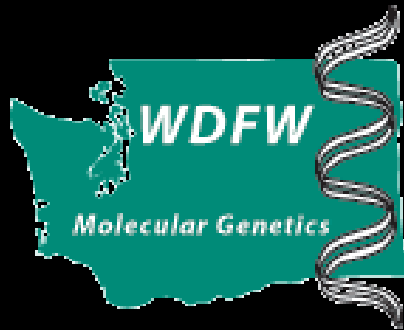


DNA-Based Evaluation of Five Chinook Populations in the Yakima River Basin and Population-of-Origin Assignments of Chinook Salmon Smolts Outmigrating Past Chandler Trap (Yakima River) in 2006

**Todd W. Kassler, WDFW Molecular Genetics Laboratory
Jennifer Von Bargaen, WDFW Molecular Genetics Laboratory**



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Background

- Joint project between WDFW (WA Dept. of Fish and Wildlife) and YN (Yakama Nation)
- Five populations in Yakima River Basin of interest that pass Chandler Trap – American R. SP, Naches R. SP, upper Yakima R. SP, Marion Drain F, and lower Yakima R. F
- A microsatellite DNA baseline was developed using samples from each of the five representative populations
- A statistical evaluation of the baseline collections was conducted to determine the relationship of the five populations
- Mixture analysis was conducted to calculate population-of-origin estimates of individual smolts outmigrating past Chandler Trap
- Five time strata were evaluated to determine abundance of each population over time

Collections

- **Baseline Collections** - Twenty collections (collected between 1989 and 2005) were sampled from spawning areas for each of the five populations
- **Unknown-origin smolts** - Smolt samples were collected at Chandler trap from January – July for genetic analysis (proportional of the total number of smolts outmigrating)

Baseline Collections

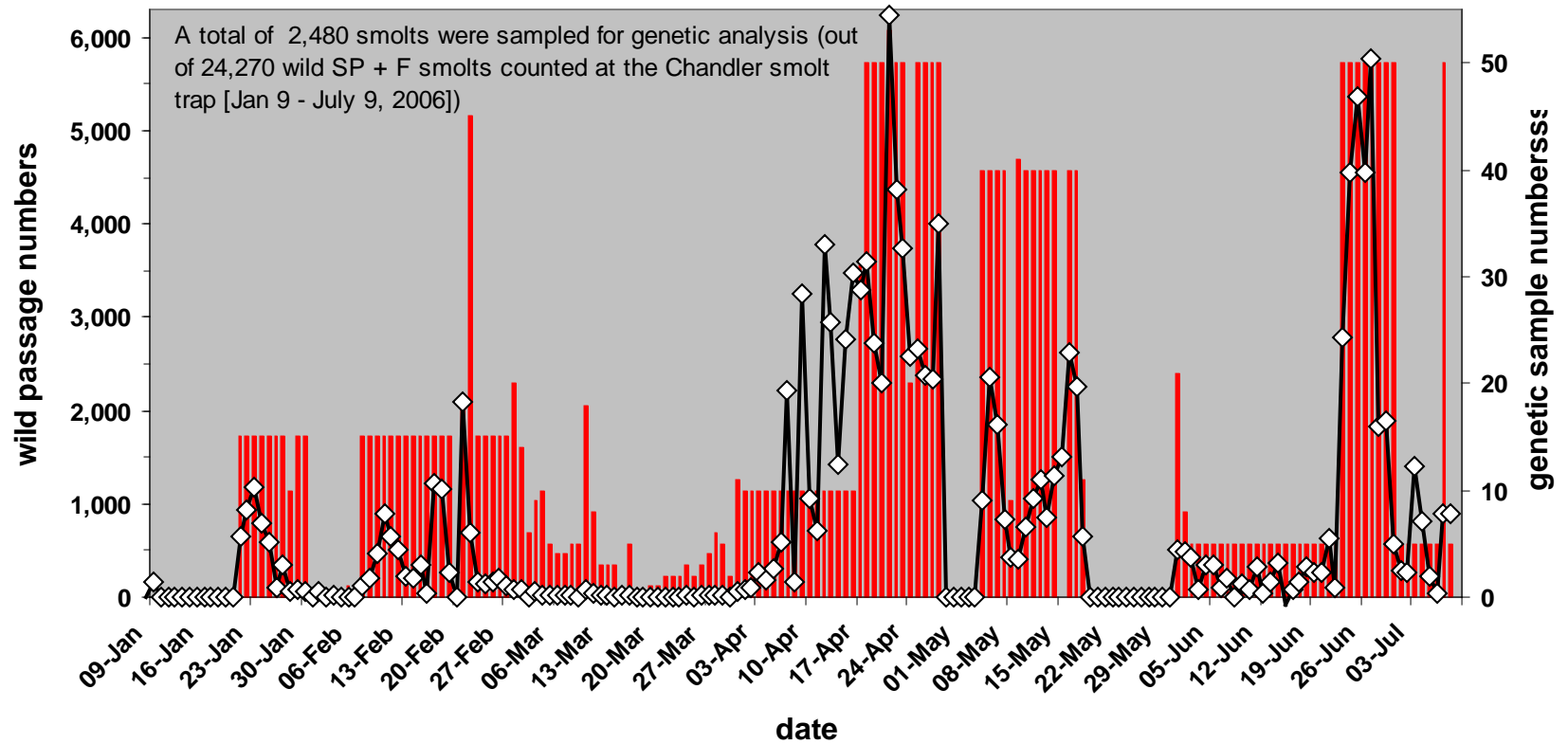
Collection Source	Collection Code	N =	Collection Source	Collection Code	N =
American R. SP	89AG	80	Marion Drain F	89BX	100
	91DQ	102		92FQ	92
	93DO	18		93DY	8
	03EH	100		05LU	65
		<u>300</u>			<u>265</u>
Naches R. SP	89AC	76	low Yakima R. F	90DF	109
	89AI	26		93DW	82
	93DQ	50		98FB	61
	93DR	32			<u>252</u>
Lit Naches R. SP	04BI	42			
	04EM	56			
		<u>282</u>			
up Yakima R. SP	92DN	24			
	97DA	123			
	03GO	99			
		<u>246</u>			

2006: Total Chinook Counts, Passage (Spring + Fall), and Genetic Samples taken at the Chandler Juvenile Facility

CatchDate	Counts			Spring	Fall	TOTAL	genetic samples (06AB)				Passage			
	Wild Chinook count	Hatch Chinook Count	TOTAL	Wild SP Chinook Passage	Wild F Chinook Passage	Total Wild Passage	"SP"	"F"	total collected	cumulative number	stratum sum	date	stratum sum	stratum as %
68	03/12/2006	3		3	14		14	3	3	591		03/13/2006		
69	03/13/2006	3		3	13		13	3	3	594		03/14/2006		
70	03/14/2006			0			0	3	3	597		03/15/2006		
71	03/15/2006	3		3	13		13		0	597		03/16/2006		
72	03/16/2006	3		3	13		13	5	5	602		03/17/2006		
73	03/17/2006			0			0		0	602		03/18/2006		
74	03/18/2006			0			0		0	602		03/19/2006		
75	03/19/2006			0			0	1	1	603		03/20/2006		
76	03/20/2006	1		1	4		4	1	1	604		03/21/2006		
77	03/21/2006			0			0	2	2	606		03/22/2006		
78	03/22/2006	2		2	9		9	2	2	608		03/23/2006		
79	03/23/2006			0			0	2	2	610		03/24/2006		
80	03/24/2006	3		3	13		13	3	3	613		03/25/2006		
81	03/25/2006	2		2	9		9	2	2	615		03/26/2006		
82	03/26/2006	3		3	13		13	3	3	618		03/27/2006		
83	03/27/2006	4		4	18		18	4	4	622		03/28/2006		
84	03/28/2006	6		6	28		28	6	6	628		03/29/2006		
85	03/29/2006	5		5	23		23	5	5	633		03/30/2006		
86	03/30/2006	2		2	9		9	2	2	635		03/31/2006		
87	03/31/2006	11		11	54		54	11	11	646		04/01/2006		
88	04/01/2006	14		14	74		74	10	10	656	714	04/02/2006	63,541	46.8%
89	04/02/2006	17		17	97		97	10	10	666		04/03/2006		
90	04/03/2006	36		36	269		269	10	10	676		04/04/2006		
91	04/04/2006	27	1	28	180		180	10	10	686		04/05/2006		
92	04/05/2006	51	2	53	311		311	10	10	696		04/06/2006		
93	04/06/2006	97		97	596		596	10	10	706		04/07/2006		
94	04/07/2006	315	4	319	2209	6	2,215	10	10	716		04/08/2006		
95	04/08/2006	20		20	168		168	10	10	726		04/09/2006		
96	04/09/2006	324	6	330	3245		3,245	10	10	736		04/10/2006		
97	04/10/2006	73	1	74	1052		1,052	10	10	746		04/11/2006		
98	04/11/2006	38	2	40	720		720	10	10	756		04/12/2006		
99	04/12/2006	176	7	183	3759	13	3,772	10	10	766		04/13/2006		
100	04/13/2006	196	4	200	2945		2,945	10	10	776		04/14/2006		
101	04/14/2006	73	1	74	1406	9	1,415	10	10	786		04/15/2006		
102	04/15/2006	146	15	161	2695	64	2,759	10	10	796		04/16/2006		
103	04/16/2006	139	25	164	3483		3,483	10	10	806		04/17/2006		
104	04/17/2006	233	43	276	3183	108	3,291	31	31	837		04/18/2006		
105	04/18/2006	354	31	385	3577	24	3,601	50	50	887		04/19/2006		

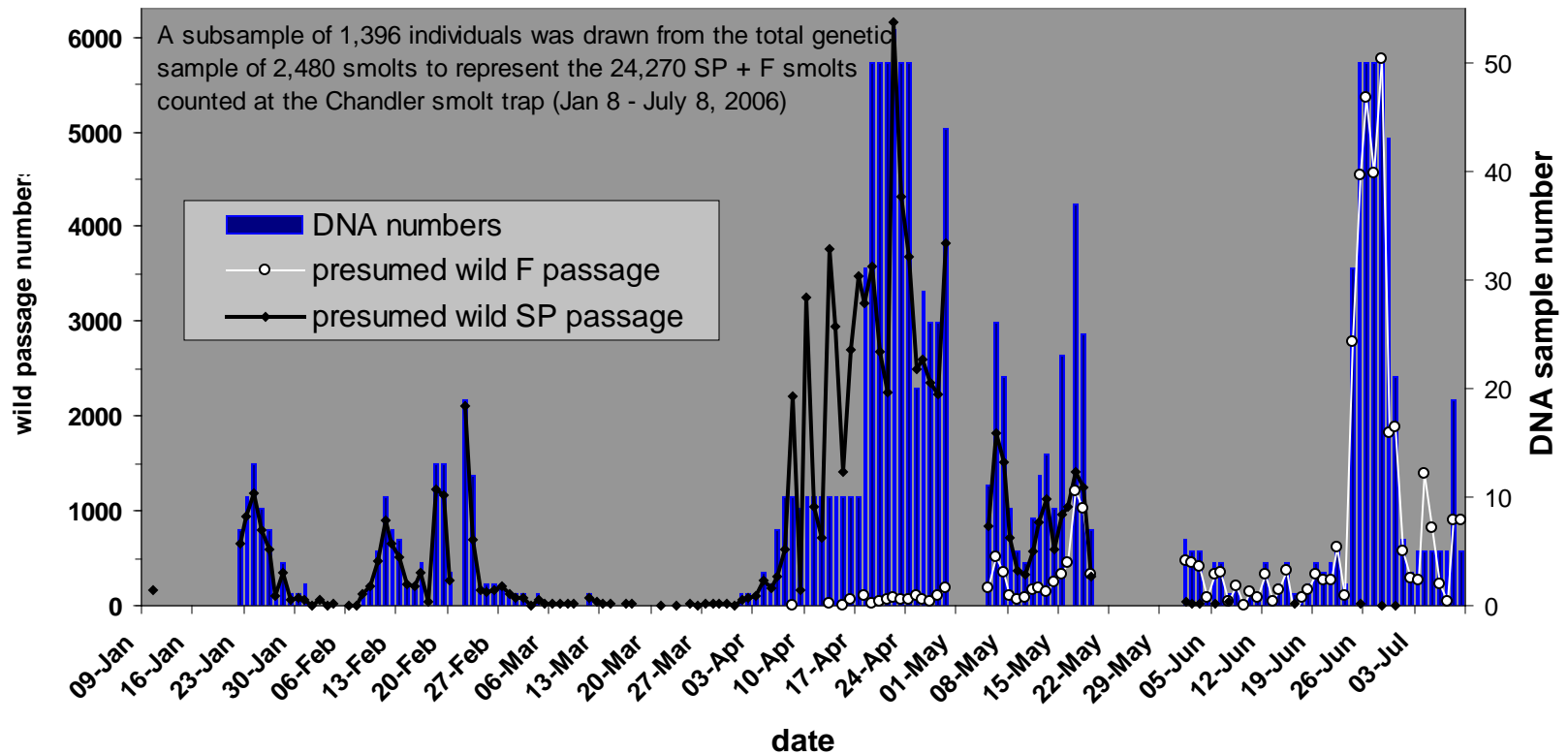
Outmigration Past Chandler Trap

Jan - July 2006 Chandler smolt estimated wild passage & total genetic sampling numbers



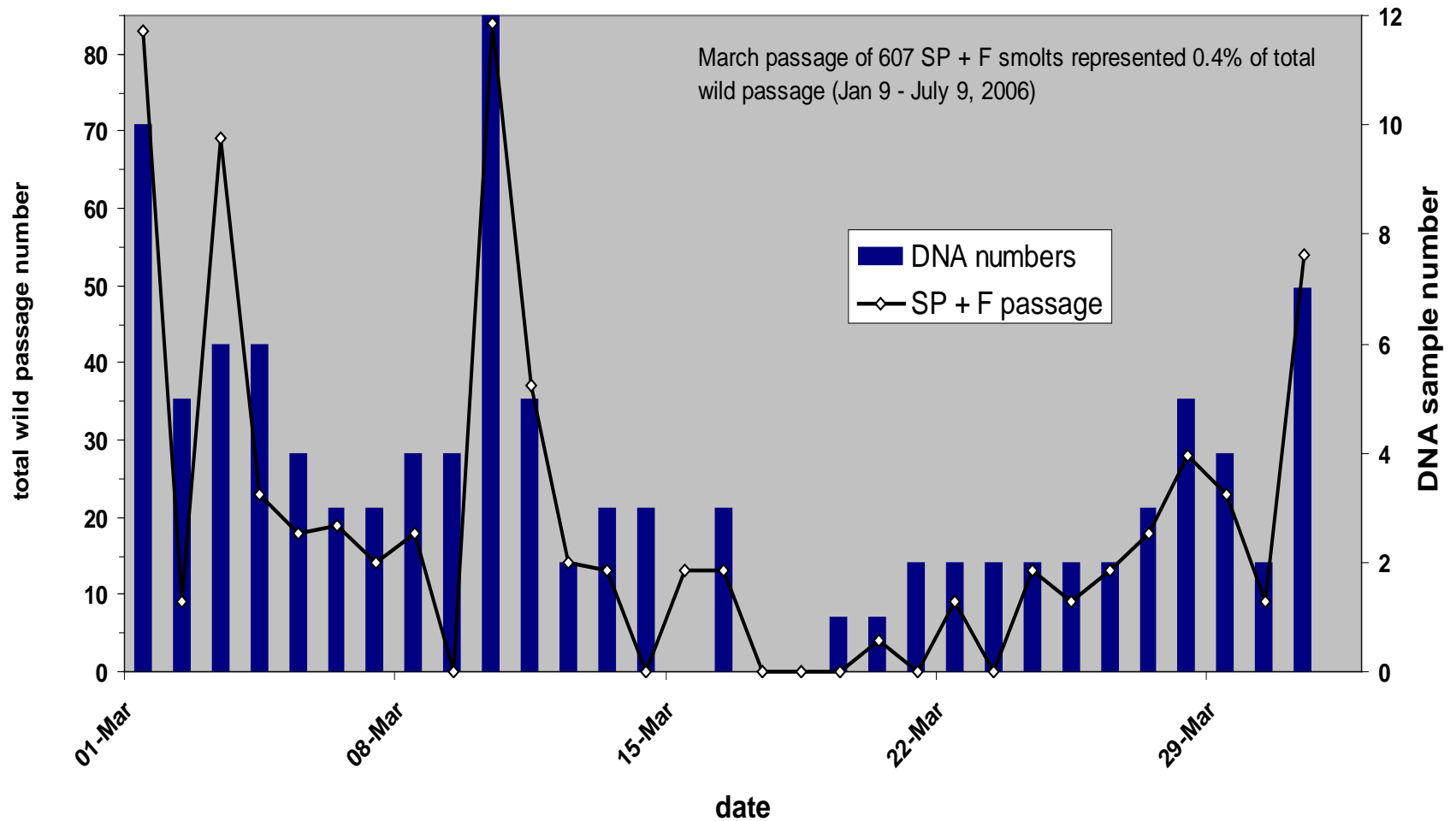
Proportional Subsampling of Smolts Collected for Genetic Analysis

Jan - July 2006 Chandler smolt estimated wild passage and proportional DNA sub-sampling numbers



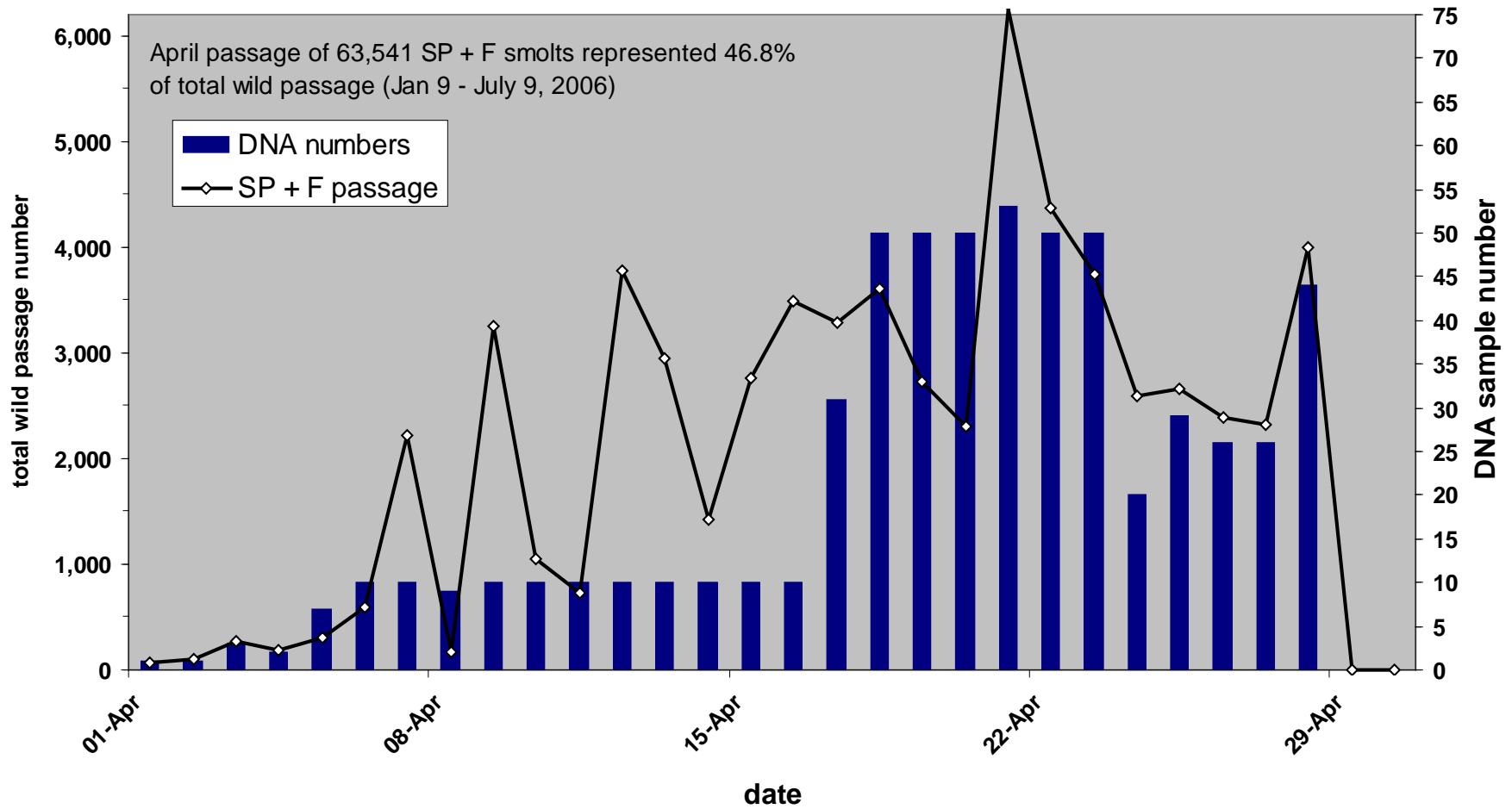
Proportional Subsampling of Smolts for the March Stratum

March 2006 stratum (N = 108 analyzed; 146 sampled)



Proportional Subsampling of Smolts for the April Stratum

April 2006 stratum (N = 602 analyzed; 714 sampled)



Laboratory Methods

- DNA was extracted from fin tissue
- PCR amplification was performed using 11 microsatellite loci
- Amplified products were run through an ABI-3730 DNA-Analyzer
- Electropherograms were scored using Genemapper software v.3.7

Jessica setting up DNA extraction



Laboratory Methods

- DNA was extracted from fin tissue
- PCR amplification was performed using 11 microsatellite loci
- Amplified products were run through an ABI-3730 DNA-Analyzer
- Electropherograms were scored using Genemapper software v.3.7

Thermalcycler's in the lab



Laboratory Methods

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The ABI-3730 DNA Analyzer



Laboratory Methods

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Electropherogram – Oki-100



Analyses of the baseline collections

- Tests of population structure and variation - genotypic differentiation, F_{ST} , linkage disequilibrium, F_{IS} , and allelic richness.
- Jackknife Analysis - Analysis to remove each individual in the baseline collections and assign it back to the most likely population-of-origin. This procedure tests each baseline collection to determine how well individuals will assign to that population based on the allele frequency differences that exist among populations.
- Neighbor-joining tree using Cavalli-Sforza and Edwards chord distance

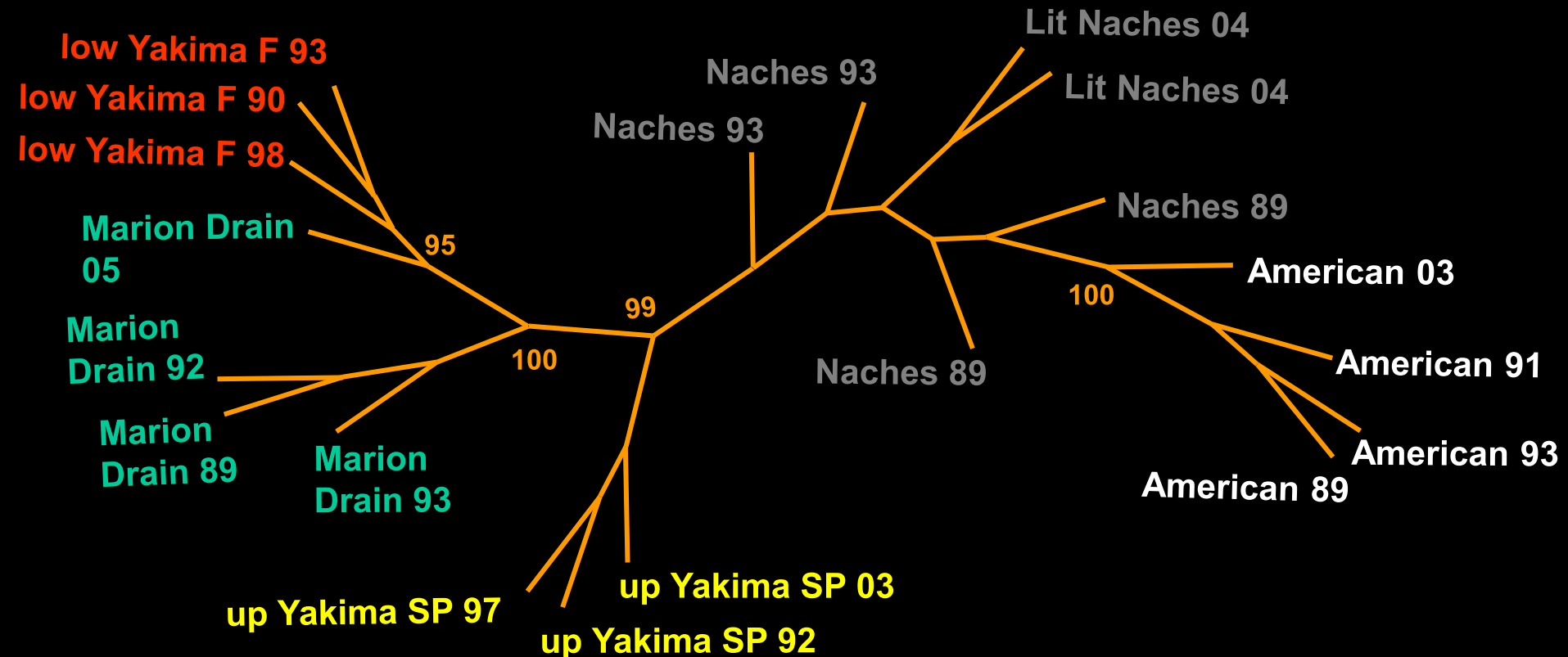
Jackknife Results – Baseline Spring Populations

	American R. SP	Naches R. SP	up Yak R. SP	Marion Drain F	low Yak R. F
American 1989	93.5%	6.5%	0.0%	0.0%	0.0%
American 1991	93.1%	6.9%	0.0%	0.0%	0.0%
American 1993	94.1%	5.9%	0.0%	0.0%	0.0%
American 2003	82.9%	17.1%	0.0%	0.0%	0.0%
Naches R. 1989	8.1%	82.4%	9.5%	0.0%	0.0%
Naches R. 1989	9.1%	90.9%	0.0%	0.0%	0.0%
Naches R. 1993	11.1%	73.3%	15.6%	0.0%	0.0%
Naches R. 1993	12.0%	76.0%	12.0%	0.0%	0.0%
Lit Naches R. 2004	9.8%	80.5%	9.8%	0.0%	0.0%
Lit Naches R. 2004	8.9%	82.2%	8.9%	0.0%	0.0%
up Yakima R. 1992	0.0%	4.3%	95.7%	0.0%	0.0%
up Yakima R. 1997	0.0%	13.9%	85.2%	0.0%	0.9%
up Yakima R. 2003	0.0%	13.1%	84.8%	0.0%	2.0%

Jackknife Results – Baseline Fall Populations

	American R. SP	Naches R. SP	up Yak R. SP	Marion Drain F	low Yak R. F
Marion Drain 1989	0.0%	0.0%	0.0%	72.8%	27.2%
Marion Drain 1992	0.0%	0.0%	0.0%	70.7%	29.3%
Marion Drain 1993	0.0%	0.0%	0.0%	87.5%	12.5%
Marion Drain 2005	0.0%	4.3%	0.0%	48.9%	46.8%
<hr/>					
low Yakima R. 1990	0.0%	0.0%	0.0%	31.7%	68.3%
low Yakima R. 1993	0.0%	1.3%	0.0%	36.3%	62.5%
low Yakima R. 1998	0.0%	0.0%	0.0%	26.0%	74.0%

Neighbor-joining tree using Cavalli-Sforza and Edwards (1967) chord distance. Bootstrap values are shown for clusters separating the five populations.



Analyses of the smolt collection

- **Mixture analysis** – Analysis to assign a population-of-origin to individual of unknown-origin. Allele frequency of unknown individual is compared with all populations in the baseline to determine the population with the most similar allele frequency. A likelihood ratio is calculated for each individual that is assigned a population. The higher the ratio the more likely the individual is from that assigned population.

Results – Population-of-origin Assignments

		American R. SP	Naches R. SP	up Yak R. SP	Marion Drain F	low Yak R. F
2004	Jan - Feb	5.2%	31.6%	62.8%	0.0%	0.4%
	March	3.9%	25.0%	71.0%	0.0%	0.0%
	April	18.9%	38.0%	43.1%	0.0%	0.0%
	May	19.5%	19.6%	16.9%	9.2%	34.8%
	June – July	3.6%	2.5%	5.7%	10.9%	77.3%
2005	Jan - Feb	20.2%	33.9%	46.0%	0.0%	0.0%
	March	20.2%	1.9%	77.9%	0.0%	0.0%
	April	23.6%	28.6%	28.5%	7.5%	11.9%
	May	3.4%	2.6%	4.7%	22.8%	66.4%
	June – July	0.0%	3.5%	22.0%	12.7%	61.8%
2006	Jan - Feb	5.3%	39.7%	54.4%	0.0%	0.6%
	March	0.0%	22.3%	77.7%	0.0%	0.0%
	April	4.6%	34.5%	60.9%	0.0%	0.0%
	May	3.3%	37.0%	54.1%	0.1%	5.5%
	June – July	0.0%	1.3%	9.0%	15.7%	74.1%

Conclusions

- The five populations are genetically differentiated. The American and Naches Rivers are the least differentiated. The spring and fall are very different.
- Over 73% of the samples from the three spring populations assign to correct population-of-origin while the assignment to the fall populations is mixed. The exception was the Marion Drain collection in 2005 that approximately 50% of the smolts assign to the lower Yakima River.
- Mixture analysis of unknown-origin smolts collected at Chandler Trap revealed that the upper Yakima River spring smolts was the most abundant spring population and lower Yakima fall smolts were the most abundant fall population.

Acknowledgements

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