Nevada Department of Wildlife

PREDATION MANAGEMENT PLAN

2013

FY12 DATA/REPORTS & FY13 PLAN

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STATE OF NEVADA

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EXECUTIVE SUMMARY

The goal of the Nevada Predation Management Program is to initiate projects consistent with the terrestrial portion of the Department's Mission "to preserve, protect, manage and restore wildlife and its habitat for the aesthetic, scientific, educational, recreational, and economic benefits to citizens of Nevada and the United States." In addition, provisions outlined in NRS 502.253 authorize the collection of a $3 fee for processing each application for a big game tag, depositing the revenue from such a fee collection into the Wildlife Fund Account and used by the Department to 1) manage and control injurious predatory wildlife, 2) pay for management activities relating to the protection of nonpredatory game animals and sensitive wildlife species and related wildlife habitat, 3) conduct research, as needed, to determine successful techniques for managing and controlling predatory wildlife, including studies necessary to ensure effective programs for the management and control of injurious predatory wildlife; 4) fund education of the general public concerning the management and control of predatory wildlife, 5) expend a portion of the money collected to enable the State Department of Agriculture to develop and carry out programs designed as described above, 6) and to develop and conduct predator management activities under the guidance of the Wildlife Commission. Another key provision of this statute was that "The money in the Wildlife Fund Account remains in the Account and does not revert to the State General Fund at the end of any fiscal year."

The first section of the 2013 Predation Management Plan provides an analysis of and recommendations for individual projects completed in FY12. The second section includes a Budget Summary for FY12, Project Proposals for FY13 and a FY13 Proposed Budget.

The Predation Management Staff Specialist position was filled in April 2012. Eight projects were conducted in FY12. Approximately $321,334 was paid to contractors and $27,234 was spent by the Nevada Department of Wildlife to implement these projects in FY12. Six of 8 FY12 projects have been recommended for continuation in FY13. Four new projects have been proposed for FY13 bringing the total to 10 projects for FY13. Approximately $525,262 will be available in FY13.

NDOW maintains a philosophy that predation management is a tool to be applied deliberately and strategically. Predator management can mean the select removal of carnivores or corvids, using nonlethal methods to reduce carnivore or corvid populations, monitoring and modeling select carnivore populations to facilitate management decision processes relative to the maintenance or restoration of viable carnivore populations, and/or studying select carnivores to better understand ecosystem function. As with any management strategy, predation management should be applied on a location specific, case-by-case basis, with clear goals, and based on best available science. It should be applied with proper intensity and at a focused scale. Equally important, after management is initiated, projects should be monitored to determine whether desired results are achieved.

There are specific times and places where controlling select predators can have a desired effect (Ballard et al 2001). In order to maximize potential for success and

reduce risk of unintended ecological consequences, strategic approaches must be employed when predator control is deemed warranted (e.g. in cases where endangered species and/or nonviable sensitive populations may be at risk). NDOW is committed to using all tools available and the most up-to-date science available, including strategic use of predator management, to preserve our wildlife heritage for the long term.

In light of issues associated with the potential listing of greater sage-grouse under criteria outlined in the Endangered Species Act (ESA), special management activities have been intensified. One of these activities deals with reducing nest predation during the spring by specifically targeting common ravens. Project 21 has been expanded to include a study of greater sage-grouse in the Virginia Mountains PMU (Units 021 and 022) to assess recruitment before and after raven removal. This project has also been expanded to include survey and inventory of common raven nests on NV Energy power transmission lines where those lines intersect greater sage-grouse habitat throughout the state. The goal of this project is to assess the relative value of perch deterrent structures and permanent nest removal as a means of non-lethal common raven population control. In addition to expanding Project 21, two new projects (Projects 29 & 30) are being proposed to reduce anthropogenic resource subsidy availability to common ravens along roads in northern Nevada and along common raven migration corridors in southern Nevada, and at public landfills and public dead animal pits. The objectives of these projects are to reduce food sources (road kill, etc) and the number or desirability of public landfills and/or dead animal pits as feeding areas for common ravens. Better waste-stream management and removal of road kills have been identified by the USFWS as non-lethal tools to help return common raven populations to more natural levels in the American West, thus reducing negative interactions with sage-grouse. The Department is required to show efforts to utilize “non-lethal” methodology to address common raven issues along with removal efforts.

FY12 Project Status Reports

Project 6: Protection of Desert Bighorn – Areas 24/22

By Pete Bradley, Mike Scott and Mike Cox

Project 6 at a Glance

GOAL: Help to establish and exceed minimum population viability of a Desert Bighorn Sheep herd reintroduced March 2001 in central Lincoln County.
PROJECT AREA: Delamar, Meadow Valley, South Pahroc and Hiko Mountain Ranges (Units 241, 243, 223).
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS:
1) The removal of carnivores is intended to result in accelerating the establishment of this desert bighorn herd. 2) Further data collection and analysis will determine the effectiveness of this project and direct wildlife management policy in the future in Area 24. 3) Data from this project may help wildlife managers determine whether or not Pre and Post Game Release Guideline (Commission Regulation 25) are based on sound science.
DURATION: 2001-Present.
TARGET SPECIES: Carnivora – Mountain Lion (Cougar), Coyote, Bobcat.
NON-TARGET SPECIES: Carnivora - American Badger
TIME PERIOD: Year round.

TOTAL KILL TO DATE:	**147 carnivores (127 coyotes, 13 cougars, 4 bobcats and 3 badgers).**
FY12 TOTAL KILL:	**21 carnivores (20 coyotes, 1 cougar).**
TOTAL EXPENDITURES TO DATE:	**$265,462**
FY12 BUDGET:	**$ 76,070**
FY12 ACTUAL EXPENDITURES:	**$ 81,463**
FY13 PROPOSED BUDGET:	**$ 82,000**

Introduction

In a March 2001 effort to reestablish native bighorn populations to central Lincoln County, NDOW released 26 desert bighorn sheep into the Delamar Range, Unit 241. Five bighorn were equipped with satellite-transmitter collars. In October 2003, 25 additional bighorn were released into the unit and 7 were equipped with ear-tag radios. A third augmentation in 2008 added an additional 53 bighorn to the Delamar Mountain herd. A fourth augmentation in early 2009 added an additional 108 bighorn to the Project Area; 75 into the Delamar Mountains and 33 into the Meadow Valley Mountains, Unit 243. A final augmentation in the fall of 2011 added an additional 75 bighorn to the Delamar Mountain herd bringing the total reintroduction effort to 287 released animals over an 11-year period. Transmitters allowed biologists to monitor location, distribution, migration, survival/mortality and predation information for individual animals and herd units. The Department's Predator Removal Contractor (PRC) was included in the monitoring loop, so that information regarding bighorn mortalities could be funneled to their employees in order to initiate predator management activities in a timely manner.

Methods

Predator management contract employees examined bighorn carcasses to determine cause of death. If it was determined that a cougar or other carnivore was the cause of death, the PRC would target the specific carnivore. Methods used to remove cougars were trailing hounds, trail set snares, traps, call boxes and foot snares. Other carnivores were removed using traps, snares, calling, shooting, aerial gunning or spotlighting. Mules were used by the PRC to check equipment and follow dogs through the predominately roadless country. Seven trail cameras were also used to help identify potential predation issues. Several thousand photos were reviewed and have helped identify future predation issues. A field camp was placed in different locations to help maximize efficiency and reduce cost.

Results and Discussion

In FY2012, the PRC removed 1 mountain lion and 20 coyotes in the Delamar Project Area (Units 241 & 243) bringing the 11 year total to 147 carnivores killed (13 cougars, 127 coyotes, 4 bobcats and 3 American badgers) and $265,462 spent.

Project 6 Carnivore Control By Year

Year	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Tot
Cougars		1		1	1		1	2	3	3	1	13
Bobcats							2		1	1		4
Coyotes								16	4	87	20	127
Badgers										3		3
Totals	0	1	0	1	1	0	3	18	8	94	21	147

(Numbers provided by the PRC)

Project 6 Predator Removal Contractor (PRC) & NDOW Expenditures By Year

Year	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Salary/Benefit	$17,523	$840	$5,486						$5,956	$49,704	**$48,063**	**$127,572**
Aerial Gunning								$3,150	$1,592	$7,491		**$12,233**
Travel				$1,560	$1,007	$1,169	$2,340	$2,500	$1,904	$6,335	**$6,867**	**23,682**
Equip/Sup				$2,180		$280	$250	$350	$177	$832	**$1,543**	**$5,612**
Hire									$1,240		**$1,680**	**$2,920**
Dog/Horse				$1,860	$3,410	$3,100	$3,100	$4,000		$2,470		**$17,940**
Vehicle				$1,987	$2,435	$3,288	$4,500	$5,000	$4,085	$8,107	**$11,983**	**$41,385**
Adm Overhead				$1,517	$1,370	$1,265	$1,646	$2,475	$2,415	$12,103	**$11,327**	**$34,118**
$3 Fee PRC Totals	**$17,523**	**$840**	**$5,486**	**$9,104**	**$8,222**	**$9,102**	**$11,836**	**$17,475**	**$17,369**	**$87,042**	**81,463**	**$265,462**
NDOW Expenses	**$17,523**	**$840**	**$5,486**	**$9,104**	**$8,222**	**$9,102**	**$11,836**	**$17,475**	**$17,369**	**$87,042**	**81,463**	**$265,462**

Over the years, non-target species (American badgers) and some bobcats were released when it was determined there were no life-threatening trap injuries and/or when animals did not pose a threat to extant bighorn herds. Cougar-caused mortalities of desert bighorn and mule deer were confirmed in the Delamar Mountains over the course of the project. Bobcat and coyote-caused mortalities of desert bighorn were also confirmed in the Delamars over the course of the project.

Additionally, in recent years, biologists and sportsmen have begun using trail cameras for research and hunting purposes and incidentally reporting the detection of cougars on water developments and springs in the Project Area. These reports have been passed on to our contractor (PRC).

Bighorn population surveys have been somewhat encouraging in the last 3-6 years. If trends continue, minimum population viability may be reached in short order in the Delamar and surrounding Mountain Ranges.

Desert Bighorn Sheep Population Surveys in the Delamar Range				
Year	***Rams***	***Ewes***	***Lambs***	***Total***
2001*	16	17	5	38
2002	3	15	3	21
2003*	7	12	2	21
2004	5	15	5	25
2005	4	23	5	32
2006	6	7	1	14
2007	12	25	9	46
2008*	6	22	4	32
2009*	7	37	10	54
2010	12	37	11	60
2011*	34	74	27	135
2012	15	31	9	55

**26 bighorn released in 2001, 25 in 2003, 53 in 2008, 75 in 2009 and 75 in 2011.*

Conclusion

This project was designed to reduce bighorn losses to predation until such time that the reintroduced herd reached minimum population viability, or where such losses were overcome by bighorn recruitment on a sustained basis.

Most known mountain lion predation incidents in the Delamars occurred from October through March. The project provided useful information concerning use patterns, season of use, relative abundance, as well as defining windows when mountain lions and bighorn sheep use areas overlap. This better understanding of the natural history of mountain lions facilitated a more strategic approach when the time came to remove a mountain lion for protection of the nascent herd.

Recently augmented or introduced bighorn populations are especially vulnerable to predation. Following the release of 287 bighorn sheep into the Delamar Mountains, only 16 (6%) confirmed carnivore-caused desert bighorn sheep mortalities (12 mountain lion, 2 bobcat and 2 coyote) have been confirmed since project inception in 2001. While additional unconfirmed carnivore kills are likely, it remains unclear what population regulation mechanisms are most influential in affecting the health of this young herd.

Recommendations

1) The Lincoln County CAB has documented the use of a dozen cameras on a single spring in Lincoln County (LCABMW 2012) and has prepared a letter to the Nevada Wildlife Commission suggesting regulatory control of this practice, a cogent recommendation especially germane for wildlife species dependent on limited water supplies such as those found in the Delamar Mountains.
2) Continue Carnivore Control Project 6 in Delamar and Meadow Valley Mountains Complex through FY13.
3) When minimum population viability is reached (approximately 150 bighorn) and sustained over a 2 year period, it is recommended the project be terminated.

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Project 18: Protection of Mule Deer - Unit 014

By Pete Bradley, Tony Wasley, Chris Hampson and Mike Dobel

Project 18 at a Glance

GOAL: Enhance existing mule deer population in Unit 014, North Washoe County
PROJECT AREA: Treatment Area - Granite Range (014); Control Areas – (Surrounding Mountain Ranges in Units 011, 012, 013, 015 and 033).
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS: 1) The removal of carnivores is intended to result in enhancement of this mule deer herd. 2) Further data collection and analysis will determine the effectiveness of this project and direct wildlife management policy in the future in Unit 014.
PROJECT DURATION: 2004-2012.
TARGET SPECIES: Carnivora - Coyote, Cougar.
TIME PERIOD: Year round.

TOTAL KILL TO DATE:	**1,204 carnivores (46 lions, 1,158 coyotes)**
FY12 TOTAL KILL:	**131 carnivores (6 lions, 125 coyotes)**
TOTAL EXPENDITURES TO DATE:	**$545,362 + $70,000 (Heritage) = $615,362**
FY12 BUDGET:	**$ 86,375**
FY12 ACTUAL EXPENDITURES:	**$ 89,324 + $70,000 (Heritage) = $159,324**
FY13 PROPOSED BUDGET:	**$ 85,000**

Introduction

Project 18 was initiated early in 2004 in the Granite Range of northern Washoe County With the removal of 66 coyotes. Later that year in December, a total of 24 mule deer were captured and fitted with ear-tag transmitters. Transmitters were attached to 8 juveniles (4 males and 4 females) and 16 adults (10 females and 6 males). All but 2 of the 24 deer were fitted with plastic All-Flex numbered ear-tags to help in identifying animals from the ground. Collars were tracked and monitored for the next 12 to 24 months. The capture and monitoring effort was initiated in an effort to better understand mule deer seasonal use patterns and to investigate survival/mortality of marked mule deer. Telemetry follow-up was conducted from both the ground (vehicle) and air (fixed-wing & helicopter). Transmitter battery life averaged 18 months with a few lasting up to the published 2 years. All transmitters stopped functioning at the end of the 2-year period.

Telemetry information gained from this portion of the study helped confirm details of two major themes of mule deer natural history:

1) Migration Behavior - During 'normal' winters, mule deer in the Granite Range simply perform an altitudinal migration, dropping in elevation during winter onto known winter ranges in the Granites. During extreme winter events, some deer move further to the east and into foothills east of Leadville Canyon and to lower elevation alluvial fans south of Little High Rock Canyon. A few deer migrate east and northeast into Hunt Unit 012. During summer months, most deer move to

the highest elevations on the southern half of the range or are located on upper elevation peaks and ridges.

2) Survival / Mortality – Before major predator removal efforts were instituted, only four mountain lions were killed in the Granites during a 2-year monitoring period for radio-collared mule deer. During this period, none of the 24 marked mule deer (8 juveniles, 16 adults) were known to have been preyed upon. Two bucks were later harvested by hunters, one during the 2006 rifle season and the other during the 2008 season. Three of the transmitters malfunctioned and were observed on "live deer" while emitting a mortality signal. Two other transmitters simply fell off of deer and were found with deer tracks coming and going from where the transmitter was left lying on the ground. One other transmitter quit working entirely in April of 2005. All other deer were known to be alive and well at the end of the 2-year monitoring period.

Methods

Target Apex Carnivores, primarily mountain lions and coyotes, were controlled on a year-round basis for the last 9 years in the Granite Mountain Range (Unit 014 – Treatment Area). NDOW funded the PRC to as many large carnivores as was possible given the constraints of weather, time and available funding using dogs, calling, call boxes, shooting, leg-hold traps, aerial gunning and snares to accomplish the treatment.

For comparison, surrounding mountain ranges received limited predator control during the same study period and included those portions of northern Washoe, Humboldt and Pershing Counties in Units 011, 012, 013, 015 and 033. Limited predator kill in control areas was associated either with agriculture, legal hunting and/or poaching.

The PRC provided bi-monthly reports to NDOW detailing fixed-wing and ground trapping efforts with GPS coordinates for all carnivores taken in Unit 014. In addition, GPS locations were recorded for most game species and feral horse observations. Coyote jaws and cougar tooth/tissue samples were collected for NDOW's age structure analysis and database.

In 2010, an extensive analysis was conducted in an attempt to identify benefits to or differences in performance of Unit 014 treatment area mule deer and California bighorn populations in comparison to adjacent northern Washoe-Humboldt-Pershing county control units in relation to different levels of predator control (Stewart and Wasley 2011).

Results and Discussion

In FY2012, the PRC took 6 cougars and 125 coyotes in Unit 014 bringing the 9 year total take to 1,204 large carnivores including 46 cougars and 1,158 coyotes with $615,362 spent. In addition, during the winter of FY12, our contractor (PRC) used Heritage Program dollars and contracted a helicopter to assess effectiveness of previous ground-based coyote control efforts and ended up gunning several dozen coyotes from the air.

Project 18 Carnivore Control By Year

Year	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Cougars	0	2	2	5	7	5	7	12	6	46
Coyotes	66	145	220	216	93	105	59	129	125	1,158
Totals	66	147	222	221	100	110	66	141	131	1,204

(Numbers provided by the PRC)

Project 18 Predator Removal Contractor (PRC) & NDOW Expenditures By Year

Year	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Salary/Benefits	$20,511	$12,465	$16,896	$50,335	$54,362	$55,770	$57,547	**$58,538**	**$326,424**
Aerial Gunning		$4,755	$5,715	$9,000	$10,500	$2,082	$5,670		**$37,722**
Travel		$1,506	$1,007	$8,782	$9,484	$5,999	$5,451	**$5,796**	**$38,025**
Equipment/Supplies		$99	$85	$200	$216	$1,679	$1,266	**$474**	**$4,019**
Hire								**$440**	**$440**
Dog and Horse									
Vehicle		$2,813	$3,801	$13,925	$15,039	$7,951	$10,101	**$11,656**	**$65,286**
Admin Overhead		$4,328	$4,442	$13,282	$14,344	$11,704	$12,926	**$12,420**	**$73,446**
$3 Fee PRC Totals	**$20,511**	**$25,966**	**$31,946**	**$95,524**	**$103,945**	**$85,185**	**$92,961**	**$89,324**	**$545,362**
Other Totals	**$33,851**	**$19,000**	**$10,000**	**$10,000**	**$10,000**	**$10,000**	**$0**	**$70,000***	**$162,851**
NDOW Expenditures	**$54,362**	**$44,966**	**$41,946**	**$105,524**	**$113,945**	**$95,185**	**$92,961**	**$159,324**	**$708,213**

**Heritage Coyote Control Project*

Mule deer survey and inventory work conducted in the spring of 2012 resulted in fawn/adult ratios of 41:100 for Unit 014, 43:100 for Units 011-013 and 46:100 for the Sheldon (Unit 033) (Figure 1). Spring mule deer surveys in Unit 015 were cancelled as most of the Lassen Interstate herd remained in California during the mild winter of 2011/2012.

Spring fawn/adult ratios have varied widely over the course of the study. In only one of 8 years since study inception was the spring fawn/adult ratio noticeably higher in Unit 014 (Treatment) than in surrounding control units (Figure 1). This occurred in 2006 prior to the majority of predator control. Significantly more carnivores were removed in Unit 014 subsequent to that time. And as Figure 1 demonstrates, the variation between years is much greater for all units than variation between units within years. This suggests mule deer production and recruitment are most often driven by landscape scale phenomena such as climate, ecological carrying capacity and nutritional availability and have little or no correlation to numbers of Apex carnivores removed in a given area (Ballard et al 2001; Wasley 2004; Hurley et al 2011; Stewart and Wasley 2011).

Because predation is complex, with effects that may be counterintuitive, management decisions made without considering ecological processes can have unintended consequences (Goodrich and Buskirk 1995; Katnik 2002; Mills 2005). Multiple authors suggest the possibility of a negative correlation between carnivore control and ungulate production and recruitment where carnivore removal can actually increase predator numbers by increasing predator production and/or by removing dominant individuals or dominant pairs, thereby allowing greater densities of 'less-educated' predators that may be more inclined to take greater risks (larger prey) in predation (Ruth and Murphy 2011; Crabtree 2012).

Extreme examples of predator control have been known to upset the balance of native ecosystems by removing ecological services provided by Apex carnivores, thus reducing nutritional availability and security cover for primary consumers (Estes et al 2011; Ruth and Murphy 2011). Specific examples include 1) the loss of riparian ecosystems in the absence of large predators because of changes in behavior and foraging patterns of ungulates in Wyoming and then subsequent riparian ecosystem resurgence once large predators returned (Berger et al 2001; Ripple and Beckta 2003); and 2) Intense and extended lethal coyote control likely is detrimental to sage-grouse populations because of an increase in exploitative competition when Lagomorph populations are released and availability of native forb and sagebrush forage is depressed (Mezquida et al 2006). It is interesting to note that, within this context, the Sheldon National Wildlife Refuge (Unit 033), an area that has had almost no large carnivore removal for more than two decades, had significantly higher greater sage-grouse nest success than adjacent units (P<=.001) (see Project 21, this report) and has maintained similar spring fawn/adult mule deer ratios to adjacent units and even exceeded those control and treatment units in 2012 for the first time in the 8-year study period (Figure1).

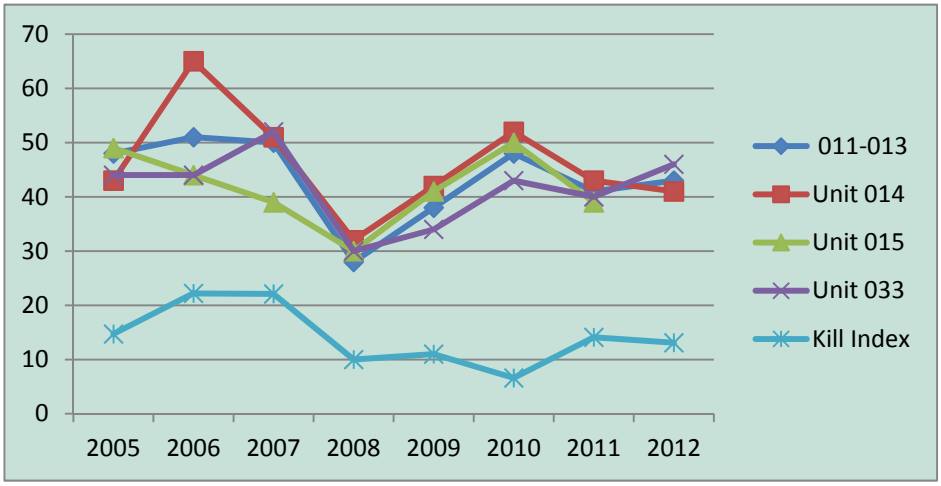

Figure 1. Northern Washoe spring fawns per 100 adult mule deer in control and treatment units over an 8-year period. Bottom line is an index of total Apex carnivores taken in Unit 014 during same period (total coyotes and cougars killed/10)

Aside from fawn ratios, other metrics used over the years to assess effects of large carnivore control on the Unit 014 mule deer herd have included hunter success, total harvest, and greater than or equal to 4 antler points in the harvest. All were independently regressed against both cougar and coyote kill. Regressions performed resulted in zero significant correlations and none of these metrics provided evidence or insight into any population level benefits of Project 18 that may have led to increased opportunity or improved buck quality.

One final metric, population trend of mule deer was tested for statistically significant differences between the predator control area and adjacent areas. No statistically significant difference existed between 014 and either 033 or 011-013. However, the population trend in 014 was statistically different from that observed in 015. While at

first appearing to support carnivore control, this was later discounted as an artifact of mild winters and an absence of migratory deer from California making the trek to Nevada's Unit 015 (NDOW 2004-2012).

Some attention was given to potential effects of carnivore control on California bighorn sheep in Unit 014. Bighorn populations increased by 75% and 175% in Units 012 and 014 respectively from 2004 to 2011. While removal of cougars and coyotes may have facilitated population growth and expansion of bighorn sheep in 014, it is important to note that a rapid growth rate sometimes follows die-offs (2001 in 014) and frequently follows augmentations (2004 in 014) of "new" sheep populations. The simultaneous healthy bighorn population increase in adjacent Unit 012, an area that is experiencing comparatively limited carnivore control, suggests once again that landscape level influences such as climate, forage availability and forage quality are acting as the main drivers of these increases. The removal of 1,900 feral horses in 2011 had a significant positive effect as well.

California Bighorn Sheep Population Estimates		
Year	***Unit 012****	***Unit 014*****
2004-5	160	40
2010	270	120
2011	280	110

**Excluding 26 animals removed for augmentation elsewhere (2004-2010).*
***Excluding 18 animals released in 2004 and 9 animals removed for augmentation elsewhere in 2010.*

Conclusion

Once again, differences in recruitment as measured by spring deer surveys were statistically insignificant between areas with or without carnivore control.

High numbers of cougars and coyotes taken out of the Granite Range over the past 9 years may have resulted in density dependent responses to that loss by Apex carnivore populations in the Region. It is likely transient carnivores, both adult and subadult, are continuing to fill empty territories and increased productivity in remaining carnivore populations are helping to fill gaps as well. Because of the great distances attained by dispersing cougars, for example, dispersal is viewed by many as the most dramatic phenomenon in cougar population dynamics (Quigley and Hornocker 2011). Similarly, many view the coyote's ability to compensate for population losses through increased productivity and survival of young as the most dramatic phenomenon in coyote population dynamics (Crabtree 2012).

Project 18's primary objective to provide a benefit to mule deer via decreased predation by cougars and coyotes has been largely unrealized in northern Washoe County. Similar patterns in deer population changes from 2004 to 2012 in the absence and presence of carnivore control strongly suggest larger landscape scale phenomena such as weather, forage availability and forage quality remain the primary drivers in mule deer population regulation. Even if a percentage of the mule deer population increase in Unit 014 could be attributed to carnivore control, the cost/benefit ratio could likely not be justified.

Recommendations

1) Continue Project 18 through FY14 to have a long-term (10 year) assessment of pros and cons of this project design on a single big game management unit.

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Project 20: Protection of California Bighorn – Unit 022

By Pete Bradley, Chris Hampson, Mike Dobel and Tony Wasley

Project 20 at a Glance

GOAL: Help to establish and exceed minimum population viability of California Bighorn Sheep herd reintroduced March 1990 in central Washoe County.
PROJECT AREA: Virginia Mountains.
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS:
1) The removal of cougars is intended to result in accelerating the establishment of this California bighorn herd. 2) Further data collection and analysis will determine the effectiveness of this project and direct wildlife management policy in the future in Unit 022.
DURATION: 2008-Present.
TARGET SPECIES: Carnivora – Mountain Lion (Cougar).
NON TARGET SPECIES: Carnivora - Black Bear.
KILL PERIOD: Year round.

TOTAL KILL TO DATE:	**12 cougars, 1 black bear.**
FY12 TOTAL KILL:	**4 cougars, 1 black bear.**
TOTAL EXPENDITURES TO DATE:	**$32,361**
FY12 BUDGET:	**$14,942**
FY12 ACTUAL EXPENDITURES:	**$ 2,864**
FY13 PROPOSED BUDGET:	**$ 2,500**

Introduction

In March 1990, in an effort to reestablish native bighorn populations to central Washoe County, NDOW released 13 California bighorn sheep into the Virginia Mountains in Unit 022. Five of the bighorn were equipped with satellite-transmitter collars. In 1991, 14 additional bighorn were released. Finally in 1997, 22 additional bighorn were released into the unit bringing the total reintroduction effort to 49 released animals over a 17-year period. Transmitters allowed biologists to monitor location, distribution, migration, survival/mortality and predation information for individual animals and herd units. The PRC was included in the monitoring loop, so that information regarding bighorn mortalities could be funneled to contract employees in a timely manner.

Methods

The PRC examined bighorn carcasses to determine cause of death and implemented control actions directed at any cougar determined to be the cause of death. Methods used to remove cougars were trailing hounds, trail set snares, traps, call boxes and foot snares.

Results and Discussion

In FY2012, the PRC removed 4 cougars and 1 black bear (non-target mortality) in the Virginia Mountain Project Area (Unit 022) bringing the 5 year total to 13 carnivores taken including 12 cougars and 1 black bear with $32,361 spent.

Project 20 Carnivore Control By Year						
Year	FY08	FY09	FY10	FY11	FY12	Total
Cougars	5	0	1	2	4	**12**
Black Bears					1	**1**
Totals	**5**	**0**	**1**	**2**	**5**	**13**

(Numbers provided by the PRC)

Project 20 Predator Removal Contractor (PRC) & NDOW Expenditures By Year						
Year	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**Total**
Salary/Benefits	$4,000	$5,807		$6,948	**$2,351**	**$19,106**
Aerial Gunning						**$0**
Travel			$240	$757		**$997**
Equipment/Supplies				$667		**$667**
Hire						**$0**
Dog and Horse						**$0**
Vehicle			$3,813	$4,528	**$115**	**$8,456**
Admin Overhead			$654	$2,083	**$398**	**$3,135**
$3 Fee PRC Totals	**$4,000**	**$5,807**	**$4,707**	**$14,983**	**$2,864**	**$32,361**
Other Totals			**$4,500**	**$310**		**$4,810**
NDOW Expenditures	**$4,000**	**$5,807**	**$9,207**	**$15,293**	**$2,864**	**$37,171**

Bighorn population surveys in the Virginia Mountains have been encouraging in the last 2-3 years. If trends continue, minimum population viability may be reached in short order. Sheep presence in adjacent ranges such as the Dogskins and Petersons (021) also suggests the herd is expanding. Sportsmen reported bighorn attempting to make their way even further southwest into the Peavine Mountain area (Unit 196).

California Bighorn Sheep Population Estimates		
Year	***Unit 022***	***Unit 021***
2005	36	0
2010	100	0
2011	110	8
2012	110	10

Conclusion

This project was designed to reduce bighorn losses to predation until such time the reintroduced herd reached minimum population viability, or when such losses are overcome by bighorn recruitment on a sustained basis.

Most known cougar predation incidents in the Virginia Mountains occurred from November through March. The project provided useful information concerning cougar

use patterns, season of use, relative abundance, as well as defining windows when cougar and bighorn sheep use areas overlap. This better understanding of cougar natural history facilitated a more strategic approach to cougar removal for protection of the nascent herd.

Recommendations

1) Encourage contractor to employ species-specific and directed approaches to mountain lion control practices to minimize the potential for non-target carnivore mortality in the future (black bear, etc).
2) Continue Carnivore Control Project 20 in Virginia Mountains through FY13.
3) When minimum population viability is reached (approximately 150 bighorn) and sustained over a 2-year period, it is recommended the project be terminated.

Project 21: Common Raven Control For Sage-grouse

By Pete Bradley, Shawn Espinosa, Larry Gilbertson and Ken Gray

Project 21 at a Glance

GOAL: Increase populations of Greater Sage-Grouse, Rio Grande Turkeys and various Waterfowl and Shorebird Species.
PROJECT AREA: High Priority Greater Sage-Grouse breeding habitat throughout northern Nevada and Wildlife Management Areas - Statewide.
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS: 1) The removal of corvids and carnivores is intended to result in long-term protection for greater sage-grouse populations. 2) Further data collection and analysis will determine the effectiveness of this project and direct wildlife management policy in the future in priority greater sage-grouse habitats.
PROJECT DURATION: 2007-Present.
TARGET SPECIES: (Corvidae- Common Raven, Carnivora- American Badger, Striped Skunk, Coyote, Red Fox, Bobcat).
TIME PERIOD: March-May.

TOTAL KILL TO DATE:	**6,850 Predators: [6,743 Common Ravens, 107 Carnivores (44 Coyotes, 63 American Badgers)]**
FY12 TOTAL KILL:	**2,061 Predators: [1,997 Common Ravens, 64 Carnivores (21 Coyotes, 43 American Badgers)].**
TOTAL EXPENDITURES TO DATE:	**$55,615 + $91,885(Heritage) = $147,500**
FY12 BUDGET:	**$16,261 + $40,000(Heritage) = $ 56,261**
FY12 ACTUAL EXPENDITURES:	**$ 9,842 + $34,657(Heritage) = $ 44,499**
FY13 PROPOSED BUDGET:	**$60,000**

Introduction

Common raven control projects were first initiated in the spring of 2007 using $3 Fee Predator Management dollars. The primary goal of the first project was to control ravens adjacent to 2 sage-grouse leks in Elko County that were located in an area which had been severely impacted from large wildfires during the summers of 2006 and 2007. This project also included aerial gunning of coyotes to reduce predation on game species concentrated in remaining intact sagebrush islands. Methodology for removing ravens was to deploy chicken eggs treated with the poison "3-chloro-*p*-toluidine hydrochloride" (CPTH) (DRC-1339). Estimates of raven losses were based on previous work and published literature (Coates et al 2007). Beginning in 2008, a raven control project was initiated to specifically treat greater sage-grouse leks located in Elko and Lincoln Counties and other upland game and waterfowl nesting concentrations on wildlife management areas (WMAs). Emergency fund dollars ($20,000/year) were available for the next 2 years until a separate budget was approved in 2010. Raven control projects have been accomplished each year since the inception of the first Predator Management Project in FY07. Total numbers of ravens taken and expenditures by funding source are detailed below (Table 1).

Study Area

Most raven control work was conducted in association with greater sage-grouse strutting grounds in 8 counties of northern and central Nevada (Churchill, Elko, Humboldt, Lander, Lincoln, Nye, Washoe and White Pine). Additional raven control work was conducted on select wildlife management areas in east-central and southern Nevada (Kirch WMA, Overton WMA and Steptoe WMA) in 2 additional counties (Clark and Nye).

Table 1. Common Raven Control By Year and Funding Source

Year	FY07	FY08	FY09	FY10	FY11	FY12	Total
Dead Ravens	200	980**	680***	890	1,996	1,997	**6,743**
$3 Fee Fund Allocated	$15,000	$20,000	$20,000	$15,000	$16,261	$16,261	**$102,522**
$3 Fee Fund Spent	$2,000*	$12,000	$17,475	$14,298	$0	$9,842	**$55,615**
Heritage $$ Allocated		$0	$0	$50,000	$50,000	$40,000	**$140,000**
Heritage $$ Spent		$0	$0	$0	$57,228	$34,657	**$91,886**
Totals Spent****	**$2,000**	**$12,000**	**$17,475**	**$14,298**	**$57,228**	**$44,499**	**$147,500**

**A portion (~$2,000) of $13,328 actually spent was used for raven control – most going to aerial gunning for coyotes.*

***Includes 55 ravens and an estimated $2,000 extra from the wildfire project along with 925 ravens and $10,000 from the sage-grouse and WMA raven control project. $20,000 allocated was from emergency fund.*

**** Includes 50 ravens and an estimated $2,000 extra from the wildfire project along with 630 ravens and $12,000 from the sage-grouse and WMA raven control project. $20,000 allocated was from emergency fund.*

*****Including both $3 Fee Predator Management dollars and Heritage dollars, a total of $242,522 has been available since 2007 to address raven control issues. Approximately 6,743 ravens were removed during this 6-year period, over 59% in just the last two fiscal years. The $50,000 FY10 raven control Heritage Project (Project 10-27) was held up in controversy when a sportsman sued the Commission and delayed BOE approval and only $3 Fee funding was used in FY10. Since there was carryover from the FY10 Heritage project (Project 10-27) into FY11 along with funding identified in the $3 Fee Predation Management program as backup, there was also no halt in raven control efforts in FY11. Final approval of FY11 Heritage Project (11-20) provided the majority of funding for FY12 raven control. Again, funding was identified in the $3 Fee Predation Management program to augment FY12 Heritage Program dollars. Availability of funding for raven control has not been an issue to date.*

Methods

The PRC boiled chicken eggs for 13-15 minutes. Eggs were allowed to cool for several hours. Cooling eggs prior to applying CPTH prevented cracking and toxicant decomposition from heat exposure. Eggs were stamped with a warning “skull and cross bones” or marked with the word “poison”. After cooling, an injection hole was punched in eggs at the end opposite the air cell. The injection hole must reach the center of the yolk with a diameter large enough to contain 1 ml of solution without spillage.

A 2% CPTH solution was made by dissolving 2 g of CPTH concentrate in 100 ml of potable water warmed to 43 C. One ml of 2% CPTH was injected into each egg injection hole using a 5-ml syringe or a 1-ml pipette resulting in a dose of 200 mg per egg. Eggs were stored in an upright position for 2-4 hours without covering injection holes to allow absorption of poison into the albumen and yolk and to prevent spillage.

Eggs were placed at treatment sites from late March through mid June 2007-2012. Eggs were placed upright to further avoid spillage of any poison that had not yet been absorbed. Eggs were placed directly on open ground and/or on perches (fence posts, etc) to facilitate detection from the air. From 62-72 hours following placement, numbers of depredated, missing and/or disturbed poison eggs were recorded. To reduce non-target species exposure, no eggs were left in the environment for over 168 hours. No leftover eggs were used on subsequent treatments. All remaining eggs and any dead ravens found were collected and disposed of properly as per poison control protocol. Depending on the species and situation, coyotes, bobcats, raccoons, badgers skunks, and foxes were removed by aerial gunning, calling, shooting, leg-hold traps or snares.

Results and Discussion

Common raven take numbers were calculated by using the most current literature estimates for efficacy of CPTH baits, and by incorporating professional judgment on the part of the PRC. The NDOW contractor removed more common ravens in the last 2 fiscal years than in the previous 4 years combined.

Project 21 Total Predator Control By Year

Year	FY07	FY08	FY09	FY10	FY11	FY12	Total
Common Ravens	200	980	680	890	1,996	**1,997**	**6,743**
American Badgers					20	**43**	**63**
Striped Skunks							
Coyotes					23	**21**	**44**
Foxes							
Bobcats							
Totals	**200**	**980**	**680**	**890**	**2,039**	**2,061**	**6,850**

(Numbers provided by the PRC)

Project 21 Predator Removal Contractor (PRC) & NDOW Expenditures By Year

Year	FY07	FY08	FY09	FY10	FY11	FY12	Total
Salary/Benefits	$2,000	$12,000	$17,475	$8,565		**$2,968**	**$43,008**
Aerial Gunning							**$0**
Travel				$558		**$3,479**	**$4,037**
Equipment/Supplies				$531			**$531**
Hire				$300			**$300**
Dog and Horse							**$0**
Vehicle				$2,356		**$2,027**	**$4,383**
Admin Overhead				$1,988		**$1,368**	**$3,356**
$3 Fee PRC Totals	**$2,000**	**$12,000**	**$17,475**	**$14,298**	**$0**	**$9,842**	**$55,615**
Other Totals					**$57,228***	**$34,657***	**$91,885**
NDOW Expenditures	**$2,000**	**$12,000**	**$17,475**	**$14,298**	**$57,228**	**$44,499**	**$147,500**

**Heritage Raven Control Projects*

Table 2. Common raven take by county, month and region (2007-2012) (#'s courtesy of the PRC).

Year	Region	County	March	April	May	June	County Totals	Region Totals
2007	East	Elko					G Total	**200**
2008	All						G Total	**980**
2009	All						G Total	**680**
2010	All						G Total	**890**
2011	East	Elko	73	217	266	152	708	
2011	East	Lander	0	81	55	0	136	
2011	East	White Pine	30	60	79	114	283	**1127**
2011	West	Humboldt	35	50	205	60	350	
2011	West	Washoe	23	16	80	0	119	**469**
2011	South	Lincoln	186	24	98	80	388	
2011	South	Nye	12	0	0	0	12	**400**
2011		Monthly Totals	359	448	783	406	G Total	**1996**
2012	East	Elko	132	274	274	76	756	
2012	East	Lander	0	18	159	37	214	
2012	East	White Pine	84	60	41	58	243	**1213**
2012	West	Churchill	0	0	63	0	63	
2012	West	Humboldt	0	165	190	0	355	
2012	West	Washoe	21	25	16	3	65	**483**
2012	South	Lincoln	80	132	64	25	301	**301**
2012		Monthly Totals	317	674	807	199	G Total	**1997**

(Numbers provided by the PRC)

Poison egg baits were deployed in 10 counties across the State. That said, Elko County accounted for over 35% and 37% of the statewide common raven take for 2011 and 2012 respectively (Table 2).

Prior to FY10, the PRC had a permit to take 1,500 ravens/year (750 in the East District and 750 in the West District). Beginning in FY10, it was decided NDOW should be the applicant that carried the permit for raven control projects related to the protection of sage-grouse and other wildlife species, while the PRC would retain its 1,500 bird permit to protect Agricultural interests. Initially, NDOW carried a permit to take 1,500 ravens. When in FY10, Heritage Project funding was officially carried forward to be used in FY11, NDOW's sage-grouse staff specialist contacted the U.S. Fish and Wildlife Service and asked for an increase in NDOW's raven take permit to 2,000. An application was filled out and approved ensuring that raven control efforts did not have to be suspended. Work continued, and Tables 1 & 2 show the 2011 sage-grouse related raven control actually increased 224% from the previous year and the 2011/2012 raven take was 178% above the 6-year average (2007-2012). NDOW's raven control efforts were not limited by available funding. Rather, raven take depicted in Tables 1 and 2 for the past two fiscal years was as close as possible to the USFWS permit cap.

Total statewide USFWS authorized take and actual common raven take including all permit requests for the last 12 years (Landfills, Power Companies, Nellis, Private

Ranches, etc) was 22,248 and 19,921 birds respectively. In 2012, USFWS authorized NDOW to take 2,000 common ravens for greater-sage-grouse nest protection. Approximately 1,997 ravens were taken that year on NDOW's permit. Permit Authorization by USFWS has not been a limiting factor for raven removal in Nevada for sage-grouse protection. Increased use of non-lethal control methods are part of the stipulations of these permits and NDOW is ramping up its efforts in this arena as well.

While short-term benefits may be realized in isolated areas, it remains unlikely current common raven control programs are having the desired effect of bolstering select ground-nesting upland game bird populations over the long term. Raven numbers rebounded each spring to abundances seen prior to CPTH application in one study conducted in northern Nevada (Coates et al 2007). Preliminary analysis of a random data set of treatment and non-treatment leks were compared in terms of population response over time (2008-2011). There did not appear to be a significant difference in grouse population response between areas where ravens were removed (*treatment*) and areas where poison eggs were not being deployed (*control*) (Table 3).

Table 3. Greater Sage-grouse Lek Counts - Common Raven Treatment vs. Control

				Annual Peak Male Attendance				4-Year
Raven Take	**County**	**PMU**	**Lek Name**	**2008**	**2009**	**2010**	**2011**	**Average**
Yes	White Pine	Butte/Buck/WP	White River Valley N2	0	0	NC	8	2.7
Yes	White Pine	Butte/Buck/WP	White River Valley N	19	14	20	19	18
Yes	White Pine	Butte/Buck/WP	Christmas Tree N	3	0	0	0	0.75
Yes	White Pine	Butte/Buck/WP	EPH Creek	12	0	5	4	5.25
Yes	White Pine	Steptoe/Cave	Williams Creek	38	35	14	36	30.75
Yes	White Pine	Steptoe/Cave	Cold Springs Junction	9	NC	18	15	16.5
Yes	White Pine	Steptoe/Cave	Cattle Camp Wash Well N	19	15	16	18	17
Yes	White Pine	Steptoe/Cave	Cattle Camp Wash Well	16	17	13	30	19
Yes	White Pine	Steptoe/Cave	Lund Group Well	9	3	6	4	5.5
Yes	Elko	Tuscarora	Willow Cr Res 19	14	24	28	49	28.75
Yes	Elko	Tuscarora	Willow Cr Res 01	14	17	32	54	29.25
Yes	Elko	Tuscarora	Willow Cr Res 06	46	69	102	133	87.5
Yes	Elko	Tuscarora	St John	30	30	37	30	31.75
Yes	Elko	North Fork	Saval 07	0		34	44	39
Yes	Elko	North Fork	Saval 05	31	13	22	10	19
Yes	Elko	North Fork	Saval 15	10	0	51	36	24.25
Yes	Elko	North Fork	Pie Creek	27	25	27	32	27.75
								65%*
No	White Pine	Butte/Buck/WP	Red Pepper Butte E	24	0	41	47	28
No	White Pine	Butte/Buck/WP	Twin Springs	41	32	42	28	35.75
No	White Pine	Butte/Buck/WP	County Line	57	37	60	41	48.75
No	Elko	Ruby	Black Sage High Beach	75	83	85	85	82
No	Elko	Tuscarora	Scraper Springs 23	17	11	8	21	14.25
No	Elko	Tuscarora	Six Mile 2	33	40	59	38	42.5
No	Elko	North Fork	Deep Creek #2	44	31	27	22	31
No	Elko	North Fork	Owyhee Meadow	67	14	49	88	54.5
No	Elko	North Fork	Upper Maggie West	9	6	29	33	19.25
No	Elko	O'Neil Basin	North Tabor Creek	12	19	6	29	16.5
								60%*

**Percent of Treatment and Control Leks above 4-year average in 2011.*

It appeared that grouse populations were affected more by annual precipitation trends than by any other environmental factors (Figure 1). Greater sage-grouse nest success data from northwest Nevada corroborates this finding and further suggests that landscapes which provide suitable nest/security cover in the form of healthy, native understory cover types (*Eriogonum, Castilleja, Sphaeralcea, Achnatherum, Festuca, etc*) also provide grouse with safe, secure nesting habitat (Figure 2). It should be noted that the Sheldon National Wildlife Refuge had no common ravens, coyotes, American badgers, striped skunks, spotted skunks or mountain lions taken with its boundary during the course of this 8-year data analysis.

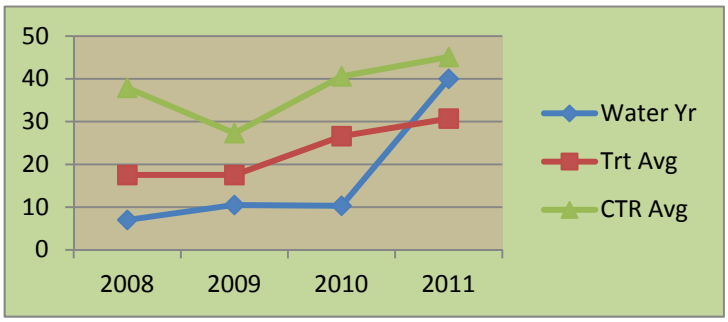

Figure 1. Yearly greater sage-grouse lek averages (Peak Male Attendance) in random sample of treatment leks (*n=17)* (*raven take*) and control leks (*n=10)* (*no raven take*) from 2008-2011. (Water year data courtesy of USGS stream flow data for Imlay, Nevada [Avg CFS/10]; Grouse data courtesy of NDOW Staff).

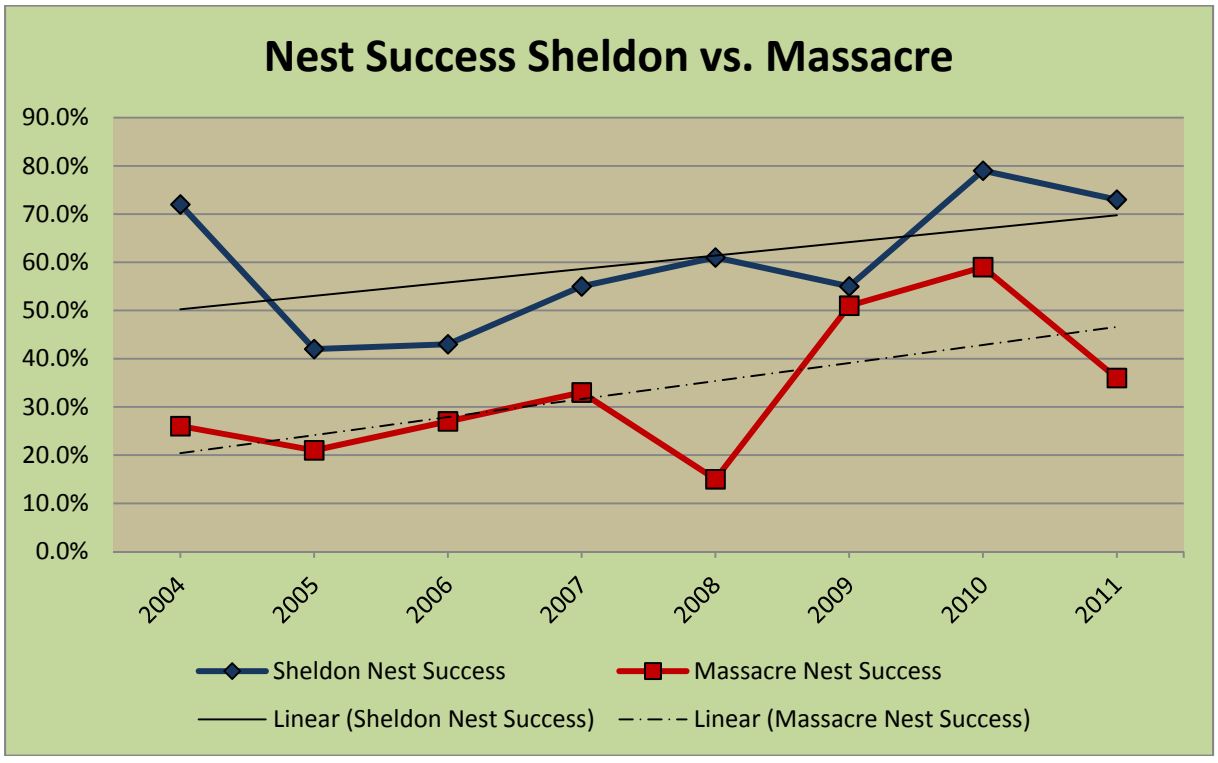

Figure 2. Sage-grouse female nest success (%) from 2004 through 2011 evaluated from wings collected during each hunting season*. Nest success for the Sheldon PMU averaged 60%; whereas the Massacre PMU nest success average 33.5%. A t-test value of 3.68 with a P-value of 0.001 indicates very high statistically significant difference between the Sheldon and Massacre PMUs with the Sheldon exhibiting consistently higher nest success values over the 8-year period.

Nest Success		
t-Test: Two-Sample Assuming Unequal Variances		
	Sheldon	*Massacre*
Mean	0.6	0.335
Variance	0.019114286	0.022285714
Observations	8	8
Hypothesized Mean Difference	0	
df	14	
t Stat	3.683754648	
P(T<=t) one-tail	0.001227522	
t Critical one-tail	1.761310115	
P(T<=t) two-tail	0.002455043	
t Critical two-tail	2.144786681	

**Nest success was evaluated through the examination of wings collected during the hunting season beginning in 2004 for both Population Management Units (Data courtesy of NDOW Staff, Statistical analysis courtesy of UNR Staff).*

Conclusion

While lethal removal of ravens may provide some short term benefit to ground nesting game birds in isolated situations, reducing anthropogenic resource subsides (i.e. open landfill dumps and road-kill carrion) is the only real long term solution for bringing raven numbers into balance within Great Basin ecosystems (Coates et al 2007).

Recommendations

1. Continue Raven Control Project 21 through FY13.
2. Expand project to include a study of greater sage-grouse recruitment in the Virginia Mountains PMU (Units 021 and 022) before and after raven control.
3. Expand project to include survey and inventory of common raven nests on NV Energy power transmission lines where those lines intersect greater sage-grouse habitat throughout the state with the goal of perch deterrent and permanent nest removal. NV Energy would be a financial partner in this effort.
4. Attempt to remove maximum allowable number of common ravens in priority greater sage-grouse habitats in 2013.
5. Strategically direct raven control to a time period between 18 March and 21 April 2013.
6. Although CPTH decomposes rapidly, it is critical to continue to remove all unconsumed poison eggs and CPTH mortalities from the field within 168 hours of placement to reduce unintended effects to non-target wildlife species (Coates et al 2007).
7. Evaluate the program annually to determine efficacy of raven control in terms of benefits to greater sage-grouse.

8. Explore alternative avenues to lethal control of common ravens that would work to reduce anthropogenic resource subsidies, the ultimate causal factors for raven increases in the Great Basin (Coates et al 2007). Focus specifically on changes in waste stream management, landfill transfer station management and road-kill carrion management along freeway, secondary and county gravel roads in priority sage-grouse habitats. See Projects 29 and 30 in Appendix.
9. Coordinate with and support efforts at the Midas Transfer Station to make waste material inaccessible to ravens. This may include alternative containers for disposal (See Project 30).
10. Allow for contingency that would provide additional funding for common raven control if deemed necessary for greater sage-grouse protection in 2013.

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Project 22: Mule Deer/Big Game Enhancement – Statewide

By Pete Bradley, Tony Wasley, Mike Dobel, Steve Kimble and Ken Gray

Project 22 at a Glance

GOAL: Enhance mule deer and other big game populations where herds may be at risk, experiencing chronic low carrying capacity and/or catastrophic decline.
PROJECT AREA: Statewide.
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS:
1) The removal of carnivores is intended to result in enhancement of mule deer and other big game herds. 2) Further data collection and analysis will determine the effectiveness of this project and direct wildlife management policy in the future statewide.
PROJECT DURATION: 2010-present.
TARGET SPECIES: Carnivora - Coyote, Cougar, Bobcat.
TIME PERIOD: Year round.

TOTAL KILL TO DATE:	**879 carnivores (862 coyotes, 17 cougars).**
FY12 TOTAL KILL:	**242 carnivores (231 coyotes, 11 cougars).**
TOTAL EXPENDITURES TO DATE:	**$328,764 +$271,166 Heritage = $599,930**
FY12 BUDGET:	**$122,713**
FY12 ACTUAL EXPENDITURES:	**$ 90,111**
FY13 PROPOSED BUDGET:	**$ 80,000**

Introduction

In 2009, Project 22 was initiated statewide to provide flexibility and opportunity to respond quickly to conditions on the ground that biologists believe could be adversely affecting population viability of select mule deer herds and other big game populations.

Project area selection criteria were developed to define where and when a carnivore control policy would be deployed to enhance or protect sensitive big game herds as follows:

1. Mule deer herds exhibiting long-term below average post-season fawn ratios, spring fawn recruitment, and/or carrying capacity (population levels).
2. Other big game species also exist and may add to the benefits realized by controlling predators.
3. Areas where long-term habitat improvements are under way.
4. Areas where recent augmentations or reintroductions are planned.
5. Areas where other big game species are below carrying capacity, where recruitment is below long-term averages and/or where big game populations recently experienced die-offs or other catastrophic conditions exist.

Methods

Target carnivore species, primarily mountain lions and coyotes, were removed statewide on a year-round basis in specific hunt units where one or more of the stated Project 22 conditions applied (Introduction). NDOW funded the PRC to take as many

large carnivores as possible in project units given the constraints of weather, time and available funding using aerial gunning, dogs, calling, call boxes, shooting, leg-hold traps and snares to accomplish the treatment. Selective and timely control work focused on critical seasonal big game ranges. The timing of control work was in accordance with individual project criteria, but occurred primarily on critical winter ranges and summer fawning areas and/or in release/augmentation areas. The PRC provided bi-monthly reports to NDOW detailing fixed-wing and ground trapping efforts with GPS coordinates for all carnivores taken and for most game species and feral horse observations. Coyote jaws and mountain lion tooth/tissue samples were collected for NDOW's age structure analysis and database.

In 2012, a preliminary analysis of carnivore control data and big game composition data was conducted in an attempt to identify changes in performance of treatment herd units and to identify control units that may be used for comparative purposes in subsequent years.

Results and Discussion

In FY2012, the PRC removed 11 lions and 231 coyotes across the state for a 3-year total take of 879 large carnivores including 17 mountain lions and 862 coyotes with $599,930 spent.

Project 22 Carnivore Control By Year

Year	FY10	FY11	FY12	Total
Mountain Lion	2	4	11	17
Coyote		631	231	862
Bobcat	0	0	0	0
Totals	2	635	242	879

(Numbers provided by the PRC)

Project 22 Predator Removal Contractor (PRC) & NDOW Expenditures By Year

Year	FY10	FY11	FY12	Total
Salary/Benefits		$4,262	**$417**	**$4,679**
Aerial Gunning	$109,145	$76,655	**$49,675**	**$235,475**
Travel	$2,400	$1,800	**$700**	**$4,900**
Equipment/Supplies				**$0**
Hire			**$26,000***	**$26,000**
Dog and Horse				**$0**
Vehicle	$5,900	$5,308	**$4,473**	**$15,681**
Admin Overhead	$18,967	$14,216	**$8,846**	**$42,029**
$3 Fee PRC Totals	**$136,412**	**$102,241**	**$90,111**	**$328,764**
Other Totals	**$152,625**	**$118,541**		**$271,166**
NDOW Expenditures	**$289,037**	**$220,782**	**$90,111**	**$599,930**

**Lion Hunter Support*

Changes in young to adult ratios for both mule deer and bighorn were compared to carnivore take in 11 hunt units prior to (2009) and during (2011-12) predator control treatments across the state in the following table. Some treated hunt units may no longer fit criteria outlined in Project 22 guidelines, but fawn data for Unit 144 show the type of increases that could be used to justify predator control, especially if improved fawn rates were maintained over the long term and above adjacent control units. Adjacent hunt units will be analyzed for suitability as control areas (no expanded carnivore take) for further comparison in FY13. Other units in this table show little or no discernible trend in recruitment values across units and need to be evaluated in FY13 to facilitate future decision-making processes.

Project 22 Carnivore Control and Fawn or Lamb Ratios By Select Unit

Select Hunt Units	FY09 Ratios	FY11 Take	FY 11 Ratios	FY12 Take	FY12 Ratios
011	51:100	0	41:100	3	41:100
031**	34:100 & 63:100	1	43:100 & 53:100	1	46:100 & 40:100
066-067	32:100	35	43:100	0	53:100
075-076	33:100	69	42:100	0	35:100
114-115**	17:100 & 35:100	2	17:100 & 38:100	5	39:100 & 27:100
144***	21:100	113	34:100	97	44:100
222	36:100	240	35:100	50	49:100
231	43:100	166	39:100	78	48:100

**Cougars and Coyotes* ***Spring Fawns :100 Adults & Lambs:100 Ewes* ****Funded in part by Heritage.*

Conclusion

Annual evaluation of this project will occur once again in FY13.

Recommendations

1) Game Division staff should evaluate proposals with regional game supervisors and biologists prior to contacting our contractor to initiate control efforts.
2) Use Project 22 for emergency projects or to complete previously identified ones.

Project 23: Pheasants & Other Birds - Mason Valley WMA

By Pete Bradley and Russelle Smith

Project 23 at a Glance

GOAL: Protect annual releases of Ring-necked Pheasants, Sterile Hybrid Ring-Necked/Manchurian Pheasants, as well as local breeding populations of Ring-necked Pheasants, Rio Grande Turkeys and various Waterfowl Species.
PROJECT AREA: Mason Valley Wildlife Management Area, Lyon County.
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS:
1) The removal of carnivores and corvids did not appear to result in long-term enhancement of pheasant, turkey and waterfowl populations in Mason Valley. Game populations may have been regulated more by the moisture regime and related changes in security cover and food availability than by predator numbers on the Management Area.
PROJECT DURATION: 2009-2012.
TARGET SPECIES: (Carnivora- American Badger, Striped Skunk, Coyote, Common Raccoon; Corvidae- Common Raven).
NON-TARGET SPECIES: (Carnivora – Gray Fox, Bobcat)
KILL PERIOD: Year round.

TOTAL KILL TO DATE:	**156 predators [63 ravens, 93 carnivores (58 coyotes, 2 gray foxes, 4 bobcats, 8 striped skunks, 1 American badger, 20 raccoons)].**
FY12 TOTAL KILL:	**24 carnivores (17 coyotes, 4 striped skunks, 1 American badger, 2 raccoons).**
TOTAL EXPENDITURES TO DATE:	**$26,131**
FY12 BUDGET:	**$ 8,345**
FY12 ACTUAL EXPENDITURES:	**$ 9,308**
FY13 PROPOSED BUDGET:	**$ 0**

Introduction

Due to a dramatic decline in the pheasant population at Mason Valley Wildlife Management Area (MVWMA), a pheasant restoration program was initiated in 2009. This program included: 1) the raising of pheasants for release and 2) the removal of carnivores and corvids on the Wildlife Management Area in order to improve establishment and recruitment of pheasants, turkeys, waterfowl and other upland game birds on the WMA.

Methods

Two surrogate incubator boxes designed to raise pheasant chicks for a period of 4 weeks were deployed. A target of 260 birds was scheduled to be released onto the MVWMA each year to augment existing wild population of ring-necked pheasants as well as to provide increased hunting opportunity. A surragator is a self contained unit that provides food, water, warmth and protection to chicks for the first five weeks of the bird's life when it is believed the greatest mortality occurs. Also, there were inferences that birds might obtain a homing instinct to live and reproduce where they were raised and released. Therefore, the surragator was placed in a location where the manager wanted

to establish a pheasant population on the MVWMA. Ring-necked pheasants were fitted with white plastic leg bands and Manchurian cross pheasants with yellow plastic leg bands. For a time period in 2010-2011, it was decided to stop using ring-necked pheasants and only utilize sterile hybrid Manchurian crosses with ring-necked stock because Manchurian pheasants appeared to exhibit naturally wild characteristics and were shown to exhibit a higher survival rate when placed in a surragator. This policy was again reversed in 2012.

Based on an assumption that fairly high numbers of released birds are lost to predation, the PRC was contracted to control predators and one of their employees worked on station full time. Common ravens were removed using DRC-1339 poison egg baits. Coyotes, bobcats, raccoons, skunks, and badgers were taken using calling, shooting, leg-hold traps, aerial gunning and snare techniques. The objective was to protect pheasants, Rio Grande turkey and waterfowl species on the Management Area.

Results

At least 156 corvids and carnivores were removed on the MVWMA and $26,131 spent during the 3-year project period. During that same period 618 ring-necked and Manchurian / ring-necked pheasant crosses were released on the Management Area. Pheasant crow counts conducted on the management area increased from 2009 to 2011 and then declined in 2012 by 33%. Record numbers of ducklings were recorded in 2011 but declined by 20% in 2012. Water levels in 2012 were down by 65% from 2011 suggesting that some of the increases seen in upland and waterfowl numbers may have been more associated with the 2011 water year than the with predator removal.

Project 23 Predator Control By Year

Year	FY10	FY11	FY12	Total
Common Raven	42	21	**0**	**63**
Coyote	30	11	**17**	**58**
Gray Fox	2	0	**0**	**2**
Bobcat	3	1	**0**	**4**
Striped Skunk	2	2	**4**	**8**
American Badger	0	0	**1**	**1**
Common Raccoon	16	2	**2**	**20**
Totals	**95**	**37**	**24**	**156**

(Numbers provided by the PRC)

Project 23 Predator Removal Contractor (PRC) & NDOW Expenditures By Year				
Year	**FY10**	**FY11**	**FY12**	**Total**
Salary/Benefits	$3,574	$5,025	**$5,530**	**$14,128**
Aerial Gunning				**$0**
Travel	$1,523	$1,050	**$732**	**$3,305**
Equipment/Supplies	$1,317	$665	**$1,197**	**$3,179**
Hire				**$0**
Dog and Horse				**$0**
Vehicle		$1,330	**$555**	**$1,885**
Admin Overhead	$1,035	$1,303	**$1,294**	**$3,633**
$3 Fee PRC Totals	**$7,450**	**$9,373**	**$9,308**	**$26,131**
NDOW Expenditures	**$7,450**	**$9,373**	**$9,308**	**$26,131**

Pheasant data for Mason Valley WMA By Year					
Year	**2009**	**2010**	**2011**	**2012**	**Total**
Ring-necked Pheasant Release	170	27	0	**80**	**277**
Manchurian Hybrid Cross Release	0	121	150	**70**	**341**
Pheasant Crow Counts / Week	1.33	2.75	8.38	**5.6**	
Ducklings banded			235	**189**	
Duckling broods				**39**	
Total Pheasants Released	**170**	**148**	**150**	**150**	**618**

Conclusion

Based on harvest data and pheasant crow count data recorded at the Mason Valley Wildlife Management Area, the Lyon County pheasant population was at its lowest level in 2008.

Between 2009 and 2011, pheasant crow counts indicated predator management on the MVWMA may have facilitated success of the pheasant release program. The 2012 data suggested that pheasant and waterfowl numbers may have been regulated more by the moisture regime and related changes in security cover and food availability than by predator numbers on the Management Area.

Recommendation

1) Terminate Project 23.

Project 25: Coyote Ecology Study – USU – Areas 16 and 17

By Pete Bradley, Tony Wasley, Steve Kimble, Tom Donham and Pat Jackson

Project 25 at a Glance

GOAL: Study effects of food availability on abundance, home range size, and litter size of coyotes.
PROJECT AREA: Toquima, Monitor and Toiyabe Mountain Ranges in Nye, Lander and Eureka Counties.
TARGET RESEARCH QUESTIONS: 1) How does availability of lagomorphs and small mammals influence coyote abundance, diet, and home range size? 2) What is the productivity of coyotes in central Nevada and how do these levels differ among 4 study sites?
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS: 1) Improved success of game population management is a potential result of an improved understanding of coyote dietary preference, coyote productivity and prey switching capabilities. 2) Improved understanding of coyote population dynamics and resource partitioning could improve our ability to manage wildlife habitats for optimum wildlife productivity statewide.
STUDY PERIOD: Year round.
DURATION: 2010-2015.

TOTAL EXPENDITURES TO DATE:	**$193,463 (1/4 $3 Fee + 3/4 P-R Federal Aid)**
FY12 BUDGET:	**$100,000 (1/4 $3 Fee + 3/4 P-R Federal Aid)**
FY12 ACTUAL EXPENDITURES:	**$ 68,463 (1/4 $3 Fee + 3/4 P-R Federal Aid)**
FY13 PROPOSED BUDGET:	**$100,000 ($3 Fee)**

Introduction

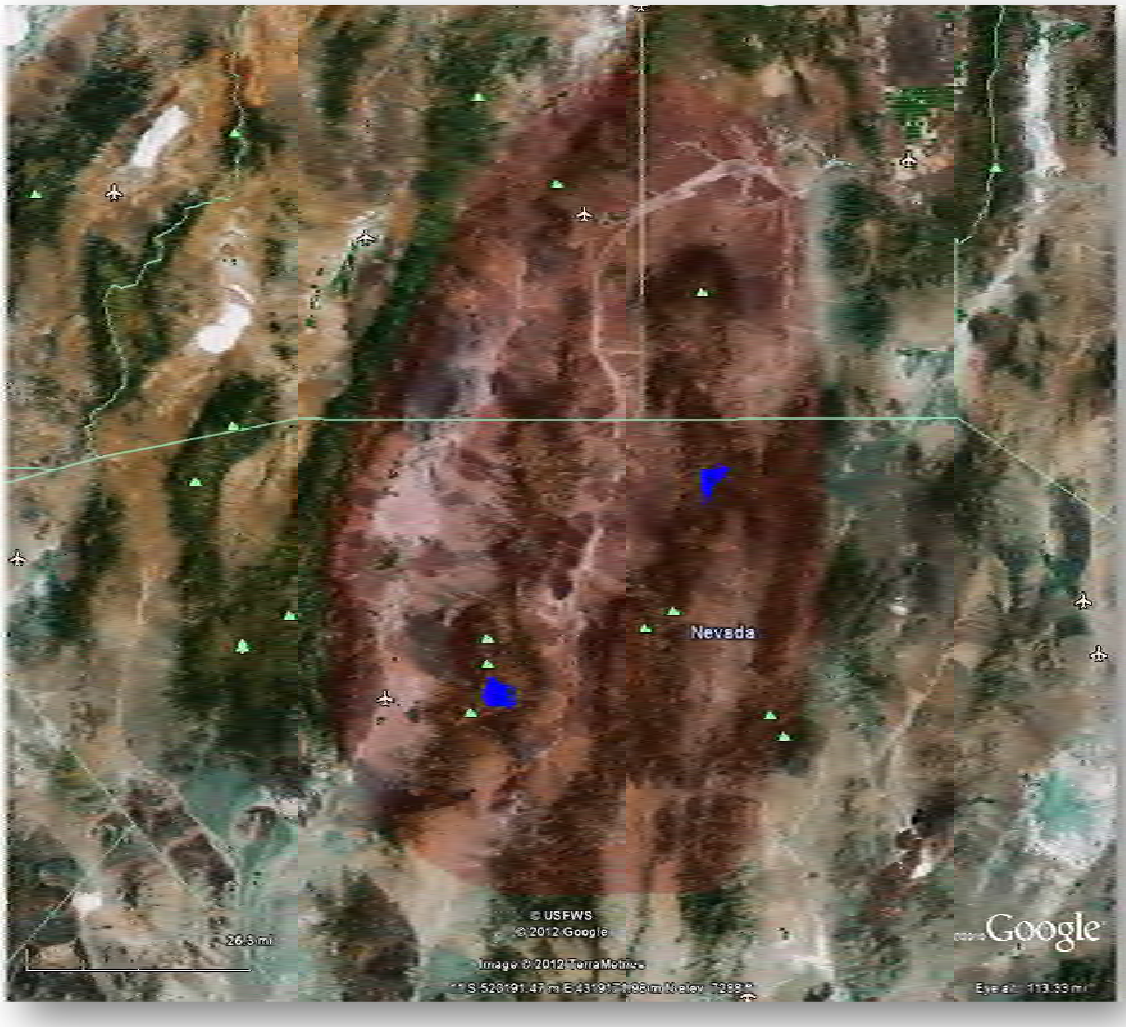
Masters candidate Pat Jackson (USU) began studying coyote ecology in the Monitor, Toiyabe, and Toquima ranges in central Nevada on 15 May 2011 (FY10) (See map). The study was designed to assess effects of food availability on abundance, home range size and litter size of coyotes.

Methods

Coyotes were trapped using Victor #3 soft catch foothold traps and immobilized with a ketamine/xylazine injection. Animals were weighed, measured, and ear tagged. Coyotes in good condition received a 280-g necklace GPS and 145-g VHF collar (GPS collar model G2C 181B, VHF collar model V5C 271B, SIRTRACK®, Havelock, New Zealand). Coyotes in fair to poor condition received a GPS collar only.

During May and June, coyote scat and Lagomorph transects were conducted along dirt roads. Scat transects involved walking 4 - 0.5 km stretches of road (per location) and removing all coyote scat. These same stretches of road were walked 4 weeks later and all scats counted and collected for later diet analysis. Lagomorph surveys consisted of driving a 15-30 km transect in each location within 1 hour of sunrise or 1 hour before

sunset, 1 day per month and counting all of those observed in the road. Passive-tracking indexes were conducted as well. Passive tracking indexes involved sweeping a 1 X 1.5 meter section free of stones and debris. One of these sections was located each kilometer along a dirt road. Each section was checked daily for 3 days for tracks of coyotes, deer, lagomorphs, cattle or feral horses. Small mammal prey abundance was analyzed by using live-trapping techniques in web arrays in the study area.



Project 25 Coyote Study Area
(Blue scribbles are coyote home ranges described further in text).

Results and Discussion

To date, 5 coyotes have been collared and prey analyses are well under way. A field study progress report for FY12 follows.

Project 25 Coyotes Collared By Year				
Year	FY10	FY11	FY12	Total
Coyotes Collared	0	3	2	5

Project 25 Expenditures By Year				
	FY10	FY11	FY12	Total
$3 Fee Totals	$25,000	$18,369	$17,116	$60,485
Other Totals	$26,522	$55,109	$51,347	$132,978
NDOW Expenditure	$51,522	$73,478	$68,463	$193,463

Coyote Report (FY12 Field Season - 7/1/2012 by Pat Jackson)

Two coyotes were captured during this quarter, both on 9 June 2012. The first was an adult lactating female (Figure 1), and is believed to be 3 years of age (Figure 2). The second was a puppy (Figure 3 and 4). An adult was observed "waiting" on the puppy approximately 300 meters away. Both were captured in the Toquima Range.

Figure 1. Lactating female coyote captured in Toquima Range, 9 June 2012.

Figure 2. Same female coyote as in Figure 1, technicians assess age and body condition.

Figure 3. Coyote pup being restrained in Y-pole.

Figure 4. Coyote pup after being released from foothold trap.

Two mortality signals were also picked up by Owyhee Air Research on 16 May 2012, one in Meadow Canyon Basin, the other in Butler Basin. The coyote in Meadow Canyon was a 10 year old + female at the time of collaring. The coyote in Butler Basin was approximately 3 years old at the time of collaring. Each dead coyote was found within 500 meters of Owyhee Air Research GPS locations.

The Meadow Canyon coyote was found on 31 May 2012 (Figure 5). There was a large hole in the skull (Figure 6), the left shoulder blade was broken in half, and the right radius and ulna were broken. It is believed this coyote died from a gunshot. Due to her lack of movement, it is believed she was shot sometime between 12-23 September 2012. There were no points collected between these two dates. Teeth were pulled for exact aging and whiskers were kept for stable isotope diet analysis.

Figure 5. Meadow Canyon coyote as it was found.

Since deployment of the collar for the Meadow Canyon coyote on 4 July 2011, 308 points were recorded on the Sirtrack GPS collar. Adaptive kernel home ranges were analyzed using Program R and ArcMap 10 for 25%, 50%, 75%, 95%, and 99% of the coyote's home range (Figure 6). A new tool in ArcMap 10 named "Movement" was used to connect each GPS location in the order they were collected (Figure 7). It is interesting to note how often this coyote moved between points.

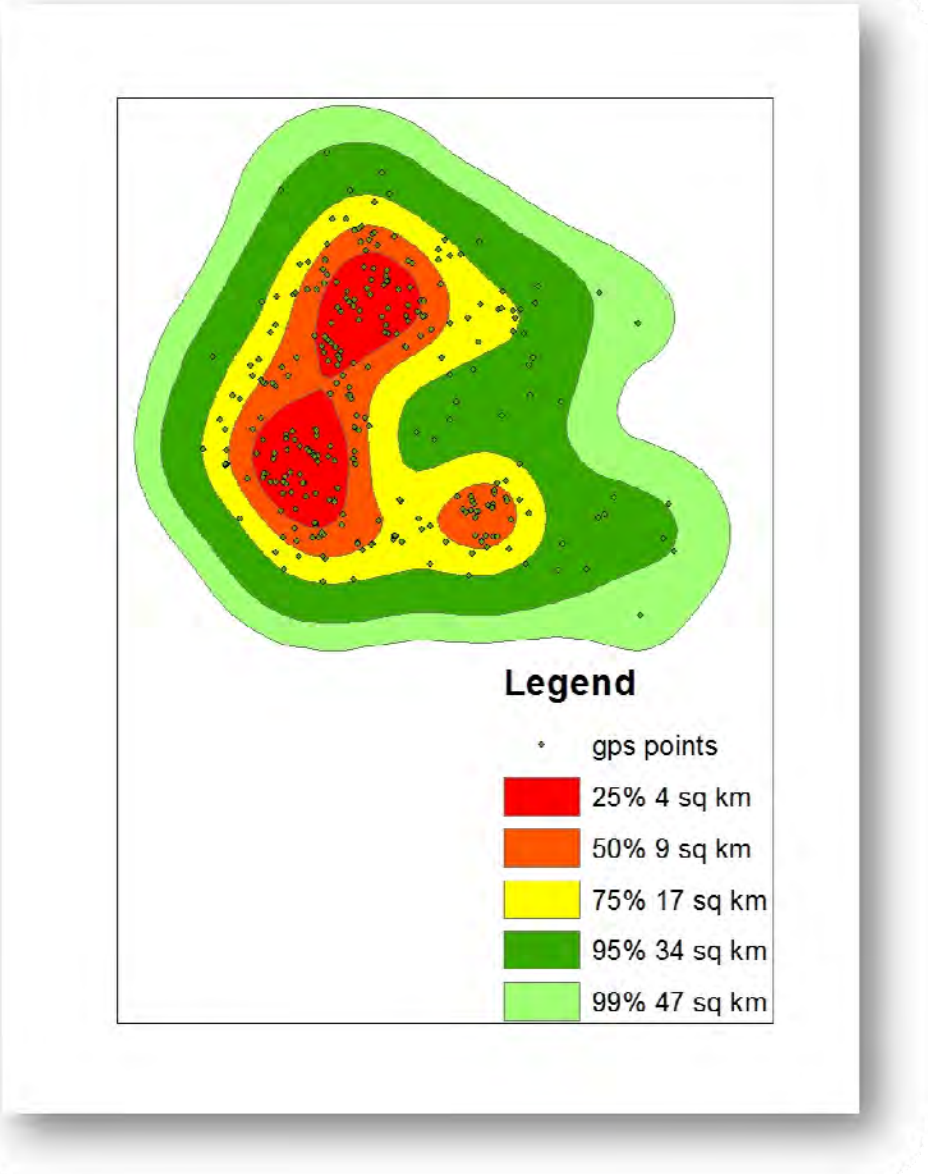


Figure 6. Adaptive kernel analysis of Meadow Canyon coyote.

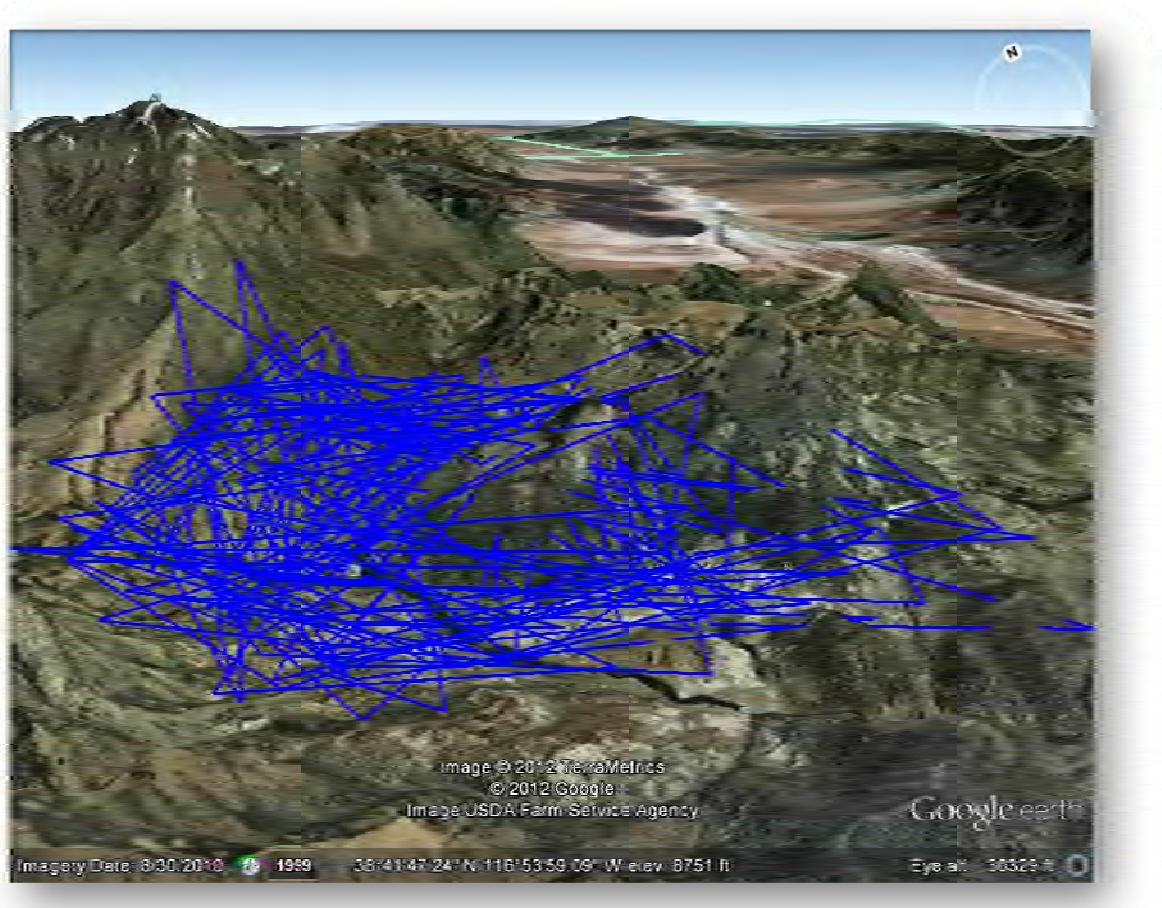


Figure 7. Movement analysis of Meadow Canyon coyote.

The Butler coyote was found on 1 June 2012 (Figure 8). There was no apparent physical damage to the coyote on initial inspection. Upon further inspection, a hole was found in the right shoulder blade (Figure 9), though this wound seemed to be old and had partially healed. It is important to note that this coyote had nursed pups and was in poor shape at the time of collaring, thus she only received a GPS collar. Cause of death was undetermined (gunshot and/or overall poor health). Due to a lack of movement it is believed she died on 28-29 October. Teeth were pulled for exact aging and whiskers were kept for stable isotope diet analysis.

Figure 8. Butler coyote as it was found.

Figure 9. Hole in right shoulder blade of Butler female (Hole is circled in red).

Since the date of deployment on 29 July 2011, 357 points were recorded on the Sirtrack GPS collar for the Butler female. Adaptive kernel home ranges were analyzed using Program R and ArcMap 10 for 25%, 50%, 75%, 95%, and 99% of the home range (Figure 10). Movement was used to connect each GPS location in the order they were collected (Figure 11).

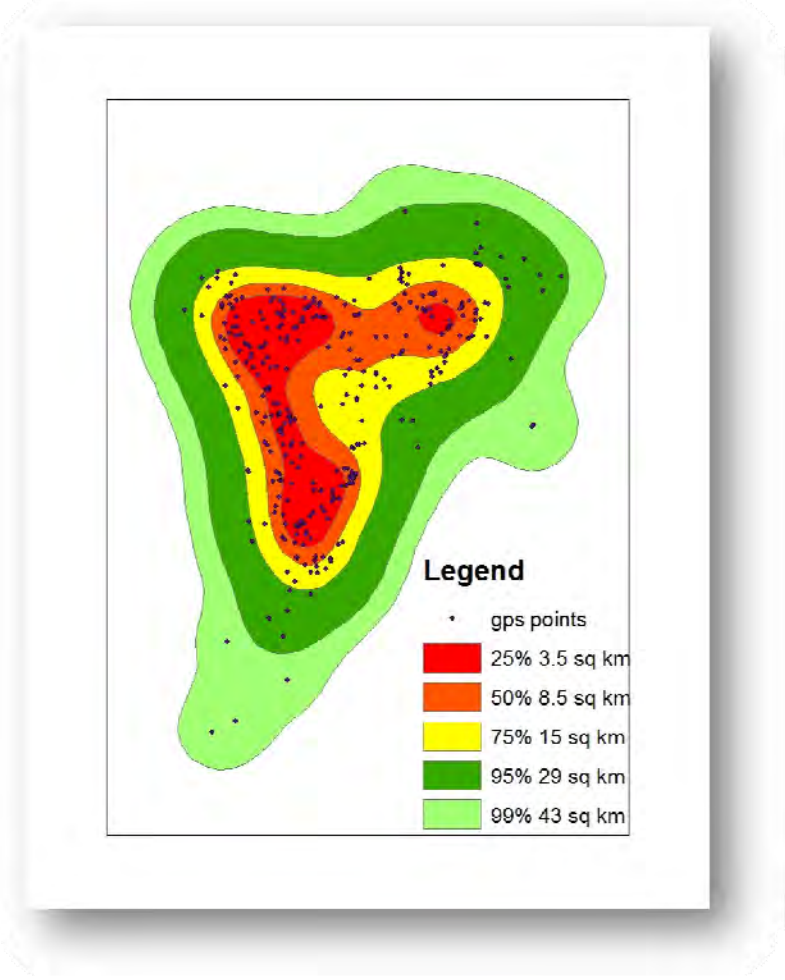


Figure 10. Adaptive kernel analysis of Butler coyote.

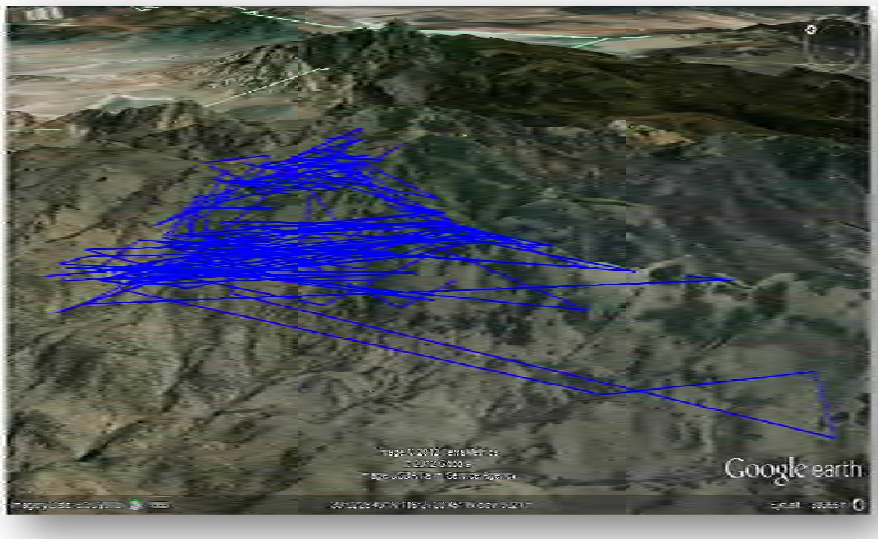


Figure 11. Movement analysis of Butler coyote.

Coyote Prey, Diet, and Abundance Report (FY12 Field Season - 7/1/2012 Pat Jackson)

Coyote Abundance and Diet - Starting 15 May 2012, coyote scat was counted in 2 week intervals on 1 kilometer transects at each site. These scats were collected for diet analysis. Passive tracking indices (PTI) were also conducted for 3 consecutive days at each site. For each PTI, a pre-determined portion of road was selected. Within this road section, a 1 meter by 1.5 meter plot was swept every 0.6 kilometers. We counted the number of coyote intrusions in every plot each morning, after which we re-swept the plot. None of this data has been analyzed to date.

Lagomorph Abundance - Starting 15 May 2012, transects were driven in each site to determine Lagomorph abundance. Surveys occurred on a pre-determined section of road from 1 hour after sunset to 1 hour before sunrise. Handheld spotlights helped technicians detect eye-shine and Lagomorph movement. Two technicians searched for lagomorphs on their respective sides of the vehicle while a third technician drove and counted lagomorphs detected on the road. Once a Lagomorph was spotted, the vehicle was stopped and distance and species was determined and recorded. Lagomorph prey species noted during this effort included the black-tailed jackrabbit, mountain cottontail and pygmy rabbit. None of this data has been analyzed to date.

Small Mammal Abundance - From 15-25 June 2012, small mammal trapping was conducted to determine small mammal abundance. Two webs of Sherman live-traps were set in each site, for 3 consecutive trap nights, totaling 3,552 trap nights. Small mammals captured on the first 2 trap nights of each trapping session received a permanent marker strip on their stomach. Rodent prey species captured during this effort included the American deer mouse, piñon mouse, least chipmunk, Uinta chipmunk, golden-mantled ground squirrel and Great Basin pocket mouse. Though this data has not been formally analyzed, preliminary analysis indicates capture rates for each site ranged from 20-48%.

Conclusion

USU student personnel are conducting carnivore research successfully in relatively harsh field conditions. NDOW biologists will continue to coordinate with project proponents to manage financial and research assistance through the $3 Predator Fee commitments to this project. The full Coyote Ecology study plan is attached for reference.

Recommendation

1) Continue Project 25.

Coyote Ecology Study Plan

Introduction

Food availability is likely the single most important factor driving coyote (*Canis latrans*) biology. Coyotes are generalist predators; their diets consist of hunted prey, carrion, vegetation, and mast, though they generally consume whatever is most readily available. Coyotes often switch from one prey source to another depending on food availability (Hamlin et al. 1984, Green et al. 1994, Ballard et al. 2001, Hurley et al. 2011). The capacity to consume a wide ranging diet and the loss of the gray wolf across much of its historic range has facilitated the growth of the coyote range which presently spans from Mexico to Alaska and from Florida to Maine (Canid Specialists Group 2011).

Coyotes forage primarily in areas where they detect prey frequently and have high rates of prey capture (Gese et al. 1996*b*). Their hunting efforts are focused on prey that have low cost/benefit ratio based on energy (Gese et al. 1996*b*) such as grasshoppers and rodents in habitats such mesic meadows and shrubs, grasslands, and sagebrush (MacCracken and Hansen 1987, Hernandez et al. 2002). Hamlin et al. (1984) discovered that sometimes grasshoppers were a major part of the coyote diet; at other times, plant materials such as chokeberry (*Prunus virginiana*), rose hips (*Rosa woodsi*), dogwood berries (*Cornus stolonifera*), and gooseberries (*Ribes* spp.) were major components of coyote diet.

The alternate-prey hypothesis states that a predator which focuses on a main prey that fluctuates in numbers will shift to alternate prey items during times when the main prey are at low abundance (Angelstam et al. 1985, Small et al. 1993, Kjellander and Nordström 2003). A study conducted in Fennoscandia conducted on roe deer (*Capreolus capreolus*), red fox (*Vulpes vulpes*) and microtines determined microtines to be the main prey species and roe deer to be the alternate prey (Angelstam et al. 1984). It is important to note that small mammal populations are cyclic and the drivers of these population cycles are debated among ecologists. However, it is generally accepted that food availability is one factor (Haukioja et al. 1983). Weather, and more precisely precipitation, plays an important role in small-mammal abundance through limiting plant production (Ernest et al. 2000, Moritz et al. 2008).

Coyote abundance is often driven by availability of food, especially in winter conditions (Gese et al. 1996*c*). For instance, Clark (1972) and O'Donoghue et al. (1997) found that coyote populations declined following decreases in Lagomorph densities. Food availably can regulate coyote abundance through litter size, home range size, habitat utilization, and survival (Knowlton 1972, Knowlton and Gese 1995, Gese et al. 1996*c*). In winters with deep snow, coyote pack sizes will increase to focus on newly available resources such as ungulate and livestock carcasses (Gese et al. 1996*c*). During winters when food sources become scarce, some coyotes such as yearlings and older individuals are driven off carcasses by dominant pack members and forced to disperse (Knowlton and Gese 1995, Gese et al. 1996*c*). During hard winters, coyotes will often abandon all territorial behavior, and all individuals of the population may disperse (Mills and Knowlton 1991).

Coyote home ranges provide resources necessary for survival and successful rearing of young (Gese et al. 1988, Gese et al. 1996*b*). Home ranges may be inherited from parents, thus home range boundaries may remain the same for several generations (Gese 1995, Knowlton and Gese 1995). Home ranges can vary in size from 4 km² in Texas to 107 km² in Washington state (Springer 1982, Andelt 1985). In Colorado, coyote home ranges were the smallest in canyons, intermediate-sized in pinyon-juniper hills, and largest in grassland prairies (Gese et al. 1988). When coyotes established home ranges at elevations ≥2,286 m, they remained there during winter (Shivik 1995, Gantz and Knowlton 2005). This behavior suggests that coyotes may choose habitats that provide suitable resources year round and that exploitation of prey may vary seasonally (Weaver 1979, Shivik 1995).

Coyote productivity is primarily dependent upon food availability and secondarily on coyote density (Knowlton 1972, Gese et al. 1996*c*). When coyote densities are near or at carrying capacity, mature coyotes will occupy and defend territories for long periods of time and point subordinate and yearling females may not reproduce (Gese 1990). In contrast, yearling females may reproduce and increase their litter sizes in areas experiencing high rates of coyote removal or in areas with ample food resources (Knowlton 1972, Gese et al. 1996*a*, Gese et al. 1996*b*). Food availability for coyote adults during mating and gestation may affect litter size of their female offspring (Knowlton and Stoddard 1983).

Human activities can impact coyote populations. Aerial gunning, trapping, poisoning, vehicle collisions, and shooting from the ground are significant sources of mortality in some populations (Gese et al. 1989, Hurley 2011). Removal efforts can modify coyote age ratios, alter home ranges, and change day-to-day activity of coyotes (Knowlton and Gese 1995). Knowlton (1972) found that as coyote removal efforts intensified, the average number of uterine swellings in pregnant females increased (Table 1). The number of uterine swellings indicates the number of unborn pups (Kennelly and Johns 1976, Kennelly 1978).

Table 1. Comparison of average litter sizes from 7 South Texas counties in relation to coyote control efforts.

Intensity of Control Effort [a]	County	Number of Pregnant Females Examined	Average Number of Uterine Swellings per Female
Intensive	Uvalde	10	6.2
	Zavala	8	8.9
	Dimmit	12	6.4
Moderate	Jim Wells	21	5.6
	Hidalgo	11	6.7
Light	Jim Hogg	17	4.2
	Duval	11	2.8

[a]Knowlton (1972:373) Reprinted from the Journal of Wildlife Management.

Factors such as ecological complexity, inconsistent research findings, varying viewpoints, and funding demands make coyote management decisions challenging.

Therefore, understanding coyote population dynamics, the role of food availability, and diet are essential for effective ecosystem management. Wildlife managers need a better understanding of coyote ecology to determine how the species interacts with its environment, how it impacts ecosystems by providing ecological services (e.g. trophic cascade service of improving forage quality and quantity on mule deer winter range by consuming black-tailed jackrabbits), how the coyote may be impacted by abundance of food (i.e. sagebrush vole, American deer mouse, piñon mouse, black-tailed jackrabbit, mule deer, pronghorn, carrion and mast), and the conditions under which coyote removal may or may not increase target game populations and /or change wildlife habitat conditions. Issues such as funding, scale, methodology, cost: benefit ratio and public perception must be taken into account before making coyote management decisions.

Our study objective is to determine how coyote abundance, diet, productivity, and home range are influenced by the availability of prey and the quality of habitat within 4 basins located in central Nevada. This knowledge will help Nevada Department of Wildlife make effective, ecologically sound coyote management decisions in the future.

Research Questions

1. How does the availability of lagomorphs and small mammals influence coyote abundance, diet, and home range size?

2. What is the productivity of coyotes in central Nevada and how do these levels differ among the 4 study sites?

Study Area

This study will be conducted in 4 basins in central Nevada located in Eureka County (Charnac Basin) and Nye County (Meadow Canyon Basin, Butler Basin, and Stoneberger Basin). All study sites are located in Nevada Department of Wildlife (NDOW) Hunt Units 161 and 162. Each study site spans 75-100 km^2. Vegetation at all study sites is dominated by sagebrush (*Artemisia* spp.), Utah juniper (*Juniperus osteosperma*), Rocky Mountain juniper (*Juniperus scopulorum*), singleleaf piñon (*Pinus monophylla*), quaking aspen (*Populus tremuloides*) and curlleaf mountain mahogany (*Cercocarpus ledifolius*).

Methods

Coyote Capture

We will capture, radio collar, and release 30-40 coyotes from 2011 to 2014. Coyote captures will be conducted from mid-May to October of each year. Capture protocols are similar to those described by Linhart and Dasch (1992), Phillips and Mullis (1996), and the Association of Fish and Wildlife Agencies (2007). We will capture coyotes using Victor No. 3 Soft Catch and 1.75 foothold traps or cable restraints. Coyotes will be immobilized with 10 mg/kg of ketamine mixed with 1 mg/kg of xylazine. Pictures will be taken of the left, right, and side views of the teeth to determine age by tooth wear. Individuals will be fitted either with a 280-g necklace Global Positioning System (GPS) collar and a 145-g Very High Frequency (VHF) collar (GPS collar model G2C 181B,

VHF collar model V5C 271B, Sirtrack®, Havelock, New Zealand). The GPS collars are outfitted with a mortality signal that is programmed to turn on when coyotes are still for >2 hours. They have a battery life of 730 days, and will collect 6 points a day at different times (1800, 2200, 2400, 0200, 0600, and 1200 hours); in addition they have a VHF transmitter with battery a life of 730 days. The VHF collars have a mortality signal and a battery life of 1,825 days. The first 15 healthy adult coyotes captured will receive both collars.

Coyote monitoring

We will monitor coyotes with GPS and VHF collars for 2 years. GPS units will automatically detach after being deployed 2 years. After detachment or in the case of coyote mortality, we will locate the GPS collar using Communications Specialists receivers and 3-way Yagi antennas (Communications Specialists, Orange, California). We will also locate coyotes once their GPS collars have fallen off so that they can be recaptured and recollared. Telemetry will be performed when conducting other surveys in each study site to determine presence or absence of each radio-collared animal and determine a general location. Data from the GPS collars will be used to assess home range size, seasonal variation, and habitat use.

Coyote abundance

Scat transects will be used to determine coyote abundance. Four 1-km transects will be randomly selected from an ArcMap layer for each study site on existing roads. All transects will be walked once every 30 days from May through August. All scats will be counted and collected for diet analysis. Scat deposition rates will be standardized by the number of days between surveys and transect length (Knowlton 1984).

Passive-tracking indices will also be used to determine coyote abundance and will be similar to those conducted by Engeman et al. (2000, 2002). Lightly traveled roads will be randomly selected in ArcMap for plot placement. Every 0.8 km along selected roads, we will sweep a plot clear of debris and fill it in with nearby loose soil. Plots will be checked for tracks and cleared every morning for 3 days. We will conduct these transects 3 consecutive days each month from May and September. We will also use our radio-collared coyotes to assess abundance using a modified capture-recapture Jolly Seber method.

Coyote productivity

Between November and February, coyote calling contests are conducted in central Nevada. As many female carcasses as possible will be collected from these contests. Uteruses will be removed from female carcasses and dissected to count placental scars and fetuses. Litter sizes will be determined using Kennelly's (1978) method by differentiating and counting primary, secondary, and reabsorption scars. Any female carcass found dead through telemetry, randomly found, or acquired from our contractor will also be analyzed for placental scars and fetuses. Carcasses will be collected and teeth will be pulled from both male and female coyotes to determine age structure.

Coyote scat analysis

Coyote scats will be collected during scat transects. Scats will be dried in the sun and stored for lab analysis. Once in the lab, scat will be placed in pantyhose and washed in a washing machine to remove small material but leave behind bones, teeth, and fur (Kelly 1991). Scat will be dissected such that bones, skin, feathers, hair, insect parts, and plant parts will be identified to genus and species when possible. We will collect samples of plants and insects as well as hair, teeth, and bones from lagomorphs and rodents, and assemble an identification key to identify parts in each scat.

Abundance of lagomorphs and small mammals

Surveys to assess lagomorph abundance will be conducted twice per month on roads within each study site using methods similar to those used by Smith and Nydegger (1985) and Ralls and Eberhardt (1997). We will drive 10-15 kph and survey for lagomorphs on the road while 2 passengers will spotlight for lagomorphs on their respective side of the vehicle. When a lagomorph is sighted, the vehicle will be stopped and the distance, species, number of individuals, and UTM coordinates will be recorded.

We will estimate small-mammal abundance using a mark-recapture study involving Sherman traps (Parmenter et al. 2003) during June and September of each field season. Two trapping webs will be established in each site. Traps will be established in a web pattern containing 12 radial lines, totaling 148 traps. The first 4 traps in each radial line will be spaced in 5-m intervals, the next 8 traps will be spaced at 10-m intervals, and an additional 4 traps will be placed in the web center. (Parmenter et al. 2003). Traps will be checked every morning, closed during the day, and then reopened every evening as recommended by Parmenter et al. (2003). All small mammals will receive a permanent marker dot on their stomach; blue for male, red for female. All *Spermophilus*, *Ammospermophilus*, *Tamias*, *Dipodomys*, *Rattus*, and *Thomomys* will receive an ear tag in each ear in addition to their permanent marker marking. Each small mammal's sex, reproductive status, and weight will also be recorded.

Statistical Analysis

Coyote abundance will be determined through scat analysis using Knowlton's (1984) techniques. Passive tracking indexes will be determined using techniques similar to those described by Engeman et al. (2000). We will use Program DISTANCE to determine lagomorph abundance. Both program DISTANCE and MARK will be used to determine small-mammal abundance following protocol established by Parmenter et al. (2003). Coyote home ranges will be determined by measuring adaptive kernels in ArcMap 9.3 (ESRI Redlands, CA) following methods detailed by (Rodgers et al. 2007).

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Project 26: Predator Removal Contractor Field Specialist Positions

By Pete Bradley

Project 26 at a Glance

GOAL: Provide additional Infrastructure Support to PRC.
PROJECT AREA: Statewide.
PROJECT DURATION: 2010-2012.
TARGET SPECIES: Carnivora- Mountain Lion, Bobcat, American Badger, Striped Skunk, Spotted Skunk, Coyote, Gray Fox, Red Fox, Kit Fox, Common Raccoon; Corvidae- Common Raven.
NON-TARGET SPECIES: Unknown.
TIME PERIOD: Year round.

TOTAL KILL TO DATE:	**Unknown.**
FY12 TOTAL KILL:	**Unknown.**
TOTAL EXPENDITURES TO DATE:	**$129,185**
FY12 BUDGET:	**$ 98,728**
FY12 ACTUAL EXPENDITURES:	**$ 24,342**
FY13 PROPOSED BUDGET:	**$ 0**

Introduction

The PRC requested financial assistance to fund personnel to assist with other projects.

Methods

PRC personnel would work statewide on aerial operations, ground trapping, raven control, and other duties as required.

Project 26 Predator Removal Contractor (PRC) & NDOW Expenditures By Year

Year	FY10	FY11	FY12	Total
Salary/Benefits	$36,585	$21,388	**$11,731**	**$69,704**
Aerial Gunning				**$0**
Travel	$5,533	$5,600	**$5,441**	**$16,574**
Equipment/Supplies	$899	$2,270	**$290**	**$3,459**
Hire	$980	$1,200	**$1,480**	**$3,660**
Dog and Horse				**$0**
Vehicle	$9,893	$5,917	**$2,015**	**$17,825**
Admin Overhead	$8,703	$5,875	**$3,385**	**$17,963**
Totals	**$62,593**	**$42,250**	**$24,342**	$**129,185**
NDOW Expenditures	**$62,593**	**$42,250**	**$24,342**	$**129,185**

Conclusion

Project 26 is redundant to other projects, especially Projects 21 and 22 which were already designed to be flexible and able to respond to identified needs. If projects are implemented during the year, those personnel costs formerly associated with this project (Project 26) can be included at that time and payments authorized under the authority of the project where personnel are used.

Recommendation

1) Terminate Project 26.

Predator Removal Contractor (PRC) $3 Fee Project Expenditure Summary and Proposed FY13 Budget

Project Name	FY09	FY10	FY11	FY12	FY13 Proposed
Project 6 – Protection of Desert Bighorn –Area 24/22	$17,475	$17,369	$87,042	**$81,463**	**$82,000**
Project 18 – Protection of Mule Deer - Unit 014	$103,945	$85,186	$92,961	**$89,324**	**$85,000**
Project 20 – Protection of California Bighorn- Unit 022	$5,807	$4,707	$14,983	**$2,864**	**$2,500**
Project 21 - Common Raven Control For Sage-grouse	$17,475	$14,298	$0	**$9,842**	**$60,000**
Project 22 – Mule Deer/Big Game Enhancement – Statewide	na	$136,412	$102,241	**$90,111**	**$80,000**
Project 23 – Pheasants & Other Birds	na	$7,450	$9,373	**$9,308**	**$0**
Project 26 – Contractor (PRC) Field Position	na	$62,593	$42,250	**$24,342**	**$0**
TOTAL Expenditures	**$144,702**	**$328,015**	**$348,850**	**$307,254**	**$309,500**

FY12 Project Expenditure Summary

Project Name	FY09	FY10	FY11	FY12	TOTALS***
Project 6 – Protection of Desert Bighorn –Area 24/22	$17,475	$17,369	$87,042	**$81,463**	**$265,462**
Project 18 – Protection of Mule Deer - Unit 014*	$113,945	$95,185	$92,961	**$159,324**	**$708,213**
Project 20 – Protection of California Bighorn- Unit 022*	$5,807	$9,207	$15,293	**$2,864**	**$37,171**
Project 21 - Common Raven Control For Sage-grouse*	$17,000	$14,298	$57,228	**$44,499**	**$147,025**
Project 22 - Mule Deer/Big Game Enhancement – Statewide*	na	$289,037	$220,782	**$90,111**	**$599,930**
Project 23 - Predator Control For Pheasants & Other Birds	na	$7,450	$9,373	**$9,308**	**$26,131**
Project 25 - Coyote Ecology Study - USU - Area 16 & 17**	na	$51,522	$73,478	**$68,463**	**$193,463**
Project 26 - Contractor (PRC) Field Position	na	$62,593	$42,250	**$24,342**	**$129,185**
TOTAL Expenditures ($326,911 FY02-08)	**$154,227**	**$546,661**	**$598,407**	**$480,374**	**$2,106,580**

** Heritage Monies included 2009-2012. **PR Grant Monies included 2002-2012. ***Some totals include years back to 2002.*

FY12 Expenditures and FY13 Starting Balance ($3 Fee Only)	
Starting Balance for FY12:	$413,264
NDOW FY12 July-June Expenditures:	-27,234
FY12 July-June Contract Expenditures*:	-321,334
$3 Fee Collected in FY12 for FY13.	$449,264
Predator Donations Collected in FY12 for FY13.	$11,302
Starting Balance for FY 13.	$525,262

***Administrative Overhead for PRC in FY12 was $39,038 (12.7%)**

FY13 Project Proposal Summary

Project 6: Protection of Desert Bighorn – Areas 24/22
Continue Project 6 and budget $82,000 for FY13 (see page 6).

Project 18: Protection of Mule Deer – Unit 014
Continue Project 18 and budget $85,000 for FY13 (see page 10).

Project 20: Protection of California Bighorn – Unit 022
Continue Project 20 and budget $2,500 for FY13 (see page 16).

Project 21: Common Raven Control For Sage-grouse
Continue Project 21 and budget $60,000 for FY13 (see page 19).

Project 22: Mule Deer/Big Game Enhancement –Statewide
Continue Project 22 and budget $80,000 for FY13 (see page 27).

Project 25: Coyote Ecology Study – USU – Area 16
Continue Project 25 and budget $100,000 for FY13 (see page 33).

Project 27: Cougar Diets Where Bighorn, Mule Deer and Cougar Coexist
Satellite collar 10 cougars in 7 study areas across Nevada (70 collars). Through the study of location data, kill-site follow-up and tissue analysis, determine seasonal diet patterns, home range, movement patterns and population linkage of cougars in Units 021/022, 033/011, 074/076, 114/115, 201/204, 211, 251/252 and possibly 101/105. Budget $30,000 for FY13 (See Appendix A).

Project 28: Ecology of Cougar Black Bear Interaction – Areas 20/29
Study diet overlap and resource partitioning of black bear and cougar populations in desert ranges adjacent the Carson/Sierra Front. Budget $22,000 for FY13 (See Appendix A).

Project 29: Carrion Management on Roads in Greater Sage-Grouse Habitat
Reduce anthropogenic resource subsidies. Budget $15,000 for FY13 (See Appendix A).

Project 30: Landfill Management in Greater Sage-Grouse Habitat
Reduce anthropogenic resource subsidies. Budget $6,000 for FY13 (See Appendix A).

PROPOSED PREDATION MANAGEMENT PROGRAM BUDGET FY13

				July 1, 2012 Beginning Balance	$525,262
Item	Unit		Day	Recommended 2013 Budget	TOTALS
Predator Removal Contractor (PRC) Approved Projects:					
Project 6 Protection of Desert Bighorn	Areas24/22			$82,000	
Project 18 Protection of Mule Deer/Big Game	Unit 014			$85,000	
Project 20 Protection of California Bighorn	Unit 022			$2,500	
Project 21 Common Raven Control for Sage-grouse & WMAs	Statewide			$60,000	
Project 22 Mule Deer/Big Game Enhancement	Statewide			$80,000	
				PRC Total	**$309,500**
NDOW Budget: Salary	*Productive Hrly Rt.				
Game Bureau Chief		$62.61	10	$5,008	
Staff Biologist		$54.02	180	$77,780	
Administrative Assistants		$35.65	3	$856	
Total Salary				**$83,644**	
Operating					
Project 25 Coyote Ecology Study	Area 16			$100,000	
Project 27 Cougar Diets in Bighorn Habitat	Statewide			$0	-not approved
Project 28 Cougar Black Bear Interaction	Areas 20/29			$0	-not approved
Project 29 Road Carrion Management in Sage-grouse Habitat	Statewide			$15,000	
Project 30 Landfill Management in Sage-grouse Habitat	Statewide			$6,000	
Aerial Surveys				$7,268	
Other Operating				$5,000	
Total Operating				**$133,268**	
In-State Travel				**$900**	
Mileage (Vehicle use)		$0.55	5000	**$ 2,750**	
Fixed Costs (Uniforms etc.)				**$200**	
				NDOW Total	**$220,762**
TOTAL EXPECTED FY13 PROGRAM EXPENDITURES:					**$530,262**
LEFTOVER FROM FY13:	Beginning Balance - Fy13 Expenditures =			**$-5,000**	(projected)
REVENUE 2012-13:	Fees collected from Tag Applications**			**$456,926**	(projected)
	Donations through Tag Application processes:			**$13,000**	(projected)
June 30, 2013 Ending Balance (Beginning Balance for FY14): ESTIMATE.					**$464,926**

*PROJECTS UPON APPROVAL BECOME PART OF NDOW CONTRACT 09-76. ALL EXPENDITURES AND INVOICES MUST CONFORM TO THE STATE OF NEVADA'S RULES AND REGULATIONS FOR PAYING CLAIMS AS PRESCRIBED IN SAM 2600. INVOICES AND BACK-UP DOCUMENTATION MUST BE DIRECTLY RELATED TO THE PROJECT AND PROJECT AREA DESCRIBED IN THIS DOCUMENT. BACK-UP SUCH A TIMESHEETS, TRAVEL CLAIMS, MILEAGE RECORDS AND OTHER DOCUMENTATION MUST CLEARLY INDICATE THE PROJECT THEY ARE ASSOCIATED WITH. 4TH QUARTER BILLINGS MUST BE RECEIVED NO LATER THAN JULY 15TH OF EACH YEAR.

**PRODUCTIVE HOURLY RATE IS A CALCULATION FOR THE COST ASSOCIATED TO FULLY FUND PERSONNEL WHICH INCLUDES SALARY/BENEFITS/LEAVE AND OTHER RELATED EXPENSES.

*** APPLICATION PROCESSES ARE FALL TURKEY, SPRING TURKEY, GUIDED DEER, MAIN BIG GAME, SECOND BIG GAME, FIRST COME FIRST SERVED, AND COUGAR DRAWS/TAG SALES.

APPENDIX A – New Projects

Project 27: Cougar Diets Where Bighorn, Mule Deer and Cougar Coexist

By Pete Bradley, Alyson Andreasen, Tony Wasley, Kelley Stewart, Jon Beckmann Mike Cox, Shawn Espinosa, Peregrine Wolff, Lee Turner, Caleb McAdoo, Kari Huebner, Curt Baughman, Tom Donham, Chris Hampson, Carl Lackey, Jason Salisbury, Mike Dobel, Steve Kimble and Ken Gray

Project 27 at a Glance

GOALS: 1) Elucidate spatial/temporal changes in Cougar diets and how these changes may be timed to epic seasonal, latitudinal and/or altitudinal migration patterns of big and small game species as well as to landscape scale changes in wildlife habitats. 2) Study effects of anthropogenic resource subsidy availability (feral horse and domestic livestock) on male and female cougar carrying capacities in these same areas.
PROJECT AREA: Statewide (Specific Study Areas likely will include Units 021/022, 033/011, 074/076, 114/115, 201/204, 211, 251/252 and possibly 101/105.)
TARGET RESEARCH QUESTIONS: 1) How do cougars modify their foraging strategies in an ever-changing food resource / habitat landscape? 2) Is alternate cougar prey availability (mule deer, porcupine, hare, feral horse and/or domestic livestock) reducing population viability of reintroduced bighorn populations?
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS:
1) In areas where anthropogenic resource subsidies for resident cougar populations are found to be a dietary factor, success of bighorn reintroduction efforts may be optimized by voluntary coordinated management of other range uses (livestock or feral horses) in and near specific bighorn release sites. 2) In areas where seasonal mule deer, elk or pronghorn migration corridors are found to provide increased food resources for resident cougar populations in close association with nascent bighorn herds, this specific circumstance may provide wildlife managers with a unique opportunity to target cougars, both temporally and spatially, that may be suppressing minimum population viability in specific bighorn herds and also impacting adjacent mule deer, elk or pronghorn populations. 3) Improved success of big game releases and big game population management are potential results of improved understanding of lion dietary preference and prey switching capabilities.
STUDY PERIOD: Year round.
DURATION: 2012-2022.
TOTAL EXPENDITURES TO DATE: $0
FY13 PROPOSED BUDGET: $30,000

Introduction

Cougar distribution has been reduced by 2/3 in North America since European contact (Hornocker and Negri 2010). In 21st Century Nevada, the Basin and Range Province retains its importance as a wilderness bastion for the species. As part of an effort to reintroduce bighorn sheep to all of their former range in Nevada, scientists are attempting to understand carnivore-prey relationships, particularly where bighorn populations overlap in distribution with mule deer, porcupine, hare, feral horse and

domestic livestock. This study was designed to help elucidate interspecific interaction between cougar, bighorn, mule deer and other prey populations in Nevada and to assess the long term prognosis for nascent bighorn herds in the State.

Methods

In cooperation with UNR and the Wildlife Conservation Society (WCS), and in particular with Dr. Jon Beckmann and Alyson Andreasen (Carnivore Research Ecologists) and Dr. Kelley Stewart (Large Mammal Ecologist), NDOW plans to monitor behavioral and physiological parameters of cougars in 7 study areas across Nevada where Desert, Rocky and California Bighorn populations share the landscape with mule deer.

Over a 10-year period, NDOW, WCS and UNR plan to satellite collar 10 cougars in 7 study areas across Nevada (70 Vectronic collars). Through the study of location data, kill-site follow-up, tissue analysis, prey availability and habitat conditions (Andreasen et al 2012), we hope to determine seasonal diet patterns, home range, movement patterns and population linkage of cougars in the Virginia/Peterson (021/022), Sheldon/Massacre (033/011), Salmon/Granite (074/076), Snake (114/115), Sweetwater (201/204), Boundary (211), Kawich/Reveille (251/252) and possibly East Humboldt/Spruce (101/105) Complexes. In the study's inaugural year (FY13), there is a proposed budget of $30,000 for the initial purchase, deployment and monitoring of 4 satellite cougar collars in either the Salmon/Granite or Sheldon/Massacre Complexes.

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Project 28: Ecology of Cougar-Black Bear Interaction

By Pete Bradley, Jon Beckmann, Carl Lackey and Alyson Andreasen

Project 28 at a Glance

GOALS: 1) Elucidate Apex Carnivore resource partitioning / competition/ commensalism in desert ranges immediately east of Sierra/Carson Front where Black Bear have established territories recently that overlap those of Cougars.
PROJECT AREA: Douglas, Lyon, Mineral and possibly Esmeralda Counties (Areas 20, 29 and possibly 21).
TARGET RESEARCH QUESTIONS: 1) Does cougar home range size differ between areas with and without black bear home range overlap? 2) How do diets of the two sympatric carnivores compare? 3) Do mule deer experience increased predation by cougars in desert ranges where black bears and cougars are sympatrics.
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS:
1) Improved success of big game population management, both ungulate and carnivore big game, is a potential result of improved understanding of lion/bear dietary preference, dietary overlap and prey switching capabilities. 2) Improved and targeted carnivore population management in these desert ranges could potentially improve attendant big game population management which has implications for improved big game tag allocation and wildlife viewing opportunities in these desert ranges adjacent the Sierra Nevada. 3) Improved mule deer population/habitat management could result from this study.
STUDY PERIOD: Year round.
DURATION: 2012-2016.
TOTAL EXPENDITURES TO DATE: $0
FY13 PROPOSED BUDGET: $22,000

Introduction

The black bear population has expanded its distribution in western Nevada recently to include historical bear habitat in desert mountain ranges east of the Sierra/Carson Front (Beckmann and Berger 2003; Lackey 2004). Natural diet overlap of bears and cougars (Hornocker and Negri 2010), and the recent range expansion by bears provide an opportunity to study resource partitioning in these two Apex Carnivores.

Methods

In cooperation with the Wildlife Conservation Society (WCS) and UNR, NDOW plans to monitor black bear and cougar movement patterns in 3 study areas of southwest Nevada. Through the study of location data, kill-site follow-up, tissue analysis, prey availability and habitat conditions (Andreasen et al 2012), we hope to begin to understand the relationship between the 2 species including differences in seasonal diet patterns, home ranges, movement patterns, and population linkages. Over a 5-year period, NDOW, WCS and UNR plan to satellite collar 5 cougars and 5 black bears in the 3 study areas (30 Vectronic collars). In the study's inaugural year (FY13), we have

budgeted $22,000 to go toward the purchase, deployment and monitoring of 3 satellite lion/bear collars in the Sweetwater Complex (Units 201/202/204).

Literature Cited

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Beckmann, J.P. and J. Berger. 2003. Rapid ecological and behavioural changes in carnivores: the responses of black bears (*Ursus americanus*) to altered food. J. Zool. Lond. 261:207-212.

Hornocker, M.G. and S. Negri (eds). 2010. Cougar: ecology and conservation. 306pp.

Lackey, C.W. 2004. Nevada's black bear: ecology and conservation of a charismatic omnivore. Nevada Department of Wildlife. Biological Bulletin #15. 46pp.

Project 29: Roadway Carrion Management to Enhance Sage-grouse Populations

By Pete Bradley, Shawn Espinosa and Ken Gray

Project 29 at a Glance

GOALS: 1) Reduce anthropogenic resource subsidy availability to Common Ravens along roads in northern Nevada and along Common Raven migration corridors in southern Nevada. 2) Study effects of anthropogenic resource availability on Greater Sage-Grouse recruitment and Common Raven abundance, home range size and clutch size.
PROJECT AREA: Greater Sage-Grouse range in northern Nevada and Common Raven migration corridors in central and southern Nevada.
TARGET RESEARCH QUESTIONS: 1) How does sage-grouse recruitment, common raven clutch size and home range size differ between 3 treatment/ control study areas before and after anthropogenic resource subsidies have been removed permanently? 2) Determine common raven migration corridors.
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS:
1) In areas where anthropogenic resource subsidies for resident common raven populations are found to be a dietary factor, greater sage-grouse nest success and brood survival may be optimized by strategic removal of these subsidies. 2) In areas where seasonal common raven migration corridors are found to link anthropogenic resource subsidies to high priority resident sage-grouse populations, greater sage-grouse nest success and brood survival may be optimized in priority sage-grouse habitats by strategic removal of these raven migration corridor food subsidies. Depending on the extent of raven migration, some of these food subsidies could be found hundreds of miles away from priority sage-grouse habitat. 3) Better road-carrion management has been identified by the USFWS as a non-lethal tool to help return common raven populations to more natural levels in the American West in the context of protection for greater sage-grouse populations.
STUDY PERIOD: Year round.
PROJECT DURATION: 2012-2022.
TOTAL EXPENDITURES TO DATE: $0
FY13 PROPOSED BUDGET: $15,000

Introduction

Common raven populations have increased in Nevada since ornithologists first documented relative abundance of passerines in the Great Basin. Robert Ridgeway, for example, made little mention of raven sightings on a USGS bird survey through northern Nevada in 1867 (Ridgeway 1877). Anthropogenic resource subsidies like road-kill carrion have, over the last 135 years, helped expand distribution and increase relative abundance of the species in the Great Basin. Some ground nesting bird species have experienced increased nest predation by ravens in recent years (Coates et al 2007). This project is an attempt to reduce anthropogenic resource subsidies in the Great Basin and to bring common raven populations in to balance with the rest of the ecosystem using non-lethal population control methods.

Methods

In cooperation with NDOT, County Road crews, USFWS and UNR, NDOW plans to hire seasonal employees to remove road carrion from three study areas in northern Nevada in and around priority greater sage-grouse nesting habitat. Carrion will be deposited underground in designated animal pits. Seasonals will also be responsible for monitoring known raven nests in treatment and control areas as well as conducting raven population surveys, raven telemetry follow-up and sage-grouse brood surveys in treatment and control areas.

In the study's inaugural year (FY13), we have budgeted $10,000 to go toward carrion removal efforts in Elko, White Pine, Lyon and Mineral Counties and $5,000 to go toward 5 VHF radio transmitters to allow us to begin to understand common raven migration in eastern Nevada.

Literature Cited

Coates, P.S. and D. J. Delehanty. 2004. The effects of raven removal on sage grouse nest success. Proc of Vert Pest Conf. 21:17-20.

Ridgeway, R. 1877. Part III – Ornithology [in] Clarence King Survey - Report of the 1867 geological exploration of the fortieth parallel. United States Geological Survey.

Project 30: Landfill Waste Stream Management to Enhance Sage-grouse Pop

By Pete Bradley, Shawn Espinosa, Mike Dobel and Ken Gray

Project 30 at a Glance

GOAL: Reduce anthropogenic resource subsidy availability to Common Ravens at public landfills and public dead animal pits across Nevada.
PROJECT AREA: Statewide with special focus on Greater Sage-Grouse nesting habitat.
TARGET OBJECTIVES: 1) Short Term - Reduce number of public landfills and dead animal pits that remain desirable foraging areas for common ravens by 50% in five years. 2) Long Term - Reduce number of public landfills and dead animal pits that remain desirable foraging areas for common ravens by 100% in ten years.
IMPLICATIONS FOR MANAGEMENT OF WILDLIFE POPULATIONS/HABITATS:
1) In areas where anthropogenic resource subsidies for resident common raven populations are found to be a dietary factor, greater sage-grouse nest success and brood survival may be optimized by strategic removal of these subsidies. 2) In areas where seasonal common raven migration corridors are found to link anthropogenic resource subsidies to high priority resident sage-grouse populations, greater sage-grouse nest success and brood survival may be optimized in priority sage-grouse habitats by strategic removal of these raven migration corridor food subsidies. Depending on the extent of raven migration, some of these food subsidies could be found hundreds of miles away from priority sage-grouse habitat. 3. Better waste-stream management has been identified by the USFWS as a non-lethal tool to help return common raven populations to more natural levels in the American West in the context of protection for greater sage-grouse populations.
PROJECT PERIOD: Year round.
DURATION: 2012-2022.
TOTAL EXPENDITURES TO DATE: $0
FY13 PROPOSED BUDGET: $6,000

Introduction

Common raven populations have increased in Nevada since ornithologists first documented relative abundance of passerines in the Great Basin. Robert Ridgeway, for example, made little mention of raven sightings on a USGS bird survey through northern Nevada in 1867 (Ridgeway 1877). Anthropogenic resource subsidies like household food waste and dead animal pits have, over the last 135 years, helped expand distribution and increase relative abundance of the species in the Great Basin. Some ground nesting bird species have experienced increased nest predation by ravens in recent years (Coates et al 2007). This project is an attempt to reduce anthropogenic resource subsidies in the Great Basin and to bring common raven populations in to balance with the rest of the ecosystem using non-lethal population control methods.

Methods

In cooperation with City and County Municipalities and the USFWS, NDOW plans to work to change waste stream policies to include changes in food waste collection, the addition of special covered pits specifically for household/commercial food waste separate from the normal household/commercial garbage pits as well as increases in the frequency of food waste and dead animal pit burial at these sites.

As the popularity of ground-squirrel shooting ("varmint hunting"), particularly in the spring, has increased in Nevada, it has come to the attention of biologists that these areas can become sources of protein for ravens. As a second prong of this project, NDOW will be evaluating proposed changes to the language regulating ground-squirrel shooting, private land animal pits and other sources of anthropogenic resource subsidies on the landscape.

In the project's inaugural year (FY13), we have budgeted $6,000 to go toward municipal fuel and personnel charges to increase burial frequency at five landfills and dead animal pits in priority greater sage-grouse habitats in Humboldt, Eureka and Lander Counties.

Recommendations

Coordinate with and support efforts at the Midas Transfer Station and other Transfer Stations to make waste material inaccessible to ravens. This may include alternative containers for disposal.

Literature Cited

Coates, P.S. and D. J. Delehanty. 2004. The effects of raven removal on sage grouse nest success. Proc of Vert Pest Conf. 21:17-20.

Ridgeway, R. 1877. Part III – Ornithology [in] Clarence King Survey - Report of the 1867 geological exploration of the fortieth parallel. United States Geological Survey.