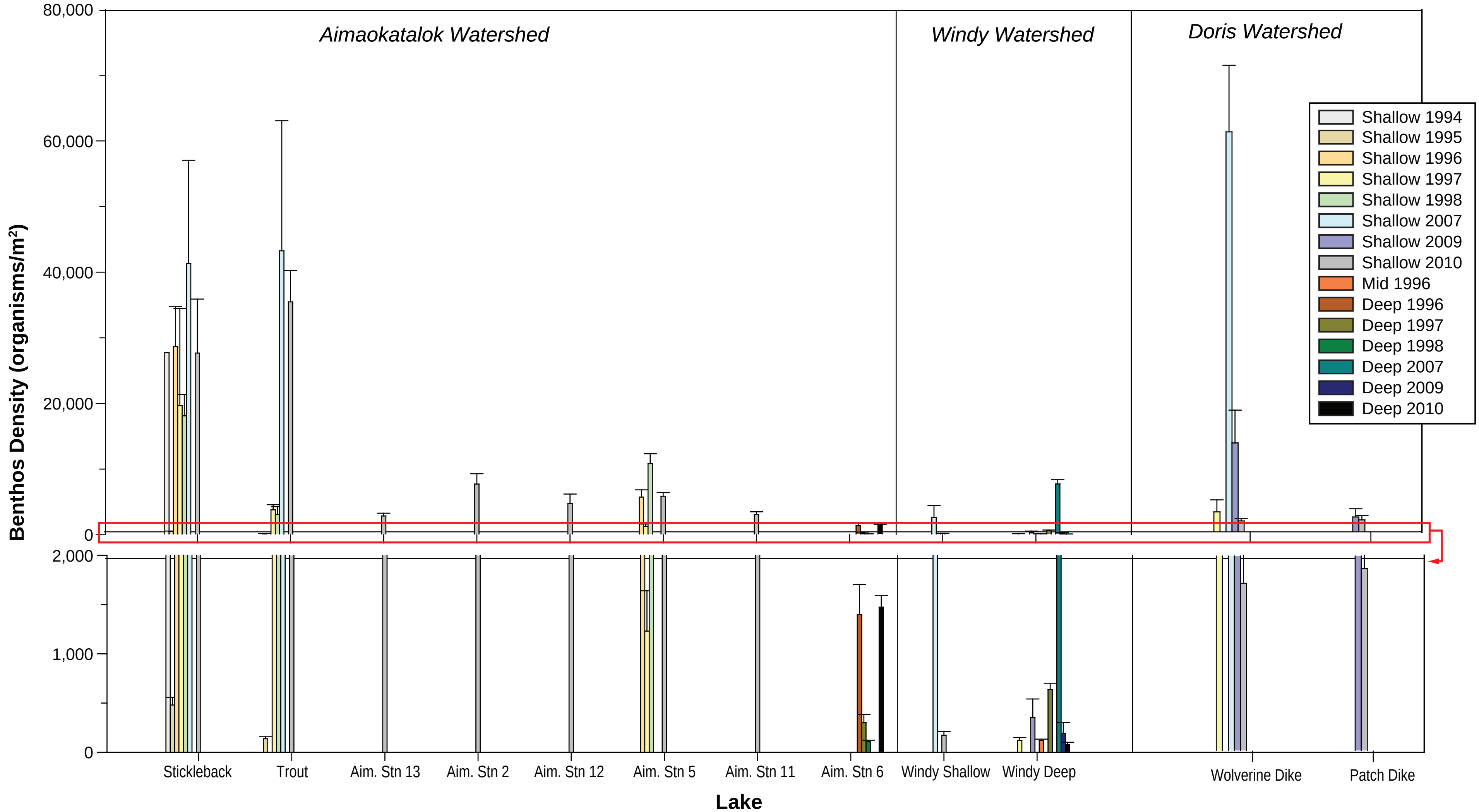

Note: Error bars represent standard error of the mean.
Shallow samples are from <5 m depth, mid samples are from 5 m to 10 m, and deep samples are from >10 m.

Average Annual Benthos Density by Depth Strata in Lakes, Hope Bay Belt Project, 1995-2010

Figure 3.9-4

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3.10 STREAM AND RIVER BENTHOS

Benthos samples were collected from streams and rivers in August 2010. All raw stream benthos density and taxonomic data are presented in Appendix 3.10-1.

3.10.1 Density

Average benthos density in most streams and rivers ranged from 600 organisms/m^2 (Koig. D/S) to 9,300 organisms/m^2 (AWRb; Figure 3.10-1). The exception was Aim. OF which had a much higher average density of 24,500 organisms/m^2. There were no apparent trends in benthos density among different watersheds (Figure 3.10-1).

3.10.2 Taxonomic Composition

Like the lakes, dipterans were the most numerous benthic organism at most stream and river sites, making up 33% to 81% of the benthos assemblages (Figure 3.10-2). Aim. OF was a notable exception to this, as Coelenterata (specifically, the genus *Hydra*) made up 94% and dipterans made up only 3% of the benthos in this stream. Aim. OF also contained the highest overall density of benthic organisms. Ostracods and oligochaetes were abundant in some study streams and rivers, making up 1 to 33% and 2 to 37% of benthos assemblages, respectively. Gastropoda, Hydracarina, and other benthos groups generally made minor contributions to the benthos taxonomic composition (Figure 3.10-2).

3.10.3 Richness and Diversity

Because dipterans were the dominant taxa found in stream and river benthic samples, benthic diversity was calculated for the whole community as well as the dipteran subset.

3.10.3.1 Community Richness and Diversity

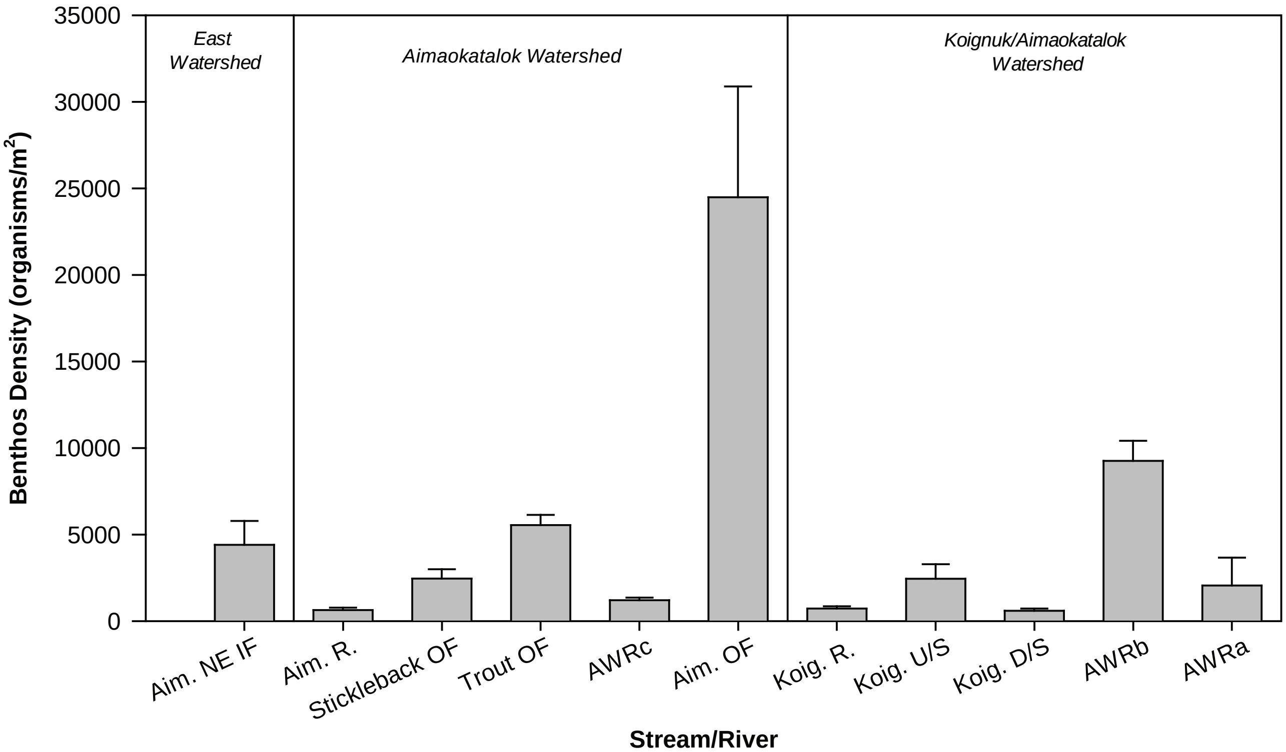
Stream and river benthos richness ranged from 10 to 20 genera/sample and averaged 15 genera/sample (Figure 3.10-3). The sites that had the lowest richness were AWRa (9 genera/sample), Aim. OF (10 genera/sample) and Stickleback OF (11 genera/sample). All other streams contained an average of at least 14 genera/sample.

Simpson's diversity did not always correspond with richness, indicating that some genus-rich sites were dominated by few genera (or a single genus) or, alternatively, that some genus-poor sites contained a relatively even distribution of genera. The average Simpson's diversity index ranged between 0.66 and 0.87 for streams in the study area. The exception to this was Aim. OF which had a diversity index of only 0.12. This is attributable to the dominance of one genus (*Hydra*), which made up 94% of the benthos assemblage at this site (Figure 3.10-3).

3.10.3.2 Dipteran Richness Diversity

Dipteran genera richness generally followed a similar trend as overall benthic richness (Figure 3.10-3). Dipteran richness ranged from 4 genera/sample at Aim. OF to 12 genera/sample at Aim. NE IF and Koig. U/S, and averaged 9 genera/sample.

Dipteran diversity was similar to community diversity at most sites, and averaged 0.67. Exceptions to this included Trout OF and Aim. OF. At Trout OF, dipteran diversity (0.26) was much lower than overall community diversity (0.66). Conversely, dipteran diversity (0.41) was much higher than community diversity (0.12) at Aim. OF. However, dipterans made up only 3% of the benthos assemblage at Aim. OF.



Note: Error bars represent standard error of the mean.

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Figure 3.10-1

Average Benthos Density in Streams and Rivers, Hope Bay Belt Project, August 2010

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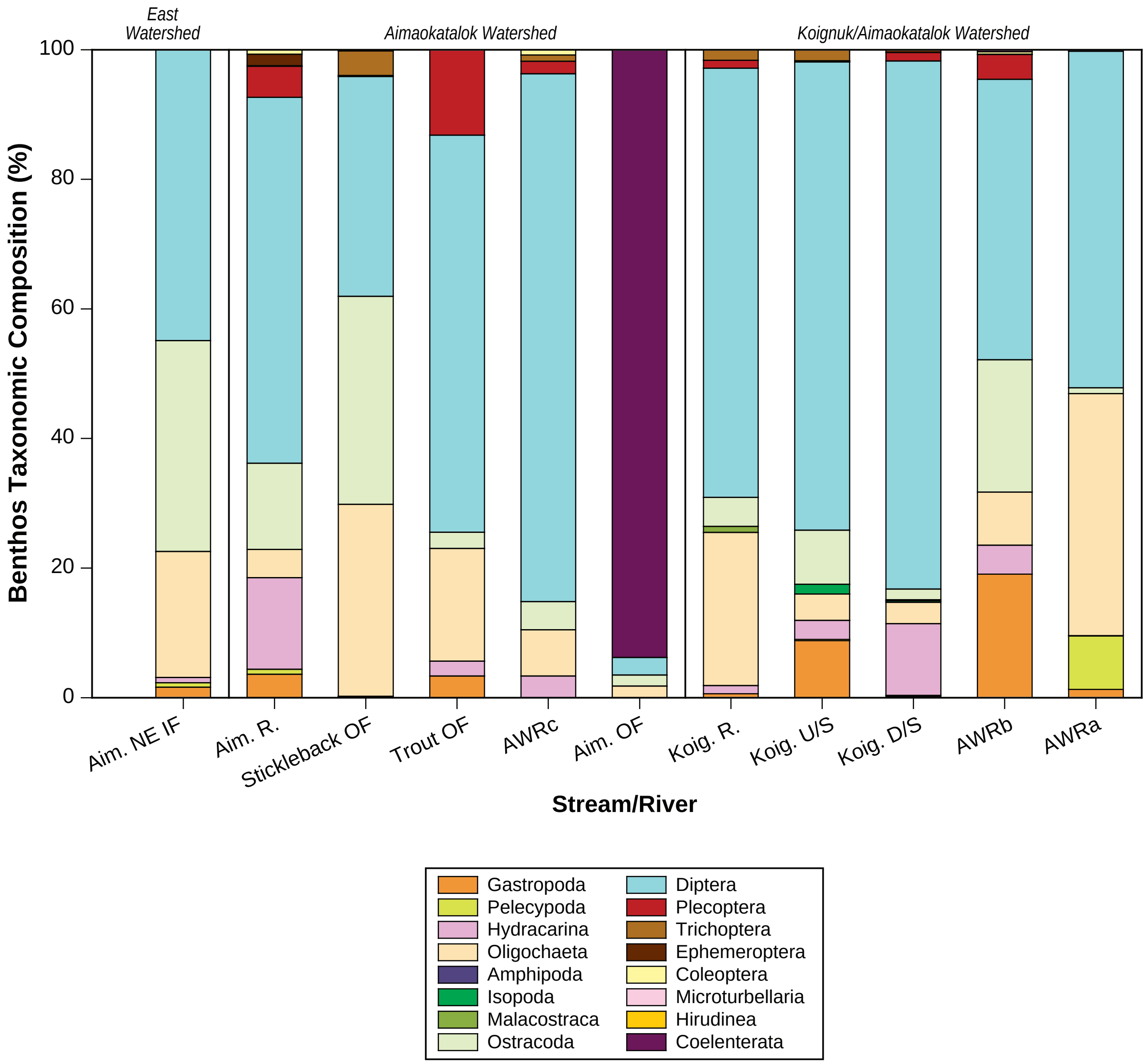

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Benthos Taxonomic Composition in Streams and Rivers, Hope Bay Belt Project, August 2010

Figure 3.10-2

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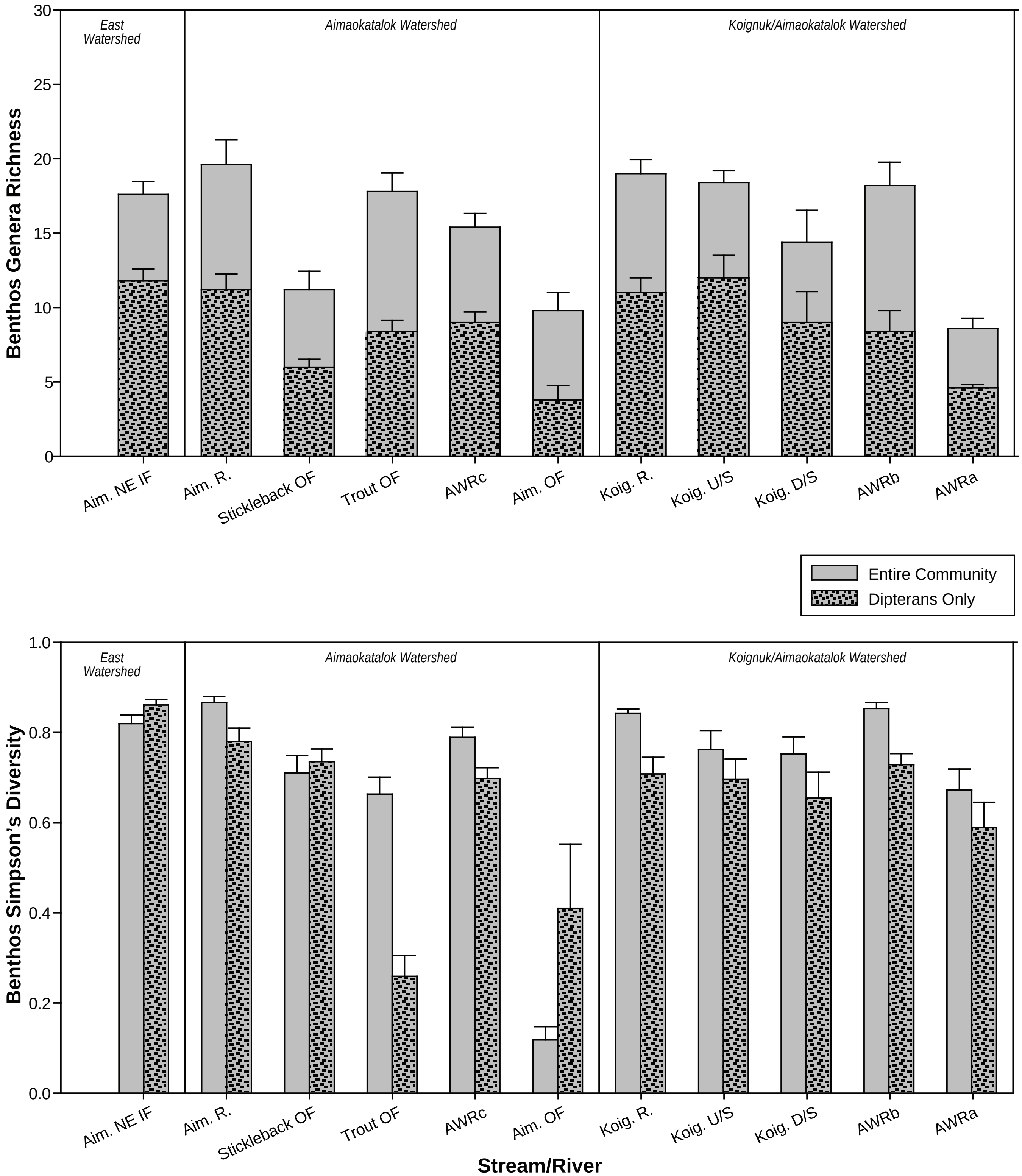

Note: Error bars represent standard error of the mean.
Superimposed bars represent the dipteran component of the benthos community.

Figure 3.10-3

Average Benthos Richness and Diversity in Streams and Rivers, Hope Bay Belt Project, August 2010

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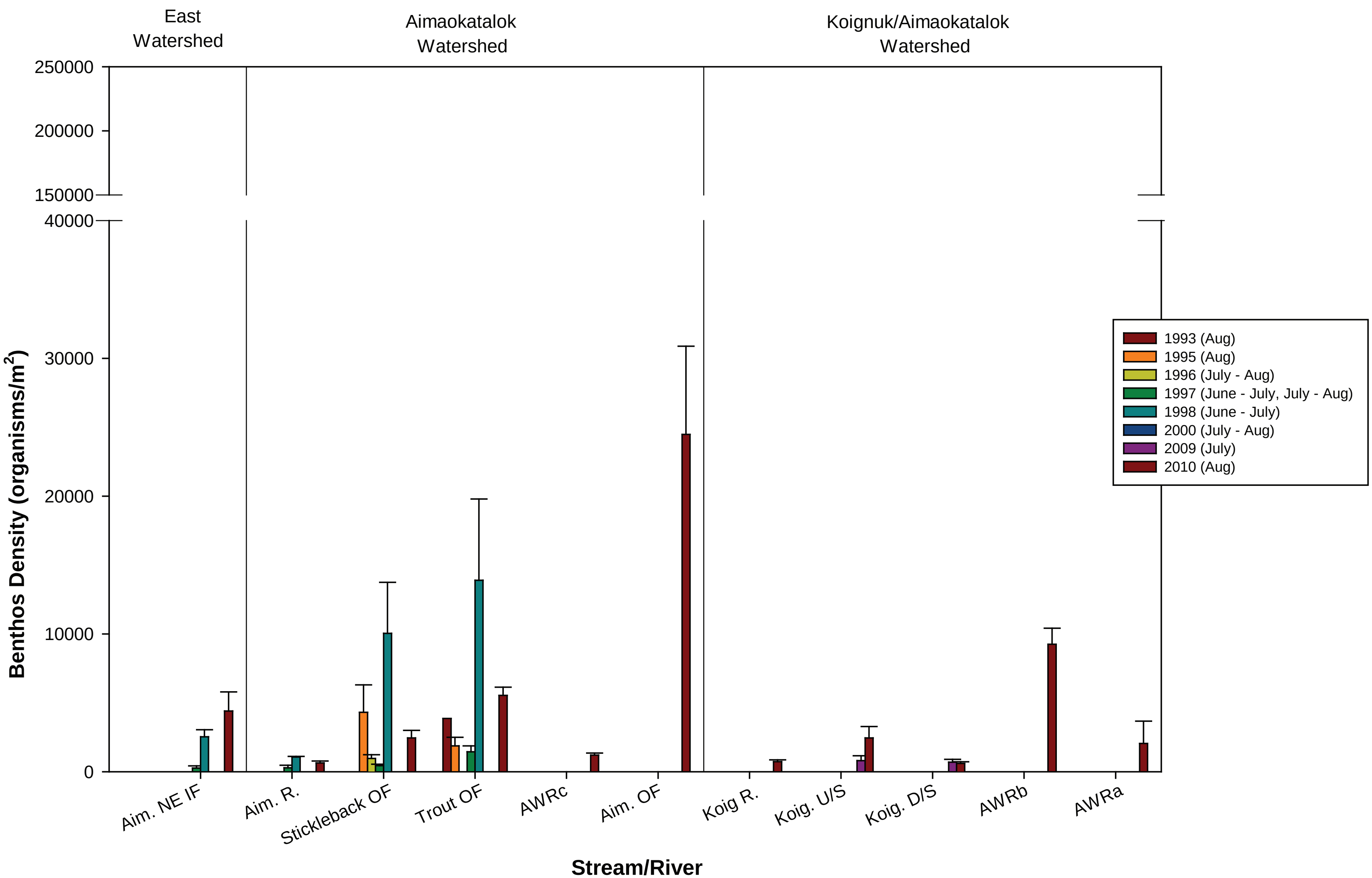
3.10.4 Annual Variation

Only historical sampling locations that were also sampled in 2010 were included in the annual comparison of benthos density shown in Figure 3.10-4. Note that historical sampling locations and methods may not correspond exactly with those sampled in 2010, and this may contribute to the variability observed between years (see Table 2.14-9 and Figures 2.14-5a to 2.14-5c for historical sampling locations and methodologies).

Stream and river benthos densities were highly variable between years (Figure 3.10-4). This high variability may be partly due to differences in methodology (the use of Hester-Dendy artificial substrate samplers installed for approximately one month vs. instantaneous samples collected using a Hess sampler) and timing of sampling. There were no clear spatial or temporal trends in stream and river benthos density at the streams and rivers sampled.



Note: Error bars represent standard error of the mean.
1993, 1995, 2009, and 2010 data were collected instantaneously using a Hess sampler; 1996, 1997, 1998, and 2000 data were collected using Hester Dendy plate samplers installed for approximately 1 month.

Figure 3.10-4

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Average Annual Benthos Density in Streams and Rivers, Hope Bay Belt Project, 1993 - 2010

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Appendix 1-1

Microcystin Sampling Results in Regional Project Area, 2010

Memorandum

Refer to File No.: N:\1009 Hope Bay\1009-002 Hope Bay Belt Baseline & EIS\1009-002-05 Freshwater WQ, SQ, AB\Word Processing\Microcystin Memo\A.1_1009-008-01_Microcystin Memorandum.doc

DATE:	July 14, 2011
TO:	Chris Hanks, Director Environment and Social Responsibility
FROM:	Carol Adly (M.Sc.), Mike Henry (Ph.D.), Deborah Muggli (M.Sc., Ph.D., R.P.Bio.)
SUBJECT:	Microcystin Sampling Results in Regional Project Area, 2010

Introduction

Microcystin is a hepatotoxin (liver toxin) produced by some species of cyanobacteria that can have negative effects on humans and other organisms. The major route of human exposure to this toxin is through the consumption of drinking water (Health Canada 2002). The Health Canada maximum acceptable concentration of microcystin LR (the most common variant of microcystin; Carmichael 1992) in drinking water is 1.5 µg/L (Health Canada 2002). Microcystin was identified by the Hope Bay Mining Limited (HBML) Environment and Social Responsibility (ESR) Department as a parameter of concern in Doris Camp drinking water, which is currently drawn from Doris Lake. Extensive water quality testing, pre- and post-treatment, is undertaken by the on-site ESR staff on a regular basis. However, Rescan was asked to sample microcystin in lakes within the Doris Watershed as well as in various other lakes in the region to determine the spatial extent of the elevated microcystin concentrations.

Methods

In order to assess the natural occurrence of microcystin in lakes in and around the Hope Bay Belt area, microcystin LR samples were collected from 8 lakes that were part of the 2010 Phase 2 freshwater baseline program or the Aquatic Effects Monitoring Program (AEMP), as well as 10 additional lakes (microcystin add-on lakes; Figure 1). Several of the add-on lakes were selected because blooms of cyanobacteria have been known to occur in these waterbodies. The timing of microcystin LR sampling for the freshwater baseline and AEMP lakes coincided with planned water quality sampling in these lakes between April and September 2010, and the add-on lakes were sampled once in September 2010. Table 1 presents the locations, dates, and depths of microcystin LR sampling.

For winter (April) microcystin-LR sampling, a 10-inch diameter ice auger was used to drill a hole through the ice, and samples were collected using modified skinny Niskin bottles. Microcystin-LR samples were collected at approximately 1 m below the ice-water interface at all sites, and an additional sample was collected at 2 m above the water-sediment interface at certain sites. A dual

Table 1. Microcystin-LR Sampling Details

	Sampling Date(s)	Sampling Depth(s) (m)	Number of Samples Collected
Freshwater Baseline Lakes (WQ Program)			
Aimaokatalok Lake, Station 5	April 25, 2010	2.8	2
	August 21, 2010	1	2
Aimaokatalok Lake, Station 6	April 25, 2010	2.6, 24	2
Aimaokatalok Lake, Station 11	April 25, 2010	2.6	1
	August 15, 2010	1	2
Trout Lake	April 26, 2010	2.8	1
	August 15, 2010	1	1
Stickleback Lake	April 26, 2010	2.8	1
	August 19-21, 2010	1	2
Windy Lake	April 19, 2010	2.8, 16	2
	August 21, 2010	1	1
AEMP Lakes (WQ Program)			
Little Roberts Lake	April 22, 2010	2.8	2
	September 12, 2010	1	1
Doris Lake North	April 22, 2010	2.8, 11.5	2
	September 12, 2010	1	1
Doris Lake South	April 22, 2010	3	2
	September 12, 2010	1	1
Reference Lake B	April 18, 2010	2.7, 4.3	2
	August 24, 2010	1	1
	September 17, 2010	1, 8.5	2
Reference Lake D	April 18, 2010	2.5	2
	August 21, 2010	1	1
	September 25, 2010	1	1
Microcystin Add-on Lakes			
MC1 Lake	September 11, 2010	1	1
MC2 Lake	September 11, 2010	1	1
MC3 Lake	September 16, 2010	1	1
MC4 Lake	September 11, 2010	1	1
MC5 Lake	September 11, 2010	1	1
Pelvic Lake	September 11, 2010	1	1
Ogama Lake	September 10, 2010	1	1
Nakhaktok Lake	September 11, 2010	1	1
Roberts Lake	September 11, 2010	1	1
Historical Boston Reference Lake	September 16, 2010	1	1
Total Number of Samples Collected			**45**

Note: April surface microcystin LR samples were collected at 1 m below the ice-water interface (ice thickness ranged from 1.6 to 2 m).