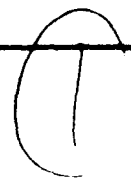
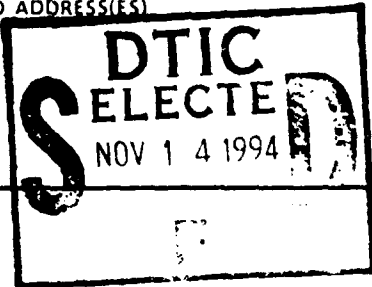


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13. ABSTRACT (Maximum 200 words) THE PURPOSE OF THIS SPECIAL STUDY IS TO ASSIST IN DETERMINING THE CAUSE OF DEATH OF WATERFOWL AND SMALL REPTILES ON SEVERAL SMALL LAKES AT RMA AND TO SUPPORT INVESTIGATIONS AS TO THE EXISTENCE OF POSSIBLE HEALTH HAZARDS. ALTHOUGH THIS PROBLEM IS NOT NEW, QUANTITATIVE DATA ON PREVIOUS KILLS ARE NOT AVAILABLE. SUBSEQUENT TO THE DISCOVERY OF THE MOST RECENT KILL, THE LAKES ON RMA WERE FLOODED AS A RESULT OF SPRING RAINS. USAEHA HAS BEEN REQUESTED TO TEST SOIL AND WATER SAMPLES FROM VARIOUS LAKES IN ORDER TO ATTEMPT TO FIND A PRESUMPTIVE CAUSE FOR THESE DEATHS. THE SAMPLES TESTED AT USAEHA WERE NOT TOXIC TO THE ANIMAL SPECIES TESTED. ANALYTICAL TESTING OF SEDIMENT AND WATER SAMPLES FAILED TO REVEAL DANGEROUS LEVELS OF PESTICIDE OR HEAVY METAL CONTAMINATION. THE CAUSE OF KILLS FOUND IN EARLY SPRING MAY BE ATTRIBUTABLE TO POISONING AT OTHER AREAS, OR THE COMPOSITION OF THESE LAKES MAY HAVE CHANGED SIGNIFICANTLY SINCE LATE WINTER OR EARLY SPRING, POSSIBLY AS A RESULT OF FLOODING CONDITIONS REPORTED IN THE RMA AREA IN APRIL					
14. SUBJECT TERMS TOXICITY, WATERFOWL, REPTILES, QUAILS				15. NUMBER OF PAGES	
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OFFICIAL STUDY NO. 93-055-73/74
SMALL ANIMAL DEATHS
ROCKY MOUNTAIN ARSENAL
DENVER, COLORADO
MAY-AUGUST 1973

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US ARMY
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ABERDEEN PROVING GROUND, MD 21010



USAEMA-LT

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

SPECIAL STUDY NO. 92-055-73/74
SMALL ANIMAL DEATHS
ROCKY MOUNTAIN ARSENAL
DENVER, COLORADO
MAY-AUGUST 1973

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1. REFERENCES.

a. Letter, AMCOM, USA Materiel Command, 25 May 1973, subject: Small Animal Deaths - Rocky Mountain Arsenal.

b. TMX, USAEMA, 131457Z Jun 73, subject: USAEMA Personnel Visit to Rocky Mountain Arsenal.

2. PURPOSE. To assist in determining the cause of death of waterfowl and small reptiles on several small lakes at Rocky Mountain Arsenal (RMA) and to support investigations as to the existence of possible health hazards.

3. BACKGROUND. Many dead waterfowl and reptiles have been found in Lakes, C, D, and E. Although this problem is not new, quantitative data on previous kills are not available. Biomedical Laboratories, Edgewood Arsenal, has been studying samples from several lakes without finding a pathologic etiology. Subsequent to the discovery of the most recent kill, the lakes on RMA were flooded as a result of Spring rains. USAEMA has been requested (reference paragraph 1a) to test soil and water samples from various lakes in order to attempt to find a presumptive cause for these deaths. Samples of sediment and water delivered to USAEMA were collected after these flood conditions had subsided. The samples used for feeding studies conducted by this agency were delivered separately from those used for heavy metal and pesticide analyses.

4. SUMMARY OF FINDINGS.

a. Feeding Study Hazard Evaluation.

(1) Samples. Two 55 gallon drums containing water samples from Lakes C and D at RMA were received by this agency. The samples were amber to brown, had an acrid odor, and were neutral (pH 7.2-7.4) in reactivity.

(2) Test Procedures. Fifteen male and fifteen female coturnix quail and thirty male albino rats (Sprague-Dawley, Wistar-Derived) were divided into three groups. Each group received either water sample C or D or local tap water as the sole supply of drinking water for 30 days.

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(3) Results. During the 30 day study, neither rats nor quail given lake water samples showed any differences in growth pattern, general health, activities or water consumption when compared to the control group receiving tap water. These results are summarized in Tables 1 and 2. This study was continued for an additional 30 days and no effects on animal health or water uptake were observed.

b. Analytical Chemistry.

(1) Samples. The following samples (RMA identification) were tested for heavy metal contamination:

Sediment: C-1, C-2, D-1, D-2, E-1, E-2

Water: C-17, D-17, E-17, D-1, C-2, E-1, D, C

(2) Testing. Soil samples were analyzed for mercury, cadmium, arsenic and lead by comparative x-ray fluorescence. Water samples were analyzed, as indicated in Table 3, by atomic absorption spectroscopy.

(3) Results. Analyses of soil samples indicated no heavy metals, except zirconium, at concentrations of 25 ppm or greater. Zirconium was found in all samples, in quantities of 0.05 to 0.1%. Among the water samples, only the cadmium level in sample D exceeded acceptable water levels as established by US Public Health Drinking Water Standards currently in effect.

c. Pesticide Residue Analyses.

(1) Samples. The following samples were tested for pesticide contamination:

Sediment: C, D, E, C-2, D-1, E-1

Water: C, D

(2) Testing. Samples were analyzed for organochlorine and organophosphorus contamination using gas chromatography with electron capture detection. The results of these tests are presented in Table 4.

(3) Results. No noteworthy concentrations of pesticides were found in any sample tested.

USAEMA-LT Special Study No. 99-055-73/74, Small Animal Deaths, Rocky Mountain Arsenal, Denver, Colorado, May-August 1973

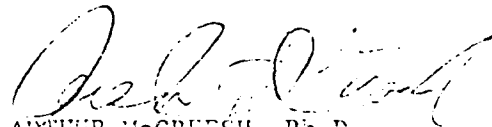
5. DISCUSSION.

a. Waterfowl kills apparently have been reported throughout eastern Colorado, which is in the migratory flight path of these birds, and these kills have been related to contamination by oil sludge ponds.

b. At a meeting held at RMA on 14 June attended by representatives of RMA, AEMA, and the AEC Ecology Program (from Edgewood Arsenal and Deseret Test Center) a program was formulated to regularly monitor wildlife, soil and water from the lake areas. The program will begin in the very near future.

c. The tests conducted on various soil and water samples submitted to USAEMA, fail to provide evidence of any form of toxic materials capable of causing the reported kills of wildlife. The high level of zirconium found in soil samples has not been explained, but may be a normal constituent of area soil. Water samples from lakes C and D were found to have pH values ranging between 7.2 and 7.4. Lake D was previously reported by RMA personnel to be very alkaline (pH=10).

6. CONCLUSIONS. The samples tested at AEMA were not toxic to the animal species tested. Analytical testing of sediment and water samples failed to reveal dangerous levels of pesticide or heavy metal contamination. The cause of kills found in early spring may be attributable to poisoning at other areas, or the composition of these lakes may have changed significantly since late winter or early spring, possibly as a result of flooding conditions reported in the RMA area in April and May 1973.


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APPROVED:


MARSHALL STEINBERG, PhD
LTC, MSC
Director, Laboratory Services

Study No. 99-55-73/74 Small Animal Deaths, RMA

Table 1. Water Consumption (grams per animal per day) by Male Albino Rats and Male and Female Coturnix Quail Given RMA Water Samples as Drinking Water, ad libitum.

Test Animals	No. Animals	Sample	Test Day				
			1	8	15	22	30
Rats	10	C <u>1</u> /	24.1	25.3	28.8	29.1	28.4
	10	D <u>2</u> /	27.1	26.2	30.3	32.6	30.2
	10	Control <u>3</u> /	28.1	26.5	28.1	31.7	27.4
Quail	10	C <u>1</u> /	48.5	91.4	57.4	101.0	82.5
	10	D <u>2</u> /	32.1	41.5	26.5	40.0	51.0
	10	Control <u>3</u> /	34.5	41.8	30.6	31.5	44.7

1/ Water from a 55 gallon drum received from Rocky Mountain Arsenal; drum labelled C (from Lake C)

2/ Water from a 55 gallon drum received from Rocky Mountain Arsenal; drum labelled D (from Lake D)

3/ Tap Water.

Study No. 99-55-73/74 Small Animal Deaths, RMA

Table 2. Weight Gain by Male Albino Rats and Male and Female Coturnix Quail Given RMA Lake Water ad Libitum for 30 Days. Weights Reported are Group Mean Weights in Grams.

Test Animals	No. Animals	Sample	Test Day					
			1	8	15	22	30	
Rats	10	C 1/	150	188	233	272	302	
	10	D 2/	141	179	224	265	294	
	10	Control 3/	144	180	222	262	274	
Quail (Male)	5	C 1/	108	109	111	114	116	
	5	D 2/	109	107	114	115	119	
	5	Control 3/	102	110	111	112	113	
Quail (Female)	5	C 1/	134	132	138	136	139	
	5	D 2/	132	127	138	140	137	
	5	Control 3/	132	134	132	133	135	

1/ Water from a 55 gallon drum received from Rocky Mountain Arsenal; drum labelled C (from Lake C)

2/ Water from a 55 gallon drum received from Rocky Mountain Arsenal; Drum labelled D (from Lake D)

3/ Tap Water

Table 3. Heavy Metal Analyses of Water Samples From RMA, June 1973. Concentrations in mg/liter.

Sample	Fe	Cr	Mn	As	Pb	Cu	Na	Hg	Zn	Ca	Cd
E-17	1.8	<0.03	0.09	-	<0.0005	0.03	54.5	0.0015	<0.02	33.1	-
C-17	0.82	<0.03	<0.03	-	<0.0005	0.02	48.8	0.00045	<0.02	23.2	-
D-17	<0.1	<0.003	<0.03	-	<0.0005	0.06	47.4	0.0012	<0.02	35.3	-
D-1	-	-	-	0.02	<0.0005	-	-	0.00089	-	-	<0.001
C-2	-	-	-	<0.01	<0.0005	-	-	0.00028	-	-	<0.001
F-1	-	-	-	0.05	<0.0005	-	-	0.00072	-	-	2.8
D	-	-	-	0.02	<0.0005	-	-	0.00058	-	-	13.6
C	-	-	-	<0.01	<0.0005	-	-	0.00032	-	-	<0.001

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Table 4. Pesticide Analyses of Sediment and Water Samples from
RMA, June 1973

<u>Sample:</u>	<u>Results:</u>
C (sediment)	0.388 ppm dieldrin 0.693 ppm aldrin 0.113 ppm endrin
C (water)	0.003 ppm dieldrin 0.002 ppm aldrin
D (sediment)	0.205 ppm dieldrin 0.019 ppm aldrin
D (water)	negative
E (sediment)	0.264 ppm dieldrin trace aldrin
D-1 (sediment)	0.272 ppm dieldrin trace aldrin trace p,p-DDT trace p,p-DDD 0.056 ppm p,p-DDE
E-1 (sediment)	0.109 ppm dieldrin trace aldrin
C-2 (sediment)	0.360 ppm dieldrin 0.145 ppm aldrin 0.099 ppm endrin