Urban Gray Fox Collaring and Corridor Project Proposal

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Abstract

The mission of the Urban Wildlife Research Project (UWRP) is to document gray fox behavior in the Palo Alto Baylands region in order to establish healthy habitats and develop the biodiverse wildlife corridors necessary for their survival. As a result, UWRP helps San Francisco Bay area people and wild nature coexist through research, advocacy, and public education. In order to expand on its impact, UWRP is developing a variety of research objectives to understand the abundance, dispersal, and habitat selection of gray foxes in Palo Alto Baylands region. Using the findings from these research objectives, UWRP hopes to establish an effective wildlife corridor in the region using methods such as camera traps and GPS collars that will not only benefit the gray fox, but other urban wildlife as well. The results of this research can also be used to inform government officials, land/wildlife managers, and community members on the needs of urban wildlife and what steps can be taken to maintain healthy urban wildlife populations.

Background:

The gray fox (*Urocyon cinereoargenteus*) is a mesocarnivore and along with its congener, the island fox (*Urocyon littoralis*), makes up the genus *Urocyon* (Collins, 1993). This genus is considered to be the most basal of all living canids (Goddard et al., 2015). Since 2009, the Urban Wildlife Research Project (UWRP) has researched wildlife in the San Francisco Bay Area (SFBA), with a special focus on the gray fox. UWRP has studied the gray fox to understand how they are adapting to areas of increasing urbanization particularly Silicon Valley. To date, the research has primarily utilized camera traps and direct observation to monitor urban wildlife and the gray fox. These methods have documented fascinating aspects of gray fox behavior such as the utilization of their tree climbing capabilities for hunting, as well as their social and kit-rearing interactions (Leikam & Kerekez, 2020).

These research efforts have allowed UWRP to not just document the social behavior of the gray fox, but to begin documenting areas of gray fox use around Silicon Valley and other areas in the SFBA. Using direct observation, documentation of gray fox sign such as tracks and scat (feces), camera traps, and photos/reports from community science efforts, UWRP has mapped potential high use areas for the gray fox and other urban wildlife. These areas consist of marshes, mountainous terrain, neighborhoods, and creeks. This information allows UWRP to help maintain California's natural biodiversity by mapping, protecting, and enhancing the corridors that wildlife use (Leikam, 2020).

The Problem:

After years of observing the gray foxes, UWRP researchers began to notice signs of possible decline in both the genetic and populational health of the gray foxes in Palo Alto, California. These signs include documented instances of incest (Leikam, 2016), disease/die-offs (Leikam, Gray Fox Report: May 2020), and overpopulation (Roemer et al., 2001; Rogers & Leikam, 2015).

In November and December 2016, the gray foxes at the Palo Alto Baylands Nature Preserve began dying. By the end of December, there were 18 dead gray foxes logged and none of the remaining seven foxes were ever found or seen again (Leikam, Gray Fox Report: May 2020). The California Department of Fish & Wildlife veterinary services had necropsied a sampling of the foxes and found the cause of the die-off to be canine distemper (Leikam, Gray Fox Report: May 2020). A similar die-off occurred at Alum Rock Park on the northeast side of San Jose, CA some two years before which was linked to high fox population density and habitat degradation. (California Landowner Incentive Program, 2022). In light of these two die-offs, it became apparent that steps had to be taken to protect SFBA fox populations.

A careful look at the surrounding riparian habitat beginning with the wooded area along Matadero Creek (Fig. 1; Latitude 37°26'26.65"N / Longitude 122° 6'38.91"W) was done in the aftermath of the die-off. This area was of habitat concern because this was where UWRP had observed at least 14 gray foxes living at the time of the die-out in 2016 (Leikam, Gray Fox Report: May 2020). The habitat runs ~ 0.82 km along the creek with ~ 0.02 km^2 of habitat (Google Earth). An area of this size could maybe support a single pair of gray foxes, but it is unlikely that it could support 14 (Veals, 2018). It could be that such crowding allowed the virus to spread from one infected fox to all the others in rapid succession. Had there been more available habitat for the foxes, less may have succumbed to canine distemper (Gortázar et al., 2006).

In and around the Palo Alto Regional Water Quality Control Plant (Fig. 1; RWQCP – Latitude 37°27'8.83"N / Longitude 122° 6'43.74"W) there is territory that could maybe support a single pair of gray foxes. The perimeter is ~ 1.4 km and has an area of ~ 0.12 km^2 (Google Earth). This may be where the RWQCP foxes, who were originally documented with the canine distemper, and the Matadero Creek foxes intersected and the transmission of the virus took place (Leikam, Gray Fox Report: May 2020).

There is also a ~ 32 km strip of land running from Redwood City to Sunnyvale and down to Mountain View along the Bay that may include several pockets of gray foxes based on direct observations (Figs. 1,2) (Leikam & Kerekez, 2020). Some evidence suggests that the populations could be islands, which would make each fox population subject to inbreeding, isolation, disease, and other threats such as habitat loss (Charlesworth & Charlesworth, 1987; Leikam & Kerekez, 2020). UWRP proposes connecting these populations by restoring vegetation for safe passage between these population islands for foxes and other species such as other mesopredators (raccoons, skunks, opossums, coyotes, and bobcats), burrowing owls, and other native wildlife that need the space to thrive.

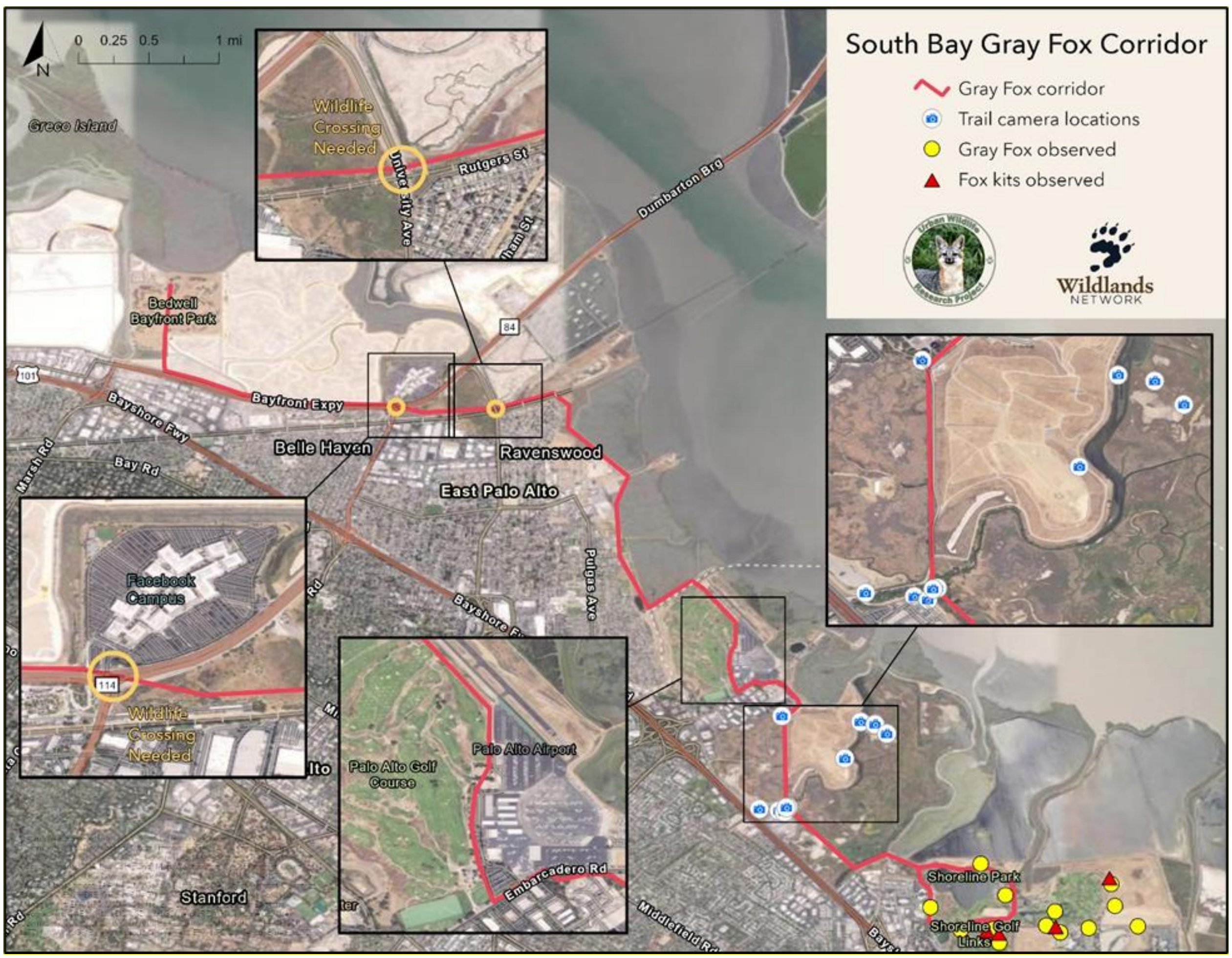

Figure 1: Satellite image map of a potential South Bay Gray Fox Corridor. Enhanced images show the area around Matadero Creek (far right), RWQCP (bottom center), and a potentially needed wildlife crossing locations by the Facebook Campus (far left) and at the intersection of University Avenue and Rutgers Street (top).

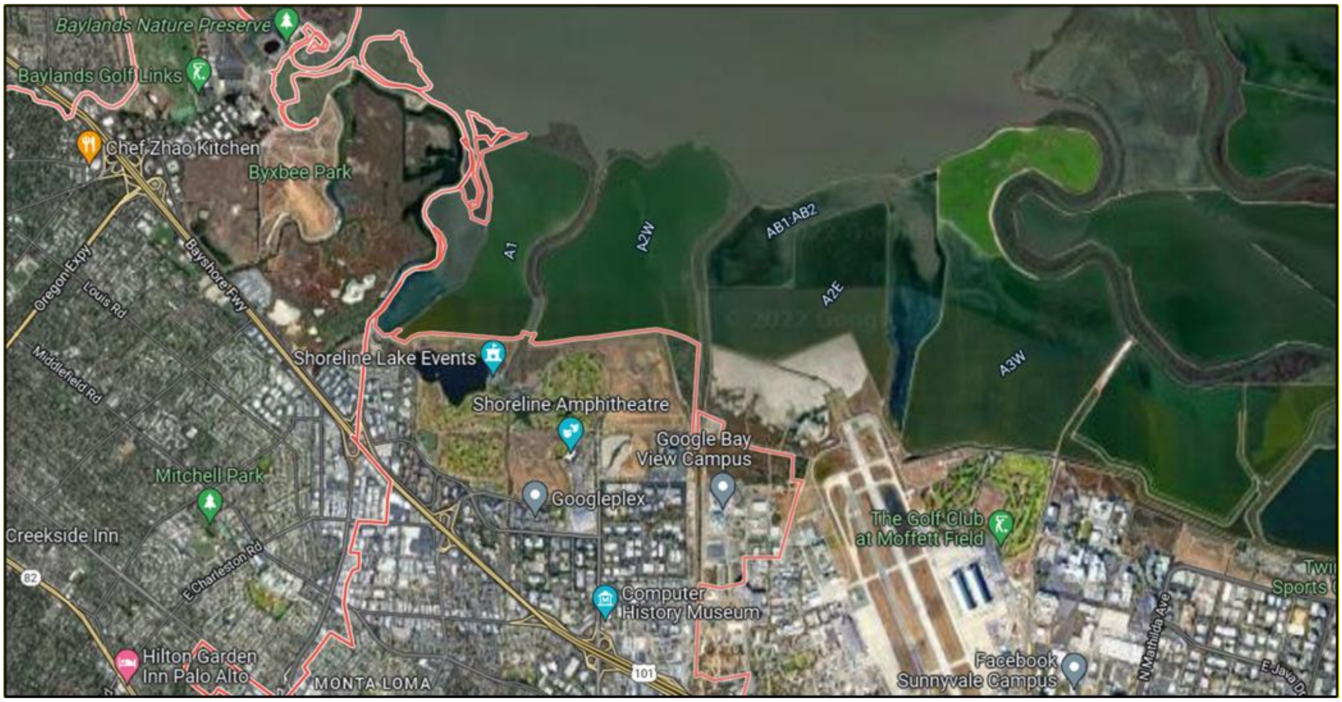

Figure 2: Satellite image map of the potential area in need of a corridor south of the Palo Alto Baylands Stretching into Mountain View, CA (Google Earth).

Overall Importance:

Wildlife corridors provide an important service for humans and wildlife alike (Noe, 2003). For wildlife, it provides a medium not just for the movement of individuals to get from one resource to another within their home range, but for young to leave their natal ranges to find a new home and a mate in order to spread genes between populations (Maiorano et al., 2017). Genetic isolation, or even a significant reduction in gene flow between populations can result in inbreeding depression which results in populations being susceptible to disease, infertility, and other ailments resulting from the enhanced expression of deleterious genes (Charlesworth &

Charlesworth, 1987). As these populations suffer, it has a cascading impact on other organisms in the ecosystem that rely on each other to survive (Polis et al., 2000).

Humans have an interest in maintaining and restoring wildlife corridors because corridors help maintain healthy ecosystems which in turn are able to provide ecosystem services for people (Noe, 2003). The foxes that UWRP focus on can serve as a great example of this. Corridors can help maintain gray fox populations in an urban environment where they are able to prey on rodents, insects, and other organisms that humans would rather not have in and around their homes (Cunningham et al., 2006). Gray foxes also interact with a variety of similar sized species that fill a similar ecological niche and would likely benefit from any corridor restoration that also benefits gray foxes (Collins, 1993; Cunningham et al., 2006). Animals such as passerine and songbirds, various species of waterfowl, pollinating insects, river otters (*Lontra canadensis*), beavers (*Castor canadensis*), bats, raccoons (*Procyon lotor*), skunks (*Mephitis mephitis and Spilogale gracilis*), opossums (*Didelphis virginiana*), bobcats (*Lynx rufus*), and coyotes (*Canis latrans*) would all likely benefit from corridor(s). This would allow those species to reduce the presence of other nuisance organisms such as feral cats (*Felis catus*), ticks, mosquitos, etc. (Cunningham et al., 2006; Pliscoff et al., 2020).

It is well established that wildlife in urban spaces benefits individual and public health (Soulsbury & White, 2015). If people can only experience nature when they get in their car to drive to an “open space” we lose an essential part of what makes us thrive. Urban joggers should be able to glimpse a gray fox or a raccoon and be reminded that we humans are a part of an ecosystem shared with other creatures.

Study Goal(s):

UWRP plans to use the data from radio-collars to identify the habitat types that makes up the corridors that the gray foxes use and where they are located. This data can help the city of Mountain View, CA as they begin development on their corridor to insure it maximizes the species it can help. UWRP also hope to better understand the ability of these gray foxes to disperse and move around their urban landscape, and to identify any potential barriers to movement. These collars can also provide critical information on gray foxes as it related to burrowing owl predation, and the data from this project could be used to assess burrowing owl nest survival in relation to gray fox movements (Rogers & Caro, 1998; Henderson & Trulio, 2019).

Using game cameras and track plates, UWRP will assess the species diversity using areas near where the corridor in Mountain View, CA is potentially going to be built to obtain a broader scale analysis as to where the corridor should be located in order to enhance corridor utility to species (Brodie et al., 2015). The results of this study will hopefully be published in a peer reviewed scientific journal. Some of the potential journals for submission include: The Journal of Urban Ecology, the Western North American Naturalist, the Southwestern Naturalist, and the Proceedings of the California Academy of Science.

Hypothesis:

UWRP hypothesizes that the gray foxes residing in the Baylands Nature Preserve (Baylands) in Palo Alto, California have limited access to corridors to facilitate dispersal and resource allocation due to anthropogenic landscape features and lack of preferred corridor habitat. It is expected that dispersal events and distances will be lower than rural and better-connected populations of gray foxes in the literature. If these gray foxes are unable to disperse, we may also expect to see smaller home ranges than rural gray foxes. This is consistent with density inflation seen in island fox populations; however, urban home-ranges are often smaller than rural ones due to resources existing at a higher density. Further study may be required to confirm the likely cause of smaller territories (Roemer et al., 2001; Rountree, 2004). When individuals do disperse, we would expect them to use habitats dominated by hardwood and shrubs along with edge habitats (Deuel et al., 2017).

We suspect our game camera analysis will detect high use areas by wildlife in areas along the proposed corridor route that have more cover, protection of sound and other disturbances, low resistance to movement, and often come edge habitats where many species habitats overlap and that similar habitats will foster pockets of gray fox populations (Lowry et al., 2013).

Rational:

With the rapid expansion of urban environments around the world over recent decades, it was only a matter of time before wildlife experts began to be curious about the impacts that these developed landscapes have on wildlife populations. To date, urban wildlife research projects exist across the country with long term studies going on in major urban centers such as New York City, Chicago, Los Angeles, Denver, and Austin (Magle et al., 2019). Of particular interest for study is how these urban landscapes potentially inhibit instances of dispersal, gene flow, and resource selection which are critical for allowing healthy wildlife population to persist in an urban landscape (Fitz Gibbon et al., 2007). Gray foxes could provide interesting and useful information on the urban landscape's ability to facilitate important wildlife behaviors such as dispersal and resource selection. This is because while gray foxes are often seen in urban areas, they are not as well adapted to these environments as other urban canids, meaning the impacts of poor urban habitat connectivity could be more observable in the gray fox (Miller & Adams, 1995). Gray foxes also compete for resources and prefer similar habitats to many other animals in these urban environments such as coyotes, raccoons, skunks, bobcats, and red foxes (*Vulpes vulpes*) (Crooks & Van Vuren, 1995; Fedriani et al., 2000; Chamberlain & Leopold, 2005). This overlap in resource use means that challenges of living in an urban environment for gray foxes, such as increased disease exposure, may be similar across species occupying similar habitat (Riley et al., 2004). This would seem to suggest that if the gray foxes residing in the Baylands of Palo Alto, California are having difficulty dispersing among other things, other wildlife species in that area might have issues as well.

The challenges that an urban environment present to wildlife dispersal and resource selection have been said to be similar to that of island ecosystems (Adams, 2005). This is because in both scenarios, there is a lack of dispersal options/routes and dispersal distances are reduced while home range overlap remains small (Trewhella et al., 1988; Roemer et al., 2001; Zimmermann et al., 2005). If a smaller than expected home range size, or one comparable to the island fox is observed, this could be suggestive of density inflation of these urban gray foxes due to a lack of dispersal options. (Roemer et al., 2001). As mentioned in the ‘Hypothesis’ section, these smaller home-ranges would also be consistent with what is seen when home-range sizes are compared between rural and urban populations, due to increased resource density in urban settings (Rountree, 2004). A further study may be required to identify what is contributing to smaller home range size. Increasing corridor and dispersal options are important to reduce inbreeding and resource overuse in wildlife populations, while lowering their densities reducing disease transmission (Gortázar et al., 2006; Krausman et al., 2014; Christie & Knowles, 2015).

In an effort to alleviate the challenges and restrictions that an urban environment can present to wildlife, research has been done on corridors and their habitat characteristics (McClure et al., 2016). To study corridor use of animals, there is a diversity of methods that are used by researchers and wildlife managers. Many of these methods utilize GPS and/or VHF radio-collars in order to establish the location of wildlife corridors and this data provides information on the preferred corridor habitat of a particular species (Pereboom et al., 2008; Leoniak et al., 2012). When studying wildlife corridors, especially in urban habitats, it is important to understand how roads, along with other anthropogenic structures, impede dispersal, if they do at all. Researchers studying urban wildlife look to see if animals avoid roads and where other barriers to movement are, along with identifying preferred locations to cross roadways also by using GPS and/or VHF radio-collar data (Harrison, 1997). These collars also have the added advantage of allowing us to see how the foxes interact with threatened or protected species using the corridor, such as burrowing owls (Cooper et al., 2015). This understanding is going to be critical to manage both species in this area.

In conjunction with the GPS collars, monitoring pre and post development of the corridor will play a vital role in maximizing the utility of the corridor for a wide array of taxa (Beier & Loe, 1992). Game camera grids can be used to answer a variety of questions on a broader scale such as species diversity in conjunction with habitat type (Goad et al., 2014). This can allow us to see what areas are most heavily utilized by a range of species and should be on a higher priority in terms of inclusion in the corridor. Cameras can give us broad scale insights into temporal partitioning, and frequency of use in terms of how often certain areas are used compared to other (Goad et al., 2014). Often times this data when compared to other landscape features can allow the impact of various landscape features on habitat use to be assessed (Goad et al., 2014). All of this information can be utilized when planning corridor development and enhancing utilization of wildlife species.

Other important considerations made when establishing wildlife corridors are those of which populations would benefit most from being connected, resource availability throughout the corridor, and the use of the corridor by nontarget species such as invasives (Newmark, 1993). These considerations can be examined using DNA sampling to see relatedness and inbreeding depression between populations indicating which ones are in most need of connection. Resource availability in the corridor can be assessed through survey methods that will vary depending on the resource being assessed and what species is using the resource. Those same game camera methods discussed previously (Page 10, ¶ 2) can be used to monitor for invasive species use of the corridor (Newmark, 1993).

Project Proposal:

Methods and Data Collection:

Several options exist to identify pockets of gray foxes near those in the Palo Alto Baylands and UWRP has already identified some presence of other gray foxes in the area (Leikam & Kerekez, 2020). To identify other areas that may have foxes near the Palo Alto Baylands, UWRP can continue to use the methods they have been using (presence/absence of fox sign/direct observation). UWRP can also employ new but common methods to find potential pockets of foxes such as citizen reports and community science apps like iNaturalist (Mueller et al., 2019). These methods are of little to no cost and will allow UWRP quickly see where pockets of foxes may be located based off sighting/observation clusters (Mueller et al., 2019).

Once these potential pockets are identified, surveys can be done to estimate the size of these populations. These survey methods can be done using camera trap grids and/or genetic analysis via scat from transects and/or hair from snare grids (Ruell & Crooks, 2007; Kämmerle et al., 2018; Stevens, 2022). The survey methods using genetic analysis offer the added benefit of allowing us to compare them to the genetics of the foxes in the Baylands so we can see how closely related the populations are and which ones suffer from the greatest amount of inbreeding and lack of gene flow (Stevens, 2022). This would indicate which ones are in the greatest need of connection via the future corridor(s) (Pelletier et al., 2017). UWRP has potential access to genetic analysis equipment via the University of California at Davis (UC-Davis) and/or California Department of Fish and Wildlife (CDFW).

Data that would greatly help to identifying the precise location(s) and habitat characteristics of the corridor(s) would be the movements and the habitat selection of the foxes in the area. This would likely be done using GPS collars to track the locations of the foxes over a period of time. This data, when placed into computer programs such as ArcGIS/ArcPro and the statistical coding program R, can tell us what areas the foxes are using to get across their home range, the size of their home range, the habitat characteristics they select for, and dispersal routes along with the habitat characteristics of those dispersal routes (Nicholson et al., 1985; Deuel et al., 2017). These programs along with the fox movement data can also allow a least-cost-path analysis to be done to determine where the greatest barriers of movement to the foxes occur (Leoniak et al., 2012; Stevenson et al., 2013). This information would help ensure the corridor goes in the most effective location for the foxes and other wildlife.

Along with the movement data, other data that could be collected to inform stakeholders as to where the corridor(s) would be best located and the habitats they should connect to would be a dietary analysis of the various fox populations (Cunningham et al., 2006). Along with this, surveying these habitats and potential corridor locations for food/prey density would also be beneficial (Adler & Levins, 1994).

Collaring Methods/Capture and Handling:

Trapping of gray foxes (n = 10-30) will occur in the fall from mid-August to the beginning of November and fitted with the 180 g GPS radio-collar (GPS Logger W500, Advanced Telemetry Systems, Isanti, MN) (Nicholson et al., 1985; Koopman et al., 2000). Foxes will be trapped using cage traps with a spring door activated by a treadle (Tomahawk, USA). The dimensions of the traps will be ~ 32 x 10 x 12 3/4 inches and traps will be placed in areas of known use by the foxes (Nicholson et al., 1985; Best Management Practices for Trapping Gray Foxes in the United States, 2014). Traps will be checked once a day to prevent foxes from being in a trap for too long. For both the safety of the researchers and the foxes, foxes will be restrained using a catchpole and secured by placing electrical tape around the muzzle, rostrum, and legs while using a blindfold to reduce animal stress (Deuel et al., 2017). If deemed necessary, an intramuscular injection of a 1:1.2 mixture of Ketamine 7.0- 10.0 mg/lbs and xylazine 0.5 - l.0 mg/lbs will be administered (Harrison, 1997; Taylor, 2021). Foxes will be given ear tags in each ear for easier identification and a DNA (hair) sample will be collected. GPS radio-collars will be programmed to record a location every 2 hours (12 locations/day) until cessation of data collection. After data collection is complete the collars will be programed to fall off. If this mechanism fails, it has been shown that GPS radio-collars generally have little to no long-term impacts on the animals (Stabach et al., 2020). Foxes will be monitored once every week with a 3-element Yagi antenna and hand-held radio telemetry receiver in order to obtain a remote download using a the ATS downloading software/antenna on a laptop to generate a KTML file.

Collaring Data Analysis:

Home-ranges and habitat selection will be calculated and analyzed using the function package “adehabitatHR” in Program R v.4.0.0 (Calenge, 2006). Home-ranges will be calculated using both 95% minimum convex polygons (MCPs) and 95% kernel density estimates (KDEs). Home ranges will be calculated for individuals with at least ~80 location fixes (Roemer et al., 2001). Habitat selection will be analyzed using both “adehabitatHR” function in Program R v.4.0.0 and Arc GIS by overlaying home-ranges on a GIS shape file of the study area showing habitat types classified by vegetation and land use. This will allow us to analyze what habitat types the foxes are utilizing at each location and what proportion of these locations are in each habitat type (Davis et al., 1994). The size of the home-ranges in our study will be compared to the size of home-ranges from other studies on gray foxes in more rural environments and on island fox populations (dispersal distances will be compared as well). This will allow us to see if there is a significant statistical difference between gray foxes in an urban landscape and those that live in more connected rural or isolated island ecosystems. This comparison will be done using an unpaired t-test on the mean home-range sizes from our study and the studies done on island and rural populations (Guillet et al., 1996). This test, along with all statistical tests in this study, will be done in the statistical program R v.4.0.1.

To analyze dispersal, dispersal distance will be defined as the distance separating the arithmetic centers of pre- and post-dispersal home-ranges. If accurate home-range estimates cannot be made after dispersal, the distance between the arithmetic center of the pre-dispersal home range and the farthest post-dispersal location will be used as the dispersal distance

(Roemer et al., 2001). If pre-dispersal home-ranges cannot be estimated, the capture location will be used as the arithmetic center of the pre-dispersal home-range (Koopman et al., 2000; Zimmermann et al., 2005). Dispersal events will be defined as movements/locations between the first date of dispersal (the median between last location date within natal range and first location date > 1km from the natal range) and the first movement/location within its post dispersal home-range (Koopman et al., 2000). Locations within these dispersal events will be used to map corridors and an analysis on habitat selection will be done using those locations using similar methodologies outlined earlier for habitat selection within the home-ranges. Survival of the foxes post collaring will be monitored, especially during dispersal, in order to see mortality as a potential cause of low dispersal and if dispersal events put the foxes at increased risk of mortality.

To further analyze habitat connectivity, potential corridors will be identified using a GIS-generated Least Cost Path Analysis (LCP) (Leoniak et al., 2012). This will allow us to better understand not just where corridors may be located, but what potential barriers to movement may be.

Camera Trap Methods:

Camera traps will be placed in a grid of (N = 15 – 30 cameras) and rotated through predetermined places along the potential corridor route and areas where pockets of gray fox populations might be. Grid locations will consist of different habitat characteristics defined through a GIS land use cover layer (Ahumada et al., 2011). The grid will be rotated on 2 – 3-week intervals upon which the grid will be picked up, and SD cards and batteries will be switched (Meek et al., 2012). Camera stations will be unbated in order to not bias the sampling results (O’Connor et al., 2017).

Camera Trap Data Analysis:

Various analysis will be done to assess occupancy and density of species diversity and individual species detected by the game camera (Tobler et al., 2015). The results of these analysis will be compared between grid locations do see if there are significant differences between them and therefore different habitat types (Clare et al., 2015). Using land use layers again in GIS, these results will be corresponded to landscape feature such as roads, trails, etc. (Ahumada et al., 2011). All relevant data analysis will be done in the statistical program R v.4.0.1.

Methods for Potential Genetic Analysis:

If time and budget permits, genetic sampling will be used to determine the genetic make up of the gray fox populations. Two methods to consider using would be hair snares or scat sampling. Hair snares where barbed wire or something similar will be placed at some of the camera stations with a bait in order to try and catch some fur for genetic analysis (Monterroso et al., 2014). If scat sampling is pursued instead. Walking transects searching for scat to collect would be the most tried and true method. The benefits of this method are this could also allow a dietary analysis to be done via the scat samples as well (Lonsinger et al., 2018).

Data Analysis for Potential Genetic Analysis:

Genetic analysis for the fox populations will be done using the scat or hair samples with genetic sampling equipment. The primary genetic assessment for these fox populations will be that of genetic diversity within each population and effective population size (N_e) (Lonsinger et al., 2018). These values will be compared across populations to indicate which populations are in greatest need of gene flow between the two and would benefit most from the corridor (Mech & Hallett, 2001).

Corridor Monitoring and Future Directions:

Monitoring:

Upon completion of the corridor(s), efforts will have to continue in order to preserve them and to make sure they remain viable for the foxes and other wildlife that will use them. Like many corridors, this monitoring will likely need to go on indefinitely into the future but the intensity of it will likely go down over time (Doerr et al., 2014). This long-term monitoring will employ such methods as, but not limited to, vegetation monitoring, lethal and nonlethal methods of invasive/exotic species removal (cats, dogs, nonnative vegetation, etc.), and camera trap surveys to monitor what wildlife is using the corridor (Beier & Loe, 1992; Hilty & Merenlender, 2004; Moseby et al., 2015; Chakraborty et al., 2021). Once established, these methods are relatively low cost and easy to execute (Beier & Loe, 1992).

Estimated Budget and Projected Timeline:

Project Timeline and Deliverables: Table 1

Table 1: Expected activities and deliverables from this project and the planned date of implementation or completion.	
Date:	Activity/Deliverable:
Dec. 2022 - Feb. 2023	Obtain permission from Mountain View for camera trapping and other potential survey methods.
Dec. 2022 - Feb. 2023	Coordinate with university partners for research support.
Mar-23	Begin camera trapping and other surveys.
Mar-23	Begin permitting process for gray fox collaring.
Oct. 2023 - Feb. 2024	Gray fox collaring (may occur over this time period for subsequent 2-3 years).
Mar-24	Data Analysis (some may be done earlier depending on data collection).
Oct. 2024	Publication/Presentation of findings to journals and conferences/stakeholders (Like the data this may be done earlier depending on data collection and analysis).
TBD	Beginning of Mountain View development of corridor, which will begin corridor monitoring portion of project. The city of Mountain View has had some delays and will be updating us as things progress.

Project Needs/Budget:

There are a variety of needs that, when addressed, will go a long way in allowing this project to get off the ground. These needs come in the form of financial, connections with universities or other institutions that have an interest in corridor research and restoration, and cooperation from landowners, just to name a few. Material needs for the project can be seen below in Table 2. Connections with universities and other institutions to collaborate with UWRP on research and corridor restoration will make getting various permits for research and scientific collection easier to obtain. It also allows for potential peer reviewed publications increasing the power and reach of UWRP's findings and makes the corridor project easier to justify to respective government agencies and relevant NGOs. Cooperation from landowners will allows for easier data collection along with establishment and future management of the corridor(s).

Table 2: Rough budget/costs for the data collection (Phase I) portion of the project. '~ Cost' is not per item but for all of that item together (Silveira et al., 2003; Lukacs & Burnham, 2005; Best Management Practices for Trapping Gray Foxes in the United States, 2014). The total cost comes out to ~ $39,550 but some of these items may be obtain through secondhand sources for little to no cost.

Item:	**Purpose:**	**~ Cost:**
30 Game cameras	Population surveys for foxes and other wildlife.	$3,000.00
60 SD Cards	For the game cameras used for the surveys.	$1,200.00
Camera batteries	Cost to power all 30 cameras for one session.	$373.20
30 DNA samples	Establish the relatedness and genetic diversity of the various fox populations.	$3,000.00
10 Cage traps	Trapping foxes for collaring and feral dogs/cats for removal from corridor.	$1,000.00
20 GPS collars	Tracking fox movements to establish corridors.	$30,000.00
Yagi antenna	Tracking fox movements to establish corridors.	$700.00
Yagi computer antenna	Downloading GPS data from collars.	$300.00

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