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Exploration of the Range Overlap Between *Cynomys leucurus* and *Cynomys ludovicianus*

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Abstract

The ranges of two species of prairie dogs, *Cynomys leucurus* and *Cynomys ludovicianus*, overlap in a narrow area in the western Great Plains in Wyoming. We used GIS software to map their distributions and infer land cover preferences within and on either side of the zone of overlap. In general, both species used habitats in proportion to their availability and did not display strong selection of their expected vegetation types (based on the literature). However, both species of prairie dogs were overrepresented in areas of human settlements and crops, which may indicate that these species prefer human-modified habitats, or perhaps that more people look for prairie dogs in those areas.

Introduction

Prairie dogs belong to the genus *Cynomys,* which includes five species: *C. ludovicianus, C. mexicanus, C. parvidens, C. gunnisoni, and C. leucurus*. For this study, we focused on two of these species, *Cynomys leucurus* and *Cynomys ludovicianus,* also known as the white-tailed and black-tailed prairie dogs, respectively.

Today, *Cynomys leucurus* occupies part of the Rocky Mountains, including Wyoming, Eastern Utah, and Western Colorado (Clark et al. 1971). On the other hand, *Cynomys ludovicianus* occupies a much wider range that includes parts of the Rocky Mountains as well as the Great Plains, extending from Northern Montana to New Mexico, Texas, and parts of northern Mexico (Hoogland 1996). In general, the two species of prairie dogs live in different ranges and have several differences between them. For example, *C. ludovicianus*, the black-tailed prairie dog is more social in comparison to *C. leucurus*. *C. leucurus* also hibernates each winter and lives in higher and colder elevations than *C. ludovicianus* (Hoogland 1995). Even their habitats are different as *C. ludovicianus* lives in grasslands, while *C. leucurus* lives in shrubland (Hoogland 1996; Knowles 2002). The distinct zones of habitation exist today and have existed in the past as well. Historically, we see that during the Pliocene and Pleistocene, white-tailed prairie dogs tended to live in the Northern Great Plains, while the black-tailed prairie dogs tended to live in the Southern Great Plains (Goodwin 1995).

While the two species of prairie dogs occupy different ranges, there is a relatively narrow area between the Rocky Mountains and the Great Plains in Wyoming where the two species of prairie dogs overlap in their ranges. This is the zone that we are interested in for the present study because it may shed light on habitats and environments of the central Great Plains during the Pleistocene; unlike the narrow range of overlap today, *C. ludovicicanus* and *C. niobrarius* (a

fossil white-tailed prairie dog probably closely related to the modern *C. leucurus*) co-occurred broadly across the central Plains in the Pleistocene, with *C. niobrarius* also ranging to the north and northwest, and *C. ludovicianus* to the south (Goodwin 1995).

We mapped the locations of modern prairie dogs that were found within the past 160 years within Wyoming and reported in MANIS, an online database of mammal specimens. We characterized the habitat and environment in the narrow region of overlap documented in our map. We used ArcGIS [ESRI, Redlands, CA, a widely used geographic information system (GIS) software package in academia and industry] to analyze the environmental correlates of the distribution of each species, using digitally available land cover data. We then evaluated the area of overlap, where we expected to see a combination of habitat characteristics that are favorable to both species.

Our goal was to map distributions, document the region of overlap in more detail, and characterize the environment of the modern area of overlap so as to inform better understanding of fossil distributions. Some of our questions were: What does the distribution of prairie dogs look like in Wyoming and how broadly do the two species overlap? What are the environmental characteristics of the range of overlap? What vegetation types do we find each species to be associated with?

Methods

Preparation of Prairie Dog Data

Source of Prairie Dog Data

      In order to analyze the data about the prairie dogs, each individual prairie dog location was plotted onto a map of Wyoming. In the past, researchers would have had to travel to visit the various museums to inspect each sample and to make sure that they were legitimate. However, thanks to the modernization of museum collection databases, there is a searchable, online database that has the location information of two million mammals. This database is a program called Mammal Networked Information System, or MANIS, which was initiated with help from the National Science Foundation. We accessed this information on a website called www.manisnet.org. Because the main portal for this information was down for maintenance, we used an alternative portal called VertNet portal to access the same database. This database included information from 32 institutions, and has records of more than 2 million mammals. Using the advanced search options, we put Wyoming for the state/province, *Cynomys* for Genus, and *leucurus* and *ludovicianus* in for the Specific Epithet, separately. We obtained 406 results for both species combined, 289 for *Cynomys leucurus* and 117 for *Cynomys ludovicianus.*

Data Cleanup

      The downloaded results came out in text form, which we copied and pasted into an Excel sheet. I then removed unnecessary information and kept important features, such as catalog number, sex, year, state, county, locality, decimal coordinates, geodetic data, and scientific name.

Accuracy Check

After cleaning up the data, I attempted to check the accuracy of each data point by using a program called Google Earth. This involved two columns on the data spreadsheet: the decimal coordinates and the locality, which is a description of the location. For example, one locality was given as Hawk Springs, 6.8 mi E. To check accuracy of this site, we first had to locate Hawk Springs, and then used the measure tool to estimate 6.8 mi E of that location (following a road if available, given that most collection is done along roads) and to determine if they approximated the coordinates given in the database. Some locality description simply had town names, while others had more specific descriptions, such as how many miles east of a certain city the point was located.

Data Plotting in Spatial Analysis

After the data were cleaned up and records with poor location information were removed, locality data was imported into ArcGIS. After cleanup, we ended up with 380 records, 269 records for *Cynomys leucurus* and 111 records for *Cynomys ludovicianus.* Using ArcGIS, we created a 5 kilometer buffer around each point to account for the location uncertainty in the MaNIS database. We used this buffered area to estimate vegetation type associated with a given prairie dog locality in subsequent analyses. After the prairie dog points were plotted, we created 20 kilometer boundaries around each species range to visualize the range of each prairie dog and to visualize the area of overlap.

Preparation of Habitat Data

Land Cover

We obtained land cover data as a shapefile from National Land Cover Database 2001 (NLCD2001; http://www.mrlc.gov/nlcd01_data.php). The land cover data set contained 42 land

cover types. For analysis, we removed all those types that were never used by either species, such as alpine tundra, water, sand dunes, and permanent snow. We clipped the remaining land cover types to within 5 kilometers of each prairie dog point, using the 5 km prairie dog buffer.

Analysis

Species' Preferences

If a land cover category represented at least 5 % of habitat associated with either or both species, then we included it in our land cover analysis. As a result, we narrowed down from 42 to 11 land cover types. These land cover types included: mixed grass prairie, Wyoming big sagebrush, human settlements, irrigated crops, dryland crops, ponderosa pine, xeric upland shrub, greasewood fans and flats, desert shrub, mountain big sagebrush, and saltbush fans and flats. We also combined human settlements with irrigated crops and dryland crops into one major category, which we called human settlements and crops. This gave us 9 land cover types in the end. To determine the land cover availability and preferences, we graphed them to show land cover percent availability versus land cover usage. We did this for each species in the region where each species was alone, as well as in the zone of overlap.

Results

Prairie Dog Distribution in Wyoming

We obtained 380 records representing 178 localities for both species combined: 269 records and 136 localities for *Cynomys leucurus*; 111 records and 42 localities for *Cynomys ludovicianus.* There were 113 localities in the region with *C. leucurus* alone, 22 localities in the region with *C. ludovicianus* alone, 23 localities with *C. leucurus* in the area of overlap, and 20 localities with *C. ludovicianus* in the area of overlap.

As seen in **Figure 1**, most of the prairie dogs were evenly spaced out, except for some in Albany County in SE Wyoming, where there was a dense number of white-tailed prairie dogs. In the area of overlap, the distribution tended to be slightly clumped, with groups of prairie dogs found in nearby sites, with some spacing between clusters. White-tailed prairie dogs were present throughout much of western Wyoming, with prairie dogs extending into the SW direction. The distribution of black-tailed prairie dogs was generally throughout eastern Wyoming. We observed two areas of overlaps, one large one, and a smaller one to the NW. The latter may result from a southward range extension of *C. ludovicianus* from SW Montana.

Land Cover Associated with Prairie Dog Localities

The top three available land cover types associated with prairie dog localities in the nonoverlapping white-tail range were: Wyoming big sagebrush, desert shrub, and then mountain big sagebrush **(Figure 2a)**. The order for the top three most utilized land cover types for white-tailed prairie dogs in the nonoverlapping area was: Wyoming big sagebrush, human settlements and crops, and desert shrub. *C. leucurus* did not use Wyoming big sagebrush as much as predicted based on its availability. It was found in human settlements and mixed grass prairie more than expected based on availability of these land cover categories.

The top three available land cover types associated with prairie dog localities in the nonoverlapping black-tail range were: mixed grass prairie, Wyoming big sagebrush, and human settlements and crops **(Figure 2b)**. *C. ludovicianus* did not use mixed grass or Wyoming big sagebrush as much as much as predicted based on their availability. It was found in human settlements more than expected based on availability.

The top three available land cover types in the area of overlap were: mixed grass prairie, Wyoming big sagebrush, and human settlements and crops **(Figure 3).** The order for the top three most used land cover types for white-tailed prairie dogs in this region was the same as the order of the top three available land cover types. The order for the top three most used land cover types for black-tailed prairie in this region dogs was: mixed grass prairie, human settlements and crops, and then Wyoming big sagebrush. In the area of overlap, both *C. leucurus* and *C. ludovicianus* did not use mixed grass prairie as much as predicted based on its availability. *C. leucurus* used Wyoming big sagebrush as expected based on availability, whereas *C. ludovicianus* did not. Both species were found in human settlements more than expected based on availability.

Discussion

Prior work suggests that black-tails prefer grasslands, whereas white-tails prefer shrublands (Hoogland 1996; Knowles 2002). In the nonoverlapping areas of our study, *C. leucurus* was found most frequently in Wyoming big sagebrush and *C. ludovicianus* was found most frequently in mixed grass prairie, which is consistent with previous literature. In the overlapping area, both species were found most frequently in mixed grass prairie. However, except for *C. leucurus* in the area of overlap, neither species of prairie dog selected their expected land cover types as much as we would expect based on land cover availability. Both species were found more frequently associated with human settlements than predicted by availability of this land cover category in the overlapping and nonoverlapping regions. This may be because prairie dogs like to live in human modified environments, or perhaps that more people look for prairie dogs in those areas.

An interesting thing to note is the apparent preference of white-tails for mixed grass prairie, which is evident in the relative usage of this habitat type compared to its availability. One explanation why white-tailed prairie dogs are found so much in mixed grass could be that they actually prefer mixed grass, but because there is not a lot of mixed grass in the core of their range, they are not able to use it that much.

In the area of overlap, we observed unanticipated results. Both prairie dogs had a similar preference in land cover: the top three preferred land cover types for both species included mixed grass prairie, Wyoming big sagebrush, and human settlements and crops (although their order differed between species). We expected that black-tails and white-tails would have distinct land cover preferences, but in this area of overlap, we see that they seem to have similar preferences. This could be due to a few reasons, one of which could be because of small sample size. Because

we used the number of localities and not the number of prairie dog specimens, we had a limited number of data points to work with. Another possibility could be simply that both species of prairie dogs simply prefer mixed grass prairie as their choice of land cover when it is available.

In this study, we were able to generally answer several of our research questions. We documented how broadly the two species overlap in Wyoming and confirmed in general the distributions in Wyoming depicted in previous maps **(Figure 1)**. We also discovered that in the nonoverlapping areas, white-tails seem to prefer shrubs, whereas black-tails seem to prefer mixed grass, which is consistent with prior knowledge. However, we were not able to clearly determine habitat selection in the area of overlap that might explain their differences in distribution. This area of overlap needs to be more thoroughly characterized in future studies.

For future research, one could look at elevation or climate data and see whether the elevation or climate data are correlated with prairie dog ranges. One could focus on the question, "Why are prairie dogs more commonly found in prairie dogs settlements than expected?" or "What are the factors that tend to keep black-tailed and white-tailed species of prairie dogs in separate regions?" One way to directly improve this study would be to have more data points in Wyoming. One would collect field data in Wyoming by observing prairie dogs and noting where prairie dogs were spotted. Collecting more data points would give much more insight into the land cover preferences of prairie dogs. We also know that white-tails and black-tails occupy a wider range than that simply in Wyoming. One could repeat the steps of this research project, but include states outside of Wyoming for more points. This may not give much insight into the land cover preferences in the area of overlap, because most of the overlap occurs in Wyoming, but it would give insight into the land cover preferences of prairie dogs in nonoverlapping regions.

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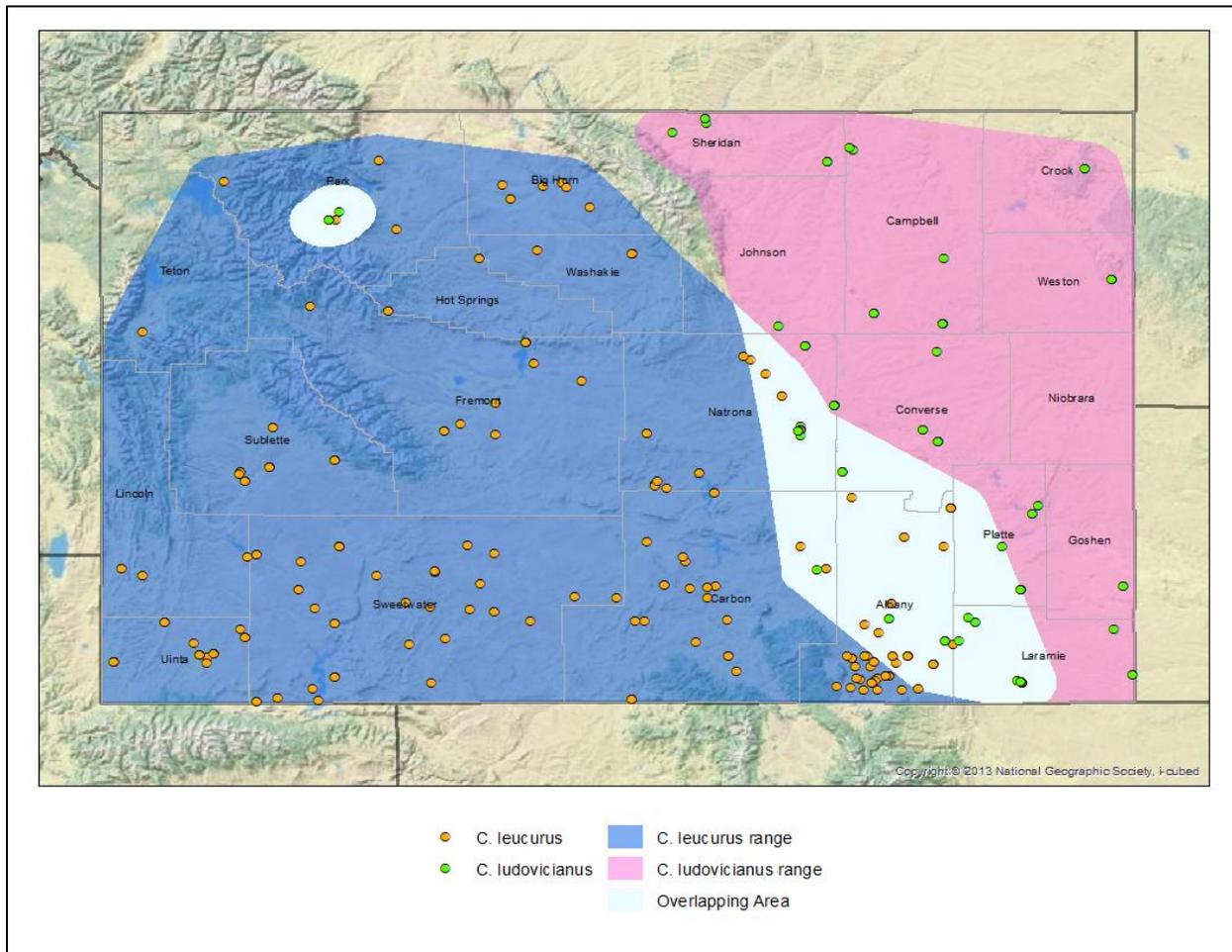
Figure 1. Distribution of *C. leucurus* and *C. ludovicianus* in Wyoming. The localities of 178 prairie dog records are plotted in this map, 136 for *C. leucurus* and 42 for *C. ludovicianus*, based on specimen records from the MaNIS database.
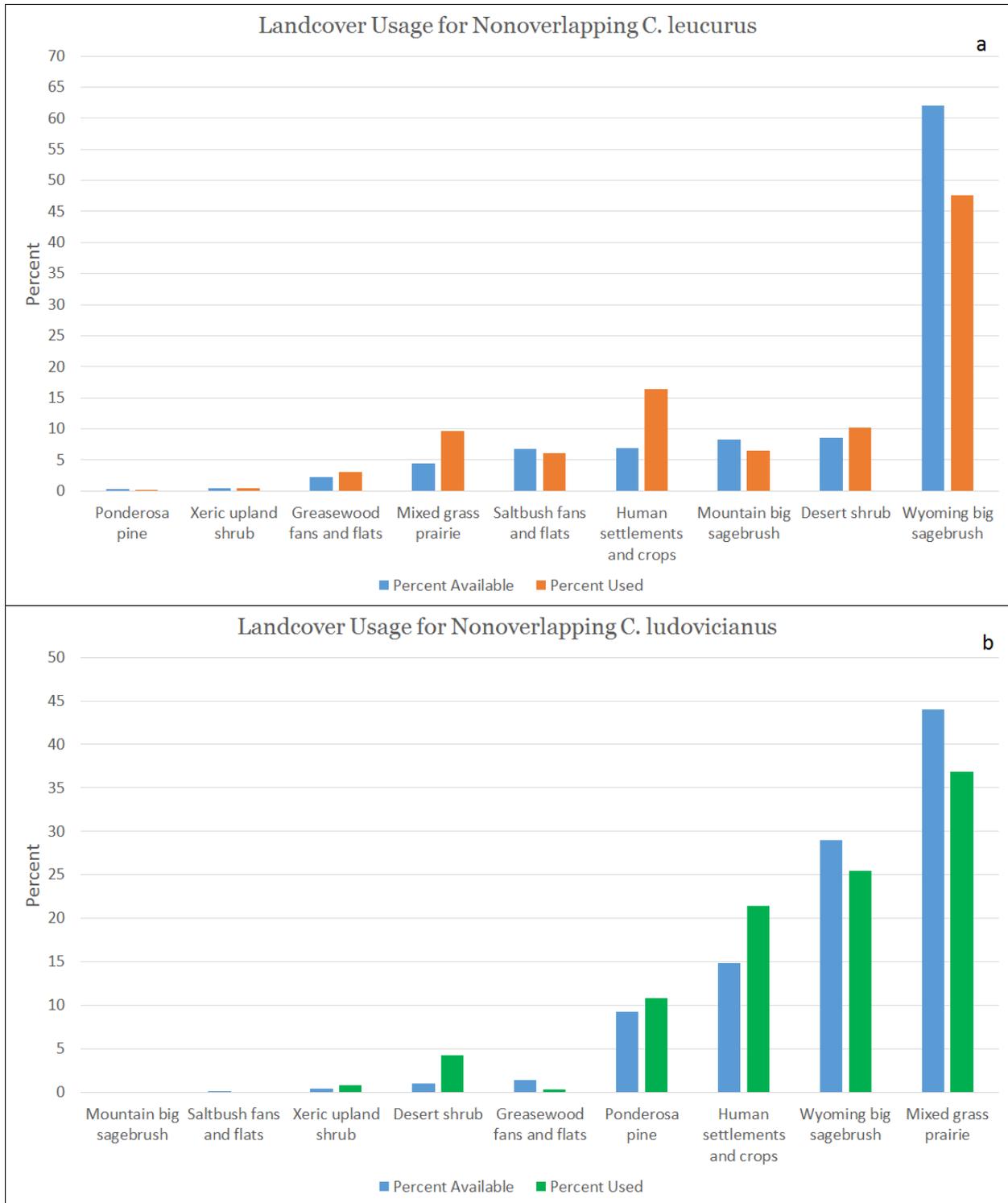
Figure 2. Land cover usage in nonoverlapping areas. 2a) The percent of land cover types available and used by *C. leucurus* in the nonoverlapping area are shown in bar graph form. 2b) The percent of land cover types available and used by *C. ludovicianus* in the nonoverlapping area are shown in bar graph form.
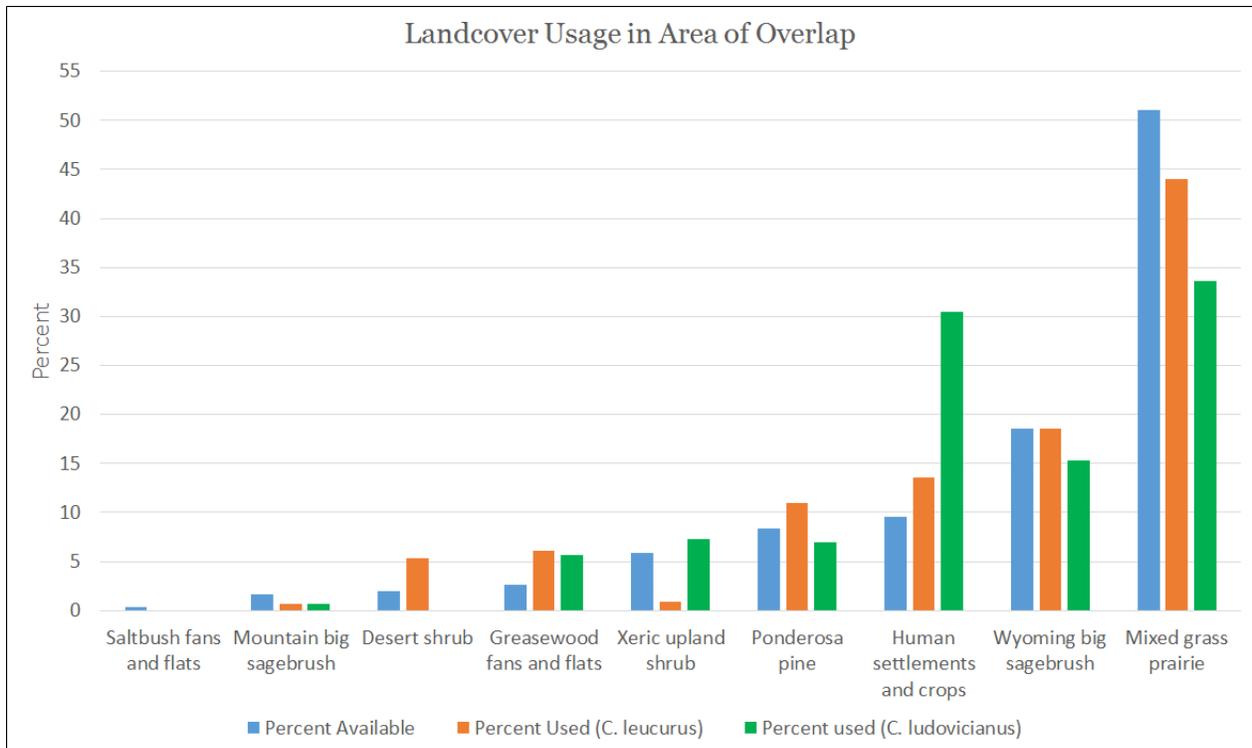
Figure 3. Land cover usage in area of overlap. The percent of land cover types available and used by both *C. leucurus* and *C. ludovicianus* in the overlapping area are shown in bar graph form.