Yankee Fork Salmon River Spring Chinook Salmon Population
Population Viability Assessment

The Yankee Fork chinook population (Figure 1) is part of the Snake River Spring/Summer Chinook ESU which has five major population groupings (MPGs), including: Lower Snake River, Grande Ronde / Imnaha, South Fork Salmon River, Middle Fork Salmon River, and the Upper Salmon River group. The ESU contains both spring and summer run chinook. The Yankee Fork population is a spring run and is one of eight extant populations in the Upper Salmon River MPG.

The ICTRT classified the Yankee Fork population as a "basic" population (Table 1) based on historical habitat potential (ICTRT 2005). A chinook population classified as basic has a mean minimum abundance threshold criteria of 500 naturally produced spawners with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction over a 100-year timeframe.

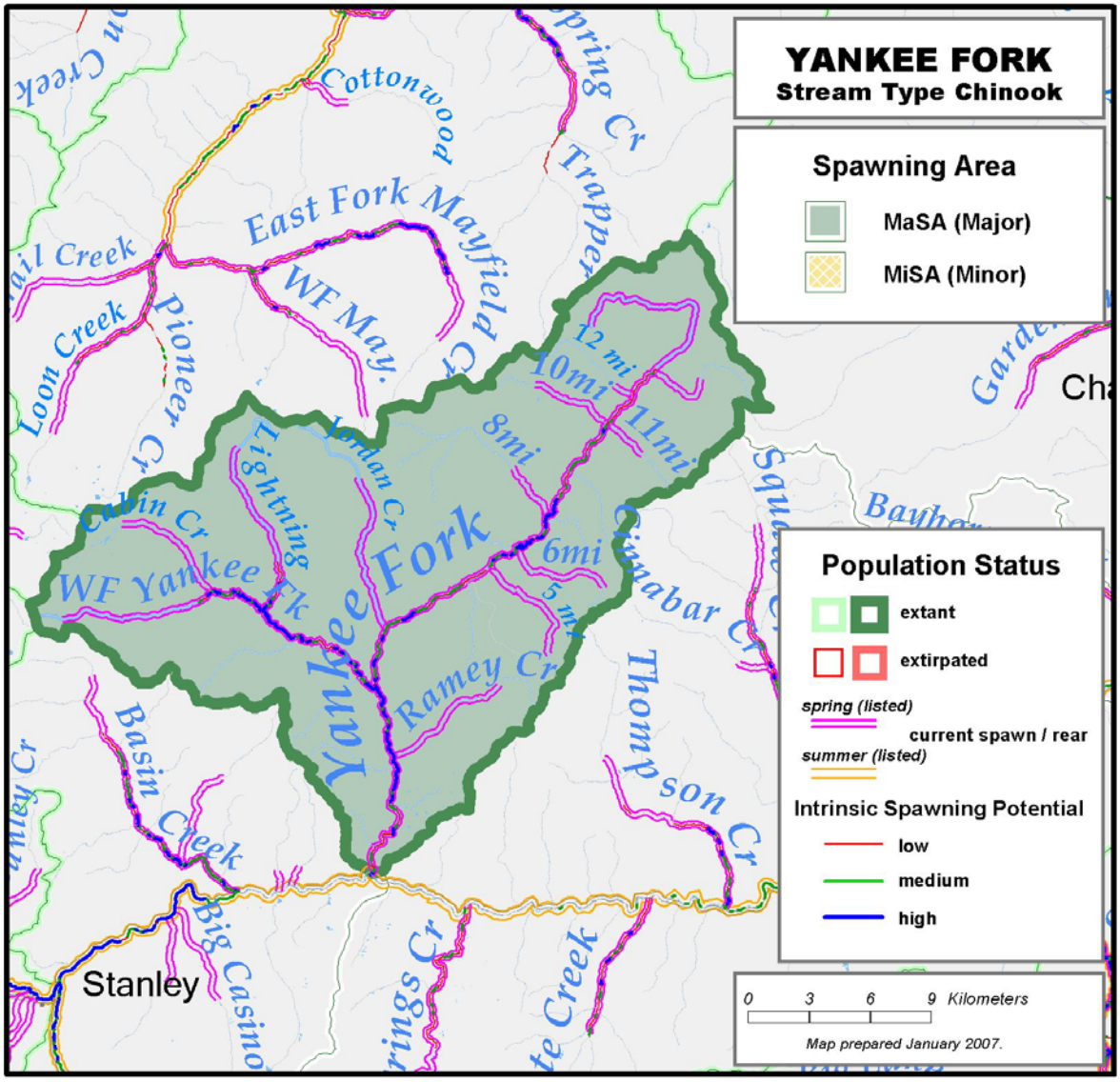

Figure 1. Yankee Fork chinook major and minor spawning areas.

Table 1. Yankee Fork chinook basin statistics

Drainage Area (km2)	493
Stream lengths km* (total)	171
Stream lengths km* (below natural barriers)	169
Branched stream area weighted by intrinsic potential (km2)	0.165
Branched stream area km2 (weighted and temp. limited)	0.165
Total stream area weighted by intrinsic potential (km2)	0.198
Total stream area weighted by intrinsic potential (km2) temp limited	0.198
Size / Complexity category	Basic / "A" (linear pattern)
Number of MaSAs	1
Number of MiSAs	0

*All stream segments greater than or equal to 3.8m bankfull width were included
**Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22°C.

Current Abundance and Productivity

Current (1961 to 2003) natural abundance (number of adult spawning in natural production areas) has ranged from 0 in 1995 to 1,488 in 1968 (Figure 2). Annual abundance estimates for Valley Creek were based on expanded redd counts. Insert expansion methodology.

Recent year natural spawners include returns originating from naturally spawning parents. Hatchery strays likely have entered the population but there is no monitoring program to detect them. Spawners originating from naturally spawning parents are assumed to have comprised an average of 100% since 1961 in the spawner/recruit analysis (Table 2 and 6). However, hatchery juveniles and F_1 hatchery adults have been released directly into the population in the recent three brood cycles.

Abundance in recent years has been variable, the most recent 10-year geomean number of natural spawners was 13 (Table 2). During the period 1979-1998, returns per spawner for chinook in Yankee Fork ranged from 0.07 (1991) to 6.64 (1997). The most recent 20 year (1978-1997) SAR adjusted and delimited (at 75% of the size threshold) geometric mean of returns per spawner was 0.80 (Table 2).

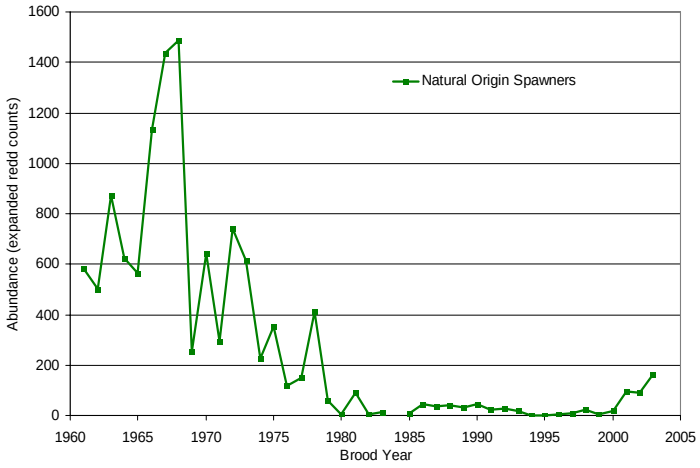

Figure 2. Yankee Fork abundance trends 1961-2003.

Table 2. Yankee Fork abundance and productivity measures

10-year geomean natural abundance	13
20-year return/spawner productivity	0.68
20-year return/spawner productivity, SAR adj. and delimited*	0.80
20-year Bev-Holt fit productivity, SAR adjusted	n/a
20-year Lambda productivity estimate	n/a
Average proportion natural origin spawners (recent 10 years)	1.0
Reproductive success adj. for hatchery origin spawners	n/a

*Delimited productivity excludes any spawner/return pair where the spawner number exceeds 75% of the size category threshold for this population. This approach attempts to remove density dependence effects that may influence the productivity estimate.

Comparison to the Viability Curve

- Abundance: 10-yr geomean natural origin spawners
- Productivity: 20-yr geomean R/S (adjusted for marine survival and delimited at 375 spawners)
- Curve: Hockey-Stick curve
- Conclusion: The Yankee Fork population is at **HIGH** risk based on current abundance and productivity. The point estimate resides below the 25% risk curve (Figure 3).

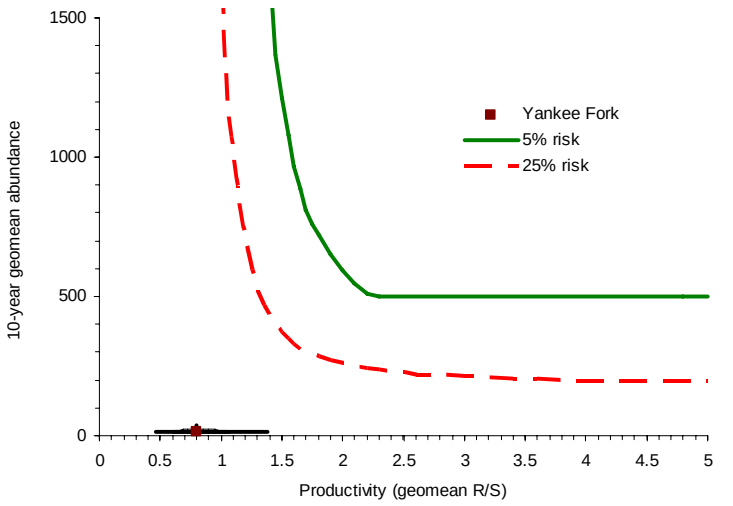

Figure 3. Yankee Fork chinook abundance and productivity metrics against a Hockey-Stick viability curve. Dataset adjusted for marine survival and delimited at the median. Estimate includes a 1 SE ellipse, 1.83 X SE abundance line, and 1.77 X SE productivity line.

Spatial Structure and Diversity

The ICTRT has identified one major spawning area (MaSA) and no minor spawning areas (MiSA) within the Yankee Fork chinook population. There are no modeled temperature limitations within this MaSA. Spawning is distributed broadly throughout the population boundaries, extending from approximately one mile upstream of the Yankee Fork Salmon River mouth to the headwaters area and the West Fork Yankee Fork Salmon River

Factors and Metrics

A.1.a. Number and spatial arrangement of spawning areas.
The Yankee Fork Salmon River Chinook population has one MaSA (Valley) and no MiSAs. The total branched stream area weighted by intrinsic potential is 164,642 m^2, an area equivalent to 1.6 MaSAs. This metric was rated *High Risk* because of the existence of only one MaSA, and the population historically would have been at high risk because of the spatial arrangement of spawning areas.

A.l.b. Spatial extent or range of population.
The IDFG has conducted annual spawner index counts since 1957 in the Yankee Fork Salmon River from Pole Camp upstream to Twelvemile Creek, and in the West Fork Yankee Fork Salmon River from its mouth upstream to Cabin Creek. Although recent escapements have been low, this metric is rated *Low Risk* because current spawning distribution mirrors historical and the historical range has not been reduced. The MaSA is occupied at both the lower and upper ends based on recent spawner surveys. Low risk is the lowest rating this population can achieve since it is characterized as a Basic A-type population.

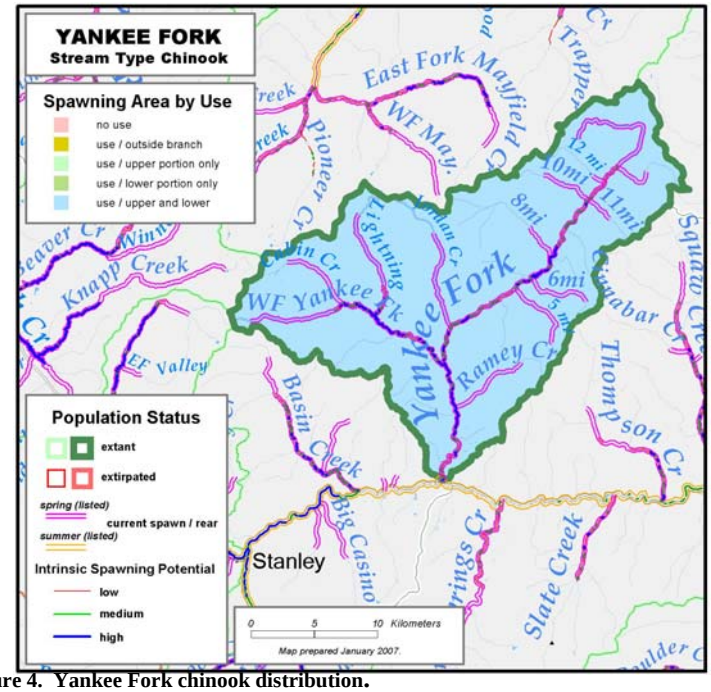

Figure 4. Yankee Fork chinook distribution.

A.1.c. Increase or decrease in gaps or continuities between spawning areas.
There has been no change in gaps when comparing current and historical spawning distribution. The population is rated at *Low* risk because the historical MaSA is occupied, gap distance and continuity have not changed, and there has been no increase in distance between this population and other populations in the MPG or ESU. This metric cannot achieve a Very Low risk rating because there are not three or more historic MaSAs.

B.1.a. Major life history strategies.
There are limited data to allow any comparisons between historic and current life history strategies. Adult spawners in the population are classified as spring run. The known major

juvenile life history strategy is a spring yearling migrant. There have been substantial anthropogenic impacts in the basin resulting from mining activities. It is not known if anthropogenic impacts would have resulted in loss of a life history strategy since they would have affected a large portion of the population. Adult spawners still occupy the upper and lower reaches of the stream. It appears all historic juvenile and adult life history strategies are present, but because data is limited the metric is rated *Low Risk*.

B.1.b. Phenotypic variation.

There is no data to indicate that any phenotypic traits have been significantly changed or lost. Similar to major life history strategies, it is not known if alterations of within-basin habitat conditions would have resulted in loss of a phenotypic trait since a large portion of the population was affected. No major selective pressures are known to exist which would cause significant changes in or loss of traits. Changes in the mainstem migration corridor (lower Snake and Columbia rivers) likely have altered timing of juvenile downstream passage and adult upstream passage. Because smolt entry into the estuary is substantially delayed relative to historic conditions, this metric is rated at *Low Risk.*

B.1.c. Genetic variation.

Genetic ratings were based on IC-TRT analysis of allozyme data presented in Waples et al. 1993. In addition, the IC-TRT analyzed WDFW and R. Waples, unpublished allozyme data, and P. Moran, unpublished microsatellite data. Samples analyzed from this population did not group with the Upper Salmon cluster. Also, the samples were not significantly different from ten hatchery samples that were all derived from Rapid River stock. There is a history of out-planting Rapid River stock into this population. This metric was rated *High* risk. Future genetic analyses indicating that this population is diverging from Rapid River stock could serve to lower the risk rating.

B.2.a. Spawner composition.

Spawner composition typically is determined from spawning ground carcass recoveries. Any marked fish that are recovered are examined for the presence of a coded-wire or PIT tag. Spawner carcass data is not collected within this population. Risk ratings are inferred from data collected in the proximate upper Salmon River Mainstem population. From 1981 through 2004 3,955 marked fish were recovered in the upstream Upper Salmon River population (at Sawtooth Fish Hatchery) and a CWT was extracted and read from 3,932 of those fish.

(1) *Out-of-ESU strays*. In the upstream Upper Salmon River Mainstem population, four out-of-ESU strays were recovered at the Sawtooth Hatchery across the 23 years of data reviewed. Two were fall Chinook that had been reared in the Hagerman Valley, one was a stray from the Tucannon River and one was a stray from the Umatilla River. Those four fish most likely were spawned in the hatchery, thus did not spawn naturally. No expansions were done to account for unmarked returns from the respective mark groups. This sub-metric is rated *Very Low* risk since the total number observed was very low.

(2) *Out-of-MPG strays from within the ESU*. Five out-of-MPG strays were recovered at the Sawtooth Hatchery across the 23 years of data reviewed. Two of the strays were Rapid River origin and two were South Fork Salmon River origin. No expansions were done to account for

unmarked returns from the respective mark groups. Rapid River stock have sporadically been released into this population. Because Rapid River derived stock could have comprised up to 10% of natural spawners and the genetic data linking Yankee Fork Salmon River samples to Rapid River, this sub-metric is rated *Moderate* risk.

(3) *Out of population within MPG strays.* Out-of-population hatchery-origin strays that could enter the population in recent years would originate from the upstream Upper Salmon River Mainstem population (Sawtooth Hatchery) or the downstream Pahsimeroi Hatchery program operated in the Pahsimeroi River population. Proportion of strays spawning naturally is suspected to be less than 10% per year however, Upper Salmon River Mainstem (Sawtooth Hatchery) origin fish have been deliberately released into the population and this sub-metric is rated *Moderate Risk*.

(4) *Within-population hatchery spawners.* There is no within population hatchery program, and this metric is rated *Very Low* risk.

The overall risk rating for metric B.2.a "spawner composition" is *High Risk* since two of the sub-metrics scored Moderate risk.

B.3.a. Distribution of population across habitat types.

The Yankee Fork Salmon River population intrinsic potential distribution historically was distributed across one EPA level IV ecoregion, Southern Forested Mountains. The current distribution is identical to the historic intrinsic distribution (Table 3 and Fig. 6). There are no substantial changes in ecoregion occupancy and this metric was rated *Low Risk* for the population. This is the lowest risk rating the population can achieve for this metric since historically only one ecoregion were represented.

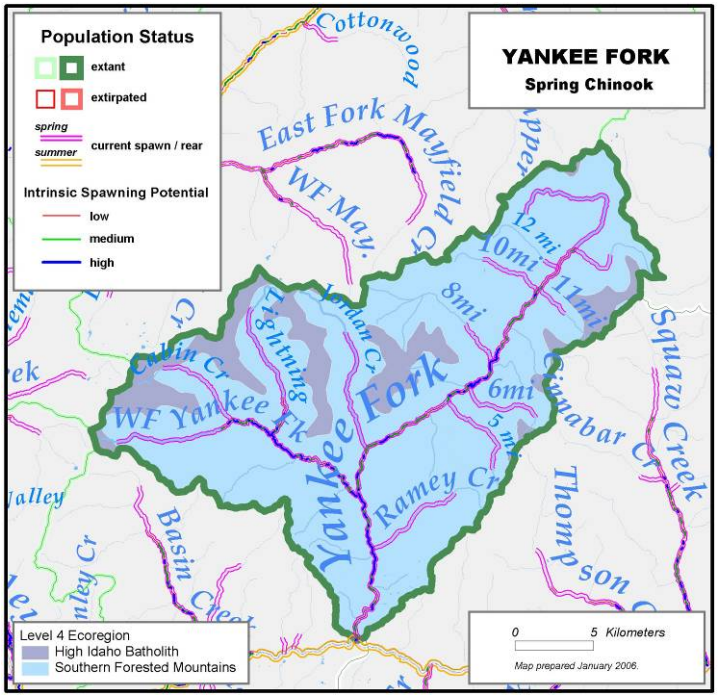

Figure 5. Yankee Fork chinook population distribution across various ecoregions.

Table 3. Yankee Fork chinook—proportion of spawning areas across various ecoregions.

Ecoregion	% of historical branch spawning area in this	% of historical branch spawning area in this	% of currently occupied spawning area in this

	ecoregion (non-temperature limited)	ecoregion (temperature limited)	ecoregion (non-temperature limited)
Southern Forested Mountains	100.0	100.0	100.0

B.4.a. Selective change in natural processes or selective impacts.

Hydropower system: The hydrosystem and associated reservoirs impose some selective mortality on smolt outmigrants and adult migrants, the selective mortality is not likely to remove more than 25% of the affected individuals. The likely impacts are rated as *Low Risk* for this action.

Harvest: Recent harvest rates for spring/summer Chinook salmon are generally less than 10% annually. There are no freshwater fisheries directly targeting wild spring/summer Chinook salmon; indirect mortalities are expected to occur in some fisheries selective for hatchery fish. It is not likely that the incidental mortality is selective for a particular group of fish or if it is, it would not select 25% or more of that particular group, therefore this action was rated as *Very Low* risk.

Hatcheries: Hatchery strays (adult spawners) likely enter the population and exogenous stock has deliberately been released into the population. The effect of hatchery fish on the population was significant, since the population is no most genetically similar to Rapid River stock. This selective impact was rated *High Risk*.

Habitat: Habitat changes resulting from land use activities in the basin may impose some selective mortality, but the extent is unknown. It is likely that in this population any mortality impacts resulting from habitat changes would have affected the entire population because of the spatial extent of habitat alterations. This selective impact was rated *Low Risk*.

Spatial Structure and Diversity Summary

Overall spatial structure and diversity has been rated *High Risk* for the Yankee Fork Salmon River population (Table 4). The lowest spatial structure/diversity risk level the population could achieve would be Low risk because of the historic (natural) number and spatial arrangement of spawning areas and total amount of intrinsic potential habitat. The current *High* risk rating is driven by a number of factors including spatial structure, genetic diversity, and the effects of hatchery fish and out-of-population stock spawning naturally.

Table 4. Spatial structure and diversity scoring table

<table>
<tr><th rowspan="2">Metric</th><th colspan="5">Risk Assessment Scores</th></tr>
<tr><th>Metric</th><th>Factor</th><th>Mechanism</th><th>Goal</th><th>Population</th></tr>
<tr><td>A.1.a</td><td>H (-1)</td><td>H (-1)</td><td rowspan="3">Moderate Risk
(Mean=0.33)</td><td rowspan="3">Moderate Risk</td><td rowspan="14">High Risk</td></tr>
<tr><td>A.1.b</td><td>L (1)</td><td>L (1)</td></tr>
<tr><td>A.1.c</td><td>L (1)</td><td>L (1)</td></tr>
<tr><td>B.1.a</td><td>L (1)</td><td>L (1)</td><td rowspan="3">High Risk</td><td rowspan="11">High Risk</td></tr>
<tr><td>B.1.b</td><td>L (1)</td><td>L (1)</td></tr>
<tr><td>B.1.c</td><td>H (-1)</td><td>H (-1)</td></tr>
<tr><td>B.2.a(1)</td><td>VL (2)</td><td rowspan="4">High Risk</td><td rowspan="4">High Risk</td></tr>
<tr><td>B.2.a(2)</td><td>M (0)</td></tr>
<tr><td>B.2.a(3)</td><td>M (0)</td></tr>
<tr><td>B.2.a(4)</td><td>VL (2)</td></tr>
<tr><td>B.3.a</td><td>L (1)</td><td>L (1)</td><td>Low Risk</td></tr>
<tr><td>B.4.a</td><td>H (-1)</td><td>H (-1)</td><td>High Risk</td></tr>
</table>

Overall Viability Rating

The Yankee Fork Salmon River Spring Chinook salmon population does not currently meet viability criteria because both Abundance/Productivity risk and Spatial Structure/diversity risk are high (Table 5). The 20-year delimited recruit per spawner point estimate (0.80) is less than replacement and significantly less than the 1.9 required at the minimum abundance threshold. The 10-year geometric mean abundance is only 3% of the minimum threshold abundance. Improvement in abundance/productivity status and spatial structure/diversity status (reduction of risk level for both categories) will need to occur before the population can be considered viable. Also, the population currently does not meet the criteria for a "maintained" population.

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	HV	HV	V	M
	Low (1-5%)	V	V	V	M
	Moderate (6 – 25%)	M	M	M	
	High (>25%)				Yankee Fork Salmon RIver

Figure 6. Viable Salmonid Population parameter risk ratings for the Yankee Fork Salmon River Spring Chinook population. This population does not currently meet viability criteria. *Viability Key: HV – Highly Viable; V – Viable; M – Maintained; Shaded cells-- not meeting viability criteria (darkest cells are at greatest risk)*

Yankee Fork Spring Chinook – Data Summary

Data type: Redd count expansions
SAR: Averaged Williams/CSS series

Table 5. Yankee Fork chinook run data (used for curve fits and R/S analysis). Data used in the productivity calculation are bolded.

Brood Year	Spawners	%Wild	Natural Run	Nat. Rtns	R/S	Rel. SAR	Adj. Rtns	Adj. R/S
1979	**60**	**1**	**60**	**7**	**0.12**	**0.87**	**6**	**0.10**
1980	**4**							
1981	**90**							
1982	**2**							
1983	**15**	**1**	**15**	**41**	**2.77**	**0.58**	**24**	**1.60**
1984								
1985	**11**	**1**	**11**	**37**	**3.26**	**1.57**	**57**	**5.11**
1986	**45**	**1**	**45**	**35**	**0.78**	**1.41**	**49**	**1.10**
1987	**37**	**1**	**37**	**33**	**0.91**	**1.83**	**61**	**1.66**
1988	**40**	**1**	**40**	**25**	**0.61**	**0.75**	**18**	**0.46**
1989	**30**	**1**	**30**	**23**	**0.75**	**1.79**	**40**	**1.34**
1990	**43**	**1**	**43**	**11**	**0.25**	**4.65**	**50**	**1.16**
1991	**22**	**1**	**22**	**2**	**0.07**	**3.01**	**5**	**0.20**
1992	**29**	**1**	**29**	**3**	**0.09**	**1.65**	**4**	**0.15**
1993	**20**	**1**	**20**	**8**	**0.39**	**1.61**	**12**	**0.62**
1994	**2**							
1995	**0**							
1996	**4**							
1997	**9**	**1**	**9**	**57**	**6.64**	**0.30**	**17**	**1.96**
1998	**21**	**1**	**21**	**101**	**4.88**	**0.30**	**30**	**1.45**
1999	2	1	2					
2000	20	1	20					
2001	95	1	95					
2002	92	1	92					
2003	161	1	161					

Table 6. Geomean abundance and productivity measures. Abundance and productivity values used in the current status assessment are boxed.

	R/S measures				Lambda measures		Abundance
	Not adjusted		SAR adjusted		Not adjusted		Nat. origin
delimited	median	75% threshold	median	75% threshold	1989-2000	1981-2000	geomean
Point Est.	2.58	0.68	1.71	0.80	n/a	n/a	13
Std. Err.	0.50	0.42	0.34	0.31			0.55
count	5	13	5	13			9

Table 7. Poptools stock-recruitment curve fit parameter estimates. Values determined to be out of bounds are highlighted in gray.

	Not adjusted for SAR							Adjusted for SAR						
SR Model	a	SE	b	SE	adj. var	auto	AICc	a	SE	b	SE	adj. var	auto	AICc
Rand-Walk	0.68	0.27	n/a	n/a	1.61	0.48	51.8	0.80	0.24	n/a	n/a	1.12	0.22	44.3
Const. Rec	17	6	n/a	n/a	n/a	n/a	46.4	21	5	n/a	n/a	n/a	n/a	39.7
Bev-Holt	50.00	166.67	18	6	0.90	0.60	50.0	50.00	186.39	21	6	0.70	0.41	43.2
Hock-Stk	0.68	0.27	9939	0	1.61	0.48	55.2	0.80	0.21	9883	0	1.12	0.22	47.7
Ricker	3.57	2.67	0.05636	0.02281	0.88	0.62	50.2	2.55	1.47	0.03927	0.01757	0.69	0.43	43.5

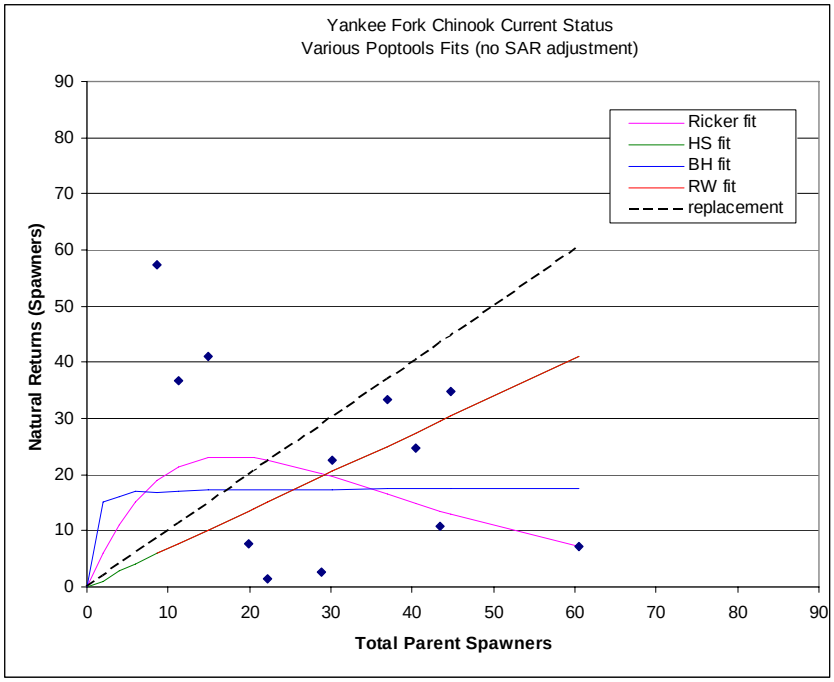

Figure 7. Stock recruitment curves for the Yankee Fork chinook population. Data not adjusted for marine survival. All points were used for the productivity calculation.

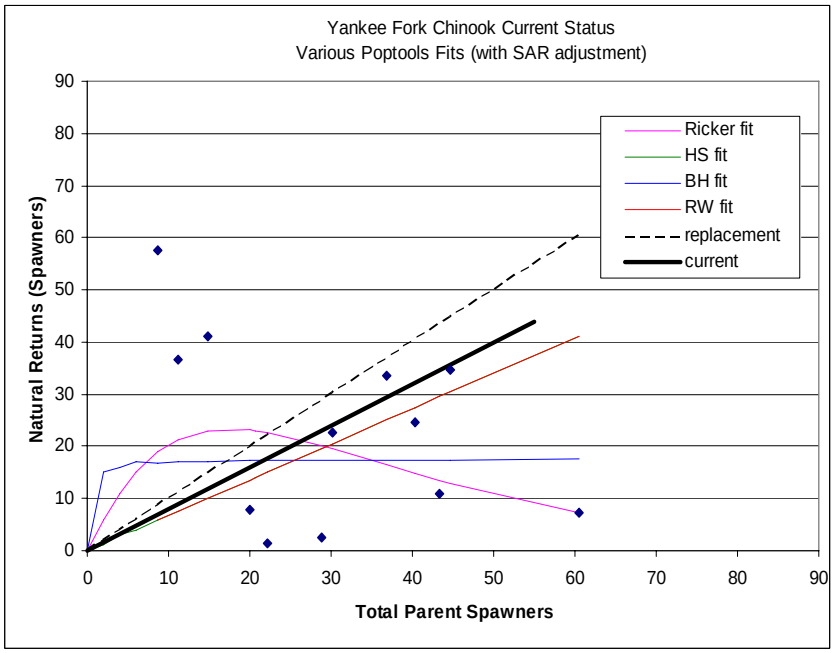

Figure 8. Stock-recruitment curves for the Yankee Fork chinook population. Data adjusted for marine survival. All points were used for the productivity calculation.