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ANIMAL TISSUE COLLECTIONS AND BONE FLUORIDE CONCENTRATIONS AT COLSTRIP, MT., 1973

COLLECTING REPORT - 1973

Animal Tissue Collections and Bone Fluoride Concentrations at Colstrip, Mt. 1973

Prepared For

Montana State Department of Fish and Game

Prepared By

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January, 1974

Montana Agricultural Experiment Station has been contracted by Montana Power Company to conduct an extensive investigation of ecological baselines and potential effects of power plant stack emissions on rangeland ecosystems in the Colstrip vicinity. The investigation includes long term studies of plant community characteristics and determinations of certain chemical concentrations in soils, plants, and animals.

Last year we applied for a permit to collect big game and upland game birds for fluoride and trace element analyses as part of our study of the total range resource. The State Department of Fish and Game authorized Keith Seaburg and Associates to collect ten antelope, ten deer, twenty grouse, and twenty ring-necked pheasants in the area covered by our study (Permit #633). In addition to these animals, we have collected bone specimens from road kills and bird wings from the Department of Fish and Game's state wide game bird collection. Several specimens of internal organs and bones were also collected from hunters in the area. To date only fluoride analyses have been completed on these specimens. A report of the fluoride concentrations of all the animals collected as of December 1, accompanies this letter. Blank spaces in the tables indicate the samples have not been analyzed at this time. Trace element concentrations in liver and kidney samples collected under the permit and those collected from hunters in the area will be completed during 1974. Bone lead analyses will also be completed during this period. A complete report of these elemental concentrations will be forwarded to you at the completion of these analyses.

Fluoride levels in all the animals collected to date are considered to be baseline concentrations for the study area. These concentrations,

strengthened by further studies during 1974 and the first half of 1975, will be the basis for comparison of fluoride and trace element levels to be determined after the Colstrip power plants become operational in June, 1975.

Cattle

The ages of most of the cattle have not been determined at this time. The Veterinary Research Laboratory (Bozeman, Montana) has personnel qualified to age these animals from their tooth structure. They have offered their services and the jaw bones will be delivered to them for aging in early 1974. Fluoride levels found in Colstrip area cattle are near or below those reported by Ewing (Ewing, 1962) for cattle grazing on unpolluted pastures.

Deer

Only mule deer were collected during 1973. These animals were aged on the basis of tooth structure by Kenneth Greer of the Montana Fish and Game Research Center. Ages ranged from two months to over eight years and fluoride showed an accumulation in these animals as they increased in age. The concentrations of this element in the bones of older mule deer did not reach the concentrations found in older cattle.

Mule Deer - Age and fluoride concentrations in bones (ppm)

Age (years)	Rib	Femur	Mandible
0.2	80	55	75
0.5	110	70	55
1.0	158	100	115

Mule Deer (Continued)

Age (years)	Rib	Femur	Mandible
1.0	200	198	160
1.2	160	80	---
1.5	190	170	160
2.0	219	147	169
2.5	216	166	197
3.5	290	224	280
3.5	230	255	215
3.5	165	157	150
over 8	---	340	375

Antelope

Age distribution was not complete in these animals. They ranged from 2.3 to six years; however, several animals have not been aged at this time. The accumulation of fluorine as a function of age so evident in deer may become more obvious with further sampling of lower and upper age groups of antelope. Further sampling is essential to provide evidence of this accumulation in antelope. As in the mule deer study, bone fluoride concentrations in older antelope are lower than comparable levels in older cattle utilizing the same range. The reasons behind this phenomena are not clear at this time.

Antelope - Age and fluoride concentrations in bones (ppm)

Age (years)	Rib	Femur	Mandible
2.3	185	205	150
2.3	---	161	---
3.3	240	245	235
3.3	255	180	210
5.3	217	240	160
5.5	---	184	210
6.0	---	325	245

Grouse

Although only three grouse were collected in the Colstrip sampling area, 75 wings or fragments of wings were received from the Fish and Game Department after aging in their annual game bird survey. If samples can be collected in 1974 from the Colstrip area to substantiate the hypothesis that the Colstrip area grouse population is truely represented by the large sample collected from the Department of Fish and Game, than a solid base-line fluoride concentration for these animals will be available from our data. I feel that the 78 animals analyzed to date are representative of those that will be influenced by the emissions of the power plant, but cannot base this upon scientific evidence in consideration of the limited sample of grouse collected from Colstrip to date.

Ring-Necked Pheasants

Fluoride levels in these animals are higher than comparable samples from sharptail grouse. Feeding habits probably contribute to this difference. Unfortunately, birds can only be aged into two categories - juvenile and adult. This prevents more thorough analyses of fluoride accumulation in these animals as a function of their age. The data available, however, indicates some accumulation in the ring-necked pheasants as they get older. The small sample size prohibits generalization from this data.

Ring-necked pheasants - Age and fluoride concentration in bones (ppm)

Age	femur	metacarpus	radius & ulna
1 month	295	300	240
1 month	---	315	265
Juvenile	---	230	240
Juvenile	---	370	---
AVERAGE	295	305	249
Adult	600	550	600
Adult	255	265	---
Adult	230	250	350
Adult	---	525	1275
Adult	---	660	---
Adult	310	300	290
Adult	200	235	235
Adult	425	560	400
Adult	---	485	685
AVERAGE	369	427	549

Peromyscus maniculatus (Deer mice)

Sex and age determinations are very difficult in this species. Age determinations were based upon size of the animal alone and sex was based on external appearances, not on disection which is essential if sexual identification is of particular importance. Little or no sexual differences were found in femur fluoride levels, but differences were found in the fluoride concentrations of the femurs of the two age groups recognized. Since fluoride has been shown to accumulate in individuals through-

out their life span this was anticipated. The marked elevation of femur fluoride concentrations in mice trapped in the vicinity of the mine tipple was noted. Small groups of mice from other mine areas did not show the marked elevation of femur fluoride found in these animals. The source of fluoride is unknown at this time but a study has been developed to thoroughly investigate this elevation of femur fluoride levels in the summer of 1974.

Mice - Average fluoride concentrations (ppm)

	Adult	Sub-adult
Tipple area	645	567
Rangeland	328	218

Microtus pennsylvanicus (Meadow vole)

Femur fluoride levels in these animals were almost twice those of the deer mice. This may be attributed to differences in their diet. The meadow voles collected at the trapping site near the mine tipple again showed a marked elevation of femur fluoride concentrations compared to the same animals from open rangeland sites. This difference in femur fluoride levels will be further studied in the summer of 1974.

Voles - Average femur fluoride concentration (ppm)

	Adult	Sub-adult
Tipple area	1090	567
Rangeland	579	302

Other Animals

Cottontail rabbit fluoride levels averaged 257 ppm in adult femurs and 220 ppm in sub-adult animals. The three coyotes analyzed to date are of unknown age and had femur fluoride levels of 350, 220, and 790 ppm. The lone adult badger analyzed had 595 ppm fluoride in her femur. A single weasel was captured in a mouse trap in the high fluoride tipple area. This animal revealed 625 ppm fluoride in its femur.

Summary

As in fluoride levels in the green plants of the Colstrip area, the concentration of fluoride in animal bones analyzed to date is normal or lower for those animals for which fluoride levels have been published. Unfortunately these levels are not available for most animals, and therefore the concentrations established by this survey cannot be verified from current literature. They will simply serve as the baseline for comparison of values determined after power plant operation.

CATTLE

Number	Age (years)	Sex	Where Collected	Samples	Fluoride conc. (ppm)
1	3	male	R42E, T1S, Sec 1	femur	205
				jaw	330
				liver	
				kidney	
2	4-6	female	R43E, T1S, Sec 14	femur	
				rib	
				jaw	
3	unknown	female	R42E, T1N, Sec 6	femur	515
4	unknown	female	R42E, T1N, Sec 6	femur	200
				jaw	
5	unknown	female	R42E, T2N, Sec 5	femur	690
				jaw	555
				rib	680
6	unknown	female	R42E, T1N, Sec 6	femur	275
7	unknown	female	R42E, T2N, Sec 32	femur	635
				jaw	570
8	unknown	female	R42N, T2N, Sec 5	femur	375
9	unknown	unknown	R41E, T2N, Sec 22	femur	710
				jaw	690
				rib	725
10	unknown	unknown	R41E, T1N, Sec 9	femur	155
				jaw	200
11	unknown	female	R41E, T2N, Sec 22	femur	590
				jaw	670
				rib	730

MULE DEER

Number	Sex	Age (years)*	Where Collected	How Collected	Samples	Fluoride conc. in bones (ppm)
1	female	1	R41E, T1N, Sec 18	Permit 633	rib	158
					femur	100
					jaw	115
					liver	
					kidney	
					fur	
2	male	2	R41E, T1N, Sec 27	Permit 633	rib	219
					femur	147
					jaw	169
					liver	
					kidney	
					fur	
3	female	3.5	R42E, T1N, Sec 33	Permit 633	rib	290
					femur	224
					jaw	280
					liver	
					kidney	
					fur	
4	female	3.5	R42E, T1N, Sec 33	Permit 633	rib	230
					femur	255
					jaw	215
					liver	
					kidney	
					fur	
5	female	1	R43E, T2N, Sec 24	Permit 633	rib	200
					femur	198
					jaw	160
					liver	
					kidney	
					fur	

* Ages determined by Kenneth Greer of Montana State Fish and Game Research Center, M. S. U.

MULE DEER (page 2)

Number	Sex	Age (years)	Where Collected	How Collected	Samples	Fluoride conc. in bones (ppm)
6	female	0.2	R41E, T1N, Sec 25	Permit 633	rib	80
					femur	55
					jaw	75
					liver	
					kidney	
7	female	1.2	R42E, T1N, Sec 7	Permit 633	rib	160
					femur	80
					jaw	lost
					liver	
					kidney	
8	female	0.5	R42E, T1N, Sec 8	Permit 633	rib	110
					femur	70
					jaw	55
					liver	
					kidney	
9	female	1.5	R42E, T1N, Sec 8	Permit 633	rib	190
					femur	170
					jaw	160
					liver	
					kidney	
10	male	unknown	R41E, T1N, Sec 7	Permit 633	rib	
					femur	
					jaw	
					liver	
					kidney	

MULE DEER (page 3)

Number	Sex	Age (years)	Where Collected	How Collected	Samples	Fluoride conc. in bones (ppm)
11	female	unknown but young	R42E, T1N, Sec 33	hunter	rib femur jaw liver kidney	150 155 150
12	female	unknown but young	R42E, T1N, Sec 33	hunter	femur jaw liver kidney	205 165
13	unknown	3.5	R43E, T1S, Sec 14	roadkill	rib femur jaw	165 157 150
14	male	over 8	R41E, T1S,	unknown, found dead in field	femur jaw	340 375
15	female	2.5	R41E, T2N, Sec 21	roadkill	rib femur jaw	216 166 197
16	male	unknown	R42E, T1N, Sec 8	hunter	rib femur jaw liver kidney	
17	male	unknown	R42E, T1N, Sec 8	hunter	rib femur jaw liver kidney	

ANTELOPE

Number	Sex	Age (years)	Where Collected	How Collected	Samples	Fluoride conc. in bones (ppm)
1	female	5.5	R41E, T3N, Sec 26	Permit 633	femur	184
					jaw	210
					liver	
					kidney	
					fur	
2	male	2.3	R42E, T1N, Sec 8	Permit 633	rib	185
					femur	205
					jaw	151
					liver	
					kidney	
					fur	
3	male	3.3	R41E, R1N, Sec 15	Permit 633	rib	240
					femur	245
					jaw	235
					liver	
					kidney	
					fur	
4	male	2.3	R41E, T2N, Sec 20	Permit 633	rib	
					femur	161
					jaw	
					liver	
					kidney	
					fur	
5	male	3.3	R42E, T2N, Sec 34	Permit 633	rib	255
					femur	180
					jaw	210
					liver	
					kidney	
6	male	5.3	R42E, T2N, Sec 34	Permit 633	rib	217
					femur	240
					jaw	160
					liver	
					kidney	

ANTELOPE (page 2)

Number	Sex	Age (years)	Where Collected	How Collected	Samples	Fluoride conc. in bones (ppm)
7	male	unknown	R40E, T3N, Sec 23	Permit 633	rib femur jaw liver kidney	
8	female	unknown	R40E, T3N, Sec 23	Permit 633	rib femur jaw liver kidney	
9	male	unknown	R42E, T1N, Sec 36	hunter	rib liver kidney	
10	male	unknown	R43E, T1N, Sec 36	hunter	rib liver kidney	155
11	female	unknown	R41E, T2N, Sec 36	caught in fence	rib femur jaw	155 145 130
12	female	unknown	R42E, T1N, Sec 3	hunter	femur jaw liver kidney	190 165
13	female	6	R42E, T1N, Sec 3	hunter	femur jaw liver kidney	325 345

ANTELOPE

Number	Sex	Age (years)	Where Collected	How Collected	Samples	Fluoride conc. in bones (ppm)
14	female	unknown	R42E, T2N, Sec 1	Permit 633	rib femur jaw liver kidney	
15	male	unknown	R42E, T2N, Sec 1	Permit 633	rib femur jaw liver kidney	

GROUSE

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. (ppm)
1	Sharptail	female	Adult	R41E, T1N, Sec 3	Permit 633	femur	455
						metacarpus	575
						liver	
						kidney	
2	Sagegrouse	male	Adult	R43E, T1N, Sec 17	Permit 633	femur	290
						metacarpus	290
						liver	295
						kidney	
						feathers	
3	Sagegrouse	male	Adult	R42E, T1S, Sec 5	Permit 633	femur	305
						metacarpus	250
						radius & ulna	255
						liver	
						kidney	
						feathers	
4	Sharptail	unknown	unknown	R40E, T2N, Sec 2	Hunter	metacarpus	370
						radius & ulna	
						feathers	
5	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	160
6	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	145
7	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	130
8	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	125

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. (ppm)
9	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	335
10	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	140
11	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	190
12	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	145
13	Sharptail	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	205
14	Sharptail	female	Juvenile	Powder River, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	85 150
15	Sagegrouse	female	Adult	Rosebud County, Ingomar, Mt.	Fish & Game Game Bird Survey	metacarpus	240
16	Sharptail	female	Adult	Powder River, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus	250
17	Sharptail	female	Adult	Powder River, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus	215
18	Sagegrouse	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	290
19	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	200 124

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. (ppm)
20	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	264 130
21	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	135 130
22	Sagegrouse	female	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	radius & ulna	115
23	Sagegrouse	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	635
24	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	167
25	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	135
26	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	135
27	Sharptail	unknown	Juvenile	Powder River, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	175
28	Sharptail	unknown	Juvenile	Treasure County, Sarpy Creek, Mt.	Fish & Game Game Bird Survey	metacarpus	80
29	Sharptail	unknown	Juvenile	Treasure County, Sarpy Creek, Mt.	Fish & Game Game Bird Survey	radius & ulna	165
30	Sharptail	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	340
31	Sharptail	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	350

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. (ppm)
32	Sharptail	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	270
33	Sharptail	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	290
34	Sharptail	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	420 390
35	Sharptail	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	405 400
36	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	95 155
37	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	230 130
38	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	214 140
39	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	115 110
40	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	150 125
41	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	115 125
42	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	115 80
43	Sharptail	male	Adult	Powder River, Ashland, Mt.	Fish & Game Game Bird Survey	radius & ulna	205

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. (ppm)
44	Sharptail	male	Juvenile	Otter Creek, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	245 170
45	Sharptail	male	Juvenile	Otter Creek, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	195 140
46	Sharptail	male	Juvenile	Otter Creek, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	205 165
47	Sharptail	male	Juvenile	Otter Creek, Ashland, Mt.	Fish & Game Game Bird Survey	radius & ulna	140
48	Sharptail	male	Juvenile	Otter Creek, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	85 80
49	Sharptail	male	Juvenile	Otter Creek, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	230 160
50	Sharptail	male	Juvenile	Otter Creek, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	95 115
51	Sharptail	male	Juvenile	Otter Creek, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	175 150
52	Sharptail	male	Juvenile	Powder River, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	150 150
53	Sagegrouse	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	255
54	Sharptail	female	Adult	Treasure County, Sarpy Creek, Mt.	Fish & Game Game Bird Survey	metacarpus	400

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. (ppm.)
55	Sharptail	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	240
56	Sharptail	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	160 255
57	Sagegrouse	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	330
58	Sagegrouse	female	Juvenile	Treasure County, Sarpy Creek, Mt.	Fish & Game Game Bird Survey	metacarpus	160
59	Sagegrouse	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	290
60	Sharptail	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	175 140
61	Sharptail	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	230
62	Sharptail	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	495
63	Sagegrouse	female	Juvenile	Rosebud County, Ingomar, Mt.	Fish & Game Game Bird Survey	metacarpus	220
64	Sharptail	unknown	Juvenile	Powder River, Lonnette, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	115 80
65	Sagegrouse	female	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	145

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. (ppm)
66	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	250 270
67	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt	Fish & Game Game Bird Survey	metacarpus radius & ulna	175 150
68	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	radius & ulna	135
69	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	200
70	Sharptail	unknown	Juvenile	Rosebud County Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	185
71	Sharptail	unknown	Juvenile	Rosebud County Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	90
72	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	100
73	Sharptail	unknown	Juvenile	Powder River, Ashland, Mt.	Fish & Game Game Bird Survey	metacarpus	160
74	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	radius & ulna	127
75	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus radius & ulna	85 95
76	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	radius & ulna	105
77	Sharptail	unknown	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	190

GROUSE (page 8)

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. (ppm)
78	Sharptail	unknown	unknown	Rosebud County, Forsyth, Mt.	Hunter	metacarpus radius & ulna	

RING-NECKED PHEASANTS

Number	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. in Bones (ppm)
1	unknown	1 month	R40E, T2N, Sec 33	Permit 633	femur	295
					metacarpus	300
					radius & ulna	240
					liver	
					kidney	
					feathers	
2	unknown	1 month	R41E, T3N, Sec 26	Permit 633	femur	
					metacarpus	315
					radius & ulna	265
					liver	
					kidney	
					feathers	
3	male	Adult	R42E, T1N, Sec 33	Permit 633	femur	555
					liver	
					kidney	
4	male	Adult	R43E, T1N, Sec 9	Permit 633	femur	600
					metacarpus	550
					radius & ulna	600
					liver	
					kidney	
					feathers	
5	female	Adult	R41E, T3N, Sec 28	Permit 633	femur	310
					metacarpus	300
					radius & ulna	290
					liver	
					kidney	
					feathers	

RING-NECKED PHEASANTS (page 2)

Number	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. in Bones (ppm)
6	female	Adult	R41E, T3N, Sec 28	Permit 633	femur	200
					metacarpus	235
					radius & ulna	235
					liver	
					kidney	
					feathers	
7	male	Adult	R41E, T3N, Sec 28	Permit 633	femur	255
					metacarpus	265
					radius & ulna	contaminated
					liver	
					kidney	
					feathers	
8	female	Adult	R41E, T3N, Sec 27	Permit 633	femur	425
					metacarpus	560
					radius & ulna	400
					liver	
					kidney	
					feathers	
9	male	Adult	R42E, T1S, Sec 12	Permit 633	femur	230
					metacarpus	250
					radius & ulna	350
					liver	
					kidney	
					feathers	
10	female	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	485
					radius & ulna	685
					feathers	

RING-NECKED PHEASANTS (page 3)

Number	Sex	Age	Where Collected	How Collected	Samples	Fluoride conc. in Bones (ppm)
11	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	525
					radius & ulna	1275
					feathers	
12	male	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus	230
					radius & ulna	240
					feathers	
13	female	Juvenile	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus feathers	370
14	male	Adult	Rosebud County, Forsyth, Mt.	Fish & Game Game Bird Survey	metacarpus feathers	660

PEROMYSCUS MANICULATUS

Number	Age	Sex	Direction & Distance From Power Plant Site	Femur Fluoride Concentration (ppm)
1	Adult	female	SE - 2.0	550
2	Adult	male	NE - 1.0	310
3	Adult	male	NE - 1.0	330
4	Adult	male	SE - 2.0	280
5	Adult	male	SE - 2.0	400
6	Adult	male	NE - 1.0	395
7	Adult	male	NE - 1.0	340
8	Adult	male	SE - 2.0	365
9	Adult	male	SE - 2.0	325
10	Adult	male	NE - 1.0	400
11	Adult	female	NE - 1.0	190
12	Adult	male	SE - 2.0	240
13	Adult	male	SE - 2.0	345
14	Adult	female	SE - 1.0	290
15	Adult	male	SE - 1.0	340
16	Adult	female	SE - 1.0	880
17	Adult	male	We - 4.0	360
18	Sub-adult	female	SE - 1.0	150
19	Adult	male	SE - 1.0	270
20	Adult	male	We - 4.0	200
21	Adult	male	SE - 1.0	310
22	Adult	male	SE - 1.0	180
23	Sub-adult	male	SE - 1.0	110
24	Adult	female	SE - 1.0	290
25	Adult	male	SE - 1.0	---
26	Sub-adult	male	SE - 1.0	155
27	Adult	male	SE - 1.0	380
28	Adult	female	SE - 1.0	160
29	Adult	female	SE - 4.0	670
30	Adult	male	SE - 4.0	700
31	Adult	female	SE - 4.0	955
32	Adult	female	SE - 4.0	190
33	Adult	male	SE - 4.0	560

PEROMYSCUS MANICULATUS (page 2)

Number	Age	Sex	Direction & Distance From Power Plant Site	Femur Fluoride Concentration (ppm)
34	Adult	female	SE - 4.0	575
35	Adult	male	SE - 4.0	560
36	Adult	male	SE - 4.0	500
37	Adult	female	SE - 4.0	1065
38	Adult	female	SE - 4.0	720
39	Sub-adult	unknown	NE - 1.5	---
40	Sub-adult	unknown	NE - 1.5	405
41	Sub-adult	unknown	NE - 1.5	360
42	Adult	female	SE - 4.0	1245
43	Adult	female	So - 1.5	334
44	Sub-adult	male	So - 1.5	305
45	Adult	male	So - 1.5	310
46	Adult	female	So - 1.5	305
47	Adult	male	So - 1.5	515
48	Adult	female	So - 1.5	540
49	Adult	female	So - 1.5	480
50	Adult	female	So - 1.5	200
51 (lost)	-----	------	--------	---
52	Adult	female	So - 1.5	260
53	Adult	female	So - 1.5	385
54	Adult	female	So - 1.5	375
55	Adult	male	So - 1.5	180
56	Adult	female	So - 1.5	240
57	Sub-adult	female	So - 1.5	211
58	Adult	female	So - 1.5	220
59	Adult	male	So - 1.5	300
60	Adult	male	So - 1.5	230
61	Adult	female	So - 1.5	220
62	Adult	male	So - 1.5	1280
63	Adult	male	SW - 1.0	310
64	Adult	female	SW - 1.0	190
65	Sub-adult	female	So - 1.5	160
66	Sub-adult	male	So - 1.5	100
67	Adult	male	So - 1.5	180

PEROMYSCUS MANICULATUS (page 3)

Number	Age	Sex	Direction & Distance From Power Plant Site	Femur Fluoride Concentration (ppm)
68	Adult	female	So - 1.5	190
69	Adult	female	So - 1.5	130
70	Adult	male	So - 1.5	170
71	Adult	male	SW - 1.0	250
72	Adult	male	So - 1.5	180
73	Adult	male	So - 3.5	270
74	Adult	male	SW - 1.0	290
75	Adult	male	SW - 1.0	220
76	Adult	female	SW - 1.5	250
77	Adult	female	SW - 1.0	195
78	Sub-adult	unknown	SE - 4.0	300
79	Sub-adult	female	SE - 4.0	---
80	Adult	female	SE - 4.0	345
81	Sub-adult	unknown	SE - 4.0	1150
82	Sub-adult	unknown	SE - 4.0	1110
83	Sub-adult	unknown	SE - 4.0	375
84	Sub-adult	unknown	SE - 4.0	1290
85	Sub-adult	unknown	SE - 4.0	410
86	Sub-adult	unknown	SE - 4.0	580
87	Sub-adult	unknown	SE - 4.0	360
88	Sub-adult	unknown	SE - 4.0	310
89	Adult	male	SE - 4.0	190
90	Sub-adult	unknown	SE - 4.0	550
91	Sub-adult	unknown	SE - 4.0	305
92	Sub-adult	unknown	SE - 4.0	965
93	Adult	female	SE - 4.0	354
94	Sub-adult	male	SE - 4.0	357
95	Adult	female	SE - 4.0	930
96	Sub-adult	unknown	SE - 4.0	430
97	unknown	unknown	SE - 4.0	1160
98	Sub-adult	unknown	SE - 4.0	1160
99	unknown	unknown	SE - 4.0	955
100	Adult	female	SE - 4.0	560

PEROMYSCUS MANICULATUS (page 4)

Number	Age	Sex	Direction & Distance From Power Plant Site	Femur Fluoride Concentration (ppm)
101	Adult	male	SE - 4.0	345
102	Adult	female	SE - 4.0	665
103	Adult	female	SE - 4.0	535
104	Adult	female	SE - 4.0	405
105	unknown	unknown	SE - 4.0	390
106	unknown	unknown	SE - 4.0	415
107	unknown	unknown	SE - 4.0	385

MICROTUS PENNSYLVANICUS

Number	Age	Sex	Direction & Distance From Power Plant Site	Femur Fluoride conc. (ppm)
1	Adult	female	SE - 2.0	705
2	Sud-adult	unknown	SE - 4.0	850
3	Sub-adult	unknown	SE - 4.0	680
4	Sub-adult	unknown	SE - 4.0	460
5	Sub-adult	unknown	SE - 4.0	520
6	Sub-adult	unknown	SE - 4.0	420
7	Sub-adult	unknown	SE - 4.0	470
8	Adult	female	SE - 4.0	1280
9	Adult	female	SE - 4.0	830
10	Adult	female	SE - 4.0	1160
11	Adult	male	ESE - 4.5	560
12	Sub-adult	unknown	ESE - 4.5	415
13	Sub-adult	unknown	ESE - 4.5	390
14	Sub-adult	unknown	ESE - 4.5	100
15	Adult	female	ESE - 4.5	810
16	Adult	male	ESE - 4.5	410
17	Adult	female	ESE - 4.5	410

RABBITS (COTTONTAIL)

Number	Sex	Age	Where Collected	How Collected	Samples	Femur Fluoride Concentration (ppm)
1	unknown	unknown	R43E, T1S, Sec 2	road kill	femur	235
2	male	Adult	R42E, T1N, Sec 1	shot	femur liver kidney	160
3	male	Adult	R42E, T1N, Sec 1	shot	femur liver kidney	380
4	unknown	Adult	R41E, T3N, Sec 28	shot	femur liver kidney	195
5	unknown	Adult	R42E, T1N, Sec 30	road kill	femur	315
6	male	Adult	R43E, T1N, Sec 29	shot	femur liver kidney	245
7	unknown	1 month	R43E, T1N, Sec 32	shot	femur liver kidney	265
8	male	Adult	R42E, T1N, Sec 33	shot	femur liver kidney	260
9	male	Adult	R43E, T2N, Sec 21	shot	femur liver kidney	270
10	unknown	unknown	R41E, T1S, Sec 22	road kill	femur	170
11	female	Adult	R41E, T1N, Sec 25	shot	femur liver kidney	220

RABBITS (COTTONTAIL) (page 2)

Number	Sex	Age	Where Collected	How Collected	Samples	Femur Fluoride Concentrations (ppm)
12	female	Adult	R41E, T1N, Sec 26	shot	femur liver kidney	335
13	female	Adult	R41E, T3N, Sec 28	shot	femur liver kidney	225
14	unknown	Adult	R41E, T1S, Sec 1	road kill	femur	400
15	unknown	unknown	R41E, T2N, Sec 22	shot	femur liver kidney	130
16	female	Adult	R41E, T1N, Sec 8	shot	femur liver kidney	182
17	unknown	Juvenile	R41E, T1N, Sec 22	shot	femur liver kidney	174
18	female	Adult	R41E, T1N, Sec 12	shot	femur liver kidney	136
19	female	Adult	R41E, T2N, Sec 18	shot	femur liver kidney	255

CARNIVORES

Number	Type	Sex	Age	Where Collected	How Collected	Samples	Fluoride (ppm)
1	Coyote	unknown	unknown	R43E, T1S, Sec 14	found dead in field	femur	350
2	Coyote	unknown	unknown	R42E, T2N, Sec 29	found dead in field	femur jaw	220 225
3	Coyote	unknown	unknown	R41E, T1N, Sec 25	road kill	femur	790
4	Badger	female	adult	R41E, T1N, Sec 36	road kill	femur liver kidney	595
5	Weasel	male	young adult	R41E, T1N, Sec 7	caught in mouse trap	femur liver kidney	625