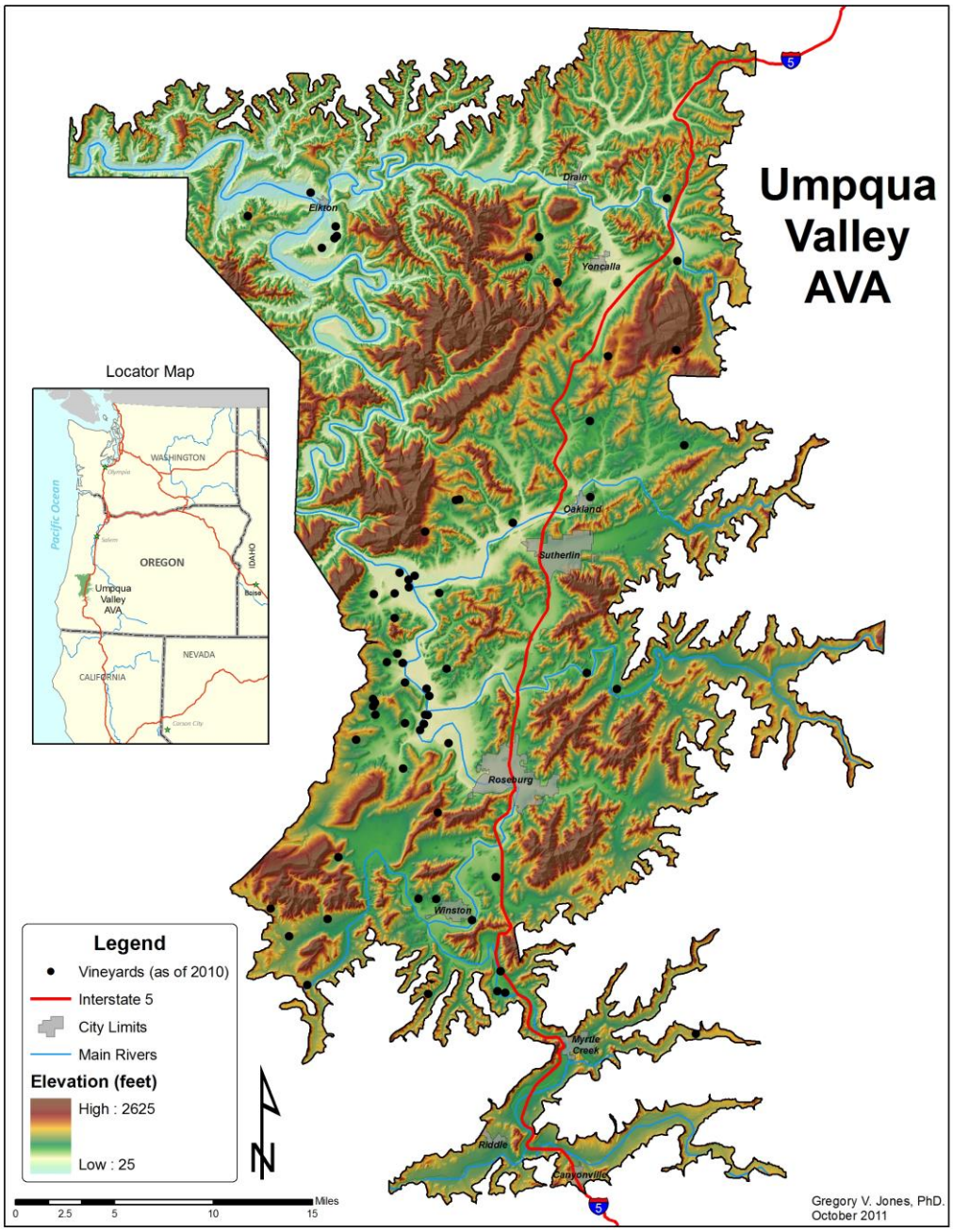
Vintage 2019
Umpqua Valley Reference Vineyard Report



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Summary:
A relatively mild early winter in 2018 was followed by a cold and wet second half of winter in 2019 that was punctuated by record snowfall in late February that downed trees across most of Douglas County producing power outages and landslides. The growing season started off with a relatively wet and overall warm spring but saw frosts during late April and early May. A warm-up from late May through June moderated through mid-vintage producing fewer than average heat spikes. Precipitation in late May brought increased disease pressure for many, while a hail event caused damage across the central portion of the county. As if earlier weather impacts weren't enough, early rains in September and a rapid cool down from September into October, challenged harvesting decisions. Degree-day totals for 2019 ended up similar to 2006, 2009, and 2013, marked by the lowest heat accumulation experienced in September and October since 2007. Phenological timing and interval lengths were similar to observations in 2018 averaging April 18th for bud break, June 12th for bloom, August 2nd for véraison, and September 29th for harvest. Basic composition values from the reference vineyards indicate that the 2019 vintage had slightly lower than average °Brix levels, average acid levels, slightly below average pH values, and slightly lower than average yields due to numerous grower-reported issues of frost, hail, shatter, and disease. The cool vintage came from substantially lower maximum temperatures while minimum temperatures were near average to slightly above average. This was largely the result of higher humidity levels, which also brought greater disease pressure both near bloom and during harvest.

Project Overview:
This work is a continuation of the 2004-2010 reference vineyard project which established a suite of reference vineyards in the Umpqua Valley AVA 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 2011 vintage, the project has been scaled back to cover only temperature, phenology, and harvest composition from eight sites (no fruit sampling as in prior years). At each of the eight 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 Roseburg NWS station and the Roseburg Agri-Met station. For phenological observations, the sites submit dates for the four main events of bud break, bloom, véraison, and harvest for a range 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 sites and are then summarized for the region.

Climate:

Dormant Season

During the winter of 2018-2019, Oregon and the PNW experienced a moderately cool winter with temperatures in the region 0.5 to 2.0°F below the 1981-2020 climate normal period[1]. The coldest area in the PNW was eastern Washington and eastern Oregon. The Roseburg weather station had a November 2018 through March of 2019 that was 0.6°F below normal. The first three months of the winter were quite mild with November through January averaging 0.9°F above average. The remainder of the winter was cooler than average with temperatures in February and March 4.8°F and 0.7°F below average, respectively. The first week of February through the second week in March saw the coldest temperatures of the winter with an absolute minimum of 27.0°F observed on few separate days in

[1] Note that all references to normal or averages in this report are to the 1981-2010 climate normal for each weather/climate parameter unless stated otherwise.

February at the Roseburg weather station. The dormant period was largely free of record temperature extremes with only one minimum temperature record of 28°F occurring on February 22nd, but four record low maximum temperatures of 36-44°F during February 10-28. February 2019 ended up the 3rd coldest on record for Roseburg.

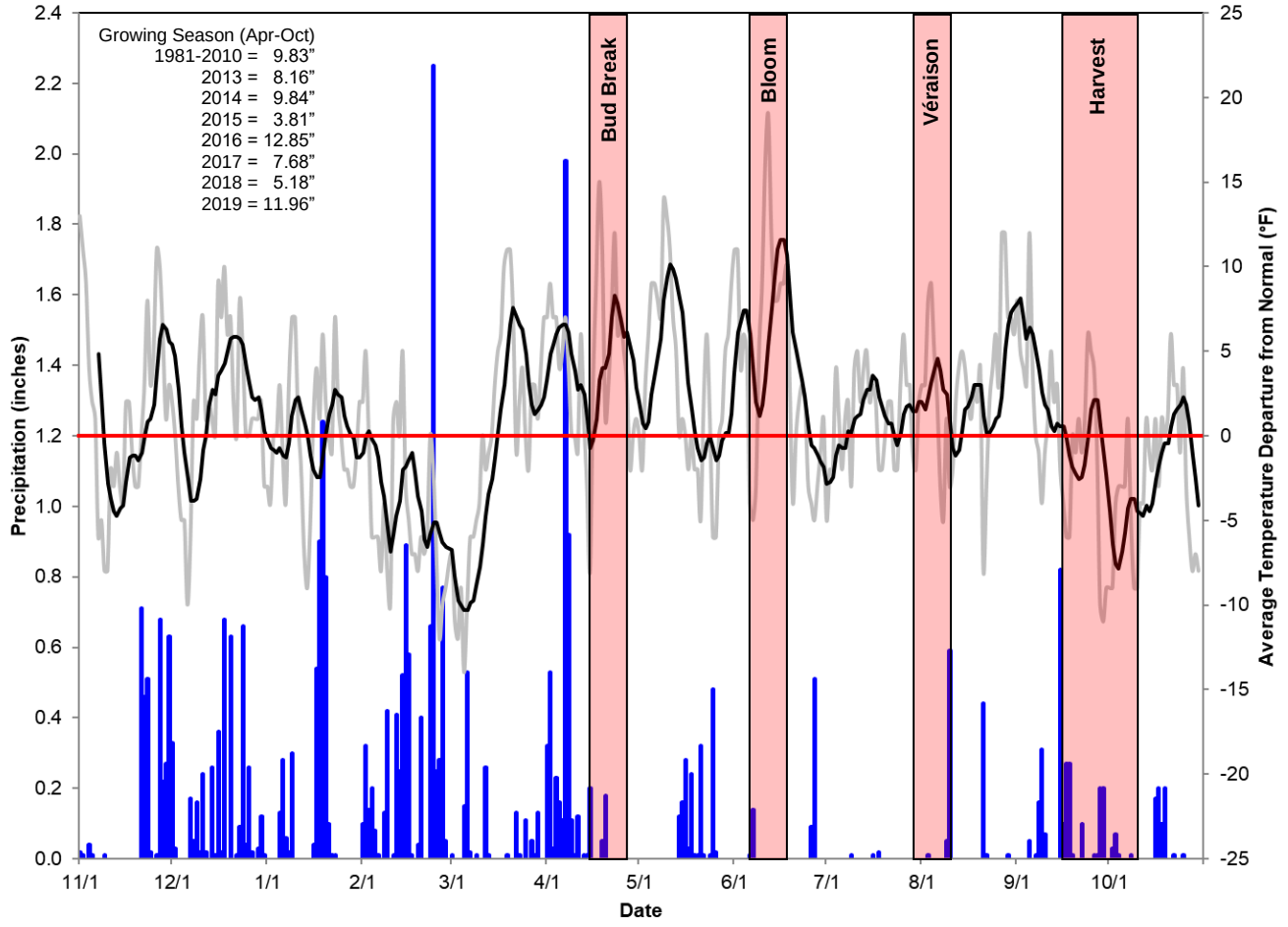

Figure 1 – Daily average temperature departures from normal and precipitation for November 1, 2018 to October 31, 2019 from the Roseburg weather station. The gray line is the day to day temperature departures from normal, the black line is the weekly average departures, and the blue bars are daily precipitation. 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 more details).

The eight reference vineyards in the region averaged 42.5°F during the winter of 2018-2019 (Table 1). Average minimum temperatures ranged from 34.7 to 37.2°F over the eight sites with an absolute minimum of 21.0°F observed on March 4th and lows down to the mid 20’s during early to late-February. On average, the sites observed a total of 40 days below freezing during the winter with a range from 22 days (Elkton site) to 46 days (southern AVA site).

Precipitation during the dormant period was largely below normal (50-80%) in much of the PNW, with the driest areas being northwestern Oregon, western Washington, and northern Washington and Idaho. However, portions of eastern Oregon, eastern Washington, and southern Idaho experienced 115-130% of normal winter precipitation. While precipitation is not observed at the reference vineyards, values from the main climate stations in the Southern Oregon region indicate that November through March was slightly below average to slightly above average. The Roseburg weather station experienced a winter with 21.56”, which was 2.31” below the 1981-2010 climate normals (10% below) with February

the only month with above normal precipitation (Figure 1). The greatest one-day precipitation amount at the Roseburg weather station occurred on February 24th with 2.25" (liquid equivalent, actually most fell as snow), which was a record for that date. This late February event was the fourth in series of cold, wet storms to hit the northern California to southern Oregon region producing several rounds of low elevation snow and extensive mountain snowpack from the Shasta Valley to the southern Willamette Valley. The most notable of these systems, however, was a persistent and colder than typical atmospheric river that arrived during the last week of the month. Over six inches of rain occurred along the southern Oregon coast with several feet of snow in the mountains and 8-16" of heavy, wet snow falling down to valley floors, resulting in thousands of downed trees with widespread power outages that lasted for days, even weeks for many. There were also numerous road closures due to landslides and downed trees across roadways from the heavy rain and snow, including coastal towns from the California border northward and throughout Douglas and Lane counties. These events resulted in February being the 5th wettest on record for Roseburg.

Table 1 – Umpqua Valley reference vineyard dormant season (November 1-March 31, 2018-19) and growing season (April 1-October 31, 2019) 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 2019 (base of 50°F with no upper cut-off).

Dormant Season (Nov 1 – Mar 31)	***Average***	***Standard Deviation***	***Maximum***	***Minimum***	***Range***
Average Temperature (°F)	42.5	0.6	43.8	41.7	2.1
Absolute Minimum Temperature (°F)	22.7	1.5	25.2	21.0	4.2
# of Days < 32°F	40	7.8	46	22	24
Growing Season (Apr 1 – Oct 31)	***Average***	***Standard Deviation***	***Maximum***	***Minimum***	***Range***
Growing Degree-Days	2526	263	2867	2021	846
Growing Season Average Temperature (°F)	61.5	1.3	63.3	59.2	4.1
Average Maximum Temperature (°F)	77.6	2.9	82.5	72.9	9.6
# of Days > 95°F	23	12	52	12	40
Average Minimum Temperature (°F)	48.6	1.1	49.8	46.8	3.0
# of Days < 32°F	4	2.4	7	1	6
Median Last Spring Frost (date or days)	Apr 8	26 days	May 2	Mar 11	52 days
Median First Fall Frost (date or days)	Oct 10	8 days	Oct 28	Oct 10	18
Median Frost-Free Period (days)	185	36 days	228	161	67 days

Growing Season

The 2019 growing season from April through October across the PNW was relatively cool compared to the last five years, ending up 0.3°F above the long-term average. Oregon was slightly warmer than the PNW average at 0.5°F above average with all four main wine growing regions in the state warmer than normal, ranging from 0.5 to 1.6°F above average during April-October. Overall the growing season average daily temperatures observed at the Roseburg weather station were cooler than the warm 2014-2017 vintages but ended up 1.6°F warmer than the 1981-2010 climate normals (Figure 1). The warmest day at the Roseburg station during the growing season was 103.1°F on August 27th with the location experiencing 16 days above 90°F and 4 days above 95°F, a significantly lower number than in 2018 (24 and 8 days, respectively) and compared to the long-term average. The growing season had four temperature extreme records set, 91°F on May 10th, 101°F on June 12th, 103°F on August 27th, and a minimum temperature record of 29°F on October 29th.

The big story for the 2019 growing season across the PNW was its ending, which was quite cool compared with recent years, with a rapid drop off in September (+0.2°F) and October, which was much colder than average (-2.5°F). The Roseburg weather station experienced a much warmer than average April, May, and June followed by a near average July, a warm August, then a 0.1°F below average September and a 3.0°F below average October.

The wet late dormant period (January through March), continued into the growing season for the Umpqua Valley with 11.96" at the Roseburg station, 22% (2.13") above average for the location in 2019 (Figure 1). Most of the rainfall came during the first three weeks of April, the middle of May, scattered events in early to mid-June and mid-August, and mid to late September (Figure 1). The station had three daily precipitation records during the 2019 growing season with 1.98" on April 7th, 0.92" on April 8th, and 0.59" on August 11th.

From a growing degree-day (GDD) standpoint spring heat accumulation in 2019 started off above average and continued so until the rain and cooler conditions in the third week in May (Figure 2). From early to late June heat accumulation tracked close to 2015, the warmest vintage so far in the region. From late June through mid-September heat accumulation tracked the average of the 1998-2018 vintages. From roughly the 25th of September through the rest of October heat accumulation stalled as seen in the flattening of the accumulation curve in Figure 2, resulting in the lowest September-October accumulation since 2007.

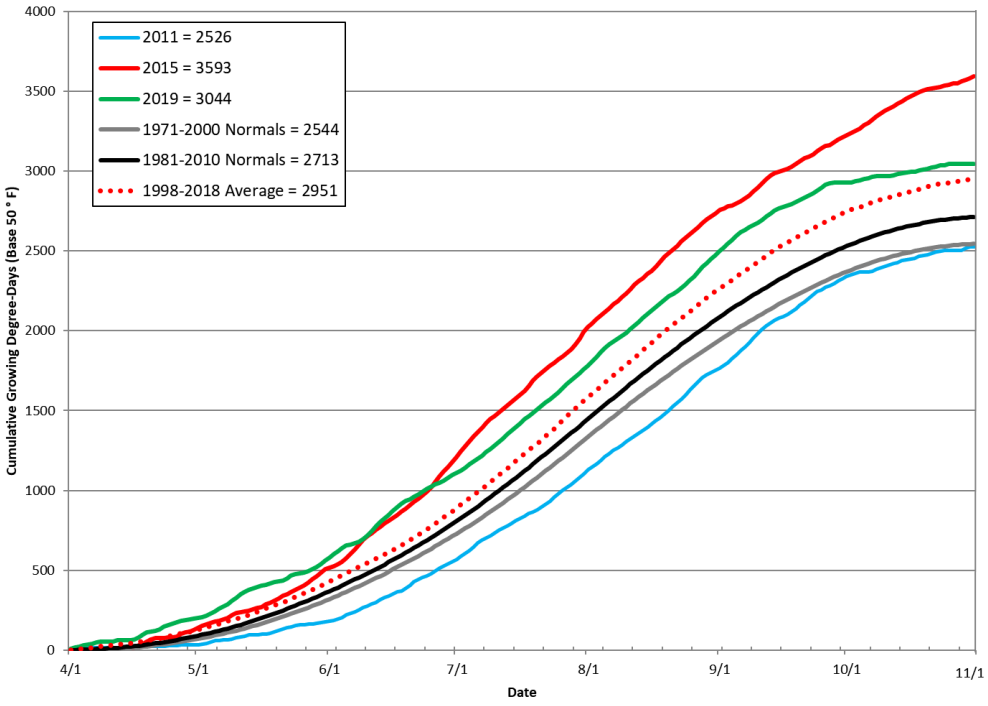

Figure 2 – Growing degree-day accumulation during April-October 2019 from the Roseburg weather station (green line). The long-term averages shown are for the 1971-2000 climate normals (gray line), 1981-2010 climate normals (black line), the 1998-2017 period average (red dotted line), 2015 the warmest 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 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 1998-2018 averages. As is common in most springs, 2019

saw wide swings in heat accumulation during April through June. Greater accumulation than average occurred during the warm mid-April through early May, followed by lower than average accumulation during the wet/cool period in late May, then wide swings between very warm and cool periods in June (Figure 3). The rest of the growing season saw mostly average daily accumulation, especially in mid-July, followed by some periods with high accumulation amounts in August, then the significant drop off in the middle to the end of September (Figure 3).

GDD accumulation for 2019 ended up 3044 for the Roseburg weather station compared to 2709 at the Roseburg Agri-Met station and 2734 at the Medford Agri-Met station at SOREC. The 3044 GDD is substantially lower than experienced in 2014 (3547) and 2015 (3593), but moderately higher than the 1981-2010 normals (2713) and slightly higher compared to the 1998-2018 average (2990) (Figure 2). The year ended up being most similar to 2006 (2933), 2009 (2985), and 2013 (3170). Compared to other locations statewide, Roseburg ended up with the third highest heat accumulation compared to state's four main wine producing region's weather stations (McMinnville 2280, Milton-Freewater 3197, and Medford 3269).

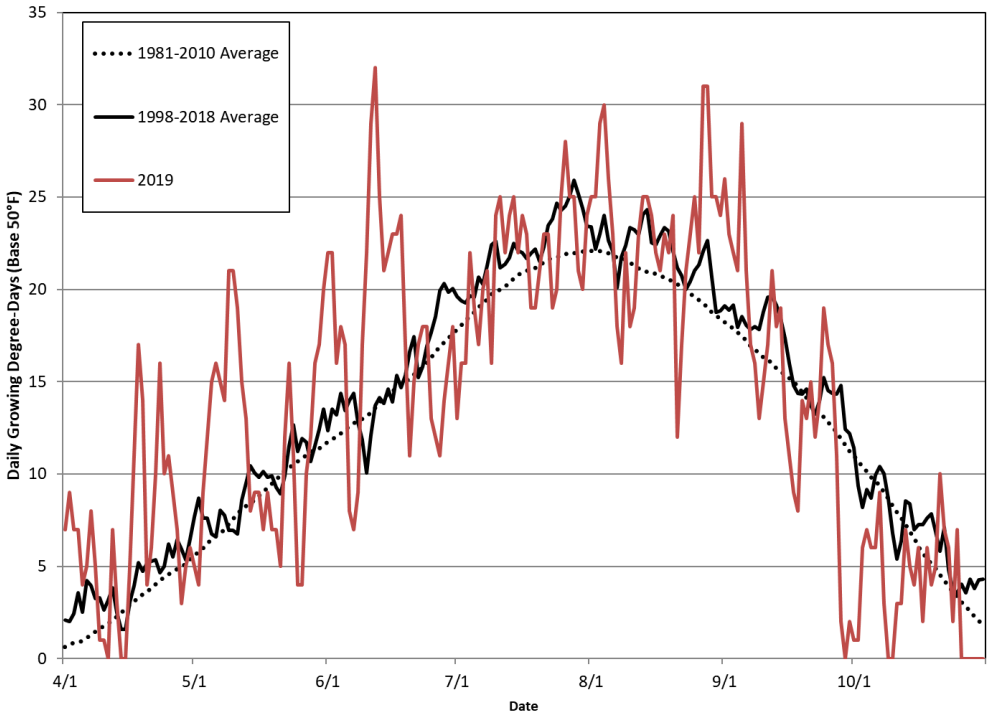

Figure 3 – Same data as in Figure 2 but shown as daily growing degree-day values during April-October 2019 from the Roseburg weather station (base 50°F). The long-term averages are derived from the 1981-2010 climate normals and the average from the 1998-2018 period of record.

For the 2019 vintage, site temperature data from the eight reference vineyards showed that the average GDD accumulation was 2526 with a standard deviation of 263 units (Table 1). Maximum accumulation was 2867 GDD (southern AVA site) while the minimum was 2021 GDD (Elkton area site). In terms of heat extremes there were 23 days on average with temperatures over 95°F across the region, ranging from a low of 12 days to a high of 52 days (Table 1). During 2019 there were 2 to 19 days over 100°F for the sites, with the hottest days of the year occurring during the second week of June, the first week of August, and the last week of August with Roseburg and most sites being over 96°F nearly every day. The

highest reference vineyard average maximum of 105.9°F and absolute maximum of 111.1°F was observed on August 27th.

The 2019 growing season saw absolute minimum temperatures that were moderately cooler than average at the reference vineyards. The coldest nights during the growing season occurred during April 28 through May 3 with temperatures dipping down to 28-35°F throughout the region. During the middle to the end of October sites saw temperatures dip into the low 30s. The sites experienced from 1 to 7 days during April through October that dropped below 32°F in 2019 with the majority occurring during mid to late April and late October. The median last frost in the spring occurred April 8th across the region but, like many years, there was a wide range from the earliest being March 11th (Elkton area site) to as late as May 2nd (southern AVA site) (Table 1). The median first fall frost was October 3rd across the reference vineyard sites with an 18 day range from the earliest first frost on October 10th to the latest on October 28th, the same as the Roseburg weather station. The resulting frost-free period median was 185 days in 2019, ranging 67 days across the sites from 161 days (southern AVA site) to 228 days (Elkton area site).

Comparisons with Previous Years

Compared to past dormant periods at the reference vineyards (starting in 2004-05), the 2018-19 winter was slightly cooler than average for the period (Table 2). While this past winter had a higher number of cold nights compared to average (40 vs 35), the region experienced moderately warmer than average absolute minimum temperatures. During the growing season, the 2019 vintage temperatures across the reference vineyards ended up near average to 0.2°F cooler than average over the entire period. Average maximum temperatures were significantly lower than average while average minimum temperatures were moderately warmer compared to the long-term average. In terms of heat accumulation, the 2019 growing season GDD average of 2526 at the reference vineyards was 129 heat units less than 2018, slightly more than the 2004-2018 average (2488), 400-500 heat units warmer than 2010 and 2011, and nearly 500 heat units lower than 2015, the warmest vintage to date in the Umpqua Valley and the majority of the western US (Table 2).

During the growing season, absolute maximum temperatures were slightly higher than average, and the sites experienced a similar number of days over 95°F during 2019. The absolute minimum temperatures observed at the reference vineyards during the growing season were slightly below the period average, while the number of days below 32°F were only one more than average. The last spring frost date was three days later than the time period average, and five days later than the 2018 vintage. The first fall frost date was three weeks earlier than the time period average, the earliest since the 2008 vintage. The result was a shorter than average frost-free period of 188 days in 2019, but not as short as seen in the 2008-2011 vintages (Table 2).

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.

Season/Variable	*Year or Period*																
Dormant Season (Nov 1 – Mar 31)	***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***	***18-19***	***Average***
Average Temperature (°F)	NA	43.7	42.3	42.7	40.9	42.2	43.6	43.9	41.9	43.4	42.9	47.1	45.3	43.3	43.4	42.5	43.3
Abs. Minimum Temperature (°F)	NA	23.3	16.0	15.9	16.4	14.1	8.8	18.5	22.0	20.6	5.6	17.3	17.5	25.3	19.2	21.0	17.4
# of Days < 32°F	NA	34	32	52	52	40	26	30	42	35	40	21	15	33	29	40	35
Growing Season (Apr 1 – Oct 31)	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***Average***
Growing Degree-Days	2636	2302	2458	2144	2243	2384	2039	2120	2380	2522	2971	3011	2760	2662	2655	2526	2488
Abs. Maximum Temperature (°F)	107.7	106.7	110.2	103.7	107.2	113.7	109.6	101.9	106.7	105.9	108.3	111.1	113.1	115.2	112.9	111.4	109.1
# of Days > 95°F	17	10	24	11	19	23	13	14	20	20	31	31	23	30	25	23	21
Abs. Minimum Temperature (°F)	33.9	30.1	23.3	28.5	24.2	28.1	27.6	27.3	29.4	29.2	30.8	30.8	33.2	28.6	24.7	23.7	28.3
# of Days < 32°F	0	2	4	2	7	5	2	6	2	2	0	1	0	3	3	4	3
Median Last Spring Frost	Apr-1*	Apr-13	Mar-27	Apr-2	Apr-20	Apr-16	Apr-24	Apr-25	Mar-31	Apr-14	Mar-27	Apr-9	Feb 23	Mar 22	Apr 3	Apr 8	Apr 5
Median First Fall Frost	Nov-5	Nov-4	Oct-26	Oct-27	Oct-11	Oct-12	Oct-19	Oct-26	Nov-9	Oct-29	Nov-30	Nov-24	Dec-7	Oct 31	Oct 18	Oct 10	Oct 31
Median Frost-Free Period	218	205	213	208	174	179	178	184	223	202	247	230	288	213	198	188	209

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. Note that the last spring frost in 2004 is from the Roseburg KQEN station observation, which correlates reasonably well with the reference vineyard sites in other years.

Phenology:

Summarizing the phenological observations over the reference vineyards and across all varieties shows a median bud break of April 18th (Table 3). During the spring of 2019 bud break was observed over a relatively long period of just under three weeks across all varieties and sites, reported as early as April 8th and as late as April 25th. The median date of flowering was June 12th with roughly a month between the earliest (June 1st) and latest (July 4th) sites across the region and over all varieties. Véraison and the start of the ripening phase during 2019 occurred over a 20-day period during late July to mid-August (median August 2nd). The earliest véraison was observed on July 24th while the latest was observed on August 12th. Harvest ranged over a 35-day period from September 6th to October 10th across varieties and sites with a median date of September 29th (Table 3).

Average intervals between phenological events (an important measure of vine and berry development timing) shows that bud break to flowering during 2019 had a median of 54 days; that flowering to véraison was 58 days on average; and that véraison to harvest was 58 days on average (Table 3). These intervals had 4 to 8-day standard deviations across sites and varieties, but a very wide range between the shortest and longest intervals due to site differences. For 2019, the length of the bud break to harvest period averaged 170 days with 24 days between the shortest and longest vineyard sites.

Table 3 –Phenological date and interval characteristics for the 2019 vintage averaged over sites and varieties.

Event/Interval	*Median*	*Standard Deviation*	*Latest or Longest*	*Earliest or Shortest*
Bud Break	April 18	4 days	April 25	April 8
Flowering	June 12	6 days	July 4	June 1
Véraison	August 2	8 days	August 12	July 24
Harvest	September 29	9 days	October 10	September 6
Bud Break to Flowering	54 days	4 days	62 days	49 days
Flowering to Véraison	58 days	8 days	66 days	42 days
Véraison to Harvest	58 days	8 days	69 days	48 days
Bud Break to Harvest	170 days	7 days	175 days	152 days

Comparisons with Previous Years

The main phenological events for the 2019 vintage were later than average for bud break but earlier than average for other events when compared to the previous fifteen vintages (Table 4). The median bud break was five days later than average but a couple of days earlier than the 2018 vintage. Bloom was two days earlier than the period average, over three weeks earlier than the cool 2011 vintage but over 10 days later than the warm 2015 and 2016 vintages. Median véraison dates during 2019 were thirteen days earlier than average, varying by +/- 8 days over sites and varieties, and occurring over a month ahead of the cool 2011 vintage but a few days behind the warm 2015 vintage. The median harvest date was six days earlier than average, over three weeks earlier than the cool 2010 and 2011 vintages, similar to the 2013 vintage, but later than the 2014-2016 vintages.

For the 2019 vintage, the period between bud break and bloom of 54 days was shorter than the period average by eight days (Table 4). The bloom to véraison period was five days shorter than the period

Table 4 – Reference vineyard average phenology comparisons for each year of the project. Note that the 2011-2019 vintage numbers come from fewer sites and varieties than the previous years (see text for details). Note that 'd' stands for days.

Stage or Interval	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*Average*
Bud Break																	
Median	4/1	4/2	4/22	4/9	4/22	4/21	4/16	5/1	4/22	4/11	4/4	3/27	3/30	4/18	4/20	4/18	4/13
Std. Deviation	7 d	11 d	4 d	7 d	8 d	5 d	7 d	7 d	4 d	7 d	7 d	8 d	6 d	7 d	5 d	4 d	7 days
Flowering																	
Median	6/5	6/13	6/14	6/9	6/23	6/16	7/2	7/3	6/21	6/9	6/10	6/1	6/1	6/17	6/15	6/12	6/14
Std. Deviation	5 d	7 d	5 d	7 d	6 d	6 d	6 d	5 d	5 d	4 d	6 d	7 d	5 d	5 d	4 d	6 d	6 days
Véraison																	
Median	8/13	8/14	8/14	8/12	8/19	8/19	8/30	9/9	8/26	8/12	8/9	7/31	8/6	8/14	8/15	8/2	8/15
Std. Deviation	7 d	10 d	9 d	9 d	9 d	7 d	11 d	8 d	7 d	6 d	7 d	9 d	7 d	9 d	9 d	8 d	8 days
Harvest																	
Median	10/5	10/10	10/8	10/7	10/15	10/8	10/19	10/26	10/3	9/27	9/22	9/23	9/18	10/6	10/4	9/29	10/5
Std. Deviation	9 d	12 d	9 d	10 d	9 d	8 d	6 d	6 d	8 d	9 d	11 d	13 d	11 d	9 d	12 d	9 d	9 days
Bud Break to Flowering																	
Median	65 d	76 d	54 d	61 d	64 d	56 d	75 d	63 d	59 d	57 d	65 d	63 d	64 d	62 d	56 d	54 d	62 days
Std. Deviation	7 d	14 d	6 d	8 d	6 d	7 d	6 d	7 d	4 d	5 d	8 d	9 d	6 d	5 d	3 d	4 d	7 days
Flowering to Véraison																	
Median	68 d	61 d	62 d	63 d	59 d	63 d	58 d	65 d	68 d	65 d	63 d	63 d	64 d	58 d	62 d	58 d	63 days
Std. Deviation	6 d	8 d	8 d	8 d	6 d	6 d	10 d	4 d	5 d	6 d	6 d	7 d	7 d	5 d	7 d	8 d	7 days
Véraison to Harvest																	
Median	55 d	51 d	51 d	56 d	55 d	51 d	46 d	49 d	41 d	44 d	44 d	48 d	45 d	51 d	48 d	58 d	50 days
Std. Deviation	11 d	15 d	10 d	11 d	10 d	9 d	10 d	8 d	7 d	8 d	11 d	9 d	12 d	10 d	12 d	8 d	10 days
Bud Break to Harvest																	
Median	185 d	194 d	168 d	175 d	174 d	171 d	185 d	177 d	164 d	166 d	173 d	172 d	170 d	170 d	169 d	170 d	174 days
Std. Deviation	13 d	13 d	8 d	13 d	11 d	9 d	8 d	9 d	7 d	11 d	10 d	14 d	13 d	10 d	13 d	7 d	11 days

average (63 days), responding to the warmth early in the season. The average length of time between véraison and harvest was 58 days, eight days longer than the period average. The average bud break to harvest interval of 170 days in 2019 was shorter than average by four 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 2019 vintage, grower-submitted harvest composition values reflect a slightly lower than average sugar accumulation showing a median 23.0 °Brix with a wide range from 21.0 to 24.7 °Brix across sites and varieties (Table 5). Harvest titratable acidity averaged 6.4 g/L in 2019 with a reported minimum of 5.1 g/L to a maximum of 8.8 g/L while pH numbers averaged 3.40 with a range from 3.20 to 3.60 over all sites and varieties. Yields averaged 2.6 tons/acre across the sites and varieties, ranging 1.5 tons/acre from a low of 1.6 to a high of 3.1 tons/acre (Table 5).

Table 5 –Harvest composition characteristics for the 2019 vintage averaged over sites and varieties.

Region	°Brix	TA (g/L)	pH	Yield (T/acre)
Median	23.0	6.4	3.40	2.6
Standard Deviation	0.8	1.2	0.11	0.6
Maximum	24.7	8.8	3.60	3.1
Minimum	21.0	5.1	3.20	1.6
Range	3.7	3.7	0..40	1.5

Comparisons with Previous Vintages

The 2019 vintage harvest composition values from the sites give a general comparison with the 2004 through 2018 vintages (Table 6). Average °Brix values of 23.0 were slightly lower than the period average but similar to many vintages over the last decade. Average titratable acidity of 6.4 g/L was right at the the period average (6.5 g/L) and similar to the 2017 and 2018 vintages. Median pH values in 2019 were slightly lower than the long-term average, similar to the last two vintages, and had lower than average site and variety variation. Yields reported from the sites show that the 2019 vintage was slightly above the period average (4%) but very consistent with the range in yields over the last five vintages. The range of 1.5 tons/acre across sites and varieties in 2019 was the same as the 2018 (Table 5).

Table 6 - Comparison of the overall harvest composition values (all varieties) for each year of the project. *Note that the 2011-2019 vintage numbers come from fewer sites and varieties than the previous years (see text for details).

Parameter	*Harvest Numbers*																
	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*Average*
°Brix	24.1	24.0	24.4	23.5	23.7	23.5	22.5	21.5	23.6	23.5	23.4	24.1	24.0	23.4	23.8	23.0	23.5
TA (g/L)	6.6	6.9	6.5	7.1	6.8	6.4	7.6	7.8	6.3	5.6	5.9	5.9	5.8	6.2	6.4	6.4	6.5
pH	3.50	3.38	3.46	3.33	3.42	3.41	3.31	3.40	3.50	3.56	3.50	3.51	3.50	3.40	3.41	3.40	3.44
Yield[1]	1.7	2.4	2.8	2.8	2.5	2.4	2.0	2.9	1.9	2.6	2.7	2.7	2.9	2.7	2.4	2.6	2.5

[1] Tons per acre

Grower Comments:

Comments on the season submitted by growers point to a challenging vintage, that started during the February cold and wet period with up to 18" of snow in 24 hours during February 24-25. Some indicated that there was heavy bud damage after the event due to reflected solar radiation from the snow softening buds too early. Most stated that the spring started off fine after the warm-up in April, but that late frost in April and early May impacted some regions and blocks depending on frost protection measures. Many mentioned the warm early May moved things rapidly to flowering but a wet and cool period in late May brought some mildew pressure, which was followed by some very warm days, which in combination likely affected fruit set to varying degrees. Comments about fruit set vary from very good to very poor, with some indicating more shatter than normal and others saying that lag phase cluster weights were down for some varieties and not others. The other weather impact during the growing season was a hail event on June 26th which was said to cause moderate to heavy damage to a few sites. The hail event was isolated to central Douglas County, but also produced a 0.50" of rain or more across the region. In terms of bird pressure, growers noted average to very low bird pressure for earlier picking times, and higher pressure with later harvesting. Other pest pressure was also stated being variable with most indicating low impacts and others mentioning late season mite issues. Many mentioned that the cold snap in February appeared to lower some insect populations, especially yellow jackets. Comments concerning disease issues ranged widely from many indicating a relatively low-pressure year, but others indicating moderate powdery mildew near flowering, and botrytis and sour rot increasing tremendously after the cool down and wet weather in late September.

Impacts and Influences:

A summary of weather-related impacts on the 2019 vintage include; 1) a mild winter followed by a hard cold snap in February with heavy snow and oscillating temperatures that potentially caused some bud damage and irregular bud growth in the spring, 2) frosts in late April and early May that likely caused some bud damage depending on the site, 3) a strong hail event in late June that hit many central county vineyards, 4) moderately cool conditions, higher humidity, and rain that brought greater powdery mildew pressure pre- and post-flowering, 5) a rapid cool down with significant precipitation in September that initiated botrytis infections and some sour rot, and 6) greater bird pressure than has been seen in recent years due to both locally cool temperatures driving bird numbers but also regional temperature patterns in western Canada driving migratory birds into Oregon toward the middle to end of the harvest period.

The cool growing season along with a wet and abrupt drop off in temperatures in September and October was unexpected in the backdrop of the extreme warmth of the last five years in the western US. Even more so with the planet on track to be the 2nd or 3rd warmest year on record! However, numerous issues contributed to the conditions seen in Oregon and the PNW during 2019. First, for much of the year, the majority of the Arctic and Subarctic (including Alaska) was much warmer than average, even with greater departures from average than many mid-latitude locations. The Arctic warmth has displaced cooler air into the mid-latitudes with the most prominent area globally being western and central North America. In addition, a very large high-pressure area developed in the southeastern US in the middle summer and became 'stuck' in place for over two months. The result for the southeastern US was extreme warmth, prolonged drought, and lower humidity levels (Atlanta was bearable in September!). At the same time, the normally dominant summer high-pressure area over the western US was smaller than usual and was shunted southwest. The result of the southeastern US blocking high and

the changes in strength and position of the Pacific high was sustained northwest to north flow over the PNW. This type of circulation typically starts in late October, not in early September. At the same time, the North Pacific was much warmer than average (+2 to 6°F), and the cooler airflow over the warmer ocean resulted in higher precipitation amounts in September than we have had in many years. So it was, a perfect storm per se.

Current Conditions:

The slow start to the wet season in the west has drought conditions remaining in place throughout much of California, Oregon, and the Four Corners region. The first real series of winter storms is currently upon us and will help with Oregon's current drought status. The longer-term seasonal drought outlook hints at the western valleys of the PNW seeing some improvement or complete drought removal over the next three months.

While there are numerous factors that drive our regional weather and climate, the two broader influences that are very prominent are North Pacific and Tropical Pacific sea surface temperatures.

The tropical Pacific continues to wax and wane between neutral and El Niño conditions. The latest reports indicate SSTs in the east-central Pacific were near thresholds of weak El Niño levels during October and early November. However, patterns in most atmospheric variables generally maintained neutral conditions. The oceanic warming is attributed to intra-seasonal variability, and the overall diagnosis indicates ENSO-neutral conditions will likely persist. Most model forecasts favor ENSO-neutral through winter and spring, with slightly higher chances for El Niño than La Niña. The official outlooks for numerous forecasting agencies are consistent with these model forecasts. When ENSO is in a neutral phase, tropical Pacific SSTs are usually close to average. However, ENSO-neutral conditions do not mean that regional weather conditions will necessarily be average, but that these types of winters tend to be the least predictable.

Overall the North Pacific and the Gulf of Alaska remain much warmer than average. However, the trend to cooler coastal waters along the west coast continues over the last couple of months due to greater coastal upwelling from more persistent offshore winds. The thought is that the current warmer than average North Pacific sea surface temperatures (SSTs) should influence both circulation and the amount of moisture in the atmosphere. The effect will likely bring a wetter than average western Canada but near average to lower than average winter precipitation the further south along the west coast. With the Tropical Pacific in a neutral phase, the North Pacific stands to have a greater impact on our winter precipitation pattern this year.

If the conditions in the tropics and north Pacific continue to hold, the weather across the western US will likely be cool to average in terms of temperatures and dry for the first part of winter and then average for precipitation and slightly warmer than average for the second part of winter. Of course, time will provide more insight as we cross the forecasting barriers for being able to have a better picture of what the spring of 2020 will bring to Oregon and the rest of the western US. Further updates will be provided in monthly Weather and Climate Summary and Forecasts and regional symposium presentations.

Future Work

- The observation network will continue for the foreseeable future focusing on site temperatures, phenology, and harvest composition and yields.

- An overview presentation will be given at a late winter/early spring meeting of the Umpqua Valley Winegrowers Association (watch for email 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 11-12, 2020 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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