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Identification of homozygous fall run Chinook salmon (*Oncorhynchus tshawytscha*) returning to Cole Rivers Hatchery on the Rogue River (OR)

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Identification of homozygous fall run Chinook salmon (*Oncorhynchus tshawytscha*) returning to Cole M. Rivers Hatchery on the Rogue River (OR)

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BACKGROUND

As described in O'Malley *et al.* (2020), the Rogue River in Oregon supports one of the largest remaining coastal runs of wild spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Pacific Northwest and California, as well as a robust run of fall Chinook salmon. The Oregon Department of Fish and Wildlife (ODFW) manages Rogue River spring and fall Chinook salmon as distinct species management units (SMUs)[1]. Spring Chinook salmon are currently defined as those adult Chinook salmon that enter freshwater during the period February through mid-July. The management goals and strategies for naturally produced spring Chinook salmon (NPCHS) in the Rogue SMU are documented in the Rogue Spring Chinook Salmon Conservation Plan, which was adopted by the ODFW Fish and Wildlife Commission on September 7, 2007 and updated in 2019. Adult Chinook salmon that enter freshwater after July 15 are classified as fall Chinook salmon. The management goals and strategies for naturally produced fall Chinook salmon (NPCHF) are documented in the Conservation Plan for Fall Chinook salmon in the Rogue Species Management Unit, which was adopted by the ODFW Fish and Wildlife Commission on January 11, 2013.

Cole M. Rivers Hatchery (CRH), located at river mile 157 on the upper Rogue River, is the largest producer of hatchery fish on the Oregon coast. Almost all fish production at CRH is to mitigate for loss of habitat due to the construction of Applegate Dam (Applegate Reservoir) and William Jess Dam (Lost Creek Reservoir). The hatchery currently rears spring Chinook salmon, coho salmon (*O. kisutch*), summer steelhead (*O. mykiss*) and winter steelhead (Rogue and Applegate). More information regarding annual production goals and adult fish returns to CRH can be found on the ODFW website.

Jess Dam blocked a significant amount of high-quality spawning and rearing habitat formerly used by naturally produced spring Chinook salmon. The hatchery spring Chinook salmon program, the largest production group at CRH, is sized to mitigate for this impact. The program began with wild fish that swam into the collection facility. Adult fish (hatchery and wild) that volitionally swim into the facility continue to be the sole source of broodstock at this time (some fish in some years are collected at the hatchery outlet and transported to the collection pond).

Broodstock protocols have attempted to maintain the historic run timing of naturally produced fish over time. In 2007, broodstock collection practices were revised so that the maturation schedule of hatchery spring Chinook salmon would mirror, as much as possible, that of the endemic portion of the wild population that historically spawned upstream of Lost Creek Dam. Broodstock selection is from adults trapped at the hatchery from April (sometimes March) through early September. Adults captured after the week of September 3 are not included in the spawn. This was intended to avoid the possibility of spawning an early run fall Chinook salmon in the spring Chinook salmon program.

[1] A Species Management Unit is a collection of populations from a common geographic region that share similar genetic and ecological characteristics.

Fall Chinook salmon are not produced at CRH. Almost all Rogue fall Chinook salmon are naturally produced (except for a small STEP hatchery program based in Gold Beach, OR) however, fall Chinook salmon do migrate into the upper Rogue River and into CRH. Following the 2007 update of the broodstock protocol, naturally produced Chinook salmon entering the hatchery after October 1 were classified as fall Chinook salmon.

In Rogue River Chinook salmon, two genetic markers appear to be highly diagnostic for adult run timing (Thompson *et al.* 2019). The two single nucleotide polymorphisms (SNPs) are located on Chromosome 28 between two genes, *greb1l* and *rock1.* Spring Chinook salmon have two copies of the "early" run allele (homozygous spring), while fall Chinook salmon have two copies of the "late" run allele (homozygous fall). Chinook salmon that have one copy of the "early" run allele and one copy of the "late" run allele (heterozygous) tend to have intermediate run timing (Thompson *et al.* 2019).

To determine the genetic composition of Rogue River Chinook salmon incorporated into the CRH broodstock, O'Malley *et al.* (2020) genotyped a subsample of fish in 2018 after they were spawned and found that most fish were homozygous spring (~88%), some fish were heterozygous (~11%), and a small percentage were homozygous fall (<1%). The four homozygous fall fish were collected after August 18 (O'Malley *et al.* 2020) (Table S3). Based on these results and the desire to protect the genetic integrity of hatchery spring Chinook salmon program, fish district managers recommended that collection of broodstock end by approximately August 15 each year.

In 2020 and 2021, the return of hatchery spring Chinook salmon to the Rogue River was very low. As the run progressed, ODFW became concerned about meeting broodstock needs at the CRH. To increase the number of fish available at spawning, ODFW decided to use a near real-time genotyping approach to identify homozygous spring and heterozygous Chinook salmon that would have otherwise been excluded from the spring Chinook salmon broodstock program based on their return date.

METHODS

2020 Sampling

ODFW collected tissue samples from 114 Chinook salmon as they returned to the CRH over a seven-week period from August 19 to September 29, 2020 (Table 1). Tissue samples were collected from the caudal fin of each fish using a hole punch and stored in individual vials filled with 95% ethanol. Samples were shipped to the State Fisheries Genomics Lab in Newport, OR and received in six batches based on their collection date: August 21 (7 samples), August 27 (13 samples), September 3 (25 samples), September 16 (58 samples), September 23 (10 samples), and September 29 (1 sample) (Table 1). Also, each fish was tagged with a numbered floy tag that corresponded to the number on the sample vial. The floy tag enabled hatchery managers to assign the genetic results to individual fish prior to spawning to ensure that all homozygous fall Chinook salmon were excluded from the broodstock.

2021 Sampling

ODFW collected tissue samples from 44 Chinook salmon as they returned to the CRH on September 22, 2021 (Table 1). Tissue samples were collected from the caudal fin of each fish using a hole punch and stored in individual vials filled with 95% ethanol. Each fish was also tagged with a numbered floy tag that corresponded to the number on the sample vial. The floy tag enabled hatchery managers to assign the genetic results to individual fish and exclude all homozygous fall Chinook salmon from the broodstock prior to spawning.

Table 1. Number of Chinook salmon sampled in 2020 and 2021 including the dates individuals were sampled at the hatchery, dates samples were received in the State Fisheries Genomics Lab, dates DNA was extracted for each batch of samples and dates the samples were genotyped.

Year	Sample Size	Date Sampled	Date Received	Date DNA Extracted	Date Genotyped
2020	7	8/19	8/21	8/25	8/25
	13	8/26	8/27	8/28	8/28
	25	9/2	9/3	9/4	9/4
	53	9/10	9/16	9/17	9/18
	5	9/15	9/16	9/17	9/18
	10	9/22	9/23	9/24	9/24
	1	9/29	9/29	10/1	10/1
2021	44	9/22	9/24	10/7	10/8

DNA Extraction and SNP Genotyping

DNA was extracted from the tissue samples using the method of Ivanova *et al.* (2006) or the Qiagen DNeasy kit, following manufacturer's protocols. Using qPCR, all samples were genotyped at two SNPs (chr28: 12277551 (Tasha SNP1 - Ots37124_12277401) and chr28: 12310799 (Tasha SNP2 - Ots37124_12310649); Otsh_v1.0 GCA_002872995.1) associated with adult run timing (Thompson *et al.* 2019). These two SNPs, referred to as *greb1l* SNP1 and *greb1l* SNP2, are located approximately ~33 kb apart on Chromosome 28, in the intergenic region between the *greb1l* and *rock1* genes.

Previous research has demonstrated that *greb1l* SNP1 is reportedly more diagnostic of adult migration phenotype than *greb1l* SNP2 in Rogue River and Klamath River populations of Chinook salmon (T. Thompson, pers. comm.). When genotypes at *greb1l* SNP1 and SNP2 disagreed (i.e. discordant genotypes), we focused on *greb1l* SNP1 to identify and exclude homozygous fall Chinook salmon from the broodstock.

Each qPCR plate contained known homozygous spring, homozygous fall, and heterozygous samples (provided by T. Thompson) and negative controls to check for contamination. Genotyping amplifications were completed in 10µL reaction volumes containing: 1.5µL ddH20, 5µL TaqMan Genotyping Master Mix (Thermo Fisher Scientific), 0.5µL 20X primer/probe mix, and 2µL unquantified template DNA. All samples were amplified on a QuantStudio 5 Real-Time PCR instrument (Thermo Fisher Scientific) with an initial denaturation at 95C for 10 min, followed by 40 cycles at 95C for 15 sec, then an annealing temperature of 58C or 64C for *greb1l* SNP1 and *greb1l* SNP2, respectively. Samples were genotyped using Thermo Fisher's cloud-based Genotyping app. All known samples had unambiguous genotypes and there was no amplification in the negative control samples giving us high confidence in assignment.

RESULTS

2020 Cole M. Rivers Hatchery Broodstock Genotypes

Samples were processed and genotyped in order of reception, with six batches, based on collection date, ranging from one sample to 58 samples. All genotypes were generated within two working days of reception. Of the 114 Chinook salmon genotyped, the majority were homozygous for the spring *greb1l* allele (SNP1: 74, 64.9%; SNP2: 71, 62.3%). However, some fish were heterozygous (SNP1: 32, 28.1%; SNP2: 33, 28.9%) and a percentage of the fish were homozygous for the fall *greb1l* allele (SNP1: 8, 7.0%; SNP2: 10, 8.8%) (Figure 1). Overall, *greb1l* SNP1 and SNP2 were discordant for seven out of the 114 Chinook salmon genotyped (Table S1).

Focusing on the *greb1l* SNP1 genotyping results, eight of the 114 fish were homozygous fall. These fish were sampled on August 19 (n = 1), September 2 (n = 2), September 10 (n = 1), and September 15 (n = 4) (Figure 2a; Table S1). These results were provided to the CRH managers, and the eight homozygous fall fish were excluded from the spring Chinook salmon broodstock prior to spawning. The remaining 106 fish were included in the spring Chinook salmon broodstock program.

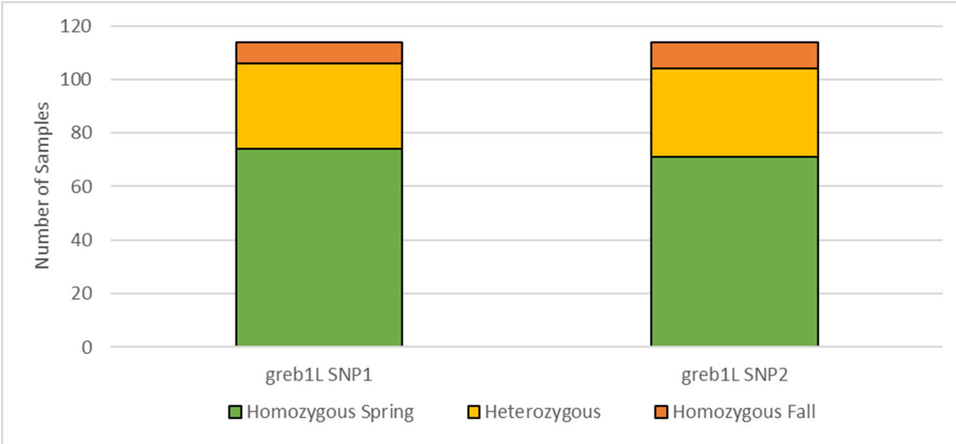
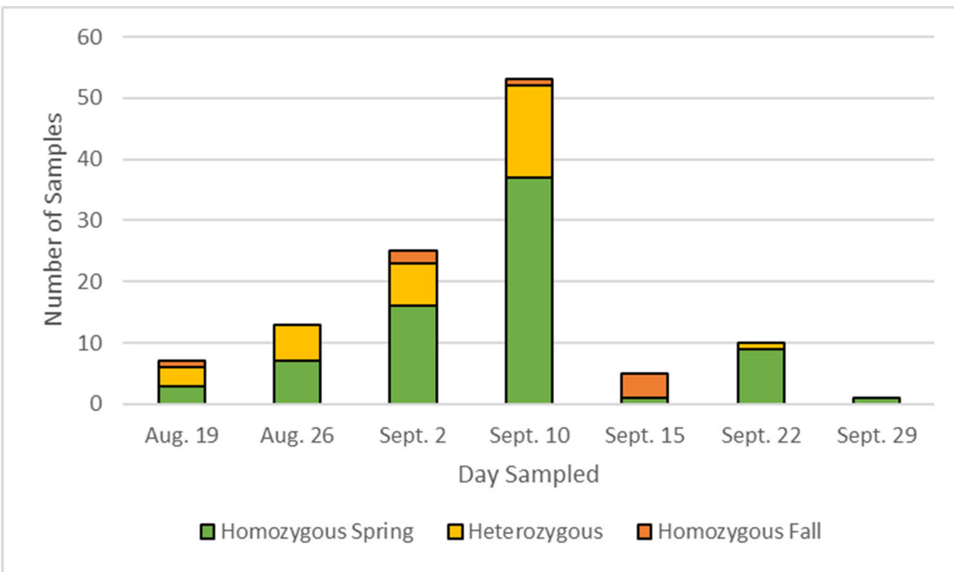


Figure 1. *Greb1l* SNP1 and SNP2 genotypes for 114 Chinook salmon sampled at the Cole M. Rivers Hatchery in 2020.

a) SNP1



b) SNP2

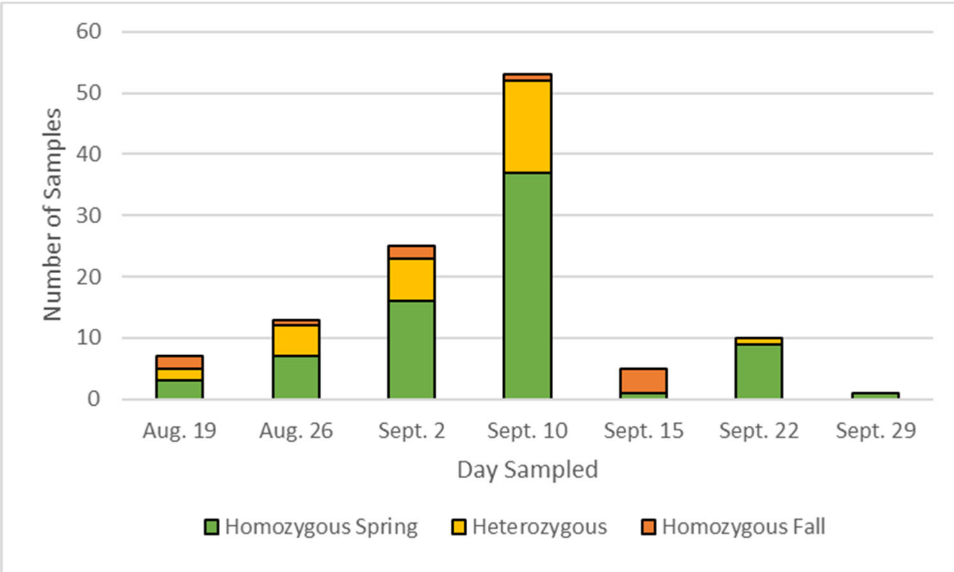


Figure 2. Distribution of Chinook salmon a) *greb1l* SNP1 and b) *greb1l* SNP2 genotypes by date sampled at Cole M. Rivers Hatchery, ranging from August 19 to September 29, 2020.

2021 Cole M. Rivers Hatchery Broodstock Genotypes

Of the 44 Chinook salmon genotyped, the majority were homozygous for the spring *greb1l* allele (SNP1: 30, 68.2%; SNP2: 27, 61.4%). However, some fish were heterozygous (SNP1: 10, 22.7%; SNP2: 12, 27.2%) and a percentage of the fish were homozygous for the fall *greb1l* allele (SNP1: 4, 9.1%; SNP2: 5, 11.4%). Overall, *greb1l* SNP1 and SNP2 were discordant for eight out of the 44 Chinook salmon genotyped in 2021 (Table S2).

Focusing on the *greb1l* SNP1 genotyping results, four out of the 44 Chinook salmon were homozygous fall. These genotyping results were provided to the CRH managers, and the four homozygous fall fish were excluded from the spring Chinook salmon broodstock at the time of spawning. The remaining 40 fish were included in the spring Chinook salmon broodstock program.

Comparison of Cole Rivers Hatchery Broodstock Genotypes Across Years (2018, 2020, and 2021)

In 2018 and 2020 there were three sampling dates that overlapped and enabled comparison of *greb1l* SNP1 and SNP2 genotypes across years. In 2018, samples were collected on August 22, August 29, and September 5 (O'Malley *et al.* 2020) while in 2020, samples were collected on August 19, August 26, and September 2 (Table 2).

Of the 58 Chinook salmon sampled in 2018 on August 22, August 29, and September 5 (O'Malley *et al.* 2020), the majority were homozygous spring (SNP1: 34, 66.7%; SNP2: 37, 64.9%), with roughly a third heterozygous (SNP1: 14, 27.5.1%; SNP2: 16, 28.1%), and the remaining fish were homozygous fall (SNP1: 3, 5.9%; SNP2: 4, 7.0%) (Figure 3). SNP1 and SNP2 were discordant for three out of the 50 Chinook salmon successfully genotyped at both SNPs (Table S3).

Of the 45 Chinook salmon genotyped in 2020 on August 19, August 26, and September 2, the majority were homozygous spring (SNP1: 26, 57.8%; SNP2: 26, 57.8%), with roughly a third heterozygous (SNP1: 16, 35.5%; SNP2: 14, 31.1%), and a small percentage were homozygous fall (SNP1: 3, 6.7%; SNP2: 5, 11.1%) (Figure 3). SNP1 and SNP2 were discordant for four out of the 45 Chinook salmon successfully genotyped during this sampling period (Table S1).

Both 2018 and 2020 showed similar genetic composition even though most fish in the 2020 subsample were collected on the later sampling date, September 2 (n = 25), while most of the fish in 2018 subsample were collected on August 22 and 29 (n = 26 and 28, respectively) (Table 2) (Figure 4).

In 2020 and 2021, there was one sampling date that overlapped, September 22. Of the 10 fish sampled on this day in 2020, the majority were homozygous for the spring *greb1l* allele (SNP1: 9, 90%; SNP2: 9, 90%) and one heterozygous fish (SNP1: 1, 10%; SNP2: 1, 10%) (Table S1). Of the 44 fish sampled on this day in 2021, most were homozygous for the spring *greb1l* allele (SNP1: 30, 68.2%; SNP2: 27, 61.4%), while some fish were heterozygous (SNP1: 10, 22.7%; SNP2: 12, 27.2%), and a percentage of the fish were homozygous fall (SNP1: 4, 9.1%; SNP2: 5, 11.4%) (Table S2).

Table 2. Comparison of the 2018 (O'Malley *et al.* 2020), 2020, and 2021 genotyping results for Chinook salmon sampled at Cole M. Rivers Hatchery on the Rogue River, OR. For each year, dates for equivalent sampling weeks on the calendar year are listed, as well as the number (n) of Chinook salmon genotyped at g*reb1l* SNP1 and number of genotypes for each of the four types (homozygous spring, heterozygous, homozygous fall, or unknown (UK) due to poor amplification).

2018			**2020**			**2021**		
Dates	**n**	**Genotype # (Spring, Het, Fall, UK)**	**Dates**	**n**	**Genotype # (Spring, Het, Fall, UK)**	**Dates**	**n**	**Genotype # (Spring, Het, Fall, UK)**
Aug. 18	106	65, 34, 1, 6		NA	NA		NA	NA
Aug. 22	26	16, 7, 0, 3	Aug. 19	7	3, 3, 1, 0		NA	NA
Aug. 29	28	15, 6, 3, 4	Aug. 26	13	7, 6, 0, 0		NA	NA

Sept. 5	4	3, 1, 0, 0	Sept. 2	25	16, 7, 2, 0		NA	NA
	NA	NA	Sept. 10	53	37, 15, 1, 0		NA	NA
	NA	NA	Sept. 15	5	1, 0, 4, 0		NA	NA
	NA	NA	Sept. 22	10	9, 1, 0, 0	Sept. 22	44	30, 4, 10, 0
	NA	NA	Sept. 29	1	1, 0, 0, 0		NA	NA
Total	**164**	**99, 34, 4, 13**	**Total**	**114**	**74, 32, 8, 0**	**Total**	**44**	**30, 4, 10, 0**

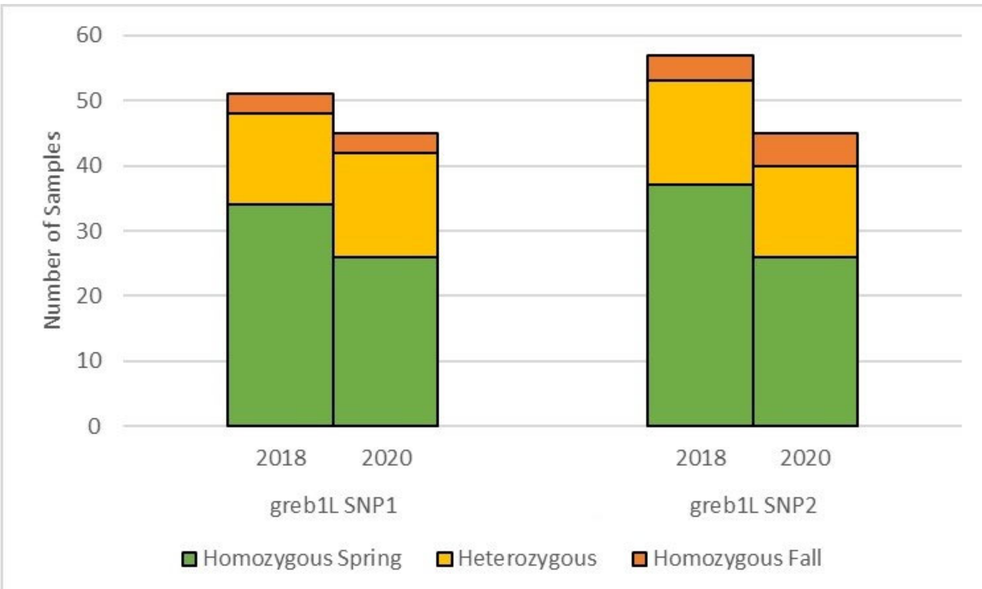
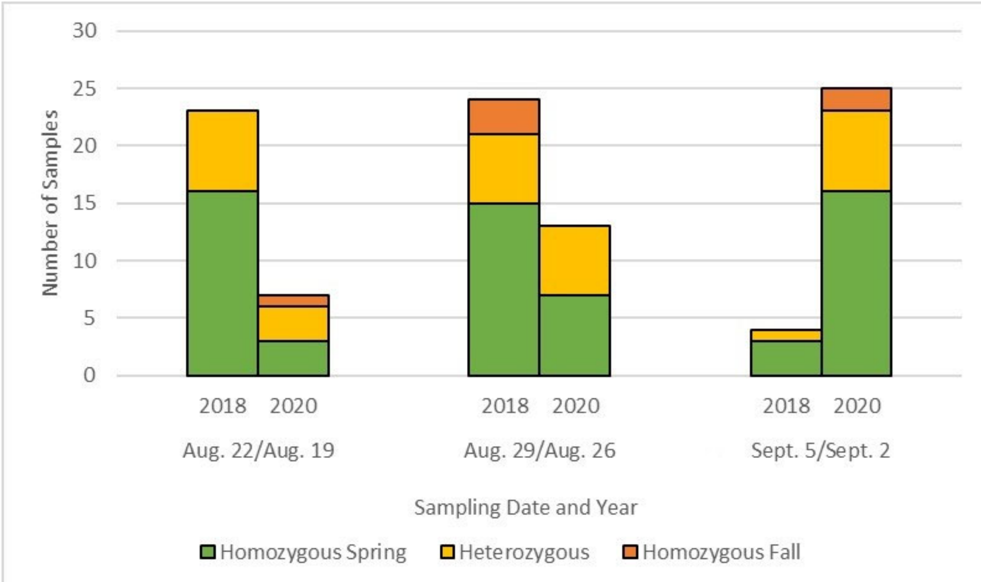


Figure 3. Comparison of *greb1l* SNP1 and SNP2 genotypes for Chinook salmon sampled at Cole M. Rivers Hatchery between August 22 – September 5 in 2018 (O'Malley *et al.* 2020) and August 19 – September 2 in 2020.

a) SNP1



b) SNP2

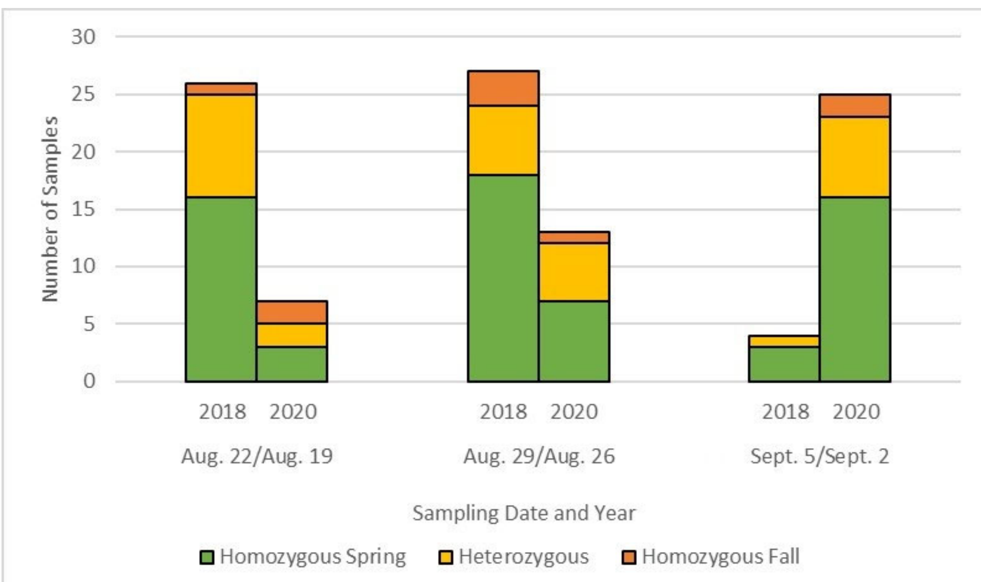


Figure 4. Distribution of Chinook salmon a) *greb1l* SNP1 and b) *greb1l* SNP2 genotypes based on sampling date at Cole M. Rivers Hatchery. Shown are three corresponding sampling dates in 2018 (Aug. 22, 29, and Sept. 5) (O'Malley *et al.* 2020) and in 2020 (Aug. 19, 26, and Sept. 2).

CONCLUSIONS

Genetic data can be incorporated on a near real-time basis to ensure that homozygous fall Chinook salmon are excluded from the Cole M. Rivers Hatchery spring Chinook salmon broodstock program. In 2020 and 2021, a subsample of Chinook salmon returning to the hatchery in late August through the end of September were sampled for genetic analysis and tagged with a numbered floy tag. Genotypes for all fish sampled within each year were generated within two working days of receiving the tissue samples. Results were communicated to hatchery managers who then used the numbered floy tag to assign genetic results to individual fish prior to spawning. By employing this approach, an additional 106 Chinook salmon in 2020 and 40 Chinook salmon in 2021 were incorporated into the spring Chinook salmon broodstock program.

In 2020, eight of the 114 Chinook salmon sampled on or between August 19 and September 29 were identified as homozygous fall and subsequently excluded from the spring Chinook broodstock program. Interestingly, 5% (1/20) of the Chinook salmon sampled in August were homozygous fall while 7.4% (7/94) of the Chinook salmon in September were homozygous fall. In 2021, four of the 44 Chinook salmon sampled on September 22 were identified as homozygous fall and subsequently excluded from the spring Chinook broodstock program. Based on the three sampling dates that overlap between the 2018 and 2020 sample collection periods, the genetic composition of Chinook salmon was similar despite the larger sample sizes in 2018. One sampling day (September 22) overlapped between 2020 and 2021 when 10 and 44 fish were sampled, respectively. While most were homozygous spring in 2020, the larger sample size in 2021 included some heterozygous fish as well as a small percentage of homozygous fall fish.

Chinook salmon identified as heterozygous were included in the broodstock in both 2020 and 2021. While we know there is a strong association between the g*reb1l* SNP1 and adult run timing in Rogue River Chinook salmon, we do not fully understand the genetic mechanism underlying this genotype-phenotype relationship. That said, if we assume a simple model of inheritance, spawning two heterozygous fish would produce offspring that are approximately one-half heterozygous fish, one quarter homozygous spring run fish and one quarter homozygous fall run fish. To avoid production of homozygous fall fish, it is recommended that heterozygous fish are spawned with homozygous spring run fish.

In summary, this study demonstrates how genetic data can be generated in nearly real-time to support fishery managers. The results helped ensure that homozygous fall run fish were excluded from the hatchery broodstock which ultimately supports a popular hatchery program and fishery. This method will be available in future years and in other systems to inform hatchery spawning practices.

ACKNOWLEDGMENTS

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SUPPLEMENTAL INFORMATION

Table S1. *Greb1l* SNP1 and SNP2 genotypes for Chinook salmon sampled at the Cole Rivers Hatchery from August 19 – September 29, 2020.

Date sampled	Sample ID	SNP1	SNP2	Multilocus genotype
8/19/2020	OtsAC20CORH_0001	Homozygous Spring	Homozygous Spring	TTAA
8/19/2020	OtsAC20CORH_0002	Heterozygous	Homozygous Fall	ATTT
8/19/2020	OtsAC20CORH_0003	Heterozygous	Heterozygous	ATAT
8/19/2020	OtsAC20CORH_0004	Homozygous Spring	Homozygous Spring	TTAA
8/19/2020	OtsAC20CORH_0005	Heterozygous	Heterozygous	ATAT
8/19/2020	OtsAC20CORH_0006	Homozygous Spring	Homozygous Spring	TTAA
8/19/2020	OtsAC20CORH_0007	Homozygous Fall	Homozygous Fall	AATT
8/26/2020	OtsAC20CORH_0008	Heterozygous	Homozygous Fall	ATTT
8/26/2020	OtsAC20CORH_0009	Homozygous Spring	Homozygous Spring	TTAA
8/26/2020	OtsAC20CORH_0010	Heterozygous	Heterozygous	ATAT
8/26/2020	OtsAC20CORH_0011	Homozygous Spring	Homozygous Spring	TTAA
8/26/2020	OtsAC20CORH_0012	Heterozygous	Heterozygous	ATAT
8/26/2020	OtsAC20CORH_0013	Heterozygous	Heterozygous	ATAT
8/26/2020	OtsAC20CORH_0014	Homozygous Spring	Homozygous Spring	TTAA
8/26/2020	OtsAC20CORH_0015	Homozygous Spring	Homozygous Spring	TTAA
8/26/2020	OtsAC20CORH_0016	Homozygous Spring	Homozygous Spring	TTAA
8/26/2020	OtsAC20CORH_0017	Homozygous Spring	Homozygous Spring	TTAA
8/26/2020	OtsAC20CORH_0018	Heterozygous	Heterozygous	ATAT
8/26/2020	OtsAC20CORH_0019	Homozygous Spring	Homozygous Spring	TTAA
8/26/2020	OtsAC20CORH_0020	Heterozygous	Heterozygous	ATAT
9/2/2020	OtsAC20CORH_0021	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0022	Heterozygous	Heterozygous	ATAT
9/2/2020	OtsAC20CORH_0023	Heterozygous	Heterozygous	ATAT
9/2/2020	OtsAC20CORH_0024	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0025	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0026	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0027	Heterozygous	Heterozygous	ATAT
9/2/2020	OtsAC20CORH_0028	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0029	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0030	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0031	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0032	Heterozygous	Heterozygous	ATAT
9/2/2020	OtsAC20CORH_0033	Heterozygous	Heterozygous	ATAT
9/2/2020	OtsAC20CORH_0034	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0035	Homozygous Fall	Homozygous Fall	AATT
9/2/2020	OtsAC20CORH_0036	Homozygous Spring	Homozygous Spring	TTAA

9/2/2020	OtsAC20CORH_0037	Heterozygous	Heterozygous	ATAT
9/2/2020	OtsAC20CORH_0038	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0039	Homozygous Spring	Heterozygous	TTAT
9/2/2020	OtsAC20CORH_0040	Homozygous Fall	Homozygous Fall	AATT
9/2/2020	OtsAC20CORH_0041	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0042	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0043	Heterozygous	Homozygous Spring	ATAA
9/2/2020	OtsAC20CORH_0044	Homozygous Spring	Homozygous Spring	TTAA
9/2/2020	OtsAC20CORH_0045	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0046	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0047	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0048	Homozygous Fall	Homozygous Fall	AATT
9/10/2020	OtsAC20CORH_0049	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0050	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0051	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0052	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0053	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0054	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0055	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0056	Heterozygous	Heterozygous	ATAT
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9/10/2020	OtsAC20CORH_0061	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0062	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0063	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0064	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0065	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0066	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0067	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0068	Homozygous Spring	Heterozygous	TTAT
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9/10/2020	OtsAC20CORH_0070	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0071	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0072	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0073	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0074	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0075	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0076	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0077	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0078	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0079	Homozygous Spring	Homozygous Spring	TTAA

9/10/2020	OtsAC20CORH_0080	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0081	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0082	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0083	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0084	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0085	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0086	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0087	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0088	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0089	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0090	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0091	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0092	Homozygous Spring	Heterozygous	TTAT
9/10/2020	OtsAC20CORH_0093	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0094	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0095	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0096	Heterozygous	Heterozygous	ATAT
9/10/2020	OtsAC20CORH_0097	Homozygous Spring	Homozygous Spring	TTAA
9/10/2020	OtsAC20CORH_0098	Homozygous Spring	Homozygous Spring	TTAA
9/15/2020	OtsAC20CORH_0100	Homozygous Fall	Homozygous Fall	AATT
9/15/2020	OtsAC20CORH_0101	Homozygous Fall	Homozygous Fall	AATT
9/15/2020	OtsAC20CORH_0102	Homozygous Fall	Homozygous Fall	AATT
9/15/2020	OtsAC20CORH_0103	Homozygous Fall	Homozygous Fall	AATT
9/15/2020	OtsAC20CORH_0104	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0105	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0106	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0107	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0108	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0109	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0110	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0111	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0112	Homozygous Spring	Homozygous Spring	TTAA
9/22/2020	OtsAC20CORH_0113	Heterozygous	Heterozygous	ATAT
9/22/2020	OtsAC20CORH_0114	Homozygous Spring	Homozygous Spring	TTAA
9/29/2020	OtsAC20CORH_0115	Homozygous Spring	Homozygous Spring	TTAA

Table S2. *Greb1l* SNP1 and SNP2 genotypes for Chinook salmon sampled at the Cole Rivers Hatchery on September 22, 2021.

Date sampled	Sample ID	SNP1	SNP2	Multilocus genotype

9/22/2021	OtsAC21CORH_0001	Homozygous Spring	Heterozygous	TTAT
9/22/2021	OtsAC21CORH_0002	Heterozygous	Heterozygous	ATAT
9/22/2021	OtsAC21CORH_0003	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0004	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0005	Homozygous Fall	Homozygous Fall	AATT
9/22/2021	OtsAC21CORH_0006	Heterozygous	Heterozygous	ATAT
9/22/2021	OtsAC21CORH_0007	Homozygous Spring	Heterozygous	TTAT
9/22/2021	OtsAC21CORH_0008	Heterozygous	Heterozygous	ATAT
9/22/2021	OtsAC21CORH_0009	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0010	Homozygous Fall	Homozygous Fall	AATT
9/22/2021	OtsAC21CORH_0011	Heterozygous	Homozygous Spring	ATAA
9/22/2021	OtsAC21CORH_0012	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0013	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0014	Homozygous Spring	Heterozygous	TTAT
9/22/2021	OtsAC21CORH_0015	Homozygous Fall	Homozygous Fall	AATT
9/22/2021	OtsAC21CORH_0016	Heterozygous	Heterozygous	ATAT
9/22/2021	OtsAC21CORH_0017	Heterozygous	Homozygous Spring	ATAA
9/22/2021	OtsAC21CORH_0018	Homozygous Fall	Homozygous Fall	AATT
9/22/2021	OtsAC21CORH_0019	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0020	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0021	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0022	Homozygous Spring	Heterozygous	TTAT
9/22/2021	OtsAC21CORH_0023	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0024	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0025	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0026	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0027	Heterozygous	Heterozygous	ATAT
9/22/2021	OtsAC21CORH_0028	Heterozygous	Heterozygous	ATAT
9/22/2021	OtsAC21CORH_0029	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0030	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0031	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0032	Homozygous Spring	Heterozygous	TTAT
9/22/2021	OtsAC21CORH_0033	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0034	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0035	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0036	Heterozygous	Homozygous Fall	ATTT
9/22/2021	OtsAC21CORH_0037	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0038	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0039	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0040	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0041	Homozygous Spring	Homozygous Spring	TTAA
9/22/2021	OtsAC21CORH_0042	Heterozygous	Heterozygous	ATAT
9/22/2021	OtsAC21CORH_0043	Homozygous Spring	Homozygous Spring	TTAA

9/22/2021	OtsAC21CORH_0044	Homozygous Spring	Homozygous Spring	TTAA

Table S3. *Greb1l* SNP1 and SNP2 genotypes for Chinook salmon sampled at the Cole Rivers Hatchery from August 18 – September 5, 2018 (O'Malley *et al.* 2020).

Date sampled	Sample ID	SNP1	SNP2	Multilocus genotype
8/18/2018	OtsAC18CORH_1701	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1702	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1703	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1704	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1705	Unknown	Heterozygous	--AT
8/18/2018	OtsAC18CORH_1706	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1707	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1708	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1709	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1710	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1711	Homozygous Spring	Heterozygous	TTAT
8/18/2018	OtsAC18CORH_1712	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1713	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1714	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1715	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1716	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1717	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1718	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1720	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1721	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1722	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1723	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1724	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1725	Homozygous Spring	Heterozygous	TTAT
8/18/2018	OtsAC18CORH_1726	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1727	Homozygous Spring	Heterozygous	TTAT
8/18/2018	OtsAC18CORH_1728	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1729	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1730	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1731	Homozygous Spring	Heterozygous	TTAT
8/18/2018	OtsAC18CORH_1732	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1733	Unknown	Heterozygous	--AT
8/18/2018	OtsAC18CORH_1734	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1735	Homozygous Spring	Heterozygous	TTAT

8/18/2018	OtsAC18CORH_1736	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1737	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1738	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1739	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1740	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1741	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1742	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1743	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1744	Homozygous Fall	Homozygous Fall	AATT
8/18/2018	OtsAC18CORH_1745	Unknown	Heterozygous	--AT
8/18/2018	OtsAC18CORH_1746	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1747	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1748	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1749	Unknown	Homozygous Spring	--AA
8/18/2018	OtsAC18CORH_1750	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1751	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1752	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1753	Homozygous Spring	Heterozygous	TTAT
8/18/2018	OtsAC18CORH_1754	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1755	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1756	Homozygous Spring	Heterozygous	TTAT
8/18/2018	OtsAC18CORH_1757	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1758	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1759	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1760	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1761	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1762	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1763	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1764	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1765	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1766	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1767	Heterozygous	Unknown	AT--
8/18/2018	OtsAC18CORH_1768	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1769	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1770	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1771	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1772	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1773	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1775	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1776	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1777	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1778	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1779	Homozygous Spring	Homozygous Spring	TTAA

8/18/2018	OtsAC18CORH_1780	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1781	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1782	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1783	Homozygous Spring	Heterozygous	AAAT
8/18/2018	OtsAC18CORH_1784	Homozygous Spring	Heterozygous	AAAT
8/18/2018	OtsAC18CORH_1785	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1786	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1787	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1788	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1789	Unknown	Heterozygous	--AT
8/18/2018	OtsAC18CORH_1790	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1791	Heterozygous	Homozygous Fall	ATTT
8/18/2018	OtsAC18CORH_1793	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1794	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1795	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1796	Heterozygous	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1797	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_1798	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_1799	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_3700	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_3701	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_3702	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_3703	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_3705	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_3706	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_3707	Heterozygous	Heterozygous	ATAT
8/18/2018	OtsAC18CORH_3708	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_3709	Homozygous Spring	Homozygous Spring	TTAA
8/18/2018	OtsAC18CORH_3710	Unknown	Heterozygous	--AT
8/22/2018	OtsAC18CORH_1801	Heterozygous	Heterozygous	ATAT
8/22/2018	OtsAC18CORH_1802	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1803	Heterozygous	Heterozygous	ATAT
8/22/2018	OtsAC18CORH_1804	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1805	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1806	Heterozygous	Heterozygous	ATAT
8/22/2018	OtsAC18CORH_1807	Heterozygous	Heterozygous	ATAT
8/22/2018	OtsAC18CORH_1808	Homozygous Spring	Heterozygous	TTAT
8/22/2018	OtsAC18CORH_1809	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1810	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1811	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1812	Unknown	Homozygous Spring	--AA
8/22/2018	OtsAC18CORH_1813	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1814	Heterozygous	Heterozygous	ATAT

8/22/2018	OtsAC18CORH_1815	Heterozygous	Homozygous Fall	ATTT
8/22/2018	OtsAC18CORH_1816	Heterozygous	Heterozygous	ATAT
8/22/2018	OtsAC18CORH_1817	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1821	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1822	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1823	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1825	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1826	Unknown	Heterozygous	--AT
8/22/2018	OtsAC18CORH_1827	Unknown	Heterozygous	--AT
8/22/2018	OtsAC18CORH_1829	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1830	Homozygous Spring	Homozygous Spring	TTAA
8/22/2018	OtsAC18CORH_1831	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1901	Unknown	Heterozygous	--AT
8/29/2018	OtsAC18CORH_1902	Unknown	Heterozygous	--AT
8/29/2018	OtsAC18CORH_1903	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1904	Unknown	Homozygous Spring	--AA
8/29/2018	OtsAC18CORH_1905	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1906	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1907	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1908	Homozygous Fall	Homozygous Fall	AATT
8/29/2018	OtsAC18CORH_1909	Heterozygous	Heterozygous	ATAT
8/29/2018	OtsAC18CORH_1910	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1911	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1913	Unknown	Homozygous Spring	--AA
8/29/2018	OtsAC18CORH_1914	Homozygous Fall	Homozygous Fall	AATT
8/29/2018	OtsAC18CORH_1915	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1916	Heterozygous	Heterozygous	ATAT
8/29/2018	OtsAC18CORH_1917	Heterozygous	Heterozygous	ATAT
8/29/2018	OtsAC18CORH_1918	Heterozygous	Unknown	AT--
8/29/2018	OtsAC18CORH_1919	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1920	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1922	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1923	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1924	Homozygous Fall	Homozygous Fall	AATT
8/29/2018	OtsAC18CORH_1925	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1926	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1927	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1929	Homozygous Spring	Homozygous Spring	TTAA
8/29/2018	OtsAC18CORH_1930	Heterozygous	Homozygous Spring	ATAA
8/29/2018	OtsAC18CORH_1931	Heterozygous	Heterozygous	ATAT
9/5/2018	OtsAC18CORH_2002	Homozygous Spring	Homozygous Spring	TTAA
9/5/2018	OtsAC18CORH_2003	Homozygous Spring	Homozygous Spring	TTAA
9/5/2018	OtsAC18CORH_2004	Homozygous Spring	Homozygous Spring	TTAA

9/5/2018	OtsAC18CORH_2005	Heterozygous	Heterozygous	ATAT

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