Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: **Effects of Oil and Gas Development on Mule Deer Populations in Western North Dakota**

Applicant: North Dakota Game and Fish Department

Principal Investigator: Dr. Josh Millspaugh/University of Missouri

Date of Application: 6/22/2011

Amount of Request: $329,374 over 2 bienniums ($164,687/biennium)

Total Amount of Proposed Project: $658,747

Duration of Project: January 2012- Dec 2015

Point of Contact (POC): Terry Steinwand Director of the North Dakota Game and Fish Department.

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ABSTRACT

Objective:

1) Investigate and quantify effects of oil and gas development to mule deer populations through study of survival, movements, resource selection, abundance, and recruitment. A key component of this objective will be the identification of mitigation measures intended to reduce and avoid impacts to mule deer populations; and 2) To model the effects of oil and gas development on population dynamics of mule deer populations.

Expected Results:

This proposal is designed to be a comprehensive assessment of oil and gas development on mule deer populations in western North Dakota. Through study of space use and demographics, we will identify key factors affecting mule deer in areas of development, which will be used to develop mitigation strategies to reduce and minimize impacts.

Duration:

January 2012 – December 2015

Budget:

The project is proposed to extend over two biennia, therefore $329,374 will be requested for each biennium. Annual reports will be prepared during November and December and will be submitted by December 31, each year.

Participants:

North Dakota Game and Fish Department, North Dakota Industrial Commission, University of Missouri, Bureau of Land Management, Mule Deer Foundation, and the United States Forest Service.

PROJECT DESCRIPTION

Objectives:

1) Investigate and quantify effects of oil and gas development to mule deer populations through study of survival, movements, resource selection, abundance, and recruitment. A key component of this objective will be the identification of mitigation measures intended to reduce and avoid impacts to mule deer populations; and 2) To model the effects of oil and gas development on population dynamics of mule deer populations.

Methodology:

Study area determination

We will divide our study area into 5 sites that have no development or are lightly developed (controls), 5 moderately developed areas, and 5 highly developed areas (Figure 1). The 5 control areas will initially be sites without oil and gas development present, but we must acknowledge these sites could turn to lightly developed areas should development occur. To identify this breakdown, we will obtain all of the well locations and develop a kernel density map (Kernohan et al. 2001) that indicates the degree of development. It is expected that lightly developed areas would have 0-1 wells per section, moderately developed areas would have an expected 2-4 wells per section and highly developed areas would have 5+ wells per section. Here is a list of possible control areas we envision now: Lone Butte area, Crosby Creek South, Long X Divide, Bowline Creek, Merrifield Creek, Kendley Plateau. Moderate sites might include: Bennett Creek, Red Wing Creek, Buckhorn Creek, Mike's Creek, and Cherry Creek. High development sites might include: Crosby Creek North, Frank's Creek, Magpie creek, NE of the Theodore Roosevelt National Park, Bell Lake Area, Burnt Creek, Chateau, Tracy Mountain, and Marmarth. The use of 3 different levels of development will facilitate comparison of mule deer response across ranges of development density and will help us forecast potential impacts from development.

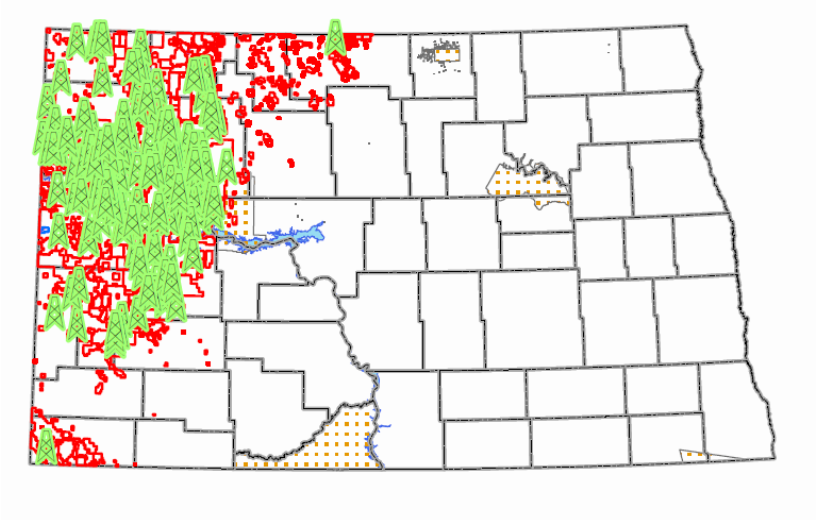

Figure 1. Gas development fields (red) and oil well locations (green) in western, North Dakota.

Capture and Telemetry

At each of the selected sites, we will capture and fit 6 female mule deer with GPS radio-tags (ATS G2110E Iridium, Isanti, MN), for a total of 90 radio-marked animals (i.e., 6 deer x 5 sites each treatment with 3 total treatment levels). We will capture mule deer during the early winter using helicopter net-gunning. We will attempt to obtain a random representation of deer by not capturing animals located together. We intend to include at least 10 fawns in each treatment category. Monitoring of fawn overwinter mortality will be an important component in subsequent demographic modeling (e.g., White and Bartmann 1997). We will attempt to capture and fit new animals in the event mortalities occur in an attempt to maintain a radio-marked sample of 90 mule deer. All animal use activities will be reviewed and approved by the University of Missouri Institutional Animal Care and Use Committee. The necessary capture, marking, and special use permits will be requested from the appropriate agencies.
Radio-tracking of mule deer is a central component to meeting the objectives listed above. GPS tags have several advantages over traditional VHF collars such as the ability to collect multiple locations each day at pre-determined times. This approach insures mule deer can be closely monitored during all times of the day. GPS tags also reduce problems with access to mule deer. Further, the quality of GPS tags is expected to be superior to locations obtained through triangulation (Millspaugh et al. 2011). Also, costs associated with personnel and vehicles for ground tracking as the only monitoring method would be prohibitive. Although aerial telemetry might result in locations with similar accuracy to GPS, it would be cost prohibitive when considering the number of locations necessary to meet study objectives. Last, use of GPS eliminates concerns over disturbance to mule deer during monitoring activities which could bias data.

The GPS tags will be programmed to collect mule deer locations at 5-hour intervals year-round. We will arrange for the service provider to email us locations on a weekly basis. This location collection schedule will allow us to monitor mule deer throughout the day at different time periods. Should we decide to alter the duty cycle, the radio-tags we purchase will allow us to modify the frequency with which we collect observations via email. For example, should some sites be developed during the course of our study and there is interest in finer scale location data, we can modify the duty cycle and collect more frequent observations by sending an email. This schedule will also afford the resolution necessary to meet our objectives. Based on this duty cycle and other specifications, we anticipate collars will operate 3 years, the length of time we expect to conduct field work. A built-in VHF transmitter will facilitate real-time tracking of deer, which would be necessary to quickly recover dead deer, and would assist in collar retrieval.

Anticipated Results:

This proposal is designed to be a comprehensive assessment of oil and gas development on mule deer populations in western North Dakota. Through study of space use and demographics, we will identify key factors affecting mule deer in areas of development, which will be used to develop mitigation strategies to reduce and minimize impacts.

Facilities:

North Dakota Game and Fish Department office in Dickinson and University of Missouri office in Columbia.

Resources:

State vehicle, computer, phones, GPS, radio-collars, fixed-wing airplane and helicopter services,

Techniques to Be Used, Their Availability and Capability:

We will use Program MARK (White and Burnham 1999) to estimate age-specific survival rates and to examine factors affecting survival. For home range analysis, we will use fixed kernel estimators with plug-in smoothing options (Kernohan et al. 2001, Gitzen et al. 2006) to estimate and evaluate size, distribution and shape of home ranges. To assess home range overlap among individuals we will use the Volume of Intersection (*VI*) Index statistic (Millspaugh et al. 2000, Millspaugh et al. 2004). To assess resource selection within the home range, we will use a resource utilization function (RUF) approach (Marzluff et al. 2004, Millspaugh et al. 2006) to examine the relationship of space use by individual mule deer to resource attributes.

To model the effects of oil and gas development on the population dynamics of mule deer populations, we will use two complementary approaches. First, we will compare resource selection functions using a risk assessment procedure outlined by McDonald and McDonald (2002). After developing the resource selection functions, we will project predicted use on the landscape in control areas and with disturbance. The response surfaces will be compared, via the volume under the response surface similar to what is described above for the *VI* index analysis, to estimate an index of risk associated with habitat changes (McDonald and McDonald 2002). In addition to identifying source and sink habitat, we can estimate the relative risk owed to displacement owed to disturbance based on landscape position. This analysis will help identify important habitats and will allow for an assessment of risk at it relates to oil and gas development. The second approach we will use directly applies the demographic data described above into an age or stage-based matrix model to estimate λ. This matrix model will be applied separately to our 3 treatment classes to infer how different levels of development might affect mule deer populations in the future. The basic matrix model uses an initial vector of abundance, which will be derived from sightability models, and either age or stage-specific recruitment and survival rates, which will be derived from our telemetry work and other monitoring activities.

Environmental and Economic Impacts while Project is Underway:

This project is designed to investigate and quantify effects of oil and gas development to mule deer populations through study of survival, movements, resource selection, abundance, and recruitment. Preliminary results may possibly be utilized by individual oil companies to initiate activities that reduce impacts to mule deer habitat before complete mitigative measures are identified.

Mule deer (*Odocoileus hemionus*) are a valuable component of the North Dakota landscape and could be impacted by gas and oil development. Mule deer are prized as a game species in North Dakota. In 2009, 10, 568 hunters applied for 2,886 antlered mule deer licenses. Again, preliminary results may possibly be utilized by individual oil companies to initiate activities that reduce impacts to mule deer habitat before complete mitigative measures are identified. This may lead to maintaining higher mule deer numbers and hunter opportunities, as well as enhancing the oil and gas industries image with the public.

Ultimate Technological and Economic Impacts:

Dependent upon the identified impacts, changes to oil/gas development may be encouraged in areas of mule deer habitat. Potential changes may include using liquid gathering systems along with horizontal drilling techniques. These changes may alter the cost of development within mule deer habitat.

Why the Project is Needed:

A primary concern with increased oil and gas development is the potential loss of important wildlife habitat through direct and indirect effects. Direct effects include direct loss of habitat through development of infrastructure (e.g., well pad, roads). Indirect effects include factors associated with the infrastructure such as traffic and noise that might reduce suitability of an area. Mule deer (*Odocoileus hemionus*) are a valuable component of the North Dakota landscape and could be impacted by gas and oil development. Mule deer are prized as a game species in North Dakota. In 2009, 10, 568 hunters applied for 2,886 antlered mule deer licenses.

This project has the potential to identify impacts of oil and gas development to mule deer in western North Dakota, but more importantly, identify mitigative measures that avoid or reduce impacts to mule deer habitat. These mitigative measures not only have the potential to reduce disturbance to mule deer and their habitat, but also provide oil companies the means to develop resources in the most wildlife friendly manner. The badlands of western North Dakota and associated wildlife are a treasured resource to the people of North Dakota and development that includes wildlife concerns will go a long way to ensure a positive working relationship among oil companies, land and resource agencies, and the people of North Dakota.

STANDARDS OF SUCCESS

The determination of success will be based upon completion of annual progress reports and a final report. The results from this study have the potential to greatly benefit mule deer habitat for the people of North Dakota. Potential mitigative measures may be used to guide future development within important big game habitat and enhance the oil/gas industries image as it relates to impacting habitat.

BACKGROUND/QUALIFICIATIONS

Joshua Millspaugh, Ph.D.

Pauline O'Connor Distinguished Professor of Wildlife Management
Fisheries and Wildlife

- **Phone:** 573-882-9423
- **E-mail:** MillspaughJ@missouri.edu
- **Address:** 302 Anheuser-Busch Natural Resources Building

Education

- Ph.D., 1999, University of Washington

Research

- Quantitative ecology, wildlife stress physiology, and ecology and management of large mammals.

Research Summary

- Millspaugh's research centers on the study of vertebrate population ecology at three scales: physiological processes, individual space use and resource selection and population-level dynamics. Many of these topics overlap within individual studies and include several themes. At each scale, he focuses on rigorous development and evaluation of field, laboratory, and statistical methods and application of these methods to help answer important conservation issues. His research has focused on large mammals, but increasingly he works with other taxa to address questions of interest.

- Current graduate and postdoctoral student projects include black-backed woodpecker demographics and space use in the Black Hills, South Dakota; modeling wildlife response to forest management and climate change; survival and space use of hellbenders in Missouri; elephant movements and stress physiology in South Africa; development of ecological monitoring protocols for the National Park Service; and spatial relationships among ungulates (bison, elk, mule deer, white-tailed deer, and pronghorn) and forage allocation in South Dakota.

North Dakota Game and Fish Department

Bruce Stillings, big game biologist.

- Experience overseeing large scale field research projects in western North Dakota.
- M.S., 1999, University of Nebraska

MANAGEMENT

The North Dakota Game and Fish Department will oversee field activities and ensure appropriate reports are submitted by deadlines.

TIMETABLE

Table 1. Time schedule and deliverables by year for North Dakota mule deer research.

	2012	2013	2014	2015
Identify study areas				
Capture and radio-mark deer				
Monitor radio-marked deer (obtain location and survivorship data)				
Monitor abundance and recruitment				
Develop movement models and resource selection function models				
Develop survival models				
Build risk assessment models				
Build demographic models that integrates abundance, recruitment, and survival data				
Archive data and annual reports[1]				
Peer reviewed publications[2]				

[1]Annual reports will be prepared during November to December and will be submitted by December 31 each year.

[2]Publications will be prepared for publication beginning 2013 to 2014, but it is expected that papers will not be in press until 2015.

BUDGET

Note: The following budget is the total project cost which includes funding for 2012-2015 (includes 2 biennium).

Project Associated Expense	NDIC's Share	Applicant's Share (Cash)	Applicant's Share (In-Kind)	Other Project Sponsor's Share
1) 122,910.00	61,455.00	61,455.00		
2) 63,810.00	31,905.00	31,905.00		
3) 387,027.00	189,013.50	144,013.50		45,000 *
4) 94,000.00	47,000.00	47,000.00		
Total: 658,747.00	**Total:** 329,373.50	**Total:** 284,373.50		**Total:** 45,000 *

* Bureau of Land Management = 40,000

* Mule Deer Foundation = 5,000

	Total
1) Personnel Services Costs	
Graduate Research Assistant (Ph. D.)	81,931
GRA Insurance	10,477
Tuition	30,502
2) Travel and Transportation	
Student travel to site (4@$1,000)	16,986
Helicopter flights ($500/hr @ 30/hrs/year)	46,824
3) Supplies and Equipment	
GPS radio tags ($2,500/each)	237,500
Computer Software	2,000
GPS downloads ($480/each/year)	133,527
Refurbish GPS transmitter ($250/each)	5,000
4) Other Costs	
Publication costs	4,000
Computer	1,500
Animal capture ($700/each)	77,000
Miscellaneous supplies for flights, field activities	11,500
Total	**658,747**

See Appendix A for biennium details.

CONFIDENTIAL INFORMATION

All radio-telemetry location data is considered to be sensitive data and is the property of the North Dakota Game and Fish Department.

PATENTS/RIGHTS TO TECHNICAL DATA

Patents/rights to technical data does not apply to this proposal.

LITERATURE CITED

Kernohan, B. J., R. A. Gitzen, and J. J. Millspaugh. 2001. Analysis of animal space use and movements. Pages 125-166 *in* J. J. Millspaugh and J. M. Marzluff, editors. Radio Tracking and Animal Populations.Academic Press, San Diego, California, USA.

Marzluff, J. M., J. J. Millspaugh, P. Hurvitz, and M. S. Handcock. 2004. Relating resources to a probabilistic measure of space use: Forest fragments and Steller's jays. Ecology 85:1411-1427.

McDonald, T. L., and L. L. McDonald. 2002. A new ecological risk assessment procedure using resource selection models and geographic information systems. Wildlife Society Bulletin 30:1015-1021.

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White, G. C., and K .P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46:120-139.

Appendix A

BUDGET

Begin date: January 1, 2012 (FY2012)

BUDGET	FY2012	FY2013	FY2014	FY2015	TOTAL
Personnel Services Costs[1]					
Graduate Research Assistant (Ph.D.)	19,294	20,066	20,868	21,703	81,931
GRA Insurance	2,468	2,567	2,669	2,773	10,477
Tuition	7,183	7,470	7,769	8,080	30,502
Travel and Transportation[2]					
Student travel to site (4@$1,000)	4,000	4,160	4,326	4,499	16,986
Helicopter flights ($500/hr @30/hrs/year)	15,000	15,600	16,224	-	46,824
Supplies and Equipment[3]					
GPS radio tags ($2,500/each)	225,000	12,500	-	-	237,500
Computer software	500	500	500	500	2,000
GPS downloads ($480/each/year)	43,200	44,496	45,831	-	133,527
Refurbish GPS transmitters ($250/each)	-	5,000	-	-	5,000
Other Costs					
Publication costs	-	-	2,000	2,000	4,000
Computer	1,500	-	-	-	1,500
Animal capture ($700/each)	63,000	14,000	-	-	77,000
Miscellaneous supplies for flights, field activities	3,500	3,500	3,500	1,000	11,500
Total (does not include overhead)	384,645	129,859	103,688	40,556	658,747

[1]Assuming 4% increase in personnel and travel/transportation costs each year.
[2]Assuming use of Game and Fish vehicle for field activities when needed. (Unknown costs to be assumed by NDGFD)
[3]Assumes 3% increase in GPS data retrieval costs each year.