Catherine Creek Spring Chinook Population

The Catherine Creek 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 spring, spring-summer, and summer run Chinook. The Catherine Creek population is a spring run and is one of seven extant populations in the Grande Ronde / Imnaha MPG. The ICTRT classified the Catherine Creek population as a "large" population (Table 1) based on historical habitat potential (ICTRT 2005). For abundance and productivity measures, however, this population is treated as an "intermediate" population because the abundance/productivity analyses are conducted based on spawners in Catherine Creek only. The quantity of habitat within Catherine Creek (excludes Indian Creek and mainstem Grande Ronde near Indian Creek) results in an intermediate size designation. A Chinook population classified as intermediate has a mean minimum abundance threshold criteria of 750 naturally produced spawners with a sufficient intrinsic productivity (greater than 1.6 recruits per spawner at the threshold abundance level) to achieve a 5% or less risk of extinction over a 100-year timeframe.

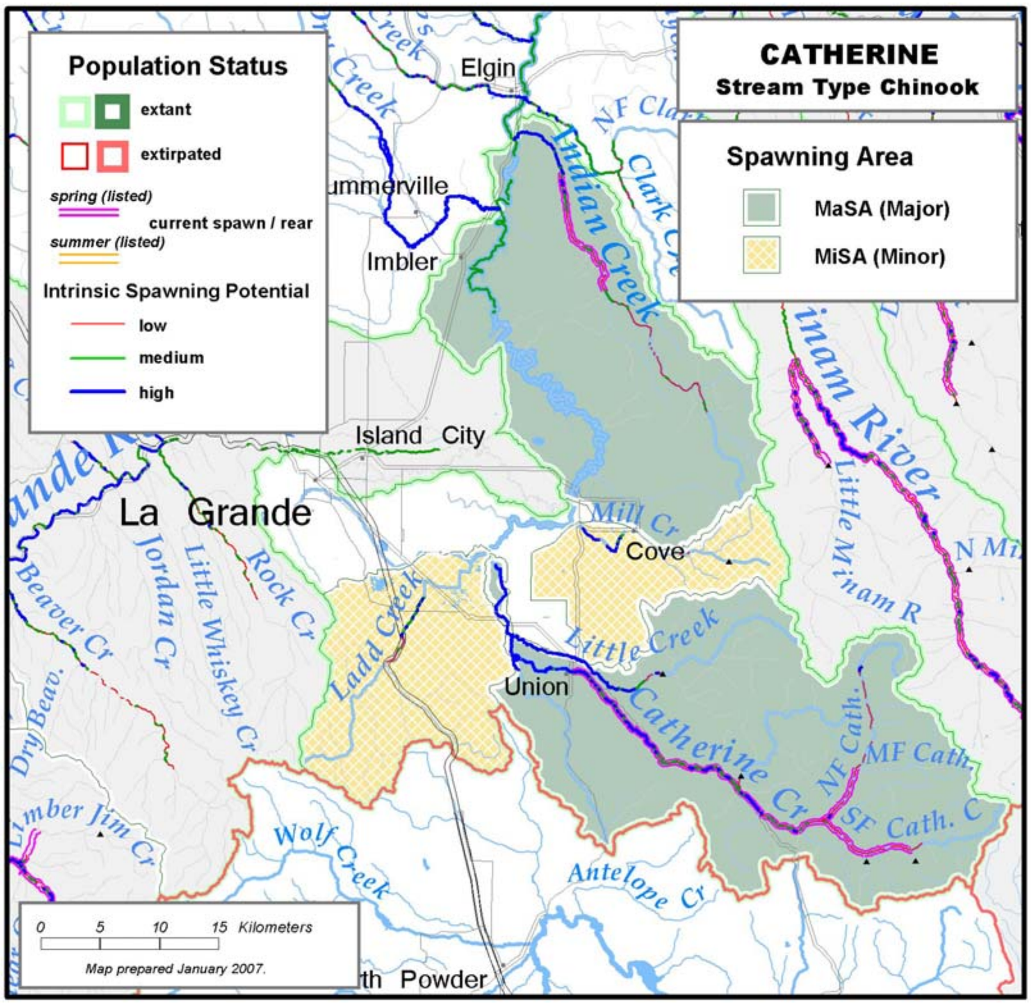

Figure 1. Catherine Creek Chinook major and minor spawning areas.

Table 1. Catherine Creek Chinook Basin Statistics

Drainage Area (km2)	1,266
Stream lengths km* (total)	482
Stream lengths km* (below natural barriers)	342
Branched stream area weighted by intrinsic potential (km2)	0.302
Branched stream area km2 (weighted and temp. limited**)	0.302
Total stream area weighted by intrinsic potential (km2)	0.341
Total stream area weighted by intrinsic potential (km2) temp limited**	0.341
Size / Complexity category	Large*** / "B" (dendritic)
Number of MaSAs	2
Number of MiSAs	2

*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^{o}C.
***This population is treated as "intermediate" for abundance and productivity calculations (considers only mainstem reaches).

Current Abundance and Productivity

Current (1955 to 2005) abundance (number of adult spawning in natural production areas) has ranged from 27 in 1994 to 2,947 in 1960 (Figure 2). Abundance estimation methods have varied through time. Prior to 1998, spawner abundance estimates are based on redds observed during spawning ground surveys conducted annually since 1955. From 1998 to present, spawner abundance was estimated based on weir counts, mark-recapture estimates, and redd counts with adjustments for pre-spawning mortality estimated from carcass recoveries.

Spawning ground surveys have been conducted once annually in index survey reaches since 1953. Additional surveys were conducted from 1964–1985 both upstream and downstream of the original fixed-survey area, but were not conducted every year. Beginning in 1986, single pass surveys were conducted over the entire known spawning habitat beginning in the North and South forks of Catherine Creek and ending in the mainstem in the town of Union. Additional supplemental surveys were conducted in selected index reaches of the spawning habitat from 1986-1996. Beginning in 1997 all known spawning habitat was surveyed multiple times. For this analysis, observations of redds and the locations of surveys are those reported in Tranquilli et al. (2004), updated with annual summaries of spawning ground survey results (personal communications, P. Keniry and F. Monzyk, ODFW NE Fisheries Research Program, La Grande, OR), and cross referenced to Beamesderfer et al. (1997).

For years when only index surveys were conducted, we used the average proportion of redds observed in areas outside historical surveys (from the 1986-2005 data) to estimate total redds at the index survey time. To account for spawning activity occurring later than the index survey dates, we calculated temporal adjustment factors for each year when multiple surveys were conducted. For years when multiple (1953-1985) surveys were not conducted, we assumed spawn timing was the same as the average of the later year-specific estimates. We estimated the total spawners each year by multiplying total redds by an estimated 2.23 spawners per redd, observed on average since operation of the weir and mark-recapture estimates have been made in Catherine Creek.

From 1998 to present, total escapement was estimated based on weir counts of jacks and adults, mark-recapture estimates of adults, and redd counts. Escapement above the weir was the sum of the known number of fish captured and subsequently passed above the weir and an estimated number of untrapped fish. The number of untrapped adults above the weir was determined from mark-recapture estimates of adults. Weir efficiency was determined from the ratio of trapped adults to the estimated total adults above the weir and applied to the number of trapped jacks to provide an estimate of total jacks above the weir. Escapement to the weir was the sum of the total trapped and estimated untrapped fish. Spawner escapement is the sum of fish released above the weir and untrapped fish. In Catherine Creek few fish spawn below the weir, and are not included in this dataset. Total spawners are estimated by multiplying an estimated pre-spawn survival rate to the escapement. Pre-spawn survival was derived from female carcass information collected on spawning ground surveys and was the ratio of spawned-out females to total observed. Female carcasses containing greater than 50% of their eggs were considered pre-spawn mortalities.

The estimate of spawners includes natural-origin and hatchery-origin fish. Prior to 1986, the hatchery fraction was 0%. From 1986-1994 the fraction of total spawners of hatchery origin was calculated based on the results of discriminate scale analyses and CWT-fin mark from carcass recoveries. From 1998 to present, the hatchery fraction of spawners was based on total spawner estimates and the proportion of hatchery origin fish determined by the presence of an adipose fin clip and coded wire tag.

Natural-origin fish are apportioned into brood year cohorts to estimate abundance of adult recruits. Prior to 1998, age structure of natural origin spawners on spawning grounds was determined from carcass recoveries when sufficient sample sizes were available (n>20). Spawners of natural origin were determined by the absence of a coded-wire tag. Only fish at least 50% spawned were used in estimates. Age was determined by scale analysis if available or age at length-age relationships. If insufficient sample sizes were available, age structure was determined from all carcasses recovered in the Grande Ronde Basin. From 1998 to 2005, age structure of natural-origin spawners was based on age specific spawner escapement estimates. Age of individual fish was determined from scales collected from fish trapped at the weir.

Recent year natural spawners include returns originating from naturally spawning parents, and hatchery fish released into Catherine Creek from Lookingglass Fish Hatchery. Prior to 1995 hatchery fish returning to Catherine Creek were of Carson or Rapid River hatchery stocks origin. The hatchery program transitioned to local Catherine Creek broodstock and hatchery returns to Catherine Creek since 2001 have been Catherine Creek origin. Natural-origin spawners have comprised an average of 83% of total spawners since 1955, while the most recent 10-year average is 75% (Table 2).

Abundance in recent years has been highly variable, the most recent 10-year geomean number of adult natural-origin spawners was 89 (Table 2). During the period 1981-2000, returns per spawner for Chinook in Catherine Creek ranged from 0.01 (1987) to 3.93 (1997). The most recent 20 year (1981-2000) SAR adjusted and median delimited (at 75% of the 750 threshold abundance level) geometric mean of returns per spawner was 0.52 (Table 2).

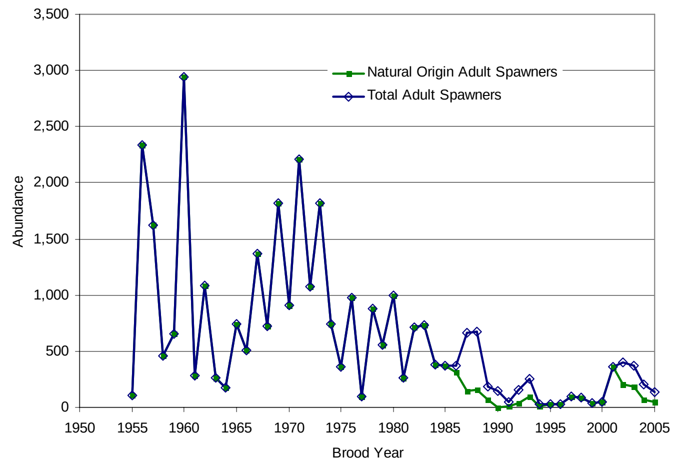

Figure 2. Catherine Creek abundance trends 1955-2005.

Table 2. Catherine Creek abundance and productivity measures

10-year geomean natural abundance (adults)	89
20-year return/spawner productivity	0.38
20-year return/spawner productivity, SAR adj. and delimited*	0.52
20-year Bev-Holt fit productivity, SAR adjusted	n/a
20-year Lambda productivity estimate	0.97
Average proportion natural origin spawners (recent 10 years)	0.75
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. This approach attempts to remove density dependence effects that may influence the productivity estimate.

Comparison to the Viability Curve

- Abundance: 10-year geomean natural origin spawners
- Productivity: 20-year geomean R/S (adjusted for marine survival and delimited at 563 spawners)
- Curve: Hockey-Stick curve
- Conclusion: The Catherine Creek population is at **HIGH** risk based on current abundance and productivity. The point estimate resides below the 25% risk curve (Figure 3).

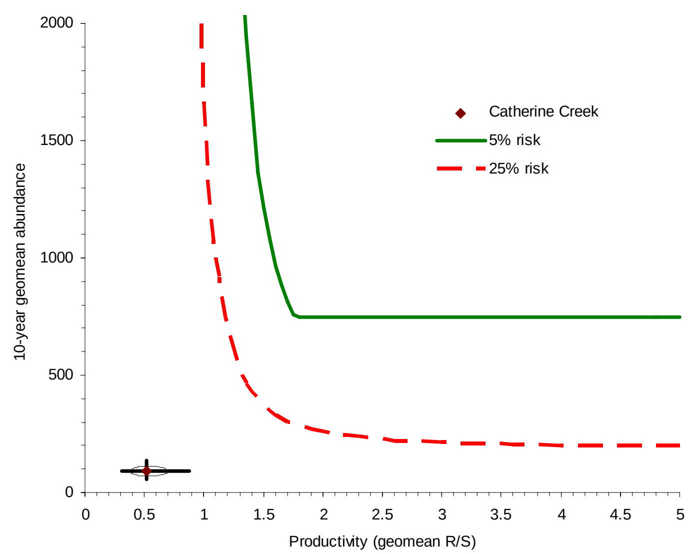

Figure 3. Catherine Creek Spring Chinook abundance and productivity metrics against a Hockey-Stick viability curve. Dataset adjusted for marine survival and delimited at 563 spawners. Estimate includes a 1 SE ellipse, 1.81 X SE abundance line, and 1.75 X SE productivity line.

Spatial Structure and Diversity

The ICTRT has identified two major spawning areas (MaSAs) and two minor spawning areas (MiSAs) within the Catherine Creek Spring Chinook population (Figure 4). Current spawning distribution is reduced substantially from historic. Currently spawning occurs in the mainstem of Catherine Creek above the town of Union and in the North and South Forks. Spawning distribution is reduced as a result of absence of spawning in Catherine Creek below Union and also in Indian Creek. Hatchery fish have comprised a significant proportion of natural spawners. Prior to 1995 hatchery fish were of Carson and Rapid River origin. No hatchery fish were observed from 1995-2000. Since 2001 hatchery fish in Catherine Creek have been Catherine Creek origin.

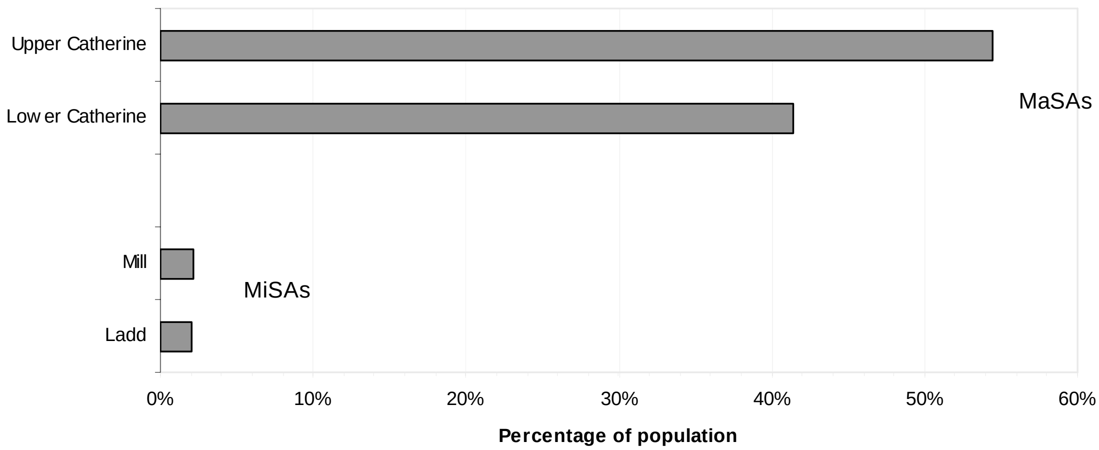

Figure 4. Proportion of major and minor spawning areas that make up the Catherine Creek population. There are no modeled temperature limitations for the MiSAs/MaSAs in this population.

Factors and Metrics

<u>A.1.a. Number and spatial arrangement of spawning areas</u>.
The Catherine Creek population has two MaSAs and two MiSAs (Figure 5) identified based on the intrinsic potential analyses. We believe that the intrinsic potential analyses identified areas that were not utilized historically, including Little Creek. The current distribution map also has information that is inconsistent with the most recent distribution data. The map shows Indian Creek as currently occupied when it actually does not meet the occupied criteria. Based on recent survey data, the Lower Catherine Creek MaSA is unoccupied as are the Ladd and Mill Creek MiSAs. The Upper Catherine Creek MaSA is currently occupied. Based on occupancy of one MaSA, the population is rated as **moderate risk** for this metric. The quantity of currently occupied habitat equals the minimum required for two MaSAs, however the distribution is continuous resulting in one MaSA.

<u>A.l.b. Spatial extent or range of population.</u>

The current spawner distribution is reduced significantly from historic with the loss of occupancy in Indian Creek and lower reaches of Catherine Creek, and the mainstem Grande Ronde River near Indian Creek. Currently 50% of the historic MaSAs are occupied and none of the MiSAs are occupied. The population rates as **moderate risk** for this metric.

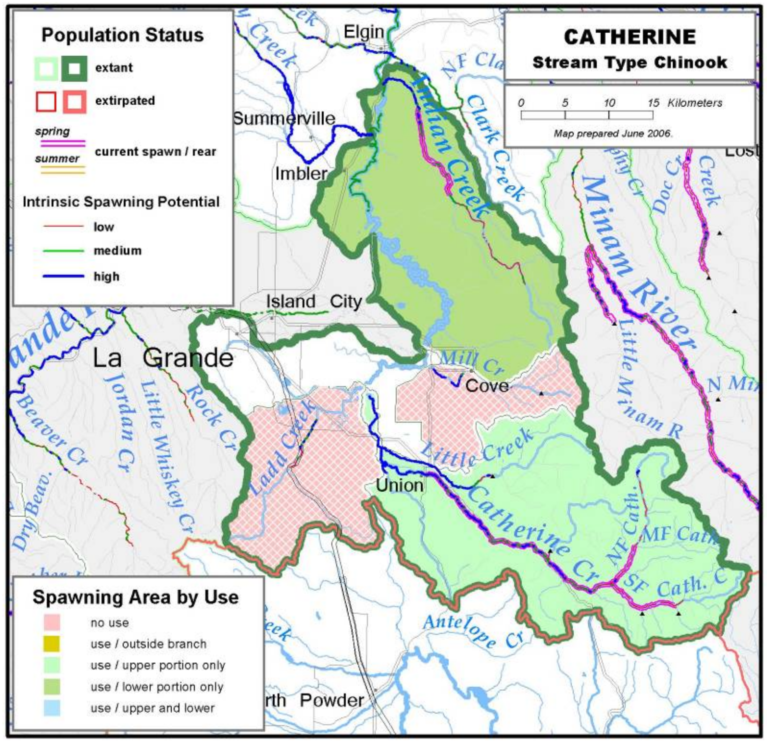

Figure 5. Catherine Creek Spring Chinook distribution.

<u>A.1.c. Increase or decrease in gaps or continuities between spawning areas.</u>

Interpretation of data for this metric is complex because the historic gap between the Lower Catherine Creek MaSA and the Upper Catherine Creek MaSA is greater than 15 km. The loss of occupancy in the Lower Catherine Creek MaSA creates a significant increase in gap between the nearest downstream population, Lookingglass Creek, however, this population is extinct. In addition, the loss of spawning in the lowest reaches of Catherine Creek increases the gap between the Upper Grande Ronde River population and Catherine Creek. This metric is rated at **moderate risk** given the intrinsic gap and the increased gap resulting from loss of occupancy in the Lower Catherine Creek MaSA.

<u>B.1.a. Major life history strategies.</u>

There are currently two primary life history pathways for the freshwater juvenile life stages: fish rear from fry to smolt in the upper reaches of Catherine Creek or fish leave the upper reaches of Catherine Creek in the fall and overwinter in the Grande Ronde valley reaches. We hypothesize that there have been reductions in the variation of juvenile pathways such as the loss of ability of fry and summer parr to move downstream from the upper rearing reaches into the Grande Ronde valley. In addition, adult migration and spawn timing has likely shifted and has reduced variability relative to historic timing as a result of flow and temperature changes in the summer season. We have rated this metric as **moderate risk** because all historical major pathways are present but have reduction in variability in pathways.

B.1.b. Phenotypic variation.

Data are not available to assess the degree to which phenotypic traits have been altered or lost. Therefore, we used habitat changes and EDT results to infer the potential for phenotypic changes. Mainstem Snake and Columbia rivers temperatures and hydrograph have been altered significantly and have impacted phenotypic variation of upstream migrating adults and downstream migrating smolts. We are unsure of the magnitude of influence. Flow and temperature changes have reduced the potential for variation in juvenile migration timing and adult migration timing within the Grande Ronde Basin. Lower flows and warmer water temperatures have likely truncated the adult migration timing and reduced opportunity for fry and summer parr downstream migration in Catherine Creek. We have rated this metric as **moderate risk** due to likely changes in mean and variability of two or more traits.

B.1.c. Genetic variation.

The Catherine Creek population has been rated as **moderate risk** for genetic variation. Genetics data indicates significant divergence from some other Grande Ronde populations, however samples are not significantly different in some years from out-of-basin hatchery stocks which were used for supplementation in the past.

B.2.a. Spawner composition.

(1) *Out-of-ESU strays*. From the early 1980's until the mid 1990's Carson and Rapid River stock hatchery fish were released into Catherine Creek as part of the LSRCP program. The use of these stocks has been discontinued. For our assessment we consider both of these hatchery stocks as out-of-ESU origin. For the period 1991–2005 (three generations) out-of-ESU hatchery fish comprised an average of 18.1% of the naturally spawning fish in Catherine Creek. This level results in a **high risk** rating for this metric.

(2) *Out-of-MPG strays from within the ESU*. We have not recovered any out-of-MPG within ESU strays in Catherine Creek. Therefore, the rating for this metric is **very low risk**.

(3) *Out of population within MPG strays*. We have not recovered any strays from the Lostine River or Upper Grande Ronde River hatchery programs. Therefore, the rating for this metric is **very low risk**.

(4) *Within-population hatchery spawners.* Adults from the local Catherine Creek hatchery broodstock supplementation program began returning in 2001. The mean percent within-population hatchery fraction for the period 2001–2005 was 57.7%. We have characterized this hatchery program as "best management practices." Given this level of hatchery fraction the criteria is rated at **high risk** for this metric.

The overall rating for spawner composition is **high risk**.

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

The intrinsic distribution of the Catherine Creek population encompassed three ecoregions of which two accounted for 10% or greater of the distribution, the Blue Mountain Basins and Continental Zone Foothills (Figure 6). The loss of spawning in the lower reaches of Catherine Creek below the town of Union has resulted in a substantial reduction in the proportion in the Blue Mountain Basins ecoregion (Table 3). We rate the Catherine Creek population as **moderate risk** for distribution across habitat types.

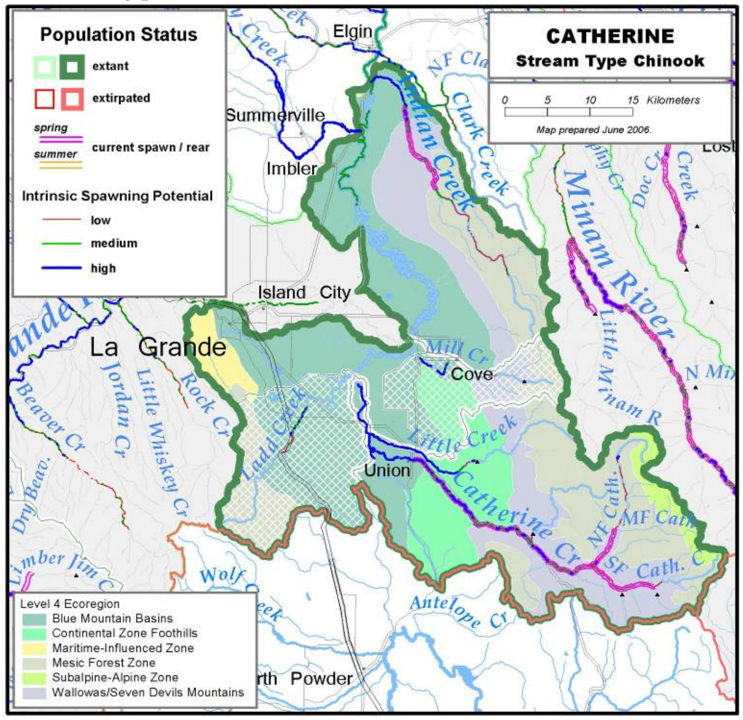

Figure 6. Catherine Creek Spring Chinook population distribution across various ecoregions.

Table 3. Catherine Creek Spring Chinook—proportion of spawning areas across various ecoregions.

Ecoregion	% of historical branch spawning area in this ecoregion (non-temperature limited)	% of historical branch spawning area in this ecoregion (temperature limited)	% of currently occupied spawning area in this ecoregion (non-temperature limited)
Blue Mountain Basins	76.1	76.1	15.4
Continental Zone Foothills	14.6	14.6	45.3
Wallowas/Seven Devils Mountains	9.3	9.3	39.3

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

Hydropower system: The hydropower system and associated reservoirs likely pose some selective mortality on juvenile migrants by altering migration timing, duration, time specific survival, and ocean entrance timing. We do not have quantitative data to assess if the mortality is selective on 25% or more of the affected individuals; however, we hypothesize that the mortality is less than 25% consistently for any population component. We have rated this metric as **low risk**.

Harvest: Current harvest regulations are very restrictive and allow for only a small proportion (5-10%) of Snake River spring-summer Chinook to be harvested annually. The methods of harvest are generally nonselective for adult sized fish. We have rated this metric as **low risk**.

Hatcheries: A hatchery supplementation program is operated within the Catherine Creek population and includes operation of a weir for broodstock collection and passage of adults to the spawning grounds. The hatchery weir is managed such that little or no selection (run-timing, age, etc.) occurs in most years. We have rated this metric as **low risk**.

Habitat: Significant changes in many habitat attributes have occurred in Catherine Creek relative to historic conditions. Flow and temperature patterns are altered with much reduced flow in summer and increased temperatures. These factors have significantly influenced adult and juvenile migration opportunity as well as availability of adult holding habitat. Selective pressures against fry and summer downstream movement and late adult migration are likely significant and affect 25% or greater of the individuals that historically expressed these traits. We have rated this metric as **moderate risk** because multiple life stages are influenced.

The overall rating for selective change is **moderate risk**.

Spatial Structure and Diversity Summary

The combined Spatial Structure/Diversity rating is moderate risk for the Catherine Creek population (Table 4). There are a substantial number of criteria that are rated at moderate or high risk. The rating for Goal A, "allowing natural rates and levels of spatially mediated processes," was moderate with metrics for number and arrangement of spawning areas, range of population and changes in gaps and continuity rated as moderate risk.

The rating for Goal B, "maintaining natural levels of variation," was moderate risk. This Goal B rating was driven by impairment for all of the Goal B metrics resulting from: loss in life history strategies; reduced phenotypic variation; genetic variation; past affects of out-of-ESU hatchery fish and recent high fractions of local origin hatchery fish (Table 5); and, selective mortality affects of the tributary habitat. We expect the risk ratings for genetic variation and out-of-ESU hatchery strays to improve over time because of the hatchery broodstock management changes that have occurred.

Table 4. Spatial structure and diversity scoring table

Metric	Risk Assessment Scores				
	Metric	Factor	Mechanism	Goal	Population
A.1.a	M (0)	M (0)			
A.1.b	M (0)	M (0)	Mean = 0 Moderate Risk	Moderate	
A.1.c	M (0)	M (0)			
B.1.a	M (0)	M (0)			
B.1.b	M (0)	M (0)	Moderate (0)		
B.1.c	M (0)	M (0)			
B.2.a(1)	H (-1)				
B.2.a(2)	VL (2)		High Risk (-1)		**Moderate Risk**
B.2.a(3)	VL (2)			Mean = (-.25) Moderate Risk	
B.2.a(4)	H (-1)				
B.3.a	M (0)	M (0)	M (0)		
B.4.a	M (0)	M (0)	M (0)		

Overall Viability Rating:

The overall viability rating for the Catherine Creek population does not meet viability criteria and is considered high risk (Figure 7). The 10-year geomean natural origin abundance is 89 adults, which is only 11.9% of the “intermediate” size population threshold of 750 and 8.9% of the 1,000 threshold for a “large” population. The point estimate of productivity (0.52, Table 6) is in the low end of the high risk zone and is one of the lowest for this ESU. The spatial structure/diversity rating is moderate risk, however there are numerous SS/D impairments that would need to be addressed to move the population to the low risk level.

		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%)			**Catherine Creek**	

Figure 7. Viable Salmonid Population parameter risk ratings for the Catherine Creek 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)***

Catherine Creek Spring Chinook – Data Summary

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

Table 5. Catherine Creek Spring Chinook run data (used for curve fits and R/S analysis). Data used in the productivity calculation are bolded.

Brood Year	Adult Spn.	%Wild	Natural Run	Nat. Rtns	R/S	Rel. SAR	Adj. Rtns	Adj. R/S
1981	**264**	**1**	**264**	**387**	**1.46**	**0.63**	**243**	**0.92**
1982	717	1	717	212	0.30	0.51	108	0.15
1983	733	1	733	206	0.28	0.58	119	0.16
1984	**378**	**1**	**378**	**117**	**0.31**	**1.65**	**194**	**0.51**
1985	**371**	**1**	**371**	**50**	**0.14**	**1.57**	**79**	**0.21**
1986	**372**	**0.80**	**310**	**4**	**0.01**	**1.41**	**6**	**0.02**
1987	669	0.22	150	10	0.01	1.83	18	0.03
1988	674	0.24	160	125	0.19	0.75	94	0.14
1989	**184**	**0.38**	**72**	**16**	**0.09**	**1.79**	**29**	**0.16**
1990	**144**	**0.00**	**0**	**5**	**0.04**	**4.65**	**25**	**0.17**
1991	**48**	**0.13**	**8**	**34**	**0.71**	**3.01**	**103**	**2.13**
1992	**160**	**0.25**	**40**	**46**	**0.29**	**1.65**	**76**	**0.48**
1993	**257**	**0.40**	**99**	**156**	**0.61**	**1.61**	**251**	**0.98**
1994	**27**	**0.50**	**14**	**19**	**0.70**	**1.04**	**20**	**0.73**
1995	**34**	**1**	**34**	**50**	**1.48**	**0.60**	**30**	**0.89**
1996	**34**	**1**	**34**	**76**	**2.22**	**0.54**	**41**	**1.21**
1997	**96**	**1**	**96**	**379**	**3.93**	**0.30**	**112**	**1.16**
1998	**91**	**1**	**91**	**290**	**3.19**	**0.30**	**86**	**0.95**
1999	**43**	**1**	**43**	**62**	**1.46**	**0.65**	**40**	**0.95**
2000	**53**	**1**	**53**	**71**	**1.33**	**1.00**	**71**	**1.33**
2001	358	0.79	358					
2002	401	0.51	207					
2003	370	0.45	190					
2004	207	0.34	70					
2005	138	0.35	49					

Table 6. Geomean abundance and productivity measures. Values used for 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.	0.92	0.50	0.85	0.52	1.06	0.97	89
Std. Err.	0.43	0.41	0.22	0.30	0.30	0.27	0.24
count	10	16	10	16	12	20	10

Table 7. Poptools stock-recruitment curve fit parameter estimates.

	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	0.38	0.14	n/a	n/a	1.30	0.72	81.2	0.38	0.11	n/a	n/a	1.04	0.61	71.7
Const. Rec	60	18	n/a	n/a	n/a	n/a	72.2	61	13	n/a	n/a	n/a	n/a	59.0
Bev-Holt	4.98	9.81	69	27	1.30	0.48	74.8	2.54	2.25	79	25	0.77	0.26	60.3
Hock-Stk	1.21	0.63	55	35	1.24	0.51	74.5	1.13	0.41	62	27	0.73	0.26	59.4
Ricker	0.99	0.46	0.00361	0.00128	1.38	0.53	77.2	1.02	0.31	0.00366	0.00086	0.81	0.27	61.5

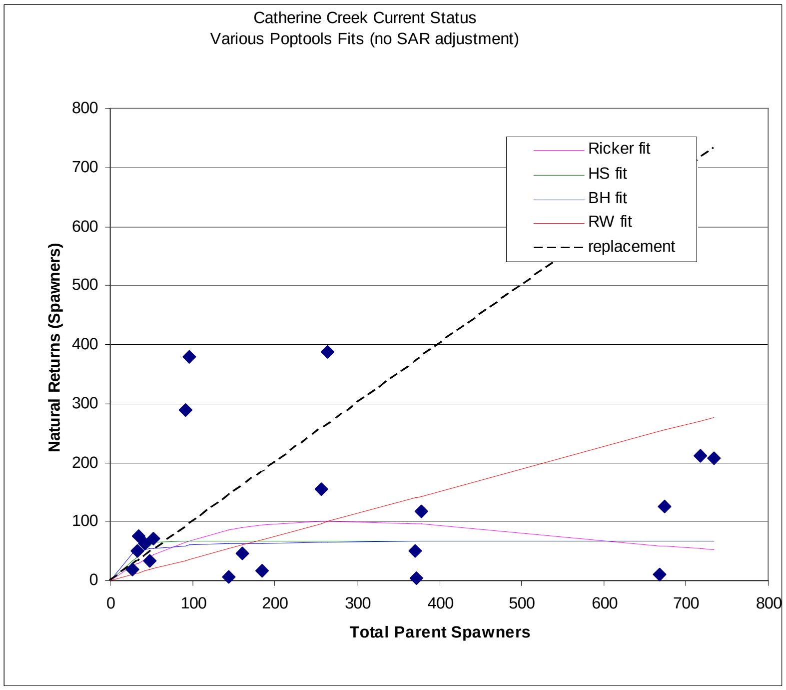

Figure 8. Stock recruitment curves for the Catherine Creek Spring Chinook population. Data not adjusted for marine survival. Points used in the current productivity calculation are bolded.

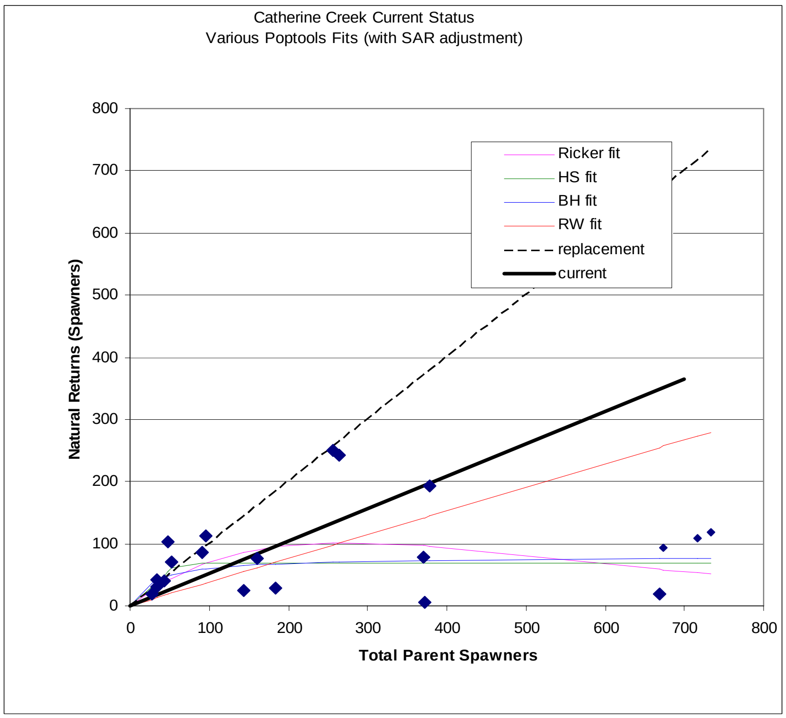

Figure 9. Stock-recruitment curves for the Catherine Creek Spring Chinook population. Data adjusted for marine survival. Points used in the current productivity calculation are bolded.