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EPA 600/3-83-014
DOE/DP/00539-047

Research and Development

EPA

Animal Investigation Program 1981 Annual Report:

Nevada Test Site and Vicinity

prepared for the
U.S. Department of Energy
under Interagency Agreement
Number DE-A108-76DP00539

ANIMAL INVESTIGATION PROGRAM 1981 ANNUAL REPORT
Nevada Test Site and Vicinity

by

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ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
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INTRODUCTION

Since 1964, the U.S. Environmental Protection Agency's (USEPA) Environmental Monitoring Systems Laboratory at Las Vegas (EMSL-LV) has conducted the Animal Investigation Program (AIP) for the Nevada Operations Office of the U.S. Department of Energy. During 1981, the major objectives of the AIP continued to be:

1. To conduct surveillance of domestic and wild animals on and around the Nevada Test Site (NTS) in order to assess the radionuclide burden present in their tissues and to monitor for possible pathological effects from the burdens.

2. To investigate alleged damage to domestic animals and wildlife resulting from the activities of the Nevada Operations Office of the U.S. Department of Energy (DOE).

3. To provide public information through education and veterinary advice to the offsite population.

4. To conduct special ad hoc investigations.

Progress during 1981 in achieving these objectives and summaries of the data collected are presented in this report. Previously published reports (Fountain 1961; Smith and Giles 1970, 1974, and 1975; and Smith et al. 1976, 1977a, 1977b, 1978a, 1978b, 1979, 1980, 1981, and 1982) have detailed the history, evolution, and accomplishments of the AIP since its beginning in 1957. As the AIP was terminated in December of 1981, this report will be the last in the series which began in 1958.

SAMPLE COLLECTION

Nevada Test Site animals sampled during 1981 included cattle, mule deer, a chukar, and a horse. Desert bighorn sheep that range the mountainous areas to the south and east of the NTS were also sampled. Animals sampled included those that died from natural causes or through accidents, those collected through the cooperation of licensed hunters, and those that were sacrificed as part of the routine sampling activities of the program.

Animals collected by rifle or shotgun fire were necropsied immediately after death and any gross pathological conditions noted. Animals collected by other means were also necropsied if a prosector was available. If advanced postmortem changes had not occurred, the adrenals, eyes, heart, kidneys, liver, lungs, muscle, spleen, thyroid, gonads, and gross lesions (if any) were sampled and prepared for histopathological evaluation. Tissues collected from large animals for radioanalyses included rumen or stomach contents, liver, lungs, tracheobronchial lymph nodes, muscle, thyroids, blood, kidneys, fetus (if present), and bone (femurs or hocks). Tissues collected from the chukar for radioanalyses included bone from the entire skeleton, muscle, and composited internal organs (liver, lungs, kidneys, and GI tract).

Fourteen beef cattle from the NTS herd were sampled during 1981. Sampling information is presented in Table 1. Except for a brief weaning period, when the calves were maintained at the Area 15 farm, each animal sampled spent its entire life grazing on the Area 18 range of the NTS (Figure 1). The management of the beef herd and soil and range surveys of the Area 18 grazing area have been published previously (Smith 1970, Leavitt 1970, and Brown and Mason 1968).

NTS animals sampled included four adult mule deer (*Odocoileus hemionus*), a chukar (*Alectoris chukar*) and a horse (*Equus caballus*). Also sampled was a domestic goat from Rachel, Nevada. Collection locations are noted on Figure 1 and sampling information is listed in Table 2.

Through the cooperation of State and Federal wildlife officials and participating hunters, bone and kidney samples were collected from 17 mature desert bighorn sheep rams (*Ovis canadensis nelsoni*) during the annual hunt. Sampling information for these animals is presented in Table 3 and the collection sites are shown in Figure 2. The majority of the sheep were collected from Clark County in southern Nevada, with seven from the Desert National Wildlife Range (DNWR). Two animals were collected in Esmeralda County which is north and west of the NTS.

TABLE 1. SAMPLING INFORMATION FOR NEVADA TEST SITE CATTLE, 1981

Animal Number	Sex	Age (Years)	Weight (kg)	Date Sampled	Remarks
1	F	5.0	550	05/14	Mature pregnant cow.
2	F	1.0	235	05/14	Extremely wild.
3	F	0.25	90	05/14	
4	F	7.0	570	05/14	Mature barren cow.
5	F	13.0	532	10/20	Pre-cancerous placque right eye.
6	F	7.0	523	10/20	
7	F	14.0	432	10/20	"Lumpy jaw" abscess.
8	F	9.0	420	10/20	Pregnant (2-month fetus).
9	M	0.5	148	10/20	Bull calf--excellent condition.
10	M	1.5	254	10/21	Bull--very wild.
11	F	1.5	250	10/21	
12	F	4.0	375	10/21	Pregnant (1 1/2-month fetus).
13	M	1.5	227	10/21	Bull.
14	M	1.5	214	10/21	Bull.

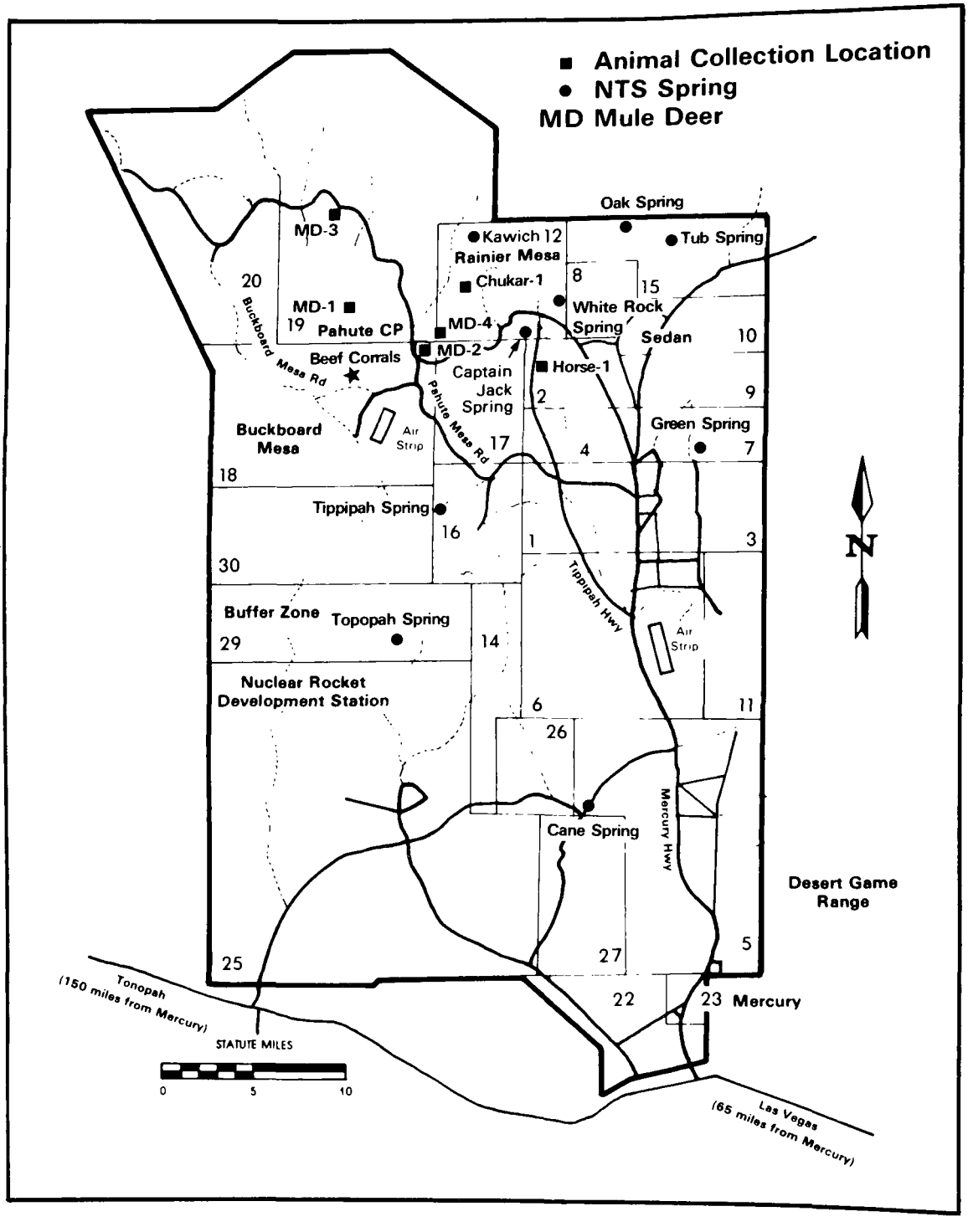

Figure 1. Sampling locations on the Nevada Test Site.

TABLE 2. SAMPLING INFORMATION FOR NEVADA TEST SITE WILDLIFE, 1981

Animal Number	Sex	Estimated Age (Years)	Weight (kg)	Date Collected	Remarks
Mule Deer-1	F	1.0	35	3/11	Collected Area 19, 1 km west of Echo Peak repeater.
Mule Deer-2	M	1.0	40	6/23	Accident victim 1 km east of Holmes Road on the Stockade Wash Road, Area 12.
Mule Deer-3	F	1.5	50	10/5	Accident victim at U19C, 3 km south of reservoir on Pahute Mesa Road in Area 19.
Mule Deer-4	F	1.0	30	10/28	Collected 1.5 km east of G tunnel in Area 12.
Horse-1	F	15-18	550	5/14	Hit by bus on Tippipah Highway, 5 km south of Area 12 camp.
Chukar-1	?	mature	0.7	12/18	Collected on N. Rainier Mesa Rd. above T. Tunnel, Area 12
Goat-1	M	0.1	12	6/2	Kid belonged to E. Fallis, Rachel, NV. Sampled because of sudden death. Enterotoxemia was diagnosis.

TABLE 3. SAMPLING INFORMATION FOR DESERT BIGHORN SHEEP, 1981

Animal Number	Sex	Estimated Age (Years)	Date Collected	Remarks
1	M	8	11/15	Killed Management Area 69*, Sheep Range, Lincoln Co.
2	M	8	11/15	Killed Management Area 70*, Monte Cristo Range, Esmeralda Co.
3	M	11	11/15	Killed Management Area 71*, Lone Mountain, Esmeralda Co.
4	M	7	11/22	Killed Management Area 72*, Arrow Canyon Range, Clark Co.
5	M	5	11/22	Killed Management Area 73*, Desert National Wildlife Range, Lincoln Co.
6	M	6	12/21	Killed Management Area 74*, Pintwater Range, Lincoln Co.
7	M	6	11/17	Killed Management Area 75*, Sheep Range, Lincoln Co.
8	M	7	11/17	Killed Management Area 76*, Sheep Range, Lincoln Co.
9	M	6	11/17	Killed Management Area 77*, Sheep Range, Lincoln Co.
10	M	7	11/26	Killed Management Area 78*, Las Vegas Range, Clark Co.
11	M	6	11/26	Killed Management Area 79*, Meadow Valley Range, Lincoln Co.
12	M	6	11/19	Killed Management Area 81*, Black Mountain, Clark Co.
13	M	10	11/19	Killed Management Area 83*, Spring Mountain Range, Clark Co.

(continued)

TABLE 3. (Continued)

Animal Number	Sex	Estimated Age (Years)	Date Collected	Remarks
14	M	8	11/19	Killed Management Area 84*, McCullough Mountains, Clark Co.
15	M	5	11/14	Killed Management Area 85*, Eldorado Mountain Range, Clark Co.
16	M	8	12/12	Killed Management Area 86*, South Eldorado Mountain Range, Clark Co.
17	M	9	12/20	Killed Management Area 87*, Newberry Mountain, Clark Co.

*Nevada Department of Wildlife Bighorn Sheep Management Area

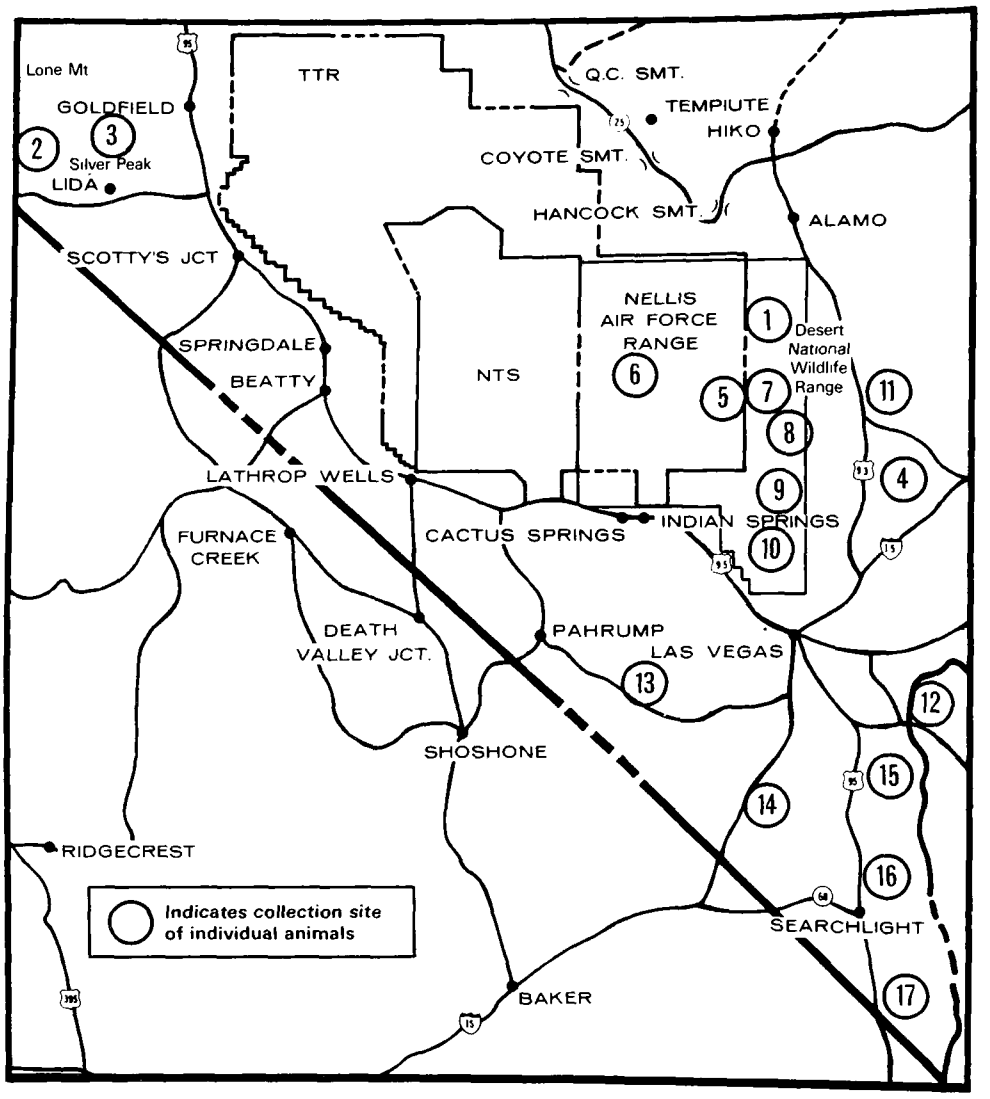

Figure 2. Approximate collection locations of 1981 desert bighorn sheep.

ANALYTICAL PROCEDURES AND METHODS

Gamma-emitting radionuclides in samples of soft tissues and rumen contents were analyzed by high resolution gamma spectroscopy. A sample of blood or tissue was collected from each animal and the tissue water was extracted and analyzed for tritium. Bone samples were analyzed for strontium-89 and -90 and plutonium-238 and -239. Selected soft tissues were also analyzed for plutonium content. The EMSL-LV performed all of the analyses for tritium and the gamma-emitting radionuclides. The DOE contractor laboratory performed the plutonium and strontium analyses.

Rumen contents and soft tissues of sufficient volume were placed in 300-milliliter aluminum containers with a 10-percent Formalin® solution as a preservative. The containers were then sealed and stored for gamma spectral analysis. Those tissues of smaller volume, i.e., thyroid gland, tracheobronchial lymph nodes, etc., were first macerated in a blender and then brought to a standard volume by suspending in agar. These samples were also sealed in 300-milliliter aluminum containers. All samples for gamma spectral analysis were analyzed for approximately 1,200 minutes on either lithium-drifted germanium or high purity germanium detectors calibrated at approximately 0.5 kilo-electronvolts (keV) per channel in the 40-keV to 2-mega-electronvolts (MeV) range. These detectors are connected to a Nuclear Data 6620 computerized gamma spectral accumulation and analysis system.

Tissues collected for strontium and plutonium analyses were placed in plastic bags and kept frozen until submitted to the analytical laboratory. The samples were prepared for analyses by ashing and radiochemical separation. Plutonium was analyzed by alpha spectrometry using plutonium-236 as an internal tracer. Analytical procedures used by the contractor laboratory are similar to those described by Talvitie 1971, 1972; Wish and Rowell 1956; Mitchell 1960; Hagan and Arrhenius 1963; and Major et al. 1975. The EMSL-LV radionuclide analytical procedures were those described by Johns et al. (1979).

All data are reported with the 95 percent confidence interval based on counting statistics and are decay corrected to time of sample collection. The minimum detectable activity (MDA) is defined as 3.3 times the standard deviation of the background counting error. Results which show a net sample activity less than the MDA are reported as such. The approximate MDAs and analytical procedures are summarized in Appendix Table A-1.

The activity values for plutonium-239 listed in this report are actually the sums of the individual isotopic activities of plutonium-239 and -240. The alpha emissions of these two isotopes cannot be separately identified (resolved) by alpha spectrometric analysis.

Quality assurance samples were included in each group of samples submitted for plutonium or strontium analyses. These were either liver, muscle, or bone samples purchased at a local meat market and to which a known amount of the nuclide was added, or they were duplicate samples collected from sacrificed animals and submitted for analyses under blind identification numbers. The purchased bone samples were ashed prior to spiking. The data from the quality assurance samples are presented in the Appendix Tables B-1 and B-2.

Quality assurance procedures for the tritium and gamma spectral analyses were both external (e.g., intercomparison study samples, duplicate and replicate analyses, etc.) and internal (e.g., blank reagent or internal standards analyses, etc.). Details of these procedures and statistical analyses of the data produced are detailed by Black et al., 1982.

Tissue and lesion samples collected for histopathological examination were fixed with a 10-percent Formalin® solution and delivered to a pathologist for interpretation.

RESULTS AND DISCUSSION

QUALITY ASSURANCE SAMPLES

As shown in the Tables B-1 and B-2 of the Appendix, analyses of duplicate muscle and bone samples indicate an average precision of analyses of 70 percent for plutonium-239 in muscle and 29.5 percent for strontium-90 in bone. The accuracy of analysis, expressed as bias, is also shown in those tables. Based on the precision and bias data for strontium-90 analyzed, the 95 percent confidence interval for the true value was calculated to range from 0.47 to 1.07 times the reported value in bone. The 95 percent confidence interval for the true value for plutonium-239 in bone ranged from 0.59 to 1.99 times the reported value. These confidence intervals were considered when conclusions were drawn from the data.

NEVADA TEST SITE CATTLE

The analytical results from tissues collected from the Area 18 beef cattle are presented in Tables C-1 through C-5 and D-1 through D-6 of the Appendix.

Naturally occurring potassium-40 was the only gamma-emitting radionuclide consistently detected in all samples. Cesium-137 was generally detected in the muscle and kidney samples. If detected, the cesium-137 levels were within a narrow range of activity; for example, twelve of fourteen muscle samples contained detectable levels ranging from 15 to 65 picocuries per kilogram (pCi/kg) wet weight.

Tritium was not detected in the blood of any of the cattle sampled during May, but was detected in 7 of 10 samples collected in October with a range of 490-1900 pCi/l of water. This range is similar to that measured in atmospheric moisture from air samples collected in Areas 12 and 15 of the NTS (Black et al. 1982).

Strontium-90 concentrations in the femur samples from the Area 18 cattle ranged from 1.6 to 4.8 picocuries per gram (pCi/g) of ash with an average of 2.4. As shown in Figure 3, this average value is similar to those reported in recent years. Strontium-89 was detected in only one of the 1981 bone samples.

Liver and lung samples collected in both May and October generally contained detectable levels of plutonium-239 as did the muscle and tracheobronchial lymph node samples collected in May. Tracheobronchial lymph node samples were not collected in October. Plutonium-239 was detected infrequently in bones and gonad samples from both sampling periods. The reported plutonium-239 tissue concentrations were similar to those reported

previously (Smith et al. 1982). Plutonium-238 was detected occasionally in the lungs and tracheobronchial lymph nodes.

NEVADA TEST SITE MULE DEER

The analytical results from tissues of the NTS mule deer are presented in Tables E-1 through E-5 of the Appendix. As was the case for the NTS cattle, naturally-occurring potassium-40 and cesium-137 were the only gamma-emitting radio-nuclides that were frequently detected in the tissue samples. Additional gamma-emitting radionuclides (^{7}Be, ^{95}Nb, ^{95}Zr, ^{103}Ru, ^{141}Ce, and ^{144}Ce) were occasionally detected in the ingesta from the rumens of sampled deer.

Nanocurie levels of tritium were found in the tissues of deer #2 and #4. Both were collected in Area 12 and it is believed that they drank from contaminated waters draining from the tunnel test area of Rainier Mesa (Scoggins, 1982). Similar levels have been seen in deer previously (Smith et al. 1980).

Strontium-90 concentrations in hock bones ranged from 1.1 to 1.8 pCi/g of ash with an average of 1.6 pCi/g of ash (Figure 3). This is similar to the average of 1.7 pCi/g of ash reported in 1980. Strontium-89 was reported in the bone sample from deer #1. However, it is thought that this value is an artifact.

Detectable levels of plutonium-238 and -239 were found in all rumen content samples. In addition, measureable amounts of plutonium-239 were found in one lung and two liver samples. None of the bone samples contained detectable levels of either radionuclide.

DESERT BIGHORN SHEEP

Analytical data from bone and kidney samples are listed in Tables F-1 and F-2 of the Appendix. The average strontium-90 concentration in the hock bones was 2.1 pCi/g of ash (Figure 3). Detectable levels of strontium-89 and plutonium-238 were not present in any of the animals sampled. Detectable levels of plutonium-239 were found in only one sample this year.

Cesium-137 concentrations ranging from 41 to 130 pCi/kg wet weight were detected in the kidneys of 5 of the 16 sheep sampled. The reported values for tritium in the 6 kidney samples which had detectable levels ranged from 430 to 1800 pCi/l, which are within the range of values reported in atmospheric moisture in air samples collected at various off-site locations from the Noble Gas and Tritium Surveillance Networks (Black et al. 1982).

NEVADA TEST SITE HORSE

An aged female feral horse was struck and killed by a bus in Area 12 on May 14. Bone and muscle samples were collected despite advanced decay. The

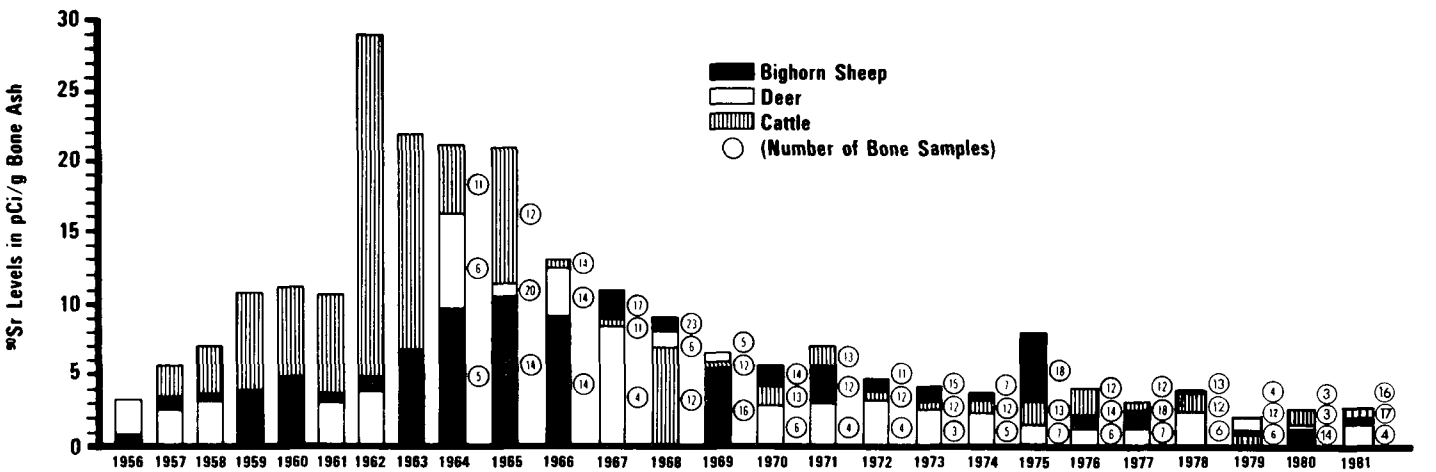

Figure 3. Annual averages of strontium-90 in bones of cattle, deer, and desert bighorn sheep, 1956-1981.

analytical results from these samples are listed in Appendix Table G-1. Potassium-40 and cesium-137 (38 ± 12 pCi/kg) were the only gamma-emitting radionuclides detected in muscle. The strontium-90 concentration of 4.7 ± 0.63 pCi/g of bone ash is of the same magnitude found in other horses sampled in previous years (Smith et al. 1981 and 1982). Plutonium-238 and -239 were not detected in either sample.

NEVADA TEST SITE CHUKAR

One chukar was collected in Area 12. The analytical data from this bird's samples are listed in Appendix Table H-1. Muscle concentration of tritium (760 ± 300 pCi/l) and cesium-137 (48 ± 17 pCi/kg) were similar to those observed in other NTS animals sampled during 1981. The strontium-90 concentration (7.1 ± 0.98 pCi/g ash) in the bone is several times greater than that observed in most NTS mammals but is similar to chukar sampled in 1979 (Smith et al. 1980).

OFFSITE GOAT

The sudden death of a goat kid alarmed its Rachel, NV owners, who requested an examination to determine if its death was related to the NTS testing activities. A diagnosis of enterotoxins was made which was based on the history and necropsy results. Tissue samples were collected and analyzed for radionuclide content (Appendix Table I-1). Potassium-40 was the only gamma-emitting radionuclide detected. Strontium-89 and plutonium-238 and -239 were not detected. The strontium-90 concentration of 4.1 ± 0.96 pCi/g of bone ash is within the range of values reported for other offsite animals, i.e., desert bighorn sheep, which were sampled during 1981.

NEVADA TEST SITE SPRING WATERS

Several natural springs that serve as a source of water for wildlife were sampled during 1981. The spring locations are shown in Figure 1. The waters were analyzed for gamma-emmiting radionuclides and tritium. The results are shown in Table 4. Detectable levels of gamma-emitting radionuclides were not found in any of the waters and the tritium levels were detectable only through tritium enrichment analytical methods.

NECROPSY AND HISTOPATHOLOGICAL EXAMINATIONS

Sacrificed animals were necropsied and selected tissue and lesion samples were collected for histopathological evaluation. The gross and microscopic pathologies observed are summarized in Appendix Table J-1.

Sarcocystis spp. were detected in the skeletal muscle of only one deer. In past years, this ubiquitous protozoan parasite was found in an estimated 25 percent of all muscle (both cardiac and skeletal) samples from deer and cattle. The reason for this apparent decline in infectious rate is not known.

TABLE 4. TRITIUM AND GAMMA ANALYSIS OF NEVADA TEST SITE SPRING WATERS, 1981

Spring Name	Date Sampled	Tritium pCi/L	Gamma Analyses
White Rock	5/6	26.0 ± 7.0	GSN
Captain Jack	5/6	38.0 ± 7.5	GSN
Green	5/6	35.0 ± 7.3	GSN
Tippipah	5/6	34.0 ± 7.3	GSN
Topopah	5/6	73.0 ± 7.9	GSN
Cane	5/6	<110	GSN
Kawitch Valley	5/6	180.0 ± 9.4	GSN
Tub	5/6	39.0 ± 7.5	GSN

GSN = Gamma Spectrum Negligible

Unusual lesions were not noted during necropsy. Occasionally observed histopathologic findings, e.g., hemosiderosis of the spleen and mild liver and kidney changes, were felt to be within normal limits by the examining pathologists. No pathology, gross or microscopic, was observed that could be attributed to ionizing radiation.

HYPOTHETICAL DOSE ESTIMATES

Although meat from animals living on the Nevada Test Site is not available for human consumption, the various doses to a standard man based on postulated consumption of the edible tissues has been calculated. The dose estimates are not presented as an implication of potential doses, but rather to place the reported radionuclide concentrations in perspective. The dose estimates are based on the techniques and parameters of the International Commission for Radiological Protection (1959, 1968, 1977) and Dillman (1969). The estimates were calculated using the maximum observed concentrations of the radionuclides in edible tissues of the cattle, deer, and chukar sampled (summarized in Table 5). It was assumed that 500 grams (about 1 pound) of the meat were consumed each day for a year, and that the radionuclide concentration remained constant for that time. The minimum detectable values of Table 5 were used in the dose calculations when they were the maximum value for a given tissue.

TABLE 5. SUMMARY OF PEAK RADIONUCLIDE CONCENTRATIONS IN SELECTED TISSUES FROM NEVADA TEST SITE ANIMALS, 1981

Nuclide	Radionuclide Concentrations (pCi/kg Wet Weight) Muscle	Liver	Blood (pCi/l)
	Area 18 Cattle		
Plutonium-238	0.054 ± 0.087*	0.21 ± 0.26*	NA
Plutonium-239	0.48 ± 0.11	2.3 ± 0.62	NA
Cesium-137	65 ± 13.0	27 ± 14	NA
Tritium	NA	NA	1900 ± 320
	NTS Mule Deer		
Plutonium-238	0.11 ± 0.18*	0.35 ± 0.76*	NA
Plutonium-239	0.082 ± 0.089*	1.1 ± 0.24	NA
Cesium-137	28 ± 13	27 ± 12	NA
Tritium	$2.4 \times 10^6 \pm 4.1 \times 10^3$**	$2.2 \times 10^6 \pm 3.6 \times 10^3$**	$8.8 \times 10^6 \pm 7.4 \times 10^3$**
	Area 12 Chukar		
Plutonium-238	1.4 ± 0.38		
Plutonium-239	0.35 ± 0.41*		
Cesium-137	48 ± 17		
Tritium	760 ± 300**		

NA = Not analyzed
* = Counting error exceeds reported activity
** = pCi/l - aqueous portion of liver or muscle

Although doses are calculated for ingestion of tissues from a chukar, these doses are not compared to the dose guide. Furthermore, these doses are not used in discussing the maximum hypothetical doses because it is doubtful that enough similar tissue could be obtained to provide the 1-year intake quantities.

The International Commission for Radiological Protection (1959) and the U.S. Department of Energy (1977) present different dose criteria for various parts of the body, based on estimates of relative radiosensitivity. The National Council on Radiation Protection and Measurements (NCRP) (1971) recognizes this philosophy, but recommends simplifying the guides for the general population, and uses the minimum guide (0.5 rem per year to the whole body for an individual in an uncontrolled area) for all body organs. The NCRP emphasizes that this is a simplifying administrative decision, rather than a reduction of the guides based on new technical information.

The indicated confidence intervals in Table 5 are twice the standard deviation (2s) based on counting statistics. The total analytical uncertainties at two standard deviations for the plutonium results are estimated to be about 0.2 pCi/kg for results of several tenths of a pCi/kg, or several times the indicated counting uncertainties. Thus, differences between values, when the values are under several tenths of a pCi/kg, have limited statistical significance given the total analytical uncertainties of the results.

Table 6 lists postulated doses based on the data summarized in Table 5. The column on the right shows the respective fraction of the radiation protection guide of 500 millirems (mrem) per year for the various postulated doses. The doses for plutonium and, to a lesser extent, cesium-137 are not delivered in 1 year. For practical purposes, however, the integrated doses for a 1-year ingestion period are related to the yearly guide.

The highest postulated dose (in edible tissue), 43 millirems (mrem), would result from ingesting muscle from the deer that drank from the contaminated Area 12 ponds. This dose is nearly 9 percent of the guide of 500 mrem per year. Tissues of deer collected away from the Area 12 ponds contained environmental levels of tritium. All of the other postulated doses are 0.1 mrem or less and are similar to or lower than those estimated for 1980 (Smith et al. 1981).

TABLE 6. POSTULATED DOSE TO MAN FOLLOWING INGESTION OF SELECTED TISSUES FOR 1 YEAR

Nuclide	Dose Calculated For	Animal Tissue Containing Maximum Concentration	pCi/kg (wet weight) or pCi/l of Tissue Water	Dose Factor mrem:pCi/day (1-year ingestion)*	Dose (mrem)	Percent of 500 mrem
Tritium	Body water	NTS mule deer, blood	$8.8 \times 10^6 \pm 7.4 \times 10^3$	3.6×10^{-5}	158	31.6
Tritium	Body water	NTS mule deer, muscle	$2.4 \times 10^6 \pm 4.2 \times 10^3$	3.6×10^{-5}	43	8.6
Cesium-137	Whole-body tissue	Area 18 cattle, muscle	65 ± 13	0.022	0.72	0.1
Plutonium-238	Bone	Area 12 chukar, muscle	1.4 ± 0.38	0.54	0.38	†
Plutonium-238	Bone	NTS mule deer, liver	0.35 ± 0.76	0.54	<0.1‡	<0.1
Plutonium-239	Bone	Area 18 cattle, liver	2.3 ± 62	0.63	0.7	0.1

*The doses from plutonium-238 and -239, and to a lesser extent cesium-137, are not delivered within the 1-year ingestion period, but, for simplification, the doses have been related to the guide for 1 year. The doses for plutonium are actually for a 50-year period, but it should be recognized that the doses are resulting from ingestion over a 1-year period. The dose factors are based on quality factor (QF) of 1 for tritium and cesium-137 and 20 for plutonium-238 and -239 (ICRP, 1977). The QF of 20 used for plutonium is twice the value used in reports for the program prior to 1979 (Smith et al. 1978b, 1979, 1980).

†The percent of the 500 mrem dose guide is not calculated for these tissues because it is not reasonable to assume that someone could consume 500 g of meat per day from NTS chukar.

‡Since the analytical counting error term is much larger than the mean, the postulated dose is calculated for the mean plus the error term and is stated as a "less than" value.

OTHER ACTIVITIES

DEER MIGRATION STUDY

A sizeable mule deer herd resides in the mountainous regions of the NTS during the summer; in unrestricted lands, these deer may be hunted by the public. A study to determine migration patterns of the herd (through tracking of individual deer fitted with collars containing miniature radio transmitters) was begun in 1975 and continued through 1981.

From June through November 1981, 25 NTS mule deer (Table 7) were captured, either by chemical restraint of free-ranging animals (Smith et al. 1978a) or by trapping at a water site (Giles 1979). Ten deer were fitted with collars containing new radio transmitters, ear tags, and reflective numbers. Five deer were fitted with re-conditioned radio transmitter collars that had been recovered from deer captured prior to 1981. This brought the total number of working transmitters in the field to 19 (4 from previous years). AIP personnel monitored the movements of the deer weekly with hand-held receivers and directional antenna. Ten other deer were captured but found unsuitable for collaring and were released after visible markers (ear tags and reflective collars) had been attached.

Fourteen of the deer were captured at the Area 12 trapsite on Rainier Mesa and immobilized with M-99® (etorphine). The other eleven deer were free-ranging animals (five in Area 12 and six in Areas 19 and 20) and were immobilized with Sernylan® (phencyclidine hydrochloride), and acepromazine maleate (Ayerest Laboratories, Inc.) injected via a syringe-dart fired from a Cap Chur™ gun (Palmer Chemical Company).

The 1981 summer and winter ranges of the NTS deer are shown in Figure 4. Deer captured in Area 12 remained there until late December when weather forced them onto their wintering ranges. Most of the marked deer went south to the Shoshone Mountain and Timber Mountain areas. One deer moved off of the mesa and spent the winter in the area around Captain Jack Spring and N Tunnel where he was seen on several occasions. One deer went north from Rainier Mesa into the deep canyons in the southern part of the Belted Range where it remained throughout the winter and most of the following summer. The last deer went south onto the Eleana Range where it stayed until its death in March of 1982. Deer from Areas 19 and 20 wintered in the Timber Mountain, Forty Mile Canyon, and the Beatty wash areas.

In the past year, by mid-July, most deer returned to the summer range where they were originally tagged. However, during the spring and early summer of 1982, many of the deer did not return to the areas or Rainier Mesa where they normally frequented. They have stayed around the edges of the mesa

TABLE 7. DEER CAPTURE INFORMATION, 1981

I.D.	Age Estimate	Sex	Weight Estimate (kg)	Date Captured	Location	Comments
1 Yellow	3-4	F	64	06/09	Area 12, Trapsite	Pregnant doe in good condition.
2 Yellow	1-2	M	42	06/19	1 mile N.W. Echo Peak Area, Repeated Site	Spike buck in good condition.
3 Yellow	3-4	M	65	06/19	U19C Water Reservoir, Area 19	Large buck in good condition, 3 x 3 antlers.
4 Yellow	5-6	M	86	06/24	2.4 km S.W. of Area 20 camp	Large buck in good condition, 4 x 4 antlers.
5 Yellow	3-4	F	42	06/26	Area 12, Trapsite	Lactating doe in fair condition.
6 Yellow	1-2	F	42	07/21	Area 12, Trapsite	Young doe in fair condition. Found dead 3/10/82, 2.4 km N. Area 16 camp, radio recovered.
7 Yellow	1-2	M	34	07/22	N. Tunnel Pond, Area 12	Young buck in fair condition, 3 x 3 antlers.
8 Yellow	1-2	F	34	07/22	Area 12, Trapsite	Young non-lactating doe in good condition.

(continued)

TABLE 7. (Continued)

I.D.	Age Estimate	Sex	Weight Estimate (kg)	Date Captured	Location	Comments
9 Yellow	2-3	M	56	08/13	Rainier Mesa, N. Central, Area 12	Mature buck in good condition, 4 x 3 antlers.
10 Yellow	1-2	M	42	08/19	U19C Water Reservoir, Area 19	Young buck in good condition, 3 x 3 antlers.
7 Blue	3-4	F	46	09/16	Intersection Holmes Rd. and Rainier Mesa Rd., Area 12	Mature lactating doe with 1 fawn.
5 White	5-6	M	90	09/10	0.2 km S. of E. Tunnel turnoff, Area 12	Mature buck in excellent condition, 4 x 4 antlers.
4 Red	2-3	F	46	10/24	Area 12, Trapsite	Mature lactating doe in good condition.
7 Red	4-6	M	65	11/04	Area 12, Trapsite	Mature buck in fair condition, 4 x 4 antlers.
10 Red	3-4	F	45	10/29	0.8 km west of Holmes Rd. & Stockade Wash Intersection	Non-lactating doe in fair condition.
R.G.	1-2	M	34	06/11	Area 12, Trapsite	Young buck in fair condition, one antler broken in trap.

(continued)

TABLE 7. (Continued)

I.D.	Age Estimate	Sex	Weight Estimate (kg)	Date Captured	Location	Comments
D.S.	1-2	M	35	06/20	Area 12, Trapsite	Young buck in fair condition.
H.G.	2	M	36	07/23	Area 12, Trapsite	Young buck in fair condition, spike antlers.
C.M.	5-6	M	92	07/29	Area 12, Trapsite	Large buck in good condition, 4 x 4 antlers.
J.T.	5-6	M	94	07/30	Area 12, Trapsite	Large buck in good condition, 4 x 4 antlers.
D.G.	5-6	M	94	08/08	Echo Peak turnoff, Area 19	Large buck in good condition, 4 x 4 antlers.
J.G.	7-8	M	98	08/24	0.8 km south of Echo Peak substation, Area 19	Large buck in good condition, 6 x 5 antlers.
C.G.	1	M	17	11/05	Area 12, Trapsite	Small buck in good condition, spike antlers.
M.M.	3-4	F	68	11/05	Area 12, Trapsite	Non-lactating doe in good condition.
H.M.	2-3	M	80	11/20	Area 12, Trapsite	Mature buck in good condition, 4 x 4 antlers.

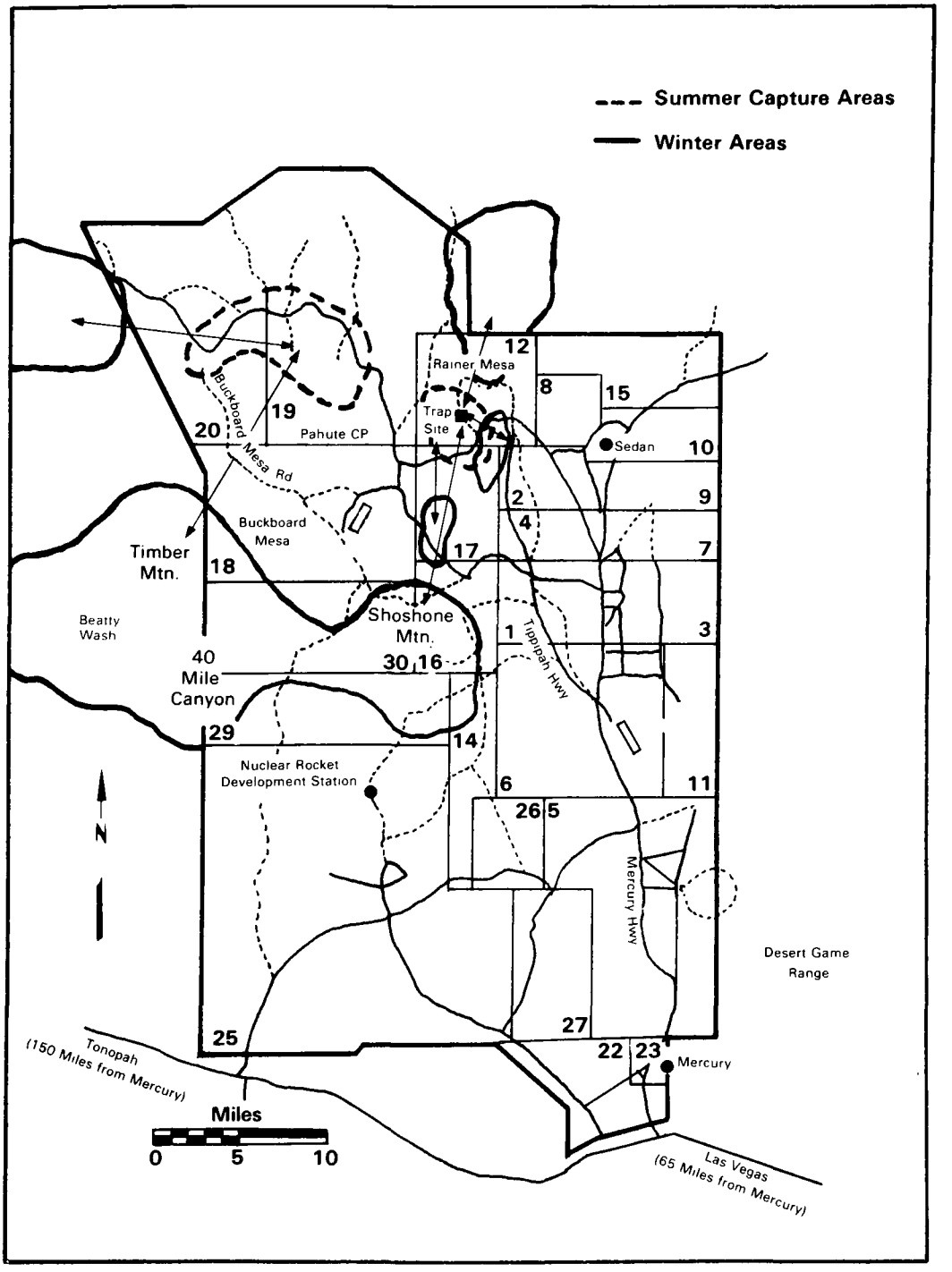

Figure 4. Mule Deer Capture and Wintering Areas, 1981.

and in the foothills on the west and northern sides of Rainier Mesa. This is thought to be due to increased traffic and frequent rains that have resulted in drinking water being widely available.

PUBLIC INFORMATION

The offsite public information program continued by direct contact with ranchers, and by briefings of groups touring the EMSL-LV or the NTS Experimental Farm. During 1981, the objectives and findings of the AIP were presented to over 700 NTS visitors in 38 different tour groups. Approximately 200 additional drop-in visitors to the farm received informal briefings.

"Big Sam," the rumen-fistulated steer, was a featured exhibit at the April 11 field day of the Nevada Cooperative Extension Services' Southern Nevada Field Laboratory in Logandale, Nevada. Approximately 100 people visited the exhibit and were briefed on the activities and findings of the AIP.

INVESTIGATIONS

There was one offsite livestock damage report during 1981. The sudden death of a goat kid in Rachel, Nevada, was investigated as the owners were concerned the death was related to the testing program. However, the cause of death was diagnosed as due to enterotoxemia. This was made on the basis of history and necropsy findings.

DECOMMISSIONING ACTIVITIES

AREA 15 FARM

The Area 15 farm, in addition to its major function as a research facility, also served as the field station for the NTS operations of the AIP. As such it provided the facilities for the maintenance of the horses, rumen-fistulated steers, and beef bulls; weaning of calves; and production of alfalfa hay. Lloyd Enterprises, a contractor, operated the farm, maintained the beef herd, and supplied support for studies conducted at the farm.

On May 11, the electric motor of the irrigation well pump was short circuited from a lightning strike. The high cost of repairs ($75,000), the frequency of occurrence (motor and pump replaced in May 1980), and the infrequent experimental use of the facilities in recent years led DOE officials to decide to decommission the farm as of December 31, 1981. As the farm workers and facilities provided required support for the AIP and as most NTS surveillance data provided by the AIP had been essentially negative in recent years, it was decided to discontinue all NTS AIP activities as of December 31, 1981. The only exception was the deer migration study which is to continue through 1983.

During November and December, all farm equipment, supplies, and facilities were prepared for decommissioning. The entire farm was put into standby condition with only the slaughter facility occasionally used. The contract for farm operation with Lloyd Enterprises was terminated December 31, 1981.

NTS BEEF HERD

All animals of the beef herd were maintained on the Area 18 range until October 1981. While on the range, all animals subsisted on the native vegetation supplemented with cottonseed oil meal during the winter months.

The herd was rounded up in May and October. At each roundup, all captured animals were identified, weighed, and sprayed for ectoparasites. Health problems were treated. Selected animals were removed from the herd for sacrifice or transfer. Following the October roundup, the entire herd was transported to Area 15 and subsequently 75 Hereford cattle, 5 Holstein heifers, and 12 goats were surplussed to the University of Nevada, Reno. The two saddle horses were transferred to the Corn Creek Station of the U.S. Fish and Wildlife Service's Wildlife Range.

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TABLE A-1. SUMMARY OF ANALYTICAL PROCEDURES AND MINIMUM DETECTABLE ACTIVITIES

Type of Analysis	Analytical Equipment	Counting Period (min)	Analytical Procedures	Sample Size	Minimum Detectable Activities (pCi/total sample)*
Gamma Spectrometry	Lithium-drifted germanium or high purity germanium detectors calibrated at approximately 0.5 KeV per channel input to 4096 channels resident in the core of the Nuclear Data 6620 computer-based gamma spectrometry system.	1,200	Radionuclide concentrations quantitated from gamma spectrum by Nuclear Data 6620 computer-based gamma spectrometry system using vendor supplied software.	300-ml aluminum cans	For: ^{54}Mn, ^{60}Co, ^{95}Zr, ^{103}Ru, ^{124}Sb, ^{132}Te, ^{131}I, ^{134}I, ^{137}Cs, ^{140}Ba - 7 pCi For: ^{125}Sb, ^{141}Ce, - 30 pCi For: ^{65}Zn, ^{106}Ru, ^{144}Ce - 20 pCi For: ^{181}W - 85 pCi For: ^{7}Be - 45 pCi
$^{89-90}Sr$	Low-background thin-window, gas-flow proportional counter with a 2.54-cm diameter window (900 $\mu g/cm^2$).	200	Chemical separation by Sr $(NO_3)_2$ precipitation and $Fe(HO)_3$ scavenge $^{89-90}Sr$ was counted as $SrCO_3$. ^{90}Sr was determined by ^{90}Y counting. Purity was checked by two successive counts at 14-day intervals for $^{89-90}Sr$ and 3 separate counts at 24-hour intervals for ^{90}Y.	10 g of ash	For: ^{89}Sr - .5 pCi ^{90}Sr - .3 pCi
^{3}H	Automatic liquid scintillation counter with output printer.	200	Sample prepared by distillation.	5 ml	0.4 pCi/ml H_2O
$^{238-239}Pu$	Alpha spectrometer with silicon surface barrier detectors operated in vacuum chambers.	1,000	Ash sample is digested with acid, purified by ion exchange, electroplated on stainless steel planchet, and counted by alpha spectrometer.	0.1-1 kg wet weight 1-10 g of ash	For all isotopes - 0.04 pCi

*The minimum detectable activities in terms of total activity per sample for standard geometries and counting times are defined as those activities which equal 3.29 times the standard deviation based on counting only [Environmental Measurements Laboratory (EML-formerly HASL) Procedures Manual, HASL-300, pages D-08-02 through D-08-06, August 1974]. These values are approximations and are applicable to ideal conditions and simple complexes of nuclides. Complex spectra or spectra showing naturally occurring radionuclides can raise the minimum detectable activities considerably.

TABLE B-1. QUALITY ASSURANCE RESULTS, SPIKED SAMPLES

Sample and Shipment No.	Nuclide	Activity Added (pCi/g Ash) - Bone (pCi/kg)* - Muscle	Activity Reported (pCi/g Ash) - Bone (pCi/kg)* - Muscle	Percent Bias**
		Bone Ash		
221248	^{239}Pu	0.055	0.077 ± 0.017	-29
16	^{90}Sr	7.3	5.6 ± 0.75	+42
221249	^{239}Pu	0.0	0.0063 ± 0.0089	-
16	^{90}Sr	0.0	1.4 ± 0.75	-
221413	^{90}Sr	1.58	3.02 ± 0.42	-15
20				
221414	^{90}Sr	1.69	3.04 ± 0.43	-19
20				
221415	^{90}Sr	1.62	3.03 ± 0.42	-16
20				
221416	^{90}Sr	1.85	2.82 ± 0.395	-38
20				
221448	^{90}Sr	0.0	1.95 ± 0.271	-
25				
221449	^{90}Sr	7.87	9.21 ± 1.23	-8
25				

* Wet Weight

** Bias (B) = Recovery -1; Recovery is average recovery $\left(\frac{x_i}{u}\right)$

where x_i = net activity reported

u = activity added

TABLE B-2. QUALITY ASSURANCE RESULTS DUPLICATE SAMPLES

Animal No./ Tissue Type	Nuclide	Activity Reported (pCi/kg - muscles)* (pCi/g ash - bone)	Precision of Analysis**
#5 Muscle	^{239}Pu	0.049	
#5 Muscle duplicate	^{239}Pu	0.12	0.74
#11 Muscle	^{239}Pu	0.035	
#11 Muscle duplicate	^{239}Pu	0.016	0.66
#5 Bone	^{90}Sr	1.6	
#5 Bone duplicate	^{90}Sr	3.2	-0.59
#11 Bone	^{90}Sr	1.9	
#11 Bone duplicate	^{90}Sr	1.9	0.0

* Wet weight

** Precision (C_v) $= 2\left(\frac{(x_1 - x_2)}{x_1 + x_2}\right) \times \frac{1}{1.128}$ where x_1 = first value, x_2 = second value

The formulas for 95% confidence interval limits:

L upper $= x_i\ (1 + B + 2C_v)$

L lower $= x_i\ (1 + B - 2C_v)$

TABLE C-1. PLUTONIUM CONCENTRATIONS IN LUNGS AND TRACHEOBRONCHIAL LYMPH NODES, BEEF CATTLE, AREA 18, NTS, MAY 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
	Lungs		
1	0.009 ± 0.009 0.11 ± 0.11	0.12 ± 0.019 1.4 ± 0.23	1.2
2	0.00062 ± 0.0029** 0.005 ± 0.023**	0.071 ± 0.015 0.57 ± 0.12	0.8
3	0.011 ± 0.014** 0.10 ± 0.13**	0.12 ± 0.024 1.1 ± 0.21	0.9
4	0.019 ± 0.0059 0.24 ± 0.075	0.26 ± 0.035 3.4 ± 0.44	1.3
Median	0.01 0.11	0.12 1.3	1.0
Range	0.00062**-0.019 0.005**-0.24	0.071-0.26 0.57-3.4	0.8-1.3
#1 Fetus	-0.0017 ± 0.0056** -0.02 ± 0.067**	0.20 ± 0.22** 0.017 ± 0.018**	
	Tracheobronchial Lymph Nodes		
1	0.02 ± 0.055** 1.2 ± 3.2**	0.17 ± 0.071 9.9 ± 4.2	5.8
2	0.0 ± 0.0078** 0.0 ± 0.3	0.23 ± 0.088 8.7 ± 3.4	3.6
3	-0.0097 ± 0.045** -0.39 ± 1.8**	0.4 ± 0.13 16.0 ± 5.3	4.0
4	0.12 ± 0.12 3.6 ± 3.6	2.0 ± 0.28 59.0 ± 8.4	3.0

(continued)

TABLE C-1. (Continued)

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
	Tracheobronchial Lymph Nodes		
Median	0.01**	0.31	
	0.6**	13.0	3.8
Range	-0.0097**-0.12	0.17-2.0	
	-0.39**-3.6	8.7-59.0	3.0-5.8

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE C-2. PLUTONIUM CONCENTRATIONS IN MUSCLES AND LIVERS, BEEF CATTLE, AREA 18, NTS, MAY 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
	Muscles		
1	0.00032 ± 0.0015** 0.0037 ± 0.017**	0.026 ± 0.0065 0.3 ± 0.075	1.2
2	0.0038 ± 0.005** 0.041 ± 0.055**	0.044 ± 0.0097 0.48 ± 0.11	1.1
3	0.0031 ± 0.0044** 0.035 ± 0.051**	0.013 ± 0.0039 1.15 ± 0.046	1.2
4	0.0054 ± 0.0087** 0.054 ± 0.087**	0.037 ± 0.012 0.37 ± 0.12	1.0
Median	0.0035** 0.038**	0.0315 0.335	1.15
Range	0.00032**-0.0054** 0.0037**-0.054**	0.013-0.044 0.15-0.48	1.0-1.2
#1 Fetus	0.0022 ± 0.0059** 0.033 ± 0.089**	0.016 ± 0.016 0.24 ± 0.25**	1.5
	Livers		
1	0.003 ± 0.0073** 0.041 ± 0.098**	0.083 ± 0.026 1.1 ± 0.34	1.3
2	0.0032 ± 0.0061** 0.042 ± 0.082**	0.047 ± 0.013 0.63 ± 0.17	1.3
3	0.005 ± 0.0064** 0.06 ± 0.077**	0.027 ± 0.007 0.32 ± 0.083	1.2
4	0.015 ± 0.019** 0.21 ± 0.26**	0.044 ± 0.016 0.61 ± 0.23	1.4

(continued)

TABLE C-2. (Continued)

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
		Livers	
Median	0.0041**	0.055	
	0.051**	0.61	1.3
Range	0.003**-0.015**	0.027-0.083	
	0.0.041**-0.21**	0.32-1.1	1.2-1.4
#1 Fetus	0.0006 ± 0.0028**	0.036 ± 0.0099	
	0.0089 ± 0.042**	0.53 ± 0.15	1.5

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE C-3. PLUTONIUM CONCENTRATIONS IN GONADS, BEEF CATTLE, AREA 18, NTS, MAY 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
1	-0.013 ± 0.02** -0.8 ± 1.2**	0.067 ± 0.082** 4.0 ± 4.9**	6.0
2	0.009 ± 0.03** 0.45 ± 1.5**	0.032 ± 0.056** 1.6 ± 2.8**	5.0
3	-0.0057 ± 0.026** -0.25 ± 1.2**	0.085 ± 0.1** 3.8 ± 4.6**	4.4
4	-0.015 ± 0.068** -0.49 ± 2.3**	0.011 ± 0.029** 0.36 ± 0.98**	3.3
Median	-0.014** -0.37**	0.0485** 2.7**	4.7
Range	-0.0057**-0.009** -0.8**-0.45**	0.011**-0.085** 0.36**-4.0**	3.3-6.0

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE C-4. PLUTONIUM AND STRONTIUM CONCENTRATIONS IN FEMURS, BEEF CATTLE, AREA 18, NTS, MAY, 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)
1	0.0016 ± 0.0044** 0.45 ± 1.2**	0.0022 ± 0.0051** 0.6 ± 1.4**	1.8 ± 4.5** 490.0 ± 1200.0**	1.8 ± 0.25 490.0 ± 70.0	28
2	-0.0029 ± 0.0091** -0.51 ± 2.4**	0.0058 ± 0.0091** 1.5 ± 2.4**	4.9 ± 5.8** 1300.0 ± 1500.0**	2.1 ± 0.29 550.0 ± 77.0	26
3	-0.0019 ± 0.009** -0.35 ± 1.6**	-0.001 ± 0.0045** -0.17 ± 0.81**	-0.65 ± 8.9** -120.0 ± 1600.0**	2.3 ± 0.41 410.0 ± 74.0	18
4	-0.0043 ± 0.02** -1.0 ± 4.8**	0.0059 ± 0.0084** 1.4 ± 2.0**	2.1 ± 3.8** 500.0 ± 900.0**	1.3 ± 0.19 300.0 ± 45.0	24
Median	-0.0024** -0.43**	0.004** 1.0**	1.95** 495.0**	1.95 450.0	25
Range	-0.0043**-0.0016** -1.0**-0.45**	-0.001**-0.0059** -0.17**-1.5**	-0.65**-4.9** -120.0**-1300.0**	1.3-2.3 300.0-550.0	18.0-28.0
#1 Fetus	-0.00055 ± 0.00026** -0.0037 ± 0.017**	0.005 ± 0.0079** 0.33 ± 0.52**	NA	NA	6.6

*Wet Weight
**Counting Error exceeds Reported Activity

TABLE C-5. GAMMA-EMITTING RADIONUCLIDE AND TRITIUM CONCENTRATIONS IN SELECTED TISSUES, BEEF CATTLE, AREA 18, NTS, MAY 1981

Animal Number	Muslces K(g/kg)* ^{137}Cs(pCi/kg)*	Lungs K(g/kg)* ^{137}Cs(pCi/kg)*	Livers K(g/kg)* ^{137}Cs(pCi/kg)*	Thyroids K(g/kg)*	Kidneys K(g/kg)* ^{137}Cs(pCi/kg)*	Blood ^{3}H(pCi/L)
1	7.2 ± 0.35 35.0 ± 15.0	7.1 ± 0.65 <64	6.5 ± 0.32 <27	2.6 ± 1.7	5.4 ± 0.29 31.0 ± 14.0	<310
2	6.9 ± 0.31 48.0 ± 13.0	7.9 ± 0.48 <45	5.4 ± 0.31 <30	GSN	2.7 ± 0.29 36.0 ± 14.0	<310
3	6.3 ± 0.34 65.0 ± 13.0	6.7 ± 0.6 <47	5.4 ± 0.29 <26	5.0 ± 2.9	5.4 ± 0.31 36.0 ± 13.0	<310
4	6.3 ± 0.3 36.0 ± 12.0	2.3 ± 0.43 690.0 ± 220.0	5.3 ± 0.27 22.0 ± 8.5	GSN	5.7 ± 0.31 26.0 ± 13.0	<310
Median	6.6 42	6.9 <56	5.4 <27	GSN	5.4 33.5	<310
Range	6.3-7.2 35-65	2.3-7.9 <45-690	5.3-6.5 22-<30	GSN-5.0	2.7-5.7 26-36	<310
#1 Fetus	4.9 ± 0.26 36.0 ± 9.9	2.8 ± 1.9 <25	4.0 ± 0.3 50.0 ± 12.0	NA	NA	NA

* Wet Weight
GSN = Gamma Spectrum Negligible
NA = Not Analyzed

TABLE D-1. PLUTONIUM CONCENTRATIONS IN LUNGS, BEEF CATTLE, AREA 18, NTS, OCTOBER 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
5	0.021 ± 0.0053 0.23 ± 0.059	0.8 ± 0.1 8.9 ± 1.1	1.1
6	0.025 ± 0.0053 0.23 ± 0.051	0.49 ± 0.052 4.7 ± 0.5	0.95
7	0.013 ± 0.0046 0.13 ± 0.046	0.20 ± 0.026 2.0 ± 0.26	1.0
8	0.014 ± 0.0043 0.14 ± 0.043	0.16 ± 0.021 1.6 ± 0.21	1.0
9	0.0058 ± 0.0066** 0.058 ± 0.066**	0.023 ± 0.0059 0.23 ± 0.059	1.0
10	0.024 ± 0.007 0.28 ± 0.084	0.22 ± 0.036 2.6 ± 0.43	1.2
11	0.007 ± 0.0076** 0.076 ± 0.083**	0.35 ± 0.042 3.8 ± 0.45	1.1
12	0.0086 ± 0.00035 0.087 ± 0.036	0.07 ± 0.012 0.71 ± 0.12	1.0
13	0.01 ± 0.0035 0.11 ± 0.039	0.27 ± 0.03 3.0 ± 0.33	1.1
14	0.0057 ± 0.0075** 0.058 ± 0.076**	0.028 ± 0.0077 0.29 ± 0.079	1.0
Median	0.012 0.12	0.21 2.3	1.0
Range	0.0057**-0.025 0.058**-0.28	0.023-0.8 0.23-8.9	0.95-1.2

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE D-2. PLUTONIUM CONCENTRATIONS IN MUSCLES, BEEF CATTLE, AREA 18, NTS, OCTOBER 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
5	0.0013 ± 0.0029** 0.0099 ± 0.023**	0.0062 ± 0.0069** 0.049 ± 0.054**	0.79
Duplicate #5	0.00 ± 0.0038** 0.00 ± 0.042**	0.011 ± 0.015** 0.12 ± 0.18**	1.1
6	-0.00046 ± 0.0021** -0.005 ± 0.023**	0.0028 ± 0.0054** 0.03 ± 0.058**	1.1
7	0.00059 ± 0.002** 0.0067 ± 0.022**	0.003 ± 0.0045** 0.033 ± 0.05**	1.1
8	0.0027 ± 0.0048** 0.022 ± 0.039**	0.0019 ± 0.004** 0.015 ± 0.033**	0.81
9	0.0012 ± 0.0027** 0.012 ± 0.028**	0.0015 ± 0.0027** 0.012 ± 0.028**	1.1
10	0.0012 ± 0.0032** 0.012 ± 0.033**	0.0024 ± 0.0046** 0.024 ± 0.047**	1.0
11	-0.0004 ± 0.0019** -0.0044 ± 0.02**	0.0032 ± 0.0054** 0.035 ± 0.059**	1.1
Duplicate #11	0.003 ± 0.0058** 0.023 ± 0.045**	0.002 ± 0.0047** 0.016 ± 0.0036**	0.77
12	0.00 ± 0.0019** 0.00 ± 0.018**	0.016 ± 0.0056 0.16 ± 0.054	0.96
13	0.0022 ± 0.0061** 0.019 ± 0.053**	0.0037 ± 0.008** 0.032 ± 0.068**	0.86
14	0.0024 ± 0.0066** 0.017 ± 0.047**	0.0048 ± 0.0094** 0.035 ± 0.068**	0.72
Median	0.0012** 0.011**	0.0031** 0.032**	0.98
Range	-0.00046**-0.003** -0.005**-0.023**	0.0015**-0.016 0.012**-0.16	0.72-1.1

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE D-3. PLUTONIUM CONCENTRATIONS IN LIVERS, BEEF CATTLE, AREA 18, NTS, OCTOBER 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
5	0.012 ± 0.013** 0.13 ± 0.13**	0.15 ± 0.03 1.5 ± 0.31	1.0
6	0.003 ± 0.0042** 0.036 ± 0.051**	0.046 ± 0.0089 0.55 ± 0.11	1.2
7	0.00 ± 0.0027** 0.00 ± 0.029**	0.073 ± 0.02 0.79 ± 0.21	1.1
8	0.0026 ± 0.0054** 0.041 ± 0.088**	0.04 ± 0.012 0.64 ± 0.19	1.6
9	-0.00029 ± 0.0014** -0.0047 ± 0.021**	0.029 ± 0.0068 0.46 ± 0.11	1.6
10	0.0092 ± 0.013** 0.061 ± 0.086**	0.086 ± 0.022 0.57 ± 0.14	0.66
11	0.0022 ± 0.006** 0.027 ± 0.073**	0.11 ± 0.028 1.3 ± 0.34	1.2
12	0.0021 ± 0.0071** 0.025 ± 0.084**	0.081 ± 0.025 0.96 ± 0.29	1.2
13	0.011 ± 0.016** 0.12 ± 0.18**	0.21 ± 0.056 2.3 ± 0.62	1.1
14	0.0073 ± 0.016** 0.089 ± 0.2**	0.0023 ± 0.0027** 0.028 ± 0.033**	1.2
Median	0.0028** 0.0385**	0.077 0.715	1.2
Range	-0.00029**-0.012** -0.0047**-0.13**	0.0023**-0.21 0.028**-2.3	0.66-1.6

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE D-4. PLUTONIUM CONCENTRATIONS IN GONADS, BEEF CATTLE, AREA 18, NTS, OCTOBER 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
5	0.18 ± 0.23** 1.1 ± 1.5**	0.064 ± 0.14** 0.41 ± 0.85**	0.63
6	0.00 ± 0.09** 0.00 ± 0.3**	-0.019 ± 0.09** -0.064 ± 0.3**	0.33
7	0.15 ± 0.36** 0.65 ± 1.5**	0.12 ± 0.31** 0.45 ± 1.3**	0.42
8	0.077 ± 0.25** 0.37 ± 1.2**	0.5 ± 0.66** 2.4 ± 3.2**	0.48
9	0.023 ± 0.063** 0.19 ± 0.52**	0.023 ± 0.063** 0.19 ± 0.52**	0.83
10	-0.004 ± 0.019** -0.041 ± 0.19**	-0.001 ± 0.0047** -0.01 ± 0.048**	1.0
11	0.12 ± 0.31** 1.2 ± 3.1**	0.15 ± 0.36** 1.5 ± 3.6**	1.0
12	0.14 ± 0.24** 1.4 ± 2.4**	0.077 ± 0.18** 0.77 ± 1.8**	1.0
13	0.014 ± 0.021** 0.15 ± 0.21**	0.048 ± 0.017 0.49 ± 0.17	1.0
14	-0.0081 ± 0.038** -0.079 ± 0.36**	0.0068 ± 0.014** 0.066 ± 0.14**	0.97
Median	0.05** 0.28**	0.056** 0.43**	0.9
Range	-0.0081**-0.18** -0.079**-1.4**	-0.019**-0.5** -0.064**-2.4**	0.33-1.0

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE D-5. PLUTONIUM AND STRONTIUM CONCENTRATIONS IN FEMURS, BEEF CATTLE, AREA 18, NTS, OCTOBER 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)
5	0.00076 ± 0.0025**	0.051 ± 0.011	14.0 ± 5.4	1.6 ± 0.22	
	0.19 ± 0.61**	13.0 ± 2.6	3500.0 ± 1300.0	390.0 ± 50.0	24.5
Duplicate	0.00058 ± 0.0027**	0.029 ± 0.0091	-6.8 ± 24.0**	3.2 ± 0.46	
#5	0.24 ± 0.11**	11.0 ± 3.7	-2700.0 ± 9600.0**	1300.0 ± 190.0	40.5
6	0.0013 ± 0.0034**	0.0013 ± 0.0034**	-8.5 ± 26.0**	3.2 ± 0.46	
	0.39 ± 1.0**	0.39 ± 1.0**	-2600.0 ± 8000.0**	980.0 ± 140.0	30.6
7	0.00 ± 0.0022**	0.011 ± 0.011**	-7.8 ± 37.0**	4.8 ± 0.7	
	0.00 ± 0.63**	3.1 ± 3.2**	-2200.0 ± 11000.0**	1400.0 ± 210.0	29.0
8	0.0042 ± 0.0067**	0.014 ± 0.0054	6.8 ± 21.0**	2.4 ± 0.35	
	1.2 ± 1.9**	3.8 ± 1.5	1900.0 ± 5800.0**	670.0 ± 98.0	27.9
9	-0.00055 ± 0.0025**	0.00053 ± 0.0018**	1.4 ± 13.0**	2.1 ± 0.3	
	-0.11 ± 0.53**	0.11 ± 0.37**	280.0 ± 2700.0**	430.0 ± 62.0	20.9
10	0.00034 ± 0.0016**	0.0036 ± 0.0052**	-3.9 ± 13.0**	2.1 ± 0.3	
	0.078 ± 0.36**	0.84 ± 1.2**	-910.0 ± 3000.0**	490.0 ± 69.0	23.2
11	0.00084 ± 0.002**	0.0066 ± 0.0024	-1.8 ± 12.4**	1.9 ± 0.28	
	0.18 ± 0.42**	1.4 ± 0.52	-390.0 ± 2700.0**	410.0 ± 60.0	21.4
Duplicate	-0.0004 ± 0.0018**	-0.0016 ± 0.0075**	-1.7 ± 13.0**	1.9 ± 0.27	
#11	-0.14 ± 0.65**	-0.56 ± 0.29**	-580.0 ± 4500.0**	660.0 ± 930.0	34.5

(continued)

TABLE D-5. (Continued)

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)
12	0.00025 ± 0.0012**	0.0044 ± 0.0052**	-0.97 ± 13.0**	2.0 ± 0.29	
	0.038 ± 0.18**	0.74 ± 0.78	-150.0 ± 1900.0**	300.0 ± 44.0	15.0
13	-0.00067 ± 0.0031**	0.0056 ± 0.0065**	-2.5 ± 18.0**	2.7 ± 0.38	
	-0.17 ± 0.77**	1.4 ± 1.6**	-620.0 ± 4500.0**	670.0 ± 93.0	24.6
14	-0.00083 ± 0.0038**	0.0016 ± 0.0031**	-5.4 ± 19.0**	3.0 ± 0.40	
	-0.23 ± 1.1**	0.45 ± 0.86**	-1500.0 ± 5300.0**	810.0 ± 110.0	27.4
Median	0.000295**	0.0053**	-1.75**	2.25	
	0.058**	1.12**	-435.00**	665.0	26.0
Range	-0.0008**-0.0042**	-0.0016**-0.051	-8.5**-14.0	1.6-4.8	
	-0.23**-1.2**	-0.56**-13.0	-2700.0**-3500.0	300.0-1400.0	15.0-40.5

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE D-6. GAMMA-EMITTING RADIONUCLIDE AND TRITIUM CONCENTRATIONS IN SELECTED TISSUES, BEEF CATTLE, AREA 18, NTS, OCTOBER 1981

Animal Number	Muscles K(g/kg)* ^{137}Cs(pCi/kg)*	Lungs K(g/kg)*	Livers K(g/kg)* ^{137}Cs(pCi/kg)*	Kidneys K(g/kg)* ^{137}Cs(pCi/kg)*	Blood K(g/kg)* ^{3}H(pCi/L)*
5	4.8 ± 0.38 25.0 ± 16.0	1.9 ± 0.47	3.6 ± 0.38 <25	2.0 ± 0.26 <27	0.94 ± 0.26 490 ± 290
6	4.0 ± 0.31 25.0 ± 10.0	2.3 ± 0.52	3.5 ± 0.31 <25	<3.4 29.0 ± 15.0	GSN 1900 ± 320
7	4.8 ± 0.29 15.0 ± 12.0	2.1 ± 0.53	3.4 ± 0.29 <25	3.0 ± 0.28 16.0 ± 10.0	GSN 520 ± 290
8	3.8 ± 0.36 55.0 ± 15.0	2.1 ± 0.47	3.9 ± 0.35 <28	2.6 ± 0.33 31.0 ± 15.0	1.9 ± 0.26 <450
9	4.2 ± 0.3 19.0 ± 14.0	3.2 ± 0.48	4.1 ± 0.21 <25	3.5 ± 0.34 27.0 ± 14.0	0.69 ± 0.34 670 ± 290
10	4.7 ± 0.4 21.0 ± 16.0	3.8 ± 0.64	3.3 ± 0.29 <25	3.5 ± 0.35 <28	0.74 ± 0.25 <450
11	4.9 ± 0.39 41.0 ± 16.0	5.3 ± 0.63	3.3 ± 0.27 <25	3.0 ± 0.32 23.0 ± 15.0	GSN 540 ± 290
12	5.1 ± 0.33 <28	3.8 ± 0.75	3.7 ± 0.28 <27	3.0 ± 0.29 <29	GSN 640 ± 290
13	5.2 ± 0.42 <27	2.5 ± 0.34	3.4 ± 0.28 27.0 ± 14.0	2.8 ± 0.29 31.0 ± 11.0	0.99 ± 0.27 600 ± 290

(continued)

TABLE D-6. (Continued)

Animal Number	Muscles K(g/kg)* ^{137}Cs(pCi/kg)*	Lungs K(g/kg)*	Livers K(g/kg)* ^{137}Cs(pCi/kg)*	Kidneys K(g/kg)* ^{137}Cs(pCi/kg)*	Blood K(g/kg)* ^{3}H(pCi/L)*
14	4.9 ± 0.31 21.0 ± 9.9	3.4 ± 0.38	3.8 ± 0.38 <25	Sample Lost	0.81 ± 0.23 <450
Median	4.8 25	2.9	3.55 <25	3.0 <29	0.72 530
Range	3.8-5.2 15-55	1.9-5.3	3.3-4.1 <25-<28	2.0-3.5 16-31	GSN-1.9 <450-1900

* Wet Weight
GSN = Gamma Spectrum Negligible

TABLE E-1. PLUTONIUM CONCENTRATIONS IN MUSCLES AND LUNGS, MULE DEER, NTS, 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
		Muscles	
1	0.0094 ± 0.015** 0.11 ± 0.18**	0.0042 ± 0.0099** 0.05 ± 0.12**	1.2
2	0.0004 ± 0.0019** 0.0041 ± 0.019**	0.008 ± 0.0087** 0.082 ± 0.089**	1.0
3	0.0014 ± 0.0033** 0.013 ± 0.03**	0.0007 ± 0.0023** 0.0064 ± 0.021**	0.92
4	0.0015 ± 0.0036** 0.019 ± 0.044**	0.0019 ± 0.004** 0.024 ± 0.05**	1.2
Median	0.00145 0.016	0.003 0.037	1.1
Range	0.0004**-0.0094** 0.0041**-0.11**	0.0007**-0.008** 0.0064**-0.082**	0.92-1.2
		Lungs	
1	0.00 ± 0.0045** 0.00 ± 0.048**	0.0068 ± 0.012** 0.072 ± 0.13**	1.1
2	0.00 ± 0.0017** 0.00 ± 0.017**	0.011 ± 0.0042 0.11 ± 0.042	1.0
3	0.0027 ± 0.0064** 0.031 ± 0.072**	0.012 ± 0.014** 0.13 ± 0.15**	1.1
4	-0.00061 ± 0.0024** -0.0075 ± 0.035**	0.011 ± 0.012** 0.14 ± 0.15**	1.2
Median	0.00** 0.00**	0.011** 0.12**	1.1
Range	-0.00061** -0.0075**-0.031**	0.0068**-0.012** 0.072**-0.14**	1.0-1.2

* Wet Weight
** Counting Error exceeds Reported Activity

t TABLE E-2. PLUTONIUM CONCENTRATIONS IN LIVER AND RUMEN CONTENTS MULE DEER, NTS, 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	Ash (%)
		Liver	
1	0.025 ± 0.054** 0.35 ± 0.76**	0.015 ± 0.041** 0.21 ± 0.58**	1.4
2	0.0017 ± 0.0033** 0.026 ± 0.05**	0.0067 ± 0.0028 0.11 ± 0.044	1.6
3	0.011 ± 0.023** 0.043 ± 0.091**	0.27 ± 0.059 1.1 ± 0.24	0.4
4	0.00 ± 0.0054** 0.00 ± 0.066**	0.0058 ± 0.012** 0.07 ± 0.15**	1.2
Median	0.0064 0.035	0.011** 0.155**	1.3
Range	0.00**-0.025** 0.00**-0.35**	0.0058**-0.27 0.07**-1.1	0.4-1.6
		Rumen Contents	
1	0.018 ± 0.0045** 0.33 ± 0.048**	0.081 ± 0.017 1.5 ± 0.3	1.8
2	0.044 ± 0.0017** 1.2 ± 0.017**	0.30 ± 0.032 8.0 ± 0.85	2.6
3	0.051 ± 0.0064** 1.1 ± 0.072**	0.21 ± 0.032 4.6 ± 0.7	2.2
4	0.038 ± 0.0024** 0.7 ± 0.035**	0.16 ± 0.024 3.0 ± 0.44	1.8
Median	0.041 0.9	0.185 3.8	2.4
Range	0.018-0.051 0.33-1.2	0.081-0.3 1.5-8.0	1.8-2.6

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE E-3. PLUTONIUM AND STRONTIUM CONCENTRATIONS IN HOCK BONES, MULE DEER, NTS, 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)
1	-0.00052 ± 0.0024**	0.011 ± 0.012**	5.2 ± 1.5	1.8 ± 0.24	
	-0.15 ± 0.67**	3.2 ± 3.4**	1500.0 ± 450.0	500.0 ± 70.0	28
2	0.011 ± 0.015**	0.0079 ± 0.012**	1.6 ± 2.6**	1.7 ± 0.23	
	3.2 ± 4.2**	2.2 ± 3.5**	450.0 ± 730.0**	470.0 ± 65.0	28
3	-0.00051 ± 0.0023**	0.001 ± 0.0033**	2.7 ± 8.0**	1.8 ± 0.26	
	-0.17 ± 0.8**	0.34 ± 1.1**	900.0 ± 2700.0**	610.0 ± 0.86	33.6
4	-0.00056 ± 0.0026**	0.0022 ± 0.0051**	5.8 ± 10.0**	1.1 ± 0.17	
	-0.21 ± 0.94**	0.79 ± 1.9**	2100.0 ± 3600.0**	390.0 ± 62.0	37
Median	-0.00052**	0.005**	4.0**	1.75	
	-0.19**	1.3**	1200.0**	485.0	30.3
Range	-0.00056**-0.011**	0.001**-0.011**	1.6**-5.8**	1.1-1.8	
	-0.21**-3.2**	0.34**-3.2**	450.0**-2100.0**	390.0-610.0	28.0-37.0

* Wet Weight
** Counting Error exceeds Reported Activity

TABLE E-4. GAMMA-EMITTING RADIONUCLIDE AND TRITIUM CONCENTRATIONS IN SELECTED TISSUES, MULE DEER, NTS, 1981

Animal Number	Muscles K(g/kg)* ^{137}Cs(pCi/kg)* ^{3}H(pCi/L)**	Lungs K(g/kg)*	Livers K(g/kg)* ^{137}Cs(pCi/kg)* ^{3}H(pCi/L)**	Kidney K(g/kg)* ^{137}Cs(pCi/kg)* ^{3}H(pCi/L)**
1	<42 23.0 ± 15.0 NA	5.3 ± 0.55	4.8 ± 0.34 <29 NA	81.0 ± 0.79 <78 450.0 ± 250.0
2	5.8 ± 0.3 28.0 ± 13.0 NA	6.3 ± 0.48	5.6 ± 0.29 27.0 ± 12.0 NA	6.7 ± 0.44 67.0 ± 19.0 $8.8 \times 10^{6} \pm 7.4 \times 10^{3}$
3	4.2 ± 0.33 <27 NA	3.7 ± 0.47	3.3 ± 0.3 <25 NA	3.3 ± 0.46 22.0 ± 15.0 <370
4	3.4 ± 0.3 <26 $2.4 \times 10^{6} \pm 4.2 \times 10^{3}$	2.4 ± 0.52	3.9 ± 0.34 <26 $2.2 \times 10^{6} \pm 3.6 \times 10^{3}$	5.5 ± 1.0 110.0 ± 44.0 $1.1 \times 10^{6} \pm 3.3 \times 10^{3}$
Median	5.0 <265	4.5	4.35 <265	6.1 <73 4.4×10^{6}
Range	3.4-<42 23-28 2.4×10^{6}	2.4-6.3	3.3-5.6 <25-<29 2.2×10^{6}	3.3-81 22-110 <370-8.8×10^{6}

* Wet Weight
** Tissue Water
NA = Not Analyzed

TABLE E-5. GAMMA-EMITTING RADIONUCLIDE AND TRITIUM CONCENTRATIONS IN RUMEN CONTENTS, MULE DEER, NTS, 1981

Animal Number	K (g/kg)*	^{3}H (pCi/L)**	^{7}Be (pCi/kg)*	^{95}Nb (pCi/kg)*	^{95}Zr (pCi/kg)*	^{103}Ru (pCi/kg)*	^{137}Cs (pCi/kg)*	^{141}Ce (pCi/kg)*	^{144}Ce (pCi/kg)*
1	5.1 ± 0.32	NA	370 ± 130	310 ± 250	130 ± 29	43 ± 16	32 ± 12	42 ± 19	140 ± 76
2	13.0 ± 0.74	NA	<167	130 ± 210	<26	<26	97 ± 14	<110	<74
3	4.3 ± 0.37	NA	1300 ± 460	<30	<30	<30	<30	<130	<87
4	3.7 ± 0.35	$2.2 \times 10^{6} \pm 4.1 \times 10^{3}$	620 ± 190	70 ± 32	<30	<30	31 ± 18	<130	270 ± 82
Median	5.7	--	545	100	<30	<30	31.5	<120	<110
Range	3.7-13.0	2.2×10^{6}	<167-1300	<30-310	<26-130	<26-43	<30-97	42-<130	<74-270

* Wet Weight
** Tissue Water
NA = Not Analyzed

TABLE F-1. PLUTONIUM AND STRONTIUM CONCENTRATIONS IN HOCK BONES, DESERT BIGHORN SHEEP, 1981

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)
1	0.0012 ± 0.0025**	0.0013 ± 0.00038	-2.6 ± 17.0**	2.0 ± 0.28	
	0.40 ± 0.84**	4.3 ± 1.3	-870.0 ± 550.0**	650.0 ± 90.0	33.1
2	0.00098 ± 0.0023**	0.00049 ± 0.0016**	-0.23 ± 13.0**	1.8 ± 0.26	
	0.47 ± 1.1**	0.23 ± 0.77**	-110.0 ± 6300.0**	850.0 ± 120.0	47.3
3	0.0015 ± 0.0028**	0.0005 ± 0.0017**	-3.0 ± 33.0**	4.7 ± 0.64	
	0.67 ± 1.3**	0.22 ± 0.73**	-1400.0 ± 15000.0**	2100.0 ± 290.0	44.3
4	-0.00044 ± 0.0015**	-0.00044 ± 0.0015**	-1.4 ± 12.0**	1.8 ± 0.26	
	-0.18 ± 0.59**	-0.18 ± 0.59**	-550.0 ± 4900.0**	720.0 ± 100.0	40.5
5	-0.00051 ± 0.0017**	-0.00051 ± 0.0017**	0.74 ± 3.7**	0.77 ± 0.12	
	-0.064 ± 0.21**	-0.064 ± 0.21**	92.0 ± 560.0**	96.0 ± 15.0	12.5
6	-0.00074 ± 0.0024**	0.0033 ± 0.0052**	1.9 ± 15.0**	3.0 ± 0.41	
	-0.21 ± 0.7**	0.95 ± 1.5**	550.0 ± 4300.0**	860.0 ± 120.0	28.7
7	0.0028 ± 0.0067**	0.0035 ± 0.0075**	-2.4 ± 18.0**	2.2 ± 0.32	
	-1.2 ± 2.8**	1.5 ± 3.2**	-1000.0 ± 7500.0**	930.0 ± 140.0	42.8
8	0.002 ± 0.0066**	0.00 ± 0.0047**	-2.4 ± 18.5**	2.6 ± 0.36	
	0.7 ± 2.3**	0.00 ± 1.6**	840.0 ± 6500.0**	910.0 ± 1300.0	35.2
9	0.0053 ± 0.0085**	0.0018 ± 0.59**	-4.9 ± 21.0**	2.8 ± 0.4	
	1.8 ± 2.8**	0.59 ± 16.0**	-1600.0 ± 6800.0**	940.0 ± 130.0	33.3
10	-0.00087 ± 0.004**	-0.00029 ± 0.0013**	-3.8 ± 10.5**	1.3 ± 0.2	
	-0.27 ± 1.3**	-0.09 ± 0.42**	-1200.0 ± 3300.0**	410.0 ± 0.62	31.2

(continued)

TABLE F-1. (Continued)

Animal Number	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)
11	0.0012 ± 0.0027**	-0.00058 ± 0.0019**	-3.2 ± 18.0**	2.6 ± 0.37	
	0.4 ± 0.93**	-0.2 ± 0.66**	-1100.0 ± 6100.0**	890.0 ± 130.0	34.3
12	-0.00072 ± 0.0034**	0.00 ± 0.0011**	0.072 ± 6.0**	0.74 ± 0.12	
	-0.25 ± 1.2**	0.00 ± 0.39**	25.0 ± 2000.0**	260.0 ± 40.0	34.7
13	0.0012 ± 0.0028**	0.0027 ± 0.0043**	1.4 ± 15.0**	1.7 ± 0.25	
	0.42 ± 0.99**	0.95 ± 1.5**	500.0 ± 5000.0**	600.0 ± 86.0	34.9
14	SAMPLE NOT COLLECTED				
15	-0.00026 ± 0.0012**	0.00078 ± 0.0021**	-5.4 ± 10.0**	1.1 ± 0.17	
	-0.07 ± 0.33**	0.21 ± 0.56**	-1500.0 ± 2700.0**	300.0 ± 45.0	26.7
16	0.0013 ± 0.0031**	0.00 ± 0.0016**	-5.5 ± 8.8**	1.5 ± 0.22	
	0.32 ± 0.75**	0.00 ± 0.37**	-1300.0 ± 2100.0**	350.0 ± 52.0	23.7
17	-0.00083 ± 0.0039**	0.0011 ± 0.0026**	5.4 ± 7.5**	1.3 ± 0.2	
	-0.3 ± 1.4**	0.4 ± 0.93**	1900.0 ± 2700.0**	460.0 ± 72.0	36.0
18	0.0017 ± 0.0033**	0.0029 ± 0.0043**	-6.4 ± 26.0**	3.1 ± 0.43	
	0.47 ± 0.89**	0.77 ± 1.2**	-1700.0 ± 6900.0**	830.0 ± 1.2	26.9
Median	0.0012**	0.0005**	-2.4**	1.8	
	0.32**	0.23**	-870.0**	720.0	34.3
Range	-0.00087**-0.0053**	-0.00053**-0.0035**	-6.4**-5.4**	0.74-4.7	
	-1.2**-1.8**	-0.18**-4.3	-1700.0**-1900.0**	96.0-2100.0	12.5-47.3

* Wet Weight

** Counting Error exceeds Reported Activity

TABLE F-2. GAMMA-EMITTING RADIONUCLIDE AND TRITIUM CONCENTRATIONS IN KIDNEYS, DESERT BIGHORN SHEEP, 1981

Animal Number	K (g/kg)*	^{137}Cs (pCi/kg)*	^{3}H (pCi/L)**
1	4.6 ± 0.68	<80	670 ± 300
2		Not Sampled	
3	8.8 ± 1.0	<93	<480
4	3.7 ± 0.48	41 ± 21	<370
5	5.8 ± 0.69	62 ± 28	<480
6	4.0 ± 0.95	130 ± 50	<370
7	3.9 ± 0.87	78 ± 43	<370
8	2.6 ± 0.32	<32	730 ± 240
9	4.8 ± 0.75	55 ± 33	950 ± 250
10	3.2 ± 0.39	<37	<370
11	3.0 ± 0.36	<29	430 ± 230
12	4.2 ± 0.72	<74	<370
13	4.8 ± 1.0	<85	<480
14	4.0 ± 0.59	<69	<480
15	4.2 ± 0.44	<39	<480
16	6.4 ± 0.91	<88	550 ± 300
17	3.6 ± 0.60	<60	1800 ± 330
Median	4.1	<65.5	<480
Range	2.6-8.8	<29-130	<370-1800

* Wet Weight
** Aqueous portion of kidney tissue

TABLE G-1. PLUTONIUM, STRONTIUM, AND GAMMA-EMITTING RADIONUCLIDE CONCENTRATIONS IN SELECTED TISSUES, NTS, HORSE, 1981

Tissue Type	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)	K(g/kg)* ^{137}Cs(pCi/kg)*
Muscle	<0.0025 <0.028	<0.0055 <0.061	NA	NA	1.1	7.7 ± 0.37 38.0 ± 12.0
Femur Bone	<0.011 <2.9	<0.013 <3.2	<13	4.7 ± 0.63 <3200 1200.0 ± 160.0	26.0	NA

* Wet Weight

TABLE H-1. PLUTONIUM, STRONTIUM, TRITIUM, AND GAMMA-EMITTING RADIONUCLIDE CONCENTRATIONS IN SELECTED TISSUES, CHUKAR, NTS, 1981

Tissue Type	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)	K(g/kg)* ^{137}Cs(pCi/kg)* ^{3}H(pCi/L)†
Muscle	0.08 ± 0.02 1.4 ± 0.38	0.02 ± 0.023** 0.35 ± 0.41**	NA	NA	1.8	8.5 ± 0.43 48.0 ± 17.0 NA
Internal Organs	NA	NA	NA	NA	NA	11.0 ± 0.85 <73 760.0 ± 300.0
Bone	0.00076 ± 0.0025** 0.066 ± 0.21**	-0.00038 ± 0.0018** -0.033 ± 0.15**	-10.0 ± 37.0** -890.0 ± 3200.0**	7.1 ± 0.98 620.0 ± 85.0	8.7	NA

*Wet Weight
**Counting Error exceeds Reported Activity
†Tissue Water
NA = Not Analyzed

TABLE I-1. PLUTONIUM, STRONTIUM, AND GAMMA-EMITTING RADIONUCLIDE CONCENTRATIONS IN SELECTED TISSUES, GOAT, 1981

Tissue Type	^{238}Pu (pCi/g Ash) (pCi/kg)*	^{239}Pu (pCi/g Ash) (pCi/kg)*	^{89}Sr (pCi/g Ash) (pCi/kg)*	^{90}Sr (pCi/g Ash) (pCi/kg)*	Ash (%)	K(g/kg)**
Muscle	NA	NA	NA	NA	NA	5.4 ± 0.39
Lung	NA	NA	NA	NA	NA	6.8 ± 0.47
Liver	NA	NA	NA	NA	NA	3.6 ± 0.31
Femur	0.0019 ± 0.0063** 0.44 ± 1.4**	0.0048 ± 0.01** 1.1 ± 2.3**	-14.0 ± 18.0** -3200.0 ± 4000.0**	4.1 ± 0.96 940.0 ± 220.0	22.9	NA

*Wet Weight
**Counting Error exceeds Reported Activity
NA = Not Analyzed

TABLE J-1. GROSS* AND MICROSCOPIC PATHOLOGY**
FOUND IN NECROPSIED ANIMALS, 1981

AREA 18 CATTLE

1

Necropsy findings: Lungs showed some emphysema resulting from agonal struggling. Uterus contained 8-month male fetus.

Histopathological findings: Mild fatty changes in the liver which are characterized by cytoplasmic swelling. Moderate hemosiderosis of the spleen. Moderate emphysema of lung.

Clinical diagnosis: Normal mature pregnant cow in excellent condition.

2

Necropsy findings: Lungs heavily traumatized by bullet.

Histopathological findings: Moderate intrapulmonary hemorrhage associated with mode of death.

Clinical diagnosis: Normal yearling heifer.

3

Necropsy findings: No gross lesions noted.

Histopathological findings: Aspirated blood in large airways of lung associated with agonal struggling. Mature active follicles in ovary.

Clinical diagnosis: Normal calf.

4

Necropsy findings: No gross lesions.

Histopathological findings: Mild accumulation of hemosiderin in the macrophages of the red pulp of the spleen. One small granuloma characterized by epitheloid cells surrounded by lymphocytes and fibroblasts is noted in the parenchyma of the lung. This is a chronic lesion and probably represents the site of a small foreign body.

* As reported by senior author.
** As reported by Dr. Billy C. Ward, College of Veterinary Medicine, Mississippi State University, Starkville, Mississippi.

(continued)

TABLE J-1. (Continued)

Clinical diagnosis: Normal mature barren cow.

5

Necropsy findings: Precancerous plaque on lateral canthus of right eye. Cyst on dorsal surface of right atrial-ventricular valve in heart.

Histopathological findings: Serous valvular cyst in heart, marked hemosiderosis of spleen, squamous plaque (precancerous) on cornea, pheochromocytoma of adrenal.

Clinical diagnosis: Normal aged barren cow with beginning cancer eye.

6

Necropsy findings: Fibrous adhesions between diaphragm and liver. Atelectic areas in lungs.

Histopathological findings: Mild hemosiderosis of spleen. Focal chronic inflamation of the liver which may be result of old reticulitis lesion.

Clinical diagnosis: Mature cow in excellent condition with healed traumatic reticulitis lesions.

7

Necropsy findings: Small abscess below right mandible.

Histopathological findings: Actinobacillosis granuloma on jaw tissue. Moderate hemosiderosis of spleen.

Clinical diagnosis: Normal aged cow with beginning "lumpy jaw."

8

Necropsy findings: Small abscess over right parotid salivary gland. Uterus contained two-month old fetus. Abscess in udder. Lungs had area of emphysema from agonal struggles.

Histopathological findings: Moderate hemosiderosis of spleen. Active follicles in ovaries.

Clinical diagnosis: Normal mature cow.

(continued)

TABLE J-1. (Continued)

9

Necropsy findings: No gross lesions noted.

Histopathological findings: Testes are inactive. No visible lesions in other tissues.

Clinical diagnosis: Normal bull calf.

10

Necropsy findings: No gross lesions noted.

Histopathological findings: No visible lesions.

Clinical diagnosis: Normal yearling bull.

11

Necropsy findings: No gross lesions noted.

Histopathological findings: Active follicles in ovaries. No other visible lesions.

Clinical diagnosis: Normal yearling heifer.

12

Necropsy findings: Uterus contained a 45-day male fetus. Lungs contained scattered area of atelectasis.

Histopathological findings: Active follicles in ovaries. No other visible lesions.

Clinical diagnosis: Normal cow.

13

Necropsy findings: No gross lesions noted.

Histopathological findings: Testes are inactive. No other visible lesions.

Clinical diagnosis: Normal yearling bull.

(continued)

TABLE J-1. (Continued)

14

Necropsy findings: No gross lesions noted.

Histopathological findings: Testes are inactive. No other visible lesions.

Clinical diagnosis: Normal yearling bull.

NEVADA TEST SITE MULE DEER

1

Necropsy findings: Trauma associated with passage of .50 caliber bullet through lungs and heart. No other gross lesions noted.

Histopathological findings: Incidental findings as follows. A few multifocal perivascular lymphoid aggregates are observed in the lungs as well as one small microgranuloma which probably represents parasite migration. Small lymphoid aggregates near cortical-medullary junction of adrenal. There appears to be a healed corneal ulcer.

Clinical diagnosis: Normal yearling doe.

2

Necropsy findings: Trauma associated with collision with motor vehicle. Neck was broken. Extensive warts on left side of body. Advanced post mortem changes present so not sampled for histopathological examination.

Clinical diagnosis: Normal yearling male deer that died in collision with motor vehicle.

3

Necropsy findings: Struck by a motor vehicle. A non-lactating female in good condition with trauma in the cervical region. Veretebrae were fractured. Advanced post mortem changes present so not sampled for histopathological examination.

Clinical diagnosis: Normal mature doe that died in collision with motor vehicle.

(continued)

TABLE J-1. (Continued)

4

Necropsy findings: Young doe in good condition. Extensive lung trauma associated with passage of .243 caliber bullet. Small cyst in thoracic cavity.

Histopathological findings: Active follicles in overies, sarcocysts in muscle, and mild focal mononuclear cell infiltrates in medulla of kidney.

Clinical diagnosis: Normal immature doe.

NEVADA TEST SITE HORSE

1

Necropsy findings: Struck by bus on right side caudal to front leg. Little external evidence of trauma. Advanced decomposition of animal precluded extensive necropsy and collection of histopathological samples.

Clinical diagnosis: Normal mature horse that died in collision with bus.

RACHEL, NV, GOAT

Necropsy findings: Rumen and abomasum full of hay and milk, mucosa of abomasum was inflamed. Mucosa of large intestine was hemorrhagic. Kidneys were soft and friable. Trachea and bronchi contained white frothy exudate and mucosa contained petechial and ecchymotic hemmorrhages. Lungs were swollen and edematous and appeared hepatized.

Histopathological findings: Spleen is congested. Mild autolysis of tubular epithelium of kidney.

Clinical diagnosis: Enterotoxemia.

DESERT BIGHORN SHEEP

All of these animals were mature males that were killed by licensed hunters. No necropsies were performed but all were apparently normal at time of death. No samples were collected for histopathological or hematological examinations.

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1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE ANIMAL INVESTIGATION PROGRAM 1981 REPORT Nevada Test Site and Vicinity		5. REPORT DATE 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) D. D. Smith and K. R. Giles		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS USEPA; Environmental Monitoring Systems Laboratory Office of Research and Development P.O. Box 15027 Las Vegas, NV 89114		10. PROGRAM ELEMENT NO. X6EH10 11. CONTRACT/GRANT NO. IA DE-AI08-76DP00539
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Department of Energy Nevada Operations Office P.O. Box 14100 Las Vegas, NV 89114		13. TYPE OF REPORT AND PERIOD COVERED Response - 1981 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Prepared for the U.S. Department of Energy under Interagency Agreement Number DE-AI08-76DP00539.

16. ABSTRACT

Data are presented from the radioanalysis of tissues collected from animals that resided on or near the Nevada Test Site (NTS). Other than naturally occurring potassium-40, cesium-137 was the only gamma-emitting radionuclide frequently detected and was within a narrow range of activity. For example, 12 of 14 cattle muscle samples contained 15 - 65 pCi of cesium-137 per kilogram. Strontium-90 and plutonium-238 or -239 tissue concentrations were similar to those of recent years. Nanocurie levels of tritium were found in tissue from two deer that drank contaminated water draining from the tunnel test areas.

Annual dose estimates to man were calculated based on the daily consumption of 0.5 kg of tissue with peak radionuclide levels. The highest postulated dose was 45 millirems to the whole body from ingestion of deer muscle that drank from the tritium contaminated waters. This dose is about 9% of the radiation protection guide.

Movement of deer on the NTS is discussed. In general, deer from Pahute Mesa winter in the Timber Mt. area with some movement off the NTS, while deer from Rainier Mesa winter in the Shoshone Mt. area.

The sudden death of an offsite goat kid was investigated and death was attributed to enterotoxemia.

No gross or microscopic lesions in necropsied animals were found that could be attributed to the effect of ionizing radiation.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT RELEASE TO THE PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED 20. SECURITY CLASS *(This page)* UNCLASSIFIED	21. NO. OF PAGES 64 22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

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