

PISMO BEACH MONARCH BUTTERFLIES:

**Temporal mapping &
visual analysis of
spatial distribution in
Danaus plexippus species**

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Abstract

The stakeholders of the Pismo Beach Monarch Butterfly Grove, including the state park agency, requested the formation of a collaborative project with some students at the California Polytechnic State University enrolled in NR 418, or Natural Resource Applications in GIS. The project site was the Pismo Beach Monarch Butterfly Grove located west of State Highway 1 at the southern boundary of the Pismo City limits. The formation of a georeferenced survey grid system and geographically positioned and referenced tree data culminated in the mapping of the monarch butterflies within the grove in a two week period. When conditions allowed, clusters of butterflies were recorded in coordination with their location on the survey grid, and data was recorded on cluster height and size (number of monarchs forming the cluster), as well as climatic conditions. The purpose of this data collection was to create a product in the form of a map series showing where the butterflies migrated to within the grove, and what preferences for tree species and locations may be visually displayed. Data was displayed in both 2D and 3D. This report will outline the methods involved in the construction of the mapped and displayed data, and may even pique the interest of the casual lepidopterophile.

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Project Description

The Grove

The Monarch Butterfly Grove at Pismo State Beach is a protected,



Figure 1. Monarch Grove

publically owned site on the central coast of California. The grove at Pismo Beach is one of the largest monarch groves in the United States. There are three primary trees in the grove that the monarchs inhabit: Eucalyptus (*Eucalyptus sp.*), Monterey Cypress (*Hesperocyparis macrocarpa*), and Monterey Pine (*Pinus radiata*). There is a tagging program taking place which allows scientists to track the life and migration patterns of the monarch butterflies. There are also state park interpreters and docents who give daily talks to the public during the season the butterflies are present. The butterflies can be found in the grove from November until March.

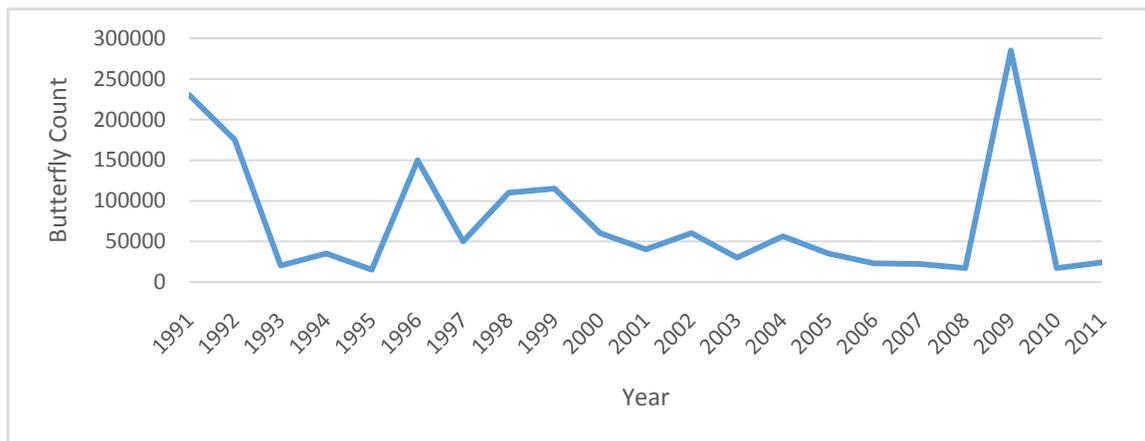


Figure 2. Past annual butterfly counts at the Pismo Beach Monarch Grove

Monarch butterflies

Monarch butterflies (*Danaus plexippus*) have two main populations. One population lives on the east side of the Rocky Mountains and they migrate south to Mexico for the winter. The monarchs that come to Pismo Beach are part of the population on the west side of the Rocky Mountain Range, known as the Western monarchs. The Western monarch's summer range extends into southern Canada, though as winter approaches they begin to migrate to escape cold temperatures. Many of them fly over 1,000 miles to winter throughout California, from San Francisco all the way to San Diego. During their wintering time, they stock up on food for their return north. After mating the females fly north to lay their eggs among milkweed plants where their young will feed as caterpillars. Young monarchs are large caterpillars with yellow, white and black stripes. After they spend a few weeks inside of a chrysalis the monarchs emerge as orange and black butterflies and the cycle of life continues. The adult monarch is functionally immobile in temperatures below 55 degrees Fahrenheit, so where it decides to overwinter is vital to its survival.



Figure 3. Monarch Life Cycle

Purpose

The purpose of this project was to collect data that would provide the monarch butterfly Grove at Pismo Beach a visual interpretation of the butterfly movement patterns. The objective was to develop a GIS map that demonstrated the density and movement of butterfly clusters within the grove. This project will ultimately provide the state park interpreters with a better understanding of the butterfly migration patterns.

Scope

This project began with data collection. This data was then applied to a georeferenced grid made by the previous group. This project ended with 3-D maps displaying the various densities of butterflies within the grove, relative heights of the clusters and temporal changes in monarch distribution. These maps will be made in ArcMap and ArcScene, version 10.2.

Stakeholders

The stakeholders include anyone that could benefit from this information being provided from this project. The Pismo Beach Monarch Butterfly Grove interpreters will be able to use the data for research as well as educational programs. They will also be able to visualize the movement of the butterflies with the 3-D map that we developed. The public are also important stakeholders since they will be able to learn valuable information about monarch butterfly migration patterns in Pismo Beach and foster an appreciation for the complex beauty of nature.

Objectives

1. Contact State Park interpreter, Danielle Patterson
2. Set up appointment to meet Danielle Patterson to learn the proper counting techniques and become familiar with the monarch butterfly Grove in Pismo Beach, Ca.

3. Set up a schedule among group members for daily data collection for a duration of two weeks.
4. Data Collection: Locate and record each individual butterfly cluster's location. Determine approximate count for each cluster found.
5. GIS mapping: Develop maps that represent data collected from the field.
6. Compile report including all data collected, maps, and email correspondences.

Methods

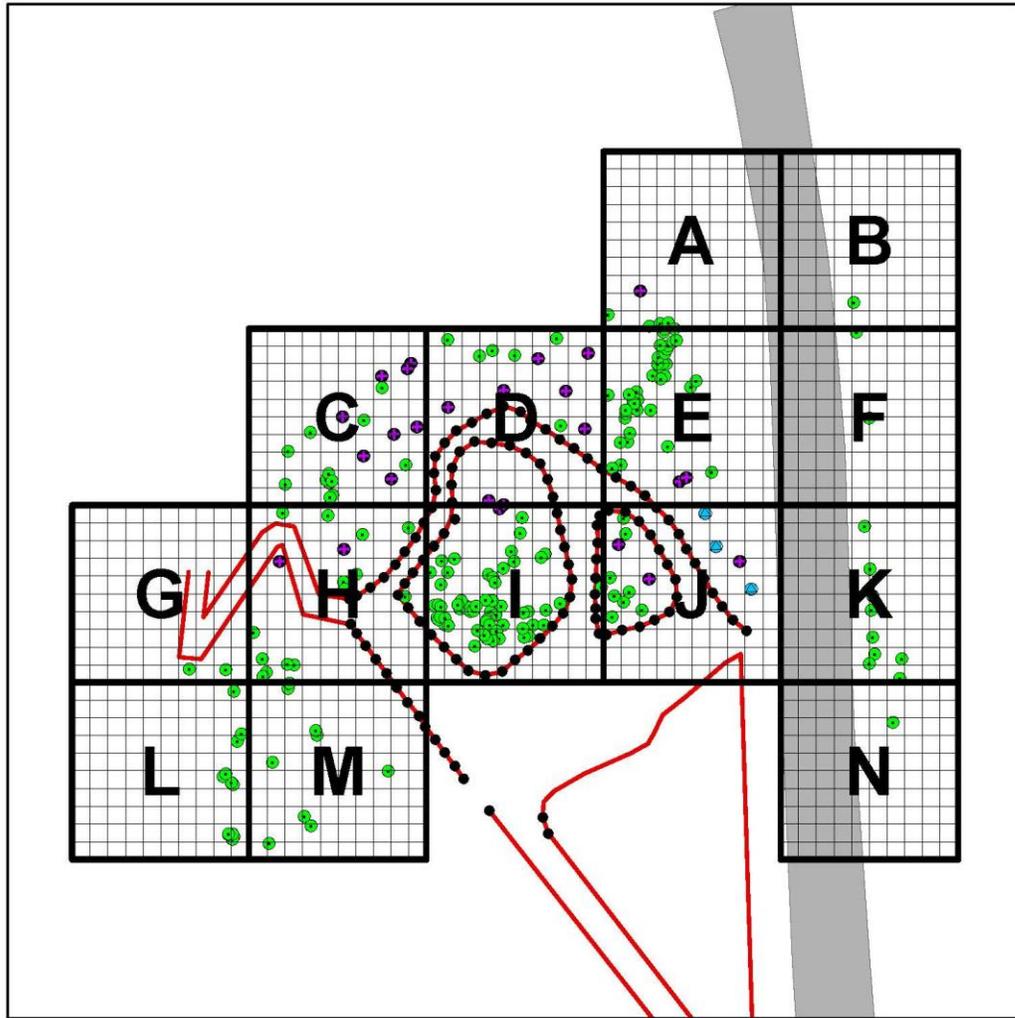
Equipment:

- Binoculars
- Major grid squares
- Minor grid squares
- Data sheets

Data was collected at the Pismo Beach Monarch Butterfly Grove each day for 11 days.

Binoculars were used to count the butterflies within the clusters. A grid map that corresponded with the grove was created by the previous group. The map is comprised of 100x100 ft. major grid squares that are broken down further into 10x10 ft. minor grid squares. This grid map was used to determine cluster and tree location.

Pismo Butterfly Major Grid Index



Legend

- Cypress
- Eucalyptus
- Monterey pine
- Posts
- Fence
- Road

0 100 200 Feet



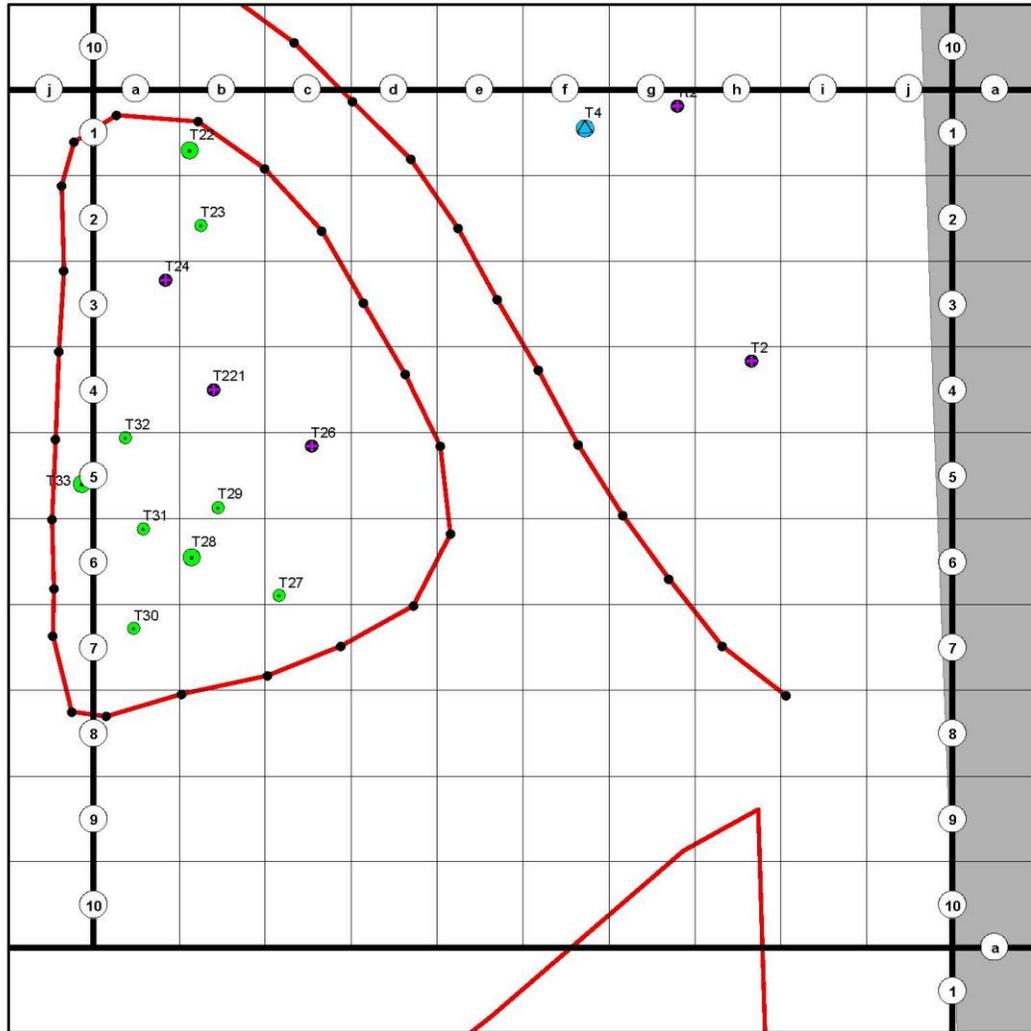
Monarch Alert
CAL POLY
SAN LUIS OBISPO



NRES GIS 2013

Figure 4. Major Grid Squares

Pismo Butterfly Grid J



Legend

- Cypress
- Eucalyptus
- Monterey pine
- Posts
- Fence
- Road

0 10 20 30 40 50 Feet



Monarch Alert
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NRES GIS 2013

Figure 5. Example of Minor Grid Squares

On the morning of the collection the participants arrived at the butterfly grove at sunrise to ensure the butterflies were still clustered. Information about time, temperature, wind speed, cloud coverage and precipitation were taken each day upon arrival. After surveying the area quickly for clusters, counting began. For each cluster two counts were taken and an average number was recorded. Along with number of butterflies, information regarding the tree species the cluster was on as well as height at the top and bottom of the cluster.

Once all of the data was collected it was entered into an excel spreadsheet then into ArcMap. The next task was to import the relevant features that would be used in the mapping process, as seen in the base layer screen shot. That included the minor grid which contained the field “minorgridlabels”. These were the unique values for each cell within the grid and acted as a reference point for butterfly location, which was recorded beneath the “ZoneCell” field. The red-lined fence and gray-filled road features were added to gain a sense of orientation on the map.

Besides features, the data itself had to be imported from the excel spreadsheets that were made and updated after each butterfly counting. This was imported as a .DBF format table and was named “monarch_dataset”.

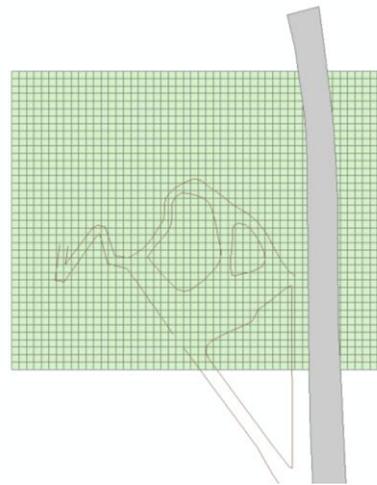


Figure 6 Base Layer Screen Shot

	A	B	C	D	E	F	G
1	Date	NumMonarchCluster	ZoneCell	TreeNum	TreeSpecies	ClusterHeightTop(m)	ClusterHeightBottom(m)
2	1/9/2014	68	D-b-2	T70	E	10	9
3	1/9/2014	720	D-b-2	T70	E	10	9
4	1/9/2014	53	D-b-2	T70	E	10	9
5	1/9/2014	94	D-b-2	T70	E	10	9
6	1/9/2014	24	D-b-2	T70	E	10	9
7	1/9/2014	77	D-b-2	T70	E	10	9
8	1/9/2014	198	D-b-2	T70	E	10	9
9	1/9/2014	611	D-b-2	T70	E	10	9

Figure 7. Example of Excel formatted data

After the dataset was imported, an address locator was created in order to geocode the “addresses” of the butterflies (their placement on the grid) to the spatially referenced grid (“minorgrid”/”grid10”). The address locator required a “key field”, which was the field that would be used later to key out the locations of the butterflies. Here the key field was the “minorgridlabel” and the locator was called “BTRFLY_LOC”.

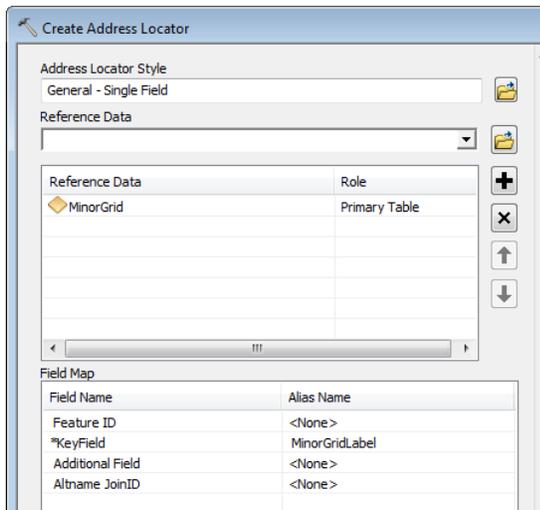


Figure 8. Address locator tool

Next the butterfly data was combined with the address locator to place point data on the grid map of the butterfly locations. This was done with the Geocode Addresses tool. The “monarch_dataset” table was the input table with the reference key or “singlekey” being the ZoneCell field of the monarch_dataset table. The BTRFLY_LOC was used as the address

locator. Once this tool was ran, its output was a point layer with the locations and other collected information on the monarchs within the grove.

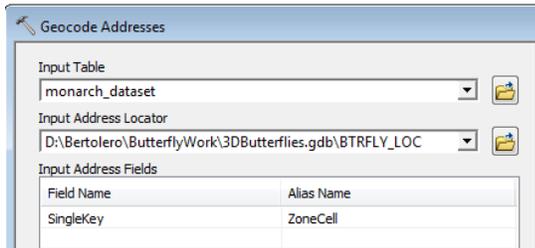


Figure 9. Geocode Addresses tool

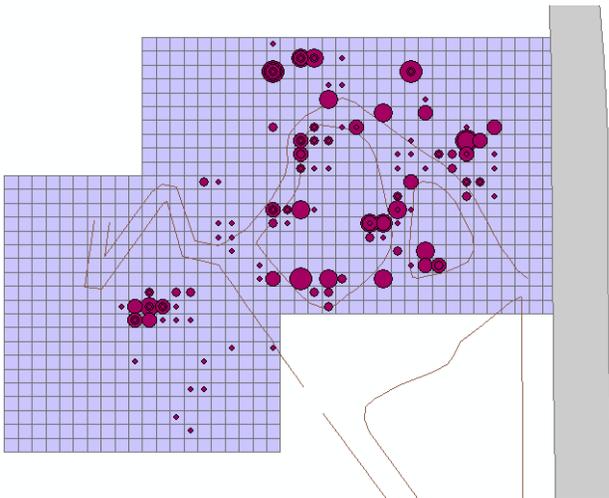


Figure 10. Geocode Address results

After the location of each observed monarch cluster was mapped, a summarization of statistics was made to determine the sums of the number of monarchs using the monarch_dataset. This output table of monarch sums was called “Sums_Output_2” and was used to determine the counts of butterflies occurring at each cell. The join tool was used to combine this data onto the minorgrid feature. This process was done for each day data was collected, to get a series of grids that contained butterfly sums associated with grid locations. The grids were symbolized with

density ranges being color coded. Dark green expresses a density within that grid location of 2-360 butterflies, light green 360-1100, yellow 1100-2400, orange 2400-4600, and red 4600-18800.

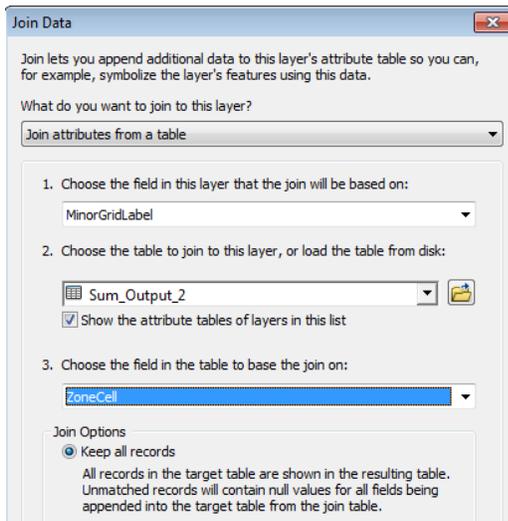


Figure 11. Join of summary statistics to minor grid

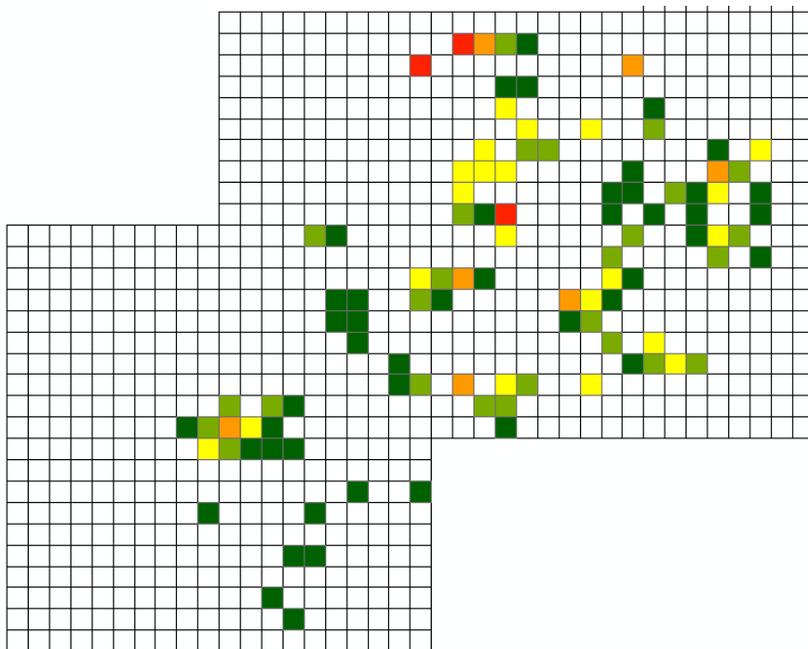


Figure 12. Symbolized Grid

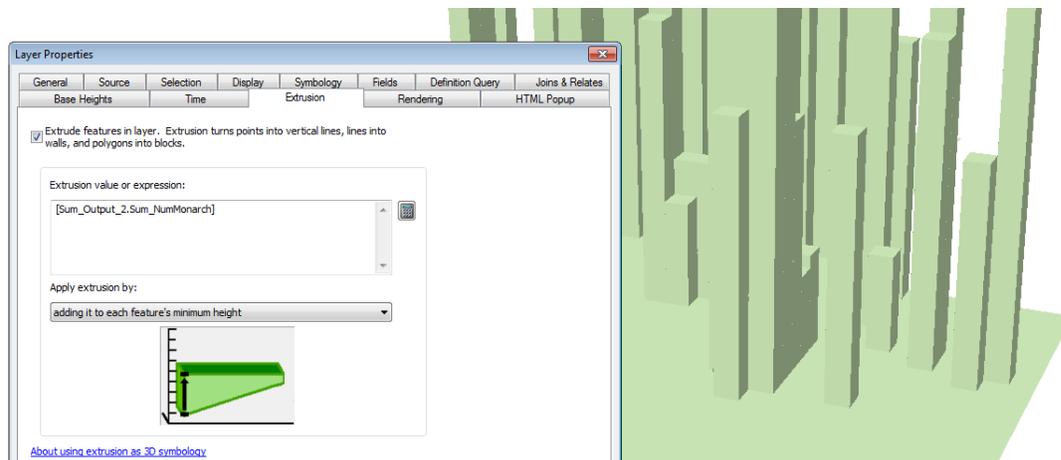


Figure 13. Extrusion by monarch number in ArcScene

With this newly added field on each minorgrid feature, ArcScene was used to extrude a summary layer to express the number of monarchs at each cell throughout the course of the entire observation period. The symbology can be changed to show the designated densities of butterflies ranging from green to red. When zoomed out, interesting data is readily observed, such as the most frequently visited cell in the whole grove; D-d-10

Another aspect of this project was to determine the heights of the clusters relative to each other within the grove. To determine the center location of a butterfly cluster, the average height to the top and bottom of the clusters was determined and converted from meters to feet with the field calculator. This yielded a file called “CLSTR_MID”. There was no height data (Z data) on the monarch cluster points enabled, so a tool was used to add Z data to the cluster feature using the “CLSTR_MID” field. The tool is called “Feature to 3D by Attribute”. The change is evident when observing a profile graph of the data.

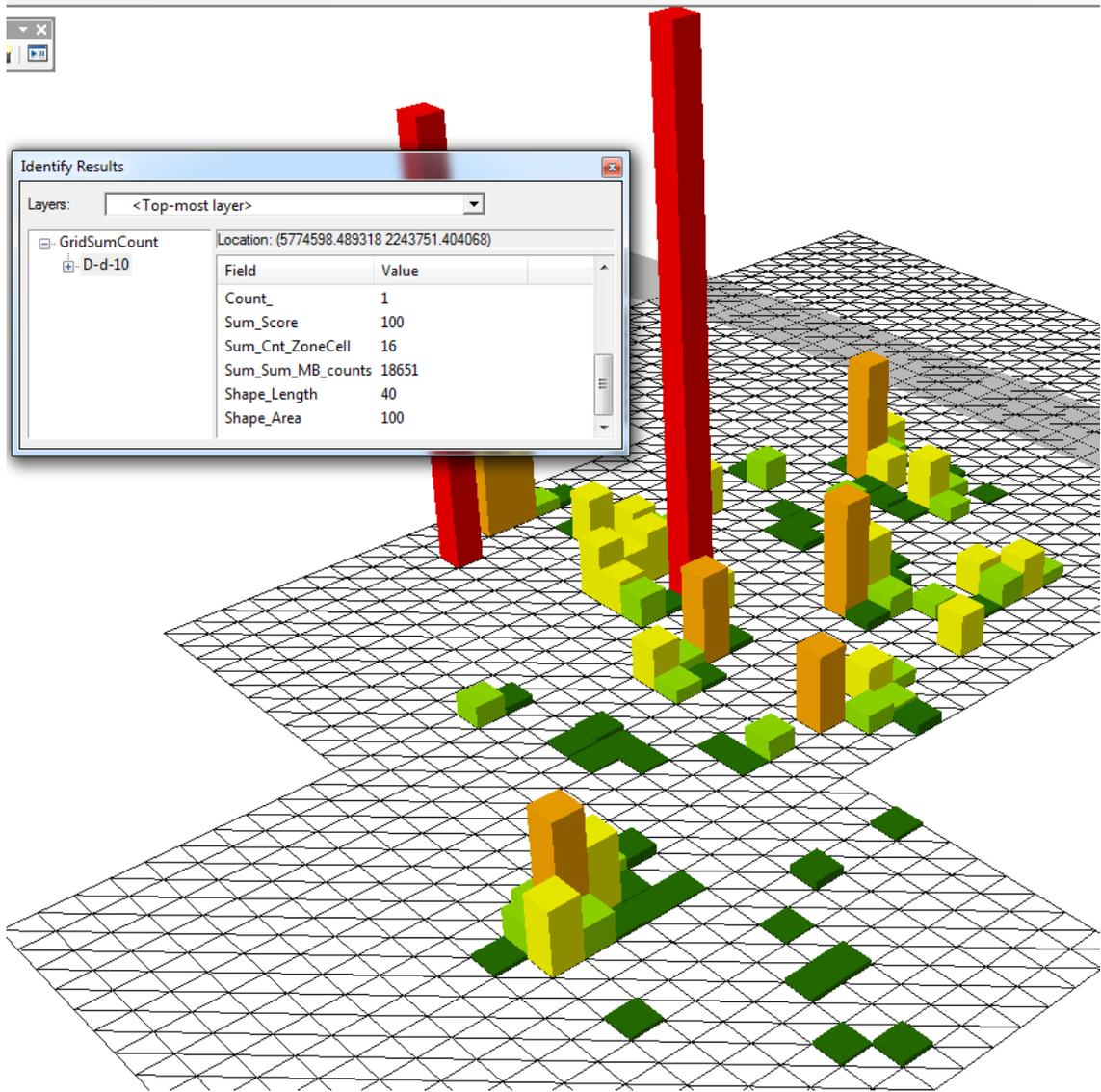


Figure 14. Representation of Most Visited Cell, D-d-10

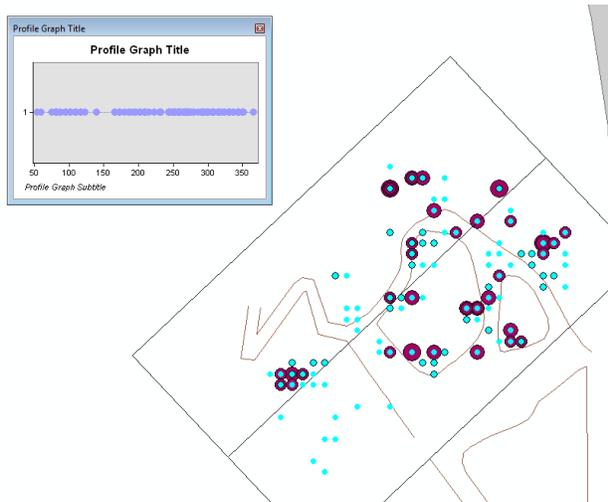


Figure 15. 2D cluster locations in ArcMap

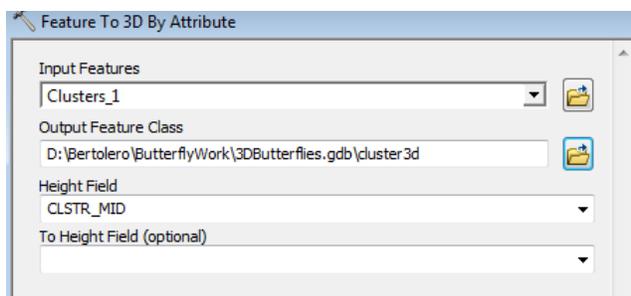


Figure 16. Converting 2D data into 3D data

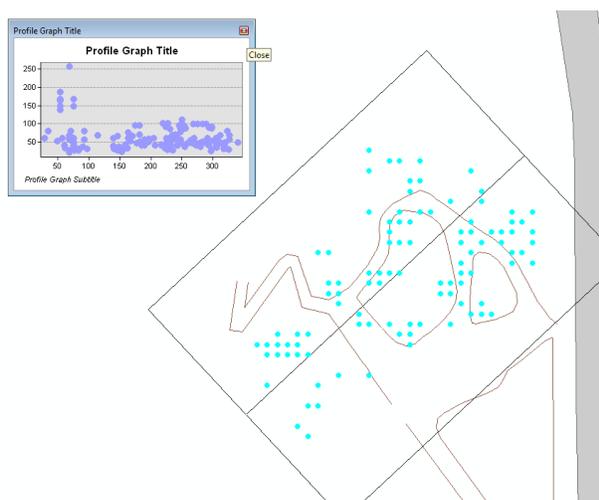


Figure 17. 3D cluster locations in ArcMap

This feature which now has Z data can be opened in ArcScene to display the clusters in 3D. The symbology was changed to show larger circles for more monarchs per cluster.

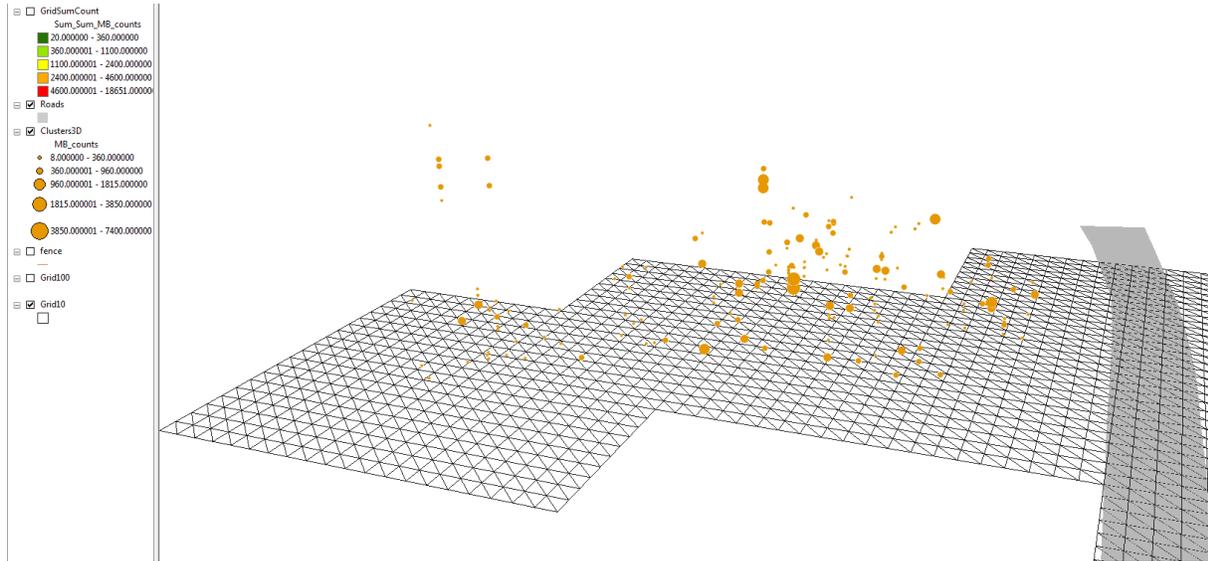


Figure 18. 3D cluster data exported to ArcScene

Point density was easily determined to get a display for how dense the placement of monarch clusters and the number of monarchs within each cluster were. The monarch cluster point feature was used and the density value was based off of the number of monarchs (“Nummonarch”). This gives a sense of the butterfly “hotspots”.

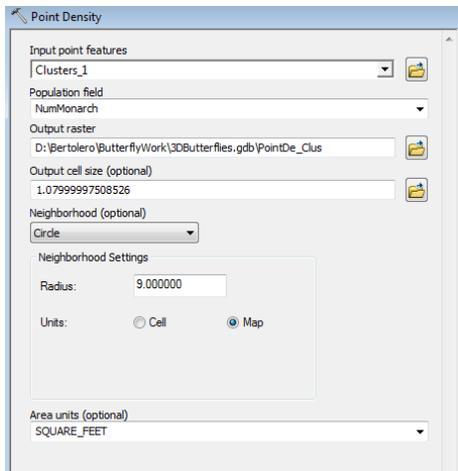


Figure 19. Population Density tool

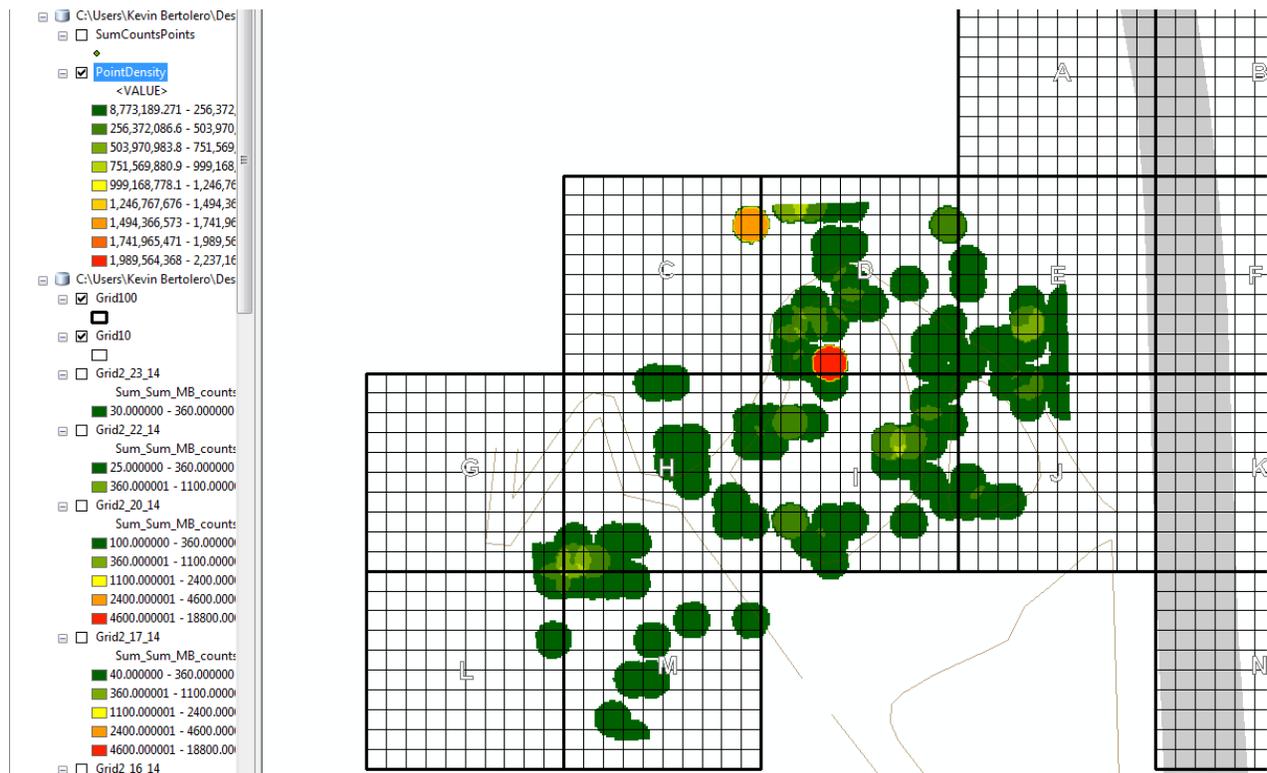


Figure 20. Visual representation of population density

After the data was mapped as a whole, it was broken down by date and individual maps of butterfly locations by date were produced with standard map making protocol and the previously described technique of geocoding. Finally, with the animation toolbar, the data was displayed and animated as changing points in time on the survey grid.

Assumptions

Because we only have data for one year we have to assume that this year is a typical year of butterfly migration.

Restrains

The first restraint we had was setting up a time to meet with Jessica, a Cal Poly grad student, who taught us how to count the butterflies in the clusters. It was hard to find a time that worked for both parties and it took us a while to begin data collection. We were dealing with a time constraint to finish the project before the



Figure 21. Monarchs Clustered Prior to Dispersal

class deadline since it took three weeks just to get started with data collection. We initially anticipated that we would be collecting data every day for a two week period, but once we learned the proper data collection techniques and requirements, we realized that the brief window of time in the morning that counts can be taken made it impossible for one of us to go every day. We ended up taking counts on 11 days of the 16 day collection period. The days were relatively evenly spaced, but there was no established pattern. This means that our data does not represent true day-to-day changes. The optimal data collecting time for counting monarchs is in the morning after daybreak, and before the air temperature reaches 55 degrees. Monarch butterflies cannot fly when air temperature is below 55 degrees, so this is the best time to count them with the highest accuracy, when they are still in clusters and have not begun to disperse. Because of the recent warm spell, the air temperature was above 55 degrees before daybreak during some of

the data collection sessions. Because the monarchs had already begun to move while data was being collected, it is possible that some of our counts were lower than they would have been if all of the butterflies were stationary.

Results

Table 1. Butterfly counts per day surveyed

Date	Jan 9	Jan 20	Feb 8	Feb 11	Feb 13	Feb 14	Feb 15	Feb 16	Feb 17	Feb 18	Feb 22	Feb 23
Counts	28,351	22,525	22,266	13,615	5,320	1,480	9,730	3,237	4,436	6,480	1,602	640

Because we were doing counts during the end of their wintering season the number of butterflies declined each day as they began their migration back up north. This is readily observed in the Butterfly counts table. More interesting facets of data collected include the average cluster height, which was 63.4 feet. The Table of results also shows how important the cypress species is within the grove. Although there were only 26 cypress trees in a grove of 210 trees in roughly 140,000 square feet, they were the most popular trees.

For access to the animations of butterfly locations, including the relative cluster heights, the grid extrusion density displays and the change by day map, refer to the included disc.

Table 2. Table of results

	Tree Number	Tree Species	Numbers
Highest Number/tree	T76	Monterey Cypress	18,343 butterflies
Most Visited Tree	T100	Monterey Cypress	34 Clusters

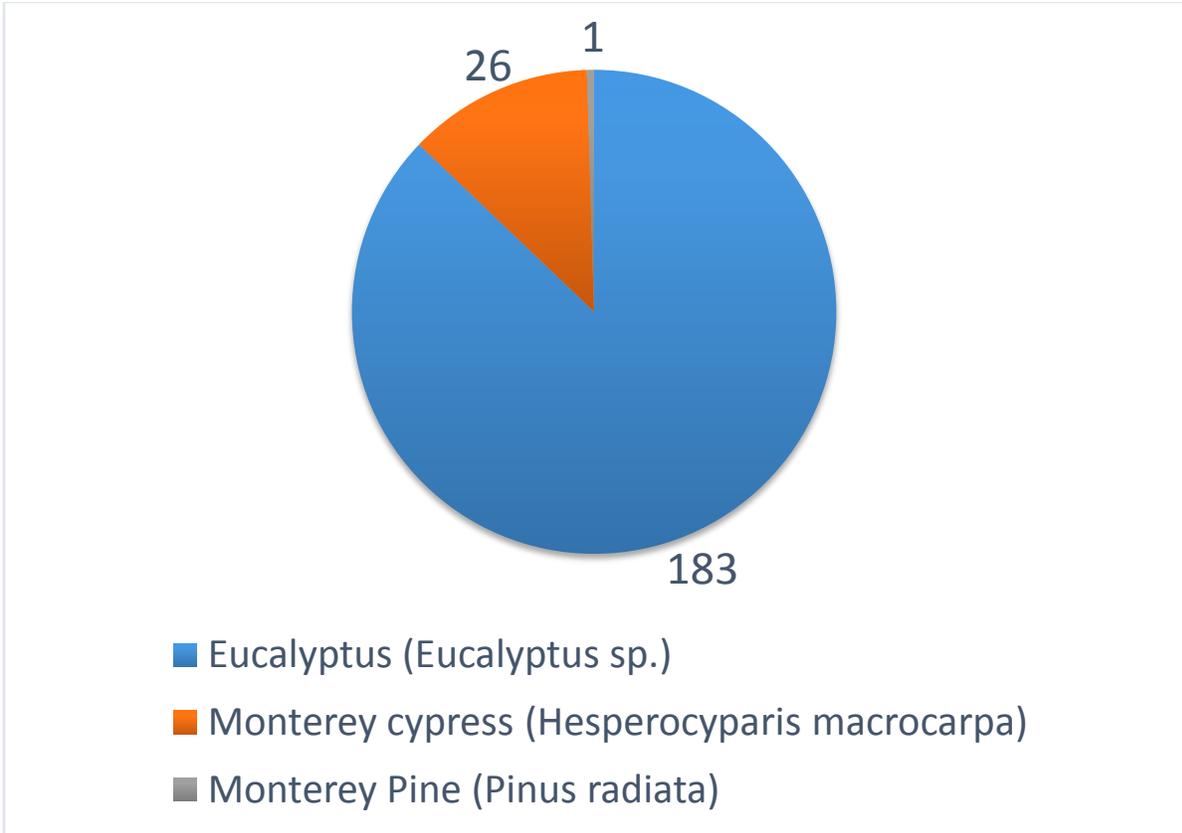
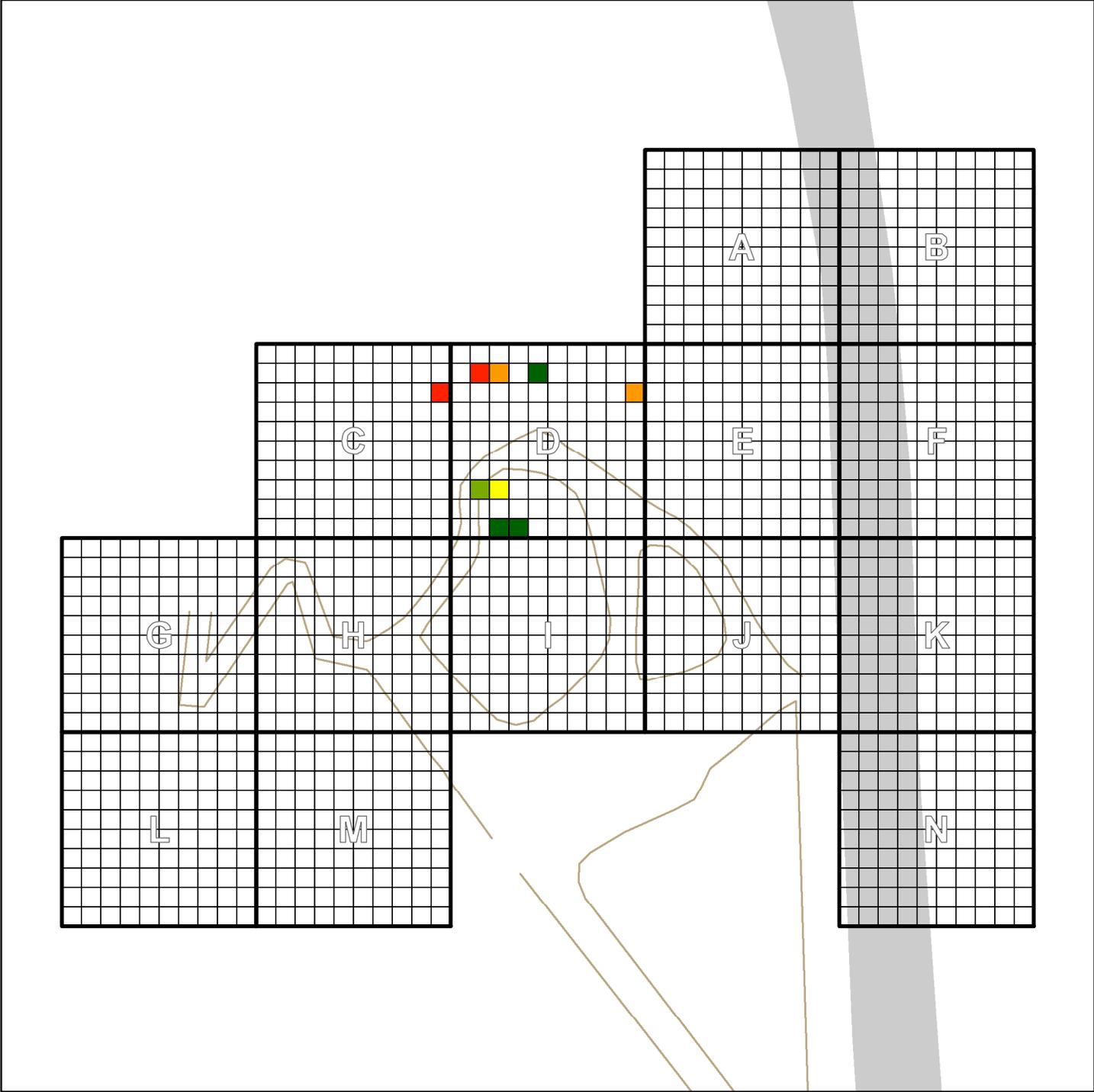


Figure 22. Number of tree species within the grove

Mapped Butterfly Clusters

Pismo Butterfly Density January 9, 2014



Butterfly Count

-  2-360
-  360-1100
-  1100-2400
-  2400-4600
-  4600-18800

0 100 200 Feet

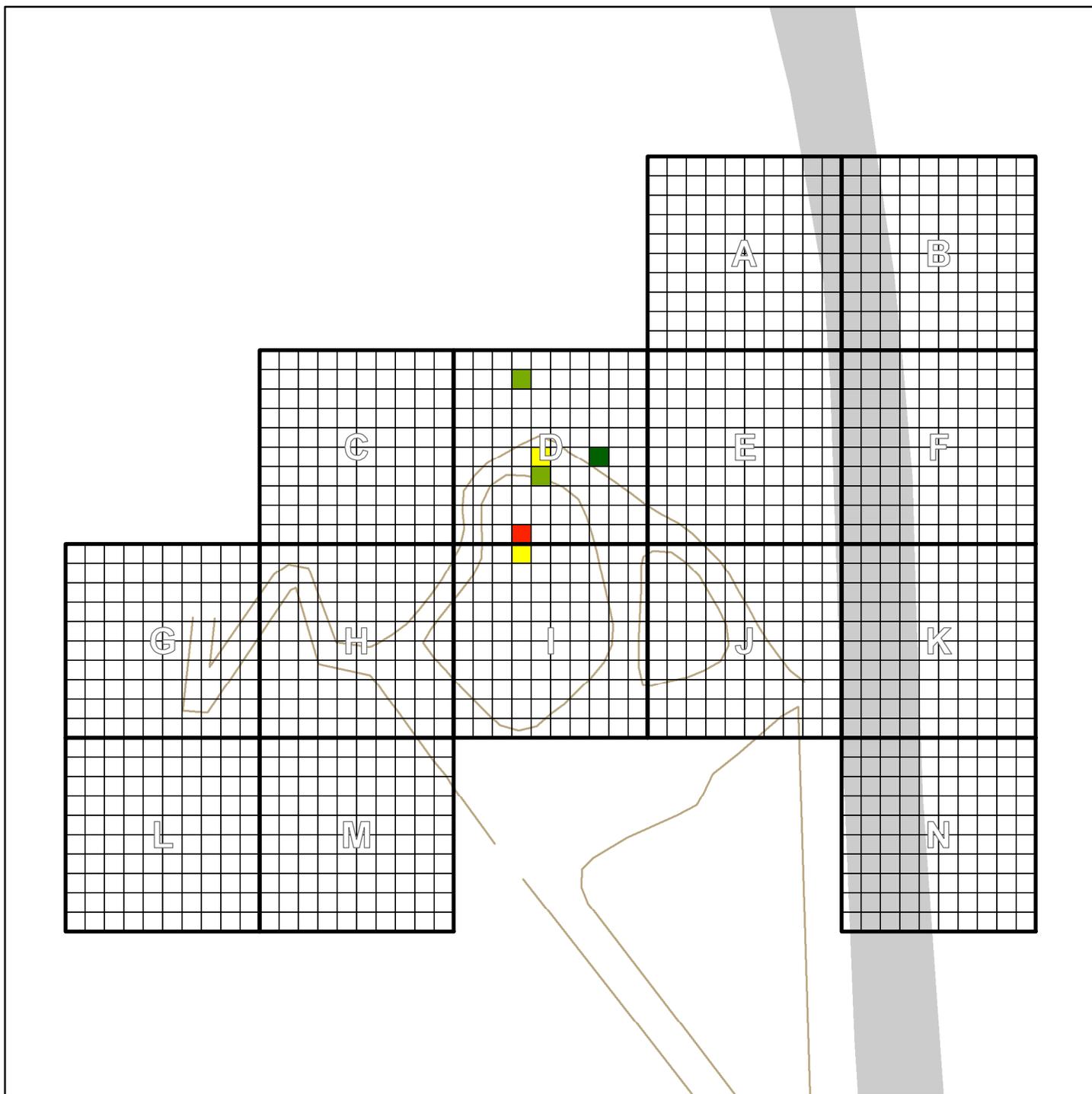
 Fencing
 Road



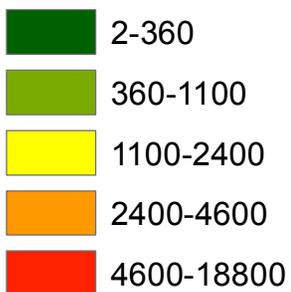
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



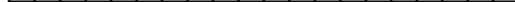
Pismo Butterfly Density January 20, 2014



Butterfly Count



0 100 200 Feet



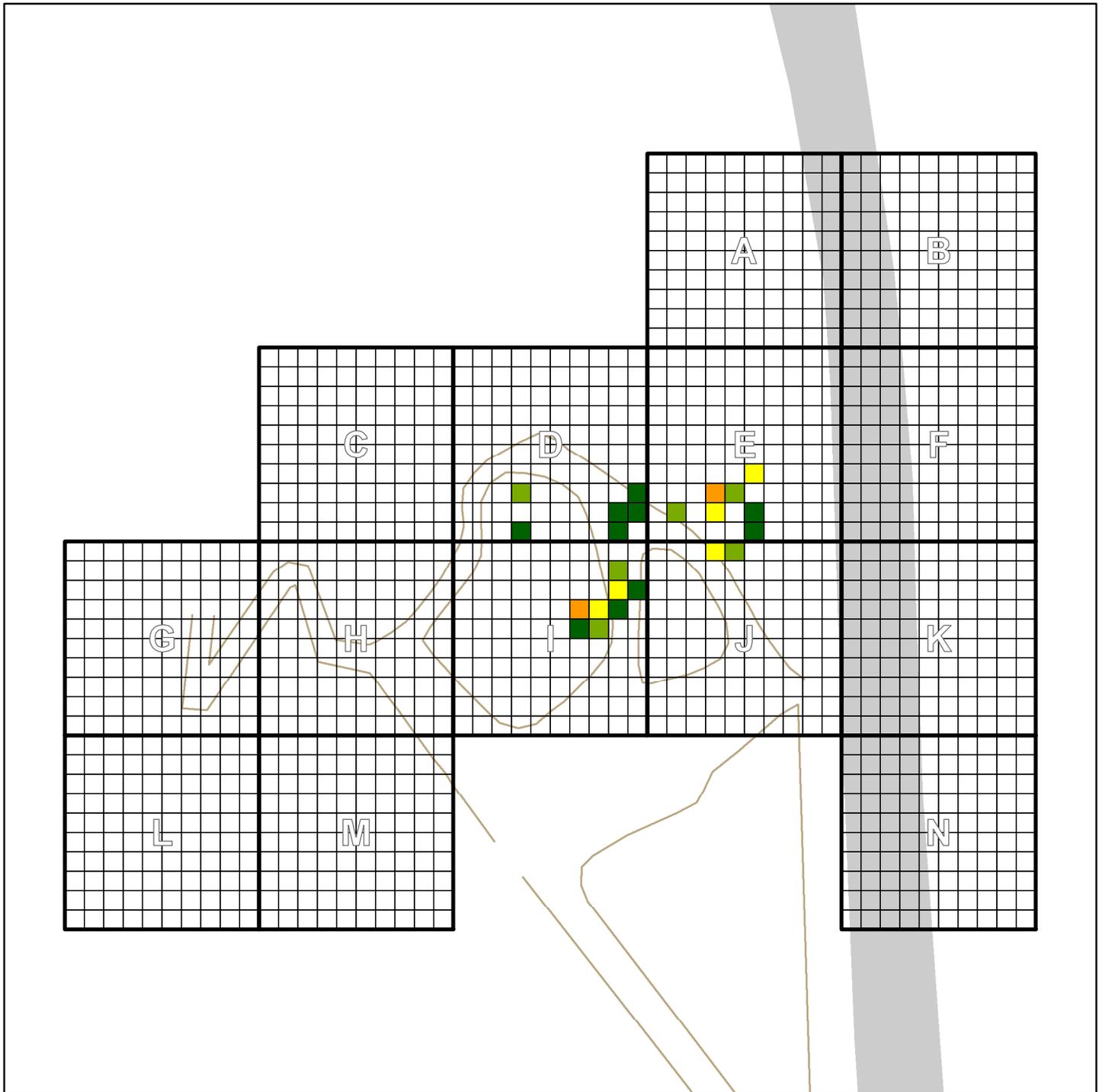
Fencing
 Road



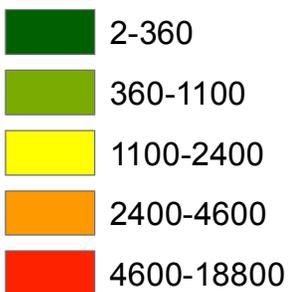
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 8, 2014



Butterfly Count



0 100 200 Feet



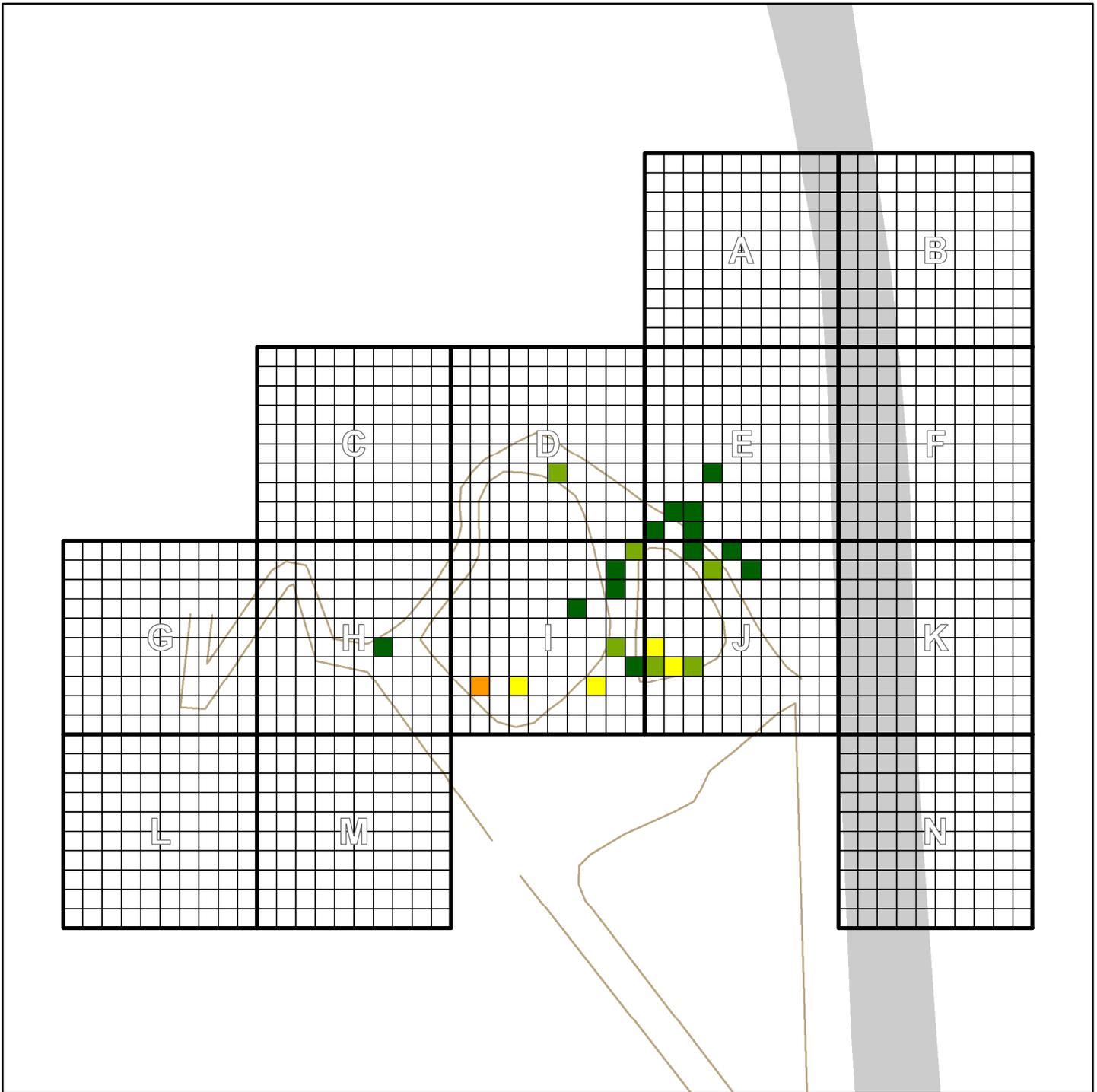
 Fencing
 Road



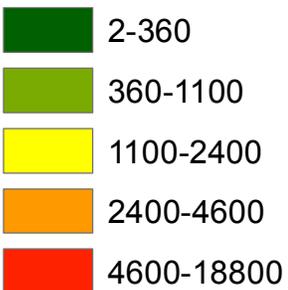
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 11, 2014



Butterfly Count



0 100 200 Feet



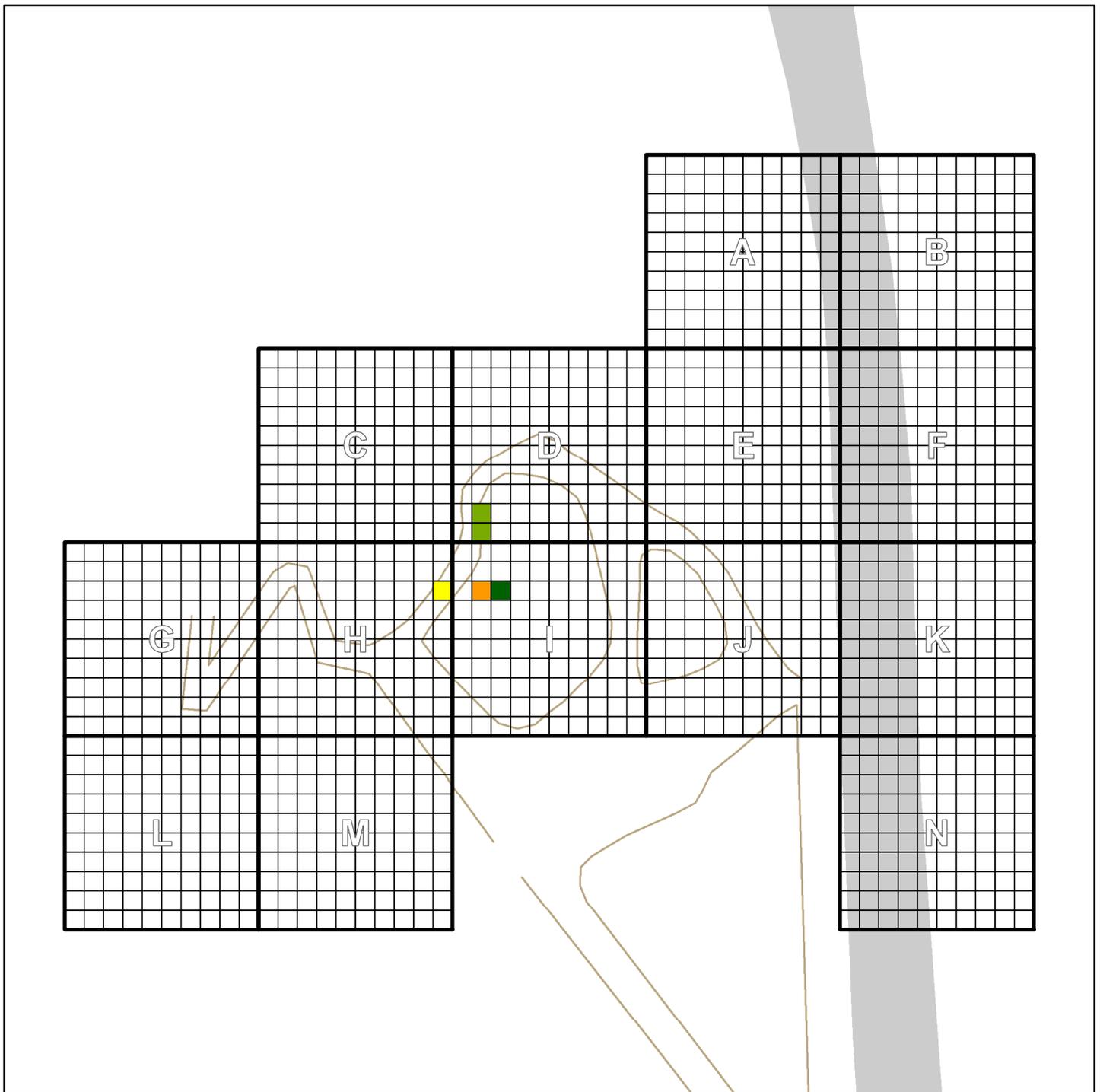
 Fencing
 Road



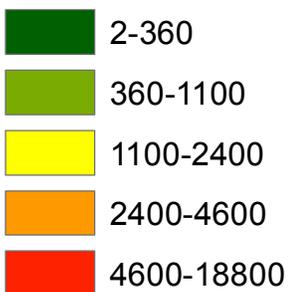
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 13, 2014



Butterfly Count



0 100 200 Feet



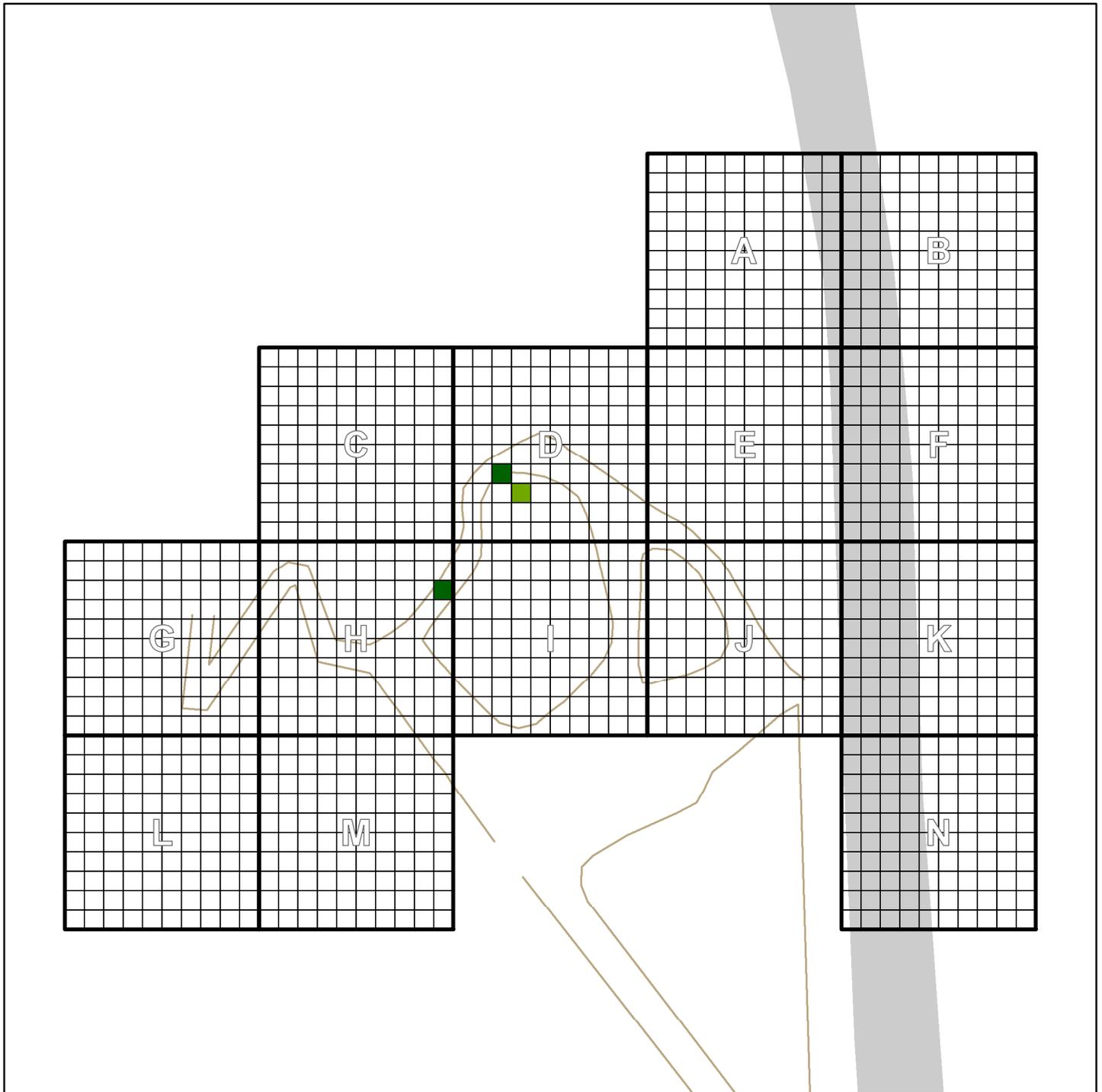
Fencing
 Road



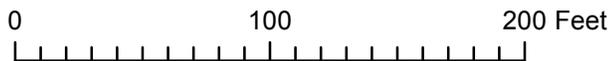
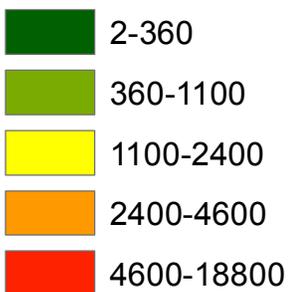
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 14, 2014



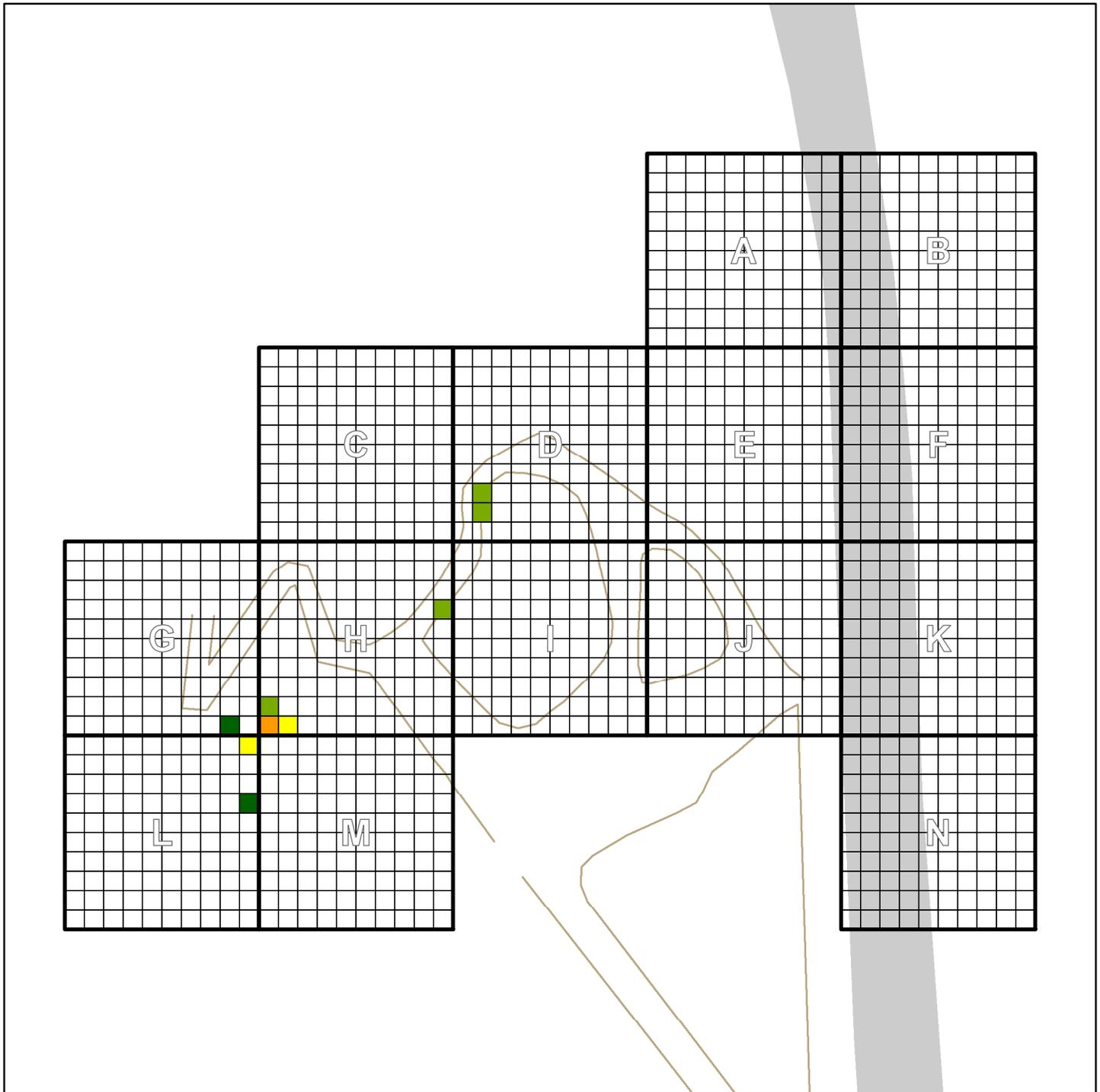
Butterfly Count



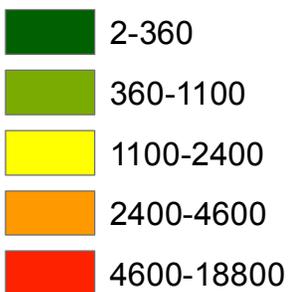
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 15, 2014



Butterfly Count



0 100 200 Feet



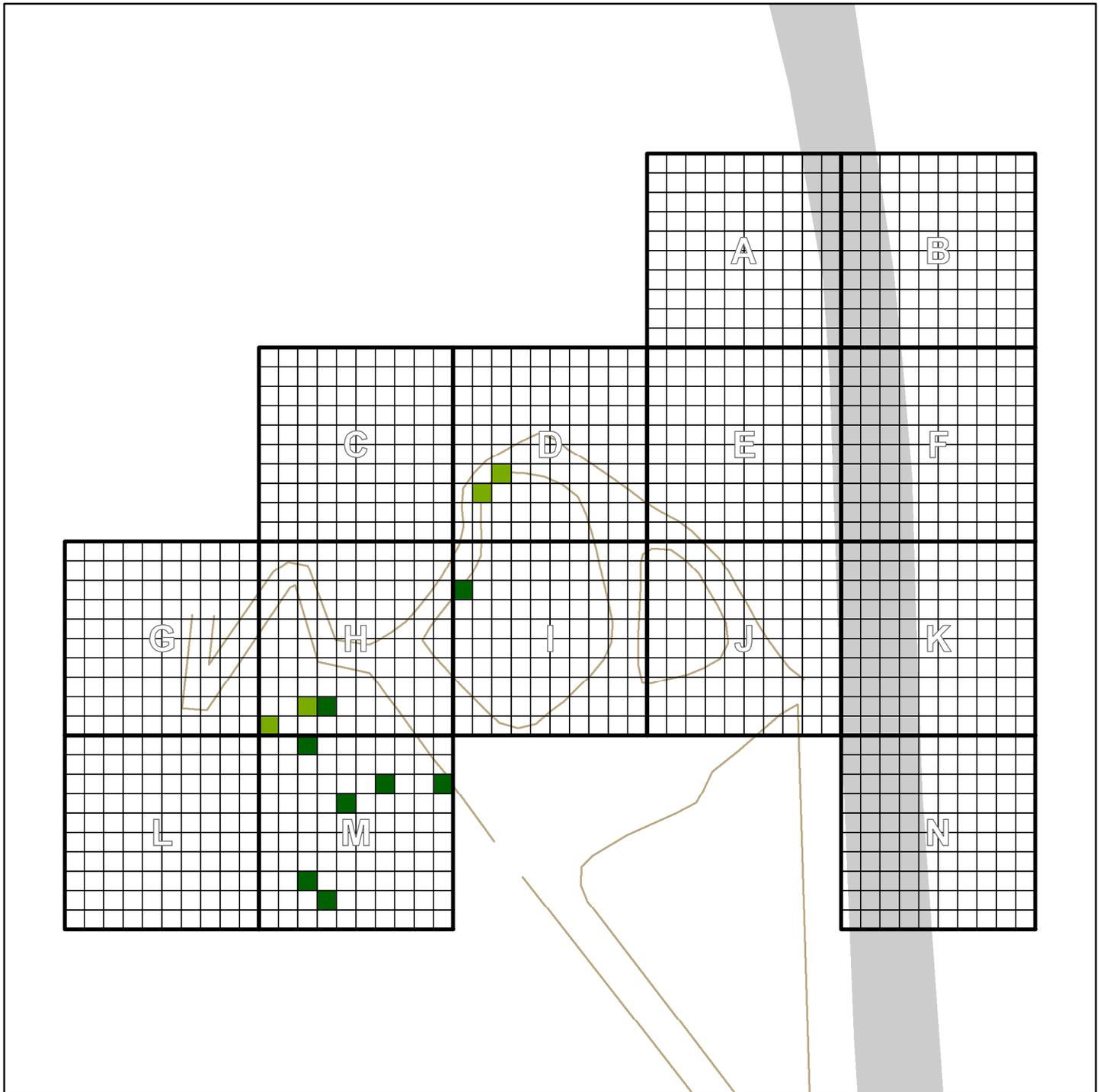
 Fencing
 Road



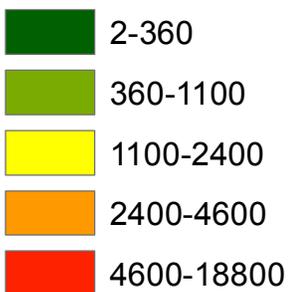
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 16, 2014



Butterfly Count



0 100 200 Feet



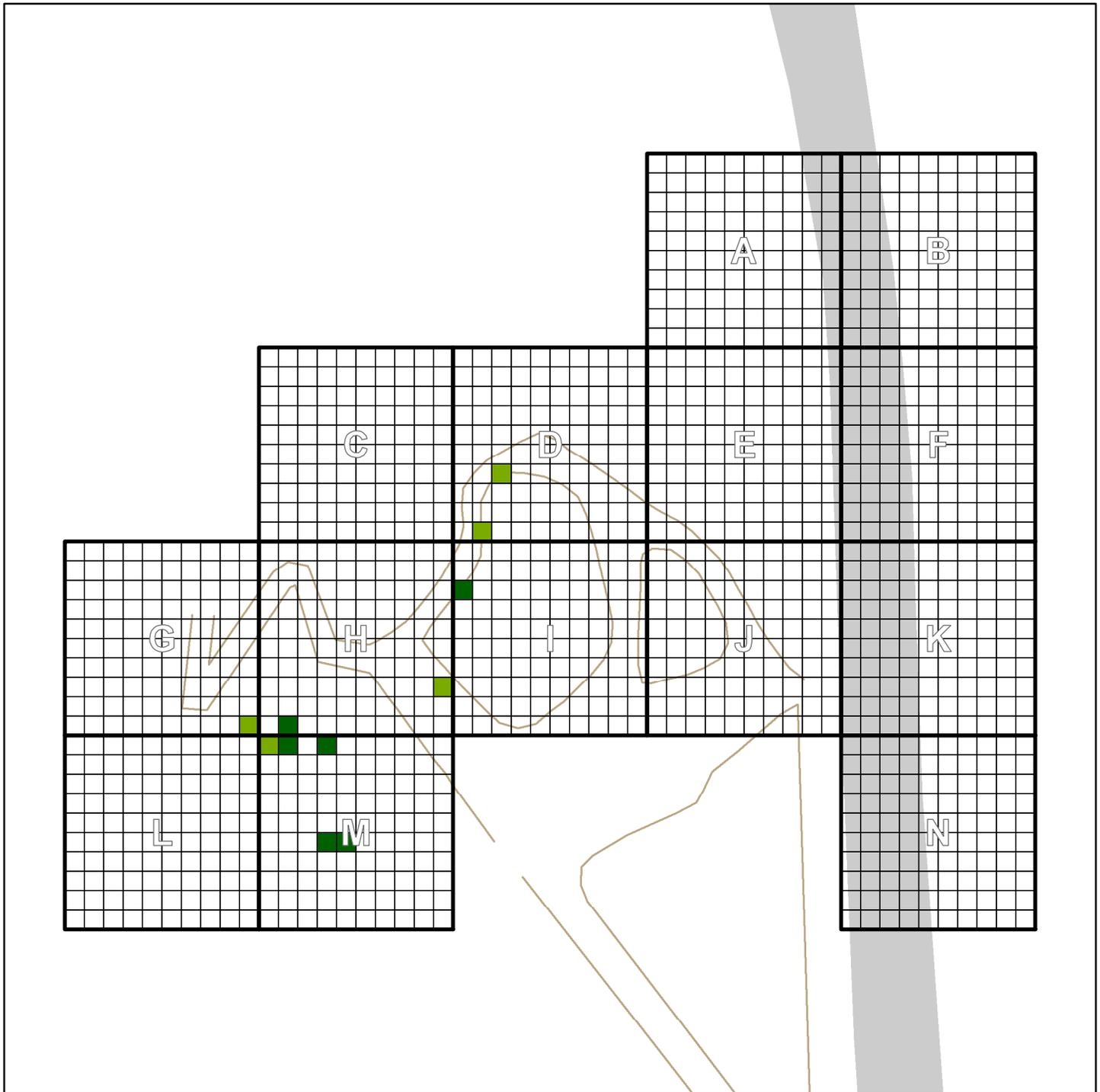
Fencing
 Road



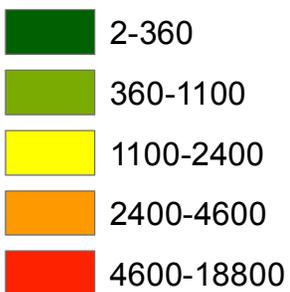
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 17, 2014



Butterfly Count



0 100 200 Feet



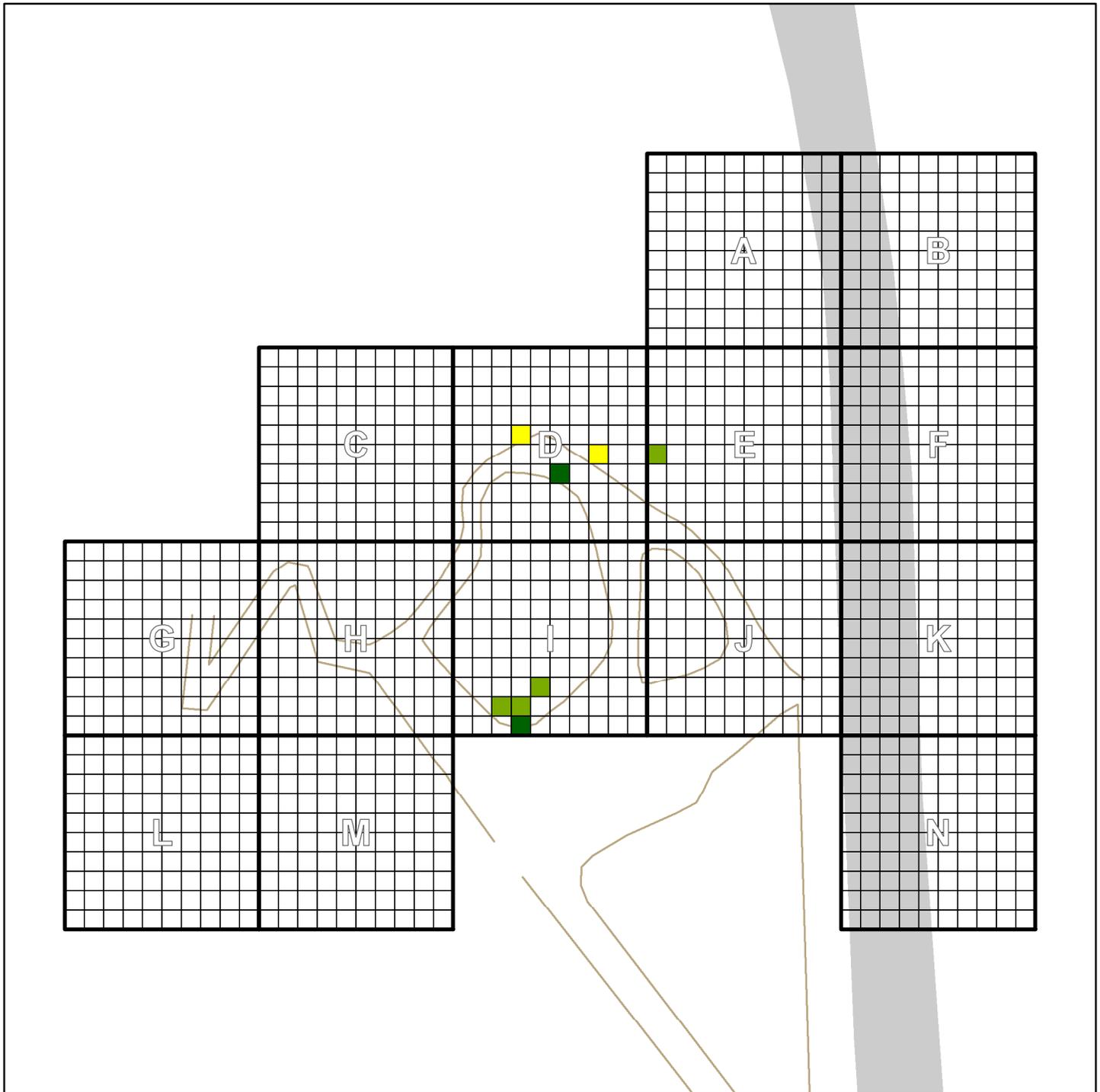
 Fencing
 Road



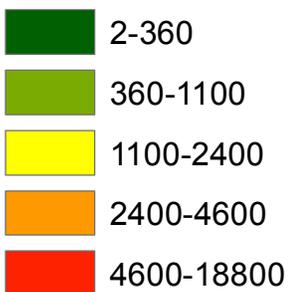
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 20, 2014



Butterfly Count



0 100 200 Feet



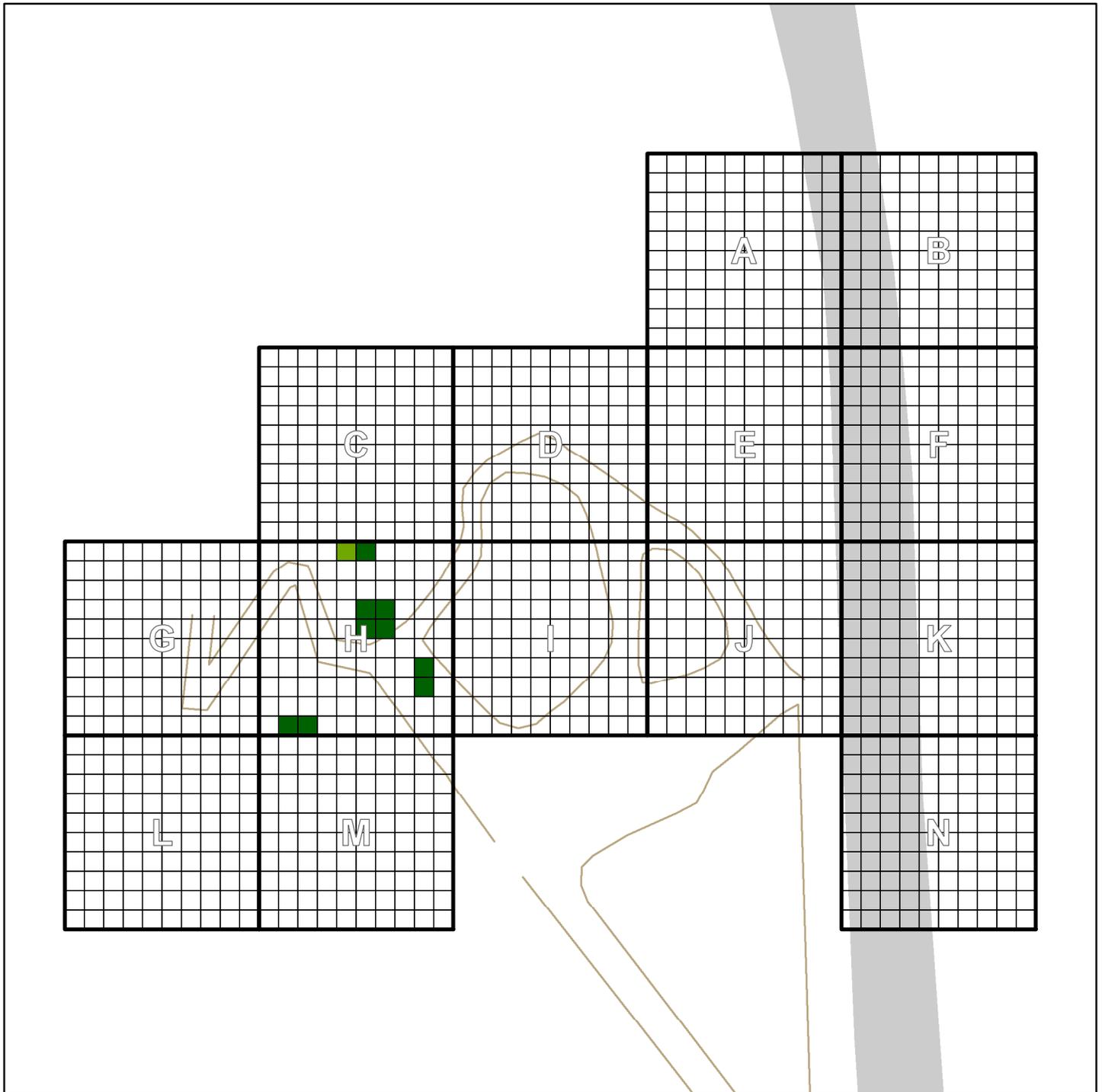
 Fencing
 Road



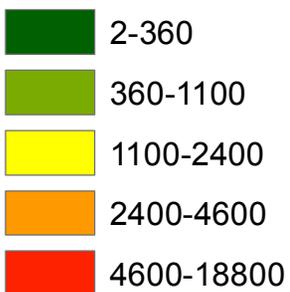
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 22, 2014



Butterfly Count



0 100 200 Feet



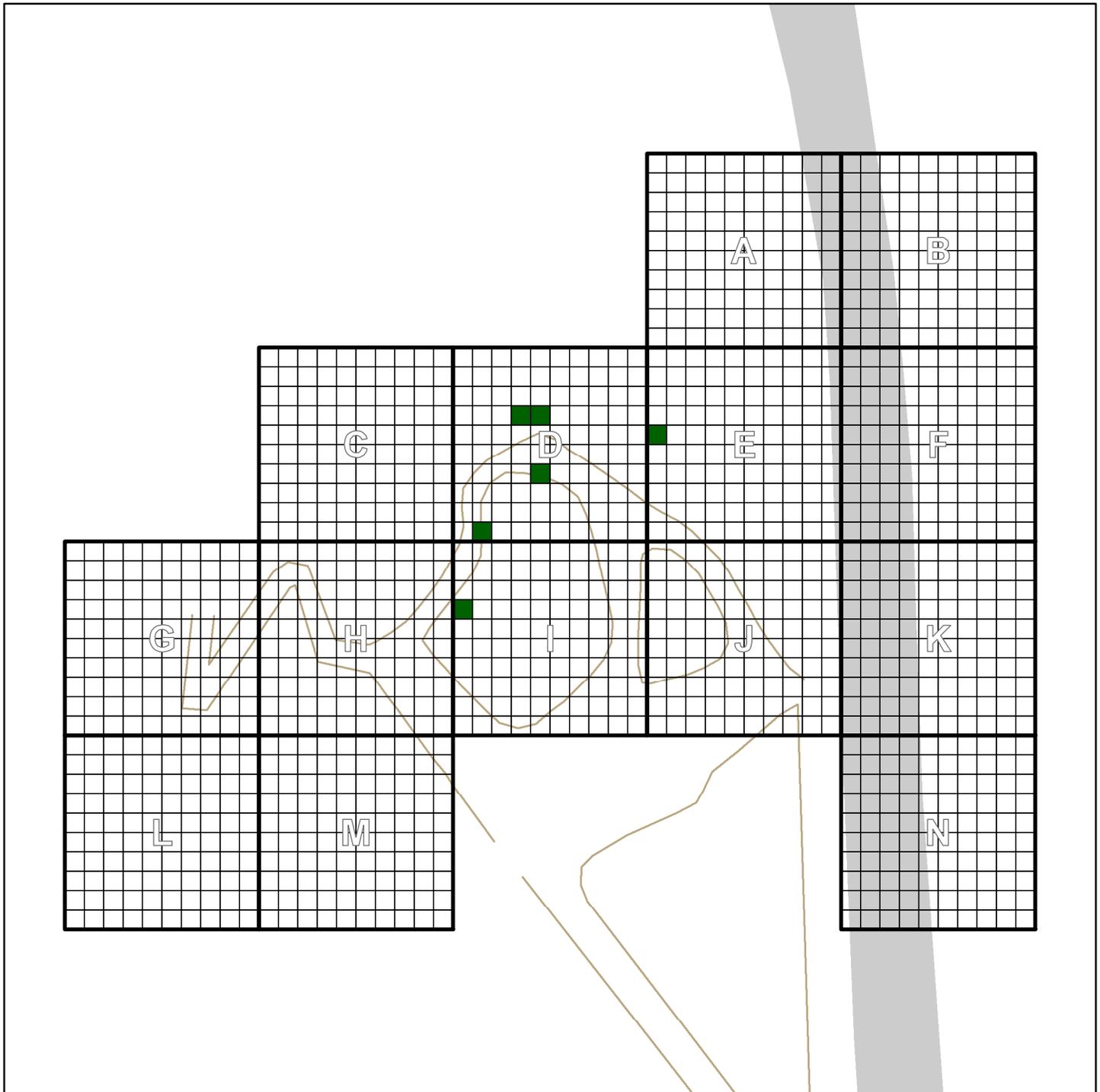
 Fencing
 Road



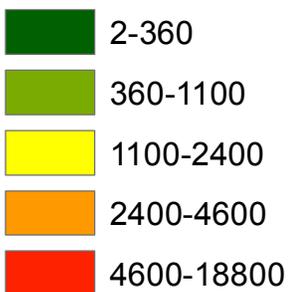
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density February 23, 2014



Butterfly Count



0 100 200 Feet



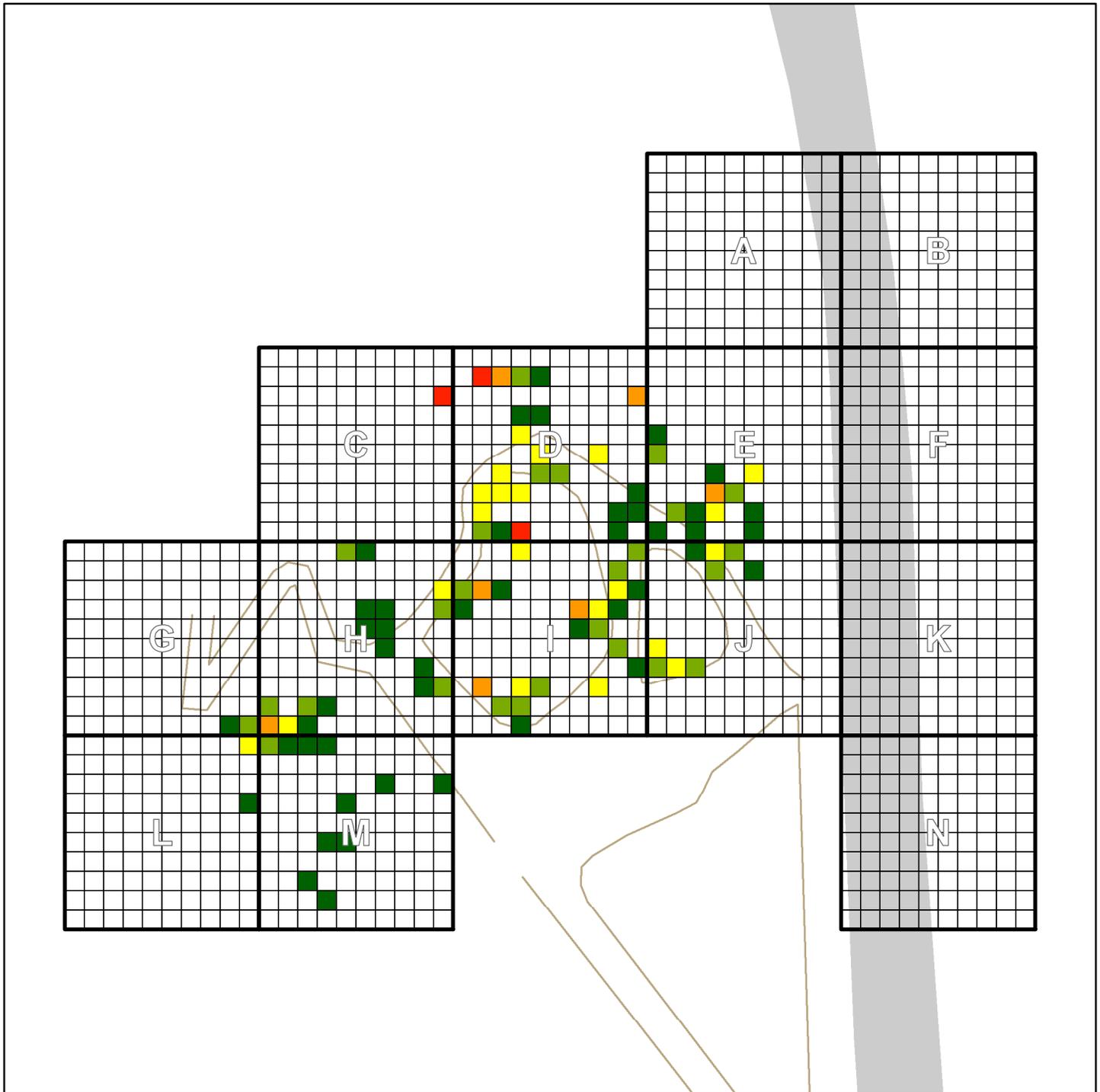
Fencing
 Road



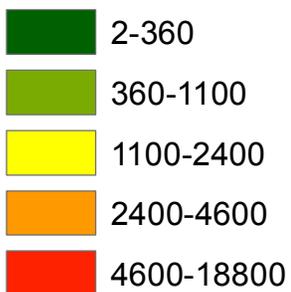
Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Pismo Butterfly Density Summation



Butterfly Count



0 100 200 Feet



 Fencing
 Road



Monarch Alert
CAL POLY
 SAN LUIS OBISPO



Conclusion

After analyzing the data in ArcMap and ArcScene, the highly variable nature of inter-grove butterfly migration becomes more readily apparent. Although there is a quantifiable preference of location based on the number of monarch that visited a given cell, there is a high degree of variation within the grove. This variation makes it difficult to make conclusive statements on the nature and preferences of butterfly habits, but thanks to GIS we are able to sift through the seemingly random movement and pull out interesting data. For example the most visited cell in the grove is D-d-10, on a cypress in the center of the site. This count could be explained by the greater density of butterflies that are able to be maintained on the cypress due to leaf morphology.

The decline in butterfly occurrence can be seen and is a result of the continuing migration down South. Through the years the number of butterflies counted have fluctuated from a high of 230,000 to a low of 17,000. Although the counts have not been completed for the current year, there is a general downtrend in the number of butterflies present in each year. This is why there must be a greater understanding of the requirements and preferences of the Monarch in regards to ideal mating habitats. The Pismo grove is one of the few mating grounds for these Monarchs, and it was previously thought that the Eucalyptus, the most prominent tree in Monarch resting grounds, was the sole species for attracting them. As we examine the data however, although there are more Eucalyptus, there are actually more butterfly occurrences in the Cypress. This provides a foundational understanding for the ecological requirements of the species. As the pursuit and acquisition of a broader range of data is gathered, other inferences may be made regarding preferences to sun angles, proximity to features such as creeks and oceans, temperature gradations and shelter from changing wind speeds.

The base effort has been made for mapping short term distributional changes, but should be continued to make evident movement patterns, if any exist. These movement patterns should be linked to other variables to identify stressors and ecological shifts driving the selection and formation of Monarch cluster location.

Acknowledgments

This project would not have been possible without the guidance of State Park Interpreter Danielle Patterson, Interpretive Specialist Mallory Classen, or Cal Poly Graduate Student Jessica Griffiths. All were important in teaching us the methodologies of counting the butterfly clusters and providing us with data we were unable to collect ourselves. David Yun, Cal Poly staff and head of the GIS Department for the City of San Luis Obispo provided technical support and advice on map and data generation using GIS software. Lastly we would like to acknowledge the group that initiated and created the georeferenced grid maps with relevant features for this project, whose members include Chad Bunn and Tyler Davison.

References

- "Monarch Butterflies of Pismo Beach, California." *Pismo Beach Monarch Butterfly Grove*. N.p., n.d. Web. 09 Mar. 2014. <<http://www.monarchbutterfly.org/>>.
- "Pismo Butterflies - California State Parks of the San Luis Obispo Coast." *Pismo Butterflies - California State Parks of the San Luis Obispo Coast*. N.p., n.d. Web. 09 Mar. 2014. <http://www.slostateparks.com/pismo_butterflys.asp>.

Appendix

DATE 2/11/14 SITE NAME _____
 # Observers 2 Observer name(s) Hayley Duncan, Nicole Bergeron
 Count Time Span 7:24am to 9:00am Total Count Time (Min) 96
 Cloud/Fog Cover 0 % Precipitation (circle one): 0 none 0 drizzle 0 rain
 Temp (°C) 55 Wind (m/s) 0 Wind (Beaufort) 0 Wind direction _____

# Monarchs Clustered	Zone (ex: A)	Cell (ex: a2)	Tree #	Tree Species	Cluster Height (top) (m)	Clstr Height (bottom) (m)
100	I	i2	T218	Eucalyptus	9m	8m
25	I	g4	T218	Euc	6	6
120	I	i2	T218	Euc	8	7
200	I	i3	T218	Euc	11	10
90	I	i3	T218	Euc	12	11
800	I	j1	T109	Euc	13	12
70	E	h10	T13	EUC	11	10
40	E	b9	T13	EUC	5	5
20	E	d7	T8a	EUC	6	6
300	E	c10	T13	EUC	6	6
360	E	c9	T8b	Euc	13	12
540	J	d2	T22	EUC	13	12
90	J	e1	T13	Euc	10	10
50	J	c1	T22	Euc	11	11
40	J	e1	T4	M. Pine	7	7
30	J	e1	T4	M. Pine	9	9
Total in Clusters:				<i>(include count from next pg)</i>	Total # Trees:	
# Loners:				<i>Tally every butterfly of each type that you see throughout the site.</i>		
# Sunners:						
# Fliers:						
# Grounders (live):						
Grand Total:				<i>(sum of all clustered butterflies plus loners, sunners, fliers, etc.)</i>		
# Mating Monarchs:						
# Dead Monarchs:						
Other Notes:						
# Monarchs Clustered	Zone (ex: A)	Cell (ex: a2)	Tree #	Tree Species	Cluster Height (top) (m)	Clstr Height (bottom) (m)

Figure 23. Data Sheet for 2/11/14

**Over-wintering Monarch Butterfly Project
Monarch Count Data Sheet**

DATE 2-16 SITE NAME Pismo
 # Observers Observer name(s) Kevin & Jyllian
 Count Time Span 7:15 to 8:40 Total Count Time (Min)
 Cloud/Fog Cover 25 % Precipitation (circle one): none drizzle rain
 Temp (°C) Wind (m/s) 0 Wind (Beaufort) 0 Wind direction
53° F

# Monarchs Clustered	Zone (ex: A)	Cell (ex: a2)	Tree #	Tree Species	Cluster Height (top) (m)	Clstr Height (bottom) (m)
272	I	a-3	T97	euk	12	11
450	D	b-8	T100	CyDress	10	8
495	D	c-7	T100	CyDress	10	7
35	M	c-1	T94	euk	6	5
325	H	d-9	T196	euk	7	6
485	L	c-9	T195	euk	9	7
285	H	a-10	T197	euk	14	12
270	H	a-10	T197	euk	15	13
110	M	J-3	T193	euk	15	13
210	M	y-3	1192	euk	12	11
40	M	e-4	192	euk	17	16
50	M	g-3	T194	euk	17	16
90	M	c-8	T177	euk	13	12
100	M	d-9	T177	euk	13	12
50	M	d-9	T177	euk	13	12
Total in Clusters: <i>(include count from next pg)</i>				Total # Trees:		
# Loners:				<i>Tally every butterfly of each type that you see throughout the site.</i>		
# Sunners:						
# Fliers:						
# Grounders (live):						
Grand Total: <i>(sum of all clustered butterflies plus loners, sunners, fliers, etc.)</i>						
# Mating Monarchs:						
# Dead Monarchs:						
Other Notes:						

Figure 26. Data Sheet For 2/16/14

Email Correspondence:

Yes, we are still on for tomorrow morning at 8am. A notebook would be a great idea so you can take notes. Everyone will need to bring a pair of binoculars because I will be using all of ours for the high school kids that are coming to the grove tomorrow. Dress warm!

Mallory Claassen
Interpretive Specialist Seasonal
Oceano Dunes District

From: Jyllian Kristine Smith [mailto:jysmith@calpoly.edu]
Sent: Friday, February 07, 2014 10:45 AM

Hi everyone,
I just wanted to check in and make sure that we are still good to go for tomorrow morning at 8:00am. I was also wondering if there was anything specific we should bring i.e. a notebook, binoculars etc. We are looking forward to coming out there tomorrow.

Thank you again,
Jyllian Smith

We will meet up with your group on Saturday 2/8 at 8am. Thanks for being patient while we were working out the details!

Mallory Claassen
Interpretive Specialist
Oceano Dunes District

From: Jyllian Kristine Smith [mailto:jysmith@calpoly.edu]
Sent: Monday, January 27, 2014 4:10 PM

Hi Mallory,
We are really sad to hear that the butterflies are leaving so early this year. I understand that your main focus would obviously be the high school students, but if we could meet up and learn the counting methods as well this weekend that would be very helpful! That way we could start counting them next week as opposed to waiting a few weeks. I spoke with my team and everyone will be able to meet on Saturday morning so I hope it works out.

Thank you,
Jyllian

From: "Mallory@Parks Claassen" <Mallory.Claassen@parks.ca.gov>
Sent: Monday, January 27, 2014 12:18:59 PM

We have about 20 high school kids that will be at the grove at 8am on Saturday, February 8th. They are taking part in our "monarch Monitoring" program that we started this year. The goal of the field trip is to

teach the kids the methods we use to count the butterflies in their clusters. I estimate them being at the grove about an hour, maybe a little longer. Danielle and I will be focused on the high school students, but perhaps it would still work out for Jyllian's group to meet us there at the same time since the goal for everyone that day will be to learn how to count the clustered butterflies? I will get in touch with Danielle and see if this would work out.

From: Jessica Griffiths [mailto:jessica.l.griffiths@gmail.com]
Sent: Sunday, January 26, 2014 4:45 PM

Hi Jyllian,

Okay, I didn't realize that you guys were going to actually be collecting count data as well. The actual monarch counting protocol is very straightforward but learning how to count massively dense clusters takes some practice.

Unfortunately I am going to a conference all next week and will probably not be back until Sat Feb 1, and I have a commitment all morning on Sun Feb 2.

The following weekend (Feb 8/9) I could join you for a couple of hours in the grove. I strongly recommend that everyone in the group be there if possible, because getting the training first-hand will really help you.

-Jessica

On Sun, Jan 26, 2014 at 11:45 AM, Jyllian Kristine Smith
<jysmith@calpoly.edu<mailto:jysmith@calpoly.edu>> wrote:

Hi Jessica,

For this project our group will be doing both data collecting and making maps of the butterfly locations. So we will need to learn how to do the actual counts. Our current plan is to hopefully learn this technique within the next week or two and then go out every day for two weeks collecting the data to put it into the GIS to show the movement of the butterflies over those few weeks. Hope this helps.

Thanks
Jyllian

Hi Jyllian,

I wasn't at the latest meeting with David & Danielle & Mallory, so I am a little bit out of the loop. Can you let me know what exactly your role will be? Are you going to be actually doing counts and collecting data, or do you just need to see *how* the data is collected so you can make the maps? Are you making the maps?

-Jessica

Danielle, Jessica, and Mallory,

My name is Jyllian, I am the group leader for this monarchbutterfly project. My team is really excited to get this project started and learn more about the monarchs. As far as I know the first step is for us to meet with one of you to learn the techniques for counting the clusters. I have spoken with my group about times that all of us can meet and go out there. With all of our busy school and work schedules it seems the best time

to go would be weekends, i.e. saturday and sunday mornings or friday afternoons.
I hope any of these times work for one of you, if not we can work try
and work something else out. It is best to reach me here by email (
jysmith@calpoly.edu<mailto:jysmith@calpoly.edu>) or at 949-351-1640<tel:949-351-1640>.

Thank you,
Jyllian Smith

Dear Danielle and Jessica,
Jyllian Smith is the group leader for the monarchbutterfly project group.
Jyllian will contact you shortly to schedule an introductory meeting
and discuss the proposed work. Please include me in all communications.

David I. Yun, GISP
NRES Department
Cal Poly State University
San Luis Obispo, CA 93407
805.781.7189<tel:805.781.7189>,

Thanks you David. Please also provide her with Mallory's contact information as I will be in and out of
my office for the next couple of weeks. It is Mallory.classen@parks.ca.gov or 805-773-5301. Best by
email.

Thanks

Danielle Patterson
State Park Interpreter

Kevin Bertolero
1034 Islay St • San Luis Obispo, CA 93405
Phone: (209)312-1075 • E-Mail: xbertolero@gmail.com

Education

California Polytechnic State University, San Luis Obispo
B.S. Forestry & Natural Resource Management
Expected Graduation: June 2015

Personal Skills:

Strong verbal and written communication
Programs: ArcMap 10, Word, Excel, Powerpoint
Independent work ethic

Team oriented
Spanish proficiency
Public speaking

Work and Volunteer Experience:

Ranger Service internship September – December 2013
with SLO Parks & Recreation

- Patrol and maintenance of city parks and open spaces
- Foster public relations with recreational users

Teaching indigenous youth with Witoto tours in the Amazon August 2013

- Construction of curriculum
- Motivating students to learn and grow

Mentoring at-risk youth September – May 2011 - 2013
in conjunction with probation department

- Planning engaging activities
- Facilitation of trust and companionship building

Maintaining trails with Ventana Wilderness Alliance in Big Sur 2011 - 2012

- Backpacking into remote forestland
- Clearing brush and building trails
- Safe dispersal of fallen redwoods blocking trails

Vice President of Sierra Student Coalition hiking club 2011 - 2012

- Organize carpools and student mobility
- Coordinate volunteer efforts
- Compose emails and comply with scholastic regulations

Empower Poly Coalition board member 2011

- Brainstorm and unite sustainability efforts campus wide
- Design and organize fundraisers

Hayley Duncan
528 Hathway Ave • San Luis Obispo, CA 93405
Phone: (650)759-1784 • E-Mail: heduncan@calpoly.edu

Education

California Polytechnic State University, San Luis Obispo
B.S. Environmental Management and Protection
Expected Graduation: June 2015

Work and Volunteer Experience:

Student Assistant at Cal Poly University April 2013 - Current

Advancement Services

San Luis Obispo, CA

- Online database entry
- Mail delivery and processing
- Various office tasks

Intern at Insignia Environmental June – September 2012

Palo Alto, CA

- Conducted research for proposals
- Performed various office and organizational tasks
- Database creation and entry
- Creation of information files for internal use

Volunteer cabin leader at San Mateo Outdoor Education March 2010, March 2011

La Honda, CA

- Supervised and stayed with youth aged 10-11 for 5 days in a camp environment
- Led educational activities about nature and conservation

Technical Skills:

- GIS
 - Basic proficiency in ArcMap
 - Knowledge of basic skills for making and enhancing maps
- Mac
- PC
- Microsoft Office
- Excell
- Power Point

Jonathan Gee
1290 Murray St • San Luis Obispo, CA 93405
Phone: (925)212-6290 • E-Mail: jgee92@gmail.com

Education:

California Polytechnic State University San Luis Obispo

B.S. Forestry and Natural Resources Expected Graduation: June 2014

Concentration: Fire and Fuels

Expected Graduation: June 2014

Work Experience:

GIS Intern at San Luis Obispo County Fire

January 2014 - Current

- Create maps for Cal Fire SLU

Grader at California Polytechnic State University

September 2013 - Current

San Luis Obispo, CA

- Grade papers for classes

Cadet at Walnut Creek Police Department

January - September 2010

Walnut Creek, CA

- Assist police officers with duties around the police station
- Help officers with cases
- Traffic control at festivals and other large events
- Help with search and rescue

Lifeguard at Dewing Park Swim Club

June - August 2008 - 2011

Walnut Creek, CA

- Supervise swimmers
- Provide first aid to injured persons
- Maintain and clean pool area and restrooms

Projects:

- Forest Regeneration Project, Cal Poly Cal Fire PG&E
 - Post-burn monitoring of the regeneration of Bishop Pine
 - Produced report for management
- Forest Sampling Project, Swanton Pacific Ranch, Cal Poly
 - Forest inventory for tree size, height, board-foot per tree
 - Basic statistical analysis
 - Produced report regarding forest health and amount of board-feet that would be a sustainable harvest

Jyllian Smith
504 Hathway Ave • San Luis Obispo, CA 93405
Phone: (949)351-1640 • E-Mail: Jysmith@calpoly.edu

Education

California Polytechnic State University, San Luis Obispo
B.S. Environmental Management and Protection
Minor Biology

Expected Graduation: June 2014

Relevant Coursework

Wildlife Management
Natural Resources Analysis
Plant Ecology

GIS
Plant Taxonomy
Land Surveying

Work and Volunteer Experience

California Polytechnic State University, San Luis Obispo, CA

09/2011 to Current

SelecTree Website Assistant

- Updated information provided to the
- Selecting pictures
- Adding to a database

Equipment Room Manager

08/2012-12/2012

- Organized Natural Resources equipment room
- prepared equipment for lab activities
- assisted students in choosing and renting equipment for personal projects

Cal Poly Wildlife Career Symposium

- Organized a national conference in which biological, consulting and wildlife professionals came to Cal poly to give presentations and speak with students about job opportunities
- Designed flyers and programs
- coordinated equipment acquisition

Cal Poly Plant Conservatory

- Performed basic greenhouse management tasks including cleaning, weeding, transplanting and general maintenance

Skills

- Geographic Information System(GIS) proficient
- Microsoft office

Kim Zetterlund
649 Stanford Dr • San Luis Obispo, CA 93405
Phone: (925)519-1113 • E-Mail: Kmzetterlund@gmail.com

Education:

California Polytechnic State University, San Luis Obispo

B.S. Forestry and Natural Resources, June 2015

Concentration: Urban Forestry

Expected Graduation: June 2015

Work Experience:

Sales Associate at Fleet Feet Sports

April-October 2010, May-August 2012

Pleasanton, CA

- Customer service experience and sales techniques
- Merchandise organization and presentation
- Analyzed customers gait and fitted them for appropriate running shoes and in store orthotics.

Nanny

January-August 2012

Pleasanton and Danville, CA

- Fed, dressed, changed diapers of infant twins
- Supervised the twins as they grew

Assistant Cross Country and Track and Field Coach

Dougherty Valley High School, San Ramon, CA

October 2010 – June 2012

- Wrote workouts and conducted practices
- Supervised athletes at home and away cross country and track meets
- Participated in officiating track meets

Skills

- Microsoft Office
- ArcGIS



prepared for
David Yun, NR 418 Applications in GIS
&
The Pismo Beach Monarch Butterfly Grove