National Park Service
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Natural Resource Stewardship and Science

Santa Monica Mountains National Recreation Area California Phenology Project Annual Report 2012-2015

Planning, Science and Resource Management

ON THIS PAGE
Photograph of post-fire recovery in *Adenostoma fasciculatum* (chamise) CPP individual #763 at Rancho Sierra Vista-Satwiwa California Phenology Project site CPP-SAMO-RSVS1. The May 2, 2013 Springs Fire burned over 22,000 acres at Rancho Sierra Vista – Satwiwa in the Santa Monica Mountains National Recreation Area. Left to Right: Pre-fire July 12, 2012, post-fire May 14, 2013, June 14, 2014 and August 3, 2015. Photographs courtesy of Crystal Anderson/National Park Service.

ON THE COVER
Photographs of six flowering California Phenology Project plant species found at Santa Monica Mountains National Recreation Area. Clockwise from left: *Adenostoma fasciculatum, Eriogonum fasciculatum, Quercus agrifolia, Quercus lobata, Sambucus nigra* and *Baccharis pilularis* Photographs courtesy of Tony Valois/National Park Service

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Planning, Science and Resource Management

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Christy Brigham, Division Chief of Planning, Science and Resource Management at Santa Monica Mountains National Recreation Area (SAMO), provided excellent leadership and was instrumental in keeping the project on track and moving forward. Tara Sagar, park botanist at SAMO was very helpful with volunteer support and all things plant-related. Special thanks go out to the Interpretation Division at SAMO, especially Barbara Applebaum, Supervisory Park Ranger and Lisa Okazaki, Education Specialist for the many hours spent developing and producing phenology-based programs and outreach efforts to local educators, students and the general public.

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Introduction

Phenology is the study of seasonal life cycle events such as leaf out and flowering in plants, insect emergence and arrival of migratory birds and other animals, especially in relation to climate. Phenology monitoring began in the Santa Monica Mountains National Recreation Area (SAMO) in late 2011 under the leadership of the California Phenology Project (CPP), a partnership between the National Park Service, the University of California Santa Barbara and the USA-National Phenology Network (USA-NPN). Funding for this pilot project was supplied in 2010 by the National Park Service Climate Change Response Program for a 3-year pilot period, after which, the program would continue indefinitely.

One intermediate goal within this project relative to SAMO was to obtain a viable baseline phenological data set where none previously existed. A second intermediate goal was to use phenology data collection as a vehicle to promote educational outreach activities that would engage and educate the public as well as promote stewardship in the next generation. The phenology coordinator from the Planning, Science and Resource Management division recruited and trained volunteers to assist in the collection of baseline data. In addition, several educational activities and workshops were hosted by the interpretive staff at SAMO, namely Lisa Okazaki, Education Specialist and Barbara Applebaum, Supervisory Park Ranger along with UCSB Professor Susan Mazer, Director of the California Phenology Project and her team.

This report is a summary of activities from January, 2012 through July, 2015. The current year 2015 was included to summarize the educational activities performed during the year. Climate and observational data for 2015 is not yet complete, therefore observation data for calendar year 2015 will be discussed on a limited basis and a complete discussion should be included in next year's annual report. A two-page resource brief was produced at the end of 2012 for the previous season's activities and in 2013, and an annual report was created for internal staff which provided more detailed information covering the 2012-2013 observing season activities.

There were some anomalous events that occurred over the three-year time period covered in this report that are worth mentioning. The May 2, 2013 Springs Fire burned more than 22,000 acres and destroyed approximately 50% of the CPP plants monitored at Rancho Sierra Vista. Dieback was reported in many individual evergreen plants on Sandstone Peak in 2014 and elsewhere throughout the region. Record rainfall in excess of 800% was recorded in July 2015. Detailed statistical analysis is beyond the scope of this report. Recent research by Dr. Susan Mazer, et. al. was published in the June 2015 issue of Ecosphere. The article provided detailed statistical analysis regarding associations between phenophase onset and preceding winter monthly conditions during the years 2011-2014, which included some of the species and individuals monitored at SAMO.

Methods

Phenological monitoring at SAMO follows the protocols established by the USA-NPN and CPP. Detailed descriptions of these protocols can be found in NRSS publication 2014/763 and publication *Phenological monitoring guide: Santa Monica Mountains National Recreation Area. A designated monitoring site of The California Phenology Project.* The USA-NPN and CPP website provides complete access to all tools necessary to facilitate a monitoring program and can be found at www.usanpn.org/cpp . The USA-NPN supplies data sheets, phenophase definitions and species profile forms. However, due to the large number of sites at SAMO, custom data sheets were created to accommodate the large number of plants being monitored. Collected data is housed in the National Phenology Database (NPDb) at USA-NPN headquarters in Tucson, Arizona and a back-up database of SAMO-specific data is housed at SAMO Park Headquarters on their network. Park neighbors and partners were also encouraged to participate in the

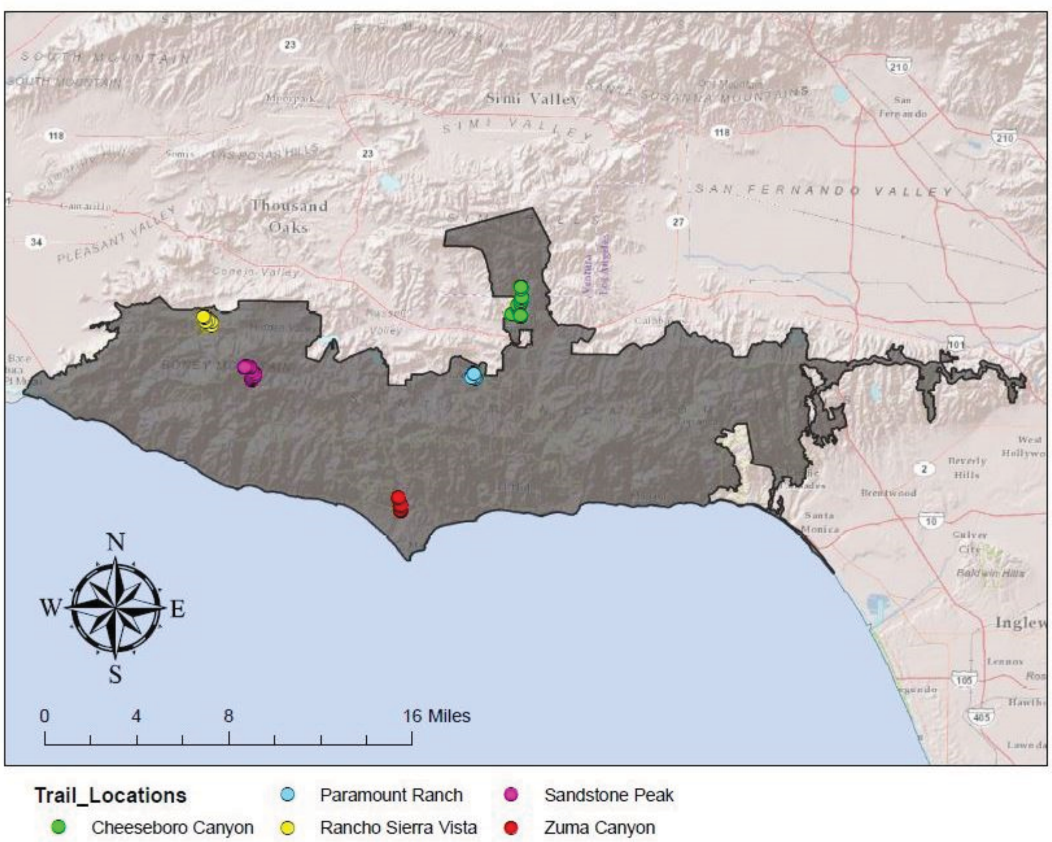
California Phenology Project. National Park Service staff visited neighbor and partner agencies to provide guidance, knowledge and training in helping neighboring agencies establish their own phenological monitoring sites within the Santa Monica Mountains.

Phenology trails, site locations and monitoring methods.

Five phenology trails were established at SAMO (see map, Fig. 1). Each trail contains from 6-10 CPP monitoring sites for a total of 40 CPP sites park-wide with up to 7 individual CPP plants per site. These sites are visited weekly by trained National Park Service volunteers and interns. Periodically the phenology coordinator for SAMO visits each site for calibration and site maintenance purposes. Six species of plants are monitored at SAMO*: Adenostoma fasciculatum Baccharis pilularis, Eriogonum fasciculatum Quercus agrifolia, Quercus lobata,* and *Sambucus nigra*. There are a total of 200 individuals monitored at SAMO for this project.

The westernmost phenology trail is located at Rancho Sierra Vista – Satwiwa. It consists of mostly non-native annual grassland with 34 CPP study plants located along its trails. It should be noted that 19 study plants were burned during the 2013 Springs Fire, but kept in the study to monitor fire effects. Sandstone Peak Trail, winds along the north east side of Sandstone Peak, the highest point in the Santa Monica Mountains. It contains 56 CPP study plants scattered among the chaparral. Cheeseboro Canyon Trail is the furthest inland of the five phenology trails and contains 35 CPP study plants. It is comprised of oak woodland and savannah. Paramount Ranch, located slightly west of Cheeseboro Canyon, contains 56 CPP study plants with oak woodland and a riparian area. Zuma Canyon Trail on the immediate coast contains 18 CPP study plants along a riparian corridor, with some areas of coastal sage and live oak woodland.

Figure 1. Phenology Monitoring Locations in the Santa Monica Mountains National Recreation Area.



Data Summaries

The step by step methods for summarizing data in CPP Protocol's SOP 10: Data Summary, Analysis and Reporting were followed. Recently, the data download methods were streamlined with the new USA-NPN data download tool that provides summarized and raw data in CSV format.

Data was downloaded directly from the USA-NPN website using the data download tool. Both summarized and raw data were downloaded for the years 2012-2015. Phenological data for 2015 complete through July 2015 with the exception of data for Sandstone Peak. Sandstone Peak data is complete through February 2015, but only contains bi-weekly data thereafter. Additionally, an unseasonable rainstorm in 2015 in July produced precipitation over 800% of normal in California for the http://www.wrcc.dri.edu/anom/cal_anom.html . SAMO received up to 1.44 inches of precipitation in some areas, compared to its normal July amount of zero to .02 inches. Following the storm, some plants at SAMO were observed in the field to be undergoing a second cycle of leaf out and flowering.

Cheeseboro Canyon was the only phenology trail with an on-site weather station. Climate summaries were calculated based on monthly weather data from Remote Automatic Weather Stations (RAWS) in three locations geocentric to the Santa Monica Mountains: Cheeseboro Canyon station at elevation 1,650 feet (NWS ID: 045313, NESS ID: FA5054C, Malibu Canyon at elevation 640 feet (NWS ID: 045452; NESS ID: CA29660E) near Paramount Ranch, and Leo Carrillo Beach at elevation 50 feet (NWS ID: 045447; NESS ID: CA424178) representing coastal conditions. The summary of reported data for the mean monthly temperature and mean monthly precipitation covers the period since inception of each station through December 2010. The RAWS program was implemented in 1985, and many stations did not come online until the mid-1990s. Malibu Canyon has only recently come online. Therefore, we also included a proxy station to represent the Santa Monica Mountains in general. While no one station can represent the many microclimates found in the Santa Monica Mountains, this geographically close National Weather Service Cooperative Observer Program (COOP) station located at the University of California, Los Angeles (UCLA), is nestled in the foothills of the range (NCDC COOP Station Number: 049152, UCLA). Additionally, the proxy station will serve to provide a standardized 30-year normal covering the decadal interval 1971-2000. The detailed data for which can be found at http://www.wrcc.dri.edu/summary/Climsmsca.html .

Results

Annual Climate Summary

Annual means for the four weather stations are shown in Tables 1 and 2. A direct comparison between the COOP station proxy site and the RAWS stations should be made with caution due to the difference in interval periods. For each station, detail is provided in Table 3 through Table 10, showing the departure from the station normal relative to that station. The annual mean for Cheeseboro was warmer and drier than the proxy site. Both Leo Carrillo and Malibu Canyon were cooler and drier than the proxy site. The precipitation anomaly July 15 of this year resulted in some plants exhibiting patterns of second growth including new leaves, flowering and fruit production.

Southern California climate is characterized by hot dry summers and cool mild winters. Although the above normal rainfall in July reduced the intensity of the continuing drought in the short term, the long term drought index remains high according to the Palmer Drought Index, an index that integrates the components of both water supply and demand. When demand for moisture is higher than what is available, the result is drought. In addition, both the Standardized Precipitation Index (SPI), and Standardized Precipitation Evapotranspiration Index (SPEI), show that abnormally warm and dry conditions are persisting across California. Evapotranspiration increases as temperature increases

(NOAA.gov). The SPEI rankings for the last 3 years for California are the most severe in the record for the period 1895-2015; and the SPI for the last 4 years have been the driest on record.

The 2014 annual summary from the National Centers for Environmental Information (NCEI) indicates that in the West and California, the year 2014 was the warmest year in the 120-year record. The effects of the drought on plants were intensified by the warmer temperatures which caused higher than normal rates of evapotranspiration. In 2014, the third driest January in 120 years was also recorded in the West. The NCEI 2013 annual report showed California to have the third driest October to December and the fourth driest January to March. Overall, 2013 was the driest calendar year on record ever experienced in California in the 120 year record. Figure 2 shows an example of the drought effects seen throughout the Santa Monica Mountains in 2013.

Figure 2. Coast live oak (*Quercus agrifolia*), displays evidence of dieback, October 2013. CPP individual 187 is located at Paramount Ranch CPP site 7.

The following tables demonstrate the mean monthly temperature and precipitation normals for four weather stations located within the Santa Monica Mountains National Recreation Area. The station "normal" represents conditions present at the 40 individual monitoring sites along five trails located within the National Recreation Area boundary. Station data since inception were used in place of the 30-year normal if no 30-year normal data existed for that station.

Table 1. Monthly temperature by station for Santa Monica Mountains National Recreation Area. RAWS station mean temperature since inception used in place of 30 year decadal period 1971-2000.

Monthly Mean Temperature in Degrees F by Station*				
Month	1971-2000 UCLA COOP 30-year Normal	1995-2010 Cheeseboro Canyon RAWS Station Mean	1999-2010 Leo Carrillo RAWS Station Mean	2006-2010 Malibu Canyon RAWS Station Mean
Jan	57.90	55.50	58.89	51.45
Feb	58.40	53.82	57.14	51.11
Mar	58.70	56.90	58.16	53.50
Apr	61.30	58.75	58.69	55.82
May	62.90	64.26	61.19	60.71
Jun	66.30	68.41	63.45	64.97
Jul	69.50	75.35	66.27	69.64
Aug	70.70	76.57	66.54	69.13
Sep	70.20	72.95	66.53	67.64
Oct	67.10	66.85	64.76	61.89
Nov	62.30	61.30	61.67	55.74
Dec	58.60	55.35	57.62	49.11
Annual	**63.70**	**63.84**	**61.64**	**59.23**

Table 2. Monthly precipitation by station for Santa Monica Mountains National Recreation Area. RAWS station mean temperature since inception used in place of most recent standard 30 year normal interval (decadal period 1981-2010).

Monthly Mean Precipitation in Inches by Station				
Month	1971-2000 UCLA COOP 30-year Normal	1995-2010 Cheeseboro Canyon RAWS Station Mean	1999-2010 Leo Carrillo RAWS Station Mean	2006-2010 Malibu Canyon RAWS Station Mean
Jan	4.09	2.89	2.74	2.70
Feb	4.93	4.12	3.31	7.02
Mar	3.54	1.42	1.57	1.11
Apr	0.86	0.83	0.85	1.42
May	0.34	0.43	0.26	0.43
Jun	0.11	0.03	0.01	0.03
Jul	0.02	0.02	0.00	0.00
Aug	0.16	0.00	0.00	0.00
Sep	0.32	0.03	1.01	0.23
Oct	0.57	0.76	0.79	1.02
Nov	1.35	1.02	0.69	0.52
Dec	2.39	2.44	2.06	4.70
Annual	**18.68**	**14.00**	**13.30**	**17.69**

Monthly departures from the normal are shown in the following tables. The years 2012-2015 are generally warmer and drier than the 30-year normal. Note that the normal July precipitation ranges from zero inches to .02 inches and in July 2015, the state of Calfornia received higher than normal precipitation with a state average of 891% http://www.calclim.dri.edu/. Precipitation amounts of .23 inches were recorded at UCLA, and at Cheeseboro Canyon 1.44 inches of precipitation was received.

Table 3. Monthly Temperature Departures from 30-year normal for UCLA - COOP weather station.

Mean Temperature (T_{avg}) Station 049152 in Degrees F						Departures from 30 Year Norm			
	1971-2000	2012	2013	2014	2015	2012	2013	2014	2015
Jan	57.9	64.27	58.42	64.76	63.53	6.37	0.52	6.86	5.63
Feb	58.4	59.31	57.84	60.59	63.62	0.91	-0.56	2.19	5.22
Mar	58.7	57.76	59.89	62.71	67.35	-0.94	1.19	4.01	8.65
Apr	61.3	60.47	61.75	63.52	63.88	-0.83	0.45	2.22	2.58
May	62.9	62.29	65.98	68.82	61.73	-0.61	3.08	5.92	-1.17
Jun	66.3	64.02	66.78	66.83	67.88	-2.28	0.48	0.53	1.58
Jul	69.5	66.4	68.84	71.97	70.82	-3.1	-0.66	2.47	1.32
Aug	70.7	73.1	69.1	71.92	71.75	2.4	-1.6	1.22	1.05
Sep	70.2	73.75	71.18	74.47	--	3.55	0.98	4.27	--
Oct	67.1	69.77	65.85	71.15	--	2.67	-1.25	4.05	--
Nov	62.3	63.02	65.47	67.42	--	0.72	3.17	5.12	--
Dec	58.6	56.68	61.79	60.23	--	-1.92	3.19	1.63	--
Annual	63.7	64.24	64.41	67.03	--	0.54	0.71	3.33	--

Table 4. Monthly Precipitation Departures from 30-year normal for UCLA - COOP weather station.

Mean Precipitation (P_{avg}) Station 049152 in Inches						Departures from 30 Year Norm			
Month	1971-2000	2012	2013	2014	2015	2012	2013	2014	2015
Jan	4.09	1.53	1.46	0.04	1.44	-2.56	-2.63	-4.05	-2.65
Feb	4.93	0.24	0.17	3.74	0.61	-4.69	-4.76	-1.19	-4.32
Mar	3.54	2.27	0.96	0.95	1.13	-1.27	-2.58	-2.59	-2.41
Apr	0.86	1.82	0	0.22	0.35	0.96	-0.86	-0.64	-0.51
May	0.34	0.01	0.48	0	0.79	-0.33	0.14	-0.34	0.45
Jun	0.11	0	0	0	0.04	-0.11	-0.11	-0.11	-0.07
Jul	0.02	0.03	0.04	0	0.23	0.01	0.02	-0.02	0.21
Aug	0.16	0	0	0.02	--	-0.16	-0.16	-0.14	--
Sep	0.32	0	0	0	--	-0.32	-0.32	-0.32	--
Oct	0.57	0.07	0.12	0	--	-0.5	-0.45	-0.57	--
Nov	1.35	1.77	0.7	0.5	--	0.42	-0.65	-0.85	--
Dec	2.39	2.69	0.24	4.33	--	0.3	-2.15	1.94	--
Annual	18.68	10.43	4.17	9.8	--	-8.25	-14.51	-8.88	--

Table 5. Monthly Temperature Departures from the Station Normal for Cheeseboro Canyon RAWS weather station

Mean Temperature (T_{avg}) Station 045313 in Degrees F						**Departures from Station Norm**			
Month	1995-2010 Mean	2012	2013	2014	2015	2012	2013	2014	2015
Jan	55.34	60.18	54.24	64.22	60.23	4.84	-1.10	8.88	4.89
Feb	53.96	55.62	54.58	58.70	61.50	1.66	0.62	4.74	7.54
Mar	56.94	54.59	60.83	60.33	66.26	-2.35	3.89	3.39	9.32
Apr	58.72	60.56	61.32	62.89	62.91	1.84	2.60	4.17	4.19
May	64.48	66.36	67.19	68.57	60.14	1.88	2.71	4.09	-4.34
Jun	68.68	67.95	70.20	69.35	72.81	-0.73	1.52	0.67	4.13
Jul	75.53	73.34	74.56	75.20	71.24	-2.19	-0.97	-0.33	-4.29
Aug	76.64	80.69	75.43	75.23	--	4.05	-1.21	-1.41	--
Sep	73.39	79.21	75.04	76.76	--	5.82	1.65	3.37	--
Oct	66.63	69.31	65.26	71.61	--	2.68	-1.37	4.98	--
Nov	61.24	61.48	62.10	64.42	--	0.24	0.86	3.18	--
Dec	55.23	52.23	58.11	55.76	--	-3.00	2.88	0.53	--
Annual	63.90	65.13	64.91	66.92	--	1.23	1.01	3.02	--

Table 6. Monthly Precipitation Departures from the Station Normal for Cheeseboro Canyon RAWS weather station.

Mean Precipitation (P_{avg}) Station 045313 in Inches						**Departures from Station Norm**			
Month	1995-2010 Mean	2012	2013	2014	2015	2012	2013	2014	2015
January	2.89	0.89	1.18	0.01	1.64	-2.00	-1.71	-2.88	-1.25
February	4.12	0.07	0.27	3.74	0.36	-4.05	-3.85	-0.38	-3.76
March	1.42	2.5	0.65	1.28	1.12	1.08	-0.77	-0.14	-0.30
April	0.83	2.62	0	0.15	0.07	1.79	-0.83	-0.68	-0.76
May	0.43	0	0.24	0	0.34	-0.43	-0.19	-0.43	-0.09
June	0.03	0	0	0	0.04	-0.03	-0.03	-0.03	0.01
July	0.02	0	0.5	0	1.44	-0.02	0.48	-0.02	1.42
August	0.00	0.01	0	0.03	--	0.01	0.00	0.03	--
September	0.03	0.01	0	0	--	-0.02	-0.03	-0.03	--
October	0.76	0.13	0.03	0.22	--	-0.63	-0.73	-0.54	--
November	1.02	1.2	0.44	0.86	--	0.18	-0.58	-0.16	--
December	2.44	1.57	0.22	3.95	--	-0.87	-2.22	1.51	--
Annual	14.00	9.00	3.53	10.24	--	-5.00	-10.47	-3.76	--

Table 7. Monthly Temperature Departures from the Station Normal for Leo Carrillo State Beach RAWS weather station.

Mean Temperature (T_{avg}) Station 045447 in Degrees F						Departures from Station Norm			
Month	1999 -2010	2012	2013	2014	2015	2012	2013	2014	2015
Jan	58.37	59.69	57.62	62.57	61.79	0.80	-1.27	3.68	2.90
Feb	57.02	57.17	56.35	58.22	61.35	0.03	-0.79	1.08	4.21
Mar	57.82	55.98	57.14	61.15	65.01	-2.18	-1.02	2.99	6.85
Apr	58.24	58.14	59.58	61.30	61.34	-0.55	0.89	2.61	2.65
May	60.95	60.66	63.65	66.39	59.44	-0.53	2.46	5.20	-1.75
Jun	63.61	62.65	64.64	64.40	63.83	-0.80	1.19	0.95	0.38
Jul	66.38	63.76	65.23	69.27	67.93	-2.51	-1.04	3.00	1.66
Aug	66.52	68.31	65.58	68.72	69.05	1.77	-0.96	2.18	2.51
Sep	66.31	68.70	67.69	70.62	--	2.17	1.16	4.09	--
Oct	64.09	67.45	64.90	68.40	--	2.69	0.14	3.64	--
Nov	61.48	61.27	63.42	66.25	--	-0.40	1.75	4.58	--
Dec	57.13	55.85	60.56	59.83	--	-1.77	2.94	2.21	--
Annual	61.49	61.64	62.20	64.76	--	-0.01	0.56	3.12	--

Table 8. Monthly Precipitation Departures from the Station Normal for Leo Carrillo State Beach RAWS weather station.

Mean Precipitation (P_{avg}) Station 045447 in Degrees F						Departures from Station Norm			
Month	1999 - 2010	2012	2013	2014	2015	2012	2013	2014	2015
Jan	2.74	1.25	0.76	0.00	2.03	-0.92	-1.41	-2.17	-0.14
Feb	3.31	0.03	0.21	0.00	0.38	-2.39	-2.21	-2.42	-2.04
Mar	1.57	1.97	0.64	6.16	0.80	0.16	-1.17	4.35	-1.01
Apr	0.85	1.37	0.03	0.20	0.15	0.67	-0.67	-0.50	-0.55
May	0.26	0.00	0.17	0.00	1.16	-0.28	-0.11	-0.28	0.89
Jun	0.01	0.00	0.00	0.00	0.06	-0.02	-0.02	-0.02	0.05
Jul	0.00	0.00	0.00	0.00	0.71	-0.04	-0.04	-0.04	0.67
Aug	0.00	0.02	0.00	0.03	0.00	0.02	0.00	0.03	--
Sep	1.01	0.00	0.00	0.00	--	-0.70	-0.70	-0.70	--
Oct	0.79	0.03	0.00	0.31	--	-0.58	-0.61	-0.30	--
Nov	0.69	1.21	0.00	0.53	--	0.47	-0.74	-0.21	--
Dec	2.06	2.25	0.00	3.09	--	0.47	-1.78	1.31	--
Annual	13.30	8.13	1.81	10.32	--	-3.47	-9.79	-1.28	--

Table 9. Monthly Temperature Departures from the Station Normal for Malibu Canyon RAWS weather station.

Mean Temperature (T_{avg}) Station 045452 in Degrees F						Departures from Station Norm			
Month	2006-2010	2012	2013	2014	2015	2012	2013	2014	2015
Jan	51.45	51.88	48.67	54.4	53.27	0.43	-2.78	2.95	1.82
Feb	51.11	50.5	49.32	53.93	55.27	-0.61	-1.79	2.82	4.16
Mar	53.50	51.89	54.76	58.05	59.64	-1.61	1.26	4.55	6.14
Apr	55.82	56.51	58.63	60.14	58.79	0.69	2.81	4.32	2.97
May	60.71	60.63	63.76	65.37	58.91	-0.08	3.05	4.66	-1.80
Jun	64.97	63.09	65.45	65.09	66.63	-1.88	0.48	0.12	1.66
Jul	69.64	66.03	68.04	71.24	69.29	-3.61	-1.60	1.60	-0.35
Aug	69.13	72.81	68.69	70.49	69.32	3.68	-0.44	1.36	0.19
Sep	67.64	71.77	69.58	72.22	--	4.13	1.94	4.58	--
Oct	61.89	63.74	59.69	63.99	--	1.85	-2.20	2.10	--
Nov	55.74	55.75	56.05	58.21	--	0.01	0.31	2.47	--
Dec	49.11	49.11	49.67	52.83	--	0.00	0.56	3.72	--
Annual	59.23	59.48	59.36	62.16	--	0.25	0.13	2.94	--

Table 10. Monthly Precipitation Departures from the Station Normal for Malibu Canyon RAWS weather station.

Mean Precipitation (P_{avg}) Station 045452 in Degrees F						Departures from Station Norm			
Month	2006-2010	2012	2013	2014	2015	2012	2013	2014	2015
Jan	2.70	0.98	1.89	0.00	1.75	-1.72	-0.81	-2.70	-0.95
Feb	7.02	0.02	0.15	4.14	0.35	-7.00	-6.87	-2.88	-6.67
Mar	1.11	4.47	0.82	0.13	1.67	3.36	-0.29	-0.98	0.56
Apr	1.42	1.96	0.00	0.26	0.16	0.54	-1.42	-1.16	-1.26
May	0.43	0.00	0.42	0.00	0.72	-0.43	-0.01	-0.43	0.29
Jun	0.03	0.00	0.00	0.00	0.05	-0.03	-0.03	-0.03	0.02
Jul	0.00	0.02	0.07	0.00	0.80	0.02	0.07	0.00	0.80
Aug	0.00	0.04	0.00	0.02	0.00	0.04	0.00	0.02	0.00
Sep	0.23	0.00	0.00	0.07	--	-0.23	-0.23	-0.16	--
Oct	1.02	0.15	0.03	0.35	--	-0.87	-0.99	-0.67	--
Nov	0.52	1.76	0.45	1.17	--	1.24	-0.07	0.65	--
Dec	4.70	2.18	0.20	4.42	--	-2.52	-4.50	-0.28	--
Annual	17.69	11.58	4.03	10.56	--	-6.11	-13.66	-7.13	--

Monitoring Effort

The 2012 monitoring season saw the recruitment of long term volunteers and short-term interns. Monitoring in 2013 added nearly 92,000 phenophase status records to the NPDb, nearly one and a half times the previous season's effort. There were fewer observers in 2013, 2014 and 2015 than in 2012. If an observer monitored only part of the year, they are still included in the counts shown in Table 11. Therefore multiple short term observers affect the counts giving the appearance of more core observers than there actually are. There were actually 5 core volunteers in 2012, 6 in 2013, 8 in 2014 and 2015 (not shown in Table 11). In 2014 there was a slight increase in the number of observers and in 2015 observations were exclusively made by the SAMO VIP core volunteer team, over half of whom had been participating in the California Phenology Project since 2012. In 2013 and 2014 back-up observers were added to alleviate gaps in data that could arise when weekly monitors are unable to participate in a given week. In 2014 some observers participated as many as three days per week as captured in the number of trail-days. A trail-day is defined as the total number of visits received by a trail location during the year. An observer-day is defined as a date with the total number of unique visits affiliated with that date. An observer can visit more than one trail in a day. Observed dates are calculated by the total number of unique dates during the year with an observation.

Table 11. Monitoring effort at SAMO as defined by phenophase status records and phenology trail visits. Raw data.

Phenology Monitoring Effort at Santa Monica Mountains National Recreation Area	2012	2013	2014	2015**	Totals
Total animal phenophase status records*	27	4034	1713	1142	6916
Total plant phenophase status records	65808	91976	136723	61912	356419
Total phenophase status records	65834	96010	138436	63054	363334
Total observers	14	10	11	9	
Total observer-days (visits per day with multiple observers/day)	259	305	605	208	1377
Total observed days (any date with an observation)	178	197	239	144	758
Total trail-days (number of times each trail visited)	242	295	424	197	1158
Cheeseboro Canyon	58	54	85	48	245
Paramount Ranch	60	76	128	67	331
Rancho Sierra Vista-Satwiwa	64	55	84	28	231
Sandstone Peak	8	56	63	20	147
Zuma Canyon	52	54	64	34	204
Total animal species observed*	4	29	27	8	
Total plant species observed	6	6	6	6	
Total species observed	10	35	33	14	
Total sites monitored	39	41	40	40	
Total CPP plant individuals monitored	178	200	199	201	

** animal observations are not part of the CPP protocol ** partial year through July 31, 2015; data* incomplete.

The number of times a trail was visited during the season varied from year to year. Sandstone Peak Trail, which saw fewer visits in 2012, deserves special mention. Data gaps of four and six months between visits occurred due to its remote location, lack of volunteer coverage and partner participation. Indeed the entire spring growing season of 2012 was lost at Sandstone Peak. The 2014 season saw the most visits during the year of any of the three years. Also, the Springs Fire on May 02, 2013 burned all of the plants in Site 1 at Rancho Sierra Vista. The mean observation gap between visits for all trails in general was relatively low and stable at 6 days between visits with only a few instances throughout the year where the gap ranged from 10-16 days on any given trail. The overall mean observation gap jumps to 8 days between visits when the Sandstone Peak 2012 data gap is added into the calculation as shown in Table 12. Data gaps were calculated as the number of days between visits.

Table 12. Number of visits per month for each year by phenology trail location in the Santa Monica Mountains National Recreation Area using raw data.

Phenology Monitoring Trail Visitation 2012-2014 Santa Monica Mountains National Recreation Area																
Visits by trail and year	Cheeseboro Canyon Number of Visits			Paramount Ranch Number of Visits			Rancho Sierra Vista - Satwiwa Number of Visits			Sandstone Peak Number of Visits			Zuma Canyon Number of Visits			Total
Month	2012	2013	2014	2012	2013	2014	2012	2013	2014	2012	2013	2014	2012	2013	2014	All
January	4	6	5	4	9	9	3	4	5	2	4	5	3	5	4	72
February	5	4	5	4	7	9	2	4	3	0	4	5	4	4	5	65
March	5	5	7	5	5	10	10	6	7	0	4	7	5	5	5	86
April	4	4	6	4	3	8	11	2	4	0	5	5	6	5	6	73
May	6	4	6	4	7	10	6	2	8	0	3	5	4	4	5	74
June	4	5	6	4	8	10	4	3	14	0	4	5	3	4	4	78
July	4	6	9	4	10	9	6	7	13	7	4	5	5	5	6	100
August	3	4	8	5	9	11	4	4	8	0	6	6	4	4	5	81
September	8	5	9	4	8	12	4	8	11	0	8	4	4	4	10	99
October	4	4	9	5	3	15	6	4	4	0	3	6	5	2	6	76
November	6	5	8	10	4	11	3	6	4	1	8	4	4	9	4	87
December	5	2	7	7	3	14	5	5	3	5	3	6	5	3	4	77
Total Visits	58	54	85	60	76	128	64	55	84	8	56	63	52	54	64	961
Mean days between visits	6	6	4	6	5	3	6	7	4	48	6	6	7	6	6	8

Phenophase Activity

Due to the amount of time elapsing between observer visits, the exact date of onset or end date of a phenophase cannot be pinpointed for an individual plant. Observation gaps of more than seven days between visits for any individual plant indicates a possible outlier and are excluded from summarized data. Therefore, it may be possible to find fewer individuals listed in the results than are actually being monitored. Additionally there were conflicts between observers that should be considered when addressing the data. There were also multiple series for the same individual in some cases. Therefore it may be possible to find a higher n-number than the number of individuals being monitored. The USA-NPN protocol defines the start of a series as two "no" status observations followed by a "yes" observation. There were large gaps in data for the year 2012 for Sandstone Peak Trail, a unique trail with a defined elevation gradient. These gaps were due to lack of volunteer coverage and absence of participation by partner groups. To capture the 2013 growing season and beyond along Sandstone Peak Trail, more effort was invested in volunteer recruitment and training to ensure regular monitoring. Table 13 helps visualize results by year for each phenophase. The phenophase raw data tables in Appendix 1 show the results by trail location for each.

Table 13. Mean onset of phenophases at SAMO for each year represented by raw data Min DOY.

SAMO Phenophase Activity	2012					2013					2014				
(n) = number DOY=Day of Year	Min DOY	Max DOY	Duration	Mean Min DOY	(n)	Min DOY	Max DOY	Duration	Mean Min DOY	(n)	Min DOY	Max DOY	Duration	Mean Min DOY	(n)
Adenostoma fasciculatum															
Flowers or flower buds	67	206	139	108	n=14	23	311	288	65	n=32	9	213	204	104	n=34
Fruits	5	366	361	119	n=47	2	352	350	16	n=41	6	365	359	63	n=37
Open flowers	69	206	137	147	n=14	74	134	60	106	n=29	122	213	91	138	n=21
Recent fruit or seed drop	60	362	302	247	n=40	3	352	349	82	n=36	6	365	359	136	n=33
Ripe fruits	5	366	361	119	n=47	2	352	350	16	n=40	6	365	359	70	n=36
Young leaves	6	366	360	108	n=40	7	360	353	21	n=40	1	358	357	15	n=42
Baccharis pilularis															
Flowers or flower buds	60	362	302	157	n=27	30	350	320	145	n=9	4	363	359	140	n=25
Fruits	5	366	361	35	n=26	6	350	344	6	n=4	1	363	362	96	n=20
Open flowers	6	362	356	113	n=25	232	350	118	240	n=4	4	363	359	164	n=24
Pollen release	60	303	243	101	n=8	238	350	112	238	n=1	8	343	335	227	n=7
Recent fruit or seed drop	60	362	302	121	n=20	62	329	267	216	n=3	1	363	362	135	n=12
Ripe fruits	5	366	361	35	n=26	6	350	344	7	n=4	1	363	362	82	n=19
Young leaves	6	365	359	45	n=32	6	350	344	33	n=11	8	363	355	70	n=25
Eriogonum fasciculatum															
Flowers or flower buds	60	363	303	86	n=29	56	226	170	76	n=38	1	357	356	90	n=51
Fruits	5	366	361	114	n=54	2	352	350	24	n=37	1	365	364	34	n=52
Leaves	61	366	305	169	n=53	2	352	350	7	n=37	1	365	364	7	n=52
Open flowers	54	363	309	105	n=29	74	226	152	119	n=37	1	357	356	124	n=51
Recent fruit or seed drop	60	365	305	225	n=51	3	352	349	109	n=36	4	365	361	89	n=48
Ripe fruits	5	366	361	117	n=54	2	352	350	27	n=37	1	365	364	38	n=51
Young leaves	5	366	361	63	n=45	7	352	345	21	n=37	6	365	359	39	n=53
Quercus agrifolia															
Breaking leaf buds	5	283	278	81	n=19	6	331	325	131	n=4	24	358	334	72	n=18
Flowers or flower buds	60	230	170	93	n=19	6	310	304	77	n=3	8	360	352	77	n=13
Fruits	6	365	359	94	n=16	2	338	336	3	n=4	6	363	357	135	n=13
Open flowers	5	223	218	99	n=19	28	112	84	84	n=3	70	116	46	89	n=12
Pollen release	19	146	127	94	n=16	41	91	50	41	n=1	70	109	39	89	n=10
Recent fruit or seed drop	76	333	257	191	n=13	199	315	116	238	n=4	6	332	326	213	n=8
Ripe fruits	6	365	359	141	n=16	2	338	336	6	n=4	6	363	357	175	n=7
Young leaves	19	339	320	85	n=60	14	350	336	136	n=5	8	360	352	75	n=18
Quercus lobata															
Breaking leaf buds	40	339	299	72	n=24	53	182	129	162	n=5	28	198	170	50	n=24
Colored leaves	90	363	273	166	n=24	2	352	350	2	n=5	8	365	357	164	n=24
Falling leaves	173	363	190	194	n=27	2	352	350	2	n=5	170	365	195	187	n=24
Flowers or flower buds	61	354	293	90	n=23	93	123	30	93	n=5	28	238	210	54	n=19
Fruits	117	362	245	141	n=21	129	319	190	131	n=4	84	356	272	120	n=21
Increasing leaf size	6	363	357	75	n=24	87	272	185	94	n=5	28	273	245	53	n=24
Leaves	6	363	357	73	n=24	2	352	350	2	n=5	8	365	357	52	n=19
Open flowers	54	313	259	106	n=22	93	123	30	93	n=4	44	124	80	58	n=19
Pollen release	75	268	193	97	n=18	112	112	0	112	n=1	44	239	195	60	n=19
Recent fruit or seed drop	201	326	125	224	n=18	291	334	43	292	n=4	190	308	118	225	n=19
Ripe fruits	244	362	118	249	n=17	291	319	28	293	n=4	212	308	96	243	n=16
Sambucus nigra															
Breaking leaf buds	5	366	361	12	n=29	2	352	350	105	n=19	1	365	364	11	n=27
Colored leaves	26	351	325	82	n=28	35	350	315	124	n=18	6	360	354	137	n=28
Falling leaves	62	365	303	160	n=27	14	329	315	139	n=17	120	343	223	179	n=28
Flowers or flower buds	60	254	194	85	n=27	62	291	229	87	n=17	28	257	229	85	n=27
Fruits	117	365	248	141	n=27	6	329	323	71	n=16	6	356	350	133	n=27
Increasing leaf size	5	366	361	21	n=29	2	350	348	9	n=19	1	365	364	24	n=27
Leaves	5	366	361	28	n=28	2	350	348	18	n=19	1	365	364	30	n=28
Open flowers	68	254	186	104	n=26	91	291	200	112	n=15	62	206	144	104	n=26
Recent fruit or seed drop	173	365	192	213	n=25	6	315	309	173	n=15	127	332	205	178	n=27
Ripe fruits	97	365	268	171	n=27	6	329	323	82	n=16	6	356	350	153	n=26

Colored bar graphs were also created to help visualize the phenophase onset data. The phenophase onset dates in the bar graphs for each species were calculated using raw data from Table 13 for individuals that had a phenophase status of "yes". Onset dates are represented by minimum day of year (Min DOY) and represents the date first observed. Multiple onset dates are included in this calculation. The USA-NPN data download tool does not distinguish between observer conflicts and a true new series of yes observations. The duration was calculated using the date first observed subtracted from the date last observed or maximum day of year (Max DOY) as specified in SOP 10. However, using this formula does not make exception for phenophases that have started in and carried over from the previous year, nor does it account for large gaps in data or multiple start dates during the year. The mean onset of phenophases was calculated by using the Min DOY values. The day of year (DOY) ranges from number 1 through 365, and represents January 1 through December 31st of any given year. Day of year is used in place of the traditional month-day-year format to conserve space in tables.

Frequency distribution charts for each species were created from raw data for each calendar year from January 2012 through December 2014. Intervals and scale are not equal between years, as the scale is based on the first and last DOY or observed dates which vary from year to year. The scale for number of observations or frequency also varies between the charts depending on lowest and highest number for each year. Also, it is possible to have more than one observer visiting and recording an observation on a plant on the same day. This could result in counts that are higher than the number of individuals being monitored. This type of intensity visualization does not account for sampling effort variations.

Additionally, a phenophase table for each species was created from summarized data using the USA-NPN data download tool for select phenophases. Summarized data removes less precise data such as those individuals with "yes" observations that started in the previous calendar year or those individuals with a date since prior "no" observation of more than 7 days. Summarized data does not eliminate those individuals with more than one series of onset for a phenophase. Further, the data download tool does not distinguish between observer conflicts and multiple starts to a series. A series can have one or more days.

Lastly, summarized data was used for the phenophase visualization calendars that were created using the USA-NPN Data Visualization Tool. This method removes less precise values, such as those observation dates that started in the previous year. The colored bars represent a "yes" observation for the phenophase and the gray bars represent a "no" observation. The "no" observations were included to distinguish patterns of visitation, since a blank space indicates no visit was made on that day.

Adenostoma fasciculatum . There are 42 *Adenostoma fasciculatum* CPP individuals monitored at 3 phenology trail locations within SAMO. See Appendix A for the tables for each year showing phenophases by plant species with details for each of the 5 phenology trails. It should be noted that all *Adenostoma fasciculatum* individuals at Rancho Sierra Vista were burned in the 2013 Springs Fire. Re-sprouting did occur in all 4 individuals. The Springs Fire was an out of season fire and occurred right before the summer dry season. This combined with low rainfall may have contributed to the severity of drought effects. All four individuals re-sprouted, but experienced dieback after re-sprouting. The USA-NPN and CPP protocols do not capture absence or presence of leaves in evergreen plants; therefore notes were recorded in the comments category of the NPDb to capture the phenomena. Monitoring ceased in 2015 of burned plants at RSVS-Site_1 that did not grow back after two seasons. Additionally, data for 2012 is skewed by data gaps of 6 months and 4 months respectively from Sandstone Peak, where 28 of the 42 individuals are located. Reproductive phenophases (flowering and fruiting) began more than 30 days later in 2014 than 2013 as shown in both raw and summarized data.

Table 14. Mean onset dates for two phenophases for *Adenostoma fasciculatum* monitored at SAMO using summarized data and first day of year. Note that the number (n) can be higher than the number of individuals monitored when more than one series is captured by the USA-NPN summarized data download tool.

Adenostoma fasciculatum	Flowers or Flower Buds			Fruits		
All sites	2012	2013	2014	2012	2013	2014
Mean First Day of Year	119	91	126	148	172	241
Standard Deviation (STD)	28.56	71.76	30.23	86.60	73.78	89.46
Standard Error (SEM)	6.09	15.30	4.41	13.21	7.86	6.17
Number (n)	22	22	47	43	88	210
Paramount Ranch						
Mean First Day of Year	121	102	135	163	190	273
Standard Deviation (STD)	32.01	38.89	16.65	76.18	58.85	61.80
Standard Error (SEM)	9.24	27.50	3.63	19.67	7.30	6.21
Number (n)	12	2	21	14	65	99
Rancho Sierra Vista-Satwiwa						
Mean First Day of Year	117	--	--	107	--	--
Standard Deviation (STD)	25.32	--	--	29.94	--	--
Standard Error (SEM)	8.01	--	--	5.99	--	--
Number (n)	10	--	--	25	--	--
Sandstone Peak						
Mean First Day of Year	--	90	118	352	124	212
Standard Deviation (STD)	--	74.82	36.42	8.57	90.17	100.18
Standard Error (SEM)	--	16.73	7.14	3.83	18.80	9.51
Number (n)	--	20	26	5	23	111

The following visualization calendars, created using the USA-NPN data visualization tool, give an overview of select phenophases for the January 2012 through August 2015 for *Adenostoma fasciculatum*. Note the large gap shown in Figure 4, which represents the period of the U.S. Government shutdown.

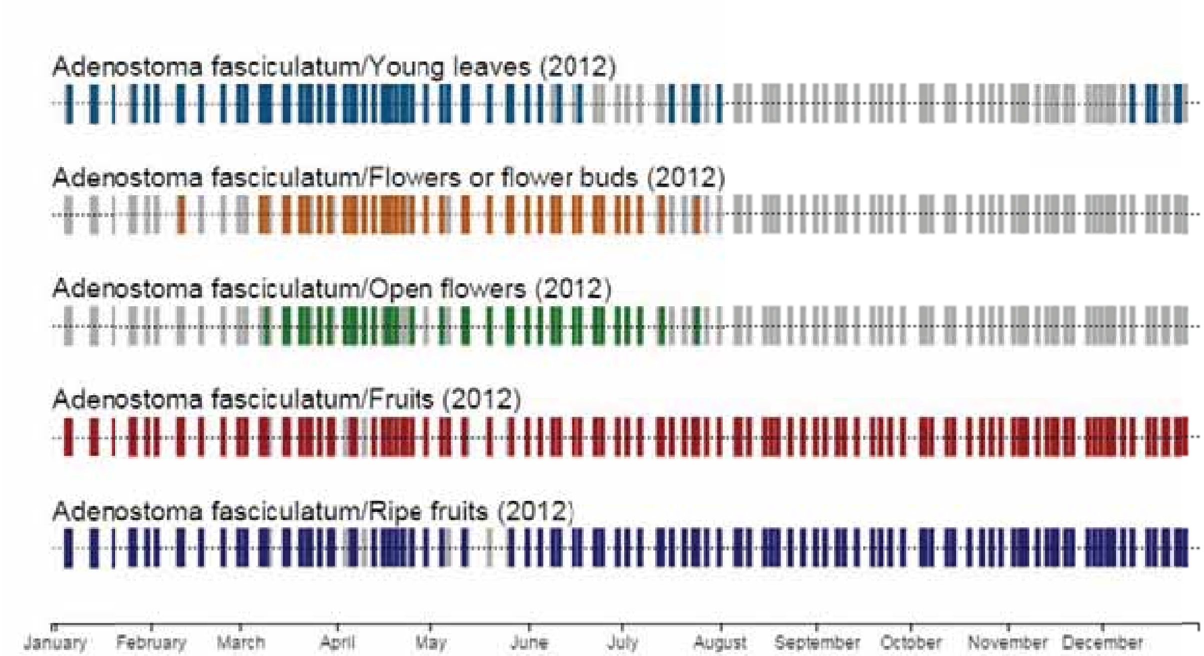


Figure 3. USA-NPN visualization calendar for *Adenostoma fasciculatum* at SAMO for calendar year 2012. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

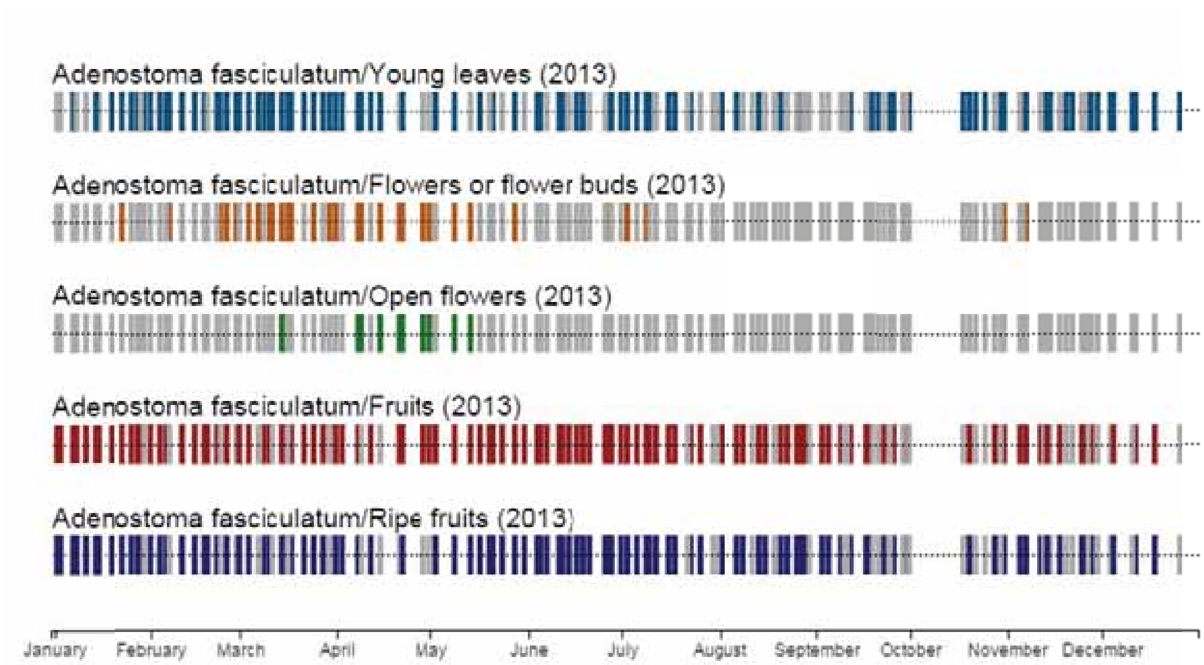


Figure 4. USA-NPN visualization calendar for *Adenostoma fasciculatum* at SAMO for calendar year 2013. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation. Note the large gap in data which occurred during the October 2013 government shutdown.

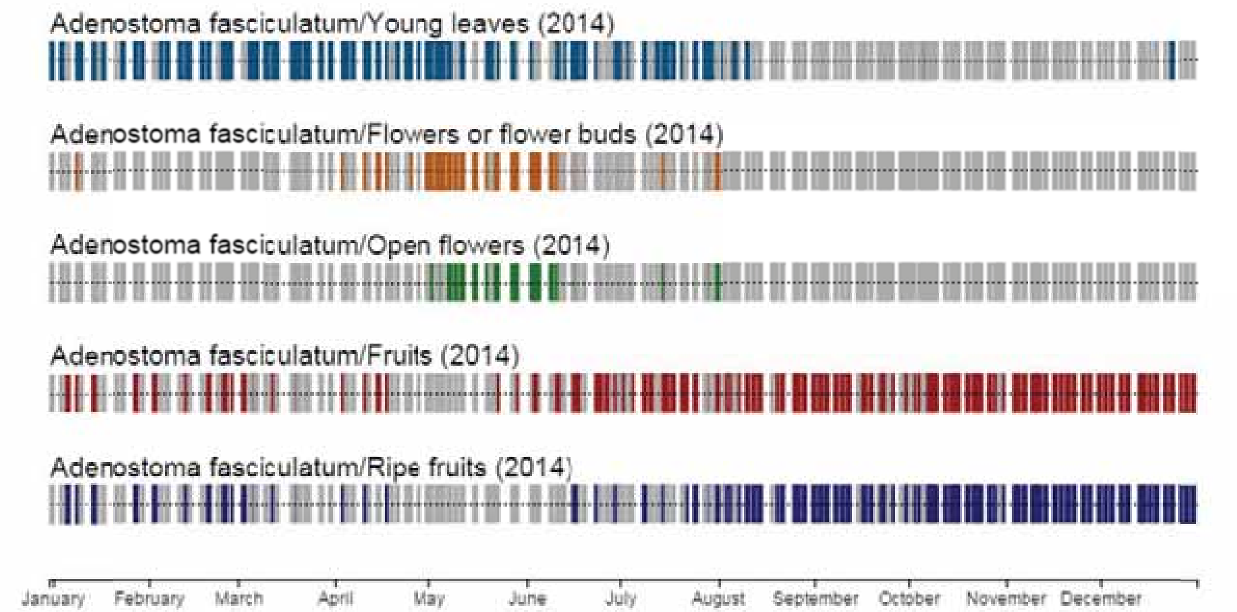


Figure 5. USA-NPN visualization calendar for *Adenostoma fasciculatum* at SAMO for calendar year 2014. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

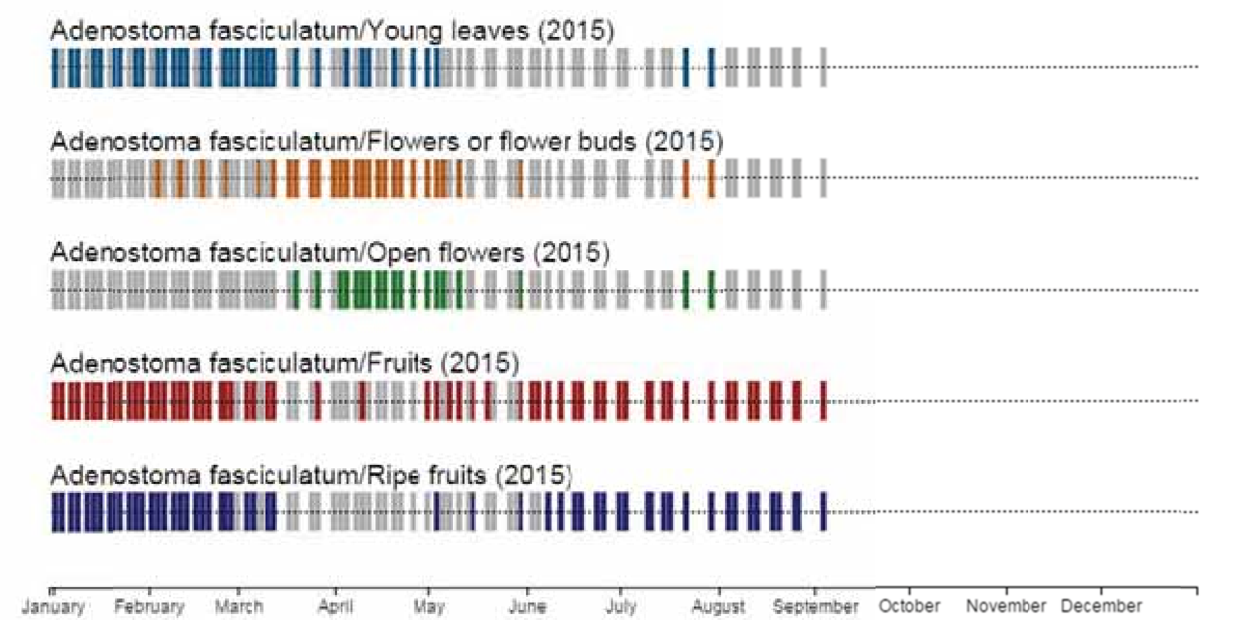


Figure 6. USA-NPN visualization calendar for *Adenostoma fasciculatum* at SAMO for calendar year 2015. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

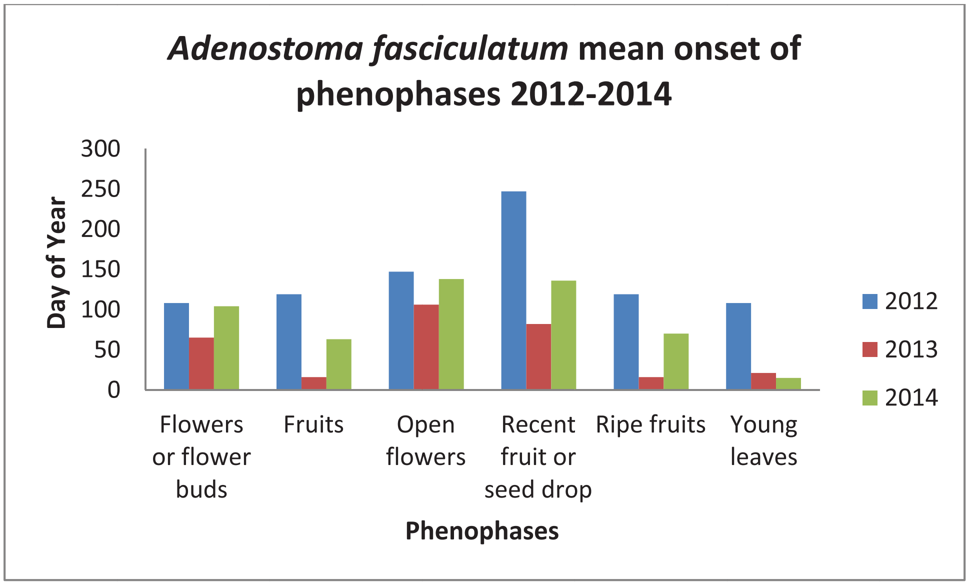


Figure 7. Mean onset of select phenophases for *Adenostoma fasciculatum* using raw data. The day of year starts with 01 on January 1st and ends with 365 on December 31st.

The next 3 figures are frequency distribution charts created from raw data showing the number of the "Yes" observations for each observation day of flowering in *Adenostoma fasciculatum* for each year for calendar years 2012-2014.

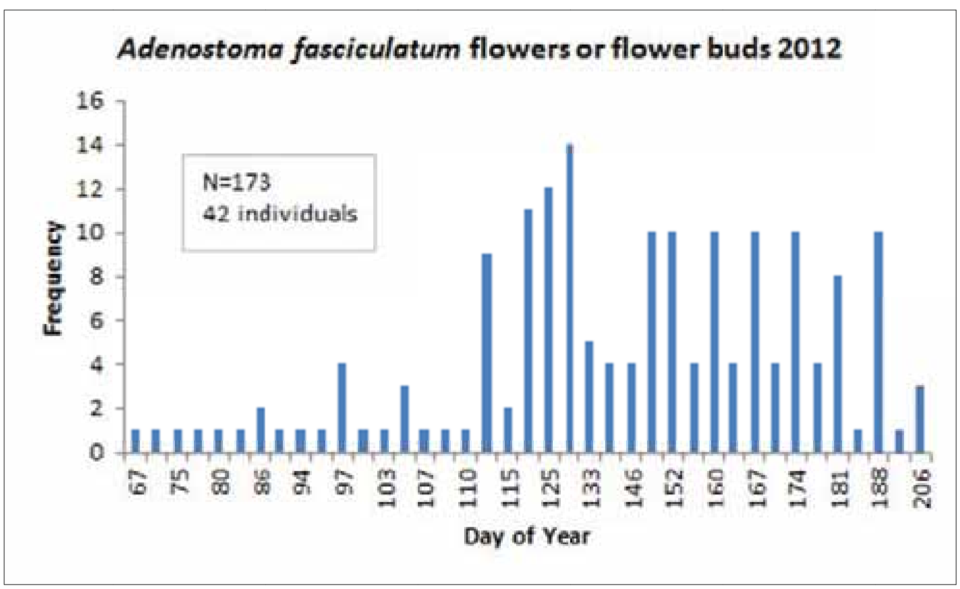


Figure 8. Frequency distribution chart from raw data showing frequency of "yes" observations per visit of flowers or flower buds in *Adenostoma fasciculatum* for the calendar year 2012.

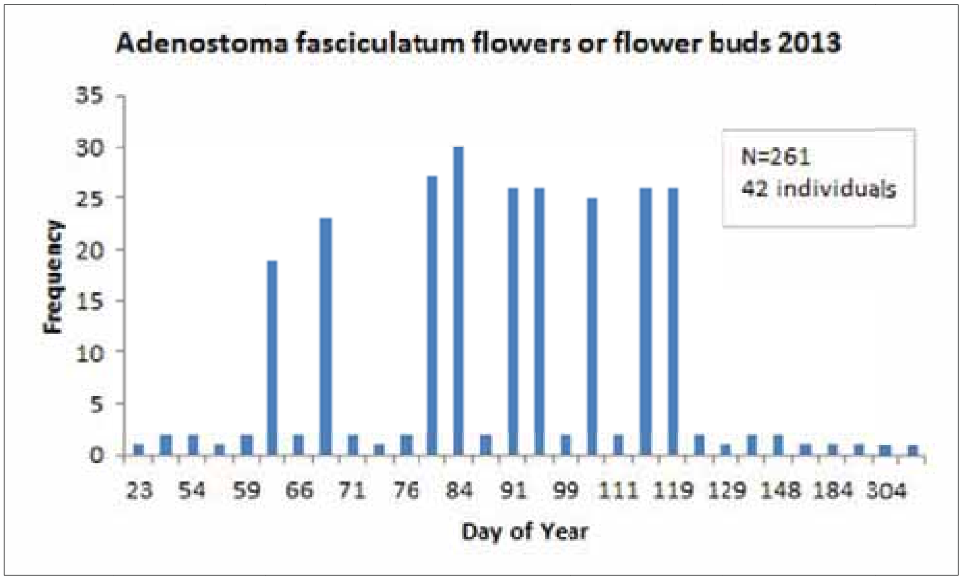


Figure 9. Frequency distribution chart from raw data showing frequency of "yes" observations per visit of flowers or flower buds in *Adenostoma fasciculatum* for the calendar year 2013.

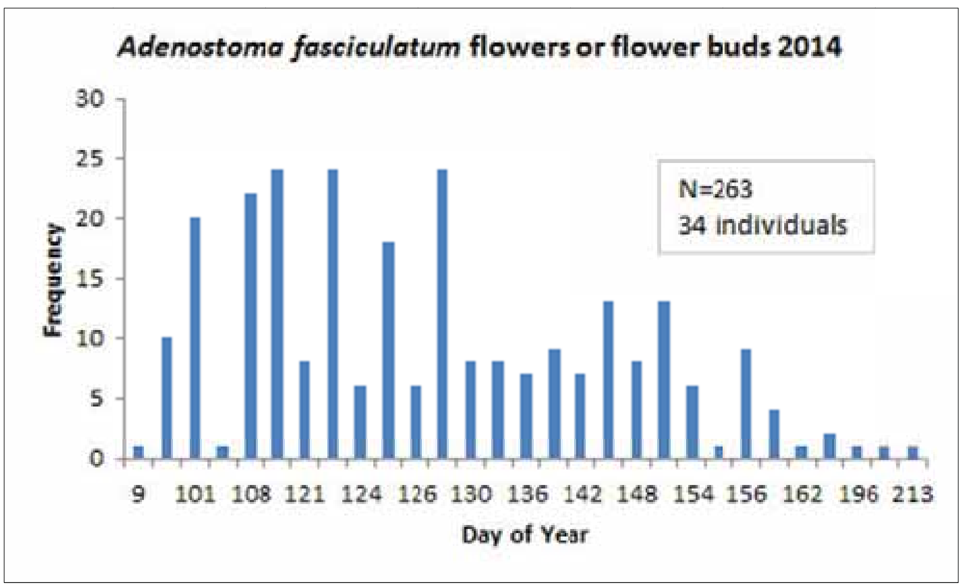


Figure 10. Frequency distribution chart from raw data showing frequency of "yes" observations per visit of flowers or flower buds in *Adenostoma fasciculatum* for the calendar year 2014.

<u>*Baccharis pilularis*</u>. There are *32 Baccharis pilularis* CPP individuals monitored at 4 phenology trail locations within SAMO. The reproductive phenophase of flowering occurred later in 2013 than in 2014; however fruiting in 2013 had an onset date of January 6, indicating a carry-over from the previous season. *B.* pilularis typically flowers in the late summer to early fall. It should be noted also that in 2013 eight of the 19 *B. pilularis* CPP individuals monitored at Rancho Sierra Vista perished in the Springs Fire. In 2014, drought killed two more CPP *Baccharis pilularis* individuals at Rancho Sierra Vista, and two *B. pilularis* CPP individuals at Paramount Ranch. Cheeseboro Overall flowering was later in 2013 than in either 2012 or 2014.

Table 15. Mean onset dates for two phenophases for *Baccharis pilularis* monitored at SAMO using summarized data and first day of year. Note that the number (n) can be higher than number of individuals monitored when more than one series is captured by the USA-NPN summarized data download tool.

Baccharis pilularis	Flowers or Flower Buds			Fruits		
All sites	2012	2013	2014	2012	2013	2014
Mean First Day of Year	196	264	199	184	200	173
Standard Deviation (STD)	98.73	58.87	108.02	118.92	126.78	115.83
Standard Error (SEM)	15.06	8.68	8.82	19.55	29.09	13.94
Number (n)	43	46	150	37	19	69
Cheeseboro Canyon						
Mean First Day of Year	273	250	285	305	315	280
Standard Deviation (STD)	27.68	59.41	48.11	38.00	4.24	74.99
Standard Error (SEM)	10.46	19.80	9.82	15.51	3.00	19.36
Number (n)	7	9	24	6	2	15
Paramount Ranch						
Mean First Day of Year	279	249	175	235	61	92
Standard Deviation (STD)	67.65	19.15	117.42	151.66	49.84	70.98
Standard Error (SEM)	20.40	4.64	13.38	53.62	18.84	12.75
Number (n)	11	17	77	8	7	31
Rancho Sierra Vista-Satwiwa						
Mean First Day of Year	118	161	221	77	310	220
Standard Deviation (STD)	71.66	87.00	38.31	12.05	29.21	97.89
Standard Error (SEM)	15.64	43.50	7.24	3.11	11.04	28.26
Number (n)	21	4	28	15	7	12
Zuma Canyon						
Mean First Day of Year	242	313	156	244	192	206
Standard Deviation (STD)	32.01	28.37	126.93	64.85	105.66	127.42
Standard Error (SEM)	16.01	7.09	27.70	22.93	61.00	38.42
Number (n)	4	16	21	8	3	11

The following visualization calendars, created using the USA-NPN data visualization tool, give an overview of select phenophases for the January 2012 through August 2015 for *Baccharis pilularis*. Note the large gap shown in Figure 12 which represents the period of the U.S. Government shutdown.

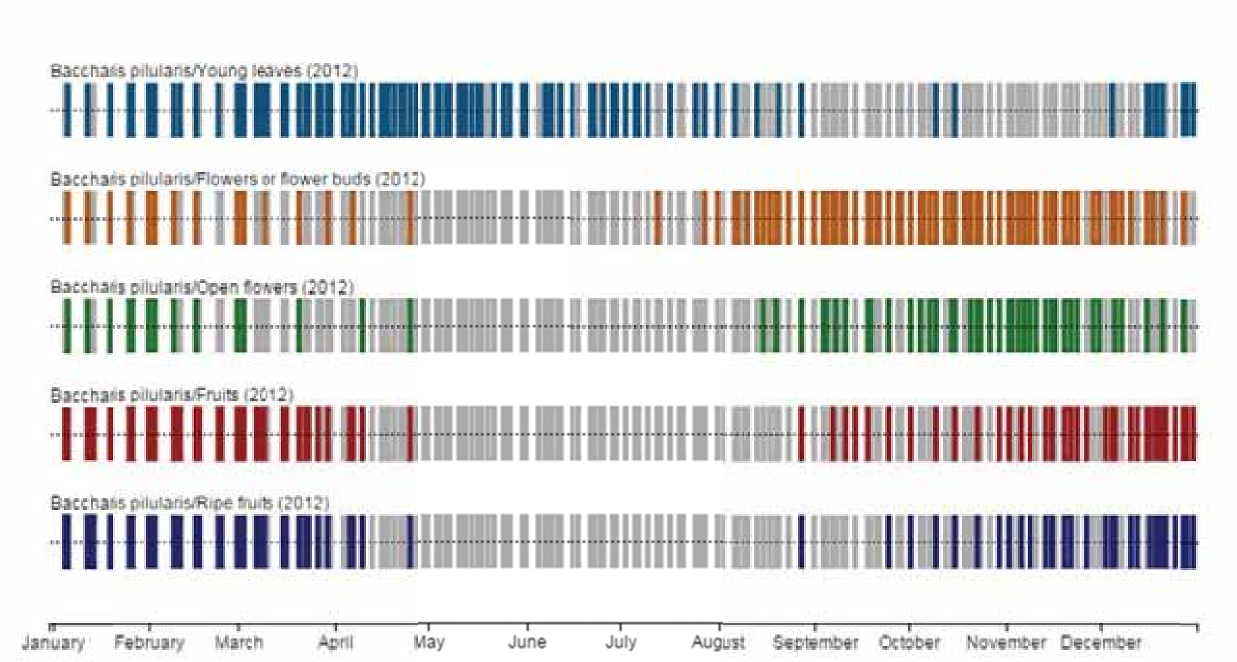


Figure 11. USA-NPN visualization calendar for *Baccharis pilularis* at SAMO for calendar year 2012. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

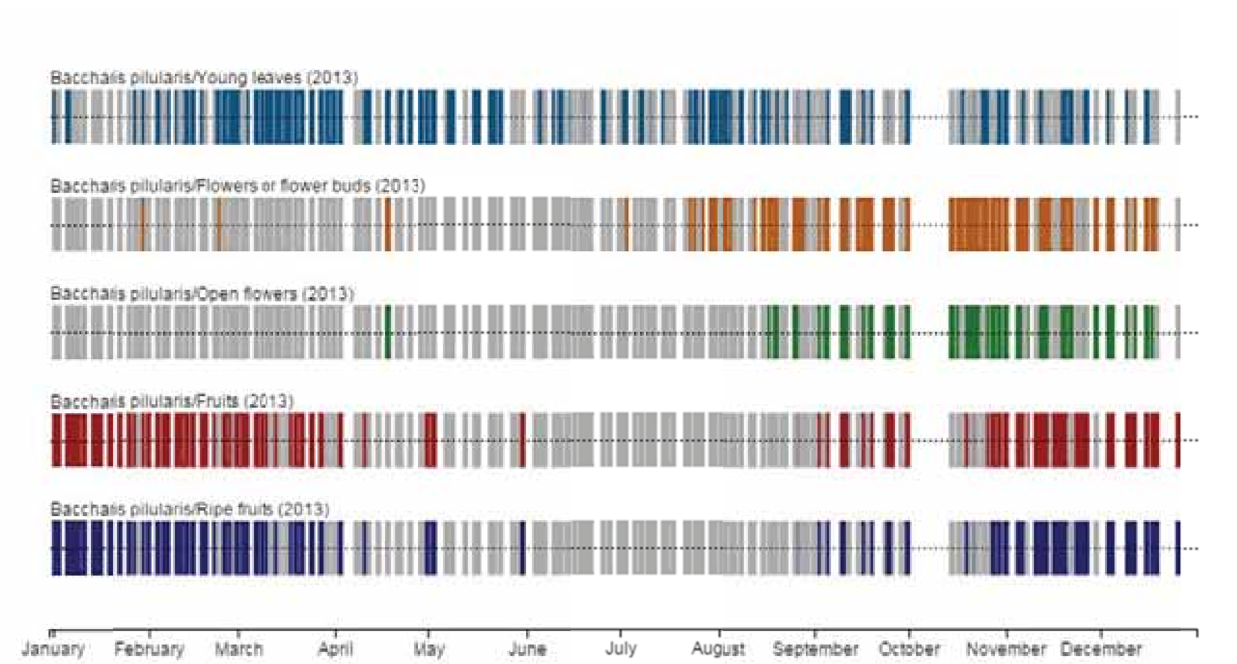


Figure 12. USA-NPN visualization calendar for *Baccharis pilularis* at SAMO for calendar year 2013. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation. Note the gap in October that occurred due to the government shutdown.

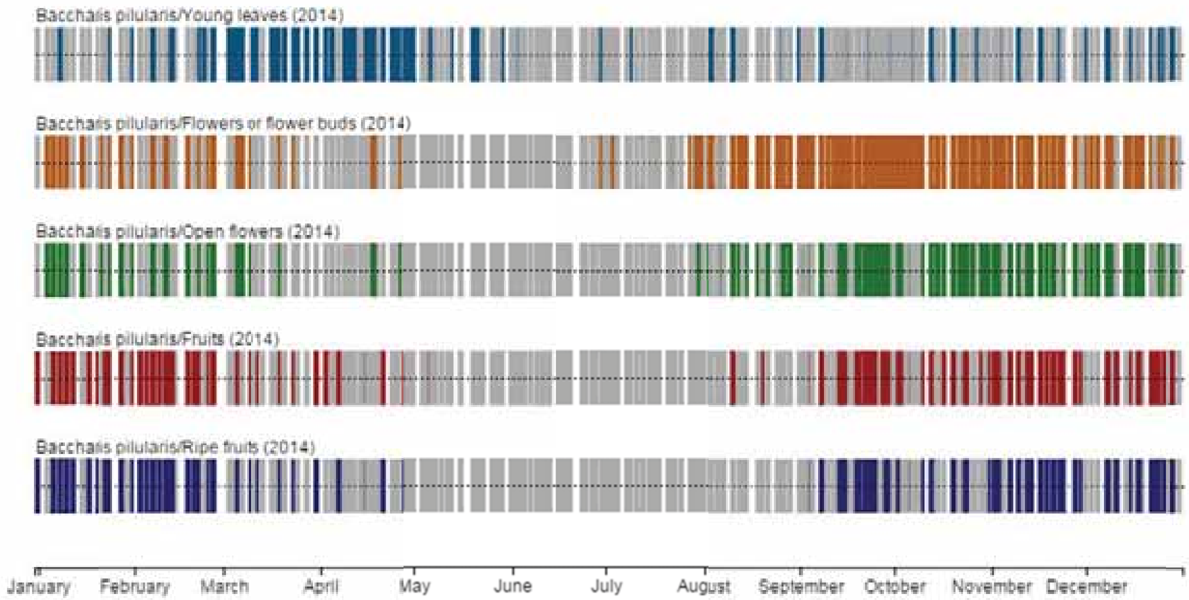


Figure 13. USA-NPN visualization calendar for *Baccharis pilularis* at SAMO for calendar year 2014. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

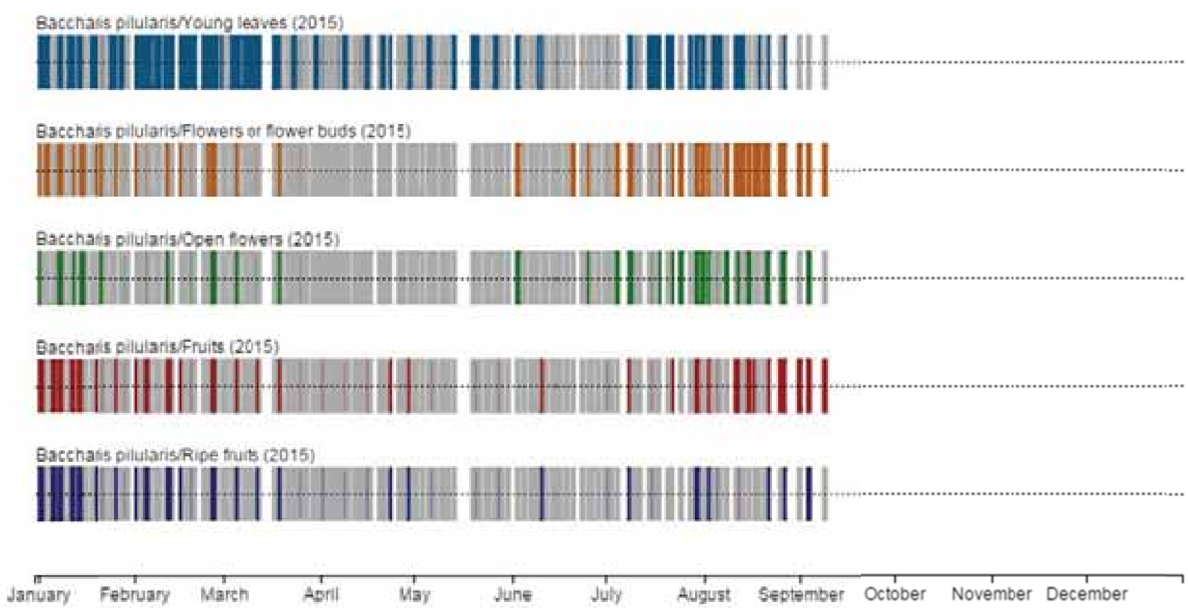


Figure 14. USA-NPN visualization calendar for *Baccharis pilularis* at SAMO for calendar year 2015. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

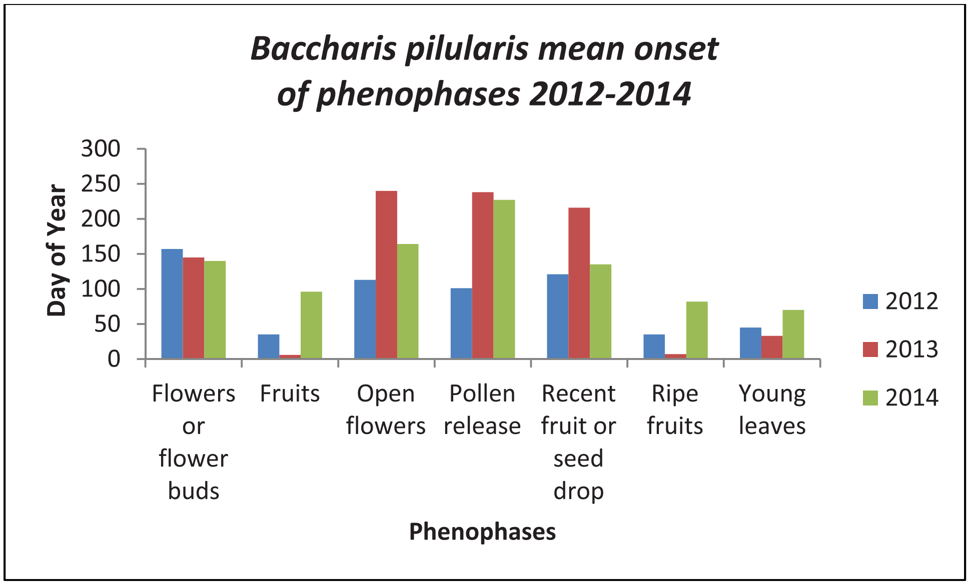


Figure 15. Mean onset of *Baccharis pilularis*. The day of year starts with 01 on January 1st and ends with 365 on December 31st.

The next 3 figures are frequency distribution charts created from raw data showing the number of the "Yes" observations for each observation day of flowering in *Baccharis pilularis* for January 2012 through December 2014.

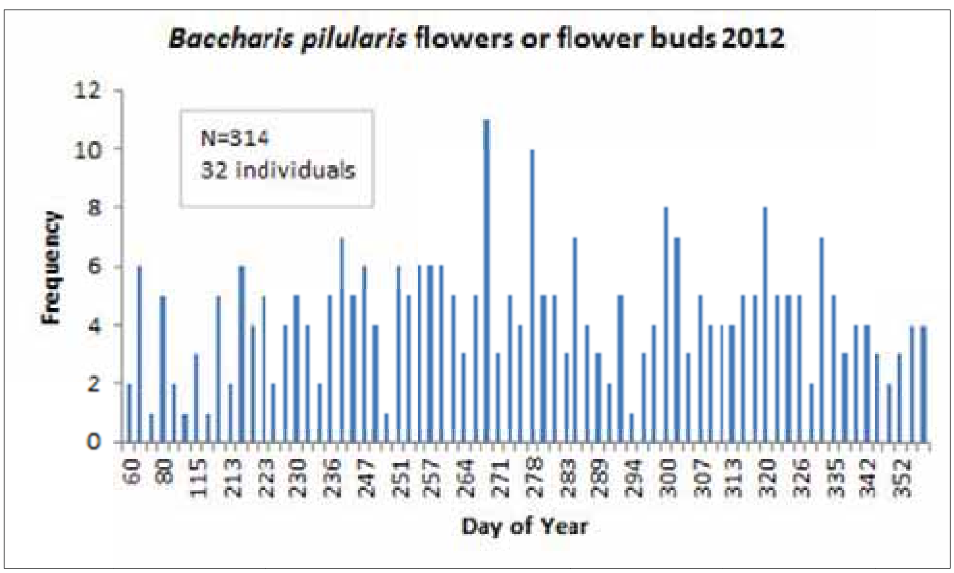


Figure 16. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds in *Baccharis pilularis* for the calendar year 2012.

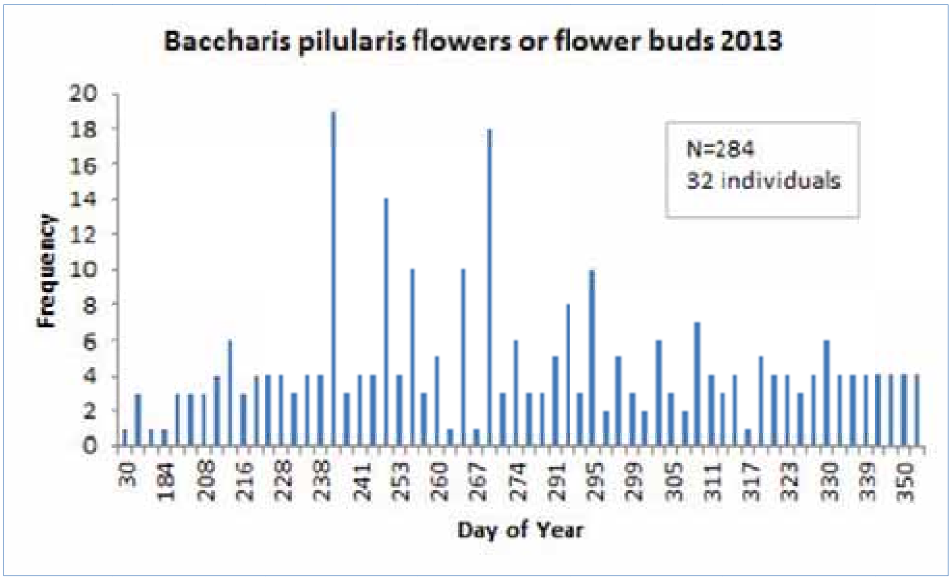


Figure 17. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds in *Baccharis pilularis* for the calendar year 2013.

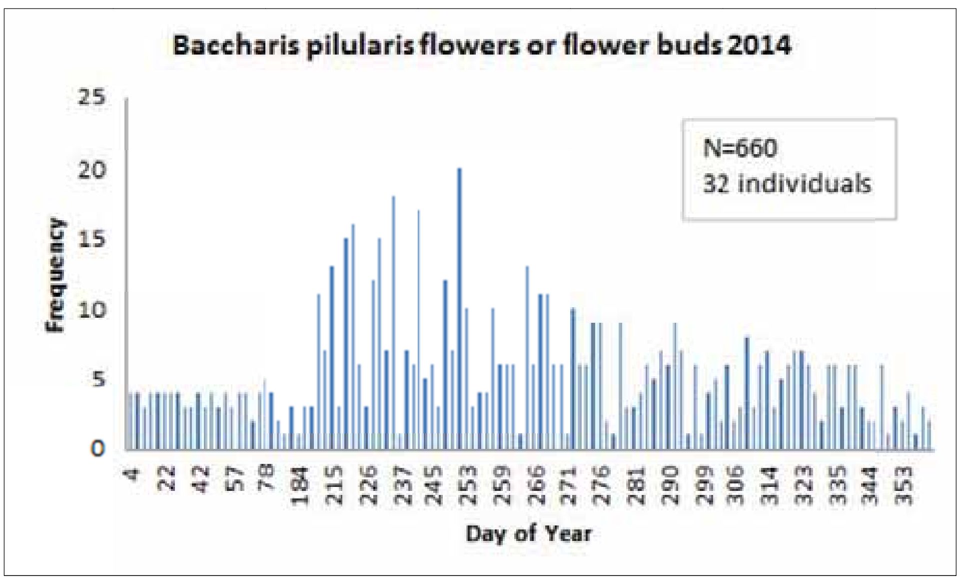


Figure 18. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds in *Baccharis pilularis* for the calendar year 2014.

Eriogonum fasciculatum. There are 55 *Eriogonum fasciculatum* CPP individuals monitored along all five phenology trail locations at SAMO. Sandstone Peak trail has the most, with 28 individuals monitored along 1.4 miles of trail. Sandstone Peak was visited in 2012 on March 31st, November 26th and then weekly for the next season. In general, flowers opened later in 2014 than in 2013 and the appearance of fruit was later as well. *Eriogonum fasciculatum* generally keeps its leaves throughout the year.

Table 16. Mean onset dates for two phenophases for *Eriogonum fasciculatum* monitored at SAMO using summarized data and first day of year. Note that the number (n) can be higher than number of individuals monitored when more than one series is captured by the USA-NPN summarized data download tool.

Eriogonum fasciculatum	Flowers or Flower Buds			Fruits		
All sites	2012	2013	2014	2012	2013	2014
Mean First Day of Year	125	127	164	136	179	207
Standard Deviation (STD)	84.53	78.57	72.19	95.92	78.53	110.43
Standard Error (SEM)	15.97	9.13	5.65	12.08	8.06	7.16
Number (n)	28	74	163	63	95	238
Cheeseboro Canyon						
Mean First Day of Year	251	256	206	187	149	190
Standard Deviation (STD)	89.84	109.44	86.71	110.98	15.65	63.15
Standard Error (SEM)	40.18	54.72	14.66	33.46	7.00	16.30
Number (n)	5	4	35	11	5	15
Paramount Ranch						
Mean First Day of Year	112	136	172	124	198	233
Standard Deviation (STD)	52.89	44.51	58.38	81.39	73.75	110.85
Standard Error (SEM)	14.67	8.27	7.03	13.96	9.29	8.88
Number (n)	13	29	69	34	63	156
Rancho Sierra Vista-Satwiwa						
Mean First Day of Year	76	66	227	145	--	197
Standard Deviation (STD)	0.50	--	86.49	122.58	--	12.33
Standard Error (SEM)	0.25	--	49.94	54.82	--	6.16
Number (n)	4	1	3	5	--	4
Sandstone Peak						
Mean First Day of Year	--	80	118	345	146	161
Standard Deviation (STD)	--	28.49	41.03	9.90	87.66	101.40
Standard Error (SEM)	--	5.29	6.49	7.00	19.60	14.64
Number (n)	--	29	40	2	20	48
Zuma Canyon						
Mean First Day of Year	83	183	141	81	121	102
Standard Deviation (STD)	70.36	129.08	82.67	37.45	61.64	70.67
Standard Error (SEM)	28.72	38.92	20.67	11.29	23.30	18.25
Number (n)	6	11	16	11	7	15

The following visualization calendars, created using the USA-NPN data visualization tool, give an overview of select phenophases for the January 2012 through August 2015 for *Eriogonum fasciculatum*. Note the large gap shown in Figure 20 which represents the period of the U.S. Government shutdown.

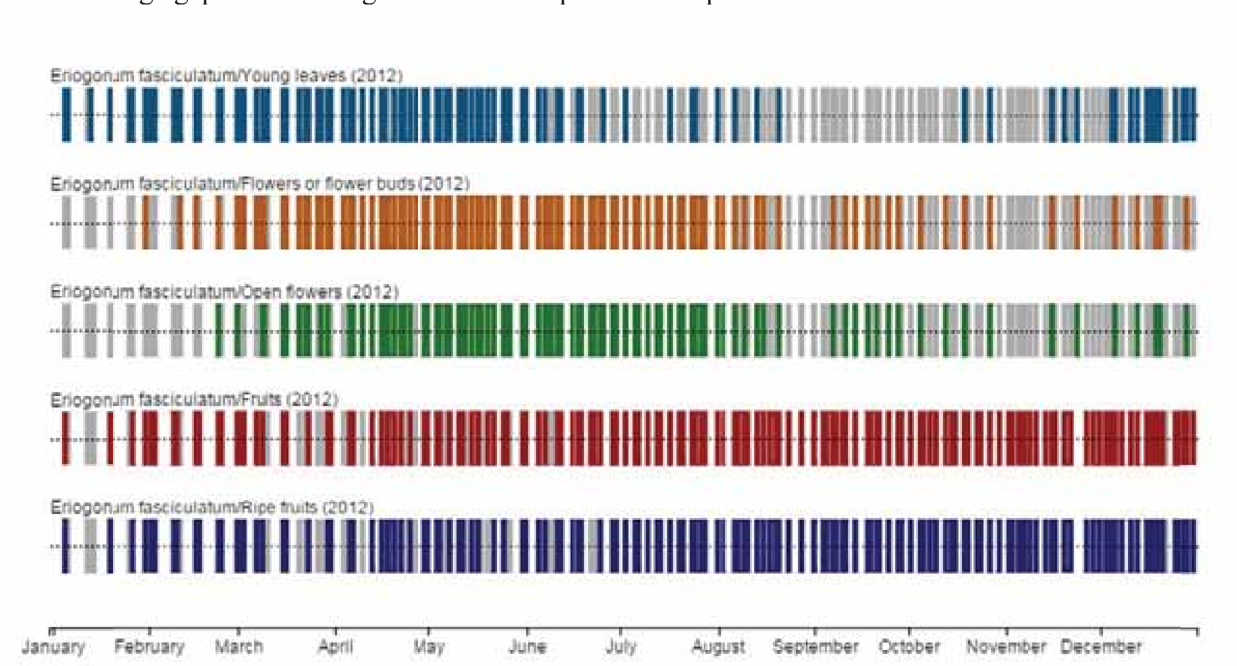


Figure 19. Select phenophases for *Eriogonum fasciculatum* at SAMO for calendar year 2012. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

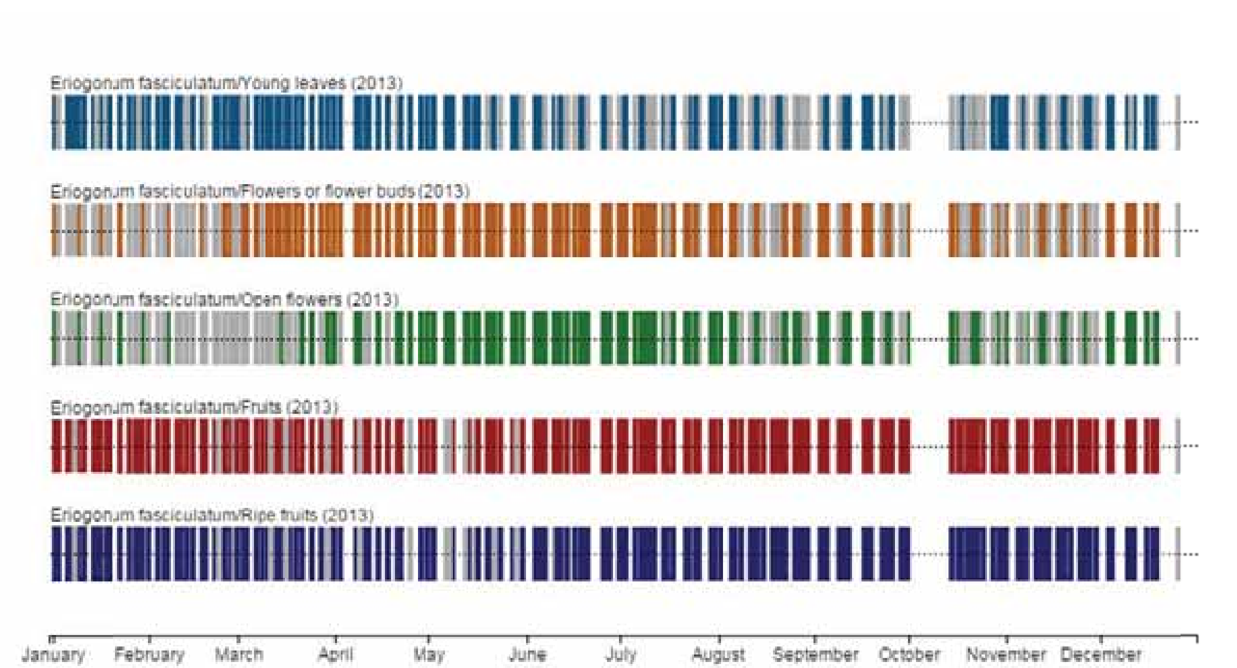


Figure 20. USA-NPN visualization calendar. Select phenophases for *Eriogonum fasciculatum* at SAMO for calendar year 2013. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation. Note gap in October which occurred due to the government shutdown.

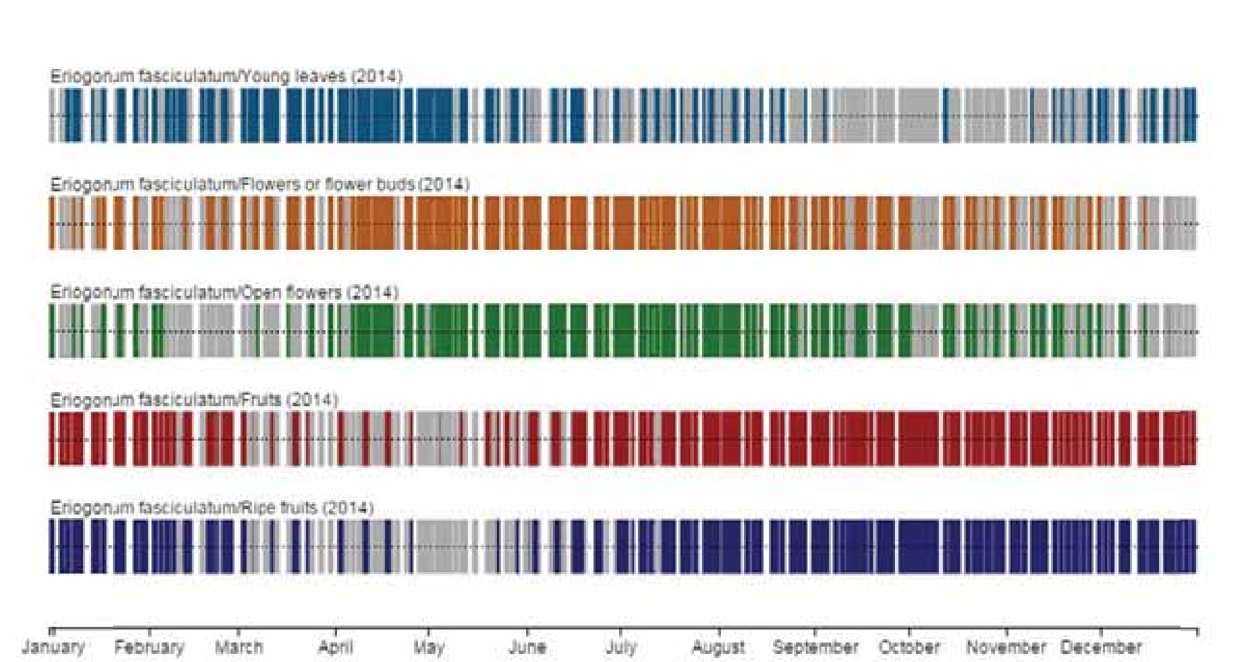


Figure 21. USA-NPN visualization calendar. Select phenophases for *Eriogonum fasciculatum* at SAMO for calendar year 2014. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

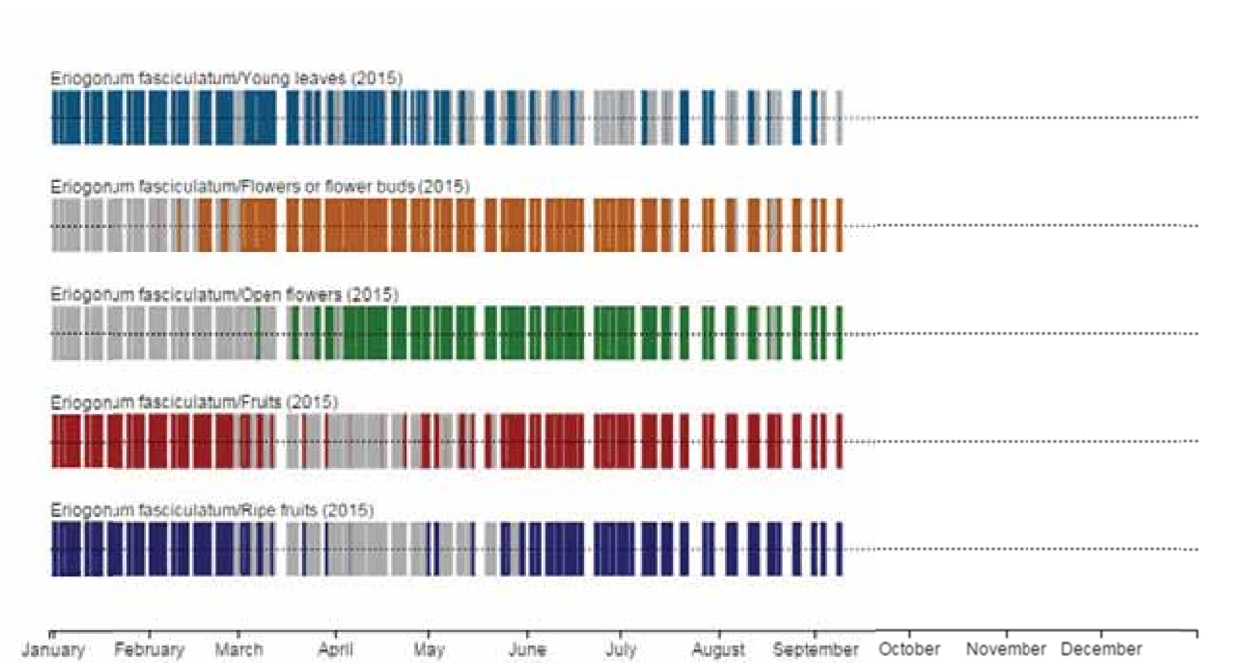


Figure 22. USA-NPN visualization calendar. Select phenophases for *Eriogonum fasciculatum* at SAMO for calendar year 2015. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

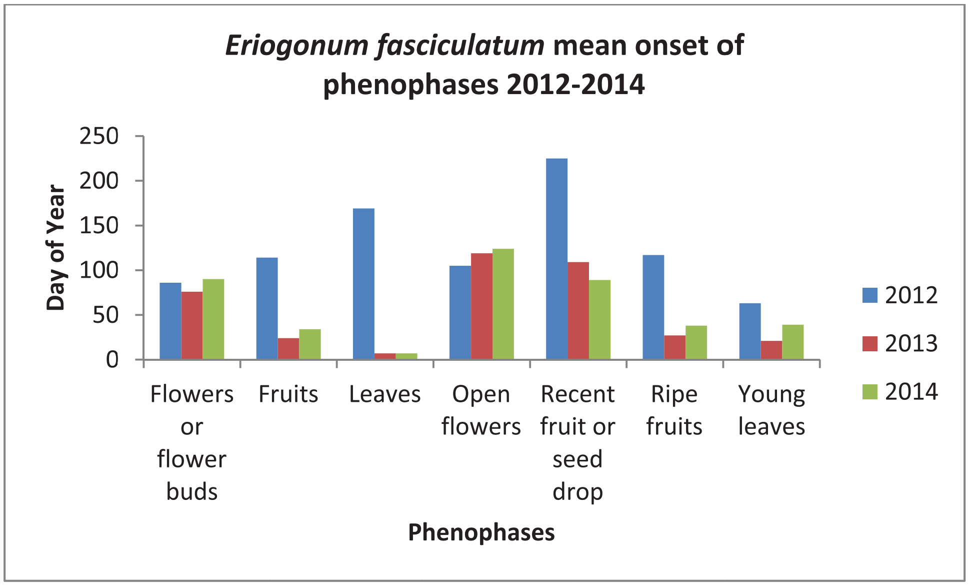


Figure 23. *Eriogonum fasciculatum* mean onset date of phenophases from raw data in Table 13.. The day of year starts with 01 on January 1st and ends with 365 on December 31st.

The next 3 figures are frequency distribution charts created from raw data showing the number of the "Yes" observations for each observation day of flowering in *Eriogonum fasciculatum* for January 2012 through December 2014.

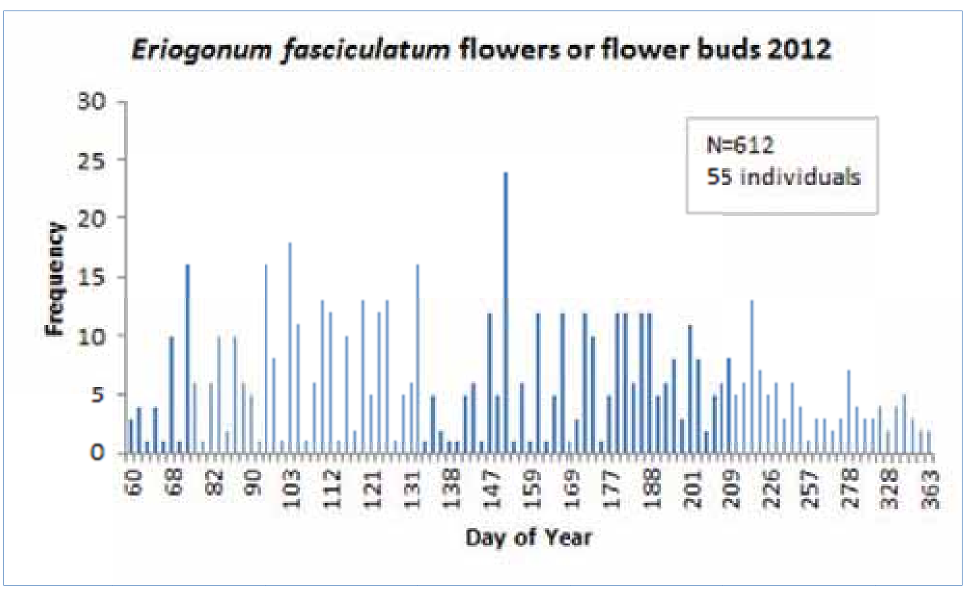


Figure 24. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds *Eriogonum fasciculatum* for the calendar year 2012.

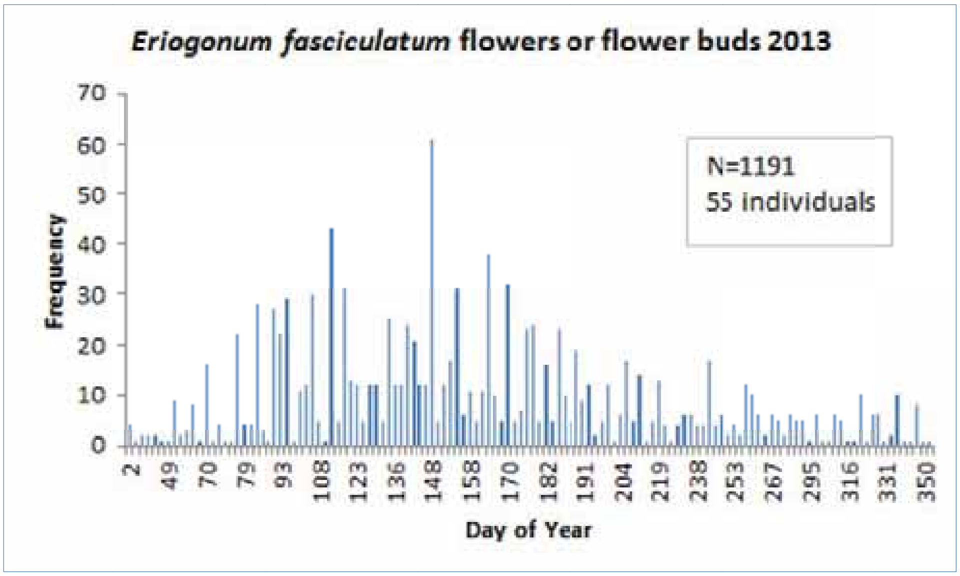


Figure 25. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds in *Eriogonum fasciculatum* for the calendar year 2013.

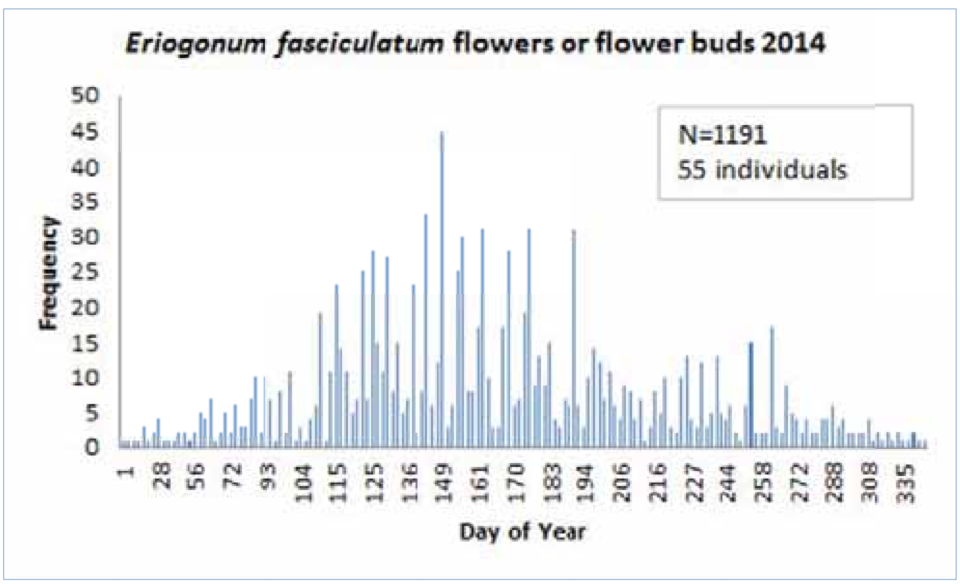


Figure 26. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds in *Eriogonum fasciculatum* for the calendar year 2014.

Quercus agrifolia. There are 19 *Quercus agrifolia* CPP individuals monitored at 4 phenology trail locations at SAMO. Preliminary data (also found in Appendix A) indicate a possible coastal-inland gradient in 2012 with *Quercus agrifolia* fruit setting later in CPP individuals at Rancho Sierra Vista-Satwiwa, the furthest west location. The trend continued in 2013, but not in 2014. Overall, flower production was observed to happen on the same day in 2013 and 2014, but opening was delayed 5 days in 2014. Flowering was shown to occur later in 2012 than in both 2013 and 2014.

Table 17. Mean onset dates for two phenophases for *Quercus agrifolia* monitored at SAMO using summarized data and first day of year. Note that the number (n) can be higher than number of individuals monitored when more than one series is captured by the USA-NPNsummarized data download tool.

Quercus agrifolia	Flowers or Flower Buds			Fruits		
All sites	2012	2013	2014	2012	2013	2014
Mean First Day of Year	121	127	81	216	143	211
Standard Deviation (STD)	51.44	90.57	27.24	96.31	115.16	79.86
Standard Error (SEM)	10.73	36.97	6.61	14.52	18.44	11.91
Number (n)	23	6	17	44	39	45
Cheeseboro Canyon						
Mean First Day of Year	84	95	82	214	20	210
Standard Deviation (STD)	17.44	8.96	10.64	77.77	8.07	90.97
Standard Error (SEM)	7.12	4.48	4.34	18.86	2.33	16.61
Number (n)	6	4	6	17	12	30
Paramount Ranch						
Mean First Day of Year	166	--	99	204	16	154
Standard Deviation (STD)	43.03	--	5.29	111.62	7.74	--
Standard Error (SEM)	13.61	--	3.06	24.96	1.61	--
Number (n)	10	--	3	20	23	1
Rancho Sierra Vista-Satwiwa						
Mean First Day of Year	87	--	96	279	25	199
Standard Deviation (STD)	15.26	--	21.04	113.84	8.49	57.50
Standard Error (SEM)	6.83	--	9.41	80.50	6.00	19.17
Number (n)	5	--	5	2	2	9
Zuma Canyon						
Mean First Day of Year	95	190	37	247	20	248
Standard Deviation (STD)	57.28	169.71	28.51	95.93	9.19	26.94
Standard Error (SEM)	40.50	120.00	16.46	42.90	6.50	12.05
Number (n)	2	2	3	5	2	5

The following visualization calendars, created using the USA-NPN data visualization tool, give an overview of select phenophases for the January 2012 through August 2015 for *Quercus agrifolia*. Note the large gap shown in Figure 28, which represents the period of the U.S. Government shutdown.

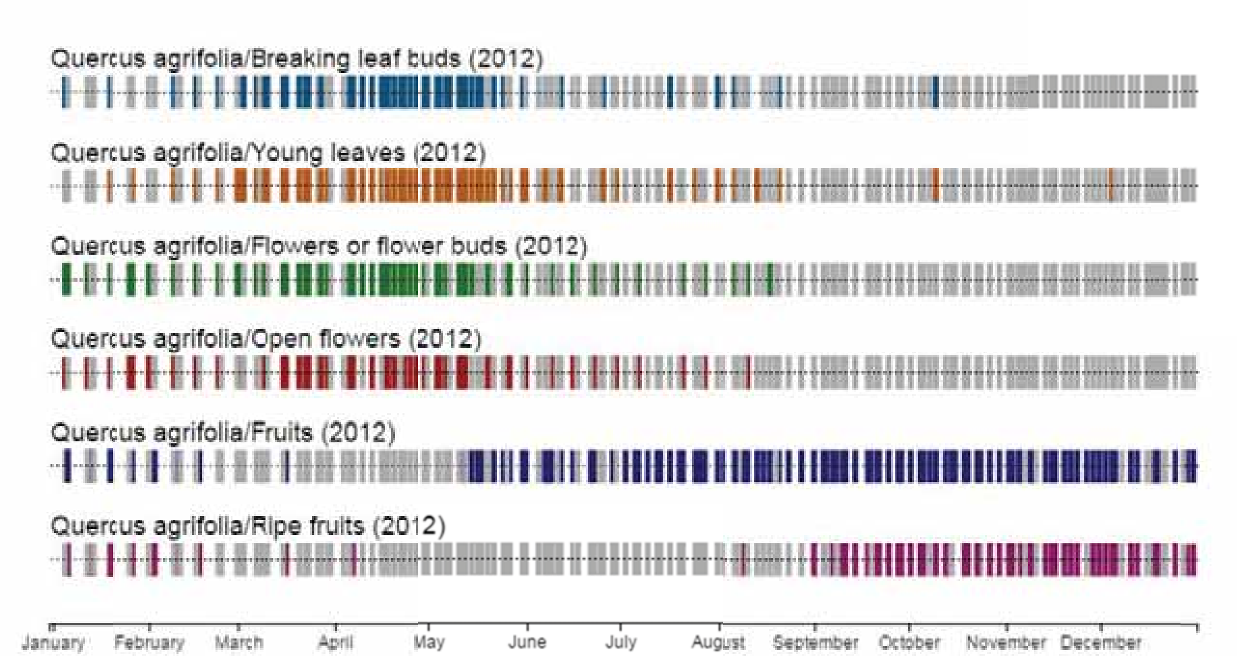


Figure 27. USA-NPN visualization calendar. Select phenophases for *Quercus agrifolia* at SAMO for calendar year 2012. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

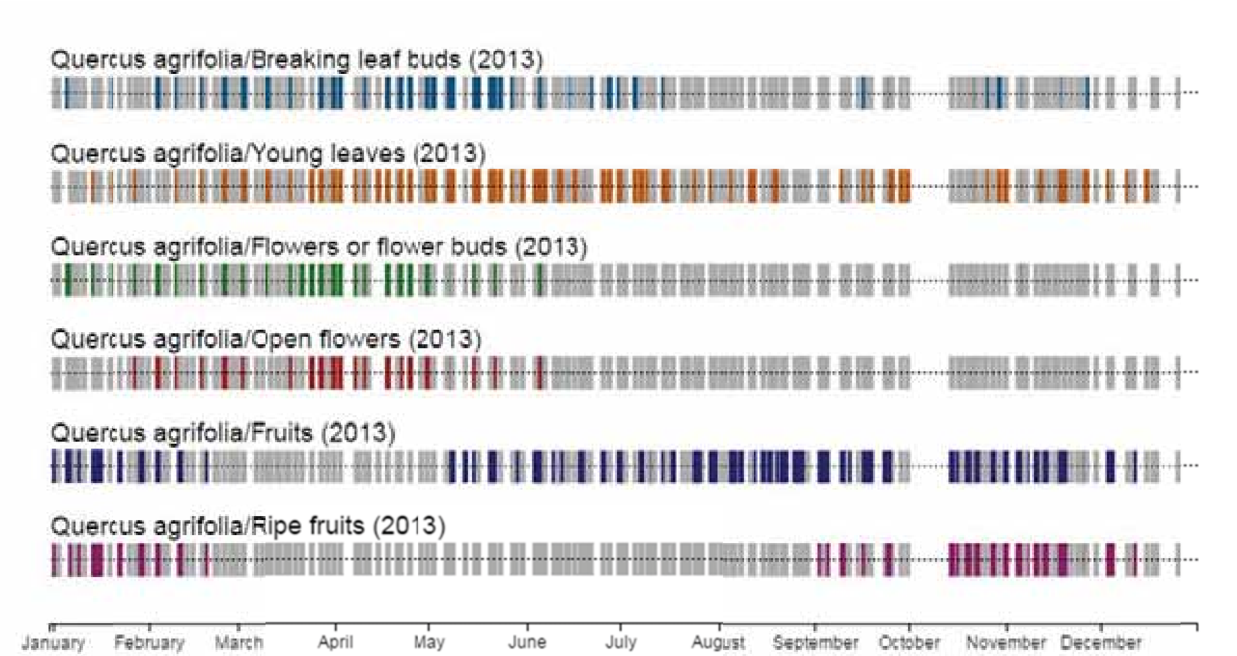


Figure 28. USA-NPN visualization calendar. Select phenophases for *Quercus agrifolia* at SAMO for calendar year 2013. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation. Note the large gap showing the absence of visitation during period of government shutdown.

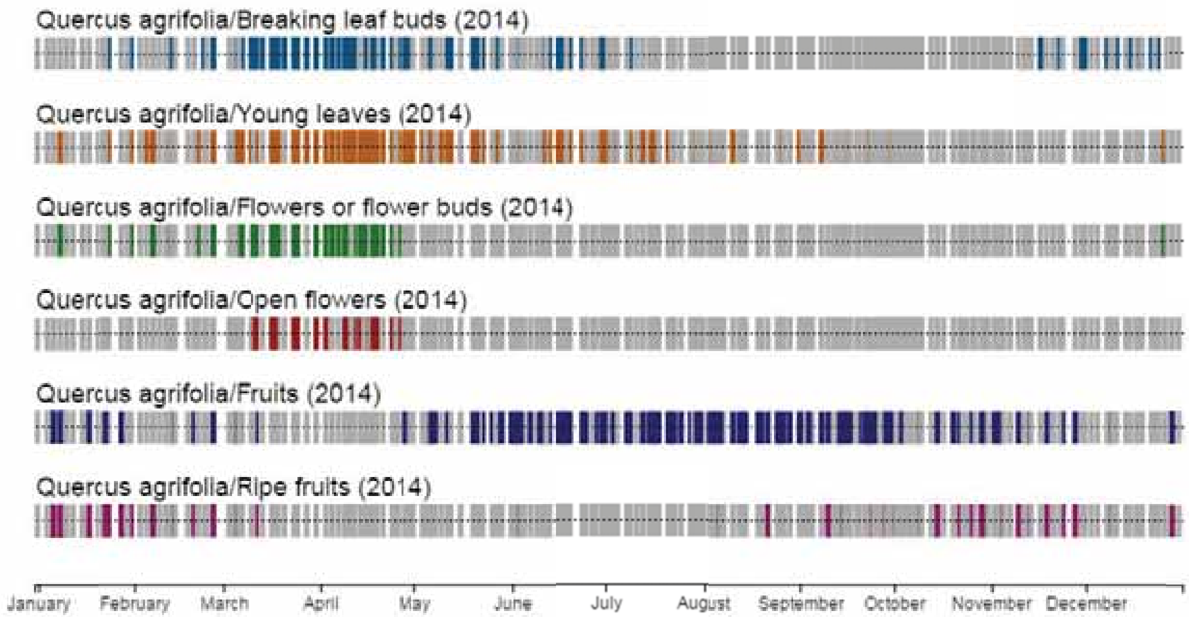


Figure 29. USA-NPN visualization calendar. Select phenophases for *Quercus agrifolia* at SAMO for calendar year 2014. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

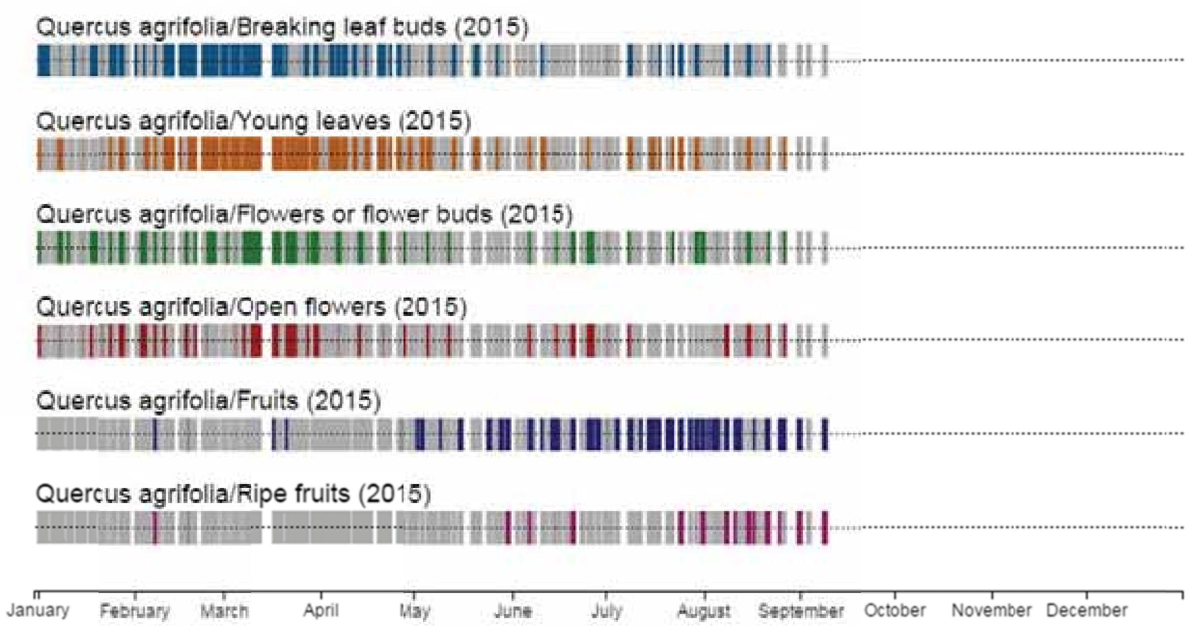


Figure 30. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Quercus agrifolia* at SAMO for calendar year 2015. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

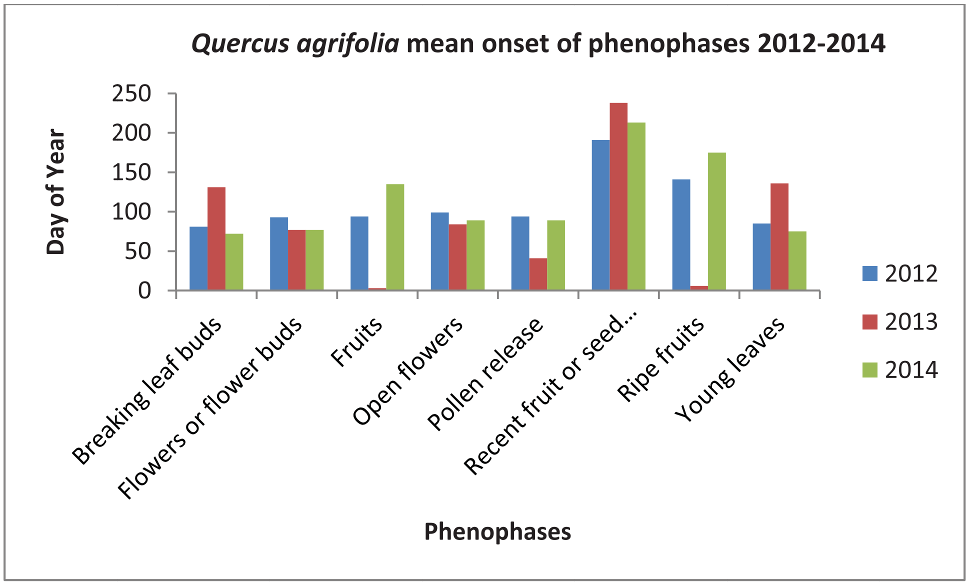


Figure 31. *Quercus agrifolia* mean onset of phenophases from raw data in Table 13. The day of year starts with 01 on January 1st and ends with 365 on December 31st.

The next 3 figures are frequency distribution charts created from raw data showing the number of the "Yes" observations for each observation day of flowering in *Quercus agrifolia* for January 2012 through December 2014.

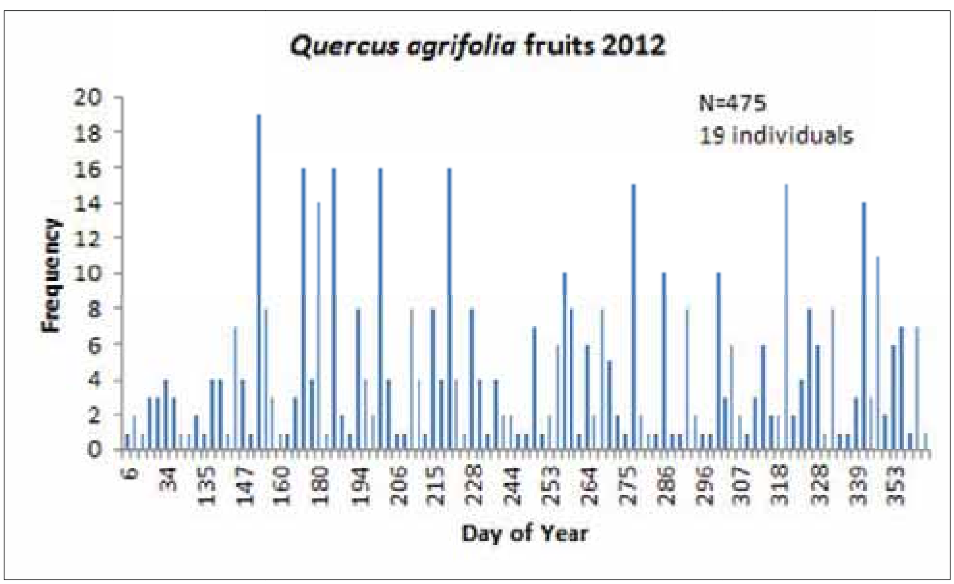


Figure 32. Frequency distribution chart from raw data showing frequency of "yes" observations of fruits in *Quercus agrifolia* for the calendar year 2012.

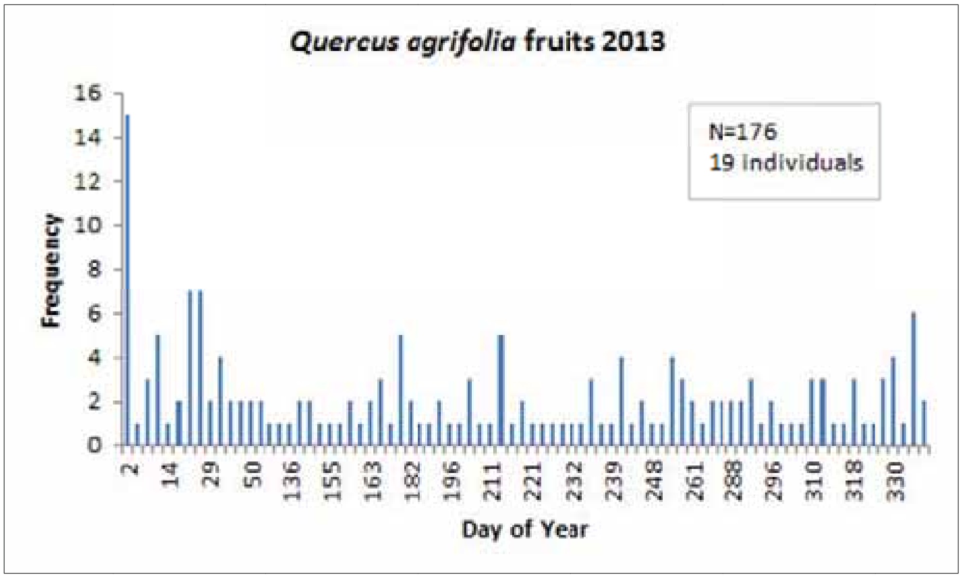


Figure 33. Frequency distribution chart from raw data showing frequency of "yes" observations of fruits in *Quercus agrifolia* for the calendar year 2013.

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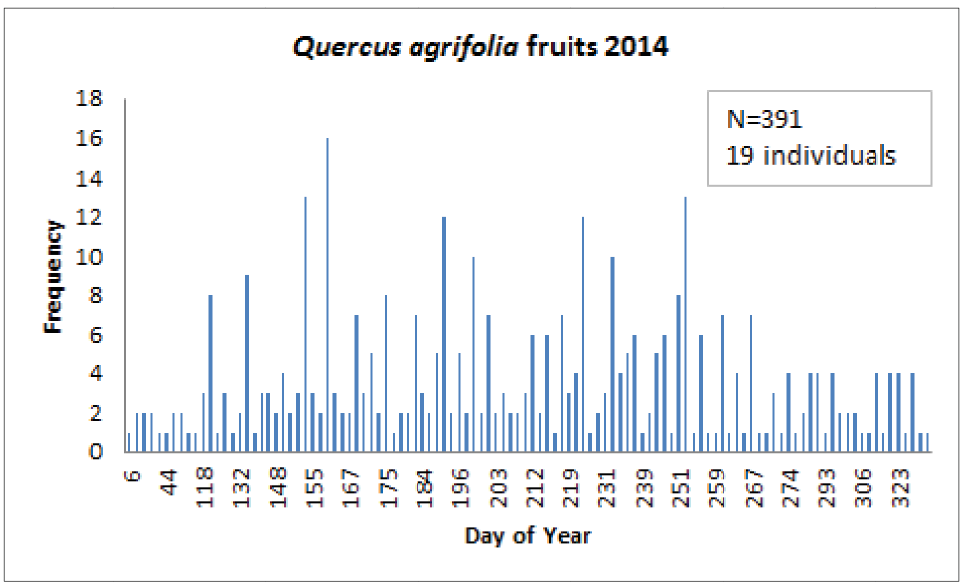

Figure 34. Frequency distribution chart from raw data showing frequency of "yes" observations of fruits *Quercus agrifolia* for the calendar year 2014.

<u>*Quercus lobata*</u>. There are 24 *Quercus lobata* CPP individuals monitored at 2 phenology trail locations within SAMO. Acorn production (fruit) was later in 2013 than in 2014. Flowering was later in 2013 than 2014. The USA-NPN changed the protocol for colored leaves in 2012. The phenophase for colored leaves has presented some difficulty for observers. Additionally, the trees need very cool temperatures to start producing vivid fall colors (Sagar, 2013). The leaf canopy on some of the trees at Cheeseboro Canyon were reported to be turning light green then immediately wilting and dropping before displaying vivid color. *Q. lobata* is a winter-deciduous tree.

Table 18. Mean onset dates for two phenophases for *Quercus lobata* monitored at SAMO using summarized data and first day of year. Note that the number (n) can be higher than number of individuals monitored when more than one series is captured by the USA-NPNsummarized data download tool.

Quercus lobata	Flowers or Flower Buds			Fruits		
All sites	2012	2013	2014	2012	2013	2014
Mean First Day of Year	118	127	92	223	183	248
Standard Deviation (STD)	77.06	84.80	31.24	88.40	72.34	71.99
Standard Error (SEM)	16.43	22.66	3.94	12.63	8.97	7.31
Number (n)	22	14	63	49	65	97
Cheeseboro Canyon						
Mean First Day of Year	111	174	71	190	206	228
Standard Deviation (STD)	109.81	118.48	73.85	91.31	108.98	68.74
Standard Error (SEM)	34.73	48.37	27.91	20.95	25.69	11.46
Number (n)	10	6	7	19	18	36
Paramount Ranch						
Mean First Day of Year	125	92	94	244	174	260
Standard Deviation (STD)	37.04	2.78	21.16	81.19	50.92	71.80
Standard Error (SEM)	10.69	0.98	2.83	14.82	7.43	9.19
Number (n)	12	8	56	30	47	61

The following 4 figures are visualization calendars created using the USA-NPN data visualization tool, showing select phenophases for the January 2012 through August 2015 for *Quercus lobata.*

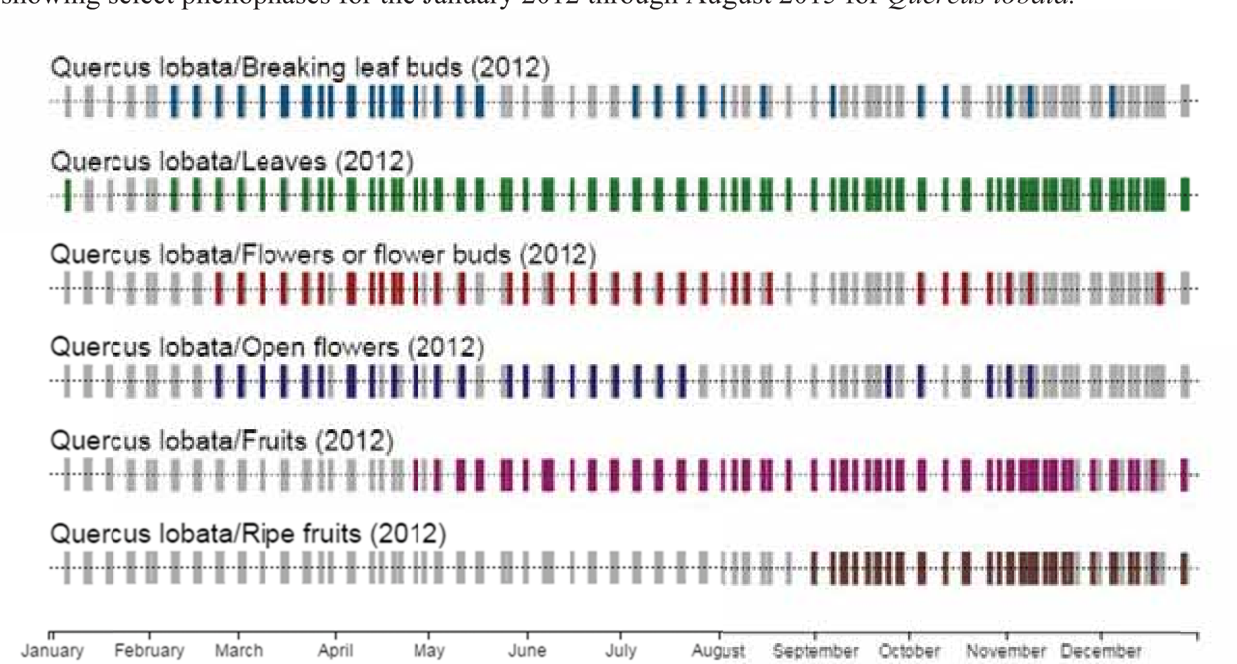

Figure 35. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Quercus lobata* at SAMO for calendar year 2012. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

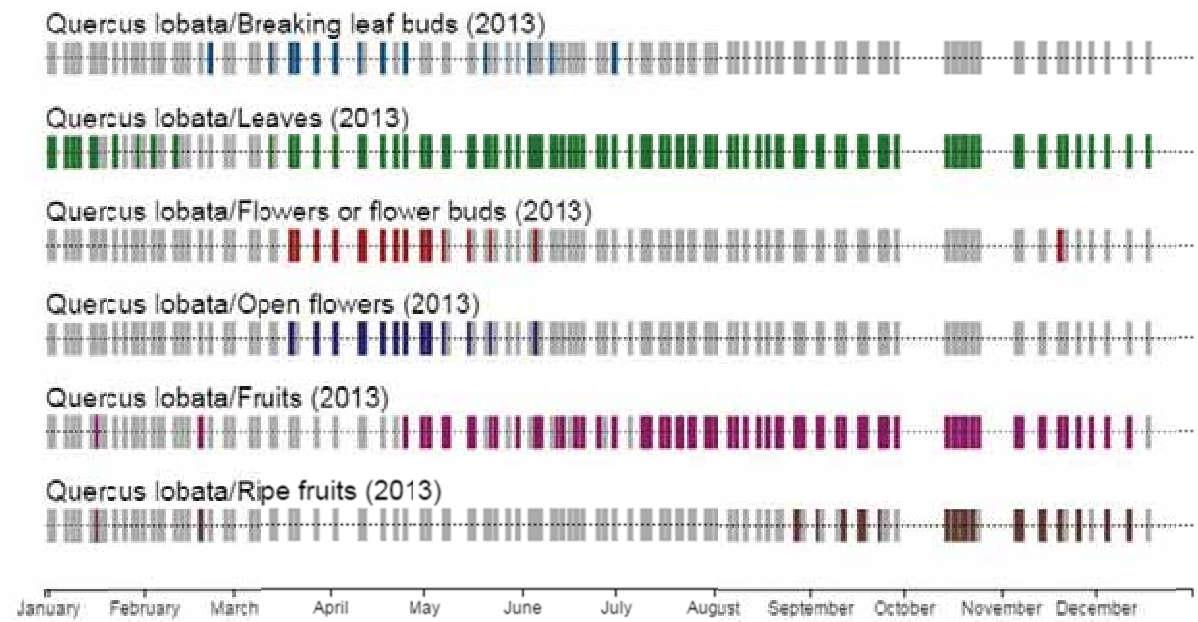

Figure 36. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Quercus lobata* at SAMO for calendar year 2013. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation. Note the large gap in October showing an absence of visitation during the government shutdown.

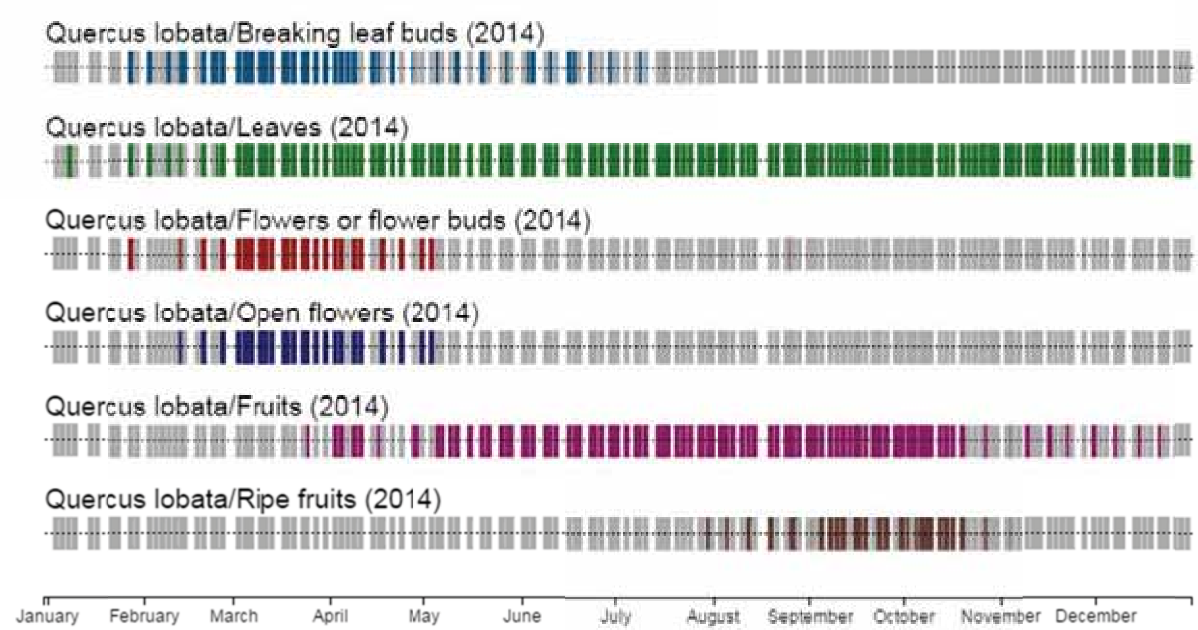

Figure 37. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Quercus lobata* at SAMO for calendar year 2014. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

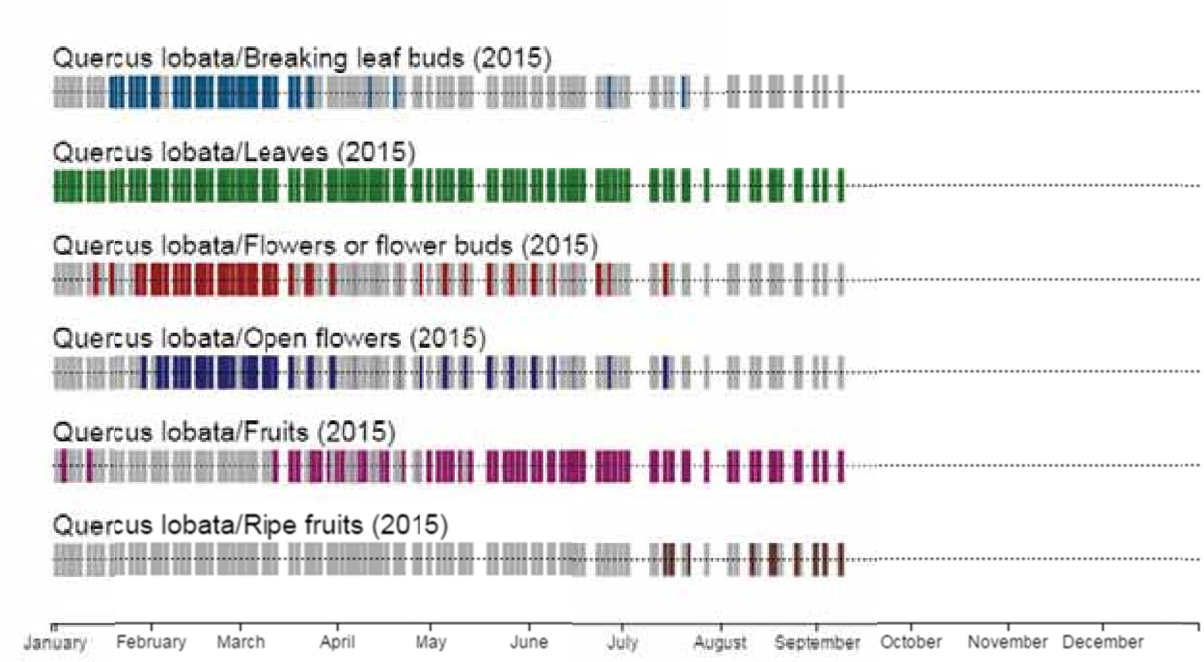

Figure 38. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Quercus lobata* at SAMO for calendar year 2015. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

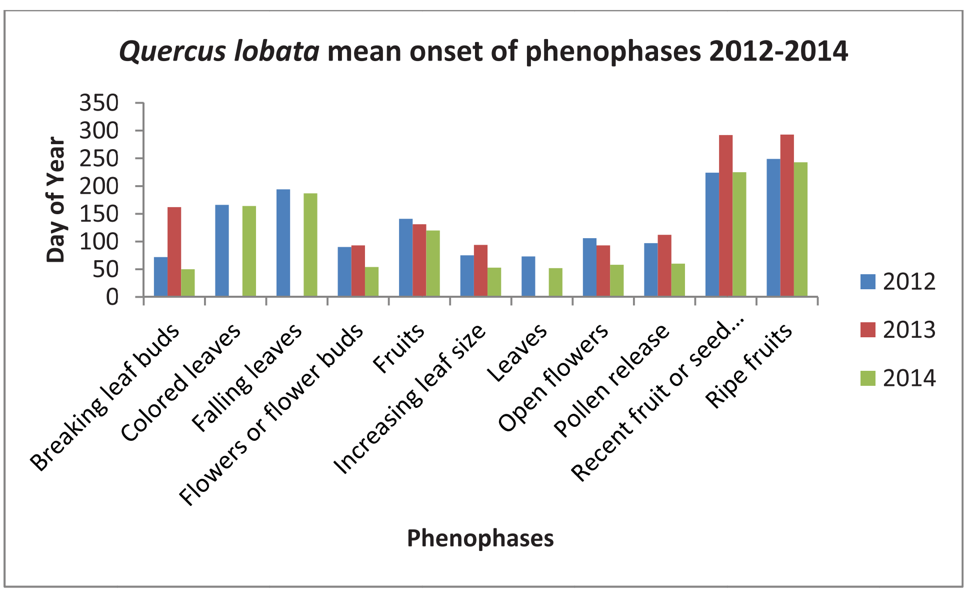

Figure 39. *Quercus lobata* mean onset of phenophases from raw data. The day of year starts with 01 on January 1st and ends with 365 on December 31st.

The next 3 figures are frequency distribution charts created from raw data showing the number of the "Yes" observations for each observation day of flowering in *Quercus lobata* for January 2012 through December 2014.

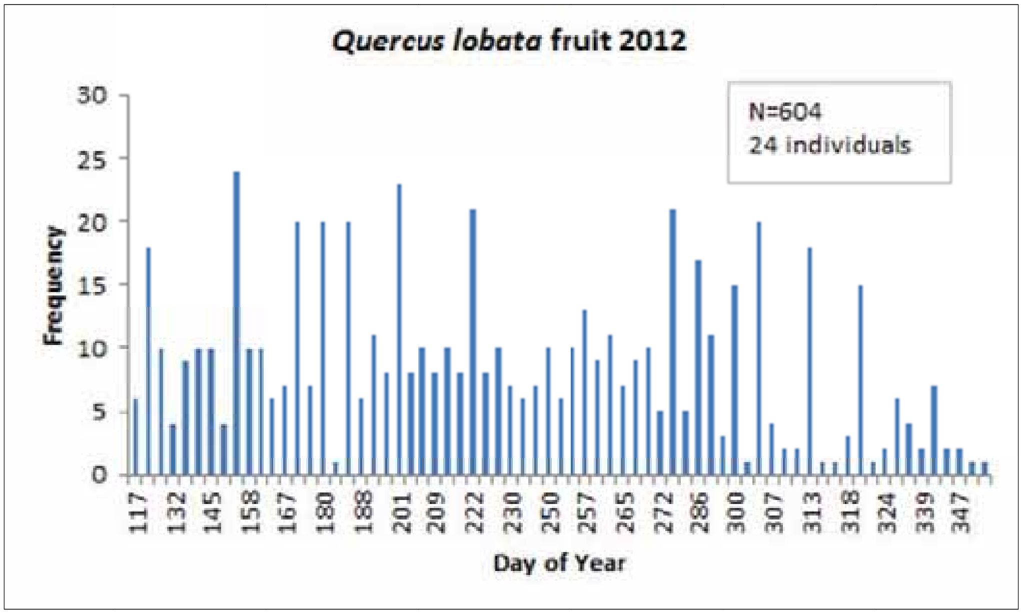

Figure 40. Frequency distribution chart from raw data showing frequency of "yes" observations of Fruits in *Quercus lobata* for the calendar year 2012.

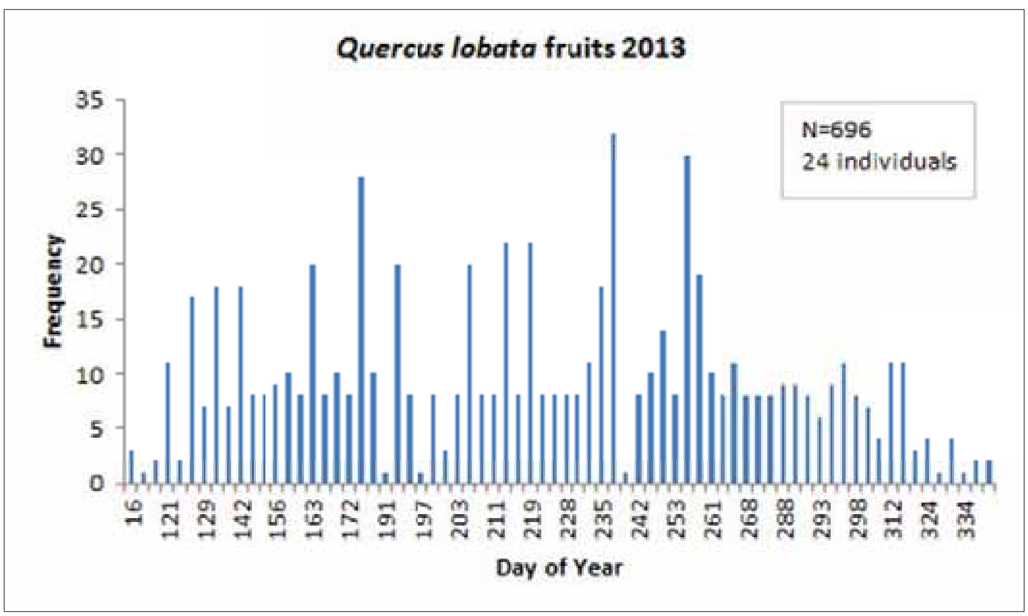

Figure 41. Frequency distribution chart from raw data showing frequency of "yes" observations of fruits in *Quercus lobata* for the calendar year 2013.

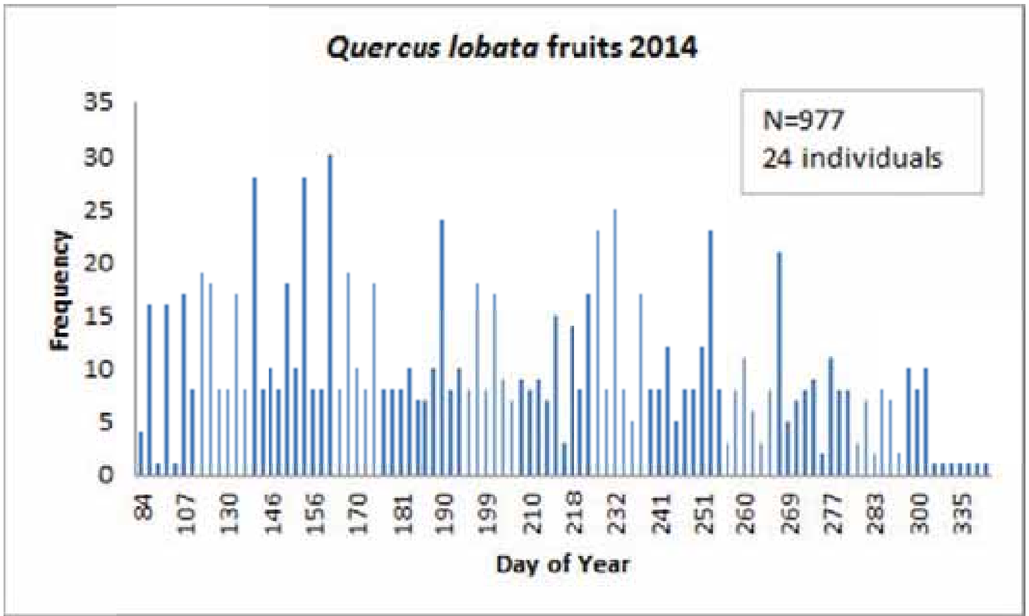

Figure 42. Frequency distribution chart from raw data showing frequency of "yes" observations of fruits in *Quercus lobata* for the calendar year 2014.

Sambucus nigra. There are 28 *Sambucus nigra* CPP individuals monitored at 4 phenology trail locations within SAMO. Breaking leaf buds occurred much later in 2013 than in either 2012 or 2014. Colored leaves were occurring progressively later in the year from 2012-2014. Fruit production was earlier in 2013, but flowering occurred at roughly the same time, with flowers in 2013 opening slightly later. Summarized data shows onset dates for flowering much earlier at Cheeseboro Canyon than either Paramount Ranch or Zuma Canyon on the coast. Overall flowering as earlier in 2014, but fruiting was increasingly later.

Table 19. Mean onset dates for two phenophases for *Sambucus nigra* monitored at SAMO using summarized data and first day of year. Note that the number (n) can be higher than number of individuals monitored when more than one series is captured by the USA-NPN summarized data download tool.

Sambucus nigra	Flowers or Flower Buds			Fruits		
All sites	2012	2013	2014	2012	2013	2014
Mean First Day of Year	116	124	104	235	240	245
Standard Deviation (STD)	68.34	64.08	46.03	91.58	83.68	61.99
Standard Error (SEM)	12.27	11.33	7.10	12.13	7.55	4.34
Number (n)	31	32	42	57	123	204
Cheeseboro Canyon						
Mean First Day of Year	96	98	80	126	221	173
Standard Deviation (STD)	42.00	27.84	49.72	8.32	82.34	64.35
Standard Error (SEM)	21.00	16.07	16.57	3.15	24.83	45.50
Number (n)	4	3	9	7	11	2

Sambucus nigra	Flowers or Flower Buds			Fruits		
Paramount Ranch						
Mean First Day of Year	139	154	110	203	221	247
Standard Deviation (STD)	67.32	65.69	26.79	34.21	45.59	65.48
Standard Error (SEM)	25.44	18.96	5.99	15.30	6.32	5.26
Number (n)	7	12	20	5	52	155
Rancho Sierra Vista-Satwiwa						
Mean First Day of Year	77	66	215	127	255	186
Standard Deviation (STD)	12.29		38.30	6.51	9.90	91.00
Standard Error (SEM)	6.14		22.11	3.76	7.00	52.54
Number (n)	4	1	3	3	2	3
Zuma Canyon						
Mean First Day of Year	121	110	82	264	261	246
Standard Deviation (STD)	79.69	62.62	17.96	86.24	105.37	42.39
Standard Error (SEM)	19.92	15.65	5.68	13.31	13.84	6.39
Number (n)	16	16	10	42	58	44

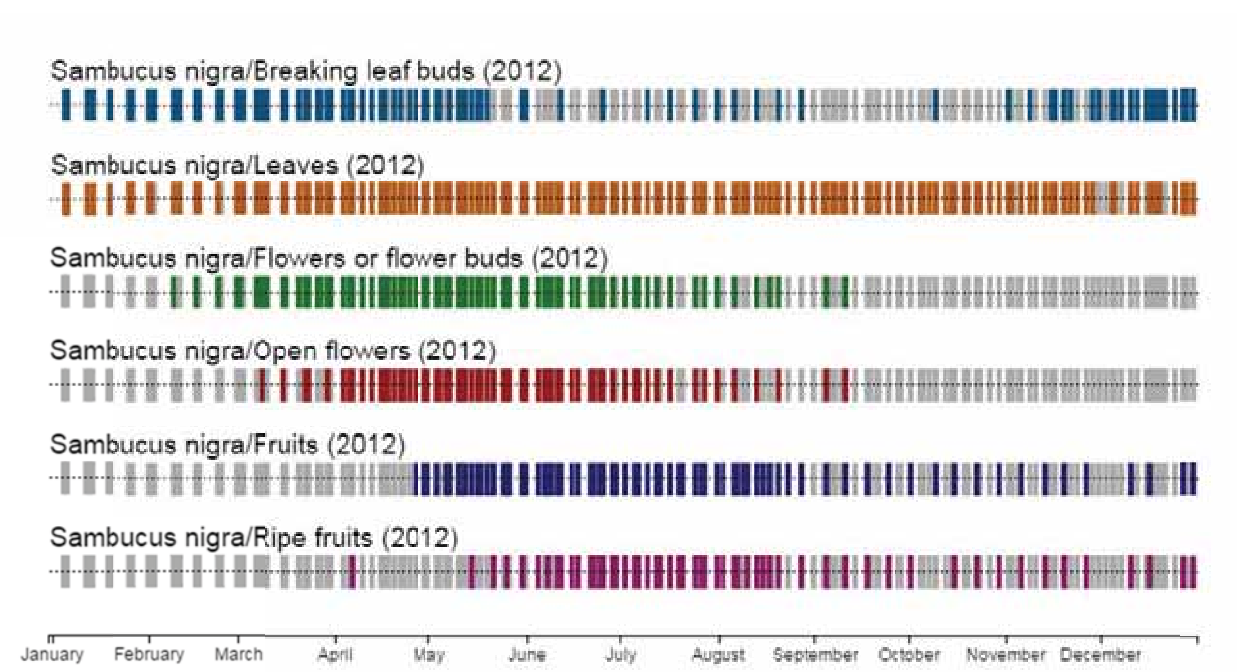

Figure 43. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Sambucus nigra* at SAMO for calendar year 2012. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

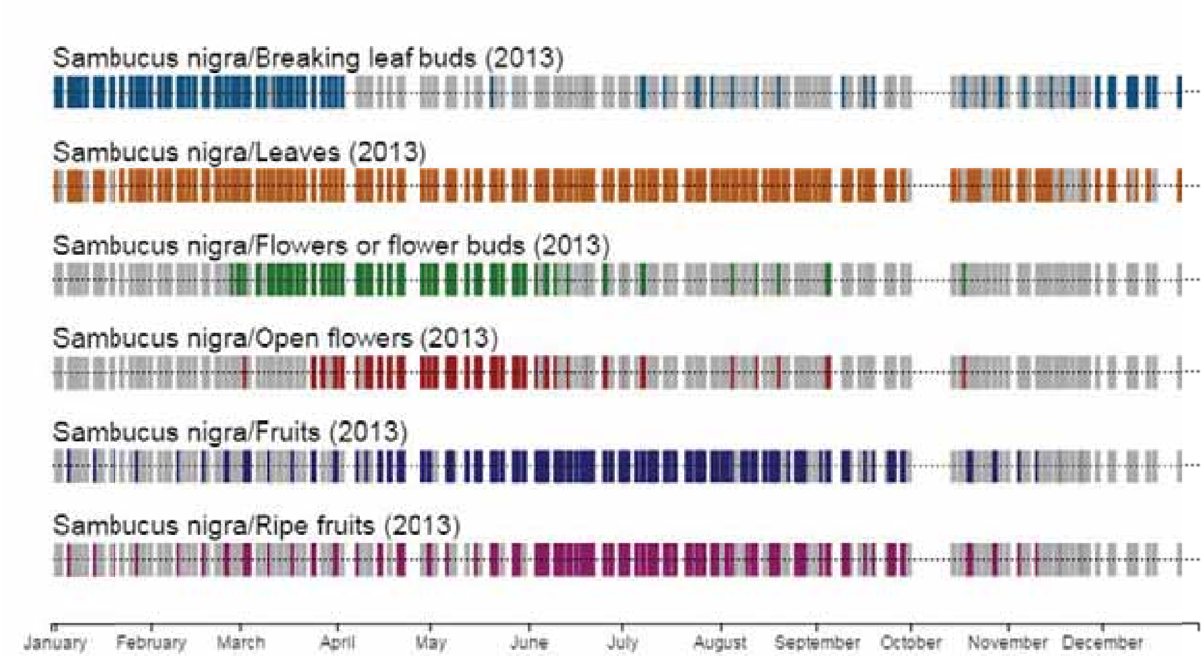

Figure 44. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Sambucus nigra* at SAMO for calendar year 2013. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation. Note gap in October showing the period of time during the government shutdown.

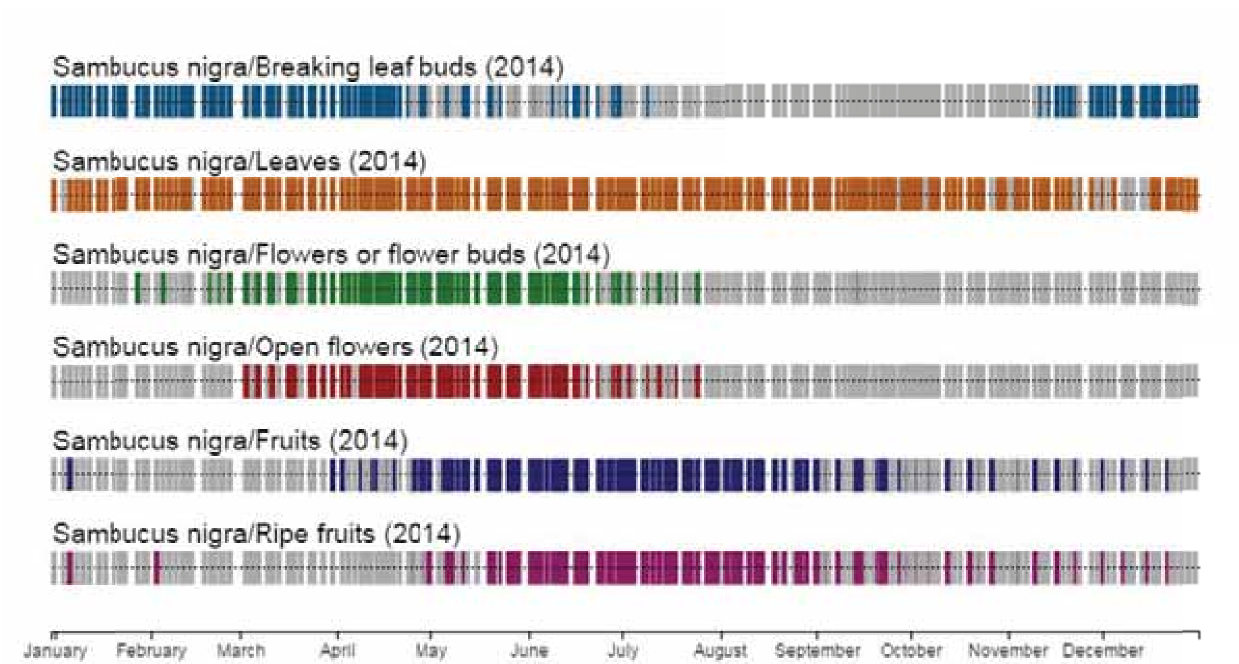

Figure 45. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Sambucus nigra* at SAMO for calendar year 2014. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

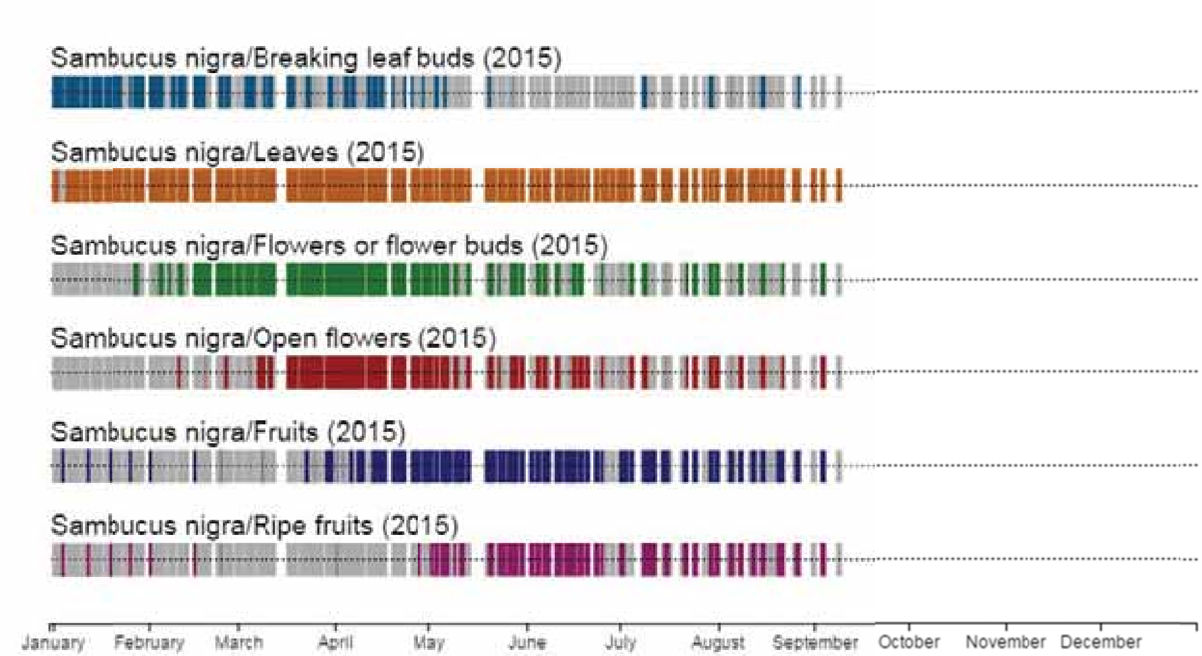

Figure 46. USA-NPN visualization calendar www.usanpn.org. Select phenophases for *Sambucus nigra* at SAMO for calendar year 2015. Each colored bar represents a "yes" observation on any given day during the calendar year and the each gray bar represents a "no" observation. Blank spaces represent absence of visitation.

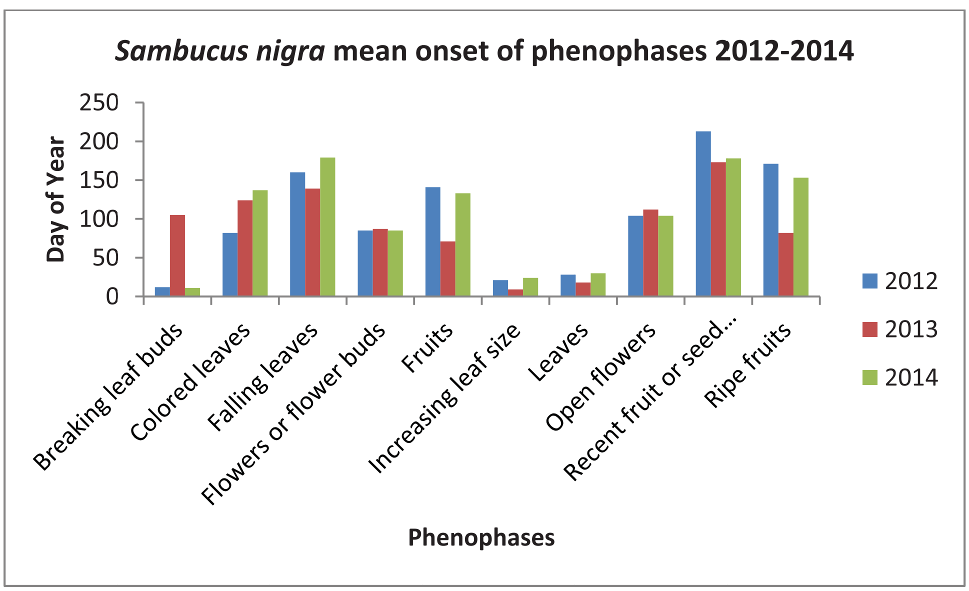

Figure 47. *Sambucus nigra* mean onset of phenophases using raw data from Table 13. The day of year starts with 01 on January 1st and ends with 365 on December 31st.

The next 3 figures are frequency distribution charts created from raw data showing the number of the "Yes" observations for each observation day of flowering in *Sambucus nigra* for January 2012 through December 2014.

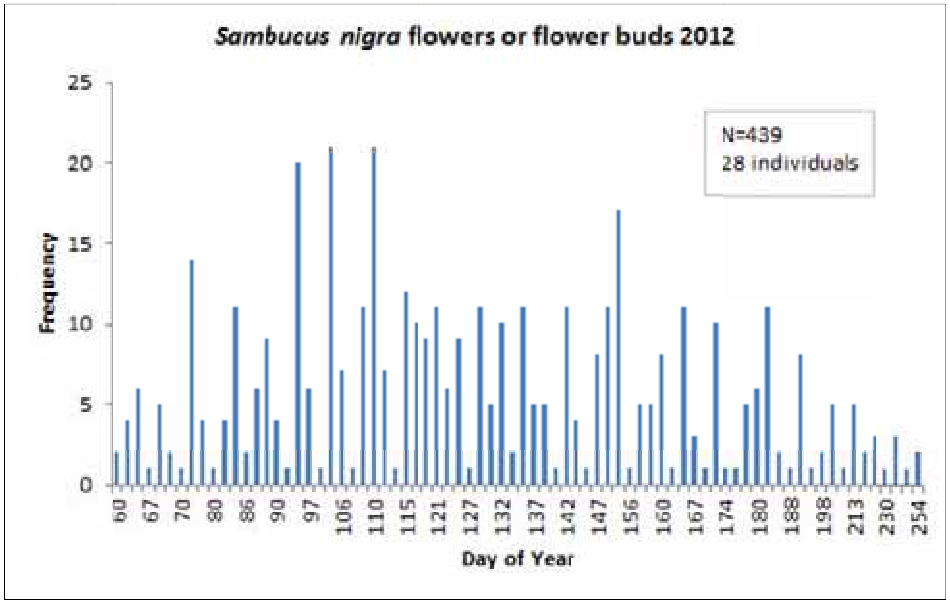

Figure 48. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds *Sambucus nigra* for the calendar year 2012.

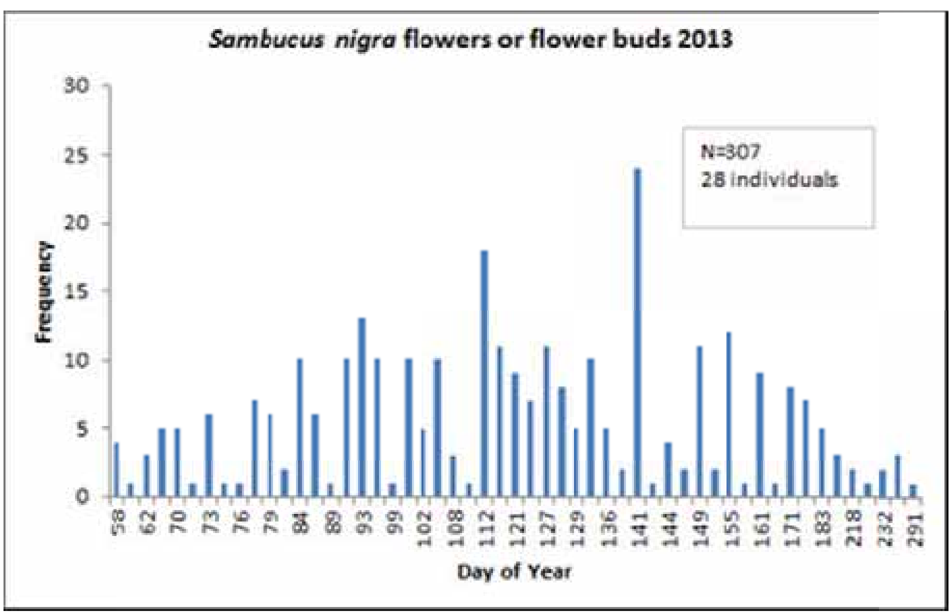

Figure 49. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds in *Sambucus nigra* for the calendar year 2013.

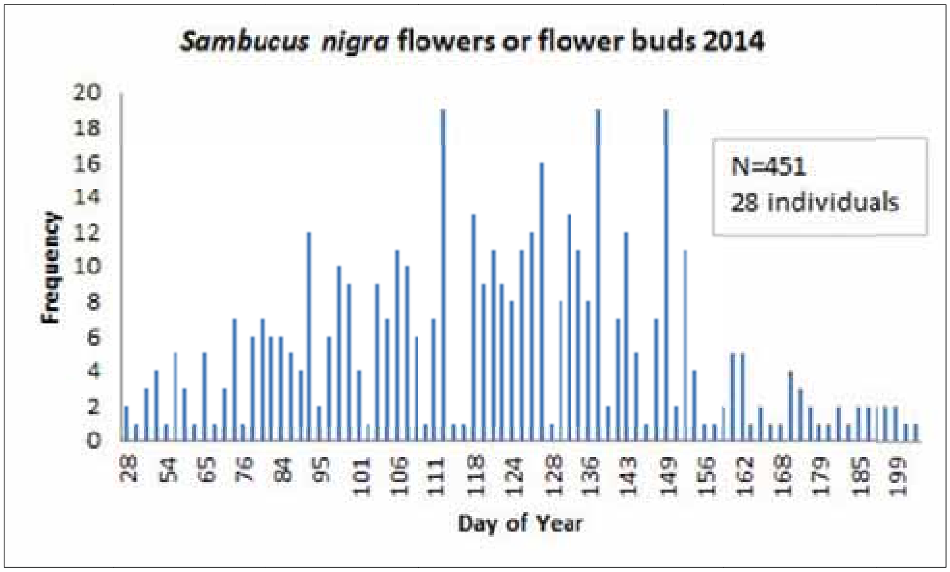

Figure 50. Frequency distribution chart from raw data showing frequency of "yes" observations of flowers or flower buds *Sambucus nigra* for the calendar year 2014.

Discussion

Results Interpretation

The four weather stations exhibited similar annual mean temperatures. Cheeseboro and UCLA had the same average temperature with Leo Carrillo and Malibu Canyon reporting annual means 2-4 degrees cooler. Precipitation normals for the 3 RAWS stations were lower than UCLA, most likely due to lack of historical data as the RAWS was not implemented until 1985 and 30 year data is not available. The departure from the 30 year normal in the years 2012, 2013 and 2014 indicated a slight increase in annual mean temperature in 2012 and 2013 and a 3 degree F increase in annual mean temperature for 2014 across all stations. All three years were drier than normal. The driest year was 2013, with departures from normal in 2013 ranging from 72-76% less precipitation. Leo Carrillo, our coastal station received only 1 inch of the historical 13 inch station normal. The UCLA-30 year normal annual precipitation is 18 inches. 2014 saw a recovery to approximately 50-70% of normal precipitation with all stations reporting approximately 10 inches ± 0.3 inches of precipitation .

Yearly variation in first flowering periods is remarkable in the Santa Monica Mountains, as dry sites and dry years can show the same effects on flowering, with variations such as more than one flowering period, longer flowering periods, shorter flowering periods or an absence of flowering periods. "First flowering can be up to six weeks apart between years. All extremes were experienced" from 2002-2007. (Prigge, B.A. and Gibson, A.C., 2012)

Onset dates for the various phenophases varied greatly between years. Extremely late onset of young leaves in *Adenostoma fasciculatum* and *Baccharis pilularis* in 2012 compared to 2013 could be the result of data gaps, rather than variations in temperature or precipitation. Leafing out in both *Quercus* species, *Sambucus nigra*, *A. fasciculatum* and *B. pilularis* was earlier in 2014 than 2013, but the appearance of young leaves in *Eriogonum fasciculatum* was later. The onset of flowers and flower buds in *S. nigra* was nearly the same for all three years, differing by only 2 days in 2013. The three shrub species flowered earlier in 2012 than 2013, but two of those species flowered much later in 2014, yet within 4 days of their 2012 flowering dates. 2012 and 2014 were years that received more precipitation than 2013. Fruiting in

Q. agrifolia, our evergreen oak species was later in 2014 than both previous years and fruiting in *Q. lobata*, our deciduous species was earlier than both 2013 and 2012.

Although detailed statistical analysis detecting correlations between climate and phenophase data is outside the scope of this report, patterns and descriptive characteristics can be discussed.

Adenostoma fasciculatum

The data gap of 6 months in 2012 forces data for this species to be viewed with caution. All reproductive phenophases occurred later in 2014 than 2013. *A. fasciculatum* is a relatively easy species to monitor due to its distinct phenophases. Fruit production in 2013 was low. Additionally, the raw data shows that at Sandstone Peak all CPP individuals produced flowers in 2013, but only 85% produced fruit. In 2014 only 50% of CPP individuals produced flowers and 32% produced fruit. Fruit production rate was also lower in 2014 than 2013, but the growth arrest rate was higher. Preliminary data for 2015 (not shown in tables) indicate a slight recovery with 67% of individuals producing flowers and 67% producing fruit, indicating a lessening of arrest rate of flowers to fruit with all individuals that produced flowers also producing fruit. The 2014 flowering Frequency distribution chart was right-skewed compared with 2012 and 2013, however when the DOY is looked at, one sees that 2013 and 2014 show most frequency between approximately 60-120 days, with 2012 showing much later, most likely due to the data gap.

Baccharis pilularis

The onset of flowers or flower buds was earlier in 2014 than 2013 and 2012. Reported opening of flowers was latest in 2013, and in 2014 opening 76 days sooner. Temporal variations such as this need to be looked at in further detail. Fruiting was later in 2014 than both 2012 and 2013. The appearance of young leaves was later in 2014. The earliest advance was reported in 2013, the driest year, with onset appearing 37 day earlier than 2014 and 12 days earlier than reported in 2012. Peak frequency or activity for *B. pilularis* CPP individuals was between day 264 and 283 in 2012, day 238 and day 274 in 2013 and in 2014 the peak height of activity was near day 253, with most of the activity between day 226 and day 259.

Eriogonum fasciculatum

The onset of flowers or flower buds was earliest in 2013 and latest in 2014. 2013 was also the driest of the three years. Fruit production was also earlier in 2013 than in 2014. Over half of the *E. fasciculatum* CPP individuals are located on Sandstone Peak and subject to the 6 month data gap. The flowering Frequency distribution charts for all three years show ultimate peak activity at or very near 148 days. This species has proven to be one of the more difficult to observe, as phenophases do not have clear endpoints and *E. fasciculatum* can flower at any time of the year with dried flowers and remaining on the plant as brown heads.

Quercus agrifolia

When observing fruiting onset dates between sites, a pattern emerges suggesting that onset of fruiting occurs later the further west the individual is located, with the western most site exhibiting an onset date up to 26 days later than the interior site in 2014. Oddly, flowering was reported to start on exactly the same day in 2013 and 2014. Fruiting was later in general for 2014 than in 2013 and 2012. Young leaves in 2013 were reported to appear 50-60 days later than either 2014 or 2012. The Frequency distribution chart for 2013 indicates a low fruit production for the year compared to the 2012 and 2014 seasons. Oaks can have years where there is extremely high fruit production (mast years) and then they rest for a year or so before producing another bumper crop. Dieback was observed in many *Q. agrifolia* individuals in 2014.

Quercus lobata
Q. lobata is monitored in only 2 locations at SAMO. The data for phenophases breaking leaf buds, flowers or flower buds, open flowers and fruit all show onset dates earlier in 2014 than in 2013 and 2012. Fruiting in 2013 was earlier than in 2012, but flowering in 2013 was later by 3 days, compared to 39 days later than the 2014 onset date. Breaking leaf buds were reported later at Paramount Ranch than at Cheeseboro Canyon for 2012 and 2014. Fruiting is also later at Paramount Ranch than at Cheeseboro Canyon for this species. The Frequency distribution charts for the fruiting phenophase show a steeper curve in 2013 than 2012 and 2014. This suggests that the activity was possibly confined to a shorter duration. At the southern end of its range, *Q. lobata* is one of two deciduous CPP species monitored at SAMO.

Sambucus nigra
Sambucus nigra is another deciduous species monitored at SAMO. Breaking leaf buds were occurring on nearly the same day in 2012 and 2014, but much later in 2013. Flowering was roughly the same across all three years with 2013 occurring 2 days later in 2013. Fruiting was earliest in 2013 and latest in 2012. Peak activity for *S. nigra,* occurred earlier in 2012, peaking between 90 and 115 days. Activity was highest from day 112 to day 141 in 2013 and day 111 to day 149 in 2014. Some of the phenophases for *S. nigra* are difficult to observe as the unopened flower buds look similar to unripe fruit, and the fruits, although fleshy, can persist in a desiccated state on the plant for long periods of time.

Education and Outreach
Collaboration between the Division of Interpretation and the Division of Planning, Science and Resources Management makes phenology monitoring at SAMO a successful joint endeavor. Collaboration with the Roads and Trails Division ensured none of the CPP plants included in the study are subjected to future maintenance by trail crews. The actual data collection and uploading of data is performed by a corps of trained volunteers, the phenology coordinator and the occasional intern. The Interpretive staff at SAMO designed several materials to promote awareness and understanding of phenology and climate change in their educational and outreach programs.

In summer of 2013, George Melendez Wright climate change intern Jessie Pearl developed a visitor center phenology activity, which included a phenology brochure with detailed instructions, a self-guided phenology hiking tour, and provided staff training at the Anthony C. Beilenson Visitor Center at King Gillette Ranch. Additionally, Jessie added a web presence for phenology to the SAMO website and produced a video showcasing her time at SAMO while also collecting and uploading data for the project.

Paramount Ranch Valley Oak (*Quercus lobata*) time lapse photography. SAMO volunteer Steve Matsuda photographs CPP *Quercus lobate* individual CPP_SAMO_PARA8_QULO-1 (188) once per week. These photos are uploaded to photo sharing website Smugmug and then retrieved by SAMO staff. Photos are then stitched into a movie at the end of each year. We currently have 2 seasons' worth of photos. The movie is posted periodically on the SAMO Facebook page.

Jr. Phenologist Program Overview and Program Modifications for Year 2
This program was originally developed by Lisa Okazaki and George M. Wright climate change intern Heather Martin. During the 2011-2012 school year, six of eight scheduled programs were pilot tested with 127 students and 16 teachers under the coordination of the Division of Interpretation and with assistance from the US Fish and Wildlife Service-Ventura Office (USFWS), Multicultural Education for Resource Issues Threatening Oceans (MERITO), and California State University Channel Islands (CSUCI). Two programs in May 2013 were cancelled due to the Springs Fire at Rancho Sierra Vista/Satwiwa where the program took place. The program was pilot tested with 4th through 12th grade students from Boys and Girls Clubs and public schools in Oxnard, Port Hueneme, Ventura, and Fillmore.

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After our Year 1 debriefing with USFWS and MERITO, some minor changes were made to the program and implemented. Students collected data on Toyon versus Coyote brush which made it much easier for students to identify the different phenophases. A new hike route had to be established to observe a limited number of Toyon located near the windmill and Satwiwa garden. The middle school field booklets, teacher guide, and staff training materials were also updated to reflect these changes. USFWS and SAMO staff also agreed to collect data on animals since SAMO had added a list of animals to the USA National Phenology Network database. An age-appropriate data sheet was developed and both plant and animal data were collected by the students and staff.

Phenology workshops hosted by SAMO Interpretation and Education
Phenology workshops for teachers were hosted by Barbara Applebaum, Supervisory Park Ranger and Lisa Okazaki, Education Specialist with help from their staff and the phenology coordinator. These 2-day workshops with a "train the trainer" approach included lecture, lecture activities and field instruction provided by CPP researchers Dr. Susan Mazer and Brian Haggerty from UCSB. In 2012, two CPP workshops targeted at teachers and educators: one in the Spring and one in the Fall. In 2013, none were held as all activities at Rancho Sierra Vista were suspended due to the Springs Fire. In 2014, one full-day CPP workshop was held in April. The focus was expanded to include partners Nature Bridge and members of the public. Two volunteers were recruited. In 2015, one full-day CPP workshop was held in April. The focus was directed to educators and the general public.

University course credit offered to CSU Channel Islands students
ESRM 490 – Special Topics, Engaging Children and Other Park Visitors in Climate Change/Phenological Data Collection at Santa Monica Mountains National Recreation Area was a course taught by NPS staff and offered to university students from CSU Channel Islands in the Spring of 2012. There were 7 students enrolled in the course. The course gave students an introduction to the park, and addressed the following topics: interpretation and place-based education, climate change in the Santa Monica Mountains and interpreting climate change to park visitors, phenological data collection, engaging elementary and middle school students in phenological data collection, and also teaching the Jr. Phenologist program to both elementary and middle school students, and assisting them with data collection. Additionally, each student was also assigned an independent project to facilitate phenology.

Smarty Plants!

The "Smarty Plants!" ranger-led nature hike was developed by Education Specialist Lisa Okazaki, and included a phenology data collection component developed by the phenology coordinator. This program was presented to 48 middle school students at Paramount Ranch in March, 2015 and consisted of one 45-minute nature hike and one 45-minute phenology workshop with a data collection activity. Students were split into two groups, with each group participating in either the hike or the workshop. Once the students completed the first activity, they reassembled at a central location where each group then switched places/leaders to participate in the other activity. The phenology workshop portion focused on the two oak species found at Paramount Ranch and utilized a customized age-appropriate data sheet based on the USA-NPN datasheet template. The ranger-led nature hike focused on possible impacts to vegetation imposed by a changing climate and spotlighted *Q. lobata* (valley oak). *Q. lobata* is at the southern end of its range and may or may not survive a changing climate. Smarty Plants! was well- received and lends its success in part to the fact that it was offered in the early spring when the showier phenophases were most active. Participants were covered in clouds of pollen when shaking a branch to record the pollen release phenophase.

Science Festival

A phenology booth was sponsored at SAMO's annual science festival in both 2013 and 2014 showcasing phenology with posters, lectures, games and hands-on participation. The Science Festival is held in April every year at Paramount Ranch and receives over 2,000 visitors, many of whom are students and teachers bussed in from Los Angeles county schools. The phenology booth was staffed by the phenology coordinator and volunteers. A custom data sheet was created in both English and Spanish, which the children used to collect data on one oak tree. In 2014, the addition of bilingual volunteers was an added plus, as they explained phenology and its principles in Spanish to many visitors. Southern California has a large Hispanic population.

Phenology speaking engagements

Part of a phenology coordinator's duties includes delivering phenology-related presentations to internal staff, as well as park partners and the public. The CPP monitoring program at SAMO was presented to various NPS divisions on an annual basis. In addition, during May of 2014 the phenology coordinator gave a presentation summarizing the CPP phenology monitoring program at SAMO at the Southern California Academy of Sciences 107th annual meeting, during the Citizen Science Symposium portion of the event held at California State University Channel Islands. In September 2014, the SAMO phenology coordinator assisted Dr. Susan Mazer with a phenology workshop at Tejon Ranch to facilitate phenology monitoring at the Tejon Ranch Conservancy's 240,000 acres of protected open space. In February of 2015, the phenology coordinator worked with two members of the Topanga State Park Docents to facilitate phenology monitoring at their park. Both members had attended the April 2014 phenology workshop hosted by Dr. Susan Mazer.

Volunteer Outreach - Core Volunteers

At SAMO, a small highly trained corps of volunteers comprises the observer network. Volunteers must attend a CPP phenology workshop or half day training from the phenology coordinator before being allowed to officially collect phenology data for the park. Volunteers participate in additional activities periodically throughout the year with a park specialist, such as the park's botanist as a way to thank them for their service. This allows them the opportunity to interact with each other and learn from expert staff. The trips can last anywhere from a couple of hours to half a day. In 2012 VIPs were treated to a spring rare flower hike, a fall forensic botany hike and a winter fern hike. In 2013 a paleo botany and fossil trip through the Santa Monica Mountains was coordinated with a local expert, and in 2014 two plant keying workshops and a cultural archeology hike were held. The core volunteers consist of mainly retired older persons and a few young persons. The younger volunteers are generally able to commit to periods of time lasting from a few months to one year.

Lessons Learned/Recommendations

A project this size cannot operate successfully without a coordinator at the park level. SAMO volunteers will eventually be lost through attrition which can leave trails without monitoring coverage and contribute to gaps in data. Efforts to retain volunteers should be maintained, however it is realized volunteer recruitment needs to be an ongoing continual process. Flyers posted at the trailhead that is in need of coverage and semi-annual phenology workshops held each spring and fall could help the park acquire a larger pool of phenology volunteers.

Spring comes early in the Santa Monica Mountains and a workshop offered in March will capture some of the more showy phenophases like young leaves, flowering and pollen release. An additional workshop in the fall would capture the actively flowering phenophase of *B. pilularis*, which is an extremely common, yet difficult plant to observe. A workshop at this time of year also gives new volunteers time to become familiar with their assigned CPP trails, CPP plants and CPP data collection methods before the upcoming spring burst of the ensuing season, when observing is most critical.

For this type of education program, the students need to be available to come out on a regular basis. It was far too difficult to train students in a short amount of time (2 hours). However, it was still a good way to introduce the connection between phenophases and climate change. This type of program seemed to work best with middle and high school students.

The large volume of plants monitored at SAMO at 200 individuals and remote trail locations requires a time commitment that must be taken into account. Volunteers put in approximately 800 hours per year collecting data. This also means a greater volume of data to manage. The new summarized data tool makes it faster to download data and easier to visualize phenophases. Multiple starts and stops show as a new series in the summarized data. Observer conflicts such as those seen in a snapshot of 2013 data from Sandstone Peak, are not distinguished from new series by the USA-NPN data download tool. This seems to be a possible departure from the two "no" observations followed by a "yes" criteria for series selection.

More QA/QC needs to happen at the park level. Ideally, a phenology coordinator should be visiting the trails on a regular basis, at least once per month. This can help reduce observer conflicts, but requires approximately 24 man-hours as the round trip hike for all 5 trails combined is 12.5 miles with 2-3 hours of driving. Now that the data download tool is up and running, it is possible to download the data for each week to review it for anomalies and go into the field if a discrepancy is noticed. Volunteers do not always upload their data in a timely manner. When using the phone app, the data is immediately accessible, but there is no data sheet to check against.

Many micro climates exist within the Santa Monica Mountains. Data loggers to record temperature were purchased in 2015 and are due to be installed at each phenology site after the departure of the phenology coordinator.

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Appendix A – Phenophase detail tables 2012-2014

** Duration does not account for gaps in data, phenophase activity carried over from previous calendar year or multiple onset dates*

Table A-1. Phenophase summary breakdown by trail for 2012 from raw data.

2012 Phenophase Activity for Six Plant Species base on data downloaded from the NPDb.
Min Day of Year = First Date Observed, Max Day of Year = Last Date Observed

						Cheeseboro Canyon 10 sites		Paramount Ranch 9 sites		Rancho Sierra Vista - Satwiwa 6 sites		Sandstone Peak 9 sites		Zuma Canyon 6 sites	
2012 Phenphases	Min DOY	Max DOY	Duration*	Mean DOY	2012 Phenophases	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY
Adenostoma fasciculatum					***Adenostoma fasciculatum***										
Flowers or flower buds	67	206	139	108	Flowers or flower buds	--	--	97	195	67	206	--	--	--	--
Fruits	5	366	361	119	Fruits	--	--	6	362	5	366	31	366	--	--
Open flowers	69	206	137	147	Open flowers	--	--	147	195	69	206	--	--	--	--
Recent fruit or seed drop	60	362	302	247	Recent fruit or seed drop	--	--	106	362	60	213	205	345	--	--
Ripe fruits	5	366	361	119	Ripe fruits	--	--	6	362	5	366	31	366	--	--
Young leaves	6	366	360	108	Young leaves	--	--	6	350	14	359	31	366	--	--
Baccharis pilularis					***Baccharis pilularis***										
Flowers or flower buds	60	362	302	157	Flowers or flower buds	250	340	209	362	60	326	--	--	219	324
Fruits	5	366	361	35	Fruits	6	363	6	362	5	366	--	--	5	365
Open flowers	6	362	356	113	Open flowers	6	340	27	362	60	326	--	--	248	324
Pollen release	60	303	243	101	Pollen release					60	294	--	--	289	303
Recent fruit or seed drop	60	362	302	121	Recent fruit or seed drop	347	353	350	362	60	115	--	--	61	345
Ripe fruits	5	366	361	35	Ripe fruits	6	363	6	362	5	366	--	--	5	365
Young leaves	6	365	359	45	Young leaves	6	363	20	362	26	213	--	--	27	365
Eriogonum fasciculatum					***Eriogonum fasciculatum***										
Flowers or flower buds	60	363	303	86	Flowers or flower buds	68	363	68	219	60	184	205	205	61	233
Fruits	5	366	361	114	Fruits	54	363	20	362	60	359	31	366	5	365
Leaves	61	366	305	169	Leaves	68	363	68	352	67	366	205	366	61	365
Open flowers	54	363	309	105	Open flowers	54	363	97	219	60	184	205	205	83	233
Recent fruit or seed drop	60	365	305	225	Recent fruit or seed drop	68	333	97	362	60	278	205	345	61	365
Ripe fruits	5	366	361	117	Ripe fruits	54	363	20	362	60	359	31	366	5	365
Young leaves	5	366	361	63	Young leaves	6	363	6	350	5	366	31	366	5	365
Quercus agrifolia					***Quercus agrifolia***										
Breaking leaf buds	5	283	278	81	Breaking leaf buds	40	145	97	132	62	133	--	--	5	283
Flowers or flower buds	60	230	170	93	Flowers or flower buds	61	131	106	230	60	146	--	--	61	135
Fruits	6	365	359	94	Fruits	6	363	13	352	198	359	--	--	135	365
Open flowers	5	223	218	99	Open flowers	12	131	147	223	69	146	--	--	5	115
Pollen release	19	146	127	94	Pollen release	75	131	112	125	69	146	--	--	19	89
Recent fruit or seed drop	76	333	257	191	Recent fruit or seed drop	208	333	76	321	97	97	--	--	296	296
Ripe fruits	6	365	359	141	Ripe fruits	6	363	6	352	97	359	--	--	261	365
Young leaves	19	339	320	85	Young leaves	40	158	97	181	60	206	--	--	19	339
Quercus lobata					***Quercus lobata***										
Breaking leaf buds	40	339	299	72	Breaking leaf buds	40	313	68	339	--	--	--	--	--	--
Colored leaves	90	363	273	166	Colored leaves	158	363	90	362	--	--	--	--	--	--
Falling leaves	173	363	190	194	Falling leaves	173	363	209	362	--	--	--	--	--	--
Flowers or flower buds	61	354	293	90	Flowers or flower buds	61	354	68	230	--	--	--	--	--	--
Fruits	117	362	245	141	Fruits	117	347	132	362	--	--	--	--	--	--
Increasing leaf size	6	363	357	75	Increasing leaf size	6	363	68	339	--	--	--	--	--	--
Leaves	6	363	357	73	Leaves	6	363	68	362	--	--	--	--	--	--
Open flowers	54	313	259	106	Open flowers	54	313	97	202	--	--	--	--	--	--
Pollen release	75	268	193	97	Pollen release	75	268	112	125	--	--	--	--	--	--
Recent fruit or seed drop	201	326	125	224	Recent fruit or seed drop	201	326	236	321	--	--	--	--	--	--
Ripe fruits	244	362	118	249	Ripe fruits	250	347	244	362	--	--	--	--	--	--
Sambucus nigra					***Sambucus nigra***										
Breaking leaf buds	5	366	361	12	Breaking leaf buds	6	363	6	362	5	366	--	--	5	365
Colored leaves	26	351	325	82	Colored leaves	173	347	90	321	26	297	--	--	40	351
Falling leaves	62	365	303	160	Falling leaves	173	347	202	321	62	297	--	--	75	365
Flowers or flower buds	60	254	194	85	Flowers or flower buds	61	187	68	230	60	194	--	--	61	254
Fruits	117	365	248	141	Fruits	117	222	147	236	120	228	--	--	121	365
Increasing leaf size	5	366	361	21	Increasing leaf size	6	363	27	352	5	366	--	--	5	362
Leaves	5	366	361	28	Leaves	6	363	48	352	5	366	--	--	5	365
Open flowers	68	254	186	104	Open flowers	68	187	97	209	94	194	--	--	75	254
Recent fruit or seed drop	173	365	192	213	Recent fruit or seed drop	173	215	188	244	176	176	--	--	177	365
Ripe fruits	97	365	268	171	Ripe fruits	159	215	167	230	97	228	--	--	135	365

Table A-2. Phenophase summary breakdown by trail for 2013 from raw data.

2013 Phenophase Activity for Six Plant Species base on data downloaded from the NPDb.
Min Day of Year = First Date Observed, Max Day of Year = Last Date Observed

2013 Phenophases	Min DOY	Max DOY	Duration*	Mean DOY	Number Individuals
Adenostoma fasciculatum					
Flowers or flower buds	23	311	288	65	n=32
Fruits	2	352	350	16	n=41
Open flowers	74	134	60	106	n=29
Recent fruit or seed drop	3	352	349	82	n=36
Ripe fruits	2	352	350	16	n=41
Young leaves	7	360	353	21	n=41
Baccharis pilularis					
Flowers or flower buds	30	350	320	145	n=9
Fruits	6	350	344	6	n=4
Open flowers	232	350	118	240	n=4
Pollen release	238	350	112	238	n=1
Recent fruit or seed drop	62	329	267	216	n=3
Ripe fruits	6	350	344	7	n=4
Young leaves	6	350	344	33	n=11
Eriogonum fasciculatum					
Flowers or flower buds	56	226	170	76	n=38
Fruits	2	352	350	24	n=37
Leaves	2	352	350	7	n=37
Open flowers	74	226	152	119	n=37
Recent fruit or seed drop	3	352	349	109	n=36
Ripe fruits	2	352	350	27	n=37
Young leaves	7	352	345	21	n=37
Quercus agrifolia					
Breaking leaf buds	6	331	325	131	n=4
Flowers or flower buds	6	310	304	77	n=3
Fruits	2	338	336	3	n=4
Open flowers	28	112	84	84	n=3
Pollen release	41	91	50	41	n=1
Recent fruit or seed drop	199	315	116	238	n=4
Ripe fruits	2	338	336	6	n=4
Young leaves	14	350	336	136	n=5
Quercus lobata					
Breaking leaf buds	53	182	129	162	n=5
Colored leaves	2	352	350	2	n=5
Falling leaves	2	352	350	2	n=5
Flowers or flower buds	93	123	30	93	n=5
Fruits	129	319	190	131	n=4
Increasing leaf size	87	272	185	94	n=5
Leaves	2	352	350	2	n=5
Open flowers	93	123	30	93	n=4
Pollen release	112	112	0	112	n=1
Recent fruit or seed drop	291	334	43	292	n=4
Ripe fruits	291	319	28	293	n=4
Sambucus nigra					
Breaking leaf buds	2	352	350	105	n=19
Colored leaves	35	350	315	124	n=18
Falling leaves	14	329	315	139	n=17
Flowers or flower buds	62	291	229	87	n=17
Fruits	6	329	323	71	n=16
Increasing leaf size	2	350	348	9	n=19
Leaves	2	350	348	18	n=19
Open flowers	91	291	200	112	n=15
Recent fruit or seed drop	6	315	309	173	n=15
Ripe fruits	6	329	323	82	n=16

2013 Phenophases	Cheeseboro Canyon 10 sites		Paramount Ranch 9 sites		Rancho Sierra Vista - Satwiwa 6 sites		Sandstone Peak 9 sites		Zuma Canyon 6 sites	
	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY
Adenostoma fasciculatum										
Flowers or flower buds	--	--	74	129	38	121	23	311	--	--
Fruits	--	--	2	293	8	121	7	352	--	--
Open flowers	--	--	74	129	99	121	98	134	--	--
Recent fruit or seed drop	--	--	3	248	--	--	7	352	--	--
Ripe fruits	--	--	2	293	8	46	7	352	--	--
Young leaves	--	--	19	352	23	360	7	352	--	--
Baccharis pilularis										
Flowers or flower buds	108	330	228	352	30	317	--	--	206	350
Fruits	2	346	2	151	8	360	--	--	6	350
Open flowers	108	330	293	352	230	317	--	--	232	350
Pollen release	--	--	35	346	239	317	--	--	238	350
Recent fruit or seed drop	2	346	2	151	239	360	--	--	62	329
Ripe fruits	2	346	2	151	8	360	--	--	6	350
Young leaves	2	192	60	326	30	331	--	--	6	350
Eriogonum fasciculatum										
Flowers or flower buds	2	346	74	193	66	353	56	226	49	350
Fruits	2	346	2	352	111	353	7	352	6	350
Leaves	2	346	2	346	8	360	7	352	6	350
Open flowers	2	346	74	193	84	353	84	226	112	350
Recent fruit or seed drop	163	346	3	352	239	295	7	352	6	350
Ripe fruits	2	346	2	352	111	353	7	352	6	350
Young leaves	2	247	11	291	8	338	7	352	6	350
Quercus agrifolia										
Breaking leaf buds	87	157	112	187	166	331	--	--	6	323
Flowers or flower buds	81	157	112	112	--	--	--	--	6	310
Fruits	2	346	2	293	212	268	--	--	6	338
Open flowers	87	157	112	112	--	--	--	--	28	98
Pollen release	93	108	--	--	--	--	--	--	41	91
Recent fruit or seed drop	247	346	199	293	254	338	--	--	253	315
Ripe fruits	2	346	2	293	248	248	--	--	14	338
Young leaves	87	163	112	272	262	331	--	--	14	350
Quercus lobata										
Breaking leaf buds	73	115	53	182	--	--	--	--	--	--
Colored leaves	2	346	2	352	--	--	--	--	--	--
Falling leaves	2	346	2	352	--	--	--	--	--	--
Flowers or flower buds	79	324	87	123	--	--	--	--	--	--
Fruits	16	346	50	334	--	--	--	--	--	--
Increasing leaf size	23	310	87	272	--	--	--	--	--	--
Leaves	2	346	2	352	--	--	--	--	--	--
Open flowers	79	157	93	123	--	--	--	--	--	--
Pollen release	87	115	93	112	--	--	--	--	--	--
Recent fruit or seed drop	212	346	129	334	--	--	--	--	--	--
Ripe fruits	16	346	50	319	--	--	--	--	--	--
Sambucus nigra										
Breaking leaf buds	2	346	2	352	8	360	--	--	6	350
Colored leaves	136	339	35	293	121	317	--	--	77	350
Falling leaves	192	339	151	291	204	268	--	--	14	329
Flowers or flower buds	58	142	74	291	60	121	--	--	62	232
Fruits	101	294	137	293	111	268	--	--	6	329
Increasing leaf size	2	310	2	346	8	360	--	--	6	350
Leaves	2	339	2	346	8	360	--	--	6	350
Open flowers	87	142	102	291	111	121	--	--	62	232
Recent fruit or seed drop	136	240	158	248	183	254	--	--	6	315
Ripe fruits	136	294	155	293	111	268	--	--	6	329

Table A-3. Phenophase summary breakdown by trail for 2014 from raw data.

2014 Phenophase Activity for Six Plant Species based on data downloaded from NPDb

Min DOY = First Observed Max DOY= Last Observed

						Cheeseboro Canyon 10 sites		Paramount Ranch 9 sites		Rancho Sierra Vista - Satwiwa 6 sites		Sandstone Peak 9 sites		Zuma Canyon 6 sites	
2014 Phenophases	Min DOY	Max DOY	Duration*	Mean Min DOY	**2014 Phenophases**	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY	Min DOY	Max DOY
Adenostoma fasciculatum					***Adenostoma fasciculatum***										
Flowers or flower buds	9	213	204	104	Flowers or flower buds	--	--	121	168	1	279	9	213	--	--
Fruits	6	365	359	63	Fruits	--	--	168	365	--	--	6	365	--	--
Open flowers	122	213	91	138	Open flowers	--	--	130	168	--	--	122	213	--	--
Recent fruit or seed drop	6	365	359	136	Recent fruit or seed drop	--	--	24	365	--	--	6	365	--	--
Ripe fruits	6	365	359	70	Ripe fruits	--	--	168	365	--	--	6	365	--	--
Young leaves	1	358	357	15	Young leaves	--	--	4	190	--	--	9	358	--	--
Baccharis pilularis					***Baccharis pilularis***										
Flowers or flower buds	4	363	359	140	Flowers or flower buds	212	363	4	358	116	306	--	--	8	360
Fruits	1	363	362	96	Fruits	6	363	42	363	1	358	--	--	6	360
Open flowers	4	363	359	164	Open flowers	277	363	4	358	116	306	--	--	8	360
Pollen release	8	343	335	227	Pollen release	--	--	323	323	234	279	--	--	8	343
Recent fruit or seed drop	1	363	362	135	Recent fruit or seed drop	6	363	363	363	1	293	--	--	6	360
Ripe fruits	1	363	362	82	Ripe fruits	6	363	42	363	1	358	--	--	6	360
Young leaves	8	363	355	70	Young leaves	57	363	66	356	44	358	--	--	8	360
Eriogonum fasciculatum					***Eriogonum fasciculatum***										
Flowers or flower buds	1	357	356	90	Flowers or flower buds	17	357	15	273	1	293	56	210	8	248
Fruits	1	365	364	34	Fruits	6	363	4	365	1	293	6	365	6	360
Leaves	1	365	364	7	Leaves	6	363	4	363	1	293	6	365	6	360
Open flowers	1	357	356	124	Open flowers	17	357	97	273	1	293	101	315	8	248
Recent fruit or seed drop	4	365	361	89	Recent fruit or seed drop	6	363	4	365	219	293	6	365	6	352
Ripe fruits	1	365	364	38	Ripe fruits	6	363	4	365	1	293	6	365	6	360
Young leaves	6	365	359	39	Young leaves	17	363	42	356	66	286	9	365	6	360
Quercus agrifolia					***Quercus agrifolia***										
Breaking leaf buds	24	358	334	72	Breaking leaf buds	70	119	64	356	44	358	--	--	24	133
Flowers or flower buds	8	360	352	77	Flowers or flower buds	70	99	95	111	66	116	--	--	8	360
Fruits	6	363	357	135	Fruits	6	363	154	154	128	306	--	--	143	276
Open flowers	70	116	46	89	Open flowers	70	99	108	108	76	116	--	--	93	114
Pollen release	70	109	39	89	Pollen release	70	99	--	--	83	109	--	--	100	104
Recent fruit or seed drop	6	332	326	213	Recent fruit or seed drop	6	332	--	--	--	--	--	--	--	--
Ripe fruits	6	363	357	175	Ripe fruits	6	363	154	154	234	271	--	--	24	38
Young leaves	8	360	352	75	Young leaves	77	119	64	273	36	197	--	--	8	360
Quercus lobata					***Quercus lobata***										
Breaking leaf buds	28	198	170	50	Breaking leaf buds	28	198	45	190	--	--	--	--	--	--
Colored leaves	8	365	357	164	Colored leaves	8	363	126	365	--	--	--	--	--	--
Falling leaves	170	365	195	187	Falling leaves	170	363	197	365	--	--	--	--	--	--
Flowers or flower buds	28	238	210	54	Flowers or flower buds	28	238	62	124	--	--	--	--	--	--
Fruits	84	356	272	120	Fruits	84	308	95	356	--	--	--	--	--	--
Increasing leaf size	28	273	245	53	Increasing leaf size	28	218	55	273	--	--	--	--	--	--
Leaves	8	365	357	52	Leaves	8	363	55	365	--	--	--	--	--	--
Open flowers	44	124	80	58	Open flowers	44	99	64	124	--	--	--	--	--	--
Pollen release	44	239	195	60	Pollen release	44	99	73	239	--	--	--	--	--	--
Recent fruit or seed drop	190	308	118	225	Recent fruit or seed drop	190	308	227	295	--	--	--	--	--	--
Ripe fruits	212	308	96	243	Ripe fruits	212	308	239	308	--	--	--	--	--	--
Sambucus nigra					***Sambucus nigra***										
Breaking leaf buds	1	365	364	11	Breaking leaf buds	6	363	4	365	1	358	--	--	6	360
Colored leaves	6	360	354	137	Colored leaves	153	335	142	332	83	275	--	--	6	360
Falling leaves	120	343	223	179	Falling leaves	170	335	176	337	181	275	--	--	120	343
Flowers or flower buds	28	257	229	85	Flowers or flower buds	28	161	78	171	36	257	--	--	57	169
Fruits	6	356	350	133	Fruits	93	218	6	356	90	271	--	--	104	296
Increasing leaf size	1	365	364	24	Increasing leaf size	17	363	6	365	1	358	--	--	6	360
Leaves	1	365	364	30	Leaves	17	363	6	365	1	358	--	--	6	360
Open flowers	62	206	144	104	Open flowers	62	161	95	171	63	206	--	--	65	169
Recent fruit or seed drop	127	332	205	178	Recent fruit or seed drop	127	223	163	288	140	268	--	--	149	332
Ripe fruits	6	356	350	153	Ripe fruits	119	218	6	356	115	271	--	--	34	296

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