

Appendix A. summary of estimated population size, parameter estimates, risk of extinction and 90% decline in abundance and needed improvements in lambda to achieve lambda = 1 and to reduce risk of decline or extinction in 50 years to below 5%, assuming that hatchery fish and wild fish reproduce at equal rates. Only estimates for stocks and ESUs that had estimates of the hatchery proportion are shown. Estimates are provided for individual stocks and ESUs (in bold).

ESU	Stock	Population Estimate (TS ₀)	Population Parameter Estimates						Risk of Extinction			Risk of 90% Decline			Notes ³
			μ	σ ²	λ (95% CI)	Prob λ < 1.0	Prob λ < 0.9	Req % Inc	50 years (95% CI)	Prob VHER ¹	Req % Inc	50 years (95% CI)	Prob VHRD ²	Req % Inc	
Lower Columbia R. chinook	Abernathy Cr fall-tule	3968	-0.27	0.02	0.76 (0.65 - 0.89)	0.94	0.88	32	1 (0.48 - 1)	0.88	16	1 (1 - 1)	0.96	31	
	Coweman R fall-tule	2923	0.23	0.19	1.26 (0.84 - 1.90)	0.14	0.07	0	0 (0 - 0.12)	0.09	0	0 (0 - 0.64)	0.18	0	
	Lewis R fall-bright	37665	-0.04	0.05	0.96 (0.78 - 1.18)	0.62	0.29	4	0 (0 - 0.36)	0.18	0	0.43 (0 - 1)	0.62	5	
	Lewis EF fall-tule	853	-0.01	0.02	0.99 (0.85 - 1.14)	0.53	0.18	1	0 (0 - 0.27)	0.21	0	0.06 (0 - 1)	0.48	1	
	Sandy R fall-late	3907	0.00	0.02	1 (0.83 - 1.19)	0.50	0.22	0	0 (0 - 0.02)	0.21	0	0.02 (0 - 1)	0.48	0	
	Sandy R fall-tule	410	-0.22	0.10	0.81 (0.24 - 2.67)	0.75	0.62	23	0.99 (0 - 1)	0.70	19	1 (0 - 1)	0.79	28	
Upper Columbia R. chinook	ESU Level	4037	-0.18	0.13	0.84 (0.61 - 1.15)	0.97	0.78	19	0.66 (0 - 1)	0.80	12	1 (0 - 1)	0.88	25	t, d
	Entiat R spr	188	-0.22	0.05	0.8 (0.66 - 0.98)	0.92	0.81	25	1 (0.08 - 1)	0.89	19	1 (0.84 - 1)	0.94	26	d
	Methow R spr	591	-0.17	0.28	0.85 (0.54 - 1.33)	0.78	0.61	18	0.79 (0 - 1)	0.70	18	0.95 (0 - 1)	0.83	28	t, d
	Wenatchee R spr	1798	-0.18	0.09	0.83 (0.65 - 1.07)	0.87	0.71	20	0.82 (0 - 1)	0.72	11	1 (0.05 - 1)	0.89	23	t, d
Snake R spr/sum chinook	ESU Level	69049	-0.22	0.07	0.81 (0.65 - 1.01)	1.00	0.94	23	0.46 (0 - 1)	0.73	7	1 (0.56 - 1)	0.93	27	
	Bear Valley/Elk Cr	713	0.03	0.16	1.03 (0.75 - 1.42)	0.41	0.20	0	0.01 (0 - 0.95)	0.27	0	0.09 (0 - 1)	0.46	2	
	Big Sheep Cr spr	NA	-0.15	0.88	0.86 (0.43 - 1.72)	0.71	0.55	16	NA	NA	NA	0.79 (0 - 1)	0.79	39	
	Camas Cr spr	NA	-0.14	0.12	0.87 (0.63 - 1.20)	0.78	0.58	15	NA	NA	NA	0.97 (0 - 1)	0.82	20	
	Cape Horn Cr spr	NA	0.02	0.22	1.02 (0.66 - 1.58)	0.45	0.25	0	NA	NA	NA	0.16 (0 - 1)	0.51	5	d
	Imnaha R spr	1092	-0.12	0.05	0.89 (0.75 - 1.06)	0.84	0.55	12	0.28 (0 - 1)	0.56	3	0.99 (0.01 - 1)	0.83	14	
	Johnson Cr sum	432	0.01	0.05	1.01 (0.84 - 1.21)	0.45	0.17	0	0 (0 - 0.55)	0.23	0	0.05 (0 - 1)	0.44	0	
	Lookingglass Cr spr	NA	-0.47	0.27	0.63 (0.43 - 0.92)	0.97	0.93	56	NA	NA	NA	1 (0.98 - 1)	0.98	73	t

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			μ	σ ²	λ (95% CI)	Prob λ < 1.0	Prob λ < 0.9	Req % Inc	50 years (95% CI)	Prob VHER ¹	Req % Inc	50 years (95% CI)	Prob VHRD ²	Req % Inc	
	Marsh Cr spr	286	0.01	0.15	1.01 (0.74 - 1.37)	0.47	0.24	0	0.03 (0 - 0.99)	0.35	0	0.17 (0 - 1)	0.51	4	
	Minam R spr	554	-0.07	0.24	0.94 (0.63 - 1.39)	0.63	0.40	6	0.28 (0 - 1)	0.51	6	0.61 (0 - 1)	0.69	15	t
	Minam R Up spr	NA	-0.06	0.09	0.94 (0.74 - 1.19)	0.67	0.35	6	NA	NA	NA	0.63 (0 - 1)	0.69	9	
	Poverty Cr	958	0.00	0.10	1 (0.77 - 1.28)	0.50	0.23	0	0 (0 - 0.95)	0.28	0	0.18 (0 - 1)	0.53	4	
	Sulphur Cr spr	200	0.03	0.47	1.03 (0.60 - 1.77)	0.43	0.26	0	0.17 (0 - 1)	0.43	7	0.21 (0 - 1)	0.51	9	
Snake R fall chinook	ESU Level	2600	-0.12	0.02	0.88 (0.76 - 1.03)	1.00	0.67	14	0.04 (0 - 1)	0.37	0	1 (0.05 - 1)	0.85	12	
Upper Willamette R chinook	ESU Level	36081	-0.47	0.09	0.62 (0.48 - 0.81)	1.00	1.00	61	1 (0.93 - 1)	1.00	41	1 (1 - 1)	0.99	65	
	McKenzie R abv Leaburg	8764	-0.14	0.24	0.87 (0.57 - 1.31)	0.76	0.57	15	0.36 (0 - 1)	0.54	8	0.92 (0 - 1)	0.81	24	
Columbia R chum	Grays R WF	NA	0.21	0.23	1.23 (0.82 - 1.85)	0.15	0.07	0	NA	NA	NA	0 (0 - 0.74)	0.20	0	
	Grays R mouth to head	NA	-0.03	0.10	0.97 (0.74 - 1.27)	0.58	0.30	3	NA	NA	NA	0.38 (0 - 1)	0.61	7	
	Hardy Cr	NA	0.04	0.06	1.04 (0.86 - 1.25)	0.34	0.13	0	NA	NA	NA	0.01 (0 - 0.93)	0.35	0	
	Crazy J	NA	0.14	0.03	1.15 (0.99 - 1.33)	0.11	0.05	0	NA	NA	NA	0 (0 - 0)	0.13	0	
	Hamilton Cr	NA	-0.08	0.05	0.92 (0.76 - 1.12)	0.74	0.40	9	NA	NA	NA	0.86 (0 - 1)	0.75	10	
	Hamilton springs	NA	0.09	0.51	1.1 (0.62 - 1.93)	0.33	0.19	0	NA	NA	NA	0.1 (0 - 1)	0.41	3	t, a
Lower Columbia R steelhead	ESU Level	NA	-0.26	0.00	0.77 (0.75 - 0.79)	1.00	1.00	30	NA	NA	NA	1 (1 - 1)	0.98	25	I
	Clackamas R sum	7185	-0.33	0.09	0.72 (0.57 - 0.92)	0.96	0.91	39	1 (0.19 - 1)	0.91	25	1 (1 - 1)	0.97	43	t
	Clackamas R win	3470	-0.36	0.06	0.69 (0.57 - 0.85)	0.97	0.93	45	1 (0.92 - 1)	0.94	30	1 (1 - 1)	0.98	46	t
	Green R win	450	-0.15	0.25	0.86 (0.24 - 3.08)	0.67	0.52	16	0.73 (0 - 1)	0.62	39	0.93 (0 - 1)	0.73	25	t

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Middle Columbia R steelhead	Kalama R sum	18673	-0.36	0.07	0.7 (0.54 - 0.90)	0.95	0.91	43	1 (0.46 - 1)	0.89	25	1 (1 - 1)	0.97	46	d
	Kalama R win	6844	-0.13	0.01	0.87 (0.78 - 0.98)	0.87	0.64	15	0 (0 - 0.99)	0.41	0	1 (0.52 - 1)	0.88	13	
	Lewis R EF win	NA	-0.17	0.02	0.84 (0.59 - 1.21)	0.76	0.61	19	NA	NA	NA	1 (0 - 1)	0.79	18	
	Sandy R win	8064	-0.19	0.03	0.83 (0.7 - 0.98)	0.90	0.77	20	0.64 (0 - 1)	0.66	5	1 (0.79 - 1)	0.92	21	
	Toutle R SF win	NA	-0.10	0.00	0.91 (0.88 - 0.93)	0.79	0.43	10	NA	NA	NA	1 (1 - 1)	0.80	6	t
	wind R sum	1218	-0.06	0.00	0.95 (0.83 - 1.08)	0.65	0.33	5	0 (0 - 0.19)	0.34	0	0.91 (0 - 1)	0.62	3	
	ESU Level	NA	-0.11	0.11	0.89 (0.68 - 1.18)	0.90	0.54	12	NA	NA	NA	0.92 (0 - 1)	0.80	16	
	Beaver Cr NF sum	NA	-0.06	0.17	0.95 (0.70 - 1.28)	0.63	0.36	5	NA	NA	NA	0.57 (0 - 1)	0.68	12	
	Deschutes R sum	9751	-0.16	0.10	0.85 (0.67 - 1.07)	0.86	0.67	18	0.38 (0 - 1)	0.58	6	1 (0.09 - 1)	0.89	22	
	Eightmile Cr win	NA	-0.08	1.62	0.92 (0.17 - 4.96)	0.57	0.43	9	NA	NA	NA	0.57 (0 - 1)	0.66	39	
	Fifteen Mile Cr win	NA	-0.01	0.03	0.99 (0.82 - 1.18)	0.54	0.22	1	NA	NA	NA	0.11 (0 - 1)	0.52	2	
	Mill Cr sum	NA	-0.03	0.00	0.97 (0.92 - 1.03)	0.69	0.17	3	NA	NA	NA	0.02 (0 - 1)	0.50	0	l
Upper Columbia R steelhead	Ramsey Cr win	NA	0.06	1.65	1.06 (0.19 - 5.75)	0.44	0.30	0	NA	NA	NA	0.29 (0 - 1)	0.53	22	
	Umatilla R sum	10062	-0.04	0.03	0.96 (0.85 - 1.10)	0.65	0.21	4	0 (0 - 0.02)	0.14	0	0.34 (0 - 1)	0.60	4	t, a, d
	Warm Springs Nfh sum	729	-0.06	0.08	0.94 (0.75 - 1.18)	0.67	0.35	6	0.06 (0 - 1)	0.41	0	0.63 (0 - 1)	0.69	9	
	ESU Level	8678	-0.37	0.11	0.69 (0.48 - 1)	1.00	0.99	45	1 (0.18 - 1)	0.99	32	1 (0.92 - 1)	0.96	50	
Snake R steelhead	ESU Level	377945	-0.32	0.02	0.73 (0.66 - 0.8)	1.00	1.00	37	1 (0.37 - 1)	0.99	10	1 (1 - 1)	0.99	35	t
	Butte Cr sum A	NA	0.06	0.65	1.07 (0.59 - 1.94)	0.39	0.23	0	NA	NA	NA	0.17 (0 - 1)	0.47	9	a

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Upper Willamette R steelhead	Camp Cr sum A run	NA	-0.03	0.21	0.97 (0.69 - 1.37)	0.56	0.32	3	NA	NA	NA	0.4 (0 - 1)	0.62	10	
	Crow Cr sum A	NA	0.03	0.25	1.03 (0.71 - 1.49)	0.42	0.22	0	NA	NA	NA	0.15 (0 - 1)	0.49	5	
	Devils Run Cr sum A	NA	0.05	0.25	1.05 (0.73 - 1.53)	0.37	0.19	0	NA	NA	NA	0.08 (0 - 1)	0.43	2	t
	Fly Cr sum A	NA	-0.04	0.27	0.97 (0.66 - 1.42)	0.57	0.34	3	NA	NA	NA	0.44 (0 - 1)	0.63	12	t
	Mccoy Cr sum A	NA	0.05	0.08	1.05 (0.85 - 1.30)	0.33	0.13	0	NA	NA	NA	0.01 (0 - 0.98)	0.35	0	
	Meadow Cr sum A	NA	-0.04	0.12	0.96 (0.75 - 1.24)	0.59	0.30	4	NA	NA	NA	0.42 (0 - 1)	0.62	8	
	Peavine Cr sum A	NA	0.07	0.29	1.07 (0.70 - 1.64)	0.35	0.19	0	NA	NA	NA	0.07 (0 - 1)	0.41	2	
	Phillips Cr sum A	NA	-0.05	0.09	0.95 (0.76 - 1.19)	0.65	0.33	5	NA	NA	NA	0.55 (0 - 1)	0.67	9	
	Snake R A	333995	-0.32	0.01	0.73 (0.67 - 0.79)	0.99	0.98	37	1 (0.63 - 1)	0.91	9	1 (1 - 1)	0.99	35	t
	Snake R B	86029	-0.30	0.04	0.74 (0.63 - 0.86)	0.97	0.93	35	0.99 (0.04 - 1)	0.86	14	1 (1 - 1)	0.98	36	t
	Summit Cr sum A	NA	0.03	0.36	1.03 (0.66 - 1.60)	0.43	0.24	0	NA	NA	NA	0.19 (0 - 1)	0.50	7	
	Swamp Cr sum A	NA	0.01	0.11	1.01 (0.79 - 1.30)	0.45	0.20	0	NA	NA	NA	0.11 (0 - 1)	0.48	3	
	ESU Level	11340	-0.15	0.08	0.86 (0.65 - 1.13)	0.97	0.71	16	0.2 (0 - 1)	0.56	4	1 (0 - 1)	0.85	19	
	Calapooia R late-win	196	-0.07	0.21	0.93 (0.61 - 1.43)	0.63	0.41	8	0.4 (0 - 1)	0.57	21	0.64 (0 - 1)	0.68	14	
WA Coast Chinook	Mollala R late-win	754	-0.29	0.12	0.75 (0.58 - 0.96)	0.95	0.87	33	1 (0.31 - 1)	0.91	27	1 (0.79 - 1)	0.96	39	
	N Santiam R late-win	2524	-0.16	0.05	0.85 (0.72 - 1.01)	0.90	0.71	18	0.61 (0 - 1)	0.67	7	1 (0.27 - 1)	0.92	19	t
	S Santiam R win	1061	-0.08	0.01	0.93 (0.85 - 1.01)	0.86	0.31	8	0 (0 - 0.56)	0.26	0	0.97 (0.01 - 1)	0.83	7	t
	S Santiam R late-win	1202	-0.22	0.09	0.8 (0.64 - 1)	0.92	0.81	25	0.98 (0.01 - 1)	0.84	17	1 (0.53 - 1)	0.94	28	
	Queets R fall	16334	0.03	0.04	1.03 (0.79 - 1.36)	0.39	0.20	0	0 (0 - 0.04)	0.17	0	0 (0 - 1)	0.41	0	t

¹ Very high extinction risk - probability that extinction in 50 years is over 25%.

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			μ	σ^2	λ (95% CI)	Prob $\lambda < 1.0$	Prob $\lambda < 0.9$	Req % Inc	50 years (95% CI)	Prob VHER ¹	Req % Inc	50 years (95% CI)	Prob VHRD ²	Req % Inc

² Very high risk of decline - probability that risk of 90% decline in 50 years is over 25%

³ Tests for underlying assumptions were made on the running sums of wild spawner only counts where possible; otherwise total mixed counts were used. The codes designate tests that failed at (p<.05). Note that a number of the "fails" are false-fails since the p-value was not adjusted for multiple tests being conducted. If p value is adjusted (p<.001) to reduce the probability of a false positive to less than 5%, none of the time series fail the diagnostic tests.

- a. Significant 1st order autocorrelation in $\ln(R_{t+1}/R_t)$ found.
- d. A model with depensatory density-dependence fit the data significantly better than model with no density-dependence. This indicates that the risk estimates are pessimistic.
- t. A model with a trend in μ fit the data significantly better than the model with no trend. This indicates that the risk estimates are optimistic.
- l. The variance versus τ plot showed significant non-linearity ($R^2 < 0.7$) indicating an underestimate of σ^2 .