DRAFT

Three Year Review of the Lower Columbia River tule fall Chinook Abundance-based Harvest Matrix

November 3, 2018

At its November 2011 meeting, the Pacific Fishery Management Council (Council) passed a motion recommending that NOAA's National Marine Fisheries Service (NMFS) consider an abundance-based management (ABM) matrix as the harvest control rule for lower Columbia River (LCR) tule fall Chinook salmon for salmon fisheries in 2012 and beyond (McIsaac 2011). The control rule identifies exploitation rate limits based on four levels of aggregate abundance consisting primarily of lower river hatchery (LRH) Chinook salmon, (Table 1). This stock grouping is most commonly referred to as the LRH stock management unit, which is the indicator stock for wild LCR tule fall Chinook salmon.

Table 1. Variable fishing exploitation rate limits based on abundance tier as proposed by the Council (from McIsaac 2011).

Lower River Hatchery (LRH) Abundance Forecast	Total Exploitation Rate Limit
0 – 30,000	0.30
30,000 – 40,000	0.35
40,000 – 85,000	0.38
>85,000	0.41

In 2012 NMFS issued a biological opinion on approval of the management of the ocean fisheries subject to the Fishery Management Plan for salmon fisheries off the coasts of Washington, Oregon and California. The biological opinion evaluated the proposed harvest impacts to the Endangered Species Act (ESA)-listed LCR Chinook Salmon Evolutionarily Significant Unit (ESU), including the ABM matrix for the tule fall Chinook salmon component (Table 1). NMFS concluded in the biological opinion that the proposed fishing seasons were not likely to jeopardize the continued existence of the LCR Chinook Salmon ESU (NMFS 2012). The opinion adopted the recommendation from the Council to assess the performance of the ABM matrix every three years as a check on projected results and any changes in key presumptions.

NMFS is conducting its second review since the ABM matrix has now been implemented for six years. This report provides our draft conclusions. We invite comments and expect to consider submitted comments prior to the Council's March 2019 meeting, at which time we plan to issue a final review. Written comments should be submitted to Jeromy Jording by February 1, 2019 at either Jeromy.Jording@noaa.gov or 510 Desmond Drive SE, Suite 103, Lacey WA 98503-1263.

The effectiveness of this ABM strategy depends, in part, on whether abundance of LCR hatchery chinook can be predicted with reasonable accuracy and precision. When the current ABM matrix (Table 1) was proposed annual tule fall Chinook salmon run sizes were predicted, for fishery management purposes, using sibling models for the LRH stock management unit. Wild fall Chinook salmon returns could not be forecasted independently because of the lack of reliable age and escapement data for most wild populations. Examining correlations between the aggregate LRH return and the abundance of wild fish in the aggregate between 1964 and 2010 suggested that the hatchery forecast provided a suitable proxy for wild returns due to common effects of marine conditions to which both hatchery and wild fish are subjected (Beamesderfer et al. 2011). Table 2 lists the annual preseason terminal run size forecast of LRH Chinook salmon since implementing the ABM matrix along with the resulting exploitation rate tier planned for each year.

Table 2. Annual LRH Chinook salmon stock forecasts and allowable preseason exploitation rates (from PFMC preseason Report I, 2018).

Year	LRH Preseason Abundance Forecast	Allowed Exploitation Rate based on ABM matrix
2012	127,000	0.41
2013	88,000	0.41
2014	110,000	0.41
2015	94,900	0.41
2016	133,700	0.41
2017	92,400	0.41
2018	62,400	0.38

Table 2 indicates that since implementation of the ABM matrix the preseason abundance of LRH fall Chinook salmon have allowed fisheries to operate at the highest tier available in all but one year. Table 3 lists the annual postseason terminal returns of LRH Chinook salmon for the same time period along with the associated postseason estimate of the exploitation rate. For context, the recent 10-year average abundance estimate for LRH fall Chinook salmon was 81,250 (PFMC 2018).

Table 3. Annual LRH Chinook salmon stock post season returns and resulting exploitation rates (from Joint Columbia River Management Staff (JCRMS) Fall Stock Status and Fisheries Report, 2018).

Year	LRH Actual Post Season Return	Exploitation Rate achieved[1]
2012	85,000	0.43
2013	104,800	0.33
2014	101,900	0.46
2015[2]	128,700	0.34
2016[2]	81,500	0.36
2017[2]	64,600	0.36

[1] *Calculated total exploitation on LCR tule Chinook salmon in all fisheries in the ocean and in the Columbia River below Bonneville Dam. These are estimated using the Fisheries Regulation Assessment Model (FRAM) which is currently used by the Council to annually estimate impacts of proposed ocean and terminal fisheries on Chinook and coho salmon stocks.*
[2] *Preliminary estimate.*

The exploitation rates calculated in Table 3 use harvest from all fisheries in marine waters and the Columbia River, below Bonneville Dam. While ongoing monitoring efforts continue to be directed at gathering consistent data regarding natural population status and trends (e.g., abundance numbers, age composition, hatchery fractions, and productivity), the time series are still too short to use for forecasting preseason abundance. As evidenced by blank columns, escapement data for two populations in Table 5, four populations in Table 6, and two populations in Table 7 were not previously monitored. Updated spawning abundances begin in 2010 in Table 5 through Table 7, with data coming from either the Washington Department of Fish and Wildlife's Salmon Conservation and Reporting Engine (SCORE) or Oregon Department of Fish and Wildlife's Salmon and Steelhead Recovery Tracker online databases. Data in each table for years prior to 2010 came from the risk assessment report examining the ABM matrix (Beamesderfer et al. 2011).

Since 2012 preseason abundance forecasts for LRH Chinook salmon have been in the high abundance tier (Table 2) except for 2018, which is consistent with high abundances seen for other fall Chinook salmon stocks in the Columbia River during that period (JCRMS 2018). Because abundance has been high fisheries have been managed subject to a 41 percent total exploitation rate limit in years 2012 – 2017, with a 38 percent limit in 2018 (Table 2). Post season estimates of abundance indicate that the abundance category was correctly forecast in four of the six years in the period. In 2012 the post season estimate of abundance was 85,000 (Table 3). This is directly at the threshold of 85,000 for the high abundance tier. In 2016 and 2017 the preliminary post season run size estimates indicate that a 38 percent preseason limit would have been appropriate rather than the 41 percent indicated by preseason abundance. Preliminary post season estimates based on FRAM model analysis indicate that exploitation rates exceeded the preseason limit in two years out of the six (2012, 2014), although the postseason abundance estimates were consistent with the preseason management tier. When more data points allow for a more comprehensive review, the estimates of exploitation rates from FRAM should be compared to independent exploitation rate estimates derived from coded-wire tag groups.

New escapement information gathered over the last four or five years shows no substantive changes in abundance or hatchery fractions that are inconsistent with previous trends (Tables 5 through 7). There is also now consistent information for eight populations resulting from increased sampling associated with the states' commitment to monitor natural-origin escapements across multiple populations to determine the effectiveness of the ABM matrix over the long term.

NMFS administers the Mitchell Act hatchery funding in the Columbia River, which has historically produced a large proportion of the overall hatchery tule Chinook salmon. In 2017 NMFS adopted a Record of Decision ("Mitchell Act ROD") which guides NMFS' decision on the distribution of funds for hatchery production under the Mitchell Act. The Mitchell Act ROD directs NMFS to apply stronger performance goals to all Mitchell Act-funded, Columbia River Basin hatchery programs that affect ESA-listed primary and contributing salmon and steelhead populations. It requires "integrated hatchery programs [to] be better integrated" and "isolated hatchery programs [to] be better isolated". These stronger performance goals reduced the risks of hatchery programs on natural-origin salmon and steelhead populations, including the LCR Chinook Salmon ESU, and primarily to the tule Chinook salmon MPGs.

These changes resulted in reductions to several of the tule Chinook salmon programs based on their biological effects to the LCR Chinook Salmon ESU. These changes will affect future annual release sizes of the aggregate LRH stock management unit that the ABM matrix relies on. NMFS analyzed these changes in production under the ESA and issued a biological opinion which found the policy direction was not likely to jeopardize the continued existence of any species affected by the hatchery production (NMFS 2017).

The ABM matrix risk assessment report (Beamesderfer et. al. 2011) estimated annual hatchery releases of lower Columbia River programs averaged 22 million LRH juveniles per year from 1998 through 2008. While this production level reflects program changes in the mid-1990s to reduce production costs and selectively eliminate programs with lower success rates, it was the level of expected annual LRH released used to set the breakpoints for the tiers in Table 1.

As levels of the aggregate LRH return are modified over the coming decade to align with NMFS' 2017 Mitchell Act ROD, the expectations about tier frequency in the ABM matrix may change depending on whether conditions remain similar to the preceding 20-year period used to develop the ABM matrix or return to conditions more representative of the longer term (1959-1998). The ABM matrix risk assessment model, which was parameterized to represent the last 20 years and represented a prolonged period of low productivity and survival, determined that annual release levels of LRH hatchery juveniles could be reduced to 16 million total, before the relationship between the aggregate LRH return and the abundance of wild fish, considered in the aggregate, no longer provides a suitable proxy for wild returns. The expected reduction in LRH releases, from the Mitchell Act program changes, will be realized in brood year 2020 (release year 2021).The expected new long-term annual total release will be approximately 17.3 million LRH juveniles, assuming level production from the Cowlitz system which is not funded by the Mitchell Act. This represents a reduction of approximately 21.4 percent from the 22 million reference level.

As part of the adaptive management strategy developed through the ABM matrix, NMFS recommends once LRH release modifications are final and ocean maturity age classes reach three years (beginning in 2024) the abundance tiers be adjusted by the same percent (21.4%), so that breakpoints would account for any reductions in production. The resulting tiers are captured in Table 4. By 2024 it should also be possible to evaluate the feasibility of forecasting the wild tule component independently.

Table 4. Variable fishing exploitation rate limits based on LRH Chinook release modifications implemented through the Mitchell Act ROD (numbers are rounded to the nearest 1,000).

LRH Abundance Forecast	Total Exploitation Rate Limit
0 – 24,000	0.30
24,000 – 31,000	0.35
31,000 – 67,000	0.38
>67,000	0.41

Table 5. Annual available escapement of Lower Columbia River tule Chinook salmon Coast strata populations.

Year	Youngs Bay		Grays / Chinook		Big Creek		Elochoman / Skamokawa		Clatskanie		Mill / Abernathy / Germany	
	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild
1991			127	47.0			196	9.0	287	10.0	2,017	85.0
1992			109	76.0			190	100.0	287	10.0	839	47.0
1993			27	52.0			288	78.0	287	10.0	885	71.0
1994			30	70.0			706	98.0	136	10.0	3,854	40.0
1995			9	39.0			156	50.0	194	10.0	1,395	51.0
1996			280	17.0			533	66.0	1,069	10.0	593	54.0
1997			15	12.0			1,875	11.0	155	10.0	603	23.0
1998			96	24.0			228	25.0	214	10.0	368	60.0
1999			195	68.0			718	25.0	233	10.0	575	69.0
2000			169	70.0			196	62.0	607	10.0	416	58.0
2001			261	43.0			2,354	82.0	607	10.0	4,024	39.0
2002			107	47.0			7,581	0.0	894	10.0	3,343	5.0
2003			398	39.0			6,820	65.0	1,088	10.0	3,810	56.0
2004			766	25.0			4,796	1.0	252	10.0	6,804	2.0
2005			147	41.0			2,204	5.0	233	10.0	2,083	13.0
2006			302	100.0			317	100.0	97	10.0	636	62.0
2007			63	100.0			165	100.0	90	10.0	335	48.0
2008			40	68.0			841	10.0	90	10.0	750	49.0
2009			312	43.0			2,246	18.0	168	56.0	604	93.0
2010	1,152	n/a	170	48.6	14,933	6.0	1,261	10.9	100	12.0	2,410	6.5
2011	4,011	39.0	416	14.9	2,640	5.0	1,084	5.8	144	9.0	1,192	7.9
2012	5,667	3.0	160	21.9	1,100	5.0	207	30.1	80	10.0	147	14.3
2013	8,180	5.0	1,644	5.5	-	0	448	17.8	38	8.0	657	19.4
2014	2,380	5.0	969	19.1	2,050	2.0	680	22.0	78	9.0	554	6.2
2015	2,011	19.0	762	28.9	-	0	988	23.7	44	9.0	989	8.1
2016	813	24.0	356	22.6	888	8.0	366	25.0	100	2.0	397	21.9
2017	n/a	n/a	565	52.3	n/a	n/a	115	67.5	n/a	n/a	95	17.4

Table 6. Annual available escapement of Lower Columbia River tule Chinook salmon Cascade stata populations.

Year	Lower Cowlitz[1]		Upper Cowlitz		Toutle		Coweeman		Kalama		Lewis[2]		Clackamas		Sandy		Washougal	
	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild	#	% wild
1991	935	26.0					340	100.0	5,152	54.0	470	100.0					3,673	47.0
1992	1,022	26.0					1,247	100.0	3,683	48.0	335	100.0					2,399	76.0
1993	1,330	6.0					890	100.0	1,961	89.0	164	100.0					3,924	52.0
1994	1,225	19.0					1,695	100.0	2,014	71.0	610	100.0					3,888	70.0
1995	1,370	13.0					1,368	100.0	3,012	69.0	409	100.0					3,063	39.0
1996	1,325	58.0					2,305	100.0	10,630	44.0	403	100.0					2,921	17.0
1997	2,007	72.0					689	100.0	3,539	40.0	305	100.0					4,669	12.0
1998	1,665	37.0					491	100.0	4,294	69.0	127	100.0					2,971	24.0
1999	969	16.0					299	100.0	2,577	3.0	331	100.0					3,129	68.0
2000	2,165	10.0					290	100.0	1,284	21.0	515	100.0					2,155	70.0
2001	3,647	44.0					802	73.0	3,553	18.0	750	70.0					3,901	43.0
2002	9,671	76.0					877	97.0	18,627	1.0	1,032	77.0					6,050	47.0
2003	7,001	88.0					1,106	89.0	24,684	0.0	738	98.0					3,444	39.0
2004	4,621	70.0					1,503	91.0	6,434	11.0	1,388	29.0					10,597	25.0
2005	2,968	17.0					853	60.0	9,053	3.0	607	100.0					2,678	41.0
2006	2,051	47.0					561	100.0	10,386	1.0	1,300	82.0					1,936	14.0
2007	1,401	53.0					234	100.0	3,296	6.0	492	73.0					1,528	87.0
2008	1,259	90.0					404	52.0	3,734	4.0	567	87.0					2,491	93.0
2009	2,602	45.0					780	63.0	7,548	10.0	299	100.0	492	49.0			2,741	30.0
2010	3,734	68.3	10,142	31.0	1,917	11.9	584	70.7	5,315	11.2	2,435	63.0	18	22.0	3,640	47.0	5,530	10.7
2011	3,685	74.5	14,182	30.0	1,498	13.2	707	88.1	7,591	5.6	2,339	70.6	117	29.0	3,542	46.0	3,224	14.6
2012	2,725	57.0	6,143	32.0	907	25.9	526	88.2	7,477	3.9	1,874	67.2	316	19.0	714	80.0	965	26.2
2013	4,320	80.5	7,366	45.0	1,754	52.1	2,322	67.5	8,487	9.6	8,173	75.5	424	92.0	2,576	97.0	3,612	33.1
2014	4,347	67.2	225	40.0	783	51.4	830	95.7	9,451	8.1	6,299	54.4	184	69.0	n/a	n/a	1,529	65.3
2015	5,981	70.0	n/a	n/a	598	63.2	1,391	97.7	6,423	45.1	11,073	54.9	310	62.0	n/a	n/a	2,925	45.6
2016	3,885	74.1	n/a	n/a	803	46.1	439	93.6	4,226	60.2	5,906	54.0	912	78.0	n/a	n/a	2,198	40.0
2017	3,630	80.6	n/a	n/a	594	52.9	841	85.7	3,041	57.0	3,865	62.4	n/a	n/a	n/a	n/a	1,112	59.2

1 *Tule Chinook salmon in the Cowlitz River were previously a conglomerate estimate.*
2 *Tule Chinook salmon estimates from both East and North Fork Lewis Rivers.*

Table 7. Annual available escapement of Lower Columbia River tule Chinook salmon Gorge stata populations.

Year	**Upper Gorge**		**White Salmon**		**Hood**	
	#	**% wild**	**#**	**% wild**	**#**	**% wild**
1991						
1992					22	73.0
1993					10	60.0
1994					39	64.0
1995					12	67.0
1996					16	81.0
1997					30	80.0
1998					40	85.0
1999					19	84.0
2000					34	94.0
2001					39	74.0
2002					36	92.0
2003					64	89.0
2004					35	89.0
2005					49	86.0
2006					55	89.0
2007					45	100.0
2008					27	78.0
2009					65	88.0
2010	84	25.0	348	89.9	n/a	n/a
2011	1,187	17.7	628	59.1	n/a	n/a
2012	407	16.2	509	43.2	n/a	n/a
2013	2,056	27.2	879	29.1	n/a	n/a
2014	1,672	19.9	973	45.9	n/a	n/a
2015	4,689	34.0	862	27.6	n/a	n/a
2016	84	25.0	348	89.9	n/a	n/a
2017	n/a	n/a	n/a	n/a	n/a	n/a

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