Summary of Oil and Natural Gas Development Impacts on Prairie Grouse

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Rising energy consumption and an increasing reliance on foreign energy sources in the United States has led the George W. Bush Administration to institute 4 initiatives addressing these issues: (1) help the nation become more energy efficient, (2) create new sources of energy, (3) increase domestic production from existing resources, and (4) work with other nations on energy efficiency (American Gas Association 2005:2–3). To increase domestic production there has been a 60% increase in recent years in the number of permits for drilling in the Rocky Mountain West (American Gas Association 2005). From 1929 to 2004, 122,496 applications to drill were filed with federal agencies in 13 western states; 95.7% were authorized, 3.0% were pending, 1.2% were withdrawn, and <0.1% were rejected (Connelly et al. 2004). These statistics suggest oil and gas development is rapidly increasing in the West, propelled by national initiatives to increase energy supplies from federal lands (Connelly et al. 2004, American Gas Association 2005).

Oil and gas development may impact other resources including ground water, surface water, fish and wildlife habitat, and archaeological sites. Understanding the impacts of disturbances such as oil and gas development on prairie grouse populations is complex. Impacts can be quantified directly through habitat loss and direct mortalities or indirectly through measuring the avoidance of birds to disturbances, evaluating trends in population parameters such as lek counts, modeling changes in habitat selection, and estimating effect sizes in vital rates such as nest success and survival. Five geologic basins (Greater Green River, Montana Thrust Belt, Paradox-San Juan, Powder River, and Uinta-Piceance) contain the majority of onshore oil and natural gas on federal lands in the United States (U.S. Departments of Interior, Agriculture, and Energy 2003). Incidentally, each of these basins underlies current habitat for greater sage-grouse (*Centrocercus urophasianus*) or Gunnison sage-grouse (*C. minimus*; Schroeder et al. 2004). Rigorous research is essential to understand direct and indirect impacts to prairie grouse across this expansive landscape. Better understanding impacts can lead to improved mitigation measures to lessen impacts on grouse populations.

Here, I summarize the current knowledge on the effects of oil and gas development and production activities on prairie grouse, based on 12 papers that report empirical evidence about impacts on greater sage-grouse and lesser prairie-chickens (*Tympanuchus pallidicinctus*; Tables 1–3). It is important to understand the experimental or sampling designs of each study including use of control and treatment areas, sample sizes, and other factors to assess the strength of inference of each study. Environmental impact studies are typically designed as quasi experiments because the impacted or treatment areas are not randomized as in a manipulative experiment (Manly 2001). However, quasi experiments with replicated treatment and control areas with pre- and post development data can provide strong inference because impacts can be inferred through temporal and spatial patterns (Green 1979). None of the identified studies was designed as a manipulative or quasi experiment (Table 1), which may be symptomatic of the inability of researchers to establish studies before oil and gas field development begins. Reviewed studies were designed as (*i*) observational studies, where radio-marked birds were used to assess parameters of interest such as survival and nest success relative to impacts from oil and gas development or (*ii*) correlative studies evaluating cause and effect relationships such as lek counts and habitat selection in relation to development infrastructure such as well pad or road densities (Tables 1 and 2).

Despite the weaknesses of some study designs, corroboration of results from different studies even under different conditions provides support that biological patterns are not artifacts of study designs, methods, investigators, or limited to temporal or spatial extent of individual studies. Replicating entire studies even under different conditions and locales is termed *metareplication* (Johnson 2002). Similar conclusions from replicated studies provide support even for small studies with relatively poor study designs. For instance, lek abandonment caused by oil and gas field disturbances has been reported from studies of lesser prairie chickens in New Mexico and greater sage-grouse in Alberta, Colorado, Montana, Utah, and Wyoming. Each study occurred under different conditions and employed different methodology (Table 2).

Most of the currently available information on impacts is focused on lek abandonment and changes in male lek attendance (Table 2). Fewer studies have examined nest success, nest initiation, survival, other vital rates, or habitat selection (Table 2). The mechanistic properties of disturbances such as noise, traffic volumes, and dust are not well understood in relation to oil and gas development and prairie grouse. For example, noise was 52.5 dB, 20 m from the center of a lek where 5 lesser prairie-chicken males displayed in New Mexico (Hunt 2004). It would be necessary for a drill rig to be 320 to 480 m from a lesser prairie chicken lek to avoid creating noise exceeding 52.5 dB; this region encompasses an area of 0.3–0.7 km^2 (Table 3; Hunt 2004).

Anecdotal evidence exists for visual, movement, and auditory disturbance by oil and gas development at several leks in Utah, which indicates that pump mufflers and strategic placement of well pads and associated infrastructure may alleviate lek abandonment (Appendix A).

Resource Management Plans prepared by field offices of the Bureau of Land Management typically apply 2 common stipulations to federal oil and gas leases occurring in habitats occupied by sage-grouse. The first stipulation calls for no surface occupancy (i.e., well pads, roads, compressor stations, etc.) within a 0.4 km (0.25 mi) region surrounding each lek. The second stipulation is a timing limitation that inhibits development activities within 3.2 km (2 mi) of leks during the breeding and nesting season (Bureau of Land Management 1997, Lyon and Anderson 2003). For example, to coincide with local breeding and nesting periods, the Resource Management Plan for the White River Field Office of the Bureau of Land Management in northwestern Colorado stipulates that oil and gas field development activities are not permitted in sage-grouse habitats within 3.2 km of leks from April 15 through July 7 (Bureau of Land Management 1997). Results suggest that no surface occupancy within 0.4 km is not adequate to avoid lek abandonment or other negative influences on prairie grouse populations, and also indicates that surface occupancy may need to be at least 1.6 km from leks to avoid declines or abandonment (Tables 2 and 3). Empirical and anecdotal evidence also indicates that lessening noise and visual disturbance of oil and gas field infrastructure may make these features more compatible with lekking grouse at distances less than 1.6 km from leks; however, these relationships have not been rigorously evaluated (Tables 2 and 3; Appendix A).

Below, I list several topics that research should address to better understand the effects of oil and gas development on prairie grouse populations. My list suggests there is a great need for research to more clearly elucidate impacts of oil and gas development on prairie grouse and to provide suitable mitigation actions to offset these impacts.

- Effects of disturbance properties such as noise, visual obstruction, dust, and traffic volumes on habitat selection and vital rates
- Effects of disturbance properties on habitat effectiveness. For example, Pitman et al. (2005) reported the presence of anthropogenic features including transmission lines, wellheads, buildings, roads, and center-pivot irrigation systems effectively eliminated 53% of otherwise suitable nesting habitat for lesser prairie chickens from 2 study areas totaling 13,380 ha in southwestern Kansas. Avoidance of anthropogenic features was believed to be related to properties of disturbances such as noise and visual obstruction
- Effects of oil and gas developments on predator communities and subsequent implications for predation rates on grouse
- Effects of weeds introduced along roads and other surface disturbances on habitat quality
- Interactions of development and climatic conditions on habitat selection and vital rates
- Effects of the timing of development and production on habitat selection and vital rates
- Effects of "phased" versus "complete" development on habitat selection and vital rates
- Effects of mitigation efforts to minimize impacts on prairie grouse. This is a very large area of research. For example, experimental studies of road and well pad densities, timing of construction activities, and habitat enhancement or rehabilitation efforts could be conducted to address specific questions relative to prairie grouse populations
- The scale of impacts on populations needs to be more clearly understood. Holloran (2005) and Naugle et al. (2006*b*) investigated this, but more needs to be done

Table 1. Summary of study designs for research studies used to review impacts of oil and gas development and production on prairie grouse, August 2006.

Study	Design	Pretreatment data	Control area(s)	Sample size(s)	Peer-reviewed[a]	Type of publication
Aldridge and Boyce (2007)	Correlative	No	No	113 nests. 669 brood locations from 35 broods. 41 chicks from 22 broods	Yes	Scientific journal
Braun et al. (2002)	Descriptive and correlative	Yes and no, depending on application	Yes and no, depending on application	Variable	Yes	Conference transaction
Crompton and Mitchell (2005)	Observational	No	Yes	20 females captured on 4 leks	No	Completion report
Holloran (2005)	Correlative and observational	No	Yes	Lek counts from 21 leks 209 females captured from 14 leks. 162 nests within 3.2 km of the Pinedale Anticline Crest	No	PhD dissertation
Hunt (2004)	Correlative	No	No	33 active leks and 39 abandoned leks	No	PhD dissertation

Table 1. Continued.

Study	Design	Pretreatment data	Control area(s)	Sample size(s)	Peer-reviewed[a]	Type of publication
Kaiser (2006)7	Correlative and observational	No	Yes	18 leks. 60 adult females, 23 yearling females, 20 yearling males	No	MS thesis
Lukas (2006)	Correlative	No	No	162 leks	No	Agency report
Lyon and Anderson (2003)	Observational	No	Yes	48 females captured on 6 leks	Yes	Scientific journal
Naugle et al. (2006*a*)	Correlative	Yes	Yes	516 leks. 40 lek complexes were sufficient (>10 counts between 1988–2005) for trend analysis	No	Progress report
Naugle et al. (2006*b*)	Correlative	No	No	292 locations for 106 birds in 2005 and 241 locations for 94 birds in 2005–2006	No	Completion report
Pitman et al. (2005)	Observational	No	No	155 nests	Yes	Scientific journal

Table 1. Continued.

Study	Design	Pretreatment data	Control area(s)	Sample size(s)	Peer-reviewed[a]	Type of publication
Robel et al. (2004)	Observational	No	No	187 nests, 18,866 locations	Yes	Conference transaction

[a]Peer review for theses and dissertations is conducted by graduate committees. These reviews are not considered to be as rigorous as peer review for scientific journals.

Table 2. Review of literature summarizing effects of oil and gas development and production on prairie grouse, August 2006. Well pad densities are reported because well pads provide an ecological indication of the associated infrastructure (roads, power lines, compressor stations, pipelines, settling ponds) within oil and gas fields (unpublished data reported in Naugle et al. [2006*b*]).

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
BROOD HABITAT SELECTION						
	GRSG	AB	P	Unknown	Oil and gas activity occurred on 1/3 of habitat area. Broods tended to be close to well sites, but at the same time they avoided areas with a greater density of visible well sites within 1 km (number of 30 m pixels within a 1 km radius from locations that were wells)	1
HATCHING DATE	GRSG	WY	D	Unknown	Nests of adult and yearlings breeding and nesting within a buffered region representing impacts of oil and gas development hatched an average of 5 days later than birds breeding and nesting outside the buffers	6
LEK ABANDONMENT						
Compressor stations	GRSG	WY	D	3.1/km^2	Nearly 200 compressor stations within 1.6-km (1 mi) from leks. Sage grouse counts were consistently lower on these leks than leks >1.6-km to compressor stations	2

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
LEK ABANDONMENT (continued)						
Noise	GRSG	UT	D	3.1/km^2	New well caused abandonment of a lek. Noise was 70 dB, 20 m from pumpjack and 45 dB at the lek, which was 200 m from pumpjack	3
	LPC	NM	P	unknown	Noise levels were about 4 decibels higher at abandoned leks than at active leks	5
	LPC	NM	P	unknown	Significant difference between ambient noise levels at active (30.4 dB) and inactive (34.8 dB) leks	5
Power lines	GRSG	WY	D	3.1/km^2	40 leks with an overhead power line within 0.4-km (0.25-mi). Growth rates based on counts were lower for leks near power lines compared to leks >0.4-km from power lines	2
	LPC	NM	P	unknown	18 of 40 (45%) abandoned leks were ≤800 m from at least 1 power line, whereas 1 of 33 (3%) active leks were ≤800 m from a power line	5
Roads	GRSG	AB	D	Active wells = 1.0/km^2, inactive wells = 2.0/km^2	Roads or well sites were developed within 200 m from 3 leks between 1983 and 1985. Since the development, these leks have become inactive	2

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
LEK ABANDONMENT (Roads – continued)						
	GRSG	AB	D	Active wells = 1.0/km^2, inactive wells = 2.0/km^2	From 1973 to 2001, leks were active at 3 sites in and 8 sites around the periphery of an active oil and gas development. In 2001, 7 leks were active, with 2 within site of an active well or power line	2
	GRSG	WY	D	0.1–0.4/km^2 from 1999 to 2004	Male lek counts within 0.0–1.0, 1.1–2.0, and 2.1–3.0 km of a main haul road declined significantly compared to control leks (>6.1 km from a main haul road)	4
	LPC	NM	P	Unknown	Road density in 1.6-km buffers was 3.3 km/km^2 and 2.4 km/km^2 on abandoned and active leks	5
Well density	GRGS	WY	P	3.1/km^2	200 CBM wells within 0.4-km (0.25 mi) from 30 known leks. Significantly fewer males per lek and lower rate of growth for these leks than 200 leks that were >0.4-km from a well	2
	LPC	NM	P	unknown	Abandoned leks had more active and total wells, greater road length, and nearer to power lines than active leks within a 1.6-km (1-mi) buffer centered on leks	5

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
LEK ABANDONMENT (Well density – continued)						
	LPC	NM	P	unknown	Mean number of active wells within 1.6 km (1-mi) from leks was 1 for active leks and 8 for abandoned leks during their last active year	5
LEK RECRUITMENT AND VISITS						
	GRSG	WY	D	unknown	Fewer males recruited on leks as distance to drill rigs decreased. No relationship between male recruitment and proximity of leks to main haul roads or producing wells	6
	GRSG	WY	D	unknown	Fewer males were recruited to leks as distance inside a region buffered to represent oil and gas development increased	6
	GRSG	WY	D	unknown	Fewer yearling females visited leks as distance to producing wells decreased. No relationship between adult female lek visits and distance to producing wells. No relationship for adult or yearling female lek visits relative to proximity to drill rigs or main haul roads	6

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
MALE LEK COUNTS						
	GRSG	UT	D	3.1/km^2	Mean annual declines were –44% for leks in developed areas, but increased 15% on undeveloped leks	3
	GRSG	WY	D	0.1–0.4/km^2 from 1999 to 2004	Control leks (<5 wells within 5 km of lek), lightly impacted leks (5–15 wells within 5 km of lek), and heavily impacted leks (>15 wells within 5 km of lek). Total males on heavily impacted leks declined 51% from the year prior to impact to 2004. Average annual declines were 16% on heavily impacted leks (excluding 3 centrally located leks that declined 89%), 19% on lightly impacted leks, and 2% on controls	4
	GRSG	WY	D	0.1–0.4/km^2 from 1999 to 2004	Negative change in annual lek counts within 5 km from drilling rigs, 3 km of producing wells, and 3 km of main haul roads	4
	GRSG	WY	P	0.1–0.4/km^2 from 1999 to 2004	Well densities exceeding 1/2.8-km^2 appeared to negatively affect male lek attendance	4

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
MALE LEK COUNTS (continued)						
	GRSG	CO	P	NW CO: active wells = 0–2.1/km^2, inactive wells = 0–1.0/km^2 North Park: active wells = 0–3.3/km^2. inactive wells = 0–1.3/km^2 Middle Park: active and inactive wells = 0–0.1/km^2	Three populations (NW CO, North Park, and Middle Park) with limited oil and gas activity were considered from 1973–2005. High males counted were correlated with numbers of active and inactive wells within 3.2 km from leks. Best model included a year effect. Weak negative effect of active wells in NW CO, but this effect disappears when yearly variation was considered	7
	GRSG	MT, WY	D	Potentially 3.2/km^2	84% decline (1988–2005) in males counted on leks after coalbed methane development in Powder River Basin. Of leks counted in 2004 or 2005, remaining leks in coalbed methane areas were either inactive or had ≤20 males, whereas larger leks (>20 males on average) were outside coalbed methane areas	9

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
NEST INITIATION						
	GRSG	WY	D	unknown	65% for females from disturbed leks, 89% for females from undisturbed leks. Effect size is 24% less for females from disturbed leks. Traffic volumes of 1–15 vehicles/day during the breeding season may reduce nest initiation rates	8
NEST PLACEMENT						
	GRSG	WY	D	unknown	Distances from disturbed leks to nests declined from those reported in Lyon and Anderson (2003), which occurred before substantial oil and gas field development. Both studies occurred in the same area indicating development had reduced the availability of nesting habitat, which may have reduced the distance females placed nests from leks	6
	GRSG	WY	D	unknown	26% of females from disturbed leks (≤3 km from gas development) nested ≤3 km from lek of capture, while 91% of females from undisturbed leks (>3 km from gas development or ≤3 km from gas development but isolated from disturbances by topography) nested ≤3 km of lek of capture	8

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
NEST PLACEMENT (continued)						
	GRSG	WY	D	unknown	1–15 vehicles/day during breeding season may increase distances moved from leks to nests	8
	LPC	KS	P	0.7–1.1/km^2	Nest locations were influenced by transmission lines, oil and gas wellheads, buildings, improved roads, and center-pivots on a 7,770 ha sand-sagebrush prairie. This was determined because the nearest 10% of nests to each landscape feature were farther from the feature than would be expected at random	11
	LPC	KS	P	0.7–1.1/km^2	Mean distance to oil or gas wellheads was 85 ± 23 m (mean ± SE) for 90% of 187 nests	12
NEST SUCCESS						
	GRSG	AB	P	Unknown	Nest success was 39% from 2001 to 2004 and nest failure was not affected by human features	1
	GRSG	WY	D	0.1–0.4/km^2 from 1999 to 2004	Percentage of avian predation responsible for depredated nests increased from 13% in 2000 to 40% in 2004 as oil and gas field development increased	4

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
	GRSG	WY	D	Unknown	50% for females from disturbed and undisturbed leks over 2 years	8
SURVIVAL						
Chicks	GRSG	AB	P	Unknown	Chick survival to 56 days was 12%. Chick failure (death) increased in habitats with greater well site densities within 1 km and in riparian habitats	1
Females	GRSG	UT	D	3.1/km^2	Annual survival rate was 12.5% for 8 females captured in coalbed methane area and 73% for 11 females captured in undeveloped area	3
	GRSG	WY	D	0.1–0.4/km^2 from 1999 to 2004	Survival for nesting adult females was 73% pretreatment and 53% post treatment (20% effect size)	4
	GRSG	WY	D	Unknown	Females that bred or nested within natural gas development buffers had 10% lower survival during early brood rearing than females that bred or nested outside buffers. This corroborates earlier results of Holloran (2005) from the same area	6

Table 2. Continued.

Response and effect	Species[a]	Location[b]	Stage[c]	Pad density (pads/km^2)	Results	Reference[d]
WINTER HABITAT						
	GRSG	MT, WY	D	Potentially 3.2/km^2	Sage-grouse avoided coalbed methane development in suitable habitat after controlling for habitat quality. The addition of mean wells/km^2 within a 1–km buffer improved model fit by 12.4 ΔAIC, indicating energy development and habitat quality were the best models explaining winter habitat selection	10
YEAR-ROUND HABITAT						
	LPC	KS	P	0.7–1.1/km^2	Mean distance to oil or gas wellheads was 72 ± 5 m (mean ± SE) in sagebrush prairie habitat not included in the area bounded by 95% of lesser prairie chicken locations	12

[a]GRSG = greater sage-grouse, LPC = lesser prairie-chicken.

[b]AB = Alberta, CO = Colorado, KS = Kansas, MT = Montana, NM = New Mexico, UT = Utah, WY = Wyoming.

[c]Development stage: D = development, P = production.

[d](1) Aldridge and Boyce (2007), (2) Braun et al. (2002), (3) Crompton and Mitchell (2005), (4) Holloran (2005), (5) Hunt (2004), (6) Kaiser (2006), (7) Lukas (2006), (8) Lyon and Anderson (2003), (9) Naugle et al. (2006*a*), (10) Naugle et al. (2006*b*), (11) Pitman et al. (2005), (12) Robel et al. (2004).

Table 3. Mean decibels (dB) for sound sources in lesser prairie-chicken (*Tympanuchus pallidicinctus*) habitat, southeastern New Mexico. Adapted from Hunt (2004:147–148).

Source	*n*	Mean dB
Active leks	33	30.4
Inactive leks	39	34.8
Control points	60	32.2
5 displaying males–dB, 20 m to lek	1	52.5
Distance (m) from oil drilling rig		
20	10	74.7
160	10	61.1
320	10	54.7
480	10	48.6
640	10	45.9
800	10	43.9
960	10	41.7
1,120	10	40.6
1,280	10	39.5
1,440	10	38.3
1,600	10	37.9
Distance (m) from Propane-powered pumpjacks		
20	10	86.5
160	10	52.0

Table 3. Continued.

Source	*n*	Mean dB
Distance (m) from Propane-powered pumpjacks (continued)		
320	10	44.4
480	10	39.7
640	10	38.0
800	10	36.4
960	10	36.5
1,120	10	36.1
1,280	10	36.2
1,440	10	35.9
1,600	10	35.3
Distance (m) from electric pumpjacks		
20	10	66.1
160	10	37.3
320	10	36.3
480	10	35.3
640	10	35.5
800	10	35.1
960	10	35.5
1,120	10	35.4
1,280	10	35.4

Table 3. Continued.

Source	*n*	Mean dB
Distance (m) from electric pumpjacks (continued)		
1,440	10	34.9
1,600	10	35.1
Distance (m) from compressor stations		
20	10	76.8
160	10	58.3
320	10	49.9
480	10	46.5
640	10	43.2
800	10	40.7
960	10	39.0
1,120	10	38.4
1,280	10	37.5
1,440	10	36.5
1,600	10	36.0
Vehicles on paved road, about 110 km/h, from 8 m		
Tanker trucks	10	90.0
Eighteen-wheelers	10	87.2
Motorcycles	2	85.6

Table 3. Continued.

Source	*n*	Mean dB
Vehicles on paved road, about 110 km/h, from 8 m (continued)		
Work trucks/welding trucks	10	85.5
Pickup trucks with trailers	10	85.1
Bus	1	81.6
Automobiles	10	81.3
Pickup trucks	10	80.8

Appendix A. Sage-grouse Leks with Energy Development

Information from Brian Maxfield
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July 29, 2006

<u>East Bench Area</u>
East Bench 16 – Active Lek

Gas well – 540 m from lek. Well has associated methane pump used primarily during winter to keep liquefied gas/condensate from freezing. Pump is active during early lekking. Well drilled in 2005 and developed in 2006. Well placed on existing well pad built 4+ years prior. Well out of sight of strutting males because of small ridge.

Sand Wash Rim – Active Lek

Gas well – 1650 m from lek. Well placed prior to 2004 (exact time unknown). Well out of sight of strutting males. Another well was planned for closer but exact location is not known yet. New well will also be out of sight of strutting males but will be closer than 1000 m.

<u>Deadman Bench Area</u>
North Deadman – Active Lek

Oil well – 335 m. Well has active single piston pump with muffler attached. Moving pump arm is in view of strutting males. Not sure about year well was placed. Lek was discovered in 1995 and I believe well was placed prior to this time, probably during 1980s energy development.

<u>Myton Bench Area</u>
Myton Bench/Wells Draw – Inactive Lek

Compressor – 1440 m.
Gas well – 530 m

More wells nearby but I will need to go in field to measure distances. Lek went inactive after compressor and wells were placed.

<u>Halfway Hollow Area</u>
South 12 Mile – Inactive Lek

Oil well – 645 m. Well has active single piston pump with no muffler attached. Moving pump arm is in full view of strutting males. Lek went inactive after well was placed. No grouse have been observed in the area since.

<u>South Slope Area</u>
South Bonanza – Active Lek

Oil wells – 210 m, 860 m, 930 m. Wells do not have active pumps but have a battery of tanks and receive vehicular visits. The two closest wells are within view of strutting males. Other well is located across a deep draw and is not visible. This lek was first located in 2006 but the landowner indicated the lek has been there for 15-20 years (at least).

Monarch Bench – Active Lek?

Oil well – 0 m. Grouse strut on well pad. When pump is active (moving) grouse will strut off pad but nearby (within 50 m). Status of lek is not positive because lek is located on tribal ground and we are not allowed access. Tribe says lek has been active in past couple of years. Well and lek have been there for many years.

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