MEMORANDUM

TO: Travis Collier, USFWS

FROM: Brandon R. Chockley

DATE: January 4, 2017

RE: 2016 Leavenworth National Fish Hatchery Report

The Fish Passage Center has been marking Chinook from the Leavenworth National Fish Hatchery facility since 1997 as part of the Smolt Monitoring Program (SMP). For purposes of this program, passage data are collected on both the juvenile and adult life stages. The SMP provides information for in-season management of the hydrosystem and post-season analyses to the federal, state, and tribal fishery agencies. We would like to provide an update of some of the information we developed under this study for the Chinook used from the Leavenworth National Fish Hatchery facility in 2016 and past years.

Under the Smolt Monitoring Program, information is collected on the timing, migration speed, and survival of juveniles from the hatchery to McNary Dam. Table 1, below, provides estimates of minimum, median, and maximum travel times from each year’s release to McNary Dam. Also provided are estimates of the 95% confidence limits around the estimated median travel time.

In addition, we are providing estimates of the 10%, 50%, and 90% passage dates of Leavenworth NFH spring Chinook juveniles at McNary Dam for each of the years of tagging (Table 2). Also, Figure 1 is provided as an illustration of how the arrival timing of the 2016 smolt release compared to the previous year and the current 10-year average arrival timing (2006–2015).
Table 1. Leavenworth Hatchery Spring Chinook Travel Times to McNary Dam

<table>
<thead>
<tr>
<th>Release Date</th>
<th>Migration Year</th>
<th>Travel Time (Days)</th>
<th>95% Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Med</td>
</tr>
<tr>
<td>17-Apr 1997</td>
<td></td>
<td>8.6</td>
<td>28.7</td>
</tr>
<tr>
<td>20-Apr 1998</td>
<td></td>
<td>10.3</td>
<td>21.7</td>
</tr>
<tr>
<td>19-Apr 1999</td>
<td></td>
<td>6.8</td>
<td>27.8</td>
</tr>
<tr>
<td>18-Apr 2000</td>
<td></td>
<td>11.9</td>
<td>36.1</td>
</tr>
<tr>
<td>17-Apr 2001</td>
<td></td>
<td>11.3</td>
<td>37.0</td>
</tr>
<tr>
<td>22-Apr, 24-Apr 2002</td>
<td></td>
<td>3.6</td>
<td>35.9</td>
</tr>
<tr>
<td>21-Apr 2003</td>
<td></td>
<td>5.8</td>
<td>27.6</td>
</tr>
<tr>
<td>19-Apr 2004</td>
<td></td>
<td>0.1</td>
<td>25.2</td>
</tr>
<tr>
<td>15-Apr 2005</td>
<td></td>
<td>11.9</td>
<td>29.8</td>
</tr>
<tr>
<td>17-Apr 2006</td>
<td></td>
<td>22.8</td>
<td>28.5</td>
</tr>
<tr>
<td>18-Apr 2007</td>
<td></td>
<td>7.7</td>
<td>30.8</td>
</tr>
<tr>
<td>28-Apr 2008</td>
<td></td>
<td>3.9</td>
<td>19.9</td>
</tr>
<tr>
<td>28-Apr 2009</td>
<td></td>
<td>8.8</td>
<td>25.4</td>
</tr>
<tr>
<td>23-Apr, 26-Apr 2010</td>
<td></td>
<td>8.1</td>
<td>22.2</td>
</tr>
<tr>
<td>19-Apr, 20-Apr 2011</td>
<td></td>
<td>9.4</td>
<td>28.2</td>
</tr>
<tr>
<td>17-Apr, 18-Apr 2012</td>
<td></td>
<td>6.0</td>
<td>28.8</td>
</tr>
<tr>
<td>23-Apr, 24-Apr 2013</td>
<td></td>
<td>6.8</td>
<td>24.8</td>
</tr>
<tr>
<td>22-Apr, 23-Apr 2014</td>
<td></td>
<td>5.5</td>
<td>22.0</td>
</tr>
<tr>
<td>14-Apr, 15-Apr 2015</td>
<td></td>
<td>8.9</td>
<td>23.8</td>
</tr>
<tr>
<td>21-Apr 2016</td>
<td>2016</td>
<td>0.01</td>
<td>17.3</td>
</tr>
</tbody>
</table>

1 Accidental release of 380 PIT-tagged fish in January 2016 not included in travel time estimates.

Figure 1. Cumulative passage timing of Leavenworth National Fish Hatchery spring Chinook to McNary Dam.
Table 2. Estimated 10%, 50%, and 90% passage dates of Leavenworth NFH spring Chinook at McNary Dam.

<table>
<thead>
<tr>
<th>Migration Year</th>
<th>10% Passage Date</th>
<th>50% Passage Date</th>
<th>90% Passage Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>1-May</td>
<td>14-May</td>
<td>22-May</td>
</tr>
<tr>
<td>1998</td>
<td>3-May</td>
<td>12-May</td>
<td>23-May</td>
</tr>
<tr>
<td>1999</td>
<td>7-May</td>
<td>17-May</td>
<td>25-May</td>
</tr>
<tr>
<td>2000</td>
<td>12-May</td>
<td>23-May</td>
<td>3-June</td>
</tr>
<tr>
<td>2001</td>
<td>15-May</td>
<td>24-May</td>
<td>31-May</td>
</tr>
<tr>
<td>2002</td>
<td>11-May</td>
<td>20-May</td>
<td>28-May</td>
</tr>
<tr>
<td>2003</td>
<td>7-May</td>
<td>19-May</td>
<td>31-May</td>
</tr>
<tr>
<td>2004</td>
<td>3-May</td>
<td>14-May</td>
<td>27-May</td>
</tr>
<tr>
<td>2005</td>
<td>5-May</td>
<td>15-May</td>
<td>3-June</td>
</tr>
<tr>
<td>2006</td>
<td>11-May</td>
<td>16-May</td>
<td>21-May</td>
</tr>
<tr>
<td>2007</td>
<td>7-May</td>
<td>19-May</td>
<td>31-May</td>
</tr>
<tr>
<td>2008</td>
<td>13-May</td>
<td>19-May</td>
<td>27-May</td>
</tr>
<tr>
<td>2009</td>
<td>16-May</td>
<td>24-May</td>
<td>1-June</td>
</tr>
<tr>
<td>2010</td>
<td>10-May</td>
<td>18-May</td>
<td>2-June</td>
</tr>
<tr>
<td>2011</td>
<td>7-May</td>
<td>19-May</td>
<td>29-May</td>
</tr>
<tr>
<td>2012</td>
<td>5-May</td>
<td>17-May</td>
<td>25-May</td>
</tr>
<tr>
<td>2013</td>
<td>8-May</td>
<td>18-May</td>
<td>1-June</td>
</tr>
<tr>
<td>2014</td>
<td>6-May</td>
<td>16-May</td>
<td>22-May</td>
</tr>
<tr>
<td>2015</td>
<td>1-May</td>
<td>8-May</td>
<td>19-May</td>
</tr>
<tr>
<td>2016¹</td>
<td>1-May</td>
<td>8-May</td>
<td>16-May</td>
</tr>
</tbody>
</table>

¹ Accidental release of 380 PIT-tagged fish in January 2016 not included in estimates of timing to MCN.

Table 3 below provides estimates of juvenile survival from release at the hatchery to McNary Dam, along with the upper and lower confidence limits on these estimates. To put in context the out-migration conditions that these spring Chinook juveniles may have experienced, Figure 2 provides the total spring flow volume (April 15–June 30) for the Upper Columbia River (as measured at Priest Rapids Dam), along with the average spring spill proportions at each of Rocky Reach, Rock Island, Wanapum, and Priest Rapids dams, for each migration year.
Table 3. Leavenworth Hatchery Spring Chinook survivals (Release to McNary Dam)

<table>
<thead>
<tr>
<th>Release Date</th>
<th>Migration Year</th>
<th>Survival</th>
<th>Confidence Limits (95%) Lower</th>
<th>Confidence Limits (95%) Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-Apr 1997</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>20-Apr 1998</td>
<td>0.546</td>
<td>0.491</td>
<td>0.602</td>
<td></td>
</tr>
<tr>
<td>19-Apr 1999</td>
<td>0.586</td>
<td>0.550</td>
<td>0.622</td>
<td></td>
</tr>
<tr>
<td>18-Apr 2000</td>
<td>0.593</td>
<td>0.520</td>
<td>0.667</td>
<td></td>
</tr>
<tr>
<td>17-Apr 2001</td>
<td>0.501</td>
<td>0.484</td>
<td>0.517</td>
<td></td>
</tr>
<tr>
<td>22-Apr, 24-Apr 2002</td>
<td>0.560</td>
<td>0.553</td>
<td>0.567</td>
<td></td>
</tr>
<tr>
<td>21-Apr 2003</td>
<td>0.662</td>
<td>0.655</td>
<td>0.669</td>
<td></td>
</tr>
<tr>
<td>19-Apr 2004</td>
<td>0.483</td>
<td>0.473</td>
<td>0.494</td>
<td></td>
</tr>
<tr>
<td>15-Apr 2005</td>
<td>0.526</td>
<td>0.500</td>
<td>0.553</td>
<td></td>
</tr>
<tr>
<td>17-Apr 2006</td>
<td>0.558</td>
<td>0.531</td>
<td>0.585</td>
<td></td>
</tr>
<tr>
<td>18-Apr 2007</td>
<td>0.593</td>
<td>0.571</td>
<td>0.615</td>
<td></td>
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<tr>
<td>28-Apr 2008</td>
<td>0.571</td>
<td>0.528</td>
<td>0.614</td>
<td></td>
</tr>
<tr>
<td>28-Apr 2009</td>
<td>0.481</td>
<td>0.442</td>
<td>0.520</td>
<td></td>
</tr>
<tr>
<td>23-Apr, 26-Apr 2010</td>
<td>0.662</td>
<td>0.603</td>
<td>0.721</td>
<td></td>
</tr>
<tr>
<td>19-Apr, 20-Apr 2011</td>
<td>0.426</td>
<td>0.383</td>
<td>0.469</td>
<td></td>
</tr>
<tr>
<td>17-Apr, 18-Apr 2012</td>
<td>0.590</td>
<td>0.551</td>
<td>0.629</td>
<td></td>
</tr>
<tr>
<td>23-Apr, 24-Apr 2013</td>
<td>0.674</td>
<td>0.537</td>
<td>0.811</td>
<td></td>
</tr>
<tr>
<td>22-Apr, 23-Apr 2014</td>
<td>0.568</td>
<td>0.518</td>
<td>0.617</td>
<td></td>
</tr>
<tr>
<td>14-Apr, 15-Apr 2015</td>
<td>0.498</td>
<td>0.426</td>
<td>0.569</td>
<td></td>
</tr>
<tr>
<td>21-Apr 2016</td>
<td>0.519</td>
<td>0.479</td>
<td>0.558</td>
<td></td>
</tr>
</tbody>
</table>

*Accidental release of 380 PIT-tagged fish in January 2016 not included in survival estimation.*

Figure 2. Total spring flow volume in the Upper Columbia River (at Priest Rapids Dam) and average spill proportion at Rocky Reach, Rock Island, Wanapum, and Priest Rapids dams. Spring period is April 15–June 30.
Finally, Table 4 contains estimates of SARs for MCN-to-BOA, both with and without jacks (90% confidence interval in parentheses). These SAR estimates were taken from Appendix B of the 2016 CSS Annual Report, which can be downloaded from the FPC webpage: www.fpc.org/documents/CSS.html. Figure 3 is provided to illustrate the time series of the SAR estimates (with jacks) over the years of available data for Leavenworth NFH spring Chinook. Please note that hatchery reports from previous years have only included “without jack” SAR estimates. Therefore, Figure 3 in this year’s report is different from what has been reported in past years.

Table 4. Overall MCN-to-BOA SARs for Leavenworth NFH Spring Chinook, 2000-2014. SARs are calculated with and without jacks. Numbers in parentheses represent 90% confidence intervals.

<table>
<thead>
<tr>
<th>Release Date(s)</th>
<th>Migration Year</th>
<th>MCN-to-BOA SARs (Without Jacks)</th>
<th>MCN-to-BOA SARs (With Jacks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-Apr</td>
<td>2000</td>
<td>1.84 (1.48-2.22)</td>
<td>1.87 (1.49-2.24)</td>
</tr>
<tr>
<td>17-Apr</td>
<td>2001</td>
<td>0.24 (0.11-0.37)</td>
<td>0.24 (0.11-0.37)</td>
</tr>
<tr>
<td>22-Apr, 24-Apr</td>
<td>2002</td>
<td>0.36 (0.34-0.38)</td>
<td>0.38 (0.35-0.40)</td>
</tr>
<tr>
<td>21-Apr</td>
<td>2003</td>
<td>0.42 (0.40-0.45)</td>
<td>0.45 (0.42-0.48)</td>
</tr>
<tr>
<td>19-Apr</td>
<td>2004</td>
<td>0.34 (0.31-0.37)</td>
<td>0.34 (0.31-0.38)</td>
</tr>
<tr>
<td>15-Apr</td>
<td>2005</td>
<td>0.09 (0.04-0.15)</td>
<td>0.11 (0.06-0.18)</td>
</tr>
<tr>
<td>17-Apr</td>
<td>2006</td>
<td>0.89 (0.72-1.06)</td>
<td>0.97 (0.80-1.16)</td>
</tr>
<tr>
<td>18-Apr</td>
<td>2007</td>
<td>0.46 (0.34-0.58)</td>
<td>0.53 (0.40-0.67)</td>
</tr>
<tr>
<td>28-Apr</td>
<td>2008</td>
<td>1.89 (1.64-2.17)</td>
<td>2.11 (1.84-2.40)</td>
</tr>
<tr>
<td>28-Apr</td>
<td>2009</td>
<td>0.59 (0.44-0.75)</td>
<td>0.65 (0.48-0.81)</td>
</tr>
<tr>
<td>23-Apr, 26-Apr</td>
<td>2010</td>
<td>0.82 (0.67-0.98)</td>
<td>1.23 (1.05-1.43)</td>
</tr>
<tr>
<td>19-Apr, 20-Apr</td>
<td>2011</td>
<td>0.35 (0.24-0.48)</td>
<td>0.38 (0.26-0.52)</td>
</tr>
<tr>
<td>17-Apr, 18-Apr</td>
<td>2012</td>
<td>1.05 (0.87-1.24)</td>
<td>1.19 (0.99-1.39)</td>
</tr>
<tr>
<td>23-Apr, 24-Apr</td>
<td>2013</td>
<td>0.69 (0.55-0.85)</td>
<td>0.77 (0.62-0.94)</td>
</tr>
<tr>
<td>22-Apr, 23-Apr</td>
<td>2014 A</td>
<td>0.59 (0.45-0.73)</td>
<td>0.75 (0.59-0.91)</td>
</tr>
</tbody>
</table>

A Migration year 2013 is incomplete with Age 2-salt adult returns through 9/16/2016.
Figure 3. Overall MCN-to-BOA SAR (with jacks) for Leavenworth NFH spring Chinook (2000–2014). Dashed lines represent 90% confidence intervals. Migration year 2014 is incomplete for yearling Chinook, with Age 2-salt adult returns through 9/16/2016.

We hope that the information we have provided regarding the use and application of information from the marked groups over the last several years is of some use to you. If you would like any additional information regarding these releases please feel free to contact us.

c: Lance Hebdon, IDFG
   Tim Copeland, IDFG
   Bill Tweit, WDFW
   Jay Hesse, Nez Perce
   Tom Rien, ODFW
   Steve Haeseker, USFWS
   Kyle Hanson, USFWS
   Erik Merrill, NPCC
   Tony Grover, NPCC
   Leslie Bach, NPCC
   Tom Kahler, Douglas County PUD
   Greg Mackey, Douglas County PUD
   FPAC