



Midpeninsula Regional  
Open Space District

R-22-14  
Meeting 22-04  
February 9, 2022

## AGENDA ITEM 11

### AGENDA ITEM

Human-Mountain Lion Interaction Study and Management Plan Annual Update (Year 1)

### GENERAL MANAGER'S RECOMMENDATION *den*

Receive a presentation and provide feedback on the first annual update of the five-year Human-Mountain Lion Interaction Study. No Board action required.

### SUMMARY

The Santa Cruz Puma Project (Puma Project) has completed the first year of a five-year Human-Mountain Lion Interaction Study and submitted their annual progress report (Attachment I). The purpose of this study is to understand factors that influence human-mountain lion interactions and develop a site-specific management plan to reduce human-mountain lion conflicts.

### BACKGROUND

The Midpeninsula Regional Open Space District (District) Board of Directors (Board) approved an agreement with the Puma Project to complete a five-year Human-Mountain Lion Interaction Study and Management Plan on July 22, 2020 ([R-20-79](#), [minutes](#)). The purpose of this study is to understand factors that influence human-mountain lion interactions and develop a site-specific management plan to reduce human-mountain lion conflicts. Efforts are focused in areas where human and mountain lion interactions are most common, which include Rancho San Antonio, Fremont Older, and Picchetti Ranch Open Space Preserves.

### *Research Approach*

The research effort has the following objectives:

- Collar mountain lions at top priority study sites (Rancho San Antonio, Fremont Older, and Picchetti Ranch Open Space Preserves), secondary priority sites (Monte Bello, Foothills, and Los Trancos Open Space Preserves), and third priority sites (Saratoga Gap, Coal Creek and Windy Hill Open Space Preserves);
- Estimate the number of individual mountain lions within Rancho San Antonio using a District-provided wildlife camera grid;
- Compare collared mountain lion home ranges within the study area to other parts of the Santa Cruz Mountains;
- Assess factors influencing human-mountain lion interactions;
- Experimentally test the efficacy of mountain lion behavioral modification methods;

- Develop a habitat use map that depicts mountain lion space/use, with attention to overlap between high human use and high mountain lion use areas; and
- Develop a site-specific human-mountain lion interaction management plan with actionable strategies for minimizing potential conflicts that is informed by prior research and survey findings.

### ***Human-Mountain Lion Interaction Management Plan***

The human-mountain lion interaction study will inform the development of a human-mountain lion interaction management plan (anticipated in years 4 and 5) that will provide management strategies for the District to reduce potential conflicts between preserve visitors and mountain lions. Potential strategies will be dependent on research results and may include the following:

- Preserve access modifications (by type, number, time of day, location, etc.);
- Reduction of vegetative cover in areas with high levels of human use; and
- Mountain lion behavioral modification methods, including the use of deterrents to modify mountain lion activity in areas with high levels of human use.

## **DISCUSSION**

The majority of work to date has focused on safely and humanely collaring mountain lions (*Puma concolor*) and gathering fine-scale data on lion movement. During year one, the Puma Project successfully collared two (2) adult mountain lions within top priority District Open Space Preserves. They have also successfully collared eight (8) additional mountain lions outside of the study area, which will provide valuable comparative data on lion behavior in other areas with lower levels of human activity. In addition, the Puma Project has been gathering human trail use data within the study area and working to develop models to understand mountain lion behavioral responses to recreational activity. Furthermore, they have developed a protocol for experimentally testing the efficacy of behavioral modification methods to reduce human-mountain lion interactions. The Puma Project is also coordinating with District staff to incorporate data from the ongoing Wildlife Picture Index study at Rancho San Antonio Open Space Preserve to develop a population estimate for mountain lions within this preserve.

### ***Collaring of mountain lions at top priority study sites***

The Puma Project has successfully collared two adult mountain lions in top priority District preserves since beginning fieldwork on November 24, 2020. The first lion was collared at Rancho San Antonio on December 23, 2020. This two-year-old female was designated 115F. Female mountain lions typically begin breeding at around 2.5 years old. 115F is now likely of breeding age and may provide valuable data on lion denning behavior within the Preserve. On April 11, 2021 the Puma Project collared a seven- to eight-year-old male mountain lion in Monte Bello Preserve. This mountain lion is on the upper end of the typical life expectancy for this species, which in the wild generally tops out at approximately 10 years. This lion was designated 118M and is likely an established dominant male. To date, the range of these individuals overlaps with several top priority preserves, including Rancho San Antonio, Fremont Older, and Picchetti Ranch Open Space Preserves.

### *Other lions collared*

A three-year-old female lion was collared at Skyline Ridge Open Space Preserve on October 21, 2021. This lion was designated 121F. While this individual was not collared in a priority preserve, the proximity of the collar location indicates that there is a high likelihood that this lion may enter priority preserves and contribute valuable data to the study.

The Puma Project also collared seven additional mountain lions on non-District properties during the last year. Two of these mountain lions, 114F, and 116M, have territories that overlap with District preserves and were collared during the timeframe of this study. While the remaining five lions are not known to have territories that overlap with District preserves, they will provide useful data that will allow for direct comparisons between lion behavior in areas with high levels of human activity (i.e., Rancho San Antonio) and other locations in the Santa Cruz Mountains where human activity is lower.

### *Mountain lion population estimate*

District staff began a Wildlife Picture Index (WPI) study at Rancho San Antonio in the fall of 2020. The study utilizes a grid of wildlife cameras to assess habitat use by mountain lions and other wildlife. The WPI helps the District to better understand species diversity and relative abundance (for example, the abundance of deer relative to the abundance of mountain lions within Rancho San Antonio), species distribution, and what factors (such as human activity) may affect wildlife behavior or use within the Preserve.

The Puma Project will use images captured from the WPI along with GPS collar data from lions moving through RSA to compare the proportion of collared and uncollared mountain lions and create an estimate of the mountain lion population within the Preserve. The data analysis portion of the collaring study will take place in years four (4) through five (5) and a population estimate will not be available until the end of the study's timeframe.

### *Comparison of mountain lion home ranges*

The Puma Project currently has GPS location data from five collared mountain lions that have territories overlapping with District preserves (114F, 115F, 116M, 118M and 121F). A list of the available data on District preserves used by each individual collared mountain lion is listed below:

- **114F:** Sierra Azul. 114F has an estimated home range of 22 square kilometers.
- **115F:** Rancho San Antonio, Los Trancos, Monte Bello, and Coal Creek Open Space Preserves. 115F has a home range estimate of 35 square kilometers (Attachment 2).
- **116M:** Sierra Azul, Bear Creek Redwoods, and St. Joseph's Hill. 116M has an estimated home range of 150 square kilometers.
- **118M:** Monte Bello, Rancho San Antonio, Fremont Older, Picchetti Ranch, Foothills, Los Trancos, and Saratoga Gap Open Space Preserves. 118M has an estimated home range of 130 square kilometers (Attachment 3)
- **121F:** This lion was collared too recently, and the collar data has not yet been analyzed.

The Puma Project will continue efforts to collar additional mountain lions near priority preserves to increase the sample size for the study and better understand habitat use on District lands.

Further analysis of home ranges, along with a comparison of home ranges for mountain lions outside of District preserves will be completed during the next year of the study.

The Puma Project maintains a public facing “Puma Tracker” website (<http://www.santacruzpumas.org/puma-tracker/>), which includes an interactive map of collared mountain lion movement data. There is an eight-week delay before location data becomes available on the website to ensure that the data is not used to seek out the location of mountain lions in real time. Data from 115F and 118M are currently available on this website.

### ***Assess factors influencing mountain lion-human interactions***

The Puma Project is utilizing data from Strava Metro (a fitness tracking app that records recreational activities like hiking, jogging, and biking) to quantify the level of human activity and create a comprehensive trail map covering the study area that can expand into the greater Santa Cruz Mountains. These data will be incorporated into the data analyses of movement and habitat use by collared lions to better understand mountain lion behavioral responses related to recreational trails. In addition, the Puma Project will use data on the intensity of human activity to understand how different human activity levels affect lion behavior. These data will be used to assess the hypothesis that mountain lions are becoming habituated to human activity in areas with high levels of recreation and trail use.

The WPI study will allow for calibration of the Strava data by comparing actual trail use quantified by camera trap data, and trail use estimates based on Strava data, which only captures trail use by Strava users. The WPI will also provide an index of deer activity to evaluate its effect on mountain lion behavior.

The Puma Project will also assess whether mountain lion age affects the behavioral response to human activity. This analysis will require additional collared lions representing diverse age-classes.

All the above-mentioned factors will be evaluated to determine the probability of human-mountain lion interactions within District preserves. This will help prioritize management objectives to reduce the potential for human-mountain lion conflict.

### ***Experimentally test the efficacy of deterrents***

On June 25, 2021, the Puma Project received approval for mountain lion behavioral modification protocols from the University of California, Santa Cruz Institutional Animal Care and Use Committee, which oversees the responsible use of animals in university research and ensures the proper treatment of animals to maintain research integrity and ethical practices. These protocols were also accepted by the California Department of Fish and Wildlife and were reviewed by District Natural Resources and Visitors Services Department staff. The goal of behavioral modification is to expose mountain lions to a stimulus that can safely and effectively ward off unwanted behavior, in this case habituated mountain lions remaining in close proximity to preserve visitors, and/or displaying unprovoked aggression. The Puma Project is attempting to instill an appropriate and otherwise instinctual mountain lion response of avoiding humans when coming into contact with human voices. A similar behavioral modification technique that utilizes trained dogs and human voices is also being implemented in northeastern Washington. The Washington project is showing some preliminary success, though findings have not yet been published.

For research on District lands, the Puma Project would locate collared mountain lions by using the signal emitted from the collar and the assistance of dogs specially trained to track their scent. Once a mountain lion is located, the researchers would play audio recordings of human voices to simulate what a mountain lion is likely to hear from hikers along a recreational trail. The researchers would then tag the treed lion with no more than five water-based paintballs on its side and rear. The researchers and dogs would then withdraw and allow the mountain lion to leave the area. The researchers would repeat the process once last time on the same day, if feasible.

As part of this work, the Puma Project would collect data on the mountain lion flight initiation distance (the distance at which animals move away) using the GPS accelerometer located within its collar both before and after the behavioral modification activities are conducted. These data would inform how lions subsequently react when they come into contact with human voices (absent all other factors, including the presence of dogs) and whether they move away and avoid humans. This research is scheduled to begin in late February 2022. The Puma Project would continue to carefully monitor collared mountain lions following the behavioral modification to quantify the response to these actions and determine if behavioral modification is an effective management tool. Behavioral modification experiments are a part of years two and three of the study with an additional year four if additional data is needed

The Puma Project would also investigate the effect of habitat modification (i.e., fuels breaks) on mountain lion behavior. Mountain lions do not typically move through open habitat and prefer to stay under cover of dense vegetation when possible. Data from previously collared mountain lions would determine how they respond to the presence of established fuel breaks. The Puma Project would also opportunistically investigate any changes in lion behavior due to the development of new fuel breaks on the landscape. The data would further be used to identify habitats that are of significant value to mountain lions (i.e., denning and/or hunting sites) so that these remain protected when developing new fuel breaks.

The Puma Project has conducted numerous activities using specially trained dogs to collar and monitor mountain lions in areas open to the public. However, in order to conduct this study without impacting the research or visitor experience, preserves or areas of preserves would need to be temporarily closed to public use. The behavioral modification study would only take place on weekdays to reduce the impact of these closures on visitors. Notifications of potential closures would be posted on site, on the District's website, and emailed/mailed to adjacent neighbors and use permit holders one week prior to potential closures. Preserves would reopen once the researchers complete the day's activities. Given the large number of neighborhood access points to District preserves, it would be impossible to staff all entry points; therefore, a District staff member would accompany the research team to contact any visitors that inadvertently enter a closed area. At most, 12 days of closures are expected as part of this research work.

## **FISCAL IMPACT**

None

**BOARD AND COMMITTEE REVIEW**

This item was first introduced at the July 8, 2020 Special Board Meeting regarding the District's Mountain Lion Conservation Efforts, and the agreement was adopted by the full Board on July 22, 2020 ([R-20-79](#), [minutes](#)).

**PUBLIC NOTICE**

Public notice was provided as required by the Brown Act. Public notice was sent to the Resource Management and Rancho San Antonio interested parties electronic mail lists.

**NEXT STEPS**

The Puma Project will continue collaring efforts with District support through years two and three of the study. The Puma Project is preparing to begin the behavioral modification study, which is scheduled to start onsite in late February. Years four and five of the study will focus on data analysis and the creation of a site-specific human-mountain lion interaction management plan. The results of the study may also be published in peer-reviewed scientific journals and contribute to the current understanding of mountain lion behavior in relation to human activity. A project update will be provided to the Board annually.

## Attachments:

1. Annual Report
2. Lion 115F Home Range
3. Lion 118M Home Range

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## Human-Mountain Lion Interaction Study Annual 2020-2021 Report

NOTE: This report was received in September of 2021 and does not include information on the lion designated as 121F which was collared on October 21, 2021. Including 121F brings to total number of lions collared in the Santa Cruz Mountains during the course of this study to 10. Details in the associated Board Report reflect the addition of 121F.

Human-Mountain Lion Interaction Study  
Santa Cruz Puma Project  
Annual Progress Report 2020 - 2021

**Background and objectives:**

In July 2020 the Midpeninsula Regional Open Space District (District) and the Santa Cruz Puma Project (SCPP) entered into an agreement to conduct a five year mountain lion collaring study to better understand the factors that influence human-mountain lion interactions, and develop a site-specific management plan that includes recommendations for reducing potential human-mountain lion conflict. This comes in response to an increase in mountain lion sightings on District preserves, especially high-use preserves such as Rancho San Antonio. Using a research based approach the SCPP will collect data related to local mountain lion population size, habitat use, and activity patterns. This information will help inform recreation and management plans that minimize the risk of potential conflict between preserve visitors and mountain lions.

The primary objectives of the Human-Mountain Lion Interaction Study are:

1. Estimate local mountain lion population size
  - i. Capture and collar mountain lions that utilize top priority study sites identified by the District
  - ii. Design and implement a mark-recapture study in order to estimate mountain lion abundance on District properties
2. Compare mountain lion home range sizes within the study area versus other parts of the Santa Cruz Mountains
  - i. Create home range maps for animals collared on District properties and compare those to data gathered from other animals collared in the Santa Cruz Mountains
3. Assess factors influencing human-mountain lion interactions
  - i. Investigate the relationship between mountain lion habitat use and recreational trails
  - ii. Evaluate the hypothesis that mountain lions are becoming habituated to human activities through repeated exposure to humans on District lands
  - iii. Investigate the role that deer play in mountain lion habitat use
  - iv. Evaluate the hypothesis that young and/or dispersing individuals select for areas with high human activity, leading to an increase in human-mountain lion interactions
  - v. Evaluate the hypothesis that high human use and higher mountain lion use cause more interactions as a matter of probability rather than mountain lion behavior
4. Experimentally test the efficacy of deterrents
  - i. Design and implement a study in which behavioral modifications using dogs and/or people are administered to evaluate mountain lion behavioral response
  - ii. Investigate the potential for forested firebreaks to serve as a deterrent that might shift mountain lion activity away from hiking trails

Each of these objectives will be addressed in the following annual report.

**Annual Report 2021:**

The following document is an annual progress report compiled by the Santa Cruz Puma Project and describes research updates related to the Human-Mountain Lion Interaction Study. The majority of work during the first year of the project has focused on data collection. SCPP has been working to capture and collar mountain lions within the study area and is collecting fine-scale animal movement data from collared individuals. SCPP is also downloading, organizing, and analyzing human trail use data within the study area and is developing models that quantify mountain lion response to outdoor recreational activity. Finally, SCPP is developing a protocol to experimentally test the efficacy of deterrents in reducing human-mountain lion interactions and will begin conducting fieldwork on this part of the project within the next few months. Overall, the first year of work has successfully generated a preliminary dataset that will contribute to a better understanding of human-mountain lion interactions.

**Specific project objectives and updates:****Objective 1: Estimate local mountain lion population size**

- i. We have successfully captured and collared nine mountain lions (7 adults, 2 kittens) since our capture permit was approved for the project in November 2020. Four of these mountain lions (114F, 115F, 116M, 118M) have territories overlapping District properties, and two lions (115F, 118M) overlap with top priority sites (Rancho San Antonio, Fremont Older, and Pichetti Ranch). All captured lions were fitted with GPS collars, which allow us to remotely monitor their habitat use, movement, and space use. While collaring mountain lions that overlap District property is our top priority, data from mountain lions at other sites will be used to obtain a sufficient sample size to address all objectives of this project. Moving forward we will continue to capture mountain lions and collect fine-scale movement data. Current movement data from mountain lions overlapping District properties can be found in Figure 1.
- ii. District researchers deployed 9 camera traps in Rancho San Antonio (RSA) in September 2020 using a standardized grid design (Fig. 2). We have been in close contact with District researchers about this camera grid and District staff and volunteers plan to begin tagging photos during the coming year. So far only photos containing mountain lions have been extracted, but no other data have been scored. Once scored, data from these camera traps will be combined with GPS collar data from overlapping mountain lions to estimate mountain lion abundance on District properties. In addition to the grid cameras, District researchers have deployed cameras at 21 sites along trails within RSA. These sites differ in their intensity of human use and vehicle use. These data will be scored and used to correct Strava trail use estimates so that we have an understanding of actual human trail use (objective 3.ii).

**Objective 2: Compare mountain lion home range sizes within the study area versus other parts of the Santa Cruz Mountains**

- i. We are currently collecting GPS location data from 4 collared mountain lions that utilize District properties. Two of these mountain lions (115F and 118M) have territories overlapping high priority sites. 115F was captured on December 23, 2020 in Rancho San Antonio and has since spent time in Los Trancos, Monte Bello, and Coal Creek Preserves. 118M was captured on April 11, 2021 in Monte

Bello Preserve and has since spent time in Rancho San Antonio, Fremont Older and Picchetti Ranch, as well as Foothills, Los Trancos, Saratoga Gap, El Sereno, and Bear Creek. Preliminary 95% MCP home range estimates for these individuals are 35km<sup>2</sup> and 130km<sup>2</sup> respectively. During the coming year we will continue to focus on collaring more mountain lions near priority sites. This will increase our sample size and allow for a more accurate understanding of mountain lion space use. Following year two we expect to have sufficient data to begin calculating home range sizes using Local Convex Hull (LoCoH) estimates. We will compare these estimates to LoCoHs estimated from collared mountain lions in other parts of the Santa Cruz Mountains.

**Objective 3: Assess factors influencing mountain lion-human interactions**

- i. We are using Strava Metro to investigate the relationship between mountain lion habitat use and human recreational activity. Using Strava data we have created a comprehensive trail map for the Santa Cruz Mountains (Fig. 3) based on active human use. This means that the map more accurately reflects real trails in the study area and offers a better representation of their ecological effects. This trail map will be incorporated into habitat selection and movement analyses to understand how mountain lions respond to the presence of recreational trails. We are also using Strava to quantify the intensity of human use on these trails at multiple temporal scales. Although the download process has been tedious, we expect to have hourly, daily, monthly, and yearly trail use estimates for all trails in Santa Cruz, Santa Clara, and San Mateo counties from 2016-present by the end of 2021. These data will be used to understand how the intensity of human activity on trails might affect mountain lion behavior near recreation areas. These findings will inform the creation of the final, site-specific human-mountain lion interaction management plan.
- ii. Using the Strava data described above we will evaluate the hypothesis that mountain lions are becoming habituated to human activities through repeated exposure to humans on District lands. The Strava data will provide an estimate of human activity and we will compare the behaviors of mountain lions that are exposed to high levels of human activity to those that are less exposed to human activity. We will calibrate Strava trail use estimates to get an estimate of actual trail use (including non-Strava users) using data from camera traps and trail counters. This will allow us to estimate the true number of people using trails within each mountain lion territory. The calibration process will begin after camera data are processed.
- iii. The index of deer activity will depend on data from the District camera grid (objective 1.i). These cameras have been deployed and photo scoring is expected to begin in 2022.
- iv. Hypotheses related to the influence of mountain lion age on responses to human activity will require more collared animals, which will occur during years 2 and 3 of the project.
- v. The factors that affect the probability of human-mountain lion encounters will be evaluated after mountain lion abundance estimates (objective 1.ii) and intensity of trail use (objective 3.i) have been calculated. These preliminary steps are currently in progress.

**Objective 4: Experimentally test the efficacy of deterrents**

- i. The University of California, Santa Cruz Institutional Animal Care and Use Committee (UCSC IACUC) approved our mountain lion behavioral conditioning protocol amendment on June 25, 2021. We are currently developing a rigorous field protocol, which we will share with District staff when complete, and we plan to begin experimentally conditioning collared mountain lions in fall 2021. Behavioral conditioning involves exposing an animal involved in an unwanted behavior to a negative stimulus in an attempt to reduce or eliminate the unwanted behavior. For our purposes, mountain lions coming into close proximity of park visitors is the unwanted behavior, and we will attempt to help mountain lions associate human voices with behavioral conditioning to encourage mountain lions to avoid recreationists. We will use a combination of dogs, human voice, and non-injurious projectiles (i.e., paintballs) as the negative stimulus and we will monitor the habitat selection, movement behavior, and space use of each mountain lion before and after each conditioning event. If successful, this will serve as a potential management strategy that can promote human-mountain lion coexistence and allow mountain lions to safely use habitat without the risk of human conflict. This work will continue throughout years 2 and 3 of the project.
- ii. Forested firebreaks refer to forested areas where understory has been cleared in an attempt to reduce wildfire risk. These areas may also be less appealing to mountain lions because they lack dense vegetative cover suitable for concealing their movements. Thus forested firebreaks may serve dual functions, fuel breaks for preventing fire spread, and as a potential strategy to deter mountain lions from approaching recreational areas. We will begin testing the effects of firebreaks during year 2 of this project. First, we will analyze data from previously tagged individuals to test how they respond to already established firebreaks. If we observe avoidance or a shift in movement behavior near these locations we will work closely with District staff to further test the potential of firebreaks to shift mountain lion activity away from high-use hiking trails on District property. We will also work closely with District staff to determine the best locations for future firebreaks and ensure that proposed locations do not interfere with critical mountain lion habitat.

**Insights from other ongoing Puma Project research:**

1. Recent work published by members of the Puma Project and collaborators found that Covid-19 shelter-in-place orders caused a temporary reduction in human mobility in the Santa Cruz Mountains (Wilmers et al., 2021). Mountain lions responded to this period of reduced human mobility by showing decreased aversion to urban areas. This finding suggests that human presence on the landscape can have significant impacts on mountain lion space use, and that mountain lions respond to changes in human activity over relatively short time scales. This research supports our hypothesis that human outdoor recreational activity might affect mountain lion space use. Interestingly, despite a reduction in human mobility more broadly, shelter-in-place orders have caused a marked

increase in recreational activity, with unknown consequences for mountain lions. Our current work will help us understand how future changes in trail use might affect mountain lion behavior.

Other recent research findings indicate that fear of humans not only affects mountain lion space use, but also has significant impacts on mountain lion energetic demands (Nickel et al. 2021). Further, we have found that mountain lions' fear of humans can indirectly affect plant architecture, causing a shift in ecological community structure near human activity centers (Yovovich et al., 2021). All of this work continues to improve our understanding of human-mountain lion interactions and highlights the importance of our current research in collaboration with the Midpeninsula Regional Open Space District.

### **Management recommendations:**

1. Management recommendations will be provided upon further data collection and analyses.

### **Conclusions and next steps:**

During the first year of the Human-Mountain Lion Interaction Study we successfully collared four mountain lions utilizing District properties and an additional three mountain lions in other parts of the Santa Cruz Mountains. We are actively collecting data on mountain lion space use and human recreational activity. As we move into year two of the project we continue collecting these data and begin preliminary analyses related to mountain lion habitat selection and movement behavior in and around District properties. We will also begin experimentally testing the efficacy of deterrents in changing mountain lion behavior. These data will contribute to our final human-mountain lion interaction management plan. This management plan will attempt to provide actionable strategies for minimizing human-mountain lion conflict, such as preserve access modifications, habitat modifications along trails, or mountain lion behavioral modifications. This final management plan will aim to reduce potential conflicts between preserve visitors and mountain lions and will contribute to a better understanding of human-mountain lion coexistence in multi-use landscapes.

### **Literature cited:**

- Wilmers, C. C., Nisi, A. C., & Ranc, N. (2021). COVID-19 suppression of human mobility releases mountain lions from a landscape of fear. *Current Biology*, 1–4. <https://doi.org/10.1016/j.cub.2021.06.050>
- Nickel, B. A., Suraci, J. P., Nisi, A. C., & Wilmers, C. C. (2021). Energetics and fear of humans constrain the spatial ecology of pumas. *Proceedings of the National Academy of Sciences of the United States of America*, 118(5). <https://doi.org/10.1073/pnas.2004592118>
- Yovovich, V., Thomsen, M., & Wilmers, C. C. (2021). Pumas' fear of humans precipitates changes in plant architecture. *Ecosphere*, 12(1). <https://doi.org/10.1002/ecs2.3309>

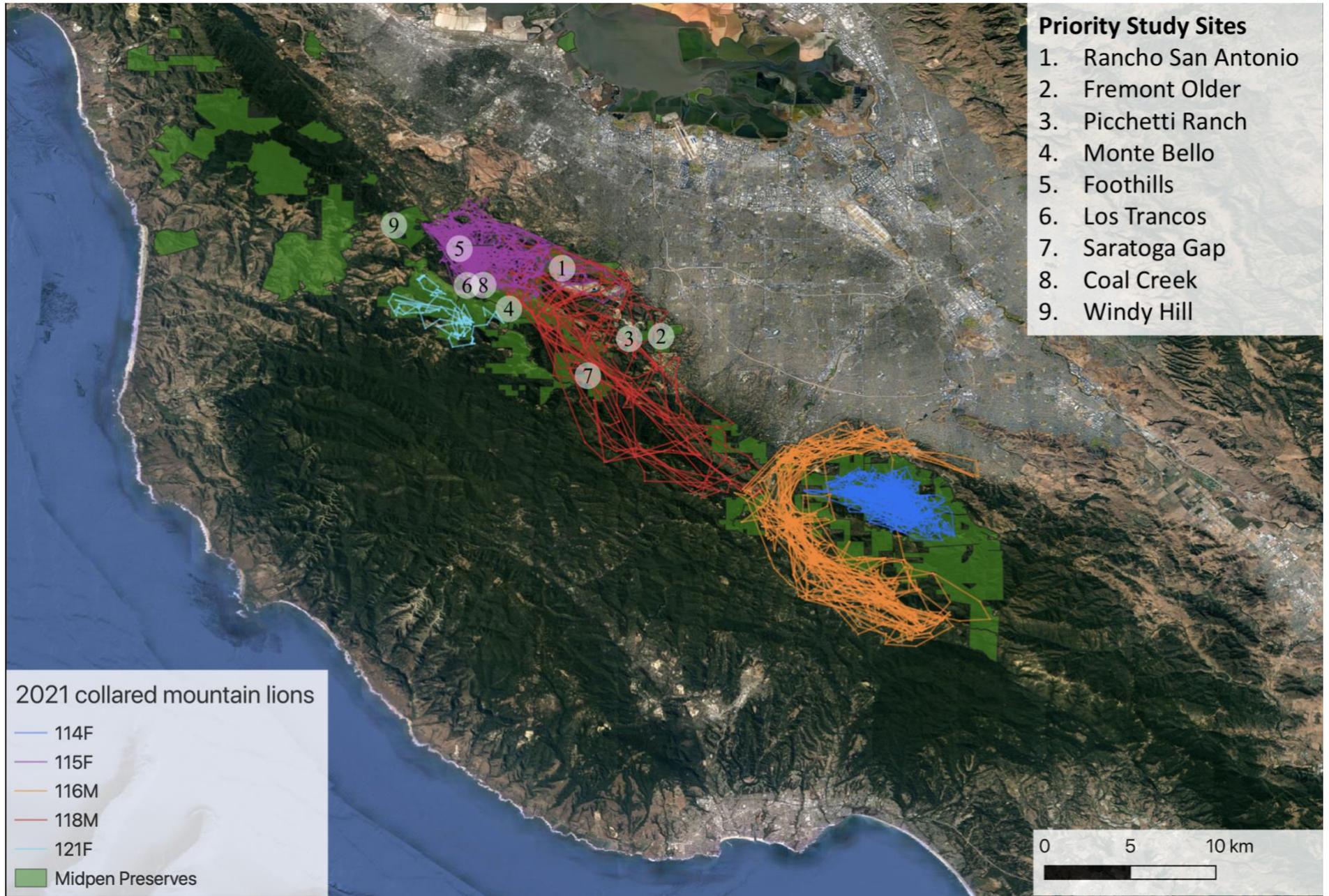
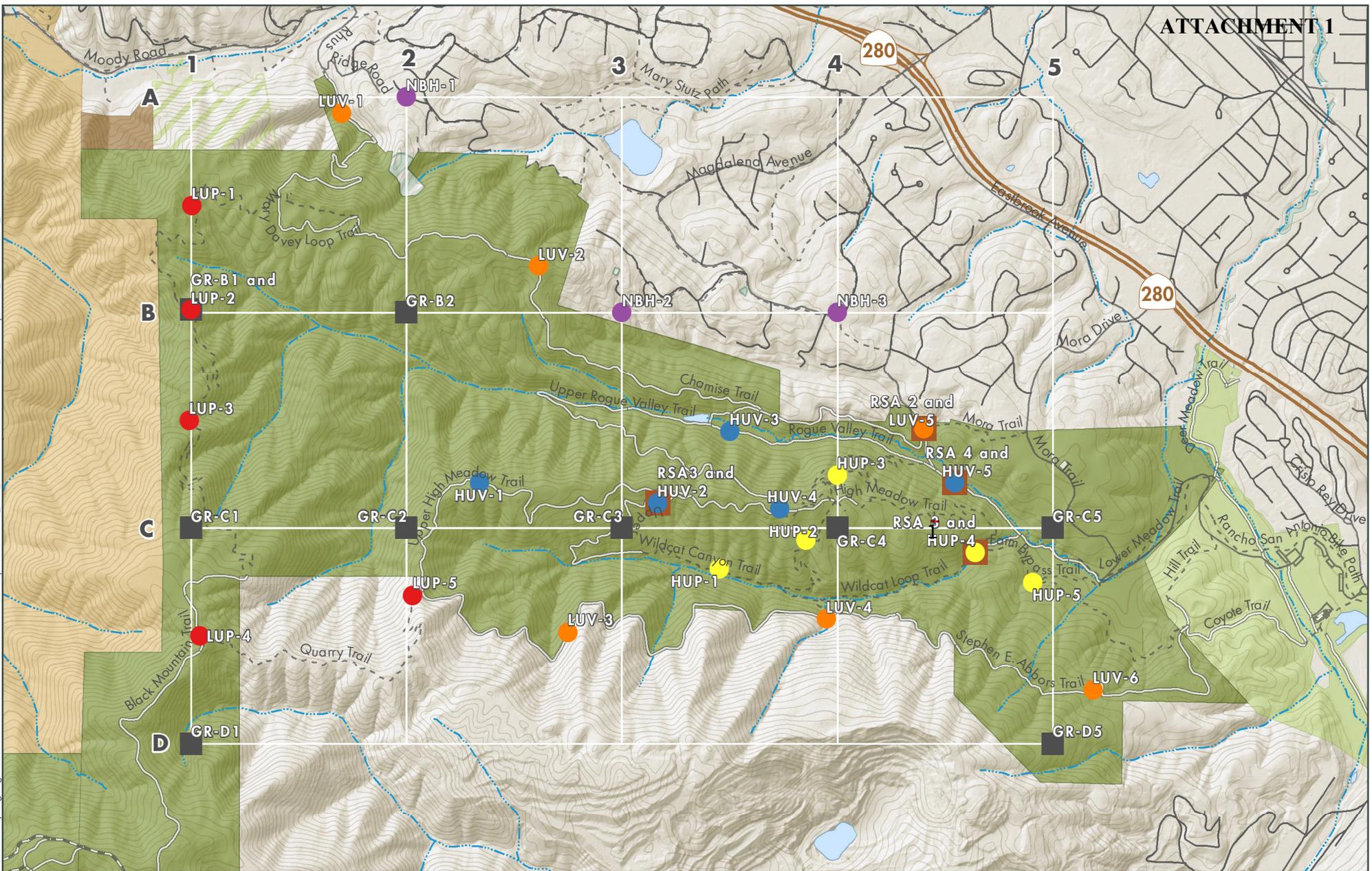


Figure 1: Collared mountain lions utilizing District properties during year 1 of the Human-Mountain Lion Interaction Study

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Created By: ngreig



### Wildlife Camera WPI Grid Map

- High Use Pedestrian Trail (n = 5)
- High Use Vehicle Road (n = 5)
- Low Use Pedestrian Trail (n = 5)
- Low Use Vehicle Road (n = 6)
- Neighborhood (n = 3)
- Grid (n = 9)
- Active Trail Camera (n = 4)

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(Midpen)  
7/9/2020



While the District strives to use the best available digital data, these data do not represent a legal survey and are merely a graphic illustration of geographic features.

Figure 2: Rancho San Antonio camera trap design. Map provided by Midpeninsula Regional Open Space District.

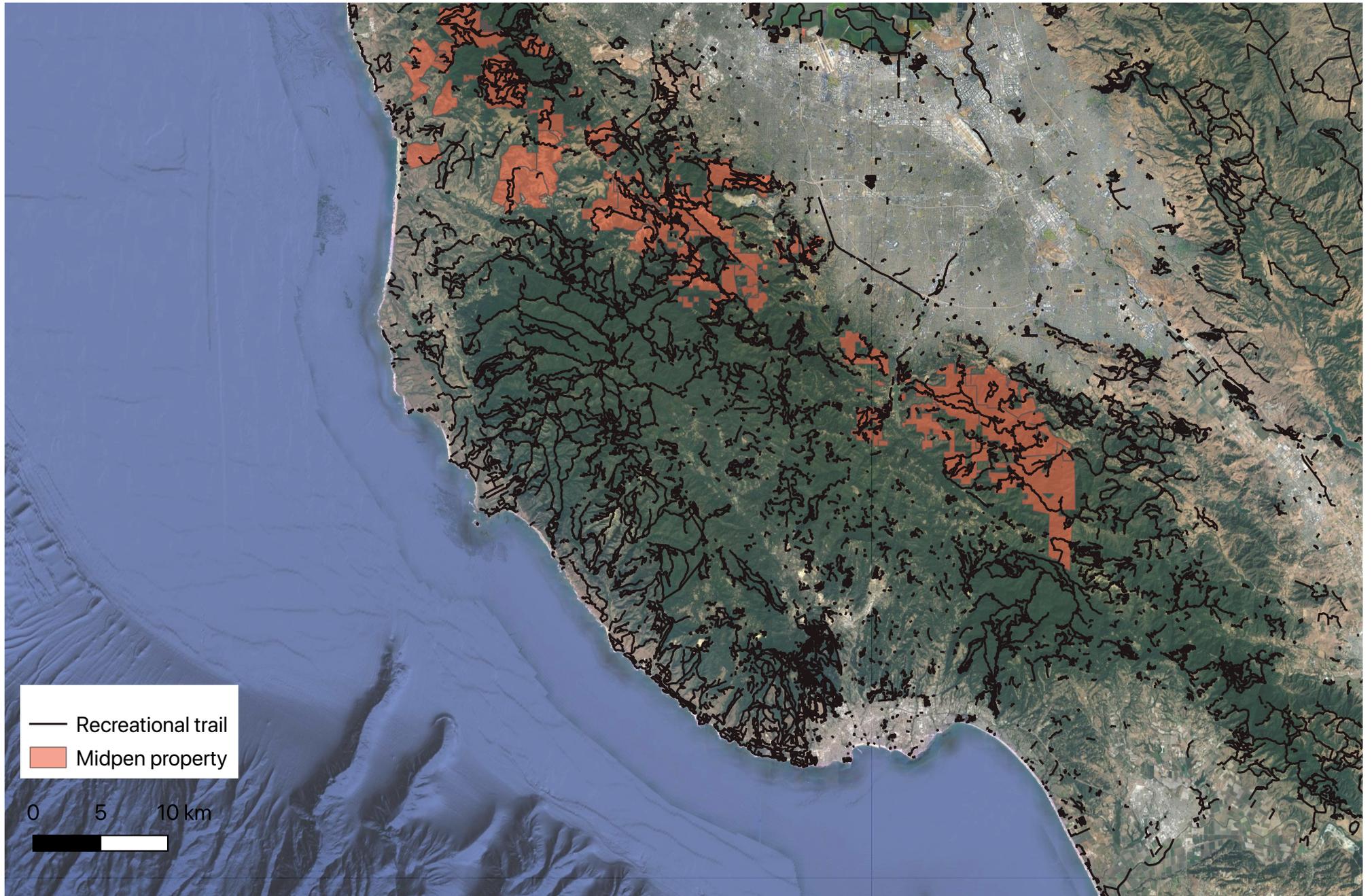
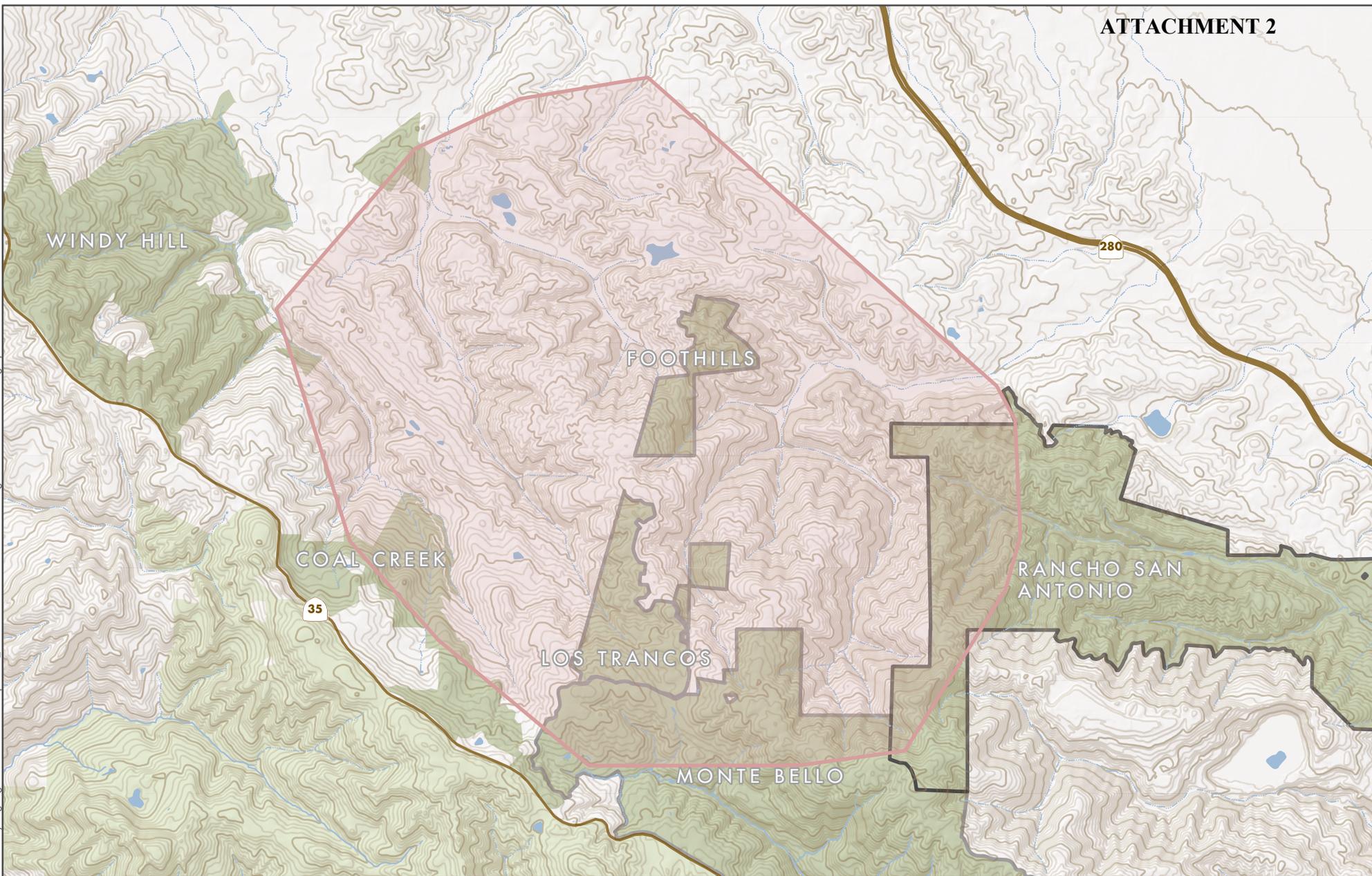


Figure 3: Regional trails network derived from Strava Metro data

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Created by: ngreig



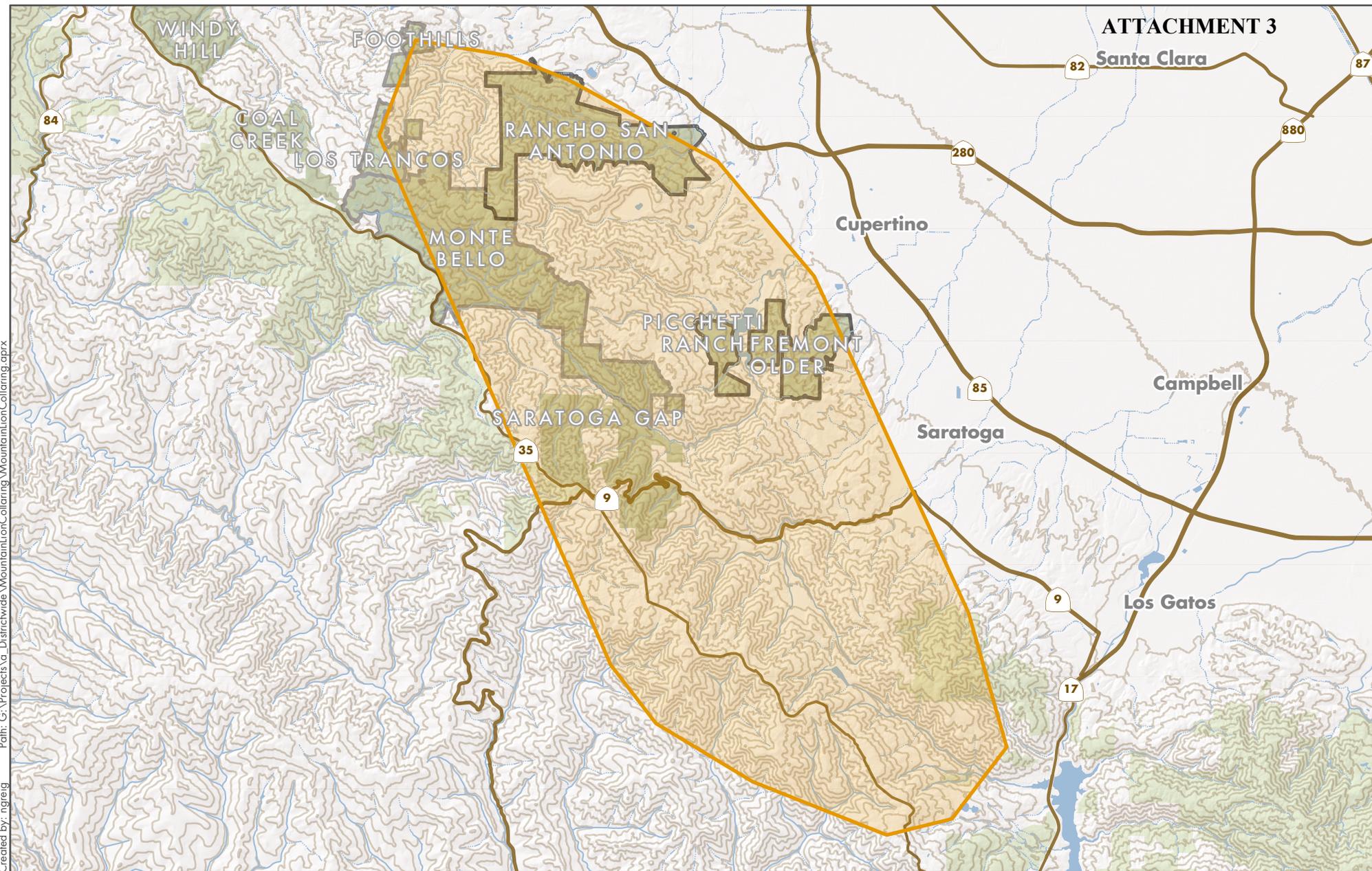
### Mountain Lion 115F 95% MCP Home Range

- 115F home range
- Primary project preserve
- Secondary project preserve
- Other Midpen preserve
- Tertiary project preserve

Midpeninsula Regional  
Open Space District  
(Midpen)  
12/16/2021



While the District strives to use the best available digital data, these data do not represent a legal survey and are merely a graphic illustration of geographic features.



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### Mountain Lion 118M 95% MCP Home Range

-  118M home range
-  Other Midpen preserve
-  Primary project preserve
-  Secondary project preserve
-  Tertiary project preserve

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(Midpen)  
12/16/2021



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