FY 2018 Predator Report Appendix

Project 22-01 and 37 comments

Annual Predator Management Project Reporting From

Please fill out this form to the best of your ability. If you have questions please contact Predator Management Staff Specialist Pat Jackson at Pjackson@ndow.org or 775-688-1676. If necessary please use additional pages in your responses.

1. Fiscal Year Reporting: **1 July 2017 – 30 June 2018**
2. Date Report Submitted: **7/1/2018**
3. Name of Contractor (include name of submitter if different): **Brian Jansen**
4. Address of Contractor:
5. Phone Number of Contractor:
6. Email of Contractor:
7. Contract Number: **3269**
8. Dates of Contract: **1 July 2017 – 30 June 2018**
9. Dates Worked:

Jacobs: (11/4-9/2017), (11/27-12-2/2017), (12/13-19/2017), (12/28-30/2017), (1/3-6/2018), (1/11-14/2018), (1/19-23/2018), (1/30-2/2/2018), (2/12-13/2018), (2/23-24/2018), (3/13-16/2018) = 47 days

Anderson: (11/29/2017) (12/14, 16, 17, 18, 19/2017) (1/3, 4, 5, 6, 20, 22, 23, 24/2018) (2/12, 23, 27, 28/2018) (3/3, 5, 9, 17/2018) (4/8/2018) = 23 days

Jansen: (8/16-9/16/2017) (5/17-29/2018) (6/9-19/2018) (6/24-30/2018) = 63 days

10. Assessment of Habitat Conditions of Project Area (if applicable):

Delamar Mountains are being severely impacted by feral horses in the central 1/3 of the range. In particular, Willow Creek, Narrow Canyon, Upper Kane Springs Canyon, and Cedar Wash have been damaged severely. The northern 1/3 of the range has localized damage by feral horses, most notably in the vicinity of Springs. The northern central parts of the range also contain many maverick cattle which are severely damaging vegetation. These cattle are unbranded and unmarked, feral cattle. The vegetation at springs, which should consist of lush grasses, forbs, and trees is non-existent. The horses and cattle have trampled every spring into a mud hole surrounded by wide berth of bare dirt. This year, it seems the horses have moved in on Jumbo Spring, as I didn't notice them last year. Last year, there was spring-side vegetation at Jumbo and this year, it is mud and bare dirt.

It seems like the deer sign has increased, or at least in the pockets where deer are, I notice much more sign than last year. Elk sign, seems to be restricted to the area around Jumbo Spring.

11. Briefly describe work conducted:
In the Jackson Mountains, Massacre Rim, Vya Rim, and Calico Mountains, we hunted for mountain lions and killed any that were captured.

In Delamar Range, we began the fiscal year, by lethally removing a few lions but then switched to capture, collar, and follow program. We live-captured mountain lions and chemically immobilized them and deployed satellite transmitting GPS collars on the animal. We then followed the animals to document what prey species they were using, in an effort to reduce predation on bighorn, while allowing for predation on the overabundant feral horses.

12. List number and species of predators removed.
Lethally removed 6 mountain lions in the Delamar, Jackson, and Massacre Rim areas. Captured and collared 6 mountain lions in the Delamar Range.

13. Provide an overall assessment of project. In your opinion should the project continue?

Predation management should continue on all areas, because ungulates do not increase rapidly and it takes time to observe the positive effect of predation control. In the Delamars, we are just beginning to understand the real predation pressure on feral horses and after a year, I think NDOW could make a responsible decision to continue collaring because they are preying upon horses adequately or that horse predation is low and the high numbers of deer being taken warrant a serious look at possibly just lethal removal of lions to aid in the deer population recovery, if it is found that the anticipated predation level on horses is too low to impact the horse population.

Project 32 Report

Project 32 Final Report to Nevada Department of Wildlife

Project Title: Re-colonization of Large Carnivores and Resulting Species Interactions: Effects on Predation Behavior and Implications for Prey

Jon Beckmann, Brian Wakeling, Pat Jackson, Carl Lackey, and Cody Schroeder

24 October 2018

Introduction

As with many areas in western North America, changes in species composition and predator-prey interactions occurred throughout the Great Basin upon arrival of settlers. In the Great Basin of Nevada, shifts in vegetation structure and composition occurred, with an expansion of browse at the expense of grazing land, largely thought to be due to grazing of vast numbers of livestock (Gruell and Swanson 2012). While these post-settlement disturbances had a drastic negative effect on bighorn sheep (*Ovis canadensis*) and pronghorn (*Antilocapra americana*) populations, mule deer (*Odocoileus hemionus*) responded favorably to the expanding browse and populations increased, presumably followed by increased numbers of cougars (*Puma concolor*) in the Great Basin (Berger and Wehausen 1991; Gruell and Swanson 2012; Woolstenhulme 2005). During the same time, black bears (*Ursus americanus)* and grizzly bears (*Ursus arctos*) were extirpated from the Great Basin of Nevada through targeted removals due to conflicts with humans, their livestock, and changes in land use patterns over the past century. As a result, cougars have been the apex predator in the Great Basin for the past 80+ years in the absence of bears and their primary prey, mule deer, now an important game species in Nevada, are in decline across the West (Robinson et al. 2002; Figure 1).

Historical records indicate viable populations of both black bears and grizzly bears were extirpated from Nevada by the early 1900s due to several anthropogenic factors, including alterations of forested habitat at a landscape scale during the mining booms at the end of the 19th century (Lackey et al 2013). Specifically, the Comstock Lode era beginning in the 1860s where massive swaths of forests were cut in the eastern Sierra Nevada for use by the pioneers and in the underground mines (Nevada Forest Industries Committee 1963, DeQuille 1947). Habitat regeneration due to changes in forestry practices and a post-1920s decline in the reliance on wood as a source of fuel was one reason the bear population in western Nevada initially began to increase and recolonize historic habitat in the 1980s. This

recolonization was enhanced by management and conservation efforts over the past 30 years (Beckmann and Berger 2003; Beckmann and Lackey 2008; Lackey et al. 2013). Yet, even in the early 1980s black bear sightings, management issues, and bear deaths from vehicles were considered very rare events in Nevada (Goodrich and Berger 1994). In 1979 the director of NDOW stated at the first Western Black Bear Workshop: "*Nevada has no bear, except for an occasional one that strays in along the Sierras adjacent to Lake Tahoe in California. Therefore, we have no management responsibilities.*" (LeCount 1979).

However, black bears are now undergoing a re-colonization process back into historic ranges in the Great Basin, particularly over the past 30 years (Lackey et al. 2013; Figure 2). In many regions across the globe, recovery of extirpated populations of large carnivores is extremely difficult and rarely accomplished due to a variety of factors, one of which is the large-scale space that carnivores must have to live on the land. This is particularly true for apex predators, such as bears, that have large home ranges and occur at low densities, especially in arid landscapes. Thus being able to successfully recover large carnivore populations and maintain those recovered populations requires: 1) identifying threats to their existence across the landscape at large scales; 2) mitigating those threats; and 3) monitoring population responses over large scales of space and time in response to management and conservation efforts. The latter includes an understanding of predator-predator interactions, space use, and relationships of top predators to prey populations.

Data from a five-year study from 2009-2014 on cougars in the western Great Basin and eastern Sierra Nevada range indicated that cougars have frequent interactions at cougar kill sites where black bears take over and scavenge prey carcasses from cougars (Andreasen, unpublished data; Figures 1, 2 & 3). We anticipate that under certain conditions these competitive interactions between black bears and cougars may have non-negligible effects on cougar predation behavior resulting in increased human-cougar conflicts and impacts on mule deer populations, while simultaneously facilitating recolonization of black bears into historic ranges.

While there have been conservation successes in re-establishing carnivores in North America, and subsequent increases in biodiversity, most of these successes have occurred in national park or other protected area settings where the majority of our knowledge of large carnivores has been established. However, these 'pristine' and highly protected landscapes comprise only a small proportion of total lands in North America, and findings from research in national parks likely have little relevance in working landscapes: the remaining checkerboard of public and private lands outside of urban areas, where humans live, work, trap, hunt, and make a living from ranching, farming, and other endeavors—and where large carnivores are difficult to conserve because they conflict with humans and human economies. To adequately manage large carnivore populations outside of protected areas and secure their ecological roles it is imperative to: 1) gain an ecological understanding of large carnivores and their interactions outside of protected areas; 2) understand what factors facilitate or impede natural expansion into historic ranges; and 3) understand how re-expansion into historic ranges will subsequently impact existing carnivores and prey as well as conflicts with humans. The Great Basin of Nevada, where we recently documented the recolonization of black bears into historic ranges (Beckmann and Lackey 2008; Lackey et al. 2013;

Figures 1 & 2), is comprised of over 80 percent public land, with multiple land uses including grazing allotments, hunting, trapping, and outdoor recreation, and thus provides an ideal study system to test predictions pertaining to carnivore re-colonization, conflict, and impact on prey populations in working landscapes.

Because black bears are recolonizing historic ranges relatively quickly in the western Great Basin, we had a narrow window of opportunity to understand the effects of these competitive interactions and subsequent effects on existing biota where cougars and mule deer are simultaneously present at higher densities than historic levels. Given that bear populations are increasing in number and geographic extent in almost all 35+ states in which black bears occur, species like grizzly bears are now beginning to expand into parts of the northern U.S. Rockies outside core areas of Yellowstone National Park, and cougar populations are also expanding eastward across the United States into historical habitat, much of these data will be key and useful to management of large carnivores and the prey populations they impact not only in Nevada but throughout the West (Williamson 2002). Further, given that many mule deer populations are currently declining throughout the West, understanding dynamic predator-prey systems will become even more imperative in the near future.

While data suggest that a single predator in a single prey system is unlikely to cause a decline in ungulate prey populations, the addition of a second predator or prey species can substantially shift predator-prey dynamics such that prey are more likely to be held at low densities by predators (Messier 1994). Thus, black bears that are re-colonizing historic ranges may substantially alter predator-prey dynamics (indirectly through competitive interactions with cougars), effectively acting as a second predator on mule deer populations. For instance, if bears aggressively usurp kills from cougars (i.e., kleptoparasitize), energy loss directly attributable to loss of food items is expected to result in increased kill rates for cougars (Murphy et al. 1998; Krofel et al. 2012). Cougars may also compensate for food losses by including additional prey items in their diet (i.e., bighorn sheep; Bolnick et al. 2010) or switching to prey items that are less energetically costly to capture (i.e., domestic livestock; Krofel et al. 2012). Here we test the prediction that these mechanisms cougars may use to compensate for food losses will likely increase with increasing densities of bears, thus leading to a potential increase in predation on mule deer and an increase in conflicts with humans. However, if bears passively scavenge after cougars voluntarily abandon their prey, then black bear re-colonization into historic ranges is unlikely to affect cougar predation behavior/rates or mule deer populations. Determining such subtleties in behavioral interactions is necessary to understand how bears that are currently recolonizing historic ranges may affect cougar population dynamics, cougar predation behavior, and both indirectly and directly affect mule deer populations.

Methods

Study Area

We captured cougar and bears (Figures 4 & 5) in the far western edge of the Great Basin and the eastern Sierra Nevada in three adjacent mountain ranges: 1. The Carson Range and Peavine Mountain are approximately 860 km² within the Sierra Nevada, 2. the Virginia Range (980 km²) and 3. Pine Nut Range (1,110 km²). The latter two ranges are more characteristic of the arid Great Basin. Cougars caught opportunistically in valley bottoms and nearby mountain ranges (Pah Rah Range, Dogskin Mountain, and Wellington Hills) also were included. Cougars in these areas have been identified genetically as a single subpopulation (Andreasen et al. 2012). These mountain ranges are characterized by steep topography with high granite peaks and deep canyons, and are separated by desert basins ranging from 15 to 64 km wide that represent expanses of sagebrush (*Artemisia* spp.) that bears and cougars use infrequently (Beckmann and Berger 2003, Andreasen et al. 2012). As a result, suitable habitat in the Great Basin is insular and naturally fragmented (Grayson 1993, Beckmann and Berger 2003). Mule deer are the primary ungulate prey available in the Sierra Nevada, whereas ungulate prey in the western Great Basin includes mule deer and free-ranging horses (*Equus ferus*), and small isolated populations of bighorn sheep and pronghorn.

Cougar Captures

We captured and marked cougars between January 2015 and December 2017 and monitored marked cougars through 2018. We used standard methods for initial capture of individuals including treeing with trained hounds, use of box traps, and to a lesser extent free-range darting (Bauer et al. 2005; Figure 5). Box traps set by researchers were monitored continuously with cellular trail cameras (Moultrie®) and very high frequency (VHF) monitors (Advanced Telemetry Systems, Isanti, Minnesota) such that animals were removed from our traps within two hours from time of capture. In addition to standard capture methods, we also released and collared cougars incidentally captured in steel foothold traps set legally to capture bobcats by licensed trappers when those trappers contacted NDOW for assistance releasing animals from those traps. In these cases, trappers indicated foothold traps were last checked within 96 hours or less ($\leq$ 4 days) from time of reporting. Because collaring cougars caught in non-target foothold traps occurred only when trappers requested assistance from NDOW, and collaring occurred as part of that release process, collaring did not result in cougars remaining in traps any longer than they otherwise would be if assistance from NDOW personnel was requested.

We chemically restrained cougars weighing over 7 kg with ketamine (2.2 mg/kg) plus medetomidine (0.075 – 0.088 mg/ml) administered with a dart projector (Pneu-Dart, Williamsport, PA) or syringe into the shoulder or hind-quarters, and reversed the cocktail with a hand injection of atipamezole (up to 0.3 mg/kg; Kreeger and Arnemo 2002, Scognamillo et al. 2003). We monitored body temperature, pulse, and respirations of cougars during processing, and we cooled or warmed cougars if body temperature deviated from normal. We marked cougars with an identifying ear-tag in one ear, a permanent tattoo in the other (bunnyrabbit.com), and each was implanted with a passive integrated transponder tag (PIT tag; Biomark, Boise, ID). We determined sex and estimated age of cougars based on dental characteristics including coloration and wear (Ashman et al. 1983, Shaw 1983) and gum-line recession (Laundré et al. 2000). We classified cougars as kittens (< 12 months), yearlings (12-24 months), or adults (>24 months). We maintained visual contact with sedated cougars until they left the capture site. We maintained safe handling protocols described by the American Society of Mammalogists (Sikes et al. 2016), as closely as possible where cougars were released from bobcat traps.

Bear Captures

We captured bears both in response to human-bear conflict reports and in backcountry areas using methods previously described in Beckmann and Berger (2003) and Lackey et al (2013). During this study we targeted bears for capture whose home ranges overlapped known, radio-marked cougars, specifically to address the questions pertaining to interspecific interactions, in three study areas in western Nevada with varying densities of bears (Carson Range: high density of bears; Pine Nut Range: medium density of bears; Virginia Range: low density of bears; see Figures 1 & 6). To have the highest probability of overlap among individuals of each species, we captured cougars first during January-March of each year and subsequently captured black bears within home ranges of collared cougars during the active season for bears (approx. March-October). To further maximize probability of recording carnivore-carnivore interactions, we monitored kill sites of collared cougars with real-time trail cameras and targeted black bears scavenging from cougars for collaring with GPS proximity collars (Figure 3).

Captured black bears and cougars were fitted with Vectronic brand GPS PLUS collars with Proximity sensors to assess behavioral responses of each species upon close interaction (Figures 6 & 8). Collars were programmed to take 1 fix every 15 seconds when a collared bear and collared cougar were within 200 meters of each other and 1 fix approximately every 3 hours otherwise. Mule deer were fit with Vectronic brand GPS PLUS Vertex Survey collars to monitor daily survival of individuals and to estimate annual adult doe survival in each study area (Figure 7).

Results

From January 2015-January 2017, we collared a total of 10 adult cougars (7 females, 3 males) across all three study area mountain ranges. We also deployed GPS PLUS Proximity collars on 30 bears captured from 2015-2017. Of those 30 bears, their capture locations were split approximately evenly between the Carson Range and the Pinenut Range, with one bear collared in the Virginia Range (small sample size in Virginia range is a reflection of the very low density of bears in the range). During the study, the GPS PLUS Proximity collars were successful in acquiring data on black bear-cougar interactions, linked successfully and functioned as planned when animals were within 200 meters generating simultaneous location and movement data on both the cougar and bear (Figure 8). However, we recorded less than 20 of these interactions real-time via the proximity collars.

Cougar kill-site data

During summers 2015-2017 field crews from NDOW and WCS identified close to 1000 kill sites by cougars using GPS cluster analyses and collected direct field data from >600 of those kill sites (Figure 9). We were focused on collecting data from kills made by cougars during the

active period of bears (1 March-1 November each year), thus the sample size of visited kill sites is smaller than the total number of identified cougar kill sites. However, we did also visit and collect data from cougar winter kill sites as time allowed once summer kill-site data collection was finished each year. These data are currently be used to estimate kill rates by cougars during the active bear season, prey species selection and level of bear-lion interactions (i.e. bears scavenging rates at cougar kill sites) across varying levels of bear densities in the study area. These data are in addition to the already existing dataset consisting of over 1000 kills made by 21 collared cougars in Nevada from 2009-2014 (Andreasen 2014). The kill site data (i.e. kill-rate, prey species selection, etc) suggest that, on average during summer months when bears are active, 50 percent of cougar-killed deer are scavenged by black bears where bears are present (Beckmann and Berger 2003; Beckmann and Lackey 2008; Beckmann et al. 2004) at moderate to high densities (Figures 1, 2, and 3). Currently we are working on multi-variate analyses to model cougar kill rates and prey selection to disentangle the impact of varying densities of bears, bear scavenging rates, habitat features, prey availability (i.e. deer, bighorn, and horse densities by habitat type), cougar sex, body condition (body mass) and reproductive status (i.e. kittens present or not). These analyses should be completed by summer 2019 and submitted to a peer-reviewed journal following review by all co-authors, including NDOW staff.

Location Data

To-date, for Project 32 animals we have collected over 35,000 GPS location data points from cougars in western Nevada; over 60,000 GPS locations from collared bears in western Nevada; and cougar diet data from over 600 documented predation events.

Creating Habitat Maps for bears and cougars using Resource Selection Probability Function (RSPF) Models

Using 20,000+ location data points from GPS collars that were attached to 7 male and 17 female black bears in backcountry regions of the Carson and Pinenut Mountain Ranges or at the urban-wildland interface, we modelled and mapped core habitat areas for black bears using Resource Selection Probability Function (RSPF) Models (see Figures 10 & 11). The RSPF analyses allowed us to estimate and map probability of habitat selection/use across the study site, allowing for predictions of habitat 'hotspots' for black bears as the population continues to expand and colonize new areas. Additionally, these models are scalable such that models/maps can be zoomed into specific areas of interest for assessing habitat selection probabilities. One product of this project will be to compare cougar-bear interactions (i.e. cougar kill rates, kill sites, bear scavenging rates at cougar kill sites, and cougar prey selection) across the various habitats that bears use based on the RSPF models. We will also develop RSPF models for cougars. These models and resulting maps (estimated completion date of late 2019 to early 2020 for cougar models and manuscript) will also help in black bear and cougar management by NDOW now and in the future.

Conclusions

This research has and will continue to 1) identify factors important in the restoration/natural re-colonization of black bears into historic ranges and important habitat for black bears and cougars across Nevada. In addition, this research allowed us to 2) obtain data that can be used by the Nevada Department of Wildlife to guide and direct regulation of hunting. For example, understanding how interactions between cougars and black bears affect population dynamics of each other and/or mule deer is important for sustainable use (i.e., sport harvest) for all three of these big game species in Nevada. For instance, scavenging by bears may affect reproductive output, survival, and recruitment of cougars and is important to understand since these populations will likely be different (i.e., lower) than models based on prey availability or harvest statistics alone would predict, particularly in fragmented habitat. Further, black bears that are re-colonizing historic ranges may substantially alter predator-prey dynamics (indirectly through competitive interactions with cougars), effectively acting as a second predator on mule deer populations; an important consideration because mule deer are in decline in several areas throughout Nevada and are an important big game species. Finally, long-term data sets, particularly pertaining to large carnivores that evoke polarized emotions, help to ensure management decisions can be grounded in the best available science.

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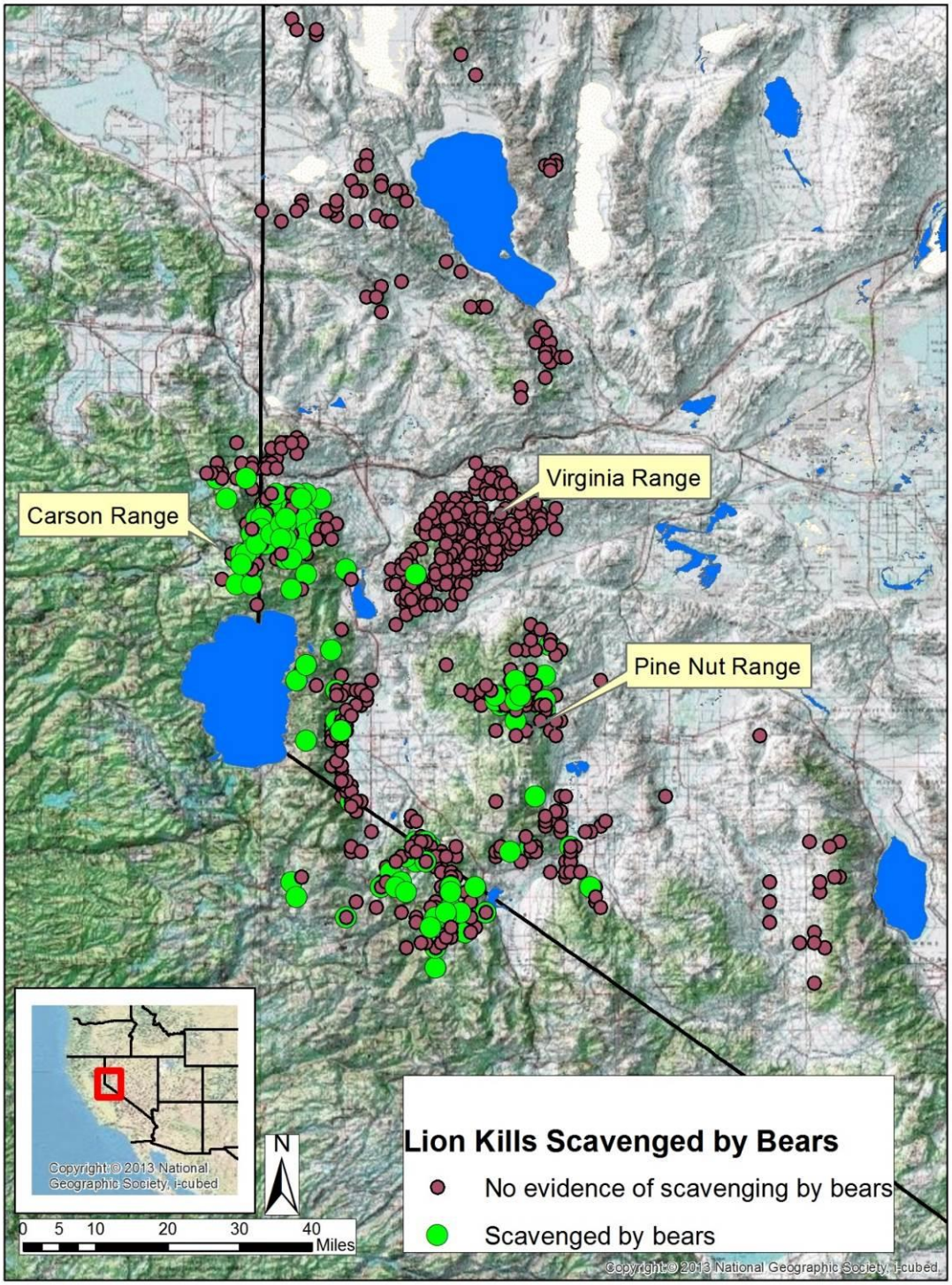

Figure 1. Western Nevada study site with cougar kills found between 2009 and 2012 (n = 803), including kills where scavenging by black bears was recorded in the Carson Range (bears = high density), Pine Nut Range (bears = moderate density), and Virginia Range (bears = low density).

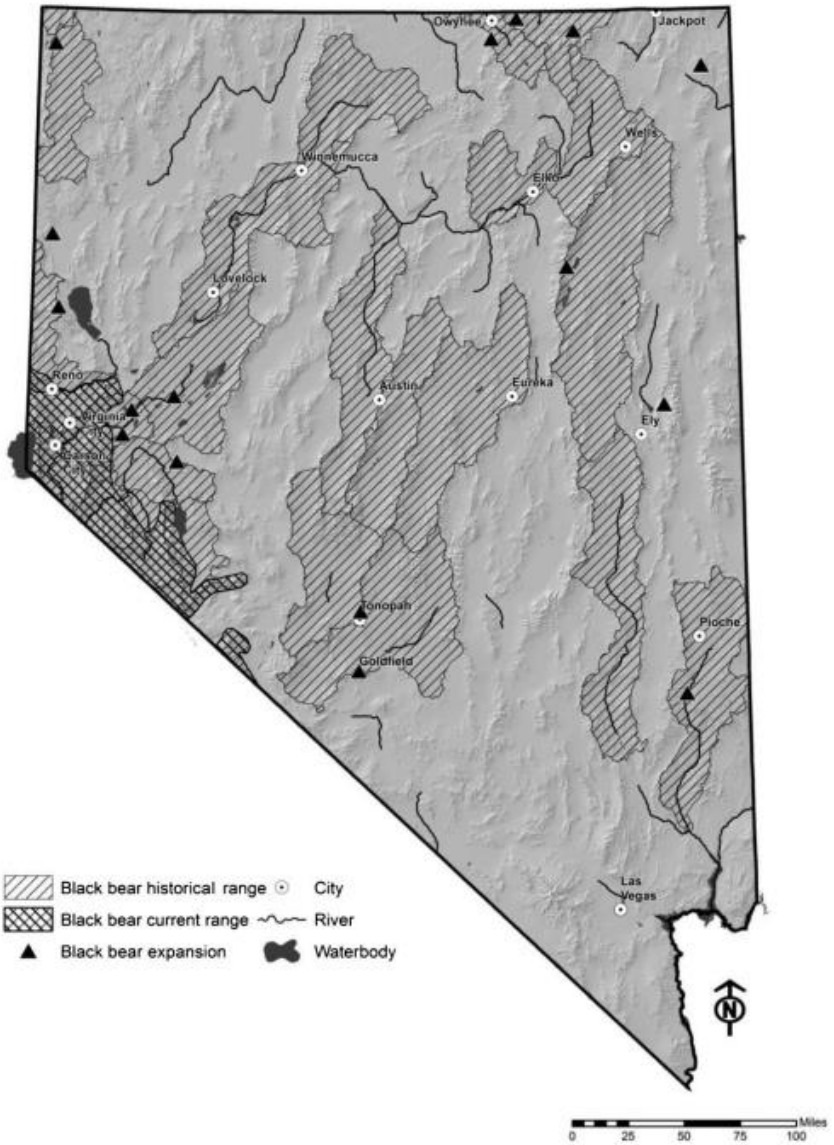
Owyhee
Jackpot
Wells
Winnemucca
Elko
Lovelock
Reno
Virginia City
Carson City
Austin
Eureka
Ely
Tonopah
Goldfield
Pioche
Las Vegas
Black bear historical range
Black bear current range
Black bear expansion
City
River
Waterbody
N
0
25
50
75
100
Miles

Figure 2. Map showing historical black bear habitat where bears were present and their current range (from Lackey et al. 2013).

Figure 3. Black bear scavenging from kill made by collared cougar. Photo from real-time camera.

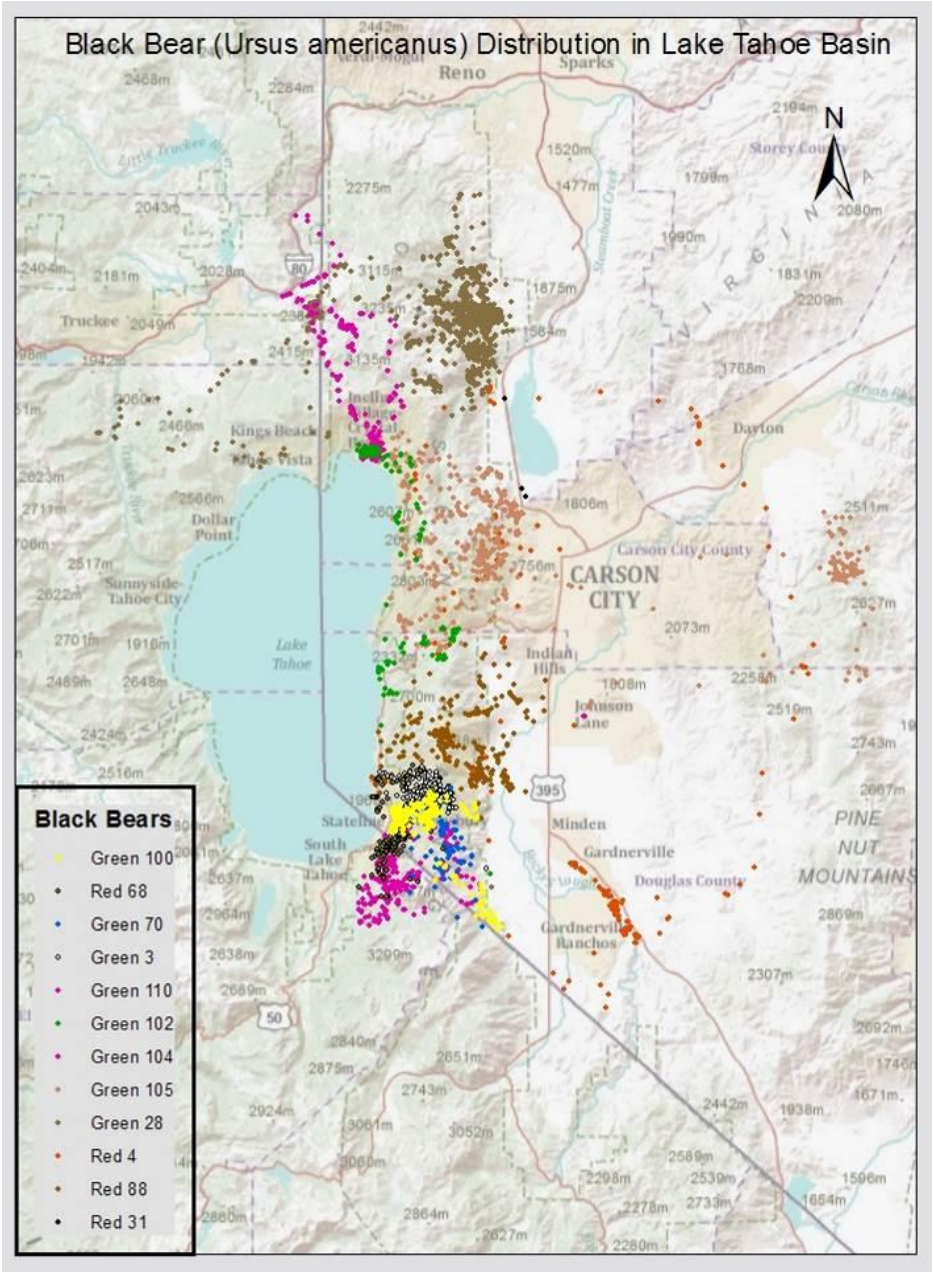
Black Bear (Ursus americanus) Distribution in Lake Tahoe Basin
N
Reno
Sparks
Truckee
Kings Beach
Dollar Point
Sunnyside-Tahoe City
Lake Tahoe
Incline Village
Dayton
Carson City County
CARSON CITY
Indian Hills
Johnson Lane
Minden
Gardnerville
Douglas County
Gardnerville Ranchos
South Lake Tahoe
PINE NUT MOUNTAINS
Black Bears
Green 100
Red 68
Green 70
Green 3
Green 110
Green 102
Green 104
Green 105
Green 28
Red 4
Red 88
Red 31

Figure 4. GPS locations from 12 black bears collared in western Nevada as an example of the GPS data used in this project.

Figure 5. Cougar bayed up tree in Great Basin study area with trained hounds (top left); cougar being fitted with GPS collar (lower left); reversal being administered (top right); six-week-old cougar kitten being measured and fitted with expandable telemetry collar at birthing den (bottom right).

Figure 6. Black bear collared with GPS collar in study area.

Figure 7. Mule deer collared and released in western Great Basin study area. Photo © Cody Schroeder.

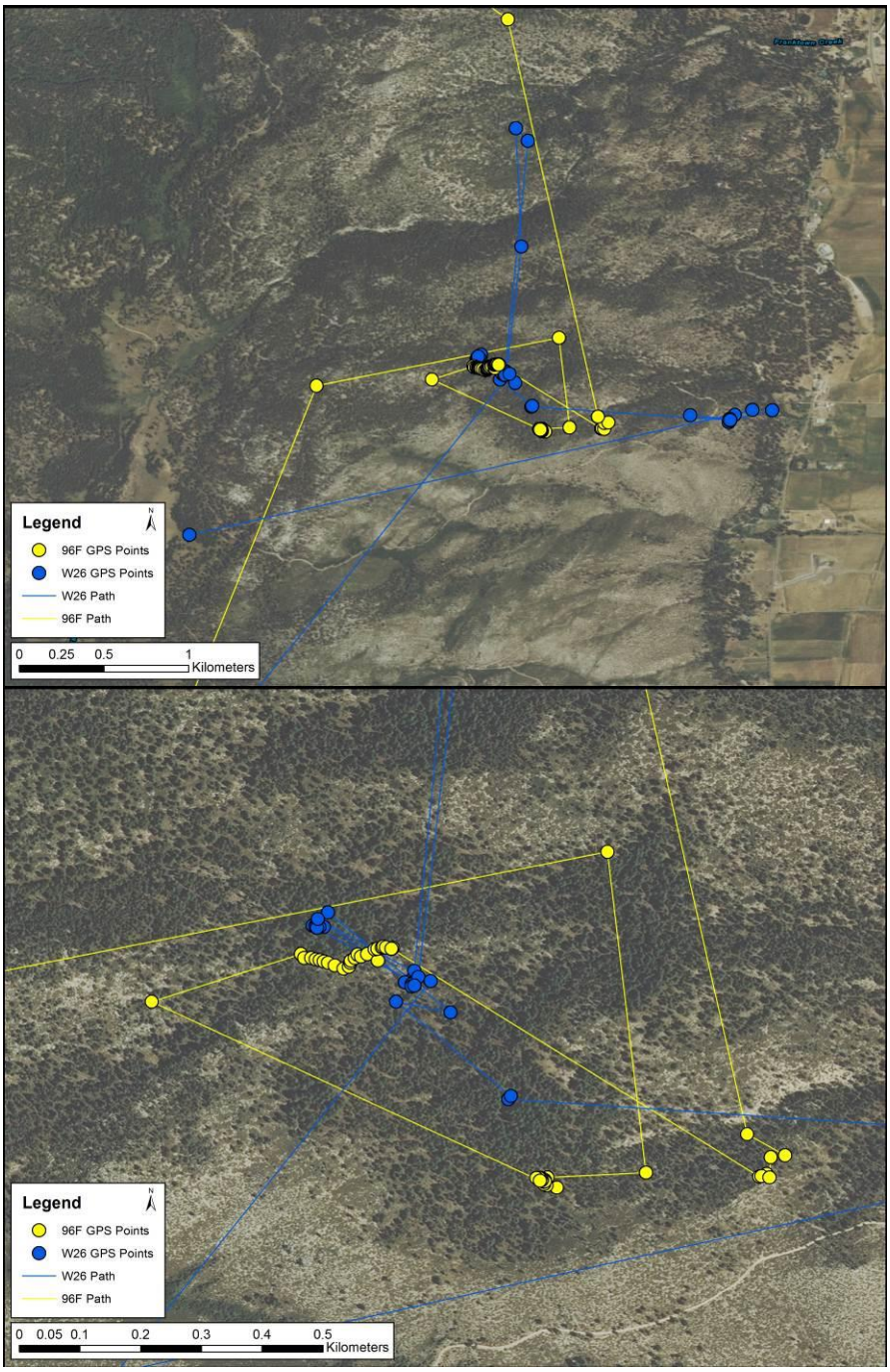

Figure 8. An example of the Vectronics GPS PLUS Proximity collars functioning properly and collecting interaction data (i.e. simultaneous points every 15 seconds for both animals) from a female cougar (96F) and a female bear (W26) when they were within 200 meters of each other in 2015. The lower image is the same data zoomed more closely.

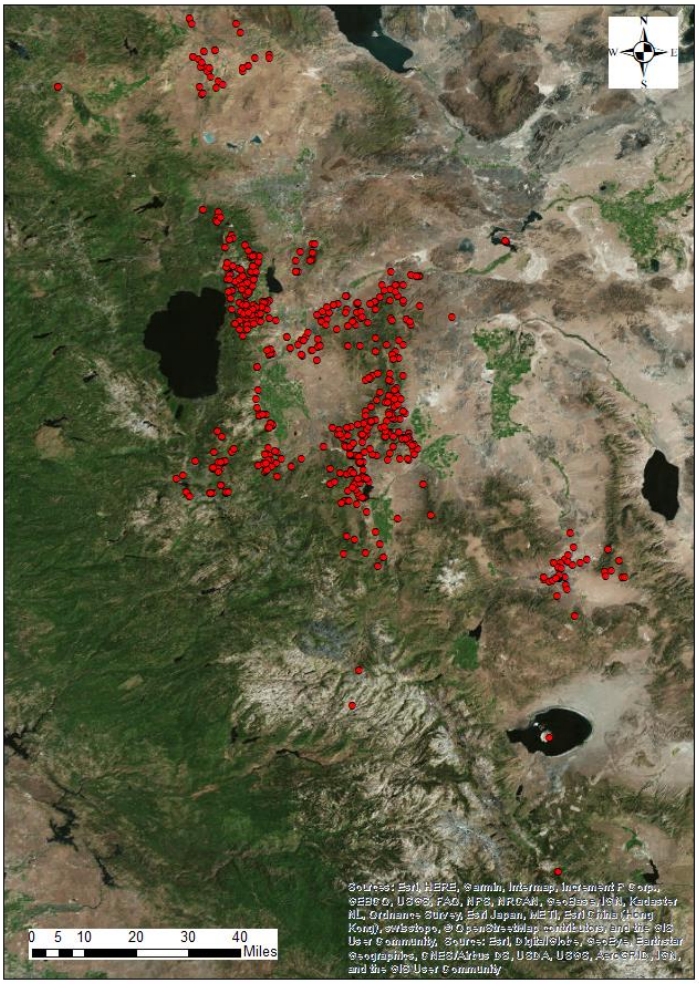

Figure 9. Location of >600 cougar kill sites made by 10 GPS collared cougars during active bear season (1 March-31 October) from 2015-2017 that were visited and surveyed by field biologists from WCS and NDOW during Project 32.

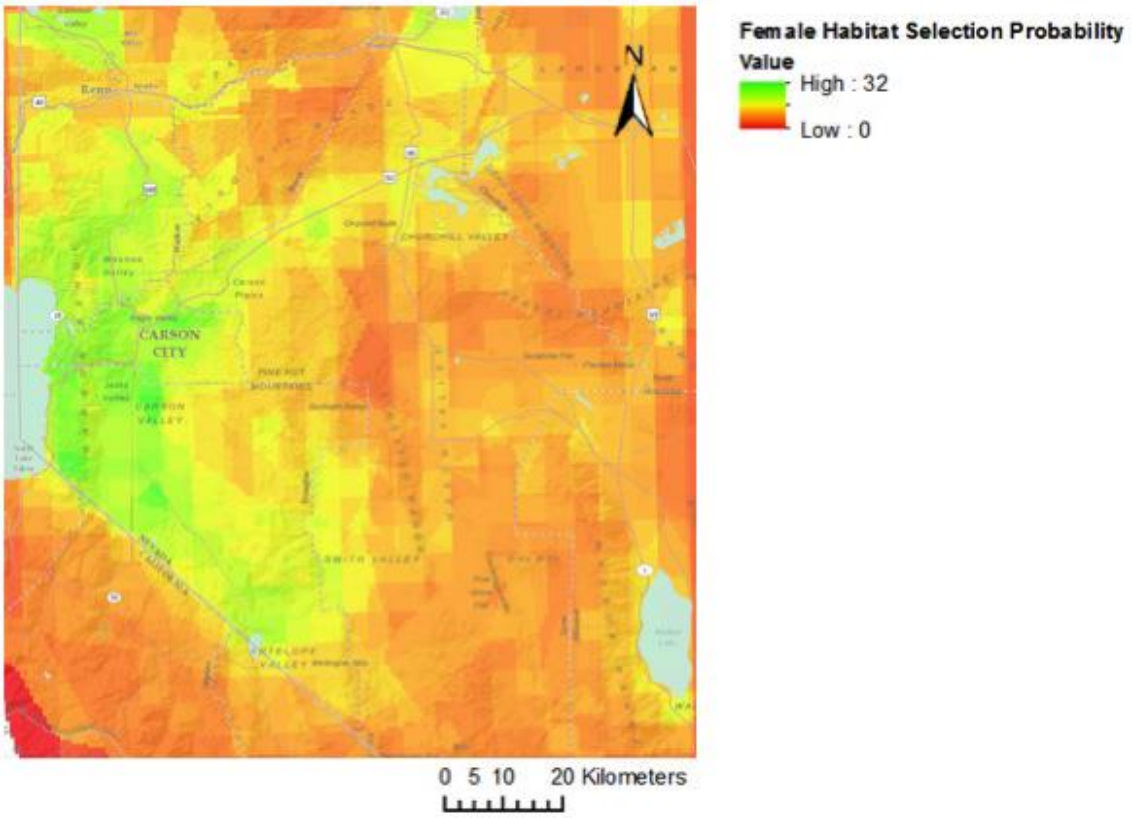

Figure 10. Resource selection probability function (RSPF) model results displaying female black bear habitat selection probability in western Nevada based on average habitat selection probability for all significant landscape variables. Higher probability of use areas are represented in green and lower probability use areas in red (from Wynn-Grant, Lackey, and Beckmann *In Prep*).

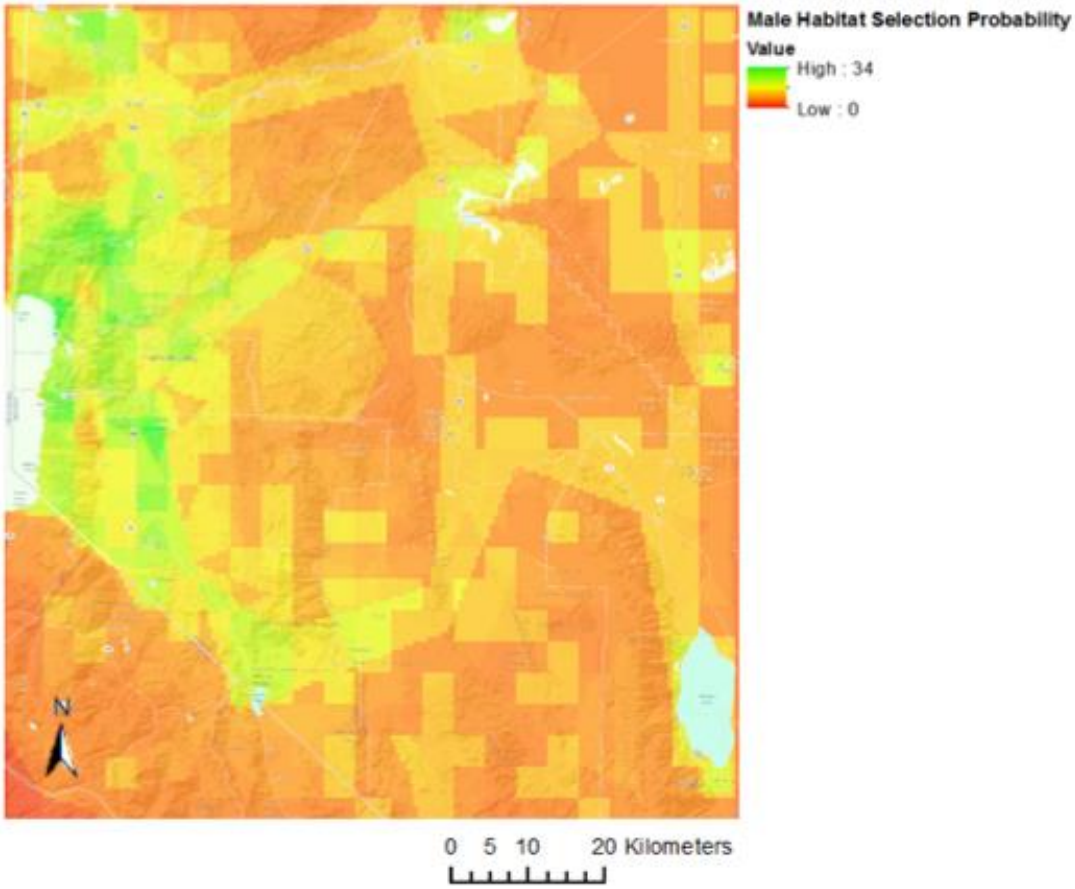

Figure 11. Resource selection probability function (RSPF) model results displaying male black bear habitat selection probability in western Nevada based on average habitat selection probability for all significant landscape variables. Higher probability of use areas are represented in green and lower probability use areas in red (from Wynn-Grant, Lackey, and Beckmann *In Prep*).

Appendix A. Summary of data and future/continuing data analyses and products from Project 32 by WCS and NDOW.

Existing Data in Hand

35,000+ GPS locations from 10 cougars collared under Project 32

60,000+ GPS locations from 30 bears collared under Project 32

600+ predation events (i.e. kill sites) for cougars visited by NDOW and WCS biologists with data on prey items, date, location, bear interactions recorded

Deer densities by habitat type in three mountain ranges of study site for 2015, 2016, and 2017

Feral horse counts in Virginia Range from NV Dept of Ag for 2015, 2016, and 2017 and BLM counts of horses for Pinenut Range for each year

Bighorn sheep population estimates for Virginia Range for 2015, 2016, and 2017

Necessary data likely needed to complete analyses

We are still trying to access 800+ kill sites data from 21 collared cougars from Alyson Andreasen's PhD work (Andreasen 2014). These data would allow us to examine impact of an increasing bear population on bear-cougar interactions over a longer period of time (8-10 years vs 3 years of Project 32). We can and are addressing all questions of Project 32 without those data, but they would be really nice to include in the analyses to increase sample sizes and to get a complete picture of how cougars are responding to bear re-colonization over a much longer time-frame.

Expected publications and estimated timeline

Dr. Jon Beckmann at WCS is teaming with Dr. Julie Young to Co-Advise a PhD student at Utah State University (Kristin Engebretsen) to complete these analyses and publications along with NDOW staff.

1) Publication using multi-variate analyses to model cougar kill rates and prey selection to disentangle the impact of varying densities of bears, bear scavenging rates, habitat features, prey availability (i.e. deer, bighorn, and horse densities by habitat type), cougar sex, body condition (body mass) and reproductive status (i.e. kittens present or not). This paper will include analyses to understand how bears and their interactions with cougars are impacting predation rates and prey item selection by cougars, along with any potential changes in livestock predation across time and as bear densities change. These analyses should be completed by summer 2019 and submitted to a peer-reviewed journal following review by all co-authors, including NDOW staff.

2) Publication on cougar and bear RSPF models. This paper will compare cougar-bear interactions (i.e. cougar kill rates, kill sites, bear scavenging rates at cougar kill sites, and cougar prey selection) across the various habitats that bears use based on the RSPF models to further understand impact of habitat use by bears on cougar kill rates and prey selection (estimated completion date of late 2019 to early 2020 for models and manuscript following review by all co-authors, including NDOW staff).

Trail Camera Reports

Trail Camera Monitoring Report Washoe County (Summer 2017)

Camera Setup Locations: Big Game Guzzlers Units in the Hays Canyon Range (4) and Coleman Rim (1).

Objectives:

1. Monitor use of big game guzzlers by various game species (some of the guzzlers have been recently constructed)
2. Monitor predator use of big game guzzlers

Trail cameras were set up on big game guzzlers during the summer of 2017. Each of the trail cameras were set up near the drinker to catch animals coming into the guzzler to water. Animal use at each of the guzzlers was noted and the various species using them was documented with the photos. Several of the guzzlers had been constructed over the past few years and biologists needed to document the amount of use at these and other sites. Generally, animal use at the newly constructed guzzlers appeared to be less than guzzler units that had been built several years ago. However, even the new big game units had some occasional use by pronghorn and or other game and non-game species. Bighorn were captured on photos taken on the Coleman Rim big game guzzler but none of the other big game units documented bighorn use. However, many of these guzzler sites are located where densities of bighorn are currently known to be very low.

Species detected:

Coleman Rim Guzzler (newer construction) – Coleman Rim Unit 011- Numerous bighorn sheep (including purple ear tagged ewe #55, and #63 from the 2013 release), female bobcat with two kittens, various non-game birds.

Table Lakes South Guzzler (newer construction) – Hays Canyon Range Unit 013 - Mule deer, pronghorn, chukar, dove, coyotes, various non-game birds.

North Table Lakes Guzzler (newer construction) – Hays Canyon Range Unit 013 - Pronghorn antelope, coyotes, dove, non-game birds. (Overall low activity)

Little Hat Guzzler (old construction) – Hays Canyon Range Unit 013 - Mule deer bucks, does and fawns, Pronghorn, bobcat with kitten, coyotes, badger, chukar, dove, Golden Eagles, Owl, Ravens, Magpies and other various non- game birds.

Lower Hays Canyon Guzzler (old construction) – Hays Canyon Range Unit 013 - Pronghorn, mule deer, chukar, dove, various non-game birds, bobcat, coyotes, various non-game birds,