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ANIMAL INVESTIGATION PROGRAM 1972 ANNUAL REPORT

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

Published May 1976

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of Understanding No. AT(26-1)-539
for the
U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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by
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Monitoring Systems Research and Development Division
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ABSTRACT

This report presents the data obtained from the radioanalyses of tissues collected from cattle, deer, desert bighorn sheep, and other wildlife that reside on or near the Nevada Test Site. Also discussed are special actinide studies with cattle from the Tonopah Test Range and Searchlight, Nevada, special sampling of an Arizona buffalo herd, and bioenvironmental sampling of the Gnome site in New Mexico and the Tatum Dome Test Site in Mississippi.

The thyroids of cattle sampled during May and deer sampled in March and May contained detectable levels of ^{131}I. The possible source of this radionuclide was an atmospheric nuclear detonation in the People's Republic of China during March.

Cesium-137 and ^{95}Zr were the only gamma-emitting radionuclides that were regularly detected in the soft tissues. Cesium-137 was found in ten beef muscle and two beef liver samples. The median values were 30 and 28 pCi/kg, respectively. One Nevada Test Site deer muscle sample had a level of 24 pCi/kg while muscle samples from Mississippi deer contained 2300 and 3100 pCi/kg.

Elevated tritium levels were found in three cattle, one deer, and a coyote. Postulated sources of these levels are discussed. The ^{90}Sr levels in bones of ruminants continued the downward trend of recent years. Cattle bones average 3.9 pCi/g ash, deer 3.1 pCi/g ash, and desert bighorn sheep 4.9 pCi/g ash.

The analysis of tissues for actinides was emphasized during 1972. Levels of ^{239}Pu detected in muscle of beef cows ranged from 0.5% to 4% of the levels found in the ingesta. These levels in the bones tended to increase with age of the animal.

Hypothetical dose estimates resulting from the daily consumption of liver or muscle containing peak activity levels were calculated using the

minimum guide of 0.5 rem per year for the whole body. These estimates expressed as a percent of 0.5 rem were: ^{3}H, 0.12%; ^{137}Cs, 0.11%; ^{203}Hg, 1.8%; U natural, 0.04%; ^{238}Pu, 0.007%; and ^{239}Pu, 0.15%.

Gross and microscopic lesions found in sampled animals are discussed. The most significant lesions reported were anthracotic-like pigments in a coyote's lung and a bile duct carcinoma in a horse.

Food habits of desert bighorn sheep were determined through the botanical analysis of rumen contents. The average composition of the ingesta was 65% grasses, 34% shrubs, and 1% forbs.

Other activities of the Animal Investigation Program are described. These include special studies, investigation surveys, and public information activities.

ACKNOWLEDGMENT

The authors wish to thank Mr. Kenneth W. Brown, Botanist, Pollutant Pathways Branch, Monitoring Systems Research and Development Laboratory, National Environmental Research Center, Las Vegas, U.S. Environmental Protection Agency, who performed the desert bighorn sheep food habit analyses that are presented in this report.

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INTRODUCTION

Since 1964, the Animal Investigation Program (AIP) has been the operation responsibility of the U.S. Environmental Protection Agency's (EPA), National Environmental Research Center, Las Vegas (NERC-LV).* The basic objectives of the AIP during 1972 were:

1. the determination of tissue concentrations of fresh and/or aged fission and activation products in biological samples obtained from cattle grazing on the Nevada Test Site (NTS) and from those grazing off-site areas, when indicated,
2. the development and conduction of wildlife studies on and near the NTS in cooperation with state and federal wildlife agencies in order to assess the radionuclide burden in tissues collected from various edible wildlife species,
3. the gross and microscopic examination of tissues collected from these domestic and wild animals for the detection of pathological changes, possibly due to the tissue concentrations of the radionuclides,
4. the maintenance of veterinary relations with the off-site population, and
5. the investigation of alleged damage to domestic animals resulting from the activities of the Nevada Operations Office (NV) of the U.S. Atomic Energy Commission (AEC).*

The progress in achieving these objectives and summaries of the data collected during 1972 are presented in this report. The history, evolution, and accomplishments of the AIP from its inception in 1957 through 1971 were reported previously.[1,2,3,4]

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*Effective January 19, 1975, the U.S. Atomic Energy Commission was designated the U.S. Energy Research and Development Administration. Effective June 29, 1975, the National Environmental Research Center, Las Vegas (NERC-LV) was designated the Environmental Monitoring and Support Laboratory, Las Vegas.

SAMPLE COLLECTION

Nevada Test Site animals sampled during 1972 included beef cattle, dairy cattle, a domestic horse, mule deer, coyote, a bobcat, and a goldfish. Samples were collected from desert bighorn sheep that inhabited the mountains adjacent to the NTS and from buffalo that lived on a refuge near Flagstaff, Arizona. In addition to these routine sampling activities, special studies required the sampling of beef animals from the Roller Coaster sites of the Tonopah Test Range and from Searchlight, Nevada; the collection of vegetation and wildlife samples from the Gnome site near Carlsbad, New Mexico; and the sampling of domestic animals, wildlife, and vegetation from and adjacent to the Tatum Salt Dome in Lamar County, Mississippi. (See "Special Studies and Investigations" page 30.)

After death each animal was necropsied and gross pathological conditions noted. If advanced post mortem changes had not occurred, the adrenals, eyes, heart, kidneys, liver, lungs, muscle, spleen, thyroid, gonads, and lesions 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. Rumen contents from desert bighorn sheep were collected for botanical analysis.

Twelve animals from the NTS beef herd were sampled during the year. Eleven of these were sacrificed and one died of natural causes. Also sampled were two dairy cows from the Area 15 farm, one of which died from natural causes. The vital statistics of all NTS cattle sampled during 1972 are presented in Table 1. Unless otherwise noted, each animal spent its entire life grazing on the Area 18 range of the NTS or was maintained in the Area 15 dairy 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.[5,6,7] Also published are reports on the management of the dairy herd.[8,9,10]

Table 1. Vital Statistics of Nevada Test Site Cattle Sampled During 1972

Animal No.	Sex	Estimated Age (yrs)	Breed	Estimated Wt. (kg)	Date Sampled	Remarks
1	M	1	Hereford	245	5/10/72	Spent entire life in Area 18, NTS.
2	F	8	"	446	5/10/72	Spent entire life in Area 18, NTS.
3	M	4	"	509	5/10/72	Spent entire life in Area 18, NTS, except for 3 months at Area 15 when on a tritium study.
4	M	1	"	261	5/10/72	Spent entire life in Area 18, NTS.
5	M	1	"	250	5/10/72	Spent entire life in Area 18, NTS.
6	F	14	Holstein	670	5/10/72	Since 1964 in Area 15 corrals. Numerous radioiodine experiments included Palanquin. Uterus contained a 3-month fetus. Died from tympanites.
7	F	11.5	"	630	5/10/72	Since 1964, in Area 15 corrals. Cystic ovaries, not responsive to treatment.
8	M	0.5	Hereford	160	10/26/72	Spent entire life in Area 18, NTS. Sacrificed in Area 18 as an extremely wild animal.
9	M	1.5	"	295	10/27/72	Spent entire life in Area 18, NTS.
10	M	1.5	"	364	10/27/72	Spent entire life in Area 18, NTS.

Table 1. Vital Statistics of Nevada Test Site Cattle Sampled During 1972 (cont'd)

Animal No.	Sex	Estimated Age (yrs)	Breed	Estimated Wt. (kg)	Date Sampled	Remarks
11	F	7	Hereford	441	10/27/72	Spent entire life in Area 18, NTS. Pre-cancerous lesion left eye. Uterus contained a 30-day fetus.
12	F	4.5	"	493	10/27/72	Spent entire life in Area 18, NTS. Uterus contained a 75-day fetus.
13	F	6.5	"	314	10/27/72	Spent entire life in Area 18, NTS. Uterus contained a 45-day fetus.
14	F	0.5	"	153	11/10/72	Spent entire life in Area 18, NTS, until transferred to Area 15 on October 26 for weaning. Died of tympaites. Not necropsied, selected samples collected by farm workers.

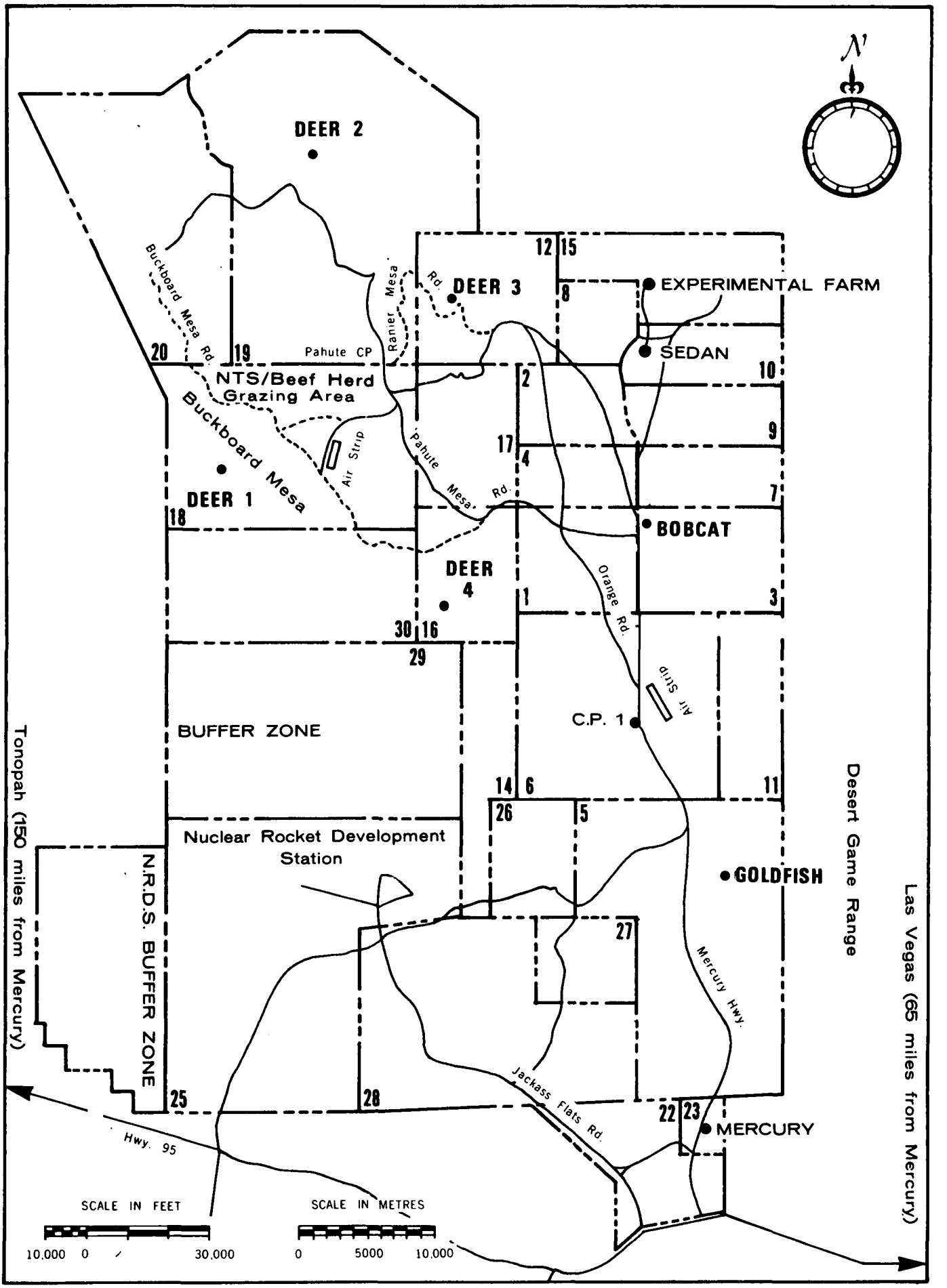

Figure 1. Location of Sampling Sites and Facilities on the Nevada Test Site.

Tissue samples were collected from four NTS mule deer during 1972. (See Table 2 for vital statistics.) Three of the deer were collected by hunting and one was collected after being struck by a motor vehicle. Collection locations are noted on Figure 1.

Other NTS animals sampled included a saddle horse from the Area 15 experimental farm that died of natural causes, a coyote shot at the farm, a bobcat that died of natural causes in Area 3, and goldfish that lived in the UE-5-C well reservoir. See Figure 1 for these locations.

Through the cooperation of state and federal wildlife officials, bone and/or tissue samples were collected from desert bighorn sheep (*Ovis canadensis nelsoni*). Most of the animals sampled were collected during the hunt held each winter in the mountains of the Desert National Wildlife Range (DNWR) which lies immediately southeast of the NTS. Sixteen mature animals were collected during the 1972 hunt. One animal that died from natural causes was also sampled. The vital statistics of these animals are presented in Table 3 and the collection sites are shown in Figure 2.

Also sampled were seven buffalo (*Bison bison*) from the Raymond Ranch Refuge near Flagstaff, Arizona. These samples were collected through the cooperation of hunters participating in the annual controlled harvest of the herd that is supervised by the Arizona Fish and Game Department.

Table 2. Vital Statistics of Nevada Test Site Mule Deer Sampled During 1972

Animal No.	Sex	Estimated Age (yrs)	Estimated Wt. (kg)	Date Sampled	Remarks
1	F	2.5	55	3/16/72	Collected in Area 18 5 miles north and west of Gate 30-1 in Cat Canyon. Was pregnant--2 feti.
2	F	3	62	5/14/72	Motor vehicular accident victim in U19e compound of Area 19. Was pregnant--fetus not sampled as grossly contaminated with soil.
3	M	1	40	8/23/72	Collected Ranier Mesa in Area 12.
4	M	1.5	60	12/12/72	Collected south side of Shoshone Mountain in Area 16.

Table 3. Vital Statistics of Desert Bighorn Sheep Sampled During 1972

Animal No.	Sex	Age (yrs)	Est. wt. (kg)	Date Collected	Samples Collected	Remarks
1	M	7	Unk	11/18/72	Kidney Lung	Hunter kill - Muddy Mountains, Clark County, Nevada
2	M	7	36	11/19/72	Bone Kidney Rumen content	Hunter kill - Bridge Canyon, Desert National Wildlife Range (DNWR)
3	M	Unk	Unk	11/20/72	Rumen content	Hunter kill - DNWR
4	M	7	76	11/20/72	Bone Kidney Rumen content	Hunter kill east of Mormon Peak, Mormon Mountain, Clark County, Nevada
5	M	7	86	11/21/72	Kidney Rumen content	Hunter kill - DNWR, Unit 27B2
6	M	Unk	Unk	11/23/72	Rumen content	Hunter kill - Meadow Valley Range
7	M	5	Unk	11/25/72	Kidney Rumen content	Hunter kill 2 miles N NE of McCullough Pass, Unit 27C1
8	M	7	Unk	11/26/72	Bone Kidney Rumen content	Hunter kill 2 miles south of Elbow Canyon, Unit 27B3
9	M	6	Unk	11/26/72	Bone Kidney Rumen content	Hunter kill - Muddy Mountains, Clark County, Nevada

Table 3. Vital Statistics of Desert Bighorn Sheep Sampled During 1972 (Cont'd)

Animal No.	Sex	Age (yrs)	Est. wt. (kg)	Date Collected	Samples Collected	Remarks
10	M	8	Unk	11/26/72	Bone Kidney Rumen content	Hunter kill - Lone Mountain, Eldorado Range, Clark County, Nevada
11	M	11	68	11/27/72	Bone Kidney Rumen content	Hunter kill - Meadow Valley Ridge
12	M	5-6	50 dressed	11/29/72	Bone Rumen content	Hunter kill - Mule Deer Ridge, Unit 27B1
13	M	4	76	12/05/72	Bone Kidney Rumen content	Hunter kill - Dead Horse Trail, DNWR, Unit 27B1
14	M	10	Unk	12/12/72	Rumen content	Hunter kill - Muddy Mountains, Clark County, Nevada
15	M	7	84	12/17/72	Bone Kidney Rumen content	Hunter kill - low hill east of Wamp Spring, DNWR, Unit 27B3.
16	M	7	76	12/18/72	Bone Kidney Rument content	Hunter kill - Indian Canyon Reservoir, Unit 27A1
17	M	7	42	12/31/72	Bone	Died from natural causes in pens at Corn Creek Field Station of the DNWR

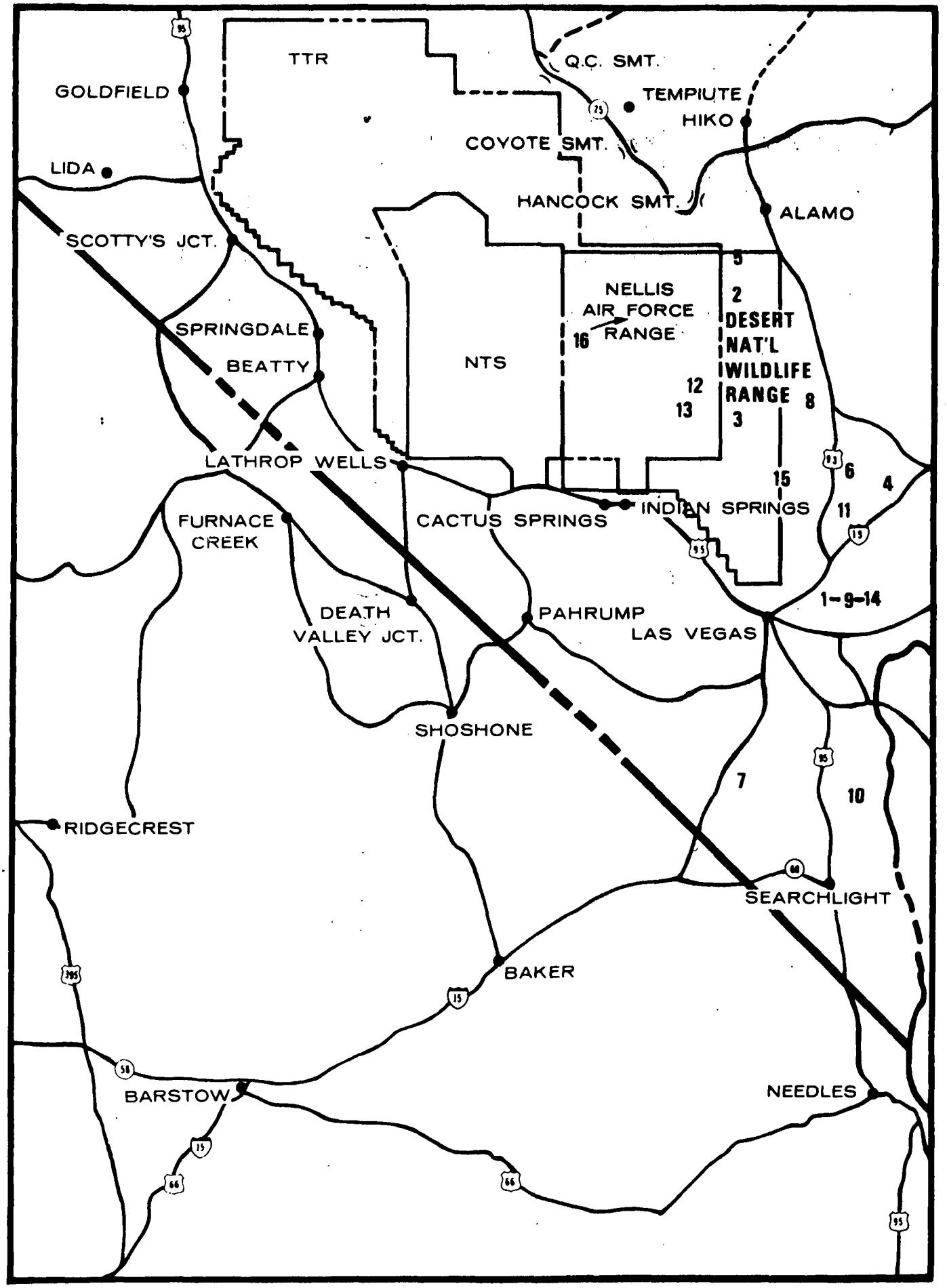

Figure 2. Locations of Collection Sites of Desert Bighorn Sheep.

ANALYTICAL PROCEDURES AND METHODS

Samples of soft tissue and rumen contents were quantitatively analyzed by gamma spectroscopy. Urine, blood and/or tissue were analyzed for tritium. Bone was analyzed for ^{89}Sr, ^{90}Sr, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu and ^{239}Pu. 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 1000-ml 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-ml 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 keV/channel.

Tissues for strontium, plutonium, and uranium analysis were prepared by dry ashing. Plutonium and uranium were analyzed by alpha spectroscopy.[11,12] Other radionuclide analytical procedures used at the National Environmental Research Center-Las Vegas (NERC-LV) were described previously.[13]

All data are reported at the 95% confidence level and are corrected to time of collection. The minimum detectable activities (MDA) for each radionuclide are listed in Appendix I and are expressed in the data tables of this report as less than a certain level of activity present in the total sample.

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

Rumen contents, 200- to 300-g samples, were collected from each desert bighorn sheep for botanical analysis. These samples were frozen until analyzed. Samples were prepared for botanical analysis by washing and screening a random aliquot, which was then examined under a binocular microscope. Individual species of browse, forbs, and grasses were identified; a visual estimate was made of the fraction of each species in the sample.[14]

RESULTS AND DISCUSSION

NTS Cattle

The analytical results from tissues collected from NTS cattle during May of 1972 are presented in the tables of Appendix II. These data were also published in another report.[15] The data from tissues collected during October are presented in the tables of Appendix III.

As in the past, the rumen contents of the grazing animals contained the greatest variety of gamma-emitting radionuclides, with ^{95}Zr, ^{103}Ru, ^{137}Cs, ^{140}Ba, and ^{141}Ce frequently detected. Of these radionuclides only ^{137}Cs and ^{95}Zr were detected in soft tissues. Cesium-137 was found in ten muscle samples and two liver samples with medians of 30 pCi/kg and 28 pCi/kg, respectively.

Mercury-203 was detected in the liver of a six-month-old Hereford calf that died of tympanites two weeks after being transferred from Area 18 to the Area 15 farm. This radionuclide probably originated as a contaminant from the mercury study conducted in the microplot area of the experimental farm which used ^{203}Hg as a tracer.[16]

With three exceptions, tritium levels found in all the cattle were at background levels. The blood of a Hereford steer, #3, contained 2100 ± 240 pCi/l. This animal had received an intravenous injection of fifty mCi of tritium during March 1971 as part of an experiment designed to determine the biological half-life of tritium in lactating and non-lactating cattle.[17] The blood of the two aged Holstein cows, #6 and #7, from Area 15 contained levels of 4600 and 1000 pCi/l, respectively. These levels are similar to those reported previously from this herd.[4]

The thyroids of all seven NTS cattle sampled during May contained detectable levels of ^{131}I (range of 2 - 21 pCi/g). These levels are attributed to a nuclear detonation conducted on March 8, 1972, by the People's Republic of China.[18]

The ^{90}Sr levels in femurs from the grazing animals averaged 3.9 pCi/g of ash as shown in Figure 3. This level is consistent with the downward trend observed in recent years. The older animals, #2, #13, and #11 (8-, 6.5-, and 7-year-old cows) had the highest levels; 8 pCi/g of ash, 5.3 pCi/g of ash, and 4.5 pCi/g of ash, respectively.

The analysis of the tissues for actinides was emphasized during 1972. These data are summarized in Table 4. The individual data are presented in the tables of Appendices II and III. It is interesting to note that levels of ^{239}Pu detected in the wet muscle tissue of each of these beef animals ranged from 0.5% to 4% of the levels reported for the wet ingesta (rumen contents).

The ^{239}Pu levels in the femurs tended to increase with age. The levels reported for five animals, 4 years of age or older, averaged 4.2 pCi/g of ash and compared to 1.8 pCi/g detected in seven animals 1.5 years or younger.

Mule Deer

The analytical results from tissues of NTS mule deer are presented in Appendix IV. In general, the same gamma-emitting radionuclides of similar magnitudes were detected in the deer tissues as were reported for the NTS beef tissues. The thyroids of deer collected in March and May contained 33 and 34 pCi/g of ^{131}I. The source also is thought to be the atmospheric nuclear detonation conducted by the People's Republic of China on March 8, 1972.[18]

The average ^{90}Sr level in bone from the four NTS deer was 3.2 pCi/g ash which is almost identical to that observed in 1971 (see Figure 3). As is explained in the Special Studies section of this report, two whitetail deer were collected in Mississippi during January and February. It is interesting to note that the levels of ^{90}Sr in the bones from the Mississippi deer were one order of magnitude higher than in the NTS deer, i.e., 31 and 37 pCi/g ash.[19,20] However, the ^{137}Cs levels in muscle and liver tissue of the NTS deer were considerably lower than those reported from tissues of the Mississippi deer.[19,20] Only one NTS deer muscle sample contained a detectable level (24 pCi/kg) while the samples

FROM 1964 ON, THE NUMBER OF BONE SAMPLES FROM EACH SPECIES IS LISTED AT THE TOP OF EACH COLUMN.

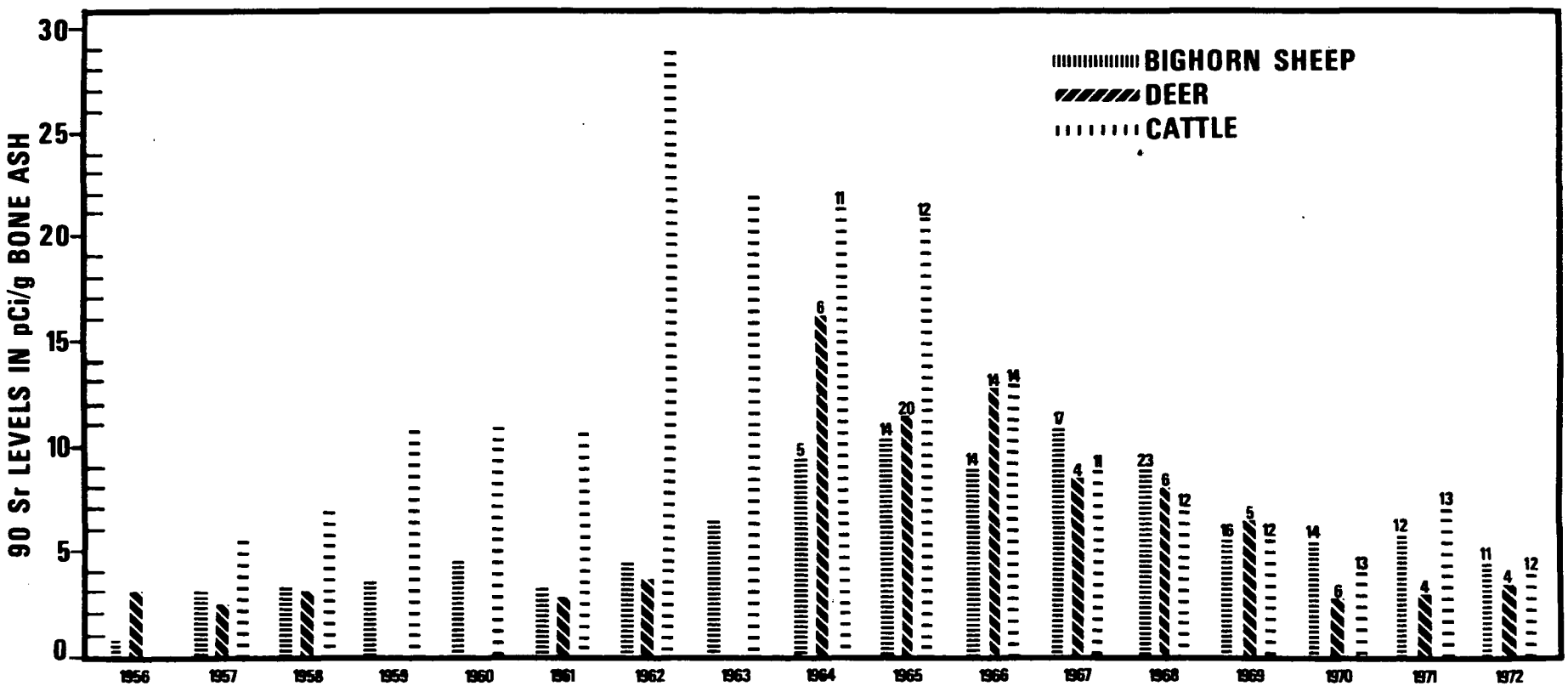

Figure 3. Comparison of ^{90}Sr in Bone of Bighorn Sheep, Deer, and Cattle.

Table 4. Median Values of Actinide Levels in 1972 NTS Beef Tissues - fCi/kg wet weight

	^{238}Pu		^{239}Pu		^{234}U		^{235}U		^{238}U	
Tissue	May	Oct	May	Oct	May	Oct	May	Oct	May	Oct
Lungs	180	<140	1400	540	240	260	19	<10	210	240
Tracheo-Bronchial Lymph Nodes	<720	<800	2700	<400	NA	2400	NA	<200	NA	2100
Muscle	<100	61	71	80	NA	42	NA	16	NA	34
Kidneys	NA	NA	NA	NA	630	150	22	<20	610	140
Liver	<230	<140	390	450	120	88.5	<30	<8	110	64.5
Rumen Contents	640	875	3600	8000	1800	2400	44	130	1700	2300
Reticulum Sediment	NA	17000	NA	68000	NA	220,000	NA	13000	NA	200,000
Femur	<82	<320	340	880	400	490	20	<60	360	470

NA = Not analyzed.

muscle, lungs, kidneys, liver, and femur. With the exception of the naturally occurring ^{40}K, gamma-emitting radionuclides were not detected. All but two tritium levels were below the MDA. The positive values were 480 ± 250 pCi/l of tissue water and 510 ± 240 pCi/l of tissue water, respectively. Strontium-90 levels in the femurs averaged 2.9 pCi/g of ash.

Actinide analyses were performed on lung and femur tissues. The data are presented in the tables of Appendix VI. Plutonium-238 levels in both the lung and bone samples were below detectable limits. Three of five lung samples contained detectable levels of ^{239}Pu, with a range of 280 - 810 fCi/kg of wet tissue. Two of five bone samples had positive values, 670 ± 630 and 450 ± 230 fCi/kg of wet tissue, respectively. These levels are slightly lower than those reported for NTS cattle sampled during October.

Horse

On May 31, a domestic horse, that had been maintained in the corrals of Area 15 since 1964, died of malignant bile duct carcinoma (see Appendix VII). The only gamma-emitting radionuclides found in its tissues were naturally occurring ^{40}K and 20 pCi/kg of ^{137}Cs in the muscle. The tritium content of the blood was 1800 ± 230. Strontium and actinide levels of the various tissues are reported in Table 6. The ^{239}Pu levels in the liver and lungs were about ten times higher than that reported for the grazing cattle.

NTS Predators

Two predators were collected from the NTS during 1972. A coyote was shot on the Area 15 farm during November and a bobcat from Area 3 that died of natural causes during December. The analytical data for the animals tissues are summarized in Table 7.

The ^{239}Pu content of the bones from both animals was from one to two orders of magnitude greater than detected in the bones of grazing animals.

Table 6. Actinide and Strontium Concentrations in Tissues from a Domestic Horse - 1972

Tissue	^{238}Pu fCi/g ash fCi/kg	^{239}Pu fCi/g ash fCi/kg	^{234}U fCi/g ash fCi/kg	^{235}U fCi/g ash fCi/kg	^{238}U fCi/g ash fCi/kg	^{89}Sr pCi/g ash fCi/kg	^{90}Sr pCi/g ash fCi/kg
Bone	<0.48 <100	1.4 ± 0.48 300 ± 100	1.1 ± 0.33 230 ± 70	<0.048 <10	0.81 ± 0.33 170 ± 70	<5.7 <1200	3.3 ± 1.1 700 ± 230
Liver	<6 <100	310 ± 32 5800 ± 600	3.7 ± 2.0 71 ± 38	<1.1 <20	2.8 ± 1.7 54 ± 33	NA	NA
Lung	<7.3 <80	310 ± 27 3400 ± 300	45 ± 8.2 500 ± 90	6.6 ± 0.36 73 ± 4	35 ± 6.4 390 ± 70	NA	NA
Muscle	<3 <20	5 ± 2 40 ± 20	NA	NA	NA	NA	NA

NA = Not analyzed.

from the Mississippi deer contained 2300 and 3100 pCi/kg, respectively. Tissue concentrations similar to those found in the Mississippi deer have been reported for whitetail deer in other areas of southeastern United States.[21]

The median values of actinide levels in NTS mule deer are shown in Table 5. Tissues from the Mississippi deer did not contain detectable levels of ^{238}Pu and ^{239}Pu.

The blood of one of the deer (#3) contained 34 nCi/l of ^{3}H. This deer was collected on Ranier Mesa approximately 1.5 - 3 miles from ponds that collect the drainage waters from E, T, and N tunnels in Area 12. Water samples collected and analyzed in March by the REECo, AEC prime support contractor, contained, respectively, 7500 nCi/l, 4400 nCi/l, and 100 nCi/l of ^{3}H. A water sample collected from the N tunnel pond in November contained 120 nCi/l. Although the terrain between the collection point and these ponds is rough, the ponds must be considered as the probable source of the deer levels.

Desert Bighorn Sheep

Samples from seventeen desert bighorn sheep were collected during 1972. The analytical data are presented in Appendix V. Gamma-emitting radionuclides in the rumen contents, lungs, and kidneys were at near background levels. This was also true of the tritium levels.

One lung sample was collected and analyzed for plutonium content. The data reported were <5.4 fCi/g ash (<150 fCi/kg wet weight) of ^{238}Pu and 18 ± 8.2 fCi/g ash (500 ± 230 fCi/kg wet weight) of ^{239}Pu.

Eleven bone samples were collected. The ^{238}Pu levels were below the MDA in all of these samples. The ^{239}Pu content of eight of the bone samples exceeded the MDA with a range of 1.5 - 17 fCi/g ash (470 - 3800 fCi/kg wet weight) and a median of 4.6 fCi/g ash (965 fCi/kg wet weight). As shown in Figure 3, the ^{90}Sr content of the bones averaged 4.9 pCi/g of ash. This compares with an average of 5.8 pCi/g ash reported during 1971.

Buffalo

During October, tissue samples were collected from seven buffalo from a refuge near Flagstaff, Arizona. Tissues collected include

Table 5. Median Values of Actinide Levels in 1972 NTS Deer Tissues - fCi/kg wet weight

Tissue	^{238}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U
Lungs	<90	210	250	22	215
Muscle	<150	<85	172.5	<12.5	156
Kidney	NA	NA	380	80	380
Liver	<220	165	92	<20	71
Rumen Contents	190	1450	1200	70	1100
Bone	<495	500	350	<30	330

Table 7. Summary of Analytical Data from Tissues Collected from NTS Predators - 1972

Tissue	^{89}Sr pCi/g ash pCi/kg	^{90}Sr pCi/g ash pCi/kg	^{238}Pu pCi/g ash pCi/kg	^{239}Pu pCi/g ash pCi/kg	^{234}U pCi/g ash pCi/kg	^{235}U pCi/g ash pCi/kg	^{238}U pCi/g ash pCi/kg	Gamma Emitters pCi/kg	^{3}H nCi/l
Bone	<5.2	3.1 ± 1.1	<0.001	0.036 ± 0.0044	2.9 ± 0.0012	0.00064 ±0.00048	0.0027 ± 0.0011	NA	NA
Coyote	<1100	650 ± 240	<0.22	7.5 ± 0.920	610 ± 250	0.13 ± 0.1	0.57 ± 0.23		
Bone	<10	2 ± 0.9	0.0036 ± 0.0027	0.130 ± 0.0095	0.0095 ± 0.0027	<0.00048	0.0086 ± 0.0025	NA	NA
Bobcat	<2100	430 ± 190	0.76 ± 0.570	28 ± 2	2 ± 0.560	<0.1	1.800 ± 0.520		
Liver Coyote	NA	NA	NA	NA	NA	NA	NA	^{137}Cs - 530	NA
Liver Bobcat	NA	NA	NA	NA	NA	NA	NA	<MDA	NA
Lung Coyote	NA	NA	0.18 ± 0.26 4.5 ± 0.65	8.8 ± 0.52 220 ± 13	NA	NA	NA	^{137}Cs - 360	NA
Lung Bobcat	NA	NA	NA	NA	NA	NA	NA	^{137}Cs - 470	NA
Muscle Coyote	NA	NA	<0.0063 <0.088	0.023 ± 0.0056 0.32 ± 0.079	0.017 ± 0.0063 0.246 ± 0.088	0.0043 ± 0.0024 0.060 ± 0.034	0.016 ± 0.0059 0.22 ± 0.083	^{137}Cs - 330	NA
Muscle Bobcat	NA	NA	NA	NA	NA	NA	NA	^{137}Cs - 120 ^{95}Zr - 100	4.2 ± 0.3
Urine Coyote	NA	NA	NA	NA	NA	NA	NA	NA	120 ± 9.4
Stomach Contents Coyote	NA	NA	NA	NA	NA	NA	NA	^{137}Cs - 210 ^{103}Ru - 730 ^{95}Zr - 140	NA
Stomach Contents Bobcat	NA	NA	NA	NA	NA	NA	NA	^{137}Cs - 220	NA

The coyote's urine contained 120 nCi/l of ^{3}H. During the summer and fall of 1972, alfalfa was grown in the glass house of the Area 15 farm in hydroponic solution that contained 100 nCi ^{3}H per ml of solution. Perhaps the coyote drank some of this solution or devoured rodents that had eaten the alfalfa while it was being air-dried following harvest.

Goldfish

Goldfish were collected from the reservoir of Well UE-5-C during July. Gamma-emitting radionuclides did not exceed the MDA's. The ^{3}H level in their tissues was near background; i.e., 600 ± 230 pCi/l.

Water

Certain natural springs and well reservoirs that might serve as sources of water for wildlife were sampled during 1972. As shown in Table 8 detectable levels of tritium were found in the waters of two well reservoirs, 720 pCi/l at UE-5-C and 250 pCi/l at the Yucca Lake well reservoir. As mentioned previously, the tritium level in the drainage pond that collects runoff waters from N tunnel in Area 12 exceeded 120 nanocuries per liter. The only gamma-emitting radionuclide detected was 190 pCi/l of ^{106}Ru in water from Oak Spring.

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 post-mortem changes. The gross and microscopic pathologies observed are summarized in Appendix VII. Also included are the results of blood chemistry tests when performed.

The following comments were received from the pathologist that examined the tissue collected from the NTS beef and deer herds.

Table 8. Analytical Data of Waters from the NTS

Water Source	Gamma Results pCi/l	Tritium Results (pCi/l)	Date Collected
Well UE-5-C Reservoir--Area 5	<MDA	720 ± 240	07/24/72
Cane Spring--Area 27	<MDA	<270	08/11/72
Tippipah Spring--Area 16	<MDA	<270	08/11/72
White Rock Spring--Area 12	<MDA	<270	08/11/72
Tubb Spring--Area 15	<MDA	<270	08/11/72
Oak Spring--Area 15	^{106}Ru-190	<270	08/11/72
Capt. Jack Spring--Area 12	<MDA	<200	08/31/72
Green Spring--Area 7	<MDA	<230	08/31/72
Well 8 Reservoir--Area 18	<MDA	<230	08/31/72
Pahute C.P. Reservoir--Area 17	<MDA	<230	08/31/72
Yucca Lake Reservoir--Area 6	<MDA	250 ± 230	08/31/72
U-12-N Drainage Pond--Area 12	<MDA	120,000 ± 1000	11/28/72

"I do not believe any of the lesions found in this group of animals are significantly different from what one would expect to find in a normal population of the same age group." Some general comments follow:

Heart - Sarcocysts were seen frequently. A lymphocytic infiltrate was seen in a few hearts and may be related to sarcocysts.

Ovary - Most of the ovaries appeared normal and active. A few cystic lesions were seen.

Kidney - The mononuclear infiltrates seen frequently in these kidneys are also commonly seen in other animals with the same frequency. The significance of their presence is unknown.

The anthracotic-like pigments reported in the coyotes lung were also noted in the lungs of a coyote collected during 1971.[4] The reason for this condition is unexplained but deserves further investigation.

The adenocarcinoma of the liver and kidney of a domestic horse was the first adenocarcinoma reported from animals residing on the NTS. Indeed, the incidence of bile duct carcinoma in horses has been described as rare.[22]

Food Habits of Desert Bighorn Sheep

During the 1972 hunt, rumen samples from fourteen desert bighorn sheep were obtained and the botanical composition determined. The species composition of each animal's ingesta is listed in Appendix VIII and the food habits are summarized in Table 9. The average composition of the ingesta was 65% grasses, 34% shrubs, and 1% forbs.

Most of the grass species were unidentified as during the winter months the foliage was desiccated and few fruiting structures remain. The favored shrubs appeared to be *Ephedra nevadensis* (Nevada joint-fir) and *Artemisia tridentata* (big sagebrush).

Table 9. Food Habits of 14 Desert Bighorn Sheep in Nevada During November and December 1972

Species	Volume %	Freq. %	No. of Animals
Grasses:			
Unidentified grass	60.2	100.0	14
Poa sp.	1.4	28.6	4
Hilaria jamesii	1.0	50.0	7
Stipa sp.	1.0	21.4	3
Festuca sp.	0.8	21.4	3
Oryzopsis hymenoides	0.4	21.4	3
Hordeum sp.	0.1	7.1	1
Bromus tectorum	Trace	7.1	1
Grass Subtotal	64.9		
Forbs:			
Eriogonum sp.	0.4	85.7	12
Unidentified forbs	0.4	35.7	5
Helianthus sp.	0.1	14.2	2
Sphaeralcea sp.	0.1	7.1	1
Phacelia sp.	Trace	7.1	1
Chaenactis sp.	Trace	14.2	2
Forb Subtotal	1.0		
Shrubs:			
Ephedra viridis	11.1	21.4	3
Cowania mexicana	7.3	57.1	8
Ephedra nevadensis	6.7	64.2	9
Unidentified shrubs	3.8	64.2	9
Artemisia tridentata	3.5	64.2	9
Ceanothus greggii	0.6	21.4	3
Ceanothus sp.	0.4	21.4	3
Cercocarpus intricatus	0.3	28.5	4
Yucca sp.	0.3	7.1	1
Coleogyne ramosissima	0.1	14.2	2
Pinus monophylla	Trace	7.1	1
Encelia sp.	Trace	7.1	1
Atriplex canescens	Trace	14.2	2
Shrub Subtotal	34.1		

Hypothetical Dose Estimates

Although meat from animals living on the NTS 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 (ICRP),[23,24] the maximum observed concentrations of the radionuclides in edible tissues of the cattle and deer sampled (summarized in Table 10), and the postulated consumption of 500 grams (about one pound) of the meat each day for a year. Table 11 indicates the doses resulting from these hypotheses. The doses are the total dose based on an intake of one year.

The ICRP[23] and the AEC[25] present different dose criteria for various parts of the body, based on estimates of relative radiosensitivity. The National Council on Radiation Protection and Measurement (NCRP)[26] 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 NCRP emphasizes that this is a simplifying administrative decision, rather than a reduction of the guides based on new technical information.

Table 10 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 (2 sigma) for the plutonium and uranium results is estimated to be about 200 fCi/kg 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. This may explain what appears to be an anomaly in the low ratios between the ^{239}Pu and ^{238}Pu results. Plutonium-238 is present in the environment primarily as a result of the burnup of the SNAP-9A power source.[27,28] The expected ratio is roughly 25, which is reflected by the numerous "less than" values in the data tables in the Appendices.[28]

Table 10. Summary of Peak Radionuclide Concentrations in Edible Tissues from NTS Cattle and Deer (pCi/kg)

	NTS Cattle May 1972		NTS Cattle Oct 1972		NTS Mule Deer 1972	
	Liver	Muscle	Liver	Muscle	Liver	Muscle
^{3}H*	NA	4600 ± 280	NA	360 ± 240	NA	34,000 ± 540
^{137}Cs	ND	40	32	50	40	24
^{203}Hg	ND	ND	590	ND	ND	ND
^{238}Pu	<0.49	0.14 ± 0.14	0.26 ± 0.088	0.20 ± 0.04	<1.0	<0.3
^{239}Pu	0.93 ± 0.4	0.1 ± 0.07	5.0 ± 1.9	0.38 ± 0.054	<0.4	0.1
^{234}U	0.39 ± 0.11	NA	1.10 ± 0.22	0.09 ± 0.029	0.29 ± 0.17	0.30 ± 0.10
^{235}U	0.036 ± 0.022	NA	0.074 ± 0.054	0.048 ± 0.018	<0.02	<0.02
^{238}U	0.31 ± 0.19	NA	1.10 ± 0.20	0.084 ± 0.027	0.27 ± 0.16	0.27 ± 0.10

*Tritium concentration was actually measured in blood.
NA = Not analyzed.
ND = Not detected.

Table 11. Postulated Dose to Man Following Ingestion of Selected Tissues for One Year

	Human organ for which dose was calculated	Animal tissue containing Maximum concentration	pCi/kg of tissue	μCi/year ingested	Rem/μCi ingested	Rem	Percent of 0.5 rem[a]
^{3}H	Body water	Deer blood[b] assumed tissue had equal concentration	34,000 ± 540	6.2	9.8×10^{-5}	6.1×10^{-4}	0.12
^{137}Cs	Whole body tissue	NTS cattle, muscle	50	0.0091	6.1×10^{-2}	5.6×10^{-4}	0.11
^{203}Hg	Kidney	NTS cattle, liver	590	0.11	8.2×10^{-2}[c]	8.8×10^{-3}	1.8
^{234}U	Bone	NTS cattle, liver	1.10 ± 0.22	0.0002	1.0	2.0×10^{-4}	0.04[d]
^{238}Pu	Bone	NTS cattle, liver	0.26 ± 0.088	4.7×10^{-5}	0.75	3.6×10^{-5}	0.007
^{239}Pu	Bone	NTS cattle, liver	5.0 ± 1.9	9.1×10^{-4}	0.85	7.8×10^{-4}	0.15

[a]The doses from uranium and ^{238}Pu, ^{239}Pu, and to a lesser extent ^{137}Cs, are not delivered with the 1-year ingestion period. But, for simplification, the doses have been related to the guide for 1 year. The doses for uranium and plutonium are actually for a 50-year period. The dose the first year after ingestion would only be about 1/50 of the indicated values.

[b]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.

[c]Based on effective energy of 0.12 MeV from Dillman,[29] versus ICRP 2[23] value of 0.15 MeV.

[d]The dose calculation for uranium was based on the observed concentration of ^{234}U and the natural ratios between the ^{234}U, ^{235}U, and ^{238}U isotopes.

The highest fraction of the postulated dose (Table 11) is due to ^{203}Hg. But it is speculated that the ^{203}Hg value resulted from contamination of the samples as a result of residual ^{203}Hg from previous experiments using the same facilities as those used for sacrificing and sampling the animals. The ^{203}Hg dose estimate is less than 2% of 0.5 rem/year. The next highest estimates are about 0.1% each for tritium and ^{137}Cs.

SPECIAL STUDIES AND INVESTIGATIONS

Tatum Dome Test Site, Mississippi

In early January, the AIP was notified that the Tatum Dome Test Site (TDTS) in Lamar County, Mississippi, was being returned to its original owners. The AEC/NV requested that the AIP initiate an extensive biological sampling of plants and animals of the area to document levels of radionuclides (especially ^{125}Sb) that might directly or indirectly enter the food web of man. Samples were collected in January and February and consisted of both terrestrial and aquatic biota including animals used by man for food in the local area: fish, rabbit, squirrel, raccoon, turtle, and quail. Analyses indicated the presence of ^{125}Sb in five species of vegetation; however, the levels reported are less than that for the cleanup criteria for soil (no criteria exist for vegetation) and in all probability the activity measured was surface contamination.[19,20] Additional samples of garden produce (turnips, radishes, rutabaga, mustard greens, onions), chicken eggs, pecans, and white-tailed deer from areas on the periphery of the site were collected and analyzed. No movement of ^{125}Sb from the site area was revealed by these analyses. Other radioisotopic levels reported in these samples are commensurate with worldwide fallout data. These analytical data were published previously.[19, 20] It was concluded that future authorized use of the TDTS would result in no significant dose to man through the food web from radionuclides produced by the tests conducted at the TDTS.

Roller Coaster Cattle Study

In February of 1972, three beef animals that grazed over the Roller Coaster site of the Tonopah Test Range (TTR) were purchased, sacrificed, necropsied, and sampled as part of the routine surveillance activities of the AIP. Analysis of selected tissues from two of these animals indicated the presence of elevated levels of plutonium when compared to the baseline data collected from cattle from the Reno area during 1971.[4] Additional studies were initiated to develop more complete

data concerning actinide levels in cattle grazing on and near the Roller Coaster site. The cattle sampled were from (1) a control herd from Searchlight, Nevada; (2) the May sacrifice of the NTS herd; and (3) a herd grazing in the Roller Coaster area of the TTR.

The analytical data and findings of this study were reported.[15] In general the uranium content of the tissues sampled was relatively consistent among the three herds; however, the ^{239}Pu was about 20 times higher in femurs from the Roller Coaster cattle than in femurs from the Searchlight cattle. On the other hand, this ratio was much lower in edible tissues. The hypothetical maximum bone dose for a man ingesting 250 g/day for 50 years was calculated to be 9.7 mrem from beef muscle and 36.4 mrem from beef liver. The only other isotopes detected in tissues were ^{90}Sr, ^{131}I, and ^{3}H; although, ^{95}Zr, ^{103}Ru, ^{140}Ba, and ^{141}Ce were frequently found in rumen contents.

Gnome Site Bioenvironmental Sampling

During October a bioenvironmental sampling program was conducted at the Gnome site, Carlsbad, New Mexico, for the documentation of radionuclide concentrations in plant and animal tissues. These concentrations might have resulted either from radioactivity released during the Gnome detonation of 1961 or from contaminated debris brought to the surface during subsequent reentry activities. The data collected from this study have been published.[30] The levels of gamma-emitting radionuclides resulting from detonation and reentry did not exceed the MDA in the tissues of birds and animals sampled. Detectable levels of tritium were found in the flesh of all animals sampled. Zirconium-95 and ^{103}Ru were detected in certain grass samples but were thought to be the result of worldwide fallout. Strontium-90 levels in the bones and plant samples were also attributed to worldwide fallout. These data indicated no radiological hazard to man through the ingestion of tissues of wildlife that reside in the area of the Gnome site.

NTS Spring Survey

During August 1972, eight natural springs located on the NTS were surveyed to determine the wildlife use and water flow at each spring. The details of the survey are reported elsewhere.[31]

Other Activities

There were no livestock damage claims during 1972.

Aerial photography and infrared scanning were used in an attempt to locate NTS deer during the winter months. One deer was identified but ground search failed to verify. The lack of success was attributed to the 2000-foot altitude of flight required because of safety considerations and the wide temperature gradients between bare ground and snow patches.

The off-site public relations program continued by direct contact with ranchers, by lectures to civic organizations, and to groups touring the Las Vegas or NTS facilities. During 1972, the objectives and findings of the AIP were described to approximately 400 NTS visitors who were part of 23 different tour groups.

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APPENDIX I. Minimum Detectable Activities for Radionuclide Analyses, Technical Support Laboratory, National Environmental Research Center-Las Vegas, Nevada

The minimum detectable activities (MDA's) 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 MDA has been defined as that activity which produced a ±100% deviation at the 95% 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 MDA's 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 liter	400 ml	1000 ml	3.5 liter
^{54}Mn	50	25	40	35	25	25	22
^{65}Zn	500	250	400	350	250	250	220
^{60}Co	50	25	40	35	25	25	22
^{95}Zr	50	25	40	35	25	25	22
^{103}Ru	50	25	40	35	25	25	22
^{106}Ru	500	250	400	350	250	250	220
^{124}Sb	50	25	40	35	25	25	22
^{125}Sb	250	125	200	175	125	125	110
^{132}Te	50	25	40	35	25	25	22
^{131}I	50	25	40	35	25	25	22
^{133}I	50	25	40	35	25	25	22
^{137}Cs	50	25	40	35	25	25	22
^{140}Ba	50	25	40	35	25	25	22
^{141}Ce	250	125	200	175	125	125	110
^{144}Ce	500	250	400	350	250	250	220

APPENDIX I. Minimum Detectable Activities for Radionuclide Analyses (cont'd)

Isotope	10-Min Count	40-Min Count			100-Min Count		
	Planchet	Planchet	400 ml	3.5 liter	400 ml	1000 ml	3.5 liter
^{181}W	600	300	475	425	300	300	260
K*	0.5	0.3	0.4	0.4	0.3	0.3	0.25
^{3}H	0.2 pCi per ml of H_2O						
^{89}Sr	5.0 pCi per sample						
^{90}Sr	2.0 pCi per sample						
^{238}Pu	0.02 pCi per sample						
^{239}Pu	0.02 pCi per sample						

*g/kg

APPENDIX II-1. Lungs - NTS Cattle - May 1972

Animal No.	^{239}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% ash	Wet wt. (kg)	Ash wt (g)
1	11 ± 6 370 ± 200	42 ± 9 1400 ± 300	16 ± 4 530 ± 130	<0.7 <23	16 ± 3 530 ± 100	3.33	1.02	34
2	12 ± 8 180 ± 120	230 ± 30 3400 ± 450	38 ± 6 570 ± 90	1.3 ± 1.3 19 ± 19	33 ± 5 490 ± 75	1.49	1.54	23
3	16 ± 7 240 ± 100	160 ± 20 2400 ± 300	16 ± 3 240 ± 45	0.76 ± 0.69 11 ± 10	14 ± 3 200 ± 44	1.47	1.36	20
4	<4 <120	22 ± 8 660 ± 240	8 ± 2 240 ± 60	1 ± 1 30 ± 30	7 ± 2 210 ± 60	3.0	1.00	30
5	5 ± 3 97 ± 60	18 ± 4 350 ± 80	4.7 ± 1.7 92 ± 30	<0.5 <9.7	4.4 ± 1.6 86 ± 30	1.96	0.97	19
MEDIAN	11 180	42 1400	16 240	0.76 19	14 210	1.96		
RANGE	<4-16 97-370	18-230 350-3400	4.7-38 92-570	<0.5-1.3 <9.7-30	4.4-33 86-530	1.47-3.33		
Dairy Cow #6	4 ± 4 250 ± 250	22 ± 5 1400 ± 300	6.7 ± 1.9 420 ± 120	<0.6 <37	6.2 ± 1 390 ± 62	6.24	2.42	151
Dairy Cow #7	<3 <240	9 ± 3 710 ± 240	4.7 ± 1.6 370 ± 120	<0.5 <39	3.9 ± 1.5 310 ± 120	7.94	3.01	239

*Wet weight

APPENDIX II-2. Tracheo-Bronchial Lymph Nodes - NTS Cattle - May 1972

Animal No.	^{238}Pu fCi/g ash	^{238}Pu fCi/kg *	^{239}Pu fCi/g ash	^{239}Pu fCi/kg*	% Ash	Wet wt (kg)	Ash wt (g)
1	<80	<720	300 ± 100	2700 ± 800	0.90	0.041	0.37
2	90 ± 80	920 ± 800	4100 ± 400	42000 ± 4000	1.02	0.036	0.37
3	200 ± 100	1300 ± 600	6900 ± 600	44000 ± 4000	0.64	0.033	0.21
4	<80	<580	130 ± 60	950 ± 400	0.73	0.041	0.30
5	<80	<660	40 ± 40	300 ± 300	0.83	0.042	0.35
MEDIAN	<80	<720	300	2700	0.83		
RANGE	<80-200	<580-1300	40-6900	300-44000	0.64-1.02		
Dairy Cow #6	90 ± 80	850 ± 800	2300 ± 200	22000 ± 2000	0.95	0.038	0.36
Dairy Cow #7	<40	<420	900 ± 100	9500 ± 1000	1.05	0.058	0.61

*Wet weight.

APPENDIX II-3. Muscle - NTS Cattle - May 1972

Animal No.	^{238}Pu fCi/g ash	^{238}Pu fCi/kg *	^{239}Pu fCi/g ash	^{239}Pu fCi/kg *	% Ash	Wet wt (kg)	Ash wt (g)
1	3 ± 3	140 ± 140	2 ± 2	94 ± 94	4.73	3.55	168
2	<3	<100	3 ± 2	100 ± 67	3.38	4.14	140
3	<3	<110	2 ± 1	71 ± 36	3.58	3.07	110
4	<3	<48	1 ± 1	16 ± 16	1.63	3.01	49
5	<2	<52	<1	<26	2.62	2.29	60
MEDIAN	<3	<100	2	71	3.38		
RANGE	<2-3	<48-140	<1-3	16-100	1.63-4.73		
Dairy Cow #6	<4	<210	<2	<100	5.21	4.28	223
6Fetus	<4	<72	3 ± 3	54 ± 54	1.82	0.33	6
Dairy Cow #7	<20	<1200	10 ± 10	620 ± 620	6.17	5.53	341

*Wet weight

APPENDIX II-4. Kidneys - NTS Cattle - May 1972

Animal No.	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt (kg)	Ash wt (g)
1	24 ± 9 110 ± 44	<4 <17	20 ± 9 88 ± 42	0.44	0.45	2
2	42 ± 17 490 ± 200	<3 <35	42 ± 17 490 ± 200	1.16	0.43	5
3	66 ± 10 720 ± 120	2 ± 1.9 22 ± 21	56 ± 10 610 ± 110	1.09	0.46	5
4	89 ± 13 870 ± 130	2 ± 2 20 ± 20	81 ± 13 790 ± 120	0.98	0.46	4.5
5	62 ± 11 630 ± 110	<2 <20	60 ± 11 610 ± 110	1.01	0.42	4.26
MEDIAN	62 630	2 22	56 610	1.01		
RANGE	24-89 110-870	<2-<4 <17-<35	20-81 88-790	0.44- 1.16		
Dairy Cow #6	100 ± 10 1000 ± 100	4.6 ± 2.4 48 ± 25	80 ± 10 840 ± 100	1.05	0.42	4.4
Dairy Cow #7	150 ± 10 1600 ± 100	6 ± 2.6 63 ± 27	150 ± 10 1600 ± 100	1.05	0.47	4.95

*Wet weight

APPENDIX II-5. Liver - NTS Cattle - May 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt (kg)	Ash wt (g)
1	<9.6 <490	7.6 ± 4.5 390 ± 230	7.6 ± 2.2 390 ± 110	<0.5 <30	6 ± 3.8 310 ± 190	5.1	1.92	98
2	5 ± 5 260 ± 260	18 ± 7 930 ± 400	6.5 ± 2.3 340 ± 120	<0.7 <36	5.4 ± 2.1 280 ± 110	5.16	3.18	164
3	<4 <230	12 ± 5 700 ± 300	2.1 ± 1.1 120 ± 60	<0.3 <17	1.5 ± 0.9 88 ± 55	5.86	3.14	184
4	<2 <48	8 ± 3 190 ± 70	4 ± 1.5 95 ± 35	1.5 ± 0.9 36 ± 22	2.3 ± 1.1 55 ± 27	2.38	2.02	48
5	<3 <91	10 ± 3 300 ± 80	3.9 ± 1.3 120 ± 40	<0.4 <12	3.6 ± 1.3 110 ± 40	3.04	2.17	66
MEDIAN	<4 <230	10 390	4 120	<0.5 30	3.6 110	5.1		
RANGE	<2-<9.6 <48-<490	7.6-18 190-93	2.1-7.6 95-390	<0.3-1.5 <12-36	1.5-6 55-310	2.38- 5.86		
Dairy Cow #6	9 ± 4 240 ± 100	22 ± 5 590 ± 140	7.8 ± 2.1 210 ± 60	<0.5 <13	6.3 ± 1.9 170 ± 50	2.70	3.70	100
Dairy Cow #7	<4 <94	31 ± 6 730 ± 100	3.5 ± 1.5 82 ± 34	0.59 ± 0.59 14 ± 14	2.6 ± 1.2 61 ± 28	2.36	5.30	125

*Wet weight.

APPENDIX II-6. Rumen Contents - NTS Cattle - May 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt (kg)	Ash wt (g)
1	200 ± 100	800 ± 300	190 ± 10	8.5 ± 2.5	150 ± 10	1.79	3.13	56
	3600 ± 2000	14000 ± 6000	3400 ± 200	150 ± 50	2700 ± 200	2.12		
2	30 ± 10	170 ± 20	100 ± 9	2.1 ± 1.3	95 ± 9	2.12	4.86	103
	640 ± 200	3600 ± 500	2100 ± 200	44 ± 27	2000 ± 200			
3	40 ± 10	220 ± 20	74 ± 6.5	1.4 ± 0.81	70 ± 6.1	2.49	3.21	80
	1000 ± 200	5500 ± 600	1800 ± 200	35 ± 20	1700 ± 200			
4	<5	140 ± 20	73 ± 9.6	5.3 ± 2.5	70 ± 9.6	1.46	3.50	51
	<72	2000 ± 300	1100 ± 100	77 ± 36	1000 ± 100			
5	12 ± 8	180 ± 20	70 ± 9.3	4.6 ± 2.5	63 ± 8.7	1.44	4.50	65
	170 ± 100	2600 ± 300	1000 ± 100	66 ± 36	910 ± 100			
MEDIAN	30 640	180 3600	74 1800	4.6 44	70 1700	1.79		
RANGE	<5-200	140-800	70-190	1.4-8.5	63-150	1.44-2.49		
	<72-3600	2000-14000	1000-3400	35 ± 150	910-2700			
Dairy Cow #6	120 ± 7	510 ± 50	1100 ± 36	37 ± 6.4	910 ± 33	2.35	3.27	77
	280 ± 200	12000 ± 1000	26000 ± 900	870 ± 150	21000 ± 800			
Dairy Cow #7	<4	37 ± 9	360 ± 25	13 ± 4.3	340 ± 24	1.38	3.90	54
	<55	510 ± 100	5000 ± 400	180 ± 100	4700 ± 300			

*Wet weight

APPENDIX II-7. Bone (Femur) - NTS Cattle - May 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	^{89}Sr pCi/g ash pCi/kg*	^{90}Sr pCi/g ash pCi/kg*	% Ash	Ca mg/g	Wet wt (kg)	Ash wt (g)
1	<0.3 <59	1.7 ± 0.4 340 ± 80	2 ± 0.3 400 ± 60	0.1 ± 0.07 20 ± 15	1.5 ± 0.3 300 ± 60	3 ± 2 600 ± 450	4 ± 1 790 ± 200	19.9	356	1.34	266
2	<0.3 <85	3.3 ± 0.5 940 ± 200	0.89 ± 0.23 250 ± 70	<0.05 <14	0.83 ± 0.22 240 ± 70	3 ± 3 860 ± 860	8 ± 2 2300 ± 470	28.5	366	0.89	254
3	<0.3 <82	2.2 ± 0.5 600 ± 100	1.4 ± 0.3 380 ± 80	<0.04 <11	1.3 ± 0.3 360 ± 180	<2 <550	4 ± 1 1100 ± 280	27.5	358	1.38	380
4	0.5 ± 0.4 130 ± 90	1.1 ± 0.4 280 ± 90	1.8 ± 0.3 460 ± 80	0.1 ± 0.08 26 ± 20	1.7 ± 0.3 440 ± 80	<2 <510	4 ± 1 1000 ± 260	26	359	0.96	246
5	<0.3 <75	0.9 ± 0.3 220 ± 80	1.8 ± 0.3 450 ± 80	0.1 ± 0.1 25 ± 25	1.7 ± 0.3 420 ± 80	<2 <500	2 ± 1 500 ± 250	25	356	0.76	190
MEDIAN	<0.3 <82	1.7 340	1.8 400	0.1 20	1.5 360	<2 <550	4 1000	26	359		
RANGE	<0.3-0.5 <59-130	0.9-3.3 220-940	0.89-2 250-460	<0.04-0.1 <11-26	0.83-1.7 240-440	<2-3 <500-860	2-8 500-2300	19.9-28.5	356-366		
Dairy Cow #6	<0.3 <75	1.2 ± 0.4 300 ± 100	3.2 ± 0.4 790 ± 100	0.07 ± 0.07 17 ± 17	2.5 ± 0.4 620 ± 90	<8 <2000	2.3 ± 0.8 570 ± 200	25	364	1.51	375
Dairy Cow #7	0.5 ± 0.4 160 ± 100	0.8 ± 0.3 250 ± 100	5.2 ± 0.5 1600 ± 150	0.2 ± 0.1 62 ± 31	3 ± 0.4 940 ± 120	<2 <620	3 ± 1 930 ± 310	31	362	1.57	490

*Wet weight

APPENDIX II-8. Gamma-Emitting Radionuclides and Tritium Concentrations in Tissues - NTS Cattle - May 1972

Animal No.	Rumen Contents K g/kg ^{95}Zr pCi/kg ^{103}Ru pCi/kg ^{140}Ba pCi/kg ^{141}Ce pCi/kg	Liver K g/kg	Lungs K g/kg ^{95}Zr pCi/kg	Thyroid ^{131}I pCi/g	Kidney K g/kg	Muscle K g/kg ^{137}Cs pCi/kg	Blood ^{3}H pCi/l
1	1.2 150 110 <MDA 210	3.8	2.6 60	18	2.6	3.8 30	650 ± 220
2	2.1 500 200 120 480	3.3	2.9 90	18	2.4	3.5 40	500 ± 220
3	1.6 680 230 80 620	3.2	2.5 80	17	2.2	4 <MDA	2100 ± 240
4	1.8 310 160 <MDA 270	3.4	4.9 <MDA	21	1.7	4.9 30	540 ± 220
5	1.4 430 120 110 300	2.5	2.9 50	19	2.0	4.3 29	420 ± 220
6	3.1 100 60 <MDA 220	2.8	2.2 30	2.9	2.3	2.9 <MDA	4600 ± 280

APPENDIX II-8. Gamma-Emitting Radionuclides and Tritium Concentrations in Tissues - NTS Cattle - May 1972

Animal No.	Rumen Contents K g/kg ^{95}Zr pCi/kg ^{103}Ru pCi/kg ^{140}Ba pCi/kg ^{141}Ce pCi/kg	Liver K g/kg	Lungs K g/kg ^{95}Zr pCi/kg	Thyroid ^{131}I pCi/g	Kidney K g/kg	Muscle K g/kg ^{137}Cs pCi/kg	Blood ^{3}H pCi/l
7	2 <MDA 90 <MDA <MDA	3.3	2.2 <MDA	2	1.6	3 30	1000 ± 230
MEDIAN	1.8 370 120 110 285	3.3	2.6 60	18	2.2	3.8 30	650
RANGE	1.2-3.1 100-680 60-230 80-120 210-620	2.5-3.8	2.2-4.9 30-90	2-21	1.6-2.6	2.9-4.9 29-40	420-4600

APPENDIX III-1. Lungs - NTS Cattle - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
8			SAMPLE NOT COLLECTED					
9	<9.4 <160	31 ± 13 540 ± 220	9.4 ± 4.0 160 ± 68	<0.47 <8	9.4 ± 4.0 160 ± 68	1.7	0.644	10.9
10	<4.2 <68	13 ± 5.4 210 ± 87	8.7 ± 3.8 140 ± 61	<0.44 <7	8.1 ± 3.6 130 ± 58	1.6	1.207	19.3
11	<6.5 <170	35 ± 12 910 ± 300	10 ± 3.8 260 ± 100	<0.38 <10	9.2 ± 3.8 240 ± 98	2.6	0.965	25.1
12	<5.5 <99	46 ± 8.9 830 ± 160	23 ± 7.2 420 ± 130	<2.2 <40	22 ± 6.7 400 ± 120	1.8	1.028	18.5
13	<7.4 <140	11 ± 5.1 200 ± 97	15 ± 5.2 290 ± 98	<1.1 <20	14 ± 4.8 270 ± 92	1.9	0.779	14.8
14			SAMPLE NOT COLLECTED					
MEDIAN	<6.5 <140	31 540	10 260	<0.47 <10	9.4 240	1.8		
RANGE	<4.2-<9.4 <68-<170	11-46 200-910	8.7-23 140-420	<0.38-<2.2 <7-<40	8.1-22 130-400	1.6-2.6		

*Wet weight

APPENDIX III-2. Tracheo-Bronchial Lymph Nodes - NTS Cattle - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
8			SAMPLE NOT COLLECTED					
9	<20 <800	<20 <800	<11 <400	<1.1 <40	<11 <400	3.8	0.03	1.14
10	NA	NA	33 ± 24 280 ± 200	<12 <100	24 ± 19 200 ± 160	0.84	0.04	0.34
11	<110 <800	<53 <400	750 ± 190 5600 ± 1400	93 ± 69 700 ± 520	670 + 170 5000 ± 1300	0.75	0.018	0.14
12	<120 <800	<62 <400	370 ± 150 2400 ± 1000	<62 <400	320 ± 150 2100 ± 1000	0.65	0.017	0.11
13	<80 <800	<40 <400	270 ± 90 2700 ± 900	<20 <200	260 ± 90 2600 ± 900	1.0	0.025	0.25
14			SAMPLE NOT COLLECTED					
MEDIAN	<95 <800	<57.5 <400	270 2400	<20 <200	260 2100	0.84		
RANGE	<20-<120 <800-<800	<20-<62 <400-<800	<11-750 280-5600	<1.1-93 <40-700	<11-670 <400-5000	0.65-3.8		

NA = Not analyzed

*Wet weight

APPENDIX III-3. Muscle - NTS Cattle - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
8	<3.1 <24	13 ± 3.2 99 ± 26	<5.1 <40	<0.25 <2	<3.8 <30	0.79	2.788	22
9	10 ± 5.3 54 ± 28	5.5 ± 3.3 29 ± 17	6.3 ± 2.1 33 ± 11	2.3 ± 1.2 12 ± 6.8	3.8 ± 1.6 20 ± 8.1	0.52	2.874	14.9
10	<4.9 <31	6.1 ± 4.0 39 ± 26	6.9 ± 2.0 44 ± 13	1.9 ± 1.1 12 ± 6.8	5 ± 1.7 32 ± 11	0.64	2.491	15.9
11	8.3 ± 3.5 68 ± 29	46 ± 6.6 380 ± 54	4.6 ± 1.7 38 ± 14	2.6 ± 1.3 21 ± 11	4.4 ± 1.7 36 ± 14	0.82	2.553	20.9
12	23 ± 4.5 200 ± 40	8 ± 2.3 70 ± 20	10 ± 3.3 90 ± 29	5.5 ± 2.0 48 ± 18	9.5 ± 3.1 84 ± 27	0.88	2.280	20.1
13	12 ± 8 120 ± 80	<9 <90	5.2 ± 2.2 52 ± 22	2.0 ± 1.0 20 ± 10	4.9 ± 2.1 49 ± 21	1.0	2.520	25.2
14			SAMPLE NOT COLLECTED					
MEDIAN	9.1 61	8.5 80	5.5 42	2.45 16	4.1 34	0.73		
RANGE	<3.1-23 <24-200	5.5-46 29-380	<5.1-10 33-90	<0.25-5.5 <2-48	<3.8-9.5 20-84	0.52-1.0		
Fetus #12	<4.2 <88	3.4 ± 2.3 72 ± 48	5.2 ± 2.4 110 ± 50	<0.9 <20	4.8 ± 2.3 100 ± 48	2.1	0.484	

*Wet weight

APPENDIX III-4. Kidneys - NTS Cattle - October 1972

Animal No.	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
8	29 ± 5.6 350 ± 67	2.0 ± 1.5 24 ± 18	27 ± 5.2 330 ± 63	1.2	0.493	5.9
9	8 ± 3.5 120 ± 53	<1.3 <20	7.3 ± 3.3 110 ± 50	1.5	0.458	6.9
10	17 ± 4.5 190 ± 50	<0.91 <10	16 ± 4.5 180 ± 50	1.1	0.469	5.2
11	14 ± 3.5 150 ± 38	<0.45 <5	13 ± 3.3 140 ± 36	1.1	0.467	5.1
12	8.2 ± 3.1 90 ± 34	2 ± 1.5 22 ± 16	7.6 ± 2.9 84 ± 32	1.1	0.473	5.2
13	NA	NA	NA	1.3	0.475	6.2
14			SAMPLE NOT COLLECTED			
MEDIAN	14 150	<1.3 <20	13 140	1.1		
RANGE	8-29 90-350	<0.45-2.0 <5-24	7.3-27 84-330	1.1-1.5		

NA = Not analyzed
*Wet weight

APPENDIX III-5. Liver - NTS Cattle - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
8	<7.4 <73	45 ± 11 450 ± 110	6.4 ± 3.1 64 ± 31	<0.6 <6.0	5.7 ± 2.6 57 ± 26	1.0	1.406	14.1
9	<7.1 <120	11 ± 5.4 190 ± 90	4.1 ± 2.2 69 ± 38	<1.2 <20	3.4 ± 1.9 58 ± 32	1.7	1.252	21.3
10	<4.8 <140	<5.9 <170	38 ± 76 1100 ± 220	2.6 ± 1.9 74 ± 54	38 ± 6.9 1100 ± 200	2.9	1.264	36.7
11	<18 <190	490 ± 190 5000 ± 1900	3.3 ± 2.0 33 ± 20	<0.3 <3	3 ± 2 30 ± 20	1.0	2.182	22
12	11 ± 6.4 110 ± 64	21 ± 5.7 210 ± 57	11 ± 3.4 110 ± 34	<0.3 <3	7.1 ± 2.8 71 ± 28	1.0	3.815	38.1
13	22 ± 7.3 260 ± 88	66 ± 11 790 ± 130	17 ± 5.3 200 ± 64	<0.83 <10	15 ± 5.0 180 ± 60	1.2	2.696	32.4
14	<4.9 <200	20 ± 5.9 800 ± 240	NA	NA	NA	4.1	0.462	18.9
MEDIAN	<7.4 <140	21 450	8.7 88.5	<0.7 <8	6.4 64.5	1.2		
RANGE	<4.8-22 <73-260	<5.9-490 <170-5000	3.3-38 33-1100	<0.3-10.6 <3-<74	3-38 30-1100	1.0-4.1		

NA = Not analyzed
*Wet weight

APPENDIX III-6. Rumen Contents - NTS Cattle - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
8	82 ± 20 2300 ± 570	680 ± 75 19000 ± 2100	86 ± 14 2400 ± 380	5.0 ± 3.0 140 ± 83	82 ± 13 2300 ± 360	2.8	1.557	43.5
9	37 ± 16 840 ± 370	230 ± 37 5300 ± 850	100 ± 20 2400 ± 450	6.5 ± 5.2 150 ± 120	100 ± 18 2300 ± 420	2.3	3.334	76.6
10	30 ± 9.3 910 ± 280	240 ± 25 7200 ± 760	43 ± 12 1300 ± 350	<0.67 <20	4.0 ± 11 1200 ± 330	3.0	3.322	99.6
11	53 ± 13 1700 ± 420	310 ± 34 10000 ± 1100	190 ± 20 6100 ± 640	5.0 ± 3.0 160 ± 95	180 ± 19 5700 ± 600	3.2	3.699	118.4
12	33 ± 10 750 ± 230	380 ± 36 8800 ± 820	57 ± 10 1300 ± 240	3.6 ± 2.7 83 ± 62	52 ± 10 1200 ± 230	2.3	2.496	57.4
13	24 ± 8.9 680 ± 250	220 ± 20 6100 ± 550	86 ± 9.6 2400 ± 270	4.3 ± 2.1 120 ± 60	82 ± 8.9 2300 ± 250	2.8	2.754	77.1
14			SAMPLE NOT COLLECTED					
MEDIAN	35 875	275 8000	86 2400	4.7 130	82 2300	2.8		
RANGE	24-82 680-2300	220-680 5300-19000	43-190 1300-6100	<0.67-6.5 <20-160	40-180 1200-5700	2.3-3.2		

*Wet weight

APPENDIX III-7. Sediment in Reticulum - NTS Cattle - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
8			SAMPLE NOT COLLECTED					
9	<33 <10000	180 ± 33 53000 ± 10000	730 ± 77 220000 ± 23000	50 ± 19 15000 ± 5700	670 ± 73 200000 ± 22000	30	0.042	12.6
10	300 ± 37 170000 ± 21000	410 ± 43 230000 ± 24000	540 ± 63 300000 ± 35000	23 ± 13 13000 ± 7200	520 ± 63 290000 ± 35000	56	0.030	16.8
11	31 ± 28 17000 ± 15000	130 ± 30 68000 ± 16000	24000 ± 1200 13000000 ± 650000	870 ± 220 470000 ± 120000	24000 ± 12000 13000000 ± 630000	54	0.029	15.6
12	<20 <4100	<10 <2000	160 ± 16 32000 ± 3300	3.8 ± 2.5 770 ± 510	150 ± 16 31000 ± 3200	20	0.021	4.2
13	130 ± 90 66000 ± 45000	200 ± 120 100000 ± 60000	72 ± 5.8 36000 ± 2900	2 ± 0.98 1000 ± 490	68 ± 5.6 34000 ± 2800	50	0.020	10.0
14			SAMPLE NOT COLLECTED					
MEDIAN	33 17000	180 68000	540 220000	23 13000	520 200000	50		
RANGE	<20-300 <4100-170000	<10-410 <2000-230000	72-24000 32000-13000000	2-870 770-470000	68-24000 31000-13000000	20-56		

*Wet weight

APPENDIX III-8. Bone (Femur) - NTS Cattle - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	^{89}Sr pCi/g ash pCi/kg*	^{90}Sr pCi/g ash pCi/kg*	% Ash	Ca mg/g	Wet wt. (kg)	Ash wt. (g)
8	<0.9 <190	1.4 ± 1.2 300 ± 250	0.81 ± 0.62 170 ± 130	<0.29 <60	0.76 ± 0.57 160 ± 120	<3.9 <810	3.5 ± 1.1 740 ± 240	21	380	0.956	200.7
9	<1.2 <310	1.7 ± 1.1 450 ± 280	1.9 ± 0.92 490 ± 240	<0.38 <100	1.8 ± 0.88 470 ± 230	<3.8 <980	2.8 ± 1.1 720 ± 290	26	390	1.467	381.4
10	<1.9 <520	<2.4 <670	4.6 ± 1.4 1300 ± 390	0.46 ± 0.36 130 ± 100	4.3 ± 1.3 1200 ± 360	<3.5 <970	2.5 ± 1.0 690 ± 280	28	380	1.884	527.5
11	<1.9 <630	3.9 ± 1.0 1300 ± 330	1.4 ± 0.73 460 ± 240	<0.18 <60	1.3 ± 0.67 420 ± 220	<4.5 <1500	4.5 ± 1.2 1500 ± 380	33	380	1.829	603.6
12	<1.3 <400	4.4 ± 1.6 1400 ± 500	1.1 ± 0.66 360 ± 210	<0.09 <30	1.0 ± 0.63 320 ± 200	<5.6 <1800	2.8 ± 1.1 910 ± 360	32	380	1.677	536.6
13	<0.93 <280	7.3 ± 1.9 2200 ± 570	1.8 ± 1.0 550 ± 300	<0.3 <90	1.7 ± 0.93 520 ± 280	<6.7 <2000	5.3 ± 1.3 1600 ± 390	30	380	1.332	399.6
14	<1.2 <320	3.4 ± 1.4 880 ± 370	3.2 ± 1.4 840 ± 370	<0.12 <30	3.0 ± 1.3 790 ± 340	<3.8 <1000	3.7 ± 1.0 950 ± 270	26	380	0.828	215.3
MEDIAN	<1.2 <320	3.4 880	1.8 490	<0.3 <60	1.7 470	<3.9 <1000	2.8 910	28	380		
RANGE	<0.9-<1.9 <190-<630	1.4-7.3 300-2200	0.81-4.6 170-1300	<0.09-0.46 <30-130	0.76-4.3 160-1200	<3.5-<6.7 <810-<2000	2.5-5.3 690-1600	21-33	380-390		

*Wet weight

APPENDIX III-9. Gamma-Emitting Radionuclides and Tritium Concentrations in Tissues - NTS Cattle - October 1972

Animal No.	Rumen Contents K g/kg ^{95}Zr pCi/kg ^{103}Ru pCi/kg ^{137}Cs pCi/kg ^{141}Ce pCi/kg	Liver K g/kg ^{137}Cs pCi/kg ^{203}Hg pCi/kg	Lungs K g/kg	Thyroid	Kidney K g/kg	Muscle K g/kg ^{137}Cs pCi/kg	Blood ^{3}H pCi/l
8	1.4 55 120 <MDA 160	3.3 24 <MDA	2.4	Gamma Spectrum Negligible	2.5	4 50	<250
9	1.1 38 64 31 <MDA	3.2 32 <MDA	3	Gamma Spectrum Negligible	2.2	4.1 40	<220
10	7.2 36 350 <MDA <MDA	2.8 <MDA <MDA	1.6	Gamma Spectrum Negligible	1.7	3.2 30	360 ± 240
11	1.5 44 140 300 <MDA	2.4 <MDA <MDA	2.1	Gamma Spectrum Negligible	1.6	3.2 29	<210
12	1.6 52 130 <MDA <MDA	3.1 <MDA <MDA	2.1	Gamma Spectrum Negligible	2.6	3 <MDA	<250
13	1.2 40 230 40 120	2.8 <MDA <MDA	2.4	Gamma Spectrum Negligible	1.5	3.5 <MDA	290 ± 210

APPENDIX III-9. Gamma-Emitting Radionuclides and Tritium Concentrations in Tissues - NTS Cattle - October 1972

Animal No.	Rumen Contents K g/kg ^{95}Zr ^{103}Ru ^{137}Cs ^{141}Ce	Liver K g/kg ^{137}Cs pCi/kg ^{203}Hg pCi/kg	Lungs K g/kg	Thyroid	Kidney K g/kg	Muscle K g/kg ^{137}Cs pCi/kg	Blood ^{3}H pCi/l
14	SAMPLE NOT COLLECTED	3.2 MDA 590	SAMPLE NOT COLLECTED	Gamma Spectrum Negligible	2.1	SAMPLE NOT COLLECTED	SAMPLE NOT COLLECTED
MEDIAN	5 42 135 40 140	3.1 28 590	2.3	Gamma Spectrum Negligible	2.1	3.5 35	250
RANGE	1.1 -7.2 36-55 64-350 31-300 120-160	2.4-3.2 24-32 0.59	1.6-3	Gamma Spectrum Negligible	1.5-2.6	3-4.4 29-50	<210-360

APPENDIX IV-1. Lungs - NTS Mule Deer - 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
1	<30 <500	<13 <200	NA	NA	NA	1.6	0.577	9.2
2	<4 <80	10 ± 4 220 ± 80	6.4 ± 2.3 140 ± 50	<0.45 <10	5 ± 2.3 110 ± 50	2.2	0.721	15.9
3	<4.3 <100	13 ± 4.3 300 ± 100	16 ± 4.3 360 ± 100	1.5 ± 1.2 34 ± 27	14 ± 4.3 320 ± 100	2.3	0.302	6.9
4	<5 <180	5.3 ± 4.2 190 ± 150	NA	NA	NA	3.6	0.330	11.9
MEDIAN	<4.6 <90	<11.5 <210	11.2 250	<0.975 <22	8.5 215	2.75		
RANGE	<4-<30 <80-<500	5.3-<13 190-300	6.4-16 140-360	<0.45-1.5 <10-34	5-14 110-320	1.6-3.6		

NA = Not analyzed
*Wet weight

APPENDIX IV-2. Muscle - NTS Mule Deer - 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
1	<30 <300	10 ± 10 100 ± 100	NA	NA	NA	0.97	1.550	15
2	<3 <200	<1 <90	NA	NA	NA	8.9	1.359	121
3	<1.8 <100	<1.5 <80	5.5 ± 1.8 300 ± 100	<0.36 <20	4.9 ± 1.8 270 ± 100	5.5	1.288	70.8
4	<2.3 <54	<1.6 <36	2 ± 1.3 45 ± 30	<0.22 <5	1.8 ± 1.2 42 ± 28	2.3	1.655	38.1
MEDIAN	<2.65 <150	<1.55 <85	3.75 172.5	<0.29 <12.5	3.35 156	3.9		
RANGE	<1.8-<30 <54-<300	<1-10 <36-100	2-5.5 45-300	<0.22-<0.36 <5-<20	1.8-4.9 42-270	0.97-8.9		
Fetus #1	<24 <600	<12 <300	NA	NA	NA	2.5	0.328	8.2

NA = Not analyzed
*Wet weight

APPENDIX IV-3. Kidneys - NTS Mule Deer - 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
1	NA	NA	NA	NA	NA	NA	NA	NA
2	NA	NA	26 ± 13 380 ± 200	<5 <80	25 ± 13 380 ± 200	1.5	0.203	3.1
3	NA	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA	NA	NA

NA = Not analyzed
*Wet weight

APPENDIX IV-4. Liver - NTS Mule Deer - 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
1	<30 <1000	<12 <400	NA	NA	NA	3.4	0.769	26.1
2	3 ± 3 50 ± 50	8 ± 3 120 ± 50	3.2 ± 1.6 52 ± 26	0.8 ± 0.8 13 ± 13	2.2 ± 1.1 36 ± 20	1.6	0.978	15.6
3	<5.6 <200	5.6 ± 5.6 200 ± 200	2.6 ± 1.7 92 ± 61	<0.54 <20	2 ± 1.5 71 ± 54	3.6	0.468	16.8
4	<5.6 <240	<3 <130	6.7 ± 4.0 290 ± 170	<0.47 <20	6.3 ± 3.7 270 ± 160	4.3	0.876	37.6
MEDIAN	<5.6 <220	6.8 165	3.2 92	<0.54 <20	2.2 71	3.5		
RANGE	3-<30 50-<1000	3-<12 120-<400	2.6-6.7 52-290	<0.47-0.8 13-<20	2-6.3 36-270	1.6-4.3		

NA = Not analyzed
*Wet weight

APPENDIX IV-5. Rumen Contents - NTS Mule Deer - 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
1	<25 <500	85 ± 25 1700 ± 500	NA	NA	NA	2.0	0.997	19.9
2	5 ± 5 100 ± 100	60 ± 15 1200 ± 300	60 ± 10 1200 ± 200	3.5 ± 2.0 70 ± 40	55 ± 10 1100 ± 200	2.0	1.308	26.2
3	<2.5 <50	17 ± 4.5 340 ± 90	17 ± 3.5 350 ± 70	0.9 ± 0.75 18 ± 15	16 ± 3.0 330 ± 60	2.0	1.218	24.4
4	13 ± 9 280 ± 190	320 ± 36 6700 ± 750	170 ± 28 3600 ± 580	<4.7 <98	140 ± 2.4 2900 ± 500	2.1	0.965	20.3
MEDIAN	9 190	72.5 1450	60 1200	3.5 70	55 1100	2.0		
RANGE	<2.5-<25 <50-<500	17-320 340-6700	17-170 350-3600	0.9-<4.7 18-<98	16-140 330-2900	2.0-2.1		

NA = Not analyzed
*Wet weight

APPENDIX IV-6. Bone (Hock) - NTS Mule Deer - 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	^{89}Sr pCi/g ash pCi/kg*	^{90}Sr pCi/g ash pCi/kg*	% Ash	Ca mg/g	Wet wt. (kg)	Ash wt. (g)
1	<2.4 <800	8.8 ± 2.9 300 ± 100	NA	NA	NA	<2.6 <880	3.8 ± 1.2 1300 ± 420	34	370	0.239	81.3
2	<5.3 <200	1.1 ± 0.53 400 ± 200	0.3 ± 0.2 110 ± 80	<0.07 <30	0.3 ± 0.2 110 ± 80	<2 <210	4 ± 1 410 ± 110	38	360	0.355	134.9
3	<0.43 <100	2.6 ± 0.87 600 ± 200	1.5 ± 0.39 350 ± 90	<0.087 <20	1.4 ± 0.39 330 ± 90	<2.4 <560	2.6 ± 1.1 600 ± 250	23	360	0.595	136.8
4	<2.5 <790	11 ± 2.9 3500 ± 890	16 ± 4.2 5000 ± 1300	<0.65 <200	15 ± 3.9 4800 ± 1200	<2.5 <760	2.3 ± 0.9 700 ± 280	31	380	0.664	199.6
MEDIAN	<2.45 <495	5.7 500	1.5 350	<0.087 <30	1.4 330	<2.45 <620	3.2 650	28.5	365		
RANGE	<0.43-<5.3 <100-<800	1.1-11 300-3500	0.3-16 110-5000	<0.07-<0.65 <20-<200	0.3-15 110-4800	<2-<2.6 <210-<880	2.3-4 410-1300	31-38	360-380		
2 Ribs	6 ± 2 600 ± 200	2 ± 0.9 200 ± 90	0.5 ± 0.25 540 ± 250	<0.06 <6	0.44 ± 0.23 440 ± 230	<2 <210	4 ± 1 410 ± 110	9.9	286	0.665	65.8

NA = Not analyzed
*Wet weight

APPENDIX IV-7. Gamma-Emitting Radionuclides and Tritium Concentrations in Tissues - NTS Mule Deer - 1972

Animal No.	Rumen Contents K g/kg ^{95}Zr pCi/kg ^{103}Ru pCi/kg ^{106}Ru pCi/kg ^{140}Ba pCi/kg ^{141}Ce pCi/kg ^{144}Ce pCi/kg	Liver K g/kg ^{137}Cs pCi/kg	Lungs K g/kg ^{95}Zr pCi/kg ^{103}Ru pCi/kg ^{106}Ru pCi/kg ^{144}Ce pCi/kg	^{131}Thyroid I pCi/g	Kidney K g/kg	Muscle K g/kg ^{137}Cs pCi/kg	^{3}Blood H pCi/l	Fetus K g/kg
1	5.0 30 <MDA 300 <MDA <MDA 460	4.1 40	3.3 <MDA <MDA 970 440	33	2.8	3.8 24	430 ± 200	2.5
2	2.6 270 190 <MDA 130 430 <MDA	3.5 <MDA	3.8 60 90 <MDA <MDA	34	3.6	4.0 <MDA	920 ± 230	SAMPLE NOT COLLECTED
3	2.9 60 150 <MDA <MDA 110 <MDA	3.3 <MDA	3.2 <MDA <MDA <MDA <MDA	Gamma Spectrum Negligible	4.0	1.2 <MDA	34000 ± 540	SAMPLE NOT COLLECTED

<MDA = Less than minimum detectable activity

APPENDIX V-1. Bone (Hock) - Desert Bighorn Sheep - 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	^{89}Sr pCi/g ash pCi/kg*	^{90}Sr pCi/g ash pCi/kg*	% Ash	Ca mg/g	Wet wt. (kg)	Ash wt. (g)
1	SAMPLE NOT COLLECTED										
2	<2.1 <540	5 ± 2.6 1300 ± 670	7.7 ± 3.1 2000 ± 810	<0.31 <80	7.3 ± 3.0 1900 ± 770	<4.6 <1200	5 ± 1.1 1300 ± 280	26	380	0.268	69.7
3	SAMPLE NOT COLLECTED										
4	<2.9 <1000	6.9 ± 2.1 2400 ± 720	10 ± 2.0 3500 ± 690	1.1 ± 0.8 380 ± 280	9.1 ± 2.0 3200 ± 690	<4.3 <1500	3.4 ± 1.0 1200 ± 360	35	380	0.131	45.8
5	SAMPLE NOT COLLECTED										
6	SAMPLE NOT COLLECTED										
7	SAMPLE NOT COLLECTED										
8	<2.1 <660	1.8 ± 1.3 570 ± 470	4.7 ± 1.9 1500 ± 600	<0.63 <200	4.4 ± 1.7 1400 ± 560	<3.4 <1100	2.6 ± 0.97 820 ± 310	32	370	0.185	59.2
9	<2.3 <530	17 ± 3.2 3800 ± 740	16 ± 3.4 3600 ± 790	<0.43 <100	15 ± 3.3 3400 ± 750	<3.6 <820	3.9 ± 1.0 900 ± 240	23	380	0.295	67.8
10	<0.76 <190	2.9 ± 1.4 730 ± 360	10 ± 2.2 2500 ± 550	<0.4 <100	9.2 ± 2.1 2300 ± 530	<4.0 <1000	4.4 ± 1.1 1100 ± 280	25	380	0.249	62.3
11	<2.2 <720	<1.3 <420	12 ± 3.6 3800 ± 1200	2 ± 1.6 660 ± 520	11 ± 3.3 3600 ± 1100	<5.2 <1700	7.9 ± 1.5 2600 ± 500	33	370	0.112	36.9
12	<1.9 <670	<1.3 <460	5.7 ± 2.0 2000 ± 690	<0.57 <200	5.4 ± 1.9 1900 ± 660	<3.4 <1200	3.4 ± 1.0 1200 ± 350	35	370	0.193	67.6

APPENDIX V-1. Bone (Hock) - Desert Bighorn Sheep - 1972 (cont'd)

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	^{89}Sr pCi/g ash pCi/kg*	^{90}Sr pCi/g ash pCi/kg*	% Ash	Ca mg/g	Wet wt. (kg)	Ash wt. (g)
13	<0.87 <200	5.2 ± 1.7 1200 ± 380	7 ± 1.3 1600 ± 420	0.57 ± 0.43 130 ± 100	6.5 ± 1.7 1500 ± 400	<3.5 <800	4.0 ± 1.0 930 ± 240	23	370	0.372	85.6
14	SAMPLE NOT COLLECTED										
15	<2.1 <650	1.5 ± 1.5 470 ± 470	1.2 ± 0.97 370 ± 300	<0.32 <100	1.1 ± 0.9 340 ± 280	<3.5 <1100	4.5 ± 1.3 1400 ± 390	31	380	0.172	53.3
16	<2.2 <690	4.1 ± 2.0 1300 ± 630	2.8 ± 1.4 890 ± 440	<0.31 <100	2.6 ± 1.4 830 ± 440	<4.7 <1500	9.4 ± 1.6 3000 ± 520	32	370	0.220	70.4
17	<1.2 <400	<2.1 <710	7.6 ± 2.9 2600 ± 970	<0.88 <300	7.1 ± 2.6 2400 ± 900	<3.5 <1200	5.3 ± 1.1 1800 ± 390	34	370	0.173	58.8
MEDIAN	<2.1 <650	2.9 730	7.6 2000	<0.57 130	7.1 1900	<3.6 <1200	4.4 1200	32	370		
RANGE	<0.76-<2.9 <190-<1000	<1.3-17 <420-3800	1.2-16 370-3800	<0.31-2 <80-660	1.1-73 340-3600	<3.4-<5.2 <800-<1700	2.6-9.4 820-3000	23-35	370-380		

APPENDIX V-2. Gamma-Emitting Radionuclides and Tritium Concentrations in Tissues - Desert Bighorn Sheep - 1972 (cont'd)

Animal No.	Rumen Contents K g/kg ^{95}Zr pCi/kg ^{103}Ru pCi/kg ^{137}Cs pCi/kg ^{141}Ce pCi/kg	Lungs K g/kg	Kidney K g/kg ^{3}H pCi/l ^{3}H pCi/kg % Moisture
1	SAMPLE NOT COLLECTED	2.4	4.9 420 ± 240 340 ± 190 80
2	1.4 220 510 190 <MDA	SAMPLE NOT COLLECTED	3.7 260 ± 240 210 ± 190 81
3	3.9 <MDA 250 <MDA <MDA	SAMPLE NOT COLLECTED	SAMPLE NOT COLLECTED
4	4.4 <MDA 220 <MDA <MDA	SAMPLE NOT COLLECTED	3.3 280 ± 260 200 ± 190 72
5	5.2 <MDA 770 <MDA <MDA	SAMPLE NOT COLLECTED	3.5 340 ± 240 260 ± 190 78
6	4.3 60 440 80 <MDA	SAMPLE NOT COLLECTED	SAMPLE NOT COLLECTED
7	2.4 <MDA <MDA <MDA <MDA	SAMPLE NOT COLLECTED	2.3 870 ± 250 700 ± 200 80

APPENDIX V-2. Gamma-Emitting Radionuclides and Tritium Concentrations in Tissues - Desert Bighorn Sheep - 1972 (cont'd)

Animal No.	Rumen Contents K g/kg ^{95}Zr pCi/kg ^{103}Ru pCi/kg ^{137}Cs pCi/kg ^{141}Ce pCi/kg	Lungs K g/kg	Kidney K g/kg ^{3}H pCi/l ^{3}H pCi/kg % Moisture
8	5.0 60 290 80 310	SAMPLE NOT COLLECTED	3.3 370 ± 240 290 ± 190 79
9	2.5 270 700 140 <MDA	SAMPLE NOT COLLECTED	Gamma Spectrum Negligible 1800 ± 260 1400 ± 210 80
10	2.3 <MDA 360 140 <MDA	SAMPLE NOT COLLECTED	Gamma Spectrum Negligible <260 <200 77
11	2.4 <MDA 280 <MDA <MDA	SAMPLE NOT COLLECTED	4.5 1400 ± 260 1100 ± 200 77
12	3.0 <MDA 130 40 <MDA	SAMPLE NOT COLLECTED	SAMPLE NOT COLLECTED
13	2.0 130 310 150 <MDA	SAMPLE NOT COLLECTED	2.4 410 ± 260 320 ± 200 78

APPENDIX V-2. Gamma-Emitting Radionuclides and Tritium Concentrations in Tissues - Desert Bighorn Sheep - 1972 (cont'd)

Animal No.	Rumen Contents K g/kg ^{95}Zr pCi/kg ^{103}Ru pCi/kg ^{137}Cs pCi/kg ^{141}Ce pCi/kg	Lungs K g/kg	Kidney K g/kg ^{3}H pCi/l ^{3}H pCi/kg % Moisture
14	3.2 <MDA 310 110 320	SAMPLE NOT COLLECTED	SAMPLE NOT COLLECTED
15	2.6 <MDA 260 <MDA <MDA	SAMPLE NOT COLLECTED	2.6 320 ± 260 260 ± 210 81
16	1.8 <MDA 140 <MDA 320	SAMPLE NOT COLLECTED	2.1 320 ± 260 220 ± 180 69
17		SAMPLE NOT COLLECTED	
MEDIAN	2.6 130 285 125 315	2.4	3.1 355 275 78.5
RANGE	1.4-5.2 60-270 130-770 40-190 310-320	2.4	2.1-4.9 <260-1800 <200-1400 69-81

APPENDIX VI-1. Lungs - Buffalo - Flagstaff, Arizona - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	% Ash	Wet wt. (kg)	Ash wt. (g)
1	<23 <270	71 ± 52 810 ± 590	NA	NA	NA	1.1	2.116	23.3
2	NA	NA	NA	NA	NA	0.95	3.366	31.9
3	<6.7 <74	55 ± 8.8 610 ± 97	NA	NA	NA	1.1	2.621	28.8
4	<7.7 <75	29 ± 11 280 ± 100	NA	NA	NA	0.97	3.393	32.9
5	<5.8 <67	<3 <34	NA	NA	NA	1.2	3.451	41.4
6	<9.1 <82	<4.9 <44	NA	NA	NA	0.9	2.227	20
7			SAMPLE NOT COLLECTED					
MEDIAN	<7.7 <75	29 280				1.035		
RANGE	<5.8-<23 <67-<270	<3-71 <34-810				0.9-1.2		

NA = Not analyzed

*Wet weight

APPENDIX VI-2. Bone - Buffalo - Flagstaff, Arizona - October 1972

Animal No.	^{238}Pu fCi/g ash fCi/kg*	^{239}Pu fCi/g ash fCi/kg*	^{234}U fCi/g ash fCi/kg*	^{235}U fCi/g ash fCi/kg*	^{238}U fCi/g ash fCi/kg*	^{89}Sr pCi/g ash pCi/kg*	^{90}Sr pCi/g ash pCi/kg*	% Ash	Ca mg/g	Wet wt. (kg)	Ash wt. (g)
1	<2.1 <590	<1.5 <420	1.4 ± 0.93 380 ± 260	<0.29 <80	1.3 ± 0.86 360 ± 240	<5 <1400	6.4 ± 1.5 1800 ± 410	28	380	0.267	74.8
2	<2.3 <870	1.8 ± 1.7 670 ± 630	5 ± 2.0 1900 ± 770	<0.18 <70	4.7 ± 1.9 1800 ± 720	<3.4 <1300	2.2 ± 0.97 850 ± 370	38	380	0.286	108.7
3	<1.3 <480	<0.79 <300	1.1 ± 0.53 400 ± 200	<0.079 <30	1.1 ± 0.53 400 ± 200	<3.4 <1300	2.5 ± 0.97 940 ± 370	38	380	0.291	110.6
4	NA	NA	NA	NA	NA	<3.3 <1100	1.3 ± 1.0 460 ± 320	34	380	0.282	95.9
5	NA	NA	NA	NA	NA	<4.7 <1600	5.6 ± 1.4 1900 ± 470	34	380	0.291	98.9
6	NA	NA	NA	NA	NA	<3.3 <910	1.6 ± 0.93 440 ± 260	28	NA	0.226	63.3
7	<1.1 <220	2.2 ± 1.1 450 ± 230	3.2 ± 1.0 640 ± 200	<0.2 <40	2.9 ± 0.9 590 ± 180	<3.5 <700	1.1 ± 0.95 230 ± 190	20	380	1.200	240.0
MEDIAN	<1.7 <535	<1.65 <435	2.3 520	<0.19 <55	2.1 495	<3.4 <1300	2.5 850	34	380		
RANGE	<1.1-<2.3 <220-<870	<0.79-2.2 <300-670	1.1-5 380-1900	<0.079-<0.29 <30-<80	1.1-4.7 360-1800	<3.3-<5 <700-<1600	1.1-6.4 230-1900	20-38	380- 380		

NA = Not analyzed
*Wet weight

APPENDIX VII. Gross* and Microscopic** Pathology Found in Necropsied Animals

Cattle

1	Necropsy findings	- No gross lesions observed
	Histopathologic findings	- Sarcocysts in cardiac and skeletal muscle, peribronchial lymphoid cuffs in lung tissue. Mononuclear infiltrate of kidney.
	Clinical diagnosis	- Normal
2	Necropsy findings	- Lungs emphysematous result of agonal struggles.
	Histopathologic findings	- Emphysema of lungs, mononuclear infiltrate of kidney, cystic corpus luteum in ovary.
	Clinical diagnosis	- Normal
3	Necropsy findings	- No gross lesions noted
	Histopathologic findings	- Sarcocysts in cardiac muscle, focal pleural thickening in lungs.
	Clinical diagnosis	- Normal
4	Necropsy findings	- No gross lesions noted
	Histopathologic findings	- Congested spleen, sarcocysts in cardiac muscle.
	Clinical diagnosis	- Normal
5	Necropsy findings	- No gross lesions noted
	Histopathologic findings	- Sarcocysts in cardiac muscle, lymphoid peribronchial cuffs in lungs.
	Clinical diagnosis	- Normal
6	Necropsy findings	- Advanced post-mortem changes, extreme emphysema of all subcutaneous tissues, advanced bloating. Rupture of left anterior ventral surface of the rumen. A 3-month fetus in uterus.
	Histopathologic findings	- Not sampled as was advanced post-mortem changes.
	Clinical diagnosis	- Tympanites (frothy bloat)

APPENDIX VII. Gross* and Microscopic** Pathology Found in Necropsied Animals (cont'd)

Cattle

7	Necropsy findings	- Cyst on left ovary, low grade endometritis, displaced hip, masculine head, displaced tail head.
	Histopathologic findings	- Sarcocysts in cardiac muscle, mononuclear infiltrate of kidney tissue, inactive ovarian tissue.
	Clinical diagnosis	- Nymphomania (cystic ovaries)
8	Necropsy findings	- No gross lesions noted except trauma associated with bullet passage through lungs, liver, and rumen.
	Histopathologic findings	- No significant lesions, tissues showed autolysis because of 2-3 hour delay between death and necropsy.
	Clinical diagnosis	- Normal
9	Necropsy findings	- No gross lesions observed
	Histopathologic findings	- Sarcocysts of cardiac muscle
	Blood chemistry	- WBC - 5600/mm^3, RBC - 7.5 x $10^6/mm^3$, PCV %- 33, Hgb g % - 9.
	Clinical diagnosis	- Normal
10	Necropsy findings	- No gross lesions observed
	Histopathologic findings	- Sarcocysts of cardiac muscle
	Blood chemistry	- WBCC- 6700/mm^3, RBC - 9.2 x $10^6/mm^3$, PCV %- 41, Hgb g % - 12.
	Clinical diagnosis	- Normal
11	Necropsy findings	- Plaque on lateral canthus of left eye. A 30-day fetus.
	Histopathologic findings	- No significant lesions
	Blood chemistry	- WBC - 5400/mm^3, RBC - 6.4 x $10^6/mm^3$, PCV % - 42, Hgb g % - 12.
	Clinical diagnosis	- Normal

APPENDIX VII. Gross* and Microscopic** Pathology Found in Necropsied Animals (cont'd)

Cattle

12	Necropsy findings	- Plaque on nictating membrane of right eye, fibrous adhesions between liver and diaphragm. A 75-day fetus in uterus.
	Histopathologic findings	- No significant lesions
	Blood chemistry	- WBC - 4000/mm^3, RBC - 7.5 x $10^6/mm^3$, PCV % - 47, Hgb % - 14.
	Clinical diagnosis	- Normal
13	Necropsy findings	- Several feet of rope in rumen, several small liver abscesses (3 cm in diameter). A 45-day fetus.
	Histopathologic findings	- Sarcocysts in cardiac muscle, chronic dermatitis perhaps due to dermatophytes.
	Blood chemistry	- WBC - 4000/mm^3, RBC - 6.8 x $10^6/mm^3$, PCV % - 43, Hgb g % - 13.
	Clinical diagnosis	- Normal
14	Necropsy findings	- Not necropsied as prosector not available, but abdomen greatly distended with gas.
	Histopathologic findings	- Not sampled
	Blood chemistry	- Not sampled
	Clinical diagnosis	- Tympanites (appearance and history)

Mule Deer

1	Necropsy findings	- Trauma associated with passage of bullet through lungs and heart, two feti, ticks on skin and in ear.
	Histopathologic findings	- Mononuclear infiltrate in kidney tissue,
	Blood chemistry	- WBC - 6600/mm^3, RBC - 19 x $10^6/mm^3$, PCV % - 51, Hgb g % - 17.
	Clinical diagnosis	- Normal

APPENDIX VII. Gross* and Microscopic** Pathology Found in Necropsied Animals (cont'd)

Mule Deer

2	Necropsy findings	- Extensive trauma of abdominal viscera with multiple fractures of ribs and right legs as result of impact with a motor vehicle--pregnant.
	Histopathologic findings	- Not sampled as advanced post-mortem changes.
	Clinical diagnosis	- Normal--death from trauma
3	Necropsy findings	- Muscle of lower portion of right rear leg is pale, 2-cm star-shaped scar in liver, trauma of bullet passage through lungs.
	Histopathologic findings	- Sarcocysts in skeletal muscle.
	Clinical diagnosis	- Normal--may be showing a selenium deficiency;i.e., "white muscle disease."
4	Necropsy findings	- No gross lesions noted
	Histopathologic findings	- Sarcocysts in skeletal muscle
	Clinical diagnosis	- Normal

Buffalo

1 through 6 Hunter killed buffalo not necropsied or sampled for histopathologic examination; however, no gross lesions were noted during the butchering procedures. All appeared normal.

Desert Bighorn Sheep

Hunter killed desert bighorn sheep not necropsied or sampled for histopathologic examination.

Horse

Necropsy findings - Edema of prepuce, lower legs and other ventral tissues, 6-8 liters of blood-tinged ascites, ulceration of glandular mucosa of stomach, gas-distended intestines,

APPENDIX VII. Gross* and Microscopic** Pathology Found in Necropsied Animals (cont'd)

Horse

Necropsy findings (cont'd)	- right kidney is involved in a large necrotic tumor mass approximately 40 cm by 30 cm. This tumor mass is attached to the liver which contains numerous metastases and abscesses. Left kidney is hypertrophied. Bladder contains 8 liters of urine. The lungs contain areas of tumor metastases and several small abscesses.
Histopathologic findings	- The neoplasm was an adenocarcinoma, the liver tissue contains a bile duct carcinoma. The lung showed bronchopneumonia. The kidney and lungs contain metastatic neoplasm.
Clinical diagnosis	- 1) Malignant bile duct carcinoma. 2) Bronchopneumonia.

Bobcat

Necropsy findings	- Animal very thin. Left canine tooth missing, incisors are worn--no other lesions noted.
Histopathologic findings	- All tissues show autolysis.
Clinical diagnosis	- Cause of death undetermined--possibly starvation associated with old age.

Coyote

Necropsy findings	- Gastric contents consisted of milk and fecal mixture from Area 15 liquid manure disposal system. No gross lesions noted.
Histopathologic findings	- Lung has pigment accumulation similar to anthracosis. Testis have no mature sperm. No other significant lesions.
Clinical diagnosis	- Normal--death from rifle bullet.

* As reported by the senior author.

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

APPENDIX VIII. Botanical Analysis of Desert Bighorn Sheep Rumen Contents - 1972

Animal No.	Date Collected	Scientific Name	Common Name	Plant Parts	% Composition
1	SAMPLE NOT COLLECTED				
2	11/19/72	Unidentified grasses		Leaves & stems	74
		Oryzopsis hymenoides	Indian ricegrass	Stems	1
		Bromus tectorum	Cheat grass	Seed	Trace
		Eriogonum sp.	Buckwheat	Stems	Trace
		Ephedra nevadensis	Nevada joint-fir	Stems	20
		Artemisia tridentata	Big sagebrush	Leaf	2
		Cowania mexicana	Cliff rose	Leaves & stems	1
		Unidentified shrubs		Leaves & stem fragments	2
3	11/20/72	Unidentified grasses		Leaves & stems	33
		Poa sp.	Bluegrass	Leaves & stems	7
		Unidentified forbs		Stem & fragments	2
		Eriogonum sp.	Buckwheat	Stems	1
		Ephedra nevadensis	Nevada joint-fir	Stems	54
		Unidentified shrubs		Woody fragments	3
4	11/20/72	Unidentified grasses		Leaves & stems	10
		Festuca sp.	Fescue	Leaves & stems	2
		Unidentified forbs		Stems & fragments	1
		Ephedra viridis	Mountain joint-fir	Stems	84
		Cercocarpus intricatus	Little leaf mahogany	Leaves	2
		Ceanothus greggii	Mojave buckbrush	Leaves	1
		Pinus monophylla	Pinyon pine	Leaves	Trace
5	SAMPLE NOT COLLECTED				

APPENDIX VIII. Botanical Analysis of Desert Bighorn Sheep Rumen Contents - 1972 (cont'd)

Animal No.	Date Collected	Scientific Name	Common Name	Plant Parts	% Composition
6	11/23/72	Unidentified grasses		Leaves & stems	14
		Hilaria jamesii	Galleta	Leaves & stems	3
		Eriogonum sp.	Buckwheat	Stems	Trace
		Ephedra viridis	Mountain joint-fir	Stems, stem fibers	71
		Ceanothus greggii	Mojave buckbrush	Leaves	6
		Yucca sp.	Yucca	Leaf fiber	4
		Cercocarpus intricatus	Littleleaf mahogany	Leaves	1
		Artemisia tridentata	Big sagebrush	Leaves	Trace
7	11/25/72	Unidentified grasses		Leaves & stems	84
		Hilaria jamesii	Galleta	Leaves & stems	3
		Eriogonum sp.	Buckwheat	Seeds	1
		Helianthus sp.	Common sunflower	Seeds	1
		Ephedra nevadensis	Nevada joint-fir	Stems	4
		Coleogyne ramosissima	Blackbrush	Stems	1
		Encelia sp.	Encelia	Seeds	Trace
		Atriplex canescens	Four-winged saltbush	Stems	Trace
		Ceanothus sp.	Buckbrush	Leaves & stems	Trace
		Unidentified shrubs		Leaves & stems	6
8	11/26/72	Unidentified grasses		Leaves & stems	89
		Stipa sp.	Needlegrass	Leaves & stems	4
		Oryzopsis hymenoides	Indian ricegrass	Leaves & stems	2
		Unidentified forbs		Leaves & stem fragments	1

APPENDIX VIII. Botanical Analysis of Desert Bighorn Sheep Rumen Contents - 1972 (cont'd)

Animal No.	Date Collected	Scientific Name	Common Name	Plant Parts	% Composition
8	11/26/72	Unidentified shrubs		Leaves, stem fragments	1
		Ephedra nevadensis	Nevada joint-fir	Stems	1
		Cowania mexicana	Cliff rose	Stem fragments	1
		Cercocarpus intricatus	Littleleaf mahogany	Leaves	1
		Artemisia tridentata	Big sagebrush	Leaves & stems	Trace
9	11/26/72	Unidentified grasses		Leaves & stems	87
		Festuca sp.	Fescue	Leaves & stems	6
		Hilaria jamesii	Galleta	Leaves & stems	1
		Hordeum sp.	Foxtail	Leaves & stems	1
		Unidentified	Compositae	Pappus	2
		Eriogonum sp.	Buckwheat	Stem fragments	Trace
10	11/26/72	Unidentified grasses		Leaves & stems	87
		Hilaria jamesii	Galleta	Leaves & stems	1
		Eriogonum sp.	Buckwheat	Leaves	Trace
		Helianthus sp.	Common sunflower	Seeds	Trace
		Ephedra nevadensis	Nevada joint-fir	Stems	9
		Artemisia tridentata	Big sagebrush	Leaves & stems	1
		Ephedra viridis	Mountain joint-fir	Stems	1
		Unidentified shrubs		Leaf fragments	1
11	11/27/72	Unidentified grasses		Leaves & stems	92
		Oryzopsis hymenoides	Indian ricegrass	Stems	2
		Hilaria jamesii	Galleta	Leaves & stems	Trace
		Eriogonum sp.	Buckwheat	Leaves & stems	1
		Sphaeralcea sp.	Mallow	Leaves, stellate tomentum, seeds	1
		Ceanothus greggii	Mojave buckbrush	Leaves & stems	2
		Ephedra nevadensis	Nevada joint-fir	Stems	2

APPENDIX VIII. Botanical Analysis of Desert Bighorn Sheep Rumen Contents - 1972 (cont'd)

Animal No.	Date Collected	Scientific Name	Common Name	Plant Parts	% Composition
11	11/27/72	*Coleogyne ramosissima*	Blackbrush	Leaves & stems	Trace
		Cowania mexicana	Cliff rose	Leaves & stems	Trace
12	11/29/72	Unidentified grasses		Leaves & stems	76
		Poa sp.	Bluegrass	Leaves, florets	2
		Eriogonum sp.	Buckwheat	Stems	Trace
		Phacelia sp.	Phacelia	Seeds	Trace
		Artemisia tridentata	Big sagebrush	Leaves & stems	12
		Cowania mexicana	Cliff rose	Leaves & stems	9
		Unidentified shrubs		Leaf and stem fragments	1
13	12/05/72	Unidentified grasses		Leaves & stems	6
		Hilaria jamesii	Galleta	Leaves & stems	1
		Unidentified forbs		Leaf fragments	Trace
		Cowania mexicana	Cliff rose	Leaves & stems	89
		Artemisia tridentata	Big sagebrush	Leaves & stems	4
14	12/06/72	Unidentified grasses		Leaves & stems	71
		Poa sp.	Bluegrass	Leaves & stems	10
		Festuca sp.	Fescue	Leaves & stems	3
		Eriogonum sp.	Buckwheat	Leaves & stems	Trace
		Artemisia tridentata	Big sagebrush	Leaves & stems	14
		Cowania mexicana	Cliff rose	Leaves & stems	1
		Ephedra nevadensis	Nevada joint-fir	Stems	1
15	12/17/72	Unidentified grasses		Leaves & stems	67
		Stipa sp.	Needlegrass	Leaves & stems	7
		Hilaria jamesii	Galleta	Leaves & stems	5
		Eriogonum sp.	Buckwheat	Stems	1
		Chaenactis sp.	Pin cushion	Seeds	Trace
		Artemisia tridentata	Big sagebrush	Leaves & stems	15

APPENDIX VIII. Botanical Analysis of Desert Bighorn Sheep Rumen Contents - 1972 (cont'd)

Animal No.	Date Collected	Scientific Name	Common Name	Plant Parts	% Composition
15	12/17/72	*Ephedra nevadensis*	Nevada joint-fir	Stems	2
		Unidentified shrubs		Stems & fragments	2
		Cowania mexicana	Cliff rose	Stems	1
16	11/18/72	Unidentified grasses		Leaves & stems	53
		Stipa sp.	Needlegrass	Leaves & stems	3
		Poa sp.	Bluegrass	Leaves & florets	.1
		Eriogonum sp.	Buckwheat	Leaves & stems	1
		Ceanothus sp.	Buckbrush	Leaves	4
		Artemisia tridentata	Big sagebrush	Leaves	2
		Unidentified shrubs		Digested leaves probably *Ceanothus* sp.	36

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