

Run Size Forecast for Yakima River Adult Spring Chinook, 2016

Preliminary¹

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¹ Some updates to 2015 age-at-return data are still pending. An updated forecast may be generated in February, 2016, but is not expected to differ substantially from this report.

Summary

In 2015 the forecast was for a return of 9,320 adult (age-4 and age-5) spring Chinook to the mouth of the Yakima River. The actual return in 2015 was estimated to be 8,795 adult spring Chinook (94% of forecast). However, the 2015 return was impaired by a thermal barrier in the lower Yakima River due to lack of winter snowpack and hot spring and summer air temperatures. This combined to severely reduce summer and fall flows and increase water temperatures. Mean daily water temperatures at Kiona (rkm 40 from the mouth of the Yakima R.) exceeded 70° F every day from May 21 to August 29, 2015 (source U.S. BOR hydromet database). Since 1997, preseason forecasts have generally been based on examination of brood cohort relationships from 1982 to present projecting age-4 returns using the return survival of age-3 fish in a given brood, and similarly projecting age-5 returns from age-4 returns. In recent years, high age-3 jack return abundance has not always been a reliable predictor of age-4 return abundance. Yakima River biologists have been collaborating with other scientists from the region to see if parameters such as NOAA ocean condition rank², jack size or other variables can help explain and correct for ocean conditions or other factors that might affect the reliability of jacks as a predictor.

To produce the 2010-2016 Yakima River forecasts, I evaluated output from at least eight different methods all of which used jack abundance in some combination with traditional cohort relationships, NOAA ocean condition rank, or jack size. These methods produced forecasts for 2016 age-4 and age-5 adult returns ranging from 2,900 to 7,000 spring Chinook. Given the relatively poor reliability of jack-based predictor methods for high jack count years, I have also been evaluating a method which uses Prosser smolt estimates, juvenile survival estimates for natural- and hatchery-origin fish from Roza to McNary Dams, and NOAA ocean rank (ocean survival index) as input variables to forecast combined age-4 and age-5 adult returns. These data are only available dating back to the 1997 brood year (1999 migration year), but were used to produce Yakima River forecasts for 2011-2014 and resulted in relatively good forecasts (a 23% under-forecast in 2011 and over-forecasts within 9% of actual returns for 2012-14). However, continued analysis of data such as Chandler flow and entrainment relationships and freshwater (smolt) survival indices has resulted in substantial year to year variation in the data used to populate this model. This model with updated juvenile and survival index data produces a forecast for 2016 of 7,200 (greater than the highest jack-based predictor). Due to continued uncertainties with data used in the smolt abundance and survival index forecast model, I chose to use a regression model of adult returns to adult spawners, jacks, and jack mideye length for jack return years 1986-2014 to produce the 2016 Yakima River forecast. This method results in a relatively conservative forecast near the average of the range of other jack-based forecast methods, and inherently incorporates factors such as freshwater or ocean conditions that might be affecting recent productivity and jack abundance. The 2016 forecast is 3,100 wild/natural and 1,510 hatchery-origin adult (age-4 and age-5) spring Chinook returns to the Yakima Basin (Table 1; hatchery proportion based on recent 10-year average hatchery proportion). Hatchery-origin returns are from the Cle Elum Supplementation and Research Facility (CESRF) in the Upper Yakima River which has been in operation since 1997.

² see <http://www.nwfsc.noaa.gov/research/divisions/fed/oeip/g-forecast.cfm>
2016 Yakima River Spring Chinook Forecast, November 20, 2015

Table 1. Forecasted return of adult Spring Chinook to the Yakima River mouth in 2016 by age and stock.

| Stock | Age-4 | Age-5 | Total Adults |
|---------------------------|--------------|------------|--------------|
| Upper Yakima Natural | 1,520 | 120 | 1,640 |
| Upper Yakima CESRF | 1,510 | 0 | 1,510 |
| Naches/American Wild | 740 | 720 | 1,460 |
| Total Run | 3,770 | 840 | 4,610 |
| Total Wild/Natural | 2,260 | 840 | 3,100 |
| Total CESRF | 1,510 | 0 | 1,510 |

The total 2016 forecasted return of 4,610 adult spring Chinook is 55% of the recent 10-year (2006-2015) average adult return of 8,320 spring Chinook.

Review of 2015 Yakima River spring Chinook return

The estimated spring Chinook return to the Yakima River mouth in 2015 was 8,790 (2,720 CESRF) adults and 560 (255 CESRF) jacks for a total return of 9,350 spring Chinook (Table 2). The final Prosser Dam counts were estimated to be: 8,720 adults (2,690 CESRF), and 540 jacks (240 CESRF) for a total count of 9,270 spring Chinook (Table 3). After reviewing Prosser and Roza counts, the estimated harvest between the two dams, and estimated spawning in the upper Yakima below Roza Dam, the final Prosser Dam counts were adjusted post-season to account for fish that were assumed to have passed upstream (uncounted) during the course of the season. The final Roza Dam counts were: 6,030 adults (2,260 CESRF), and 400 jacks (210 CESRF) for a total count of 6,400 spring Chinook (Table 4). Age information from all available sampling data is used to reconstruct the river mouth run components, and to produce brood cohort tables for the forecast. Since age data from scale samples do not always agree with jack counts based on video or physical observations, adjustments are typically made during run reconstruction resulting in slight discrepancies between adult and jack river mouth run size estimates compared to Prosser Dam and harvest below Prosser Dam estimates, and between Prosser and Roza Dam estimates. The reader may also notice some discrepancies in CESRF and wild/natural count estimates throughout this report due to inherent inaccuracies involved with video-based mark sampling.

Harvest was estimated at 780 adults and 30 jacks. Harvest consisted of approximately 300 wild/natural adults, <5 wild/natural jacks, 480 CESRF adults, and 30 CESRF jacks with about 60 adults and no jacks harvested in tribal fisheries below Prosser Dam (Table 5). The mark-selective, non-Indian recreational fishery in the Yakima River in 2015 harvested about 420 spring Chinook.

Estimated escapements were: 5,470 spring Chinook (330 jacks; approximately 36% of the total escapement was estimated to be returns from the CESRF) into the upper Yakima River subbasin (Tables 2 and 6), and 2,100 spring Chinook into the Naches River and its associated subbasins

(Table 2). A total of about 1,320 redds were counted in the upper Yakima River subbasin and 610 redds were counted in the Naches River and its associated subbasins (Table 7).

Forecast for 2016 Yakima River spring Chinook return

Age-4:age-3 and age-5:age-4 cohort ratios and regression relationships for wild/natural fish in the upper Yakima and Naches subbasins independently and for the aggregate Yakima River return were reviewed for all brood years dating back to 1982 (Tables 8-10). Similar relationships were analyzed for the 1997-2011 brood CESRF returns (Table 11). Since most Yakima River spring Chinook return at age-4, the survival of age-3 fish (jacks) in the previous year are the primary driver in these forecasting techniques. Due to continued uncertainties with data in the smolt abundance and survival index models used to forecast the 2011-2014 returns, a regression model of adult returns to adult spawners, jacks, and jack mideye length for jack return years 1986-2014 to produce the 2016 aggregate Yakima River forecast. This method results in a relatively conservative forecast about equal to the average of values for all forecast methods evaluated (Table 12), and inherently incorporates factors such as freshwater or ocean conditions that might be affecting recent productivity and jack abundance. The hatchery proportion was estimated using the recent 10-year average hatchery proportion. Age and stock specific regressions were then used to apportion these aggregate natural- and hatchery-origin forecasts into their component parts. This method projects returns for 2016 spring Chinook to the Yakima River mouth of: 3,770 age-4 and 840 age-5 fish for a total projected return of 4,610 adult spring Chinook. The forecast includes 3,100 wild/natural (67%) and 1,510 CESRF-origin (33%) adult (age-4 and age-5) spring Chinook returns to the Yakima Basin in 2016.

On average since 1997, the data indicate that forecasting has been accurate to within about +/- 34% of the actual return (Table 13). Note also that a variety of factors can affect the Yakima River mouth return rate of CESRF fish relative to their natural counterparts. These factors include: year-to-year variances in release numbers (Table 14), mark-selective fisheries in the lower Columbia River which target adipose-fin-clipped fish (all CESRF fish are adipose-clipped), variances in freshwater and ocean survival, and climate change impacts such as the thermal barrier in the lower Yakima River observed in 2015.

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Table 2. Yakima River Spring Chinook Run (CESRF and wild/natural, Adults and Jacks combined) Reconstruction, 1990-Present.

| Year | River Mouth Run Size ¹ | | | Harvest Below Prosser | | Harvest Above Prosser | | Spawners Below Roza ² | | Roza Count | Roza Removals ³ | Est. Escapement | | Redd Counts | |
|------|-----------------------------------|-------|--------|-----------------------|---------|-------------------------|------|----------------------------------|-------------------------|---------------------|----------------------------|-----------------|------------|-------------|--|
| | Adults | Jacks | Total | Prosser Count | Prosser | Above Roza ² | Roza | Count | Upper Y.R. ⁴ | Naches ⁵ | Upper Y.R. | Naches | Upper Y.R. | Naches | |
| 1990 | 4,280 | 92 | 4,372 | 131 | 2,255 | 532 | 282 | 2,047 | 31 | 2,016 | 1,380 | 678 | 464 | | |
| 1991 | 2,802 | 104 | 2,906 | 27 | 2,879 | 5 | 131 | | 40 | 1,583 | 1,121 | 582 | 460 | | |
| 1992 | 4,492 | 107 | 4,599 | 184 | 4,415 | 161 | 39 | 3,027 | 18 | 3,009 | 1,188 | 1,230 | 425 | | |
| 1993 | 3,800 | 119 | 3,919 | 44 | 3,875 | 85 | 56 | 1,869 | 0 | 1,869 | 1,865 | 637 | 554 | | |
| 1994 | 1,282 | 20 | 1,302 | 0 | 1,302 | 25 | 10 | 563 | 0 | 563 | 704 | 285 | 272 | | |
| 1995 | 526 | 140 | 666 | 0 | 666 | 79 | 9 | 355 | 0 | 355 | 223 | 114 | 104 | | |
| 1996 | 3,060 | 119 | 3,179 | 100 | 3,079 | 375 | 26 | 1,631 | 0 | 1,631 | 1,047 | 801 | 184 | | |
| 1997 | 3,092 | 81 | 3,173 | 0 | 3,173 | 575 | 20 | 1,445 | 261 | 1,184 | 1,133 | 413 | 339 | | |
| 1998 | 1,771 | 132 | 1,903 | 0 | 1,903 | 188 | 3 | 795 | 408 | 387 | 917 | 147 | 330 | | |
| 1999 | 1,513 | 1,268 | 2,781 | 8 | 2,773 | 596 | 55 | 1,704 | 738 | 966 | 418 | 212 | 186 | | |
| 2000 | 17,519 | 1,582 | 19,101 | 90 | 19,011 | 2,368 | 204 | 12,327 | 667 | 11,660 | 4,112 | 3,770 | 888 | | |
| 2001 | 21,225 | 2,040 | 23,265 | 1,793 | 21,472 | 2,838 | 289 | 12,516 | 718 | 11,798 | 5,829 | 3,226 | 1,192 | | |
| 2002 | 14,616 | 483 | 15,099 | 328 | 14,771 | 2,780 | 29 | 8,922 | 878 | 8,044 | 3,041 | 2,816 | 943 | | |
| 2003 | 4,868 | 2,089 | 6,957 | 59 | 6,898 | 381 | 83 | 3,842 | 584 | 3,258 | 2,592 | 868 | 935 | | |
| 2004 | 13,974 | 1,315 | 15,289 | 135 | 15,154 | 1,544 | 90 | 11,005 | 718 | 10,287 | 2,515 | 3,414 | 719 | | |
| 2005 | 8,059 | 699 | 8,758 | 34 | 8,724 | 440 | 28 | 6,352 | 667 | 5,685 | 1,904 | 2,009 | 574 | | |
| 2006 | 5,951 | 363 | 6,314 | 0 | 6,314 | 600 | 14 | 4,028 | 664 | 3,364 | 1,672 | 1,245 | 447 | | |
| 2007 | 2,968 | 1,335 | 4,303 | 10 | 4,293 | 269 | 13 | 3,025 | 716 | 2,309 | 986 | 722 | 313 | | |
| 2008 | 6,615 | 1,983 | 8,598 | 539 | 8,059 | 993 | 9 | 5,478 | 1,144 | 4,334 | 1,578 | 1,372 | 495 | | |
| 2009 | 7,441 | 4,679 | 12,120 | 1,517 | 10,603 | 836 | 18 | 8,633 | 1,595 | 7,038 | 1,117 | 1,575 | 482 | | |
| 2010 | 11,027 | 2,114 | 13,142 | 156 | 12,986 | 1,585 | 9 | 9,900 | 1,526 | 8,374 | 1,491 | 2,668 | 552 | | |
| 2011 | 13,398 | 4,561 | 17,960 | 909 | 17,051 | 3,471 | 0 | 10,520 | 1,936 | 8,584 | 3,060 | 1,898 | 580 | | |
| 2012 | 11,083 | 970 | 12,053 | 1,331 | 10,722 | 1,989 | 7 | 6,826 | 1,350 | 5,476 | 1,900 | 1,468 | 811 | | |
| 2013 | 7,101 | 3,144 | 10,245 | 1,191 | 9,054 | 1,462 | 171 | 6,053 | 1,240 | 4,813 | 1,369 | 648 | 376 | | |
| 2014 | 8,850 | 2,472 | 11,322 | 221 | 11,101 | 1,950 | 23 | 7,997 | 1,269 | 6,728 | 1,130 | 1,149 | 379 | | |
| 2015 | 8,795 | 556 | 9,351 | 83 | 9,268 | 732 | 0 | 6,433 | 967 | 5,466 | 2,103 | 1,321 | 614 | | |

1. River Mouth run size is the greater of the Prosser count plus lower river harvest or estimated escapement plus all known harvest and removals.

2. Estimated as the average number of fish per redd in the upper Yakima times the number of redds between the Naches confluence and Roza Dam.

3. Roza removals include harvest above Roza, hatchery removals, and/or natural broodstock removals.

4. Estimated escapement into the upper Yakima River is the Roza count less harvest or broodstock removals above Roza Dam except in 1991 when Upper Yakima River escapement is estimated as the (Prosser count - harvest above Prosser - Roza subtractions) times the proportion of redds counted in the upper Yakima.

5. Naches River escapement is estimated as the Prosser count less harvest above Prosser and the Roza counts, except in 1983 and 1990 when it is estimated as the upper Yakima fish/redd times the Naches redd count.

Table 3. Estimated Spring Chinook counts at Prosser Dam, 1985-Present.

| Year | Adults | | Jacks | | Total Passage | | | Actual CESRF Percent | Forecast CESRF Percent |
|------|-----------------|------------------------|--------|-------|------------------------|-------|--------|------------------------|------------------------|
| | CESRF | Wild/Nat. ² | Total | CESRF | Wild/Nat. ² | Total | Total | Wild/Nat. ² | CESRF |
| 1985 | | | 3,815 | | | 424 | 4,239 | | |
| 1986 | | | 8,557 | | | 352 | 8,909 | | |
| 1987 | | | 3,758 | | | 326 | 4,084 | | |
| 1988 | | | 3,590 | | | 323 | 3,913 | | |
| 1989 | | | 4,112 | | | 242 | 4,354 | | |
| 1990 | | | 2,202 | | | 53 | 2,255 | | |
| 1991 | | | 2,750 | | | 129 | 2,879 | | |
| 1992 | | | 4,282 | | | 133 | 4,415 | | |
| 1993 | | | 3,795 | | | 80 | 3,875 | | |
| 1994 | | | 1,283 | | | 19 | 1,302 | | |
| 1995 | | | 528 | | | 138 | 666 | | |
| 1996 | | | 2,946 | | | 133 | 3,079 | | |
| 1997 | | | 3,126 | | | 47 | 3,173 | | |
| 1998 | | | 1,771 | | | 132 | 1,903 | | |
| 1999 | | | 1,795 | | | 978 | 2,773 | | |
| 2000 | 41 ¹ | 17,381 | 17,422 | 741 | 848 | 1,589 | 19,011 | 18,229 | |
| 2001 | 7,803 | 11,960 | 19,763 | 1,087 | 622 | 1,709 | 21,472 | 12,582 | 8,890 |
| 2002 | 7,393 | 6,661 | 14,054 | 369 | 348 | 717 | 14,771 | 7,009 | 7,762 |
| 2003 | 1,257 | 3,742 | 4,999 | 989 | 910 | 1,899 | 6,898 | 4,652 | 2,246 |
| 2004 | 4,195 | 10,218 | 14,413 | 170 | 571 | 741 | 15,154 | 10,789 | 4,365 |
| 2005 | 737 | 7,160 | 7,897 | 540 | 287 | 827 | 8,724 | 7,447 | 1,277 |
| 2006 | 2,448 | 3,563 | 6,012 | 151 | 151 | 302 | 6,314 | 3,714 | 2,599 |
| 2007 | 823 | 2,044 | 2,867 | 866 | 560 | 1,426 | 4,293 | 2,604 | 1,689 |
| 2008 | 3,264 | 3,127 | 6,391 | 1,169 | 499 | 1,668 | 8,059 | 3,626 | 4,433 |
| 2009 | 3,039 | 3,590 | 6,629 | 3,183 | 791 | 3,974 | 10,603 | 4,381 | 6,222 |
| 2010 | 6,601 | 4,327 | 10,928 | 1,491 | 567 | 2,058 | 12,986 | 4,894 | 8,092 |
| 2011 | 5,705 | 7,043 | 12,748 | 2,770 | 1,533 | 4,303 | 17,051 | 8,576 | 8,475 |
| 2012 | 4,715 | 5,206 | 9,921 | 475 | 326 | 801 | 10,722 | 5,532 | 5,190 |
| 2013 | 2,665 | 3,841 | 6,506 | 1,461 | 1,087 | 2,548 | 9,054 | 4,928 | 4,126 |
| 2014 | 3,643 | 5,061 | 8,704 | 1,430 | 967 | 2,397 | 11,101 | 6,028 | 5,073 |
| 2015 | 2,690 | 6,035 | 8,725 | 241 | 302 | 543 | 9,268 | 6,337 | 2,931 |

1. There were no CESRF adults returning in 2000. These are marked fish, presumably out-of-basin strays.

2. All fish prior to 2000 are assumed to be wild.

Table 4. Estimated Spring Chinook counts at Roza Dam, 1982-Present.
(total counts including fish collected and removed for broodstock)

| Year | CESRF | <u>Adults</u> | | <u>Jacks</u> | | Total | Total Passage |
|------|-------|------------------------|---------------------|--------------|------------------------|-------|------------------|
| | | Wild/Nat. ¹ | Total | CESRF | Wild/Nat. ¹ | | |
| 1982 | | | 1,057 | | | 89 | 1,146 |
| 1983 | | | 860 | | | 147 | 1,007 |
| 1984 | | | 1,371 | | | 248 | 1,619 |
| 1985 | | | 2,189 | | | 239 | 2,428 |
| 1986 | | | 2,979 | | | 288 | 3,267 |
| 1987 | | | 1,854 | | | 74 | 1,928 |
| 1988 | | | 1,467 | | | 108 | 1,575 |
| 1989 | | | 2,375 | | | 141 | 2,515 |
| 1990 | | | 2,007 | | | 40 | 2,047 |
| 1991 | | | No counts available | | | | |
| 1992 | | | 2,965 | | | 62 | 3,027 |
| 1993 | | | 1,795 | | | 74 | 1,869 |
| 1994 | | | 554 | | | 9 | 563 |
| 1995 | | | 280 | | | 75 | 355 |
| 1996 | | | 1,576 | | | 55 | 1,631 |
| 1997 | | | 1,396 | | | 49 | 1,445 |
| 1998 | | | 740 | | | 55 | 795 |
| 1999 | | | 879 | | | 825 | 1,704 |
| 2000 | | 11,109 | 11,109 | 688 | 530 | 1,218 | 12,327 |
| 2001 | 6,180 | 5,010 | 11,190 | 990 | 336 | 1,326 | 12,516 |
| 2002 | 6,298 | 2,405 | 8,703 | 86 | 133 | 219 | 8,922 |
| 2003 | 1,151 | 784 | 1,935 | 1,133 | 774 | 1,907 | 3,842 |
| 2004 | 2,985 | 7,093 | 10,078 | 216 | 711 | 927 | 11,005 |
| 2005 | 726 | 4,876 | 5,602 | 540 | 210 | 750 | 6,352 |
| 2006 | 1,851 | 1,906 | 3,757 | 127 | 144 | 271 | 4,028 |
| 2007 | 899 | 1,101 | 2,000 | 833 | 192 | 1,025 | 3,025 |
| 2008 | 2,678 | 1,419 | 4,097 | 1,123 | 258 | 1,381 | 5,478 |
| 2009 | 2,860 | 2,294 | 5,154 | 2,743 | 736 | 3,479 | 8,633 |
| 2010 | 5,509 | 2,752 | 8,261 | 1,206 | 433 | 1,639 | 9,900 |
| 2011 | 4,280 | 3,444 | 7,724 | 1,845 | 951 | 2,796 | 10,520 |
| 2012 | 3,552 | 2,704 | 6,256 | 350 | 220 | 570 | 6,826 |
| 2013 | 2,112 | 2,074 | 4,186 | 1,157 | 710 | 1,867 | 6,053 |
| 2014 | 2,774 | 3,445 | 6,219 | 1,055 | 723 | 1,778 | 7,997 |
| 2015 | 2,260 | 3,775 | 6,035 | 211 | 187 | 398 | 6,433 |

1. All fish prior to 2000 are assumed to be wild.

Table 5. Spring Chinook Harvest (adults and jacks combined) in the Yakima River Basin, 1982-Present.

| Year | Tribal | | Non-Tribal | | River Totals | | Harvest | |
|------|--------|-----------|------------|------------------|--------------|-----------|---------|-------------------|
| | CESRF | Wild/Nat. | CESRF | Wild/Nat. | CESRF | Wild/Nat. | Total | Rate ¹ |
| 1982 | 0 | 434 | 0 | 0 | 0 | 434 | 434 | 23.8% |
| 1983 | 0 | 84 | 0 | 0 | 0 | 84 | 84 | 5.8% |
| 1984 | 0 | 289 | 0 | 0 | 0 | 289 | 289 | 10.9% |
| 1985 | 0 | 865 | 0 | 0 | 0 | 865 | 865 | 19.0% |
| 1986 | 0 | 1,340 | 0 | 0 | 0 | 1,340 | 1,340 | 14.2% |
| 1987 | 0 | 517 | 0 | 0 | 0 | 517 | 517 | 11.6% |
| 1988 | 0 | 444 | 0 | 0 | 0 | 444 | 444 | 10.5% |
| 1989 | 0 | 747 | 0 | 0 | 0 | 747 | 747 | 15.2% |
| 1990 | 0 | 663 | 0 | 0 | 0 | 663 | 663 | 15.2% |
| 1991 | 0 | 32 | 0 | 0 | 0 | 32 | 32 | 1.1% |
| 1992 | 0 | 345 | 0 | 0 | 0 | 345 | 345 | 7.5% |
| 1993 | 0 | 129 | 0 | 0 | 0 | 129 | 129 | 3.3% |
| 1994 | 0 | 25 | 0 | 0 | 0 | 25 | 25 | 1.9% |
| 1995 | 0 | 79 | 0 | 0 | 0 | 79 | 79 | 11.9% |
| 1996 | 0 | 475 | 0 | 0 | 0 | 475 | 475 | 14.9% |
| 1997 | 0 | 575 | 0 | 0 | 0 | 575 | 575 | 18.1% |
| 1998 | 0 | 188 | 0 | 0 | 0 | 188 | 188 | 9.9% |
| 1999 | 0 | 604 | 0 | 0 | 0 | 604 | 604 | 21.7% |
| 2000 | 53 | 2,305 | 0 | 100 | 53 | 2,405 | 2,458 | 12.9% |
| 2001 | 572 | 2,034 | 1,252 | 772 | 1,825 | 2,806 | 4,630 | 19.9% |
| 2002 | 1,373 | 1,207 | 492 | 36 ² | 1,865 | 1,243 | 3,108 | 20.6% |
| 2003 | 134 | 306 | 0 | 0 | 134 | 306 | 440 | 6.3% |
| 2004 | 289 | 712 | 569 | 109 ² | 858 | 820 | 1,679 | 11.0% |
| 2005 | 46 | 428 | 0 | 0 | 46 | 428 | 474 | 5.4% |
| 2006 | 246 | 354 | 0 | 0 | 246 | 354 | 600 | 9.5% |
| 2007 | 123 | 156 | 0 | 0 | 123 | 156 | 279 | 6.5% |
| 2008 | 521 | 414 | 586 | 11 ² | 1,107 | 425 | 1,532 | 17.8% |
| 2009 | 1,089 | 715 | 541 | 8 ² | 1,630 | 723 | 2,353 | 19.4% |
| 2010 | 345 | 194 | 1,154 | 48 ² | 1,499 | 241 | 1,741 | 13.2% |
| 2011 | 1,361 | 1,261 | 1,579 | 179 ² | 2,940 | 1,440 | 4,380 | 24.4% |
| 2012 | 1,220 | 1,302 | 735 | 63 ² | 1,955 | 1,364 | 3,320 | 27.5% |
| 2013 | 846 | 975 | 786 | 46 ² | 1,632 | 1,021 | 2,653 | 25.9% |
| 2014 | 576 | 715 | 826 | 54 ² | 1,402 | 769 | 2,171 | 19.2% |
| 2015 | 121 | 271 | 385 | 38 ² | 506 | 309 | 815 | 8.7% |

1. Harvest rate is the river total harvest as a percentage of the river mouth run size given in Table 1.
2. Estimate of post-release mortality of unmarked fish.

Table 6. Escapement (Roza Dam counts less brood stock collection and harvest above Roza) of natural- (NoR) and hatchery-origin (HoR) spring Chinook to the upper Yakima subbasin, 1982 – present.

| Year | Wild/Natural (NoR) | | | CESRF (HoR) | | | Total | | | PHOS ¹ | PNI ¹ |
|-------------------|--------------------|-------|--------------------|-------------|-------|--------|--------|--------|--------|-------------------|------------------|
| | Adults | Jacks | Total | Adults | Jacks | Total | Adults | Jacks | Total | | |
| 1982 | | | 1,146 | | | | | | | | |
| 1983 | | | 1,007 | | | | | | | | |
| 1984 | | | 1,535 | | | | | | | | |
| 1985 | | | 2,331 | | | | | | | | |
| 1986 | | | 3,251 | | | | | | | | |
| 1987 | | | 1,734 | | | | | | | | |
| 1988 | | | 1,340 | | | | | | | | |
| 1989 | | | 2,331 | | | | | | | | |
| 1990 | | | 2,016 | | | | | | | | |
| 1991 | | | 1,583 ² | | | | | | | | |
| 1992 | | | 3,009 | | | | | | | | |
| 1993 | | | 1,869 | | | | | | | | |
| 1994 | | | 563 | | | | | | | | |
| 1995 | | | 355 | | | | | | | | |
| 1996 | | | 1,631 | | | | | | | | |
| 1997 | 1,141 | 43 | 1,184 | | | | | | | | |
| 1998 | 369 | 18 | 387 | | | | | | | | |
| 1999 | 498 | 468 | 966 | | | | | | | | |
| 2000 | 10,491 | 481 | 10,972 | 688 | 688 | 10,491 | 1,169 | 11,660 | 5.9% | | |
| 2001 | 4,454 | 297 | 4,751 | 6,065 | 982 | 7,047 | 10,519 | 1,279 | 11,798 | 59.7% | 62.6% |
| 2002 | 1,820 | 89 | 1,909 | 6,064 | 71 | 6,135 | 7,884 | 160 | 8,044 | 76.3% | 56.7% |
| 2003 | 394 | 723 | 1,117 | 1,036 | 1,105 | 2,141 | 1,430 | 1,828 | 3,258 | 65.7% | 60.3% |
| 2004 | 6,536 | 671 | 7,207 | 2,876 | 204 | 3,080 | 9,412 | 875 | 10,287 | 29.9% | 77.0% |
| 2005 | 4,401 | 175 | 4,576 | 627 | 482 | 1,109 | 5,028 | 657 | 5,685 | 19.5% | 83.7% |
| 2006 | 1,510 | 121 | 1,631 | 1,622 | 111 | 1,733 | 3,132 | 232 | 3,364 | 51.5% | 66.0% |
| 2007 | 683 | 161 | 844 | 734 | 731 | 1,465 | 1,417 | 892 | 2,309 | 63.4% | 61.2% |
| 2008 | 988 | 232 | 1,220 | 2,157 | 957 | 3,114 | 3,145 | 1,189 | 4,334 | 71.9% | 58.2% |
| 2009 | 1,843 | 701 | 2,544 | 2,234 | 2,260 | 4,494 | 4,077 | 2,961 | 7,038 | 63.9% | 61.0% |
| 2010 | 2,436 | 413 | 2,849 | 4,524 | 1,001 | 5,525 | 6,960 | 1,414 | 8,374 | 66.0% | 60.2% |
| 2011 | 3,092 | 926 | 4,018 | 3,162 | 1,404 | 4,566 | 6,254 | 2,330 | 8,584 | 53.2% | 65.3% |
| 2012 | 2,359 | 191 | 2,550 | 2,661 | 265 | 2,926 | 5,020 | 456 | 5,476 | 53.4% | 65.2% |
| 2013 | 1,708 | 678 | 2,386 | 1,587 | 840 | 2,427 | 3,295 | 1,518 | 4,813 | 50.4% | 66.5% |
| 2014 | 3,099 | 685 | 3,784 | 2,150 | 794 | 2,944 | 5,249 | 1,479 | 6,728 | 43.8% | 69.6% |
| 2015 | 3,357 | 163 | 3,520 | 1,779 | 167 | 1,946 | 5,136 | 330 | 5,466 | 35.6% | 73.7% |
| Mean ³ | 2,694 | 381 | 3,074 | 2,619 | 758 | 3,377 | 5,197 | 1,173 | 6,371 | 53.6% | 65.8% |

1. Proportionate Natural Influence equals Proportion Natural-Origin Broodstock (PNOB; 1.0 as only NoR fish are used for supplementation line brood stock) divided by PNOB plus Proportion Hatchery-Origin Spawners (PHOS).
2. This is a rough estimate since Roza counts are not available for 1991.
3. For NoR columns, mean of 1997-present values. For all other columns, mean of 2001-present values.

Table 7. Yakima Basin spring Chinook redd count summary, 1982 – present.

| Year | Upper Yakima River System ¹ | | | | Naches River System | | | | |
|------|--|------|----------|-------|---------------------|---------------------|---------|---------------|-------|
| | Mainstem ² | Cle | | | American | Naches ² | Bumping | Little Naches | Total |
| | | Elum | Teanaway | Total | | | | | |
| 1982 | 610 | 30 | 0 | 640 | 11 | 25 | 6 | 12 | 54 |
| 1983 | 387 | 15 | 0 | 402 | 36 | 27 | 11 | 9 | 83 |
| 1984 | 677 | 31 | 0 | 708 | 72 | 81 | 26 | 41 | 220 |
| 1985 | 795 | 153 | 3 | 951 | 141 | 168 | 74 | 44 | 427 |
| 1986 | 1,716 | 77 | 0 | 1,793 | 464 | 543 | 196 | 110 | 1,313 |
| 1987 | 968 | 75 | 0 | 1,043 | 222 | 281 | 133 | 41 | 677 |
| 1988 | 369 | 74 | 0 | 443 | 187 | 145 | 111 | 47 | 490 |
| 1989 | 770 | 192 | 6 | 968 | 187 | 200 | 101 | 53 | 541 |
| 1990 | 727 | 46 | 0 | 773 | 143 | 159 | 111 | 51 | 464 |
| 1991 | 568 | 62 | 0 | 630 | 170 | 161 | 84 | 45 | 460 |
| 1992 | 1,082 | 164 | 0 | 1,246 | 120 | 155 | 99 | 51 | 425 |
| 1993 | 550 | 105 | 1 | 656 | 214 | 189 | 88 | 63 | 554 |
| 1994 | 226 | 64 | 0 | 290 | 89 | 93 | 70 | 20 | 272 |
| 1995 | 105 | 12 | 0 | 117 | 46 | 25 | 27 | 6 | 104 |
| 1996 | 711 | 100 | 3 | 814 | 28 | 102 | 29 | 25 | 184 |
| 1997 | 364 | 56 | 0 | 420 | 111 | 108 | 72 | 48 | 339 |
| 1998 | 123 | 24 | 1 | 148 | 149 | 104 | 54 | 23 | 330 |
| 1999 | 199 | 24 | 1 | 224 | 27 | 95 | 39 | 25 | 186 |
| 2000 | 3,349 | 466 | 21 | 3,836 | 54 | 483 | 278 | 73 | 888 |
| 2001 | 2,910 | 374 | 21 | 3,305 | 392 | 436 | 257 | 107 | 1,192 |
| 2002 | 2,441 | 275 | 110 | 2,826 | 366 | 226 | 262 | 89 | 943 |
| 2003 | 772 | 87 | 31 | 890 | 430 | 228 | 216 | 61 | 935 |
| 2004 | 2,985 | 330 | 129 | 3,444 | 91 | 348 | 205 | 75 | 719 |
| 2005 | 1,717 | 287 | 15 | 2,019 | 140 | 203 | 163 | 68 | 574 |
| 2006 | 1,092 | 100 | 58 | 1,250 | 136 | 163 | 115 | 33 | 447 |
| 2007 | 665 | 51 | 10 | 726 | 166 | 60 | 60 | 27 | 313 |
| 2008 | 1,191 | 137 | 47 | 1,375 | 158 | 165 | 102 | 70 | 495 |
| 2009 | 1,349 | 197 | 33 | 1,579 | 92 | 159 | 163 | 68 | 482 |
| 2010 | 2,199 | 219 | 253 | 2,671 | 173 | 171 | 168 | 40 | 552 |
| 2011 | 1,663 | 171 | 64 | 1,898 | 212 | 145 | 175 | 48 | 580 |
| 2012 | 1,276 | 125 | 69 | 1,470 | 337 | 196 | 189 | 89 | 811 |
| 2013 | 552 | 85 | 34 | 671 | 170 | 66 | 85 | 55 | 376 |
| 2014 | 962 | 138 | 53 | 1,153 | 129 | 65 | 158 | 27 | 379 |
| 2015 | 1,258 | 39 | 24 | 1,321 | 239 | 177 | 152 | 46 | 614 |
| Mean | 1,073 | 127 | 28 | 1,228 | 165 | 172 | 117 | 49 | 503 |

¹ Yakima River redd counts include redds between the Naches River confluence and Roza Dam. In some years, water conditions preclude accurate counts in this reach and the number of redds is estimated using historical proportions for this reach.

² Including minor tributaries.

Table 8. Brood Table for Upper Yakima wild/natural stock.

| Brood Year | Estimated Spawners | Estimated Yakima R. Mouth Returns | | | | Returns/Spawner |
|------------|--------------------|-----------------------------------|--------------------|-----------------|--------------------|-------------------|
| | | Age-3 | Age-4 | Age-5 | Total | |
| 1982 | 1,280 | 324 | 4,016 | 411 | 4,751 | 3.71 |
| 1983 | 1,125 | 408 | 1,882 | 204 | 2,494 | 2.22 |
| 1984 | 1,715 | 92 | 1,348 | 139 | 1,578 | 0.92 |
| 1985 | 2,578 | 114 | 2,746 | 105 | 2,965 | 1.15 |
| 1986 | 3,960 | 171 | 2,574 | 149 | 2,893 | 0.73 |
| 1987 | 2,003 | 53 | 1,571 | 109 | 1,733 | 0.87 |
| 1988 | 1,400 | 53 | 3,138 | 132 | 3,323 | 2.37 |
| 1989 | 2,466 | 68 | 1,779 | 9 | 1,856 | 0.75 |
| 1990 | 2,298 | 79 | 566 | 0 | 645 | 0.28 |
| 1991 | 1,713 | 9 | 326 | 22 | 358 | 0.21 |
| 1992 | 3,048 | 87 | 1,861 | 95 | 2,043 | 0.67 |
| 1993 | 1,925 | 66 | 1,606 | 57 | 1,729 | 0.90 |
| 1994 | 573 | 60 | 737 | 92 | 890 | 1.55 |
| 1995 | 364 | 59 | 1,036 | 129 | 1,224 | 3.36 |
| 1996 | 1,657 | 1,059 | 12,882 | 630 | 14,571 | 8.79 |
| 1997 | 1,204 | 621 | 5,839 | 155 | 6,615 | 5.49 |
| 1998 | 390 | 434 | 2,803 | 145 | 3,381 | 8.68 |
| 1999 | 1,021 ¹ | 164 | 722 | 45 | 930 | 0.91 |
| 2000 | 11,864 | 856 | 7,689 | 127 | 8,672 | 0.73 |
| 2001 | 12,087 | 775 | 5,074 | 222 | 6,071 | 0.50 |
| 2002 | 8,073 | 224 | 1,875 | 148 | 2,247 | 0.28 |
| 2003 | 3,341 ¹ | 158 | 1,036 | 63 | 1,257 | 0.38 |
| 2004 | 10,377 | 207 | 1,547 | 75 | 1,828 | 0.18 |
| 2005 | 5,713 | 293 | 2,630 | 14 | 2,936 | 0.51 |
| 2006 | 3,378 | 868 | 2,887 | 133 | 3,888 | 1.15 |
| 2007 | 2,322 | 456 | 3,976 | 65 | 4,498 | 1.94 |
| 2008 | 4,343 | 1,135 | 3,410 | 123 | 4,668 | 1.07 |
| 2009 | 7,056 ¹ | 283 | 2,572 | 109 | 2,964 | 0.43 |
| 2010 | 8,383 | 923 | 3,854 | 77 ² | 4,854 ² | 0.58 ² |
| 2011 | 8,584 | 832 | 3,890 ² | | | |
| 2012 | 5,483 | 197 ² | | | | |
| 2013 | 4,984 | | | | | |
| 2014 | 6,751 | | | | | |
| 2015 | 5,466 ² | | | | | |

1. Approximately 45-50% of these fish were jacks.

2. Preliminary.

Table 9. Brood Table for Naches/American wild stock.

| Brood Year | Estimated Spawners | Estimated Yakima R. Mouth Returns | | | | Returns/Spawner |
|------------|--------------------|-----------------------------------|--------------------|------------------|-------|--------------------|
| | | Age-3 | Age-4 | Age-5 | Age-6 | Total |
| 1982 | 108 | 127 | 1,274 | 601 | 0 | 2,002 |
| 1983 | 232 | 190 | 1,257 | 1,257 | 8 | 2,713 |
| 1984 | 570 | 164 | 1,109 | 1,080 | 0 | 2,354 |
| 1985 | 1,020 | 213 | 667 | 931 | 0 | 1,811 |
| 1986 | 4,123 | 103 | 670 | 852 | 31 | 1,657 |
| 1987 | 1,729 | 39 | 231 | 400 | 0 | 669 |
| 1988 | 2,167 | 51 | 815 | 1,557 | 11 | 2,434 |
| 1989 | 1,517 | 39 | 332 | 371 | 0 | 741 |
| 1990 | 1,380 | 40 | 326 | 168 | 0 | 533 |
| 1991 | 1,121 | 10 | 32 | 144 | 127 | 314 |
| 1992 | 1,188 | 52 | 1,034 | 661 | 0 | 1,747 |
| 1993 | 1,865 | 53 | 603 | 817 | 17 | 1,489 |
| 1994 | 704 | 21 | 160 | 167 | 0 | 348 |
| 1995 | 223 | 73 | 201 | 498 | 0 | 771 |
| 1996 | 1,047 | 209 | 4,010 | 2,359 | 0 | 6,579 |
| 1997 | 1,133 | 220 | 4,644 | 1,377 | 0 | 6,241 |
| 1998 | 917 | 364 | 2,167 | 2,316 | 12 | 4,859 |
| 1999 | 418 ¹ | 185 | 369 | 279 | 0 | 833 |
| 2000 | 4,112 | 131 | 2,286 | 346 | 0 | 2,762 |
| 2001 | 5,829 | 144 | 1,598 | 785 | 0 | 2,526 |
| 2002 | 3,041 | 78 | 975 | 443 | 0 | 1,496 |
| 2003 | 2,592 | 75 | 387 | 1,028 | 0 | 1,489 |
| 2004 | 2,515 | 227 | 514 | 232 | 0 | 973 |
| 2005 | 1,904 | 246 | 844 | 174 | 0 | 1,264 |
| 2006 | 1,672 | 237 | 1,215 | 759 | 0 | 2,211 |
| 2007 | 986 | 182 | 2,239 | 1,033 | 0 | 3,454 |
| 2008 | 1,578 | 653 | 1,262 | 803 | 0 | 2,718 |
| 2009 | 1,117 | 144 | 542 | 116 | 0 | 802 |
| 2010 | 1,491 | 381 | 972 | 224 ² | | 1,577 ² |
| 2011 | 3,060 | 208 | 1,881 ² | | | 1.06 ² |
| 2012 | 1,900 | 105 ² | | | | |
| 2013 | 1,369 | | | | | |
| 2014 | 1,130 | | | | | |
| 2015 | 2,103 ² | | | | | |

1. Approximately 48% of these fish were jacks.

2. Preliminary.

Table 10. Brood Table for Yakima River aggregate (wild/natural).

| Brood Year | Estimated Spawners | Estimated Yakima R. Mouth Returns | | | | | Returns/Spawner |
|------------|--------------------|-----------------------------------|--------------------|------------------|-------|--------------------|-------------------|
| | | Age-3 | Age-4 | Age-5 | Age-6 | Total | |
| 1982 | 1,388 | 451 | 5,290 | 1,012 | 0 | 6,753 | 4.86 |
| 1983 | 1,357 | 598 | 3,138 | 1,461 | 8 | 5,206 | 3.84 |
| 1984 | 2,285 | 256 | 2,457 | 1,219 | 0 | 3,932 | 1.72 |
| 1985 | 3,598 | 327 | 3,412 | 1,037 | 0 | 4,776 | 1.33 |
| 1986 | 8,083 | 274 | 3,244 | 1,000 | 31 | 4,550 | 0.56 |
| 1987 | 3,732 | 92 | 1,802 | 508 | 0 | 2,402 | 0.64 |
| 1988 | 3,567 | 104 | 3,953 | 1,689 | 11 | 5,757 | 1.61 |
| 1989 | 3,983 | 107 | 2,111 | 379 | 0 | 2,597 | 0.65 |
| 1990 | 3,678 | 119 | 892 | 168 | 0 | 1,178 | 0.32 |
| 1991 | 2,834 | 20 | 358 | 166 | 127 | 672 | 0.24 |
| 1992 | 4,236 | 140 | 2,894 | 756 | 0 | 3,790 | 0.89 |
| 1993 | 3,790 | 119 | 2,209 | 874 | 17 | 3,218 | 0.85 |
| 1994 | 1,277 | 81 | 897 | 260 | 0 | 1,238 | 0.97 |
| 1995 | 587 | 132 | 1,236 | 627 | 0 | 1,995 | 3.40 |
| 1996 | 2,704 | 1,268 | 16,892 | 2,989 | 0 | 21,150 | 7.82 |
| 1997 | 2,337 | 841 | 10,482 | 1,532 | 0 | 12,855 | 5.50 |
| 1998 | 1,307 | 798 | 4,970 | 2,460 | 12 | 8,240 | 6.30 |
| 1999 | 1,439 ¹ | 349 | 1,091 | 324 | 0 | 1,764 | 1.23 |
| 2000 | 15,976 | 987 | 9,975 | 472 | 0 | 11,434 | 0.72 |
| 2001 | 17,916 | 919 | 6,671 | 1,007 | 0 | 8,597 | 0.48 |
| 2002 | 11,113 | 302 | 2,849 | 592 | 0 | 3,743 | 0.34 |
| 2003 | 5,933 ² | 233 | 1,423 | 1,091 | 0 | 2,746 | 0.46 |
| 2004 | 12,893 | 434 | 2,061 | 307 | 0 | 2,802 | 0.22 |
| 2005 | 7,617 | 539 | 3,475 | 187 | 0 | 4,201 | 0.55 |
| 2006 | 5,050 | 1,105 | 4,102 | 892 | 0 | 6,099 | 1.21 |
| 2007 | 3,308 ² | 638 | 6,216 | 1,098 | 0 | 7,952 | 2.40 |
| 2008 | 5,922 | 1,787 | 4,672 | 926 | 0 | 7,385 | 1.25 |
| 2009 | 8,172 | 426 | 3,115 | 225 | 0 | 3,766 | 0.46 |
| 2010 | 9,875 | 1,303 | 4,826 | 301 ³ | | 6,431 ³ | 0.65 ³ |
| 2011 | 11,644 | 1,040 | 5,771 ³ | | | | |
| 2012 | 7,383 | 302 ³ | | | | | |
| 2013 | 6,352 | | | | | | |
| 2014 | 7,882 ³ | | | | | | |
| 2015 | 7,569 ³ | | | | | | |

1. Approximately 48% of these fish were jacks.

2. Approximately 36% of these fish were jacks.

3. Preliminary.

Table 11. Brood Table for Cle Elum SRF Spring Chinook.

| Brood Year | Estimated Spawners ¹ | Estimated Yakima R. Mouth Returns | | | Returns/Spawner |
|------------|---------------------------------|-----------------------------------|--------------------|-----------------|--------------------|
| | | Age-3 | Age-4 | Age-5 | Total |
| 1997 | 261 | 741 | 7,753 | 176 | 8,670 |
| 1998 | 408 | 1,242 | 7,939 | 602 | 9,782 |
| 1999 | 738 ² | 134 | 714 | 16 | 864 |
| 2000 | 567 | 1,103 | 3,647 | 70 | 4,819 |
| 2001 | 595 | 396 | 845 | 9 | 1,251 |
| 2002 | 629 | 345 | 1,886 | 69 | 2,300 |
| 2003 | 441 | 121 | 800 | 12 | 932 |
| 2004 | 597 | 805 | 3,101 | 116 | 4,022 |
| 2005 | 510 | 1,305 | 3,052 | 21 | 4,378 |
| 2006 | 419 | 3,038 | 5,812 | 264 | 9,114 |
| 2007 | 449 | 1,277 | 5,174 | 108 | 6,558 |
| 2008 | 457 | 2,344 | 4,567 | 65 | 6,976 |
| 2009 | 486 | 461 | 2,663 | 58 | 3,181 |
| 2010 | 336 | 1,495 | 3,183 | 30 ³ | 4,707 ³ |
| 2011 | 377 | 1,233 | 2,340 ³ | | |
| 2012 | 374 | | 221 ³ | | |
| 2013 | 398 | | | | |
| 2014 | 384 | | | | |
| 2015 | 442 ³ | | | | |

1. These are the total number of natural fish collected at Roza Dam and taken to the CESRF for production brood stock.

2. 357 or 48% of these fish were jacks.

3. Preliminary.

Table 12. Summary of 2016 Yakima River Spring Chinook forecast values using various methods or models.

| Projection | Method or Model |
|------------|---|
| 2,920 | Average Adult per Jack Return Rate for adult return years 2000-2015 |
| 6,080 | Regression of age3:age4 and age4:age5 cohort returns for brood years 1982-2011 |
| 3,320 | Regression of jacks and jack post-eye length to adult returns for adult return years 2000-2015 |
| 3,310 | Regression of jacks, jack post-eye length, and NOAA ocean rank (ocean survival index) to adult returns for adult return years 2000-2015 |
| 5,370 | Regression of adult returns to jack returns for jack return years 1982-2014 |
| 4,610 | Regression of adult returns to adult spawners, jacks, and jack mideye length for jack return years 1986-2014 |
| 4,950 | Average return rates of age4:age3 and age5:age4 fish for brood years 2001-2010 |
| 7,010 | Regression of adult returns to jacks, and freshwater and ocean survival indices for adult return years 2001-2015 |
| 4,700 | Average of above predictors |
| 4,500 | Geometric mean of above predictors |

Table 13. Age-3 (jack) returns in prior year and forecasted versus actual returns of age-4 and age-5 spring Chinook.

| Year | Yr-1 Jacks | Forecast | Actual | Difference | AbsDiff |
|----------------------------------|---------------|---------------------|--------|------------|---------|
| 1997 | 119 | 3,300 | 3,090 | 6.8% | 6.8% |
| 1998 | 81 | 1,400 | 1,770 | -20.9% | 20.9% |
| 1999 | 132 | 1,200 | 1,510 | -20.5% | 20.5% |
| 2000 | 1,268 | 5,200 | 17,520 | -70.3% | 70.3% |
| 2001 | 1,582 | 26,100 | 21,220 | 23.0% | 23.0% |
| 2002 | 2,040 | 21,780 | 14,620 | 49.0% | 49.0% |
| 2003 | 483 | 6,370 | 4,870 | 30.8% | 30.8% |
| 2004 | 2,089 | 19,160 | 13,970 | 37.2% | 37.2% |
| 2005 | 1,315 | 14,500 | 8,060 | 79.9% | 79.9% |
| 2006 | 699 | 6,670 | 5,950 | 12.1% | 12.1% |
| 2007 | 363 | 4,160 | 2,970 | 40.1% | 40.1% |
| 2008 | 1,335 | 10,060 | 6,610 | 52.2% | 52.2% |
| 2009 | 1,983 | 15,910 | 7,440 | 113.8% | 113.8% |
| 2010 | 4,679 | 16,570 | 11,030 | 50.2% | 50.2% |
| 2011 | 2,114 | 10,320 | 13,400 | -23.0% | 23.0% |
| 2012 | 4,561 | 12,040 ¹ | 11,080 | 8.7% | 8.7% |
| 2013 | 970 | 7,330 | 7,100 | 3.2% | 3.2% |
| 2014 | 3,144 | 9,110 | 8,850 | 2.9% | 2.9% |
| 2015 | 2,472 | 9,320 | 8,790 | 6.0% | 6.0% |
| 2016 | 556 | 4,610 | | | |
| Average Error in forecast: 34.2% | | | | | |

1. Adjusted from model forecast by -30% due to high jack count.

Table 14. CESRF Smolt Releases by Brood Year¹

| Brood Year | Migration Year | Total Release | Return Year for: | | |
|-------------------|----------------|---------------|------------------|-------|-------|
| | | | Age-3 (jack) | Age-4 | Age-5 |
| 1997 | 1999 | 386,048 | 2000 | 2001 | 2002 |
| 1998 | 2000 | 589,683 | 2001 | 2002 | 2003 |
| 1999 | 2001 | 758,789 | 2002 | 2003 | 2004 |
| 2000 | 2002 | 834,285 | 2003 | 2004 | 2005 |
| 2001 ² | 2003 | 370,236 | 2004 | 2005 | 2006 |
| 2002 | 2004 | 836,904 | 2005 | 2006 | 2007 |
| 2003 | 2005 | 824,692 | 2006 | 2007 | 2008 |
| 2004 | 2006 | 785,448 | 2007 | 2008 | 2009 |
| 2005 | 2007 | 860,002 | 2008 | 2009 | 2010 |
| 2006 | 2008 | 642,795 | 2009 | 2010 | 2011 |
| 2007 | 2009 | 771,265 | 2010 | 2011 | 2012 |
| 2008 | 2010 | 849,305 | 2011 | 2012 | 2013 |
| 2009 | 2011 | 832,941 | 2012 | 2013 | 2014 |
| 2010 | 2012 | 794,781 | 2013 | 2014 | 2015 |
| 2011 | 2013 | 769,182 | 2014 | 2015 | 2016 |
| 2012 | 2014 | 802,716 | 2015 | 2016 | 2017 |
| 2013 | 2015 | 646,755 | 2016 | 2017 | 2018 |

1. Release target is 720,000 to 810,000 smolts, but was intentionally reduced in start-up years of 1997 and 1998.
2. Approximately ½ of production destroyed due to high presence of agents causing Bacterial Kidney Disease (BKD).