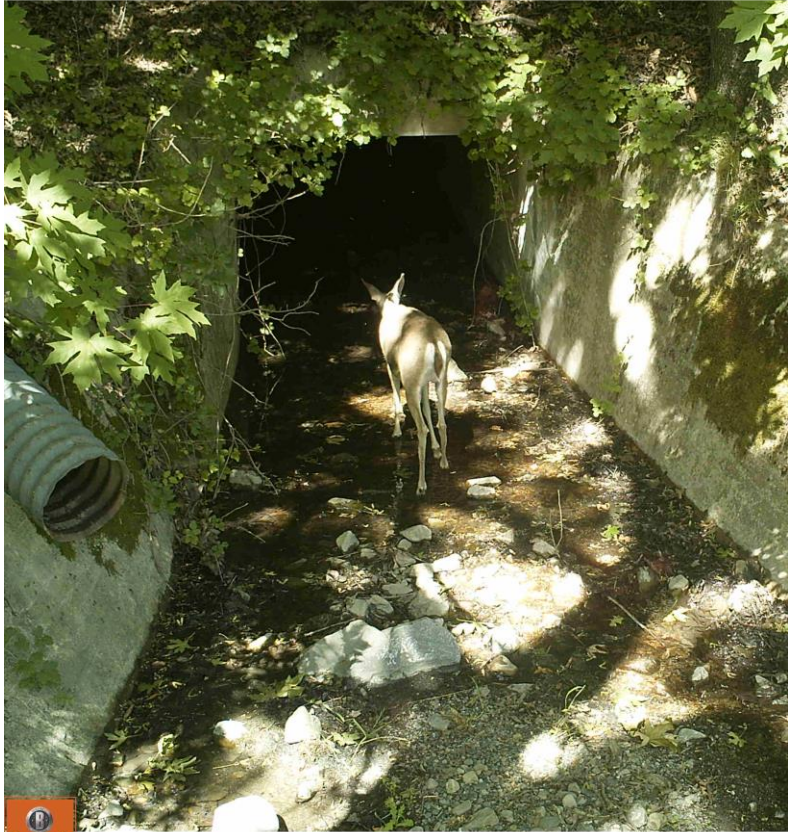


Highway 17 Wildlife Connectivity Project: Lexington Study Area.



Deer at the Hwy 17 Trout Creek Culvert.

Prepared for
Midpeninsula
Regional Open Space
District (MROSD) and
Peninsula Open
Space Trust (POST)
by Pathways for
Wildlife.

12/31/2016



Mountain lion hit on Hwy 17 at Lexington.

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Executive Summary

Background

Highway 17 bisects the Santa Cruz Mountains from the Town of Los Gatos to the city of Santa Cruz. Highway 17 is a wildlife sensitive highway in regards to the high amount of animal-vehicle collisions that occur on a consistent basis. The Santa Cruz Mountains are becoming increasingly isolated by habitat fragmentation, which is making it more difficult for species such as mountain lions to travel in and out of the mountain range. This is a problem which could lead to genetic isolation if new individuals are unable to immigrate into the population (Beier 1993 & 1995). Highway 17 currently lacks the appropriate culverts and bridges for animals to cross the highway, resulting in animals routinely being hit on the highway.

Habitat Connectivity Needs

The Santa Cruz Mountain lion population is considered an important source population, in which there are documented breeding individuals producing juveniles that will need to disperse out of their parental home range to find their own (Wilmers et al. 2013). Currently, there are approximately 50-70 mountain lions present in the mountain range (Wilmers pers. comm. 2015). The home ranges of mountain lions in the Santa Cruz Mountains have been found to be approximately 160 km² for males and 60 km² for females (UCSC Puma Project). Dispersing juveniles must often travel far out of their parental home range, while avoiding established adult male territories, and often must travel through a fragmented landscape that includes a matrix of roads and highways (Forman, R. T. 2010, Urban Carnivores 2010).

Experts found that there needs to be at least one new individual immigrating into a population each year to maintain a genetically healthy population (Beier 1993). A recent study by the Santa Cruz Puma Project has documented that the Santa Cruz mountain lion population has a low genetic diversity (Wilmers pers. comm. 2014). Each year, over the past nine years, there are one or more documented mountain lion fatalities due to vehicle collisions on Highway 17, which could be contributing to the low genetic diversity status of the puma population.

This information documents the need for providing habitat connectivity for mountain lions and other wildlife species to have the ability to move across the landscape to increase genetic flow and ensure viable population health. Highway 17 is having a negative effect on the mountain lion population by fragmenting the landscape; however, there is a way to reconnect habitats by allowing animals to safely cross the highway. **Wildlife crossing structures** have been used successfully throughout the world to connect fragmented habitats and provide safe passages for wildlife movement across existing roads (Safe Passages 2010). These crossing structures can be culverts and underpasses for wildlife to cross underneath the highway safely, or they could be overpasses and land bridges for them to cross over the road. Wildlife crossing structures have proven to be very successful in almost doubling the population size for the Florida panther and preventing vehicle collisions with mountain lions and other wildlife in Banff Canada (Gloyne, C. C. & Clevenger, A. P. 2001, Safe Passages 2010).

Development of the Highway 17 Wildlife Connectivity Project

In September 2013, Midpeninsula Regional Open Space District (MROSD), Peninsula Open Space Trust (POST), Land Trust of Santa Cruz County (LTSCC), and Pathways for Wildlife joined as project partners to work with collaborators; Nancy Siepel at Caltrans District 5, Caltrans District 4, Ann Calnan at Santa Clara Valley Transportation Authority, the UC Santa Cruz Puma Project, the Department of Fish and Wildlife, and Santa Clara County Parks to identify the best location for a wildlife crossing structure on Highway 17 in Santa Clara County and ways to implement a connectivity design for the study area.

Project & Study Results

The objective of the study was to identify an area which would be the most beneficial location to install a wildlife crossing structure for animals to provide the ability for animals to safely cross the highway. To identify this location, Pathway for Wildlife was hired to determine where the majority of animals were attempting to cross the highway.

Three types of data was collected and then overlaid using GIS mapping software. The data includes; 1) roadkill data, 2) UCSC Puma Project radio collar data of mountains



lions that had successfully crossed the highway, and 3) field camera data at existing culverts. The data results indicated a Hot Spot location, in which animals were consistently being hit at Trout Creek, which crosses under Highway 17 at the Lexington Reservoir. Radio collar data from the UCSC Puma Project revealed that the majority of successful crossings over Highway 17 by radio collared mountain lions also occurred at Trout Creek and within the vicinity of it.

There is an existing cement box culvert that Trout Creek runs through. This culvert was monitored for 3 years on both the west and east side of the culvert. Data results showed that multiple species of wildlife would consistently approach the culvert, investigate it, and then walk away from it. The avoidance by animals in not using the culvert to travel through is most likely due to the lack of visibility through the culvert. Several studies have shown that there is a high preference of culvert use by animals if there is a clear line of visibility through it (Safe Passages, 2007).

Next Steps

In February 2016, Midpeninsula Regional Open Space District awarded a contract to a highly qualified consulting team of wildlife connectivity experts, engineers, and landscape architects to conduct a conceptual design and feasibility study for new wildlife crossing structures or retrofit of existing structures from the Town of Los Gatos to the Bear Creek Road overcrossing on Highway 17 in Santa Clara County, California.

To be included in this effort is the conceptual design of a multi-use (pedestrian, equestrian, cyclist, and dog accessible) Bay Area Ridge Trail crossing to improve public access in the South Bay Foothills. The consulting team will produce a creative design solution to meet project goals and protect natural resources.

1.0 Introduction

In December 2012, Midpeninsula Regional Open Space District (MROSD) hired Pathways for Wildlife to conduct a wildlife connectivity study on Highway 17 in Santa Clara County. The results of this study would include the creation of a wildlife connectivity design that could be used as a blueprint for improving the ability for wildlife to safely cross Highway 17 between Los Gatos and the Lexington Reservoir; this included areas where wildlife were routinely being hit by vehicles. There are currently very few opportunities for wildlife to safely cross Highway 17 along the entire span of the highway.

In September 2013, Peninsula Open Space Trust (POST) and the Land Trust of Santa Cruz County (LTSCC) joined as project partners to work with collaborators; Nancy Siepel at Caltrans District 5, Caltrans District 4, Ann Calnan at Santa Clara Valley Transportation Authority, the UC Santa Cruz Puma Project, the Department of Fish and Wildlife, and Santa Clara County Parks to identify the best location for a wildlife crossing structure on Highway 17 in Santa Clara County and ways to implement a connectivity design for the study area. This report includes data results and recommendation from the project to date.

2.0 Regional Conservation Planning Efforts for Wildlife

Several regional conservation efforts have identified the Lexington Study Area as a critical linkage in connecting the Santa Cruz Mountains to the Diablo and Gabilan Ranges in order to maintain landscape connectivity for mountain lions and other species.

1) California Essential Habitat Connectivity Project. Spencer, W. D., P. Beier, K. Penrod, K. Winters, C. Paulman, H. Rustigian-Romsos, J. Strittholt, M. Parisi, and A. Pettler. *Prepared for California Department of Transportation, California Department of Fish and Game, and Federal Highways Administration* (2010).

2) Critical Linkages: Bay Area & Beyond. Penrod, K., P.E. Garding, C. Paulman, P.



Beier, S. Weiss, N. Schaefer, R. Branciforte and K. Gaffney. *Produced by Science & Collaboration for Connected Wildlands, Fair Oaks, CA in collaboration with the Bay Area Open Space Council's Conservation Lands Network (2013) (Figure 1).*

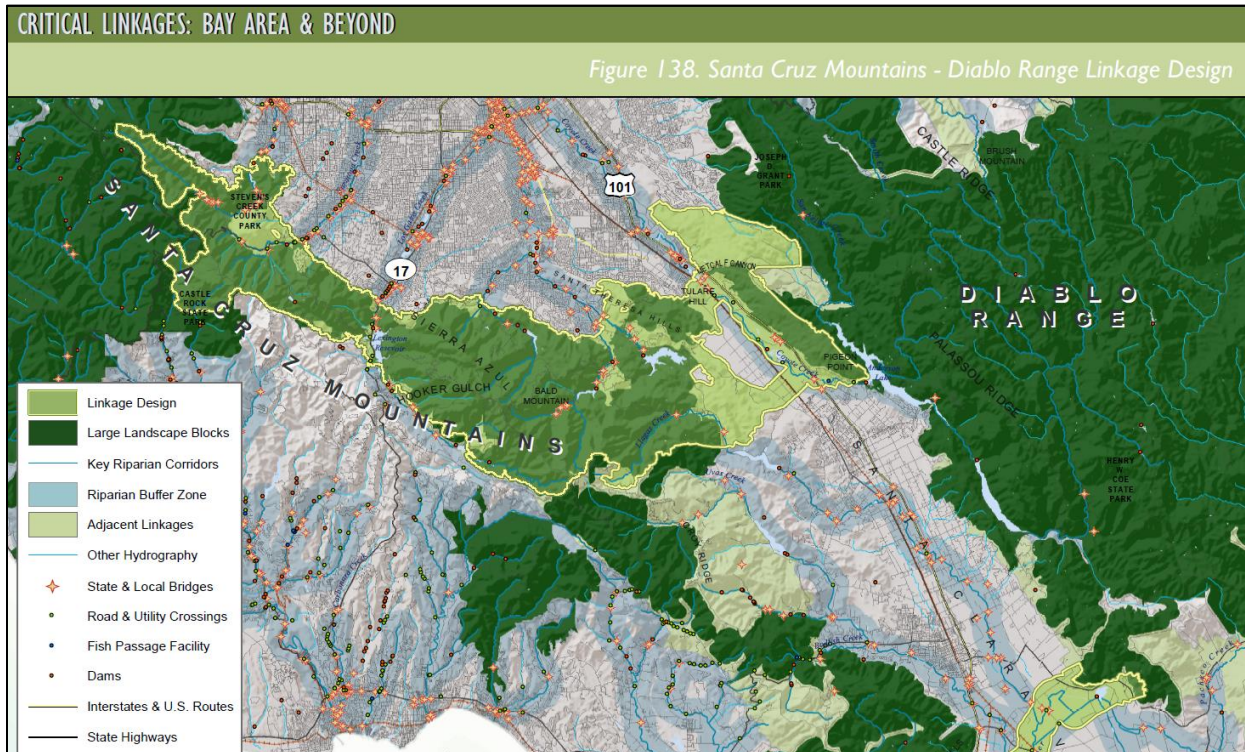


Figure 1: Bay Area Critical Linkage Design for the Santa Cruz Mountains to the Diablo Range.

3) Caltrans District 5 Wildlife Corridor and Habitat Connectivity Plan: Caltrans Region 5 biologist, Nancy Siepel, has been instrumental in advancing the project. In partnership with UC Davis, Nancy Siepel recently completed a first district-wide planning effort to evaluate and prioritize potential mitigation projects for Santa Cruz, San Luis Obispo, San Benito and Santa Clara counties. Throughout these four counties, Highway 17 was identified as one of the high-priority highways for addressing wildlife connectivity issues (Regional Wildlife Corridor and Habitat Connectivity Plan, Huber, P.R, Thorne, J. H, Bjorkman, J, and R.M. Boynton. *Prepared for California Department of Transportation, District 5 (2014).*

4) Midpeninsula Regional Open Space District Vision Plan: Top 25 Future Open Space

Projects: Priority Action # 20. Wildlife Passage and Ridge Trail Improvements to provide safe wildlife corridors across Hwy 17 and add a new Bay Area Ridge Trail crossing. This Priority Action was among the highest rated actions for future implementation as rated by the public through the Vision Plan planning process, which involved over 2000 public participants, technical experts, partners, stakeholders, and different user groups. MidPen’s Board of Directors adopted this Priority Action as a priority for funding through a general obligation bond funding measure that was passed by over 2/3 of the region’s voters in June 2012.

The goals of this project meet the objectives of the regional conservation planning efforts in implementing the linkage designs by improving the ability for wildlife to safely cross underneath Highway 17 and connecting existing open space owned by Midpeninsula Regional Open Space District and Santa Clara County Parks.

3.0 Study Area & Sites

The study area spans from the town of Los Gatos to the Alma Bridge at Bear Creek Road (Figure 2). A fifth site, Aldercroft culvert lies to the south of the study area, but warranted further analysis. The majority of the study area consists of protected lands, either owned or managed by Midpeninsula Regional Open Space District and Santa Clara County Parks, which are bisected by Highway 17. Within the study area there are three study sites which include; the Ravine Culvert, Trout Creek Culvert, Lexington Culvert. Aldercroft Culvert lies to the south of the main study area (Figure 2).

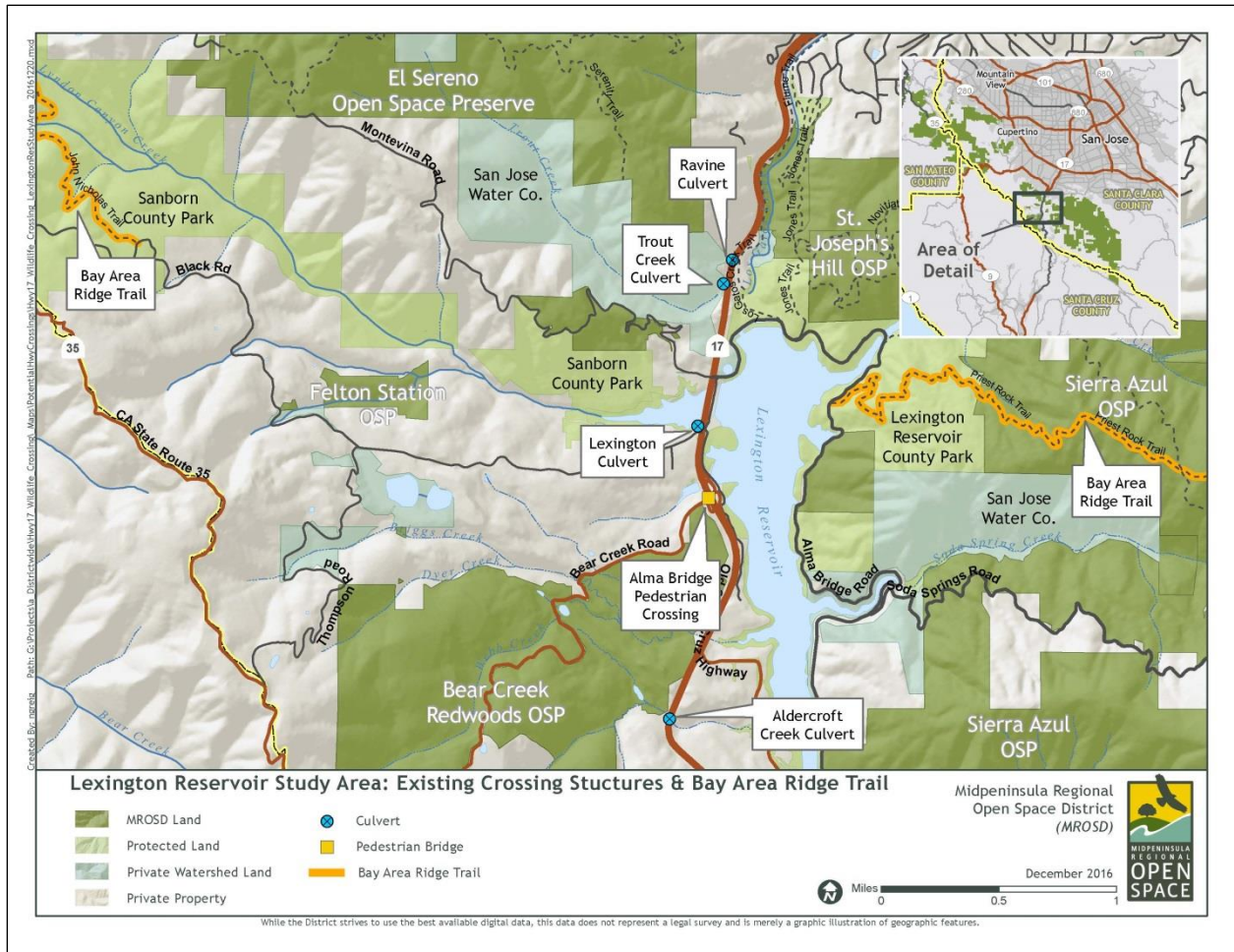


Figure 2: Lexington Study Area.

4.0 Methods used for Determining the Location of a Wildlife Crossing Structure.

Four different types of research methods were used for determining the most beneficial location in which to install a wildlife crossings structure that will improve the permeability of the landscape for wildlife movement across Highway 17. These methods include; 1)UCSC Puma Project Models, 2) UCSC Puma Project Radio Collar Data, 3) Roadkill Data, and 4) Field Camera Surveys.

4.1 UCSC Puma Project Santa Cruz Mtns. Mountain Lion Connectivity Analysis & Radio Collar Data.

Chris Wilmers of the UC Santa Cruz Puma Project conducted a landscape connectivity analysis for the Santa Cruz Mountains based on GPS radio collar data collected from mountain lions and their recorded movements. His analysis produced a parcel-specific connectivity design that shows critical habitats needed to maintain landscape connectivity for mountain lion movement (Figure 3). As depicted in the map, the darkest portions of the linkage design reflect the best locations for mountain lion movement across the highway. The properties on both the east and west sides north of the Lexington Reservoir are critical in connecting important habitats for mountain lion movement across Highway 17.

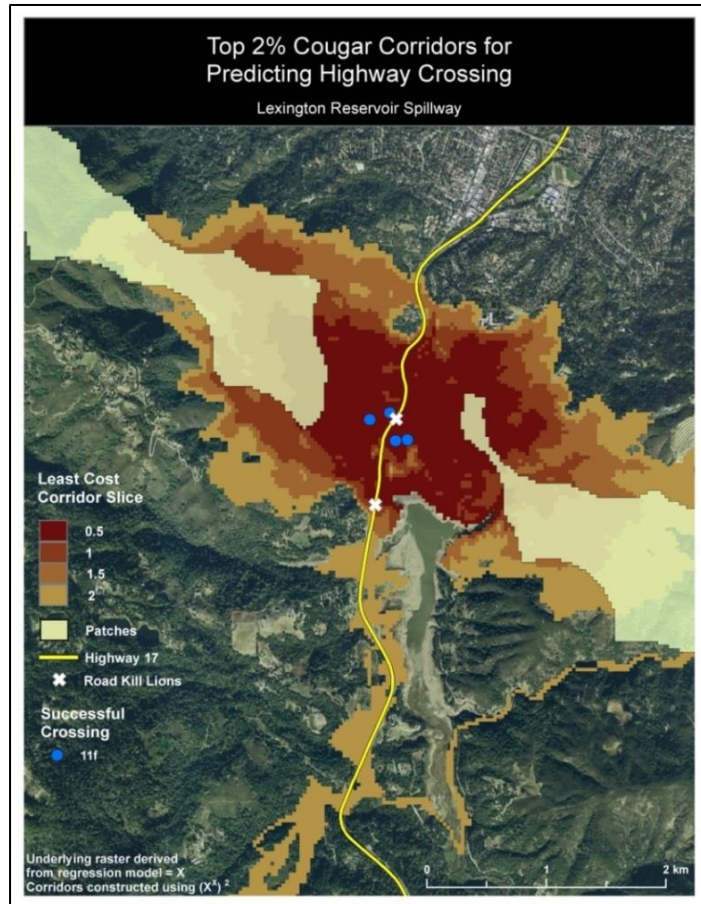


Figure 3: UCSC Puma Project Connectivity Model

4.2 Animal-Vehicle Collision Data

Caltrans contributed their animal vehicle collision data from 2005-2010, which was combined with data from weekly roadkill surveys conducted by Pathways for Wildlife.

4.3 Field Camera Surveys

Camera stations were set up at 4 culverts; 1) Trout Creek Culvert 2) Lexington Culvert 3) Ravine Culvert and 4) Aldercroft Culvert, with the objective to document wildlife

activity and passage/attempted passage through them (Figure 2).

5.0 Data Results

5.1 UCSC Puma Project Telemetry Data & Roadkill Survey Results.

In the last nine years, 14 mountain lions have been hit on the entire stretch of Highway 17, which includes Santa Clara and Santa Cruz Counties. Within Santa Clara County, 9 mountain lions have been hit (Table 1). Out of this total, 5 mountain lions have been hit within the study area, color coded as light blue (Table 1).

Date	Animal	Number	Location
2007	Mountain lion	1	Hwy 17 by the Cats Restaurant, southbound, near spillway to Lexington reservoir.
2009	Mountain lion	1	Found dead on northbound Hwy 17 near spillway to Lexington reservoir.
1/12/2010	Mountain lion	1	Hwy 17 by the Cats Restaurant, southbound.
8/29/2010	Mountain lion	1	Found in County Park away from highway and exhibited signs of being been hit by a car.
2/9/2011	Mountain lion	1	Hwy 17, hit by the Ravine Culvert..
10/1/2011	Mountain lion	1	Puma was hit at the intersection of Highway 17 & 85.
10/15/2011	Mountain lion	1	Hwy 17 by Summit Road.
8/28/2014	Mountain lion	1	By Redwood Estates-UCSC Puma Project-young male with ear tag.
12/23/2015	Mountain lion	1	Juvenile south of the Bear Creek exit at Hebard Road.
Total		9	

Table 1: Mountain lion Vehicle Collision Data for Hwy 17, Santa Clara County, 2007-2015.

Each year, there have been one or more mountain lion fatalities due to animal vehicle collisions. Contributed data from the UCSC Puma Project show that two different mountain lions, 11F and 26M, successfully crossed Highway 17. However, three mountain lions have been hit by vehicles where the two mountain lions had successfully crossed (Figure 4). **This data indicates locations in which mountain lions will most likely continue to try and cross Highway 17 (Wilmers pers. com 2013).**

Highway 17 UCSC Mountain lion Crossings & Roadkill Data (2000-2016)

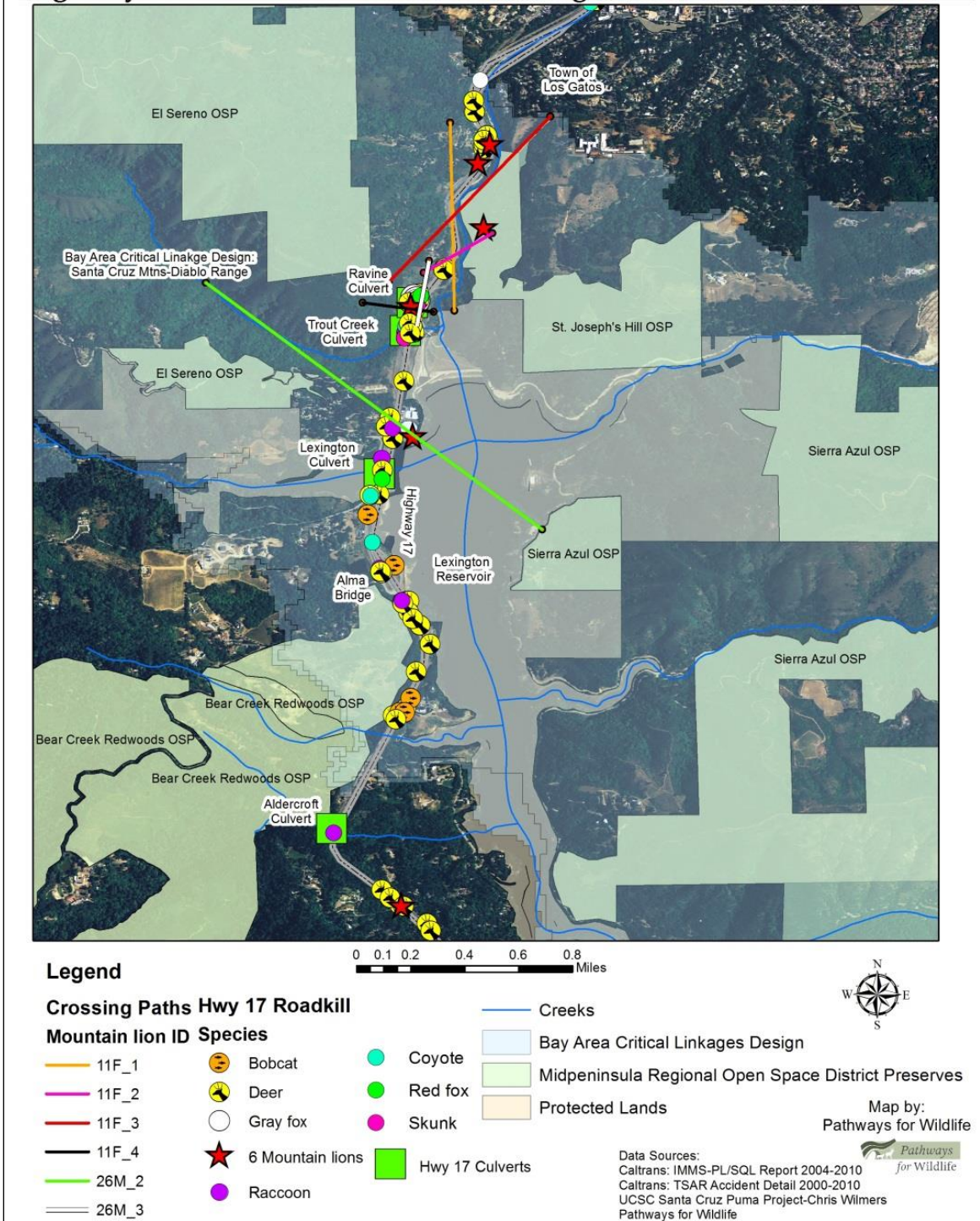


Figure 4: UCSC Puma Project Hwy 17 Mountain lion crossing and Roadkill Data Results.

5.2 Animal-Vehicle Collision Data Results

A total of 273 animals that have been recorded hit on Highway 17 in the past 10 years from the town of Los Gatos to the Summit within the study areas (Caltrans roadkill data 2000-2011, Pathways for Wildlife, Figure 5). The highest percentages of animals recorded hit by cars have been deer at 70% (Chart 1).

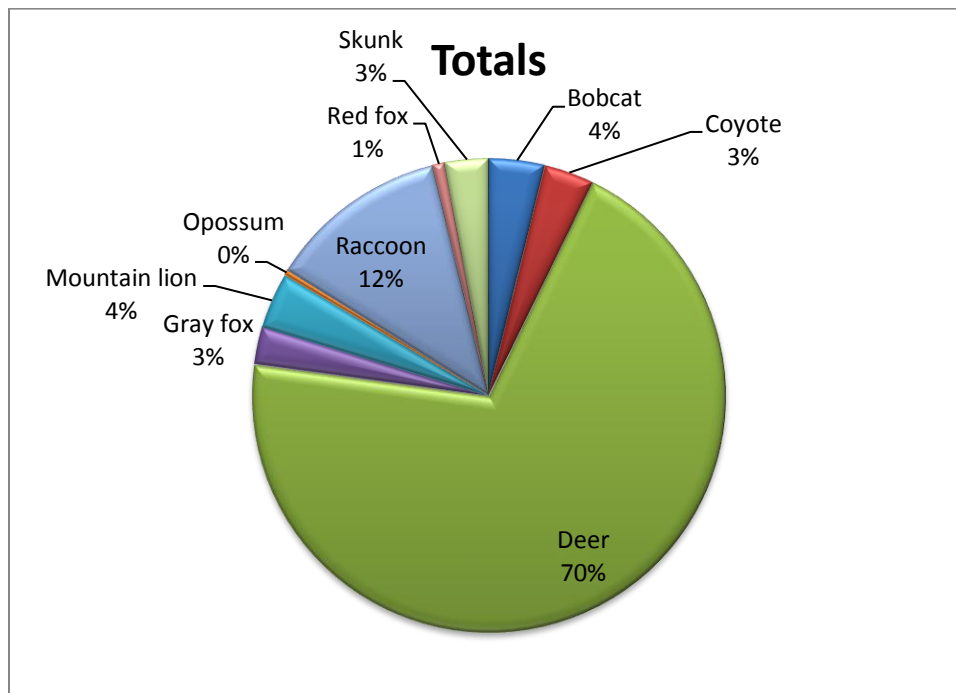


Chart 1: Animal Vehicle Collision Data by Species.

Within Santa Clara County, the majority of animals have been hit within the study area (Figure 5). A substantial number of these animals were hit at the ravine in which Trout Creek runs underneath Highway 17. This location is considered a **Hot Spot**, where animals are consistently being hit by vehicles.

Highway 17 Roadkill Data for Santa Clara County 2000-2016

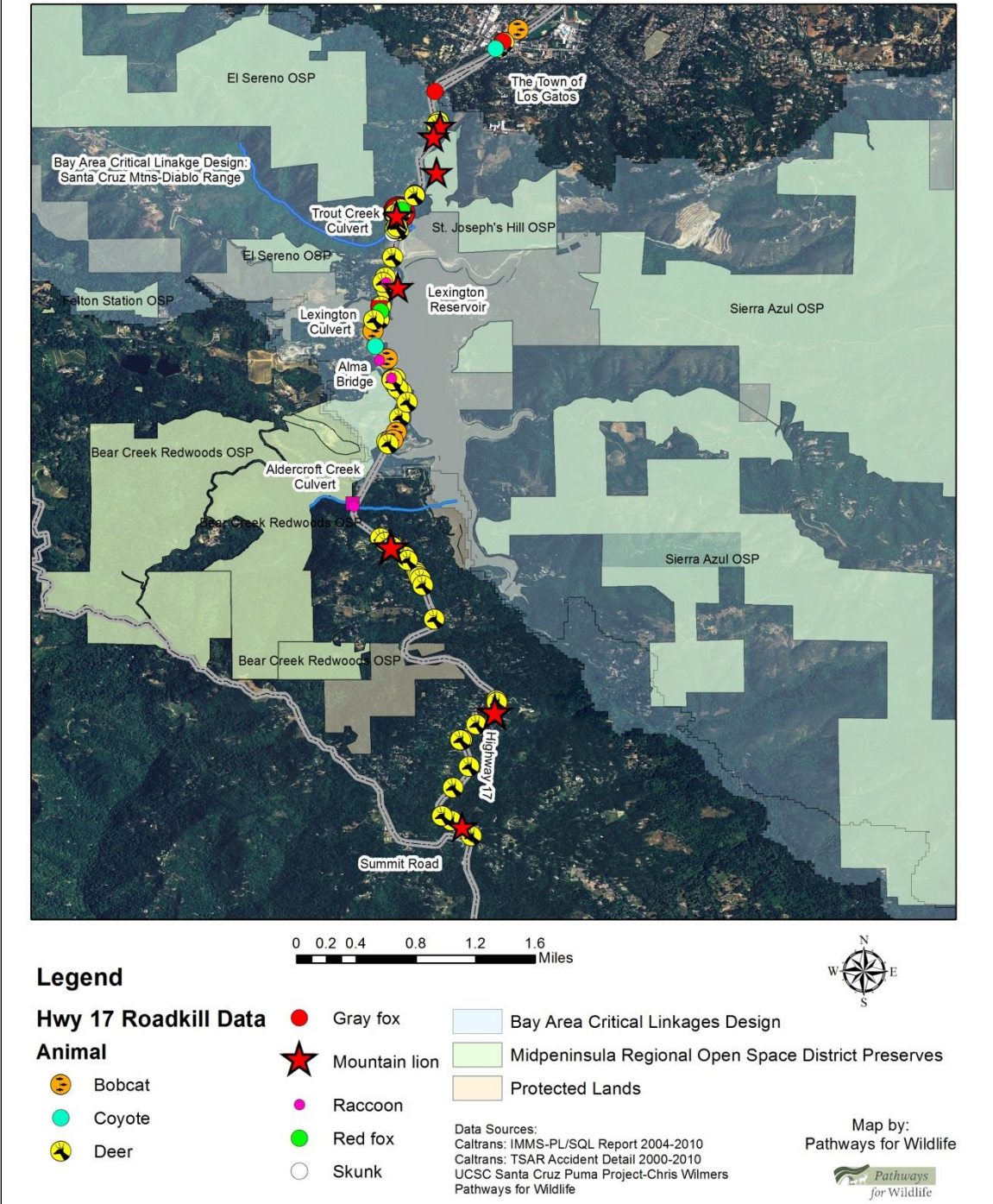


Figure 5: Figure 1: Hwy 17 Santa Clara County Roadkill Data: 2000-2016.

Within the study area, which spans from the town of Los Gatos to the Bear Creek Road exit at Alma Bridge, a total of 119 animals have been recorded hit by vehicles (Table 2). Of these, the highest percentage includes; deer (82) and bobcat (9) (Chart 2).

Animal	Totals	Juveniles
Bobcat	9	1
Coyote	5	
Deer	82	
Gray fox	5	
Mountain lion	5	
Raccoon	8	2
Red fox	2	
Skunk	3	
Total	119	2

Table 2: Total Number of Animals hit within the Study Area.

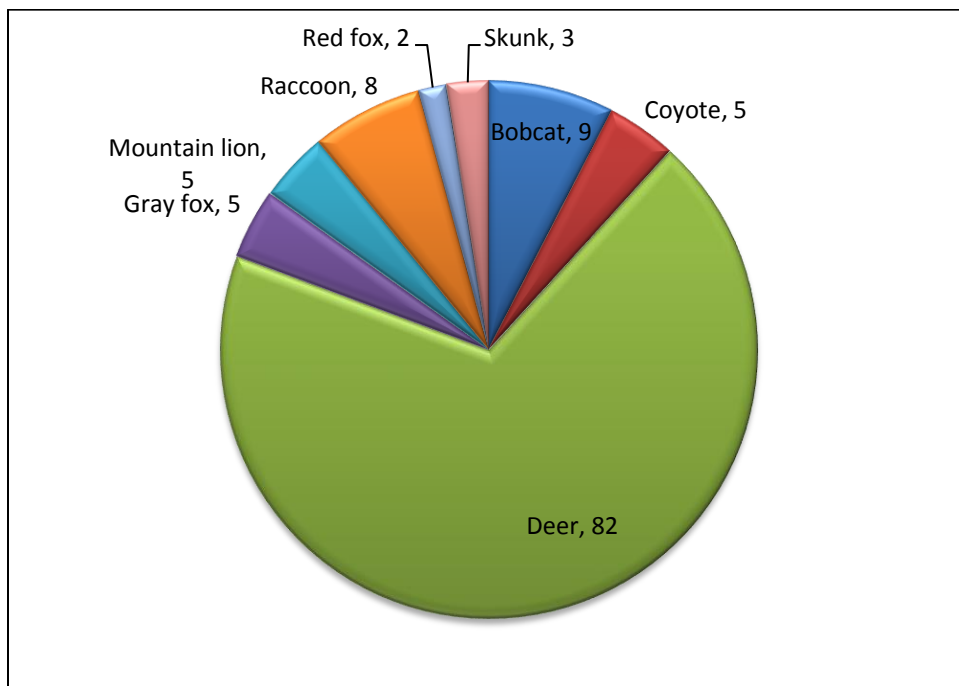


Chart 2: Animal Vehicle Collision Data within the Study Area.

Juveniles

Juveniles of all species have consistently been recorded hit on Highway 17 throughout the study during late fall and winter. For example a juvenile mountain lion was hit on 12-23-2015 (Figure 6), while a juvenile bobcat was hit on 9-28-2016 (Figure 7). These juveniles might have been dispersing out of their parental home range in attempting to establish their own. Of note, many of these juveniles, were hit on southbound lanes attempting to cross east towards the Sierra Azul Range.

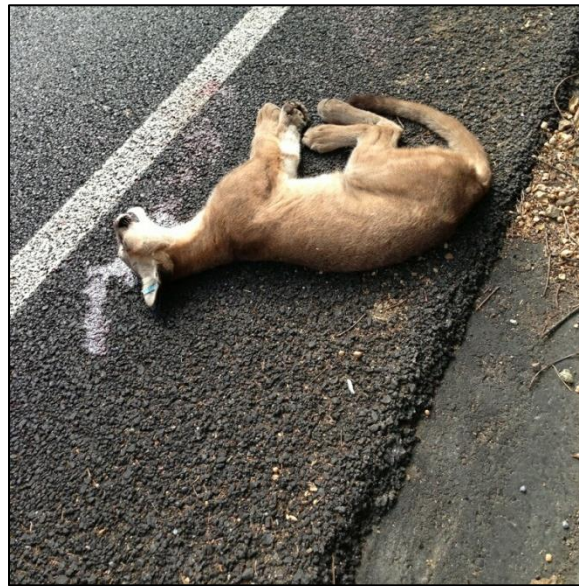


Figure 6: Juvenile mountain lion hit at Hebard Road, southbound, on 12-23-2015.



Figure 7: Juvenile bobcat hit at Trout Creek, southbound, on 9-28-2016.

Alma Bridge at the Bear Creek Road Exit

During the month of April 2016, there had been a substantial increase in the number of deer recorded hit by Alma Bridge on Highway 17 at the Bear Creek exit, southbound (Figures 8 & 9).



Figure 8: Deer hit on Highway 17 at the Bear Creek exit, southbound 4-11-2016.

On the west side of where the deer have been hit, is a ravine in which deer have often been observed grazing. On 4-27-2016, a male deer was recorded approaching Montevina Road, which runs parallel to Hwy 17 at the Bear Creek exit (Figure 10). Deer are walking up the ravine, across Montevina Road, and then onto the highway at this location.



Figure 9: Male deer hit on Highway 17 at the Bear Creek exit, southbound 4-26-2016.



Figure 10: Male deer walking towards Montevina Road by the Bear Creek exit at the Alma Bridge.

5.3 Camera Study Data Results

1. Camera Station Totals

A total of 3,030 animal detections have been recorded at the 6 camera stations; 1) Lexington Culvert northbound 2) Trout Creek Culvert Northbound 3) Trout Creek Culvert Southbound 4) Ravine Culvert Southbound 5) Aldercroft Northbound and 6) Aldercroft Southbound (Table 3).

The cameras with the highest amount of detections include; Lexington Culvert northbound with 1853 detections, Trout Creek Culvert northbound with 844 detections, and Aldercroft Southbound with 158 detections (Table 3 & Chart 3). **However, the detections of animals using the culverts to travel through highly varied, with only the Lexington culvert being used by animals to successfully cross under the highway.** Please see the sections on each culvert for more information.

The camera stations had a different number of monitoring months due to different camera set ups dates and camera malfunctions. The average detection per month was calculated to better compare the camera results. The camera station with the highest average detections per month was the Lexington Culvert northbound (51), the second highest is the Trout Creek Culvert northbound (23), and the third is Aldercroft Southbound (18) (Chart 4).

Camera Number	Camera Name	Camera Monitoring Period	Number of Monitoring Months	Total Number of Animals Detected	Average Detections per Month
1	Lexington Culvert Northbound	Nov 2013-Dec 2016	36	1853	51
2	Trout Creek Culvert Northbound	Nov 2013-Dec 2016	36	844	23
3	Trout Creek Culvert Southbound	Nov 2013-Dec 2016	36	95	3
4	Ravine Culvert Southbound	Nov 2013-August 2014	10	9	1
5	Aldercroft Northbound	Apr 2016-Dec 2016	9	71	8
6	Aldercroft Southbound	Apr 2016-Dec 2016	9	158	18
Grand Total				3030	

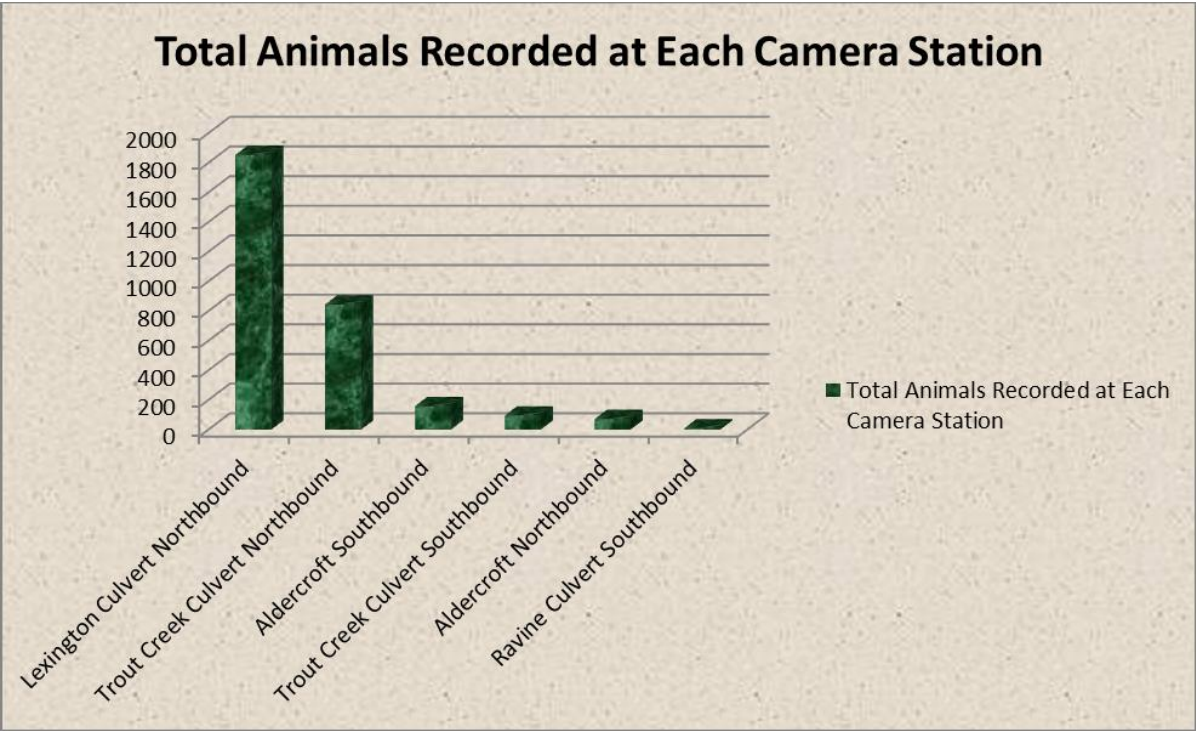


Chart 3: Total Animals Recorded at Each Camera Station.

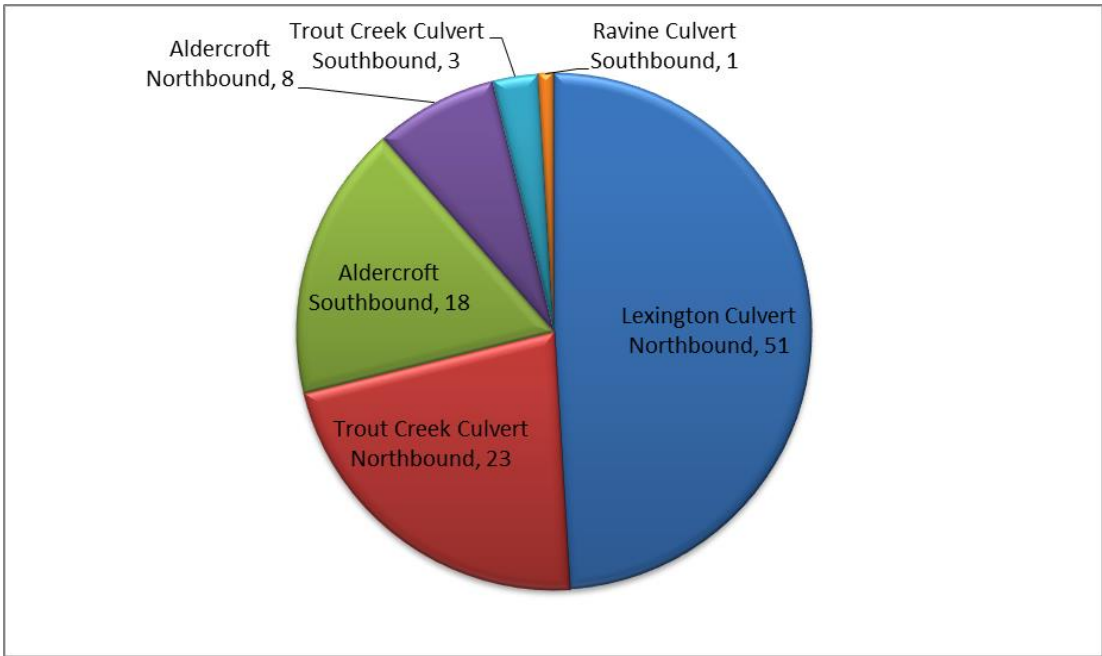


Chart 4: Average Detections per Month.

2. Species Totals

The species with the highest number and percentage of combined detections include; skunk (948), raccoon (743), gray fox (672), deer (464), and bobcat (109) (Table 4 & Charts 5 & 6). The high percentage of documented mesocarnivores is due to the high use of the Lexington culvert. Mesocarnivores, such as skunks, raccoons, gray fox, and bobcats were consistently traveling through the culvert each month. Please see the section on the Lexington Culvert for more information.

The majority of deer was recorded at the Trout Creek culvert on the northbound side, while a mountain lion was recorded approaching the Trout Creek Culvert on the southbound side. However, there were no records of large mammals traveling through the Trout Creek Culvert due to the culvert having very poor visibility through it. Please see the sections on the Trout Creek Culvert for more information.

Camera Name	Bobcat	Coyote	Deer	Gray fox	Mountain lion	Opossum	Raccoon	Red Fox	Skunk	Total Animals Recorded at Each Camera Station
Lexington Culvert Northbound	84	5	19	517		26	242	40	920	1853
Trout Creek Culvert Northbound	14		362	142		4	305		17	844
Trout Creek Culvert Southbound	3		9	3	1		79			95
Ravine Culvert Southbound	1		1	7						9
Aldercroft Northbound	3		63	2		2	1			71
Aldercroft Southbound	4	10	10	1		6	116		11	158
Total by Species	109	15	464	672	1	38	743	40	948	3030

Table 4: Total Number of Detections by Species.

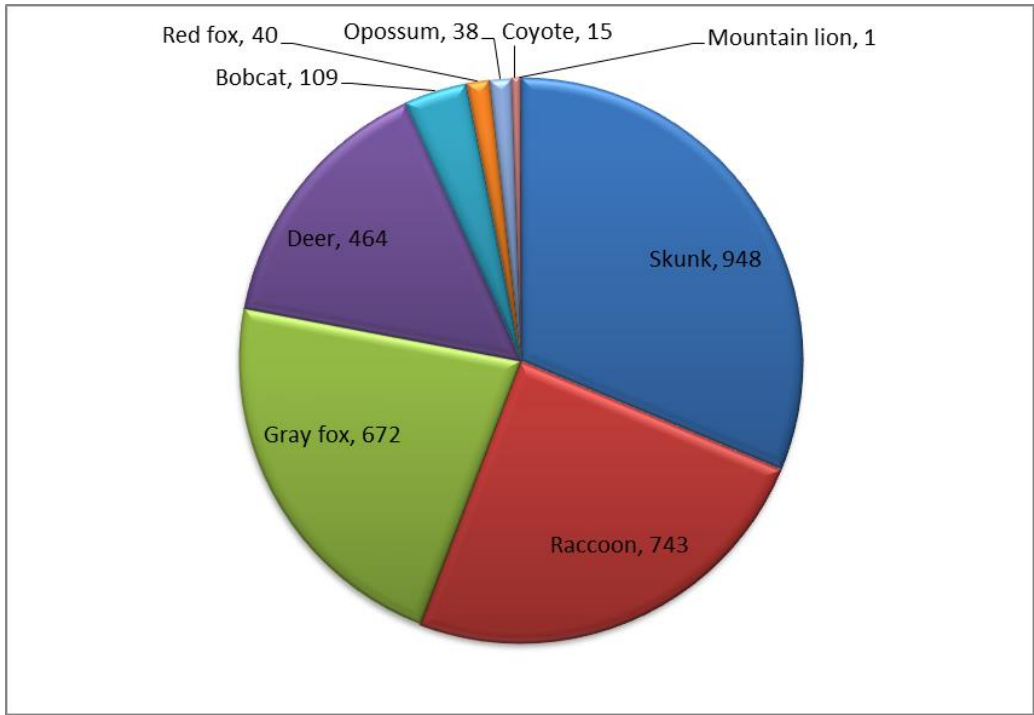


Chart 5: Percentage of Detections by Species.

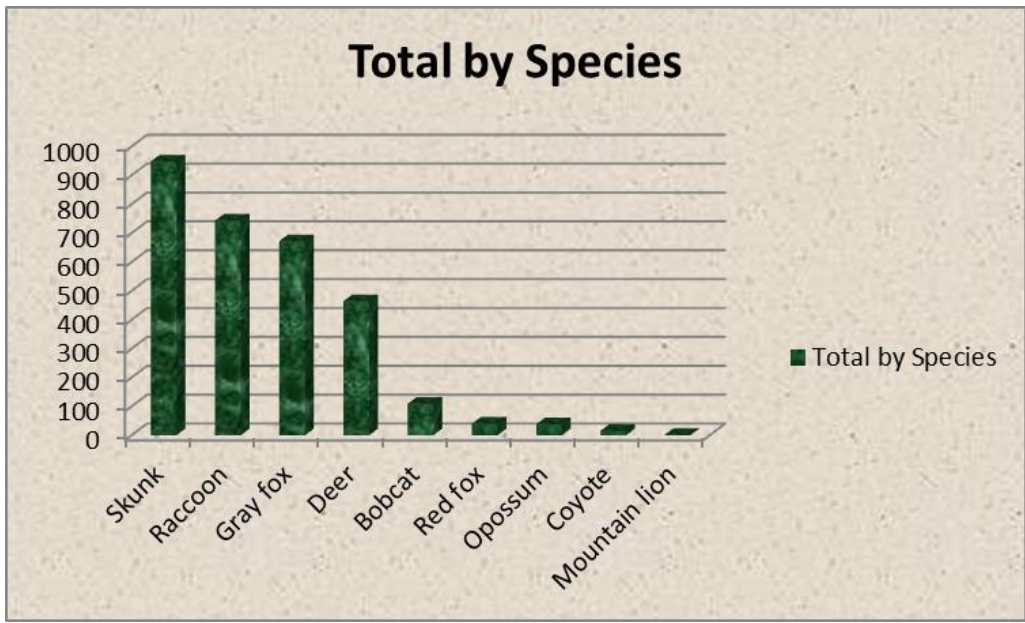


Chart 6: Percentage of Detections by Species.

5.4 Highway 17 Trout Creek Culvert

Throughout the study period, there have been very few animals documented traveling through this culvert, except for a family of raccoons. However, 626 animals have been recorded consistently and on a monthly basis, approaching the culvert, investigating it, and then turning away or traveling across the entrance of the culvert (Table 6 & Appendix A). On 9-15-2015, a mountain lion was recorded on the southbound, east, side of the culvert but did not travel through it.

The avoidance by animals in not using the culvert to travel through is most likely due to the lack of visibility through the culvert. Several studies have shown that there is a high preference of culvert use by animals if there is a clear line of visibility through it (Safe Passages, 2007).

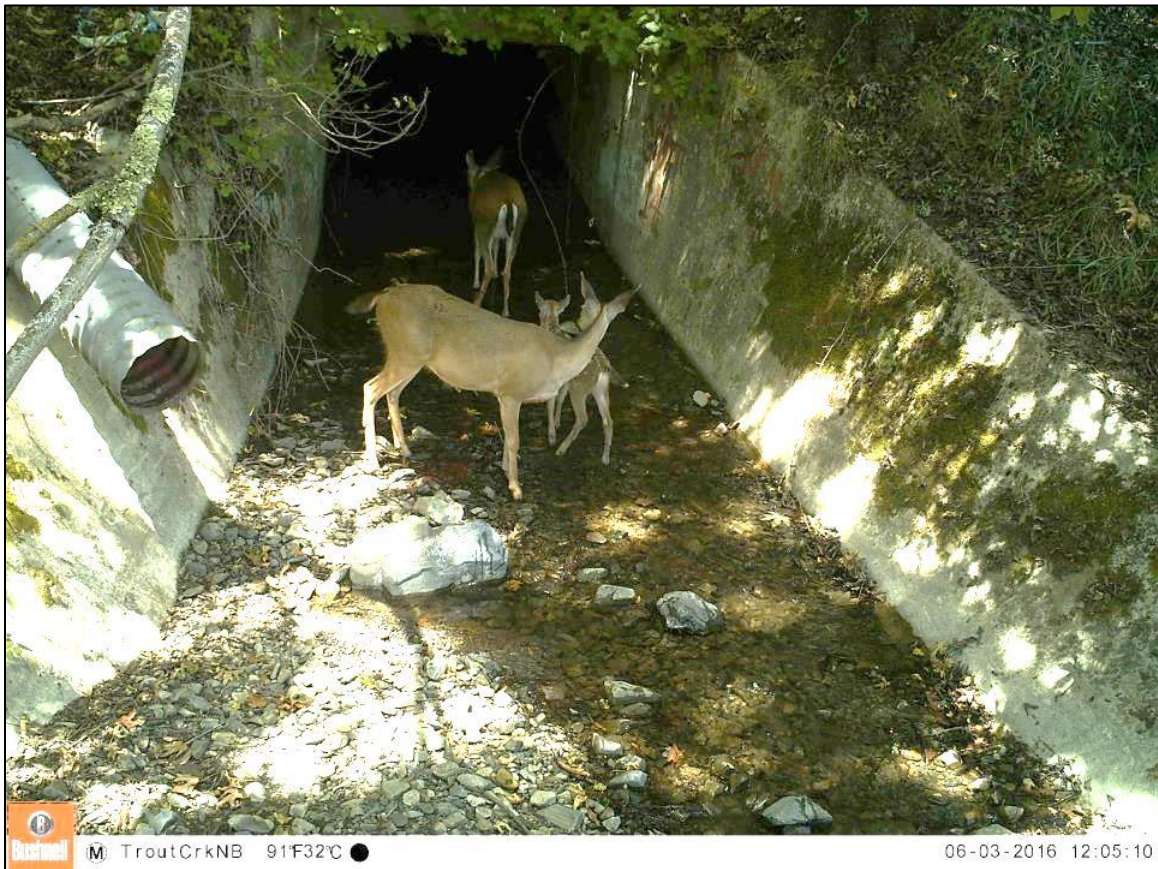


Figure 10: Deer at Trout Creek Culvert 4/2/2014.

The total number of detections recorded on the northbound side of the culvert is 844, while the total detections on the southbound side were 95 (Table 5). The species with the highest number and percentage of combined detections include; raccoon (384), deer (371), and gray fox (145) (Chart 7).

Species	Trout Creek Culvert Southbound Total 2013-2016	Trout Creek Culvert Northbound Total 2013-2016	Total by Species
Bobcat	3	14	17
Deer	9	362	371
Gray fox	3	142	145
Mountain lion	1	0	1
Opossum	0	4	4
Raccoon	79	305	384
Skunk	0	17	17
Total	95	844	939

Table 5: Trout Creek Culvert Data Results.

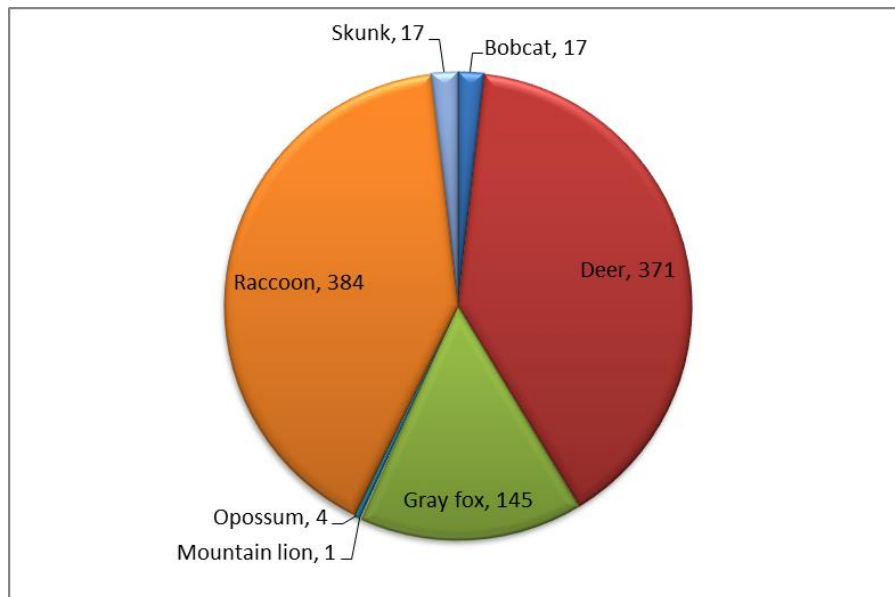


Chart 7: Detections by Species.

Site	Cross: Yes	Cross: No
Trout Creek Culvert Northbound	92	591
Trout Creek Culvert Southbound	42	35
Totals	134	626

Table 6: Trout Creek Culvert Data Results.

Camera 1. Trout Creek Northbound (east side)



Figure 11: Deer at Trout Creek Culvert 7/5/2014.

The total number of detections recorded on the northbound side of the culvert is 884. Since 2015, there have been an additional 338 detections (Table 7).

Species	Northbound Total 2013-2016	Northbound Total 2013-2015
Bobcat	14	13
Deer	362	191
Gray fox	142	66
Opossum	4	4
Raccoon	305	219
Skunk	17	13
Total	844	506

Table 7: Trout Creek Culvert Northbound Data Results.

In comparing the data collected from 2013-2015 to 2013-2016, there is a consistency in the species recorded along with the percentages of species visiting the culvert. The majority of species recorded is deer, raccoon, and gray fox in both the 2013-2015 to 2013-2016 data sets (Charts 8 & 9). **The majority of deer and gray fox consistently investigated the culvert, then turned back, and walked away from it (Figure 11 & Appendix A).**

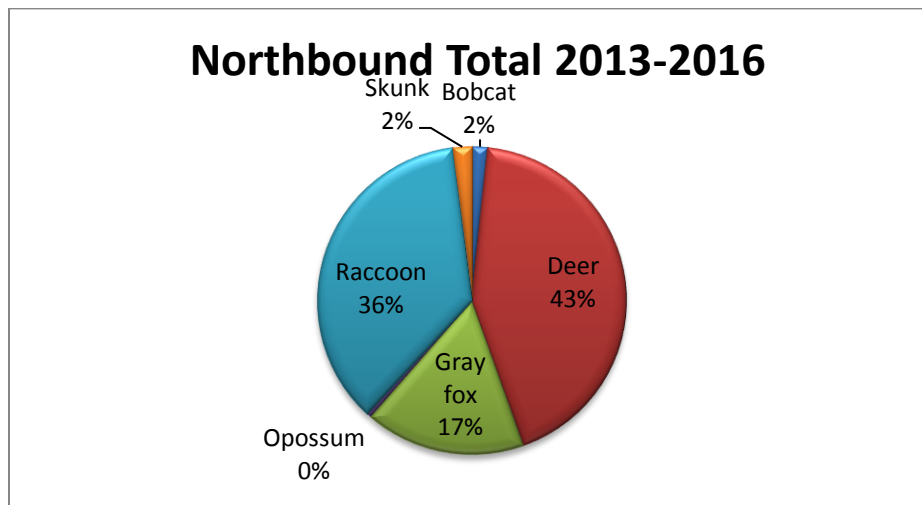


Chart 8: Percentage of Detections by Species.

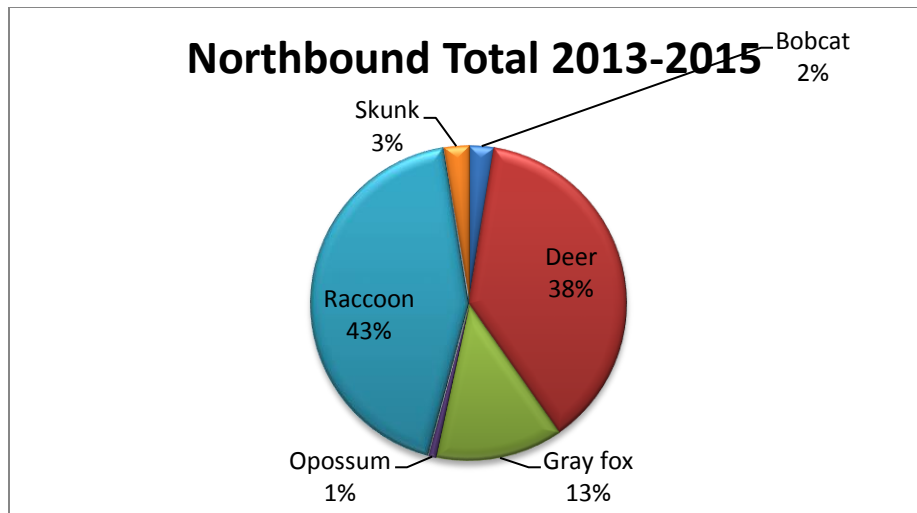


Chart 9: Percentage of Detections by Species.

Camera 2. Trout Creek Southbound (west side)

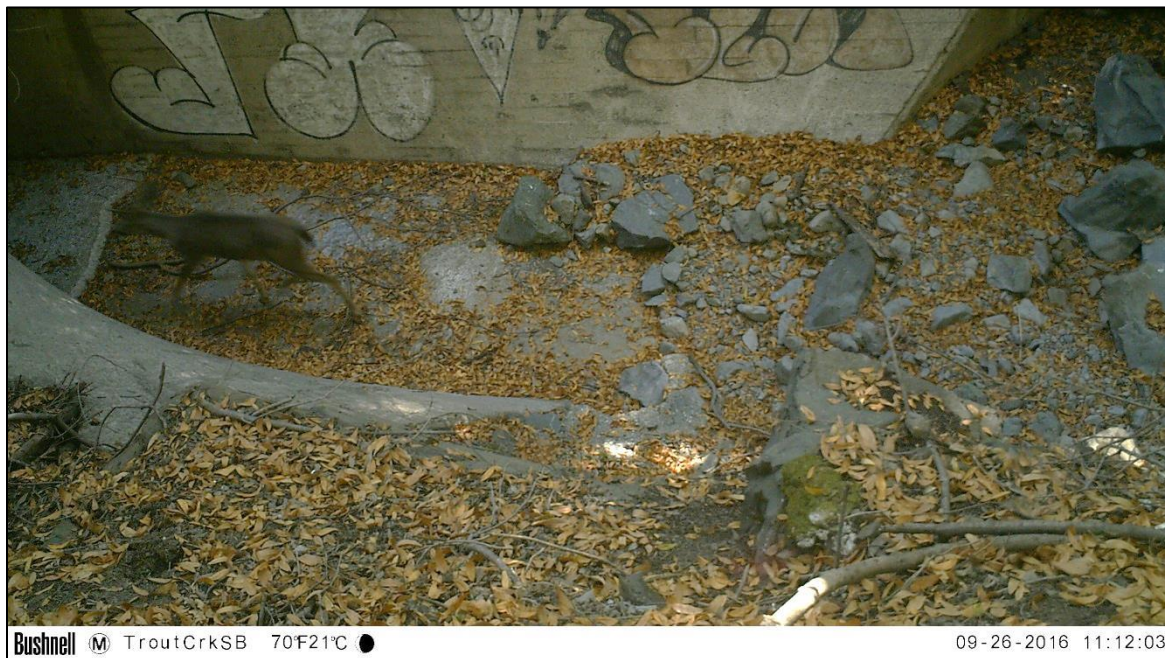


Figure 12: Deer at Trout Creek investigating the Culvert 9/26/2016 at 11:12:03.

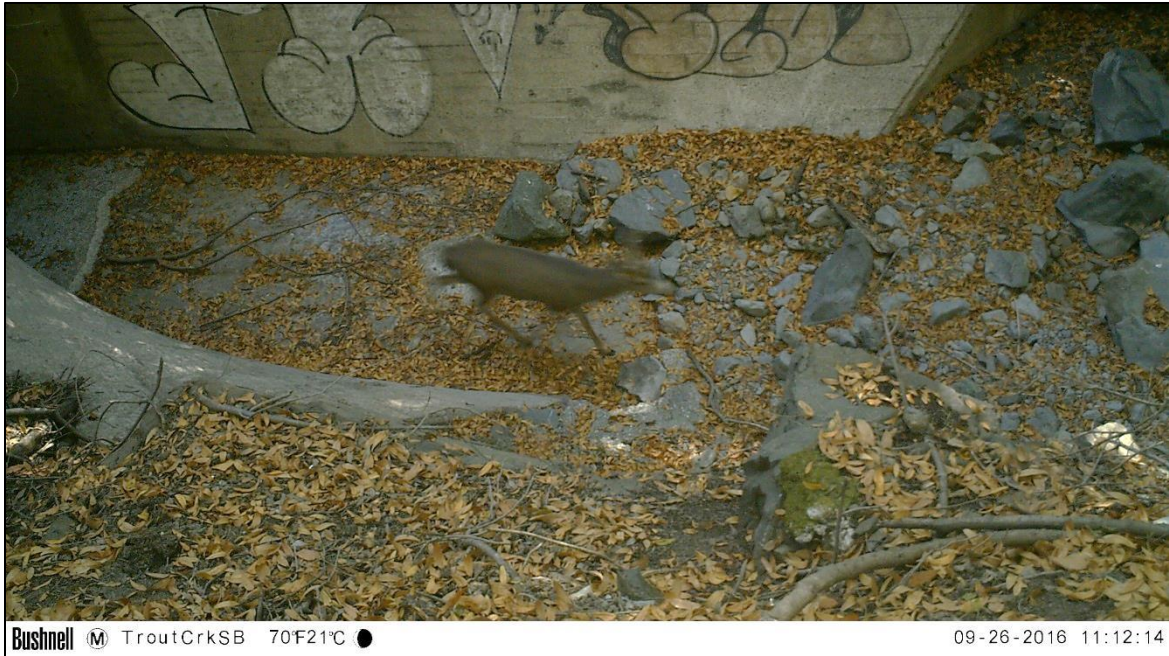


Figure 13: Deer at Trout Creek walking away from the Culvert 9/26/2016 at 11:12:14.

The total number of detections recorded on the southbound side of the culvert is 95. Since 2015, there have been an additional 78 detections (Table 8). This increase is due to a family of raccoons that was traveling through the culvert and foraging front of it in the creek (Table 8). As observed on the northbound side of the culvert, several deer walked into the culvert entrance and then walked back out of it (Figures 12 & 13).

Species	Southbound Total 2013-2016	Southbound Total 2013-2015
Bobcat	3	2
Deer	9	6
Gray fox	3	2
Mountain lion	1	1
Raccoon	79	6
Total	95	17

Table 8: Trout Creek Culvert Southbound Data Results.

In comparing the data collected from 2013-2015 to 2013-2016, there is a consistency in the species recorded along with the percentages of species visiting the culvert. The majority of species recorded is raccoon and deer in both the 2013-2015 to 2013-2016 data sets (Charts 10 & 11). This is also the same majority of species that have been recorded on the northbound, east, side of the culvert. Mesocarnivores such as bobcats and gray fox, have also been recorded on each side of the culvert. **Overall, there has been a high biodiversity of species recorded on both sides of the culvert (Tables 7 & 8).**

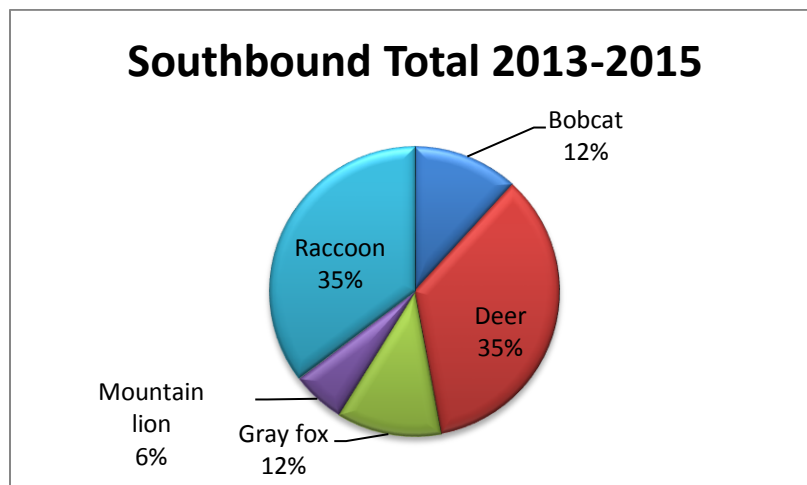


Chart 10: Percentage of Detections by Species.

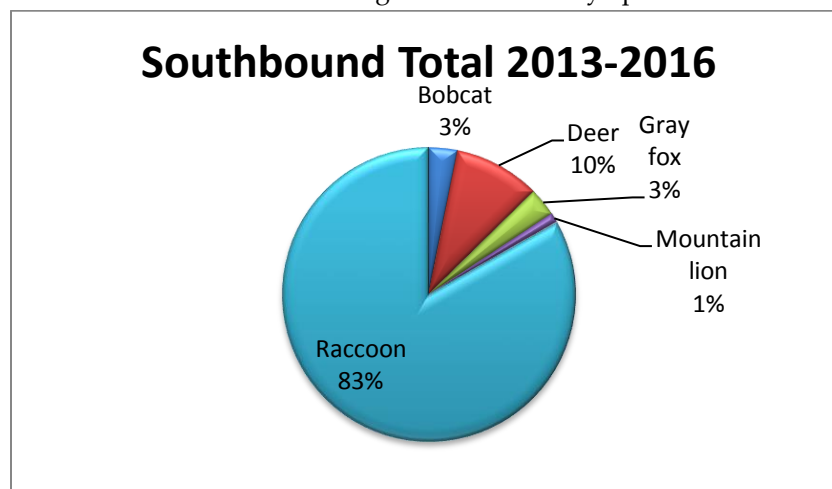


Chart 11: Percentage of Detections by Species.

Supplemental Camera B: Facing the Culvert

In May 2016, a second camera station was added to the Trout Creek Culvert southbound site on the west side of the highway, to gather information about what species of wildlife might be traveling around the vicinity of the culvert, along with how animals are accessing the culvert, and potential movement patterns. Multiple individuals of deer were recorded traveling in the habitat adjacent to the culvert entrance (Table 8, Figures 14-16).



Figure 14: Deer at Trout Creek Culvert 5/21/2016.

The total number of detections recorded on the camera side of the culvert is 51 (Table 8). The species with the highest number and percentage of detections include; deer (19) and raccoon (13) (Chart 12). Interestingly, there was a similar amount of detections of bobcat (8) and gray fox (8) (Table 8).

Species	Northbound Total May 2014 & May-Nov 2016
Bobcat	8
Deer	19
Gray fox	8
Opossum	3
Raccoon	13
Total	51

Table 8: Trout Creek Culvert Southbound Camera B Data Results.

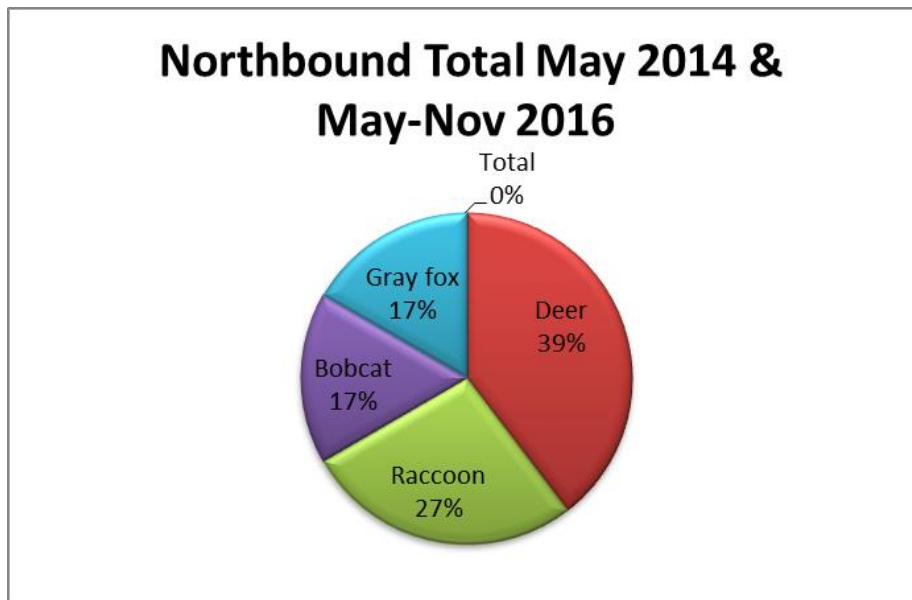


Chart 12: Percentage of Detections by Species.

In terms of routes animals are traveling along, it was found that deer are accessing the site from the service road that leads to the highway along the fence line that is down (Figures 15 & 16).



Figure 15: Deer walking up to Highway 17 from Trout Creek on 5-28-2016.

The camera also recorded several detections of two fawns traveling both in and out of the creek bed throughout the month via this route (Figure 16).



Figure 16: Fawns walking down from service road at Highway 17 to Trout Creek on 5-30-2016.

Unfortunately, on 6/4/2016 a fawn the size of the fawns recorded at the camera station,

was recorded hit at the median across from the service road that leads out to Highway 17 at Trout Creek (Figure 17). Due to the size and presence of the fawn hit, this could be one of the fawns detected at the camera station as we only recorded a single fawn traveling alone with its mother after 6/4/2016.

We hope this data may be useful for determining how 1) animals are accessing the culvert site, 2) locations for directional fencing and electromats to a potential future wildlife crossing, and 3) a better understanding of the roadkill hot spot at this location in terms of where animals are traveling to the Trout Creek Culvert site and accessing the highway.

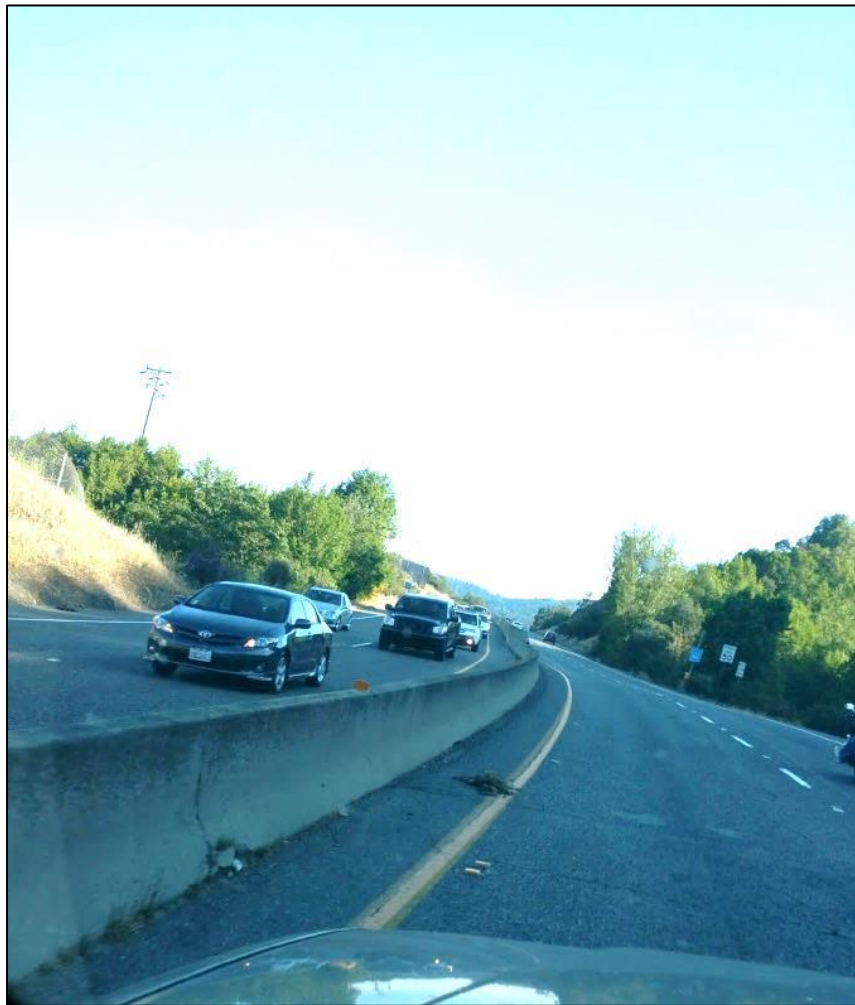


Figure 17: Fawn hit, southbound at the median, on Hwy 17.

5.5 Highway 17 Lexington Culvert



Figure 18: Two Gray fox using Lexington Culvert



Figure 19: Bobcat using Lexington Culvert



Figure 20: Red fox at Lexington Culvert



Figure 21: Deer investigating Lexington Culvert

A total of 1,298 animals have been recorded at the Lexington Culvert (Table 9). The majority of species detected were mesocarnivores, mid-sized animals, such as skunk (920), gray fox (517), raccoon (242) and bobcats (84) (Table 9). Nineteen deer approached the culvert but did not go through it (Figure 21). In comparing the data collected from 2013-2015 to 2013-2016, there is a consistency in the species recorded along with the percentages of species visiting the culvert. The majority of species recorded is skunk and gray fox in both the 2013-2015 to 2013-2016 data sets (Charts 13 & 14).

Species	Northbound Total 2013-2016	Northbound Total 2013-2015
Bobcat	84	76
Coyote	5	5
Deer	19	6
Gray fox	517	327
Opossum	26	18
Raccoon	242	204
Red fox	40	40
Skunk	920	622
Total	1853	1298

Table 9: Lexington Culvert Northbound Data Results.

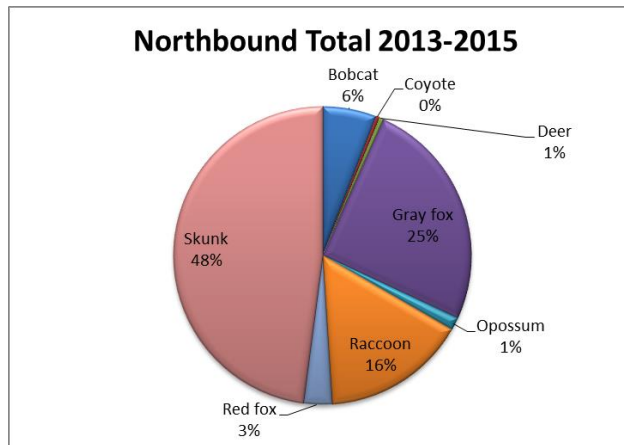


Chart 13: Percentage of Detections by Species.

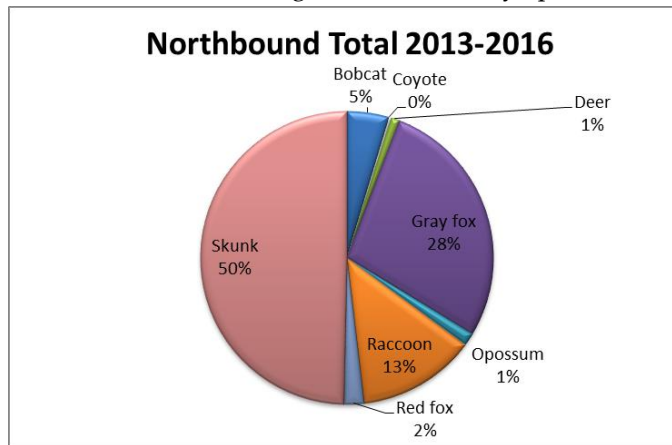


Chart 14: Percentage of Detections by Species.

5.6 Highway 17 Ravine Culvert



Figure 22: Ravine Culvert, southbound, west side.

The ravine culvert had the overall least detections (9) (Table 10). In each picture taken, the animal was recorded traveling along the highway and there were no records of animals investigating the culvert. Because of the hazardous conditions in the ability to access the culvert from the highway, this culvert was only monitored for a 10 month period. Throughout the monitoring period the detection rate of animals recorded per month was very low.

Animal	Southbound Detections
Bobcat	1
Deer	7
Gray fox	1
Total	9

Table 10: Ravine Culvert Southbound Data Results.

5.7 Aldercroft Creek Culvert

The Aldercroft Culvert located adjacent to the Midpeninsula Regional Open Space Bear Creek Redwood Preserve and runs west/east underneath Highway 17. This culvert was added to this study relatively recently. Aldercroft creek runs through the preserve, through the Aldercroft Culvert, and feeds into the Lexington Reservoir. The culvert is large enough for mammals such as deer and mountain lions to travel through it. The culvert dimensions are 11ft 1 inch high and the width is 11ft 7 inches wide (Figures 23 and 24). Two cameras were set up in April 2016 on both the west and east side of the culvert to document if animals are traveling through the culvert.



Figure 23: Hwy 17 Aldercroft Culvert: Southbound, west side on March 2016.



Figure 24: Hwy 17 Aldercroft Culvert: Northbound, east side on September 2016.

Throughout the study period, deer and coyotes, approached the culvert and investigated it, but have not yet been recorded traveling through the culvert (Figures 27-32). This could be due to a variety of factors; the existing pool of water on the east side (pictured above) or the culvert dimensions and structure. The culvert is long, 90 feet, and takes approximately three minutes to walk through and has a cement base. The pool of water never dissipated throughout the study period.

Aldercroft Northbound (east side)

A camera was set up on the east side of the culvert, in which there is a large pool of water at the mouth of the culvert due to water flowing from Aldercroft creek through the culvert. The camera station was at first set up at the base of the pool of water at the culvert to record if wildlife species might be walking through the water to the culvert. The camera was then set up on the entrance of the culvert, in which there were no detections of animals traveling through the culvert.

Within the first month of monitoring multiple species; deer, bobcat, and gray fox were

recording traveling along the banks of the pool of water (Figures 25 & 26). **Throughout the monitoring period, on a monthly basis, different deer individuals would walk into the base of the water pool, investigate the culvert but then walk away (Figures 27 & 28).**



Figure 25: Aldercroft Culvert Northbound: Bobcat on 7-31-2016.



Figure 26: Aldercroft Culvert Northbound: Gray fox on 4-26-2016.



Figure 27: Aldercroft Culvert: Northbound (east side) Deer heading towards the culvert on 9-3-2016.



Figure 28: Aldercroft Culvert: Northbound (east side) Deer walking away from the culvert on 9-3-2016.

The total amount of detections recorded was 71 (Table 11). The majority of species recorded was deer (63) (Table 11 and Chart 15).

Species	Northbound Totals 2016
Bobcat	3
Deer	63
Gray fox	2
Opossum	2
Raccoon	1
Total	71

Table 11: Aldercroft Culvert Northbound Data Results.

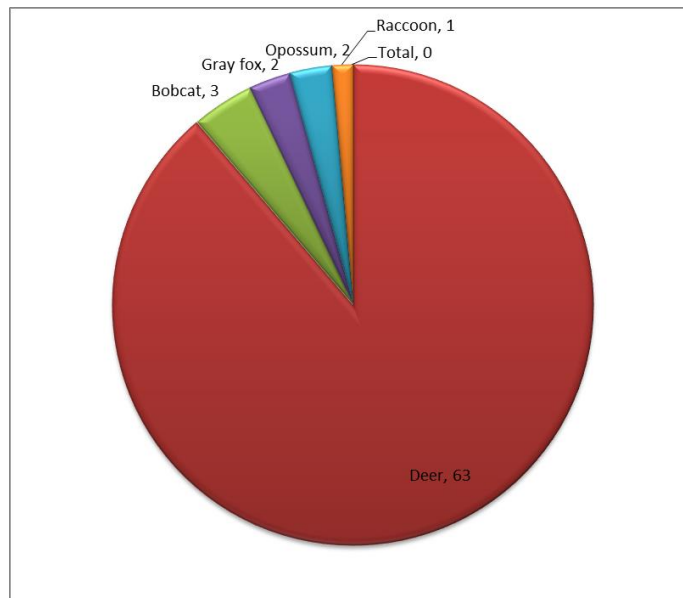


Chart 15: Detections by Species.

Aldercroft Southbound (west side)

On the west side of the culvert, southbound, there were several deer recorded investigating the culvert but then turning away as documented on the other side of the culvert (Figures 29 & 30). Throughout the monitoring period, multiple species were recording traveling adjacent to the entrance of the culvert such as; deer, bobcat, and coyote. **The majority of these species, would walk towards the culvert and then travel south up a trail, that begins from the entrance of the south side of the culvert, and runs adjacent to the highway (Figures 31 & 32).**



Figure 29: Aldercroft Culvert: Southbound (west side) Deer heading towards the culvert on 6-21-2016.



Figure 30: Aldercroft Culvert: Southbound (west side) Deer walking away from the culvert on 6-21-2016.



Figure 31: Aldercroft Culvert: Southbound (west side) Coyote walking towards the culvert on 9-24-2016.



Figure 32: Aldercroft Culvert: Southbound (west side) Coyote heading south at the culvert on 9-24-2016.

The total amount of detections recorded was 158. The majority of species recorded was raccoon (116), Skunk (11), deer (10), and coyote (10) (Table 12 and Chart 16). There was a raccoon family that would routinely foraging in the creek in front of the culvert entrance, which accounts for the high number of raccoon detections.

Species	Southbound Totals 2016
Bobcat	4
Coyote	10
Deer	10
Gray fox	1
Opossum	6
Raccoon	116
Skunk	11
Total	158

Table 12: Aldercroft Culvert Southbound Data Results.

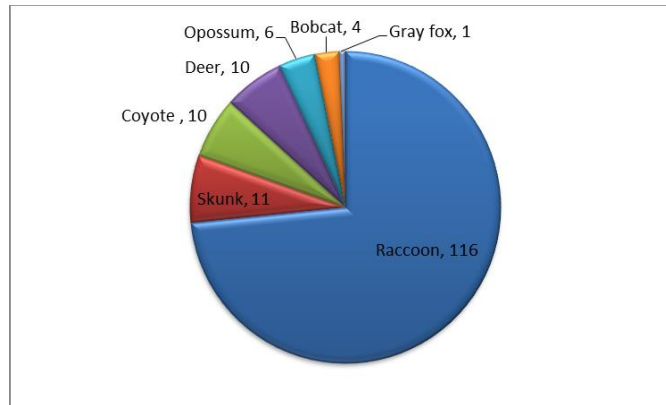


Chart 16: Detections by Species.

6.0 Wildlife Use of Crossing Structures

Out of the four culverts monitored, the majority of animals crossing through a culvert occurred at the Lexington Culvert with 1,425 successful crossings (Table 13 & Chart 17). At Trout Creek, all recorded crossings were by a family of raccoons, which had taken up residence by the culvert in 2016. There were no detections of animals crossing through the Ravine culvert and only 12 raccoons crossed into the Aldercroft Culvert.

Camera Name	Cross: Yes	Cross: No
Lexington Culvert Northbound	1425	323
Trout Creek Culvert Northbound	92	591
Trout Creek Culvert Southbound	42	35
Aldercroft Northbound		40
Aldercroft Southbound	12	84
Ravine Culvert		9
Total by Species	1571	1082

Table 13: Wildlife Use of Crossing Structures.

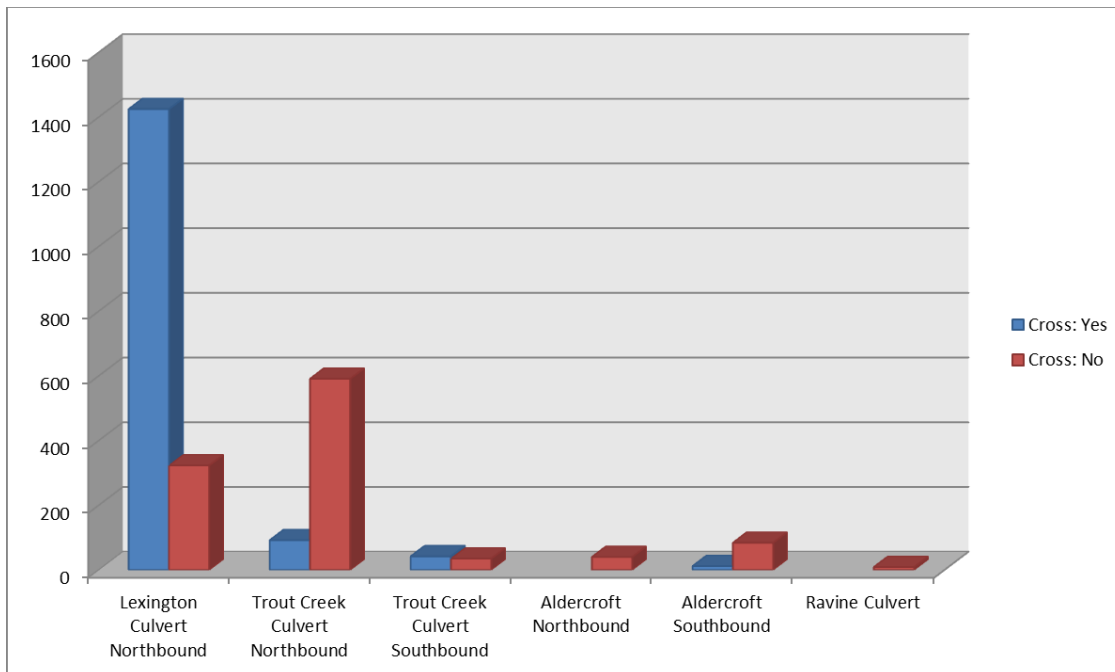


Chart 17: Wildlife Use of Crossing Structures.

7.0 Juvenile Detections

Having recorded juveniles traveling with their parents is significant in that it increases the conservation value of the habitat at these locations three fold in that the habitat is providing: 1) resources such as food and water; 2) breeding and natal den habitat; and 3) habitat for juveniles to disperse though to establish their own home range. **These three functions of the habitat indicate this is an important wildlife linkage** (Hilty *et al* 2006). Furthermore, there were juveniles recorded at four out of the six camera stations throughout the entire study area (Tables 14-17 & Chart 18).

1. Lexington Culvert

Species	Number of Juvenile Detections
Bobcat	2
Deer	3
Gray fox	4
Raccoon	7
Skunk	9
Total	25

Table 14: Juvenile Detections at the Lexington Culvert.

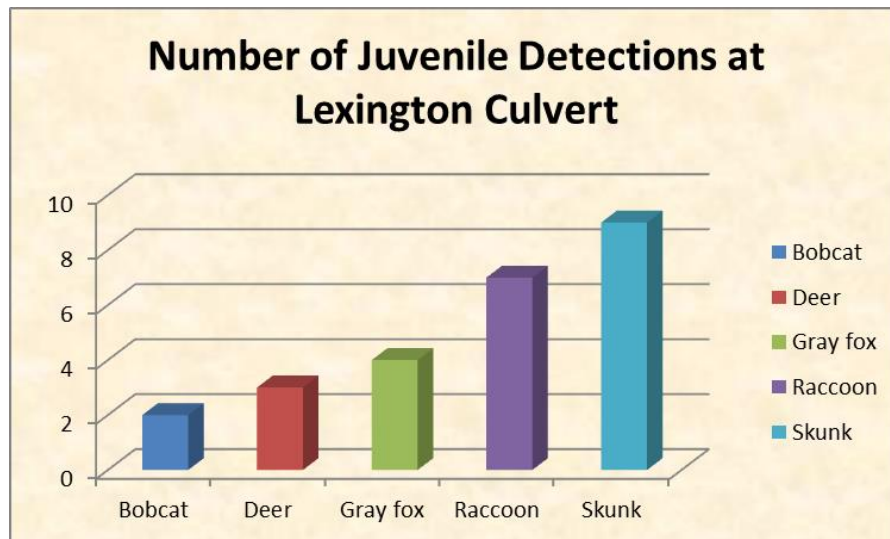


Chart 18: Juveniles at the Lexington Culvert.

2. Trout Creek Culvert Northbound

Species	Number of Juvenile Detections
Deer	113
Raccoon	27
Total	140

Table 15: Juvenile Detections at Trout Creek Northbound Culvert.

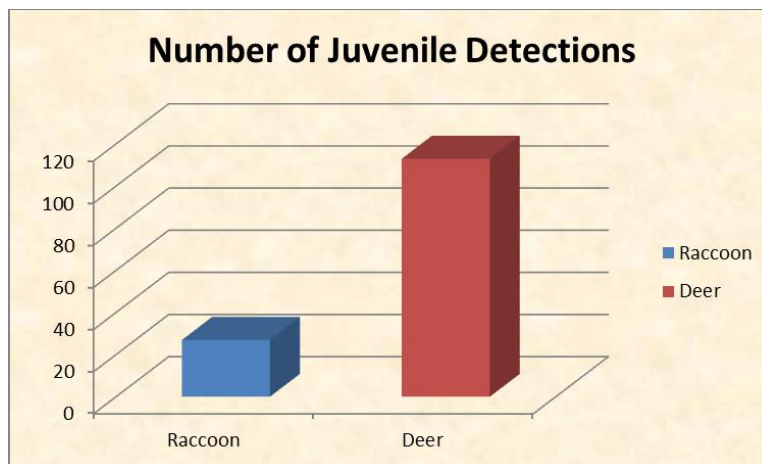


Chart 19: Juveniles at the Trout Creek Northbound Culvert.

3. Trout Creek Culvert Southbound

Species	Number of Juvenile Detections
Deer	7
Total	7

Table 16: Juvenile Detections at Trout Creek Southbound Culvert.

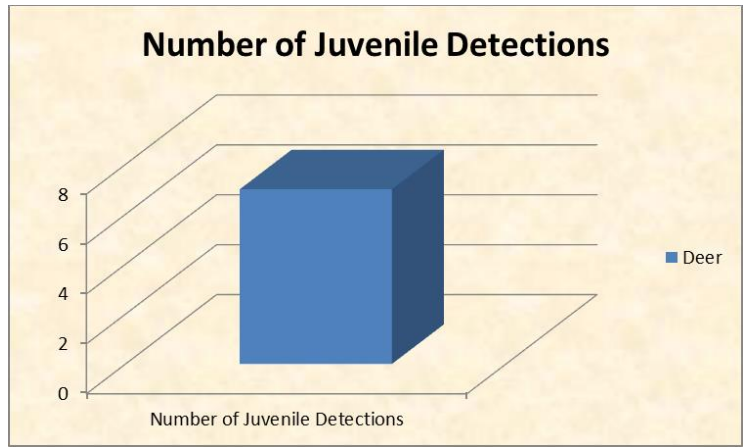


Chart 20: Juvenile Detections at Trout Creek Southbound Culvert.

4. Aldercroft Creek Culvert Northbound

Species	Number of Juvenile Detections
Deer	16
Opossum	2
Total	18

Table 17: Juvenile Detections at Aldercroft Culvert Northbound Culvert.

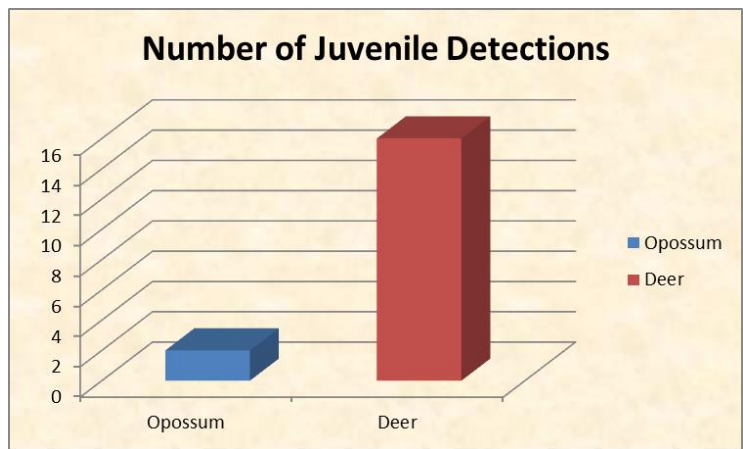


Chart 21: Juvenile Detections at Aldercroft Culvert Northbound Culvert.

8.0 Discussion & Recommendations

8.1 Summary & Trout Creek Culvert

Highway 17 currently lacks the appropriate culverts and bridges for animals to cross the highway, resulting in animals routinely being hit on the highway. **Based on the data collected by this project, the ravine in which Trout Creek runs underneath Highway 17 is the best location in which to install a wildlife crossing structure (Table 18).**

1) UCSC Puma Data	Two mountain lions have successfully crossed Highway 17 at or in the vicinity of the Trout Creek Ravine.
2) Mountain lion Roadkill Data & Radio Collar Data	Three mountain lions have been hit by vehicles where two mountain lions had successfully crossed at or in the vicinity of the Trout Creek Ravine.
3) Roadkill Data	There is a hot spot at Trout Creek, in which the majority of animals are being hit. There is a high biodiversity of wildlife that have been hit at the hot spot.
4) Camera Data at Trout Creek	Deer, bobcats, gray fox, and raccoons consistently approach the Trout Creek Culvert, investigate it, but did not travel through it. There is a high biodiversity of wildlife on both sides of the culvert.
5) Camera Data at Aldercroft Culvert	Deer and coyotes consistently approach the Aldercroft Culvert, investigate it, but did not travel through it. There is a high biodiversity of wildlife on both sides of the culvert.

Table 18: Summary of Data Results & Findings.

There is an existing culvert at Trout Creek, however, the camera data has documented that animals consistently approach the culvert but do not travel through it (Table 5). This is most likely due to poor visibility through it. Animals tend to need to be able to have a clear line of visibility through a culvert to be willing to travel through it (Safe Passages 2007).

The Lexington Reservoir culvert is a large 10' by 10' round culvert with a clear line of visibility through it. **However, the only documented species that have been using the culvert are medium sized animals, such as gray fox, red fox, and bobcats** (Table 9). Very few large animals such as deer have been recorded at the camera station and there have been no documented mountain lions approaching the culvert. This could be due to the length of the culvert which is 127 feet and spans 6 lanes of traffic.

Also, the habitat on the west side of the culvert has very little cover in terms of a tree line leading from the ravine to the culvert, resulting in a large open area. Mountain lions tend to travel along high vegetation cover and tree lines, which is lacking at the west side of the culvert (Dickson et al. 2005). However, the Trout Creek culvert has suitable vegetative cover on either side for mountain lions to navigate and travel along.

The roadkill data analysis has documented a hot spot at the Trout Creek Culvert in which animals are routinely being hit by vehicles on the highway. This could be due to animals attempting to cross the highway to access water at the Lexington Reservoir, juveniles dispersing out of their parental range, or animals traveling to find mates.

8.2 Maintenance of Vegetation at Culverts

In the month of September 2015, the vegetation in front of the west side of the Lexington Culvert had become overgrown, blocking visibility through the culvert (Figure 33). This resulted in a significant decrease of passages through the culvert by wildlife species such as; bobcat, gray fox, skunk, and raccoon, that were typically traveling through the culvert on a consistent monthly basis. Pathways for Wildlife cleared the overgrown vegetation in front of the culvert (Figure 34). After several weeks

from when the vegetation was cleared, wildlife that had been regularly using the culvert to travel through, returned and were using the culvert again. **This helps make the case for the importance of having clear visibility and line of sight through culverts for facilitating wildlife movement through them.**

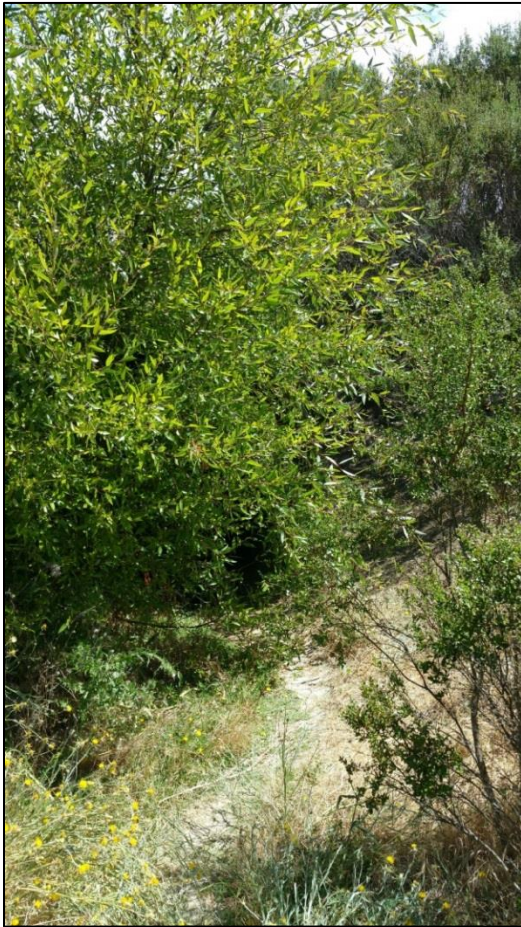


Figure 32: Vegetation Overgrown in front of Culvert.



Figure 33: Vegetation Clearance.

8.3 Aldercroft Culvert

Deer and coyotes consistently approached the Aldercroft Creek Culvert, investigated it, but did not travel through it (Figures 27-32). However, there is a high biodiversity of wildlife on both sides of the culvert (Tables 11 & 12). On the west side of the culvert, it was documented that animals would approach the entrance of the culvert but then traveled up a trail heading south, which runs adjacent to the highway (Figure 32).

On the east side of the culvert, there is a large pool of water, which was consistently full throughout the summer months. Deer would often walk into the pool of water, looking at the culvert, but then walk away from it (Figures 27 & 28). The pool of water is deep at the mouth of the culvert, approximately 5-6 feet, which might be acting as a barrier for wildlife movement through the culvert, especially for species of mesocarnivores. **Recommendations include, managing the pool of water by including drainage improvements so that animals can access the culvert. Other improvements could include creating banks for animals to walk along to access the culvert. Lastly, adding in directional fencing on both sides of the culvert to guide animals to the culvert would be highly beneficial in keeping wildlife off the highway and possibly increasing animals using the culvert to cross through it.**

8.4 Medians

Medians, which have been installed to prevent head-on collisions between vehicles, also pose a problem for wildlife that have been attempting to cross the highway. Medians are a barrier to wildlife movement across roads as animals tend to become trapped at the median wall and have a high probability of becoming hit by a vehicle (Figures 35 & 36). **These medians increase the need for a wildlife crossing to make the highway permeable for wildlife movement by installing safe passages for them to travel across the road (Safe Passages, 2010).**

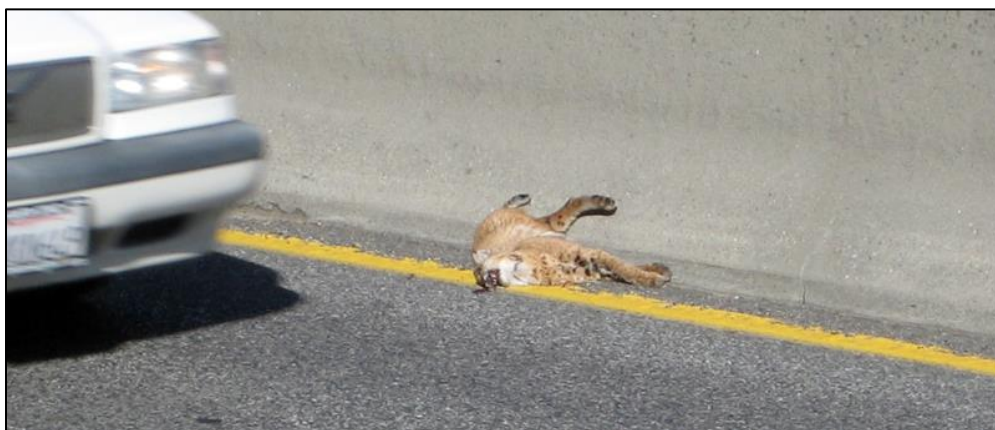


Figure 35: Bobcat hit on Highway 17 on 7-19-2010.



Figure 36: Deer hit on Highway 17 on 5-4-2010.

8.5 Installing a Wildlife Crossing Structure as a Solution

The scientific literature and various case studies have shown that a 10'h by 20'w box culvert was used in many locations throughout North America by large mammals, such as deer and mountain lions, to cross underneath various highways (Safe Passages, 2010). In Florida, large 8'h by 25'w box culverts were used successfully as highway crossings structures for panthers and black bears. The cost of box culverts is modest compared to open-span bridges, bridge extensions, or wildlife overpasses (Safe Passage, 2007).

In the Bay Area, through several studies, deer have been documented to consistently travel through box culverts at Hwy 68 in Salinas, Monterey, and Hwy 116 in Sonoma (SR68 Wildlife Connectivity Study and Sonoma Land Trust Wildlife Connectivity Study) (Figure 37). Mountain lions have also been documented to travel through culverts in San Luis Obispo at Hwy 101 Cuesta Grade (Caltrans District 5, Nancy Siepel) (Figure 38).



Figure 37: Deer traveling through Hwy 68 Box Culvert.



Figure 38: Mountain lion traveling through a Hwy 101 culvert at Cuesta Grade, San Luis Obispo, photo courtesy of Nancy Siepel, Caltrans District 5.

There have also been studies showing successful use of land bridges by large mammals in crossing over highways (Gloyne & Clevenger (2001). Land bridges extend from existing habitat on one side of the highway to the other and are vegetated so that animals perceive the extension of the bridge as part of the landscape they are walking on (Figures 39 & 40).



Figure 39: I-90 Landscaped wildlife bridge-Washington State Transportation Dept.



Figure 40: Land Bridge Visual Design: <http://www.sonorandesert.org>.

Directional fencing would also be used on either side of the highway to prevent animals from crossing on top of the roadway and to funnel animals into the crossing. The inclusion of a wildlife crossing structure along Highway 17 would greatly increase the safety of drivers as well as wildlife (Safe Passages 2010, Beier 1995).

The importance for providing habitat connectivity for wildlife are three fold: **1)** Animals need to be able to access resources such as water and food **2)** Juveniles need to have the ability to travel through the landscape to establish their own home range and **3)** To maintain genetically healthy populations, animals must be able to find viable mates.

The installation of a 13'h x 23'w (or larger) undercrossing or appropriately sized overcrossing with directional fencing to guide animals to the crossing structure would greatly enhance the ability for wildlife to safely cross under Highway 17 and provide a permanent solution for preventing animal-vehicle collisions at this location (Clevenger and Huijser 2011). This win-win solution would also help maintain healthy animal populations by increasing the ability for genetic flow to occur between populations.

9.0 Next Steps: Feasibility Design for Constructing a Wildlife Undercrossing.

Midpeninsula Regional Open Space District has made significant conservation investments on both sides of Highway 17 in creating a linkage of connected habitats from the Santa Cruz Mountains to the Sierra Azul. In February 2016, Midpeninsula Regional Open Space District awarded a contract to a highly qualified consulting team of wildlife connectivity experts, engineers, and landscape architects to conduct a conceptual design and feasibility study for new wildlife crossing structures or retrofit of existing structures from the Town of Los Gatos to the Bear Creek Road overcrossing on Highway 17 in Santa Clara County, California. The target species for this wildlife crossing are mountain lion (*Puma concolor*) and deer (*Odocoileus hemionus*).

To be included in this effort is the conceptual design of a multi-use (pedestrian, equestrian, cyclist, and dog accessible) Bay Area Ridge Trail crossing to improve public access in the South Bay Foothills. The consulting team will produce a creative design

solution to meet project goals and protect natural resources.

9.1 Project Costs

The cost of the crossing structure will be determined during the Feasibility Design phase, which will include environmental documents, technical studies, engineering designs, and permits costs. Directional fencing, to guide animals to the crossing, would also need to be installed as part of the connectivity design. Regular inspection and maintenance is a critical part of fence function and should be considered as part of the cost.

10.0 Acknowledgments

We would like to thank Midpeninsula Regional Open Space District (MROSD) and Peninsula Open Space Trust (POST) for funding and supporting this study.

We would also like to thank Nancy Siepel, at Caltrans District 5, for her work as a senior scientific advisor and project partner. We would also like to thank Don Rocha at Santa Clara County Parks for facilitating permits to conduct wildlife surveys on their properties and for their support of the project.

Lastly, we would like to thank Chris Wilmers and his team at the UCSC Santa Cruz Puma Project for their great data contributions, consulting on the project results, and feedback on the reports.



11.0 Literature Cited

2016 Highway 17 Wildlife Passage Structures and Bay Area Ridge Trail Crossing: Conceptual Design and Feasibility Study: Preliminary Alternatives Report, June 2016 prepared by Trail People.

Beier, P. (1993). Determining minimum habitat areas and habitat corridors for cougars. *Conservation Biology*, 7(1), 94-108.

Beier, P. (1995). Dispersal of juvenile cougars in fragmented habitat. *The Journal of Wildlife Management*, 228-237.

CA Central Coast Connectivity Project Report 2008-2012, prepared by Pathways for Wildlife.

CA Central Coast Connectivity Project Annual Report 2013-2014, prepared by Pathways for Wildlife.

Clevenger, A.P., M.P. Huijser. 2011. Wildlife Crossing Structure Handbook, Design and Evaluation in North America, Publication No. FHWA-CFL/TD-11-003. Department of Transportation, Federal Highway Administration, Washington D.C. USA.

Critical Linkages: Bay Area & Beyond. Penrod, K., P.E. Garding, C. Paulman, P. Beier, S. Weiss, N. Schaefer, R. Branciforte and K. Gaffney. Produced by Science & Collaboration for Connected Wildlands, Fair Oaks, CA in collaboration with the Bay Area Open Space Council's Conservation Lands Network (2013).

Dickson, Brett G., Jeffrey S. Jenness, and Paul Beier. "Influence of vegetation, topography, and roads on cougar movement in southern California." *Journal of wildlife Management* 69.1 (2005): 264-276.

Forman, R. T. (2010). *Safe passages: highways, wildlife, and habitat connectivity*. J. P. Beckmann, A. P. Clevenger, M. Huijser, & J. A. Hilty (Eds.). Island Press.

Foster, M. L., & Humphrey, S. R. (1995). Use of highway underpasses by Florida

panthers and other wildlife. *Wildlife Society Bulletin*, 95-100.

Gehrt, Stanley D., Seth PD Riley, and Brian L. Cypher. *Urban carnivores: ecology, conflict, and conservation*. JHU Press, 2010.

Gloyne, C. C., & Clevenger, A. P. (2001). Cougar Puma concolor use of wildlife crossing structures on the Trans-Canada highway in Banff National Park, Alberta. *Wildlife Biology*, 7(2), 117-124.

Highway 17 Mountain lion Crossings & Culvert Overlay Analysis. August 2013. Prepared for the Land Trust of Santa Cruz County by Pathways for Wildlife in collaboration with the UC Santa Cruz Puma Project.

Hilty, J. A., Lidicker Jr, W. Z., & Merenlender, A. (2006). *Corridor ecology: the science and practice of linking landscapes for biodiversity conservation*. Island Press.

Safe Passages: A User's Guide to Developing Effective Highway Crossings for Carnivores and Other Wildlife. (2007). Prepared by Bill Ruediger and Monique DiGiorgio, Southern Rockies Ecosystem Project.

The Nature Conservancy's Pajaro Study (2012-2013), prepared by Pathways for Wildlife.

U.S. Department of Transportation Federal Highway Administration 2013, Highway Safety Improvement Program Statistics, retrieved from <http://safety.fhwa.dot.gov/>

Wilmers, C. C., Wang, Y., Nickel, B., Houghtaling, P., Shakeri, Y., Allen, M. L., & Williams, T. (2013). Scale dependent behavioral responses to human development by a large predator, the puma.

Wilmers, C. 2014, Santa Cruz Puma Project website, retrieved from <http://santacruzpumas.org/>

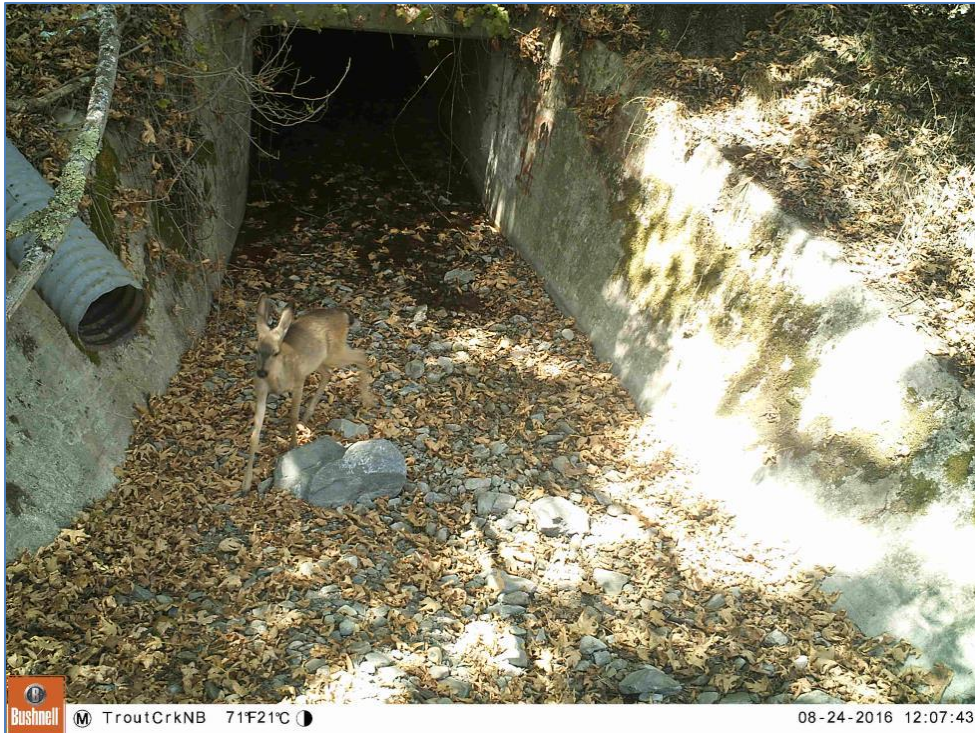
12.0 Appendix: Camera Data

Camera 1. Trout Creek Northbound (east side)

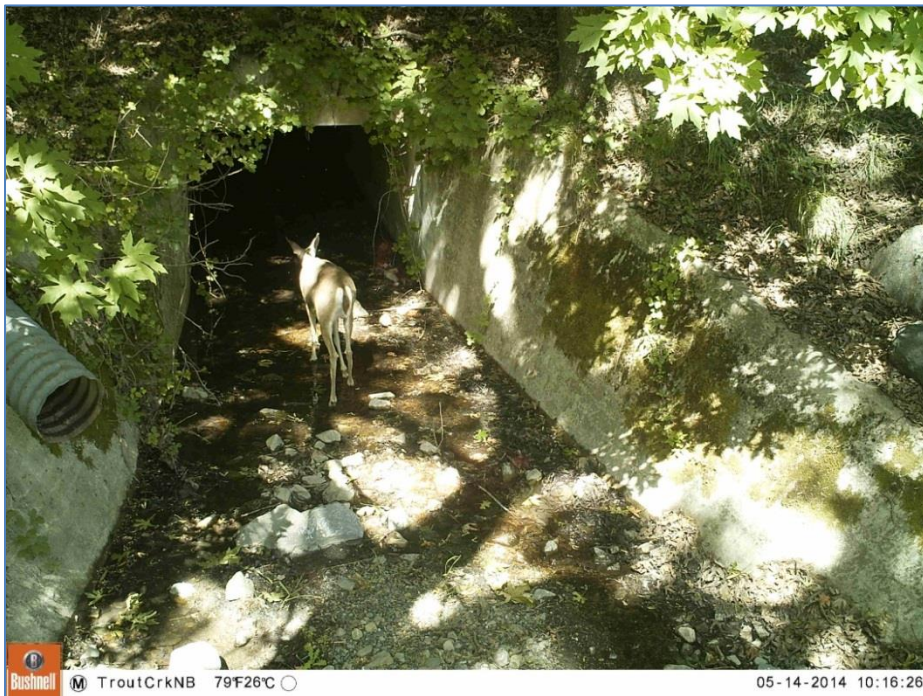
2016







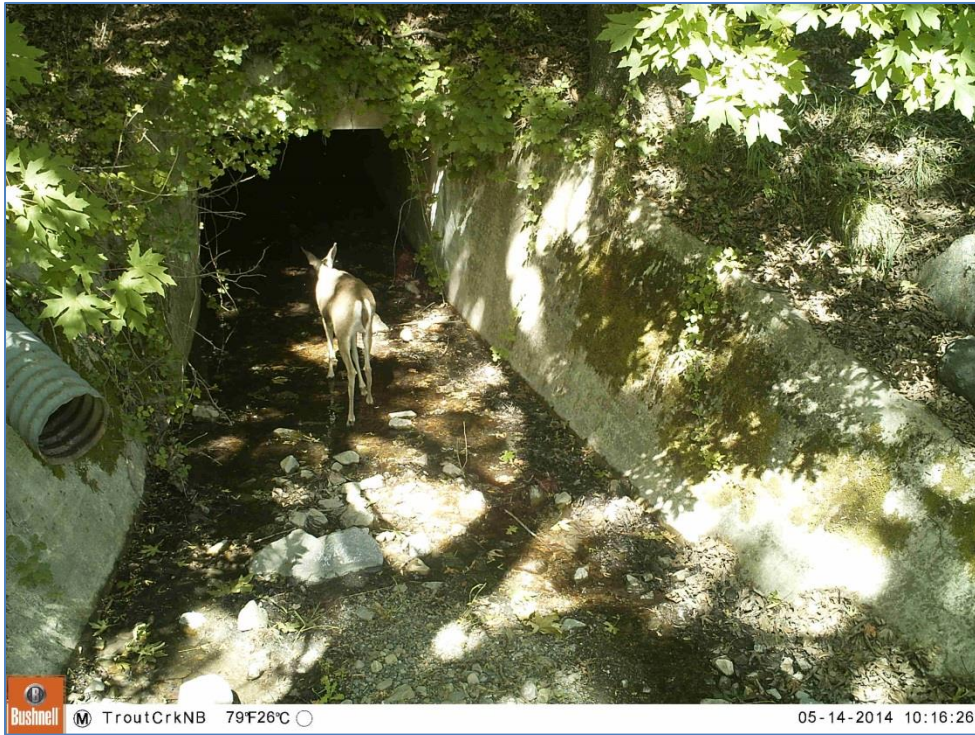
2015

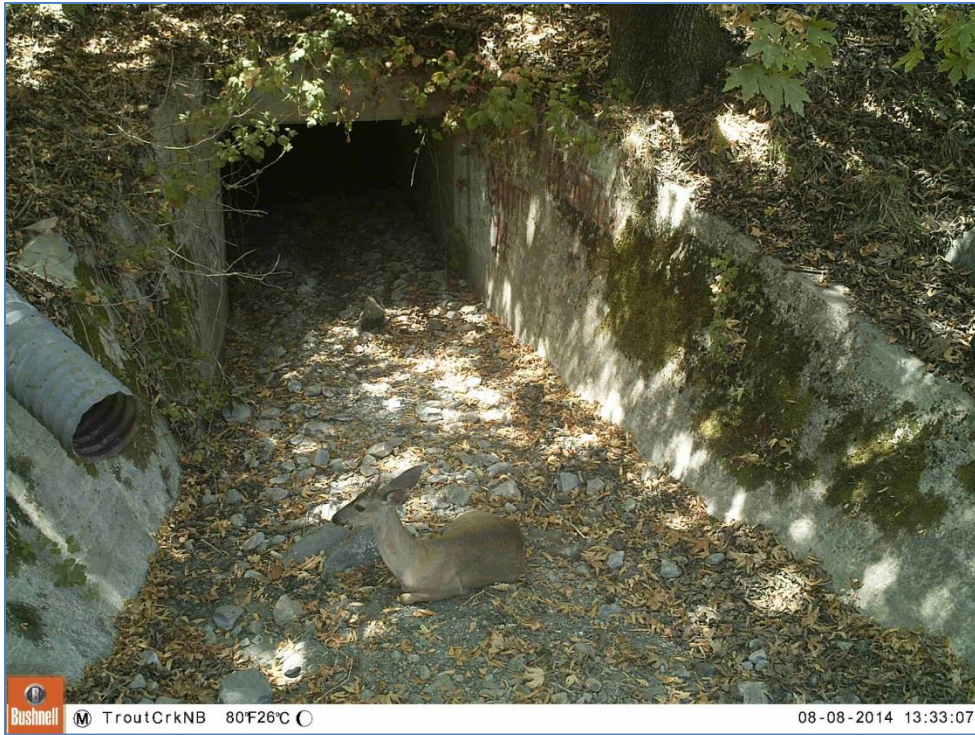




2014









Camera 2. Trout Creek Culvert Southbound (west side)

2014





Bushnell M Hwy17TroutsB 68F20°C 07-05-2014 10:16:59

2015



Bushnell M TroutCrkSB 59F15°C 07-07-2015 05:05:10



Bushnell  TroutCrkSB 53°F11°C ●


09-15-2015 22:26:38



Bushnell  TroutCrkSB 53°F11°C ●

09-15-2015 22:26:38



Bushnell  TroutCrkSB 53°F11°C ●

09-15-2015 22:26:39

2016



Bushnell  TroutCrkSB 41°F5°C ●



01-31-2016 22:43:32



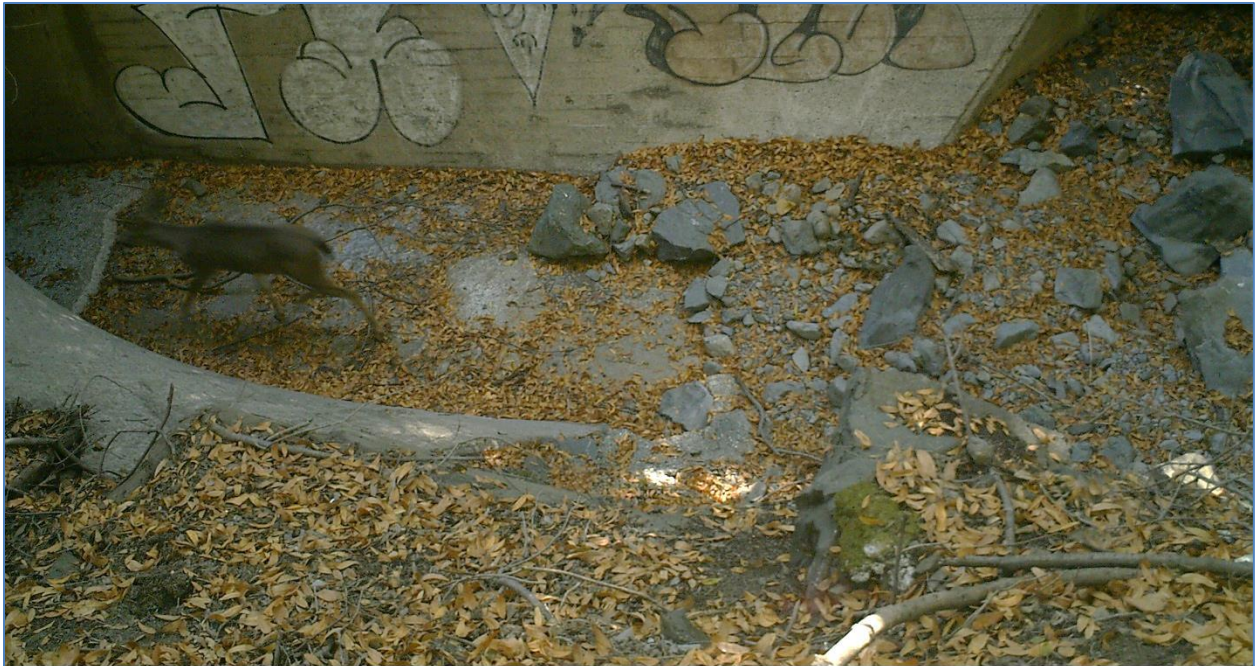
Bushnell  TroutCrkSB 59°F15°C 

05-16-2016 21:24:16



Bushnell  TroutCrkSB 46°F7°C 

09-15-2016 05:20:40



Bushnell M TroutCrkSB 70°F21°C ●

09-26-2016 11:12:03



Bushnell M TroutCrkSB 70°F21°C ●

09-26-2016 11:12:14

Camera 3. Trout Creek Culvert Southbound (west side) Supplemental Camera B: Facing the Culvert

2016







Camera 4. Lexington Culvert Northbound (east side)

2013



2014







2015







2016





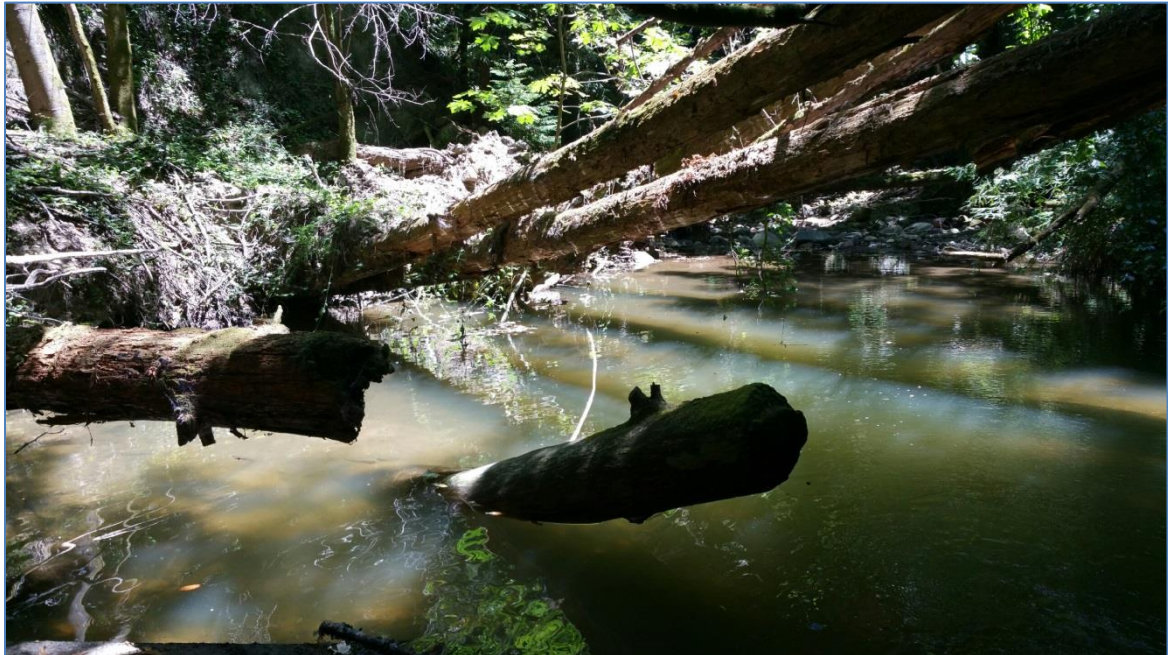






Camera 5. Aldercroft Culvert Northbound (east side)

2016





Bushnell

04-17-2016 07:56:35



Bushnell

04-26-2016 01:43:22



Bushnell

05-03-2016 16:00:38



Bushnell

05-03-2016 16:03:26



Bushnell

05-24-2016 06:14:00



Bushnell

06-26-2016 13:42:17



Bushnell

06-23-2016 14:10:15



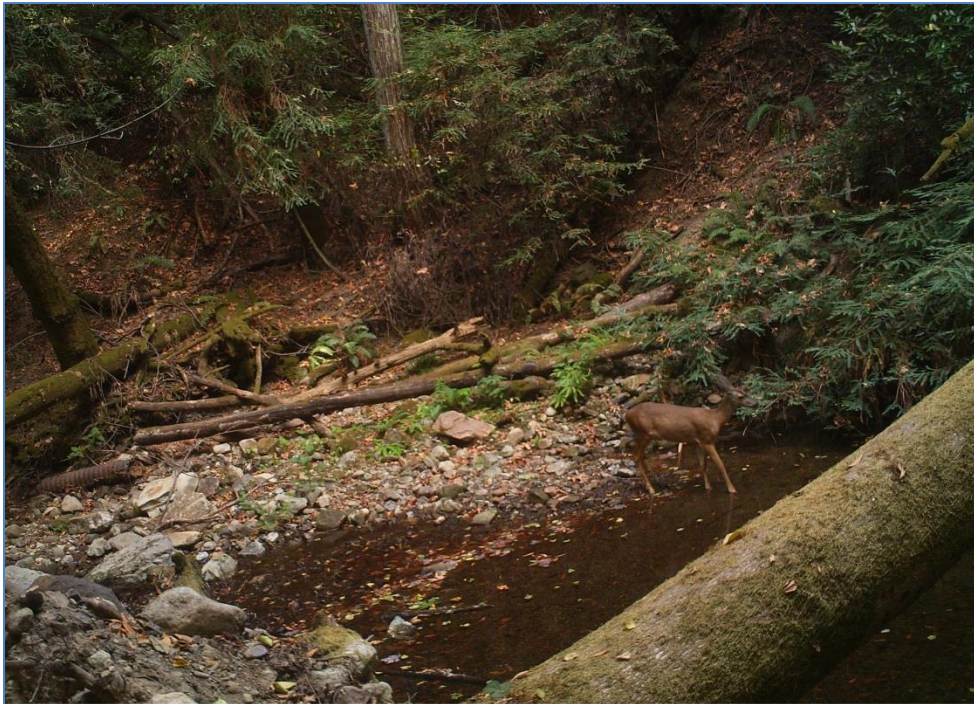
Bushnell

07-31-2016 05:36:00



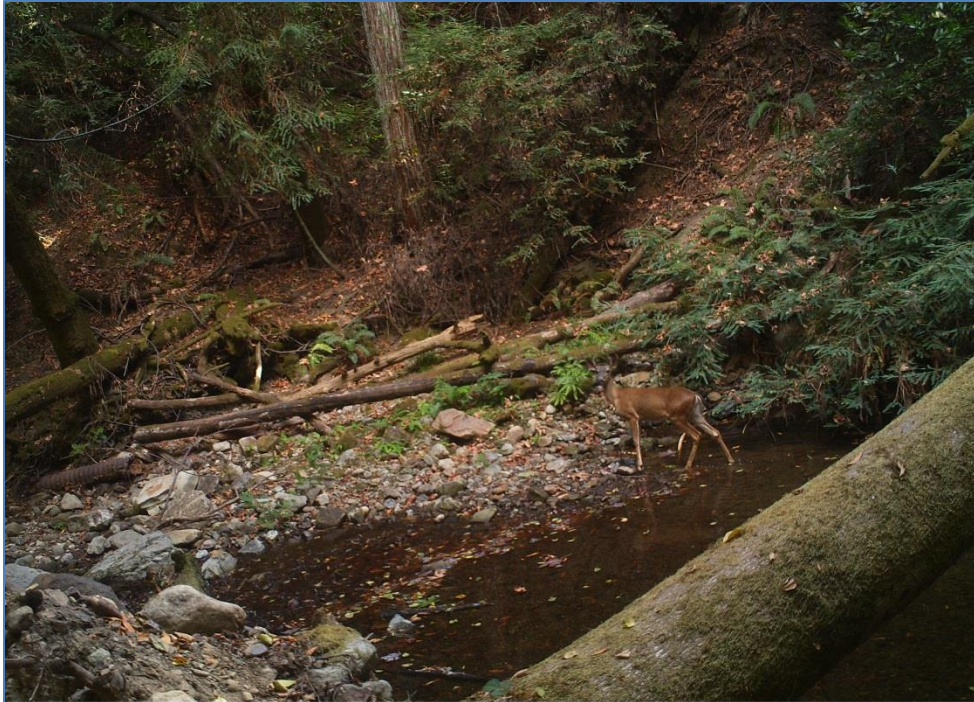
Bushnell

09-03-2016 10:27:15



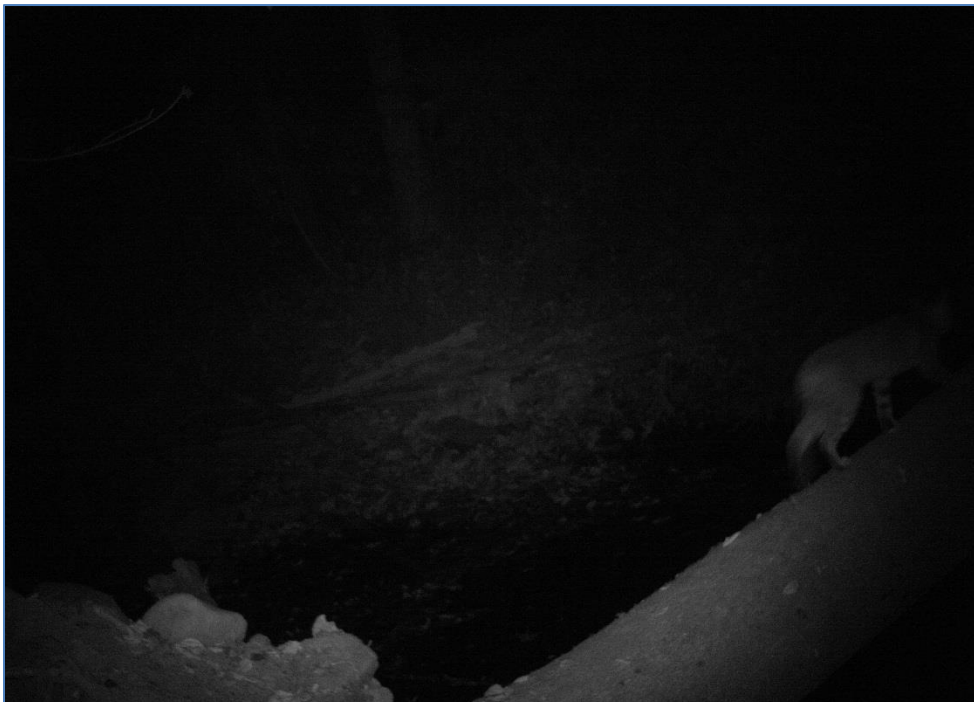
Bushnell

09-03-2016 15:32:11



Bushnell

09-03-2016 15:34:58



Bushnell

09-10-2016 05:51:50

Camera 6. Aldercroft Culvert Southbound (west side)

2016





Bushnell (M) AldecrfSB 42°F5°C ○

04-22-2016 21:24:59



Bushnell (M) AldecrfSB 42°F5°C ○

04-22-2016 21:25:58



Bushnell M AldecrfSB 64°F17°C

06-21-2016 11:38:22



Bushnell M AldecrfSB 64°F17°C

06-21-2016 11:39:16



Bushnell  AldecrfSB 50°F10°C 

08-13-2016 04:01:12



Bushnell  AldecrfSB 50°F10°C 

09-03-2016 21:33:33



Bushnell (M) AldecrfSB 59°F15°C

09-20-2016 01:33:13



Bushnell (M) AldecrfSB 50°F10°C

09-24-2016 09:38:27



Bushnell (M) AldecrfSB 41°F5°C ●



10-05-2016 09:02:40



Bushnell (M) AldecrfSB 46°F7°C ●



11-07-2016 04:17:55



Bushnell  AldecrfSB 42°F5°C 

11-16-2016 11:25:58



Bushnell  AldecrfSB 42°F5°C 

11-16-2016 11:26:08



Bushnell  Aldec fSB 41°F5°C 

12-08-2016 06:34:54