Duck Creek Bioassessment
Summer 2005

Duck Creek below Taku Boulevard

Bioassessment Background

Duck Creek is listed as an impaired water body by the state of Alaska. Four decades of urbanization in the watershed have contributed to poor water quality and loss of aquatic habitat, diminishing the creek's ability to support fish and wildlife (Koski and Lorenz 1999). In recent years, restoration efforts have included sediment removal, channel and riparian restoration, wetland creation, and improved fish passage.

Since 1996, the stream channel between Taku Boulevard and Mendenhall Boulevard has been restored. The aquatic invertebrate community was surveyed in this reach in 1994-1996, providing baseline information on stream health to gage the success of restoration efforts (Milner, 1996). Invertebrate communities are unique indicators of water and habitat quality because they integrate impacts from multiple stressors over time (Rinella et al. 2003). Invertebrates are also important components of aquatic food webs as they transfer energy from primary producers to secondary consumers such as fishes, waterfowl, and other birds.

This report summarizes the results of an invertebrate bioassessment on Duck Creek at Taku Boulevard and Aspen Avenue in the spring and summer of 2005. Results are compared to the baseline survey of 1994/1996.

Methods

Aquatic invertebrates were sampled at Taku Boulevard and Aspen Avenue on 23 and 24 April and 11 June of 2005. Invertebrate sampling, processing, and data analysis procedures were similar to those outlined by the Environmental and Natural Resources Institute (ENRI) at the University of Alaska Anchorage for conducting biological assessments in streams (AK SOP Methods 1-4).

Invertebrate samples downstream of Taku Boulevard were collected in a 100 m long reach restored in 1996/1997. Restoration included replacing fine sediments with cobbles and gravels, narrowing the channel, and increasing the channel depth and sinuosity. Sampling at Aspen Avenue took place in a pond 5 m upstream of the road. The pond has a maximum depth of approximately 1 m, the bottom consists of a thick layer of fine sediment, and thick stands of emergent horsetail (*Equisetum*) cover most of the surface. No restoration has occurred at the Aspen Avenue site.

Aquatic invertebrate data were summarized using five bioassessment metrics that reflect species diversity and tolerance for degraded water quality. Two of the metrics rely on the number of taxa in the insect orders Ephemeroptera (mayflies, E), Plecoptera (stoneflies, P), and Trichoptera (caddisflies, T). EPT taxa are generally most sensitive to water quality degradation. The bioassessment metrics used were:

Percent EPT Taxa – The number EPT individuals divided by the total number of individuals in a sample. In southeastern Alaska, percent EPT Taxa ranges from 65 to 75% in unimpaired streams and from 5 to 40% in urban streams (Rinella et al. 2003).

EPT Richness – The number of EPT genera in a sample. In southeastern Alaska, EPT Richness ranges from 13 to 18 in unimpaired streams and from 4 to 10 in urban streams (Rinella et al. 2003).

Percent Dominant Taxa – The most abundant taxon as a percentage of the total number of organisms in a sample. Numerical dominance by one or two taxa in a community can indicate environmental stress. In southeastern Alaska, Percent Dominant Taxa ranges from 25 to 40% in unimpaired streams and from 45 to 60% in urban streams (Rinella et al. 2003).

Taxa Richness – The number of taxa in a sample. Taxa richness in southeastern Alaska streams ranges from 19 to 23 in unimpaired streams and from 14 to16 in urban streams (Rinella et al. 2003). Taxa richness is sensitive to the taxonomic level of identification. For example, members of the dipteran family Chironomidae (midges) are generally not identified beyond the family level (as in this study). Because the midges in a sample usually belong to several genera, identifying them to genus can greatly increase taxa richness. Taxa richness values given above include midge genera.

FBI (Family Biotic Index) – This index ranges from 0 (most sensitive to water quality degredation) to 10 (very tolerant of degradation). FBI is calculated by multiplying the total number of individuals in a family by the family FBI score and then dividing by the total number of individuals in the sample. In this assessment, several invertebrate orders were treated as families because family level identification was not practical.

Results

The aquatic invertebrate community at the sites examined showed no improvement since baseline data were collected 10 years ago (Table 1). All bioassessment metrics were below or within the range exhibited by other urbanized streams in southeastern Alaska.

Percent EPT taxa values were zero or nearly zero at both sites in both months. Caddisflies were the only EPT taxa collected and they were rare - only 4 individuals were found in the subsamples processed for calculating metrics. Consequently, EPT richness was very low (0-3).

Percent Dominant Taxa in April samples decreased at both sites from 1996 to 2005. This finding should be interpreted with caution because three small and nondescript taxa found in this assessment may have been overlooked or ignored in the baseline survey of 1994/1996. These taxa included the orders Ostracoda (seed or mussel shrimps), Gastropoda (snails), and Bivalvia (clams). Furthermore, although Percent Dominant Taxa decreased at Taku Boulevard over the period, the two most abundant taxa present in

2005 – oligochaets and chironomids, both indicators of poor water quality – made up 97% of the invertebrate community.

Taxa richness also improved over the 10-year period. Apparent gains in Taxa Richness may be real, but could also be explained by the inclusion of overlooked (e.g. seed shrimp) or rare taxa (e.g. various limnephilid caddisfly genera) in calculating the metrics as described above. Even if these gains are real, Duck Creed Taxa Richness values continue to be far below those found in unimpaired water bodies.

FBI values were similar among sites, did not change over the 10-year period, and suggest an invertebrate community dominated by taxa that are tolerant of poor water quality.

Discussion

This bioassessment was conducted at two sites in the upper portion of the Duck Creek watershed where baseline invertebrate community data were collected 10 years ago. Care should be taken in applying these findings to other parts of the watershed.

Duck Creek continues to show signs of environmental stress. Low flows and high iron floc and sediment loadings continue to plague the stream between Taku Boulevard and Aspen Avenue, hindering recovery of the invertebrate community.

Increased stream flows and improved invertebrate habitat (gravels and cobbles) below Taku Boulevard following restoration were short-lived. Groundwater seepage high in dissolved iron has coated these new substrates and many of the invertebrates with iron deposits. Interstitial spaces within the streambed – critical habitat for invertebrates – have filled with silt and sand. In some places, iron floc is so abundant that accumulations where water is slow and shallow have dammed the stream, creating pools up to 8 m long; sediment in these small impoundments exhibit evidence of anoxia. Stream productivity Between Taku and Mendenhall boulevards is probably further suppressed by a lack of sunlight penetrating the thick riparian canopy.

Future restoration efforts in Duck Creek should aim towards augmenting stream flow in combination with control and removal of sediment and dissolved iron.

Literature Cited

Koski, K and M. Lorenz. 1999. Duck Creek Watershed Management Plan. Prepared for the Duck Creek Advisory Group and the 319 Program of the Clean Water Act. Juneau, Alaska.

Milner, A.M. 1996. A Summary of Bioassessments in Duck Creek: 1994-1996, Institute of Arctic Biology, University of Alaska Fairbanks

Rinella, D.J., D.L. Bogan and E.B. Major. 2003. 2002 Alaska Biological Monitoring and Water Quality Assessment Program report. Environment and Natural Resources Institute, University of Alaska Anchorage, Anchorage, AK. Prepared for the Alaska Department of Environmental Conservation.

Table 1. Aquatic invertebrate taxa and standard bioassessment metrics from two sites in Duck Creek in spring and summer of 1994/1996 and 2005. Biotic Index values for invertebrate families and orders are given in parentheses.

	Taku Boulevard				**Aspen Avenue**			
Sampling Date	4/23/05	4/12/96	6/11/05	6/13/94	4/24/05	4/12/96	6/11/05	6/13/94
Taxon								
TRICHOPTERA								
Limnephilidae (4)							X	
Onocosmoecus				X				
Lenarchus			X[1]					
Ecclisomyia			X[1]					
Grammotaulius[2]					X		X[1]	
Halesochila[2]							X	
DIPTERA								
Ceratopogonidae (10)								X
Chironomidae (6)	X	X	X	X	X	X	X	X
Empididae (6)								X
Similiidae (6)								
Tipulidae (3)		X		X		X		X
Dicranota			X				X	
Culicidae			X					
COLEOPTERA								
Dytiscidae (5)	X[TR]		X				X[TR]	
OLIGOCHAETA (8)	X	X	X	X	X	X	X	X
OSTROCODA (8)			X		X		X	
GASTROPODA			X		X		X	
BIVALVIA (8)	X		X[TR]		X		X	
HIRUDINEA (8)							X	
% EPT TAXA	**0**	**0**	**0**	**NA**	**<0.01**	**0**	**.01**	**0**
EPT RICHNESS	**0**	**0**	**2**	**1**	**1**	**0**	**3**	**0**
% DOM TAXA	**54**	**88**	**51**	**NA**	**47**	**97**	**77**	**67**
TAXA RICHNESS	**4**	**3**	**10**	**4**	**6**	**3**	**11**	**5**
FBI	**6.1**	**6.0**	**5.9**	**NA**	**6.3**	**6**	**6.2**	**6.2**

[1]Taxa used for Taxa Richness and FBI calculations only; [2]Confirmation of identification pending