UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

April 16, 1998

TECHNICAL ASSISTANCE REQUEST

Docket No. 030-04530
License No. 19-00915-03
Control No. 125345

MEMORANDUM TO: Donald A. Cool, Director
Division of Industrial and Medical Nuclear Safety

FROM: A. Randolph Blough, Director
Division of Nuclear Materials Safety

SUBJECT: RELEASE FOR UNRESTRICTED USE OF SITES FORMERLY USED FOR BURIAL OF LOW-LEVEL RADIOACTIVE WASTE UNDER NRC LICENSE NO. 19-00915-03

Background

In October 1996, the Low-Level Waste and Decommissioning Projects Branch, Division of Waste Management, published a Draft Branch Technical Position concerning a Screening Methodology for Assessing Prior Land Burial of Radioactive Waste Authorized Under Former 10 CFR 20.304 and 20.302 (61 FR 56716-24). The United States Department of Agriculture (USDA) proposes to use Step 2 of the screening methodology to demonstrate that materials remaining in a former burial site at the Jornada Experimental Range in Las Cruces, New Mexico, a USDA facility, pose minimal risk to members of the public. The USDA requests that the site be released for unrestricted use.

In 1991, the University of Utah carried out a study on the Jornada Experimental Range in which goats and coyotes were given certain radioactive material. At the conclusion of the study, these goats and coyotes were buried on the site. The USDA assumed responsibility for the burial site in June of 1991.

The radioactive material buried at the site on February 1, 1991 consisted of 7.2 μCi of ^{54}Mn, 98 μCi of ^{65}Zn, 71 μCi of ^{125}I, and 86 μCi of ^{134}Cs. Presently, only ^{134}Cs remains in quantities sufficient to significantly contribute to the dose calculated by the screening methodology. According to the screening methodology, the highest potential dose to a member of the public from the Jornada Experimental Range burial site is 5 millirem.

Action Required

Review USDA's submission concerning its former burial site, and determine if there is any reason that the sites should not be released for unrestricted use.

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Recommended Action

The Draft Branch Technical Position states, "Although this methodology estimates doses, they are very conservative estimates. Actual doses produced by a site would be a fraction of the doses estimated using this screening." It goes on to say, "If the total dose is less than the 100 mrem/yr screening level, the site passes Step 2 and, in general, the site will require no additional evaluations." Therefore, on July 1, 1998, Region I intends to release this former burial site for unrestricted use based on our independent review of the licensee's analysis against the criteria in the Draft Branch Technical Position. If there is any reason the region should not do so, please inform us prior to July 1 so that we may consider another course of action.

Attachment:
Letter from USDA dated December 19, 1997

Reviewer: Keith D. Brown (KDB1)
(610) 337-5048
Request Needed by: July 1, 1998

DOCUMENT NAME: G:\DNMS\DOCWORK\TAR\BURIALS2.TAR

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OFFICE	DNMS/RI	N	DNMS/RI	N	DNMS/RI	N		
NAME	KBrown		JKinneman		RBlough			
DATE	04/16/98		04/17/98		04/17/98		04/ /98	

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United States Department of Agriculture

Office of the Assistant Secretary for Administration

Policy Analysis and Coordination Center

Human Resources Management

Safety and Health Management Division

Radiation Safety Staff
4700 River Road, Unit 91
Riverdale, MD 20737
Phone: 301-734-4945
Fax: 301-734-5050

DEC 19 1997

030-04530

Keith Brown, Ph.D., Health Physicist
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406

Dear Dr. Brown:

This is a request to amend the U.S. Department of Agriculture (USDA) license (License Number 19-00915-03, Docket Number 030-04530) to remove the Agricultural Research Service's Jornada Experimental Range in Las Cruces, New Mexico, from the list of USDA radioactive waste burial sites. The enclosed analysis of the burial site was conducted using the screening criteria in the Nuclear Regulatory Commission's Branch Technical Position Paper (FR, Vol. 61, No. 214, dated November 4, 1996.) The analysis indicates that the maximum exposure resulting from unrestricted use of the burial site would be approximately 5 milllirem per year. We request that the burial site in Las Cruces, New Mexico, be released for unrestricted use and the USDA license be amended to remove Las Cruces, New Mexico, from the list of USDA radioactive waste burial sites.

If you have any questions, please contact me on 301-734-4945.

Sincerely,

Daniel R Shap

for John T. Jensen
Director
Radiation Safety Staff

cc: w/out enclosures
C. Onstad AD-SPA, ARS
J. Williams, AAO-SPA, ARS
A. Schipper, RSC
W. Horner, RSC
J. Lunney, RSC
C. Veillon, RSC
D. Smith, RSC

cc: w/enclosures
K. Harstad, ARS
P. Smith, ASHM-SPA, ARS
Location Files

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Technical Analysis In Support of the
Release for Unrestricted Use
Of the Shallow Land Burial Site
At
USDA, ARS, Jornada Experimental Range, Las Cruces, New Mexico

Background

Burial of certain quantities of radioactive waste in soil without prior approval of the Nuclear Regulatory Commission (NRC) was authorized in 10 CFR 20.304 on January 29, 1959. This authorization was rescinded on January 28, 1981.

A field study was performed at the Jornada Experimental Range in the spring of 1991 under the approval of the University of Utah involving coyote predation studies. Radioactive goats and coyotes were buried on the range at the conclusion of the study.

The U.S. Department of Agriculture (USDA) assumed responsibility for the site in June of 1991 and received formal approval from the NRC for burial of radioactive material under 10 CFR 20.302 on January 8, 1994.

The original burials at the site consisted of the following:

Date of burial: February 1, 1991

Isotopes and activities:

Isotopes	Goats	Coyotes	Total (μCi)
^{54}Mn	--	7.2	7.2
^{65}Zn	93.2	5.2	98.4
^{125}I	--	71.0	71.0
^{134}Cs	81.0	5.0	86.0

Site Description and Hydro-geology

The Jornada Experimental Range lies within the Chihuahuan Desert, which is the largest desert in North America. The range consists of approximately 200,000 acres of grassland dedicated to pasture and grazing research. The main office complex is approximately 15 miles north of Las Cruces, New Mexico.

The burial site is on the eastern side of the Jornada Experimental Range, T18S, R2E, Section 34, Dona Ana County, New Mexico. The burial site is an additional two miles north of the office complex, accessible by passing through two fence gates used for cattle control.

The burial pit is 5 feet wide, 30 feet long and 8 feet deep. Materials were buried with a minimum of 6 feet of overburden. An area 40 feet by 80 feet surrounding the pit is currently fenced with barbed wire and contains no gates. No structures are within approximately two miles of the burial site.

The water table in this vicinity is approximately 400 feet below the surface (based on a water well 2 miles to the east of the site). A 10-12 inch layer of caliche (calcium carbonate layer above which evaporation exceeds percolation) is found approximately 4 feet below the surface and some 2-3 feet above the buried materials.

The average annual rainfall for the Jornada Experimental Range is approximately 10 inches per year. The average annual evaporation rate is approximately 87 inches per year.

Based on these conditions actual leaching of the buried materials should be negligible due to the arid nature of the environment and the later of caliche.

Site Inspection History

Members of the USDA Radiation Safety Staff have inspected the Jornada Experimental Range on two occasions in 1995 and 1997. No violations regarding the burial site were noted. In addition, the site was inspected by an NRC inspector on 8/14/97. No violations were noted at that time.

Members of the Jornada Experimental Range staff conducted semi-annual inspections of the burial site to assure the integrity of the physical barriers and to check for unusual disturbances.

Current Site Status and Dose Calculation

Based on the current isotopes and activities estimated for the Jornada burial site, the calculated potential dose to a maximally exposed individual would be 5 mRem per year.

[Based on the NRC Branch Technical Position on Screening Methodology, FR Vol. 61, No. 214, 11/4/96]

In addition, the dose is due exclusively to the ^{134}Cs remaining and the dose decreases by a factor of two every two years.

The calculated dose value is less than the 100 mRem per year dose limit. Therefore the Jornada burial site is a candidate for unrestricted release.

Signed by:

Jack F. Patterson
Certified Health Physicist
Radiation Safety Staff

12/15/97
Date

Attachments

The following attachments are used to document the site history.

1 Map showing location of Jornada burial site.

2 Spreadsheet calculation of dose using screening methodology.

3 Descriptive brochure of the Jornada Experimental Range.

4 Letter from Frederick Knowlton, Utah State University requesting burial of radioactive materials on USDA property, dated 6/6/91.

5a Letter from John Jensen, USDA Radiation Safety Staff requesting license amendment and burial of radioactive materials under 10 CFR 20.302, dated 6/27/91.

5b Response letter from Elizabeth Ullrich, US NRC requesting additional information, dated 5/20/92.

5c Response letter from John Jensen, USDA Radiation Safety Staff, dated 7/9/92, with enclosure letter dated 6/18/92.

5d Response letter and amended license from Elizabeth Ullrich, US NRC, dated 1/8/94.

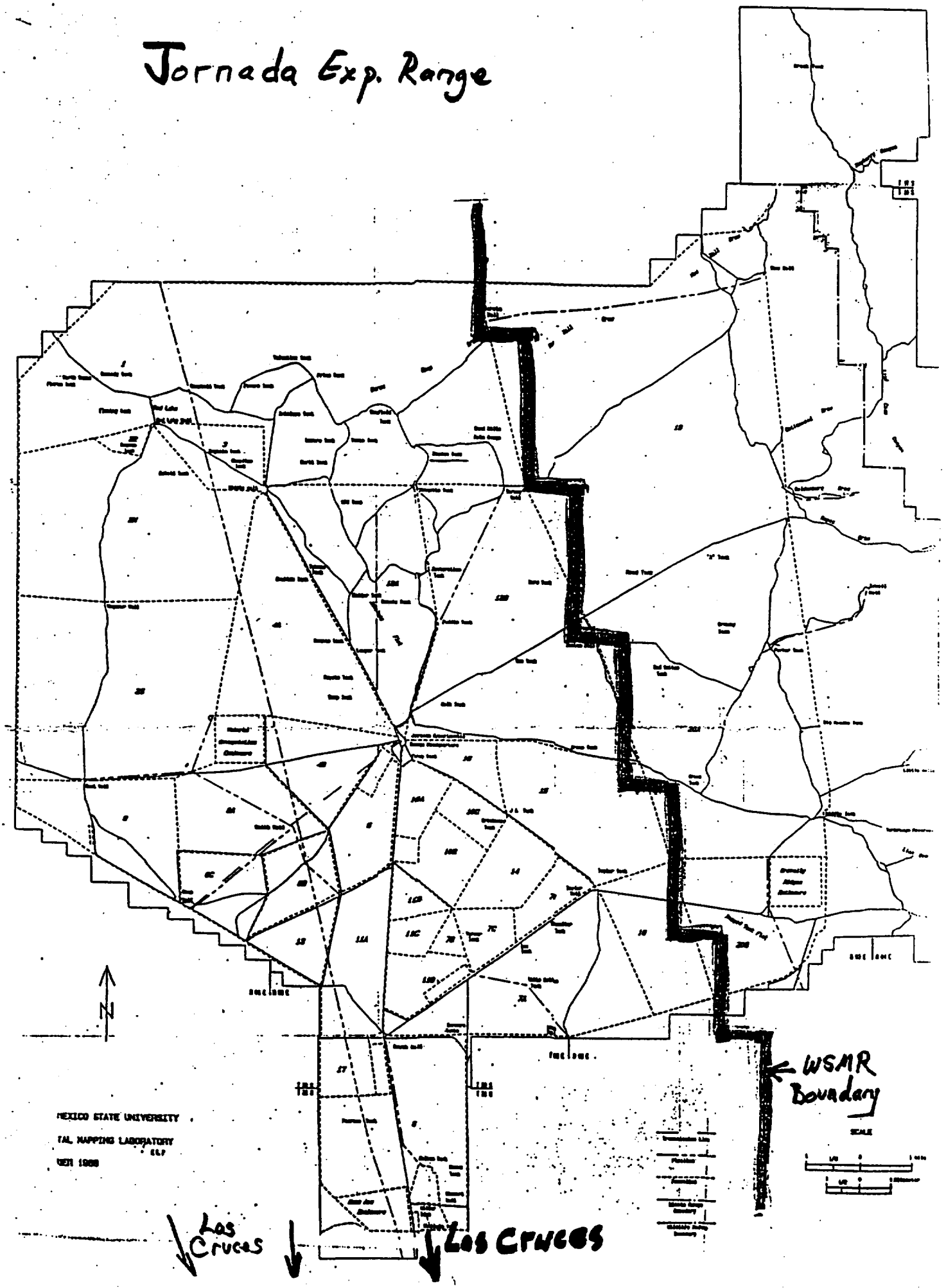
6a Letter from John Kinneman, US NRC, to Dr. Sunderland, Utah State University regarding the coyote predation study, dated 1/21/92.

6b Response letter from Dr. Sunderland dated 1/27/92.

6c Response letter from Francis Costello, US NRC, dated 2/18/92.

7 Letter from Russell Reidinger dated 7/5/91.

8 Letter from Kris Havstad, dated 6/30/92.


Jornada Exp. Range
N
WSMR Boundary
Las Cruces
Las Cruces

Calculation Dates

Date of Burial	1-Feb-91

Analysis Date	1-Jan-98

Decay Calculation for Current Activity

Isotope	Half-Life	Original Activity (μCi)	Current Activity (μCi)
54-Mn	312	7.2	0.03
65-Zn	244	98.4	0.08
125-I	60	71.0	0.00
134-Cs	754	86.0	8.43

Groundwater Pathway Screening Methodology

Isotope	Current Activity (μCi)	Est. Water Use (ml/yr)	Potential Concentration (μCi/ml)	10 CFR 20, Appendix B Value (μCi/ml)	Potential Dose (mRem/yr)
54-Mn	0.03	9.1E+07	2.9E-10	3.00E-05	4.8E-04
65-Zn	0.08	9.1E+07	8.3E-10	5.00E-06	8.3E-03
125-I	0.00	9.1E+07	1.7E-19	2.00E-06	4.1E-12
134-Cs	8.43	9.1E+07	9.3E-08	9.00E-07	5.1E+00

Total:	5.2	mRem/yr

The Jornada Experimental Range Las Cruces, New Mexico

A Laboratory Without Walls

Agricultural Research Service

Agricultural Research Service

The Agricultural Research Service (ARS) is the primary research agency of the U.S. Department of Agriculture. Research programs are planned and carried out in light of national priorities with the cooperation and advice of Congress, U.S. industry, state agricultural experiment stations and universities, USDA action agencies, and other organizations and institutions interested in the future of U.S. agriculture.

ARS mission is to:
Develop new knowledge and technology needed to solve technical agricultural problems of broad scope and high national priority in order to ensure adequate production of high quality food, fiber, and other agricultural products to meet the institutional needs of the American consumer, to sustain a viable food and agricultural economy, and to maintain a quality environment and natural resource base.

ARS conducts research on animal and plant production; protection of animals and plants from diseases; use and improvement of soil, water, and air resources; processing, storage, and food safety; and human nutrition.

At present, ARS has over 100 locations strategically located across major farm and rangeland ecosystems and climate zones of the United States. Consequently, ARS has the ability to bring research expertise to bear on the same national problems in several different geographic locations.

Jornada Experimental Range mission is to:
Develop new knowledge of ecosystem processes as a bases for management and remediation of desert rangelands.

The Jornada Experimental Range has the largest acreage of any ARS field station. It is located in the Southern Plains Area, a subunit of ARS, that is headquartered at College Station, Texas.

Visitors and Information

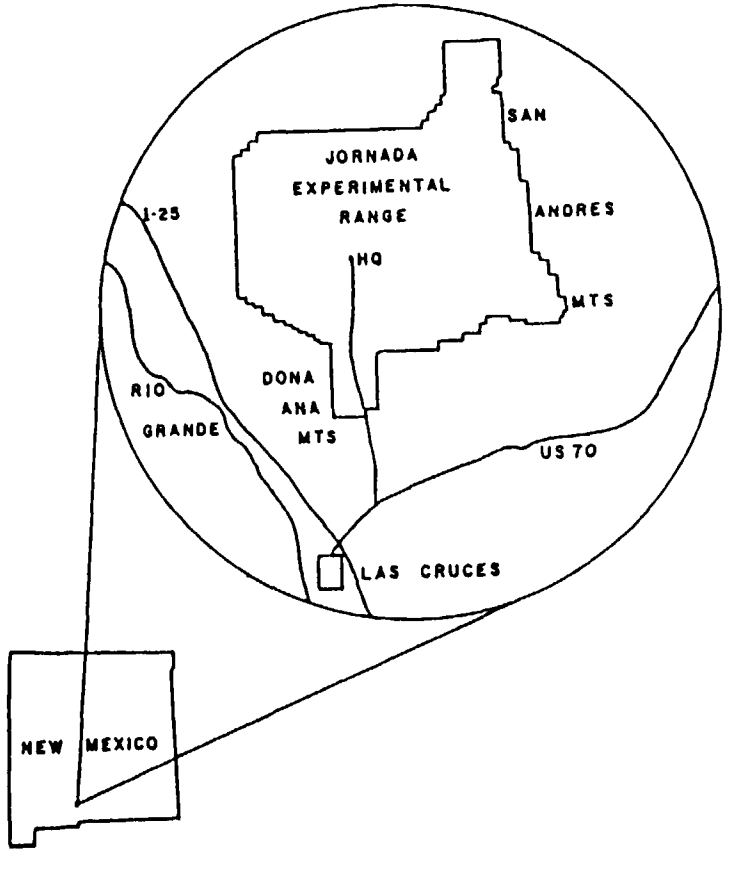
Visitors are most welcome at the Jornada Experimental Range. For information or tours, contact:

Research Leader, ARS-USDA
Jornada Experimental Range
Box 30003, NMSU, Dept. 3JER
Las Cruces, NM 88003-0003
Telephone: (505) 646-4842
Fax: (505) 646-5889
Email: vgamboa@nmsu.edu

The Jornada Experimental Range Las Cruces, New Mexico

Location

The Jornada Experimental Range is located 23 miles (37 kilometers) north of Las Cruces. Most of the Experimental Range is on the Jornada del Muerto Plain, which lies between the Rio Grande Valley on the west and the San Andres Mountains on the east. The crest of the San Andres Mountains roughly coincides with the eastern boundary of the Range.



Historical Highlights

1598 Don Juan de Oñate followed the Rio Grande northward during his conquest and settlement of New Mexico. During the next three centuries, the Jornada del Muerto (Journey of Death) Plain was traversed by mission supply caravans, the Santa Fe-Chihuahuan trade caravans and, finally, stagecoach lines. This trail is still visible a few miles west of the Jornada Experimental Range.

1858 First land survey of the area which later formed the Jornada Experimental Range, with records made of soils and vegetation.

1880 Beginning of a decade during which ranches were established at springs in the San Andres Mountains.

1901 C.T. Turney, a rancher, settled at site of present-day Jornada Headquarters and gained control of water sources in the area.

1904 E.O. Wooton, visionary botanist with the New Mexico College of Agriculture and Mechanic Arts, started cooperative range investigations with C.T. Turney and other ranchers in southern New Mexico.

1912 Largely through the efforts of Wooton, the Public Domain lands comprising the C.T. Turney ranch were set aside by Presidential Executive Order as the Jornada Range Reserve, administered under Wooton's direction by the Bureau of Plant Industry within the USDA. Turney remained as the first of a continuing succession of cooperating ranchers.

1915 Jornada Range Reserve was transferred from the Bureau of Plant Industry to the U.S. Forest Service.

1927 Jornada Range Reserve renamed Jornada Experimental Range.

1945 U.S. Army leased mountain portion of Jornada as a buffer zone for White Sands Missile Range.

1953 Additional area leased by Army.

1954 Jornada Experimental Range transferred from the Forest Service to the Agricultural Research Service (ARS).

1971 Research and grazing use reinstated on part of the Army-controlled portion of the Jornada Experimental Range.

1977 Selected as a Biosphere Reserve by UNESCO's Man and the Biosphere Program. Also, designated as an Ecological Reserve by The Institute of Ecology.

1983 Domestic sheep introduced on the Jornada Experimental Range.

1984 Cooperative rancher arrangement discontinued, and all livestock purchased and managed by Experimental Range staff as property of the State of New Mexico.

1989 Included as one of eighteen sites of the National Science Foundation's network for long-term ecological research in the United States.

1994 Cooperative agreement (labeled the Ecosystem Stewardship Project) established with Beck Land and Cattle Company to manage livestock production in Pastures 1A and 1B within a holistic framework.

Present Research Activities

Our research emphasis on rangeland management continues the original focus of the Jornada Experimental Range that began in 1912 (see page 20), but with an increased emphasis on understanding basic ecological processes in desert environments. Our core research program has four principle objectives:

1. ***Determine effects of stressors upon ecosystem processes.*** Understanding impacts of various stressors or perturbations, including human activities, is crucial to development of appropriate management practices. We want to identify indicators that can be incorporated into technologies to monitor and assess resource conditions. This research is being conducted in cooperation with scientists and staff of the Environmental Protection Agency (EPA) as part of their Environmental Monitoring and Assessment Program (EMAP).

2. ***Develop new knowledge to enhance survival and dispersal of native plants used for remediation of degraded rangeland.*** Plants in arid environments are challenged in acquiring sufficient water and nutrients for growth. Traditional methods for revegetation are generally economically and ecologically unsuccessful in this harsh environment. We want to develop affordable technologies for remediation that utilize natural processes to promote plant dispersal, establishment, and reproduction. Basic ecological processes that enhance plant survival by supplying essential nutrients and water during stressful periods are also studied.

3. ***Identify chemical attributes of shrubs which contribute to their landscape dominance.*** Plants, including shrubs such as creosotebush and tarbush, maintain chemical-based defenses which provide substantial competitive advantages in desert environments. We are examining the chemical basis of plant-animal and plant-environment interactions to learn how to manage arid rangelands either dominated by or with an increasing presence of these plants. In addition, we are looking for chemical components which may have value for medicinal or industrial uses.

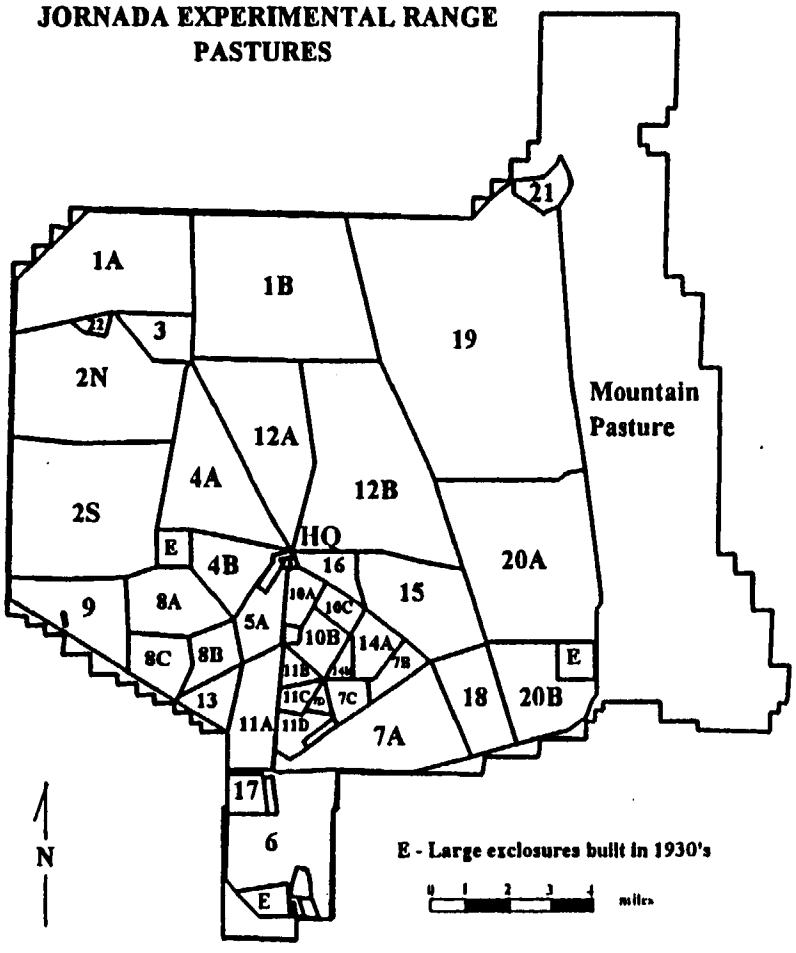
4. ***Create innovative methods that manipulate livestock foraging and associated behaviors.*** Domestic livestock learn to forage. However, manipulating principles of social organization have been applied in only a limited fashion to livestock production systems. Our research focuses on developing practical technologies to manipulate animals based on principles governing group and individual behavior. Our goal is to affect animal distribution to more effectively manipulate forage utilization under extensive rangeland conditions.

Collaborative Research

To fully utilize the scientific resources of the Jornada Experimental Range our research program is built on strong collaborations with other agencies and institutions with interest in the use and mangement of desert rangelands. A key example is our formal arrangement with EPA's Las Vegas, NV, laboratory to house scientists and staff for our cooperative research on environmental monitoring.

Our central collaboration is with the Long-Term Ecological Research (LTER) program of the National Science Foundation. The Jornada Experimental Range is one of eighteen sites that comprise the LTER national network. At the Jornada Experimental Range scientists from New Mexico State University, Duke University, Dartmouth, the State University of New York at Buffalo, and other agencies are conducting research on nutrient cycling, effects of consumers, animal population dynamics, and other processes related to desertification. This network is a collaboration among over 600 scientists and students from throughout the United States.

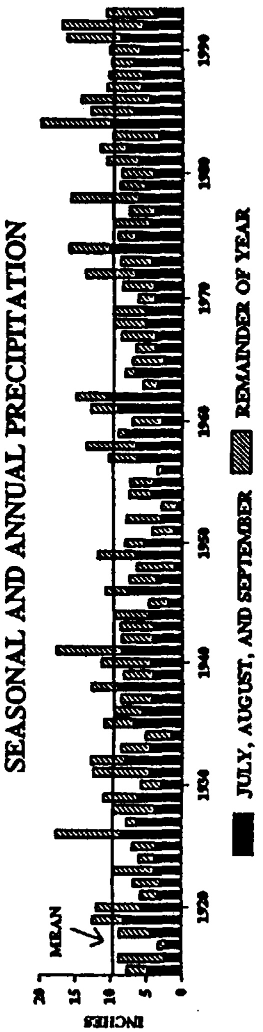
Our program compliments and enhances research activities at New Mexico State University, and we directly collaborate with faculty in the Agricultural Experiment Station, the College of Arts and Sciences, and the Physical Sciences Laboratory. These scientific activities span from identification of nutritional requirements of heifer calves to application of unique technologies for monitoring rangelands. Numerous other collaborators on studies of ecological processes in deserts include the U.S. Geological Survey, the Technology Engineering Center of the Corps of Engineers, the National Oceanographic and Atmospheric Association, the University of New Mexico, the Oregon Graduate Institute, the National Park Service, and the U.S. Fish and Wildlife Service.

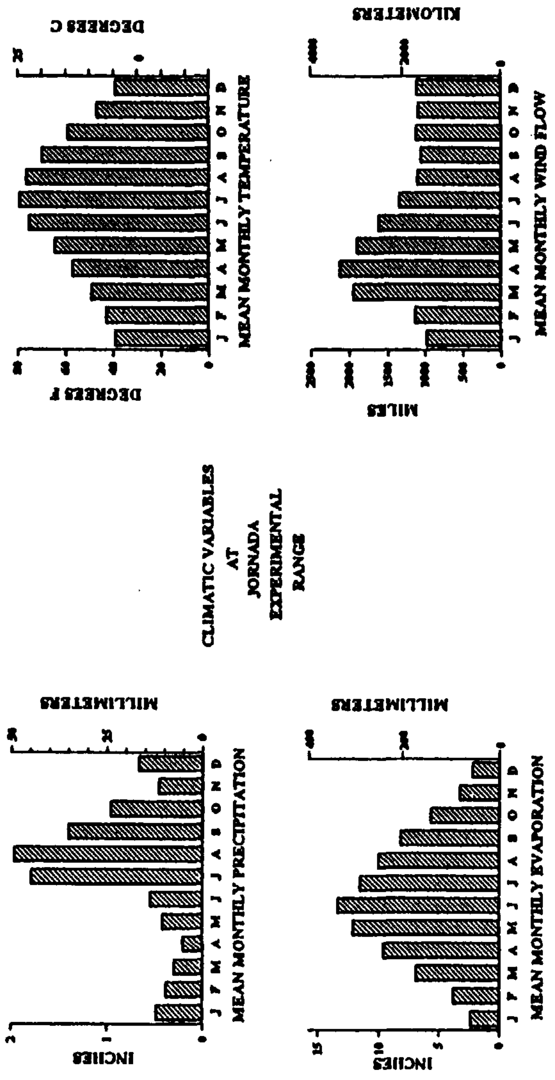


Area

In 1912, 193,394 acres (78,266 hectares) were withdrawn from the Public Domain for the Jornada Experimental Range. A smaller acreage is included within the present fenced boundaries. Thirty-five pastures and two large exclosures totaling 105,238 acres (42,621 hectares) encompass most of the relatively level plains. These pastures are the site of most past and current research. An additional area (Pastures 19, 20A & 20B, 21, the Gravelly Ridges Exclosure and the Mountain Pasture) is managed under a Memorandum of Understanding with the White Sands Missile Range. Area in individual pastures is as follows:

Pasture No.	*Acres*	*Hectares*
1A	7,970	3,226
1B	11,863	4,802
2N	8,346	3,378
2S	9,591	3,882
3	1,384	560
4A	5,473	2,215
4B	2,151	870
5A	1,452	587
5B	182	73
6	5,084	2,058
7A	5,179	2,096
7B	741	300
7C	673	272
7D	217	87
8A	2,723	1,102
8B	1,232	498
8C	1,480	599
9	3,093	1,252
10A	804	325
10B	1,103	446
10C	648	262
11A	2,354	953
11B	459	185
11C	469	189
11D	823	333
12A	5,992	2,425
12B	10,905	4,414
13	1,012	409
14A	1,067	431
14B	326	131
15	4,483	1,814
16	1,151	465
17	730	295
18	2,547	1,031
19	24,277	9,828
20A	10,528	4,262
20B	3,439	1,388
21	828	335
22	251	101
Mountain Pasture	41,193	16,671
Dona Ana Exclosure	640	259
Gravelly Ridges Exclosure	640	259
Natural Revegetation Exclosure	640	259





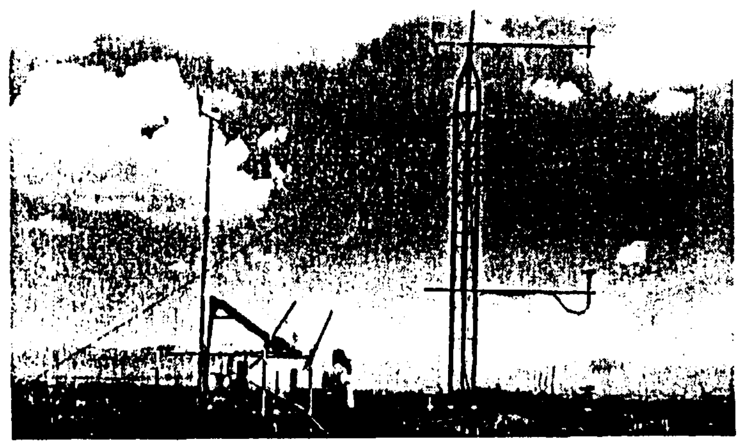
Climate

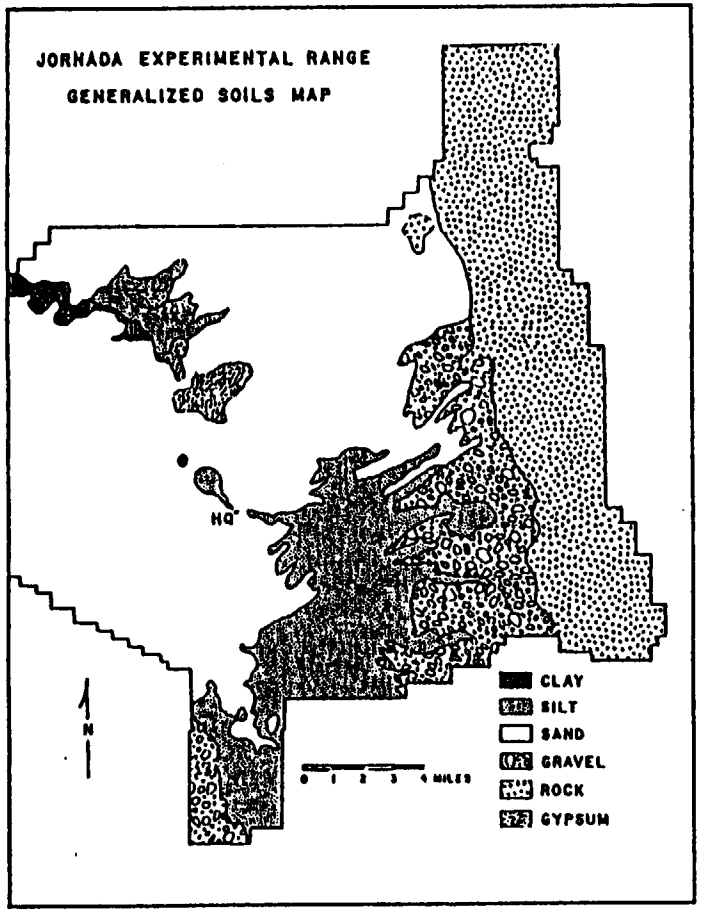
The Jornada Experimental Range lies within the Chihuahuan Desert, the largest desert in North America. The climate is typical of semidesert grassland, the most arid of the North American grassland regions. There is an abundance of sunshine, a wide range between day and night temperatures, low relative humidity, and extremely variable precipitation.

There are two precipitation peaks: summer rains occur primarily in July, August, and September; whereas, winter precipitation occurs from December to February. Winter frontal storms originate over the Pacific Ocean and are characterized by gentle, low-intensity precipitation that covers wide areas and may last for several days. Summer precipitation originates in the Gulf of Mexico and occurs as intense, convective thunderstorms that are highly localized and of short duration.

Rainfall records exist for the Jornada Experimental Range headquarters since 1915 and at other locations on the Range for equal or shorter timespans. Mean annual precipitation is 9.72 inches (247 mm) with 53 percent of the annual rainfall occurring between July 1 and September 30. Droughts, or periods of low rainfall that seriously injure vegetation, are a recurrent climatic phenomenon. Severe droughts occurred in 1916-18, 1921-26, 1934, and 1951-57. The 1951-57 drought is believed to be the most severe in the past 350 years.

Mean maximum ambient temperature is highest in June when it averages 97°F(36°C); temperature is lowest in January when the mean maximum is 56°F(13.3°C). The effective growing season, when both precipitation and temperature are favorable, is normally July through September.





Geology and Soils

Elevations range from 4,200 feet (1,260 meters) on the plains to 8,500 feet (2,833 meters) in the mountains. The San Andres Mountains were formed from a west-dipping fault block and have moderate to steep slopes on the west and precipitous slopes on the east. Rocks in the mountains were derived from marine sediments deposited during the Paleozoic.

Materials deposited by the ancestral Rio Grande and washed in from the surrounding mountains have formed the Jornada Plain, which occupies the level-to-gently-undulating floor of the intermountain basin. The basin is closed, with no external drainage, and water occasionally collects in the scattered low spots or playas. Coarser sediments are found near the foothills, and finer soil particles, the silts and clays, are found in the lowest areas. Both water and wind erosion processes are still active and microrelief changes are continuous.

Twenty-two different soil types are present on the Jornada Plain. These soils have almost no humus or organic matter, and there is little change in texture between surface soil and subsoil. Lime content is high in all soil types. Through time, lime from the soil and from calcareous dust has leached downward and deposited at the depth to which rainfall normally penetrates, from a few inches to several feet. This zone of lime accumulation, or caliche layer, is often so thick and dense that penetration by water or roots is severely limited.

Common Plants on the Jornada Experimental Range

Perennial Grasses:	
Black grama	*Bouteloua eriopoda*
Mesa dropseed	*Sporobolus flexuosus*
Red threeawn	*Aristida purpurea var. longiseta*
Wooton's threeawn	*Aristida pansa*
Tobosa	*Pleuraphis mutica*
Burrograss	*Scleropogon brevifolius*
Sand dropseed	*Sporobolus cryptandrus*
Alkali sacaton	*Sporobolus airoides*
Plains bristlegrass	*Setaria macrostachya*
Bush muhly	*Muhlenbergia porteri*
Fluffgrass	*Dasyochloa pulchella*
Annual Grasses:	
Six-weeks threeawn	*Aristida adscensionis*
Six-weeks grama	*Bouteloua barbata*
Needle grama	*Bouteloua aristidoides*
False buffalograss	*Munroa squarrosa*
Perennial Forbs:	
Desert baileya	*Baileya multiradiata*
Woolly paperflower	*Psilostrophe tagetina*
Leatherweed croton	*Croton pottsii*
Spiny-leaved perezia	*Perezia nana*
Annual Forbs:	
Tumbling russianthistle	*Salsola australis*
Wislizenus spectaclepod	*Dithyrea wislizenii*
Chinchweed	*Pectis papposa*
Shrubs and Shrublike Plants:	
Creosotebush	*Larrea tridentata*
Honey mesquite	*Prosopis glandulosa var.glandulosa*
Tarbush	*Flourensia cernua*
Broom snakewood	*Gutierrizia sarothrae*
Fourwing saltbush	*Atriplex canescens*
Soaptree yucca	*Yucca elata*
Longleaf ephedra	*Ephedra trifurca*
Whitethorn	*Acacia constricta*
Ocotillo	*Fouquieria splendens*
Wheeler sotol	*Dasylirion wheeleri*
Trees:	
Red-berry juniper	*Juniperus erythrocarpa*
Mexican pinyon pine	*Pinus cembroides*

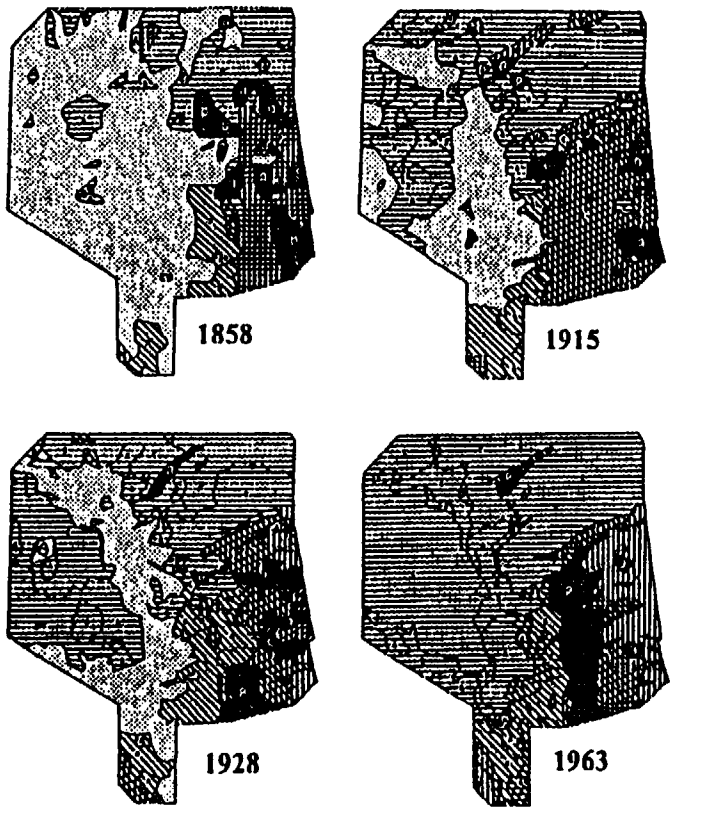
Nomenclature Sources: Kelly W. Allred, 1993, A Field Guide to the Grasses of New Mexico, and 1988, A Field Guide the Flora of the Jornada Plain (publications of the NM Agricultural Experiment Station).

Vegetation

The Jornada Experimental Range is usually classified as semidesert grassland, an ecosystem which covers about 26 million acres (10.5 million hectares) in southeastern Arizona, southern New Mexico, western Texas, and northern Mexico. Thus, research results are applicable to much larger areas. Although called "grassland", the region contains a complex of vegetation types ranging from nearly pure stands of grass, through savanna types with grass interspersed by shrubs or trees, to nearly pure stands of shrubs. The mountains, plains, and drainageways provide a great variety of habitats for plants, and the flora is rich in species. On the Experimental Range, some 545 species of higher plants have been collected.

On the Jornada Plain, the major grass species on sandy soils are black grama, mesa dropseed, and red threeawn. Shrubs or shrub-like plants on sandy soils include honey mesquite, fourwing saltbush, soaptree yucca, and broom snakeweed. Extensive dunes have developed where mesquite has invaded sandy soils. Low-lying areas with heavier soils, and which receive water from surface runoff, are dominated by tobosa and burrograss. Tarbush is a frequent invader of these heavy soils. Slopes with gravelly soils near the mountains are typically dominated by creosotebush. In years with favorable winter and spring moisture, many annual grasses and forbs are also abundant across soil types.

Within the mountains, shrub types are mixed. Major dominants include honey mesquite, creosotebush, sotol, ocotillo, and whitethorn. Some areas of scrub woodland are dominated by red-berry juniper and Mexican pinyon pine.



Major brush species by species composition classes on the Jornada Experimental Range.

Brush Invasion

The increase in brush on the Jornada Plain is well documented. A land survey made in 1858 included notes on soils and vegetation. From these notes, the relative abundance of brush types in 1858 was reconstructed. Extent of brush types was also determined from vegetative surveys made on the Jornada Plain in 1915, 1928, and 1963.

In 1858, good grass cover was present on more than 90 percent of the 144,475 acres (58,492 hectares) studied. By 1963, less than 25 percent of the area had good grass cover. The table below shows the percentage of area occupied by dense (55 to 100 percent of perennial plant composition) brush cover of the major shrubs at various dates.

Vegetation Cover[1]	1858	1915	1928	1963
			Percent	
Brush-free	58	25	23	0
Honey mesquite	5	24	22	50
Creosotebush	0	3	5	14
Tarbush	0	2	5	9

[1] *Dense cover ≥ 55% of perennial plant composition.*

Mesquite is the primary invader on sandy soils. Tarbush has increased on the heavier soils, and creosotebush occupies shallow and gravelly soils. Collectively, the spread of brush has been ubiquitous and rapid. As a result, range carrying capacities have been drastically lowered. Periodic droughts, unmanaged livestock grazing, and brush seed dispersal by humans, livestock, and rodents have all contributed to the spread of the shrubs. Brush has increased in permanent livestock exclosures erected during the 1930's, demonstrating that brush invades grasslands even in the absence of livestock grazing. Once established, brush effectively monopolizes soil moisture and nutrients, and grass reestablishment is generally very limited without selective control of brush species. However, traditional brush control practices are expensive and frequently only of short-term effectiveness. New technologies are needed, but at present there are few management options for controlling continued brush encroachment.

Animals Found on the Jornada Experimental Range

Large herbivores:

Pronghorn antelope	*Antilocapra americana*
Mule deer	*Odocoileus hemionus*
Desert bighorn sheep	*Ovis canadensis mexicanus*
Gemsbok (oryx)	*Oryx gazella*

Carnivorous mammals:

Coyote	*Canis latrans*
Gray fox	*Urocyon cinereoargenteus*
Desert fox	*Vulpes macrotis*
Badger	*Taxidea taxus*
Bobcat	*Felis rufus*
Striped skunk	*Mephitis mephitis*

Small mammals:

Ord's kangaroo rat	*Dipodomys ordii*
Merriam's kangaroo rat	*Dipodomys merriami*
Banner-tailed kangaroo rat	*Dipodomys spectabilis*
White-throated wood rat	*Neotoma albigula*
Southern plains wood rat	*Neotoma micropus*
Silky pocket mouse	*Perognathus flavus*
Spotted ground squirrel	*Spermophilus spilosoma*
Deer mouse	*Peromyscus maniculatus*
Harvest mouse	*Reithrodontomys megalotis*
Desert cottontail	*Sylvilagus audubonii*
Blacktailed jackrabbit	*Lepus californicus*

Birds:

Roadrunner	*Geococcyx californianus*
Redtailed hawk	*Buteo jamaicensis*
Swainson's hawk	*Buteo swainsoni*
Golden eagle	*Aquila chrysaetos*
Burrowing owl	*Speotyto cunicularia*
Mourning dove	*Zenaida macroura*
Gambel quail	*Lophortyx gambelii*
Scaled quail	*Callipepla squamata*
Black-throated sparrow	*Amphispiza bilineata*
Western kingbird	*Tyrannus verticalis*
Scott's oriole	*Icterus parisorum*
Curve-billed thrasher	*Toxostoma curvirostre*
Lesser nighthawk	*Chordeiles acutipennis*
Chihuahuan raven	*Corvus cryptoleucus*
Cactus wren	*Campylorhynchus brunneicapillus*
Turkey vulture	*Cathartes aura*
White-crowned sparrow	*Zonatrichia leucophrys*
Lark Bunting	*Calamospiza melanocorys*

Animals Found on the Jornada Experimental Range (continued)

Reptiles and amphibians:

Prairie rattlesnake	*Crotalus viridis*
Diamondback rattlesnake	*Crotalus atrox*
Texas horned lizard	*Phrynosoma cornutum*
Side-blotched lizard	*Uta stansburiana*
Western whiptail lizard	*Cnemidophorus tigris*
Little striped whiptail	*Cnemidophorus inornatus*
Gopher snake	*Pituophis melanoleucus*
Western spadefoot toad	*Spea multiplicata*
Couch's spadefoot toad	*Scaphiopus couchi*

Insects:

Lesser migratory locust	*Melanoplus sanguinipes*
Snakeweed grasshopper	*Hesperotettix viridis*
Painted lady butterfly	*Vanessa cardui*
Harvester ant	*Pogonomyrmex rugosus*
Darkling beetle	*Eleodes hispilabris*
Subterranean termite	*Gnathamitermes tubiformans*

Wildlife

The Jornada Experimental Range lies within the Chihuahuan biotic province. The fauna is representative of that found in the upper Sonoran and Transition Life Zones throughout the Southwest.

A small band of antelope (< 100 individuals) inhabit the Jornada Plain, and mule deer inhabit the foothills and mountains. A number of gemsbok, introduced from Africa, have taken up residence throughout the range. The ubiquitous coyote is the most abundant of the carnivorous animals. Recent studies have estimated coyote population densities at 3-4 animals/mi^2.

Rabbit and rodent populations are cyclic. Cottontails and jackrabbits combined have been censused at densities up to 1,700 animals per section (656/km^2). Several rodent species are abundant in grama grasslands and shrub dominated areas. Rodents are least abundant in the tobosa and burrograss areas. Both rodents and rabbits can consume large quantities of forage when they are abundant.

The Experimental Range, like areas throughout the northern Chihauhuan Desert, is an important wintering ground for grassland birds. Seed eaters and raptors are common during winter months.

Insect populations are seasonal and reach peak abundance during late summer. Foliage feeding insects, such as grasshoppers, can periodically reach high densities and can compete with larger herbivores for available forage. Ants, termites, and dung beetles are important scavengers. Termite biomass has been estimated at 27 lbs/acre (30 kg/ha), and termites influence important processes such as nutrient cycling, organic matter decomposition, and soil-water status.

Desert Ecology

Although extremely complex, deserts and desert grasslands are among the simplest natural landscapes found on Earth. Furthermore, these systems are extraordinarily sensitive to both human and non-human influences. Because of these two attributes, scientists have been especially reliant on desert ecosystems to develop general understandings of ecosystem processes. Scientists working in desert and grassland environments have contributed greatly to the development of ideas relating to landscape continuity, disturbance, plant-animal interactions, stability and change. These ideas futher contribute to the management of human interactions with forest, farmland and ocean ecosystems.

Earlier models of desert ecosystems suggested these system were predictable with predictions being based chiefly upon soil and climatic constraints. Ecologists have since learned that the chaotic nature of disturbance and adaptation make predictions of these ecosystem responses difficult, at best. Current paradigms are built on early ecosystem concepts, but with modifications that integrate new theories involving thermodynamics, quantum mechanics, chaos, complexity and adaptive systems.

By increasing our understanding of changes in ecosystem patterns and processes, we can learn to predict future trends with some degree of certainty. This will require integrating information from research examining ecosystems from organismal to global perspectives. This trend toward highly interactive science is occurring on the Jornada Experimental Range as scientists examining the chemistry of a single leaf closely interact with scientists modeling global chemical budgets.

Because of the Jornada Experimental Range's long history of desert research, we can examine these changes across a large landscape over a relatively long period of time. The resulting knowledge will be critical if we are going to manage human interactions with desert ecosystems in a manner to ensure these ecosystems remain vigorous while meeting societal needs.

Livestock Management

Grazing management follows a "Best Pasture System", which, as the name implies, means that if animals are moved they go to the pasture with the best forage at that time. Under this system, cattle normally use tobosa and burrograss areas during the growing season; black grama range in winter; and mesquite sand dunes in late winter and spring. Flexibility in both time of grazing, and number and kind of animals is essential if arid ranges are to be properly managed.

Cattle management is fairly typical of range livestock operations in the Southwest. The cattle herd is a commercial crossbred type (primarily Angus x Hereford) of mature females, 2-year-old heifers and yearling replacement heifers. Our calving season is February-April, with weaning of calves in October. Cattle are marketed either through public auction or contract, and all livestock receipts return to our operation to fund our research and management programs.

Domestic sheep were introduced on the Jornada Experimental Range in 1983. Between February 1983 and February 1984 coyotes killed 44% of the original 144 head flock. Therefore, in order to conduct studies on mixed-species stocking, protecting sheep from coyote predation became of paramount importance, and required multifaceted and innovative strategies. Guarding dogs, specifically the Turkish Akbash breed, form the backbone of our current predation management program. In addition, another strategy has been to bond sheep to cattle. Since cattle in a herd and sheep in a flock do not consistently associate as a group under free-ranging conditions, it is necessary to modify sheep behavior. To do this the two species are brought together in close association when lambs are between 45 and 90 days-of age. The resulting cohesive group we have termed a flerd. Bonded sheep consistently stay close to cattle, and when threatened by coyotes move in close proximity to cattle. Apparently this close association with cattle serves to intimidate marauding canines. Predation losses under multifaceted management of the flerd are almost non existent.

In 1994, Pastures 1A and 1B (19,833 acres) were set aside for holistic management in a cooperative agreement with the Beck Land and Cattle Company, Nutt, NM. This collaboration, labeled the Ecosystem Stewardship Project, is intent on sustaining a functional rangeland ecosystem while managing for livestock production.

Past Research (1915-1992)

Rainfall, stocking, and vegetation have been continuously recorded since 1915. Many significant contributions have been made to our understanding of the ecology and biology of native plants and animals. Much past research has been directed at problems associated with the rangeland livestock industry. Some of the contributions toward better management of arid rangelands are as follows:

1. Development of proper timing and grazing utilization standards for black grama and tobosa rangelands.
2. Improved livestock distribution techniques including water development and salting practices.
3. Establishment of principles of flexible herd management to cope with fluctuating forage supplies.
4. Improved brush-control methods.
5. Development of methods and equipment for revegetation of depleted rangelands.

A complete bibliography of the hundreds of scientific publications authored by research personnel at the Experimental Range is available upon request.

Data Management

A variety of regional data are maintained in a Geographic Information System, including layers of elevation, hydrology, geology, soils, vegetation, grazing history, physical structures, and digital remotely sensed images. Historical data sets are documented and entered into a hard disk database with personal computers as file servers. Data files are readily transferrable through a local network at New Mexico State University and Internet. Access requests, except for meterological data which are unrestricted, are treated on a case-by-case basis. Access is through data management personnel with the LTER program and protocol follows LTER network standards.

Selected Publications

Jardine, J.T. and C.L. Forsling. 1922. Range and cattle management during drought. U.S. Dept. Agric. Bull. 1031. 84 pp.

Nelson, E.W. 1934. The influence of precipitation and grazing on black grama range. U.S. Dept. Agric. Tech. Bull. 409. 32 pp.

Canfield, R.H. 1939. The effect of intensity of clipping on density and yield of black grama and tobosa grass. U.S. Dept. Agric. Tech. Bull. 681. 32 pp.

Paulsen, H.A. and F.N. Ares. 1962. Grazing values and management of black grama and tobosa grasslands and associated shrub ranges of the Southwest. U.S. Dept. Agric. Tech. Bull. 1270. 56 pp.

Buffington, L.C. and C.H. Herbel. 1965. Vegetation changes on a semidesert grassland range from 1858 to 1963. Ecol. Monog. 35:139-164.

Herbel, C.H., F.N. Ares and R.A. Wright. 1972. Drought effects on a semi-desert range. Ecology 53:1084-1093.

Ares, F.N. 1974. The Jornada Experimental Range: An epoch in the era of southwestern range management. Soc. Range Manage., Range Monog. 1.

Herbel, C.H. and W.L. Gould. 1980. Managing semidesert ranges of the Southwest. N. Mex. Ext. Circ. 456. 48 pp.

Anderson, D.M. and G. Tietjen. 1982. Drylot shrink of cattle grazing semidesert rangeland during February, May, July, and October. Proc., West. Sec., Amer. Soc. Anim. Sci. 33:242-245.

Hennessy, J.T., R.P. Gibbens, J.M. Tromble and M. Cardenas. 1985. Mesquite (*Prosopis glandulosa* Torr.) dunes and interdunes in southern New Mexico: A study of soil properties and soil water relations. J. Arid Environ. 9:27-38.

Anderson, D.M., C.V. Hulet, J.N. Smith, W.L. Shupe and L.W. Murray. 1987. Bonding of young sheep to heifers. Appl. Anim. Behav. Sci. 19:31-40.

Gibbens, R.P., R.F. Beck, R.P. McNeeley and C.H. Herbel. 1992. Recent rates of mesquite establishment in the northern Chihuahuan Desert. J. Range Manage. 45:585-588.

Gibbens, R.P., K.M. Havstad, D.D. Billheimer and C.H. Herbel. 1993. Creosotebush vegetation after 50 years of lagomorph exclusion. Oecologia 94:210-217.

Fencing crew on the Jornada Range Reserve in October, 1912.
Mr. C. Turney seated at far right.

October 1994

United States Department of Agriculture
Animal and Plant Health Inspection Service
Science and Technology
Denver Wildlife Research Center
Building 16, P.O. Box 25266
Denver Federal Center
Denver, CO 80225-0266

ECOLOGICAL AND BEHAVIORAL APPLICATIONS PROJECT
USDA/APHIS/S&T/DWRC
UTAH STATE UNIVERSITY
LOGAN, UTAH 84322-5295

TO: John Jensen, Radiological Safety Office, USDA/ARS, Greenbelt, Maryland .20705

FROM: Leader, Ecological and Behavioral Applications Project, USDA/APHIS/S&T/DWRC, Utah State University, Logan, Utah

DATE: June 6, 1991

SUBJECT: Request for burial of radioactive materials

The following information is submitted in support of a request to bury a small quantity of radioactive materials on the USDA Jornada Experimental Range:

Location: USDA/ARS, Jornada Experimental Range
Dona Ana County, New Mexico

Description of situation:

Pit: 5' wide, 30' long, and 8' deep. Materials will be buried with a minimum of 6' of overburden.

Fence: An area 40' by 80' around the pit will be fenced with metal "T" posts at 10-foot intervals with braces in 2 directions at each of the 4 corners. Four strands of barbed wire with no gates will be attached to the outside of the posts. Metal signs 8" x 12" with the radiation logo and "Radioactive materials" clearly visible will be securely attached to the fence on each of the four sides of the exclosure.

Hydro-geology: The area is in the sandy dune area on the eastern side of the Jornada Experimental Range. The water table in this vicinity is about 400' below the surface (based on a windmill driven well 2 miles to the east). A 10-12" layer of caliche (calcium carbonate layer above which evaporation exceeds percolation) is located 4' below the surface and some 2-3 feet above the buried materials. Leaching of materials should be negligible because of the arid nature of the environment and the layer of caliche.

Form of materials: Biologic materials comprised of:

48 adult Angora goats (est. wt. = 2,400 lbs)
20 kid goats (est. wt. = 150 lbs)
40 adult coyotes (est. wt. = 1,000 lbs)

Isotopes:

	Estimates in uCi		
Isotope	Goats	Coyotes	Total
^{54}Mn	- -	7.2	7.2
^{65}Zn	93.2	5.2	98.4
^{125}I	- -	71.0	71.0
^{134}Cs	81.0	5.0	86.0

Estimates of quantities made on the basis of following calculations:

Adult goats:

Each marking collar = 2 reservoirs with 15 uCi ^{134}Cs each.
38 collars placed on goats.
1 collar (and goat) not recovered.
24 recovered with reservoirs intact (full).
4 collars recovered with 2 empty reservoirs.
7 collars recovered with 1 empty reservoir.
2 collars punctured by coyotes (3 reservoirs punctured).

- Total of 18 reservoirs punctured = 270 uCi ^{134}Cs dispensed.
- Previous studies indicate about 28% of fluid from 60 mL collars ends up contaminating carcass of goat.
- Hence, expect 81 uCi (.30 x 270) ^{134}Cs to be on carcasses of adult goats.

Kid goats:

Each marking collars = 2 reservoirs each with 33.3 uCi ^{65}Zn.
34 collars placed on kid goats.
29 collars recovered with reservoirs full.
1 collar recovered with 2 reservoirs empty.
2 collars recovered with 1 reservoir empty.
2 collars punctured by coyotes (3 reservoirs punctured).

- Total of 7 reservoirs punctured = 233 uCi ^{65}Zn dispensed.
- Previous studies indicate about 39% of fluid from 30 mL collars ends up on the carcass of the goat.
- Hence expect about 93.2 uCi ^{65}Zn (.40 x 233) to be on carcasses of kid goats.

Potential radioactive materials in coyote carcasses:

^{54}Mn (assuming captured coyotes ingested all unrecovered baits):

- 187 baits, each with 12.25 uCi ^{54}Mn, placed in field and not recovered (total of 2290.75 uCi).
- Gut to blood absorption for Mn is 0.1 (229.075 uCi absorbed in coyote carcasses).
- Effective half life ^{54}Mn = 23 days.
- 1 February to 31 May = 120 days (5.2 effective half lives).
- 229 uCi x 5 eff. half lives = 7.16 uCi remaining in coyote carcasses.

^{125}I (assuming captured coyotes ingested all unrecovered baits):

- 188 baits, each with 2.0 uCi ^{125}I, placed in field and not recovered (total of 376 uCi).
- Gut to blood absorption for I is 1.0 (376 uCi absorbed in coyote carcasses).
- Effective half life ^{125}I = 42 days.
- 1 February to 31 May = 120 days (2.86 effective half lives).
- 376 uCi x 2.5 eff. half lives = 71 uCi remaining in coyote carcasses.

^{65}Zn (from collars punctured by coyotes):

- 3 reservoirs punctured by coyotes (total of 100 uCi ^{65}Zn dispensed during coyote attacks).
- Previous studies indicate on average coyotes ingest 5.2% of fluid from 30 mL collars.
- Hence coyotes estimated to ingest 5.2 uCi ^{65}Zn.

^{134}Cs (from collars punctured by coyotes):

- 3 reservoirs punctured by coyotes (total of 45 uCi ^{134}Cs dispensed during coyote attacks).
- Previous studies indicate on average coyotes ingest 11.1% of fluid from 60 mL collars.
- Hence coyotes estimated to ingest 5.0 uCi ^{134}Cs.

If additional information is needed in support of this request, please contact me by memorandum or telephone (801 + 750-2508).

Frederick F. Knowlton

125345

NEXT PAGE →→→ MEMORY RECEIVING

~~125324~~

United States Department of Agriculture
Agricultural Research Service
Radiological Safety Staff
6303 Ivy Lane
Greenbelt, Maryland
20770-1433

JUN 27 1991

John D. Kinneman
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406

Dear Mr. Kinneman:

This is a request for burial of radioactive material under 10 CFR 20.302. Frederick F. Knowlton, Leader, Ecological and Behavioral Applications Project, APHIS, conducted an experiment earlier this year under the Utah State University (USU) license with reciprocity from the State of New Mexico at the USDA, ARS, Jornada Experimental Range in Las Cruces, New Mexico. The reciprocity agreement was rescinded by the State of New Mexico on May 10, 1991. Through discussions with Frank Costello, of your office, we understand that any continuing activities associated with this experiment are considered USDA licensed activities under the USDA U.S. Nuclear Regulatory Commission License No. 19-00915-03.

The enclosed letter from Dr. Knowlton, describes the radioactive materials he has buried at the Jornada Experimental Range as a result of the experiment. He also describes the hydrogeological characteristics and security of the burial site. The USDA Radiological Safety Staff has determined that, because of the short half-lives of the radioisotopes and the distance of the materials to the water table, the material is not likely to migrate from the burial site and the burial is not likely to result in exposures to individuals living in the surrounding area. The USDA will control access to the burial site for at least 6 half-lives (approximately 12 years) at which time there will be approximately one microcurie of cesium-134 remaining.

If you have any questions or if our understandings are incorrect, please contact me on FTS 344-0193.

Sincerely,

John T. Jensen
Director

Enclosure

125345

OFFICIAL RECORD COPY ML 10

DEC 2 9 1991 ~~125321~~

bcc:
C. Havstaad, SPA (w/Enclosure)
F. Horn, SPA (w/Enclosure)
M. Fall, APHIS
F. Knowlton, APHIS