

# Biological Assessment for Pine and Babb Creeks, Tioga & Lycoming Counties

June 15, 2010

## Technical Report Provided through the Trout Unlimited AMD Technical Assistance Program

### Background

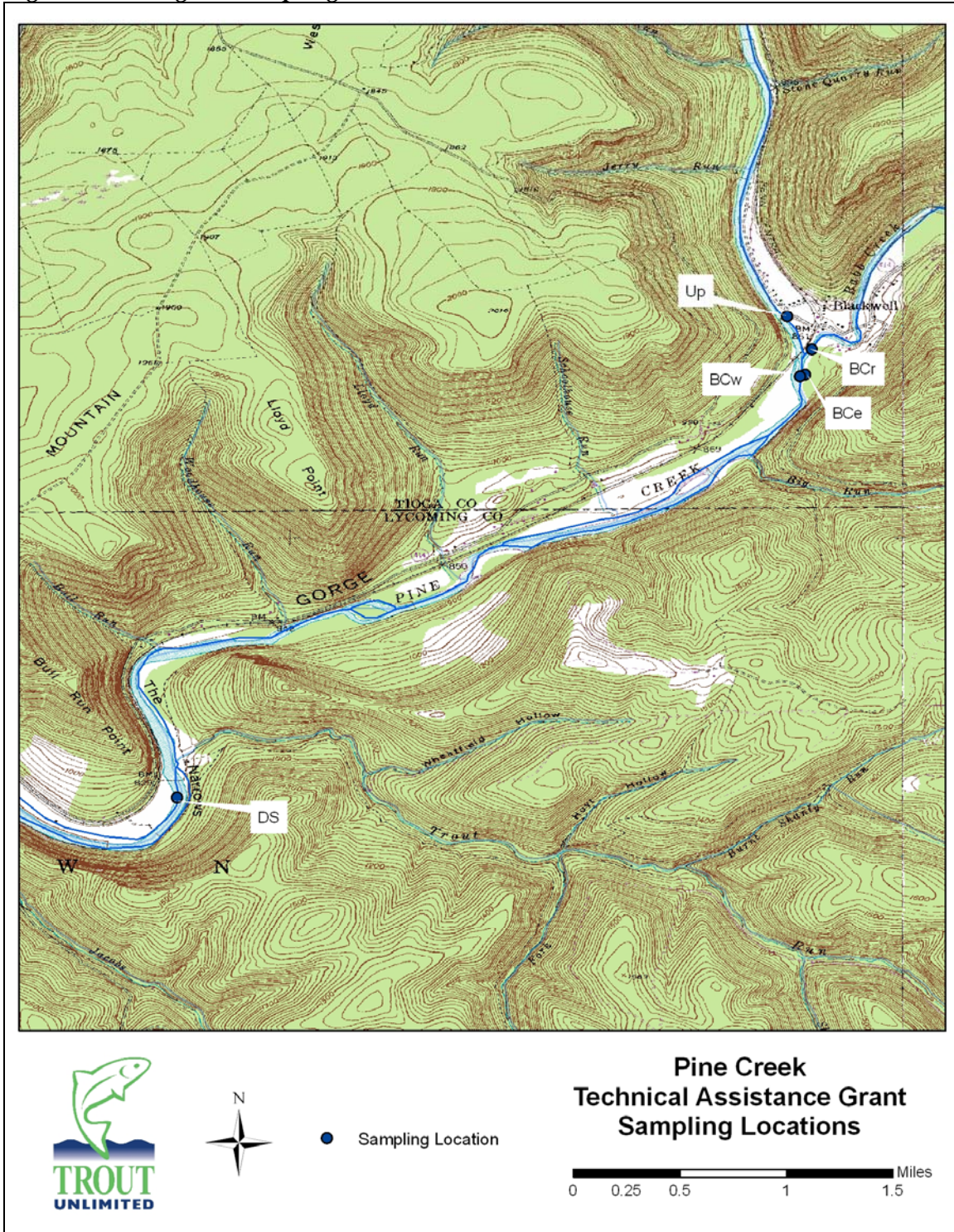
The Pine Creek Headwaters Protection Group (PCHPG) requested a technical assistance grant (TAG) to reassess the benthic macroinvertebrate populations in Pine and Babb Creeks at sampling locations studied by Ross in 1990. This TAG was requested in response to post 1991 abandoned mine drainage (AMD) treatment systems in the Babb Creek watershed. Accordingly, benthic macroinvertebrate collections were made at five locations (Table 1, Figure 1) in Pine and Babb Creeks on December 17<sup>th</sup>, 2009 by Trout Unlimited (TU) personnel.

**Table 1. Site Locations**

Sample Point ID	Description*	Latitude	Longitude
UP	Upstream site about 300 m above the confluence of the two creeks	41.557	-77.383
BCw	Directly opposite BCe	41.553	-77.382
BCr	Babb Creek site about 50 m from confluence	41.554	-77.381
BCe	Site on east side of confluence and 50 m downstream	41.553	-77.382
DS	Downstream site about 6 km below confluence	41.524	-77.424

\* Site Descriptions from Ross, 1991

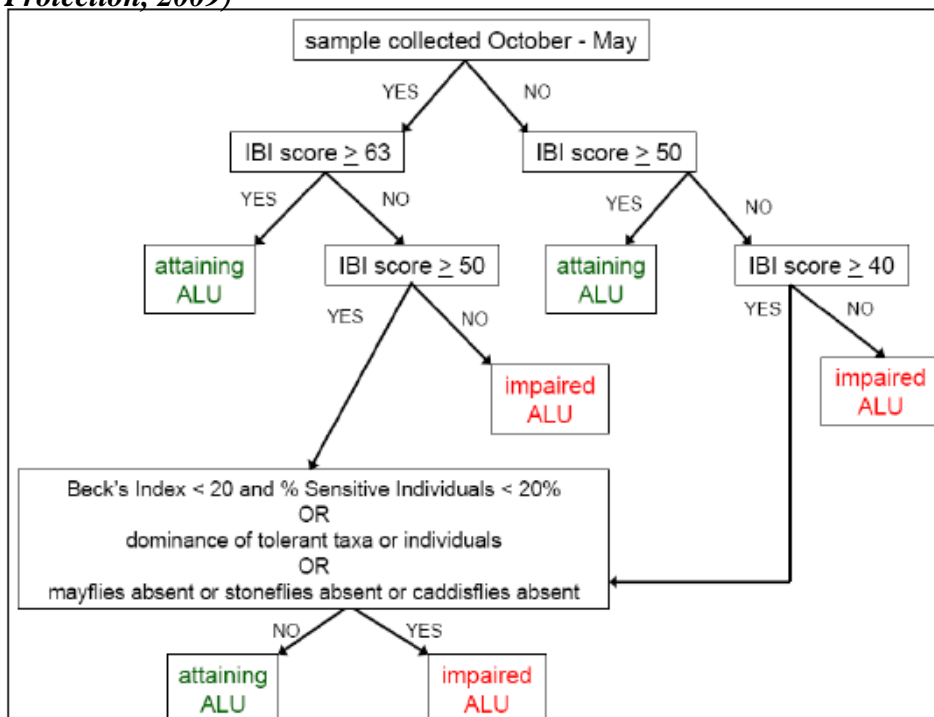
Figure 1. Biological Sampling Locations



Ross (1991) assessed benthic macroinvertebrate populations with a Hess sampler using triplicate methodologies (duplicate in the case of BCe and BCw). TU and PCHPG determined that although a change in sampling methodologies would not allow for a direct comparison of data from 1990 to 2009, it was beneficial to mirror 2009 collection methodologies to current Pennsylvania Department of Environmental Protection (DEP) protocol so that the results of the TAG would be acceptable by state agencies. As such, collections were made according to DEP's Instream Comprehensive Evaluation (ICE) protocol (specifically section C.1.b. *Antidegradation Surveys*). In short benthic macroinvertebrate samples consisted of a combination of six D-frame efforts in a 100-meter stream section. These efforts were spread out so as to select the best riffle habitat areas with varying depths. Each effort consisted of an area of 1 m<sup>2</sup> to a depth of at least 4 inches as substrate allowed and was conducted with a 500 micron mesh 12-inch diameter D-frame kick net. The six individual efforts were composited and preserved with ethanol for processing in the lab.

No sub-sampling was required for these samples as the individual counts were less than or near 200. Individuals were identified to genus or to the next highest possible taxonomic level. The samples were evaluated according to the six metrics comprising the DEP's Index of Biological Integrity (Total Taxa Richness, EPT Taxa Richness, Beck's Index V.3, Shannon Diversity, Hilsenhoff Biotic Index, and Percent Sensitive Individuals). These metrics were standardized and used to determine if the stream met the Aquatic Life Use (ALU) threshold for cold water fishes, warm water fishes, and trout stocked fishes (Figure 2).

**Figure 2. ALU Attainment and Impairment Thresholds for Cold Water Fishes (CWF), Warm Water Fishes (WWF), and Trout Stocked Fishes (TSF) Protected Uses (Department of Environmental Protection, 2009)**



## Results and Discussion

### Site: UP

Site UP is located on Pine Creek approximately 300 meters above the confluence of Babb Creek. Collections made at this location serve as reference for Pine Creek before it mixes with Babb Creek. Ross' 1990 collections revealed a robust population of benthic macroinvertebrates composed of 47 taxa (Figure 3) with 34% Ephemeroptera, 21% Trichoptera, 17% Plecoptera, 11% Coleoptera, and 17% other taxa (Figure 4). While a direct comparison of Ross' percent composition by taxa cannot be made to the data collected in 2009, it is apparent that Pine Creek at this location still contains a healthy benthic macroinvertebrate population. The 2009 samples contained 26 taxa (Figure 3) with a composition of 27% Ephemeroptera, 12% Trichoptera, 15% Plecoptera, 8% Coleoptera, and 38% other taxa (Figure 3).

Furthermore, the 2009 data indicate no biological impairment (Table 2). The average adjusted standardized core metric score (68.5) included as part of the IBI for this site indicates that the stream is currently meeting the ALU benchmark.

**Table 2. Site: UP IBI Metrics**

METRIC	OBSERVED VALUE	STANDARDIZED METRIC SCORE	ADJUSTED STANDARDIZED METRIC SCORE
Total Taxa Richness	26	0.788	0.788
EPT Taxa Richness (PTV 0 – 4)	12	0.632	0.632
Beck's Index, version 3	15	0.395	0.395
Hilsenhoff Biotic Index	3.58	0.792	0.792
Shannon Diversity	2.43	0.849	0.849
Percent Sensitive Individuals (PTV 0 – 3)	55.3	0.655	0.655
<b>IBI SCORE =</b>			<b>68.5</b>

### Site: BCw

BCw is located on Pine Creek's west bank approximately 50 meters downstream of the confluence of Babb and Pine Creeks. Ross' data indicate that the pollution from Babb Creek was of minimal impact to the benthic community at this site in 1990, probably due to a lack of complete mixing of Babb's waters with Pine Creek. A total of 38 taxa (Figure 3) comprised of 32% Ephemeroptera, 24% Trichoptera, 13% Plecoptera, 8% Coleoptera, and 24% other taxa (Figure 4) were found. Data collected in 2009 indicate a marked difference in taxa richness (Figure 3) and a lack of Ephemeroptera (Figure 4). Furthermore, the average adjusted standardize core metric score (46.8) does not meet the

ALU benchmark (Table 3). However, given that 1) both sites UP and BCe do meet the ALU threshold; and 2) there is no evidenced pollutant inputs between UP and BCe, BCw's decreased IBI is more likely due to habitat degradation or poor capture of individuals because of high stream velocity. A re-sampling of this site in 2010 is suggested to further investigate these conditions.

**Table 3 . Site: BCw IBI Metrics**

<b>METRIC</b>	<b>OBSERVED VALUE</b>	<b>STANDARDIZED METRIC SCORE</b>	<b>ADJUSTED STANDARDIZED METRIC SCORE</b>
Total Taxa Richness	9	0.273	0.273
EPT Taxa Richness (PTV 0 – 4)	5	0.263	0.263
Beck's Index, version 3	2	0.053	0.053
Hilsenhoff Biotic Index	3.79	0.766	0.766
Shannon Diversity	1.86	0.649	0.649
Percent Sensitive Individuals (PTV 0 – 3)	67.9	0.803	0.803
<b>IBI SCORE =</b>			<b>46.8</b>

Site: BCr

BCr is located on Babb Creek approximately 50 meters upstream from its mouth. Collections made at this location serve as reference for Babb Creek before its confluence with Pine Creek. Data from 1990 reveal only 2 pollution-tolerant taxa at this site (Figures 3 and 4). Ross (1991) suggested that the absence of a robust community structure and decreased taxa richness was indicative of pollution from toxic substances rather than organic enrichment or physical habitat degradation. Specifically, the impaired benthic macroinvertebrate population was determined to have probably been a response to reduced pH and increased concentrations of metals from acid mine drainage.

Conversely, collections made in 2009 suggest a much different and more optimistic scenario. A total of 23 taxa (Figure 3) were collected comprised of 30% Ephemeroptera, 13% Trichoptera, 17% Plecoptera, and 39% other taxa (Figure 4). What's more, data collected at this site indicate no biological impairment (Table 4). The average adjusted standardized core metric score (64.8) included as part of the IBI for this site indicates that the stream is meeting the ALU benchmark. These findings are corroborated by the recent removal of Babb Creek from the DEP's 303(d) list of impaired waters.

**Table 4 . Site: BCr IBI Metrics**

METRIC	OBSERVED VALUE	STANDARDIZED METRIC SCORE	ADJUSTED STANDARDIZED METRIC SCORE
Total Taxa Richness	23	0.697	0.697
EPT Taxa Richness (PTV 0 – 4)	12	0.632	0.632
Beck’s Index, version 3	14	0.368	0.368
Hilsenhoff Biotic Index	3.77	0.768	0.768
Shannon Diversity	2.61	0.914	0.914
Percent Sensitive Individuals (PTV 0 – 3)	42.9	0.507	0.507
<b>IBI SCORE =</b>			<b>64.8</b>

Site: BCE

BCE is located on Pine Creek’s east bank, approximately 50 meters downstream of the confluence of Babb and Pine Creeks and directly across from BCw. In 1990, the benthic macroinvertebrate community at this site was impaired presumably as a result of the pollution from Babb Creek. Only 3 taxa (Figure 3) representing Trichoptera and other non-sensitive orders were found (Figure 4).

As with collections from BCr, the benthic macroinvertebrate population at BCE showed marked improvement in 2009. A total of 23 taxa (Figure 3) of which 43% were Ephemeroptera, 4% were Trichoptera, 17% were Plecoptera, 9% were Coleoptera, and the remaining 26% from other taxa (Figure 4). Furthermore, data collected at this site indicate no biological impairment (Table 5). The average adjusted standardized core metric score (75.3) included as part of the IBI for this site indicates that the stream is meeting the benchmark for its ALU. These findings are corroborated by the 1999 removal of five miles of Pine Creek from the DEP’s 303(d) list of impaired waters.

**Table 5 . Site: BCE IBI Metrics**

METRIC	OBSERVED VALUE	STANDARDIZED METRIC SCORE	ADJUSTED STANDARDIZED METRIC SCORE
Total Taxa Richness	23	0.697	0.697
EPT Taxa Richness (PTV 0 – 4)	13	0.684	0.684
Beck’s Index, version 3	14	0.368	0.368
Hilsenhoff Biotic Index	2.63	0.909	0.909
Shannon Diversity	2.68	0.937	0.937
Percent Sensitive Individuals (PTV 0 – 3)	78.0	0.923	0.923
<b>IBI SCORE =</b>			<b>75.3</b>

Site: DS

DS is located on Pine Creek, approximately 4 miles (6 km) below the confluence of Babb and Pine Creeks. Ross classified DS as a recovery site in 1990. A total of 16 taxa (Figure 3) comprised of 13% Ephemeroptera, 38% Trichoptera, 13% Plecoptera, 19% Coleoptera, and 19% from other taxa (Figure 4) were found. A marked increase in both total taxa (Figure 3) and community composition (Figure 4) was found in 2009. A total of 33 taxa were found of which 39% were Ephemeroptera, 9% Trichoptera, 9% Plecoptera, 9% Coleoptera, and 33% from other taxa. Also, data collected at this site indicate no biological impairment (Table 6). The average adjusted standardized core metric score (79.7) included as part of the IBI for this site indicates that the stream is meeting the ALU benchmark.

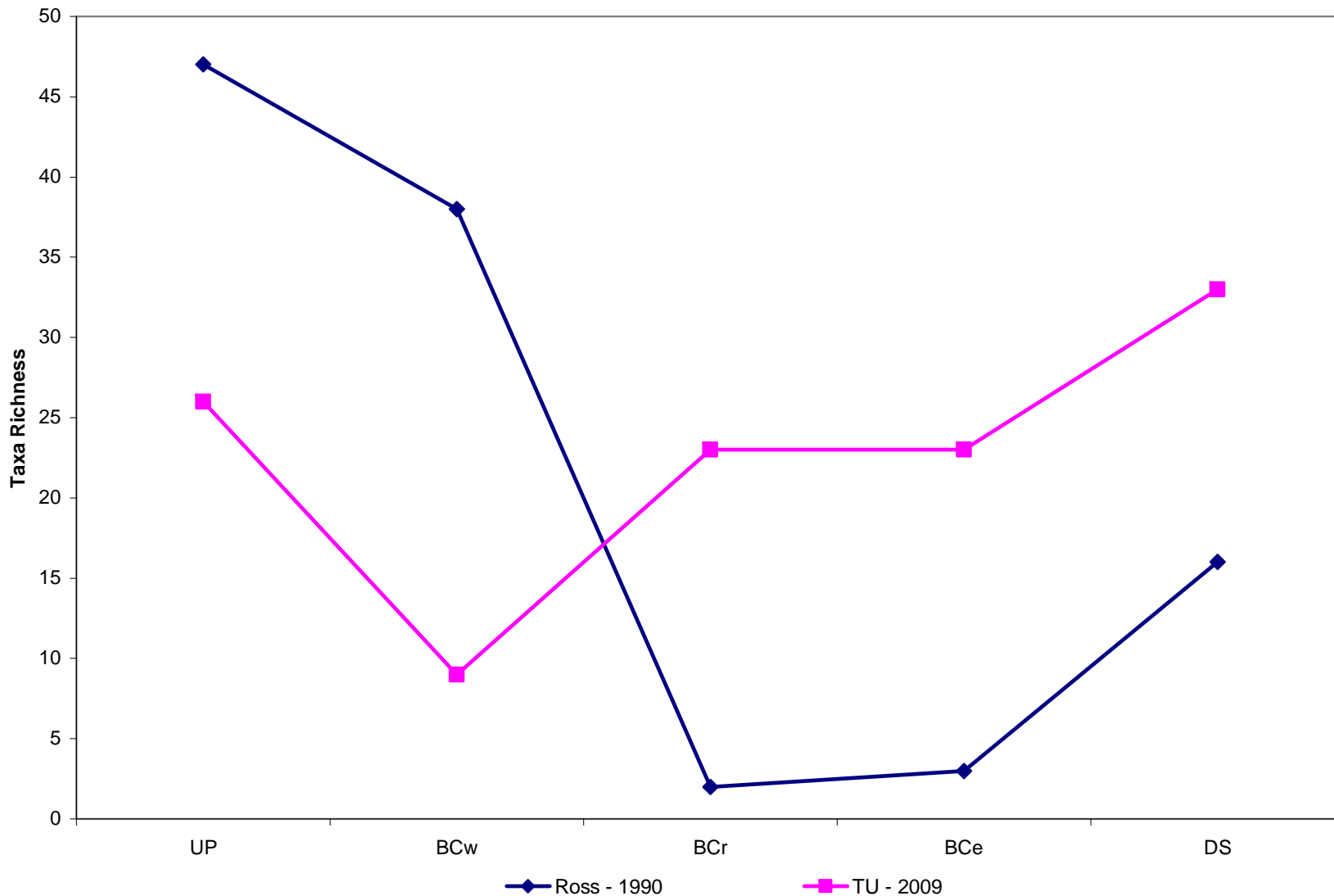
**Table 6. Site: DS IBI Metrics**

<b>METRIC</b>	<b>OBSERVED VALUE</b>	<b>STANDARDIZED METRIC SCORE</b>	<b>ADJUSTED STANDARDIZED METRIC SCORE</b>
Total Taxa Richness	33	1.000	1.000
EPT Taxa Richness (PTV 0 – 4)	14	0.737	0.737
Beck’s Index, version 3	16	0.421	0.421
Hilsenhoff Biotic Index	2.98	0.866	0.866
Shannon Diversity	2.72	0.950	0.950
Percent Sensitive Individuals (PTV 0 – 3)	68.3	0.809	0.809
		<b>IBI SCORE =</b>	<b>79.7</b>

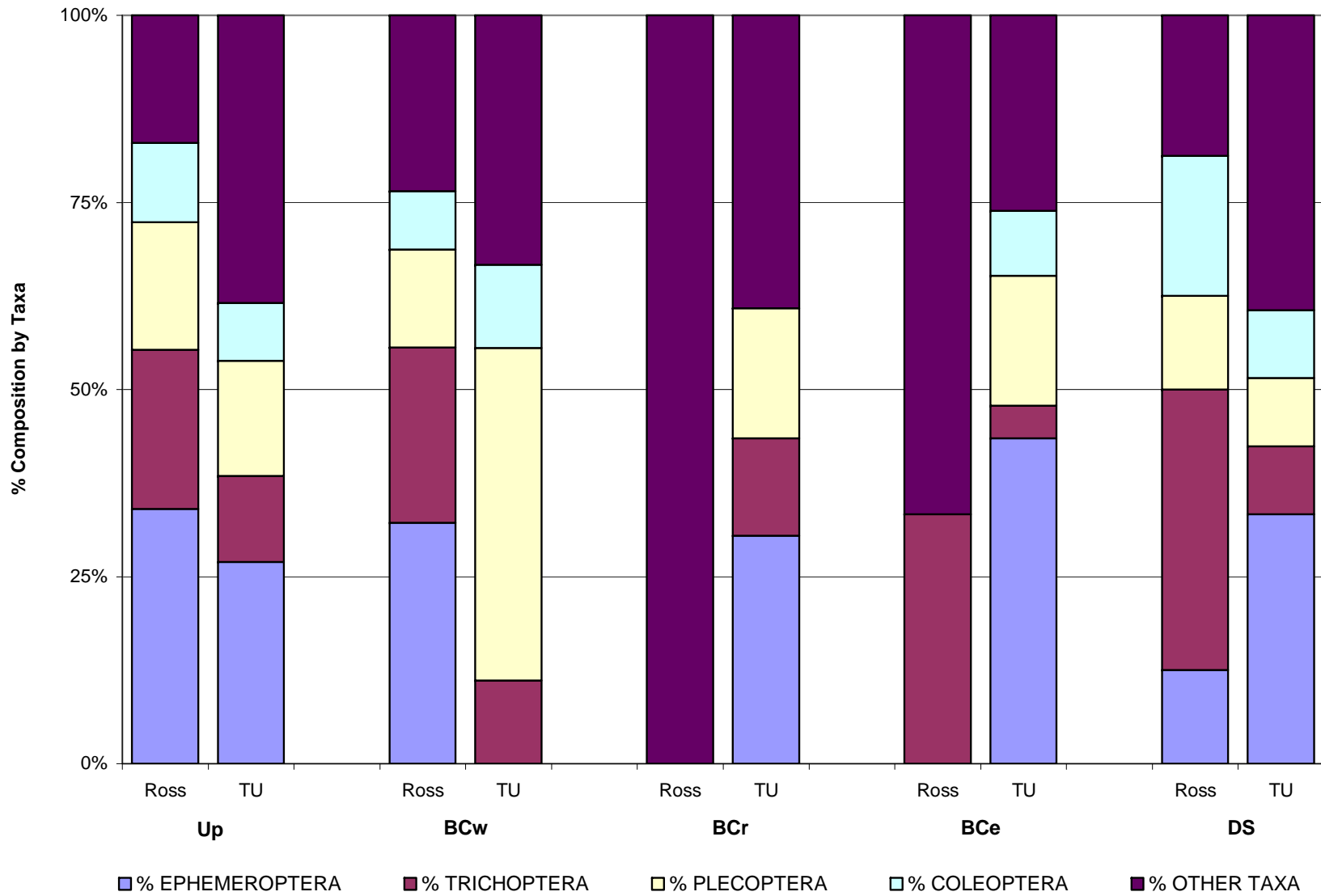
**Summary**

In 1990, Ross initiated a benthic macroinvertebrate study to 1) document reported decreases in mayfly hatches on Pine Creek; and 2) provide a benchmark of biological conditions that was at that time absent from Babb and Pine Creeks. Two of Ross’ sites (UP and BCw) were sampled as reference sites, two (BCr and BCe) were presumed affected by AMD, and one (DS) was a presumed recovery site. As expected, the highest scores for total taxa, total densities, and species diversity were found at the reference sites. A significant decrease in these values was seen at the AMD-affected sites and then these values increased slightly at the downstream site. Ross concluded that the patterns of community structure and low organism density at sites BCr, BCe, and DS suggested that the streams were indeed impacted by acid mine drainage.

Sampling at Ross' sites in 2009 produced vastly different results. All but one site (BCw) met the DEP ALU benchmark for a cold water fishery and none of the sites sampled indicated an impact by acid mine drainage. This change in biological condition is undoubtedly due to the extensive AMD-abatement projects implemented in the Babb Creek watershed since the early 1990's.



**Figure 3. Percent Composition by Taxa.** Data addended to Ross, 1991 were summarized to produce this graphic. Note that this graphic should be used to demonstrate data trends and not as a direct comparison of Ross (1991) to TU (2009).



*Figure 4. Taxa Richness. Data addended to Ross, 1991 were summarized to produce this graphic. Note that this graphic should be used to demonstrate data trends and not as a direct comparison of Ross (1991) to TU (2009).*

## **References**

Department of Environmental Protection, 1990. Survey Protocol. Instream Comprehensive Evaluation Surveys. Draft. 391-3200-001

Ross R. M., 1991. The Effect of Acid Mine Drainage and Related Sources of Pollution on Aquatic Macroinvertebrate Life in Pine Creek