Martin Griffin Preserve
grassland monitoring 2020/2021

Henry Inman - written November 2021

In 2020, three monitoring plots were established at Martin Griffin Preserve to assess the species cover and track encroachment from shrubs and trees in the grasslands. The map below shows the patches of grassland that were monitored.

The plots were selected using GIS (geographic information science) methods. GIS polygons were drawn around the grassland areas using visual approximation. The light brown areas on the map here are grasslands, lighter green areas are shrublands, and the dark green areas are forested. The grassland stands needed to be large enough to accommodate the circular plots with a 15 meter radius, so smaller stands were eliminated, leaving the three stands shown above for surveying. The center point for the circular monitoring plots were then randomly selected with GIS.

MGP-01-HWY

This plot is located between Picher Canyon and Volunteer Canyon, on a steep hillside overlooking Highway 1. The plot is accessible via a pullout on the road, the shrub cover between this plot and the Olive Hyde Trail to it's immediate north is too dense to easily traverse.

Each plot had three 1-meter quadrats. At each of 50 points within the three 1-meter quadrats, the presence or absence of every species identified to exist within the quadrat was recorded (as "hits"). These lists compare the species found within these three quadrats, and the pie charts below compare the relative abundance of hits per nativity. Note, MGP-01-HWY in 2020 was the first plot I recorded and had a much higher instance of unidentified plants than any other plot, as my familiarity with the flora increased.

Plants Present in both 2020 and 2021

plants in green are native,
in black are non-native

Coyote Brush - *Baccharis pilularis*
Purple Needle Grass - *Stipa pulchra*
California Oat Grass - *Danthonia californica*
California Plantain - *Plantago erecta*
Purple False Brome - *Brachypodium distachyon*
Slender Wild Oat - *Avena barbata*

Danthonia californica © 2002 Bart and Susan Eisenberg

Plants Present in 2020, not in 2021

Wild Strawberry - *Frageria vesca*
Common Wild Oat - *Avena fatua*
Rattlesnake Grass - *Briza maxima*
Little Rattlesnake Grass - *Briza minor*
Smooth Cat's Ear - *Hypochaeris glabra*
Hairy Cat's Ear - *Hypochaeris radicata*
English plantain - *Plantago lanceolata*

Fragaria vesca © 2020 Cara Wilcox

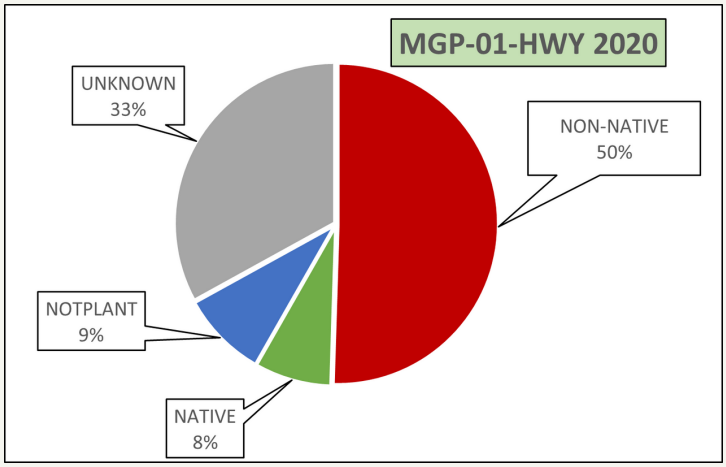
Plants Present in 2021, not in 2020

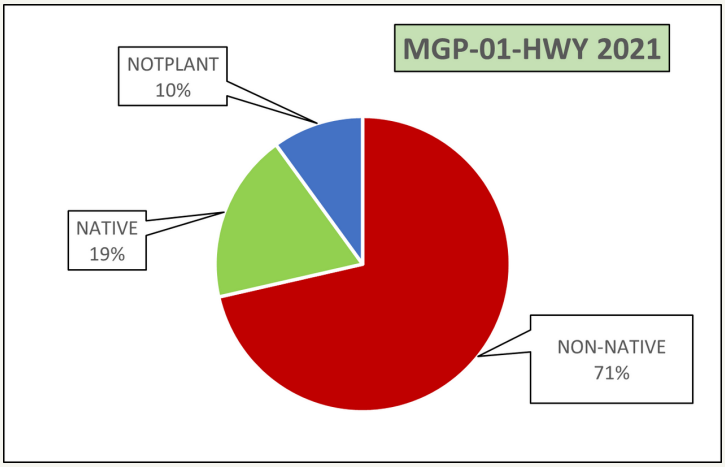
Morning glory - *Calystegia purpurata*
California ponysfoot - *Dichondra donelliana*
Ladies' tobacco - *Pseudognaphalium californicum*
Coast tarweed - *Madia sativa*
Pale flax - *Linum bienne*
Scarlet pimpernel - *Lysimachia arvensis*
Brome Fescue - *Festuca bromoides*
Common sow thistle - *Sonchus oleraceus*
Spring Vetch - *Vicia sativa*
Italian Rye Grass - *Festuca perennis*
Brome Fescue Grass - *Festuca bromoides*
Narrowleaf cottonrose - *Logfia gallica*

Dichondra donelliana © 2013 Terry Gosliner

Relative Cover by Nativity

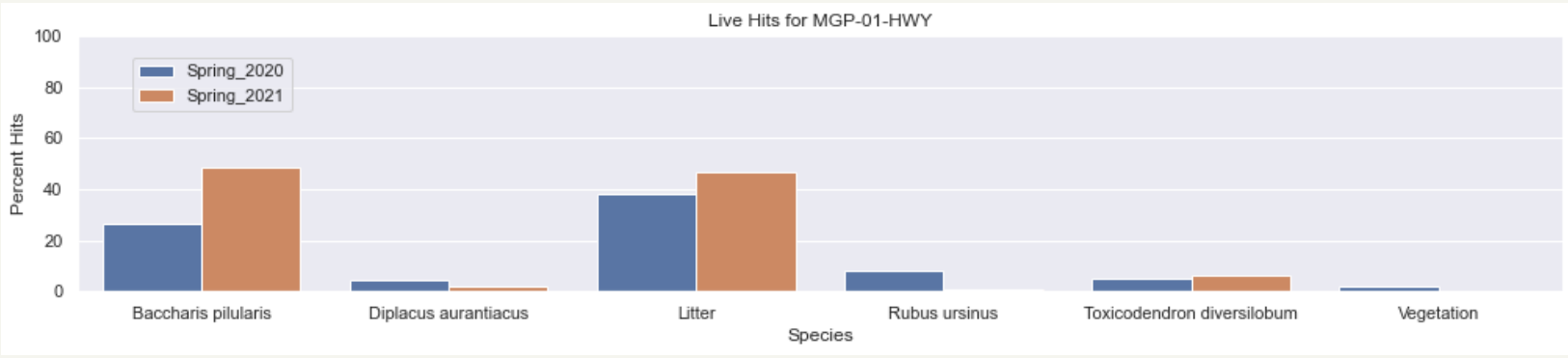
Each plot had three 1-meter quadrats. At each of 50 points within the three 1-meter quadrats, the presence or absence of every species identified to exist within the quadrat was recorded (as "hits"). These charts compare the relative abundance of hits per nativity. Note, MGP-01-HWY in 2020 was the first plot I recorded and had a much higher instance of unidentified plants than any other plot, as my familiarity with the flora increased.





Shrub Transects

Each plot also had 3 shrub transects, which are lines extending from the center of the plot to the outer edge of the circle. At fixed points along the transect, the presence or absence of shrubby or vine species were recorded. If none were present, or if vegetation or litter were recorded vertically atop the shrub or vine species, these values were also recorded. This provides a sense of the relative cover of shrubs at the plots. Coyote Brush (*Baccharis pilularis)* presence nearly doubled along the transects in plot MGP-01-HWY.



MGP-02-OLH

This plot is located in a patch of grassland north of the Olive Hyde trail.

Plants Present in both 2020 and 2021

Coyote Brush - *Baccharis pilularis*
Purple Needle Grass - *Stipa pulchra*
California Plantain - *Plantago erecta*
California ponysfoot - *Dichondra donelliana*
Scarlet Pimpernel - *Lysimachia arvensis*
English Plantain - *Plantago lanceolata*

Plantago erecta ©2008 Steve Matson

Plants Present in 2020, not in 2021

California Oat Grass - Danthonia californica
Ladies' Tobacco - Pseudognaphalium californicum
Slender Wild Oat - *Avena barbata*
Purple False Brome - *Brachypodium distachyon*
Italian Thistle - *Carduus pycnocephalus*
Brome Fescue Grass - *Festuca bromoides*
Italian Rye Grass - *Festuca perennis*
Farmer's Foxtail - *Hordeum murinum*

Avena barbata ©2004 Carol W. Witham

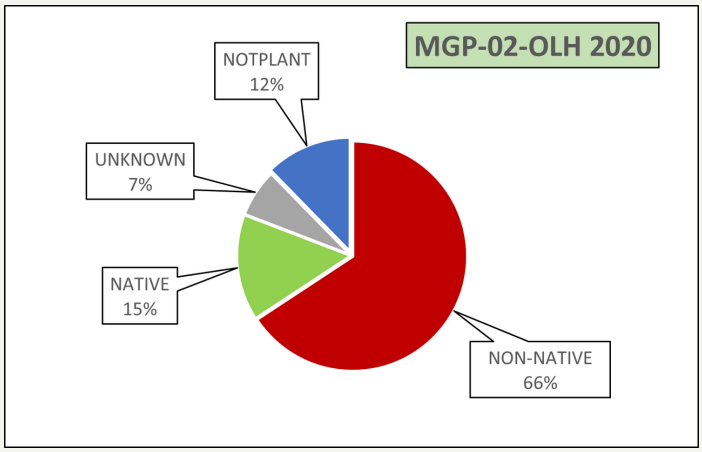
Plants Present in 2021, not 2020

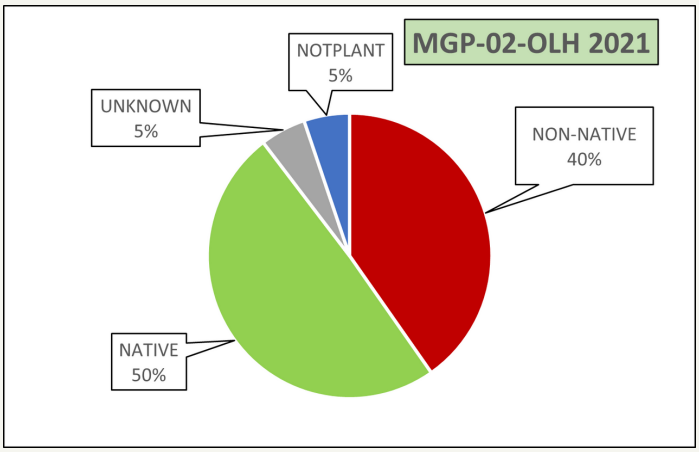
Rattlesnake grass - *Briza maxima*
Ripgut brome - *Bromus diandrus*
Sticky Monkeyflower - *Diplacus aurantiacus*
Wild Strawberry - *Fragaria vesca*
Spring Vetch - *Vicia sativa*

Diplacus aurantiacus ©2009 Keir Morse

Relative Cover by Nativity

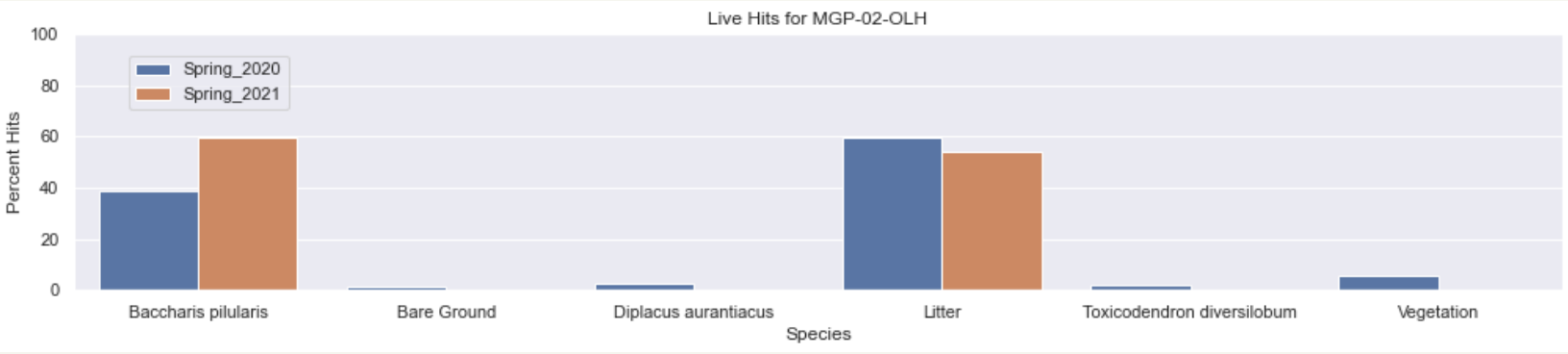
Native cover was observed to increase within the quadrats in MGP-02.





Shrub Transects

Similar to the change observed with MGP-01, Coyote Brush (*Baccharis pilularis)* presence increased along the transects in plot MGP-02. There was minimal presence of Sticky Monkeyflower (*Diplacus aurantiacus)* and Poison Oak (*Toxicodendron diversilobum)* in 2020, and no presence of these shrub species in 2021.



MGP-03-POL

This plot is located in the grassland north of the camera trap on Zumie's loop.

Plants Present in both 2020 and 2021

**plants in green are native,
in black are non-native**

Wild Strawberry - *Fragaria vesca*
Coyote Brush - *Baccharis pilularis*
Purple Needle Grass - *Stipa pulchra*
California Oat Grass - *Danthonia californica*
English Plantain - *Plantago lanceolata*
Purple False Brome - *Brachypodium distachyon*
Slender Wild Oat - *Avena barbata*
Rattlesnake grass - *Briza maxima*
Hairy Cat's Ear - *Hypochaeris radicata*
Scarlet Pimpernel - *Lysimachia arvensis*

Stipa pulchra ©2004 Carol W. Witham

Plants Present in 2020, not in 2021

Wild Strawberry - *Frageria vesca*
Sticky Monkeyflower - *Diplacus aurntiacus*
European foxtail grass - *Festuca bromiodes*
Hedgehog Dogtail - *Cynosurus echinatus*
Little Rattlesnake Grass - *Briza minor*

Cynosurus echinatus
©2009 Barry Rice

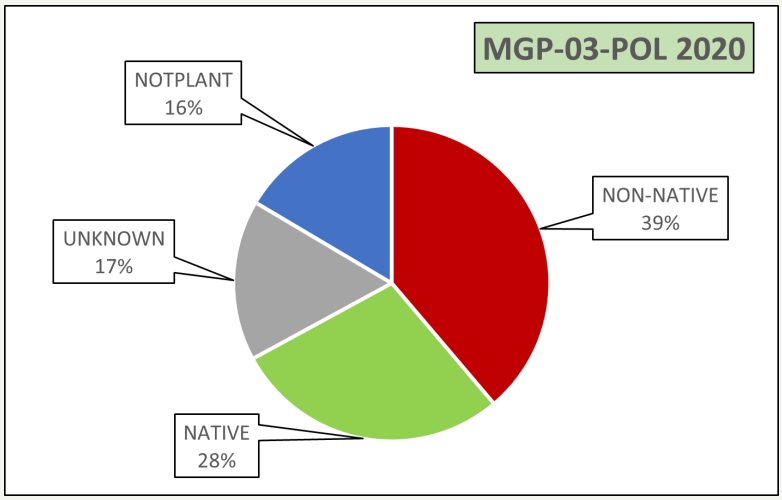
Plants Present in 2021, not in 2020

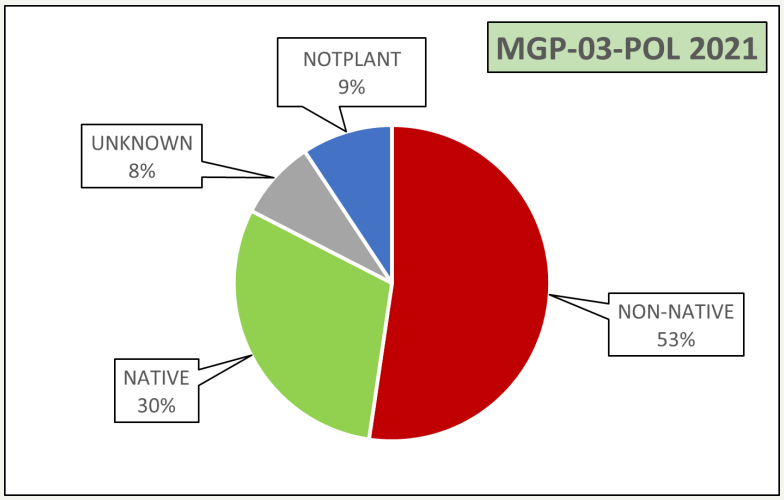
California ponysfoot - *Dichondra donelliana*
Common brome grass - Bromus vulgaris
California Soaproot - Chlorogalum pomeridianum
Wild Strawberry - Fragaria vesca
California honeysuckle - Lonicera hispidula
California blackberry - Rubus ursinus
Fremont's Deathcamas - Toxicoscordion fremontii
Pale flax - *Linum bienne*
Silver Hairgrass - *Aira caryophyllea*
Silverleaf Cotoneaster - *Cotoneaster pannosus*
Cranesbill - *Geranium dissectum*
Spring vetch - Vicia sativa
Purple awned wallaby grass - *Rytidosperma penicillatum*

Rubus ursinus ©2014 Jean Pawek

Relative Cover by Nativity

Although the number of native species recorded in 2021 was higher than in 2020 for MGP-03, the cover of native plants was not shown to increase.

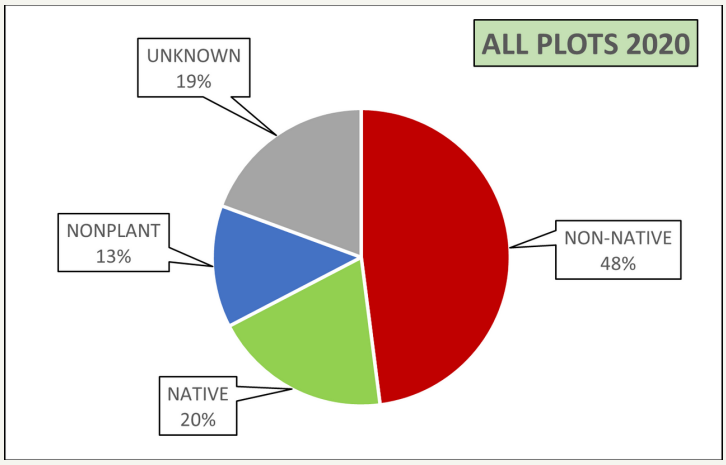


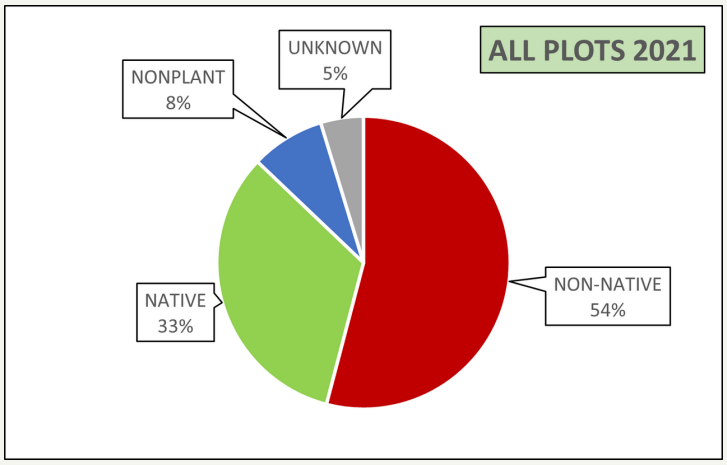


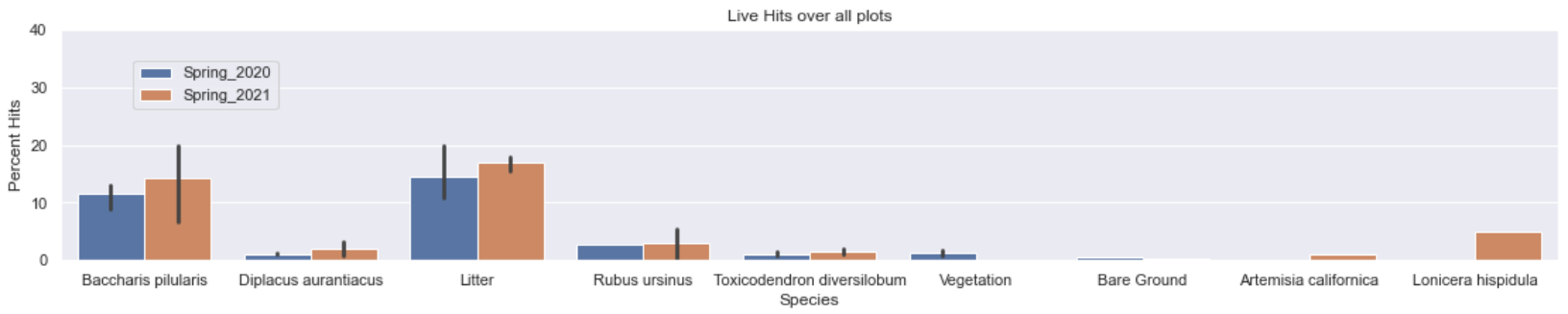
Shrub Transects

Unlike the other two plots, Coyote Brush (*Baccharis pilularis)* cover decreased along the transects in plot MGP-03. Cover for each other shrub or vine species increased, as well as litter cover.

Data Summary over All Plots







Based on the charts above, it is possible that native cover increased over all plots from 2020 to 2021, although the high number of unknown hits found in 2020 may account for the observed increase as well. Shrub cover and diversity seems to have increased over all plots between the two years, which may be a reflection of a pattern of shrub encroachment on grasslands observed over several decades at Martin Griffin Preserve. The level of non-native species was consistently high, these non-native species were mostly invasive annual grasses. Invasive shrubs and vines such as French Broom are present on MGP property but were not found in the plots.

Project Overview and Discussion

Because such a high proportion of my findings were recorded as "unknown" for the first year, it is hard to make definitive conclusions - 2020 can be regarded as a trial year for this monitoring project. I used a monitoring protocol that I was already familiar with through my work with the National Park Service, with a well described protocol publicly available, and simplified it so that the readings would not take very much time during the monitoring season in the Spring, which is also an important time of year for invasive species removal work. I spent time in 2020 setting up the monitoring system, finding the plot locations using the GIS techniques described above, gathering equipment, and creating datasheets, and in 2021 I was able to focus more of my time on keying out the plants I had found to species, so I expect that in future years with my improved skill and an established protocol for reading and analyzing data, I will be able to focus even more of my time on keying out plants and reduce the size of the unknown plant observations.

Another factor that may have influenced these results was the date range of when I collected the data. Spring 2020 data was collected from May 22nd - June 5th, while Spring 2021 data was collected from April 30th to May 25th. Two out of the three plots had a higher number of species found in 2021/absent 2020 than found 2020/absent 2021, and based on this I believe that the earlier date range may have captured more of the diversity that could be found at the plots. Some grassland species such as Deathcamas, Spring Vetch, and Narrowleaf Cottonrose bloom in April (source: iNaturalist detection data) and may have been difficult to detect or identify, rather than not present, during my late-spring monitoring in 2020. On the other hand, some species are more detectable later in the season, in May or June, such as Hedgehog Dogtail grass, Rattlesnake Grass, and Farmer's Foxtail grass. I think that the April-May monitoring time is a good mid-season compromise for detecting an array of species.

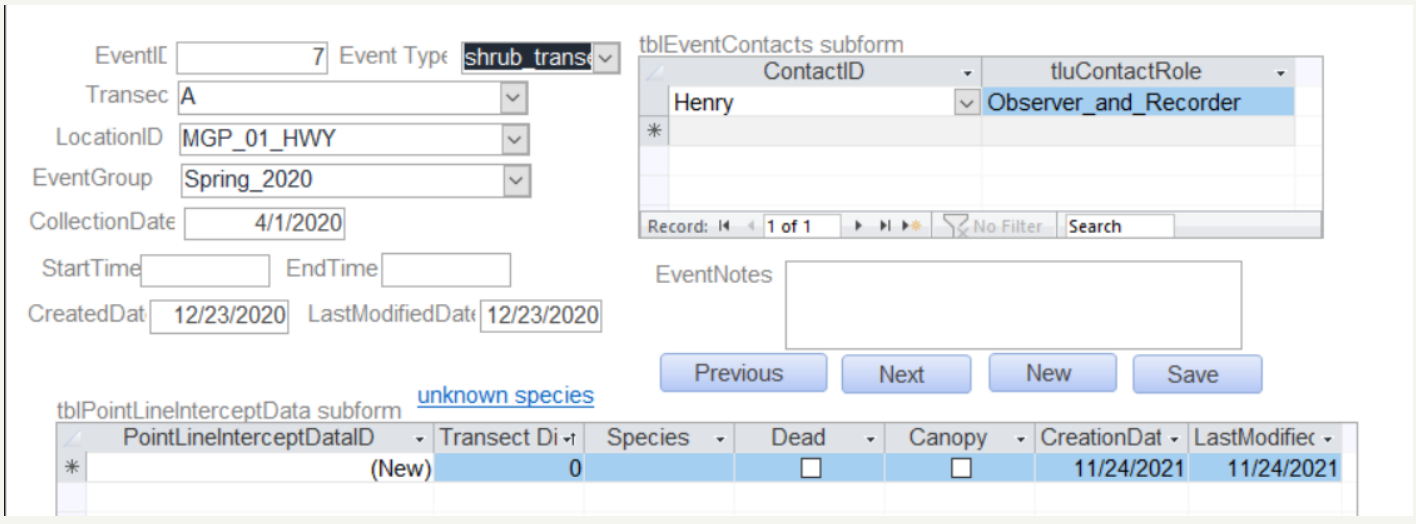
Another possible factor was the variation in rainfall experienced over these two years.

Source: Bolinas Community Public Utility District

March 2020: 3 inches ////// March 2021: 2.45 inches
April 2020: 1.10 inches ////// April 2021: 0.1 inches
May 2020: 1.70 inches ////// May 2021: 0.05 inches
June 2020: 0.0 inches ////// June 2021: 0.12 inches

During the rainy season overall (recorded as July '19 - June '20, and July '20 - June '21), 2020 received 22.7 inches of rain and 2021 received 16.42 inches of rain. It's not clear to me how this may have affected plants observed at the plots. As shown in the bar chart above comparing shrub transect data over all plots in 2020 vs 2021, the shrubs seemed to have grown and had an increased presence in 2021, and native species presence may have increased in the drier year, but this could also be explained by the changed timing of the monitoring season. I hope to learn more about impact of rainfall on the plants at MGP with continued annual monitoring.

The data was collected in the field using paper data sheets, and then stored in a Microsoft Access database built specifically for this project. The database includes linked tables, which makes it easier to make changes (for example, if a species name changes, I only have to update one row in the table holding Species data, and not each instance where the species was found). The database also has custom-made forms for easy data entry.



The comparative species lists were made using SQL searches, the pie charts were made in Excel, and the bar charts were made using Python libraries matplotlib, pandas, and seaborn. These techniques are described in the protocol. In the future, I would like to use Python techniques to create the nativity pie charts as well, once I had learned how to use Python, it was much faster than manipulating data in Excel. Another possible analysis for future years would be a fuels analysis - I changed the fuels protocol after the first year because it was very time consuming. I based the protocol on Fire Forward's protocol, and this protocol initially monitored each fuel found on three continuous transects. I altered this protocol to only count fuels found on the points I was using to monitor shrub transects. After next year, I will have two years of data with the same protocol and can make comparisons. I also collected data on dead shrubby material observed vertically above live shrubby material on the shrub transects - this could indicate dieback - dead shrubs underneath live shrubs were not recorded, as this is part of the usual growth pattern of shrubs. To simplify my first year of analysis, I omitted this data and only looked into live plant growth. Although the shrub and vine transect data were separated and analyzed by species, the more robust quadrat species data were lumped into categories by nativity. Future analysis could hone in on information about the change in cover for specific species, or describe which species were most common. Additionally, my relative inexperience with statistics leaves room for improvement. I would like to learn how to do a power analysis on this project to determine how statistically significant my findings are, and if the protocol or number of plots monitored needs to be adjusted.

This system could potentially be used to monitor the impact of invasive species removal, planting, burning, or other land management techniques. The plot locations chosen currently are not in any locations that have active land management projects, as they are intended to simply capture baseline information about what is present on the preserve, and how species presence and abundance may be changing over time. Generally each plot takes 2-3 days in the field to monitor, so it is a significant amount of time dedicated to this project during the already busy Spring period, but establishing plots in planned restoration areas may be a useful tool to learn about and communicate the impact and importance of restoration activities. It may also be useful to compare managed grasslands to unmanaged grasslands, either by selecting amongst these plots a location for restoration, or choosing new locations.