Fish Program responses to Commission questions associated with the Willapa Bay Policy

Commissioner McIsaac's questions from his email sent on 11/8/2021

1. Staff to provide:
    a. Genetic History Information on hatchery programs
        i. Chinook salmon

        [*The information below concerns the out-of-basin stocking history for Chinook in Willapa Bay. We discuss the potential genetic effects of this stocking in the ESU section below (1b)*].

        1. The slide from a previous staff ppt showing some information on bringing in stocks not native to Willapa Bay—the request is to send it to the Fish Committee members at this time.

Forks Creek Production: Out of Basin Stocks

Species	Stock	Years Released
Chinook	Big Soos	1954-58
	Deschutes	1964-67, 69-70
	Elk River	1974
	Finch Creek	1971, 79
	Kalama	2019
	Spring Creek	1953
	Trask	1974-75
	Unspecific Wild	1953-71
Coho	Big Soos	1952-56, 58
	Cowlitz	1990, 91
	Dungeness	1956-57
	Humptulips	1982
	Lake Creek	1961
	Satsop	1973
	Unspecific Wild	1952-71
	Washington State	1960
Chum	Unspecific Wild	1959-62

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Nemah & Naselle Production: Out of Basin Stocks

Hatchery	Species	Stock	Years Released
Nemah	Chinook	Abernathy	1972
		Big Soos	1954-58
		Deschutes	1962, 64-67
		Elochoman	1959
		Klickitat	1958
		Unspecific Wild	1954
	Coho	Big Soos	1954-56
		Dungeness	1956-57
		Unspecific Wild	1953-54, 62-65
	Chum	Undetermined Mix	1988
		Washington State	1961-62
Naselle	Chinook	Spring Creek	1953
		Unspecific Wild	1953
	Coho	Big Soos	1952-53
		Cowlitz	1991
		Dungeness	1982
		Humptulips	1980-83
		Satsop	1993
		Sol Duc	1981
		Unspecific Wild	1952-53

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a. The information detail from which the slide was prepared, including the stock source, the date the stock was introduced, the number of eggs fish released, and any other relevant information. This would be provided at the next Fish Committee meeting.

See Table 1, Pages 10-11 for out-of-basin Chinook transfers.

2. If there have been more out-of-basin stock transfers than those shown on that summary slide, provide the information on all such transfers.

The data provided in Table 1 (and others) are exhaustive with respect to information available in RMIS (rmpc.org). However, prior to 2008, stock names were used inconsistently, and data are less reliable (HEAT unit, pers comm).

3. Provide information on the between-hatchery transfers of eggs or juveniles between the three Willapa Bay hatcheries for the past 20 years (date, stock source, number of fish, stage of life, etc.).

See Table 2, Page 12 for in-basin Chinook transfers.

4. Information on the transfer of Kalama Falls spring chinook as referenced in a recent Commission meeting (date of transfer, number fish, stage of life at transfer and release, reason for transfer, etc.).

Table 3. Year, stock source, release location and total numbers of Kalama Falls Spring Chinook released in Forks Creek.

Year	Stock Source	Release Location	Total
2019	KALAMA R HATCH 27.0002	FORK CR 24.0356	567,560

- ***This was a SRKW program and was supported by the HSRG review. There is no spring Chinook population in Willapa.***
- ***See page 5 of the HSRG Review of WDFW Hatchery Production Increases for Forks Creek Spring Chinook.***
- ***Eggs were transferred from Kalama Falls (KFH) to Beaver Creek for eying in the fall of 2018, then transferred to Forks Creek for hatching, rearing, and release in 2019 as sub-yearlings.***
- ***Total release was 567,560. Of these, 100,956 were Ad-clipped + Coded-Wire-Tagged, the rest were ad-clipped.***
- ***Goal was 1,000,000 depending on available broodstock at KFH.***
- ***Broodstock was only available the one year.***

ii. Chum salmon

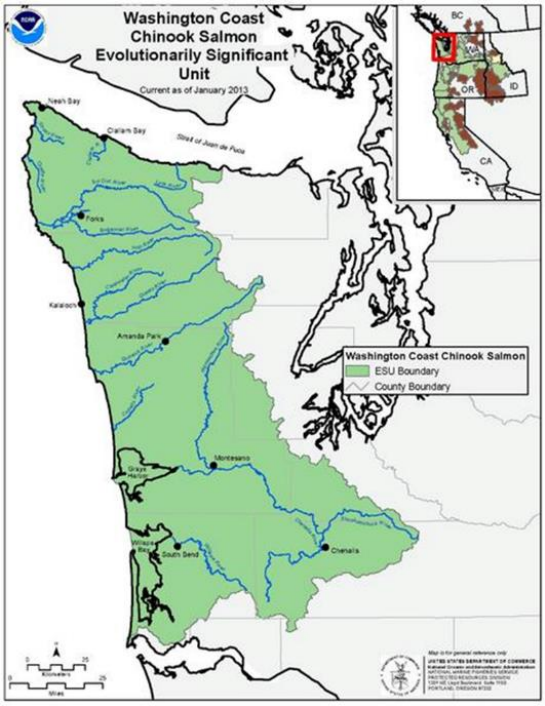
1. Any information about current or past chum salmon hatchery programs, including stocks used, numbers reared, locations released, etc.

See Table 4, Page 13 for out-of-basin Chum transfers.
See Table 5, Page 14 for in-basin Chum transfers.

iii. Coho salmon
1. Any information about out-of-basin stocks transferred into Willapa Bay hatcheries or, in the past 20 years, between hatcheries in Willapa Bay.

See Table 6; Page 15-17 for out-of-basin Coho transfers
See Table 7, page 18 for in-basin Coho transfers.

b. A briefing on the chinook salmon ESU established under the federal ESA that includes Willapa Bay chinook salmon, including
i. The geographic boundary and populations involved.



According to NOAA (1997) the following Chinook populations are included in the Washington Coast ESU: NORTH COAST [Hoko R. (fall), Dickey R. (fall), Sol Duc R (summer, fall), Calawah R (summer, fall), Quillayute/Bogachiel R. (summer, fall), Hoh R. (spring/summer, fall), Queets/Clearwater R. (spring, fall), Quinault R. (spring/summer, fall)]; GRAYS HARBOR AND CHEHALIS BASIN [Humptulips R. (fall), Hoquim R. (fall), Wishkah R. (fall), Wynoochee R. (fall), Satsop R. (summer, fall), Chehalis R. (spring, fall), Skookumchuck R (spring, fall), Newaukum R. (summer/fall)]; WILLAPA BAY [North R./Fall R. (fall), Smith Cr. (fall)]. Marshall et. al (1995) stated that in Willapa Bay

natural spawning fall Chinook occurred in the Fall, North, Nemah, Naselle, Palix, and Willapa rivers.

ii. The ESA designation following the federal status review (endangered, threatened, or not listed) and a summary of the rationale as to why.
    1. What the role of Willapa chinook was in that determination.

The Washington Coast Chinook ESU is not listed under the Endangered Species Act. Concerning the listing status NOAA (1997:xxii-xxiii) stated "[l]ong-term trends for most populations in this ESU have been upward; however, several smaller populations are experiencing sharply downward trends. Fall-run populations are predominant and tended to be at a lower risk than spring or summer runs. Hatchery production is significant in the southern portion of this ESU, whereas the majority of the populations in the northern portion of the ESU have minimal hatchery influence. The BRT unanimously concluded that chinook salmon in this ESU are not in danger of extinction nor are they likely to become so in the foreseeable future." Citing Marshall et al. (1995), NOAA (1997:218) stated that are hatchery strays that found spawning in Willapa Bay rivers, but "their reproductive success is unknown." Finally, NOAA (1997:255) considered hatchery influence on natural populations of the ESU to be the greatest in Willapa Bay, "where there have been numerous introductions of stocks from outside of the ESU."

iii. Anything else the staff feels is relevant in this area.

In this section we will review the genetic identity of the Willapa Bay Chinook populations (North/Fall, Forks Creek, Nemah, and Naselle) with respect to the other Washington Coast ESU populations, neighboring ESUs (Puget Sound ESU, and Lower Columbia ESU), and historical out-of-basin releases in Willapa Bay. For this analysis we used two methods (Fst and principal component analysis) that are standard practice for molecular genetic studies. Fst is a measure of genetic divergence among populations. Mathematically, F-statistics partition total molecular variation into component parts – within individuals, among individuals within populations, and among populations. Fst is the proportion of total molecular variation that is attributed to genetic difference among populations. Since the statistic is essentially a percentage, it ranges between zero and one; the greater the Fst the more differentiated the populations.

Based on Fst, Willapa Bay fall Chinook populations are over two to over four times more differentiated from Lower Columbia and Puget Sound ESU populations than they are from other Washington Coast ESU populations. In addition, the amount of differentiation between the four Willapa Bay populations and the populations in the other ESUs is roughly the same across all Willapa Bay populations. However, the wild North/Fall river

population appears to be slightly more differentiated from the other ESU populations and slightly less differentiated from the Washington Coast ESU populations than are the other three Willapa Bay populations (Table 8).

Table 8. Average pairwise Fst between the four Willapa Bay populations and populations in the Lower Columbia,Puget sound, and Washington Coast ESUs. Larger Fst more differentiation, lower Fst, less differentiation.

Willapa Populations	Lower Columbia (ESU)	Puget Sound ESU	Washington Coast ESU (no Willapa pops)
North/Fall	0.094	0.115	0.025
Forks Creek	0.087	0.092	0.033
Naselle	0.083	0.088	0.029
Nemah	0.080	0.087	0.029

Within Willapa Bay there is little differentiation between the Naselle and Nemah populations, and slightly more differentiation between Forks Creek, and Naselle and Nemah populations. The differentiation between the North/Fall river population, and Forks Creek, Naselle and Nemah populations is an order of magnitude larger than the differentiation among the other three populations (Table 9). The Forks Creek, Naselle and Nemah populations are combined hatchery- and natural-origin collections.

Table 9. Average pairwise Fst between the four Willapa Bay populations.

	North/Fall	Forks Creek	Naselle
Forks Creek	0.013	-	-
Naselle	0.011	0.002	-
Nemah	0.010	0.003	0.000

The second statistic we used was principal component analysis (PCA). PCA takes the correlation structure among the molecular data, without regard to the identity of any of the populations and partitions that structure into new variables that account for a decreasing amount of the total molecular variance. Therefore, the first principal component accounts for the most amount of variation among the among population molecular data, the second component the second most amount, and so on. One of the fundamental differences between PCA and Fst, is that the identity of the

populations (that is, the ESU to which a population belongs) is not included in the PCA, and genetic structure among the ESUs is "discovered" from the analysis. In other words, the PCA does not know whether the Willapa Bay populations are in the Washington Coast, Puget Sound, or Lower Columbia ESUs, while that design is an explicit part of the Fst analysis.

As with the Fst, the Washington Coast, Puget Sound, and Lower Columbia ESUs are well differentiated in a PCA (Figure 1). The Washington Coast ESU shows more within-ESU differentiation that do the Puget Sound, and Lower Columbia populations. As you will see below that differentiation is associated with geography. The Willapa Bay hatchery-based populations (six "populations", three hatchery- and three natural-origin populations, one each for each location) cluster tightly together, while the North/Fall population falls to the left of that cluster. This suggest that there is significant genetic differentiation between North/Fall population and the rest of the Willapa Bay populations.

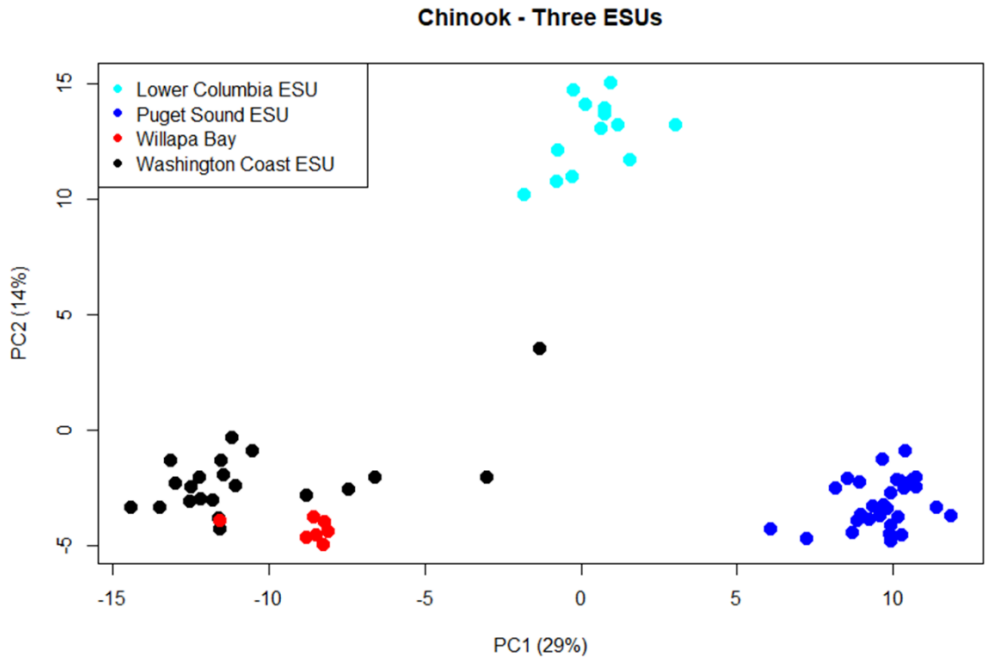


Figure 1. Components 1 and 2 from a PCA of populations within the Washington Coast, Puget Sound, and Lower Columbia ESUs. Components 1 and 2 account for a total of 43% of the molecular variation.

Within the Washington Coast ESU there appears to be significant geographic structuring. Populations from rivers that drain into Gray Harbor, Willapa Bay populations, and the North Coast populations each occupy distinct regions of PCA space, indicating significant genetic differences (Figure 2). Consistent with Figure 1, the wild North/Fall river population appears

somewhat intermediate between the other Willapa Bay populations and the Grays Harbor populations. The divide between the North River and Chehalis basins is geographically narrow and typographically low. It's possible geologically that these two basins were connected, resulting in gene flow between populations in these basins.

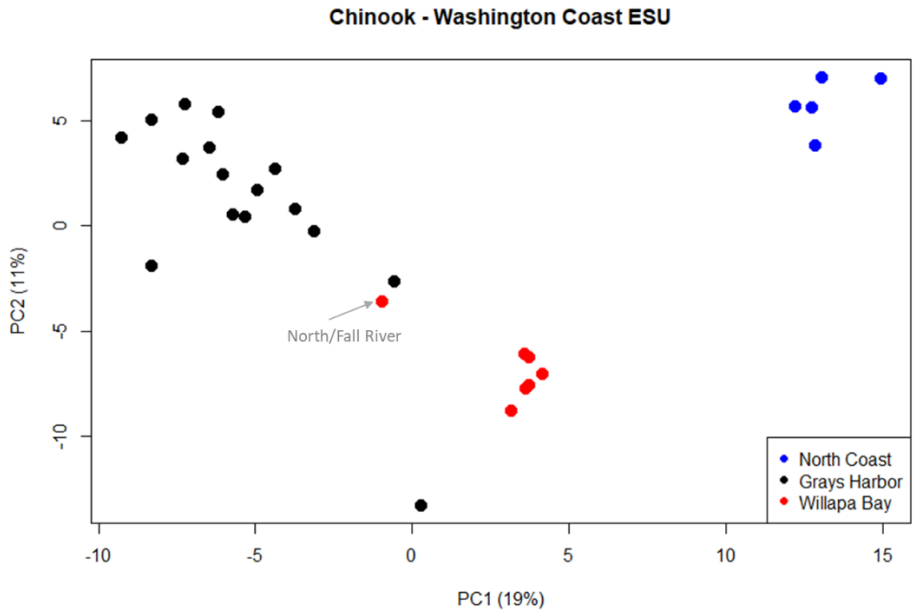


Figure 2. Components 1 and 2 from a PCA of populations within the Washington Coast ESU only. Components 1 and 2 account for a total of 30% of the molecular variation.

GENETIC STRUCTURE CONCLUSIONS. Despite repeated releases of out-of-basin populations into Willapa Bay, Willapa Bay Chinook have maintained their Washington Coast ESU genetic identity. Furthermore, there is significant genetic structuring within the Washington Coast ESU, with the Willapa Bay populations showing a unique genetic signature within the ESU (as do the North Coast and Gray Harbor populations, respectively). It would require additional genetic analyses to understand the origin of this differentiation. Nevertheless, these data suggest that the Willapa Bay environment may exert a different selective pressure than the other Washington Coast ESU populations, or the environments associated with the out-of-basin releases, and Willapa Bay populations are more fit in Willapa Bay than populations outside Willapa Bay.

2. Staff should be prepared to discuss the fall chinook spawning escapement goal review that was included in the final stages of the Policy 3622 Comprehensive Review, including information about how spawners and recruits were estimated.

See page 102 of the Comprehensive Review of the Willapa Bay Salmon Management Policy C-3622 2015-2018.

3. Staff should bring any additional information or analysis to the December 2 Fish Commission that they feel was not addressed or insufficiently addressed at the November 2 Fish Committee meeting.
4. Fish Committee Commissioners should consider whether an additional alternative for a Policy 3622 document should be prepared, beyond
    a. the status quo 2015 policy language and
    b. the October 2021 staff recommended revised policy language.

    If so, they should bring relevant ideas and/or direction for further work to the December 2 Fish Committee meeting dealing with the Willapa Bay Policy review.
5. ***There is no #5 to respond to.***

Commissioner Anderson's questions from his email sent on 11/8/2021

1. Somewhere I noticed a suggestion that the sport fishery be managed (conservation actions shared equally-- 50/50?) between freshwater and saltwater. Is that the intent and why would that enhance the future plan?
This is currently written in the Commission's Willapa Bay Salmon Management Policy C-3622 and staff are not recommending any changes.

2. Chinook management—"Management will be flexible for stocks achieving spawner objectives consistently over time and coupled with positive preseason forecasts." The metric is 3 of 5 years. Why this metric and not some other more conservative or less conservative?
Three out of five years is the general brood cycle for Chinook Salmon and the Commission's Grays Harbor Basin Salmon Management Plan C-3621 contains the same provision. This metric allows for conservation actions to occur if spawner goals are not met for most years of a brood cycle. Furthermore, the metric maintains consistency in fisheries management for the two neighboring basins.

3. If the above metric is not met, then the impact rate on Willapa and Naselle river Natural origin falls should not exceed 20%. Why continue to use the in bay impact rate and not utilize the more conventional total impact rate.
In years of low preterminal exploitation, this management strategy allows for more flexibility in the terminal area. The current base period for FRAM is 2009-2015; a time period when Willapa Bay did not have the same robust monitoring that has come to fruition since policy implementation (2015) and later. We have better knowledge of terminal in-house fisheries than the FRAM model does currently.

4. Does the plan as suggested allow for an August commercial fishery that helps update the Chinook run size? I believe that has been the case in years past.

Yes, staff recommends allowing commercial fisheries in the south bay (areas 2M, 2N, 2P, and 2R) before Labor Day. This allows catch of excess hatchery fish produced for Southern Resident Orca after they are no longer available as prey for the whales and provides data to inform developing in-season update models. We allowed commercial fisheries in these areas in August of 2021 and despite initial concerns, feedback from recreational and commercial fishers was positive.

5. The fall "Chinook rebuilding/broodstock management will be consistent with HMP's formulated from science-based risk management described in the Technical Procedures Document". Does this wording preclude the policy/legal, and social issues that will be a part of decision making?

No. The policy/legal, and social issues that will be a part of decision making are included in the science-based risk management framework.

Table 1. Year, stock source, release location, and total number of out-of-basin Willapa Bay hatchery Chinook Salmon transfers from 1950 to present.

Year	Stock Source	Release Location	Total
1953	SPRING CR 29.0159	FORK CR 24.0356	1,037,259
1953	SPRING CR 29.0159	NASELLE R-SF 24.0584	35,529
1953	SPRING CR 29.0159	NASELLE R 24.0543	717,250
1953	SPRING CR 29.0159	NORTH NEMAH R24.0460	145,275
1953	SPRING CR 29.0159	UPR SALMON C 24.0620	96,565
1953	SPRING CR 29.0159	WILLAPA R-SF 24.0277	75,154
1954	BIG SOOS CR 09.0072	FORK CR 24.0356	305,740
1954	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	292,603
1955	BIG SOOS CR 09.0072	CANYON CR 24.0439	90,100
1955	BIG SOOS CR 09.0072	FORK CR 24.0356	249,212
1955	BIG SOOS CR 09.0072	MIDDLE NEMAH 24.0505	133,383
1955	BIG SOOS CR 09.0072	NASELLE R 24.0543	140,590
1955	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	360,530
1955	BIG SOOS CR 09.0072	WILLAPA R-SF 24.0277	100,120
1955	BIG SOOS CR 09.0072	WILLAPA R 24.0251	400,035
1956	BIG SOOS CR 09.0072	FORK CR 24.0356	375,146
1956	BIG SOOS CR 09.0072	NASELLE R 24.0543	118,950
1956	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	504,905
1956	BIG SOOS CR 09.0072	WILLAPA R-SF 24.0277	99,806
1956	BIG SOOS CR 09.0072	WILLAPA R 24.0251	252,628
1957	BIG SOOS CR 09.0072	CANYON CR 24.0439	67,060
1957	BIG SOOS CR 09.0072	FORK CR 24.0356	975,452
1957	BIG SOOS CR 09.0072	NASELLE R 24.0543	187,465
1957	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	708,720
1958	BIG SOOS CR 09.0072	FORK CR 24.0356	963,743
1958	BIG SOOS CR 09.0072	NASELLE R 24.0543	98,900
1958	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	468,815
1958	KLICKITAT R 30.0002	NORTH NEMAH R24.0460	75,158
1959	ELOCHOMAN R 25.0236	NORTH NEMAH R24.0460	102,276
1962	DESCHUTES R 13.0028	NORTH NEMAH R24.0460	181,000
1963	DESCHUTES R 13.0028	JOHNSON SLU 24.0252	100,225
1964	DESCHUTES R 13.0028	FORK CR 24.0356	291,211
1964	DESCHUTES R 13.0028	NORTH NEMAH R24.0460	308,288
1965	DESCHUTES R 13.0028	FORK CR 24.0356	165,390
1965	DESCHUTES R 13.0028	JOHNSON SLU 24.0252	102,542
1965	DESCHUTES R 13.0028	NORTH NEMAH R24.0460	105,522
1966	DESCHUTES R 13.0028	FORK CR 24.0356	278,704
1966	DESCHUTES R 13.0028	JOHNSON SLU 24.0252	34,140
1966	DESCHUTES R 13.0028	NORTH NEMAH R24.0460	306,945

1967	DESCHUTES R 13.0028	FORK CR 24.0356	441,059
1967	DESCHUTES R 13.0028	NORTH NEMAH R24.0460	441,150
1969	DESCHUTES R 13.0028	FORK CR 24.0356	1,000,847
1970	DESCHUTES R 13.0028	FALL R 24.0191	253,800
1970	DESCHUTES R 13.0028	FORK CR 24.0356	613,253
1970	DESCHUTES R 13.0028	JOHNSON CR 24.0603	100,000
1970	DESCHUTES R 13.0028	MILL CR 24.0322	118,440
1970	DESCHUTES R 13.0028	NORTH R 24.0034	254,820
1970	DESCHUTES R 13.0028	WILLAPA R 24.0251	50,760
1971	COWLITZ R 26.0002	FALLS CR 24.0383	125,970
1971	FINCH CR 16.0222	FORK CR 24.0356	1,008,752
1971	FINCH CR 16.0222	JOHNSON SLU 24.0252	50,544
1971	FINCH CR 16.0222	WILLAPA R-SF 24.0277	96,720
1971	FINCH CR 16.0222	WILLAPA R 24.0251	219,480
1972	ABERNATHY CR 25.0297	NORTH NEMAH R24.0460	70,173
1972	WASHINGTON - GENERAL	JOHNSON CR 24.0603	28,728
1974	ELK R (ELK R HT)	FORK CR 24.0356	28,322
1974	TRASK R (TRASK HT)	FORK CR 24.0356	29,532
1974	WASHINGTON - GENERAL	JOHNSON SLU 24.0252	548,850
1975	TRASK R (TRASK HT)	FORK CR 24.0356	18,970
1977	WASHINGTON - GENERAL	NASELLE R 24.0543	388,000
1979	FINCH CR 16.0222	FORK CR 24.0356	17,974
1982	COWLITZ R 26.0002	NASELLE R-SF 24.0584	270,000
2019	KALAMA R HATCH 27.0002	FORK CR 24.0356	567,560

Table 2. Year, stock source, release location, and total number of in-basin Willapa Bay hatchery Chinook Salmon transfers from 2001 to present.			
Year	**Stock Source**	**Release Location**	**Total**
2001	WILLAPA R 24.0251	NASELLE R 24.0543	2,130,100
2002	WILLAPA R 24.0251	NASELLE R 24.0543	1,923,000
2002	WILLAPA R 24.0251	NORTH NEMAH R24.0460	376,200
2004	NEMAH R 24.0460	NASELLE R 24.0543	537,000
2004	WILLAPA R 24.0251	NASELLE R 24.0543	1,000,000
2005	WILLAPA R 24.0251	NORTH NEMAH R24.0460	1,175,800
2006	WILLAPA R 24.0251	NASELLE R 24.0543	1,300,000
2006	WILLAPA R 24.0251	NORTH NEMAH R24.0460	398,900
2007	NEMAH R 24.0460	NASELLE R 24.0543	500,000
2008	WILLAPA R 24.0251	NASELLE R 24.0543	1,073,000
2008	WILLAPA R 24.0251	NORTH NEMAH R24.0460	170,395
2009	WILLAPA R 24.0251	NASELLE R 24.0543	744,000
2010	WILLAPA R 24.0251	NORTH NEMAH R24.0460	978,488
2011	WILLAPA R 24.0251	NORTH NEMAH R24.0460	1,156,469
2012	NASELLE R 24.0543	NORTH NEMAH R24.0460	427,464
2012	WILLAPA R 24.0251	NORTH NEMAH R24.0460	799,110
2013	NASELLE R 24.0543	M NEMAH R TR 24.0508	1,033,922
2014	NEMAH R 24.0460	FORK CR 24.0356	714,006
2016	NEMAH R 24.0460	NASELLE R 24.0543	582,615
2016	WILLAPA R 24.0251	NORTH NEMAH R24.0460	2,352,777
2017	WILLAPA R 24.0251	NASELLE R 24.0543	951,981
2017	WILLAPA R 24.0251	NORTH NEMAH R24.0460	2,017,775
2018	WILLAPA R 24.0251	NASELLE R 24.0543	392,438
2018	WILLAPA R 24.0251	NORTH NEMAH R24.0460	1,450,935
2019	WILLAPA R 24.0251	NASELLE R 24.0543	741,725
2019	WILLAPA R 24.0251	NORTH NEMAH R24.0460	2,397,100

Table 4. Year, stock source, release location, and total numbers of out-of-basin Willapa Bay hatchery Chum Salmon transfers from 1950 to present.			
Year	**Stock Source**	**Release Location**	**Total**
1961	WASHINGTON - GENERAL	NORTH NEMAH R24.0460	575,280
1961	WASHINGTON - GENERAL	WILLIAMS CR 24.0461	1,269,700
1962	WASHINGTON - GENERAL	WILLIAMS CR 24.0461	213,180
1974	WASHINGTON - GENERAL	JOHNSON SLU 24.0252	200,000
1977	FINCH CR 16.0222	ELLSWORTH CR 24.0552	475,000
1977	WASHINGTON - GENERAL	BEAR R 24.0689	500,000
1978	WASHINGTON - GENERAL	BEAR R 24.0689	400,000
1978	WASHINGTON - GENERAL	DELL CR 24.0576	135,000
1978	WASHINGTON - GENERAL	ELLSWORTH CR 24.0552	200,000
1979	WASHINGTON - GENERAL	ELLSWORTH CR 24.0552	180,000
1979	WASHINGTON - GENERAL	INDIAN CR TR 24.0698	38,300
1980	FINCH CR 16.0222	DELL CR 24.0576	700,000
1980	FINCH CR 16.0222	ELLSWORTH CR 24.0552	300,000
1980	FINCH CR 16.0222	MIDDLE NEMAH 24.0505	95,000
1980	WILLIAMS CR STOCK	WILLIAMS CR 24.0461	50,000
1981	WILLIAMS CR STOCK	NASELLE R 24.0543	1,006,221
2007	WILLIAMS CR STOCK	NORTH NEMAH R24.0460	80,400
2008	WILLIAMS CR STOCK	NORTH NEMAH R24.0460	66,760
2009	WILLIAMS CR STOCK	NORTH NEMAH R24.0460	186,900
2010	WILLIAMS CR STOCK	NORTH NEMAH R24.0460	22,350
2011	WILLIAMS CR STOCK	NORTH NEMAH R24.0460	30,954
2012	WILLIAMS CR STOCK	NORTH NEMAH R24.0460	62,406

Table 5. Year, stock source, release location, and total numbers of in-basin Willapa Bay hatchery Chum Salmon transfers from 2001 to present.			
Year	**Stock Source**	**Release Location**	**Total**
2003	NEMAH R 24.0460	NORTH R 24.0034	209,800
2004	WILLAPA R 24.0251	NORTH R 24.0034	200,000
2005	NASELLE R 24.0543	WILLAPA R-SF 24.0277	80,000
2005	NEMAH R 24.0460	WILLAPA R 24.0251	30,000
2005	WILLAPA R 24.0251	NORTH R 24.0034	345,000
2006	NASELLE R 24.0543	WILLAPA R-SF 24.0277	18,700
2007	CANON R 24.0435	NORTH NEMAH R24.0460	2,970
2007	NASELLE R 24.0543	NORTH NEMAH R24.0460	1,980
2007	NASELLE R 24.0543	WILLAPA R-SF 24.0277	50,000
2007	NEMAH R 24.0460	MILL CR 24.0322	50,000
2007	NEMAH R 24.0460	WILLAPA R-SF 24.0277	150,000
2007	NORTH R 24.0034	FORK CR 24.0356	48,500
2007	WILLAPA R 24.0251	NORTH R 24.0034	65,000
2012	NORTH R 24.0034	FORK CR 24.0356	212,500
2013	NORTH R 24.0034	FORK CR 24.0356	39,275
2014	WILLAPA R 24.0251	NORTH R 24.0034	70,000
2015	NORTH R 24.0034	FORK CR 24.0356	31,200
2017	NEMAH R 24.0460	FORK CR 24.0356	89,530
2018	NASELLE R 24.0543	FORK CR 24.0356	253,151
2018	NEMAH R 24.0460	FORK CR 24.0356	44,197
2019	NASELLE R 24.0543	NORTH NEMAH R24.0460	227,100
2020	NASELLE R 24.0543	NORTH NEMAH R24.0460	150,195
2020	NORTH R 24.0034	FORK CR 24.0356	266,655

Table 6. Year, stock source, release location, and total numbers of out-of-basin Willapa Bay hatchery Coho Salmon transfers from 1950 to present.			
Year	**Stock Source**	**Release Location**	**Total**
1952	BIG SOOS CR 09.0072	MILL CR 24.0322	5000
1952	BIG SOOS CR 09.0072	NASELLE R 24.0543	30940
1952	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	15120
1952	BIG SOOS CR 09.0072	TRAP CR 24.0346	5200
1952	BIG SOOS CR 09.0072	UPR SALMON C 24.0620	31460
1952	BIG SOOS CR 09.0072	WILLAPA R 24.0251	5070
1953	BIG SOOS CR 09.0072	CANYON CR 24.0439	25056
1953	BIG SOOS CR 09.0072	FORK CR 24.0356	100365
1953	BIG SOOS CR 09.0072	NASELLE R 24.0543	43628
1953	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	29864
1953	BIG SOOS CR 09.0072	NORTH R 24.0034	49994
1953	BIG SOOS CR 09.0072	SMITH CR 24.0035	18658
1953	BIG SOOS CR 09.0072	TRAP CR 24.0346	30174
1953	BIG SOOS CR 09.0072	WILLAPA R-SF 24.0277	50026
1953	BIG SOOS CR 09.0072	WILLAPA R 24.0251	27884
1953	ISSAQUAH CR 08.0178	PALIX R -MF 24.0434	38759
1954	BIG SOOS CR 09.0072	FORK CR 24.0356	23625
1954	BIG SOOS CR 09.0072	NASELLE R 24.0543	14660
1954	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	26985
1954	BIG SOOS CR 09.0072	UPR SALMON C 24.0620	13440
1955	BIG SOOS CR 09.0072	BEAR R 24.0689	21876
1955	BIG SOOS CR 09.0072	CANYON CR 24.0439	16660
1955	BIG SOOS CR 09.0072	FALLS CR 24.0383	10500
1955	BIG SOOS CR 09.0072	FORK CR 24.0356	9324
1955	BIG SOOS CR 09.0072	MILL CR 24.0322	3920
1955	BIG SOOS CR 09.0072	NASELLE R-SF 24.0584	25586
1955	BIG SOOS CR 09.0072	NASELLE R 24.0543	51857
1955	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	165490
1955	BIG SOOS CR 09.0072	NORTH R 24.0034	49770
1955	BIG SOOS CR 09.0072	UPR SALMON C 24.0620	24021
1956	BIG SOOS CR 09.0072	BEAR R 24.0689	24520
1956	BIG SOOS CR 09.0072	CANYON CR 24.0439	31430
1956	BIG SOOS CR 09.0072	FALLS CR 24.0383	15219
1956	BIG SOOS CR 09.0072	FORK CR 24.0356	52644
1956	BIG SOOS CR 09.0072	MILL CR 24.0322	5544
1956	BIG SOOS CR 09.0072	NASELLE R-SF 24.0584	27280
1956	BIG SOOS CR 09.0072	NASELLE R 24.0543	45800
1956	BIG SOOS CR 09.0072	NORTH NEMAH R24.0460	72280
1956	BIG SOOS CR 09.0072	NORTH R 24.0034	59203

1956	BIG SOOS CR 09.0072	STRINGER CR 24.0339	6084
1956	BIG SOOS CR 09.0072	UPR SALMON C 24.0620	29680
1956	BIG SOOS CR 09.0072	WILLAPA R-SF 24.0277	64906
1956	BIG SOOS CR 09.0072	WILLAPA R 24.0251	67873
1956	BIG SOOS CR 09.0072	WILLIAMS CR 24.0461	15280
1956	DUNGENESS R 18.0018	CANYON CR 24.0439	11773
1956	DUNGENESS R 18.0018	FORK CR 24.0356	77278
1956	DUNGENESS R 18.0018	MILL CR 24.0322	9650
1956	DUNGENESS R 18.0018	NASELLE R 24.0543	58575
1956	DUNGENESS R 18.0018	NORTH NEMAH R24.0460	50325
1956	DUNGENESS R 18.0018	NORTH R 24.0034	24240
1956	DUNGENESS R 18.0018	STRINGER CR 24.0339	5018
1956	DUNGENESS R 18.0018	UPR SALMON C 24.0620	25850
1956	DUNGENESS R 18.0018	WILLAPA R-SF 24.0277	26715
1956	DUNGENESS R 18.0018	WILLAPA R 24.0251	27125
1957	DUNGENESS R 18.0018	CANYON CR 24.0439	38275
1957	DUNGENESS R 18.0018	ELKHORN CR 24.0046	15000
1957	DUNGENESS R 18.0018	FALLS CR 24.0383	15000
1957	DUNGENESS R 18.0018	FORK CR 24.0356	51148
1957	DUNGENESS R 18.0018	NASELLE R-SF 24.0584	9016
1957	DUNGENESS R 18.0018	NASELLE R 24.0543	31578
1957	DUNGENESS R 18.0018	NORTH R 24.0034	59453
1957	DUNGENESS R 18.0018	SMITH CR 24.0035	25000
1957	DUNGENESS R 18.0018	STRINGER CR 24.0339	6000
1957	DUNGENESS R 18.0018	UPR SALMON C 24.0620	20805
1957	DUNGENESS R 18.0018	WILLAPA R-SF 24.0277	50850
1957	DUNGENESS R 18.0018	WILLAPA R 24.0251	44526
1957	DUNGENESS R 18.0018	WILLIAMS CR 24.0461	9975
1958	BIG SOOS CR 09.0072	FALLS CR 24.0383	20087
1958	BIG SOOS CR 09.0072	FORK CR 24.0356	49674
1958	BIG SOOS CR 09.0072	LTL NORTH R 24.0134	20770
1958	BIG SOOS CR 09.0072	MILL CR 24.0322	19968
1958	BIG SOOS CR 09.0072	NORTH R 24.0034	28832
1958	BIG SOOS CR 09.0072	WILLAPA R-SF 24.0277	25016
1958	BIG SOOS CR 09.0072	WILLAPA R 24.0251	23585
1959	SATSOP SPRNG 22.0462	BLACK LK (24)	31200
1959	SATSOP SPRNG 22.0462	JOHNSON SLU 24.0252	50600
1961	LAKE CR 20.0313	BLACK LK (24)	150148
1961	LAKE CR 20.0313	JOHNSON SLU 24.0252	56245
1963	SATSOP SPRNG 22.0462	BLACK LK (24)	40280
1963	SATSOP SPRNG 22.0462	FALL R 24.0191	21250
1963	SATSOP SPRNG 22.0462	JOHNSON SLU 24.0252	27002
1964	SATSOP SPRNG 22.0462	CLEARWATER C 24.0040	22386

1964	SATSOP SPRNG 22.0462	FALL R 24.0191	31707
1964	SATSOP SPRNG 22.0462	NASELLE R 24.0543	26480
1964	SATSOP SPRNG 22.0462	NORTH NEMAH R24.0460	5680
1964	SATSOP SPRNG 22.0462	UPR SALMON C 24.0620	26960
1965	SATSOP SPRNG 22.0462	NASELLE R-SF 24.0584	34520
1965	SATSOP SPRNG 22.0462	NASELLE R 24.0543	76120
1965	SATSOP SPRNG 22.0462	UPR SALMON C 24.0620	38800
1973	SATSOP R 22.0360	FORK CR 24.0356	85932
1973	SATSOP R LATE STOCK	FORK CR 24.0356	26906
1973	SATSOP R LATE STOCK	NASELLE R 24.0543	27104
1973	SATSOP R TRIBS	NASELLE R 24.0543	30030
1980	GRAYS R 25.0093	RUSSIAN CR 24.0625	146000
1980	HUMPTULIPS R 22.0004	BEAR R 24.0689	128100
1980	HUMPTULIPS R 22.0004	DELL CR 24.0576	62580
1980	HUMPTULIPS R 22.0004	ELLSWORTH CR 24.0552	63840
1980	HUMPTULIPS R 22.0004	MIDDLE NEMAH 24.0505	178066
1980	HUMPTULIPS R 22.0004	NASELLE R 24.0543	20000
1980	HUMPTULIPS R 22.0004	SOUTH NEMAH R24.0503	170700
1981	DUNGENESS R 18.0018	CLEARWATER C 24.0544	40000
1981	DUNGENESS R 18.0018	ELLSWORTH CR 24.0552	10000
1981	DUNGENESS R 18.0018	UPR SALMON C 24.0620	60000
1981	HUMPTULIPS R 22.0004	JOHNSON CR 24.0581	293630
1981	HUMPTULIPS R 22.0004	NASELLE R 24.0543	913660
1981	SOL DUC R 20.0096	NASELLE R 24.0543	1029282
1982	DUNGENESS R 18.0018	NASELLE R 24.0543	462395
1982	HUMPTULIPS R 22.0004	GREEN CR 24.0341	77720
1982	HUMPTULIPS R 22.0004	STRINGER CR 24.0339	77720
1982	HUMPTULIPS R 22.0004	TRAP CR 24.0346	78880
1982	HUMPTULIPS R 22.0004	WILLAPA R-SF 24.0277	264480
1983	HUMPTULIPS R 22.0004	NASELLE R 24.0543	475000
1985	SATSOP SPRNG 22.0462	NORTH R 24.0034	20000
1990	COWLITZ R 26.0002	FORK CR 24.0356	8800
1991	COWLITZ R 26.0002	FORK CR 24.0356	171275
1991	COWLITZ R 26.0002	NASELLE R 24.0543	89000
1993	SATSOP R 22.0360	NASELLE R 24.0543	112000
1993	SATSOP R LATE STOCK	FORK CR 24.0356	97200
1998	BINGHAM CR 22.0465	FORK CR 24.0356	111600
2000	SATSOP R 22.0360	UNNAMED CR 24.0063	4050
2010	CHEHALIS R 22.0190	ALDER CR 24.0653	10874

Table 7. Year, stock source, release location, and total numbers of in-basin Willapa Bay hatchery Coho Salmon transfers from 2001 to present.			
Year	**Stock Source**	**Release Location**	**Total**
2002	NASELLE R 24.0543	INDIAN CR 24.0697	5,000
2002	WILLAPA R 24.0251	BUTTE CR 24.0060	50,000
2003	NASELLE R 24.0543	INDIAN CR 24.0697	5,000
2004	WILLAPA R 24.0251	BUTTE CR 24.0060	50,000
2004	WILLAPA R 24.0251	NORTH R 24.0034	300,000
2005	NASELLE R 24.0543	WILLAPA R-SF 24.0277	100,000
2006	NASELLE R 24.0543	WILLAPA R-SF 24.0277	100,000
2006	WILLAPA R 24.0251	NORTH R 24.0034	200,000
2007	NASELLE R 24.0543	WILLAPA R-SF 24.0277	100,000
2007	WILLAPA R 24.0251	NORTH R 24.0034	300,000
2008	NEMAH R 24.0460	WILLAPA R TR 24.0299	160,000
2008	WILLAPA R 24.0251	NASELLE R 24.0543	100,000
2008	WILLAPA R 24.0251	NORTH R 24.0034	300,000
2009	NEMAH R 24.0460	JOHNSON CR 24.0581	50,000
2009	NEMAH R 24.0460	NASELLE R 24.0543	465,000
2009	NEMAH R 24.0460	WILLAPA R TR 24.0299	100,000
2009	WILLAPA R 24.0251	NASELLE R 24.0543	105,000
2009	WILLAPA R 24.0251	NORTH R 24.0034	280,000
2010	NASELLE R 24.0543	WILLAPA R TR 24.0299	100,000
2010	NEMAH R 24.0460	NASELLE R 24.0543	491,695
2010	WILLAPA R 24.0251	NASELLE R 24.0543	102,480
2011	NASELLE R 24.0543	WILLAPA R TR 24.0299	100,000
2011	NEMAH R 24.0460	NASELLE R 24.0543	708,000
2011	WILLAPA R 24.0251	NASELLE R 24.0543	350,274
2011	WILLAPA R 24.0251	NORTH R 24.0034	290,000
2012	WILLAPA R 24.0251	NASELLE R 24.0543	129,337
2012	WILLAPA R 24.0251	NORTH R 24.0034	580,000
2013	WILLAPA R 24.0251	NASELLE R 24.0543	133,955
2013	WILLAPA R 24.0251	NORTH R 24.0034	285,000
2014	WILLAPA R 24.0251	NORTH R 24.0034	280,000
2015	WILLAPA R 24.0251	NASELLE R 24.0543	203,900
2015	WILLAPA R 24.0251	NORTH R 24.0034	300,000
2016	NASELLE R 24.0543	INDIAN CR 24.0697	245
2016	WILLAPA R 24.0251	NORTH R 24.0034	270,000
2017	WILLAPA R 24.0251	NORTH R 24.0034	280,000
2018	WILLAPA R 24.0251	NASELLE R 24.0543	109,974
2018	WILLAPA R 24.0251	NORTH R 24.0034	280,000
2019	WILLAPA R 24.0251	NORTH R 24.0034	280,000
2020	WILLAPA R 24.0251	NORTH R 24.0034	290,000