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GENERAL OBJECTIVES FOR A RESEARCH STUDY TO EVALUATE GREATER SAGE-GROUSE AND BENTONITE MINING IN THE BIGHORN BASIN, WYOMING

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Background

Greater sage-grouse (*Centrocercus urophasianus*) were once commonly found across the >600,000 km^2 sagebrush (*Artemisia* spp.) biome, but currently occupy 56% of their historical distribution of potential habitat (Schroeder et al. 2004). In addition to large-scale habitat loss, population declines are also attributed to the loss, degradation, and fragmentation of remaining sagebrush habitats (Braun 1998, Connelly et al. 2004). Recently, the U.S. Fish and Wildlife Service (2010) concluded that greater sage-grouse are warranted for protection under the Endangered Species Act of 1973, but because threats are moderate in magnitude and do not occur across their range at an equal intensity, the listing is precluded to other species under severe threat of extinction. The effects of energy development have been cited as the leading cause of decline for sage-grouse in the eastern portion of their range, which includes Wyoming (U. S. Fish and Wildlife Service 2010). Other factors that may influence sage-grouse populations include exurbanization, invasion exotic weeds, excessive livestock grazing, wildfire, and mining. Bentonite deposits in Wyoming make up 70% of the world's supply and mines in the Bighorn Basin produced over 50% of Wyoming's total bentonite production in 2008 (Wyoming Mining Association 2009). Bentonite clay extraction is carried out by open-pit mining that leads to loss of sagebrush habitat. In addition, mining support activities increase disturbance activities near mines. To date, most bentonite mining in the Bighorn Basin has occurred in areas dominated by saltbush desert, but plans call for mining operations to eventually begin mining in sagebrush habitats, which are occupied by sage-grouse (L. Bucher, American Colloid Company, personal communication, 2010). These mining activities may prevent or limit the ability of the sagebrush landscape in the Bighorn Basin to provide the space and resources to meet the life history requirements of greater sage-grouse.

Objective 1 - Bentonite Clay Mining Effects on Demographic Rates of Greater Sage-Grouse

The first objective of our study is to monitor the effects of bentonite clay mining on sage-grouse by comparing demographic rates, such as hen survival, nest survival, and brood survival, of sage grouse in an area actively mined (Greybull) to a reference area (Hyattville) where mining is not currently taking place. The reference area is scheduled to be mined in the future and collecting demographic rates for that population will provide baseline information for evaluating impacts or appropriate mitigations in the future. To accomplish this first objective, we will capture and monitor 40–50 radio-marked females in each study areas using a combination of VHF and GPS transmitters. These females and their nests and broods will be monitored with radio telemetry. Habitat information will also be collected at nest, brood, and random locations to provide

information that should be useful for restoration of mined locations. We also expect to obtain data to evaluate avoidance of bentonite infrastructure.

Objective 2 – Migration Patterns of Greater Sage-Grouse in the Eastern Bighorn Basin, Wyoming

One vital, but often overlooked, aspect of the life history of the greater sage-grouse is migration behavior and habitat requirements. Consequently, the second objective of our project is to model the migration patterns of sage-grouse in the eastern Bighorn Basin. This information will provide baseline information on this population that can be used to help mitigate any potential negative effects by mining or other land use activities. Reaching this objective will require capturing and attaching Argos-real time GPS transmitters to 10 grouse in each study area. These GPS transmitters will provide us with a large number of locations necessary to precisely model the multiple migration corridors that may be used by grouse from both study areas.

Objective 3 – Greater Sage-Grouse Use of Reclamation Lands after Bentonite Clay Mining

Mine reclamation is an integral component of bentonite mining; however little is known about sage-grouse use of reclaimed sites. The third objective of our study is to monitor the use of these reclaimed lands by sage grouse. We will obtain data to answer this objective through assessing location data provided by grouse with GPS transmitters at the Greybull study area and compare use patterns to a stratification of reclaimed sits. Stratification may be based on age since treatment, soil type, seed mix, etc. GPS transmitters will allow us to gather the quantity of precise locations needed. Occupancy modeling techniques also may be utilized to evaluate the use of reclamation areas.

Literature Cited

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Budget for Bentonite Mining and Greater Sage-Grouse Study, Bighorn Basin, Wyoming, 2011-2015.

Item	Qty	Cost	2011	2012	2013	2014	2015	Total
Grouse capture and radio-transmitters								0
Grouse capturing and spotlighting equipment			500	250	250	--	--	1,000
Satellite GPS transmitters (@ $4,150)	20	$ 3,950	79,000	--	--	-8300	--	70,700
UHF/VHF Reciever			2,100					2,100
UHF Antenna			200					200
ARGOS satellite system	20	$ 1,600	32,000	32,000	32,000	--	--	96,000
VHF transmitters (@ $200)	70	$ 200	14,000		4,000	--	--	18,000
VHF Recievers (4@ $700)			2,100					2,100
VHF antennas (4 @ $120)			480					480
VHF 5 element antenna (1 @ $160)			160					160
VHF rooftop antennas (3@$75)			225					225
Aerial locations (2 flights/year@$1000)	2	$ 1,000	2,000	2,000	2,000			6,000
Purchase 2 new ATVs			16,000	--	--	--	--	16,000
Purchase 1 new mule/ranger/razor type ATV			12,500	--	--	--	--	12,500
Purchase 1 new off-road vehicle trailer			2,500	--	--	--	--	2,500

Workstation computer for spatial analyses			5,000	--	--	--	--	5,000
Subtotal, no indirect costs			**168,765**	**34,250**	**38,250**	**-8,300**	**0**	**232,965**
Equipment and field supplies								0
Binoculars			1,200	--	--	--	--	1,200
GPS units			1,200	--	--	--	--	1,200
Repairs			500	500	500	500	--	2,000
Sampling equipment/supplies			500	250	--	--	--	750
Student expenses								0
Page charges			--	--	--	--	3,000	3,000
Statistical modeling workshops, lodging, and per diem			--	--	--	--	1,000	1,000
Stipend, tuition, and fees			22,000	35,811	36,000	39,000	40,000	172,811
Travel expenses			500	500	500	500	1,000	3,000
Technicians								0
Technicians (2 @ $13/hr for 5 mo)	2	$ 10,400	20,800	20,800	20,800	--	--	62,400
Technician FICA, workmen's comp, and Medicare (@9.0%)	2	$ 936	1,872	1,872	1,872			5,616
Lead technician (1 hired by UW for $15/hr for 5 months)	1	$ 12,000	12,000	12,000	12,000	--	--	36,000

Lead technician FICA, workmen's comp, and SS(@9.0%)	1	$ 1,080	1,080	1,080	1,080	--	--	3,240
Technician housing (3 units for 6 months)	3	$ 11,250	$ 11,250	$ 11,250	$ 11,250	--	--	33,750
Transportation								
Off-road vehicle safety equipment, bags, accessories			500	300	200	--	--	1,000
Rent 4x4 pickups (2 @($900/mo.) X 5 months	2	$ 4,950	9,900	10,197	10,503	--	--	30,600
Vehicle usage (i.e., fuel and repairs @ 60¢/mile)			12,000	13,000	14,000	500	500	40,000
Administrative								
Faculty summer salary (plus 46% benefits)			5,183	10,365	11,712	12,063	--	39,323
Travel expenses			500	500	500	500	500	2,500
Subtotal, applicable indirect costs			**100,985**	**118,425**	**120,917**	**53,063**	**46,000**	**439,390**
University of Wyoming indirect costs (@20%)			20,197	23,685	24,183	10,613	9,200	87,878
Grand Total			**289,947**	**176,360**	**183,350**	**55,376**	**55,200**	**760,233**