

Sage Hill: An Analysis of Non-Native Plant Species and Vegetation Cover

2021-2022 Practicum Team



Photo by Tara Bretzfelder, 2022

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Photo by Tara Bretzfelder, 2022

Meet the Sage Hill team!



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Abstract

Both climate change and human development have played major roles in the introduction of plant species from varying areas of the globe. Although not all introduced plants are detrimental to the ecosystems around them, the invasive and noxious species compete for resources with native plants in Southern California. In order to conserve and protect native species of plants on Sage Hill, the 2021-2022 Practicum Team gridded and assessed both native and non-native coverage, and created GIS layers of species coverage at the site. Additionally, the team compiled research for an on-site species index that delivers crucial information, such as seeding period and mechanical culling methods. This information was expanded upon by incorporating traditional ecological knowledge and input from experts in geography, First Nations history, botany and environmental science. Upon completion of the species index and gridded data maps, the top five most pernicious species were determined. The ultimate goal of this report is to provide future caretakers of the land with detailed and readily accessible knowledge.



Image: Kuruvungna Village Springs, Gabrielino Tongva Springs Foundation

Sage Hill at UCLA acknowledges the Gabrielino/Tongva peoples as the traditional land caretakers of Tovaangar (the Los Angeles basin and So. Channel Islands). As a land grant institution, we pay our respects to the Honuukvetam (Ancestors), 'Ahihirom (Elders), and 'Eyoohiinkem (our relatives/relations) past, present, and emerging.



California Scrub-Jay at Sage Hill. Photo: Nurit Katz, 2019 (iNaturalist)

Introduction

Sage Hill is a 6.5 acre parcel of coastal sage scrub, oak woodland, and riparian habitat nestled in the northwest corner of UCLA's campus. It is home to a diverse community of mammals, birds, insects, and plants, and is used as a resource for students to gain hands-on experience in their academic careers. The goal of our 2021-2022 practicum project was to design a weed management plan for Sage Hill. While Sage Hill retains a vibrant native plant community, it is also significantly encroached upon by non-native plant species. Our client's vision is to reduce non-native plant populations, with the synergistic goals of preventing the decimation of native plant communities and increasing native plant species representation. Our research this year lays the groundwork for this mission of native plant species restoration. We conducted a thorough assessment of both the native and non-native plant communities at Sage Hill, and created databases for species distribution and species information. We hope that future implementation of invasive species removal and native plant restoration using our guides will lead Sage Hill to become an important natural space for UCLA students, faculty, and researchers, local Gabrielino/Tongva peoples, and conservation enthusiasts alike.

Methods: Field Surveys

Grids, Assessments, Outputs

Gridding

Starting from the wall separating the parking lot from the bottom of the hill (Western edge), and going up to the fence which marks the top of the hill (Eastern boundary), we created 10 m x 10 m grids using field tape measures. Using compasses on our phones, we laid the gridlines along cardinal directions. Flags were placed at each corner of the grids, and labeled with the grid IDs of the 4 plots that intersect at that point. Columns going from East to West were indicated by numbers, and rows going North to South were labeled alphabetically. The majority were squares with 10 meter edges, but the rows with edges marked by the top and bottom fences were somewhat irregularly shaped due to site boundaries and topography.



Figure 1. Map of our survey grids.

Tara,
Jose,
Facu

Date 27 April 2022
Time 5:00 pm

Sage Hill Practicum 2021-22 Data Collection Table

Grid ID	7D	
Coordinates		
Native Species Present + % Cover	Toyon 20 % White Sage 15 % CA Brittlebush 3 % bunch grass 4 % Laurel Sumac 10 %	
Non-native Species Present + % Cover	Creeping Lantana (mint) 5 % Short Pod Mustard 20 % Hairy Vetch 3 % Carob tree 20 %	
Total % Native Species Cover	52 %	
Total % Non-native Cover	48 %	
Total % Vegetation Cover	90 %	
Other Notes	Dirt cover = 10 %	

Figure 2. Example of survey data sheet.

Surveys

Each grid was assessed for native and nonnative vegetation cover. This included percent vegetation cover, percent dirt cover, as well as percent cover of each observed species, separated by native and non-native. Tree cover was considered the area of grid covered by the crown. Hand-drawn maps of notable features and distinguishable vegetation were drawn on the backs of these sheets in case we needed to return to a grid and flags had been moved by wildlife or visitors. Vegetation surveys were conducted by at least two team members to ensure plant identifications were accurate, and were supplemented by iNaturalist and expert opinions.

Field Data Outputs

The survey data from each grid was then entered into spreadsheets for analysis and creation of deliverables.

- For each species observed during surveys, we created a **Species Information Page**, which includes physical descriptions, life history details, and best management practices for the nonnative species present at Sage Hill. All observed species, native and non-native alike, were compiled into a **Master Species List**.
- Species observation data from surveys was input into **GIS** software to create maps of cover by species, and by category of native or non-native.
- Information regarding cover and level of invasiveness was used to develop a preliminary **Invasive Species Ranking System** to determine which should be top priority for removal and management.

	Grid ID	Surveyed By	Date	Time	Verbatim Total % Native Species Cover	Verbatim Total % Non-Native Species Cover	Total % Vegetation Cover	Total % Dirt Cover	Artemisia californica	Quercus agrifolia	Malosma laurina	Mule Fat	Purple Sage	Encelia californica	Coyote Bush	Purple Needle Grass	Solanum xanthi
3	1A	Izzy	11 Feb 2022	8:30 AM	40	60	85	15	10	15	5	10					
4	1B	Izzy	11 Feb 2022	9:00 AM	20	70	85	15	15			5					
5	1C	David, Jose	18 Feb 2022	9:00 AM	80	20	70	30			80						
6	1D	David, Jose	18 Feb 2022	9:00 AM	100	0	65	35			75						
7	1E	David, Jose	25 May 2022	3:20 PM	0	100	10	90									
8	1F	Tara, Jose	6 April 2022	2:00 PM	48	25	73	27	20		10			10			
9	2A	Izzy	11 Feb 2022	10:15 AM	33	44	90	10	10	15			5	3			
10	2B	Izzy	11 Feb 2022	9:30 AM	40	48	85	15	20		4			5	10	1	
11	2C	Izzy, Hanna	18 Feb 2022	9:00 AM	60	35	65	35	10		50						25
12	2D	Izzy, Hanna	18 Feb 2022	9:00 AM	80	19	80	20	45		35						2
13	2E	Annabel	16 Mar 2022	3:16 PM	26.5	92	80	20	20	6	0.5						
14	2F	Tara, Jose	6 April 2022	2:30 PM	45	10	55	45									
15	2G	Tara, Jose	6 April 2022	3:00 PM	15	10	25	75									
16	3A	Tara	11 Feb 2022	10:20 AM	50	87	85	15	25	20			5				
17	3B	Izzy	11 Feb 2022	9:45 AM	35	37	85	15	13		15			5		2	1
18	3C	Annabel, Kewi	18 Feb 2022	9:00 AM	65	67.5	50	50	25		5					10	35

Figure 3. Sample Vegetation Survey Spreadsheet.

Methods: GIS and Data Analysis

In order to visualize our field data, we created two GIS layers. First, we drew a new outline of Sage Hill's boundaries based on aerial imagery obtained from the 2019-2020 practicum team (sagehill_outline.lyr). We then drew survey grids within the (new) Sage Hill boundaries based on a 12x12m grid with origin at -13186356.067000, 4038804.347000 (approximate coordinates of our first grid corner). Each grid was assigned its respective grid_id. The GIS grids were sized at 12x12m instead of 10x10m because our gridding methods and the topography of the site led us to create plots that corresponded to slightly larger areas in ArcMap. To create species distribution maps, we joined our survey spreadsheet with the grid shapefile in R based on grid_id. Then, we used this new shapefile that had our survey data attached to the grids to create maps that displayed different species' percentage covers in each grid.

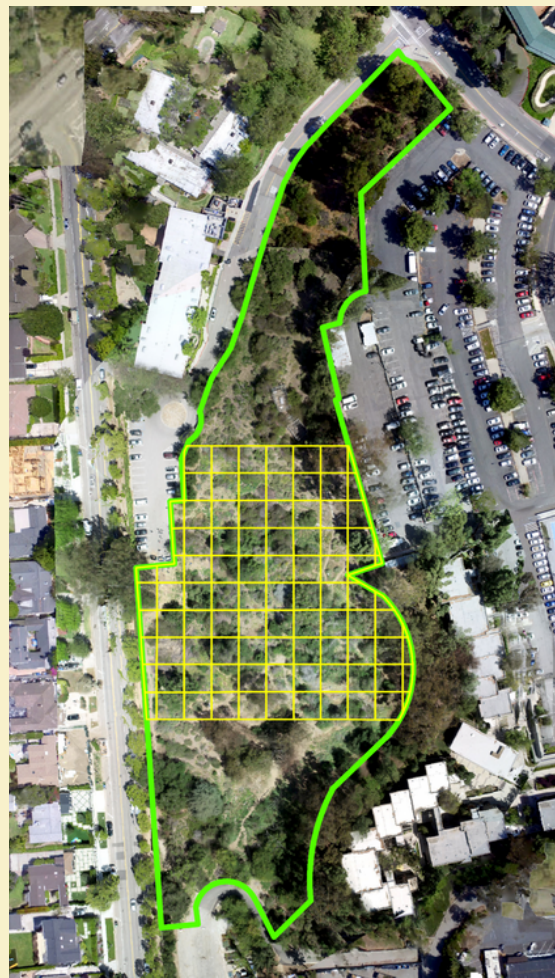


Figure 4. New Sage Hill boundary and grids.

In order to determine the percent cover of native species, non-native species, and individual species, we calculated each grid's area in ArcMap, then calculated the relevant percent cover with the following formula:

$$\text{overall \% cover} = \sum_{i=1}^n [\text{percent cover in grid}_i] * [\text{area of grid}_i]$$

where n = the number of grids.

GIS and Data Analysis

Results

From our field survey data, we created seven maps: % Native cover, % Non-native cover, and a % cover map for each of our top five priority removal species (*Ehrharta calycina*, *Bromus madritensis ssp. rubens*, *Cortaderia selloana*, *Bromus diandrus*, *Hirschfeldia incana*). Each map shows the percentage of the relevant category/species in each grid. See appendix for all maps.

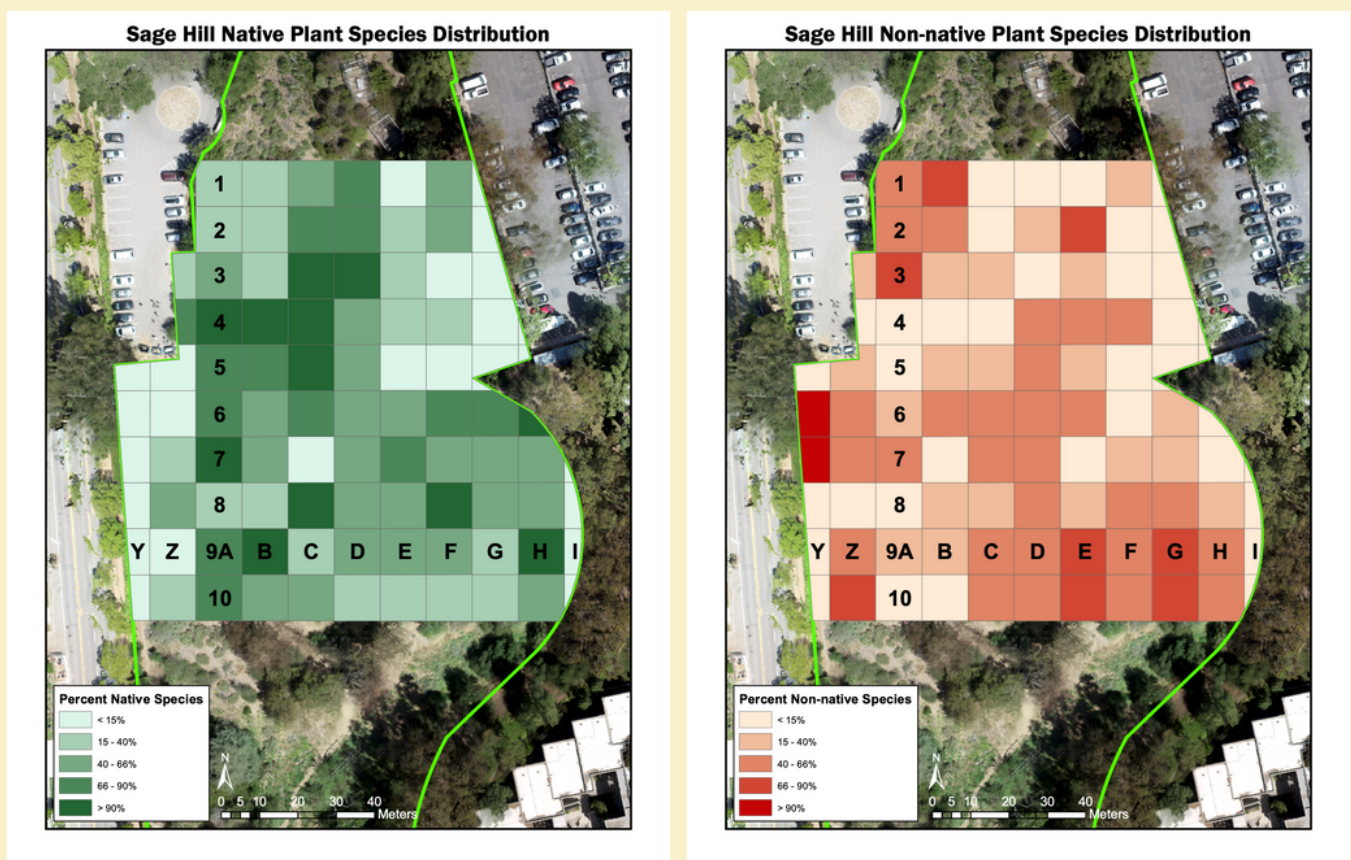


Figure 5. Maps of native and non-native plant species distributions.

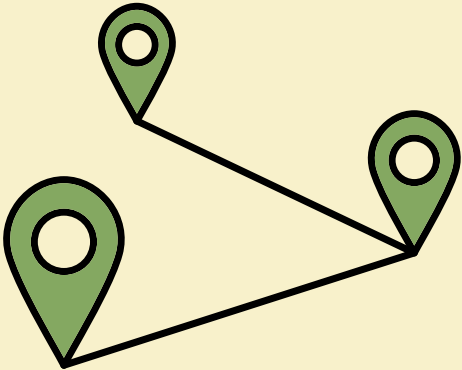
All together, our team was able to survey a total of 88 grids, which covered 2.9 acres, or 45% of Sage Hill. Within said area, 52% is covered by native plant species and 37% by non-native plant species. For species richness in our survey area, we found 31 native and 42 non-native species. Coverages for our top priority species for removal can be found on page 12.

Project Deliverables

Products created from field data

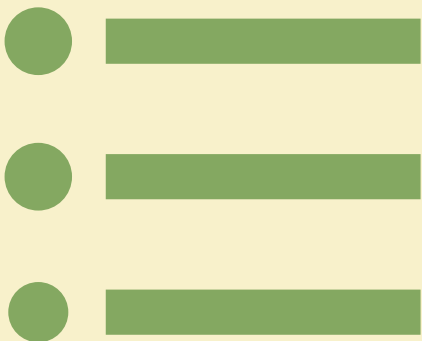
Survey Data Spreadsheets

Example and Content can be found on page 7.



Maps

See Page 8 for GIS Methods, and Appendix for Maps.



Master Species List

See Page 11.



Non-native Species Information Pages

See Page 12.



Invasive Species Priority Ranking

See Page 13.

Master Species List

Sage Hill Species List						
Common Name:	Scientific Name:	Family:	CAL-IPC Rating:	Average Distribl	Expert Opinion	Priority Ranking
Perennial/Purple Veldtgrass	Ehrharta calycina	Poaceae	High	2.920	Anthony - this one!	1
Pampas Grass	<i>Cortaderia selloana</i>	Poaceae	High	0.030		2
Compact Brome/ Red Brome	<i>Bromus madritensis ssp. rubens</i>	Poaceae	High	0.279		2
Black Mustard	Brassica nigra	Brassicaceae	Moderate	3.273		3
Short-pod Mustard	Hirschfeldia incana	Brassicaceae	Moderate	5.033		3
Ripgut	Bromus diandrus	Poaceae	Moderate	10.644		3
Smilo Grass	Stipa miliacea var. miliacea	Poaceae	Limited	1.017		4
Wild Radish	Raphanus sativus	Brassicaceae	Limited	1.645		4
Slender Wild Oat	<i>Avena barbata</i>	Poaceae	Moderate	0.006		5
Panic Veldtgrass	<i>Ehrharta erecta</i>	Poaceae	Moderate	0.119		5
Bermuda Buttercup	<i>Oxalis pes-caprae</i>	Oxalidaceae	Moderate	0.151		5
Italian Thistle	<i>Carduus pycnocephalus</i>	Asteraceae	Moderate	0.387		5
Wall Barley/ Hare Barley	<i>Hordeum murinum</i>	Poaceae	Moderate	0.773		5
California Bur Clover	<i>Medicago polymorpha</i>	Fabaceae	Limited	0.012		6
Chinese/Glossy Privet	<i>Ligustrum lucidum</i>	Oleaceae	Limited	0.023		6
Castor Bean	<i>Ricinus communis</i>	Euphorbiaceae	Limited	0.035		6
London Rocket	<i>Sisymbrium irio</i>	Brassicaceae	Limited	0.128		6

Figure 6. Sample Master Species List with priority invasive species in bold..

The master species list is an excel spreadsheet that lists all non-native and invasive plant species found on Sage Hill. The file consists of each plant's:

- Common name
- Scientific name
- Family
- Cal-IPC rating
- Average distribution on site
- Priority ranking

This is a condensed, comprehensive list of much of the information found in the non-native species information pages, excluding the weed management section. Having an excel sheet that is exponentially shortened in length compared to the species information pages allows for quicker access to each plant's important ecological factors and priority ranking. This file will help future students and staff quickly determine if a plant is non-native and/or invasive, while also providing them essential information they will need in order to decide which plants are of the highest concern and need to be set as a priority for removal.

Non-Native Species Information Pages

We conducted research on all of the non-native plants found on Sage Hill in order to help visitors to the hill identify each species, understand their ecological impact, and determine the best weed management plan to implement. Every plant on this page was found and input into the iNaturalist database by other community members or by one of our own teammates. Since other iNaturalist users have also made observations of non-native plants, some species were not present in our survey area. There are a total of 54 species accounted for in the species information pages, and each plant has its own designated page.

14) Wild Radish
Raphanus sativus

Other Common Names: (none)
Family: Brassicaceae
Origin: Native to eastern Europe and Asia
CAL-IPC Rating: Limited
Removal Priority: 4

Description:

- ❖ cotyledons are distinctively kidney-shaped and 0.5 to 1 inch long
- ❖ form rosettes until the flower stem develops at maturity
- ❖ lower leaves are alternate and vary in size and shape from being deeply lobed and ovate to having leaflets
- ❖ usually covered with stiff, flattened hairs
- ❖ taproot can be more than 3 ft deep
- ❖ At maturity, several flowering stems develop
- ❖ Flowers have four petals and can be white, yellow, pink, or purple
- ❖ Seed produce yellow-brown pods that each contains 1 to 10 seeds

Mature Size: up to 2 feet tall
Bloom Period: April - July


Information: Radishes reproduce only by seed. Seeds are not dispersed from the fruit and primarily fall to the base of the parent plant. The seeds have a long dormancy and can stay viable in the soil for several years. In non-crop areas they can be toxic to livestock if consumed in large amounts.

Habitat: Although they are typically weeds of cultivated crops, orchards, vineyards, and neglected gardens, they can also be common in parks, roadsides, and disturbed locations in natural areas

Similar/Look-alike Species: N/A

Weed Management Plan:

Mechanical: Hand-pull, removing most of the root system, before plants produce seed. Hand weeding may need to be repeated to control later developing plants. Mowing can help reduce seed production but does not harm the basal leaves, thus allowing plants to regrow. Repeated mowing is required to prevent seed set. This is not an effective means of control. Tillage is a common and effective method of control in agricultural areas and would also be effective, if practical, in natural areas or other non-crop sites.



Source: iNaturalist Photo 63061432, © Joseph Patrick O'Malley

Each species page includes:

- 1) Common and scientific names
- 2) Family
- 3) Origin
- 4) Cal-IPC rating
- 5) Removal priority
- 6) Physical description
- 7) Mature size
- 8) Bloom period
- 9) Habitat
- 10) Similar/Look-alike species
- 11) Weed management plan (mechanical and chemical)
- 12) Photos of the plant, leaves, and defining physical features.

Figure 7. Example species information page for Wild radish.

One of the main sources of information was the California Invasive Plant Council (Cal-IPC). This booklet will hopefully serve as a significant resource for future staff and students who are working on managing the vegetation, health, and restoration of Sage Hill. We hope that by making this resource easily accessible to the public, there will be more accurate and quicker identification, less confusion about which plants are native or non-native, and increased ease of determine which plants to remove or keep. These pages will also be an influential guide in the creation of annual management plans.

Priority Species Ranking

Preliminary Ranking of Invasive Species for Removal

Species name	Cover	Invasivity
Pampas Grass (<i>Cortaderia selloana</i>)	0.03%	High
Purple Veldtgrass (<i>Ehrharta calycina</i>)	2.85%	High
Red Brome (<i>Bromus madritensis ssp. rubens</i>)	0.28%	High
Ripgut Brome (<i>Bromus diandrus</i>)	10.54%	Moderate
Shortpod Mustard (<i>Hirschfeldia incana</i>)	5.38%	Moderate

Figure 8. Table of top 5 priority invasive species for removal, with species name, cover, and invasiveness ranking.

Our invasive species priority ranking can be found on our Master Species List (Figure 6, Page 11). We ranked the invasive species by adding weight to the following factors in descending order: Cal-IPC rating, average % cover, fire risk, and expert opinion. The species with a 1 ranking are the top priority for removal, a 2 ranking being second priority, and so on. Our top 2 species have very limited cover: these were chosen because while they are not widespread, they are highly invasive. Their removal should be prioritized because it would be very manageable, and could prevent future negative ecological impacts on the native plant community at Sage Hill resulting from their presence and potential spread.

Conclusion

Our results indicate that there is significant non-native species presence on Sage Hill, with both high species richness and population distribution. Perennial Veldtgrass (*Ehrharta calycina*), Red Brome (*Bromus madritensis* ssp. *rubens*), and Pampas Grass (*Cortaderia selloana*) should be prioritized for removal based on Cal-IPC invasivity ratings, percent cover of Sage Hill, and ease of removal. Although these species appear to have a relatively small distribution on Sage Hill, we expect that their populations will increase rapidly, and become detrimental to the native plant communities if left unmanaged. Ripgut Brome (*Bromus diandrus*) and Shortpod Mustard (*Hirschfeldia incana*) should also be prioritized for removal because they are considered moderately invasive and have the highest distribution on Sage Hill. Effective removal methods for all of these species can be found in our Non-native Plant Species Information Booklet. Population locations of these species can be found on our distribution maps (Appendix). Hopefully, efforts to reduce the populations of these non-native species will prove effective. For us and future practicum teams at Sage Hill, only time will determine the effectiveness of management efforts. We are passing the torch to future teams for upkeep and modification of management plans to ensure that native recovery continues and improves.



Practicum Team and Advisor, Cully Nordby at Sage Hill Photo: Peter Bohler, 2022 (UCLA Newsroom)

Future Recommendations

Despite our best efforts, our team was unable to fully survey the entirety of Sage Hill within the permitted time frame. That said, it would be in future practicum teams' best interest to completely survey the rest of Sage Hill. This would allow us to fully grasp the total number of species present at the site. Before undergoing such a task, the development of a well-researched protocol for surveying should be done. This should include how to determine accurate vegetation coverage (both native and non-native) in relation to dirt. It should also include how to gauge the percent coverage of trees when surveying a grid. Together, these two requirements will ensure that consistency is preserved between teams if they work at separate times. In our case, miscommunication led to inconsistencies and ultimately resulted in members needing to revisit gridded sites in order to match methods done by other members. Lastly, the inclusion of hand drawn maps for each grid (detailing small landmarks) could provide better insight into where the gridded location is in the unlikely event that flagging is lost or removed. All of these recommendations will greatly assist in saving time and maintaining efficiency.

Once surveys are complete, re-ranking of non-native species will be necessary. As new species are added and their area coverage increases, their threat ranking to Sage Hill will surely need to be adjusted. Currently, the system for ranking utilizes CAL-IPC rating and percent coverage to prioritize removal. Future teams should incorporate other factors such as: invasiveness, intensity as a fire hazard, and expert opinions. Together, future teams can utilize all of these factors to create a master formula to efficiently rank species as they are added to the lists. Upon its completion, the rankings (along with their corresponding maps) will allow teams to develop more comprehensive management plans that can detail when and how to deal with high priority species throughout the year.

Alongside data collection, future teams should also consider improving the Sage Hill website and welcome poster. In doing so, teams can promote the importance of the site while also spreading awareness. Displaying our accomplishments and progress on the website can serve as a source of encouragement to those who want to contribute to the health of Sage Hill. Additionally, updating contact information on the website will make managing and organizing future requests pertaining to Sage Hill more simple. The website can also be used to coordinate mass weeding events to assist in restoring Sage Hill and reducing the non-native plant population.

Thank you!

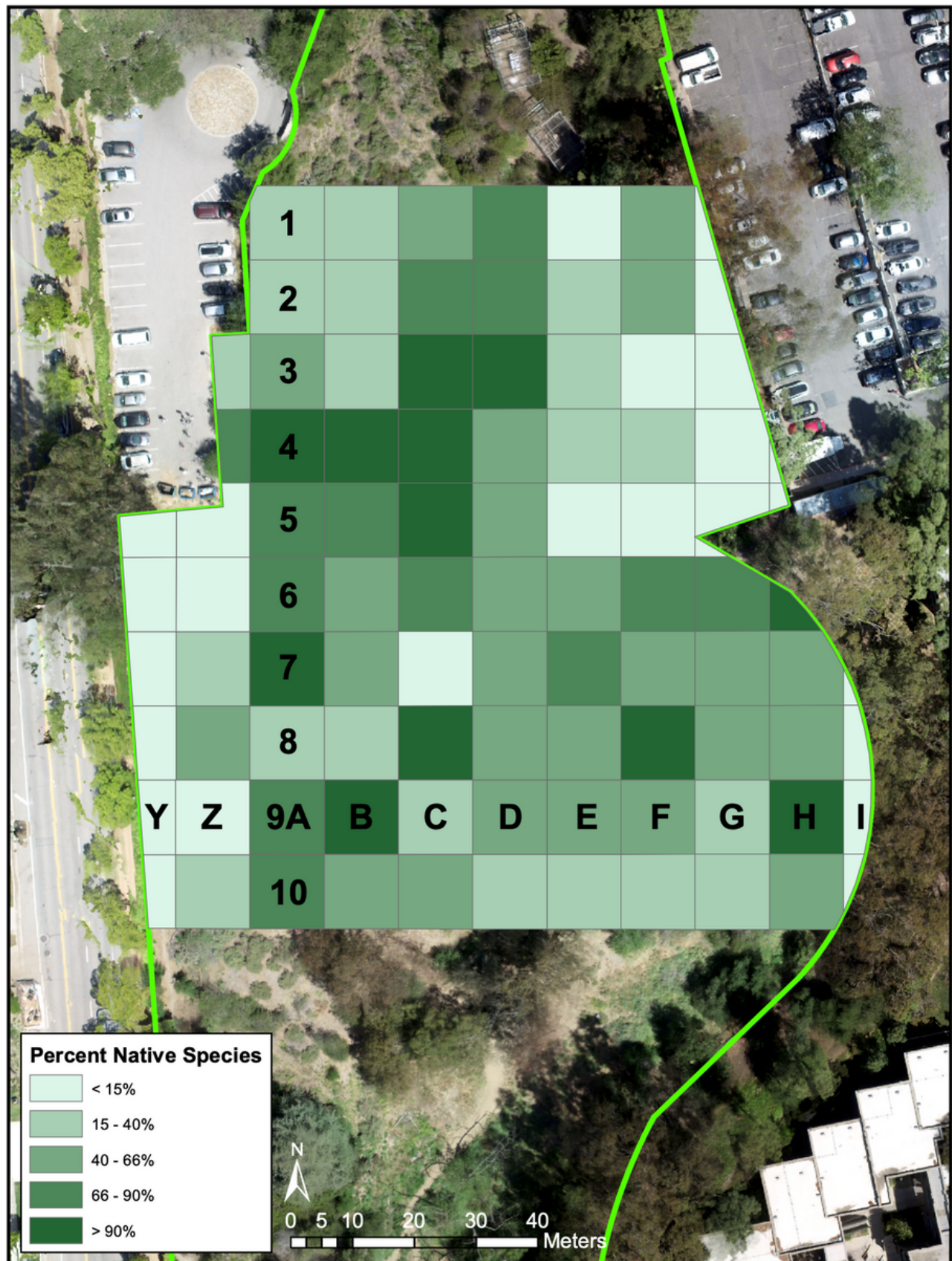
We would like to extend our gratitude to our advisor, Dr. Cully Nordby, as well as Noah Garrison, Dr. Tom Gillespie, Dr. Travis Longcore, Dr. Anthony Baniaga, Bob Ramirez, and Mitzlayolxochitl Aguilera for their guidance, expertise, and support in completing this project.



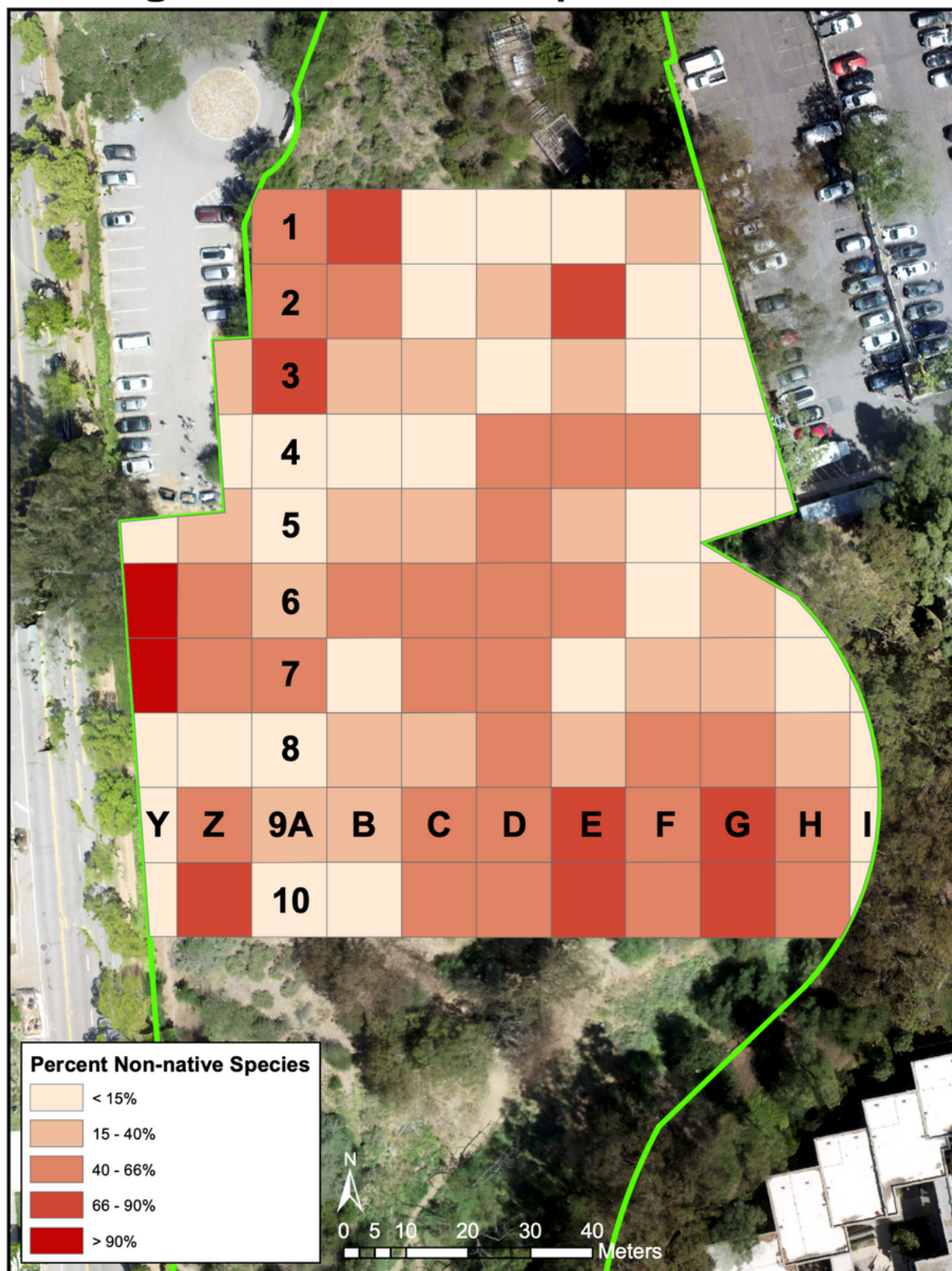
Practicum Team with Tom Gillespie, Mitzlayolxochitl Aguilera at Sage Hill;
Practicum team with Bob Ramirez at Kuruvungna Springs Photos: Cully Nordby, 2022

Appendix

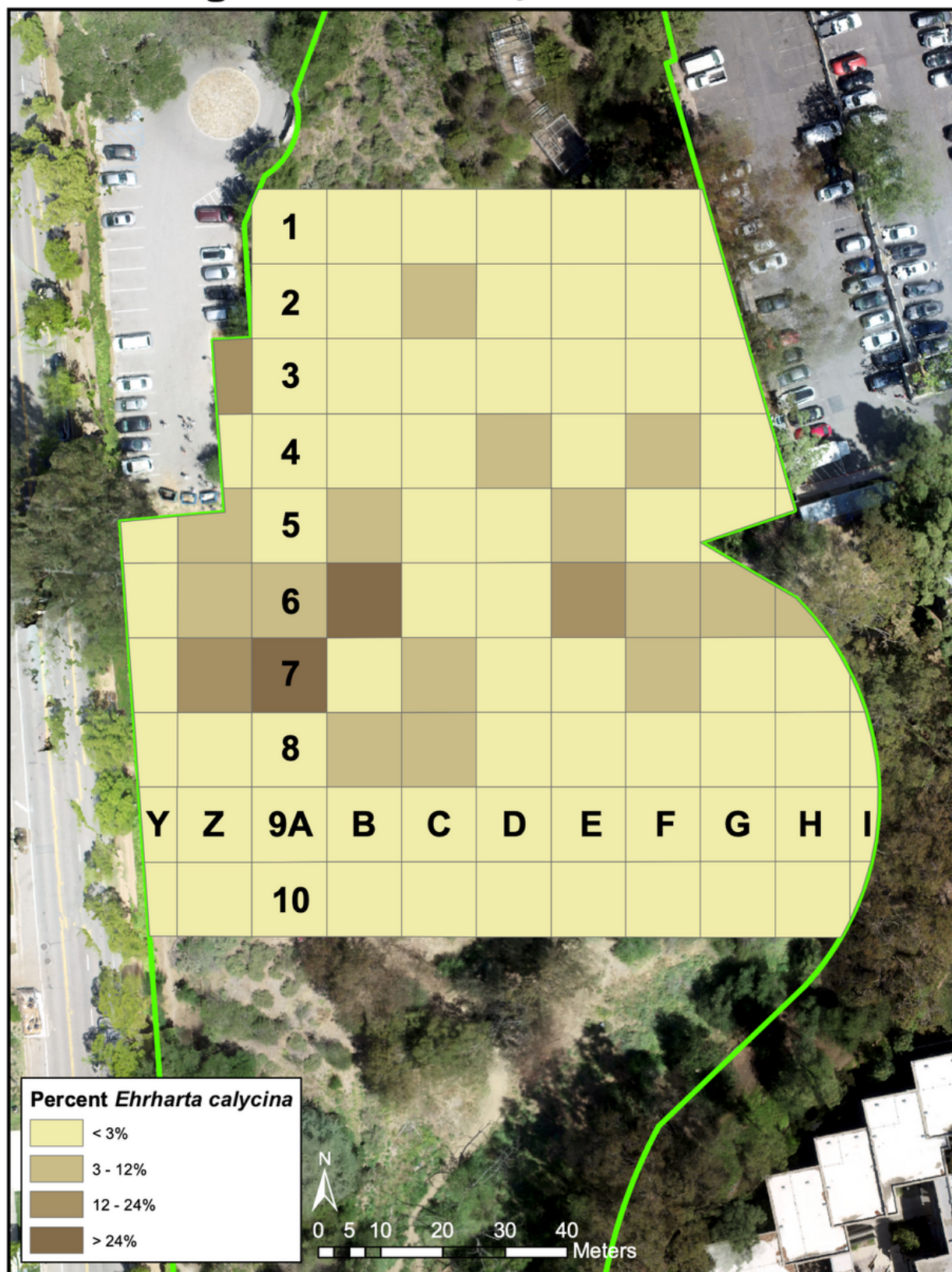
Sage Hill Native Plant Species Distribution



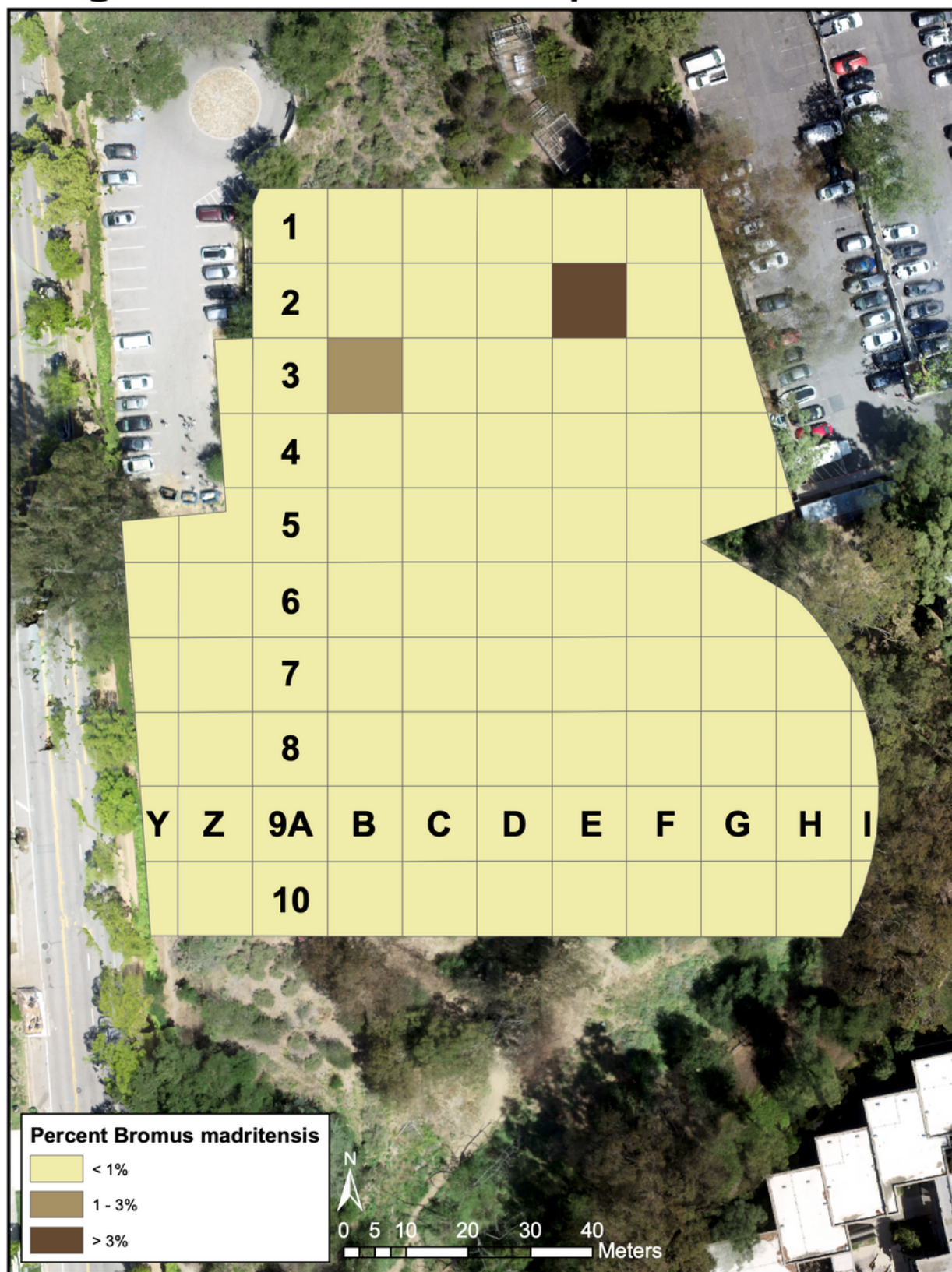
Sage Hill Non-native Plant Species Distribution



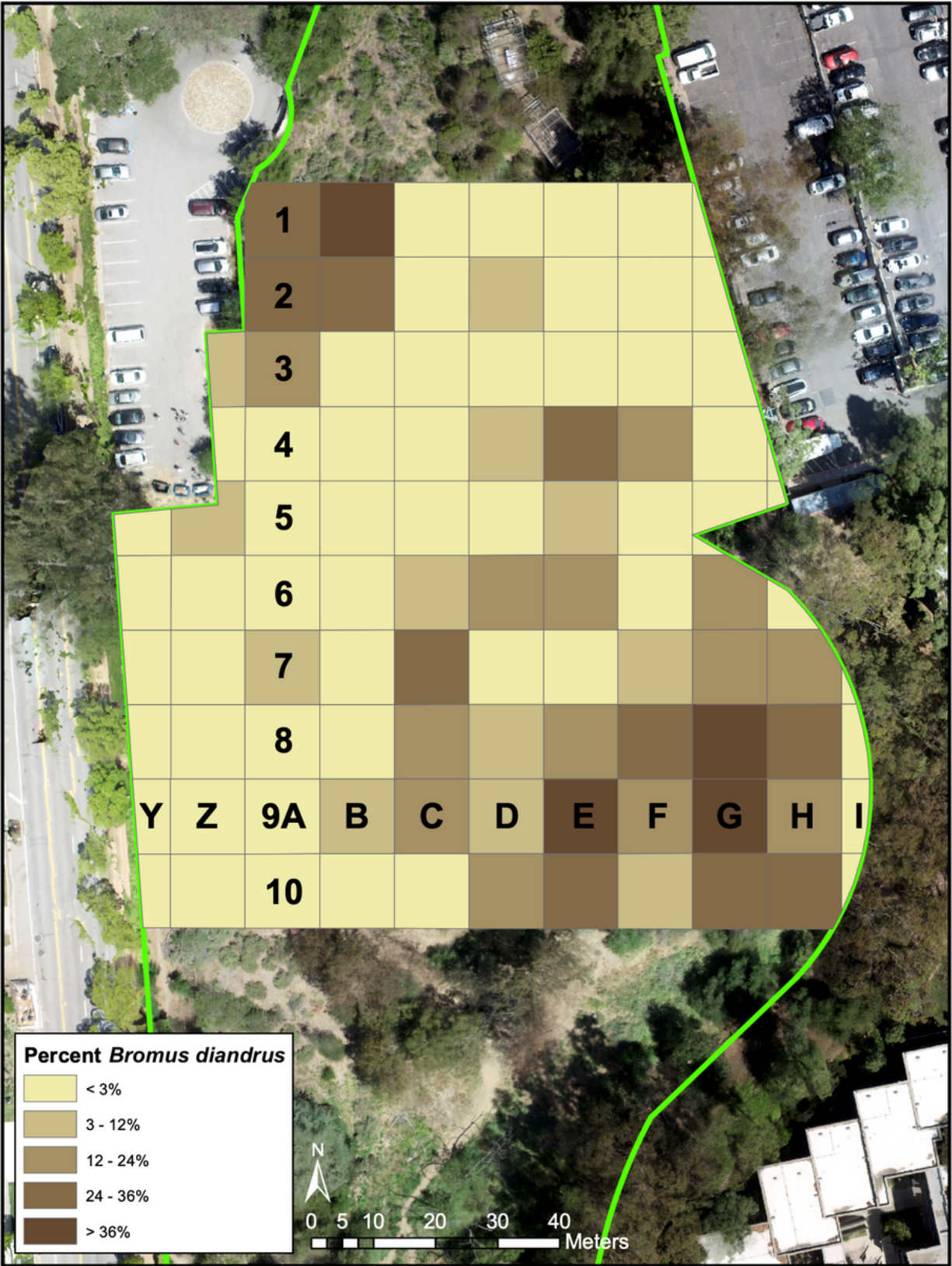
Sage Hill *Ehrharta calycina* Distribution



Sage Hill *Bromus madritensis* ssp. *rubens* Distribution



Sage Hill *Bromus diandrus* Distribution



Sage Hill *Hirschfeldia incana* Distribution

