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NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

LONG-TERM RECEIVING WATER STUDY DATA COMPENDIUM: SEPTEMBER 2000 TO AUGUST 2001

TECHNICAL BULLETIN NO. 868

SEPTEMBER 2003

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. In 1999, a fourth river was added, the Leaf River in south central Mississippi. The objectives of this on-going 10- to 20-year study are a) to provide to the industry short-term and long-term information as to whether there are differences in aquatic communities upstream/downstream from representative point source effluent discharges from pulp and paper mills; and b) to determine the significance of any differences. The practical applications within this broad objective include creating a data base 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. Because it characterizes the aquatic communities and the river waters at multiple sites along an upstream/downstream stretch of each river, as well as the mill effluent, the experimental design provides for a comprehensive representation of the receiving waters.

This report is the third annual summary of the monitoring parameters for the four LTRWS rivers, covering the study year from September 2000 to August 2001. Note that in most cases these summaries are not the detailed data sets, but rather graphs and tables that present an overview of the third study year data. 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 the series of annual data summaries for each water year in the study, as well as reports specifically directed at the analysis and interpretation of the LTRWS database to address effluent effects questions identified in the goals of the study.

Ronald A. Yeske

September 2003

MOT DU PRÉSIDENT

En 1998, NCASI a réalisé un large éventail d'échantillonnage et de collecte de données dans le cadre des études à long terme des cours d'eau récepteurs (*Long-Term Receiving Water Studies, LTRWS*) et ce, pour trois cours d'eau récepteurs différents: Codorus Creek dans le centre Sud de la Pennsylvanie de même que les rivières McKenzie et Willamette dans l'Ouest de l'Oregon. Une quatrième rivière a été ajoutée en 1999, la rivière Leaf dans le centre Sud du Mississippi. Les objectifs de cette étude qui se déroule en continu sur une période de 10 à 20 ans sont 1) fournir à l'industrie des informations à court terme et à long terme sur toute différence dans les milieux aquatiques entre l'amont et l'aval d'émissaires représentatifs de fabriques de pâtes et papiers et 2) s'il y a des différences, déterminer si elles sont significatives. De ces larges objectifs découlent certaines applications pratiques dont la création d'une base de données qui permet de démontrer la variabilité temporelle et spatiale des propriétés abiotiques et biotiques des cours d'eau à l'étude; l'étude des marges de sécurité relatives à l'ajout d'un effluent dans un cours d'eau ; l'identification de changements des conditions des eaux réceptrices qui peuvent survenir suite à des modifications éventuelles des procédés ou du traitement des effluents des fabriques et la possibilité de fournir une première indication quant aux impacts subtils des effluents sur le cours d'eau, impacts qui autrement passeraient inaperçus. Afin d'atteindre ces objectifs la LTRWS a créé un design expérimental dans lequel on retrouve un programme flexible de surveillance et de collecte de données. En effectuant la caractérisation des milieux aquatiques et des rivières en différents endroits selon des tronçons amont/aval pour chaque rivière de même que la caractérisation des effluents des fabriques, le design expérimental procure une représentation complète des eaux réceptrices.

Ce rapport est le troisième d'une série de synthèses annuelles de surveillance des paramètres des quatre rivières à l'étude par LTRWS et couvre la période allant de septembre 2000 à août 2001. Mentionnons que dans la plupart des cas, les données détaillées ne sont pas présentées mais on montre plutôt les graphiques et tableaux qui illustrent les résultats de la troisième année de collecte de données. Les cartes, photos et descriptions de chaque site de surveillance sont également incluses afin d'illustrer le programme d'échantillonnage. Dans les pages suivantes, le lecteur trouvera les données synthèses qui lui procureront une représentation systématique de l'étendue et du champ couvert par la collecte de données.

Des rapports additionnels seront publiés tout au long de l'étude. Ces rapports incluront des séries de synthèses annuelles pour chaque année de l'étude, de même que des analyses et des interprétations de la base de données de la LTRWS afin de répondre aux questions soulevées dans les objectifs de cette étude quant aux impacts des effluents.

Ronald A. Yeske

Septembre 2003

LONG-TERM RECEIVING WATER STUDY DATA COMPENDIUM: SEPTEMBER 2000 TO AUGUST 2001

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SEPTEMBER 2003

ABSTRACT

The NCASI Long-Term Receiving Water Study (LTRWS), begun in 1998, is a 10- to 20-year project involving four different U.S. receiving waters: Codorus Creek in Pennsylvania; the Leaf River in Mississippi; the McKenzie River in Oregon; and the Willamette River in Oregon. The LTRWS objectives are to evaluate possible differences in the aquatic community upstream/downstream of representative point source effluent discharges from pulp and paper mills. 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 is the third annual overview of the monitoring study, covering the period from September 2000 to August 2001. The monitoring at Codorus Creek during this period included four sampling dates at eight sampling sites for biotic community data, 11 sampling dates at six sites for water quality data, and two sampling dates for mill effluent. Among the aquatic community findings for Codorus Creek were four divisions of periphyton, 210 macroinvertebrate taxa (an increase of 11% over the previous year), and 41 fish taxa (a 14% increase over the previous year). This was the first full year of monitoring for the Leaf River, with two sampling dates at six sampling sites for biotic community data, 11 sampling dates along six sites for water quality data, and nine sampling dates for mill effluent. Among the aquatic community findings for the Leaf were three to four divisions of periphyton on artificial and natural substrate, 76 macroinvertebrate taxa (a 9% increase over the previous year), 29 fish taxa using boat electrofishing gear (a decrease of 6% from the second study year) and 14 fish taxa using backpack electrofishing gear. The McKenzie River data included four sampling dates at six sampling sites for biotic community data, 11 sampling dates along five sites for water quality data, and four sampling dates for mill effluent. Among the McKenzie aquatic community findings were four divisions of periphyton, 244 macroinvertebrate taxa (a 14% increase from the previous study year), eight fish taxa using boat electrofishing gear (a decrease of 50% from the previous year) and 13 fish taxa using backpack electrofishing gear. The Willamette River included four sampling dates at six sampling sites for biotic community data, 11 sampling dates along five sites for water quality data, and three sampling dates for mill effluent. Among the findings for the Willamette aquatic communities were three divisions of periphyton, 261 macroinvertebrate taxa (a 45% increase over the previous study year), 14 fish taxa using boat electrofishing gear (a 26% decrease from the second study year) and 20 fish taxa using backpack electrofishing gear. Additional reports directed at the interpretation of the data with respect to addressing effluent effects questions identified in the study objectives, will be issued over the course of the study.

KEYWORDS

data summary, long-term receiving water study

RELATED NCASI PUBLICATIONS

Technical Bulletin No. 867 (August 2003). *Integration of a relative risk multi-stressor risk assessment with the NCASI long-term receiving water studies to assess effluent effects at the watershed level, Leaf River, Mississippi.*

Technical Bulletin No. 856 (January 2003). *Long-term receiving water study data compendium: September 1999 to August 2000.*

Technical Bulletin No. 846 (May 2002). *Turbidity: A literature review on the biological effects of turbidity on aquatic organisms and an assessment of turbidity in two long-term receiving water study rivers in Oregon.*

Technical Bulletin No. 843 (May 2002). *Long-term receiving water study data compendium: August 1998 to September 1999.*

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*.

COMPENDIUM DES DONNEES - ETUDES A LONG TERME DES COURS D'EAU RECEPTEURS : SEPTEMBRE 2000 A AOUT 2001

BULLETIN TECHNIQUE NO. 868
SEPTEMBRE 2003

RESUME

L'étude à long terme des cours d'eau récepteurs (LTRWS) de NCASI est un projet qui a démarré en 1998. Cette étude s'échelonne sur une période de 10 à 20 ans et implique quatre cours d'eau récepteurs des États-Unis: Codorus Creek, Pennsylvanie; la rivière Leaf, Mississippi; la rivière McKenzie, Oregon et la rivière Willamette, Oregon. Les objectifs de la LTRWS sont d'évaluer les différences possibles dans le milieu aquatique entre l'amont et l'aval d'émissaires représentatifs de fabriques de pâtes et papiers. Le design expérimental comprend de nombreux sites d'échantillonnage et de nombreuses variables pour chaque cours d'eau récepteur à l'étude. Parmi les composantes mesurées mentionnons la chimie de l'eau et des effluents, la caractérisation des effluents à l'aide de bioessais de toxicité chronique, la température et le débit de la rivière, la radiation solaire et des mesures détaillées du périphyton, des macroinvertébrés benthiques et des communautés de poissons. Ce rapport présente la troisième revue annuelle de l'étude de surveillance, couvrant la période de septembre 2000 à août 2001. La surveillance réalisée à Codorus Creek pendant cette période comprenait quatre dates d'échantillonnage pour huit sites d'échantillonnage de la communauté biotique, 11 dates d'échantillonnage pour six sites d'échantillonnage de la qualité de l'eau et deux dates d'échantillonnage des effluents des fabriques. Parmi les résultats obtenus à Codorus Creek, mentionnons quatre divisions de périphyton, 210 taxons de macroinvertébrés (une augmentation de 11% depuis l'année précédente) et 41 taxons de poissons (une augmentation de 14% depuis l'année précédente). Il s'agissait de la première année complète de surveillance pour la rivière Leaf. L'étude comprenait deux dates d'échantillonnage pour les six sites d'échantillonnage de la communauté biotique, 11 dates d'échantillonnage pour les six sites d'échantillonnage de la qualité de l'eau et neuf dates d'échantillonnage des effluents des fabriques. Parmi les résultats obtenus à la rivière Leaf, mentionnons trois à quatre divisions de périphyton sur un substrat artificiel et naturel, 76 taxons de macroinvertébrés (une augmentation de 9% depuis l'année précédente), 29 taxons de poissons en utilisant un dispositif de pêche électrique installé sur un bateau (une diminution de 6% par rapport à la seconde année de l'étude) et 14 taxons de poissons en utilisant un dispositif de pêche électrique portatif. En ce qui concerne la rivière McKenzie, la surveillance a été réalisée selon quatre dates d'échantillonnage pour six sites d'échantillonnage de la communauté biotique, 11 dates d'échantillonnage pour cinq sites d'échantillonnage de la qualité de l'eau et quatre dates d'échantillonnage pour les effluents de fabriques. Parmi les résultats obtenus à la rivière McKenzie mentionnons quatre divisions de périphyton, 244 taxons de macroinvertébrés (une augmentation de 14% depuis l'année précédente), huit taxons de poissons en utilisant un dispositif de pêche électrique installé sur un bateau (une diminution de 50% depuis l'année précédente) et 13 taxons de poissons en utilisant un dispositif de pêche électrique portatif. Pour ce qui est de la rivière Willamette, la surveillance consistait en quatre dates d'échantillonnage pour six sites d'échantillonnage de la communauté biotique, 11 dates d'échantillonnage pour cinq sites d'échantillonnage de la qualité de l'eau et trois dates d'échantillonnage des effluents de fabriques. Parmi les résultats obtenus à la rivière Willamette mentionnons trois divisions de périphyton, 261 taxons de macroinvertébrés (une augmentation de 45% depuis l'année précédente), 14 taxons de poissons en utilisant un dispositif de pêche électrique installé sur un bateau (une diminution de 26% par rapport à la seconde année de l'étude) et 20 taxons de poissons en utilisant un dispositif de pêche électrique portatif. Des rapports

additionnels seront publiés tout au long de cette étude afin d'interpréter ces données en regard des questions reliées aux impacts des effluents qui se trouvent dans les objectifs de l'étude.

MOTS CLES

étude à long terme des cours d'eau récepteurs, sommaire des données

AUTRES PUBLICATIONS DE NCASI DANS CE DOMAINE

Bulletin technique no. 867 (août 2003). *Integration of a relative risk multi-stressor risk assessment with the NCASI long-term receiving water studies to assess effluent effects at the watershed level, Leaf River, Mississippi.*

Bulletin technique no. 856 (janvier 2003). *Long-term receiving water study data compendium: September 1999 to August 2000.*

Bulletin technique no. 846 (mai 2002). *Turbidity: A literature review on the biological effects of turbidity on aquatic organisms and an assessment of turbidity in two long-term receiving water study rivers in Oregon.*

Bulletin technique no. 843 (mai 2002). *Long-term receiving water study data compendium: August 1998 to September 1999.*

Bulletin technique no. 842 (février 2002). *Integrated long-term receiving water studies: site selection process and a description of the selected study sites.*

Bulletin technique no. 841 (février 2002). *A compendium of field methods used in NCASI long-term receiving water studies.*

Bulletin technique no. 833 (septembre 2001). *Evaluation of nutrient criteria and response variables based upon the NCASI long-term receiving water study experience*.

Bulletin technique no. 829 (juillet 2001). *The effects of a bleached kraft mill effluent on periphyton and macroinvertebrates in streamside mesocosm studies*.

Bulletin technique no. 828 (juillet 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: SEPTEMBER 2000 TO AUGUST 2001

1.0 INTRODUCTION

This report summarizes the data collected during the third year (2000 to 2001) of the Long-Term Receiving Water Study (LTRWS), a 10- to 20-year NCASI project. This is the third annual summary to be issued, the first was issued in May 2002, NCASI (2002a), and the second was issued in 2003, NCASI (2003). Reports addressing study objectives will continue to be issued separately.

The LTRWS involves four different U.S. receiving waters, including Codorus Creek in Pennsylvania, the Leaf River in Mississippi, and the McKenzie and Willamette rivers in Oregon. These locations represent warm and coldwater stream types, as well as streams ranging from effluent-dominated to those 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 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: a) to determine whether there were detectable differences in biological monitoring parameters upstream and downstream of mill effluent discharges, and b) to determine the significance of any differences in terms of broader river ecological functioning. Specific project goals included a) addressing temporal variability over a 10- to 20-year timeline, b) addressing spatial variability along upstream/downstream river gradients, c) identifying the margin of safety for effluent addition, d) investigating possible changes in effluent effects that might arise from mill process or effluent treatments changes, e) providing an early indication of adverse effects by carrying out a study of exceptional depth and detail, and f) providing a study template for others to use. 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 instream habitat evaluations to watershed-based risk assessments. The temporal scale was incorporated through sampling schedules to address seasonal variations and long-term annual variations. Field studies included instream or streamside monitoring of abiotic (water temperature, water flow, conductivity, 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 (2002c).

This compendium will give 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 will be provided at the start of each section of data (Section 3). Complete descriptions of the LTRWS sites and field methods are presented in NCASI Technical Bulletin No. 841 (2002c).

2.0 APPROACH

2.1 Experimental Design

The experimental design for the biotic and abiotic components of the study was originally set to maximize the ability to analyze temporal variations within and between different sets of study variables. At the onset it was recognized that flexibility would be needed to accommodate any unknown factors that might occur during such a long study (e.g., changing conditions in the field necessitating changing site locations, additions; subtractions, or modifications to field or laboratory methodologies). Changes that occurred during the 2000 to 2001 study year are described in Table 2.1.

Table 2.1 Changes to the LTRWS Sampling, Analysis, or Data Handling for the Study Year 2000 to 2001

Type of Change	LTRWS Component	Description
Addition	Water Chemistry	In vivo chlorophyll analysis added for all rivers starting in June 2001
Addition	Water Chemistry	COD analysis added for the Leaf River and Codorus Creek
Addition	Water Chemistry	TOC analysis added for the Leaf River and Codorus Creek
Addition	Fish	Leaf River backpack electrofishing annual sampling started September 2000
Modification	Water Temperature	From September 1, 2000 to March 15, 2001, Vemco-Minilog-T data loggers were used to collect temperature data; after March 15, 2001, Tidbit data loggers were used to collect temperature data for the McKenzie and Willamette Rivers.
Modification	Periphyton	Wooden dowels chlorophyll *a* analysis (Leaf River, September, 2000) switched to sand periphyton analysis in May 2001
Modification	Macroinvertebrates and periphyton	Starting in March 2001, macroinvertebrates and periphyton were sampled across from Bellingers Boat Launch (RM 19) instead of at Bellingers (RM 18.5) on the McKenzie River.
Modification	Macroinvertebrates and periphyton	From September 2000 to August 2001, macroinvertebrates and periphyton were sampled at Walterville (RM 20.5) instead of Hendricks (RM 22.4) on the McKenzie River due to low flow conditions.

2.2 Sampling Schedule

River water quality was sampled once monthly for chemical analysis at each river, except for during the month of December (Table 2.2). Biotic elements were sampled quarterly (Table 2.3) for Codorus Creek, the McKenzie River, and the Willamette River; the Leaf River was sampled once in the fall of 2000 for all biotic elements, and once in the spring of 2001 for benthic macroinvertebrates and periphyton.

Table 2.2 Water Quality Sampling Schedule, Study Year 2000 to 2001

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Day(s)	25	23	27	[a]	29	26	26	30	21	18/20[b]	30	2

[a]not sampled for this month
[b]Codorus Creek sampled June 20, all other rivers June 18

Table 2.3 Biological Sampling Schedule, Study Year 2000 to 2001

Season	Codorus Creek	Leaf River	McKenzie River	Willamette River
Fall 2000	August 22-24	October 16-18	September 21-22	September 19-21
Winter 2000	November 14-16		December 7-8	December 5-7
Spring 2001	March 20-22	March 17-18[a]	March 8-9	March 6-8
Summer 2001	June 12-13		July 12-13	July 10-12

[a] benthic macroinvertebrates and periphyton only

2.3 Codorus Creek Sampling Area

Codorus Creek is located in the County of York in south central Pennsylvania. The study area of the creek extends from just above Lake Marburg (created from the impoundment of one tributary of the West Branch of Codorus Creek) to its confluence with the Susquehanna River (Figure 2.1). There were eight sampling locations along this stretch of the creek (Table 2.4); six were sampled for all biotic and abiotic elements, one (East Branch) was sampled for biotic elements, and another (Indian Rock) for fish only. The East Branch and Indian Rock sampling was done as part of the Western Washington University Research Agreement fish experimental design. A detailed description of each site is available in NCASI Technical Bulletin No. 841 (2002c) and NCASI Technical Bulletin No. 842 (2002b). Figures 2.2 through 2.8 show upstream views taken at each of the quarterly seasonal sampling events for periphyton and macroinvertebrates.

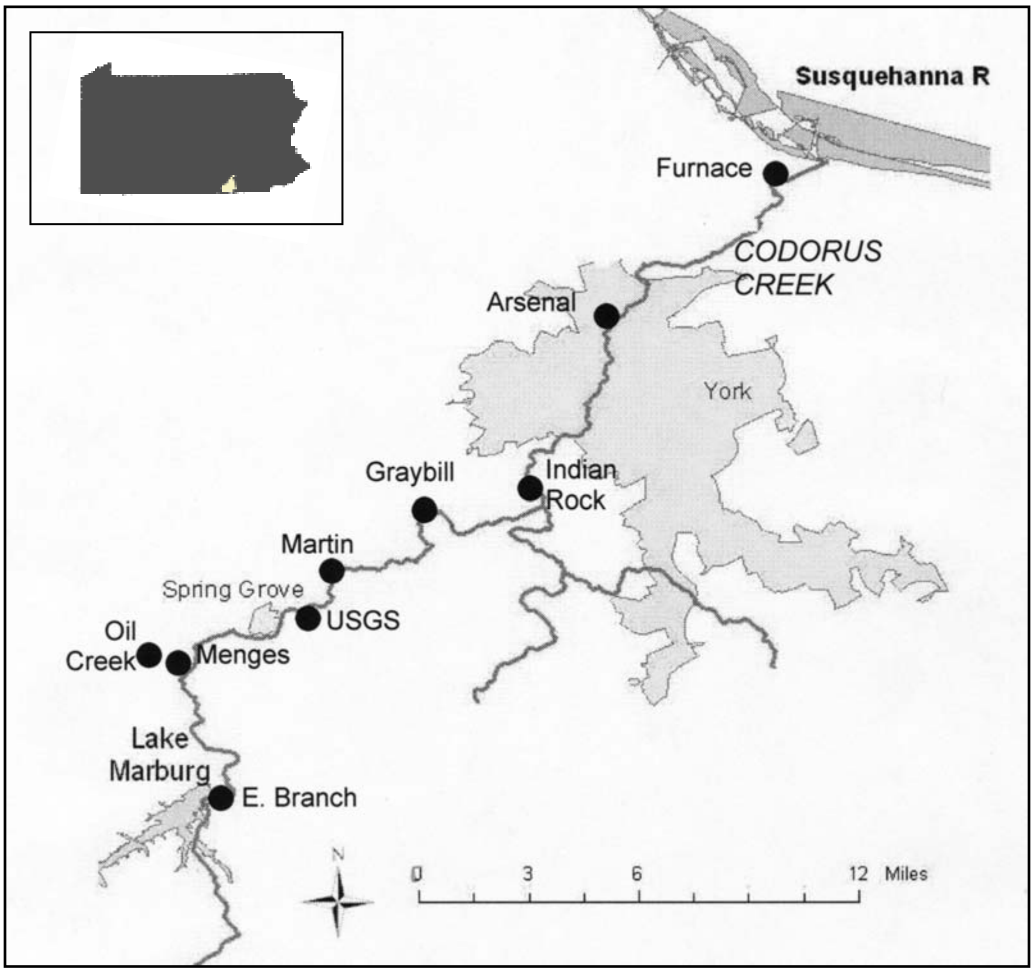


Figure 2.1 Codorus Creek in the Area of the LTRWS

Table 2.4 Sampling Site Descriptions for Codorus Creek, Pennsylvania

Sample Site	Site Description	Sampled Elements
Oil Creek	Tributary sampled upstream of the confluence with Codorus Creek	All abiotic elements No biotic
East Branch	Located on the West Branch above Lake Marburg Dam	All biotic elements No abiotic elements
Menges	Located on the West Branch below the hypolimnetic discharge from Lake Marburg and above the mill	All biotic elements All abiotic elements
USGS	Located on the West Branch below the mill thermal effluent discharge	All biotic elements All abiotic elements
Martin	Located on the West Branch below the mill process water effluent discharge	All biotic elements All abiotic elements
Graybill	Located on the West Branch	All biotic elements All abiotic elements
Indian Rock	Located on the West Branch just above the confluence with the South Branch	Fish only No abiotic elements
Arsenal	Located on the main stem of Codorus Creek, in the city of York	All biotic elements All abiotic elements
Furnace	Located on the main stem just above its confluence with the Susquehanna River	All biotic elements All abiotic elements

August 2000

November 2000

March 2001

June 2001

Figure 2.2 East Branch, Codorus Creek

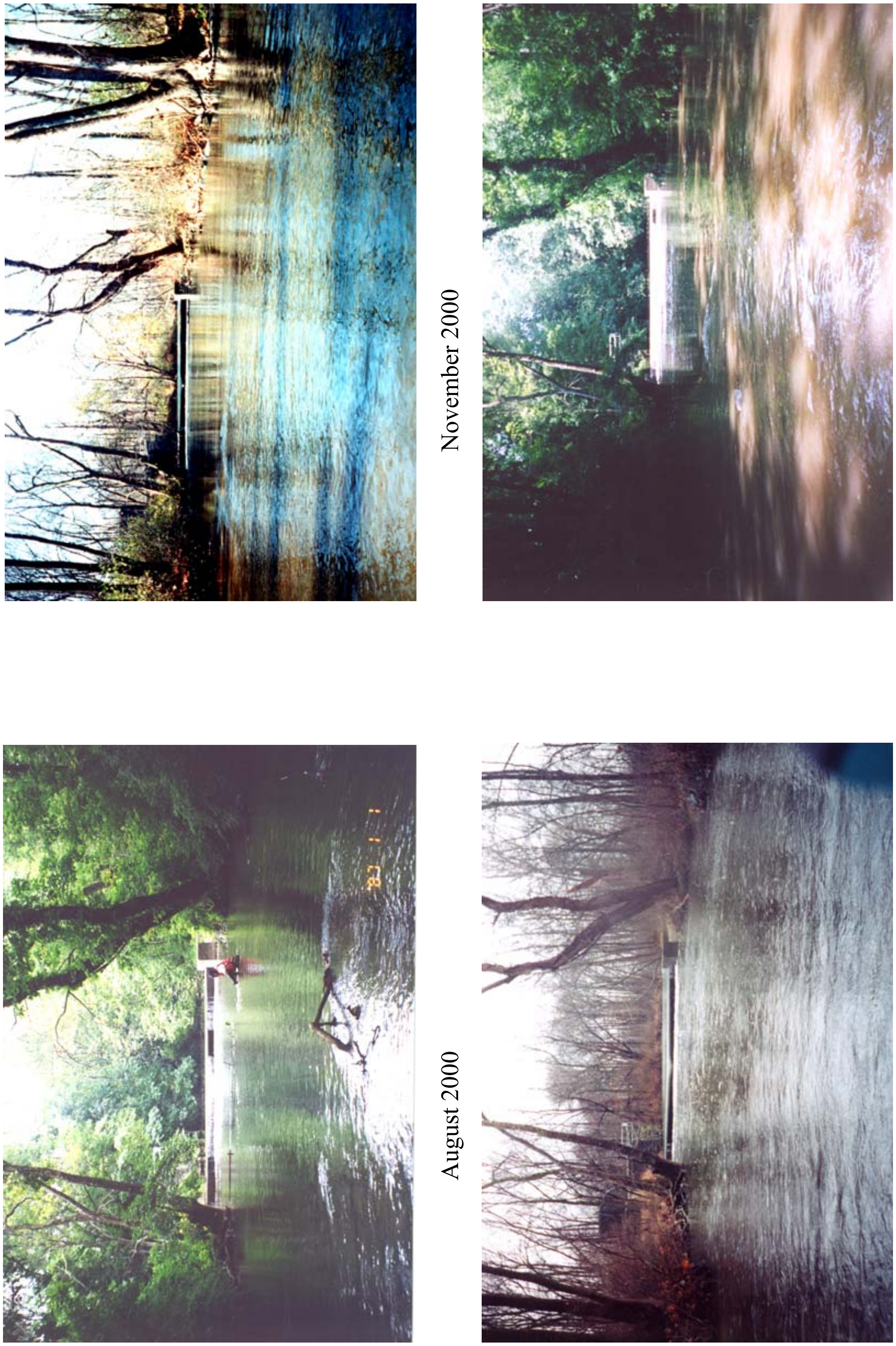
August 2000

November 2000

March 2001

June 2001

Figure 2.3 Menges, Codorus Creek



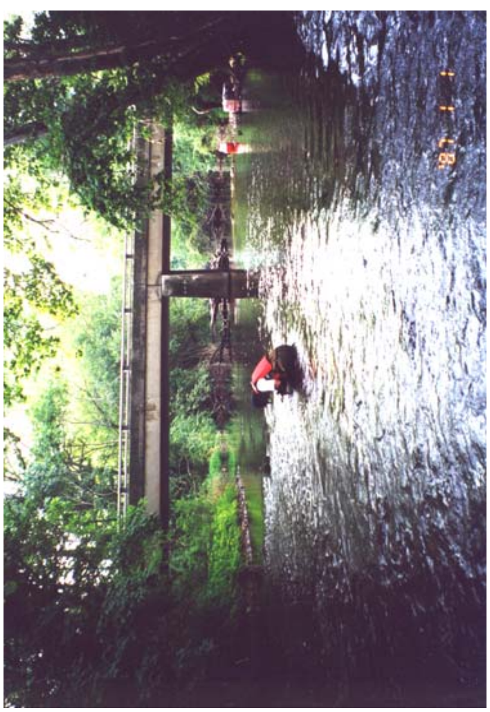
August 2000

November 2000

March 2001

June 2001

Figure 2.4 USGS, Codorus Creek



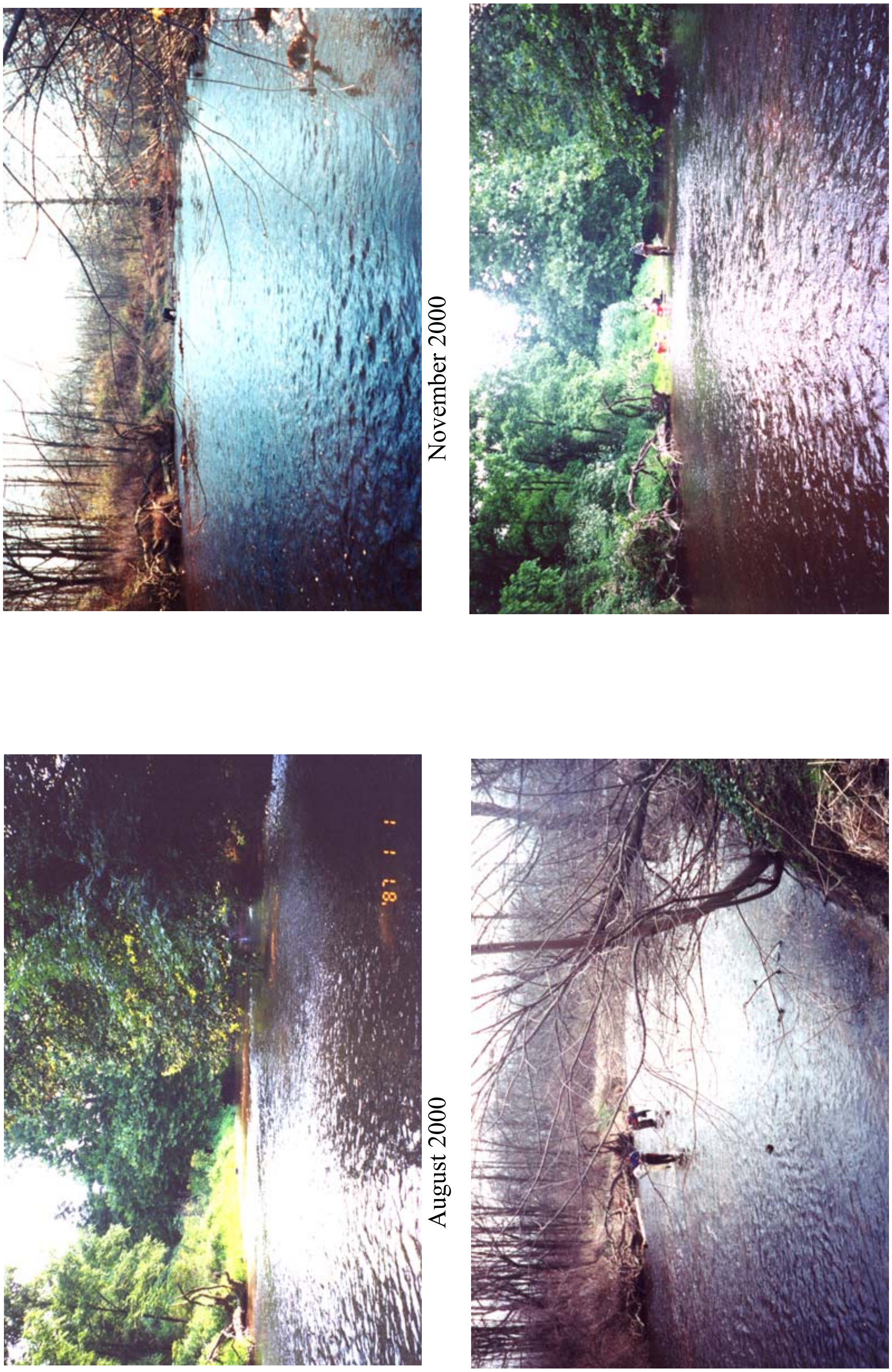
August 2000

November 2000

March 2001

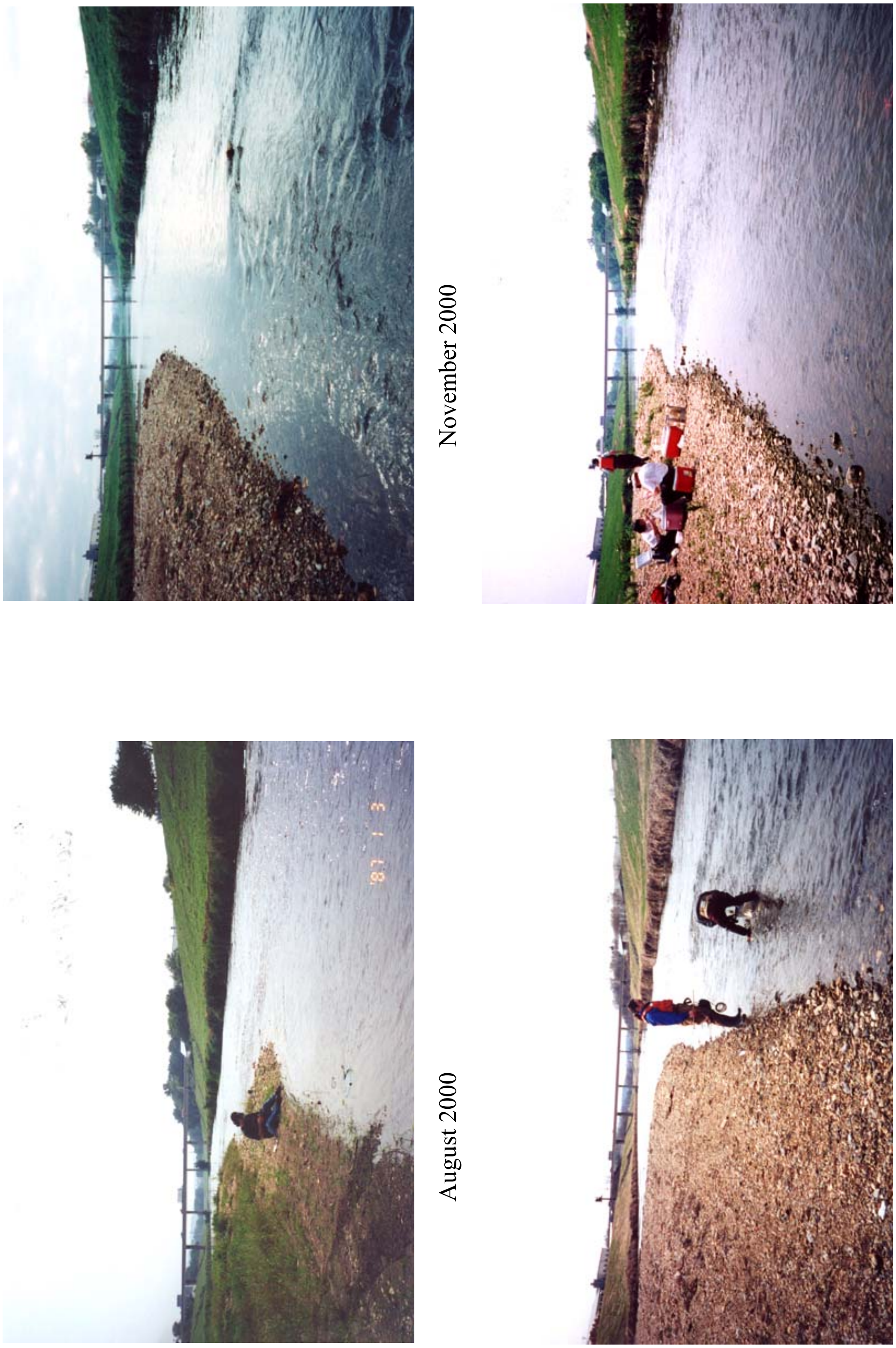
June 2001

Figure 2.5 Martin, Codorus Creek



August 2000 · November 2000 · March 2001 · June 2001

Figure 2.6 Graybill, Codorus Creek



August 2000

November 2000

March 2001

June 2001

Figure 2.7 Arsenal, Codorus Creek


August 2000


November 2000


March 2001

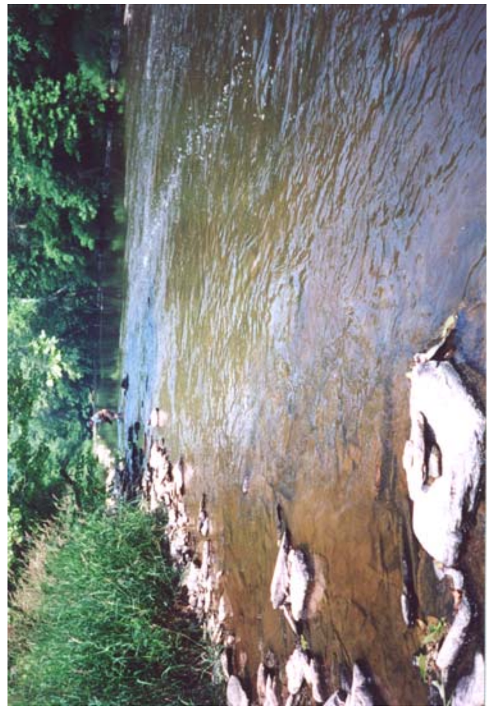

June 2001

Figure 2.8 Furnace, Codorus Creek

2.4 Leaf River Sampling Area

The Leaf River is located in SE Mississippi, flowing in a southeasterly direction from its headwaters, joining with the Chickasawhay River to form the Pascagoula River. The LTRWS is located downstream of Hattiesburg and extends 32 river miles (RM), most of which are located in Perry County. The sampling locations begin four river miles above the paper mill discharge at New Augusta and extend downstream of the mill discharge to just below McLain (Figure 2.9). Of the 12 sampling locations along this stretch of the river (Table 2.5), six were sampled for abiotic elements; the remaining six were sampled for the biotic elements. A detailed description of each site is available in NCASI Technical Bulletin No. 841 (2002c) and NCASI Technical Bulletin No 842 (2002b). Figures 2.10 through 2.15 show upstream views taken at each of the quarterly seasonal macroinvertebrate/periphyton sampling events.

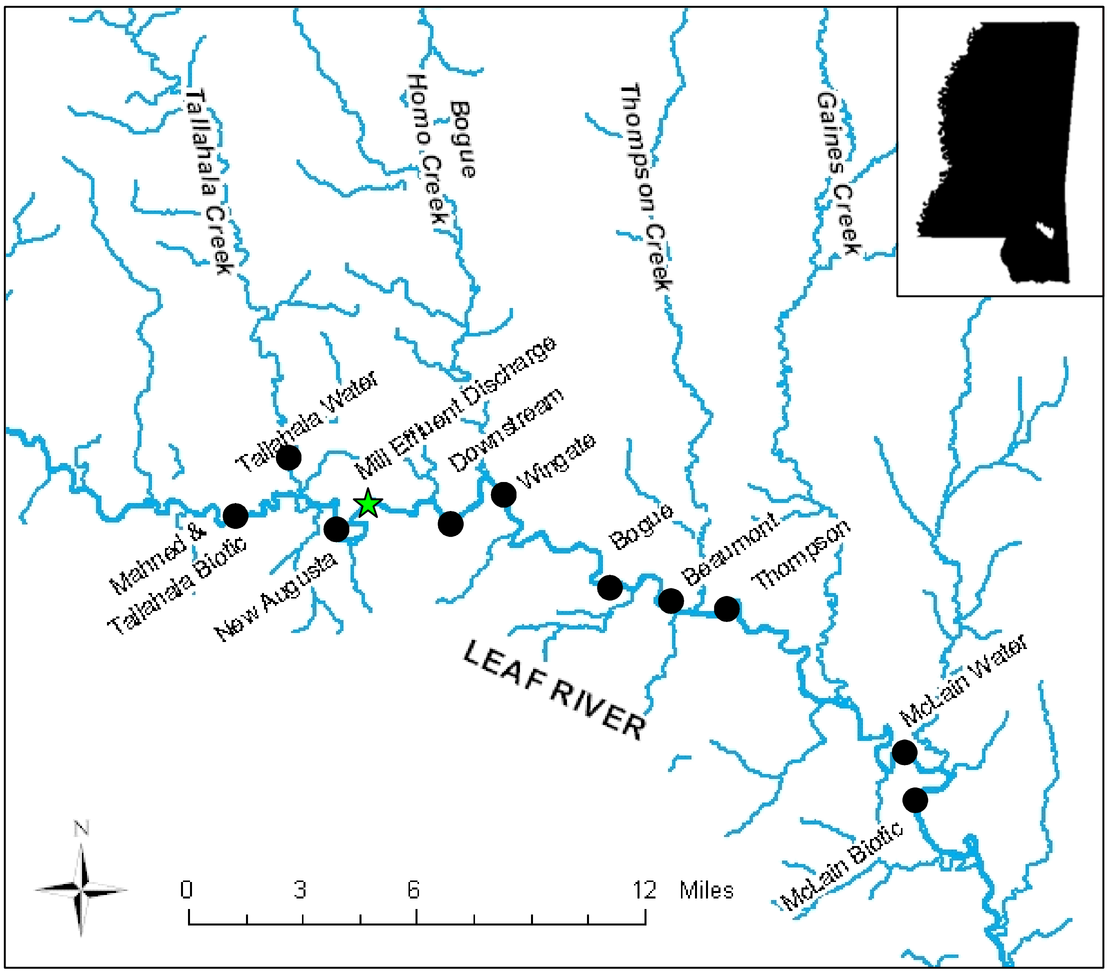


Figure 2.9 The Leaf River in the Area of the LTRWS

Table 2.5 Sampling Site Descriptions for the Leaf River

Sample Site	Site Description	Sampled Elements
Tallahalla Creek	Located on the tributary stream, upstream of its confluence with the Leaf River	Abiotic elements only
Tallahalla	Located on the Leaf River upstream of the confluence with Tallahalla Creek and 4.3 RM upstream of the mill effluent discharge	Biotic elements only
Mahned	Located on the Leaf River 4.7 RM upstream of the mill effluent discharge	Abiotic elements only
New Augusta	Located on the Leaf River 1.5 RM upstream of the mill effluent discharge	Biotic elements only
Downstream	2 sites (A and B) located approximately 2 RM downstream of the mill effluent discharge	Biotic elements only
Wingate	Located 4.4 RM downstream of the mill effluent discharge	Abiotic elements only
Bogue	Located upstream of the town of Beaumont, 10.3 RM downstream of the mill effluent discharge	Biotic elements only
Beaumont	Located in Beaumont, 12.2 RM downstream of the mill effluent discharge	Abiotic elements only
Thompson	Located downstream of Beaumont, 13 RM downstream of the mill	Biotic elements only
McLain Bridge	Located at the highway bridge, upstream of the town of McLain, 26.8 RM downstream of the mill	Abiotic elements only
McLain	Located downstream of the highway bridge, 27.5 RM downstream of the mill	Biotic elements only

October 2000

May 2001

Figure 2.10 Tallahala, Leaf River

October 2000

May 2001

Figure 2.11 New Augusta, Leaf River

October 2001

May 2001

Figure 2.12 Downstream, Leaf River

October 2000

May 2001

Figure 2.13 Bogue, Leaf River

October 2000

May 2001

Figure 2.14 Thompson, Leaf River

October 2000

May 2001

Figure 2.15 McLain, Leaf River

2.5 McKenzie River Sampling Area

The McKenzie River originates in the Cascade Mountains in central Oregon and runs west into the Willamette Valley where it joins the Willamette River. The study area of the river extends approximately 20 RM, from Hendricks Bridge at the upstream end to Armitage State Park at the downstream end (Figure 2.16). There are five water quality sampling locations, five benthic macroinvertebrate sampling locations, four backpack electrofishing areas, and five boat electrofishing areas (Table 2.6). A detailed description of each site is available in NCASI Technical Bulletin No. 841 (2002c) and NCASI Technical Bulletin No. 842 (2002b). Figures 2.17 through 2.21 show upstream views taken at each of the quarterly seasonal macroinvertebrate/periphyton sampling events.

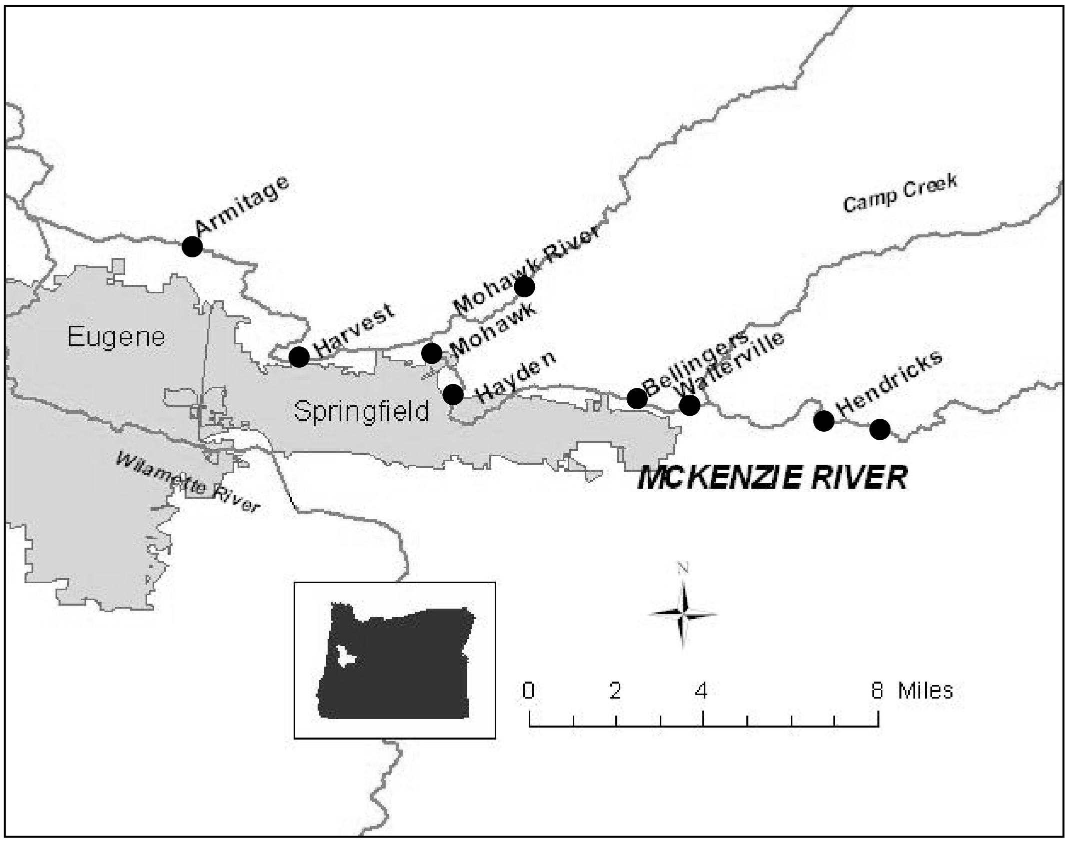


Figure 2.16 McKenzie River in the Area of the LTRWS

Table 2.6 Sampling Site Descriptions for the McKenzie River, Oregon

Sample Site	Site Description	Sampled Elements
Hendricks	RM 26-26.5	Fish only
Hendricks	RM 22.4. Located 7.6 river miles above the mill effluent discharge	All abiotic elements only[a]
Walterville	RM 20.5. Alternate sample location when Hendricks can't be reached due to low water	Macroinvertebrates and periphyton
Bellingers	RM 18.5-19. Located approximately 3.5 river miles above the mill effluent discharge	All biotic elements
Hayden	Located just above the mill effluent discharge	Abiotic elements only
Mohawk	RM 14. Located 1.1 river miles below the mill effluent discharge	All biotic elements
Harvest	RM 10. Located approximately 4 river miles below the mill effluent discharge	All biotic elements All abiotic elements
Armitage/Coburg	RM 6. Located 8.3 river miles below the mill effluent outfall	All biotic elements All abiotic elements
Mohawk River	Tributary sampled upstream of the confluence with the McKenzie River	Abiotic elements only

[a] Due to low flow conditions, macroinvertebrates and periphyton were not sampled at Hendricks (RM22.4) during the 2000 to 2001 study year

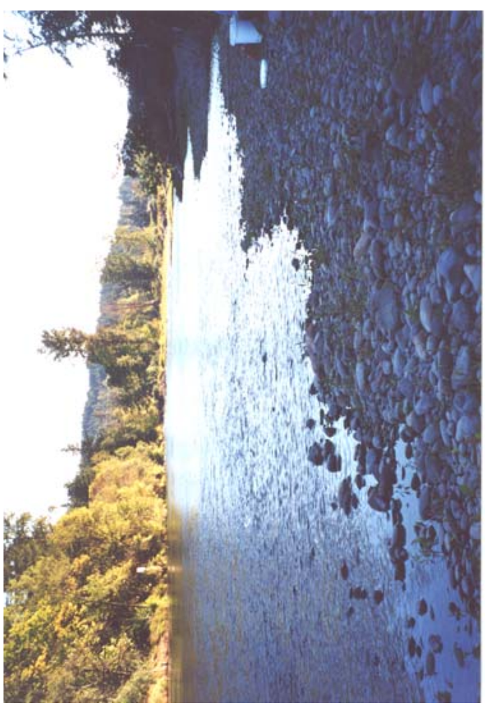
September 2000

December 2000

March 2001

July 2001

Figure 2.17 Walterville RM 20.5, McKenzie River



September 2000

December 2000

March 2001

July 2001

Figure 2.18 Bellingers RM 18.5 and Across from Bellingers Boat Launch RM 19, McKenzie River

September 2000

December 2000

March 2001

July 2001

Figure 2.19 Mohawk RM 14, McKenzie River

September 2000

December 2000

March 2001

July 2001

Figure 2.20 Harvest RM 10, McKenzie River

September 2000

December 2000

March 2001

July 2001

Figure 2.21 Armitage RM 6, McKenzie River

2.6 Willamette River Sampling Area

The Willamette River is located in the Willamette Valley, which runs between the Coastal Range and the Cascade Mountain Range in Western Oregon. The study area of the river extends from Harrisburg to Corvallis, a length of approximately 32 RM (Figure 2.22). There are five water quality sites, seven macroinvertebrate/periphyton sites, six boat electrofishing areas, and four backpack electrofishing areas (Table 2.7). While different sampling elements were of necessity collected from different regions of a sample site, if they came from the same general area, they have the same site name. A detailed description of the sites is available in NCASI Technical Bulletin No. 841 (2002c) and NCASI Technical Bulletin No. 842 (2002b). Figures 2.23 through 2.29 show upstream views taken at each of the quarterly/seasonal sampling events for macroinvertebrates and periphyton.

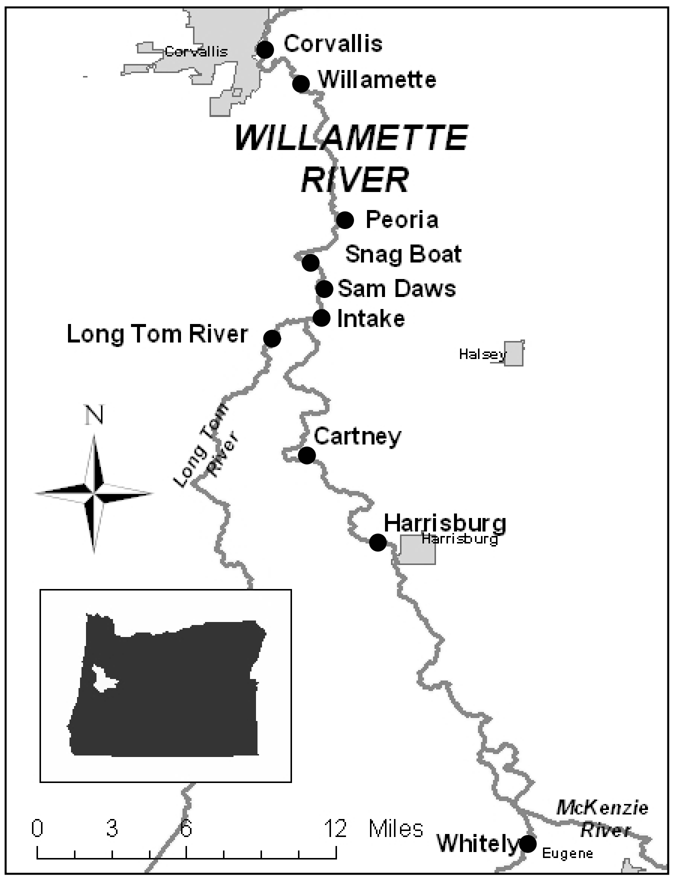


Figure 2.22 Willamette River in the Area of the LTRWS

Table 2.7 Sampling Site Descriptions for the Willamette River, Oregon

Sample Site	Site Description	Sampled Elements
Whitely	RM 176. Located above the confluence with the McKenzie River	Macroinvertebrates and periphyton
Harrisburg	RM 160. Located below the city of Harrisburg and 14.7 river miles above the mill effluent discharge	All biotic elements All abiotic elements
Cartney	RM 156. Located 12.7 river miles above the mill effluent discharge	All biotic elements All abiotic elements
Intake	RM 148. Located 0.6 river miles above the mill effluent discharge	Biotic elements only
Sam Daws	RM 145.5. Located 1.0 river mile below the mill effluent discharge	Fish
Snag Boat	RM 143.5. Located 2.2 river miles the mill effluent discharge	Macroinvertebrates and periphyton
Peoria	Located just downstream of the city of Peoria	Fish and abiotic elements
Long Tom Confluence	RM 136	Fish
Willamette	RM 134	Macroinvertebrates and periphyton
Fisher Lane	RM 132	Fish only
Corvallis	RM 128	All biotic elements All abiotic elements
Long Tom River	Tributary sampled just upstream of the confluence with the Willamette River	Abiotic elements only

September 2000

December 2000

March 2001

July 2001

Figure 2.23 Whitely RM 176, Willamette River

September 2000

December 2000

March 2001

July 2001

Figure 2.24 Harrisburg RM 160, Willamette River

September 2000

December 2000

March 2001

July 2001

Figure 2.25 Cartney RM 156, Willamette River

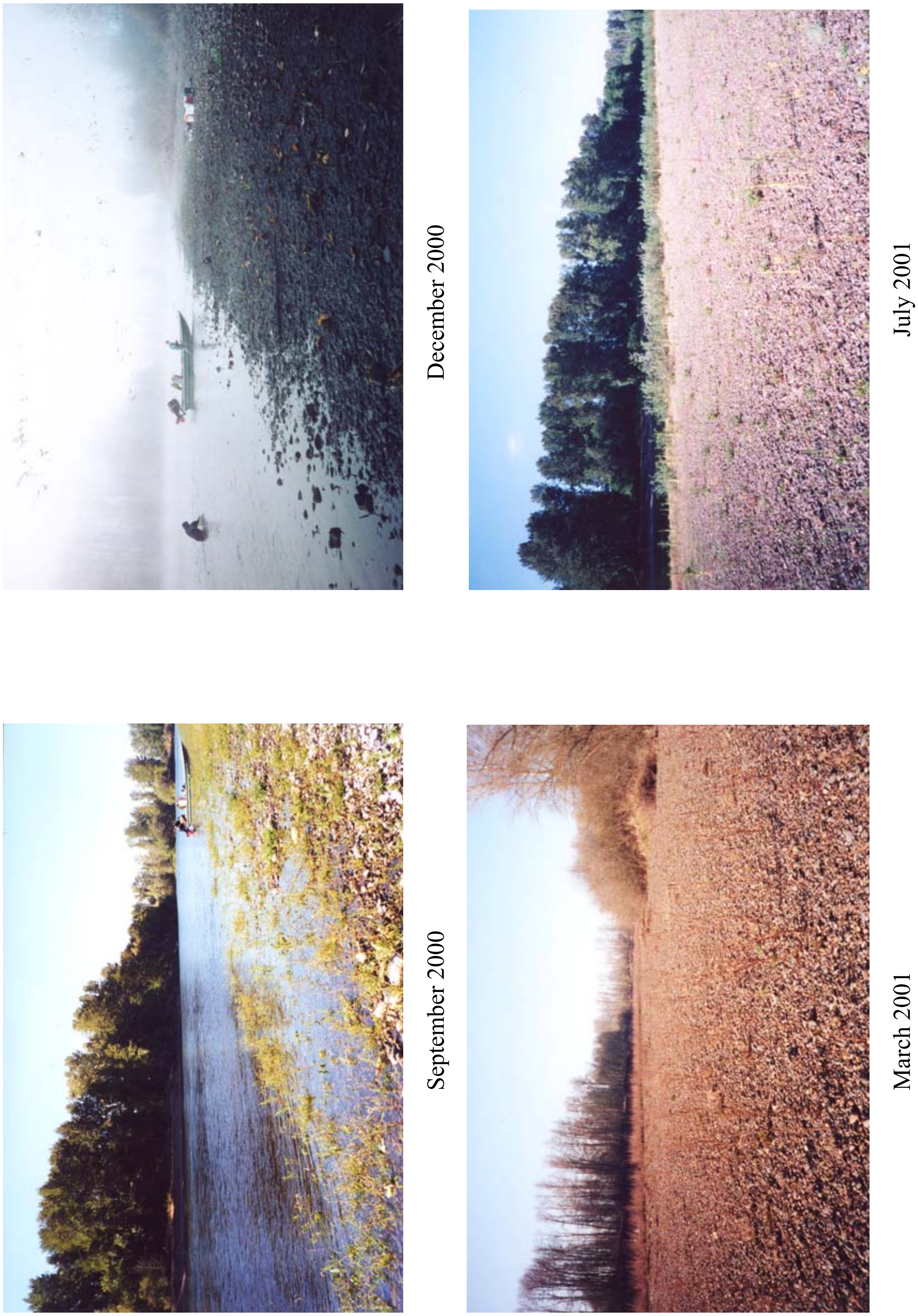


Figure 2.26 Intake RM 148, Willamette River

September 2000

December 2000

March 2001

July 2001

Figure 2.27 Snag Boat RM 143.5, Willamette River

September 2000

December 2000

March 2001

July 2001

Figure 2.28 Willamette Park RM 134, Willamette River

September 2000

December 2000

March 2001

July 2001

Figure 2.29 Corvallis RM 128, Willamette River

3.0 METHODS AND RESULTS

3.1 Water Temperature

In-river temperatures were recorded near the mill intake points for the McKenzie and Willamette Rivers. No temperature data were collected for Codorus Creek or the Leaf River. Between September 1, 2000 and March 15, 2001, Vemco-Minilog-T data loggers were used to collect temperature; after March 15, 2001 Tidbit data loggers were used. The 7d moving mean of the maximum temperature smoothes out some of the daily fluctuations and provides a picture of the mean temperature over a period of time. It was calculated by taking the mean of the 24h maximum for a 7d period encompassing the 3d prior and the 3d after each day. Daily fluctuations represent the difference between the minimum and maximum temperatures that occur during the 24h period from midnight to midnight. Gaps in both of the line segments (7d moving mean and 24h fluctuation) indicate data gaps due to loss of the data logger or loss of data in the electronic transfer. For the Willamette River, gaps in the 7d moving mean line segment are due to record low flows during the winter of 2000 to 2001, which caused the temperature data logger to be exposed to the air. These gaps show up as peaks on the 24h fluctuation line.

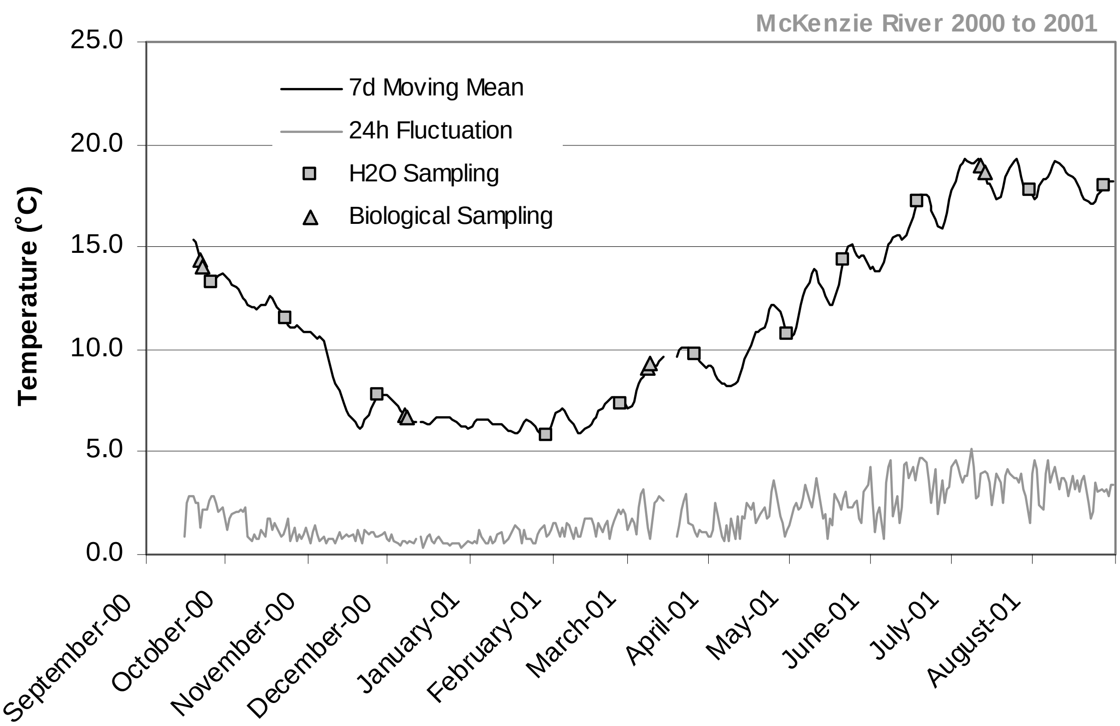


Figure 3.1 McKenzie River Water Temperature, 7d Moving Mean of the Maximum and 24h Fluctuation, from September 2000 to August 2001, Measured at Springfield, Oregon (LTRWS sampling dates are indicated by symbols.)

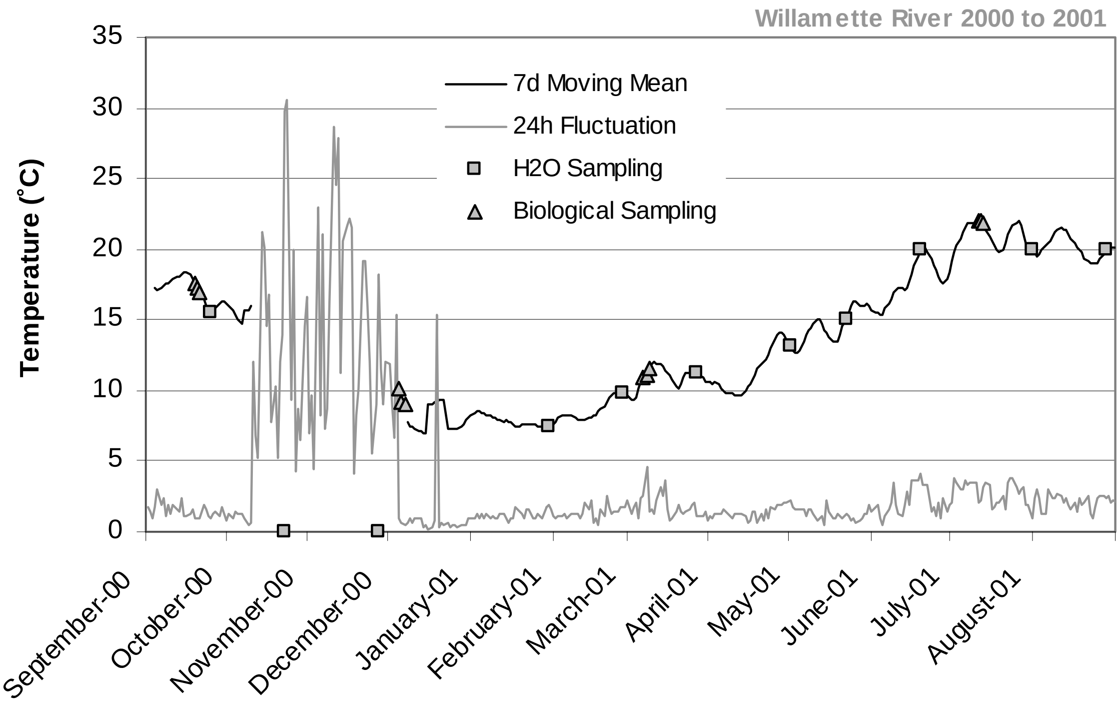


Figure 3.2 Willamette River Water Temperature, 7d Moving Mean of the Maximum and the 24h Fluctuation, from September 2000 to August 2001, Measured at Halsey, Oregon (LTRWS sampling dates are indicated by symbols.)

3.2 Solar Radiation

Solar radiation measurements were made using LI-COR LI-200SA pyranometer sensors placed near the mill effluent discharge locations for Codorus Creek (Spring Grove, Pennsylvania) and the Willamette River (near Halsey, Oregon). The pyranometers were deployed for the entire sampling season and data were downloaded in conjunction with fieldwork. The sensors record the solar radiation between 400 nm and 1100 nm wavelength every 3h and report an integrated value (in W h m^{-2}). The eight measurements per 24h were summed to give the total solar radiation per day. Gaps in the line segment indicate data gaps due to equipment failure or interference.

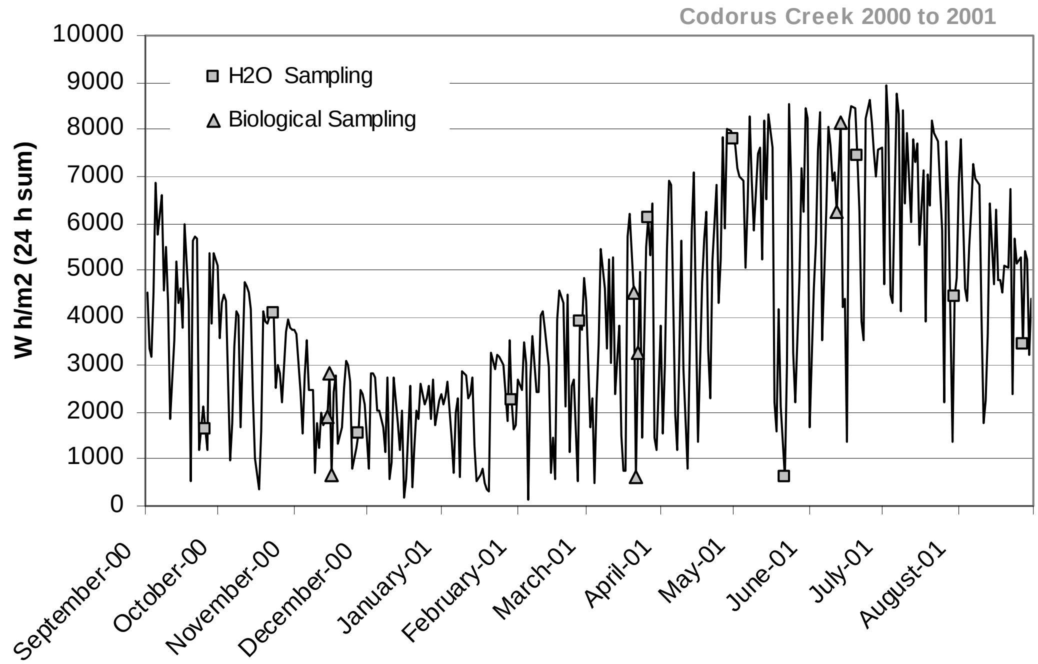


Figure 3.3 Daily Solar Radiation for the Codorus Creek LTRWS Area, Measured at Spring Grove, Pennsylvania, from September 2000 to August 2001 (LTRWS sampling dates are indicated by symbols.)

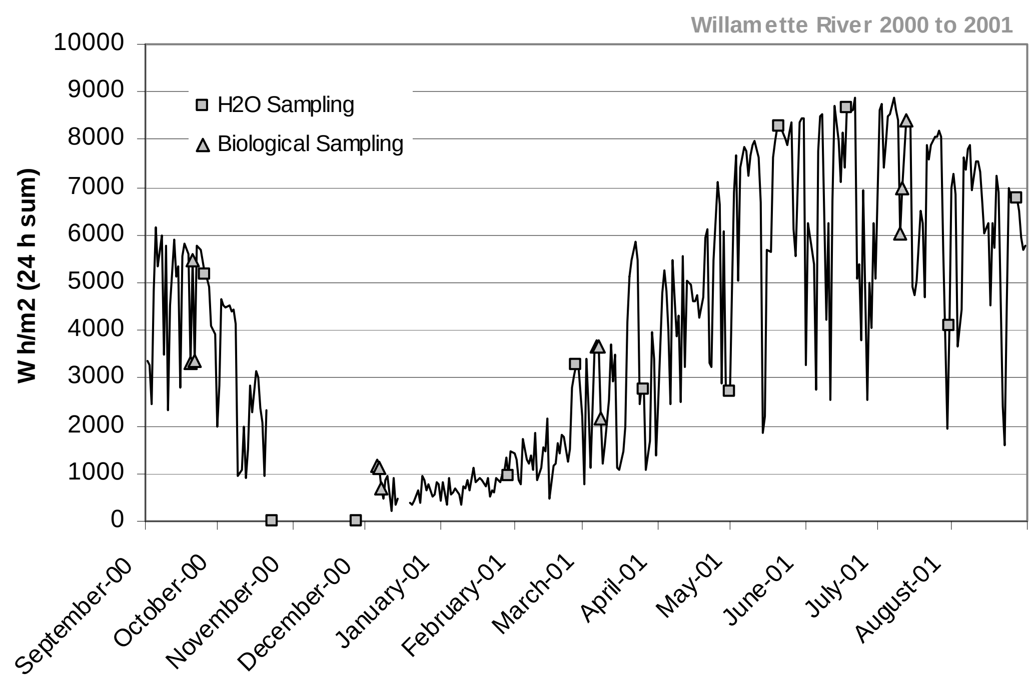


Figure 3.4 Daily Solar Radiation for the Willamette River LTRWS Area, Measured near Halsey, Oregon, from September 2000 to August 2001 (LTRWS sampling dates are indicated by symbols.)

3.3 Water Flow

River flow was obtained from the U.S. Geological Survey (USGS) website. Reported values were daily flow in cubic feet per second (cfs) and feet above datum. The measurements for Codorus Creek were taken from USGS gauging station #01574500 at Spring Grove, Pennsylvania, located within the study area. The Leaf River measurements were recorded at USGS Gauging station #0247460 near New Augusta, Mississippi. The McKenzie River data were recorded at USGS gauging station #14162500 at Vida, Oregon, located 16 river miles (RM) upstream of the study area. The Willamette River data was recorded at USGS gauging station #14166000 at Harrisburg, Oregon, located at the most upstream point of the study area.

The McKenzie River gauging station, unlike the other three LTRWS rivers, is located outside of the LTRWS area; therefore, a modification was applied to the flow data in order to better represent flow conditions in the study area. A more detailed description of the modification is given in NCASI 2003.

Instream waste concentration was calculated as percent effluent per total river volume. The daily amount of effluent discharged from the plant in million gallons per day was converted to instream flow in cfs. The total river volume is the river flow plus the effluent discharge. The values represent the theoretical effluent concentration at the point of discharge without any consideration for jet or diffuser dynamics or mixing. Gaps in the line segments indicate loss of data due to equipment failure.

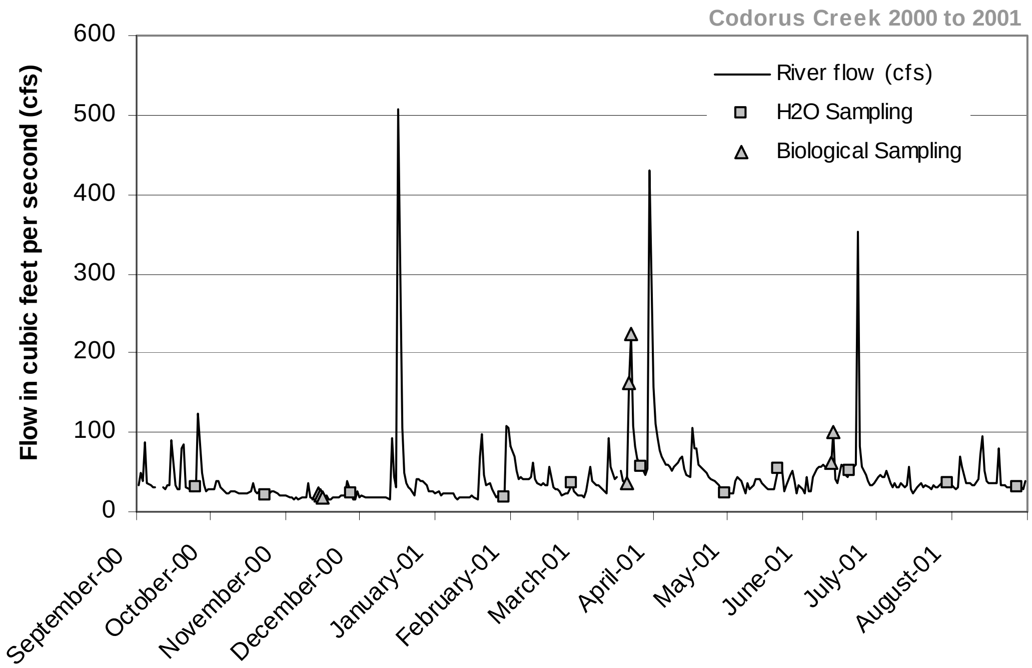


Figure 3.5 Codorus Creek Water Flow from September 2000 to August 2001 (LTRWS sampling dates are indicated by symbols.)

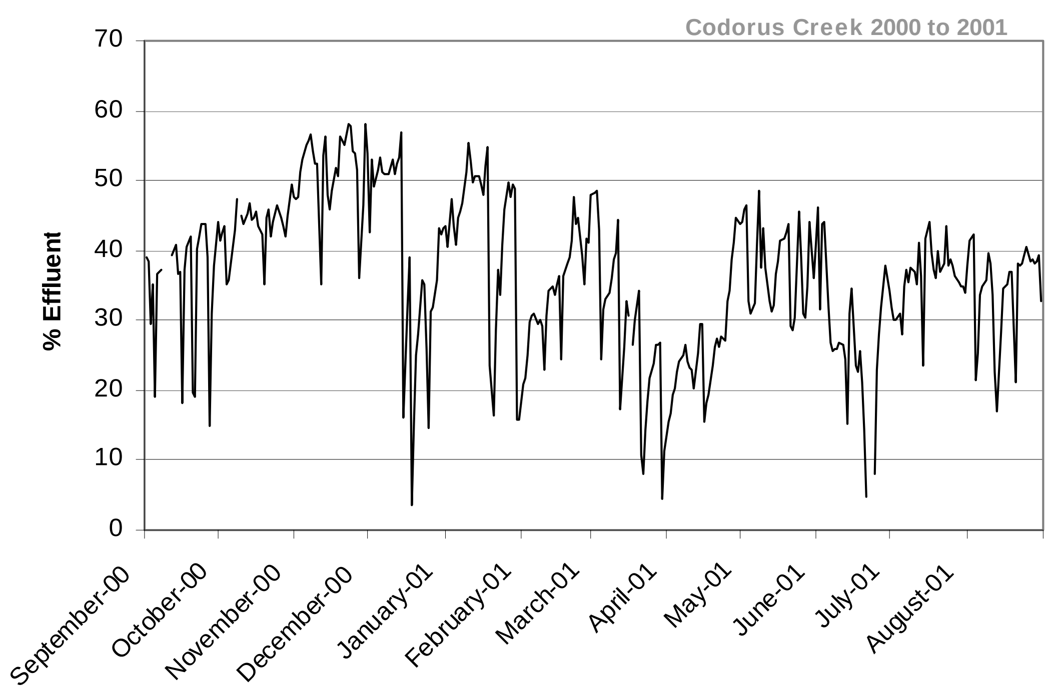


Figure 3.6 Codorus Creek Instream Waste Concentration at Point of Discharge as a Percent of Total River Volume, from September 2000 to August 2001

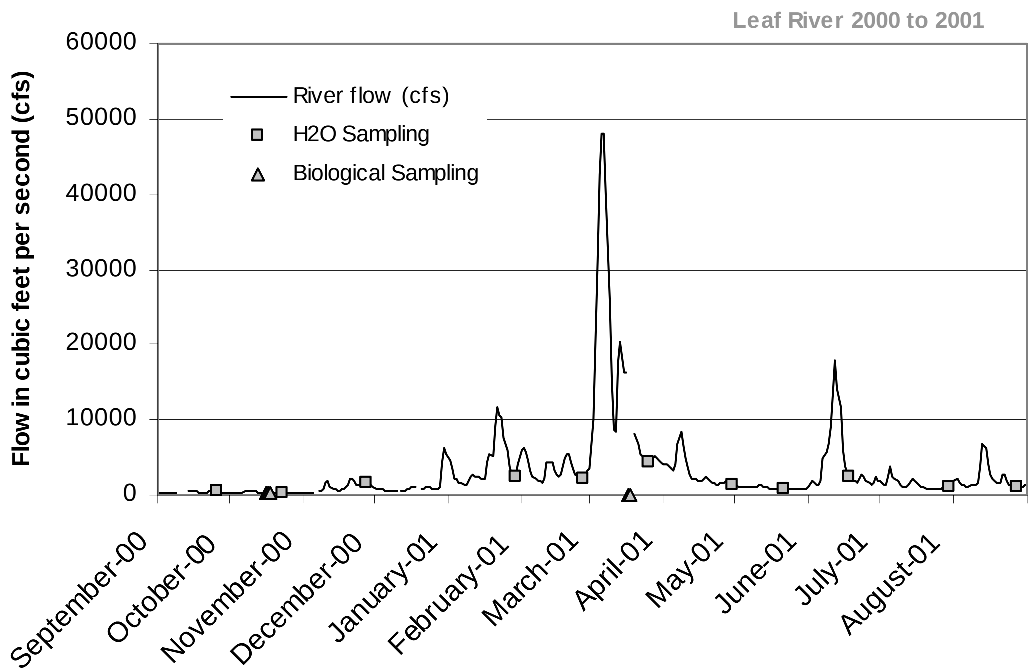


Figure 3.7 Leaf River Water Flow from September 2000 to August 2001 (LTRWS sampling dates are indicated by symbols.)

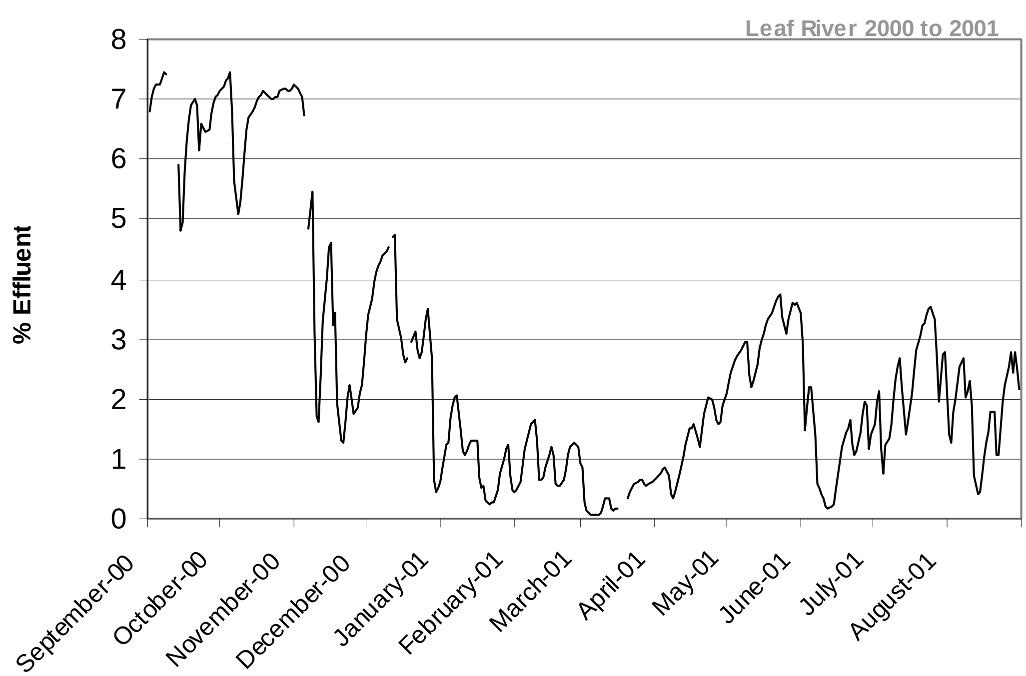


Figure 3.8 Leaf River Instream Waste Concentration at Point of Discharge as a Percent of Total River Volume, from September 2000 to August 2001

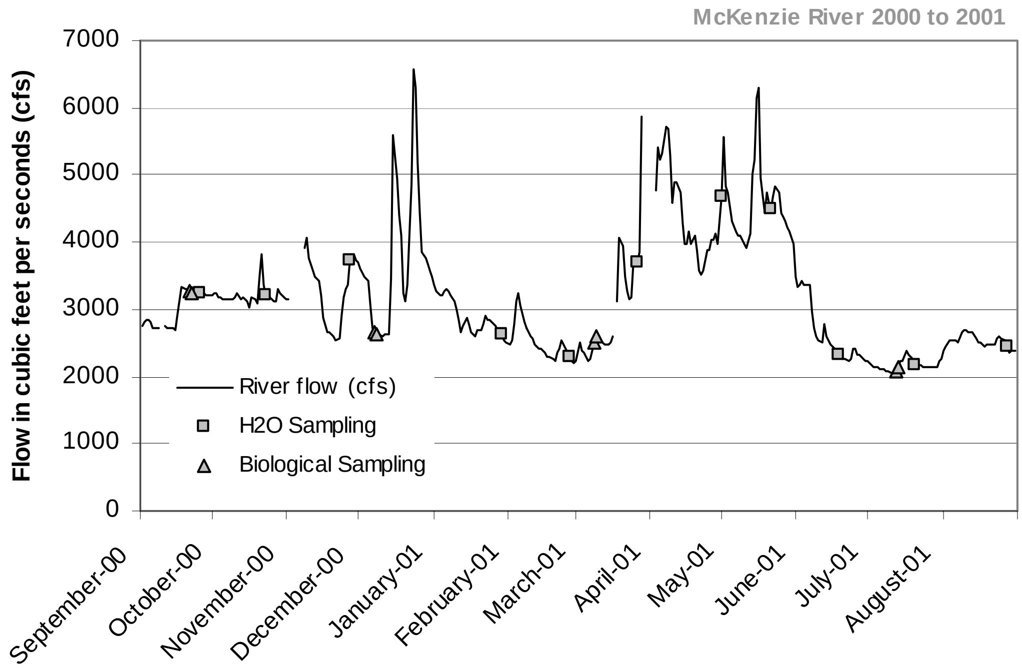


Figure 3.9 McKenzie River Water Flow from September 2000 to August 2001 (LTRWS sampling dates are indicated by symbols.)

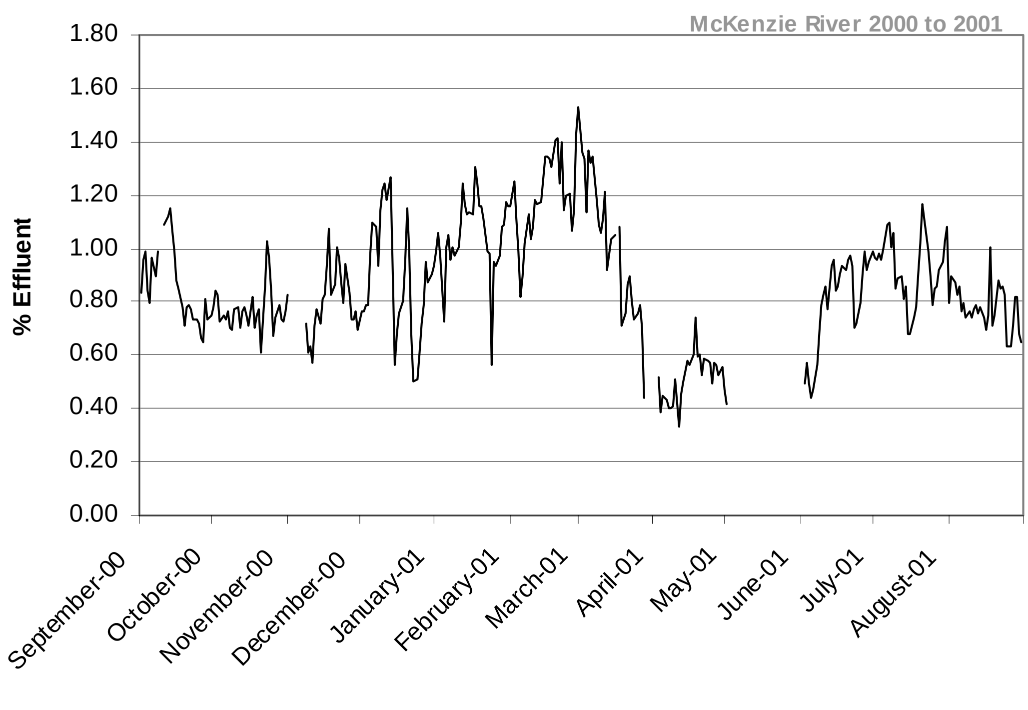


Figure 3.10 McKenzie River Instream Waste Concentration at point of discharge as a percent of total river volume, from September 2000 to August 2001

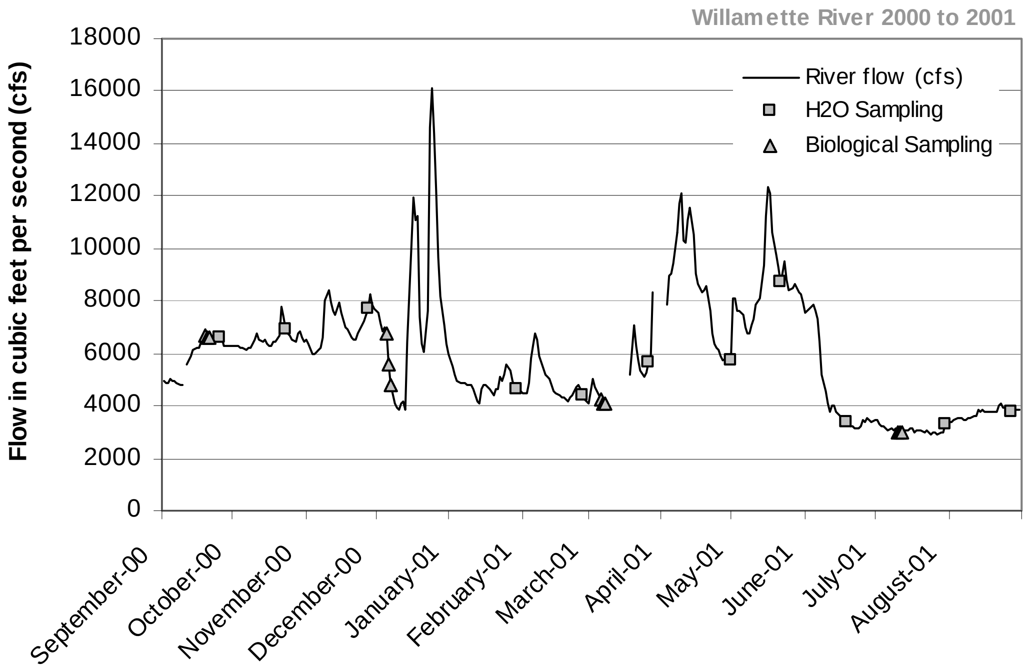


Figure 3.11 Willamette River Water Flow from September 2000 to August 2001 (LTRWS sampling dates are indicated by symbols.)

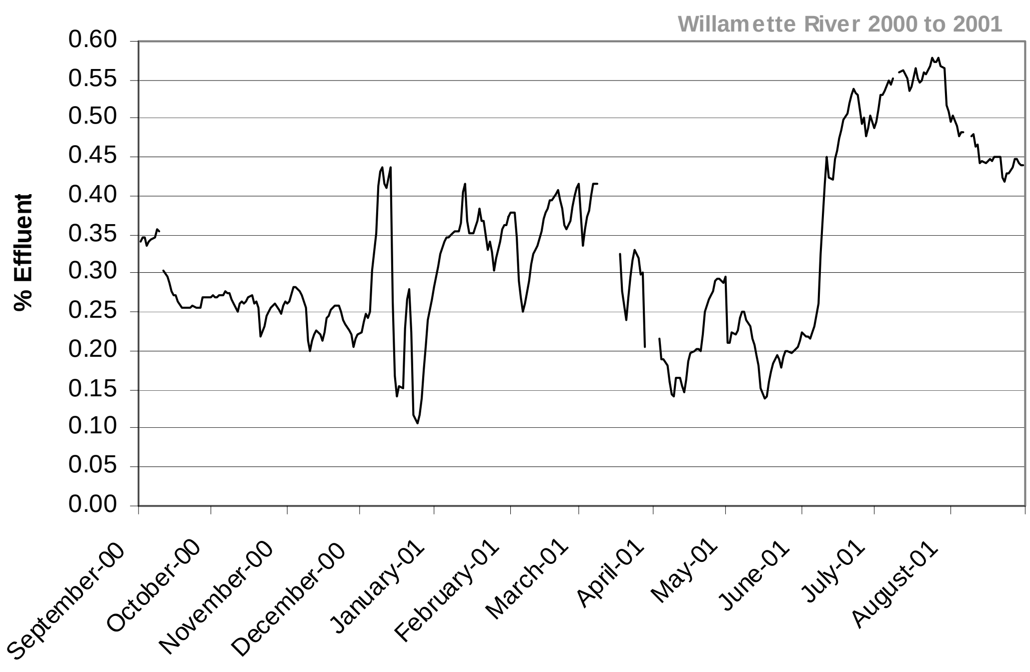


Figure 3.12 Willamette River Instream Waste Concentration at Point of Discharge as a Percent of Total River Volume, from September 2000 to August 2001

3.4 Water Chemistry

River water samples were taken monthly for analysis at each LTRWS river. All sites were sampled on the same day (except in June when sampling on Codorus Creek occurred two days after the three other rivers) and in a downstream to upstream direction. Grab samples were collected 6 inches below the surface in acid-washed bottles, and shipped cold to the Northwest Aquatic Biology Facility (NABF) in Anacortes within 24 h and processed within 48 h. Most of the water quality analysis in this report was done at NABF, the exceptions were river pH and temperature, which were recorded in the field at the time of sampling, and total phosphorus and total nitrogen which were analyzed at the NCASI West Coast Regional Center (WCRC) in Corvallis, Oregon. Analyses included, but were not limited to, pH, temperature, color, conductivity, turbidity, total organic compounds (TOC), chemical oxygen demand (COD), hardness, total phosphorus, total nitrogen, and in vivo chlorophyll. TOC analysis was added for the Leaf River and Codorus Creek during the 2000 to 2001 study year. In vivo chlorophyll analysis was added in June 2001 for all LTRWS rivers.

Table 3.1 Codorus Creek Water Chemistry

Station	Date	pH	Temp (ºC)	Color (Pt-Co units)	Conductivity (µs/cm)	Turbidity (NTU)	TOC (mg/L)	COD (mg/L)	Hardness (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)
Menges	9/25/00	7.4	13.0	17	172	7	4	10	63	FQA	FQA
USGS	9/25/00	7.9	17.7	16	312	13	7	16	90	FQA	FQA
Martin	9/25/00	7.9	21.5	193	1045	11	9	68	231	FQA	FQA
Graybill	9/25/00	8.0	19.5	162	942	12	7	58	210	FQA	FQA
Furnace	9/25/00	8.1	18.1	62	618	8	19	26	175	FQA	FQA
Oil Creek	9/25/00	8.3	16.8	55	899	14	18	17	183	FQA	FQA
Menges	10/23/00	7.6	10.0	10	174	6	8	8	61	FQA	FQA
USGS	10/23/00	7.6	13.8	16	319	10	14	12	89	FQA	FQA
Martin	10/23/00	7.8	16.4	152	1174	9	24	64	197	FQA	FQA
Graybill	10/23/00	7.9	12.9	153	1059	12	59	63	190	FQA	FQA
Furnace	10/23/00	7.9	12.2	92	702	7	19	31	169	FQA	FQA
Oil Creek	10/23/00	8.1	9.9	29	984	9	19	19	191	FQA	FQA
Menges	11/27/00	7.6	8.3	13	176	8	11	8	64	0.05	1.67
USGS	11/27/00	7.8	10.5	21	304	4	8	5	87	0.12	3.00
Martin	11/27/00	7.7	15.8	148	1006	8	62	42	203	0.08	2.16
Graybill	11/27/00	7.9	12.3	109	772	8	49	33	161	0.07	2.81
Furnace	11/27/00	8.0	9.2	76	620	5	17	24	154	0.10	3.79
Oil Creek	11/27/00	8.0	8.3	47	479	10	20	12	124	0.34	5.64
Menges	1/29/01	7.1	0.7	ND [<10 Pt-Co]	203	5	6	5	71	ND	3.68
USGS	1/29/01	7.8	2.5	12	393	7	15	9	111	ND	4.77
Martin	1/29/01	7.8	11.1	126	1115	10	28	73	221	0.03	4.30
Graybill	1/29/01	7.9	7.2	111	1027	4	34	58	207	ND	4.38
Furnace	1/29/01	8.0	3.6	37	596	3	16	18	153	0.02	5.06
Oil Creek	1/29/01	8.1	1.0	18	850	6	9	14	186	0.07	8.07
Menges	2/26/01	7.4	3.8	13	240	8	7	8	70	ND	4.57
USGS	2/26/01	7.6	6.6	10	513	9	18	10	120	0.13	5.38
Martin	2/26/01	7.8	10.6	109	990	11		57	197	0.05	4.71
Graybill	2/26/01	7.8	11.0	91	841	6		45	178	0.04	4.68
Furnace	2/26/01	7.9	7.3	46	568	5	20	20	144	0.05	4.65
Oil Creek	2/26/01	7.8	5.0	16	676	7		20	156	0.08	5.81
Menges	3/26/01	7.3	4.4	13	193	13	8	3	69	0.04	4.80
USGS	3/26/01	7.8	7.3	11	301	10	15	8	98	0.09	4.69
Martin	3/26/01	7.9	11.1	76	694	8	18	39	154	0.10	4.22
Graybill	3/26/01	7.8	9.7	51	584	5	20	31	141	ND	4.43
Furnace	3/26/01	7.9	7.4	36	387	6	17	7	115	0.03	4.37
Oil Creek	3/26/01	7.9	6.2	15	452	6	18	8	133	0.10	5.69

Note: ND = Non-detect; FQA = Failed quality assurance

(Continued on next page)

Table 3.1 Continued

Station	Date	pH	Temp (ºC)	Color (Pt-Co units)	Conductivity (µs/cm)	Turbidity (NTU)	TOC (mg/L)	COD (mg/L)	Hardness (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	In Vivo Chlorophyll (mg/L)
Menges	4/30/01	7.5	11.7	12	189	7	8	3	68	0.13	4.38	
USGS	4/30/01	7.8	15.1	16	344	12	15	10	108	0.08	4.95	
Martin	4/30/01	7.7	19.4	127	1306	7	25	77	248	ND	4.32	
Graybill	4/30/01	7.8	17.1	101	1042	9	17	50	227	0.03	4.64	
Furnace	4/30/01	8.0	16.5	28	500	7	18	17	143	0.03	4.74	
Oil Creek	4/30/01	7.9	11.8	15	579	16	15	10	151	0.03	7.70	
Menges	5/21/01	7.4	11.8	16	154	20	9	10	59	0.05	2.46	
USGS	5/21/01	7.5	16.6	22	252	42	14	10	86	0.11	3.26	
Martin	5/21/01	7.7	19.5	123	847	43	34	50	185	0.12	3.07	
Graybill	5/21/01	7.8	17.5	98	844	36	12	51	196	0.12	3.63	
Furnace	5/21/01	7.9	15.7	60	539	22	29	24	151	0.09	4.38	
Oil Creek	5/21/01	7.8	14.2	40	562	98	13	17	152	0.44	7.38	
Menges	6/20/01	7.5	13.6	ND [<10 Pt-Co]	171	13	6	9	56	0.05	1.63	1.23
USGS	6/20/01	7.8	18.8	10	281	19	15	10	88	0.11	3.21	1.27
Martin	6/20/01	7.9	20.9	29	690	13	19	15	100	0.10	3.53	1.49
Graybill	6/20/01	7.9	21.3	84	839	11	14	14	117	0.10	3.79	1.62
Furnace	6/20/01	8.1	24.1	73	1069	10	8	18	155	0.32	4.35	2.37
Oil Creek	6/20/01	8.1	20.9	17	762	33	4	20	181	0.76	11.79	3.93
Menges	7/30/01	7.6	12.2	10	163	6	6	11	66	ND	1.45	0.88
USGS	7/30/01	7.7	18.2	15	271	17	10	11	78	0.02	2.60	2.09
Martin	7/30/01	7.8	22.0	124	833	13	12	57	174	ND	2.65	7.50
Graybill	7/30/01	7.9	21.3	110	831	11	10	38	183	0.03	2.99	7.46
Furnace	7/30/01	8.0	20.6	61	686	9	9	30	180	0.05	3.97	4.21
Oil Creek	7/30/01	8.1	19.2	35	936	28		18	197	0.38	11.19	6.98
Menges	8/27/01	7.8	12.6	ND [<10 Pt-Co]	163	5	2	11	59	ND	1.35	0.92
USGS	8/27/01	7.7	21.5	10	243	17	7	15	75	ND	2.40	1.92
Martin	8/27/01	7.9	24.8	142	1040	12	40	75	210	0.04	2.00	7.95
Graybill	8/27/01	8.0	23.6	141	983	12	28	67	213	0.03	2.17	8.04
Furnace	8/27/01	8.2	23.3	84	713	11	15	47	186	0.23	3.55	3.86
Oil Creek	8/27/01	8.2	21.3	31	897	24	18	20	188	0.20	11.40	4.33

Note: ND = Non-detect

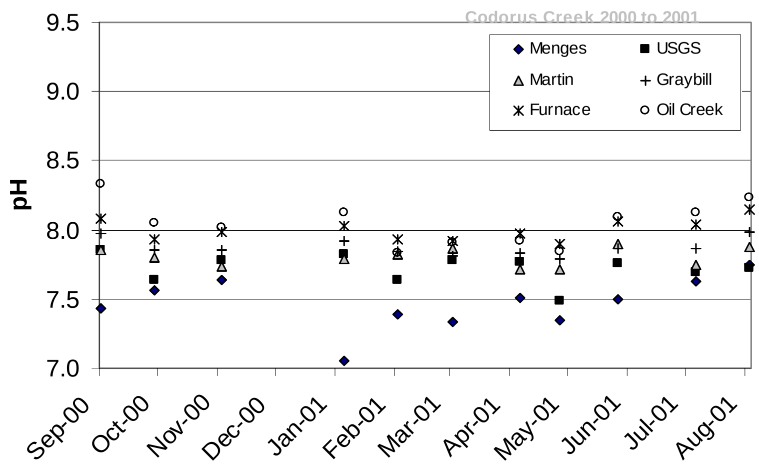


Figure 3.13 Codorus Creek pH

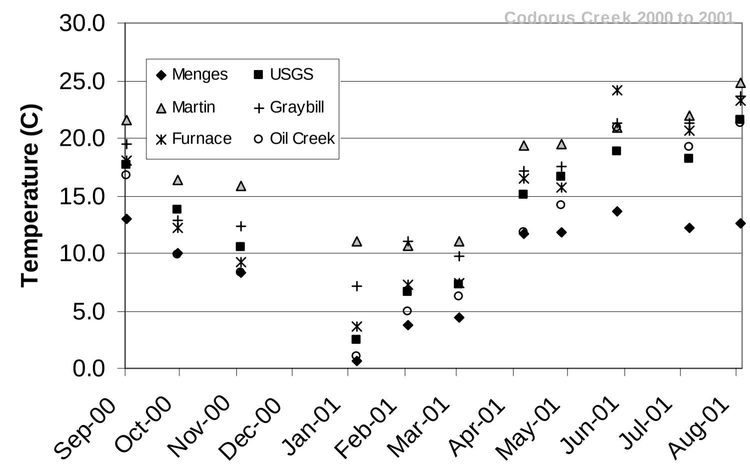


Figure 3.14 Codorus Creek Temperature

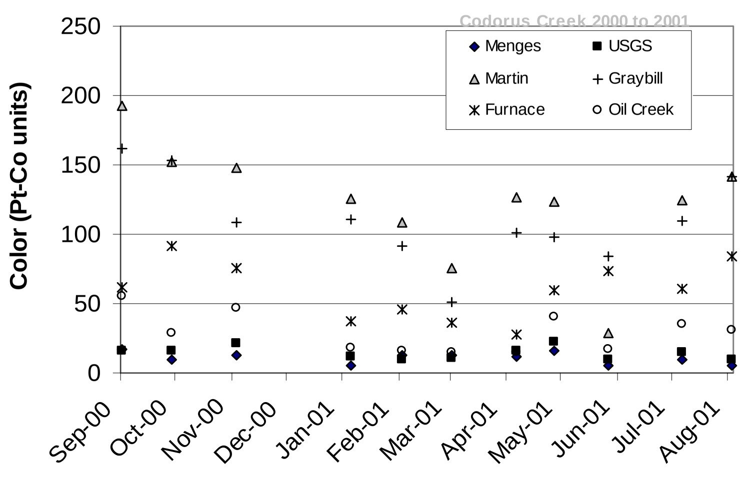


Figure 3.15 Codorus Creek Color

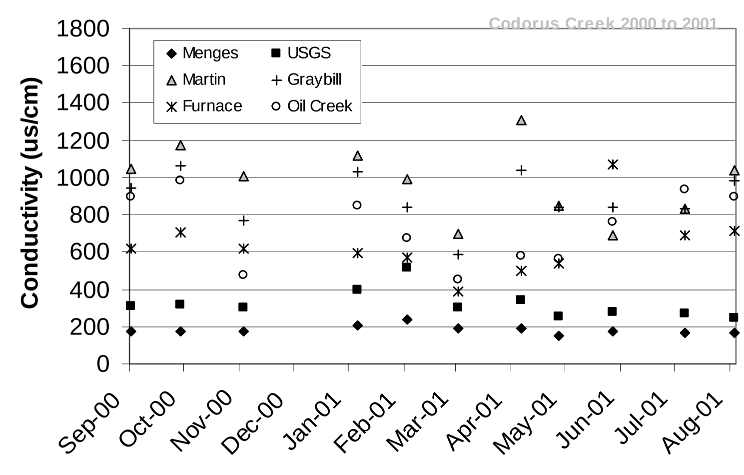


Figure 3.16 Codorus Creek Conductivity

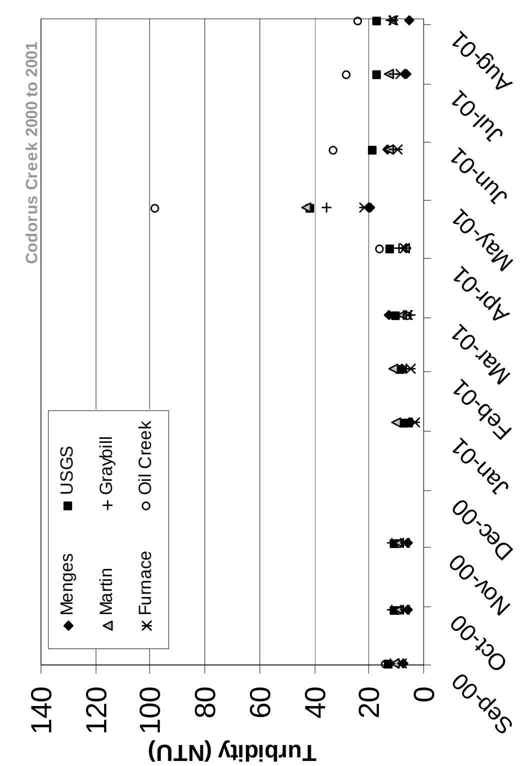


Figure 3.17 Codorus Creek Turbidity

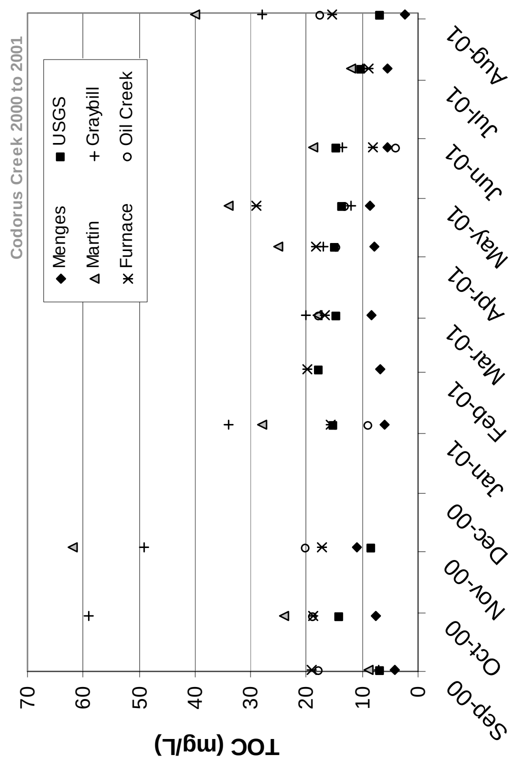


Figure 3.18 Codorus Creek TOC

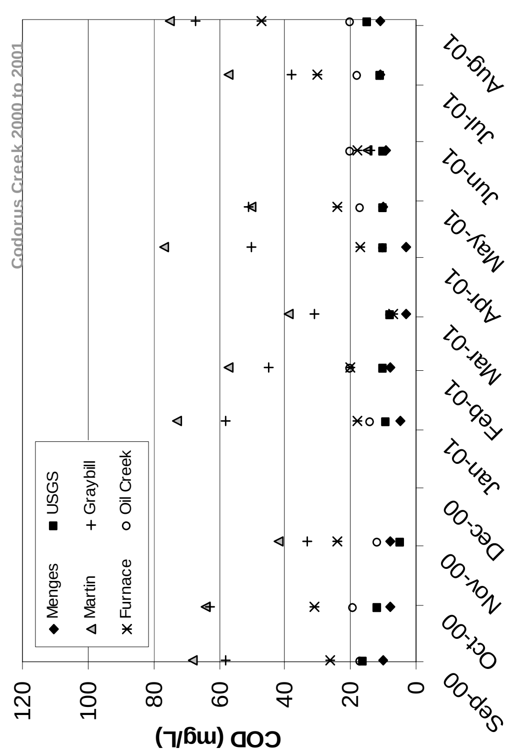


Figure 3.19 Codorus Creek COD

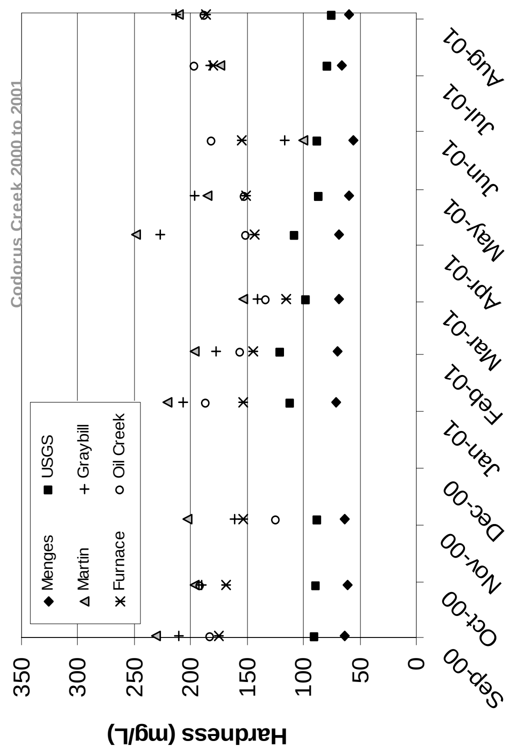


Figure 3.20 Codorus Creek Hardness

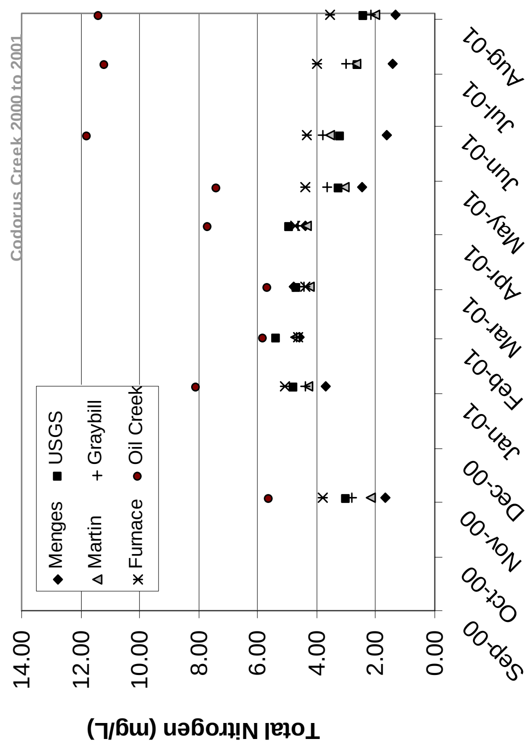


Figure 3.22 Codorus Creek Total Nitrogen

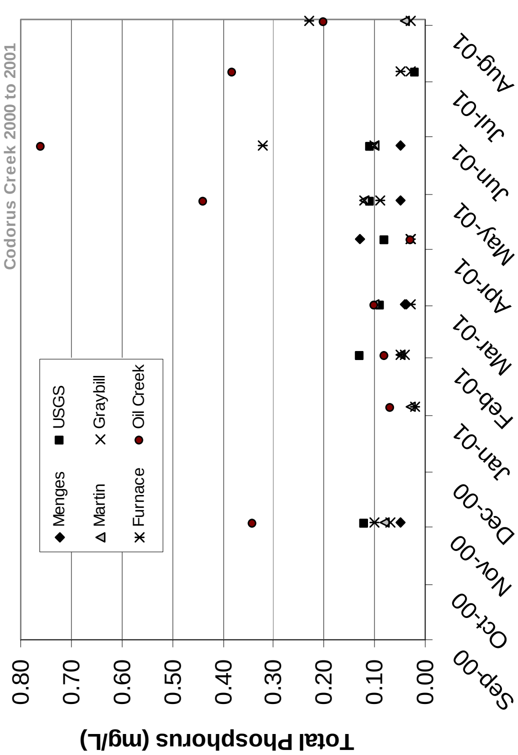


Figure 3.21 Codorus Creek Total Phosphorus

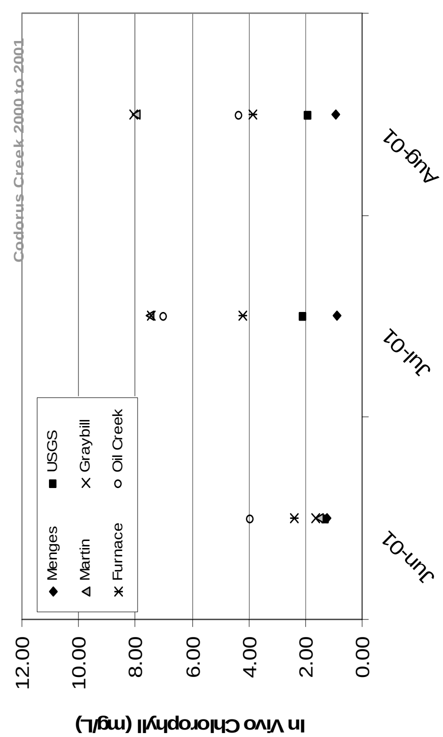


Figure 3.23 Codorus Creek In Vivo Chlorophyll

Table 3.2 Leaf River Water Chemistry

Station	Date	pH	Temp (ºC)	Color (Pt-Co units)	Conductivity (µs/cm)	Turbidity (NTU)	TOC (mg/L)	COD (mg/L)	Hardness (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)
Tallahala	9/25/00	6.9	28.2	30	198	4	9	20	14	FQA	FQA
Mahned	9/25/00	7.5	28.2	24	89	4	5	16	11	FQA	FQA
New Augusta	9/25/00	7.5	28.5	27	101	5	5	17	12	FQA	FQA
Wingate	9/25/00	7.7	29.0	81	229	5	15	31	18	FQA	FQA
Beaumont	9/25/00	7.6	29.2	65	242	6	14	35	18	FQA	FQA
McLain	9/25/00	7.8	29.1	60	234	6	15	31	19	FQA	FQA
Tallahala	10/23/00	7.3	29.3	20	130	2	7	13	12	FQA	FQA
Mahned	10/23/00	7.2	28.0	19	91	5	6	14	13	FQA	FQA
New Augusta	10/23/00	7.2	28.0	17	89	3	5	12	14	FQA	FQA
Wingate	10/23/00	7.6	28.0	51	316	4	13	31	20	FQA	FQA
Beaumont	10/23/00	7.3	27.5	52	304	4	13	27	21	FQA	FQA
McLain	10/23/00	7.3	29.0	49	303	6	12	27	22	FQA	FQA
Tallahala	11/27/00	7.3	12.1	67	119	12	12	25	22	0.46	1.19
Mahned	11/27/00	7.1	11.9	57	81	18	10	22	17	0.15	1.19
New Augusta	11/27/00	7.2	12.0	58	85	18	11	18	18	0.18	1.19
Wingate	11/27/00	7.2	12.2	64	135	17	12	21	21	0.22	1.26
Beaumont	11/27/00	7.2	12.0	67	140	18	12	24	21	0.27	1.33
McLain	11/27/00	7.3	12.1	65	142	18	14	33	21	0.31	1.48
Tallahala	1/29/01	7.1	11.9	59	103	17	10	22	25	0.15	0.99
Mahned	1/29/01	6.9	11.7	55	78	19	8	18	19	0.09	1.07
New Augusta	1/29/01	6.9	11.6	54	82	20	9	15	19	0.08	1.02
Wingate	1/29/01	7.0	12.0	64	124	21	9	24	22	0.02	0.96
Beaumont	1/29/01	7.0	11.8	64	120	20	12	26	22	0.04	1.02
McLain	1/29/01	7.0	11.0	65	121	23	12	19	21	0.04	0.97
Tallahala	2/26/01	7.0	17.0	75	94	17	14	27	23	0.09	1.07
Mahned	2/26/01	6.9	17.0	64	86	13	11	19	20	0.05	1.04
New Augusta	2/26/01	6.8	17.5	76	86	16	13	26	20	0.10	1.04
Wingate	2/26/01	7.0	17.5	95	135	20	18	33	20	0.09	1.05
Beaumont	2/26/01	6.9	17.0	102	121	28	19	34	19	0.04	1.06
McLain	2/26/01	6.7	17.0	106	111	31	17	31	17	ND	0.99
Tallahala	3/26/01	7.0	16.3	72	83	18	13	18	23	0.14	0.70
Mahned	3/26/01	7.0	16.6	54	82	16	10	16	19	0.07	0.79
New Augusta	3/26/01	6.9	17.4	53	83	14	10	15	20	0.10	0.75
Wingate	3/26/01	7.0	16.7	68	100	15	11	19	20	0.12	0.74
Beaumont	3/26/01	6.9	16.4	62	102	17	13	20	20	0.09	0.77
McLain	3/26/01	6.9	16.3	64	93	15	12	20	19	0.07	0.72

Note: ND = Non-detect; FQA = Failed quality assurance

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Table 3.2 Continued

Station	Date	pH	Temp (ºC)	Color (Pt-Co units)	Conductivity (µs/cm)	Turbidity (NTU)	TOC (mg/L)	COD (mg/L)	Hardness (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	In Vivo Chlorophyll (mg/L)
Tallahala	4/30/01	7.1	23.3	83	105	10	11	13	25	0.32	1.32	
Mahned	4/30/01	7.2	23.3	52	121	8	9	12	22	0.07	1.00	
New Augusta	4/30/01	7.1	22.7	59	107	9	9	21	23	0.10	1.02	
Wingate	4/30/01	7.1	23.2	51	164	8	11	40	25	0.17	1.00	
Beaumont	4/30/01	7.2	22.9	74	159	9	12	37	23	ND	0.94	
McLain	4/30/01	7.2	22.4	77	147	8	13	20	23	0.16	0.92	
Tallahala	5/21/01	7.4	28.7	51	103	6	9	15	25	0.16	0.57	
Mahned	5/21/01	7.3	28.0	29	102	11	7	15	18	0.11	0.73	
New Augusta	5/21/01	7.4	27.8	38	107	10	7	15	20	0.10	0.72	
Wingate	5/21/01	7.6	28.9	56	187	11	17	25	23	0.13	0.72	
Beaumont	5/21/01	7.5	27.9	56	177	14	13	23	23	0.10	0.70	
McLain	5/21/01	7.5	27.8	55	163	13	9	17	22	0.06	0.60	
Tallahala	6/18/01	6.9	28.3	113	92	16	15	34	24	0.20	0.90	4.95
Mahned	6/18/01	6.9	28.2	81	72	15	14	30	18	0.14	1.02	8.65
New Augusta	6/18/01	6.9	28.5	88	78	13	14	33	19	0.16	0.96	8.17
Wingate	6/18/01	7.1	28.2	103	117	14	16	40	21	0.14	0.95	7.93
Beaumont	6/18/01	7.0	27.9	103	112	13	18	38	21	0.13	0.95	9.95
McLain	6/18/01	6.9	27.9	101	101	15	17	42	19	0.12	0.94	8.59
Tallahala	7/30/01	7.4	31.6	58	111	8	11	23	20	0.18	0.96	4.63
Mahned	7/30/01	7.3	31.3	42	81	10	4	20	15	0.13	0.95	10.48
New Augusta	7/30/01	7.3	31.0	43	85	9	12	21	16	0.09	0.93	9.66
Wingate	7/30/01	7.3	31.0	58	149	7	11	25	18	0.07	0.96	12.53
Beaumont	7/30/01	7.2	30.3	59	135	10	9	20	15	0.05	0.84	6.03
McLain	7/30/01	7.1	30.3	47	121	8	1	18	13	0.11	0.76	4.99
Tallahala	8/27/01	7.0	26.9	85	86	13	9	28	21	0.15	1.04	3.55
Mahned	8/27/01	6.9	28.0	53	103	9	4	21	18	0.09	1.12	6.73
New Augusta	8/27/01	6.9	27.5	54	98	11	6	24	19	0.09	1.06	7.35
Wingate	8/27/01	7.2	28.0	98	153	10	12	33	20	0.09	1.09	9.60
Beaumont	8/27/01	6.9	28.2	92	147	10	11	24	17	0.09	1.03	5.26
McLain	8/27/01	6.6	28.1	105	176	9	7	29	17	0.07	1.02	4.10

Note: ND = Non-detect

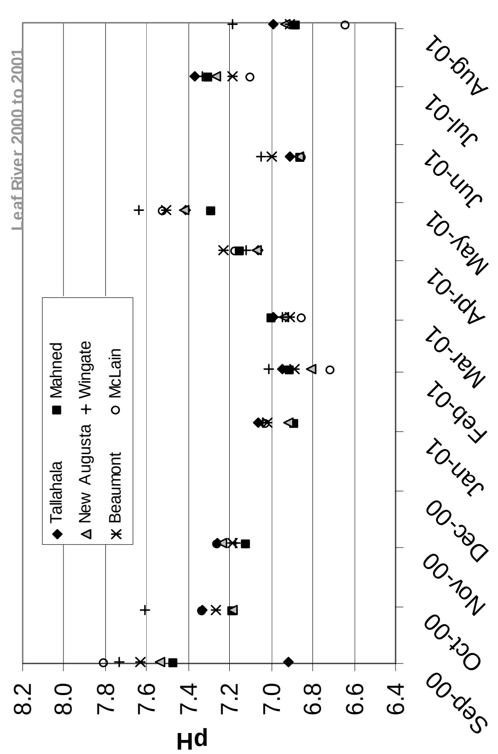

Figure 3.24 Leaf River pH

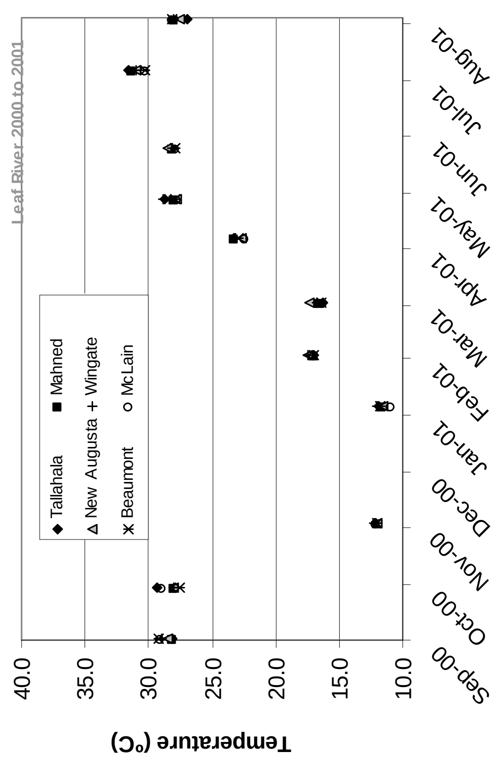

Figure 3.25 Leaf River Temperature

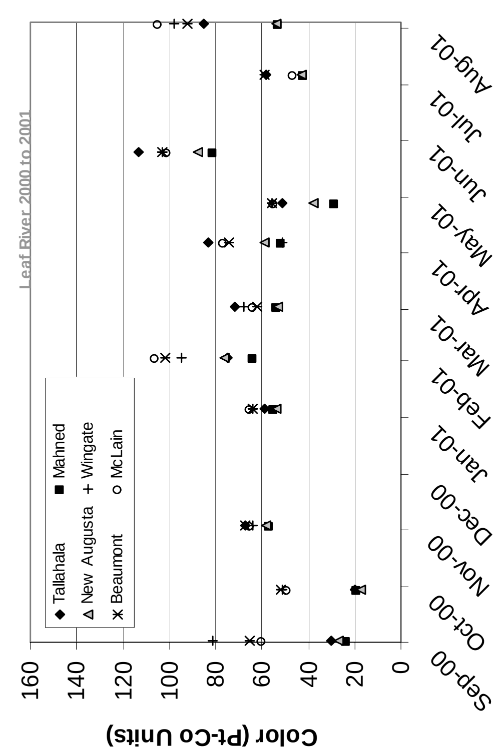

Figure 3.26 Leaf River Color

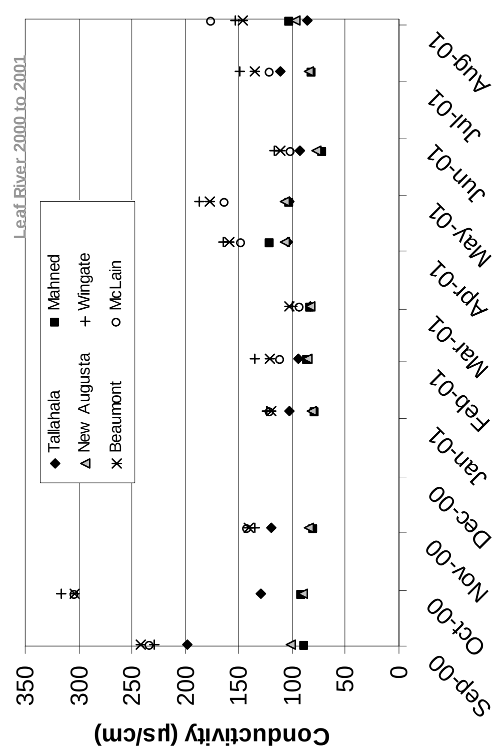

Figure 3.27 Leaf River Conductivity

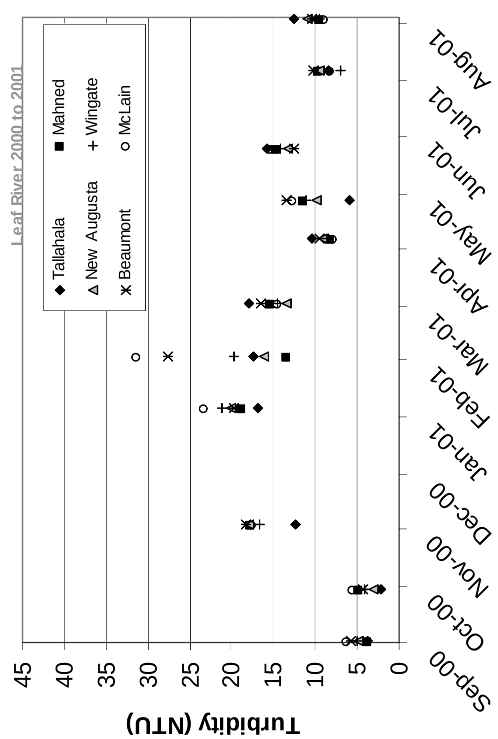

Figure 3.28 Leaf River Turbidity

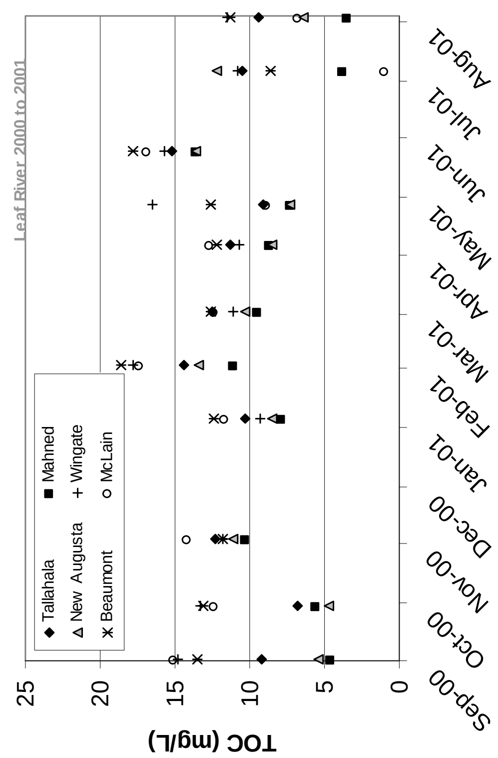

Figure 3.29 Leaf River TOC

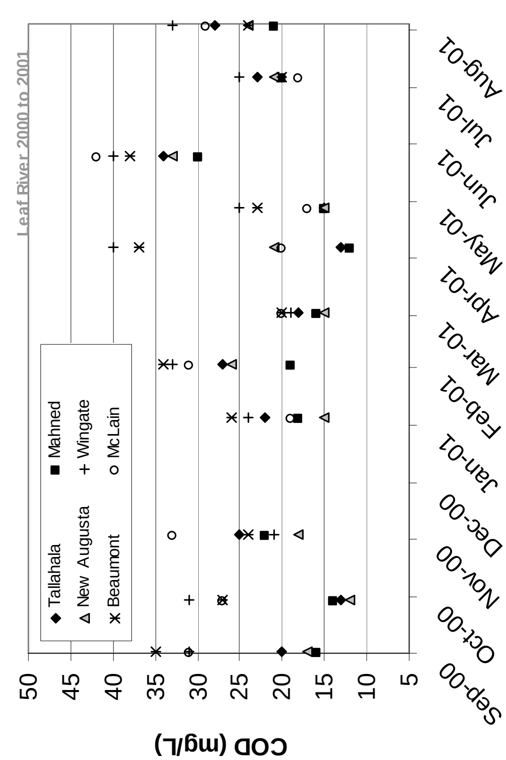

Figure 3.30 Leaf River COD

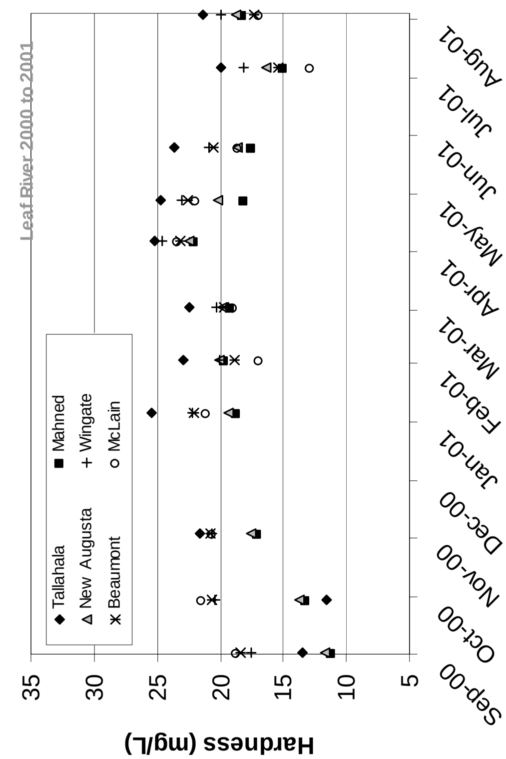

Figure 3.31 Leaf River Hardness

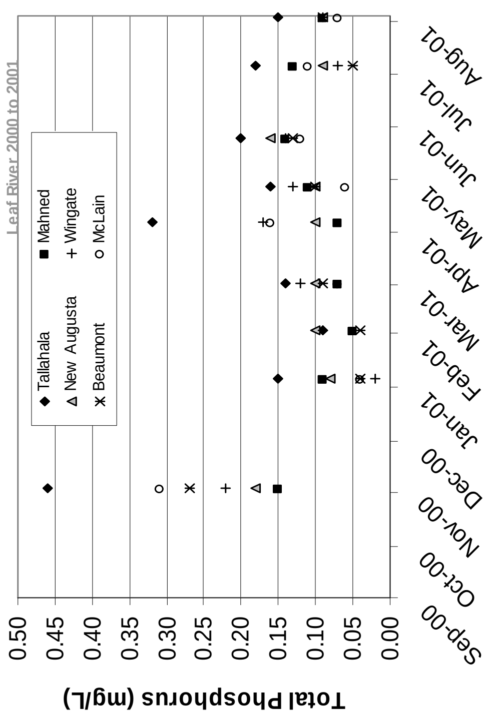

Figure 3.32 Leaf River Total Phosphorus

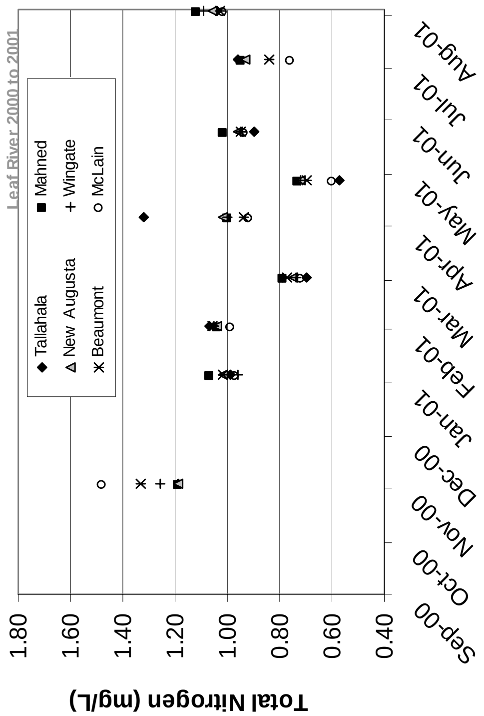

Figure 3.33 Leaf River Total Nitrogen

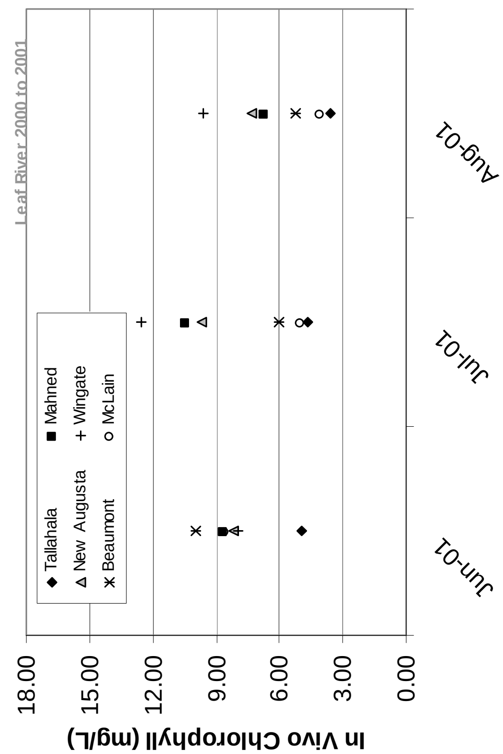

Figure 3.34 Leaf River In Vivo Chlorophyll

Table 3.3 McKenzie River Water Chemistry

Station	Date	pH	Temp (ºC)	Color (Pt-Co units)	Conductivity (µs/cm)	Turbidity (NTU)	Hardness (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)
Hendricks	9/25/00	7.5	11.0	ND [<10 Pt-Co]	54	1	16	FQA	FQA
Hayden Bridge	9/25/00	7.6	10.5	ND [<10 Pt-Co]	53	1	17	FQA	FQA
Harvest	9/25/00	7.7	10.0	10	65	2	18	FQA	FQA
Armitage (Coburg)	9/25/00	7.5	10.0	10	64	3	18	FQA	FQA
Mohawk River	9/25/00	7.6	14.0	21	70	4	25	FQA	FQA
Hendricks	10/23/00	7.3	10.0	ND [<10 Pt-Co]	57	2	17	FQA	FQA
Hayden Bridge	10/23/00	7.6	9.0	11	56	2	17	FQA	FQA
Harvest	10/23/00	7.3	9.0	16	66	2	18	FQA	FQA
Armitage (Coburg)	10/23/00	7.5	9.0	ND [<10 Pt-Co]	64	2	18	FQA	FQA
Mohawk River	10/23/00	7.3	9.0	31	61	5	22	FQA	FQA
Hendricks	11/27/00	7.3	8.0	ND [<10 Pt-Co]	58	1	17	0.07	0.06
Hayden Bridge	11/27/00	7.5	7.5	ND [<10 Pt-Co]	59	1	18	0.07	0.04
Harvest	11/27/00	7.5	8.0	11	75	2	18	0.07	0.08
Armitage (Coburg)	11/27/00	7.5	8.0	10	68	2	19	0.06	0.08
Mohawk River	11/27/00	7.4	7.0	46	65	5	23	0.04	0.18
Hendricks	1/29/01	7.3	6.0	ND [<10 Pt-Co]	58	1	17	ND	0.10
Hayden Bridge	1/29/01	7.4	5.0	ND [<10 Pt-Co]	56	1	18	ND	0.08
Harvest	1/29/01	7.4	5.0	ND [<10 Pt-Co]	61	2	17	ND	0.13
Armitage (Coburg)	1/29/01	7.4	5.0	11	64	2	18	0.02	0.14
Mohawk River	1/29/01	7.2	5.5	26	52	5	17	ND	0.23
Hendricks	2/26/01	7.3	7.0	ND [<10 Pt-Co]	58	1	18	0.06	0.10
Hayden Bridge	2/26/01	7.2	6.0	ND [<10 Pt-Co]	62	1	18	0.10	0.08
Harvest	2/26/01	7.3	5.5	ND [<10 Pt-Co]	72	2	19	0.04	0.17
Armitage (Coburg)	2/26/01	7.2	6.0	ND [<10 Pt-Co]	70	2	19	0.06	0.14
Mohawk River	2/26/01	7.1	6.0	14	53	4	18	0.04	0.17
Hendricks	3/26/01	7.4	8.5	15	50	2	16	0.04	0.08
Hayden Bridge	3/26/01	7.4	8.5	16	50	2	16	0.06	0.09
Harvest	3/26/01	7.4	9.0	10	63	3	17	0.05	0.12
Armitage (Coburg)	3/26/01	7.5	9.0	13	61	2	17	0.05	0.12
Mohawk River	3/26/01	7.4	9.0	21	46	6	17	0.03	0.23

Note: ND = Non-detect; FQA = Failed quality assurance

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Table 3.3 Continued

Station	Date	pH	Temp (ºC)	Color (Pt-Co units)	Conductivity (µs/cm)	Turbidity (NTU)	Hardness (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	In Vivo Chlorophyll (mg/L)
Hendricks	4/30/01	7.3	9.0	ND [<10 Pt-Co]	48	1	15	0.09	0.11	
Hayden Bridge	4/30/01	7.3	9.0	ND [<10 Pt-Co]	51	2	15	0.09	0.06	
Harvest	4/30/01	7.4	10.0	ND [<10 Pt-Co]	59	2	16	0.08	0.10	
Armitage (Coburg)	4/30/01	7.3	9.0	ND [<10 Pt-Co]	57	2	16	0.06	0.11	
Mohawk River	4/30/01	7.2	11.0	18	49	5	17	0.07	0.14	
Hendricks	5/21/01	7.3	12.5	24	48	3	15	0.07	0.14	
Hayden Bridge	5/21/01	7.3	13.0	16	46	2	16	0.09	0.09	
Harvest	5/21/01	7.3	13.0	21	52	2	16	0.13	0.13	
Armitage (Coburg)	5/21/01	7.3	12.5	26	50	3	15	0.05	0.10	
Mohawk River	5/21/01	7.3	14.0	33	47	5	17	0.08	0.16	
Hendricks	6/18/01	7.2	13.5	ND [<10 Pt-Co]	57	1	17	0.07	0.11	1.02
Hayden Bridge	6/18/01	7.3	14.0	ND [<10 Pt-Co]	56	1	18	0.05	0.06	0.29
Harvest	6/18/01	7.5	13.5	9	72	1	20	ND	0.09	0.27
Armitage (Coburg)	6/18/01	7.4	13.5	10	79	2	19	0.04	0.12	1.00
Mohawk River	6/18/01	7.2	15.3	16	56	3	19	ND	0.14	0.44
Hendricks	7/30/01	7.3	14.0	7	55	1	18	0.08	0.03	0.67
Hayden Bridge	7/30/01	7.4	17.5	13	56	1	18	0.10	0.02	0.37
Harvest	7/30/01	7.5	14.5	8	71	2	20	0.10	0.06	1.26
Armitage (Coburg)	7/30/01	7.5	15.0	9	71	1	20	0.05	0.05	2.02
Mohawk River	7/30/01	7.4	14.0	17	61	4	22	0.11	0.08	0.89
Hendricks	8/27/01	7.4	17.0	ND [<10 Pt-Co]	54	1	17	ND	0.22	0.66
Hayden Bridge	8/27/01	7.3	16.0	ND [<10 Pt-Co]	55	2	18	ND	0.07	1.50
Harvest	8/27/01	7.3	15.5	ND [<10 Pt-Co]	67	2	19	ND	0.19	1.46
Armitage (Coburg)	8/27/01	7.4	16.0	ND [<10 Pt-Co]	66	1	19	ND	0.20	0.98
Mohawk River	8/27/01	7.3	20.0	10	64	5	23	ND	0.20	1.31

Note: ND = Non-detect

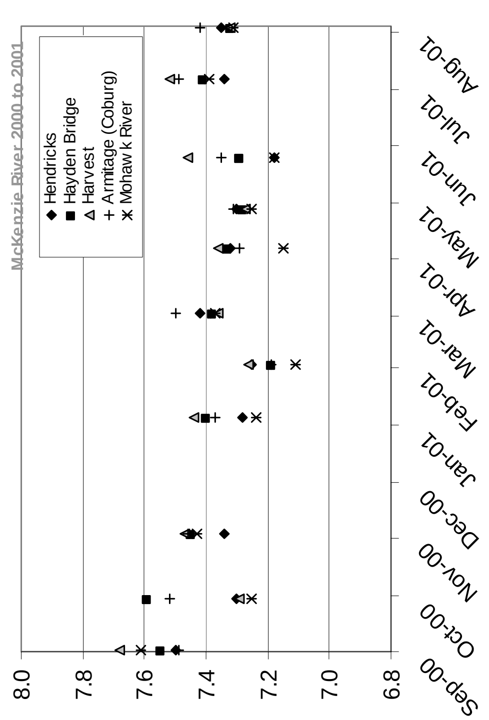

Figure 3.35 McKenzie River pH

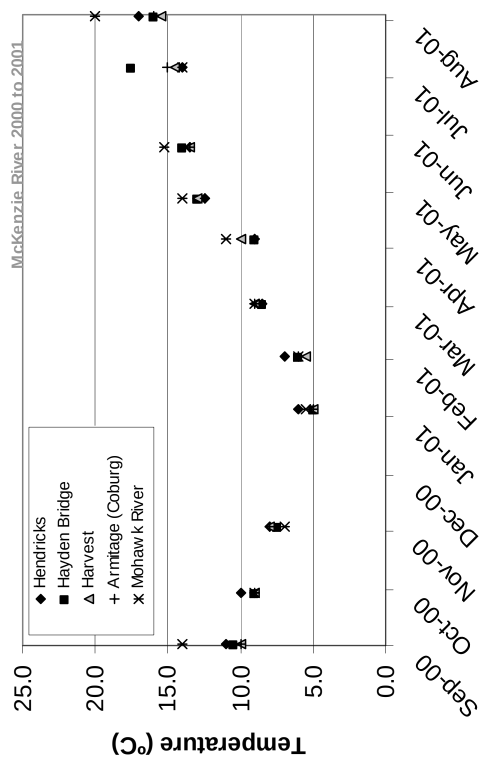

Figure 3.36 McKenzie River Temperature

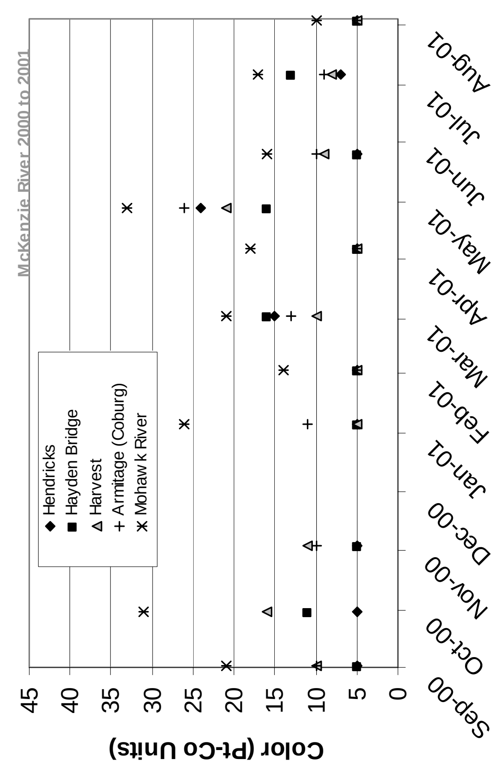

Figure 3.37 McKenzie River Color

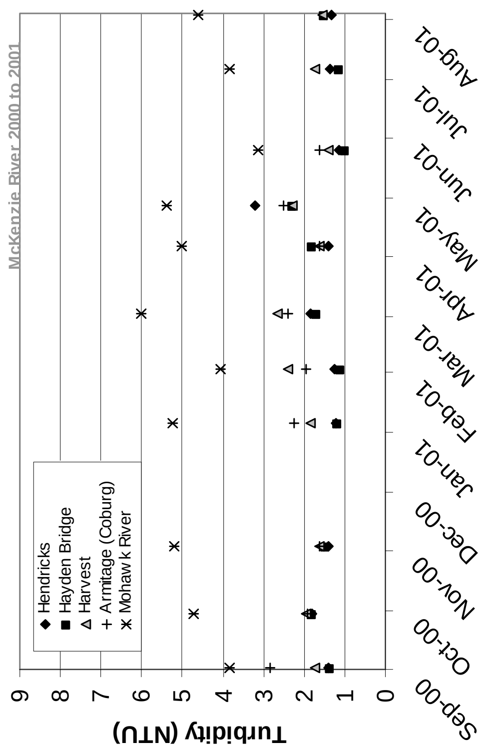

Figure 3.39 McKenzie River Turbidity

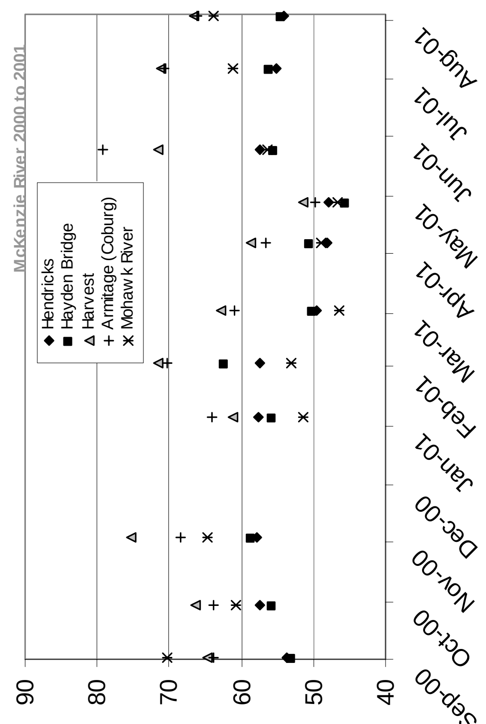

Figure 3.38 McKenzie River Conductivity

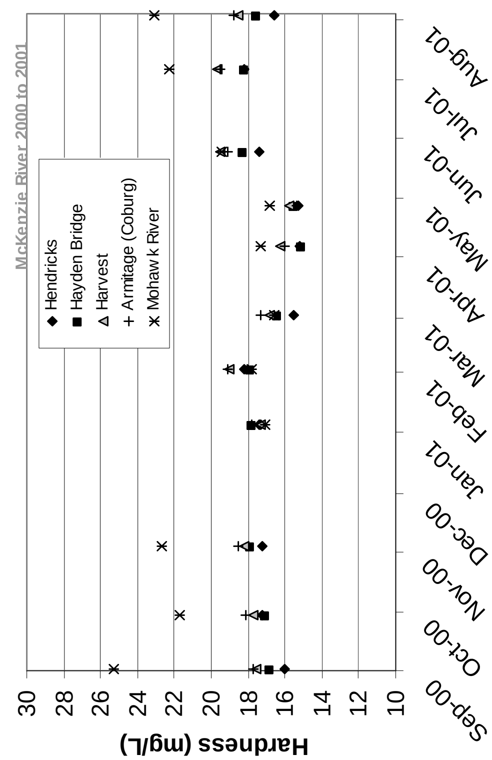

Figure 3.40 McKenzie River Hardness

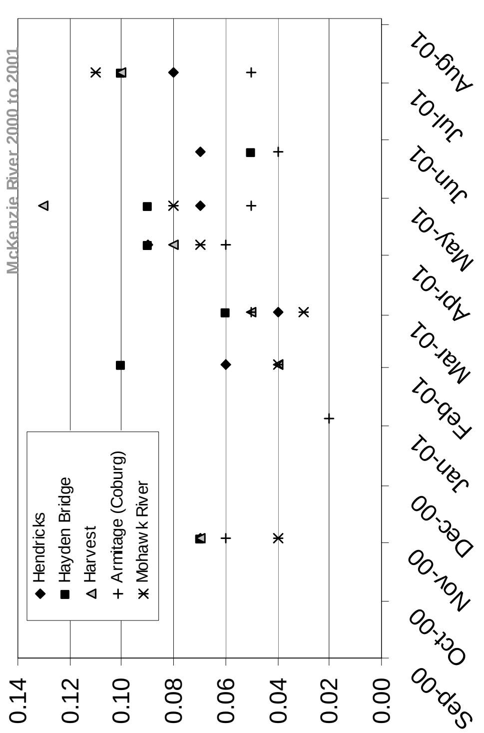

Figure 3.41 McKenzie River Total Phosphorus

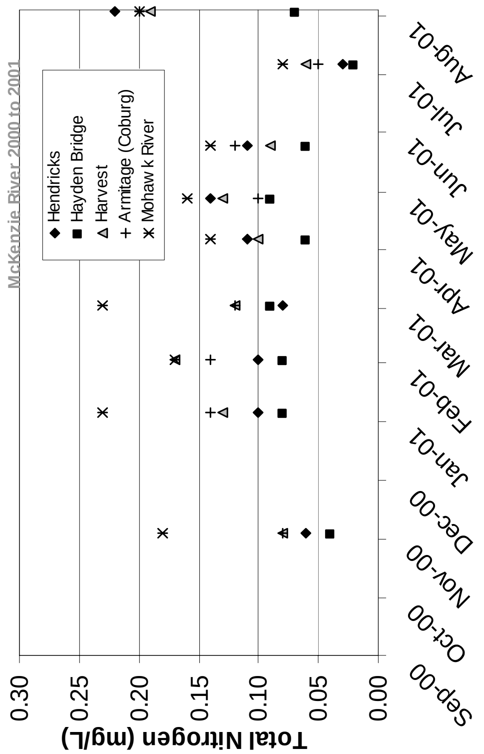

Figure 3.42 McKenzie River Total Nitrogen

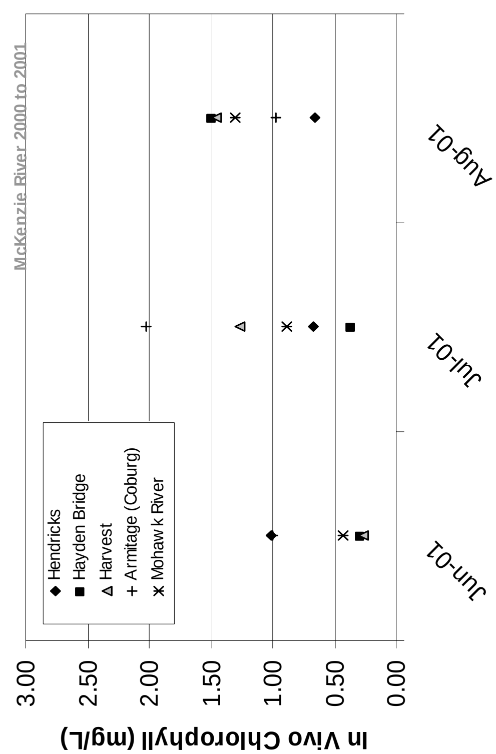

Figure 3.43 McKenzie River In Vivo Chlorophyll

Table 3.4 Willamette River Water Chemistry

Station	Date	pH	Temp (ºC)	Color (Pt-Co units)	Conductivity (µs/cm)	Turbidity (NTU)	Hardness (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)
Harrisburg	9/25/00	7.6	13.0	ND [<10 Pt-Co]	65	3	18	FQA	FQA
Cartney	9/25/00	7.5	13.0	ND [<10 Pt-Co]	61	3	18	FQA	FQA
Peoria	9/25/00	7.1	13.0	ND [<10 Pt-Co]	126	2	41	FQA	FQA
Corvallis	9/25/00	7.6	13.0	12	69	3	19	FQA	FQA
Long Tom River	9/25/00	7.5	13.0	14	60	3	18	FQA	FQA
Harrisburg	10/23/00	7.6	11.0	11	69	2	22	FQA	FQA
Cartney	10/23/00	7.3	11.5	10	65	3	19	FQA	FQA
Peoria	10/23/00	7.1	11.0	ND [<10 Pt-Co]	121	3	38	FQA	FQA
Corvallis	10/23/00	7.3	11.0	17	74	5	20	FQA	FQA
Long Tom River	10/23/00	7.1	12.0	46	77	19	23	FQA	FQA
Harrisburg	11/27/00	7.5	9.0	11	87	3	19	0.05	0.18
Cartney	11/27/00	7.4	9.0	10	84	2	19	0.07	0.17
Peoria	11/27/00	7.2	9.0	ND [<10 Pt-Co]	117	3	35	0.08	0.13
Corvallis	11/27/00	7.5	8.5	ND [<10 Pt-Co]	75	3	20	0.07	0.22
Long Tom River	11/27/00	7.4	6.0	50	106	16	28	0.16	0.44
Harrisburg	1/29/01	7.4	5.5	ND [<10 Pt-Co]	76	3	21	0.03	0.34
Cartney	1/29/01	7.4	6.0	13	71	3	20	0.02	0.38
Peoria	1/29/01	7.1	6.0	ND [<10 Pt-Co]	117	2	38	ND	0.32
Corvallis	1/29/01	7.4	5.5	16	83	4	22	0.04	0.44
Long Tom River	1/29/01	7.4	5.0	46	140	18	46	0.03	1.84
Harrisburg	2/26/01	7.3	6.5	10	73	3	21		
Cartney	2/26/01	7.2	6.5	ND [<10 Pt-Co]	73	3	21		
Peoria	2/26/01	7.0	7.0	ND [<10 Pt-Co]	110	2	35		
Corvallis	2/26/01	7.2	6.5	11	85	5	24		
Long Tom River	2/26/01	7.3	7.0	48	135	14	46		
Harrisburg	3/26/01	7.3	9.0	19	66	3	20	0.04	0.24
Cartney	3/26/01	7.3	9.0	16	66	4	20	0.05	0.28
Peoria	3/26/01	7.2	9.0	15	111	2	37	0.04	0.24
Corvallis	3/26/01	7.4	9.5	15	78	5	22	0.05	0.33
Long Tom River	3/26/01	7.4	10.0	50	130	16	44	0.03	0.74

Note: ND = Non-detect; FQA = Failed quality assurance

(Continued on next page)

Table 3.4 Continued

Station	Date	pH	Temp (ºC)	Color (Pt-Co units)	Conductivity (µs/cm)	Turbidity (NTU)	Hardness (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	In Vivo Chlorophyll (mg/L)
Harrisburg	4/30/01	7.3	10.0	16	60	4	18	0.07	0.22	
Cartney	4/30/01	7.3	11.0	13	60	2	18	0.17	0.19	
Peoria	4/30/01	7.1	12.0	13	108	2	34	0.07	0.17	
Corvallis	4/30/01	7.4	12.0	11	75	2	21	0.09	0.26	
Long Tom River	4/30/01	7.4	11.0	16	65	2	20	0.09	0.26	
Harrisburg	5/21/01	7.3	12.0	17	64	3	18	0.06	0.21	
Cartney	5/21/01	7.2	13.0	17	54	3	18	0.05	0.20	
Peoria	5/21/01	7.1	13.5	21	74	4	24	0.05	0.20	
Corvallis	5/21/01	7.4	14.0	22	59	4	18	0.04	0.20	
Long Tom River	5/21/01	7.3	13.0	22	54	4	18	0.04	0.22	
Harrisburg	6/18/01	7.3	14.5	ND [<10 Pt-Co]	66	2	20	0.06	0.29	0.99
Cartney	6/18/01	7.3	15.0	ND [<10 Pt-Co]	67	2	20	0.04	0.32	1.44
Peoria	6/18/01	7.0	12.5	14	115	8	39	0.49	2.32	6.93
Corvallis	6/18/01	7.2	15.5	17	92	2	25	0.09	0.22	1.04
Long Tom River	6/18/01	7.3	14.5	19	73	2	21	0.12	0.29	0.88
Harrisburg	7/30/01	7.5	16.5	14	71	2	20	0.09	0.31	1.75
Cartney	7/30/01	7.4	16.0	ND [<10 Pt-Co]	69	2	21	0.06	0.31	1.86
Peoria	7/30/01	7.1	16.0	ND [<10 Pt-Co]	102	2	33	0.07	0.11	1.29
Corvallis	7/30/01	7.4	17.0	34	76	3	22	0.06	0.25	1.79
Long Tom River	7/30/01	7.2	19.0	49	126	15	39	0.04	0.60	3.13
Harrisburg	8/27/01	7.3	17.0	ND [<10 Pt-Co]	68	2	22	ND	0.22	2.65
Cartney	8/27/01	7.3	17.5	ND [<10 Pt-Co]	65	3	20	ND	0.27	2.83
Peoria	8/27/01	6.9	17.0	ND [<10 Pt-Co]	94	2	31	0.03	0.07	1.15
Corvallis	8/27/01	7.3	17.0	ND [<10 Pt-Co]	71	2	21	ND	0.15	4.94
Long Tom River	8/27/01	7.2	17.0	ND [<10 Pt-Co]	66	2	20	ND	0.18	2.16

Note: ND = Non-detect

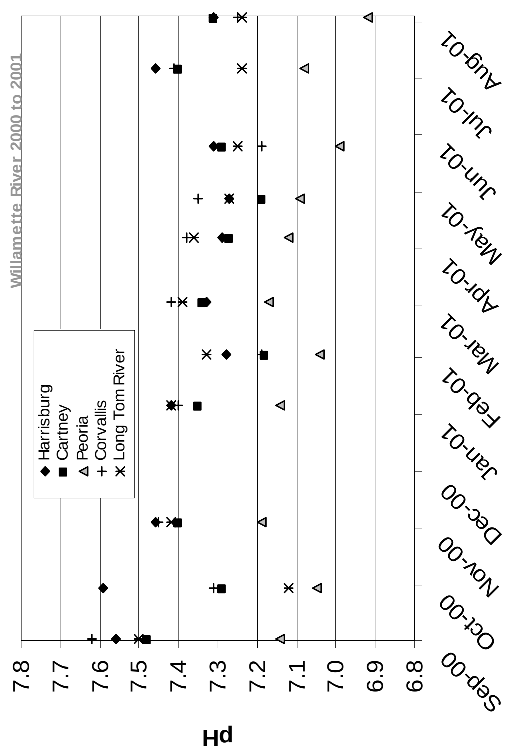

Figure 3.44 Willamette River pH

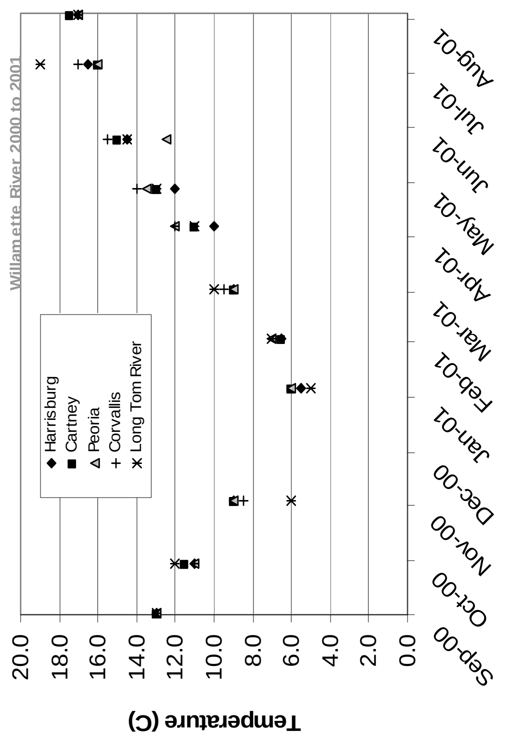

Figure 3.45 Willamette River Temperature

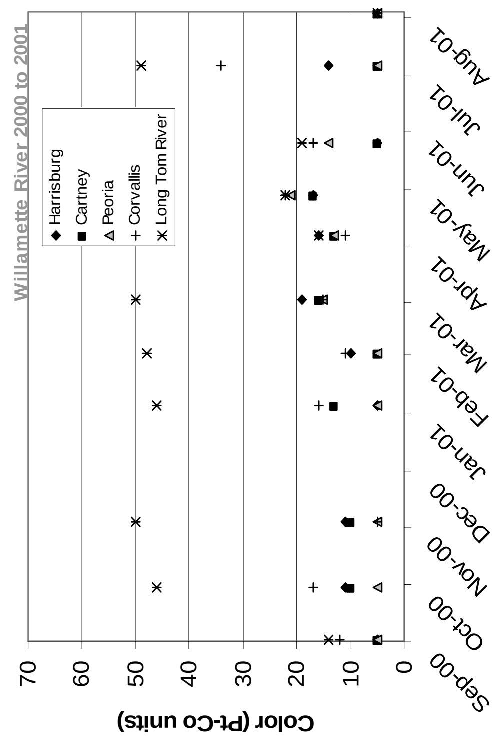

Figure 3.46 Willamette River Color

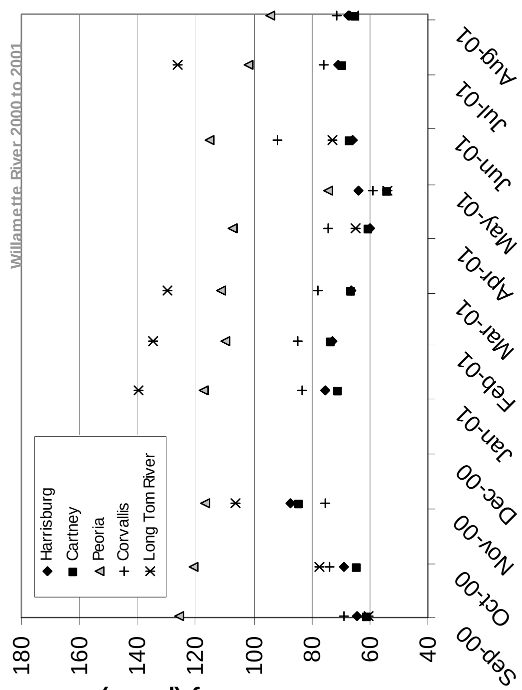

Figure 3.47 Willamette River Conductivity

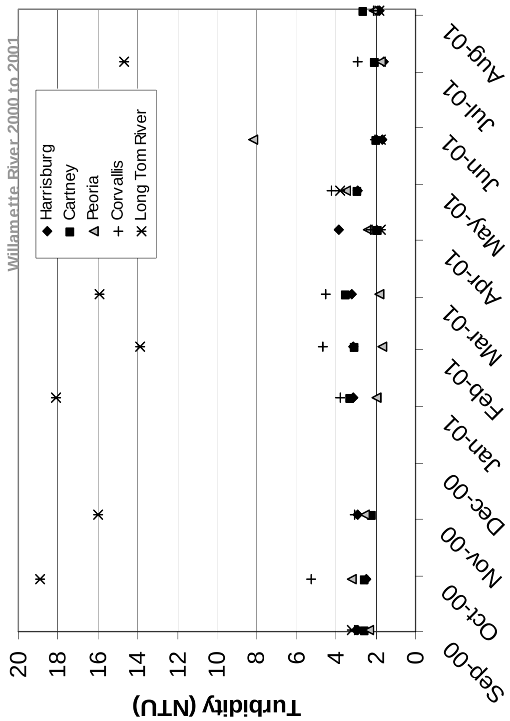

Figure 3.48 Willamette River Turbidity

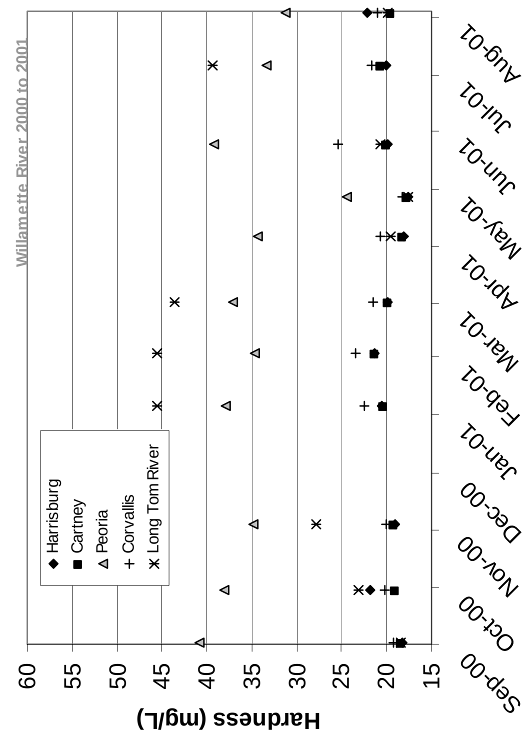

Figure 3.49 Willamette River Hardness

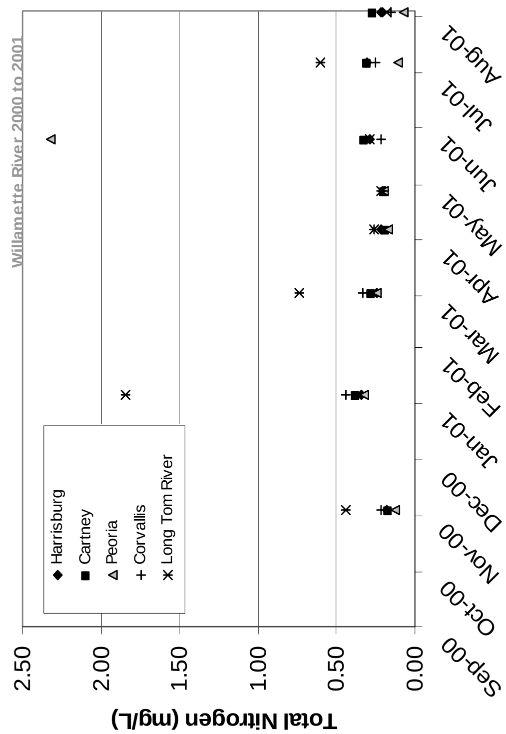

Figure 3.51 Willamette River Total Nitrogen

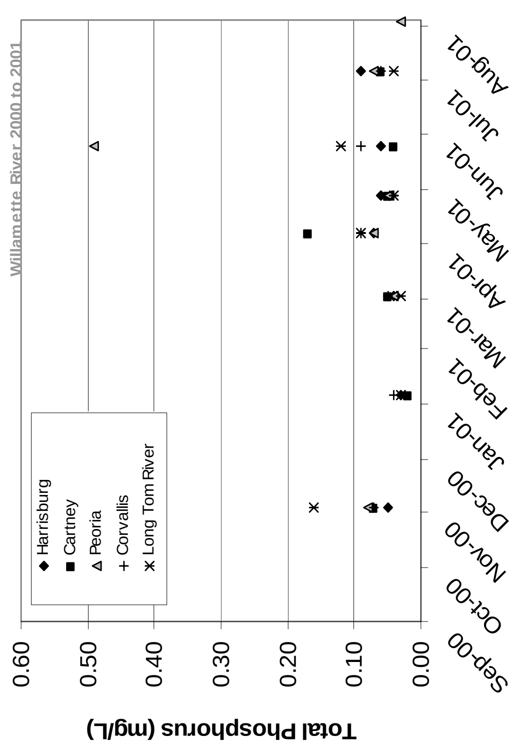

Figure 3.50 Willamette River Total Phosphorus

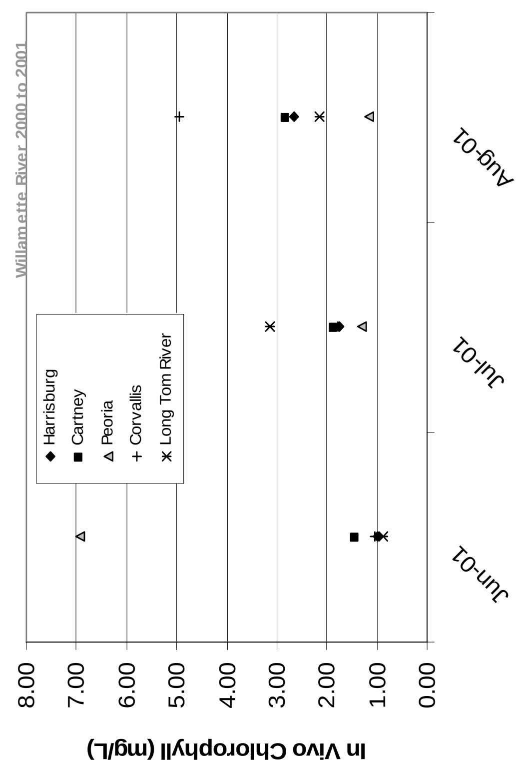

Figure 3.52 Willamette River In Vivo Chlorophyll

3.5. Effluent Chemistry

Samples of effluent were taken by local mill personnel and shipped overnight on ice to the NCASI West Coast Regional Center for chemical characterization, and to NABF for general water quality analysis including but not limited to color, tannin/lignin, conductivity, turbidity, TSS, BOD, COD and TOC. The New Augusta mill collected composite samples in November and February, and grab samples from April to August 2001; the remaining mills collected grab samples. The value reported for phytosterols is the sum for four analytes: campesterol, stigmasterol, β-sitosterol and stigmatanol. The value reported for resin acids is the sum for ten analytes: pimaric acid, sandrocopimaric acid, isopimaric acid, palustric acid, dehyroacietic acid, abietic acid, neoabieteic acid, 14-chlorodehydroabietic acid, 12-chlorodehydroabeitic acid, and dichlorodehydroabietic acid. The phytosterol non-detect column and the resin acids non-detect column report how many out of the total components measured were non-detects. Tables 3.5-3.8 present the results of the analyses.

Table 3.5 Mill Effluent Analysis for the Codorus Creek Facility, Located in Spring Grove, Pennsylvania

Date	Color (PCU)	Tannin/ Lignin (mg/L)	Conduc-tivity (µs/cm)	Turbidity (NTU)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	TOC (mg/L)	Total P (mg/L)	Phyto-sterols (µg/L)	Phyto-sterols non-detects	Resin Acids (µg/L)	Resin Acids non-detects
9/25/00	463	8.6	1965	3	7.0	5.0	166	50	ND	1.2	3/4	ND	10/10
3/5/01	296	7.8	2265	5	9.0	6.0	166	79	ND	ND	4/4	2.36	8/10

Note: ND = non-detect

Table 3.6 Mill Effluent Analysis for the Leaf River Facility, Located in New Augusta, Mississippi

New Augusta, MS

Date	Sample Type	Color (PCU)	Tannin/ Lignin (mg/L)	Conduc-tivity (µs/cm)	Turbidity (NTU)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	TOC (mg/L)	Total P (mg/L)	Phyto-sterols (µg/L)	Phyto-sterols non-detects	Resin Acids (µg/L)	Resin Acids non-detects
11/13/00	composite	607	20.2	2490	2	5.0		420	128	0.03b	5.7	2/4	30.3	4/10
2/5/01	composite	869	20.8	2500	5	9.0	4.8	496	180	0.04b	15.4	1/4	76.3	3/10
4/23/01	grab	758	21.3			11.5		473	178	ND				
4/30/01	grab	847	23.6			20.3		486	177	0.42				
5/7/01	grab	673	19.1	3080	9	15.3	3.9	387	149	0.55	3.0	3/4	34.8	4/10
5/14/01	grab	702	16.8			19.3		349	128	0.76				
5/21/01	grab	537	16.8			14.3		333	147	0.66				
6/25/01	grab	1017	32.5	2905	17	33.5	8.1	500	207		23.6	1/4	92.5	3/10
8/20/01	grab	659	18.5	2470	7	11.0		334	123	0.20	2.2	3/4	11.2	7/10

Note: ND = non-detect

Table 3.7 Mill Effluent Analysis for the McKenzie River Facility, Located in Springfield, Oregon

Date	Color (PCU)	Tannin/ Lignin (mg/L)	Conduc-tivity (µs/cm)	Turbidity (NTU)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	TOC (mg/L)	Total P (mg/L)	Phyto-sterols (µg/L)	Phyto-sterols non-detects	Resin Acids (µg/L)	Resin Acids non-detects
10/23/00	173	16.8	1244	16	22.8		100	55	0.41	23.0	0/4	1.4	9/10
12/11/00	129	15.7	1330	24	31.5	18.2	116	67	0.72	67.9	0/4	12.3	6/10
6/11/01	175	20.8	1436	21	38.5		123	57	0.55	67.9	0/4	20.5	4/10
8/28/01	130	16.3	1756	16	28.0	17.2	129	65	0.46	16.6	0/4	12.2	6/10

Table 3.8 Mill Effluent Analysis for the Willamette River Facility, Located near Halsey, Oregon

Date	Color (PCU)	Tannin/ Lignin (mg/L)	Conduc-tivity (µs/cm)	Turbidity (NTU)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	TOC (mg/L)	Total P (mg/L)	Phyto-sterols (µg/L)	Phyto-sterols non-detects	Resin Acids (µg/L)	Resin Acids non-detects
11/13/00	448	20.2	2028	12	19.8		272	111	1.31	384.3	0/4	10.8	6/10
1/29/01	512	24.7	1907	18	20.0	18.3	340	131	0.60	471.6	0/4	4.2	9/10
3/19/01	555	27.5	2060	12	16.5		338	156	0.88	494.9	0/4	14.4	5/10

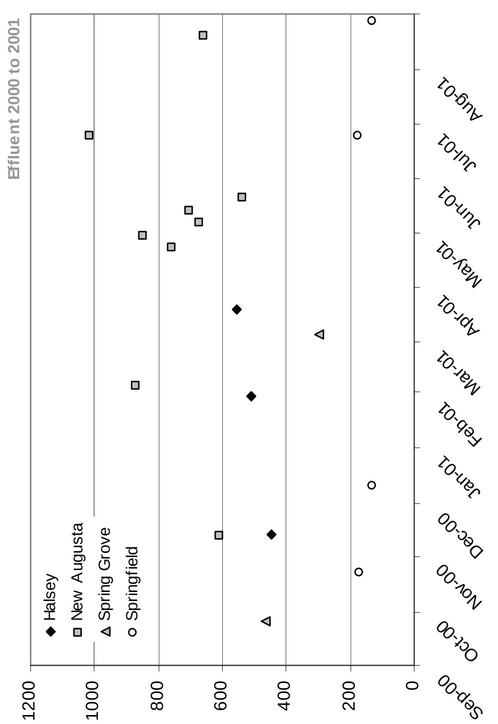

Figure 3.53 Mill Effluent Color

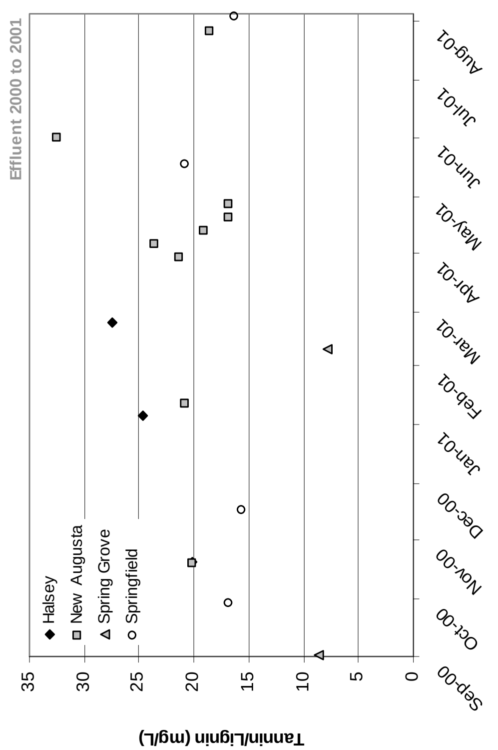

Figure 3.54 Mill Effluent Tannin/Lignin

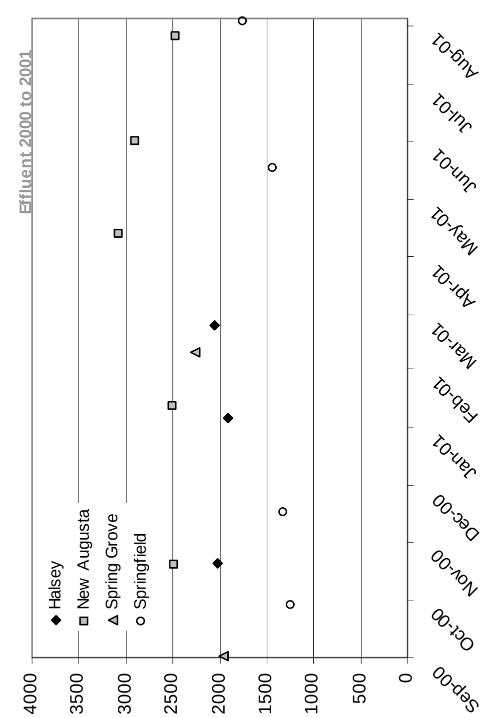

Figure 3.55 Mill Effluent Conductivity

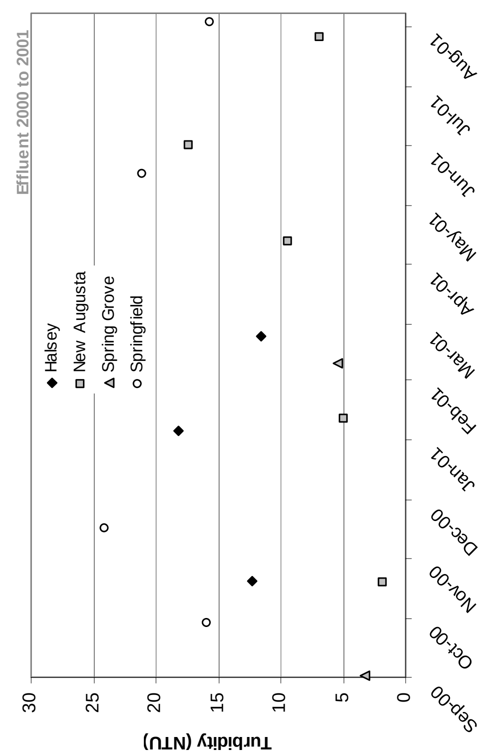

Figure 3.56 Mill Effluent Turbidity

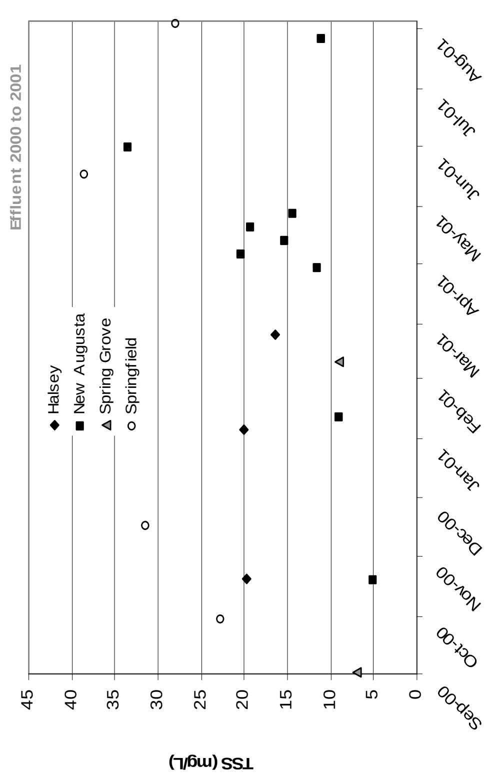

Figure 3.57 Mill Effluent TSS

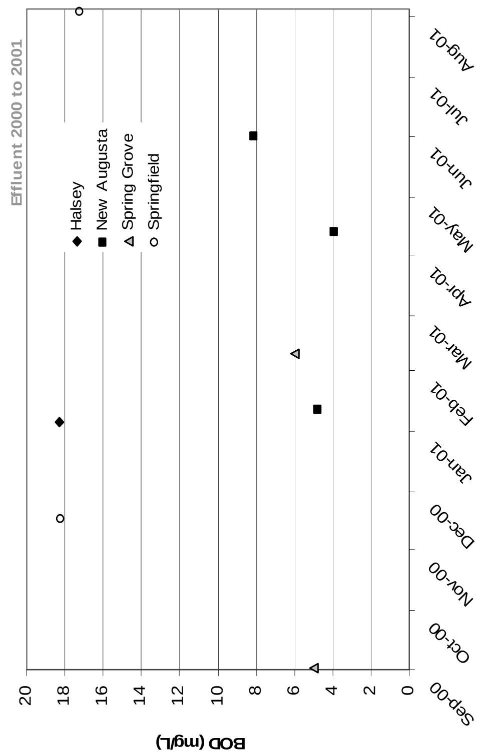

Figure 3.58 Mill Effluent BOD

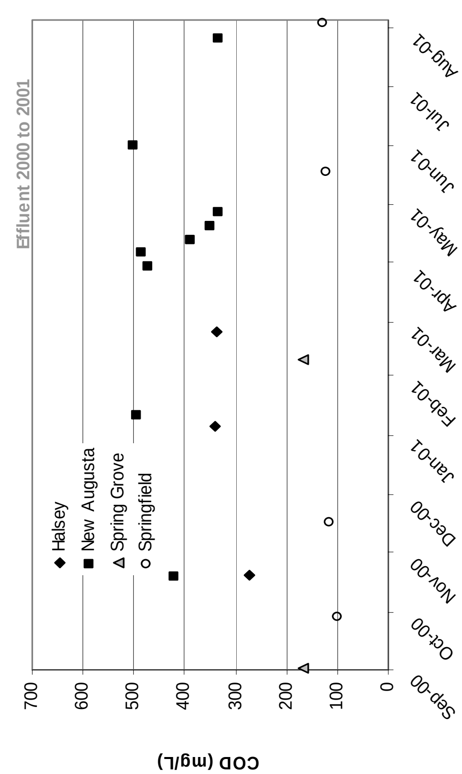

Figure 3.59 Mill Effluent COD

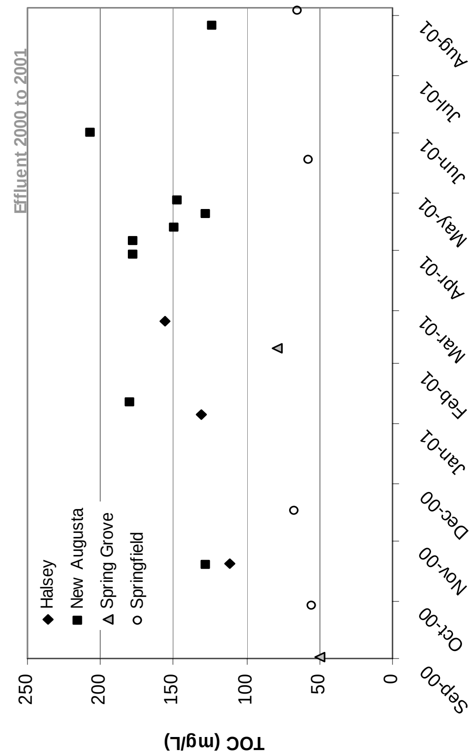

Figure 3.60 Mill Effluent TOC

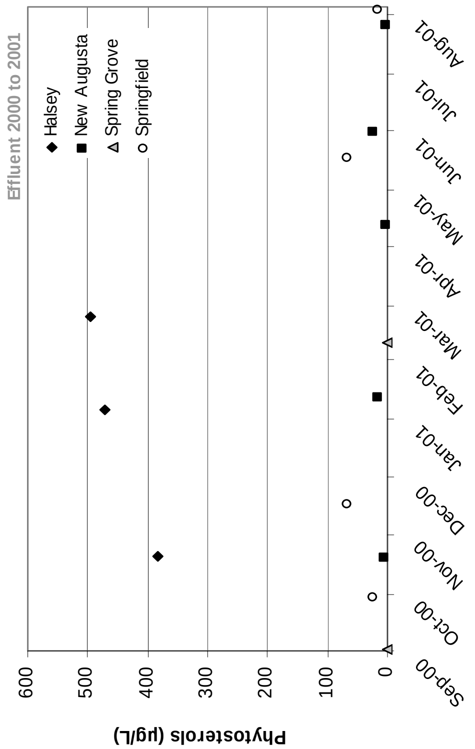

Figure 3.62 Mill Effluent Phytosterols

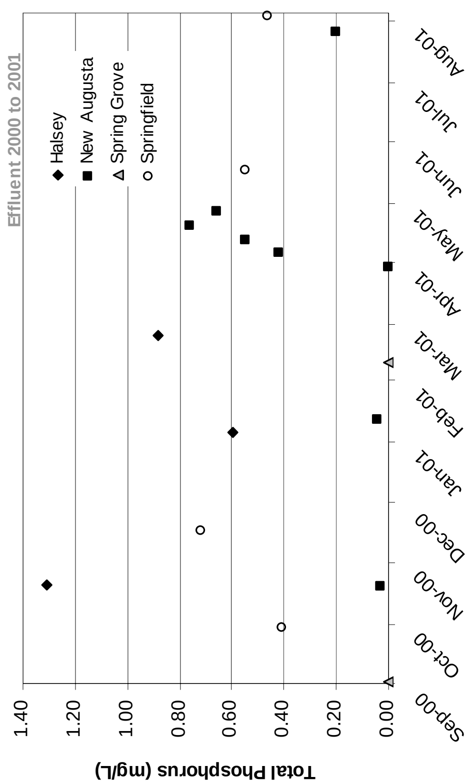

Figure 3.61 Mill Effluent Total Phosphorus

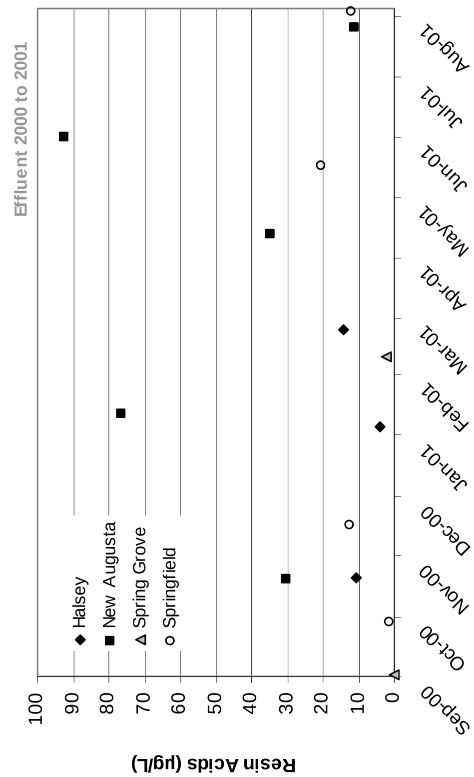

Figure 3.63 Mill Effluent Resin Acids

3.6 Effluent Bioassays

Local mill personnel took samples of effluent. Grab samples or composite samples were taken for New Augusta, the remaining mills collected grab samples. The samples were shipped overnight on ice to NABF for echinoderm and bivalve chronic assays, and to the NCASI Southern Aquatic Biology Facility in New Bern, North Carolina, for ceriodaphnia and fathead minnow chronic bioassays. Assays were performed within 7 d of sampling. The LTRWS local mill locations were Spring Grove, Pennsylvania for Codorus Creek, New Augusta, Mississippi, for the Leaf River, Springfield, Oregon for the McKenzie River, and near Halsey, Oregon, for the Willamette River.

Table 3.9 Effluent IC25 (% v/v) for the LTRWS Mills

Spring Grove, PA

Date	Echinoderm[a] (Fertilization)	Bivalve[b] (Normal Development)	Ceriodaphnia (Reproduction)	Fathead Minnow (Growth)
9/25/00	>70.0	39.6	>100.0	>100.0
3/5/01	>70.0	39.4	>100.0	>100.0

New Augusta, MS

Date	Echinoderm[a] (Fertilization)	Bivalve[b] (Normal Development)	Ceriodaphnia (Reproduction)	Fathead Minnow (Growth)
11/13/00	34.8	13.1		
2/5/01	20.4	4.4		
4/23/01				
4/30/01				
5/7/01	7.0	7.7	>100.0	>100.0
5/14/01				
5/21/01				
6/25/01	7.6	4.4	80.1	>100.0
8/20/01	25.1	14.2	>100.0	>100.0

Springfield, OR

Date	Echinoderm[a] (Fertilization)	Bivalve[b] (Normal Development)	Ceriodaphnia (Reproduction)	Fathead Minnow (Growth)
10/23/00		15.1	58.3	>100.0
12/11/00	>70.0	31.7	94.2	>100.0
6/11/01	>100.0			>100.0
6/11/01			>100.0	>100.0
8/28/01	>70.0		>100.0	>100.0

Halsey, OR

Date	Echinoderm[a] (Fertilization)	Bivalve[b] (Normal Development)	Ceriodaphnia (Reproduction)	Fathead Minnow (Growth)
11/13/00	28.4	13.8	65.3	>100.0
1/29/01	61.1	10.3	91.4	>100.0
3/19/01	39.9	11.7	>100.0	>100.0

[a] *Dendraster excentricus* or *Strongylocentrotus purpuratus*
[b] *Mytilius galloprovincialis*

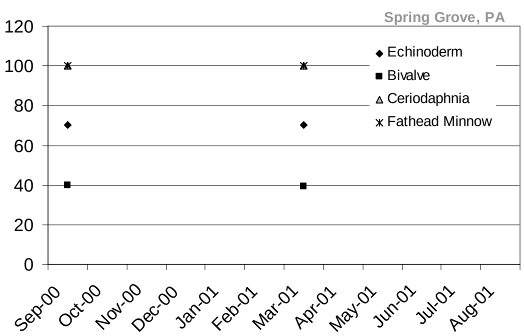

Figure 3.64 Spring Grove, PA, IC25s

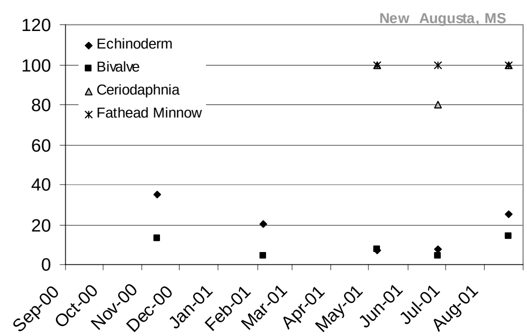

Figure 3.65 New Augusta, MS, IC25s

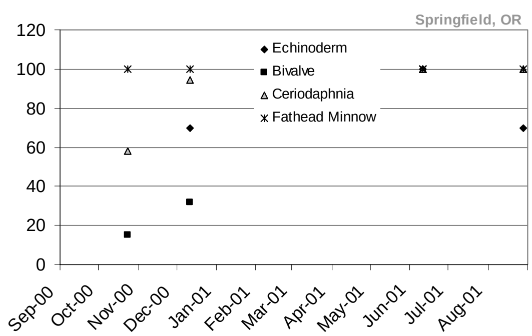

Figure 3.66 Springfield, OR, IC25s

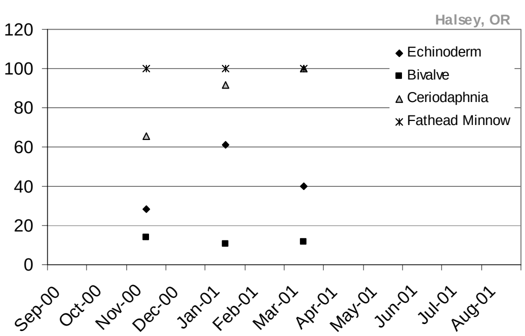

Figure 3.67 Halsey, OR, IC25s

3.7 Periphyton

Periphyton samples were taken quarterly for chlorophyll *a* and semi-annually for taxonomic evaluation on Codorus Creek, McKenzie River, and Willamette River. On Codorus Creek, McKenzie River, and Willamette River, sampling was done by scraping and rinsing five cobble-size (7 to 13 cm in diameter) randomly selected rocks. Detached periphyton were rinsed into a container, filtered, and the volume (total volume and filtered volume) recorded. Rock surface area was estimated using the caliper method (Dudley et al. 2001). The Leaf River was sampled in the fall for both chlorophyll *a* and taxonomy, and in the spring for chlorophyll *a* only. Fall 2000 chlorophyll *a* and taxonomy sampling for the Leaf River were done using an artificial substrate, wooden dowels, exposed for five weeks with three replicates per site. Spring 2001 chlorophyll *a* sampling on the Leaf River was done using native sand samples with one replicate per site. All samples were split, with a portion field-filtered for pigment analysis and a portion preserved with Lugol's Iodine for taxonomic analysis when needed. Samples were analyzed for chlorophyll *a* within 28 d using trichromatic methods (APHA 1998). Spring 2001 Leaf River periphyton taxonomy on the Leaf River was done using scrapings from Hester-Dendy plates and native sand samples. Periphyton taxonomy was conducted by PhycoTech, Inc. (St. Joseph, Michigan).

The periphyton and benthic macroinvertebrates shared the same sampling sites, with Codorus Creek having seven sites, the Leaf River having six sites, McKenzie River having five sites, and the Willamette River having eight sampling sites. There were three missing samples for the Leaf River for the May 2001 sampling date; the Hester-Dendy plates deployed at Downstream and McLain were not recovered, and the sand periphyton sample for New Augusta could not be analyzed. There were no missing samples for Codorus Creek, the McKenzie River, and the Willamette River.

Table 3.10 Codorus Creek Periphyton Summary, August 2000

	East Branch	Menges	USGS	Martin	Graybill	Arsenal	Furnace
No. of Diatom Taxa	20	15	11	8	9	12	4
No. of Non-Diatom Taxa	11	11	10	8	9	10	8
No. of Divisions	3	3	4	3	3	3	3

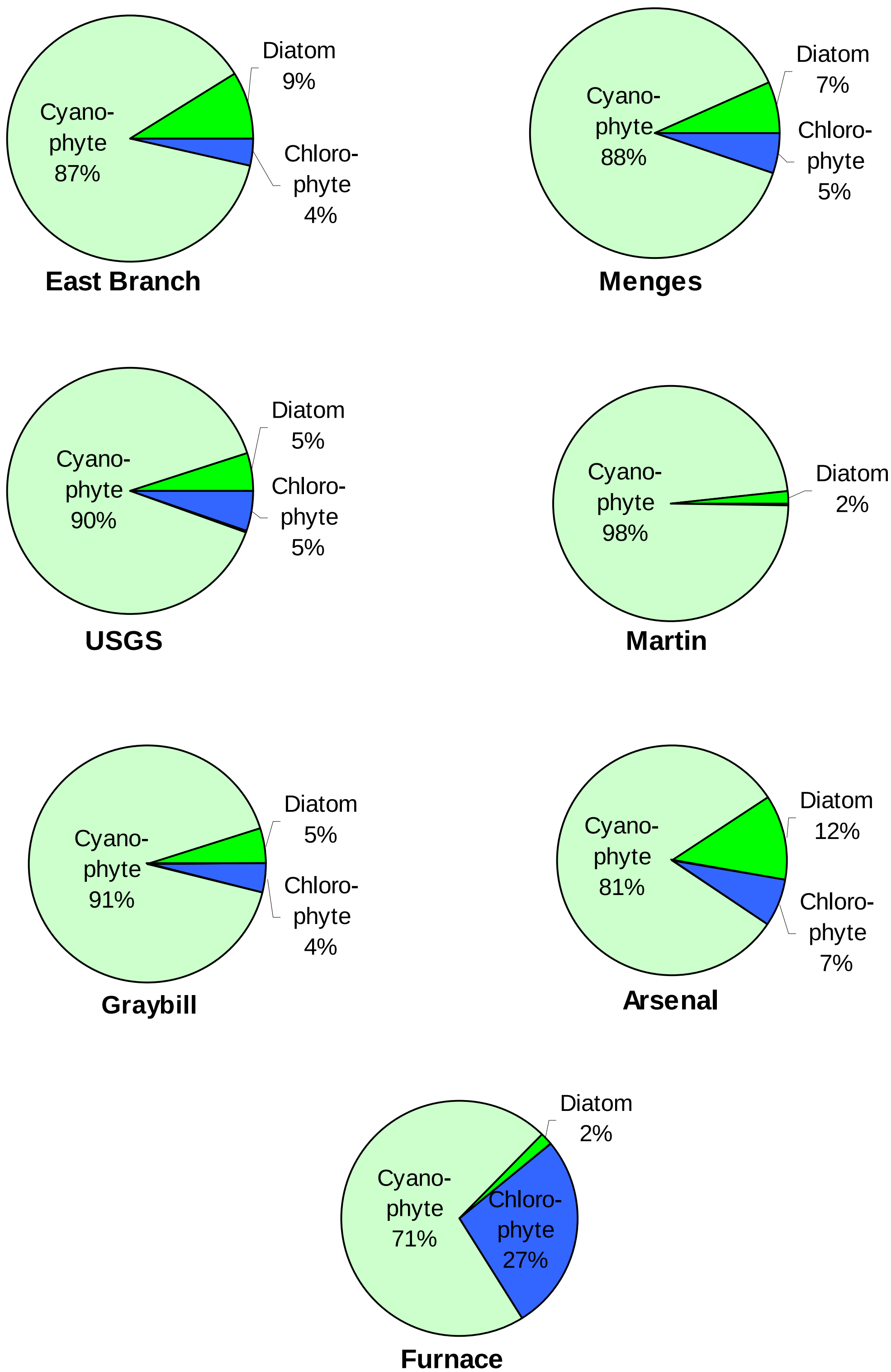

Figure 3.68 Codorus Creek Periphyton Cell or Colony Distribution by Taxonomic Division Excluding Divisions Contributing < 1%), August 2000

Table 3.11. Codorus Creek Periphyton Summary, June 2001

	East Branch	Menges	USGS	Martin	Graybill	Arsenal	Furnace
No. of Diatom Taxa	17	20	22	17	10	22	11
No. of Non-Diatom Taxa	10	7	5	9	7	4	9
No. of Divisions	3	3	3	3	3	3	3

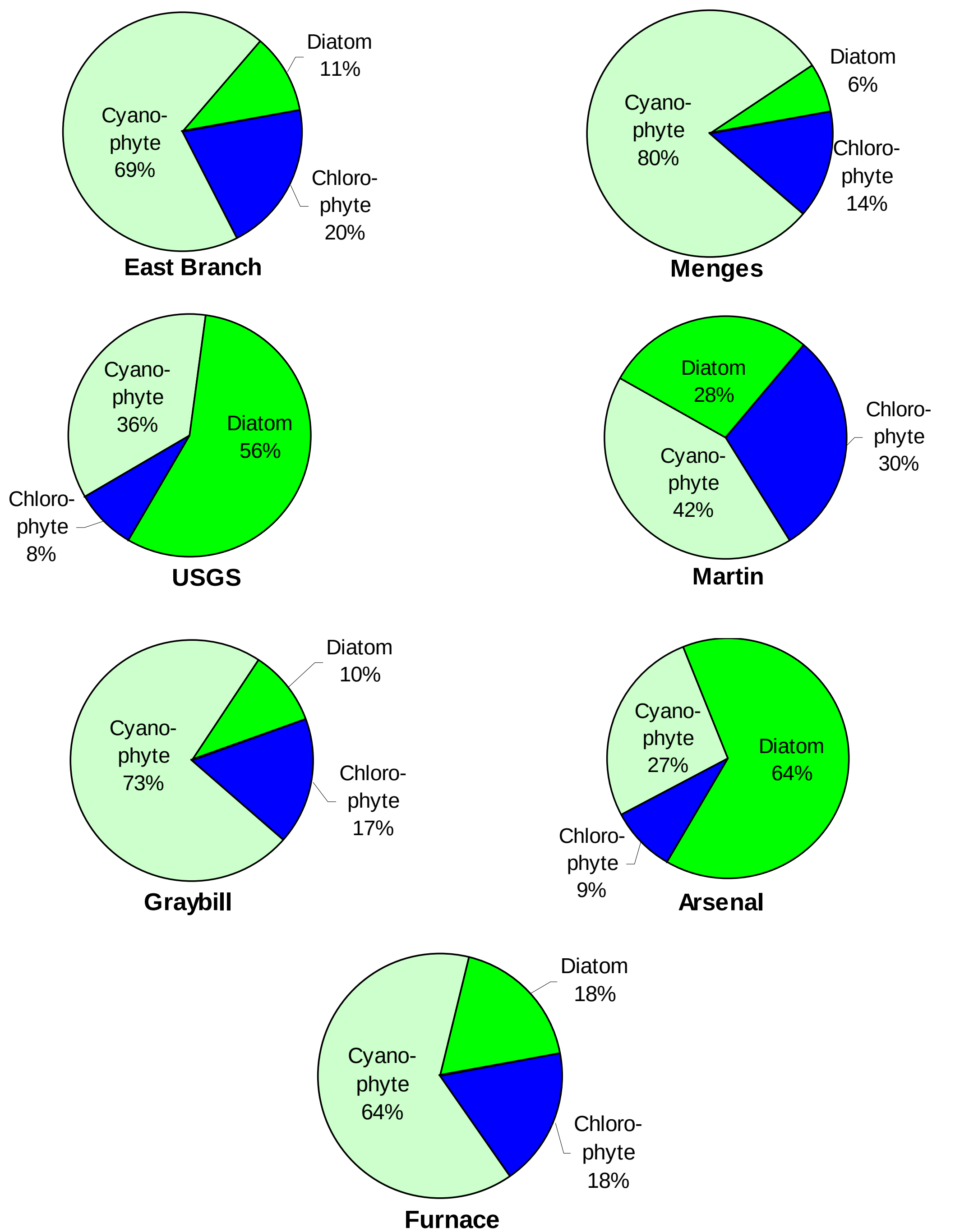

Figure 3.69 Codorus Creek Periphyton Cell or Colony Distribution by Taxonomic Division (Excluding Divisions Contributing < 1%), June 2001

Table 3.12 Leaf River Periphyton Summary, Study Year 2000 to 2001

Date	Sampling Substrate		Tallahala	New Augusta	Downstream	Bogue	Thompson	McLain
October 2000	Wooden dowels	No. of Diatom Taxa	7	6	11	4	6	7
October 2000	Wooden dowels	No. of Non-Diatom Taxa	14	11	14	13	7	10
October 2000	Wooden dowels	No. of Divisions	4	3	3	4	3	3
May 2001	Sand	No. of Diatom Taxa	26	no data	15	22	13	15
May 2001	Sand	No. of Non-Diatom Taxa	5	no data	3	3	6	9
May 2001	Sand	No. of Divisions	4	no data	3	4	4	2
May 2001	Hester-Dendy Plates	No. of Diatom Taxa	7	9	no data	9	7	no data
May 2001	Hester-Dendy Plates	No. of Non-Diatom Taxa	9	12	no data	9	6	no data
May 2001	Hester-Dendy Plates	No. of Divisions	3	3	no data	3	3	no data

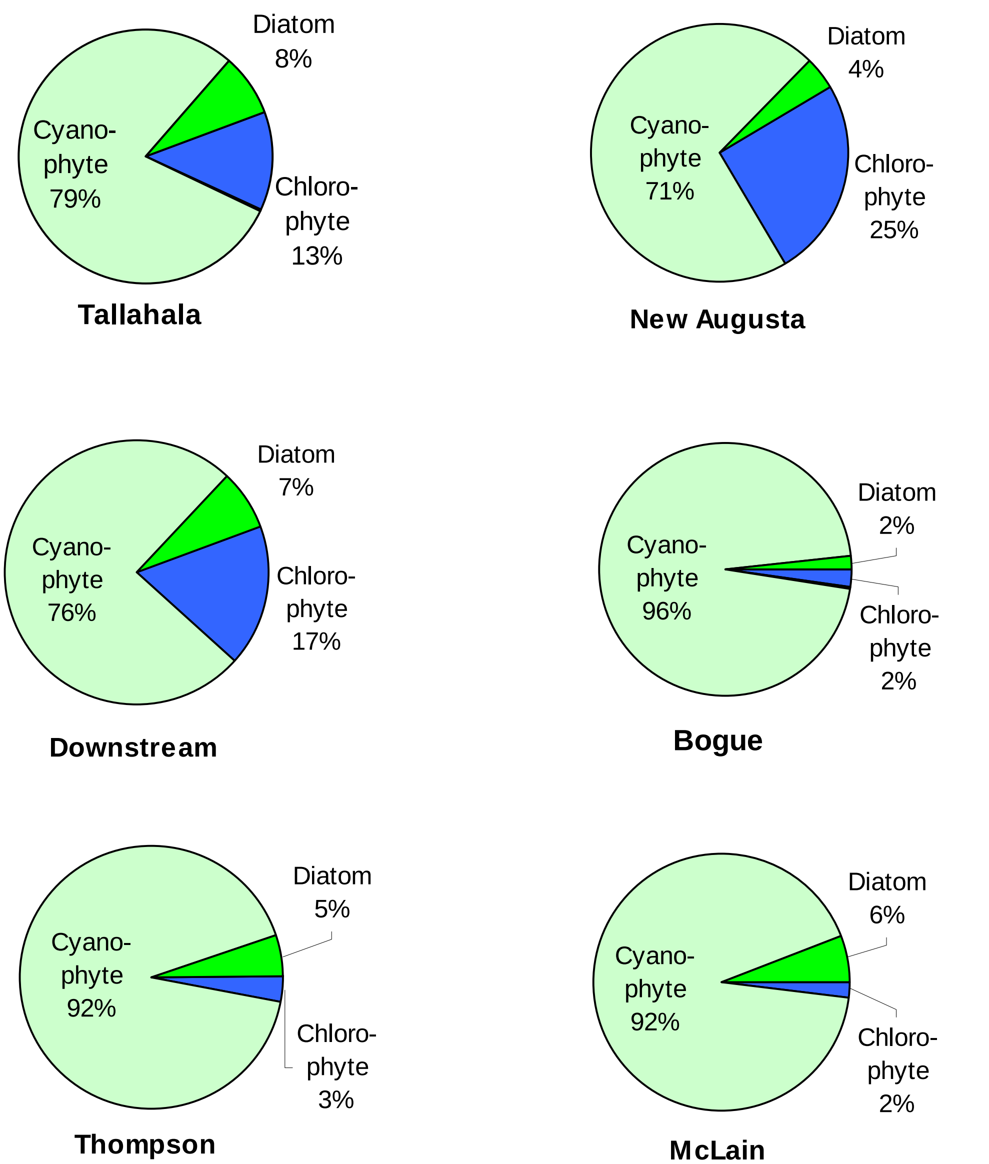

Figure 3.70 Leaf River Periphyton Cell or Colony Distribution by Taxonomic Division Using Wooden Dowels (Excluding Divisions Contributing < 1%), October 2000

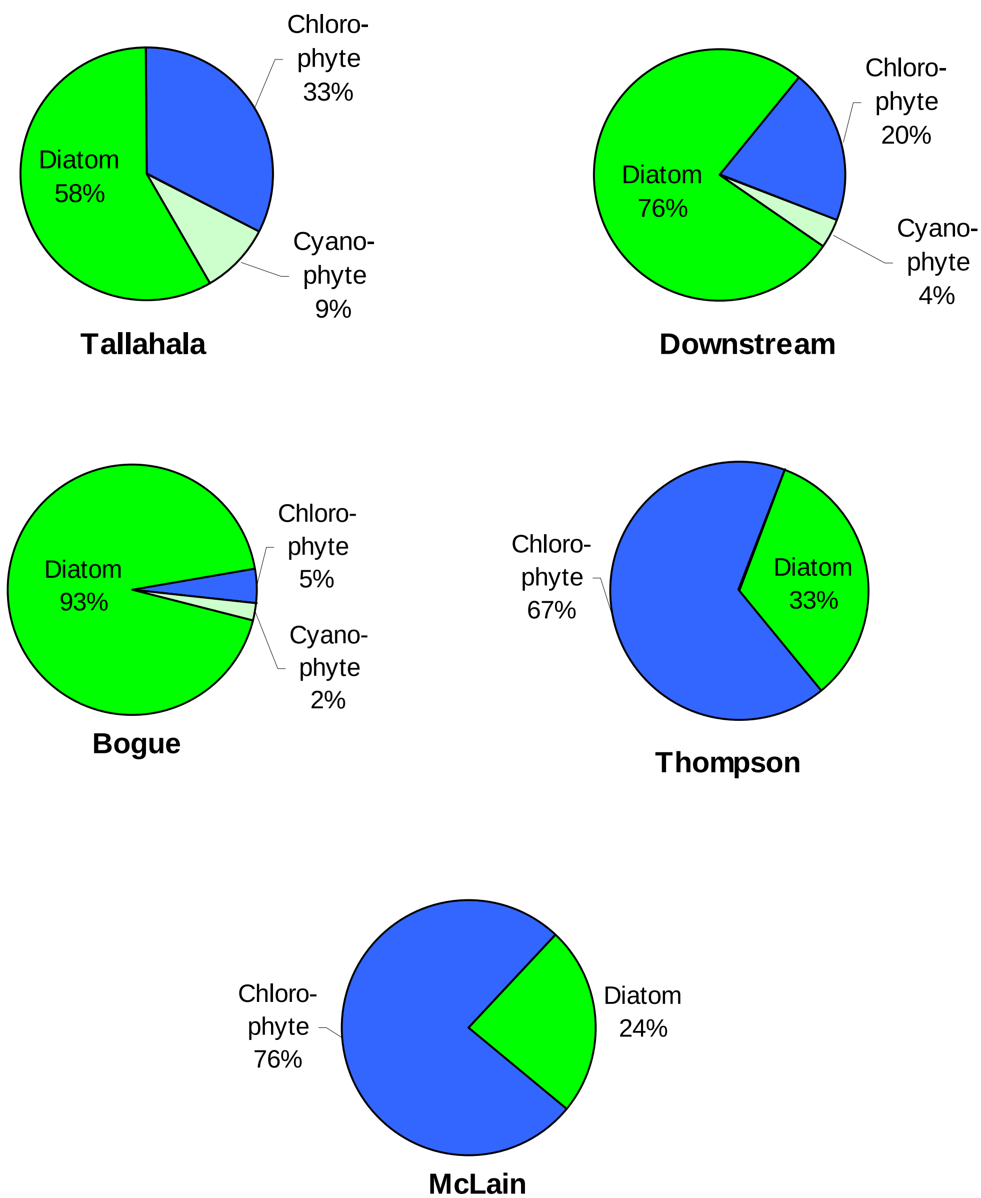

Figure 3.71 Leaf River Periphyton Cell or Colony Distribution by Taxonomic Division Using Sand Periphyton (Excluding Divisions Contributing < 1%), May 2001

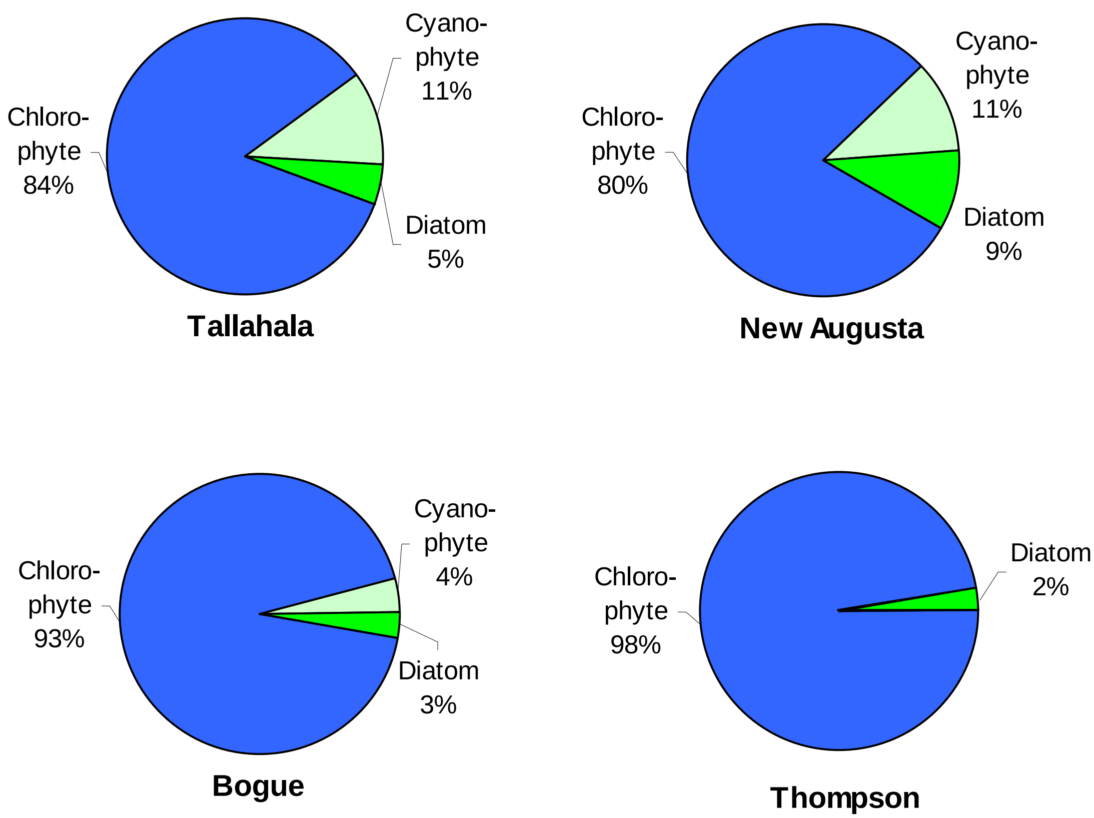

Figure 3.72 Leaf River Periphyton Cell or Colony Distribution by Taxonomic Division Using Hester-Dendy Plates (Excluding Divisions Contributing < 1%), May 2001

Table 3.13 McKenzie River Periphyton Summary, September 2000

	Walterville RM20.5	Bellingers RM18.5	Mohawk RM14	Harvest RM10	Armitage RM6
No. of Diatom Taxa	12	23	21	17	19
No. of Non-Diatom Taxa	14	18	13	17	14
No. of Divisions	4	3	3	3	3

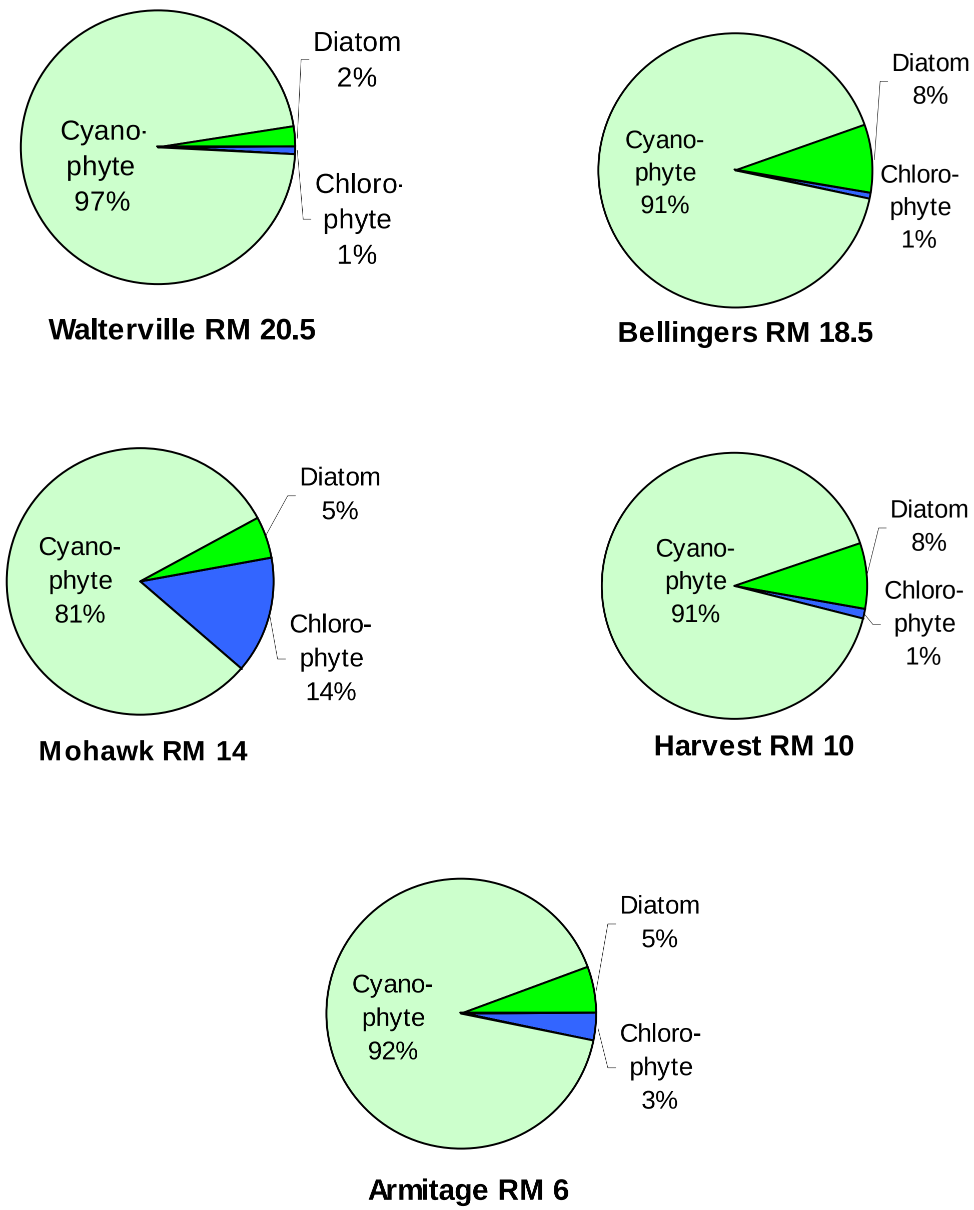

Figure 3.73 McKenzie River Periphyton Cell or Colony Distribution by Taxonomic Division (Excluding Divisions Contributing < 1%), September 2000

Table 3.14 McKenzie River Periphyton Summary, July 2001

	Walterville RM20.5	Bellingers RM18.5	Mohawk RM14	Harvest RM10	Armitage RM6
No. of Diatom Taxa	17	21	29	20	20
No. of Non-Diatom Taxa	7	8	7	11	7
No. of Divisions	3	3	3	3	3

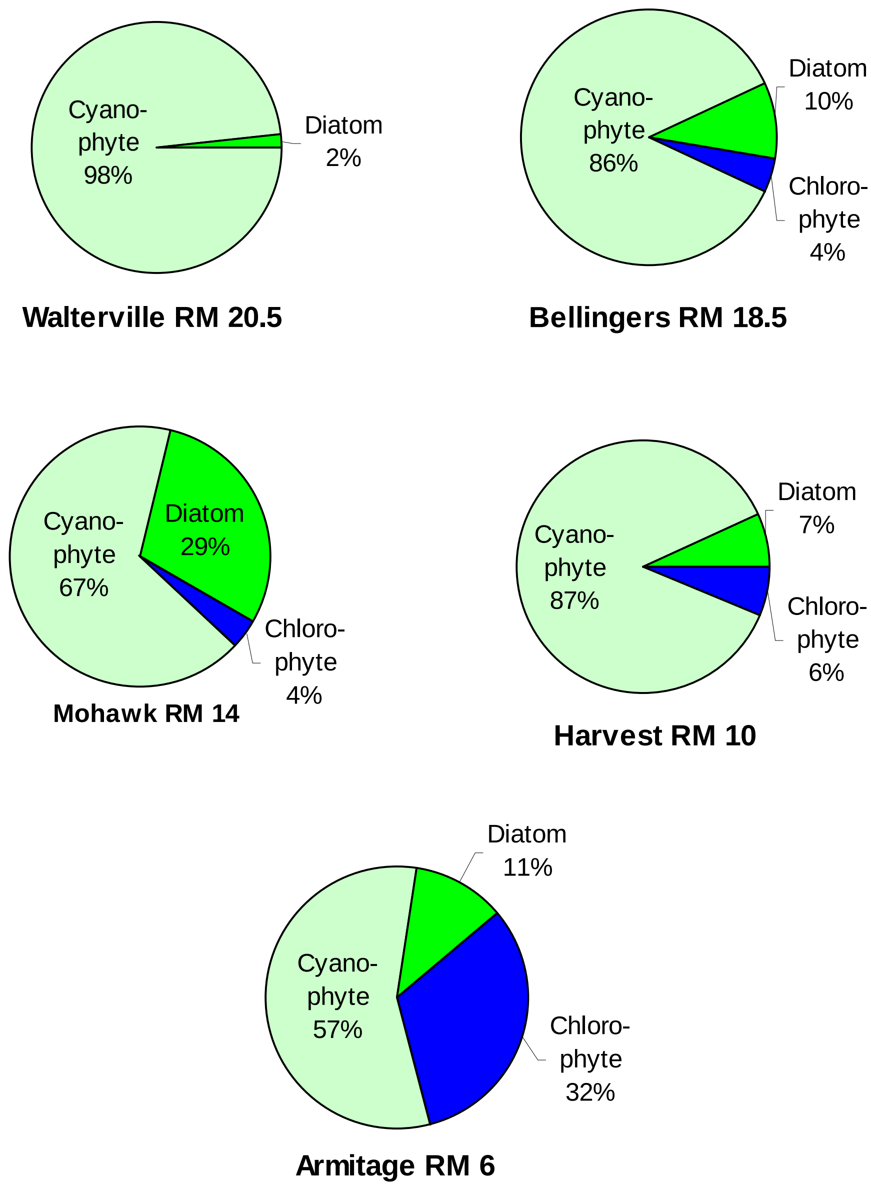

Figure 3.74 McKenzie River Periphyton Cell or Colony Distribution by Taxonomic Division (Excluding Divisions Contributing < 1%), June 2001

Table 3.15 Willamette River Periphyton Summary, September 2000

	Whitely RM 176	Harrisburg RM160	Cartney RM156	Intake RM148	Sam Daws RM 145.5	Snag Boat RM143.5	Willamette RM134	Corvallis RM128
No. of Diatom Taxa	18	20	26	27	26	24	19	12
No. of Non-Diatom Taxa	12	13	10	15	15	14	14	12
No. of Divisions	3	3	3	3	3	3	3	3

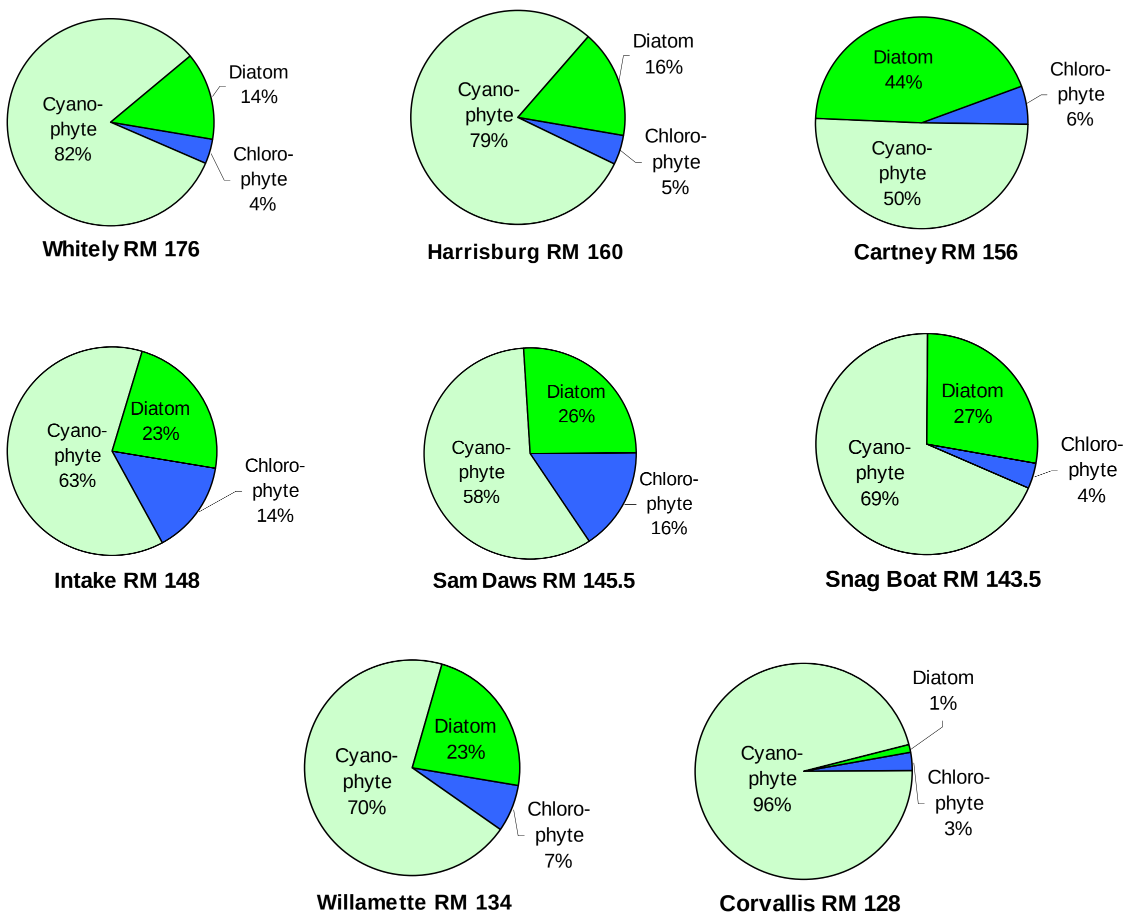

Figure 3.75 Willamette River Periphyton Cell or Colony Distribution by Taxonomic Division (Excluding Divisions Contributing <1%), September 2000

Table 3.16 Willamette River Periphyton Summary, July 2001

	Whitely RM 176	Harrisburg RM160	Cartney RM156	Intake RM148	Sam Daws RM 145.5	Snag Boat RM143.5	Willamette RM134	Corvallis RM128
No. of Diatom Taxa	16	14	13	19	27	24	13	15
No. of Non-Diatom Taxa	11	9	9	8	11	12	7	11
No. of Divisions	3	3	3	3	3	3	3	3

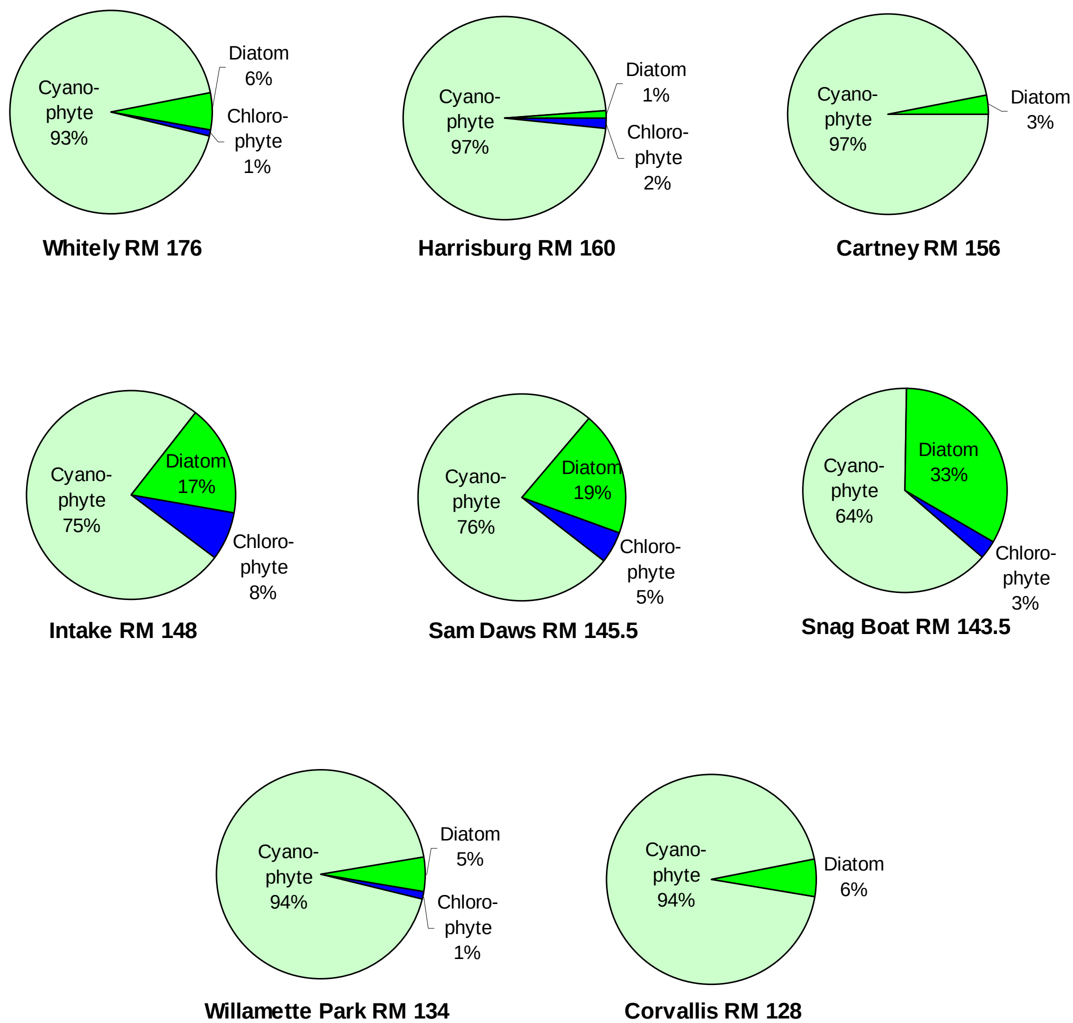

Figure 3.76 Willamette River Periphyton Cell or Colony Distribution by Taxonomic Division (Excluding Divisions Contributing <1%), July 2001

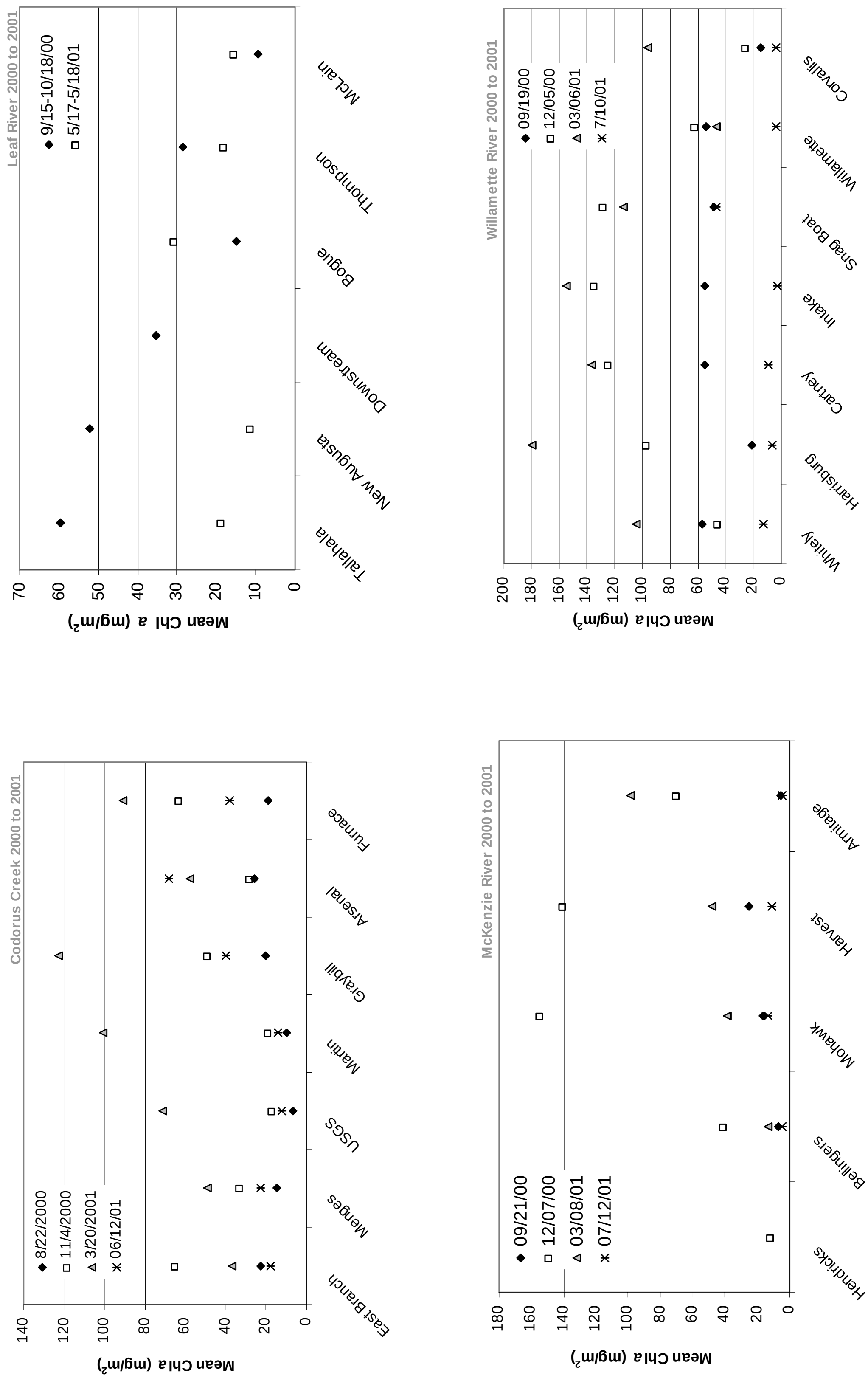

Figure 3.77 Mean Chlorophyll *a* (mg/m^2) LTRWS Rivers for Study Year 2000 to 2001

3.8 Benthic Macroinvertebrates

Benthic macroinvertebrates were collected quarterly on Codorus Creek, McKenzie River, and Willamette River for biomass and taxonomic evaluation. All samples from Codorus Creek, McKenzie River, and Willamette River were collected using a Hess sampler with five replicates per site. Leaf River samples were collected twice during the sampling period covered in this compendium, using Hester-Dendy multi-plate samplers exposed for five weeks, with three replicates per site, and macroinvertebrate collections from natural woody debris. All data were normalized to area ($1m^2$). Samples were preserved in 10% buffered formalin and shipped to Benthix Consulting for taxonomic evaluation. Samples were returned in 10% buffered formalin to NABF for biomass analysis.

The benthic macroinvertebrate sampling sites were the same as the periphyton sampling sites, with Codorus Creek having seven sites, the Leaf River having six sites, the McKenzie River having five sites, and the Willamette River having eight sampling sites. The Leaf River had two missing samples; the Hester-Dendy plates deployed at McLain and Downstream were not recovered for the May 2001 sampling date. There were no missing samples for Codorus Creek, McKenzie River, or Willamette River.

3.8.1 *Codorus Creek Benthic Macroinvertebrates*

Table 3.17 Codorus Creek Benthic Macroinvertebrate Taxa List by Sampling Site, Study Year 2000 to 2001

Order	Family	Genus	Species	Furnace	Arsenal	Graybill	Martin	USGS	Menges	East Branch
Amphipoda	Gammaridae	Gammarus	x	✓	✓	✓	✓	✓	✓	
Coleoptera	Curculionidae	Lixus	x						✓	
	Dryopidae	Helichus	x						✓	
	Dytiscidae	x	x			✓				✓
		Cybister	x	✓						
		Hydroporous	x						✓	
	Elmidae	Ancyronyx	variegatus		✓	✓	✓	✓		✓
		Dubiraphia	vittata	✓	✓	✓	✓	✓	✓	✓
		Macronychus	glabratus	✓	✓	✓	✓	✓		✓
		Microcylloepus	pusillus	✓						
		Optioservus	x	✓	✓	✓	✓	✓	✓	✓
			ovalis					✓	✓	✓
			trivittatus		✓	✓	✓	✓	✓	✓
		Oulimnius	latiusculus	✓		✓			✓	✓
		Stenelmis	x	✓	✓	✓	✓	✓	✓	✓
	Hydrophilidae	x	x		✓	✓				✓
		Berosus	x				✓			
	Psephenidae	Ectopria	x		✓					
		Psephenus	herricki	✓	✓	✓	✓	✓	✓	✓
	Ptilodactylidae	Anchytarsus	bicolor			✓			✓	✓
	Stratiomyidae	x	x							✓
Decapoda	Cambaridae	x	x	✓	✓	✓	✓	✓	✓	✓
Diptera	Ceratopogonidae	Ceratopogon	x	✓		✓				✓
		cf. Bezzia	x	✓	✓	✓	✓	✓	✓	✓
		Culicoides	x			✓				✓
	Chironomidae	Ablabesmyia	mallochi	✓	✓	✓	✓	✓		✓
		Brillia	flavifrons		✓	✓	✓	✓	✓	✓
		Cardiocladius	x	✓	✓		✓	✓	✓	✓
		Chaetocladius	x					✓	✓	✓
		Chironomus	x		✓	✓	✓	✓	✓	✓
		Cladotanytarsus	mancus gr.		✓			✓		✓
			vanderwulpi gr.		✓					✓
			vanderwulpi gr. A	✓	✓	✓		✓	✓	✓
			vanderwulpi gr. B		✓	✓		✓	✓	✓
		Conchapelopia	fasciata gr.		✓				✓	
		Corynoneura	x	✓	✓	✓	✓	✓	✓	✓
		Cricotopus	x	✓	✓	✓	✓	✓	✓	✓
			bicinctus	✓	✓	✓	✓	✓	✓	✓
			cf. sylvestris				✓			
			sp. C	✓	✓	✓	✓	✓	✓	✓
			trifascia	✓	✓	✓	✓	✓	✓	✓
		Cricotopus/Orthocladius gr.	x	✓	✓	✓	✓	✓	✓	✓
		Cryptochironomus	cf. blarina		✓					
			cf. sorex	✓	✓	✓	✓	✓	✓	✓
		Diamesa	x	✓	✓	✓		✓	✓	✓
		Diamesa/Sympotthastia	x							
		Dicrotendipes	fumidus	✓	✓		✓	✓	✓	✓
			neomodestus	✓	✓	✓	✓	✓	✓	✓
			nervosus				✓			
		Diplocladius	cultriger							✓
		Doncricotopus	bicaudatus		✓		✓	✓	✓	✓
		Eukiefferiella	claripennis gr.		✓	✓			✓	✓
			coerulescens gr.	✓	✓					✓
			devonica gr.	✓	✓			✓	✓	✓
			pseudomontana gr.	✓						
		Hayesomyia	senata	✓	✓	✓	✓	✓	✓	
		Heleniella	x			✓				
		Helopelopia	cornuticaudata						✓	

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Table 3.17 Continued

Order	Family	Genus	Species	Furnace	Arsenal	Graybill	Martin	USGS	Menges	East Branch
Diptera	Chironomidae	Heterotrissocladius	marcidus gr.	✓				✓	✓	✓
		Hydrobaenus	x	✓	✓	✓	✓	✓	✓	✓
		Limnophyes	x							✓
		Lopescladius	x				✓			
		Meropelopia	flavifrons	✓	✓		✓			
			sp. A	✓	✓	✓	✓	✓	✓	✓
			sp. B	✓	✓	✓	✓	✓	✓	✓
		Microtendipes	pedellus gr.	✓	✓	✓	✓	✓	✓	✓
		Nanocladius	crassicornis	✓			✓			
			distinctus		✓	✓	✓	✓	✓	
			spiniplenus	✓			✓	✓	✓	✓
		Natarsia	baltimoreus			✓		✓	✓	✓
			sp. A of Roback		✓	✓		✓	✓	
		Neozavrelia	x							✓
		Nilotanypus	fimbriatus	✓	✓	✓	✓	✓		✓
		Nimbocera	x	✓	✓	✓	✓	✓	✓	✓
			sp. A	✓	✓	✓	✓	✓	✓	✓
			sp. B				✓	✓		✓
		Orthocladius	x	✓	✓	✓	✓	✓	✓	✓
			ashei/rivicola	✓		✓			✓	
			carlatus			✓			✓	✓
			lignicola					✓		✓
			mallochi		✓	✓		✓	✓	✓
			rivicola				✓			
			rivulorum		✓	✓		✓	✓	
			sp. A		✓		✓	✓	✓	✓
			sp. B					✓		✓
		Pagastia	x	✓	✓				✓	✓
			partica	✓	✓	✓			✓	✓
			sp. A							✓
		Paracladopelma	undine					✓		
		Parakiefferiella	x	✓	✓	✓	✓	✓	✓	✓
		Paralauterborniella	nigrohalterale			✓		✓		✓
		Parametriocnemus	x	✓	✓	✓	✓	✓	✓	✓
		Paratanytarsus	x	✓	✓		✓	✓	✓	✓
			inopertus gr.		✓			✓		
		Paratendipes	cf. albimanus	✓	✓	✓	✓	✓	✓	✓
		Phaenopsectra	obediens gr.	✓	✓	✓	✓	✓	✓	✓
			punctipes gr.	✓	✓		✓	✓		
		Polypedilum	aviceps	✓		✓			✓	✓
			cf. halterale	✓	✓		✓	✓		
			fallax		✓	✓	✓		✓	✓
			flavum	✓	✓	✓	✓	✓	✓	✓
			illinoense gr.	✓	✓	✓	✓	✓	✓	✓
			scalaenum	✓	✓	✓	✓	✓	✓	✓
		Potthastia	gaedii gr.				✓	✓	✓	✓
			longimana	✓					✓	✓
		Procladius	x		✓			✓		
		Pseudochironomus	x		✓					
		Rheocricotopus	robacki	✓	✓	✓	✓	✓	✓	✓
		Rheotanytarsus	x	✓	✓	✓	✓	✓	✓	✓
		Stempellinella	x	✓		✓			✓	✓
		Stictochironomus	x		✓			✓	✓	✓
			poecilopterus					✓		✓
		Stilocladius	x							✓
		Sublettea	coffmani			✓			✓	✓
		Synorthocladius	semivirens	✓	✓	✓	✓	✓	✓	✓
		Tanypus	x					✓		

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Table 3.17 Continued

Order	Family	Genus	Species	Furnace	Arsenal	Graybill	Martin	USGS	Menges	East Branch
Diptera	Chironomidae	Tanytarsus	curticornis gr.		✓	✓		✓	✓	✓
			eminulus gr.							✓
			pallidicornis & aculeatus gr.	✓	✓	✓	✓	✓	✓	✓
			sp. D	✓	✓	✓	✓	✓	✓	✓
			sp. E	✓	✓		✓	✓		✓
			sp. F					✓		
			sp. G			✓			✓	✓
		Thienemanniella	x	✓	✓	✓	✓	✓	✓	✓
		Thienemannimyia gr.	x	✓	✓	✓	✓	✓	✓	✓
		Tvetenia	bavarica gr.	✓	✓	✓	✓	✓	✓	✓
			discoloripes gr.		✓				✓	
		Zavrelimyia	x					✓		
	Dolichopodidae	x	x						✓	
	Empididae	Chelifera	x	✓	✓	✓	✓	✓	✓	✓
		Clinocera	x	✓	✓	✓		✓	✓	✓
		Hemerodromia	x	✓	✓	✓	✓	✓	✓	✓
	Muscidae	cf. Limnophora	x							✓
	Psychodidae	cf. Pericoma	x		✓					
	Simuliidae	Prosimulium	x		✓				✓	✓
		Simulium	x	✓	✓	✓	✓	✓	✓	✓
	Tabanidae	Chrysops	x			✓		✓	✓	
		Tabanus	x			✓	✓		✓	
	Tipulidae	Antocha	x	✓	✓	✓	✓	✓	✓	✓
		Dicranota	x							✓
		Limnophila	x			✓		✓	✓	✓
		Pseudolimnophila	x						✓	
		Tipula	x	✓					✓	✓
Ephemeroptera	Baetidae	Acentrella	turbida						✓	✓
		Baetis	x	✓	✓	✓		✓	✓	✓
		Diphetor	x						✓	✓
	Caenidae	Caenis	x	✓	✓	✓	✓	✓	✓	✓
	Ephemerellidae	x	x			✓			✓	✓
		Attenella	x	✓	✓				✓	✓
		Ephemerella	subvaria	✓		✓			✓	✓
		Serratella	x							✓
	Ephemeridae	Ephemera	x				✓	✓	✓	✓
	Heptageniidae	Stenonema/Stenacron	x	✓	✓	✓	✓	✓	✓	✓
	Isonychiidae	Isonychia	x							✓
	Leptohyphidae	Tricorythodes	x	✓	✓	✓	✓	✓	✓	
	Leptophlebiidae	Leptophlebia	x						✓	
		x	x						✓	✓
Gastropoda	Ancylidae	x	x	✓	✓	✓	✓	✓	✓	✓
	Physidae	Physella	x		✓	✓	✓		✓	✓
		Gyraulus	x		✓	✓	✓		✓	
Hemiptera	Veliidae	Rhagovelia	x	✓						
Hirudinea	Erpobdellidae	Mooreobdella	fervida	✓	✓		✓			
		Helobdella	x		✓					
			fusca				✓			
			stagnalis		✓					
Hydracarina	x	x	x	✓	✓	✓	✓	✓	✓	✓
Hydroida	Hydridae	Hydra	x	✓	✓					
Isopoda	Asellidae	Caecidotea	x	✓	✓	✓	✓	✓	✓	
Lepidoptera	Pyralidae	Petrophila	x	✓	✓					
Megaloptera	Corydalidae	Corydalus	cornutus	✓	✓	✓	✓	✓		
	Sialidae	Sialis	x	✓	✓	✓	✓	✓	✓	✓
Odonata	Aeshnidae	x	x							✓
	Calopterygidae	x	x							✓
	Coenagrionidae	Argia	x	✓	✓	✓	✓	✓	✓	

(Continued on next page)

Table 3.17 Continued

Order	Family	Genus	Species	Furnace	Arsenal	Graybill	Martin	USGS	Menges	East Branch
Odonata	Coenagrionidae	Coenagrion/Enallagma	x					✓		
	Gomphidae	x	x		✓					
Pelecypoda	Sphaeriidae	x	x	✓	✓	✓	✓	✓	✓	✓
Plecoptera	x	x	x			✓	✓		✓	✓
	Capniidae	Allocapnia	x			✓	✓	✓	✓	✓
	Chloroperlidae	Suwallia	x							✓
	Leuctridae	Leuctra	x							✓
	Nemouridae	Amphinemura	x	✓		✓			✓	
		Prostoia	x			✓				✓
	Perlidae	x	x		✓	✓	✓			✓
		Acroneuria	x							✓
		Perlesta	x			✓				✓
	Taeniopterygidae	Taenionema	atlanticum							✓
		Taeniopteryx	x							✓
			metequi	✓	✓	✓		✓	✓	✓
	Glossosomatidae	Anagapetus	x			✓				
Trichoptera		Glossosoma	x						✓	✓
	Goeridae	Goera	x						✓	✓
	Hydropsychidae	x	x	✓	✓	✓	✓	✓	✓	✓
		Cheumatopsyche	x	✓	✓	✓	✓	✓	✓	✓
		Diplectrona	modesta						✓	
		Hydropsyche	x			✓	✓		✓	✓
			type A	✓	✓	✓	✓	✓	✓	✓
			type B	✓	✓	✓	✓	✓	✓	✓
	Hydroptilidae	Hydroptila	x	✓	✓	✓	✓	✓	✓	✓
		Leucotrichia	pictipes	✓	✓			✓		✓
		Ochrontrichia	x			✓	✓			
	Lepidostomatidae	Lepidostoma	x	✓						
	Leptoceridae	Ceraclea	x			✓	✓			
		Mystacides	x					✓		
		Oecetis	x				✓			
	Philopotamidae	Chimarra	x			✓	✓	✓	✓	✓
		Dolophilodes	x			✓			✓	
	Psychomyiidae	Psychomyia	flavida	✓	✓	✓	✓	✓	✓	✓
	Uenoidae	Neophylax	x							✓
Tricladida	x	x	x	✓	✓	✓	✓	✓	✓	✓

Table 3.18 Codorus Creek Benthic Macroinvertebrate Community Summary, Study Year 2000 to 2001

Date	Site	Total # Taxa	% EPT[1]	% Chironomidae	% Diptera	Total Abundance (count/site)
August 2000	Furnace	56	41.9	81.3	8.3	2852
August 2000	Arsenal	71	40.2	30.4	32.4	9877
August 2000	Graybill	54	21.2	39.2	40.0	5847
August 2000	Martin	44	41.9	27.6	28.9	6549
August 2000	USGS	54	38.0	26.0	26.4	1901
August 2000	Menges	80	22.8	38.2	52.7	6983
August 2000	East Branch	72	36.2	47.6	52.0	2473
November 2000	Furnace	56	8.1	76.9	78.1	5441
November 2000	Arsenal	60	2.8	79.2	81.4	3901
November 2000	Graybill	59	22.2	40.1	42.0	10510
November 2000	Martin	60	18.2	43.4	46.9	8259
November 2000	USGS	71	37.8	39.7	41.0	3780
November 2000	Menges	75	44.1	31.2	45.5	6557
November 2000	East Branch	76	26.7	45.6	60.8	5315
March 2001	Furnace	66	4.9	64.9	66.4	1916
March 2001	Arsenal	65	0.7	88.1	90.7	2172
March 2001	Graybill	81	3.8	68.4	70.0	9382
March 2001	Martin	68	4.3	74.5	75.3	9478
March 2001	USGS	90	15.0	76.3	77.1	5081
March 2001	Menges	85	8.9	80.2	86.0	12751
March 2001	East Branch	99	11.7	65.0	82.8	5655
June 2001	Furnace	43	23.5	15.0	15.2	1000
June 2001	Arsenal	73	5.3	72.4	73.2	3591
June 2001	Graybill	59	11.8	61.4	62.2	5082
June 2001	Martin	64	10.5	45.0	47.1	11642
June 2001	USGS	53	46.1	15.0	15.1	1789
June 2001	Menges	73	7.9	70.9	79.3	6824
June 2001	East Branch	86	25.6	57.7	65.2	6278

[1] EPT = Ephemeroptera, Plecoptera, Trichoptera taxa

Table 3.19 Codorus Creek Benthic Macroinvertebrate Biomass, Study Year 2000 to 2001(means for 5 replicates)

	Mean Dry Weight (g/m^2)						
	East Branch	Menges	USGS	Martin	Graybill	Arsenal	Furnace
08/22/00	1.2474	7.4963	2.3081	4.7940	2.4926	6.5126	4.1809
11/14/00	6.0807	19.5226	6.0830	9.0230	11.3351	3.7009	5.0630
03/20/01	6.7721	8.5260	4.4630	8.0086	8.2488	2.5035	5.6574
06/12/01	3.8719	7.4491	2.4381	17.6797	8.0486	7.4421	1.7830

	Mean Ash-Free Dry Weight (g/m^2)						
	East Branch	Menges	USGS	Martin	Graybill	Arsenal	Furnace
08/22/00	0.6549	5.1581	1.1114	3.0500	1.5570	3.8893	2.6604
11/14/00	4.3581	15.9758	3.9156	6.4407	8.6916	2.2328	3.1819
03/20/01	4.6526	6.6626	2.8435	5.9447	5.7244	1.2258	3.5167
06/12/01	2.3784	4.8000	1.1058	9.8077	5.9556	5.7935	0.7091

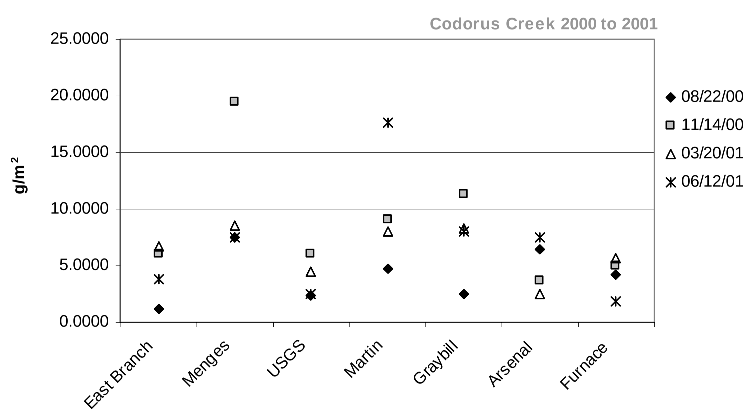


Figure 3.78 Codorus Creek Benthic Macroinvertebrate Mean Dry Weight

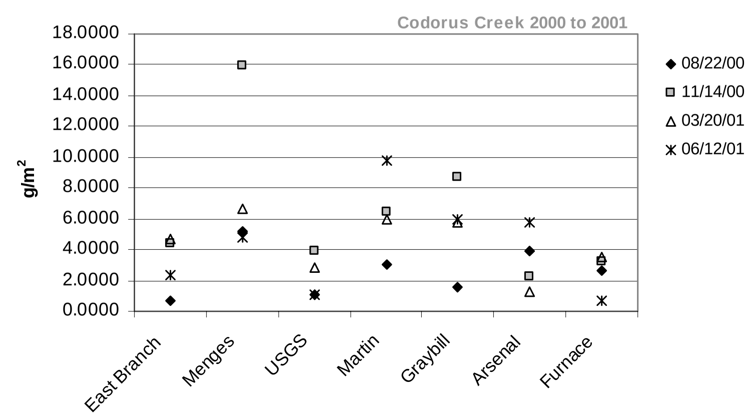


Figure 3.79 Codorus Creek Benthic Macroinvertebrate Mean Ash-Free Dry Weight

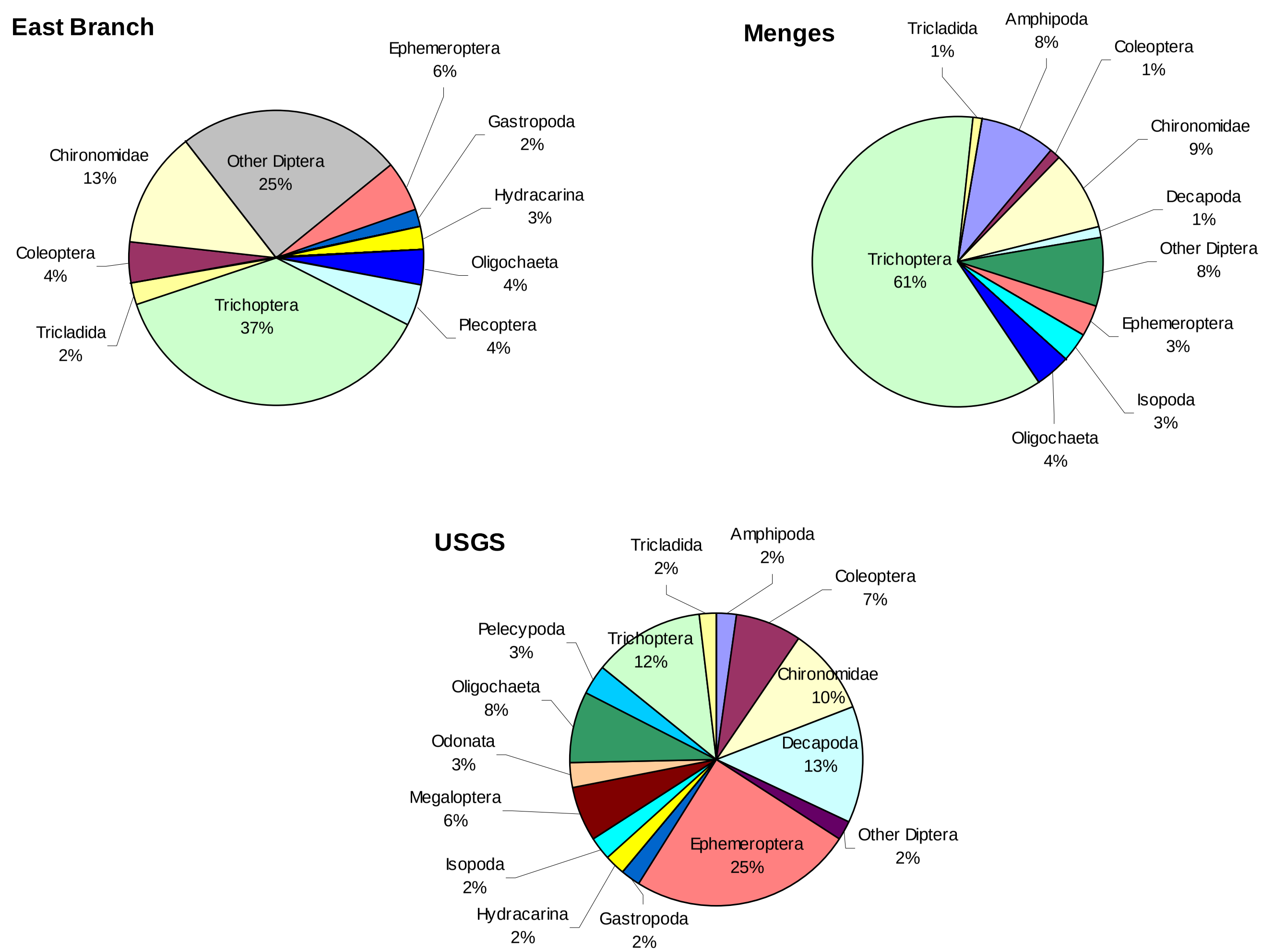


Figure 3.80 Benthic Macroinvertebrate Family Distribution by Percent Dry Weight for Codorus Creek Sampling Sites Upstream of Mill Discharge, Study Year 2000 to 2001 (represents the sum of all replicates and seasonal samples for the entire study year for all families contributing >1% of the total)

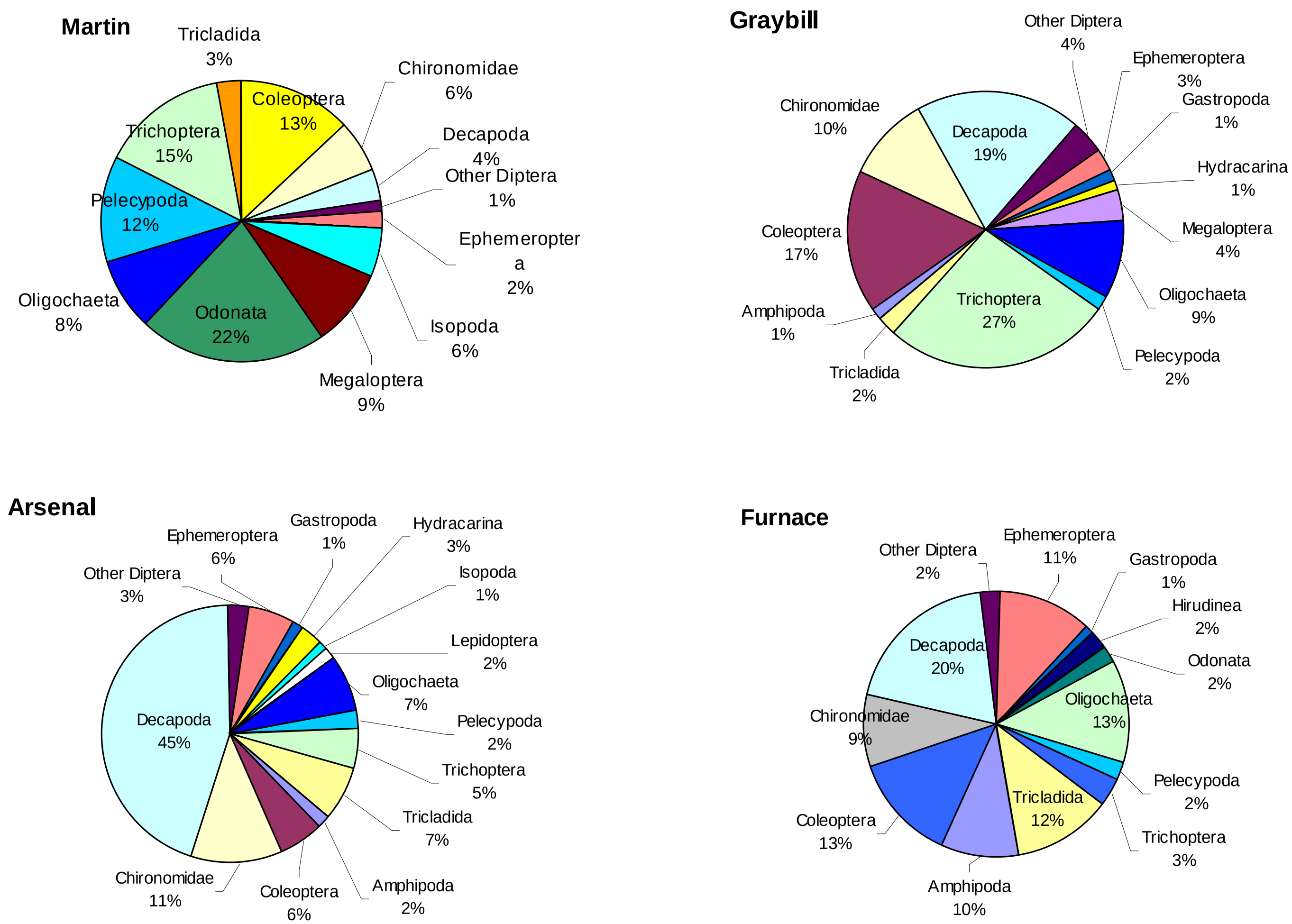


Figure 3.81 Benthic Macroinvertebrate Family Distribution by Percent Dry Weight for Codorus Creek Sampling Sites Downstream of Mill Discharge, Study Year 2000 to 2001 (represents the sum of all replicates and seasonal samples for the entire study year for all families contributing >1% of the total)

3.8.2 *Leaf River Benthic Macroinvertebrates*

Table 3.20 Leaf River Benthic Macroinvertebrate Taxa List by Sampling Site Using Hester-Dendy Plates, Study Year 2000 to 2001

Order	Family	Genus	Species	Tallahalla	New Augusta	Downstream	Bogue	Thompson	McLain
Coleoptera	Elmidae	Ancyronyx	variegatus	✓	✓		✓		
		Macronychus	glabratus	✓					
		Ordobrevia	x		✓				
		Stenelmis	x		✓		✓		
Diptera	Chironomidae	Ablabesmyia	x			✓			
			mallochi					✓	
		Axarus			✓			✓	
		Corynoneura		✓	✓	✓	✓	✓	✓
		Cricotopus	bicinctus	✓	✓		✓	✓	✓
		Cricotopus/Orthocladius gr.	x	✓	✓	✓	✓	✓	✓
		Cricotopus	x	✓			✓	✓	
		Cryptochironomus	cf. sorex			✓			
		Dicrotendipes	neomodestus	✓		✓		✓	✓
		Glyptotendipes	x	✓	✓	✓	✓		
		Nanocladius	crassicornis	✓	✓	✓	✓	✓	✓
			distinctus	✓	✓	✓	✓	✓	✓
			downesi	✓		✓		✓	
			unknown	✓			✓	✓	
		Nilothauma	x	✓	✓	✓	✓	✓	
		Parachironomus	arcuatus gr.	✓	✓	✓			
		Paratanytarsus	x					✓	
		Pentaneura	x	✓	✓			✓	
		Phaenopsectra	obediens gr.			✓			✓
		Polypedilum	flavum	✓	✓	✓	✓	✓	✓
			illinoense gr.		✓				✓
			scalaenum		✓				
		Pseudochironomus	x	✓					
		Rheocricotopus	robacki	✓	✓				
		Rheopelopia	x	✓	✓		✓	✓	
		Rheotanytarsus	x	✓	✓	✓	✓	✓	✓
		Stelechomyia	perpulchra	✓	✓	✓	✓	✓	
		Stenochironomus	x		✓				
		Tanytarsus	curticornis gr.			✓			
			pallidicornis&aculeatus gr.	✓	✓		✓		✓
			sp. D	✓	✓	✓		✓	✓
			sp. E				✓		✓
		Thienemanniella	x	✓	✓	✓	✓	✓	✓
		Thienemannimyia gr.	x	✓	✓			✓	
	Empididae	Hemerodromia	x	✓	✓		✓	✓	
	Simuliidae	Simulium	x	✓	✓	✓	✓	✓	✓
Ephemeroptera	Baetidae	Baetis	x	✓	✓	✓	✓	✓	✓
	Caenidae	Caenis	hilaris	✓	✓	✓	✓	✓	✓
	Heptageniidae	Heptagenia	flavescens	✓	✓		✓	✓	
		Stenonema	exiguum	✓	✓	✓	✓	✓	✓
			integrum	✓	✓	✓	✓	✓	✓
			type A	✓	✓	✓	✓	✓	✓
		unknown	x	✓	✓		✓	✓	
	Isonychiidae	Isonychia	x	✓	✓	✓	✓	✓	✓
	Leptohyphidae	Asioplax	dolani	✓	✓	✓	✓	✓	✓
		Tricorythodes	fictus	✓	✓	✓	✓	✓	✓
Gastropoda	Ancylidae	x	x	✓	✓	✓	✓	✓	✓
Hydracarina	x	x	x	✓	✓	✓	✓	✓	✓
Hydroida	Hydridae	Hydra	x				✓		
Megaloptera	Corydalidae	Corydalus	cornutus	✓	✓	✓	✓	✓	✓
Odonata	Calopterygidae		early instar					✓	
	Coenagrionidae	Argia	x			✓			
Pelecypoda	Sphaeriidae		x			✓	✓	✓	
Plecoptera	Perlidae	x	x		✓				
	Perlidae	Neoperla	x	✓	✓				

(Continued on next page)

Table 3.20 Continued

Order	Family	Genus	Species	Tallahalla	New Augusta	Downstream	Bogue	Thompson	McLain
Plecoptera	Perlidae	Paragnetina	x			✓	✓	✓	
		Perlesta	x	✓			✓	✓	
		x	x		✓				
Trichoptera	Hydropsychidae	Cheumatopsyche	x	✓	✓	✓	✓	✓	✓
		Hydropsyche	x	✓	✓	✓	✓	✓	✓
		Potamyia	flava		✓		✓		
		x	x	✓	✓	✓	✓	✓	✓
	Hydroptilidae	Hydroptila	x	✓	✓	✓	✓	✓	✓
		Mayatrichia	x		✓		✓		
		Oxyethira	x	✓	✓	✓	✓	✓	
	Leptoceridae	Ceraclea	x	✓			✓		
		Nectopsyche	x		✓	✓	✓		
		Oecetis	x		✓			✓	
	Philopotamidae	Chimarra	x	✓	✓	✓	✓	✓	✓
	Polycentropodidae	Cyrnellus	fraternus			✓			✓
		Neureclipsis	x	✓	✓		✓	✓	✓
		Nictiophylax	x	✓	✓				

Table 3.21 Leaf River Benthic Macroinvertebrate Taxa List by Sampling Site Using Natural Woody Substrate, Study Year 2000 to 2001

Order	Family	Genus	Species	Tallahala	New Augusta	Downstream	Bogue	Thomspon	McLain
Coleoptera	Elmidae	x	x					✓	
		Macronychus	glabratus	✓	✓		✓	✓	✓
		Stenelmis	x	✓			✓	✓	
Diptera	Chironomidae	Ablabesmyia	mallochi	✓			✓	✓	
		Cricotopus	bicinctus	✓		✓			
		Cricotopus/Orthocladius gr.	x	✓					✓
		Nanocladius	crassicornis	✓					
		Polypedilum	flavum	✓		✓			
		Rheotanytarsus	x	✓	✓	✓	✓	✓	
		Thienemanniella	x	✓		✓			
		Thienemannimyia gr.	x	✓	✓	✓	✓	✓	✓
	Empididae	Hemerodromia	x			✓		✓	
	Simuliidae	x	x		✓				
		Simulium	x	✓	✓	✓	✓		
	Tabanidae	Chrysops	x						✓
Ephemeroptera	Baetidae	x	x		✓			✓	
		Baetis	x	✓	✓	✓	✓	✓	✓
			intercalaris	✓		✓	✓	✓	✓
		Heterocloeon	x		✓				
		Procloeon	x				✓	✓	✓
			rivulare					✓	
	Caenidae	x	x					✓	
		Caenis	hilaris	✓			✓	✓	
	Heptageniidae	x	x		✓				
		Heptagenia	x	✓		✓	✓	✓	✓
			flavescens						✓
		Stenonema	exiguum	✓			✓	✓	✓
			mexicanum		✓	✓		✓	
			terminatum	✓		✓	✓	✓	✓
	Isonychiidae	Isonychia	sicca		✓			✓	
	Leptohyphidae	Asioplax	dolani	✓					
		Tricorythodes	fictus	✓	✓	✓	✓	✓	✓
	Tricorythidae	Tricorythodes	x	✓			✓	✓	✓
Hemiptera	Naucoridae	Pelocoris	x						✓
Hydracarina	x	x	x	✓					
Megaloptera	Corydalidae	Corydalus	x	✓			✓		
Odonata	Coenagrionidae	Argia	x	✓					✓
	Gomphidae	Erpetogomphus	x	✓					
Plecoptera	Perlidae	x	x		✓		✓		
		Beloneuria	x	✓					✓
		Neoperla	x						✓
		Paragnetina	x		✓		✓		
		Perlesta	x				✓		✓
Trichoptera	Hydropsychidae	x	x		✓				
		Cheumatopsyche	x	✓	✓	✓	✓	✓	✓
		Hydropsyche	x	✓		✓	✓		
			type A	✓	✓		✓	✓	✓
			type B	✓	✓	✓		✓	✓
	Hydroptilidae	x	x		✓				
		Hydroptila	x			✓	✓		
		Oxyethira	x	✓		✓			
	Leptoceridae	Ceraclea	x	✓	✓	✓	✓	✓	
	Philopotamidae	Chimarra	x	✓			✓	✓	
	Polycentropodidae	Neureclipsis	x	✓					
		Nictiophylax	x	✓					

Table 3.22 Leaf River Benthic Macroinvertebrate Community Summary Using Hester-Dendy Plates, Study Year 2000 to 2001

Date	Site	Total # Taxa	% EPT[1]	% Chironomidae	% Diptera	Total Abundance (count/site)
October 2000	Tallahalla	37	60.2	37.4	38.4	1933
October 2000	New Augusta	39	72.3	25.0	27.2	2829
October 2000	Downstream	42	70.3	26.4	27.0	1224
October 2000	Bogue	28	53.3	27.0	44.6	1732
October 2000	Thompson	34	60.3	33.6	38.7	1546
October 2000	McLain	32	43.5	48.5	53.5	823
May 2001	Tallahalla	39	59.1	39.7	40.5	3163
May 2001	New Augusta	44	66.8	32.3	32.9	3699
May 2001	Downstream	no sample				
May 2001	Bogue	37	44.0	54.5	55.2	3598
May 2001	Thompson	38	42.6	57.2	57.3	3972
May 2001	McLain	no sample				

[1] EPT = Ephemeroptera, Plecoptera, Trichoptera taxa

Table 3.23 Leaf River Benthic Macroinvertebrate Community Summary Using Natural Woody Substrate, Study Year 2000 to 2001

Date	Site	Total # Taxa	% EPT[1]	% Chironomidae	% Diptera	Total Abundance (count/site)
October 2000	Tallahalla	14	90.3	0.0	1.6	62
October 2000	New Augusta	13	83.6	0.0	16.4	116
October 2000	Downstream	5	100.0	0.0	0.0	16
October 2000	Bogue	12	93.3	0.0	5.0	60
October 2000	Thompson	7	97.5	0.0	0.0	40
October 2000	McLain	9	63.6	0.0	9.1	11
May 2001	Tallahalla	23	78.3	18.9	18.9	143
May 2001	New Augusta	9	72.1	20.9	23.3	43
May 2001	Downstream	16	69.8	29.1	30.2	179
May 2001	Bogue	16	84.3	7.8	7.8	51
May 2001	Thompson	19	86.0	7.0	8.8	57
May 2001	McLain	12	96.4	3.6	3.6	55

[1] EPT = Ephemeroptera, Plecoptera, Trichoptera taxa

Table 3.24 Leaf River Benthic Macroinvertebrate Biomass Using Hester-Dendy Plates, Study Year 2000 to 2001 (means for 3 replicates)

	Mean Dry Weight (g/m^2)					
	Tallahala	New Augusta	Downstream	Bogue	Thompson	McLain
10/16/00	2.1566	2.9176	1.7929	1.9217	2.3622	1.4472
03/17/01	4.2775	8.5940	no data	6.2711	9.2779	no data

	Mean Ash-Free Dry Weight (g/m^2)					
	Tallahala	New Augusta	Downstream	Bogue	Thompson	McLain
10/16/00	1.2494	1.8026	1.0225	1.0393	0.6183	1.1457
03/17/01	3.2393	7.3131	no data	5.0390	8.1135	no data

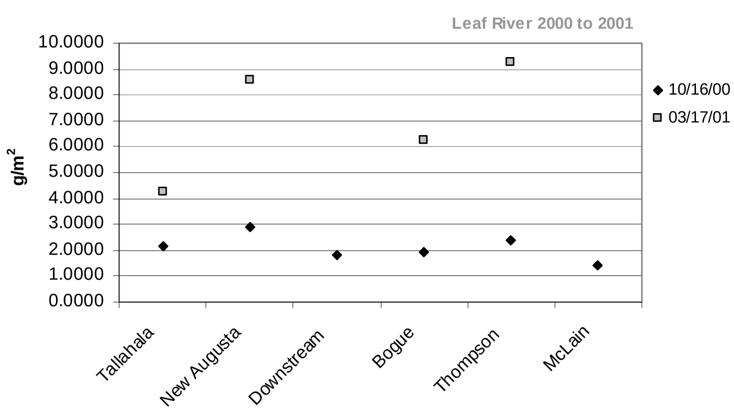


Figure 3.82 Leaf River Benthic Macroinvertebrate Mean Dry Weight Using Hester-Dendy Plates

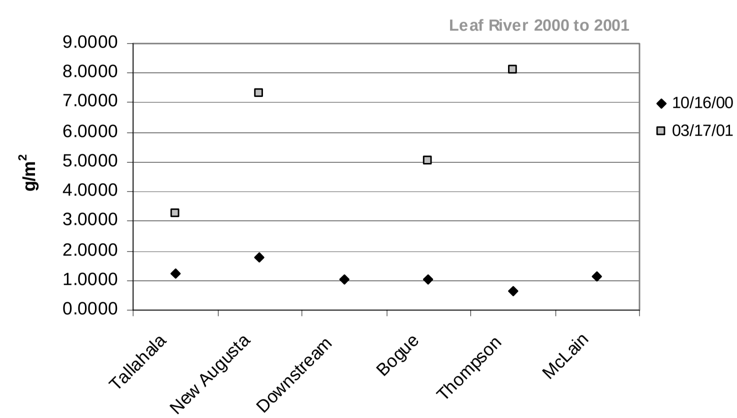


Figure 3.83 Leaf River Benthic Macroinvertebrate Mean Ash-Free Dry Weight Using Hester-Dendy Plates

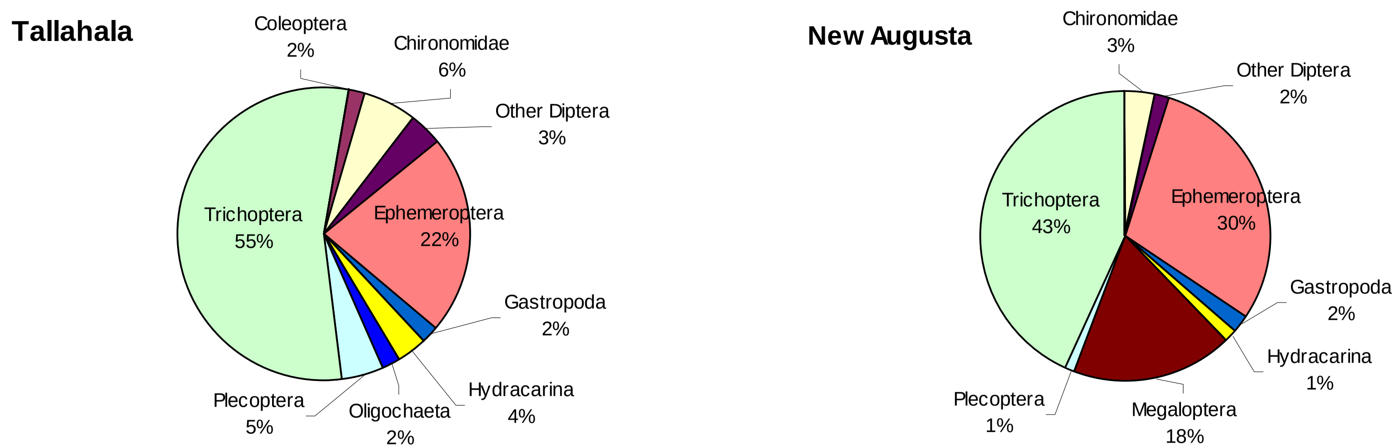


Figure 3.84 Benthic Macroinvertebrate Family Distribution by Percent Dry Weight for the Leaf River Sampling Sites Upstream of Mill Discharge Using Hester-Dendy Plates, Study Year 2000 to 2001 (represents the sum of all replicates and seasonal samples for the entire study year for all families contributing >1% of the total)

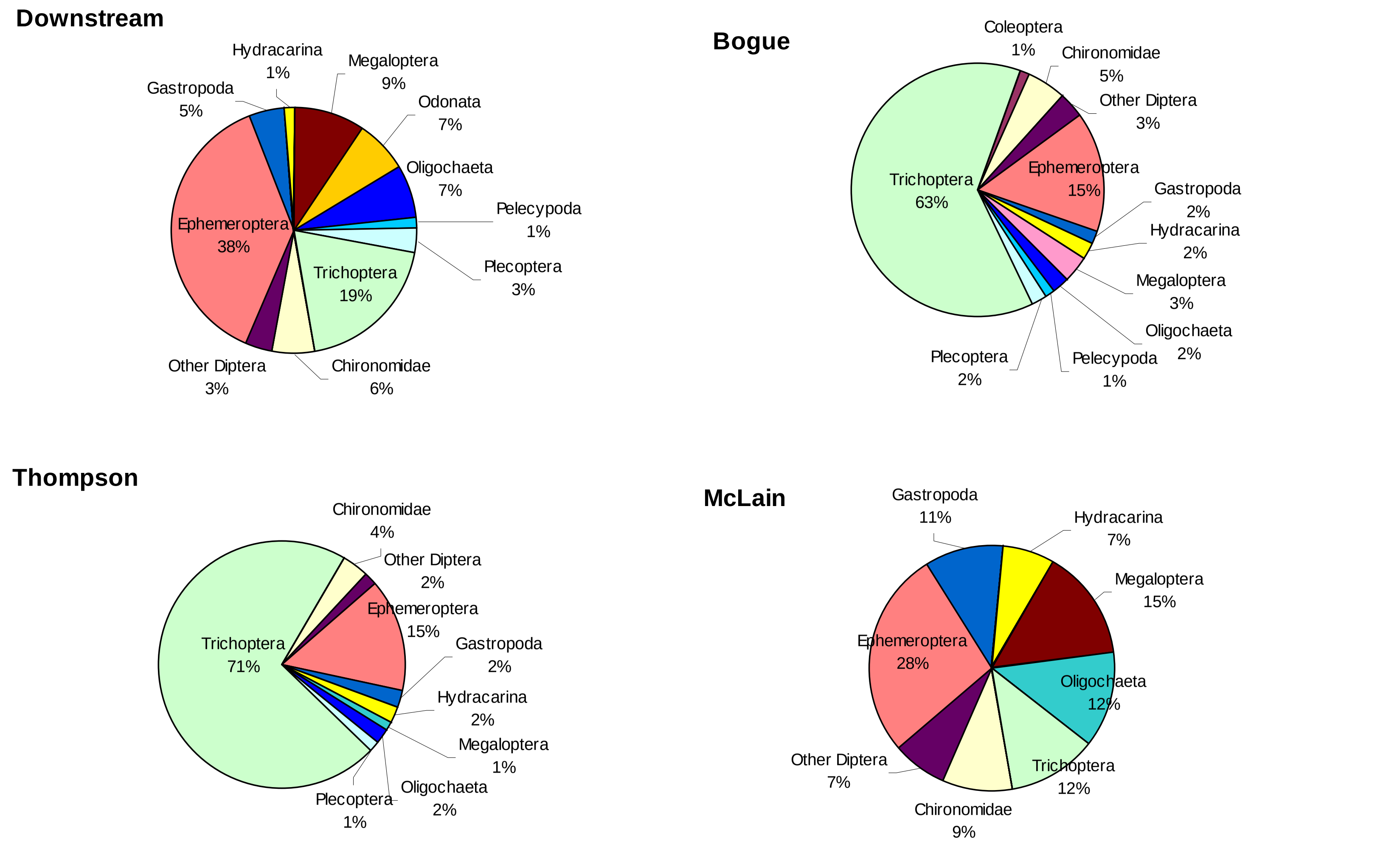


Figure 3.85 Benthic Macroinvertebrate Family Distribution by Percent Dry Weight for the Leaf River Sampling Sites Downstream of Mill Discharge Using Hester-Dendy Plates, Study Year 2000 to 2001 (represents the sum of all replicates and seasonal samples for the entire study year for all families contributing >1% of the total)

3.8.3 *McKenzie River Benthic Macroinvertebrates*

Table 3.25 McKenzie River Benthic Macroinvertebrate Taxa List by Sampling Site, Study Year 2000 to 2001

Order	Family	Genus	Species	Armitage RM 6	Harvest RM 10	Mohawk RM 14	Bellingers RM 18.5	Walterville RM 20.5
Amphipoda	Gammaridae	x	x	✓				
		Gammarus	x	✓	✓	✓		
Coleoptera	Dytiscidae	x	x					✓
		Hydrovatus	x	✓	✓	✓	✓	✓
		Oreodytes	x	✓			✓	
	Elmidae	x	x	✓	✓	✓	✓	✓
		Ampumixis	dispar	✓			✓	✓
		Cleptelmis	x	✓		✓		
		Gonielmis	x			✓		
		Heterlimnius	x					✓
		Macronychus	glabratus	✓		✓	✓	✓
		Narpus	x	✓	✓	✓	✓	✓
		Optioservus	x	✓	✓	✓	✓	✓
		Rhizelmis	nigra		✓	✓	✓	✓
		Rhizelmis	x					✓
		Stenelmis	x				✓	✓
		Zaitzevia	x	✓	✓	✓	✓	✓
Diptera	x	x	x				✓	✓
	Ceratopogonidae	x	x	✓				✓
		cf. Bezzia	x				✓	✓
		Culicoides	x	✓				
		Probezzia	x				✓	
	Chironomidae	Ablabesmyia	mallochi	✓		✓		
		Brillia	flavifrons	✓	✓	✓	✓	✓
		Cardiocladius	x	✓	✓	✓	✓	✓
		Chironomus	x	✓		✓		
		Cladotanytarsus	vanderwulpi gr. A				✓	✓
			vanderwulpi gr. B	✓		✓	✓	
			vanderwulpi gr. C				✓	✓
		Conchapelopia	fasciata gr.		✓		✓	✓
		Corynoneura	x	✓	✓	✓	✓	✓
		Cricotopus	x	✓	✓	✓	✓	
			bicinctus	✓	✓	✓	✓	✓
			nostocicola	✓	✓	✓	✓	✓
			sp. B	✓	✓		✓	✓
			sp. C	✓	✓	✓	✓	✓
			trifascia	✓	✓	✓	✓	
		Cricotopus/Orthocladius gr.	x	✓	✓	✓	✓	✓
		Cryptochironomus	cf. sorex	✓		✓		
		Demichryptochironomus	x		✓		✓	
		Diamesa	x	✓		✓		✓
		Dicrotendipes	fumidus	✓	✓			
		Eukiefferiella	brehmi gr.		✓		✓	✓
			claripennis gr.	✓	✓	✓	✓	✓
			coerulescens gr.	✓	✓	✓	✓	✓
			devonica gr.	✓	✓	✓	✓	✓
			gracei gr.		✓		✓	✓
			pseudomontana gr.	✓	✓	✓	✓	✓
		Euryhapsis	x				✓	
		Heleniella	x	✓	✓	✓	✓	✓
		Heterotrissocladius	marcidus gr.	✓		✓	✓	✓
		Krenosmittia	x		✓	✓	✓	✓
		Limnophyes	x				✓	✓
		Lopescladius	x				✓	✓
		Micropsectra	x	✓	✓	✓	✓	✓
			sp. A	✓	✓	✓	✓	✓
			sp. B			✓		
		Microtendipes	pedellus gr.	✓	✓	✓	✓	✓

(Continued on next page)

Table 3.25 Continued

Order	Family	Genus	Species	Armitage RM 6	Harvest RM 10	Mohawk RM 14	Bellingers RM 18.5	Walterville RM 20.5
Diptera	Chironomidae	Monodiamesa	x	✓		✓	✓	
		Nanocladius	crassicornis	✓	✓	✓	✓	
			distinctus	✓	✓	✓	✓	✓
			rectinervis	✓	✓	✓	✓	✓
		Nilotanypus	fimbriatus	✓	✓	✓	✓	✓
		Nimbocera	sp. A	✓		✓	✓	
		Orthocladius	x			✓	✓	✓
			ashei	✓	✓	✓	✓	✓
			ashei/rivicola	✓	✓	✓	✓	✓
			carlatus		✓			
			curtiseta	✓	✓		✓	✓
			luteipes	✓	✓	✓	✓	
			mallochi	✓	✓	✓	✓	✓
			rivicola			✓		✓
			rivulorum	✓	✓	✓	✓	
			saxosus		✓	✓		
			sp. A				✓	
			sp. B	✓	✓			✓
			sp. C	✓	✓	✓	✓	✓
		Pagastia	x			✓		
			partica	✓	✓	✓		✓
			sp. A	✓	✓	✓		✓
		Paracladopelma	undine	✓		✓	✓	
			winnelli				✓	
		Parakiefferiella	x	✓	✓	✓	✓	
		Parametriocnemus	x		✓		✓	✓
		Paratanytarsus	x	✓	✓	✓	✓	✓
			tenellulus gr.	✓	✓	✓	✓	
		Pentaneura	x	✓	✓	✓	✓	
		Phaenopsectra	obediens gr.	✓	✓	✓	✓	
			punctipes gr.	✓				
		Polypedilum	aviceps	✓	✓	✓	✓	✓
			laetum	✓	✓		✓	✓
			fallax	✓	✓	✓	✓	✓
			flavum	✓				
			illinoense gr.			✓		
			scalaenum	✓	✓	✓	✓	✓
			tritum	✓	✓	✓	✓	✓
		Potthastia	gaedii gr.	✓	✓	✓	✓	✓
			longimana	✓	✓	✓	✓	✓
		Procladius	x	✓				
		Rheocricotopus	eminellobus		✓	✓	✓	✓
			robacki	✓	✓	✓	✓	✓
		Rheopelopia	x		✓			✓
			perda				✓	
		Rheotanytarsus	x	✓	✓	✓	✓	✓
		Robackia	demeijerei				✓	✓
		Smittia	x				✓	
		Stempellina	x	✓			✓	
		Stempellinella	x		✓	✓	✓	
		Sublettea	coffmani	✓	✓	✓	✓	✓
		Symposiocladius	lignicola				✓	
		Sympotthastia	x		✓			
		Synorthocladius	semivirens	✓	✓	✓	✓	✓
		Tanytarsus	curticornis gr.	✓	✓	✓	✓	✓
			gregarius & lugens gr.	✓				
			pallidicornis&aculeatus gr.	✓	✓	✓	✓	✓
			sp. D			✓		
		Thienemanniella	x	✓	✓	✓	✓	✓
		Thienemannimyia gr.	x	✓	✓	✓	✓	✓
		Tvetenia	bavarica gr.		✓	✓	✓	✓
			discoloripes gr.	✓	✓			✓

(Continued on next page)

Table 3.25 Continued

Order	Family	Genus	Species	Armitage RM 6	Harvest RM 10	Mohawk RM 14	Bellingers RM 18.5	Walterville RM 20.5
Diptera	Empididae	x	x					✓
		Chelifera	x	✓	✓	✓	✓	✓
		Hemerodromia	x	✓	✓	✓	✓	✓
		Trichoclinocera	x				✓	✓
	Muscidae	x	x	✓			✓	
	Simuliidae	x	x		✓			
		Prosimulium	x		✓			✓
		Simulium	x		✓		✓	✓
	Tabanidae	Chrysops	x	✓				
	Tanyderidae	x	x		✓			✓
		Protanyderus	x			✓	✓	✓
	Tipulidae	x	x					✓
		Antocha	x	✓	✓	✓	✓	✓
		Cryptolabis	x					✓
		Dicranota	x				✓	✓
		Hesperoconopa	x				✓	✓
		Hexatoma	x					✓
Ephemeroptera	Baetidae	x	x			✓	✓	✓
		Acentrella	x	✓	✓	✓	✓	✓
		Baetis	x	✓	✓	✓	✓	✓
		Diphetor	hageni	✓	✓	✓	✓	✓
		Heterocloeon	x		✓			
		Procloeon	x	✓				
	Ephemerellidae	x	x	✓	✓	✓	✓	✓
		Attenella	margarita	✓	✓	✓	✓	✓
		Caudatella	x		✓			
		Drunella	x		✓	✓	✓	✓
			doddsi		✓			
			type A		✓	✓	✓	✓
		Epeorus	x		✓			✓
		Ephemerella	x	✓	✓	✓	✓	✓
			aurivilli		✓			✓
			inermis		✓			
		Eurylophella	x				✓	
		Serratella	levis	✓	✓	✓	✓	✓
			tibialis		✓		✓	✓
		Timpanoga	hecuba				✓	✓
	Heptageniidae	x	x	✓	✓	✓	✓	✓
		Epeorus (Iron)	x	✓	✓	✓	✓	✓
		Heptagenia	x	✓	✓	✓	✓	✓
		Leucrocuta	x				✓	
		Rithrogena	x	✓	✓	✓	✓	✓
		Stenonema	x	✓				
	Leptophlebiidae	x	x	✓	✓		✓	✓
		Leptophlebia	x	✓	✓	✓		✓
		Paraleptophebia	x		✓	✓	✓	
			bicornuta	✓	✓	✓	✓	✓
			sp. B	✓	✓	✓	✓	✓
		Tricorythodes	x	✓	✓		✓	
Gastropoda	x	x	x	✓	✓	✓		
	Ancylidae	x	x		✓	✓		
	Hydrobiidae	x	x		✓			
		Amnicola	x	✓	✓	✓		
	Physidae	Physella	x	✓	✓	✓	✓	
	Planorbidae	x	x		✓	✓		✓
		Gyraulus	x		✓			
		Vorticifex	effusa	✓	✓	✓	✓	✓
	Pleuroceridae	Juga	x	✓	✓	✓	✓	✓
			hemphilli				✓	✓
			plicifera	✓	✓	✓	✓	✓
Hemiptera	Corixidae	Sigara	x	✓				
Hydracarina	x	x	x	✓	✓	✓	✓	✓

(Continued on next page)

Table 3.25 Continued

Order	Family	Genus	Species	Armitage RM 6	Harvest RM 10	Mohawk RM 14	Bellingers RM 18.5	Walterville RM 20.5
Hydroida	Hydridae	Hydra	x	✓	✓	✓	✓	
Lepidoptera	Pyralidae	Petrophila	x	✓		✓		
Odonata	Gomphidae	x	x					✓
Oligochaeta	x	x	x	✓	✓	✓	✓	✓
Pelecypoda	Sphaeriidae	x	x			✓	✓	
Plecoptera	x	x	x	✓	✓	✓	✓	
	Capniidae	x	x	✓	✓	✓	✓	✓
	Chloroperlidae	x	x	✓		✓	✓	✓
		Neaviperla	forcipata				✓	
		Suwallia	x	✓	✓	✓	✓	✓
		Sweltsa	x		✓		✓	
	Leuctridae	x	x	✓			✓	
		Despaxia	augusta	✓	✓		✓	✓
	Nemouridae	x	x		✓	✓	✓	✓
		Malenka	x		✓	✓	✓	
		Zapada	x		✓	✓		
		Zapada	cinctipes		✓		✓	✓
	Perlidae	x	x	✓	✓		✓	✓
		Calineuria	californica	✓	✓	✓	✓	✓
		Claassenia	sabulosa	✓	✓	✓	✓	✓
		Hesperoperla	pacifica		✓		✓	✓
	Perlodidae	x	x	✓	✓	✓	✓	✓
		Cascadoperla	trictura		✓		✓	
		Cultus	x		✓	✓	✓	✓
		Isogenoides	x		✓		✓	
		Isoperla	type A	✓	✓	✓	✓	✓
			type B				✓	✓
			type C	✓	✓		✓	✓
		Osobenus	yakimae		✓			
		Perlinodes	aureus				✓	✓
		Skwala	x	✓	✓	✓	✓	✓
			curvata		✓		✓	
	Pteronarcyidae	Pteronarcys	x				✓	✓
			californica		✓	✓		✓
Trichoptera	x	x	x	✓	✓	✓	✓	✓
	Brachycentridae	x	x					✓
		Amiocentrus	aspilus			✓		✓
		Brachycentrus	x	✓	✓			
			occidentalis	✓	✓	✓	✓	✓
		Micrasema	x					✓
	Glossosomatidae	x	x	✓	✓		✓	✓
		Glossosoma	x	✓	✓	✓	✓	✓
	Hydropsychidae	x	x	✓	✓	✓	✓	✓
		Arctopsyche	grandis	✓	✓	✓	✓	✓
		Cheumatopsyche	x	✓	✓		✓	
		Hydropsyche	x	✓	✓	✓	✓	✓
	Hydroptilidae	Hydroptila	x	✓	✓	✓	✓	✓
	Lepidostomatidae	Lepidostoma	x	✓	✓	✓	✓	✓
	Leptoceridae	Ceraclea	x	✓	✓	✓		
		Mystacides	alafimbriata	✓				
	Leptoceridae	Oecetis	x	✓				
	Limnephilidae	x	x				✓	✓
		Asynarchus	x					✓
			gilvipes	✓		✓	✓	✓
	Philopotamidae	Chimarra	x				✓	✓
	Psychomyiidae	psychomyia	flavida				✓	
	Rhyacophilidae	Rhyacophila	x		✓		✓	✓
			arnaudi		✓	✓	✓	✓
			type A				✓	✓
			type B	✓	✓	✓	✓	✓
			type C		✓	✓	✓	✓
Tricladida	x	x	x	✓	✓	✓	✓	✓

Table 3.26 McKenzie River Benthic Macroinvertebrate Community Summary, Study Year 2000 to 2001

Date	Site	Total # Taxa	% EPT[1]	% Chironomidae	% Diptera	Total Abundance (count/site)
September 2000	Armitage RM6	62	33.6	41.5	41.8	3188
September 2000	Harvest RM10	98	27.9	58.2	58.6	15965
September 2000	Mohawk RM14	62	13.6	53.9	56.0	2360
September 2000	Bellingers RM18.5	77	39.7	41.9	50.9	3649
September 2000	Walterville RM20.5	96	44.7	39.6	41.5	5891
December 2000	Armitage RM6	58	68.8	19.1	20.3	2062
December 2000	Harvest RM10	65	53.8	42.2	42.5	10154
December 2000	Mohawk RM14	54	20.2	22.5	28.0	4328
December 2000	Bellingers RM18.5	57	47.5	35.0	46.8	4160
December 2000	Walterville RM20.5	66	72.9	16.5	21.1	4319
March 2001	Armitage RM6	67	26.6	67.8	68.6	8103
March 2001	Harvest RM10	79	52.0	41.6	42.2	13541
March 2001	Mohawk RM14	67	16.8	51.5	54.8	9987
March 2001	Bellingers RM18.5	81	41.3	46.4	51.6	6871
March 2001	Walterville RM20.5	74	39.4	38.7	42.5	5210
July 2001	Armitage RM6	92	6.4	69.9	69.6	10306
July 2001	Harvest RM10	92	14.7	59.6	61.9	14642
July 2001	Mohawk RM14	75	2.8	16.8	18.1	19138
July 2001	Bellingers RM18.5	94	14.5	67.6	69.9	11852
July 2001	Walterville RM20.5	95	19.2	49.2	52.5	11346

[1] EPT = Ephemeroptera, Plecoptera, Trichoptera taxa

Table 3.27 McKenzie River Benthic Macroinvertebrate Biomass, Study Year 2000 to 2001(means for 5 replicates)

	Mean Dry Weight (g/m^2)				
	Walterville RM 20.5	Bellingers RM 18.5	Mohawk RM 14	Harvest RM 10	Armitage RM 6
9/21/2000	2.8184	1.7798	1.9879	4.2267	1.3835
12/7/2000	4.9300	3.1933	3.0749	8.8056	3.4505
3/8/2001	8.2751	7.8749	4.8853	11.1681	4.8612
7/12/2001	4.4214	5.4984	8.2512	8.6844	6.2756

	Mean Ash Free Dry Weight (g/m^2)				
	Walterville RM 20.5	Bellingers RM 18.5	Mohawk RM 14	Harvest RM 10	Armitage RM 6
9/21/2000	1.1860	0.9063	1.1470	2.3140	0.6502
12/7/2000	2.1547	1.5123	1.6205	5.3107	1.6719
3/8/2001	6.4118	5.1028	2.7230	8.3900	3.1895
7/12/2001	2.7926	3.7337	3.1149	5.5419	2.8256

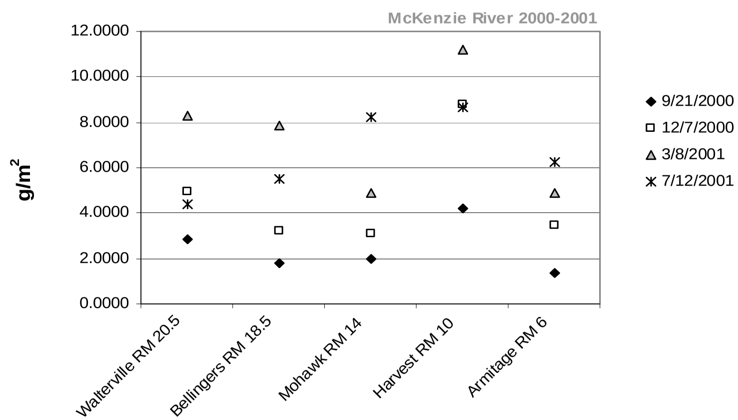


Figure 3.86 McKenzie River Benthic Macroinvertebrate Mean Dry Biomass

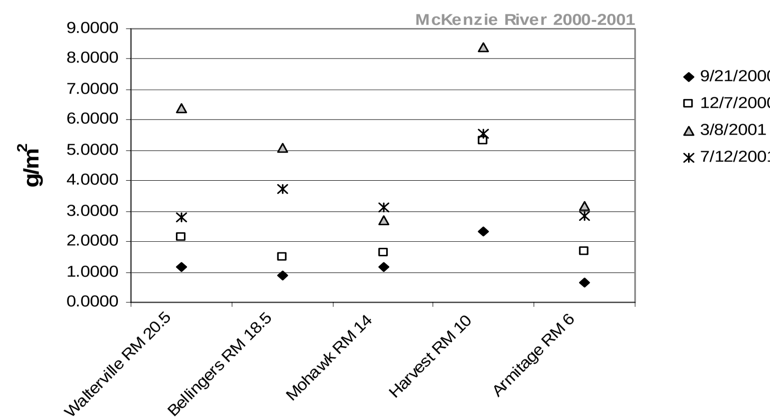
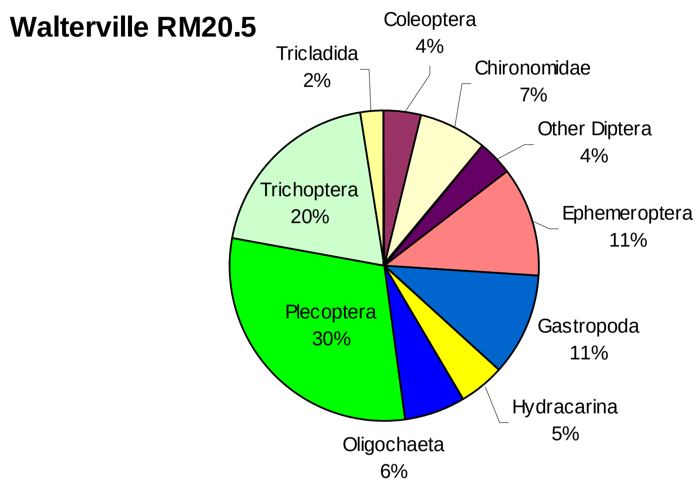


Figure 3.87 McKenzie River Benthic Macroinvertebrate Mean Ash- Free Dry Biomass



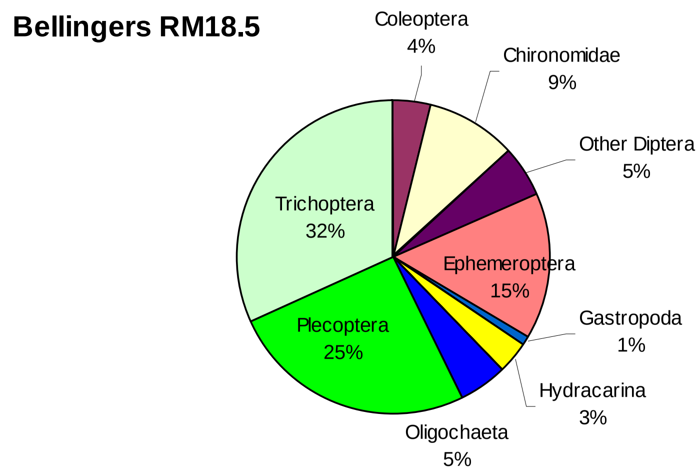


Figure 3.88 Benthic Macroinvertebrate Family Distribution by Percent Dry Weight for the McKenzie River Sampling Sites Upstream of Mill Discharge, Study Year 2000 to 2001 (represents the sum of all replicates and seasonal samples for the entire study year for all families contributing >1% of the total)

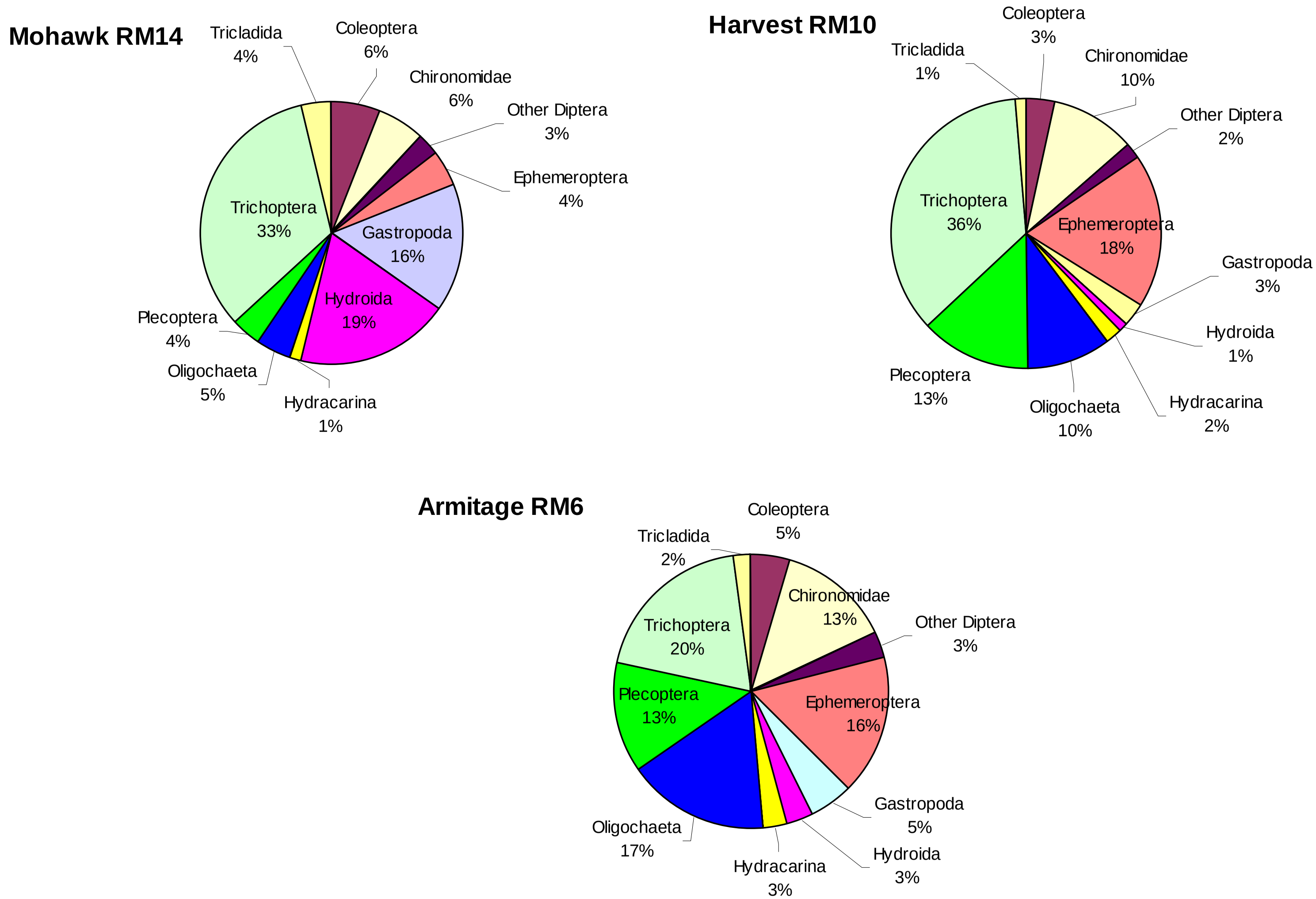


Figure 3.89 Benthic Macroinvertebrate Family Distribution by Percent Dry Weight for the McKenzie River Sampling Sites Downstream of Mill Discharge, Study Year 2000 to 2001 (represents the sum of all replicates and seasonal samples for the entire study year for all families contributing >1% of the total)

3.8.4 *Willamette River Benthic Macroinvertebrates*

Table 3.28 Willamette River Benthic Macroinvertebrate Taxa List by Sampling Site, Study Year 2000 to 2001

Order	Family	Genus	Species	Corvallis RM128	Willamette RM134	Snag Boat RM143.5	Sam Daws RM145.5	Intake RM148	Cartney RM156	Harrisburg RM160	Whitely RM176
Amphipoda	Gammaridae	x	x	✓	✓	✓	✓	✓	✓	✓	✓
		Gammarus	x	✓	✓	✓	✓	✓	✓	✓	✓
Coleoptera	x	x	x							✓	✓
	Dytiscidae	x	x		✓	✓	✓	✓	✓	✓	✓
		Oreodytes	x		✓	✓	✓	✓	✓	✓	✓
	Elmidae	x	x		✓		✓			✓	✓
		Cleptelmis	x								✓
		Dubiraphia	x			✓					
		Gonielmis	x	✓							
		Narpus	x	✓	✓	✓	✓	✓	✓	✓	✓
		Optioservus	x	✓	✓	✓	✓	✓	✓	✓	✓
		Ordobrevia	x					✓	✓		
			nubrifera				✓	✓			✓
		Rhizelmis	nigra								✓
		Stenelmis	x		✓		✓				
		Zaitzevia	x	✓	✓	✓	✓	✓	✓	✓	✓
	Haliplidae	x	x				✓				✓
		Brychius	x	✓		✓				✓	✓
		Halipus	x	✓							
	Hydrophilidae	x	x		✓		✓	✓		✓	
		Hydrobius	x				✓				
Diptera	x	x	x				✓				
	Ceratopogonidae	x	x				✓			✓	
		Culicoides	x		✓		✓	✓			
	Chironomidae	Ablabesmyia	x				✓				
			mallochi	✓	✓	✓			✓		✓
			rhamphe gr.	✓							
		Brillia	flavifrons		✓	✓	✓	✓	✓	✓	✓
		Cardiocladius	x		✓	✓	✓	✓	✓	✓	✓
		Chironomus	x	✓		✓				✓	✓
		Cladotanytarsus	x				✓				
			mancus gr.		✓		✓				
			vanderwulpi gr. A							✓	
			vanderwulpi gr. B	✓	✓	✓	✓	✓	✓	✓	✓
		Conchapelopia	x				✓				
			fasciata gr.		✓			✓	✓	✓	
		Corynoneura	x	✓	✓	✓	✓		✓	✓	
		Cricotopus	x		✓	✓	✓	✓	✓	✓	✓
			bicinctus	✓	✓	✓	✓	✓	✓	✓	✓
			cf. sylvestris	✓							
			sp. B	✓	✓	✓	✓	✓	✓	✓	✓
			sp. C	✓	✓	✓	✓	✓	✓	✓	✓
			trifascia	✓	✓	✓	✓	✓	✓	✓	✓
		Cricotopus/Orthocladius gr.	x	✓	✓	✓	✓	✓	✓	✓	✓
		Cryptochironomus	x				✓				
			cf. sorex	✓	✓	✓	✓	✓	✓	✓	✓
		Demichryptochironomus	x		✓			✓	✓		
		Diamesa	x	✓	✓	✓	✓	✓	✓	✓	✓
		Dicrotendipes	x				✓				
			fumidus	✓	✓	✓	✓	✓	✓	✓	✓
			neomodestus	✓	✓	✓			✓		
		Doncricotopus	bicaudatus								✓
		Endochironomus	x	✓							
		Eukiefferiella	x				✓				
			brehmi gr.								✓
			claripennis gr.	✓	✓		✓	✓	✓	✓	✓
			coerulescens gr.	✓	✓	✓	✓	✓	✓	✓	✓
			devonica gr.	✓	✓	✓	✓	✓	✓	✓	✓

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Table 3.28 Continued

Order	Family	Genus	Species	Corvallis RM128	Willamette RM134	Snag Boat RM143.5	Sam Daws RM145.5	Intake RM148	Cartney RM156	Harrisburg RM160	Whitely RM176
Diptera	Chironomidae	Eukiefferiella	pseudomontana gr.	✓	✓		✓	✓	✓	✓	✓
		Euryhapsis	x		✓			✓	✓	✓	✓
		Heleniella	x				✓	✓	✓		
		Heterotrissocladius	marcidus gr.	✓						✓	
		Limnophyes	x	✓							✓
		Micropsectra	x				✓				
			sp. A	✓	✓	✓	✓	✓	✓	✓	✓
			sp. B	✓	✓	✓		✓	✓	✓	✓
		Microtendipes	x				✓				
			pedellus gr.	✓	✓	✓	✓	✓	✓	✓	✓
		Monodiamesa	x				✓				
		Nanocladius	x				✓				
			crassicornis	✓	✓	✓	✓	✓	✓	✓	✓
			distinctus	✓		✓		✓	✓	✓	✓
			rectinervis	✓	✓	✓	✓	✓	✓	✓	✓
		Nilotanypus	fimbriatus							✓	
		Nilothauma	x	✓			✓				
		Nimbocera	x	✓	✓	✓	✓	✓	✓	✓	✓
			sp. A	✓	✓	✓	✓	✓	✓	✓	✓
			sp. B						✓		
		Orthocladius	x		✓	✓	✓	✓		✓	
			ashei	✓	✓	✓	✓	✓	✓	✓	✓
			ashei/rivicola	✓	✓	✓	✓	✓	✓	✓	✓
			carlatus		✓		✓	✓	✓	✓	✓
			luteipes		✓		✓	✓	✓	✓	✓
			mallochi	✓	✓	✓	✓	✓	✓	✓	✓
			rivicola	✓	✓	✓	✓	✓	✓	✓	✓
			rivulorum		✓		✓	✓	✓	✓	✓
			sp. A								
			sp. B		✓		✓				✓
			sp. C	✓	✓	✓	✓	✓	✓	✓	✓
		Pagastia	partica				✓		✓	✓	✓
			sp. A					✓			✓
		Parachironomus	x				✓				
			cf. tenuicaudatus		✓				✓	✓	
		Paracladopelma	undine		✓				✓	✓	
		Parakiefferiella	x				✓	✓			✓
		Parametriocnemus	x	✓		✓		✓			✓
		Paratanytarsus	x				✓				
			tenellulus gr.	✓	✓	✓	✓	✓	✓	✓	✓
		Pentaneura	x		✓		✓	✓	✓	✓	
		Phaenopsectra	x				✓				
			obediens gr.	✓	✓	✓	✓	✓	✓	✓	✓
			punctipes gr.			✓					
		Polypedilum	x				✓				
			aviceps	✓	✓	✓	✓	✓	✓	✓	✓
			fallax	✓	✓	✓	✓	✓	✓	✓	✓
			flavum		✓			✓	✓	✓	
			illinoense gr.	✓							
			laetum	✓	✓	✓		✓	✓	✓	✓
			scalaenum	✓	✓	✓	✓		✓	✓	
			tritum						✓		
		Potthastia	x				✓				
			gaedii gr.	✓	✓	✓	✓	✓	✓	✓	✓
			longimana		✓	✓	✓	✓	✓	✓	✓
		Procladius	x	✓		✓				✓	
		Pseudochironomus	x	✓		✓	✓				✓
		Pseudosmittia	x	✓	✓	✓					
		Rheocricotopus	eminellobus							✓	
			robacki	✓	✓		✓	✓	✓	✓	✓
		Rheotanytarsus	x	✓	✓	✓	✓	✓	✓	✓	✓
		Robackia	x				✓				
			demeijerei		✓	✓	✓	✓	✓	✓	✓

(Continued on next page)

Table 3.28 Continued

Order	Family	Genus	Species	Corvallis RM128	Willamette RM134	Snag Boat RM143.5	Sam Daws RM145.5	Intake RM148	Cartney RM156	Harrisburg RM160	Whitely RM176
Diptera	Chironomidae	Stempellinella	x		✓				✓		
		Stilocladius	x	✓							
		Stictochironomus	x			✓				✓	
		Sublettea	x				✓				
			coffmani		✓				✓	✓	
		Synorthocladius	x				✓				
			semivirens	✓	✓	✓	✓	✓	✓	✓	✓
		Tanytarsus	x				✓				
			curticornis gr.	✓	✓	✓	✓	✓		✓	
			eminulus gr.	✓	✓	✓	✓	✓	✓	✓	✓
			gregarius & lugens gr.	✓	✓	✓	✓	✓	✓	✓	✓
			pallidicornis&aculeatus gr.	✓	✓	✓	✓	✓	✓	✓	✓
			sp. D	✓	✓						✓
			sp. J	✓	✓	✓	✓	✓	✓	✓	
		Thienemanniella	x	✓	✓	✓	✓	✓	✓	✓	✓
		Thienemannimyia gr.	x	✓	✓	✓	✓	✓	✓	✓	✓
		Tvetenia	bavarica gr.						✓		✓
			discoloripes gr.	✓	✓	✓	✓	✓	✓	✓	✓
		Xenochironomus	xenolabis	✓							
	Dolichopodidae	x	x							✓	
	Empididae	Chelifera	x	✓	✓	✓	✓	✓	✓	✓	✓
		Hemerodromia	x	✓	✓	✓	✓	✓	✓	✓	✓
	Ephydridae	x	x	✓			✓				
	Limoniidae	Erioptera	x				✓				
	Simuliidae	x	x	✓	✓	✓		✓			
		Prosimulium	x		✓						
		Simulium	x	✓	✓		✓	✓	✓		✓
	Tabanidae	x	x				✓				
	Tanyderidae	Protanyderus	x					✓		✓	
	Tipulidae	x	x			✓	✓	✓			
		Antocha	x	✓	✓	✓	✓	✓	✓	✓	✓
Ephemeroptera	Ameletidae	Ameletus	velox	✓			✓			✓	
	Baetidae	x	x	✓		✓			✓	✓	✓
		Acentrella	x		✓	✓	✓	✓	✓	✓	✓
			insignificans	✓	✓	✓	✓	✓	✓	✓	✓
			turbida		✓			✓		✓	✓
		Baetis	x	✓	✓	✓	✓	✓		✓	✓
			tricaudatus	✓	✓	✓	✓	✓		✓	✓
		Diphetor	hageni		✓			✓		✓	
		Procloeon	x	✓	✓	✓		✓	✓	✓	
	Caenidae	Caenis	x		✓	✓	✓	✓	✓		
			latipennis		✓	✓	✓	✓		✓	
	Ephemerellidae	x	x		✓		✓	✓	✓		✓
		Attenella	x		✓		✓				
			margarita		✓	✓		✓	✓	✓	✓
		Caudatella	heterocaudata		✓			✓		✓	
		Ephemerella	aurivilli		✓						
			inermis	✓	✓	✓	✓	✓	✓	✓	✓
			infrequens	✓	✓	✓	✓	✓	✓	✓	✓
		Eurylophella	x	✓					✓		
			lodi			✓					
		Serratella	x				✓				
			levis	✓	✓	✓		✓	✓	✓	✓
	Heptageniidae	x	x	✓	✓	✓		✓	✓	✓	✓
		Epeorus	albertae	✓	✓		✓	✓	✓	✓	✓
		Nixe	x				✓				
			criddlei	✓	✓	✓	✓	✓	✓	✓	✓
		Rithrogena	x		✓	✓	✓	✓	✓		
			hageni	✓	✓	✓	✓	✓	✓	✓	✓
		Stenonema	x		✓	✓	✓			✓	
			terminatum	✓	✓	✓	✓	✓	✓	✓	✓

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Table 3.28 Continued

Order	Family	Genus	Species	Corvallis RM128	Willamette RM134	Snag Boat RM143.5	Sam Daws RM145.5	Intake RM148	Cartney RM156	Harrisburg RM160	Whitely RM176
Ephemeroptera	Leptophlebiidae	Asioplax	x				✓	✓			
			edmundsi						✓		
		Paraleptophebia	x	✓	✓	✓	✓	✓	✓	✓	
			bicornuta	✓	✓	✓		✓	✓	✓	✓
			vaciva			✓	✓	✓	✓	✓	
		Tricorythodes	x	✓	✓	✓	✓	✓	✓	✓	✓
			minutus	✓	✓	✓	✓	✓	✓	✓	✓
	Potamanthidae	Anthopotamus	x							✓	
Gastropoda	x	x	x	✓	✓	✓	✓	✓	✓		✓
	Ancylidae	x	x	✓	✓	✓	✓	✓	✓	✓	✓
	Hydrobiidae	x	x	✓	✓					✓	
		Amnicola	x	✓	✓	✓	✓	✓	✓	✓	✓
	Physidae	Physella	x	✓	✓	✓	✓	✓	✓	✓	✓
	Planorbidae	x	x		✓			✓			✓
		Gyraulus	x	✓	✓		✓	✓	✓	✓	✓
		Vorticifex	effusa		✓					✓	
	Pleuroceridae	Juga	x	✓			✓	✓			✓
			hemphilli								
			plicifera	✓	✓		✓	✓	✓	✓	✓
Hemiptera	Corixidae	x	x			✓	✓				
Hirudinea	x	x	x	✓	✓			✓	✓		
	Glossiphoniidae	Deserobdella	x				✓				
			picta	✓	✓	✓			✓	✓	✓
Hydracarina	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓
Hydroida	Hydridae	Hydra	x	✓	✓	✓	✓	✓	✓	✓	✓
Isopoda	Asellidae	x	x	✓							
		Caecidotea	x								✓
Lepidoptera	Pyralidae	x	x			✓				✓	
		Petrophila	x		✓	✓	✓	✓	✓	✓	✓
Odonata	Coenagrionidae	x	x	✓							
	Gomphidae	x	x				✓		✓		
		Ophiogomphus	x		✓		✓		✓	✓	
Oligochaeta	x	x	x		✓		✓	✓	✓	✓	✓
Pelecypoda	x	x	x		✓						✓
	Sphaeriidae	x	x	✓	✓	✓	✓	✓	✓	✓	✓
Plecoptera	x	x	x					✓	✓		
	Capniidae	x	x						✓		
	Chloroperlidae	x	x					✓	✓		
		Neaviperla	forcipata								
		Suwallia	x	✓			✓	✓		✓	
	Leuctridae	Despaxia	augusta	✓			✓				
	Perlidae	x	x					✓		✓	
		Calineuria	californica							✓	
		Claassenia	x				✓				
			sabulosa		✓		✓	✓	✓	✓	
	Perlodidae	x	x	✓	✓	✓	✓	✓	✓	✓	✓
		Isogenoides	x	✓	✓	✓	✓	✓	✓	✓	
		Isoperla	type A	✓	✓	✓	✓	✓	✓	✓	✓
			type C				✓	✓	✓	✓	✓
		Skwala	x	✓	✓			✓	✓	✓	
	Taeniopterygidae	Taenionema	x	✓			✓				
		Taeniopteryx	nivalis				✓				
Trichoptera	x	x	x					✓	✓		✓
	Brachycentridae	Amiocentrus	aspilus		✓						
		Brachycentrus	x				✓				✓
			occidentalis	✓	✓		✓	✓	✓	✓	✓
	Glossosomatidae	Glossosoma	x	✓	✓	✓	✓	✓	✓	✓	✓
		Protoptila	x	✓	✓						
	Goeridae	Goera	archaon	✓							
	Hydropsychidae	x	x	✓	✓	✓		✓	✓	✓	✓
		Cheumatopsyche	x	✓			✓	✓	✓	✓	✓
		Hydropsyche	x	✓	✓	✓	✓	✓	✓	✓	✓

(Continued on next page)

Table 3.28 Continued

Order	Family	Genus	Species	Corvallis RM128	Willamette RM134	Snag Boat RM143.5	Sam Daws RM145.5	Intake RM148	Cartney RM156	Harrisburg RM160	Whitely RM176
Trichoptera	Hydroptillidae	x	x			✓		✓	✓		✓
		Hydroptila	x	✓	✓	✓	✓	✓	✓	✓	✓
		Leucotrichia	pictipes		✓					✓	✓
	Lepidostomatidae	Lepidostoma	x	✓	✓	✓	✓	✓	✓	✓	✓
	Leptoceridae	x	x						✓		✓
		Ceraclea	x	✓	✓	✓	✓	✓	✓	✓	✓
		Mystacides	x							✓	✓
			alafimbriata	✓	✓	✓				✓	✓
	Limnephilidae	x	x					✓			
		Dicosmoecus	gilvipes		✓						
	Molannidae	x	x	✓							
	Polycentropodidae	Polycentropus	x	✓							
	Psychomyiidae	Psychomyia	x				✓				
			flavida	✓	✓	✓		✓	✓	✓	✓
	Rhyacophilidae	Rhyacophila	type B								✓
			type C					✓			✓
Tricladida	x	x	x	✓	✓	✓	✓	✓		✓	✓

Table 3.29 Willamette River Benthic Macroinvertebrate Community Summary, Study Year 2000 to 2001

Date	Site	Total # Taxa	% EPT[1]	% Chironomidae	% Diptera	Total Abundance (count/site)
September 2000	Corvallis RM128	71	1.9	66.9	67.7	2536
September 2000	Willamette RM134	72	15.6	76.2	76.4	4734
September 2000	Snag Boat RM143.5	46	7.6	55.1	55.3	2440
September 2000	Sam Daws RM 145.5	64	4.5	89.9	90.2	3053
September 2000	Intake RM148	65	6.2	65.3	65.5	3836
September 2000	Cartney RM156	51	5.0	83.0	83.0	4153
September 2000	Harrisburg RM160	60	6.0	92.7	92.7	6375
September 2000	Whitely RM176	55	2.8	67.3	67.5	2575
December 2000	Corvallis RM128	53	11.8	33.7	35.2	1461
December 2000	Willamette RM134	60	13.6	71.1	72.3	1174
December 2000	Snag Boat RM143.5	40	9.8	51.6	52.1	407
December 2000	Sam Daws RM 145.5	61	21.8	66.8	68.6	1638
December 2000	Intake RM148	61	35.3	38.8	40.8	1357
December 2000	Cartney RM156	60	20.2	49.5	49.8	1694
December 2000	Harrisburg RM160	59	17.6	75.8	77.1	2882
December 2000	Whitely RM176	56	25.9	25.4	30.2	1112
March 2001	Corvallis RM128	64	6.2	63.1	63.9	2427
March 2001	Willamette RM134	69	23.7	68.9	70.2	3083
March 2001	Snag Boat RM143.5	55	12.3	77.3	78.4	1960
March 2001	Sam Daws RM 145.5	75	14.4	68.2	69.1	4245
March 2001	Intake RM148	74	24.6	69.6	70.5	7565
March 2001	Cartney RM156	68	41.0	50.4	51.1	4429
March 2001	Harrisburg RM160	68	38.7	53.9	54.6	5817
March 2001	Whitely RM176	66	7.8	81.5	82.4	4242
July 2001	Corvallis RM128	68	20.1	48.0	48.8	4917
July 2001	Willamette RM134	93	20.3	63.7	63.9	7700
July 2001	Snag Boat RM143.5	62	16.4	56.5	56.6	5831
July 2001	Sam Daws RM 145.5	82	14.8	67.3	67.5	10940
July 2001	Intake RM148	80	34.0	46.2	46.8	7073
July 2001	Cartney RM156	78	20.7	60.4	60.5	7304
July 2001	Harrisburg RM160	83	41.0	39.2	39.2	4209
July 2001	Whitely RM176	82	15.9	51.7	52.2	9425

[1] EPT = Ephemeroptera, Plecoptera, Trichoptera taxa

Table 3.30 Willamette River Benthic Macroinvertebrate Biomass, Study Year 2000 to 2001(means for 5 replicates)

	Mean Dry Weight (g/m^2)							
	Corvallis RM128	Willamette RM134	Snag Boat RM143.5	Sam Daws RM145.5	Intake RM148	Cartney RM156	Harrisburg RM160	Whitely RM176
9/19/2000	13.2049	5.4326	1.3070	1.6144	1.9528	2.4316	1.5526	1.4663
12/5/2000	30.5023	5.1412	1.3479	3.5153	3.1919	2.6619	1.9574	2.6947
3/6/2001	8.2444	7.6533	1.9533	4.4347	8.1558	5.1158	7.0991	2.9807
7/10/2001	7.0533	6.7116	2.9791	5.7593	7.1070	3.9621	5.8163	10.2509

	Mean Ash Free Dry Weight (g/m^2)							
	Corvallis RM128	Willamette RM134	Snag Boat RM143.5	Sam Daws RM145.5	Intake RM148	Cartney RM156	Harrisburg RM160	Whitely RM176
9/19/2000	5.3430	2.0865	0.8226	1.0456	0.9119	1.5056	0.9516	0.7284
12/5/2000	6.4895	0.7916	0.7537	1.5563	1.6067	1.0077	1.0330	0.9000
3/6/2001	2.3816	3.2479	0.8940	2.8251	6.0584	3.3563	5.3114	1.5870
7/10/2001	2.4065	3.5528	1.0740	2.9621	4.6593	2.1258	2.7074	7.0156

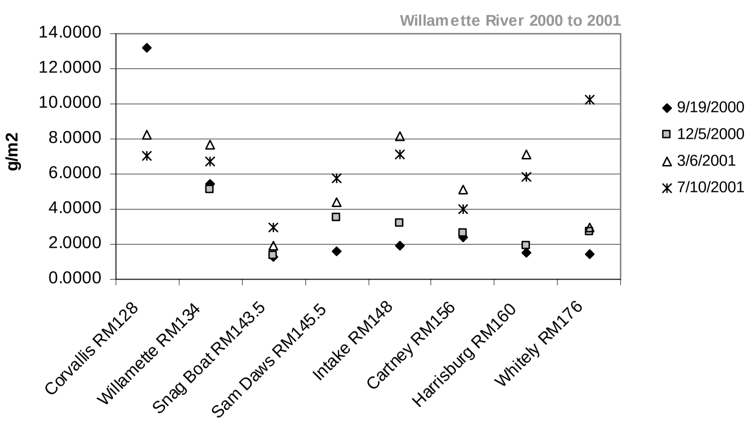

Figure 3.90 Willamette River Benthic Macroinvertebrate Mean Dry Biomass

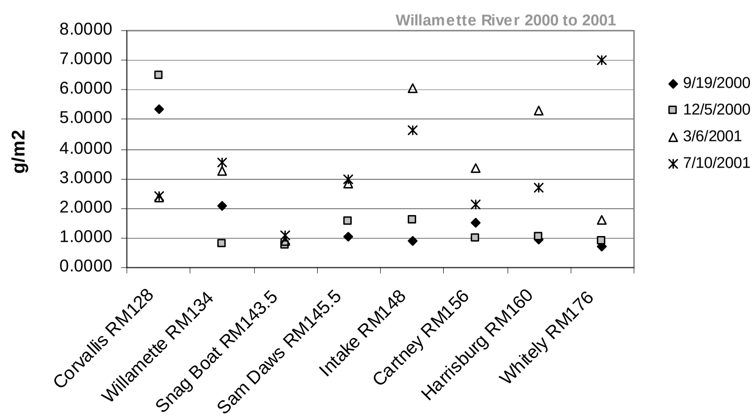

Figure 3.91 Willamette River Benthic Macroinvertebrate Mean Ash-Free Dry Biomass

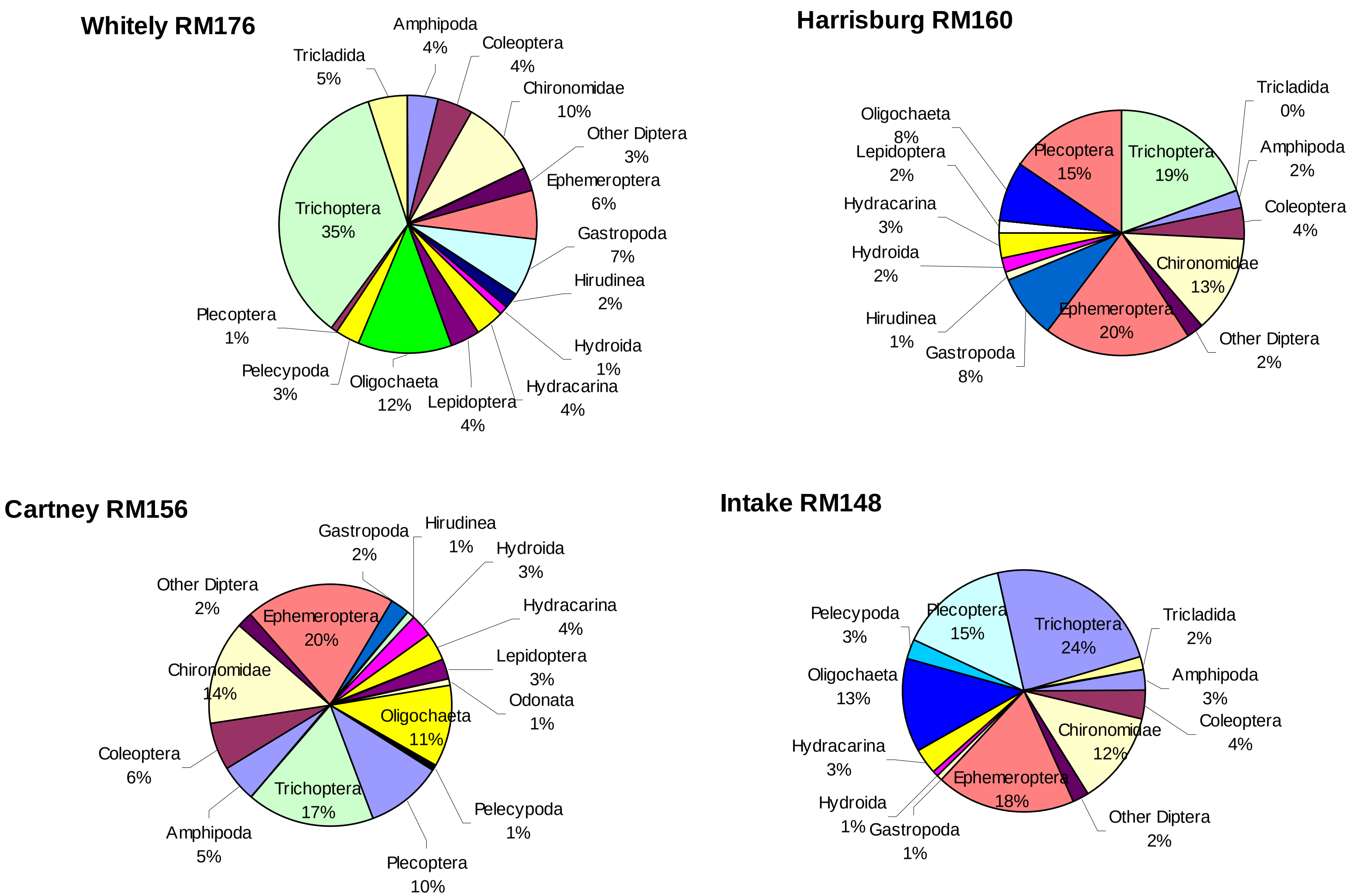

Figure 3.92 Benthic Macroinvertebrate Family Distribution by Percent Dry Weight for the Willamette River Sampling Sites Upstream of Mill Discharge, Study Year 2000 to 2001 (represents the sum of all replicates and seasonal samples for the entire study year for all families contributing >1% of the total)

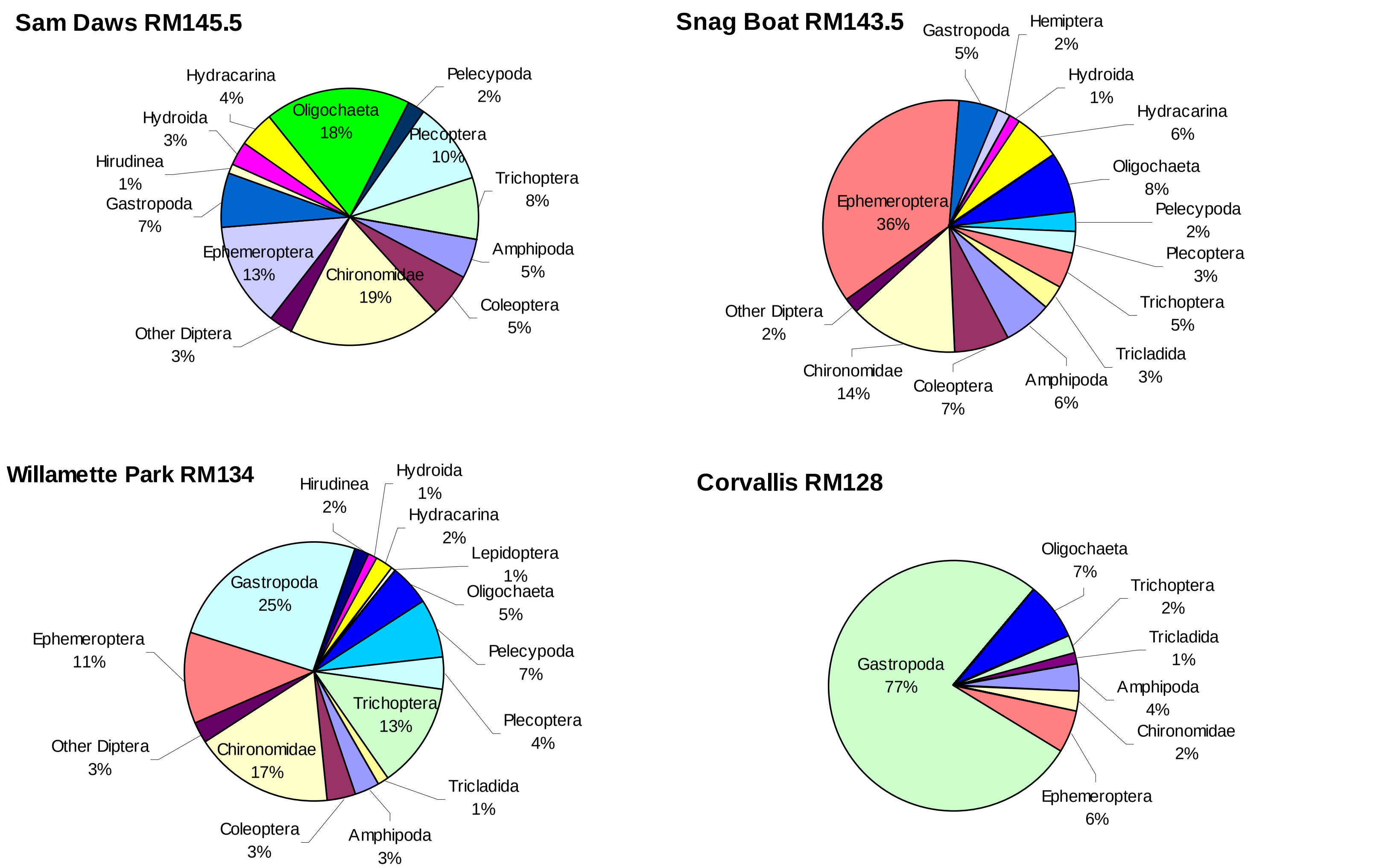

Figure 3.93 Benthic Macroinvertebrate Family Distribution by Percent Dry Weight for the Willamette River Sampling Sites Downstream of Mill Discharge, Study Year 2000 to 2001 (represents the sum of all replicates and seasonal samples for the entire study year for all families contributing >1% of the total)

3.9 Fish

Fish on Codorus Creek, McKenzie River, and Willamette River were sampled under a three-year research agreement with Western Washington University (WWU), Bellingham, Washington, starting in the fall of 1998. The experimental design provided by WWU examined different fish habitats along the LTRWS area for fish communities. Sampling was done using electrofishing techniques on a quarterly basis. All fish sampling was done by WWU personnel, along with one or more NCASI personnel. When time and conditions allowed, fish were identified, measured, and weighed on site, then 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 macroinvertebrate and periphyton sites, along with one added site, Indian Rock Dam, for a total of eight fish sampling sites. Shocking was done in three runs of approximately 600 s each. The data were not normalized to shock time. There were three missing samples for the November 2000 sampling date: East Branch, USGS, and Furnace.

The Leaf River, a wide, unregulated river, had a design that sampled for fish annually during the fall, the historically low flow season. The experimental design called for boat electroshocking at six sites, two upstream, and four downstream of the mill effluent discharge. Boat electrofishing was done as one continuous run for approximately 30 min. at each site. Boat electrofishing on the Leaf River was conducted with assistance from the Mississippi Department of Wildlife, Fisheries, and Parks. Backpack electrofishing was initiated on the Leaf River in October 2000, and was carried out at five of the six designated sites, each with one run of approximately 10 min. The data were not normalized to shock time. Due to low flow conditions, Tallahala, the most upstream site, was not sampled. All fish were identified, measured, and weighed on site, then returned to the river.

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 NCASI macroinvertebrate and periphyton sites. The McKenzie River had five sampling sites, and the Willamette had six sampling sites for boat electrofishing. Boat electrofishing was carried out as two runs of approximately 250 m each. Due to sampling permit issues that took effect in January 2001, boat electrofishing data is available only for the September 2000 sampling date. Boat electrofishing at Intake (RM 148.5) on the Willamette River, and Bellingers (RM 18.5) on the McKenzie River was not carried out during the 2000 to 2001 study year. Supplemental near-shore backpack electrofishing was included at sites where the bank was accessible. Backpack electrofishing was carried out at four sites on the McKenzie River and six sites on the Willamette River as three runs of approximately 600 s at each site. Backpack electrofishing data are available only for the September 2000, December 2000 and July 2001 sampling dates; data for the March 2000 sampling date were lost. There were four missing samples for the December 2000 sampling date: Harvest and Armitage on the McKenzie River, and Whitely and Willamette Park on the Willamette River. Data were also lost for the June 2001 sampling of Cartney on the Willamette River. Data in this compendium were not normalized for time or distance.

3.9.1. *Codorus Creek Fish*

Table 3.31 Codorus Creek: East Branch Backpack Fish Data Summary for August 2000 to June 2001

EAST BRANCH	Sampling Date/# of runs =	08/22/00			3 Runs	03/24/01			3 Runs	06/09/01			2 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):													
White sucker	*Catostomus commersoni*	45	21.03	66.02	3.19	13	13.27	95.38	9.34	25	17.12	106.56	17.63
Northern hogsucker	*Hypentelium nigricans*	2	0.93	40.00	0.50		0.00			3	2.05	69.00	4.13
Sunfish (Centrarchidae):													
Rock bass	*Ambloplites rupestris*		0.00				0.00				0.00		
Lepomis	*Lepomis*		0.00				0.00				0.00		
Redbreast sunfish	*Lepomis auritus*		0.00				0.00				0.00		
Green sunfish	*Lepomis cyanellus*	2	0.93	87.00	12.89		0.00				0.00		
Pumpkinseed	*Lepomis gibbosus*		0.00				0.00				0.00		
Bluegill	*Lepomis macrochirus*		0.00				0.00			1	0.68	71.00	6.95
Redear sunfish	*Lepomis microlophus*		0.00				0.00				0.00		
Smallmouth bass	*Micropterus dolomieui*		0.00				0.00				0.00		
Largemouth bass	*Micropterus salmoides*		0.00				0.00				0.00		
Sculpins (Cottidae):													
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00		
Carps & minnows (Cyprinidae):													
Central stoneroller	*Campostoma anomalum*		0.00			1	1.02	75.00	4.29	2	1.37	86.00	9.68
Rosyside dace	*Clinostomus funduloides*		0.00			11	11.22	50.27	1.48	4	2.74	92.75	8.85
Satinfin shiner	*Cyprinella analostanus*		0.00				0.00				0.00		
Spotfin shiner	*Cyprinella spilopterus*		0.00				0.00				0.00		
Common carp	*Cyprinus carpio Linnaeus*		0.00				0.00				0.00		
Cutlips minnow	*Exoglossum maxillingua*	8	3.74	71.13	3.85	1	1.02	110.00	16.98	3	2.05	65.00	3.86
Common shiner	*Luxilus cornutus*	17	7.94	85.12	6.11	14	14.29	88.14	7.34	4	2.74	88.50	10.07
Golden shiner	*Notemigonus crysoleucas*		0.00				0.00				0.00		
Spottail shiner	*Notropis hudsonius*		0.00			4	4.08	53.00	1.13		0.00		
Swallowtail shiner	*Notropis procne*	24	11.21	53.13	1.47	15	15.31	63.73	3.53		0.00		
Bluntnose minnow	*Pimephales notatus*		0.00				0.00			1	0.68	84.00	7.15
Dace	*Rhinichthys*		0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*	50	23.36	52.38	1.46	21	21.43	46.43	1.18	16	10.96	53.87	1.65
Longnose dace	*Rhinichthys cataractae*	12	5.61	66.25	3.36	5	5.10	66.40	3.44	12	8.22	60.58	2.51
Creek chub	*Semotilus atromaculatus*	40	18.69	72.48	4.64	4	4.08	70.25	4.04	12	8.22	88.91	8.81
Fallfish	*Semotilus corporalis*	2	0.93	102.50	12.10		0.00			1	0.68	150.00	44.00
Cyprinid			0.00				0.00			16	10.96	67.60	4.24

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Table 3.31 Continued

EAST BRANCH-continued	Sampling Date/# of runs =	08/22/00			3 Runs	03/24/01			3 Runs	06/09/01			2 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bullhead catfishes (Ictaluridae):													
Yellow bullhead	*Ameiurus natalis*		0.00				0.00				0.00		
Margined madtom	*Noturus insignis*		0.00			3	3.06	117.33	14.87		0.00		
Topminnows & Killifishes (Fundulidae):													
Banded killifish	*Fundulus diaphanus*		0.00				0.00				0.00		
Perches & darters (Percidae):													
Greenside darter	*Etheostoma blennioides*		0.00				0.00				0.00		
Tessellated darter	*Etheostoma olmstedi*	12	5.61	50.17	1.11	6	6.12	52.33	1.58	7	4.79	56.43	1.72
Banded darter	*Etheostoma zonale*		0.00				0.00			1	0.68	61.00	2.20
Shield darter	*Percina peltata*		0.00				0.00				0.00		
Darter			0.00				0.00				0.00		
Trout and Salmon (Salmonidae):													
Rainbow trout	*Oncorhynchus mykiss*		0.00				0.00			4	2.74	296.50	276.25
Brown trout	*Salmo trutta*		0.00				0.00			6	4.11	238.17	166.67
Fish:													
Unidentified			0.00				0.00			28	19.18		
n (Total Individuals)		214				98				146			

Table 3.32 Codorus Creek: Menges Backpack Fish Data Summary for August 2000 to June 2001

MENGES	Sampling Date/# of runs =	08/22/00			3 Runs	11/17/00			3 Runs	03/11/01			1 Run	06/09/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):											0.00						
White sucker	*Catostomus commersoni*	14	24.56	45.79	1.03	2	8.00	290.50	284.00		0.00			27	46.55	265.19	256.83
Northern hogsucker	*Hypentelium nigricans*		0.00				0.00				0.00				0.00		
Sunfish (Centrarchidae):																	
Rock bass	*Ambloplites rupestris*		0.00				0.00				0.00				0.00		
Lepomis	*Lepomis*		0.00				0.00				0.00				0.00		
Redbreast sunfish	*Lepomis auritus*		0.00				0.00			11	68.75	83.64	10.64		0.00		
Green sunfish	*Lepomis cyanellus*	36	63.16	43.17	1.88		0.00				0.00			10	17.24	74.70	13.32
Pumpkinseed	*Lepomis gibbosus*		0.00				0.00				0.00				0.00		
Bluegill	*Lepomis macrochirus*		0.00				0.00				0.00				0.00		
Redear sunfish	*Lepomis microlophus*		0.00				0.00				0.00				0.00		
Smallmouth bass	*Micropterus dolomieui*		0.00				0.00				0.00				0.00		
Largemouth bass	*Micropterus salmoides*		0.00				0.00				0.00				0.00		
Sculpins (Cottidae):																	
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00			1	1.72	109.00	19.36
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00				0.00		
Carps & minnows (Cyprinidae):																	
Central stoneroller	*Campostoma anomalum*		0.00				0.00				0.00				0.00		
Rosyside dace	*Clinostomus funduloides*		0.00				0.00				0.00				0.00		
Satinfin shiner	*Cyprinella analostanus*		0.00				0.00				0.00				0.00		
Spotfin shiner	*Cyprinella spilopterus*		0.00				0.00				0.00				0.00		
Common carp	*Cyprinus carpio Linnaeus*		0.00				0.00				0.00				0.00		
Cutlips minnow	*Exoglossum maxillingua*		0.00				0.00				0.00				0.00		
Common shiner	*Luxilus cornutus*		0.00				0.00				0.00				0.00		
Golden shiner	*Notemigonus crysoleucas*		0.00				0.00				0.00				0.00		
Spottail shiner	*Notropis hudsonius*		0.00				0.00				0.00				0.00		
Swallowtail shiner	*Notropis procne*		0.00				0.00				0.00				0.00		
Bluntnose minnow	*Pimephales notatus*		0.00				0.00				0.00				0.00		
Dace	*Rhinichthys*		0.00				0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*	3	5.26	40.33	0.61		0.00				0.00			1	1.72	49.00	1.16
Longnose dace	*Rhinichthys cataractae*	2	3.51	65.50	3.88		0.00				0.00				0.00		
Creek chub	*Semotilus atromaculatus*		0.00				0.00				0.00				0.00		
Fallfish	*Semotilus corporalis*		0.00				0.00				0.00				0.00		
Cyprinid			0.00				0.00				0.00				0.00		

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Table 3.32 Continued

MENGES-continued	Sampling Date/# of runs =	08/22/00			3 Runs	11/17/00			3 Runs	03/11/01			1 Run	06/09/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bullhead catfishes (Ictaluridae):																	
Yellow bullhead	*Ameiurus natalis*		0.00				0.00				0.00				0.00		
Margined madtom	*Noturus insignis*		0.00				0.00				0.00				0.00		
Topminnows & Killifishes (Fundulidae):																	
Banded killifish	*Fundulus diaphanus*		0.00				0.00				0.00				0.00		
Perches & darters (Percidae):																	
Greenside darter	*Etheostoma blennioides*		0.00				0.00				0.00				0.00		
Tessellated darter	*Etheostoma olmstedi*	2	3.51	49.00	1.79		0.00				0.00				0.00		
Banded darter	*Etheostoma zonale*		0.00				0.00			1	6.25	54.00	-		0.00		
Shield darter	*Percina peltata*		0.00				0.00				0.00				0.00		
Darter			0.00				0.00				0.00				0.00		
Trout and Salmon (Salmonidae):																	
Rainbow trout	*Oncorhynchus mykiss*		0.00				0.00				0.00				0.00		
Brown trout	*Salmo trutta*		0.00			23	92.00	191.30	82.74	4	25.00	193.00	76.00	19.0	32.76	249.68	179.47
Fish:																	
Unidentified			0.00				0.00				0.00				0.00		
n (Total Individuals)		57				25				16				58			

Table 3.33 Codorus Creek: USGS Backpack Fish Data Summary for August 2000 to June 2001

USGS	Sampling Date/# of runs =	08/22/00			3 Runs	03/24/01			3 Runs	06/09/01			2 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):													
White sucker	*Catostomus commersoni*	1	1.22	61.00	1.66		0.00			2	4.88	208.50	107.50
Northern hogsucker	*Hypentelium nigricans*		0.00			1	0.75	79.00	4.82		0.00		
Sunfish (Centrarchidae):													
Rock bass	*Ambloplites rupestris*		0.00				0.00				0.00		
Lepomis	*Lepomis*		0.00				0.00				0.00		
Redbreast sunfish	*Lepomis auritus*		0.00				0.00				0.00		
Green sunfish	*Lepomis cyanellus*		0.00			1	0.75	123.00	39.01	1	2.44	140.00	64.00
Pumpkinseed	*Lepomis gibbosus*		0.00				0.00			4	9.76	81.00	10.80
Bluegill	*Lepomis macrochirus*		0.00				0.00				0.00		
Redear sunfish	*Lepomis microlophus*		0.00				0.00				0.00		
Smallmouth bass	*Micropterus dolomieui*		0.00				0.00				0.00		
Largemouth bass	*Micropterus salmoides*	2	2.44	61.00	2.94		0.00			1	2.44	-	1.46
Sculpins (Cottidae):													
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00		
Carps & minnows (Cyprinidae):													
Central stoneroller	*Campostoma anomalum*		0.00				0.00			1	2.44	73.00	3.68
Rosyside dace	*Clinostomus funduloides*	3	3.66	53.33	1.67		0.00				0.00		
Satinfin shiner	*Cyprinella analostanus*		0.00			5	3.76	67.20	3.22		0.00		
Spotfin shiner	*Cyprinella spilopterus*		0.00			1	0.75	48.00	0.78	3	7.32	71.67	3.95
Common carp	*Cyprinus carpio Linnaeus*		0.00				0.00			1	2.44	640.00	-
Cutlips minnow	*Exoglossum maxillingua*		0.00				0.00				0.00		
Common shiner	*Luxilus cornutus*		0.00				0.00				0.00		
Golden shiner	*Notemigonus crysoleucas*		0.00				0.00				0.00		
Spottail shiner	*Notropis hudsonius*	49	59.76	58.20	2.03	8	6.02	48.13	0.90		0.00		
Swallowtail shiner	*Notropis procne*	1	1.22	40.00	0.40	100	75.19	49.68	0.98		0.00		
Bluntnose minnow	*Pimephales notatus*		0.00				0.00			2	4.88	81.00	5.81
Dace	*Rhinichthys*		0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00				0.00		
Longnose dace	*Rhinichthys cataractae*	4	4.88	72.25	5.23		0.00			3	7.32	74.00	4.73
Creek chub	*Semotilus atromaculatus*		0.00			1	0.75	124.00	78.72	1	2.44	117.00	22.55
Fallfish	*Semotilus corporalis*		0.00				0.00				0.00		
Cyprinid			0.00			9	6.77	42.67	0.50	21.0	51.22	59.57	1.99

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Table 3.33 Continued

USGS-continued	Sampling Date/# of runs =	08/22/00			3 Runs	03/24/01			3 Runs	06/09/01			2 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bullhead catfishes (Ictaluridae):													
Yellow bullhead	*Ameiurus natalis*		0.00				0.00				0.00		
Margined madtom	*Noturus insignis*		0.00				0.00				0.00		
Topminnows & Killifishes (Fundulidae):													
Banded killifish	*Fundulus diaphanus*		0.00				0.00				0.00		
Perches & darters (Percidae):													
Greenside darter	*Etheostoma blennioides*		0.00				0.00				0.00		
Tessellated darter	*Etheostoma olmstedi*	22	26.83	56.09	1.92	7	5.26	58.43	2.55	1.0	2.44	59.00	2.03
Banded darter	*Etheostoma zonale*		0.00				0.00				0.00		
Shield darter	*Percina peltata*		0.00				0.00				0.00		
Darter			0.00				0.00				0.00		
Trout and Salmon (Salmonidae):													
Rainbow trout	*Oncorhynchus mykiss*		0.00				0.00				0.00		
Brown trout	*Salmo trutta*		0.00				0.00				0.00		
Fish:													
Unidentified			0.00				0.00				0.00		
n (Total Individuals)		82				133				41			

Table 3.34 Codorus Creek: Martin Backpack Fish Data Summary for August 2000 to June 2001

MARTIN	Sampling Date/# of runs =	08/22/00			3 Runs	11/17/00			3 Runs	03/24/01			3 Runs	06/09/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):																	
White sucker	*Catostomus commersoni*		0.00			3	17.65	280.67	245.33	5	4.67	78.80	4.88	5	12.82	193.80	198.55
Northern hogsucker	*Hypentelium nigricans*		0.00				0.00				0.00				0.00		
Sunfish (Centrarchidae):																	
Rock bass	*Ambloplites rupestris*		0.00				0.00				0.00				0.00		
Lepomis	*Lepomis*		0.00				0.00				0.00				0.00		
Redbreast sunfish	*Lepomis auritus*		0.00				0.00			4	3.74	104.25	37.69		0.00		
Green sunfish	*Lepomis cyanellus*		0.00				0.00			7	6.54	120.00	43.38	4	10.26	115.00	37.56
Pumpkinseed	*Lepomis gibbosus*		0.00				0.00			2	1.87	67.00	5.89		0.00		
Bluegill	*Lepomis macrochirus*		0.00				0.00				0.00			1	2.56	59.00	3.84
Redear sunfish	*Lepomis microlophus*		0.00				0.00				0.00				0.00		
Smallmouth bass	*Micropterus dolomieui*		0.00				0.00				0.00				0.00		
Largemouth bass	*Micropterus salmoides*		0.00				0.00			1	0.93	64.00	3.92	4	10.26	260.50	362.25
Sculpins (Cottidae):																	
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00				0.00		
Carps & minnows (Cyprinidae):																	
Central stoneroller	*Campostoma anomalum*	4	19.05	103.25	12.75		0.00			3	2.80	121.00	22.49	2	5.13	97.00	10.96
Rosyside dace	*Clinostomus funduloides*		0.00				0.00				0.00				0.00		
Satinfin shiner	*Cyprinella analostanus*		0.00				0.00			39	36.45	68.31	3.82		0.00		
Spotfin shiner	*Cyprinella spilopterus*		0.00				0.00			25	23.36	67.76	3.71	5	12.82	75.00	5.50
Common carp	*Cyprinus carpio Linnaeus*		0.00				0.00				0.00			3	7.69	536.33	2468.63
Cutlips minnow	*Exoglossum maxillingua*		0.00				0.00				0.00				0.00		
Common shiner	*Luxilus cornutus*		0.00				0.00				0.00				0.00		
Golden shiner	*Notemigonus crysoleucas*		0.00				0.00				0.00				0.00		
Spottail shiner	*Notropis hudsonius*	1	4.76	94.00	7.07	2	11.76	91.50	5.75	6	5.61	91.17	8.93	10	25.64	98.30	10.33
Swallowtail shiner	*Notropis procne*		0.00				0.00			3	2.80	62.67	2.86		0.00		
Bluntnose minnow	*Pimephales notatus*		0.00				0.00				0.00				0.00		
Dace	*Rhinichthys*		0.00				0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*	4	19.05	50.00	1.32	8	47.06	52.88	-	9	8.41	62.33	2.82	1	2.56	40.00	0.62
Longnose dace	*Rhinichthys cataractae*	7	33.33	75.57	5.43	2	11.76	71.00	-	2	1.87	68.00	3.40	1	2.56	81.00	6.62
Creek chub	*Semotilus atromaculatus*	1	4.76	56.00	1.91		0.00				0.00			1	2.56	75.00	4.73
Fallfish	*Semotilus corporalis*		0.00				0.00				0.00				0.00		
Cyprinid			0.00				0.00			1	0.93	38.00	0.41		0.00		

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Table 3.34 Continued

MARTIN-continued	Sampling Date/# of runs =	08/22/00			3 Runs	11/17/00			3 Runs	03/24/01			3 Runs	06/09/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bullhead catfishes (Ictaluridae):																	
Yellow bullhead	*Ameiurus natalis*	4	19.05	59.00	2.73	1	5.88	173.00	65.00		0.00			2.0	5.13	220.00	147.50
Margined madtom	*Noturus insignis*		0.00				0.00				0.00				0.00		
Topminnows & Killifishes (Fundulidae):																	
Banded killifish	*Fundulus diaphanus*		0.00				0.00				0.00				0.00		
Perches & darters (Percidae):																	
Greenside darter	*Etheostoma blennioides*		0.00				0.00				0.00				0.00		
Tessellated darter	*Etheostoma olmstedi*		0.00				0.00				0.00				0.00		
Banded darter	*Etheostoma zonale*		0.00				0.00				0.00				0.00		
Shield darter	*Percina peltata*		0.00				0.00				0.00				0.00		
Darter			0.00				0.00				0.00				0.00		
Trout and Salmon (Salmonidae):																	
Rainbow trout	*Oncorhynchus mykiss*		0.00				0.00				0.00				0.00		
Brown trout	*Salmo trutta*		0.00			1	5.88	250.00	128.00		0.00				0.00		
Fish:																	
Unidentified			0.00				0.00				0.00				0.00		
n (Total Individuals)		21				17				107				39			

Table 3.35 Codorus Creek: Graybill Backpack Fish Data Summary for August 2000 to June 2001

GRAYBILL	Sampling Date/# of runs =	08/22/00			2 Runs	11/18/00			3 Runs	03/25/01			3 Runs	06/10/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):																	
White sucker	*Catostomus commersoni*		0.00			9	23.08	326.11	381.22	3	4.62	79.00	10.64	4	12.12	323.00	392.50
Northern hogsucker	*Hypentelium nigricans*		0.00				0.00				0.00				0.00		
Sunfish (Centrarchidae):																	
Rock bass	*Ambloplites rupestris*		0.00				0.00				0.00				0.00		
Lepomis	*Lepomis*		0.00				0.00				0.00				0.00		
Redbreast sunfish	*Lepomis auritus*		0.00			5	12.82	104.80	23.24	9	13.85	112.89	35.38	6	18.18	149.67	82.17
Green sunfish	*Lepomis cyanellus*		0.00			11	28.21	102.00	23.29	5	7.69	104.00	25.51	14	42.42	106.43	29.36
Pumpkinseed	*Lepomis gibbosus*		0.00				0.00				0.00				0.00		
Bluegill	*Lepomis macrochirus*		0.00				0.00				0.00				0.00		
Redear sunfish	*Lepomis microlophus*		0.00				0.00				0.00				0.00		
Smallmouth bass	*Micropterus dolomieui*		0.00				0.00				0.00				0.00		
Largemouth bass	*Micropterus salmoides*	1	7.14	80.00	6.83		0.00				0.00				0.00		
Sculpins (Cottidae):																	
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00				0.00		
Carps & minnows (Cyprinidae):																	
Central stoneroller	*Campostoma anomalum*		0.00				0.00				0.00				0.00		
Rosyside dace	*Clinostomus funduloides*		0.00				0.00			4	6.15	67.25	3.37		0.00		
Satinfin shiner	*Cyprinella analostanus*		0.00				0.00				0.00				0.00		
Spotfin shiner	*Cyprinella spilopterus*	4	28.57	58.25	2.38		0.00			15	23.08	64.73	2.73	3	9.09	83.00	7.66
Common carp	*Cyprinus carpio Linnaeus*		0.00				0.00				0.00			2	6.06		
Cutlips minnow	*Exoglossum maxillingua*		0.00				0.00				0.00				0.00	503.00	2014.50
Common shiner	*Luxilus cornutus*		0.00				0.00				0.00				0.00		
Golden shiner	*Notemigonus crysoleucas*		0.00			1	2.56	126.00	18.00	1	1.54	112.00	16.61	1	3.03	176.00	53.00
Spottail shiner	*Notropis hudsonius*		0.00			1	2.56	95.00	6.39	13	20.00	88.15	7.77	1	3.03	74.00	3.91
Swallowtail shiner	*Notropis procne*		0.00				0.00			4	6.15	53.50	1.58		0.00		
Bluntnose minnow	*Pimephales notatus*		0.00				0.00				0.00				0.00		
Dace	*Rhinichthys*		0.00				0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*	3	21.43	60.67	2.34	2	5.13	61.00	2.15	1	1.54	55.00	2.20		0.00		
Longnose dace	*Rhinichthys cataractae*	2	14.29	92.00	9.15	1	2.56	89.00	7.00		0.00				0.00		
Creek chub	*Semotilus atromaculatus*		0.00			2	5.13	98.50	13.15	1	1.54	150.00	37.74	2	6.06	83.00	8.46
Fallfish	*Semotilus corporalis*		0.00				0.00				0.00				0.00		
Cyprinid			0.00				0.00			8	12.31	30.38	0.24		0.00		

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Table 3.35 Continued

GRAYBILL-continued	Sampling Date/# of runs =	08/22/00			2 Runs	11/18/00			3 Runs	03/25/01			3 Runs	06/10/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bullhead catfishes (Ictaluridae):																	
Yellow bullhead	*Ameiurus natalis*	2	14.29	64.50	3.11	6	15.38	188.00	129.80		0.00				0.00		
Margined madtom	*Noturus insignis*		0.00				0.00				0.00				0.00		
Topminnows & Killifishes (Fundulidae):																	
Banded killifish	*Fundulus diaphanus*		0.00				0.00				0.00				0.00		
Perches & darters (Percidae):																	
Greenside darter	*Etheostoma blennioides*		0.00				0.00				0.00				0.00		
Tessellated darter	*Etheostoma olmstedi*	2	14.29	59.00	2.49	1	2.56	72.00	4.00	1	1.54	57.00	2.38		0.00		
Banded darter	*Etheostoma zonale*		0.00				0.00				0.00				0.00		
Shield darter	*Percina peltata*		0.00				0.00				0.00				0.00		
Darter			0.00				0.00				0.00				0.00		
Trout and Salmon (Salmonidae):																	
Rainbow trout	*Oncorhynchus mykiss*		0.00				0.00				0.00				0.00		
Brown trout	*Salmo trutta*		0.00				0.00				0.00				0.00		
Fish:																	
Unidentified			0.00				0.00				0.00				0.00		
n (Total Individuals)		14				39				65				33			

Table 3.36 Codorus Creek: Indian Rock Backpack Fish Data Summary for August 2000 to June 2001

INDIAN ROCK	Sampling Date/# of runs =	08/23/00			3 Runs	11/18/00			1 Run	03/25/01			2 Runs	06/10/01			2 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):																	
White sucker	*Catostomus commersoni*	2	3.23	56.5	2.32		0.00				0.00			4	6.67	162.75	149.13
Northern hogsucker	*Hypentelium nigricans*		0.00				0.00				0.00				0.00		
Sunfish (Centrarchidae):																	
Rock bass	*Ambloplites rupestris*	2	3.23	101.50	21.34		0.00				0.00			5	8.33	166.20	116.26
Lepomis	*Lepomis*		0.00				0.00				0.00			2	3.33	43.50	1.51
Redbreast sunfish	*Lepomis auritus*	1	1.61	65.00	4.61	7	58.33	127.29	38.14	3	3.57	72.33	10.51		0.00		
Green sunfish	*Lepomis cyanellus*	3	4.84	105.67	24.77	3	25.00	108.33	20.33	1	1.19	131.00	41.90	2	3.33	121.00	43.00
Pumpkinseed	*Lepomis gibbosus*		0.00				0.00				0.00				0.00		
Bluegill	*Lepomis macrochirus*	1	1.61	31.00	0.54		0.00				0.00			1	1.67	72.00	7.89
Redear sunfish	*Lepomis microlophus*		0.00				0.00				0.00				0.00		
Smallmouth bass	*Micropterus dolomieui*		0.00				0.00				0.00				0.00		
Largemouth bass	*Micropterus salmoides*	1	1.61	59.00	2.78		0.00				0.00				0.00		
Sculpins (Cottidae):																	
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00			2	2.38	59.50	1.44		0.00		
Carps & minnows (Cyprinidae):																	
Central stoneroller	*Campostoma anomalum*	3	4.84	72.33	5.08		0.00				0.00				0.00		
Rosyside dace	*Clinostomus funduloides*		0.00				0.00				0.00				0.00		
Satinfin shiner	*Cyprinella analostanus*		0.00				0.00			1	1.19	61.00	1.64		0.00		
Spotfin shiner	*Cyprinella spilopterus*	3	4.84	70.67	3.03		0.00			35	41.67	63.69	2.14	1	1.67	-	4.73
Common carp	*Cyprinus carpio Linnaeus*		0.00				0.00				0.00			1	1.67	541.00	2412.00
Cutlips minnow	*Exoglossum maxillingua*		0.00				0.00				0.00				0.00		
Common shiner	*Luxilus cornutus*		0.00				0.00				0.00				0.00		
Golden shiner	*Notemigonus crysoleucas*		0.00				0.00				0.00				0.00		
Spottail shiner	*Notropis hudsonius*	12	19.35	49.58	1.05		0.00			23	27.38	56.09	1.64	4	6.67	68.50	3.32
Swallowtail shiner	*Notropis procne*	9	14.52	50.56	1.19		0.00			13	15.48	59.85	2.09		0.00		
Bluntnose minnow	*Pimephales notatus*		0.00				0.00				0.00			2	3.33	77.50	6.60
Dace	*Rhinichthys*	1	1.61	45.00	0.83		0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*	2	3.23	44.50	0.93		0.00				0.00				0.00		
Longnose dace	*Rhinichthys cataractae*	6	9.68	63.17	3.24		0.00				0.00				0.00		
Creek chub	*Semotilus atromaculatus*		0.00				0.00				0.00				0.00		
Fallfish	*Semotilus corporalis*		0.00				0.00				0.00				0.00		
Cyprinid		5	8.06	-	-		0.00				0.00			13.0	21.67	49.23	1.15

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Table 3.36 Continued

INDIAN ROCK-continued	Sampling Date/# of runs =	08/23/00			3 Runs	11/18/00			1 Run	03/25/01			2 Runs	06/10/01			2 Runs
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Bullhead catfishes (Ictaluridae):																	
Yellow bullhead	*Ameiurus natalis*	1	1.61	103.00	14.00	2	16.67	232.50	177.50		0.00			1.0	1.67	203.00	120.00
Margined madtom	*Noturus insignis*		0.00				0.00				0.00				0.00		
Topminnows & Killifishes (Fundulidae):																	
Banded killifish	*Fundulus diaphanus*		0.00				0.00				0.00				0.00		
Perches & darters (Percidae):																	
Greenside darter	*Etheostoma blennioides*		0.00				0.00				0.00				0.00		
Tessellated darter	*Etheostoma olmstedi*	10	16.13	52.00	1.54		0.00			5	5.95	50.20	1.57	24.0	40.00	54.04	1.69
Banded darter	*Etheostoma zonale*		0.00				0.00				0.00				0.00		
Shield darter	*Percina peltata*		0.00				0.00			1	1.19	78.00	5.04		0.00		
Darter			0.00				0.00				0.00				0.00		
Trout and Salmon (Salmonidae):																	
Rainbow trout	*Oncorhynchus mykiss*		0.00				0.00				0.00				0.00		
Brown trout	*Salmo trutta*		0.00				0.00				0.00				0.00		
Fish:																	
Unidentified			0.00				0.00				0.00				0.00		
n (Total Individuals)		62				12				84				60			

Table 3.37 Codorus Creek: Arsenal Backpack Fish Data Summary for August 2000 to June 2001

ARSENAL	Sampling Date/# of runs =	08/23/00			3 Runs	11/18/00			1 Run	03/25/01			3 Runs	06/10/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):																	
White sucker	*Catostomus commersoni*	1	1.30	75	4.58		0.00			4	5.00	58.50	2.44	4	13.79	356.50	528.75
Northern hogsucker	*Hypentelium nigricans*		0.00				0.00				0.00				0.00		
Sunfish (Centrarchidae):																	
Rock bass	*Ambloplites rupestris*	21	27.27	105.52	43.34	2	20.00	106.50	41.40	20	25.00	70.85	19.12	7	24.14	145.33	54.92
Lepomis	*Lepomis*		0.00				0.00				0.00				0.00		
Redbreast sunfish	*Lepomis auritus*	16	20.78	123.31	50.94	5	50.00	117.20	33.60	12	15.00	52.33	6.74	6	20.69	121.50	46.00
Green sunfish	*Lepomis cyanellus*	3	3.90	59.00	8.62		0.00			1	1.25	110.00	23.82		0.00		
Pumpkinseed	*Lepomis gibbosus*	1	1.30	73.00	7.65	2	20.00	124.00	39.00		0.00			1	3.45	130.00	51.00
Bluegill	*Lepomis macrochirus*	5	6.49	43.20	2.09		0.00				0.00			4	13.79	49.00	2.16
Redear sunfish	*Lepomis microlophus*		0.00				0.00				0.00				0.00		
Smallmouth bass	*Micropterus dolomieui*	1	1.30	60.00	3.16	1	10.00	94.00	9.00		0.00			1	3.45	209.00	100.00
Largemouth bass	*Micropterus salmoides*		0.00				0.00				0.00				0.00		
Sculpins (Cottidae):																	
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00				0.00		
Carps & minnows (Cyprinidae):																	
Central stoneroller	*Campostoma anomalum*		0.00				0.00				0.00			1	3.45	55.00	1.45
Rosyside dace	*Clinostomus funduloides*		0.00				0.00				0.00				0.00		
Satinfin shiner	*Cyprinella analostanus*		0.00				0.00				0.00				0.00		
Spotfin shiner	*Cyprinella spilopterus*		0.00				0.00				0.00			1	3.45	62.00	2.12
Common carp	*Cyprinus carpio Linnaeus*		0.00				0.00				0.00			1	3.45	680.00	-
Cutlips minnow	*Exoglossum maxillingua*		0.00				0.00				0.00				0.00		
Common shiner	*Luxilus cornutus*		0.00				0.00				0.00				0.00		
Golden shiner	*Notemigonus crysoleucas*		0.00				0.00				0.00				0.00		
Spottail shiner	*Notropis hudsonius*		0.00				0.00			5	6.25	49.00	1.08		0.00		
Swallowtail shiner	*Notropis procne*	16	20.78	37.81	0.49		0.00			19	23.75	43.89	0.76		0.00		
Bluntnose minnow	*Pimephales notatus*		0.00				0.00				0.00				0.00		
Dace	*Rhinichthys*		0.00				0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00			2	2.50	35.00	0.36		0.00		
Longnose dace	*Rhinichthys cataractae*		0.00				0.00				0.00				0.00		
Creek chub	*Semotilus atromaculatus*		0.00				0.00				0.00				0.00		
Fallfish	*Semotilus corporalis*		0.00				0.00				0.00				0.00		
Cyprinid		2	2.60	-	-		0.00			14	17.50	31.21	0.24	2.0	6.90	-	-

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Table 3.37 Continued

ARSENAL-continued																	
	Sampling Date/# of runs =	08/23/00			3 Runs	11/18/00			1 Run	03/25/01			3 Runs	06/10/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bullhead catfishes (Ictaluridae):																	
Yellow bullhead	*Ameiurus natalis*	1	1.30	265.00	-		0.00				0.00				0.00		
Margined madtom	*Noturus insignis*		0.00				0.00				0.00				0.00		
Topminnows & Killifishes (Fundulidae):																	
Banded killifish	*Fundulus diaphanus*		0.00				0.00			2	2.50	53.00	1.33		0.00		
Perches & darters (Percidae):																	
Greenside darter	*Etheostoma blennioides*		0.00				0.00				0.00				0.00		
Tessellated darter	*Etheostoma olmstedi*	7	9.09	46.43	1.07		0.00			1	1.25	52.00	1.66	1.0	3.45	57.00	1.72
Banded darter	*Etheostoma zonale*	3	3.90	39.00	0.63		0.00				0.00				0.00		
Shield darter	*Percina peltata*		0.00				0.00				0.00				0.00		
Darter			0.00				0.00				0.00				0.00		
Trout and Salmon (Salmonidae):																	
Rainbow trout	*Oncorhynchus mykiss*		0.00				0.00				0.00				0.00		
Brown trout	*Salmo trutta*		0.00				0.00				0.00				0.00		
Fish:																	
Unidentified			0.00				0.00				0.00				0.00		
n (Total Individuals)		77				10				80				29			

Table 3.38 Codorus Creek: Furnace Backpack Fish Data Summary for August 2000 to June 2001

FURNACE	Sampling Date/# of runs =	08/23/00			3 Runs	03/25/01			1 Run	06/10/01			3 Runs
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Suckers (Catostomidae):													
White sucker	*Catostomus commersoni*		0.00			1	0.55	99.00	11.08		0.00		
Northern hogsucker	*Hypentelium nigricans*		0.00				0.00				0.00		
Sunfish (Centrarchidae):													
Rock bass	*Ambloplites rupestris*		0.00				0.00			2	2.70	121.50	44.50
Lepomis	*Lepomis*		0.00				0.00				0.00		
Redbreast sunfish	*Lepomis auritus*		0.00			1	0.55	114.00	27.45		0.00		
Green sunfish	*Lepomis cyanellus*	20	19.05	86.50	13.63	7	3.83	95.14	18.47	11	14.86	108.36	30.98
Pumpkinseed	*Lepomis gibbosus*		0.00				0.00				0.00		
Bluegill	*Lepomis macrochirus*		0.00				0.00			3	4.05	67.33	8.56
Redear sunfish	*Lepomis microlophus*		0.00			4	2.19	52.25	1.04		0.00		
Smallmouth bass	*Micropterus dolomieui*		0.00				0.00			1	1.35	239.00	200.00
Largemouth bass	*Micropterus salmoides*		0.00				0.00				0.00		
Sculpins (Cottidae):													
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*	1	0.95	61.00	1.62		0.00				0.00		
Carps & minnows (Cyprinidae):													
Central stoneroller	*Campostoma anomalum*	2	1.90	90.50	10.81	2	1.09	81.00	6.38		0.00		
Rosyside dace	*Clinostomus funduloides*		0.00				0.00				0.00		
Satinfin shiner	*Cyprinella analostanus*		0.00			1	0.55	71.00	2.39		0.00		
Spotfin shiner	*Cyprinella spilopterus*		0.00			14	7.65	61.71	2.09	1	1.35	75.00	5.06
Common carp	*Cyprinus carpio Linnaeus*		0.00				0.00				0.00		
Cutlips minnow	*Exoglossum maxillingua*		0.00				0.00				0.00		
Common shiner	*Luxilus cornutus*		0.00				0.00				0.00		
Golden shiner	*Notemigonus crysoleucas*		0.00				0.00				0.00		
Spottail shiner	*Notropis hudsonius*	24	22.86	44.71	0.80	64	34.97	45.66	0.73		0.00		
Swallowtail shiner	*Notropis procne*		0.00			80	43.72	47.54	0.91		0.00		
Bluntnose minnow	*Pimephales notatus*		0.00				0.00			2	2.70	71.50	3.96
Dace	*Rhinichthys*		0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00				0.00		
Longnose dace	*Rhinichthys cataractae*	1	0.95	58.00	1.98		0.00			2	2.70	68.00	3.62
Creek chub	*Semotilus atromaculatus*		0.00				0.00				0.00		
Fallfish	*Semotilus corporalis*		0.00				0.00				0.00		
Cyprinid			0.00			4	2.19	36.75	0.33	25.0	33.78	42.88	0.89

(Continued on next page)

Table 3.38 Continued

FURNACE-continued	Sampling Date/# of runs =	08/23/00			3 Runs	03/25/01			1 Run	06/10/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bullhead catfishes (Ictaluridae):													
Yellow bullhead	*Ameiurus natalis*		0.00				0.00				0.00		
Margined madtom	*Noturus insignis*		0.00				0.00				0.00		
Topminnows & Killifishes (Fundulidae):													
Banded killifish	*Fundulus diaphanus*		0.00				0.00				0.00		
Perches & darters (Percidae):													
Greenside darter	*Etheostoma blennioides*	11	10.48	67.27	3.97	1	0.55	62.00	2.60	8.0	10.81	74.50	4.81
Tessellated darter	*Etheostoma olmstedi*	34	32.38	50.38	1.46	4	2.19	54.50	1.96	9.0	12.16	53.89	1.57
Banded darter	*Etheostoma zonale*	11	10.48	51.00	1.73		0.00			9.0	12.16	58.56	3.71
Shield darter	*Percina peltata*	1	0.95	74.00	3.98		0.00				0.00		
Darter			0.00				0.00			1.0	1.35	49.00	0.53
Trout and Salmon (Salmonidae):													
Rainbow trout	*Oncorhynchus mykiss*		0.00				0.00				0.00		
Brown trout	*Salmo trutta*		0.00				0.00				0.00		
Fish:													
Unidentified			0.00				0.00				0.00		
n (Total Individuals)		105				183				74			

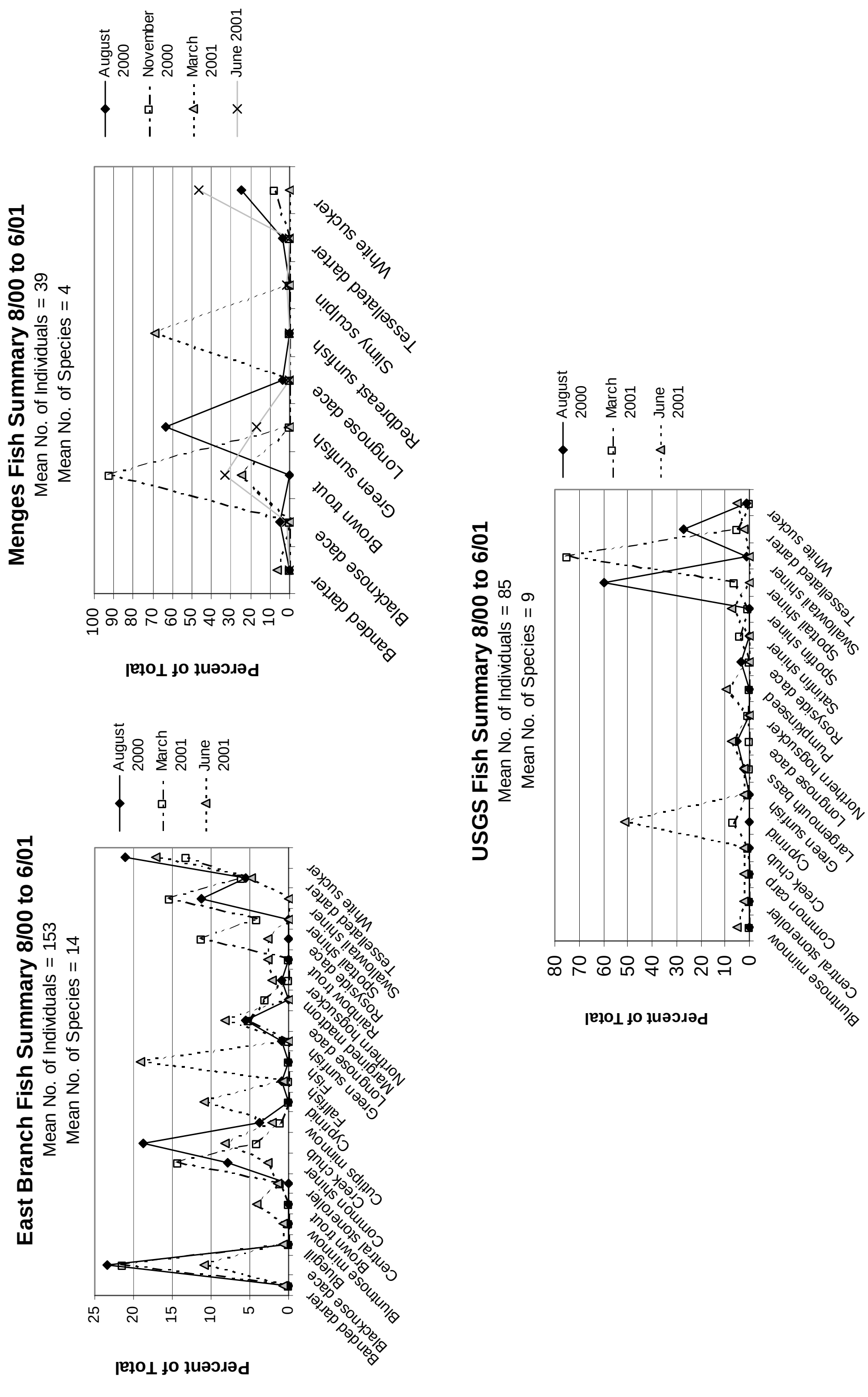


Figure 3.94 Percent Fish Distribution for Upstream Sites (East Branch, Menges and USGS) Codorus Creek, August 2000 to June 2001, Backpack Electrofishing Samples

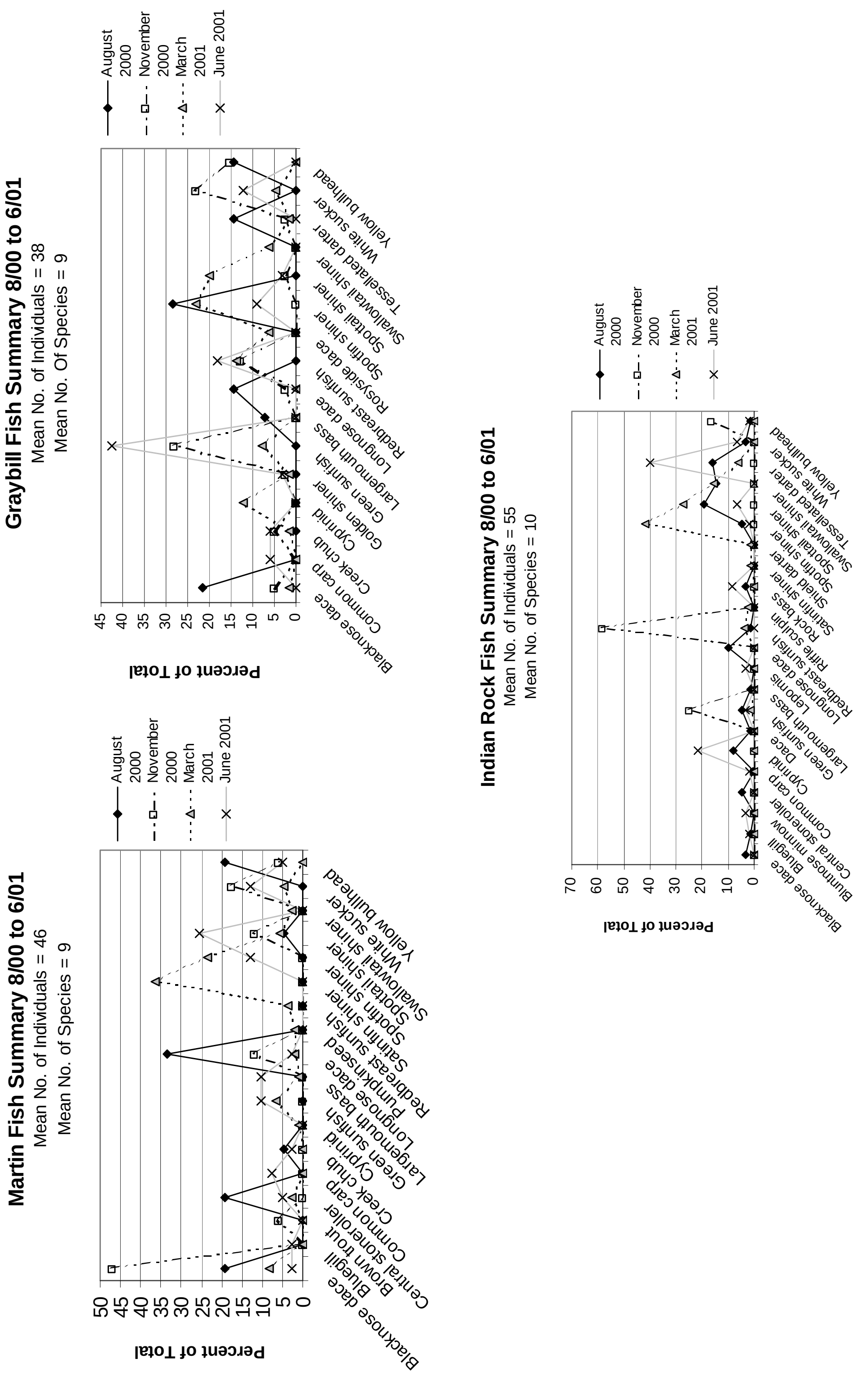


Figure 3.95 Percent Fish Distribution for Downstream Sites (Martin, Graybill, and Indian Rock) Codorus Creek, August 2000 to June 2001, Backpack Electrofishing Samples

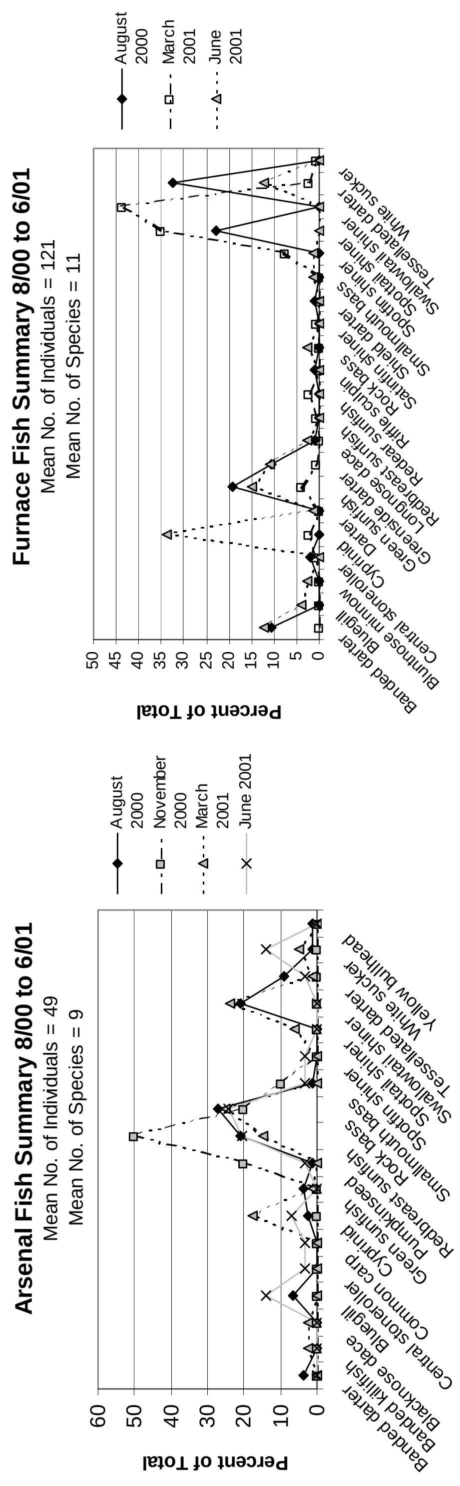


Figure 3.96 Percent Fish Distribution for Downstream Sites (Arsenal and Furnace) Codorus Creek, August 2000 to June 2001, Backpack Electrofishing Samples

3.9.2 *Leaf River Fish*

Table 3.39 Leaf River Boat Electrofishing Data Summary for October 2000

LEAF RIVER		NEW AUGUSTA (RM 1.7)				DOWNSTREAM (RM 2.0)				BOGUE (RM 10.3)			
	Sampling Date/# of runs =	10/16/2000			1 Run	10/16/2000			1 Run	10/17/2000			1 Run
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bowfin (Amiidae):													
Bowfin	*Amia calva*	1	0.71	642.00	2676.00		0.00				0.00		
Freshwater eel (Anguillidae):													
American eel	*Anguilla rostrata*		0.00			1	0.56	590.00	230.00		0.00		
Suckers (Catostomidae):													
Quillback carpsucker	*Carpiodes cyprinus*	18	12.77	417.17	863.78	11	6.18	389.46	723.64	9	14.29	355.33	618.89
Highfin carpsucker	*Carpiodes velifer*	3	2.13	274.00	302.67	7	3.93	279.57	309.14	3	4.76	209.67	128.67
Blue sucker	*Cycleptus elongatus*		0.00				0.00			1	1.59	454.00	2678.00
Northern hogsucker	*Hypentelium nigricans*	1	0.71	323.00	350.00		0.00				0.00		
Smallmouth buffalo	*Ictiobus bubalus*		0.00				0.00			1	1.59	622.00	4173.00
Blacktail redhorse	*Moxostoma poecilurum*	5	3.55	339.40	416.80	11	6.18	313.00	340.00	12	19.05	256.42	179.33
Sunfishes (Centrarchidae):													
Shadow bass	*Ambloplites ariommus*		0.00			2	1.12	131.50	59.00	2	3.17	177..50	109.00
Warmouth sunfish	*Lepomis gulosus*		0.00			1	0.56	170.00	90.00		0.00		
Bluegill sunfish	*Lepomis macrochirus*	4	2.84	144.00	46.50	14	7.87	160.07	93.29	2	3.17	163.50	75.00
Longear sunfish	*Lepomis megalotis*	27	19.15	102.56	22.52	42	23.60	102.10	23.29	8	12.70	117.00	34.50
Redear sunfish	*Lepomis microlophus*	2	1.42	197.00	128.00	6	3.37	214.50	211.33		0.00		
Spotted sunfish	*Lepomis puntatus*		0.00			1	0.56	82.00	10.00		0.00		
Spotted bass	*Micropterus punctulatus*	18	12.77	189.11	84.11	20	11.24	183.60	86.60	10	15.87	223.50	135.40
Largemouth bass	*Micropterus salmoides*		0.00				0.00				0.00		
Herrings (Clupeidae):													
Skipjack herring	*Alosa chrysochloris*	6	4.26	143.83	22.00	5	2.81	140.40	23.20		0.00		
Gizzard shad	*Dorosoma cepedianum*		0.00				0.00				0.00		
Carps & minnows (Cyprinidae):													
Blacktail shiner	*Cyprinella venustus*	3	2.13	59.33	1.33	12	6.74	68.42	-	3	4.76	57.00	-
Emerald shiner	*Notropis atherinoides*	1	0.71	84.00	2.00	1	0.56	82.00	2.00		0.00		
Mooneyes (Hiodontidae):													
Mooneye	*Hiodon tergisus*		0.00			1	0.56	230.00	104.00		0.00		
Bullhead catfishes (Ictaluridae):													
Blue catfish	*Ictalarus furcatus*		0.00			1	0.56	718.00	4173.00		0.00		
Channel catfish	*Ictalarus punctatus*	6	4.26	348.00	331.33	10	5.62	345.90	311.80	4	6.35	329.75	376.50
Flathead catfish	*Pylodictis olivaris*		0.00				0.00			4	6.35	379.50	615.50
Gars (Lepisosteidae):													
Spotted gar	*Lepisosteus oculatus*	8	5.67	486.63	364.75	8	4.49	491.38	377.00		0.00		
Longnose gar	*Lepisosteus osseus*	1	0.71	460.00	180.00	1	0.56	405.00	128.00		0.00		
Mullets (Mugilidae):													
Striped mullet	*Mugil cephalus*	36	25.53	400.56	851.94	19	10.67	407.21	838.16	3	4.76	365.33	558.67
Perches & darters (Percidae):													
Blackbanded darter	*Percina nigrofasciata*		0.00			2	1.12	64.50	2.00	1	1.59	72.00	2.00
Drums (Sciaenidae):													
Freshwater drum	*Aplodinotus grunniens*	1	0.71	545.00	2540.00	2	1.12	444.00	1249.00		0.00		
n (Total Individuals)		141				178				63			

(Continued on next page)

Table 3.39 Continued

LEAF RIVER		THOMPSON (RM 13.0)				MCLAIN (RM 27.5)			
	Sampling Date/# of runs =	10/17/2000			1 Run	10/17/2000			1 Run
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bowfin (Amiidae):									
Bowfin	*Amia calva*		0.00				0.00		
Freshwater eel (Anguillidae):									
American eel	*Anguilla rostrata*		0.00				0.00		
Suckers (Catostomidae):									
Quillback carpsucker	*Carpiodes cyprinus*	17	16.50	382.47	742.47	34	23.29	315.24	383.65
Highfin carpsucker	*Carpiodes velifer*	2	1.94	275.50	306.00	14	9.59	220.86	147.86
Blue sucker	*Cycleptus elongatus*		0.00				0.00		
Northern hogsucker	*Hypentelium nigricans*	2	1.94	240.50	149.00		0.00		
Smallmouth buffalo	*Ictiobus bubalus*		0.00				0.00		
Blacktail redhorse	*Moxostoma poecilurum*	20	19.42	256.57	287.60	5	3.42	284.20	259.20
Sunfishes (Centrarchidae):									
Shadow bass	*Ambloplites ariommus*	1	0.97	96.00	14.00	2	1.37	120.50	34.00
Warmouth sunfish	*Lepomis gulosus*		0.00				0.00		
Bluegill sunfish	*Lepomis macrochirus*	1	0.97	182.00	120.00	2	1.37	91.00	14.00
Longear sunfish	*Lepomis megalotis*	11	10.68	98.09	18.73	18	12.33	100.89	22.28
Redear sunfish	*Lepomis microlophus*		0.00				0.00		
Spotted sunfish	*Lepomis puntatus*		0.00				0.00		
Spotted bass	*Micropterus punctulatus*	6	5.83	214.83	136.33	5	3.42	184.80	84.40
Largemouth bass	*Micropterus salmoides*		0.00			2	1.37	253.00	197.00
Herrings (Clupeidae):									
Skipjack herring	*Alosa chrysochloris*		0.00				0.00		
Gizzard shad	*Dorosoma cepedianum*		0.00			11	7.53	288.73	251.09
Carps & minnows (Cyprinidae):									
Blacktail shiner	*Cyprinella venustus*	3	2.91	53.33		33	22.60	45.48	-
Emerald shiner	*Notropis atherinoides*		0.00				0.00		
Mooneyes (Hiodontidae):									
Mooneye	*Hiodon tergisus*		0.00				0.00		
Bullhead catfishes (Ictaluridae):									
Blue catfish	*Ictalarus furcatus*		0.00				0.00		
Channel catfish	*Ictalarus punctatus*	24	23.30	323.33	310.33	8	5.48	300.50	178.25
Flathead catfish	*Pylodictis olivaris*		0.00				0.00		
Gars (Lepisosteidae):									
Spotted gar	*Lepisosteus oculatus*		0.00			5	3.42	525.40	464.40
Longnose gar	*Lepisosteus osseus*		0.00				0.00		
Mullets (Mugilidae):									
Striped mullet	*Mugil cephalus*	16	15.53	350.69	636.50	7	4.79	346.00	520.43
Perches & darters (Percidae):									
Blackbanded darter	*Percina nigrofasciata*		0.00				0.00		
Drums (Sciaenidae):									
Freshwater drum	*Aplodinotus grunniens*		0.00				0.00		
n (Total Individuals)		103				146			

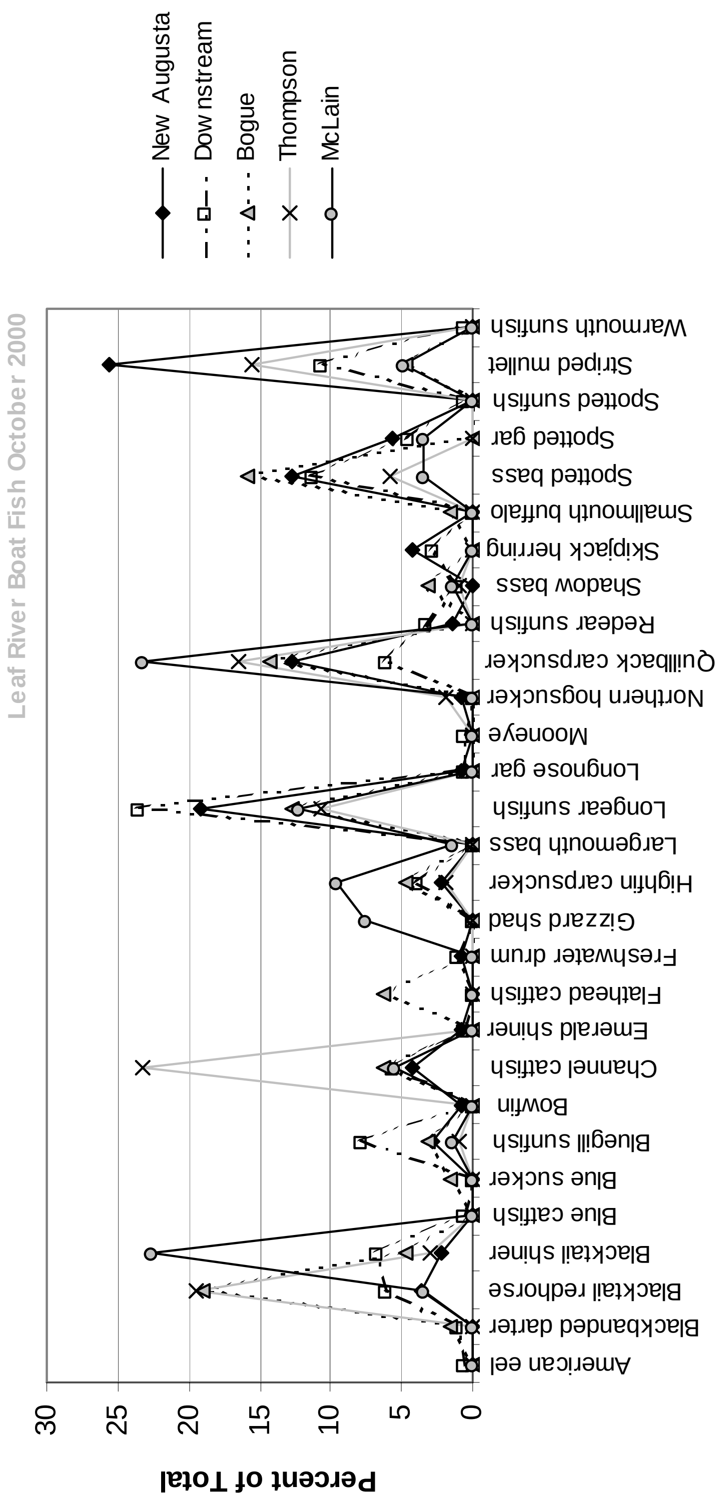


Figure 3.97 Leaf River Boat Fish Distribution for October 2000

Table 3.40 Leaf River Backpack Electrofishing Data Summary for October 2000

LEAF RIVER		NEW AUGUSTA (RM 1.7)				DOWNSTREAM (RM 2.0)				BOGUE (RM 10.3)			
	Sampling Date/# of runs =	10/16/2000			1 Run	10/16/2000			1 Run	10/17/2000			1 Run
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bowfin (Amiidae):													
Bowfin	*Amia calva*		0.00				0.00				0.00		
Suckers (Catostomidae):													
Highfin carpsucker	*Carpiodes velifer*		0.00				0.00			5	3.16	49.80	1.57
Sunfishes (Centrarchidae):													
Longear sunfish	*Lepomis megalotis*	18	7.83	57.82	3.87	14	7.18	49.86	2.70	4	2.53	46.50	3.39
Spotted bass	*Micropterus punctulatus*	1	0.43	112.00	12.35	1	0.51	131.00	18.50	1	0.63	148.00	28.14
Carps & minnows (Cyprinidae):													
Blacktail shiner	*Cyprinella venustus*	130	56.52	37.11	0.52	101	51.79	37.24	0.57	81	51.27	37.21	0.50
Longnose shiner	*Notropis longirostris*	31	13.48	37.93	0.51	14	7.18	41.29	0.63	26	16.46	40.23	0.51
Weed shiner	*Notropis texanus*	2	0.87	59.50	1.42	4	2.05	66.75	2.20		0.00		
Mimic shiner	*Notropis volucellus*	22	9.57	41.36	0.54	47	24.10	41.13	0.52	8	5.06	36.88	0.37
Bullhead minnow	*Pimaphales vigilax*	23	10.00	48.74	1.03		0.00			33	20.89	32.03	0.31
Topminnows & Killifishes (Fundulidae):													
Blackspotted topminnow	*Fundulus olivaceus*		0.00			4	2.05	42.75	0.75		0.00		
Bullhead catfishes (Ictaluridae):													
Channel catfish	*Ictalarus punctatus*	2	0.87	98.00	11.52		0.00				0.00		
Perches & darters (Percidae):													
Blackbanded darter	*Percina nigrofasciata*	1	0.43	71.00	2.23		0.00				0.00		
Livebearers (Poeciliidae):													
Mosquitofish	*Gambusia affinis*		0.00			9	4.62	25.78	0.22		0.00		
Soles (Soleidae):													
Hogchocker	*Trinectes maculatus*		0.00			1	0.51	62.00	4.15		0.00		
n (Total Individuals)		230				195				158			

(Continued on next page)

Table 3.40 Continued

LEAF RIVER	Sampling Date/# of runs =	THOMPSON (RM 13.0) 10/17/2000 1 Run				MCLAIN (RM 27.5) 10/17/2000 1 Run			
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Bowfin (Amiidae):									
Bowfin	*Amia calva*		0.00				0.00		
Suckers (Catostomidae):									
Highfin carpsucker	*Carpiodes velifer*	2	1.22	29.50	0.34		0.00		
Sunfishes (Centrarchidae):									
Longear sunfish	*Lepomis megalotis*	5	3.05	30.20	0.43	1	0.62	60.00	2.98
Spotted bass	*Micropterus punctulatus*		0.00				0.00		
Carps & minnows (Cyprinidae):									
Blacktail shiner	*Cyprinella venustus*	73	44.51	31.71	0.30	123	76.40	35.80	0.42
Longnose shiner	*Notropis longirostris*	55	33.54	45.10	0.93	27	16.77	34.00	0.37
Weed shiner	*Notropis texanus*	1	0.61	66.00	2.05		0.00		
Mimic shiner	*Notropis volucellus*	3	1.83	45.33	0.82	2	1.24	42.00	0.60
Bullhead minnow	*Pimaphales vigilax*	2	1.22	54.50	1.48		0.00		
Topminnows & Killifishes (Fundulidae):									
Blackspotted topminnow	*Fundulus olivaceus*		0.00				0.00		
Bullhead catfishes (Ictaluridae):									
Channel catfish	*Ictalarus punctatus*	1	0.61	52.00	1.10		0.00		
Perches & darters (Percidae):									
Blackbanded darter	*Percina nigrofasciata*		0.00				0.00		
Livebearers (Poeciliidae):									
Mosquitofish	*Gambusia affinis*	22	13.41	24.50	0.17	6	3.73	30.00	0.30
Soles (Soleidae):									
Hogchocker	*Trinectes maculatus*		0.00			2	1.24	48.50	2.05
n (Total Individuals)		164				161			

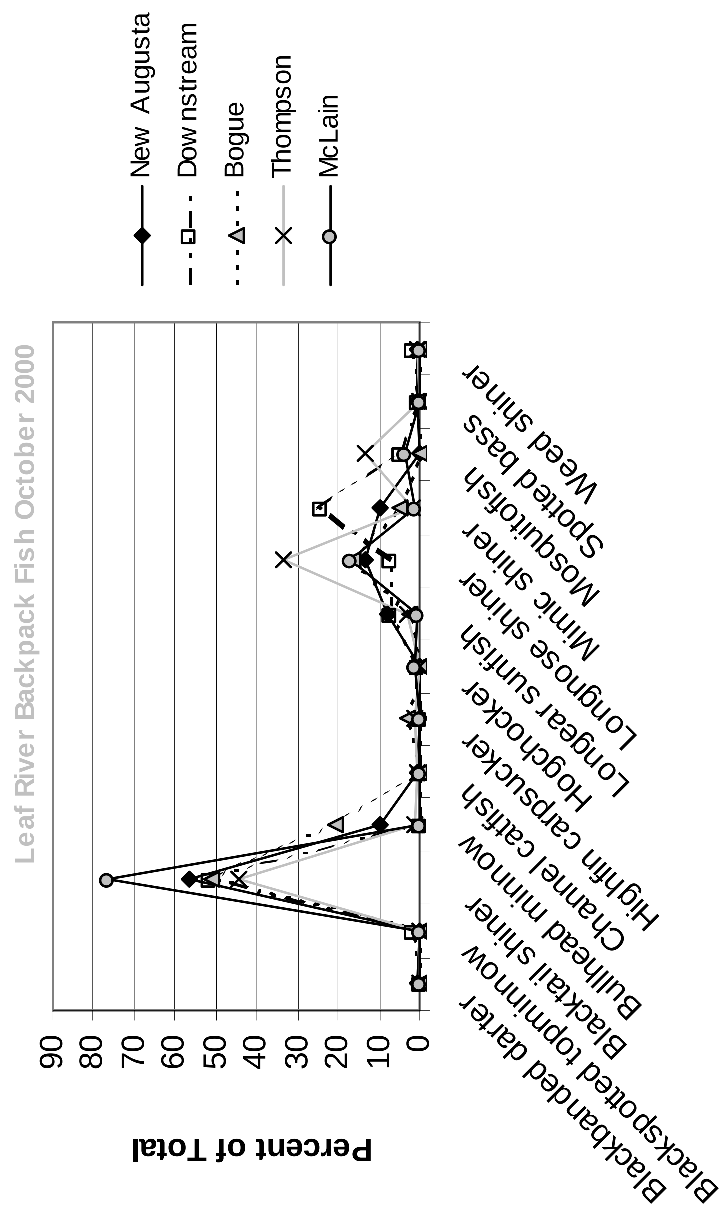


Figure 3.98 Leaf River Backpack Fish Distribution for October 2000

3.9.3 *McKenzie River Fish*

Table 3.41 McKenzie River Boat Electrofishing Data Summary for September 2000

MCKENZIE RIVER	Sampling Date =	HENDRICKS (RM 26.5) 09/20/00				MOHAWK (RM 13.7) 09/20/00				HARVEST (RM 10) 09/19/00				ARMITAGE (RM 6) 09/20/00			
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Suckers (Catostomidae):																	
Largescale sucker	*Castomus macrocheilus*	2	4.17	296.50	650.45	4	8.89	444.25	1021.48	11	26.19	498.55	1369.75	8	20.00	490.75	1286.68
Sculpins (Cottidae):																	
Torrent sculpin	*Cottus rhotheus*	2	4.17	50.75	16.75		0.00				0.00				0.00		
Carps and Minnows (Cyprinidae):																	
Northern pike minnow	*Ptychocheilus oregonensis*	7	14.58	195.23	234.64	1	2.22	375.00	420.00	7	16.67	326.57	337.86	3	7.50	303.00	240.67
Redside shiner	*Richardsonius balteatus*		0.00				0.00				0.00			1	2.50	80.00	6.00
Trout and Salmon (Salmonidae):																	
Cutthroat trout	*Oncorhynchus clarki*	5	10.42	231.60	176.50	38	84.44	251.53	153.29	16	38.10	274.44	189.56	19	47.50	290.00	232.63
Rainbow trout, wild	*Oncorhynchus mykiss*	8	16.67	34.14	18.13	1	2.22	200.00	72.00	3	7.14	333.67	350.67	7	17.50	9.22	8.00
Chinook salmon	*Oncorhynchus tshawytscha*	24	50.00	123.29	17.33		0.00			5	11.90	138.60	26.00		0.00		
Mountain whitefish	*Prosopium williamsoni*		0.00			1	2.22	258.00	152.00		0.00			2	5.00	266.00	187.50
n (Total Individuals)		48				45				42				40			

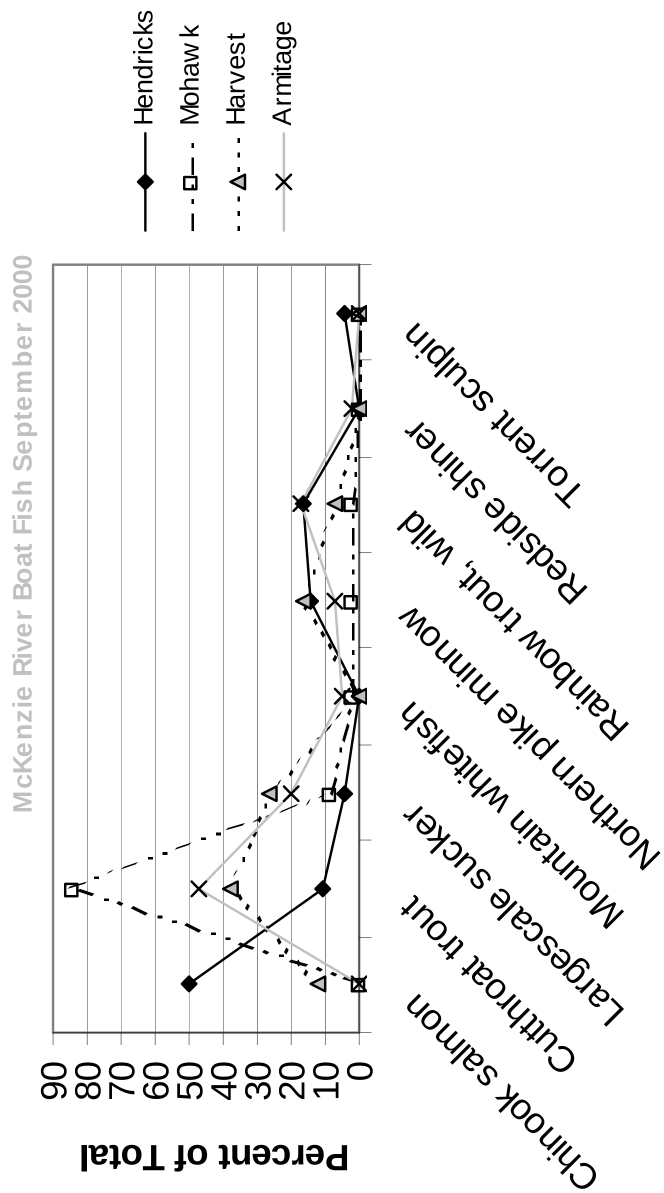


Figure 3.99 McKenzie River Boat Fish Distribution for September 2000

Table 3.42 McKenzie River: Hendricks RM 26.5 Backpack Electrofishing Data Summary for September 2000 to June 2001

HENDRICKS	Sampling Date/# of runs =	09/23/00			3 Runs	12/10/00			2 Runs	06/22/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Sculpins (Cottidae):													
Prickly sculpin	*Cottus asper*		0.00				0.00			1	2.44	147.00	47.54
Mottled sculpin	*Cottus bairdi*	2	2.70	41.50	1.28	1	4.35	56.00	2.47		0.00		
Paiute sculpin	*Cottus beldingi*		0.00				0.00			2	4.88	67.50	3.94
Shorthead sculpin	*Cottus confusus*	3	4.05	70.00	4.61		0.00				0.00		
Riffle sculpin	*Cottus gulosus*	13	17.57	60.15	3.24		0.00				0.00		
Reticulate sculpin	*Cottus perplexus*	14	18.92	55.29	2.32	5	21.74	53.00	1.82	19	46.34	56.05	2.57
Torrent sculpin	*Cottus rhotheus*	26	35.14	52.81	3.42	15	65.22	54.57	3.04	15	36.59	73.80	6.56
Sculpin		3	4.05	29.67	0.25		0.00			2	4.88	52.00	2.05
Carps and Minnows (Cyprinidae):													
Longnose dace	*Rhinichthys cataractae*		0.00				0.00				0.00		
Speckled dace	*Rhinichthys osculus*	9	12.16	63.11	3.30		0.00				0.00		
Redside shiner	*Richardsonius balteatus*		0.00			1	4.35	77.00	4.08		0.00		
Lamprey (Petromyzontidae):													
Western brook lamprey	*Lampetra richardsoni*	4	5.41	68.25	0.91	1	4.35	112.00	2.45	2	4.88	108.00	2.39
Trout and Salmon (Salmonidae):													
Cutthroat trout	*Oncorhynchus clarki*		0.00				0.00				0.00		
n (Total Individuals)		74				23				41			

Table 3.43 McKenzie River: Bellingers RM 18.5 Backpack Electrofishing Data Summary for September 2000 to June 2001

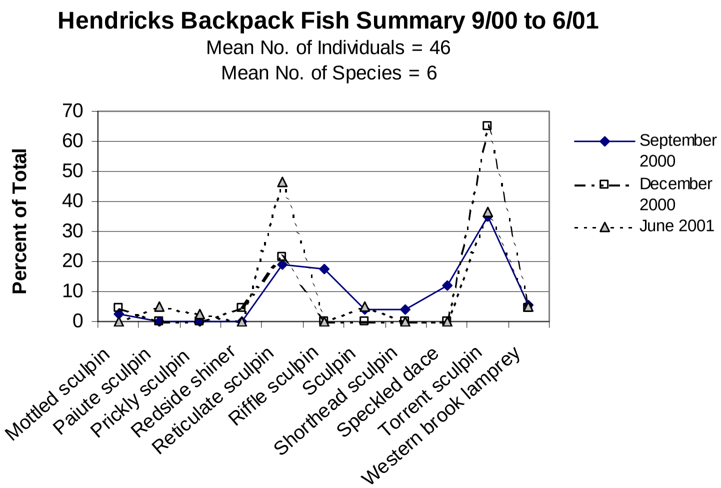
BELLINGERS	Sampling Date/# of runs =	09/23/00			3 Runs	12/10/00			2 Runs	06/22/01			2 Runs
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Sculpins (Cottidae):													
Prickly sculpin	*Cottus asper*		0.00				0.00				0.00		
Mottled sculpin	*Cottus bairdi*		0.00				0.00				0.00		
Paiute sculpin	*Cottus beldingi*		0.00				0.00				0.00		
Shorthead sculpin	*Cottus confusus*		0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00		
Reticulate sculpin	*Cottus perplexus*	59	76.62	55.41	2.60	23	54.76	58.09	2.90	29	85.29	55.93	2.94
Torrent sculpin	*Cottus rhotheus*	11	14.29	45.09	1.54	12	28.57	45.67	2.37	3	8.82	74.00	6.42
Sculpin			0.00			7	16.67	35.00	0.34	1	2.94	59.00	2.84
Carps and Minnows (Cyprinidae):													
Longnose dace	*Rhinichthys cataractae*		0.00				0.00				0.00		
Speckled dace	*Rhinichthys osculus*	1	1.30	40.00	0.63		0.00			1	2.94	58.00	2.14
Redside shiner	*Richardsonius balteatus*	3	3.90	94.33	8.99		0.00				0.00		
Lamprey (Petromyzontidae):													
Western brook lamprey	*Lampetra richardsoni*	3	3.90	81.00	1.06		0.00				0.00		
Trout and Salmon (Salmonidae):													
Cutthroat trout	*Oncorhynchus clarki*		0.00				0.00				0.00		
n (Total Individuals)		77				42				34			

Table 3.44 McKenzie River: Harvest RM 10 Backpack Electrofishing Data Summary for September 2000 to June 2001

HARVEST									
	Sampling Date/# of runs =	09/23/00			3 Runs	06/22/01			3 Runs
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Sculpins (Cottidae):									
Prickly sculpin	*Cottus asper*		0.00				0.00		
Mottled sculpin	*Cottus bairdi*		0.00				0.00		
Paiute sculpin	*Cottus beldingi*	61	19.55	49.39	1.73	21	26.25	61.29	3.50
Shorthead sculpin	*Cottus confusus*	1	0.32	55.00	1.79		0.00		
Riffle sculpin	*Cottus gulosus*	13	4.17	70.77	4.69		0.00		
Reticulate sculpin	*Cottus perplexus*	19	6.09	58.53	3.15	30	37.50	57.67	3.24
Torrent sculpin	*Cottus rhotheus*	35	11.22	46.56	2.25	16	20.00	71.75	7.16
Sculpin		88	28.21	30.50	0.34	8	10.00	48.38	1.93
Carps and Minnows (Cyprinidae):									
Longnose dace	*Rhinichthys cataractae*	1	0.32	63.00	2.85		0.00		
Speckled dace	*Rhinichthys osculus*	92	29.49	58.55	2.57	5	6.25	60.00	2.73
Redside shiner	*Richardsonius balteatus*	1	0.32	84.00	5.51		0.00		
Lamprey (Petromyzontidae):									
Western brook lamprey	*Lampetra richardsoni*		0.00				0.00		
Trout and Salmon (Salmonidae):									
Cutthroat trout	*Oncorhynchus clarki*	1	0.32	72.00	3.73		0.00		
n (Total Individuals)		312				80			

Table 3.45 McKenzie River: Armitage, RM 6.0 Backpack Electrofishing Data Summary for September 2000 to June 2001

ARMITAGE	Sampling Date/# of runs =	09/22/00			3 Runs	06/23/01			2 Runs
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Sculpins (Cottidae):									
Prickly sculpin	*Cottus asper*		0.00				0.00		
Mottled sculpin	*Cottus bairdi*		0.00				0.00		
Paiute sculpin	*Cottus beldingi*	14	13.86	46.71	1.76	47	51.09	50.02	2.80
Shorthead sculpin	*Cottus confusus*	8	7.92	54.50	2.17	1	1.09	47.00	1.42
Riffle sculpin	*Cottus gulosus*		0.00				0.00		
Reticulate sculpin	*Cottus perplexus*	8	7.92	59.25	3.38		0.00		
Torrent sculpin	*Cottus rhotheus*	39	38.61	52.95	2.73	21	22.83	70.95	6.04
Sculpin			0.00			13	14.13	45.85	1.36
Carps and Minnows (Cyprinidae):									
Longnose dace	*Rhinichthys cataractae*	22	21.78	47.95	1.40	5	5.43	68.20	3.94
Speckled dace	*Rhinichthys osculus*	10	9.90	54.20	1.96	5	5.43	63.40	3.34
Redside shiner	*Richardsonius balteatus*		0.00				0.00		
Lamprey (Petromyzontidae):									
Western brook lamprey	*Lampetra richardsoni*		0.00				0.00		
			0.00				0.00		
Trout and Salmon (Salmonidae):			0.00				0.00		
Cutthroat trout	*Oncorhynchus clarki*		0.00				0.00		
n (Total Individuals)		101				92			



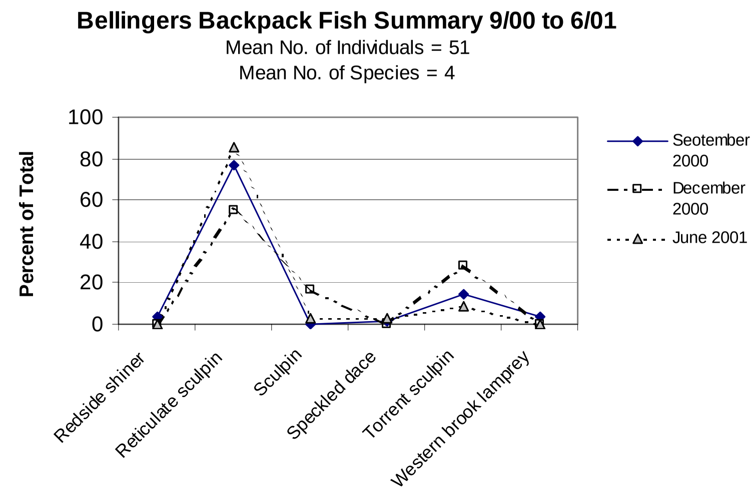
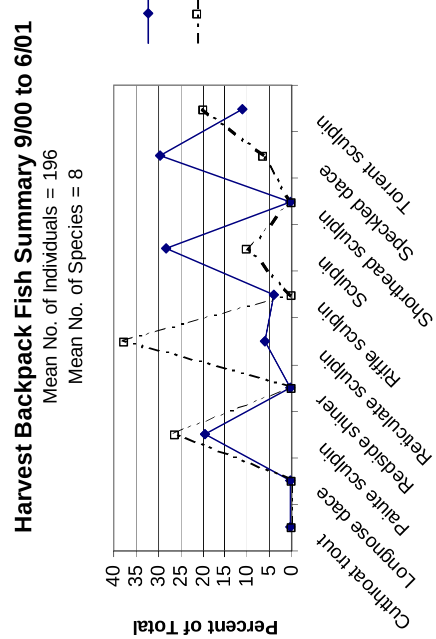


Figure 3.100 Percent Fish Distribution for Upstream Sites (Hendricks and Bellingers) McKenzie River, September 2000 to June 2001, Backpack Electrofishing Samples



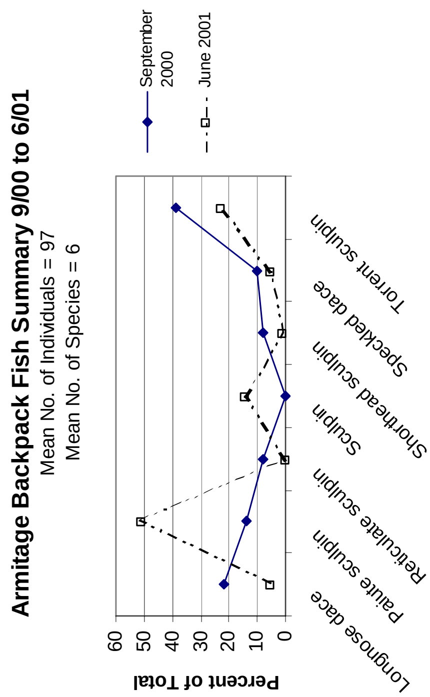


Figure 3.101 Percent Fish Distribution for Downstream Sites (Harvest and Armitage), McKenzie River, September 2000 to June 2001, Backpack Electrofishing Samples

3.9.4 *Willamette River Fish*

Table 3.46 Willamette River Boat Electrofishing Data Summary for Upstream Sites (Harrisburg and Cartney), September 2000

WILLAMETTE RIVER	Sampling Date =	HARRISBURG (RM 160) 09/21/00				CARTNEY (RM 156) 09/21/00			
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Suckers (Catostomidae):									
Largescale sucker	*Castomus macrocheilus*	12	54.55	454.17	1004.94	14	36.84	472.64	1215.19
Mountain sucker	*Castomus platyrhynchus*		0.00			1	2.63	300.00	234.00
Sculpins (Cottidae):									
Prickly sculpin	*Cottus asper*		0.00				0.00		
Paiute sculpin	*Cottus beldingi*		0.00			1	2.63	59.00	1.83
Torrent sculpin	*Cottus rhotheus*		0.00			1	2.63	79.00	6.00
Carps and Minnows (Cyprinidae):									
Chiselmouth	*Acrocheilus alutaceus*		0.00				0.00		
Common carp	*Cyprinus carpio*		0.00				0.00		
Peamouth	*Mylocheilus caurinus*		0.00				0.00		
Northern pike minnow	*Ptychocheilus oregonensis*	4	18.18	274.25	201.25	5	13.16	246.80	286.80
Redside shiner	*Richardsonius balteatus*		0.00			3	7.89	109.33	11.00
Trout and Salmon (Salmonidae):									
Cutthroat trout	*Oncorhynchus clarki*	1	4.55	112.00	12.00	3	7.89	278.67	219.67
Rainbow trout, wild	*Oncorhynchus mykiss*		0.00				0.00		
Chinook salmon	*Oncorhynchus tshawytscha*	2	9.09	141.00	31.00	2	5.26	178.00	52.00
Mountain whitefish	*Prosopium williamsoni*	3	13.64	137.33	22.00	8	21.05	151.13	30.00
n (Total Individuals)		22				38			

Table 3.47 Willamette River Boat Electrofishing Data Summary for Downstream Sites (Sam Daws, Peoria, and Willamette Park), September 2000

WILLAMETTE RIVER		SAM DAWS (RM 145)				PEORIA (RM 136)				WILLAMETTE PARK (RM 134)			
	Sampling Date =	09/19/00				09/19/00				09/19/00			
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Suckers (Catostomidae):													
Largescale sucker	*Castomus macrocheilus*	21	36.84	462.43	1117.86	10	10.31	385.90	843.46	18	66.67	425.00	900.00
Mountain sucker	*Castomus platyrhynchus*		0.00				0.00				0.00		
Sculpins (Cottidae):													
Prickly sculpin	*Cottus asper*		0.00			1	1.03	125.00	24.00		0.00		
Paiute sculpin	*Cottus beldingi*		0.00				0.00				0.00		
Torrent sculpin	*Cottus rhotheus*	1	1.75	102.00	16.00		0.00				0.00		
Carps and Minnows (Cyprinidae):													
Chiselmouth	*Acrocheilus alutaceus*		0.00			14	14.43	142.71	28.76		0.00		
Common carp	*Cyprinus carpio*	1	1.75	470.00	1418.80		0.00				0.00		
Peamouth	*Mylocheilus caurinus*		0.00			1	1.03	127.00	19.00		0.00		
Northern pike minnow	*Ptychocheilus oregonensis*	1	1.75	223.00	96.00	6	6.19	137.00	24.83	1	3.70	193.00	71.00
Redside shiner	*Richardsonius balteatus*	13	22.81	106.54	11.38	57	58.76	100.14	8.78		0.00		
Trout and Salmon (Salmonidae):													
Cutthroat trout	*Oncorhynchus clarki*	4	7.02	232.50	149.25	1	1.03	255.00	180.00		0.00		
Rainbow trout, wild	*Oncorhynchus mykiss*	1	1.75	295.00	248.00		0.00				0.00		
Chinook salmon	*Oncorhynchus tshawytscha*	4	7.02	138.00	25.75		0.00			2	7.41	141.00	28.00
Mountain whitefish	*Prosopium williamsoni*	11	19.30	148.09	30.18	7	7.22	145.00	27.00	6	22.22	158.00	37.00
n (Total Individuals)		57				97				27			

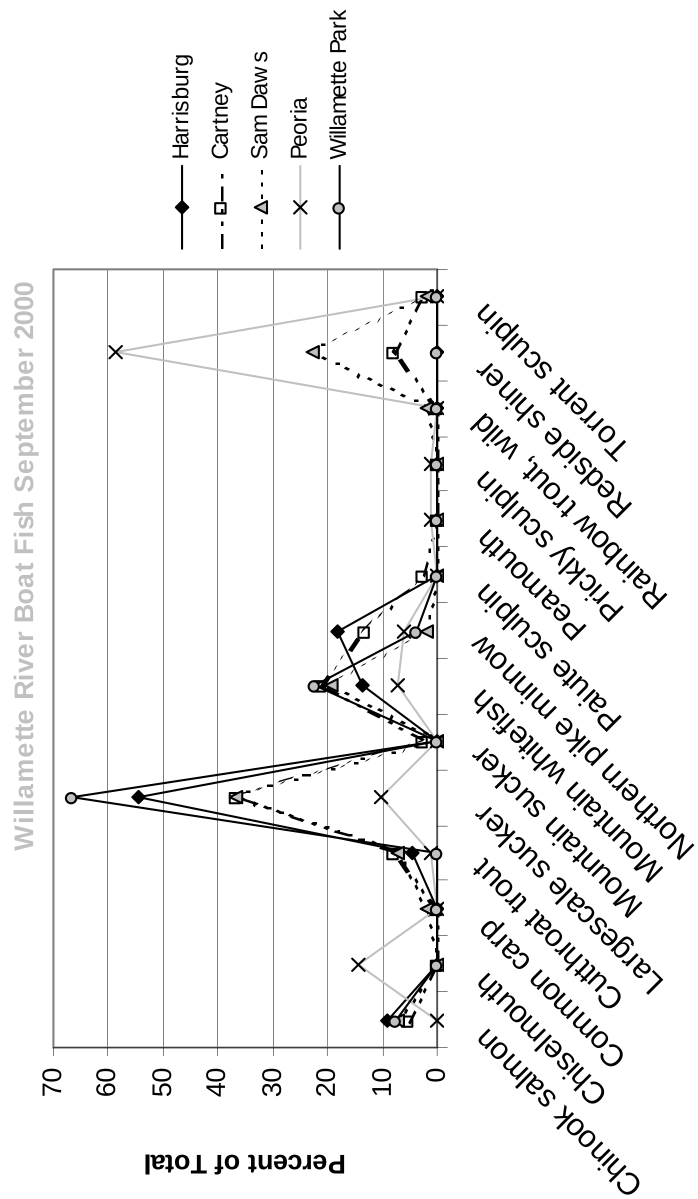


Figure 3.102 Willamette River Boat Fish Distribution for September 2000

Table 3.48 Willamette River: Whitely RM 177 Backpack Electrofishing Data Summary for September 2000 to June 2001

WHITELY	Sampling Date/# of runs =	09/22/00			3 Runs	06/23/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):									
Largescale sucker	*Castomus macrocheilus*	9	4.05	70.67	3.55		0.00		
Sculpins (Cottidae):									
Prickly sculpin	*Cottus asper*		0.00				0.00		
Mottled sculpin	*Cottus bairdi*		0.00				0.00		
Paiute sculpin	*Cottus beldingi*		0.00			2	1.09	68.50	5.25
Slimy sculpin	*Cottus congnatus*		0.00				0.00		
Riffle sculpin	*Cottus gulosus*	40	18.02	54.08	2.36		0.00		
Reticulate sculpin	*Cottus perplexus*	8	3.60	43.38	1.11	158	85.87	62.94	3.52
Torrent sculpin	*Cottus rhotheus*	8	3.60	81.13	7.24	23	12.50	86.78	9.73
Sculpin			0.00				0.00		
Carps and Minnows (Cyprinidae):									
Chiselmouth	*Acrocheilus alutaceus*		0.00				0.00		
Peamouth	*Mylocheilus caurinus*		0.00				0.00		
Northern pike minnow	*Ptychocheilus oregonensis*		0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00		
Longnose dace	*Rhinichthys cataractae*		0.00				0.00		
Leopard dace	*Rhinichthys falcatus*		0.00				0.00		
Speckled dace	*Rhinichthys osculus*	155	69.82	39.03	0.75	1	0.54	43.00	0.88
Dace	*Rhinichthys*		0.00				0.00		
Redside shiner	*Richardsonius balteatus*	2	0.90	40.00	0.52		0.00		
Cyprinid			0.00				0.00		
Lamprey (Petromyzontidae):									
Western brook lamprey	*Lampetra richardsoni*		0.00				0.00		
n (Total Individuals)		222				184			

Table 3.49 Willamette River: Harrisburg RM 160 Backpack Electrofishing Data Summary for September 2000 to June 2001

HARRISBURG	Sampling Date/# of runs =	09/21/00			3 Runs	12/09/00			2 Runs	06/21/01			2 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):													
Largescale sucker	*Castomus macrocheilus*	1	0.81	75.00	3.14	6	6.00	66.80	2.56		0.00		
Sculpins (Cottidae):													
Prickly sculpin	*Cottus asper*		0.00			2	2.00	96.00	11.25	2	2.22	120.50	103.00
Mottled sculpin	*Cottus bairdi*	15	12.20	54.73	2.15		0.00				0.00		
Paiute sculpin	*Cottus beldingi*	3	2.44	59.33	3.33		0.00			3	3.33	66.00	55.33
Shorthead sculpin	*Cottus confusus*		0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00		
Reticulate sculpin	*Cottus perplexus*	19	15.45	58.11	2.53	32	32.00	56.03	2.47	57	63.33	61.14	50.56
Torrent sculpin	*Cottus rhotheus*	9	7.32	58.44	3.86	22	22.00	57.35	2.50	20	22.22	73.05	60.05
Sculpin			0.00			27	27.00	65.67	3.11		0.00		
Carps and Minnows (Cyprinidae):													
Chiselmouth	*Acrocheilus alutaceus*		0.00			2	2.00	42.50	1.07		0.00		
Peamouth	*Mylocheilus caurinus*		0.00				0.00				0.00		
Northern pike minnow	*Ptychocheilus oregonensis*		0.00				0.00			1	1.11	99.00	84.00
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00				0.00		
Longnose dace	*Rhinichthys cataractae*	23	18.70	51.00	1.27	2	2.00	54.50	1.69	3	3.33	48.33	41.67
Leopard dace	*Rhinichthys falcatus*	2	1.63	58.00	1.60		0.00				0.00		
Speckled dace	*Rhinichthys osculus*	40	32.52	51.10	1.60	2	2.00	48.50	1.31	2	2.22	57.00	49.00
Dace	*Rhinichthys*	8	6.50	37.80	0.40	5	5.00	55.00	2.15		0.00		
Redside shiner	*Richardsonius balteatus*	3	2.44	88.67	6.52		0.00			1	1.11	96.00	77.00
Cyprinid			0.00				0.00				0.00		
Lamprey (Petromyzontidae):													
Western brook lamprey	*Lampetra richardsoni*		0.00				0.00			1	1.11	127.00	-
n (Total Individuals)		123				100				90			

Table 3.50 Willamette River: Cartney RM 156 Backpack Electrofishing Data Summary for September 2000 to June 2001

CARTNEY	Sampling Date/# of runs =	09/21/00			3 Runs	12/09/00			2 Runs
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Suckers (Catostomidae):									
Largescale sucker	*Castomus macrocheilus*	43	27.39	57.53	1.29	6	6.38	68.12	3.33
Sculpins (Cottidae):									
Prickly sculpin	*Cottus asper*		0.00				0.00		
Mottled sculpin	*Cottus bairdi*	18	11.46	50.50	1.69		0.00		
Paiute sculpin	*Cottus beldingi*		0.00			3	3.19	57.67	2.73
Slimy sculpin	*Cottus congnatus*		0.00				0.00		
Riffle sculpin	*Cottus gulosus*	11	7.01	49.55	1.57		0.00		
Reticulate sculpin	*Cottus perplexus*		0.00			8	8.51	58.63	2.82
Torrent sculpin	*Cottus rhotheus*	21	13.38	47.62	1.33	67	71.28	55.46	2.46
Sculpin			0.00			4	4.26	51.75	1.61
Carps and Minnows (Cyprinidae):									
Chiselmouth	*Acrocheilus alutaceus*		0.00				0.00		
Peamouth	*Mylocheilus caurinus*		0.00				0.00		
Northern pike minnow	*Ptychocheilus oregonensis*		0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00		
Longnose dace	*Rhinichthys cataractae*		0.00				0.00		
Leopard dace	*Rhinichthys falcatus*	3	1.91	33.67	0.33		0.00		
Speckled dace	*Rhinichthys osculus*	60	38.22	38.25	0.59	5	5.32	37.80	0.52
Dace	*Rhinichthys*		0.00			1	1.06	41.00	0.59
Redside shiner	*Richardsonius balteatus*		0.00				0.00		
Cyprinid		1	0.64	-	0.45		0.00		
Lamprey (Petromyzontidae):									
Western brook lamprey	*Lampetra richardsoni*		0.00				0.00		
n (Total Individuals)		157				94			

Table 3.51 Willamette River: Intake RM 148.5 Backpack Electrofishing Data Summary for September 2000 to June 2001

INTAKE	Sampling Date/# of runs =	09/21/00			3 Runs	12/09/00			2 Runs	06/21/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):													
Largescale sucker	*Castomus macrocheilus*	10	7.09	54.50	1.58	7	10.00	66.67	3.05	2	2.25	69.50	-
Sculpins (Cottidae):													
Prickly sculpin	*Cottus asper*		0.00			7	10.00	56.86	2.00	8	8.99	80.00	6.12
Mottled sculpin	*Cottus bairdi*	14	9.93	51.93	1.51		0.00				0.00		
Paiute sculpin	*Cottus beldingi*		0.00			1	1.43	75.00	6.59	2	2.25	72.50	-
Slimy sculpin	*Cottus congnatus*		0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00				0.00		
Reticulate sculpin	*Cottus perplexus*		0.00			3	4.29	49.33	1.58	10	11.24	57.20	2.89
Torrent sculpin	*Cottus rhotheus*	6	4.26	51.67	1.75	16	22.86	58.58	2.39	12	13.48	80.82	9.75
Sculpin			0.00			12	17.14	51.43	1.78	19	21.35	40.50	1.25
Carps and Minnows (Cyprinidae):													
Chiselmouth	*Acrocheilus alutaceus*		0.00				0.00				0.00		
Peamouth	*Mylocheilus caurinus*		0.00				0.00				0.00		
Northern pike minnow	*Ptychocheilus oregonensis*		0.00			1	1.43	48.00	0.93		0.00		
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00			1	1.12	49.00	1.10
Longnose dace	*Rhinichthys cataractae*		0.00			2	2.86	68.00	3.00	11	12.36	55.18	1.60
Leopard dace	*Rhinichthys falcatus*	6	4.26	35.50	0.41		0.00			12	13.48	52.92	-
Speckled dace	*Rhinichthys osculus*	74	52.48	41.21	0.68	6	8.57	42.33	0.86	11	12.36	54.18	2.29
Dace	*Rhinichthys*		0.00			15	21.43	50.50	0.92	1	1.12	45.00	0.97
Redside shiner	*Richardsonius balteatus*	31	21.99	29.25	-		0.00				0.00		
Cyprinid			0.00				0.00				0.00		
Lamprey (Petromyzontidae):													
Western brook lamprey	*Lampetra richardsoni*		0.00				0.00				0.00		
n (Total Individuals)		141				70				89			

Table 3.52 Willamette River: Peoria RM 136 Backpack Electrofishing Data Summary for September 2000 to June 2001

PEORIA	Sampling Date/# of runs =	09/21/00			3 Runs	12/11/00			2 Runs	06/21/01			3 Runs
		Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)	Count	% of Total	Mean Total Length (mm)	Mean Weight (g)
Suckers (Catostomidae):													
Largescale sucker	*Castomus macrocheilus*	15	15.63	46.36	0.86	21	20.00	48.43	1.15		0.00		
Sculpins (Cottidae):													
Prickly sculpin	*Cottus asper*		0.00				0.00				0.00		
Mottled sculpin	*Cottus bairdi*	7	7.29	48.71	1.17		0.00			1	9.09	64.00	3.50
Paiute sculpin	*Cottus beldingi*		0.00			1	0.95	59.00	1.99		0.00		
Slimy sculpin	*Cottus cognatus*		0.00				0.00				0.00		
Riffle sculpin	*Cottus gulosus*	13	13.54	44.00	0.95		0.00				0.00		
Reticulate sculpin	*Cottus perplexus*	3	3.13	47.67	1.38	21	20.00	46.04	1.32	4	36.36	53.50	2.06
Torrent sculpin	*Cottus rhotheus*	16	16.67	53.00	1.93	21	20.00	56.00	2.31	6	54.55	73.00	5.90
Sculpin			0.00			4	3.81	47.00	1.43		0.00		
Carps and Minnows (Cyprinidae):													
Chiselmouth	*Acrocheilus alutaceus*		0.00				0.00				0.00		
Peamouth	*Mylocheilus caurinus*		0.00				0.00				0.00		
Northern pike minnow	*Ptychocheilus oregonensis*		0.00				0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00				0.00		
Longnose dace	*Rhinichthys cataractae*		0.00			1	0.95	52.00	1.32		0.00		
Leopard dace	*Rhinichthys falcatus*		0.00				0.00				0.00		
Speckled dace	*Rhinichthys osculus*	34	35.42	34.53	0.34	21	20.00	38.57	0.73		0.00		
Dace	*Rhinichthys*		0.00			14	13.33	33.93	0.34		0.00		
Redside shiner	*Richardsonius balteatus*		0.00				0.00				0.00		
Cyprinid		8	8.33	32.50	0.26		0.00				0.00		
Lamprey (Petromyzontidae):													
Western brook lamprey	*Lampetra richardsoni*		0.00			1	0.95	133.00	4.56		0.00		
n (Total Individuals)		96				105				11			

Table 3.53 Willamette River: Fisher Lane RM 132 Backpack Electrofishing Data Summary for September 2000 to June 2001

FISHER LANE									
	Sampling Date/# of runs =	09/21/00			3 Runs	06/21/01			3 Runs
		Count	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**	**Count**	**% of Total**	**Mean Total Length (mm)**	**Mean Weight (g)**
Suckers (Catostomidae):									
Largescale sucker	*Castomus macrocheilus*	13	10.92	51.23	1.09	1	2.94	85.00	-
Sculpins (Cottidae):									
Prickly sculpin	*Cottus asper*		0.00				0.00		
Mottled sculpin	*Cottus bairdi*	28	23.53	43.88	1.17		0.00		
Paiute sculpin	*Cottus beldingi*		0.00				0.00		
Slimy sculpin	*Cottus congnatus*		0.00				0.00		
Riffle sculpin	*Cottus gulosus*		0.00				0.00		
Reticulate sculpin	*Cottus perplexus*		0.00			19	55.88	62.05	-
Torrent sculpin	*Cottus rhotheus*	11	9.24	50.60	1.91	5	14.71	79.20	-
Sculpin			0.00			1	2.94	25.00	-
Carps and Minnows (Cyprinidae):									
Chiselmouth	*Acrocheilus alutaceus*		0.00				0.00		
Peamouth	*Mylocheilus caurinus*		0.00			2	5.88	89.50	-
Northern pike minnow	*Ptychocheilus oregonensis*		0.00				0.00		
Blacknose dace	*Rhinichthys atratulus*		0.00				0.00		
Longnose dace	*Rhinichthys cataractae*		0.00				0.00		
Leopard dace	*Rhinichthys falcatus*	9	7.56	35.00	0.35	1	2.94	54.00	-
Speckled dace	*Rhinichthys osculus*	29	24.37	37.71	0.51		0.00		
Dace	*Rhinichthys*		0.00				0.00		
Redside shiner	*Richardsonius balteatus*	26	21.85	39.50	0.63	3	8.82	90.00	-
Cyprinid			0.00				0.00		
Lamprey (Petromyzontidae):									
Western brook lamprey	*Lampetra richardsoni*	3	2.52	111.00	2.27	2	5.88	105.00	-
n (Total Individuals)		119				34			

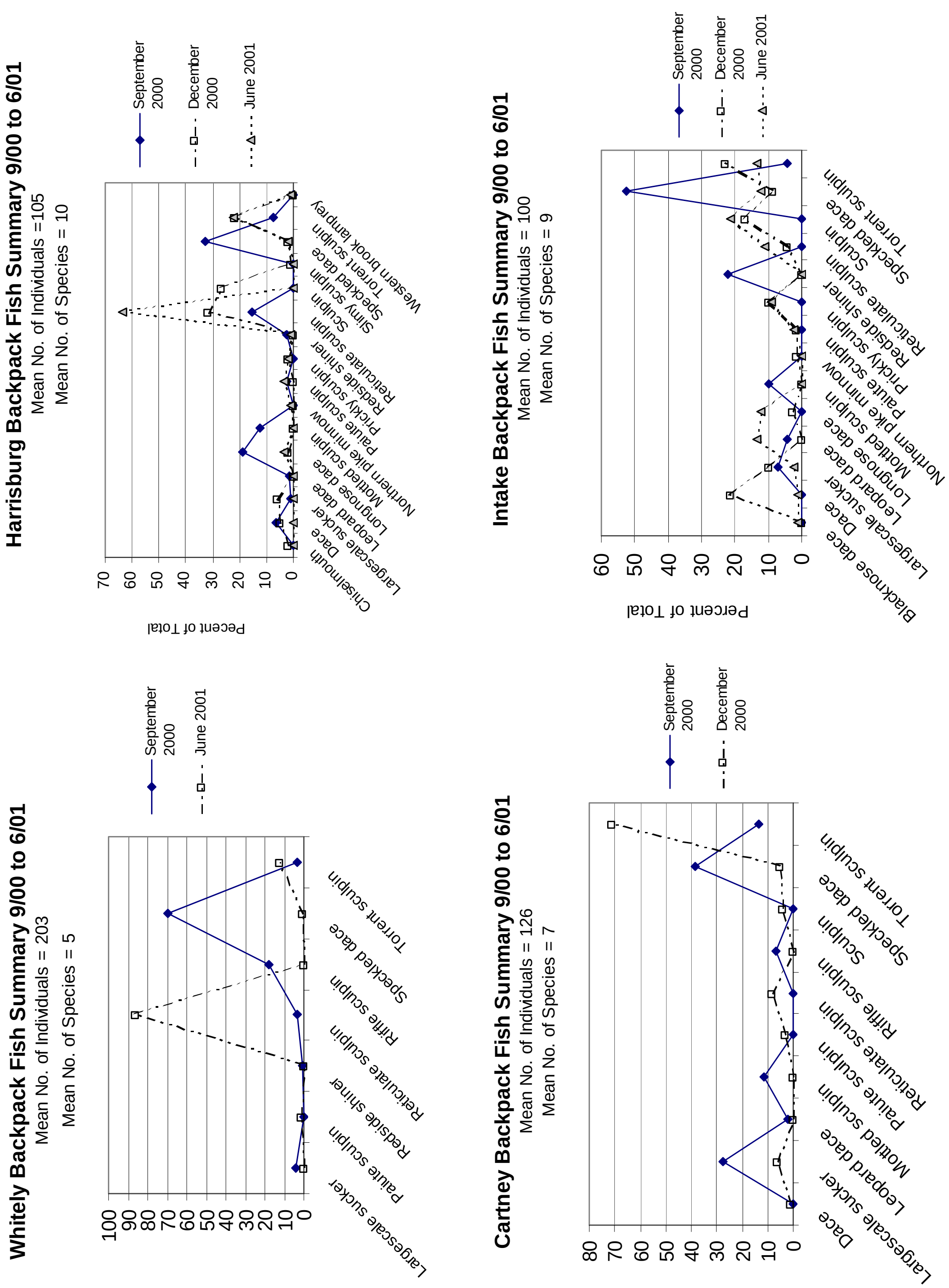


Figure 3.103 Percent Fish Distribution for Upstream Sites (Whitely, Harrisburg, Cartney and Intake), Willamette River September 2000 to June 2001, Backpack Electrofishing

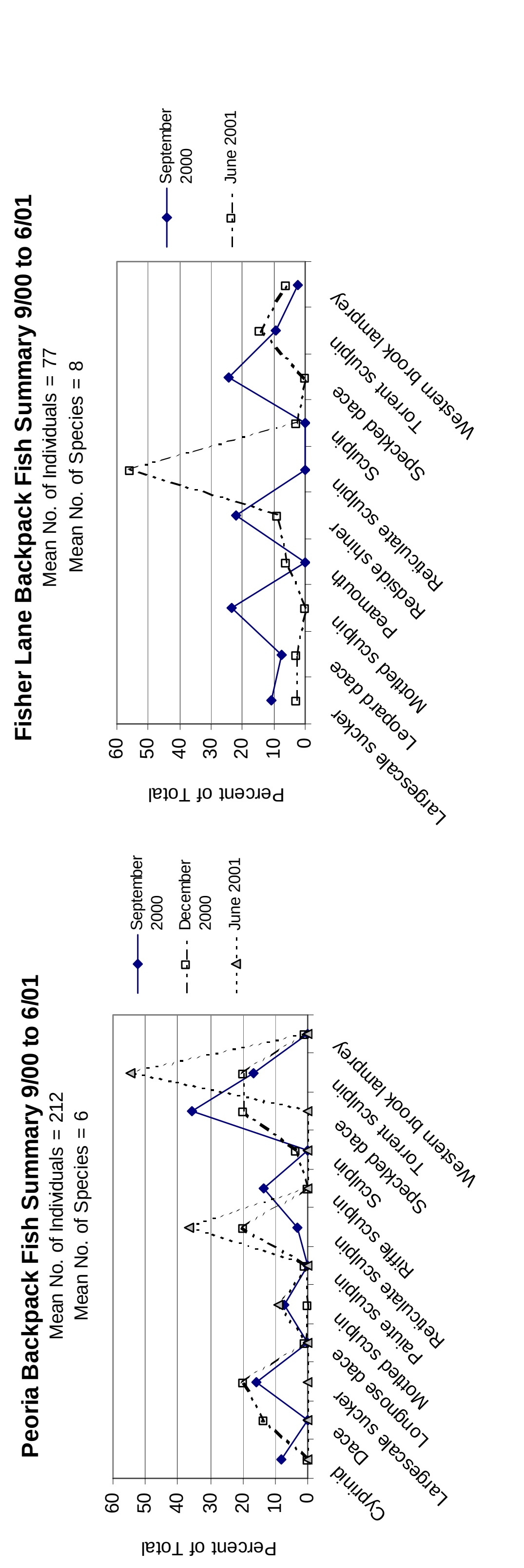


Figure 3.104 Percent Fish Distribution for Downstream Sites (Peoria and Fisher Lane), September 2000 to June 2001, Backpack Electrofishing Samples

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 2000 to 2001 study year. Additional reports will be issued for each study 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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