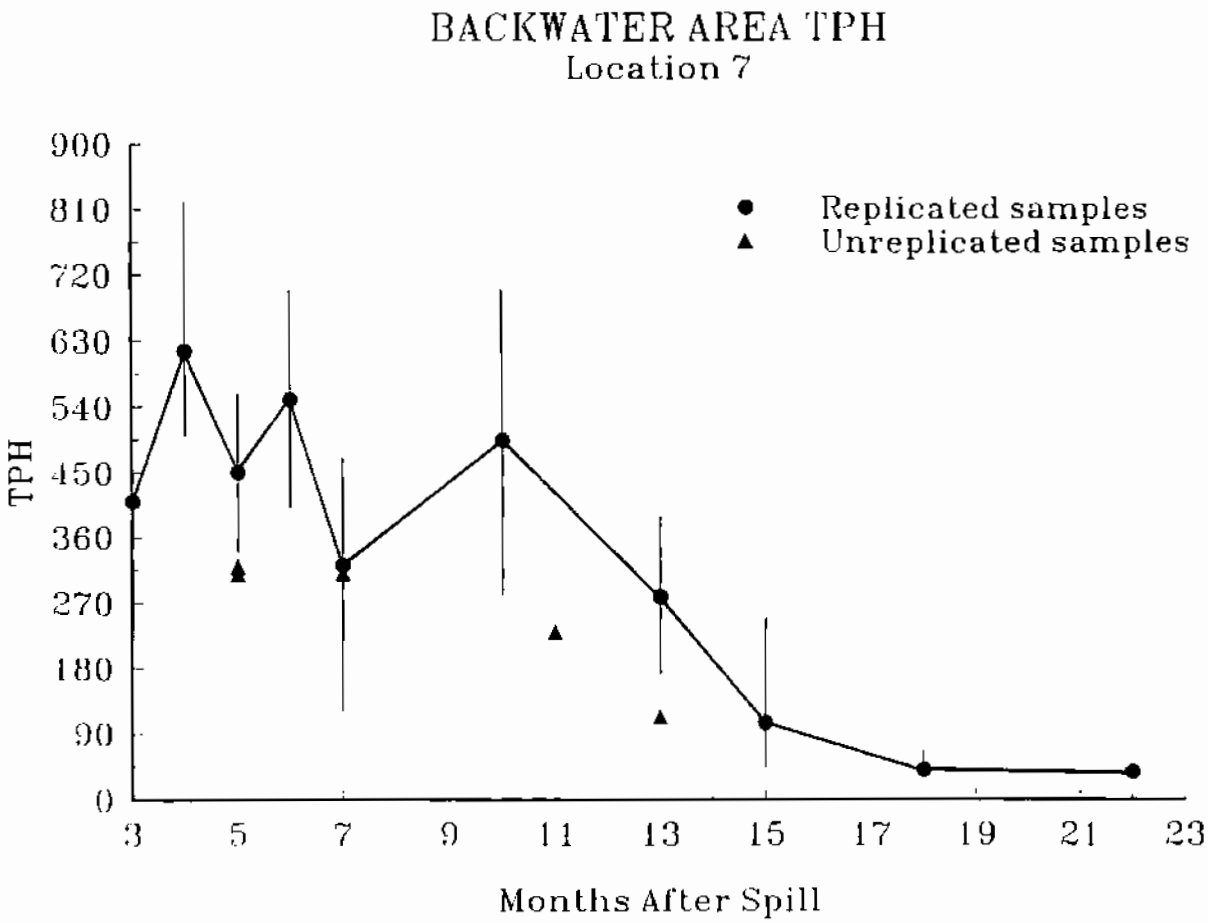

BACKWATER AREA TPH
Location 6
Replicated samples
Unreplicated samples
TPH
900
810
720
630
540
450
360
270
180
90
0
3
5
7
9
11
13
15
17
19
21
23
Months After Spill

Figure 7.


BACKWATER AREA TPH
Location 7
Replicated samples
Unreplicated samples
TPH
900
810
720
630
540
450
360
270
180
90
0
3
5
7
9
11
13
15
17
19
21
23
Months After Spill

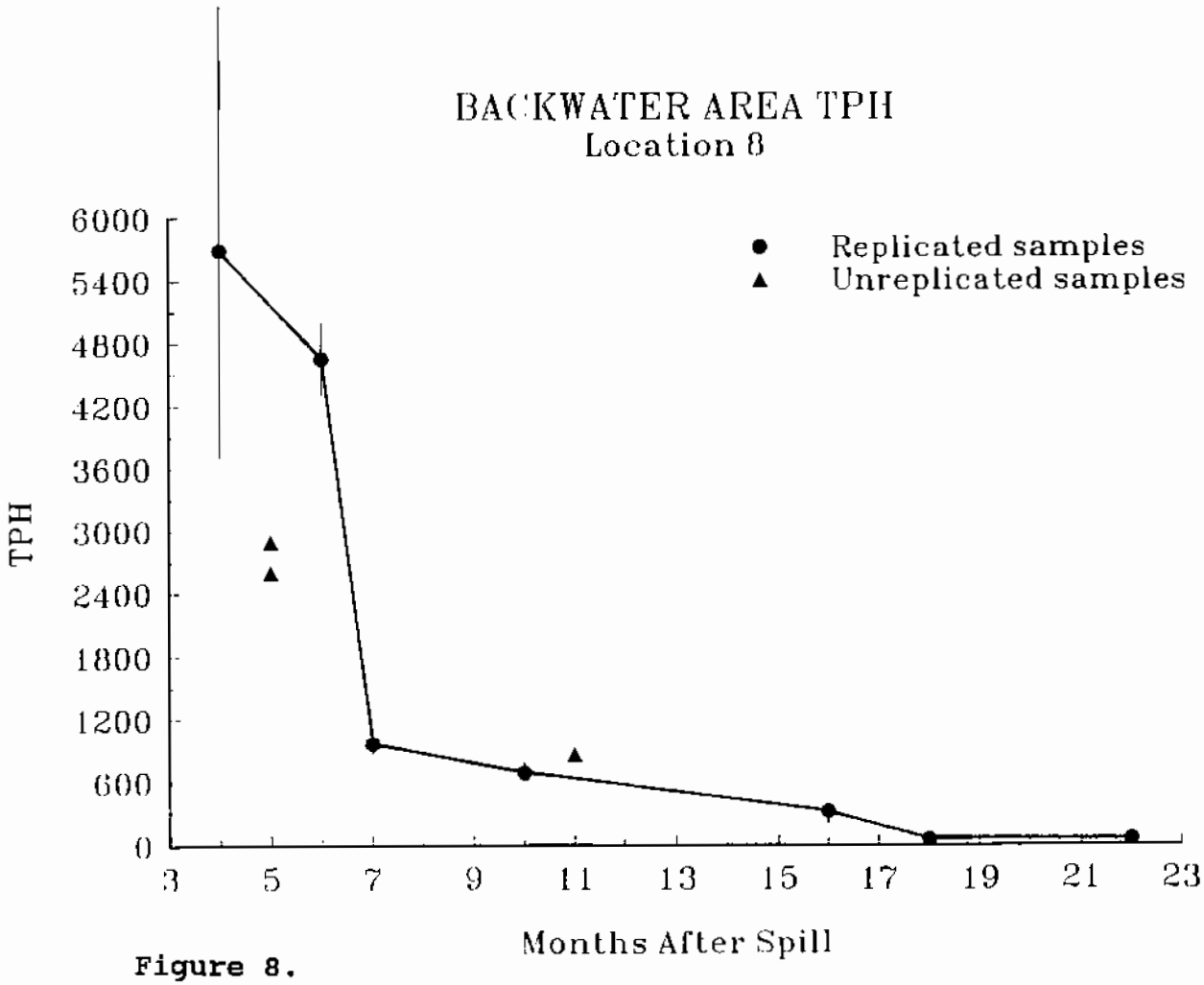

BACKWATER AREA TPH
Location 8
Replicated samples
Unreplicated samples
TPH
6000
5400
4800
4200
3600
3000
2400
1800
1200
600
0
3
5
7
9
11
13
15
17
19
21
23
Months After Spill

Figure 8.

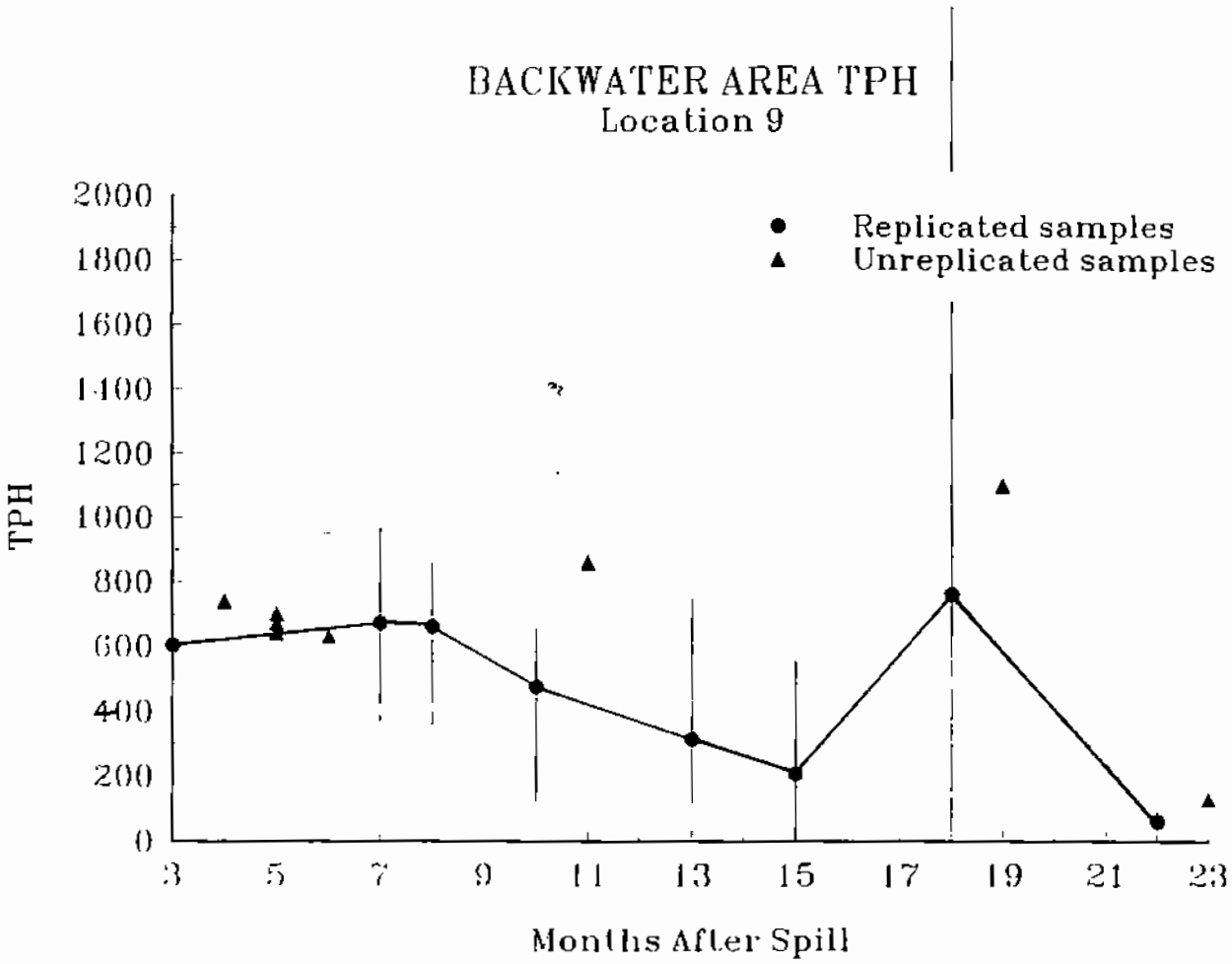

BACKWATER AREA TPH
Location 9
Replicated samples
Unreplicated samples
TPH
2000
1800
1600
1400
1200
1000
800
600
400
200
0
3
5
7
9
11
13
15
17
19
21
23
Months After Spill

Figure 9.

consistently below 80 mg/kg (the maximum observed value for upstream sites) until 15 to 18 months after the spill (Table 4). Maximum observed values for site 9 still exceeded 80 mg/kg after 24 months.

During the time of our study, hydrocarbon concentrations at site 5 were similar to concentrations in upstream locations. Hydrological conditions of the river at this site provided a slow steady current and would have prevented settling of oil residues in this area. The low levels of TPH at this site also coincide with the apparent lack of invertebrate response at location 5 noted earlier.

Measured concentrations of TPH in riffle samples did not differ substantially among locations by July 1989 (about 6 months after the spill), and sampling of riffle areas was discontinued at this time.

Synthesis

After 18 months, effects of the Gasconade River oil spill are evident in the backwater areas at the four most downstream locations. Although concentrations of oil in the sediments have diminished, diversity of backwater communities in sites 6-9 have not changed appreciably. The functional groups of Shredders and Scrapers have been either eliminated or reduced in number in samples collected from these locations. The probabilities that no Shredders will be found in samples from sites 7, 8, and 9 is significantly higher than the same probabilities for other locations. The probabilities that a large number of Scrapers

Table 4. First sampling dates at which measured TPH concentrations in backwater areas of locations downstream from the spill site reached levels of 80 mg/kg or less. Months after spill are in parentheses.

Location	First Date Minimum < 80 mg/kg		First Date Maximum < 80 mg/kg	
4	11-01-89	(11)	11-01-89	(11)
5	5-02-89	(5)	6-05-89	(6)
6	7-26-89	(7)	10-15-90	(23)
7	3-26-90	(15)	6-06-90	(18)
8	6-21-90	(18)	6-21-90	(18)
9	6-15-90	(18)	N/A	(24+)

will be found in samples from locations 6 and 7 are significantly less than those for other locations. No effects attributable to the oil spill were identified in riffle habitats.

The impact of flooding during May 1990 was evident in relative abundance and diversity of organisms from all locations. The high flows and effective scouring of the river may initiate recovery of the backwater downstream areas. Based on conclusions in this report, additional monitoring of backwaters may be informative. However, such monitoring should be conducted with a design similar to that used in this study. Replication of sampling in a study of this nature is essential.

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Literature Cited

Academy of Natural Sciences of Philadelphia. 1983. Oil in the freshwater environment: a literature review. Draft Report No. 83-4DD, June 25 1984. Division of Environmental Research, Acad.Nat.Sci.Phil. 282 pp.

Barton,D.R. and R.R. Wallace. 1979. The effects of an experimental spillage of oil sands tailings sludge on benthic invertebrates. Environ. Pollut. 18:305-312.

Bishop, Y.M.M., S.E.Fienberg, and P.W.Holland. 1975. Discrete multivariate analysis: theory and practice, MIT Press, Cambridge Mass.

Bobra, A.M., W.Y.Shiu, and D.McKay. 1983. A predictive correlation for the acute toxicity of hydrocarbons and chlorinated hydrocarbons to the water flea (Daphnia magna). Chemosphere 12((/10):1121-1129.

Brown, M.B. 1976. Screening effects in multidimensional contingency tables. Applied Statistics. 25:37-46.

Buikema, A.L.Jr., D.R.Lee, and J.Cairns Jr. 1976. A screening bioassay using Daphnia pulex for refinery wastes discharged into freshwater. Journal of Testing and Evaluation. 4(2):119-125.

Cairns,J.Jr. and A.L.Buikema Jr. 1984. Restoration of Habitats Impacted by Oil Spills. Butterworth Publ., Stoneham, Mass. 182 pp.

Cronk, J.K.,W.J.Mitsch, and R.M.Sykes. 1990. Effective modelling of a major inland oil spill on the Ohio River. Ecol.Mod. 51:161-192.

Crunkilton, R.L. 1984. Missouri water pollution investigations-1984. Missouri Department of Conservation, Jefferson City. 34 pp.

Crunkilton,R.L. and R.M.Duchrow. 1990. Impact of a massive crude oil spill on the invertebrate fauna of a Missouri Ozark stream. Environ. Pollut. 63:13-31.

Cushman, R.M. and J.C.Goyert. 1984. Effects of a synthetic crude oil on pond benthic insects. Environ. Pollut. 33:163-186.

Freeman, D.H. 1987. Applied Categorical Data Analysis. Marcel Dekker, New York.

Green,J. and M.W.Trett (editors). 1989. The Fate and Effects of Oil in Freshwater. Elsevier Applied Science. ISBN 1-85166-3118-5 338 pp.

Guiney, P.D., J.L.Sykora, and G.Keleti. 1987. Environmental impact of an aviation kerosene spill on stream water quality in Cambria County, Pennsylvania. Environ. Toxicol. Chem. 6:977-988.

Harrel, R.C. 1985. Effects of a crude oil spill on water quality and macrobenthos of a southeast Texas stream. Hydrobiologica 124:223-228.

Lu, P-Y, R.L.Metcalf, N.Plummer, and D.Mandel. 1977. The environmental fdate of three carcinogens:benzo(a)pyrene, benzidine and vinyl chloride evaluated in laboratory model ecosystems. Arch. Environ. Contam. Toxicol. 6:129-142.

Masnik, M.T., J.R.Stauffer, C.H.Hocutt, and J.H.Wilson. 1976. The effects of an oil spill on the macroinvertebrates and fish in a small southwestern Virginia creek. J. Environ. Sci.Health. 4-5:281-296.

Millemann, R.E., S.J. Tumminia, J.L.Forte, and K.L.Daniels. 1984. Comparative toxicities of coal derived and shale derived crude oils and a petroleum derived fuel oil to the freshwater snails, Helisoma trivolvis and Physa gyrina. Environ. Pollut. 33(1):23-38.

Monticello,D.J. and W.R.Finnerty. 1985. Microbial desulfurization of fossil fuels. Annu.Rev Microbiol. 39:371-389.

Muller,H. 1987. Hydrocarbons in the freshwater environment: a literature review. Archiv. Hydrobiol, Advances in Limnology, 24:1-69.

National Academy of Sciences. 1973. Research Needs in water quality criteria to the Environmental Studies Board of the Nat. Acad.Sci., Washington DC. 64pp.

Petrakis, L. and F.T.Weiss. 1980. Petroleum in the Marine Environment. Advances in Chemistry Series 185. American Chemical Society, Washington DC. 371 pp.

Read, T.R.C. and N.A.C. Cressie. 1988. Goodness of fit statistics for discrete multivariate data. Springer-Verlag, New York.

Rosenburg, D.M. and A.P.Wiens. 1976. Community and species responses of Chironomidae (Diptera) to contamination of fresh waters by crude oil and petroleum products, with special reference to the Trail River, Northwest Territories. J. Fisheries Res. Board Can. 33:1955-63.

Ryck, F.M. and R.M.Duchrow. (1973-74) Oil pollution and the aquatic environment in Missouri. 1960-1972. Trans Mo.Acad.Sci. 7-8:164-171.

Schultz, D. and L.B. Tebo. 1975. Boone Creek Oil Spill. In 1975 conference on prevention and control of oil pollution. San Francisco, CA. pp 583-588.

Shailubhai. K. 1986. Treatment of petroleum industry sludge in soil. Trans.in Biotech. 4:202-206.

Southworth, G.R., J.J.Beauchamp, and P.K.Schmieder (1978). Bioaccumulation potential of polycyclic aromatic hydrocarbons in Daphnia pulex. Water Res. 12(11):973-977.

Trucco, R.G.,F.R.Englehardt, and B.Stacey. 1983. Toxicity, accumulation and clearance of aromatic hydrocarbons in Daphnia pulex. Environ. Pollut. 31:191-202.

Vandermeulen, J.H. and S.E.Hrudley. 1987. Oil in freshwater: chemistry, biology, and countermeasure technology. Proceedings of a symposium on freshwater oil pollution, Alberta, Canada. Permagon Press. 520 pp.

Appendix A

Detailed rationale and explanation of construction of log-linear models for statistical analysis of macroinvertebrate data.

DATA ANALYSIS FOR GASCONADE RIVER BENTHOS STUDY

Statistical analysis of data from a large environmental project such as the survey of benthos abundance on the Gasconade River may be considered to involve three major parts:

1. Identification of Relevant Factors
2. Assignment of Probability Structure
3. Construction of Appropriate Statistical Hypotheses

These three overall components of the current analysis, along with the numerous details subsumed by each, will be discussed in turn. A thorough discussion of these topics is somewhat laborious, but is necessary because the overall question to be addressed -- the long-term "impact" of the 1988 oil spill on the benthic fauna of the Gasconade River -- is poorly defined in statistical terms.

1. Identification of Relevant Factors

Benthic samples were taken at a number of locations on the river at a number of times throughout 1989 and 1990. Benthic fauna may differ both spatially and temporally in a river without regard to the effects of an environmental perturbation, so that both location and sampling period become factors of interest in the study. The perturbation under examination, the oil spill, is confounded with differences among individual locations in that one location either experienced the oil spill or did not. For this reason, as will be reiterated later, hypotheses constructed around the effects of the oil spill must be formulated in terms of consistency among locations subjected to like oil conditions and inconsistency between groups of locations. Nevertheless, the unique characteristics of each location must be considered so that differences between groups of locations are not attributed to tbe effects of oil unless inherent variability among locations is insufficient to account for those differences. Such an approach is necessarily conservative, but is dictated by the physical realities of the situation.

The assertion that the question of determining whether or not the benthic community has been impacted by the oil spill is poorly defined in statistical terms is the direct result of the absence of a readily available response measurement. That is, it is difficult to know how one measures the "impact" of environmental perturbation to a

bentbic community in a manner that can be agreed upon and interpreted by various parties. Certainly a wide variety of quantities have been suggested to represent various aspects of community composition; these include indices of diversity, evenness, pollution sensitivity, taxonomic loss, similarity, and dissimilarity, among others. It must be acknowledged that agreement on the usefulness of such quantities, either individually or as a concept, does not currently exist. Use of a wide variety of potential response variables leads to prohlems in interpretation and independence of results, and thus remains a poor approach to probabilistic analysis. The view adopted here is that in such a situation the entire concept of a response variable is tenuous, and that assessment of the associations among measured quantities and relevant environmental conditions provides a cleaner avenue to meaningful interpretation than does construction of an arbitrarily defined response. The measurements made during this project were counts of benthic invertebrates, and it is these counts that constitute the remaining factor of interest. While summary quantities reflective of community composition are a source of confusion and disagreement, the concept that different species and taxonomic groups play different roles in the functioning of a community has received wide acceptance. Because an environmental perturbation may affect these groups differentially, counts of the number of benthic invertebrates were considered separately for four functional groups: shredders, scrapers, predators, and collectors. Raw counts of the number of organisms in these groups were used rather than relative abundance so that independence could be reasonably assumed among the individual analyses.

Consideration of the objective and design of this study have led to the identification of three main factors of interest:

i) Location

ii) Sampling Period

iii) Invertebrate Numbers

The factor of location provides the necessary means to identify an effect of the oil spill although, as previously indicated, such identification requires an effect detectable above and beyond what might reasonably be produced by inherent variance among locations. The effect of time is reflected in the factor of sampling period and, although one would certainly anticipate a detectable difference in the benthic community at different times, the questions of interest will center on the interaction of time with the degree of association between the other two factors. That is, in order for any potential effect of the oil spill to be separated from potential effects due to time, association between

location and invertebrate numbers indicative of oil effects must not further be influenced by time differences. For detection of any potential oil effect, time as measured by sampling period may be associated with invertebrate numbers but must not be associated with the association of invertebrate numbers to location. The third factor identified is counts of invertebrate numbers in each of four functional groups. Counts were used in this analysis because of the lack of a readily interpretable response variable.

2. Assignment of Probability Structure

Assigning a probability structure to this problem involves three interrelated components: definition of the random variables; assumed probability distributions of those variables; and determination of the statistical model to be used.

2.1 Definition of variables and random variables

Identification of the relevant factors to be considered leads directly to definition of the variables and random variables involved in the analysis. For the factor of location, a non-random variable with 9 discrete values is immediately identified. But because samples were taken from both riffle and backwater areas, and different sampling techniques were necessarily used to obtain these samples, any analysis must account for differences between riffle and backwater areas. It is well known and accepted that different ecological conditions in riffle and backwater areas result in distinct benthic communities. Thus, separate (but parallel) analyses were conducted for riffle and backwater samples. Two locations contained only one of these habitat types, one location having only riffles and one only backwater. The result is a location variable having 8 discrete values for each of the analyses. For each analysis, regardless of whether riffle or backwater samples were involved, the variable of location will be indexed as L_j, j=1, ..., 8. The specific river locations thus identified by the index j will differ according to whether the analysis includes riffle or backwater samples.

For the factor of sampling period, a non-random variable with 5 discrete values is identified. Because heavy rains resulted in all riffle areas being inaccessible for the final sampling period, the analyses conducted with riffle samples have only 4 values for this variable. In addition, certain riffle and backwater locations were not accessible at certain sampling periods, resulting in observations of zero counted invertebrates not because such were observed but because of the sampling design. In the analyses conducted, these observations are known as "structural zeros". Sampling periods

identified in this report as periods 4, 5, 6, 7, and 8 will be indexed as P_i, i=1, ..., 5 for backwater samples and P_i, i=1, ..., 4 for riffle samples.

The factor of counts of invertebrate numbers is the only identified factor of a random nature involved in the study. Several choices present themselves for definition of a random variable, the most obvious being to simple define a random variable as the number of organisms within a functional group, indexed to location and sampling period. But the characteristics of the overall problem argue for an alternative approach in which the number of organisms are grouped into abundance categories. First, each of the other factors readily define categorical variables so that the problem is perhaps best approached from the theory of categorical data analysis. Second, the occurrence of numbers of organisms in the mid-range of the overall productivity of the Gasconade River lack interpretability relative to the effects of the oil spill. Yet differences in this range of number of organisms could well produce statistically detectable differences among locations. Finally, the problem of assessing the impact of the oil spill on the benthic community lacks a well-defined response, as previously alluded to in Section 1. For these reasons abundance categories were created separately for each functional group according to the following rules:

i) Three abundance categories were created into which each replicate sample of organisms taken at a location in a sampling period could fall. While arbitrary, three categories were used because this seemed the maximum number possible with five replicate samples.

ii) To allow the analysis to proceed on a basis which accounted for the overall benthic abundance on the Gasconade River, abundance categories were created relative to the total population of all sampling locations over all sampling periods.

iii) To accentuate the total disappearance of a functional group, the lowest abundance category was defined to be zero organisms if greater than 10% of all samples had zero organisms for that functional group. The remaining categories were then defined as number of organisms below or equal to the median for all samples with positive counts, and number of organisms greater than this median. The median value for number of organisms was calculated after exclusion of samples with zero counts. Thus, if greater than 10% of all samples had zero counts for a functional group, the abundance categories for that group were defined as Zero

(being equal to no organisms), Low (being less than or equal to the median number of organisms for samples with positive counts), and High (being greater than the median number of organisms for samples with positive counts).

iv) If less than 10% of all samples had counts of zero for a given functional group, the abundance categories for that group were defined as less than or equal to the first quartile, greater than the first quartile but less than or equal to the third quartile, and greater than the third quartile. That is, for a given functional group, if Q_1 denotes the first quartile (or 25th percentile) of all counts and Q_3 denotes the third (or 75th percentile) the abundance categories for that group were defined as Low (count $\leq Q_1$), Middle ($Q_1 <$ count $\leq Q_3$), and High ($Q_3 <$ count).

These abundance categories for counts of number of organisms in a given functional group thus defined a categorical variable O_k, k=1, 2, 3.

The three factors of period, location, and organism abundance were used to create a three dimensional contingency table for each functional group with 96 cells for riffle samples (4 periods x 8 locations x 3 abundances) and 120 cells for backwater samples (5 periods x 8 locations x 3 abundances). The random variable to be analyzed was defined as the number of observations or individual samples falling into each of these cells. The entire project involved a total of 8 separate analyses (4 functional groups for each riffle and backwater samples).

2.2 Assumed probability distribution

The probability distribution assumed to hold for each of the 8 analyses is that of one multinomial distribution with 96 or 120 categories for riffle and backwater samples, respectively. It could be argued that each analysis constitutes a series of trinomial distributions, one for each sampling period and location combination. The reasons for assuming one overall multinomial rather than a series of trinomials are that (1) cell frequencies are missing for location-period combinations in which high water prohibited access, and (2) the counts of invertebrate abundance are considered characteristics of the samples rather than a response to explanatory factors. The first point results in unfixed marginal totals for the overall contingency table in each analysis, emphasizing the non-experimental nature of the benthic survey conducted. The second point foreshadows the factor-response structure discussed below and provides an indication

that the statistical hypotheses of interest will be hypotheses of independence rather than hypotheses of homogeneity.

2.3 Determination of statistical model

The issue of factor-response structure in a statistical model has been alluded to several times in the preceding sections, where it was indicated the current analysis eschews the concept of a response variable. The essence of this issue may be described by contrasting a one response, two factor situation with a three response (or three factor) situation. In a categorical framework, the former generally models the probability of observations falling into various response categories -- or a function of those probabilities -- as a linear additive function of the explanatory factors. The statistical hypotheses used in this situation center on the question of homogeneity of those response probabilities across levels of the two factors. This one response, two factor situation implies a certain amount of control was available over the levels of the two explanatory factors, as well as requiring a clearly interpretable response variable. In dimensions of greater than two, such models are heavily dependent on the particular parametrization used, and interactions which are discovered during the analysis rather than hypothesized a priori can cause interpretational difficulties. In contrast, the three response structure treats the data as having arisen from a survey or cross-sectional design in which all three factors represent characteristics of the individual sampling units. In this way, all three variables are treated symmetrically. The statistical hypotheses used in this structure center on the questions of independence and conditional independence of the three factors. The distinction between these two approaches (one response versus multiple responses) is often overlooked as the two approaches are entirely equivalent in the case of two dimensional contingency tables. But for three dimensional tables, such as those considered here involving sampling period, location, and organism abundance, hypotheses of homogeneity and independence are not equivalent.

The general statistical framework developed to deal with questions of dependence among multiple categorical factors is that of the log-linear model. Assuming one multinomial distribution for the number of samples falling into the cells of a contingency table, the log-linear approach models the logarithm of the cell probabilities (or equivalently the logarithm of the expected frequencies) as an additive, linear function of effects associated with all of the factors included in the study. A total of eight log-linear analyses were conducted in this study, corresponding to the

combinations of the four functional groups with riffle or backwater samples. The general structure of these models is given following the notation used by Bishop, Fienberg, and Holland (1975).

2.3.1 Notation

Define the following parameters to represent effects of the three factors sampling period, location, and organism abundance:

Parameters	Index Range	Effect Represented
$U_{1(i)}$	i=1, ..., I	Sampling Period
$U_{2(j)}$	j=1, ..., J	Location
$U_{3(k)}$	k=1, ..., K	Organism Abundance
$U_{12(ij)}$	i,j=(1,1), ..., (I,J)	Period x Location
$U_{13(ik)}$	i,k=(1,1), ..., (I,K)	Period x Abundance
$U_{23(jk)}$	j,k=(1,1), ..., (J,K)	Location x Abundance
$U_{123(ijk)}$	i,j,k=(1,1,1), ..., (I,J,K)	Period x Location x Abundance

For riffle analyses, I=4 (periods 4, 5, 6, and 7), J=8 (locations 1, 2, 3, 4, 5, 7, 8, and 9), and K=3 (abundances Small, Middle, and Large in each case). For backwater analyses, I=5 (periods 4, 5, 6, 7, and 8), J=8 (locations 1, 2, 3, 5, 6, 7, 8, and 9), and K=3 (abundances Zero, Small, and Large for functional groups shredders and scrapers, and Small, Middle, and Large for predators and collectors).

2.3.2 Saturated model

Given the above notation and using $\mathcal{L}_{ijk} = \log(p_{ijk})$ where p_{ijk} is the probability of an observation falling into the i,j,kth cell of the contingency table described by sampling period, location, and organism abundance, the saturated log-linear model for each of the eight analyses may be written as

$$\mathcal{L}_{ijk} = U + U_{1(i)} + U_{2(j)} + U_{3(k)} + U_{12(ij)} + U_{13(ik)} + U_{23(jk)} + U_{123(ijk)}$$

Parameter restrictions on this model are that each parameter group sums to zero across any subscript (e.g., $\sum_i U_{1(i)} = \sum_i U_{12(ij)} = \sum_j U_{12(ij)} = 0$). Thus, this saturated

model includes as many parameters as the number of cells in the table and the parameter estimates, while unique, are simply another representation of the observed cell frequencies.

2.3.3 Model construction

The model building process proceeds in a manner that may be described as backwards elimination. That is, parameters are eliminated from the model if they do not sufficiently decrease the measure of discrepancy between observed and fitted data. The measure of discrepancy used was the likelihood ratio chi-square statistic, which is necessarily equal to zero for the saturated model. Initial selection of candidate models was based on a screening of terms through tests of partial and marginal association (Brown 1976). Under suitable regularity conditions the nesting (or additive decomposition) property of the likelihood ratio statistic provides asymptotic chi-square tests for the significance of individual parameter values. Given two competing models, each with non-significant likelihood ratio goodness of fit tests, tests for the significance of particular parameters were constructed using the difference in likelihood ratio statistics. The parameter constraints given in Section 2.3.2 may be considered to define an "internal constraints problem" so that maximum likelihood estimates are also minimum discrimination estimates (Read and Cressie 1988). In addition, the model building strategy used in these analyses followed the hierarchy principle. That is, if any term was deemed significant in the model then its lower order relatives were also included in the model (see Bishop, Fienberg, and Holland 1975 for a complete discussion).

3. Construction of Statistical Hypotheses

The statistical hypotheses of interest are those of association or, more precisely, partial association. The hierarchy principle implies that no simplification of the saturated model is possible if the three-way interaction term $U_{123(ijk)}$ cannot be eliminated from the model. The first hypothesis tested in each analysis was thus

$$H_0\text{:}\ \ U_{123(ijk)} = 0, \text{ all i,j,k}$$

Given acceptance of this hypothesis, the two-way interaction terms were tested using the difference in likelihood ratio chi-square statistics between models in which two-way terms were included and eliminated. That is, if Ω represents the full parameter space for the saturated model, reduced models may be identified by the subspaces

$\Omega_1, \Omega_2, \ldots$ etc. such that $\Omega_1 \subset \Omega_2 \subset \ldots \subset \Omega$. For example, the parameter spaces corresponding to the test of no three-way interaction given as H_0 above are the full saturated model space which contains IxJxK parameters, and the reduced space having only IxJxK−(I−1)x(J−1)x(K−1) elements. Then the likelihood ratio chi-square statistic for testing the hypotheses

$$H_0\colon\ \underset{\sim}{U} \in \Omega \qquad \text{versus} \qquad H_1\colon\ \underset{\sim}{U} \in \Omega_h$$

is given by

$$G_h^2 = -2 \log \frac{\sup\limits_{u \varepsilon \Omega_h} \text{likelihood for model with parameter space } \Omega_h}{\sup\limits_{u \varepsilon \Omega} \text{likelihood for saturated model with parameter space } \Omega}$$

and for $\Omega_m \subset \Omega_h$ a test of the hypotheses

$$H_0\colon\ \underset{\sim}{U} \in \Omega_h \qquad \text{versus} \qquad H_1\colon\ \underset{\sim}{U} \in \Omega_m$$

is given by

$$T = G_m^2 - G_h^2 \qquad \text{with degrees of freedom } \dim(\Omega_h) - \dim(\Omega_m)\ .$$

Although each of the three factors period, location, and organism abundance are treated symmetrically in the analysis, one two-way interaction term has special meaning in the context of the study. This is the interaction or partial association of organism abundance with location, and this interaction may the called the *study association* (Freeman 1987). Inference about the impact of the oil spill on the benthic invertebrate community is based on the significance and consistency across location of this study association. Explicitly, the study association in both riffle and backwater analyses involves (J−1)x(K−1) = 8x3=24 parameters corresponding to the following effects:

Parameter	Effect
$U_{12(11)}$	Location 1 x Abundance Class 1 Effect
$U_{12(12)}$	Location 1 x Abundance Class 2 Effect
$U_{12(13)}$	Location 1 x Abundance Class 3 Effect
$U_{12(21)}$	Location 2 x Abundance Class 1 Effect
.	.
.	.
.	.
$U_{12(83)}$	Location 8 x Abundance Class 3 Effect

In a log-linear model, these parameter terms are generalizations of average odds ratios, and thus reflect the odds of obtaining samples with different organism abundances at the various locations, after adjusting for the effect of sampling period. A hypothesis constructed to test for detectable effects of the oil spill must be formulated in terms of consistency of study association parameters among locations subjected to like oil conditions and inconsistency in these parameters between groups of locations. Specifically, to infer that the oil spill has resulted in a decreased probability of finding a high number of organisms in a particular functional group, parameter estimates of location x high abundance class effects must be negative for all or almost all locations below the oil spill and neutral or positive for all or almost all locations above the oil spill. Alternatively, we may have parameters for location x low (or zero) abundance class effects positive for locations below the spill and negative for locations above the spill.

Finally, the substantive interpretation of model parameters and tests of those parameters should be noted. The log-linear models constructed in the eight analyses of this study are models for the log probability of an observation falling into a given period x location x abundance category. As a result, the interpretation attached to the parameter estimates is an effect on the probability of a certain occurrence, rather than an effect on the average level of a continuous variable. A significant negative parameter estimate for a given location x high abundance term does not imply that less organisms are expected in that location for *every* sample, but rather that the probability of obtaining a sample with a high number of organisms is decreased for that location relative to the set of all locations considered.

Appendix B

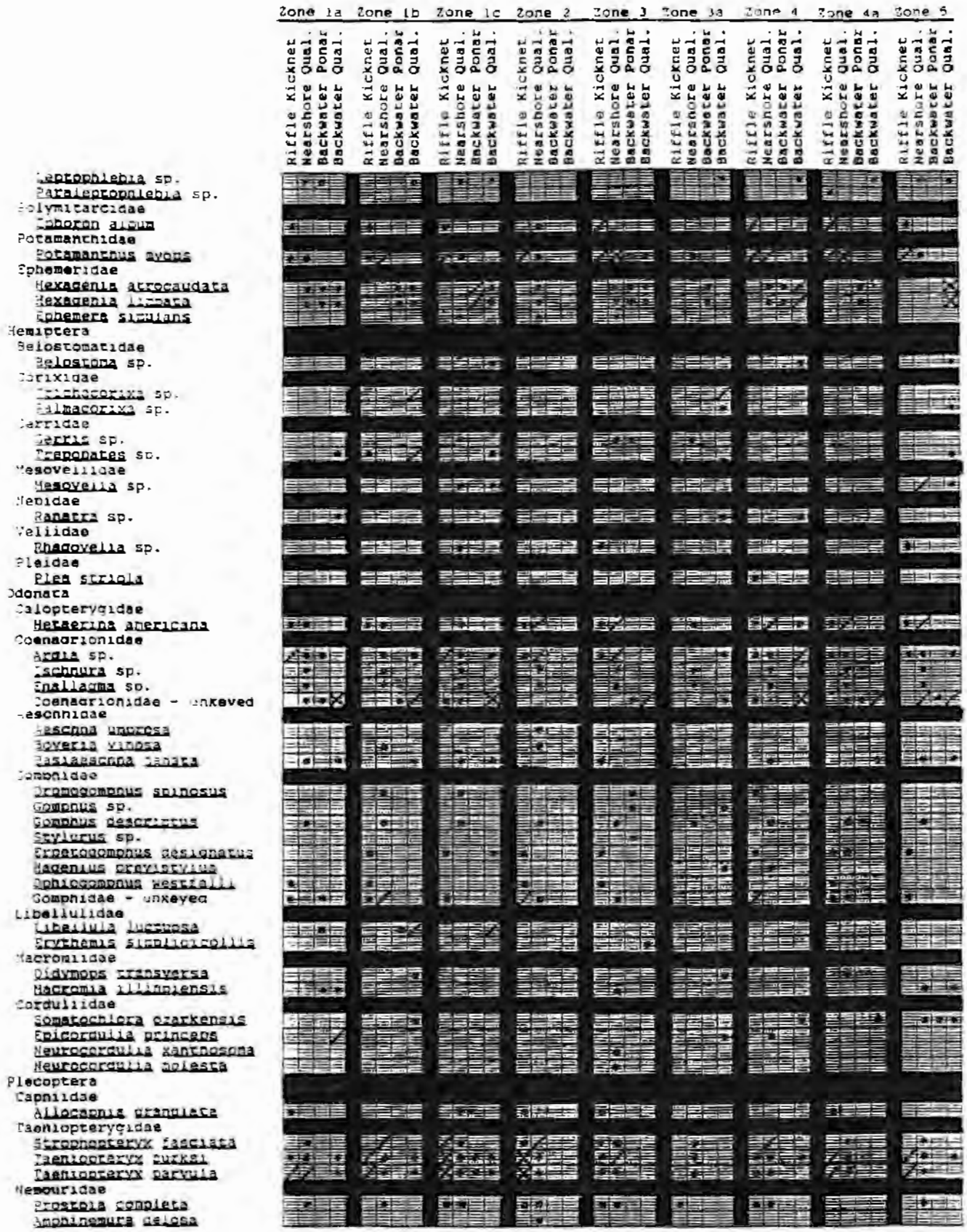
Average abundance for all samples collected on the Gasconade River by MDNR reconnaissance sampling (March, May, and June 1989) and by this study (July 1989 - June 1990). This table also represents a complete species listing for the both studies.

Symbols are:

- • less than 5 individuals/sample (rare)
- / 5 - 50 individuals/sample (common)
- X greater than 50 individuals/sample (abundant)

	Zone 1a			Zone 1b			Zone 1c			Zone 2			Zone 3			Zone 1e			Zone 4			Zone 4a			Zone 5		
	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Riffle Kicknet	Nearshore Qual.	Backwater Ponar
Platyhelminthes																											
Turbellaria																											
Dugesia tigrina																											
Cnidaria																											
Hydrozoa																											
Hydra sp.																											
Nematomorpha																											
Gordiidae																											
Gordius sp.																											
Annelida																											
Hirudinea																											
Erpobdellidae																											
Mooreobdella fervida																											
Erpobdella sp.																											
Glossiphoniidae																											
Helobdella sp.																											
Batracobdella phalera																											
Placobdella ornatipes																											
Oligochaeta																											
Enchytraeidae																											
Lumbriculidae																											
Naididae																											
Aeolosoma timonoi																											
Chaetogaster diaphanus																											
Dero sp.																											
Haemonais waldvogeli																											
Nais sp.																											
Nais bretscheri																											
Nais pardalis/variabilis																											
Nais simplex																											
Nais communis																											
Ophidonais serpentina																											
Pristina irtenensis																											
Pristina longiseta																											
Slavina appendiculata																											
Stylaria lacustris																											
Wapsa nobilis																											
Tubificidae																											
Aulodrilus pigueti																											
Branchiura sowerbyi																											
Ilyodrilus templetoni																											
Limnodrilus cervix																											
Limnodrilus hoffmeisteri																											
Limnodrilus udekemianus																											
Quistadrilus multisetosus																											
Unknown sp. w/o capiliform chaeta																											
Unknown sp. with capilliform chaeta																											
Mollusca																											
Gastropoda																											
Pleuroceridae																											
Elimia potosiensis																											
Pleurocera acuta																											
Viviparidae																											
Campeloma decisum																											
Hydrobiidae																											
Hydrobiidae-unkeyed																											
Somatogyrus sp.																											
Lymnaeidae																											
Lymnaea sp.																											
Physidae																											
Physa sp.																											
Physella gyrina																											
Planorbidae																											
Gyraulus parvus																											
Helisoma anceps																											
Ancylidae																											
Ferrissia rivularis																											
Pelecypoda																											
Corbiculidae																											
Corbicula fluminea																											
Sphaeriidae																											
Pisidium spp.																											
Sphaerium sp.																											

	Zone 1a				Zone 1b				Zone 1c				Zone 2				Zone 1				Zone 1a				Zone 4				Zone 4a				Zone 5			
	Riffle	Kicknet	Nearshore	Qual.	Riffle	Kicknet	Nearshore	Qual.	Riffle	Kicknet	Nearshore	Qual.	Riffle	Kicknet	Nearshore	Qual.	Riffle	Kicknet	Nearshore	Qual.	Riffle	Kicknet	Nearshore	Qual.	Riffle	Kicknet	Nearshore	Qual.	Riffle	Kicknet	Nearshore	Qual.	Riffle	Kicknet	Nearshore	Qual.
Unionidae																																				
Alasmidonta marginata																																				
Anodonta imbecillis																																				
Cumberlandia monodonta																																				
Elliptio crassidens																																				
Elliptio dilatata																																				
Fusconaia flava																																				
Lampsilis cardium																																				
Lasmigona complanata																																				
Ligumia subrostrata																																				
Pleurobema sintoxia																																				
Quadrula quadrula																																				
Quadrula pustulosa																																				
Arthropoda																																				
Crustacea																																				
Amphipoda																																				
Hyalella azteca																																				
Stygobromus sp.																																				
Decapoda																																				
Palaemonetes kadiakensis																																				
Orconectes luteus																																				
Orconectes punctimanus																																				
Isopoda																																				
Lirceus sp.																																				
Arachnida																																				
Acarina																																				
Lebertia sp.																																				
Insecta																																				
Collembolla																																				
Entomobryidae																																				
Entomobrya sp.																																				
Ephemeroptera																																				
Neoephemeridae																																				
Neoephemera sp.																																				
Siphlonuridae																																				
Siphlonurus marshalli																																				
Baetidae																																				
Pseudocloeon dubium																																				
Baetis intercalaris																																				
Cloeon spp.																																				
Oligoneuriidae																																				
Isonychia bicolor																																				
Heptageniidae																																				
Leucrocuta sp. A																																				
Leucrocuta sp. B																																				
Rithrogena impersonata																																				
Stenacron interpunctatum																																				
Stenonema femoratum																																				
Stenonema mediopunctatum																																				
Stenonema terminatum																																				
Stenonema pulchellum																																				
Ephemerellidae																																				
Attenella sp.																																				
Dannella lita																																				
Ephemerella invaria																																				
Ephemerella needhami																																				
Eurylophella bicolor																																				
Eurylophella temporalis																																				
Serratella deficiens																																				
Serratella serrata																																				
Tricorythidae																																				
Tricorythodes sp.																																				
Caenidae																																				
Brachycercus sp.																																				
Caenis sp.																																				
Baetiscidae																																				
Baetisca lacustris																																				
Leptophlebiidae																																				
Choroterpes sp.																																				


Zone 1a
Zone 1b
Zone 1c
Zone 2
Zone 3
Zone 3a
Zone 4
Zone 4a
Zone 5
Riffle Kicknet
Nearshore Qual.
Backwater Ponar
Backwater Qual.
Leptophlebia sp.
Paraleptophlebia sp.
Polymitarcidae
Ephoron album
Potamanthidae
Potamanthus myops
Ephemeridae
Hexagenia atrocaudata
Hexagenia limbata
Ephemera simulans
Hemiptera
Belostomatidae
Belostoma sp.
Corixidae
Trichocorixa sp.
Palmacorixa sp.
Gerridae
Gerris sp.
Trepobates sp.
Mesoveliidae
Mesovelia sp.
Nepidae
Ranatra sp.
Veliidae
Rhagovelia sp.
Pleidae
Plea striola
Odonata
Calopterygidae
Hetaerina americana
Coenagrionidae
Argia sp.
Ischnura sp.
Enallagma sp.
Coenagrionidae - unkeyed
Aeschnidae
Aeschna umbrosa
Boyeria vinosa
Basiaeschna janata
Gomphidae
Dromogomphus spinosus
Gomphus sp.
Gomphus descriptus
Stylurus sp.
Erpetogomphus designatus
Hagenius brevistylus
Ophiogomphus westfalli
Gomphidae - unkeyed
Libellulidae
Libellula lucrosa
Erythemis simplicicollis
Macromiidae
Didymops transversa
Macromia illinoiensis
Corduliidae
Somatochlora ozarkensis
Epicordulia princeps
Neurocordulia xanthosoma
Neurocordulia molesta
Plecoptera
Capniidae
Allocapnia granulata
Taeniopterygidae
Strophopteryx fasciata
Taeniopteryx burksi
Taeniopteryx parvula
Nemouridae
Prostoia completa
Amphinemura delosa

	Zone 1a				Zone 1b				Zone 1c				Zone 2				Zone 3				Zone 3a				Zone 4				Zone 4a				Zone 5			
	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.	Riffle	Kicknet	Nearshore Qual.	Backwater Qual.
Perlidae																																				
Acroneuria internata																																				
Acroneuria ozarkensis																																				
Neoperla robisoni																																				
Neoperla falavan																																				
Neoperla catoxae																																				
Agnetina flavescens																																				
Perlesta browni																																				
Perlesta squputa																																				
Perlesta decipiens																																				
Perlinella ephyre																																				
Perlinella drymo																																				
Perlodidae																																				
Isoperla decepta																																				
Isoperla dorii																																				
Isoperla richardsoni																																				
Isoperla stilinata																																				
Pteronarcyidae																																				
Pteronarcys pictetii																																				
Megaloptera																																				
Corydalidae																																				
Corydalus cornutus																																				
Sialidae																																				
Sialis sp.																																				
Trichoptera																																				
Brachycentridae																																				
Brachycentrus lateralis																																				
Helicopsychidae																																				
Helicopsyche borealis																																				
Helicopsyche lipneila																																				
Hydropsychidae																																				
Cheumatopsyche sordida																																				
Cheumatopsyche narwoodi																																				
Cheumatopsyche aphanta																																				
Cheumatopsyche campyla																																				
Hydropsyche scalaris																																				
Hydropsyche simulans																																				
Hydropsyche alvata																																				
Ceratopsyche morosa																																				
Ceratopsyche sparna																																				
Potamyia flava																																				
Hydroptilidae																																				
Hydroptila ajax																																				
Hydroptila perdida																																				
Hydroptila spatulata																																				
Hydroptila albicornis																																				
Hydroptila armata																																				
Hydroptila angusta																																				
Hydroptila hamata																																				
Ochrotrichia ansica																																				
Ochrotrichia tarsalis																																				
Oxyethira pallida																																				
Ithytrichia clavata																																				
Neotrichia vibrans																																				
Glossosomatidae																																				
Protoptila lega																																				
Protoptila maculata																																				
Rhyacophilidae																																				
Rhyacophila sp.																																				
Polycentropidae																																				
Neureclipsis crepuscularis																																				
Polycentropus sp.																																				
Polyplectropus sp.																																				
Nyctiophylax affinis																																				
Cyrnellus fraternus																																				
Philopotamidae																																				
Chimarra obscura																																				
Chimarra socia																																				
Lepidostomatidae																																				
Lepidostoma sp.																																				

	Zone 1a				Zone 1b				Zone 1c				Zone 2				Zone 3				Zone 3a				Zone 4				Zone 4a				Zone 5			
	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar	Riffle	Kicknet	Nearshore Qual.	Backwater Ponar
Leptoceridae																																				
Ceraclea cancellata																																				
Ceraclea transversa																																				
Ceraclea punctata																																				
Ceraclea tarsipunctata																																				
Ceraclea flava																																				
Ceraclea maculata																																				
Oecetis avara																																				
Oecetis nocturna																																				
Oecetis cinerascens																																				
Setodes oxanius																																				
Triaenodes injusta																																				
Triaenodes ona																																				
Nectopsyche candida																																				
Nectopsyche intervena																																				
Nectopsyche exquisita																																				
Nectopsyche pavida																																				
Limnephilidae																																				
Pychnopsyche sp.																																				
Psychomyiidae																																				
Psychomyia flavida																																				
Phryganeidae																																				
Agrypnia vestita																																				
Lepidoptera																																				
Pyralidae																																				
Parapoyx sp.																																				
Acentria sp.																																				
Tortricidae																																				
Archipes sp.																																				
Nepticulidae																																				
Nepticula sp.																																				
Neuroptera																																				
Sisyridae																																				
Climacia sp.																																				
Coleoptera																																				
Georyssidae																																				
Georyssus sp.																																				
Gyrinidae																																				
Dineutus sp.																																				
Gyrinus sp.																																				
Haliplidae																																				
Peltodytes sp.																																				
Haliplus sp.																																				
Hydrophilidae																																				
Berosus sp.																																				
Tropisternus sp.																																				
Psephenidae																																				
Ectopria nervosa																																				
Psephenus herricki																																				
Dryopidae																																				
Helichus lithophilus																																				
Dytiscidae																																				
Laccophilus sp.																																				
Hydroporus sp.																																				
Elmidae																																				
Dubiraphia vittata																																				
Ancyronyx variegata																																				
Macronychus glabratus																																				
Microcylloepus pusillus																																				
Stenelmis beameri																																				
Stenelmis lateralis																																				
Stenelmis bicarinata																																				
Stenelmis humerosa-sinuata																																				
Optioservus ozarkensis																																				
Scirtidae																																				
Cyphon sp.																																				
Lymnichidae																																				
Lutrochus sp.																																				
Diptera																																				
Chaoboridae																																				
Chaoborus sp.																																				

	Zone 1a				Zone 1b				Zone 1c				Zone 2				Zone 3				Zone 3a				Zone 4				Zone 4a				Zone 5			
	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.
Ceratopogonidae																																				
Bezzia/Palpomyia sp.																																				
Dasyhelea sp.																																				
Empididae																																				
Hemerodromia sp.																																				
Chelifera sp.																																				
Clinocera sp.																																				
Psychodidae																																				
Pericoma sp.																																				
Psychoda sp.																																				
Stratiomyidae																																				
Nemotelus sp.																																				
Odontomyia sp.																																				
Culicidae																																				
Anopheles sp.																																				
Dolichopodidae																																				
Rhaphium sp.																																				
Athericidae																																				
Atherix Variegata																																				
Tabanidae																																				
Tabanus sp.																																				
Chrysops sp.																																				
Tanyderidae																																				
Protoplasa sp.																																				
Simuliidae																																				
Prosimulium sp.																																				
Simulium sp.																																				
Tipulidae																																				
Limnoniinae - unkeyed																																				
Hexatoma sp.																																				
Tipula sp.																																				
Chironomidae																																				
Chironominae - pupae																																				
Polypedilum sp.																																				
Cryptochironomus sp.																																				
Demicryptochironomus sp.																																				
Chironomus sp.																																				
Paracladopelma/Parataurterpornielia																																				
Tribelos/Phaenopsectra sp.																																				
Microtendipes sp.																																				
Dicrotendipes sp.																																				
Paratendipes sp.																																				
Glyptotendipes sp.																																				
Cryptotendipes sp.																																				
Pseudochironomus sp.																																				
Stichtochironomus sp.																																				
Nilodorum sp.																																				
Stenochironomus sp.																																				
Cladotanytarsus sp.																																				
Paratanytarsus sp.																																				
Rheotanytarsus sp.																																				
Stempellinella sp.																																				
Tanytarsus sp.																																				
Lauterborniella sp.																																				
Xenochironomus sp.																																				
Orthocladinae - pupae																																				
Cricotopus sp.																																				
Eukiefferiella sp.																																				
Orthocladius sp.																																				
Parametriocnemus sp.																																				
Hydrobaenus sp.																																				
Epoicocladius sp.																																				
Corynoneura sp.																																				
Rheocricotopus sp.																																				
Synorthocladius sp.																																				
Brillia sp.																																				
Paracricotopus sp.																																				
Nanocladius sp.																																				
Thienemanniella sp.																																				

	Zone 1a				Zone 1b				Zone 1c				Zone 2				Zone 3				Zone 3a				Zone 4				Zone 4a				Zone 5			
	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.	Riffle Kicknet	Nearshore Qual.	Backwater Ponar	Backwater Qual.
Tanypodinae - pupae																																				
Procladius sp.																																				
Ablabesmyia sp.																																				
Coelotanypus sp.																																				
Tanypus sp.																																				
Nilotanypus sp.																																				
Larsia sp.																																				
Thienemannimyia sp.																																				
Macropelopia sp.																																				
Guttipelopia sp.																																				
Diamesinae																																				
Potthastia sp.																																				

Appendix C

I. Sample period (4-7), Location (1-9), Replicate (1-5), EPT Index, EPT/Chironomidae ratio, Shannon Diversity Index (H), and Evenness or Relative Diversity (J) for riffle samples.

II. Sample period (4-8), Location (1-9), Replicate (1-5), Shannon Diversity Index (H), and Evenness or Relative Diversity (J) for backwater samples.

DIVERSITY AND EPT INDICIES
RIFFLE SAMPLES

PERIOD	LOC	REP	EPT	EPT_C	H	J
4	1	1	17	48.429	2.32732	0.42243
4	1	2	19	.	2.38130	0.43223
4	1	3	19	32.375	2.62331	0.47619
4	1	4	17	18.818	2.47077	0.44846
4	1	5	15	293.000	2.11230	0.38340
4	2	1	22	5.219	1.63590	0.29657
4	2	2	16	10.278	1.33634	0.24256
4	2	3	19	5.865	1.94814	0.35360
4	2	4	17	9.316	1.84390	0.33468
4	2	5	18	35.750	1.84552	0.33498
4	3	1	18	67.500	2.13351	0.38725
4	3	2	16	16.000	2.45753	0.44606
4	3	3	17	38.667	1.77118	0.32148
4	3	4	12	22.970	2.23206	0.40514
4	3	5	20	25.571	2.08651	0.37872
4	4	1	17	6.806	2.85046	0.51738
4	4	2	20	20.050	2.50443	0.45458
4	4	3	21	6.414	2.77058	0.50288
4	4	4	18	13.192	2.41771	0.43883
4	4	5	20	7.000	2.65014	0.48102
4	5	1	15	39.400	2.15586	0.39131
4	5	2	17	42.400	2.18502	0.39624
4	5	3	20	80.500	2.57820	0.46796
4	5	4	15	150.000	2.27783	0.41344
4	5	5	19	41.000	2.66693	0.48407
4	7	1	11	13.000	2.02320	0.36723
4	7	2	18	7.538	2.12656	0.38635
4	7	3	17	6.000	2.92649	0.53118
4	7	4	20	5.125	2.87274	0.52143
4	7	5	17	51.333	2.17475	0.39474
4	8	1	11	26.500	2.45861	0.44626
4	8	2	16	19.773	2.27048	0.41211
4	8	3	16	12.065	2.41022	0.43748
4	8	4	17	8.933	2.52742	0.45875
4	8	5	13	11.000	2.53639	0.46401
4	9	1	11	108.000	2.13166	0.38691
4	9	2	16	53.200	2.54168	0.46134
4	9	3	16	140.000	2.41545	0.43842
4	9	4	16	35.667	2.21146	0.40140
4	9	5	15	31.750	2.65684	0.48218
5	1	1	25	4.031	2.99907	0.54436
5	1	2	19	6.371	2.67212	0.48501
5	1	3	27	14.241	2.72948	0.49542
5	1	4	21	17.379	2.55134	0.46309
5	1	5	21	15.741	2.60988	0.47372
5	2	1	15	44.500	2.32972	0.42286
5	2	2	12	49.667	1.90543	0.34585
5	2	3	12	25.800	1.97404	0.35831
5	2	4	15	9.632	2.03484	0.36934
5	2	5	13	9.000	2.25474	0.40925
5	3	1	19	8.161	2.71028	0.49194
5	3	2	24	25.783	2.52397	0.43812
5	3	3	20	8.393	2.60938	0.47362

DIVERSITY AND EPT INDICIES
RIFFLE SAMPLES

PERIOD	LOC	REP	EPT	EPT_C	H	J
5	3	4	20	19.2188	2.73226	0.49593
5	3	5	15	11.4444	2.35543	0.42753
5	4	1	16	2.3030	2.91256	0.52865
5	4	2	20	10.6207	2.[illegible]	0.31361
5	4	3	16	2.8913	2.65716	0.48230
5	4	4	16	3.5342	2.39814	0.43438
5	4	5	24	5.1271	2.80022	0.50826
5	5	1	17	43.4167	1.96337	0.35637
5	5	2	20	12.0721	1.94472	0.35298
5	5	3	22	9.2968	2.16946	0.39378
5	5	4	16	11.8793	2.26225	0.41062
5	5	5	20	28.5208	2.01183	0.36516
5	7	1	19	19.8579	2.11877	0.38457
5	7	2	17	32.6250	2.03351	0.36946
5	7	3	18	17.8333	2.14599	0.38951
5	7	4	22	11.0909	2.33635	0.36962
5	7	5	22	13.3617	2.00699	0.36428
5	8	1	21	9.0714	2.36849	0.42990
5	8	2	15	88.0000	2.16686	0.39330
5	8	3	18	56.6667	2.36551	0.42936
5	8	4	24	4.1484	2.67185	0.48496
5	8	5	25	10.6134	2.49932	0.45368
5	9	1	9	25.7500	1.93950	0.35204
5	9	2	13	14.0000	2.43120	0.44128
5	9	3	13	14.1818	2.27837	0.41354
5	9	4	15	47.3333	2.21023	0.40118
5	9	5	10	21.8333	2.34680	0.42596
6	3	1	16	4.7413	1.75325	0.31823
6	3	2	24	2.9653	2.20661	0.40052
6	3	3	21	10.8333	1.64299	0.29822
6	3	4	19	4.5000	1.99985	0.36299
6	3	5	21	3.2326	1.95553	0.35495
6	4	1	22	11.2105	2.15165	0.39054
6	4	2	19	4.8462	2.19025	0.39759
6	4	3	15	8.2727	1.84539	0.33495
6	4	4	18	7.4259	1.78413	0.32383
6	4	5	17	5.8295	2.31450	0.42010
6	5	1	10	5.0000	2.44010	0.44290
6	5	2	15	3.2286	2.63836	0.47888
6	5	3	14	2.9250	2.34191	0.42508
6	5	4	23	2.7556	3.02552	0.54916
6	5	5	16	4.0000	2.47407	0.44906
6	7	1	18	0.7468	2.86904	0.52076
6	7	2	19	5.1923	3.08807	0.55906
6	7	3	20	2.7714	3.04709	0.55307
6	7	4	21	5.5417	2.84436	0.51628
6	7	5	16	5.4483	2.69016	0.48829
6	9	1	9	1.4615	2.95700	0.53672
6	9	2	13	1.5385	3.06366	0.55664
6	9	3	15	2.2000	3.25261	0.59054
6	9	4	8	1.8000	2.57495	0.46738
6	9	5	20	1.3524	3.22979	0.58623
7	1	1	22	9.8667	2.75049	0.49924

DIVERSITY AND EPT INDICIES
RIFFLE SAMPLES

PERIOD	LOC	REP	EPT	EPT_C	H	J
7	1	2	16	13.5600	2.46653	0.44770
7	1	3	19	12.1429	2.70076	0.49021
7	1	4	16	6.0508	2.60481	0.47280
7	1	5	21	11.8333	2.38698	0.43326
7	3	1	21	48.7000	2.26677	0.41144
7	3	2	24	13.6984	2.85987	0.51904
7	3	3	25	54.6667	2.86311	0.51605
7	3	4	23	56.5000	2.30559	0.41848
7	3	5	13	22.1250	2.31438	0.42008
7	4	1	17	4.0000	3.06437	0.55621
7	4	2	18	2.3934	2.90459	0.52721
7	4	3	21	1.3688	2.80272	0.50872
7	4	4	18	3.2500	3.08258	0.55951
7	4	5	17	4.3000	2.63099	0.47755
7	5	1	24	9.7083	2.88488	0.52363
7	5	2	22	8.5238	2.67923	0.48630
7	5	3	22	19.2143	2.64727	0.48050
7	5	4	23	8.1071	2.49859	0.45352
7	5	5	22	13.3846	2.63304	0.47792
7	7	1	16	2.1927	2.66382	0.48351
7	7	2	10	10.1176	2.41589	0.43850
7	7	3	18	6.3684	2.58815	0.46977
7	7	4	19	3.6622	2.79179	0.50673
7	7	5	13	3.6441	2.19757	0.39888
7	8	1	13	8.0000	2.47598	0.44941
7	8	2	20	6.9783	2.87188	0.52127
7	8	3	15	81.0000	2.05878	0.37369
7	8	4	17	6.6000	2.36967	0.43012
7	8	5	14	12.0000	2.42107	0.43944

DIVERSITY INDICIES
BACKWATER SAMPLES

PERIOD	LOC	REP	H	J
4	1	1	2.23523	0.40571
4	1	2	2.18404	0.39642
4	1	3	1.82383	0.33104
4	1	4	1.42237	0.25817
4	1	5	1.55082	0.28149
4	2	1	1.52562	0.27691
4	2	2	1.46752	0.26637
4	2	3	1.47317	0.26739
4	2	4	1.72994	0.31400
4	2	5	1.40264	0.25453
4	3	1	2.15894	0.39186
4	3	2	1.78597	0.32410
4	3	3	1.40650	0.25529
4	3	4	0.90193	0.16371
4	3	5	1.06752	0.19376
4	5	1	0.94913	0.17227
4	5	2	1.54580	0.28058
4	5	3	2.01910	0.36648
4	5	4	1.81333	0.32913
4	5	5	2.14652	0.38961
4	6	1	1.00103	0.18170
4	6	2	0.37627	0.06830
4	6	3	0.85767	0.15567
4	6	4	0.80262	0.14568
4	6	5	0.46244	0.08394
4	7	1	0.27892	0.05063
4	7	2	1.08322	0.19661
4	7	3	0.47185	0.08565
4	7	4	0.15581	0.02828
4	7	5	0.99410	0.18044
4	8	1	0.35752	0.06489
4	8	2	0.35432	0.06431
4	8	3	0.14023	0.02545
4	8	4	0.07103	0.01289
4	8	5	0.27607	0.05011
4	9	1	0.33059	0.06000
4	9	2	0.49193	0.08929
4	9	3	0.26962	0.04894
4	9	4	0.60672	0.11012
4	9	5	0.57628	0.10460
5	1	1	1.55717	0.28264
5	1	2	1.74118	0.31604
5	1	3	1.35474	0.24590
5	1	4	1.65084	0.29964
5	1	5	1.55153	0.28162
5	2	1	1.10077	0.19980
5	2	2	1.30318	0.23654
5	2	3	1.27041	0.23059
5	2	4	1.31136	0.23802
5	2	5	1.45049	0.26328
5	3	1	1.68250	0.30535
5	3	2	1.17804	0.21382
5	3	3	1.62625	0.29481

DIVERSITY INDICIES
BACKWATER SAMPLES

PERIOD	LOC	REP	H	J
5	3	4	1.45328	0.26378
5	3	5	1.43397	0.26028
5	5	1	1.87297	0.33996
5	5	2	1.42032	0.25780
5	5	3	1.60909	0.29206
5	5	4	1.27538	0.23113
5	5	5	1.60640	0.29121
5	6	1	1.19796	0.21744
5	6	2	1.05348	0.19122
5	6	3	1.07850	0.19572
5	6	4	1.24086	0.22523
5	6	5	0.92231	0.16741
5	7	1	0.50746	0.09211
5	7	2	0.33314	0.06047
5	7	3	0.59877	0.10868
5	7	4	0.71791	0.13031
5	7	5	0.49897	0.09057
5	8	1	0.21423	0.03888
5	8	2	0.45775	0.08308
5	8	3	0.61014	0.11075
5	8	4	0.72442	0.13149
5	8	5	0.35085	0.06368
5	9	1	0.34286	0.06223
5	9	2	0.28759	0.05220
5	9	3	0.33043	0.05998
5	9	4	0.70319	0.12764
5	9	5	0.28345	0.05145
6	1	1	2.18053	0.39579
6	1	2	1.76368	0.32012
6	1	3	0.86985	0.15789
6	1	4	2.16435	0.39285
6	1	5	1.25042	0.22696
6	3	1	1.82876	0.33194
6	3	2	2.12331	0.38540
6	3	3	2.15283	0.39076
6	3	4	1.82210	0.33073
6	3	5	2.53175	0.45953
6	5	1	2.95319	0.53603
6	5	2	1.87105	0.33961
6	5	3	1.51949	0.27580
6	5	4	2.59225	0.47052
6	5	5	2.16696	0.39332
6	6	1	1.24849	0.22661
6	6	2	1.45288	0.26371
6	6	3	0.96509	0.17517
6	6	4	1.21920	0.22129
6	6	5	1.21715	0.22092
6	7	1	0.64659	0.11736
6	7	2	0.90185	0.16369
6	7	3	0.80990	0.14700
6	7	4	0.63759	0.11569
6	7	5	0.32657	0.05928
6	9	1	0.42880	0.07783

DIVERSITY INDICIES
BACKWATER SAMPLES

PERIOD	LOC	REP	N	J
6	9	2	0.53346	0.09683
6	9	3	0.54336	0.09863
6	9	4	0.62614	0.11365
6	9	5	0.47791	0.08674
7	1	1	2.42189	0.43959
7	1	2	2.19952	0.39923
7	1	3	2.09324	0.37994
7	1	4	1.81371	0.32920
7	1	5	1.61192	0.29258
7	2	1	1.35367	0.24606
7	2	2	0.95940	0.17414
7	2	3	1.61825	0.29373
7	2	4	1.87447	0.34023
7	2	5	1.86822	0.33910
7	3	1	2.03569	0.36950
7	3	2	2.48109	0.45034
7	3	3	2.27615	0.41314
7	3	4	2.02574	0.36769
7	3	5	1.92987	0.35029
7	5	1	1.93641	0.35148
7	5	2	1.91785	0.34811
7	5	3	2.01299	0.36538
7	5	4	2.25332	0.40900
7	5	5	2.33140	0.42317
7	6	1	1.75802	0.31909
7	6	2	1.80395	0.32779
7	6	3	1.86053	0.33770
7	6	4	1.90862	0.34643
7	6	5	1.34588	0.24429
7	7	1	1.01906	0.18497
7	7	2	1.31155	0.23806
7	7	3	1.22902	0.22308
7	7	4	1.19620	0.21712
7	7	5	1.20836	0.21933
7	8	1	0.27090	0.04917
7	8	2	0.65916	0.11964
7	8	3	0.20653	0.03749
7	8	4	0.41773	0.07582
7	8	5	0.66089	0.11996
7	9	1	0.88880	0.16132
7	9	2	0.82918	0.15050
7	9	3	0.82084	0.14899
7	9	4	0.71796	0.13032
7	9	5	0.98243	0.17832
8	1	1	0.47327	0.08590
8	1	2	0.61396	0.11144
8	1	3	0.98304	0.17843
8	1	4	0.44886	0.08147
8	1	5	0.94803	0.17208
8	2	1	1.32065	0.23971
8	2	2	0.61908	0.11237
8	2	3	0.52958	0.09612
8	2	4	1.01607	0.18443

DIVERSITY INDICIES
BACKWATER SAMPLES

PERIOD	LOC	REP	H	J
8	2	5	0.82827	0.15034
8	3	1	0.49331	0.08958
8	3	2	1.07167	0.19452
8	3	3	0.64005	0.11617
8	3	4	0.80956	0.14694
8	3	5	0.86773	0.15750
8	5	1	0.51857	0.09413
8	5	2	0.47451	0.08613
8	5	3	0.56300	0.10219
8	5	4	0.58069	0.10540
8	5	5	0.53855	0.09775
8	6	1	0.70155	0.12734
8	6	2	0.62651	0.11372
8	6	3	0.57629	0.10460
8	6	4	0.32855	0.05964
8	6	5	0.62206	0.11291
8	7	1	0.42821	0.07772
8	7	2	0.89117	0.16178
8	7	3	0.16140	0.02930
8	7	4	0.16496	0.02994
8	7	5	0.30996	0.05626
8	8	1	0.26206	0.04757
8	8	2	0.15371	0.02790
8	8	3	0.14759	0.02679
8	8	4	0.14248	0.02586
8	8	5	0.20693	0.03756
8	9	1	0.20052	0.03640
8	9	3	0.27217	0.04940
8	9	4	0.31786	0.05769
8	9	5	0.20483	0.03718
8	9	5	0.23744	0.04310

Appendix D

I. Sample period (4-7), Location (1-9), Replicate (1-5), and relative abundance of Annelida (RTax1), Mollusca (RTax2), Crustacea (RTax3), Ephemeroptera (RTax4), Plecoptera (RTax5), Hemiptera (RTax6), Odonata (RTax7), Megaloptera-Lepidoptera-Neuroptera (RTax8), Tricoptera (RTax9), Coleoptera (RTax10), Other Taxa (RTax11), Other Diptera (RTax12), and Chironomidae (RTax13) for riffles

II. Sample period (4-8), Location (1-9), Replicate (1-5), and relative abundance of Annelida (RTax1), Mollusca (RTax2), Crustacea (RTax3), Ephemeroptera (RTax4), Plecoptera (RTax5), Hemiptera (RTax6), Odonata (RTax7), Megaloptera-Lepidoptera-Neuroptera (RTax8), Tricoptera (RTax9), Coleoptera (RTax10), Other Taxa (RTax11), Other Diptera (RTax12), and Chironomidae (RTax13) for backwaters.

TAXONOMIC GROUP RELATIVE ABUNDANCES

RIFFLE SAMPLES

PERIOD	LOC	REP	RTAX1	RTAX2	RTAX3	RTAX4	RTAX5	RTAX6	RTAX7	RTAX8	RTAX9	RTAX10	RTAX11	RTAX12	RTAX13
4	1	1	0.03	0.40	0.00	0.41	0.00	0	0.00	0.00	0.03	0.11	0.00	0.00	0.01
4	1	2	0.01	0.44	0.01	0.36	0.00	0	0.00	0.00	0.05	0.09	0.04	0.00	0.00
4	1	3	0.02	0.36	0.00	0.46	0.00	0	0.01	0.01	0.04	0.05	0.04	0.01	0.02
4	1	4	0.01	0.36	0.00	0.44	0.00	0	0.02	0.00	0.07	0.03	0.03	0.01	0.03
4	1	5	0.00	0.26	0.00	0.66	0.00	0	0.00	0.01	0.03	0.02	0.00	0.00	0.00
4	2	1	0.00	0.70	0.00	0.13	0.00	0	0.00	0.00	0.04	0.04	0.00	0.05	0.03
4	2	2	0.01	0.74	0.00	0.18	0.00	0	0.00	0.01	0.01	0.03	0.01	0.01	0.02
4	2	3	0.01	0.59	0.00	0.24	0.00	0	0.01	0.01	0.05	0.03	0.00	0.01	0.05
4	2	4	0.00	0.59	0.00	0.28	0.00	0	0.00	0.01	0.04	0.03	0.01	0.01	0.03
4	2	5	0.00	0.62	0.00	0.26	0.00	0	0.00	0.00	0.05	0.04	0.00	0.00	0.01
4	3	1	0.00	0.50	0.00	0.40	0.00	0	0.00	0.00	0.05	0.03	0.00	0.00	0.01
4	3	2	0.00	0.35	0.00	0.51	0.00	0	0.01	0.00	0.03	0.04	0.01	0.00	0.03
4	3	3	0.00	0.70	0.00	0.19	0.00	0	0.00	0.00	0.06	0.04	0.01	0.00	0.01
4	3	4	0.00	0.28	0.00	0.59	0.00	0	0.01	0.00	0.06	0.02	0.01	0.01	0.03
4	3	5	0.01	0.56	0.00	0.28	0.00	0	0.01	0.01	0.03	0.07	0.01	0.01	0.01
4	4	1	0.01	0.23	0.00	0.54	0.00	0	0.01	0.00	0.03	0.08	0.02	0.00	0.08
4	4	2	0.02	0.28	0.00	0.53	0.00	0	0.01	0.01	0.02	0.07	0.03	0.01	0.03
4	4	3	0.02	0.20	0.00	0.50	0.00	0	0.01	0.01	0.04	0.08	0.01	0.04	0.08
4	4	4	0.01	0.37	0.00	0.46	0.00	0	0.01	0.01	0.03	0.04	0.03	0.00	0.04
4	4	5	0.01	0.19	0.00	0.59	0.00	0	0.00	0.00	0.03	0.05	0.03	0.01	0.09
4	5	1	0.04	0.37	0.00	0.46	0.00	0	0.00	0.00	0.04	0.05	0.03	0.01	0.01
4	5	2	0.02	0.48	0.00	0.41	0.00	0	0.00	0.01	0.02	0.03	0.03	0.00	0.01
4	5	3	0.02	0.39	0.00	0.43	0.00	0	0.00	0.01	0.08	0.06	0.01	0.00	0.01
4	5	4	0.00	0.36	0.00	0.51	0.00	0	0.00	0.00	0.01	0.09	0.01	0.00	0.00
4	5	5	0.01	0.29	0.00	0.34	0.01	0	0.00	0.00	0.06	0.04	0.01	0.01	0.01
4	7	1	0.03	0.50	0.00	0.31	0.03	0	0.00	0.00	0.04	0.06	0.00	0.00	0.03
4	7	2	0.01	0.52	0.00	0.29	0.01	0	0.01	0.01	0.03	0.06	0.01	0.00	0.04
4	7	3	0.03	0.19	0.00	0.47	0.02	0	0.00	0.00	0.05	0.11	0.04	0.00	0.09
4	7	4	0.04	0.32	0.00	0.31	0.03	0	0.03	0.00	0.09	0.09	0.00	0.00	0.08
4	7	5	0.01	0.55	0.01	0.26	0.03	0	0.02	0.00	0.06	0.04	0.01	0.00	0.01
4	8	1	0.01	0.14	0.00	0.71	0.02	0	0.00	0.00	0.00	0.07	0.01	0.00	0.03
4	8	2	0.01	0.20	0.00	0.59	0.01	0	0.00	0.01	0.01	0.11	0.04	0.00	0.03
4	8	3	0.00	0.21	0.00	0.58	0.01	0	0.00	0.00	0.01	0.11	0.02	0.00	0.05
4	8	4	0.01	0.27	0.00	0.39	0.00	0	0.00	0.00	0.02	0.19	0.06	0.01	0.05
4	8	5	0.00	0.18	0.00	0.35	0.03	0	0.00	0.00	0.03	0.36	0.01	0.00	0.04
4	9	1	0.02	0.50	0.00	0.33	0.00	0	0.00	0.00	0.03	0.10	0.01	0.01	0.00
4	9	2	0.01	0.29	0.00	0.50	0.01	0	0.00	0.01	0.06	0.11	0.00	0.00	0.01
4	9	3	0.01	0.25	0.00	0.48	0.00	0	0.00	0.00	0.07	0.15	0.01	0.01	0.00
4	9	4	0.00	0.32	0.00	0.32	0.02	0	0.01	0.00	0.03	0.08	0.01	0.00	0.01
4	9	5	0.02	0.31	0.00	0.43	0.03	0	0.00	0.01	0.08	0.09	0.02	0.00	0.02
5	1	1	0.08	0.14	0.00	0.43	0.04	0	0.01	0.00	0.04	0.10	0.02	0.00	0.13
5	1	2	0.02	0.20	0.00	0.48	0.03	0	0.00	0.00	0.03	0.11	0.04	0.00	0.08
5	1	3	0.01	0.06	0.00	0.68	0.08	0	0.01	0.00	0.03	0.06	0.01	0.00	0.06
5	1	4	0.02	0.05	0.00	0.70	0.03	0	0.00	0.00	0.05	0.09	0.03	0.00	0.04
5	1	5	0.02	0.01	0.00	0.72	0.04	0	0.01	0.01	0.02	0.10	0.01	0.00	0.05
5	2	1	0.02	0.22	0.01	0.47	0.03	0	0.00	0.00	0.05	0.17	0.01	0.00	0.01
5	2	2	0.00	0.38	0.00	0.45	0.01	0	0.00	0.00	0.05	0.07	0.01	0.00	0.01
5	2	3	0.03	0.41	0.00	0.40	0.00	0	0.01	0.00	0.03	0.10	0.01	0.00	0.02
5	2	4	0.00	0.53	0.00	0.30	0.02	0	0.00	0.00	0.07	0.04	0.00	0.00	0.04
5	2	5	0.02	0.47	0.00	0.26	0.03	0	0.00	0.00	0.07	0.07	0.01	0.01	0.04
5	3	1	0.00	0.10	0.00	0.69	0.00	0	0.01	0.00	0.07	0.02	0.01	0.00	0.09
5	3	2	0.00	0.05	0.00	0.78	0.02	0	0.01	0.00	0.07	0.02	0.02	0.00	0.03
5	3	3	0.01	0.16	0.00	0.66	0.02	0	0.00	0.00	0.03	0.03	0.00	0.00	0.08

TAXONOMIC GROUP RELATIVE ABUNDANCES

RIFFLE SAMPLES

PERIOD	LOC	REP	RTAX1	RTAX2	RTAX3	RTAX4	RTAX5	RTAX6	RTAX7	RTAX8	RTAX9	RTAX10	RTAX11	RTAX12	RTAX13
5	3	4	0.00	0.14	0.00	0.62	0.05	0.00	0.01	0.00	0.08	0.05	0.01	0.00	0.04
5	3	5	0.00	0.27	0.00	0.46	0.08	0.00	0.00	0.00	0.04	0.08	0.03	0.00	0.05
5	4	1	0.10	0.06	0.00	0.47	0.01	0.00	0.01	0.00	0.02	0.05	0.04	0.01	0.22
5	4	2	0.09	0.13	0.01	0.51	0.03	0.00	0.01	0.00	0.10	0.03	0.02	0.00	0.06
5	4	3	0.01	0.32	0.00	0.36	0.00	0.00	0.00	0.00	0.08	0.04	0.02	0.01	0.15
5	4	4	0.01	0.27	0.00	0.25	0.25	0.00	0.00	0.01	0.03	0.01	0.01	0.01	0.15
5	4	5	0.06	0.09	0.00	0.50	0.10	0.00	0.00	0.00	0.08	0.01	0.02	0.01	0.13
5	5	1	0.01	0.16	0.00	0.63	0.00	0.00	0.00	0.00	0.16	0.02	0.00	0.00	0.02
5	5	2	0.02	0.11	0.00	0.63	0.00	0.00	0.00	0.00	0.14	0.02	0.01	0.00	0.06
5	5	3	0.03	0.02	0.00	0.67	0.00	0.00	0.00	0.00	0.14	0.02	0.01	0.01	0.09
5	5	4	0.02	0.09	0.00	0.57	0.00	0.00	0.00	0.00	0.22	0.01	0.01	0.00	0.07
5	5	5	0.02	0.13	0.00	0.60	0.00	0.00	0.00	0.00	0.20	0.01	0.00	0.00	0.03
5	7	1	0.03	0.05	0.00	0.76	0.00	0.00	0.02	0.00	0.06	0.03	0.00	0.00	0.04
5	7	2	0.01	0.09	0.00	0.75	0.01	0.00	0.01	0.00	0.09	0.01	0.00	0.00	0.03
5	7	3	0.03	0.10	0.00	0.73	0.01	0.00	0.01	0.00	0.06	0.02	0.00	0.00	0.04
5	7	4	0.14	0.03	0.00	0.69	0.01	0.00	0.01	0.00	0.04	0.01	0.00	0.00	0.07
5	7	5	0.01	0.07	0.00	0.72	0.01	0.00	0.01	0.00	0.08	0.02	0.00	0.00	0.06
5	8	1	0.01	0.03	0.00	0.74	0.01	0.00	0.01	0.00	0.04	0.07	0.01	0.00	0.09
5	8	2	0.01	0.08	0.00	0.75	0.00	0.00	0.00	0.00	0.14	0.02	0.00	0.00	0.01
5	8	3	0.01	0.09	0.00	0.70	0.01	0.00	0.00	0.00	0.12	0.05	0.00	0.00	0.01
5	8	4	0.02	0.03	0.00	0.57	0.05	0.00	0.00	0.00	0.07	0.05	0.01	0.03	0.17
5	8	5	0.07	0.10	0.00	0.58	0.03	0.00	0.00	0.00	0.07	0.05	0.04	0.00	0.06
5	9	1	0.03	0.05	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.03
5	9	2	0.06	0.07	0.00	0.65	0.01	0.01	0.00	0.00	0.02	0.10	0.03	0.00	0.05
5	9	3	0.04	0.21	0.00	0.41	0.03	0.00	0.00	0.00	0.02	0.23	0.01	0.01	0.03
5	9	4	0.04	0.25	0.00	0.48	0.02	0.00	0.01	0.00	0.01	0.17	0.00	0.00	0.01
5	9	5	0.01	0.24	0.00	0.43	0.01	0.00	0.00	0.00	0.03	0.20	0.01	0.04	0.02
6	3	1	0.09	0.00	0.00	0.72	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.16
6	3	2	0.06	0.02	0.00	0.62	0.01	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.22
6	3	3	0.04	0.01	0.00	0.80	0.03	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.08
6	3	4	0.04	0.01	0.00	0.71	0.01	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.17
6	3	5	0.06	0.01	0.00	0.62	0.03	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.22
6	4	1	0.06	0.06	0.00	0.61	0.01	0.00	0.01	0.00	0.13	0.04	0.00	0.01	0.07
6	4	2	0.23	0.03	0.00	0.50	0.03	0.00	0.00	0.00	0.08	0.01	0.00	0.00	0.12
6	4	3	0.05	0.05	0.00	0.64	0.03	0.00	0.00	0.00	0.12	0.02	0.00	0.00	0.10
6	4	4	0.14	0.05	0.00	0.61	0.03	0.00	0.00	0.00	0.06	0.01	0.00	0.01	0.09
6	4	5	0.06	0.16	0.00	0.48	0.02	0.00	0.00	0.00	0.14	0.02	0.01	0.00	0.11
6	5	1	0.31	0.14	0.00	0.34	0.05	0.00	0.00	0.00	0.03	0.02	0.03	0.00	0.08
6	5	2	0.12	0.05	0.00	0.44	0.06	0.00	0.00	0.02	0.10	0.00	0.01	0.00	0.19
6	5	3	0.34	0.10	0.00	0.27	0.04	0.00	0.00	0.00	0.06	0.00	0.01	0.02	0.15
6	5	4	0.21	0.12	0.00	0.24	0.07	0.00	0.00	0.00	0.16	0.02	0.02	0.00	0.17
6	5	5	0.33	0.06	0.00	0.31	0.06	0.00	0.00	0.00	0.10	0.01	0.00	0.00	0.12
6	7	1	0.08	0.24	0.00	0.22	0.01	0.00	0.00	0.00	0.05	0.02	0.00	0.00	0.37
6	7	2	0.10	0.16	0.00	0.46	0.03	0.00	0.01	0.00	0.09	0.04	0.00	0.00	0.11
6	7	3	0.08	0.20	0.00	0.41	0.00	0.00	0.01	0.00	0.07	0.05	0.00	0.00	0.18
6	7	4	0.10	0.05	0.00	0.60	0.05	0.00	0.00	0.00	0.05	0.01	0.01	0.00	0.13
6	7	5	0.08	0.05	0.00	0.63	0.04	0.00	0.01	0.00	0.03	0.02	0.00	0.00	0.13
6	9	1	0.09	0.07	0.00	0.04	0.27	0.00	0.00	0.00	0.11	0.11	0.00	0.02	0.29
6	9	2	0.01	0.07	0.00	0.20	0.17	0.00	0.00	0.00	0.09	0.15	0.00	0.00	0.30
6	9	3	0.02	0.08	0.00	0.28	0.20	0.00	0.00	0.00	0.07	0.07	0.00	0.05	0.25
6	9	4	0.06	0.03	0.00	0.24	0.24	0.00	0.00	0.00	0.06	0.06	0.00	0.00	0.30
6	9	5	0.05	0.07	0.01	0.12	0.20	0.00	0.01	0.01	0.16	0.04	0.00	0.01	0.35
7	1	1	0.07	0.12	0.00	0.50	0.00	0.00	0.00	0.00	0.18	0.03	0.00	0.02	0.07

TAXONOMIC GROUP RELATIVE ABUNDANCES

RIFFLE SAMPLES

PERIOD	LOC	REP	RTAX1	RTAX2	RTAX3	RTAX4	RTAX5	RTAX6	RTAX7	RTAX8	RTAX9	RTAX10	RTAX11	RTAX12	RTAX13
7	1	2	0.01	0.14	0.01	0.60	0.00	0	0.00	0	0.12	0.04	0.00	0.04	0.05
7	1	3	0.06	0.05	0.01	0.63	0.02	0	0.00	0	0.12	0.03	0.00	0.01	0.06
7	1	4	0.04	0.20	0.00	0.41	0.00	0	0.00	0	0.20	0.03	0.00	0.01	0.10
7	1	5	0.02	0.11	0.00	0.67	0.00	0	0.00	0	0.09	0.02	0.00	0.02	0.06
7	3	1	0.00	0.05	0.00	0.54	0.01	0	0.00	0	0.09	0.01	0.00	0.29	0.01
7	3	2	0.05	0.06	0.00	0.53	0.02	0	0.00	0	0.17	0.04	0.00	0.08	0.05
7	3	3	0.01	0.06	0.00	0.42	0.03	0	0.00	0	0.21	0.04	0.00	0.21	0.01
7	3	4	0.01	0.02	0.00	0.83	0.00	0	0.00	0	0.07	0.02	0.00	0.04	0.02
7	3	5	0.02	0.06	0.00	0.74	0.00	0	0.00	0	0.10	0.02	0.00	0.02	0.04
7	4	1	0.01	0.08	0.01	0.48	0.00	0	0.01	0	0.16	0.06	0.01	0.01	0.16
7	4	2	0.04	0.03	0.01	0.44	0.00	0	0.01	0	0.16	0.05	0.00	0.01	0.25
7	4	3	0.02	0.27	0.01	0.27	0.00	0	0.01	0	0.13	0.03	0.00	0.00	0.25
7	4	4	0.12	0.06	0.02	0.36	0.01	0	0.02	0	0.16	0.09	0.00	0.01	0.16
7	4	5	0.01	0.04	0.01	0.59	0.00	0	0.01	0	0.13	0.04	0.00	0.00	0.17
7	5	1	0.03	0.00	0.00	0.67	0.04	0	0.01	0	0.09	0.06	0.01	0.00	0.08
7	5	2	0.06	0.01	0.00	0.66	0.02	0	0.00	0	0.12	0.04	0.00	0.00	0.09
7	5	3	0.03	0.00	0.01	0.76	0.02	0	0.02	0	0.07	0.05	0.00	0.00	0.04
7	5	4	0.31	0.01	0.00	0.52	0.01	0	0.01	0	0.06	0.02	0.00	0.00	0.07
7	5	5	0.12	0.00	0.00	0.68	0.02	0	0.00	0	0.08	0.02	0.00	0.01	0.06
7	7	1	0.10	0.06	0.00	0.44	0.01	0	0.00	0	0.03	0.01	0.00	0.13	0.22
7	7	2	0.12	0.24	0.00	0.49	0.01	0	0.00	0	0.01	0.01	0.00	0.07	0.05
7	7	3	0.04	0.20	0.00	0.53	0.01	0	0.00	0	0.05	0.00	0.00	0.07	0.09
7	7	4	0.06	0.18	0.01	0.51	0.01	0	0.00	0	0.04	0.02	0.00	0.02	0.15
7	7	5	0.06	0.42	0.00	0.37	0.00	0	0.00	0	0.02	0.00	0.01	0.00	0.11
7	8	1	0.00	0.28	0.00	0.39	0.01	0	0.00	0	0.11	0.08	0.01	0.05	0.06
7	8	2	0.02	0.17	0.00	0.47	0.02	0	0.00	0	0.12	0.05	0.00	0.05	0.09
7	8	3	0.01	0.23	0.00	0.36	0.02	0	0.01	0	0.07	0.29	0.00	0.01	0.01
7	8	4	0.01	0.26	0.00	0.47	0.00	0	0.00	0	0.07	0.09	0.00	0.02	0.08
7	8	5	0.00	0.24	0.00	0.48	0.01	0	0.00	0	0.10	0.10	0.00	0.01	0.05

TAXONOMIC GROUP RELATIVE ABUNDANCES

BACKWATER SAMPLES

PERIOD	LOC	REP	RTAX1	RTAX2	RTAX3	RTAX4	RTAX5	RTAX6	RTAX7	RTAX8	RTAX9	RTAX10	RTAX11	RTAX12	RTAX13
4	1	1	0.21	0.07	0.00	0.01	0.00	0	0.04	0.00	0.00	0.20	0.01	0.00	0.44
4	1	2	0.33	0.04	0.01	0.01	0.00	0	0.00	0.00	0.01	0.10	0.00	0.01	0.49
4	1	3	0.42	0.13	0.00	0.00	0.00	0	0.00	0.00	0.00	0.27	0.00	0.01	0.17
4	1	4	0.53	0.12	0.00	0.00	0.00	0	0.00	0.01	0.00	0.18	0.00	0.00	0.16
4	1	5	0.58	0.04	0.00	0.00	0.00	0	0.01	0.01	0.01	0.11	0.01	0.00	0.23
4	2	1	0.60	0.01	0.01	0.01	0.00	0	0.00	0.00	0.00	0.05	0.00	0.02	0.31
4	2	2	0.62	0.03	0.00	0.01	0.00	0	0.00	0.00	0.00	0.12	0.00	0.02	0.21
4	2	3	0.56	0.03	0.00	0.01	0.00	0	0.00	0.00	0.00	0.09	0.00	0.02	0.30
4	2	4	0.00	0.05	0.00	0.00	0.00	0	0.00	0.01	0.01	0.27	0.00	0.02	0.64
4	2	5	0.62	0.04	0.00	0.00	0.00	0	0.00	0.00	0.00	0.04	0.00	0.03	0.26
4	3	1	0.32	0.11	0.03	0.03	0.00	0	0.00	0.00	0.00	0.21	0.00	0.04	0.26
4	3	2	0.55	0.07	0.00	0.02	0.00	0	0.00	0.00	0.00	0.07	0.00	0.03	0.26
4	3	3	0.64	0.03	0.00	0.00	0.00	0	0.00	0.00	0.00	0.04	0.00	0.02	0.28
4	3	4	0.78	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.05	0.00	0.00	0.15
4	3	5	0.76	0.02	0.00	0.03	0.00	0	0.00	0.00	0.00	0.01	0.00	0.01	0.17
4	5	1	0.80	0.08	0.00	0.01	0.00	0	0.01	0.01	0.00	0.01	0.00	0.00	0.08
4	5	2	0.63	0.09	0.00	0.01	0.00	0	0.00	0.00	0.00	0.10	0.00	0.02	0.15
4	5	3	0.43	0.32	0.00	0.03	0.00	0	0.02	0.00	0.00	0.03	0.00	0.05	0.13
4	5	4	0.51	0.26	0.00	0.01	0.00	0	0.06	0.00	0.00	0.04	0.00	0.06	0.06
4	5	5	0.49	0.14	0.01	0.04	0.00	0	0.03	0.00	0.01	0.12	0.00	0.00	0.16
4	6	1	0.76	0.02	0.00	0.02	0.00	0	0.00	0.00	0.00	0.02	0.02	0.02	0.14
4	6	2	0.92	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.07
4	6	3	0.76	0.03	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.21
4	6	4	0.80	0.14	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.06
4	6	5	0.89	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.09
4	7	1	0.94	0.03	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.03
4	7	2	0.74	0.03	0.00	0.03	0.00	0	0.00	0.00	0.00	0.00	0.00	0.01	0.19
4	7	3	0.90	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.01	0.07
4	7	4	0.97	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4	7	5	0.76	0.09	0.00	0.01	0.00	0	0.01	0.00	0.00	0.00	0.00	0.00	0.12
4	8	1	0.93	0.04	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0.00	0.01	0.01
4	8	2	0.93	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.04	0.03
4	8	3	0.98	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4	8	4	0.99	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	8	5	0.95	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.04
4	9	1	0.93	0.04	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.04	0.00
4	9	2	0.89	0.05	0.00	0.00	0.00	0	0.00	0.00	0.00	0.01	0.00	0.05	0.00
4	9	3	0.95	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.01	0.02
4	9	4	0.86	0.06	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.05	0.03
4	9	5	0.87	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.07	0.04
5	1	1	0.59	0.02	0.00	0.01	0.00	0	0.00	0.00	0.00	0.06	0.00	0.04	0.27
5	1	2	0.54	0.02	0.00	0.02	0.00	0	0.00	0.00	0.00	0.07	0.00	0.03	0.32
5	1	3	0.66	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.04	0.00	0.03	0.24
5	1	4	0.44	0.02	0.00	0.01	0.00	0	0.00	0.01	0.01	0.02	0.01	0.10	0.40
5	1	5	0.51	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.03	0.00	0.05	0.39
5	2	1	0.60	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.01	0.37
5	2	2	0.67	0.04	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.28
5	2	3	0.67	0.03	0.02	0.00	0.00	0	0.01	0.00	0.00	0.02	0.01	0.01	0.22
5	2	4	0.68	0.05	0.01	0.00	0.00	0	0.00	0.00	0.01	0.01	0.00	0.01	0.24
5	2	5	0.65	0.06	0.03	0.00	0.00	0	0.01	0.00	0.01	0.02	0.02	0.02	0.18
5	3	1	0.50	0.03	0.00	0.17	0.00	0	0.00	0.00	0.02	0.03	0.00	0.07	0.18
5	3	2	0.73	0.07	0.01	0.01	0.01	0	0.00	0.00	0.00	0.00	0.01	0.03	0.14
5	3	3	0.59	0.06	0.00	0.01	0.00	0	0.00	0.00	0.00	0.04	0.00	0.11	0.17

TAXONOMIC GROUP RELATIVE ABUNDANCES

BACKWATER SAMPLES

PERIOD	LOC	REP	RTAX1	RTAX2	RTAX3	RTAX4	RTAX5	RTAX6	RTAX7	RTAX8	RTAX9	RTAX10	RTAX11	RTAX12	RTAX13
5	3	4	0.62	0.10	0.00	0.04	0.00	0	0.00	0.00	0.00	0.05	0.00	0.11	0.08
5	3	5	0.69	0.07	0.00	0.03	0.00	0	0.00	0.00	0.00	0.04	0.00	0.06	0.12
5	5	1	0.52	0.08	0.01	0.00	0.00	0	0.01	0.00	0.03	0.05	0.00	0.01	0.24
5	5	2	0.59	0.13	0.00	0.01	0.00	0	0.00	0.00	0.01	0.05	0.01	0.00	0.20
5	5	3	0.60	0.15	0.00	0.00	0.00	0	0.00	0.00	0.02	0.06	0.01	0.01	0.13
5	5	4	0.66	0.09	0.00	0.01	0.00	0	0.00	0.00	0.02	0.01	0.02	0.00	0.20
5	5	5	0.59	0.06	0.00	0.01	0.00	0	0.00	0.00	0.03	0.10	0.01	0.04	0.15
5	6	1	0.66	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.33
5	6	2	0.66	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.01	0.01	0.32
5	6	3	0.67	0.03	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.30
5	6	4	0.65	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.32
5	6	5	0.78	0.02	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.19
5	7	1	0.90	0.02	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.07
5	7	2	0.94	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.01	0.04
5	7	3	0.89	0.02	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0.00	0.01	0.07
5	7	4	0.85	0.04	0.00	0.00	0.00	0	0.01	0.00	0.01	0.00	0.00	0.00	0.10
5	7	5	0.90	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.01	0.00	0.00	0.07
5	8	1	0.96	0.03	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	8	2	0.92	0.03	0.01	0.00	0.00	0	0.00	0.00	0.02	0.01	0.00	0.00	0.02
5	8	3	0.86	0.02	0.00	0.00	0.00	0	0.00	0.00	0.01	0.00	0.00	0.01	0.09
5	8	4	0.84	0.02	0.00	0.00	0.00	0	0.01	0.00	0.01	0.00	0.01	0.01	0.11
5	8	5	0.94	0.03	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.02
5	9	1	0.94	0.03	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.02	0.01
5	9	2	0.95	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.02	0.01
5	9	3	0.94	0.02	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.01	0.03
5	9	4	0.87	0.05	0.00	0.00	0.00	0	0.01	0.00	0.00	0.00	0.00	0.01	0.05
5	9	5	0.95	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.02	0.01
6	1	1	0.39	0.03	0.00	0.04	0.00	0	0.01	0.01	0.02	0.08	0.02	0.03	0.39
6	1	2	0.49	0.02	0.00	0.02	0.00	0	0.00	0.00	0.00	0.03	0.00	0.08	0.36
6	1	3	0.82	0.03	0.00	0.00	0.00	0	0.00	0.00	0.00	0.02	0.00	0.01	0.13
6	1	4	0.37	0.09	0.01	0.03	0.01	0	0.02	0.00	0.01	0.02	0.03	0.01	0.42
6	1	5	0.70	0.01	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0.00	0.02	0.25
6	3	1	0.51	0.01	0.00	0.08	0.00	0	0.00	0.00	0.01	0.12	0.00	0.02	0.25
6	3	2	0.45	0.05	0.00	0.03	0.00	0	0.00	0.01	0.02	0.06	0.00	0.06	0.33
6	3	3	0.53	0.06	0.01	0.02	0.00	0	0.01	0.00	0.01	0.06	0.04	0.02	0.25
6	3	4	0.57	0.07	0.00	0.01	0.00	0	0.00	0.00	0.00	0.05	0.00	0.04	0.24
6	3	5	0.34	0.14	0.01	0.02	0.00	0	0.01	0.01	0.04	0.05	0.03	0.07	0.27
6	5	1	0.09	0.16	0.08	0.04	0.00	0	0.03	0.00	0.00	0.18	0.04	0.01	0.35
6	5	2	0.52	0.03	0.00	0.01	0.00	0	0.00	0.00	0.01	0.22	0.02	0.03	0.15
6	5	3	0.68	0.08	0.00	0.03	0.00	0	0.00	0.00	0.01	0.03	0.01	0.02	0.15
6	5	4	0.20	0.15	0.09	0.04	0.00	0	0.01	0.00	0.03	0.13	0.10	0.02	0.22
6	5	5	0.45	0.14	0.01	0.06	0.00	0	0.00	0.01	0.01	0.09	0.02	0.09	0.13
6	6	1	0.59	0.13	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.28
6	6	2	0.56	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.08	0.36
6	6	3	0.68	0.00	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.31
6	6	4	0.54	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.01	0.00	0.45
6	6	5	0.72	0.01	0.00	0.03	0.00	0	0.00	0.00	0.00	0.00	0.00	0.04	0.20
6	7	1	0.86	0.00	0.00	0.04	0.00	0	0.00	0.00	0.00	0.00	0.01	0.04	0.05
6	7	2	0.82	0.05	0.00	0.02	0.00	0	0.00	0.00	0.00	0.01	0.00	0.03	0.07
6	7	3	0.83	0.02	0.00	0.02	0.00	0	0.00	0.00	0.00	0.01	0.00	0.04	0.07
6	7	4	0.88	0.03	0.00	0.00	0.00	0	0.00	0.00	0.01	0.00	0.01	0.02	0.05
6	7	5	0.93	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.01	0.05
6	9	1	0.92	0.01	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.06

TAXONOMIC GROUP RELATIVE ABUNDANCES
BACKWATER SAMPLES

PERIOD	LOC	REP	RTAX1	RTAX2	RTAX3	RTAX4	RTAX5	RTAX6	RTAX7	RTAX8	RTAX9	RTAX10	RTAX11	RTAX12	RTAX13
6	9	2	0.90	0.03	0.00	0.02	0	0	0.00	0.00	0.00	0.00	0.00	0.01	0.04
6	9	3	0.89	0.02	0.00	0.04	0	0	0.00	0.00	0.00	0.00	0.00	0.03	0.02
6	9	4	0.88	0.01	0.00	0.02	0	0	0.00	0.00	0.00	0.00	0.00	0.03	0.07
6	9	5	0.91	0.01	0.00	0.01	0	0	0.00	0.00	0.00	0.00	0.00	0.01	0.05
7	1	1	0.28	0.08	0.00	0.08	0	0	0.01	0.00	0.01	0.02	0.00	0.07	0.46
7	1	2	0.40	0.05	0.00	0.05	0	0	0.00	0.00	0.01	0.01	0.01	0.02	0.44
7	1	3	0.37	0.14	0.00	0.09	0	0	0.01	0.01	0.00	0.03	0.00	0.03	0.33
7	1	4	0.51	0.03	0.00	0.02	0	0	0.00	0.00	0.00	0.03	0.00	0.04	0.37
7	1	5	0.66	0.04	0.00	0.03	0	0	0.00	0.00	0.01	0.03	0.00	0.04	0.18
7	2	1	0.60	0.24	0.01	0.01	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.13
7	2	2	0.79	0.09	0.01	0.03	0	0	0.00	0.00	0.00	0.00	0.00	0.03	0.06
7	2	3	0.58	0.09	0.00	0.03	0	0	0.00	0.00	0.00	0.00	0.00	0.08	0.21
7	2	4	0.49	0.13	0.00	0.05	0	0	0.00	0.00	0.00	0.01	0.00	0.09	0.22
7	2	5	0.53	0.16	0.00	0.04	0	0	0.00	0.00	0.00	0.00	0.00	0.02	0.24
7	3	1	0.42	0.08	0.00	0.05	0	0	0.00	0.00	0.00	0.02	0.00	0.04	0.40
7	3	2	0.24	0.07	0.00	0.16	0	0	0.00	0.00	0.01	0.02	0.00	0.07	0.42
7	3	3	0.14	0.07	0.00	0.13	0	0	0.00	0.00	0.00	0.06	0.01	0.08	0.52
7	3	4	0.34	0.10	0.00	0.06	0	0	0.00	0.00	0.01	0.03	0.00	0.03	0.42
7	3	5	0.48	0.12	0.00	0.03	0	0	0.00	0.00	0.00	0.04	0.00	0.02	0.31
7	5	1	0.54	0.06	0.00	0.06	0	0	0.00	0.00	0.02	0.06	0.00	0.04	0.20
7	5	2	0.51	0.05	0.01	0.07	0	0	0.00	0.00	0.04	0.00	0.02	0.03	0.27
7	5	3	0.30	0.05	0.00	0.11	0	0	0.00	0.00	0.00	0.06	0.02	0.06	0.40
7	5	4	0.30	0.07	0.00	0.07	0	0	0.01	0.00	0.00	0.03	0.01	0.04	0.46
7	5	5	0.26	0.06	0.00	0.05	0	0	0.00	0.00	0.05	0.09	0.02	0.03	0.41
7	6	1	0.50	0.09	0.00	0.03	0	0	0.00	0.00	0.00	0.00	0.00	0.06	0.32
7	6	2	0.51	0.02	0.00	0.01	0	0	0.00	0.00	0.01	0.00	0.00	0.05	0.41
7	6	3	0.44	0.04	0.00	0.04	0	0	0.00	0.00	0.00	0.01	0.00	0.06	0.42
7	6	4	0.19	0.04	0.00	0.00	0	0	0.00	0.00	0.01	0.01	0.00	0.05	0.69
7	6	5	0.56	0.01	0.00	0.00	0	0	0.00	0.00	0.00	0.04	0.00	0.04	0.36
7	7	1	0.74	0.01	0.00	0.02	0	0	0.00	0.00	0.00	0.00	0.00	0.03	0.19
7	7	2	0.70	0.01	0.00	0.01	0	0	0.00	0.02	0.00	0.01	0.00	0.08	0.18
7	7	3	0.71	0.03	0.00	0.03	0	0	0.00	0.00	0.00	0.00	0.00	0.08	0.15
7	7	4	0.72	0.01	0.00	0.01	0	0	0.00	0.00	0.01	0.01	0.00	0.08	0.17
7	7	5	0.72	0.02	0.00	0.02	0	0	0.00	0.00	0.00	0.00	0.00	0.03	0.19
7	8	1	0.96	0.01	0.00	0.01	0	0	0.00	0.00	0.00	0.00	0.00	0.01	0.02
7	8	2	0.89	0.00	0.00	0.05	0	0	0.00	0.00	0.00	0.00	0.00	0.02	0.04
7	8	3	0.97	0.01	0.00	0.01	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.01
7	8	4	0.92	0.01	0.00	0.03	0	0	0.00	0.00	0.00	0.00	0.00	0.02	0.01
7	8	5	0.86	0.01	0.00	0.04	0	0	0.00	0.00	0.00	0.00	0.00	0.05	0.03
7	9	1	0.82	0.06	0.00	0.02	0	0	0.00	0.00	0.00	0.00	0.00	0.01	0.09
7	9	2	0.83	0.04	0.00	0.05	0	0	0.00	0.00	0.01	0.00	0.00	0.00	0.07
7	9	3	0.84	0.04	0.00	0.05	0	0	0.01	0.00	0.00	0.00	0.00	0.00	0.06
7	9	4	0.88	0.03	0.00	0.02	0	0	0.00	0.00	0.00	0.00	0.00	0.01	0.08
7	9	5	0.80	0.02	0.00	0.04	0	0	0.00	0.00	0.00	0.00	0.00	0.02	0.12
8	1	1	0.90	0.02	0.00	0.05	0	0	0.00	0.00	0.00	0.02	0.00	0.01	0.00
8	1	2	0.85	0.02	0.00	0.09	0	0	0.00	0.00	0.00	0.00	0.00	0.02	0.02
8	1	3	0.76	0.08	0.00	0.00	0	0	0.00	0.00	0.00	0.07	0.00	0.04	0.04
8	1	4	0.91	0.01	0.00	0.03	0	0	0.00	0.00	0.00	0.01	0.00	0.00	0.03
8	1	5	0.78	0.02	0.00	0.08	0	0	0.00	0.00	0.00	0.05	0.00	0.02	0.05
8	2	1	0.68	0.05	0.00	0.09	0	0	0.00	0.03	0.01	0.00	0.00	0.05	0.09
8	2	2	0.87	0.01	0.00	0.01	0	0	0.00	0.04	0.00	0.01	0.00	0.01	0.03
8	2	3	0.89	0.01	0.00	0.05	0	0	0.00	0.01	0.00	0.01	0.00	0.00	0.03
8	2	4	0.72	0.02	0.00	0.07	0	0	0.00	0.05	0.00	0.02	0.00	0.10	0.02

TAXONOMIC GROUP RELATIVE ABUNDANCES
BACKWATER SAMPLES

PERIOD	LOC	REP	RTAX1	RTAX2	RTAX3	RTAX4	RTAX5	RTAX6	RTAX7	RTAX8	RTAX9	RTAX10	RTAX11	RTAX12	RTAX13
8	2	5	0.78	0.03	0.00	0.12	0	0	0.03	0	0.00	0.00	0	0.00	0.03
8	3	1	0.90	0.01	0.00	0.04	0	0	0.00	0	0.00	0.01	0	0.01	0.03
8	3	2	0.77	0.02	0.00	0.02	0	0	0.00	0	0.01	0.01	0	0.03	0.15
8	3	3	0.87	0.01	0.00	0.03	0	0	0.00	0	0.00	0.01	0	0.03	0.05
8	3	4	0.83	0.00	0.00	0.04	0	0	0.01	0	0.00	0.01	0	0.01	0.09
8	3	5	0.80	0.00	0.00	0.02	0	0	0.00	0	0.00	0.00	0	0.01	0.16
8	5	1	0.88	0.02	0.00	0.03	0	0	0.00	0	0.00	0.06	0	0.00	0.01
8	5	2	0.91	0.00	0.02	0.02	0	0	0.00	0	0.00	0.01	0	0.00	0.03
8	5	3	0.90	0.04	0.00	0.01	0	0	0.00	0	0.00	0.02	0	0.00	0.02
8	5	4	0.89	0.04	0.00	0.02	0	0	0.00	0	0.00	0.00	0	0.02	0.04
8	5	5	0.90	0.01	0.00	0.02	0	0	0.00	0	0.00	0.03	0	0.00	0.04
8	6	1	0.86	0.01	0.00	0.04	0	0	0.00	0	0.00	0.00	0	0.03	0.05
8	6	2	0.87	0.01	0.00	0.05	0	0	0.00	0	0.00	0.00	0	0.03	0.05
8	6	3	0.92	0.01	0.00	0.02	0	0	0.00	0	0.00	0.01	0	0.01	0.02
8	6	4	0.95	0.01	0.00	0.01	0	0	0.00	0	0.00	0.00	0	0.00	0.03
8	6	5	0.89	0.01	0.00	0.02	0	0	0.00	0	0.00	0.00	0	0.01	0.08
8	7	1	0.91	0.03	0.00	0.01	0	0	0.00	0	0.00	0.00	0	0.04	0.01
8	7	2	0.80	0.06	0.00	0.05	0	0	0.00	0	0.00	0.00	0	0.00	0.09
8	7	3	0.98	0.00	0.00	0.00	0	0	0.00	0	0.00	0.00	0	0.01	0.01
8	7	4	0.97	0.01	0.00	0.00	0	0	0.00	0	0.00	0.00	0	0.02	0.00
8	7	5	0.95	0.01	0.00	0.01	0	0	0.00	0	0.00	0.00	0	0.01	0.01
8	8	1	0.96	0.01	0.00	0.01	0	0	0.00	0	0.00	0.01	0	0.00	0.01
8	8	2	0.98	0.00	0.00	0.01	0	0	0.00	0	0.00	0.00	0	0.00	0.01
8	8	3	0.98	0.00	0.00	0.00	0	0	0.00	0	0.00	0.01	0	0.00	0.01
8	8	4	0.98	0.01	0.00	0.00	0	0	0.00	0	0.00	0.00	0	0.00	0.01
8	8	5	0.97	0.01	0.00	0.01	0	0	0.00	0	0.00	0.00	0	0.00	0.01
8	9	1	0.97	0.01	0.00	0.00	0	0	0.00	0	0.00	0.00	0	0.00	0.02
8	9	2	0.97	0.01	0.00	0.00	0	0	0.00	0	0.00	0.00	0	0.00	0.01
8	9	3	0.95	0.01	0.00	0.01	0	0	0.00	0	0.00	0.00	0	0.01	0.02
8	9	4	0.95	0.01	0.00	0.00	0	0	0.00	0	0.00	0.00	0	0.00	0.02
8	9	5	0.97	0.01	0.00	0.00	0	0	0.00	0	0.00	0.00	0	0.00	0.02

Appendix E

I. Sample period (4-7), Location (1-9), Replicate (1-5), and relative abundance of functional groups of Shredders (RFG1), Scrapers (RFG2), Predators (RFG4), and Collectors (RFG5) in riffles.

II. Sample period (4-8), Location (1-9), Replicate (1-5), and relative abundance of functional groups of Shredders (RFG1), Scrapers (RFG2), Predators (RFG4), and Collectors (RFG5) in backwaters.

FUNCTIONAL GROUP RELATIVE ABUNDANCES
RIFFLE SAMPLES

PERIOD	LOC	REP	RFG1	RFG2	RFG3	RFG4	RFG5	NFG
4	1	1	0.01	0.60	0	0.01	0.38	4
4	1	2	0.01	0.66	0	0.01	0.32	4
4	1	3	0.01	0.57	0	0.01	0.42	4
4	1	4	0.01	0.52	0	0.03	0.44	4
4	1	5	0.00	0.44	0	0.01	0.54	4
4	2	1	0.01	0.77	0	0.01	0.22	4
4	2	2	0.01	0.80	0	0.01	0.18	4
4	2	3	0.01	0.67	0	0.02	0.29	4
4	2	4	0.01	0.69	0	0.01	0.29	4
4	2	5	0.01	0.75	0	0.01	0.23	4
4	3	1	0.01	0.68	0	0.01	0.31	4
4	3	2	0.00	0.67	0	0.01	0.32	4
4	3	3	0.01	0.83	0	0.01	0.16	4
4	3	4	0.01	0.47	0	0.01	0.51	4
4	3	5	0.02	0.72	0	0.02	0.24	4
4	4	1	0.03	0.39	0	0.01	0.56	4
4	4	2	0.01	0.44	0	0.01	0.53	4
4	4	3	0.02	0.33	0	0.02	0.63	4
4	4	4	0.01	0.50	0	0.02	0.47	4
4	4	5	0.02	0.30	0	0.01	0.67	4
4	5	1	0.00	0.47	0	0.01	0.51	4
4	5	2	0.01	0.63	0	0.01	0.36	4
4	5	3	0.01	0.55	0	0.01	0.43	4
4	5	4	0.00	0.57	0	0.01	0.42	3
4	5	5	0.00	0.46	0	0.02	0.52	4
4	7	1	0.01	0.64	0	0.03	0.32	4
4	7	2	0.01	0.66	0	0.03	0.29	4
4	7	3	0.03	0.46	0	0.03	0.48	4
4	7	4	0.04	0.31	0	0.07	0.38	4
4	7	5	0.01	0.70	0	0.05	0.24	4
4	8	1	0.02	0.54	0	0.03	0.41	4
4	8	2	0.03	0.46	0	0.01	0.50	4
4	8	3	0.05	0.55	0	0.01	0.40	4
4	8	4	0.04	0.57	0	0.01	0.38	4
4	8	5	0.03	0.58	0	0.04	0.35	4
4	9	1	0.00	0.65	0	0.02	0.33	4
4	9	2	0.01	0.51	0	0.03	0.45	4
4	9	3	0.01	0.62	0	0.02	0.35	4
4	9	4	0.01	0.67	0	0.03	0.29	4
4	9	5	0.01	0.51	0	0.04	0.44	4
5	1	1	0.05	0.29	0	0.02	0.65	4
5	1	2	0.05	0.36	0	0.01	0.57	4
5	1	3	0.08	0.33	0	0.01	0.57	4
5	1	4	0.03	0.31	0	0.00	0.65	4
5	1	5	0.05	0.37	0	0.02	0.57	4
5	2	1	0.01	0.43	0	0.02	0.53	4
5	2	2	0.01	0.48	0	0.01	0.51	4
5	2	3	0.00	0.51	0	0.01	0.49	3
5	2	4	0.04	0.62	0	0.00	0.34	3
5	2	5	0.04	0.56	0	0.01	0.40	4
5	3	1	0.01	0.39	0	0.02	0.58	4
5	3	2	0.02	0.32	0	0.01	0.64	4
5	3	3	0.03	0.30	0	0.01	0.66	4

FUNCTIONAL GROUP RELATIVE ABUNDANCES
RIFFLE SAMPLES

PERIOD	LOC	REP	RFG1	RFG2	RFG3	RFG4	RFG5	NFG
5	3	4	0.06	0.38	0	0.02	0.55	4
5	3	5	0.08	0.38	0	0.01	0.54	4
5	4	1	0.04	0.19	0	0.05	0.72	4
5	4	2	0.04	0.18	0	0.02	0.76	4
5	4	3	0.01	0.38	0	0.02	0.59	4
5	4	4	0.25	0.32	0	0.01	0.41	4
5	4	5	0.11	0.12	0	0.01	0.76	4
5	5	1	0.00	0.24	0	0.00	0.75	4
5	5	2	0.04	0.20	0	0.00	0.76	4
5	5	3	0.01	0.10	0	0.01	0.87	4
5	5	4	0.02	0.18	0	0.02	0.79	4
5	5	5	0.01	0.23	0	0.02	0.75	4
5	7	1	0.01	0.22	0	0.03	0.74	4
5	7	2	0.01	0.27	0	0.02	0.71	4
5	7	3	0.01	0.23	0	0.02	0.74	4
5	7	4	0.01	0.19	0	0.03	0.78	4
5	7	5	0.01	0.17	0	0.02	0.80	4
5	8	1	0.01	0.26	0	0.02	0.72	4
5	8	2	0.00	0.32	0	0.00	0.67	4
5	8	3	0.00	0.30	0	0.01	0.68	4
5	8	4	0.04	0.18	0	0.03	0.75	4
5	8	5	0.02	0.21	0	0.03	0.74	4
5	9	1	0.00	0.23	0	0.02	0.75	3
5	9	2	0.02	0.21	0	0.01	0.76	4
5	9	3	0.04	0.44	0	0.01	0.50	4
5	9	4	0.01	0.38	0	0.03	0.58	4
5	9	5	0.01	0.42	0	0.01	0.55	4
6	3	1	0.01	0.06	0	0.01	0.92	4
6	3	2	0.01	0.14	0	0.00	0.84	4
6	3	3	0.02	0.09	0	0.00	0.89	4
6	3	4	0.02	0.11	0	0.01	0.87	4
6	3	5	0.02	0.07	0	0.00	0.90	4
6	4	1	0.03	0.15	0	0.02	0.80	4
6	4	2	0.03	0.13	0	0.00	0.83	4
6	4	3	0.01	0.21	0	0.01	0.77	4
6	4	4	0.01	0.14	0	0.01	0.84	4
6	4	5	0.02	0.29	0	0.01	0.68	4
6	5	1	0.03	0.20	0	0.02	0.75	4
6	5	2	0.05	0.20	0	0.01	0.74	4
6	5	3	0.04	0.18	0	0.02	0.77	4
6	5	4	0.06	0.26	0	0.02	0.67	4
6	5	5	0.03	0.21	0	0.01	0.74	4
6	7	1	0.02	0.26	0	0.02	0.70	4
6	7	2	0.05	0.32	0	0.01	0.62	4
6	7	3	0.02	0.24	0	0.01	0.73	4
6	7	4	0.06	0.29	0	0.01	0.64	4
6	7	5	0.04	0.29	0	0.02	0.66	4
6	9	1	0.31	0.29	0	0.07	0.33	4
6	9	2	0.10	0.31	0	0.05	0.53	4
6	9	3	0.16	0.28	0	0.10	0.46	4
6	9	4	0.24	0.09	0	0.00	0.67	3
6	9	5	0.19	0.33	0	0.03	0.45	4
7	1	1	0.03	0.22	0	0.01	0.74	4

FUNCTIONAL GROUP RELATIVE ABUNDANCES
RIFFLE SAMPLES

PERIOD	LOC	REP	RFG1	RFG2	RFG3	RFG4	RFG5	NFG
7	1	2	0.02	0.23	0	0.01	0.75	4
7	1	3	0.03	0.15	0	0.02	0.81	4
7	1	4	0.01	0.39	0	0.01	0.59	4
7	1	5	0.03	0.18	0	0.01	0.78	4
7	3	1	0.01	0.11	0	0.01	0.88	4
7	3	2	0.02	0.16	0	0.02	0.80	4
7	3	3	0.03	0.20	0	0.02	0.75	4
7	3	4	0.00	0.09	0	0.00	0.90	4
7	3	5	0.01	0.20	0	0.00	0.79	3
7	4	1	0.15	0.17	0	0.04	0.64	4
7	4	2	0.18	0.12	0	0.02	0.68	4
7	4	3	0.16	0.28	0	0.02	0.54	4
7	4	4	0.15	0.09	0	0.04	0.73	4
7	4	5	0.04	0.16	0	0.01	0.79	4
7	5	1	0.02	0.21	0	0.06	0.71	4
7	5	2	0.02	0.24	0	0.02	0.71	4
7	5	3	0.02	0.36	0	0.04	0.58	4
7	5	4	0.02	0.12	0	0.02	0.84	4
7	5	5	0.02	0.10	0	0.02	0.85	4
7	7	1	0.02	0.08	0	0.02	0.88	4
7	7	2	0.01	0.28	0	0.01	0.70	4
7	7	3	0.04	0.24	0	0.02	0.70	4
7	7	4	0.07	0.23	0	0.02	0.69	4
7	7	5	0.04	0.47	0	0.00	0.49	4
7	8	1	0.04	0.39	0	0.01	0.56	4
7	8	2	0.03	0.27	0	0.03	0.67	4
7	8	3	0.01	0.37	0	0.03	0.39	4
7	8	4	0.04	0.38	0	0.01	0.57	4
7	8	5	0.04	0.35	0	0.02	0.59	4

FUNCTIONAL GROUP RELATIVE ABUNDANCES
BACKWATER SAMPLES

PERIOD	LOC	REP	RFG1	RFG2	RFG3	RFG4	RFG5	NFG
4	1	1	0.27	0.03	0.00	0.10	0.60	4
4	1	2	0.21	0.02	0.00	0.09	0.68	4
4	1	3	0.07	0.06	0.00	0.04	0.83	4
4	1	4	0.13	0.08	0.00	0.03	0.76	4
4	1	5	0.14	0.04	0.00	0.07	0.75	4
4	2	1	0.01	0.01	0.00	0.17	0.82	4
4	2	2	0.09	0.03	0.00	0.08	0.80	4
4	2	3	0.20	0.02	0.00	0.05	0.74	4
4	2	4	0.34	0.04	0.01	0.07	0.54	5
4	2	5	0.13	0.02	0.00	0.04	0.80	4
4	3	1	0.09	0.10	0.00	0.08	0.74	4
4	3	2	0.04	0.03	0.00	0.20	0.72	4
4	3	3	0.03	0.03	0.00	0.10	0.84	4
4	3	4	0.02	0.02	0.00	0.05	0.91	4
4	3	5	0.03	0.02	0.00	0.10	0.85	4
4	5	1	0.03	0.04	0.00	0.02	0.92	4
4	5	2	0.08	0.04	0.00	0.05	0.82	4
4	5	3	0.10	0.21	0.03	0.02	0.65	5
4	5	4	0.03	0.18	0.00	0.09	0.71	4
4	5	5	0.02	0.14	0.07	0.14	0.64	5
4	6	1	0.00	0.06	0.00	0.16	0.78	3
4	6	2	0.00	0.01	0.00	0.07	0.92	3
4	6	3	0.00	0.00	0.00	0.21	0.79	2
4	6	4	0.00	0.00	0.00	0.06	0.94	2
4	6	5	0.00	0.00	0.00	0.09	0.91	2
4	7	1	0.00	0.03	0.00	0.03	0.94	3
4	7	2	0.06	0.01	0.00	0.13	0.80	4
4	7	3	0.00	0.00	0.00	0.08	0.92	2
4	7	4	0.00	0.01	0.00	0.01	0.97	3
4	7	5	0.00	0.03	0.00	0.10	0.87	3
4	8	1	0.00	0.03	0.00	0.01	0.96	3
4	8	2	0.00	0.01	0.00	0.06	0.93	3
4	8	3	0.00	0.00	0.00	0.00	0.99	3
4	8	4	0.00	0.01	0.00	0.00	0.99	2
4	8	5	0.00	0.01	0.00	0.03	0.96	3
4	9	1	0.00	0.04	0.00	0.04	0.93	3
4	9	2	0.00	0.02	0.00	0.05	0.93	3
4	9	3	0.00	0.02	0.00	0.03	0.95	3
4	9	4	0.00	0.05	0.00	0.08	0.87	3
4	9	5	0.00	0.01	0.00	0.11	0.88	3
5	1	1	0.12	0.01	0.00	0.06	0.81	4
5	1	2	0.11	0.02	0.00	0.12	0.74	4
5	1	3	0.10	0.02	0.00	0.06	0.81	4
5	1	4	0.27	0.02	0.00	0.15	0.56	4
5	1	5	0.22	0.01	0.00	0.09	0.68	4
5	2	1	0.02	0.01	0.00	0.01	0.97	4
5	2	2	0.13	0.04	0.00	0.07	0.76	4
5	2	3	0.01	0.05	0.00	0.03	0.92	4
5	2	4	0.03	0.05	0.00	0.03	0.90	4
5	2	5	0.01	0.05	0.00	0.05	0.89	4
5	3	1	0.00	0.03	0.00	0.13	0.83	3
5	3	2	0.02	0.07	0.00	0.05	0.86	4
5	3	3	0.06	0.06	0.00	0.14	0.74	4

FUNCTIONAL GROUP RELATIVE ABUNDANCES
BACKWATER SAMPLES

PERIOD	LOC	REP	RFG1	RFG2	RFG3	RFG4	RFG5	NFG
5	3	4	0.02	0.07	0	0.11	0.80	4
5	3	5	0.03	0.06	0	0.08	0.82	4
5	5	1	0.07	0.05	0	0.06	0.81	4
5	5	2	0.01	0.11	0	0.01	0.86	4
5	5	3	0.07	0.10	0	0.03	0.80	4
5	5	4	0.16	0.06	0	0.02	0.76	4
5	5	5	0.13	0.03	0	0.07	0.77	4
5	6	1	0.06	0.01	0	0.06	0.87	4
5	6	2	0.01	0.00	0	0.04	0.96	3
5	6	3	0.01	0.02	0	0.04	0.93	4
5	6	4	0.02	0.01	0	0.09	0.88	4
5	6	5	0.02	0.01	0	0.06	0.92	4
5	7	1	0.02	0.03	0	0.01	0.94	4
5	7	2	0.00	0.00	0	0.06	0.94	2
5	7	3	0.01	0.02	0	0.06	0.92	4
5	7	4	0.03	0.04	0	0.04	0.90	4
5	7	5	0.02	0.01	0	0.02	0.95	4
5	8	1	0.00	0.02	0	0.00	0.98	2
5	8	2	0.01	0.03	0	0.02	0.95	4
5	8	3	0.01	0.02	0	0.02	0.95	4
5	8	4	0.01	0.02	0	0.03	0.95	4
5	8	5	0.00	0.02	0	0.02	0.96	3
5	9	1	0.00	0.03	0	0.02	0.95	3
5	9	2	0.02	0.01	0	0.01	0.96	4
5	9	3	0.02	0.02	0	0.01	0.94	4
5	9	4	0.01	0.05	0	0.04	0.91	4
5	9	5	0.00	0.00	0	0.03	0.97	3
6	1	1	0.15	0.04	0	0.06	0.76	4
6	1	2	0.15	0.02	0	0.09	0.74	4
6	1	3	0.04	0.03	0	0.02	0.92	4
6	1	4	0.08	0.09	0	0.05	0.77	4
6	1	5	0.02	0.01	0	0.04	0.92	4
6	3	1	0.07	0.05	0	0.04	0.85	4
6	3	2	0.09	0.09	0	0.09	0.74	4
6	3	3	0.01	0.08	0	0.05	0.86	4
6	3	4	0.01	0.08	0	0.05	0.85	4
6	3	5	0.02	0.17	0	0.09	0.72	4
6	5	1	0.02	0.18	0	0.06	0.74	4
6	5	2	0.02	0.05	0	0.06	0.87	4
6	5	3	0.04	0.06	0	0.08	0.83	4
6	5	4	0.02	0.14	0	0.04	0.80	4
6	5	5	0.04	0.11	0	0.11	0.74	4
6	6	1	0.00	0.03	0	0.06	0.91	3
6	6	2	0.01	0.00	0	0.19	0.81	3
6	6	3	0.00	0.00	0	0.07	0.93	2
6	6	4	0.01	0.01	0	0.12	0.87	4
6	6	5	0.01	0.01	0	0.18	0.81	4
6	7	1	0.00	0.03	0	0.07	0.90	3
6	7	2	0.00	0.04	0	0.05	0.91	3
6	7	3	0.00	0.02	0	0.07	0.91	3
6	7	4	0.00	0.02	0	0.04	0.94	3
6	7	5	0.00	0.02	0	0.02	0.96	3
6	9	1	0.00	0.00	0	0.01	0.98	3

FUNCTIONAL GROUP RELATIVE ABUNDANCES
BACKWATER SAMPLES

PERIOD	LOC	REP	RFG1	RFG2	RFG3	RFG4	RFG5	NFG
6	9	2	0.00	0.02	0	0.02	0.95	3
6	9	3	0.00	0.00	0	0.03	0.96	4
6	9	4	0.00	0.00	0	0.07	0.92	3
6	9	5	0.00	0.01	0	0.03	0.96	5
7	1	1	0.17	0.08	0	0.12	0.64	4
7	1	2	0.08	0.06	0	0.05	0.81	4
7	1	3	0.12	0.14	0	0.10	0.65	4
7	1	4	0.11	0.03	0	0.08	0.77	4
7	1	5	0.04	0.04	0	0.07	0.85	4
7	2	1	0.07	0.24	0	0.01	0.68	4
7	2	2	0.00	0.09	0	0.03	0.88	3
7	2	3	0.03	0.09	0	0.10	0.78	4
7	2	4	0.01	0.13	0	0.12	0.74	4
7	2	5	0.02	0.15	0	0.04	0.79	4
7	3	1	0.04	0.08	0	0.08	0.81	4
7	3	2	0.05	0.05	0	0.13	0.77	4
7	3	3	0.04	0.06	0	0.13	0.77	4
7	3	4	0.02	0.09	0	0.05	0.84	4
7	3	5	0.02	0.10	0	0.05	0.83	4
7	5	1	0.09	0.04	0	0.09	0.78	4
7	5	2	0.04	0.06	0	0.05	0.85	4
7	5	3	0.01	0.05	0	0.06	0.87	4
7	5	4	0.00	0.05	0	0.11	0.84	3
7	5	5	0.04	0.06	0	0.08	0.81	4
7	6	1	0.02	0.00	0	0.26	0.72	3
7	6	2	0.00	0.02	0	0.30	0.69	3
7	6	3	0.01	0.01	0	0.36	0.62	4
7	6	4	0.04	0.00	0	0.57	0.40	3
7	6	5	0.01	0.00	0	0.31	0.69	3
7	7	1	0.00	0.01	0	0.19	0.80	3
7	7	2	0.03	0.02	0	0.17	0.78	4
7	7	3	0.01	0.03	0	0.19	0.78	4
7	7	4	0.01	0.01	0	0.19	0.79	4
7	7	5	0.00	0.01	0	0.18	0.80	4
7	8	1	0.00	0.01	0	0.01	0.98	4
7	8	2	0.02	0.00	0	0.04	0.94	3
7	8	3	0.00	0.01	0	0.00	0.99	4
7	8	4	0.00	0.01	0	0.03	0.96	4
7	8	5	0.00	0.01	0	0.07	0.92	4
7	9	1	0.02	0.06	0	0.03	0.90	5
7	9	2	0.01	0.04	0	0.04	0.92	4
7	9	3	0.02	0.04	0	0.02	0.93	4
7	9	4	0.00	0.03	0	0.03	0.94	3
7	9	5	0.00	0.01	0	0.06	0.93	4
8	1	1	0.00	0.02	0	0.01	0.97	3
8	1	2	0.01	0.02	0	0.03	0.94	4
8	1	3	0.01	0.08	0	0.04	0.86	4
8	1	4	0.03	0.01	0	0.00	0.95	4
8	1	5	0.03	0.02	0	0.03	0.92	4
8	2	1	0.02	0.05	0	0.11	0.82	4
8	2	2	0.00	0.01	0	0.09	0.90	3
8	2	3	0.01	0.00	0	0.03	0.96	3
8	2	4	0.00	0.02	0	0.17	0.81	3

FUNCTIONAL GROUP RELATIVE ABUNDANCES
BACKWATER SAMPLES

PERIOD	LOC	REP	RFG1	RFG2	RFG3	RFG4	RFG5	NFG
8	2	5	0.00	0.03	0	0.03	0.93	3
8	3	1	0.00	0.01	0	0.02	0.97	3
8	3	2	0.02	0.02	0	0.08	0.89	4
8	3	3	0.01	0.00	0	0.05	0.94	3
8	3	4	0.04	0.00	0	0.04	0.92	3
8	3	5	0.02	0.00	0	0.03	0.94	3
8	5	1	0.01	0.02	0	0.00	0.97	3
8	5	2	0.03	0.00	0	0.00	0.96	3
8	5	3	0.01	0.02	0	0.01	0.96	4
8	5	4	0.01	0.01	0	0.02	0.96	4
8	5	5	0.02	0.00	0	0.01	0.97	3
8	6	1	0.00	0.00	0	0.08	0.92	2
8	6	2	0.00	0.00	0	0.07	0.93	3
8	6	3	0.00	0.01	0	0.06	0.94	4
8	6	4	0.00	0.00	0	0.02	0.97	4
8	6	5	0.01	0.00	0	0.08	0.92	3
8	7	1	0.00	0.02	0	0.05	0.93	3
8	7	2	0.00	0.04	0	0.07	0.89	3
8	7	3	0.00	0.00	0	0.01	0.98	3
8	7	4	0.00	0.01	0	0.02	0.97	3
8	7	5	0.00	0.01	0	0.02	0.97	3
8	8	1	0.00	0.01	0	0.01	0.98	3
8	8	2	0.00	0.00	0	0.01	0.99	3
8	8	3	0.00	0.00	0	0.01	0.99	4
8	8	4	0.00	0.00	0	0.01	0.99	4
8	8	5	0.00	0.01	0	0.01	0.98	3
8	9	1	0.00	0.00	0	0.02	0.98	3
8	9	3	0.00	0.01	0	0.03	0.96	3
8	9	4	0.00	0.01	0	0.02	0.97	4
8	9	5	0.00	0.01	0	0.01	0.98	3
8	9	5	0.00	0.00	0	0.02	0.98	4

Appendix F

Summary of samples collected by MDNR in March, May, and June 1989 from riffles and backwaters of the Gasconade River.

	Total # Organisms	Taxa Richness	Total # EPT Taxa	EPT/Chironomidae Ratio	Scrapers/Collector-Filterers Ratio	Shredders/Total # Organisms Ratio	Coefficient of Community Loss
Early March 1989 Riffle							
Zone 1c upstream #1	427	24	13	44.5	-	-	-
Zone 1c upstream #2	1561	60	23	13.5	-	-	-
Zone 1c downstream #1	546	45	19	6.2	-	-	-
Zone 1c downstream #2	819	52	21	6.8	-	-	-
Zone 2 downstream	566	54	22	6.5	-	-	-
Zone 3 downstream	712	61	22	4.2	-	-	-
Zone 5 downstream	21	5	1	0.25	-	-	-
Late March 1989 Riffle							
Zone 1c upstream	287	39	15	6.19	100	-	0
Zone 3 downstream	431	41	11	2.03	173	-	0.36
Zone 4 downstream	302	24	7	0.50	5759	-	0.96
Zone 5 downstream	32	15	5	1.22	205	-	2.13
Late March 1989 Leaf Packs							
Zone 1c upstream	310	33	-	-	-	100	-
Zone 3 downstream	103	19	-	-	-	52.7	-
Zone 4 downstream	309	47	-	-	-	17.5	-
Zone 5 downstream	74	29	-	-	-	116.2	-
May 1989 Riffle							
Zone 1c upstream	1437	56	23	21.60	100	-	0
Zone 2 downstream	1070	56	27	1.36	86	-	0.39
Zone 3 downstream	908	42	22	7.29	566	-	0.57
Zone 4 downstream	585	43	16	1.47	746	-	0.63
Zone 5 downstream	389	38	13	1.51	128	-	0.86
June 1989 Riffle							
Zone 1c upstream	1147	59	26	2.70	100	-	0
Zone 2 downstream	521	33	17	17.50	327	-	0.87
Zone 3 downstream	627	52	22	4.60	204	-	0.36
Zone 4 downstream	611	36	15	6.80	401	-	0.86
Zone 4a downstream	232	26	12	69.00	1976	-	1.42
Zone 5 downstream	355	25	13	27.00	274	-	1.36

	Total # Organisms	Taxa Richness	Total # EPT Taxa	EPT/Chironomidae Ratio	Scrapers/Collector-Filterers Ratio	Shredders/Total # Organisms Ratio	Coefficient of Community Loss
Early March 1989 Backwater							
Zone 1c upstream #1	312	45	-	-	-	-	-
Zone 1c upstream #2	93	22	-	-	-	-	-
Zone 1c upstream #3	110	38	-	-	-	-	-
Zone 1c downstream	297	50	-	-	-	-	-
Zone 3 downstream	102	29	-	-	-	-	-
Zone 5 downstream	102	12	-	-	-	-	-
Late March 1989 Backwater							
Zone 1c upstream	220	27	-	-	-	-	0
Zone 3 downstream	41	11	-	-	-	-	1.81
Zone 4 downstream	148	19	-	-	-	-	0.84
Zone 5 downstream	91	9	-	-	-	-	2.33
May 1989 Backwater							
Zone 1c upstream	200	29	-	-	-	-	0
Zone 2 downstream	146	26	-	-	-	-	0.38
Zone 3 downstream	168	26	-	-	-	-	0.61
Zone 4 downstream	105	20	-	-	-	-	0.90
Zone 5 downstream	193	20	-	-	-	-	0.85
June 1989 Backwater							
Zone 1c upstream	239	22	-	-	-	-	0
Zone 2 downstream	1352	15	-	-	-	-	0.80
Zone 3 downstream	236	23	-	-	-	-	0.26
Zone 4 downstream	190	7	-	-	-	-	2.14
Zone 4a downstream	212	3	-	-	-	-	3.60
Zone 5 downstream	1512	10	-	-	-	-	0.66

Relative Abundance (%) of dominant taxa collected during early March 1989 Reconnaissance sampling

TAXA	(N=427) Zone 1c upstream #1	(N=1561) Zone 1c upstream #2	(N=546) Zone 1c downstream #1	(N=819) Zone 1c downstream #2	(N=117) Zone 1c upstream #1	(N=91) Zone 1c upstream #2	(N=110) Zone 1c upstream #3	(N=297) Zone 1c downstream	(N=566) Zone 2 downstream	(N=712) Zone 3 downstream	(N=111)	(N=21) Zone 5 downstream	(N=102)
	r	r	r	r	b	b	b	b	r	r	b	r	b
Enchytraeidae	-	-	-	-	-	-	-	-	-	-	-	-	-
Acteonais lamondi	-	-	-	-	-	-	-	-	-	-	-	-	-
Nais spp.	<1	1	1	1	-	-	-	-	2	5	-	10	-
Ophidonais serpentina	-	<1	-	<1	-	-	-	-	4	5	-	62	-
Branchiura sowerbyi	-	-	-	-	1	-	1	-	-	-	-	-	7
Ilyodrilus templetoni	-	-	-	-	-	-	-	-	-	-	-	-	-
Limnodrilus spp.	-	-	-	-	20	30	2	23	-	-	6	-	57
Tubificidae w/o cc	-	-	-	-	11	24	5	16	-	-	4	-	19
Tubificidae w/ cc	-	-	-	-	-	-	-	-	-	-	-	-	-
Elimia potosiensis	2	7	-	44	-	-	-	-	10	3	-	-	-
Pleurocera acuta	-	-	-	-	6	4	3	3	-	-	-	-	-
Campeloma decisum	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrobiidae	-	-	-	-	-	-	-	-	-	-	-	-	-
Ferissia rivularis	-	-	-	-	-	-	-	-	-	-	-	-	-
Corbicula fluminea	<1	<1	<1	<1	-	-	-	-	1	<1	-	5	-
Pisidium spp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudocloeon spp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Baetis intercalaris	-	-	-	-	-	-	-	-	-	-	-	-	-
Isonychia bicolor	-	-	-	-	-	-	-	-	-	-	-	-	-
Leucrocuta spp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenonema spp.	1	1	9	2	-	-	-	-	6	12	-	-	-
Ephemerella spp.	85	46	50	29	1	1	5	1	36	38	2	-	-
Eurylophella spp.	<1	1	5	<1	1	1	1	7	4	5	2	-	-
Tricorythodes sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ephoron album	-	-	-	-	-	-	-	-	-	-	-	-	-
Potamanthus myops	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexagenia spp.	-	-	-	-	2	-	-	-	-	-	-	-	8
Coenagrionidae	-	-	-	-	5	-	1	1	-	-	-	-	1
Isoperia spp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Cheumatopsyche spp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydroptila spp.	2	26	29	6	2	4	21	3	0	2	1	5	-
Ectopria nervosa	-	-	-	-	-	-	-	-	-	-	-	-	-
Dubiraphia vittata	-	-	-	-	8	2	5	5	-	-	4	-	-
Stenelmis spp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum spp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Chironomus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Paracladopelma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Tribelos sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Microtendipes sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Paratendipes sp.	-	-	-	-	1	-	-	5	-	-	2	-	-
Paratanytarsus sp.	-	-	-	-	10	11	28	11	-	-	19	-	-
Tanytarsus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/Orthocladius	2	2	9	3	2	1	2	1	7	8	18	19	-
Eukiefferiella spp.	-	-	-	-	-	-	-	-	-	-	-	-	-

N=Total number of organisms in the sample
r=Riffle sample taken with Kicknet
b=Backwater sample taken with Petite Ponar
-=Absent from the sample

Relative abundance (%) of dominant taxa collected during late March 1989 reconnaissance sampling

	(N=287) Zone 1c upstream (N=220)		(N=431) Zone 3 downstream (N=41)		(N=302) Zone 4 downstream (N=148)		(N=32) Zone 5 downstream (N=90)		(N=110) Zone 1c upstream	(N=103) Zone 3 downstream	(N=109) Zone 4 downstream	(N=74) Zone 5 downstream
TAXA	r	b	r	b	r	b	r	b	LP	LP	LP	LP
Enchytraeidae	1	-	<1	-7	8	-	-	1	-	-	-	-
Acteonais lamondi	-	-	-	-	-	-	-	-	-	-	-	-
Nais spp.	-	-	-	-	-	-	-	-	2	11	2	5
Ophidonais serpentina	1	-	5	-	2	-	16	-	1	23	3	31
Branchiura sowerbyi	-	1	-	7	-	14	-	23	-	-	-	-
Ilyodrilus templetoni	-	-	-	-	-	-	-	-	-	-	-	-
Limnodrilus spp.	-	31	6	24	3	9	-	27	-	-	-	-
Tubificidae w/o cc	-	8	-	15	-	32	-	44	-	-	-	-
Tubificidae w/ cc	-	1	-	-	-	11	-	-	-	-	-	-
Elimia potosiensis	2	-	-	-	66	-	22	-	-	-	13	-
Pleurocera acuta	-	-	-	-	-	-	-	-	-	-	-	-
Campeloma decisum	-	-	-	17	-	9	-	1	-	-	-	-
Hydrobiidae	-	<1	-	-	-	5	-	-	-	-	-	-
Ferissia rivularis	-	-	-	-	-	-	-	-	-	-	-	-
Corbicula fluminea	-	-	-	-	-	-	-	-	-	-	-	-
Pisidium spp.	-	-	-	-	-	-	-	-	-	-	-	-
Pseudocloeon spp.	-	-	-	-	-	-	-	-	-	-	-	-
Baetis intercalaris	-	-	-	-	-	-	-	-	-	-	-	-
Isonychia bicolor	-	-	-	-	-	-	-	-	-	-	-	-
Leucrocuta spp.	-	-	-	-	-	-	-	-	-	-	-	-
Stenonema spp.	18	-	14	-	1	-	-	-	10	-	3	7
Ephemerella spp.	48	-	19	-	2	-	3	-	56	11	7	1
Eurylophella spp.	2	-	13	-	2	-	3	-	2	6	3	-
Tricorythodes sp.	-	-	1	-	-	-	9	-	-	-	-	-
Caenis sp.	-	-	-	-	-	-	-	-	-	-	-	-
Ephoron album	-	-	-	-	-	-	-	-	-	-	-	-
Potamanthus myops	-	-	-	-	-	-	-	-	-	-	-	-
Hexagenia spp.	-	-	-	-	-	-	-	-	-	-	-	-
Coenagrionidae	-	-	-	-	-	-	-	-	-	-	-	-
Isoperla spp.	-	-	-	-	-	-	-	-	-	-	1	7
Cheumatopsyche spp.	-	-	-	-	-	-	-	-	-	-	-	-
Hydroptila spp.	-	-	-	-	-	-	-	-	-	-	-	-
Ectopria nervosa	-	-	-	5	-	-	-	-	-	-	-	-
Dubiraphia vittata	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis spp.	-	-	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-	-	-
Simulium sp.	-	-	-	-	-	-	-	-	6	-	4	-
Polypedilum spp.	2	-	5	-	-	-	-	-	5	2	1	1
Chironomus sp.	-	12	-	-	-	-	-	-	-	-	-	-
Paracladopelma sp.	-	17	-	-	-	-	-	-	-	-	-	-
Tribelos sp.	-	8	-	-	-	-	-	-	-	-	-	-
Microtendipes sp.	-	-	-	-	-	-	-	-	-	-	-	-
Paratendipes sp.	-	5	-	17	-	-	-	-	-	-	-	-
Paratanytarsus sp.	-	-	-	-	-	-	-	-	-	-	-	-
Tanytarsus sp.	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/Orthocladius	4	-	12	-	9	-	19	-	1	32	31	12
Eukiefferiella spp.	-	-	-	-	-	-	-	-	4	2	13	1

N=Total # of organisms in the sample
r=Riffle sample taken with Kicknet
b=Backwater sample taken with Petite Ponar
LP=Leaf Pack sample taken from riffle by hand
-=Absent from the sample

Relative Abundance (%) of dominant taxa collected during May 1989 reconaissance sampling

	(N=1437) Zone 1c upstream (N=200)		(N=1070) Zone 2 downstream (N=146)		(N=908) Zone 3 downstream (N=168)		(N=585) Zone 4 downstream (N=105)		(N=389) Zone 5 downstream (N=193)	
TAXA	r	b	r	b	r	b	r	b	r	b
Enchytraeidae	-	-	-	-	-	-	-	-	-	-
Acteonais lamondi	-	11	-	-	-	-	-	10	-	4
Nais spp.	3	2	6	4	4	21	2	16	1	3
Ophidonais serpentina	-	4	-	12	-	1	-	-	-	-
Branchiura sowerbyi	-	-	-	-	-	-	-	-	-	-
Ilyodrilus templetoni	-	-	-	-	-	-	-	-	-	-
Limnodrilus spp.	-	7	-	12	-	4	-	3	-	17
Tubificidae w/o cc	-	17	-	12	-	18	-	20	-	8
Tubificidae w/ cc	-	-	-	-	-	-	-	-	-	-
Elimia potosiensis	5	-	10	-	47	-	50	-	10	-
Pleurocera acuta	-	-	-	-	-	-	-	-	-	-
Campeloma decisum	-	-	-	-	-	15	-	10	-	2
Hydrobiidae	-	4	-	17	-	-	-	-	-	-
Ferissia rivularis	-	-	-	-	-	-	-	-	-	-
Corbicula fluminea	-	-	-	-	-	-	-	-	-	-
Pisidium spp.	-	<1	-	10	-	-	-	-	-	1
Pseudocloeon spp.	6	-	12	-	2	-	<1	-	5	-
Baetis intercalaris	3	-	4	-	7	-	6	-	5	-
Isonychia bicolor	8	-	4	-	<1	-	2	-	1	-
Leucrocuta spp.	3	-	1	-	1	-	4	-	7	-
Stenonema spp.	30	-	2	-	1	-	2	-	-	-
Ephemerella spp.	-	-	-	-	-	-	-	-	-	-
Eurylophella spp.	-	-	-	-	-	-	-	-	-	-
Tricorythodes sp.	8	-	1	-	12	-	2	-	4	-
Caenis sp.	-	-	-	-	-	-	-	-	-	-
Ephoron album	-	-	-	-	-	-	-	-	-	-
Potamanthus myops	-	-	-	-	-	-	-	-	-	-
Hexagenia spp.	-	8	-	1	-	1	-	7	-	1
Coenagrionidae	-	-	-	-	-	-	-	-	-	-
Isoperia spp.	-	-	-	-	-	-	-	-	-	-
Cheumatopsyche spp.	6	-	1	-	2	-	<1	-	-	-
Hydroptila spp.	-	-	-	-	-	-	-	-	-	-
Ectopria nervosa	-	-	-	-	-	-	-	-	-	-
Dubiraphia vittata	-	9	-	7	-	1	-	1	-	1
Stenelmis spp.	2	-	4	-	6	-	1	-	11	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-
Simulium sp.	<1	-	6	-	1	-	1	-	7	-
Polypedilum spp.	<1	6	<1	3	1	11	6	1	-	-
Chironomus sp.	-	-	-	-	-	-	-	-	-	-
Paracladopelma sp.	-	-	-	-	-	-	-	-	-	-
Tribelos sp.	-	8	-	1	-	-	-	-	-	-
Microtendipes sp.	-	-	-	-	-	-	-	-	-	-
Paratendipes sp.	-	-	-	-	-	-	-	-	-	-
Paratanytarsus sp.	-	-	-	-	-	-	-	-	-	-
Tanytarsus sp.	-	-	-	-	-	-	-	-	-	-
Cricotopus/Orthocladius	1	-	26	-	<1	-	8	-	19	-
Eukiefferiella spp.	-	-	-	-	-	-	-	-	-	-

N=Total # of organisms in the sample
r=Riffle sample taken with Kicknet
b=Backwater sample taken with Petite Ponar
-=Absent from the sample

Relative Abundance (%) of dominant taxa collected during June 1989 reconnaissance sampling

	(N=1147) Zone 1c upstream		(N=521) Zone 2 downstream		(N=627) Zone 1 downstream		(N=611) Zone 4 downstream		(N=232) Zone 4a downstream		(N=355) Zone 5 downstream	
	(N=239)		(N=1352)		(N=216)		(N=190)		(N=212)		(N=1512)	
TAXA	r	b	r	b	r	b	r	b	r	b	r	b
Enchytraeidae	-	-	-	-	-	-	-	-	-	-	-	-
Actaonais lamondi	-	-	-	-	-	-	-	-	-	-	-	-
Nais spp.	-	-	-	-	-	-	-	-	-	-	-	-
Ophidonais serpentina	-	-	-	-	-	-	-	-	-	-	-	-
Branchiura sowerbyi	-	-	-	-	-	-	-	-	-	-	-	-
Ilyodrilus templetoni	-	-	-	-	-	-	-	-	-	-	-	-
Limnodrilus spp.	-	-	-	-	-	-	-	-	-	-	-	-
Tubificidae w/o cc	-	-	-	-	-	-	-	-	-	-	-	-
Tubificidae w/ cc	-	-	-	-	-	-	-	-	-	-	-	-
Elimia potosiensis	3	-	27	-	17	-	27	-	28	-	11	-
Pleurocera acuta	-	-	-	-	-	-	-	-	-	-	-	-
Campeloma decisum	-	-	-	-	-	-	-	-	-	-	-	-
Hydrobiidae	-	-	-	-	-	-	-	-	-	-	-	-
Ferissia rivularis	9	-	-	-	1	-	-	-	-	-	-	-
Corbicula fluminea	5	-	1	-	4	-	2	-	3	-	10	-
Pisidium spp.	-	-	-	-	-	-	-	-	-	-	-	-
Pseudocloeon spp.	-	-	-	-	-	-	-	-	-	-	-	-
Baetis intercalaris	-	-	-	-	-	-	-	-	-	-	-	-
Isonychia bicolor	4	-	12	-	3	-	9	-	<1	-	1	-
Leucrocuta spp.	4	-	1	-	1	-	3	-	19	-	9	-
Stenonema spp.	11	-	3	-	4	-	5	-	5	-	3	-
Ephemerella spp.	-	-	-	-	-	-	-	-	-	-	-	-
Purylophella spp.	-	-	-	-	-	-	-	-	-	-	-	-
Tricorythodes sp.	-	-	-	-	-	-	-	-	-	-	-	-
Caenis sp.	5	-	<1	-	1	-	-	-	5	-	3	-
Ephoron album	8	-	5	-	4	-	19	-	38	-	8	-
Potamanthus myops	-	-	-	-	-	-	-	-	-	-	-	-
Hexagenia spp.	-	-	-	-	-	-	-	-	-	-	-	-
Coenagrionidae	-	-	-	-	-	-	-	-	-	-	-	-
Isoperla spp.	-	-	-	-	-	-	-	-	-	-	-	-
Cheumatopsyche spp.	5	-	4	-	3	-	1	-	<1	-	<1	-
Hydroptila spp.	-	-	-	-	-	-	-	-	-	-	-	-
Ectopria nervosa	-	-	-	-	-	-	-	-	-	-	-	-
Dubiraphia vittata	-	24	-	2	-	3	-	-	-	-	-	<1
Stenelmis spp.	5	-	22	-	16	-	6	-	3	-	12	-
Ceratopogonidae	-	7	-	-	-	7	-	4	-	-	-	1
Simulium sp.	9	-	1	-	8	-	<1	-	-	-	4	-
Polypedilum spp.	-	5	-	<1	-	6	-	-	-	-	-	1
Chironomus sp.	-	6	-	<1	-	-	-	-	-	-	-	<1
Paracladopelma sp.	-	7	-	-	-	1	-	-	-	-	-	-
Tribelos sp.	-	22	-	-	-	1	-	-	-	-	-	-
Microtendipes sp.	13	-	-	-	-	-	-	-	-	-	-	-
Paratendipes sp.	-	-	-	-	-	-	-	-	-	-	-	-
Paratanytarsus sp.	-	-	-	-	-	-	-	-	-	-	-	-
Tanytarsus sp.	-	7	-	-	-	3	-	-	-	-	-	-
Cricotopus/Orthocladius	-	-	-	-	-	-	-	-	-	-	-	-
Eukiefferiella spp.	-	-	-	-	-	-	-	-	-	-	-	-

N=Total # of organisms in the sample
r=Riffle sample taken with Kicknet
b=Backwater sample taken with Petite Ponar
-=Taxa absent from the sample

Appendix G

Summary of TPH data by location and sampling date and listing of TPH data file from MDNR database.

GASCONADE RIVER TPH DATA

SUMMARY OF SAMPLING BY LOCATION

LOCATION=1

	TPH			
	N	MIN	MAX	MEAN
DATE				
24JUL89	3.00	46.00	46.00	46.00
03NOV89	2.00	21.00	31.00	26.00
13FEB90	3.00	24.00	38.00	31.33
29MAR90	3.00	38.00	76.00	58.33
11JUN90	3.00	22.00	42.00	31.67
17OCT90	3.00	39.00	39.00	39.00

GASCONADE RIVER TPH DATA

SUMMARY OF SAMPLING BY LOCATION

LOCATION=2

	TPH			
	N	MIN	MAX	MEAN
DATE				
25JUL89	3.00	65.00	79.00	72.67
27OCT89	3.00	20.00	43.00	30.33
29MAR90	3.00	34.00	54.00	41.33
19JUN90	3.00	25.00	25.00	25.00
17OCT90	3.00	39.00	51.00	43.00

GASCONADE RIVER TPH DATA
SUMMARY OF SAMPLING BY LOCATION

LOCATION=3

	TPH			
	N	MIN	MAX	MEAN
DATE				
01MAR89	3.00	25.00	34.00	28.00
10MAR89	1.00	48.00	48.00	48.00
29MAR89	2.00	35.00	56.00	45.50
03MAY89	1.00	53.00	53.00	53.00
07MAY89	1.00	41.00	41.00	41.00
24MAY89	1.00	32.00	32.00	32.00
05JUN89	2.00	35.00	35.00	35.00
05JUL89	2.00	17.00	50.00	33.50
25JUL89	3.00	28.00	37.00	32.67
25OCT89	2.00	23.00	26.00	24.50
13NOV89	1.00	22.00	22.00	22.00
12JAN90	1.00	10.00	10.00	10.00
29JAN90	3.00	18.00	24.00	20.33
27MAR90	3.00	31.00	38.00	33.33
13JUN90	3.00	25.00	25.00	25.00
18OCT90	3.00	39.00	43.00	40.33

GASCONADE RIVER TPH DATA

SUMMARY OF SAMPLING BY LOCATION

LOCATION=4

	TPH			
	N	MIN	MAX	MEAN
DATE				
01MAR89	2.00	25.00	34.00	29.50
02MAY89	1.00	660.00	660.00	660.00
05JUN89	1.00	120.00	120.00	120.00
05JUL89	1.00	50.00	50.00	50.00
26JUL89	3.00	110.00	200.00	146.67
01NOV89	2.00	29.00	36.00	32.50
01FEB90	3.00	46.00	300.00	152.00
28MAR90	3.00	28.00	89.00	64.33
19JUN90	3.00	39.00	59.00	48.00
18OCT90	3.00	39.00	70.00	51.67

GASCONADE RIVER TPH DATA
SUMMARY OF SAMPLING BY LOCATION

LOCATION=5

	TPH			
	N	MIN	MAX	MEAN
DATE				
01MAR89	1.00	120.00	120.00	120.00
29MAR89	2.00	82.00	140.00	111.00
02MAY89	3.00	71.00	110.00	88.67
09MAY89	1.00	64.00	64.00	64.00
24MAY89	1.00	50.00	50.00	50.00
05JUN89	2.00	35.00	35.00	35.00
06JUL89	2.00	33.00	58.00	45.50
26JUL89	3.00	32.00	55.00	44.33
27OCT89	2.00	35.00	44.00	39.50
31JAN90	3.00	10.00	27.00	21.00
27MAR90	3.00	0.00	25.00	15.33
13JUN90	3.00	34.00	48.00	40.33
23OCT90	3.00	36.00	38.00	36.67

GASCONADE RIVER TPH DATA

SUMMARY OF SAMPLING BY LOCATION

LOCATION=6

	TPH			
	N	MIN	MAX	MEAN
DATE				
26JUL89	3.00	74.00	760.00	441.33
07NOV89	2.00	21.00	92.00	56.50
01FEB90	3.00	48.00	160.00	86.67
28MAR90	3.00	58.00	89.00	74.67
11JUN90	3.00	35.00	91.00	65.33
15OCT90	3.00	41.00	50.00	46.00

GASCONADE RIVER TPH DATA
SUMMARY OF SAMPLING BY LOCATION

LOCATION=7

	TPH			
	N	MIN	MAX	MEAN
DATE				
30MAR89	2.00	330.00	490.00	410.00
26APR89	3.00	500.00	820.00	616.67
03MAY89	2.00	340.00	560.00	450.00
09MAY89	1.00	320.00	320.00	320.00
24MAY89	1.00	310.00	310.00	310.00
06JUN89	2.00	400.00	700.00	550.00
06JUL89	1.00	310.00	310.00	310.00
27JUL89	6.00	120.00	470.00	321.67
26OCT89	3.00	280.00	700.00	493.33
13NOV89	1.00	230.00	230.00	230.00
12JAN90	1.00	113.00	113.00	113.00
30JAN90	6.00	170.00	390.00	278.33
26MAR90	7.00	42.00	250.00	104.14
06JUN90	3.00	50.00	70.00	58.67
15JUN90	8.00	25.00	40.00	33.38
16OCT90	6.00	29.00	50.00	37.67

GASCONADE RIVER TPH DATA
SUMMARY OF SAMPLING BY LOCATION

LOCATION=8

	TPH			
	N	MIN	MAX	MEAN
DATE				
26APR89	9.00	3700.00	9500.00	5688.89
11MAY89	1.00	2900.00	2900.00	2900.00
24MAY89	1.00	2600.00	2600.00	2600.00
07JUN89	2.00	4300.00	5000.00	4650.00
06JUL89	1.00	990.00	990.00	990.00
27JUL89	3.00	870.00	1100.00	966.67
31OCT89	2.00	560.00	800.00	680.00
13NOV89	1.00	860.00	860.00	860.00
09APR90	3.00	200.00	410.00	320.00
21JUN90	3.00	44.00	57.00	51.33
19OCT90	3.00	42.00	58.00	51.00

GASCONADE RIVER TPH DATA

SUMMARY OF SAMPLING BY LOCATION

LOCATION=9

	TPH			
	N	MIN	MAX	MEAN
DATE				
09MAR89	3.00	140.00	810.00	423.33
28MAR89	4.00	500.00	920.00	737.50
26APR89	1.00	740.00	740.00	740.00
04MAY89	1.00	700.00	700.00	700.00
10MAY89	1.00	640.00	640.00	640.00
24MAY89	1.00	670.00	670.00	670.00
06JUN89	1.00	630.00	630.00	630.00
06JUL89	1.00	1100.00	1100.00	1100.00
28JUL89	3.00	360.00	970.00	670.00
02AUG89	3.00	350.00	860.00	660.00
26OCT89	4.00	120.00	660.00	475.00
13NOV89	1.00	130.00	130.00	130.00
31JAN90	6.00	110.00	750.00	311.67
26MAR90	6.00	34.00	590.00	204.67
06JUN90	3.00	250.00	4500.00	2250.00
15JUN90	7.00	25.00	1100.00	279.29
21JUN90	3.00	42.00	810.00	394.00
16OCT90	6.00	39.00	92.00	59.67

GASCONADE RIVER TPH DATA

OBS	HABITAT	SED	TPH	DEPTH	DATE	REL	SAMPNO	ZONE	COMMENT	SITECODE	LOCATION
1	bkwater	muck	46	0.0	24JUL89	l july	890369	1a		Z1-a,J,bw	1
2	bkwater	muck	46	0.0	24JUL89	l july	890370	1a		Z1-a,J,bw	1
3	bkwater		46	0.0	24JUL89	l july	890294	1a	GCMS	Z1-a,J,bw	1
4	bkwater		31	2.0	03NOV89	e nov	894339	1a			1
5	bkwater		21	2.0	03NOV89	e nov	894340	1a			1
6	bkwater		32	4.0	13FEB90	e feb	900431	1a		Z1-a,J,bw	1
7	bkwater		24	3.5	13FEB90	e feb	900432	1a		Z1-a,J,bw	1
8	bkwater		38	5.0	13FEB90	e feb	900430	1a	TOC	Z1-a,J,bw	1
9	bkwater	sandy silt	61	5.5	29MAR90	l march	900397	1a	TOC	Z1-a,J,bw	1
10	bkwater	sandy silt	38	5.5	29MAR90	l march	900398	1a		Z1-a,J,bw	1
11	bkwater	sandy silt	76	5.5	29MAR90	l march	900399	1a		Z1-a,J,bw	1
12	bkwater	sandy silt	42	5.0	11JUN90	e june	901111	1a	TOC	Z1-a,J,bw	1
13	bkwater	sandy silt	31	5.0	11JUN90	e june	901112	1a		Z1-a,J,bw	1
14	bkwater	sandy silt	22	4.0	11JUN90	e june	901113	1a		Z1-a,J,bw	1
15	bkwater	siltsnddet	39	3.0	17OCT90	l oct	907536	1a	TPH is <39, TOC	z1-a,J,bw	1
16	bkwater	siltsnddet	39	3.0	17OCT90	l oct	907357	1a	TPH is <39	z1-a,J,bw	1
17	bkwater	siltsnddet	39	4.0	17OCT90	l oct	907358	1a		z1-a,J,bw	1
18	nrshore	sand/grav	19	0.0	24JUL89	l july	890371	1a		Z1-a,J,ns	1
19	nrshore	sand/grav	56	0.0	24JUL89	l july	890372	1a		Z1-a,J,ns	1
20	nrshore	sand/grav	4	0.0	24JUL89	l july	890373	1a	TPH is < 4	Z1-a,J,ns	1
21	riffle	gravel	4	0.0	24JUL89	l july	890366	1a	TPH is < 4	Z1-a,J,rf	1
22	riffle	gravel	4	0.0	24JUL89	l july	890367	1a	TPH is < 4	Z1-a,J,rf	1
23	riffle	gravel	7	0.0	24JUL89	l july	890368	1a	TPH is 7.4	Z1-a,J,rf	1
24	bkwater	muck	65	0.0	25JUL89	l july	890375	1b		Z1-b,BC,bw	2
25	bkwater		74	0.0	25JUL89	l july	890350	1b		Z1-b,BC,bw	2
26	bkwater		79	0.0	25JUL89	l july	890374	1b	GCMS	Z1-b,BC,bw	2
27	bkwater	silt	20	1.0	27OCT89	l oct	894335	1b		Z1-b,BC,bw	2
28	bkwater	silt	43	1.0	27OCT89	l oct	894336	1b		Z1-b,BC,bw	2
29	bkwater		28	0.0	27OCT89	l oct	894334	1b	TOC	Z1-b,BC,bw	2
30	bkwater	silty sand	34	5.0	29MAR90	l march	900434	1b	TOC	Z1-b,BC,bw	2
31	bkwater	silty sand	36	5.0	29MAR90	l march	900435	1b		Z1-b,BC,bw	2
32	bkwater	silty sand	54	5.0	29MAR90	l march	900436	1b		Z1-b,BC,bw	2
33	bkwater	sansildetg	25	3.0	19JUN90	l june	901115	1b	TOC, TPH <25	Z1-b,BC,bw	2
34	bkwater	sansildetg	25	3.0	19JUN90	l june	901116	1b	TPH <25	Z1-b,BC,bw	2
35	bkwater	sansildetg	25	3.0	19JUN90	l june	901117	1b	TPH <25	Z1-b,BC,bw	2
36	bkwater	siltsndgra	39	3.0	17OCT90	l oct	907360	1b	TPH is <39, TOC		2
37	bkwater	siltsndgra	39	2.0	17OCT90	l oct	907361	1b	TPH is <39		2
38	bkwater	silty sand	51	2.0	17OCT90	l oct	907362	1b			2
39	nrshore		4	0.0	25JUL89	l july	890345	1b	TPH is < 4	Z1-b,BC,ns	2
40	nrshore		4	0.0	25JUL89	l july	890346	1b	TPH is < 4	Z1-b,BC,ns	2
41	nrshore		4	0.0	25JUL89	l july	890344	1b	TPH is < 4	Z1-b,BC,ns	2
42	riffle		4	0.0	25JUL89	l july	890347	1b	TPH is < 4	Z1-b,BC,rf	2
43	riffle		4	0.0	25JUL89	l july	890349	1b	TPH is < 4	Z1-b,BC,rf	2
44	riffle		4	0.0	25JUL89	l july	890348	1b	TPH is < 4	Z1-b,BC,rf	2
45	bkwater	silty sand	34	0.0	01MAR89	e march	890229	1c	GCMS		3
46	bkwater	sand	25	0.0	01MAR89	e march	890230	1c			3
47	bkwater	sandy silt	25	0.0	01MAR89	e march	890231	1c			3
48	bkwater	muck	48	0.0	10MAR89	e march	890248	1c		Z1-C,M,bw	3
49	bkwater	sandy silt	35	1.5	29MAR89	l march	890265	1c		Z1-C,M,bw	3
50	bkwater	muck	56	8.0	29MAR89	l march	890263	1c	GCMS	Z1-C,M,bw	3
51	bkwater	silt	53	5.0	03MAY89	e may	890187	1c		Z1-C,M,bw	3
52	bkwater	muck	41	0.0	07MAY89	e may	890279	1c	toxicity	Z1-C,M,bw	3
53	bkwater	silt	32	0.0	24MAY89	l may	890312	1c	post toxicity sed com	p	3
54	bkwater	silty sand	35	1.5	05JUN89	e june	891369	1c		Z1-c,M,bw	3

GASCONADE RIVER TPH DATA

OBS	HABITAT	SED	TPH	DEPTH	DATE	REL	SAMPNO	ZONE	COMMENT	SITECODE	LOCATION
55	bkwater	silt	35	5.0	05JUN89	e june	891367	1c		Z1-c,M,bw	3
56	bkwater		50	0.0	05JUL89	e july	890334	1c	fish larval study	Z1-c,M,bw	3
57	bkwater		17	0.0	05JUL89	e july	890335	1c	fish larval study	Z1-c,M,bw	3
58	bkwater		37	0.0	25JUL89	l july	890377	1c		Z1-c,M,bw	3
59	bkwater		28	0.0	25JUL89	l july	890376	1c		Z1-c,M,bw	3
60	bkwater		33	0.0	25JUL89	l july	890383	1c	GCMS	Z1-c,M,bw	3
61	bkwater	sandy silt	26	3.0	25OCT89	l oct	894313	1c			3
62	bkwater	sandy silt	23	5.0	25OCT89	l oct	894314	1c			3
63	bkwater		22	0.0	13NOV89	e nov	890826	1c	toxicity	Z1-c,M,bw	3
64	bkwater		10	0.0	12JAN90	e jan	900277	1c	TPH<10 repeat 89-0280		3
65	bkwater	muck	24	5.0	29JAN90	l jan	900402	1c		Z1-c,M,bw	3
66	bkwater	muck	19	5.0	29JAN90	l jan	900403	1c		Z1-c,M,bw	3
67	bkwater	muck	18	2.5	29JAN90	l jan	900401	1c	GCMS	Z1-c,M,bw	3
68	bkwater	sandy silt	31	6.0	27MAR90	l march	900445	1c	GCMS	Z1-c,M,bw	3
69	bkwater	sandy silt	31	6.0	27MAR90	l march	900446	1c		Z1-c,M,bw	3
70	bkwater	sandy silt	38	6.0	27MAR90	l march	900447	1c		Z1-c,M,bw	3
71	bkwater	sandy silt	25	7.0	13JUN90	e june	900801	1c	GCMS, TPH <25	Z1-c,M,bw	3
72	bkwater	sandy silt	25	7.0	13JUN90	e june	900802	1c	TPH <25	Z1-c,M,bw	3
73	bkwater	sandy silt	25	7.0	13JUN90	e june	900803	1c	TPH <25	Z1-c,M,bw	3
74	bkwater	silty sand	43	7.0	18OCT90	l oct	907365	1c			3
75	bkwater	silty sand	39	6.0	18OCT90	l oct	907366	1c	TPH is <39		3
76	bkwater	silty sand	39	6.0	18OCT90	l oct	907364	1c	TOC, GCMS TPH is < 39		3
77	bkwater*	muck	26	8.0	29MAR89	l march	890264	1c	dup 0263 for TPH only	Z1-C,M,bw	3
78	bkwater*	sandy silt	36	6.0	27MAR90	l march	900448	1c	dup 0447	Z1-c,M,bw	3
79	bkwater*	sandy silt	25	7.0	13JUN90	e june	900804	1c	dup 0803, TPH <25	Z1-c,M,bw	3
80	bkwater*	silty sand	39	6.0	18OCT90	l oct	907367	1c	dup 7366, TPH is <39		3
81	blwater	sandy silt	31	4.0	25OCT89	l oct	894312	1c	GCMS		3
82	nrshore		39	0.0	26JUL89	l july	890381	1c		Z1-c,M,ns	3
83	nrshore		110	0.0	26JUL89	l july	890382	1c		Z1-c,M,ns	3
84	nrshore		120	0.0	26JUL89	l july	890384	1c		Z1-c,M,ns	3
85	riffle	gravel	17	0.0	01MAR89	e march	890232	1c			3
86	riffle	gravel	5	0.0	25JUL89	l july	890378	1c	TPH is 4.6	Z1-c,M,rf	3
87	riffle	gravel	4	0.0	25JUL89	l july	890379	1c	TPH is < 4	Z1-c,M,rf	3
88	riffle	gravel	12	0.0	25JUL89	l july	890380	1c		Z1-c,M,rf	3
89	bkwater	sand	34	0.0	01MAR89	e march	890235	2			4
90	bkwater	sand/grav	25	0.0	01MAR89	e march	890234	2	GCMS		4
91	bkwater	muck	660	0.5	02MAY89	e may	890185	2		Z2,IF,bw	4
92	bkwater	sandy silt	120	1.5	05JUN89	e june	891371	2		Z2,IF,bw	4
93	bkwater		50	0.0	05JUL89	e july	890336	2	fish larval study		4
94	bkwater		110	0.0	26JUL89	l july	890392	2		Z2,IF,bw	4
95	bkwater		200	0.0	26JUL89	l july	891398	2		Z2,IF,bw	4
96	bkwater		130	0.0	26JUL89	l july	890393	2	GCMS	Z2,IF,bw	4
97	bkwater		29	0.0	01NOV89	e nov	894348	2			4
98	bkwater		36	0.0	01NOV89	e nov	894349	2			4
99	bkwater	sansiltdet	300	1.0	01FEB90	e feb	900439	2	sandy silt w/leaves	Z2,IF,bw	4
100	bkwater	sansiltdet	46	1.0	01FEB90	e feb	900440	2	sandy silt w/leaves	Z2,IF,bw	4
101	bkwater		110	0.0	01FEB90	e feb	900438	2	TOC	Z2,IF,bw	4
102	bkwater	silty sand	89	2.0	28MAR90	l march	900768	2	TOC	Z2,IF,bw	4
103	bkwater	silty sand	28	2.0	28MAR90	l march	900769	2		Z2,IF,bw	4
104	bkwater	silty sand	76	2.0	28MAR90	l march	900770	2		Z2,IF,bw	4
105	bkwater	sansiltdet	39	2.0	19JUN90	l june	901106	2		Z2,IF,bw	4
106	bkwater	sansiltdet	46	2.0	19JUN90	l june	901107	2		Z2,IF,bw	4
107	bkwater	sansiltdet	59	2.0	19JUN90	l june	901108	2		Z2,IF,bw	4
108	bkwater	sandy silt	39	1.0	18OCT90	l oct	907369	2	TPH is <39, TOC		4

GASCONADE RIVER TPH DATA

OBS	HABITAT	SED	TPH	DEPTH	DATE	REL	SAMPNO	ZONE	COMMENT	SITECODE	LOCATION
109	bkwater	sandy silt	70	2.0	18OCT90	l oct	907370	2			4
110	bkwater	sandy silt	46	1.0	18OCT90	l oct	907371	2			4
111	bkwater*	sandy silt	170	1.5	05JUN89	e june	891372	2	dup 1371	Z2,IF,bw	4
112	nrshore		4	0.0	26JUL89	l july	890388	2	TPH is < 4	Z2,IF,ns	4
113	nrshore	sand/grav	4	0.0	26JUL89	l july	890389	2	TPH is < 4	Z2,IF,ns	4
114	nrshore	gravel	4	0.0	26JUL89	l july	890390	2	TPH is < 4	Z2,IF,ns	4
115	riffle	gravel	7	0.0	01MAR89	e march	890233	2	TPH is < 7		4
116	riffle		55	0.0	26JUL89	l july	890385	2		Z2,IF,rf	4
117	riffle	sand/grav	4	0.0	26JUL89	l july	890386	2	TPH is < 4	Z2,IF,rf	4
118	riffle		190	0.0	26JUL89	l july	890387	2		Z2,IF,rf	4
119	bkwater	sandy silt	120	0.0	01MAR89	e march	890236	3	GCMS	Z3,PD,bw	5
120	bkwater	sandy silt	140	3.5	29MAR89	l march	890267	3		Z3,PD,bw	5
121	bkwater	silt	82	1.5	29MAR89	l march	890266	3		Z3,PD,bw	5
122	bkwater	sandy silt	85	1.0	02MAY89	e may	890181	3		Z3,PD,bw	5
123	bkwater	silt	71	0.0	02MAY89	e may	890183	3		Z3,PD,bw	5
124	bkwater	silt	110	0.1	02MAY89	e may	890184	3		Z3,PD,bw	5
125	bkwater	silt	64	0.0	09MAY89	e may	890290	3	toxicity GCMS	Z3,PD,bw	5
126	bkwater	silt	50	0.0	24MAY89	l may	890313	3	post toxicity sed com	p	5
127	bkwater	silt	35	2.5	05JUN89	e june	891373	3		Z3,PD,bw	5
128	bkwater	sandy silt	35	2.0	05JUN89	e june	891375	3		Z3,PD,bw	5
129	bkwater		58	0.0	06JUL89	e july	890342	3	fish larval study	Z3,PD,bw	5
130	bkwater		33	0.0	06JUL89	e july	890343	3	fish larval study		5
131	bkwater		55	0.0	26JUL89	l july	890398	3		Z3,PD,bw	5
132	bkwater		32	0.0	26JUL89	l july	890399	3		Z3,PD,bw	5
133	bkwater		46	0.0	26JUL89	l july	890401	3	GCMS	Z3,PD,bw	5
134	bkwater	sandy silt	35	2.0	27OCT89	l oct	894331	3		Z3,PD,bw	5
135	bkwater	silt	44	3.0	27OCT89	l oct	894332	3		Z3,PD,bw	5
136	bkwater	sandy silt	10	2.0	31JAN90	l jan	900406	3		Z3,PD,bw	5
137	bkwater	sandy silt	27	2.0	31JAN90	l jan	900407	3		Z3,PD,bw	5
138	bkwater	sandy silt	26	2.0	31JAN90	l jan	900405	3	TOC	Z3,PD,bw	5
139	bkwater	sandy silt	21	3.0	27MAR90	l march	900772	3	TOC, TPH <21	Z3,PD,bw	5
140	bkwater	sandy silt	0	2.5	27MAR90	l march	900773	3	No result,broken at l	abZ3,PD,bw	5
141	bkwater	sandy silt	25	3.0	27MAR90	l march	900774	3		Z3,PD,bw	5
142	bkwater	sansiltgra	34	5.0	13JUN90	e june	900823	3	TOC	Z3,PD,bw	5
143	bkwater	sansiltgra	48	4.0	13JUN90	e june	900824	3		Z3,PD,bw	5
144	bkwater	sansiltgra	39	4.0	13JUN90	e june	900825	3		Z3,PD,bw	5
145	bkwater	siltsnddet	38	2.5	23OCT90	l oct	907373	3	TOC		5
146	bkwater	siltsnddet	36	3.0	23OCT90	l oct	907374	3	TPH is <36		5
147	bkwater	siltsnddet	36	3.0	23OCT90	l oct	907375	3	TPH is <36		5
148	bkwater*	silt	33	3.0	27OCT89	l oct	894333	3	dup 4332	Z3,PD,bw	5
149	nrshore		4	0.0	26JUL89	l july	890396	3	TPH is < 4	Z3,PD,ns	5
150	nrshore	sand/grav	4	0.0	26JUL89	l july	890397	3	TPH is < 4	Z3,PD,ns	5
151	nrshore		150	0.0	26JUL89	l july	890402	3		Z3,PD,ns	5
152	riffle		4	0.0	26JUL89	l july	890394	3	TPH is < 4	Z3,PD,rf	5
153	riffle		4	0.0	26JUL89	l july	890395	3	TPH is < 4	Z3,PD,rf	5
154	riffle		4	0.0	26JUL89	l july	890400	3	TPH is < 4	Z3,PD,rf	5
155	bkwater		760	0.0	26JUL89	l july	890391	3a		Z3-a,RF,bw	6
156	bkwater		74	0.0	26JUL89	l july	891399	3a		Z3-a,RF,bw	6
157	bkwater		490	0.0	26JUL89	l july	891400	3a		Z3-a,RF,bw	6
158	bkwater		21	1.5	07NOV89	e nov	890477	3a			6
159	bkwater		92	5.0	07NOV89	e nov	890478	3a			6
160	bkwater	muck	52	6.0	01FEB90	e feb	900444	3a		Z3-a,RF,bw	6
161	bkwater	muck	48	2.0	01FEB90	e feb	900443	3a		Z3-a,RF,bw	6
162	bkwater	muck	160	5.5	01FEB90	e feb	900442	3a	TOC	Z3-a,RF,bw	6

GASCONADE RIVER TPH DATA

OBS	HABITAT	SED	TPH	DEPTH	DATE	REL	SAMPNO	ZONE	COMMENT	SITECODE	LOCATION
163	bkwater	muck	89	6.0	28MAR90	l march	900776	3a	TOC	Z3-a,RF,bw	6
164	bkwater	muck	77	6.0	28MAR90	l march	900777	3a		Z3-a,RF,bw	6
165	bkwater	muck	58	6.0	28MAR90	l march	900778	3a		Z3-a,RF,bw	6
166	bkwater	silt	35	6.0	11JUN90	e june	901103	3a	TOC	Z3-a,RF,bw	6
167	bkwater	silt	91	6.0	11JUN90	e june	901104	3a		Z3-a,RF,bw	6
168	bkwater	silt, det	70	5.0	11JUN90	e june	901105	3a		Z3-a,RF,bw	6
169	bkwater	muck	50	8.0	15OCT90	l oct	901148	3a	TOC		6
170	bkwater	muck	47	8.0	15OCT90	l oct	901149	3a			6
171	bkwater	muck	41	8.0	15OCT90	l oct	901150	3a			6
172	nrshore	gravel	9500	0.0	26JUL89	l july	890439	3a	oil line	Z3-a,RF,ns	6
173	nrshore		780	0.0	26JUL89	l july	890440	3a		Z3-a,RF,ns	6
174	nrshore		190	0.0	26JUL89	l july	890441	3a		Z3-a,RF,ns	6
175	nrshore		2000	0.0	26JUL89	l july	890442	3a	GCMS		6
176	bkwater	muck	330	5.0	30MAR89	l march	890270	4		Z4,PC,bw-2	7
177	bkwater	muck	490	5.0	30MAR89	l march	890268	4	GCMS	Z4,PC,bw-1	7
178	bkwater	muck	820	3.0	26APR89	l april	890284	4		Z4,PC,bw-1	7
179	bkwater	muck	500	5.0	26APR89	l april	890286	4		Z4,PC,bw-2	7
180	bkwater	muck	530	5.0	26APR89	l april	890287	4			7
181	bkwater	muck	560	5.0	03MAY89	e may	890189	4		Z4,PC,bw-1	7
182	bkwater	muck	340	6.0	03MAY89	e may	890191	4		Z4,PC,bw-2	7
183	bkwater	silt	320	0.0	09MAY89	e may	890280	4	toxicity	Z4,PC,bw-1	7
184	bkwater	muck	310	0.0	24MAY89	l may	890314	4	post toxicity sed com	p	7
185	bkwater	muck	700	3.5	06JUN89	e june	891376	4		Z4,PC,bw-1	7
186	bkwater	muck	400	5.0	06JUN89	e june	891378	4		Z4,PC,bw-2	7
187	bkwater		310	0.0	06JUL89	e july	890341	4	fish larval study	Z4,PC,bw-2	7
188	bkwater		340	0.0	27JUL89	l july	890415	4		Z4,PC,bw-2	7
189	bkwater		320	0.0	27JUL89	l july	890416	4		Z4,PC,bw-2	7
190	bkwater		470	2.0	27JUL89	l july	890451	4		Z4,PC,bw-1	7
191	bkwater		300	2.0	27JUL89	l july	890452	4		Z4,PC,bw-1	7
192	bkwater		380	0.0	27JUL89	l july	890420	4	GCMS	Z4,PC,bw-2	7
193	bkwater		120	0.0	27JUL89	l july	890454	4	GCMS	Z4,PC,bw-1	7
194	bkwater	muck	280	3.0	26OCT89	l oct	894319	4			7
195	bkwater	muck	500	3.0	26OCT89	l oct	894317	4	GCMS		7
196	bkwater	muck	700	3.0	26OCT89	l oct	894318	4	GCMS		7
197	bkwater		230	0.0	13NOV89	e nov	890827	4	toxicity	Z4,PC,bw-2	7
198	bkwater		113	0.0	12JAN90	e jan	900276	4	repeat analysis 89-02	79	7
199	bkwater	sandy silt	280	2.5	30JAN90	l jan	900410	4		Z4,PC,bw-1	7
200	bkwater	sandy silt	170	2.5	30JAN90	l jan	900411	4		Z4,PC,bw-1	7
201	bkwater	muck	260	5.5	30JAN90	l jan	900414	4		Z4,PC,bw-2	7
202	bkwater	muck	260	5.5	30JAN90	l jan	900415	4		Z4,PC,bw-2	7
203	bkwater	muck	310	3.0	30JAN90	l jan	900413	4	GCMS	Z4,PC,bw-2	7
204	bkwater	sandy silt	390	2.0	30JAN90	l jan	900409	4	GCMS	Z4,PC,bw-1	7
205	bkwater	sandy silt	52	4.0	26MAR90	l march	900779	4	GCMS	Z4,PC,bw-1	7
206	bkwater	sandy silt	42	5.0	26MAR90	l march	900780	4		Z4,PC,bw-1	7
207	bkwater	sandy silt	250	4.5	26MAR90	l march	900781	4		Z4,PC,bw-1	7
208	bkwater	muck	60	5.0	26MAR90	l march	900782	4	GCMS	Z4,PC,BW-2	7
209	bkwater	muck	110	4.5	26MAR90	l march	900783	4		Z4,PC,bw-2	7
210	bkwater	muck	130	4.5	26MAR90	l march	900784	4		Z4,PC,bw-2	7
211	bkwater	muck	85	4.5	26MAR90	l march	900785	4		Z4,PC,bw-2	7
212	bkwater	muck	56	0.0	06JUN90	e june	900976	4		Z4,PC,bw-2	7
213	bkwater	muck	70	0.0	06JUN90	e june	900977	4		Z4,PC,bw-2	7
214	bkwater	muck	50	0.0	06JUN90	e june	900978	4		Z4,PC,bw-2	7
215	bkwater	sandy silt	39	5.0	15JUN90	e june	900806	4	GCMS	Z4,PC,bw-1	7
216	bkwater	sandy silt	36	4.5	15JUN90	e june	900807	4		Z4,PC,bw-1	7

GASCONADE RIVER TPH DATA

OBS	HABITAT	SED	TPH	DEPTH	DATE	REL	SAMPNO	ZONE	COMMENT	SITECODE	LOCATION
217	bkwater	sandy silt	34	5.0	15JUN90	e june	900808	4		Z4,PC,bw-1	7
218	bkwater	silt	25	6.0	15JUN90	e june	900809	4	GCMS, TPH <25	Z4,PC,bw-2	7
219	bkwater	silt	40	6.0	15JUN90	e june	900810	4		Z4,PC,bw-2	7
220	bkwater	silt	34	8.0	15JUN90	e june	900811	4		Z4,PC,bw-2	7
221	bkwater	silt	27	6.0	15JUN90	e june	901291	4		Z4,PC,bw-2	7
222	bkwater	silt	32	8.0	15JUN90	e june	901292	4		Z4,PC,bw-2	7
223	bkwater	sandy silt	29	5.0	16OCT90	l oct	901296	4			7
224	bkwater	sandy silt	33	3.0	16OCT90	l oct	901297	4			7
225	bkwater	muck	33	5.0	16OCT90	l oct	901300	4			7
226	bkwater	muck	36	6.0	16OCT90	l oct	901696	4			7
227	bkwater	sandy silt	50	5.0	16OCT90	l oct	901295	4	TOC, GCMS		7
228	bkwater	muck	45	5.0	16OCT90	l oct	901299	4	TOC, GCMS		7
229	bkwater*	muck	750	6.0	03MAY89	e may	890192	4	dup 0191	Z4,PC,bw-2	7
230	bkwater*	muck	360	5.0	06JUN89	e june	891379	4	dup 1378	Z4,PC,bw-2	7
231	bkwater*	muck	230	5.5	30JAN90	l jan	900416	4	dup 0415	Z4,PC,bw-2	7
232	bkwater*	silt	300	8.0	15JUN90	e june	900812	4	dup 0811	Z4,PC,bw-2	7
233	bkwater*	silt	25	8.0	15JUN90	e june	901293	4	dup 1292	Z4,PC,bw-2	7
234	bkwater*	muck	39	6.0	16OCT90	l oct	901697	4	dup 1696		7
235	nrshore	sand/grav	7	1.0	26APR89	l april	890285	4	TPH is < 7	Z4,PC,ns	7
236	nrshore		6	0.0	27JUL89	l july	890412	4	TPH is < 6	Z4,PC,ns	7
237	nrshore		6	0.0	27JUL89	l july	890413	4	TPH is < 6	Z4,PC,ns	7
238	nrshore		50	0.0	27JUL89	l july	890414	4		Z4,PC,ns	7
239	riffle	sand/grav	700	1.0	30MAR89	l march	890269	4	oil line	Z4,PC,ns	7
240	riffle		7	0.0	27JUL89	l july	890417	4	TPH is 6.7	Z4,PC,rf	7
241	riffle		6	0.0	27JUL89	l july	890418	4	TPH is < 6	Z4,PC,rf	7
242	riffle		6	0.0	27JUL89	l july	890419	4	TPH is < 6	Z4,PC,rf	7
243	bkwater	muck	9500	2.0	26APR89	l april	890288	4a		Z4-a,31.5,bw	8
244	bkwater	muck	5700	3.0	26APR89	l april	890289	4a		Z4-a,31.5,bw	8
245	bkwater	muck	6000	0.0	26APR89	l april	890301	4a		Z4-a,31.5,bw	8
246	bkwater	muck	6100	0.0	26APR89	l april	890302	4a	stir & set		8
247	bkwater	muck	4500	0.0	26APR89	l april	890303	4a	stir & set		8
248	bkwater	muck	4900	0.0	26APR89	l april	890304	4a	stir & set		8
249	bkwater	muck	5800	0.0	26APR89	l april	890305	4a	stir & set 2x		8
250	bkwater	muck	3700	0.0	26APR89	l april	890306	4a	stir & set 2x		8
251	bkwater	muck	5000	0.0	26APR89	l april	890307	4a	stir & set 2x		8
252	bkwater	muck	2900	0.0	11MAY89	e may	890311	4a	toxicity GCMS	Z4-a,31.5,bw	8
253	bkwater	muck	2600	0.0	24MAY89	l may	890317	4a	post toxicity sed com	p	8
254	bkwater	muck	5000	3.0	07JUN89	e june	891384	4a		Z4-a,31.5,bw	8
255	bkwater	muck	4300	0.0	07JUN89	e june	891385	4a		Z4-a,31.5,bw	8
256	bkwater		990	0.0	06JUL89	e july	890340	4a	fish larval study	Z4a,31.5,bw	8
257	bkwater		930	0.0	27JUL89	l july	890430	4a		Z4-a,31.5,bw	8
258	bkwater		1100	0.0	27JUL89	l july	890431	4a		Z4-a,31.5,bw	8
259	bkwater		870	0.0	27JUL89	l july	890438	4a	GCMS	Z4-a,31.5,bw	8
260	bkwater	silt	560	3.5	31OCT89	l oct	894321	4a			8
261	bkwater	silt	800	4.0	31OCT89	e oct	894322	4a			8
262	bkwater		860	0.0	13NOV89	e nov	890830	4a	toxicity	Z4-a,31.5,bw	8
263	bkwater	muck	350	5.0	09APR90	e april	900425	4a	GCMS	Z4-a,31.5,bw	8
264	bkwater	muck	200	5.0	09APR90	e april	900426	4a		Z4-a,31.5,bw	8
265	bkwater	muck	410	4.0	09APR90	e april	900427	4a		Z4-a,31.5,bw	8
266	bkwater	muck	57	4.5	21JUN90	l june	901120	4a	GCMS	Z4-a,31.5,bw	8
267	bkwater	muck	44	4.5	21JUN90	l june	901121	4a		Z4-a,31.5,bw	8
268	bkwater	muck	53	4.5	21JUN90	l june	901122	4a		Z4-a,31.5,bw	8
269	bkwater	muck	58	4.0	19OCT90	l oct	907402	4a			8
270	bkwater	muck	42	4.0	19OCT90	l oct	907403	4a			8

GASCONADE RIVER TPH DATA

OBS	HABITAT	SED	TPH	DEPTH	DATE	REL	SAMPNO	ZONE	COMMENT	SITECODE	LOCATION
271	bkwater	muck	53	3.0	19OCT90	l oct	907401	4a	TOC, GCMS		8
272	bkwater*	muck	160	4.0	09APR90	e april	900428	4a	dup 0427	Z4-a,31.5,bw	8
273	bkwater*	muck	46	4.5	21JUN90	l june	901123	4a	dup 1122	Z4-a,31.5,bw	8
274	bkwater*	muck	39	4.0	19OCT90	l oct	907403	4a	dup 7403		8
275	nrshore		6	0.0	27JUL89	l july	890432	4a	TPH is 5.9	Z4-a,31.5,ns	8
276	nrshore		7	0.0	27JUL89	l july	890433	4a		Z4-a,31.5,ns	8
277	nrshore		5	0.0	27JUL89	l july	890435	4a	TPH is < 5	Z4-a,31.5,ns	8
278	riffle		5	0.0	27JUL89	l july	890434	4a	TPH is < 5	Z4-a,31.5,rf	8
279	riffle		6	0.0	27JUL89	l july	890436	4a	TPH is < 6	Z4-a,31.5,rf	8
280	riffle		6	0.0	27JUL89	l july	890437	4a	TPH is < 6	Z4-a,31.5,rf	8
281	bkwater	muck	810	3.0	09MAR89	e march	890244	5	GCMS	Z5,HI,bw-1	9
282	bkwater	muck	320	3.0	09MAR89	e march	890246	5	GCMS	Z5,HI,bw-1	9
283	bkwater	silty sand	140	1.0	09MAR89	e march	890247	5			9
284	bkwater	muck	500	3.0	28MAR89	l march	890259	5	GCMS	Z5,HI,bw-1	9
285	bkwater	muck	900	3.0	28MAR89	l march	890271	5		Z5,HI,bw-1	9
286	bkwater	muck	630	0.0	28MAR89	l march	890274	5	stir & set		9
287	bkwater	muck	920	0.0	28MAR89	l march	890281	5	stir & set 2x		9
288	bkwater	silt	740	2.0	26APR89	l april	890278	5		Z5,HI,bw-1	9
289	bkwater	muck	700	0.0	04MAY89	e may	890200	5	GCMS	Z5,HI,bw-1	9
290	bkwater	muck	640	0.0	10MAY89	e may	890308	5	toxicity GCMS	Z5,HI,bw-1	9
291	bkwater	silt	670	0.0	24MAY89	l may	890315	5	post toxicity sed com	p	9
292	bkwater	muck	630	1.0	06JUN89	e june	891380	5		Z5,HI,bw-1	9
293	bkwater		1100	0.0	06JUL89	e july	890339	5	fish larval study	Z5,HI,bw-2	9
294	bkwater		680	0.0	28JUL89	l july	890409	5		Z5,HI,bw-2	9
295	bkwater		970	0.0	28JUL89	l july	890411	5		Z5,HI,bw-2	9
296	bkwater		360	0.0	28JUL89	l july	890410	5	GCMS	Z5,HI,bw-2	9
297	bkwater		860	0.5	02AUG89	e aug	890473	5	GCMS		9
298	bkwater		770	0.7	02AUG89	e augst	890427	5			9
299	bkwater		350	0.3	02AUG89	e augst	890428	5			9
300	bkwater	silt	560	5.0	26OCT89	l oct	894325	5			9
301	bkwater	silt	660	5.0	26OCT89	l oct	894326	5			9
302	bkwater	muck	120	0.0	26OCT89	l oct	894328	5	site out of water,dri	ed	9
303	bkwater	silt	560	5.0	26OCT89	l oct	894324	5	GCMS		9
304	bkwater		130	0.0	13NOV89	e nov	890828	5	toxicity	Z5,HI,bw-2	9
305	bkwater	sandy silt	330	5.5	31JAN90	l jan	900418	5		Z5,HI,bw-2	9
306	bkwater	sandy silt	750	5.5	31JAN90	l jan	900419	5		Z5,HI,bw-2	9
307	bkwater	silt	220	1.5	31JAN90	l jan	900423	5		Z5,HI,bw-1	9
308	bkwater	silt	120	1.5	31JAN90	l jan	900424	5		Z5,HI,bw-1	9
309	bkwater	sandy silt	340	5.5	31JAN90	l jan	900417	5	GCMS	Z5,HI,bw-2	9
310	bkwater	silt	110	1.5	31JAN90	l jan	900422	5	TOC	Z5,HI,bw-1	9
311	bkwater	muck	62	2.0	26MAR90	l march	900787	5	TOC	Z5,HI,bw-1	9
312	bkwater	sandy silt	34	2.5	26MAR90	l march	900788	5		Z5,HI,bw-1	9
313	bkwater	sandy silt	42	3.0	26MAR90	l march	900789	5		Z5,HI,bw-1	9
314	bkwater	sandy silt	260	5.0	26MAR90	l march	900791	5		Z5,HI,bw-2	9
315	bkwater	sandy silt	590	5.0	26MAR90	l march	900792	5		Z5,HI,bw-2	9
316	bkwater		240	0.0	26MAR90	l march	900790	5	TOC	Z5,HI,bw-2	9
317	bkwater	sandy silt	250	0.0	06JUN90	e june	900979	5		Z5,HI,bw-2	9
318	bkwater	sandy silt	4500	0.0	06JUN90	e june	900980	5		Z5,HI,bw-2	9
319	bkwater	sandy silt	2000	0.0	06JUN90	e june	900981	5		Z5,HI,bw-2	9
320	bkwater	sandy silt	25	2.0	15JUN90	e june	900814	5	TOC, TPH <25	Z5,HI,bw-1	9
321	bkwater	sandy silt	25	2.0	15JUN90	e june	900815	5	TPH <25	Z5,HI,bw-1	9
322	bkwater	sandy silt	48	3.0	15JUN90	e june	900816	5		Z5,HI,bw-1	9
323	bkwater	muck	230	4.0	15JUN90	e june	900817	5	GCMS	Z5,HI,bw-2	9
324	bkwater	muck	77	4.5	15JUN90	e june	900818	5		Z5,HI,bw-2	9

GASCONADE RIVER TPH DATA

OBS	HABITAT	SED	TPH	DEPTH	DATE	REL	SAMPNO	ZONE	COMMENT	SITECODE	LOCATION
325	bkwater	muck	450	5.0	15JUN90	e june	900819	5		Z5,HI,bw-2	9
326	bkwater	muck	1100	5.0	15JUN90	e june	900820	5		Z5,HI,bw-2	9
327	bkwater	sansiltdet	330	8.0	21JUN90	l june	901126	5	GCMS	Z5,HI,bw-2	9
328	bkwater	sansiltdet	810	8.0	21JUN90	l june	901127	5		Z5,HI,bw-2	9
329	bkwater	sansiltdet	42	8.0	21JUN90	l june	901128	5		Z5,HI,bw-2	9
330	bkwater	sandy silt	39	1.0	16OCT90	l oct	907406	5	TPH is <39, TOC		9
331	bkwater	sandy silt	39	1.0	16OCT90	l oct	907407	5	TPH is <39		9
332	bkwater	sandy silt	39	1.0	16OCT90	l oct	907408	5	TPH is <39		9
333	bkwater	silty sand	69	3.0	16OCT90	l oct	907410	5			9
334	bkwater	silty sand	80	5.0	16OCT90	l oct	907411	5			9
335	bkwater	silty sand	92	3.0	16OCT90	l oct	907409	5	TOC, GCMS		9
336	bkwater*	muck	840	3.0	09MAR89	e march	890245	5	dup 0244 for TPH only	Z5,HI,bw-1	9
337	bkwater*	muck	760	3.0	28MAR89	l march	890260	5	dup 0259	Z5,HI,bw-1	9
338	bkwater*	muck	700	3.0	28MAR89	l march	890272	5	dup 0271	Z5,HI,bw-1	9
339	bkwater*	muck	540	3.0	28MAR89	l march	890273	5	dup 0271	Z5,HI,bw-1	9
340	bkwater*	muck	430	0.0	28MAR89	l march	890275	5	dup 0274		9
341	bkwater*	muck	630	0.0	28MAR89	l march	890276	5	dup 0274		9
342	bkwater*	muck	860	0.0	28MAR89	l march	890282	5	dup 0281		9
343	bkwater*	muck	970	0.0	28MAR89	l march	890283	5	dup 0281		9
344	bkwater*		440	0.5	02AUG89	e aug	890472	5	dup 0473 GCMS		9
345	bkwater*	sandy silt	630	5.5	31JAN90	l jan	900420	5	dup 0419	Z5,HI,bw-2	9
346	bkwater*	sansiltdet	59	8.0	21JUN90	l june	901129	5	dup 1128	Z5,HI,bw-2	9
347	bkwater*	silty sand	84	5.0	16OCT90	l oct	907412	5	dup 7411		9
348	nrshore		510	3.0	28JUL89	l july	890403	5		Z5,HI,ns	9
349	nrshore		61	2.0	28JUL89	l july	890404	5		Z5,HI,ns	9
350	nrshore		9	0.0	28JUL89	l july	890455	5	TPH is 8.7	Z5,HI,ns	9
351	nrshore		7	0.0	28JUL89	l july	890456	5	TPH is 6.8	Z5,HI,ns	9
352	nrshore		9	0.0	28JUL89	l july	890457	5	TPH is 8.9	Z5,HI,ns	9
353	nrshore		200	2.0	28JUL89	l july	890405	5		Z5,HI,ns	9
354	riffle	gravel	10	1.5	28MAR89	l march	890262	5			9
355	riffle	detritus	6000	1.5	28MAR89	l march	890261	5			9
356	riffle		5	0.3	28JUL89	l july	890406	5	TPH is < 5	Z5,HI,rf	9
357	riffle		5	0.3	28JUL89	l july	890407	5	TPH is < 5	Z5,HI,rf	9
358	riffle		5	1.0	28JUL89	l july	890408	5	TPH is < 5	Z5,HI,rf	9
359	bkwater	silt	100	5.0	08MAR89	e march	890239	6			.
360	bkwater	silt	26	5.0	27MAR89	l march	890255	6			.
361	bkwater	silt	17	3.0	27MAR89	l march	890256	6	control		.
362	bkwater	sandy silt	180	0.0	27MAR89	l march	890257	6	GCMS		.
363	bkwater	muck	53	0.0	04MAY89	e may	890195	6		Z6,G,bw-2	.
364	bkwater	sandy silt	120	0.0	04MAY89	e may	890197	6		Z6,G,bw-2	.
365	bkwater	muck	220	0.0	04MAY89	e may	890198	6		Z6,G,bw-1	.
366	bkwater	muck	41	0.0	10MAY89	e may	890309	6	toxicity GCMS	Z6,G,bw-2	.
367	bkwater	muck	36	0.0	24MAY89	l may	890316	6	post toxicity sed com	p	.
368	bkwater	silt	26	6.5	07JUN89	e june	891389	6			.
369	bkwater	muck	69	6.0	07JUN89	e june	891387	6		Z6,G,bw-1	.
370	bkwater	muck	30	5.5	07JUN89	e june	891388	6		Z6,G,bw-2	.
371	bkwater		33	0.0	06JUL89	e july	890338	6	fish larval study	Z6,G,bw-1	.
372	bkwater		69	0.0	28JUL89	l july	890421	6		Z6,G,bw-1	.
373	bkwater		92	0.0	28JUL89	l july	890422	6		Z6,G,bw-1	.
374	bkwater		110	0.0	28JUL89	l july	890426	6	GCMS	Z6,G,bw-1	.
375	bkwater		23	0.0	28JUL89	l july	890360	6	GCMS	Z6,G,bw-2	.
376	bkwater		21	0.0	02NOV89	e nov	890697	6		Z6,G,bw-2	.
377	bkwater		14	0.0	02NOV89	e nov	890698	6		Z6,G,bw-2	.
378	bkwater		66	0.0	02NOV89	e nov	894343	6		Z6,G,bw-1	.

GASCONADE RIVER TPH DATA

OBS	HABITAT	SED	TPH	DEPTH	DATE	REL	SAMPNO	ZONE	COMMENT	SITECODE	LOCATION
379	bkwater		67	0	02NOV89	e nov	894344	6		Z6,G,bw-1	.
380	bkwater		0	0	02NOV89	e nov	890699	6	GCMS data only	Z6,G,bw-2	.
381	bkwater		45	0	02NOV89	e nov	894345	6	TOC	Z6,G,bw-1	.
382	bkwater		30	0	13NOV89	e nov	890829	6	toxicity	Z6,G,bw-1	.
383	nrshore	sandy silt	125	3	08MAR89	e march	890240	6	GCMS		.
384	riffle	sandy silt	38	1	08MAR89	e march	890243	6	GCMS		.
385	riffle	sand/grav	19000	1	08MAR89	e march	890242	6	oil line GCMS		.
386	riffle	sand/grav	10	1	08MAR89	e march	890241	6			.
387	riffle		35	0	27MAR89	l march	890258	6			.
388	riffle		20	0	28JUL89	l july	890423	6			.
389	riffle		16	0	28JUL89	l july	890429	6			.
390	bkwater	muck	76	0	03MAR89	e march	890237	7	GCMS		.
391	sandbar		10	0	18AUG89	l aug	890609	7	TPH is < 10		.
392	sandbar		10	0	18AUG89	l aug	890610	7	TPH is < 10		.
393	sandbar		10	0	18AUG89	l aug	890611	7	TPH is < 10		.
394	sandbar	sand	7	0	02NOV89	e nov	890639	7	TOC TPH is < 7	Z7,MR	.
395	bkwater	sand	250	0	03MAR89	e march	890238	8	GCMS		.
396	bkwater	silty sand	1400	0	13MAR89	e march	890253	8			.
397	bkwater	muck	150	0	13MAR89	e march	890252	8			.
398	channel	sand	10	0	13MAR89	e march	890250	8	TPH is < 10		.
399	channel	gravel	2600	0	13MAR89	e march	890251	8			.
400	sandbar		9100	0	18AUG89	l aug	890601	8			.
401	sandbar		10	0	18AUG89	l aug	890602	8	TPH is < 10		.
402	sandbar		10	0	18AUG89	l aug	890603	8	TPH is < 10		.
403	sandbar		1300	0	18AUG89	l aug	890604	8	oiled area		.
404	sandbar		500	0	18AUG89	l aug	890605	8	oiled area		.
405	sandbar		10	0	18AUG89	l aug	890606	8	TPH is < 10	Z8,MR	.
406	sandbar		10	0	18AUG89	l aug	890607	8	TPH is < 10	Z8,MR	.
407	sandbar		10	0	18AUG89	l aug	890608	8	TPH is < 10	Z8,MR	.
408	sandbar	sand	7	0	02NOV89	e nov	890640	8	TOC TPH is < 7	Z8,MR	.
409	bkwater		30	0	13NOV89	e nov	890831	MD	MDOC sample		.
410	bkwater		540	0	13NOV89	e nov	890832	MD	MDOC sample		.
411	bkwater		7	0	13NOV89	e nov	890833	MD	MDOC TPH < 7		.
412	bkwater		110	0	13NOV89	e nov	890834	MD	MDOC sample		.
413	bkwater		51	0	13NOV89	e nov	890835	MD	MDOC sample		.
414	bkwater		590	0	13NOV89	e nov	890836	MD	MDOC sample		.
415	bkwater		41	0	05JUL89	e july	890337	m1	fish larval study		.
416	bkwater	muck	230	5	07JUN89	e june	891382	m3	1 time only		.