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NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

**LONG-TERM RECEIVING WATER STUDY  
DATA COMPENDIUM:  
AUGUST 1998 TO SEPTEMBER 1999**

**TECHNICAL BULLETIN NO. 843  
MAY 2002**

by  
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## PRESIDENT'S NOTE

In 1998 NCASI implemented a full range of sampling and data collection as part of the Long-Term Receiving Water Studies (LTRWS) at three different receiving waters: Codorus Creek in south central Pennsylvania, and the McKenzie and Willamette Rivers in western Oregon. The objectives of this on-going 10- to 20-year study are (1) to provide the industry short-term and long-term information as to whether there are differences in aquatic communities upstream/downstream of representative point source effluent discharges from pulp and paper mills; and (2) to determine the significance of these differences, if there are any. The practical applications within these broad objectives include: creating a database that demonstrates the natural temporal and spatial variability of abiotic and biotic properties of the study streams; studying the margin of safety for effluent addition to the stream; identifying changing receiving water conditions that might arise following possible future changes in mill processes or effluent treatment; and providing an early indication of possible subtle effluent effects that might not otherwise be known. To accomplish these goals the LTRWS created an experimental design that included a flexible monitoring and data collection program. By characterizing the aquatic communities, the river waters and the mill effluent discharges at multiple sites along an upstream/downstream stretch of each river, the experimental design provides for a comprehensive representation of the receiving waters.

This report presents summaries of the monitoring parameters for the first year of the study, covering the study year from August 1998 to September 1999, for the three rivers then included in the LTRWS. Note that in most cases these are not the detailed data sets, but rather graphs and tables that illustrate the results of the first year of data collection. Also included are maps, photographs and descriptions of each monitoring location to illustrate the sampling plan. As demonstrated in the following pages, these summaries present a systematic picture of the extent and coverage of the data collection.

Additional reports will be issued over the course of the study. These will include annual data summaries similar to this one for each water year in the study, as well as reports specifically directed at the analysis and interpretation of the LTRWS data base to address effluent effects questions identified in the goals of the study.

A handwritten signature in black ink, appearing to read "Ron A. Yeske".

Ronald A. Yeske

May 2002



# **LONG-TERM RECEIVING WATER STUDY DATA COMPENDIUM: AUGUST 1998 TO SEPTEMBER 1999**

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MAY 2002**

## **ABSTRACT**

The NCASI Long-Term Receiving Water Study (LTRWS), a 10- to 20-year project involving four different U.S. receiving waters, was begun in 1998. One of the chief LTRWS objectives is to evaluate possible differences in the aquatic communities upstream/downstream of representative point source effluent discharges from pulp and paper mills. Within this goal are specific objectives which include: 1) identifying the extent of natural temporal and spatial variability of abiotic and biotic properties of the study streams, 2) defining the margin of safety for effluent addition to the streams, 3) identifying changes in receiving water conditions that might arise following possible future changes in mill process or effluent treatment, and 4) providing an early indication of possible subtle effluent effects that might not otherwise be known. In addition, the LTRWS may serve as a study template for others to use in carrying out monitoring in other receiving waters. The experimental design includes multiple sampling sites and variables for each of the receiving waters in the study. The measured components include water and effluent chemistry, characterization of the effluents with chronic bioassays, river temperature and flow, solar radiation, and detailed measurements of the periphyton, benthic macroinvertebrates and fish communities. This report summarizes the data collected during the first year of the study, from August 1998 to September 1999, for the three rivers then included in the study: Codorus Creek, Pennsylvania; the McKenzie River, Oregon; and the Willamette River, Oregon. Similar reports will be issued for each monitoring year of the LTRWS. Additional reports will be issued over the course of the study directed at the interpretation of the data with respect to addressing effluent effects questions identified in the study objectives.

## **KEYWORDS**

data summary, Long-Term Receiving Water Study

## **RELATED NCASI PUBLICATIONS**

Technical Bulletin No. 842 (February 2002). *Integrated Long-Term Receiving Water Studies: Site selection process and a description of the selected study sites.*

Technical Bulletin No. 841 (February 2002). *A compendium of field methods used in NCASI Long-Term Receiving Water Studies.*

Technical Bulletin No. 833 (September 2001). *Evaluation of nutrient criteria and response variables based upon the NCASI Long-Term Receiving Water Study experience.*

Technical Bulletin No. 829 (July 2001). *The effects of a bleached kraft mill effluent on periphyton and macroinvertebrates in streamside mesocosm studies.*

Technical Bulletin No. 828 (July 2001). *The effects of an unbleached kraft mill effluent on periphyton and macroinvertebrates in streamside mesocosm studies.*



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## **LONG-TERM RECEIVING WATER STUDY DATA COMPENDIUM: AUGUST 1998 TO SEPTEMBER 1999**

### **1.0 INTRODUCTION**

This report summarizes the data collected during the first year (1998 to 1999) of the Long-Term Receiving Water Study (LTRWS), a 10- to 20-year industry supported project. Annual summaries of the data will be issued throughout the lifetime of this study. Additional bulletins containing analysis of specific components in addressing study objectives will be issued separately.

The LTRWS involves four different U.S. receiving waters, including Codorus Creek in Pennsylvania (Figure 2.1), and two rivers in Oregon, the McKenzie River (Figure 2.9) and the Willamette River (Figure 2.15). A fourth river, the Leaf River in Mississippi, was added to the LTRWS in 2000, and will be covered in later annual summaries. These locations represent warm and coldwater stream types, as well as streams ranging from effluent-dominated to those that are more typical of industry receiving waters. Mill process types represented in the LTRWS include both bleached and unbleached kraft. Studies now underway at these locations provide an opportunity to complete before/after process change comparisons for these mills as they go undergo “cluster rule” or other process or effluent treatment changes in the future. A detailed description of the site selection process for the LTRWS was presented in Hall et al. (1999) and NCASI (2002b).

The scope and framework for these studies were developed based on input from a committee of industry representatives with knowledge and skills in aquatic biology and environmental issues related to mill effluent discharges. Two broad objectives were established: 1) to determine whether there were detectable differences in biological monitoring parameters upstream and downstream of mill effluent discharges, and 2) to determine the significance of these differences in terms of broader river ecological functioning. Specific project goals included: 1) addressing temporal variability over a 10- to 20-year timeline, 2) addressing spatial variability along upstream/downstream river gradients, 3) identifying the margin of safety for effluent addition, 4) investigating possible changes in effluent effects that might arise from mill process or effluent treatment changes, 5) providing an early indication of adverse effects by carrying out a study of exceptional depth and detail, and 6) providing a study template for use by others. Hall and Miner (1997) reported further details of the LTRWS scope and framework as well as other study attributes which were considered to be desirable.

To address the objectives and goals of the study, the experimental design needed to be broad, incorporating multiple spatial and temporal scales; field and laboratory assays; and biotic and abiotic components. The spatial aspect included multiple upstream/downstream sampling sites to address spatial variation, and also components to address responses on different spatial scales, from in-stream habitat evaluations to watershed-based risk assessments. The temporal scale was incorporated through sampling schedules to address seasonal variation and long-term annual variations. Field studies included in-stream or streamside monitoring of abiotic (water temperature, water flow, and solar radiation), and biotic (periphyton, benthic macroinvertebrates and fish) components. Laboratory evaluations included water chemistry and effluent chronic bioassays. A more detailed description of the experimental design is given in NCASI Technical Bulletin No. 842 (2002b).

This compendium gives a brief outline of the sampling schedule and the sampling design for each river (Section 2) including a general list of sampling sites for each LTRWS river. A short description of the field methods is provided at the start of each section of data (Section 3). A complete description of the LTRWS sites and field methods is presented in NCASI Technical Bulletin No. 841 (2002a).

## **2.0 APPROACH**

### **2.1 Sampling Schedule**

The sampling schedules for the biotic and abiotic components of the study were set to maximize the ability to analyze temporal variations within and between different sets of study variables. Sampling for water quality was set on a monthly basis in order to provide reasonably detailed patterns for each river's natural and industry-related seasonal variations. The biotic samples were less frequent, set quarterly, to accommodate the slower response time of organisms to seasonal and environmental changes. When possible, all the biotic components were sampled within the same time frame. However, the fish sampling was done by a separate team, and occasionally sampling was at a different time, up to several weeks apart, from other fieldwork.

**Table 2.1.** Sampling Schedules: a) Water Quality Samples b) Periphyton and Benthic Macroinvertebrate Samples c) Fish Samples

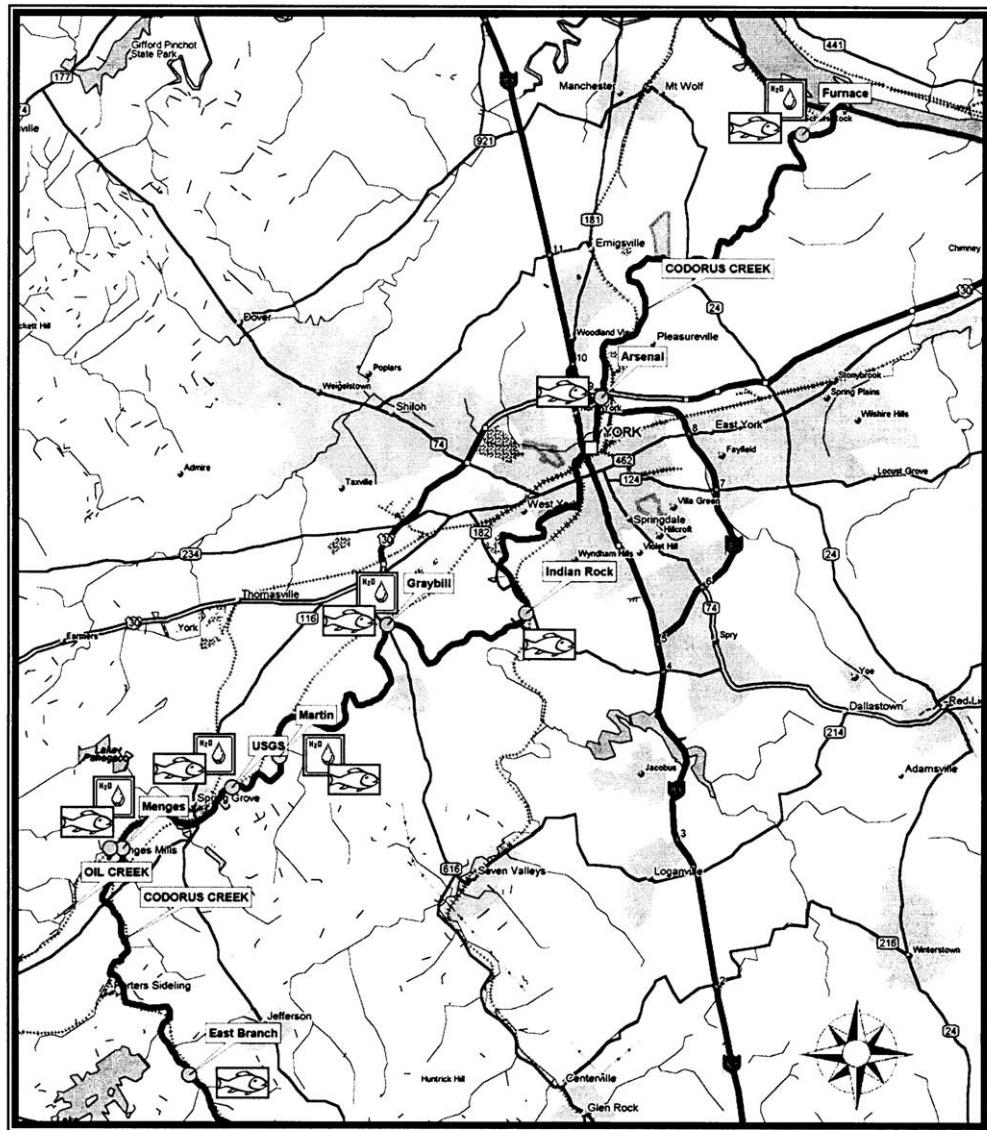
<b>a) Water Quality</b>		
<b>McKenzie</b>	<b>Willamette</b>	<b>Codorus</b>
8/25/98	8/25/98	8/25/98
9/22/98	9/22/98	9/22/98
10/20/98	10/20/98	10/20/98
11/17/98	11/17/98	11/17/98
12/15/98	12/15/98	12/15/98
1/12/99	1/12/99	1/12/99
2/2/99	2/2/99	2/2/99
3/23/99	3/23/99	3/23/99
4/20/99	4/20/99	4/20/99
5/18/99	5/18/99	5/18/99
6/22/99	6/22/99	6/22/99
7/6/99	7/6/99	7/6/99
8/17/99	8/17/99	8/17/99

<b>b) Periphyton/Benthic Macroinvertebrates</b>		
<b>McKenzie</b>	<b>Willamette</b>	<b>Codorus</b>
8/11-12/98	8/18-19/98	8/31-9/4/98
		10/27/98
11/12/98	11/10/98	
		3/16/99
		6/8-10/99
7/8-9/99	7/6-7/99	

<b>c) Fish</b>		
<b>McKenzie</b>	<b>Willamette</b>	<b>Codorus</b>
	8/12-20/98	
9/14-16/98		9/2-3/98
		11/19-20/98
12/16-18/98	12/12-15/98	
		3/26-27/99
3/17-18/99	2/16-18/99	
		6/6-7/99
6/19-20/99	6/16-18/99	

## 2.2 Codorus Creek Sampling Site Locations

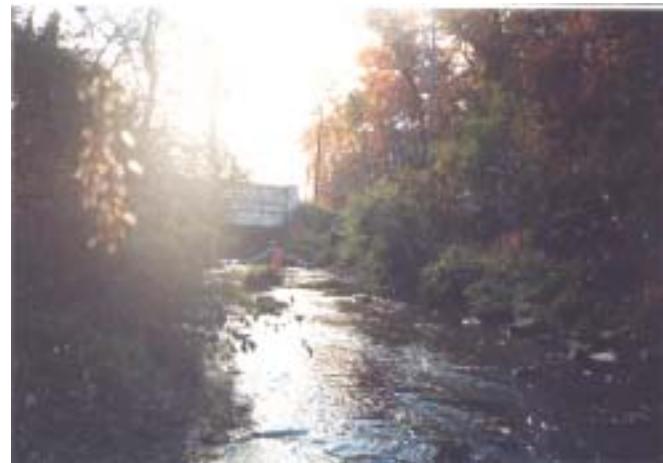
The mill is located at Spring Grove, Pennsylvania, along the West Branch of Codorus Creek. Sampling locations along the Creek were chosen to represent conditions upstream and downstream of the effluent discharge, as well as to assess influences of nearby tributaries (Figure 2.1). Five of the sites (East Branch, Menges, USGS, Martin and Graybill) were located on the West Branch of Codorus Creek and the three remaining sites (Indian Rock Dam, Arsenal and Furnace) were on the main stem below the confluence of the West Branch with the South and East Branches. Unless otherwise noted, sites were sampled for both biotic and abiotic components. The furthest upstream site, East Branch (located on the East Fork of the West Branch), was classified by the Pennsylvania Fish and Boat Commission as a cold water trout stream and is located upstream of the hypolimnetic discharge from Lake Marburg; this site was sampled for biotics only. Menges Mills was an additional cold water site downstream of the Lake Marburg discharge and just upstream of the confluence of the West Branch with a tributary, Oil Creek. One sampling site was located on the Oil Creek tributary, for water quality sampling only. The next site downstream from Menges Mills was USGS, a warm-water site downstream of the mill non-contact water discharge in Spring Grove. The mill effluent enters Codorus Creek below USGS and above Martin. All sites downstream of the mill effluent outfall are classified as warm water sites. Martin was located 2.2 river Km downstream of the effluent outfall. The next site was Graybill, 10 river Km downstream from the effluent and just upstream from the confluence of the three branches of Codorus Creek. The first site on the main stem, Indian Rock Dam, was sampled for fish only. Arsenal Bridge was located just downstream of the City of York. Codorus Furnace was located just before Codorus Creek joins the Susquehanna River. Figures 2.2 through 2.8 show views looking upstream from the periphyton/macroinvertebrate sites for each of the quarterly/seasonal samples.



**Figure 2.1** Codorus Creek LTRWS Area  
Fish symbols = biological monitoring sites; water drop symbols = water quality sites



September 1998



October 1998



March 1999



June 1999

**Figure 2.2** East Branch, Codorus Creek, Upstream View



September 1998



October 1998



March 1999



June 1999

**Figure 2.3** Menges, Codorus Creek, Upstream View



September 1998



October 1998



March 1999



June 1999

**Figure 2.4** USGS, Codorus Creek, Upstream View

September 1998

No photo available



October 1998



March 1999



June 1999

**Figure 2.5** Martin, Codorus Creek, Upstream View



September 1998



March 1999

October 1998

No photo available



June 1999

**Figure 2.6** Graybill, Codorus Creek, Upstream View



September 1998



October 1998



March 1999



June 1999

**Figure 2.7** Arsenal, June 1999, Upstream View



September 1998



October 1998



March 1999

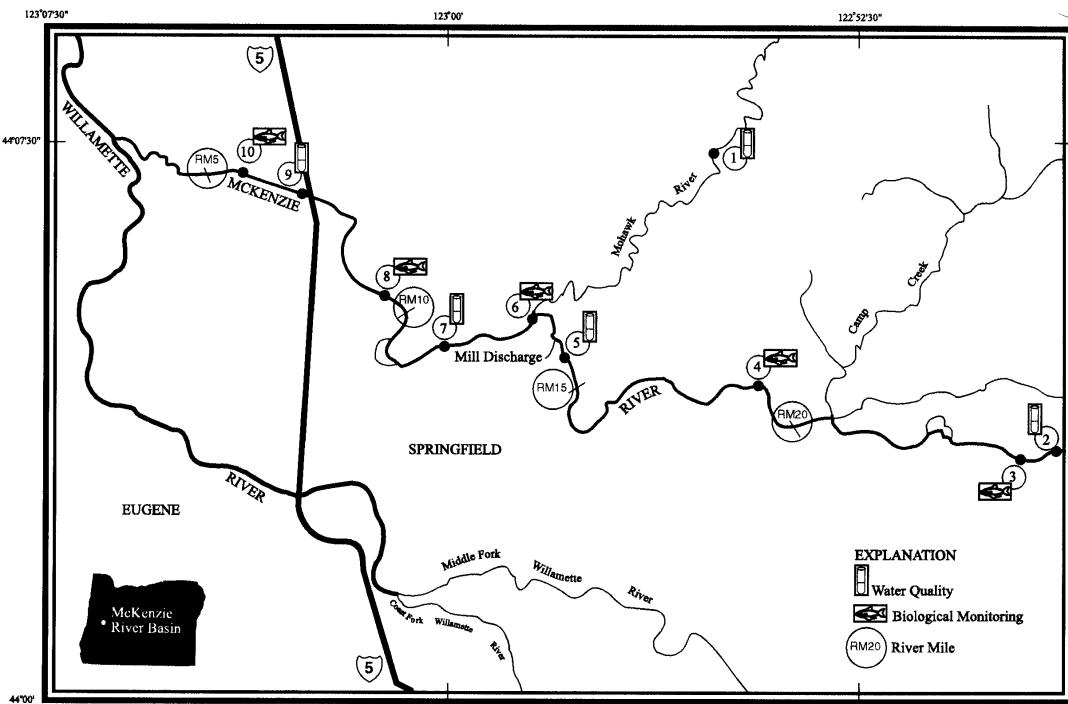


June 1999

**Figure 2.8** Furnace, Codorus Creek, Upstream View

## 2.3 McKenzie River Sampling Site Locations

The mill on the McKenzie River is located in Springfield, Oregon. Sampling sites were chosen to represent conditions upstream and downstream of the effluent discharge, as well as to assess potential influences from nearby tributaries (Figure 2.2). The mill effluent enters the river between RM 14.7 and the Hayden Bridge. The upstream sites were Deerhorn, Hendricks Bridge, Waltermville, Bellinger's and Hayden Bridge. The site furthest upstream was Deerhorn, at RM 30.0; this was sampled for fish only. The next site downriver was Hendricks Bridge at RM 22.4 and 14.8 river Km above the mill discharge. The areas were sampled in the vicinity of the Hendricks Bridge, one for water quality, one for fish, and one for macroinvertebrates and periphyton. The next site was Waltermville at RM 20.5, sampled for macroinvertebrates and periphyton only. Bellinger's at RM 18.5 was 5.5 river Km above the discharge; this site was sampled for biotic components only. Hayden Bridge was immediately above the discharge and was monitored for water quality only. The three sites downstream of the effluent discharge were the Mohawk River confluence, Harvest Lane and Armitage State Park. The Mohawk River confluence site at RM 14 was 1.8 river Km downstream of the mill discharge and located at the confluence of the Mohawk with the McKenzie. This site was monitored for all components. The Harvest site at RM 10 was between 6 and 7 river Km downstream and has two close areas, one sampled for water quality and the other for biotics. Armitage (also called Coburg Bridge) at RM 6 was 12 to 13 river Km downstream and had two areas, one monitored for biotic and one for abiotic components. Below Armitage, the McKenzie joins the Willamette River. The Mohawk River, which enters the McKenzie just above the Mohawk confluence site, had one site which was sampled for water quality only, located several kilometers upstream of the confluence. Figures 2.10 through 2.14 show upstream views of the five sites sampled for periphyton/macroinvertebrates taken during the quarterly sampling dates.



**Figure 2.9** McKenzie River LTRWS Area  
RM represents River Mile above the Willamette River. Numbers indicate LTRWS sample locations.

August 1998

No photo available



February 1999



November 1998



July 1999

**Figure 2.10** Hendricks RM 22.4, McKenzie River, Upstream View

August 1998

No photo available



November 1998

February 1999

No photo available



July 1999

**Figure 2.11** Bellingers RM 18.5, McKenzie River, Upstream View



August 1998



November 1998



February 1999



July 1999

**Figure 2.12** Mohawk RM 14, McKenzie River, Upstream View



August 1998



November 1998



February 1999



July 1999

**Figure 2.13** Harvest RM 10, McKenzie River, Upstream View



August 1998



November 1998



February 1999

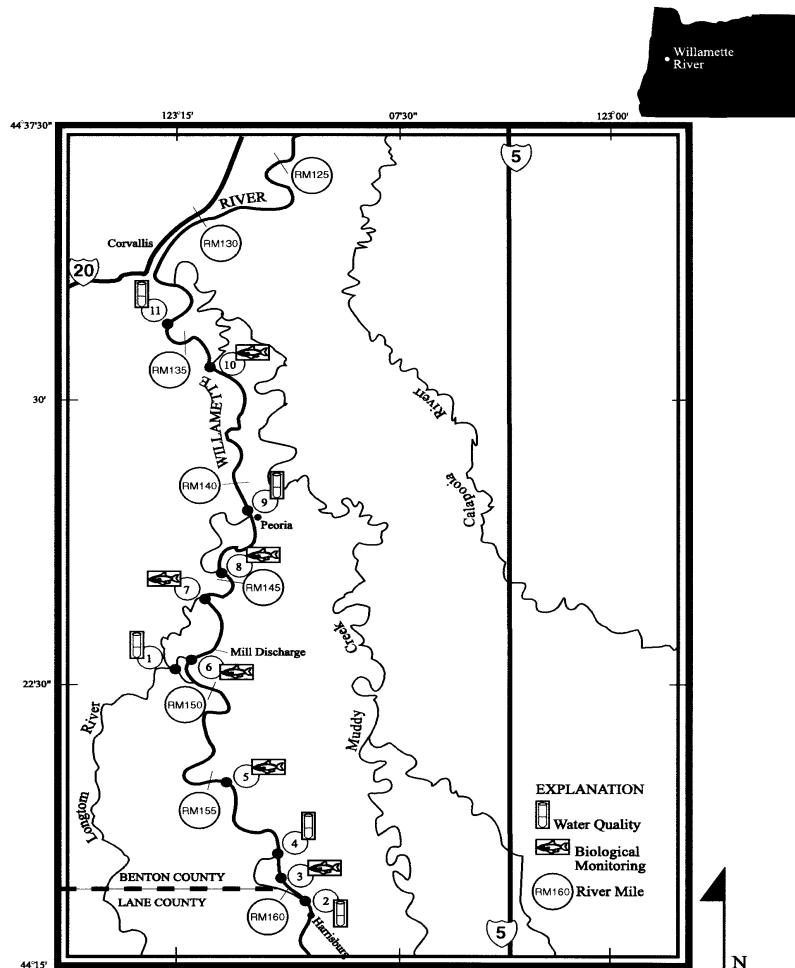


July 1999

**Figure 2.14** Armitage RM 6, McKenzie River, Upstream View

## 2.4 Willamette River Sampling Site Locations

The local mill on the Willamette River is located near Halsey, Oregon. Sampling sites were chosen to represent conditions upstream and downstream of the effluent discharge, as well as to assess any influences from nearby tributaries (Figure 2.3). There were four main sites (Whitely, Harrisburg, Cartney and Intake) upstream of the mill discharge and four main sites downstream (Snag Boat, Peoria, Willamette Park and Corvallis). The site furthest upstream was Whitely at RM 176, located upstream of the confluence of the McKenzie and Willamette Rivers; this site was sampled for macroinvertebrates and periphyton. A boat electrofishing site was located at RM 168.5. The Harrisburg site (at RM 160 and 23.6 river Km above the discharge) and the Cartney site (at RM 156 and 20.4 river Km above the effluent discharge) were both sampled for all components. Another boat electrofishing site was located at RM 148.5. The Intake site at RM 148 was located just above the effluent discharge (0.9 river Km above) and was sampled for macroinvertebrates and periphyton. Snag Boat, at RM 143.5 and 3.7 river Km below the effluent discharge, was sampled for all the biotic components. The August 1998 sample for macroinvertebrates and periphyton was taken at Sam Daws Bend at RM 146 and 3.7 miles below the discharge, thereafter it was sampled at Snag Boat. Peoria, at RM 141 and 10.2 river Km below the effluent discharge, was sampled for water quality only. Another boat electrofishing site was located at RM 136. The Willamette Park site (at RM 134) was sampled for all the biotic components. The furthest downstream site, Corvallis, at RM 128 and 23.9 river Km downstream from the effluent discharge, was sampled for water quality, macroinvertebrates and periphyton. A site on the Long Tom River, just above the confluence with the Willamette, was sampled for water quality. Figures 2.16 through 2.22 show upstream views of the sites sampled for periphyton and macroinvertebrates taken during the quarterly sample dates.



**Figure 2.15** Willamette River LTRWS Area

RM represents River Mile above Columbia River. Numbers indicate LTRWS sample locations.

August 1998

No photo available



November 1998



February 1999



July 1999

**Figure 2.16** Whitely RM 176, Willamette River, Upstream View



August 1998



November 1998



February 1999



July 1999

**Figure 2.17** Harrisburg RM 160, Willamette River, Upstream View



August 1998



November 1998

February 1999

No photo available



July 1999

**Figure 2.18** Cartney RM 156, Willamette River, Upstream View



August 1998



November 1998

February 1999

No photo available



July 1999

**Figure 2.19** Intake RM 148, Willamette River, Upstream View

August 1998

No photo available



February 1999

No photo available



July 1999

**Figure 2.20** Snag Boat RM 143.5, Willamette River, Upstream View



August 1998



November 1998



February 1999



July 1999

**Figure 2.21** Willamette RM 134, Willamette River, Upstream View



August 1998



November 1998

February 1999

No photo available



July 1999

**Figure 2.22** Corvallis RM 128, Willamette River, Upstream View

### 3.0 METHODS AND RESULTS

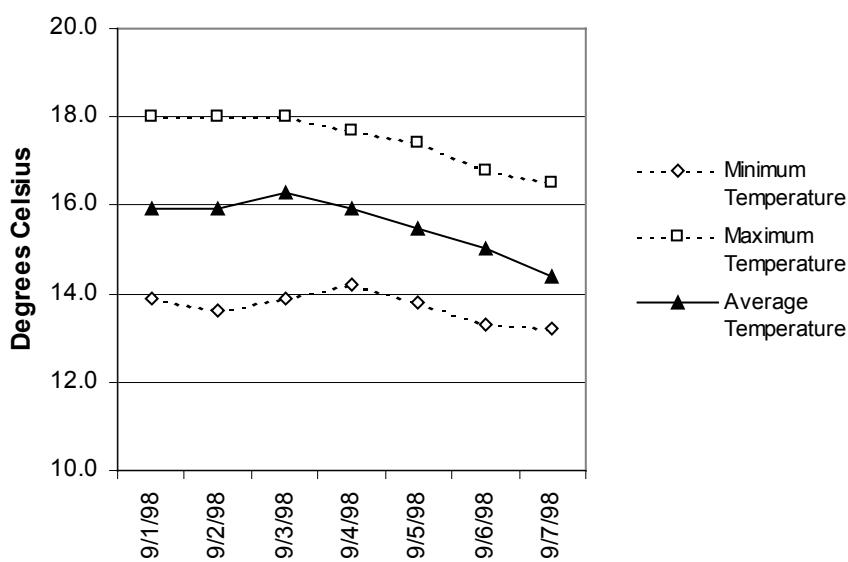
#### 3.1 Water Temperature

In-river temperature was recorded using Vemco Minilog-T data loggers placed near the mill discharge points in the Willamette and McKenzie Rivers. The dataset is limited for the McKenzie River due to loss or vandalism of the data loggers. No data logger was placed in Codorus Creek during this sampling period.

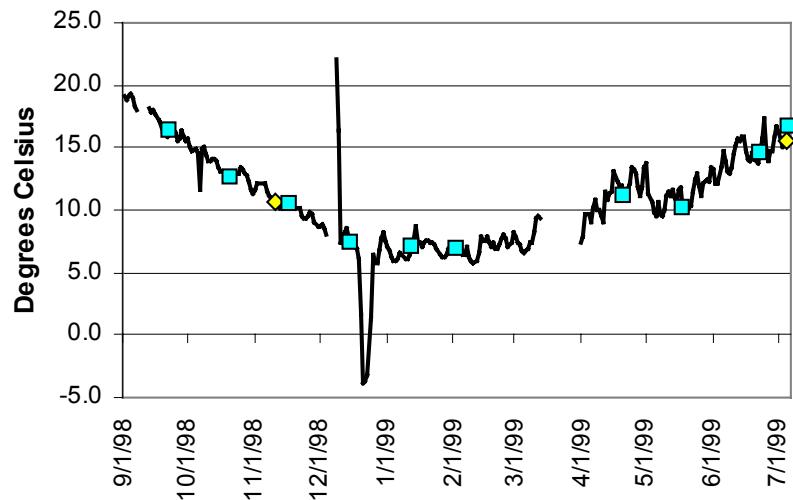
**Table 3.1** McKenzie River Water Temperature (°C)

<b>McKenzie River</b>		°Celsius		
<b>Date</b>		<b>Minimu</b>	<b>Maximu</b>	<b>Averag</b>
9/1/9		13.9	18.0	15.9
9/2/9		13.6	18.0	15.9
9/3/9		13.9	18.0	16.3
9/4/9		14.2	17.7	15.9
9/5/9		13.8	17.4	15.5
9/6/9		13.3	16.8	15.0
9/7/9		13.2	16.5	14.4

\*limited data due to loss/vandalism of data loggers



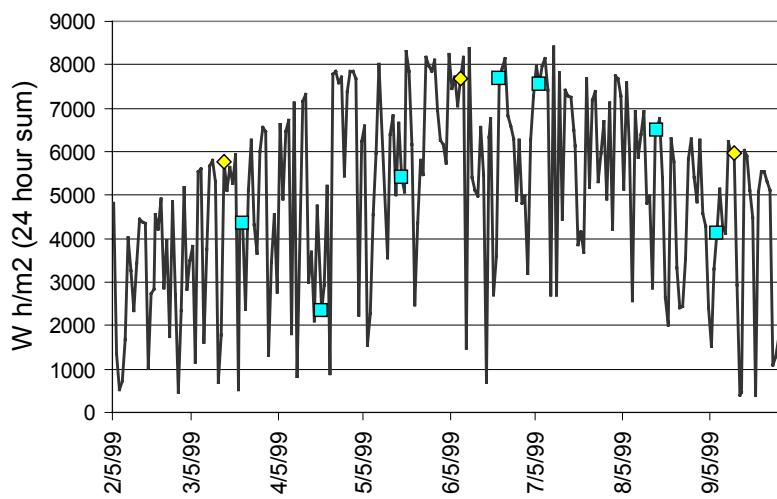
**Figure 3.1.** McKenzie River Water Temperature (°C) Recorded at Weyerhaeuser Discharge near Hayden Bridge



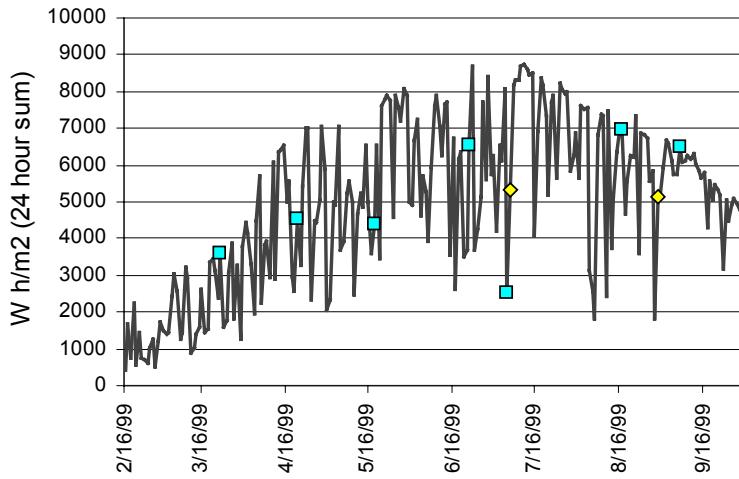
**Figure 3.2** Willamette River Mean Water Temperatures ( $^{\circ}\text{C}$ ) for the 1998 to 1999 Sampling Season Recorded South of Peoria, Downstream of the Pope and Talbot Discharge. LTRWS sampling dates are indicated by symbols (squares for water and diamonds for biological samples).

### 3.2 Solar Radiation

Solar radiation measurements were made using LI-COR LI-200SA pyranometer sensors placed near the mill effluent outfall locations for Codorus Creek (Spring Grove, Pennsylvania) and the Willamette River (Halsey, Oregon). The pyranometers were deployed in February of 1999. They measured the solar radiation between 400 nm and 1100 nm wavelength every three hours. The data were stored and periodically downloaded in conjunction with fieldwork. The output was the 24 h sum of the measurements, in  $\text{W} \cdot \text{h}/\text{m}^2/24 \text{ h}$ .



**Figure 3.3.** Solar Radiation Recorded at Spring Grove, Pennsylvania, February 1999 to October 1999. LTRWS sampling dates are indicated by symbols (squares for water and diamonds for biological samples).

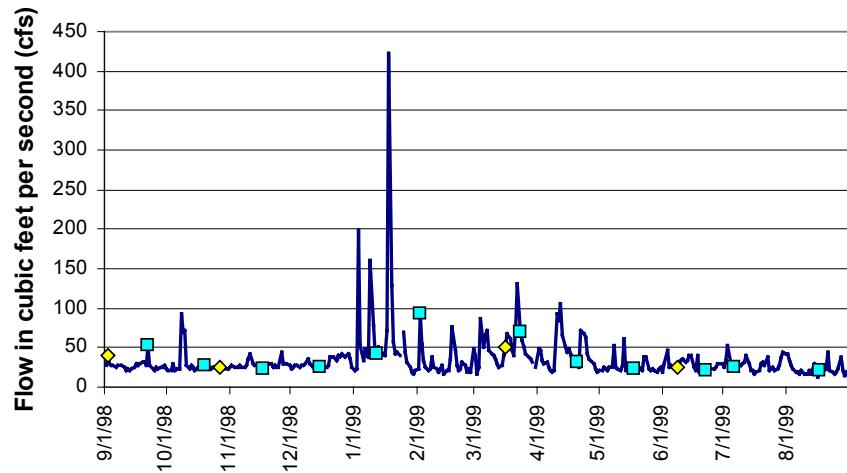


**Figure 3.4** Solar Radiation Recorded at Halsey, Oregon, February 1999 to October 1999. LTRWS sampling dates are indicated by symbols (squares for water and diamonds for biological samples).

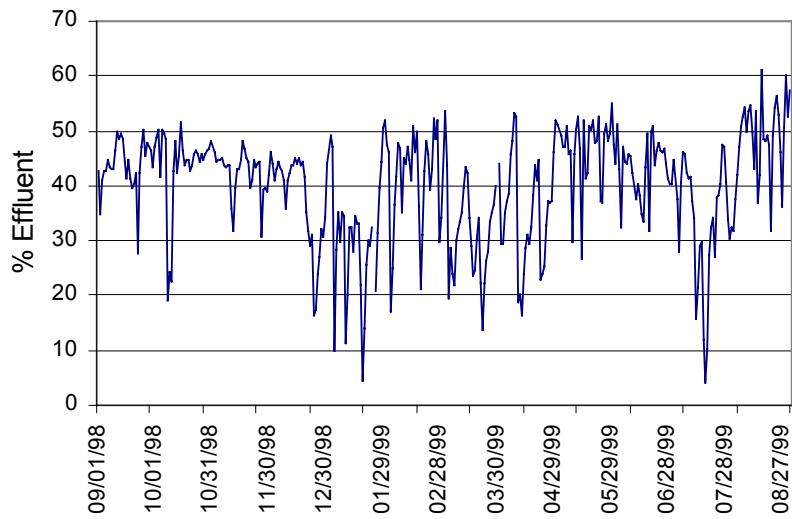
### 3.3 Water Flow

River flow data were obtained from the US Geological Survey (USGS) web site. Reported values were daily flow in cubic feet per second (cfs) and feet above datum. The measurements for Codorus Creek were taken from the USGS gauging station at Spring Grove, Pennsylvania, McKenzie River data from the station at Vida, Oregon, and Willamette data from the station at Harrisburg, Oregon.

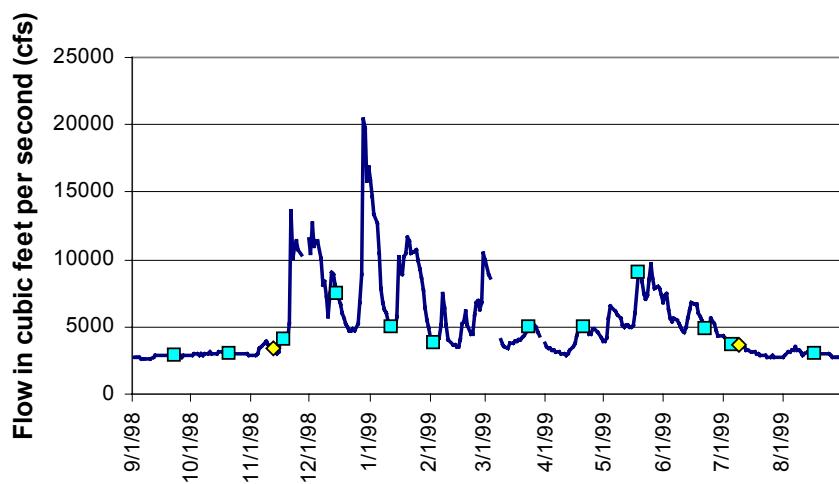
In-stream waste concentration was calculated as percent effluent from the daily amount of effluent discharged from the plant in million gallons per day, converted to instream flow in cfs, and the river flow plus the effluent cfs. The values represent the theoretical effluent concentration at the point of discharge without any consideration for jet or diffuser dynamics or mixing.



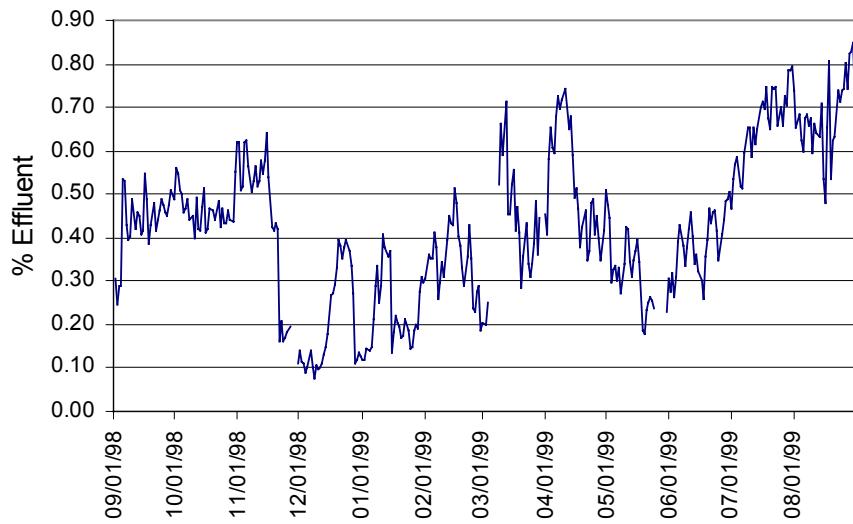
**Figure 3.5** Codorus Creek Water Flow from September 1998 to September 1999. LTRWS sampling dates are indicated by symbols (squares for water samples and diamonds for biological samples).



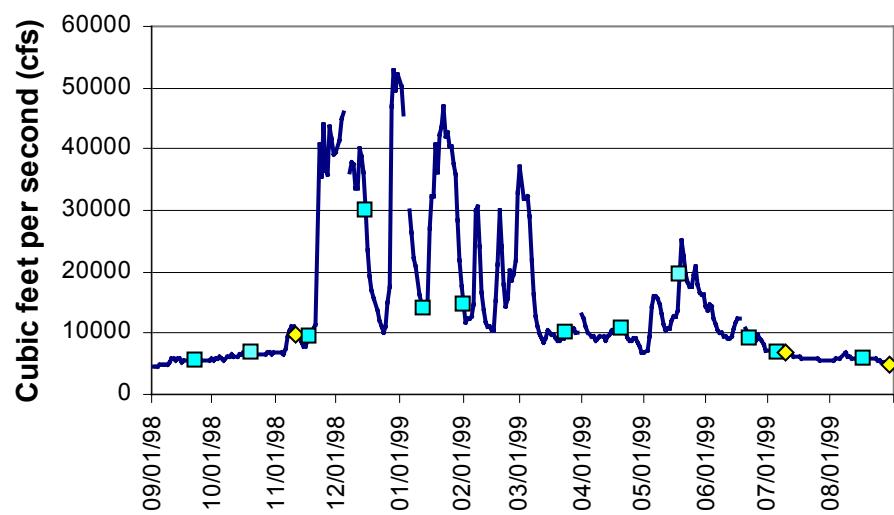
**Figure 3.6** Codorus Creek Instream Waste Concentration (% effluent) from September 1998 to September 1999



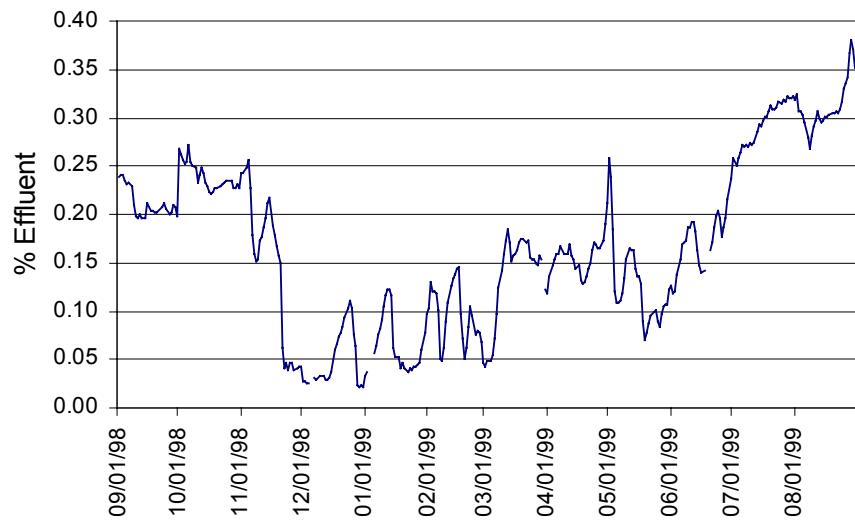
**Figure 3.7** McKenzie River Flow from September 1998 to September 1999. LTRWS sampling dates are indicated by symbols (squares for water samples and diamonds for biological samples).



**Figure 3.8** McKenzie River Instream Waste Concentration (% effluent) from September 1998 to September 1999



**Figure 3.9** Willamette River Flow from September 1998 to September 1999. LTRWS sampling dates are indicated by symbols (squares for water samples and diamonds for biological samples).



**Figure 3.10.** Willamette River Instream Waste Concentration (% Effluent)

### 3.4 Water Chemistry

Water quality samples were taken monthly on each LTRWS river. The sites for each river were sampled on the same day, in a downstream to upstream direction. They were sub-surface grab samples taken approximately six inches below the surface in acid-washed bottles. The samples were shipped cold to the Anacortes Northwest Aquatic Biology Facility (NABF) within 24 hours and processed within 48 hours. All the water quality analysis in this report was done at the NABF.

### 3.4.1 Codorus Creek Water Chemistry

**Table 3.2** Codorus Creek pH

Date	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99	8/17/99
Menges Mill	7.2	7.4	7.6	7.3	7.0	7.5	7.2	7.3	7.3	7.3	7.3
USGS Gaging Station	7.4	7.6	7.7	7.5	7.2	7.6	7.7	7.4	7.4	7.7	7.7
Martin Bridge	7.6	7.5	7.7	7.6	7.6	7.5	7.8	7.6	7.7	7.6	7.6
Graybill Rd. Bridge	7.6	7.7	7.6	7.6	7.7	7.5	7.7	7.6	7.6	7.8	7.7
Furnace	7.6	7.9	8.0	7.7	7.8	7.6	8.0	7.8	7.8	8.0	8.0
Oil Creek	7.4	7.9	7.8	7.9	8.0	7.5	7.8	7.7	7.9	8.0	8.1

**Table 3.3** Codorus Creek Temperature (°C)

Date	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99	8/17/99
Menges Mill	15.4	10.4	10.6	5.8	1.7	3.0	4.7	8.5	12.8	12.0	12.9
USGS Gaging Station	19.9	16.0	13.6	8.1	2.4	6.2	7.2	11.0	17.0	17.0	22.1
Martin Bridge	22.5	20.4	18.4	14.2	8.6	10.1	9.7	16.3	22.0	21.6	25.7
Graybill Rd. Bridge	24.1	17.7	15.2	10.0	6.0	8.3	8.5	12.5	18.8	20.0	23.4
Furnace	23.0	15.3	11.7	5.7	2.3	5.7	7.3	10.5	18.5	19.0	22.8
Oil Creek	21.8	13.0	10.0	3.5	0.4	4.6	4.7	8.9	15.3	17.1	21.0

**Table 3.4** Codorus Creek Color (Pt-Co units)

Date	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99	
Menges Mill	53	10	6	3	2	19	18	13	13	7	7
USGS Gaging Station	17	12	25	7	9	24	23	21	17	17	17
Martin Bridge	66	128	190	135	102	99	74	188	142	104	104
Graybill Rd. Bridge	136	118	214	140	92	104	61	128	120	96	96
Furnace	60	54	58	63	60	54	33	48	40	37	37
Oil Creek	51	21	21	16	38	19	18	19	15	12	12

**Table 3.5** Codorus Creek Conductivity (uS/cm)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99	7/17/99
Menges Mill	171	166	155	166	163	202	196	184	170	161.1	160.8
USGS Gaging Station	273	291	312	276	290	319	288	317	322	281	242
Martin Bridge	537	955	1199	1144	877	782	647	1204	1038	890	965
Graybill Rd. Bridge	867	909	1193	1195	850	777	561	940	945	880	1040
Furnace	353	650	689	781	627	637	377	514	932	628	687
Oil Creek	263	849	909	978	620	650	406	490	718	782	1111

**Table 3.6** Codorus Creek Turbidity (NTU)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99	7/17/99
Menges Mill	67	7	4	7	6	27	6	3	8	9	11
USGS Gaging Station	32	11	11	15	6	19	14	9	20	24	14
Martin Bridge	54	8	7	9	11	23	12	9	16	19	12
Graybill Rd. Bridge	29	6	5	4	8	32	11	8	19	17	11
Furnace	87	4	4	2	13	15	14	5	9	11	15
Oil Creek	141	8	5	5	5	66	10	12	35	27	43

**Table 3.7** Codorus Creek COD (mg/L)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99	7/17/99
Menges Mill	15	4	5	6	1	1	9	8	12	1	12
USGS Gaging Station	15	6	4	6	2	5	14	11	10	10	11
Martin Bridge	42	58	95	62	61	30	41	91	93	66	78
Graybill Rd. Bridge	60	52	75	57	56	40	33	42	80	63	79
Furnace	37	33	26	32	36	27	18	18	19	31	34
Oil Creek	41	21	25	29	8	18	14	12	16	13	22

**Table 3.8** Codorus Creek Ammonia (mg/L)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99	8/17/99
Menges Mill	0.15	0.03	0.00	0.02	0.06	0.12	0.00	0.01	0.10	0.04	0.11
USGS Gaging Station	0.08	0.02	0.00	0.03	0.13	0.08	0.04	0.06	0.13	0.13	0.05
Martin Bridge	0.11	0.36	0.06	0.11	0.83	0.54	0.21	0.10	0.11	0.28	0.11
Graybill Rd. Bridge	0.02	0.06	0.00	0.04	0.63	0.23	0.13	0.09	0.06	0.04	0.05
Furnace	0.12	0.05	0.00	0.15	0.37	0.06	0.07	0.10	0.14	0.04	0.08
Oil Creek	0.22	0.01	0.05	0.15	0.16	0.27	0.00	0.07	0.09	0.04	0.05

**Table 3.9** Codorus Creek Nitrate/Nitrite (mg/L)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	4/20/99	5/18/99	6/21/99	8/17/99
Menges Mill	2.00	1.40	1.40	1.28	1.58H	2.24	3.96	1.86	1.51	0.90
USGS Gaging Station	2.50	2.10	2.10	2.06	2.45H	2.68	4.15	3.61	2.78	1.59
Martin Bridge	2.04	1.40	1.10	1.05	1.91H	2.13	2.57	1.82	1.80	0.10
Graybill Rd. Bridge	1.84	1.90	1.70	1.27	2.47H	2.45	3.59	2.33	2.03	1.14
Furnace	1.93	3.70	3.90	3.34	3.62H	3.58	4.41	3.91	3.70	2.95
Oil Creek	2.51	5.40	6.20	6.62	6.45H	5.50	6.63	8.57	10.06	4.05

H = did not meet holding time (not included in plots)

**Table 3.10** Codorus Creek Orthophosphate (mg/L)

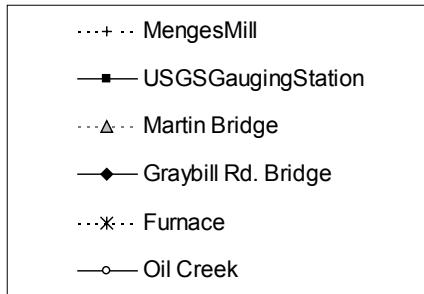
	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99	8/17/99
Menges Mill	0.09	0.00	0.00	0.00	0.00	0.00	FQA	0.00	0.00	0.02	0.02
USGS Gaging Station	0.11	0.05	0.00	0.06	0.07	0.05	FQA	0.05	0.12	0.07	0.06
Martin Bridge	0.11	0.04	0.00	0.04	0.03	0.04	FQA	0.04	0.07	0.05	0.04
Graybill Rd. Bridge	0.10	0.05	0.00	0.04	0.05	0.03	FQA	0.05	0.06	0.05	0.04
Furnace	0.11	0.14	0.00	0.07	0.16	0.11	FQA	0.07	0.14	0.10	0.37
Oil Creek	0.09	0.42	0.46	0.54	0.27	0.25	FQA	0.29	0.85	0.52	0.64

**Table 3.11** Codorus Creek Total Phosphorus (mg/L)

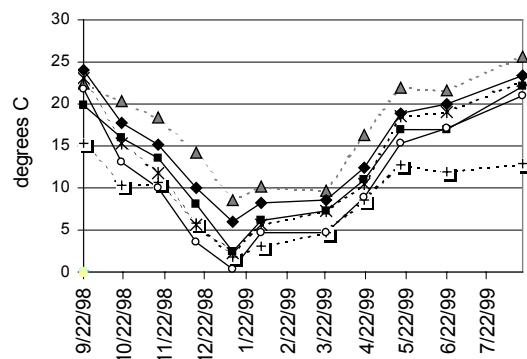
	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/21/99
Menges Mill	0.27	0.04	ND	0.07	ND	0.07	0.05	0.04	0.05	0.08
USGS Gaging Station	0.22	0.11	0.13	0.10	0.11	0.10	0.09	0.11	0.20	0.12
Martin Bridge	0.24	0.11	0.11	0.10	0.10	0.12	0.08	0.13	0.15	0.11
Graybill Rd. Bridge	0.19	0.09	0.08	0.09	0.06	0.13	0.07	0.10	0.13	0.13
Furnace	0.27	0.19	0.09	0.10	0.23	0.22	0.08	0.12	0.21	0.16
Oil Creek	0.59	0.54	0.61	0.63	0.34	0.37	0.17	0.37	0.98	0.69
ND <0.03										

**Table 3.12** Codorus Creek Total Kjehldahl Nitrogen (TKN) (mg/L)

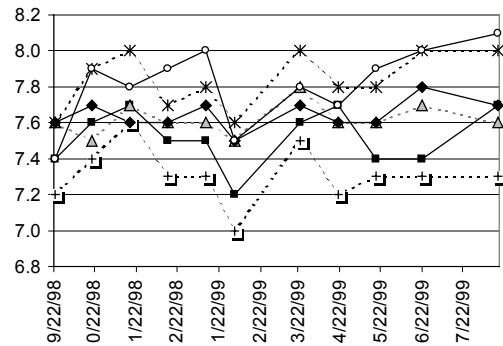
	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	4/20/99	5/18/99	6/21/99	8/17/99
Menges Mill	1.29	0.28	0.28	0.26	0.26	0.52	0.63	0.60	0.35	0.48
USGS Gaging Station	0.75	0.35	0.37	0.26	0.65	0.46	0.95	1.31	0.55	0.40
Martin Bridge	0.99	1.10	1.23	1.23	1.85	1.47	2.04	1.47	1.15	1.20
Graybill Rd. Bridge	1.16	0.76	0.80	1.27	1.65	1.24	2.22	1.17	0.91	1.30
Furnace	1.24	0.72	0.76	1.12	1.31	0.83	1.03	0.93	0.81	0.92
Oil Creek	1.60	0.65	0.77	0.80	0.82	1.22	0.87	0.98	0.55	0.63



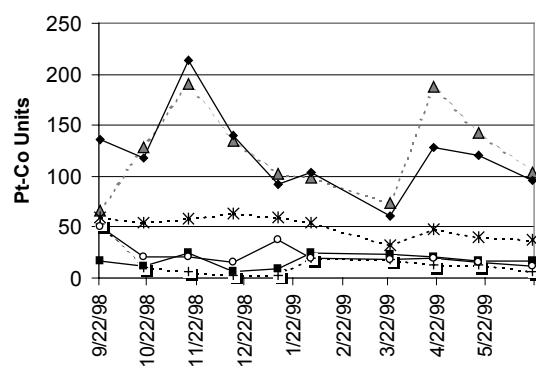
**Figure 3.11** Legend for Codorus Creek Water Chemistry Figures



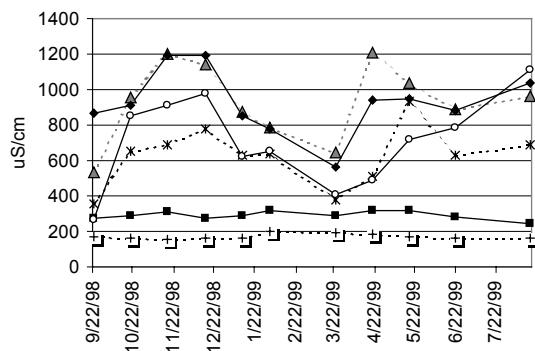
**Figure 3.13** Codorus Creek Temperature



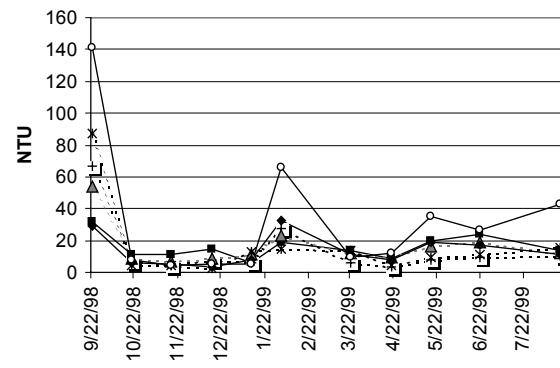
**Figure 3.12** Codorus Creek pH



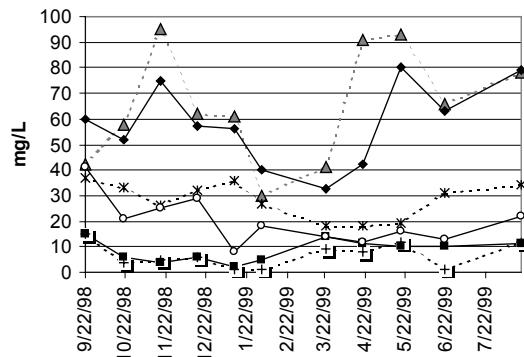
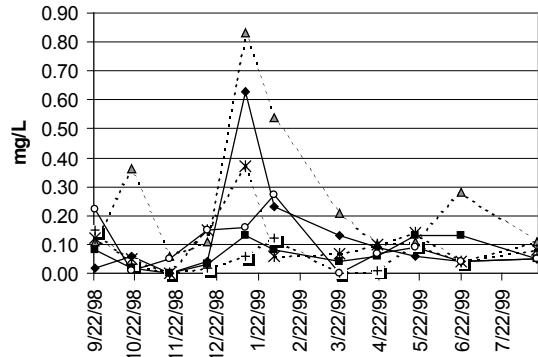
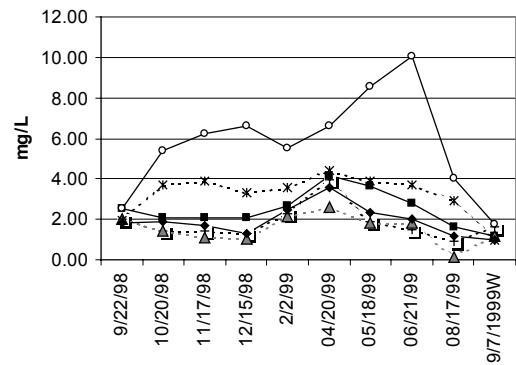
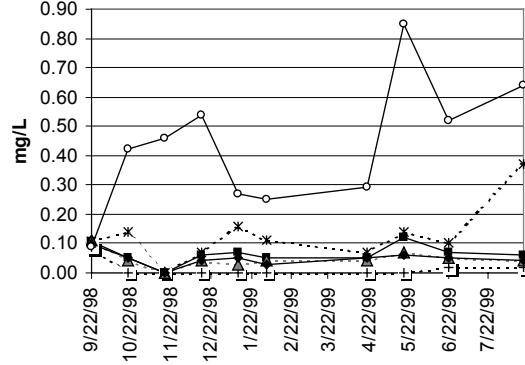
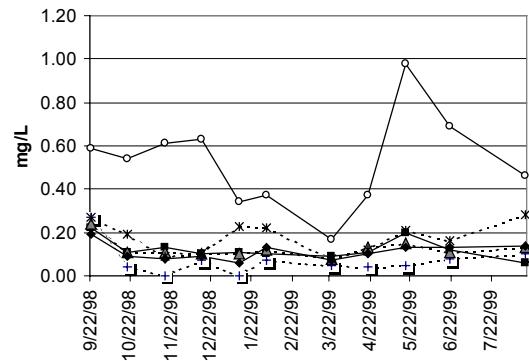
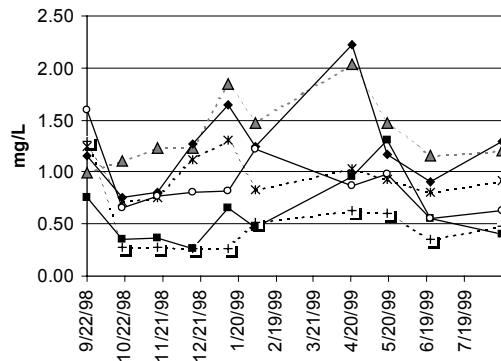
**Figure 3.14** Codorus Creek Color



**Figure 3.15** Codorus Creek Conductivity



**Figure 3.16** Codorus Creek Turbidity

**Figure 3.17** Codorus Creek COD**Figure 3.18** Codorus Creek Ammonia**Figure 3.19** Codorus Creek Nitrate/Nitrite**Figure 3.20** Codorus Creek Orthophosphate**Figure 3.21** Codorus Creek Total Phosphorus**Figure 3.22** Codorus Creek TKN

### 3.4.2 McKenzie River Water Chemistry

**Table 3.13** McKenzie River pH

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Hendricks	7.7	7.8	7.8	7.6	7.3	7.1	7.9	7.1	7.6	7.7	7.1
Hayden Bridge	7.7	7.8	7.8	7.8	7.5	7.2	7.9	7.1	7.6	7.8	7.1
Harvest	7.9	7.8	7.8	7.8	7.6	7.2	7.8	7.1	7.6	7.7	7.1
Coburg Rd. Bridge	8.0	7.8	7.8	7.8	7.4	7.1	7.8	7.2	7.6	7.7	6.9
Mohawk	7.6	7.6	7.6	7.6	7.4	7.1	7.8	6.9	7.4	7.7	7.1

**Table 3.14** McKenzie River Temperature (°C)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Hendricks	13.0	10.0	7.0	5.0	6.0	6.0	8.0	9.0	10.0	12.0	16.0
Hayden Bridge	11.0	9.0	7.5	4.5	6.0	6.5	8.0	8.5	9.5	12.0	15.0
Harvest	12.0	9.0	8.0	5.0	6.0	6.5	8.0	9.0	10.0	13.0	15.0
Coburg Rd. Bridge	11.0	8.5	7.5	4.5	6.5	6.5	8.0	9.0	10.0	13.0	14.5
Mohawk	16.0	9.5	8.0	6.0	7.0	7.0	9.0	10.0	13.0	17.0	21.0

**Table 3.15** McKenzie River Color (Pt-Co units)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Hendricks	5	1	3	1	7	13	7	12	4	12	FQA
Hayden Bridge	8	2	5	2	8	11	8	13	13	7	FQA
Harvest	6	12	8	6	2	15	8	16	8	8	FQA
Coburg Rd. Bridge	5	9	8	4	5	17	7	13	11	7	FQA
Mohawk	25	36	36	14	25	29	14	22	34	19	FQA

FQA=failed quality assurance

**Table 3.16** McKenzie River Conductivity ( $\mu\text{S}/\text{cm}$ )

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Hendricks	53.7	56.3	50.0	43.4	48.0	50.6	44.1	45.0	39.0	41.0	49.9
Hayden Bridge	53.1	54.8	50.0	42.3	47.0	50.2	84.7	44.0	40.0	49.0	50.6
Harvest	64.8	63.8	58.0	45.0	52.0	53.9	53.4	52.0	46.0	50.0	63.9
Coburg Rd. Bridge	61.9	64.3	57.0	43.8	51.0	53.5	56.3	51.0	45.0	48.0	62.8
Mohawk	69.0	63.0	54.0	38.1	43.0	40.4	43.5	44.0	45.0	52.0	61.6

Table 3.17 McKenzie River Turbidity (NTU)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Hendricks	2	1	2	1	2	3	1	1	6	1	2
Hayden Bridge	1	1	3	2	3	3	2	2	6	1	1
Harvest	2	1	3	4	4	4	3	1	5	2	1
Coburg Rd. Bridge	1	2	3	2	4	4	3	2	10	1	1
Mohawk	3	3	7	6	9	11	5	3	13	4	3

**Table 3.18** McKenzie River COD (mg/L)

Table 3.19 McKenzie River Ammonia (mg/L)

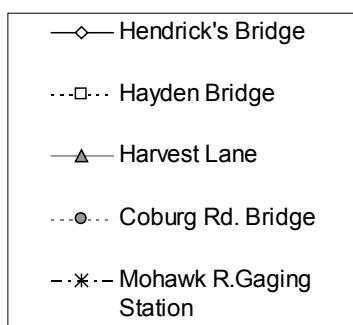
**Table 3.20** McKenzie River Nitrate/Nitrite (mg/L)

Table 3.21 McKenzie River Total Phosphorus (mg/L)

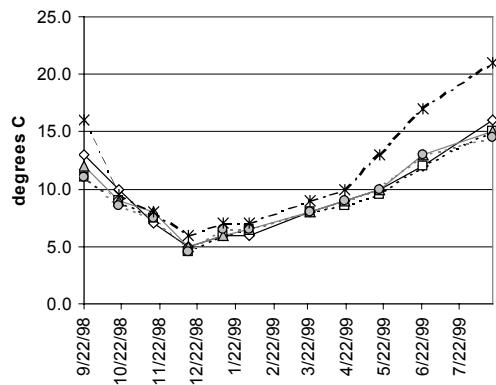
**Table 3.22** McKenzie River total Kjehldahl nitrogen (TKN) (mg/L)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Hendricks	0.08	0.08	0.09	0.09	0.05	0.12	FQA	0.21	0.34	0.21	0.12
Hayden Bridge	0.08	0.08	0.09	0.09	0.06	0.09	FQA	0.13	0.31	0.15	0.13
Harvest	0.13	0.13	0.13	0.10	0.07	0.17	FQA	0.35	0.39	0.22	0.27
Coburg Rd. Bridge	0.10	0.10	0.22	0.10	0.06	0.15	FQA	0.20	0.36	0.19	0.26
Mohawk	0.14	0.14	0.15	0.27	0.06	0.16	FQA	0.19	1.13	0.17	0.20

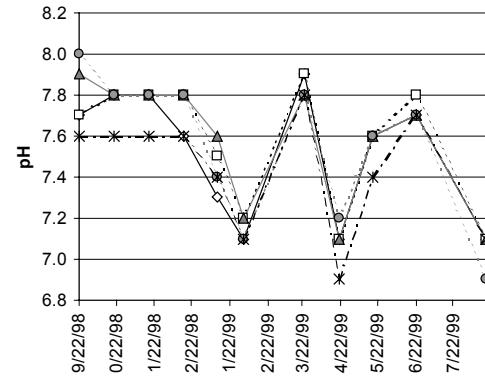
FQA=failed quality assurance



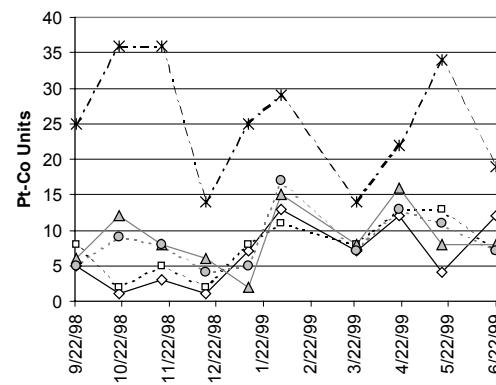
**Figure 3.23** Legend for McKenzie River Water Chemistry Figures



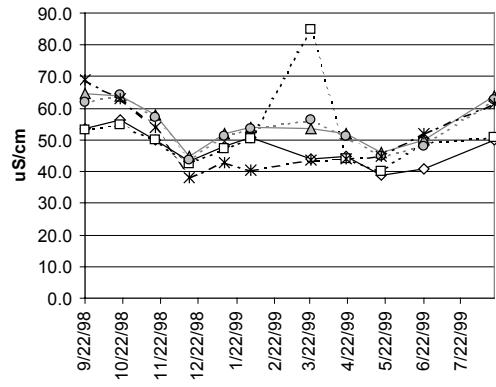
**Figure 3.25** McKenzie Temperature



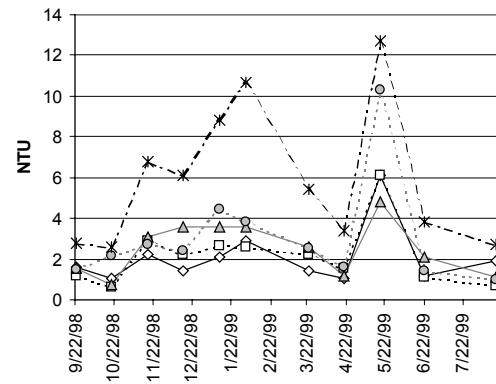
**Figure 3.24** McKenzie pH



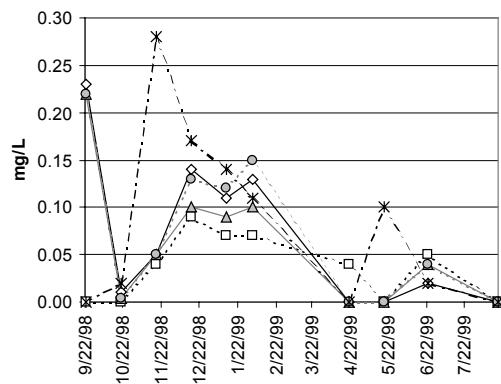
**Figure 3.26** McKenzie Color



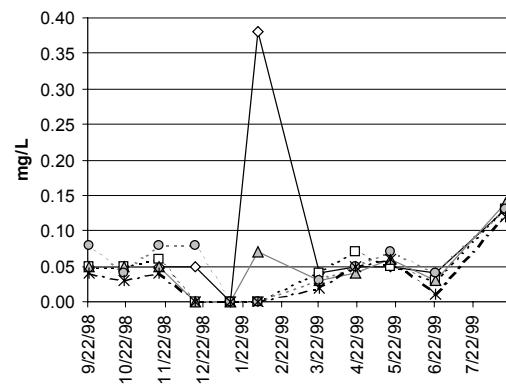
**Figure 3.27** McKenzie Conductivity



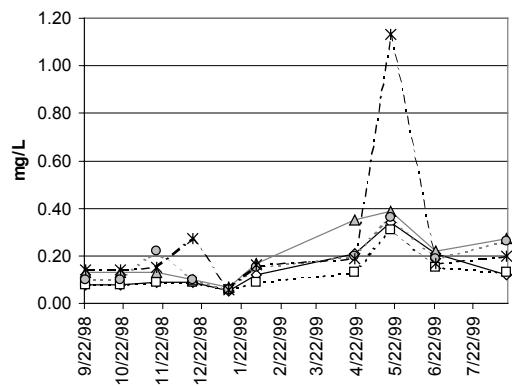
**Figure 3.28** McKenzie Turbidity



**Figure 3.29** McKenzie Nitrate/Nitrite



**Figure 3.30** McKenzie Total Phosphorus



**Figure 3.31** McKenzie TKN

### 3.4.3 Willamette River Water Chemistry

**Table 3.23** Willamette River pH

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	7.6	7.8	7.8	7.8	7.4	7.2	7.8	7.4	7.4	7.7	7.0
Cartney	7.6	7.7	7.8	7.8	7.8	7.1	7.8	6.9	7.6	7.6	7.0
Peoria Park	7.4	7.4	7.8	7.8	7.6	7.1	7.6	6.8	7.7	7.4	6.7
Corvallis	7.8	7.8	7.8	7.5	7.6	7.1	7.8	7.0	7.6	7.6	6.9
Long Tom River	7.8	8.0	7.9	7.8	7.8	7.6	7.8	7.1	7.6	7.9	6.9

**Table 3.24** Willamette River Temperature (°C)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	14.5	10.5	8.5	6.0	6.5	6.7	8.5	9.5	11.0	12.5	17.0
Cartney	14.0	10.5	8.5	5.5	6.5	6.7	8.0	9.5	10.5	13.0	17.0
Peoria Park	15.0	10.0	9.0	6.0	6.5	6.7	9.5	10.5	11.0	15.0	18.0
Corvallis	14.5	10.5	9.0	6.0	6.5	7.0	9.0	10.0	10.5	13.5	17.5
Long Tom River	14.0	11.0	8.0	5.5	7.0	7.0	10.0	9.5	14.0	13.0	17.0

**Table 3.25** Willamette River Color (Pt-Co units)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	9	6	9	24	28	26	14	18	17	11	FQA
Cartney	7	4	8	21	30	22	14	17	16	10	FQA
Peoria Park	8	7	13	28	31	34	18	20	18	15	FQA
Corvallis	9	13	15	32	35	35	20	21	16	15	FQA
Long Tom River	7	54	100	60	44	56	31	19	38	12	FQA

FQA=Failed quality assurance

**Table 3.26** Willamette River Conductivity ( $\mu\text{S}/\text{cm}$ )

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	64.8	69.3	61.0	52.6	54.0	59.3	68.6	52.0	49.0	56.0	57.5
Cartney	64.7	63.0	61.0	50.9	56.0	57.2	56.5	53.0	49.0	49.0	55.8
Pearl Park	102.0	96.8	90.0	54.8	67.0	64.1	84.4	72.0	58.0	85.0	104.7
Corvallis	74.7	71.8	71.0	55.8	70.0	66.0	68.4	64.0	57.0	59.0	71.3
Long Tom River	66.0	76.6	83.0	57.2	75.0	55.1	120.6	54.0	66.0	51.0	60.6

**Table 3.27 Willamette River Turbidity (NTU)**

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	3	2	4	11	9	10	4	4	10	2	2
Cairney	2	2	3	13	13	11	4	4	11	2	2
Pearla Park	2	3	4	15	17	25	5	4	8	3	4
Corvallis	2	5	7	12	17	29	6	3	9	4	3
Long Tom River	2	27	61	36	48	37	13	3	17	3	2

Table 3.28 Willamette River Ammonia (mg/L)

**Table 3.29** Willamette River Nitrate/Nitrite (mg/L)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	0.28	0.08	0.11	0.17	0.19	0.24	FQA	0.01	0.38	0.05	ND
Cartney	0.29	0.10	0.11	0.17	0.22	0.27	FQA	0.03	ND	0.06	ND
Peoria Park	0.23	0.03	0.09	0.27	0.36	0.38	FQA	0.04	ND	0.05	ND
Corvallis	0.30	0.12	0.14	0.31	0.45	0.44	FQA	0.11	0.03	0.09	ND
Long Tom River	0.30	0.13	0.35	0.55	0.76	0.38	FQA	0.11	0.07	0.03	ND

ND[&lt;0.01]; FQA=failed quality assurance

**Table 3.30** Willamette River Orthophosphate (mg/L)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	0.04	0.03	ND	0.04	0.04	0.03	FQA	ND	0.03	0.04	0.03
Cartney	0.04	0.03	ND	0.03	0.04	0.03	FQA	0.03	0.05	0.03	0.02
Peoria Park	0.04	0.02	ND	0.04	0.04	0.03	FQA	ND	0.03	0.03	0.03
Corvallis	0.05	0.02	ND	0.04	0.04	0.07	FQA	0.03	ND	0.02	0.02
Long Tom River	0.05	0.03	0.15	0.04	0.04	0.07	FQA	0.03	0.04	0.02	0.02

ND[&lt;0.02]; FQA=failed quality assurance

**Table 3.31** Willamette River Total Phosphorus (mg/L)

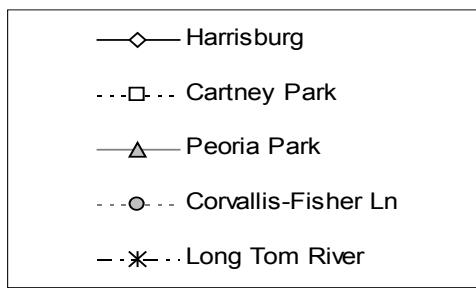
	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	0.08	0.06	0.06	0.07	ND	0.08	0.05	0.06	0.07	0.05	0.13
Cartney	0.08	0.07	0.07	0.09	ND	0.09	0.08	0.06	0.08	0.05	0.14
Peoria Park	0.09	0.07	0.07	0.13	0.04	0.05	0.05	0.06	0.06	0.18	0.18
Corvallis	0.08	0.07	0.07	0.09	0.05	0.09	0.05	0.06	0.06	0.14	0.13
Long Tom River	0.09	0.08	0.08	0.09	ND	0.07	0.06	0.08	0.08	0.06	0.13

ND [&lt;0.05]

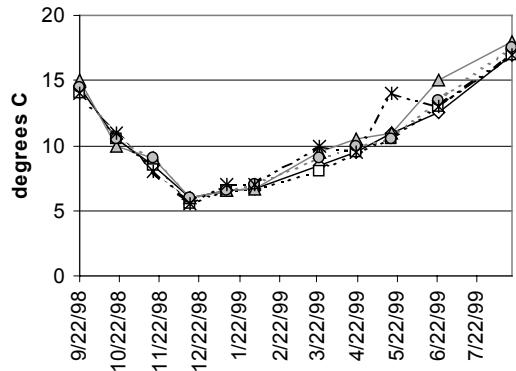
**Table 3.32** Willamette River Total Kjehldahl Nitrogen (TKN) (mg/L)

	9/22/98	10/20/98	11/17/98	12/15/98	1/12/99	2/2/99	3/23/99	4/20/99	5/18/99	6/22/99	8/17/99
Harrisburg	0.28	0.18	0.18	0.17	0.12	0.22	FQA	0.30	0.64	0.27	0.29
Cartney	0.25	0.18	0.17	0.13	0.11	0.32	FQA	0.50	0.51	0.16	0.25
Peoria Park	0.28	0.20	0.14	0.18	0.10	0.18	FQA	0.70	0.85	0.19	0.26
Corvallis	0.24	0.22	0.09	0.17	0.11	0.25	FQA	0.18	0.30	0.19	0.20
Long Tom River	0.33	0.54	0.48	0.32	0.14	0.17	FQA	0.17	0.93	0.24	0.25

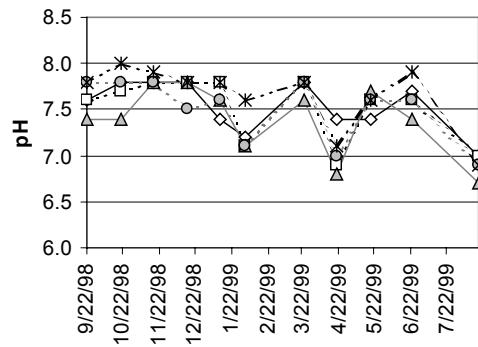
FQA=failed quality assurance



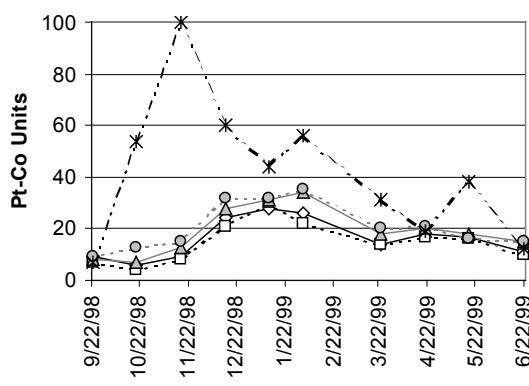
**Figure 3.32** Legend for Willamette River Water Chemistry Figures



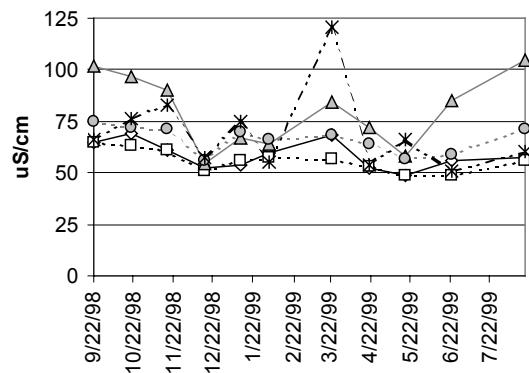
**Figure 3.34** Willamette Temperature



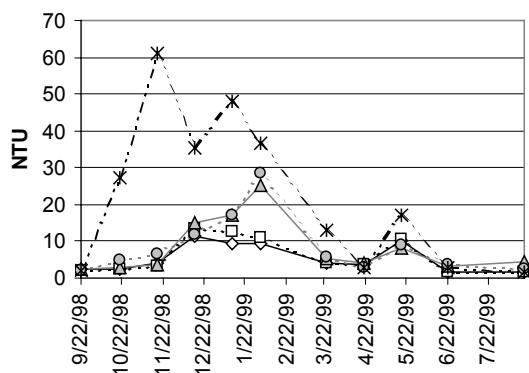
**Figure 3.33** Willamette pH



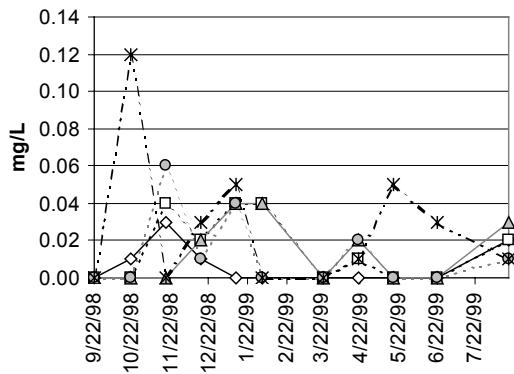
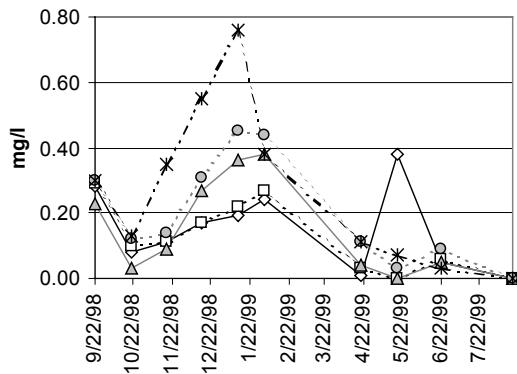
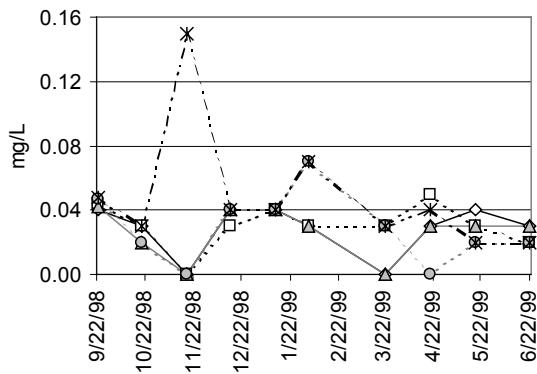
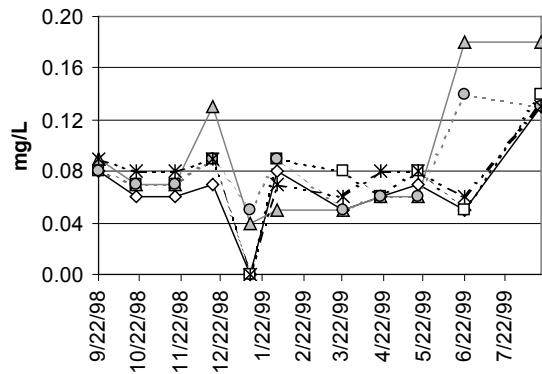
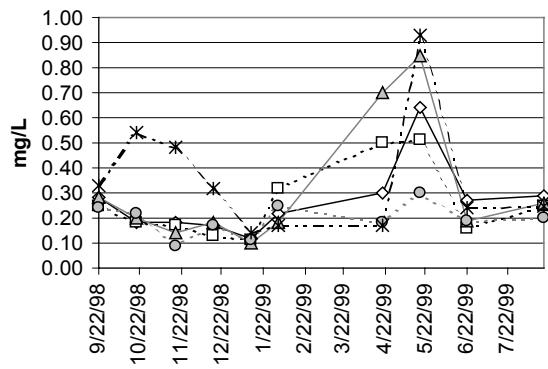
**Figure 3.35** Willamette Color



**Figure 3.36** Willamette Conductivity



**Figure 3.37** Willamette Turbidity

**Figure 3.38** Willamette Ammonia**Figure 3.39** Willamette Nitrate/Nitrite**Figure 3.40** Willamette Orthophosphate**Figure 3.41** Willamette Total Phosphorus**Figure 3.42** Willamette TKN

### 3.5 Effluent Chemistry

Grab samples of effluent were taken by local mill personnel and shipped overnight on ice to the West Coast Regional Center in Corvallis, Oregon, for analysis.

**Table 3.33 Mill Effluent Analysis for Oregon (Halsey and Springfield) and Pennsylvania (Spring Grove), September 1998 to September 1999**

<b>Halsey, OR</b>									
Date	Color (PCU)	Tannin/ Lignin (mg/L)	Conduc- tivity (umhos/cm)	Turbidity (NTU)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	TOC (mg/L)	Phyto- sterols (ug/L)
3/1/99	1014	33.1	2830	21.4	25.5	19.6	389	131.0	0.58
5/4/99	810	29.2	3110	7.7	7.5	16.8	356	122.0	1.48
9/7/99	1152	42.1	3240	18.1	8.5		492	155.5	68.1
									2.1 <sup>f</sup>

<b>Springfield, OR</b>									
Date	Color (PCU)	Tannin/ Lignin (mg/L)	Conduc- tivity (umhos/cm)	Turbidity (NTU)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	TOC (mg/L)	Phyto- sterols (ug/L)
1/1/98	132	13.5	1115	21.7	24.0	15.2	125	30.4	0.68
2/2/99	163	18.0	1616	30.2	41.8	28.6	175	40.8	0.34
4/26/99	161	15.7				21.6	150	43.3	0.82
5/4/99	100	14.6	1718	33.1		25.8	145	36.2	
6/7/99	440	33.7	1938	15.0	19.7		30.0	187	42.2
7/13/99								36.2	0.63
7/14/99	327	29.9				11.5	190	2.81	
7/20/99	299	22.4				16.6	142	31.1	2.77
7/27/99	248	16.8				22.4	131	22.3	2.61
8/4/99	187	18.0				50.5	453	37.2	1.07
8/10/99	168	16.8	2140	18.5	29.3	30.4	145	39.1	26.6 <sup>a</sup>
									4.6 <sup>f</sup>

<b>Spring Grove, PA</b>									
Date	Color (PCU)	Tannin/ Lignin (mg/L)	Conduc- tivity (umhos/cm)	Turbidity (NTU)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	TOC (mg/L)	Phyto- sterols (ug/L)
10/9/98	360	5.5	1700	12.7	11.0		159	66.8	16.6 <sup>b</sup>
1/4/99	290	7.9	1694	10.6	10.3	7.7	146	63.8	9.9 <sup>b</sup>
4/6/99	298	6.7	1862	5.4	6.8	3.5	139	57.1	2.0 <sup>c</sup>
6/21/99	239	5.6	1692	4.5	4.8	3.9	182	54.7	0.03
									ND <sup>d</sup>

<sup>e</sup> ND's=1

<sup>f</sup> ND's=2

<sup>g</sup> ND's=3

<sup>h</sup> ND's=9

<sup>i</sup> ND's=4

<sup>j</sup> ND's=10

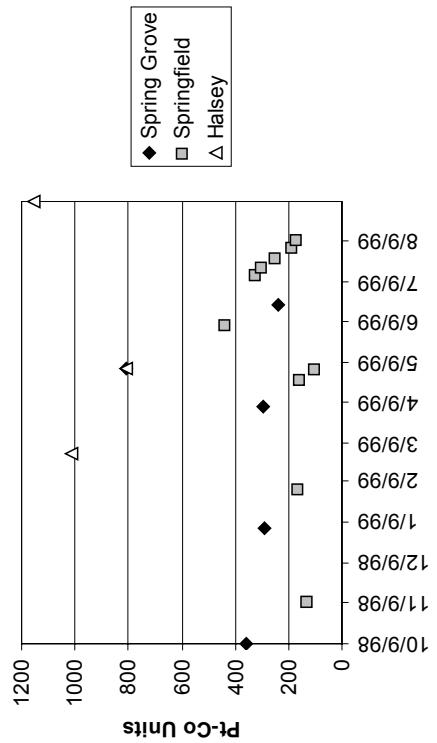


Figure 3.43 Mill Effluent Color (Pt-Co Units)

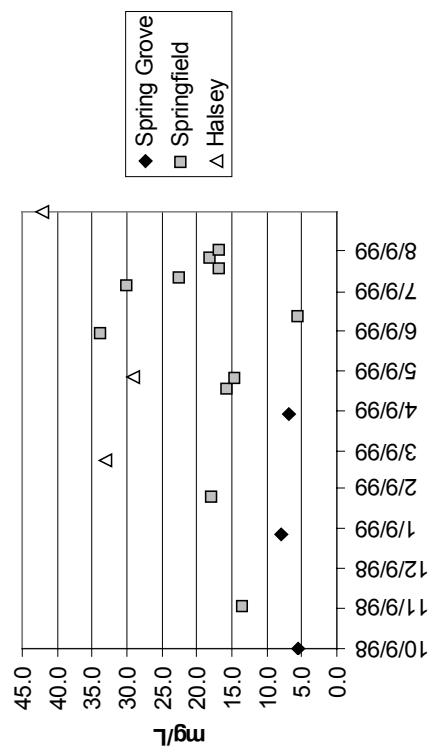


Figure 3.44 Mill Effluent Tannin/Lignin (mg/L)

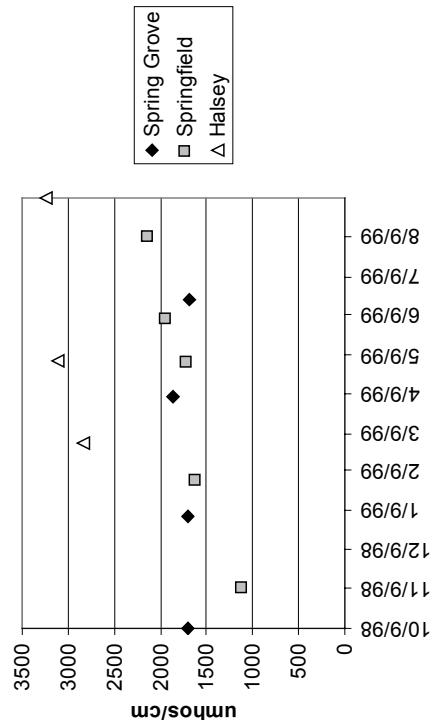


Figure 3.45 Mill Effluent Conductivity (umhos/cm)

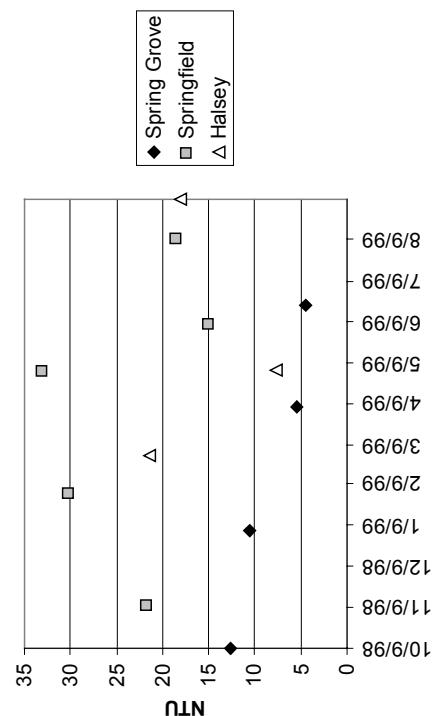


Figure 3.46 Mill Effluent Turbidity (NTU)

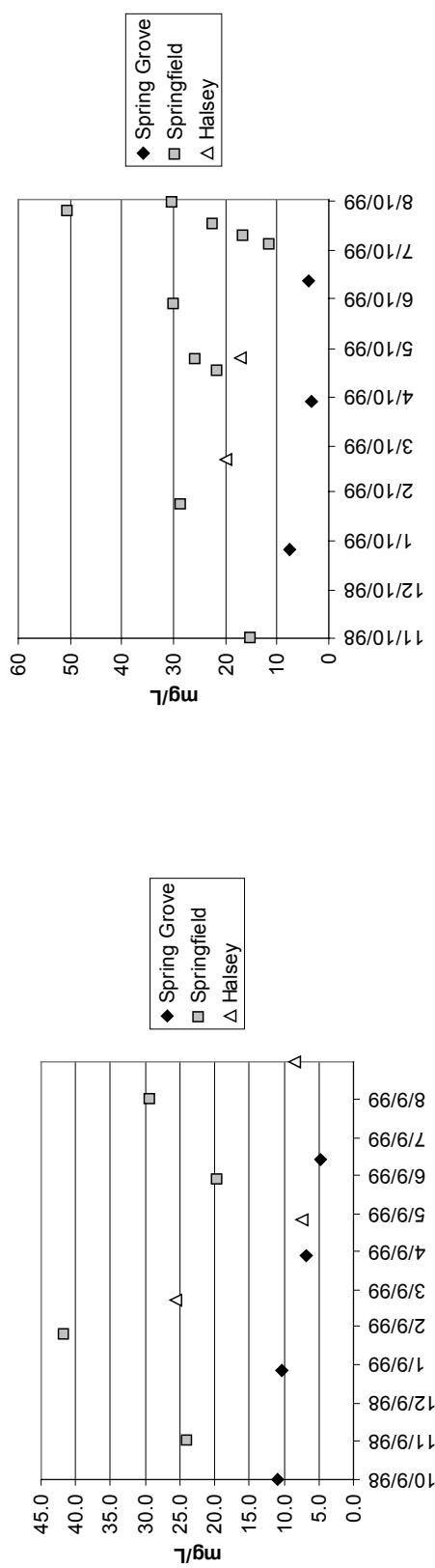


Figure 3.47 Mill Effluent TSS (mg/L)

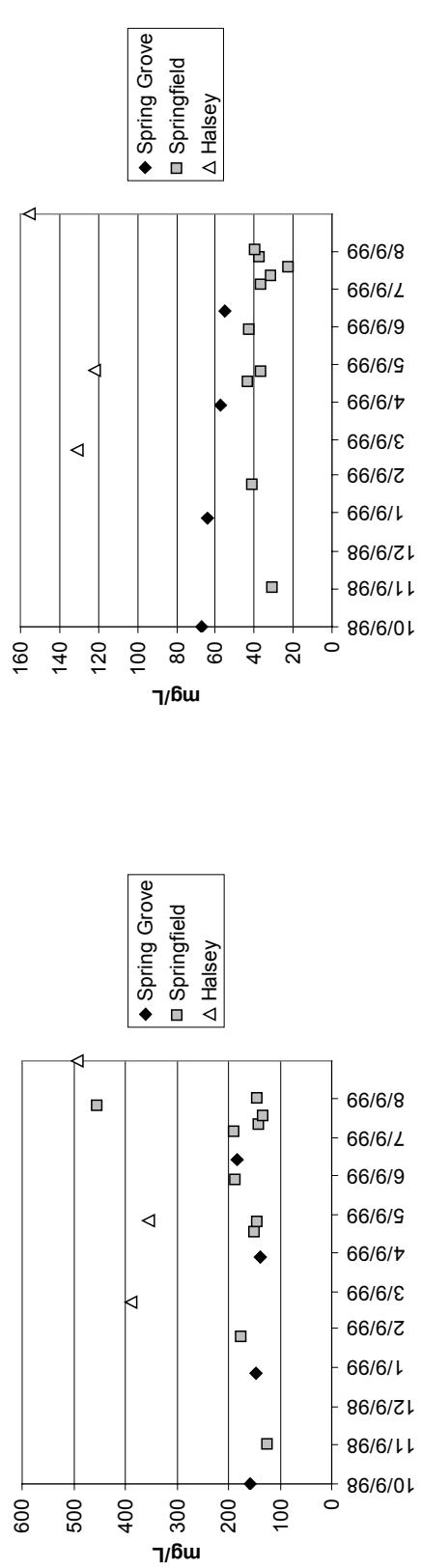


Figure 3.49 Mill Effluent COD (mg/L)

Figure 3.48 Mill Effluent BOD (mg/L)

Figure 3.50. Mill Effluent TOC (mg/L)

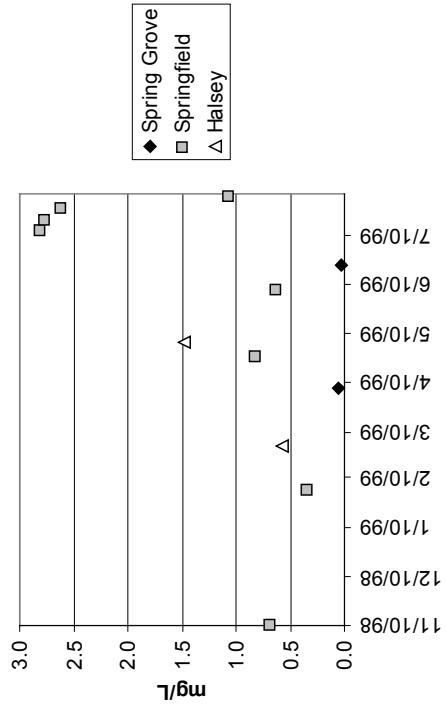


Figure 3.51 Mill Effluent Total Phosphorus (mg/L)

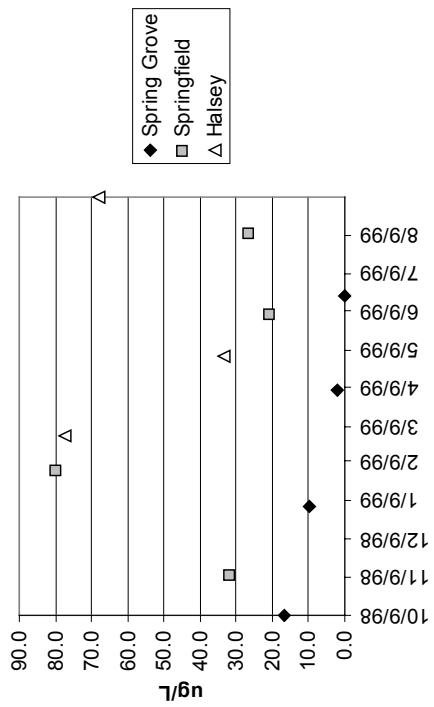


Figure 3.52 Mill Effluent Phytosterols (ug/L)

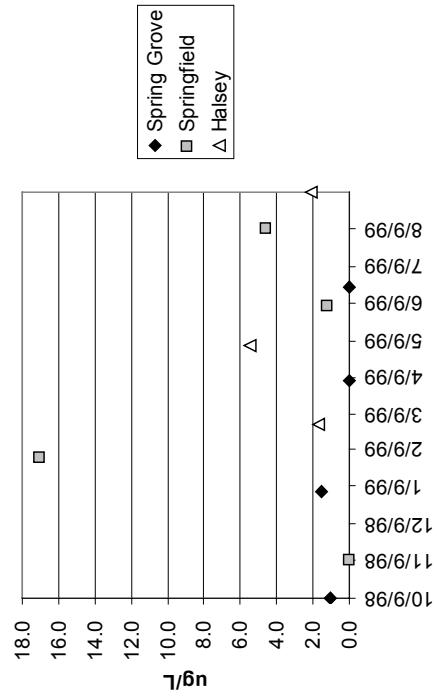


Figure 3.53 Mill Effluent Resin Acids (ug/L)

### 3.6 Effluent Bioassays

Grab samples of effluent were taken approximately four times during the year by local mill personnel. The samples were shipped overnight on ice to the NABF in Anacortes, Washington, for echinoderm and bivalve chronic assays, and to the Southeastern Aquatic Biology Facility in New Bern, North Carolina, for ceriodaphnia and fathead minnow chronic bioassays. Assays were performed within seven days of sampling. The LTRWS local mill locations were Spring Grove, Pennsylvania, for Codorus Creek; Springfield, Oregon, for the McKenzie River; and Halsey, Oregon, for the Willamette River.

**Table 3.34** Effluent IC25 (% volume/volume) for Oregon (Halsey and Springfield) and Pennsylvania (Spring Grove)

#### Halsey, OR

Date	Echinoderm <sup>a</sup> (Fertilization)	Bivalve <sup>b</sup> (Normal development)	Ceriodaphnia (Reproduction)	Fathead Minnow (Growth)
3/1/99	19.7	2.5	29.8	
5/4/99	30.8	4.1	62.2	
9/7/99	1.8			74

#### Springfield, OR

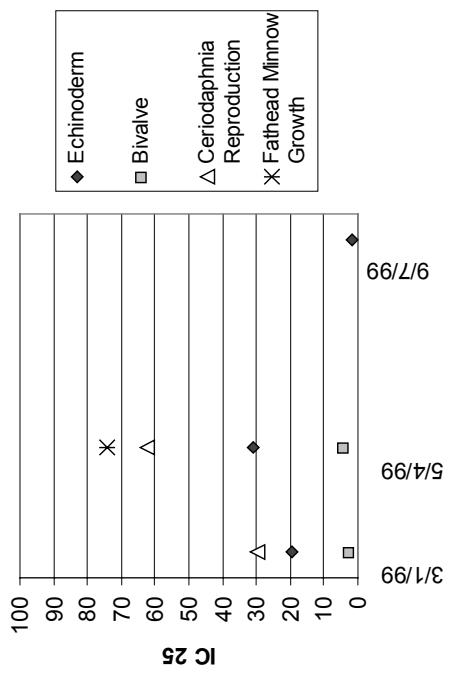
Date	Echinoderm <sup>a</sup> (Fertilization)	Bivalve <sup>b</sup> (Normal development)	Ceriodaphnia (Reproduction)	Fathead Minnow (Growth)
11/10/98	>70	28.4	11.3	>100
2/2/99	>70	38.3	NA	>100
6/7/99	22.3	4.7	>100	>100
8/10/99	61.7	14.6	>100	>100

#### Spring Grove, PA

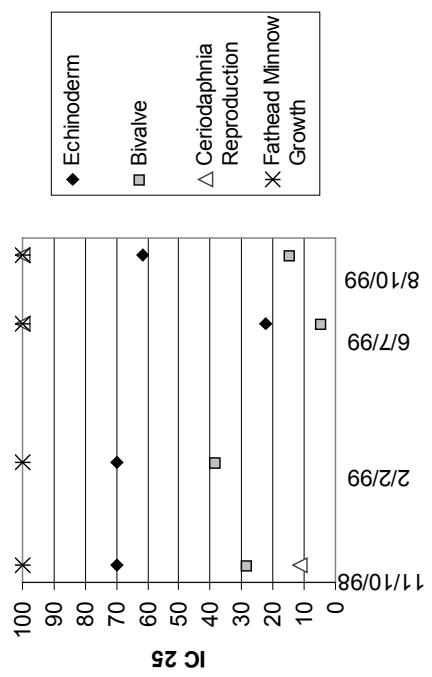
Date	Echinoderm <sup>a</sup> (Fertilization)	Bivalve <sup>b</sup> (Normal development)	Ceriodaphnia (Reproduction)	Fathead Minnow (Growth)
10/9/98	55.7	NA	94.8	>100
1/4/99	>70	36.8	>100	>100
4/6/99		38.6	>100	>100
6/21/99	>70	58.6	>100	>100

<sup>a</sup> *D. excentricus* or  
*S. purpuratus*

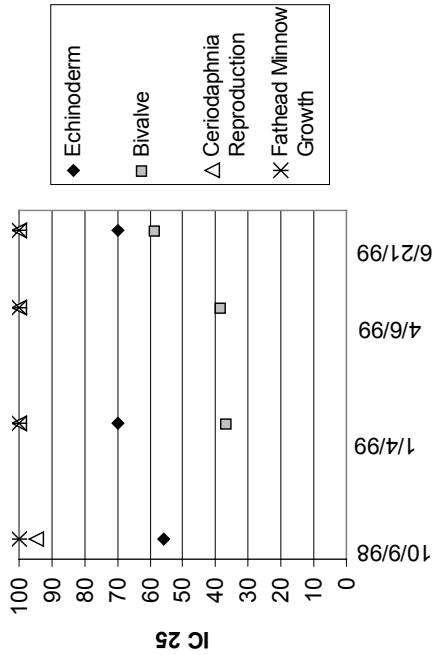
<sup>b</sup> *M. galloprovincialis*



**Figure 3.54** Effluent Bioassays: Halsey, Oregon



**Figure 3.55** Effluent Bioassays: Springfield, Oregon



**Figure 3.56** Effluent Bioassays: Spring Grove, Pennsylvania

### 3.7 Periphyton

Periphyton samples were taken quarterly for chlorophyll *a* and annually for taxonomic evaluation. Sampling was done by scraping and rinsing two to five cobble-size (7 to 13 cm in diameter) randomly selected rocks. Detached periphyton were rinsed into a container and the volume recorded. Rock surface area was estimated by tracing the rock silhouette onto plastic film and later analyzing area with image analysis software. The samples were split, with a portion field-filtered for pigment analysis, a portion frozen for biomass measures, and the final portion preserved with Lugol's Iodine for taxonomic analysis. Samples were analyzed for chlorophyll *a* within 28 d using trichromatic methods (APHA 1998). Periphyton taxonomy was conducted by PhycoTech, Inc. (St. Joseph, Michigan). The periphyton and benthic macroinvertebrates shared the same sampling sites, with Codorus Creek being sampled at seven sites, the McKenzie River at five sites and the Willamette River at seven sampling sites.

### 3.7.1. Codorus Creek Periphyton

**Table 3.35** Codorus Creek Periphyton Taxonomy, September 1998 (average of 2 replicates per site)

	E.	Branch	Menges	USGS	Martin	Graybill	Arsenal	Furnace
Dominant Taxa		<i>Achnanthes biasolettiana v. subatomus</i>	<i>Navicula viridula v. germanii</i>	<i>Achnanthes subatomoides</i>	<i>Achnanthes subatomoides</i>	<i>Nitzschia inconspicua</i>	<i>Nitzschia inconspicua</i>	<i>Nitzschia inconspicua</i>
# of Diatom Taxa	38	36	34	29	27	36	34	
# of Non-diatom taxa	5	6	3	8	2	7	9	
# of Divisions	3	4	3	4	3	5	5	
<u>For Diatoms:</u>								
Shannon Diversity Index (H)	log e	1.47	2.27	3.09	2.60	1.55	1.92	2.06
Shannon Equitability Index (J)	log e	0.10	0.19	0.26	0.20	0.10	0.14	0.15
% Cyanobacteria		1	3	8	2	0	5	3
% Diatoms		98	81	85	86	98	93	93
% Green Algae		<1	3	0	3	<1	1	3
Total Abundance (cells/cm <sup>2</sup> )		1,210,852	157,092	136,460	598,336	4,520,368	916,500	981,659

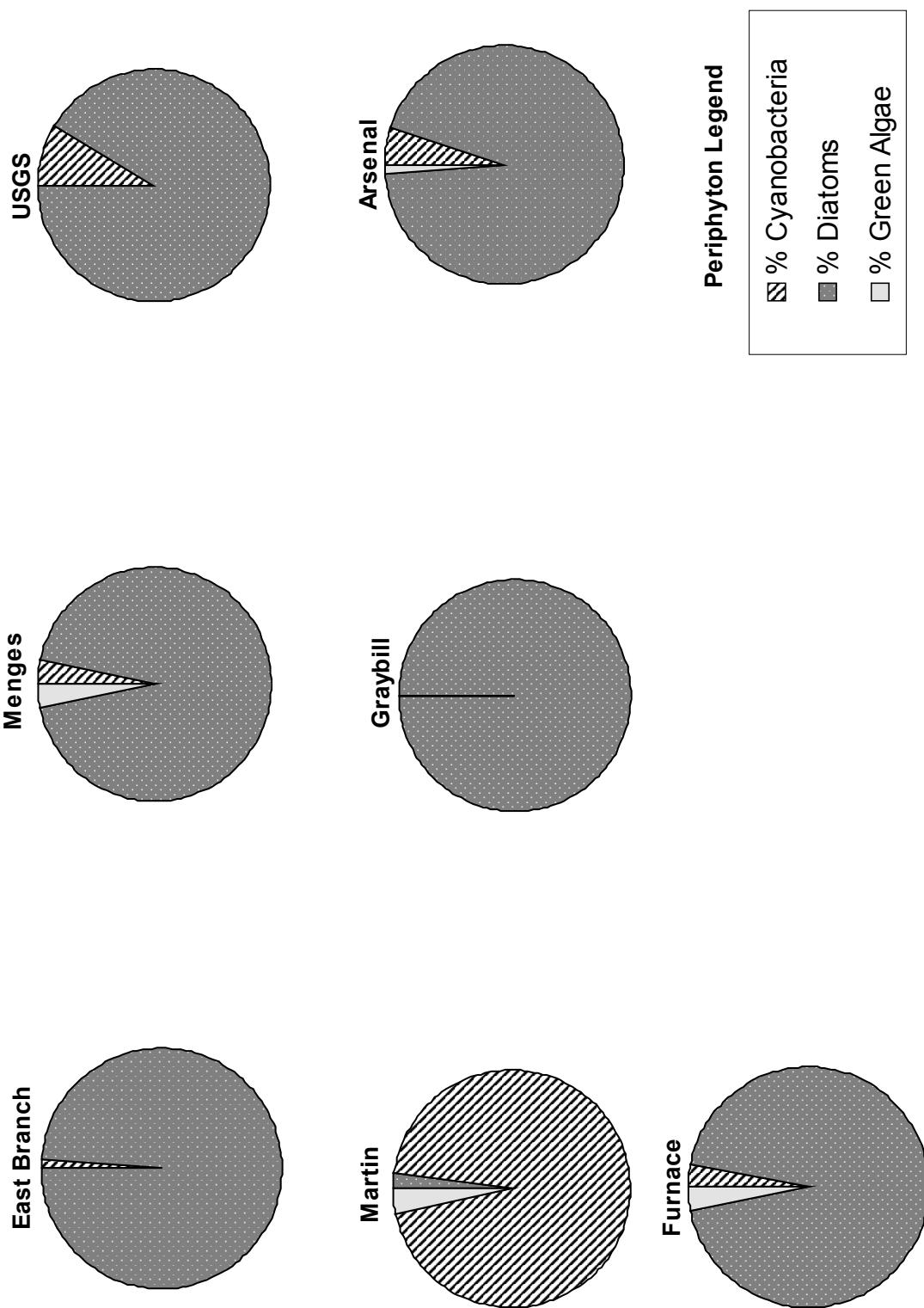
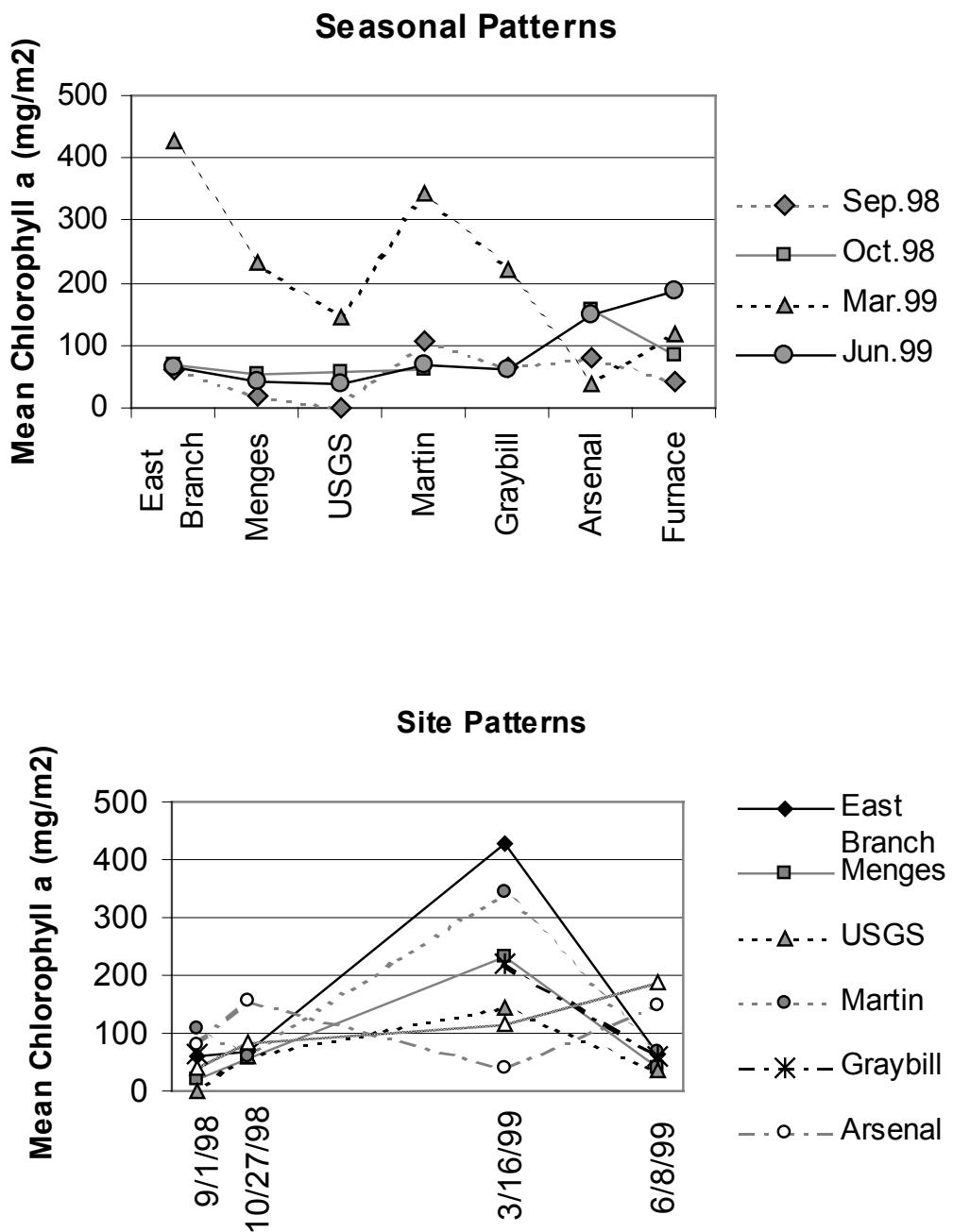


Figure 3.57 Codorus Creek Percent Distribution of Periphyton at Each Sampling Site, September 1998



**Figure 3.58** Codorus Creek Periphyton Mean Chlorophyll *a*, September 1998 to June 1999

### 3.7.2 McKenzie River Periphyton

**Table 3.36** McKenzie River Periphyton Taxonomy, August 1998 (average of 2 replicates per site)

	Hendricks (RM 22.4)	Walterville (RM 20.5)	Mohawk (RM 14)	Harvest (RM 10)	Armitage (RM 6.5)
Dominant Taxa	<i>Nitzschia fonticola</i>	<i>Phormidium fragile</i>	<i>Achnanthes minutissima</i>	<i>Achnanthes minutissima</i>	<i>Achnanthes biascelliana v. subatomus</i>
# of Diatom Taxa	45	37	39	33	38
# of Non-diatom taxa	12	14	14	9	8
# of Divisions	3	3	4	4	3
<u>For Diatoms:</u>					
Shannon Diversity Index	(H) log e	2.00	2.10	2.30	2.40
Shannon Equitability Index	(J) log e	0.15	0.15	0.16	0.19
% Cyanobacteria	24	55	12	13	14
% Diatoms	65	42	83	72	84
% Green Algae	7	1	4	13	2
Total Abundance (cells/cm <sup>2</sup> )	462,480	701,286	419,674	2,426,447	283,564

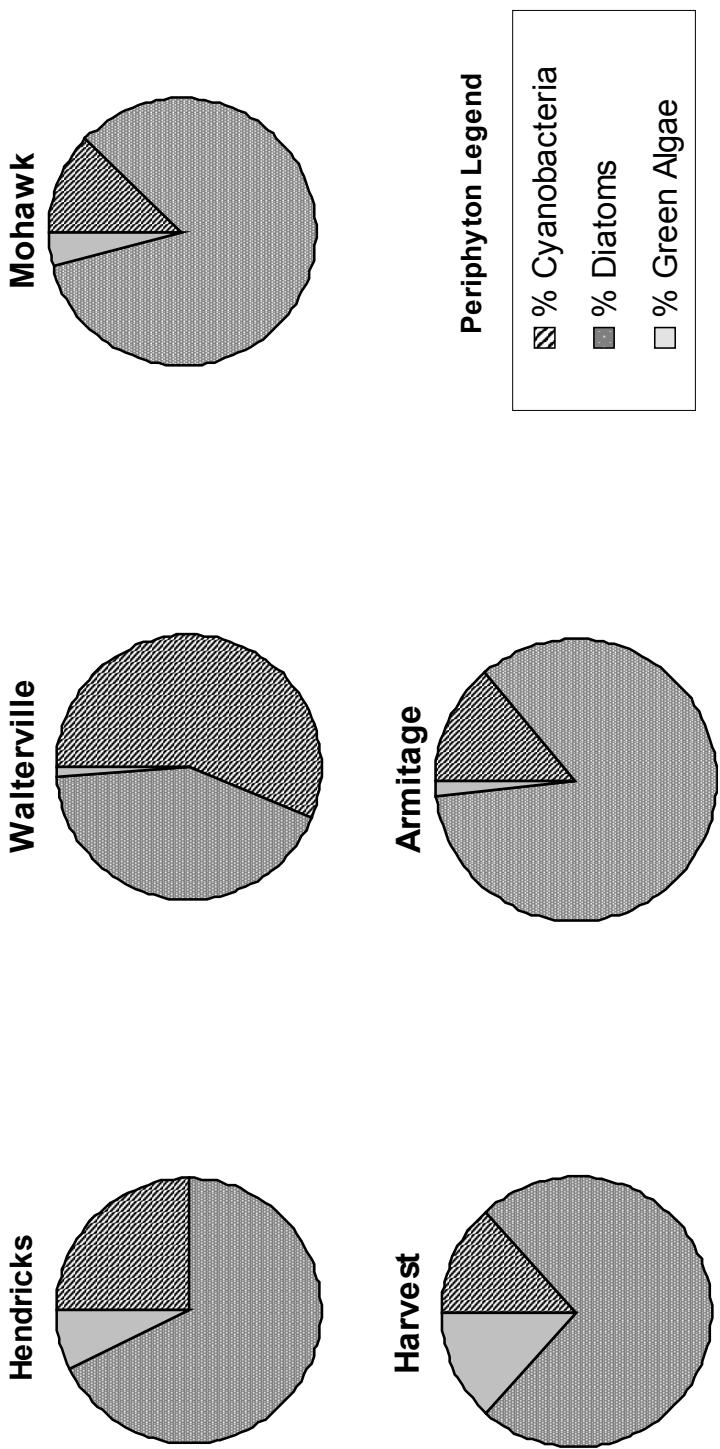
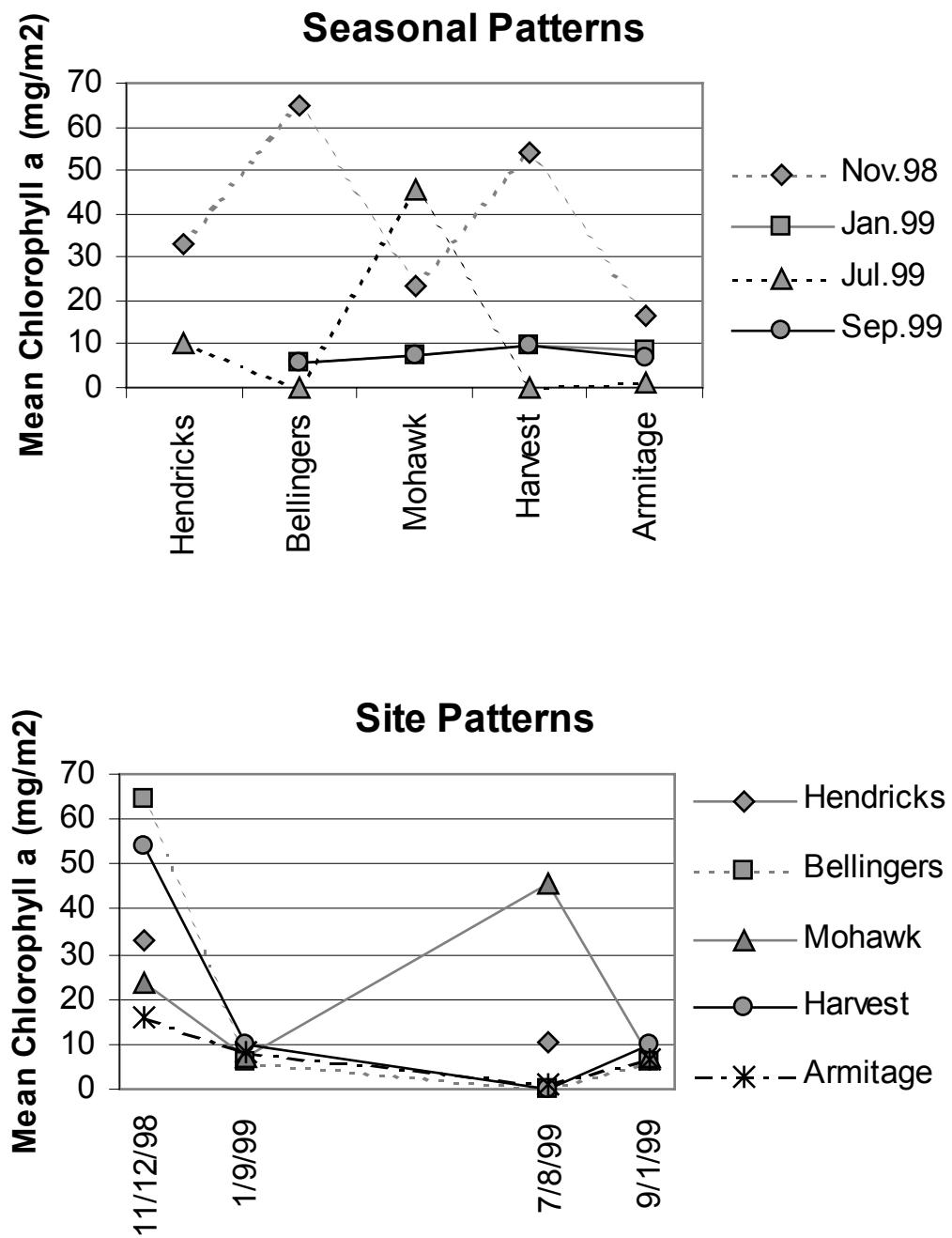


Figure 3.59 McKenzie River Percent Distribution of Periphyton at Each Sampling Site, August 1998



**Figure 3.60.** McKenzie River Periphyton Mean Chlorophyll *a*, November 1998 to September 1999

### 3.7.3 Willamette River Periphyton

**Table 3.37** Willamette River Periphyton Taxonomy, August 1998 (average of 2 replicates per site)

	Whitely (RM176)	Harrisburg (RM160)	Cartney (RM156)	Intake (RM148)	Sam Daws (RM 145.5)	Willamette (RM 134)	Corvallis (RM128)
Dominant Taxa	<i>Nitzschia palea</i>	<i>Nitzschia palea</i>	<i>Nitzschia palea</i>	<i>Achnanthes minutissima v. 2</i>	<i>Achnanthes minutissima v. 2</i>	<i>Achnanthes minutissima v. 2</i>	<i>Cocconeis placentula v. lineata</i>
# of Diatom Taxa	28	25	30	29	28	33	29
# of Non-diatom taxa	5	8	8	8	7	9	10
# of Divisions	3	4	4	3	4	5	4
For Diatoms:							
Shannon Diversity Index (H)	2.59	2.86	2.96	2.67	2.82	2.55	2.33
Shannon Equitability Index (J) log e	0.17	0.20	0.21	0.18	0.20	0.18	0.18
% Cyanobacteria	7	2	2	<1	2	<1	18
% Diatoms	93	90	94	98	96	97	68
% Green Algae	<1	7	3	2	1	2	2
Total Abundance (cells/cm <sup>2</sup> )	4,625,128	1,546,155	1,610,955	2,166,936	1,726,822	1,668,791	403,685

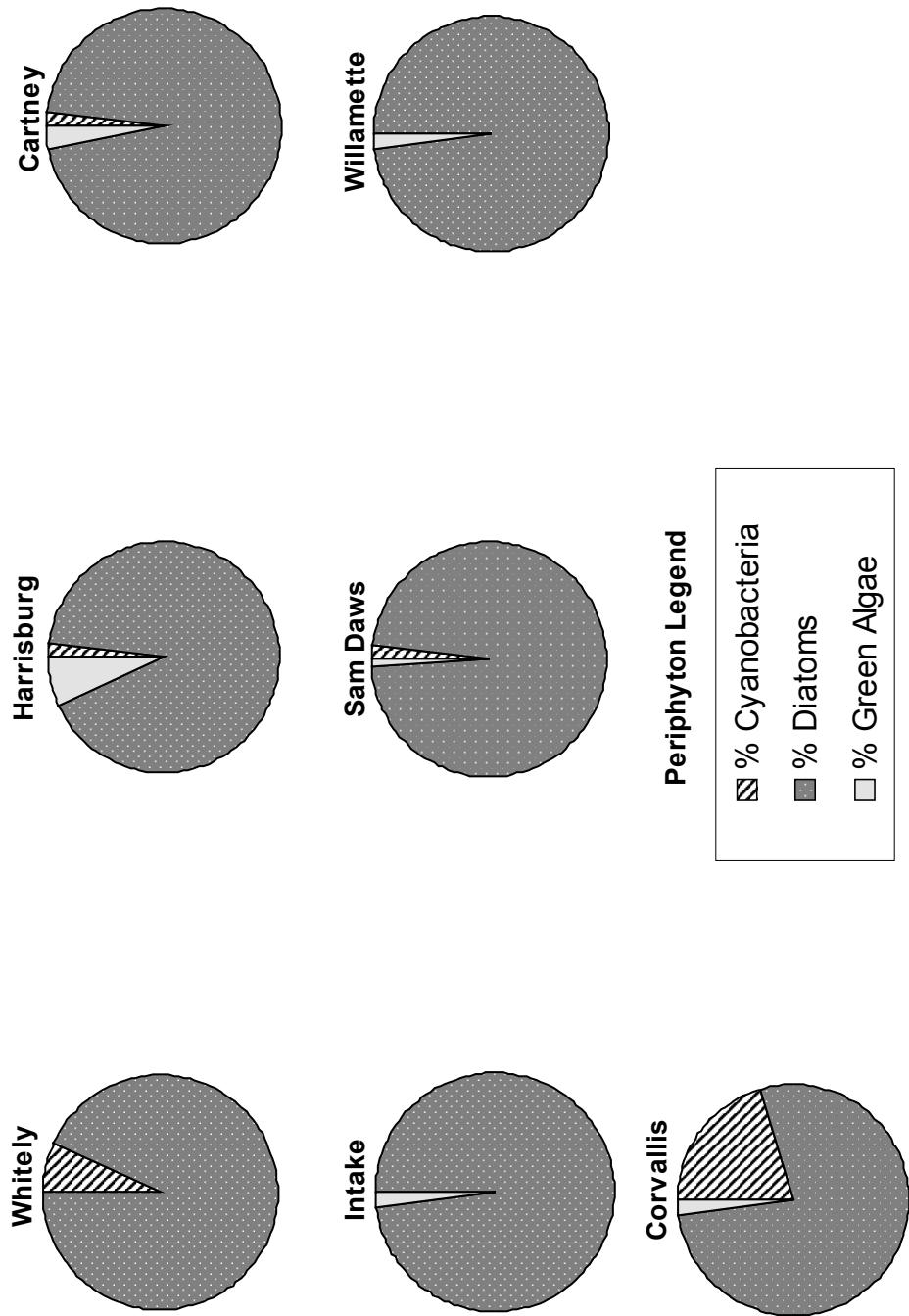
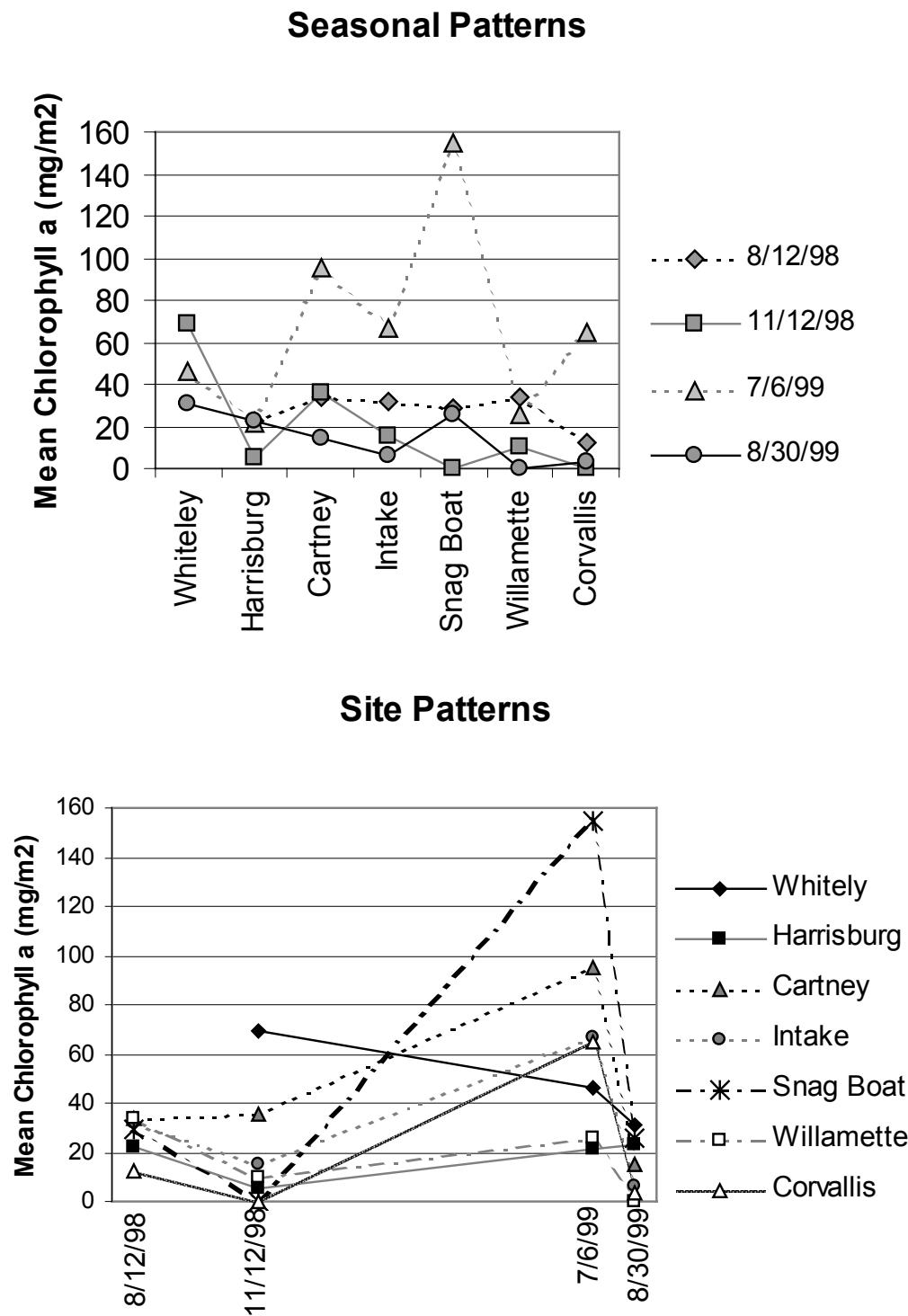


Figure 3.61 Willamette River Percent Distribution of Periphyton at Each Sampling Site, August 1998



**Figure 3.62** Willamette River Periphyton Mean Chlorophyll *a*, August 1998 to August 1999

### 3.8 Benthic Macroinvertebrates

Benthic macroinvertebrates were collected quarterly for biomass and taxonomic evaluation. The initial sampling method used for macroinvertebrate collection for all three rivers was a kick net with three replicates. This was modified for the second sampling date of November 1998, to a Surber sampler with five replicates. The Surber method was used for the remainder of the sampling year. All data were normalized to area ( $1\text{ m}^2$ ). Samples were preserved in 10% ethanol and shipped to Benthix Consulting for taxonomic evaluation. Samples were then returned, in 10% ethanol, to NABF, Anacortes, Washington, for biomass assays. The benthic macroinvertebrate sampling sites were the same as the periphyton sampling sites, with Codorus Creek having seven sites, the McKenzie River having five sites and the Willamette River seven sampling sites. No samples were taken on the McKenzie or the Willamette during the winter sampling date (February 1999) due to high water conditions. The summer (July 1999) McKenzie River sample was lost during shipment resulting in no data for that date. The Willamette River site Sam Daws was sampled on the first sampling date, but was replaced by a similar site downstream, Snag Boat. Annual summaries of macroinvertebrate data labeled "Snag Boat" consist of the combined Sam Daws and Snag Boat data (see Tables 3.48 and 3.52; Figures 3.71, 3.72, and 3.74).

### 3.8.1 Codorus Creek Benthic Macroinvertebrates

**Table 3.38** Codorus Creek Benthic Macroinvertebrate Taxa List by Sampling Site for September 1998 to June 1999

			Furnace	Arsenal	Graybill	Martin	USGS	Menges	East Branch
Order	Family	Genus							
<b>Amphipoda</b>	Gammaridae	Gammarus							
<b>Coleoptera</b>	Dryopidae	Helichus							
	Dytiscidae								
	Elmidae	Ancyronyx							
		Dubiraphia							
		Macronychus							
		Optioservus							
		Oulimnius							
		Stenelmis							
	Hydrophilidae								
		Berosus							
	Psephenidae	Ectopria							
		Psephenus							
	Ptilodactylidae	Anchytaurus							
<b>Decapoda</b>	Cambaridae								
<b>Diptera</b>	Ceratopogonidae								
		Alluaudomyia							
		Bezzia							
		Ceratopogon							
		Culicoides							
		Dasyhelea							
		Forcipomyia							
		Probezzia							
	Chaoboridae	Chaoborus							
	Chironomidae	Ablabesmyia							
		Brillia							
		Cardiocladius							
		Chaetocladius							
		Chironomus							
		Cladotanytarsus							
		Conchapelopia							
		Corynocera							
		Corynoneura							
		Cricotopus							
		Cricotopus/Orthocladius							
		Cryptochironomus							
		Cryptotendipes							
		Diamesa							
		Dicrotendipes							

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**Table 3.38** Continued

Order	Family	Genus	Furnace	Arsenal	Graybill	Martin	USGS	Menges	East Branch
<b>Diptera</b>	Chironomidae	Diplocladius							
		Doncricotopus							
		Epoicocladius							
		Eukiefferiella							
		Glyptotendipes							
		Hayesomyia							
		Helopelopia							
		Hydrobaenus							
		Limnophyes							
		Lopescladius							
		Meropelopia							
		Micropsectra							
		Microtendipes							
		Nanocladius							
		Natarsia							
		Nilotanyapus							
		Nimbocera							
		Orthocladius							
		Pagastia							
		Paracladopelma							
		Parakiefferiella							
		Paralauterborniella							
		Parametriocnemus							
		Paratanytarsus							
		Paratendipes							
		Phaenopsectra							
		Polypedilum							
		Potthastia							
		Procladius							
		Pseudochironomus							
		Pseudosmittia							
		Rheocricotopus							
		Rheopelopia							
		Rheotanytarsus							
		Stempellina							
		Stempellinella							
		Stenochironomus							
		Stictochironomus							
		Sublettea							
		Synorthocladius							
		Tanytarsus							
		Thienemanniella							
		Thienemannimyia							
		Tvetenia							
	Dolichopodidae	Dolichopus							
	Empididae	Chelifera							
		Clinocera							
		Dolichocephala							
		Hemerodromia							

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**Table 3.38** Continued

<b>Order</b>	<b>Family</b>	<b>Genus</b>	Furnace	Arsenal	Graybill	Martin	USGS	Menges	East Branch
<b>Diptera</b>	Muscidae								
	Muscidae	Limnophora							
	Psychodidae	Pericoma							
	Simuliidae	Prosimulium	█						
		Simulium	█	█	█	█	█	█	█
	Tabanidae	Chrysops			█				
		Tabanus			█				
	Tipulidae							█	
		Antocha	█	█	█	█	█	█	█
		Dicranota						█	█
	Erioptera		█						█
		Limnophila			█			█	
	Pseudolimnophila				█				
		Tipula		█				█	█
<b>Ephemeroptera</b>	Baetidae								
		Acentrella						█	█
		Baetis	█	█				█	█
		Diphetor							
	Caenidae	Caenis	█	█	█	█	█	█	█
	Ephemerellidae		█		█				
		Attenella		█	█				█
		Ephemerella						█	█
		Serratella		█				█	█
	Ephemeridae	Ephemera					█		█
	Heptageniidae	Stenacron	█			█	█		
	Heptageniidae	Stenonema		█		█	█		█
	Heptageniidae	Stenonema/Stenacron		█		█	█		█
	Isonychiidae	Isonychia	█						
	Leptophlebiidae							█	█
	Potamanthidae	Anthopotamus	█						
	Tricorythidae	Tricorythodes	█	█	█	█	█		
<b>Gastropoda</b>	Ancylidae		█	█	█	█	█	█	█
	Lymnaeidae								
	Physidae	Physella		█		█	█	█	█
	Planorbidae			█	█	█	█		
		Gyraulus		█	█	█	█		
<b>Hemiptera</b>	Gerridae	Rheumatobates				█			
	Veliidae	Rhagovelia		█		█			
<b>Hirudinea</b>	Erpobdellidae	Mooreobdella			█				
	Glossiphoniidae	Helobdella			█		█	█	█
<b>Hydracarina</b>				█	█	█	█	█	█
<b>Hydroida</b>	Hydridae	Hydra		█	█		█		

(Continued on next page)

**Table 3.38** Continued

<b>Order</b>	<b>Family</b>	<b>Genus</b>	<b>Furnace</b>	<b>Arsenal</b>	<b>Graybill</b>	<b>Martin</b>	<b>USGS</b>	<b>Menges</b>	<b>East Branch</b>
<b>Isopoda</b>	Asellidae	Caecidotea							
<b>Lepidoptera</b>	Pyralidae	Petrophila							
		Synclita							
<b>Megaloptera</b>	Corydalidae	Corydalus							
	Sialidae	Sialis							
<b>Odonata</b>	Calopterygidae								
	Coenagrionidae	Argia							
	Gomphidae								
		Stylogomphus							
<b>Oligochaeta</b>									
<b>Pelecypoda</b>	Sphaeriidae								
	Unionidae	Elliptio							
	Capniidae								
	Chloroperlidae								
	Nemouridae	Amphinemura							
	Perlidae								
		Acroneuria							
	Perlodidae								
	Taeniopterygidae	Taeniopteryx							
<b>Trichoptera</b>	Glossosomatidae	Angapetus							
		Glossosoma							
		Protoptila							
	Goeridae	Goera							
	Helicopsychidae	Helicopsyche							
	Hydropsychidae	Cheumatopsyche							
		Hydropsyche							
	Hydroptilidae	Hydroptila							
		Leucotrichia							
	Lepidostomatidae	Lepidostoma							
	Leptoceridae	Ceraclea							
		Mystacides							
	Limnephilidae								
	Philopotamidae	Chimarra							
		Dolophilodes							
	Polycentropodidae	Cernotina							
	Psychomyiidae	Psychomyia							
	Uenoidae	Neophylax							
<b>Tricladida</b>									

**Table 3.39** Codorus Creek Benthic Macroinvertebrate Community Metrics, September 1998

	Menges	USGS	Martin	Greybill	Arsenal	Furnace
<b>Richness (cumulative from 3 replicates)</b>	70	63	54	60	70	49
# EPT taxa	11	12	9	11	13	14
# Diptera taxa	50	39	31	35	41	25
EPT:Chironomid abundance ratio	1:2.94	2.13:1	1:1.30	1.50:1	1:1.71	1.43:1
% EPT	20.6%	48.8%	26.3%	38.3%	25.5%	35.3%
% Chironomidae	60.7%	22.9%	34.2%	25.6%	43.6%	24.7%
% Diptera	70.5%	23.1%	34.7%	26.3%	44.9%	25.4%
Community diversity index (Shannon H') log e	3.32	2.47	2.2	2.4	2.83	2.89
Community similarity index (Jaccard)	USGS 0.374	USGS 0.370	Martin 0.538	Martin 0.556	Greybill 0.568	Arsenal 0.495
Hilsenhoff Biotic Index	5.59	5.05	5.16	4.98	6.03	5.24
Tolerance (based on mean values from 3 replicates)	1.6:64	2.44:1	1.25:1	1.16:1	1:1.11	2.23:1
Feeding (based on mean values from 3 replicates)	CG CF PR SH SC UN PH CG CF PR SH SC UN PH	CG CF PR SH SC UN PH CG CF PR SH SC UN PH	CG CF PR SH SC UN PH CG CF PR SH SC UN PH	CG CF PR SH SC UN PH CG CF PR SH SC UN PH	CG CF PR SH SC UN PH CG CF PR SH SC UN PH	CG CF PR SH SC UN PH CG CF PR SH SC UN PH
Feeding group abundance	166	265	839	736	509	125
CG = Collector-Gatherer	127	90	133	102	337	26
CF = Collector-Filterer	216	24	402	332	280	27
PR = Predator	25	648	1048	852	459	279
SH = Shredder	3	0	15.3	24	25	21
SC = Scraper	0	1	0	27	86	2
UN = Unknown						
PH = Piercer-herbivore						

**Table 3.40** Codorus Creek Benthic Macroinvertebrate Community Metrics, October 1998

	Menges	USGS	Martin	Greybill	Arsenal	Furnace
<b>Richness (cumulative from 5 replicates)</b>						
Total # taxa	83	51	56	63	57	61
# EPT taxa	16	6	10	12	11	12
# Diptera taxa	46	31	28	32	26	27
EPT:Chironomid abundance ratio	1.46:1	1.53:1	1.2:67	1.3:07	1.2:12	1:1.58
<b>Composition (based on mean values from 5 replicates)</b>						
% EPT	41.9%	44.2%	14.3%	12.0%	14.6%	25.6%
% Chironomidae	28.6%	28.8%	38.1%	36.8%	30.8%	40.5%
% Diptera	39.6%	29.2%	38.7%	37.6%	34.2%	43.1%
% Oligochaeta	8.5%	3.2%	18.7%	10.3%	8.2%	1.4%
Community diversity index (Shannon H') log e	3.182	2.685	2.577	2.576	3.127	2.986
<b>Community similarity index (Jaccard)</b>						
USGS	0.337					
Martin	0.330	0.463				
Greybill	0.344	0.457	0.552			
Arsenal	0.359	0.417	0.444	0.479		
Furnace	0.340	0.451	0.479	0.473	0.535	
<b>Hilsenhoff Biotic Index</b>						
Tolerance (based on mean values from 5 replicates)	1:22.84	3.78:1	1.58:1	2.84:1	1.22:1	5.95:1
Feeding (based on mean values from 5 replicates)						
% Feeding groups						
replicates)						
CG	48.6%	25.9%	31.1%	17.8%	25.2%	15.1%
CF	33.7%	11.1%	16.2%	13.0%	8.7%	7.3%
PR	10.6%	12.3%	9.5%	6.4%	33.1%	7.5%
SH	5.1%	8.7%	16.9%	25.0%	13.9%	24.1%
SC	1.5%	41.9%	25.7%	36.8%	10.7%	43.6%
UN	0.6%	0.2%	0.6%	0.4%	2.0%	1.5%
PH	0.0%	0.0%	0.0%	0.7%	6.4%	0.8%
CG	402.0	67.4	332.0	236.6	96.4	65.2
CF	278.6	28.8	173.4	172.4	33.4	31.6
PR	87.4	32.0	101.2	84.8	126.6	32.4
SH	42.4	22.6	180.4	331.8	53.0	103.8
SC	12.2	109.0	274.4	489.0	40.8	188.0
UN	5.0	0.4	6.4	5.0	7.6	6.6
PH	0	0	0.2	8.8	24.4	3.6

CG = Collector-Gatherer

CF = Collector-Filterer

PR = Predator

SH = Shredder

SC = Scraper

UN = Unknown

PH = Piercer-Herbivore

**Table 3.41** Codorus Creek Benthic Macroinvertebrate Community Metrics, March 1999

	Menges	USGS	Martin	Graybill	Arsenal	Furnace
<b>Richness (cumulative from 5 replicates)</b>	59	67	66	83	60	62
# EPT taxa	6	5	10	12	7	8
# Diptera taxa	43	49	44	57	40	42
EPT:Chironomid abundance ratio	1.43:07	1.5:6	1:20.66	1:14.48	1:19.46	1:36.08
% EPT	1.7%	12.1%	3.4%	3.9%	4.0%	2.1%
% Chironomidae	75.0%	68.0%	69.0%	56.2%	78.1%	76.1%
% Diptera	80.5%	68.9%	69.4%	57.8%	81.0%	79.2%
Community diversity index (Shannon H') log e	2.52	2.87	2.67	2.48	2.69	2.36
<b>Community similarity index (Jaccard)</b>						
USGS	0.537					
<b>Martin</b>	0.344	0.565				
<b>Graybill</b>	0.434	0.530	0.461			
<b>Arsenal</b>	0.308	0.494	0.385	0.402		
<b>Furnace</b>	0.424	0.573	0.505	0.480	0.506	
<b>Hilsenhoff Biotic Index</b>						
Hydropsychidae:Trichoptera abundance ratio						
Total Abundance						
<b>Tolerance (based on mean values from 5 replicates)</b>	1.8:1	1.96:1	1.28:1	5.48:1	2.57:1	6.93:1
<b>Feeding (based on mean values from 5 replicates)</b>						
Ratio Scrappers:Filters						
% Feeding groups						
<b>CG</b>	62.8%	26.6%	17.3%	12.5%	20.5%	18.5%
<b>CF</b>	3.1%	8.9%	16.9%	6.4%	3.5%	2.5%
<b>PR</b>	24.9%	9.5%	5.4%	7.0%	7.6%	3.5%
<b>SH</b>	3.5%	37.2%	37.6%	38.6%	56.3%	56.9%
<b>SC</b>	5.6%	17.5%	21.6%	35.2%	9.1%	17.7%
<b>UN</b>	0.1%	0.2%	0.2%	0.2%	2.9%	0.8%
<b>PH</b>	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
<b>Feeding group abundance</b>						
<b>CG</b>	202.0	87.6	120.0	168.8	26.6	42.2
<b>CF</b>	10.0	29.4	117.2	87.0	4.6	5.8
<b>PR</b>	80.0	31.2	37.4	94.4	9.8	8.0
<b>SH</b>	11.4	122.6	261.4	523.6	73.0	129.6
<b>SC</b>	18.0	57.6	150.0	477.0	11.8	40.2
<b>UN</b>	0.2	0.8	1.2	2.4	3.8	1.8
<b>PH</b>	0	0	0.2	2.6	0.0	0.0

CG = Collector-Gatherer  
 CF = Collector-Filterer  
 PR = Predator  
 SH = Shredder  
 SC = Scraper  
 UN = Unknown  
 PH = Piercer-herbivore

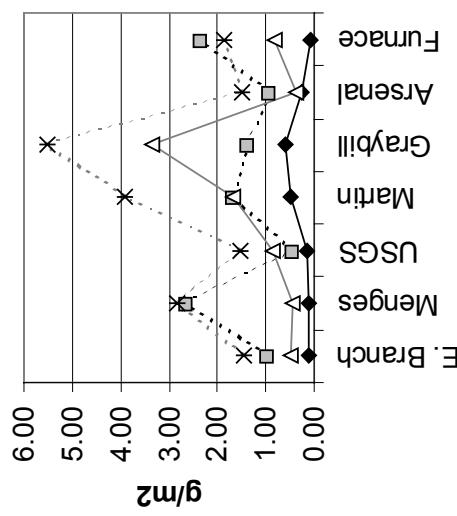
**Table 3.42** Codorus Creek Benthic Macroinvertebrate Community Metrics, June 1999

Richness (cumulative from 5 replicates)		Menges	USGS	Martin	Graybill	Arsenal	Furnace
Total # taxa		88	63	63	65	79	58
# EPT taxa		12	8	9	9	8	9
# Diptera taxa		60	42	39	39	52	34
EPT:Chironomid abundance ratio		1:32.1	1:06.1	1:5.31	1:39.1	1:8.51	1:2.65
% EPT		2.4%	27.3%	11.9%	25.3%	9.2%	15.2%
Community diversity index (Shannon H') log e		77.99%	25.88%	63.4%	18.2%	78.2%	40.4%
% Chironomidae		91.4%	26.3%	64.6%	19.0%	79.2%	41.8%
% Diptera		2.64	2.91	2.30	2.35	2.89	2.65
Community similarity index (Jaccard)		USGS	USGS	Martin	Graybill	Arsenal	Furnace
		Menges	0.510				
		Martin	0.438	0.575			
		Graybill	0.457	0.524	0.542		
		Arsenal	0.653	0.614	0.543	0.516	
		Furnace	0.490	0.532	0.532	0.618	0.612
Tolerance (based on mean values from 5 replicates)		Menges	USGS	Martin	Graybill	Arsenal	Furnace
		6.15	5.37	6.42	5.01	6.21	6.20
		1:1.35	1:1.20	1:1.10	1:1.35	1:2.13	1:1.24
		2075.2	353.6	17388.4	1710.2	1290.4	772.8
Feeding (based on mean values from 5 replicates)		Menges	USGS	Martin	Graybill	Arsenal	Furnace
		1:43.44	1:63.1	1:1.36	2.50:1	1:4.53	3.01:1
% Feeding groups							
CG = Collector-Gatherer							
CF = Collector-Filterer							
PR = Predator							
SH = Shredder							
SC = Scraper							
UN = Unknown							
PH = Piercer-Herbivore							
Feeding group abundance							
CG							
CF							
PR							
SH							
SC							
UN							
PH							
CG							
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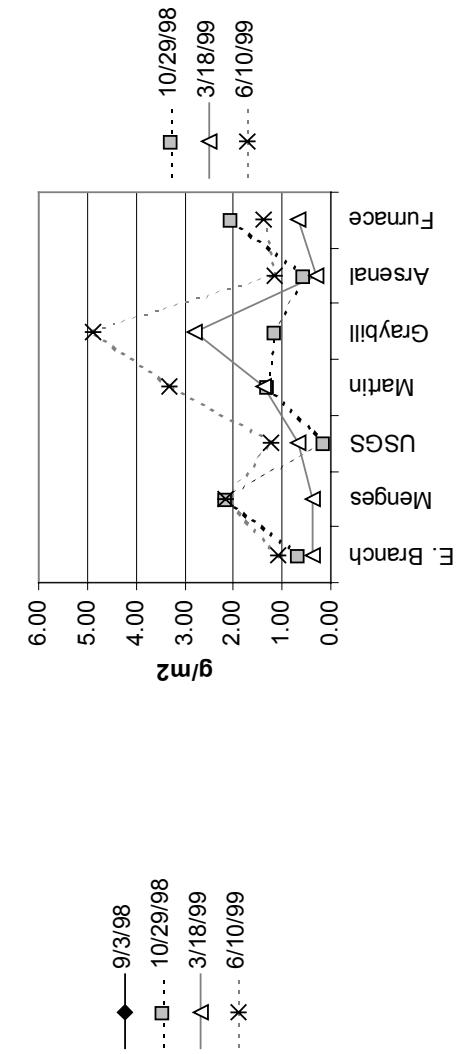
**Table 3.43** Codorus Creek Benthic Macroinvertebrate Biomass September 1998 to June 1999,  
Dry Weights and Ash-Free Dry Weights (mean for 3-5 replicates)

<b>Average Dry Weight (g/m<sup>2</sup>)</b>						
E. Branch	Menges	USGS	Martin	Graybill	Arsenal	Furnace
9/3/98	0.0955	0.1134	0.1441	0.4700	0.5779	0.2424
10/29/98	0.9572	2.6538	0.4519	1.6736	1.3789	0.9210
3/18/99	0.4924	0.4633	0.8517	1.6788	3.3434	0.3671
6/10/99	1.4555	2.8282	1.5436	3.9298	5.5003	1.4956
						1.8489

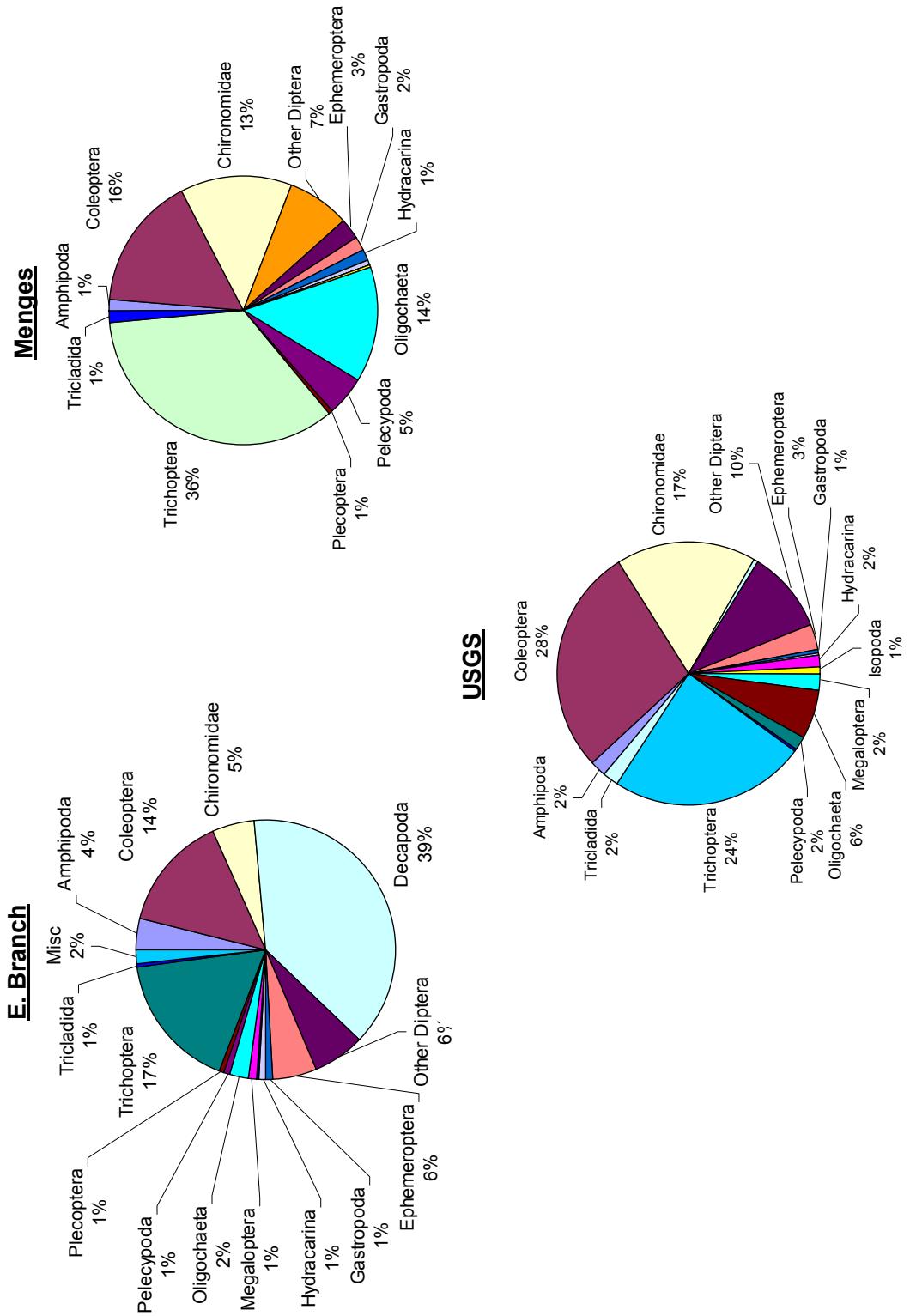
<b>Average Ash Free Dry Weights (g/m<sup>2</sup>)</b>						
E. Branch	Menges	USGS	Martin	Graybill	Arsenal	Furnace
10/29/98	0.6736	2.1608	0.1582	1.3119	1.1462	0.5623
3/18/99	0.3591	0.3645	0.6749	1.3694	2.8080	0.2855
6/10/99	1.0719	2.1716	1.2153	3.3341	4.8680	1.1651
						1.3806



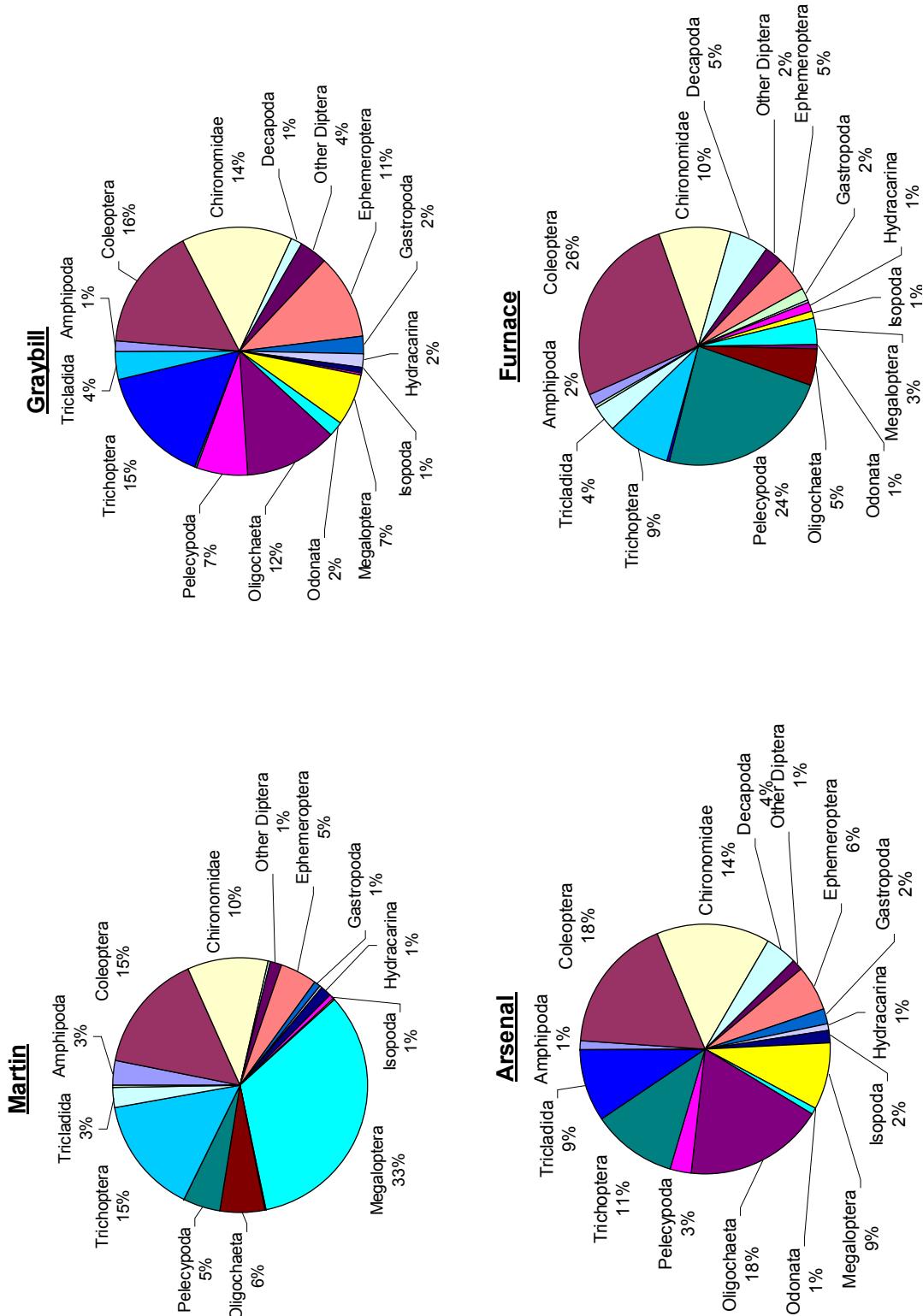
**Figure 3.63** Codorus Creek Benthic Macroinvertebrate  
Mean Biomass: Dry Weights



**Figure 3.64** Codorus Creek Benthic Macroinvertebrate  
Mean Biomass: Ash Free Dry Weights



**Figure 3.65** Study Year Summary of Codorus Creek Benthic Macroinvertebrate Dry Weight Percent Distribution at Sampling Sites Upstream of Mill Discharge



**Figure 3.66** Study Year Summary of Codorus Creek Benthic Macroinvertebrate Dry Weight Percent Distribution at Sampling Sites Downstream of Mill Discharge

### 3.8.2 McKenzie River Benthic Macroinvertebrates

**Table 3.44** McKenzie River Benthic Macroinvertebrate Taxa List by Sampling Site  
for August 1998 to November 1998

[Orange square denotes presence at a site during the sampling year]

Order	Family	Genus	Armitage RM 6.5	Harvest RM 10	Mohawk RM 14	Bellinger RM 18.5	Hendricks RM 22.4
<b>Amphipoda</b>	Gammaridae	Gammarus		■	■		
<b>Coleoptera</b>	Dytiscidae	Hydrovatus					■
		Oreodytes		■			
	Elmidae	Cleptelmis		■			
		Dubiraphia					■
		Heterlimnius		■			
		Narpus	■	■	■	■	■
		Optioservus	■	■	■	■	■
		Rhizelmis			■	■	
		Zaitzevia	■	■	■	■	■
<b>Diptera</b>	Ceratopogonidae	Bezzia				■	
		Culicoides	■				
		Dasyhelea	■		■		
		Mallochohelea	■			■	■
	Chironomidae			■	■	■	■
		Ablabesmyia	■	■			
		Cardiocladius	■	■	■	■	
		Cladotanytarsus			■		■
		Conchapelopia	■	■	■	■	■
		Corynoneura	■	■	■	■	
		Cricotopus	■	■	■	■	■
		Cricotopus/Orthocladius	■	■	■	■	■
		Cryptochironomus	■		■	■	■
		Demicryptochironomus				■	
		Dicrotendipes	■	■			
		Eukiefferiella	■	■	■	■	■
		Heleniella					■
		Heterotrissocladius	■		■		■
		Lopescladius					■
		Micropsectra	■	■	■	■	■
		Microtendipes	■	■	■	■	■
		Nanocladius	■	■			
		Nilotanypus	■	■		■	
		Orthocladius	■	■	■	■	
		Pagastia				■	
		Parachaetocladius	■	■		■	■
		Paracladopelma				■	■

(Continued on next page)

**Table 3.44** Continued

<b>Order</b>	<b>Family</b>	<b>Genus</b>	<b>Armitage RM 6.5</b>	<b>Harvest RM 10</b>	<b>Mohawk RM 14</b>	<b>Bellinger RM 18.5</b>	<b>Hendricks RM 22.4</b>
<b>Diptera</b>	Chironomidae	Parakiefferiella					
		Parametriocnemus					
		Paratanytarsus					
		Paratendipes					
		Pentaneura					
		Phaenopsectra					
		Polypedilum					
		Pothastia					
		Psectrocladius					
		Rheocricotopus					
		Rheopelopia					
		Rheotanytarsus					
		Robackia					
		Stempellina					
		Stempellinella					
		Sublettea					
		Sympothastia					
		Synorthocladius					
		Tanytarsus					
		Thienemanniella					
		Thienemannimyia					
		Tvetenia					
	Dolichopodidae						
	Empididae	Chelifera					
		Hemerodromia					
		Trichoclinocera					
	Ephydriidae	Discocerina					
	Muscidae						
	Simuliidae	Simulium					
	Tanyderidae	Protanyderus					
	Tipulidae	Antocha					
		Tipula					
<b>Ephemeroptera</b>	Baetidae						
		Acentrella					
		Baetis					
		Diphetor					
	Ephemerellidae	Attenella					
		Drunella					
		Ephemerella					
		Serratella					
		Timpanoga					

(Continued on next page)

**Table 3.44** Continued

<b>Order</b>	<b>Family</b>	<b>Genus</b>	<b>Armitage</b>	<b>RM 6.5</b>	<b>Harvest</b>	<b>RM 10</b>	<b>Mohawk</b>	<b>RM 14</b>	<b>Bellinger</b>	<b>RM 18.5</b>	<b>Hendricks</b>	<b>RM 22.4</b>
<b>Ephemeroptera</b>	Heptageniidae											
		Epeorus										
		Heptagenia										
		Rhithrogena										
		Stenonema										
	Leptophlebiidae	Paraleptophlebia										
	Tricorythidae	Tricorythodes										
<b>Gastropoda</b>	Ancylidae											
	Hydrobiidae	Amnicola										
	Physidae	Physella										
	Planorbidae											
	Planorbidae	Gyraulus										
		Vorticifex										
	Pleuroceridae	Juga										
<b>Hemiptera</b>	Corixidae											
	Saldidae											
<b>Hydracarina</b>												
<b>Hydroida</b>	Hydridae	Hydra										
<b>Lepidoptera</b>	Pyralidae	Petrophila										
<b>Oligochaeta</b>												
<b>Pelecypoda</b>	Sphaeriidae											
<b>Plecoptera</b>	Chloroperlidae	Suwalla										
	Leuctridae	Despaxia										
	Nemouridae	Malenka										
		Zapada										
	Perlidae											
		Calineuria										
		Claassenia										
		Hesperoperla										
	Perlodidae											
		Isoperla										
		Skwala										
	Pteronarcyidae	Pteronarcys										

(Continued on next page)

**Table 3.44** Continued

<b>Order</b>	<b>Family</b>	<b>Genus</b>	<b>Armitage RM 6.5</b>	<b>Harvest RM 10</b>	<b>Mohawk RM 14</b>	<b>Bellinger RM 18.5</b>	<b>Hendricks RM 22.4</b>
<b>Trichoptera</b>	Brachycentridae	Brachycentrus					
	Glossosomatidae	Glossosoma	■				■
	Hydropsychidae				■	■	
		Arctopsyche					
		Cheumatopsyche	■	■			
		Hydropsyche	■	■	■	■	■
	Hydroptilidae	Hydroptila	■	■	■	■	■
	Lepidostomatidae	Lepidostoma	■	■	■	■	■
	Leptoceridae	Ceraclea			■		
		Nectopsyche		■			
	Psychomyiidae	Psychomyia	■				
	Rhyacophilidae	Rhyacophila		■	■	■	■
<b>Tricladida</b>			■	■	■	■	

**Table 3.45** McKenzie River Benthic Macroinvertebrate Community Metrics, August 1998

	Hendricks	Walterville	Mohawk	Harvest	Armitage
<b>Richness (cumulative from 3 replicates)</b>	<b>22.4</b>	<b>20.5</b>	<b>14</b>	<b>10</b>	<b>6.5</b>
Total # taxa	59	70	68	72	76
# EPT taxa	14	24	23	25	23
# Diptera taxa	38	40	31	38	44
<b>Composition (based on mean values from 3 replicates)</b>					
EPT:Chironomid abundance ratio	1 : 1.22	1.15 : 1	1 : 1.53	1 : 5.44	1:2.27
% EPT	34.7%	42.1%	15.2%	11.4%	21.7%
% Chironomidae	42.4%	36.7%	23.2%	62.2%	49.2%
% Diptera	44.9%	40.9%	29.2%	64.9%	50.8%
Community diversity index (Shannon H') log e	3.173	2.979	2.774	2.846	3.023
<b>Community similarity index (Jaccard)</b>					
Walterville	Hendricks	Walterville	Mohawk	Harvest	
Walterville	0.441				
Mohawk	0.471				
Harvest	0.489	0.521			
Armitage	0.516	0.485	0.564		0.611
<b>Hilsenhoff Biotic Index</b>					
Hydropsychidae:Trichoptera abundance ratio	4.39	4.41	4.63	5.90	4.85
Total Abundance	0	1:10.5	1:24.6	1:8.6	1:7.7
	818	1462	1397	1811	1190
<b>Tolerance (based on mean values from 3 replicates)</b>	1 : 1.2	1.2 : 1	1 : 1	1 : 1.25	1 : 1
<b>Feeding (based on mean values from 3 replicates)</b>					
% Feeding groups	CG	28.9%	34.1%	14.2%	38.0%
	CF	13.1%	3.1%	7.8%	10.4%
	PR	15.2%	17.5%	15.6%	21.2%
	SH	29.1%	24.7%	17.2%	22.3%
	SC	13.0%	20.6%	39.5%	8.0%
	UN	0.9%	0.1%	5.7%	0.1%
CG = Collector-Gatherer					
CF = Collector-Filterer	CG	236	498	198	688
PR = Predator	CF	107	45	109	189
SH = Shredder	PR	124	256	218	384
SC = Scraper	SH	238	361	240	178
UN = Unknown	SC	106	301	552	404
PH = Piercer-herbivore	UN	7	1	80	144
				2	232
				2	2

**Table 3.46** McKenzie River Benthic Macroinvertebrate Community Metrics, November 1998

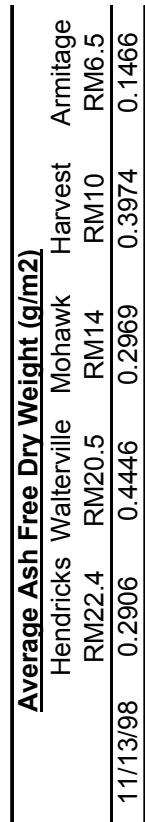
	Hendricks	Bellingers	Mohawk	Harvest	Armitage
<b>Richness (cumulative from 5 replicates)</b>	<b>22.4</b>	<b>18.5</b>	<b>14</b>	<b>10</b>	<b>6.5</b>
Total # taxa	45	56	45	42	38
# EPT taxa	13	15	10	10	9
# Diptera taxa	23	34	24	21	21
<b>Composition (based on mean values from 5 replicates)</b>	<b>1:3.15</b>	<b>1:5.62</b>	<b>1:45.28</b>	<b>1:8.07</b>	<b>1:9.8</b>
EPT:Chironomid abundance ratio	12.4%	11.9%	1.5%	3.0%	6.0%
% PPT	39.0%	67.1%	66.2%	24.0%	58.5%
% Chironomidae	52.9%	72.7%	79.0%	29.2%	70.4%
% Diptera	29.1%	14.4%	6.7%	59.0%	16.3%
% Oligochaeta	1.978	1.449	1.633	1.64	2.161
Community diversity index (Shannon H') log e					
<b>Community similarity index (Jaccard)</b>	<b>Hendricks</b>	<b>Bellingers</b>	<b>Mohawk</b>	<b>Harvest</b>	<b>Armitage</b>
Bellingers	0.479				
Mohawk	0.368	0.444			
Harvest	0.338	0.417	0.525		
Armitage	0.354	0.435	0.450	0.574	
<b>Tolerance (based on mean values from 5 replicates)</b>	<b>Hilsenhoff Biotic Index</b>	<b>4.33</b>	<b>4.57</b>	<b>4.63</b>	<b>4.99</b>
Hydropsychidae:Trichoptera abundance ratio	1:20.7	1:2.87	1:30	1:30	1:20
Total Abundance	486.6	2186.0	943.6	564.4	217.8
<b>Feeding (based on mean values from 5 replicates)</b>	<b>Ratio Scrapers:Filterers</b>	<b>10.92:1</b>	<b>1.75:1</b>	<b>3.25:1</b>	<b>18.7:1</b>
% Feeding groups	CG	84.3%	88.8%	78.6%	82.8%
	CF	0.5%	1.4%	1.2%	0.4%
	PR	4.5%	3.7%	1.3%	1.5%
	SH	3.5%	3.6%	6.7%	1.1%
	SC	5.4%	2.4%	3.9%	1.3%
	UN	1.8%	0.0%	8.4%	8.1%
	PH	0.0%	0.0%	0.0%	7.2%
	CG	410.2	1941.2	741.8	467.6
	CF	2.4	30.6	11.2	2.0
	PR	22.0	80.8	12.0	6.4
	SH	17.0	79.2	63.0	39.8
	SC	26.2	53.4	36.4	37.4
	UN	8.6	0.6	79.2	11.2
	PH	0.2	0.2	0.0	0.0

CG = Collector-Gatherer  
 CF = Collector-Filterer  
 PR = Predator

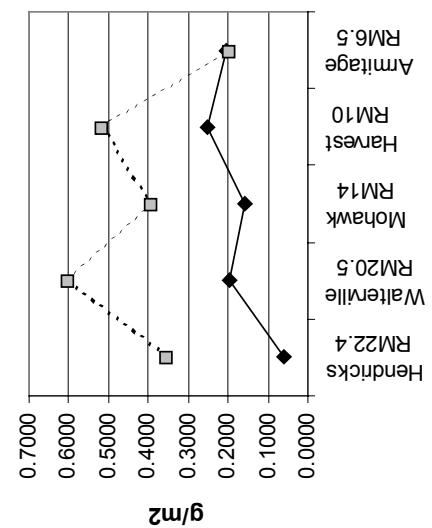
SH = Shredder  
 SC = Scraper  
 UN = Unknown  
 PH = Piercer-herbivore

**Table 3.47** McKenzie River Benthic Macroinvertebrate Biomass August 1998 to November 1998,  
Dry and Ash-Free Dry Weight (mean for 3-5 replicates)

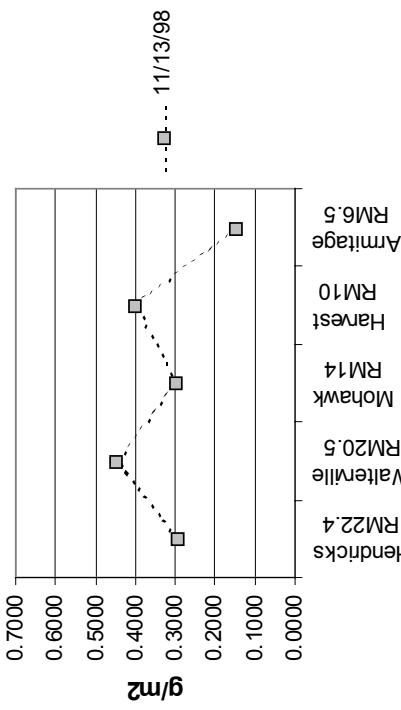
<u>Average Dry Weight (g/m<sup>2</sup>)</u>				Harvest	Armitage
Hendricks	Walterville	Mohawk	RM14	RM10	RM6.5
RM22.4	RM20.5				
08/11/98	0.0584	0.1980	0.1588	0.2525	0.2067
11/13/98	0.3544	0.6017	0.3933	0.5175	0.1959



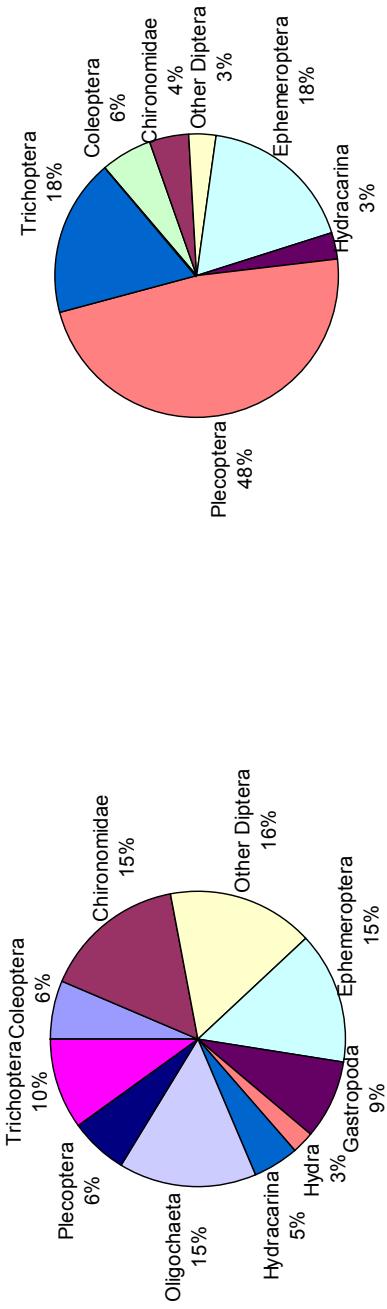
**Figure 3.67** McKenzie River Benthic Macroinvertebrate Mean Biomass: Dry Weights



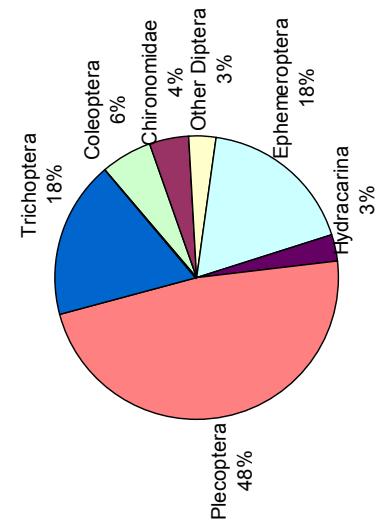
**Figure 3.68** McKenzie River benthic Macroinvertebrate Mean Biomass: Ash Free Dry Weights



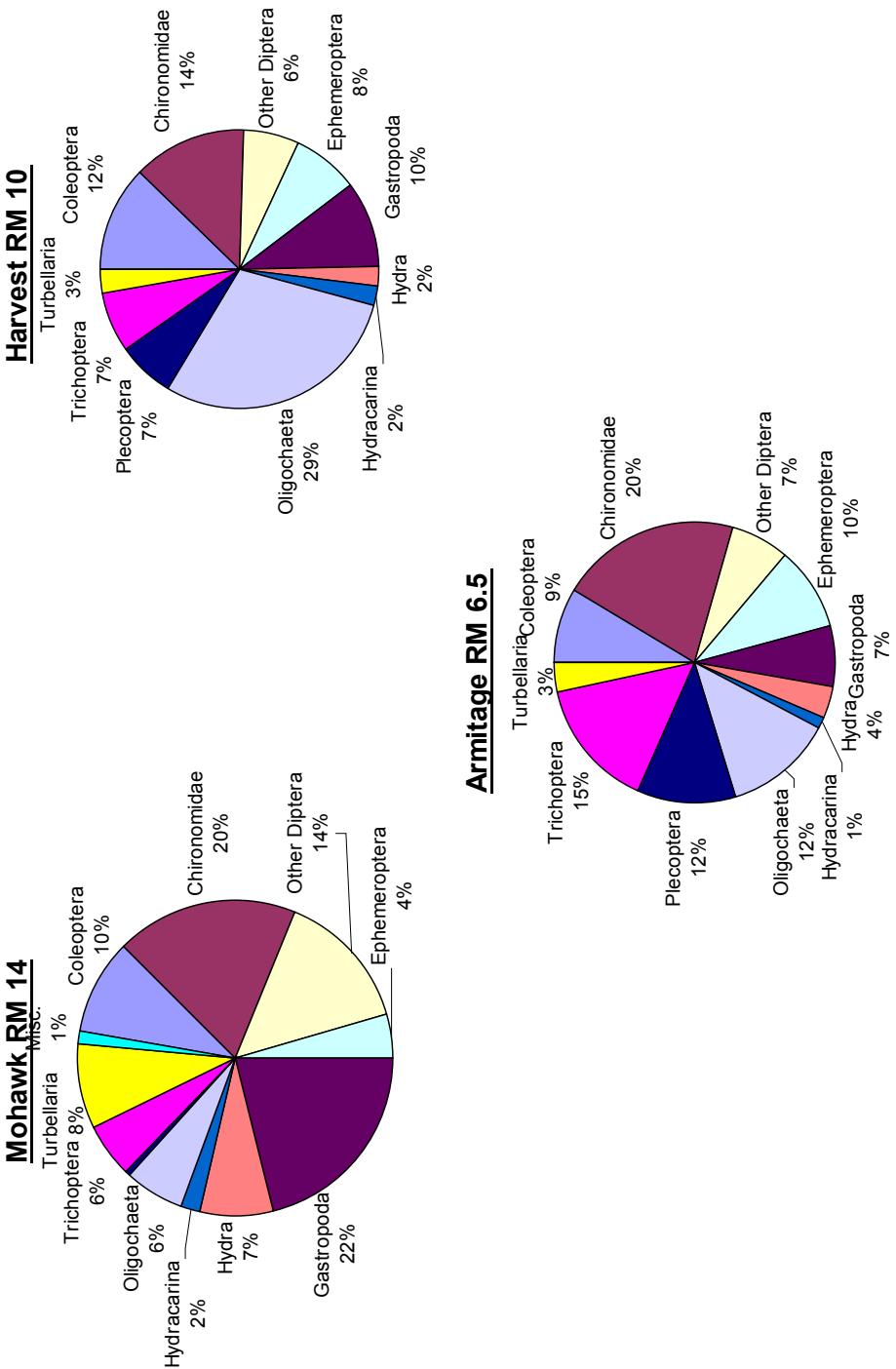
**Hendricks RM 22.4**



**Walterville RM 20.5**



**Figure 3.69** Study Year Summary of McKenzie River Benthic Macroinvertebrate Dry Weight Percent Distribution at Sampling Sites Upstream of Mill Discharge



**Figure 3.70** Study Year Summary of McKenzie River Benthic Macroinvertebrate Dry Weight Percent Distribution at Sampling Sites Downstream of Mill Discharge

### 3.8.3 Willamette River Benthic Macroinvertebrates

**Table 3.48** Willamette River Benthic Macroinvertebrate Taxa List  
by Sampling Site for August 1998 to July 1999

[Orange box] denotes presence at a site during the sampling year

Order	Family	Genus	Corvallis	RM 128	Willamette	RM 134	Snag Boat	RM 143.5	Intake	RM 148	Cartney	RM 156	Harrisburg	RM 160	Whitley	RM 176
<b>Amphipoda</b>	Gammaridae	Gammarus														
<b>Coleoptera</b>	Dytiscidae	Oreodytes														
	Elmidae	Dubiraphia														
		Heterlimnius														
		Narpus														
		Optioservus														
		Ordobrevia														
		Stenelmis														
		Zaitzevia														
	Haliplidae	Brychius														
	Psephenidae	Psephenus														
<b>Diptera</b>	Ceratopogonidae	Bezzia														
		Ceratopogon														
		Culicoides														
		Dasyhelea														
	Chironomidae															
		Ablabesmyia														
		Brillia														
		Cardiocladius														
		Chironomus														
		Cladotanytarsus														
		Conchapelopia														
		Corynoneura														
		Cricotopus														
		Cricotopus/Orthocladius														
		Cryptochironomus														
		Demicryptochironomus														
		Dicrotendipes														
		Eukiefferiella														
		Heleniella														
		Heterotrissocladius														
		Limnophyes														
		Micropsectra														
		Microtendipes														
		Nanocladius														
		Nilotanypus														
		Nimbocera														
		Odontomesa														
		Orthocladius														
		Pagastia														
		Parachironomus														
		Paracladopelma														

(Continued on next page)

**Table 3.48** Continued

Order	Family	Genus	Corvallis	RM 128	Willamette	RM 134	Snag Boat	RM 143.5	Intake	RM 148	Cartney	RM 156	Harrisburg	RM 160	Whitley	RM 176
Diptera	Chironomidae	Parakiefferiella														
		Paratanytarsus														
		Pentaneura														
		Phaenopsectra														
		Polypedilum														
		Pothastia														
		Procladius														
		Psectrocladius														
		Pseudosmittia														
		Rheocricotopus														
		Rheopelopia														
		Rheotanytarsus														
		Robackia														
		Smittia														
		Stempellinella														
		Stictochironomus														
		Sublettea														
		Synorthocladius														
		Tanytarsus														
		Thienemanniella														
		Thienemannimyia														
		Tvetenia														
	Culicidae	Aedes														
	Dolichopodidae															
	Empididae	Chelifera														
		Hemerodromia														
		Trichoclinocera														
	Ephydriidae	Parydra														
	Simuliidae	Simulium														
	Stratiomyidae															
	Tanyderidae	Protanyderus														
	Tipulidae	Antocha														
		Gonomyia														
		Tipula														
Ephemeroptera																
	Baetidae	Acentrella														
		Baetus														
		Diphetor														
	Caenidae	Caenis														
	Ephemerellidae	Attenella														
		Ephemerella														
		Serratella														
		Timpanoga														
	Heptageniidae															
		Epeorus														
		Heptagenia														
		Rhithrogena														
		Stenacron														
		Stenonema														

(Continued on next page)

**Table 3.48** Continued

<b>Order</b>	<b>Family</b>	<b>Genus</b>	Corvallis	RM 128	Willamette	Snag Boat	RM 143.5	Intake	RM 148	Cartney	RM 156	Harrisburg	RM 160	Whitley	RM 176
Ephemeroptera	Heptageniidae	Stenonema/Stenacron													
	Leptophlebiidae	Leptophlebia													
		Paraleptophlebia													
	Tricorythidae	Tricorythodes													
Gastropoda	Ancylidae														
	Hydrobiidae	Amnicola													
	Lymnaeidae	Stagnicola/Fossaria													
	Physidae	Physella													
	Planorbidae														
		Gyraulus													
Hemiptera	Pleuroceridae	Juga													
	Corixidae														
Hirudinea	Sigara														
Hydracarina															
Hydroids	Hydridae	Hydra													
Isopoda	Asellidae	Caecidotea													
Lepidoptera	Pyralidae	Petrophilà													
Odonata	Gomphidae	Ophiogomphus													
Oligochaeta															
Pelecypoda	Sphaeriidae														
Plecoptera	Chloroperlidae														
	Leuctridae	Despaxia													
	Nemouridae	Zapada													
	Perlidae	Claassenia													
	Perlodidae														
		Isogenoides													
		Isoperla													
Rhynchobdellida		Skwala													
	Glossiphoniidae	Deserobdella													
		Helobdella													

(Continued on next page)

**Table 3.48** Continued

<b>Order</b>	<b>Family</b>	<b>Genus</b>	Corvallis	RM 128	Willamette	RM 134	Snag Boat	RM 143.5	Intake	RM 148	Cartney	RM 156	Harrisburg	RM 160	Whitney	RM 176
Trichoptera	Brachycentridae	Brachycentrus														
	Glossosomatidae															
		Glossosoma														
		Protoptila														
	Goeridae	Goera														
	Hydropsychidae															
		Cheumatopsyche														
		Hydropsyche														
	Hydroptilidae	Hydroptila														
		Leucotrichia														
		Oxyethira														
	Lepidostomatidae	Lepidostoma														
	Leptoceridae															
		Ceraclea														
		Mystacides														
		Nectopsyche														
		Oecetis														
	Limnephilidae															
	Psychomyiidae	Psychomyia														
	Rhyacophilidae	Rhyacophila														
Tricladida																

**Table 3.49** Willamette River Benthic Macroinvertebrate Community Metrics, August 1998

**Table 3.50** Willamette River Benthic Macroinvertebrate Community Metrics, November 1998

		CORVALLIS	WILLAMETTE	SNAG BOAT	INTAKE	CARTNEY	HARRISBURG	WHITELEY
<b>Richness (cumulative from 5 replicates)</b>	Total # taxa	<b>128</b>	<b>134</b>	<b>143.5</b>	<b>148</b>	<b>156</b>	<b>160</b>	<b>176</b>
	# EPT taxa	17	36	30	23	30	28	42
	# Diptera taxa	4	8	3	2	6	3	12
<b>Composition (based on mean values from 5 replicates)</b>	# Diptera	5	22	20	16	17	18	20
	EPT:Chironomid abundance ratio	1.2	1.2:2.3	1:83.3	1:15.75	1:10.5	1:15.88	1:2.17
	% EPT	3.4%	9.1%	0.2%	1.6%	1.4%	1.3%	6.0%
	% Chironomidae	6.8%	20.4%	13.8%	25.3%	15.1%	21.4%	13.1%
	% Diptera	7.4%	21.2%	15.4%	26.5%	15.1%	22.2%	13.8%
	% Oligochaeta	64.8%	61.1%	79.6%	63.1%	78.0%	66.5%	59.9%
	Community diversity index (Shannon H') log e	1.448	1.975	1.001	1.613	1.104	1.507	1.797
	Community similarity index (Jaccard)							
		<b>128</b>	<b>134</b>	<b>143.5</b>	<b>148</b>	<b>156</b>	<b>160</b>	
		134	0.311					
		143.5	0.231	0.327				
		148	0.229	0.333	0.293			
		156	0.317	0.415	0.333	0.341		
		160	0.324	0.429	0.372	0.350	0.354	
		176	0.255	0.441	0.298	0.327	0.429	0.316
<b>Tolerance (based on mean values from 5 replicates)</b>	Hilsenhoff Biotic Index	5.17	4.92	5.42	5.41	5.14	5.64	5.73
	Hydropsychidae:Trichoptera abundance ratio	0	1:1.13	0:0.2	0:6.0	1:1.5	0:0.4	1:1.12
	Total Abundance	35.2	74.6	362.4	49.8	139.2	118.8	212.8
<b>Feeding (based on mean values from 5 replicates)</b>	Ratio Scrapers:Filterers	3.8:1	1.36:1	1:6.05	1:1.08	1:1.57	3.06:1	2.19:1
	% Feeding groups							
	CG	68.8%	75.6%	84.8%	77.9%	89.2%	77.9%	70.6%
	CF	2.8%	5.9%	6.7%	5.2%	3.2%	3.0%	5.4%
	PR	4.0%	2.4%	2.0%	5.2%	2.3%	4.2%	7.1%
	SH	1.7%	4.3%	1.5%	2.4%	1.6%	1.3%	3.5%
	SC	10.8%	8.0%	1.1%	4.8%	2.0%	9.3%	11.7%
	UN	11.9%	3.8%	0.0%	3.6%	1.7%	2.0%	1.5%
	PH	0.0%	0.0%	4.0%	0.8%	0.0%	2.2%	0.2%
	CG	24.2	56.4	307.2	38.8	124.2	92.6	150.2
	CF	1.0	4.4	24.2	2.6	4.4	3.6	11.4
	PR	1.4	1.8	7.2	2.6	3.2	5.0	15.2
	SH	0.6	3.2	5.4	1.2	2.2	1.6	7.4
	SC	3.8	6.0	4.0	2.4	2.8	11.0	25.0
	UN	4.2	2.8	0	1.8	2.4	2.4	3.2
	PH	0	0	14.4	0.4	0	2.6	0.4

CG = Collector-Gatherer  
 CF = Collector-Filterer  
 PR = Predator  
 SH = Shredder  
 SC = Scraper  
 UN = Unknown

**Table 3.51** Willamette River Benthic Macroinvertebrate Community Metrics, July 1999

		Corvallis	Willamette	Snag Boat	Intake	Cartney	Harrisburg	Whitley
<b>Richness (cumulative from 5 replicates)</b>	<b>Total # taxa</b>	<b>128</b>	<b>134</b>	<b>143.5</b>	<b>148</b>	<b>156</b>	<b>160</b>	<b>176</b>
	# EPT taxa	61	60	59	59	69	65	68
	# Diptera taxa	14	11	12	11	18	9	18
<b>Composition (based on mean values from 5 replicates)</b>	EPT:Chironomid abundance ratio	1.9.29	1.9.25	1:10.49	1:16.22	1:5.8	1:17.83	1:10.37
	% EPT	8.2%	9.2%	7.9%	5.0%	14.2%	4.7%	7.9%
	% Chironomidae	76.0%	84.9%	82.3%	81.9%	82.3%	84.5%	81.9%
	% Diptera	76.1%	85.2%	82.4%	81.9%	82.4%	84.7%	82.2%
	Community diversity index (Shannon H') log e	2.159	2.071	2.144	2.102	2.380	2.305	2.546
	Community similarity index (Jaccard)							
		<b>128</b>	<b>134</b>	<b>143.5</b>	<b>148</b>	<b>156</b>	<b>160</b>	
		134	0.494					
		<b>143.5</b>	0.538	0.608				
		148	0.519	0.566	0.788			
		<b>156</b>	0.477	0.483	0.620	0.620		
		160	0.432	0.582	0.550	0.610	0.540	
		176	0.483	0.542	0.608	0.608	0.631	0.583
	Hilsenhoff Biotic Index	4.51	5.17	5.73	6.05	5.48	6.12	5.89
	Hydropsychidae:Trichoptera abundance ratio	1.3.40	1:1.33	1:2.00	1:1.36	1:1.30	0	1.147
	Total Abundance	564.4	592	1324.8	1228.4	1762.6	662.4	1096.8
	Ratio Scrapers:Filterers							
	% Feeding groups							
	CG	67.9%	47.5%	49.1%	49.6%	47.6%	38.5%	44.0%
	CF	3.0%	2.6%	1.0%	2.0%	3.7%	5.6%	7.3%
	PR	1.7%	3.0%	9.0%	12.1%	3.6%	7.6%	10.2%
	SH	9.5%	41.1%	37.4%	34.1%	42.6%	39.6%	36.7%
	SC	17.6%	5.6%	3.5%	2.3%	2.6%	8.7%	1.8%
	UN	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	PH	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	CG	383.2	281.2	650.2	609.6	839.0	254.8	482.2
	CF	17.0	15.2	13.0	24.0	65.4	37.0	80.4
	PR	9.6	18.0	119.8	148.2	62.6	50.4	111.8
	SH	53.8	243.4	495.2	418.4	750.2	262.6	402.8
	SC	99.2	33.2	46.6	28.2	45.2	57.4	19.6
	UN	1.6	0.2	0.0	0.0	0.0	0.0	0.0
	PH	0.0	0.8	0.0	0.0	0.2	0.2	0.0

CG = Collector-Gatherer  
 CF = Collector-Filterer  
 PR = Predator  
 SH = Shredder  
 SC = Scraper  
 UN = Unknown

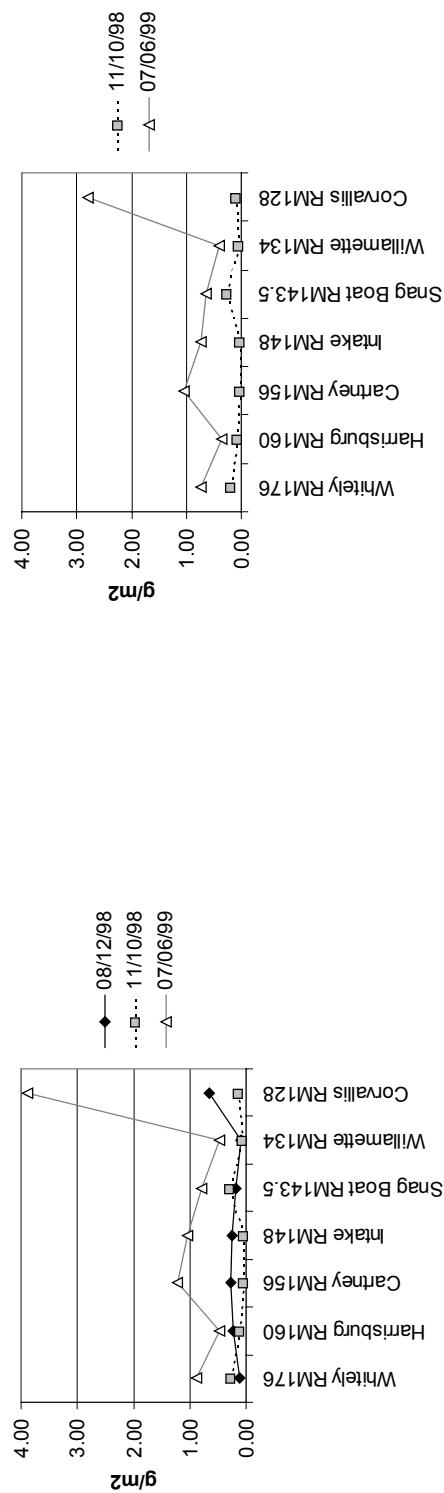
Feeding (based on mean values from 5 replicates)

**Table 3.52** Willamette River Benthic Macroinvertebrate Biomass August 1998 to July 1999

<u>Average Dry Weight (g/m<sup>2</sup>)</u>							
	Whitely RM176	Harrisburg RM160	Cartney RM156	Intake RM148	Snag Boat RM143.5	Willamette RM134	Corvallis RM128
08/12/98	0.1204	0.2151	0.2787	0.2457	0.1736	0.0887	0.6637
11/10/98	0.2816	0.1029	0.0519	0.0372	0.3027	0.0633	0.1363
07/06/99	0.8747	0.4837	1.2127	1.0329	0.7867	0.4758	3.8812

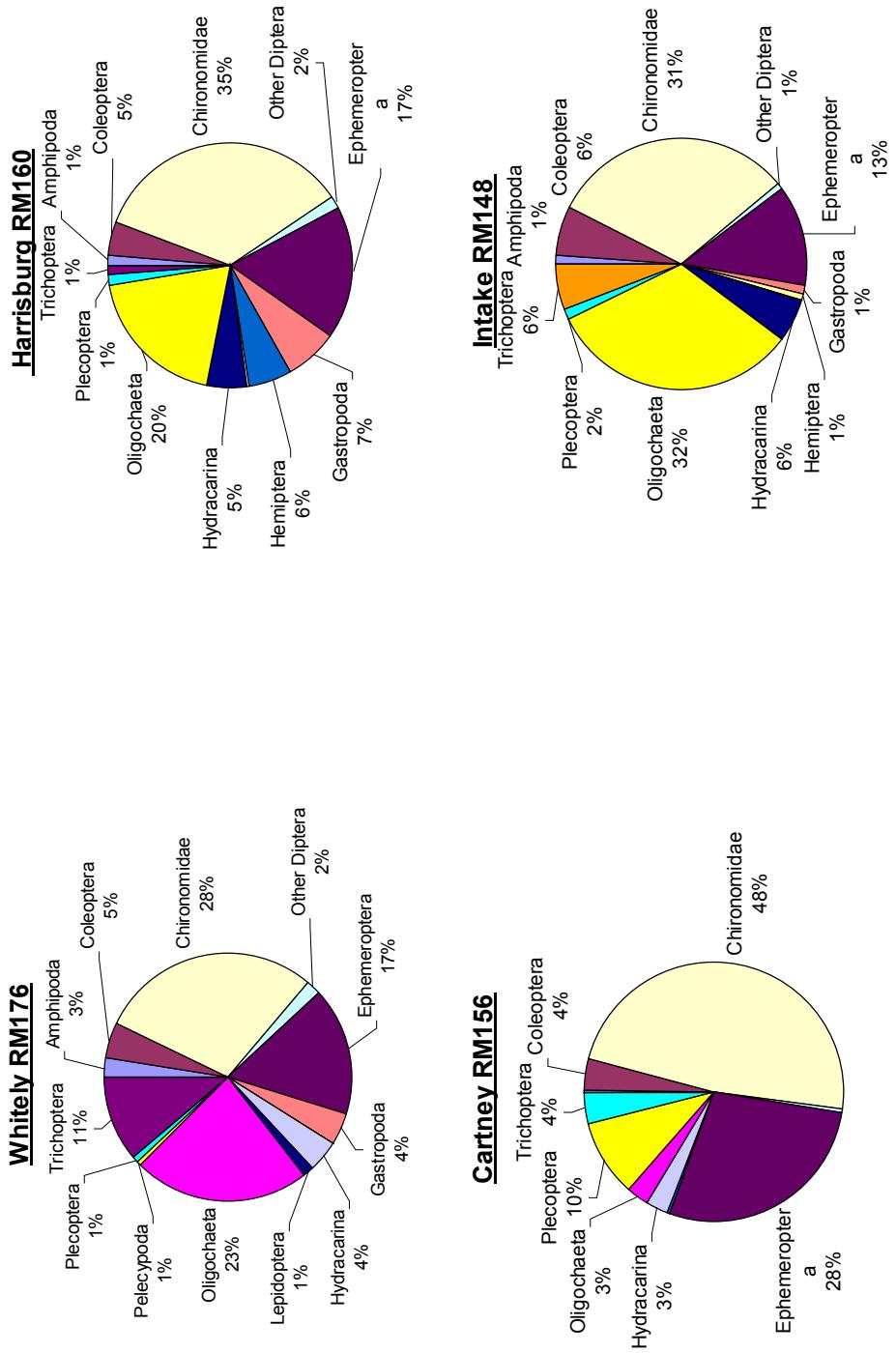
<u>Average Ash Free Dry Weight (g/m<sup>2</sup>)</u>							
	Whitely RM176	Harrisburg RM160	Cartney RM156	Intake RM148	Snag Boat RM143.5	Willamette RM134	Corvallis RM128
11/10/98	0.1798	0.0803	0.0332	0.0293	0.2667	0.0474	0.0969
07/06/99	0.7272	0.3492	1.0474	0.7272	0.6461	0.3946	2.8011



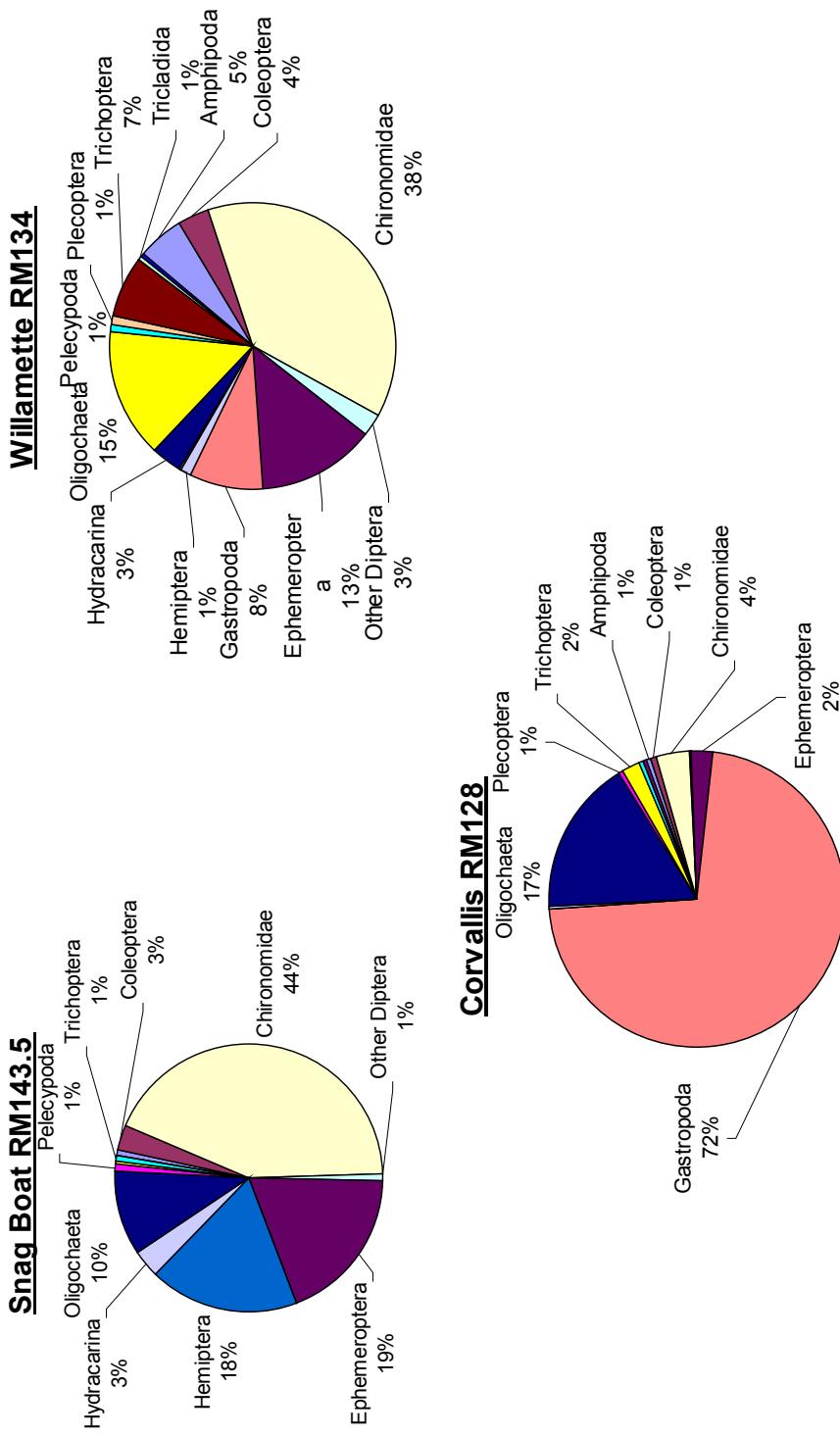
**Figure 3.71** Willamette River Benthic Macroinvertebrate Mean Biomass: Dry Weights



**Figure 3.72** Willamette River Benthic Macroinvertebrate Mean Biomass: Ash Free Dry Weights



**Figure 3.73** Study Year Summary of Willamette River Benthic Macroinvertebrate Dry Weight Percent Distribution at Sampling Sites Upstream of Mill Discharge



**Figure 3.74** Study Year Summary of Willamette River Benthic Macroinvertebrate Dry Weight Percent Distribution at Sampling Sites Downstream of Mill Discharge

### 3.9 Fish

Fish were sampled under a three-year research agreement, begun in 1998, with Western Washington University (WWU) in Bellingham, Washington. The experimental design provided by WWU examined different habitats along the LTRWS area for fish communities. Sampling was on a quarterly basis using electrofishing techniques. All fish sampling was done by WWU personnel, along with one or more NCASI personnel. When time and conditions allowed, fish were identified, weighed, measured on-site and returned to the river. Otherwise, they were frozen and transported back to WWU for later examination.

Codorus Creek, a wadeable stream, had a design that called for backpack electrofishing at each of the established NCASI Codorus Creek sites, along with two added sites, East Branch and Indian Rock Dam, for a total of eight sampling sites. Shocking was done in three runs of approximately 600 s each. The data were not normalized to shock time. The November 1998 Codorus Creek sampling date had high water resulting in one site substitution; John Rudy Park was sampled in place of Codorus Furnace.

For the McKenzie and Willamette Rivers, both large fast moving rivers, the design focused on boat electrofishing at different areas within the LTRWS area at or near the NCASI macroinvertebrate and periphyton sites. The McKenzie River had six sampling sites and the Willamette River had eight sampling sites for boat electrofishing. Supplemental nearshore backpack electrofishing was included at sites where the bank was accessible. Boat electrofishing data was normalized to 250 m shock distance. The backpack electrofishing data for the McKenzie and Willamette will be published at a later date.

### 3.9.1 Codorus Creek Fish

**Table 3.53** Codorus Creek: East Branch Fish Data Summary for September 1998 to June 1999

EAST BRANCH	Sampling Date# of runs =	Sep.1.98			Nov.19.98			Mar.26.99			Jun.6.99		
		3 pools			3 pools			3 pools			3 pools		
		Ave. Total Length (mm)	Ave. Weight (g)	% of Total									
<b>Trouts:</b>													
Rainbow Trout	<i>Salmo gairdneri</i>	0	0.00	258.33	164.67	0	0.00	228.00	184.00	3	0.87	294.00	350.33
Brown Trout	<i>Salmo trutta Linnaeus</i>	3	1.05			1	0.26			1	0.29	285.00	240.00
<b>Carp and Minnows:</b>													
Central Stone Roller	<i>Campostoma anomalum</i>	3	1.05	88.00	7.83	9	2.36	106.89	14.84	2	0.58	99.00	9.65
Goldfish	<i>Carassius auratus</i>	0	0.00			0	0.00			0	0.00		2
Rosy sided Dace	<i>Clinostomus funduloides</i>	0	0.00			0	0.00			1	0.29	71.00	2.34
Satinfin Shiner	<i>Cyprinella analostanus</i>	0	0.00			0	0.00			0	0.00		0
Spottin Shiner	<i>Cyprinella spilopterus</i>	0	0.00			0	0.00			0	0.00		0
Cyprinidae	<i>Cyprinidae</i>	39	13.59		1.15	13	3.40	NA	0.41	156	45.09	NA	NA
Common Carp	<i>Cyprinus carpio Linnaeus</i>	0	0.00			0	0.00			0	0.00		0
Cutlips Minnow	<i>Exoglossum maxillingua</i>	6	2.09	72.67	5.28	6	1.57	68.33	8.59	1	0.29	46.00	0.98
Common Shiner	<i>Luxilus cornutus</i>	14	4.88	87.50	7.09	51	13.35	77.69	5.52	31	8.96	67.06	2.86
River Chub	<i>Nocomis microtopon</i>	0	0.00			14	3.66	109.64	16.19	1	0.29	NA	NA
Golden Shiner	<i>Notemigonus crysoleucas</i>	0	0.00			0	0.00			0	0.00		0
Conney Shiner	<i>Notropis amoenus</i>	0	0.00			0	0.00			0	0.00		0
Spottail Shiner	<i>Notropis hudsonius</i>	7	2.44	48.71	0.95	8	2.09	54.75	1.22	9	2.60	62.22	2.05
Swallowtail Shiner	<i>Notropis procone</i>	12	4.18	52.25	1.12	16	4.19	60.06	1.85	20	5.78	51.35	1.06
Rosey Faced Shiner	<i>Notropis rubellus</i>	0	0.00			0	0.00			0	0.00		0
Bluntnose Minnow	<i>Pimephales notatus</i>	0	0.00			0	0.00			0	0.00		0
Fathead Minnow	<i>Pimephales promelas</i>	0	0.00			0	0.00			0	0.00		0
Blacknose Dace	<i>Rhinichthys atratulus</i>	62	21.60	50.42	1.22	90	23.56	51.42	1.27	8	2.31	73.38	3.58
Longnose Dace	<i>Rhinichthys cataractae</i>	31	10.80	64.00	2.69	13	3.40	65.62	2.83	8	2.31	NA	NA
Creek Chub	<i>Semotilus atromaculatus</i>	40	13.94	84.50	7.25	32	8.38	92.56	10.48	20	5.78	NA	NA
Fallfish	<i>Semotilus corporalis</i>	1	0.35	125.00	17.71	0	0.00			1	0.29	120.00	20.80
<b>Suckers:</b>													
White Sucker	<i>Catostomus commersoni</i>	47	16.38	110.91	25.37	75	19.63	121.89	30.92	12	3.47	77.08	NA
Northern Hogsucker	<i>Hypentelium nigricans</i>	4	1.39	142.26	55.66	14	3.66	132.50	60.66	4	1.16	NA	NA

(Continued on next page)

Table 3.53 Continued

**Table 3.54** Codorus Creek: Menges Fish Data Summary for September 1998 to June 1999

MENGES	Sampling Date/# of runs =	Sep. 1.98			Nov. 19.98			Mar. 26.99			Jun. 6.99			3 pools				
		3 pools			3 pools			3 pools			3 pools			3 pools				
		Count	% of Total	Ave. Total Length (mm)	Count	% of Total	Ave. Total Length (mm)	Count	% of Total	Ave. Total Length (mm)	Count	% of Total	Ave. Total Length (mm)	Count	% of Total	Ave. Total Length (mm)		
<b>Trouts:</b>																		
Rainbow Trout		Salmo gairdneri	0	0.00	183.06	154.60	0	0.00	13.70	188.13	167.37	0	0.00	52.63	205.63	104.30	0	0.00
Brown Trout		Salmo trutta Linnaeus	17	9.88			30					30					49	29.17
																	153.00	87.22
<b>Carp and Minnows:</b>																		
Central Stone Roller		Campostoma anomalum	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Goldfish		Carassius auratus	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Rosy-sided Dace		Clinostomus funduloides	0	0.00			4	1.83			43.25	0.88			0	0.00	0	0.00
Satinfin Shiner		Cyprinella analostanensis	0	0.00			0	0.00			0	0.00			1	0.60	87.00	8.67
Spottin Shiner		Cyprinella spilopterus	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Cyprinidae		Cyprinidae	0	0.00			63	28.77			NA	NA			1	1.75	NA	0.00
Common Carp		Cyprinus carpio Linnaeus	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Cutlip Minnow		Exoglossum maxillingua	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Common Shiner		Luxilus cornutus	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
River Chub		Nocomis micropogon	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Golden Shiner		Notemigonus crysoleucas	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Comely Shiner		Notropis amoenus	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Spottail Shiner		Notropis hudsonius	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Swallowtail Shiner		Notropis procone	1	0.58			50.00	0.90			0	0.00			0	0.00	0	0.00
Rosey Faced Shiner		Notropis rubellus	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Bluntnose Minnow		Pimephales notatus	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Fathead Minnow		Pimephales promelas	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Blacknose Dace		Rhinichthys atratulus	2	1.16	48.50	0.97	2	0.91	36.00	0.45	0	0.00			1	0.60	68.00	3.20
Longnose Dace		Rhinichthys cataractae	5	2.91	73.00	4.76	13	5.94	52.46	1.44	3	5.26	79.33	4.87	10	5.95	77.10	5.88
Creek Chub		Semotilus atromaculatus	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
Fallfish		Semotilus corporalis	0	0.00			0	0.00			0	0.00			0	0.00	0	0.00
<b>Suckers:</b>		Catostomus commersoni	62	36.05	195.47	122.46	11	5.02	189.00	136.09	2	3.51	197.00	135.20	42	25.00	317.33	354.87
White Sucker		Hypentelium nigricans	0	0.00			0	0.00			1	1.75	290.00	266.00	0	0.00	0	0.00
Northern Hogsucker																		

(Continued on next page)

Table 3.54 Continued

MENGES - continued									
		Sampling Date/# of runs = Sep.19.98		3 pools		Nov.19.98		3 pools	
		Ave. Total Length (mm)	% of Total Weight (g)	Count	% of Total	Ave. Total Length (mm)	% of Total Weight (g)	Count	% of Total
<b>Bullheads and Catfish:</b>									
Yellow Bullhead	<i>Ameiurus natalis</i>	0	0.00	0	0.00	0	0.00	0	0.00
Margined Madtom	<i>Naturus insignis</i>	0	0.00	0	0.00	0	0.00	0	0.00
<b>Killifishes:</b>									
Banded Killifish	<i>Fundulus diaphanus</i>	0	0.00	5	2.28	45.20	0.98	0	0.00
<b>Sunfishes:</b>									
Rock Bass	<i>Ambloplites rupestris</i>	0	0.00	5	2.28	76.40	9.70	0	0.00
Lepomis	<i>Lepomis</i>	0	0.00	0	0.00	0	0.00	0	0.00
Redbreast Sunfish	<i>Lepomis auritus</i>	0	0.00	54	24.66	NA	NA	0	0.00
Green Sunfish	<i>Lepomis cyanellus</i>	75	43.60	10	4.57	49.10	3.30	11	19.30
Pumpkinseed	<i>Lepomis gibbosus</i>	0	0.00	0	0.00	0	0.00	0	0.00
Pumpkinseed/Green Sun	<i>Lepomis hybrid.</i>	0	0.00	0	0.00	0	0.00	0	0.00
Bluegill	<i>Lepomis macrochirus</i>	10	5.81	2.10	5	2.28	48.00	2.20	2
Redear Sunfish	<i>Lepomis microlophus</i>	0	0.00	0	0.00	0	0.00	0	0.00
Smallmouth Bass	<i>Micropterus dolomieu</i>	0	0.00	1	0.46	97.00	12.70	0	0.00
Largemouth Bass	<i>Micropterus salmoides</i>	0	0.00	1	0.46	94.00	11.30	0	0.00
<b>Perches:</b>									
Greenside Darter	<i>Etheostoma blennioides</i>	0	0.00	0	0.00	0	0.00	0	0.00
Tessellated Darter	<i>Etheostoma olmstedi</i>	0	0.00	13	5.94	55.85	1.87	6	10.53
Banded Darter	<i>Etheostoma zonale</i>	0	0.00	0	0.00	0	0.00	0	0.00
Shield Darter	<i>Percina peltata</i>	0	0.00	0	0.00	0	0.00	0	0.00
<b>Sculpins:</b>									
Sculpin	<i>Cottidae</i>	0	0.00	2	0.91	96.50	13.35	0	0.00
Mottled Sculpin	<i>Cottus bairdii</i>	0	0.00	0	0.00	0	0.00	0	0.00
Slimy Sculpin	<i>Cottus cognatus</i>	0	0.00	0	0.00	1	1.75	101.00	10.60
Total individuals=		85		96		20		65	

**Table 3.55** Codorus Creek: USGS Fish Data Summary for September 1998 to June 1999

USGS		Sampling Date# of runs =	Sep.2.98						Nov.19.98						Mar.27.99						Jun.6.99						
			Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	
<b>Trouts:</b>	Rainbow Trout	<i>Salmo gairdneri</i>	0	0.00	94.50	7.65	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
	Brown Trout	<i>Salmo trutta Linnaeus</i>	2	0.92	94.50	7.65	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
<b>Carp and Minnows:</b>																											
Central Stone Roller		<i>Campostoma anomalum</i>	9	4.13	91.56	10.03	3	2.16	78.00	5.50	1	1.16	124.00	25.67	1	0.68	111.00	16.86									
Goldfish		<i>Carassius auratus</i>	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
Rosy sided Dace		<i>Clinostomus funduloides</i>	0	0.00			0	0.00			0	0.00			0	0.00			8	5.44	60.13	3.95					
Satinfin Shiner		<i>Cyprinella analostanus</i>	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
Spotfin Shiner		<i>Cyprinella splendens</i>	1	0.46	67.00	2.81	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
Cyprinidae		<i>Cyprinidae</i>	6	2.75	NA	0.95	1	0.72	NA	0.67	7	8.14	NA	NA	5	3.40	NA	NA	0	0.00			0	0.00			
Common Carp		<i>Cyprinus carpio Linnaeus</i>	3	1.38	97.33	13.49	2	1.44	389.50	1892.16	0	0.00			0	0.00			0	0.00			0	0.00			
Cutlips Minnow		<i>Exoglossum maxillingua</i>	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
Common Shiner		<i>Luxilus cornutus</i>	0	0.00			0	0.00			4	4.65	71.75	4.23	0	0.00			0	0.00			0	0.00			
River Chub		<i>Lucania microlophus</i>	0	0.00			0	0.00			1	1.16	93.00	0.00	0	0.00			0	0.00			0	0.00			
Golden Shiner		<i>Notemigonus crysoleucas</i>	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
Comely Shiner		<i>Notropis aequipinnatus</i>	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
Spottail Shiner		<i>Notropis hudsonius</i>	38	17.43	71.08	3.59	4	2.88	59.25	1.59	0	0.00			3	2.04	78.33	4.55									
Swallowtail shiner		<i>Notropis praecone</i>	21	9.63	55.86	1.80	23	16.55	51.91	1.35	5	5.81	59.60	1.96	5	3.40	52.00	3.37									
Rosey Faced Shiner		<i>Notropis rubellus</i>	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
Bluntnose Minnow		<i>Pimephales notatus</i>	0	0.00			0	0.00			0	0.00			0	0.00			1	0.68	87.00	7.90					
Fathead Minnow		<i>Pimephales promelas</i>	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
Blacknose Dace		<i>Rhinichthys atratulus</i>	6	2.75	53.83	1.42	0	0.00			5	5.81	NA	NA	2	1.36	28.50	0.20									
Longnose Dace		<i>Rhinichthys cataractae</i>	15	6.88	59.20	2.30	4	2.88	62.50	3.25	1	1.16	126.00	27.70	16	10.88	92.50	14.67									
Creek Chub		<i>Semotilus atromaculatus</i>	0	0.00			5	3.60	113.40	24.12	1	1.16	0	0.00	0	0.00	0	0.00									
Fallfish		<i>Semotilus corporalis</i>	0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			0	0.00			
<b>Suckers:</b>		<i>Catostomus commersoni</i>	23	10.55	116.70	42.71	35	25.18	129.57	41.34	3	3.49	67.67	3.10	5	3.40	103.80	13.20									
White Sucker		<i>Catostomus commersoni</i>	1	0.46	201.00	95.03	1	0.72	308.00	335.00	0	0.00	0	0.00	0	0.00	0	0.00									
Northern Hog sucker		<i>Hypentelium nigricans</i>																									

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Table 3.55 Continued

		Sampling Date# of runs = Sep.2.98		3 pools		Nov.19.98		3 pools		Mar.27.99		3 pools		Jun.6.99		3 pools	
		Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)
<b>Bullheads and Catfish:</b>																	
Yellow Bullhead	<i>Ameiurus natalis</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.68	82.00	7.24
Margined Madtom	<i>Noturus insignis</i>	0	0.00	0	0.00									0	0.00	0	0.00
<b>Killifishes:</b>																	
Banded Killifish	<i>Fundulus diaphanus</i>	0	0.00	0	0.00									0	0.00	0	0.00
<b>Sunfishes:</b>																	
Rock Bass	<i>Ambloplites rupestris</i>	0	0.00	0	0.00									0	0.00	0	0.00
Lepomis	<i>Lepomis</i>	0	0.00	0	0.00									0	0.00	0	0.00
Redbreast Sunfish	<i>Lepomis auritus</i>	0	0.00	0	0.00									0	0.00	0	0.00
Green Sunfish	<i>Lepomis cyanellus</i>	73	33.49	60.62	8.89	45	32.37	50.91	4.08	22	25.58	47.27	1.98	92	62.59	71.55	8.20
Pumpkinseed	<i>Lepomis gibbosus</i>	2	0.92	102.00	19.07	0	0.00	1	0.72	160.00	90.74	0	1.16	47.00	2.20	0	0.00
Pumpkinseed/Green Sun	<i>Lepomis hybrid</i>	0	0.00	0	0.00									0	0.00	0	0.00
Bluegill	<i>Lepomis macrochirus</i>	3	1.38	67.00	7.10	4	2.88	48.50	3.00	0	0.00	0	0.00	0	0.00	0	0.00
Redear Sunfish	<i>Lepomis microlophus</i>	0	0.00	0	0.00									0	0.00	0	0.00
Smallmouth Bass	<i>Micropterus dolomieu</i>	0	0.00	0	0.00									0	0.00	0	0.00
Largemouth Bass	<i>Micropterus salmoides</i>	11	5.05	81.00	7.50	2	1.44	75.50	5.43	1	1.16	53.00	NA	0	0.00	0	0.00
<b>Perches:</b>																	
Greenside Darter	<i>Etheostoma blennioides</i>	0	0.00	0	0.00									0	0.00	0	0.00
Tesselated Darter	<i>Etheostoma olmstedi</i>	4	1.83	53.00	1.75	9	6.47	64.44	2.96	18	20.93	NA	NA	7	4.76	57.43	2.33
Banded Darter	<i>Etheostoma zonale</i>	0	0.00	0	0.00									0	0.00	0	0.00
Shield Darter	<i>Percina peltata</i>	0	0.00	0	0.00									0	0.00	0	0.00
<b>Sculpins:</b>																	
Sculpin	<i>Cottidae</i>	0	0.00	0	0.00									0	0.00	0	0.00
Mottled Sculpin	<i>Cottus bairdi</i>	0	0.00	0	0.00									0	0.00	0	0.00
Slimy Sculpin	<i>Cottus cognatus</i>	0	0.00	0	0.00									0	0.00	0	0.00
n (total individuals)=		93				61								58		100	

**Table 3.56** Codorus Creek: Martin Fish Data Summary for September 1998 to June 1999

MARTIN	Sampling Date/# of runs =	Sep.2.98			3 pools			Nov.20.98			3 pools			Mar.26.99			3 pools			Jun.6.99			3 pools			
		Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)
<b>Trouts:</b>																										
Rainbow Trout																										
Brown Trout																										
<b>Carp and Minnows:</b>																										
Central Stone Roller																										
Goldfish																										
Rosy sided Dace																										
Satinin Shiner																										
Spotfin Shiner																										
Cyprinidae																										
Common Carp																										
Cutlips Minnow																										
Exoglossum maxillostoma																										
Luxilus cornutus																										
Nocomis microtopon																										
Notemigonus crysoleucas																										
Notropis amoenus																										
Notropis hudsonius																										
Notropis priscus																										
Notropis rubellus																										
Pimephales notatus																										
Pimephales promelas																										
Rhinichthys atratulus																										
Rhinichthys cataractae																										
Semotilus atromaculatus																										
Semotilus corporalis																										
<b>Suckers:</b>																										
Catostomus commersoni	3	7.14	222.67	158.38	10	12.82	192.20	84.40	11	11.96	222.18	160.78	7	8.86	141.43	84.92	0	0.00	0	0.00	0	0.00	0	0.00	0	
Hypentelium nigricans	0	0.00			0	0.00			0	0.00																

(Continued on next page)

Table 3.56 Continued

Sampling Date# of runs = Sep.2.98		3 pools		Nov.20.98		3 pools		Mar.26.99		3 pools		Jun.6.99		3 pools	
		Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)
<u>Bullheads and Catfish:</u>															
Yellow Bullhead	<i>Ameiurus natalis</i>	6	14.29	48.67	1.41	6	7.69	168.33	85.04	3	3.26	4	5.06	165.75	90.02
Margined Madtom	<i>Noturus insignis</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<u>Killifishes:</u>															
Banded Killifish	<i>Fundulus diaphanus</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<u>Sunfishes:</u>															
Rock Bass	<i>Ambloplites rupestris</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Lepomis	<i>Lepomis</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Redbreast Sunfish	<i>Lepomis auritus</i>	0	0.00	0	0.00	7	8.97	87.71	14.31	12	13.04	82.67	14.33	6	7.59
Green Sunfish	<i>Lepomis cyanellus</i>	17	40.48	NA	12.39	29	37.18	68.97	8.35	20	21.74	71.30	8.47	25	31.65
Pumpkinseed	<i>Lepomis gibbosus</i>	3	7.14	105.33	25.86	1	1.28	100.00	18.45	0	0.00	0	0.00	1	1.27
Pumpkinseed/Green Sun	<i>Lepomis hybrid</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Bluegill	<i>Lepomis macrochirus</i>	3	7.14	85.00	11.89	0	0.00	0	0.00	0	0.00	3	3.26	114.33	38.17
Redear Sunfish	<i>Lepomis microlophus</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Smallmouth Bass	<i>Micropterus dolomieu</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Largemouth Bass	<i>Micropterus salmoides</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<u>Perches:</u>															
Greenside Darter	<i>Etheostoma blennioides</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Tesselated Darter	<i>Etheostoma olmstedi</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Banded Darter	<i>Etheostoma zonale</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Shield Darter	<i>Percina peltata</i>	0	0.00	0	0.00	0	0.00	4	4.35	NA	NA	0	0.00	0	0.00
<u>Sculpins:</u>															
Sculpin	<i>Cottidae</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Mottled Sculpin	<i>Cottus bairdi</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Slippery Sculpin	<i>Cottus cognatus</i>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total individuals=		29				43						42			36

**Table 3.57** Codorus Creek: Graybill Fish Data Summary for September 1998 to June 1999

<b>GRAYBILL</b>	Sampling Date# of runs =	Sep.2.98			3 pools			Nov.20.98			3 pools			Mar.26.99			3 pools			Jun.7.99			3 pools		
		Ave. Total Length (mm)	% of Total	Ave. Weight (g)	Count	Ave. Total Length (mm)	% of Total	Ave. Weight (g)	Count	Ave. Total Length (mm)	% of Total	Ave. Weight (g)	Count	Ave. Total Length (mm)	% of Total	Ave. Weight (g)	Count	Ave. Total Length (mm)	% of Total	Ave. Weight (g)	Count	Ave. Total Length (mm)	% of Total	Ave. Weight (g)	Count
<b>Trouts:</b>																									
Rainbow Trout																									
Brown Trout																									
<b>Carp and Minnows:</b>																									
Central Stone Roller																									
Goldfish																									
Rosy sided Dace																									
Satinfin Shiner																									
Spottin Shiner																									
Cyprinidae																									
Common Carp																									
Cutlips Minnow																									
Common Shiner																									
River Chub																									
Golden Shiner																									
Comely Shiner																									
Spottail Shiner																									
Swallowtail shiner																									
Rosey Faced Shiner																									
Bluntnose Minnow																									
Fathead Minnow																									
Blacknose Dace																									
Longnose Dace																									
Creek Chub																									
Fallfish																									
<b>Suckers:</b>																									
White Sucker																									
Northern Hogsucker																									
<i>Catostomus commersoni</i>	5	13.16	222.40	128.73	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	
<i>Hypentelium nigricans</i>	0	0.00																							

(Continued on next page)

Table 3.57 Continued

		Sampling Date# of runs = Sep.2.98						Sampling Date# of runs = Sep.2.98						Sampling Date# of runs = Sep.2.98							
		3 pools			Nov.20.98			3 pools			Mar.26.99			3 pools			Jun.7.99				
		Ave. Total Length (mm)	% of Total	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	
<b>Bullheads and Catfish:</b>																					
Yellow Bullhead	<i>Ameiurus natalis</i>	1	2.63	215.00	158.12	1	1.19	70.00	3.70	5	7.46	135.00	45.10	4	7.55	167.50	95.41	0	0.00		
Margined Madtom	<i>Noturus insignis</i>	0	0.00			0	0.00		0	0.00											
<b>Killifishes:</b>																					
Banded Killifish	<i>Fundulus diaphanus</i>	0	0.00			0	0.00		0	0.00								0	0.00		
<b>Sunfishes:</b>																					
Rock Bass	<i>Ambloplites rupestris</i>	0	0.00			0	0.00		0	0.00								0	0.00		
Lepomis	<i>Lepomis</i>	0	0.00			0	0.00		0	0.00								0	0.00		
Redbreast Sunfish	<i>Lepomis auritus</i>	12	31.58	83.83	22.01	30	35.71	64.53	5.96	28	41.79	57.25	4.81	6	11.32	156.67	106.71				
Green Sunfish	<i>Lepomis cyanellus</i>	3	7.89	45.00	1.53	11	13.10	44.09	1.63	10	14.93	NA	3.07	24	45.28	65.96	7.59				
Pumpkinseed	<i>Lepomis gibbosus</i>	1	2.63	73.00	6.35	0	0.00		0	0.00								0	0.00		
Pumpkinseed/Green Sun	<i>Lepomis hybrid</i>	0	0.00			0	0.00		0	0.00								0	0.00		
Bluegill	<i>Lepomis macrochirus</i>	0	0.00			0	0.00		3	3.57	52.00	2.73	1	1.49	70.00	5.43	0	0.00			
Redear Sunfish	<i>Lepomis microlophus</i>	0	0.00			0	0.00		0	0.00								0	0.00		
Smallmouth Bass	<i>Micropterus dolomieu</i>	0	0.00			0	0.00		0	0.00								0	0.00		
Largemouth Bass	<i>Micropterus salmoides</i>	1	2.63	79.00	7.21	0	0.00		0	0.00							0	0.00			
<b>Perches:</b>																					
Greenside Darter	<i>Etheostoma blennioides</i>	0	0.00			0	0.00		0	0.00								0	0.00		
Tesselated Darter	<i>Etheostoma olmstedi</i>	0	0.00			2	2.38	65.00	2.85	2	2.99	65.50	3.57	1	1.89	59.00	1.81				
Banded Darter	<i>Etheostoma zonale</i>	0	0.00			0	0.00		0	0.00							0	0.00			
Shield Darter	<i>Percina peltata</i>	0	0.00			0	0.00		0	0.00							0	0.00			
<b>Sculpins:</b>																					
Sculpin	<i>Cottidae</i>	0	0.00			0	0.00		0	0.00							0	0.00			
Mottled Sculpin	<i>Cottus bairdi</i>	0	0.00			0	0.00		0	0.00							0	0.00			
Slimy Sculpin	<i>Cottus cognatus</i>	0	0.00			0	0.00		0	0.00							0	0.00			
n (total individuals)=		18				47											46				35

**Table 3.58** Codorus Creek: Indian Rock Dam Fish Data Summary for September 1998 to June 1999

		Sampling Date# of runs = Sep.3.98		3 pools		Nov.19.98		3 pools		Mar.27.99		2 pools		Jun.7.99		3 pools		
		Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	
<b>Trouts:</b>																		
Rainbow Trout		Salmo gairdneri	0	0.00		0	0.00			0	0.00			1	1.69	418.00	823.00	
Brown Trout		Salmo trutta Linnaeus	0	0.00		0	0.00			0	0.00			1	1.69	232.00	122.00	
<b>Carp and Minnows:</b>																		
Central Stone Roller		<i>Campostoma anomalum</i>	0	0.00		0	0.00			0	0.00			4	6.78	80.75	6.58	
Goldfish		<i>Carassius auratus</i>	0	0.00		0	0.00			0	0.00			0	0.00	0.00	0.00	
Rosy sided Dace		<i>Clinostomus funduloides</i>	0	0.00		0	0.00			0	0.00			0	0.00	0.00	0.00	
Satinfin Shiner		<i>Cyprinella analostanus</i>	0	0.00		0	0.00			10	10.31	NA	NA	6	10.17	75.67	4.55	
Spottail Shiner		<i>Cyprinella splendens</i>	2	2.82	52.00	1.08	17	19.10	65.65	2.27	10	10.31	NA	NA	2	3.39	45.00	0.92
		<i>Cyprinidae</i>	2	2.82	NA	NA	0	0.00		24	24.74	NA	NA	1	1.69	511.00	1986.00	
		<i>Cyprinus carpio Linnaeus</i>	1	1.41	512.00	1723.68	0	0.00		0	0.00							
Common Carp		<i>Exoglossum maxillingua</i>	0	0.00		0	0.00			0	0.00			0	0.00	0.00	0.00	
Cutlip Minnow		<i>Luxilus cornutus</i>	0	0.00		0	0.00			4	4.12	NA	NA	0	0.00	0.00	0.00	
Common Shiner		<i>Nocomis micropogon</i>	0	0.00		0	0.00			1	1.03	NA	NA	0	0.00	0.00	0.00	
River Chub		<i>Notemigonus crysoleucas</i>	0	0.00		0	0.00			0	0.00			1	1.69	79.00	4.04	
Golden Shiner		<i>Notropis aeneus</i>	0	0.00		0	0.00			11	11.34	NA	NA	0	0.00	0.00	0.00	
Comely Shiner		<i>Notropis hudsonius</i>	14	19.72	60.79	2.07	14	15.73	80.64	4.58	0	0.00		11	18.64	80.00	5.17	
Spottail Shiner		<i>Notropis praeche</i>	2	2.82	57.00	1.41	4	4.49	61.25	1.80	0	0.00		0	0.00	0.00	0.00	
Swallowtail Shiner		<i>Notropis rubellus</i>	0	0.00		0	0.00			2	2.25	68.00	2.50	0	0.00	0.00	0.00	
Rosey Faced Shiner		<i>Pimephales notatus</i>	0	0.00		0	0.00			0	0.00			0	0.00	0.00	0.00	
Bluntnose Minnow		<i>Pimephales promelas</i>	0	0.00		0	0.00			0	0.00			0	0.00	0.00	0.00	
Fathead Minnow		<i>Rhinichthys atratulus</i>	0	0.00		0	0.00			14	14.43	NA	NA	0	0.00	0.00	0.00	
Blacknose Dace		<i>Rhinichthys cataractae</i>	0	0.00		0	0.00			0	0.00			0	0.00	0.00	0.00	
Longnose Dace		<i>Semotilus atromaculatus</i>	0	0.00		0	0.00			0	0.00			0	0.00	0.00	0.00	
Creek Chub		<i>Semotilus corporalis</i>	0	0.00		0	0.00			1	1.03	178.00	64.10	0	0.00	0.00	0.00	
<b>Suckers:</b>																		
White Sucker		<i>Catostomus commersoni</i>	2	2.82	238.50	140.24	7	7.87	173.57	71.81	2	2.06	147.50	NA	5	8.47	208.00	168.97
Northern Hogsucker		<i>Hypentelium nigricans</i>	0	0.00		3	3.37	125.33	21.83	1	1.03	240.00	178.70	0	0.00	0.00	0.00	

(Continued on next page)

Table 3.58 Continued

**Table 3.59** Codorus Creek: Arsenal Fish Data Summary for September 1998 to June 1999

<u>ARSENAL</u>	Sampling Date# of runs =	Sep.3.98		3 pools		Nov.19.98		2 pools		Mar.27.99		3 pools		Jun.7.99		3 pools	
		Ave. Total Length (mm)	% of Total	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Total Length (mm)	Ave. Weight (g)	Count
<b>Trouts:</b>																	
Rainbow Trout																	
Brown Trout																	
<b>Carp and Minnows:</b>																	
Central Stone Roller																	
Goldfish																	
Rosy sided Dace																	
Satinfin Shiner																	
Spottail Shiner																	
Cyprinidae																	
<i>Cyprinus carpio Linnaeus</i>	4	3.57	NA														
Common Carp																	
Cutlips Minnow																	
Common Shiner																	
River Chub																	
Golden Shiner																	
Comely Shiner																	
Spottail Shiner																	
Swallowtail Shiner																	
Rosey Faced Shiner																	
Bluntnose Minnow																	
Fathead Minnow																	
Blacknose Dace																	
Longnose Dace																	
Creek Chub																	
Fallfish																	
<b>Suckers:</b>																	
White Sucker	2	1.79	192.00	0.00	11	12.09	215.82	150.50	0	0.00			6	25.00	226.67	218.47	
Northern Hogsucker	0	0.00			1	1.10	196.00	95.70	0	0.00			0	0.00			

(Continued on next page)

Table 3.59 Continued

**Table 3.60.** Codorus Creek: Furnace Fish Data Summary for September 1998 to June 1999  
 (John Rudy Park substituted for Furnace for November 1998 sampling)

FURNACE		Sampling Date# of runs =	Sep 3.98	3 pools	JohnRudyPark substituted	Mar.27.99	3 pools	Jun.7.99	3 pools
				Ave. Total Length (mm)	Ave. Weight (g)	Ave. Total Length (mm)	Ave. Weight (g)	Ave. Total Length (mm)	Ave. Weight (g)
		Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)
<b>Trouts:</b>									
Rainbow Trout	<i>Salmo gairdneri</i>	0	0.00			0	0.00		
Brown Trout	<i>Salmo trutta Linnaeus</i>	0	0.00			0	0.00		
<b>Carp and Minnows:</b>									
Central Stone Roller	<i>Campostoma anomalum</i>	0	0.00			0	0.00		
Goldfish	<i>Carassius auratus</i>	0	0.00			0	0.00		
Rosy sided Dace	<i>Clinostomus funduloides</i>	0	0.00			0	0.00		
Satinfin Shiner	<i>Cyprinella analostanus</i>	0	0.00			0	0.00		
Spottin Shiner	<i>Cyprinella splendens</i>	5	6.67	61.80	2.04	18	3.85	62.56	9.94
Cyprinidae	<i>Cyprinella splopterus</i>	2	26.67	24.00	0.13	137	29.34	NA	0.54
Common Carp	<i>Cyprinus carpio Linnaeus</i>	0	0.00			0	0.00		
Cutlip Minnow	<i>Exoglossum maxillingua</i>	0	0.00			0	0.00		
Common Shiner	<i>Luxilus cornutus</i>					0	0.00		
River Chub	<i>Nocomis micropogon</i>	0	0.00			0	0.00		
Golden Shiner	<i>Notemigonus crysoleucas</i>	0	0.00			0	0.00		
Conney Shiner	<i>Notropis amoenus</i>	0	0.00			0	0.00		
Spottail Shiner	<i>Notropis hudsonius</i>	17	22.67	53.88	1.53	215	46.04	45.18	0.68
Swallowtail Shiner	<i>Notropis procone</i>	5	6.67	43.60	0.73	66	14.13	47.97	0.86
Rose Faced Shiner	<i>Notropis rubellus</i>	0	0.00			0	0.00		
Bluntnose Minnow	<i>Pimephales notatus</i>	0	0.00			0	0.00		
Fathead Minnow	<i>Pimephales promelas</i>	0	0.00			0	0.00		
Blacknose Dace	<i>Rhinichthys atratulus</i>	0	0.00			0	0.00		
Longnose Dace	<i>Rhinichthys cataractae</i>	0	0.00			0	0.00		
Creek Chub	<i>Semotilus atromaculatus</i>	0	0.00			0	0.00		
Fallfish	<i>Semotilus corporalis</i>	0	0.00			0	0.00		
<b>Suckers:</b>									
White Sucker	<i>Catostomus commersoni</i>	0	0.00			3	0.64	57.00	1.54
Northern Hogsucker	<i>Hypentelium nigricans</i>	0	0.00			0	0.00	0	0.00

(Continued on next page)

**Table 3.60** Continued

<b>FURNACE - continued</b>									
		Sampling Date# of runs = Sep.3.98		3 pools		John Rudy Park substituted		Mar.27.99	
		Count	% of Total	Ave. Length (mm)	Ave. Weight (g)	Count	% of Total	Ave. Length (mm)	Ave. Weight (g)
<b>Bullheads and Catfish:</b>									
Yellow Bullhead	<i>Ameiurus natalis</i>	0	0.00			0	0.00		
Margined Madtom	<i>Natirus insignis</i>	0	0.00			0	0.00		
<b>Killifishes:</b>									
Banded Killifish	<i>Fundulus diaphanus</i>	0	0.00			0	0.00		
<b>Sunfishes:</b>									
Rock Bass	<i>Ambloplites rupestris</i>	1	1.33	173.00	112.73	2	0.43	95.50	21.30
Lepomis	<i>Lepomis</i>	0	0.00			0	0.00		
Redbreast Sunfish	<i>Lepomis auritus</i>	2	2.67	94.50	20.07	0	0.00		
Green Sunfish	<i>Lepomis cyanellus</i>	21	28.00	82.05	11.49	9	1.93		
Pumpkinseed	<i>Lepomis gibbosus</i>	1	1.33	95.00	19.50	0	0.00		
Pumpkinseed/Green Sun	<i>Lepomis hybrid</i>	0	0.00			0	0.00		
Bluegill	<i>Lepomis macrochirus</i>	1	1.33	79.00	8.76	0	0.00		
Redear Sunfish	<i>Lepomis microlophus</i>	0	0.00			0	0.00		
Smallmouth Bass	<i>Micropterus dolomieu</i>	3	4.00	111.00	22.50	5	1.07	83.80	7.02
Largemouth Bass	<i>Micropterus salmoides</i>	0	0.00			0	0.00		
<b>Perches:</b>									
Greenside Darter	<i>Etheostoma blennioides</i>	2	2.67	57.00	2.29	0	0.00		
Tesselated Darter	<i>Etheostoma olmstedi</i>	8	10.67	52.13	1.32	10	2.14	57.40	2.00
Banded Darter	<i>Etheostoma zonale</i>	7	9.33	44.71	0.93	2	0.43	48.00	1.45
Shield Darter	<i>Percina peletieri</i>	0	0.00			0	0.00		
<b>Sculpins:</b>									
Sculpin	<i>Cottidae</i>	0	0.00			0	0.00		
Mottled Sculpin	<i>Cottus bairdi</i>	0	0.00			0	0.00		
Slimy Sculpin	<i>Cottus cognatus</i>	0	0.00			0	0.00		
n (total individuals)=		46				28			27

**Table 3.61** Codorus Creek: John Rudy Park Data Summary for November 1998 (substitute site for Furnace)

<u>JOHN RUDY PARK</u>		Sampling Date/# of runs = Nov.20.98		3 pools		Sampling Date/# of runs = Nov.20.98		3 pools	
<b>JOHN RUDY PARK - continued</b>									
<b>Trouts:</b>									
Rainbow Trout		Salmo gairdneri	0	0.00	254.00	196.90			
Brown Trout		Salmo trutta Linnaeus	0	0.00					
<b>Carp and Minnows:</b>									
Central Stone Roller		Campostoma anomalum	0	0.00					
Goldfish		Carassius auratus	1	0.98					
Rosy-sided Dace		Clinostomus funduloides	0	0.00					
Satinfin Shiner		Cyprinella analostanus	0	0.00					
Spotfin Shiner		Cyprinella spilopterus	3	2.94	75.00	3.80			
Cyprinidae		Cyprinidae	16	15.69	NA	NA			
Common Carp		Cyprinus carpio Linnaeus	1	0.98	588.00	2724.00			
Cutlip Minnow		Exoglossum maxillingua	0	0.00					
Common Shiner		Luxilus cornutus	0	0.00					
River Chub		Nothonotus micropogon	0	0.00					
Golden Shiner		Notemigonus crysoleucas	0	0.00					
Comely Shiner		Notropis aeneus	1	0.98	69.00	2.60			
Spottail Shiner		Notropis hudsonius	0	0.00					
Swallowtail shiner		Notropis procone	0	0.00					
Rosey-faced Shiner		Notropis rubellus	0	0.00					
Bluntnose Minnow		Pimephales notatus	0	0.00					
Fathead Minnow		Pimephales promelas	0	0.00					
Blacknose Dace		Rhinichthys atratulus	1	0.98	52.00	1.36			
Longnose Dace		Rhinichthys cataphractus	0	0.00					
Creek Chub		Semotilus atromaculatus	0	0.00					
Fallfish		Semotilus corporalis	0	0.00					
<b>Suckers:</b>									
White Sucker		Catostomus commersoni	0	0.00					
Northern Hogsucker		Hypentelium nigricans	0	0.00					
n (total individuals) = 79									
<b>Killifishes:</b>									
Banded Killifish		Fundulus diaphanus	0	0.00					
<b>Sunfishes:</b>									
Rock Bass		Ambloplites rupestris	25	24.51	94.80	21.86			
Lepomis		Lepomis auritus	0	0.00					
Redbreast Sunfish		Lepomis cyanellus	17	16.67	83.94	11.41			
Green Sunfish		Lepomis gibbosus	0	0.00					
Pumpkinseed		Pumpkinseed/Green Sun Lepomis hybrid	3	2.94	82.67	12.33			
Bluegill		Lepomis macrochirus	4	3.92	49.00	3.22			
Redear Sunfish		Lepomis microlophus	0	0.00					
Smallmouth Bass		Micropterus dolomieu	3	2.94	84.67	9.12			
Largemouth Bass		Micropterus salmoides	0	0.00					
<b>Perches:</b>									
Greenside Darter		Etheostoma blennioides	0	0.00					
Tasseled Darter		Etheostoma olmstedi	24	23.53	54.63	1.70			
Banded Darter		Etheostoma zonale	3	2.94	52.67	1.90			
Shield Darter		Percina peltata	0	0.00					
<b>Sculpins:</b>									
Sculpin		Cottidae	0	0.00					
Mottled Sculpin		Cottus bairdii	0	0.00					
Slimy Sculpin		Cottus cognatus	0	0.00					

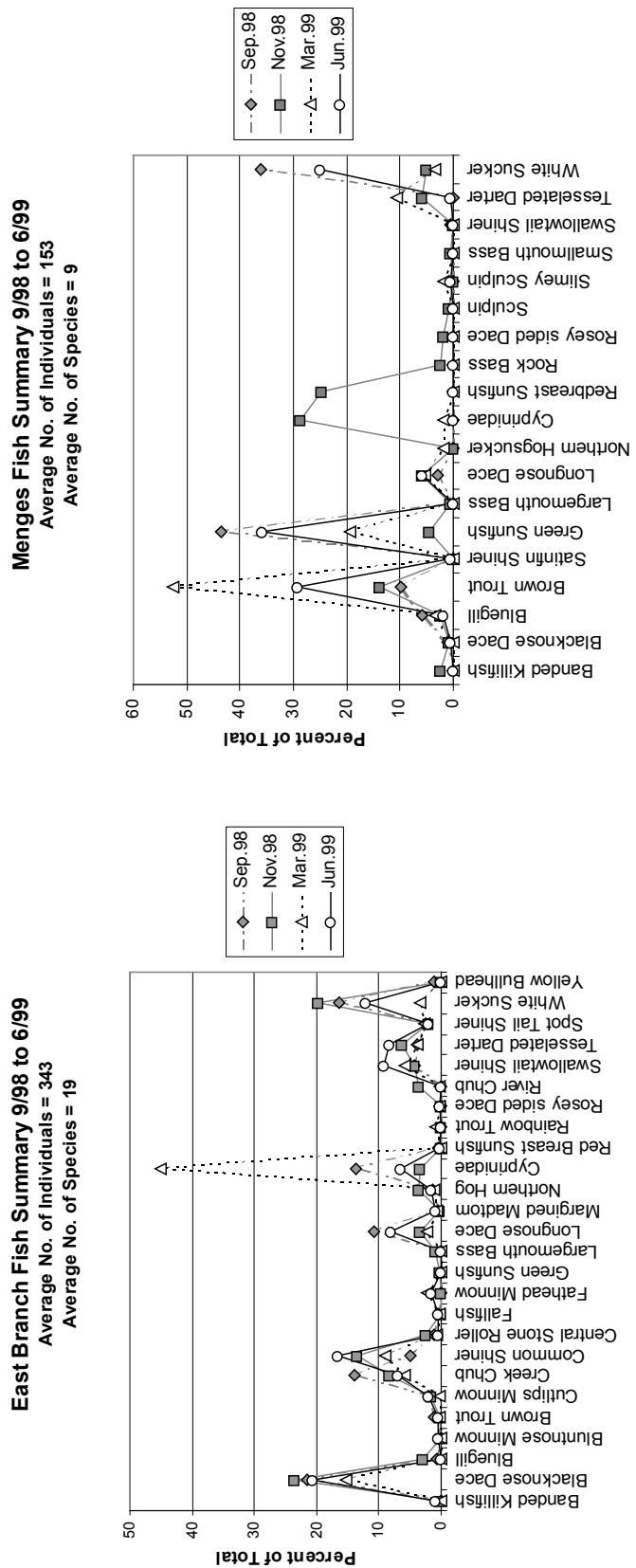
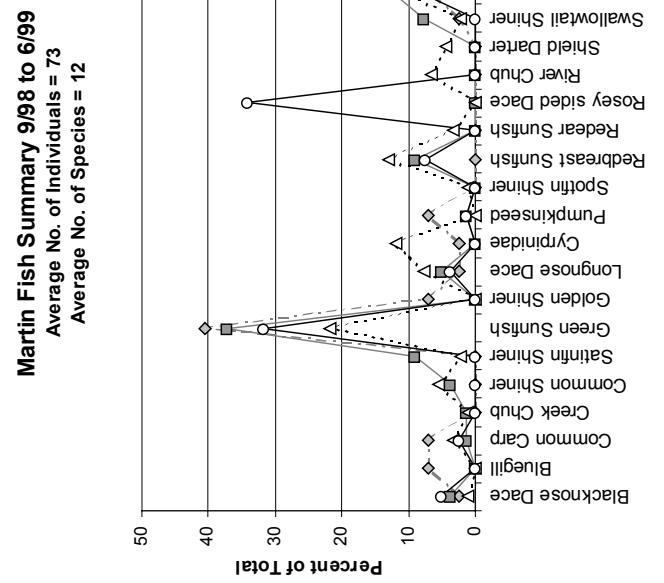
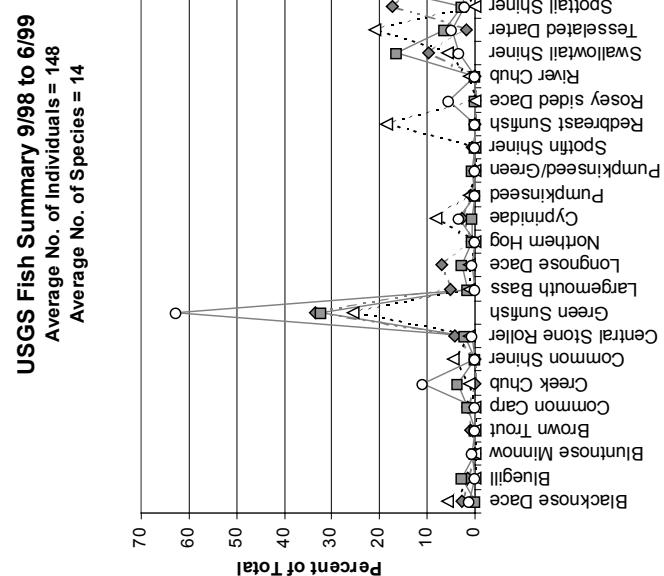


Figure 3.75 Fish Taxa Summary for East Branch and Menges, Codorus Creek



**Figure 3.76** Fish Taxa Summary for USGS and Martin, Codorus Creek

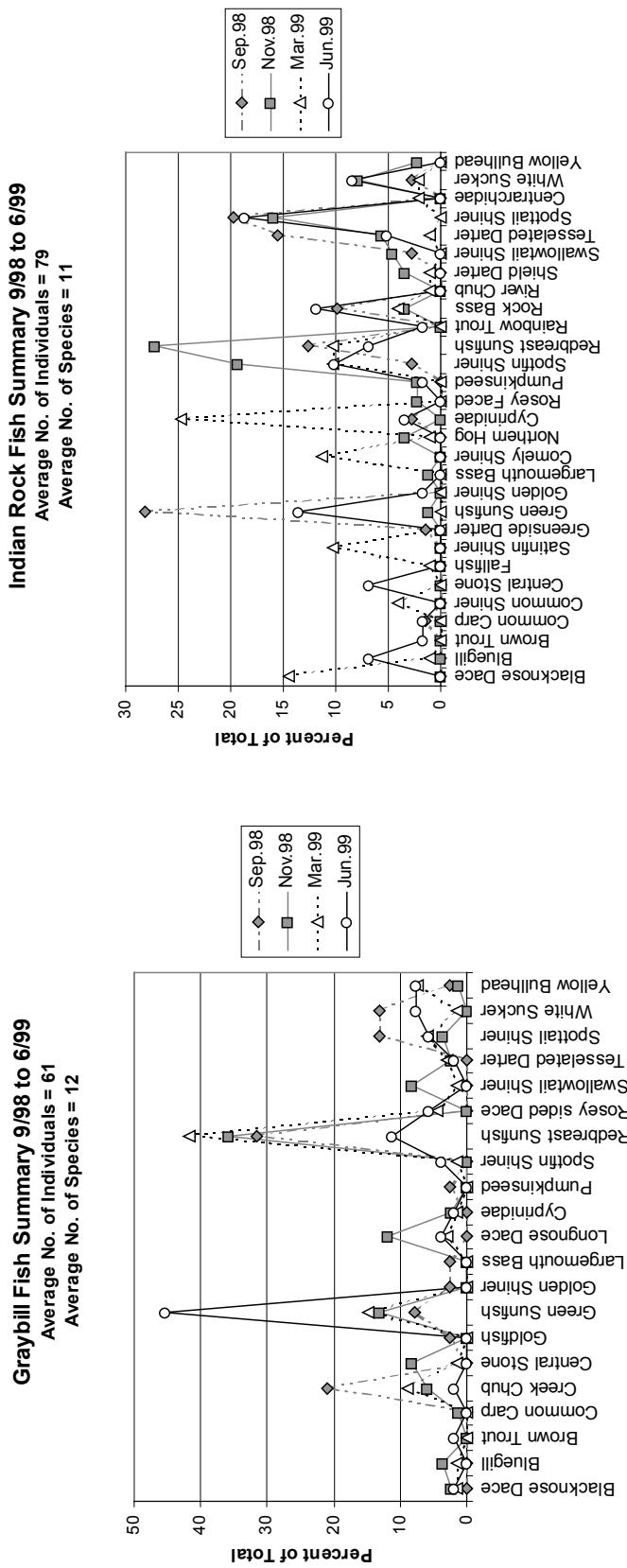


Figure 3.77 Fish Taxa Summary for Graybill and Indian Rock Dam, Codorus Creek

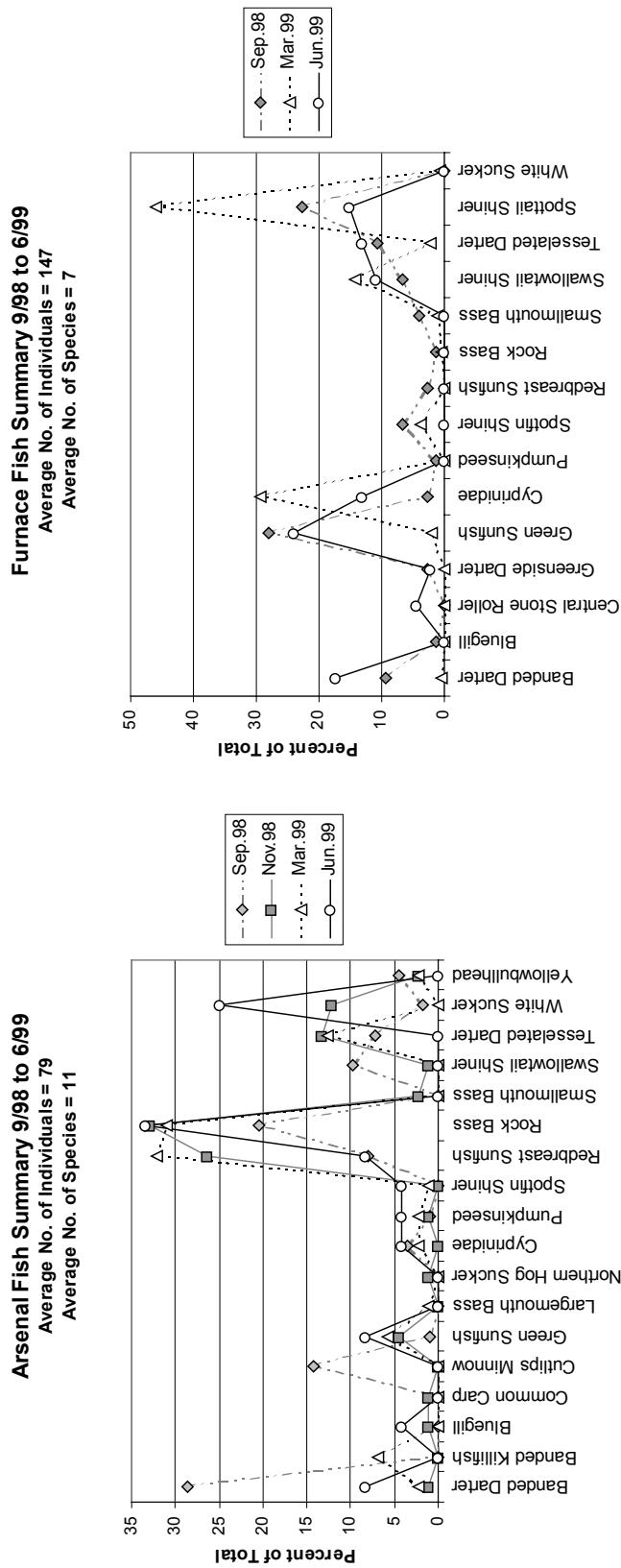


Figure 3.78 Fish Taxa Summary for Arsenal and Furnace, Codorus Creek

### 3.9.2 *McKenzie River Fish*

**Table 3.62** McKenzie River: Armitage, RM 6.0, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 6.0 (Armitage) - Mc Kenzie River Boat Elecfrofishing</b>			Date: Dec. 98	Date: Mar. 99	Date: Jun. 99			
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	1.8	7.1	0.0	0.0	28.8	54.6
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	2.5	9.7	0.0	0.0	5.0	9.5
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Carps and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Pearmouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	10.8	42.2	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	0.0	0.0	5.0	9.5
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	9.7	37.7	21.3	100.0	13.2	24.9
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.8	3.2	0.0	0.0	0.8	1.6
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			25.7		21.3		52.8	

**Table 3.63** McKenzie River: Harvest, RM 10.0, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 10.0 (Harvest) - McKenzie River Boat Electrofishing</b>			Date: Dec.98	Date: Mar.99	Date: Jun.99			
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	2.0	10.5	9.0	38.4	22.5	60.0
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	0.0	0.0	0.8	2.2
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	0.0	0.0	2.5	6.7
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Carp and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	0.0	0.0	3.3	8.9
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	17.0	89.5	13.7	58.6	8.3	22.2
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.7	3.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			19.0		23.4		37.5	

**Table 3.64** McKenzie River: Mohawk, RM 13.7, Boat Electrofishing Data Summary  
for December 1998 to June 1999

			Date:	Dec.98	Date:	Mar.99	Date:	Jun.99
			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	2.9	20.5	2.0	20.0	15.8	38.8
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	0.0	0.0	4.2	10.2
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Carps and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.8	2.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	3.0	30.0	8.3	20.4
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	11.3	79.5	2.0	20.0	11.7	28.6
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	3.0	30.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			14.2		10.0		40.8	

**Table 3.65** McKenzie River: Bellingers, RM 18.5, Boat Electrofishing Data Summary  
for December 1998 to June 1999

			Date:	Dec.98	Date:	Mar.99	Date:	Jun.99
			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	0.8	4.4	11.2	66.3
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Carp and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	4.0	21.1	0.0	0.0
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	10.0	100.0	14.2	74.6	5.7	33.7
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			10.0		19.0		16.8	

**Table 3.66** McKenzie River: Hendricks, RM 26.5, Boat Electrofishing Data Summary  
for December 1998 to June 1999

			Date:	Dec.98	Date:	Mar.99	Date:	Jun.99
			Count	% of Total	Count	% of Total	Count	% of Total
<b><u>Sturgeons:</u></b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b><u>Trout and Salmon:</u></b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	1.0	25.0	0.0	0.0	4.7	15.3
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	0.0	0.0	18.1	59.1
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	0.0	0.0	0.7	2.3
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
<b><u>Carp and Minnows:</u></b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Pearmouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b><u>Suckers:</u></b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	3.0	75.0	3.8	100.0	7.1	23.3
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.0	0.0	0.0	0.0	0.0	0.0
<b><u>Sunfish:</u></b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b><u>Perch:</u></b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b><u>Sculpins:</u></b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			4.0		3.8		30.7	

**Table 3.67** McKenzie River: Deerhorn, RM 30.0, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 30.0 (Deerhorn) - McKenzie River Boat Electrofishing</b>			Date: Dec.98	Date: Mar.99	Date: Jun.99			
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	0.0	0.0	6.4	28.1
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	7.0	87.5	6.8	30.1
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	6.0	100.0	0.0	0.0	0.0	0.0
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Carp and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	0.0	0.0	1.0	12.5	9.5	41.8
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			6.0		8.0		22.6	

### 3.9.3 Willamette River Fish

**Table 3.68** Willamette River: RM 129.5, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 129.5 - Willamette River Boat Electrofishing</b>			Date: Dec.98	Date: Mar.99	Date: Jun.99			
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	0.0	0.0	1.0	2.8
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	1.0	4.2	0.0	0.0	0.0	0.0
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	1.0	4.2	0.8	3.4	0.0	0.0
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	2.0	8.3	2.6	11.2	1.0	2.8
<b>Carp and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.8	3.4	1.0	2.8
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	2.6	11.2	9.2	26.0
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	1.0	2.8
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	20.0	83.3	16.4	70.7	20.0	56.5
Mountain Sucker	<i>Catostomus platyrhynchus</i>	Catostomidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	2.2	6.2
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			24.0		23.2		35.4	

**Table 3.69** Willamette River: RM 134, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 134 - Willamette River Boat Electrofishing</b>			Date:	Dec.98	Date:	Mar.99	Date:	Jun.99
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	0.0	0.0	3.4	3.5
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	4.6	4.8
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	2.0	4.8	0.0	0.0	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	4.0	9.5	5.6	12.9	2.0	2.1
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	10.0	23.8	18.2	41.9	3.2	3.3
<b>Carp and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	1.0	1.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	1.4	3.2	2.4	2.5
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	2.0	4.8	1.4	3.2	37.0	38.6
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	6.6	6.9
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	24.0	57.1	16.8	38.7	33.4	34.9
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.0	0.0	0.0	0.0	1.2	1.3
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	1.0	1.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			42.0		43.4		95.8	

**Table 3.70** Willamette River: RM 136, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 136 - Willamette River Boat Electrofishing</b>			Date: Dec.98	Date: Mar.99	Date: Jun.99			
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	0.8	1.6	4.4	5.9
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	2.2	4.3	0.0	0.0	15.4	20.6
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	1.4	2.7	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	5.6	11.0	6.2	8.3
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	5.2	10.3	3.2	6.3	0.0	0.0
<b>Carps and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	10.8	21.3	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	2.8	5.5	3.4	4.6
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	3.6	7.1	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	1.2	2.4	11.2	22.0	14.0	18.8
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	2.8	3.8
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	13.2	26.1	26.0	51.0	25.6	34.3
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	1.2	2.4	0.0	0.0	1.4	1.9
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	13.2	26.1	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	1.4	1.9
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			50.6		51.0		74.6	

**Table 3.71** Willamette River: RM 145, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 145 - Willamette River Boat Electrofishing</b>			Date:	Dec. 98	Date:	Mar. 99	Date:	Jun. 99
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	0.0	0.0	1.2	0.8
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	1.0	3.6	23.0	24.7	2.4	1.5
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	0.0	0.0	1.0	1.1	1.2	0.8
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	0.0	0.0	2.4	1.5
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	6.0	21.4	10.0	10.8	0.0	0.0
<b>Carp and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	12.0	12.9	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	4.0	14.3	31.0	33.3	20.4	12.8
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	50.4	31.6
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	16.0	57.1	16.0	17.2	72.0	45.1
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	1.0	3.6	0.0	0.0	0.0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	3.6	2.3
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	6.0	3.8
n (total individuals)=			28.0		93.0		159.6	

**Table 3.72** Willamette River: RM 148.5, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 148.5 - Willamette River Boat Electrofishing</b>			Date: Dec.98	Date: Mar.99	Date: Jun.99			
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	3.6	7.9	5.0	13.5
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	3.0	7.3	0.0	0.0	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	1.2	2.6	2.0	5.4
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	10.0	24.4	22.8	50.0	6.0	16.2
<b>Carps and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	1.2	2.6	3.0	8.1
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	28.0	68.3	16.8	36.8	20.0	54.1
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.0	0.0	0.0	0.0	1.0	2.7
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			41.0		45.6		37.0	

**Table 3.73** Willamette River: Cartney, RM 156, Boat Electrofishing Data Summary  
for December 1998 to June 1999

RM 156 (Cartney) - Willamette River Boat Electrofishing			Date: Dec.98	Date: Mar.99	Date: Jun.99			
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	0.0	0.0	7.0	10.4
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	1.2	1.8
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	5.0	17.2	0.0	0.0	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	4.0	9.9	1.2	1.8
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	21.0	72.4	10.0	24.8	4.2	6.2
<b>Carps and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	2.0	5.0	7.0	10.4
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	4.0	9.9	28.4	42.1
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	0.0	0.0	18.4	45.5	18.4	27.3
Mountain Sucker	<i>Catostomus platyrhynchus</i>	Catostomidae	0.0	0.0	2.0	5.0	0.0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	3.0	10.3	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			29.0		40.4		67.4	

**Table 3.74** Willamette River: Harrisburg, RM 160, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 160 (Harrisburg) - Willamette River Boat Electrofishing</b>			Date: Dec.98	Date: Mar.99	Date: Jun.99			
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	3.4	3.1
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	2.4	4.4	2.4	2.2
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	9.6	8.7
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	1.1	2.8	0.0	0.0	0.0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	2.3	5.8	0.0	0.0	1.2	1.1
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	2.2	5.6	18.0	32.7	2.0	1.8
<b>Carps and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	2.2	5.6	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	4.8	4.3
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	1.2	3.0	0.0	0.0	26.0	23.6
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	31.0	28.1
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	30.8	77.2	34.6	62.9	28.8	26.1
Mountain Sucker	<i>Catostomus platynynchus</i>	Catostomidae	0.0	0.0	0.0	0.0	1.2	1.1
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			39.9		55.0		110.4	

**Table 3.75** Willamette River: RM 168.5, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 168.5 - Willamette River Boat Electrofishing</b>			Date:	Dec.98	Date:	Mar.99	Date:	Jun.99
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0.0	0.0	5.0	11.1
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	7.4	22.3	3.2	17.4	1.0	2.2
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	0.0	0.0	0.0	0.0
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	13.8	41.6	12.8	69.6	14.0	31.1
<b>Carps and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	12.0	36.1	1.6	8.7	25.0	55.6
Mountain Sucker	<i>Catostomus platyrhynchus</i>	Catostomidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0.0	0.0	0.0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0.8	4.3	0.0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
Sculpin		Cottidae	0.0	0.0	0.0	0.0	0.0	0.0
n (total individuals)=			33.2		18.4		45.0	

**Table 3.76** Willamette River: RM 176, Boat Electrofishing Data Summary  
for December 1998 to June 1999

<b>RM 176 - Willamette River Boat Electrofishing</b>			Date:	Dec.98	Date:	Mar.99	Date:	Jun.99
Data normalized to 250 meters			Count	% of Total	Count	% of Total	Count	% of Total
<b>Sturgeons:</b>								
Sturgeon		Acipenseridae	0.0	0.0	0	0.0	0	0.0
<b>Trout and Salmon:</b>								
Cutthroat Trout	<i>Oncorhynchus clarki clarki</i>	Salmonidae	0.0	0.0	3	9.4	3.4	10.6
Coho Salmon	<i>Oncorhynchus kisutch</i>	Salmonidae	0.0	0.0	0	0.0	1.4	4.4
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Salmonidae	1.0	4.0	2	6.3	0	0.0
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Salmonidae	0.0	0.0	0	0.0	0	0.0
Mountain Whitefish	<i>Prosopium williamsoni</i>	Salmonidae	9.0	36.0	11.6	36.3	1	3.1
<b>Carp and Minnows:</b>								
Chiselmouth	<i>Acrocheilus alutaceus</i>	Cyprinidae	0.0	0.0	0	0.0	0	0.0
Common Carp	<i>Cyprinus carpio carpio</i>	Cyprinidae	0.0	0.0	0	0.0	0	0.0
Peamouth	<i>Mylocheilus caurinus</i>	Cyprinidae	0.0	0.0	0	0.0	3.8	11.9
Golden Shiner	<i>Notemigonus crysoleucas</i>	Cyprinidae	0.0	0.0	0	0.0	0	0.0
Northern Squawfish	<i>Ptychocheilus oregonensis</i>	Cyprinidae	2.0	8.0	0	0.0	22.8	71.3
Redside Shiner	<i>Richardsonius balteatus</i>	Cyprinidae	0.0	0.0	0	0.0	0	0.0
<b>Suckers:</b>								
Largescale Sucker	<i>Catostomus macrocheilus</i>	Catostomidae	13.0	52.0	15.4	48.1	25.6	80.0
Mountain Sucker	<i>Catostomus platyrhynchos</i>	Catostomidae	0.0	0.0	0	0.0	0	0.0
<b>Sunfish:</b>								
Smallmouth Bass	<i>Micropterus dolomieu</i>	Centrarchidae	0.0	0.0	0	0.0	0	0.0
<b>Perch:</b>								
Troutperch	<i>Percopsis omiscomaycus</i>	Percopsidae	0.0	0.0	0	0.0	0	0.0
<b>Sculpins:</b>								
Mottled Sculpin	<i>Cottus bairdii</i>	Cottidae	0.0	0.0	0	0.0	0	0.0
Riffle Sculpin	<i>Cottus gulosus</i>	Cottidae	0.0	0.0	0	0.0	0	0.0
Reticulate Sculpin	<i>Cottus perplexus</i>	Cottidae	0.0	0.0	0	0.0	0	0.0
Torrent Sculpin	<i>Cottus rhotheus</i>	Cottidae	0.0	0.0	0	0.0	0	0.0
Sculpin		Cottidae	0.0	0.0	0	0.0	0	0.0
n (total individuals)=			25.0		32.0		58.0	

#### 4.0 SUMMARY AND CONCLUSIONS

This compendium characterizes the depth and extent of data collected in the LTRWS and provides a summary of monitoring parameters for the 1998 to 1999 water year. Additional reports will be issued for each water year over the course of the LTRWS. These data represent in part the information that will be utilized in addressing the overall study objective of fully assessing the potential for mill effluent effects on the aquatic community in effluent receiving waters.

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