Genetic Analysis of Chum Salmon collected on Vashon Island in 2018

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Introduction

Up to 250 Chum salmon juveniles from Minter Creek Hatchery were planted in Shingle Mill Creek on Vashon Island each May from 2012 through 2018 (WDFW records). In fall 2018, adult Chum salmon spawners were found in Shingle Mill Creek and Judd Creek on Vashon Island. The Vashon Nature Center has been monitoring animals and plants on Vashon Island and was interested in the origins of these adult Chum salmon. WDFW is developing a Chum salmon SNP genetic baseline and compared these unknown adult Chum salmon spawners to the baseline to estimate their origins.

Methods

Genomic DNA was extracted from unknown adult Chum salmon tissue samples using Machery-Nagel spin columns. Samples were genotyped at 350 Chum salmon SNP genotypes in the Oke_GTseq350 panel used for the Chum salmon SNP baseline (Small et al. 2018). SNP genotypes were generated with a GT-seq protocol (Campbell et al. 2015): briefly, samples are subjected to an initial tailed, multiplex PCR reaction that adds sequencing primer sites to target DNA, in a second PCR reaction unique barcode DNA sequences are added to the target DNA (amplicon), barcoded amplicons are pooled and sequenced on a next-generation sequencer. Using the barcodes, perl scripts split pooled sample sequences into individual files and assembles the SNP genotypes for each individual.

Samples were assigned to the Chum salmon SNP baseline as unknown fish using the program ONCOR. The program calculates the likelihood of each unknown fish arising from each of the baseline collections (Table 2), based on the genotype of the fish and the allele frequencies of each baseline collection. The baseline population with the highest likelihood of assignment is hypothesized as the population of origin of the unknown fish.

Results

WDFW had space in another Chum salmon project to process 27 samples (see Appendix 1 for the list of samples analyzed. Of the 27 samples, 16 samples had sufficient genotypic data to assign to the genetic baseline. We tried the assignments two ways, one where the Vashon Island samples were assigned to the baseline as unknown samples and one where the Vashon Island samples were included in the baseline to see if they assigned back to their collection. Both analyses had the same result where half of the samples assigned to Minter Creek Hatchery and half of the samples assigned to Curley Creek (see Figure 1), and one sample assigned to Hoodsport Hatchery in Hood Canal. One sample, 18PR0020 assigned weakly to both Curley and Skookum creeks. The results indicate that the Vashon Island Chum salmon are strays from other populations and hatcheries because they assigned back to other collections in the baseline and not back to the Vashon Island collection when it was included in the baseline. None of the chum salmon found assigned back to salmon planted in the creek from Minter Creek hatchery.

Acknowledgements
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References:

Campbell NR, Harmon SA, Narum SR. 2015. Genotyping-in-Thousands by sequencing (GT-seq): A cost effective SNP genotyping method based on custom amplicon sequencing. Mol Ecol Resources 15: 855-867.

Kalinowski S. ONCOR software for genetic stock identification, available at http://www.montana.edu/kalinowski/

Small, MP, Warheit K, Pascal C, Seeb L, Ruff C, Zischke J, Winans G, Seeb J. 2018. Chum Salmon Southern Area Genetic Baseline Enhancement Part 1 and Part 2: Amplicon Development, Expanded Baseline Collections, and Genotyping. Report to the Southern Fund Panel, PSC, 45 pp.

Table 1. List of individual Chum salmon collections in the SNP genetic baseline and their reporting groups (geographic and run timing group).

Pop	Region	Pop	Region
CurleyCr	SPS	10DungenessF	SJF
MinterCr_H	SPS	10_14upper_Skagit	NPS
GreenR_H	SPS	98_10Nooksack	NPS
MillCr	SPS	10_18Snoh/Sky	NPS
Sherwood_S	SPS	10_18Stilly	NPS
Sherwood_F	SPS	14Lo_Sauk	NPS
Chico/Grovers	SPS	98_14Skagit_lo	NPS
Skookum	SPS	Samish	NPS
Kennedy	SPS	Sooke	WCVI
10HoodH_F	HC_F	Conuma	WCVI
11NFSkok_F	HC_F	Nitinat	WCVI
98_11Dewatto_F	HC_F	Hopedale	Fraser
11Anderson	HC_F	Peach	Fraser
10Big_Beef_F	HC_F	Squawkum	Fraser
Duckabush_F	HC_F	Big_Qualicum	GeorgiaSt
Lilliwaup_F	HC_F	Campbell	GeorgiaSt
11DIRU_PuyH	SPS_W	Cheakamus	GeorgiaSt
Nisqually	SPS_W	Cowichan	GeorgiaSt
03Dose_S	HC_S	Lang	GeorgiaSt
12_14Dose_S	HC_S	Little_Qualicum	GeorgiaSt
12_14Hamma_S	HC_S	Nanaimo	GeorgiaSt
14Duck_S	HC_S	Phillips	GeorgiaSt
16NFSkok_S	HC_S	Puntledge	GeorgiaSt
05Pysht	SJF	Snake	GeorgiaSt
18LyreCr	SJF	Southgate	GeorgiaSt
96Hoko	SJF	Nimpkish	JohnstoneSt

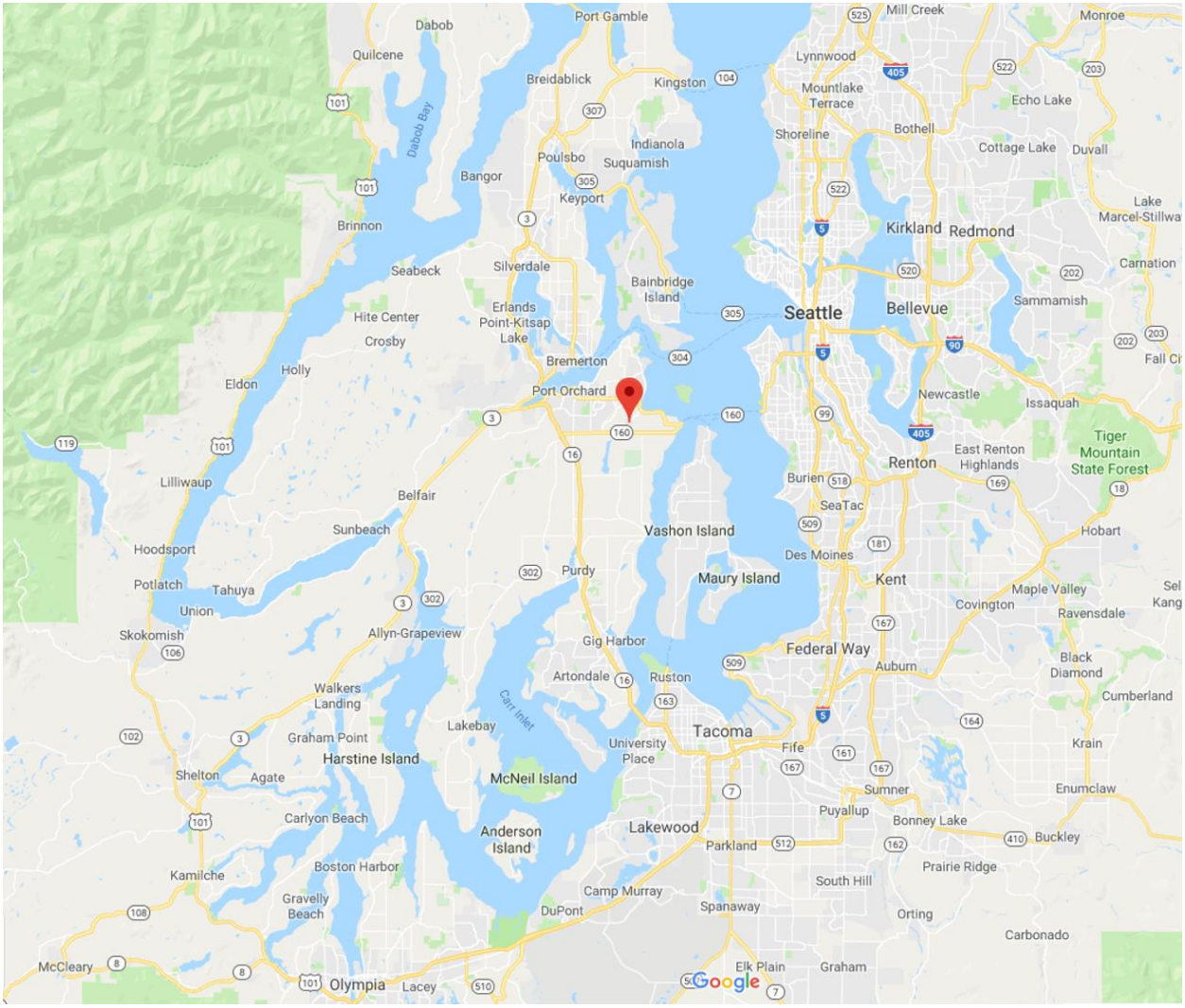

Figure 1. Map of Puget Sound and Vashon Island showing the location of Curley Creek near Vashon Island (red pin).

Appendix 1. Biological data, assignments, and WDFW codes for Chum salmon samples analyzed in 2019. Samples in yellow cells had insufficient genotypic data and were excluded from analyses.

assign	WDFW code	Number	Date	Stream	Species	Gender	Size	Adipose	Spawned out	Collector	Location	Additional Notes
	18PR0001	1	11/1/2018	Judd Creek	Coho	Female	Unknown	Adipose	Unknown-Predation	KK	Judd-6	Half eaten, but found near 2 redds
MinterCrH	18PR0002	2	11/6/2018	Judd Creek	Chum	Female	31"	Adipose	Partly Spawned-Predation	KK	Judd-1	Still had some eggs, found near redd.
	18PR0003	3	11/9/2018	Judd Creek	Coho	Female	23.5"	Adipose	Spawned out	PC	Judd-2	47.408828/-122.469468
HoodsportH	18PR0004	4	11/9/2018	Judd Creek	Unknown	Unknown	Unknown	Unknown	Unknown-Predation	PC	Judd-2	Head only- 047.409522/-122.469968
	18PR0005	5	11/13/2018	Judd Creek	Coho	Female	21"	No Adipose	Spawned out	LT	Judd-1	
MinterCrH	18PR0006	6	11/25/2018	Judd Creek	Chum	Male	32"	Unknown	Unknown	PC	Judd-2	047.406626/-122.468933
MinterCrH	18PR0007	7	11/25/2018	Judd Creek	Unknown	Unknown	Unknown	Unknown-Predation	Unknown	PC	Judd-2	Head only
MinterCrH	18PR0008	8	11/30/2018	Judd Creek	Chum	Unknown	26.5"	Adipose	Unknown	PC	Judd-2	047.404539/-122.470501
MinterCrH	18PR0009	9	11/30/2018	Judd Creek	Chum	Male	26"	Adipose	Unknown	PC	Judd-2	
MinterCrH	18PR0010	10	11/30/2018	Judd Creek	Chum	male	30"	Adipose	Unknown	PC	Judd-2	047.404155/-122.470611
MinterCrH	18PR0011	11	12/3/2018	Judd Creek	Unknown	Unknown	Unknown	Unknown	Unknown-Predation	PC	Judd-2	Head only
MinterCrH	18PR0012	12	12/9/2018	Judd Creek	Chum	Unknown	20.5"	Adipose	Unknown	PC	Judd-2	
CurleyCr	18PR0013	13	10/14/2018	Shinglemill Creek	Chum	Male	30"	Unknown	Unknown-Predation	JK	Shing-1	
	18PR0014	14	11/30/2018	Shinglemill Creek	Chum	Male	30"	Adipose	Prespawned-Predation	KK	Shing-1	
	18PR0015	15	11/8/2018	Shinglemill Creek	Chum	Male	31"	Adipose	Spawned out	KK	Shing-1	
CurleyCr	18PR0016	16	11/3/2018	Shinglemill Creek	Chum	Male	Unknown	Unknown	Unknown	MM	Shing-2	
CurleyCr	18PR0017	17	11/9/2018	Shinglemill Creek	Chum	Male	30"	Adipose	Spawned out	KK	Shing-1	
CurleyCr	18PR0018	18	11/9/2018	Shinglemill Creek	Chum	Male	27"	Adipose	Spawned out	KK	Shing-1	
	18PR0019	19	10/31/2018	Shinglemill Creek	Chum	Male	20"	Adipose	Unknown	MM	Shing-2	
CurleyCr	18PR0020	20	10/31/2018	Shinglemill Creek	Chum	Male	20"	Adipose	Unknown	MM	Shing-2	
CurleyCr	18PR0021	21	11/4/2018	Shinglemill Creek	Chum	Male	28"	Adipose	Spawned out	KK	Shing-2	
CurleyCr	18PR0022	22	11/4/2018	Shinglemill Creek	Chum	Male	30"	Adipose	Prespawned-Predation	KK	Shing-2	
	18PR0023	23	11/4/2018	Shinglemill Creek	Chum	Male	30"	Unknown	Unknown	JK	Shing-1	
	18PR0024	24	11/4/2018	Shinglemill Creek	Chum	Male	32"	Unknown	Unknown	JK	Shing-1	
	18PR0025	25	11/4/2018	Shinglemill Creek	Chum	Unknown	Unknown	Unknown	Unknown	JK	Shing-1	
	18PR0026	26	10/28/2018	Shinglemill Creek	Chum	Female	26"	Unknown	Unknown-Predation	GK	Shing-1	
	18PR0027	27	11/14/2018	Shinglemill Creek	Chum	Male	25.5"	Adipose	Prespawned-Predation	KK	Shing-1	