Juvenile Salmonid Monitoring on the Mainstem Trinity River, California, 2013

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Key words: Trinity River, salmon, downstream migrant trapping, Chinook salmon, coho salmon, steelhead, abundance index, juvenile salmon, rotary screw trap.

The correct citation for this report is:

# Table of Contents

List of Tables ..................................................................................................................... iv
List of Figures .................................................................................................................... iv
List of Appendices ............................................................................................................. vi
Introduction ......................................................................................................................... 2
Methods............................................................................................................................... 4
Results................................................................................................................................. 4
  Catch Totals ..................................................................................................................... 6
  Abundance Indices ........................................................................................................... 6
  Hatchery/Natural Contribution ...................................................................................... 12
  Chinook Salmon Population Estimation ........................................................................ 12
  Outmigrant Timing ......................................................................................................... 12
  Migration Rate ............................................................................................................... 15
  Fish Size ......................................................................................................................... 15
  Fish Condition ................................................................................................................ 19
References ......................................................................................................................... 23
Acknowledgements ........................................................................................................... 23
Appendices ........................................................................................................................ 24
List of Tables

Table 1. Week of the Year (WOY) and corresponding first calendar date. ....................... 4

Table 2. Period and duration of 2013 spring/summer monitoring and percent of
time sampled at Pear Tree Rotary Screw Trap site (PTRST; rkm 118) and
Willow Creek Rotary Screw Trap site (WCRST; rkm 34). ................................................. 6

Table 3. Juvenile salmonid catch totals in 2013 for trapping at Pear Tree Rotary
Screw Trap (PTRST; rkm 118) and Willow Creek Rotary Screw Trap
(WCRST; rkm 34), on the Trinity River, California, operated by the Hoopa
Valley Tribal Fisheries Department, U. S. Fish and Wildlife Service, Arcata
Fish and Wildlife Office and the Yurok Tribal Fisheries Program. Hatchery
fish totals are expanded catch based on adipose fin clip rate. ................................. 7

Table 4. California Department of Fish and Game, Trinity River Hatchery
juvenile salmonid releases, 2013 .................................................................................. 7

Table 5. Catch totals of non-target fish species captured at Pear Tree Rotary
Screw Trap site (PTRST) and Willow Creek Rotary Screw Trap site (WCRST)
on the mainstem Trinity River, California, 2013. ............................................................. 8

Table 6. Juvenile salmonid proportional discharge based abundance indices, at
Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap
(WCRST), 2013. .............................................................................................................. 8

Table 7. Juvenile salmonid emigration duration and peak as inferred from
proportional discharge based abundance indices, at Pear Tree Rotary Screw
Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. ......................... 14

Table 8. Juvenile salmonid maximum migration rate from Trinity River Hatchery
to Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw
Trap (WCRST) sampling sites, operated by the Hoopa Valley Tribal Fisheries
Department, U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office,
and the Yurok Tribal Fisheries Program, 2013 ............................................................. 15

List of Figures

Figure 1. Location of the Trinity River rotary screw trap sites near Willow Creek
(rkm 34) and Pear Tree Gulch (rkm 118), California, operated by the Yurok
Tribal Fisheries Program, U. S. Fish and Wildlife Service, Arcata Fish and
Wildlife Office, and the Hoopa Valley Tribal Fisheries Department. ....................... 3

Figure 2. Mean daily discharge (m$^3$/s) as recorded near Helena, California (U.S.
Geological Survey Water Resource gage station #11-526400) and Hoopa (U.S.
Geological Survey Water Resource gage station #11-530000), California and
mean daily water temperatures (°C) recorded at USGS gage #11-526400 and
the Willow Creek Rotary Screw Trap (WCRST) in 2013. ........................................... 5
Figure 3. Weekly proportional discharge based abundance indices for natural age-0 and hatchery age-0 Chinook salmon captured at Pear Tree Rotary Screw Trap (PTRST; rkm 118) and Willow Creek Rotary Screw Trap (WCRST; rkm 34) in 2013. ................................................................................................................. 9

Figure 4. Weekly proportional discharge based abundance indices for natural age-0, natural age-1, and hatchery age-1 coho salmon captured at Pear Tree Rotary Screw Trap (PTRST, rkm 118) and Willow Creek Rotary Screw Trap (WCRST, rkm 34) in 2013. ........................................................................................................................................ 10

Figure 5. Weekly proportional discharge based abundance indices for natural age-0, natural age-1, natural age-2, and hatchery age-1 steelhead captured at Pear Tree Rotary Screw Trap (PTRST, rkm 118) and Willow Creek Rotary Screw Trap (WCRST, rkm 34) in 2013. ........................................................................................................................................ 11

Figure 6. Weekly mark-recapture population estimates of natural age-0 and hatchery age-0 Chinook salmon captured at Pear Tree Rotary Screw Trap (PTRST; rkm 118) and Willow Creek Rotary Screw Trap (WCRST; rkm 34) in 2013. ........................................................................................................................................ 13

Figure 7. Weekly mean fork lengths of age-0 and age-1 Chinook salmon captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. ........................................................................................................................................ 16

Figure 8. Weekly mean fork lengths for natural age-0, natural age-1, and hatchery coho salmon captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. ........................................................................................................................................ 17

Figure 9. Weekly mean fork lengths for natural age-0, age-1, age-2, and hatchery age-1 steelhead captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. ........................................................................................................................................ 18

Figure 10. Weekly mean K value for age-0 Chinook salmon (pooled natural and hatchery) captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. ........................................................................................................................................ 20

Figure 11. Weekly mean K value for natural age-1 coho salmon captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. ........................................................................................................................................ 21

Figure 12. Weekly mean K value for natural age-1 steelhead captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. ........................................................................................................................................ 22
List of Appendices

Appendix 1. Trinity River at Pear Tree rotary screw trap site weekly Chinook salmon catches and abundance indices, 2013. .......................................................... 25

Appendix 2. Trinity River at Willow Creek rotary screw trap site weekly Chinook salmon catches and abundance indices, 2013. ............................................ 26

Appendix 3. Trinity River at Pear Tree rotary screw trap site weekly coho salmon catches and abundance indices, 2013. .......................................................... 27

Appendix 4. Trinity River at Willow Creek rotary screw trap site weekly coho salmon catches, and abundance indices, 2013. ......................................................... 28

Appendix 5. Trinity River at Pear Tree rotary screw trap site weekly steelhead catches and abundance indices, 2013. .......................................................... 29

Appendix 6. Trinity River at Willow Creek rotary screw trap site weekly steelhead catches and abundance indices, 2013. .......................................................... 30

Appendix 7. Trinity River at Pear Tree rotary screw trap site weekly age-0 Chinook salmon population estimate input and results, 2013. ................................. 31

Appendix 8. Trinity River at Willow Creek rotary screw trap site weekly age-0 Chinook salmon population estimate input and results, 2013. ................................. 32

Appendix 9. Trinity River at Pear Tree rotary screw trap site weekly Chinook and coho salmon fork lengths, 2013. .......................................................... 33

Appendix 10. Trinity River at Willow Creek rotary screw trap site weekly Chinook and coho salmon fork lengths, 2013. .......................................................... 34

Appendix 11: Trinity River at Pear Tree rotary screw trap site weekly steelhead fork lengths, 2013. .......................................................... 35

Appendix 12: Trinity River at Willow Creek rotary screw trap site weekly steelhead fork lengths, 2013. .......................................................... 36

Appendix 13. Fulton's condition factor (K) for pooled natural and hatchery age-0 Chinook salmon with FL>50mm from the Pear Tree and Willow Creek rotary screw trap sites, 2013. .......................................................... 37

Appendix 14. Fulton's condition factor (K) for age-1 coho salmon from the Pear Tree and Willow Creek Rotary screw trap sites, 2013. .......................................................... 38

Appendix 15. Fulton's condition factor (K) for natural age-1+ steelhead from the Pear Tree and Willow Creek rotary screw trap sites, 2013. .......................................................... 39
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Executive Summary.—This report presents juvenile salmonid emigration monitoring data collected in 2013 at both Pear Tree Bar (PTRST; river kilometer [rkm] 118) and Willow Creek (WCRST; rkm 34), California on the mainstem Trinity River. Monitoring at PTRST is conducted to estimate juvenile salmonid population size passing PTRST during the sampling season. Monitoring at WCRST is conducted to estimate juvenile salmonid population size and emigration timing during the monitoring period. In 2013, two rotary screw traps were operated at PTRST from January 15 through September 1, with successful sampling for 207 of the 230 day sampling period and at WCRST three rotary screw traps were operated from March 16 through August 30, with successful sampling for 143 days of the 169 day sampling period.

Age of salmonid outmigrants, mean length by week, migration rates, and hatchery contributions were estimated. Catch data were used to calculate proportional discharge based abundance indices for juvenile Chinook salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), and steelhead (O. mykiss). Catch data of other fishes are also presented.

Juvenile salmonid emigration target dates were developed by the Trinity River Restoration Program (TRRP) to assess at what date 80% of the juvenile salmonid population had reached Willow Creek and to help manage water temperatures in the mainstem Trinity River. The estimate of the week in which 80% of the juvenile Chinook salmon population passed WCRST, as inferred from the proportional discharge based abundance index was Week of the Year (WOY) 24 (June 5-June 11), which occurred before the TRRP management target date of July 9. The estimate of the week in which 80% of the natural coho salmon smolt population passed the WCRST was WOY 21 (May 15-May 21), which occurred prior to the TRRP management target date of June 4. The estimate of the week in which 80% of the steelhead smolt population passed the WCRST, as inferred from proportional discharge based abundance index, was WOY 20 (May 8 – May 14), which occurred prior to the TRRP management target date of May 22.
Weekly stratified mark-recapture population estimates of emigrating age-0 Chinook salmon were calculated for both naturally and hatchery-produced sub-populations. At PTRST an estimated 2,480,622 (SD=131,529; CV = 0.053) naturally-produced age-0 Chinook salmon and 677,188 (SD = 47,178, CV = 0.071) age-0 hatchery Chinook salmon passed the site between January 15 and September 1. At WCRST between March 16 and August 30, an estimated 4,828,842 (SD = 548,891; CV = 0.113) naturally-produced age-0 Chinook salmon and 384,512 (SD = 54,666; CV = 0.142) age-0 hatchery Chinook salmon passed the site.

**Introduction**

This report presents annual data collected to: (1) evaluate the production of juvenile Chinook salmon (*Oncorhynchus tshawytscha*), from the upper 65 kilometers of the mainstem Trinity River below Lewiston Dam, the primary restoration reach of the Trinity River Restoration Program (TRRP); and (2) provide data to enable evaluation of the production and outmigrant timing of juvenile salmonids through the lower Trinity River in response to managed flow releases, thermal regimes, and restoration efforts. Information collected by this project is needed to address TRRP Integrated Assessment Plan objective 3, and sub-objective 3.2 (TRRP and ESSA 2009):

**Objective 3**: Restore and maintain natural production of anadromous fish populations  
**Sub-objective 3.2**: Increase freshwater production of anadromous fish.

Juvenile salmonid emigration from the mainstem Trinity River has been monitored since 1989 with rotary screw traps. This data series report summarizes the outmigrant monitoring data collected in 2013 cooperatively by the U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Hoopa Valley Tribal Fisheries Department, and Yurok Tribal Fisheries Program at Pear Tree Gulch (PTRST) and Willow Creek (WCRST) on the mainstem Trinity River (Figure 1). The intent of this data series report is to provide timely dissemination of data to local managers and for inclusion in agency databases, and provide basic biological information to evaluate the effectiveness of habitat restoration efforts, especially flow regimes recommended in the Record of Decision (USDOI 2000), in restoring the fishery resources of the Trinity River. In addition to quantifying salmonid outmigrant production and timing, fish condition and hatchery/natural composition of the outmigrants are assessed.

A technical report synthesizing multi-year datasets developed by this project will be periodically published to evaluate trends in outmigrant salmonid production, outmigrant timing, hatchery/natural contribution and condition/health. Monitoring emigrating juvenile salmonid populations in conjunction with habitat availability and suitability studies is expected to provide a direct evaluation of TRRP restoration efforts because these studies focus on the early freshwater life-history phase which is directly affected by instream conditions and management actions. In addition, it is intended that this basic information will be used by the TRRP to aid in development of a salmon production model for the Trinity River.
Figure 1. Location of the Trinity River rotary screw trap sites near Willow Creek (rkm 34) and Pear Tree Gulch (rkm 118), California, operated by the Yurok Tribal Fisheries Program, U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, and the Hoopa Valley Tribal Fisheries Department.
Methods

For details on background, study site, and monitoring methods for the data presented in this report, the reader is referred to the 2009 Trinity River Juvenile Salmonid Outmigrant Monitoring Report by Harris et al. (2012).

Results

Data are grouped by Week of the Year (WOY; Table 1). Graphs of water temperature and discharge through the sampling periods are presented in Figure 2.

Sampling Efforts

In 2013, trapping at PTRST began in the third week of January and trapping at WCRST was initiated the first week of March (Table 2). Sampling occurred at both sites in each sampling week, although occasionally traps were not run for complete sample weeks. To ensure that the greatest portion of the natural Chinook salmon emigration, as well as portions of the hatchery and natural coho salmon (O. kisutch) and steelhead (O. mykiss) smolt emigration were sampled, efforts were made to install the traps as early as possible and continue sampling throughout the summer. Sampling at Pear Tree Bar has occurred between early January and late August since 2007, and sampling at Willow Creek has occurred from March through August since 2005. It is important for readers to note that without sampling year-round, portions of annual production are excluded from estimates and indices presented in this report.

Table 1. Week of the Year (WOY) and corresponding first calendar date.

<table>
<thead>
<tr>
<th>WOY</th>
<th>Week Beginning</th>
<th>WOY</th>
<th>Week Beginning</th>
<th>WOY</th>
<th>Week Beginning</th>
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<td>18</td>
<td>04/30</td>
<td>35</td>
<td>08/27</td>
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<tr>
<td>2</td>
<td>01/08</td>
<td>19</td>
<td>05/07</td>
<td>36</td>
<td>09/03</td>
</tr>
<tr>
<td>3</td>
<td>01/15</td>
<td>20</td>
<td>05/14</td>
<td>37</td>
<td>09/10</td>
</tr>
<tr>
<td>4</td>
<td>01/22</td>
<td>21</td>
<td>05/21</td>
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<td>09/17</td>
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<td>6</td>
<td>02/05</td>
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<td>06/04</td>
<td>40</td>
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<tr>
<td>7</td>
<td>02/12</td>
<td>24</td>
<td>06/11</td>
<td>41</td>
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<tr>
<td>8</td>
<td>02/19</td>
<td>25</td>
<td>06/18</td>
<td>42</td>
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<tr>
<td>9</td>
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<td>26</td>
<td>06/25</td>
<td>43</td>
<td>10/22</td>
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<td>07/02</td>
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<td>28</td>
<td>07/09</td>
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<tr>
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<td>03/19</td>
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<td>07/16</td>
<td>46</td>
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<tr>
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<td>30</td>
<td>07/23</td>
<td>47</td>
<td>11/19</td>
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<tr>
<td>14</td>
<td>04/02</td>
<td>31</td>
<td>07/30</td>
<td>48</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>52</td>
<td>12/24</td>
</tr>
</tbody>
</table>
Figure 2. Mean daily discharge (m$^3$/s) as recorded near Helena, California (U.S. Geological Survey Water Resource gage station #11-526400) and Hoopa (U.S. Geological Survey Water Resource gage station #11-530000), California and mean daily water temperatures (°C) recorded at USGS gage #11-526400 and the Willow Creek Rotary Screw Trap (WCRST) in 2013. USGS gage #11-526400 is located approximately 100m downstream of the Pear Tree Rotary Screw Trap (PTRST). Heavy line on discharge plot indicates sampling period, dashed line on discharge plot indicates no sampling.
Table 2. Period and duration of 2013 spring/summer monitoring and percent of time sampled at Pear Tree Rotary Screw Trap site (PTRST; rkm 118) and Willow Creek Rotary Screw Trap site (WCRST; rkm 34). Distinct days are total number of days sampled with at least one trap.

<table>
<thead>
<tr>
<th>Site</th>
<th>Trap</th>
<th>Start-End dates</th>
<th>Days Trapped</th>
<th>Days possible</th>
<th>Trapping Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTRST</td>
<td>1 (2.4m)</td>
<td>15-Jan - 1 Sep</td>
<td>206</td>
<td>230</td>
<td>89.6%</td>
</tr>
<tr>
<td>PTRST</td>
<td>2 (1.5m)</td>
<td>16-Jan - 1 Sep</td>
<td>159</td>
<td>229</td>
<td>69.4%</td>
</tr>
<tr>
<td>Distinct Days</td>
<td></td>
<td>15-Jan - 1 Sep</td>
<td>207</td>
<td>230</td>
<td>90.0%</td>
</tr>
<tr>
<td>WCRST</td>
<td>1 (2.4m)</td>
<td>10 Apr – 30 Jun</td>
<td>79</td>
<td>81</td>
<td>97.5%</td>
</tr>
<tr>
<td>WCRST</td>
<td>2 (2.4m)</td>
<td>28 Mar – 30 Aug</td>
<td>121</td>
<td>156</td>
<td>77.6%</td>
</tr>
<tr>
<td>WCRST</td>
<td>3 (2.4m)</td>
<td>16 Mar – 30 Aug</td>
<td>138</td>
<td>168</td>
<td>82.1%</td>
</tr>
<tr>
<td>Distinct Days</td>
<td></td>
<td>16 Mar – 30 Aug</td>
<td>143</td>
<td>168</td>
<td>85.1%</td>
</tr>
</tbody>
</table>

Catch Totals

Catch totals of the primary salmonids of interest (Chinook salmon, coho salmon and steelhead) are presented in Table 3. Chinook salmon were the most commonly captured salmonid at both sites, comprising approximately 97% and 95% of the total salmonid catch at PTRST and WCRST, respectively. Hatchery salmonid releases from Trinity River Hatchery (TRH) are presented in Table 4. Catch totals of other fish species are presented in Table 5.

Abundance Indices

The proportional discharge based abundance indices for natural age-0 Chinook salmon were 1,166,770 and 2,738,445 at PTRST and WCRST, respectively (Figure 3; Table 6; Appendix 1 and Appendix 2). The age-0 hatchery Chinook salmon abundance indices were 327,376 at PTRST and 149,464 at WCRST. Natural age-0 Chinook salmon were captured on the first day of trap operation at both sites, indicating that some age-0 Chinook salmon emigrated prior to trap installation.

The proportional discharge based abundance indices for age 1 naturally produced coho salmon were 1,468 and 5,070 fish at PTRST and WCRST, respectively (Figure 4; Table 6; Appendix 3 and Appendix 4). Age-0 naturally produced coho salmon abundance indices were 1,273 and 615 at PTRST and WCRST, respectively. Abundance indices of hatchery age-1 coho salmon were 7,556 and 46,698 at PTRST and WCRST, respectively. Natural age-1 coho salmon were captured at the beginning of the sampling period at both trap sites, indicating that portions of each respective population emigrated prior to trap installation.

Natural age-1 coho salmon were captured at the beginning of the sampling period at both trap sites, indicating that portions of each respective population emigrated prior to trap installation. At PTRST, proportional discharge based abundance indices of natural age-0 and age-1 steelhead were 18,967 and 8,832, respectively (Figure 5; Table 6; Appendix 5). Abundance indices of age-0 and age-1 steelhead at WCRST were 7,066 and 54,969, respectively (Figure 5; Table 6; Appendix 6). Abundance indices of hatchery age-1 steelhead were 10,550 at PTRST and 88,878 at WCRST. Sampling periods at both trap sites missed portions of each respective population that emigrated prior to or after trapping operations.
Table 3. Juvenile salmonid catch totals in 2013 for trapping at Pear Tree Rotary Screw Trap (PTRST; rkm 118) and Willow Creek Rotary Screw Trap (WCRST; rkm 34), on the Trinity River, California, operated by the Hoopa Valley Tribal Fisheries Department, U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office and the Yurok Tribal Fisheries Program. Hatchery fish totals are expanded catch based on adipose fin clip rate. NA = Not Applicable (i.e. no fish of a particular age class exist in the Trinity River).

<table>
<thead>
<tr>
<th>Site</th>
<th>Species</th>
<th>Hatchery Age-0</th>
<th>Hatchery Age-1+</th>
<th>Natural Age-0</th>
<th>Natural Age-1+</th>
<th>Natural Age-2+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTRST</td>
<td>Chinook salmon</td>
<td>39,895</td>
<td>24</td>
<td>132,311</td>
<td>259</td>
<td>NA</td>
<td>172,489</td>
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<tr>
<td>PTRST</td>
<td>coho salmon</td>
<td>NA</td>
<td>917</td>
<td>169</td>
<td>138</td>
<td>NA</td>
<td>1,224</td>
</tr>
<tr>
<td>PTRST</td>
<td>steelhead</td>
<td>NA</td>
<td>1,218</td>
<td>1,627</td>
<td>1,042</td>
<td>29</td>
<td>3,916</td>
</tr>
<tr>
<td>WCRST</td>
<td>Chinook salmon</td>
<td>22,168</td>
<td>12</td>
<td>274,499</td>
<td>91</td>
<td>NA</td>
<td>296,770</td>
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<tr>
<td>WCRST</td>
<td>coho salmon</td>
<td>NA</td>
<td>2,609</td>
<td>53</td>
<td>386</td>
<td>NA</td>
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<td>NA</td>
<td>6,155</td>
<td>705</td>
<td>4,666</td>
<td>8</td>
<td>11,534</td>
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</table>

Table 4. California Department of Fish and Game, Trinity River Hatchery juvenile salmonid releases, 2013. AD-clipped = adipose fin clipped fish.

<table>
<thead>
<tr>
<th>Species</th>
<th>Release Season</th>
<th>Number Released</th>
<th>Percentage AD-clipped or Marked</th>
<th>Release Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook salmon</td>
<td>Spring</td>
<td>2,737,980</td>
<td>23.1</td>
<td>06/01 - 06/15</td>
</tr>
<tr>
<td>Chinook salmon</td>
<td>Fall</td>
<td>1,419,865</td>
<td>22.9</td>
<td>10/01 - 10/14</td>
</tr>
<tr>
<td>coho salmon</td>
<td>Spring</td>
<td>511,618</td>
<td>100.0</td>
<td>03/15 - 03/20</td>
</tr>
<tr>
<td>steelhead</td>
<td>Spring</td>
<td>849,391</td>
<td>98.7</td>
<td>03/15 - 03/29</td>
</tr>
</tbody>
</table>

1Chinook salmon releases include both spring-run and fall-run races released in the spring and fall release seasons.
2Coho salmon were marked with a right maxillary clip.
3The coho salmon mark rate was not available at the time of this report and is reported as the target rate.
Table 5. Catch totals of non-target fish species captured at Pear Tree Rotary Screw Trap site (PTRST) and Willow Creek Rotary Screw Trap site (WCRST) on the mainstem Trinity River, California, 2013.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Species</th>
<th>Life stage</th>
<th>PTRST Catch</th>
<th>WCRST Catch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamprey</td>
<td><em>Entosphenus spp.</em></td>
<td>Ammocete</td>
<td>1,574</td>
<td>1,155</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eyed juvenile</td>
<td>60</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adult</td>
<td>48</td>
<td>13</td>
</tr>
<tr>
<td>Sucker</td>
<td><em>Catostomus spp.</em></td>
<td></td>
<td>156</td>
<td>2,350</td>
</tr>
<tr>
<td>Speckled dace</td>
<td><em>Rhinichthys osculus</em></td>
<td></td>
<td>185</td>
<td>812</td>
</tr>
<tr>
<td>Threespine stickleback</td>
<td><em>Gasterosteus aculeatus</em></td>
<td></td>
<td>42</td>
<td>529</td>
</tr>
<tr>
<td>Golden shiner</td>
<td><em>Notemigonus crysoleucas</em></td>
<td></td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Sculpin</td>
<td><em>Cottus spp.</em></td>
<td></td>
<td>0</td>
<td>413</td>
</tr>
<tr>
<td>Green sturgeon</td>
<td><em>Acipenser medirostris</em></td>
<td>Juvenile</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Brown trout</td>
<td><em>Salmo trutta</em></td>
<td>Juvenile</td>
<td>581</td>
<td>54</td>
</tr>
<tr>
<td>Sunfish</td>
<td><em>Lepomis spp.</em></td>
<td></td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td>Sockeye salmon</td>
<td><em>Oncorhynchus nerka</em></td>
<td>Juvenile</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Season Total</td>
<td></td>
<td></td>
<td>2,649</td>
<td>5,507</td>
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</table>

Table 6. Juvenile salmonid proportional discharge based abundance indices, at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. NA = Not Applicable (i.e. no fish of a particular age class exist in the Trinity River).

<table>
<thead>
<tr>
<th>Site</th>
<th>Species</th>
<th>Hatchery Age-0</th>
<th>Hatchery Age-1</th>
<th>Natural Age-0</th>
<th>Natural Age-1</th>
<th>Natural Age-2+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTRST</td>
<td>Chinook salmon</td>
<td>327,376</td>
<td>290</td>
<td>1,166,770</td>
<td>2,028</td>
<td>NA</td>
<td>1,496,464</td>
</tr>
<tr>
<td>PTRST</td>
<td>coho salmon</td>
<td>NA</td>
<td>7,556</td>
<td>1,273</td>
<td>1,468</td>
<td>NA</td>
<td>10,297</td>
</tr>
<tr>
<td>PTRST</td>
<td>steelhead</td>
<td>NA</td>
<td>10,550</td>
<td>18,967</td>
<td>8,832</td>
<td>352</td>
<td>38,701</td>
</tr>
<tr>
<td>WCRST</td>
<td>Chinook salmon</td>
<td>149,464</td>
<td>744</td>
<td>2,738,445</td>
<td>2,119</td>
<td>NA</td>
<td>2,890,772</td>
</tr>
<tr>
<td>WCRST</td>
<td>coho salmon</td>
<td>NA</td>
<td>46,698</td>
<td>615</td>
<td>5,070</td>
<td>NA</td>
<td>52,383</td>
</tr>
<tr>
<td>WCRST</td>
<td>steelhead</td>
<td>NA</td>
<td>88,878</td>
<td>7,066</td>
<td>54,969</td>
<td>10,978</td>
<td>161,891</td>
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Figure 3. Weekly proportional discharge based abundance indices for natural age-0 and hatchery age-0 Chinook salmon captured at Pear Tree Rotary Screw Trap (PTRST; rkm 118) and Willow Creek Rotary Screw Trap (WCRST; rkm 34) in 2013.
Figure 4. Weekly proportional discharge based abundance indices for natural age-0, natural age-1, and hatchery age-1 coho salmon captured at Pear Tree Rotary Screw Trap (PTRST, rkm 118) and Willow Creek Rotary Screw Trap (WCRST, rkm 34) in 2013.
Figure 5. Weekly proportional discharge based abundance indices for natural age-0, natural age-1, natural age-2, and hatchery age-1 steelhead captured at Pear Tree Rotary Screw Trap (PTRST, rkm 118) and Willow Creek Rotary Screw Trap (WCRST, rkm 34) in 2013.
Hatchery/Natural Contribution

Chinook salmon were captured at PTRST and WCRST throughout the 2013 sampling season with the spring/summer emigration dominated by naturally-produced fish comprising 78% and 95%, respectively, of the total proportional discharge based abundance indices (Appendix 1 and Appendix 2).

Age-1 coho salmon smolts were predominantly hatchery origin at PTRST, which comprised 84% of the total age-1 proportional discharge based index in 2013 (Appendix 3). Age-1 coho salmon emigrants were predominantly hatchery origin at WCRST, comprising 89% of the total age-1 proportional discharge based index in 2013 (Appendix 4).

Based on proportional discharge based abundance indices at PTRST and WCRST, age-1 hatchery steelhead comprised 54% (Appendix 5) and 62% (Appendix 6), respectively, of the total age-1 abundance index.

Chinook Salmon Population Estimation

During the 2013 sampling season, freeze branded hatchery Chinook salmon marked at TRH and delivered to the trap sites were used to estimate trap efficiency for generating population estimates during the sampling period (Appendix 7 and Appendix 8). Weekly stratified mark-recapture population estimates of emigrating age-0 Chinook salmon were calculated for both naturally and hatchery-produced sub-populations (Figure 6). At PTRST an estimated 2,480,622 (SD=131,529; CV = 0.053) naturally-produced age-0 Chinook salmon and 677,188 (SD = 47,178, CV = 0.071) age-0 hatchery Chinook salmon passed the site between January 15 and September 1. At WCRST between March 16 and August 30, an estimated 4,828,842 (SD = 548,891; CV = 0.11) naturally-produced age-0 Chinook salmon and 384,512 (SD = 54,666; CV = 0.14) age-0 hatchery Chinook salmon passed the site.

Outmigrant Timing

The Chinook salmon population in the Trinity River is composed of both naturally-produced and hatchery-produced fish of both spring and fall races. The vast majority of juveniles during the spring/summer emigration period emigrate as age-0 fish, with the natural and hatchery emigration periods overlapping (Appendix 1 and Appendix 2). The week marking the cumulative passage of 80% of the natural juvenile Chinook salmon population at WCRST, as inferred from the proportional discharge based abundance index, was WOY 24 (June 11 – June 17), which occurred before the TRRP management target date of July 9 (TRRP and ESSA 2009). Based on proportional discharge based abundance indices, the natural age-0 Chinook salmon emigration peaked at PTRST in WOY 10, and peaked at WCRST in WOY 19. The hatchery age-0 Chinook salmon emigration peaked in WOY 23 at PTRST and WOY 24 at WCRST.
Figure 6. Weekly mark-recapture population estimates of natural age-0 and hatchery age-0 Chinook salmon captured at Pear Tree Rotary Screw Trap (PTRST; rkm 118) and Willow Creek Rotary Screw Trap (WCRST; rkm 34) in 2013. Error bars represent one standard deviation of the mean weekly estimate.
Table 7. Juvenile salmonid emigration duration and peak as inferred from proportional discharge based abundance indices, at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. Values represent week of the year.

<table>
<thead>
<tr>
<th>Site</th>
<th>Species</th>
<th>Emigration Duration</th>
<th>Emigration Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Natural Age-0</td>
<td>Natural Age-0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age-1+</td>
<td>Hatchery</td>
</tr>
<tr>
<td>PTRST</td>
<td>Chinook salmon</td>
<td>3-35</td>
<td>22-35</td>
</tr>
<tr>
<td>PTRST</td>
<td>coho salmon</td>
<td>6-35</td>
<td>11-25</td>
</tr>
<tr>
<td>PTRST</td>
<td>steelhead</td>
<td>11-35</td>
<td>11-35</td>
</tr>
<tr>
<td>WCRST</td>
<td>Chinook salmon</td>
<td>11-35</td>
<td>22-34</td>
</tr>
<tr>
<td>WCRST</td>
<td>coho salmon</td>
<td>12-27</td>
<td>11-27</td>
</tr>
<tr>
<td>WCRST</td>
<td>steelhead</td>
<td>18-35</td>
<td>12-29</td>
</tr>
</tbody>
</table>

The coho salmon population in the Trinity River is composed of both naturally-produced and hatchery populations. The vast majority of Trinity River coho salmon emigrate to the ocean as age-1 smolts while the emigration of age-0 fish is presumably a redistribution of rearing juveniles. Natural age-1 coho salmon were captured in the first week of sampling at both sites and emigration continued through early June (WOY 23) at PTRST and late June (WOY 26) at WCRST. Hatchery age-1 coho salmon abruptly emigrated from the upper river, with approximately 75% of the total flow based index passing PTRST within two weeks of release from TRH (Table 7, Appendix 3 and Appendix 4). Interpretation of the data suggests that the sampling period did not encompass the entire naturally-produced age-1 coho salmon emigration. The week marking the cumulative passage of 80% of the naturally produced age-1 coho population at WCRST, as inferred from the proportional discharge based index, was WOY 21 (May 21-May 27), which occurred prior to the TRRP management target date of June 4 (TRRP and ESSA 2009). Natural age-0 coho salmon emigration peaked in WOY 24 at PTRST and WOY 18 at WCRST. Natural age-1 coho salmon emigration peaked in WOY 12 at PTRST and WOY 18 at WCRST. Hatchery coho salmon emigration peaked in WOY 12 at PTRST and WOY 18 at WCRST.

The steelhead populations in the Trinity River are composed of both natural populations that exhibit highly variable juvenile life history patterns, as well as a hatchery-produced component. All juvenile age classes of steelhead were generally captured throughout the sampling season at PTRST and WCRST, with peaks in abundance occurring during the early portion of sampling for age-1, and in July for age-0 fish. Age-1 or older natural steelhead were present throughout the sampling period (Table 7; Appendix 5 and Appendix 6). The majority of hatchery-produced age-1 steelhead emigrated by the end of June. The week marking the cumulative passage of 80% of the natural steelhead smolt population at WCRST, as inferred from the proportional discharge based abundance index, was WOY 20 (May 14 – May 20), which occurred prior to the TRRP management target date of May 22 (TRRP and ESSA 2009). Natural age-0 steelhead emigration peaked in WOY 35 at PTRST and WOY 26 at WCRST. Natural age-1 steelhead emigration peaked in WOY 14 at PTRST and WOY 14 at WCRST. Hatchery steelhead emigration peaked in WOY 12 at PTRST and WOY 18 at WCRST.
Migration Rate

Maximum migration rates of salmonids released from TRH are presented in Table 8. These values should be considered maximums, as hatchery fish are released on a volitional basis.

Fish Size

Chinook salmon fork lengths generally increased through the season at both PTRST and WCRST (Figure 7; Appendix 9 and Appendix 10).

Natural age-0 coho salmon fork lengths generally increased through the sampling season at both PTRST and WCRST (Figure 8; Appendix 9 and Appendix 10). Hatchery and natural age-1 coho salmon fork lengths generally decreased through the sampling season at WCRST. Natural age-1 coho salmon fork lengths generally increased through the sampling season at PTRST, but fork lengths of age-1 hatchery coho salmon showed no consistent pattern.

Natural age 0 and age-1 steelhead fork lengths generally increased through the sampling season at both sites (Figure 9; Appendix 11 and Appendix 12). Hatchery and natural age-2 steelhead fork lengths remained relatively stable through the sampling season at both sites.

Table 8. Juvenile salmonid maximum migration rate from Trinity River Hatchery to Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST) sampling sites, operated by the Hoopa Valley Tribal Fisheries Department, U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, and the Yurok Tribal Fisheries Program, 2013.
Figure 7. Weekly mean fork lengths of age-0 and age-1 Chinook salmon captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. Error bars represent one standard deviation of the mean.
Figure 8. Weekly mean fork lengths for natural age-0, natural age-1, and hatchery coho salmon captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. Error bars represent one standard deviation of the mean.
Figure 9. Weekly mean fork lengths for natural age-0, age-1, age-2, and hatchery age-1 steelhead captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. Error bars represent one standard deviation of the mean.
Fish Condition

Fulton’s condition factor ($K = 100,000 \times (\text{weight} / \text{length}^3)$) was calculated on a subsample of age-0 Chinook salmon larger than 50 mm (Figure 10, Appendix 13), age-1 coho salmon (Figure 11, Appendix 14), and age 1+ steelhead (Figure 12, Appendix 15). Due to the inability to determine the origin of unmarked individuals, clipped and non-clipped juvenile Chinook salmon are pooled in weekly mean calculations. Weekly mean condition factor of juvenile Chinook salmon showed no trend through the season at Pear Tree and generally decreased at Willow Creek. Age-1 coho salmon condition factor data presented are hatchery and natural combined due to the small sample size of natural origin coho salmon. Weekly mean condition factor of juvenile coho salmon generally decreased at both sites. Weekly mean condition factor of steelhead decreased slightly at both sites through the season.
Figure 10. Weekly mean K value for age-0 Chinook salmon (pooled natural and hatchery) captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. Error bars represent one standard deviation of the mean.
Figure 11. Weekly mean K value for natural age-1 coho salmon captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. Error bars represent one standard deviation of the mean.
Figure 12. Weekly mean K value for natural age-1 steelhead captured at Pear Tree Rotary Screw Trap (PTRST) and Willow Creek Rotary Screw Trap (WCRST), 2013. Error bars represent one standard deviation of the mean.
References


Acknowledgements

Special thanks to Al Andreoli, for allowing access through his property at the WCRST. In addition, the partners greatly appreciate the California Department of Fish and Wildlife and the Trinity River Hatchery staff for providing juvenile Chinook salmon and facilitating mark-recapture efforts.
Appendices
Appendix 1. Trinity River at Pear Tree rotary screw trap site weekly Chinook salmon catches and abundance indices, 2013. NC = no clip, AD = adipose fin clip.

<table>
<thead>
<tr>
<th>Week Starting of Year</th>
<th>Mean Daily Discharge (m³/s)</th>
<th>Trap Days Sampled</th>
<th>Weekly Chinook Salmon Catch</th>
<th>Weekly Chinook Salmon Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hatchery</td>
<td>Natural</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NC AD Age-1</td>
<td>Age-0</td>
</tr>
<tr>
<td>1/15/2013 3</td>
<td>22</td>
<td>7</td>
<td>0 0 4</td>
<td>463 30</td>
</tr>
<tr>
<td>1/22/2013 4</td>
<td>35</td>
<td>14</td>
<td>0 0 4</td>
<td>1,745 22</td>
</tr>
<tr>
<td>1/30/2013 5</td>
<td>28</td>
<td>14</td>
<td>0 0 0</td>
<td>5,846 14</td>
</tr>
<tr>
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<td>24</td>
<td>14</td>
<td>0 0 4</td>
<td>9,005 11</td>
</tr>
<tr>
<td>2/12/2013 7</td>
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<td>12</td>
<td>0 0 1</td>
<td>10,802 16</td>
</tr>
<tr>
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<td>12</td>
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</tr>
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<td>14</td>
<td>0 0 0</td>
<td>10,366 11</td>
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<tr>
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<td>14</td>
<td>0 0 0</td>
<td>18,403 36</td>
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<td>14</td>
<td>0 0 4</td>
<td>8,870 59</td>
</tr>
<tr>
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<td>12</td>
<td>0 0 6</td>
<td>1,394 26</td>
</tr>
<tr>
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<td>22</td>
<td>12</td>
<td>0 0 0</td>
<td>1,505 6</td>
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<td>14</td>
<td>0 0 0</td>
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<td>14</td>
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<tr>
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</tr>
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<td>8/27/2013 35</td>
<td>31</td>
<td>8</td>
<td>77 23 0</td>
<td>169 0</td>
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</tbody>
</table>

Totals 365 30,671 9,224 24 132,311 257 172,477 251,773 75,603 290 1,166,770 2,028 1,496,464
Appendix 2. Trinity River at Willow Creek rotary screw trap site weekly Chinook salmon catches and abundance indices, 2013. NC = no clip, AD = adipose fin clip.

<table>
<thead>
<tr>
<th>Week Starting of Year</th>
<th>Mean Daily Discharge (m³/s)</th>
<th>Trap Days Sampled</th>
<th>Weekly Chinook Salmon Catch</th>
<th>Weekly Chinook Salmon Indices</th>
</tr>
</thead>
<tbody>
<tr>
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<td>NC</td>
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<td>Age-0</td>
</tr>
<tr>
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<td>11</td>
<td>112</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
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Appendix 3. Trinity River at Pear Tree rotary screw trap site weekly coho salmon catches and abundance indices, 2013.

R-MAX = right maxillary clip.

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Appendix 4. Trinity River at Willow Creek rotary screw trap site weekly coho salmon catches, and abundance indices, 2013. 
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Totals: 
338 | 2,606 | 56 | 386 | 3,048 | 46,698 | 615 | 5,070 | 52,383.
Appendix 5. Trinity River at Pear Tree rotary screw trap site weekly steelhead catches and abundance indices, 2013. AD = adipose fin clip.

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Appendix 7. Trinity River at Pear Tree rotary screw trap site weekly age-0 Chinook salmon population estimate input and results, 2013. NC = no clip, AD = adipose fin clip.

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<th>Marks Re captures</th>
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Sampling Fraction is the proportion of week days sampled.
Appendix 8. Trinity River at Willow Creek rotary screw trap site weekly age-0 Chinook salmon population estimate input and results, 2013. NC = no clip, AD = adipose fin clip.

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<th>Catch AC</th>
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Total: 291,548 5,119 30,007 2,481 0.077 4,828,842 548,891 384,512 54,666

*Sampling Fraction is the proportion of trap days sampled during the week.
## Appendix 9. Trinity River at Pear Tree rotary screw trap site weekly Chinook and coho salmon fork lengths, 2013.

**Natural and Hatchery combined**

<table>
<thead>
<tr>
<th>Week Starting of Year</th>
<th>Chinook Salmon*</th>
<th>Natural Coho Salmon</th>
<th>Hatchery Coho Salmon</th>
</tr>
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<td>Age-1</td>
<td></td>
</tr>
<tr>
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<td>n   mean  min  max SD</td>
<td>n   mean  min  max SD</td>
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*Natural and Hatchery combined*
Appendix 10. Trinity River at Willow Creek rotary screw trap site weekly Chinook and coho salmon fork lengths, 2013.

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<th>Natural Coho Salmon</th>
<th>Hatchery Coho Salmon</th>
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<td>Age-0</td>
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<td>n   mean  min  max  SD</td>
<td>n   mean  min  max  SD</td>
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</tr>
</tbody>
</table>

*Natural and Hatchery combined.
### Appendix 11: Trinity River at Pear Tree rotary screw trap site weekly steelhead fork lengths, 2013.

| Week Starting of Year | Natural Steelhead | | Hatchery Steelhead | | |
|-----------------------|-------------------|---|-------------------|---|
|                       | Age-0             | Age-1 | Age-2             | Age-1 |
|                       | n | mean | min | max | SD | n | mean | min | max | SD | n | mean | min | max | SD |
| 1/15/2013              | 3 | 0    | --- | --- | --- | 0  | 5 | 72.4 | 56 | 93 | 13.35 | 1 | 285 | 285 | 285 | --- |
| 1/22/2013              | 4 | 0    | --- | --- | --- | 0  | 15 | 77.9 | 50 | 133 | 23.07 | 0 | --- | --- | --- | --- |
| 1/30/2013              | 5 | 0    | --- | --- | --- | 0  | 11 | 64.6 | 51 | 76 | 8.88 | 0 | --- | --- | --- | --- |
| 2/5/2013               | 6 | 0    | --- | --- | --- | 0  | 12 | 74.2 | 61 | 88 | 9.63 | 0 | --- | --- | --- | --- |
| 2/12/2013              | 7 | 0    | --- | --- | --- | 0  | 10 | 66.6 | 51 | 75 | 9.76 | 0 | --- | --- | --- | --- |
| 2/19/2013              | 8 | 0    | --- | --- | --- | 0  | 41 | 71.5 | 50 | 96 | 12.8 | 1 | 154 | 154 | 154 | --- |
| 2/26/2013              | 9 | 0    | --- | --- | --- | 0  | 89 | 76.8 | 44 | 137 | 19.97 | 0 | --- | --- | --- | --- |
| 3/5/2013               | 10 | 0 | --- | --- | --- | 0 | 201 | 74.5 | 47 | 138 | 15.18 | 5 | 163.6 | 153 | 180 | 10.55 |
| 3/12/2013              | 11 | 0 | --- | --- | --- | 0 | 124 | 84.7 | 50 | 152 | 21.19 | 3 | 167.7 | 158 | 180 | 11.24 |
| 3/19/2013              | 12 | 0 | --- | --- | --- | 0 | 65 | 87.6 | 57 | 147 | 18.6 | 1 | 174 | 174 | 174 | --- |
| 3/26/2013              | 13 | 0 | --- | --- | --- | 0 | 115 | 88.4 | 50 | 150 | 17.86 | 4 | 170.8 | 164 | 178 | 7.27 |
| 4/2/2013               | 14 | 0 | --- | --- | --- | 0 | 48 | 97 | 65 | 165 | 23.9 | 1 | 192 | 192 | 192 | --- |
| 4/9/2013               | 15 | 0 | --- | --- | --- | 0 | 70 | 103.4 | 68 | 140 | 26.72 | 7 | 200.7 | 180 | 228 | 19.3 |
| 4/16/2013              | 16 | 3 | 28.7 | 28 | 29 | 0.58 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 4/23/2013              | 17 | 0 | --- | --- | --- | 0 | 102 | 79.2 | 67 | 94 | 9.93 | 2 | 193 | 180 | 206 | 18.38 |
| 4/30/2013              | 18 | 12 | 23.8 | 20 | 27 | 2.38 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 5/7/2013               | 19 | 64 | 25.3 | 22 | 30 | 2.08 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 5/14/2013              | 20 | 133 | 27.5 | 19 | 38 | 2.99 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 5/21/2013              | 21 | 62 | 29.6 | 22 | 45 | 3.83 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 5/28/2013              | 22 | 107 | 28.1 | 22 | 54 | 4.34 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 6/4/2013               | 23 | 88 | 31.4 | 23 | 60 | 6.86 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 6/11/2013              | 24 | 102 | 32.9 | 22 | 63 | 7.07 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 6/18/2013              | 25 | 41 | 36.6 | 24 | 64 | 9.23 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 6/25/2013              | 26 | 46 | 48.7 | 31 | 76 | 9.46 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 7/2/2013               | 27 | 50 | 48.1 | 31 | 68 | 9.35 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 7/9/2013               | 28 | 29 | 50.5 | 30 | 68 | 8.85 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 7/16/2013              | 29 | 34 | 57.4 | 43 | 77 | 8.93 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 7/23/2013              | 30 | 82 | 53.7 | 33 | 77 | 8.31 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 7/30/2013              | 31 | 148 | 59.1 | 40 | 85 | 8.97 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 8/6/2013               | 32 | 135 | 58.6 | 41 | 85 | 8.47 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 8/13/2013              | 33 | 17 | 56.4 | 48 | 82 | 8.25 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 8/20/2013              | 34 | 35 | 60 | 42 | 87 | 9.23 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |
| 8/27/2013              | 35 | 134 | 56.1 | 34 | 93 | 10.52 | 0 | --- | --- | --- | 0 | --- | --- | --- | --- |

Natural Steelhead: Age-0, Age-1, Age-2, Age-1Week, Starting Week of Year
Hatchery Steelhead: Age-1
### Appendix 12: Trinity River at Willow Creek rotary screw trap site weekly steelhead fork lengths 2013.

<table>
<thead>
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<th>Week of Year</th>
<th>Natural Steelhead</th>
<th>Hatchery Steelhead</th>
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</tr>
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<td>0</td>
<td>---</td>
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<td>---</td>
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</tr>
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Appendix 13. Fulton's condition factor (K) for pooled natural and hatchery age-0 Chinook salmon with FL>50mm from the Pear Tree and Willow Creek rotary screw trap sites, 2013.

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Appendix 14. Fulton's condition factor (K) for age-1 coho salmon from the Pear Tree and Willow Creek Rotary screw trap sites, 2013.

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Appendix 15. Fulton's condition factor (K) for natural age-1+ steelhead from the Pear Tree and Willow Creek rotary screw trap sites, 2013.

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<th>Willow Creek Trap Site</th>
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