THE NATIONAL MARINE FISHERIES SERVICE REPORT ON REGULATORY ACTIVITIES

The National Marine Fisheries Service (NMFS) provides this report on issues relevant to ocean salmon harvest management in 2024.

<u>Status of Endangered Species Act (ESA) listing petitions and determinations</u>

Washington Coast Chinook: NMFS received a petition in July 2023 to list either an Evolutionary Significant Unit (ESU) of spring-run Chinook salmon on the Washington coast; or, to list the Washington Coast Chinook ESU (which includes both spring- and fall-run Chinook salmon), based primarily on the decline in the status of the spring-run component of the ESU. Last December, NMFS found that the petition met the standard for further review to determine if these ESUs warrant listing given new information. NMFS will conduct a status review of Chinook salmon on the Washington Coast to inform its determination as to whether the petitioned action to list is warranted.

Oregon Coast/Southern Oregon Northern California Coast Chinook ESUs: In August 2022, NMFS received a petition to list the Oregon Coast (OC) and the Southern Oregon/Northern California (SONC) Chinook ESUs under the ESA, or, alternatively, to list only spring-run Chinook salmon in each of the ESUs. The 90-day finding issued in January 2023 concluded that (1) the petitioners met the standard for further review to determine if these ESUs warrant listing given new information and (2) that the petitioned action to list only the spring-run components of the OC and SONCC Chinook salmon ESUs is not warranted. NMFS is currently conducting a status review to inform its determination as to whether the petitioned action to list is warranted.

Olympic Peninsula Steelhead Distinct Population Segment (DPS): In August 2022, NMFS received a petition to list the DPS. The 90-day finding issued in February 2023 concluded that the petitioners met the standard for further review to determine if the DPS warrants listing given new information. NMFS is currently conducting a status review to inform its determination as to whether the petitioned action to list is warranted.

Upper Klamath/Trinity River Chinook ESU: NMFS received the petition in 2017 and announced a positive 90-day finding in 2018. NMFS continues to evaluate this petition and to incorporate traditional ecological knowledge in the evaluation of the petition.

<u>Status of Regulatory Actions</u>

Amendment 24: Amendment 24 amends the Pacific Coast Salmon Fishery Management Plan (Salmon FMP) to clarify the technical process for reviewing updates to models used to determine the Chinook salmon abundance threshold that may trigger additional management measures to limit the impact of ocean salmon fisheries on Southern Resident killer whales which are listed under the ESA. On February 21, 2024, NOAA's Administrator of Fisheries approved Amendment 24 to the Salmon FMP. The notice of NMFS determination for Amendment 24 published in the

Federal Register on February 27, 2024.

Snohomish Coho Rebuilt Rule: NMFS is proposing to remove the rebuilding plan for the Snohomish coho salmon stock from regulation, as this stock is rebuilt and is no longer required to be managed under a rebuilding plan. The proposed rule to remove the rebuilding plan should publish in the Federal Register at the beginning of March 2024. The proposed rule will have a 30-day public comment period.

California Coastal (CC) Chinook Salmon Evolutionarily Significant Unit (ESU) Biological Opinion: NMFS re-initiated its consultation on the effect of ocean salmon fisheries on the CC Chinook Salmon ESU in 2023. In our 2023 guidance letter, and subsequent reports to the Council, NMFS provided an overview of the performance of the impacts on CC Chinook in ocean salmon fisheries relative to the take limit under the Endangered Species Act (ESA) in recent years, summarized the actions taken to address the instances where the take limit had been exceeded, and described NMFS' rationale for re-initiation. In November 2023, the PFMC adopted a framework of management measures for the ocean salmon fisheries off the coast of California and recommended it to NMFS for implementation in regulation. The management framework specifies management measures designed to ensure that the fishery does not exceed the Salmon FMP conservation objective for CC Chinook salmon. We expect to complete the consultation before April.

Performance Report for the Sacramento Winter-run Chinook Control Rule

FINAL

Review of the Sacramento River Winter Chinook Control Rule

February 20, 2024

At its November 2017 meeting, the Pacific Fishery Management Council (Council) proposed to update the harvest control rule (HCR) for Sacramento River Winter Chinook (SRWC) salmon for salmon fisheries in 2018 and beyond (Tracy 2017). The control rule provides a *de minimis* option at projected escapements of age-3 spawners below 500, ramps down allowable impacts as the forecast of escapement falls below 3,000, and provides a conservative policy approach that balances an acceptably low extinction risk with fishing opportunity on target stocks of Chinook salmon with the goal of eliminating fishery impacts as a significant impediment to species recovery for SRWC.

The harvest control rule uses a forecast of SRWC age-3 escapement in the absence of salmon fisheries (E_3^0) to determine the allowable age-3 impact rate.[1] If E_3^0 is above 3,000, a maximum impact rate of 20 percent is allowed. If E_3^0 is between 3,000 and 500, then the impact rate ranges from 20 percent to 10 percent. If E_3^0 is below 500, then the impact rate has a steeper decline from 10 percent until it reaches zero at an E_3^0 of zero (Figure 1).

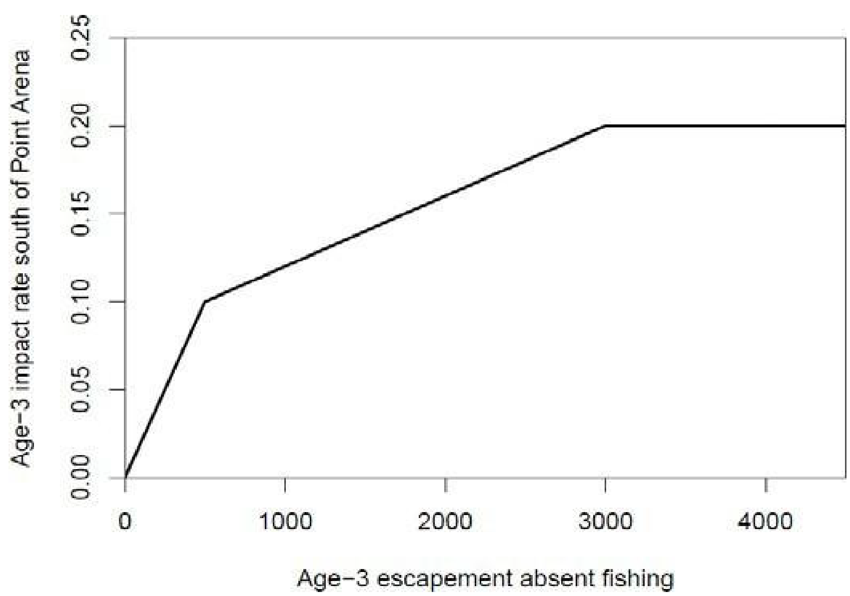

Figure 1. The adopted Sacramento River winter-run Chinook salmon harvest control rule for management of ocean fisheries south of Point Arena, California.

Subsequently, the HCR also incorporates and maintains the fishing season and size restrictions listed in Table 1.

[1] O'Farrell, M., N. Hendrix, and M. Mohr. 2016. An evaluation of preseason abundance forecasts for Sacramento River winter Chinook salmon. Pacific Fishery Management Council Briefing Book for November 2016, 35 pages. Available: https://www.pcouncil.org/documents/2016/11/agenda-item-d-2-attachment-1-an-evaluation-of-preseason-abundance-forecasts.pdf/ (website accessed August 8, 2023).

Table 1. Fishing Season and Size Restrictions for Ocean Chinook Salmon Fisheries, South of Point Arena, California.

Fishery	Location	Shall open no earlier than	Shall close no later than	Minimum size limit (total length[1]) shall be
Recreational	Between Point Arena and Pigeon Point	1st Saturday in April	2nd Sunday in November	20 inches
	Between Pigeon Point and the U.S./Mexico border	1st Saturday in April	1st Sunday in October	
Commercial	Between Point Arena and the U.S./Mexico border†	May 1	September 30†	26 inches
	†Exception: Between Point Reyes and Point San Pedro, there may be an October commercial fishery conducted Monday through Friday, but shall end no later than October 15.			

[1]Total length of salmon means the shortest distance between the tip of the snout or jaw (whichever extends furthest while the mouth is closed) and the tip of the longest lobe of the tail, without resort to any force or mutilation of the salmon other than fanning or swinging the tail (50 CFR 660.402).

In 2018 NOAA's National Marine Fishery Service (NMFS) issued a biological opinion under the authority of Section 7 of the Endangered Species Act (ESA), evaluating the proposed harvest impacts of implementing the new HCR on the ESA-listed SRWC Salmon Evolutionarily Significant Unit (ESU). NMFS concluded in the biological opinion that the proposed update to the control rule was not likely to jeopardize the continued existence of the SRWC ESU (NMFS 2018). The opinion concurred with the recommendation from the Council to assess the performance of the harvest framework every five years as a check on projected results and any changes in key presumptions and adopted it as a term and condition in its opinion.

This HCR depends on escapement and abundance forecasts of the SRWC salmon stock. The effectiveness of the HCR depends, in large part, on whether SRWC abundance can be predicted with reasonable accuracy and precision. Table 2 lists the annual preseason forecast of SRWC salmon since implementing the control rule along with the resulting exploitation rate that fisheries were managed to during each corresponding year, and compares that information with the exploitation rate achieved each year.

Table 2. Annual SRWC salmon forecasts used to determine harvest control rule (HCR)level and pre- and post-season resulting exploitation rates (from PFMC 2023).

Year[1]	SRWC preseason abundance forecast of age-3 escapement in the absence of fisheries	Allowable Age-3 Impact Rate based on HCR	Age-3 Impact Rate achieved
2018	1,594	14.4%	8.5%
2019	1,924	15.7%	14.8%
2020	3,077	≤ 20%	16.2%
2021	9,063	≤ 20%	14.7%
2022	5,971	≤ 20%	15.2%
2023	4,540	≤ 20%	n/a

Table 2 indicates that since implementation of the current HCR the preseason abundance of SRWC salmon have allowed fisheries to operate at the highest tier available in the majority of years. Table 3 lists the annual postseason return of SRWC salmon for the same time period. For comparative context, the recent 10-year average (2013-2022) for ocean escapement of SRWC Chinook salmon was 4,510 (PFMC 2023, Table B-3).

Table 3. Annual SRWC salmon escapements with the corresponding year of ocean fisheries, i.e., the year that the adults were last subjected to the possibility of harvest. Escapement occurs in the winter following the fishing year (from PFMC 2023).

Year	Adult Escapement	Jack Escapement
2018	7,570	559
2019	6,743	686
2020	10,239	277
2021	5,561	477
2022	2,447	54

The allowable impact rates calculated in Table 2 are based on harvest impacts from all ocean salmon fisheries. During this time preseason abundance forecasts for SRWC salmon have fluctuated, with a high in 2021 (Table 2). Because abundance has been on the higher end of the framework, fisheries have been managed subject to ensuring they do not exceed an age-3 impact rate limit of 20 percent in the majority of years (Table 2) since the HCR was implemented.

Preliminary post season estimates based on harvest model analysis indicate that impact rates achieved have not exceeded the preseason limit in any year and that the impact rate achieved has been well below the limit in all but one year and stable since the HCR was implemented. Escapements have been above the 10-year average in every year since the HCR was

[1] The year corresponds to the fishery management year for which age-3 ocean impact rate apply. Due to the timing of fisheries relative to the return of winter-run spawners, the realized escapement comes one calendar year after the fishing management year of relevance. For example, the forecast of 4,540 reported for Year 2023 is the forecast of what escapement in calendar year 2024 would be in the absence of fishing during 2023.

implemented. Based on this information, NMFS concludes that (1) fisheries over the past five years have been managed consistent with the control rule; (2) escapements have consistently exceeded the spawner abundance criterion of 2,500 associated with low risk evaluated in the biological opinion, and; (3) fisheries managed under the SWRC harvest control rule have continued to be consistent with the outcomes and expectations of NMFS' 2018 biological opinion evaluating effects of the HCR on this ESU (NMFS 2018).

Ongoing monitoring efforts continue to be directed at gathering consistent natural population status and trends (e.g., abundance numbers, age composition, hatchery fractions, and productivity). NMFS and the Council will continue to report on the performance of the harvest control rule and the status and trends of the SWRC ESU at 5-year intervals consistent with the provisions of the biological opinion.

References

Tracy, C. 2017. Letter transmitting the Pacific Fishery Management Council's recommendation for a new Endangered Species Act harvest control rule for Sacramento River Winter Chinook. Letter to B. Thom, National Marine Fisheries Service, from C. Tracy, Executive Director, Pacific Fisheries Marine Council, Portland, OR. December 6, 2017.

National Marine Fisheries Service (NMFS). 2018. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation. Effects of the Pacific Coast Salmon Plan Fisheries on the Sacramento River Winter-run Chinook salmon Evolutionarily Significant Unit. NMFS, WCR, Sustainable Fisheries Division. WCR-2017-8012. March 30, 2018.

Pacific Fishery Management Council (PFMC). 2023. *Review of 2022 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan*. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Performance Report for Lower Columbia Coho Harvest Control Rule

FINAL

Three Year Review of the Lower Columbia River Natural Coho
Abundance-based Harvest Matrix

February 20, 2024

In November 2014, the Pacific Fishery Management Council (Council) proposed to update the harvest control rule (HCR) for lower Columbia River (LCR) natural coho salmon for salmon fisheries in 2015 and beyond (McIsaac 2015). The control rule identifies exploitation rate (ER) limits based on two levels of parental escapement and five levels of marine survival (a 2 x 5 harvest matrix), see Table 1.

Table 2. Harvest management matrix for Lower Columbia River natural coho showing allowable fishery exploitation rates based on parental escapement and marine survival index.

Parental Escapement (rate of full seeding)		**Marine Survival Index (based on return of jacks per hatchery smolt)**					
		Very Low (≤ 0.06%)	**Low (≤ 0.08%)**	**Medium (≤ 0.17%)**	**High (≤ 0.40%)**	**Very High (> 0.40%)**	
Normal	≥ 0.30	10%	15%	18%	23%	30%	Allowable exploitation rate
Very Low	< 0.30	≤ 10%	≤ 15%	≤ 18%	≤ 23%	≤ 30%	

In 2015, NOAA's National Marine Fishery Service (NMFS) issued a biological opinion under the authority of Section 7 of the Endangered Species Act (ESA), evaluating the proposed harvest impacts of implementing the new harvest control rule on the ESA-listed LCR Coho Salmon Evolutionarily Significant Unit (ESU). NMFS concluded in the biological opinion that the proposed update to the HCR was not likely to jeopardize the continued existence of the LCR Coho Salmon ESU (NMFS 2015). The opinion concurred with the recommendation from the Council to assess the performance of the HCR every three years as a check on projected results and any changes in key presumptions.

The LCR coho ESU is synonymous with the Lower Columbia River natural coho stock (LCN coho) in the Fishery Management Plan. The harvest management matrix depends on parental escapement and marine survival of the LCN coho stock, which includes only natural-origin coho salmon. In Table 1 the average seeding level of parental escapement is expressed as a percentage of the full seeding level. If a particular parental escapement was greater than 100 percent of full seeding, parental escapement is set at 100 percent (NMFS 2015). For example, in 2014 the parental escapement of the Clatskanie population was 3,246 (Table 2) which is 270 percent of the full seeding level, but the parental escapement is set at 100 percent. The parental seeding level used to establish the tiers in the matrix is the average seeding levels of ten LCN coho populations (McIsaac 2015). The ten primary populations are: Clatskanie, Scappoose, Elochoman/Skamokawa, Grays/Chinook, Clackamas, Sandy, Lower Cowlitz, Toutle, Coweeman, and East Fork Lewis. Full seeding levels for Oregon populations were defined based on a combination of stock-recruitment and habitat analyses (Kern and Zimmerman 2013). Full seeding levels for Washington populations were defined as equilibrium abundance in stock-recruitment parameters inferred with the Ecosystem Diagnosis and Treatment Model from assessments of the available habitat quantity and quality (Beamesderfer et al. 2014). In the event that LCN coho average spawning escapements (calculated as an average of the ten reference populations) fall below 30 percent of full seeding, the Council would then work to the extent possible to minimize LCN coho ERs on adult returns from the corresponding brood year, and in no case exceed the ER limit for the given marine survival index category.

Table 2 shows the LCN coho salmon parental escapements for the 10 populations used to determine harvest matrix seeding level. These data indicate that average parental brood year escapement levels have been in the normal category and actually well above the 30 percent criterion since implementation of the new control rule in 2015.

Table 3 lists the annual pre- and post-season returns of LCN coho salmon since 2015 along with the associated marine survival index, preseason ER limit, and postseason ER estimate. Returns of Lower Columbia River hatchery adult coho are highly correlated with the marine survival index based on jack returns per smolts – indicating that this marine survival index predicts marine conditions which likely affect both hatchery and wild coho.

Table 3. Annual LCN coho salmon parental escapements in 10 populations used to determine harvest matrix seeding level (N.O. esc = natural origin escapement), (full seeding determinations are described in Kern and Zimmerman 2013).

Populations	**Year →**	**2013**		**2014**		**2015**		**2016**		**2017**		**2018**		**2019**		**2020**	
	Full seeding level	**N.O. esc.**	**% of full**	**N.O. esc.**	**% of full**	**N.O. esc.**	**% of full**	**N.O. esc.**	**% of full**	**N.O. esc.**	**% of full**	**N.O. esc.**	**% of full**	**N.O. esc.**	**% of full**	**N.O. esc.**	**% of full**
Clatskanie	1,200	611	51%	3,246	100%	240	20%	464	39%	566	47%	25	2%	146	12%	1,233	100%
Scappoose	1,200	979	82%	1,587	100%	487	41%	1,200	100%	387	32%	178	15%	384	32%	1,036	86%
Elochoman/ Skamokawa	2,429	768	32%	3,079	100%	328	14%	754	31%	896	37%	1,076	44%	1,664	69%	1,725	71%
Grays/Chinook	1,113	862	77%	2,689	100%	312	28%	627	56%	400	36%	406	36%	746	67%	962	86%
Clackamas	3,800	4,012	100%	10,672	100%	1,784	47%	1,628	43%	7,598	100%	3,159	83%	4,044	100%	9,012	100%
Sandy	1,200	667	56%	5,942	100%	443	37%	939	78%	2,384	100%	537	45%	1,052	88%	601	50%
Lower Cowlitz[1]	3,890	6,802	100%	24,544	100%	2,474	64%	4,365	100%	2,674	69%	2,762	71%	3,191	82%	4,740	100%
Toutle[2]	3,164	4,697	100%	12,730	100%	2,186	69%	3,639	100%	2,004	63%	2,012	64%	3,838	100%	4,318	100%
Coweeman	931	3,693	100%	6,876	100%	1,238	100%	2,988	100%	2,349	100%	2,518	100%	3,501	100%	4,362	100%
East Fork Lewis	568	2,408	100%	3,940	100%	544	96%	1,143	100%	1,463	100%	1,610	100%	2,497	100%	2,653	100%
	Average		**80%**		**100%**		**51%**		**75%**		**68%**		**56%**		**75%**		**89%**

1. Lower Cowlitz full-seeding and spawner estimates are for tributary habitat only and do not include the main stem river.
2. Toutle coho population includes both the North Fork/Green population and South Fork Toutle population.

Table 4. Annual LCN coho salmon stock pre- and post-season returns and resulting exploitation rates (from PFMC 2023a and JCRMS 2023).

Year	Average Parental Escapement (rate of full seeding)	Marine Survival Index	Preseason LCN coho forecast	Postseason LCN coho run	Exploitation Rate limit preseason	Exploitation Rate achieved[1]
2015	Normal	High	35,900	**20,900**	23.0%	**24.3%**
2016	Normal	Medium	40,000	**25,100**	18.0%	9.0%
2017	Normal	Medium	30,100	31,200	18.0%	11.0%
2018	Normal	Medium	21,900	29,700	18.0%	11.1%
2019	Normal	High	36,900	**34,100**	23.0%	19.5%
2020	Normal	Medium	24,800	55,400	18.0%	7.0%
2021	Normal	Very High	39,200	70,500	30.0%	10.6%
2022	Normal	High	65,700	73,100	23.0%	11.7%
2023	Normal	High	45,500	n/a	23.0%	n/a

[1] Calculated total exploitation on LCN coho 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.

The ERs presented in Table 3 use harvest from all fisheries in marine waters and the Columbia River, below Bonneville Dam. Ongoing monitoring efforts continue to be directed at gathering consistent information on natural population status and trends (e.g., abundance, age composition, hatchery fractions, and productivity). New escapement information that has been gathered over the last four or five year shows no substantive changes in abundance or hatchery fractions that are inconsistent with previous trends (Table 4, Table 5) used in NMFS' assessment of the HCR. As evidenced by blank columns prior to 2010, escapement data for 14 populations in Table 5 were not previously monitored, but instead are now tracked including six populations which are included in the annual assessment of parental escapement that is used to define each year's ER limit. Tracking escapement of these populations is expected to continue since they are now part of the tier selection calculations. Updated spawning abundances come from either the Washington Department of Fish and Wildlife's Salmon Conservation and Reporting Engine or Oregon Department of Fish and Wildlife's Salmon and Steelhead Recovery Tracker online databases.

Since implementing the new harvest control rule, parental escapement has consistently been in the normal category and the marine survival index has ranged from medium to very high, resulting in four years with an ER limit if 18%, four years with an ER limit of 23%, and one year with an ER limit of 30% (Table 3); the higher end of the framework tiers. Post-season estimates of abundance indicate that the abundance was over-forecast in three of the eight years with estimates of post-season returns since the new HCR was implemented in 2015.
Preliminary post-season estimates based on FRAM model analysis indicate that exploitation rates exceeded the preseason limit in 2015 but have been well below the limit since 2016, indicating the approach is risk averse to forecast error. When more data points allow for a more comprehensive review, the review should include comparisons of the estimates of exploitation rates from FRAM to independent exploitation rate estimates derived from coded-wire tag groups that are now being used to track the new status information on the additional populations being

monitored. Trends in pHOS should also be evaluated once more data points associated with the new control rule are available given Council fisheries harvesting LCN coho are broadly mark selective and the long-term expectation is that levels of pHOS will decline from historically high averages.

Based on this information, NMFS concludes that (1) fisheries over the past review period have been managed consistent with the control rule; (2) escapements have consistently exceeded the parental escapements in 10 populations used to determine harvest matrix seeding level associated with low risk evaluated in the biological opinion, with the post-season LCN abundance continuing to build over time (Table 3) and; (3) fisheries managed under the harvest management matrix for LCN coho salmon have continued to be consistent with the outcomes and expectations of NMFS' 2015 biological opinion evaluating effects of the HCR on this ESU (NMFS 2015).

Table 5. Natural-origin spawning escapement numbers and the proportion of natural spawners composed of hatchery-origin fish (pHOS[1]) on the spawning grounds for LCN coho salmon populations in Oregon from 2008 through 2021. (http://www.odfwrecoverytracker.org/)*.

Major Population Group	Oregon Population	Origin	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total Average	Pre-HCR update (2010-14) Average	Post-HCR update (2015+) Average
Coast	Youngs Bay	Natural	68	161	129	-	-	-	-	-	-	-	-	-	-	119	119	n/a
		pHOS	61%	66%	46%	-	-	-	-	-	-	-	-	-	-	58%	58%	n/a
	Big Creek	Natural	279	160	409	-	-	-	-	-	-	-	-	-	-	283	283	n/a
		pHOS	52%	21%	18%	-	-	-	-	-	-	-	-	-	-	30%	30%	n/a
	Clatskanie	Natural	1,686	1,546	619	611	3,246	240	464	566	25	146	1,233	476	1,139	923	1,542	536
		pHOS	3%	1%	11%	11%	4%	4%	6%	19%	68%	40%	10%	46%	-	19%	6%	28%
	Scappoose	Natural	1,960	298	210	979	1,587	487	1,200	387	178	384	-	921	508	758	1,007	581
		pHOS	0%	0%	0%	0%	0%	0%	0%	3%	2%	0%	-	0%	-	0%	0%	1%
Cascade	Clackamas	Natural	4,009	2,253	1,663	4,012	10,672	1,784	1,628	7,598	3,159	4,044	-	10,572	13,991	5,449	4,522	6,111
		pHOS	26%	10%	8%	3%	14%	11%	9%	12%	10%	5%	-	2%	-	10%	12%	8%
	Sandy	Natural	901	3,494	1,165	667	5,942	443	393	2,384	537	1,052	-	3,819	7,152	2,329	2,434	2,254
		pHOS	12%	8%	3%	12%	3%	4%	3%	0%	8%	0%	-	0%	-	5%	8%	3%
Gorge	Lower Gorge	Natural	920	216	96	151	362	30	395	-	16	184	-	-	523	289	349	230
		pHOS	7%	54%	56%	6%	51%	38%	7%	-	36%	4%	-	-	-	29%	35%	21%
	Upper Gorge/ Hood	Natural	223	232	169	561	42	4	57	-	107	193	-	510	60	196	245	155
		pHOS	85%	69%	78%	65%	76%	64%	65%	-	28%	18%	-	74%	-	62%	75%	50%

[1] For example, Clatskanie in 2010 had 1,686 natural-origin spawners and 3% hatchery spawners. To calculate hatchery-origin numbers multiply (1,686/(1-.03))-1,686 = 52 hatchery-origin spawners.

*http://www.odfwrecoverytracker.org/summary/#/species=1&run=2&esu=159/esu=159&metric=1&level=3/filter=160&start_year=1992&end_year=2017 Date accessed: August 7, 2023.

Table 6. Natural-origin spawning escapement numbers and the proportion of all natural spawners composed of hatchery-origin fish (pHOS[1]) on the spawning grounds for LCN coho salmon populations in Washington from 2008 through 2022. (https://fortress.wa.gov/dfw/score/score/species/coho.jsp?species=Coho)*.

Major Population Group	Washington Population	Origin	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total Average	Pre-HCR update (2010-14) Average	Post-HCR update (2015+) Average
Coast	Grays/Chinook	Natural	479	301	461	862	2,689	312	627	400	406	746	962	1,114	814	783	958	673
		pHOS	79%	93%	42%	65%	40%	48%	58%	67%	69%	58%	42%	57%	44%	59%	64%	55%
	Elochoman / Skamokawa	Natural	858	605	477	768	3,079	328	754	896	1,076	1,664	1,725	1,450	756	1,110	1,157	1,081
		pHOS	72%	59%	27%	39%	36%	36%	34%	25%	41%	36%	21%	46%	n/a	39%	46%	34%
	Mill Creek	Natural	207	128	130	146	988	220	356	303	245	378	475	421	482	345	320	360
		pHOS	12%	19%	2%	6%	12%	7%	13%	8%	15%	27%	12%	14%	24%	13%	10%	15%
	Abernathy	Natural	471	254	277	387	959	248	501	314	344	757	686	742	819	520	470	551
		pHOS	12%	18%	2%	7%	12%	7%	13%	8%	15%	28%	9%	14%	24%	13%	10%	15%
	Germany	Natural	164	115	128	164	529	159	228	202	326	301	309	222	392	249	220	267
		pHOS	12%	18%	2%	7%	12%	7%	13%	8%	16%	27%	11%	14%	25%	13%	10%	15%
Cascade	Lower Cowlitz	Natural	5,482	4,316	5,135	6,802	24,544	2,474	4,365	2,674	2,762	3,191	4,740	5,906	4,293	5,899	9,256	3,801
		pHOS	15%	11%	14%	19%	5%	8%	9%	22%	8%	6%	7%	15%	19%	12%	13%	n/a
	Upper Cowlitz/Cispus	Natural	2,774	7,615	1,601	12	6,850	374	911	5,200	172	3,562	8,915	9,666	11,532	4,553	3,770	5,042
		pHOS	94%	77%	74%	100%	87%	84%	96%	73%	99%	79%	74%	81%	52%	82%	86%	80%
	Tilton	Natural	899	1,963	1,270	2,653	8,920	1,362	2,629	5,195	1,321	1,559	2,401	6,399	7,275	3,373	3,141	3,518
		pHOS	85%	84%	87%	78%	55%	72%	80%	69%	84%	89%	91%	76%	56%	77%	78%	77%
	SF Toutle	Natural	1,653	1,180	1,876	2,825	8,364	1,453	2,372	1,165	1,117	2,243	2,418	2,581	2,036	2,406	3,180	1,923
		pHOS	20%	12%	11%	14%	19%	50%	22%	8%	8%	10%	6%	11%	11%	16%	15%	16%
	NF Toutle[2]	Natural	1,408	877	1,203	1,872	4,366	733	1,267	839	895	1,595	1,900	2,188	2,015	1,628	1,945	1,429
		pHOS	53%	52%	53%	54%	51%	53%	59%	51%	50%	56%	51%	51%	56%	53%	53%	53%

Major Population Group	Washington Population	Origin	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total Average	Pre-HCR update (2010-14) Average	Post-HCR update (2015+) Average
	Coweeman	Natural	3,799	3,311	3,200	3,693	6,876	1,238	2,988	2,349	2,518	3,501	4,362	4,541	4,311	3,591	4,176	3,226
		pHOS	9%	5%	4%	13%	16%	18%	15%	11%	26%	25%	15%	20%	9%	14%	9%	18%
	Kalama	Natural	75	46	47	59	150	31	74	64	79	143	245	253	268	118	75	145
		pHOS	96%	90%	85%	85%	90%	88%	64%	58%	63%	51%	74%	76%	61%	75%	89%	67%
	NF Lewis[3]	Natural	2,141	4,327	1,897	1,372	4,780	990	3,303	4,241	2,951	4,392	7,677	4,698	1,461	3,402	2,903	3,714
		pHOS	26%	25%	15%	85%	66%	79%	65%	55%	71%	52%	44%	62%	62%	54%	43%	61%
	EF Lewis	Natural	1,640	1,502	2,617	2,408	3,940	544	1,143	1,463	1,610	2,497	2,653	4,561	4,070	2,358	2,421	2,318
		pHOS	23%	6%	7%	9%	13%	17%	34%	38%	13%	8%	9%	7%	8%	15%	12%	17%
	Salmon Creek	Natural	1,952	1,320	1,421	1,749	4,627	953	2,017	1,660	1,733	2,612	2,808	2,915	2,938	2,208	2,214	2,205
		pHOS	8%	6%	5%	2%	2%	2%	4%	10%	11%	9%	9%	3%	2%	6%	5%	6%
	Washougal	Natural	597	399	386	423	834	151	322	272	302	584	858	860	1,026	540	528	547
		pHOS	40%	11%	12%	33%	68%	61%	72%	75%	70%	55%	61%	17%	39%	47%	33%	n/a
Gorge	Lower Gorge	Natural	555	446	498	631	1,537	340	706	509	555	1,075	1,113	1,344	1,363	821	733	876
		pHOS	24%	12%	15%	23%	27%	13%	7%	15%	20%	26%	9%	6%	20%	17%	20%	15%
	Upper Gorge/ Hood	Natural	40	122	104	112	50	156	88	78	83	128	21	46	n/a	86	86	86
		pHOS	15%	14%	15%	16%	14%	14%	15%	14%	19%	20%	19%	0%	n/a	15%	15%	14%

[1] For example, Mill Creek in 2010 had 207 natural-origin spawners and 12 % hatchery spawners. To calculate hatchery-origin numbers multiply (207/(1-.12))-207) = 28 hatchery-origin spawners.

[2] Natural-origin escapement numbers and proportion of hatchery-origin fish combines the Green River (NF Toutle) coho salmon, the North Fork Toutle River coho salmon, and trap count data.

[3] Natural-origin escapement numbers and proportion of hatchery-origin fish combines the Cedar Creek (NF Lewis) coho salmon and the North Fork Lewis River Mainstem coho salmon.

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Performance Report for Lower Columbia Chinook Harvest Control Rule

FINAL

Periodic Review of the
Lower Columbia River Tule Fall Chinook Abundance-based Harvest Matrix

February 22, 2024

Summary: Under the terms of the current biological opinion and as requested by the PFMC, NMFS reviews the Abundance Based Management (ABM) matrix for Lower Columbia River (LCR) tule fall Chinook every three to five years. The purpose of the review is to assess the key assumptions and expectations used in the derivation of the matrix, and assess its performance. NMFS provided a draft review document to the PFMC in November 2023 and requested comment and feedback as well as additional discussion with the states of Oregon and Washington on several technical issues prior to finalizing the report. This final version of the review document incorporates the discussions to date. No additional comments were received.

Based on the available information, NMFS concludes that (1) fisheries over the review period have been managed consistent with the long-term expectation of risk under implementation of the ABM matrix; (2) updates to forecast methodology have retained the ability to forecast abundances of the LRH correctly; and (3) fisheries managed under the ABM matrix continue to be consistent with the outcomes and expectations of the 2012 biological opinion.

ODFW and WDFW have committed to evaluate existing data to determine the feasibility of forecasting LCR natural tule fall Chinook, the accuracy of such forecasts, and any impediments to producing them in a time and manner to inform fishery management. NMFS anticipates that this work will be completed within one year. An evaluation of whether LRH abundance remains a suitable surrogate for LCR natural tule Chinook salmon must be completed in time to inform the next periodic review and the results available to consider in other fishery management forums. To ensure that this is accomplished, NMFS will work with the appropriate co-managers to develop a workplan and timeline for this evaluation and will consider what additional PFMC engagement may be needed. The workplan and timeline should be completed by December 2024.

Finally, as explained in detail below, NMFS recommends an adjustment to the abundance tiers to reflect the reductions in Mitchell Act hatchery production and the anticipated resulting abundance of adult LRH. The table on the right reflects the ABM matrix with the updated abundance tiers compared with the original matrix represented by the table on the left.

LRH Abundance Forecast (original tiers)	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

LRH Abundance Forecast (updated tiers)	Total Exploitation Rate Limit
0 – 24,000	0.30
24,001 – 31,000	0.35
31,001 – 67,000	0.38
>67,000	0.41

Background:
In November 2011, the Pacific Fishery Management Council (PFMC) passed a motion recommending that NOAA's National Marine Fisheries Service (NMFS) consider an abundance-based management (ABM) matrix as the harvest control rule (HCR) for Lower Columbia River (LCR) tule fall Chinook salmon for management of salmon fisheries in 2012 and beyond (NMFS 2012). The HCR identifies exploitation rate (ER) limits based on four levels of abundance of LCR hatchery tule (LRH) Chinook salmon (Table 1). The LRH stock management unit is the indicator stock surrogate for the tule component of the LCR Chinook Salmon Evolutionarily Significant Unit (ESU) (PFMC 2023a). Although LRH is often considered a hatchery stock, the LRH run does include a small proportion of naturally-produced LCR tule (LCR natural tule) fall Chinook salmon (WDFW and ODFW 2023).

Table 1. Variable fishing exploitation rate limits based on the ABM matrix as proposed by the PFMC and adopted by NMFS (NMFS 2012).

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, acting on the PFMC recommendation, NMFS issued a biological opinion on the management of the ocean fisheries subject to the Pacific Coast Salmon Fishery Management Plan for salmon fisheries off the coasts of Washington, Oregon and California. The opinion evaluated the impacts to the Endangered Species Act (ESA)-listed LCR Chinook Salmon Evolutionarily Significant Unit (ESU) from the proposed action including the ABM matrix for the tule fall Chinook salmon component (Table 1). NMFS (2012) concluded that the HCR, combined with the management objectives for the spring and bright components of the LCR Chinook Salmon ESU, would not jeopardize the continued existence of the ESU (NMFS 2012).

Under the terms of the biological opinion and as requested by the PFMC, NMFS agreed to review the ABM matrix every three to five years. The purpose of the review is to assess the assumptions and expectations described by Beamesderfer et al. (2011), and performance of the ABM matrix (NMFS 2012). The risk metrics for the proposed abundance-based matrix are equivalent to those of a fixed exploitation rate of 36 percent (NMFS 2012). As described in NMFS (2012), the review should include, but is not limited to, forecast methods, the relationship between LCR hatchery and natural-origin fish, and population specific information used by Beamesderfer et al. (2011) such as population specific hatchery contribution.

In the sections below, we review the performance of the ABM and review information received in response to questions posed by NMFS since the last review.

Performance

The effectiveness of this HCR depends, in part, on whether abundance of LRH can be predicted with reasonable accuracy. When the ABM matrix was proposed, LCR tule fall Chinook salmon run sizes were predicted using sibling models based on reconstructed runs of the aggregate LRH (LCR natural tules are a small component of LRH). LCR natural tules could not be forecasted independently because of the lack of reliable age and escapement data for most wild populations. Correlations between the LRH return and the abundance of LCR natural tule between 1964 and 2010 suggested that the LRH forecast provided a suitable surrogate for LCR natural tules due to common effects of marine and freshwater conditions to which both hatchery and wild fish are subject (Beamesderfer et al. 2011).

Since implementation of the ABM matrix (2012 to 2023), the LRH forecast (pre-season run size forecast) has averaged 86,400 (range 51,000 to 133,700) and has been high enough to allow fisheries to operate at the highest two tiers (Table 2). During the same time period, the actual LRH return (post-season reconstructed run) has averaged 82,200 (range 48,900 to 128,700) and the ER achieved has averaged 36 percent (Table 3). While the average return has been slightly over-forecast, the ABM tier was correctly forecast in seven out of eleven years (Table 3). In 2012, 2016, and 2017 the forecast allowed for a higher ER limit (41 percent compared to 38 percent) than what would have been appropriate given the return. In 2022, the forecast set a lower ER limit (38 percent compared to 41 percent) than what would have been appropriate given the return. The post-season ERs were below the allowable limit for 9 out of 11 years but exceeded the allowable ER in 2012 and 2014.

Based on this information, NMFS concludes that (1) fisheries over the past review period have been managed consistent with the control rule long-term expectation of risk levels equal to a fixed ER of 36 percent (Table 3); (2) updates to forecast methodology have retained the ability to forecast abundances of the LRH correctly (Table 3); and (3) fisheries managed under the LCR tule fall Chinook salmon HCR continue to be consistent with the outcomes and expectations of NMFS (2012). NMFS may re-evaluate these conclusions after review and consideration of new information, as described below, and comments received on this report.

Table 2. Forecast and allowable exploitation rate (based on ABM matrix) for LRH Chinook salmon for years 2012 to 2023 (PFMC 2023a).

Year	**LRH Forecast**	**Allowable Exploitation Rate**
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
2019	54,500	0.38
2020	51,000	0.38
2021	73,100	0.38
2022	73,000	0.38
2023	77,100	0.38
Average	86,400	0.40

Table 3. Post-season returns and exploitation rates for LRH Chinook salmon for years 2012 to 2022 (PFMC 2023b).

Year	LRH Return	Percent of Forecast	Exploitation Rate achieved[1]
2012	85,000	66.9%	0.430
2013	104,800	119.1%	0.349
2014	101,900	92.6%	0.444
2015	128,700	135.6%	0.360
2016	81,900	61.3%	0.374
2017	64,600	69.9%	0.367
2018	53,000	84.9%	0.359
2019	48,900	89.7%	0.324
2020	77,900	152.7%	0.267
2021	74,700	102.2%	0.377
2022	87,500	119.9%	0.306
Average	82,600	99.5%	0.360

[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 and the Columbia River Fall Chinook Fishery Model.*

Additional Information Requested/Received

Changes in the escapement datasets and forecast methodology emerged since our last review of the HCR. In order for NMFS to evaluate the effect of these changes to the HCR, NMFS requested more information from Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW). The following subsections summarize the information and analyses provided by ODFW and WDFW. Additional documentation is compiled in a memorandum based on the communications received. (Siniscal 2023).

1) What was the effect of changes to the methodology for estimating escapement on escapement trends relative to the estimates used in the biological opinion?

In 2010, WDFW modified and expanded their escapement monitoring program to improve estimates of LCR Chinook salmon and to include Viable Salmonid Population parameters and other population demographic metrics (i.e., proportion of hatchery-origin spawners, age structure, percent females, spawn timing, and spatial distribution). The implementation of this intensive monitoring programs for fall Chinook salmon has resulted in robust abundance estimates for most populations of LCR fall Chinook salmon since 2010 (Wilson et al., 2020b; Dammerman et al., 2022).

In 2020, WDFW paired the robust abundance estimates with historical peak (pre-2010) counts to inform new peak count expansion factors. The revised expansion factors were then applied to peak counts across the historical time series to update the historical escapement estimates and compute associated estimates of uncertainty (Wilson et al., 2020b; Dammerman et al., 2022). The revised abundance estimates for the historical fall Chinook escapement follow the same trends as the historical estimates and are higher than the historical estimates for most populations despite not including jacks (the original estimates included jacks). The original historical estimates numbers are also within the confidence intervals of the new abundance estimates (Wilson et al., 2020a). Thus, we do not have reason to expect this would change the underlying relationship between LRH and LCR natural tules that is foundational to the HCR. Escapement data for LRH populations in the Coast and Cascade Major Population Groups (MPG) are provided in Table 4 and Table 5. Data for years prior to 2010 have been updated from Beamesderfer et al. (2011) to reflect the new abundance estimates. Methodology for the Oregon LRH populations has not changed from previous methods.

As monitoring and estimation methods continue to improve, historical abundance estimates could undergo further revision. We will continue to evaluate the effects of future changes to escapement methods in subsequent periodic performance reviews of the LCC tule ABM matrix.

Table 4. Escapement information (total spawners (#) and proportion wild) for Coast MPG populations of Lower Columbia River tule Chinook Salmon for years 1995 through 2021 (Source: https://www.streamnet.org/home/data-maps/fish-hlis/).

Year	Grays / Chinook		Big Creek		Elochoman / Skamokawa		Clatskanie		Mill / Abernathy / Germany	
	Spawners	Prop. Wild	Spawners	Prop. Wild	Spawners	Prop. Wild	Spawners	Prop. Wild	Spawners	Prop. Wild
1995	24	39.0			388	0.50	194	0.10	1,743	0.51
1996	307	17.0			944	0.66	1,069	0.10	652	0.54
1997	6	12.0			640	0.11	155	0.10	598	0.23
1998	852	24.0			455	0.25	214	0.10	456	0.60
1999	176	68.0			1,241	0.25	233	0.10	666	0.69
2000	401	70.0			221	0.62	607	0.10	1,050	0.58
2001	714	43.0			3,282	0.82	607	0.10	3,976	0.39
2002	281	47.0			9,640	0.00	894	0.10	3,301	0.05
2003	319	39.0			4,929	0.65	1,088	0.10	2,977	0.56
2004	626	25.0			8,737	0.01	401	0.10	2,512	0.02
2005	103	41.0			2,985	0.05	370	0.10	2,072	0.13
2006	319	100.0			391	1.00	212	0.10	575	0.62
2007	88	100.0			284	1.00	93	0.10	326	0.48
2008	95	34.7			1,730	0.10	94	0.10	745	0.49
2009	555	37.8	7,196	0.00	1,254	0.18	167	0.56	712	0.93
2010	170	48.8	14,768	0.06	1,260	0.11	103	0.12	2,410	0.06
2011	416	14.9	2,709	0.05	1,083	0.06	152	0.09	1,192	0.08

2012	160	21.9	1,096	0.05	206	0.30	80	0.10	147	0.14
2013	1,644	5.5	946	0.00	448	0.18	39	0.08	657	0.19
2014	969	19.1	2,583	0.02	680	0.22	76	0.09	554	0.06
2015	762	28.7	2,586	0.00	989	0.23	76	0.09	989	0.08
2016	356	22.5	582	0.08	368	0.25	76	0.07	397	0.22
2017	565	52.2	1,279	0.00	114	0.68	n/a	n/a	95	0.18
2018	734	70.2	12,301	0.01	77	0.35	76	0.01	14	0.43
2019	591	58.2	936	0.02	163	0.23	49	0.02	263	0.05
2020	581	34.9	1,256	0.02	178	0.33	n/a	n/a	85	0.28
2021	343	49.0	6,173	0.05	275	0.31	n/a	n/a	93	0.27
2012-2021 average	671	36.22	2,974	0.02	350	0.31	67	0.07	329	0.19
Long term average	450	41.61	4,185	0.03	1,591	0.35	297	0.11	1,084	0.33

Table 5. Escapement information (total spawners (#) and proportion wild) for Cascade MPG populations of Lower Columbia River tule Chinook Salmon for years 1995 through 2021 (Source: https://www.streamnet.org/home/data-maps/fish-hlis/).

Year	Lower Cowlitz[1]		Coweeman		Toutle		Upper Cowlitz		Kalama		Lewis[2]		Clackamas		Washougal		Sandy[3]	
	#	Prop. Wild	#	Prop. Wild	#	Prop. Wild	#	Prop. Wild	#	Prop. Wild	#	Prop. Wild	#	Prop. Wild	#	Prop. Wild	#	Prop. Wild
1995	2,231	0.13	1,501	1.00	405				2,734	0.69	200	1.00			2,464	0.39		
1996	1,602	0.58	2,454	1.00	1,376		437		8,353	0.44	1,256	1.00			2,992	0.17		
1997	2,710	0.72	524	1.00	560		27		2,525	0.40	1,737	1.00			3,505	0.12		
1998	2,108	0.37	340	1.00	1,353		257		3,062	0.69	1,329	1.00			3,043	0.24		
1999	997	0.16	227	1.00	720		1		3,006	0.03	1,249	1.00			3,205	0.68		
2000	2,363	0.10	184	1.00	879		1		1,529	0.21	1,689	1.00			2,207	0.70		
2001	4,652	0.44	698	0.73	4,971		3,646		2,861	0.18	4,132	0.70			3,483	0.43		
2002	13,514	0.76	756	0.97	7,896		6,113		18,950	0.01	5,224	0.77			6,139	0.47		
2003	10,048	0.88	1,052	0.89	13,943		4,165		37,885	0.00	6,518	0.98			3,527	0.39		
2004	4,466	0.70	1,513	0.91	4,711		2,145		7,250	0.11	2,171	0.29			10,795	0.25		
2005	2,870	0.17	661	0.60	3,303		2,901		8,633	0.03	2,536	1.00			2,735	0.41		
2006	2,944	0.47	632	1.00	5,752		1,782		9,481	0.01	1,332	0.82			2,765	0.14		
2007	1,847	0.53	455	1.00	1,149		1,325		3,101	0.06	1,012	0.73			1,657	0.87		
2008	1,828	0.90	369	0.52	1,725		1,845		3,466	0.04	1,256	0.87			1,870	0.93	*2,549*	*0.80*
2009	2,602	0.45	666	0.63	539		7,491		6,907	0.10	2,437	1.00	489	0.49	3,139	0.30	*2,057*	*0.97*
2010	3,734	0.68	584	0.71	1,917	0.21	9,808	0.21	5,315	0.11	2,490	0.64	n/a	n/a	5,530	0.11	*2,304*	*1.00*
2011	3,685	0.74	707	0.88	1,498	0.33	12,914	0.33	7,591	0.06	2,364	0.71	118	0.29	3,224	0.15	*6,731*	*0.93*
2012	2,725	0.57	526	0.88	907	0.35	5,564	0.35	7,477	0.04	1,950	0.68	321	0.19	965	0.27	*314*	*0.70*
2013	4,320	0.80	2,322	0.68	1,754	0.50	6,488	0.50	8,487	0.10	5,872	0.71	422	0.92	3,612	0.33	*9,615*	*0.97*
2014	4,347	0.67	830	0.96	783	0.36	6,231	0.36	9,451	0.08	5,553	0.55	183	0.69	1,529	0.65	*2,725*	*0.91*
2015	5,981	0.70	1,391	0.98	598	0.60	5,647	0.60	6,423	0.45	7,489	0.45	308	0.62	2,925	0.46	*n/a*	*n/a*
2016	3,885	0.74	439	0.94	803	0.77	3,959	0.77	4,226	0.60	4,769	0.46	910	0.78	2,198	0.40	*4,773*	*0.99*
2017	3,630	0.81	841	0.86	594	0.98	1,520	0.98	3,041	0.57	3,762	0.53	90	0.38	1,112	0.59	*6,229*	*1.00*
2018	3,553	0.84	244	0.89	244	0.92	674	0.92	2,548	0.64	2,087	0.63	709	0.95	1,019	0.89	*12,622*	*0.99*
2019	5,072	0.89	366	0.78	466	1.00	544	1.00	2,763	0.53	2,033	0.74	928	0.95	1,817	0.87	*8,014*	*0.99*
2020	4,863	0.92	807	0.92	708	0.88	2,265	0.88	4,700	0.68	4,442	0.68	111	1.00	5,042	0.75	*20,824*	*1.00*
2021	4,756	0.85	669	0.91	819	0.79	863	0.79	4,195	0.47	3,827	0.52	40	0.90	1,956	0.74	*8,927*	*0.95*
2012-21 avg.	4,313	0.78	844	0.88	768	0.72	3,376	0.72	5,331	0.42	4,178	0.59	402	0.74	2,218	0.59	*8,227*	*0.94*
Long term average	3,975	0.61	806	0.87	2,236	0.64	3,408	0.64	6,887	0.27	2,989	0.76	386	0.68	3,128	0.47	*6,745*	*0.94*

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.
3 Data under review. Estimates include tule fall Chinook salmon and bright late-fall Chinook salmon

(2) How have the forecasting methodologies evolved since Beamesderfer et al. (2011)?

As mentioned above, the performance of the HCR depends on whether LRH stock abundance can be predicted with reasonable accuracy and precision. Beamesderfer et al. (2011) described and evaluated the precision and potential use of both LRH and LCR natural tules for forecasting methods and determined that the sibling models in use at the time were the best scientific information available. The forecast methodology for LRH abundance has evolved from the methods described by Beamesderfer et al. (2011). The current forecasting methodology is described briefly here[2]. Forecasts for LRH are computed, using an ensemble model, which fits eight different models (Table 6) to observed returns in the historical time series, makes predictions for the upcoming year, and averages the predictions based on a weighting criterion described by Dormann et al. (2018).

Table 6. A suite of 8 models run for each brood. The 8 models are variants of sibling regressions, cohort ratios, and average returns. A weighted average of the predictions of each of the 8 models is used as the forecast for an upcoming year.

Description
Sibling regression with constant slope and intercept.
Sibling regression with time-varying intercept.
Sibling regression with time-varying slope.
Sibling regression with time-varying slope and intercept.
Time varying "cohort ratio" model. Time varying slope, Intercept=0.
Constant "cohort ratio" model. Constant slope, Intercept=0
Time-varying Intercept-only model. Random walk on return, no sibling predictor.
Constant Intercept-only model. Long-term average, no sibling predictor.

(3) Are the available data sufficient to forecast natural LCR tule abundance?

The available time series of LCR natural tules since implementing the HCR is now over 10 years long. In prior reviews of the HCR, NMFS had determined that data were insufficient for forecasting abundance of LCR natural tules (NMFS 2015; 2019). As mentioned above, methodologies to forecast LRH abundance have continued to evolve since 2012. NMFS (2012) recommended continuing to examine forecast methods, the relationship between LRH and natural-origin fish, and population specific information used in the risk analysis. Consistent with this expectation, NMFS recommends an evaluation of whether:

[2] WDFW and ODFW are the agencies responsible for producing the forecasts and the following description is based on information provided by these agencies.

- sufficient data exist to forecast LCR natural tules and, if so, an assessment of the accuracy of such forecasts and the feasibility of producing them in a time and manner that would be informative for managing fisheries.
- the available information indicates that the LRH abundance remains a suitable surrogate for natural LCR tule abundance going forward.

ODFW and WDFW commit to evaluating existing data to determine the feasibility of forecasting LCR natural tule fall Chinook, the accuracy of such forecasts, and any impediments to producing them in a time and manner to inform fishery management. NMFS anticipates that this will be completed within one year. An evaluation of whether LRH abundance remains a suitable surrogate for LCR natural tules must be completed in time to inform the next periodic review of the LCR ABM matrix and to inform related issues in other fishery management forums. To ensure that this is accomplished, NMFS will work with the appropriate co-managers to develop a workplan and timeline for this evaluation and will consider what additional PFMC engagement may be needed. The workplan and timeline should be completed by December 2024.

<u>(4) Does the reduction in Mitchell Act production affect the HCR matrix?</u>

The abundance of LRH is used as a surrogate for the abundance of LCR natural tule in the HCR (Beamesderfer et al. 2011; NMFS 2012). Beamesderfer et. al. (2011) estimated that annual hatchery releases from lower Columbia River programs averaged approximately 22 million LRH juveniles per year from 1998 through 2008. This production level reflects program changes that were implemented in the mid-90's to reduce production costs and eliminate programs with lower success rates. The level of releases (22 million) was used to set the breakpoints for the ABM matrix, but did not reflect any future changes to hatchery production. As described by Beamesderfer et. al. (2011), tier frequencies in the future will depend on average size and variability in the LRH run size which in turn is affected by hatchery production, ocean survival patterns, and ocean exploitation rates. If parameters changed significantly in the future, then the tier break points could change as well (Beamesderfer et. al. 2011).

In 2017, NMFS reviewed the effects of the Mitchell Act funded hatcheries on ESA-listed species and completed a biological opinion (NMFS 2017). The majority of the hatcheries that produce tule Chinook salmon in the LCR are funded by the Mitchell Act. The opinion reduced the maximum amount of LRH juveniles that could be released from Mitchell Act hatchery programs substantially (NMFS 2017). The overall production goal as of release year 2022 (brood year 2021) inclusive of the Mitchell Act programs and including the Cowlitz Hatchery, which is not funded by Mitchell Act, will be approximately 17.3 million LRH juveniles. This represents a substantial reduction in hatchery production from the 22 million used to set the breakpoints in the ABM matrix. Since the majority of the LCR tule Chinook abundance is comprised of returns from these hatchery programs, we anticipate that the abundance of adult LRH will be lower when fish from those programs return. The reductions were realized with the juveniles released in 2022 (i.e., brood year 2021 for tule fall Chinook) (NMFS 2017). Tule fall Chinook adults mature starting at age three, therefore the reductions in hatchery production will result in fewer hatchery adult returns starting in 2024.

In the 2019 review of the tule harvest matrix, NMFS recommended that once the production changes were final and the adults from the reduced production had recruited to fisheries, the abundance tiers should be adjusted to reflect the reduced production (NMFS 2019). While actual releases of hatchery fish fluctuate from year to year and are typically less than program goals, using the production goal of approximately 17.3 million as the basis for the adjustment to the breakpoints acknowledges the production levels evaluated in the Mitchell Act opinion and the potential that those goals could be attained, while adjusting the breakpoints in the matrix to account for reduced production. As part of the adaptive management strategy developed through the ABM matrix and based on the 2019 review, NMFS recommends an adjustment to the abundance tiers to reflect the reductions in hatchery production and the resulting abundance of adult LRH. The program production goal of 17.3 million represents a reduction of approximately 21.4 percent from the 22 million reference level. After applying this reduction to the ABM matrix, the corresponding abundance breakpoints are shown in Table 7.

Table 7. Variable fishing exploitation rate limits based on reduced hatchery releases of LRH Chinook salmon implemented by the Mitchell Act opinion (numbers are rounded to the nearest 1,000) (NMFS 2017).

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

NMFS is aware that LRH release goals may change again in the future and may revise the ABM matrix as needed once changes have been realized and the adult fish have recruited to the fishery.

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