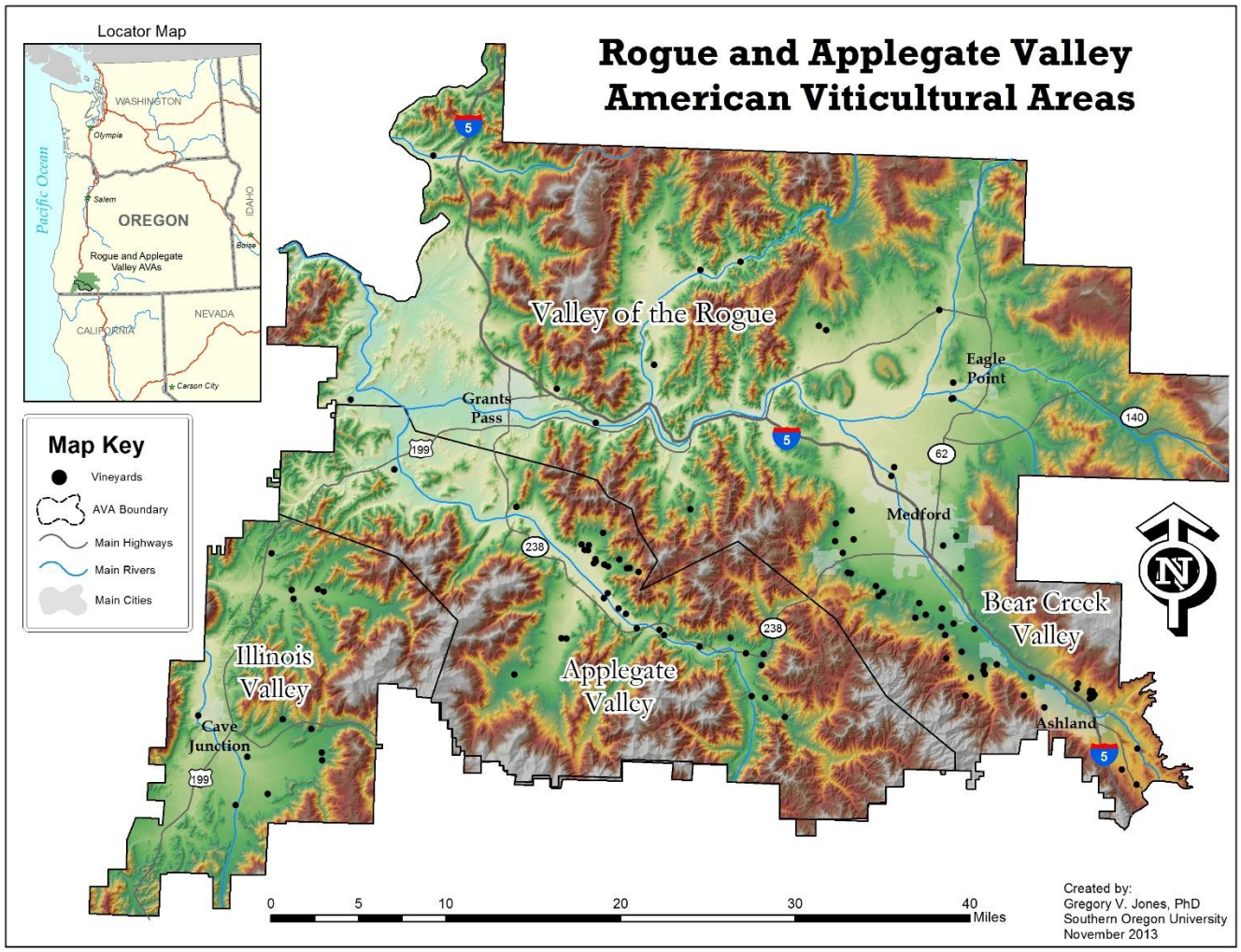
Vintage 2018
Rogue Valley Reference Vineyard Report



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Summary:
The 2017-2018 winter and growing season were highlighted by a relatively mild and dry winter, a cool spring, a dry summer with low heat stress but numerous regional fires, and a glorious October. The winter over the western US was generally mild ending up with near average temperatures, low winter freeze risk compared to previous years, and was drier than average in most regions including Southern Oregon. A moderately cool spring led to a late start to the growing season with bud break slightly delayed compared to average, however a warm May through August brought plant growth timing to near average to slight ahead of average in the region. The 2018 vintage ended with growing degree-day totals that were above average, very similar to 2017, but below the records set in the 2015 and 2016 vintages. The Rogue Valley vintage saw a few mild frosts during early to mid-April, a warm and mostly dry bloom period, experienced a string of a 100 days or more without precipitation during the middle of the summer, and had a prolonged harvest period from very beneficial weather conditions in October. Overall the growing season saw substantially lower heat stress compared to average, and evidence points to smoke playing a role in lowering maximum temperatures and overall heat accumulation in the region. Growers reported generally low impacts from weather risks in 2018. All sites reported a very good fruit set and crop load. The first picking was reported on September 6th and continued through to the last picking reported on October 25th across the different varieties and sites. Growers reported composition levels at harvest that exhibited slightly above average °Brix, slightly lower than average acid and pH values, and yields that were on average 12-18% up. Bird pressure was reported to be average to none depending on harvest timing, while other pest issues were mixed with yellow jackets reported as being exceptionally problematic. Disease pressure was reported as being generally lower than average for most sites over the growing season.

Project Overview:
This project is a continuation of the 2003-2009 reference vineyard project which established a suite of reference vineyards in the Rogue and Applegate Valley AVAs with a purpose of providing an in depth look at spatial variations in important characteristics of temperature, phenology, composition, and yields in the region. Starting with the 2010 vintage, the project was scaled back to cover only temperature, phenology, and harvest composition from six sites (one in the Illinois Valley, two in the Applegate Valley, two in the Bear Creek Valley, and one in the Valley of the Rogue). At each of the six sites temperature devices record at 15-minute intervals during both the dormant season (Nov 1-Mar 31) and the growing season (Apr 1-Oct 31). The observations are then aggregated to hourly and daily average, maximum, and minimum values and summarized over the entire region. Additional summaries are done for the Medford NWS station at the airport and the Agri-Met station at SOREC. For phenological observations, the six sites submit dates for the four main events of bud break, bloom, véraison, and harvest for a mix of varieties planted at each site. The phenological data are then summarized by average dates and intervals between dates for the entire region. Finally, harvest composition values for °Brix, titratable acidity, and pH, along with yields are submitted by the six sites and are then summarized for the region.

Climate:

The winter of 2017-18 (November 1 through March 31) was characterized by strong month to month variation in temperatures statewide with November warmer than average, December cooler than average, January substantially warmer than average, and a generally cooler than average February and March. Temperatures during November through March at the Medford station ended up 0.3°F below average while those at the reference vineyards were near average to slightly warmer than the last 14 years (Table 1 and 2). January was the warmest month of the winter with Medford temperatures running 2.7°F warmer than normal (Figure 1). In terms of record events, the winter experienced seven

record high temperatures but no record low temperatures. The winter's coldest periods came during mid-February to early March at the Medford weather station (Figure 1). During the same time the absolute winter lows at the reference vineyards dropped to 16.9°F to 23.0°F (Table 1). The remainder of the 2017-18 winter was slightly cooler than average with temperatures in February and March 3.0°F and 1.4°F below average, respectively. During the dormant period from November to March the region experienced an average of 76 days below 32°F, which was near the long-term average (Table 2). While precipitation is not observed at the reference vineyards, values from the main climate stations in the region indicate that November through March were all drier than average, ending up 5-15 inches below the long-term average (7.2" below for Medford) with no record events during the winter at the Medford station (Figure 1).

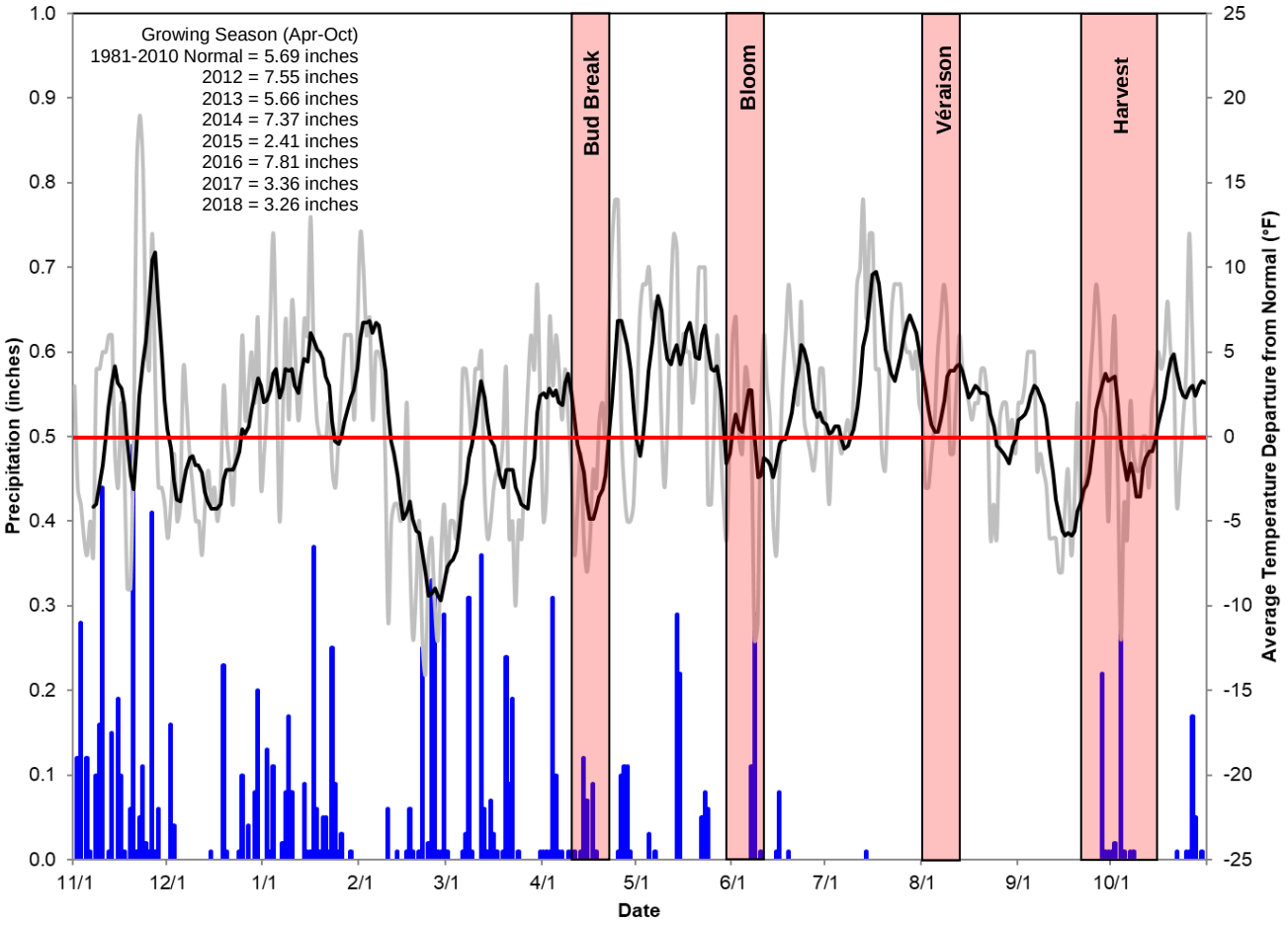

Figure 1 – Daily average temperature departures from normal and precipitation for November 1, 2017 to October 31, 2018 from the Medford Airport weather station. The gray line is the day to day temperature departures from normal, the black line is the weekly average departures, and the blue bars are daily precipitation. The long-term average is derived from the 1981-2010 climate normals. The vertical red bars represent the variation in region-wide average phenology (see text for details).

Following a relatively cool and wet March in the western US, April saw slightly warmer conditions and near average precipitation. As a result, a later than average bud break from the end of the second to third weeks of April occurred, averaging April 21st (see more in the phenology section that follows). Late April started off a period five months of mostly warmer than average temperatures with May being +3.7°F warmer than average for Medford. The warm May caught plant growth up to average conditions with a region-wide average bloom date on June 7th (Figure 1) with two rain events totaling 0.4" during the later portion of the bloom period. Across the west many locations saw 70-120 days or more without

any precipitation from mid-May through mid-September. The warmer mid-summer conditions produced a region-wide average véraison on August 12th. While the summer was warmer than normal, the overall signature was fewer extremes, especially heat events over 100°F where Medford only saw 11 days in 2018 when 15 or more is normally seen. In addition, there were no record maximum temperature events at the Medford station and Figure 1 shows that there were only two heat spikes during the 2018 growing season that neared 15°F above normal, occurring in late April and mid-July. The warmest periods in the summer occurred during mid to late June, mid to late July, and early August when daily temperatures were consistently between 90-100°F. The highest temperature of the summer was 105°F and was observed on multiple days in July at the Medford station. September 2018 started off relatively warm, then cooled off during the middle of the month (Figure 1) and slowed ripening. Ultimately September ended up slightly below average in terms of temperatures (-0.9°F at Medford) and remained lower than average in overall rainfall. Harvest in 2018 started similar to what was seen in 2017, but slightly later than the 2013-2016 vintages with the first picking reported in early September, but the bulk of the harvest came in from the last couple of days in September through mid-October in the region (median harvest date was October 1st). A relatively warm and largely dry early October allowed for a slow transition through to the end of harvest (Figure 1).

Overall the growing season daily temperature departures observed at the Medford weather station were cooler than the 2014-2017 vintages but 1.4°F warmer than the 1981-2010 climate normals. All four main wine growing regions in Oregon were warmer than normal, ranging from 1.4 to 2.3°F above average during April-October. The substantially drier conditions during the dormant period (5-15” below average), continued into the growing season which totaled 3.26” at the Medford station, 43% (2.4”) below average for the location (Figure 1).

From a growing degree-day (GDD) standpoint spring heat accumulation started off near average but much lower than the very warm springs in the last few years. However, by early May the spring ended up being above the accumulation during the 2015 spring which held until early June. From mid-June on heat accumulation tracked above the average during 2001-2017 but remained below that seen in 2015, the warmest vintage in the region. The relatively cool conditions in early to mid-September slowed heat accumulation, but it picked back up in the warmer than average October ending the growing season total for Medford of 3457 GDD (Figure 2).

Figure 3 shows the same degree-day data but, instead of cumulative as in Figure 2, it gives the daily accumulation relative to the 1981-2010 and 2001-2017 averages. As is common in most springs, 2018 saw wide swings in heat accumulation during April through June, with the warm May the most evident departure in Figure 3. Leading up to flowering there was a period of cool and highly variable conditions that resulted in near average heat accumulation. The rest of the growing season saw mostly average to greater than average daily accumulation, especially in mid-July through mid-August, until the significant drop off in the middle of September (Figure 3). GDD accumulation for 2018 ended up 3457 for the Medford weather station compared to 2436 at the Roseburg Agri-Met station and 2750 at the Medford Agri-Met station at SOREC. The 3457 GDD is lower than experienced in 2014 (3896), 2015 (3917), but substantially more than the 1981-2010 normals (2970) and slightly more than the 2001-2017 average (3359) (Figure 2). The year ended up being most similar to 2003 (3109 GDD), 2013 (3170), and 2017 (3131). Compared to other locations statewide, Medford ended up with the highest heat accumulation compared to state’s four main wine producing regions (McMinnville 2317, Roseburg 3164 and Milton-Freewater 3417).

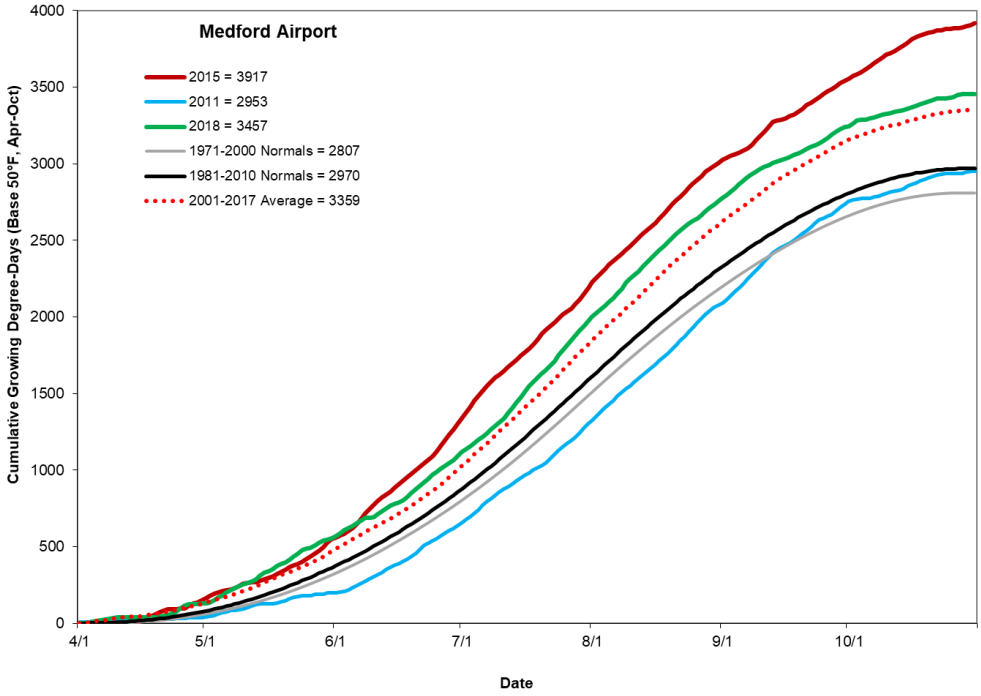

Figure 2 – Growing degree-day accumulation during April-October 2018 from the Medford Airport weather station (green line). The long-term averages shown are for the 1971-2000 climate normals (gray line), 1981-2010 climate normals (black line), the 2001-2017 period average (red dotted line), 2015 the previous warmest year since 1998 (red line), and 2011 the coolest year since 1998 (blue line). Data calculated from daily Tmax and Tmin observations for April 1st through October 31st using a base of 50°F with no upper cut-off.

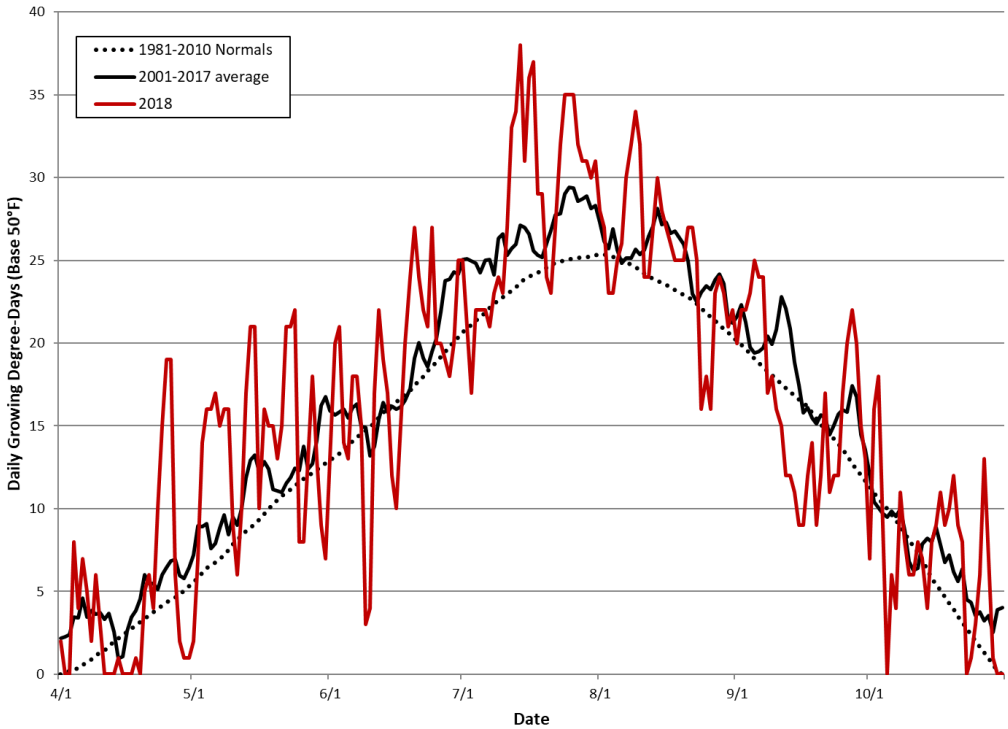

Figure 3 – Same data as in Figure 2 but shown as daily growing degree-day values during April-October 2018 from the Medford Airport weather station (base 50°F). The long-term averages are derived from the 1981-2010 climate normals and the average from the 2001-2017 period of record.

For the 2018 vintage, site temperature data from the six reference vineyards showed that the average GDD accumulation was 2765 with a standard deviation of 205 units (Table 1). Maximum accumulation was 3121 GDD (Bear Creek Valley site) while the minimum was 2586 GDD (Illinois Valley site). In terms of heat extremes there were 29 days on average with temperatures over 95°F across the region, ranging from a low of 17 days to a high of 40 days (Table 1). In addition, there were numerous days over 100°F for the region (5 to 23), with the hottest days of the year during a period of July 12-26 with Medford and most sites being over 100°F nearly every day. The highest reference vineyard average maximum of 104.9°F and absolute maximum of 107.1°F was observed on July 25th.

The 2018 growing season saw absolute minimum temperatures that were slightly cooler than average at the reference vineyards. The coldest nights during the growing season occurred during April 1-4 with temperatures dipping down to 22-30°F throughout the region followed by some moderately cold nights during April 17-23 (Table 2). During October 12-17 sites in the Illinois Valley, Applegate Valley, and Sam's Valley saw temperatures dip into the upper 20s, while the Bear Creek Valley sites remained in the upper 30s. The sites experienced from 4 to 26 days during April through October that dropped below 32°F in 2018 with the majority occurring during early April and mid to late October. The median last frost in the spring occurred April 19th across the region but, like most years, there was a wide range from the earliest being April 3rd to as late as April 23rd (Table 1). The median first fall frost was October 2nd across the reference vineyard sites with a very wide range from the earliest first frost on September 15th to as late as November 7th, the same as the Medford weather station. The resulting frost-free period median was 167 days in 2018, ranging 72 days across the sites from 146 days (Illinois Valley site) to 218 days (Bear Creek Valley site).

Comparisons with Previous Years

Compared to past dormant periods at the reference vineyards (starting in 2004-05), the 2017-18 winter was slightly warmer than average for the period (Table 2). While this past winter had a similar number of cold nights compared to average (76 vs 74), the region experienced moderately warmer than average absolute minimum temperatures with lower winter freeze impacts than in recent years. During the growing season, the 2018 vintage temperatures across the reference vineyards ended up 0.5°F above to 0.5°F cooler than those experienced during the entire period. Average maximum temperatures were slightly lower than average while average minimum temperatures were moderately cooler compared to the long-term average. In terms of heat accumulation, the 2018 growing season GDD at the reference vineyards was nearly 50 heat units cooler than 2017, moderately higher (4%) than the 2003-2017 average (2669), 450-600 heat units warmer than 2010 and 2011, nearly 300 heat units lower than 2015, the warmest vintage to date in the Rogue Valley and the majority of the western US (Table 2).

During the growing season, absolute maximum temperatures were moderately lower than average, and the sites experienced fewer days over 95°F during 2018. The absolute minimum temperatures observed at the reference vineyards during the growing season were below the period average, while the number of days below 32°F was one more than average. The last spring frost date was eight days earlier than the time period average, and substantially earlier than observed during the last two vintages. The first fall frost date was two weeks earlier than the time period average and over two months earlier than the 2016 vintage. The result was a shorter than average frost-free period of 167 days in 2018, but not as short as seen in 2017 (Table 2).

Table 1 – Rogue Valley reference vineyard dormant season (November 1-March 31, 2017-18) and growing season (April 1-October 31, 2018) climate characteristics. Note that the dormant season minimum temperature value is the average absolute low temperature experienced. Growing degree-days are calculated from April-October 2018 (base of 50°F with no upper cut-off).

Dormant Season (Nov 1 – Mar 31)	***Average***	***Standard Deviation***	***Maximum***	***Minimum***	***Range***
Average Temperature (°F)	41.4	0.6	42.4	40.8	1.6
Absolute Minimum Temperature (°F)	19.8	1.5	23.0	16.9	6.1
# of Days < 32°F	76	12	87	57	30
Growing Season (Apr 1 – Oct 31)	***Average***	***Standard Deviation***	***Maximum***	***Minimum***	***Range***
Growing Degree-Days	2765	205	3121	2586	546
Growing Season Average Temperature (°F)	62.6	1.0	64.4	61.8	2.6
Average Maximum Temperature (°F)	82.1	1.4	83.7	80.3	3.4
# of Days > 95°F	29	9	40	17	23
Average Minimum Temperature (°F)	44.8	3.5	50.1	40.7	9.4
# of Days < 32°F	12	10	26	1	25
Median Last Spring Frost (date or days)	4/19	9 days	4/23	4/3	20 days
Median First Fall Frost (date or days)	10/2	23 days	11/7	9/15	53 days
Median Frost-Free Period (days)	167	32 days	218	146	72

Table 2 – Reference vineyard climate comparisons across the dormant (November 1 – March 31) and growing seasons (April 1 – October 31) for each year of the project. *Note that for the 2012-2018 vintages the data come from fewer sites than the 2003-2010 period (see text for details).

Season/Variable	***Year***																
Dormant Season	***02-03***	***03-04***	***04-05***	***05-06***	***06-07***	***07-08***	***08-09***	***09-10***	***10-11***	***11-12***	***12-13***	***13-14***	***14-15***	***15-16***	***16-17***	***17-18***	***Average***
Average Temperature (°F)	NA	42.8	41.1	40.3	40.8	39.2	39.9	41.1	40.5	39.6	40.5	40.3	45.0	42.8	41.2	41.4	41.1
Absolute Minimum Temperature (°F)	NA	18.4	18.1	16.0	9.8	15.0	12.4	8.4	15.3	16.3	15.2	-7.2	15.0	11.3	4.3	16.9	12.3
# of Days < 32°F	NA	51	84	77	77	96	85	65	72	101	82	86	45	51	64	76	74
Growing Season	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***Average***
Growing Degree-Days	2903	2737	2463	2699	2510	2535	2680	2300	2223	2559	2638	3042	3049	2778	2819	2765	2669
Absolute Maximum Temperature (°F)	113.1	111.9	108.9	114.6	110.2	111.5	115.6	111.3	105.1	106.2	108.8	109.0	113.0	113.8	116.6	107.1	111.0
# of Days > 95°F	47	42	37	40	25	36	36	29	24	30	37	48	40	34	39	29	36
Absolute Minimum Temperature (°F)	20.9	30.1	26.4	23.3	21.6	19.7	21.6	21.5	23.3	30.0	25.9	25.6	27.6	29.3	21.4	22.3	24.4
# of Days < 32°F	10	5	10	17	10	22	16	13	15	5	17	3	7	1	14	12	11
Median Last Spring Frost (date)	5/1	4/2	4/19	5/8	4/27	5/5	4/30	5/6	5/6	5/10	5/1	4/28	4/9	4/26	5/3	4/19	4/27
Median First Fall Frost (date)	10/10	10/25	9/25	10/11	9/24	10/9	10/2	10/23	10/25	10/21	10/3	11/11	11/1	12/5	10/3	10/2	10/16
Median Frost-Free Period (days)	162	206	159	156	150	157	155	170	172	164	154	197	206	223	153	167	172

The maximum and minimum temperatures are the absolute values recorded for the entire region for that year and season. Frost dates and the frost-free period are the median observed over the entire region for that year.

Phenology:

Summarizing the phenological observations for the entire region and across all varieties shows a median bud break of April 21st (Table 3). During the spring of 2018 bud break was observed over a relatively long period of nearly a month across all varieties and sites, reported as early as April 6th and as late as May 3rd. The median date of flowering was June 7th with just over two weeks between the earliest (May 30th) and latest (June 16th) sites across the region and over all varieties. Véraison and the start of the ripening phase during 2018 occurred over a 14-day period during early to mid-August (median August 12th). The earliest véraison was observed on August 2nd while the latest was observed on August 26th. Harvest ranged over a 50-day period from September 6th to October 25th across varieties and sites with a median date of October 1st (Table 3).

Average intervals between phenological events (an important measure of vine and berry development timing) shows that bud break to flowering during 2018 had a median of 53 days; that flowering to véraison was 63 days on average; and that véraison to harvest was 51 days on average (Table 3). These intervals had 3 to 11-day standard deviations across sites and varieties, but a very wide range between the shortest and longest intervals due to site differences. For 2018, the length of the bud break to harvest period averaged 163 days with 74 days between the shortest and longest vineyard sites.

Table 3 –Phenological date and interval characteristics for the 2018 vintage averaged over sites and varieties. Note that for the 2010-2018 vintages the data come from fewer sites (see text for details).

Event/Interval	*Median*	*Standard Deviation*	*Latest or Longest*	*Earliest or Shortest*
Bud Break	April 21	8 days	May 3	April 6
Flowering	June 7	5 days	June 16	May 30
Véraison	August 12	4 days	August 16	August 2
Harvest	October 1	12 days	October 25	September 6
Bud Break to Flowering	53 days	10 days	68 days	33 days
Flowering to Véraison	63 days	3 days	70 days	60 days
Véraison to Harvest	51 days	11 days	79 days	40 days
Bud Break to Harvest	163 days	18 days	200 days	126 days

Comparisons with Previous Years

For the Rogue Valley the main phenological events for the 2018 vintage were later than average for bud break but earlier than average for later events when compared to the previous fifteen vintages (Table 4). The median bud break was four days later than average and later than every vintage since 2012. Bloom was five days earlier than the period average, over three weeks earlier than the cool 2011 vintage but five to eight days later than later than the warm 2015 and 2016 vintages. Median véraison dates during 2018 were four days earlier than average, varying by +/- 4 days over sites and varieties, and occurring over three weeks ahead of the cool 2011 vintage but seven days behind the warm 2015 and 2016 vintages. The median harvest date was four days earlier than average, over three weeks earlier than the cool 2010 and 2011 vintages but a few days to nearly two weeks later than the previous five vintages.

For the 2018 vintage, despite the cool March and April, a warm May accelerated growth and resulted in bud break and bloom of 53 days that was shorter than the period average (Table 4). The bloom to véraison period in 2018 was 3 days shorter than the period average (66 days), responding to the warm, dry summer period. The average length of time between véraison and harvest was 51 days, one day

Table 4 – Reference vineyard average phenology comparisons for the 2003 to 2018 vintages. *Note that the 2010-2018 vintage numbers come from fewer sites and varieties than the previous years (see text for details). Note that 'd' stands for days.

Stage Interval	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*Average*
Bud Break																	
Median	4/18	4/2	4/15	4/25	4/19	4/30	4/23	4/20	5/2	4/24	4/15	4/11	4/1	4/4	4/15	4/21	4/17
Std. Deviation	10 d	8 d	10 d	9 d	10 d	9 d	10 d	9 d	10 d	4 d	4 d	7 d	7 d	4 d	8 d	8 d	8 days
Flowering																	
Median	6/11	6/4	6/19	6/12	6/10	6/22	6/15	6/27	7/1	6/16	6/8	6/5	6/2	5/31	6/5	6/7	6/12
Std. Deviation	10 d	6 d	7 d	6 d	7 d	8 d	8 d	8 d	6 d	5 d	6 d	9 d	6 d	4 d	8 d	5 d	7 days
Véraison																	
Median	8/20	8/11	8/22	8/16	8/16	8/24	8/20	8/31	9/3	8/22	8/11	8/11	8/5	8/5	8/10	8/12	8/16
Std. Deviation	7 d	6 d	9 d	6 d	6 d	7 d	8 d	7 d	9 d	8 d	6 d	4 d	8 d	7 d	7 d	4 d	7 days
6Harvest																	
Median	10/7	10/1	10/19	10/9	10/9	10/14	10/7	10/26	10/26	10/7	9/26	9/24	9/16	9/21	9/29	10/1	10/5
Std. Deviation	12 d	10 d	10 d	12 d	12 d	9 d	13 d	12 d	6 d	12 d	14 d	13 d	13 d	10 d	10 d	12 d	11 days
Bud Break to Flowering																	
Median	52 d	64 d	65 d	48 d	52 d	51 d	52 d	66 d	57 d	53 d	55 d	56 d	61 d	57 d	52 d	53 d	56 days
Std. Deviation	10 d	7 d	10 d	9 d	10 d	7 d	8 d	9 d	11 d	6 d	6 d	10 d	10 d	4 d	6 d	10 d	8 days
Flowering to Véraison																	
Median	69 d	68 d	64 d	67 d	68 d	65 d	64 d	66 d	66 d	63 d	66 d	64 d	64 d	69 d	66 d	63 d	66 days
Std. Deviation	9 d	9 d	9 d	6 d	8 d	9 d	8 d	10 d	6 d	6 d	6 d	9 d	6 d	6 d	6 d	3 d	7 days
Véraison to Harvest																	
Median	48 d	50 d	59 d	52 d	54 d	52 d	47 d	57 d	50 d	43 d	50 d	45 d	45 d	44 d	53 d	51 d	50 days
Std. Deviation	8 d	10 d	11 d	11 d	11 d	9 d	12 d	14 d	9 d	10 d	14 d	14 d	13 d	11 d	12 d	11 d	11 days
Bud Break to Harvest																	
Median	172 d	186 d	189 d	168 d	174 d	166 d	163 d	188 d	175 d	168 d	165 d	165 d	165 d	172 d	167 d	163 d	172 days
Std. Deviation	15 d	12 d	14 d	14 d	14 d	11 d	16 d	15 d	9 d	13 d	14 d	14 d	16 d	10 d	15 d	18 d	14 days

longer than the period average. The average bud break to harvest interval of 163 days in 2018 was shorter than average by nine days, but roughly similar to the last six vintages. Even though the individual dates of phenological events vary quite a lot from year to year, the long-term data for these intervals between events continues to converge toward very consistent lengths for each growth interval for the region.

Composition:

For the 2018 vintage, grower-submitted harvest composition values reflect a near average season showing a median 24.3°Brix with a wide range from 21.5 to 27.2 °Brix across sites and varieties (Table 5). Harvest titratable acidity averaged 5.8 g/L with a minimum of 4.2 g/L to a maximum of 8.0 g/L while pH numbers averaged 3.41 with a range from 3.25 to 3.86 over all sites and varieties. Yields averaged 3.8 tons/acre across the sites and varieties, ranging 5.1 tons/acre from a low of 0.9 to a high of 6.0 tons/acre (Table 5). The low of 0.5 tons/acre was reported as due to lingering impacts from previous winter's freeze damage.

Table 5 –Harvest composition characteristics for the 2018 vintage averaged over sites and varieties.

Region	°Brix	TA (g/L)	pH	Yield (T/acre)
Median	24.3	5.8	3.41	3.8
Standard Deviation	1.3	0.9	0.15	1.1
Maximum	27.2	8.0	3.86	6.0
Minimum	21.5	4.2	3.25	0.9

Comparisons with Previous Vintages

The 2018 vintage harvest composition values from the sites give a general comparison with the 2003 through 2017 vintages (Table 6). Average °Brix values of 24.3 were slightly higher than the period average but similar to the 2012-2016 vintages. Average titratable acidity of 5.8 g/L was slightly lower than the period average (6.0 g/L) and roughly the same as the 2017 vintage. Median pH values in 2018 were very close to the long-term average and had normal site and variety variation. Yields reported from the sites show that the 2018 vintage was above the period average (+18%) and in the range of yields experienced during the 2013-2015 vintages. The range of 5.1 tons/acre across sites and varieties in 2018 was the same as the 2017 and substantially more than past vintages (Table 5).

Table 6 – Reference vineyard average harvest composition comparisons for the 2003 to 2018 vintages. *Note that the 2010-2018 vintage numbers come from fewer sites and varieties than the previous years.

Parameter	*Harvest Numbers*																
	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*Average*
°Brix	24.4	24.5	23.4	24.1	23.6	23.9	23.5	23.2	23.8	24.0	24.2	24.5	24.4	24.1	23.8	24.3	24.0
TA (g/L)	6.1	5.8	6.3	5.9	6.3	6.2	5.9	7.1	7.0	5.5	6.3	5.4	5.4	5.0	5.7	5.8	6.0
pH	3.42	3.49	3.39	3.50	3.37	3.43	3.55	3.47	3.42	3.56	3.45	3.49	3.50	3.49	3.44	3.41	3.46
Yield[1]	2.9	2.6	2.8	3.1	3.2	3.0	2.9	2.2	3.9	2.9	3.6	3.8	4.2	3.3	3.4	3.8	3.2

[1] Tons per acre

Conclusions:

The main signatures for the 2017-18 winter were relatively mild (near average temperatures with lower than average winter freeze risk) and a relatively dry winter that continued into a dry growing season. The 2018 vintage in the western US ended up as near the average of the last five vintages but with lower than average heat stress, continued drought, and fires raging in or near many wine regions with numerous days of smoke. Production is likely to be near average in California, up in Washington and

Idaho due to continued recovery from previous winter's damage, and slightly higher in Oregon due to a good fruit set, little to no disease pressure and a near perfect harvest period.

In Southern Oregon the vintage started mostly dry and cool with bud break occurring 4-8 days later than average in the Rogue Valley and Umpqua Valley. While not as warm as the 2014 through 2016 vintages, 2018 ended up very close to the temperatures and heat accumulation numbers experienced in the 2017 vintage. One of the most evident weather/climate issues that unfolded in the 2018 vintage was the overall dryness with most of Southern Oregon seeing 70-120 days without any rain, resulting in 40-60% less than average precipitation for the growing season. The second issue was the reduced number of heat extremes and a flip-flop in the expected regional differences. While many locations statewide broke records for the number of days over 90°F, heat spikes over 100°F were down region-wide. The regional flip-flop saw the Rogue Valley see lower maximum temperatures than the Umpqua Valley. This was likely due to the Rogue Valley seeing more frequent days and thicker amounts of mid to high level smoke than the Umpqua Valley. Other weather risks during the 2018 growing season were mixed with some late, but mild frost events into mid to late April, early October frosts in some locations in the Rogue Valley, overall little to no rain during bloom, and very little rain during the main period of harvest. During the ripening period leading up to harvest a cool down in September slowed things down but was followed by a relatively warm and dry early to mid-October that allowed for a slow but steady harvest.

The reference vineyard temperature observations in the Rogue Valley reflect the general conditions seen across Oregon and the region. The dormant period ended up with near average temperatures and days below 32°F but higher than average absolute minimums. The slightly cool and dry spring was followed a very warm late April and month of May that continued into a warmer than average June through August. This period saw a stretch of 70-120 days without measurable rain. The growing season ended up 1.4-2.3°F across Oregon winegrowing regions with GDD accumulation 5-17% higher than the 1981-2010 climate normal. Averaged over the reference vineyard sites GDD was 2765, which was lower than the 2014 and 2015 vintages, slightly lower than 2016 and 2017 but higher than the long-term average. Heat extremes observed at the reference vineyards during 2018 were below average with 5-23 days above 100°F across the sites and 29 days above 95°F averaged over the region. Phenological observations from the sites showed that bud break was four days later than average, while the rest of the events were roughly four to six days earlier than average. The intervals between growth stages remained generally consistent compared to other years, indicating consistent growth cycles between quite varied vintages. Basic composition values reflect the close to average vintage with °Brix levels slightly above average, acid levels slightly lower than average, pH values slightly below average, and moderately higher than average yields (+18%).

Comments on the season submitted by growers point to a relatively easy vintage. Most stated that the cool spring slowed early season growth but that the warm May accelerated things to a near average flowering period. The majority of growers noted that the flowering period was nearly ideal, and that fruit set was great, however a few noted some rain and variable set with some varieties at record high levels and others at record low levels. In terms of bird pressure, growers noted similar pressure to the 2017 harvest that picked up with later pick dates in 2018, but most reporting average to very low bird pressure or even no birds at all. Other pest pressure was also stated being variable with some mentioning that deer, turkeys and voles or ground squirrels were the most problematic, likely due to the dry conditions, while the majority said that yellow jackets continued the trend from past years of being especially aggressive and numerous. Comments concerning disease issues ranged widely from many

indicating a relatively low-pressure year for botrytis and powdery mildew, to some reports of not seeing any disease at all, to others mentioning increasing concerns for red blotch.

As noted in previous vintage reports, the warmer conditions during the past five vintages (2012-2018) throughout the western US has been linked to a moderate rebound in sea surface temperatures over both the North and Tropical Pacific Ocean. However, the winter of 2017 through much of 2018 was characterized by La Niña conditions (cooler tropical sea surface temperatures) which contributed significantly to the slightly cooler conditions and moderately to the drier conditions seen across the west. We also continue to see more variability in both ocean temperatures and the circulation of the atmosphere. Given this backdrop and the current conditions, what does the 2018-19 winter and the spring of 2019 hold for the western US and Southern Oregon?

Signs of El Niño development continue as we progress further into winter with east-central tropical Pacific SSTs warming to El Niño levels. Both surface and subsurface waters also continue to be markedly warmer than average, however, the atmospheric variables over the region have shown mainly ENSO-neutral patterns. Only lower-level wind anomalies averaged weakly westerly in the eastern Pacific provide a suggestion of El Niño conditions in the atmosphere. The official Climate Prediction Center (CPC) outlook calls for an 80% chance of El Niño prevailing during winter, and a 55-60% chance of continuing into spring 2019. As such the CPC has indicated that an El Niño watch is in effect. Other forecasts from statistical and dynamical models also collectively show ongoing El Niño-level SSTs, most likely weak to moderate in strength, continuing through spring. If these conditions for El Niño development continue to hold, the weather across the PNW and the northern tier of states is forecast to be warmer than average and near average to drier than average, while central to southern California across the southern tier of states is forecast to see near average temperatures and higher than average precipitation.

Forecasting conditions during the late winter and into spring of 2019 will depend on how the dynamic patterns of sea surface temperatures in the Pacific play out and how the Tropical to Arctic circulation of the atmosphere responds. Another area to watch is the North Pacific and the Gulf of Alaska as the ocean continues to warm to record levels with the upper 300 ft of the North Pacific Ocean north of 40°N now warmer (relative to normal) than at any time in the modern data record (1980-present). The current North Pacific sea surface temperatures (SSTs) have had a strong influence over our fall and start of winter conditions, but the spatial pattern is not quite what we saw with the 'Blob' in 2012-2016 as the bulk of the warmth is a little further to the west. Most observation networks believe that the warming North Pacific will likely interact with the warming Tropical Pacific (see above) to enhance the normal weather/climate patterns in the west during El Niño years. The evidence currently would point to a warmer than average spring, like what we experienced in 2014-2016. As ocean and atmospheric conditions unfold over the next 2-3 months, we will have a much better picture of what the spring of 2019 will bring to Oregon and the rest of the western US. Further updates will be provided as more information becomes available.

Future Work

- The observation network will continue with the reduced number of sites (six) and focus on site temperatures, phenology, and harvest composition and yields for the foreseeable future.
- An overview presentation will be given at the annual meeting of the Rogue Valley Winegrowers Association which will be held on January 26, 2019 (see RVWA email newsletter and web site announcements for further details).

- The results will also be used to provide a Southern Oregon component to the Oregon Wine Symposium's "Vintage Overview" session during February 12-13, 2019 in Portland at the Oregon Convention Center.
- A synthesis report with further in-depth analyses of the study will be compiled and made available as more data are gathered and processed.

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