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Analytical results of soil sampling by two field
methods--A comparison

By

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This report is preliminary and has not been reviewed for conformity with the U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS or the USFWS.

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INTRODUCTION

The U.S. Geological Survey (USGS) and the U.S. Fish and Wildlife Service (USFWS) are independently conducting studies in the San Joaquin Valley of California to determine the extent and severity of environmental degradation due to the accumulations of Se and other contaminants from agricultural irrigation. The USGS studies were initiated in April, 1985, and consist of soil sampling on agricultural lands serviced by the San Luis Drain. The USFWS studies were initiated in June, 1985, and consisted of evaluating possible contamination of biotic and abiotic components on 74,900 acres of wetland managed primarily for migratory waterfowl. These latter studies include soil sampling.

The sampling tools and techniques employed by the USGS and USFWS differ. For the results obtained by one agency to be useful to the other agency, the effects of these two sampling techniques on the analytical results need to be tested. Also, because the USFWS field and sample-handling techniques are much more costly (i.e., labor intensive, and time consuming) than the USGS techniques, it would be beneficial to the USFWS to adopt the USGS techniques if the latter techniques provide comparable results.

The present study had two main objectives: (1) to test for differences between sampling methods by collecting and analyzing samples of soil using the USGS and USFWS tools and techniques and, (2) to determine the analytical error (reproducibility) by duplicate analyses of each sample.

METHODS

Statistical Methods

A two-factor factorial design replicated among units was chosen to evaluate variation between two sampling methods and two analyses of each sample. The statistical model follows, where y_{ijk} represents the reported analytical value, u represents the grand mean, and the remaining terms represent deviations from the mean. These deviations are due to the replicated units, U_i ; the two main effects, sampling methods (M_j) and repeated analyses (A_k); and their two-way interactions. The final term in the equation (E_{ijk}) represents random errors.

$$y_{ijk} = u + U_i + M_j + A_k + MA_{jk} + E_{ijk}$$

An example of the computations, for aluminum, are given in table 1.

Sampling Design

The USFWS, during 1985-1986, conducted an environmental contaminant study on approximately 46,000 acres of waterfowl hunting areas, known as the West Grasslands, and 28,900 acres of State Wildlife Management Areas (WMA) and National Wildlife Refuges (NWR) in the northern San Joaquin Valley of California (fig. 1). Fifteen study units were identified within these wetlands. Ten units within the West Grasslands were selected according to the canal system used to irrigate waterfowl food plants and to flood marshes during the fall. Five units consisted of three WMA's and two NWR's. "A" and "C" sites were selected within each of these 15 units. "A" sites were those wetlands that receive water directly from the agricultural subsurface tile drains and/or fresh irrigation water. "C" sites are those wetlands that

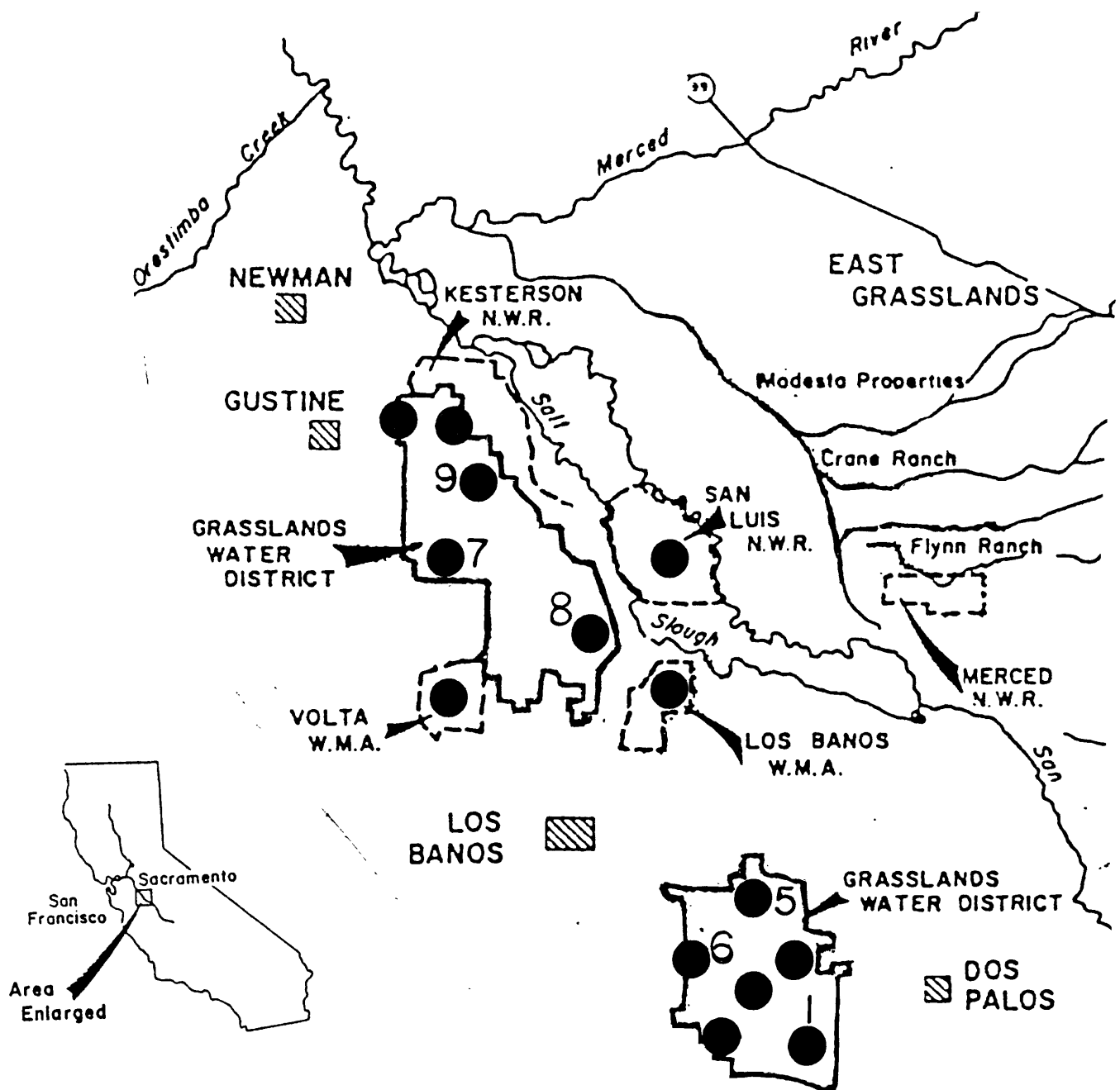


Figure 1. Map showing the locations of the West Grasslands Wildlife Management Areas with management units indicated by solid dots. Management units included in this study are numbered.

receive water from the "A" sites and, when drained, discharge their water into a ditch or canal. Within each "A" and "C" site, three locations for soil sampling were randomly chosen along a randomly aligned linear transect. At each of the three locations, three soil samples were collected from within 4 m of each other and combined to yield a single sample. From 90 possible soil sampling locations in "A" and "C" sites, 10 locations were randomly selected for sampling by both USGS and USFWS methods. At each of the 10 locations, scientists from the two agencies collected three soil cores within 15 cm of each other. The three samples were combined to yield a single sample for each sampling method and location. The sample selection process and field sampling are illustrated in figure 2.

Field Sampling Tools and Techniques

U.S. Fish and Wildlife Service

A 2-ft (61-cm) split-barrel steel pipe was used to take core samples. The split-barrel corer was fitted with removable steel extension tubes to allow the sampler to be driven into the ground (fig. 3). The interior of the split barrel is fitted with an acid washed (10% HNO_3) PVC pipe to prevent the soil sample from coming into contact with the metal. The upper air-escape hole was covered with parafilm which was punctured to release air. The parafilm prevents soil from coming into contact with the metal end of the sampler. The distal end of the split barrel was threaded to accept a 3.5-in (9-cm) stainless steel (no. 316) nose piece with a tapered end to allow easier passage through the soil.

The split-barrel corer was driven into the soil with a tubular post pounder to a depth of 24 in (fig. 4a). The sampler was extracted from the ground using a lever device (fig. 4b). Once extracted from the soil, the nose piece was removed and the top half of the barrel was lifted to expose the core. The surface horizon was separated, based on differences in structure, texture, and color. Surface horizon depths were generally from 3.5 to 12.0 cm deep. The subsurface horizons from three cores were slid from the barrel into a 3.8-l acid-washed polyethylene bottle, fitted with a teflon-lined cap, using a plastic knife or fingers wrapped in parafilm. The sample was never in contact with a person's skin. Between sample sites, the interior of the barrel was scrubbed with a brush, using deionized water, and rinsed with deionized water. The sample was taken to the field laboratory at the end of the work day and frozen. The samples were packed in dry ice and shipped to the Patuxent Wildlife Research Center, Maryland, for preparation.

U.S. Geological Survey

Soil samples were collected by hand augering to 24 in with a 3.5-in diameter bucket-type auger (fig. 5) commercially available from Art's Manufacturing and Supply, American Falls, Idaho. The bucket is made of stainless steel, and the cutting tips are made of high carbon alloy steel and stellite hard surfaced. The surface horizon was removed and the remaining soil from the core was placed into a 15-in diameter plastic pan and mixed. After mixing, a portion of the material was saved in a paper bag. The saved portions from each of the three cores collected at a sample location were recombined and mixed, and a 2-qt sub-sample was collected by filling two paper bags with soil using a stainless steel trowel. Between sampling locations, the auger, plastic pan, and trowel were scrubbed with a brush and tap water to

Chart of Sampling Location Selection Process

Total number of Management Units	15
"A" and "C" Sites within units	x 2
Sampling Locations within sites	x 3

Total possible sampling locations	90

Ten of the 90 locations were randomly selected for the USGS/USFWS methods comparison study. USGS and USFWS each collected a composite soil sample at each of the 10 locations, resulting in a total of 20 samples. Each of the 20 samples were analyzed in duplicate, resulting in a total of 40 analyses.

Diagram Showing Field Sampling at One Location

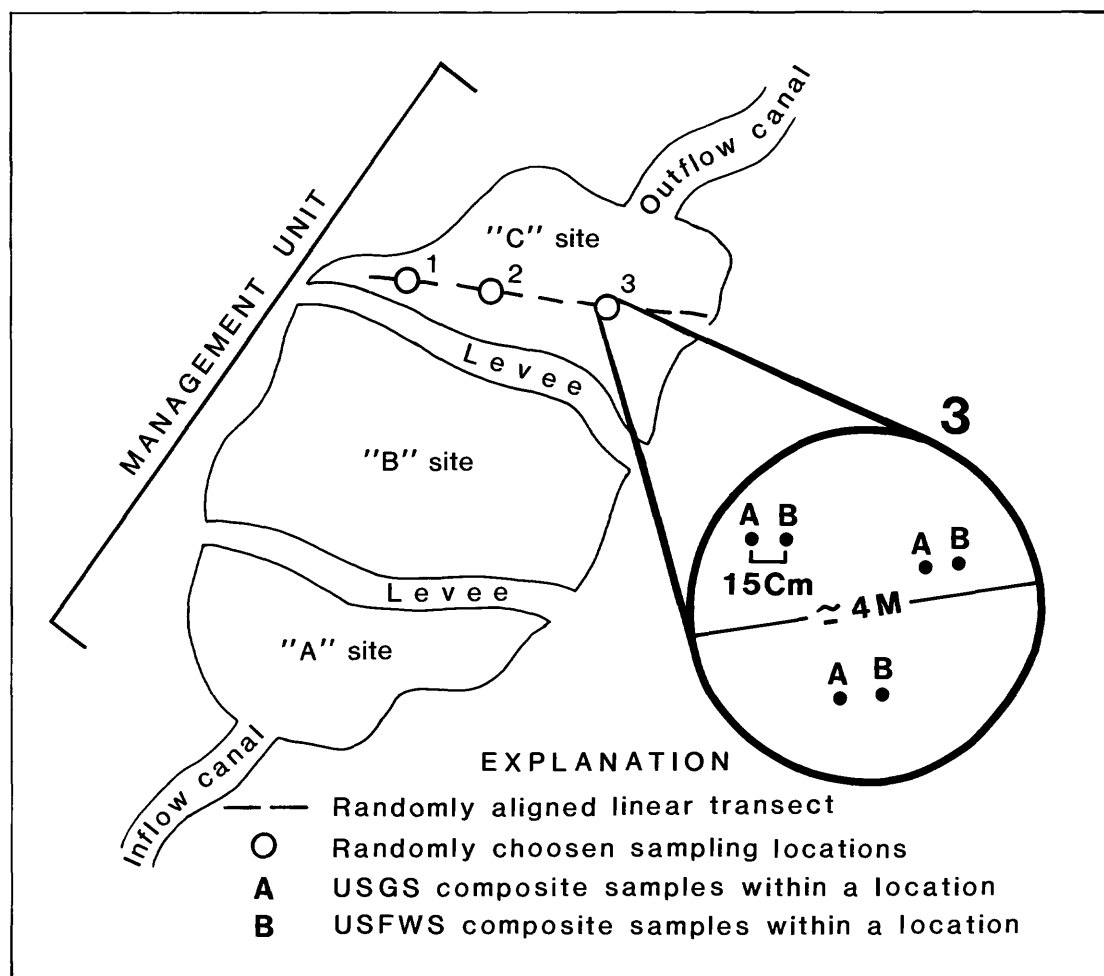


Figure 2. Chart and diagram illustrating the sample selection process and field sampling.

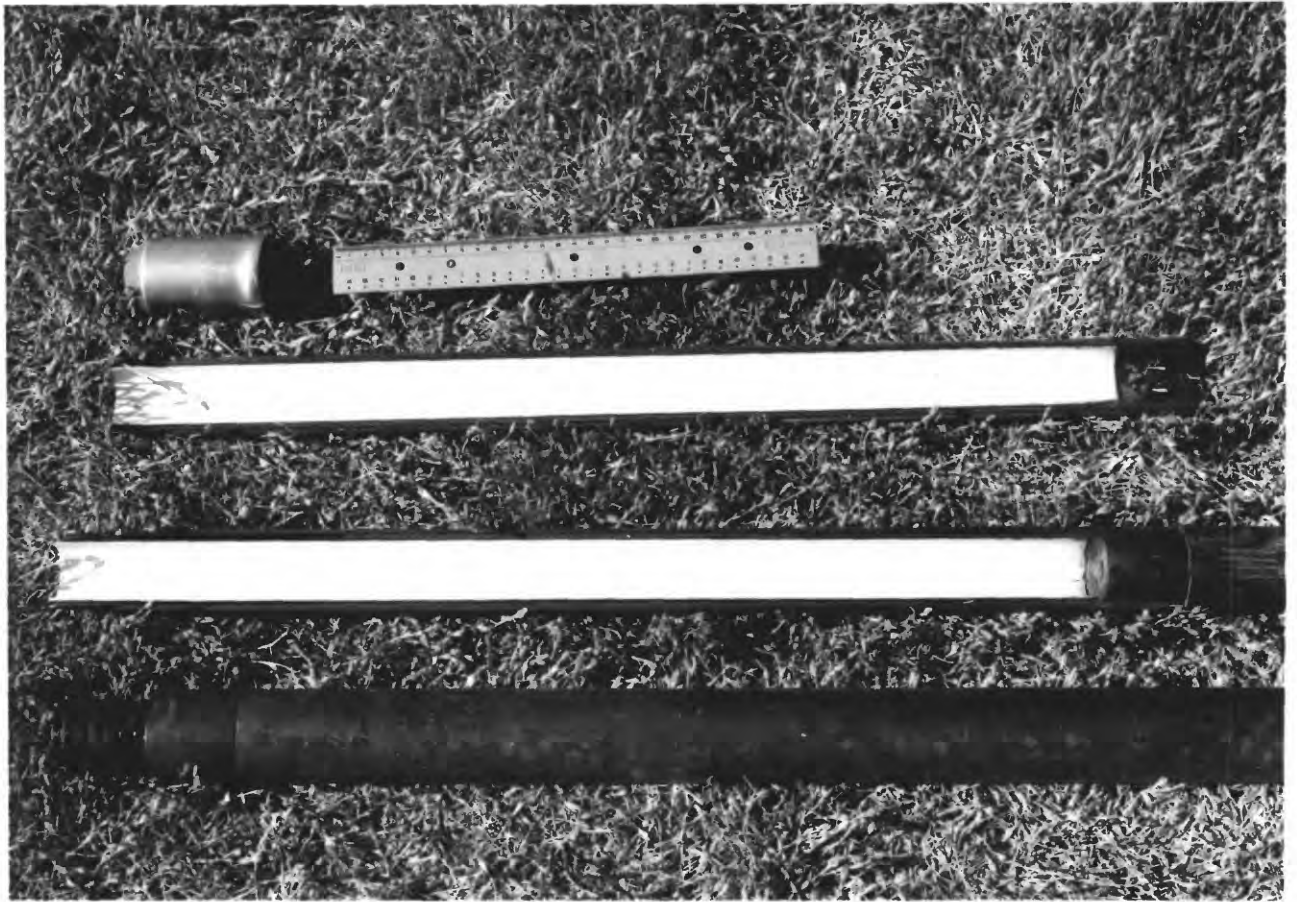


Figure 3. Photograph showing the soil sampling device used by the U.S. Fish and Wildlife Service.



Figure 4a and 4b. Photographs showing the tools used to insert and remove the U.S. Fish and Wildlife Service soil sampler from the ground.



Figure 5. Photograph showing the soil sampling device used by the U.S. Geological Survey.

remove adhering soil particle. The cleaned tools were then rinsed with tap water. No special effort was made to prevent contact between the sample and the person's skin; however, leather gloves were usually worn while sampling. The samples were mailed to the central laboratory in Denver, Colorado.

Laboratory Methods

All USGS samples were air dried at ambient temperature and prepared for chemical analysis by disaggregating with a mechanical mortar and pestle and sieving through a 10-mesh (2-mm) screen. A split of the minus-2-mm material was ground in a ceramic plate grinder to minus 100 mesh. A sub-sample of the minus-100-mesh material was analyzed for major and trace elements. All USFWS samples were dried and then homogenized with a mortar and pestle and a sub-sample was analyzed for major and trace elements. Both USGS and USFWS samples were split into two parts and arranged in a random sequence and analyzed in that sequence to convert any systematic laboratory bias to a random error. The USGS and the USFWS each prepared the samples collected by their techniques in their own laboratories, however, all analyses were performed in the laboratories of the USGS in Denver, Colorado.

Major- and trace-element analyses were performed using a Jarrell Ash inductively coupled argon plasma atomic emission spectrometer operated under conditions as reported by Crock and others (1983). Arsenic and selenium analyses were performed using separate continuous flow hydride generation atomic absorption spectroscopy systems similar to those of Crock and Lichte (1982) and Briggs and Crock (1986).

COMPARISON OF METHODS AND RECOMMENDATIONS

Variance analysis (table 2) shows that for 24 of 30 elements the largest portion (>50%) of the natural variation occurs among the 10 different sampling units. Error variance exceeded 50% of the total variation for the remaining elements (Ce, La, Nd, Pb, Th, and Yb). For these six elements, an examination of the data for individual samples (table 4) shows that small differences in concentration were measured from sample to sample, and therefore, the total natural variation was small. Thus, any analytical errors would result in a large analytical error variance relative to the total variance.

Minimal variation was measured between methods, between analyses, or their interaction (table 2). This suggests that the USGS and USFWS field sampling and sample preparation techniques show no bias in their effects on determining element concentrations in soils of the West Grasslands. This can also be observed from table 3, where the means and standard deviations compiled for 30 elements in samples collected by the two different methods are nearly equal.

Based on the data presented, either the USGS or USFWS field sampling and sample preparation techniques could be used to evaluate total element concentration of soils in the West Grasslands. The amount of contamination introduced by the USGS techniques relative to the USFWS techniques is not great enough to be measurable by the analytical techniques used in this study. The data also suggest that the precautions taken by the USFWS techniques to prevent sample contamination and preserve sample integrity are unnecessary. We suggest that the USGS technique is more cost-effective than the USFWS technique, and does not compromise the quality of the analytical data obtained.

REFERENCES CITED

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- Crock, J. G., and Lichte, F. E., 1982, An improved method for the determination of trace levels of arsenic and antimony in geologic materials by automated hydride generation-atomic absorption spectroscopy: *Analytica Chimica Acta*, v. 144, p. 223-233.
- Crock, J. G., Lichte, F. E., and Briggs, P. E., 1983, Determination of elements in National Bureau of Standards Geologic Reference Materials SRM 278 obsidian and SRM 688 basalt by inductively coupled argon plasma-atomic emission spectrometry: *Geostandards Newsletter*, v. 7, p. 335-340.

TABLE 1.--Analysis of variance design, using aluminum as an example

Source of variation	Sum of squares	Degrees of freedom	Mean square	F ratio	Estimated variance
Among units	4.742	9	0.526	24.5*	0.1217
Between methods	0.042	1	0.042	1.96	0.0008
Between analyses	0.0022	1	0.0022	0.10	0.0
Methods X analyses	0.0022	1	0.0022	0.10	0.0
Error	0.581	27	0.021	---	0.0261
Total	5.3694	39			0.1486

* Statistically significant at the 0.01 probability level.

TABLE 2. Estimated variance components, expressed as a percentage of total variance, for elements in soils of the Grasslands and State Wildlife Management Areas, California

Element	Total variance	Between methods	Among units	Between analyses	Interaction, methods by analyses	Error
Al	0.1486	0.6	81.9	0.0	0.0	17.6
As	3.0531	0.6	69.5	3.3	0.0	26.6
Ba	2105	0.0	90.6	0.0	0.0	9.4
Be	0.0	0.0	0.0	0.0	0.0	0.0
Ca	0.4684	0.3	87.2	0.0	0.0	12.5
Ce	11.23	0.0	28.0	0.0	0.0	72.0
Co	19.52	0.0	87.7	0.0	0.0	12.3
Cr	1375	0.0	85.0	0.0	1.0	14.1
Cu	100.1	0.0	79.8	0.0	0.2	20.1
Fe	0.5764	0.0	83.7	0.0	0.0	16.3
Ga	2.536	0.9	74.9	0.0	0.0	24.2
K	0.0401	0.4	95.8	0.1	0.0	3.6
La	3.213	0.0	12.6	0.0	4.0	83.4
Li	96.10	0.0	83.4	0.2	0.0	16.5
Mg	0.1875	0.0	93.4	0.0	0.0	6.6
Mn	35927	0.0	89.9	0.1	0.0	10.0
Na	0.0650	0.7	77.4	0.0	0.0	21.9
Nd	3.041	0.0	35.3	0.0	0.0	64.7
Ni	920.7	0.0	81.1	0.0	0.7	18.2
P	0.0002	0.4	94.4	0.0	0.2	5.0
Pb	2.302	5.1	18.6	0.0	0.0	76.4
Sc	10.68	0.0	85.1	0.0	0.0	14.9
Se	0.0187	0.0	94.7	0.0	0.0	5.3
Sr	8938	0.2	84.3	0.0	0.8	14.8
Th	3.258	0.0	46.7	0.0	0.0	53.3
Ti	0.0017	0.0	79.0	0.2	0.0	20.7
V	488.8	0.0	86.2	0.0	0.0	13.8
Y	3.322	0.0	81.3	0.8	0.0	17.9
Yb	0.0250	0.0	0.0	0.0	0.0	100.0
Zn	288.6	0.0	82.3	0.0	0.3	17.4

TABLE 3.--Summary statistics for elements determined in soils from the Grasslands and State Wildlife Management Areas, California

Element, unit of measure	USGS Method		USFWS Method	
	Mean	Standard deviation	Mean	Standard deviation
Al, %	7.7	0.370	7.6	0.379
As, ppm	5.6	1.47	5.8	1.85
Ba, ppm	768	46.7	766	42.5
Be, ppm	1.0	0.0	1.0	0.0
Ca, %	1.9	0.728	1.8	0.599
Ce, ppm	50.2	2.68	50.2	3.78
Co, ppm	16.7	4.32	16.7	4.30
Cr, ppm	118	36.8	119	35.2
Cu, ppm	29.8	9.76	31.1	9.76
Fe, %	3.6	0.749	3.6	0.730
Ga, ppm	17.8	1.51	17.6	1.57
K, %	2.2	0.196	2.1	0.193
La, ppm	24.7	1.59	24.6	1.85
Li, ppm	40.1	9.25	40.4	9.84
Mg, %	1.7	0.416	1.7	0.417
Mn, ppm	705	18.5	707	18.4
Na, %	1.9	0.248	1.9	0.247
Nd, ppm	22.5	1.43	22.4	1.96
Ni, ppm	96.6	29.8	100	29.3
P, %	0.049	0.0169	0.047	0.0160
Pb, ppm	15.0	1.32	14.5	1.40
Sc, ppm	12.6	3.28	12.8	3.09
Se, ppm	0.19	0.133	0.20	0.134
Sr, ppm	315	99.5	300	83.9
Th, ppm	10.9	1.73	10.8	1.79
Ti, %	0.31	0.0382	0.31	0.0423
V, ppm	95.0	21.1	95.0	21.9
Y, ppm	16.0	1.73	16.2	1.81
Yb, ppm	2.0	0.0	2.0	0.224
Zn, ppm	72.8	15.9	73.5	17.2

Table 4. Listing of samples collected by USGS and USFWS and results of analyses for thirty elements.

Sample ¹	Al, %	As, ppm	Ba, ppm	Be, ppm	Ca, %	Ce, ppm	Co, ppm	Cr, ppm	Cu, ppm	Fe, %
1 1A3-1	7.90	7.70	700.00	1.00	1.70	48.00	19.00	140.00	41.00	4.20
2 1A3-2	8.00	8.20	680.00	1.00	1.70	50.00	19.00	140.00	42.00	4.30
3 1A3-3	7.80	8.20	670.00	1.00	1.70	48.00	19.00	130.00	40.00	4.20
4 1A3-4	7.90	7.40	680.00	1.00	1.70	48.00	19.00	140.00	41.00	4.30
5 1C2-1	8.00	7.20	730.00	1.00	1.50	54.00	18.00	130.00	38.00	4.20
6 1C2-2	8.00	7.40	740.00	1.00	1.50	51.00	18.00	130.00	38.00	4.20
7 1C2-3	8.00	7.40	740.00	1.00	1.50	54.00	18.00	130.00	38.00	4.20
8 1C2-4	8.00	6.50	740.00	1.00	1.50	52.00	18.00	130.00	38.00	4.20
9 5C1-1	7.30	2.20	740.00	1.00	1.80	52.00	13.00	94.00	42.00	3.20
10 5C1-2	7.30	3.30	740.00	1.00	1.80	50.00	12.00	92.00	23.00	3.20
11 5C1-3	7.20	2.40	720.00	1.00	1.80	54.00	12.00	92.00	23.00	3.20
12 5C1-4	7.30	3.10	720.00	1.00	1.80	50.00	13.00	95.00	23.00	3.20
13 6A1-1	7.60	6.50	760.00	1.00	1.80	48.00	18.00	130.00	34.00	3.80
14 6A1-2	7.10	7.20	730.00	1.00	3.30	47.00	10.00	55.00	17.00	2.40
15 6A1-3	7.70	6.30	770.00	1.00	1.80	51.00	18.00	130.00	35.00	4.00
16 6A1-4	7.60	6.00	760.00	1.00	1.80	48.00	17.00	130.00	34.00	3.80
17 7C1-1	7.90	6.80	790.00	1.00	1.60	54.00	19.00	140.00	32.00	3.90
18 7C1-2	7.90	6.10	780.00	1.00	1.50	52.00	20.00	140.00	30.00	4.00
19 7C1-3	7.80	5.40	790.00	1.00	1.60	58.00	20.00	130.00	31.00	3.80
20 7C1-4	7.90	5.90	780.00	1.00	1.50	53.00	20.00	140.00	32.00	4.00
21 7C2-1	7.70	6.30	780.00	1.00	1.60	52.00	19.00	140.00	32.00	3.90
22 7C2-2	8.10	6.10	810.00	1.00	1.60	53.00	21.00	150.00	36.00	4.20
23 7C2-3	8.00	6.20	790.00	1.00	1.60	54.00	20.00	150.00	35.00	4.10
24 7C2-4	8.00	5.50	810.00	1.00	1.60	53.00	20.00	150.00	35.00	4.10
25 7C3-1	8.30	7.00	850.00	1.00	1.30	49.00	24.00	180.00	43.00	4.70
26 7C3-2	8.40	6.40	850.00	1.00	1.30	51.00	24.00	180.00	45.00	4.90
27 7C3-3	8.20	7.90	820.00	1.00	1.30	49.00	23.00	170.00	44.00	4.70
28 7C3-4	8.20	6.40	830.00	1.00	1.30	49.00	24.00	180.00	43.00	4.70
29 8A1-1	7.00	7.00	790.00	1.00	1.80	44.00	9.00	63.00	14.00	2.30
30 8A1-2	7.50	4.50	800.00	1.00	2.00	47.00	12.00	80.00	17.00	2.80
31 8A1-3	7.10	2.80	810.00	1.00	1.90	45.00	10.00	66.00	14.00	2.40
32 8A1-4	7.50	4.00	800.00	1.00	2.00	54.00	12.00	78.00	17.00	2.80
33 8C3-1	7.20	5.00	740.00	1.00	3.50	48.00	11.00	61.00	18.00	2.60
34 8C3-2	7.30	4.60	750.00	1.00	3.60	54.00	11.00	66.00	19.00	2.80
35 8C3-3	7.30	5.10	760.00	1.00	3.50	48.00	11.00	61.00	19.00	2.70
36 8C3-4	7.40	4.00	750.00	1.00	3.70	50.00	12.00	66.00	20.00	2.80
37 9C2-1	7.40	3.40	780.00	1.00	1.50	50.00	17.00	130.00	25.00	3.30
38 9C2-2	7.50	5.50	800.00	1.00	1.50	48.00	16.00	120.00	26.00	3.20
39 9C2-3	7.50	4.80	790.00	1.00	1.50	44.00	15.00	110.00	23.00	3.10
40 9C2-4	7.30	3.70	810.00	1.00	1.50	44.00	15.00	110.00	20.00	2.80

¹ First position indicates sampling unit, second position indicates "A" or "C" site within unit, third position indicates sampling location (1, 2, or 3) along transect, and last position indicates whether USFWS (1 and 3) or USGS (2 and 4) sampling technique was used.

Table 4. Listing of samples collected by USGS and USFWS and results of analyses for thirty elements. (cont.)

Sample	Ga, ppm	K, %	La, ppm	Li, ppm	Mg, %	Mn, ppm	Na, %	Nd, ppm	Ni, ppm	P, %
1 1A3-1	18.00	1.90	23.00	51.00	1.90	840.00	1.70	22.00	110.00	.06
2 1A3-2	18.00	1.90	24.00	52.00	2.00	860.00	1.80	23.00	110.00	.07
3 1A3-3	18.00	1.90	23.00	51.00	1.90	840.00	1.70	23.00	110.00	.07
4 1A3-4	18.00	1.90	23.00	51.00	1.90	830.00	1.70	24.00	110.00	.07
5 1C2-1	18.00	1.90	26.00	53.00	1.80	720.00	1.70	24.00	99.00	.06
6 1C2-2	19.00	1.90	26.00	53.00	1.80	720.00	1.70	24.00	100.00	.06
7 1C2-3	19.00	1.90	26.00	54.00	1.80	730.00	1.70	25.00	100.00	.06
8 1C2-4	19.00	1.90	25.00	53.00	1.80	720.00	1.80	23.00	98.00	.06
9 5C1-1	16.00	2.20	26.00	37.00	1.20	440.00	1.80	21.00	110.00	.04
10 5C1-2	16.00	2.20	25.00	37.00	1.20	440.00	1.80	20.00	73.00	.04
11 5C1-3	15.00	2.10	28.00	36.00	1.20	440.00	1.80	23.00	71.00	.04
12 5C1-4	17.00	2.20	25.00	37.00	1.20	450.00	1.80	22.00	73.00	.04
13 6A1-1	17.00	1.90	24.00	50.00	1.80	730.00	1.60	22.00	110.00	.05
14 6A1-2	16.00	2.00	23.00	29.00	1.40	450.00	2.30	21.00	48.00	.05
15 6A1-3	18.00	1.90	24.00	51.00	1.90	760.00	1.60	23.00	110.00	.05
16 6A1-4	18.00	1.90	24.00	50.00	1.80	720.00	1.60	23.00	110.00	.05
17 7C1-1	18.00	2.30	25.00	37.00	1.70	850.00	2.10	24.00	120.00	.04
18 7C1-2	18.00	2.20	25.00	37.00	1.70	860.00	2.00	24.00	120.00	.04
19 7C1-3	18.00	2.20	28.00	37.00	1.70	910.00	2.00	25.00	120.00	.04
20 7C1-4	18.00	2.20	26.00	38.00	1.70	880.00	2.00	23.00	120.00	.04
21 7C2-1	18.00	2.20	25.00	39.00	1.90	810.00	2.00	23.00	120.00	.04
22 7C2-2	20.00	2.30	26.00	43.00	2.10	900.00	2.10	24.00	130.00	.05
23 7C2-3	20.00	2.20	27.00	43.00	2.00	870.00	2.10	25.00	120.00	.05
24 7C2-4	20.00	2.30	26.00	42.00	2.00	870.00	2.10	24.00	120.00	.05
25 7C3-1	20.00	2.30	24.00	49.00	2.40	990.00	1.50	23.00	150.00	.07
26 7C3-2	20.00	2.30	25.00	50.00	2.50	960.00	1.50	23.00	150.00	.07
27 7C3-3	20.00	2.30	24.00	48.00	2.30	940.00	1.50	23.00	140.00	.07
28 7C3-4	20.00	2.30	24.00	48.00	2.40	1000.00	1.50	23.00	140.00	.07
29 8A1-1	16.00	2.30	22.00	24.00	.83	450.00	2.00	19.00	50.00	.02
30 8A1-2	17.00	2.40	24.00	30.00	1.00	540.00	2.00	22.00	63.00	.02
31 8A1-3	15.00	2.40	22.00	26.00	.88	460.00	2.00	20.00	52.00	.02
32 8A1-4	16.00	2.40	27.00	30.00	1.00	530.00	2.00	23.00	64.00	.02
33 8C3-1	15.00	2.00	23.00	31.00	1.50	480.00	2.30	20.00	53.00	.05
34 8C3-2	16.00	2.00	27.00	33.00	1.60	510.00	2.30	21.00	57.00	.06
35 8C3-3	17.00	2.00	24.00	31.00	1.60	490.00	2.30	22.00	54.00	.05
36 8C3-4	16.00	2.00	25.00	33.00	1.70	520.00	2.30	22.00	58.00	.06
37 9C2-1	18.00	2.40	25.00	31.00	1.40	710.00	2.00	23.00	110.00	.03
38 9C2-2	18.00	2.40	24.00	30.00	1.40	720.00	2.00	21.00	100.00	.03
39 9C2-3	17.00	2.40	22.00	29.00	1.30	670.00	2.10	18.00	97.00	.02
40 9C2-4	16.00	2.40	20.00	26.00	1.20	610.00	2.10	19.00	88.00	.02

Table 4. Listing of samples collected by USGS and USFWS and results of analyses for thirty elements. (cont.)

Sample	Pb, ppm	Sc, ppm	Se, ppm	Sr, ppm	Th, ppm	Ti, %	V, ppm	Y, ppm	Yb, ppm	Zn, ppm
1 1A3-1	12.00	16.00	.30	230.00	10.00	.36	120.00	18.00	2.00	87.00
2 1A3-2	14.00	16.00	.30	220.00	9.00	.37	120.00	18.00	2.00	86.00
3 1A3-3	13.00	16.00	.30	220.00	9.00	.36	120.00	18.00	2.00	84.00
4 1A3-4	13.00	16.00	.30	220.00	9.00	.37	120.00	18.00	2.00	85.00
5 1C2-1	14.00	15.00	.30	250.00	12.00	.35	120.00	18.00	2.00	91.00
6 1C2-2	15.00	15.00	.30	250.00	13.00	.35	120.00	17.00	2.00	90.00
7 1C2-3	15.00	15.00	.30	250.00	15.00	.36	120.00	18.00	2.00	91.00
8 1C2-4	16.00	15.00	.30	250.00	11.00	.36	120.00	17.00	2.00	89.00
9 5C1-1	13.00	11.00	.10	300.00	12.00	.32	78.00	15.00	2.00	86.00
10 5C1-2	14.00	11.00	.10	300.00	11.00	.31	78.00	15.00	2.00	75.00
11 5C1-3	13.00	10.00	.10	290.00	12.00	.31	76.00	15.00	2.00	72.00
12 5C1-4	14.00	11.00	.10	290.00	12.00	.31	77.00	15.00	2.00	74.00
13 6A1-1	16.00	14.00	.50	270.00	11.00	.34	110.00	16.00	2.00	84.00
14 6A1-2	14.00	7.00	.50	500.00	11.00	.27	67.00	13.00	2.00	51.00
15 6A1-3	16.00	14.00	.50	270.00	13.00	.35	110.00	17.00	2.00	87.00
16 6A1-4	16.00	14.00	.50	270.00	12.00	.34	110.00	16.00	2.00	84.00
17 7C1-1	15.00	13.00	.10	290.00	10.00	.30	96.00	17.00	2.00	66.00
18 7C1-2	17.00	14.00	.10	290.00	10.00	.31	97.00	17.00	2.00	68.00
19 7C1-3	14.00	13.00	.30	290.00	10.00	.31	95.00	18.00	2.00	66.00
20 7C1-4	14.00	14.00	.10	290.00	11.00	.31	99.00	17.00	2.00	70.00
21 7C2-1	16.00	14.00	.10	280.00	10.00	.31	97.00	17.00	2.00	75.00
22 7C2-2	15.00	15.00	.10	290.00	14.00	.33	110.00	18.00	2.00	82.00
23 7C2-3	15.00	15.00	.10	290.00	13.00	.34	100.00	17.00	2.00	80.00
24 7C2-4	17.00	15.00	.10	290.00	13.00	.33	100.00	17.00	2.00	80.00
25 7C3-1	14.00	17.00	.20	240.00	12.00	.34	120.00	18.00	2.00	97.00
26 7C3-2	18.00	17.00	.20	250.00	11.00	.34	120.00	18.00	2.00	98.00
27 7C3-3	15.00	17.00	.20	240.00	10.00	.33	120.00	18.00	2.00	94.00
28 7C3-4	15.00	17.00	.20	240.00	10.00	.33	120.00	18.00	2.00	95.00
29 8A1-1	16.00	8.00	.10	320.00	9.00	.23	57.00	13.00	1.00	42.00
30 8A1-2	15.00	9.00	.10	330.00	11.00	.28	70.00	14.00	2.00	52.00
31 8A1-3	15.00	8.00	.10	330.00	9.00	.24	60.00	14.00	2.00	44.00
32 8A1-4	15.00	9.00	.10	330.00	12.00	.28	70.00	15.00	2.00	53.00
33 8C3-1	12.00	8.00	.10	520.00	11.00	.28	72.00	14.00	2.00	57.00
34 8C3-2	13.00	8.00	.10	550.00	12.00	.30	77.00	14.00	2.00	59.00
35 8C3-3	17.00	8.00	.10	540.00	10.00	.29	74.00	14.00	2.00	56.00
36 8C3-4	15.00	8.00	.10	550.00	10.00	.30	79.00	14.00	2.00	60.00
37 9C2-1	15.00	12.00	.10	280.00	11.00	.26	80.00	14.00	2.00	58.00
38 9C2-2	14.00	11.00	.10	290.00	8.00	.25	78.00	14.00	2.00	56.00
39 9C2-3	14.00	11.00	.10	290.00	7.00	.24	75.00	14.00	2.00	53.00
40 9C2-4	15.00	10.00	.10	290.00	7.00	.23	68.00	14.00	2.00	49.00