

ANIMAL INVESTIGATION PROGRAM 1973 ANNUAL REPORT:  
NEVADA TEST SITE AND VICINITY

Monitoring Systems Research and Development Division  
Environmental Monitoring and Support Laboratory  
U.S. ENVIRONMENTAL PROTECTION AGENCY  
Las Vegas, NV 89114

Published May 1977

This study performed under a Memorandum  
of Understanding No. EY-76-A-08-0539  
for the  
U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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NEVADA TEST SITE AND VICINITY

by  
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Las Vegas, NV 89114

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## ABSTRACT

Data are presented from the radioanalysis of tissues collected from cattle, deer, desert bighorn sheep, and other wildlife that resided on or near the Nevada Test Site during 1973. Routine activities and special investigations of the Animal Investigation Program are also discussed.

Iodine-131 was detected in the thyroid of a Nevada Test Site mule deer. The postulated source was worldwide fallout from a nuclear detonation conducted by the People's Republic of China.

Other than the naturally occurring potassium-40, cesium-137 was the only gamma-emitting radionuclide detected with any consistency in soft tissues. Nine muscle samples from the Nevada Test Site beef herd contained levels of cesium-137 ranging from 14 to 50 pCi/kilogram. Muscle from two deer contained 20 and 30 pCi/kilogram. Rabbit muscle contained 200 pCi/kilogram and muscle from a feral horse contained 40 pCi/kilogram.

Tritium levels in all animal tissues sampled were at background except for animals residing at the Area 15 farm and for a feral horse. Postulated sources of these exposures are discussed.

The strontium content in bones continued the downward trend observed during recent years. Bones from grazing beef cattle averaged 3.2 pCi/gram of ash, deer bones averaged 2.7 pCi/gram of ash, and bones from desert bighorn sheep averaged 4.1 pCi/gram of ash. Tissue samples also were analyzed for actinides because of the intense interest in their environmental fate. The appendices of this report list the concentrations of plutonium-238 and -239, and uranium-234, -235, and 238 found in each tissue from each animal sampled. Also discussed are possible reasons for some seemingly anomalous results. The detectable levels of plutonium-239 in muscle from four beef cattle ranged from 0.25 percent to 0.8 percent of that reported for their ingesta. The relationship between liver (six animals) and ingesta was more variable, with a range of 0.13 percent to 32 percent.

Hypothetical dose estimates to man are calculated on the basis of the daily consumption of liver or muscle from the Nevada Test Site animals that contained peak activity levels. These estimates expressed as a percent of 0.5 rem are: for whole body--tritium, 0.02 percent and cesium-137, 0.11 percent; and for the gastrointestinal tract--ruthenium-103, 0.14 percent. The percentage doses for bone are: total uranium, <0.01 percent; plutonium-238, 0.02 percent; and plutonium-239, 0.03 percent. The apparently anomalous results are excluded from these estimates.

The dietary habits of desert bighorn sheep were determined through botanical analyses of rumen contents. The average composition of the ingesta was: grasses, 61.3 percent; shrubs, 31.1 percent; and forbs, 7.6 percent.

Gross and microscopic lesions found in necropsied animals are discussed. In general, these lesions are consistent with the physical condition of the animal and type of population sampled.

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## INTRODUCTION

The Animal Investigation Program is conducted for the Energy Research and Development Administration by the Environmental Monitoring and Support Laboratory-Las Vegas, U.S. Environmental Protection Agency. During 1973, the major objectives of this program remained as stated in previous annual reports (Smith and Giles 1975, Smith et al., 1976). These basic responsibilities are summarized as follows:

1. To conduct surveillance of domestic and wild animals on and around the Nevada Test Site to assess the radionuclide burden present in their tissue and to detect any 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. Energy Research and Development Administration.
3. To maintain public relations through education and veterinary advice to the off-site population.
4. To conduct special ad hoc investigations.

The progress in achieving these responsibilities and the data collected during 1973 are presented in this report.

## SAMPLE COLLECTION

Animals from the Nevada Test Site sampled during 1973 included beef cattle, dairy cattle, mule deer, quail, and a jackrabbit. Samples were also collected from desert bighorn sheep that inhabit mountain areas adjacent to the Nevada Test Site. In addition to those sacrificed as part of the routine sampling activities of the program, these animals included some that died of other causes. A special study was also conducted which involved the sampling of beef animals from the Rocky Flats area of Colorado.

Each of the sacrificed animals was killed by firing a .243 caliber bullet into its brain. After death, each animal was necropsied and any gross pathological conditions were noted. If advanced postmortem changes had not occurred, the adrenals, eyes, heart, kidneys, liver, lungs, muscle, spleen, thyroid, gonads, and lesions (if any) were sampled and prepared for histopathological evaluation. Tissues collected for radioanalysis included rumen or stomach contents, liver, lung, tracheo-bronchial lymph nodes, muscle, thyroid, blood or urine, kidney, fetus (if present), and bone (vertebrae and/or femur). Rumen contents from desert bighorn sheep were collected for botanical analysis. If fresh blood was available, heparinized samples were collected for hematological examination.

Twelve animals from the Nevada Test Site beef herd were sacrificed and sampled during the year. Also sampled were three fetuses found during necropsy. The vital statistics of all the Nevada Test Site cattle sampled during 1973 are presented in table 1. Unless otherwise noted, each animal spent its entire life grazing on the Area 18 range of the Nevada Test Site or was maintained in the Area 15 corrals. Figure 1 shows the locations of the herds and facilities. The management of the beef herd and soil and range surveys of the Area 18 grazing area have been published previously (Smith 1970a, Leavitt 1970, and Brown and Mason 1968). Reports have also been published on the management of the dairy herd (Smith and Engel 1969, Smith 1970b, and Smith 1973). Four cattle (two dairy, two beef) maintained in the corrals of the Area 15 farm were sampled. Both beef animals and one dairy cow died from natural causes.

TABLE 1. VITAL STATISTICS OF NEVADA TEST SITE  
CATTLE SAMPLED DURING 1973

Animal No.	Sex	Estimated Age	Breed	Weight (kg)	Date Sampled	Remarks
Bov-1	F	2 yrs.	Hereford	345	05/16/73	
Fetus-1		8½ mos.	"	NW	05/16/73	Fetus of Bov-1.
Bov-2	M	2 yrs.	"	160	05/16/73	
Bov-3	F	5 yrs.	"	460	05/16/73	
Fetus-3	F	7-8 mos.	"	NW	05/16/73	Fetus of Bov-3.
Bov-4	F	9 yrs.	"	415	05/16/73	
Fetus-4	M	8½ mos.	"	NW	05/16/73	Fetus of Bov-4.
Bov-5	M	1 yr.	"	273	05/16/73	
Bov-6	M	1 yr.	"	248	05/16/73	
Bov-7	F	6 mos.	"	115	10/18/73	
Bov-8	M	1½ yrs.	"	325	10/18/73	
Bov-9	F	6½ yrs.	"	390	10/18/73	Squamous cell carcinoma right eye.
Bov-10	F	4½ yrs.	"	435	10/18/73	Actinomycosis of right maxilla.
Bov-11	F	2½ yrs.	"	350	10/18/73	
Bov-12	M	1½ yrs.	"	215	10/18/73	
903	M	9 yrs.	"	1,000*	05/09/73	Big Sam, fistulated steer. Periodically on open range. Cause of death tympanites.
16	F	15 yrs.	Holstein	500*	05/23/73	One of cows in the original dairy herd. Cause of death traumatic reticulitis.
779	M	1 yr.	Hereford	200*	05/24/73	Fistulated steer. Cause of death postsurgical peritonitis.
46	F	13 yrs.	"	500*	06/13/73	Weight loss. Appeared to be dying. Sacrificed. Suffering from displaced abomasum.

NW = Not weighed.

\*Weight was estimated.

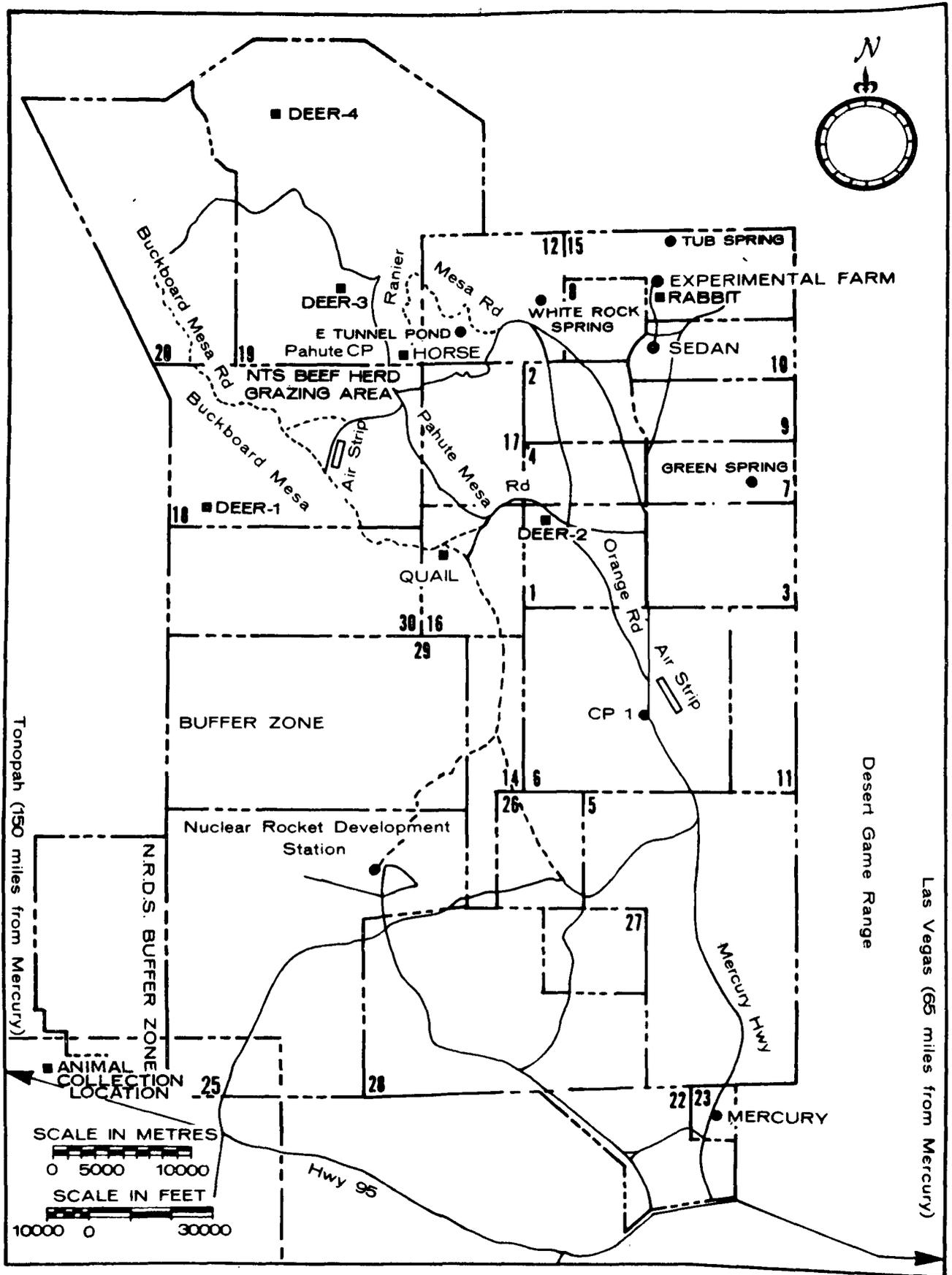


Figure 1. Location of sampling sites and facilities on the Nevada Test Site.

Tissue samples were collected from four Nevada Test Site mule deer during 1973. (See table 2 for vital statistics.) Two of the deer were collected by hunting, one was collected after being struck by a motor vehicle, and one died when it became entangled in a rope fence. Collection locations are noted on figure 1.

Other Nevada Test Site animals sampled included a jackrabbit shot at the Area 15 experimental farm, a quail collected at the Tippipah Spring, and a feral horse that died from a collision with a motor vehicle in Area 12. Vital statistics on these animals are presented in table 2 and collection sites are shown in figure 1.

Through the cooperation of State and Federal wildlife officials and participating hunters, tissue and/or rumen ingesta samples were collected from 20 desert bighorn sheep (Ovis canadensis nelsoni) during the annual hunt. The vital statistics of these animals are presented in table 3 and the collection sites are shown in figure 2. Most of the animals were collected in southern Nevada with 11 coming from the Desert National Wildlife Range. Three were collected from the Muddy Mountains-Boulder Wash area, three from the Eldorado Mountains, and one each from the Meadow Valley Range area and the Highland Range. One ram was collected from central Nevada near the Lone Mountain in Esmeralda County.

Also sampled during 1973 were ten beef animals that had grazed pastures adjacent to the Rocky Flats Plant near Denver, Colorado. Sampling information and vital statistics are presented in another report (Smith and Black 1975).

TABLE 2. VITAL STATISTICS OF NEVADA TEST SITE  
WILDLIFE COLLECTED DURING 1973

Animal No.	Sex	Estimated Age	Estimated Weight (kg)	Date Collected	Remarks
Mule Deer - 1	M	18 mos.	49	05/26/73	Collected, Area 18, Timber Mountain.
Mule Deer - 2	M	3-4 yrs.	85	05/15/73	Road kill, Tippipah Highway, junction of Pahute Mesa Road.
Mule Deer - 3	M	Adult	80	08/29/73	Collected, Echo Peak, Area 19.
Mule Deer - 4	M	Adult	NW	12/10/73	Area 19, U19N, tangled in rope fence. Found dead by security personnel.
Rabbit - 1	M	Young adult	NW	08/17/73	Collected, Area 15 farm.
Quail - 1	M	Adult	NW	04/14/73	Collected, Area 16, Tippipah Spring.
Horse	F	6-8 mos.	150	08/24/73	Road kill, Stockade Wash Road between Tunnels U12E and U12G.

NW = Not weighed.

TABLE 3. VITAL STATISTICS OF DESERT BIGHORN SHEEP  
SAMPLED DURING 1973

Animal No.	Sex	Age (yrs)	Est. wt. (kg)	Date Collected	Samples Collected	Remarks
1	M	6	Unk	11/17/73	Bone, kidney, lung, rumen ingesta	Hunter kill-- E. of Muddy Mts.
2	M	6	Unk	11/17/73	Bone, lung, rumen ingesta	Hunter kill-- Black Mt.
3	M	6	65	11/17/73	Kidney, liver, lung, rumen ingesta	Hunter kill-- White Rock Spring area, DNWR.
4	M	6	Unk	11/18/73	Lung	Hunter kill-- Lone Mt., Esmeralda, Co.
5	M	7	Unk	11/18/73	Bone, kidney, lung, rumen ingesta	Hunter kill-- Eldorado Mts.
6	M	7	80	11/18/73	Bone, lung, rumen ingesta	Hunter kill-- Highland Range.
7	M	7	75	11/20/73	Bone, lung, rumen ingesta	Hunter kill-- Disappointment Canyon, DNWR
8	M	4	55	11/20/73	Bone, liver, lung, rumen ingesta	Hunter kill-- Sheep Range, DNWR.
9	M	5	85	11/20/73	Bone, liver, lung, rumen ingesta	Hunter kill-- Ringbolt Rapids, near Nelson.
10	M	9	65	11/20/73	Bone, liver, lung, kidney, rumen ingesta	Hunter kill-- N.E. side of Gass Peak, DNWR.
11	M	8	Unk	11/21/73	Lung, rumen ingesta	Hunter kill-- Eldorado Mts.
12	M	8	Unk	11/21/73	Liver	Hunter kill-- near Wamp Spring, DNWR.

Unk = Unknown.

DNWR = the Desert National Wildlife Range.

TABLE 3. CONTINUED

Animal No.	Sex	Age (yrs)	Est. wt. (kg)	Date Collected	Samples Collected	Remarks
13	M	8	60	11/21/73	Bone, kidney, lung, rumen ingesta	Hunter kill-- 1 mi. S. of Wamp Spring, DNWR
14	M	8	75	11/25/73	Bone, kidney, liver, lung, rumen ingesta	Hunter kill-- 1 mi. N. of Sheep Canyon, DNWR.
15	M	10	Unk	12/01/73	Rumen ingesta	Hunter kill-- Meadow Valley area.
16	M	10	70	12/07/73	Kidney, liver, lung, rumen ingesta	Hunter kill-- Sheep Range, DNWR.
17	M	7	70	12/12/73	Bone, kidney, lung, rumen ingesta	Hunter kill-- Boulder Wash area.
18	M	9	70	12/14/73	Bone, kidney, liver, lung, rumen ingesta	Hunter kill-- 2 mi. E. of Quail Spring, DNWR.
19	M	6	65	12/18/73	Bone, kidney, lung, rumen ingesta	Hunter kill-- Quartz Spring area, Nellis Air Force Range, portion of DNWR.
20	M	Unk	Unk	12/18/73	Bone, kidney, lung, rumen ingesta	Hunter kill-- E. of gravel reservoir on Nellis Air Force range portion of DNWR.

Unk = Unknown.

DNWR = the Desert National Wildlife Range.

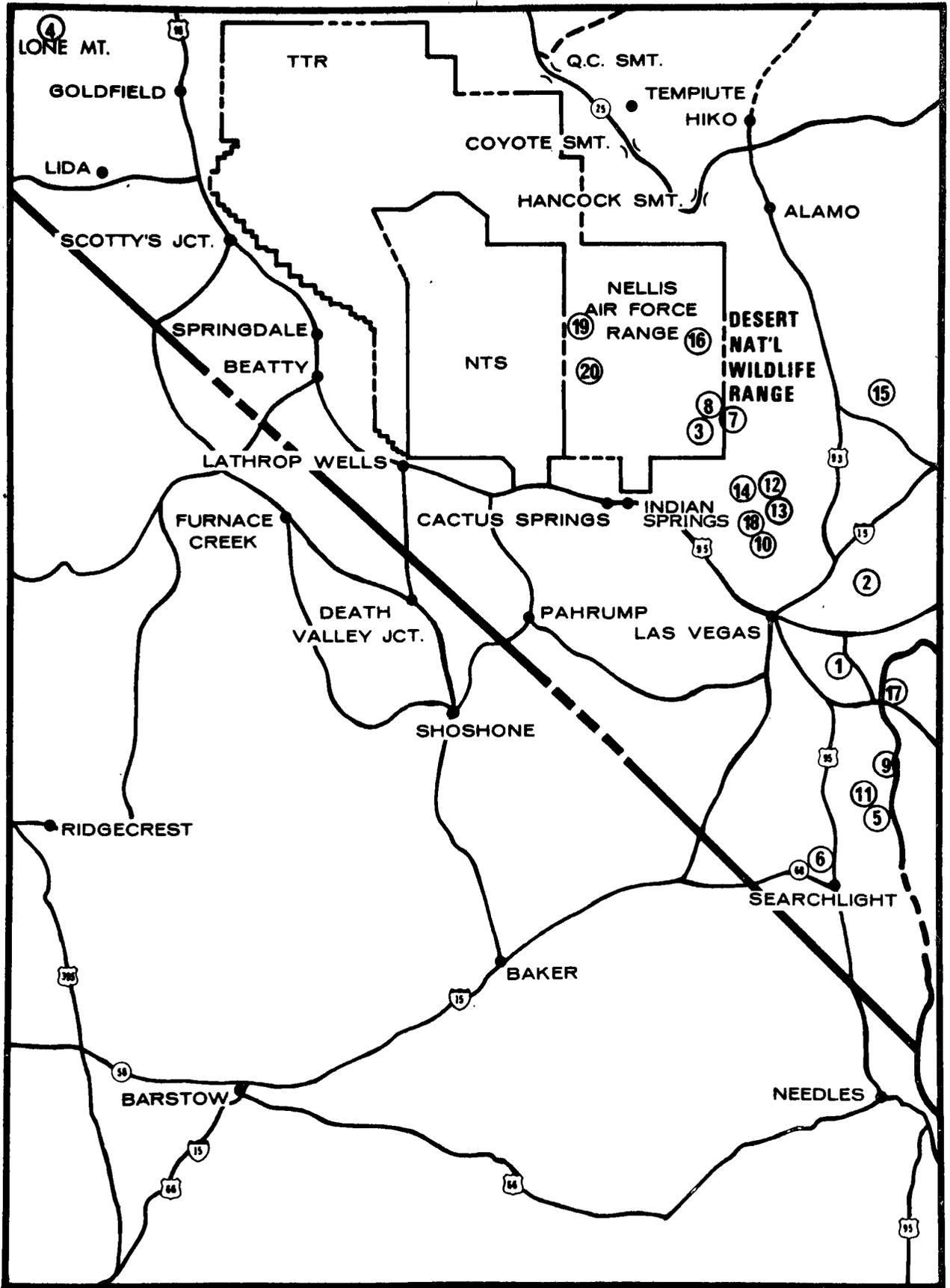


Figure 2. Approximate collection sites of 1973 desert bighorn sheep.

## ANALYTICAL PROCEDURES AND METHODS

Samples of soft tissue and rumen contents were quantitatively analyzed by gamma spectroscopy. A urine, blood and/or tissue sample from each animal was analyzed for tritium. The bone was analyzed for strontium-89 and -90, uranium-234, -235, and -238, and plutonium-238 and -239. Selected soft tissues were also analyzed for plutonium and uranium content.

The soft tissues of sufficient volume and rumen contents were prepared for gamma analysis by grinding and placing in 1,000-milliliter polyethylene Marinelli beakers. Those of smaller volume, i.e., thyroid, kidneys, etc., were prepared for analysis by macerating in a blender and were placed in an agar suspension in a 400-milliliter container. The samples were counted for 100 minutes on a 4-inch by 4-inch NaI(Tl) crystal connected to a 400-channel pulse-height analyzer calibrated at 10 kiloelectronvolts/channel.

Tissues for strontium, plutonium, and uranium analysis were prepared by dry ashing. Plutonium and uranium were analyzed by alpha spectroscopy (Talvitie 1971, 1972). Other radionuclide analytical procedures used at the Environmental Monitoring and Support Laboratory-Las Vegas were described previously (Johns 1975).

All data are reported at the 95-percent confidence level and are corrected to time of collection. The minimum detectable activities for each radionuclide are listed in appendix A. Results which show a net sample count less than the two-sigma counting error are reported as less than the two-sigma error.

Tissue and lesion samples collected for histopathological examination were first fixed in a 10-percent formalin solution. They were then dehydrated with alcohol and embedded in paraffin prior to sectioning with a microtome. A 5-micrometer section was placed on a glass slide, stained with hematoxylin and eosin, and delivered to a pathologist for interpretation.

When fresh blood was available, two milliliters were withdrawn from the jugular vein, placed in a heparinized tube, and two blood smear slides made. These were airmailed to the United Medical Laboratories, Inc., of

Portland, Oregon, where a complete blood cell count and a differential count were made. Other analyses performed include hemoglobin, hematocrit, and packed cell volume.

If available, a 200- to 300-gram sample of rumen ingesta was collected from each desert bighorn sheep. These samples were frozen until prepared for analysis by washing and screening. An aliquot was then examined under a binocular microscope for identification of individual species of browse, forbs, and grasses (Munz and Keck 1965 and Hitchcock 1950). After the species in the sample were identified, a visual estimate of the percentage of each species was made and recorded (Leach 1956).

## RESULTS AND DISCUSSION

### NEVADA TEST SITE CATTLE

The analytical results from tissues collected from the Nevada Test Site grazing beef cattle during May and October of 1973 are presented in the tables of appendix B and C, respectively. Data from tissues of animals maintained in the corrals of the Area 15 farm are presented in the tables of appendix D.

As would be expected, the rumen contents from the grazing animals contained the greatest variety of gamma-emitting radionuclides. Cesium-137, ruthenium-103, ruthenium-106, zirconium-95, and cobalt-60 were occasionally detected in soft tissues. Detectable levels of cesium-137 were found in nine muscle samples with a range of 14 to 50 pCi/kilogram/wet weight. Ruthenium-103 was found only in one lung and one liver sample. Both of these samples were collected in May from different animals. Rumen contents from the corralled cattle were not analyzed for gamma-emitting radionuclides. Of the tissue samples collected from the corralled animals, detectable levels of cesium-137 were found in only one muscle, one liver, and two lung samples, and ruthenium-103 was found in one liver sample.

Tritium levels in the blood collected from all range cattle were at background ( $\sim 200$  pCi/liter). The blood samples from the corralled cattle contained levels ranging from 2,200 to 4,400 pCi/liter. These levels are of the same magnitude reported for the dairy herd in 1971 and 1972 (Smith and Giles 1975, Smith et al., 1976). The source of their exposure is most probably the Sedan crater which is approximately 2 miles away. It is interesting to note that similar levels of tritium were found in the urine of the employees who work at the Area 15 experimental farm (Douglas et al., 1970).

As shown in figure 3, bone samples (vertebrae and femur) from grazing cattle averaged 3.2 pCi/gram of ash of strontium-90. This level is slightly lower than the 3.9 pCi/gram of ash average of 1972 and reflects the downward trend observed during recent years. The levels in bone from three beef fetuses, near term, averaged 2.2 pCi/gram of ash. Their dams averaged

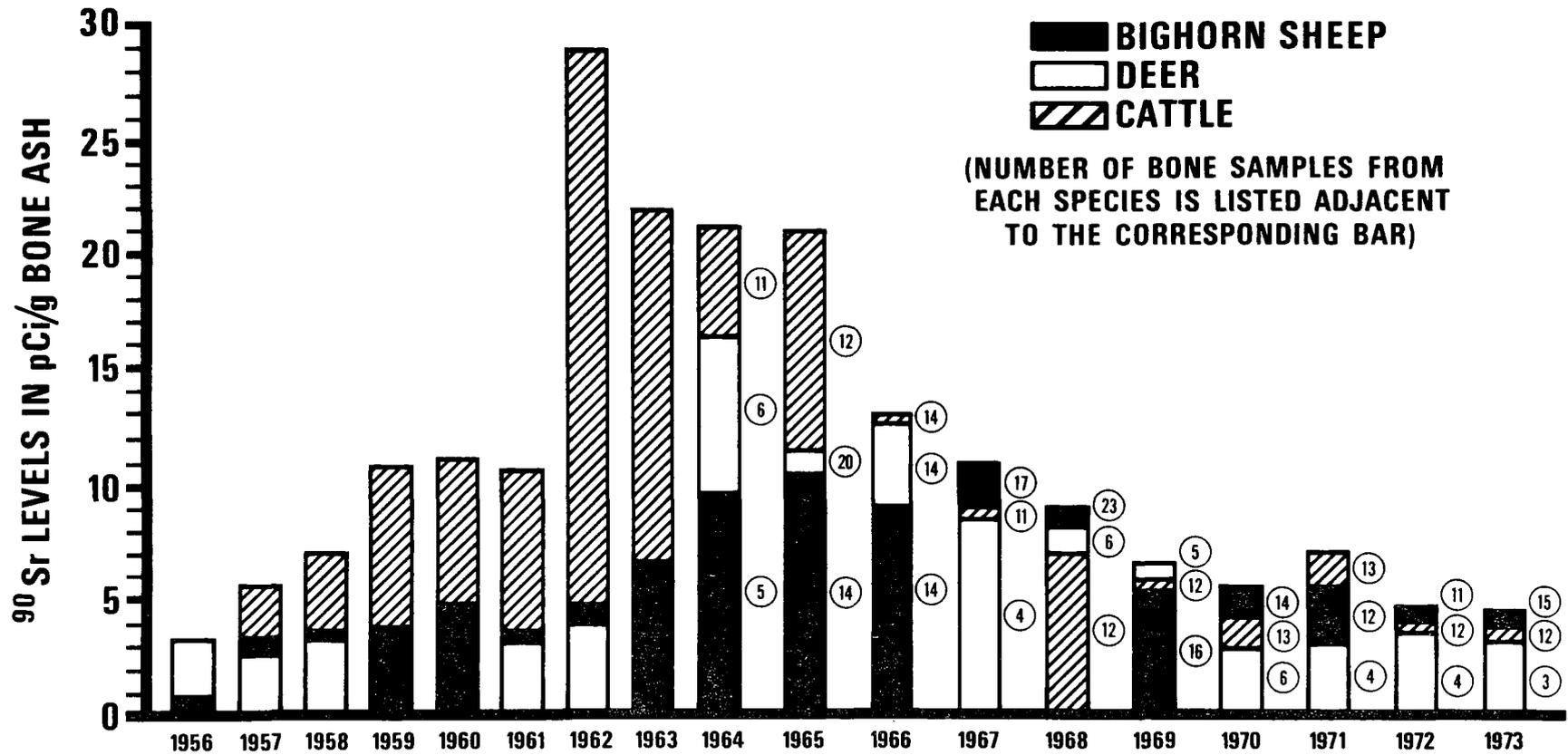


FIGURE 3. Annual averages of strontium-90 in the bones of desert bighorn sheep, deer, and cattle - 1956 through 1973.

3.3 pCi/gram of ash. Strontium-89 was detected in only three femur samples from animals sacrificed in October.

Actinide analyses are summarized in table 4. The data are presented in the tables in appendices B, C, and D.

The unexpected elevated plutonium results for Cow No. 45 may have resulted from its being confined and sacrificed in conjunction with another experimental animal which had been dosed with plutonium-238 (Stanley et al., 1974). Concentrations of plutonium in the samples from other corralled animals (appendix D) may have resulted from contamination during housing in the corral or during sample collection. A slight potential for cross-contamination between samples during analysis must also be recognized for all samples. Samples are normally segregated into expected activity levels prior to analysis to minimize this problem.

The uranium isotopic ratios for some of the samples in the appendices are different from the expected natural ratios (uranium-234, -235, and -238, approximately 1:0.05:1). These differences may relate to varying enrichment of the contaminating nuclear material, analytical or sampling error, and/or solubility differences. Several investigators (Osmund 1974, Thurber 1962) have found that the 1:1 ratio of uranium-234 to uranium-238 found in natural uranium does not hold true for samples that have undergone leaching or partial dissolution. It is thought that uranium-234 becomes more soluble than uranium-238 because of recoil fractionation of the isotopic matrix during the decay process.

The anomalous results for plutonium and uranium analyses in appendices B, C, and D have been recalculated and/or recounted to verify the values reported. In addition to the previous comments, it should be emphasized that the stated two-sigma error terms are based on counting statistics only and constitute a small part of the total error involved. The total error is undoubtedly higher.

Plutonium-238 is present in the environment primarily as a result of the burnup of the SNAP-9A power source (Krey and Krajewski 1972, Hardy et al., 1972). The expected ratio of plutonium-239 to plutonium-238 is roughly 25, which is reflected by the numerous "less than" values in the data tables in the appendices. Other than the samples possibly contaminated from the

TABLE 4. MEDIAN VALUES OF ACTINIDE CONCENTRATIONS IN TISSUES FROM NEVADA TEST SITE CATTLE (fCi/kg wet weight)

Tissue	ACTINIDE AND HERD SAMPLED														
	<sup>238</sup> Pu			<sup>239</sup> Pu			<sup>234</sup> U			<sup>235</sup> U			<sup>238</sup> U		
	May <sup>1</sup>	Oct <sup>2</sup>	CC <sup>3</sup>	May <sup>1</sup>	Oct <sup>2</sup>	CC <sup>3</sup>	May <sup>1</sup>	Oct <sup>2</sup>	CC <sup>3</sup>	May <sup>1</sup>	Oct <sup>2</sup>	CC <sup>3</sup>	May <sup>1</sup>	Oct <sup>2</sup>	CC <sup>3</sup>
Lungs	190	300	<250	430	1,400	410	170	340	610	<26	<26	86	200	260	370
Tracheo-Bronchial Lymph Nodes	<2,300	<4,200	<7,900*	7,000	<14,000	210,000*	1,500	2,800	17,000*	<480	<1,200	1,200*	<840	2,500	17,000*
Muscles	<140	110	225	<99	<31	290	210	NA	275	32	NA	50	82	NA	87
Livers	160	91	<580	210	<150	440	140	130	320	<20	<19.5	<20	94	104	240
Rumen Contents	1,300	3,000	400*	15,000	22,000	7,500*	3,400	3,500	17,000*	100	150	210*	2,400	3,400	5,500*
Reticulum Sediments	<28,000	<25,000	150,000*	290,000	<41,000	420,000*	370,000	170,000	330,000*	15,000	<9,500	11,000*	340,000	180,000	330,000*
Vertebrae	<360	1,950	<2,300	<320	1,450	13,500	400	<410	1,500	<70	<210	<106	350	410	980
Femur	NA	<1,200	1,150	NA	1,900	6,050	NA	<685	1,900	NA	<215	<115	NA	<420	1,580

<sup>1</sup>May = Beef cattle sampled in May.

<sup>2</sup>Oct = Beef cattle sampled in October.

<sup>3</sup>CC = Corralled cattle from Area 15 who are sampled throughout the year.

\*Samples from only one animal.

NA = Not analyzed.

plutonium-238 experiments, the plutonium-238 values should be less than the plutonium-239 values.

Patterson et al. (1974) have reported that plutonium-238 may be more soluble and thus potentially more mobile in the environment than plutonium-239. Thus, it is possible that the plutonium 239:238 ratios for animal tissue (intake results are in part from plutonium intake from plants) may be lower than the ratios on fallout and soil.

It is difficult to rationalize many of the apparently anomalous values in appendices B, C, and D, e.g., unusual uranium and plutonium isotopic ratios. Until further verification or rationalization of the data is available, prudence should be used in interpreting the results.

The detectable levels of plutonium-239 in muscle from four beef animals ranged from 0.25 percent to 0.8 percent of that reported from their rumen contents at time of sacrifice. The relationship between liver and rumen contents was more variable with a range of 0.13 percent to 32 percent in six animals with detectable liver levels.

Plutonium was not detected in the tissues of any fetuses except for plutonium-238 in the fetuses of Cow No. 1. As discussed in the Hypothetical Dose Estimates section, the value for fetus 1-F may be an erroneous value.

In order to maintain the Nevada Test Site beef herd at a manageable size of approximately 100 animals, surplus animals are occasionally transferred to other research institutions. During 1973, 26 yearling Herefords were transferred to the U.S. Environmental Protection Agency's Robert S. Kerr Environmental Research Laboratory in Ada, Oklahoma, to be used on a study to evaluate the use of feedlot wastes as nitrogen and roughage sources in cattle fattening rations. Also, 25 beef animals were transferred to the University of Nevada, Reno.

Prior to transfer, blood and fecal samples were collected for analysis of gamma-emitting radionuclides and for hematological examination. These data are maintained in the files of the Animal Investigation Program. Gamma-emitting radionuclide levels within these samples seldom exceeded the minimum detectable activities and hematological data were within normal limits.

## MULE DEER

The analytical results from tissues of the Nevada Test Site mule deer are presented in the tables of appendix E. In general, these data are similar to those reported for the Nevada Test Site beef cattle. However, the thyroids from Mule Deer No. 3 contained 18 pCi/gram wet weight of iodine-131. A possible source of this was worldwide fallout from the June 26 nuclear detonation by the People's Republic of China. Data from an air samples collected in late July indicated that fresh fission products were present in the atmosphere (U.S. Environmental Protection Agency 1974).

The average strontium-90 level in bone from three Nevada Test Site mule deer (one samples was lost) was 2.7 pCi/gram of ash. This is slightly lower than the average reported in 1972 (see figure 3). Strontium-89 was not detected in any of the samples.

The median values of actinide levels in Nevada Test Site mule deer are shown in table 5. Levels in all tissues, except for plutonium-238 in the lungs, were similar to those reported in 1972 (Smith et al., 1976). During 1973, plutonium-238 was detected in all lungs sampled with a range of 520 to 53,000 fCi/kilogram wet weight while in 1972 detectable levels were not found in any samples.

Tritium levels in the tissue of all sampled deer were at background.

## DESERT BIGHORN SHEEP

Twenty desert bighorn sheep were sampled during 1973. The analytical data are presented in tables of appendix F. Some of these data have been previously reported (Brown et al., 1976). Other than the naturally occurring potassium-40, gamma-emitting radionuclides did not exceed the minimum detectable activities in any of the tissues sampled. The rumen contents occasionally contained detectable levels of zirconium-95, ruthenium-103, and cesium-137.

Tritium levels in the aqueous portions of kidney tissues ranged from 240 to 730 pCi/liter (median value of 390 pCi/liter). These values are considered to be within environmental limits; e.g., water from Lake Mead averaged 890 pCi/liter (U.S. Environmental Protection Agency 1974).

TABLE 5. MEDIAN VALUES OF ACTINIDE LEVELS IN 1973 NEVADA TEST SITE DEER TISSUES (fCi/kg wet weight)

Tissue	<sup>238</sup> Pu	<sup>239</sup> Pu	<sup>234</sup> U	<sup>235</sup> U	<sup>238</sup> U
Lungs	4,950	<290	390	70	275
Muscle	160	<83	250*	43.5*	60*
Liver*	<105	<38*	1,030*	374*	825*
Rumen Contents	<290	1,800	1,800	75	1,450
Bone	<710	610	730	<40	320

\* Samples from only two animals analyzed.

The average strontium-90 content in hock bone was 4.1 pCi/gram of ash. See figure 3 for comparisons with previous years.

The median values of actinide levels in liver, lungs, and bone for selected desert bighorn sheep are shown in table 6. Uranium values were higher in animals collected in southern Nevada than in animals collected from the Desert National Wildlife Range which borders the Nevada Test Site (Brown et al. 1976). This was also the case in a 1972 study with cattle from an area near Searchlight, Nevada, and from the Nevada Test Site (Smith et al, 1976). This probably reflects the levels of naturally occurring uranium present in the soils of the two areas (Garside 1973).

Rumen ingesta from 18 desert bighorn sheep were analyzed for determination of food habits. Ten of these animals were collected from the Desert National Wildlife Range, seven from areas in southern Nevada, and one from Esmeralda County. Results from the botanical analysis of the ingesta from each animal are listed in appendix G, and are described in greater detail in another

TABLE 6. MEDIAN VALUES OF ACTINIDE LEVELS IN 1973 DESERT BIGHORN SHEEP TISSUES (fCi/kg wet weight)

Tissue	<sup>238</sup> Pu	<sup>239</sup> Pu	<sup>234</sup> U	<sup>235</sup> U	<sup>238</sup> U
Lungs	275	185	440	<35	240
Liver	345	1,470	290	<73	160
Bone	2,000	510	1,100	<150	690

publication (Brown et al., 1976). Grasses made up slightly more than 50 percent of the diet for animals from the Desert National Wildlife Range, 72 percent for animals from southern Nevada, and nearly 100 percent for the Esmeralda County ram. Browse contents were 46 percent, 13 percent, and trace amounts; and forb contents were 4 percent, 15 percent, and trace amounts, respectively. The food habits of all 18 desert bighorn sheep are summarized in table 7.

#### OTHER NEVADA TEST SITE WILDLIFE

As stated previously, other wildlife sampled on the Nevada Test Site included a quail, a jackrabbit, and a feral horse.

Gamma-emitting radionuclides were not detected in a whole-body scan of the quail. Cesium-137 was the only gamma emitter, other than naturally occurring potassium-40 that was found in the jackrabbit. As 190 pCi/kilogram of cesium-137 was detected in a whole-body scan, the rabbit was dissected and individual tissues were submitted for analysis. Levels of cesium-137 found are as follows: pelt-1,200 pCi/kilogram, muscle-200 pCi/kilogram, gastrointestinal tract, heart, and lungs-1,000 pCi/kilogram, and liver-negligible. Muscle tissue from the rabbit was analyzed for tritium content and was found to contain  $6,600 \pm 250$  pCi/liter of available water (moisture was 72 percent). This level is of the same magnitude found in cattle at the Area 15 farm.

Muscle tissue from the feral horse was analyzed for gamma-emitting radionuclides and tritium. The results were 40 pCi/kilogram of cesium-137 and  $25,000 \pm 300$  pCi/liter of tritium. Evidently the horse drank water from

TABLE 7. SUMMARY - FOOD HABITS OF 18 DESERT BIGHORN SHEEP IN NEVADA DURING NOVEMBER AND DECEMBER 1973

Species	Volume Percent	Frequency Percent	Animals
<b>Grasses</b>			
<i>Stipa speciosa</i>	17.3	88	16
<i>Oryzopsis hymenoides</i>	14.8	77	14
Unidentified grasses	11.1	55	10
<i>Sitanion hystrix</i>	10.8	55	10
<i>Hilaria jamesii</i>	4.6	38	7
<i>Elymus cinereus</i>	1.5	27	5
<i>Sporobolus</i> spp.	1.1	11	2
<i>Bromus tectorum</i>	0.1	5	1
Grass subtotal	61.3 Percent		
<b>Forbs</b>			
<i>Euphorbia</i> spp.	3.5	38	7
Unidentified forbs	2.0	55	10
<i>Eriogonum</i> spp.	0.5	33	6
<i>Erodium cicutarium</i>	0.4	16	3
<i>Argemone</i> spp.	0.3	11	2
<i>Sphaeralcea</i> spp.	0.3	11	2
<i>Linum lewisii</i>	0.2	5	1
<i>Chaenactis</i> spp.	0.2	11	2
<i>Astragalus</i> spp.	0.1	11	2
<i>Phlox</i> spp.	0.1	5	1
Forb subtotal	7.6 Percent		
<b>Shrubs</b>			
<i>Yucca schidigera</i>	10.0	50	9
<i>Cowania mexicana</i>	5.1	50	9
<i>Ephedra viridis</i>	3.8	50	9
Unidentified shrubs	2.4	50	9
<i>Artemisia tridentata</i>	2.4	33	6
<i>Atriplex canescens</i>	1.9	11	2
<i>Juniperus monosperma</i>	1.5	11	2
<i>Cercocarpus intricatus</i>	1.4	22	4
<i>Yucca brevifolia</i>	0.8	11	2
<i>Encelia</i> spp.	0.8	5	1
<i>Ephedra nevadensis</i>	0.3	5	1
<i>Coleogyne ramosissima</i>	0.2	16	3
<i>Atriplex</i> spp.	0.2	16	3
<i>Quercus gambelii</i>	0.2	5	1
<i>Arctostaphylos</i> spp.	0.1	5	1
<i>Pinus</i> spp.	Trace	5	1
Shrub subtotal	31.1 Percent		

the drainage ponds below E tunnel in Area 12 which contained over 3  $\mu$ Ci/liter when sampled in April.

Selected tissues from the rabbit and horse were submitted for actinide, strontium, and calcium analysis. These data are tabulated in table 8.

Uranium and plutonium values in the tissues from the horse were generally of the same magnitude found in ruminants at the Nevada Test Site. No explanation is readily available for the elevated levels seen in the single jackrabbit sampled. Sampling of this species will be increased during 1974 in order to determine whether this value is an anomaly or is valid.

#### NEVADA TEST SITE WATERS

As in previous years, selected natural springs and drainage ponds that might serve as a source of water for wildlife were periodically sampled. During 1973, samples from Tub Spring, Green Spring, and White Rock Spring were analyzed. Detectable levels of gamma-emitting radionuclides were not found and tritium levels were less than 240 pCi/liter. However, water samples collected in April from the second and third reservoirs of Haines Pond (E tunnel, Area 12) contained respectively, 120 and 120 pCi/liter of ruthenium-106, 36 and 44 pCi/liter of cesium-137, and  $3,300 \pm 5.3$  and  $3,400 \pm 5.4$  nCi/liter of tritium.

#### NECROPSY AND HISTOPATHOLOGICAL EXAMINATIONS

All sacrificed animals were necropsied and selected tissue and lesion samples were collected for histopathological evaluation. Animals that died from natural causes were also necropsied if a prosector was available and histopathological specimens collected if unaffected by postmortem changes. The gross and microscopic pathologies observed are summarized in appendix H. Also included are the results of hematology examinations when performed.

A frequent histopathological finding was the presence of sarcocysts in muscle tissue. This ubiquitous parasite is commonly found in cattle from other areas and has little clinical significance. Other histopathological findings were usually consistent with the general condition of the individual animal; i.e., amyloidosis is concomitant to a long-standing infection or suppurative process, e.g., the traumatic reticulitis of Cow No. 16.

TABLE 8. ACTINIDE, STRONTIUM, AND CALCIUM CONCENTRATIONS IN SELECTED TISSUES FROM NEVADA TEST SITE WILDLIFE - 1973

Animal Tissue	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	<sup>89</sup> Sr (pCi/g Ash) (fCi/kg*)	<sup>90</sup> Sr (pCi/g Ash) (fCi/kg*)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
Rabbit Muscle	130±27 2,700±530	390±55 7,800±1,100	70±13 1,400±260	<6 <120	60±13 1,200±260	NA	NA	2	NA	0.484	9.7
Rabbit Bone	21,000±1,700 2,000,000±160,000	830±73 78,000±6,900	38±6 3,600±560	2.4±1.6 230±150	35±5.4 3,300±510	<7.9 <74	10±1.6 940±150	9.4	370	0.535	50.3
Horse Muscle	79±1.1 790±110	29±9.7 290±97	94±9.4 940±94	19±4.3 190±43	24±4.8 240±48	NA	NA	1	NA	1.335	13.4
Horse Bone	9.5±4.3 2,100±940	6.4±3.4 1,400±740	<0.86 <190	<0.59 <130	1±1 230±220	<1.5 <320	5.9±1.2 1,300±260	22	360	1.356	298.3

\* Wet weight.  
NA = Not analyzed.

## HYPOTHETICAL DOSE ESTIMATES

Although meat from animals living on the Nevada Test Site is not available for consumption by the general public, the dose to a standard man based on postulated consumption of the meat can be 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 on Radiological Protection (1959, 1968) and Dillman (1969), the maximum observed concentrations of the radionuclides in edible tissues of the cattle and deer sampled (summarized in table 9), and the postulated consumption of 500 grams (about 1 pound) of the meat each day for a year. Table 10 indicates the doses resulting from these hypotheses. The postulated doses from consumption of tissue from desert bighorn sheep are similar to those in table 10, and have been previously discussed by Brown et al., 1976.

The International Commission on Radiological Protection (1959) and the U.S. Energy Research and Development Administration (1975) present different dose criteria for various parts of the body, based on estimates of relative radiosensitivity. The National Council on Radiation Protection and Measurements (1971) recognizes this philosophy, but for the general population recommends simplifying the guides, and uses the minimum guide (0.5 rem per year for the whole body) for all body organs. The National Council on Radiation Protection and Measurements emphasizes that this is a simplifying administrative decision, rather than a reduction of the guides based on new technical information.

Table 9 presents a summary of the maximum observed concentrations in edible tissues of the animals. The indicated error terms are the two-sigma counting error. The total analytical error or uncertainty (two-sigma) for the plutonium and uranium results is estimated to be about 200 fCi/kilogram for results of several hundred femtocuries per kilogram, or several times the indicated counting errors. Thus values under several hundred femtocuries have limited statistical significance.

TABLE 9. SUMMARY OF PEAK RADIONUCLIDE CONCENTRATIONS IN EDIBLE TISSUES FROM NEVADA TEST SITE CATTLE AND DEER (pCi/kg fresh weight)

Nuclide	Corralled Cattle		NTS Beef Herd May 1973		NTS Beef Herd October 1973		Mule Deer	
	Liver	Muscle	Liver	Muscle	Liver	Muscle	Liver	Muscle
$^3\text{H}$	Blood	4,400	---*	---	---	---	---	---
$^{103}\text{Ru}$	50	---	80	---	---	---	150	---
$^{137}\text{Cs}$	30	40	---	50	20	20	---	30
$^{234}\text{U}$	0.61	0.70	0.77	0.54	0.34	<0.2	1.9	0.36
$^{235}\text{U}$	<0.02	0.22	0.26	0.17	<0.1	<0.97	0.73	0.062
$^{238}\text{U}$	0.25	0.43	0.27	0.17	<0.17	<0.14	1.5	0.068
$^{238}\text{Pu}^\dagger$	<0.6	<0.4	0.51	98	0.6	0.25	<0.13	21
$^{239}\text{Pu}^\dagger$	0.44	0.71	0.45	<0.17	1.0	<0.085	<0.047	0.094

\* --- = Less than minimum detectable activity.

† Data from cow no. 45 (Tables D-3 and D-4) are excluded because the cow was corralled and sacrificed with an experimental cow which had been dosed with plutonium-238.

An analytical result of 98 pCi of plutonium-238 per kilogram was reported from the muscle of Animal No. 1-F (the fetus of Cow No. 1). None of the other samples from this fetus or its dam indicated abnormal exposure. Thus, the significance of this result is questionable, and the data are not considered in the dose estimates.

Table 10 indicates postulated doses based on the maximum concentrations for the various nuclides taken from the data summarized in table 9. The column on the right indicates the respective fraction of the guide of 500 mrem/year for the various postulated doses. The doses from plutonium, uranium, 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, 0.7 mrem, is for ruthenium-103. The postulated doses for ruthenium-103 and cesium-137 (similar to ruthenium dose) are about 0.1 percent of the guide, respectively. The cesium-137 dose is the same as that postulated in 1972 (Smith et al., 1976). If the plutonium values from Cow No. 46 and Animal No. 1-F are excluded, the 1973 values are also similar to the 1972 values.

TABLE 10. POSTULATED DOSE TO MAN FOLLOWING INGESTION OF SELECTED TISSUES FOR 1 YEAR

Isotope	Human Organ for Which Dose was Calculated	Animal Tissue Containing Maximum Concentration	pCi/kg of Tissue	Ingestion pCi/day (½ kg/day)	Dose Factor mrem:pCi/day (1-year ingestion)	Dose (mrem)	Percent of 0.5 rem <sup>a</sup>
<sup>3</sup> H <sup>b</sup>	Body water	Corralled cattle, blood	4,400	2,200	3.6x10 <sup>-5</sup>	0.08	0.02
<sup>103</sup> Ru	Gastrointestinal tract	Mule deer, liver	150	75	0.009	0.7	0.14
<sup>137</sup> Cs	Whole body tissue	NTS beef herd, muscle, May	50	25	0.022	0.6	0.11
<sup>234</sup> U	Bone	Mule deer, liver	1.9	0.95	0.019	0.02	<0.01
<sup>235</sup> U	Bone	NTS beef herd, muscle, Oct	<0.97	<0.5	0.018	0.009	<0.01
<sup>238</sup> U	Bone	Mule deer, liver	1.5	0.75	0.017	0.01	<0.01
Total U					0.036	0.04	<0.01
<sup>238</sup> Pu	Bone	Corralled cattle, liver	700	350	0.27	94	19
<sup>238</sup> Pu	Bone	NTS beef herd, liver, Oct	0.6	0.3	0.27	0.08	0.02
<sup>239</sup> Pu	Bone	NTS beef herd, liver, Oct	1.0	0.50	0.32	0.2	0.03

<sup>a</sup>The doses from uranium and plutonium-238 and -239, and to a lesser extent cesium-137, are not delivered within the 1-yr. ingestion period. But, for simplification, the doses have been related to the guide for 1 yr. The doses for uranium and plutonium are actually for a 50-yr. period.

<sup>b</sup>The tritium concentration was for blood. It is assumed the muscle concentration (water plus organic) per kilogram was equal to the blood concentration per liter.

## SPECIAL STUDIES AND INVESTIGATIONS

### ROCKY FLATS STUDY

In November of 1973, arrangements were made by the U.S. Energy Research and Development Administration's Rocky Flats Area Office for the purchase of ten beef animals that grazed a 900-acre pasture adjacent to the eastern edge of the Rocky Flats Plant. These animals were transported to the Nevada Test Site where they were sacrificed, necropsied, and sampled. Analyses were made for uranium, plutonium, and americium. These data have been published previously (Smith and Black 1975).

### ALMENDRO STUDY

Almendro was an underground, contained nuclear weapons test conducted at 0600 hours PDT on June 6, 1973. The detonation occurred 3,490 feet below ground surface in drill hole U19v, Area 19 of the Nevada Test Site. This location is in a pinyon pine-juniper woodland on Pahute Mesa. The yield of the nuclear explosive was "intermediate" (between 200 and 1,000 kilotons of TNT equivalent).

In May of 1973, the Animal Investigation Program conducted ground and aerial surveys of the area surrounding the Almendro site before the detonation to determine if deer, feral horses, or other large animals were in the area. Following the detonation, surveys were made to determine if any large animals present were injured by ground motion or rock falls.

Predetonation surveys revealed limited utilization of browse in the area by mule deer. Observations made from the air in a low level helicopter flight, minutes after detonation, failed to locate any large animals in the area. Ground observations made in the afternoon of the same day also failed to locate any deer or feral horses, although a limited number of fresh deer tracks were found about 10,000 feet to the southwest of ground zero.

Periodic observations during the summer months failed to produce any evidence of adverse effects on large mammal residents.

#### OTHER ACTIVITIES

There were no livestock damage claims during 1973.

The Animal Investigation Program resources were utilized to obtain experimental animals for a study to determine plutonium uptake by grazing animals. Details of this study, conducted under the auspices of the Nevada Applied Ecology Group, are presented elsewhere (Smith 1974).

Preparations were made for a study on the winter migration patterns of the Nevada Test Site mule deer herd. This will be determined by the tracking of deer that have been captured and equipped with a radio-transmitter collar. These preparations included the development of specifications for the telemetry equipment, the assignment of transmitting frequencies, and the training of personnel in the use of immobilizing equipment and drugs. This study is currently in progress.

The off-site public relations program continued by direct contact with ranchers, by lectures to civic organizations, and to groups touring the Environmental Monitoring and Support Laboratory-Las Vegas or the Nevada Test Site facilities. During 1973, the objectives and findings of the Animal Investigation Program were described to approximately 720 Nevada Test Site visitors in 25 different tour groups.

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APPENDIX A. MINIMUM DETECTABLE ACTIVITIES FOR RADIONUCLIDE ANALYSES,  
METHODS DEVELOPMENT AND ANALYTICAL SUPPORT BRANCH,  
ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY-  
LAS VEGAS, NEVADA

The minimum detectable activities in terms of total activity per sample for standard geometries and counting times are based on a combination of a number of technical experiments and operational experience. By means of experimentation, the minimum detectable activities have been defined as that activity which produced a  $\pm 100$  percent deviation at the 95 percent confidence level. These values 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.

MINIMUM DETECTABLE ACTIVITIES IN pCi FOR TOTAL SAMPLE

Isotope	10-Min Count	40-Min Count			100-Min Count		
	Planchet	Planchet	400 ml	3.5 l	400 ml	1,000 ml	3.5 l
<sup>54</sup> Mn	50	25	40	35	25	25	22
<sup>65</sup> Zn	500	250	400	350	250	250	220
<sup>60</sup> Co	50	25	40	35	25	25	22
<sup>95</sup> Zr	50	25	40	35	25	25	22
<sup>103</sup> Ru	50	25	40	35	25	25	22
<sup>106</sup> Ru	500	250	400	350	250	250	220
<sup>124</sup> Sb	50	25	40	35	25	25	22
<sup>125</sup> Sb	250	125	200	175	125	125	110
<sup>132</sup> Te	50	25	40	35	25	25	22
<sup>131</sup> I	50	25	40	35	25	25	22
<sup>133</sup> I	50	25	40	35	25	25	22
<sup>137</sup> Cs	50	25	40	35	25	25	22
<sup>140</sup> Ba	50	25	40	35	25	25	22
<sup>141</sup> Ce	250	125	200	175	125	125	110
<sup>144</sup> Ce	500	250	400	350	250	250	220
<sup>181</sup> W	600	300	475	425	300	300	260
K <sup>*</sup>	0.5	0.3	0.4	0.4	0.3	0.3	0.25

\* Grams of stable potassium per kilogram of sample (wet weight) as determined from <sup>40</sup>K activity.

APPENDIX A. CONTINUED

Isotope	Minimum Detectable Activity	Length of Count Time
<sup>3</sup> H	0.2 pCi per ml of H <sub>2</sub> O	200 minutes
<sup>89</sup> Sr	5 pCi per sample	50 minutes
<sup>90</sup> Sr	2 pCi per sample	50 minutes
<sup>238</sup> Pu	0.02 pCi per sample	1,000 Minutes
<sup>239</sup> Pu	0.02 pCi per sample	1,000 minutes
<sup>234</sup> U	0.02 pCi per sample	1,000 minutes
<sup>235</sup> U	0.02 pCi per sample	1,000 minutes
<sup>238</sup> U	0.02 pCi per sample	1,000 minutes

TABLE B-1. ACTINIDE CONCENTRATIONS IN LUNGS, AREA 18 CATTLE, MAY

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	<73 <730	140±61 1,400±610	120±22 1,200±220	36±12 360±120	60±16 600±160	1	2.806	28.06
1-F	<11 <160	<4.1 <62	URANIUM SAMPLE WAS LOST			1.5	0.353	5.3
2	<56 <560	87±34 870±340	16±5.8 160±58	<1 <10	24±6.8 240±68	1	1.587	15.9
3	<40 <440	<39 <430	20±7.8 220±86	<2.7 <30	19±7.5 210±83	1.1	1.072	11.8
3-F	<12 <140	<5.7 <68	15±6.4 180±77	<1.8 <22	4.3±3.7 52±45	1.2	0.491	5.9
4	19±9.7 190±97	260±29 2,600±290	27±11 270±110	<5 <50	33±13 330±130	1	1.713	17.1
4-F	<7.9 <79	<6.3 <63	4.3±5.3 93±53	<2 <20	5.5±4.1 55±41	1	0.390	3.9
5	<17 <190	<15 <170	11±4.5 120±49	<0.36 <4	17±5.5 190±60	1.1	0.978	10.8
6	<59 <940	58±43 930±690	9.4±6.9 150±110	<2.5 <40	8.1±6.3 130±100	1.6	1.084	17.3
MEDIAN	19 190	<39 <430	15.5 170	<2.25 <26	18 200	1.1		
RANGE	<7.9- <79- <940	<4.1- <62- 2,600	9.3- 93- 1,200	<0.36- <4- 360	4.3- 52- 600	1- 1.6		

\* Wet weight.  
F = Fetus.

B-1

TABLE B-2. ACTINIDE CONCENTRATIONS IN TRACHEO-BRONCHIAL LYMPH NODES, AREA 18 CATTLE, MAY

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	<430 <3,000	<140 <990	<110 <760	<99 <680	<200 <1,400	0.69	0.0203	0.14
1-F	SAMPLE NOT COLLECTED							
2	220±210 2,000±1,900	2,600±320 23,000±2,900	170±120 1,500±1,100	<38 <340	<77 <690	0.90	0.0182	0.164
3	<960 <4,800	1,400±680 7,000±3,400	380±340 1,900±1,700	<96 <480	<170 <840	0.50	0.0108	0.054
3-F	SAMPLE NOT COLLECTED							
4	<150 <1,800	12,000±780 140,000±9,400	250±120 3,000±1,400	<42 <500	320±120 3,900±1,400	1.2	0.0247	0.296
4-F	SAMPLE NOT COLLECTED							
5	<270 <2,300	210±140 1,800±1,200	<56 <470	<29 <240	<63 <530	0.84	0.0191	0.16
6	SAMPLE NOT COLLECTED							
MEDIAN	<270 <2,300	1,400 7,000	380 1,500	<42 <480	<170 <840	0.84		
RANGE	<150-<430 <1,800- <4,800	<140-12,000 <990- 140,000	<56-380 <470- 3,000	<29-<99 <240- <680	<63-320 <530- 3,900	0.50- 1.2		

\* Wet weight.

F = Fetus.

B-2

TABLE B-3. ACTINIDE CONCENTRATIONS IN MUSCLES, AREA 18 CATTLE, MAY

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	<9.1 <100	6.6±5.1 93±56	20±4.1 220±45	<0.91 <10	<24 <26	1.1	2.739	30.1
1-F	8,900±660 98,000±7,300	<12 <130	NA	15±3.6 170±40	15±3.6 160±40	1.1	1.243	13.7
2	<14 <140	<9.9 <99	48±8.6 480±86	8.6±3.8 86±38	14±5.2 140±52	1	3.515	35.2
3	<11 <110	9.5±5.9 94±58	34±9.3 340±92	3.4±2.8 34±28	8.2±4.3 81±43	0.99	2.865	28.4
3-F	<12 <76	<8.9 <58	17±7.5 110±49	<0.62 <4	6.9±6 45±39	0.65	0.470	3.06
4	<14 <140	<4.8 <48	20±3.8 200±38	1.6±1.2 16±12	8.9±2.8 89±28	1	3.177	31.8
4-F	<42 <300	<24 <170	26±11 190±79	<1.4 <10	<9.7 <70	0.72	0.496	3.6
5	<13 <170	12±6.8 160±89	42±6.9 540±90	4.2±2.3 55±30	13±3.9 170±51	1.3	1.930	25.1
6	<20 <200	12±10 120±100	17±3.3 170±33	3.2±1.4 32±14	4±1.6 40±16	1	2.492	24.9
MEDIAN	<14 <140	<9.9 <99	23 210	3.2 32	8.9 82	1		
RANGE	<9.1-8,900 <76- 98,000	<4.8- <24 <48- <170	20-48 110- 540	<0.6-15 <4- 170	4-15 26- 170	0.63- 1.3		

\* Wet weight.  
F = Fetus.  
NA = not analyzed.

TABLE B-4. ACTINIDE CONCENTRATIONS IN LIVERS, AREA 18 CATTLE, MAY

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	12±8.5 160±110	24±10 310±130	4.5±1.2 58±15	<0.31 <4	3.9±1 51±13	1.3	2.033	26.4
1-F	<11 <180	<4.3 <69	24±8.1 390±130	3.1±2.7 49±44	<1.2 <20	1.6	0.456	7.3
2	<9.2 <110	17±7.7 210±92	28±9.2 340±110	<2.3 <28	17±7.7 200±93	1.2	2.246	26.95
3	39±31 510±400	<15 <200	9.2±6.2 120±80	<1.5 <20	<6.2 <80	1.3	3.051	39.7
3-F	<14 <140	<3.8 <38	77±12 770±120	26±7.2 260±72	27±8.9 270±89	1	0.344	3.44
4	<89 <470	<53 <280	4.7±4.5 25±24	<0.94 <5	<3.8 <20	0.53	2.455	13.01
4-F	<7.1 <100	<3.4 <47	18±8.6 250±120	11±5.9 160±82	19±7.9 260±110	1.4	0.474	6.64
5	<9.1 <91	45±11 450±110	4.9±3.3 49±33	<0.80 <8	9.4±4.1 94±41	1	1.379	13.8
6	<27 <330	21±15 250±180	12±4.7 140±57	<1.7 <20	12±4.5 140±54	1.2	1.606	19.3
MEDIAN	12 160	17 210	12 140	<1.7 <20	9.4 250	1.2		
RANGE	<9.2-<89 <91- 510	<3.4-<53 <38- 450	4.5-77 25- 770	<0.31-26 <4- 260	<1.2-27 <20 270	0.53- 1.6		

\* Wet weight.  
F = Fetus.

B-4

TABLE B-5. ACTINIDE CONCENTRATIONS IN RUMEN CONTENTS, AREA 18 CATTLE, MAY

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	SAMPLE LOST							
1-F	SAMPLE NOT COLLECTED							
2	53±16 900±270	820±710 14,000±1,200	180±20 3,000±340	4.4±3.8 74±64	120±16 2,000±280	1.7	3.619	61.5
3	50±13 1,300±350	810±65 21,000±1,700	240±22 6,300±580	4.2±3.8 110±98	210±21 5,400±540	2.6	3.429	89.2
3-F	SAMPLE NOT COLLECTED							
4	<16 <280	220±35 3,700±590	130±15 2,200±250	3.4±2.4 58±41	82±12 1,400±200	1.7	3.776	64.2
4-F	SAMPLE NOT COLLECTED							
5	190±25 3,700±480	1,600±120 31,000±2,300	180±14 3,400±270	5.3±2.6 100±49	130±12 2,400±230	1.9	2.335	44.4
6	<130 <2,500	750±220 15,000±4,500	190±55 3,800±1,100	<6.5 <130	130±31 2,600±620	2	2.458	49.2
MEDIAN	53 1,300	810 15,000	180 3,400	4.4 100	130 2,400	1.9		
RANGE	<16-190 <280-3,700	220-1,600 3,700-31,000	130-240 2,200-6,300	3.4-<6.5 58-<130	82-210 1,400-5,400	1.7- 2.6		

\* Wet weight  
F = Fetus.

TABLE B-6. ACTINIDE CONCENTRATIONS IN RETICULUM SEDIMENTS, AREA 18 CATTLE, MAY

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	SAMPLE NOT COLLECTED							
2	<57 <6,300	2,600±260 290,000±2,900	650±75 72,000±8,200	32±17 3,500±1,900	760±81 84,000±8,900	11	0.042	4.6
3	<43 <15,000	<27 <9,500	600±74 21,000±2,600	190±190 6,800±6,500	600±77 21,000±2,700	35	0.0152	5.3
4	24,000±2,900 1,000,000±120,000	1,100,000±76,000 48,000,000±3,200,000	22,000±1,900 940,000±79,000	640±3.3 27,000±140	13,000±1,400 550,000±69,000	42	0.0529	22.2
5	<53 <28,000	470±79 250,000±42,000	1,600±120 840,000±64,000	49±23 26,000±12,000	810±87 430,000±46,000	53	0.011	5.8
6	<61 <28,000	980±130 450,000±58,000	800±96 370,000±44,000	33±22 15,000±9,900	740±91 340,000±42,000	46	0.0158	7.3
MEDIAN	<57 <28,000	980 290,000	800 370,000	49 15,000	760 340,000	42		
RANGE	<43-24,000 <6,3000- 1,000,000	<27-1,100,000 <9,500- 48,000,000	600-940,000 21,000- 940,000	32-640 3,500- 27,000	600-13,000 21,000- 550,000	11- 53		

\* Wet weight.

B-6

TABLE B-7. ACTINIDE, STRONTIUM, AND CALCIUM CONCENTRATIONS IN VERTEBRAE, AREA 18 CATTLE, MAY

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	<sup>89</sup> Sr (pCi/g Ash) (pCi/kg*)	<sup>90</sup> Sr (pCi/g Ash) (pCi/kg*)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
1	<3.1 <520	4.6±2.3 790±390	3.9±1.4 660±240	<0.47 <80	3.6±1.4 610±240	<3 <510	3.5±0.88 590±150	17	360	1.559	265
1-F	<2.1 <170	<1.1 <86	4.7±1.9 380±150	<0.12 <10	3.1±1.7 250±140	<3.7 <300	2.6±0.95 210±77	8.1	350	0.671	54.4
2	<2.6 <440	5.2±1.9 880±330	<1.6 <280	<0.65 <110	<2.1 <360	<4.5 <770	3.6±1.2 610±200	17	370	2.415	410.6
3	<1.9 <350	4.2±1.6 760±290	<2.2 <400	<0.17 <31	<2.2 <400	<4.3 <780	2.4±1.1 440±200	18	370	2.946	530.3
3-F	<6.1 <410	<2.4 <160	10±2.4 700±160	<2.1 <140	<4.5 <300	<2.5 <170	1.5±0.91 100±61	6.7	330	0.254	17
4	<3.8 <690	13±3.2 2,300±580	2.8±1.2 500±220	<0.28 <50	1.7±0.94 300±170	<4.9 <890	4±1.2 720±220	18	370	3.222	580
4-F	<2.1 <200	<0.85 <80	<2.1 <200	<0.74 <70	<2.1 <200	<4.1 <390	2.6±1.1 240±100	9.4	350	0.436	41
5	<2.8 <280	<3.2 <320	3.5±1.2 350±120	<0.09 <9	3.5±1.2 350±120	<5 <500	4.5±1.3 450±130	10	360	2.687	268.7
6	<2.6 <360	2.2±1.3 310±180	4.1±1.9 570±260	<0.5 <70	2.9±1.4 400±200	<4.6 <650	4.4±1.1 620±160	14	360	2.390	334.6
MEDIAN	<2.6 <360	<3.2 <320	3.5 400	<0.47 <70	<2.9 350	<4.3 <510	3.5 450	14	360		
RANGE	<1.9-<6.1 <170- <690	<0.85-13 <80- 2,300	<1.6-10 <200- 660	<0.09-<2.1 <9- <140	1.7-<4.5 <200- 610	<2.5-<5 <170- <890	1.5-4.5 100- 720	6.7- 18	330- 370		

B-7

\* Wet weight.  
F = Fetus.

TABLE B-8. GAMMA-EMITTING RADIONUCLIDES AND TRITIUM CONCENTRATIONS IN SELECTED TISSUES,\* AREA 18 CATTLE, MAY

Animal No.	Rumen Contents K (g/kg) <sup>60</sup> Co (pCi/kg) <sup>103</sup> Ru (pCi/kg) <sup>106</sup> Ru (pCi/kg) <sup>137</sup> Cs (pCi/kg)	Liver K (g/kg) <sup>103</sup> Ru (pCi/kg)	Lungs K (g/kg) <sup>103</sup> Ru (pCi/kg)	Thyroid	Kidney K (g/kg)	Muscle K (g/kg) <sup>137</sup> Cs (pCi/kg)	Thymus K (g/kg)	Blood <sup>3</sup> H (pCi/l)
1	2.2 <MDA 140 <MDA <MDA	2.9 (Fetus 1.9) <MDA (Fetus <MDA)	2.8 (Fetus 1.1) <MDA (Fetus <MDA)	GSN	0.9	3.2 (Fetus 3.6) 40 (Fetus 50)	NS	330±240
2	1.7 <MDA <MDA 300 <MDA	2.7  80	2.2  <MDA	GSN	1	4.1 20	5	<240
3	2.9 <MDA <MDA <MDA 80	2.4 (Fetus 1.4) <MDA (Fetus <MDA)	1.8 (Fetus 1) <MDA (Fetus <MDA)	GSN	0.9	7.8 (Fetus 1.8) <MDA (Fetus <MDA)	NS	<240
4	1.8 <MDA <MDA <MDA <MDA	2.7 (Fetus 1) <MDA (Fetus <MDA)	3.4 (Fetus 0.7) <MDA (Fetus <MDA)	GSN	1.3	4.2 (Fetus 2.9) 30 (Fetus <MDA)	NS	<240
5	1.5 <MDA 160 <MDA MDA	2.6  <MDA	2.7  <MDA	GSN	1.4	3.1 30	2	240±240
6	1.9 80 230 <MDA 40	2.3  <MDA	2.9  250	GSN	3	4.4  50	3	310
MEDIAH	1.85 <MDA <MDA <MDA <MDA	2.65 (Fetuses 1.4) <MDA (Fetuses <MDA)	2.75 (Fetuses 1) <MDA (Fetuses <MDA)	GSN	1.15	4.15 (Fetuses 2.9) 35 (Fetuses <MDA)	3	<240
RANGE	1.5-2.9 <MDA-80 <MDA-160 <MDA-300 <MDA-80	2.3-29 (Fetuses 1-1.9) <MDA-80 (Fetuses <MDA)	1.8-3.4 (Fetuses 0.7-1.1) <MDA-250 (Fetuses <MDA)	GSN	0.9-3	3.1-7.8 (Fetuses 1.8-3.6) <MDA-50 (Fetuses <MDA-50)	2-5	<240-330

\* Wet weight.

<MDA = Less than minimum detectable activity.

GSN = Gamma spectrum negligible.

NS = Not sampled.

TABLE C-1. ACTINIDE CONCENTRATIONS IN LUNGS, AREA 18 CATTLE, OCTOBER

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
7	SAMPLE NOT COLLECTED							
8	22±8.7 360±140	21±8.1 330±130	11±4.9 170±78	<1.6 <26	10±4.2 160±67	1.6	0.387	6.2
9	23±9.2 300±120	210±34 2,700±440	26±6.1 340±79	3.2±2.2 41±29	22±5.3 280±69	1.3	0.632	8.2
10	25±11 370±160	110±20 1,600±300	80±18 1,200±270	6.7±5.6 100±84	11±8 160±120	1.5	0.226	3.4
11	25±8.3 300±100	120±21 1,400±250	22±5.3 260±64	<1.5 <18	22±4.9 260±59	1.2	0.846	10.2
12	5.3±1.4 250±64	13±2.1 620±100	17±2.8 820±130	<0.32 <15	18±2.8 850±130	4.7	0.635	29.8
MEDIAN	23 300	110 1,400	22 340	<1.6 <26	18 260	1.5		
RANGE	5.3-25 250- 370	13-210 330- 2,700	11-80 170- 1,200	<0.32-6.7 <15- 100	10-22 160- 850	1.2- 4.7		

\* Wet weight.

TABLE C-2. ACTINIDE CONCENTRATIONS IN TRACHEO-BRONCHIAL LYMPH NODES, AREA 18 CATTLE, OCTOBER

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
7	<410 <6,600	<870 <14,000	240±180 3,900±2,900	<120 <1,900	210±160 3,300±2,600	1.6	0.0064	0.102
8	<300 <5,700	5,800±890 110,000±17,000	<110 <2,100	<68 <1,300	130±95 2,500±1,800	1.9	0.0104	0.198
9	<200 <2,000	2,600±540 26,000±5,400	280±140 2,800±1,400	<71 <710	160±100 1,600±1,000	1	0.0196	0.196
10	<320 <4,200	<700 <9,200	380±290 4,900±3,800	<70 <1,200	<190 <2,500	1.3	0.0076	0.01
11	<230 <3,500	<390 <5,900	170±110 2,600±1,700	<50 <750	<67 <1,000	1.5	0.0133	0.1995
12	NA	NA	<360 <3,600	<310 <3,100	<400 <4,000	0.99	0.0101	0.010
MEDIAN	<300 <4,200	<870 <14,000	240 2,800	<70 <1,200	160 2,500	1.3		
RANGE	<200-<410 <2,000- <6,600	<390-5,800 <5,900- 110,000	<110-380 <2,100- 4,900	<50-<310 <750- <3,100	<67-<400 <1,000- <4,000	0.99- 1.9		

\* Wet weight.  
NA = Not analyzed.

TABLE C-3. ACTINIDE CONCENTRATIONS IN MUSCLES, AREA 18 CATTLE, OCTOBER

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
7	9.1±3.0 100±33	<2.8 <31	NA	NA	NA	1.1	1.318	14.5
8	6.1±3.7 250±150	<2.1 <85	<4.9 <200	<2.4 <97	<3.4 <140	4.1	1.459	59.8
9	3.4±2.0 47±28	<2.1 <30	NA	NA	NA	1.4	1.126	15.8
10	10±2.9 120±35	<2.6 <31	NA	NA	NA	1.2	1.364	16.4
11	13±3.6 160±43	4.6±2.2 55±26	NA	NA	NA	1.2	1.386	16.6
12	7.2±2.8 93±36	<1.8 <24	NA	NA	NA	1.3	0.932	12.1
MEDIAN	8.15 110	<2.35 <31				1.25		
RANGE	3.4-13 47-250	<1.8-4.6 <24-<85				1.1- 4.1		

\* Wet weight.  
NA = Not analyzed.

TABLE C-4. ACTINIDE CONCENTRATIONS IN LIVERS, AREA 18 CATTLE, OCTOBER

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
7	SAMPLE NOT COLLECTED							
8	6.5±6.2 91±87	58±12 810±170	11±4.1 160±58	<1.2 <17	11±3.7 150±52	1.4	1.058	14.8
9	11±6.5 520±310	21±12 1,000±570	7.1±4.6 340±220	<2 <97	<3.5 <170	4.8	0.982	47.1
10	<0.8 <16	4.8±1.8 97±37	5±1.4 100±29	<0.5 <10	1.9±0.8 39±16	2	1.293	25.9
11	0.43±0.43 6.5±6.5	1.9±1 29±15	NA	NA	NA	1.5	1.377	20.7
12	40±18 600±270	<10 <150	3.9±3.6 59±52	<1.5 <22	<2.5 <37	1.5	0.825	12.4
MEDIAN	6.5 91	<10 <150	6.1 130	<1.4 <19.5	<3 104	1.5		
RANGE	0.43-40 <16- 600	1.9-58 29- 1,000	3.9-11 59- 340	<0.5-<2 <10- <97	1.9-11 <37- <170	1.4- 4.8		

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\* Wet weight.  
NA = Not analyzed.

TABLE C-5. ACTINIDE CONCENTRATIONS IN RUMEN CONTENTS, AREA 18 CATTLE, OCTOBER

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
7	140±25 5,600±990	1,300±120 52,000±4,500	360±44 14,000±1,700	10±6.7 390±260	310±38 12,000±1,500	3.9	1.064	41.5
8	9.4±3.6 170±65	140±17 2,500±300	36±7.2 650±130	2±1.7 36±31	30±6.1 540±110	1.8	1.591	28.6
9	650±90 13,000±1,800	1,600±170 32,000±3,400	1,400±140 28,000±2,900	60±34 1,200±690	1,100±130 23,000±2,600	2	1.021	20.4
10	SAMPLE LOST							
11	94±15 3,000±480	690±62 22,000±2,000	110±15 3,500±490	4.7±3.1 150±100	110±15 3,400±480	3.2	1.395	44.6
12	52±11 620±130	560±52 6,700±630	130±24 1,600±290	9.2±5.8 110±70	130±23 1,600±280	1.2	1.208	14.5
MEDIAN	94 3,000	690 22,000	130 3,500	9.2 150	130 3,400	2		
RANGE	9.4-650 170-13,000	140-1,600 2,500-52,000	36-1,400 650-28,000	2-60 36-1,200	30-1,100 540-23,000	1.2- 3.9		

\* Wet weight.

TABLE C-6. ACTINIDE CONCENTRATIONS IN RETICULUM SEDIMENTS, AREA 18 CATTLE, OCTOBER

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
7	<120 <9,000	<190 <14,000	560±100 41,000±7,600	32±30 2,300±2,200	620±100 45,000±7,400	7.3	0.0436	3.2
8	SAMPLE NOT COLLECTED							
9	<71 <12,000	<94 <16,000	650±110 110,000±19,000	48±32 8,100±5,400	590±100 100,000±17,000	17	0.0549	9.3
10	<120 <52,000	<190 <84,000	730±120 330,000±56,000	<33 <15,000	730±120 330,000±53,000	45	0.0508	22.9
11	<83 <25,000	<140 <41,000	570±110 170,000±32,000	<32 <9,500	600±110 180,000±32,000	30	0.0304	9.1
12	<100 <34,000	<180 <60,000	1,300±150 440,000±51,000	61±36 20,000±12,000	1,300±150 430,000±49,000	33	0.055	18.2
MEDIAN	<100 <25,000	<180 <41,000	650 170,000	<33 <9,500	620 180,000	30		
RANGE	<71-<120 <9,000- <52,000	<94-<190 <14,000- <84,000	560-1,300 41,000- 440,000	<32-61 2,300- 20,000	590-1,300 45,000- 430,000	7.3- 45		

\* Wet weight.

TABLE C-7. ACTINIDE, STRONTIUM, AND CALCIUM CONCENTRATIONS IN VERTEBRAE, AREA 18 CATTLE, OCTOBER

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	<sup>89</sup> Sr (pCi/g Ash) (pCi/kg*)	<sup>90</sup> Sr (pCi/g Ash) (pCi/kg*)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
7	<5.2 <670	<7.5 <970	<2.4 <310	<1 <130	2.1±1.7 270±220	<24 <3,100	1.8±0.77 240±100	13	350	0.823	107
8	30±7.4 5,700±1,400	<7.9 <1,500	7.4±3.2 1,400±600	<1.2 <220	2.9±2.1 550±390	<24 <4,500	1.8±0.79 350±150	19	360	1.149	218.3
9	25±6.4 5,400±1,400	<7.3 <1,600	<1.7 <380	1.4±1.3 310±290	7.3±2.6 1,600±580	<28 <6,200	2.9±0.95 640±210	22	380	1.776	390.7
10	8.9±4.2 1,700±790	7.4±4.0 1,400±760	<2.3 <440	<1.1 <200	2.1±1.7 400±320	<29 <5,600	3.8±1.0 730±190	19	370	1.211	230.1
11	15±5.3 2,200±800	15±5.9 2,300±890	<2.2 <330	<1.5 <220	<1.7 <260	<20 <3,000	2.7±0.8 410±120	15	370	1.294	194.1
12	<3.6 <510	5.7±3.9 800±540	<3.2 <450	<1.3 <180	3±2.6 420±360	<14 <1,900	2.7±0.6 380±84	14	360	1.013	141.8
MEDIAN	12 1,950	7.45 1,450	<2.35 <410	<1.25 <210	2.5 410	<24 <3,800	2.7 395	17	365		
RANGE	<3.6-30 <510- 5,700	5.7-15 800- 2,300	<1.7-7.4 <310- 1,400	<1-<1.5 <130- 310	<1.7-7.3 <260- 1,600	<14-<29 <1,900- <6,200	1.8-3.8 240- 730	13- 22	350- 380		

\* Wet weight.

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TABLE C-8. ACTINIDE, STRONTIUM, AND CALCIUM CONCENTRATIONS IN FEMURS, AREA 18 CATTLE, OCTOBER

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	<sup>89</sup> Sr (pCi/g Ash) (pCi/kg*)	<sup>90</sup> Sr (pCi/g Ash) (pCi/kg*)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
7	<5.2 <1,100	<9 <1,900	<2 <410	<0.90 <190	<1.5 <310	<24 <5,000	2.2±0.81 470±170	21	360	0.692	145.3
8	<6.2 <1,600	<8.1 <2,100	6.2±2.7 1,600±700	<0.65 <170	<1.6 <420	<24 <6,200	3.5±0.81 920±210	26	380	1.650	429
9	<4.3 <1,300	<5 <1,500	<3 <910	<2.5 <750	<3.7 <1,100	<32 <9,700	5±1.1 1,500±330	30	380	2.038	611.4
10	5.4±3.8 1,400±1,000	<3.8 <1,000	<1.8 <460	<0.73 <190	<1.3 <330	34±23 8,800±6,100	3.2±1.0 830±260	26	380	0.850	221
11	<4.6 <1,100	9.6±5 2,300±1,200	<1.8 <440	<1 <240	1.7±1.6 420±390	28±20 6,600±4,800	2.6±0.83 630±200	24	370	0.549	137.8
12	<3.9 <810	9 1,900±860	<5.7 <1,200	<4.3 <910	<6.2 <1,300	30±19 6,300±3,900	3±0.81 630±170	21	370	0.534	112.1
MEDIAN	<4.9 <1,200	<8.55 <1,900	<2.5 <685	<0.95 <215	<1.65 <420	29 6,450	3.1 730	25	375		
RANGE	<3.9- <810- <1,600	<3.8- <1,000- 2,300	<1.8- <410- 1,600	<0.65- <170- <910	<4.3- <310- <1,300	<24- <5,000- <9,700	2.2- 470- 1,500	21- 30	360- 380		

\* Wet weight.

TABLE C-9. GAMMA-EMITTING RADIONUCLIDES AND TRITIUM CONCENTRATIONS IN SELECTED TISSUES,<sup>\*</sup>  
AREA 18 CATTLE, OCTOBER

Animal No.	Rumen Contents	Liver	Lungs	Thyroid	Kidney	Muscle	Blood
	K (g/kg) <sup>95</sup> Zr (pCi/kg) <sup>103</sup> Ru (pCi/kg) <sup>137</sup> Cs (pCi/kg)	K (g/kg) <sup>137</sup> Cs (pCi/kg)	K (g/kg) <sup>137</sup> Cs (pCi/kg)		K (g/kg)	K (g/kg) <sup>137</sup> Cs (pCi/kg)	<sup>3</sup> H (pCi/l)
7	1.1 <MDA 200 60	1 20	1.1 <MDA	GSN	1	0.9 <MDA	420±240
8	0.5 <MDA 230 <MDA	1 <MDA	0.7 <MDA	GSN	1.7	1.4 20	330±240
9	0.6 <MDA <MDA <MDA	1 <MDA	0.8 <MDA	GSN	2.5	1.3 <MDA	380±240
10	0.4 <MDA <MDA 30	1.4 <MDA	0.7 <MDA	GSN	1.6	1.5 20	350±240
11	0.9 <MDA <MDA 40	1.8 <MDA	1.1 20	GSN	2.1	1.1 20	500±240
12	0.6 <30 110 20	0.9 <MDA	1 <MDA	GSN	1.7	1.5 14	490±240
MEDIAN	0.6 <MDA 110 25	1 <MDA	0.9 <MDA	GSN	1.7	1.35 17	400
RANGE	0.4-1.1 <MDA-<30 <MDA-230 <MDA-60	0.9-1.8 <MDA-20	0.7-1.1 <MDA-20	GSN	1-2.5	0.9-1.5 <MDA-20	330-500

\* All values reported on wet weight basis.  
<MDA = Less than minimum detectable activity.  
GSN = Gamma spectrum negligible.

TABLE D-1. ACTINIDE CONCENTRATIONS IN LUNGS, CORRALLLED CATTLE, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
902	<110 <1,200	<60 <660	85±1.2 940±13	10±2.5 110±27	64±8.5 700±93	1.1	1.859	20.4
16	<25 <250	30±16 300±160	61±9.7 610±97	8.6±3.6 86±36	17±5.1 170±51	1	2.684	26.8
779	NOT SAMPLED							
46	<15 <160	37±14 410±150	29±10 320±110	<2.9 <32	34±10 370±110	1.1	1.880	20.7
MEDIAN	<25 <250	37 410	61 610	8.6 86	34 370	1.1		
RANGE	<15-<110 <160-<1,200	30-<60 300-<660	29-85 320-940	<2.9-10 <32-110	17-64 170-700	1- 1.1		

\* Wet weight.

TABLE D-2. ACTINIDE CONCENTRATIONS IN TRACHEO-BRONCHIAL LYMPH NODES, CORRALLLED CATTLE, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
902								
			NOT SAMPLED					
16								
			NOT SAMPLED					
779								
			NOT SAMPLED					
46	<110 <7,900	2,800±360 210,000±27,000	230±88 17,000±6,500	<16 <1,200	230±88 17,000±6,500	7.4	0.0408	3.02

\* Wet weight.

TABLE D-3. ACTINIDE CONCENTRATIONS IN MUSCLES, CORRALLLED CATTLE, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
902	17±5.7 200±69	19±4.7 230±56	22±5.7 260±68	5±2.7 60±32	8.3±3.6 100±43	1.2	2.194	26.3
16	<37 <410	65±32 710±350	64±13 700±140	20±7.5 220±82	39±11 430±120	1.1	1.297	14.3
779	<25 <250	<35 <350	13±3.8 130±38	<1.2 <12	2.2±1.7 22±17	0.99	1.214	12
46	<9.3 <93	9.8±5.2 98±52	29±6.2 290±62	4.1±2.4 41±24	7.5±3.2 75±32	1	3.137	31.4
MEDIAN	<21 <225	27 290	25.5 275	4.55 50.5	7.9 87.5	1.05		
RANGE	<9.3-<37 <93-<410	9.8-65 98-710	13-64 130-700	<1.2-20 <12-220	2.2-39 22-430	0.99- 1.2		

\* Wet weight.

TABLE D-4. ACTINIDE CONCENTRATIONS IN LIVERS, CORRALLED CATTLE, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
902	<8.8 <97	40±10 440±110	55±10 610±110	<0.45 <5	23±6.6 250±73	1.1	2.069	22.8
16	<58 <580	40±37 400±370	32±8.9 320±89	<2 <20	24±7.8 240±78	1	2.305	23.1
779	NOT SAMPLED							.
46 <sup>†</sup>	1,500±140 21,000±2,000	58±15 810±210	19±5.3 260±74	<1.4 <20	8.6±3.4 120±47	1.4	2.358	33
MEDIAN	<58 <580	40 440	32 320	<1.4 <20	23 240	1.1		
RANGE	<8.8-1,500 <97-21,000	40-58 400-810	19-55 260-610	<0.45-<2 <5-<20	8.6-24 120-250	1- 1.4		

\* Wet weight.

<sup>†</sup> Possibly contaminated during sampling as was confined and sacrificed in conjunction with an experimental animal which had been dosed with plutonium-238.

TABLE D-5. ACTINIDE CONCENTRATIONS IN RUMEN CONTENTS, CORRALLLED CATTLE, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
902				NOT SAMPLED				
16				NOT SAMPLED				
779				NOT SAMPLED				
46	29±16 400±220	540±56 7,500±780	1,200±46 17,000±650	15±5.1 210±72	390±26 5,500±370	1.4	3.113	43.6

\* Wet weight.

D-6. ACTINIDE CONCENTRATIONS IN RETICULUM SEDIMENTS, CORRALLLED CATTLE, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
902				NOT SAMPLED				
16				NOT SAMPLED				
779				NOT SAMPLED				
46	230±68 150,000±45,000	640±91 420,000±60,000	500±85 330,000±56,000	17±15 11,000±1,000	500±70 330,000±46,000	66	0.035	23.1

\* Wet weight.

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TABLE D-7. ACTINIDE CONCENTRATIONS IN WHOLE FETUSES, CORRALLLED CATTLE, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	<sup>89</sup> Sr (pCi/g Ash) (pCi/kg*)	<sup>90</sup> Sr (pCi/g Ash) (pCi/kg*)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
16	<1.9 <44	<1.7 <40	<1.3 <30	<0.13 <3	<0.87 <20	<1.9 <43	1.2±0.74 28±17	23	230	1.959	450.6

\* Wet weight.  
NA = Not analyzed.

TABLE D-8. ACTINIDE, STRONTIUM, AND CALCIUM CONCENTRATIONS IN BONES\*, CORRALLLED CATTLE, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg†)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg†)	<sup>234</sup> U (fCi/g Ash) (fCi/kg†)	<sup>235</sup> U (fCi/g Ash) (fCi/kg†)	<sup>238</sup> U (fCi/g Ash) (fCi/kg†)	<sup>89</sup> Sr (pCi/g Ash) (pCi/kg†)	<sup>90</sup> Sr (pCi/g Ash) (pCi/kg†)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
902	3.6±3.0 1,200±1,000	30±4.5 10,000±1,500	7.9±2.1 2,600±690	<0.30 <100	7.0±1.9 2,300±630	<3.3 <1,100	3.3±1.1 1,100±360	33	370	0.994	328
16	<2.9 <500	120±12 21,000±2,000	11±2.2 1,800±370	0.82±0.71 140±120	6.5±1.8 1,100±300	<2.4 <410	2.8±0.76 470±130	17	372	2.418	411.1
779	<3.5 <1,100	6.8±3.0 2,100±920	4.2±1.4 1,300±430	<0.42 <130	2.8±1.3 860±400	<2.2 <680	2.0±0.74 620±230	31	378	0.447	138.6
46	<23 <4,100	33±16 6,000±2,900	6.7±1.8 1,200±320	<0.40 <72	4.8±1.5 860±270	<1.7 <310	1.2±0.72 220±130	18	370	2.037	366.7
MEDIAN	3.55 1,150	31.5 8,000	7.3 1,550	41 115	5.65 935	<2.3 <545	2.4 545	24.5	371		
RANGE	<2.9-<23 <500-4,100	6.8-120 2,100-21,000	4.2-11 1,200-2,600	<0.3-0.82 <72-140	2.8-7.0 860-2,300	<1.7-<3.3 <310-<1,100	1.2-3.3 220-1,100	17- 33	370- 378		

\*Femurs were sampled from animals nos. 902 and 779, and the vertebrae from nos. 16 and 46.  
 †Wet weight.

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TABLE D-9. GAMMA-EMITTING RADIONUCLIDES AND TRITIUM CONCENTRATIONS IN SELECTED TISSUES,\* CORRALLLED CATTLE, 1973

Animal No.	Liver	Lungs	Thyroid	Kidney	Muscle	Blood
	K (g/kg) <sup>103</sup> Ru (pCi/kg) <sup>137</sup> Cs (pCi/kg)	K (g/kg) <sup>137</sup> Cs (pCi/kg)		K (g/kg)	K (g/kg) <sup>137</sup> Cs (pCi/kg)	<sup>3</sup> H (pCi/l)
902	3.2 <MDA <MDA	2.2 <MDA	GSN	NS	2.5 <MDA	4,400 ± 310
16	1.8 50 <MDA	1.7 30	GSN	1.1	3.6 <MDA	2,200 ± 280
779	NS	NS	GSN	NS	4.1 40	NS
46	2.9 <MDA 30	2 <MDA	GSN	1.6	3.9 <MDA	2,500 ± 280
MEDIAN	2.9 <MDA <MDA	2 <MDA	GSN	1.35	3.75 <MDA	2,500
RANGE	1.8-3.2 <MDA-50 <MDA-30	1.7-2.2 <MDA-30	GSN	1.1-1.6	2.5-4.1 <MDA-40	2,200-4,400

\*All values reported on wet weight basis.  
 <MDA = Less than minimum detectable activity.  
 GSN = Gamma spectrum negligible.  
 NS = Not sampled.

TABLE E-1 ACTINIDE CONCENTRATIONS IN LUNGS, MULE DEER, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	84±31	<35	21±6.7	<3.3	19±6.3	0.97	0.902	8.749
	810±300	<340	200±65	<32	180±61			
2	540±49	<14	7.1±5.6	<2.3	6.5±4.4	1.7	0.799	13.6
	9,100±830	<240	120±96	<39	110±74			
3	5,300±410	<19	58±11	18±5.6	37±7.9	1	1.167	11.7
	53,000±4,100	<190	580±110	180±56	370±79			
4	56±13	28±9.7	140±19	11±5	118±17	0.93	0.988	9.2
	520±120	260±90	1,300±180	100±45	1,100±160			
MEDIAN	312	<16.5	40	7.1	28	0.985		
	4,950	<290	390	70	275			
RANGE	56-5,300	<14-<35	7.1-140	<2.3-18	6.5-118	0.93-		
	520-53,000	<190-<340	120-1,300	<32-180	110-1,100			

\* Wet weight.

TABLE E-2. ACTINIDE CONCENTRATIONS IN MUSCLES, MULE DEER, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	1,500±110 21,000±1,600	6.7±4.8 94±67	NA	NA	NA	1.4	1.349	18.9
2	<7.8 <57	11±4.9 78±36	49±12 360±90	8.5±5.2 62±38	<7.1 <52	0.73	1.326	9.7
3				SAMPLE LOST				
4	17±8 160 ± 75	<9 <83	15±4.9 140±46	2.7±2.2 25 ± 21	7.2±3.5 68±33	0.94	1.246	11.7
MEDIAN	17 160	<9 <83	32 250	5.6 43.5	7.15 60	0.94		
RANGE	<7.8-1,500 <57-21,000	6.7-11 78-94	15-49 140-360	2.7-8.5 25-62	<7.1-7.2 <52-68	0.73- 1.4		

\* Wet weight.  
NA = Not analyzed.

TABLE E-3. ACTINIDE CONCENTRATIONS IN LIVERS, MULE DEER, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	<13 <130	<4.8 <47	16±6.3 160±62	<1.8 <18	15±5.8 150±57	0.98	0.906	8.88
2	<8.4 <59	<4.3 <30	270±39 1,900±270	100±23 730±160	210±34 1,500±240	0.70	0.991	6.94
3	SAMPLE LOST							
4	SAMPLE NOT COLLECTED							

\*Wet weight.

TABLE E-4. ACTINIDE CONCENTRATIONS IN RUMEN CONTENTS, MULE DEER, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	<8.3 <290	34±9.4 1,200±330	54±11 1,900±380	<2.1 <73	37±8.9 1,300±310	3.5	0.430	15.1
2	11±10 220±210	90±15 1,800±300	85±10 1,700±210	3.8±2.2 77±44	80±10 1,600±210	2	0.902	18
3	SAMPLE LOST							
4	41±9.2 530±120	250±27 3,300±350	NA	NA	NA	1.3	0.715	9.3
E-4 MEDIAN	11 <290	90 1,800	69 1,800	3 75	59 1,450	2		
RANGE	<8.3-41 220- 530	34-250 1,200- 3,300	54-85 1,700- 1,900	<2.1-3.8 <73- 77	37-80 1,300- 1,600	1.3- 3.5		

\* Wet weight.  
NA = Not analyzed.

TABLE E-5. ACTINIDE, STRONTIUM, AND CALCIUM CONCENTRATIONS IN BONES (HOCK), MULE DEER, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	<sup>89</sup> Sr (pCi/g Ash) (pCi/kg*)	<sup>90</sup> Sr (pCi/g Ash) (pCi/kg*)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
1	<2.2 <710	<1.3 <410	1±0.56 320±180	<0.063 <20	0.69±0.47 220±150	<3.1 <1,000	2±0.75 630±240	32	376	0.580	185.6
2	<2.2 <710	1.8±1.2 610±410	2.2±1.2 730±380	<0.12 <40	0.97±0.7 320±230	<2.8 <930	3±0.82 980±270	33	376	0.418	137.9
3	SAMPLE LOST										
4	<5.2 <1,500	<9.3 <2,700	<3.1 <900	<2.4 <690	<3.3 <970	<17 <5,000	3.1±1 900±290	29	360	0.227	65.8
MEDIAN	<2.2 <710	1.8 610	2.2 730	<0.12 <40	0.97 320	<3.1 <1,000	3 900	32	376		
RANGE	<2.2-<5.2 <710-<1,500	<1.3-<9.3 <410-<2,700	1-<3.1 320-<900	<0.063-<2.4 <20-<690	0.69-<3.3 220-<970	<2.8-<17 <930-<5,000	2-3.1 630-980	29- 33	360- 376		

\* Wet weight

TABLE E-6. GAMMA-EMITTING RADIONUCLIDES AND TRITIUM CONCENTRATIONS IN SELECTED TISSUES,\*  
MULE DEER, 1973

Animal No.	Rumen Contents K (g/kg) <sup>95</sup> Zr (pCi/kg) <sup>103</sup> Ru (pCi/kg) <sup>137</sup> Cs (pCi/kg)	Liver K (g/kg) <sup>103</sup> Ru (pCi/kg)	Lungs K (g/kg) <sup>137</sup> Cs (pCi/kg)	Thyroid <sup>131</sup> I (pCi/g)	Kidney K (g/kg)	Muscle K (g/kg) <sup>137</sup> Cs (pCi/kg)	Blood <sup>3</sup> H (pCi/l)
1	3.2 <MDA <MDA <MDA	3.9 150	2.6 50	<MDA	1.7	3.3 30	<240
2	4 <MDA 80 <MDA	3.4 <MDA	3.1 40	<MDA	1.4	3.3 <MDA	290±240
3	3.1 30 200 <MDA	3 <MDA	1.6 <MDA	18	3.3	3.6 <MDA	360±250
4	1.4 <MDA <MDA 110	NS	1 <MDA	NS	NS	1.5 20	NS
MEDIAN	3.15 <MDA 80 <MDA	3.4 <MDA	2.1 40	<MDA	1.7	3.3 20	290
RANGE	1.4-4 <MDA-30 <MDA-200 <MDA-110	3-3.9 <MDA-150	1-3.1 <MDA-50	<MDA-18	1.4-3.3	1.5-3.6 <MDA-30	<240-360

E-6

\* All values reported on wet weight basis.  
<MDA = Less than minimum detectable activity.  
NS = Not sampled.

TABLE F-1. ACTINIDE CONCENTRATIONS IN LUNGS, BIGHORN SHEEP, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1	<6.9 <97	11±11 160±150	NA	NA	NA	1.4	0.268	3.8
2	77±29 740±280	<14 <130	46±21 440±200	<5.7 <55	34±18 330±170	0.96	0.092	0.9
3	<6.7 <120	<9.4 <170	10±5.6 180±100	<1.8 <33	11±5.2 190±94	1.8	0.267	4.8
4	30±13 280±120	21±11 190±100	<12 <110	<5 <46	12±9.9 110±92	0.92	0.199	1.8
5	1,000±98 10,000±940	<15 <140	53±17 510±160	10±10 100±96	41±18 390±170	0.96	0.237	2.3
6	11±6.4 110±63	29±10 280±100	53±16 520±160	<3.4 <33	54±15 530±150	0.98	0.235	2.3
7	14±7.4 270±140	<7.9 <150	5.8±3.1 110±58	<1.2 <23	4.2±2.6 79±50	1.9	0.303	5.8
8	11±5.9 160±82	16±7 230±98	16±6.6 220±92	<1.7 <24	14±6.1 200±86	1.4	0.235	3.3

F-1-1

See footnotes on page F-1-3.

TABLE F-1. CONTINUED

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
9	35±24 420±290	23±19 280±230	170±27 2,100±330	10±6.3 120±75	170±27 2,100±330	1.2	0.192	2.3
10	130±21 1,300±210	55±13 550±130	NA	NA	NA	1	0.339	3.4
11	10±7.4 280±200	<5.2 <140	18±8.9 480±240	<2.8 <75	8.9±6.7 240±180	2.7	0.057	1.5
12	SAMPLE NOT COLLECTED							
13	40±15 440±160	190±33 2,100±360	140±19 1,500±210	6.4±4 70±44	150±21 1,700±230	1.1	0.326	3.6
14	80±16 800±160	22±8.4 220±84	16±8.5 160±85	<3.5 <35	1.7±6.9 170±69	1	0.297	3
15	SAMPLE NOT COLLECTED							
16	10±4.6 220±96	76±13 1,600±270	NA	NA	NA	2.1	0.233	4.9
17	450±43 4,900±470	<14 <150	22±9.1 240±100	<2.5 <28	18±8.7 200±96	1.1	0.230	2.5

F-1-2

See footnotes on page F-1-3.

TABLE F-1. CONTINUED

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
18	<11 <140	<14 <180	NA	NA	NA	1.3	0.326	4.2
19	<4.8 <82	<7.1 <120	NA	NA	NA	1.7	0.286	4.9
20	3.3±1.9 170±100	29±5 1,500±260	12±2.9 630±150	<0.46 <24	10±2.5 530±130	5.2	0.293	15.2
MEDIAN	12.5 275	15.5 185	18 440	<3.4 <35	14 240	1.25		
RANGE	3.3-1,000 <82- 10,000	<5.2-190 <120- 2,100	5.8-170 <110- 2,100	<0.46-10 <23- 120	1.7-170 79- 2,100	0.92- 5.2		

\* Wet weight.  
NA = Not analyzed.

TABLE F-2. ACTINIDE CONCENTRATIONS IN LIVERS, BIGHORN SHEEP, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
1, 2	SAMPLES NOT COLLECTED							
3	11±5.5 330±160	83±14 2,400±410	4.5±3.3 130±95	<2.4 <70	5.5±3.4 160±100	2.9	0.428	12.9
4, 5, 6, 7	SAMPLES NOT COLLECTED							
8	<7.3 <80	19±10 210±110	NA	NA	NA	1.1	0.479	5.3
9	1,800±310 33,000±5,500	670±140 12,000±2,500	720±78 13,000±1,400	35±14 630±260	610±72 11,000±1,300	1.8	0.443	7.9
10	790±93 11,000±1,300	210±39 2,900±550	NA	NA	NA	1.4	0.469	6.5
11	SAMPLE NOT COLLECTED							
12	61±32 360±190	93±39 550±230	49±29 290±170	<12 <73	25±22 150±130	0.59	0.81	0.48
13	SAMPLE NOT COLLECTED							

F-2-1

See footnotes on page F-2-2

TABLE F-2. CONTINUED

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	Ash (%)	Wet wt. (kg)	Ash wt. (g)
14	<1.6 <23	5.4±2.9 75±40	NA	NA	NA	1.4	0.472	6.6
15	SAMPLE NOT COLLECTED							
16	7.9±3.1 150±59	34±6.3 640±120	NA	NA	NA	1.9	0.482	9.2
17	SAMPLE NOT COLLECTED							
18	69±32 830±390	190±43 2,300±520	NA	NA	NA	1.2	0.462	5.5
MEDIAN	36 345	88 1,470	49 290	<12 <73	25 160	1.4		
RANGE	<1.6-1,800 <23- 33,000	5.4-670 75- 12,000	4.5-720 130- 13,000	<2.4-35 <70- 630	5.5-610 150 11,000	0.59- 2.9		

\* Wet weight.  
NA = Not analyzed.

TABLE F-3. ACTINIDE, STRONTIUM, AND CALCIUM CONCENTRATIONS IN BONES (HOCK), BIGHORN SHEEP, 1973

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	<sup>89</sup> Sr (pCi/g Ash) (pCi/kg*)	<sup>90</sup> Sr (pCi/g Ash) (pCi/kg*)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
1	21±4.2 9,000±1,800	<1.9 <820	2.8±1.9 1,200±830	<0.86 <370	1.7±1.3 740±550	<0.86 <370	2.3±0.79 1,000±340	43	370	0.240	103.2
2	<1.7 <420	<2.1 <500	16±3.6 3,800±870	1.5±1.4 350±330	13±3.2 3,200±760	<0.83 <200	1.2±0.75 290±180	24	370	0.370	88.8
3, 4	SAMPLES NOT COLLECTED										
5	17±3.1 5,500±980	<0.59 <190	3.8±1.5 1,200±470	<0.47 <150	2±1.1 630±350	<21 <6,800	2.8±1 910±320	32	370	0.196	62.7
6	2.6±1.2 850±400	0.94±0.76 310±250	3.9±1.7 1,300±550	<0.42 <140	2.6±1.4 870±450	<22 <7,400	2.6±1 860±330	33	360	0.236	77.9
7	<1.6 <520	2.6±2 850±650	3.6±1.5 1,200±500	<0.33 <110	1.9±1.1 620±350	<1.3 <420	3±1.1 1,000±370	33	370	0.932	307.6
8	1.9±1 610±330	<0.41 <130	1.8±0.94 570±300	<0.38 <120	1±0.72 320±230	2.2±1.2 700±380	2.4±0.97 770±310	32	380	0.203	64.9
9	28±4.4 9,500±1,500	<0.62 <210	2.1±1.2 720±400	<0.41 <140	0.91 310	<19 <660	1.8±0.91 610±310	34	370	0.207	70.4
10	45±5.8 15,000±1,900	1.7±1.7 550±550	6.4±3.3 2,100±1,100	<1.2 <410	3.9±3 1,300±1,000	<1 <330	6.4±0.97 2,100±320	33	380	0.185	61.1
11, 12	SAMPLES NOT COLLECTED										
13	9.4±2.4 3,000±770	<2.0 <650	3±2 950±640	<0.81 <260	1.3±1.1 420±340	<1.1 <360	4.4±1 1,400±330	32	380	0.223	71.4
14	2.4±1.2 780±380	<0.44 <140	3.4±1.6 1,100±520	<0.47 <150	2.2±1.3 690±420	<28 <8,900	5.6±1.4 1,800±450	32	380	0.236	75.5

F-3-1

See footnote on page F-3-2.

TABLE F-3. CONTINUED

Animal No.	<sup>238</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>239</sup> Pu (fCi/g Ash) (fCi/kg*)	<sup>234</sup> U (fCi/g Ash) (fCi/kg*)	<sup>235</sup> U (fCi/g Ash) (fCi/kg*)	<sup>238</sup> U (fCi/g Ash) (fCi/kg*)	<sup>90</sup> Sr (pCi/g Ash) (pCi/kg*)	<sup>94</sup> Sr (pCi/g Ash) (pCi/kg*)	Ash (%)	Ca (mg/g)	Wet wt. (kg)	Ash wt. (g)
15	9.1±5 2,000±1,100	15±5.9 3,400±1,300	13±2.7 2,800±600	<0.59 <130	13±2.5 2,800±560	<2 <450	11±1.6 2,500±350	22	360	0.420	92.4
16	SAMPLE NOT COLLECTED										
17	77±8.3 27,000±2,900	<1.5 <510	1.5±0.94 520±330	<0.49 <170	2.5±1.2 880±420	<1.3 <450	3.4±1.1 1,200±400	35	370	0.164	57.4
18	0.77±0.68 240±210	<0.58 <180	2.5±1.3 780±410	<0.39 <120	1.7±1.1 520±350	<21 <6,600	7.7±1.4 24,000±440	31	380	0.210	65.1
19	2.4±1.1 790±360	1.6±0.91 540±300	2.7±1.2 880±400	<0.28 <93	1.6±0.88 520±290	<1.5 <500	4.2±1.5 14,000±430	33	360	0.226	70.1
20	24±3.5 7,300±1,100	1.6±0.87 510±270	2.4±1.1 740±350	<0.52 <160	2.3±1.1 700±340	1.8±1.4 560±44	2.9±1.2 900±37	31	380	0.094	29
MEDIAN	9.1 2,000	1.7 <510	3 1,100	<0.49 <150	2 690	1.8 <500	3 1,000	32	370		
RANGE	0.77-77 240- 27,000	<0.41-15 <130- 3,400	1.5-16 520- 3,800	<0.28-1.5 <93- <410	<0.91-13 <310- 3,200	<0.83- 28 560- <8,900	1.2-11 900- 24,000	22- 43	360- 380		

F-3-2

\* Wet weight.

TABLE F-4. GAMMA-EMITTING RADIONUCLIDES AND TRITIUM CONCENTRATIONS IN  
SELECTED TISSUES,\* BIGHORN SHEEP, 1973

Animal No.	Rumen Contents	Lungs	Kidney	Liver
	K (g/kg) <sup>103</sup> Ru (pCi/kg) <sup>137</sup> Cs (pCi/kg) <sup>95</sup> Zr (pCi/kg)	K (g/kg)	K (g/kg) <sup>3</sup> H (pCi/l) <sup>3</sup> H (pCi/kg) (% Moisture)	K (g/kg)
1	2.0 <MDA 90 <MDA	2.7	3.3 670±250 NA NA	2.5
2	2.1 <MDA <MDA <MDA	5.1	SNC	SNC
3	2.7 <MDA 280 <MDA	1.7	3.9 NA 110±59 24	2.5
4	SNC	3.3	SNC	SNC
5	2.5 300 <MDA 160	2.7	4.9 <240 NA NA	SNC
6	GSN	2.6	SNC	SNC
7	4.4 <MDA 80 <MDA	2.1	SNC	SNC
8	2.7 <MDA 100 <MDA	3.5	SNC	2.9
9	GSN	3.6	SNC	2.9

See footnotes on page F-4-3.

TABLE F-4. CONTINUED

Animal No.	Rumen Contents	Lungs	Kidney	Liver
	K (g/kg) <sup>103</sup> Ru (pCi/kg) <sup>137</sup> Cs (pCi/kg) <sup>95</sup> Zr (pCi/kg)	K (g/kg)	K (g/kg) <sup>3</sup> H (pCi/l) <sup>3</sup> H (pCi/kg) (% Moisture)	K (g/kg)
10	4.8 <MDA 120 <MDA	2.0	3.1 390±250 NA NA	3.1
11	SNC	GSN	SNC	SNC
12	SNC	SNC	SNC	GSN
13	4.4 <MDA 90 <MDA	1.8	3.4 <240 NA NA	SNC
14	4.0 <MDA 130 <MDA	2.3	2.6 520±240 NA NA	2.2
15	GSN	SNC	SNC	SNC
16	6.2 <MDA 410 <MDA	3.1	3.1 NA 64±55 23	2.3
17	1.7 <MDA <MDA <MDA	1.8	1.7 730±250 NA NA	SNC
18	4.7 <MDA 260 <MDA	1.8	3.4 370±240 NA NA	2.6

See footnotes are page F-4-3.

TABLE F-4. CONTINUED

Animal No.	Rumen Contents K (g/kg) <sup>103</sup> Ru (pCi/kg) <sup>137</sup> Cs (pCi/kg) <sup>95</sup> Zr (pCi/kg)	Lungs K (g/kg)	Kidney K (g/kg) <sup>3</sup> H (pCi/l) <sup>3</sup> H (pCi/kg) (% Moisture)	Liver K (g/kg)
19	1.2 <MDA 220 <MDA	2.4	GSN NA 130±72 30	SNC
20	1.5 <MDA 160 <MDA	2.0	GSN NA 100±57 24	SNC
MEDIAN	2.7 <MDA 90 <MDA	2.5	3.3 390 105 24	2.55
RANGE	1.2-6.2 <MDA-300 <MDA-410 <MDA-160	1.7-5.1	1.7-4.9 240-730 64-130 23-30	2.2-3.1

\* All values reported on wet weight basis.  
 <MDA = Less than minimum detectable activity.  
 SNC = Sample not collected.  
 GSN = Gamma spectrum negligible.  
 NA = Not analyzed.

APPENDIX G. BOTANICAL ANALYSES OF DESERT BIGHORN SHEEP RUMEN CONTENTS, 1973

Animal No.	Scientific Name	Common Name	Composition Percent
1	<i>Stipa speciosa</i>	Desert needlegrass	13
	<i>Oryzopsis hymenoides</i>	Indian rice grass	33
	<i>Sitanion hystrix</i>	Squirrel tail grass	17
	Unidentified grass		6
	<i>Euphorbia</i> spp.	Spurge	11
	Unidentified forbs		7
	Unidentified shrubs		13
2	<i>Stipa speciosa</i>	Desert needlegrass	36
	<i>Oryzopsis hymenoides</i>	Indian rice grass	12
	Unidentified grasses		19
	<i>Euphorbia</i> spp.	Spurge	14
	Unidentified forbs		6
	<i>Eriogonum</i> spp.	Buckwheat	3
	<i>Argemone</i> spp.	Poppy	1
	<i>Cowania mexicana</i>	Cliff rose	4
	<i>Ephedra viridis</i>	Mountain joint fir	2
Unidentified shrubs		3	
3	<i>Stipa speciosa</i>	Desert needlegrass	19
	Unidentified grasses		9
	<i>Hilaria jamesii</i>	Galleta grass	6
	Unidentified shrubs		4
	<i>Eriogonum</i> spp.	Buckwheat	1
	<i>Yucca schidigera</i>	Mohave yucca	38
	<i>Cowania mexicana</i>	Cliff rose	6
	<i>Ephedra viridis</i>	Mountain joint fir	11
	Unidentified shrubs		2
<i>Cercocarpus intricatus</i>	Little-leaved mahogany	4	
4	<i>Stipa speciosa</i>	Desert needlegrass	13
	Unidentified grasses		72
	<i>Sitanion hystrix</i>	Squirrel tail grass	9
	<i>Elymus cinereus</i>	Giant wild rye grass	6
	Unidentified forbs		Trace
5	<i>Stipa speciosa</i>	Desert needlegrass	13
	<i>Oryzopsis hymenoides</i>	Indian rice grass	27
	<i>Sitanion hystrix</i>	Squirrel tail grass	28
	<i>Elymus cinereus</i>	Giant wild rye grass	6
	<i>Euphorbia</i> spp.	Spurge	16
	<i>Eriogonum</i> spp.	Buckwheat	2
	<i>Chaenactis</i> spp.	Pincushion	1

APPENDIX G. CONTINUED

Animal No.	Scientific Name	Common Name	Composition Percent
5	<i>Astragalus</i> spp.	Loco weed	2
	Unidentified shrubs		4
	<i>Arctostaphylos</i> spp.	Manzanita	1
6	<i>Stipa speciosa</i>	Desert needlegrass	18
	<i>Oryzopsis hymenoides</i>	Indian rice grass	21
	<i>Sitanion hystrix</i>	Squirrel tail grass	27
	<i>Hilaria jamesii</i>	Galleta grass	10
	<i>Elymus cinereus</i>	Giant wild rye grass	4
	<i>Sporobolus</i> spp.	Dropseed grass	6
	Unidentified forbs		1
	<i>Erodium cicutarium</i>	Heron's bill	2
	<i>Yucca schidigera</i>	Mohave yucca	1
	Unidentified shrubs		3
	<i>Ephedra nevadensis</i>	Nevada joint fir	6
	<i>Coleogyne ramosissima</i>	Black brush	1
	<i>Pinus</i> spp.	Pine	Trace
7	<i>Stipa speciosa</i>	Desert needlegrass	10
	Unidentified grasses		26
	<i>Hilaria jamesii</i>	Galleta grass	4
	<i>Sporobolus</i> spp.	Dropseed grass	14
	<i>Cowania mexicana</i>	Cliff rose	6
	<i>Ephedra viridis</i>	Mountain joint fir	17
	<i>Artemisia tridentata</i>	Big sagebrush	2
	<i>Juniperus monosperma</i>	Juniper	1
	<i>Cercocarpus intricatus</i>	Little-leaved mahogany	9
	<i>Yucca brevifolia</i>	Joshua tree	8
	<i>Coleogyne ramosissima</i>	Black brush	3
8	<i>Oryzopsis hymenoides</i>	Indian rice grass	36
	<i>Sitanion hystrix</i>	Squirrel tail grass	26
	<i>Hilaria jamesii</i>	Galleta grass	19
	<i>Euphorbia</i> spp.	Spurge	3
	<i>Eriogonum</i> spp.	Buckwheat	3
	<i>Yucca schidigera</i>	Mohave yucca	4
	<i>Cowania mexicana</i>	Cliff rose	1
	<i>Ephedra viridis</i>	Mountain joint fir	2
	<i>Yucca brevifolia</i>	Joshua tree	6
	<i>Coleogyne ramosissima</i>	Black brush	Trace

APPENDIX G. CONTINUED

Animal No.	Scientific Name	Common Name	Composition Percent
9	<i>Stipa speciosa</i>	Desert needlegrass	18
	<i>Oryzopsis hymenoides</i>	Indian rice grass	39
	Unidentified grasses		29
	Unidentified forbs		4
	<i>Erodium cicutarium</i>	Heron's bill	2
	<i>Argemone</i> spp.	Poppy	5
	Unidentified shrubs		3
10	<i>Stipa speciosa</i>	Desert needlegrass	24
	<i>Sitanion hystrix</i>	Squirrel tail grass	16
	<i>Hilaria jamesii</i>	Galleta grass	17
	<i>Bromus tectorum</i>	Cheat grass	2
	<i>Cowania mexicana</i>	Cliff rose	1
	<i>Ephedra viridis</i>	Mountain joint fir	2
	Unidentified shrubs		8
	<i>Artemisia tridentata</i>	Big sagebrush	2
<i>Atriplex canescens</i>	Four-winged saltbush	28	
12	<i>Stipa speciosa</i>	Desert needlegrass	34
	<i>Oryzopsis hymenoides</i>	Indian rice grass	13
	<i>Euphorbia</i> spp.	Spurge	3
	<i>Erodium cicutarium</i>	Heron's bill	3
	<i>Sphaeralcea</i> spp.	Mallow	2
	<i>Yucca schidigera</i>	Mohave yucca	4
	<i>Cowania mexicana</i>	Cliff rose	19
	<i>Ephedra viridis</i>	Mountain joint fir	12
	<i>Artemisia tridentata</i>	Big sagebrush	4
	<i>Atriplex canescens</i>	Four winged saltbush	6
14	<i>Stipa speciosa</i>	Desert needlegrass	19
	<i>Oryzopsis hymenoides</i>	Indian rice grass	6
	<i>Sitanion hystrix</i>	Squirrel tail grass	14
	<i>Hilaria jamesii</i>	Galleta grass	21
	<i>Elymus cinereus</i>	Giant wild rye grass	4
	<i>Euphorbia</i> spp.	Spurge	2
	<i>Astragalus</i> spp.	Loco weed	Trace
	<i>Yucca schidigera</i>	Mohave yucca	32
	<i>Artemisia tridentata</i>	Big sagebrush	2
	15	<i>Stipa speciosa</i>	Desert needlegrass
<i>Oryzopsis hymenoides</i>		Indian rice grass	14
Unidentified grasses			3
Unidentified forbs			2
<i>Yucca schidigera</i>		Mohave yucca	5

APPENDIX G. CONTINUED

Animal No.	Scientific Name	Common Name	Composition Percent
15	<i>Cowania mexicana</i>	Cliff rose	32
	<i>Ephedra viridis</i>	Mountain joint fir	8
	<i>Artemisia tridentata</i>	Big sagebrush	14
	<i>Quercus gambelii</i>	Gambel's oak	3
16	<i>Stipa speciosa</i>	Desert needlegrass	6
	<i>Oryzopsis hymenoides</i>	Indian rice grass	20
	Unidentified grasses		18
	Unidentified forbes		2
	<i>Eriogonum</i> spp.	Buckwheat	Trace
	<i>Yucca schidigera</i>	Mohave yucca	36
	<i>Cowania mexicana</i>	Cliff rose	7
	<i>Cercocarpus intricatus</i>	Little-leaved mahogany	4
<i>Atriplex canescens</i>	Four-winged saltbush	2	
17	<i>Stipa speciosa</i>	Desert needlegrass	42
	<i>Oryzopsis hymenoides</i>	Indian rice grass	18
	<i>Sitanion hystrix</i>	Squirrel tail grass	25
	<i>Euphorbia</i> spp.	Spurge	12
	<i>Eriogonum</i> spp.	Buckwheat	Trace
	<i>Chaenactis</i> spp.	Pincushion	2
	<i>Ephedra viridis</i>	Mountain joint fir	Trace
	<i>Coleogyne ramosissima</i>	Black brush	1
18	<i>Stipa speciosa</i>	Desert needlegrass	6
	<i>Oryzopsis hymenoides</i>	Indian rice grass	9
	<i>Sitanion hystrix</i>	Squirrel tail grass	17
	Unidentified forbs		2
	<i>Yucca schidigera</i>	Mohave yucca	36
	<i>Cowania mexicana</i>	Cliff rose	7
	Unidentified shrubs		3
<i>Artemisia tridenta</i>	Big sagebrush	20	
19	<i>Stipa speciosa</i>	Desert needlegrass	13
	<i>Oryzopsis hymenoides</i>	Indian rice grass	15
	<i>Hilaria jamesii</i>	Galleta grass	6
	Unidentified forbs		8
	<i>Yucca schidigera</i>	Mohave yucca	28
	<i>Ephedra viridis</i>	Mountain joint fir	14
	Unidentified shrubs		4
	<i>Cercocarpus intricatus</i>	Little-leaved mahogany	9
<i>Coleogyne ramosissima</i>	Black brush	3	

APPENDIX G. CONTINUED

Animal No.	Scientific Name	Common Name	Composition Percent
20	<i>Stipa speciosa</i>	Desert needlegrass	21
	<i>Oryzopsis hymenoides</i>	Indian rice grass	6
	Unidentified grasses		3
	<i>Sitanion hystrix</i>	Squirrel tail grass	15
	<i>Hilaria jamesii</i>	Galleta grass	6
	<i>Euphorbia</i> spp.	Spurge	4
	<i>Sphaeralcea</i> spp.	Mallow	4
	<i>Linum lewisii</i>	Blue flax	3
	<i>Juniperus monosperma</i>	Juniper	26
	<i>Encelia</i> spp.	Encelia	12

APPENDIX H. GROSS\* AND MICROSCOPIC PATHOLOGY† FOUND IN NECROPSIED ANIMALS

Cattle

- 1     Necropsy findings     - No gross lesions noted. Uterus contained 8½ month fetus.
- Histopathologic findings - No significant lesions noted; however, many of the tissues showed postmortem autolysis resulting from incomplete preservation during the fixation process.
- Clinical diagnosis     - Normal.
- 2     Necropsy findings     - No gross lesions noted.
- Histopathologic findings - No significant lesions noted; however, many of the tissues showed postmortem autolysis resulting from incomplete preservation during the fixation process.
- Clinical diagnosis     - Normal
- 3     Necropsy findings     - Minor fibrinous adhesions between rib cage and dorsal surface of right apical lobe of the lung. Uterus contained 7½ month female fetus.
- Histopathologic findings - No significant lesions noted.
- Clinical diagnosis     - Normal.
- 4     Necropsy findings     - No gross lesions noted. Uterus contained 8½ month male fetus.
- Histopathologic findings - No significant lesions noted. Focal hemorrhages in lungs.
- Clinical diagnosis     - Normal.
- 5     Necropsy findings     - No gross lesions noted.
- Histopathologic findings - No significant lesions noted.

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See footnotes on page H-7.

APPENDIX H. CONTINUED

Cattle

- 5 Clinical diagnosis - Normal.
- 6 Necropsy findings - No gross lesions noted.
- Histopathologic findings - No significant lesions noted; however, many of the tissues showed postmortem autolysis resulting from incomplete preservation during the fixation process.
- Clinical diagnosis - Normal.
- 7 Necropsy findings - No gross lesions noted.
- Histopathologic findings - No significant lesions noted.
- Hematology findings - RBC/cmm -  $12.6 \times 10^6$ , WBC/cmm -  $8.3 \times 10^3$ , MCV/cu. $\mu$  - 38, Hb g % - 15, and hematocrit % - 48.
- Clinical diagnosis - Normal.
- 8 Necropsy findings - No gross lesions noted. Reticulum sediment contains numerous copper wire filaments--penetration had not occurred.
- Histopathologic findings - Sarcocysts in cardiac muscle.
- Hematology findings - RBC/cmm -  $9.48 \times 10^6$ , WBC/cmm -  $2 \times 10^3$ , MCV/cu. $\mu$  - 39, Hb g% - 11.6, and Hematocrit % - 37.
- Clinical diagnosis - Normal.
- 9 Necropsy findings - Apparent squamous cell carcinoma. Lateral canthus of right eye. Lobes of left lung show consolidation, probably postmortem gravitation.
- Histopathologic findings - Sarcocysts in cardiac muscle hemorrhage and emphysema in lungs.

See footnotes on page H-7.



APPENDIX H. CONTINUED

Corralled  
Cattle

- 16      Necropsy findings      - Very emaciated and in poor condition. Liver contained serous cysts of approximately 0.5 cm in diameter. Lung contained a circumscribed abscess approximately 2 cm in diameter. Uterus contained a 4 month fetus. A wire, 8 cm long, was found in reticulum.
- Histopathologic findings      - Thickened glomerular membranes in kidney. Mild emphysema in lung tissue, homogenous eosinophilic infiltration of the adrenal cortex (amyloidosis). Sarcocysts in cardiac muscle. Eosinophilic infiltrate in sinusoids of liver. Comment, "This cow had generalized amyloidosis possibly secondary to traumatic reticulitis."
- Hematology findings              - Sample not collected.
- Clinical diagnosis                 - Chronic traumatic reticulitis.
- 779      Necropsy findings                 - In early May, a rumenotomy was performed on this animal and a rumen cannula installed. It never fully recovered from surgery and died May 24. Was not necropsied by experienced personnel; however, evidence of peritonitis was found. Samples were not collected for histopathology or hematology analysis.
- Clinical diagnosis                 - Post-surgical peritonitis.
- 902      Necropsy findings                 - This animal had a rumen fistula for 8 years of its 9-year life. Found dead May 6, was greatly distended with gas. When animal was moved the intrarumen pressure blew out the cannula and rumen contents spurted 20 feet into the air. The rumen

See footnotes on page H-7.

APPENDIX H. CONTINUED

Corralled  
Cattle

902     Necropsy findings contd   - contained frothy, fresh green alfalfa. Most internal organs showed advanced postmortem decomposition. The lungs were compressed cranially and showed congestion on the ventral portion. Another animal in the same pen evidenced clinical tympanites (bloat). Because of the advanced decomposition, samples were not taken for histopathology or hematology examination.

Clinical diagnosis                   - Tympanites.

46       Necropsy findings           - An aged Holstein cow in poor condition that would not conceive. Euthanized on June 13. The abomasum was found in the ventral left apex of the abdominal cavity pressing against the ribs and diaphragm. The omasum lies to the right of the abomasum. Right horn of uterus contains 21 day fetus. Uterine walls are thickened and inflamed.

Histopathologic findings       - Uterus shows mild endometritis cardiac muscle contains sarcocysts. Kidney shows mild glomerulitis is cortical necrosis of adrenal. Large cystic follicle in ovary.

Hematology findings               - Sample not collected.

Clinical diagnosis                 - Displaced abomasum and chronic metritis.

See footnotes on page H-7.

APPENDIX H. CONTINUED

Mule  
Deer

- |   |                                 |   |
|---|---------------------------------|---|
| 1 | <u>Necropsy findings</u>        | - Ticks in both ears. In poor condition. No gross lesions noted.  |
|   | <u>Histopathologic findings</u> | - No significant lesions noted; however, many of the tissues showed postmortem autolysis and fixation artifacts resulting from incomplete preservation during the fixation process.   |
|   | <u>Hematology findings</u>      | - Sample not collected.   |
|   | <u>Clinical diagnosis</u>       | - Normal.   |
| 2 | <u>Necropsy findings</u>        | - Deer died as a result of collision with motor vehicle. Suffered extensive trauma including rupture of rumen with spillage of contents into peritoneal cavity. Rupture of liver and spleen with massive hematoma. Lungs were penetrated by rib splinters. Heart was ruptured, right hip and pubis shattered, mandible fractured. |
|   | <u>Histopathologic findings</u> | - Not sampled, as advance postmortem changes present.   |
|   | <u>Hematology findings</u>      | - Sample not collected.   |
|   | <u>Clinical diagnosis</u>       | - Extensive trauma.   |
| 3 | <u>Necropsy findings</u>        | - Hunter kill. No gross lesions noted, except trauma of bullet passage through thoracic cavity.   |
|   | <u>Histopathologic findings</u> | - No significant lesions.   |
|   | <u>Hematology findings</u>      | - Sample not collected.   |
|   | <u>Clinical diagnosis</u>       | - Normal.   |

See footnotes on page H-7.

APPENDIX H. CONTINUED

Mule  
Deer

- 4      Necropsy findings      - Animal found dead with antlers entangled in a rope fence. Advanced postmortem changes with putrefaction, hair slippage, and discoloration. Left thorax badly bruised with fractured ribs.
- Histopathologic findings      - Not sampled, as advanced post-mortem changes.
- Hematology findings      - Sample not collected.
- Clinical diagnosis      - Death from shock and lack of water because of entanglement in rope.

Desert Bighorn Sheep      All sheep sampled were collected by participants in annual hunt. No necropsies were performed, but all animals appeared to be healthy. All were adult males.

Rabbit

- 1      Necropsy findings      - No gross lesions noted. Samples not collected for histopathology or hematology examination.
- Clinical diagnosis      - Normal.

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\*As reported by senior author.

†As reported by Dr. Billy C. Ward, Department of Pathology, Washington State University, Pullman, Washington.

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- 108 Richard S. Davidson, Battelle Memorial Institute, Columbus, OH
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