Development and assessment of freshwater mussel growth-increment chronologies in the Pacific Northwest

Bryan Black
Hatfield Marine Science Center
Newport, OR 97365
bryan.black@oregonstate.edu
541-867-0283

We have completed a manuscript describing three freshwater mussel chronologies, "Bryant Park" near Albany, Oregon directly upstream of the confluence of the Calapooia River; the "Dexter" chronology in the Middle Fork of the Willamette River at Elijah Bristow State Park; and the "Steamboat" chronology for Steamboat Creek at a sample site located below the Canton Creek confluence, as well as their interrelationships with one another and climate. The manuscript by BA Black, J Dunham, B Blundon, M Raggon, and D Zima, "Freshwater mussel growth-increment chronologies and relationships with stream discharge and temperature in the Pacific Northwest, USA," is currently in review at *Marine and Freshwater Research*. A copy of the manuscript is included with this report. In summary, the three chronologies positively correlate with one another and negatively relate to river discharge. For example, in a regression between annual discharge and the Steamboat chronology, the R^2 is 0.67.

Over the past several months, we have completed an additional four mussel chronologies, partially funded through the United States Geological Survey (USGS). These chronologies are i) the Williamson River near Spring Creek along the eastern side of the Cascades in OR, ii) Beaver Creek (Warm Springs River) in the Deschutes River watershed of OR, iii) Bear Valley Creek of the Salmon River watershed in central ID and, iv) the Stanley Lake outlet of the Salmon River watershed in central ID. We had originally planned to develop a chronology for the Fiver Rivers portion of the Alsea River in the OR Coast Range, but after they had been thin-sectioned and prepared for analysis, we found that the mussels were too young and damaged to allow growth-increment analysis. We were, however, able to complete a number of chronologies for the Cascade Mountains, eastern Oregon, and central Idaho. Additional chronologies are being developed for these regions through the USGS, and all chronologies will be compiled into a regional synthesis for publications in a peer-reviewed journal. Procedures for mussel preparation and chronology development are detailed in the publication presently in peer review.

We have conducted a preliminary analysis of the seven mussel chronologies developed to date as we prepare for larger region-wide syntheses of mussel growth in the Pacific Northwest. In summary, all mussel chronologies span between approximately twenty and forty years, and chronologies tend to positively correlate with one another (Figure 1). When the seven chronologies are entered into principal components analysis (common interval 1987 through 2003), the leading component accounts for 44% of the variance in the data set, while second component accounts for an additional 25%. The relatively large portion of variance captured by the first component reflects a high degree of synchrony among sites.

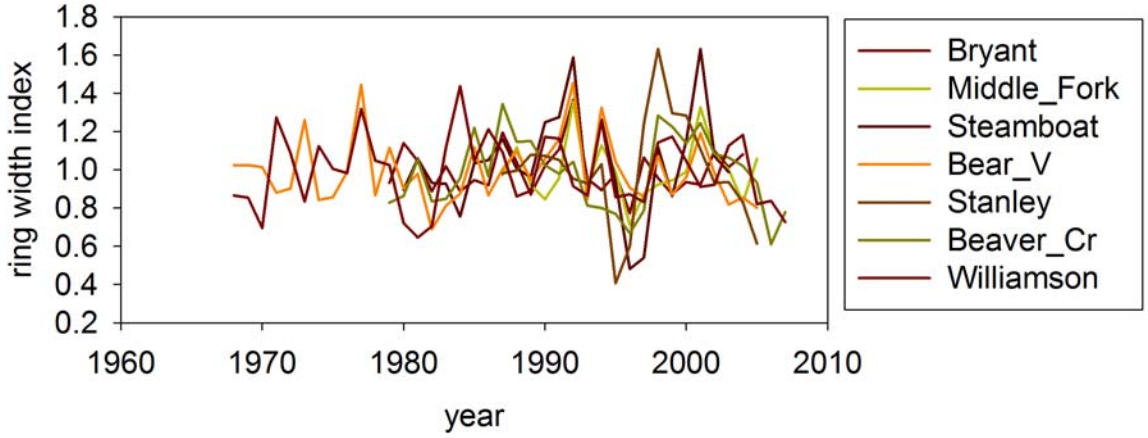

Figure 1. Freshwater mussel growth-increment chronologies for seven sites in Oregon and Idaho.

Although some growth patterns are shared among sites, there are still important differences, as identified in a plot of principal components scores for the seven sites (Figure 2). In general, the PCA segregates sites with respect to geography. In particular, Stanley, Williamson, and Beaver, all eastern Oregon and Idaho chronologies group, as do the three chronologies from the Willamette River basin: Steamboat, Middle Fork, and Bryant. A notable exception is Bear Valley, a site located in central Idaho that groups with the Willamette chronologies (Figure 2). Overall, the leading principal component in this analysis strongly relates to precipitation and river discharge during the growing season. Indeed, correlations between the leading component and the Palmer Drought Severity Index, a measure of soil moisture, exceed 0.7 and are highly significant from March through October (data not shown). Thus the first principal component sorts sites along a gradient from highly sensitive (negative PC values) to less sensitive (positive PC values) to river flow. The reason Bear Valley is as sensitive to river flow as sites from the Willamette Basin is not apparent, though Bear Valley is an unusually high elevation. Also, the interpretation of the second principal component is not clear, though it, too, seems to separate chronologies according to geography, closely grouping low-elevation, eastern sites from high elevation and western sites (Figure 2).

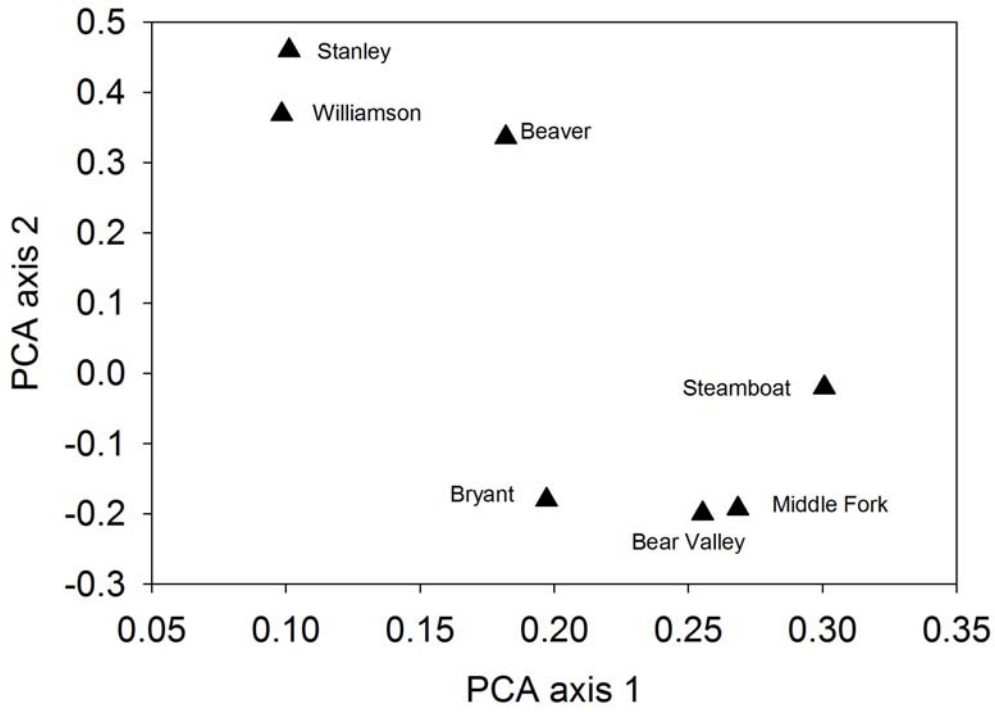

Figure 2. Scores for each of the seven freshwater mussel chronologies in a principal components analysis.

Additional chronologies are being developed to extend the current analysis and should be completed by autumn of 2010. Also, chronology length will be extended at several sites. In particular, we have discovered several mussels in excess of 100 year in age at the Williamson site. In our original collection, we did not have enough long-lived individuals for a 100-year chronology, but a return to the site did yield several old individuals that may allow the development of a centennial-length chronology in the coming months. If successful, this would be by far the longest chronology yet developed and would provide valuable insight into the long-term flow patterns of the Williamson River.