Temperature provides first order control of most fundamental processes in aquatic insects (Ward and Stanford, 1982). Metabolism, growth, reproduction, timing of emergence, and distributions of aquatic insect species are all directly controlled by temperature (Vannote and Sweeney 1978, 1980). Temperature governs the composition of insect communities both spatially as well as temporally. Vannote and Sweeney (1978, 1980) found species have thermal optima where growth and fecundity are maximized. **One way to try and determine these optimal temperatures as well as temperature tolerances is through empirical approaches using existing data. Empirical methods can be used to try and determine a taxa's** temperature niche or "thermal window" of occurrence.

A statistical approach known as weighted averaging (WA) was used to calculate empirical measures of macroinvertebrate temperature optima and tolerances. A weighted averaging estimate of an individual taxa's optimum for temperature is the mean of the temperature weighted by the abundance of that individual at all sites. WA has a long history of use in ecology and has been used by the authors in previous studies (Munn et al. 2002, Black et al. 2004) and recently recommended by the USEPA for the calculation of macroinvertebrate temperature tolerances (Yuan 2006). The computer program C2 (ver. 1.7.4) was used to calculate all optima and tolerance values (http://www.staff.ncl.ac.uk/staff/stephen.juggins/software/C2Home.htm)

Two sets of data were used for this study. One was compiled from data collected by the USGS as part of the National Water Quality Assessment Program (http://water.usgs.gov/nawqa/). The other was compiled from work done by USEPA as part of the Wadeable Streams Assessment (http://water.epa.gov/type/rsl/monitoring/streamsurvey/). Four data files are included:

1. USGS_data: This file contains all of the USGS taxa, temperature and percent abundance of urban and agricultural land cover within the watershed upstream of the sampling site data used to calculate taxa specific macroinvertebrate optimal temperatures and tolerances.

2. EPA_data: This file contains all of the EPA taxa, temperature and percent abundance of urban and agricultural land cover within the watershed upstream of the sampling site data used to calculate taxa specific macroinvertebrate optimal temperatures and tolerances.

3. USGS_results: This file contains a taxa specific list of temperature optima and tolerances generated from the data contained in USGS_data.

4. EPA_results: This file contains a taxa specific list of temperature optima and tolerances generated from the data contained in EPA_data.

The raw USGS macroinvertebrate data used for this study is contained within the USGS BioData-Aquatic Bioassessment Data for the Nation web site (https://aquatic.biodata.usgs.gov/landing.action). Only those macroinvertebrate data sites with water temperature data collected during the macroinvertebrate sampling were used. Sites were sampled between 1993 and 2009 and were limited to those sites in WA, OR, CA, ID, WY, MT, UT, CO, and NV (Figure 1). Only those sites with watershed upstream of the sampling site with less than 50% urban and agricultural land cover were used. Land cover data for the sites was based on land cover data contained in the 2001 National Land Cover Data set found at (http://www.epa.gov/mrlc/nlcd-2001.html). Water temperature data used with the USGS macroinvertebrate data for this study is contained within the National Water Information System found at (http://waterdata.usgs.gov/nwis).

All EPA data used for this study was collected as part of the Wadeable Streams Assessment and can be found at

(http://water.epa.gov/type/rsl/monitoring/streamsurvey/web_data.cfm). Only those macroinvertebrate samples for which water temperature data collected during the macroinvertebrate sampling were used. Sites were sampled between 2000 and 2003 and were limited to those sites in WA, OR, CA, ID, WY, MT, UT, CO, and NV (Figure 1). Only those sites with watershed upstream of the sampling site with less than 50% urban and agricultural land cover were used. Land cover data for the sites was based on land cover data contained in the 2001 National Land Cover Data set and was found at http://water.epa.gov/type/rsl/monitoring/streamsurvey/web_data.cfm).

Prior to the calculation of taxa specific optima and tolerances, analytical taxa names found at 2 or fewer sites were removed from the data sets. For those taxa found at 3 or less sites and accounted for less than 0.5% of the total number of taxa found at a site were also eliminated prior to the analysis.

REFERENCES

Black, R.W. M.D. Munn, and R.W. Plotnikoff. 2004. Using macroinvertebrates to identify biota-land cover optima at multiple scales in the Pacific Northwest, USA. *J. N. Am. Benthol. Soc.* 23:340-362.

Munn, M.D., R.W. Black, and S.J. Gruber. 2002. Response of benthic algae to environmental gradients in agriculturally dominated landscape. *J. N. Am. Benthol. Soc.* 21:221-237.

Vannote, R.L. and B.W. Sweeney. 1980. Geographical analysis of thermal equilibeia: A conceptual model for evaluating the effect of natural and modified thermal regimes on aquatic insect communities. *Am. Nat*. 115:667-695.

Ward, J.V., and J.A. Stanford. 1982. Thermal responses in the evolutionary ecology of aquatic insects. *Ann. Rev. Entomol*. 27:97-117.

Yuan, L.L. 2006. Estimation and application of macroinvertebrate tolerance values. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/P-04/116F. Washington D.C.