Wildlife Camera Trap Monitoring in the Cascade-Siskiyou National Monument

Friends Research Fund 2024 Final Report

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Table of Contents

Introduction

This project began in 2020 to identify suitable locations along Interstate 5 (I-5) for a wildlife crossing. Currently, the cameras are used to monitor and inventory wildlife species that inhabit the various habitats around I-5. To accomplish this, camera traps (also known as trail cameras or game cameras) are used, as they are a non-invasive and relatively inexpensive method for monitoring and inventorying wildlife species (Kelly, 2008; Tobler et al., 2008; Reece et al., 2021). When the Cascade-Siskiyou National Monument (CSNM) was established in 2000 (and later expanded in 2017) it was done so in recognition of its varied landscape, remarkable ecology, and rich biological diversity (BLM, 2008; McClaughry, 2020). Approximately 8 km (5 mi) of I-5 runs through the western portion of the CSNM, starting just south of the Siskiyou Summit and running to the California border (Fig. 1).

One of the goals of this report was to use statistical analyses to highlight the CSNM's biodiversity along this section of the I-5 corridor using four years of camera trap data. The species in our study are primarily medium- to large-bodied mammals. Currently, we monitor and inventory 19 species (18 mammal species and 1 bird species). Our target species range in size from Douglas' squirrel (*Tamiasciurus douglasii*) to elk (*Cervus canadensis*) and includes two rare species, the Pacific fisher (*Pekania pennanti*) and

the ringtail (*Bassariscus astutus*) both of whom are listed as species of concern in the Oregon Conservation Strategy. Our one bird species is wild turkey (*Meleagris gallopavo*). We monitor these 19 species as these are involved in the majority of wildlife-vehicle collisions (WVCs). Collisions with the larger-bodied species result in wildlife being killed and can cause serious injury or death to humans who happen to hit them. Elk and black-tailed deer (*Odocoileus hemionus*) alone account for 6,000 collisions in Oregon annually (Oregon Department of Fish and Wildlife, 2022).

This report will highlight our work during the summer of 2024, which was funded through grant money provided by Friends of Cascade-Siskiyou National Monument (FCSNM), the Southern Oregon Wildlife Crossing Coalition (SOWCC), WILDLABS, and the SOU Institute for Applied Sustainability (IAS). The report will cover our methods for field work, computer work, analyses, findings, and how our work/findings promote understanding, appreciation, preservation, and protection in the Cascade-Siskiyou National Monument.

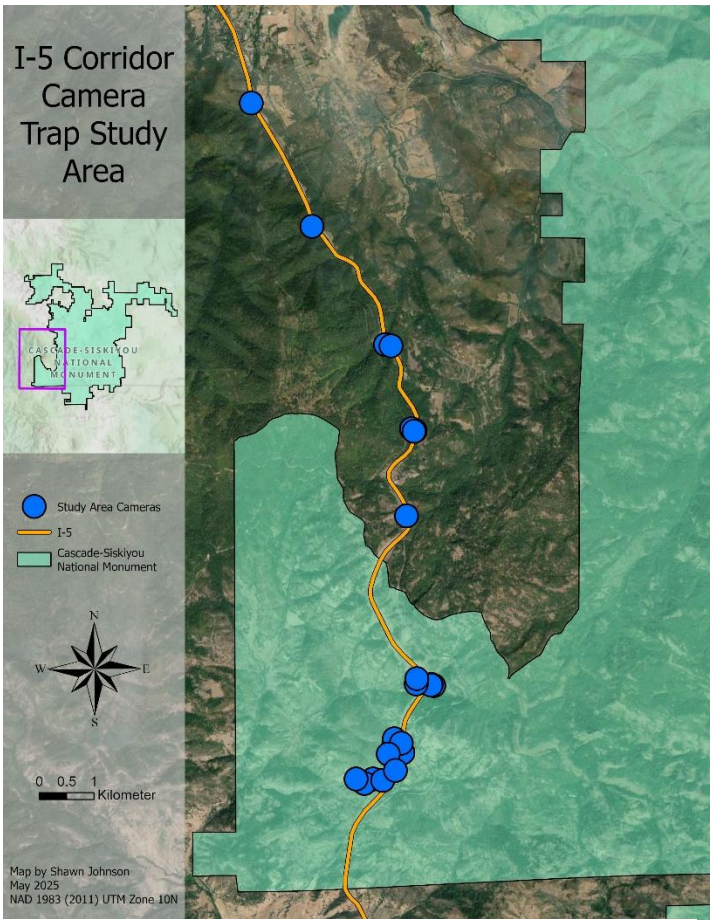

Figure 1. Map of study area with all camera locations. The study area is the 16-kilometer stretch of I-5 from Ashland, Oregon to the California border. I-5 bisects the CSNM from the Siskiyou Summit to the California border.

Methods

Study Area

Our study area is the 16-kilometer (10-mile) stretch of I-5 between Ashland, OR, and the California border (Fig. 1). Currently, 28 cameras are deployed along this corridor in various habitats, elevations, and distances from I-5. 19 of the cameras are deployed in the Cascade-Siskiyou National Monument, specifically Bear Gulch and the Mariposa Preserve.

Field Work

In June, we performed an initial check of the 28 camera sites to record camera metadata and perform a routine check. Metadata included the latitude and longitude of the location, the camera make/model, key numbers, and camera settings. Routine checks were performed once a month, where we would swap out camera

SD cards, replace batteries if needed, and clear out any vegetation that may be triggering the camera's motion detection system. SD cards would be swapped for another of the same storage capacity (32 GB, 64 GB, & 128 GB). Alkaline batteries would be replaced if they had a remaining charge of less than 33%. Lithium batteries would be replaced if they had a remaining charge of less than 100%. All SD cards were then brought back to the SOU campus for data transfer to an on-premise PC.

Computer Work

Data collected from the SD cards was uploaded to a dedicated GPU-enabled PC on campus. All data was backed up to Box, a cloud service, and an external SSD drive. All images were processed by MegaDetector, a machine learning tool used to reduce the time it takes to classify images by drawing bounding boxes around an animal, person, or vehicle. We used Timelapse, a free open-source software application, to classify all images. Data would then be exported as CSV files and combined to form a large working dataset.

Analyses

Our working dataset consisted of 8,294 unique events ranging from August 2020 to August 2024. An event refers to when one individual or individuals trigger the camera trap multiple times within a short time span. For our dataset, this timespan was 10 minutes. Events are used as a way to prevent over estimating species abundance. For example, if we have 50 images of one deer grazing in front of the camera for 7 minutes, we classify this as one deer and consolidate the 50 data points into 1 event for analysis purposes. We performed three primary analyses with our dataset: a Shannon-Weiner diversity index (SWI), a capture rate, and a seasonal analysis of the crossing site.

Shannon-Weiner Diversity Index

To calculate the Shannon-Weiner Diversity Index (SWI), we used the standard SWI equation to calculate index values at every camera location:

$$H' = \sum_{i=1}^{s} p_i(\ln * p_i)$$

In the SWI equation s is species richness, and p_i is the proportion of s individuals of that species that make up the total individuals of all species. The SWI takes into account species richness s–the number of individual species observed at a camera site–and species evenness p_i–or how evenly individuals are distributed among those species. Higher index values indicate higher biodiversity.

Capture Rate

To calculate the capture rate (also referred to as the Relative Abundance Index), we divided the sum of individuals of a species in all events by the number of trap nights for each camera site location:

$$Capture\ Rate\ = \left(\frac{Sum\ \ of\ Individuals}{Trap\ Nights}\right) * 100$$

Trap nights are defined as the number of 24-hour periods the camera was active. Capture rate is a good indicator of species activity at the various camera locations. We excluded several species from the final graph due to irrelevance, data skew, or both. These included all small rodents (rats and mice), all bat species, and California ground squirrel (*Otospermophilus beecheyi*).

Crossing Site Seasonal Analysis

As of September 2024, we had one year's worth of data at the crossing site location. With these data, we performed a species seasonal analysis at the crossing site. We classified the seasons using the meteorological season months: summer = June, July, August; fall = September, October, November; winter = December, January, February; spring = March, April, May. Capture rates from all present species were then added to each season. To prevent skewing, we removed two groups from this analysis: all small mammals (rat and mouse species) and black-tailed deer. Both of these groups had capture rates much higher than any other species resulting in a skewed graph and were therefore removed. However, it's important to note that black-tailed deer were observed at all four crossing locations in all seasons.

Project Findings & Outcomes

Findings

We compiled species richness and capture rate for every camera location into a graph to represent the observed species and their relative activity at the location (Fig. 2).

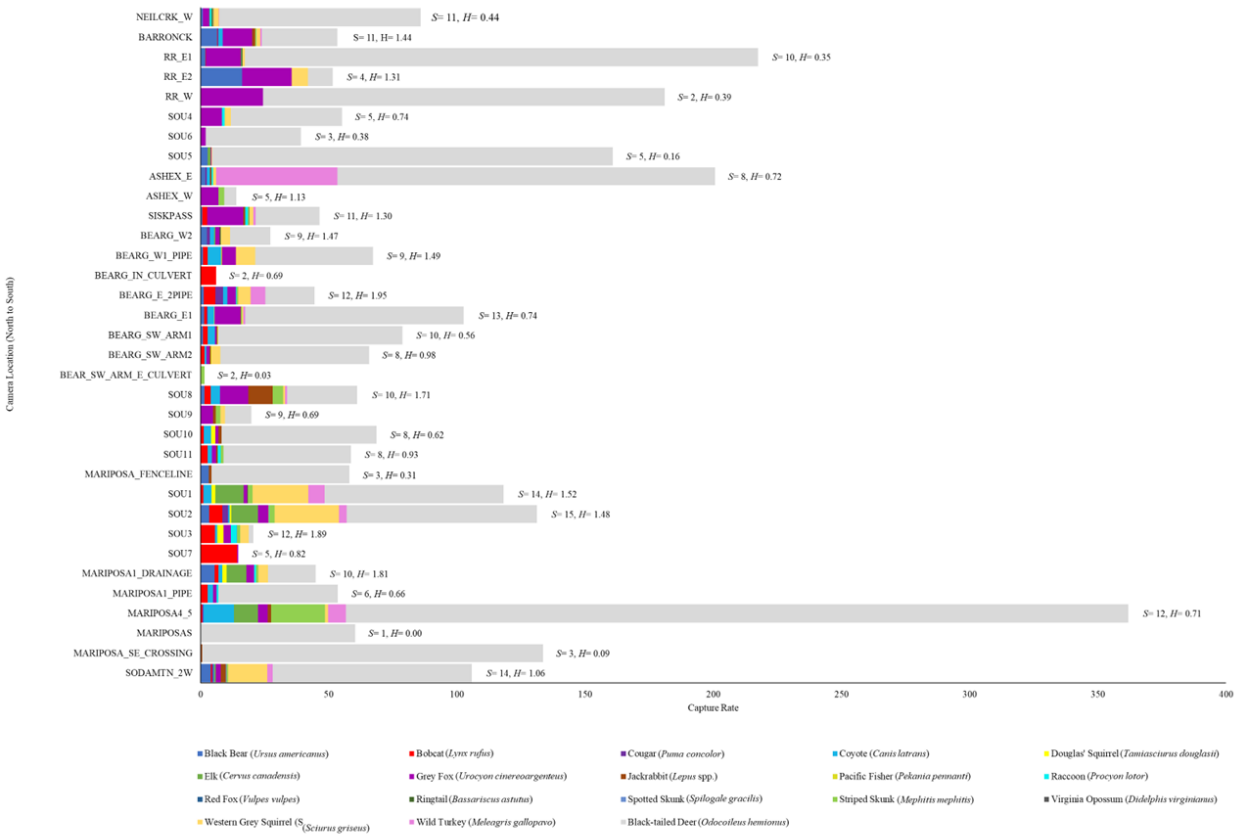

Figure 2. Species composition and capture rate from all cameras in the study area. On the y-axis are the geographic camera locations from north to south, and on the x-axis is the capture rate for individual species at each camera site. Each species has a different color associated with it. S *represents species richness and* H *represents the Shannon-Weiner Diversity Index value. For representative purposes, 3 species were removed from this graph to reduce skewing (all bat species, California ground squirrel, and all small Rodentia species).*

The graph is a good visual representation of biodiversity and how it shifts geographically from the northern locations to the southern locations. There is an increase in species richness and diversity index values south of the Siskiyou Pass (all camera locations below the “SISKPASS” location on the graph). All cameras south of the Siskiyou Pass are located in the CSNM.

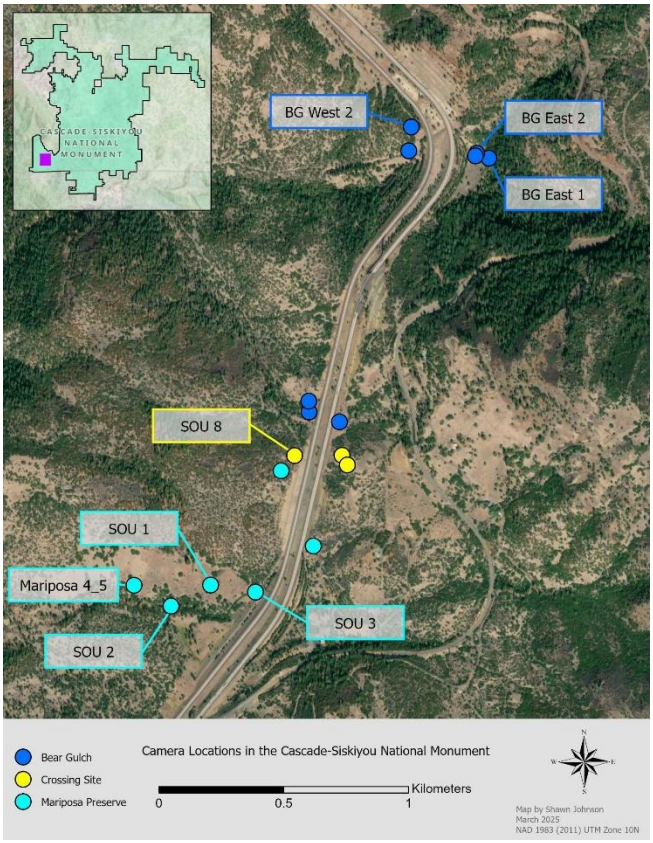

Figure 3. Map of camera locations in the CSNM. Locations with labeled camera names were those with a high SWI and/or species richness

The highest values for species richness and the SWI were found primarily in the CSNM. Of the top 10 locations with the highest SWI values, 8 of them are in the CSNM (Table 1). Similar to the SWI values, 7 of the top 10 locations with the highest species richness were locations in the CSNM (Table 2).

The camera locations in the CSNM are in a relatively small area, occupying an area close to I-5 along a 1.6-kilometer (1 mile) stretch of highway from Bear Gulch to the Mariposa Preserve (Fig. 3). This small area reinforces our understanding of how biodiverse and ecologically important the CSNM is.

*Table 1. Top 10 camera locations based on diversity index values. *Indicates a location in the CSNM. **Indicates a camera that was in a specific location in the CSNM but is no longer deployed in that specific location.*

Camera Location	Diversity Index
Bear Gulch East 2 Pipe*	1.95
SOU 3*	1.89
Mariposa 1 Drainage**	1.81
SOU 8*	1.71
SOU 1*	1.52
Bear Gulch West 1 Pipe*	1.49
SOU 2*	1.48
Bear Gulch West 2*	1.47
Barron Creek	1.35
Railroad Bridge East 2	1.31

*Table 2. Top 10 camera locations based on species richness values. *Indicates a location in the CSNM. **Indicates a camera that was in a specific location in the CSNM but is no longer deployed in that specific location.*

Camera Location	Species Richess
SOU 2*	15
SOU 1*	14
Soda Mountain 2 West**	14
Bear Gulch East 1*	13
Bear Gulch East 2 Pipe*	12
SOU 3*	12
Mariposa 4_5*	12
Neil Creek	11
Barron Creek	11
Siskiyou Pass	11

Seasonal analysis

Our seasonal analysis of the crossing site revealed three key takeaways: first, we found that three species were only present in the area during spring: black bear (*Ursus americanus*), coyote (*Canis latrans*), and wild turkey (Fig. 4). Second, we found that two species were present in the area all year around: jackrabbit (*Lepus spp.*) and striped skunk (*Mephitis mephitis*).

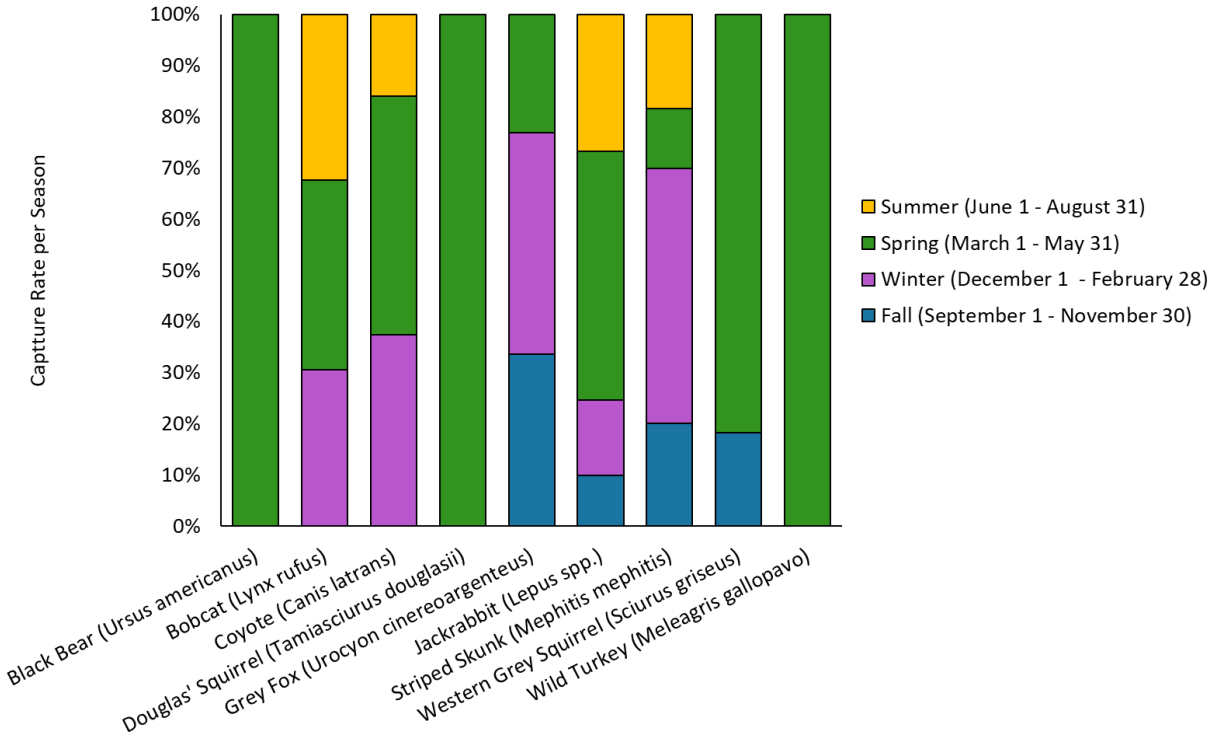

Figure 4. Seasonal analysis of the crossing site using one full year of data. To prevent skewing all rat and mouse species were removed, and black-tailed deer were removed. However, black-tailed deer were observed at all locations during all seasons.

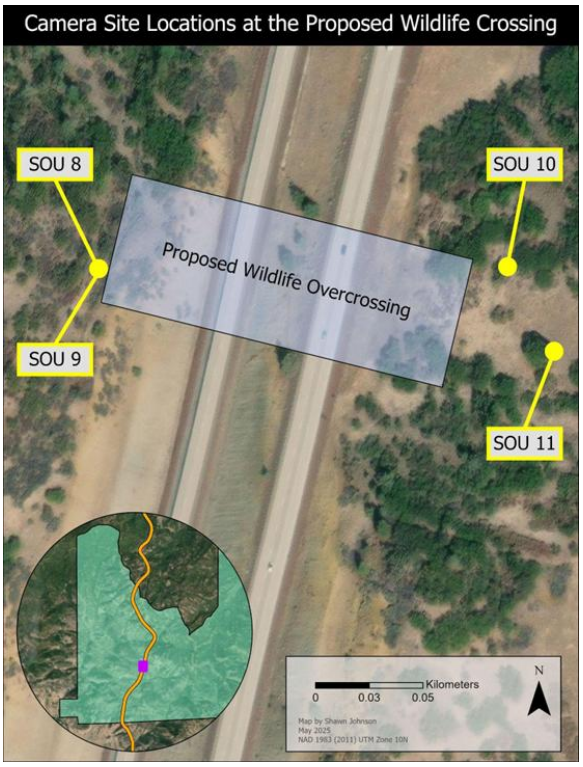

Figure 5. Crossing site location within the CSNM.

Third, in one year, we were able to capture four of the six known predator species: black bear, bobcat (*Lynx rufus*), coyote, and grey fox (*Urocyon cinereoargenteus*). Cougar (*Puma concolor*) and the rare Pacific fisher are the two species not yet observed at the crossing site. We were able to capture one of the two large-bodied ungulate species in the area. Black-tailed deer were observed during all seasons. Elk are the ungulate species not observed at the crossing location. For these findings, it is important to highlight that this is one year's worth of data in a small area. With cameras SOU 8 and 9 located almost on the same tree, and SOU 10 and 11 only 40 meters apart. This analysis emphasizes the high species richness and wildlife movement in such a small location and timescale.

Outcomes

The Friends Research Fund enabled us to maintain the cameras over the summer, a period during which sparse data collection or camera site maintenance had previously occurred. This summer was the first year data was collected by students who were compensated for their work. In the past, cameras were out all summer with no one to collect their SD cards or maintain their locations. Oftentimes their SD cards would fill up or they would run out of batteries resulting in several months of no data being collected. The Friends Research Fund allowed us to check the cameras monthly to retrieve SD cards and to maintain the camera's field of view, allowing us to collect valuable summertime data and to start filling in these data gaps.

This project allowed us to create a Standard Operating Procedure (SOP) to streamline our process in the field and out of the field. A goal we've had for a while for this monitoring project was to standardize what we do, how we do it, and document it for future reference by future capstone students, student interns, and research assistants. Our SOP provides lists and instructions for equipment, safety procedures, field work procedures (pre-, during, and post-), procedures for using our on-premise PC, MegaDetector and Timelapse, and how we manage our data pipeline from SD cards to our PC.

During the summer, we were able to collaborate with Dr. Bernadette Boscoe, a professor in the Computer Science department. Dr. Karen Mager, our mentor for this project, and Dr. Boscoe began a collaboration in the spring of 2024 to design and implement a low-energy, on-premises data pipeline that uses AI (MegaDetector) responsibly. We were able to contribute to the streamlining of this pipeline and now implement it into our data collection and analysis process. Dr. Boscoe was able to publish a research paper on the pipeline using the work we completed over the summer (link to paper). Future plans for this aspect of the project is to connect our PC to solar power in order to be more sustainable and to offset the power used when running MegaDetector on our image datasets.

Promoting Understanding, Appreciation, Preservation, and Protection of the CSNM

One of our objectives for this project was to align our goals with the mission statement of Friends of Cascade-Siskiyou National Monument. Documenting the presence and diversity of wildlife species that use the CSNM's various habitats is essential for understanding, preserving, and protecting the monument's ecological integrity. Our project recorded high mammal biodiversity index values in the CSNM compared to nearby locations outside the monument providing data that reinforces the value of CSNM as a unique and irreplaceable conservation area and as the ideal place for a wildlife crossing. By addressing the data gap in wildlife crossing pre-construction monitoring, our work informs conservation planning and strengthens arguments for enhancing wildlife connectivity within and around the CSNM. In addition to the wildlife crossing these findings can serve ongoing advocacy efforts to ensure the CSNM remains protected.

In addition to contributing scientific data, this project provided and continues to provide hands-on learning opportunities for students, immersing them in the CSNM's exceptional biodiversity and unique landscapes. Moreover, the images and videos of wildlife we capture helps raise public awareness and appreciation by sharing the Monument's rich biodiversity with stakeholders and the broader community. In these ways, our project support the CSNM's long-term preservation for future generations.

Budget

Materials and Supplies		
Item	**Quantity**	**Total**
SD Cards	10	$253.50
SD Card Case	1	$15.99
Battery Tester	1	$7.99
Batteries	104	$85.52
	Total Cost	**$363.00**

Stipends			
Date Range	**Hours**	**Hourly Rate**	**Total**
June 17 - September 15, 2024	42	$18.00	$750.00
June 17 - September 15, 2024	42	$18.00	$750.00
		Total Stipends	**$1,500.00**

Mileage				
Proposed Travel	**Number of Miles**	**Number of Trips**	**Cost per Mile**	**Total**
To Hilt, CA from Grants Pass, OR	1056	8	$0.67	$708.00
To Hilt, CA from Jacksonville, OR	640	8	$0.67	$429.00
			Total Mileage Cost	**$1,137.00**

Cost Summary	
Materials & Supplies	$363.00
Stipends	$1,500.00
Mileage	$1,137.00
Total Cost	**$3,000.00**

Figure 4. Detailed budget of grant money provided by Friends of Cascade-Siskiyou National Monument. Our budget primarily paid for our work hours and travel expenses allowing us to maintain the camera sites and collect data over the summer. In addition, the Friends Research Fund allowed us to purchase much needed equipment for the project.

Acknowledgements
We would like to thank Zaynab Brown, Daniel Collay, and everyone at Friends of Cascade-Siskiyou National Monument. Amy Amrhein and Jack Williams of the Southern Oregon Wildlife Crossing Coalition, Charlie Schelz of the BLM (ret.), WILDLABS, SOU's Institute for Applied Sustainability, and SOU's STEM-REx program. Special thanks to our mentor Dr. Karen Mager for everything she does for us and to Dr. Bernadette Boscoe for her support and expertise.

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Appendix A - Figures

Figures

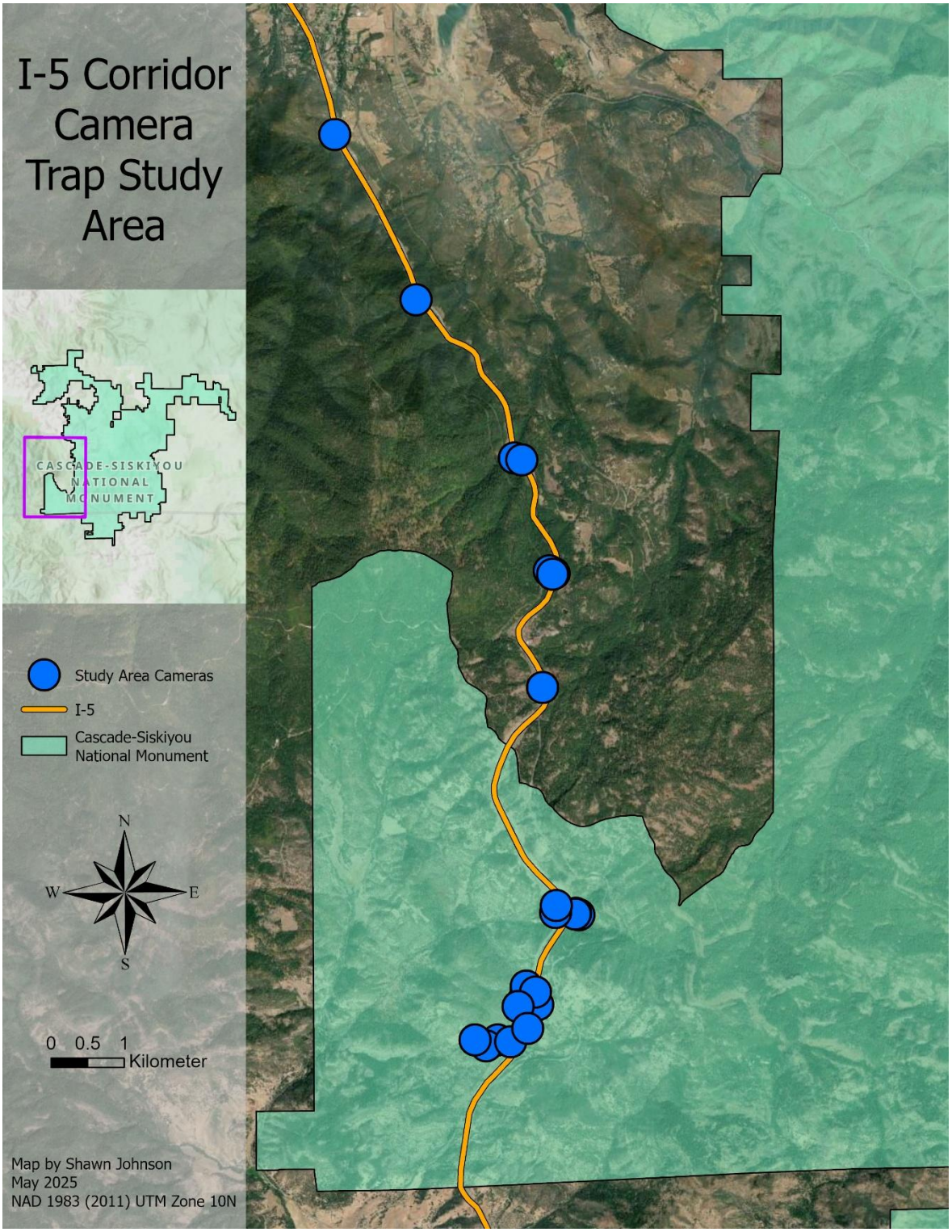

Figure A1. Map of study area with all camera locations. The study area includes the 16-kilometer stretch of I-5 from Ashland, Oregon to the California border. I-5 bisects the CSNM from the Siskiyou Summit to the California border.

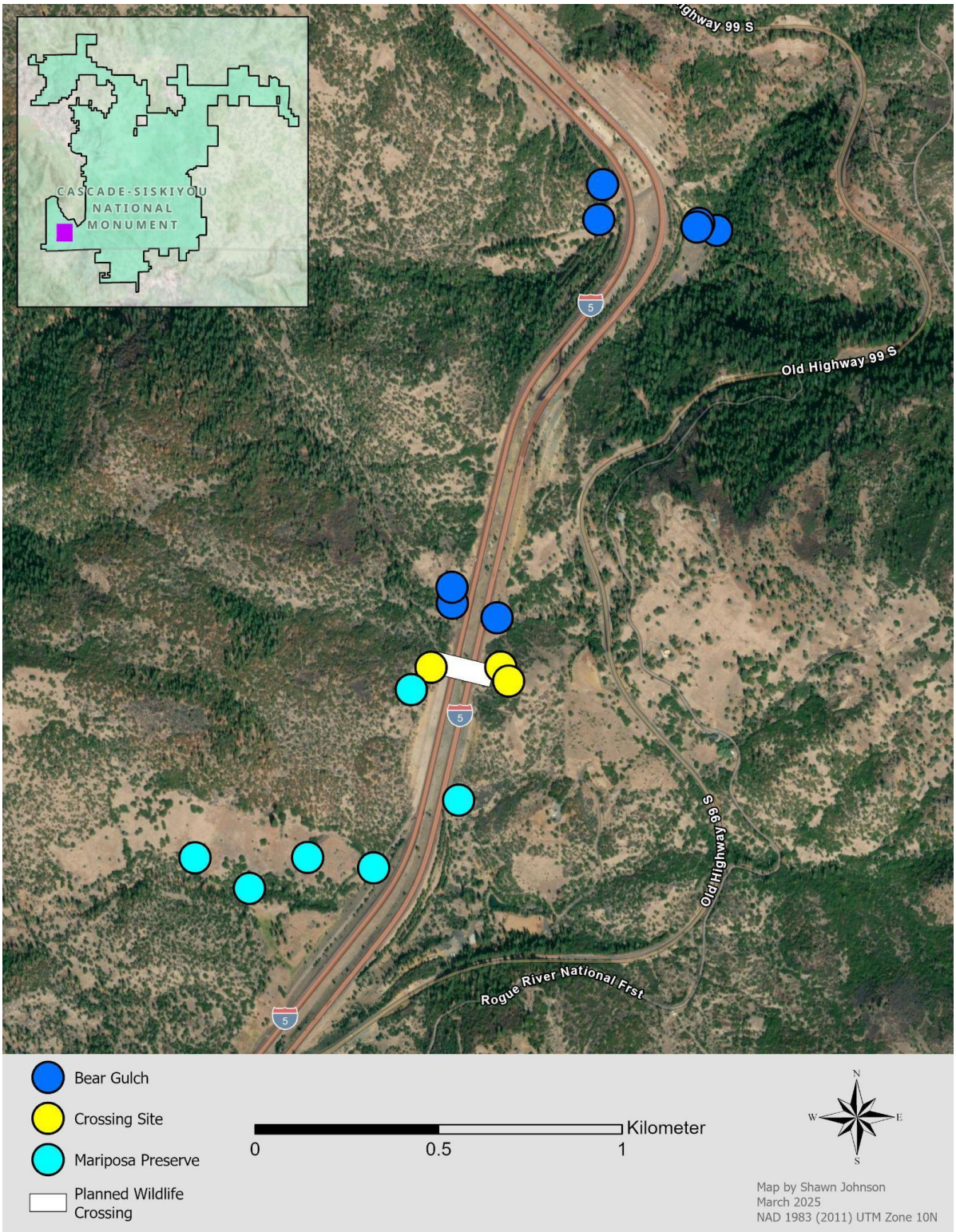

Figure A2. Map of camera locations in the Cascade-Siskiyou National Monument. Currently, there are 19 cameras in the CSNM. 8 cameras in Bear Gulch and 11 in the Mariposa Preserve. 4 of the 11 cameras in the Mariposa Preserve are located at the proposed wildlife crossing site denoted in yellow.

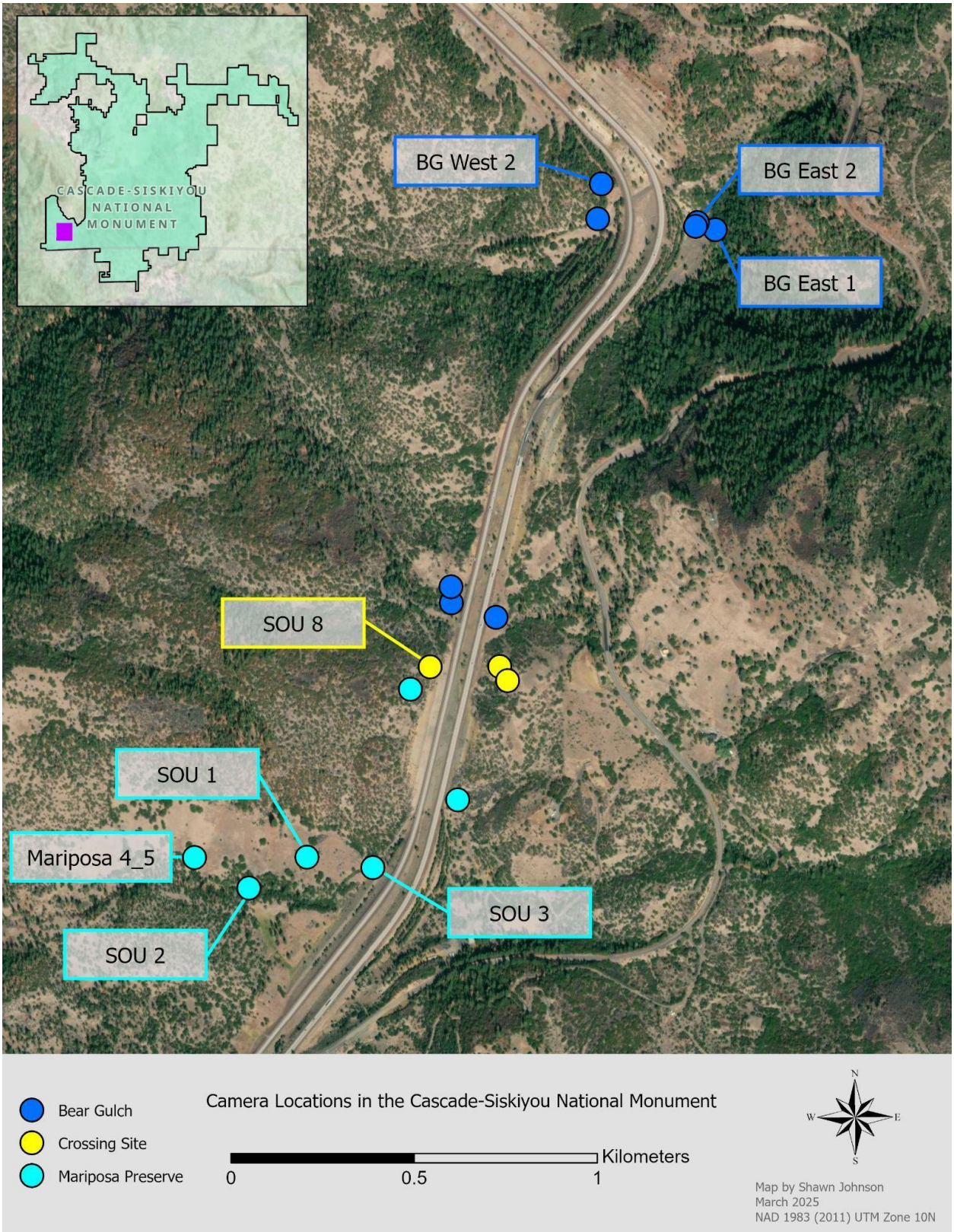

Figure A3. Map of the camera locations in the Cascade-Siskiyou National Monument that show the highest SWI values and species richness.

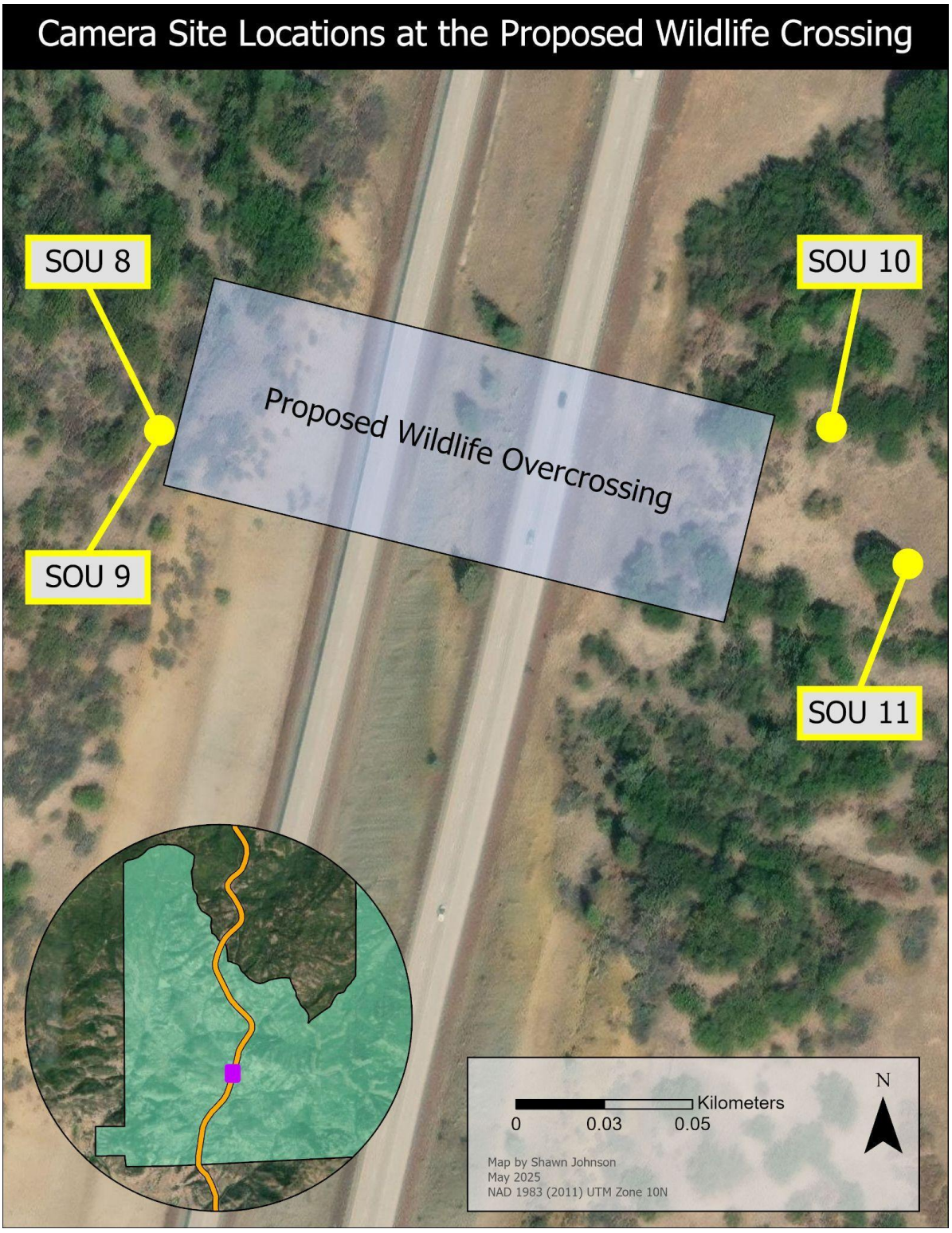

Figure A4. Map of the proposed crossing site in the Mariposa Preserve in the Cascade-Siskiyou National Monument with our four camera locations.

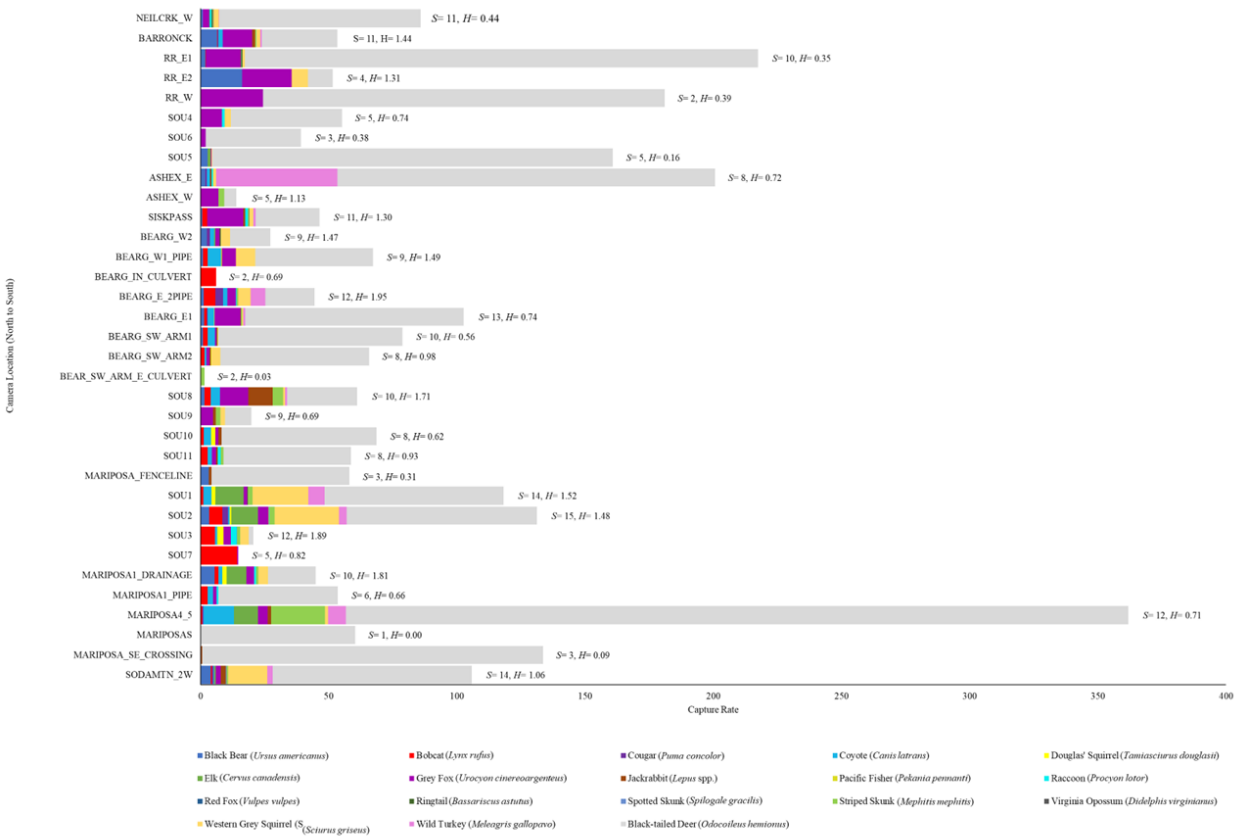

Figure A5. Species composition and capture rate from all cameras in the study area. On the y-axis are the geographic camera locations from north to south, and on the x-axis is the capture rate for individual species at each camera site. Each species has a different color associated with it. *S* represents species richness and *H* represents the Shannon-Weiner Diversity Index value. For representative purposes, 3 species were removed from this graph to reduce skewing (all bat species, California ground squirrel, and all small Rodentia species)

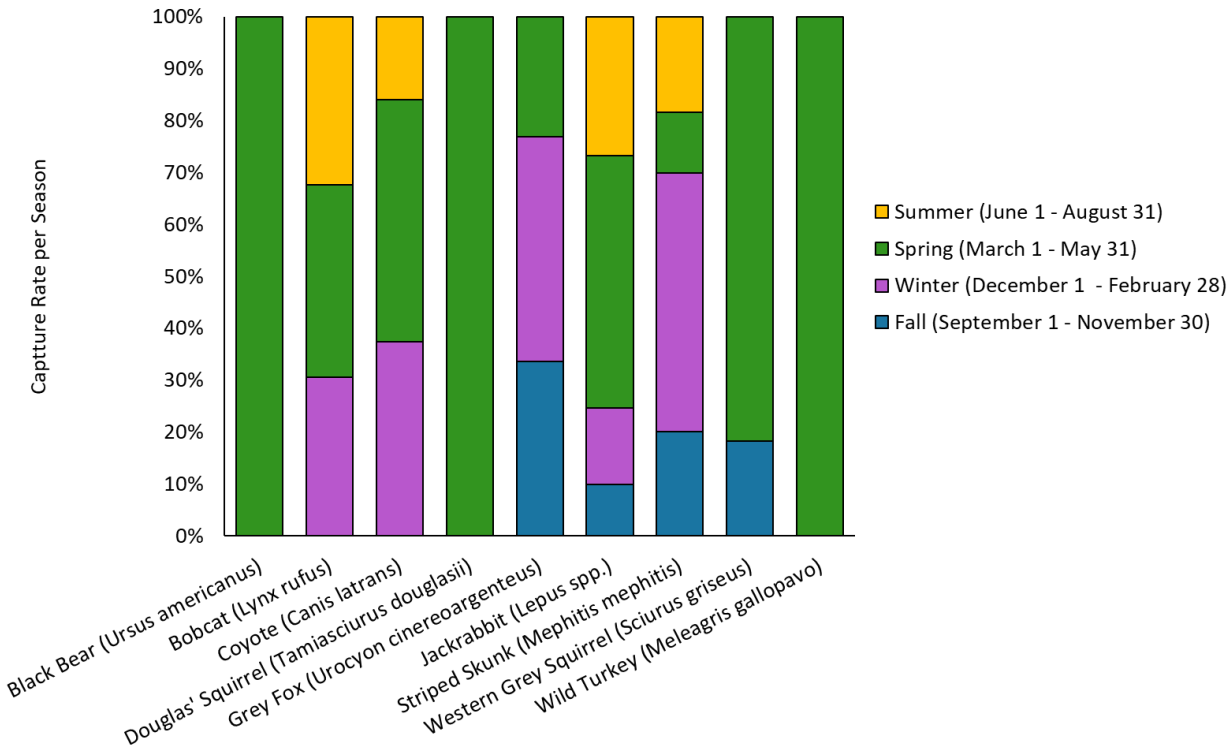

Figure A6. Seasonal analysis of the crossing site using one full year of data. To prevent skewing all rat and mouse species were removed, and black-tailed deer were removed. However, black-tailed deer were observed at all locations during all seasons.

Appendix B - Tables

Table B1. Table with all relevant values for each camera location in the study area.

Camera Location (North to South)	Spp. Richess	Diversity Index	Capture Rate	Trap Nights
Neil Creek	11	0.44	85.90	688
Barron Creek	11	1.35	53.30	728
Railroad Bridge East 1	10	0.35	217.58	603
Railroad Bridge East 2	4	1.31	51.61	31
Railroad Bridge West 1	2	0.39	181.08	37
SOU 4	5	0.74	56.65	203
SOU 6	3	0.38	41.18	51
SOU 5	5	0.16	161.35	401
Mt. Ashland Exit East	8	0.72	200.61	165
Mt. Ashland Exit West	5	1.13	44.19	43
Siskiyou Pass	11	1.30	46.58	790
Bear Gulch West 2	9	1.47	27.69	242
Bear Gulch West 1 Pipe	9	1.49	84.95	299
Bear Gulch East 2 In Culvert	2	0.69	11.21	116
Bear Gulch East 2 Pipe	12	1.95	50.40	621
Bear Gulch East 1	13	0.74	103.42	760
Bear Gulch SW Arm 1	10	0.56	80.83	433
Bear Gulch SW Arm 2	8	0.98	120.62	257
Bear Gulch SW East Arm In Culvert	2	0.03	308.82	68
SOU 8	10	1.71	61.11	252
SOU 9	9	0.69	149.70	167
SOU 10	8	0.62	69.77	172
SOU 11	8	0.93	64.80	179
Mariposa Fenceline	3	0.31	58.06	93
SOU 1	14	1.52	128.88	800
SOU 2	15	1.48	131.80	676
SOU 3	12	1.89	47.04	540
SOU 7	5	0.82	20.81	471
Mariposa 1 Drainage	10	1.81	44.96	129
Mariposa 1 Pipe	6	0.66	54.86	144
Mariposa 4_5	12	0.71	362.30	443
Mariposa South	1	0.00	60.27	73
Mariposa SE Crossing	3	0.09	136.99	146
Soda Mountain 2 West	14	1.06	107.05	454

Table B2. Top 10 camera locations based on diversity index values. *Indicates a location in the CSNM. **Indicates a camera that was located in a specific location in the CSNM but is no longer deployed in that specific location.

Camera Location	Diversity Index
Bear Gulch East 2 Pipe*	1.95
SOU 3*	1.89
Mariposa 1 Drainage**	1.81
SOU 8*	1.71
SOU 1*	1.52
Bear Gulch West 1 Pipe*	1.49
SOU 2*	1.48
Bear Gulch West 2*	1.47
Barron Creek	1.35
Railroad Bridge East 2	1.31

Table B3. Top 10 camera locations based on species richness values. *Indicates a location in the CSNM. **Indicates a camera that was located in a specific location in the CSNM but is no longer deployed in that specific location.

Camera Location	Species Richess
SOU 2*	15
SOU 1*	14
Soda Mountain 2 West*	14
Bear Gulch East 1*	13
Bear Gulch East 2 Pipe*	12
SOU 3*	12
Mariposa 4_5*	12
Neil Creek	11
Barron Creek	11
Siskiyou Pass	11