Wallowa/Lostine Rivers Spring Chinook Population

The Wallowa/Lostine Rivers Spring/Summer 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 Wallowa/Lostine Rivers population is a spring run and is one of seven extant populations in the Grande Ronde / Imnaha MPG.

The ICTRT classified the Wallowa/Lostine Rivers population as a "large" population (Table 1) based on historical habitat potential (ICTRT 2005). A Chinook population classified as large has a mean minimum abundance threshold criteria of 1,000 naturally produced spawners with a sufficient intrinsic productivity (greater than 1.45 recruits per spawner at the threshold abundance level) to achieve a 5% or less risk of extinction over a 100-year timeframe.

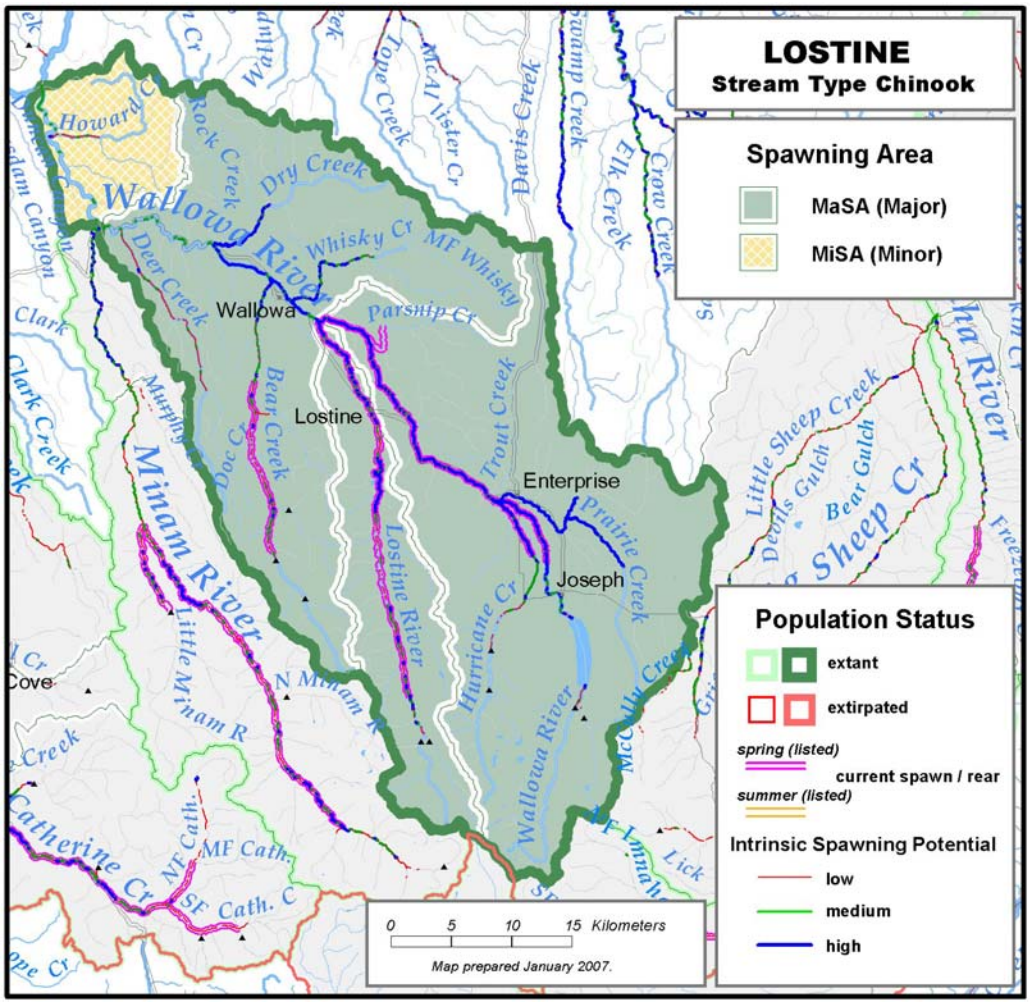

Figure 1. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population boundary and major (MaSA) and minor (MiSA) spawning areas.

Table 1. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population basin statistics and intrinsic potential analysis summary.

Drainage Area (km2)	1,852
Stream lengths km[a] (total)	720
Stream lengths km[a] (below natural barriers)	560
Branched stream area weighted by intrinsic potential (km2)	0.894
Branched stream area km2 (weighted and temp. limited)[b]	0.894
Total stream area weighted by intrinsic potential (km2)	1.053
Total stream area weighted by intrinsic potential (km2) temp limited[b]	1.053
Size / Complexity category	Large / "B" (Dendritic structure)
Number of Major Spawning Areas	3
Number of Minor Spawning Areas	1

[a]All stream segments greater than or equal to 3.8m bankfull width were included

[b]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 (1952 to 2005) abundance (number of adult spawners in natural production areas) has ranged from 37 (1995) to 1,463 in 1964 (Figure 2). Abundance estimation methods have varied through time. Prior to 1997 for the Lostine River and all other streams, spawner abundance was estimated from expanded redd counts multiplied by an average 3.2 spawners per redd estimate. From 1997 to present, spawner abundance in the Lostine River was calculated from escapement estimates based on weir counts, mark-recapture estimates, and redd counts, adjusted for pre-spawning mortality estimated from carcass recoveries.

Spawning ground surveys have evolved over time to become more expansive spatially and temporally since initial index surveys were conducted in1952. Initially, index surveys were conducted once yearly in only a portion of available spawning habitat of each stream. Although these surveys were scheduled to take place following peak spawning, they were not total estimates of redds because they did not account for spatial and temporal variability in Chinook salmon spawning. Beginning in 1986, surveys were designed to account for this variability by conducting extensive and supplemental surveys. Extensive area surveys covered nearly all possible spring Chinook spawning areas of a stream and were conducted on the same date of the index survey. One or more supplemental surveys were conducted at approximately one week intervals following the initial index survey. Initially, supplemental surveys were conducted in index areas only but have evolved to cover entire spawning areas. Table 2 lists the implementation years and types of surveys conducted in the four streams where significant Chinook spawning occurs within the population.

Table 2. Dates and types of surveys conducted on streams in the Wallowa Basin.

Stream	Index Only	Index and extensive areas with supplemental in index area	Index and extensive with supplemental in all areas	Index with supplemental in index area	Index and extensive (no suppl.)
Lostine River	1949-1985	1987-1995	1996-2005		1986
Wallowa River	1955-1957, 1963-1994 1996		2004-2005	1995, 1997-2005	
Hurricane Creek	1963-1985 1996-1997			1986-1995, 1998-2005	
Bear Creek	1964-1992				1993-2005

In years when extensive and/or supplemental surveys were conducted, spatial and/or temporal expansion factors were developed to expand redd counts for years when no supplemental surveys were conducted. On the Lostine River, spatial expansions were developed using 1988-2005 survey data. The spatial expansion factor was calculated as the ratio of redd counts in the index areas to total redd counts in the combined index and extensive areas. In some years, however, small sections of extensive areas were not surveyed and redds needed to be estimated before calculating an expansion factor. We estimated the number of redds in unsurveyed sections by first calculating the ratio of redds in that section to redds in the adjacent upstream section for years when data was available then multiplied the average ratio by the redd count in the upper section to estimated redds in the unsurveyed section. After accounting for all missed sections, spatial expansion factors were calculated as described above. The average spatial expansion factor from 1988-2005 was used in years when no extensive surveys were conducted.

Temporal expansion factors were developed using 1987-2005 survey data. From 1987-1995, the temporal expansion factor was calculated as the ratio of index redd counts to the total redds in index areas observed during all surveys. From 1996-2005, the ratio was the total redds during the first survey (index and extensive areas) divided by the total redds in the same areas after two supplemental surveys. The average temporal expansion factor from 1987-2005 was used in years when no supplemental surveys were conducted.

For years when supplemental surveys were not conducted, redd counts were first expanded spatially by dividing index counts by year specific spatial expansion factor. The average temporal expansion factor was used to expand the estimate temporally. For years when only index counts were conducted, average spatial and temporal expansion factors were used to estimate total redds. From 1996 to 2005, when both extensive and supplemental surveys were conducted on all areas, redd counts represent a census inventory of spawning and no expansions were necessary.

In the Wallowa River, there were insufficient data to calculate both temporal and spatial expansion factors. For this stream, we used temporal expansion factors calculated for the Lostine River to expand Wallowa River redd counts since dates of index surveys for both streams were similar. We did not attempt to expand redd counts spatially because the two years when extensive surveys were conducted were heavily influence by hatchery outplants and we did not feel the data derived from extensive surveys represented conditions prior to hatchery influences.

In Hurricane Creek, no spatial expansions were needed as the index sections account for all spawning areas. Temporal expansions were calculated using 1988-1989, 1991, 1993, and 2000-2005. In these years supplemental surveys were carried out in mid to late September when most spawning is completed. Average temporal expansion factors were used to expand for years when only index surveys were conducted.

In Bear Creek, we did not attempt to expand index redd counts because insufficient data existed to calculate expansion factors and we did not substitute expansion factors from other streams because dates of initial index surveys on Bear Creek did not correlate with any other stream. Few redds are observed in Bear Creek.

Once total redds were estimated for each stream, we estimated adult spawners for each stream and year where data were available. An average of 3.2 spawners per redd was used based on Imnaha River estimates (Beamesderfer et al. 1997). Spawner abundance was estimated by multiplying fish per redd by the expanded redd count for each year and stream. Total spawners for the population was the sum of all streams. We did not attempt to adjust total spawners to account for years when surveys were not conducted on some streams; however, for the most recent 25 years there were no missing data.

From 1997 to present in the Lostine River, 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 adults and jacks 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 above the weir was the sum of the total trapped and estimated untrapped fish. The estimated escapement below the weir was determined by first calculating a fish per redd estimate above the weir and applying this ratio to the observed number of redds below the weir. Total escapement was the sum of the estimated escapement above and below the weir. Total spawners were estimated by multiplying an estimated pre-spawn survival rate to the estimated total 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. Females carcasses with greater 50% of eggs retained were considered pre-spawn mortalities.

The estimated total spawners includes hatchery- and natural-origin fish. Prior to 1986 the hatchery fraction was 0%. From 1986-1994 the fraction of total spawners that were hatchery-origin fish was calculated based on results of discriminate scale analyses and CWT-fin marked fish recovery. The proportion of total adult spawners of hatchery origin for years 1995-2005 was

derived from carcasses recovered during spawning ground surveys that were >50% spawned and observations at the Lostine weir (1997-2005). Hatchery origin was determined by the presence of a fin mark and coded-wire tag.

Age structure of adults of natural origin on spawning grounds was determined from carcass recoveries when sufficient sample sizes were available (n>20). Adults of natural origin were determined by the absence of a fin mark and coded-wire tag. Only fish >50% spawned were used in estimates. Age was determined by scale analysis and length-age relationships.

Recent year natural spawners include returns originating from naturally spawning parents, and hatchery strays (prior to 2000) primarily produced from Lookingglass Fish Hatchery releases in the Grande Ronde Basin. Prior to 2000, strays were of Carson and Rapid River hatchery stock origin. A hatchery supplementation program was initiated in the Lostine River beginning with adult Lostine River collections in 1997. For the period 2000-2005, all hatchery fish in the Wallowa/Lostine Rivers Population were of Lostine River origin. Spawners originating from naturally spawning parents have comprised an average of 85% since 1959, while the most recent 10-year average is 70% (Table 3).

Abundance in recent years has been variable, the most recent 10-year geomean number of natural-origin spawners was 276 (Table 3). During the period 1981-2000, returns per spawner for Chinook in Wallowa/Lostine population ranged from 0.05 (1987) to 8.44 (1981). The most recent 20-year (1981-2000) SAR adjusted and delimited (at 75% of the 1,000 abundance threshold) geometric mean of returns per spawner was 0.78 (Table 3).

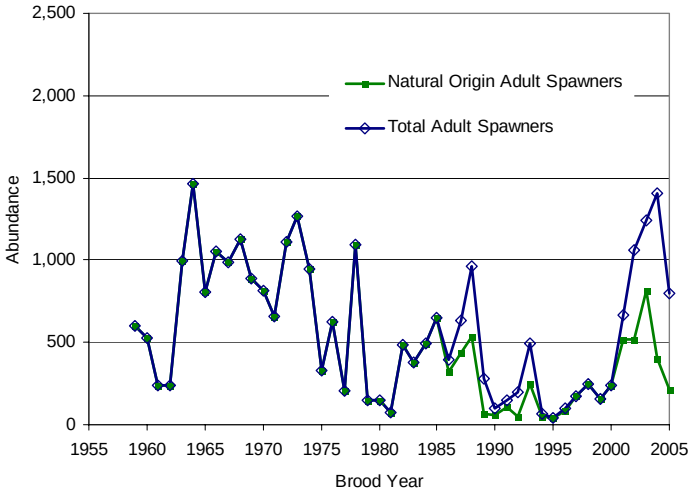

Figure 2. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population spawner abundance estimates (1959-2005).

Table 3. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population abundance and productivity estimates.

10-year geomean natural abundance	276
20-year return/spawner productivity	0.72
20-year return/spawner productivity, SAR adj. and delimited[a]	0.78
20-year Bev-Holt fit productivity, SAR adjusted	n/a
20-year Lambda productivity estimate	1.05
Average proportion natural origin spawners (recent 10 years)	0.70
Reproductive success adj. for hatchery origin spawners	n/a

[a]Delimited productivity excludes any spawner/return pair where the spawner number exceeds 75% of the size 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-year geomean natural origin spawners
- Productivity: 20-year geomean R/S (adjusted for marine survival and delimited at 750 spawners)
- Curve: Hockey-Stick curve
- Conclusion: The Wallowa/Lostine Rivers Chinook population is at **HIGH** risk based on current abundance and productivity. The point estimate resides below the 25% risk curve (Figure 3).

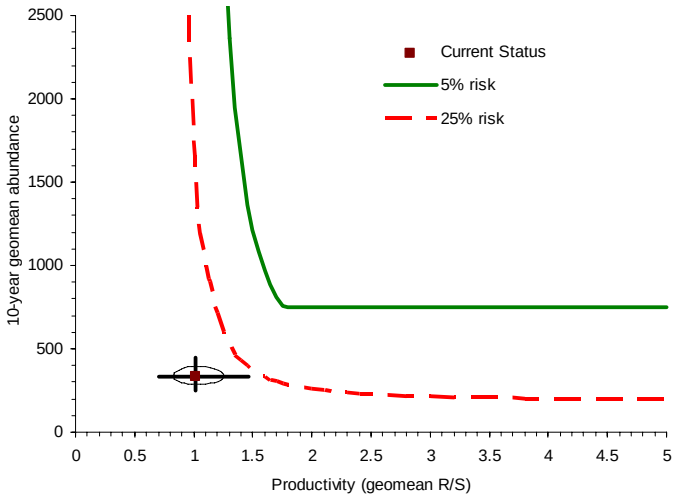

Figure 3. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population current estimate of abundance and productivity compared to the viability curve for this ESU. The point estimate includes a 1 SE ellipse and 95% CI (1.81 X SE abundance line, and 1.73 X SE productivity line).

Spatial Structure and Diversity

The ICTRT has identified three major spawning areas (MaSAs) and one minor spawning area (MiSA) within the Wallowa/Lostine Rivers Spring Chinook population (Figure 4). Currently spawning occurs in the Lostine River from the mouth to the headwaters, Wallowa River upstream of the confluence with the Lostine River, Hurricane Creek, Bear Creek, and in some years in the lower reach of Parsnip Creek. Spawning distribution may be reduced from historic in the Wallowa River below the confluence with the Lostine River. Out-of-ESU hatchery strays and supplementation fish from the Lostine River have comprised a significant proportion of natural spawners since the mid 1980s.

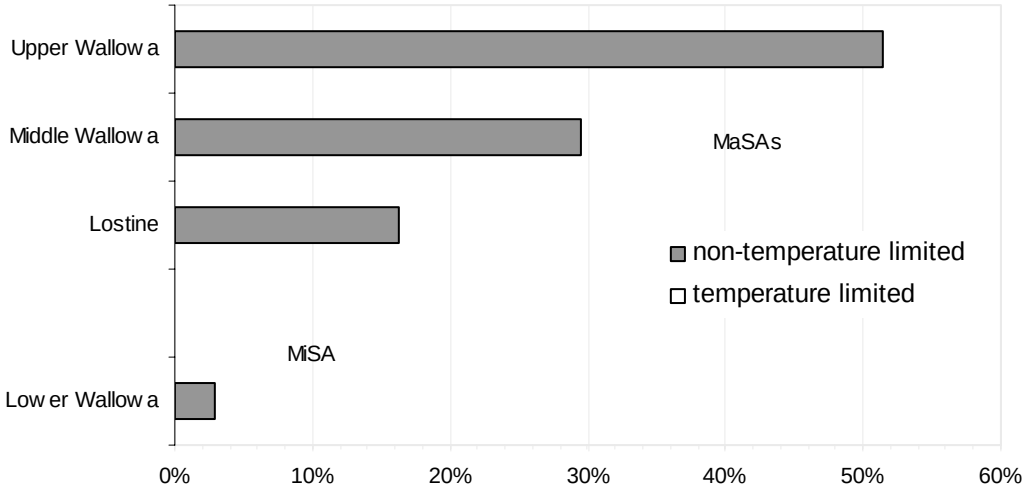

Figure 4. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population distribution of intrinsic potential habitat across major and minor spawning areas.

Factors and Metrics

A.1.a. Number and spatial arrangement of spawning areas.

The Wallowa/Lostine population has three MaSAs and one MiSA (Figure 4) identified based on the intrinsic potential analyses. Current spawner distribution is similar to historic with a small reduction in the lower portion of the Middle Wallowa MaSA (Figure 5). Currently the upper Wallowa and Lostine MaSAs are occupied in a branched configuration separated by one or more confluences. We have rated this metric as **low risk**.

A.l.b. Spatial extent or range of population.

The lower portion of the Middle Wallowa MaSA is not currently used and this results in loss of occupancy in this MaSA. With the loss of occupancy in this MaSA, the historical range is reduced and 67% of the historical MaSAs are occupied. We have rated this metric as **moderate risk**.

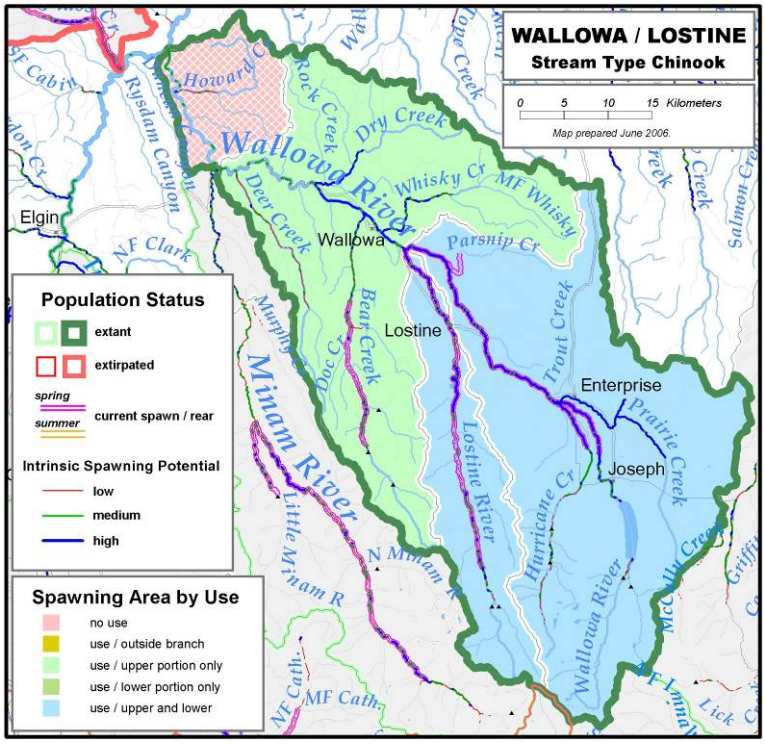

Figure 5. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population current spawning distribution and spawning area occupancy designations.

A.1.c. Increase or decrease in gaps or continuities between spawning areas.

There has been a minor increase in gap between the Wallowa/Lostine population and the Minam River population as a result of reduction in range of spawning. This reduction has not changed gap distances significantly between MaSAs within the population. We have rated the population as **low risk**.

B.1.a. Major life history strategies.

There are currently two primary life history pathways utilized for the freshwater juvenile stages: fish rear from emergent fry to smolt in the reaches that are used for spawning, or, fish redistribute downstream in the fall from the spawning areas into the lower mainstem Wallowa and Grande Ronde rivers, where they overwinter prior to beginning seaward migration in the spring. We hypothesize that these were the primary historic life history strategies. There is historic documentation from the early 1900's that a significant number of adults spawned through October. Current spawn timing is truncated significantly with no spawning in October. Thus, it appears there has been a significant reduction in variability of life history pathways. We have rate this metric as **moderate risk**.

B.1.b. Phenotypic variation.

We use habitat changes, EDT results, and documented changes in phenotypic traits to assess this metric. Mainstem Snake and Columbia rivers temperatures and hydrograph have been altered significantly. These changes have influenced variation in migration patterns of adults and smolts. We are unsure of the magnitude of influence. Historically the Wallowa/Lostine population included adults that migrated to the spawning grounds in late summer-early fall and spawned throughout the month of October and in early November. Recent surveys indicate there are no longer October spawners in the population and this component has been lost. We have rated this metric as **moderate risk** due to changes in one or more traits and the loss of the late spawners.

B.1.c. Genetic variation.

The Wallowa/Lostine population has been rated as **low risk** for genetic variation. There is consistent temporal variation within the population and the population is significantly different from other Grande Ronde populations. In some years the Lostine samples are similar to hatchery samples, however in comparison to other Grande Ronde populations there is less similarity. There is limited information on substructure within the population. Information comparing similarity of Wallowa, Hurricane, and Lostine natural-origin fish would be useful for better understanding of the population substructure.

B.2.a. Spawner composition.

(1) *Out-of-ESU spawners*. From the early 1980's until the mid 1990's Carson and Rapid River stock hatchery fish were released at Lookingglass Fish Hatchery, upper Grande Ronde River, Catherine Creek, and adults were outplanted into the Wallowa River and Hurricane Creek. The use of these stocks has been discontinued. For our assessment we consider both of these stocks as out-of-ESU origin. During this time period, a significant number of hatchery fish strayed into and spawned in the Lostine River and in some years adults outplanted into Hurricane Creek and Wallowa River spawned naturally. The last year out-of-ESU strays were recovered in this population was in 2000. For the period 1991-2005 (3 generations) out-of-ESU hatchery fish comprised 13.7% of the natural spawning fish. This fraction results in a **high risk** rating.

(2) *Out-of-MPG spawners from within the ESU*. We have not recovered any other out-of-MPG Snake River hatchery fish in this population. Therefore, the rating for this metric is **very low risk**.

(3) *Out of population within MPG spawners*. We have not recovered any Catherine Creek or upper Grande Ronde River hatchery fish in this population. The rating is **very low risk** for this metric.

(4) *Within-population hatchery spawners.* Adults from the local Lostine River hatchery broodstock supplementation program began returning in 2000. The hatchery fraction increased from 2000-2005. This hatchery program has been characterized as not using best management practices because of the significant number of Lostine River hatchery adults that have been outplanted into the Wallowa River and Hurricane Creek (use of broodstock from one MaSA to

supplement another MaSA disrupting natural substructure). The mean hatchery fraction for the period 2000-2005 is 44.25%. This fraction of hatchery-origin fish results in a **high risk** rating.

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

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

The intrinsic potential distribution of the Wallowa/Lostine population encompassed four ecoregions (Figure 6) of which only one accounted for more than 10% (Table 4) of the distribution (Blue Mountain Basins). There has not been any significant changes in ecoregion distribution from the intrinsic potential. We have rated this metric as **low risk**.

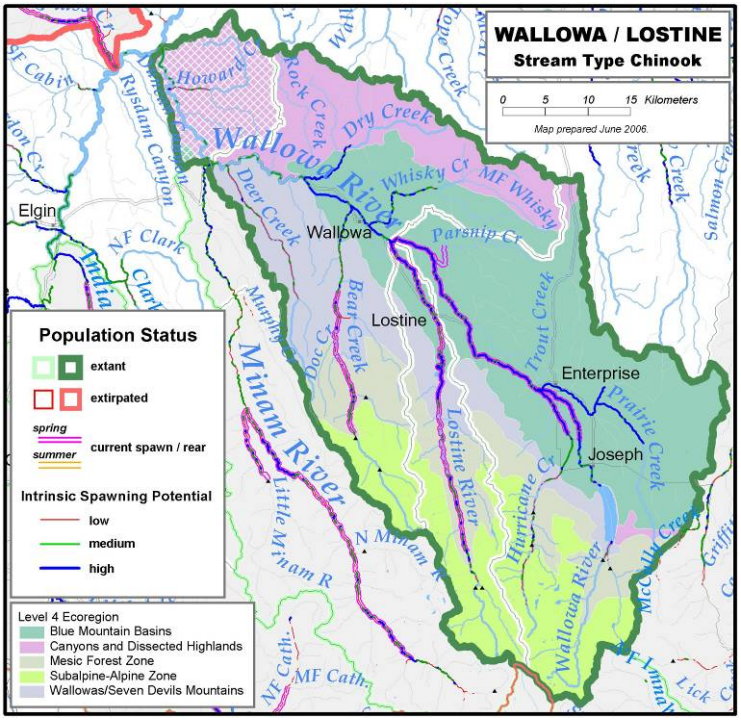

Figure 6. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population spawning distribution across EPA level 4 ecoregions..

Table 4. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population proportion of current spawning areas across EPA level 4 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	88.0	88.0	81.0
Canyons and Dissected Highlands	3.2	3.2	0.0
Mesic Forest Zone	4.5	4.5	10.8
Wallowas/Seven Devils Mountains	4.2	4.2	8.2

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 Lostine River 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: Changes in some habitat attributes have occurred within this population. Flow and temperature patterns are altered with significantly reduced flow and elevated temperatures in some reaches. We do not believe these changes have resulted in mortality rates high enough to impact 25% of the individuals within a single trait distribution. We have rated the metric as **low risk**.

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

Spatial Structure and Diversity Summary

The combined integrated Spatial Structure/Diversity rating is moderate risk for the Wallowa/Lostine population (Table 5). The rating for Goal A, “allowing natural rates and levels of spatially mediated processes,” was low risk. The current spawning distribution is similar to historic with only a minor reduction in range in the lower reaches of the Wallowa River. Good continuity exists in the spawner distribution without any significant increases in gaps. The rating for Goal B “maintaining natural levels of variation” was moderate risk. The Goal B rating was primarily driven by the loss of late spawning adults (October spawners) in the population, high spawner composition risk due to past out-of-ESU strays, and recent high fraction of local origin hatchery fish.

Table 5. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population spatial structure and diversity risk rating summary.

Metric	Risk Assessment Scores				
	Metric	Factor	Mechanism	Goal	Population
A.1.a	L (1)	L (1)	Mean = 0.67 Low Risk	Low	**Moderate Risk**
A.1.b	M (0)	M (0)			
A.1.c	L (1)	L (1)			
B.1.a	M (0)	M (0)	Moderate (0)	Mean = (.25) Moderate Risk	
B.1.b	M (0)	M (0)			
B.1.c	L (1)	L (1)			
B.2.a(1)	H (-1)	H (-1)	High Risk (-1)		
B.2.a(2)	VL (2)				
B.2.a(3)	VL (2)				
B.2.a(4)	H (-1)				
B.3.a	L (1)	L (1)	L (1)		
B.4.a	L (1)	L (1)	L (1)		

Overall Viability Rating:

The overall rating for the Wallowa/Lostine population does not meet viability criteria and is considered high risk (Figure 7). The 10-year geomean natural origin abundance is 276, which is only 27.6% of the 1,000 threshold abundance. The point estimate of productivity 0.78 (Table 7) is in the high risk zone and well below the goal of 1.45 recruits per spawner at the threshold abundance. The spatial structure/diversity rating is moderate risk due to reduced life history diversity and spawner composition.

		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%)			**Wallowa/ Lostine**	

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Figure 7. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population risk ratings integrated across the four viable salmonid population (VSP) metrics. ***Viability Key: HV – Highly Viable; V – Viable; M – Candidate for Maintained; Shaded cells-- not meeting viability criteria (darkest cells are at greatest risk)***

Wallowa/Lostine Rivers Spring/Summer Chinook – Data Summary

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

Table 6. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population abundance and productivity data used for curve fits and R/S analysis. Bolded values were used in estimating the current productivity (Table 7).

Brood Year	Adult Spn.	%Wild	Nat. Adults	Nat. Rtns	R/S	Rel. SAR	Adj. Rtns	Adj. R/S
1981	**72**	**1.00**	**72**	**607**	**8.44**	**0.63**	**381**	**5.31**
1982	**489**	**1.00**	**489**	**352**	**0.72**	**0.51**	**180**	**0.37**
1983	**375**	**1.00**	**375**	**682**	**1.82**	**0.58**	**393**	**1.05**
1984	**492**	**1.00**	**492**	**161**	**0.33**	**1.65**	**265**	**0.54**
1985	**649**	**1.00**	**649**	**60**	**0.09**	**1.57**	**94**	**0.14**
1986	**393**	**0.77**	**317**	**121**	**0.31**	**1.41**	**171**	**0.44**
1987	**635**	**0.68**	**435**	**34**	**0.05**	**1.83**	**62**	**0.10**
1988	965	0.55	532	235	0.24	0.75	176	0.18
1989	**277**	**0.24**	**64**	**93**	**0.33**	**1.79**	**166**	**0.60**
1990	**95**	**0.60**	**57**	**6**	**0.06**	**4.65**	**26**	**0.27**
1991	**148**	**0.65**	**106**	**41**	**0.28**	**3.01**	**124**	**0.84**
1992	**194**	**0.25**	**49**	**87**	**0.45**	**1.65**	**145**	**0.74**
1993	**496**	**0.49**	**246**	**363**	**0.73**	**1.61**	**585**	**1.18**
1994	**67**	**0.75**	**50**	**57**	**0.86**	**1.04**	**60**	**0.90**
1995	**37**	**1.00**	**37**	**165**	**4.43**	**0.60**	**99**	**2.66**
1996	**96**	**0.88**	**85**	**272**	**2.84**	**0.54**	**148**	**1.54**
1997	**170**	**1.00**	**170**	**550**	**3.23**	**0.30**	**163**	**0.95**
1998	**246**	**1.00**	**246**	**834**	**3.39**	**0.30**	**248**	**1.01**
1999	**158**	**0.96**	**158**	**478**	**3.02**	**0.65**	**310**	**1.96**
2000	**241**	**0.75**	**241**	**380**	**1.58**	**1.00**	**380**	**1.58**
2001	663	0.74	518					
2002	1,065	0.48	517					
2003	1,245	0.59	812					
2004	1,408	0.28	406					
2005	798	0.28	217					

Table 7. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population geometric mean abundance and productivity estimates (values used for current productivity and abundance are shown in boxes).

	R/S measures				Lambda measures		Abundance
	Not adjusted		SAR adjusted		Not adjusted		Nat. origin
delimited	median	75% threshold	median	75% threshold	1987-1998	1981-2000	geomean
Point Est.	1.26	0.76	1.26	0.78	1.05	1.05	276
Std. Err.	0.48	0.34	0.26	0.22	0.27	0.25	0.21
count	10	19	10	19	12	20	10

Table 8. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population stock-recruitment curve fit parameter estimates. Biologically unrealistic or highly uncertain values are highlighted in grey.

	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	0.72	0.23	n/a	n/a	1.22	0.63	75.8	0.73	0.16	n/a	n/a	0.79	0.39	60.2
Const. Rec	164	45	n/a	n/a	n/a	n/a	69.6	165	27	n/a	n/a	n/a	n/a	48.8
Bev-Holt	6.06	10.83	196	82	1.12	0.49	72.1	3.65	2.75	224	63	0.48	0.06	49.5
Hock-Stk	1.24	0.56	165	92	1.08	0.53	72.5	1.40	0.44	141	51	0.49	0.08	49.9
Ricker	1.97	0.88	0.00320	0.00114	1.17	0.45	71.9	1.83	0.45	0.00293	0.00063	0.45	-0.02	48.3

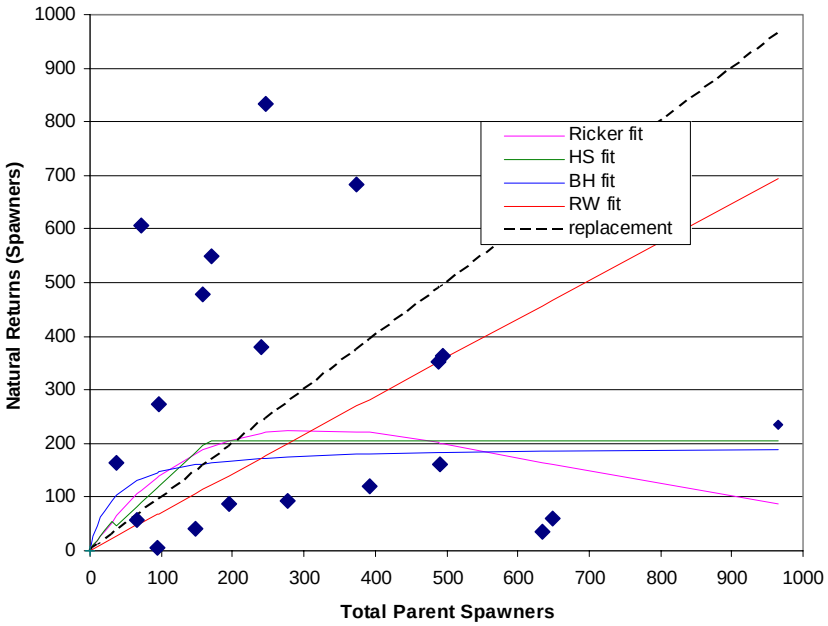

Figure 8. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population stock recruitment curves. Bolded points were used in estimating the current productivity. Data were not adjusted for marine survival.

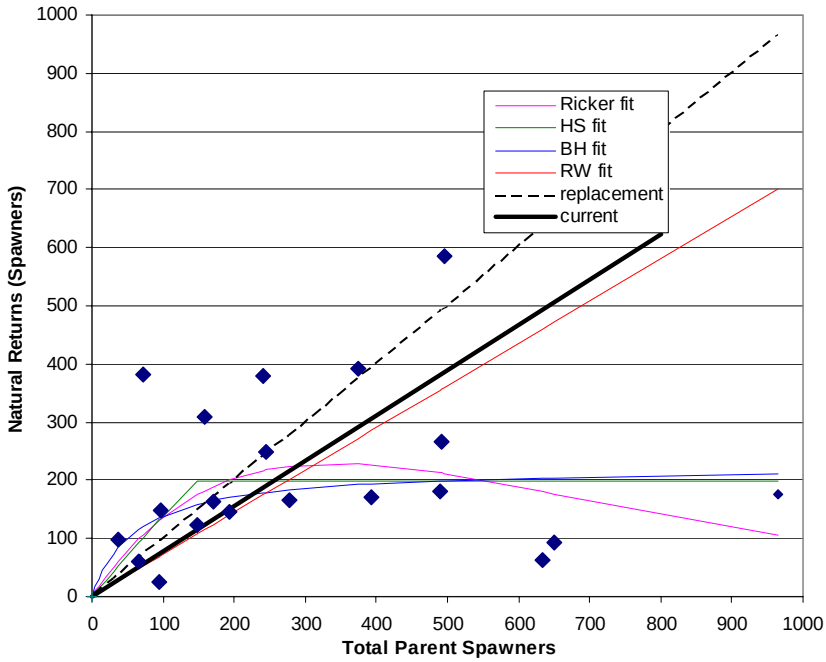

Figure 9. Wallowa/Lostine Rivers Spring/Summer Chinook Salmon population stock recruitment curves. Bolded points were used in estimating the current productivity. Data were adjusted for marine survival.