September 6, 2005

Mr. Bruce Ramsey
Assistant Director, Energy and Paleontology
U.S. Forest Service
Rosslyn Plaza Building C
1601 North Kent Street
Arlington, VA 22209

Dear Bruce:

Subject: Project Final Report entitled "Summary of Oil and Gas Exploration and Production Activities, Leasing Process, Permitting Stipulations for U.S. Forest Service Lands, and Literature Survey of Observed Impacts to Wildlife and Fisheries"
Agreement No. 53-3187-5-6009; EERC Fund No. 9085

Enclosed is the final deliverable for the project conducted by the Energy & Environmental Research Center (EERC) for the U.S. Department of Agriculture (USDA) Forest Service under Agreement No. 53-3187-5-6009. As you requested during our meeting on July 19, 2005, the final deliverable is in the form of a final report entitled "Summary of Oil and Gas Exploration and Production Activities, Leasing Process, Permitting Stipulations for U.S. Forest Service Lands, and Literature Survey of Observed Impacts to Wildlife and Fisheries." The final report includes a summary of the results of the project, a series of maps generated over the course of the project, a listing of stipulations for each national forest and grassland, a bibliography of the literature examined under the literature survey, and abstracts from selected publications. The databases that were generated by the EERC over the course of the project, and which are the basis for the maps and statistics provided in the final report, have been compiled onto a CD-ROM and are also enclosed.

In closing, I want to thank you for the tremendous support and guidance that you provided the EERC over the course of this project. It has truly been a pleasure working with you and the Forest Service. I sincerely hope that we will be able to work together again in the near future.

Sincerely,

James A. Sorensen
Senior Research Manager

JAS/sml

Enclosure

c: John Harju, EERC

SUMMARY OF OIL AND GAS EXPLORATION AND PRODUCTION ACTIVITIES, LEASING PROCESS, PERMITTING STIPULATIONS FOR U.S. FOREST SERVICE LANDS, AND LITERATURE SURVEY OF OBSERVED IMPACTS TO WILDLIFE AND FISHERIES

Project Final Report

Prepared for:

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EERC DISCLAIMER

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INTRODUCTION AND BACKGROUND

There are currently 26 U.S. Department of Agriculture (USDA) Forest Service (USFS) districts (i.e. National Forests and National Grasslands) that have petroleum production wells located within their boundaries. Many of these districts are in regions where there is great interest, on the part of both industry and government, in expanding oil and gas exploration and production (E&P) activities.

E&P activities are restricted on a significant portion of the lands under USFS management for a variety of ecological, cultural, and socioeconomic reasons. Permits for E&P activities on lands with these restrictions, if they are considered at all, will typically require either an environmental assessment (EA) or environmental impact study (EIS), both of which are time-consuming and expensive. However, a substantial portion of the USFS acreage has no such restrictions, and E&P permits on these lands may qualify for a categorical exclusion (CE) if the proposed activity is within a specified threshold of environmental impact. In order to develop a better understanding of the key issues affecting the E&P permitting process, a variety of products were generated. These products are summarized in this report. Specifically, maps, data sets, and a literature survey were developed to identify areas of recent E&P activity, the use stipulations that are being applied in each area, and the impact of E&P activities on wildlife and fisheries that have been scientifically observed and documented. These products provide technically based tools to support USFS decision makers in evaluating and possibly streamlining the process by which permits are issued for E&P activities, especially with regard to identifying areas that may qualify for a CE.

In July 2005, USFS contracted the Energy & Environmental Research Center (EERC) to acquire and compile the following:

1) Updated data on drilling activities on and around selected USFS lands.

2) Updated data on the leasing process and permitting restrictions (stipulations) for selected USFS lands.

3) Peer-reviewed scientific literature on the observed impacts of E&P activities on wildlife and fisheries.

The acquired data sets were compiled into a geographic information system (GIS) and used to develop a series of maps based upon the database. The maps are provided in Appendix A.

SUMMARY OF DRILLING ACTIVITY DATA SETS AND MAPS

Because the latest drilling activity map available to USFS was based on 1990 data, the original intent of the project was to develop an updated drilling activity map based on the most recently available data. Although drilling activity data were acquired for all of the states in which E&P activities have occurred on USFS land, as the project evolved, the USFS project manager directed the EERC to focus solely on developing a set of maps for the Little Missouri National Grasslands in North Dakota. To that end, a series of North Dakota drilling activity maps were generated depicting drilling activities during six time intervals: 1) prior to 1980; 2) 1981 through 1985; 2) 1986 through 1990; 3) 1991 through 1995; 4) 1996 through 2000; and 5) 2001 through July 2005. A set of maps that focus specifically on the Little Missouri National Grasslands in North Dakota were also generated. The drilling activity maps for both North Dakota and the Little Missouri National Grasslands are provided in Appendix A. The database from which these maps were generated, and the drilling activity databases for each of the states included in this study have been provided as project deliverables to USFS in a CD-ROM format.

SUMMARY OF LEASING PROCESS AND PERMITTING STIPULATIONS

The oil and gas leasing process of USFS, and leasing decisions for selected forests or grasslands with high potential for containing oil or natural gas resources are summarized below. At the request of USFS, the EERC prepared a series of summary maps and information, compiled primarily from the Energy Policy Conservation Act (EPCA) I and EPCA II study, as well as other information on forest plan decisions provided by USFS. The databases that were used to generate the graphs and maps illustrated below have been provided as project deliverables to USFS in a CD-ROM format.

Leasing Process

The Department of the Interior Bureau of Land Management (BLM) acts as the onshore leasing agent for the federal government. BLM schedules and conducts competitive bid lease sales, collects the bonus bids, and issues leases to the successful bidders. As the land management agency, the Forest Service decides whether or not to lease and under what conditions (stipulations) the leases will be issued. USFS decisions about leasing are made in conjunction with approved forest plans, or stand-alone EISs. Either process involves compliance with the Environmental Policy Act as well as the Endangered Species Act and includes public notice and opportunity for comment on proposed leasing decisions. BLM is an official cooperator in these efforts.

Lease Stipulations

If USFS decides to allow leasing, the agency also determines under what conditions leasing would be allowed. In effect, the agency determines the conditions under which possible future exploration or production would be conducted. Lease stipulations are used when the conditions affect the lessee’s ability to explore or develop or significantly increase the lessee’s cost of exploration or development. At the time leasing occurs, there is no certainty of whether and where there will be future oil and gas development, but there is extensive knowledge of surface resources or other forest uses for which exploration or development would or would not be incompatible. Lease stipulations are used to ensure future exploration and development are compatible with other resources or uses and the management scheme for the lands in question. Lease stipulations can be highly restrictive. The most restrictive stipulation is "No Surface Occupancy," meaning no activity allowed on the leasehold. Less restrictive stipulation are used when exploration or development activity can coexist with a resource or activity, such as important wildlife habitat, but only under certain conditions. For example, the timing of activity is restricted to times when key bighorn sheep habitat is not occupied (e.g., winter range for big horn sheep).

Categories of Lease Terms or Lease Stipulations

The following explains standard lease terms and general lease stipulations used by BLM and USFS:

- Standard Lease Terms (SLTs). Implies that the lessee can occupy the surface to explore or develop the lease, but a permit and approval must be obtained. Anywhere within the leasehold is available for placement of a road and drill site.

- Controlled Surface Use (CSU). All or part of the leasehold is not available for the placement of a road or drill site either with respect to **timing** (no drilling on bighorn sheep winter range time, December 1 through March 30) or **physical restriction or adaptation** (e.g., no visual evidence of the producing well; or all compressors are limited to 30 decibels of noise).

- No Surface Occupancy (NSO). All or part of the leasehold cannot be used or occupied for roads or drill sites (e.g., no surface occupancy on slopes greater than 40% because of unstable soils; or no surface occupancy within ¼ mile of the Bear Crossing Campground).

- No Lease **(**NL**)**. This is a category used in this report to indicate lands where exploration and development are not allowed. This category includes any lands covered by a NSO lease, lands for which USFS has not made a leasing decision, and lands withdrawn from leasing by law (wilderness).

Permitting of Exploration or Development of a Lease

National Forest System (NFS) lands includes all the National Forest and National Grasslands, Recreation Areas, and Monuments managed by USFS. Exploration or development activity on NFS lands is governed by the USDA Forest Service Oil and Gas Resources Regulation (36 CFR, Subpart 228, Section E).

An application for permit to drill must be approved by USFS and BLM after site-specific environmental analysis. Proposals to drill on a leasehold must be consistent with the lease terms and lease stipulations. Any modifications of the terms must be approved by the agencies and after public notice and comment. The lease terms and stipulations are viewed as the road map for managing the resources by the agencies, and also an agreement between the agencies and interested public on how the resource will be managed.

Summary of High-Oil-and-Gas-Potential Forests or Grassland Lease Decisions

This section summarizes the USFS decisions, or status of leasing, for high-potential forests and grasslands. Figure 1 shows the distribution of NFS lands according to the lease terms or stipulation categories for the areas studied. SLTs are in effect over 19% of lands, 34% of lands are classified as CSU, and 47% classified as NL. The inventory of plants, animals, other forest resources, and other resource users protected by either not leasing or applying stipulations is shown in Appendix B.

Under EPCA, Congress directed the Department of the Interior to complete a summary of BLM and USFS land management plan decisions for oil and gas leasing. A contract was issued to Advanced Resources International (ARI) to complete a study of the most important gas-prone areas with large amounts of public lands (EPCA I). EPCA I summarized the leasing decisions for federally managed lands, primarily by BLM and USFS for the Montana Thrust Belt, Powder River Basin, Greater Green River Basin, Uinta/Piceance Basin, and Paradox/San Juan Basin. ARI completed a second phase of that study (EPCA II) and included the Denver Basin, Appalachian Basin, Black Warrior Basin, Florida Peninsula, and northern Alaska.

For national forests or grasslands only, the following figures include a summary of EPCA I and EPCA II studies and the Dakota Prairie Grasslands Plan Revision leasing decisions. The summaries are displayed as pie charts for the lower 48 states (Figure 2) and also as bar graphs for each study area (Figure 3). Figures 4 through 12 are maps that show, by area, the application of the stipulation categories, as well as a pie chart summary for each area.

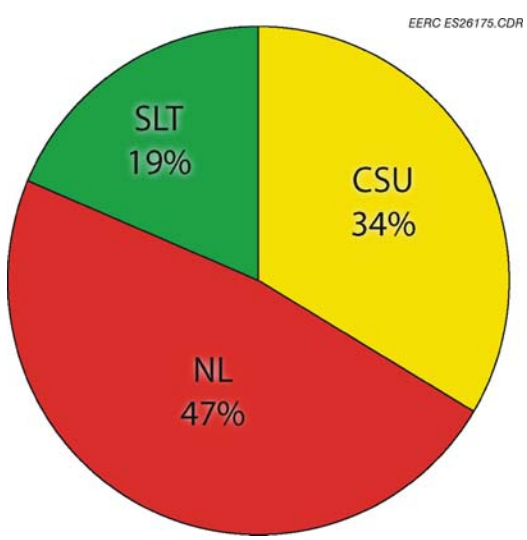


Figure 1. Summary of the distribution of NFS lands according to the lease terms or stipulation categories for the EPCA areas studied. NL also includes lands classified under NSO.

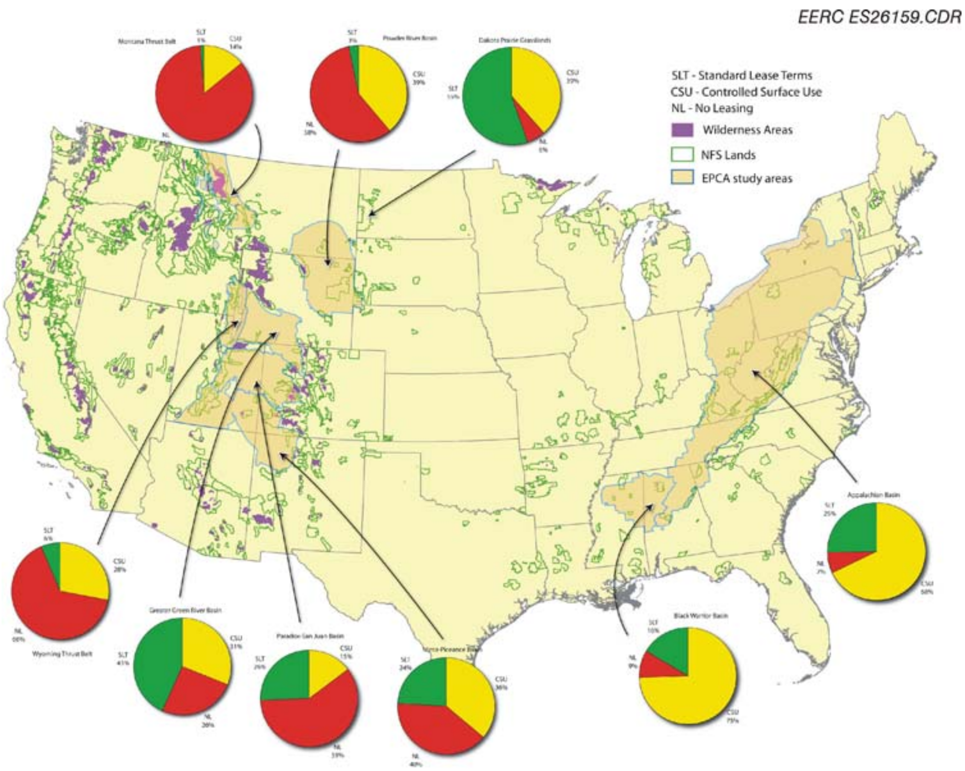


Figure 2. EPCA study areas and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.

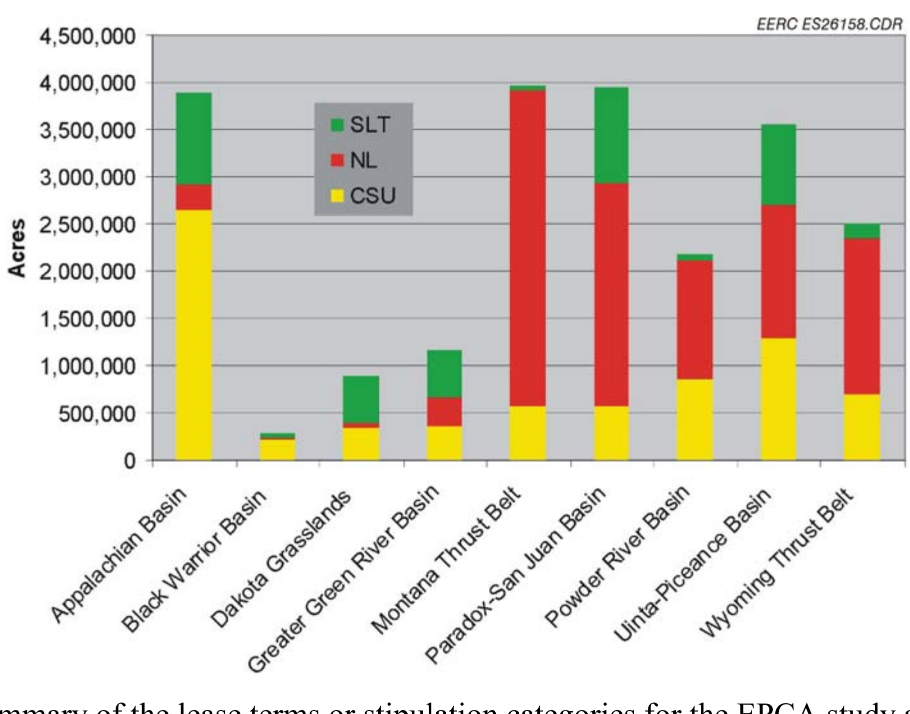
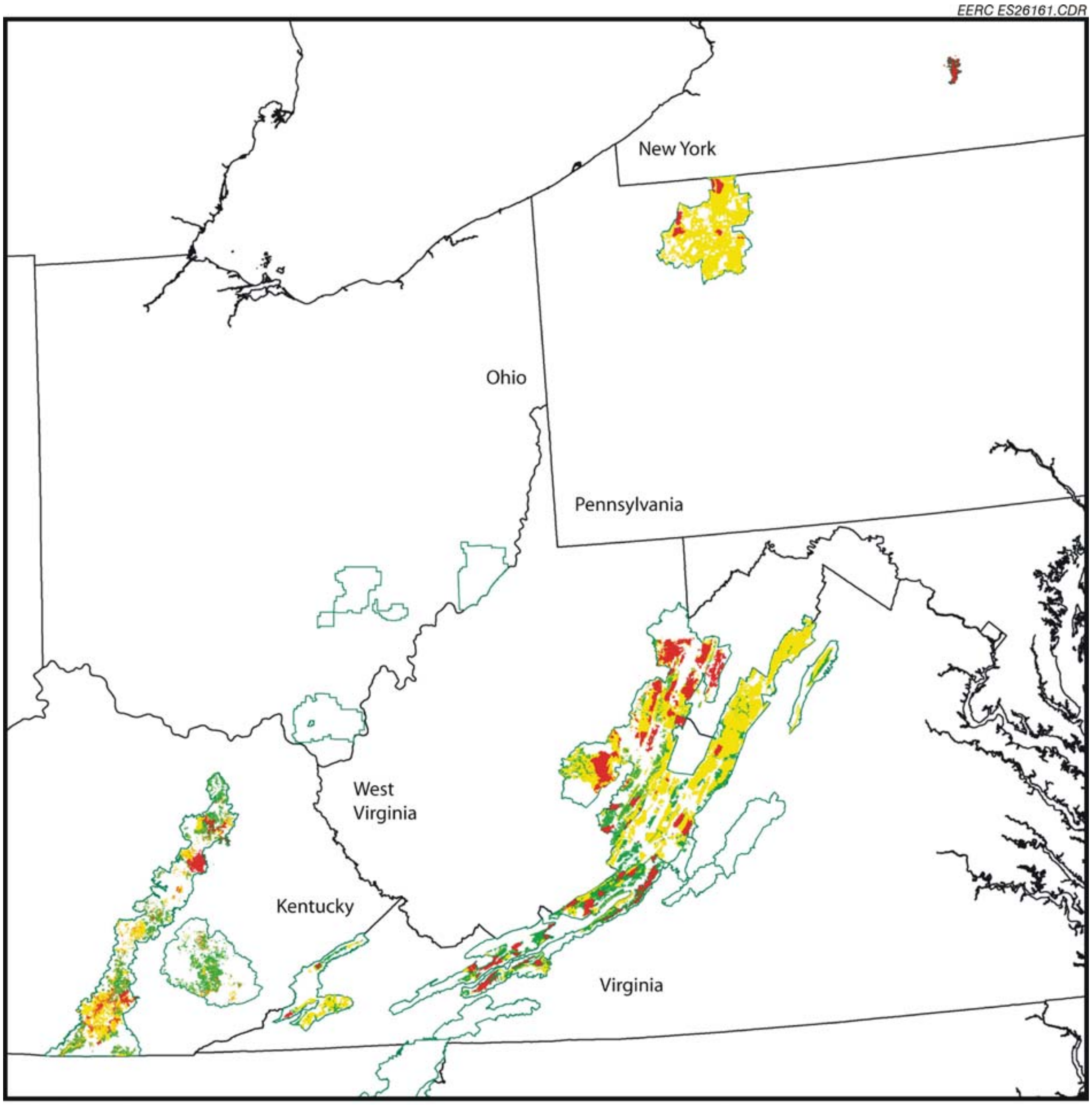


Figure 3. Summary of the lease terms or stipulation categories for the EPCA study areas. NL also includes lands classified under NSO.



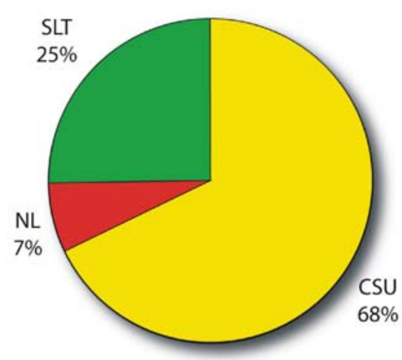
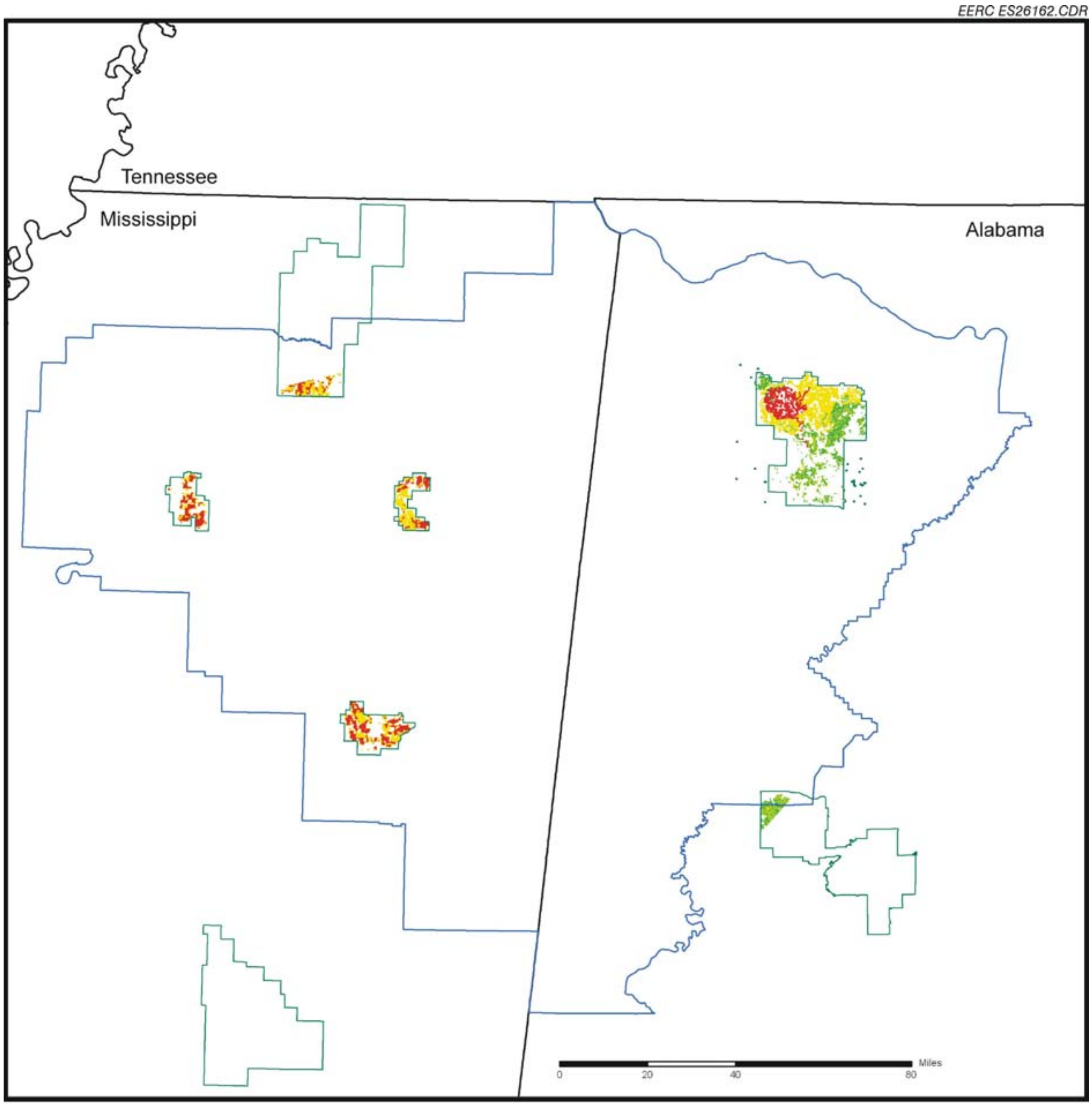


Figure 4. Applachian Basin and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.



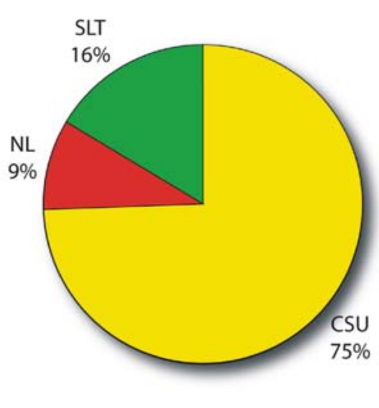
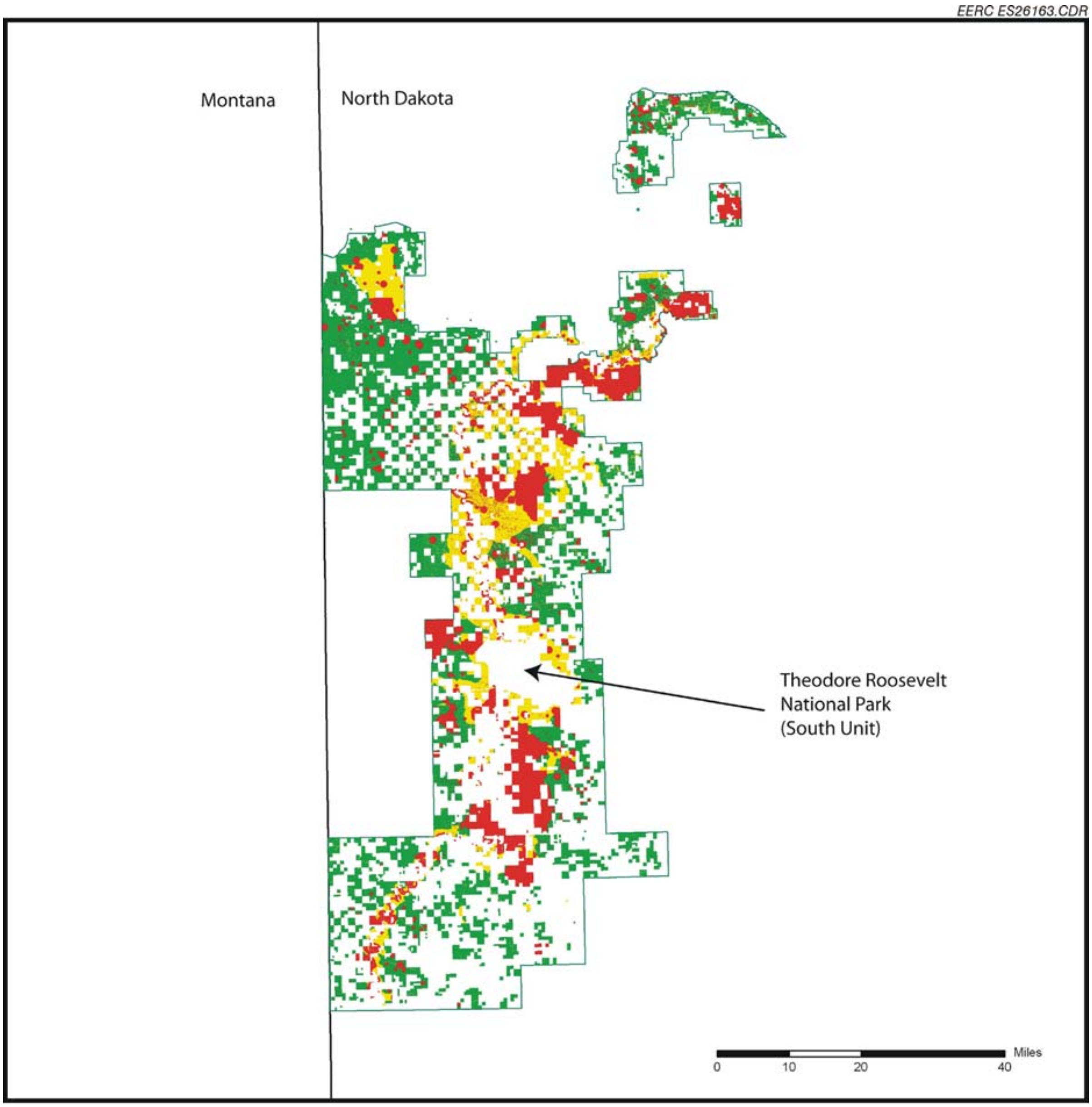


Figure 5. Black Warrior Basin and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.



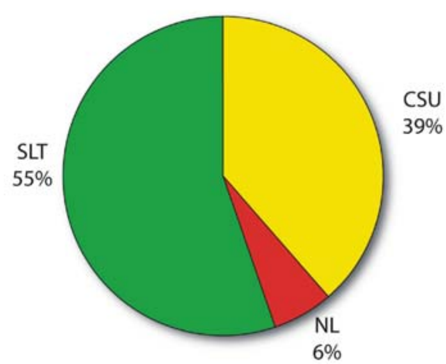


Figure 6. Dakota Prairie Grasslands and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.

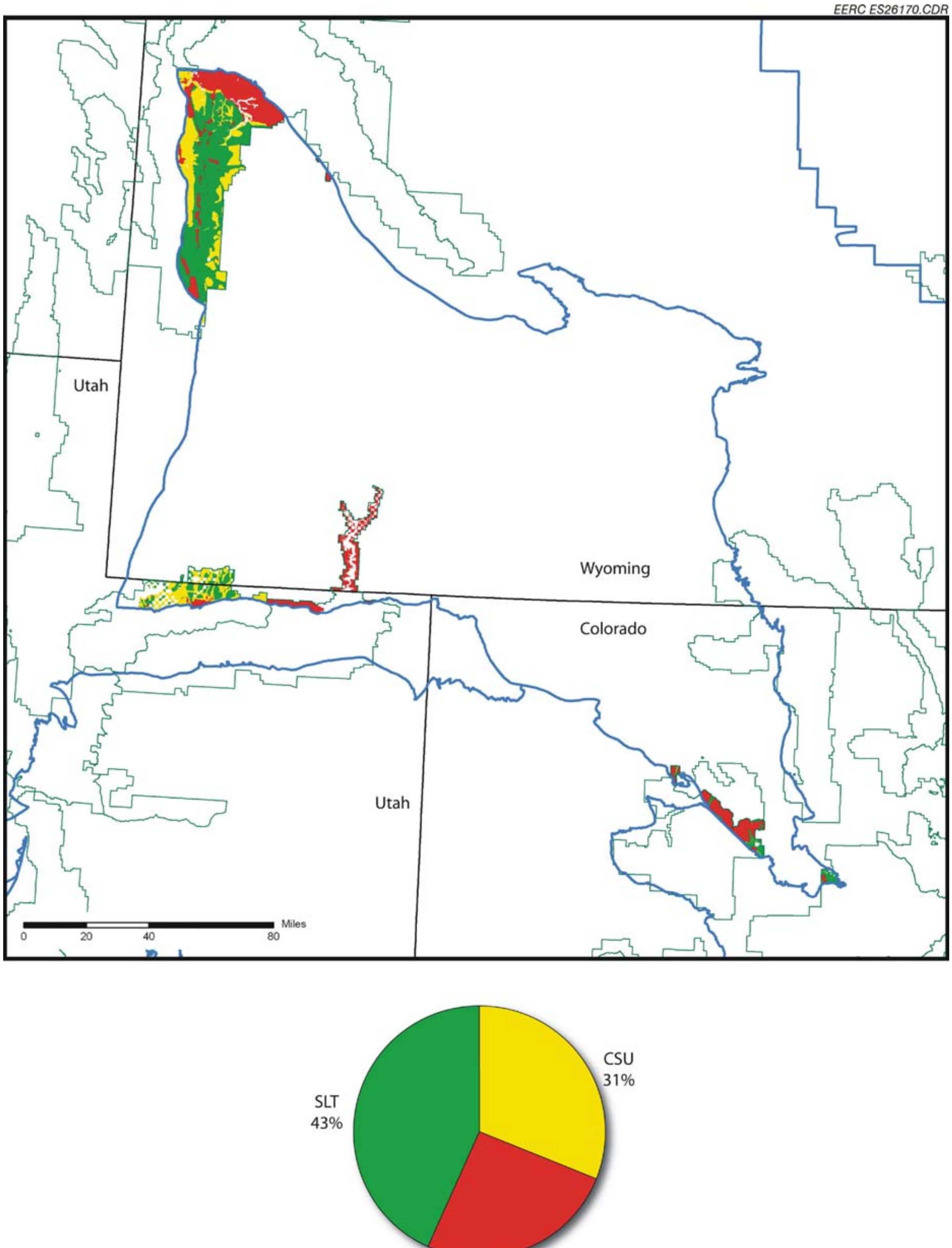
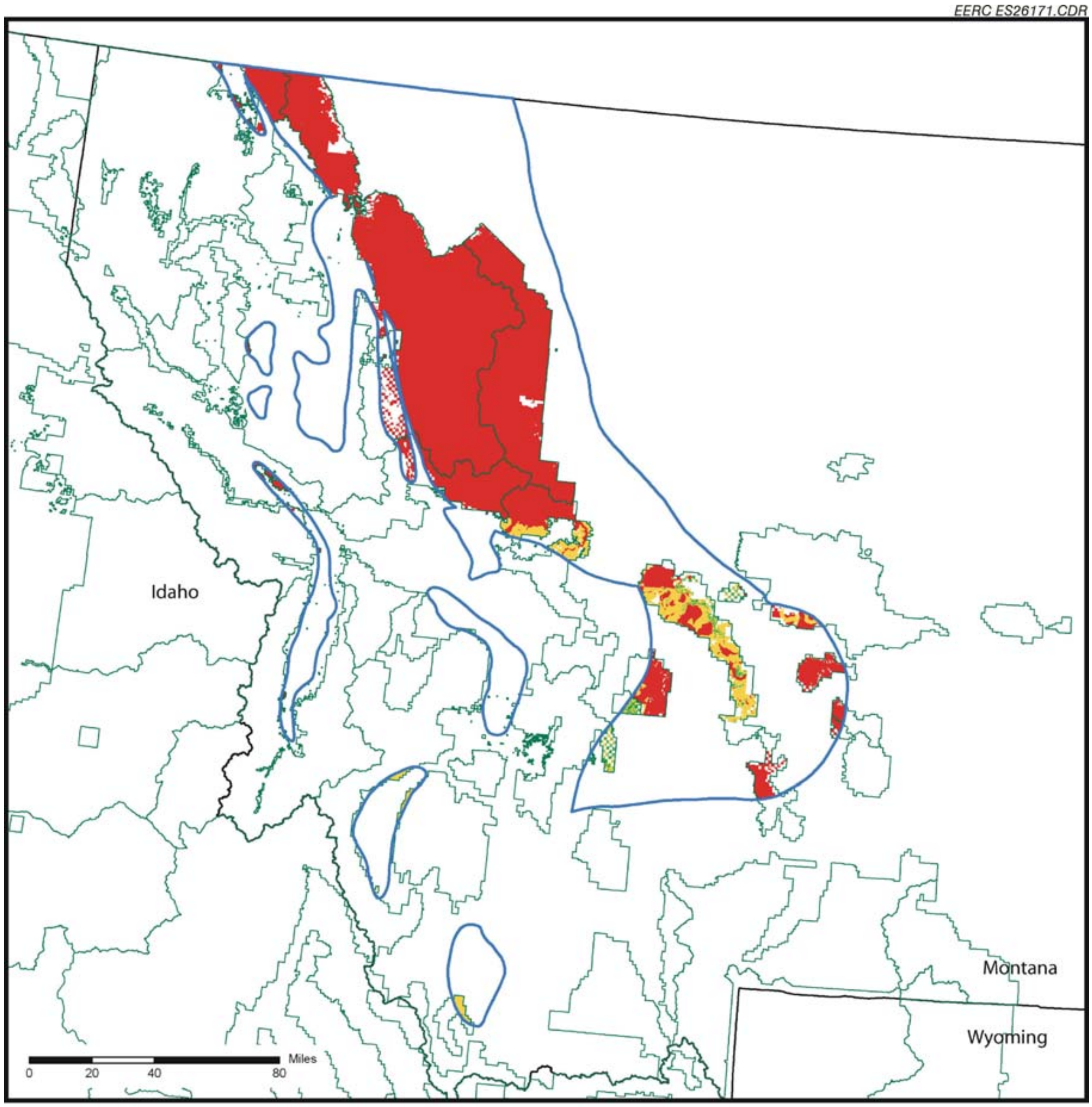


Figure 7. Greater Green River Basin and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.



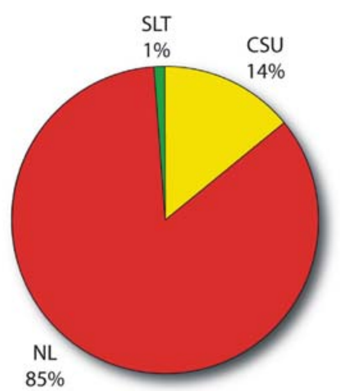


Figure 8. Montana Thrust Belt Basin and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.

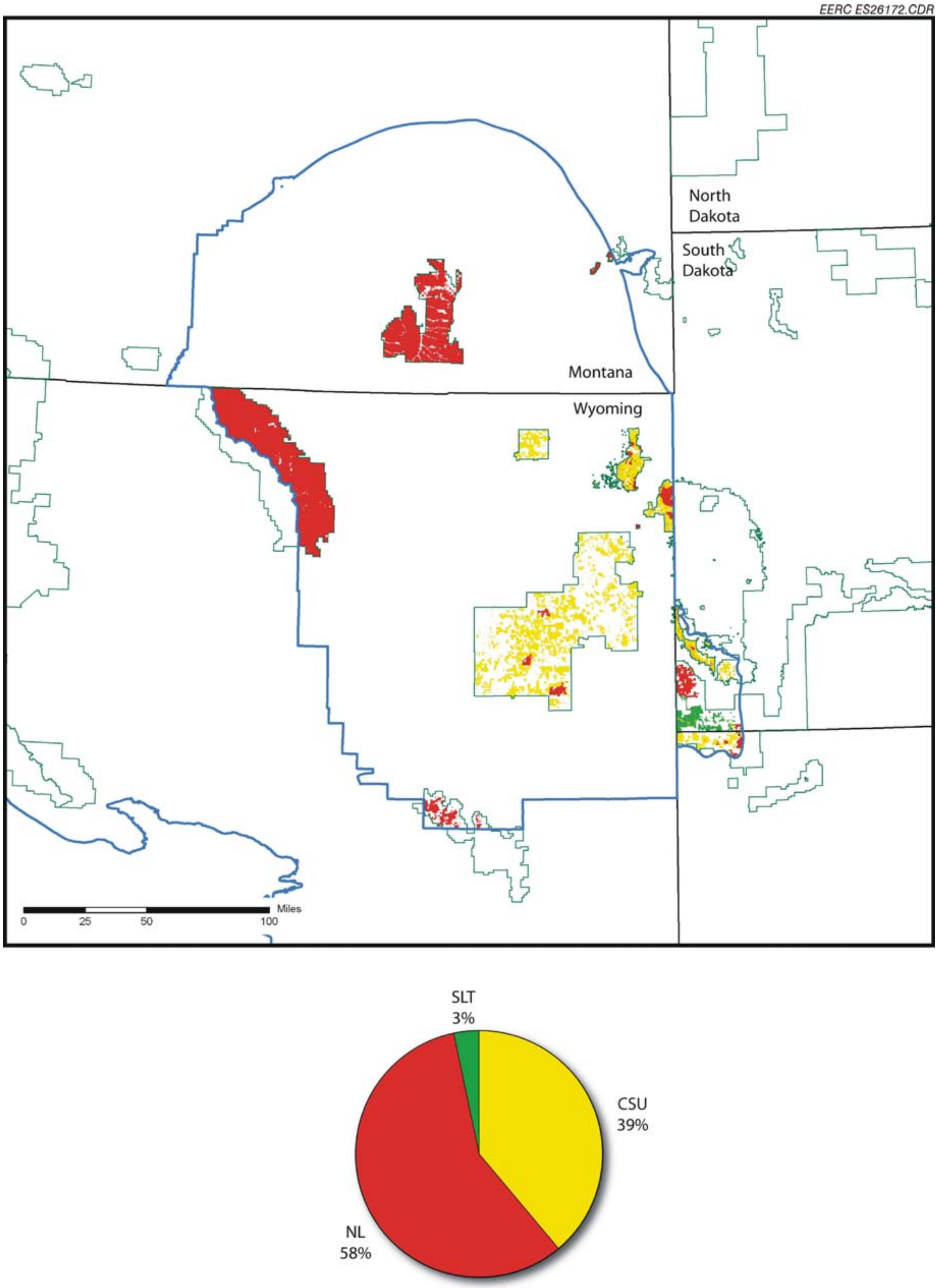
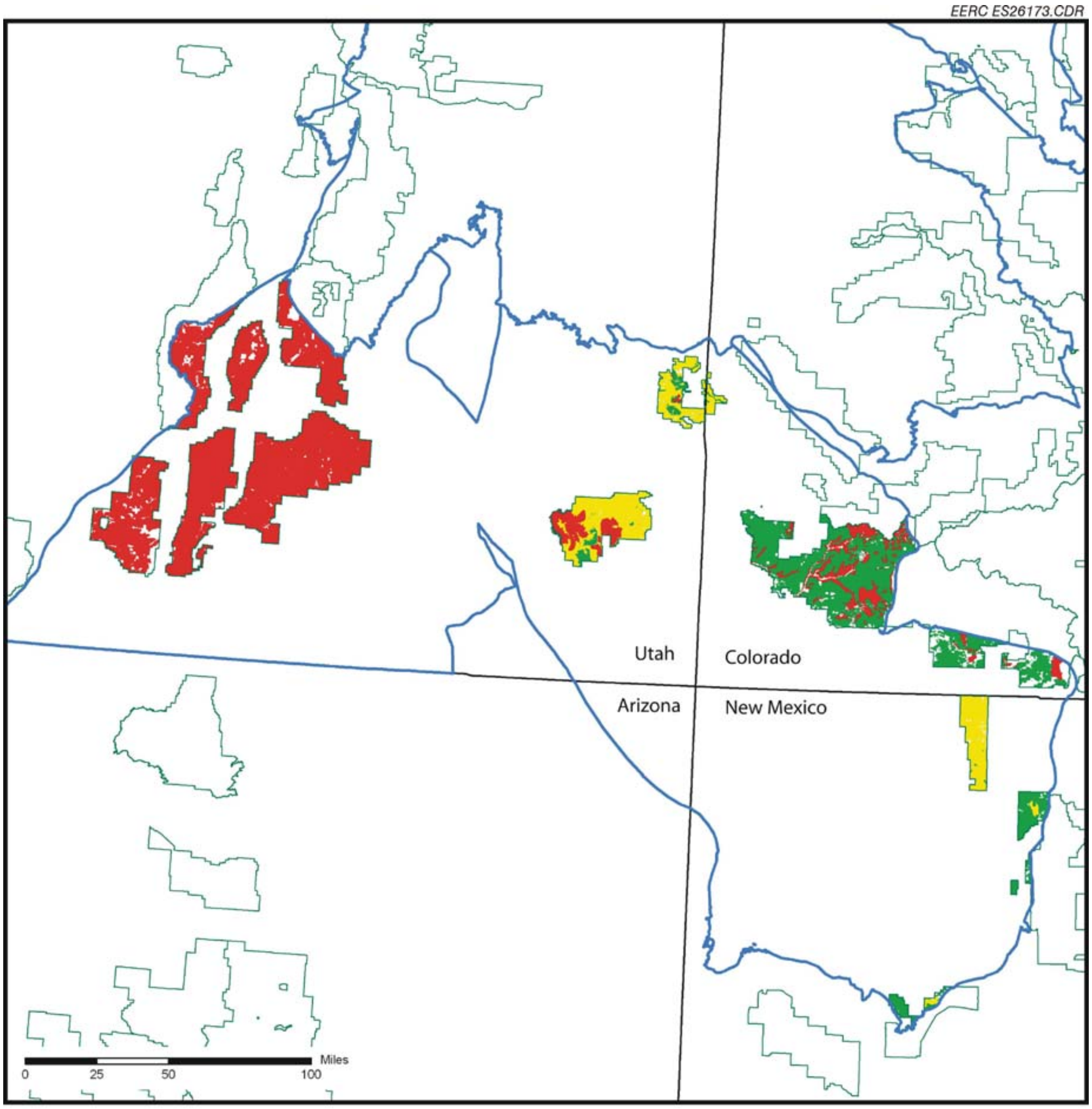


Figure 9. Powder River Basin and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.



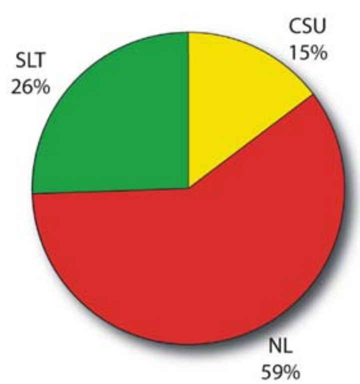


Figure 10. Paradox/San Juan and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.

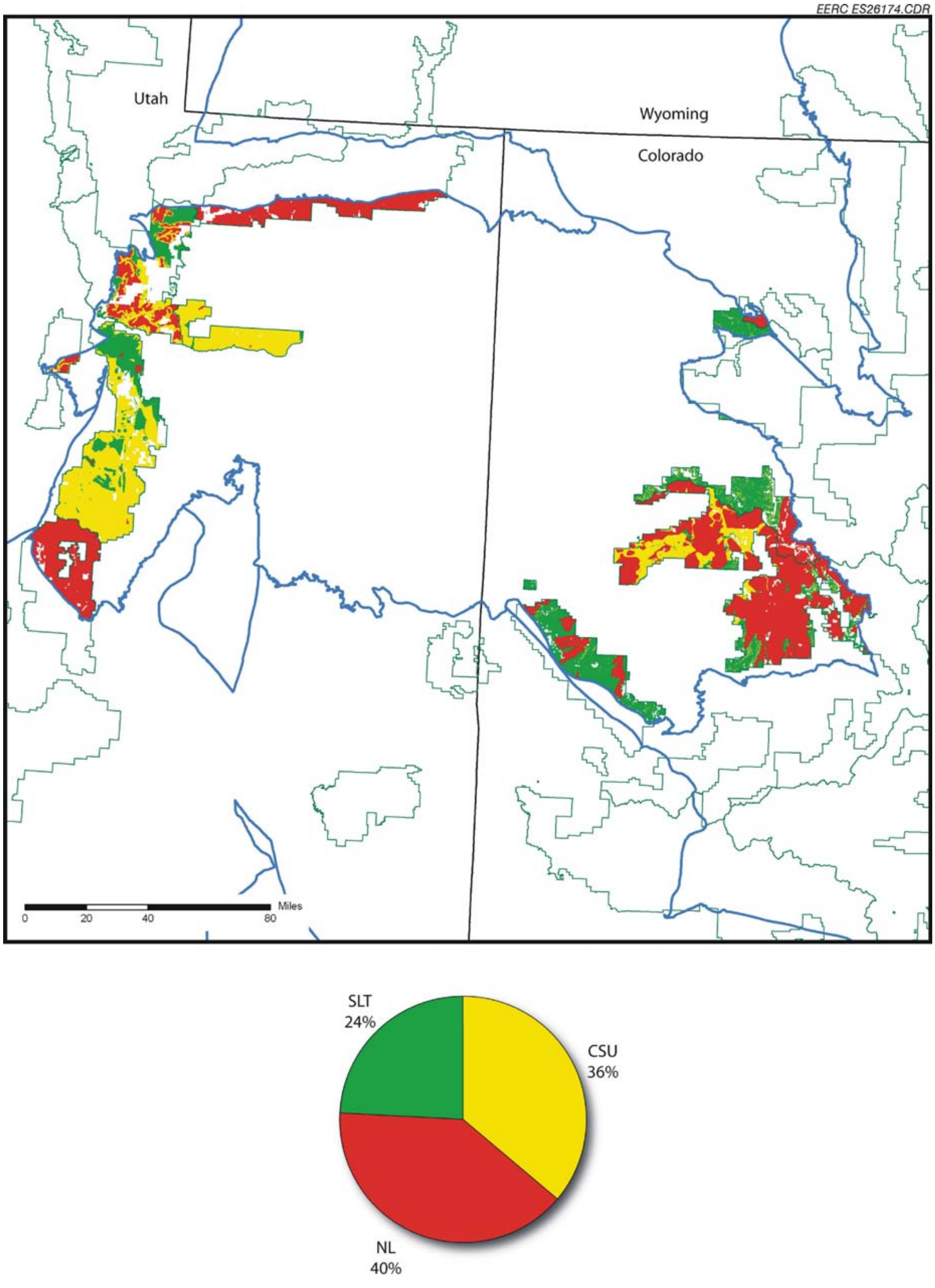
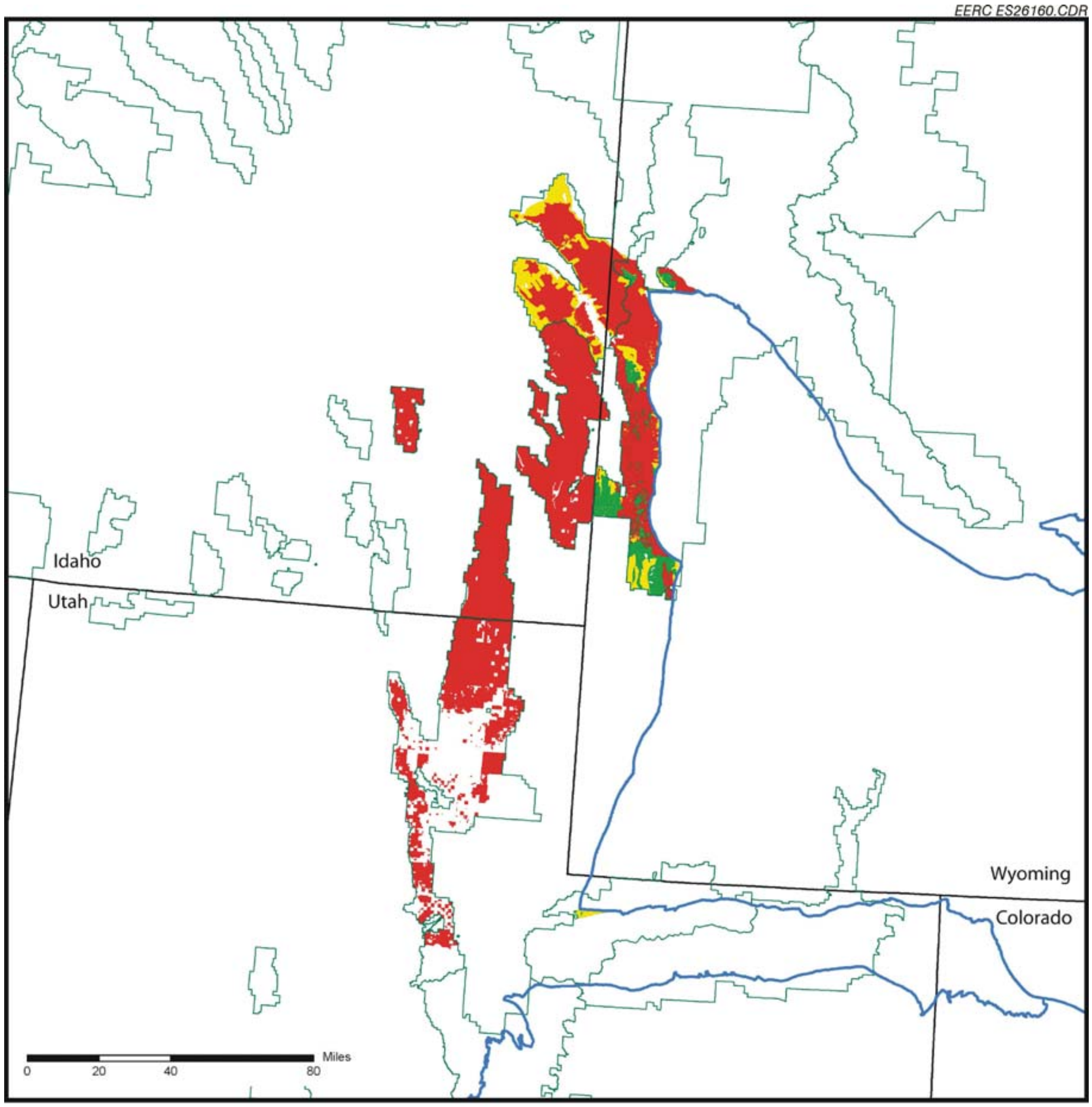


Figure 11. Uinta – Piceance Basin and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.



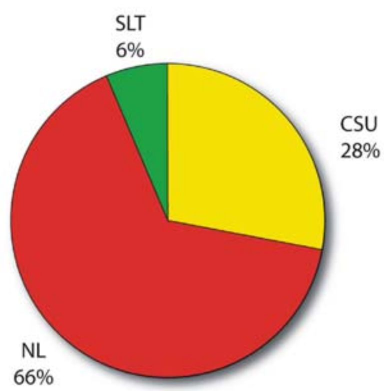


Figure 12. Wyoming Thrust Belt Basin and the distribution of NFS lands according to lease terms or stipulation categories. NL also includes lands classified under NSO.

SUMMARY OF LITERATURE SURVEY ON THE IMPACT OF E&P ACTIVITIES ON WILDLIFE AND FISHERIES

A review of the readily available literature regarding impacts from oil and gas E&P activities on wildlife and fishery populations, soil, and groundwater was performed by the EERC. Over 50 published reports and papers were collected and reviewed; however, emphasis was given to 1) peer-reviewed literature sources and 2) field-based studies that documented observed effects. Because of the preponderance of literature that has been generated from studies in Alaska, a priority was also placed on obtaining literature that was based on studies from North American locations other than Alaska (although some peer-reviewed Alaska-based studies were included). A complete bibliography of the documents included in the literature survey is provided in Appendix C. A copy of the abstract for each paper collected and reviewed as part of the literature survey is provided in Appendix D. A brief summary of some of the general findings of the literature survey is given below.

Although numerous reports of potential adverse impacts to fish and wildlife ecosystems can be found on various nongovernmental organizations' Web sites and literature productions, a significant amount of published, peer-reviewed literature sources obtained as part of this literature review provide a less negative view of the impacts. The readily available literature examined to date does document impacts to soil and groundwater and changes in wildlife activity and ranges due to oil and gas exploration. However, a majority of these impacts appear to occur on a localized level. In the case of soil and groundwater impacts, most of the field-based studies of North American sites are focused on the remediation of spills that occurred prior to the mid-1980s, before strict spill control regulations were in place.

With respect to impacts on North American wildlife and fisheries, some studies suggested only minor effects on wildlife. For example, a study by Van Dyke et al. (1996) found that although the use of habitat by elk in south-central Montana was altered at a local scale as a result of oil drilling activities, abandonment of their original range did not occur. A similar study of black bears in Alberta, Canada, by Tietje and Ruff (1983) also found that construction and operation of oil field facilities had little impact on habitat use or population range dynamics.

Other studies found significant beneficial effects to some wildlife species from oil and gas activities. For example, a study by Ballard et al. (2000) focusing on arctic fox populations in the Prudhoe Bay oil field in Alaska suggests that oil- and gas-related activities have led to an increase in fox population density compared to adjacent, undeveloped tundra habitat. This increase is thought to be a result of increased locations for suitable den sites in newly constructed culverts and road embankments. Ballard and Cronin (1995) also found that caribou herds in the Alaskan arctic are not adversely affected by oil field development and in most cases illustrate a positive relationship between oil facility development and population increases. These population increases are thought to occur because of the presence of gravel production pads, which provide the caribou with an area with fewer mosquitoes during crucial periods of calving and calf development.

REFERENCES

Ballard, W.B., and Cronin, M.A., 1995, Arctic Alaska caribou herds in relation to oil field development, Symposium on Impacted Wildlife, 6th, Thorne Ecological Institute.

Ballard, W.B., Cronin, M.A., Rodrigues, R., Skoog, R.O., and Pollard, R.H., 2000, Arctic fox, Alopex lagopus, den densities in the Prudhoe Bay oil field, Alaska: Canadian Field-Naturalist v. 4, no. 3, p. 453–456.

Tietje, W.D., Ruff, R.L., 1983, Responses of black bears to oil development in Alberta (Ursus americanus, Cold Lake): Wildlife Society Bulletin, v. 11, no. 2, p. 99–112.

Van Dyke, F., and Klein, W.C., 1996, Response of elk to installation of oil wells: Journal of Mammalogy, v. 77, no. 4, p. 1028–1041.

APPENDIX A

MAPS

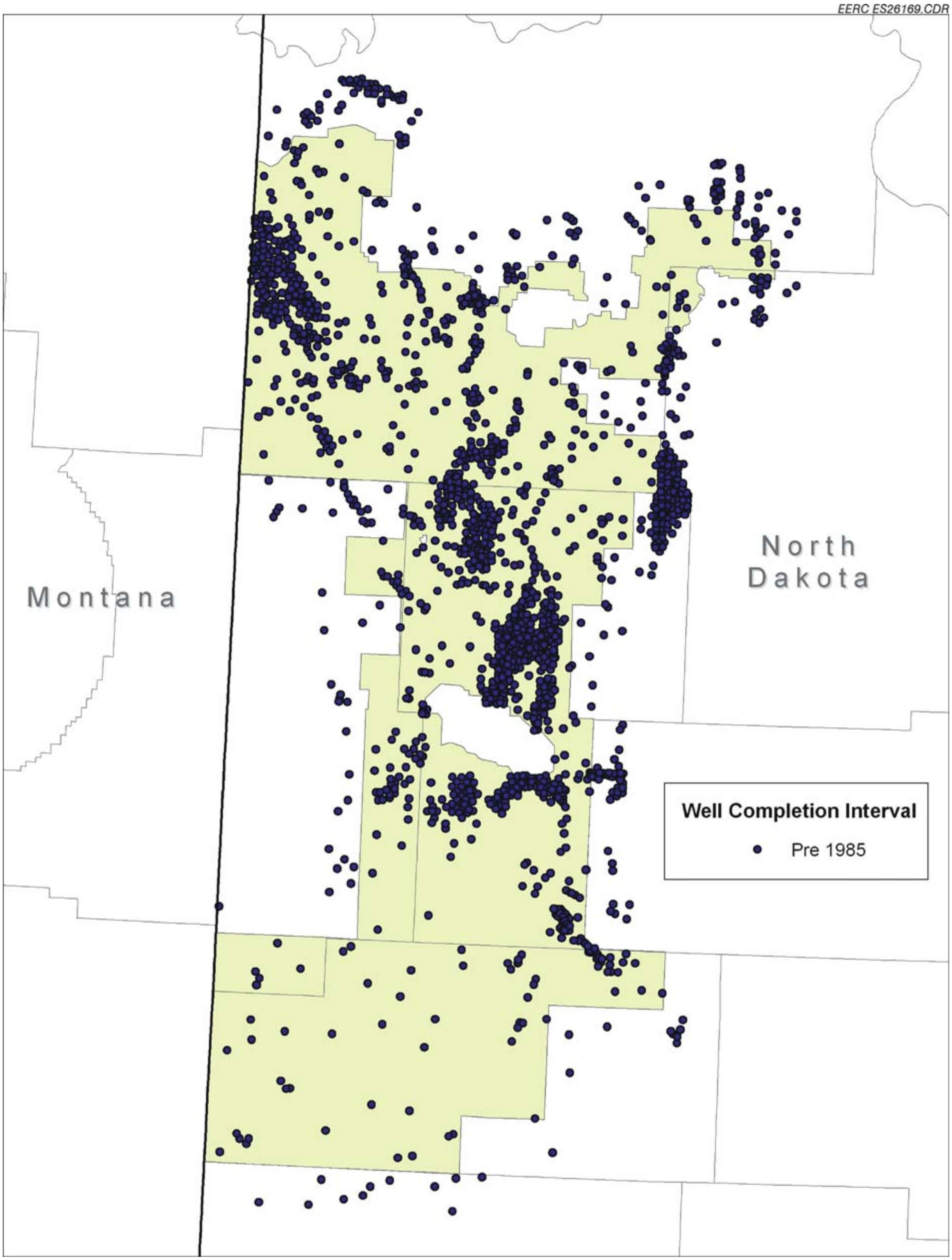


Figure A-1. North Dakota oil and gas drilling activity on and around the area designated as the Dakota Prairie Grasslands for the time period prior to 1985.

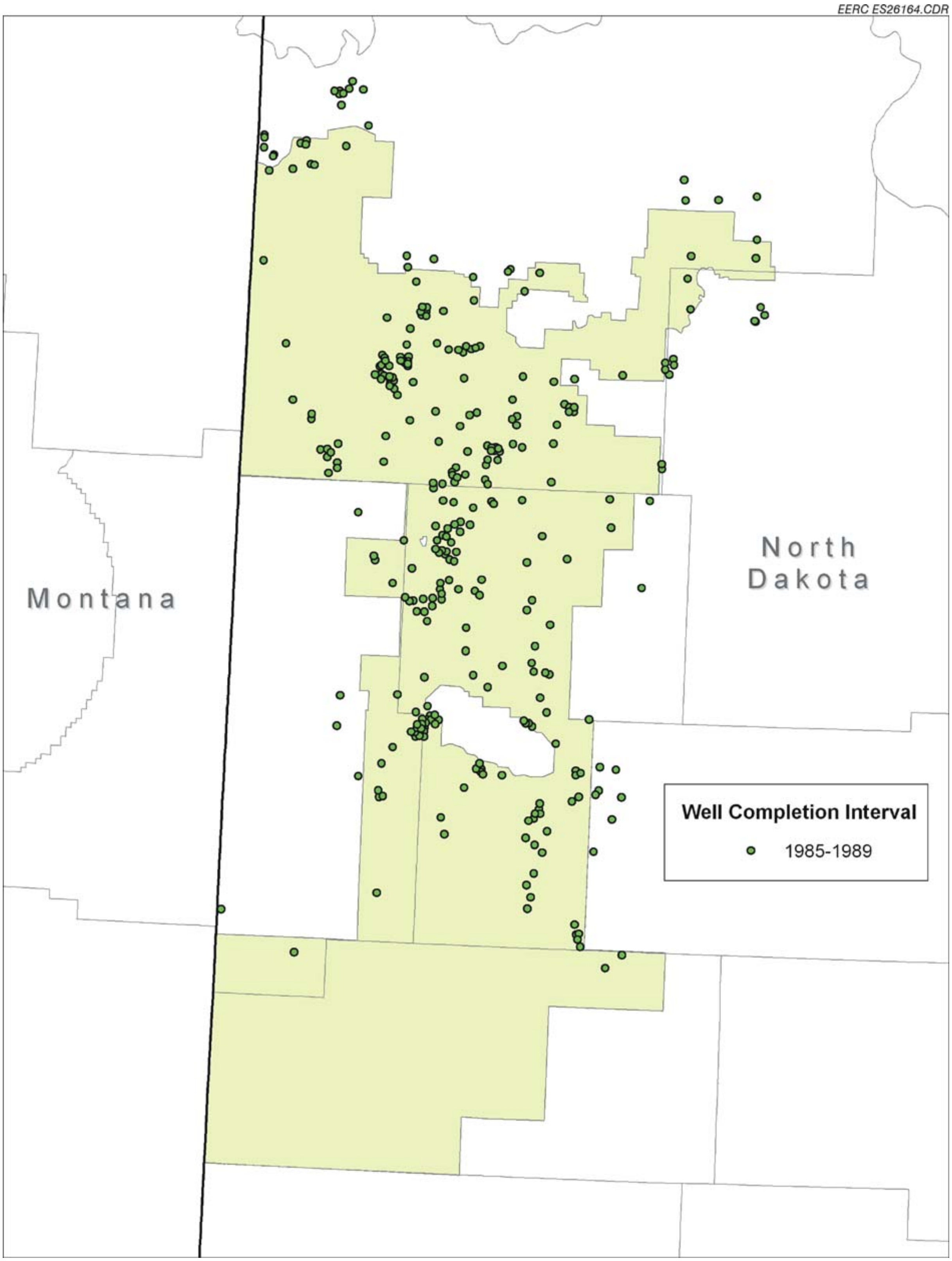


Figure A-2. North Dakota oil and gas drilling activity on and around the area designated as the Dakota Prairie Grasslands for the time period of 1985–1989.

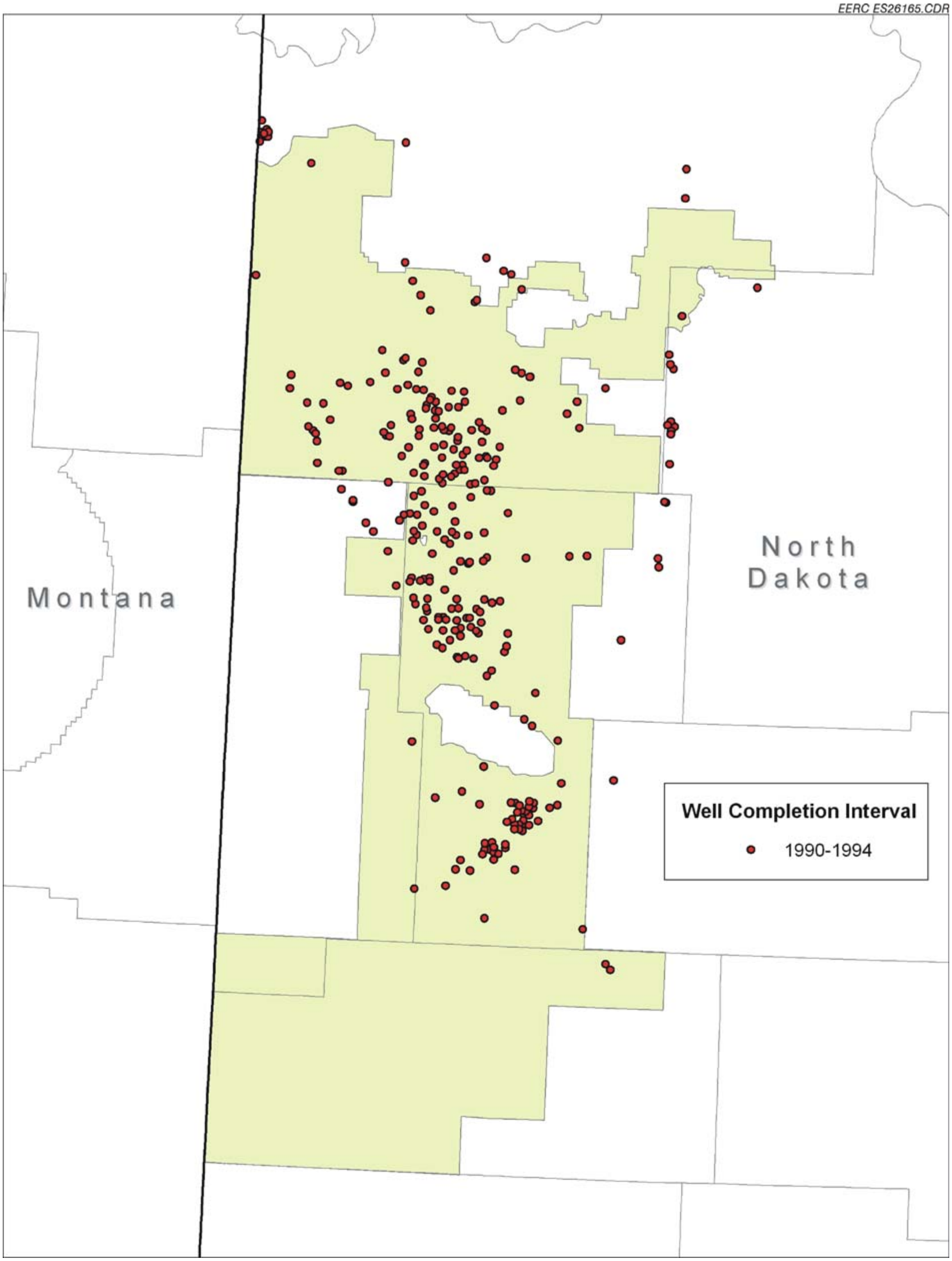


Figure A-3. North Dakota oil and gas drilling activity on and around the area designated as the Dakota Prairie Grasslands for the time period of 1990–1994.

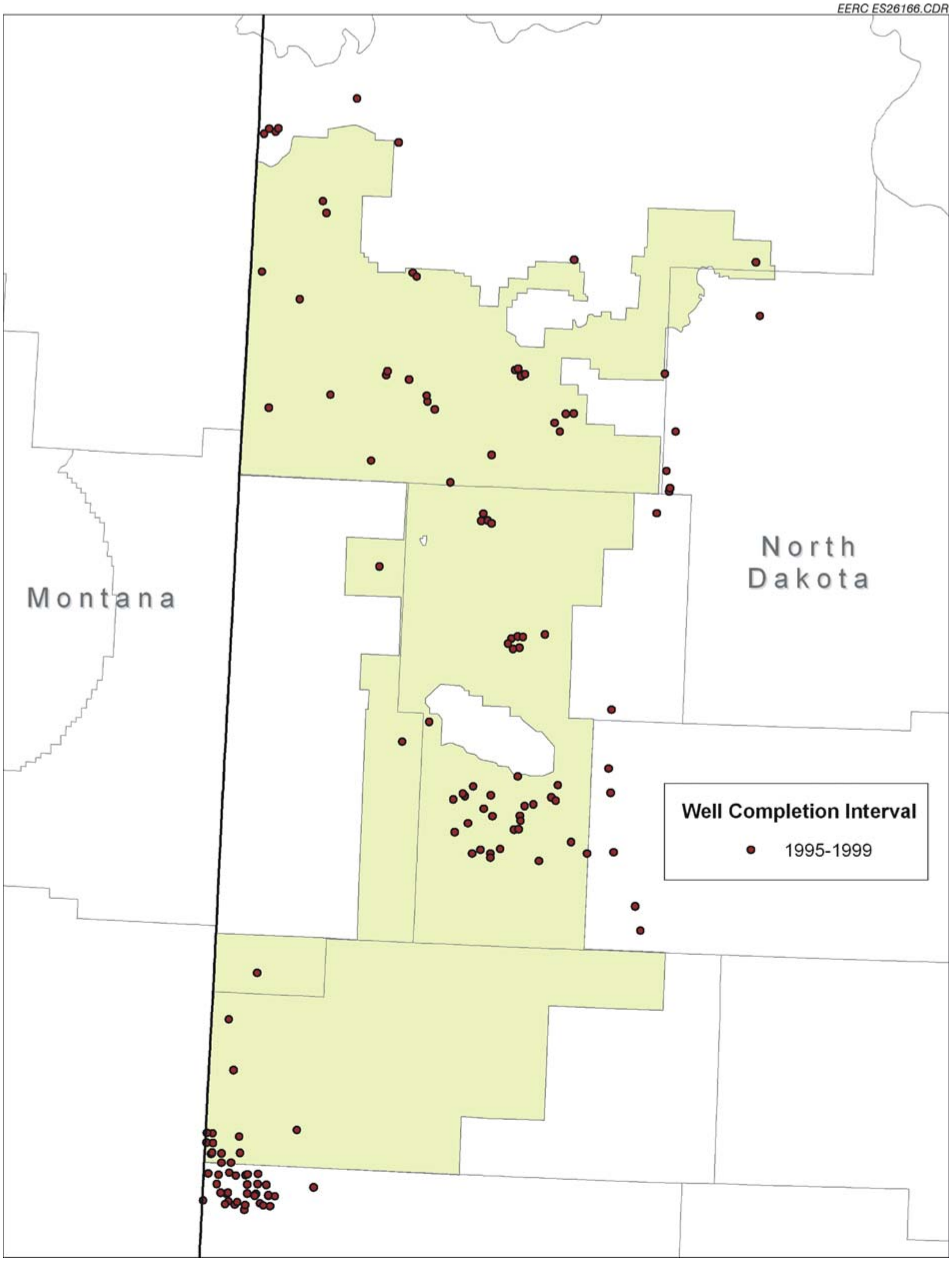


Figure A-4. North Dakota oil and gas drilling activity on and around the area designated as the Dakota Prairie Grasslands for the time period of 1995–1999.

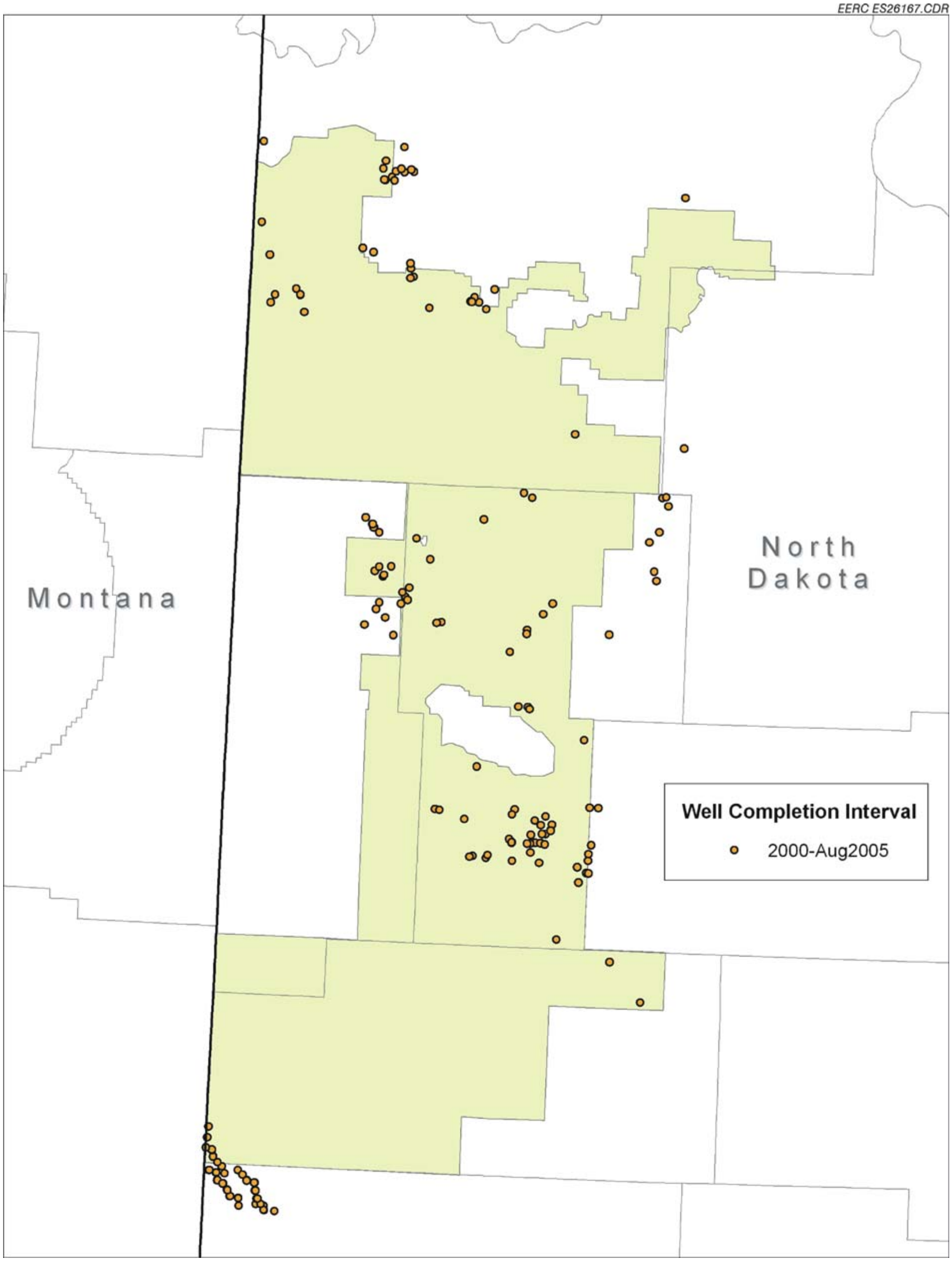


Figure A-5. North Dakota oil and gas drilling activity on and around the area designated as the Dakota Prairie Grasslands for the time period 2000 – August 2005.

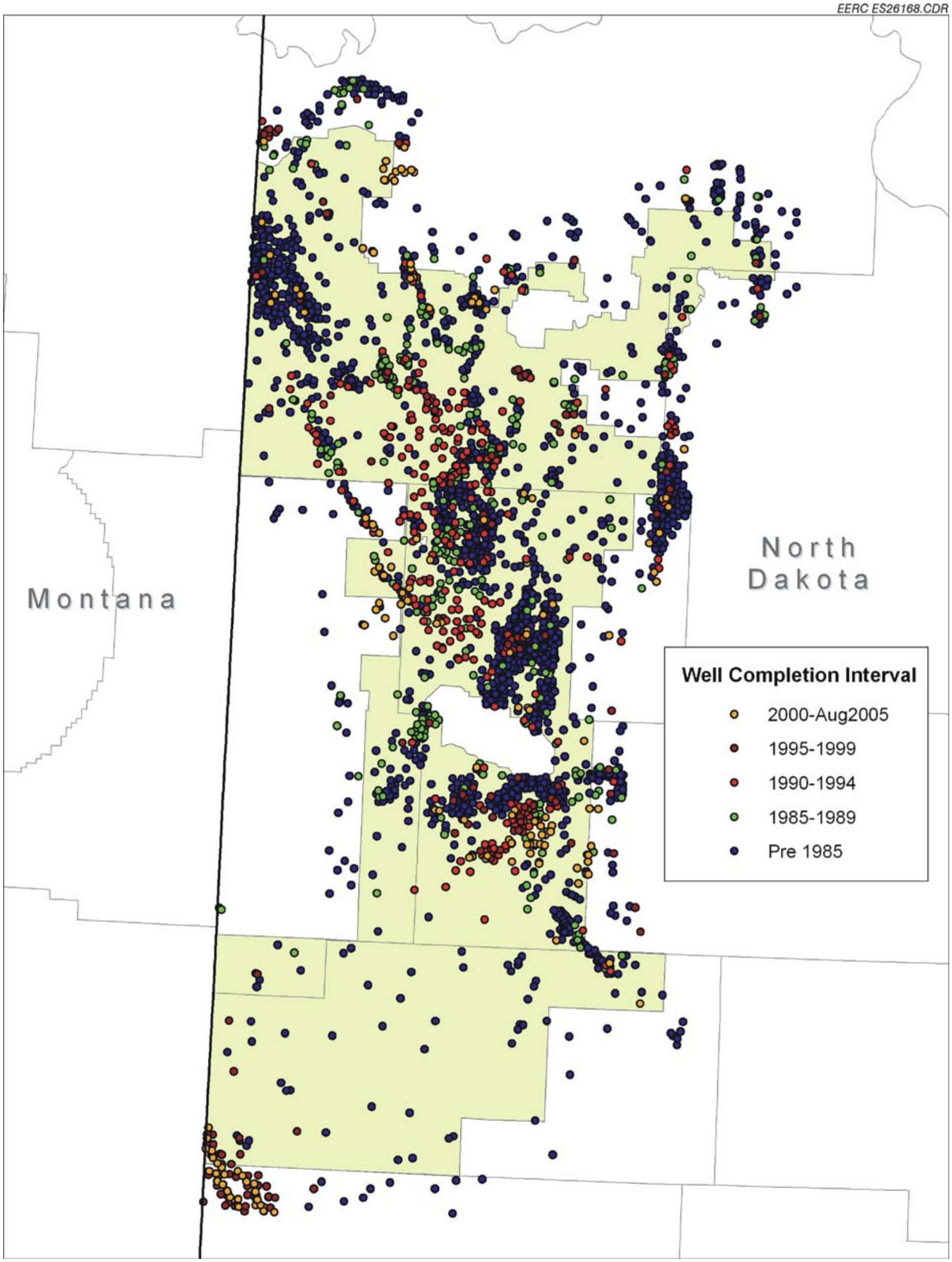


Figure A-6. North Dakota oil and gas drilling activity on and around the area designated as the Dakota Prairie Grasslands for the time period between 1980 and August 2005.

APPENDIX B

COMBINED FOREST STIPULATIONS

Uinta Forest

STIPULATION	ACTION	DATES
No Surface Occupancy (NSO)		
Geologic Hazards/Unstable Soil	Unstable soils; high erosion or unstable	
	Steep slopes	
	Wetland/riparian areas	
Wildlife	Critical sage grouse habitat	
	Critical elk yearlong range	
Research Natural Areas		
Roadless Areas		
Developed Campgrounds		
Retention Visual Quality Objective (VQO)		
Controlled Surface Use (CSU)		
Geologic Hazards/Unstable Soils	Design or relocate to minimize disturbance and unstable areas	
	Steep slopes	
	Wetland/riparian areas	
Wildlife	Critical deer winter range	
	Critical elk summer range	
	Critical deer summer range	
	Critical elk yearlong range	
	Sensitive plant and animal species	
Roadless Areas		
Semiprimitive Nonmotorized Areas		
Retention VQO		
Timing Limitations (TL)		
Wildlife	Critical sage grouse habitat	April 1 – May 31
	Critical elk winter range	November 15 – April 30
	Critical deer winter range	November 15 – April 30
	Critical deer summer range	April 15 – May 15
	Critical elk calving range	May 1 – June 30
	Critical elk yearlong range	November 15 – June 30

Nebraska National Forest and Oglala, Buffalo Gap National Grasslands

STIPULATION	ACTION	DATES
NSO		
Geological	Slopes >40% Slopes between 25% and 40% with highly erodible soils or subject to mass failure	
Archeological Resources		
Developed Recreational Sites		
Wildlife	Mountain plover nests and nesting areas Bald eagle nests Bald eagle roosts Burrowing owl, golden eagle, merlin, ferruginous and Swainson's hawk nests sharptail or sage grouse display grounds	
Undifferentiated		
CSU		
Geological	Fossils Paleontology and geological resouces	
Floodplains, Water, Wetland, Woody Draws, Riparian		
High Scenic Integrity Objective Areas		
Moderate Scenic Integrity Objective Areas		
Wildlife	Black-footed ferret habitat	
Undifferentiated	Mountain plover habitat	
TL		
Wildlife	Ferruginous and Swainson's hawk nests	March 1 – July 30 1
	Golden eagle nests	February 1 – July 31
	Merlin nests	April 1 – August 15
	Sharptail grouse display ground	March 1 – June 15
	Sage grouse display grounds	March 1 – June 15
	Mountain plover nest or aggregation area	March 15 – July 31
	Black-footed ferret habitat	March 1 – August 31
	Swift fox dens	March 1 – July 31
MISC.		
No Lease Areas		

Manti La Sal National Forest

STIPULATION	ACTION	DATES
NSO		
Geological	Slope >35% High erosion rating	
Riparian Area		
Discretionary	No lease	
Undifferentiated		
Administrative	Peavine corridor SPR management unit La Sal Peaks oil and gas analysis area Major peaks and passes of the Abajo mountains Portion of the Sinbad Ridge/Sewemup mesa area High-density/low-disturbance cultural area in the San Juan analysis area Research natural area	
Management	Developed recreation sites Management units Undeveloped motorized recreation (Huntington Canyon) Sage grouse leks, nesting and brooding areas Semiprimitive recreation Special land designation Research protection and interpretation Municipal water supply Watershed protection and improvement	
Collector Road		
Visual Quality Objective Area		
Wildlife	Sage grouse leks, nesting and brooding area	
CSU		
Semiprimitive Recreation		
Undifferentiated		
Wildlife	General big game winter range Key big game winter range	
TL		
Wildlife	Elk calving season Raptors/migratory bird nesting season Big game winter range	May 1 – July 5 May 1 – July 5 December 1 – April 15
Misc.		
Utility Corridor		
Dark Canyon Wilderness		
Leasable Mineral Management		
Wood Fiber Production of Harvest		
Production and Forage		

Grand Mesa, Uncompahgre and Gunnison National Forests		
STIPULATION	**ACTION**	**DATES**
NSO		
Geological	Floodplains	
	Aquatic/riparian/wetlands habitats as well as areas subject to mass soil movement	
	Alpine/tundra areas	
	High geologic hazard (e.g., active mass wasting)	
	Slopes >60%	
Visual Quality	Low visual absorption capability	
	Scenic byway corridor	
3A Management Areas	Semiprivate nonmotorized areas	
Administrative Sites		
Recreation Complexes	Campgrounds, picnic grounds, overlooks, etc.	
Sensitive Areas	Protection of aesthetic values perceived as highly sensitive by public	
Wildlife	Summer range (concentrated use)	
	Sage grouse leks	
	Bighorn sheep lambing/breeding areas	
CSU		
Geological	Moderate geologic hazard (e.g., special design areas)	
	Slopes 40%–60%	
Watersheds of Special Interest to Municipalities		
Visual Quality	Leasing final environmental impact statement to retain existing visual quality	
Recreation Complexes	Major ski trails	
Wildlife	Big game winter range	
	Elk calving areas	
	Migration routes and staging areas	
	Sage grouse leks	
Gunnison VQO Undifferentiated		

Continued . . .

Grand Mesa, Uncompahgre and Gunnison National Forests
(Continued)

STIPULATION	ACTION	DATES
TL		
Wildlife	Big game winter range Elk calving areas Migration routes and staging areas Sage grouse leks	December 1 – April 30 April 16 – June 30 March 1 – May 30 November 1 – December 31 October 15 – December 31 for staging areas March 1 – May 31
OTHER		
Threatened and Endangered Species Are Protected by the Endangered Species Act Gunnison and NLA Undifferentiated	No additional protection is required beyond the act	

Bridger–Teton National Forest

STIPULATION	ACTION	DATES
Not available for leasing		
Wilderness Area	Teton Gros ventre Bridger	
Krug Memorandum	Land north of the 11th parallel in MA 61	
Shoal Creek WSA		
DFC/MA Combination	DFC2A/MA 12, 13, 35, 41, 44, 47 DFC 2B/MA 35, 41, 44, 62 DFC 4A/MA 32 DFC 9A/MA 41 DFC 9B/MA 41	
Land in DFC 10 South of Alpine		
Periodic Springs and Recharge Area within DFC 4 in MA 33, 34		
Kendall warm springs		
Sweeney Lakes in DFC 2A		
Big Sandy Creek and at the South End of Wind River Range in DFC 2A		
NSO		
Commissary Ridge in DFC 12 Ridgecrests	Salt River, Wyoming, range crests or crests in MA 11, 22, 23, 24, 25, 26, 31, 32, 33, 34, 35, 48, 49	
Wild and Scenic Rivers		
National Trails		
Research Natural Areas	Identified areas to maintain quality of recreational experience and to protect developed areas	
Recreational Areas	Campgrounds, special use areas, and administrative sites Identified areas to protect water quality	
Water Quality		
Palisades WSA	Bighorn sheep area which straddles the MA's boundary	
Wildlife	Elk feedground along Hogback River bighorn sheep area Crucial big game winter range Mitigate impact on wildlife	
NSO Undifferentiated		

Continued . . .

<u>Bridger–Teton National Forest</u>
(continued)

STIPULATION	ACTION	DATES
CSU		
MA 12 MA 11 DFC 12		
Wildlife	Grizzly bear Crucial elk habitat Crucial elk winter range Elk winter range	
TL		
Wildlife	Crucial winter range Elk calving area Big game parturition areas Grizzly bear	November 15 – April 30 May 15 – June 30 May 15 – June 30 May 15 – June 30
OTHER CONCERNS		
(determine whether a forest plan amendment is needed)	Cultural, historical or paleontological area Confer with adjoining unit or other agencies to document management needs Coordinate leasing analysis	
National Scenic Highways	Stipulation needed and confer with adjoining unit or other agencies to document management needs Coordinate leasing analysis	
Grand Tetons National Park Visual Quality	Stipulation needed and confer with adjoining unit or other agencies to document management needs Coordinate leasing analysis	
Other Visual Quality	Stipulation needed	
National Landmarks	Stipulation needed	
Wild and Scenic River	Stipulation needed	
Other	Stipulation needed	
LEASE NOTICE AREAS		
Restricted or Prohibited Access Visual Quality Objective Threatened or Endangered Species Sensitive Species Old Growth		

Beaverhead National Forest

STIPULATION	ACTION	DATES
NSO		
Geological	Slopes >65%	
	Areas of mass failure	
	Slopes >35% and soils prone to failure	
	Slopes >60%	
Perennial Streams and Lakes		
MA8 Areas	Primitive and semiprimitive recreation areas	
MA7 Areas	Campgrounds and administrative sites	
MA2 Areas	Administrative sites over 40 acres	
MA 29 Areas	National recreation trails	
Grasshopper and Rock Creek Recreation Areas		
Campgrounds		
Scenic Resources	Foreground retention	
	Roads and trails buffered	
MA3 Areas	Heritage resource sites and traditional cultural areas	
Research Natural Areas		
Wildlife	Bald eagle and peregrine falcon nests	
	West slope cutthroat trout habitat	
CSU		
Geological	Areas sensitive to soil compaction	
	Areas of mass failure	
	30% to 65% slopes	
	Slopes >35% and soils prone to failure	
	Slopes >65%	
Scenic and Recreational River Candidates		
Grasshopper and Rock Creek Recreational Areas		
Summer Homes		
MA8 Areas		
Scenic Resources	Foreground retention	
	Foreground of partial retention	
	Middle and background retention	
	Middle and background partial retention	
	Roads, trails, and sites buffered	
Wildlife	Grizzly Bear habitat	
	Fluvial Arctic grayling recovery site	
	Fluvial Arctic grayling occupied and influencing habitat	
	West Slope cutthroat trout habitat	

Continued . . .

Beaverhead National Forest
(Continued)

STIPULATION	ACTION	DATES
TL		
Wildlife	Big game birthing areas Big game winter range Bald eagle and peregrine falcon nesting areas Goshawk, trumpeter swan, ferruginous hawk nesting areas	April 1 – July 1 Dec. 1 – May 15 February 1 – September 1 April 1 – September 1
OTHER		
	CSU undifferentiated NSO undifferentiated	

White River National Forest

STIPULATION	ACTION	DATES
NSO		
Geological	Slopes >60%	
	Paleontologic sites	
Roadless		
Historic Sites, Open Lihic Scatters		
Management Area	1B ski areas	
	3B primitive recreation area	
Research Natural Area		
National Recreation Trail		
Recreation Special Use Development		
Developed Recreation Facilities, Backcountry Huts		
And Recreational Residence and Cabins		
Administrative Sites		
Alpine	Lands above timberline	
Scenic	Maroon Creek corridor	
No Leasing Areas		
Wildlife	Critical bighorn sheep area	
	Federal, state threatened, endangered and candiate species	
	Gold Medal Fisheries	
	Colorado River cutthroat trout fisheries	
Roadless Area		
CSU		
Geological	Coal leases	
	Slopes between 40%–60%	
Undifferentiated		
Developed Recreation Facilities, Backcountry Huts and Recreational Residence and Cabins		
Sensitive Travel Routes	Level 1	
Communication Sites		
TL		
Snowmobile and X-Country Ski Corridors		December 1 – April 1
Wildlife	Big game winter range	December 1 – April 30
	Elk producing area	May 1 – June 30
	Colorado River cutthroat trout fisheries	June 1 – October 1
	Boreal western toad	April 15 – August 15

Thunder Basin National Grasslands

STIPULATION	ACTION	DATES
NSO		
Geology	Slope >40% Slope 25% and <40% with highly erodible soils or soils susceptible to mass failure Paleontological and geological	
Backcountry Nonmotorized		
Archeological		
Historical Rangeland		
Research Natural Areas		
Wildlife	Mountain plover nests and nesting areas Bald eagle nests Bald eagle winter roosts Golden eagle nests Merlin nests Ferruginous hawk nests Swainson's hawk nests Burrowing owl nests Sharptail grouse display grounds Sage grouse display grounds	
CSU		
Geology	Paleontology	
Riparian Areas, Woody Draws, Wetlands, and Floodplains		
Recreational	Dispersed recreational sites	
Scenic	High scenic integrity	
	Moderate scenic integrity	
Wildlife	Black-footed ferret habitat Black-footed ferret reintroduction habitat Mountain plover habitat Zoological (black-footed ferret reintroduction objectives)	Drilling and use requirements

Continued . . .

Thunder Basin National Grasslands
(continued)

STIPULATION	ACTION	DATES
TL		
	Ferruginous hawk and Swainson's hawk nests	March 1 – July 31
Wildlife	Golden eagle nests	February 1 – July 31
	Merlin nests	April 1 – August 15
	Sharptail grouse display grounds	March 1 – June 15
	Sagegrouse display grounds	March 1 – June 15
	Mountain plover nests or nest aggregation areas	March 15 – July 31
	Area around prairie dog colonies	March 1 – August 31
	Ferret occupied prairie dog colonies	Drilling and use requirements
	Swift fox dens	March 1 – August 31
	Deer winter habitat	December 15 – March 15
	Elk winter habitat	December 15 – March 15
	Elk calving grounds	May 1 – June 31
	Antelope winter habitat	December 15 – March 15
	Zoological (black-footed ferret reintroduction objectives)	Project modification
	Black-footed ferret reintroduction habitat	Drilling and use requirements
	Big game range	Dec 15 – Mar 15
OTHER	CSU undifferentiated	
	NSO undifferentiated	
	NAA undifferentiated	

Cibola National Forest

STIPULATION	ACTION	DATES
CSU		
Wildlife	Closed circulation system for all oil and gas drilling Blacktail prairie dog towns	
TL		
Wildlife	Ferruginous and Swainson's hawk nesting season	
	Suitable nesting site	March 1 – April 31
	Active nests	April 1 – July 31
Unclassified Stipulations		
No Surface Disturbing Work to Without a Cultural Resource Survey Leased Lands Will Be Examined Prior to Surface Disturbing Activities Upon Any Threatened, Endangered, Proposed, or Sensitive Plant or Animal Species		

Routt Medicine Bow-Routt National Forests

STIPULATION	ACTION	DATES
NSO		
Geological	High erosion hazard soils High geologic hazard Slopes over 60%	
Heritage Resource Areas		
Developed Recreation Sites		
Bear River Corridor		
Eligible Wild and Scenic River		
Research Natural Area		
Backcountry Nonmotorized		
Backcountry Motorized		
Recreation		
Municipal Watersheds		
CSU		
Geological	Slopes between 40%–60% Erosive and hydric soils Alpine environments Sensitive watersheds	
Visual Resources		
Developed Recreation Sites		
Shortly/Cataract Unique Natural Area		
Special Interest Areas		
Residential Interface		
Wildlife	Cutthroat trout habitat	
TL		
Wildlife	Grouse breeding complex Big game – winner range Big game birthing area Known active raptor nests Sandhill crane nesting area	March 1 – June 30 December 15 – May 15 May 1 – July 30 February 1 – August 15 May 1 – July 1

Continued . . .

Routt Medicine Bow-Routt National Forests
(continued)

STIPULATION	ACTION	DATES
Lease Notice		
	Special uses Threatened an endangered species Vegetation (active/planned timber sales)	
Additional		
	TL/CSU NSO Timing limitations	November 15 – July 31

Helena National Forest

STIPULATION	ACTION	DATES
NSO		
Geological	Slopes of >40% and sensitive soils	
	Slopes of >60% and sensitive soils*	
	Slopes of >40% in municipal watershed*	
Rocky Mountain Front*		
Silver King/Falls and Elkhorn E2 Areas*		
Visual*		
Municipal Watersheds*		
Municipal Watersheds Permit*		
Water Quality		
Administrative Sites		
Wetland Areas		
Riparian Areas		
Research Natural Areas		
Non Motorized Management Areas		
Wild and Scenic River Candidates		
Developed Recreation Sites		
Scenery Resources		
Wilderness Bill Area*		
Elkhorn Recreational Area*		
Research Natural Area Candidate*		
Wildlife	Core mountain goat habitat	
	Core mountain goat range*	
	Gates of the mountain game preserve	
	Rocky Mountain front ecosystem	
	Continental Divide biological corridor	
	Grizzly bear habitat	
	Grizzly bear spring habitat*	
	Grizzly bear denning and summer occupied habitat	
	Bald eagle and peregrine falcon habitat	
	Bald eagle and peregrine falcon nests*	
	Native trout species stream	
	Big game winter range*	
	Elkhorn WMA*	
	Threatened and endangered species area*	
	Sensitive trout species stream*	

Continued . . .

Helena National Forest
(continued)

STIPULATION	ACTION	DATES
CSU		
Geological	Slopes 30%–40%	
	Slopes 40%–60%	
	0%–40% slopes in municipal watersheds	
Water Quality		
Research Natural Area*		
Proposed Elkhorn Recreation and WMA*		
Sensitive Plants*		
Scenery Resources		
Visual Quality	Mid and background retention	
	Partial	
Wildlife	Big game winter range	
	Big game travel routes	
	Big game winter range and birthing area*	
	Elk migration route*	
	Continental Divide biological corridor	
	Threatened and Endangered species occupied area	
	Threatened and endangered species area*	
	Native trout species stream	
	Sensitive trout species stream*	
TL		
Developed Recreation Site	400 feet to ½-mile buffer	May 25– September 15
Hunting Season Travel Restrictions		October 15 – December 1
Wildlife	Big game winter range	December 1 – May 15
	Big game birthing areas	April 15 – June 30
	Big game summer range	June 1 – September 30
	Wolf winter prey habitat	December 1 – May 15
	Bald eagle and peregrine falcon habitat	February 1 – July 31
	Grizzly bear denning area	October 15 – April 15
	Grizzly bear spring habitat	April 1 – June 30
	Grizzly bear summer area	July 1 – September 15
	Grizzly bear situation 1*	April 15 – October 15
	Grizzly bear seasonal range*	October 15 – April 15
		April 1 – June 30
		July 1 – September 15
	Threatened and endangered species*	July 1 – September 15
		April 15 – October 15
	Wolf prey area	December 1 – May 15
	Elkhorn mountain core	
	Elkhorn mountain periphery	

Continued . . .

Helena National Forest
(continued)

STIPULATION	ACTION	DATES
MISC		
Leasing Decisions for Specific Lands In Addition the Forest Supervisor Shall Review the Availability Decision on Which Lands All Administrative League Available for Leasing is Subject to the Verifying Oil and Gas Leasing On the Specific Lands Has Been Adequately Addressed in a NEPA The Document also Ensuring Conditions Have Surfaced Occupancy Are Properly Included as Stipulations. Wolf Recovery Area		

* Indicates addition from primary Appendix 1: Changed or Added Stipulations.

Ashley National Forest

STIPULATION	ACTION	DATES
NSO		
Geological	Slopes >35% Geological or unstable soils	
Riparian Areas >40 acres		
Wetlands >40 acres		
Research Natural Areas		
Recreational Sites and Trailheads		
CSU		
Semiprimitive-Nonmotorized/Roadless Areas		
Visual Quality	Retention or partial retention	
Sensitive Plants		
Sensitive Wildlife		
TL		
Wildlife	Sage grouse habitat	April 1 – May 31
	Elk winter and yearlong range	November 15 – April 30
	Deer winter range	November 15 – April 30
	Elk calving areas	May 1 – June 30
Unclassified Stipulations		
Cultural and Paleontological Resources	Contact USFS to determine need for site-specific inventory	
Floodplain and Wetland	Activities restricted or precluded	
Sensitive Plants/Wildlife Species	Survey will be rquired to determine if present	
Endangered or Threatened Species		

Black Hills National Forest

STIPULATION	ACTION	DATES
NSO		
Geological	Steep slopes >40%	
Reservoirs		
Riparian Areas		
Developed Recreational Areas		
Cultural Sites		
Designated Nonmotorized		
Designated Significant Caves		
Designated Historical Sites		
Designated Significant Scenic Habitat		
No Leasing		
Wildlife	Raptor nests	
Scenic Integrity		
CSU		
Visual Resource Management		
Riparian Areas		
Areas of Visibility to Public		
Areas of Significant Cave Locations		
Mineral Leasing		
Scenic Integrity		
Visual Quality		
TL		No dates listed in EPCA
Areas of High Recreational Activity		
Areas of High Seasonal Public Use		
Wildlife	Winter range	
	Raptor nests	
	Grouse nesting	
	Spring elk calving range	

San Juan National Forest

Notice

The permitee/lessee must comply with all the rules and regulations of the Secretary of Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System when not inconsistent with the rights granted by the Secretary of the Interior in the permit.

APPENDIX C

BIBLIOGRAPHY OF PUBLISHED LITERATURE ON THE EFFECTS OF E&P ACTIVITIES ON WILDLIFE AND FISH

BIBLIOGRAPHY OF PUBLISHED LITERATURE ON THE EFFECTS OF E&P ACTIVITIES ON WILDLIFE AND FISH

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APPENDIX D

ABSTRACTS FROM PUBLISHED LITERATURE

U.S. Fish and Wildlife Service Contaminant Report # R6/718C/02.
Cheyenne, WY. Aug. 15 pp

Oil Field Produced Water Discharges into Wetlands in Wyoming

ABSTRACT

Approximately 600 oil field produced water discharges are permitted in Wyoming by the State's Department of Environmental Quality's (WDEQ) National Pollutant Discharge Elimination System (NPDES) permit program. Wyoming is one of a few states that allows the discharge of oil field produced water into surface waters for beneficial use by livestock and wildlife. Sixty-six wetland sites receiving oil field produced water discharges in Wyoming were surveyed to determine the percentage of discharges in compliance with NPDES permit requirements and to determine the amount of chronic oil releases associated with these discharges. Separator pits were also surveyed to determine wildlife mortality and to assess implementation of wildlife deterrents. Although limited in scope, this survey of oil field produced water discharges in Wyoming shows that: inefficient oilwater separation is causing a chronic discharge of oil into some of the wetlands receiving oil field produced water; and, over half (53 percent) of the sites surveyed used only flagging to deter migratory birds from oil pits used to skim oil from produced water. Additionally, approximately 85 percent of the oil field produced water discharges surveyed went into ephemeral streams.

Oil and Petrochemical Pollution
2, (4, 1985, 265–280)

Environmental Contamination in the Oil Fields of Western Pennsylvania

Albers, P.H., Belisle, A.A., Swineford, D.M., Hall, R.J.

ABSTRACT

The effects on freshwater wildlife of chronic exposure to oil field discharges are not well known. Collections of wastewater, aquatic invertebrates, fish, salamanders, and small mammals were made in several streams in the oil fields of western Pennsylvania during 1980-81. Estimates of the petroleum content of two wastewater discharges were high (21.9 and 8.4 ppm) and one was low (0.3 ppm). Water conductivity was inversely related to aquatic invertebrate biomass. Hydrocarbons accumulated in significantly greater amounts in crayfish, fish, and small mammals from collection sites with oil extraction activity than from sites without oil extraction activity. Estimates of total petroleum in invertebrates, trout, and suckers averaged between 200 and 280 ppm for oil extraction sites and between 8 and 80 ppm for sites without oil extraction activity. Oil extraction activity did not affect metal accumulation by fish. Oil and wastewater discharges in oil fields disrupt community composition and can cause an overall reduction in stream productivity.

Biological Conservation
83, (2, 1998, 195-208)

Northern Alaska Oil Fields and Caribou: A Commentary

Ballard, W.B., Cronin, M.A., Bryan, J.D., Pierson, B.J., McKendrick, J.D.

ABSTRACT

We discuss the status of caribou, Rangifer tarandus, herds relative to oil field development in the Prudhoe Bay region of Alaska. The Central Arctic caribou herd, which spends June and July in and around oil fields in the Prudhoe Bay region, has increased since the inception of oil field development and has demographics similar to those of adjacent herds which are not near oil fields. Although oil field development may impact individual caribou through disturbance or impedance of movements, herd-level impacts of the oil fields are not apparent. Caribou populations characteristically fluctuate dramatically, and differentiating human and non-human impacts is difficult or impossible. The herd is the unit of management, and management objectives are being met. The experience in northern Alaska's oil fields indicates resource extraction and wildlife populations can be compatible when managed properly.

Canadian Field-Naturalist
114, (3, 2000, 453–456**)**

Arctic Fox, Alopex Lagopus, Den Densities in the Prudhoe Bay Oil Field, Alaska

Ballard, W.B., Cronin, M.A., Rodrigues, R., Skoog, R.O., Pollard, R.H.

ABSTRACT

Studies conducted in the Prudhoe Bay, Alaska area since the 1970s suggested that Arctic Fox (Alopex lagopus) populations may have increased as a result of oil field development. During 1993, we estimated fox den densities within the Prudhoe Bay area and compared our estimates with those made previously in the same area and from other Arctic areas. The number of natal fox dens was stable between 1992 (n = 25) and 1993 (n = 26), as was mean litter size (4.6 and 4.4 pups per litter in 1992 and 1993, respectively). Fox den density was greater (1/15.2 km^2) within developed areas than on adjacent undeveloped tundra (1/28.1 km^2), and foxes used culverts and road embankments as den sites in addition to natural dens. Densities of fox dens in Prudhoe Bay development area and adjacent tundra were within the range of density estimates

Journal of Wildlife Management
61, (4, October 1997, 1127–1133)

Effects of Petroleum Exploration on Woodland Caribou in Northeastern Alberta

Bradshaw, C.J.A., Boutin, S., Hebert, D.M.

ABSTRACT

Woodland caribou (Rangifer tarandus caribou) in northeastern Alberta apparently have declined and are classified as endangered. Petroleum exploration has been implicated as a possible cause. We examined the effects of simulated petroleum exploration (i.e., loud noise) on caribou movement and behavior. We monitored 5 (1993) and 20 (1994) radiocollared caribou during 3 periods (pretest, test, and post-test) over 2 treatments (exposed and control). Exposed caribou moved significantly faster than control caribou (2.3 ± 0.2 SE vs. 1.6 km/hr ± 0.1), but not significantly farther. Exposed caribou crossed habitat boundaries significantly more than did controls (0.53 ± 0.16 vs. 0.27 changes/period ± 0.14). Disturbance did not affect significantly the proportion of time allocated to feeding. Treatment caribou demonstrated higher overall movement rates in 1993 than 1994 (2.7 ± 0.2 vs. 1.7 km/hr ± 0.1), displacement (3.5 ± 1.3 vs. 2.3 km ± 0.6), and more time allocated to feeding (27.5 ± 2.9 vs. 9.0% ± 1.7). Habitat boundaries crossed did not differ significantly between years. We suggest that increased movement may result in higher energy expenditure during winter, and that disturbed caribou may switch habitat type for cover or escape terrain. We believe that differences in movement between years resulted from higher snow depths in 1994. We also suggest that land-use managers should limit total disturbance during winter rather than mitigate industrial activity with timing restrictions.

Arctic
36, (3, 1983, Pages. 227–231)

Caribou and Petroleum Development in Arctic Alaska

Cameron, R.D.

ABSTRACT

Intensive petroleum-related development on Alaska's Arctic Slope is not always compatible with the habitat requirements of barren-ground caribou (Rangifer tarandus granti). Surface alteration can result in displacement of caribou from previously occupied components of range. Although, to date, losses of habitat have been localized, apparently with no adverse effects on herd productivity, uncontrolled or improperly planned future development on state and federal lands could remove large areas of caribou habitat, with potentially serious consequences to all of the arctic herds. Caribou represent a valuable recreational and subsistence resource. State and federal land management agencies must fully acknowledge the potential conflicts associated with industrial activity and adopt conservative policies of subsurface leasing and surface development.

Arctic
45, (4, 1992, 338–342)

Redistribution of Calving Caribou in Response to Oil Field Development on the Arctic Slope of Alaska

Cameroon, R.D. , Reed, D.J. , Dau, J.R. , Smith, W.T.

ABSTRACT

Aerial surveys were conducted annually in June 1978-87 near Prudhoe Bay to determine changes in the distribution of calving Rangifer tarandus granti that accompanied petroleum-related development. With construction of an oil field access road through a calving concentration area, mean caribou density (no./km^2) decreased from 1.41 to 0.31 within 1 km and increased from 1.41 to 4.53 5-6 km from the road. Concurrently, relative caribou use of the adjacent area declined, apparently in response to increasing surface development. Perturbed distribution associated with roads reduced the capacity of the nearby area to sustain parturient females, and insufficient spacing of roads may have depressed overall calving activity. Use of traditional calving grounds and of certain areas therein appears to favor calf survival principally through lower predation risk and improved foraging conditions. Given the possible loss of those habitats through displacement and the crucial importance of the reproductive process, a cautious approach to petroleum development on the Arctic Slope is warranted. -from Authors

Arctic
58, (1, March 2005, 1–9)

Central Arctic Caribou and Petroleum Development: Distributional, Nutritional, and Reproductive Implications

Cameron, R.D., Smith, W.T., White, R.G., Griffith, B.

ABSTRACT

We synthesize findings from cooperative research on effects of petroleum development on caribou (Rangifer tarandus granti) of the Central Arctic Herd (CAH). The CAH increased from about 6000 animals in 1978 to 23,000 in 1992, declined to 18,000 by 1995, and again increased to 27 000 by 2000. Net calf production was consistent with changes in herd size. In the Kuparuk Development Area (KDA), west of Prudhoe Bay, abundance of calving caribou was less than expected within 4 km of roads and declined exponentially with road density. With increasing infrastructure, high-density calving shifted from the KDA to inland areas with lower forage biomass. During July and early August, caribou were relatively unsuccessful in crossing road/pipeline corridors in the KDA, particularly when in large, insect-harassed aggregations; and both abundance and movements of females were lower in the oil field complex at Prudhoe Bay than in other areas along the Arctic coast. Female caribou exposed to petroleum development west of the Sagavanirktok River may have consumed less forage during the calving period and experienced lower energy balance during the midsummer insect season than those under disturbance-free conditions east of the river. The probable consequences were poorer body condition at breeding and lower parturition rates for western females than for eastern females (e.g., 1988-94: 64% vs. 83% parturient, respectively; $p = 0.003$), which depressed the productivity of the herd. Assessments of cumulative effects of petroleum development on caribou must incorporate the complex interactions with a variable natural environment.

California Fish and Game
87, (2, 2001, 45–50)

Trace Metal Concentrations in San Joaquin Kit Foxes From the Southern San Joaquin Valley of California

Charlton, K.G., Hird, D.W., Spiegel, L.K.

ABSTRACT

We measured kidney concentrations of zinc (Zn), copper (Cu), cadmium (Cd), lead (Pb), nickel (Ni), chromium (Cr), and molybdenum (Mo) in radio-collared San Joaquin kit foxes, Vulpes macrotis mutica, that died between 1991 and 1993. We compared results for kit foxes inhabiting an oil field with kit foxes inhabiting an undeveloped reference site. Concentrations of Zn, Cu, Cd, Pb, Ni, Cr, and Mo in kit fox kidneys were either below detectable levels or were within ranges reported for other mammals from unpolluted sites. Concentrations of Zn, Cu, and Cd tended to be higher in foxes from the oil field, although these differences were not significant.

Condor
107, (2, May 2005, 289–304**)**

Population Size and Trend of Yellow-Billed Loons in Northern Alaska

Earnst, S.L., Stehn, R.A., Platte, R.M., Larned, W.W., Mallek, E.J.

ABSTRACT

The Yellow-billed Loon (Gavia adamsii) is of conservation concern due to its restricted range, small population size, specific habitat requirements, and perceived threats to its breeding and wintering habitat. Within the U.S., this species breeds almost entirely within the National Petroleum Reserve-Alaska, nearly all of which is open, or proposed to be opened, for oil development. Rigorous estimates of Yellow-billed Loon population size and trend are lacking but essential for informed conservation. We used two annual aerial waterfowl surveys, conducted 1986-2003 and 1992-2003, to estimate population size and trend on northern Alaskan breeding grounds. In estimating population trend, we used mixed-effects regression models to reduce bias and sampling error associated with improvement in observer skill and annual effects of spring phenology. The estimated population trend on Alaskan breeding grounds since 1986 was near 0 with an estimated annual change of -0.9% (95% CI of -3.6% to +1.8%). The estimated population size, averaged over the past 12 years and adjusted by a correction factor based on an intensive, lake-circling, aerial survey method, was 2221 individuals (95% CI of 1206-3235) in early June and 3369 individuals (95% CI of 1910-4828) in late June. Based on estimates from other studies of the proportion of loons nesting in a given year, it is likely that <1000 nesting pairs inhabit northern Alaska in most years. The highest concentration of Yellow-billed Loons occurred between the Meade and Ikpikpuk Rivers; and across all of northern Alaska, 53% of recorded sightings occurred within 12% of the area.

Landscape Ecology and Wildlife Habitat Evaluation: Critical Information for Ecological Risk Assessment, Land-Use Management Activities, and Biodiversity Enhancement Practices, *ASTM STP 1458*, L. Kapustka, H. Galbraith, M. Luxon, and G. R. Biddinger, Eds., ASTM International, West Conshohocken, PA, 2004.

Toward a Framework for Assessing Risk to Vertebrate Populations from Brine and Petroleum Spills at Exploration and Production Sites

Efroymson, R. A., Carlsen, T. M., Jager, H. I., Kostova, T., Carr, E. A.,
Hargrove, W.W., Kercher, J., and Ashwood, T. L.,

ABSTRACT

Brine and petroleum spills may affect terrestrial vertebrates through loss of reproductive habitat or reduced food availability rather than direct toxicity. An ecological framework for evaluating impacts of these spills includes individual-based population models, a site conceptual trophic model, habitat suitability maps, and a hypothetical spill generator. Simulation results for mammal populations in the Tallgrass Prairie Preserve petroleum exploration and production (E&P) site in Oklahoma are presented. Simulated American badger (*Taxodea taxus*) populations decrease with increasing spill area and crash if 30% of habitat is disturbed. Fragmentation has no apparent effect. The time to extinction for prairie vole (*Microtus ochrogaster*) populations decreases with increasing spill area. Vole density is sensitive to the interaction of predation and fragmentation, with fragmentation causing population extinction in the presence of predation and stabilizing the population in the absence of predation. Model results will aid in developing “exclusion criteria” for leaving unrestored habitat at E&P sites.

International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production
1, 1996, 419–423

Environmental Assessment on Alaska's North Slope

Herlugson, C.J., Parnell, J.A.

ABSTRACT

Since oil production began at Prudhoe Bay, Alaska, in 1977, numerous monitoring programs have examined the region's biota in an effort to establish baseline conditions and support impact assessments. These programs are used to reduce or mitigate changes resulting from oil and gas development. North Slope exploration and production operations are governed by a complex set of regulations that often require monitoring. Monitoring programs are conducted annually to measure air emissions, water quality, and the distribution and abundance of wildlife within the operating area.

Environmental Management
21, (5, September 1997)

Impoundment Productivity in the Prudhoe Bay Oil Field, Alaska: Implications for Waterbirds

Kertell, Kenneth, Howard, Randall L.

ABSTRACT

To evaluate impoundments as habitat for waterbirds, a comparison was carried out between impoundments and natural ponds in the Prudhoe Bay oil field, Alaska, from 1991 to 1993. The comparison was made with respect to macroinvertebrate productivity, phytoplankton biomass (chlorophyll a), and nutrient availability (phosphorus and nitrogen). Based on the results of this study, it is speculated that impoundments and ponds may have similar value as feeding habitat for invertebrate-eating waterbirds. Thus, the presence of impoundments may be consistent with waterbird management goals on the Arctic Coastal Plain.

Environmental Toxicology and Chemistry
11, (12, 1992, 1691–1707)

Of Measured Risks: The Environmental Impacts of the Prudhoe Bay, Alaska, Oil Field

Maki A.W.

ABSTRACT

The 20th anniversary of the filing of the Trans-Alaska Pipeline System (TAPS) Environmental Impact Statement (EIS) affords an opportunity to assess retrospectively the environmental impacts of the resultant North Slope oil fields, now the largest single source of U.S. domestic oil production. As the oil field expanded, particularly to near-shore areas such as the Endicott Development, additional EIS documents were prepared to assess impacts not included in the original TAPS EIS. In the ensuing years, numerous agency- monitored and industry-sponsored environmental monitoring studies, estimated to average $4 million per year, have been conducted in and around the oil field, making the Alaskan North Slope one of the most studied environments in North America. In this paper, the EIS requirement of the National Environmental Policy Act (NEPA) is examined as a predictive environmental risk assessment. A tabulated summary of the predicted environmental impacts from the original TAPS and offshore Endicott Development EIS documents is compared with the extensive amount of resultant monitoring data. These data confirm localized impacts to air and water quality; however, regulated discharges remain well below criteria established for the protection of human health and the environment. As predicted, some unavoidable habitat losses to resident and migratory wildlife have occurred within the oil field and pipeline corridors. Approximately 2% of the land surface in developed portions of the oil field was actually altered. However, careful monitoring of wildlife populations demonstrates that no species has experienced a measurable decline, and most continue to utilize oil field habitat for breeding, nesting, and summer forage. As habitat does not appear to be limiting the growth of North Slope caribou herds, the Central Arctic Herd has been able to accommodate the incremental habitat loss due to the oil field and has shown a sevenfold increase in numbers since the oil field development began in the early 1970s. Offshore monitoring data for the gravel causeways verify the predicted small, localized effects on water circulation and show the possibility is low that fish are experiencing resulting significant negative effects. The challenge faced in the EIS process is not how to ensure zero impact, as this is not a realistic goal, but instead it is how to predict impacts and describe mitigation measures accurately to ensure that the resultant ecological responses remain within a normal range of ecosystem oscillations that can be used to describe sustainable development. This review demonstrates that in the EIS process, a well-designed program using the best available field data can indeed provide a relatively accurate prediction of subsequent impacts.

United States Environmental Protection Agency, Office of Research and Development, (Report) EPA
(600 /3-80-019, January 1980)

Effects of Petroleum Compounds on Estuarine Fishes

Martin, B.J.

ABSTRACT

Effects of the carcinogenic polycyclic aromatic hydrocarbons (PAH), benzo left bracket a right bracket -pyrene (B2P), and methylcholanthrene (MCA) were investigated with sheepshead minnows (Cyprinodon variegatus) and channel catfish (Ictalurus punctatus). A closed-circulating system was designed to maintain up to 100 sheepshead minnows in artificial seawater for longterm exposures. Fish were maintained in this system for up to 31 weeks with weekly contaminations of PAH. Due to their chemical properties significant levels of BaP and MCA remained in the water column for only ca. 24 hours each week and no tumors were observed in the exposed fish during the period of the study. The incidence and types of lesions in control and exposed fish were basically similar except in catfish that were fed PAH contaminated food. High levels of contamination (1mg/gm food) appeared to be toxic and lower levels of contamination (0. 1 mg/gm food) produced sufficient stress to make the catfish susceptible to fatal parasite infestations. Both species accumulated radioactively labelled PAH at concentrations much higher than their nominal concentrations in the water. These results demonstrate that sheepshead minnows function well as experimental organisms in artificial seawater in a closed system maintained at a noncoastal facility. Thus, they provide an excellent model system for the study of longterm effects of chronic exposure to polluting agents

Arctic
49, (1, March 1996, 23–28)

Effects of Petroleum Development on Terrain Preferences of Calving Caribou

Nellemann, C. , Cameron, R.D.

ABSTRACT

We investigated terrain preferences of caribou (Rangifer tarandus granti) in an oilfield region near Prudhoe Bay, Alaska. Under disturbance-free conditions, the distribution of calving caribou determined by aerial transect surveys was correlated with indices of terrain ruggedness based on map contours. Caribou preferred quadrants dominated by fine textured rugged terrain, particularly when present in large clusters, and avoided quadrants with flatter terrain. Displacement of maternal females from a zone within 4 km of roads and production-related facilities reduced use of rugged terrain types in that zone by 52%; the remaining preferred terrain was scattered and less accessible. This reduction was accompanied by a 43% increase in caribou use of rugged terrain 4-10 km from surface development. Given that terrain ruggedness is positively correlated with forage quality and biomass availability, combined underuse and overuse of these important habitats may compromise summer nutrition of lactating female caribou, thereby depressing body condition and, hence, subsequent reproductive success.

Ecological Applications
13, (3, 2003, Pages. 687–703)

Land Use and Land Cover Change in the Greater Yellowstone Ecosystem: 1975–1995

Parmenter, A.W., Hansen, A., Kennedy, R.E., Cohen, W., Langner, U., Lawrence, R., Maxwell, B., Gallant, A., Aspinall, R.,

ABSTRACT

Shifts in the demographic and economic character of the Greater Yellowstone Ecosystem (GYE) are driving patterns of land cover and land use change in the region. Such changes may have important consequences for ecosystem functioning. The objective of this paper is to quantify the trajectories and rates of change in land cover and use across the GYE for the period 1975–1995 using satellite imagery. Spectral and geographic variables were used as inputs to classification tree regression analysis (CART) to find ''rules'' which defined land use and land cover classes on the landscape. The resulting CART functions were used to map land cover and land use across seven Landsat TM scenes for 1995. We then used a thresholding technique to identify locations that differed in spectral properties between the 1995 and 1985 time periods. These ''changed'' locations were classified using CART functions derived from spectral and geographic data from 1985. This was similarly done for the year 1975 based on Landsat MSS data. Differences between the 1975, 1985, and 1995 maps were considered change in land cover and use. We calibrated and tested the accuracy of our models using data acquired through manual interpretation of aerial photos. Elevation and vegetative indices derived from the remotely sensed satellite imagery explained the most variance in the land use and land cover classes (i.e., defined the ''rules'' most often). Overall accuracies from our study were good, ranging from 94% at the coarsest level of detail to 74% at the finest. The largest changes over the study period were the increases in burned, urban, and mixed conifer-herbaceous classes and decreases in woody deciduous, mixed woody deciduous–herbaceous, and conifer habitats. These changes have important implications for ecological function and biodiversity. The expansion of mixed conifer classes may increase fuel loads and enhance risk to the growing number of rural homes. The reduction of woody deciduous cover types is likely reducing population sizes for the numerous plant and animal species that specialize on this habitat type. Some of these species are also negatively influenced by the increase of rural homes in and near woody deciduous habitats.

Canadian Field-Naturalist
110, (4, 1996, 649–658)

Parasitic Insect Abundance and Microclimate of Gravel Pads and Tundra within the Prudhoe Bay Oil Field, Alaska, in Relation to Use by Caribou, Rangifer Tarandus Granti

Pollard, R.H., Ballard, W.B., Noel, L.E., Cronin, M.A.

ABSTRACT

Parasitic insects such as mosquitoes and flies are a bother to caribou during the post-calving period. Observers have indicated that caribou use gravel pads and other oil field surfaces during this season to avoid these insects. Parasitic abundance and weather conditions were monitored on active and inactive gravel drilling pads, and in adjacent tundra, during the 1992 and 1993 calving periods. Inactive pads had lower ambient air temperatures than active pads or the nearby tundra. Both active and inactive had lower abundances of mosquitoes than did the tundra. Abundance was positively linked to temperature and negatively linked to humidity and wind velocity. Caribou were evident on both active and inactive pads during periods of mosquito infestations.

Environmental Geosciences
12, (2, June 2005, 65–72)

Oil Field-Produced Water Discharges into Wetlands: Benefits and Risks to Wildlife

Ramirez Jr., P.

ABSTRACT

Wyoming is one of a few states that allow the discharge of produced water from oil fields into surface waters for beneficial use by livestock and wildlife. Oil field discharges of produced water create wetlands that provide habitat for aquatic migratory birds and other wildlife. Wetlands surveyed in Wyoming from 1996 to 1999 showed that inefficient oil-water separation contributed to the discharge of oil into some wetlands receiving produced water. Over 62% of the sites surveyed had inadequate measures to exclude wildlife, particularly migratory birds, from entering skim pits used to separate oil from produced water. The risk of oil discharges into wetlands can be reduced significantly by proper maintenance of equipment used to separate oil from produced water; immediate removal of oil from production skim pits or tanks to prevent overflow into the receiving wetlands; installation of secondary or tertiary containment ponds or tanks to capture any oil accidentally discharged from the primary or secondary pits or tanks; or construction of wetland-based treatment systems for removing metals, radionuclides, and hydrocarbons from the produced water prior to discharge into natural wetlands. Wildlife mortality in skim pits can be prevented using closed containment systems, eliminating pits or keeping oil off open pits or ponds, or using effective and proven wildlife exclusionary devices.

California Fish and Game
83, (1, December 1997, 38–42)

The Occurrence of Hydrogen Sulfide Gas in San Joaquin Kit Fox Dens and Rodent Burrows in an Oil Field in California

Spiegel, L.K., Dao, T.C.

ABSTRACT

We measured levels of hydrogen sulfide gas (H_2S) in kit fox, Vulpes macrotis mutica, dens; rodent burrows; and ambient air at oil-developed and control sites in southwestern Kern County, California. Hydrogen sulfide levels in ambient air and fox dens at the oil-developed site were higher than those at the control site, but were lower than concentrations known to cause health effects to animals. Hydrogen sulfide levels in rodent burrows at the undeveloped site were higher than levels at 60-cm depths in kit fox dens at the oil-developed site. This suggests that exposure risks to fossorial mammals at the oil-developed site are similar to that occurring from the natural decay of plant material found in rodent caches. However, exposure effects to animals from repeated, low-level concentrations (i.e., < 1.0 ppm) of H_2S are unknown.

Gulf of Mexico Science
16, (1, June 1998, 73–82)

Spatial Variation in Fish Density at Three Petroleum Platforms as Measured with Dual-Beam Hydroacoustics

Stanley, D.R., Wilson, C.A.

ABSTRACT

Despite the number and ubiquitous placement of petroleum platforms in the northern Gulf of Mexico, little information exists on associated fisheries resources due to the difficulties of sampling these sites with traditional fish census methods. From 1994 to 1996 dual-beam hydroacoustics were employed on quarterly research trips to measure the density and in situ target strengths of fishes associated with petroleum platforms in 20, 60, and 219 m of water. Density varied significantly with platform, distance from the platform, depth, and platform side. Platforms on the continental shelf had a near-field area of influence of approximately 18 m, whereas the near-field are of influence for the site on the continental slope was 10 m, although the relationship was not as well defined as the other sites. Average estimated abundance over the study period was 26,347 at the 60-m site, 13,444 at the 20-m site and 11,224 at the 219-m site. Fishes were distributed throughout the water column at the sites on the continental shelf, whereas on the continental slope (water depth 219 m), over 88% of the fishes were found in the upper 60 m of the site.

Wildlife Society Bulletin
11, (2, 1983, 99–112)

Responses of Black Bears to Oil Development in Alberta (Ursus Americanus, Cold Lake)

Tietje, W.D., Ruff, R.L.

ABSTRACT

The responses of Ursus americanus to the construction and operation of oil construction facilities were studied near Cold Lake. The numbers and sex and age structure of bear cohorts pre- and during development were not significantly different. The same was true of bears on and off development sites. Female bears were especially tenacious in their continued occupancy of traditional areas. Adult males displayed variability in their responses while subadult males found oil sites desirable. The activity pattern of a female with cubs was perhaps altered in oil site operations. In the absence of appropriate management strategies, secondary impacts of oil extraction such as new roads, increased bear hunting (both legal and illegal) and human habitation may be of greater consequence to the numbers and behaviours of black bears than the primary impacts of habitat alteration and loss.-from Authors

Journal of Mammalogy
77, (4, November 1996, 1028–1041)

Response of Elk to Installation of Oil Wells

Van Dyke, F., Klein, W.C.

ABSTRACT

Environmental disturbance can affect use of home range by large, free- ranging ungulates, but quantitative assessments of such effects are rare. We compared seasonal and annual use of range and habitat in the population of elk (Cervus elaphus) at Line Creek in southcentral Mortana, 1988-1991, before, during, and after installation of an oil well. Use of range by elk during the post-drilling period in autumn was different from use during drilling and pre-drilling periods, but use of range also changed during the same periods in another local population of elk not subjected to disturbance from oil drilling. Use of range grid cells containing or adjacent to the well site declined during the post-drilling period, but seasonal and annual sizes in range and boundaries for the population were similar in all periods. Distances between individually marked elk did not differ across periods, suggesting that drilling did not affect the social stability of elk. Use of forest habitats in autumn increased after initiation of drilling. Results suggested that elk compensated for site-specific environmental disturbance by shifts in use of range, centers of activity, and use of habitat rather than abandonment of range.

Journal of Wildlife Management
62, (2 SUPPL., 1998, 707–717)

Factors Affecting the Spatial Distribution of San Joaquin Kit Foxes

Warrick, G.D., Cypher, B.L.

ABSTRACT

Determining the factors that influence or limit the distribution of endangered species can have important conservation implications. We investigated the spatial distribution of endangered San Joaquin kit foxes (Vulpes macrotis mutica) within a 31,400-ha area of the Naval Petroleum Reserves in California (NPRC) from 1988 to 1995 by relating capture rates of kit foxes to habitat factors, visitation rates of larger predators, and prey counts. Capture rates also were related to habitat factors on a smaller portion (11,500 ha) of NPRC from 1981 to 1995. Kit foxes were relatively evenly distributed in 1981-82, and regression models consequently explained only 6% of the spatial variation in capture rates. Afterwards, the distribution of kit foxes became more restricted, and models explained 36-60% of the variation in rates of capture. Capture rates were negatively associated with topographic ruggedness, were lower within a fenced area (limited public access and no livestock grazing; $P < 0.001$), and were often higher within burned areas ($P < 0.001$). After 1987, capture rates were usually negatively associated with oil-field development. Visitation rates of coyotes (Canis latrans), a major predator of kit foxes, were higher within the fenced area ($P \leq 0.034$). Capture rates were negatively correlated ($\tau_{132} = -0.22$, $P = 0.01$) with coyote visitation rates during 1992-95. Locations of bobcat (Lynx rufus) captures and visits to scent stations overlapped very little with capture locations of kit foxes. Counts of lagomorphs (a significant prey item) were negatively associated with burning, and between 1992 and 1995, lagomorph counts were positively associated with oil-field development. Capture rates were not correlated with lagomorph counts during 1988-91 ($\tau_{77} = -0.09$, $P = 0.44$) or 1992-95 ($\tau_{77} = 0.15$, $P = 0.18$). Our findings indicated the relation between kit foxes and the habitat factors studied was somewhat flexible, and the spatial distribution of kit foxes was not determined primarily by prey abundance. Predator density and topographic ruggedness appear to be important underlying factors governing the spatial distribution of kit foxes at NPRC.

Archives of Environmental Contamination and Toxicology
17, (5, 1988, 683–697)

Drilling Fluids and the Arctic Tundra of Alaska: Assessing Contamination of Wetlands Habitat and the Toxicity to Aquatic Invertebrates and Fish

Woodward, D.F., Snyder-Conn, E., Riley, R.G., Garland, T.R.

ABSTRACT

Drilling for oil on the North Slope of Alaska results in the release of large s of used drilling fluids into arctic wetlands. These releases usually come from regulated discharges or seepage from reserve pits constructed to hold used drilling fluids. A study of five drill sites and their reserve pits showed an increase in common and trace elements and organic hydrocarbons in ponds near-to and distant from reserve pits. Ions elevated in water were Ba, Cl, Cr, K, SO_4 and Zn. Concentrations of Cu, Cr, Fe, Pb, and Si in sediments were higher in near and distant ponds than in control ponds. The predominant organics in drill site waters and sediments consisted of aromatic and paraffinic hydrocarbons characteristic of petroleum or a refined product of petroleum. In 96-hr exposures in the field, toxicity to Daphnia Middendorffiana was observed in water from all reserve pits, and from two of five near ponds, but not from distant ponds. In laboratory tests with Daphnia magna, growth and reproduction were reduced in dilutions of 2.5% drilling fluid (2.5 drilling fluid: 97.5 dilution water) from one reserve pit, and 25% drilling fluid from a second. Growth and reproduction were not affected at these dilutions of fluid from the other three reserve pits. Additional regulations - such as an upper limit on aromatic hydrocarbon content and toxicity to sensitive organisms - are needed to improve safety for aquatic organisms in habitats receiving used drilling fluids.

Western North American Naturalist
62, (2, 2002, 151–159)

Movements and Home Ranges of San Joaquin Kit Foxes (Vulpes Macrotis Mutica) Relative to Oil-Field Development

Zoellick, B.W., Harris, C.E., Kelly, B.T., O'Farrell, T.P., Kato, T.T., Koopman, M.E.

ABSTRACT

We examined the effect of oil-field development on movements and patterns of spatial use of San Joaquin kit foxes (Vulpes macrotis mutica) on the Naval Petroleum Reserves in California (NPRC) in the San Joaquin Valley. To do this, we compared movements and home ranges of kit foxes from June 1984 to September 1985 in areas developed for petroleum production (30% of native habitat lost to production facilities) and areas with little development (3%). Distances traveled nightly by kit foxes did not differ between levels of petroleum development or between sexes ($P > 0.2$). Mean length of nightly movements during breeding (14.6 km) was longer than during pup-rearing (10.7 km) and pup-dispersal (9.4 km) periods ($P = 0.01$). Mean size of home ranges was 4.6 ±0.4 ($s\bar{x}$) km^2 ($n = 21$) and did not differ between levels of petroleum development and sexes ($P > 0.2$). Overlap of home ranges of foxes from the same social group (78 ± 4.3%) was greater than that of same-sex foxes (35 ± 7.8%) and males and females of different social groups (32 ± 8.0%, $P < 0.01$). Overlap of home ranges did not differ between kit foxes inhabiting developed and undeveloped areas ($P > 0.4$). Despite extensive overlap of home ranges, kit foxes on NPRC maintained relatively exclusive core areas, particularly adjacent foxes of the same sex. Future studies should examine which levels of habitat conversion impact spatial use of kit foxes.