Appendix A

Transportation Plan

Transportation Plan
ASU Year-Round Drilling Demonstration Project

Introduction and Purpose

Shell Exploration & Production Company (Shell), Ultra Resources, Inc. (Ultra), and Anschutz Pinedale Corporation (Anschutz) and any leasehold successor, hereinafter collectively referred to as "ASU", propose a Demonstration Project for winter 2005–2006 and spring 2006 to demonstrate that such a development plan will reduce the surface disturbance footprint through consolidation of locations and associated development activities.

ASU proposes to have three well pads occupied during winter 2005–2006 and spring 2006 utilizing one existing pad, expanding one pad and creating one new pad. Two rigs would be drilling on each pad beginning November 15, 2005. All rigs would move onto the pads prior to November 15, 2005. Completions would begin May 1, 2006 while drilling continues. The proposed well pads involved in the Demonstration Project would all be located in Township 32 North, Range 109 West and include the Mesa 7-29 in Section 29 operated by Shell, the Mesa 7-34 in Section 34 operated by Ultra and Mesa 10-35 in Section 35 operated by Anschutz. Pad locations for this Demonstration Project were selected in consultation with BLM and Wyoming Game and Fish Department with consideration of several wildlife issues.

The purpose of this plan is to describe: 1) the estimated traffic volumes for the Demonstration Project, 2) the traffic routes that would be utilized by ASU and their contractors during the Demonstration Project, and 3) the measures that would be implemented to minimize traffic-related impacts to wildlife. This plan does not address regular operational activities for producing wells or routine field visits by ASU management, field superintendents and safety personnel which are covered under the 2000 PAPA ROD.

Existing Traffic

All three operators have existing traffic for ongoing production in the lease sections included in the Demonstration Project. Anschutz and Shell would not have any existing well-required truck traffic on the demonstration pads during winter 2005-2006. Ultra has one producing well on the pad to be included in the Demonstration Project which would require truck traffic during winter 2005-2006.

Estimated Traffic Volumes – Drilling

ASU proposes to have three demonstration well pads occupied during the winter 2005-2006 beginning November 15, 2005 and ending July 31, 2006. Two drilling rigs would operate on each pad. ASU would use existing public and BLM roads to the greatest extent possible for access to each pad location. Following are the anticipated traffic and activity levels associated with this Demonstration Project:

1. Each rig would have the following personnel on location 24 hours per day. Each person would have a vehicle, but would typically not leave location on most days.
    a. Drilling Foreman
    b. Toolpusher
    c. Mud Engineer
    d. Directional Driller, when needed
    e. MWD Technician, when needed

2. Each rig would typically have two six-man crews, each working a 12-hour shift. Shift changes are generally at 6:00 a.m. and 6:00 p.m.

3. Rig traffic. The estimated traffic required for each well for the 35 to 40 days it takes to finish the well has been estimated as following:

   a. Fuel Tankers – 17
   b. General Hauling – 88
   c. Mud and Waste Haulers – 44
   d. Water Trucks – 49
   e. Downhole tool delivery and Misc. Supplies – 70
   f. Construction, management, roustabouts and services – 284
   g. Cement, barite, and mud chemicals – 48

   This traffic estimate includes approximately 299 roundtrips by heavy trucks and 301 roundtrips by pickup trucks or autos. The trip total reflects a decrease in supply traffic with two rigs on the same well pad and is approximately 33 percent less than normal traffic to single wells on separate pads. Crews would be being bused, further reducing traffic because both rigs would be on the same pad. Each operator plans for their two rigs to be similar so that some sharing of spare parts would be possible, further reducing traffic.

4. Vehicles required for emergencies. These cannot be predicted or quantified, but must be noted in this plan.

Estimated Traffic Volumes – Completions

For the Demonstration Project, well completions would commence on May 1, 2006 to minimize impacts to big game and sage-grouse. The development plan of drilling through the winter and holding completion activities until May would lead to multiple wells requiring completion. Consequently, rig traffic required to complete up to 45 wells would be reduced by about 74 percent for all three consolidated pads compared to rig traffic required to complete 45 wells, each on a single well pad.

Following are the anticipated heavy rig traffic and activity associated with completions that would be required beginning May 1:

Shell: Assumes completion of all 20 wells with 4 complete moves of rig equipment to and from location. Shell is also considered reducing batches to 3. Some components such as water hauling, proppant, chemicals, and workforce will be the same regardless of the number of trips.

- Baseline: Move equipment to and from location for 20 Individual completions (Frac equipment, tanks, flowback equipment, rentals) = 102 trips x 20 wells = 2,040 trips
- Demonstration Project: Move equipment to and from location for 4 batch completions (i.e., 5 wells) = 528 trips (74% less than baseline)
- Also Considered: Move Equipment to and from location for 3 batch completions = 396 trips (80% less than baseline)

Ultra: Assumes completion of all 10 wells with 2 complete moves of rig equipment to and from location. Some items such as water hauling, proppant, chemicals and workforce will be the same number of trips regardless.

- Baseline: Move equipment to and from location for 10 Individual completions (frac equipment, tanks, flowback equipment, rentals) = 102 trips x 10 wells = 1,020 trips.
- Demonstration Project: Move equipment to and from location for 2 batch completions = 265 trips (74% less).

Anschutz: Assumptions for well completions traffic are similar to those outlined above for Ultra.

ASU Committed Traffic Measures

In addition to the above reductions in travel caused by the demonstration development scenario, ASU proposes the following measures to minimize traffic and activity impacts during winter 2005–2006 and spring 2006:

ASU is committing to the following to minimize traffic and human activity in the Project Area:

1. Busing of rig crews. Three buses will be maintained for transporting rig crews to and from drill rigs. Each bus will accommodate 10-15 passengers and gear. Each bus will be maintained by a drilling contractor and will make 2 round trips per day at shift change. This equates to 42 total round trips per week compared to more than 500 weekly round trips without busing. The shift changes are currently at 6:00 a.m. and 6:00 p.m. Because active sage grouse leks are greater than 0.25 miles from the demonstration well pads, it is expected that adjustments to the shift changes to avoid traffic on roads in the vicinity of occupied leks would not be necessary.
2. Buses will load from man-camps at Marbleton (4 roundtrips per day) and in Boulder (2 roundtrips per day) to the rig sites and return.

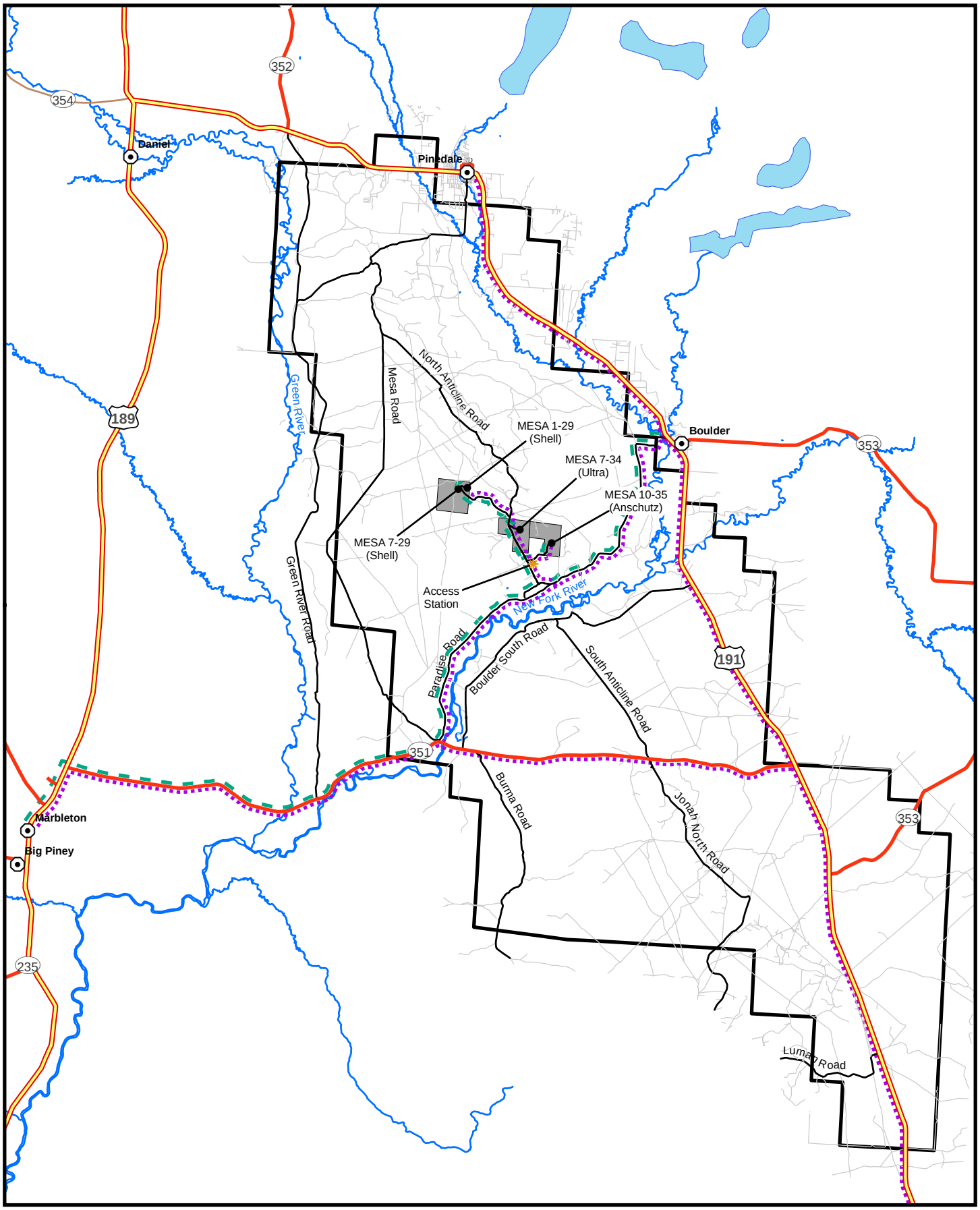
   The buses will access the pads from Marbleton as follows (see Figure 1):

   North on U.S. Highway 189 to State Highway 351;
   East on State Highway 351 to Paradise Road (a county road);
   Northeast on Paradise Road to North Anticline Road;
   To access Shell's Mesa 7-29 well pad in Section 29, Ultra's Mesa 7-34 well pad in Section 34 from North Anticline Road existing resource roads will be utilized.
   To access Anschutz Mesa 10-35 in Section 35 existing and new resource roads would be utilized.

   The buses would access the pads from Boulder as follows (see Figure 1):

   South on U.S. Highway 191 to State Highway 351;
   West on State Highway 351 to Paradise Road (a county road);
   Northeast on Paradise Road to North Anticline Road;
   To access Shell's Mesa 7-29 well pad in Section 29, Ultra's Mesa 7-34 well pad in Section 34 from North Anticline Road existing resource roads would be utilized. To access Anschutz Mesa 10-35 in Section 35 existing and new resource roads would be utilized.

   Busing from the Marbleton and Boulder man-camps would eliminate the potential for crew members missing the bus and the need for additional trips to the drilling location. ASU will not tolerate workers who miss the bus and drive personal vehicles to the demonstration pads.



PINEDALE ANTICLINE PROJECT AREA (PAPA)

BUS TRAFFIC

CONTRACTOR ACCESS

5 2.5 0 5 Miles

N W E S

FIGURE 1
TRANSPORTATION PLAN
ASU YEAR-ROUND DRILLING DEMONSTRATION PROJECT

3. Contractors would use either U.S. Highway 191 or U.S. Highway 189 to State Highway 351 and Paradise Road and then proceed to North Anticline Road where they would follow the route of the bused rig crews.
4. As much as possible, equipment and bulk supplies would be delivered and stored on the well pads or in Shell's case on the adjacent Mesa 1-29 pad prior to November 15, 2005. Shell would reduce truck traffic utilizing the Mesa 1-29 staging area by approximately 120 round trips or 3,100 miles. Anschutz and Ultra would store equipment and bulk supplies on pads which is expected to reduce deliveries of storable equipment and supplies during the winter by approximately 40%.
5. As part of normal operational winter maintenance, roads would be plowed the minimum amount necessary to allow safe navigation. Plows would provide breaks in snow piled berms along the road margins (knockouts) to allow free movement of wildlife across roads.
6. All project-related personnel and vendors would be advised personally and by mail of traffic and activity restrictions and rules of conduct while on the Mesa. These will include, but are not limited to,
   a. No stopping to observe wildlife,
   b. No harassment of wildlife,
   c. No firearms or pets.
7. Crews would be trained on behaviors appropriate for minimizing disturbance to wildlife.
8. The North Anticline Road access from Section 2, T.31 N., R.109 W. is the only authorized access route to the Demonstration Project Area.

ASU proposes the following measures to encourage activity reductions during the period November 15, 2005 through April 30, 2006:

1. **Access Station:** ASU is committing to fund hosted workers to the BLM Pinedale Office to operate an access station. The access station, a small trailer, would be located on BLM land on the North Anticline Road in Section 2, T.31 N., R.109 W., adjacent to Ultra's Riverside 5-2 pad location. The North Anticline Road is the only authorized access route to the Demonstration Project. Hosted workers would monitor essential traffic to the pads and encourage non-essential traffic to obey existing crucial winter range restrictions to minimize human disturbance to wildlife. Hosted workers would be trained by and report to the BLM Pinedale Field Office. Traffic data would be compiled to differentiate between essential development activity and non-essential public traffic. Data collected would also distinguish traffic associated with drilling activity on the demonstration pads from traffic associated with normal producing well operations. The access station would be open 24 hours a day, seven days a week from November 15, 2005 through April 30, 2006.

   There would be space available at the station to allow vehicles to turn around and leave the area. By turning back non-scheduled contractors, a reduction in non-essential traffic to the demonstration locations is expected. By informing the public on current travel restrictions, most would be expected voluntarily comply with the restrictions.

   ASU would fund signage located at the intersection of Paradise Road and North Anticline Road (indicating that there is an access station ahead on North Anticline Road), on the approach leading to the station, and prominently on the trailer. All signs would list the existing crucial winter range stipulations and traffic restrictions.

2. Prominent signs would be posted at the access station and at field entrances advising of travel restrictions.

3. Specified times would be set with all contractors and vendors for non-critical rig visits.

4. Speed limits would be posted and included in the “Code of Conduct during Winter Drilling Activity.”

5. In consultation with BLM and WGFD, ASU would install up to 10 gates and supply other needed material in big game crucial winter range to encourage compliance with the existing crucial winter range traffic restrictions. The gates would be constructed of steel pipe and maintained by BLM after installation. Access to gate keys would be managed by the BLM. ASU would assist BLM in placing signage on or near the gate explaining existing traffic restrictions.

6. ASU would fund development and printing of information cards explaining the existing big game crucial winter range traffic restrictions, encouraging compliance with the regulations. Information cards would be developed in consultation with the BLM. The cards should be available at the BLM Pinedale Field Office and public places in the Pinedale Anticline area including community facilities, libraries, schools, and interested businesses. ASU would fund notices in local newspapers that would provide similar information and printed monthly during the winter travel restriction period.

7. ASU is committing to train rig crews on behaviors appropriate for minimizing disturbance to wildlife. Training would most likely occur during pre-spud meetings. The training would be consistent with current documents on such conduct and would be reviewed with BLM and WGFD wildlife experts for their concurrence. A laminated sheet providing the code of conduct for contractors and employees during winter drilling activity would be required in each vehicle used by contractors and vendors. The sheets would also provide instruction on the types of human activity that create stress to wildlife. All vendors would be advised, in person and by mail, of traffic and activity restrictions and rules of conduct.

Appendix B

U.S. Fish and Wildlife Service Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4000 Airport Parkway
Cheyenne, Wyoming 82001

AUG 02 2005

In Reply Refer To:
ES-61411/W.02/WY9658

Memorandum

To: Pricilla Mecham, Field Manager, Bureau of Land Management, Pinedale Field Office, Pinedale, Wyoming

From: Brian T. Kelly, Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, Cheyenne, Wyoming

Subject: Scoping Comments for ASU's Proposed Year-Round Drilling in the Pinedale Anticline Project Area

This is regarding your scoping notice of July 14, 2005, received in this office on July 18, for Anschutz Pinedale Corporation, Shell Exploration & Production Company and Ultra Resources, Inc.'s (collectively known as ASU) proposed year-round drilling program located in T32N, R109W, in the Pinedale Anticline Project Area (PAPA), Sublette County, Wyoming. ASU proposes to drill nine wells from one well pad from November 15, 2005 to July 31, 2006. Drilling activities are proposed to occur during normally prohibited dates for the protection of big game species and greater sage-grouse. In response to the scoping notice the U.S. Fish and Wildlife Service (Service) is providing you with the following information for your use in preparation of an Environmental Assessment (EA).

Federal Agency Responsibilities

The Service has responsibility, under a number of federal laws, treaties, Executive Orders, and memoranda of agreement, for the conservation and management of fish and wildlife resources. Some of these same authorities also require other federal agencies to consider, avoid, or prevent adverse impacts to fish, wildlife, and wetland resources. To ensure resources are afforded adequate consideration and protection, federal agencies are often required to consult with the Service regarding potential impacts their actions may have on fish and wildlife resources.

Our comments include information on (1) threatened, endangered and candidate species, (2) migratory birds, (3) wetlands and riparian areas, and (4) sensitive species, including petitioned species. The Service provides recommendations for protective measures for threatened and endangered species in accordance with the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Protective measures for migratory birds are provided in accordance with the Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703 and the Bald and Golden Eagle Protection Act (BGEPA), 16 U.S.C. 668. Wetlands are afforded protection under Executive

Orders 11990 (wetland protection) and 11988 (floodplain management), as well as section 404 of the Clean Water Act. Other fish and wildlife resources are considered under the Fish and Wildlife Coordination Act, 48 Stat. 401, as amended, 16 U.S.C. 661 *et seq*, and the Fish and Wildlife Act of 1956, as amended, 70 Stat. 1119, 16 U.S.C. 742a-742j.

The Bureau of Land Management (Bureau) and their non-federal representatives should work with the Service in developing surveys, impact minimization measures, and conservation measures for all federally listed species. If the proposed project may affect a listed species, consultation with the Service pursuant to section 7(a)(2) of the Act will be required. Section 7 (a)(1) of the Act directs federal agencies to utilize their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation and recovery of listed species. Therefore we encourage the Bureau to incorporate measures into each project design for the conservation of listed species.

In accordance with section 7 of the Act, my staff has determined that the following threatened or endangered species, or species proposed for listing under the Act, may be present in the project areas. We would appreciate receiving information as to the current status of each of these species within or near the project area.

SPECIES	STATUS	HABITAT
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	Found throughout state
Black-footed ferret (*Mustela nigripes*)	Endangered	Prairie dog towns
Grizzly bear (*Ursus arctos horribilis*)	Threatened	Montane forests
Gray wolf (*Canis lupus*)	Experimental	Greater Yellowstone ecosystem
Canada lynx (*Lynx canadensis*)	Threatened	Montane forests
Kendall Warm Springs dace (*Rhinichthys osculus thermalis*)	Endangered	Kendall Warm Springs
Ute ladies'-tresses (*Spiranthes diluvialis*)	Threatened	Seasonally moist soils and wet meadows of drainages below 7000 feet

If the proposed action may lead to consumptive use of water in the Colorado River System or the Platte River System, impacts to threatened and endangered species inhabiting the downstream reaches of these systems should be included in the evaluation.

Colorado River fish	Endangered	Downstream riverine habitat of the Yampa, Green and Colorado river systems

Platte River species	Endangered	Downstream riverine habitat of the Platte River in Nebraska

Bald eagle: While habitat loss still remains a threat to the bald eagle's full recovery, most experts agree that its recovery to date is encouraging. Bald eagles may live up to 30 years in the wild. Adult eagles establish life-long pair bonds and build huge nests in the tops of large trees near rivers, lakes, marshes, or other wetland areas. Bald eagles may use the same nest in consecutive years. Although bald eagles may range over great distances, they usually return to nest within 100 miles of where they were fledged.

In order to reduce potential adverse effects to the bald eagle, a disturbance-free buffer zone of 1-mile should be maintained around eagle nests and winter roost sites. Activity within 1 mile of an eagle nest or roost may disturb the eagles and result in "take." If a disturbance-free buffer zone of 1-mile is not practicable, then the activity should be conducted outside of February 15 – August 15 to protect nesting birds and November 1 through April 15 to protect roosting birds. The two primary causes of raptor (including bald eagles) mortality are electrocutions and collisions with power lines. If any part of this project will involve construction of new power lines or modification of existing lines, the Service recommends that the project proponent take strong precautionary measures to protect bald eagles and other raptors by raptor-proofing power lines. Power lines should be built to meet all the requirements of the National Electrical Safety Code and the standards identified in the *Suggested Practices for Raptor Protection on Power Line: The State of the Art, Avian Power Line Interaction Committee* (APLIC 1996), to minimize electrocution potential.

Black-footed ferret: Black-footed ferrets may be affected if prairie dog towns are impacted. In Wyoming, black-footed ferret surveys are no longer recommended in black-tailed prairie dog towns or in white-tailed prairie dog towns except those noted in our February 2, 2004, letter, previously sent to your office. We encourage the Bureau to protect all prairie dog towns for their value to the prairie ecosystem and the myriad of species that rely on them. We further encourage you to analyze potentially disturbed prairie dog towns for their value to future black-footed ferret reintroduction.

If white-tailed prairie dog towns or complexes greater than 200 acres will be disturbed, surveys for ferrets <u>may</u> be recommended in order to determine if the action will result in an adverse effect to the species. Surveys may be recommended even if only a portion of the white-tailed prairie dog town or complex, as identified in the February 2004 letter, will be disturbed. According to the *Black-Footed Ferret Survey Guidelines* (USFWS 1989), a prairie dog complex consists of two or more neighboring prairie dog towns less than 7 km (4.3 miles) from each other. If a field check indicates that prairie dog towns may be affected, you should contact this office for guidance on ferret surveys and the protection of prairie dog ecosystems.

Grizzly bear: The grizzly bear has a wide range of habitat tolerance. Contiguous, relatively undisturbed mountainous habitat having a high level of topographic and vegetative diversity characterizes most areas where the species remains. Habitat loss and direct and indirect human-caused mortality is related to the decline in numbers. We strongly encourage the enforcement of food storage and garbage disposal stipulations. In addition, contractor should be aware of, and provide to their employees and subcontractors, information on the protected status of the grizzly

bear and on appropriate personal safety measures and behavior in grizzly bear habitat. Project activities may occur during the denning season (November to March) to avoid disturbance to grizzly bears. We recommend that your actions comply with the Interagency Grizzly Bear Guidelines (1986) and the Final Conservation Strategy for the Grizzly Bear in the Yellowstone Ecosystem (2003).

Gray wolf: All wolves within Wyoming are now considered part of the nonessential experimental population. Although such wolves remain listed and protected under the Act, flexibility is provided for their management under the provisions of the final rule and special regulations promulgated for the nonessential experimental population on November 22, 1994 (59 FR 60252). Requirements for interagency consultation under section 7 of the Act differ based on the land ownership and/or management responsibility where wolves occur. Management flexibility is provided for managing wolves existing outside of the National Park or National Wildlife Refuge System (e.g., Bureau of Land Management lands). Wolves designated as nonessential experimental in these areas are treated as proposed rather than listed. Two provisions of section 7 apply to Federal actions outside National Parks or National Wildlife Refuges: (1) section 7 (a)(1), which states all Federal agencies shall utilize their authorities to carry out programs for the conservation of listed species; and, (2) section 7 (a)(4), which requires Federal agencies to confer with the Service on actions that are likely to jeopardize the continued existence of the species.

Wolves are dependant on movements of big game populations and may occur in large ungulate migration, wintering, or parturition areas. During project activities wolves may change their use of certain areas based upon changes in big game population numbers and movement of herds. Project planning should consider impacts to big game populations, including wintering grounds and migration corridors.

Canada lynx: The Service published a Final Rule in the Federal Register on March 24, 2000 (65 FR 16052) listing the Canada lynx (*Lynx canadensis*) in the contiguous United States as threatened. Historically, lynx were observed in every mountain range in the state. Concentrations of observations occur in western Wyoming in the Wyoming and Salt River ranges and continuing north through the Tetons and Absaroka ranges in and around Yellowstone National Park. Numerous records have also come from the west slope of the Wind River Range, with fewer observations in the Bighorn and Uinta mountains (Reeve et al. 1986). In Wyoming, the lynx lives in subalpine/coniferous forests of mixed age and structural classes. Mature forests with downed logs and windfalls provide cover for denning sites, escape, and protection from severe weather. Early to mid–successional forest with high stem densities of conifer saplings provide optimal habitat for the lynx's primary prey, the snowshoe hare. Snowshoe hare reach their highest densities in regenerating forests that provide visual cover from predators and thermal cover (Wolff 1980, Litvaitis et al. 1985). It is likely that winter, when food is less abundant and less nutritious and energy demands are higher, is the limiting season for snowshoe hares (Pietz and Tester 1983).–To most benefit lynx, habitats should retain an overstory for concealment and forested connectivity between feeding, security, and denning habitats.

On federal lands, federal agencies have agreed to apply the Lynx Conservation Assessment and Strategy (LCAS, Ruediger et al., 2000) to project evaluations in order to analyze effects of planned and on-going projects on the lynx and lynx habitat. The LCAS contains the best

available information regarding management actions and their effects on lynx and provides standards and guidelines which, when implemented, will provide consistent and effective conservation of lynx on federal lands.

The Service has identified significant threats to the lynx including (1) loss and/or modification of habitat; (2) past commercial harvest (trapping), which is partially responsible for the extremely small lynx population; (3) inadequate regulatory mechanisms to protect lynx and their habitat; and (4) other factors such as increased human access into suitable habitat and human-induced changes in habitat allowing other species (e.g., bobcats and coyotes) to move into lynx habitat and compete with them. Examples of human alteration of forests include loss of and conversion of forested habitats through urbanization, ski area and other developments; fragmentation that leads to isolation of forested habitats by highways or other major construction; and certain timber harvesting practices and fire suppression measures.

Kendall Warm Springs Dace. The Kendall Warm Springs Dace was listed as endangered in 1970 in the only location where it is known to occur, on the Green River in Sublette County, Wyoming. This location is a series of small thermal springs and seeps approximately 300 meters in length which feeds into the Green River. A three meter high waterfall forms a barrier to fish migration into Kendall Warm Springs from the Green River. Adult Kendall Warm Springs Dace average in size from 23 to 54 millimeters. Breeding males are often a bright purple color while females are typically dull olive green. Recent population accounts of this species place their numbers at between 200,000 and 300,000 individuals. The potential threats to the Kendall Warm Springs Dace include: (1) water table lowering or contamination in the area surrounding the Kendall Warm Springs, (2) potential collection of individuals, (3) introduction of exotic fish species into Kendall Warm Springs, and (4) destruction of riparian stream-side vegetation or in-stream habitat. Management objectives for the recovery of this species are to maintain the existing population and protect its habitat.

Ute ladies'-tresses: Ute ladies'-tresses (*Spiranthes diluvialis*) is a perennial, terrestrial orchid, 8 to 20 inches tall, with white or ivory flowers clustered into a spike arrangement at the top of the stem. Ute ladies'-tresses typically blooms from late July through August; however, depending on location and climatic conditions, it may bloom in early July or still be in flower as late as early October. Ute ladies'-tresses is endemic to moist soils near wetland meadows, springs, lakes, and perennial streams where it colonizes early successional point bars or sandy edges. The elevation range of known occurrences is 4,200 to 7,000 feet in alluvial substrates along riparian edges, gravel bars, old oxbows, and moist to wet meadows. Soils where Ute ladies'-tresses have been found typically range from fine silt/sand, to gravels and cobbles, as well as to highly organic and peaty soil types. Ute ladies'-tresses is not found in heavy or tight clay soils or in extremely saline or alkaline soils. Ute ladies'-tresses seems intolerant of shade and small scattered groups are found primarily in areas where vegetation is relatively open. Surveys should be conducted by knowledgeable botanists trained in conducting rare plant surveys. Ute ladies'-tresses is difficult to survey for primarily due to its unpredictability of emergence of flowering parts and subsequent rapid desiccation of specimens. The Service does not maintain a list of "qualified" surveyors but can refer those wishing to become familiar with the orchid to experts who can provide training or services.

Platte River water depletions: Water depletions to the Platte River system may affect the federally listed whooping crane (*Grus americana*), interior least tern (*Sterna antillarum*), piping

plover (*Charadrius melodus*), pallid sturgeon (*Scaphirhynchus albus*), bald eagle (*Haliaeetus leucocephalus*), Eskimo curlew (*Numenius borealis*), and western prairie fringed orchid (*Platanthera praeclara*). In addition, depletions may contribute to the destruction or adverse modification of designated critical habitat for the whooping crane, and proposed critical habitat for the northern Great Plains breeding population of the piping plover. Depletions include evaporative losses and/or consumptive use, often characterized as diversions from the Platte River or its tributaries less return flows. Project elements that could be associated with depletions to the Platte River system include, but are not limited to, ponds (detention/irrigation storage/stock watering), created or enhanced wetlands, hydrostatic testing of pipelines, dust abatement, and water treatment facilities. Any actions that may result in a water depletion to the Platte River system should be identified. The document should also include an estimate of the amount and timing of average annual water depletion (both existing and new depletions), describe methods of arriving at such estimates, describe location of where depletion occurs as specifically as possible, if and when it will be returned to the system and what the depletion is being used for. Note that if the project has peculiarities or oddities, the Service may have more specific questions regarding these particular water depletions.

Colorado River water depletions: Formal consultation is required for projects that may lead to depletions of water to the Colorado River system. Federal agency actions resulting in water depletions to the Colorado River system may affect the endangered Bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), Humpback chub (*Gila cypha*), and Razorback sucker (*Xyrauchen texanus*) downstream in the Green and Colorado river systems.
In general, depletions include evaporative losses and/or consumptive use of surface or groundwater within the affected basin, often characterized as diversions less return flows. Project elements that could be associated with depletions include, but are not limited to, ponds (detention/recreation/irrigation storage/stock watering), lakes (recreation/irrigation storage/power generation), reservoirs (recreation/irrigation storage/municipal storage/power generation), hydrostatic testing of pipelines, wells, dust abatement, diversion structures, and water treatment facilities. Any actions that may result in a water depletion should be identified. The document should also include an estimate of the amount and timing of average annual water depletion (both existing and new depletions), describe methods of arriving at such estimates, describe location of where depletion occurs as specifically as possible, if and when it will be returned to the system and what the depletion is being used for. Note that if the project has peculiarities or oddities, the Service may have more specific questions regarding these particular water depletions.

Candidate Species
The yellow-billed cuckoo (*Coccyzus americanus),* is candidate species for listing as threatened or endangered and may occur in portions of the project area. The Service has determined that sufficient information exists to propose the yellow-billed cuckoo (*Coccyzus americanus)* as a candidate species for listing under the Act; however, the proposal to list is currently precluded by higher priority listing actions. Conservation measures for candidate species are voluntary but recommended and should be incorporated into project planning. The Service recommends that federal, state, and other parties give consideration to candidate species in environmental planning to avoid possible delays should the species be listed prior to the completion of the project. Protection provided to these species now may preclude possible listing in the future. We would appreciate receiving information on the status of the yellow-billed cuckoo in or near the project area.

Migratory Birds
Please recognize that consultation on listed species may not remove the Bureau's obligation to protect the many species of migratory birds, including eagles and other raptors protected under the MBTA and BGEPA. The MBTA, enacted in 1918, prohibits the taking of any migratory birds, their parts, nests, or eggs except as permitted by regulations and does not require intent to be proven. Section 703 of the MBTA states, "Unless and except as permitted by regulations ... it shall be unlawful at any time, by any means or in any manner, to ... take, capture, kill, attempt to take, capture, or kill, or possess ... any migratory bird, any part, nest, or eggs of any such bird..." The BGEPA prohibits knowingly taking, or taking with wanton disregard for the consequences of an activity, any bald or golden eagles or their body parts, nests, or eggs, which includes collection, molestation, disturbance, or killing.

In order to promote the conservation of migratory bird populations and their habitats, the Service recommends the Bureau implement those strategies outlined within the Memorandum of Understanding directed by the President of the U.S. under the Executive Order 13186, where possible.

Sensitive Species
Federal agencies are also encouraged to consider sensitive species or species at risk in project review. Your consideration of these species is important in preventing their inclusion on the Endangered Species List. The Wyoming Natural Diversity Database maintains the most current information on sensitive plants in Wyoming. The database must charge for data retrieval to financially support the database and staff. The staff can be contacted at (307) 766-5026.

Pygmy Rabbit
The Service has reviewed the April 21, 2003, petition to list the pygmy rabbit (*Brachylagus idahoensis*) under the Act and has concluded on May 20, 2005, that the petition does not contain substantial scientific information to move ahead toward a year-long review. However, the Service continues to encourage federal agencies to analyze project areas for potential effects to pygmy rabbits and their habitats and to provide this information to the Service for review. This smallest of the Leporidae family occurs in portions of many western states including southwestern Wyoming where they have been confirmed to occur in a few isolated populations in Lincoln, Uinta, Sweetwater, Sublette and Fremont counties. Pygmy rabbits are sagebrush obligate species, primarily found in dense western big sagebrush (*Artemisia tridentate ssp.*) communities preferably where at least two other species of sagebrush and forbs occur as well. Conversion of sagebrush grasslands, habitat fragmentation and overgrazing are considered potential threats to pygmy rabbits. Project planning measures that retain large tracts of suitable habitat and corridors to adjacent habitat will aid in the conservation of this species.

Greater Sage-grouse
The Service has determined that the greater sage-grouse (*Centrocercus urophasianus*) is unwarranted for listing at this time. However, the Service continues to have concerns regarding sage-grouse population status, trends and threats, as well as concerns for other sagebrush obligates. The following information is provided for your use in the evaluation of proposed actions and their potential effects to the sage-grouse.

Greater sage-grouse are dependent on sagebrush habitats year-round. Habitat loss and degradation, as well as loss of population connectivity have been identified as important factors

contributing to the decline of greater sage-grouse populations rangewide (Braun 1998, Wisdom et al. 2002). Therefore, any activities that result in loss or degradation of sagebrush habitats that are important to this species should be closely evaluated for their impacts to sage-grouse. If important breeding habitat (leks, nesting or brood rearing habitat) is present in the project area, the Service recommends no project-related disturbance March 1 through June 30, annually. Minimization of disturbance during lek activity, nesting, and brood rearing is critical to sage-grouse persistence within these areas. Likewise, if important winter habitats are present, we recommend no project-related disturbance November 15 through March 14.

We recommend you contact the Wyoming Game and Fish Department to identify important greater sage-grouse habitats within the project area, and appropriate mitigative measures to minimize potential impacts from the proposed project. The Service recommends surveys and mapping of important greater sage-grouse habitats where local information is not available. The results of these surveys should be used in project planning, to minimize potential impacts to this species. No project activities that may exacerbate habitat loss or degradation should be permitted in important habitats.

In Wyoming, information suggests that greater sage-grouse populations are negatively affected by energy development activities, especially those that degrade important sagebrush habitat, even when mitigative measures are implemented (Braun 1998, Lyon 2000). Greater sage-grouse populations can repopulate areas developed for resource extraction after habitat reclamation for the species (Braun 1987). However, there is no evidence that populations attain their previous levels and reestablishment of sage-grouse in a reclaimed area may take 20 to 30 years, or longer (Braun 1998). Therefore, this project should be carefully evaluated for long-term and cumulative effects on the greater sage-grouse, since reclamation may not restore populations to pre-activity levels. The Bureau should ensure this activity does not exacerbate greater sage-grouse declines on either a local or range-wide level.

In 2000, the U.S. Forest Service, the Bureau of Land Management,-and the U.S. Fish and Wildlife Service signed a Memorandum of Understanding (MOU) with the Western Association of Fish and Wildlife Agencies (WAFWA) to conserve the greater sage-grouse and its habitat. This MOU outlined the participation of Federal and State wildlife agencies, including the Wyoming Game and Fish Department, in greater sage-grouse conservation, and these commitments should be considered in project planning in sage-grouse habitat. Additionally, unless site-specific information is available, greater sage-grouse habitat should be managed following the guidelines by Connelly *et al.* 2000 (also known as the WAFWA guidelines).

Wetlands/Riparian Areas

Wetlands perform significant ecological functions which include: (1) providing habitat for numerous aquatic and terrestrial wildlife species, (2) aiding in the dispersal of floods, (3) improving water quality through retention and assimilation of pollutants from storm water runoff, and (4) recharging the aquifer. Wetlands also possess aesthetic and recreational values. The Service recommends measures be taken to avoid and minimize wetland losses in accordance with Section 404 of the Clean Water Act and Executive Order 11988 (floodplain management) as well as the goal of "no net loss of wetlands." If wetlands may be destroyed or degraded by proposed actions, those wetlands should be inventoried and fully described in terms of their functions and values. Acreage of wetlands, by type, should be disclosed and specific actions should be outlined to avoid, minimize, and compensate for all unavoidable wetland impacts.

Riparian or streamside areas are a valuable natural resource and impacts to these areas should be avoided whenever possible. Riparian areas are the single most productive wildlife habitat type in North America. They support a greater variety of wildlife than any other habitat. Riparian vegetation plays an important role in protecting streams, reducing erosion and sedimentation as well as improving water quality, maintaining the water table, controlling flooding, and providing shade and cover. In view of their importance and relative scarcity, impacts to riparian areas should be avoided. Any potential, unavoidable encroachment into these areas should be further avoided and minimized. Unavoidable impacts to streams should be assessed in terms of their functions and values, linear feet and vegetation type lost, potential effects on wildlife, and potential effects on bank stability and water quality. Measures to compensate for unavoidable losses of riparian areas should be developed and implemented as part of the project.

Plans for mitigating unavoidable impacts to wetland and riparian areas should include mitigation goals and objectives, methodologies, time frames for implementation, success criteria, and monitoring to determine if the mitigation is successful. The mitigation plan should also include a contingency plan to be implemented should the mitigation not be successful. In addition, wetland restoration, creation, enhancement, and/or preservation does not compensate for loss of stream habitat; streams and wetlands have different functions and provide different habitat values for fish and wildlife resources.

Best Management Practices (BMPs) should be implemented within the project area wherever possible. BMPs include, but are not limited to, the following: installation of sediment and erosion control devices (e.g., silt fences, hay bales, temporary sediment control basins, erosion control matting); adequate and continued maintenance of sediment and erosion control devices to insure their effectiveness; minimization of the construction disturbance area to further avoid streams, wetlands, and riparian areas; location of equipment staging, fueling, and maintenance areas outside of wetlands, streams, riparian areas, and floodplains; and re-seeding and re-planting of riparian vegetation native to Wyoming in order to stabilize shorelines and streambanks.

Recommendations

Natural gas development poses a serious threat to wildlife habitat. Habitat fragmentation, disruption of seasonal migration routes, disruption of breeding activity, and increased predation may be caused by well pads, access roads, pipelines, power lines, transmission stations, compressor noise, and increased traffic that accompany natural gas development. Therefore, the Service encourages the Bureau to consider the following during the preparation of the environmental assessment and the decision whether to grant this proposal.

The Bureau should insist that directional drilling methods be used in natural gas extraction at all times of the year to minimize threats to wildlife and their habitats. The anticipated level of threats to wildlife should weigh heavily on the decision whether or not to approve this proposal. The Service is supportive of a year-round directional drilling proposal only if (1) the project proponent committed to conduct site specific analysis of each well pad site and include stipulations as recommended by the Service, the Bureau, and the Wyoming Game and Fish Department to reduce impacts to wildlife, (2) the project proponent committed to enhance off-site wildlife habitats in-kind and at least at a 1:1 ratio, (3) the Bureau committed to deny drilling activities in areas where impacts to wildlife are such that no stipulations or mitigation would replace the habitat that stands to be lost, (4) the Bureau committed to monitoring truck traffic and human presence to ensure that an overall reduction is in fact taking place within the field, and (5)

the Bureau committed to deny exceptions to stipulations as requested by project proponents except when in the case of an actual emergency. The Service is concerned with the overwhelming authorization of exceptions to wildlife protection stipulations that are occurring on Bureau lands. These stipulations are identified in National Environmental Policy Act documents which are reviewed by those who believe that these measures will be implemented. We believe that this proposal may be a viable option for companies to gather the resource quickly and still conserve wildlife only if wildlife protection measures are implemented and monitored to ensure their effectiveness.

The Service reminds the Bureau that habitat enhancement projects should consider potential effects (beneficial or negative) to listed and proposed species, migratory birds, and petitioned species as indicated above. The Service further encourages continued research regarding the impacts of natural gas development to wildlife within the PAPA and we would appreciate receiving data regarding listed and sensitive species.

We appreciate your efforts to ensure the conservation of endangered, threatened, and candidate species and migratory birds. If the scope of the project is changed, or the project is modified, in a manner that you determine may affect a listed species, this office should be contacted to discuss consultation requirements pursuant to section 7(a)(2) of the Act. If you have further questions regarding our comments or your responsibilities under the Act, please contact Kathleen Erwin of my staff at the letterhead address or phone (307)772-2374, extension 28.

cc: FWS, Region 6, Federal Activities Coordinator, Denver (B. Dach)
WGFD, Non-Game Coordinator, Lander (B. Oakleaf)
WGFD, Statewide Habitat Protection Coordinator, Cheyenne (V. Stelter)

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Appendix C

Wildlife Technical Report

Mule Deer Over-Winter Mortality in the Sublette Herd Unit

INTRODUCTION

Potential impacts to mule deer by natural gas development in the vicinity of Pinedale, Wyoming, were addressed by U.S. Bureau of Land Management (BLM) in the *Draft Environmental Impact Statement* (DEIS) *for the Pinedale Anticline Oil and Gas Exploration and Development Project Sublette County, Wyoming* (BLM, 1999). In that document and the accompanying Technical Report, BLM observed that human-related factors causing mule deer to expend energy during winter, in addition to the energy that would be expended without those factors, could lead to increased over-winter mortality. Too, migratory mule deer that normally wintered in the vicinity of natural gas developments are expected to avoid them, potentially forced to depend on inferior habitats for over-winter survival (BLM, 1999). Potential for similar impacts to wintering mule deer by natural gas development have been echoed by Sawyer et al. (2002) and Lutz et al. (2003).

The Pinedale Anticline Oil and Gas Exploration and Development Project (Pinedale Anticline Project Area or PAPA) is within winter range utilized by mule deer in the Sublette Herd Unit. Recognizing the importance of the PAPA to wintering mule deer and other big game, the Record of Decision (ROD) on the *Environmental Impact Statement* (EIS) *for the Pinedale Anticline Oil and Gas Exploration and Development Project Sublette County, Wyoming* issued by BLM stated (page 19, BLM, 2000a):

> *To ensure protection of wintering big game, all surface-disturbing or human activity associated with construction, including roads, pipelines well pads, drilling, completion or workover operations, will be seasonally and location restricted pursuant to the Mitigation Guidelines and Standard Practices described in Appendix A* (of the EIS, BLM 2000b). *To protect important big game winter habitat, activities or surface use will not be allowed from November 15 through April 30 within certain areas encompassed by the authorization.*

In 2004, Questar Exploration and Development Company (Questar) proposed to modify its strategy for future development of its 14,800-acre leasehold in the PAPA. To shorten the period necessary to develop their leases and to provide for more economically-attractive drilling rig utilization, Questar proposed to begin year-round drilling within their leases in the northern portion of the PAPA. BLM (2004) analyzed the environmental consequences of Questar's proposal (including various applicant-committed measures to avoid or minimize environmental harm) in an Environmental Assessment (Questar EA) and issued a Decision Record for the Questar Year-Round Drilling Proposal (EA Number WY-100-EA5-034) with a Finding of No Significant Impact (BLM, 2004).

A *Wildlife Technical Report* was appended to the Questar EA (Appendix E in BLM, 2004), Section 2 of which examined mule deer over-winter mortality in the Sublette Herd Unit. Analyses of over-winter fawn mortality indicated that fawn mortality rate increased with increasing winter snowfall estimated for each month on crucial winter ranges used by the population. From winter 2001-02 through winter 2003-04, total snowfall from October through April had significant effects on fawn mortality whereas before 2001, fawn mortality was significantly related to total snowfall from November through March. The report concluded that prior to 2001, mule deer fawns in the Sublette Herd Unit were apparently less susceptible to

effects by snowfall in October and April than they had been since 2001. During the period 2001-2004, development in the PAPA progressed and at the same time annual precipitation (during water years) on the crucial winter ranges had been below average. Similar drought conditions were experienced by mule deer in the Wyoming Range Herd Unit since 2001 but elevated fawn mortality rates were not observed to be excessive in that herd unit until 2004, after more than 4 consecutive years of below-average precipitation. Those comparisons suggested that other factors in addition to winter snowfall and drought might be influencing fawn mortality on the Sublette Herd Unit winter ranges and most likely were cumulative effects due to climate and/or recent changes in land uses throughout the herd unit which extends well beyond the PAPA.

This Wildlife Technical Report provides an analysis of the variation in demographic parameters of mule deer in the Sublette Herd Unit before and during natural gas developments on the PAPA with the addition of data collected for winter 2004-05. Unlike the technical report appended to the Questar EA, similar analyses are not provided here for mule deer in two winter range complexes within the Wyoming Range Herd Unit since fawn and adult deer carcasses could not be surveyed in 2005 on those winter ranges (Gary Fralick, Wyoming Game and Fish Department, Thayne, personal communication with Golder Associates, Inc. July 2005).

METHODS

Over-winter Survival Rates. Wyoming Game and Fish Department (WGFD) biologists have been collecting data useful for estimating adult and fawn over-winter survival rates for mule deer in the Sublette Herd Unit (Doug McWhirter, Scott Smith, Dean Clause) since winter 1992-93. The required data are 1) counts of fawns and adults alive during early winter, usually December, 2) counts of fawns and adults alive during spring, usually April, and 3) counts of fawn and adult carcasses made in late April or early May, after the spring survey of surviving animals. Three ratios, ***A, B,*** and ***C*** are constructed from these 3 counts (White et al., 1996):

- ***A*** = fawns counted in December/adults counted in December (pre-winter)
- ***B*** = fawns counted in April/adults counted in April (post-winter)
- ***C*** = fawn carcasses counted in April-May/adult carcasses counted in April-May (post-winter).

Estimates of adult over-winter survival ($\hat{S}_a$) and fawn over-winter survival ($\hat{S}_f$) are computed from these 3 ratios (see White et al., 1996 for derivation of the estimates):

$$\hat{S}_a = \frac{C - A}{C - B}$$

and

$$\hat{S}_f = \left[\frac{C - A}{C - B}\right]\left[\frac{B}{A}\right]$$

Variances for the estimated survival rates were computed by the delta method (see Appendix in White et al., 1996) and 90% confidence intervals were estimated as ±1.64 $\hat{S}$E ($\hat{S}$). Estimates of over-winter mortality rates ($\hat{W}$) are related to survival by $\hat{W} = 1 - \hat{S}$.

Climatological Data. Total monthly precipitation (inches of water), total monthly snowfall (inches of snow), average maximum and minimum temperatures (^{o}F) for each month were

compiled for all National Weather Service (NWS) Cooperative Observer stations in western Wyoming, southeastern Idaho, and northeastern Utah (Western Regional Climate Center, Historical Climate Summaries, available at http://www.wrcc.dri.edu/climsum.html) from January 1970 through June 2005. These data were compiled by water year (also called a hydrologic year), October of one year through September of the next year, rather than by calendar year.

All monthly totals (precipitation, snowfall) and averages (temperature) reported by each NWS station were examined for missing data (number of days not reported in a given month). Data for months with >5 days of missing data were determined to be inadequate following NWS protocol for computing annual summary statistics and were designated the same as if no data were reported for that month. NWS provides latitude and longitude for each reporting station. Since not all of the winter ranges utilized by mule deer in the Sublette are proximate to NWS stations and many NWS stations report >5 days of missing data or no data at all for varying periods, climatological data were estimated for winter ranges by interpolation.

Latitude and longitude at the approximate center of the crucial winter range were averaged over all crucial winter ranges delineated for the Sublette Herd Unit. Euclidean distances (km) from the winter range average center point were computed to each NWS station, based on the reported coordinates for each station. A routine was developed to select the closest 5 stations (an arbitrary number) with adequate data to a winter range center point for each month in each water year, 1971 to 2005. The value of a particular climatological variable, $\boldsymbol{Y}$, for each month at the approximate centers of crucial winter range complexes, $\boldsymbol{x}$, was interpolated as the weighted average of the variable's value at the 5 closest stations ($\boldsymbol{x_i}$) (see page 153, Burrough 1986):

$$\hat{\boldsymbol{Y}}(\boldsymbol{x}) = \sum_{i=1}^{5} \lambda_i \, \boldsymbol{Y}(\boldsymbol{x_i}) \quad \text{where} \quad \Sigma \lambda_i = 1$$

The weights, λ_i, are reciprocals of distance, d_i, between a NWS station and the approximate winter range center point divided by the sum of those values for all 5 NWS stations having adequate data:

$$\lambda_i = (1/d_i) \;/\; \sum_{i=1}^{5} (1/d_i)$$

Thus, climatological variables measured at NWS stations close to a crucial winter range complex have greater influence on that variable's estimate $\hat{\boldsymbol{Y}}(\boldsymbol{x})$ on the complex than more distant NWS stations.

RESULTS and DISCUSSION

Over-winter Mortality Rates – Sublette Herd Unit. Raw data collected by WGFD biologists on Sublette Herd Unit winter ranges each year are provided in Table 1. Included are the 3 ratios, ***A***, ***B***, and ***C***, that are used to estimate over-winter survival of fawn and adult mule deer. Estimates of fawn and adult survival rates are provided in Table 2.

Ratios ***A*** and ***B*** are related to fawn and adult survival rates by $\hat{S}_f / \hat{S}_a = \boldsymbol{B} / \boldsymbol{A}$ (see equation 9 in Paulik and Robson, 1969). Consequently, $\hat{S}_f < \hat{S}_a$ for any given winter. To be consistent with analyses presented in the DEIS and Technical Report (BLM, 1999), survival rates were converted to mortality rates ($\hat{W} = 1 - \hat{S}$). Time series plots of fawn and adult mortality rates are provided in Figure 1.

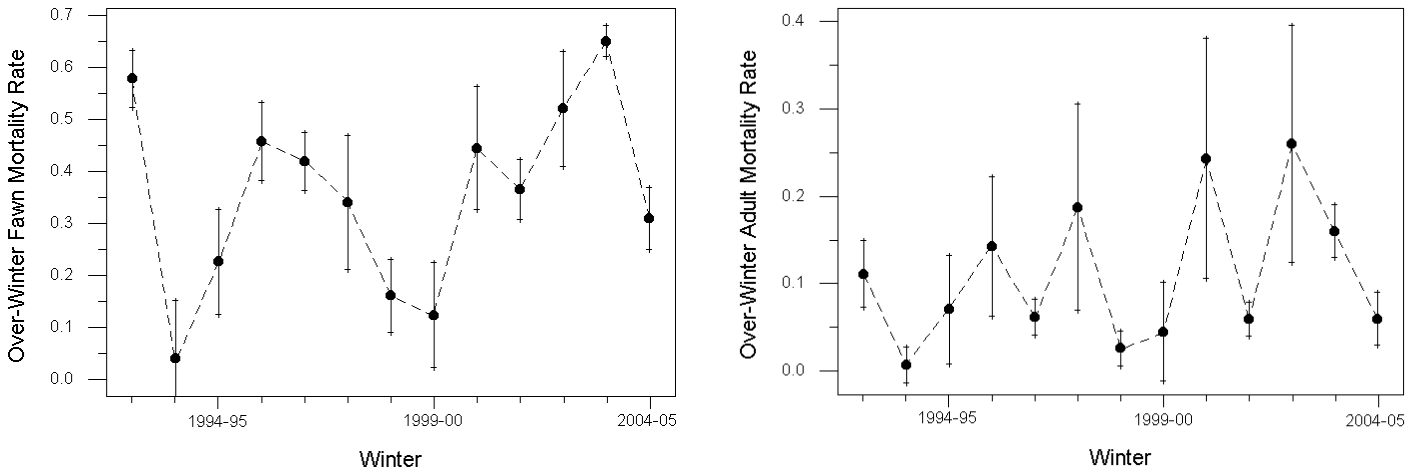
Table 1. Data Collected by Wyoming Game and Fish Department for Mule Deer in the Sublette Herd Unit and 3 Ratios Derived from the Data That Are Used to Estimate Over-winter Survival Rates for Fawns and Adults.

Winter	Counts in December		Ratio A	Counts in April		Ratio B	Carcasses Counted		Ratio C
	Fawns	Adults		Fawns	Adults		Fawns	Adults	
1992-93	2090	4658	0.449	329	1544	0.213	105	45	2.333
1993-94	1587	4241	0.374	536	1483	0.361	13	6	2.167
1994-95	2698	5370	0.502	681	1629	0.418	21	13	1.615
1995-96	2358	5406	0.436	691	2506	0.276	35	25	1.400
1996-97	2181	3967	0.550	709	2081	0.341	182	49	3.714
1997-98	2694	4218	0.639	931	1796	0.518	65	56	1.161
1998-99	3115	5843	0.533	1120	2441	0.459	43	13	3.308
1999-00	3064	5248	0.584	1258	2349	0.536	16	10	1.600
2000-01	3227	5273	0.612	1185	2640	0.449	56	50	1.120
2001-02	3730	7139	0.522	760	2156	0.353	183	57	3.211
2002-03	2727	5429	0.502	724	2193	0.330	51	52	0.981
2003-04	3664	6040	0.607	760	2986	0.255	485	194	2.500
2004-05	3066	5556	0.552	1234	3042	0.406	45	15	3.000

Variance estimates on survival rates (likewise on mortality rates) are large for many years with corresponding wide confidence intervals, in part due to small samples of fawn and adult carcasses. Thus, fawn over-winter mortality rates on the Sublette Herd Unit winter range complex do not differ significantly (P > 0.10) from the previous year's mortality rate, as evident from overlapping 90% confidence intervals, with a few exceptions. In 1993-94 fawn mortality was significantly less than in the previous year and mortality in 1995-96 was significantly greater than in 1994-1995 (Figure 1a). Most notable are fawn mortality rates from winters 2000-01 through 2003-04 which are significantly higher than for the 2 years preceding 2000-01. Fawn mortality in 2004 was significantly greater than for any year prior to 2000-2001, except 1992-1993. In 2005 however, fawn mortality declined so that it was significantly less than in 2004. Likewise, the adult mortality rate in 2005 was significantly less than the mortality rate observed in 2004 (Figure 1b).

Table 2. Over-winter Survival Rate Estimates for Fawns ($\hat{S}_f$) and Adults ($\hat{S}_a$), Mortality Rate Estimates for Fawns ($\hat{W}_f$) and Adults ($\hat{W}_a$), Variances (Var), Standard Errors (SE), and 90% Confidence Intervals (90%CI) for Each Winter on the Sublette Herd Unit.

Winter	Fawns					Adults				
	$\hat{S}_f$	$\hat{W}_f$	Var	SE	90%CI	$\hat{S}_a$	$\hat{W}_a$	Var	SE	90%CI
1992-93	0.42	0.58	0.0011	0.033	±0.05	0.89	0.11	0.0005	0.023	±0.04
1993-94	0.96	0.04	0.0045	0.067	±0.11	0.99	0.01	0.0002	0.012	±0.02
1994-95	0.77	0.23	0.0037	0.061	±0.10	0.93	0.07	0.0014	0.038	±0.06
1995-96	0.54	0.46	0.0021	0.046	±0.08	0.86	0.14	0.0023	0.048	±0.08
1996-97	0.58	0.42	0.0012	0.034	±0.06	0.94	0.06	0.0002	0.013	±0.02
1997-98	0.66	0.34	0.0061	0.078	±0.13	0.81	0.19	0.0051	0.071	±0.12
1998-99	0.84	0.16	0.0018	0.042	±0.07	0.97	0.03	0.0001	0.012	±0.02
1999-00	0.88	0.12	0.0037	0.061	±0.10	0.95	0.05	0.0012	0.035	±0.06
2000-01	0.56	0.44	0.0051	0.072	±0.12	0.76	0.24	0.0070	0.083	±0.14
2001-02	0.63	0.37	0.0012	0.034	±0.06	0.94	0.06	0.0001	0.012	±0.02
2002-03	0.48	0.52	0.0042	0.065	±0.11	0.74	0.26	0.0068	0.082	±0.14
2003-04	0.35	0.65	0.0004	0.020	±0.03	0.84	0.16	0.0003	0.016	±0.03
2004-05	0.69	0.31	0.0013	0.036	±0.06	0.94	0.06	0.0004	0.021	±0.03



1a **1b**

Figure 1. Mule Deer Mortality Rate Estimates (With 90% CI on the Estimates) for Fawn (1a) and Adult (1b) Mule Deer on the Sublette Herd Unit Winter Ranges.

Comparison of Mortality Rates on the Mesa and Pinedale Front Winter Range Complexes. Two mule deer winter range complexes – the Mesa and Pinedale Front – have served as treatment (the Mesa) and control (Pinedale Front) areas in Phase II of the Sublette Mule Deer Study (Sawyer et al., 2004). The study was designed to detect changes in mule deer habitat use, animal distribution, abundance, and population parameters due to natural gas development on the Mesa (treatment). Data for computing over-winter mortality have also been collected by WGFD biologists on both of the winter ranges and reported separately most years since winter 1992-93. Raw data and the 3 ratios, ***A***, ***B***, and ***C***, are provided in Table 3.

Table 3. Data Collected by WGFD for Mule Deer on the Mesa and Pinedale Front Winter Range Complexes and 3 Ratios Derived from the Data Required to Estimate Over-winter Survival Rates for Fawns and Adults in Table 4.

Winter Range Complex	Winter	Counts in December		Ratio A	Counts in April		Ratio B	Carcasses Counted		Ratio C
		Fawns	Adults		Fawns	Adults		Fawns	Adults	
Mesa Complex	1992-93	841	1929	0.436	288	1189	0.242	unknown	unknown	none
	1993-94	853	2348	0.363	518	1406	0.368	unknown	unknown	none
	1994-95	1136	2476	0.459	521	1312	0.397	18	12	1.500
	1995-96	889	2125	0.418	511	1962	0.260	35	25	1.400
	1996-97	1026	1873	0.548	501	1508	0.332	99	25	3.960
	1997-98	1042	1567	0.665	512	931	0.550	20	28	0.714
	1998-99	1473	2996	0.492	828	1982	0.418	21	3	7.000
	1999-00	1547	2550	0.607	764	1390	0.550	12	9	1.333
	2000-01	1458	2420	0.602	707	1685	0.420	41	32	1.281
	2001-02	1275	2546	0.501	460	1366	0.337	121	43	2.814
	2002-03	914	1864	0.490	470	1489	0.316	9	8	1.125
	2003-04	1201	2063	0.582	319	1215	0.263	273	130	2.100
	2004-05	1183	2162	0.547	547	1477	0.370	33	8	4.125
Pinedale Front Complex	1992-93	1249	2729	0.458	41	355	0.115	unknown	unknown	none
	1993-94	734	1893	0.388	18	77	0.234	unknown	unknown	none
	1994-95	1562	2894	0.540	160	317	0.505	3	1	3.000
	1995-96	1469	3281	0.448	180	544	0.331	no data	no data	none
	1996-97	1155	2094	0.552	208	573	0.363	83	24	3.458

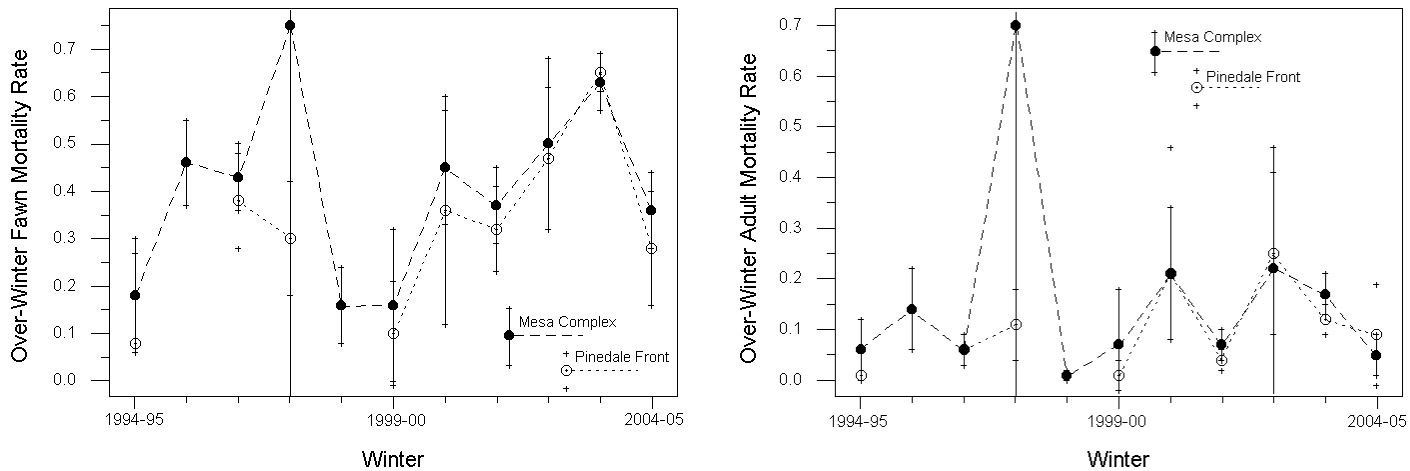
Table 3 concluded

Winter Range Complex	Winter	Counts in December		Ratio A	Counts in April		Ratio B	Carcasses Counted		Ratio C
		Fawns	Adults		Fawns	Adults		Fawns	Adults	
Pinedale Front Complex	1997-98	1652	2651	0.623	419	865	0.484	45	25	1.800
	1998-99	1642	2847	0.577	292	459	0.636	22	10	2.200
	1999-00	1517	2698	0.562	494	959	0.515	4	1	4.000
	2000-01	1769	2853	0.620	478	955	0.501	15	14	1.071
	2001-02	2455	4593	0.535	300	790	0.380	62	14	4.429
	2002-03	1813	3565	0.509	254	704	0.361	42	44	0.955
	2003-04	2463	3977	0.619	441	1771	0.249	212	64	3.313
	2004-05	1883	3394	0.555	687	1565	0.439	12	7	1.714

Sample sizes, particularly numbers of fawn and adult carcasses, are very small during several years when divided between the two winter range complexes (Table 3). Hence, variances for estimates of fawn and adult mortality rates are large and corresponding 90% confidence intervals on the estimates are very wide (Table 4 and Figure 2). In most winters since 1994-95, fawn mortality rates on the Mesa winter range complex have tended to be higher than rates on the Pinedale Front complex, when adequate data have been collected on the two areas. Because of the large variances, none of the mortality estimates for one area is significantly different from estimates on the other area in any given year. Fawn mortality on both complexes was significantly less ($P < 0.10$) in winter 2004-05 than during the previous winter (Figure 2a). Likewise in 2004-05, the adult mortality rate on the Mesa was significantly less ($P < 0.10$) than the previous winter, but no significant differences in adult mortally for the two winters were observed on the Pinedale Front (Figure 2b).

Table 4. Over-winter Survival Rate Estimates for Fawns ($\hat{S}_f$) and Adults ($\hat{S}_a$), Mortality Rate Estimates for Fawns ($\hat{W}_f$) and Adults ($\hat{W}_a$), Variances (Var), Standard Errors (SE), and 90% Confidence Intervals (90%CI) on the Mesa and Pinedale Front Winter Range Complexes.

Winter Range Complex	Winter	Fawns					Adults				
		$\hat{S}_f$	$\hat{W}_f$	Var	SE	90%CI	$\hat{S}_a$	$\hat{W}_a$	Var	SE	90%CI
Mesa Complex	1994-95	0.82	0.18	0.0057	0.075	±0.12	0.94	0.06	0.0013	0.037	±0.06
	1995-96	0.54	0.46	0.0028	0.053	±0.09	0.86	0.14	0.0023	0.048	±0.08
	1996-97	0.57	0.43	0.0018	0.042	±0.07	0.94	0.06	0.0003	0.016	±0.03
	1997-98	0.25	0.75	0.5667	0.753	±1.24	0.30	0.70	0.8224	0.907	±1.49
	1998-99	0.84	0.16	0.0022	0.047	±0.08	0.99	0.01	0.0001	0.008	±0.01
	1999-00	0.84	0.16	0.0091	0.095	±0.16	0.93	0.07	0.0045	0.067	±0.11
	2000-01	0.55	0.45	0.0052	0.072	±0.12	0.79	0.21	0.0064	0.080	±0.13
	2001-02	0.63	0.37	0.0022	0.047	±0.08	0.93	0.07	0.0003	0.017	±0.03
	2002-03	0.50	0.50	0.0115	0.107	±0.18	0.78	0.22	0.0221	0.149	±0.24
	2003-04	0.37	0.63	0.0012	0.034	±0.06	0.83	0.17	0.0006	0.025	±0.04
	2004-05	0.64	0.36	0.0022	0.047	±0.08	0.95	0.05	0.0005	0.022	±0.04
Pinedale Front Complex	1994-95	0.92	0.08	0.0131	0.115	±0.19	0.99	0.01	0.0008	0.028	±0.05
	1995-96	-	-	-	-	-	-	-	-	-	-
	1996-97	0.62	0.38	0.0040	0.063	±0.10	0.94	0.06	0.0004	0.019	±0.03
	1997-98	0.70	0.30	0.0051	0.071	±0.12	0.89	0.11	0.0019	0.044	±0.07
	1998-99	1.14	-0.14	0.0174	0.132	±0.22	1.04	-0.04	0.0015	0.039	±0.06
	1999-00	0.90	0.10	0.0047	0.068	±0.11	0.99	0.01	0.0004	0.020	±0.03
	2000-01	0.64	0.36	0.0205	0.143	±0.24	0.79	0.21	0.0239	0.155	±0.25
	2001-02	0.68	0.32	0.0030	0.055	±0.09	0.96	0.04	0.0002	0.014	±0.02
	2002-03	0.53	0.47	0.0088	0.094	±0.15	0.75	0.25	0.0092	0.096	±0.16
	2003-04	0.35	0.65	0.0006	0.024	±0.04	0.88	0.12	0.0004	0.020	±0.03
	2004-05	0.72	0.28	0.0050	0.071	±0.12	0.91	0.09	0.0037	0.061	±0.10

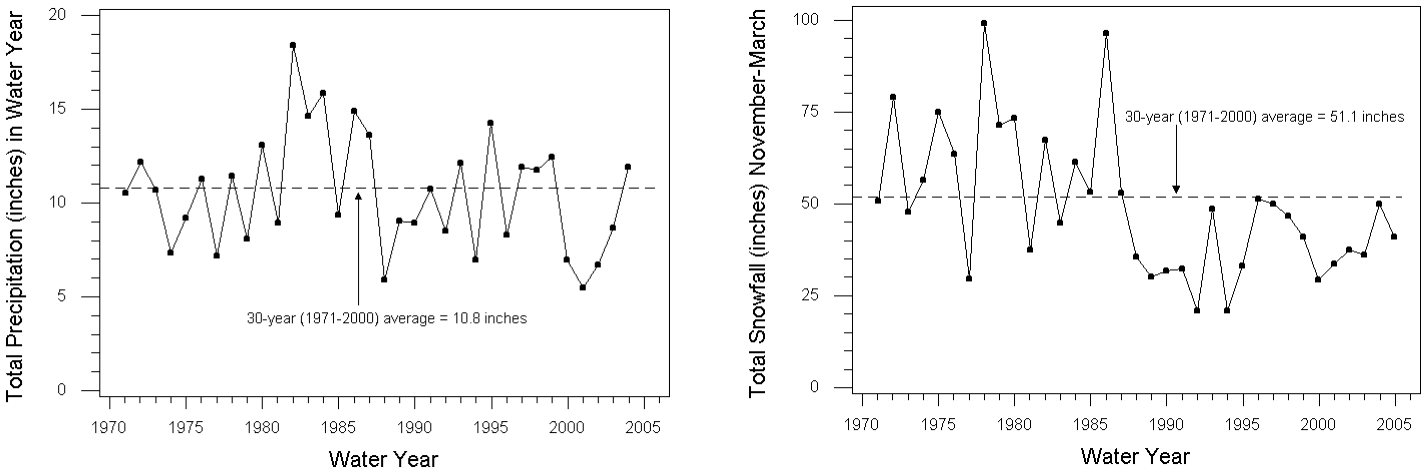


2a **2b**

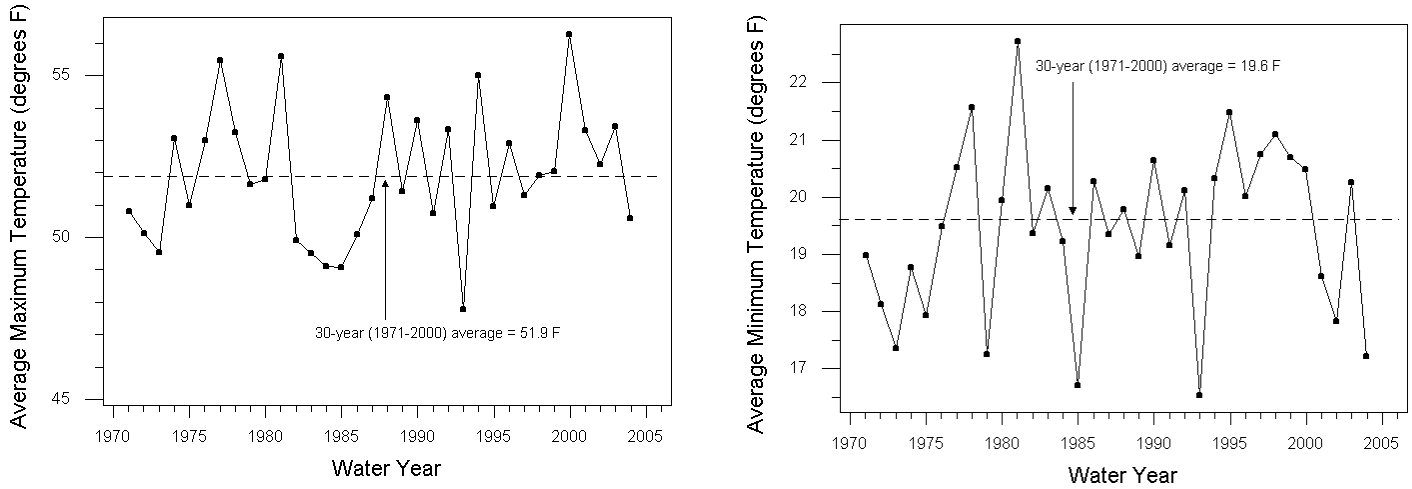
Figure 2. Comparisons of Mule Deer Mortality Rate Estimates (With 90% CI on the Estimates) for Fawn (2a) and Adult (2b) Mule Deer on the Mesa and Pinedale Front Winter Range Complexes.

Climatological Trends. NWS stations used to interpolate monthly precipitation and snowfall at the approximate center of crucial winter ranges in the Sublette Herd Unit (latitude 42.68 ^{o}N, longitude -109.79 ^{o}W) were listed in Table 2.3-3 of Appendix E in the Questar EA (BLM, 2004). The same NWS stations were used to estimate minimum and maximum monthly temperatures on mule deer crucial winter range. Estimates of total precipitation for each water year, total snowfall from November through March, maximum and minimum temperatures averaged for each water year are shown in Figure 3. In each plot, 30-year averages from water years 1971 through 2000 are also shown as estimated at the approximate center of the Sublette Herd Unit winter range complex.

During the 4-year period from 2000 through 2003, total precipitation on mule deer crucial winter range had been consistently below the 30-year average, whereas total precipitation in water year 2004 was above average (Figure 3a). On the other hand, total snowfall between November and March has been below the 30-year average since water year 1987 (Figure 3b). Snowfall during those months was at the 30-year average in water year 1996.



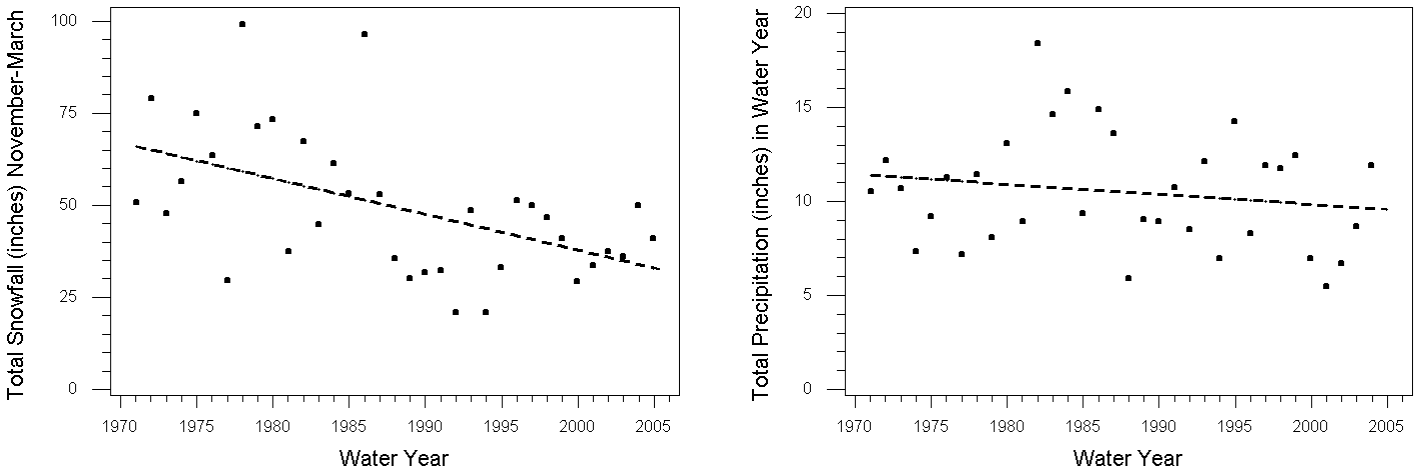
3a **3b**



3c **3d**

Figure 3. Total Water Year Precipitation (3a), Total Snowfall November Through March (3b), Average Maximum (3c) and Average Minimum (3d) Temperatures for Each Water Year Since 1971 With 30-Year Averages (From 1971 Through 2000) Interpolated on the Sublette Winter Range Complex.

The only discernable trend in these data is for total snowfall, November through March, which has significantly decreased ($P < 0.005$) since water year 1971 (Figure 4a). Alternatively, there has been no similar significant ($P > 0.3$) downward trend in total precipitation (Figure 4b). With less precipitation as snowfall during winter (principally during January), it appears that patterns of total monthly precipitation have changed on the Sublette Winter Range Complex, though a closer examination of that possibility is not presented in this report.



4a **4b**

Figure 4. Linear Regressions of Total Snowfall November through March (4a) and Total Water Year Precipitation (4b) Over Time. The Downward Trend of Total Snowfall ($Y = 1976.3 – 0.969 X$) is Significant ($r^2 = 0.263$, $P < 0.005$) but No Similar Significant Trend Exists for Precipitation ($r^2 = 0.03$, $P > 0.30$).

Other investigators have demonstrated direct relationships between mule deer over-winter mortality and snowfall or snow on the ground (Roper and Lipscomb, 1973; Leckenby and

Adams, 1986; Bartmann and Bowden, 1984). Energy expense by mule deer traveling through snow increases exponentially with increasing snow depth relative to the height of a deer or relative to animals' sinking depth in snow (Parker *et al.*, 1984). Fawns will expend more energy than adult deer when moving through snow. Such differential energy cost of locomotion through snow contributes to higher mortality rates in fawns (Hobbs, 1989). Though snow depths on the ground were not measured by any NWS stations proximate to Sublette Herd Unit winter ranges, total monthly snowfall was report by many of the stations and has been used in the following analyses as an indicator of snow on the ground.

Relationships of Fawn Mortality to Climatological Conditions. Noted in the Questar EA, WGFD biologist Doug McWhirter expressed reservations about the validity of mule deer carcass counts made during the first year of data collection (1993). Specifically, carcasses of mule deer that died in winters prior to the first year of study may have been included in the tallies. Consequently, data from winter 1992-93 are not included in the following analyses.

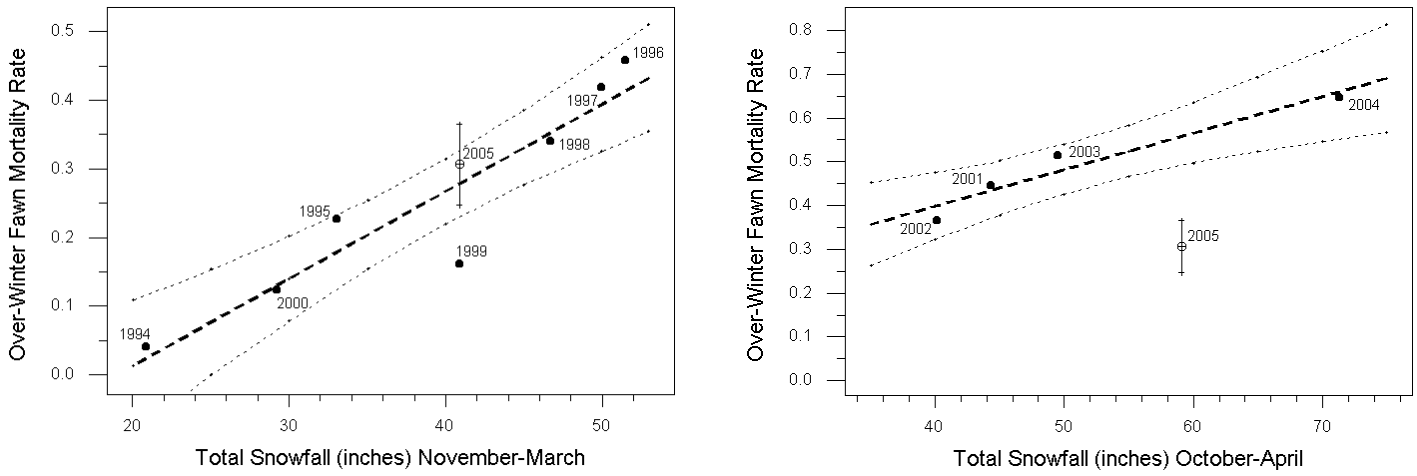
In the Technical Report prepared for the Questar EA (BLM, 2004 Appendix E), over-winter fawn mortality rates in the Sublette Herd Unit from 1994 through 2000 were found to have a significant relationship ($r^2 = 0.871$, $P = 0.002$) to total snowfall, November through March. Alternatively, fawn mortality rates from 2001 through 2004 were found to have a significant relationship ($r^2 = 0.923$, $P = 0.039$) to total snowfall, October through April. Total water year precipitation had been well below average on winter ranges since 2000 so that by 2003, there were 4 consecutive water years of below-average precipitation. That level of drought may be responsible for the observed susceptibility to longer periods of winter snow by mule deer fawns on Sublette winter ranges.

Total precipitation during water year 2004 was above the 30-year average (Figure 3a). The fawn mortality rate observed over winter 2004-05 was significantly less than during the previous winter, but total snowfall from November – March 2004-05 was also less than snowfall the year before. By plotting the 2005 fawn mortality rate on linear regressions of fawn mortality rates observed from 1994-2000 (Figure 5a) and mortality rates observed from 2001-2004 (Figure 5b), the 2005 observation is clearly most similar to the mortality pattern observed from 1994 through 2000 (Figure 5a) when total snowfall, November – March, had greater effect than snowfall from October – April as in Figure 5b.

The fawn mortality rate and winter snowfall observed in 2005 lends additional support to the suggestion that precipitation occurring on the Sublette Herd Unit crucial winter ranges during previous years has some effect on fawn mortality and that precipitation interacts with winter snowfall to increase or decrease the influence of snow. Indeed, further analysis (stepwise regression) determined that the total precipitation for two consecutive years immediately prior to any given winter had a significant effect on over-winter fawn mortality. When total snowfall, November through March, and total precipitation in the two previous water years are used in linear multiple regression, over-winter fawn mortality in the Sublette Herd Unit can be visualized on a continuous surface in three-dimensional space (Figure 6).

Fawn mortality increases with increasing snowfall but decreases with more total precipitation in the two water years prior to that winter. Consequently, similar mortality rates may be observed during winters with very different amounts of snow, the effects of which are ameliorated or exacerbated by overall moist or dry conditions during the two previous years. Vegetation growth and nutritional content on Sublette crucial winter ranges has undoubtedly been enhanced or limited by precipitation regimes in a given growing season, as well as the previous

growing season. Ultimately, availability of nutritional forage as a function of precipitation is most likely a key factor in fawn over-winter survival (McKinney, 2003).



5a **5b**

Figure 5. Linear Regressions (heavy dashed lines) of Fawn Mortality Rates Against Total Snowfall, November through March Observed in Winters 1994-2000 (5a) and October through November Observed in Winters 2001-2004 (4b) with 90% Confidence Intervals on the Regression Line (dotted lines). Fawn Mortality (with 90% Confidence Intervals on the Estimate) Plotted with Total Snowfall Observed in 2005 is Most Similar to the Mortality Pattern Observed from 1994 through 2000 (5a).

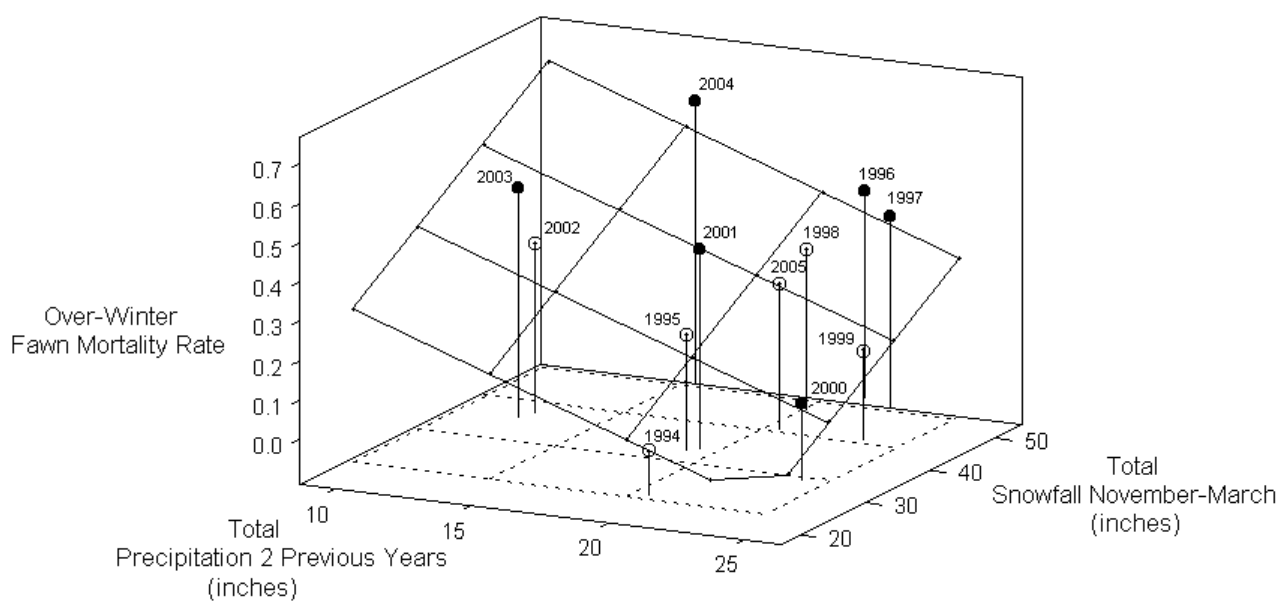


Figure 6. Multiple Linear Regression of Over-Winter Fawn Mortality Rate Against Two Independent Variables: Total Precipitation During the Two Previous Water Years and Total Snowfall from November through March. Years with Fawn Mortality Values as Solid Circles are Above the Regression Surface, Years with Open Circles are Below the Surface. The Multiple Regression Equation is Y (Over-Winter Fawn Mortality Rate) = 0.314 + 0.013 X_1 (Total Snowfall November-March) – 0.025 X_2 (Total Precipitation 2 Previous Years); multiple r^2 = 0.786, P = 0.001.

Further analysis (again using stepwise regression) determined that the Average Minimum Temperature during November of any year also significantly affects fawn mortality rates, although not by itself but in combination with the variables Total Snowfall November-March and Total Precipitation 2 Previous Years. The resultant multiple regression equation with three independent variables is Y (Over-Winter Fawn Mortality Rate) = 0.233 + 0.015 X_1 (Total Snowfall November-March) – 0.020 X_2 (Total Precipitation 2 Previous Years) – 0.011 X_3 (November Average Minimum Temperature); multiple $r^2 = 0.873$, P = 0.001.

These three independent variables account for more than 87 percent of the variation in fawn mortality in the Sublette Herd Unit. The inverse influence of November Average Minimum Temperature on fawn mortality is possibly due to duration of early winter snow cover with low temperatures and/or crusting snow - melting during the day but freezing at night - that persists through much or all of the remaining winter.

Observed over-winter adult mortality rates occur independently of any of the climatological conditions that affect fawn mortality.

CONCLUSION

Analyses presented in the *Wildlife Technical Report* appended to the Questar EA (BLM, 2004) were inconclusive about potential effects from natural gas development within mule deer crucial winter ranges on over-winter fawn mortality. The principal difficulty stemmed from the coincidence of natural gas development with an extended period of below-average precipitation. During that period from 2001 through 2004, fawn mortality rates were significantly higher in three out of the four years than expected by the relationship of fawn mortality to total snowfall November through March that had been established prior to development, from 1994 through 2000 (BLM, 2004). Increased over-winter fawn mortality was an expected consequence of increased energy expense during winter if deer were escaping from vehicular traffic and other natural gas activities within crucial winter range (BLM, 1999). That conclusion would have been credible if precipitation patterns since 2001 had been consistent with precipitation observed prior to natural gas development on the PAPA.

Above-average precipitation on the Sublette crucial winter ranges occurred in water year 2004. Over-winter mortality of mule deer fawns observed in 2005 closely coincided with the relationship of mortality to total snowfall November through March observed from 1994 through 2004. If natural gas developments within crucial winter range affect over-winter fawn mortality rates, the analyses presented demonstrates that those effects are masked by the strong influence of winter snowfall, precipitation (with presumed effects on winter forage), and temperatures during early winter.

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