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RADIOLOGICAL SURVEY OF PLANTS, ANIMALS, AND SOIL AT FIVE ATOLLS IN THE MARSHALL ISLANDS

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COLLEGE OF FISHERIES
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HEALTH AND
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By
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ABSTRACT

The Division of Operational Safety's portion of the Pacific Radioecology Program began in 1974 and it is a continuing program to determine the kinds and amounts of radionuclides distributed in the foods, plants, animals, and soils of the Central Pacific, especially the Marshall Islands.

As part of this program, Wotje, Ailuk, Utirik, Rongelap, and Bikini atolls were visited in 1976 and samples collected. Results of the radiometric analyses of the samples are presented.

Results of these analyses indicate that ^{90}Sr and ^{137}Cs are predominant in the terrestrial environment and, in addition, ^{241}Am and $^{239,240}Pu$ are also important in the soil from Rongelap and Bikini atolls. Naturally occurring ^{40}K is the predominant radionuclide in marine organisms, while ^{60}Co is significant in the tridacnid clams. Amounts of radioactivity vary with distance from the Bikini test site and in relation to the fallout pattern from the March 1954 Bravo test. Thus, samples from Bikini Atoll had the greatest amounts of radioactivity while the northern islands of Rongelap had slightly lower amounts. The southern islands of Rongelap Atoll and Utirik Atoll had intermediate amounts of radioactivity while Ailuk and Wotje atolls had the least radioactivity of the atolls visited.

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INTRODUCTION

As stated in a previous progress report (Nelson, 1977),

> "The Division of Operational Safety or DOS (now Safety Standards and Compliance) portion of the Laboratory of Radiation Ecology (LRE) Pacific Radioecology Program (formerly Johnston Atoll Program) began on 1 July 1974 and is continuing. The purpose of this program is to determine the kinds and amounts of radionuclides distributed in the foods, plants, animals, and soil of the Central Pacific, especially the Marshall Islands, and to furnish these data to SSS/ERDA and other appropriate agencies (Lawrence Livermore Laboratory, Nevada Operations Office ERDA) so that they may make an assessment of the dose of ionizing radiation received by the people living throughout the Central Pacific."

Here we report the results of the analyses of samples collected on a field trip conducted in September-October 1976.

SAMPLING PROGRAM

Atolls visited in the Marshall Islands are shown in Figure 1. This trip was a joint survey with personnel from Brookhaven National Laboratory. Representative biological and soil samples were collected with emphasis on food items common to the diet of the Marshallese people (i.e., fish, coconut, pandanus, breadfruit, coconut crabs, etc.) although nonedible portions of these items were also collected and analyzed. Soils were collected to provide data for estimating future distribution and quantities of radionuclides in the environment and biota. Sampling sites are shown in Figures 2 through 5.

The number of samples, after division into tissues or soil fractions, is shown in Table 1. Slightly less than half the samples were biota-plants, fish, clams, and coconut crabs - and the rest were soils - surface (0-2.5cm) and profile (0-100+cm).

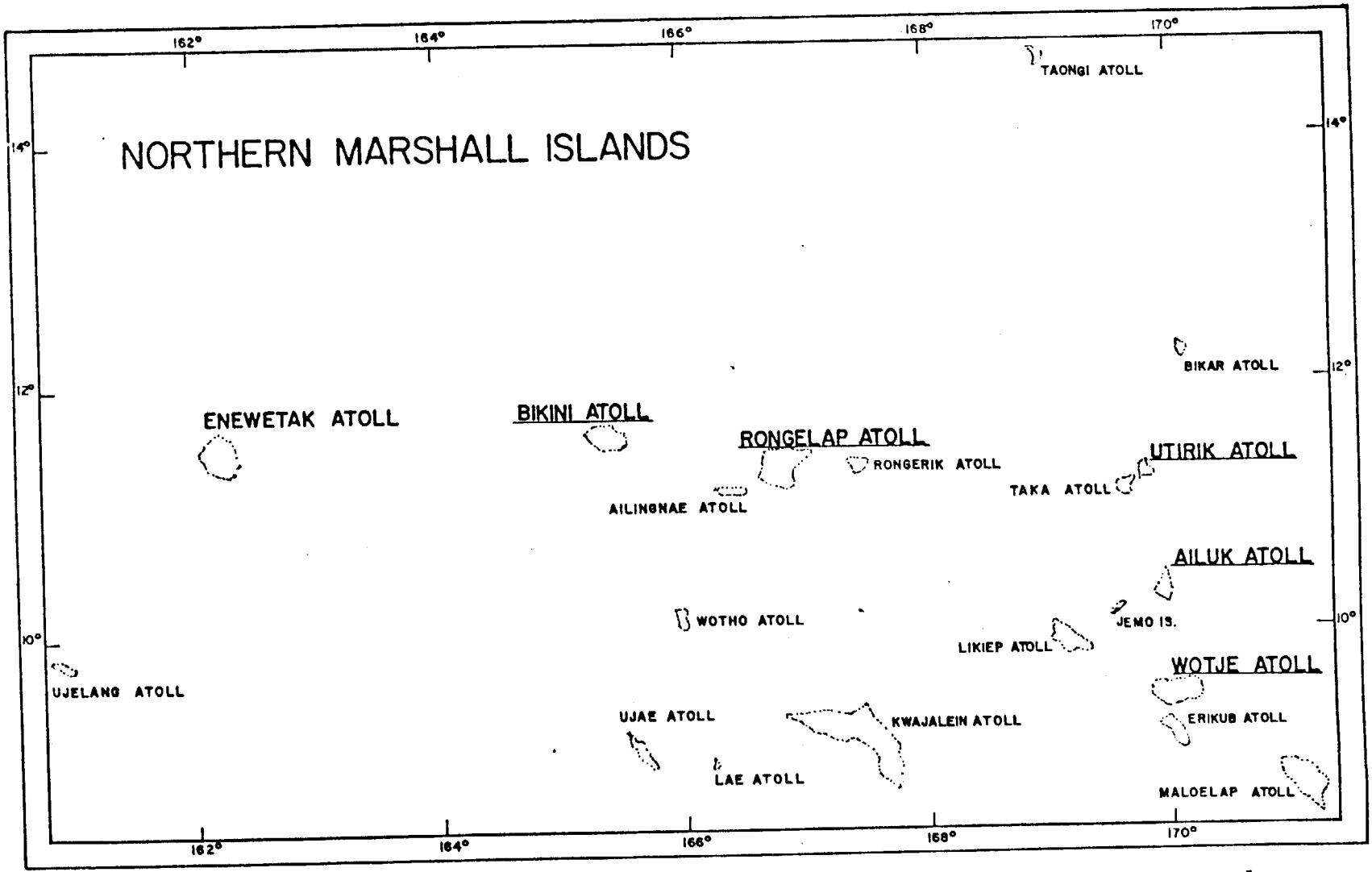

Figure 1. Five atolls (underlined) in the northern Marshall Islands where samples were collected September-October 1976.

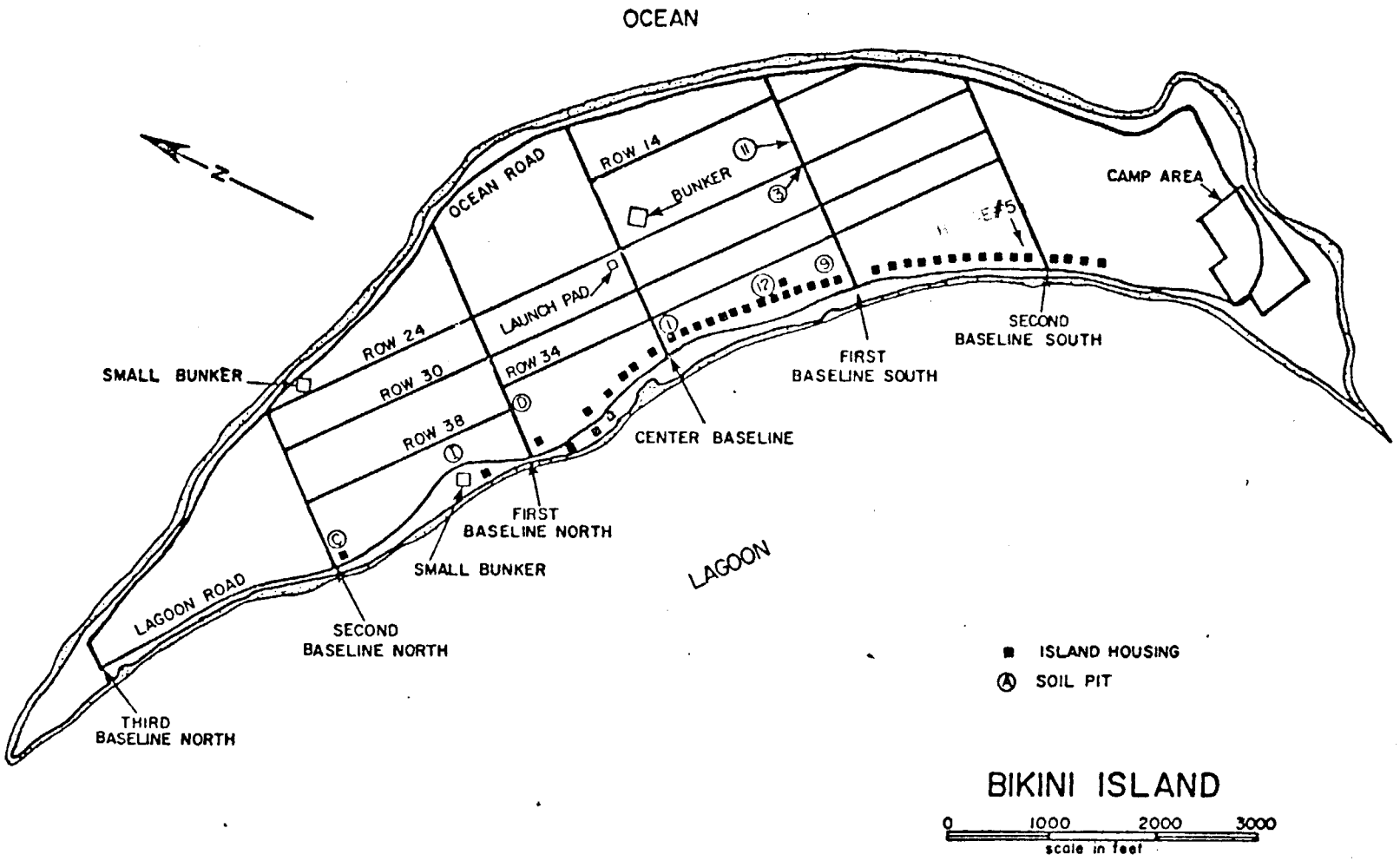

Figure 2. Sampling sites on Bikini Island, Bikini Atoll, October 1976.

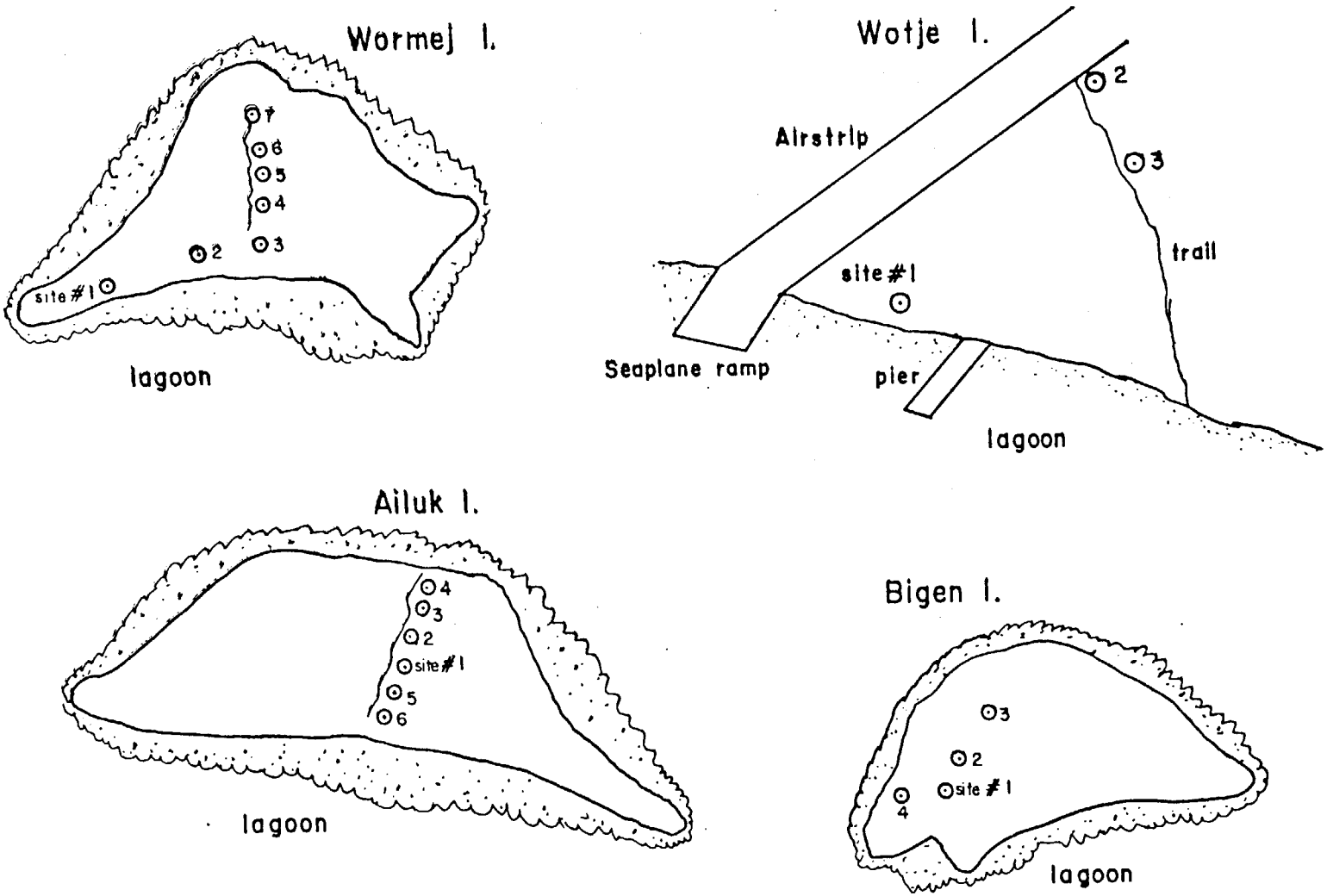

Figure 3. Sampling Sites on Wormej and Wotje Islands, Wotje Atoll and on Ailuk and Bigen Islands, Ailuk Atoll, September 1976.

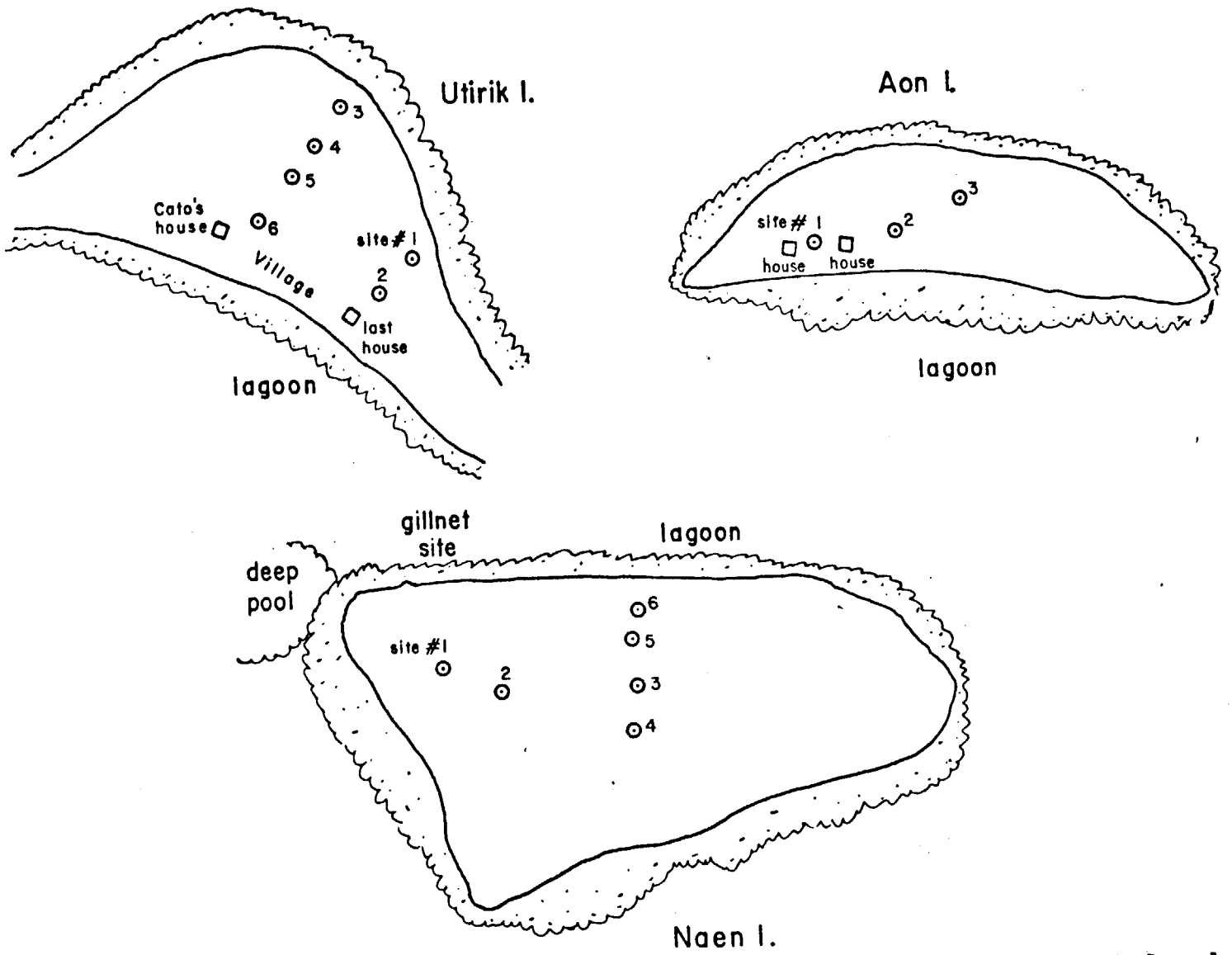

Figure 4. Sampling Sites on Utirik and Aon Islands, Utirik Atoll and on Naen Island, Rongelap Atoll, September 1976.

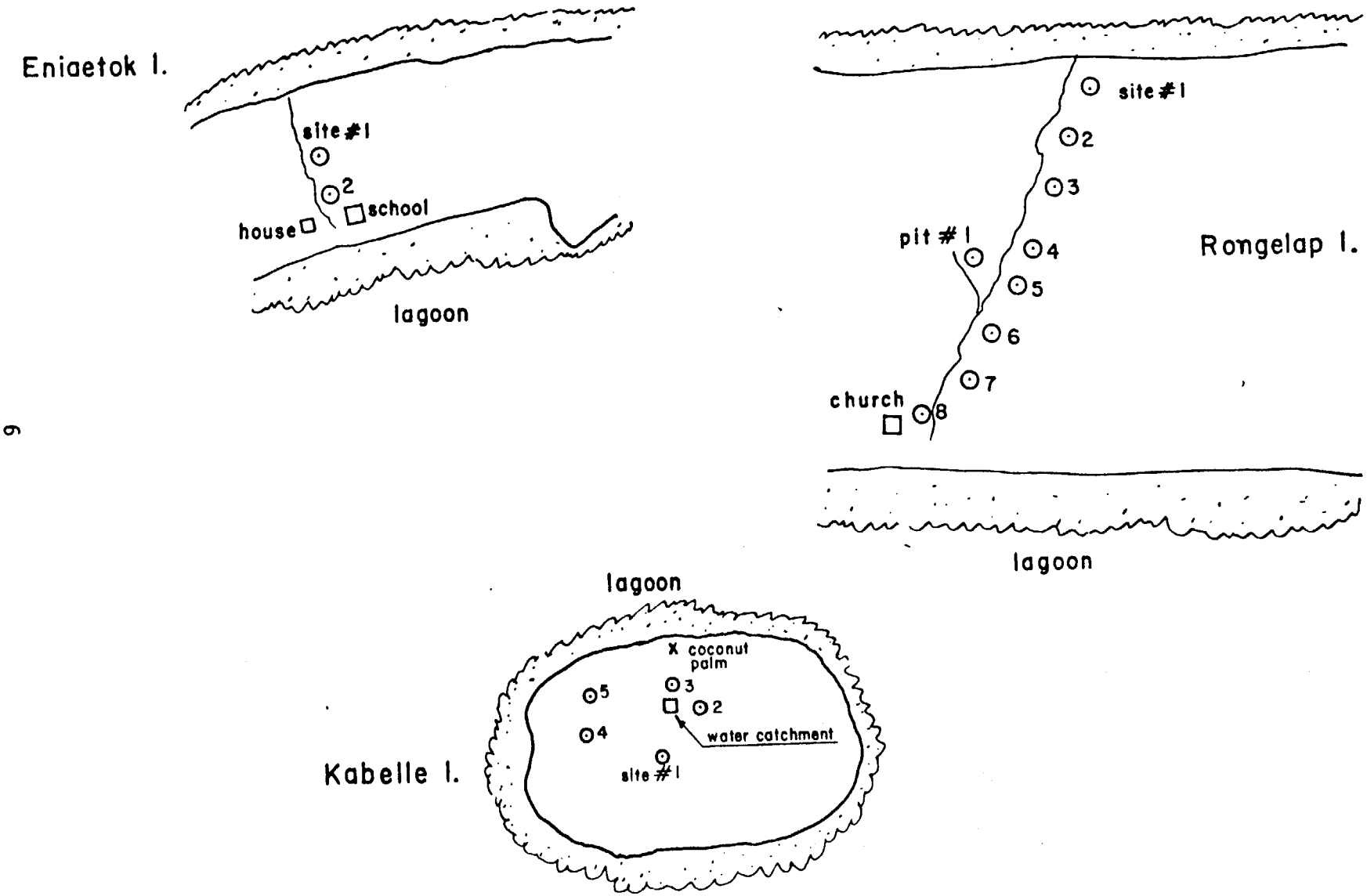

Figure 5. Sampling Sites on Eniaetok, Rongelap, and Kabelle Islands, Rongelap Atoll, September 1976.

TABLE 1. Number of samples processed and analyzed that were collected during the September-October 1976 field trip to the Marshall Islands

Atoll	SAMPLES PROCESSED					SAMPLES ANALYZED		
	Plants	Soil	Marine	Coconut Crab	Total	γ	^{90}Sr	$^{239,240}Pu$
Wotje	31	32	3	0	66	65	30	17
Ailuk	24	39	2	0	65	65	23	12
Utirik	19	33	0	0	52	52	19	9
Rongelap	15	82	22	18	137	137	51	30
Bikini	21	0	0	0	21	21	8	5
	110	186	26	18	341	340	131	73

In addition to the samples our Laboratory collected, personnel from Brookhaven National Laboratory collected samples, made TLD measurements and took radiation survey readings with sodium iodide (NaI) scintillation detectors and a pressurized ion chamber. The results of the Brookhaven analyses and measurements may be combined with the LRE results in a series of joint reports to the open literature.

ANALYTICAL METHODS

Gamma-Ray Spectrometry

All of the samples were analyzed by gamma-ray spectrometry, either with a 3 x 3 inch sodium iodide (thallium-drifted) crystal and 200-channel, pulse-height analyzers or with a germanium (lithium-drifted) diode detector and 4096-channel, pulse-height analyzer. Soil samples were analyzed on the Ge(Li) system, and the biological samples were analyzed on both systems.

All samples were oven-dried, ground and a portion compressed in polyvinyl chloride (PVC) pipe 2 inches in diameter and either ½ or 1 inch deep that was used as a sample holder for radionuclide measurement. Fifty grams of tissue or 68 grams of soil could be compressed into the 2 x 1 inch container. The densities of the biological and soil samples were 1.0 and 1.35, respectively. These samples were then analyzed for gamma-emitting radionuclides.

The gamma-emitting radionuclides in samples counted on the NaI crystal were determined by a method of least squares. The radionuclides values in samples counted on the Ge(Li) detector were calculated manually or with a computer by adding the counts in an energy range of five channels under a peak in the spectrum, subtracting the appropriate background counts, and applying correction factors to convert counts to picocuries (pCi). A set of previously reported reference spectra for the different geometries and radionuclides was used. All values were corrected for decay to the date of collection.

Strontium-90 and Plutonium Analyses

To measure ^{90}Sr content, ^{90}Y was chemically separated from ^{90}Sr, collected on a filter paper and counted with a low-level beta counting system. Plutonium was extracted by ion exchange, electroplated on platinum discs, and analyzed by alpha spectrometry with systems using surface barrier alpha detectors and pulse-height analyzers. Chemical yield was determined by use of ^{242}Pu as a tracer.

Error Limits

For a single sample, the errors given for all radionuclides listed are two-sigma, propagated, counting errors. The error term for more than one sample is one standard deviation and disregards counting error.

Limits of Detection

Many factors influence the limit of detection, including the type of detector and analyzer, the presence of other radionuclides, the duration of the counting period, the size and density of the sample, and the geometry relationship of the sample and detector. Hence, the limits of detection varied considerably for various radionuclides and types of samples, but can be summarized by stating that the detection limits were approximately as follows:

By gamma detection	
^{40}K	2.1 pCi/g or less
^{238}U	0.41 " "
^{60}Co, ^{125}Sb, ^{137}Cs, ^{155}Eu, ^{241}Am	0.12 pCi/g or less
By beta detection	
^{90}Sr	0.2 pCi/g or less
By alpha detection	
$^{239,240}Pu$	0.02 pCi/g or less

RESULTS

Data are presented for the results of the analyses of the samples collected by LRE in the Marshall Islands in 1976. Appendix Tables 1 through 18 give the data for single samples. The data are first presented atoll by atoll and then summarized by comparisons between atolls for selected sample types. All data are given as picocuries per gram of dry weight, except where expressly noted. Table 2 gives the mean wet weight to dry weight ratios for the biological samples.

Ailuk and Wotje Atolls

Samples from Bigen and Ailuk Islands at Ailuk Atoll and from Wotje and Wormej Islands at Wotje Atoll were collected during the September-October 1976 field trip. Results of the analyses of these samples of fish, plants and soil for gamma-emitting radionuclides, ^{90}Sr and $^{239,240}Pu$ are given in Appendix Tables 1 (fish), 2 and 3 (plants) and 4 through 7 (soil).

In the fish, naturally occurring ^{40}K was the most abundant radionuclide. Except for a small amount of ^{137}Cs in one fish sample, no fallout radionuclides were measured in any of the other fish samples. In plants ^{40}K was also the predominant radionuclide; however ^{137}Cs was above the limits of detection in all plant samples and ^{90}Sr was measurable in about one-third of the samples analyzed. Of the plants sampled, pandanus fruit had the most ^{137}Cs while unprocessed arrowroot tubers had the most ^{90}Sr. Processing the arrowroot tubers for food removes most of the ^{90}Sr.

Cesium-137 was the predominant radionuclide in the soil samples from Wotje and Ailuk atolls, but the amount measured was less than 1 pCi/g in all samples except four from Bigen Island, the northern most sampling location on these two

Table 2 . Common names and wet weight to dry weight ratios of some Micronesian organisms.

Species	Number of Samples	Tissue	Mean Wet/Dry Ratio	Deviation
		FISH		
Mullet	2	Eviscerated Whole	3.41	±0.42
"	2	Viscera	3.11	±0.85
Goatfish	1	Entire	3.64	
"	2	Eviscerated Whole	3.52	±0.00
"	2	Viscera	4.00	±0.23
Convict Surgeon	2	Entire	3.89	±0.10
"	1	Eviscerated Whole	3.55	
"	1	Viscera	6.38	
Carangidae	1	Entire	3.39	
Yellowfin Tuna	1	Liver	4.08	
		INVERTEBRATES		
Tridacna	3	Muscle	3.98	± 0.13
"	3	Mantle	6.97	± 0.09
"	3	Kidney	4.51	± 0.52
"	3	Viscera	5.37	± 0.13
Coconut Crab	6	Muscle	4.52	± 0.14
"	6	Hepatopancreas	1.83	± 0.26
"	6	Exoskeleton	1.34	± 0.03
		PLANTS		
Breadfruit	6	Edible	7.92	± 4.63
"	5	Inedible	5.31	± 1.52
"	16	Leaves	4.38	± 0.52
Pandanus	9	Edible	6.97	± 2.09
"	10	Inedible	4.57	± 1.44
"	17	Leaves	3.67	± 0.72
Papaya	4	Edible	11.0	± 3.21
"	4	Inedible	9.46	± 1.42
"	3	Seeds	6.25	± 1.03
Coconut	6	Meat	1.76	± 0.47
"	19	Leaves	2.46	± 0.38

Table 2. (Continued)

Species	Number of Samples	Tissue	Mean Wet/Dry Ratio	Deviation
		PLANTS		
Banana	2	Edible	3.87	± 0.81
Squash	1	"	22.8	
Yam	1	"	4.24	
Taro Root	1	"	1.40	
Arrow Root	1	"	2.76	

atolls. Concentrations of ^{137}Cs in these four samples ranged from 1.1 to 1.6 pCi/g. Strontium-90 and $^{239,240}Pu$ were measurable in the samples analyzed. Concentrations were less than a picocurie in all samples but one, the surface soil from site #3 on Bigen Island. Soil at this site contained 3.8 pCi of $^{239,240}Pu$ per gram. Americium-241 was detected in only a few of the soil samples.

Utirik Atoll

The two predominant radionuclides in plant samples from Utirik Atoll were ^{40}K and ^{137}Cs (Appendix Table 8). Of the 19 samples analyzed, the edible portion of the three Pandanus fruit samples contained the greatest amounts of ^{137}Cs (average 14 pCi/g). Values of ^{90}Sr in the plants ranged up to 2.1 pCi/g. Plutonium-239,240 values were below the limits of detection in the five plant samples analyzed.

Soil samples from Utirik Atoll contained ^{137}Cs, ^{90}Sr, and $^{239,240}Pu$ in most of the samples analyzed for these radionuclides (Appendix Tables 9 and 10). Americium-241 and ^{60}Co were also detected in many of the surface soil samples. Cesium-137 values ranged up to 5.3 pCi/g and averaged about 3 pCi/g in the nine surface soil samples. Soil samples from 5-10 cm below the surface contained less than 0.5 pCi of ^{137}Cs per gram. In the surface samples analyzed, ^{90}Sr values ranged from 0.5 to 3.2 pCi/g while $^{239,240}Pu$ values ranged from 0.08 to 1.3 pCi/g. Americium-241 and ^{60}Co values were less than a pCi/g.

Rongelap Atoll

Most samples of marine organisms from Rongelap contained ^{40}K and ^{60}Co with ^{40}K the predominant radionuclide (Appendix Tables 1 and 11). Cobalt-60 was present in less than pCi/g amounts, except in the Tridacna clam kidney which contained from 7.6 to 16 pCi/g. Samples of terrestrial organisms also contained

^{137}Cs and ^{90}Sr with ^{137}Cs the predominant radionuclide in the plants (Appendix Table 12) and ^{90}Sr in the coconut crabs (Appendix Table 13). Most plant samples contained 10 to 100 pCi of ^{137}Cs per gram of dry tissue, however, coconut milk samples contained up to 355 pCi/g. The exoskeleton of the coconut crabs contained 50 to 340 pCi of ^{90}Sr per gram. The other tissues contained 1 to 20 pCi/g.

The results of the analyses of the soil samples are given in Appendix Tables 14 through 17. Cesium-137 and ^{90}Sr are the predominant radionuclides, although ^{60}Co, ^{155}Eu, ^{241}Am, and $^{239,240}Pu$ were also detected in most of the samples analyzed for these specific radionuclides. Antimony-125 was also present in the soils from Naen Island. Radionuclide values were lowest on Rongelap and Eniaetok Islands and highest on Naen. Cesium-137 and ^{90}Sr values in surface soils from Naen averaged several hundred pCi/g and ranged up to 980 and 523 pCi/g for ^{137}Cs and ^{90}Sr, respectively. Cesium-137 values in soil from Rongelap Island were less than a hundred pCi/g. Plutonium-239,240 and ^{241}Am values in Rongelap and Eniaetok Island soils were commonly 1 to 5 pCi/g, while in Naen soils values for these radionuclides ranged to 65 pCi/g.

Bikini Atoll

Plants were the only sample type collected at Bikini Atoll. Results of the analyses of these samples are in Appendix Table 18. Cesium-137 and ^{90}Sr are the predominant radionuclides. The greatest ^{137}Cs and ^{90}Sr values are in the leaves of the pandanus. Leaves from a pandanus plant near pit #9 (see Figure 2) contained 2350 pCi of ^{137}Cs per gram, while leaves from a plant near House #5 contained 483 pCi of ^{90}Sr per gram. Plutonium-239,240 values were usually less than the limits of detection.

DISCUSSION AND CONCLUSIONS

Comparison Between Atolls

Moving in a northerly direction, radioactivity values were least in the samples from Wotje Atoll, increased slightly at Ailuk Atoll and increased significantly at Utirik. From Utirik, radioactivity values increased to the west. Thus, Rongelap Atoll had higher values than Utirik and Bikini had the highest values of any atoll sampled during this survey. This pattern has been noted previously (Nelson, 1977) and is a result of the fallout distribution from the 1 March, 1954 Bravo test on Bikini Atoll. The south to north increase in radioactivity is also apparent at Rongelap Atoll where the southern islands have radioactivity levels about a factor of ten lower than the northern islands.

Differences Due to Sample Type

As noted previously (Nelson, 1977) ^{90}Sr and ^{137}Cs are the predominant radionuclides in biological and soil samples from the terrestrial environment. In addition, ^{241}Am and $^{239,240}Pu$ are important in soils from Rongelap Atoll and Bikini Atoll (Nelson, 1977) because of the quantity of these radionuclides and because they are alpha-emitters, which have a higher potential health hazard than most of the gamma-emitters. Pandanus leaves continue to be the best indicator species for ^{137}Cs because they concentrate ^{137}Cs and are abundant and available through the year. These leaves may also be used as an indicator for ^{90}Sr, if coconut crabs are not available. The exoskeleton of these crabs contains more ^{90}Sr than any other biological sample measured; however, these crabs are often absent or scarce on the more populated islands.

In the marine environment, ^{40}K is the predominant radionuclide. Cobalt-60 was the only fallout radionuclide present in a significant number of the marine samples and the values for this radionuclide were usually less than a pCi.

The kidney of the Tridacna had the greatest amounts of ^{60}Co of the marine samples analyzed.

SUMMARY

The DOE's portion of LRE's Pacific Radioecology Program began on 1 July 1974. The purpose of this program is to determine the types and amounts of radionuclides in biological and environmental samples from the Central Pacific, especially the Marshall Islands. A field trip was conducted for this program in September-October 1976. About 340 samples were collected and about 340 γ-spectrum, 130 strontium-90 and 75 plutonium-239,240 analyses were performed.

Results of the analyses indicate that ^{90}Sr and ^{137}Cs are predominant in the terrestrial environment and, in addition, ^{241}Am and $^{239,240}Pu$ are also important in the soil from Rongelap Atoll. Potassium-40 is the predominant radionuclide in the marine organisms, while ^{60}Co is important in the kidney of the Tridacna clams.

Amounts of radioactivity between atolls and and between islands within Rongelap Atoll vary with distance from the test site at Bikini Atoll and in relation to the fallout pattern from the March 1954 Bravo test. Plants from Bikini Island had the highest amounts of radioactivity, primarily ^{137}Cs, while plants from Naen Island at Rongelap Atoll had slightly lower amounts. The southern islands of Rongelap Atoll and Utirik Atoll had intermediate amounts of radioactivity, while Ailuk and Wotje Atolls had the lowest amounts of radioactivity of the atolls visited during this field trip.

REFERENCES CITED

Nelson, V. A. 1977. Radiological survey of plants, animals, and soil at Christmas Island and Seven Atolls in the Marshall Islands. U.S. ERDA Report NVO-269-32. College of Fisheries, University of Washington, Seattle.

APPENDIX TABLE 1

Some Radionuclides in Fish Collected at Rongelap, Ailuk, and Wotje Atolls in September 1976

Atoll/Island	Species	Tissue	Radionuclide Concentration in pCi/g, dry[a]			
			^{40}K	^{60}Co	^{137}Cs	^{90}Sr
Rongelap/Rongelap	Yellowfin Tuna	Liver	ns[b]	0.08±0.03	0.04±0.03	na[b]
Rongelap/Tufa	Goatfish	Evisc. whole[c]	10 ±2.2	0.08±0.07	ns	na
"	"	Viscera	11 ±7.3	0.51±0.35	ns	na
Rongelap/Eniaetok	Goatfish	Evisc. whole	8 ±2.4	0.78±0.14	ns	<0.19
"	"	Viscera	ns	ns	ns	na
"	Mullet	Evisc. whole	8.6±1.9	0.12±0.06	0.10±0.05	<0.20
"	"	Viscera	32 ±19	ns	ns	na
Rongelap/Kabelle	Mullet	Evisc. whole	5 ±2.2	ns	0.07±0.06	<0.09
"	"	Viscera	3.8±1.7	ns	0.09±0.06	na
Rongelap/Naen	Convict Surgeon	Entire	6.6±1.3	0.07±0.05	ns	<0.85
Ailuk/Ailuk	Convict Surgeon	Entire	8.9±2.7	ns	ns	<0.90
Ailuk/Bigen	Gerridae	Entire	11 ±1.7	ns	ns	na
Wotje/Wotje	Goatfish	Entire	15 ±4.6	ns	ns	<0.41
Wotje/Wormej	Convict Surgeon	Evisc. whole	8.5±1.4	ns	0.06±0.03	na
"	"	Viscera	16 ±5	ns	ns	na

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error. na = not analyzed.

c. Evisc. whole = eviscerated whole fish, i.e. the entire fish less the viscera.

APPENDIX TABLE 2

Predominant Radionuclides in Plants Collected at Wotje Atoll in September 1976

Island	Site	Sample Type		Radionuclide Concentration in pCi/gi dry[a]			
				^{40}K	^{137}Cs	^{90}Sr	$^{239,240}Pu$
Wotje	#2	Coconut,	meat	4.7±0.4	0.98±0.03	<0.12	<0.001
"	"	"	milk	na[b]	na	<0.88	na
"	"	"	leaves	2.7±1.1	0.42±0.07	<0.08	0.96±0.02
Wormej	"	"	"	1.7±1.3	1.6 ±0.13	na	na
"	#1	"	"	3.0±1.4	0.22±0.05	<0.05	na
"	#2	"	copra	6.1±0.3	1.1 ±0.02	<0.12	<0.001
Wotje	#1	Pandanus,	edible fruit	7.6±0.5	2.4 ±0.04	<0.18	0.002±0.002
"	"	"	inedible fruit	8.4±1.5	2.2 ±0.14	na	na
"	"	"	leaves	6.5±1.7	0.18±0.05	<0.09	na
"	#2	"	"	15 ±3.2	2.0 ±0.18	<0.14	na
Wormej	#5	"	"	3.2±1.2	0.44±0.10	0.25±0.08	na
"	#1	"	edible fruit	9.7±0.1	2.2 ±0.03	<0.18	<0.001
"	"	"	inedible fruit	7.5±1.7	1.4 ±1.1	0.79±0.13	na
"	"	"	leaves	5.4±1.3	0.88±0.09	0.44±0.12	na
Wotje	"	Breadfruit,	edible fruit	1.6±1.3	0.55±0.06	<0.12	<0.001
"	"	"	inedible fruit	14 ±0.4	0.73±0.03	na	na
"	"	"	leaves	12 ±1.6	0.92±0.09	0.21±0.10	na
Wormej	#3	"	edible fruit	11 ±0.4	1.0 ±0.03	<0.12	<0.001
"	"	"	inedible fruit	16 ±0.5	1.3 ±0.03	na	na
"	"	"	leaves	8.7±1.9	0.76±0.09	0.099±0.028	na
"	#1	"	"	8.9±2.0	1.3 ±0.14	na	na
Wotje	"	Papaya,	leaves	18 ±0.7	1.1 ±0.05	na	na
"	"	"	edible fruit	18 ±0.5	0.76±0.03	<0.78	<0.002
"	"	"	skin	16 ±2.6	0.99±0.11	na	na
"	"	"	seeds	22 ±4.1	1.4 ±0.03	na	na
Wormej	#2	"	edible fruit	19 ±0.5	2.6 ±0.04	<0.18	<0.001
"	"	"	skin	26 ±0.7	3.5 ±0.05	na	na
"	"	"	seeds	16 ±0.6	4.0 ±0.06	na	na
Wotje	Village	Taro,	root	6.5±1.5	0.35±0.06	<0.15	<0.001
"	"	Yam,	edible	8.1±1.3	0.16±0.11	<0.14	<0.001
"	"	Squash,	edible	33 ±0.7	1.1 ±0.4	<0.32	<0.001

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. na = not analyzed.

APPENDIX TABLE 3

Predominant Radionuclides in Plants Collected on Ailuk Atoll in September 1976

Island	Site	Sample Type		Radionuclide Concentration in pCi/g, dry[a]			
				^{40}K	^{137}Cs	^{90}Sr	$^{239,240}Pu$
Bigen	#1	Coconut,	meat	3.9±1.4	2.3 ±0.12	<0.07	<0.001
"	"	"	leaves	3.0±1.5	1.2 ±0.10	<0.07	na
Ailuk	#1	"	leaves	2.2±1.3	0.57±0.07	na[b]	na
"	#6	"	"	4.7±1.3	1.4 ±0.11	na	na
Bigen	#4	Pandanus,	edible fruit	10 ±2.8	5.0 ±2.5	<0.41	0.007
"	"	"	inedible fruit	9.5±1.7	4.2 ±0.2	na	na
"	#1	"	edible fruit	11 ±2.7	13 ±0.36	<0.49	0.036±0.012
"	"	"	inedible fruit	11 ±1.8	11 ±0.34	2.0 ± 0.3	na
"	"	"	leaves	2.7±1.4	1.8 ±0.11	0.14± 0.04	na
Ailuk	Village	"	edible fruit	11 ±1.6	2.9 ±0.13	0.25± 0.06	<0.001
"	"	"	inedible fruit	6.2±1.2	1.5 ±0.11	0.15± 0.10	na
"	#1	"	edible fruit	5.7±2.2	15 ±0.36	na	na
"	"	"	inedible fruit	4.9±1.4	11 ±0.25	0.14± 0.03	na
"	"	"	leaves	2.3±1.2	3.6 ±0.18	0.25	na
"	Village	Breadfruit,	edible fruit	15 ±1.7	2.8 ±0.15	<0.10	<0.001
"	"	"	inedible fruit	23 ±2.8	4.1 ±0.20	na	na
"	"	"	edible fruit	15 ±2.3	2.0 ±0.17	<0.18	<0.001
"	"	"	inedible fruit	10 ±0.2	1.5 ±0.13	na	na
"	"	"	leaves	3.3±2.1	2.3 ±0.15	na	na
Bigen	#1	"	leaves	2.9±1.4	0.67±0.07	1.0 ± 0.1	na
Ailuk	Village	Papaya,	edible fruit	21 ±2.7	2.8 ±0.17	<0.32	0.030±0.022
"	"	"	inedible fruit	17 ±3.3	2.4 ±0.19	<0.19	na
"	"	Arrowroot[c]	edible	6.2±1.2	4.0 ±0.18	462 ±58	0.030±0.006
"	"	Banana,	edible	13 ±2.5	0.38±0.16	<0.33	0.009±0.004

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. na = not analyzed.

c. Unprocessed tubers.

APPENDIX TABLE 4

Predominant Radionuclides in Soil Collected on Wormej Island, Wotje Atoll, September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]				
		^{137}Cs	^{238}U	^{241}Am	$^{239,240}Pu$	^{90}Sr
Site #1	0-2.5	0.59±0.09	0.69±0.31	0.09±0.08	0.074±0.014	0.32±0.14
"	2.5-5	0.46±0.08	0.63±0.59	ns[b]	0.18 ±0.03	0.32±0.22
"	5-10	0.86±0.14	ns	ns	na[b]	na
Site #3	0-2.5	0.23±0.08	0.69±0.39	ns	na	0.34±0.18
"	2.5-5	0.16±0.05	ns	ns	na	na
"	5-10	0.10±0.04	ns	0.23±0.12	na	na
"	10-15	0.06±0.03	0.62±0.25	ns	na	na
"	15-25	ns	ns	ns	na	na
"	25-35	ns	0.84±0.32	ns	na	na
"	35-50	ns	0.93±0.33	ns	na	na
"	50-75	ns	0.73±0.63	ns	na	na
"	75-100	ns	0.97±0.31	ns	na	0.25±0.22
Site #5	0-2.5	0.94±0.08	0.58±0.55	ns	0.16 ±0.03	0.68±0.22
"	2.5-5	0.35±0.06	ns	ns	na	na
"	5-10	0.17±0.05	0.48±0.21	ns	na	na
Site #6	0-2.5	0.34±0.08	ns	ns	na	0.47±0.22
"	2.5-5	0.33±0.05	ns	ns	na	na
Site #7	0-2.5	0.66±0.12	ns	ns	na	na
"	2.5-5	0.25±0.08	ns	0.20±0.18	0.12 ±0.02	na

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error. na = not analyzed.

APPENDIX TABLE 5

Some Radionuclides in Soil Collected on
Wotje Island, Wotje Atoll, September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]				
		^{137}Cs	^{238}U	^{241}Am	$^{239,240}Pu$	^{90}Sr
Site #1	0-2.5	0.31±0.08	0.91±0.36	0.12±0.09	0.038 ±0.008	0.61±0.32
"	2.5-5	0.21±0.07	ns[b]	ns	na[b]	na
"	5-10	0.07±0.04	0.79±0.59	ns	na	na
Site #2	0-2.5	0.78±0.11	ns	ns	na	<0.18
"	2.5-5	0.50±0.10	ns	ns	na	na
"	5-10	0.31±0.08	ns	0.25±0.18	na	na
Site #3	0-2.5	0.18±0.06	ns	ns	na	na
"	2.5-5	0.10±0.05	0.51±0.29	ns	na	na
"	5-10	ns	ns	ns	na	na
"	10-15	0.06 0.04	ns	ns	na	na
"	15-25	ns	ns	ns	na	na
"	25-35	ns	ns	ns	na	na
"	35-50	ns	0.74±0.59	ns	na	na

a. The error values for all radionuclides

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error.
na = not analyzed.

APPENDIX TABLE 6

Some Radionuclides in Soil Collected on Ailuk Island, Ailuk Atoll, September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]		
		^{137}Cs	^{238}U	Other
Site #1	0-2.5	0.48±0.09	1.2 ±0.84	^{90}Sr 0.77±0.22
"	2.5-5	0.28±0.08	0.62±0.34	
"	5-10	0.23±0.08	1.4 ±0.36	
"	10-15	0.15±0.07	ns[b]	
"	15-25	0.07±0.03	ns	
"	25-35	0.05±0.04	ns	
"	35-50	ns	ns	
"	50-75	ns	ns	
"	75-100	ns	0.44±0.24	
Site #2	0-2.5	0.73±0.12	0.66±0.39	
"	2.5-5	0.32±0.08	ns	
"	5-10	0.16±0.05	0.52±0.32	
Site #3	0-2.5	ns	ns	
"	2.5-5	0.07±0.04	0.95±0.28	
"	5-10	0.18±0.07	ns	
Site #4	0-2.5	0.98±0.12	0.65±0.29	
"	2.5-5	0.12±0.05	0.43±0.31	
"	5-10	ns	ns	
Site #5	0-2.5	0.61±0.11	0.68±0.33	
"	2.5-5	0.22±0.06	ns	
"	5-10	0.10±0.04	0.62±0.31	
Site #6	0-2.5	0.22±0.07	0.68±0.38	^{90}Sr 0.27±0.14
"	2.5-5	0.19±0.07	0.81±0.32	
"	5-10	ns	ns	

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error.

APPENDIX TABLE 7

Some Radionuclides in Soil Collected on Bigen Island
Ailuk Atoll, September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a] ^{137}Cs	^{238}U	Other
Site #1	0-2.5	1.2 ±0.15	ns[b]	$^{239,240}Pu$ 0.098±0.018 ^{90}Sr 0.56 ±0.16
"	2.5-5	0.70±0.11	ns	
"	5-10	0.53±0.11	0.92± 0.33	
"	10-15	0.35±0.08	ns	
"	15-25	0.18±0.06	ns	
"	25-35	ns	ns	
Site #2	0-2.5	0.91±0.13	0.54± 0.36	
"	2.5-5	0.41±0.09	ns	
"	5-10	0.21±0.07	ns	
Site #3	0-2.5	1.1 ±0.13	ns	$^{239,240}Pu$ 3.8 ±0.6 ^{90}Sr 0.27 ±0.12
"	2.5-5	0.77±0.11	ns	
"	5-10	0.38±0.09	ns	$^{239,240}Pu$ 0.056±0.008
Site #4	0-2.5	0.84±0.12	ns	^{90}Sr 0.41 ±0.14
"	2.5-5	1.6 ±0.17	ns	
"	5-10	1.2 ±0.13	0.98±0.74	

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error.

APPENDIX TABLE 8

Predominant Radionuclides in Plants Collected on Utirik Atoll in September 1976

Island	Sample Type		Radionuclide Concentration in pCi/g, dry[a]			
			^{40}K	^{137}Cs	^{90}Sr	$^{239,240}Pu$
Anon	Coconut,	leaves	2.4±1.1	1.3±0.12	0.14±0.08	na[b]
Utirik	"	leaves	2.0±1.3	2.0±0.11	0.13±0.03	na
Eerukku	"	leaves	3.4±1.1	0.5±0.1	0.82±0.12	na
"	"	meat	23 ±3.3	1.4±0.15	<0.42	<0.001
"	"	milk	ns[b]	ns	<1.7	na
Aon	Pandanus,	edible fruit	11 ±1.9	17 ±0.44	1.3 ±0.52	<0.003
"	"	inedible fruit	7.1±1.4	8.8±0.26	0.52±0.16	na
"	"	leaves	3.5±1.2	3.5±0.17	2.1 ±0.3	na
Eerukku	"	edible fruit	10 ±2.4	3.0±0.18	na	<0.001
"	"	inedible fruit	8.6±1.5	1.9±0.13	na	na
"	"	leaves	6.8±1.4	1.1±0.11	0.52±0.10	na
Utirik	"	edible fruit	3.3±0.5	22 ±0.5	na	<0.001
"	"	inedible	3.5±1.6	21 ±0.37	na	na
"	"	leaves	2.5±1.5	4.2±0.17	0.13±0.06	na
"	Breadfruit,	edible fruit	14 ±1.6	5.1±0.19	na	na
"	"	inedible fruit	15 ±2.6	5.7±2.8	<0.13	<0.001
"	"	leaves	11 ±1.6	4.5±0.19	na	na
"	"	leaves	5.2±1.8	2.9±2.3	0.95±0.09	na
Aon	"	leaves	11 ±1.9	4.2±0.22	1.5 ±0.3	na

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error. na = not analyzed.

APPENDIX TABLE 9

Some Radionuclides in Soil Collected on Utirik Island, Utirik Atoll, September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]			
		^{60}Co	^{137}Cs	^{241}Am	Other
Site #1	0-2.5	0.16±0.08	3.6 ±0.26	0.26±0.12	
"	2.5-5	ns[b]	0.83±0.10	0.21±0.15	
"	5-10	0.08±0.06	0.32±0.07	ns	
Site #2	0-2.5	0.18±0.06	3.9 ±0.26	0.64±0.14	$^{239,240}Pu$ 1.3 ±0.2 ^{90}Sr 2.9 ±0.5
"	2.5-5	ns	0.35±0.02	ns	
"	5-10	ns	0.14±0.03	ns	
Site #3	0-2.5	0.09±0.05	4.0 ±0.15	0.67±0.14	
"	2.5-5	ns	0.83±0.10	ns	
"	5-10	ns	0.41±0.08	ns	
Site #4	0-2.5	0.10±0.08	5.3 ±0.31	0.18±0.13	^{90}Sr 3.2 ±0.4
"	2.5-5	0.14±0.10	1.9 ±0.17	0.25±0.19	
"	5-10	ns	0.47±0.10	ns	
Village	0-2.5	ns	1.0 ±0.11	ns	^{90}Sr 0.50 ±0.14 $^{239\ 240}Pu$ 0.075±0.018

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error.

APPENDIX TABLE 10

Some Radionuclides in Soil Collected at Utirik Atoll
September 1976

Island	Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a] ^{137}Cs	^{238}U	^{241}Am	Other
Eerukku	Center of Isle	litter	0.97±0.18	1.5 ±1.4	ns[b]	$^{238,240}Pu$ 0.52±0.10
"	"	0-2.5	2.3 ±0.21	ns	0.17±0.11	^{90}Sr 0.89±0.16
"	"	2.5-5	3.3 ±0.21	ns	0.43±0.19	
"	"	5-10	1.9 ±0.12	0.47±0.24	0.17±0.07	
"	"	10-15	0.82±0.07	ns	ns	
"	"	15-25	ns	ns	ns	
"	"	25-35	ns	ns	ns	
"	"	35-50	ns	ns	ns	
Aon	Site #1	0-2.5	3.2 ±0.21	ns	ns	$^{239,240}Pu$ 0.75±0.34
"	"	2.5-5	1.5 ±0.16	ns	0.15±0.09	^{90}Sr 1.0 ±0.2
"	"	5-10	0.59±0.07	0.99±0.24	ns	
"	"	10-15	0.38±0.06	ns	ns	
"	Site #2	0-2.5	1.4 ±0.15	ns	0.28±0.20	^{90}Sr 1.1 ±0.2
"	"	2.5-5	0.36±0.09	ns	0.21±0.19	
"	"	5-10	0.35±0.09	0.92±0.36	ns	
"	"	10-15	0.18±0.07	ns	ns	
"	"	15-25	0.07±0.04	0.74±0.30	ns	
"	Site #3	0-2.5	1.6 ±0.17	ns	0.27±0.11	
"	"	2.5-5	0.52±0.10	1.3 ±0.78	ns	
"	"	5-10	ns	ns	ns	

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error.

APPENDIX TABLE 11

Predominant Radionuclides in Tridacna Clams From
Kabelle Island, Rongelap Atoll, September 1976

Island	Number of Clams	Tissue	Radionuclide Concentration in pCi/g, dry[a]	
			^{40}K	^{60}Co
Kabelle	1	Muscle	7.1±2.1	0.30±0.12
"	"	Mantle	7.0±2.5	0.46±0.09
"	"	Kidney	5.9±1.9	12 ±0.4
"	"	Remainder	5.8±2.4	0.68±0.16
Kabelle	"	Muscle	4.8±3.7	0.47±0.20
"	"	Mantle	7.4±1.9	0.78±0.11
"	"	Kidney	nsb	7.6 ±0.3
"	"	Remainder	ns	0.61±0.10
Kabelle	"	Muscle	ns	0.55±0.18
"	"	Mantle	6.7±2.1	0.76±0.12
"	"	Kidney	7.7±2.4	16 ±0.4
"	"	Remainder	5.6±2.2	0.85±0.11

a. The error values for ^{40}K and ^{60}Co are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated, counting error.

APPENDIX TABLE 12.

Predominant Radionuclides in Plants Collected at Rongelap Atoll in September 1976

Island	Site	Sample Type		Radionuclide Concentration in pCi/g, dry[a]			
				^{40}K	^{137}Cs	^{90}Sr	$^{239,240}Pu$
Rongelap	#5	Coconut,	meat	3.6±1.4	25 ±0.4	<.12	<0.001
"	"	"	milk	ns[b]	355 ±14	<2.1	na[b]
"	"	"	leaves	5.1±1.2	61 ±0.7	na	na
"	#1	"	"	4.2±1.1	11 ±0.2	na	na
Eniaetok	#1	"	meat	9.1±1.6	13 ±0.3	<0.20	<0.001
"	"	"	milk	54 ±48	54 ±6	na	na
"	"	"	leaves	2.6±1.6	5.8±0.4	na	na
Naen	#1	"	meat	6.0±1.4	35 ±0.3	0.18	<0.002
"	"	"	milk		348 ±16	<32	na
"	"	"	leaves	5.8±1.2	42 ±0.5	9.5±0.8	na
"	#4	"	"		64 ±0.6	na	na
Rongelap	#3	Pandanus,	leaves	7.3±1.4	60 ±0.6	15 ±0.8	na
Naen	#1	"	"	22 ±2.2	125 ±0.9	55 ±3	na
Eniaetok	#2	"	"	7.3±1.6	35 ±0.5	0.21±0.05	na
"	Village	Breadfruit,	"	13 ±1.8	14 ±0.4	na	na

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error. na = not analyzed.

APPENDIX TABLE 13

Predominant Radionuclides in Coconut Crabs Collecte
at Rongelap Atoll in September 1976

Island	Tissue	Radionuclide Concentration in pCi/g, ^{40}K	^{60}Co	^{137}Cs	^{90}Sr
Naen	Muscle	7.7±1.7	0.66±0.08	130±0.8	10 ± 1.6
"	Hepatopancreas	1.9±1.0	1.1 ±0.1	44±0.6	14 ± 1.8
"	Exoskeleton	2.3±1.0	ns[b]	28±0.4	330 ±26
Naen	Muscle	6.8±1.5	0.74±0.08	160±0.9	2.7± 0.2
"	Hepatopancreas	2.7±1.1	2.0 ±0.1	72±0.7	20 ± 1.6
"	Exoskeleton	ns	0.13±0.05	40±0.5	340 ±28
Kabelle	Muscle	7.4±1.5	0.44±0.06	47±0.5	3.5± 0.3
"	Hepatopancreas	4.4±1.6	0.87±0.14	36±0.8	na
"	Exoskeleton	ns	ns	8.6±0.4	200 ±16
Kabelle	Muscle	8.8±2.2	0.34±0.09	39±0.7	2.9± 0.2
"	Hepatopancreas	4.6±1.2	2.4 ±0.1	21±0.4	12 ± 1
"	Exoskeleton	1.6±1.3	ns	8.1±0.4	na
Tufa	Muscle	10 ±2.2	0.12±0.09	12±0.4	1.2± 0.2
"	Hepatopancreas	2.9±1.3	0.13±0.05	4.8±0.3	7.4± 0.6
"	Exoskeleton	2.2±1.3	0.12±0.04	2.2±0.1	130 ±10
Tufa	Muscle	5.5±2.0	0.26±0.08	12 ±0.4	1.2± 0.2
"	Hepatopancreas	3.4±1.1	0.36±0.07	4.0±0.4	6.9± 0.6
"	Exoskeleton	ns	ns	2.0±0.3	51 ± 4.4

a. The error values for all radionuclides are two-sigma, propagated, counting e
sample.

b. ns = not significant; the net sample count is less than the two-sigma, propa
na = not analyzed.

APPENDIX TABLE 14

Some Radionuclides in Soil Collected on Rongelap Island, Rongelap Atoll, in September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]			
		^{60}Co	^{137}Cs	^{155}Eu	^{241}Am
I. Sample sites along trail from church to ocean					
Site #1 (Ocean side ridge)	0-2.5	0.30±0.07	31 ±0.6	0.56±0.17	1.4 ±0.18
Site #2	0-2.5	0.53±0.11	13 ±0.4	1.8 ±0.24	3.2 ±0.32
Site #3	0-2.5	0.70±0.12	15 ±0.5	1.7 ±0.21	3.2 ±0.24
Site #4 (Center of island)	0-2.5	0.34±0.11	39 ±0.7	1.0 ±0.27	1.6 ±0.33
Site #5	0-2.5	0.93±0.13	58 ±0.9	2.0 ±0.27	4.4 ±0.32
Site #6	0-2.5	ns[b]	15 ±0.4	0.52±0.20	0.59±0.25
"	2.5-5	0.14±0.07	7.1 ±0.4	0.47±0.13	0.76±0.16
"	5-10	ns	2.6 ±0.2	0.23±0.17	0.20±0.19
Site #7 (Edge of village)	0-2.5	0.53±0.10	31 ±0.6	1.1 ±0.24	2.0 ±0.30
Site #8 (Next to church)	0-2.5	ns	1.7 ±0.2	ns	ns
Pit #1	litter	ns	21 ±0.7	ns	ns
"	0-2.5	0.84±0.14	36 ±0.8	2.2 ±0.25	4.2 ±0.30
"	2.5-5	0.28±0.08	13 ±0.5	0.33±0.16	0.86±0.17
"	5-10	ns	5.6 ±0.3	ns	ns
"	10-5	0.14±0.13	12 ±0.5	ns	ns
"	15-25	ns	1.1 ±0.1	ns	ns
"	25-35	ns	0.22±0.1	ns	ns
"	35-50	ns	0.16±0.1	ns	ns

a. The error values are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma counting error.

APPENDIX TABLE 15

Predominant Radionuclides in Soil Collected on Eniaetok Island, Rongelap Atoll, September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]					
		^{60}Co	^{137}Cs	^{155}Eu	^{241}Am	$^{239\ 240}Pu$	^{90}Sr
Site #1	0-2.5	0.69±0.12	29±0.7	2.1 ±0.23	3.5 ±0.27	na[b]	9.4±0.8
"	2.5-5	0.19±0.09	19±0.5	0.66±0.22	1.4 ±0.28	na	na
"	0-2.5	ns[b]	11±0.4	ns	0.23±0.13	na	na
Site #2	0-2.5	1.4 ±0.16	79±0.9	4.4 ±0.38	8.1 ±0.53	17 ±2.6	na
"	2.5-5	0.47±0.10	48±0.9	0.52±0.21	1.4 ±0.23	3.8±1.2	11 ±1.8
"	5-10	ns	25±0.5	0.18±0.18	0.31±0.24	0.5±0.1	7.7±0.7

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error. na = not analyzed.

APPENDIX TABLE 16

Predominant Radionuclides in Soil Collected on
Kabelle Island, Rongelap Atoll, in September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]					
		^{60}Co	^{137}Cs	^{155}Eu	^{241}Am	$^{239,240}Pu$	^{90}Sr
Site #1 (Pisonia forest)	0-2.5	1.2 ±0.11	34 ±0.5	4.0 ±0.19	8.0 ±0.25	17 ±5	24± 2
"	2.5-5	0.60±0.06	36 ±0.4	1.2 ±0.16	2.4 ±0.24	7.6±1.2	27± 2.2
"	5-10	0.47±0.09	33 ±0.6	0.91±0.20	1.8 ±0.21	28 4.1	130±17
"	10-15	ns[b]	18 ±0.4	ns	0.51±0.23	na[b]	na
"	15-25	0.14±0.05	9.2±0.3	0.16 0.12	0.15±0.12	na	na
"	25-35	ns	1.5±0.1	ns	ns	na	na
Site #2 (Water catchment)	0-2.5	1.5 ±0.10	27 ±0.4	8.2 ±2.5	14 ±0.29	na	27± 4.2
"	2.5-5	0.22±0.07	10 ±0.4	ns	0.31±0.13	na	na
"	5-10	0.18±0.06	6.6±0.3	ns	ns	na	na
Site #3 (1974 Pit #6)	0-2.5	1.8 ±0.11	203 ±1.0	6.7 ±0.3	13 ±0.35	na	163±22
"	2.5-5	0.29±0.06	11 ±0.2	0.87±0.12	1.4 ±0.17	na	na
"	5-10	0.69±0.07	40 ±0.4	1.8 ±0.15	3.3 ±0.18	na	na
Site #4							
"	0-2.5	1.8 ±0.18	33 ±0.7	6.2 ±0.36	11 ±0.51	16 ±2.5	45± 7
"	2.5-5	1.1 ±0.14	72 ±0.9	3.5 ±0.37	6.3 ±0.49	na	na
"	5-10	0.34±0.09	30 ±0.7	0.73±0.20	1.6 ±0.23	na	na
Site #5	0-2.5	0.47±0.09	52 ±0.7	1.6 ±0.26	3.3 ±0.37	4.9±1.1	23± 3.5
"	2.5-5	0.22±0.07	6.2±0.3	ns	0.15±0.11	na	na
"	5-10	ns	3.7±0.2	ns	ns	na	na

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error. na = not analyzed.

APPENDIX TABLE 17

Predominant Radionuclides in Soil Collected on Naen Island, Rongelap Atoll, in September 1976

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]						
		^{60}Co	^{125}Sb	^{137}Cs	^{155}Eu	^{241}Am	$^{239,240}Pu$	^{90}Sr
Site #1	0-2.5	4.0 ±0.17	2.2 ±0.32	148 ±0.7	14 ±0.42	26 ±0.58	49 ±7.4	36 ± 5
"	2.5-5	4.8 ±0.30	3.3 ±0.69	263 ±2.1	13 ±0.63	27 ±0.72	42 ±6.9	523 ± 67
"	5-10	0.73±0.07	0.80±0.24	83 ±0.6	0.81±0.18	1.5 ±0.18	4.4±1.2	46 ± 7
"	10-15	0.14±0.06	0.48±0.17	42 ±0.4	ns[b]	ns	na[b]	na
"	15-25	ns	ns	5.8±0.3	ns	ns	na	na
"	25-35	ns	ns	0.7±0.1	ns	0.25±0.14	na	na
"	35-50	ns	ns	0.2 0.1	ns	ns	na	na
Site #2	0-2.5	8.0 ±0.55	5.7 ±1.9	980 ±4.9	20 ±1.4	44 ±1.5	na	282 ± 43
"	2.5-5	2.6 ±0.23	2.4 ±0.78	298 ±2.1	1.8 ±0.49	4.2 ±0.52	na	na
"	5-10	0.55±0.12	0.95±0.36	57 ±0.9	0.37±0.31	1.9 ±0.40	na	na
"	10-15	0.22±0.11	0.66±0.26	16 ±0.5	ns	0.75±0.32	na	na
"	15-25	0.22±0.07	ns	10 ±0.4	0.39±0.22	0.72±0.26	na	na
"	25-35	0.15±0.10	ns	2.4±0.2	ns	ns	na	na
"	35-50	ns	ns	2.2±0.2	ns	ns	na	na
"	50-75	ns	ns	0.3±0.1	ns	ns	na	na
Site #3	0-2.5	1.8 ±0.12	0.94±0.40	196 ±1	5.8 ±0.34	11 ±0.44	18 ±2.8	89 ± 7
"	2.5-5	3.1 ±0.24	1.9 ±0.68	236 ±1.7	6.9 ±0.50	14 ±0.59	na	na
"	5-10	2.1 ±0.16	1.2 ±0.49	185 ±1.1	5.2 ±0.43	8.4 ±0.62	na	na
"	10-15	0.77±0.11	0.91±0.29	44 ±0.7	0.78±0.24	2.0 ±0.34	na	na
"	15-25	0.37±0.08	0.55±0.21	8.8±0.3	0.28±0.14	0.31±0.13	na	na
"	25-35	0.16±0.06	0.28±0.13	2.2±0.2	ns	ns	na	na
"	35-50	0.06 0.04	ns	0.6 0.1	ns	ns	na	na
"	50-75	ns	ns	ns	ns	ns	na	na

Table 17 (Cont.)

Collection Location	Soil Depth (cm)	Radionuclide Concentration in pCi/g, dry[a]						
		^{60}Co	^{125}Sb	^{137}Cs	^{155}Eu	^{241}Am	$^{239,240}Pu$	^{90}Sr
Site #4	0-2.5	5.5 ±0.19	3.7 ±0.56	242 ±1.2	21 ±0.15	22 ±0.7	57 ±8.8	236 ±36
"	2.5-5	1.4 ±0.11	ns	66 ±0.7	1.4 ±0.18	3.2 ±0.21	na	54 ± 4.2
"	5-10	0.40±0.08	0.37±0.21	17 ±0.5	0.18±0.15	0.40±0.16	na	34 ± 2.8
"	10-15	ns	ns	5.7±0.2	ns	ns	na	na
"	15-25	ns	ns	3.9±0.2	ns	0.31±0.18	na	na
"	25-35	0.07±0.05	ns	0.5±0.1	ns	ns	na	na
"	35-50	ns	0.15±0.13	0.3±0.1	ns	0.16±0.15	na	na
Site #5	0-2.5	5.4 ±0.21	ns	70 ±0.7	17 ±0.4	36 ±0.5	65 ±9,6	491 ±63
"	2.5-5	1.7 ±0.16	1.1 ±0.23	23 ±0.5	3.8 ±0.3	7.2 ±0.35	na	na
"	5-10	0.57±0.09	ns	14 ±0.4	ns	0.33±0.15	na	na
"	10-15	ns	0.20±0.15	4.1±0.2	ns	ns	na	na
"	15-25	ns	ns	0.5±0.1	ns	ns	na	na
Site #6	0-2.5	1.6 ±0.16	1.4 ±0.70	149 ±1.3	6.4 ± 0.44	13 0.5	na	166 ±14
"	2.5-5	0.25±0.08	ns	15 ±0.5	0.28± 0.20	0.32±0.26	1.8± 0.3	23.4± 1.8
"	5-10	0.31±0.08	0.51±0.23	23 ±0.5	ns	0.35±0.24	0.7± 0.1	14.6± 1.2
"	10-15	0.26±0.07	ns	8 ±0.3	0.12± 0.11	0.14±0.11	na	na
"	15-25	0.14±0.05	0.26±0.12	2.3±1.7	ns	0.11±0.10	na	na

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error. na = not analyzed.

APPENDIX TABLE 18

Predominant Radionuclides in Plants Collected on Bikini Island in September and October 1976

Sample Type	Collection Site	Radionuclide Concentration in pCi/g, dry[a]			
		^{40}K	^{137}Cs	^{90}Sr	$^{239,240}Pu$
Coconut, leaves	1st BLS, row 35.5	ns[b]	38±0.4	na[b]	na
" "	Pit #11	ns	103±1.0	na	na
" "	Pit #3	ns	48±0.8	na	na
" "	Pit C	5.8±0.3	108±1.3	na	na
" "	Pit I	ns	133±1.5	na	na
Breadfruit, edible fruit	Pit I	13 ±3.2	64±0.9	39± 5.8	<.001
" inedible	"	10 ±1.3	55±0.4	na	na
" leaves	"	4.6±1.4	26±0.3	na	na
" "	Pit C	3.5±0.9	42±0.3	na	na
" "	Pit D	3.1±1.0	326±1.3	na	na
" "	Pit #9	13 ±1.6	57±0.5	na	na
" "	Pit #12	1.9±1.3	25±0.4	na	na
Pandanus, leaves	Pit #9	7.9±2.8	2350±7.1	123±16	na
" "	Pit #C	6.0±2.3	221±2.2	104±12	na
" "	House #5	ns	1060±4.2	483±64	na
" "	Pit #1	3.1±2.7	106±1.2	40± 4	0.015±0.004
" edible fruit	"	10 ±6.5	398±5.2	12± 1.6	<.002
" inedible fruit	"	5.2±1.2	164±1	12± 1	<.001
Papaya, edible fruit	Pit #12	26 ±3.7	99±1.1	23± 3	<.001
" skin	"	29 ±4.7	114±1.3	na	na
" seeds	"	16 ±4.5	115±1.0	na	na

a. The error values for all radionuclides are two-sigma, propagated, counting errors for a single sample.

b. ns = not significant; the net sample count is less than the two-sigma, propagated counting error. na = not analyzed.

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