Use of Radiocarbon Dating and Dendrochronology to Investigate a Submerged Forest in Eld Inlet

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Abstract
We use evaluation of historic maps and photographs, field investigations, and a combination of carbon dating and tree-ring analysis of exhumed snags in Mud Bay (Eld Inlet) to test the evidence for, and possibly date submergence in this estuary, 5 mi southwest of Olympia, Washington. Studies of submerged forests in Puget Sound by previous researchers show evidence of submergence, possibly caused by movement along shallow crustal faults that intersect the south Puget Lowland (Gower et al., 1985; Sherrod, 2001). The discovery of a submerged Squaxin Island tribal village site of Qw’Psed in Mud Bay provided early evidence of submergence of Mud Bay (Grose and others, 2005). Carolyn Garrow-Laney turned up additional evidence of submergence there (Garrow-Laney, 2003).

Investigations in Mud Bay are challenging because of the interesting historical use of the area and the common pilings. To look for possible in-river subfossil trees, we have sampled exhumed snags using handsaws and increment borers, have mapped them geographically using GPS (global positioning system) to within several meters and have noted certain characteristics of each snag such as size and geologic/geomorphic environment.

Two submerged (>2m), bark bearing Douglas fir snags for have yielded calibrated calendric radiocarbon ages of A.D. 1490 ± 10 years B.P. (1710 ± 190 years B.P.) respectively at 5±1.0 percent probability (5±B.8.5), and thus these snags are not correlative. In our future investigations we will complete the reconnaissance mapping and sample collection of submerged snags and use dendrochronology to test for correlations of the samples with nearby trending chronologies.

This proposed research will assist in the interpretation of the paleoecologic and environmental history of Mud Bay as well as provide important field education for local school students to recent pedologic history. The project has been greatly assisted by a Partners-in-Science grant from the M.J. Murdock Charitable Trust.

Introduction
At the Squaxin village archeological dig on the eastern shore of Eld Inlet (Figs. 1 and 2; red circle on the photo to the right above), researchers found evidence of a layer of forest floor debris more than a meter thick. Other researchers at various sites around the southern Puget Sound have found submerged forests in the growth position. Brian Sherrod combined analysis of in situ core from the Little Skookum Inlet and the Nisqually delta with radiocarbon dates of submerged tree roots to provide evidence of subsidence of at least one meter in the Nisqually delta salt marshes and possibly three meters at Little Skookum Inlet. (Sherrod, 2005)

Background and Discussion
Shoreline erosion from changing creek beds can expose trees buried for centuries in anoxic conditions that retard decay. Comparing sequential photographs from Mud Bay taken decades apart allowed us to see changes in the creek beds as they erode towards salt water at low tide and helped focus our searches for more recently exposed snags. Changes in shore lines as well as changes in the creek bed are visible when comparing the two aerial photographs of Eld Inlet above and its tributary, Perry Creek, Figs. 3 and 4 below. Any woody debris not in the growth position, such as horizontal logs or branches buried in the mud, were suspect because such debris could be the result of logs carried into creeks at high tide. As the shoreline changes and as creeks erode, human artifacts from potential subfossil trees and to document the effects of historic sedimentation. Each sample was sanded with progressively finer grit sandpaper (up to 2000 grit) until they were polished. The sanded samples were then scanned onto blocks of wood. Once the mounting was polished, the sanded samples were then scanned onto blocks of wood. Once the mounting was polished.

Methods
We documented the deposits and snags in Eld Inlet during low tide using boats to access areas distant from the shoreline. We sampled exhumed snags using saws and increment borers and documented the locations of the snags using personal computers, GPS, and verbal descriptions. Where possible, we attempted to core the submerged using a soil coring tool. We used Government Land Office plat maps and historic photos to help us distinguish plinings and other human artifacts from potential subfossil trees and to document the effects of historic sedimentation. Each sample had to be carefully prepared for scanning and analysis. Using imaged software (Ikariya, 1998), we measured tree rings of sampled snags. We will compare the measured series with established tree ring chronologies using another program, COFECHA, (Holmes, 1983).


Acknowledgments

We thank the southeastern Puget Lowland, from Gower et al. (1985). Photos courtesy of Washington Dept. of Natural Resources.

Fig. 2. Comparison of aerial photographs of Eld Inlet taken in 1958 and 2003. Location of photos Map shows Squaxin location, Mud Bay, and Perry Creek. Photographs courtesy of Washington Dept. of Natural Resources.

Fig. 3. Perry Creek drainage into Eld Inlet, (1958) Development showing the beginnings of the bridge for Highway 101.

Fig. 4. Perry Creek (2003) showing the locations of the two snags pictured above in red circles. Notice the changes in creek beds between the two white triangles.

While eroding mud from around an exposed snag in Perry Creek (Fig. 5d), we uncovered an apparent layer of forest floor, identifiable by grass stems, pieces of bark, and other small woody debris. The layer measures 6 cm in thickness. Immediately above it is a layer of dark sand about 1 m in thickness from the same area previously dated by P. Pringle and M. Polenz. This leaves us with many questions. Why are two snags in close proximity showing such different radiocarbon ages? If it were possible to excavate down through the mud, could we find a root system for either snag? If so, these other trees could demonstrate subaerial forest succession such as a lateral spreading, that is responsible for our previous dating? Using a technique of Yamaguchi (1980), we were able to virtually cross date these two snags with one set of subfossil trees in Eld Inlet to better assess the calendric age of the snags.

Preliminary Results
We submitted a sample from a large bearing snag (no. 1) in Perry Creek (Fig. 6d) for radiocarbon dating. The results (Figs. 7-10) do not match the date of the mud from the same area previously dated by P. Pringle and M. Polenz. This leaves us with many questions. Why are two snags in close proximity showing such different radiocarbon ages? If it were possible to excavate down through the mud, could we find a root system for either snag? If so, these other trees could demonstrate subaerial forest succession such as a lateral spreading, that is responsible for our previous dating? Using a technique of Yamaguchi (1980), we were able to virtually cross date these two snags with one set of subfossil trees in Eld Inlet to better assess the calendric age of the snags.

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