

Evaluating Wildlife Use in the Coast to Cleveland Wildlife Corridor in Orange County

UCLA Environmental Science Practicum 2015-2016



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I. Abstract

Wildlife corridors are significant for allowing gene flow and encouraging biodiversity between otherwise isolated populations living in fragmented habitats. This study evaluates the effectiveness of the existing “Coast to Cleveland” wildlife corridor, located between the 22,000 acre Laguna Coast Wilderness Park and the Limestone Canyon Regional Park, in light of recent redevelopment in Orange County. As past literature suggests, the two primary carnivores of the region, coyotes (*Canis latrans*) and bobcats (*Lynx rufus*) have historically relied on the corridor to migrate between habitats. However, this study’s findings suggest that while coyotes and other small, generalist mammals are using the corridor, bobcat presence within the corridor appears to have significantly decreased. These results demonstrate the need to either improve the current wildlife corridor or to construct a new one in order to maintain connectivity and thus healthy wildlife communities.

II. Introduction

Urban development has been drastically increasing to accommodate the world’s human population growth. (White, 2007). Researchers analyzing urban development across the United States assigned scores to various urban areas in order to more clearly demonstrate the relationship between factors such as density, activity, land-use, and street accessibility (Ewing, 2014). In this study, the average score is calibrated to 100, while any score greater than 100 signifies a greater degree of urban sprawling. Orange County, California - which contains the study area of the Laguna Coast Wilderness Park, the “Coast to Cleveland Wildlife Park” and the Limestone Canyon Regional Park - has an MSA Density Score of 134. This indicates that Orange County has a higher level of urban development than other cities. In addition, this extensive urban growth has led to a greater demand for roads, resulting in greater road development and an MSA Street Accessibility score of 144, the second highest score in the state of California. This score is based on the number of four-way intersections, road density, distribution, and area coverage (Ewing, 2014). Based on these findings, it is evident that Orange County has a higher than average level of urban development and roads. While this urban connectivity is beneficial for human transportation, the heavy prevalence of roads, highways, and extensive urban sprawl is likely to have fragmented habitats and is detrimental to many animal populations that rely on habitat connectivity for their survival.

In many studies, it has been shown that large mammals such as cougars, mountain lions, and bobcats are typically deterred by large roadways and human presence, often turning around at the edges of these systems (Ng, 2004; Pratt-Bergstrom, 2014). The unnatural noise and substrate discourages them from approaching or crossing, isolating them onto one side of the freeway (Clevenger 2002). These barriers to movement can be devastating for large

carnivorous species such as mountain lions because they require such an expansive territory – 200 square km for males and 75 for females (Jao, 2015). Additionally, since they are typically solitary animals with non-overlapping home ranges, males may kill other mountain lions that wander into their territory (Jao, 2015). When these types of carnivores experience barriers to movement and are restricted to an area below its home range requirements, the genetic effects of small populations such as inbreeding depression and genetic drift can occur, ultimately reducing that species' diversity and fitness. In the Santa Monica Mountains, for example, mountain lion populations are so low that the mortality of even one individual can severely impact genetic diversity to the point of threatening the collapse of the entire population (Jao, 2015).

In a recent study by the United States Geological Survey, bobcat home ranges within Orange County were studied and mapped using GPS-collars and camera traps. Overall, it was found that human-induced barriers prevented mobility between sections in this area (Alonso, 2008). Bobcats were often observed approaching the side of a highway before ultimately turning around and returning the way it had come. While there were many attempts by wildlife to cross to the freeway, very few were documented successfully making it across the freeway to the natural habitat on the other side (Alonso, 2008). A similar study indicated that human activity is one of the main deterrents to movement for a large range of animals, including coyotes and mountain lions (Trombulak, 2001). In general, natural vegetation, substrate, and lighting, in addition to limited roads and human activity, have proved to be most effective at successfully promoting habitat connectivity between fragmented regions (Barnum, 2003; Mass Highway, 2009). These studies are critical in determining where and how wildlife will traverse anthropogenic road systems.

Since the initial construction of the nation's interstate highway systems in the 1950s, road systems have greatly impacted much of the valuable natural habitat necessary for many species' survival (White, 2007). Roads can impede migration, fragment populations, and separate animals from their food and other resources, thus contributing to habitat loss for many animals (Jackson "Overview", 2000). This significant contribution to habitat loss and fragmentation can result in large declines in population density for many species (Jaeger & Bowman, 2004; Forman et al, 2003; Forman, 1998).

It is clear that the influence of roads is high, especially in densely human populated cities where wildlife habitats are smaller and more spread out due to urban development, habitat destruction and degradation, and fragmentation. Another major impact that roads have on wildlife is increasing mortality among wildlife populations due to direct collisions (Gibbs, 2002). Fences and highway walls are a common approach to deter wildlife from entering roads. While this helps to decrease wildlife mortality, it also further contributes to population and habitat fragmentation (Jaeger and Fahrig, 2004). The ability to move between fragmented habitats can be imperative to certain species survival, and thus, wildlife corridors and crossings

are vital for the health of many animal populations (Cavallaro, 2005). There are many types of wildlife crossings, which is the broad term for paths by which animals can cross manmade barriers and obstacles, such as roads or highways (Barnum, 2003). These help to minimize the effects of habitat fragmentation by connecting habitats separated by urban barriers.

Due to the heavy urban development in Orange County, our targeted study area is the existing “Coast to Cleveland” wildlife corridor that connects the Laguna Coast Wilderness Park with the inland Limestone Canyon Regional Park in the Cleveland National Forest. This six mile long corridor, which was originally a drainage path, was adapted as a means to allow wildlife to pass through areas of heavy urban development and to keep a connection between these two larger areas of natural habitat. Following the path of the San Diego Creek bed, wildlife must travel along a revegetated path before ultimately crossing under the I-5 highway via an unlit corridor.

Unfortunately, it is unclear whether animal species are making it under the I-5 highway to reach the inland habitat. In a 2007 study conducted by the USGS, they found that bobcats were deterred from advancing past the southwestern side of the I-5 and were failing to successfully cross to the inland side of the highway. Since the completion of this study, there has been extensive redevelopment in the area, potentially affecting wildlife movement along this designated corridor. Despite this recent development, there has been little research to determine whether or not species are utilizing this pathway and thus, a reassessment of the corridor is necessary. It is critical that connectivity between the Laguna Greenbelt and Limestone Canyon is successful because it contributes so heavily to the longevity and overall survival of many species living in the study area (Harry Huggins, Director, Laguna Greenbelt, inc, pers. comm). It is imperative to provide an easily accessible route from one habitat to the other in order to increase the overall area of viable territory for large mammals and to preserve gene flow and population diversity. This study aims to determine exactly how this wildlife corridor functions: if species use this corridor to travel between habitats and if so, which species are utilizing it the most.

III. Research Questions

After careful consideration of the client’s interest and information from our field surveys, we have developed three questions that we would like to address with our project. Due to the nature of the issue, our research questions are arranged in a hierarchical order. They are, as follows:

1. Are bobcats and coyotes using the existing wildlife corridor?
2. If they are using it, how far are they traveling before turning around?

3. Are there specific portions of the corridor in which many animals are averse to?

First, we want to address whether the corridor is still being used by wildlife after the recent redevelopment of Irvine. We predict that the animals are partially using the wildlife corridor, but we would like to confirm this for bobcats and other species of interest.

If wildlife are in fact using the tunnel, knowing the areas of the wildlife corridor in which animals are most likely to turn back will aid us in identifying specific bottleneck locations within the corridor where animals show the most aversion. For the purposes of this study, we will not explore why animals are failing to travel through the entire corridor but for future research, we have several hypotheses:

1. Wildlife cannot see the end of the tunnel due to curves found within the corridor. Since wildlife prefer a clear line-of-sight, they are averse to using that part of the corridor.
2. Diurnal species may have a preference for well-lit areas and the lack of sufficient lighting within the tunnel may impact corridor usage for diurnal species, while it should not impact nocturnal species.
3. Significant human presence in the culvert, as exemplified by empty cans and graffiti, is repelling animals from continuing through this part of the corridor.
4. Because the corridor was originally designed and co-opted onto an existing flood-control system, wildlife are averse to using the corridor during rainstorms when areas such as the culvert are almost completely flooded from water.

Although we cannot predict which, if any, of the hypotheses may explain why wildlife are averse to using the corridor, we expect that by answering our questions, we can accurately assess the effectiveness of the existing corridor for wildlife movement and connectivity.

IV. Methodology

Study Site

The study site is the Serrano Creek leading up to the I-5 freeway at Bake Parkway in Irvine, California. This area is the main crossing between the 22,000 acres of the Laguna Greenbelt nature preserve and the 120,000 acres of the Limestone Canyon in Cleveland National Park (Figure 1). In addition to the I-5 undercrossing, a field survey led to the identification of three additional potential barriers to crossing between the natural areas, all along the Serrano creek. These three choke points are located at Lake Forest Drive, Irvine Center Drive, and Research Drive. These are all roads with adjacent human development which may hinder wildlife crossing. We used both camera-traps and track-pads in order to increase the probability of capturing wildlife presence in the study area.

Camera-Traps

We installed a total of 18 Cuddeback infrared, motion sensor cameras. These cameras are 'no flash' and have the capability to record up to thirty seconds of video after being triggered, providing information about presence/absence and behavior. The cameras take eight AA batteries and are equipped with 32 GB memory cards. We affixed the cameras either to trees, nearby metal protrusions, or to wooden stakes approximately 24-30 inches above the ground. Because of the exposed visibility of the cameras in urban areas, one camera was equipped with a lock to prevent theft after some cameras were stolen. Each of the potential road barriers (Lake Forest Drive, Irvine Center Drive, and Research Drive) was equipped with four cameras - two on each side - for a total of twelve cameras. Two cameras were also placed at the entrance to the culvert near the I-5 freeway. Additionally, we placed one camera midway between each barrier for a total of three cameras as well as one camera in the culvert running perpendicular to the North Serrano Creek. Data collection occurred every week on Friday, during which time the field team exchanged memory cards and checked to ensure that the batteries were functioning. Images and videos were backed up immediately on an external hard drive to prevent any data loss. Data collection started on March 11 and ended on May 13 however camera placement was staggered throughout this time due to permitting delays. The total time of data collection ranged from 2-6 weeks depending on location.

Track-Pads

In addition to the camera traps, we utilized track-pads to increase the probability of capturing wildlife movement. These track-pads (1 x 1 m) were constructed with wooden frames. The target species of interest are bobcats and coyotes, thus larger, uncovered trackpads are necessary. Data collection occurred during the rainy season, which made the dirt in these areas relatively impressionable. For this reason, we had originally chose to use the natural substrate rather than a petroleum and sand mixture, which is often used in trackpad studies over hard substrates. However, after initial data collection began we found that the silt in the area was too fine to reliably capture tracks and we replaced the substrate with thick-grained construction grade sand mixed with water. We placed a total of eleven track-pads. Each of the barriers were equipped with two track-pads, one on either side of the barrier. Three additional track-pads were placed between barriers. Data collection occurred every week on Friday, coinciding with camera check-up times. The field team took a picture from above of the track-pad, if tracks were present, and then wiped the substrate flat. Any pictures with clear, defined tracks were sent for identification to the local wildlife tracks organization, Orange County Trackers.

V. Results

There were a total of 436 wildlife sightings from the seventeen usable cameras at the end of the study. Eight species in total were detected throughout the trapping period: coyotes (*Canis latrans*), bobcats (*Lynx rufus*), desert cottontails (*Sylvilagus audubonii*), raccoons (*Procyon lotor*), dusky-footed woodrats (*Neotoma fuscipes*), California ground squirrels (*Otospermophilus beecheyi*), fox squirrels (*Sciurus niger*) and humans (*Homo sapiens*). The two target species of interest are bobcats and coyotes. 397 of the 436 total sightings were composed of target species sightings. Of these, 396 of the sightings were coyotes while only one sighting was that of a bobcat.

There was approximately eighty sightings per week throughout the eleven locations. The locations with large numbers of sightings were at barrier bottlenecks. Location 6, located in a tunnel, had zero sightings while Location 1, which is near the Laguna Coast Wilderness Park, had the plurality of target species sightings. Notably, it was also the location where the single bobcat was seen. 68.3% of animal sightings occurred between sunset and sunrise while 83.3% of human sightings also occurred within this time. There is a moderate negative correlation between the percentage of daytime animal activity and total daytime human sightings.

Among the other species captured by the cameras, there were, in total: 28 cottontails, 4 raccoons, 4 squirrels, 3 woodrats, and 24 humans. Small mammal sightings are noticeably fewer at each location, when compared to the number of target species sightings. The data for the results were gathered solely from the camera traps as the trackpads failed to collect prints due to inadequate silty substrate.

Below are collaborated summarized results from the data period, with the two targeted species of interest being bobcats and coyotes.

VI. Discussion

As seen by the results, there is a moderate negative correlation between the times of greatest human daytime activity and that of animals. This can explain why the wildlife, with the exception of squirrels, seem to be using the corridor more during the night. However, if the time of day is disregarded, there is a weak positive correlation between human and animal sightings. This is slightly unexpected as we thought there might be a negative correlation between the two. This could be because human activity was fairly random and low density. The highest density of target animals was also at Location 1 whereas the highest density of humans was at Location 11, which are on opposite ends of the corridor. However, this information does not disregard the clear human presence throughout the corridor in the forms of heavy graffiti,

litter, and incidents where our cameras were stolen. The impact of human presence is also supported by the moderate negative correlation stated above.

Wildlife were sighted at ten of the eleven locations. Locations 1, 5, 8, and 11 have the most sightings and from the map, all of these locations are placed a fair distance from each other throughout Serrano Creek. Location 1 is at the entrance of the corridor while Location 11 is the last part of Serrano Creek before it enters the I-5 freeway. This appears to suggest that the wildlife are using the full length and expanse of the corridor despite redevelopment of the area. However, it is important to consider that this does not mean that the corridor is functioning as intended. There is still uncertainty whether the corridor is successfully facilitating gene flow between populations. There is also the matter of the unknown impact on specialist species. Coyotes are generalist species and can adapt to urban environments. For example, coyotes are diurnal but from our study, it is clear that coyotes have shifted to a more nocturnal lifestyle to avoid human presence. Bobcats, though, are specialist species.

However, this is not to say that there are no problems with coyotes. Several videos at Location 8 have shown coyotes staring at a large grate over a culvert and then turning and walking away instead of attempting to slip through. More concerning is the species composition of the detected wildlife. A vast majority of the total sightings are of coyotes, which was one of our target species. This indicates that the local coyote population has continued to utilize the wildlife corridor despite recent development, which is consistent with existing literature that states the coyotes are able to persist even in heavily developed areas. Unfortunately, the cameras were only able to capture one bobcat. It appears even more poorly in contrast to the last major study done in this area, the 2007 USGS Bobcat Study, which geo-tracked the movements of a number of bobcats and coyotes, to a lesser extent.

The USGS Study, whose study site overlapped with our study in the coastal area of the 405/5 freeway, had 47 bobcat sightings in 8 months. The authors also commented that several bobcats and coyotes suffered mortalities after encountering increased human presence due to the start of redevelopment in Orange County. Nine years later and our study has only camera-trapped one bobcat in two months of study. Bobcats are solitary and have a large home range and even if our study site included the range of only one bobcat, it should have been multiple times, not just once. This illustrates that increased redevelopment since 2007 has had an impact on the bobcat populations. While coyotes may have survived in urban areas, due to their generalist natures, bobcats might have had more difficulties in passing through the more urbanized wildlife corridor which accounts for their significant reduction in the corridor.

Generalist species, which can do well in human-caused habitat fragmented areas, are the primary users of the corridor as evidenced by the numbers of coyotes, raccoons, and squirrels. Specialist species, such as bobcats, woodrats, and cottontails tend to have more difficulties when encountering urbanization and significant human presence. One concept to consider is the vegetation of the corridor and its ends. The primary vegetation type of the

Laguna Coast Wilderness Park near the corridor is coastal sage scrub whereas that of the Limestone Canyon on the inland end of the corridor is coastal sage scrub and chaparral. However, the corridor itself was revegetated heavily with riparian vegetation, which is suitable for running along creek beds. Perhaps the difference in vegetation is negatively impacting the corridor for specialist species like bobcats.

In order to better understand the ineffectiveness of the wildlife corridor for bobcats, expanded studies are needed. One study that may be useful would be to camera-trap the area around the I-5 freeway in order to see if wildlife are successfully making their way completely. From our video at Location 8, coyotes are facing an increasing number of difficulties such as grates and other obstacles that come with more human development. Another potential study we recommend would be looking into either investing in the new, proposed wildlife corridor or to invest in a renovation of the existing wildlife corridor to assist the wildlife attempting to cross. Studying the effects of a new corridor might benefit fragmented wildlife communities.

With the study concluded, we have four recommendations. First, clear and specific goals must be needed before proposing any changes to the corridor. Is the corridor designed for generalist or specialist species? Is the corridor designed for all species or only medium-sized wildlife? Specific details are crucial before garnering enough political capital to justify any changes to the corridor. Second, the continuation of the camera trap study needs to incorporate trapping on both sides of the 5 freeway as well as GPS trapping in order to see if animals are moving continuously throughout the habitats of the corridor. Such telemetry data will be very useful in any corridor renovation proposals. Third, stronger barriers are needed along the corridor to keep humans out and to keep the wildlife in. The USGS study commented that bobcats were getting killed while attempting to use the streets and roads so appropriate fencing might reduce such casualties by forcing the bobcats to use the corridor instead of the road. Finally, it would be ideal to widen the corridor or to create a flyover to buffer humans as well as expand the coastal sage scrub habitat. Species would be more inclined to live along the corridor if the habitat had their preferred vegetation type, in this case, coastal sage scrub. However, coastal sage scrub does not grow well in tunnels or major drainage areas so this would require major infrastructure development for the corridor.

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VIII. Appendix

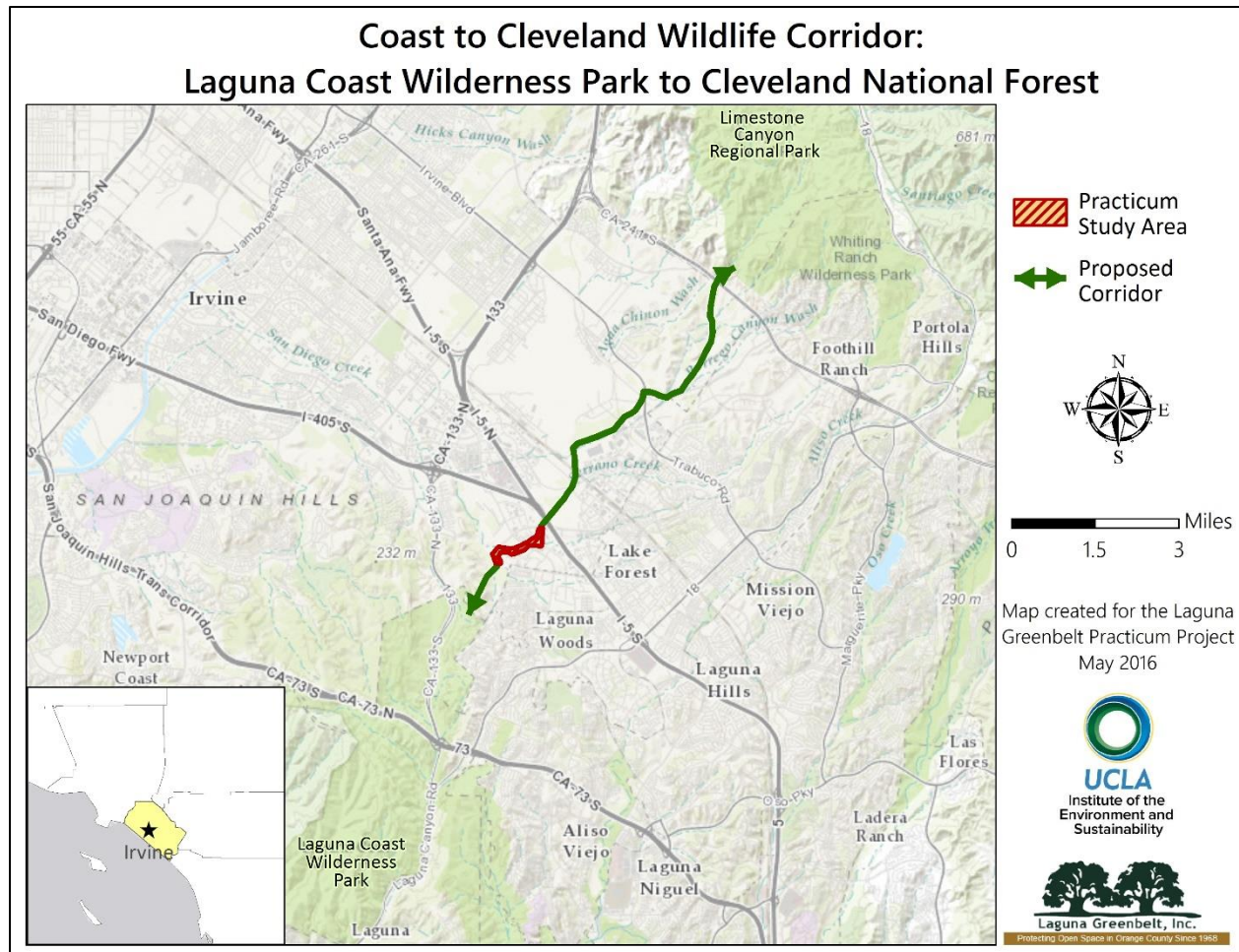


Figure 1: Map of the Area of Study – This map displays the Coast to Cleveland Wildlife Corridor in respect to the city of Irvine and Orange County. It also shows the particular segment of the corridor that was studied.

Camera Trap Methodology: Study Locations



Figure 2: Map of Camera Trap Locations – This map displays the locations of camera trap groupings throughout the study site. The dashed line represents an underground tunnel in which the Location 6 camera was placed.

Total Species Abundance	
Species	Total Sightings
Coyote*	396
Bobcat*	1
Desert Cottontail	28
Raccoon	4
Squirrel	4
Dusky-footed Woodrat	3
Humans	24
Total	436

Figure 3: Chart of Total Species Abundance – This chart details the species seen as well as their number of sightings throughout the study period.

Target Species by Location			
Location	Sightings/Week	% Day	% Night
1	28.8	22.2	77.8
2	4.6	30.4	69.6
3	6.3	36.0	64.0
4	8.0	68.8	31.3
5	16.3	46.2	53.8
6	0.0	0.0	0.0
7	1.3	30.0	70.0
8	5.0	47.5	52.5
9	1.6	46.2	53.8
10	1.8	28.6	71.4
11	5.9	10.6	89.4
Total	79.4	31.7	68.3

Figure 4: Chart of Target Species by Location – This chart shows, per location, the number of sightings per week as well as the percentage breakdown between day/night sightings.

Target Species by Time of Day		
	Coyotes	Bobcats
Daytime	126	0
Nighttime	270	1
Total	396	1

Figure 5: Chart of Target Species by Time of Day

Camera Trap Results: Target Species Sightings



Figure 6: Map of Target Species Sightings – This map shows the sightings per week of the target species at each location, giving an idea of natural bottlenecks in the corridor.

Small Mammals by Location			
Location	Sightings/Week	% Day	% Night
1	0.6	22.2	77.8
2	0.0	30.4	69.6
3	0.0	36.0	64.0
4	4.5	68.8	31.3
5	0.0	46.2	53.8
6	0.0	0.0	0.0
7	0.1	30.0	70.0
8	1.8	47.5	52.5
9	0.1	46.2	53.8
10	0.0	28.6	71.4
11	1.4	10.6	89.4
Total	8.5	31.7	68.3

Figure 7: Chart of Small Mammals by Location – This chart shows, per location, the number of sightings per week as well as the percentage breakdown between day/night sightings.

Small Mammals by Time of Day				
	Cottontails	Raccoons	Squirrels	Woodrats
Daytime	8	0	4	0
Nighttime	20	4	0	3
Total	28	4	4	3

Figure 8: Chart of Small Mammals by Time of Day

Camera Trap Results: Small Mammal Sightings



Figure 9: Map of Small Mammal Sightings – This map shows the sightings per week of small mammals at each location. Interestingly, small mammal presence is higher at areas where the target species' presence are lowest.

Humans by Location	
Location	Total Sightings
1	0.6
2	0.0
3	0.0
4	4.5
5	0.0
6	0.0
7	0.1
8	1.8
9	0.1
10	0.0
11	1.4
Total	8.5

Figure 10: Chart of Humans by Location – This chart shows the total sightings of humans at each location.

Total Human Sightings per Location



Figure 11: Map of Total Human Sightings per Location – This map shows the total number of humans seen per location.

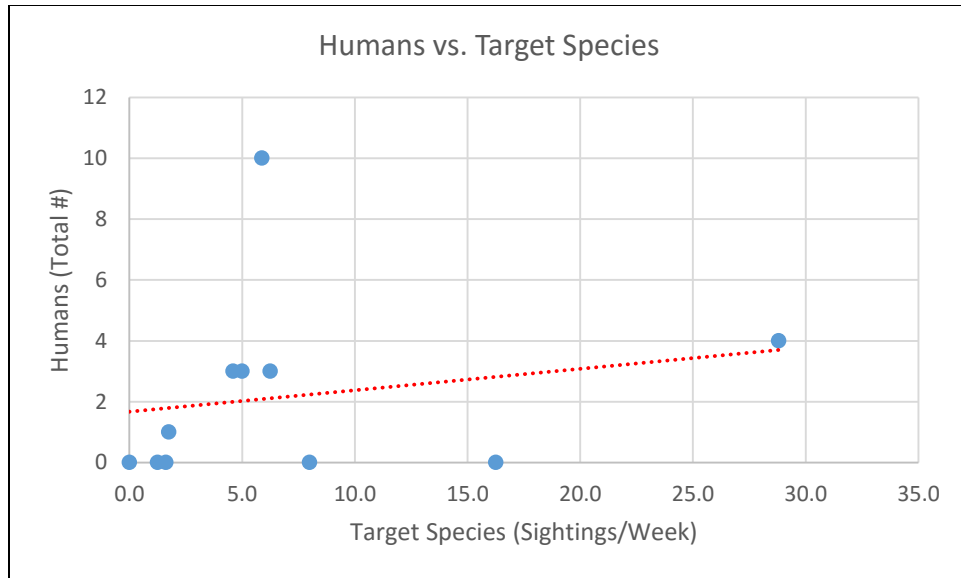


Figure 12: Graph of Humans vs. Target Species – This graph shows a slight positive correlation ($r = 0.23$) between the total number of humans and the sightings per week of the target species.

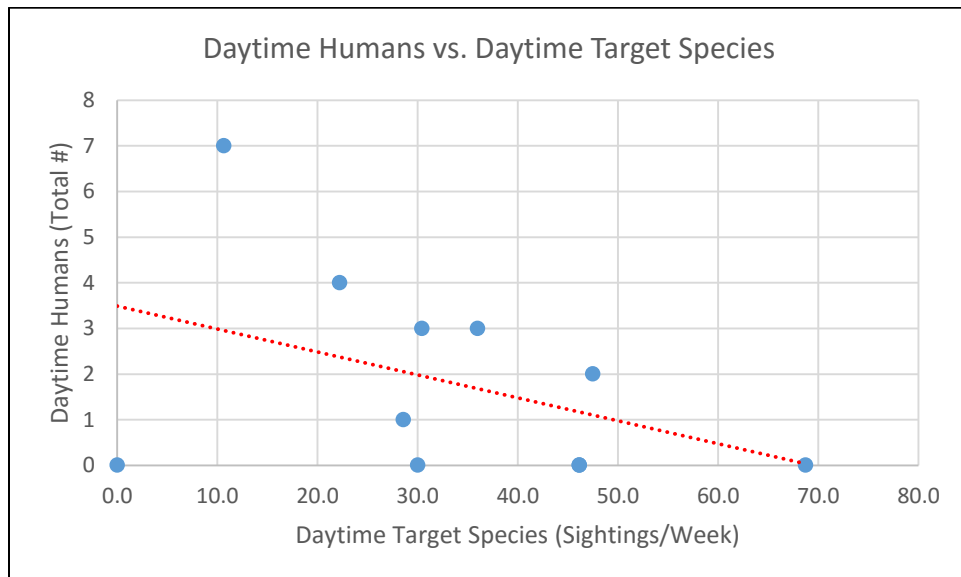


Figure 13: Graph of Daytime Human sightings vs. Daytime Target Species – This graph shows a moderate negative correlation ($r = -0.42$) between the total number of humans sighted in the day in respect to the daytime sightings per week of the target species.