Background

The National Park Service seeks to draft a removal program focused on non-native brook trout from the White River, a glacial-fed tributary to the Puyallup River originating on Mt. Rainier, while limiting impact on native species. A key component of this plan is to identify native and non-native fish. Cutthroat trout (*Oncorhynchus clarki*) inhabit the White River and its tributaries and it is unclear whether they are native Coastal Cutthroat (*O. clarki clarki*) or descendants of Westslope Cutthroat trout (*O. clarki lewisi*) stocked historically in the region. To identify the unknown Cutthroat trout, ten fish (WDFW code 16QE) were collected from ponds and seasonal tributaries draining into the White River, on September 14, 2016 and August 8, 2017. Starting with this collection, the primary objective is to identify the genetic ancestry of Cutthroat Trout observed in alpine lakes and tributaries of the upper White River.

Methods:
The WDFW genetics lab genotyped Mt Rainier Cutthroat trout samples at seven microsatellite loci (Ogo3, Omm1138, One108, Ots103, Omy77, Ots1, and Ots3M), the microsatellite component of the locus suite for genotyping Coastal Cutthroat trout. These loci distinguish Coastal Cutthroat trout from Westslope Cutthroat trout and from the hatchery strain of Coastal Cutthroat trout planted in Washington, and from Rainbow trout, both hatchery and wild. The loci also distinguish some local populations of native Coastal Cutthroat trout.

The microsatellite genotypes for the Mt. Rainier Cutthroat trout were compared to microsatellite genotypes for Coastal and Westslope Cutthroat trout collections in the WDFW baseline (Table 1) in a factorial correspondence analysis (Belkhir et al. 2001).

Results and discussion:
One allele (*Ogo3*197) was unique to the Mt. Rainier Cutthroat trout (Appendix 1). Two samples (Appendix 1) failed to produce genotypes and were eliminated from analyses. The remaining samples showed no similarity to Rainbow trout or to Westslope Cutthroat trout (WCT) and were similar to other Coastal Cutthroat trout (CCT): in a FCA plot including hatchery WCT that had been planted in the region (Figure 1), the Cutthroat trout from Mt. Rainier plotted with the cluster of CCT. Because including the WCT compressed the CCT onto the right side of axis 1, obscuring relationships among CCT, we conducted a second FCA excluding the WCT (Figure 2). In the second FCA, the Mt. Rainier Cutthroat trout and hatchery CCT (broodstock origin Lake Whatcom in North Puget Sound) are more visible. The Mt. Rainier Cutthroat trout plot distantly from hatchery CCT and close to native CCT from Central Puget Sound (Cedar and Snoqualmie
rivers). The pattern to the genetic variation suggests that Mt Rainier Cutthroat trout are native CCT rather than descendants of hatchery CCT or hatchery WCT.

Acknowledgements:
Funding was provided by the Coastal Cutthroat Coalition. Samples were collected by WDFW and Mt Rainier National Park personnel. Todd Kassler administered the contract for WDFW.

Reference:
Belkhir, K, P Borsa, L Chikhi, N Raufaste, F Bonhomme. 2001. GENETIX 4.05, logiciel sous Windows™ pour la genetique des populations. Montpellier (France): Laboratoire Genome, Populations, Interactions, CNRS UMR 5000, Universite de Montpellier II.

Table 1. List of collections used in the study to compare to the unknown Cutthroat trout from Mt. Rainier. Coastal Cutthroat trout are abbreviated “CCT” and Westslope Cutthroat trout are abbreviated “WCT”. The collections listed below Mt Rainier constitute the WDFW Cutthroat trout genetic baseline. Cascade appeared to be a naturalized hatchery population.

<table>
<thead>
<tr>
<th>status</th>
<th>collection</th>
<th>code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>Mt. Rainier</td>
<td>16QE</td>
</tr>
<tr>
<td>WCT_hatchery</td>
<td>TwinLakesWCT</td>
<td>99GB</td>
</tr>
<tr>
<td>CCT_hatchery</td>
<td>14TokulH</td>
<td>14MK</td>
</tr>
<tr>
<td>CCT_hatchery</td>
<td>01TokulH</td>
<td>01NZ</td>
</tr>
<tr>
<td>CCT_native</td>
<td>Cedar</td>
<td>05BB</td>
</tr>
<tr>
<td>CCT_native</td>
<td>Snoqualmie</td>
<td>09J</td>
</tr>
<tr>
<td>CCT_hatchery</td>
<td>Cascade</td>
<td>14QW</td>
</tr>
<tr>
<td>CCT_native</td>
<td>Doe</td>
<td>14QX</td>
</tr>
<tr>
<td>CCT_native</td>
<td>Garrison</td>
<td>14QZ</td>
</tr>
<tr>
<td>CCT_native</td>
<td>Goodman</td>
<td>00CU</td>
</tr>
<tr>
<td>CCT_native</td>
<td>GraysH</td>
<td>11OI</td>
</tr>
<tr>
<td>CCT_native</td>
<td>Nooksack</td>
<td>95VF</td>
</tr>
<tr>
<td>CCT_native</td>
<td>Kennedy</td>
<td>14JG</td>
</tr>
<tr>
<td>CCT_native</td>
<td>McLane</td>
<td>14JG</td>
</tr>
<tr>
<td>CCT_native</td>
<td>Skookum</td>
<td>14JG</td>
</tr>
</tbody>
</table>
Figure 1. A factorial correspondence analysis plot of Coastal and Westslope Cutthroat trout collections and the unknown trout from Mt Rainier.

Figure 2. A factorial correspondence analysis plot of only Coastal Cutthroat trout collections and the unknown trout from Mt. Rainier.
Appendix I. List of unknown Cutthroat trout collected in the White River on Mt. Rainier, their genotypes at seven microsatellite loci, and the sample data that accompanied the tissue samples. Question marks indicate loci that had no data.

<table>
<thead>
<tr>
<th>Site code</th>
<th>Species</th>
<th>Sample ID</th>
<th>Fork Length</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>LW18</td>
<td>ONCL</td>
<td>716-046</td>
<td>210</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>LW18</td>
<td>ONCL</td>
<td>716-071</td>
<td>180</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>LW17</td>
<td>ONCL</td>
<td>716-069</td>
<td>180</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>LW17</td>
<td>ONCL</td>
<td>716-035</td>
<td>160</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>LW17</td>
<td>ONCL</td>
<td>716-056</td>
<td>190</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>LW16</td>
<td>ONCL</td>
<td>716-022</td>
<td>190</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>LW16</td>
<td>ONCL</td>
<td>716-032</td>
<td>185</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>LW16</td>
<td>ONCL</td>
<td>714-072</td>
<td>210</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>LW16</td>
<td>ONCL</td>
<td>716-073</td>
<td>155</td>
<td>9/14/2016</td>
</tr>
<tr>
<td>outlet</td>
<td>ONCL</td>
<td>713-022</td>
<td>113</td>
<td>8/8/2017</td>
</tr>
</tbody>
</table>