WRD RESOURCE ROOM

ZION

Inventory of the Aquatic Resources in the East & North Forks of the Virgin River in & above Zion National Park, Utah

Terence P. Boyle
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&
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Applied Research Branch
Water Resources Division
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INTRODUCTION

In order to preserve and protect natural resources within the National Park System, it is important to understand the underlying ecological factors controlling and maintaining critical resource attributes of the system. The factors governing the ecological components of stream systems are highly variable. In general, the structure and function of ecological communities in arid streams is a function of the nature and strength of those factors. Inventories of natural resources addressing management concerns for preserving natural systems should include analysis of the status of these factors. Preservation of the environmental conditions is critical to sustaining the natural condition of aquatic resources.

In lotic systems the River Continuum Concept (RCC; Vannote *et al.* 1980), provides a complex hypothesis, or paradigm, that can be used as a framework to determine and integrate critical environmental factors (i.e., both physical and chemical), and the biological components comprising the stream ecosystem. The RCC describes how various physical/chemical factors, and the resulting biological community change as small headwater streams become a large river. The RCC as proposed in its original form delineates the longitudinal succession as observed in streams in the northern mid-western United States and in the northern Cascades, however, continued comparative studies have resulted in a broader expansion of the original concepts framed by the RCC (Minshall *et al.* 1985).

In this study the RCC served as a framework to identify critical ecological variables for collection and to interpret data from the Virgin River. This resource inventory of the Virgin River ecosystem was designed to provide Zion National Park with a database that can be used to establish the ecological status of the aquatic communities in the river, serve as a baseline on which to monitor and assess future change, and predict changes in community attributes due to alteration of hydrological regimes.

The RCC has been widely used by aquatic ecologists to link instream community structure and function to basin-wide ecological processes. In its present form, the RCC hypothesizes that as one moves longitudinally downstream, local environmental and biological factors change, affecting the dynamics and flow of energy in the form of organic carbon and nutrients through the system. In response, the aquatic community adapts to maximize the available energy.

Changes in structure and function of the aquatic macroinvertebrate communities in response to these environmental and biological changes has been well documented for streams in the northern Mid-west and Pacific Northwest (Cummins 1974). The composition functional feeding groups within the community is a reflection, at least in part, of the available food resources. Aquatic invertebrates have developed various functional feeding adaptations (i.e., shredding, gathering, filtering, grazing/scraping) based on the size (coarse vs. fine), location (e.g. attached, suspended, deposited), and/or form (i.e., allochthonous vs. autochthonous) of the available organic material. Shredders, for example, are adapted to feed primarily on coarse particulate organic material (CPOM; >1 mm), primarily allochthonous organic material and associated microbes. Shredders are most abundant where allochthonous material is present (i.e, small, heavily canopied headwater streams). Shredders reduce CPOM to fine and very-fine particulate organic material (FPOM; <1mm and >63μm, and VPOM; <63μm) which, because of the reduced size, are more readily transported downstream. Energy sources in mesic streams appear to shift from CPOM in the headwaters to FPOM and VPOM as one moves downstream. In response, the functional and structural attributes of the community shift. As availability of transported FPOM and VPOM increases downstream, collector-gatherers and collector-filterers adapted to collect FPOM and VPOM from the substrate and the water column, become more prevalent. Scrapers adapted to feed or graze directly on periphyton standing crops occur in

conjunction with stream conditions that favor development of autochthonous energy sources.

The RCC contends that community structure and function, energy flow, and other important features related to organic inputs and processing within the stream ecosystem change from upstream to downstream, regulated by the environmental and biological changes along a longitudinal component characteristic of stream ecosystems. Knowledge of how certain critical ecosystem variables shape stream community structure and function along the stream gradient allow certain qualified predictions to be made if these variables were to be changed. For the purpose of this study selected physical, chemical, and biological variables along the stream gradient were examined to characterize the stream ecosystem of the East and North Forks of Virgin River in and above Zion National Park. An effort to determine the role of the hydrological regime in regulating the existing biological community is a special focus of this report. Establishing the role of the hydrological flow regime in maintaining the structure and function of the aquatic communities of the Virgin River system will allow inferences to be made on the effects of departure from these existing conditions in the future.

STUDY AREA

The East and North Forks of the Virgin River are located in the Wasatch and Uintah Mountain, and the Colorado Plateau Ecoregions of southwestern Utah in and above Zion National Park (Omernik 1987). The North Fork begins south of the Maragount Plateau at an elevation of 2,500 m and flows approximately 40 km through a relatively undisturbed upper catchment and Zion National Park before joining with the East Fork downstream of Springdale, Utah, at an elevation of 1,150 m. The East Fork is approximately 70 km long and begins south of the Sevier River Basin at elevations around 2,500 m. The upper East Fork flows south passing adjacent to the towns of Glendale, Orderville, and Mount Carmel Junction before flowing through Zion National Park. Land use in the upper North Fork catchment (above the Zion Narrows) is limited to seasonal recreation and rangeland grazing. Access by road into this area is generally limited to a few dry months during the summer and fall. Ownership is a mixture of private, Bureau of Land Management, National Forest, and National Park Service lands. Land uses in the upper East Fork catchment (upstream from Mt. Carmel Junction) are more extensive and including various agricultural activities, urban development, and pasture and rangeland grazing (UWRL 1976). Much of the water from the upper East Fork is diverted for domestic and municipal use, and/or irrigation. As a result, flows in the East Fork below Mount Carmel Junction are severally diminished during dry periods. The majority of flow during this period in the lower East Fork within Zion National Park is attributable to accretion of groundwater from the Navajo Sandstone formation. In both lower catchments within Zion National Park recreational and associated activities comprise the primary land uses, especially along the North Fork river corridor.

The majority of the annual precipitation in the region is from Pacific fronts, December

through March, and falls as snow in the mountains and rain at lower elevations (Gregory 1950). The precipitation patterns exhibited by the North Fork catchment reflect a hydrograph dominated by spring snow-melt, while in the East Fork a rainfall runoff hydrograph predominates (Hermes 1991). Localized heavy rainfall events bringing moisture from the Gulf of Mexico are prevalent from July through September. Like most unregulated arid streams, the East and North Forks are subject to frequent and intense flash floods. Summer high flow events can be particularly dramatic, with discharges increasing by orders of magnitude (Diaz 1992). The intensity and magnitude of these sudden flows are highly erosive and have the potential to alter the physical characteristics of the stream channel and bed materials.

METHODS

Ten sample sites were chosen in reaches that reflect changes in environmental factors (i.e., gradient, stream order, discharge, temperature) along the natural river continuum in an attempt to identify factors that may affect the functional and structural components of the aquatic community (Figure 1). Elevations, gradients, and stream orders were determined using 1:100,000 scale topographic maps. For stream order the smallest permanent tributaries shown on the map were designated as first order (Strahler 1957). Discharge was measured directly in the field at the time of sampling using velocity area methodology (Bureau of Reclamation 1984). Velocities were measured at 0.6 depth using a Price AA current meter. Temperature was also measured in the field at the time of sampling using a hand held thermometer.

Each site was sampled for a suite of chemical and biological variables following standard methods referenced in Table 1. Dissolved oxygen and pH were measured in the field at the time of sampling. In addition, water and organic samples were collected. Organic material transported in the water column was collected by passing water through a series of sieves. The volume of water was recorded and used to calculate final concentrations. Chemical analyses (i.e., Kjeldahl nitrogen, nitrate/nitrite, total phosphorus, and organic carbon content of various detrital fractions, CPOM, FPOM, VPOM) were performed by the Soils Testing Laboratory at Colorado State University.

Benthic macroinvertebrate communities were collected with a Surber sampler equipped with a 260 μm meshed net. Five Surber samples were collected in each of the predominant benthic habitats identified at each site. Benthic habitats, substrates where invertebrate communities were collected, were characterized by collecting a representative sample of the material and measuring the particle size distribution characterized using the grade scale

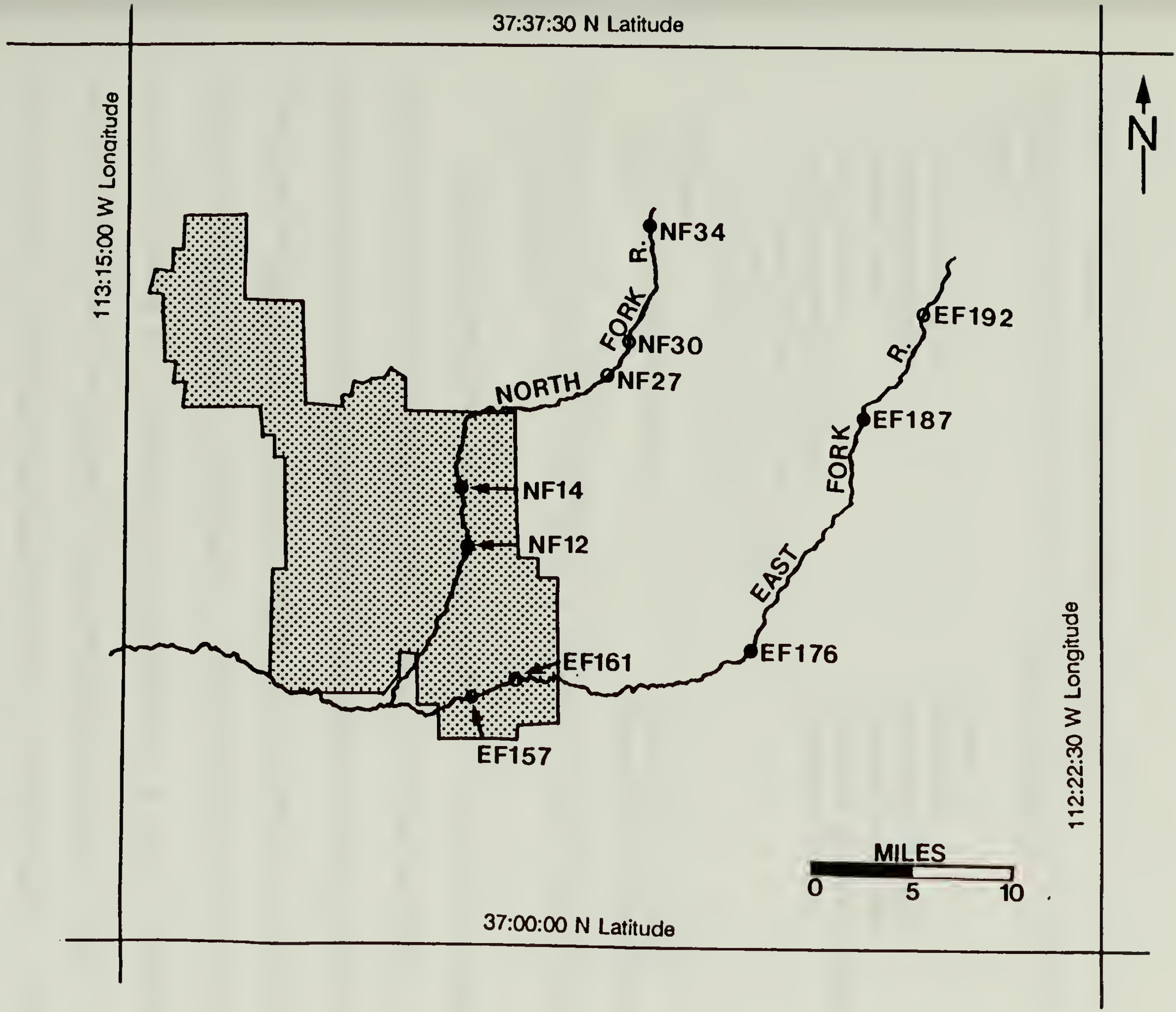


Figure 1. Location of sample sites on the East and North Forks of the Zion River.

developed by American Geophysical Union (Chow 1964). In addition, substrates were photographed to evaluate substrate changes due to high flow events. Photos were also used to document disturbance and indicate degree of substrate embeddedness by sand, fines, and clays after flow events. No attempt was made to quantify substrate types within a reach.

Table 1. Chemical and biological variables and methods.

Variable	Method (Reference)
Chemical	
pH	Electrode[1]
Dissolved oxygen	Electrode[1]
Total phosphorous	Persulfate digestion[1]
Nitrate/nitrate	Cadmium reduction[1]
Total nitrogen	Persulfate digestion/cadmium reduction[1]
Particulate carbon fractions	Oxidation diffusion[2]
Coarse CPOM (>1.0 mm)	
Fine FPOM (>63 µm ≤ 1.0 mm)	
Very fine VPOM (<63 µm)	
Biological	
Benthic macroinvertebrates	Surber (260 µm mesh)[3]
Fish	Electrofishing (2 pass removal)[4]

[1]APHA Standard Methods (1975), [2]Synder & Trofymow (1984), [3]Wetzel & Likens (1979), and [4]Hankin (1986)

Benthic invertebrates collected were identified to lowest possible taxonomic level using keys in Edmunds *et al.* (1976), Flint (1984), Flowers and Hilsenhoff (1975), Hilsenhoff (1984), Hilsenhoff and Bilmyer (1973), Merritt and Cummins (1984), Pennak (1978), Shefter and Wiggins (1986), and Wiggins (1977). Structural analysis of the benthic macroinvertebrate community consisted of determinations of density (i.e., the total number of individuals per unit area), taxonomic richness (i.e., the number of taxa present at a site). Functional group analysis included only the class insecta, all other organisms were grouped as "other". Functional groups were assigned to each insect taxa based on feeding strategies listed in Merritt and Cummins (1984).

Chemical, physical, and biological measurements and collections were made, in general, on a biweekly schedule over twelve sampling periods (Table 2). Actual date of collections at individual sites are reported in Appendix A and B. On the East Fork, however, EF187 was not sampled until the forth sampling period, beginning June 22nd. Because of the addition of EF187, the sampling at EF176 was decreased to once a month. EF176, because of the diminished flows was atypical of the natural systems. EF161 was also sampled monthly, due to lack of accessibility to the site. On the North Fork, all sites were sampled biweekly, with the exception of NF14 which was also relatively inaccessible. In addition, NF27 was not sampled during the sampling period starting on July 17, due to impassable roads limiting accessibility.

Table 2. Sample sites and sampling periods for collections.

	Beginning Date of Bi-weekly Sampling PeriodSite										
	5/11	5/25	6/8	6/22	7/6	7/20	8/3	8/17	8/31	9/14	9/28
EF192	*	*	*	*	*	*	*	*	*	*	*
EF187				*	*	*	*	*	*	*	*
EF176	*	*	*	*	*		*		*		*
EF161		*		*		*		*		*	
EF157	*	*	*	*	*	*	*	*	*	*	*
NF34	*	*	*	*	*	*	*	*	*	*	
NF30	*	*	*	*	*	*	*	*	*	*	
NF27	*	*	*	*	*	*		*	*	*	
NF14		*		*		*		*		*	
NF12	*	*	*	*	*	*	*	*	*	*	*

Fish communities were sampled at four sites on the North Fork (NF34, NF30, NF27, NF12) and East Fork (EF192, EF187, EF176, EF161) on July 8-9. Fish collections were made in cooperation with the State of Utah, Department of Game and Fish, and research personnel from the Department of Biology, University of Nevada, Las Vegas. Two successive passes (c_1

and c_2) of equal effort were made using both backpack and bank electrofishing gear (Hankin 1986). Fish captured were enumerated by species, weighed, measured, and released. Population size (N) was estimated by

$$N = c_{12}/(c_1 - c_2),$$

with variance of the population estimated determined by

$$var[N] = [c_1^2 c_2^2 (c_1 + c_2)]/(c_1 + c_2)^4,$$

and standard error

$$se(N) = var[N].$$

Confidence intervals (95 percent) on the true population size [N] was calculated by

$$1.96 \times se\ (N)$$

at each reach sampled (Seber and Le Cren 1967). Three or more catches are required to test the assumption of constant capture probability (White *et al*. 1982). For this analysis it was assumed that all species present were equally liable to be captured and had the same capture probability on each pass.

Species biomass was estimated by multiplying the average weight of all the individuals of each species captured within the sample reach by the estimated population size for each species. Total biomass was determined at each site was determined by the addition of each individual specie biomass found per site. Goodman's rule

$$var(xy) = x^2(var\ y) + y^2(var\ x) - ((var\ x)(var\ y))$$

was used to calculate the variance (Seber and Le Cren 1967).

RESULTS AND DISCUSSION

Physical/Chemical Components

Two distinctly different gemorphic zones with differing environmental attributes (i.e, gradient, shading, substrates), separated by narrow canyons, were identified on both the East and North Forks of the Virgin River. On both rivers a marked geomorphic transition is evident between the sites located in the upper catchments (EF192, EF187, EF176, NF34, NF30, NF27) and those in the lower catchments (EF161, EF157, NF12; Table 3). On both the East and North Forks the three upper catchment sites are separated from the lower river sites by narrow canyons, the Zion Narrows on the North Fork and Paraunweap Canyon on the East Fork.

In general, gradients on the North Fork were higher than those at comparable stream orders on the East Fork (Table 3). The gradient at NF34 (68.9 m/km) was the highest, more than double that at EF192 (30.3 m/km). Gradients at the other upper North Fork sites, NF30 and NF27 of 29.7 and 30.3 m/km, however, were comparable with the gradient at EF192. Gradients tended to decrease in a downstream fashion. Gradients of the lower sites were less than those found at the sites in the upper catchment, with the exception of EF176. The gradient at EF176, 8.0 m/km was the lowest of both rivers. Gradients at the lower sites, NF12, EF161 and EF157, were relatively similar, 9.5, 10.2 and 8.5 m/km, respectively.

Canopy cover and shading of the river by riparian vegetation decreased downstream as the river widened, fitting the general tenets of the RCC. Riparian vegetation along the lower sites was in many places discontinuous, often consisting of a single line of trees. Sources of litter inputs and shading, as a result, were reduced. However, due to canyon walls shading at EF161, NF14, and NF12 was notable.

Table 3. Environmental characteristics of sample sites.

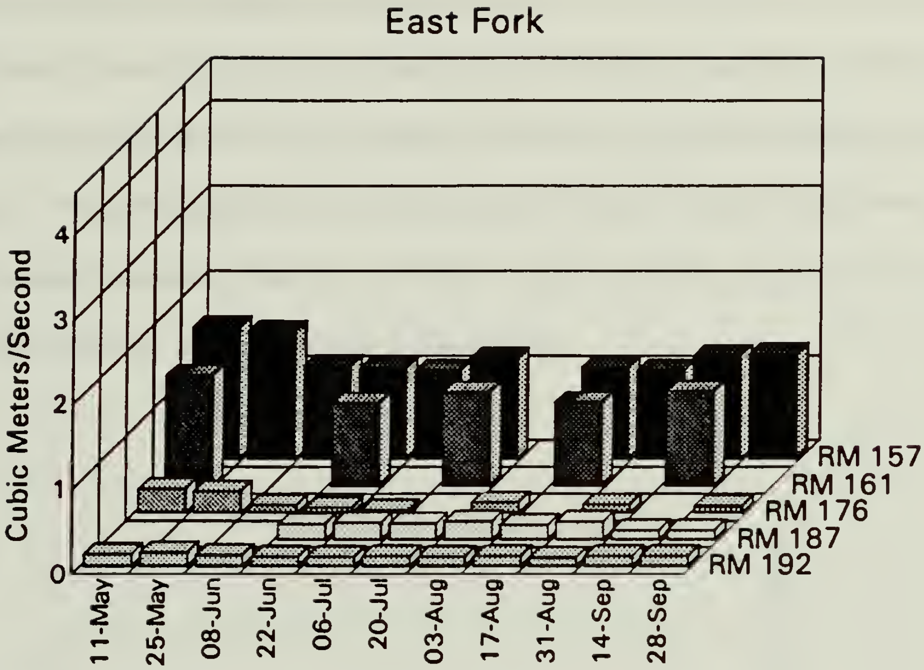
Site	Elevation (m)	Gradient (m/km)	Stream Order	Substrate*	Shading of Stream
EF192	2000	30.3	Second	Coarse Gravel	Riparian Vegetation
EF187	1800	15.2	Third	Coarse Gravel/Cobble	
EF176	1550	8.0	Third	Coarse Gravel/Cobble	
EF161	1300	10.2	Fourth	Sand/Gravel/Cobble/Boulders	Canyon Walls
EF157	1250	8.5	Fourth	Sand/Gravel/Cobble/Boulders	
NF34	2050	68.9	Second	Coarse Gravel	Riparian Vegetation
NF30	1950	29.7	Third	Coarse Gravel/Cobble	
NF27	1800	30.3	Third	Coarse Gravel/Cobble	
NF14	1400	18.4	Fourth	Cobble/Small Boulders	Canyon Walls
NF12	1300	9.5	Fourth	Sand/Gravel/Cobble/Boulders	Canyon Walls

*Particle size of dominant substrates at sites, see text for complete descriptions

Diversity of bed materials increased in complexity as one moved downstream. Substrates at the second order sites, NF34 and EF192, were dominated by clean, coarse gravel, while substrates at the third order sites, NF30, NF27, EF187, and EF176 were more complex, ranging from coarse gravel to cobble, small boulder mixtures. Only at EF187 were substrates embedded with fine sand and silt consistently throughout the study period. Substrates at the fourth order site NF12 were comprised primarily of a mixture of large cobble and small boulders. Small areas of mixed gravel and sand were also found along the stream margin. Substrates at the lower East Fork sites (EF161 and EF157) were more diverse, again primarily comprised of cobble, small boulders, but large areas of sand and gravel/sand mixtures were also present. Substrates at the lower sites on both rivers were commonly embedded by sand transported by high flows. After sand was deposited it was gradually transported downstream and underlying substrates were again exposed. Dense mats of filamentous algae developed on the large boulders as they reemerged.

Discharges measured at the sites during the study period are depicted in Figure 2 (see Appendix A for data). Only at the lower North Fork site, NF12, was a snow-melt hydrograph apparent from the discharge measurements. On both forks, discharge increased downstream due to the added flow from tributaries and groundwater accretion. There was, however, a reduction of flow at EF176 due to withdrawal of water from the East Fork for municipal and irrigation use. Despite these withdrawls, measurements in the lower East Fork at EF161 and EF157 showed substantial increased in flow of several times that of the discharge at EF176.

Because of the time interval between discharge measurements, high flows resulting from summer rainfall runoff events were not evident. Discharge measurements taken every two weeks indicate that there was relatively little apparent fluctuation in discharge throughout the study period. Only a slight increase in discharge is apparent in the lower North Fork during the August



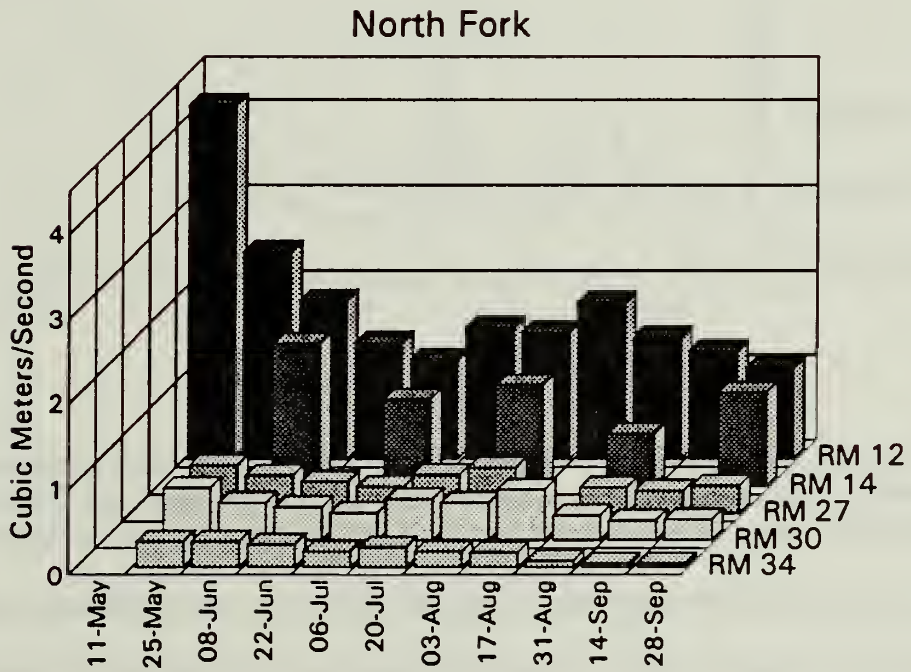


Figure 2. Discharge (m^3/sec) measured at sample sites on the East and North Forks.

17th sampling period. Hydrographs from the North Fork near Springdale, Utah (0940550), the East Fork near Glendale (USGS gage 09404450), and the Virgin River below the confluence of the East and North Forks at Virgin, Utah (USGS gage 09406000), however, reflect the intensity of the flows associated with the summer rainfall runoff events during the sampling period (Figure 3; USGS 1986). The hydrographs from these gages indicate numerous high flow events did occur during the sample period. Rainfall runoff events resulting in flows several times higher than baseflow were prevalent in July, August, and September.

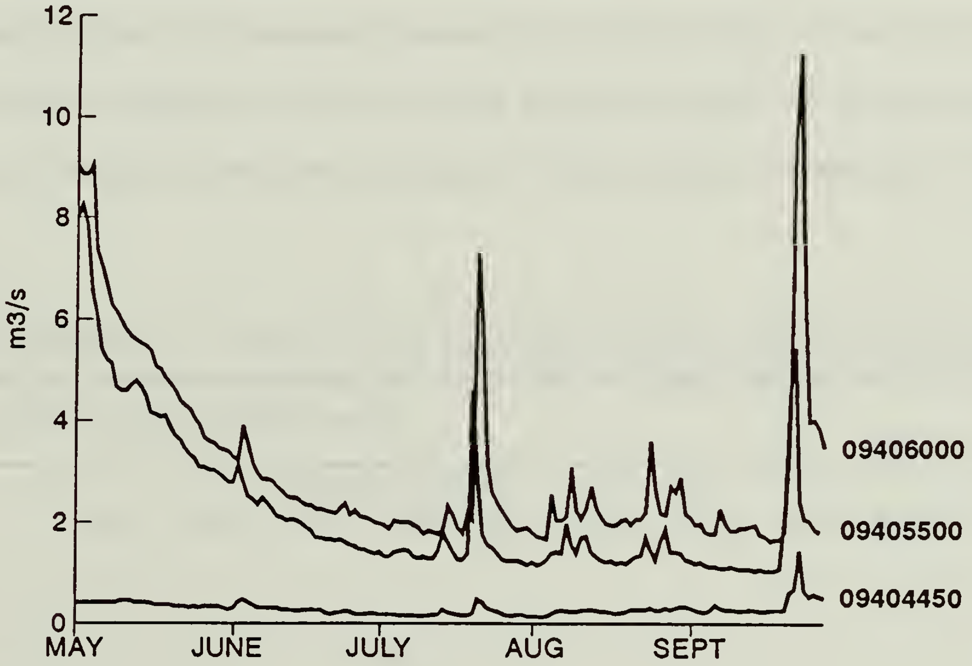


Figure 3. Hydrographs from May to October 1987 (Water Year 1986) for the East Fork near Glendale (09404450), the North Fork of the Virgin River near Springdale, Utah (09406000) and the Virgin River below the confluence of the East and North Forks at Virgin, Utah (0940550).

Substrate disturbance was commonly observed associated with these high flows. After high flows (indicated in the field by above bank high water and debris marks), substrates in the channel were disturbed (i.e., algal and periphyton growth on rock surfaces were eradicated,

evidence of deposition and scouring of bed materials was observed, and channel morphology altered). Periodic physical disturbance of substrates was commonly recorded starting in mid-July, corresponding to the high flow events recorded by the hydrographs at the USGS gages on the East and North Forks. The extent and degree of disturbance (patchiness) varied at sites and over time (Table 4). For example, even though substrates were disturbed at NF34 and NF12, no evidence of disturbance was found at NF30 and NF27 during the second sample period in July. Substrates at EF187 did not appear disturbed (i.e., remaining embedded with fine sand and silt) over the extent of the study. EF187 is located at the USGS gage site (09404450) on the East Fork near Glendale. The hydrograph showed that very little variation in flow occurred (see Figure 3), although substrates at the site above EF192 and below EF176 were frequently disturbed (i.e., dramatic scouring and deposition of bed material, and alteration of channel morphology).

Table 4. Reported evidence of disturbance of substrates due to high flows. (T) total or complete disturbance of bed materials recorded at site and (P) partial or patchy disturbance of substrates recorded at site during the sampling period.

	Sampling Periods								
	6/8	6/22	7/6	7/20	8/3	8/17	8/31	9/14	9/28
EF192				T	T				
EF187									
EF176				T					
EF161				NS*	T				
EF157				T	T				
NF34				P	P	P			
NF30					P	P			
NF27					T	NS			
NF14				NS	T				
NF12				T	T				

NS* Site not sampled during this period

Water temperatures measured at the lower sites on both forks, in general, were higher than

at the upper sites, with the exception of EF176 (see Appendix A). Diurnal fluctuations of the water temperature at the lower sites within the Park, especially in the lower East Fork, varied as much as 10°C (Peterson, 1991). Temperatures measured at the lower East Fork sites mid-summer were consistently over 20°C, while at the lower North Fork site only once did temperatures measured exceed 20°C. In addition, temperatures at the upper sites did not exceed 20°C, with the exception of EF176. Temperatures measured at EF176 were regularly above 20°C, and during mid-summer a high of 27°C was measured. Temperatures above 20°C usually restrict coldwater species, such as salmonids (Hynes 1976).

In general, pH varied from 7.7 to 8.4 with little change during the course of the collecting period among sites, indicating a well-buffered system. Dissolved oxygen varied between 7.1 and 9.8 mg/L and was always at or above saturation (see Appendix A for individual chemical values). These pH and dissolved oxygen ranges observed do not pose limitation on a aquatic biota.

Total nitrogen concentrations, comprised of Kjeldahl nitrogen and nitrate/nitrite, were higher in the East Fork than in the North Fork (Figure 4) and the levels at EF176, EF161, and EF157, downstream of grazing, agriculture, and several small towns and communities, were greater than the other East or North Fork sites. Elevated levels of nitrate/nitrite were also reported at the lower East Fork sites by Sandberg and Sultz (1985). As most of the nitrogen fraction at these sites is in the form of nitrate/nitrite, this indicates that the elevated nitrogen levels are probably a result of upstream land use along the stream corridor. Elevated nitrogen concentration at the other East and North Fork sites were only found during spring and mid-summer rainfall runoff events. Fisher (1986) reported that nitrate-nitrogen concentrations in flood waters were significantly higher than in free-flowing streams and rivers in the southwest region of the United States.

Total phosphorus concentrations from the East and North Forks showed two periods with

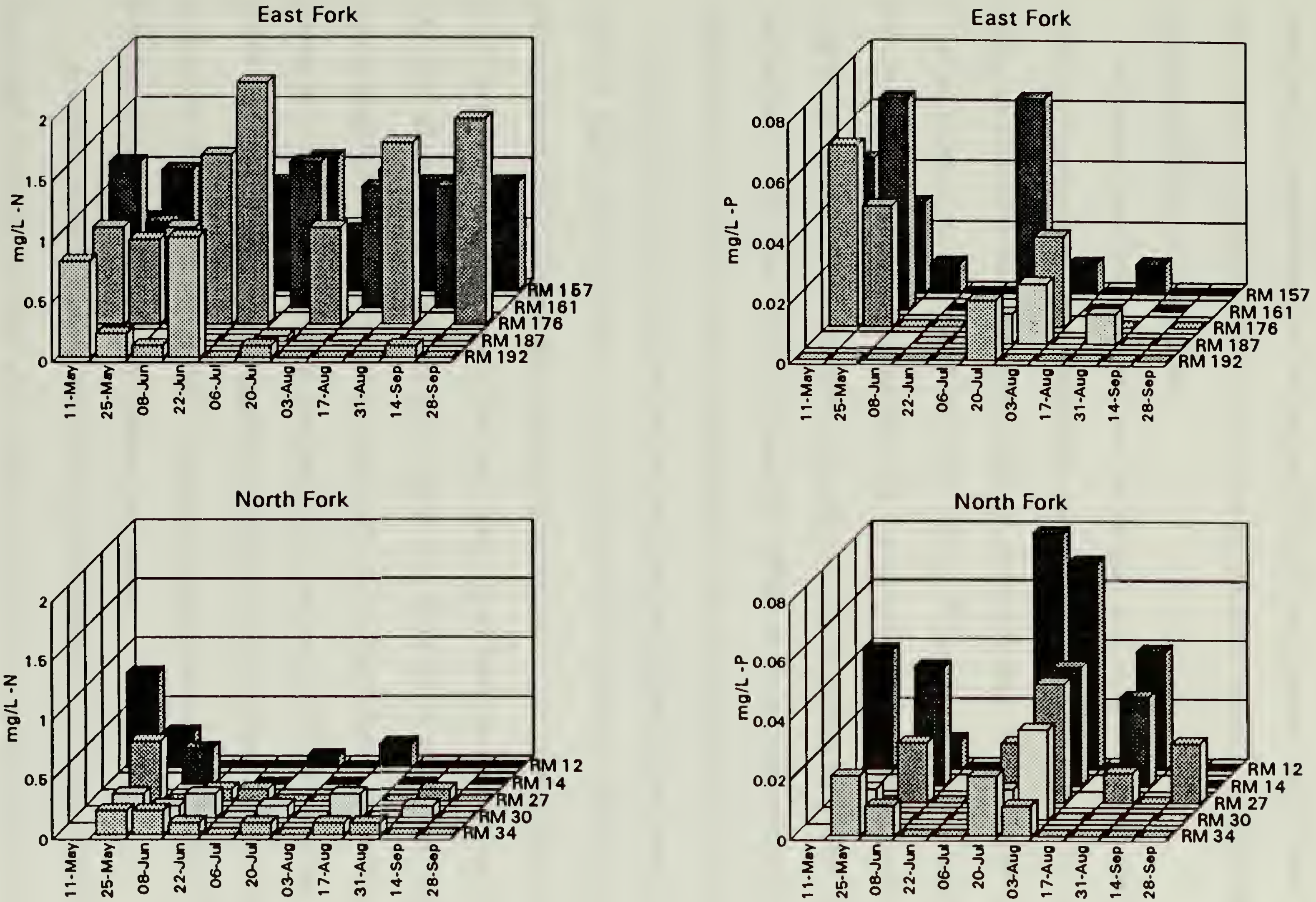


Figure 4. Total Nitrogen (mg/l-N) and Total Phosphorus (mg/l-P) concentrations measured at sites on the East and North Forks.

elevated concentrations, in May and again during mid-summer (Figure 4). Increases in total phosphorus concentrations in the East and North Forks appeared to be related to high flows rather than being diluted by them. There was no evidence, however, of longitudinal increases in total phosphorus concentrations.

In aquatic systems, nutrients such as nitrogen and phosphorus frequently limit primary production (algal growth) and detrital processing. If N:P ratios are above 12:1, phosphorus is usually considered to be the limiting nutrient for photosynthesis. For ratios below this, nitrogen is usually limiting (Lambou *et al.* 1976). The ratio of nitrogen to phosphorus found at the North Fork and upper East Fork sites indicated that nitrogen may be the limiting primary production, while at the EF176, EF161, and EF157 phosphorus may be limiting as a result of the elevated nitrogen levels. We were unable to assess the affects of these levels on primary production. Artificial samplers used to assess algal standing crops were repeatedly lost during high flows.

During the period of study, VPOM was the dominant organic fraction being transported in both the East and North Forks. Of the three carbon fractions measured proportionally concentrations of VPOM were the largest being transported in the North and East Forks (Figure 5). In fact, the concentration of VPOM was much higher than reported in many lotic systems (Hobbie and Likens 1973, Naiman 1976, 1982). The amounts of FPOM and CPOM measured were substantially less. No consistent downstream trends were noted in any of the three fractions measured. However, in general, in the East Fork the amount of FPOM measured at EF161 and EF157 was greater than at sites upstream throughout the sampling period. Because of the longitudinal disruption of flow at EF176, this would suggest that the source of FPOM is due to localized terrestrial inputs and not upstream processes.

Increases in concentrations of FPOM and CPOM appear to be related to increases in flows associated with summer rainfall runoff events. Concentrations of terrestrially derived transported

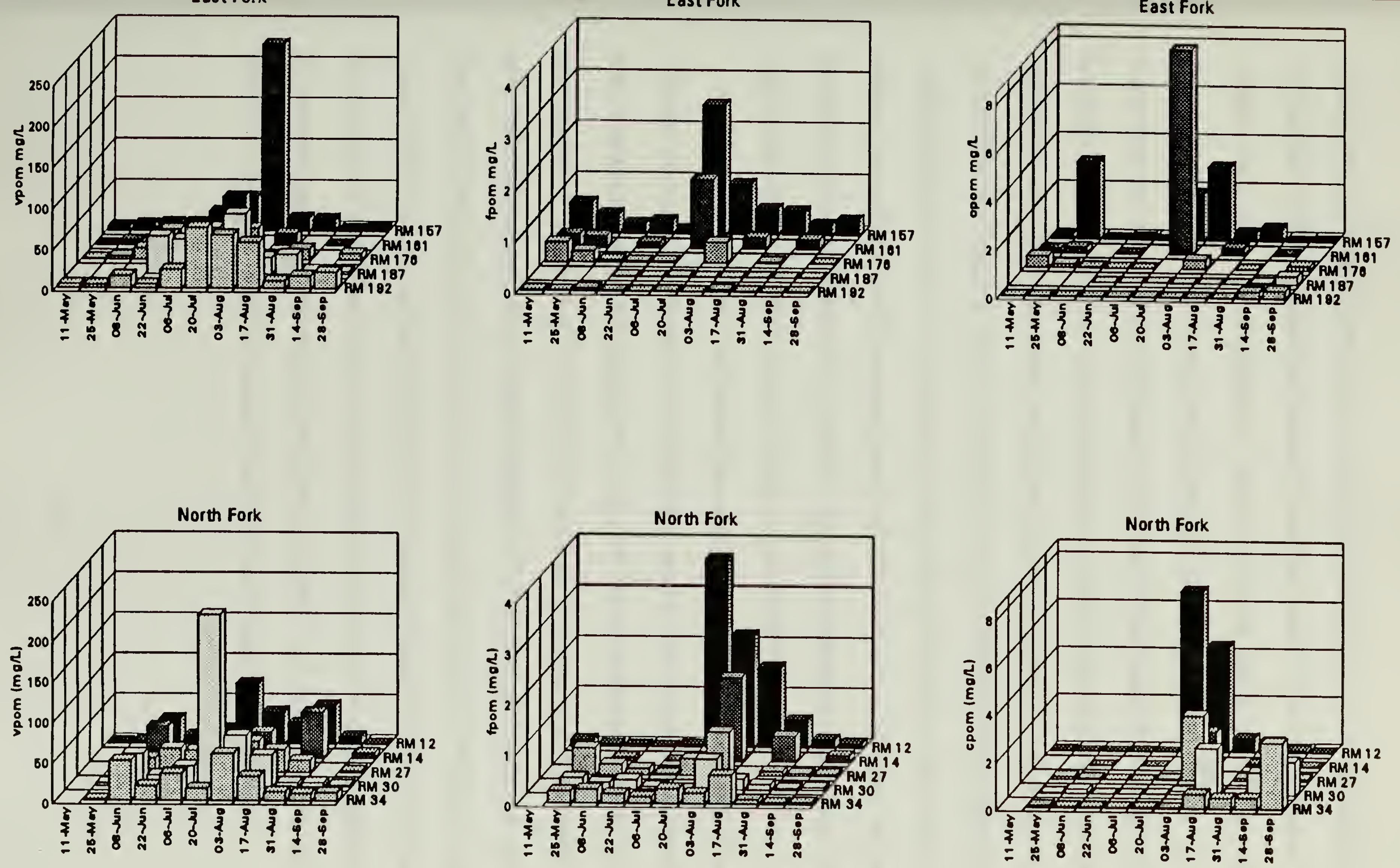


Figure 5. Organic material fractions (VPOM: Very fine particulate organic material, FPOM: Fine particulate organic material, and CPOM: Coarse particulate organic material) at sample sites on the East and North Forks.

organic material entering the stream carried by overland flow are not reflected by the maximum concentration being transported through the system due to time lags between concentration peaks, runoff peaks, and collections. Bilby and Likens (1978) found that maximum FPOM concentrations occurred before peak discharge and then dropped rapidly. In addition, they found that the length of time between runoff events also affected concentrations measured. Because samples were taken at fixed intervals of time throughout the study, it is doubtful if collections were taken the rising limb of the storm hydrograph. It is therefore doubtful that concentrations of organic matter were measured when they were at their highest concentration. On both East and North Forks in mid-July at the onset of high flow events, when initial standing stocks of terrestrial organic materials stored in dry channels and adjacent to the stream was high (N.J. Hoefs, personal observation), peaks in organic concentrations measured in the stream were greater than subsequently measured in August and September.

The retention ability of arid streams is considered to be relative low, due to lack of physical retention devices (i.e., wood debris, backwaters, eddies, and rough bed materials). However, large quantities of terrestrially derived FPOM and CPOM was observed incorporated in sediments and trapped in backwaters and eddies immediately following high flow events (N.J. Hoefs, personal observations). After the initial increase in FPOM during mid-summer at both the lower East and North Fork sites a relative slow incremental decrease in FPOM concentrations were measured throughout August, indicating a slow release of retained FPOM. The same trend was also evident of CPOM at NF12. CPOM retention was much less, as indicated by the much quicker decrease in concentrations measured over time. The majority of the CPOM observed during this time was relatively buoyant and, as a result, less readily retained.

Biotic Components

Benthic Macroinvertebrates Communities

Benthic habitats

Benthic macroinvertebrate community collections were made in the two prominent habitats at each of the sites, with the exception of NF34 and EF192 where only one habitat predominated. At NF34 and EF192 the benthic habitat identified for collecting macroinvertebrate communities was classified as coarse gravel (16-32mm). Two habitats, both in "fine" and "coarse" substrates were identified and sampled at the third order sites on both the North Fork (NF30 and 27) and East Fork (EF187). The "fine" habitat was classified as a mixture of coarse and very coarse gravel (32-64mm) and the "coarse" habitat sampled was dominated primarily by small cobble (64-250mm) mixed with very coarse gravel and a few small boulders (250-500mm). The other third order site on the East Fork, EF176, was not typical of the other three third order sites. Initially only a "fine" substrate was sampled characterized by a mixture of medium (8-16mm) and coarse gravel, however, with changing flow conditions an additional "coarse" sample resembling the other third order sites was also periodically sampled. In general, at these sites, "fine" benthic habitats samples were predominantly coarse gravel, while "coarse" habitats included a mixture comprised primarily of small cobbles interspersed with various size classes of gravel.

Habitats defined as "fine" and "coarse" at the sites at EF161, EF157, NF14, and NF12 were not comparable to those in the upper catchments (EF192, EF187, EF176, NF34, NF30, NF27). "Fine" substrates were composed primarily of mixtures of gravel, however, more sand (≥2mm), and a few cobbles (64-250mm) were included. The "coarse" habitat samples were taken from areas primarily of cobbles and small boulders with sand comprising the majority of the interstitial material. The substrates at the lower sites became inundated with sand mid-July. After a period

of time, at the East Fork sites, the underlying substrates were re-exposed and samples reflect recolonization of the original substrates types. The substrates at the North Fork sites, however, were never completely excavated. The samples taken after mid-July are from isolated boulder islands (≥500mm) surrounded by unstable sands.

Community Structure

Eight-six taxa of aquatic insects and 96 total invertebrate taxa were identified in community collections from the East and North Forks from May to October, 1987 (Table 5). The aquatic insect taxa collected were highly diverse covering the major orders of aquatic insects. These numbers are an underestimation of the actual number of taxa present because of the large number of taxa that could not be identified to species, primarily in the dipteran family Chironomidae and also we quantitatively sampled the predominant habitats and did not exhaustively examine all possible habitats. Taxa richness found in both the East and North Forks, however, is comparable to other arid stream systems (Gray 1980).

Taxa richness and density of the macroinvertebrate communities collected from the East and North Forks revealed several trends (Figures 6-15). On the East Fork with the exception of EF187, the number of taxa found at the sites rarely exceeded 15, whereas in the upper North Fork sites NF34, NF30, and NF27, taxa richness commonly reached 20. Numbers found at the lower North Fork sites (NF14, and NF12) were comparable to numbers found at the lower East Fork sites (EF161 and EF157).

In addition, during the majority of the collection periods, taxa richness and densities of individuals from the coarse benthic habitats were higher than that found in fine habitats. Coarse habitats were comprised of a greater diversity of substrate materials, with composites of

Table 5. Benthic macroinvertebrate taxa from the East and North Forks of the Virgin River.

- ARTHROPODA
  - ARACHNIDA
    - ACARINA
      - HYDRACARINA
  - CRUSTACEA
    - AMPHIPODA
      - TALITRIDAE
        - *Hyalella azteca*
    - ISOPODA
      - ASELLIDAE
        - *Asellus sp.*
    - OSTRACODA
  - INSECTA
    - COLEOPTERA
      - CURCULIONIDAE
        - *Stenopelmus sp.*
      - DRYOPIDAE
        - *Helichus sp. A*
      - DYTISCIDAE L
      - DYTISCIDAE A
        - *Agabus rectus A*
        - *Oreodytes sp. L*
      - ELMIDAE
        - *Cleptelmis ornata L*
        - *Cleptelmis ornata A*
        - *Heterelmis sp. L*
        - *Microcylloepus sp. L*
        - *Microcylloepus sp. A*
        - *Narpus sp. L*
        - *Optioservus sp. L*
        - *Optioservus sp. A*
        - *Ordobrevia sp. A*
        - *Zaitzevia parvula L*
      - HYDROPHILIDAE L
      - STAPHYLINIDAE
    - COLLEMBOLA
      - ENTOMOBRYIDAE
    - DIPTERA
      - ATHERICIDAE
        - *Atherix sp.*
      - CERATOPOGONIDAE
      - CERATOPOGONIDAE P
        - *Forcipomyia sp.*
      - CHIRONOMIDAE P
      - DIXIDAE
        - *Dixa sp.*
      - DOLICHOPODIDAE
      - EMPIDIDAE
      - EMPIDIDAE P
        - *Wiedemannia sp.*
      - EPHYDRIDAE
      - MUSCIDAE
        - *Limnophora sp.*
      - PSYCHODIDAE
      - SARCOPHAGIDAE
      - SIMULIIDAE
        - *Simulium sp.*
        - *Simulium sp. P*
      - STRATIOMYIDAE
        - *Caloparyphus sp.*
        - *Euparyphus sp.*
      - TABANIDAE
        - *Chrysops sp.*
        - *Tabanus sp.*

- INSECTA (cont.)
  - DIPTERA(cont.)
    - TANYDERIDAE
      - *Protanyderus sp.*
    - TIPULIDAE
    - TIPULIDAE P
      - *Dicranota sp.*
      - *Gonomyia sp.*
      - *Hesperoconopa sp.*
      - *Hexatoma sp.*
      - *Ormosia sp.*
      - *Pedicia sp.*
      - *Tipula sp.*
  - EPHEMEROPTERA
    - BAETIDAE
      - *Baetis insignificans*
      - *Baetis sp.*
      - *Baetis tricaudatus*
    - EPHEMERELLIDAE
      - *Drunella doddsi*
      - *Drunella grandis*
      - *Ephemerella sp.*
      - *Ephemerella inermis*
    - HEPTAGENIIDAE
      - *Epeorus sp.*
      - *Heptagenia sp.*
      - *Rhithrogena sp.*
    - LEPTOPHLEBIIDAE
      - *Paraleptophlebia sp.*
    - TRICORYTHIDAE
      - *Tricorythodes sp.*
      - *Tricorythodes minutus*
  - HEMIPTERA
    - GERRIDAE
      - *Metrobates sp.*
    - NAUCORIDAE
      - *Ambrysus sp.*
    - VELIIDAE
      - *Rhagovelia sp.*
  - LEPIDOPTERA
    - PYRALIDAE
      - *Petrophila sp.*
  - MEGALOPTERA
    - CORYDALIDAE
      - *Corydalus sp.*
  - ODONATA
    - COENAGRIONIDAE
      - *Argia sp.*
    - CORDULEGASTRIDAE
      - *Cordulegaster sp.*
  - PLECOPTERA
    - CAPNIIDAE
    - CHLOROPERLIDAE
      - *Suwallia sp.*
      - *Sweltsa sp.*
    - NEMOURIDAE
      - *Amphinemura sp.*
    - PERLIDAE
      - *Hesperoperla pacifica*
    - PERLODIDAE
      - *Isogenoides zionensis*
      - *Isogenoides elongatus*
      - *Isoperla sp.*

ARTHROPODA (cont.)
INSECTA (cont.)
PLECOPTERA (cont.)
PTERONARCYIDAE
Pteronarcella sp.
TAENIOPTERYGIDAE
Taeniopteryx sp.
TRICHOPTERA
BRACHYCENTRIDAE
Brachycentrus americanus
Micrasema sp.
GLOSSOSOMATIDAE
Glossosoma sp.
HELICOPSYCHIDAE
Helicopsyche borealis
HYDROPSYCHIDAE
Hydropsyche sp.
HYDROPTILIDAE
Hydroptila sp.
Leucotrichia sp.
Mayatrichia sp.
Neotrichia sp.
Ochrotrichia sp.
LEPIDOSTOMATIDAE
Lepidostoma sp.
LIMNEPHILIDAE
Hesperophylax magnus
Oligophlebodes sp.
Psychoglypha sp.
PHILOPOTAMIDAE
Wormaldia sp.
POLYCENTROPIDAE
Polycentropus sp.
PSYCHOMYIIDAE
Tinodes sp.
RHYACOPHILIDAE
Rhyacophila sp.
SERICOSTOMATIDAE
Gumaga griscola

ANNELIDA
HIRUDINEA (6)
RHYNCHOBDELLIDA
GLOSSIPHONIIDAE
Helobdella stagnalis
PISCICOLIDAE
Myzobdella lugubris

MOLLUSCA
GASTROPODA
PULMONATA
LYMNAEIDAE
PHYSIDAE
Physa sp. (2)
PELECYPODA
SPHAERIIDAE (2)

NEMATOMORPHA

L = Larvae, P = Pupae, A = Adults

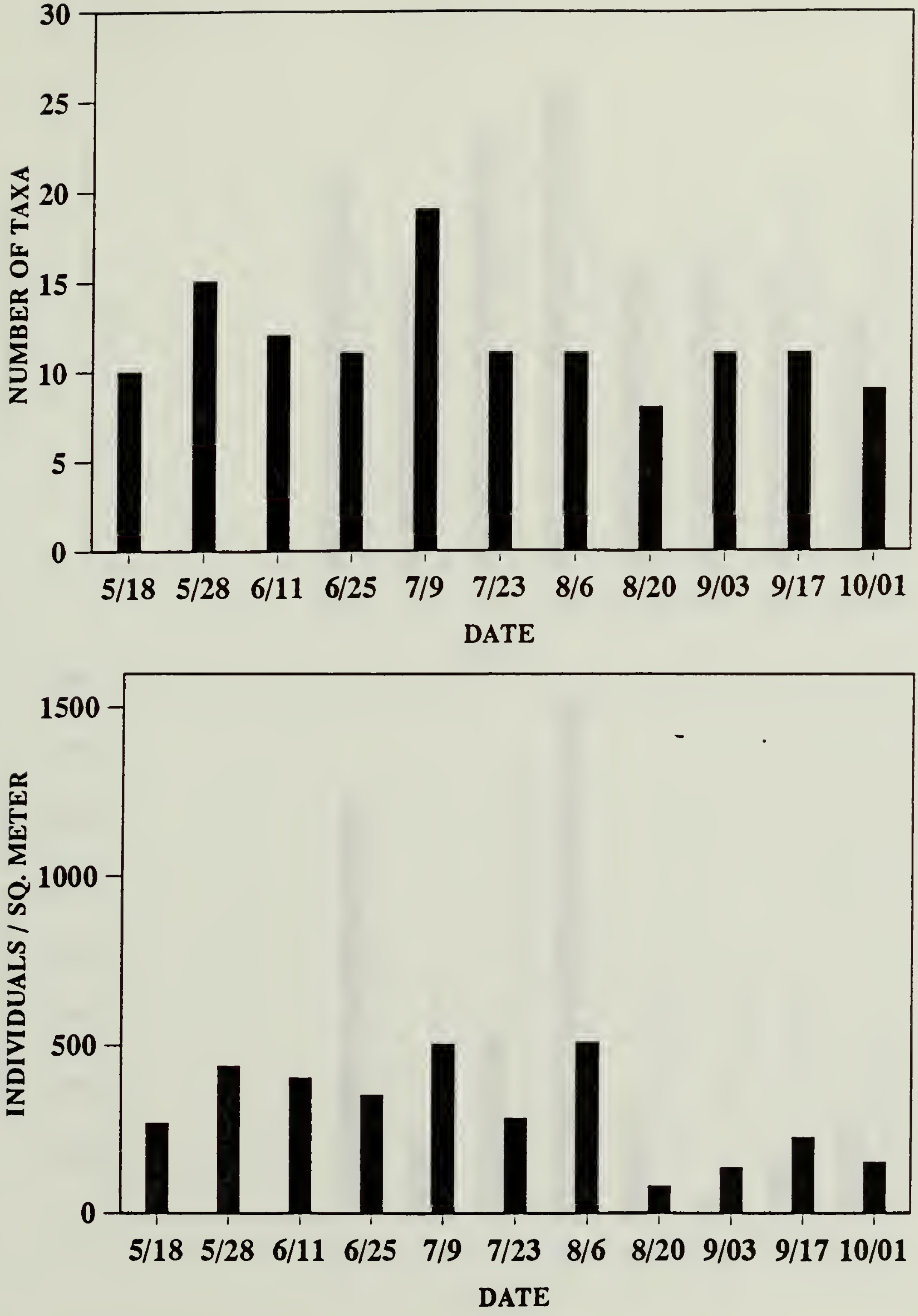


Figure 6. Taxa richness and density (individuals/sq. meter) of invertebrate sampled at EF 192 for each sample periods.

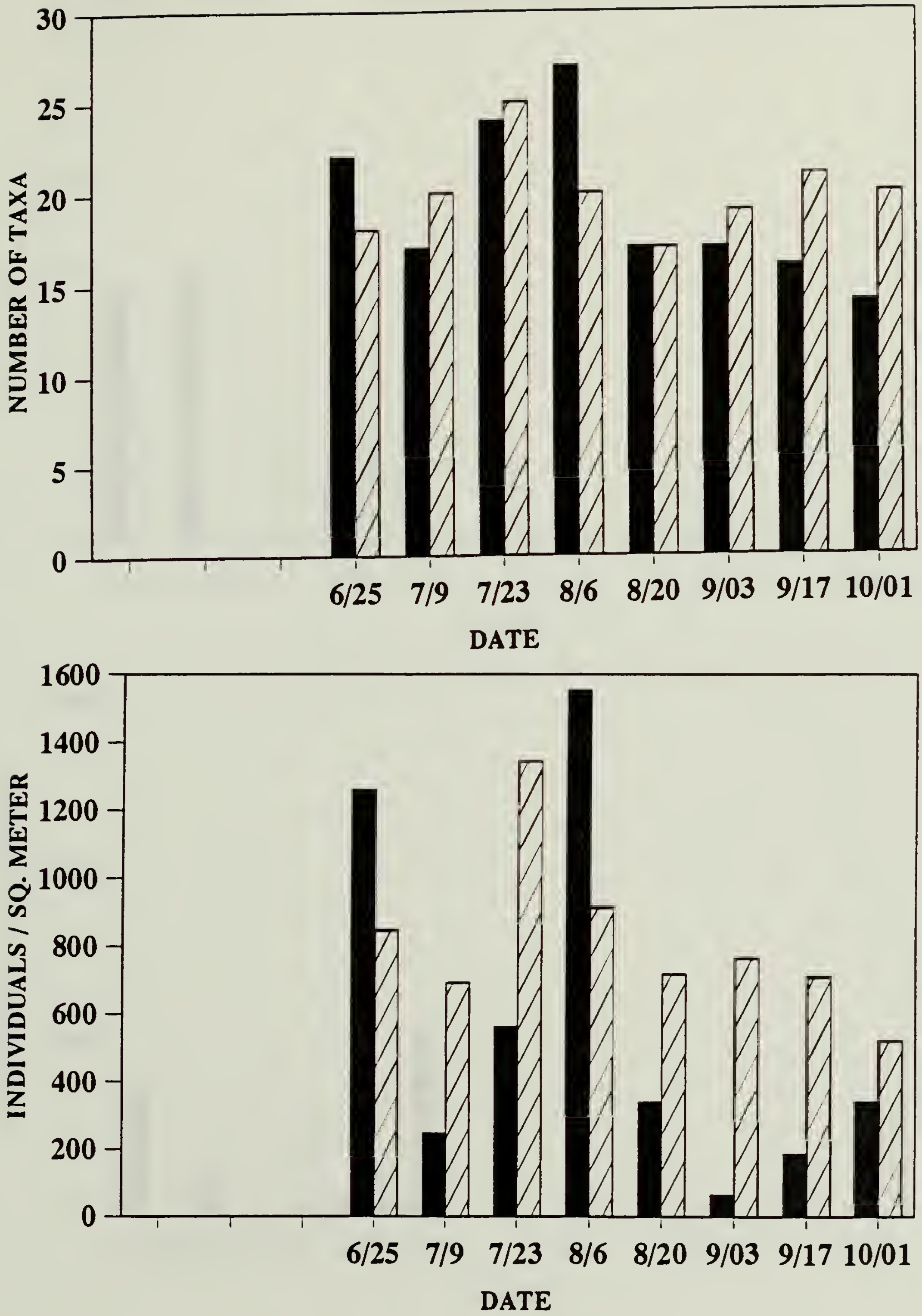
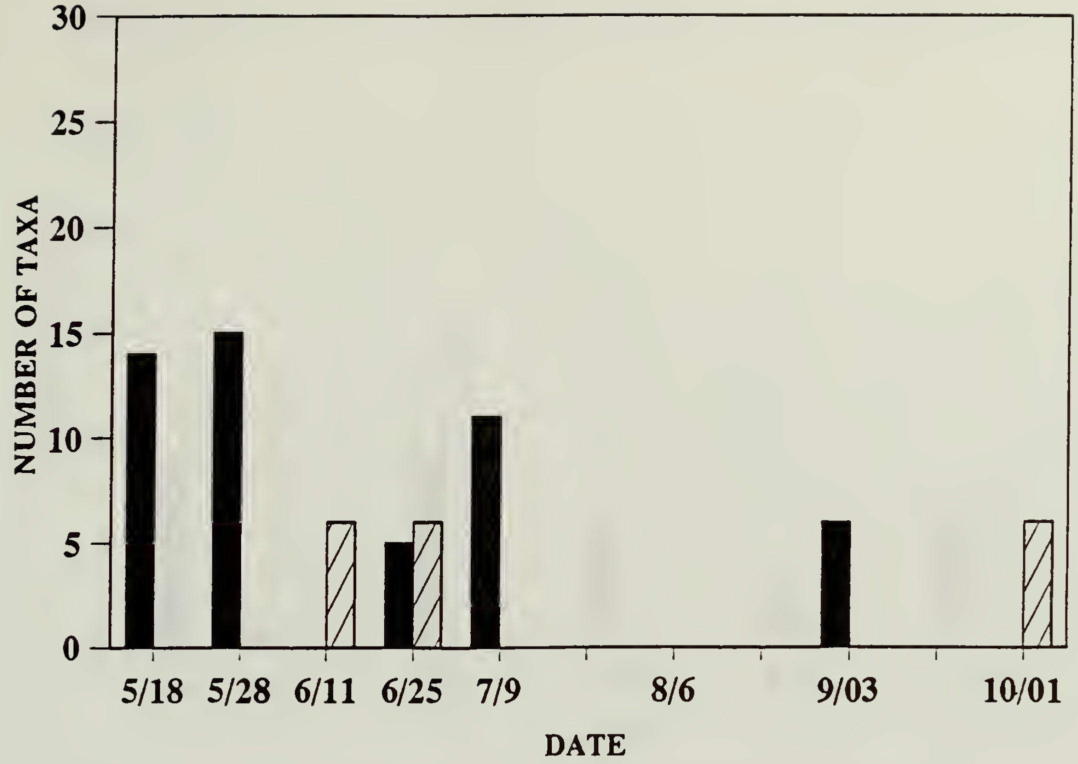


Figure 7. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at EF 187 for each sample periods. Communities collected in "fine" benthic habitat, are indicated by black bars, communities collected in "coarse" habitat are indicated by hatched bars (see text for definition of habitats).



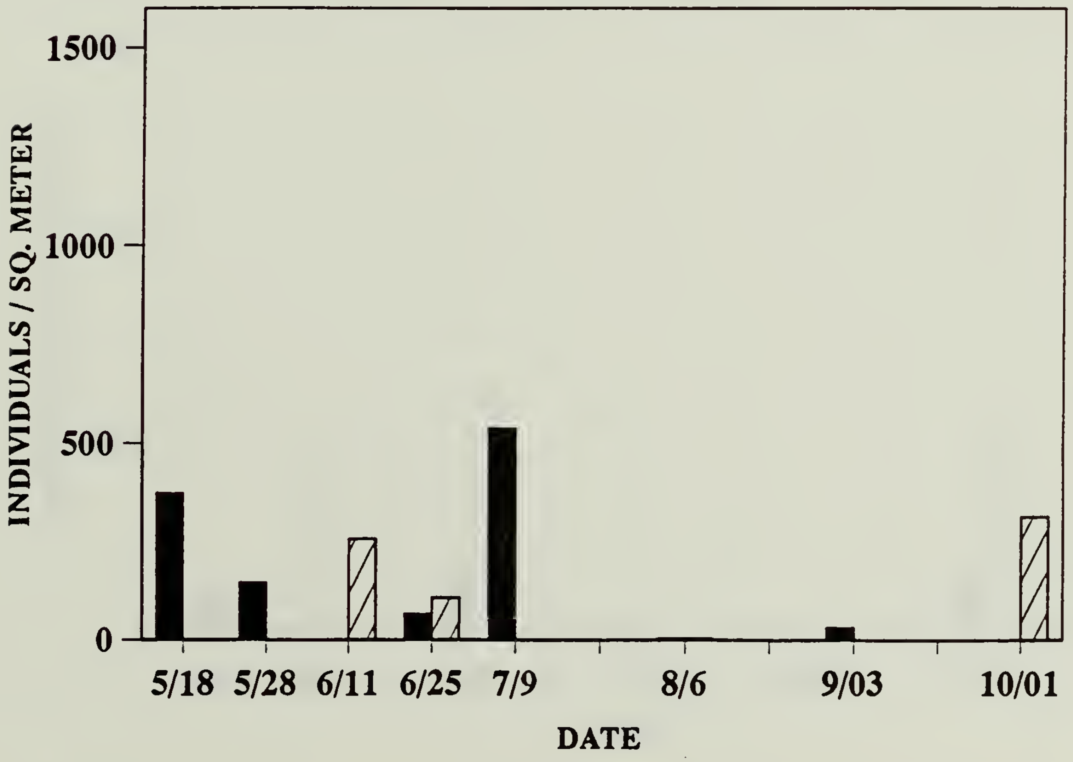


Figure 8. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at EF 176 for each sample periods. Communities collected in "fine" benthic habitat, are indicated by black bars, communities collected in "coarse" habitat are indicated by hatched bars (see text for definition of habitats). No invertebrates were found in August 6 samples.

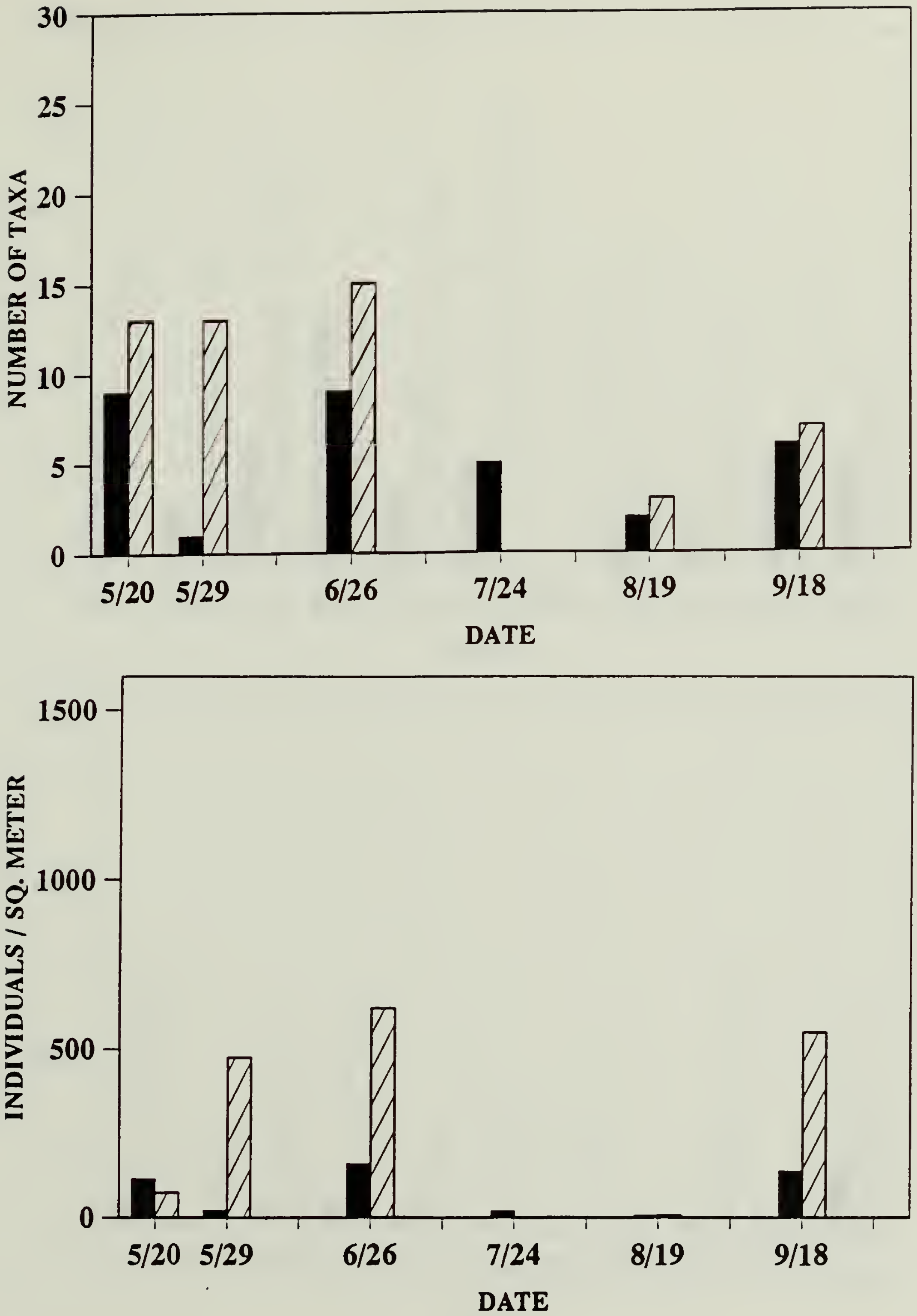


Figure 9. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at EF 161 for each sample periods. Communities collected in "fine" benthic habitat, are indicated by black bars, communities collected in "coarse" habitat are indicated by hatched bars (see text for definition of habitats).

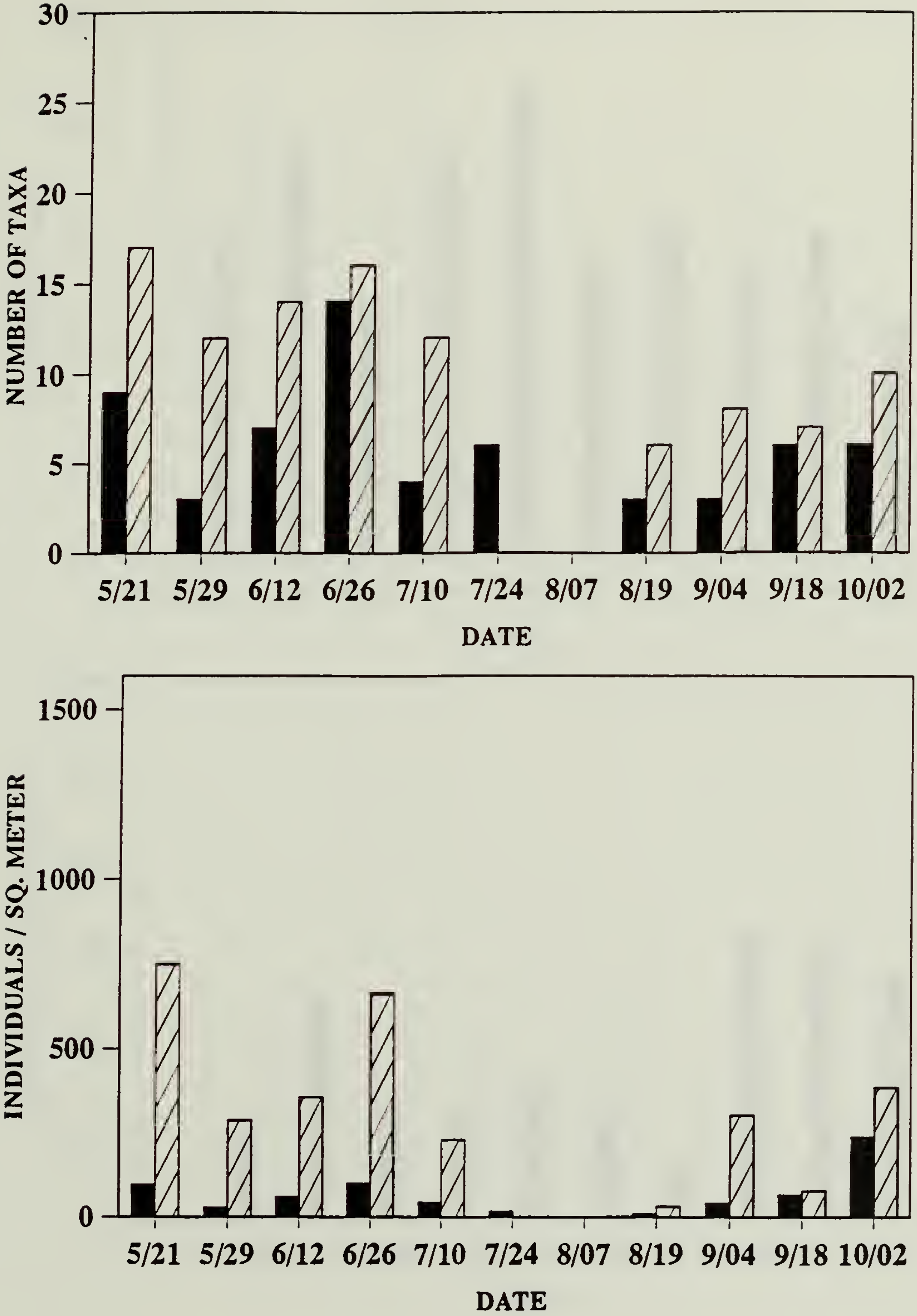


Figure 10. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at EF 157 for each sample periods. Communities collected in "fine" benthic habitat, are indicated by black bars, communities collected in "coarse" habitat are indicated by hatched bars (see text for definition of habitats). No invertebrates were found in August 7 samples.

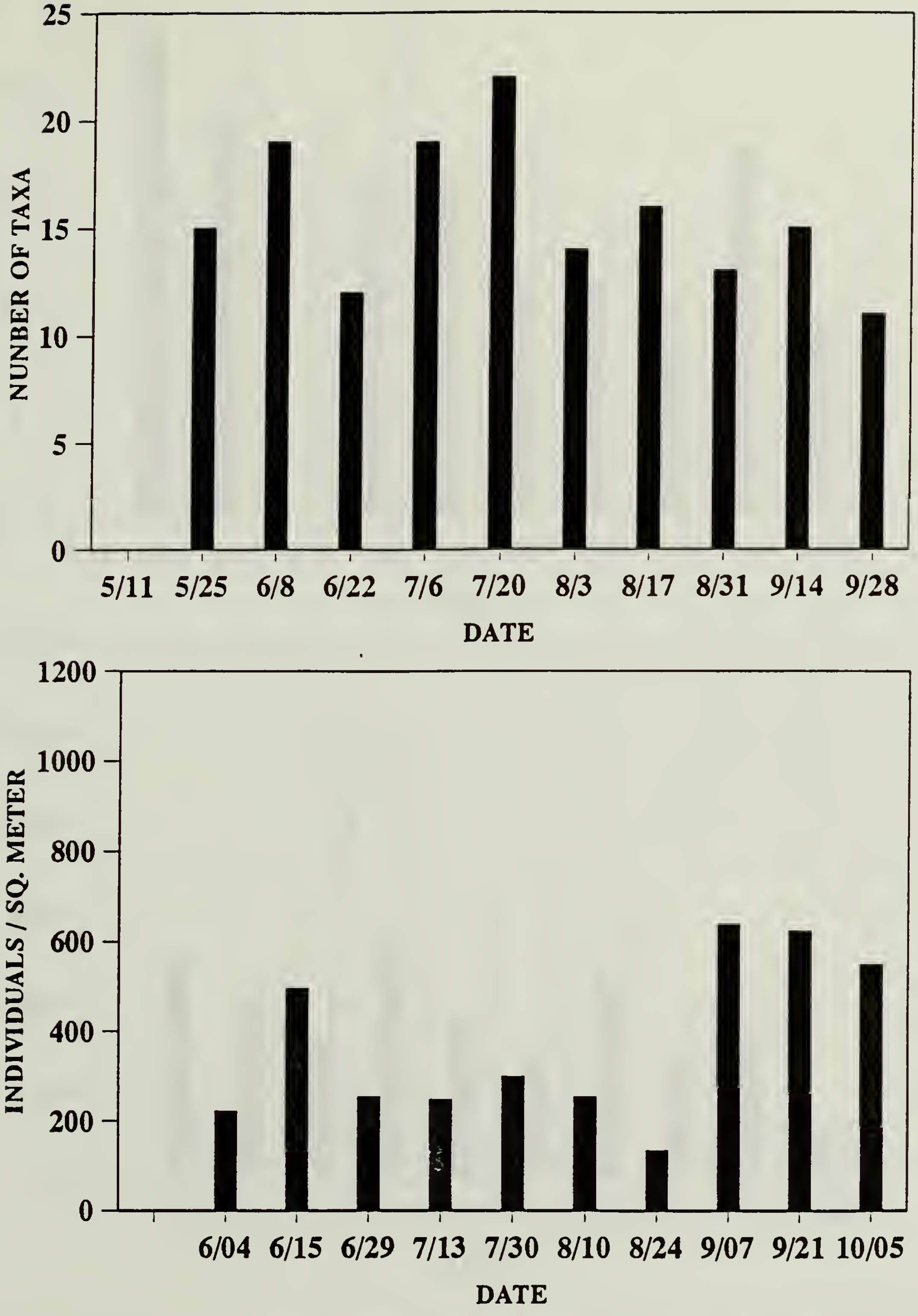


Figure 11. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at NF 34 for each sample periods.

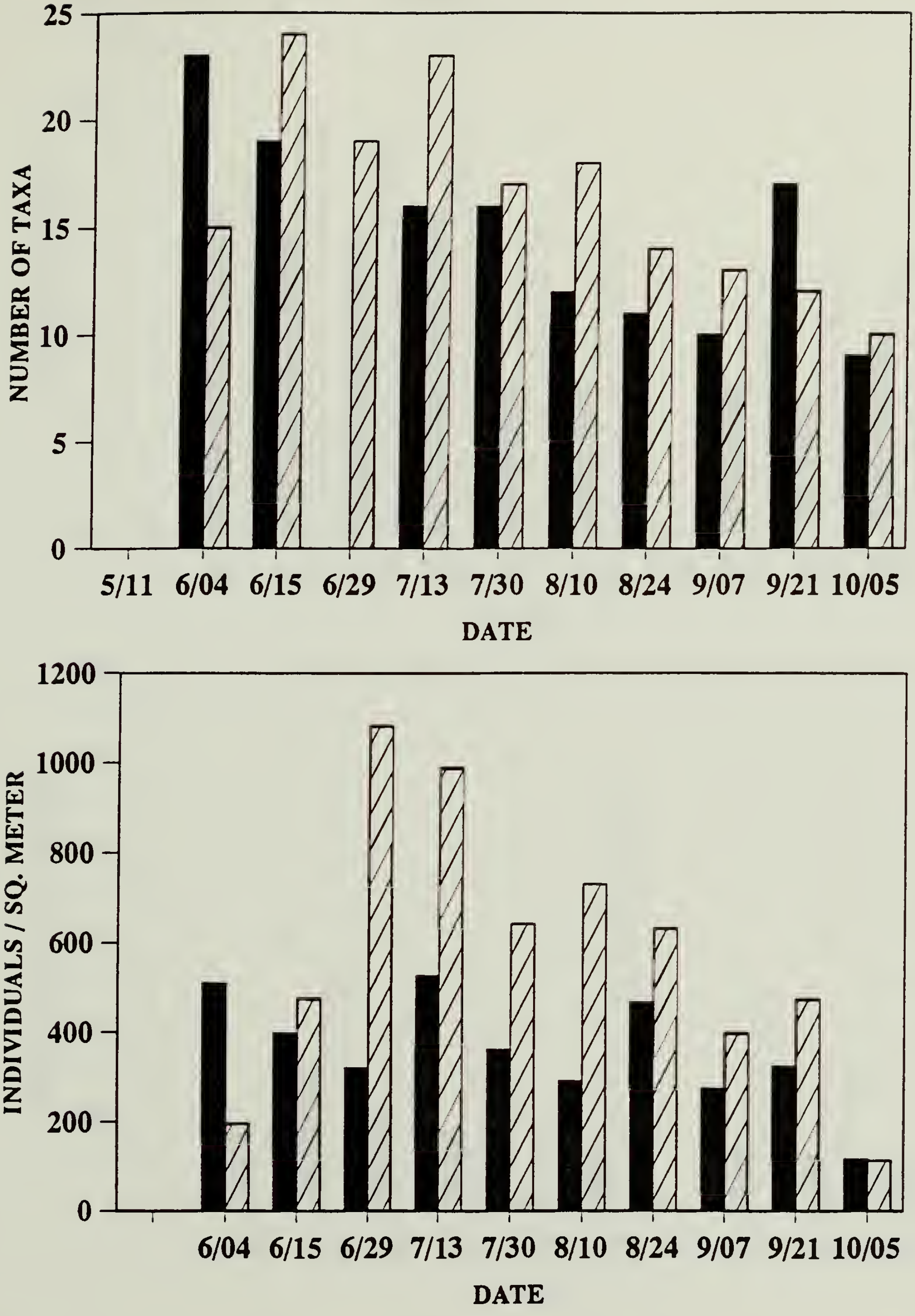


Figure 12. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at NF 30 for each sample periods. Communities collected in "fine" benthic habitat, are indicated by black bars, communities collected in "coarse" habitat are indicated by hatched bars (see text for definition of habitats).

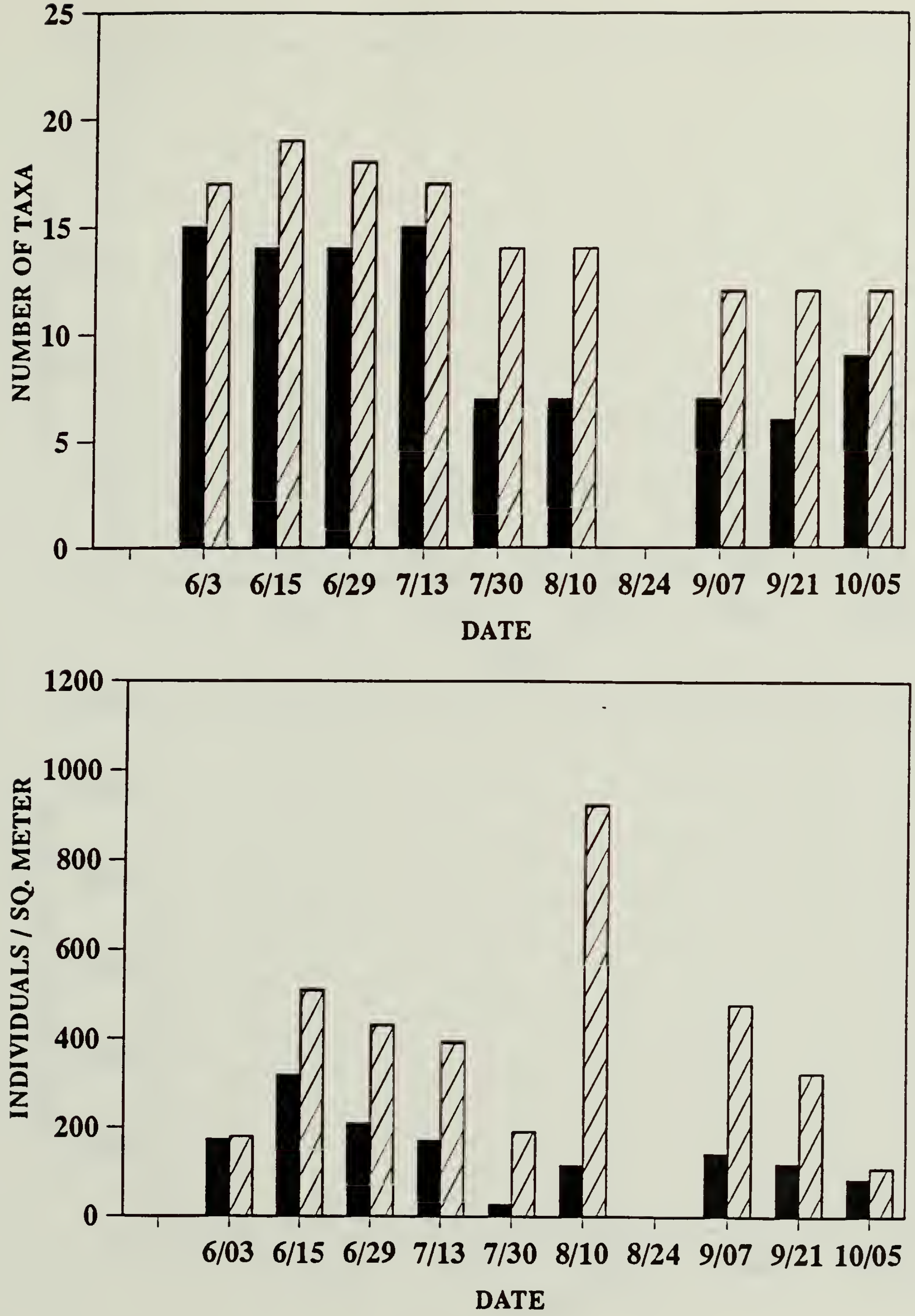


Figure 13. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at NF 27 for each sample periods. Communities collected in "fine" benthic habitat, are indicated by black bars, communities collected in "coarse" habitat are indicated by hatched bars (see text for definition of habitats). No invertebrates were found in August 24 samples.

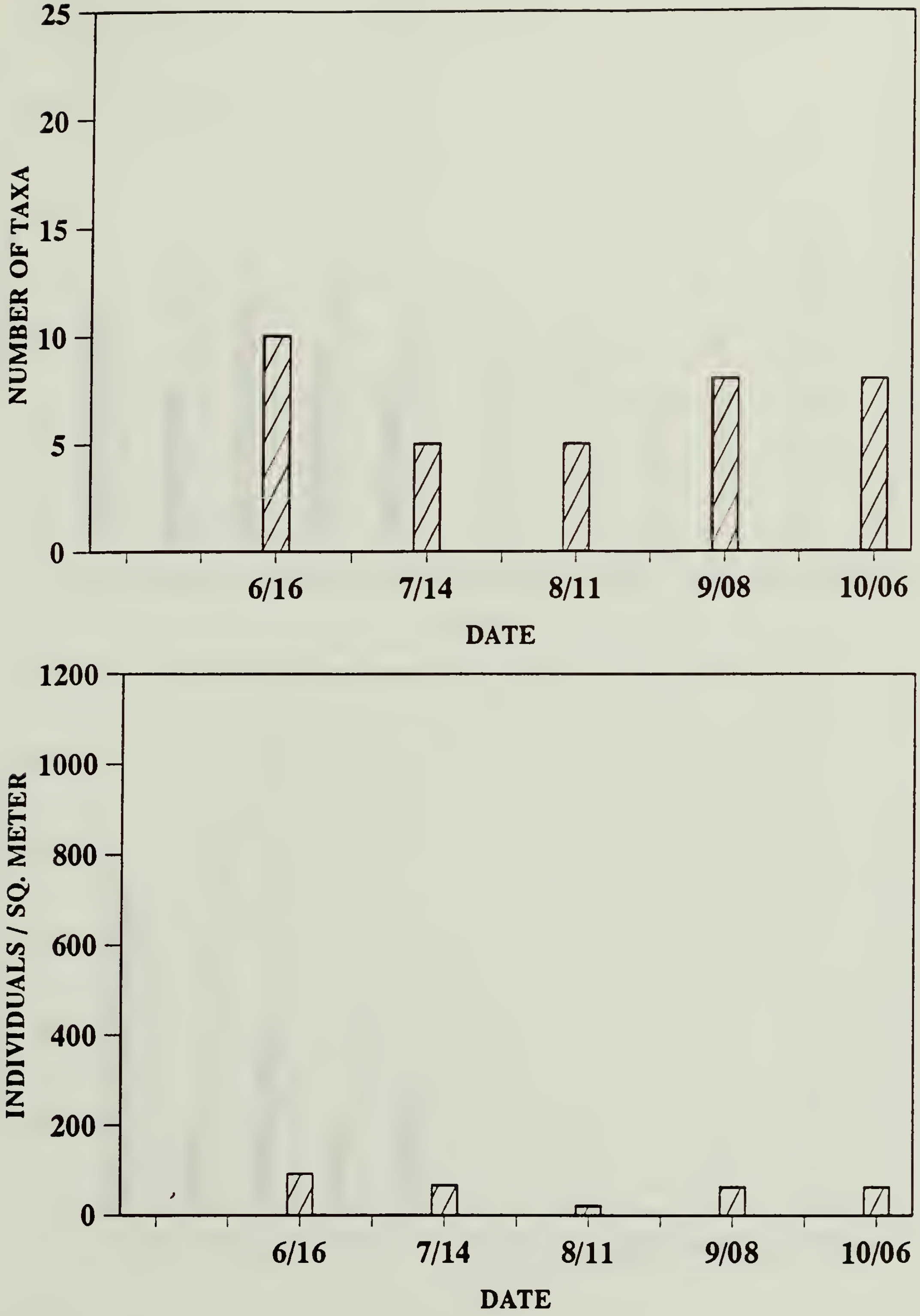


Figure 14. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at NF 14 for each sample periods. Communities collected communities collected in "coarse" habitat are indicated by hatched bars (see text for definition of habitat).

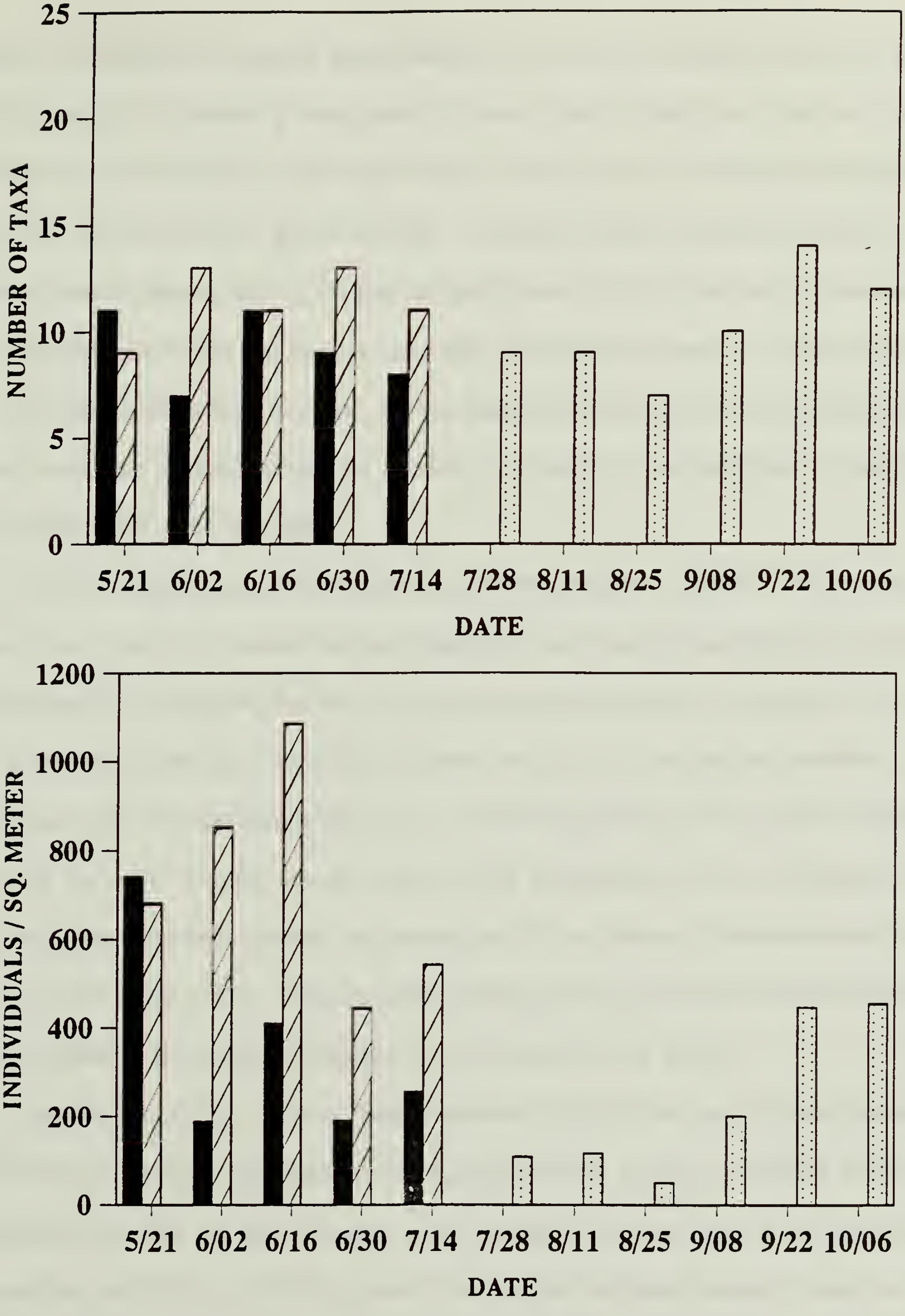


Figure 15. Taxa richness and density (individuals/sq. meter) of invertebrates sampled at NF12 for each sample periods. Communities collected in "fine" benthic habitat, are indicated by black bars, communities collected in "coarse" habitat are indicated by hatched bars. Dotted bars indicate the predominant habitat type found after deposition of sand material (see text for definition of habitats).

boulders, cobbles with interstitial areas mixtures of various size classes of sand and gravel, than the fine samples, generally a homogenous coarse gravel at the upper sites and sand/gravel mixtures at the lower sites. At the upper sites, however, some of the highest measurements of taxa were found in the finer gravel habitats. In general, both the highest numbers of taxa and densities were observed during the first sampling period in July, after which decreases in both were associated with site disturbance associated with high flow events. Trends in both habitats were generally comparable, however, the invertebrates sampled from finer substrates appeared more susceptible to disturbance. As a result, community trends reflected in these habitats in some cases were more dramatic.

At EF192 (Figure 6) both taxa richness and densities were highest in the sampling period in early July. During the second sampling period in July a partial redistribution and scouring of the bed material (comprised primarily of coarse gravel) was observed. A decrease in invertebrate taxa and density were also apparent, however, recovery of invertebrate densities to previous levels was found the next sampling period. A second high flow event was noted during the last sampling period in August, during which all the substrates within the sampling area were disturbed. Densities were severely depressed and did not recover to previous levels throughout the rest of the study period. Taxa richness, although slightly reduced directly after high flows, did not appear to be as greatly affected by the disturbance as density.

Substrates at EF187 were not directly affected by high flows over the study period (Figure 7). There was no visible disruption in the substrate noted, however, changes in the degree of embeddedness over the study period were observed. During high flows (as indicated by disturbances at EF192 and EF176) prior to the second sampling period in July the degree of embeddedness decreased, dropping from approximately 25 percent to less than 5 percent. Invertebrate taxa richness and densities at this time, and the sampling period following were the

highest found at this site. Density of invertebrates were twice that of the other East Fork sites. In August and September an increase in degree of embeddedness again was observed (reported exceeding 75 percent) and during the last sampling period it was noted that many of the gravel substrates were totally (100%) embedded with fine materials, primarily clays and silts. Some decrease in taxa richness and substantial decreases in densities primarily in the finer substrates were found.

Invertebrates at EF176 were lower than at the other East Fork sites (Figure 8). In August after a high flow event (debris and water marks were measured up to 1.5 m above the stream bank) which greatly altered channel morphology and disturbed the substrates, no invertebrates were found. Taxa richness the following sampling period had recovered to previous levels and by October densities reached previous levels. In general, recovery of taxa richness to previous levels was more rapid than density.

At the lower East Fork sites, EF161 and EF157, (Figures 9 and 10) densities and taxa richness in the fine substrate sampled, primarily sand and gravel, initially were lower than found in the coarse substrate sampled. Sand substrates, due to its homogeneity and instability, support fewer taxa at much lower densities (Hynes 1970). Densities of the invertebrate communities at these sites showed reductions that could be attributed to high flows. Taxa richness and densities decreased after the second sampling period in July at both sites. Even though both taxa richness and densities recovered somewhat after high flow events, taxa richness at these sites did not return to previous levels. In addition, recovery was much quicker in the coarser substrates sampled.

Trends observed in invertebrate richness and densities, in the North Fork were very similar to those observed in the East Fork. At the upper North Fork sites, NF34 and NF27, (Figures 11 and 13) reduction in invertebrate densities reflected substrate disturbance associated with high

flow events. Taxa richness was also decreased in many cases, however, not as dramatically as densities. In contrast to the East Fork, many of the high flow events only disturbed the finer substrates or patches of substrates, as a result, the degree and rates of recovery varied. The substrate at site NF30 was less distrubed due to the width of the canyon which allowed flood waters to spread. When sites were only partially disturbed, recovery rates were much faster with recolonization as a result of migration or drift from adjacent unaffected substrates. However, reductions in densities in some cases were dramatic, for example, at NF27, reductions of invertebrates in fine bed materials exceeded 75 percent. Brooks and Boulton (1991) determined that experimental disturbance reduced up to 83% of the taxa and 97% of the density of individuals in a stream. Recolonization time was dependent on the size and/or patchiness of the area disturbed. Fisher (1986) estimated that recolonization time for macroinvertebrates in Sycamore Creek was at least four weeks after significant flood induced disturbance.

NF14 had lower densities and fewer taxa than the other North Fork site (Figure 14). This simplification of the benthic macroinvertebrate community could not directly be attributed to high flow events. However, this site was located in the narrowest reach of the river completely bounded by rock walls. There are three aspects of this site that make it different than the other sites. First, the river is physically constrained by the Narrows which consists of sandstone cliffs up to one hundred meters high which focus the force of the water through the narrow canyon. As a result, a small increase in flow could potentially produce a major disruption of the benthic habitat. Secondly, due to the high degree of shading primary production may be limited, and third, this area of the river is subject to a high frequency of physical disturbance due to hikers through the Narrows.

At NF12 (Figure 15) fluctuations in the invertebrate densities and taxa could be directly attributed to alteration of bed materials associated with high flows. During the second sampling

period in July a dramatic change in substrate and invertebrate densities were found. The fine substrate sampled (mixture of various size classes of gravel) and the coarse substrate (primarily boulders) were replaced by sand that had been transported into the site during high flows in mid-July. The number of taxa was only slightly reduced by the substrate change, however, densities were drastically reduced and did not recover until late September with the re-emergence of the boulder substrates.

Functional Feeding Group Analysis

Analysis of the feeding groups of the benthic invertebrates before and after the onset of the summer rainfall runoff events in mid-July provided additional insight of the factors affecting the invertebrate communities in the East and North Forks (Figures 16- 25). The functional feeding group composition at EF192 was comprised primarily of collector-gatherers and collector-filterers (Figure 16). Proportion of filterers and gatherers within the community changed after mid-July. The percentage of filterers decreased from 22 to 8 percent and gatherers increased from 51 to 73 percent. As a whole, however, the percent of collectors (gatherers and filterers together) did not change dramatically. The proportion of the EF192 community comprised of shredders, did not exceed 10 percent. The percentage of shredders at EF192, was the highest observed on both the East and North Forks. After mid-July an increase in shredders was evident. Increased concentrations in CPOM were also measured at EF192 after mid-August associated with fall riparian leaf abscission. This increase in available allochthonous organic material may account for the increased percentage of shredders observed.

The functional group composition found at NF34 (Figure 21) was similar to that found at EF192. Collectors, primarily gatherers comprised the majority of the composition: the percentage of filterers found at NF34 was not as great as that found at EF192. Scrappers and

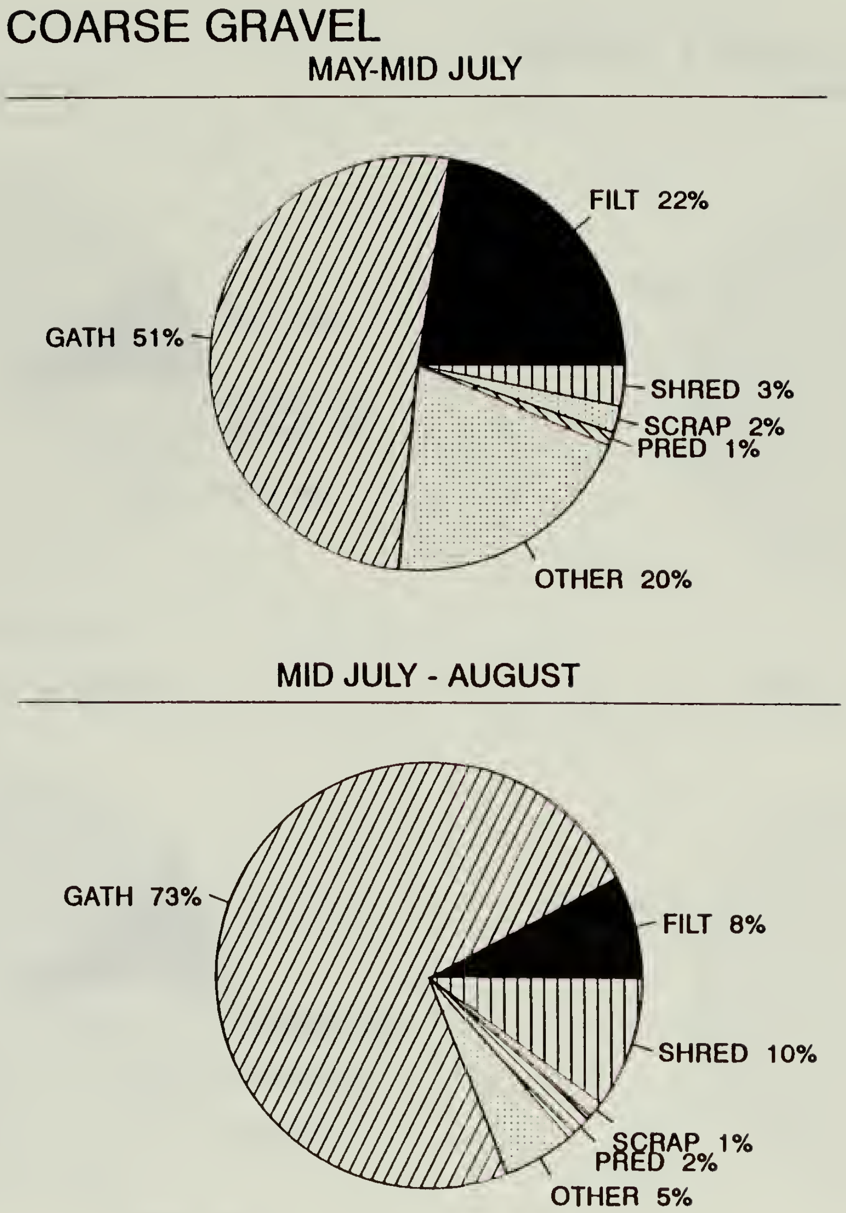


Figure 16. Feeding group analysis of benthic invertebrates before and after summer rainfall runoff events (Mid-July) at EF192 in the predominant benthic habitat.

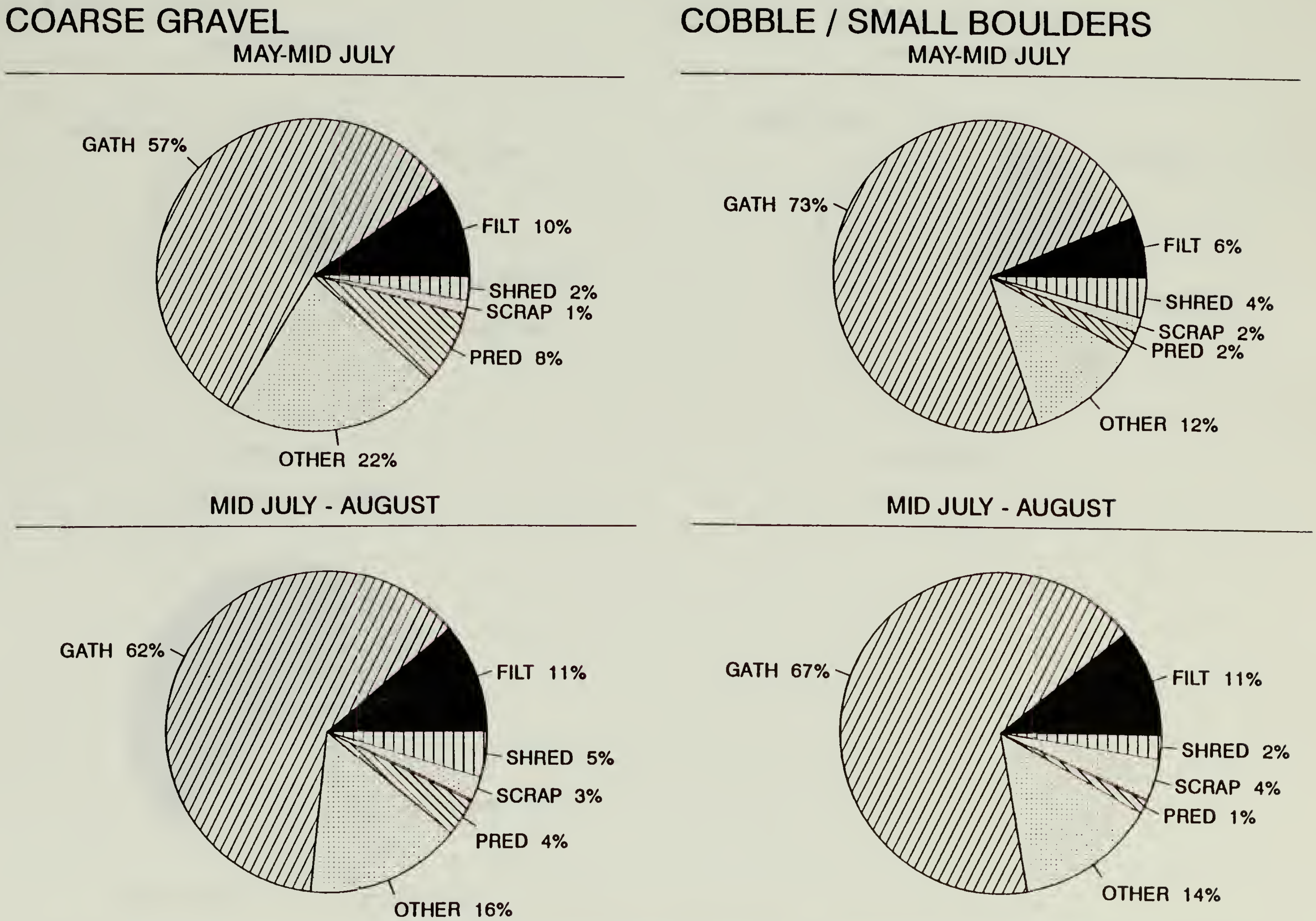


Figure 17. Feeding group analysis of benthic invertebrates collected from the predominant benthic habitats before and after summer rainfall runoff events (Mid-July) at EF187. (see text for description of benthic habitats).

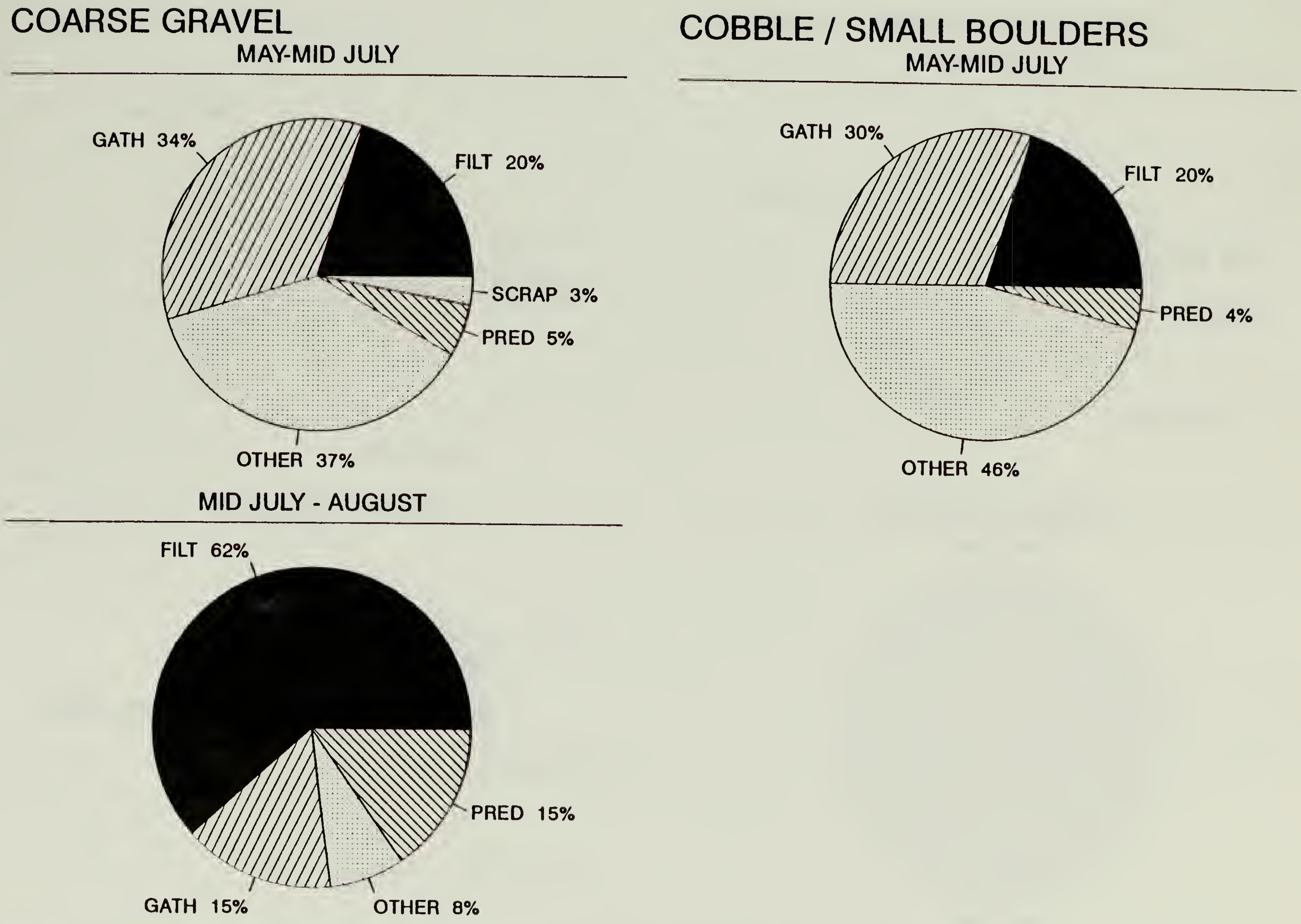


Figure 18. Feeding group analysis of benthic invertebrates collected from the predominant benthic habitat types before and after summer rainfall runoff events (Mid-July) at EF176. The cobble/boulder habitat after mid-July was not analyzed. (see text for description of benthic habitats).

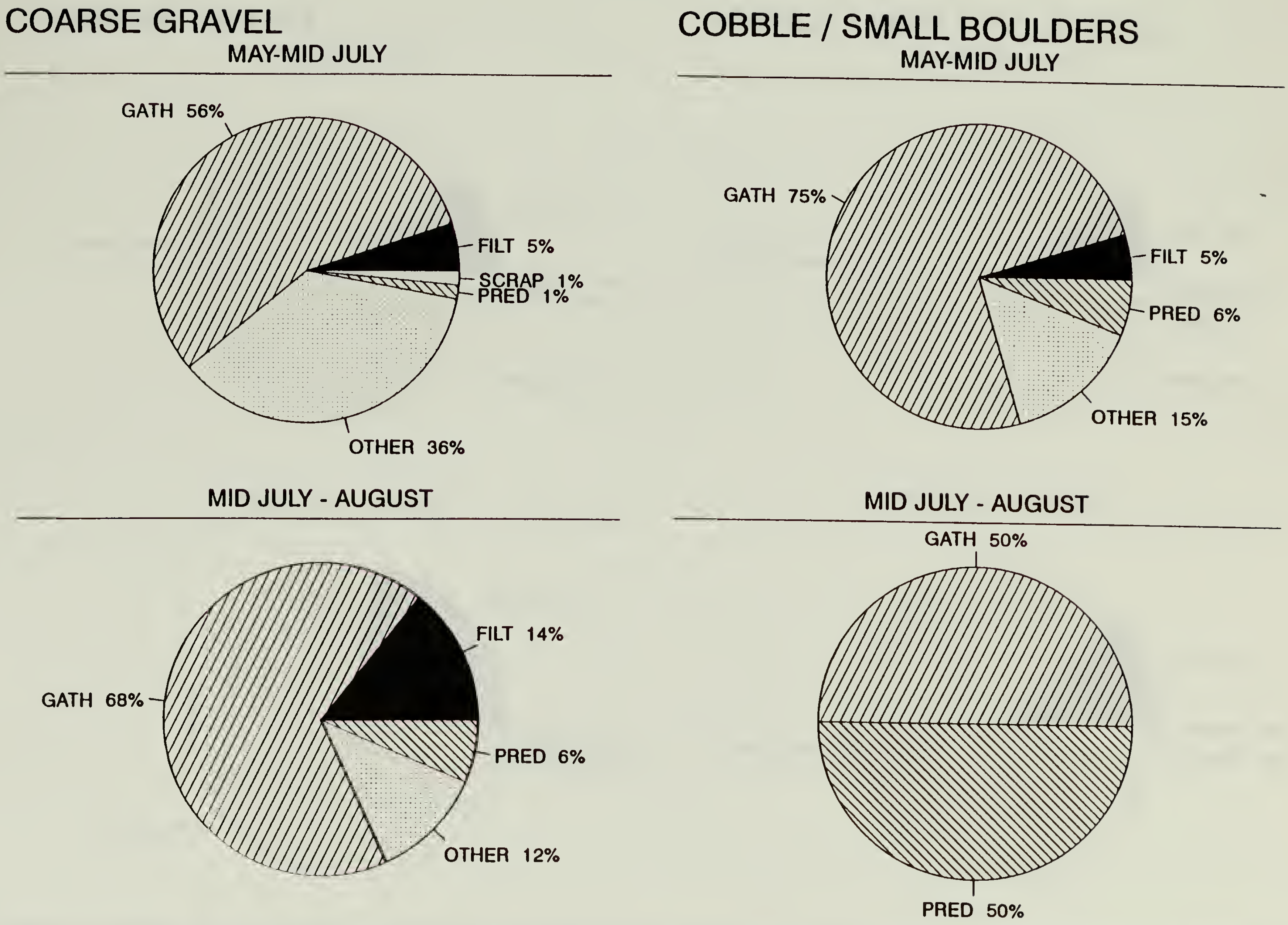


Figure 19. Feeding group analysis of benthic invertebrates collected from fine and coarse benthic habitat types before and after summer rainfall runoff events (Mid-July) at EF161. (See text for description of benthic habitats).

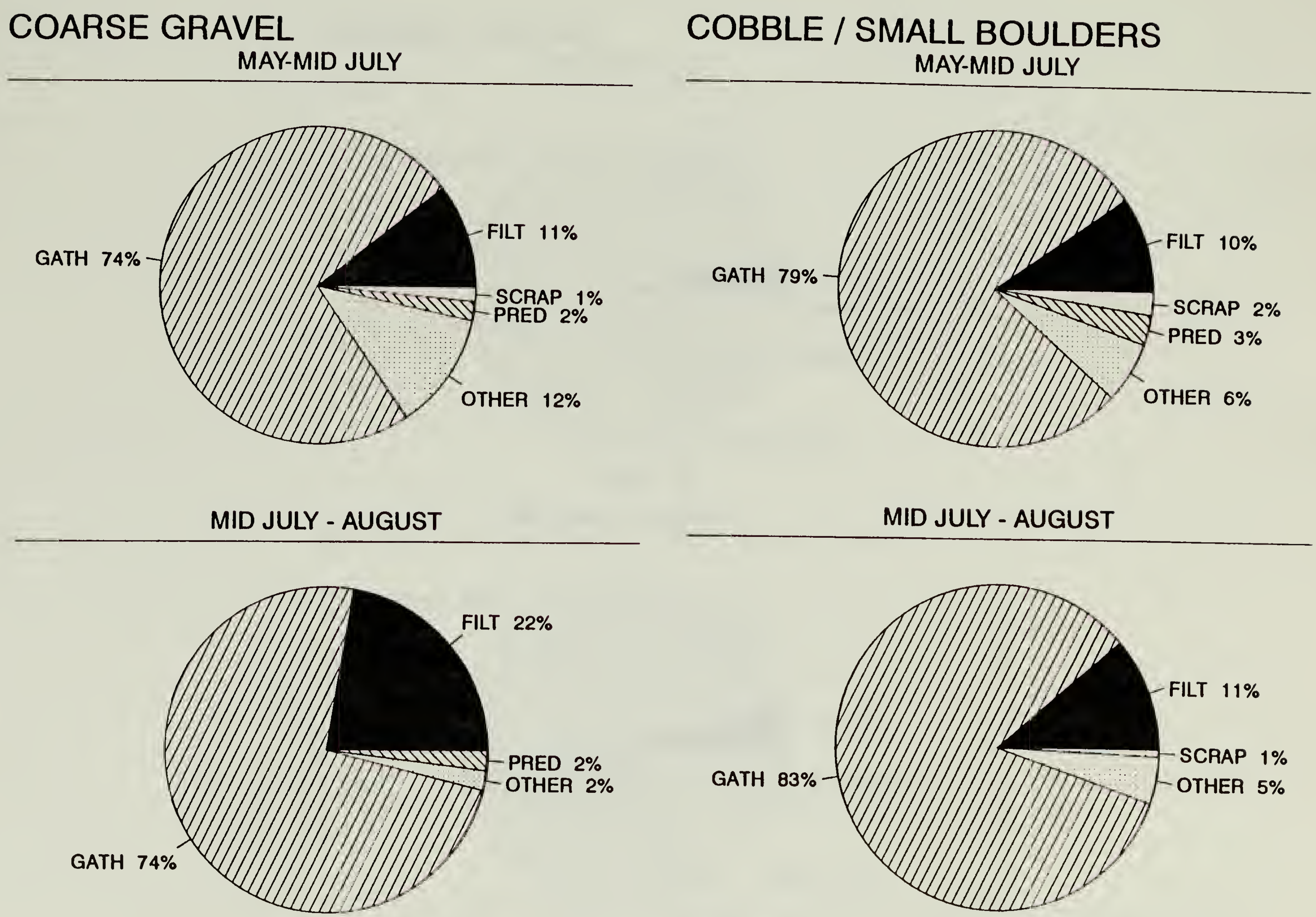


Figure 20. Feeding group analysis of benthic invertebrates collected from fine and coarse benthic habitat types before and after summer rainfall runoff events (Mid-July) at EF157. (See text for description of benthic habitats).

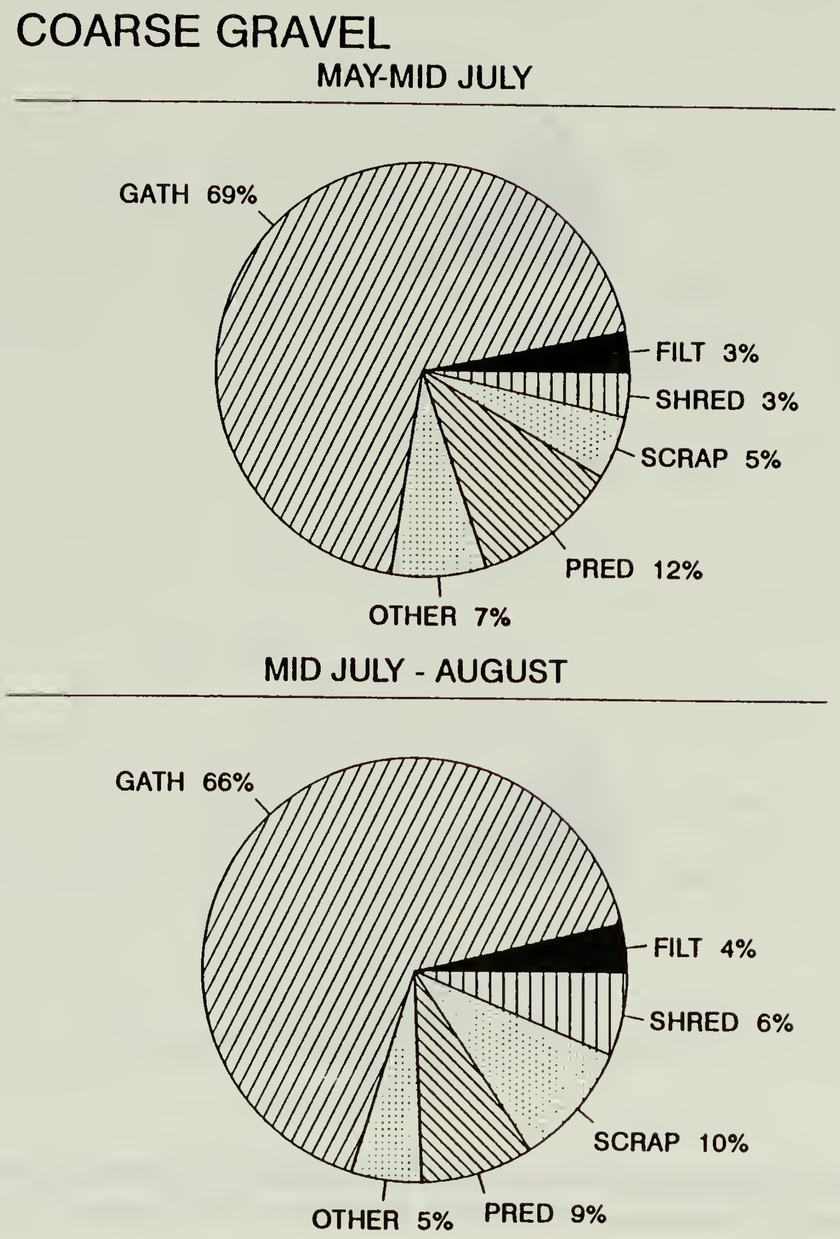


Figure 21. Feeding group analysis of benthic invertebrates before and after summer rainfall runoff events (Mid-July) at NF30 from the predominant benthic habitat.

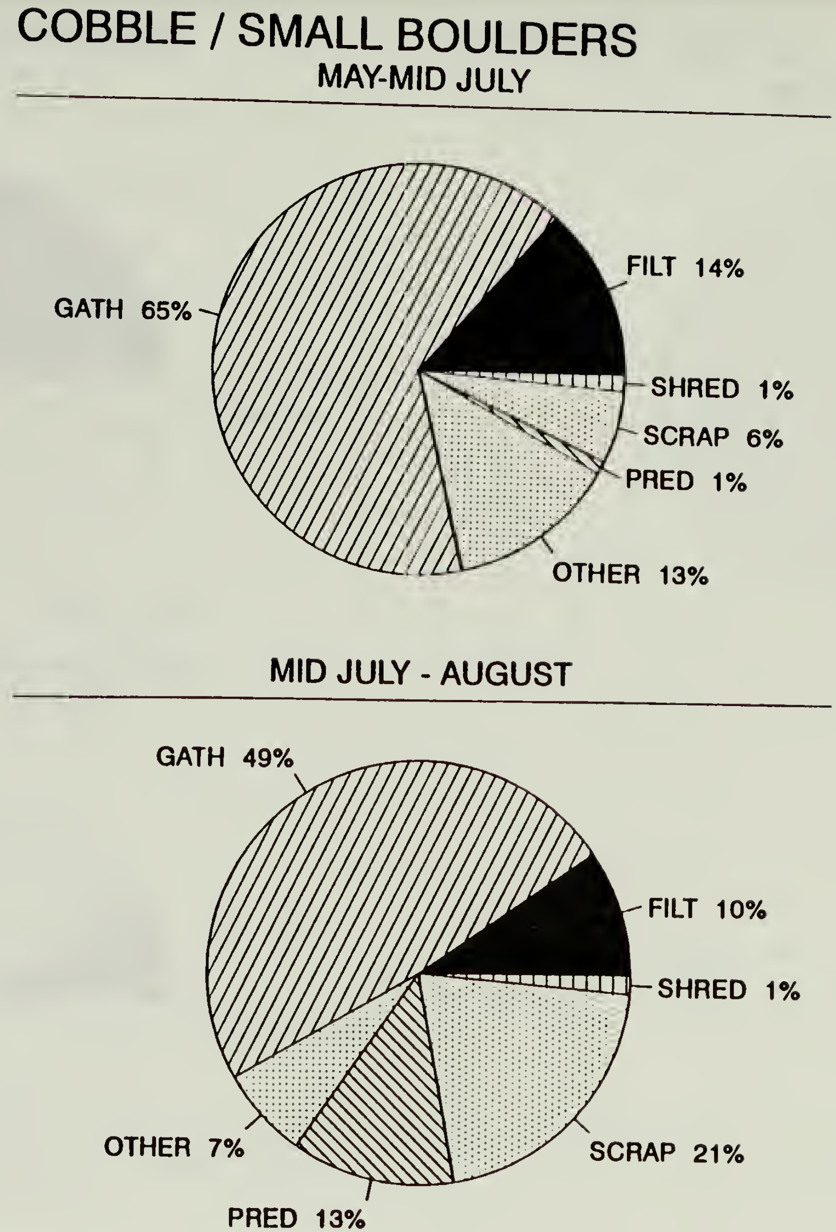


Figure 24. Feeding group analysis of benthic invertebrates collected from the predominant benthic habitat before and after summer rainfall runoff events (Mid-July) at NF14. (see text for description of benthic habitats).

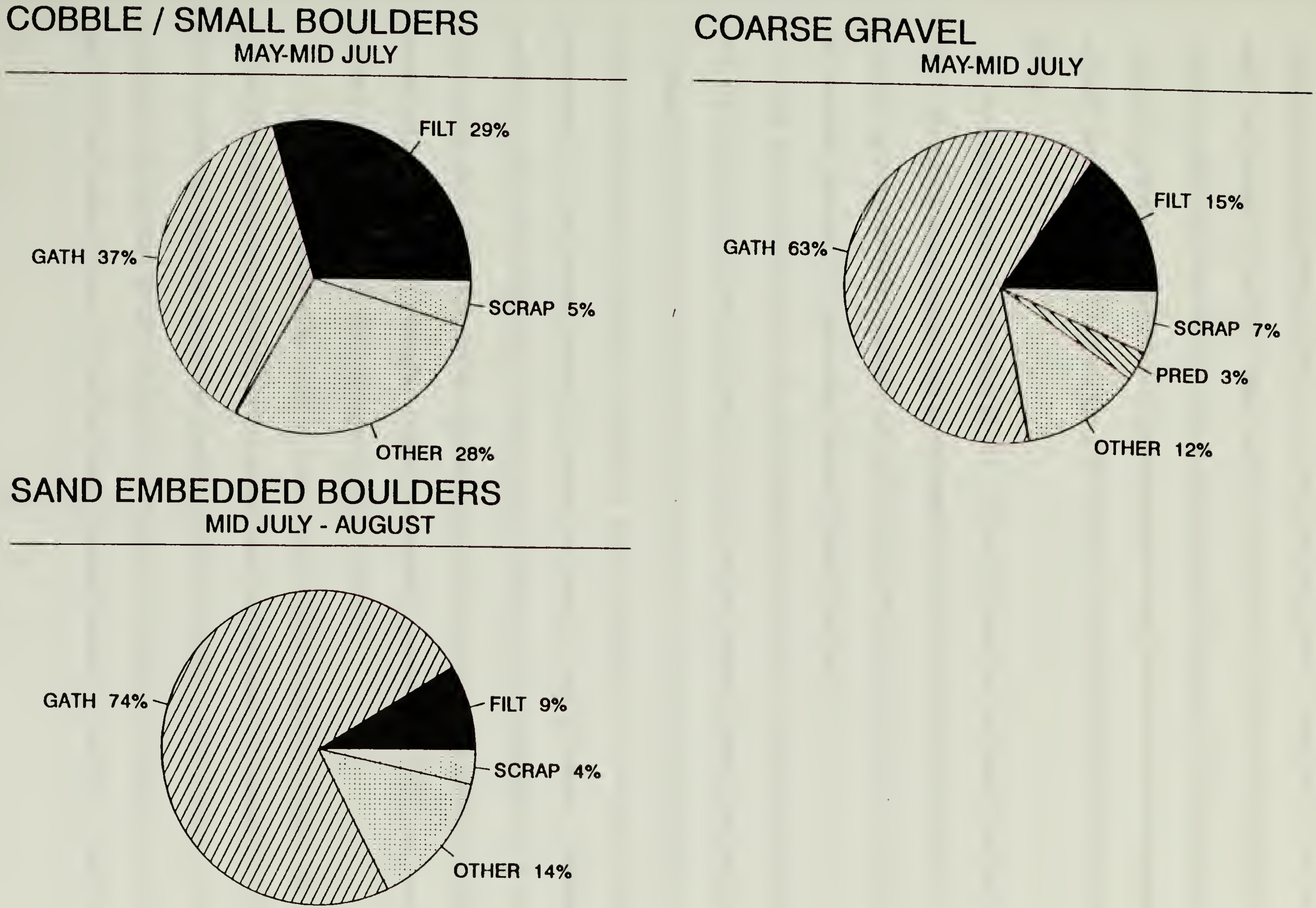


Figure 25. Feeding group analysis of benthic invertebrates collected from the predominant benthic habitats before and after summer rainfall runoff events (Mid-July) at NF12. (see text for description of benthic habitats).

predators were also more prevalent at this site. The proportion of shredders at this headwater site did not exceed six percent. Little change in composition of the functional groups occurred during the study period at this site. Although disturbance (shifting of bed materials and scouring of periphyton) was observed at both of these headwater sites and in some cases associated with reduced densities of invertebrates, the percentage of functional groups was not dramatically altered.

Functional group composition EF187 (Figure 17), where no substrate disturbance was evident during the study period, was comparable to that found at EF192 and NF34. At EF187, functional groups remained relatively consistent temporally during the length of the study and also spatially between the predominant benthic habitats analyzed.

This was not the case at North Fork sites, NF30 and NF27, where temporal differences were evident (Figures 22 and 23). Before mid-July, in both benthic habitats sampled gatherers comprised approximately 50 percent of the community. In the finer benthic habitat, of coarse gravel, scrapers and predators comprised a large proportion the remaining community composition. In the coarser habitat, of cobble and small boulders, filterers, dominated the remaining proportion of community. After mid-July, functional groups collected in the two of the communities were remarkably similar, gatherers increased and scrapers decreased. Both of the benthic habitat types sampled at these sites were altered periodically by high flow event which reduced densities and taxa richness (see Figures 12 and 13).

The functional composition at EF176 was unlike the others analyzed (Figure 18). Before mid-July the communities collected in the predominant habitats were dominated by non-insect taxa. Gatherers, however, were the dominant insect functional group followed by filterers (comprising 20 percent) in both substrates. Scrapers, in relatively low proportions, were only found in the coarse gravel. Substrates were severely altered in mid-July at this site, the

cobble/small boulder substrate was completely inundated by finer material. In the coarse gravel habitat a dramatic shift in functional feed groups were found. Filterers were the predominant feeding group, comprising 62 percent of the community, followed by gatherers. Scrapers were completely eliminated from the community.

At NF14, within the Narrows collectors were the primary functional group found (Figure 24). Gatherers and filters comprised approximately 80 percent of the community before mid-July and 60 percent after mid-July. This was the only case where a reduction in collectors was found after mid-July. Scrapers, surprisingly, comprise a large proportion of the community both before and after mid-July. Scrapers are adapted to feed or graze directly on periphyton standing crops and occur in conjunction with stream conditions that favor development of autochthonous energy sources. The low densities and number of invertebrate taxa at this site are thought to be related to limited primary production due to the nearly constant shading by the canyon walls. Even though scrapers comprised a large proportion of the community, actual densities were low.

Gatherers, filterers and collectors, made up the predominant portion of the functional groups at the lower sites EF161, EF157, and NF12 (Figures 19, 20, and 25). Predators and scrapers in relatively low proportions, were the only other functional groups represented. With the exception of the cobble/small boulder habitat sampled after mid-July at EF161 (Figure 19), the proportion of collectors (gatherers and filters combined) increased after mid-July. Gatherers select food based on particle size rather than origin. They consume particles roughly in proportion to the occurrence in the environment. For example, in arid stream immediately after floods, gatherers consume primarily FPOM, but, switch to diatoms and *Cladophora*-derived detritus as they become available (Fisher et al. 1982, Gray 1980).

No shredders were found at these sites despite the fact that all these sites showed large increases in CPOM at the onset of the rainfall runoff events in mid-July. Shredding insects are

considered relatively rare in arid streams, thought primarily due to the temporal stochasticity of organic material inputs and lack of retention. Retention time of CPOM does not appear to be long enough in arid stream systems for shredders to complete their life cycles (Fisher 1986). Also shredders are large univoltine organisms requiring a full year to complete their life cycle. This renders them more vulnerable to disturbance.

Fish Communities

Species distributions

The fish community in the East and North Forks of the Virgin River is naturally depauperate, which is typical of southwestern arid streams (Deacon and Minckley 1974). Ten species (speckled dace, *Rhinichthys osculus*; flannelmouth sucker, *Catostomus latipinnis*; desert sucker, *Catostomus clarki*; mountain sucker, *Catostomus platyrhynchus*; Virgin spinedace, *Lepidomeda mollispinis mollispinis*; Bonneville cutthroat trout, *Salmo clarki utah*; rainbow trout, *Oncorhynchus mykiss*; brown trout, *Salmo trutta*; brook trout, *Salvelinus fontinalis* and goldfish, *Carassius auratus*) were collected during the July of 1987 (Table 6). The speckled dace, flannelmouth sucker, desert sucker, and Virgin spinedace are all native to the Virgin River basin; the latter an endemic subspecies. It is unknown whether Bonneville cutthroat or the mountain sucker are native to the Bonneville basin (Cross 1975), or introduced by man, or arrived naturally as a result of headwater capture from the Bonneville basin (R.J. Behnke, Colorado State University, Fort Collins, CO. personal communication). If cutthroat trout are native to the Virgin River basin, however, one would expect to find a species native to the Colorado River Basin rather than the Bonneville basin (Behnke 1970).

Salmonids dominated the fish communities at the upper sites on both rivers (NF34, NF30, NF27, EF192, and EF187; Table 6). At the upper North Fork sites cutthroat trout were dominant,

Table 6. Fish collected in the North and East Forks of the Virgin River.

LOCATION	DATE	SPECIES*										
		VSD	SD	DS	FM	MT	BRT	BKT	RBT	CT	RBXCT	GD
NORTH FORK VIRGIN RIVER												
NF 34	07-08-87							11	9	4	1	
NF 30	07-08-87									11	1	
NF 27	07-08-87									6		
NF 12	07-06-87	58	127	544	11		9					
EAST FORK VIRGIN RIVER												
EF 192	07-09-87						50					
EF 187	07-09-87					7	68		6			
EF 176	07-09-87		15			1						2
EF 157	07-07-87	21	133	35	23							

*VSD-Virgin Spinedace; SD-Speckled Dace; DS-Desert Sucker; FM-Flannelmouth Sucker; MT- Mountain Sucker; BRT-Brown Trout; BKT-Brook Trout; RBT-Rainbow Trout; CT-Cutthroat Trout; RBXCT-Rainbow-Cutthroat Trout Hybrid; GD-Goldfish

comprising 46 percent of the individuals present. Brook trout and rainbow trout were also present in relatively high numbers at NF34, possibly a result of stocking to enhance recreational fishing associated with the Navajo Lake Recreational Area north of this site. Cross (1975) indicated that until 1970 rainbow trout were regularly stocked throughout the Virgin River basin. On the East Fork brown trout was the dominant species, comprising 100 percent of the community at EF192, and 84 percent at EF187. No cutthroat trout and only relatively low proportions of rainbow trout were found in the upper catchment. No salmonids were found below EF187 on the East Fork. EF176 was subject to extreme daily temperature fluctuations. Daily temperatures routinely exceeded 20°C (see Appendix A). Streams with mean temperatures above 20°C are considered unsuitable for salmonids (Hynes 1970). Brown trout, however, were found at the lower North Fork site, NF12, where water temperature exceeded 20°C only in mid-summer. Canyon shading and/or groundwater accretion appears to be great enough to maintain summer temperature refugia within the tolerance range of brown trout.

The only non-salmonid species (mountain suckers, speckled dace and goldfish) at the upper sites were found at EF187 and EF176. Mountain suckers, comprised approximately nine percent of the community at EF187. The mountain sucker prefer clear, cold water below 21°C (Sigler and Miller 1963). A mountain sucker was also found at EF176, where water temperatures regularly exceed 21°C. The majority (83 percent) of the fish community at EF176 was composed of speckled dace. Speckled dace are relatively tolerant of warm water (Sigler and Miller 1963). As a result, their distributions did not appear to be limited by the high temperatures measured at this site. Goldfish, a tolerant exotic able to withstand high temperatures and degraded conditions, were also found at this site. The goldfish found appeared to be recent introductions and no evidence of a sustained population was evident.

The fish communities at the lower sites on the East and North Forks, EF157 and NF12,

were composed primarily of native species, with the exception of brown trout present at NF12. The native fish communities at these sites were comprised Virgin spinedace, speckled dace, desert suckers and flannelmouth suckers. Virgin spinedace made up approximately 10 percent of the community at both sites. The Virgin spinedace was generally observed mid-water, in deep runs and pools associated with cover. The upstream distribution limit of the Virgin spinedace is thought to occur on the North Fork in Zion National Park below the Narrows approximately 2-3 kilometers above the 1987 collection site. No Virgin spinedace were observed above the Temple of Sinawava or collected above the Narrows. On the East Fork, Virgin spinedace were observed throughout the 1987 sampling season above Dennet Canyon on the East Fork. It is presumed that the falls within Parunuweap mark the upper boundary of the Virgin spinedace distribution on the East Fork (Dr. James Deacon, University of Nevada, Las Vegas, personal communication). No Virgin spinedace were found at the upper East Fork sites sampled.

Speckled dace comprised 63 percent of the individuals collected and dominated community at EF157, while at NF12 they comprised less than 20 percent of the individuals. Speckled dace were found to be more widely dispersed throughout the stream reach than the Virgin spinedace. Sigler and Miller (1963) reported that speckled dace have been found to be habitat generalists, living in a wide variety of habitats. The presence of the speckled dace at EF176 reflects their tolerance for high temperatures and an ability to adapt to a wide range of habitats.

At NF12 the fish community was dominated by desert suckers, comprising approximately 75 percent of the individuals collected. Relatively few flannelmouth suckers were found (less than 2 percent of the community). At EF157, on the other hand, the number of desert suckers (11 percent) was not markedly greater than the number of flannelmouth suckers collected (16 percent). Desert suckers are morphologically adapted for scraping algae and diatoms from rock

surfaces, and have longer intestinal tracks and shorter gill rakers than the flannelmouth sucker. The flannelmouth, on the other hand, is reported to be more generalized in its food habits, feeding on a wide variety of materials. Cross (1975) observed a predilection in the desert sucker for rocky substrates, while flannelmouth suckers appeared more general in their habitat selection being found predominantly over sand substrates. At the time fish communities were sampled in July, the substrate at the North Fork site was predominantly large cobble and small boulders covered with a heavy growths of filamentous algae and diatoms. The East Fork substrate, at this time was more diverse with large expanses of small boulders, cobble, gravel, and sand. Deacon *et al.* (1991) found that the North Fork had more deeper riffle habitat, supporting abundant standing stocks of periphyton, than did the East Fork, thus may provide more suitable habitat for desert sucker and explain its high relative abundance in the North Fork. In addition, temperature preferences of these species vary. Deacon *et al.* (1987) found temperature preferenda of 25.9°C for the flannelmouth sucker, and 17.5°C for the desert sucker. Temperatures exceeding 20°C were commonly measured at the East Fork site. Even though the fish communities at EF157 and NF12 were similar, in regards to species composition, relative species abundances appear to be related to available habitat.

Fish Biomass

The greatest fish biomass (g/m^2) in both the upper and lower catchments were found on the North Fork (Table 7). At the upper sites biomass was the highest at NF34, EF192, and EF187, while biomass at NF30 and NF27 were lower. Fish biomass was low at EF176, where only a few individuals were found, possible due to high seasonal temperatures and lack of habitat. At the upper sites, with the exception of EF176, fish biomass did not appear to be related to available invertebrates or densities at the time of sampling, even though the fish

communities were composed exclusively of invertivores. Densities of invertebrates found at NF30 and NF27 (see Figures 12 and 13) were much greater than found at NF34 and EF192 (see Figures 6 and 11). Fish biomass at NF34 and EF192 were greater than at NF30 and NF27 where high flows were associated with reductions in invertebrate densities later in the season. The prevailing fish population may be reflecting the greater instability at these sites in previous years, rather than current conditions.

Table 7. Biomass of fish communities sampled in the North and East Forks of the Virgin River.

Site	Date	Area (m^2)	Population estimate N*	Total Biomass g**	Biomass g/m^2
NF34	7/8	61	25±2	1305±487	21.4±8.0
NF30	7/8	141	12***	750	5.3
NF27	7/8	127	6±2	508±175	4.0±1.4
NF12	7/6	1505	780±23	65105±8086	43.3±5.4
EF192	7/9	106	53±3	1372±646	12.9±6.0
EF187	7/9	190	86±7	3602±1211	19.0±6.4
EF176	7/9	279	20±5	105±69	0.4±0.2
EF157	7/9	277	263±36	2876±789	10.4±2.8

*Total fish population ± Standard error.
**Biomass per site weighted by individual species weights.
***No fish caught on second pass; N based on one pass.

Biomass was at the greatest at NF12 due to the high density of desert suckers found. Biomass at EF157 was statistically significantly less than found at NF12. Even though the fish biomass was lower at the EF157 the presence of a diverse native community and the Virgin spinedace reflect the integrity of the site. The Virgin spinedace once considered common to abundant throughout the Virgin River system, however, has been restricted to a fraction of its original distribution (Valdez *et al.* 1991).

Two distinct fish communities were found in the East and North Forks. In the upper catchments, the fish community was dominated by non-native salmonids, while in the lower catchment the fish community was composed primarily of native species. The structure of both of these communities appear to be influenced by environmental conditions, primarily the stochasticity of flows, and resulting reduction of available food resources and habitat. As a result, the effects of biotic interactions on existing community structure is minimal or sporadic. Biotic interactions could become important determinants of community structure if physical variability is reduced or species adapted to existing physical stochasticity are introduced. Population densities and biomass of non-native species appeared curtailed in the upper catchment at sites where food resources and habitat were shown to be affected by high flows. The populations of native fish comprising the communities within Zion National Park, on the other hand, having adapted to stochastic flow events (Minckley 1973, Deacon and Minckley 1974) appear relatively stable (Valdaz *et al.* 1991).

SUMMARY AND CONCLUSION

The East and North Forks hydrologically are highly stochastic, responding to variable rainfall runoff events typical of the region. Over the period of study numerous high flows of magnitudes able to disturb stream substrates and alter channel morphology were observed. Both the concentration of nutrients and organic material measured in the East and North Forks appeared to be a function of discharge in that the concentrations of total nitrogen, total phosphorus and organic concentrations increased during high flows. Concentrations in transported organic material (CPOM and FPOM) appeared to be primarily due to the addition of terrestrially derived organic matter entering the system carried by overland flow. Proportionally, concentrations of VPOM were the largest being transported. Nutrients and organic material retention, however, were relatively short in the streams as indicated by the lack of persistence of measured elevated levels. The ability of the biotic community to utilize these resources, especially organic material was limited as a result.

Physical disturbance, usually in the form of floods, may be the primary determinant of biotic community structure in streams (Resh *et al.* 1988). The highly variable hydrological discharge, unstable shifting substrates, and large amounts of transported inorganic depositional material were responsible for reduced taxonomic and functional complexity of the benthic macroinvertebrate community of the East and North Fork of the Virgin River. Decreases in invertebrate densities were commonly associated with substrate disturbance. Invertebrate densities and taxa richness appeared to remain relatively constant with increasing flows until flows were sufficiently high to initiate substrate movement, after which densities declined in some cases to zero. Density recovery rates to pre-disturbance levels appeared dependent on the proportion of area disturbed (patchiness). Invertebrate densities were repeatably reduced, but

generally reappeared in numbers approximating former levels. Taxa richness appeared, however, relatively resilient to disturbance. Gray (1980) suggests that the life history, the rapid life cycles and rapid growth of arid stream invertebrates adapt them to the highly stochastic hydrologic events characteristic of arid streams similar to the East and North Forks. The invertebrates found throughout the East and North Forks were primarily collector-gatherers and, in general, after the onset of high flow in mid-July, these groups increased proportionately to the other functional groups. Collector-gatherers appeared to be able to utilize the available food resources (VPOM). Shredders were primarily confined to the upper stream sites. Shredders did not increase in response to the increased CPOM levels measured at the lower East and North Fork sites within Zion National Park. Shredders are usually larger organisms with a univoltine life history and, as a result, are more vulnerable to, and less able to recover from, frequent disruption.

The structure of fish communities appeared to be related to temperature and flow regimes. Coldwater salmonids dominated in the upper reaches, while native warmwater species dominated the fish communities in the lower reaches within Zion National Park. Native fish were abundant in the East and North Forks within Zion National Park. Native fish communities in the southwestern United States have declined with increased settlement and development. Most of these reductions of native fish populations have resulted from loss of habitat, declines in water quality, and the invasion of non-native species associated with the alteration of the flow regimes within the Colorado River system (Hubbs and Deacon 1964, Minckley and Deacon 1968, Minckley 1973, Deacon 1979). Currently, populations of Virgin spinedace and native fish communities at the lower East and North Fork sites within Zion National Park appear to be relatively undisturbed. However, there is evidence that the red shiner *Notropis lutrensis,* and mosquitofish *Gambusia affinis* now present in the Virgin River basin, can affect the distribution

and abundance of native fish communities in arid streams (Minckley and Deacon 1968). High flow variability and low habitat heterogeneity to which the native fishes of the Virgin River are uniquely adapted, appear to have prevented the invasion and establishment of the red shiner and other non-native species characteristic of less variable rivers (Deacon 1979, Cross 1985, Valdez et al. 1991). The red shiner, an opportunistic species, adapted to variable habitats east of the Rocky Mountains and already established in the lower Virgin River, poses an expecially serious threat. In addition, slight temperature reduction could encourage establishment of trout. Thus, exclusion of exotic species, shown to affect the structure of native fish communities in other southwestern streams, may depend in part on maintaining the natural variability of flow, temperature, and water quality in these sections of the North and East Forks of the Virgin River (Deacon 1979, 1980). It also depends in part on preventing introduction of pre-adapted exotics.

The longitudinal patterns observed in the East and North Forks differed from those hypothesized under the original tenets of the RCC (Vannote *et al*. 1980). Stream energetics, nutrient and organic material dynamics, and biotic community structure and function pattems were primarily controlled by the stochastic hydrologic regime and differing geomorphic attributes of the individual reaches examined, rather than changing longitudinal pattern in downstream physical stream variables (i.e., slope velocity, substrates, depth) and biological processes (i.e., upstream reduction of organic material, and alterations of water chemistry or nutrients).

The RCC did, however, provide a framework from which the critical ecological variables controlling the biotic communities in the East and North Forks of the Virgin River were identified. A gradual predicable change in structure and function of stream communities along the headwater to large river gradient was not apparent. Communities did not reflect a longitudinal progression of nutrient additions, and flow of energy related to the input, availability, and processing of organic material by the biotic component of the system. Upstream reaches,

however, did differ from downstream reaches in several ways. These differences were related to a number of physical characteristics of the East and North Fork stream systems, primarily temperature, habitat stability, localized nutrient and organic loading along a specific reach, and short retention times controlled by the regional geomorphology and hydrological regime. As a result, the structure and function of the biotic community reflect life histories that allow them to adapt to the variability of this system.

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APPENDIX A
(Chemistry Data)

EAST FORK VIRGIN RIVER

SITE DATE	Discharge m^3/sec	pH	Temp. °C	Disolved Oxygen mg/l	NO_3-NO_2 mg/l-N	Kjeldahl mg/l-N	Total Nitrogen mg/l-N	Total Phosphorus mg/l-P	CPOM mg/l	FPOM mg/l	VPOM mg/l
EF-192											
5/18	0.14	7.73	8	.	0	0.8	0.8	0	0.000	0.023	5
5/28	0.16	7.98	8	.	0	0.2	0.2	0	0.000	0.008	4
6/11	0.13	7.98	9	8.9	0	0.1	0.1	0	0.000	0.045	15
6/25	0.11	8.09	10	8.8	0	0	0	0	0.000	0.007	5
7/09	0.11	8.07	9	8.8	0	0	0	0	0.000	0.000	23
7/23	0.12	8.03	10	9.85	0	0.1	0.1	0.02	0.010	0.013	74
8/06	0.11	8.07	13	8.2	0	0	0	0	0.000	0.004	65
8/20	0.12	8.22	11	9.2	0	0	0	0	0.000	0.043	56
9/30	0.10	8.03	10	9.2	0	0	0	0	0.007	0.014	9
9/17	0.12	8.30	8	9.35	0	0.1	0.1	0	0.272	0.004	15
10/01	0.12	8.09	6	9.2	0	0	0	0	0.317	0.008	20
EF-187											
6/25	0.18	8.06	15	8.4	0	0	0	0	0.000	0.013	46
7/09	0.20	7.99	14	8.7	0	0	0	0	0.000	0.006	42
7/23	0.19	7.95	14	8.35	0	0.4	0.4	0.01	0.011	0.020	56
8/06	0.21	8.02	16	8.35	0	0	0	0.02	0.002	0.006	73
8/20	0.17	8.05	14	9.4	0	0	0	0	0.000	0.009	20
9/03	0.21	8.04	13	8.05	0	0	0	0.01	0.000	0.009	24
9/17	0.11	8.04	10.5	8.75	0	0	0	0	0.060	0.003	5
10/01	0.11	8.06	10	8.75	0	0	0	0	0.340	0.006	3
EF-176											
5/18	0.28	7.73	8	.	0.4	0.4	0.8	0.06	0.469	0.388	1
5/28	0.25	7.83	18	.	0.5	0.2	0.7	0.04	0.140	0.216	4
6/11	0.09	7.87	20	7.45	0.7	0.1	0.8	0	0.043	0.042	14
6/25	0.06	8.02	26	6.9	1.3	0.1	1.4	0	0.002	0.023	37
7/09	0.03	8.02	27	7.1	1.5	0.5	2	0	0.000	0.022	30
8/06	0.12	8.09	24	7.05	0.8	0	0.8	0:03	0.379	0.403	38
9/03	0.10	8.02	20	7.6	1.5	0	1.5	0	0.021	0.026	13
10/01	0.08	8.01	21	8.1	1.6	0.1	1.7	0	0.176	0.007	8
EF-161											
5/20	1.33	7.79	14	.	0.9	0.3	1.2	0.05	0.171	0.261	3
5/29	.	8.18	17	.	0.5	0.2	0.7	0.07	0.249	0.228	6
6/26	0.97	8.30	18	9.7	0.9	0	0.9	0	0.028	0.110	15
7/24	1.10	8.20	18	8.35	1	0.2	1.2	0.07	8.494	1.334	59
8/19	0.98	8.15	18	8.3	1	0	1	0	0.277	0.217	14
9/18	1.11	8.29	18	8.75	1	0	1	0	0.067	0.186	1
EF-157											
5/21	1.56	8.11	15	.	0.4	0.2	0.6	0.02	0.206	0.599	6
5/29	1.51	8.11	13	.	0.5	0.5	1	0.03	3.196	0.383	8
6/12	1.10	8.10	15	8.45	0.4	0.1	0.5	0.01	0.031	0.199	10
6/26	1.07	8.19	23	8.55	0.8	0.1	0.9	0	0.083	0.255	10
7/10	1.05	8.09	15	9.05	0.9	0	0.9	0	0.000	0.090	24
7/24	1.19	.	25	7.5	1	0.1	1.1	0.03	1.925	2.521	41
8/07	.	7.50	20	7.4	0.5	0	0.5	0.01	3.044	0.974	228
8/19	1.09	8.32	14	8.6	1	0	1	0	0.336	0.501	16
9/04	1.05	0.03	15	9.2	0.9	0	0.9	0.01	0.543	0.460	15
9/18	1.22	8.28	12	9.2	0.9	0	0.9	0	0.016	0.213	2
10/02	1.24	8.25	12	9.2	0.9	0	0.9	0	0.029	0.299	4

NORTH FORK VIRGIN RIVER

SITE DATE	Discharge m^3/sec	pH	Temp. °C	Disolved Oxygen mg/l	NO_3-NO_2 mg/l-N	Kjeldahl mg/l-N	Total Nitrogen mg/l-N	Total Phosphorus mg/l-P	CPOM mg/l	FPOM mg/l	VPOM mg/l
NF-34											
6/04	0.30	8.16	14	7.4	0	0.2	0.2	0.02	0.078	0.241	1
6/15	0.30	8.17	10	8.9	0	0.2	0.2	0.01	0.050	0.270	49
6/29	0.26	8.12	11	9.35	0.1	0	0.1	0	0.040	0.191	18
7/13	0.18	8.12	11	9.35	0	0	0	0	0.032	0.131	33
7/30	0.23	8.15	12	8.05	0	0.1	0.1	0.02	0.042	0.292	15
8/10	0.18	8.35	17	7.95	0	0	0	0.01	0.015	0.209	58
8/24	0.17	8.27	11	8.7	0	0.1	0.1	0	0.610	0.567	30
9/07	0.07	8.27	12	8.1	0	0.1	0.1	0	0.459	0.090	11
9/21	0.04	8.16	9	8.8	0	0	0	0	0.460	0.027	9
10/05	0.04	8.18	11	7.7	0	0	0	0	2.781	0.034	10
NF-30											
6/03	0.61	8.15	8	8.4	0	0.2	0.2	0.01	0.035	0.223	4
6/15	0.44	8.10	12	9.8	0	0.1	0.1	0	0.182	0.133	40
6/29	0.39	8.13	14	8.4	0.2	0	0.2	0	0.000	0.191	14
7/13	0.32	8.19	15	9.4	0	0	0	0	0.000	0.052	25
7/30	0.48	8.09	14	8.45	0	0.1	0.1	0.01	0.014	0.009	212
8/10	0.44	8.31	16	8.9	0	0	0	0.03	0.145	0.603	63
8/24	0.59	8.35	11	8.75	0	0.2	0.2	0	1.939	0.212	39
9/07	0.29	8.20	12	8.7	0	0	0	0	0.056	0.110	5
9/21	0.23	8.21	9	9.3	0	0.1	0.1	0	0.950	0.040	5
10/05	0.24	8.15	11	8.7	0	0	0	0	1.403	0.058	2
NF-27											
6/03	0.56	8.16	16	7.5	0	0.5	0.5	0	0.126	0.533	7
6/15	0.44	8.13	18	9.05	0	0	0	0.02	0.059	0.218	17
6/29	0.37	8.08	20	7.5	0	0.1	0.1	0	0.010	0.132	29
7/13	0.31	8.20	20	9.35	0	0.1	0.1	0	0.000	0.035	27
7/30	0.45	8.10	16	7.8	0	0	0	0.02	0.059	0.330	35
8/10	0.53	8.28	14	8.4	0	0	0	0.04	2.705	0.855	38
9/07	0.30	8.17	9	8.7	0	0	0	0.01	0.122	0.090	28
9/21	0.26	8.22	7	9.45	0	0.1	0.1	0	0.000	0.051	15
10/05	0.32	8.19	6	9.4	0	0	0	0.02	0.093	0.040	2
NF-14											
6/16	1.67	8.05	17	8.35	0	0.3	0.3	0.04	0.008	0.076	39
7/14	1.01	8.09	16	8.1	0	0	0	0	0.000	0.009	23
8/11	1.18	8.21	16	9.1	0	0	0	0.04	1.444	1.656	32
9/08	0.61	8.15	13	8.9	0	0	0	0.03	0.124	0.506	57
10/06	1.09	8.19	12	9.2	0	0	0	0	0.021	0.128	7
NF-12											
5/21	4.16	8.16	12	.	0	0.8	0.8	0.04	0.048	0.139	2
6/02	2.44	8.16	13	8.1	0	0.3	0.3	0	0.000	0.042	4
6/16	1.83	8.06	15	8.3	0	0	0	0.01	0.000	0.033	31
6/30	1.37	8.25	18	8.8	0	0	0	0	0.006	0.019	11
7/14	1.16	8.09	20	8.05	0	0	0	0	0.000	0.045	19
7/24	1.54	7.95	17	7.3	0	0.1	0.1	0.08	6.789	3.719	75
8/11	1.40	8.25	21	8.8	0	0	0	0.07	4.482	2.224	40
8/25	1.84	6.75	15	8.7	0	0.2	0.2	0	0.615	1.591	26
9/08	1.43	8.35	15	9.1	0	0	0	0.04	0.454	0.545	48
9/22	1.27	8.21	11	9.2	0	0	0	0	0.132	0.167	10
10/06	1.07	8.14	11	9.2	0	0	0	0	0.037	0.099	1

APPENDIX B
(Invertebrate Community Data)

OLIGOCHAETA	0	0	1	0	0	0	1	2	2	0	1	0	0	0	3	0	0	0	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
ARTHROPODA																																																		
ARACHNIDA																																																		
ACARINA																																																		
HYDRACARINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1	2	2	0	0	0	0	0	0	0	0	0	0
INSECTA																																																		
COLEOPTERA																																																		
ELMIDAE																																																		
Narpus sp.	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	1	2	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLLEMBOLA																																																		
ENTOMOBRYIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																																																			
CERATOPOGONIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	0	0	3	0	0	0	2	0	0	0	0	0	1	0	0	1	0	0	0	0	2	4	0	3	4	2	0	3	0	4	0	1	0	0	0	0	0	0	2	0	1	0	0	2	0	0	0	0	0	0
EMPIDIDAE																																																		
Chelifera sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SARCOPHAGIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE																																																		
Simulium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	2	0	1	1	1	2	3	0
TIPULIDAE																																																		
Antocha sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesperoconopa sp.	0	1	0	1	0	2	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0
Hexatoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																																																		
BAETIDAE																																																		
Baetis sp. I	16	5	4	7	6	17	24	31	12	21	4	3	7	7	15	3	8	9	15	8	11	8	12	17	20	7	1	6	9	4	0	0	0	0	0	6	5	4	2	5	8	10	5	7	7	0	4	4	7	2
EPHEMERELLIDAE																																																		
Drunella coloradoensis	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	1	2	1	0	1	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsi	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	3	0	4	2	1	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																																																		
Cinygmula sp.	0	0	0	0	0	5	2	0	0	5	0	0	0	0	2	1	0	1	1	1	0	1	1	0	0	0	0	0	3	8	3	2	6	3	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epeorus sp.	0	0	0	1	0	1	3	4	3	5	0	0	1	0	3	0	0	3	0	5	1	2	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.	7	5	14	5	4	6	10	10	7	6	6	1	19	16	10	2	2	5	2	5	0	0	0	0	0	11	14	17	9	6	1	2	0	0	0	27	32	37	67	59	62	26	55	3	31	38	49	56	33	27
LEPTOPHLEBIIDAE																																																		
Paraleptophlebia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PLECOPTERA																																																		
CHLOROPERLIDAE																																																		
Suwallia sp.	3	2	6	0	2	2	3	6	4	6	2	0	5	4	4	7	1	1	2	0	0	1	2	0	1	0	0	0	0	0	2	2	3	0	13	1	4	1	1	4	3	1	3	1	1	1	2	1	2	0
Sweltsa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEMOURIDAE																																																		
Amphinemura sp.	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	2	3	2	3	3	6	0	0	1	2	0	0	1	0	0	1	1	0	0	1	2	4	1	9	15	2	0	0	2	4	0
PERLODIDAE																																																		
Isogenoides zionensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	1	0	1	2	1	2	0	1	1	2	0	1	0	0	2	0	0	2	0
PTERONARCYIDAE																																																		
Pteronarcella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	3	1	6	0	2	1	1	2	3	0
TRICHOPTERA																																																		
BRACHYCENTRIDAE																																																		
Brachycentrus americanus	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
GLOSSOSOMATIDAE																																																		
Glossosoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	1	0	0	0	0	1	1	1	1	3	1	0	0	0	2	0	3	1	2	0	0	0	0	1	3	0	0	1	0	1	1	1	0	0	0	2	2	2	2	3	1	2	2	2	0	0	0	3	3	0
LIMNEPHILIDAE																																																		
Oligophlebodes sp.	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHYACOPHILIDAE																																																		
Rhyacophila sp. I	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp. II	0	0	1	2	0	0	0	0	0	0	0	0	0	1	1	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp. III	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	1	2	3	1	2	0	1	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	1	0	0	0	0	5	0	0	0	0	3	0

COARSE SUBSTRATE SAMPLES 1987	JUNE 3					JUNE 15					JUNE 29					JULY 17					JULY 30					AUGUST 10					AUGUST 24					SEPTEMBER 7					SEPTEMBER 21					OCTOBER 5				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ANNELIDA																																																		
OLIGOCHAETA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
ARTHROPODA																																																		
ARACHNIDA																																																		
ACARINA																																																		
HYDRACARINA	0	0	0	0	0	1	0	0	3	1	0	2	0	0	0	5	0	2	0	4	0	0	1	1	1	0	1	0	2	4	0	0	4	1	1	0	2	0	0	0	0	0	0	2	3	2	0	0	0	0
INSECTA																																																		
COLEOPTERA																																																		
DRYOPIDAE																																																		
Helichus sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELMIDAE																																																		
Cleptelmis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	1	3	0	0	0	5	0	7	3	0	5	4	0	3	2	1	2	0	5	4	1	2	4	0	0	1	4	1	7	0	1	1	1	0	1	0	2	1	1	0	5	3	1	6	3	2	0	0	0	0
STAPHYLINIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																																																		
ATHERICIDAE																																																		
Atherix sp.	0	0	0	1	0	1	0	0	1	0	0	5	0	4	1	6	4	0	2	5	0	2	1	2	2	3	5	3	6	5	0	0	1	0	1	0	1	2	0	0	4	2	0	2	2	0	1	0	1	0
CHIRONOMIDAE	0	7	1	4	1	4	7	6	5	14	1	14	6	9	4	5	4	0	0	3	0	2	0	1	0	0	2	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EMPIDIDAE																																																		
Chelifera sp.	0	0	0	0	0	0	0	3	3	0	0	5	0	3	0	1	1	0	0	0	0	1	0	2	1	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wiedemannia sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE																																																		
Simulium sp.	2	0	2	1	1	3	2	0	0	0	6	1	8	8	15	6	2	1	7	0	0	1	0	1	2	0	1	1	2	34	1	0	0	0	0	0	1	2	0	0	0	1	0	0	0	1	0	0	0	0
TIPULIDAE																																																		
Antocha sp.	0	0	0	0	0	0	0	0	2	1	0	1	0	0	0	2	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																																																		
BAETIDAE																																																		
Baetis sp. I	13	2	8	3	2	5	9	6	15	14	37	76	19	24	16	64	76	17	10	82	26	63	44	65	42	43	38	27	68	34	39	69	53	31	72	2	58	16	15	50	32	24	15	26	32	4	0	6	0	0
EPHEMERELLIDAE																																																		
Drunella grandis	0	0	0	0	0	2	0	2	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella sp.	0	0	1	0	1	0	0	1	0	1	0	6	2	2	1	2	1	0	0	2	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																																																		
Cinygmula sp.	1	0	0	0	1	7	2	5	7	1	6	6	0	0	4	1	0	0	0	4	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
Epeorus sp.	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptagenia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	6	7	4	0	10	0	0	2	1	0
Rhithrogena sp.	3	7	9	1	2	6	2	1	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	3	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLECOPTERA																																																		
CHLOROPERLIDAE																																																		
Suwallia sp.	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweltsa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEMOURIDAE																																																		
Amphinemura sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PERLODIDAE																																																		
Isogenoides zionensis	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	1	3	2	1	1	5	10	2	2	2	7	7	1	3	0	0	1	1	0	3	0	11	0	2	2	2	0	2	3	3	0	0	1
PTERONARCYIDAE																																																		
Pteronarcella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0
TRICHOPTERA																																																		
BRACHYCENTRIDAE																																																		
Brachycentrus	1	1	2	1	0	0	0	0	0	0	0	20	2	17	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus americanus	0	0	0	0	0	5	1	22	3	10	0	0	0	0	0	4	1	1	3	0	0	0	0	0	0	0	6	3	0	1	0	1	0	0	0	0	0	2	1	0	3	4	1	2	2	6	0	4	1	1
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	1	2	0	1	0	4	0	2	0	1	0	2	0	1	0	0	0	0	0	0	0	0	3	0	0	0	1	0	1	0	0	0	1	2	0	5	3	0	0	3	2	0	4	2	2	9	0	2	0	2
HYDROPTILIDAE																																																		
Ochrotrichia sp.	0	1	0	0	0	0	0	0	1	0	2	0	3	0	2	2	0	0	3	1	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PSYCHOMYIIDAE																																																		
Tinodes sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHYACOPHILIDAE																																																		
Rhyacophila sp. I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp. III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEMATODA	0	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLATYHELMINTHES																																																		
TURBELLARIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ANNELIDA
OLIGOCHAETA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ARTHROPODA
ARACHNIDA
ACARINA
HYDRACARINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	3	1	0	0	0	0	0	0
INSECTA
COLEOPTERA
ELMIDAE
Optioservus sp.	0	0	1	1	5	3	0	8	1	2	2	1	0	3	6	3	3	8	3	7	2	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	5	1	1	2	2	0	3	6	1	1	0	1	1	0
DIPTERA
ATHERICIDAE
Atherix sp.	0	1	0	0	0	0	1	2	0	0	2	0	0	1	2	2	1	0	1	5	2	4	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2	3	1	0	1	0	1	0	2	0	0
CERATOPOGONIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyia sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	7	2	4	0	7	4	2	4	0	3	4	0	0	0	4	0	0	1	3	0	0	3	0	2	0	0	3	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0
EMPIDIDAE
Chelifera sp.	3	0	1	1	4	0	0	8	10	11	4	6	0	0	1	1	0	2	0	0	0	2	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wiedemannia sp.	1	0	1	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE
Simulium sp.	3	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	4	3	4	0	4	0	0	0	0	0
STRATIOMYIDAE
Caloparyphus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TANYDERIDAE
Protanyderus sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TIPULIDAE
Antocha sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexatoma sp.	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA
BAETIDAE
Baetis sp. I	15	26	18	28	2	2	7	2	2	9	20	8	0	18	15	45	24	35	33	28	23	27	8	24	21	5	5	10	19	62	60	42	46	38	20	12	22	1	21	12	8	9	4	16	4	1	2	3	2	0
EPHEMERELLIDAE
Ephemerella sp.	4	0	2	1	2	8	1	0	5	3	5	1	0	0	3	0	0	3	0	1	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE
Cinygmula sp.	3	15	3	5	15	2	7	14	9	12	4	1	0	14	6	1	4	1	0	0	0	0	2	7	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epeorus sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.	1	5	5	11	0	8	1	0	0	2	8	0	0	0	0	0	0	1	2	1	0	0	0	0	1	1	2	1	1	0	0	0	1	0	0	2	4	0	7	7	3	4	4	3	3	3	4	0	9	1
PLECOPTERA
CHLOROPERLIDAE
Suwallia sp.	1	7	2	11	1	3	2	0	2	12	0	2	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEMOURIDAE
Amphinemura sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PERLIDAE
Hesperoperla pacifica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PERLODIDAE
Isogenoides zionensis	0	1	3	0	4	0	2	0	1	1	6	2	0	1	0	5	2	3	3	5	11	7	3	5	3	0	4	1	1	0	0	0	0	0	0	0	3	2	0	2	8	2	2	4	1	1	0	0	1	0
PTERONARCYIDAE
Pteronarcella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	3	0	0	0	0	0	0	4	0	0
TRICHOPTERA
BRACHYCENTRIDAE
Brachycentrus americanus	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	4	0	0	0	0	1	0	0	3	1	1	2	4	2	0	0	17	5	3	1	4	0	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	1	1	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	1	0	1	0	0	3	2	0	2	2	3	0	2	0	5	2	0	2	5	0
HYDROPTILIDAE
Ochrotrichia sp.	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHYACOPHILIDAE
Rhyacophila sp. I	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp. III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
MOLLUSCA
GASTROPODA
PULMONATA
PLANORBIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEMATODA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLATYHELMINTHES
TURBELLARIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ARTHROPODA																																													
ARACHNIDA																																													
ACARINA																																													
HYDRACARINA	0	0	0	2	0	0	2	0	1	0	1	0	0	0	0	3	1	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INSECTA																																													
COLEOPTERA																																													
ELMIDAE																																													
Optioservus sp.	0	0	1	2	0	2	0	1	1	0	3	3	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																																													
ATHERICIDAE																																													
Atherix sp.	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	1	0
CERATOPOGONIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0
CHIRONOMIDAE	0	0	2	1	0	2	2	0	14	0	1	3	0	0	0	5	2	5	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
EMPIDIDAE																																													
Chelifera sp.	1	0	0	0	0	0	1	0	2	0	0	1	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE																																													
Simulium sp.	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0
EPHEMEROPTERA																																													
BAETIDAE																																													
Baetis sp. I	2	0	4	1	0	8	0	7	13	6	9	6	8	6	3	6	1	0	5	10	3	0	1	0	0	8	7	8	6	15	9	6	19	14	10	7	11	10	14	10	4	5	0	2	0
EPHEMERELLIDAE																																													
Ephemerella sp.	1	1	4	0	0	5	2	4	15	3	2	6	3	3	2	4	0	2	3	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																																													
Cinygmula sp.	0	0	3	2	0	1	6	6	7	6	2	2	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epeorus sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptagenia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.	9	3	10	10	3	0	10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEMIPTERA																																													
GERRIDAE																																													
Metrobates sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLECOPTERA																																													
CHLOROPERLIDAE																																													
Suwallia sp.	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERLODIDAE																																													
Isogenoides zionensis	0	2	3	2	4	1	2	1	3	2	4	3	2	2	0	2	2	2	3	1	1	1	1	0	0	1	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	1	2
PTERONARCYIDAE																																													
Pteronarcella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
TRICHOPTERA																																													
BRACHYCENTRIDAE																																													
Brachycentrus	0	0	0	0	0	0	0	1	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus americanus	1	1	1	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0
HELICOPSYCHIDAE																																													
Helicopsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	1	0	0	0	0	1	0	5	0	2	2	0	1	1	1	0	0	2	1	0	0	0	0	2	0	1	0	1	1	1	1	0	0	0	0	0	0	0	3	0	3	4	1	
HYDROPTILIDAE																																													
Mayatrichia sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neotrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEMATODA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ARTHROPODA																																													
ARACHNIDA																																													
ACARINA																																													
HYDRACARINA	2	1	1	0	0	0	0	0	1	0	2	0	0	0	0	2	1	0	4	0	7	0	2	0	0	1	0	0	0	0	0	2	1	0	0	0	5	0	2	0	0	1	0	3	1
INSECTA																																													
COLEOPTERA																																													
DRYOPIDAE																																													
Helichus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELMIDAE																																													
Cleptelmis sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Optioservus sp.	0	0	0	0	0	2	0	0	2	0	2	4	1	3	3	5	4	0	2	1	7	2	2	0	0	0	0	0	0	0	1	0	1	0	0	3	1	0	1	2	2	0	0	1	1
COLLEMBOLA																																													
ENTOMOBRYIDAE	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																																													
ATHERICIDAE																																													
Atherix sp.	0	0	0	0	0	1	0	0	1	0	1	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0
CERATOPOGONIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	4	2	2	1	0	1	2	13	4	0	2	6	5	1	0	4	18	5	8	2	10	1	6	0	0	0	0	0	0	0	0	1	2	0	0	4	3	4	0	4	2	0	0	0	0
EMPIDIDAE																																													
Chelifera sp.	1	0	0	0	0	0	0	0	0	0	0	1	3	1	1	1	2	0	1	0	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wiedemannia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
SIMULIIDAE																																													
Simulium sp.	1	0	1	1	1	0	0	3	0	2	0	0	0	0	0	0	0	3	1	1	0	0	0	0	0	3	0	0	3	0	0	6	0	3	2	0	0	0	0	0	4	0	2	2	3
TABANIDAE																																													
Chrysops sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TANYDERIDAE																																													
Protanyderus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0
TIPULIDAE																																													
Antocha sp.	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																																													
BAETIDAE																																													
Baetis sp. I	0	3	2	4	1	0	6	1	6	2	19	5	16	7	13	5	18	8	14	13	3	10	14	0	0	54	15	10	76	27	35	45	33	36	44	10	28	13	23	21	0	4	0	6	0
EPHEMERELLIDAE																																													
Drunella grandis	1	0	0	0	1	2	1	3	2	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella sp.	0	0	0	1	2	6	14	3	22	3	4	7	11	3	6	0	15	2	7	1	1	4	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																																													
Cinygmula sp.	0	0	0	0	2	12	20	6	14	7	6	7	6	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epeorus sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptagenia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.	2	6	12	3	5	3	0	6	0	4	0	6	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	1	0	2	3	0	0	3	0	0	0	0	0
TRICORYTHIDAE																																													
Tricorythodes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEMIPTERA																																													
PLECOPTERA																																													
CHLOROPERLIDAE																																													
Suwallia sp.	0	1	0	0	0	2	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEMOURIDAE																																													
Amphinemura sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERLODIDAE																																													
Isogenoides zionensis	0	0	0	0	1	0	0	0	1	1	2	4	2	2	9	6	6	2	6	1	0	5	2	0	0	1	0	1	0	0	2	1	1	0	1	5	0	1	0	2	1	3	0	0	0
PTERONARCYIDAE																																													
Pteronarcella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
TRICHOPTERA																																													
BRACHYCENTRIDAE																																													
Brachycentrus	0	0	0	0	0	0	0	0	0	0	17	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus americanus	11	0	1	1	0	8	4	6	7	0	3	0	0	2	0	0	4	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	0	3	0	4	0	0	2	2	1	1	1
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	0	0	2	0	4	1	6	3	1	0	3	1	1	0	0	3	0	0	0	3	0	0	0	0	0	2	1	3	0	0	0	1	3	0	2	0	0	0	1	1	0	0	3	2
HYDROPTILIDAE																																													
Mayatrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrotrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEMATODA	0	2	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ANNELIDA																									
OLIGOCHAETA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ARTHROPODA																									
ARACHNIDA																									
ACARINA																									
HYDRACARINA	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	3	0	0	1	0	0	0	0
CRUSTACEA																									
OSTRACODA	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
INSECTA																									
DIPTERA																									
ATHERICIDAE																									
Atherix sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
CHIRONOMIDAE	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0
EPHEMEROPTERA																									
BAETIDAE																									
Baetis sp. I	2	3	0	0	0	1	8	3	2	0	0	0	0	0	1	4	4	0	1	3	3	0	0	8	2
Baetis sp. II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMERELLIDAE																									
Ephemerella sp.	3	5	0	3	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
HEPTAGENIIDAE																									
Heptagenia sp.	1	4	1	0	2	5	2	1	4	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
TRICORYTHIDAE																									
Tricorythodes sp.	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	1	2	0
HEMIPTERA																									
VELIIDAE																									
Rhagovelia sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLECOPTERA																									
PERLODIDAE																									
Isogenoides zionensis	1	1	0	0	1	0	0	0	0	0	1	1	0	2	0	2	1	0	0	1	2	1	0	0	0
TRICHOPTERA																									
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	1	1	4	3	0	3	0	0	0	2	0	0	0	1	0	1	0	0	0	0	2	1	0	0

ARTHROPODA					
INSECTA					
EPHEMEROPTERA					
BAETIDAE					
Baetis sp. I	0	0	0	1	2
Baetis sp. II	2	1	0	1	0
EPHEMERELLIDAE					
Ephemerella sp.	4	1	2	3	10
PLECOPTERA					
PERLODIDAE					
Isogenoides zionensis	0	1	2	0	1
TRICHOPTERA					
HYDROPSYCHIDAE	0	0	0	0	0
Hydropsyche sp.	1	1	2	1	2

ANNELIDA																																																							
OLIGOCHAETA	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	2	0	0	0		
ARTHROPODA																																																							
ARACHNIDA																																																							
ACARINA																																																							
HYDRACARINA	0	2	0	2	2	2	2	1	1	2	2	0	3	0	0	1	2	0	1	0	1	0	0	1	0	0	0	0	0	1	0	0	5	1	4	0	0	1	0	0	3	1	6	0	3	17	6	7	4	4	7	7	0	0	6
INSECTA																																																							
COLEOPTERA																																																							
ELMIDAE																																																							
Microcylloepus sp.	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Optioservus sp.	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																																																							
ATHERICIDAE																																																							
Atherix sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
CERATOPOGONIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	5	6	5	2	9	2	7	4	3	17	6	1	6	13	12	1	2	3	2	0	0	1	0	0	2	2	0	0	0	3	0	0	0	1	1	0	1	0	2	0	2	6	7	0	2	22	16	18	3	11	32	12	6	10	2
EMPIDIDAE																																																							
Wiedemannia sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
SIMULIIDAE																																																							
Simulium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
STRATIOMYIDAE																																																							
Caloparyphus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																																																							
BAETIDAE																																																							
Baetis sp. I	4	12	17	3	6	1	0	0	0	2	6	7	31	9	9	11	3	6	1	2	11	3	6	1	2	0	0	0	0	1	3	2	7	3	3	2	1	5	0	1	4	1	3	1	2	14	9	6	3	0	22	13	4	6	9
Baetis sp. II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMERELLIDAE																																																							
Ephemerella sp.	27	78	32	31	28	1	3	2	1	19	3	1	12	4	7	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	1	1	3	4	0	0	2
HEPTAGENIIDAE																																																							
Heptagenia sp.	5	3	5	2	1	0	1	3	0	0	1	0	0	0	2	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	0	2	4	0	0	0	2	2	2	0	0
TRICORYTHIDAE																																																							
Tricorythodes sp.	0	8	0	1	0	0	1	0	0	3	1	1	7	3	1	1	1	5	1	2	12	21	12	11	27	11	5	6	1	13	4	9	6	0	1	2	1	4	0	0	7	18	5	4	3	1	5	10	2	3	2	2	2	0	0
PLECOPTERA																																																							
PTERONARCYIDAE																																																							
Pteronarcella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																																																							
HELICOPSYCHIDAE																																																							
Helicopsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	21	9	8	9	1	3	2	3	3	9	3	19	5	5	9	2	2	6	2	3	1	1	0	0	2	0	0	1	1	0	1	0	1	0	0	0	1	0	0	3	2	0	2	1	12	5	7	0	2	19	14	13	6	0
HYDROPTILIDAE																																																							
Mayatrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	7	2	1	2	0	2	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrotrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0
POLYCENTROPIDAE																																																							
Polycentropus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

ARTHROPODA																														
ARACHNIDA																														
ACARINA																														
HYDRACARINA	0	1	0	3	0	6	0	0	5	5	0	0	0	3	0	2	4	3	0	1	3	3	2	3	0	0	0	0	0	0
INSECTA																														
COLEOPTERA																														
ELMIDAE																														
Microcylloepus sp.	0	0	0	0	0	2	0	1	0	0	4	1	0	0	0	1	1	2	1	1	0	2	0	1	0	0	0	0	0	0
Optioservus sp.	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																														
CHIRONOMIDAE	15	13	4	65	0	106	20	8	5	14	27	31	4	15	27	2	1	2	0	2	0	1	0	1	0	0	0	0	0	0
EMPIDIDAE																														
Wiedemannia sp.	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																														
BAETIDAE																														
Baetis sp. I	1	13	0	4	0	0	0	0	1	0	17	22	0	10	24	3	10	3	10	4	7	6	7	10	10	0	0	0	0	0
Baetis sp. II	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMERELLIDAE																														
Ephemerella sp.	23	31	7	11	3	53	7	7	5	37	8	10	5	4	16	1	3	1	1	1	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																														
Cinygmula sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptagenia sp.	4	0	0	0	0	2	0	0	0	9	0	1	2	2	3	0	4	0	0	0	0	0	0	3	4	0	0	0	0	0
Rhithrogena sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICORYTHIDAE																														
Tricorythodes sp.	2	11	0	3	1	0	2	5	0	3	0	1	0	2	9	1	2	0	2	0	21	35	24	27	27	0	0	0	0	0
HEMIPTERA																														
GERRIDAE																														
Metrobates sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLECOPTERA																														
PERLODIDAE																														
Isogenoides zionensis	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTERONARCYIDAE																														
Pteronarcella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																														
HELICOPSYCHIDAE																														
Helicopsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	17	43	16	29	0	62	7	10	6	10	98	85	6	32	38	24	42	14	17	12	9	8	0	9	15	0	0	0	0	0
HYDROPTILIDAE																														
Mayatrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	12	2	3	6	4	1	5	7	3	0	0	0	0	0
POLYCENTROPIDAE																														
Polycentropus sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ARTHROPODA																																																							
ARACHNIDA																																																							
ACARINA																																																							
HYDRACARINA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	0	0	0	0	0
INSECTA																																																							
COLEOPTERA																																																							
DRYOPIDAE	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
ELMIDAE																																																							
Cleptelmis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Narpus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Optioservus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	2
DIPTERA																																																							
CERATOPOGONIDAE	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
CHIRONOMIDAE	0	0	1	1	1	3	4	6	6	10	0	3	4	1	2	4	8	31	0	0	14	19	5	12	5	0	0	0	0	0	4	0	6	7	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EMPIDIDAE																																																							
Chelifera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.	1	0	3	3	0	4	2	16	27	12	0	0	0	0	0	0	1	11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0
TIPULIDAE																																																							
Antocha sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Hexatoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																																																							
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. II	3	0	0	1	1	2	8	9	11	6	4	6	6	12	13	3	16	31	0	0	10	31	13	24	14	12	25	34	23	10	31	21	32	55	19	1	4	5	3	6	6	10	9	9	4	7	9	17	10	6	4	7	3	3	4
EPHEMERELLIDAE																																																							
Drunella grandis	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																																																							
Cinygmula sp.	0	0	3	2	0	0	0	1	0	0	0	1	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epeorus sp.	9	7	20	15	5	2	9	2	2	4	1	4	12	5	7	6	6	14	0	0	1	4	1	1	0	0	2	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptagenia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEPTOPHLEBIIDAE																																																							
Paraleptophlebia sp.	0	0	4	4	2	2	1	6	5	0	9	2	2	0	3	1	1	0	0	0	1	1	9	5	1	0	0	1	1	0	5	1	6	0	3	0	0	0	0	0	2	0	1	0	0	1	0	2	0	1	1	0	1	1	0
PLECOPTERA																																																							
NEMOURIDAE																																																							
Amphinemura sp.	0	0	0	0	0	0	0	1	0	0	1	1	2	0	0	0	1	4	0	0	1	3	5	5	3	0	3	1	2	1	4	6	5	3	7	1	1	2	2	2	0	5	2	1	0	4	16	5	5	5	5	5	2	2	4
PERLODIDAE																																																							
Isogenoides zionensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	1	0	1	0	1	0	0	0	2	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0
Isoperla sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																																																							
BRACHYCENTRIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	3	3	14	7	5	5	4	9	1	7	1	1	12	5	12	3	1	6	0	0	0	1	1	0	4	0	2	2	1	1	3	0	0	2	2	0	0	2	1	0	0	3	1	2	0	2	0	0	5	1	4	6	3	1	1
HYDROPTILIDAE																																																							
Hydroptilila sp.	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mayatrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrotrichia sp.	0	0	0	0	0	0	0	0	0	0	11	7	10	8	9	0	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PHILOPOTAMIDAE																																																							
Wormaldia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	12	0	0	0	5	0	0	1	0	0	0	1	0	4	1	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHYACOPHILIDAE																																																							
Rhyacophila sp. I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp. II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila sp. III	0	2	1	3	1	1	2	1	1	1	1	3	1	0	4	0	1	1	0	0	1	6	3	5	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	3	1	0	0	0
MOLLUSCA																																																							
PELECYPODA																																																							
SPHAERIIDAE																																																							
Pisidium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

	JUNE 2[illegible]					JULY [illegible]					JUNE 2[illegible]					AUGUST 6					AUGUST 20					SEPTEMBER 3					SEPTEMBER 17					OCTOBER 1				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ANNELIDA																																								
HIRUDINEA																																								
RHYNCHOBDELLIDA																																								
GLOSSIPHONIIDAE																																								
Helobdella sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
ARTHROPODA																																								
ARACHNIDA																																								
ACARINA																																								
HYDRACARINA	0	0	0	0	0	8	13	10	0	3	3	0	9	0	3	0	1	0	3	0	1	0	1	5	0	4	1	2	4	4	0	1	2	3	3	4	0	0	1	0
INSECTA																																								
COLEOPTERA																																								
DRYOPIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DYTISCIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oreodytes sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELMIDAE																																								
Cleptelmis sp.	0	3	6	21	0	0	2	20	1	0	8	8	6	2	3	7	13	15	47	8	7	6	7	1	0	0	3	13	15	6	22	2	2	7	26	6	7	1	2	0
Narpus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	0	0	0	0	0	0	1	1	0	0	1	2	0	2	0	0	0	4	5	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	1	1	0	2
DIPTERA																																								
CERATOPOGONIDAE	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	5	3	14	12	3	6	9	12	5	8	10	11	22	17	32	8	8	6	24	13	0	0	3	5	0	3	3	2	12	27	3	2	2	4	3	3	7	10	4	6
EMPIDIDAE																																								
Chelifera sp.	0	0	2	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	1
EPHYDRIDAE	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	2	0	1	0	0	0
Simulium sp.	0	0	0	0	0	0	0	0	0	0	0	2	5	2	0	0	0	3	3	1	0	0	5	0	0	8	0	2	0	0	4	18	0	3	5	0	0	0	0	0
TIPULIDAE																																								
Antocha sp.	8	10	6	1	0	0	4	3	3	0	4	4	6	3	1	2	2	0	0	1	1	6	2	1	0	0	2	0	0	0	1	3	0	2	2	2	1	0	0	0
Dicranota sp.	0	2	0	2	0	0	2	2	0	0	3	2	0	2	1	0	0	0	2	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Hexatoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula sp.	0	0	0	0	1	0	2	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																																								
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. II	34	35	24	95	5	0	22	36	72	1	74	38	114	69	53	36	23	68	52	11	45	61	41	54	5	15	46	39	10	55	7	71	4	26	21	10	9	10	4	3
EPHEMERELLIDAE																																								
Drunella grandis	0	0	0	0	0	0	0	0	0	0	1	3	2	3	0	3	1	0	4	3	3	2	3	3	0	4	1	5	0	11	0	0	0	0	4	3	5	4	1	0
Ephemerella sp.	4	2	3	9	3	0	2	4	0	0	1	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
HEPTAGENIIDAE																																								
Heptagenia sp.	0	0	2	0	0	1	2	0	0	0	5	1	8	1	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0
LEPTOPHLEBIIDAE																																								
Paraleptophlebia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0
TRICORYTHIDAE																																								
Tricorythodes sp.	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	1	0	0	1	2	1	0	1	1	1	0	0	0	0	0	0
ODONATA																																								
COENAGRIONIDAE																																								
Argia sp.	0	0	0	2	0	0	0	1	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	1	0	0	1	0	0	0	1	0	0	0
PLECOPTERA																																								
NEMOURIDAE																																								
Amphinemura sp.	5	1	0	7	5	0	5	0	2	0	3	2	7	1	2	8	0	3	4	1	2	0	1	2	0	0	0	0	0	1	0	5	0	0	0	0	0	0	0	0
TRICHOPTERA																																								
BRACHYCENTRIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus americanus	5	0	0	11	0	0	3	2	1	0	2	3	11	3	1	4	0	2	5	0	2	2	14	0	0	0	0	4	4	0	5	3	3	6	0	14	20	13	2	5
Micrasema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	3	1	12	1	0	1	3	0	0	2	4	2	1	0	4	5	3	3	1	12	7	12	4	0	5	7	12	2	18	5	7	9	10	15	18	22	26	1	8
HYDROPTILIDAE																																								
Neotrichia sp.	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrotrichia sp.	2	8	8	4	5	0	7	27	8	7	10	10	6	4	2	0	3	2	4	0	1	8	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
SERICOSTOMATIDAE																																								
Gumaga griscola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	0	0	0	0	0	0	0	0	0	0
MOLLUSCA																																								
GASTROPODA																																								
PULMONATA																																								
PHYSIDAE																																								
Physa sp.	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

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	JUNE 25					JULY 9					JULY 23					AUGUST 6					AUGUST 20					SEPTEMBER 2					SEPTEMBER 17					OCTOBER 1				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ANNELIDA																																								
HIRUDINEA																																								
RHYNCHOBDELLIDA																																								
GLOSSIPHONIIDAE																																								
Helobdella sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
ARTHROPODA																																								
ARACHNIDA																																								
ACARINA																																								
HYDRACARINA	3	3	0	2	0	0	3	8	2	2	0	1	1	2	0	0	4	0	0	0	8	0	8	2	2	1	0	1	4	0	3	8	2	0	1	1	2	1	0	0
CRUSTACEA																																								
AMPHIPODA																																								
GAMMARIDAE																																								
Gammarus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0
INSECTA																																								
COLEOPTERA																																								
ELMIDAE																																								
Cleptelmis sp.	4	3	3	4	1	0	1	1	0	2	3	4	0	8	1	5	4	8	14	5	1	0	0	2	2	3	7	3	3	2	1	4	1	2	1	2	0	2	1	0
Optioservus sp.	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	2	5	2	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																																								
CERATOPOGONIDAE	0	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
CHIRONOMIDAE	8	57	17	9	15	3	8	3	26	6	12	30	14	35	11	34	23	5	7	3	0	5	4	0	0	4	4	0	1	0	7	0	0	4	5	13	19	28	8	18
EMPIDIDAE																																								
Chelifera sp.	3	8	11	5	4	0	2	2	3	1	0	0	1	1	0	0	0	1	1	1	3	0	0	0	0	0	1	1	0	0	0	0	0	1	0	2	0	0	1	0
PSYCHODIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	5	0	24	5	0	0	0	0	0	0	4	0	1	1	0	0	0	0	0	0	0	0	0	0	0
TIPULIDAE																																								
Antocha sp.	5	4	11	4	3	1	0	0	2	0	0	1	2	0	0	0	2	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Dicranota sp.	1	2	0	2	0	1	0	1	3	2	4	1	0	0	0	0	5	3	6	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hexatoma sp.	0	0	0	0	0	0	0	0	0	0	2	1	2	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Tipula sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																																								
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. II	42	18	67	33	73	5	0	5	1	1	7	2	1	1	81	74	12	95	10	22	17	8	20	6	2	79	22	26	33	31	3	5	2	4	1	0	1	0	0	0
EPHEMERELLIDAE																																								
Drunella grandis	0	0	2	0	1	1	0	0	1	0	1	0	3	1	2	4	1	4	2	3	1	1	2	0	0	0	0	0	0	2	0	0	0	0	1	0	0	2	1	0
Ephemerella sp.	8	8	9	10	14	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																																								
Heptagenia sp.	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEPTOPHLEBIIDAE																																								
Paraleptophlebia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICORYTHIDAE																																								
Tricorythodes sp.	2	1	0	1	2	0	0	1	0	3	1	0	0	0	2	7	3	1	0	0	8	3	6	3	4	0	1	0	1	0	0	1	0	1	0	0	0	2	0	0
HEMIPTERA																																								
GERRIDAE																																								
Metrobates sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ODONATA																																								
COENAGRIONIDAE																																								
Argia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	1	2	0	2	0	1	0	1	0	1	3	2	2	0	0	0	1	1	1	1
PLECOPTERA																																								
NEMOURIDAE																																								
Amphinemura sp.	2	0	1	2	8	0	0	2	0	1	8	2	1	2	8	8	15	4	5	4	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERLODIDAE																																								
Isogenoides zionensis	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																																								
BRACHYCENTRIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus americanus	0	0	0	44	0	0	1	0	0	0	0	1	0	0	1	0	1	3	2	0	3	0	0	4	0	1	3	0	0	0	0	0	0	2	1	3	7	10	2	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	5	0	3	10	2	0	0	0	0	0	0	1	1	0	0	4	12	4	14	5	2	3	6	2	5	7	7	2	3	9	1	3	2	1	0	7	3	5	4	2
HYDROPTILIDAE																																								
Neotrichia sp.	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrotrichia sp.	6	7	7	3	4	2	3	2	3	0	0	1	1	2	0	4	3	3	0	1	3	2	2	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	1
SERICOSTOMATIDAE																																								
Gumaga griscola	0	0	0	0	0	0	1	0	1	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EAST FORK VIRGIN RIVER RIVER MILE 187 CONTINUED
FINE SUBSTRATE SAMPLES 1987

	JUNE 22					JULY 6					JULY 20					AUGUST 3					AUGUST 17					AUGUST 31					SEPTEMBER 14					OCTOBER 5				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
MOLLUSCA																																								
GASTROPODA																																								
PULMONATA																																								
PHYSIDAE																																								
Physa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELECYPODA																																								
SPHAERIIDAE																																								
Pisidium sp.	0	1	0	0	0	0	0	0	0	0	3	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0

FINE SUBSTRATE SAMPLES 1987	MAY 18					MAY 28					JUNE 25					JULY 9					SEPTEMBER 3				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ANNELIDA																									
HIRUDINEA																									
RHYNCHOBDELLIDA																									
GLOSSIPHONIIDAE																									
Helobdella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ARTHROPODA																									
ARACHNIDA																									
ACARINA																									
HYDRACARINA	5	4	3	1	2	2	4	0	0	2	0	1	0	0	0	5	16	5	0	3	1	0	0	0	0
INSECTA																									
COLEOPTERA																									
DYTISCIDAE	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oreodytes sp.	0	2	4	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STAPHYLINIDAE	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLLEMBOLA																									
ENTOMOBRYIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DIPTERA																									
CERATOPOGONIDAE	0	2	0	0	0	0	0	0	0	2	3	0	1	0	0	1	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	19	28	17	35	15	5	4	5	9	5	9	10	4	0	0	0	2	1	5	0	0	0	0	0	0
DOLICHOPODIDAE	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EMPIDIDAE																									
Wiedemannia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0
EPHYDRIDAE	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUSCIDAE																									
Limnophora sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.	3	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	6	1	62	1	0	0	0	0	0
TABANIDAE																									
Tabanus sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																									
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. II	0	0	0	0	1	1	0	1	0	0	1	2	0	0	0	13	17	12	63	9	0	0	0	1	1
EPHEMERELLIDAE																									
Ephemerella sp.	5	2	2	5	1	1	1	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																									
Heptagenia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	0	0	0	0	0	0
TRICORYTHIDAE																									
Tricorythodes sp.	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	4	0	3	2	3	0	0	0	0	0
PLECOPTERA																									
PERLODIDAE																									
Isogenoides zionensis	0	0	1	1	1	1	0	2	1	1	0	0	1	0	0	1	2	0	0	0	0	0	2	0	0
TRICHOPTERA																									
HYDROPSYCHIDAE	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hydropsyche sp.	0	2	0	4	0	0	1	0	2	0	0	0	0	0	0	1	0	1	7	0	2	1	1	3	1
HYDROPTILIDAE																									
Ochrotrichia sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ARTHROPODA															
ARACHNIDA															
ACARINA															
HYDRACARINA	15	0	0	0	0	2	4	14	0	0	0	1	3	1	3
INSECTA															
DIPTERA															
CHIRONOMIDAE	47	0	0	0	0	1	6	9	0	0	7	2	3	4	1
SIMULIIDAE	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0
Simulium sp.	26	0	0	0	0	1	1	0	0	0	46	34	18	3	0
EPHEMEROPTERA															
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. II	29	0	0	0	0	1	1	2	0	0	8	4	4	1	1
EPHEMERELLIDAE															
Ephemerella sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICORYTHIDAE															
Tricorythodes sp.	0	0	0	0	0	2	1	3	0	0	0	0	0	0	0
PLECOPTERA															
PERLODIDAE															
Isogenoides zionensis	3	0	0	0	0	2	1	0	0	0	0	0	0	0	0
TRICHOPTERA															
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

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	MAY 20					MAY 29					JUNE 26					JULY 24					AUGUST 19					SEPTEMBER 18				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ARTHROPODA																														
ARACHNIDA																														
ACARINA																														
HYDRACARINA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
INSECTA																														
DIPTERA																														
ATHERICIDAE																														
Atherix sp.	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1
CHIRONOMIDAE	0	1	3	1	0	0	0	1	0	0	5	10	6	5	15	1	0	0	1	0	0	0	0	0	0	0	0	3	2	2
SIMULIIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.	0	0	0	0	1	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	2
TIPULIDAE																														
Dicranota sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																														
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. I	0	0	2	1	1	0	0	0	0	0	3	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Baetis sp. II	7	3	2	4	5	1	2	0	0	1	4	5	2	0	1	0	0	0	0	0	1	1	0	0	0	6	9	7	7	16
EPHEMERELLIDAE																														
Ephemerella sp.	0	0	5	2	10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEPTAGENIIDAE																														
Heptagenia sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICORYTHIDAE																														
Tricorythodes sp.	0	0	4	0	0	0	0	0	1	0	2	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
LEPIDOPTERA																														
PYRALIDAE																														
Petrophila sp.	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																														
BRACHYCENTRIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachycentrus americanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
HYDROPTILIDAE																														
Mayatrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EAST FORK VIRGIN RIVER
COARSE SUBSTRATE SAMPLES 1987

	RIVER MILE 161 MAY 20					MAY 29					JUNE 26					AUGUST 19					SEPTEMBER 18				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ARTHROPODA																									
ARACHNIDA																									
ACARINA																									
HYDRACARINA	0	0	0	2	4	1	0	0	0	0	2	4	0	1	0	1	0	0	0	0	0	0	0	0	0
INSECTA																									
COLEOPTERA																									
ELMIDAE																									
Microcylloepus sp.	0	0	0	0	0	0	2	0	0	2	1	1	0	0	3	0	0	0	0	0	0	0	0	0	0
Optioservus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																									
ATHERICIDAE																									
Atherix sp.	0	0	0	0	0	0	0	0	0	0	7	4	6	9	15	0	1	0	0	0	1	1	1	1	1
CERATOPOGONIDAE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	3	0	0	4	6	1	6	3	0	20	5	18	4	17	10	0	0	0	0	0	9	10	8	4	2
EMPIDIDAE																									
Wiedemannia sp.	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Simulium sp.	1	0	11	7	1	0	0	0	1	1	2	2	0	5	8	0	0	0	0	0	5	52	3	43	13
STRATIOMYIDAE																									
Caloparyphus sp.	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																									
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0
Baetis sp. I	3	11	6	6	4	4	8	6	4	3	16	24	11	21	15	0	0	0	0	0	0	0	0	0	0
Baetis sp. II	17	21	15	52	11	5	4	7	11	7	0	9	12	18	10	0	1	0	0	0	35	32	6	20	8
EPHEMERELLIDAE																									
Ephemerella sp.	20	37	6	72	11	5	10	24	16	20	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
TRICORYTHIDAE																									
Tricorythodes sp.	2	2	0	4	0	1	8	7	8	11	0	6	2	8	7	0	0	0	0	0	0	0	0	0	0
HEMIPTERA																									
VELIIDAE																									
Rhagovelia sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEPIDOPTERA																									
PYRALIDAE																									
Petrophila sp.	0	0	1	1	6	3	6	3	0	8	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
MEGALOPTERA																									
CORYDALIDAE																									
Corydalus sp.	1	0	0	0	0	0	0	0	0	0	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0
ODONATA																									
COENAGRIONIDAE																									
Argia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																									
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	2	2	0	0	0
HYDROPTILIDAE																									
Mayatrichia sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEPIDOSTOMATIDAE																									
Lepidostoma sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

FINE SUBSTRATE SAMPLES 1987

	MAY 21					MAY 29					JUNE 12					JUNE 26					JULY 10					JULY 24					AUGUST 19					SEPTEMBER 4					SEPTEMBER 18					OCTOBER 2				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ARTHROPODA																																																		
ARACHNIDA																																																		
ACARINA																																																		
HYDRACARINA	0	0	0	1	0	0	0	0	0	0	1	1	0	2	0	2	4	1	0	4	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
INSECTA																																																		
COLEOPTERA																																																		
ELMIDAE																																																		
Microcylloepus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DIPTERA																																																		
ATHERICIDAE																																																		
Atherix sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	0	0	1	1	0	0	0	0	0	0	0	1	5	3	0	2	0	2	6	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	7	0	2	0	0
EMPIDIDAE																																																		
Wiedemannia sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE	0	0	0	0	0	0	1	0	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.	2	2	2	2	1	0	0	0	0	0	4	0	3	0	0	1	0	0	0	0	6	3	3	1	1	0	1	1	1	0	0	0	0	0	0	0	0	1	2	0	0	5	1	0	2	17	1	5	0	6
EPHEMEROPTERA																																																		
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. I	0	1	3	1	1	2	4	0	1	2	2	0	5	4	0	5	3	2	5	11	2	8	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. II	5	2	9	4	2	0	0	0	0	0	2	2	0	1	0	2	5	4	3	7	5	4	4	1	9	1	3	2	1	0	0	1	1	0	0	8	1	7	8	3	2	1	16	8	2	30	1	9	2	5
EPHEMERELLIDAE																																																		
Ephemerella sp.	2	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICORYTHIDAE																																																		
Tricorythodes sp.	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	4	2	23	5	9	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
HEMIPTERA																																																		
GERRIDAE																																																		
Metrobates sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEPIDOPTERA																																																		
PYRALIDAE																																																		
Petrophila sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																																																		
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	3	1	0	3	0	0	0	0
HYDROPTILIDAE																																																		
Mayatrichia sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

COARSE SUBSTRATE SAMPLES 1987

	MAY 21					MAY 29					JUNE 12					JUNE 26					JULY 10				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ARTHROPODA																									
ARACHNIDA																									
ACARINA																									
HYDRACARINA	0	1	0	3	2	1	0	0	0	0	1	4	3	4	7	15	4	25	5	7	5	4	0	0	17
INSECTA																									
COLEOPTERA																									
ELMIDAE																									
Heterelmis sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Microcylloepus sp.	0	0	0	1	1	0	1	0	0	1	0	2	1	0	0	6	4	3	3	2	0	0	0	0	1
Optioservus sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLLEMBOLA																									
ENTOMOBRYIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DIPTERA																									
ATHERICIDAE																									
Atherix sp.	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	1	3	3	0	1	0	0	0	0	1
CERATOPOGONIDAE	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	1	2	3	1	1	0	0	2	2	0	4	3	2	1	2	3	0	3	2	3	0	0	0	3	1
DOLICHOPODIDAE	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EMPIDIDAE																									
Chelifera sp.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wiedemannia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHYDRIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUSCIDAE																									
Limnophora sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PSYCHODIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIMULIIDAE	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.	0	4	0	0	4	0	1	0	0	0	2	5	0	4	2	3	15	22	7	10	0	0	0	4	2
STRATIOMYIDAE																									
Caloparyphus sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																									
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. I	3	5	1	11	13	13	6	3	5	9	9	5	5	7	8	16	12	6	3	7	5	8	9	3	9
Baetis sp. II	14	15	4	48	28	24	0	6	0	2	4	5	4	6	14	11	4	11	9	7	3	4	1	4	4
EPHEMERELLIDAE																									
Ephemerella sp.	6	0	1	43	35	9	0	5	3	1	0	0	1	1	4	0	2	1	0	0	0	0	0	0	0
TRICORYTHIDAE																									
Tricorythodes sp.	9	5	6	52	22	12	0	8	1	5	7	3	2	3	15	19	21	5	3	10	0	4	0	0	6
LEPIDOPTERA																									
PYRALIDAE																									
Petrophila sp.	0	0	0	1	2	1	4	5	0	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
MEGALOPTERA																									
CORYDALIDAE																									
Corydalus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	3	0	3	1
TRICHOPTERA																									
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	0	0	0	0	1	2	0	0	0	0	1	2	0	0	0	0	1	0	0	0	0	1	0	0	0
HYDROPTILIDAE																									
Leucotrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mayatrichia sp.	0	0	0	0	1	0	0	0	0	0	0	1	0	1	3	2	4	3	1	3	0	0	1	0	0
Ochrotrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
POLYCENTROPIDAE																									
Polycentropus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

	AUGUST 19					SEPTEMBER 4					SEPTEMBER 18					OCTOBER 2				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ARTHROPODA																				
ARACHNIDA																				
ACARINA																				
HYDRACARINA	0	0	0	1	0	1	4	2	0	1	0	3	0	1	0	4	5	6	0	0
INSECTA																				
COLEOPTERA																				
ELMIDAE																				
Heterelmis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Microcylloepus sp.	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Optioservus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLLEMBOLA																				
ENTOMOBRYIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA																				
ATHERICIDAE																				
Atherix sp.	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	1	0	0	0
CERATOPOGONIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE	0	0	0	0	0	0	4	0	0	0	0	2	5	2	1	52	31	22	16	2
DOLICHOPODIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EMPIDIDAE																				
Chelifera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wiedemannia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
EPHYDRIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUSCIDAE																				
Limnophora sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PSYCHODIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
SIMULIIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium sp.	0	0	0	0	0	1	4	3	0	5	0	1	2	0	0	0	7	0	0	0
STRATIOMYIDAE																				
Caloparyphus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA																				
BAETIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis sp. II	0	1	2	3	0	25	29	37	17	7	3	3	5	0	2	6	9	5	2	3
EPHEMERELLIDAE																				
Ephemerella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICORYTHIDAE																				
Tricorythodes sp.	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2	2	0
LEPIDOPTERA																				
PYRALIDAE																				
Petrophila sp.	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MEGALOPTERA																				
CORYDALIDAE																				
Corydalus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																				
HYDROPSYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheumatopsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsyche sp.	2	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	1	0
HYDROPTILIDAE																				
Leucotrichia sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Mayatrichia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrotrichia sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
POLYCENTROPIDAE																				
Polycentropus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0