AMCHITKA RADIOBIOLOGICAL PROGRAM PROGRESS REPORT

MARCH 1972 TO DECEMBER 1972

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ABSTRACT

The Amchitka Radiobiological Program, to collect biological and environmental samples for radiometric analyses, began in 1970 and is continuing. An account of the program from July 1970 to February 1972 has been given in two previous progress reports, Held (1971) and Held (1972). This report extends the account of the program through 1972.

Recent results of analyses have been appended to previously prepared tables and include analyses for: 1) gamma-emitting radionuclides in air filters, seawater, freshwater, marine algae, marine invertebrates, marine fish, sea otter, and freshwater aufwuchs, moss, plants, and fish; 2) strontium-90 (^{90}Sr) in rats and birds; and 3) tritium (^3H) in seawater, freshwater, and fish. Tables from the previous reports were revised by summarizing the pre-Cannikin data, recalculating the values for zirconium-95 (^{95}Zr) and niobium-95 (^{95}Nb), and adding data for beryllium-7 (^7Be). Also, the limits of ^3H detection were lowered to about 15 tritium units (TU).

The results of the recent analyses indicate that: 1) no new radionuclides are present; 2) the most abundant radionuclides are naturally occurring ^7Be and potassium-40 (^{40}K); 3) the trace quantities of fission products, induced radionuclides and ^3H present are from world fallout; and, 4) a trace of ^3H contamination remains in some Long Shot ponds as previously reported. It is concluded from the results of analyses of samples collected between September 1969 and December 1972 as reported in this and two previous progress reports, that there were no radionuclides of Milrow or Cannikin origin in the water, plants, and animals of Amchitka Island.

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1. INTRODUCTION

The present Amchitka Radiobiological Program was initiated in July 1970, by the University of Washington's Laboratory of Radiation Ecology at the request of the U.S. Atomic Energy Commission, Nevada Operations Office. The program is designed to provide a periodic documentation of radionuclides, both naturally occurring and man-made, in biological and environmental samples from Amchitka and its environs. Seafoods and radionuclides potentially available to man through the food web are emphasized. However, organisms other than food organisms are also collected and analyzed in a search for indicator organisms (species that significantly concentrate one or more radionuclides). Concentrations of radionuclides other than those potentially hazardous to man are measured as a means of providing clues to the origin of radionuclides at Amchitka. Unexpected combinations or concentrations of radionuclides would indicate the presence of newly added radionuclides to the environment, presumably from fresh world fallout, nuclear-powered vessels, or from nuclear detonations at Amchitka Island. The program is complemented by other Amchitka radiological surveillance studies being conducted by the U.S. Geological Survey, who is primarily concerned with the measurement of ^3H as the most likely indicator of seepage from the underground tests.

A summary of the first progress report, as stated by Held (1972), is as follows:

The first progress report (NVO-269-11) covered the period July 1970 to April 1971. This report included the results of radio-metric analyses of fish collected in the fall of 1969 and the results of analyses of seawater, freshwater, marine organisms, anadromous fish, freshwater plants, and lichens collected in September 1970. It concluded that artificial or man-made radionuclides did not originate at Amchitka except for tritium which had previously been reported to be present in pond water and test holes near the Long Shot SGZ site. The Long Shot device was detonated in 1965 and the Milrow device was detonated in 1969.

The summary and conclusions of the second progress report as stated by Held (1972) are as follows:

Biological and environmental samples collected periodically before and after the Cannikin test were analyzed for radionuclide content. The radionuclides found were either naturally occurring or from worldwide fallout, with the exception of tritium previously reported from ponds and test holes near the SGZ of the Long Shot nuclear detonation.

The greatest concentrations of fallout radionuclides in air filters, marine algae, and freshwater plants occurred in the spring of 1971. The post-Cannikin concentrations of radionuclides were either lower than immediate pre-Cannikin values or approximately the same. The concentrations of gamma-emitting radionuclides in one sponge, in two crab livers, and in fish collected after the Cannikin test showed no marked changes.

Iron-55 concentrations in Amchitka fish collected in the fall of 1970 and in canned salmon from the 1971 Bristol Bay pack were within the range of values previously reported. Cesium-137 and ^{60}Co were found in the Ptarmigan and sea birds.

Fewer kinds of radionuclides were detected in seawater samples in 1971 than in September 1970. Most of the radioactivity in the ponds and lakes at Amchitka is associated with particulates. Zirconium-95-niobium-95 was the most abundant gamma-emitting radionuclide detected in seawater just prior to the Cannikin test and just after the Cannikin test. Only naturally occurring ^{40}K was detectable before and after the Cannikin test with an in situ gamma probe that has a limit of detection of approximately 1 pCi of ^{95}Zr per liter of seawater.

It was concluded that there was no release of radioactivity as a result of the Cannikin test.

In this, the third progress report, the format of the previous reports has been followed, but some corrections and amendments have been made in the tables in addition to appending new data. All of the ^{95}Zr - ^{95}Nb values were recalculated and reported individually as ^{95}Zr and ^{95}Nb , and the tables were, in addition, amended to include values for naturally occurring ^7Be . Also inserted into the tables were the results of recent analyses of a few samples that had been collected during the period covered by the earlier reports. Another change in the tables was the reduction of the pre-Cannikin data from a listing of the results of individual analyses (Held 1972) to values for the mean, standard deviation, and range only.

In the calculation of these values for the pre-Cannikin data the re-computed values for ^{95}Zr , ^{95}Nb , and ^7Be were used as well as new data from a few previously unreported analyses. Therefore, the values for the pre-Cannikin data in this report may be slightly different than the values would be if calculated from Held (1972).

In this way, the tables were shortened and a convenient means of comparing pre- and post-Cannikin data was provided. The post-Cannikin data for the period November 1971 to February 1972 from the second progress report have been repeated in this report as a listing of the results of individual analyses, and to this listing has been added the results of analyses of samples collected in 1972 after February.

Figure 1 shows the geographical location of Amchitka Island. Figure 2 shows general collection sites for the program. Figures 3 through 6 present the specific collection sites for the shaded areas shown in Figure 2.

2. METHODS

Essentially all samples were analyzed by gamma-ray spectrometry with 3-by 3-inch NaI(Tl) crystals and 200-channel, pulse-height analyzers.

FIGURE 1. Location Map

FIGURE 2. Location of Collection Sites on and near Amchitka Island, Alaska

FIGURE 3. Amchitka Island Base Camp Area

FIGURE 4. Collection Sites (Overlay of LLL Chart of January 1971, UTM Coordinates 49-55 and 96-02)

FIGURE 5. Long Shot Ground Zero Vicinity

FIGURE 6. Collection Sites (Overlay of LLL Charts of January 1971, UTM Coordinates, 43-48 and 07-01)

Selected samples were analyzed in greater detail with a Ge(Li) diode system and a 4,096-channel, pulse-height analyzer. Chemical separation and X-ray spectrometry were used for iron-55 (^{55}Fe) determinations. Using these methods, the limits of detection for individual radionuclides are well below the radioactivity concentration guides for radionuclides in drinking water.

The NaI system is used routinely for gamma-spectrum analyses because the output data from this system is automatically transferred to punch cards for computer analyses and because it is more efficient for counting gamma photons than the Ge(Li) system, hence requiring less counting time for the same counting accuracy.

The Ge(Li) system has a much greater resolution for gamma photon energies than the NaI system. It is used especially for samples with gamma-emitting radionuclides of energies that cannot be resolved by the NaI detector such as ^{95}Zr and ^{95}Nb . The 724- and 756-keV gamma photons from ^{95}Zr and the 765-keV gamma photon from ^{95}Nb appear as a single peak on the NaI spectrum and as three peaks on the Ge(Li) spectrum.

When a sample containing ^{95}Zr and ^{95}Nb was counted by the two systems in the same day, the value for ^{95}Zr plus ^{95}Nb , as determined by the NaI system, was about the same as the sum of the values for the two radionuclides as determined by the Ge(Li) system. Hence, the composite value of ^{95}Zr plus ^{95}Nb , as determined by the NaI system, is assumed to be valid for the day it was counted.

In the original computation of ^{95}Zr plus ^{95}Nb values, as reported in Held (1971) and Held (1972), an error was made in the decay correction factor. This is the factor that corrects the value obtained on the day of counting to the backward extrapolated value for radioactivity in the sample on the day of collection. The radioactivity of the sample on the day of collection is the conventional method for reporting results of analyses. In the original computation it was assumed that the ratio of ^{95}Zr atoms to ^{95}Nb atoms, undergoing decay, was 1:1 as would be the ratio if the two radionuclides were in secular equilibrium; however, the radionuclides are actually in transient equilibrium and the ratio of ^{95}Zr to ^{95}Nb in d/m is 1 to 2.17, a value which was derived as follows: at transient equilibrium,

$$N_1 \lambda_1 = N_2 (\lambda_2 - \lambda_1)$$

where N_1 = number of ^{95}Zr atoms

$$N_2 = \quad " \quad " \quad ^{95}\text{Nb} \quad "$$

$$\lambda_1 = \text{decay constant for } ^{95}\text{Zr} = 0.01066/\text{day}$$

$$\lambda_2 = \quad " \quad " \quad " \quad ^{95}\text{Nb} = 0.0198/\text{day}$$

$$^{95}\text{Nb}:^{95}\text{Zr}, \text{ decay rate} = \lambda_2/\lambda_1 = 1.86$$

$$^{95}\text{Nb}:^{95}\text{Zr}, \text{ atoms} = N_2/N_1 = \lambda_1/\lambda_2 - \lambda_1 = 1.166$$

$$^{95}\text{Nb}:^{95}\text{Zr}, \text{ in d/m} = N_2 \lambda_2/N_1 \lambda_1 = 2.17$$

To correct the error in the original calculation of the $^{95}\text{Zr} + ^{95}\text{Nb}$ values, the composite values for $^{95}\text{Zr} + ^{95}\text{Nb}$ on the day of counting were used to calculate individual values for ^{95}Zr and ^{95}Nb which then were corrected for decay to the date of collection. To do this, it was assumed that ^{95}Zr and ^{95}Nb were in transient equilibrium at the time of sample counting and collection and that the equilibrium value was 1:2.17, i.e. 32 percent of the disintegrations were ^{95}Zr and 68 percent ^{95}Nb . After the values for ^{95}Zr and for ^{95}Nb , on the day of counting, had been determined, each value was corrected for decay to the date of sample collection by use of the decay correction factor for ^{95}Zr . (At equilibrium, both parent and daughter activities decrease at equal rates, the rate of decrease being dependent on the half-life of the parent.) The ^{95}Zr and ^{95}Nb values for the date of sample collection, calculated in this manner, are the ^{95}Zr and ^{95}Nb values recorded in the tables of this report.

The question arises as to whether or not ^{95}Zr and ^{95}Nb were at equilibrium. To answer this question, the ratio of ^{95}Zr to ^{95}Nb was calculated from the data for those samples which were counted by the Ge(Li) system and compared to the theoretical ratio of 2.17. Generally, the values were similar, but not always, which suggests that an error remains in some of the recomputed values for ^{95}Zr and ^{95}Nb . For this reason, the decay correction period (in days) are shown in the tables as Δt values so that the reader can estimate the magnitude and significance of the decay corrections. The half-life for ^{95}Zr is 65 days and the decay rate is 1.07 percent per day. If the ^{95}Zr in the sample was produced at various unknown times and is not in equilibrium with its daughter, ^{95}Nb , an accurate decay correction cannot be made.

A second change in previously reported data is the addition of the results of analyses for ^7Be . Beryllium-7, which is produced by the interaction of cosmic-ray particles with nuclei of gases in the atmosphere and has a 53-day half-life, is relatively abundant in some Amchitka plants. Furthermore, the 477-keV gamma photon emitted by ^7Be makes some contribution to the photon peaks for the 428-keV gamma from antimony-125 (^{125}Sb), the 497-keV gamma from ruthenium-103 (^{103}Ru), and the 512-keV gamma from ^{106}Ru when measured on the NaI system. By inclusion of the reference spectrum for ^7Be in the analyses of the total spectrum, new information for ^7Be and more accurate information for ^{125}Sb , ^{103}Ru , and ^{106}Ru was obtained.

The calculation of the ^7Be values and the recalculation of the ^{95}Zr and ^{95}Nb data were discussed in Held (1972) with the comment that the corrected values would be presented in the final report. However, it was decided to make the corrections in the data for past and present samples at this time and also to apply the corrected methods to the analyses of future samples. Although the corrected values are more accurate, they have not changed the previously reported conclusions.

A major contribution of this report is the result of analyses for ^3H in water and biota samples which will be used as supplementary information in the interpretation of the results of gamma spectrum analyses. Since the last report, Dr. Schell has constructed a distillation unit, see Figure 7, and developed a method for the measurement of ^3H in free water

FIGURE 7. Vacuum Distillation Unit for Preparing Samples for Tritium Measurement

that is more sensitive than our previous method. The limits of detection have been lowered from 200 to about 15 TU. The method, in essence, is simply the distillation of water from the samples by temperature differential and vacuum, mixing of the distillate with Insta-gel, and counting the sample in a liquid scintillation spectrometer.

The significant parts of the distillation unit are the sample jars, distillate jars, capillary leak tube, manifold, vacuum pump, heater, cooler, and water and refrigerant pumps. The heater and cooler are visible in the figure. Also, the vacuum pump can be seen at the bottom of the figure. A significant feature of the unit is the capillary leak tube that joins the vacuum manifold to the tube that extends from the sample jar to the distillate jar. The capillary leak tube prevents back diffusion from distillate to sample and permits noncondensable gases to escape.

In use, the samples were placed in the jars shown in the foreground of the figure. The water that was distilled from the sample was transferred to a similar jar on the far side of the unit, not visible in the figure. The sample jars were bathed in warm water and the distillate jars were bathed in a refrigerant. The loss of water in distillation is negligible and no cross-contamination was found in the simultaneous distillation of samples with 10,000 TU and zero TU. Biota samples were processed in the same way as the water samples except that the samples were lyophilized rather than heated to prevent sample decomposition. Tritium in bound water was not measured as only free water is removed by lyophilization.

With this unit, 10 distillations can occur simultaneously. To analyze a sample for ^3H , 8 ml of the distillate was mixed with 15 ml of Insta-gel in a 25-ml polyethylene vial. Sample vials with ^3H standards and background vials interspersed were counted in a Packard Model 3175 Liquid Scintillation Spectrometer at 5 C (Sauzay and Schell, 1972). Usually, 20 sample vials and six standard and background vials were counted as a unit. For one counting sequence, the unit was cycled six times and the counting time for each sample vial was 50 minutes per cycle or a total of 300 minutes for the sequence. The background was 4.3 c/m and the efficiency of the spectrometer, in terms of ^3H units, was 1 c/m = ~ 75 TU. The one-sigma error term for a 300-minute count of a sample was ± 13 TU. The continuous low and constant background count indicates the continuing integrity and sensitivity of the system.

The error term for single sample counting rates given in the tables is the combined counting error for the background, standard, and sample, hence, the term "propagated error." The error limits are "two-sigma" or two standard deviations, except for the ^3H data which is one standard deviation. Therefore, the error term given in the other tables is expressed as the two-sigma, propagated, counting error for a single count of a sample.

3. RESULTS AND DISCUSSION

The results of recent analyses were appended to the tables of the second progress report (Held 1972) except for Tables 8, 14, 18, and

19 which remain unchanged. All Held (1972) tables except Table 1 were revised to include a summary of pre-Cannikin data, recalculated values for ^{95}Zr and ^{95}Nb , and the inclusion of ^7Be data. The specific revisions in the tables are as follows:

<u>TABLE NO.</u>	<u>TITLE</u>	<u>REMARKS</u>
2	Some Gamma-Emitting Radionuclides on Air Filters at Ground Level at the Amchitka Island Base Camp	The table was updated to include 42 new samples
3	Gamma-Emitting Radionuclides in the Freshwater Moss <u>Fontinalis</u> Collected at Amchitka Island	The table was updated to include 12 new samples. Also, data were added for ^{54}Mn
4	Gamma-Emitting Radionuclides in the Freshwater <u>Ranunculus</u> Collected at Amchitka Island	The table was updated to include 16 new samples. Also data were added for ^{54}Mn
5	Some Gamma-Emitting Radionuclides in the Marine Algae <u>Fucus</u> Collected at Amchitka Island	The table was revised to include data on <u>Fucus</u> only. Also, data were added for 12 new samples.
6	Gamma-Emitting Radionuclides in Lichens Collected at Amchitka Island	This table was revised to add two new stations and new data for six samples.
7	Some Gamma-Emitting Radionuclides in Invertebrates Collected at Amchitka Island	This table was revised to add new pre- and post-Cannikin data.
9	^{137}Cs and ^{40}K in Marine Fish Collected Off Amchitka Island	This table was revised to summarize pre-Cannikin data for like species from the same location. Also columns were deleted for "range," "specimen number," and "grams dry sample." New information added was the number of fish and data for 48 samples.

<u>TABLE NO.</u>	<u>TITLE</u>	<u>REMARKS</u>
10	^{137}Cs and ^{40}K in Salmon Collected in the Bering Sea Off Amchitka Island	New data were added to comprise the pre-Canni- kin summary. Also, the table was revised to include 10 new post- Cannikin samples.
11	Iron-55 Specific Activity Values in Fish Collected at Amchitka Island	New data were added for 19 samples. Also, the specimen number and size were deleted and values for mg Fe were added.
12	Iron-55 Specific Activity Values in Canned Salmon from the Bristol Bay Pack	New data were added for 8 samples. Also, the specimen number was de- leted and values for mg Fe were added.
13	Some Gamma-Emitting Radionuclides in Birds Collected at Amchitka Island	The table was revised by adding the number of samples and by deleting grams per dry sample and four species for which there were no new data. Also, new data were added for 10 samples.
15	Gamma-Emitting Radionuclides in Samples Collected with a Filter- Sorption Bed from Intertidal areas of Amchitka Island	The table was revised by adding ^{137}Cs data and new data for six samples. Also, data for $^{110\text{m}}\text{Ag}$ were deleted.
16	Gamma-Emitting Radionuclides in Samples Collected with a Filter- Sorption Bed from Lakes on Amchitka Island	The table was revised by deleting the ^{60}Co data and adding one new area, Ice Box Lake. Also, new data were added for seven samples.
17	Some Gamma-Emitting Radionuclides in Samples Collected with a Filter- Sorption Bed from Long Shot Mud Pit No. 1 on Amchitka Island	This table was revised by deleting data for ^{60}Co and ^{65}Zn . Also, data were added for three samples.

In addition to new data appended to the tables from Held (1972), there are new data for new categories presented in Tables 20 through 27.

Table 20, concerning sea otter, presents radionuclide data identified by gamma-spectrum analyses of four tissues of one sea otter obtained

in February 1971. Potassium-40 appeared in all samples. Radionuclides, ^{60}Co and ^{137}Cs , were present in the liver samples in amounts less than 1/30 the amount of naturally occurring ^{40}K .

Table 21 presents radionuclide data about a community of organisms (aufwuchs) that attach themselves to surfaces on bottoms of ponds and streams. Periphyton, including diatoms, are an important part of this community. Twelve collections of aufwuchs have been made since September 1970 in a Long Shot pond that was slightly contaminated with ^3H . Seven man-made or artificial radionuclides were present in amounts and ratios to be expected from world fallout. Their abundance was considerably less than the abundance of naturally occurring ^7Be or ^{40}K . Samples of aufwuchs from other areas were sought as "control samples" but quantities sufficient for analyses were not found. Since aufwuchs are good accumulators of radionuclides and there were no unexpected radionuclides or radionuclide ratios in the samples from the ^3H contaminated ponds, the results of these analyses is additional evidence that no radionuclides other than ^3H from the Long Shot detonation are present in the ponds.

Table 22 reports ^{90}Sr content in the bones of four rats and ptarmigans collected between October and December 1971. The amount of ^{90}Sr in rats ranged from 1 to 10 pCi/g, dry. The amount of ^{90}Sr in ptarmigans ranged from 18 to 35 pCi/g, dry. For comparison, the amount of ^{90}Sr in the femur of rats collected at Amchitka in 1965 was 0.64 pCi/g, dry.

Table 23 presents data concerning gamma-emitting radionuclides in vegetation collected at various dosimeter stations on Amchitka Island. Most of the sample collection sites were near Cannikin, but one series of collections included vegetation samples from each of the 16 dosimeter stations which were distributed the length of the Island. At the time the thermoluminescent dosimeters (TLDs) were "staked out" (Cannikin D-2), a measurement of the environmental radiation was made with a NaI crystal detector and a collection of the dominant vegetation was made for gamma-spectrum analyses. When the TLDs were picked up (D+30), the procedure was repeated and, as a consequence, there are two measures of environmental radiation (instrument and TLDs) to supplement the gamma-spectrum analyses of the vegetation samples.

Table 24 summarizes instrument and TLD readings from a memorandum dated December 14, 1971, from K. W. Gustafson, Eberline Instrument Co., Field Manager, to the Test Manager's Representative. Inspection of the table indicates no significant difference in the pre-Cannikin and post-Cannikin instrument readings. Likewise, the TLD readings indicated no contamination of the terrestrial environment, as the values that were observed were virtually the same as would be expected from background radiation. In the vegetation samples, six fallout radionuclides plus ^7Be and ^{40}K were detected, but there were no short-lived radionuclides or unexpected radionuclide ratios that would indicate contamination from local sources.

The greatest single contribution of new data in this report are the results of ^3H analyses listed in Tables 25 to 27. As a result of the development of the distillation unit and the procedure for ^3H analyses, as described in the Methods section, the limits of detection for ^3H have been reduced from 200 to about 15 TU. Some results of ^3H analyses are reported in Held (1971) to complement the results of gamma-spectrum analysis, but most of the results of ^3H analyses have been reported by Teledyne Isotopes, Castagnola, 1969a; Castagnola, 1969b; Essington, Fenske, and Nork, 1970; Essington, Forslow, and Castagnola, 1970 and 1971; Essington, 1971, and by the U.S. Geological Survey, Beetem et al, 1971; Schroder and Ballance, 1972a; and Schroder and Ballance, 1972b.

In Held (1972) the results of ^3H analyses for 33 samples collected in September 1970 are given. The sensitivity of the method in use at that time was 200 ± 200 TU and the results showed "that the only locations where ^3H concentrations were significantly above detectable limits were in the immediate vicinity of the Long Shot ground zero (GZ) site." Five samples near GZ ranged from 590 to 3,630 TU and seven other samples from near GZ and 21 samples from other areas of the Island, including Milrow, were less than the limits of detection.

No results of ^3H analyses by the Laboratory of Radiation Ecology were reported in Held (1972). However, the results of ^3H analyses by the U.S. Environmental Protection Agency's National Environmental Research Center in Las Vegas, Nevada, (personal communication) were discussed. Analyses of salmon, crab, scallop, and shrimp samples, collected in Washington and Alaska in August and September 1971, were compared with similar samples collected at or near Amchitka prior to and following the Cannikin detonation. For these analyses, the limit of detection was 300 pCi of ^3H per liter of water (or kg of tissue). The greatest value reported was 730 ± 330 pCi/kilogram of salmon from Mountain Village on the Yukon River, and the conclusion was reached that "it appears that the ^3H content of marine fish and invertebrates from Amchitka is comparable to or less than the ^3H content of samples from other areas of Alaska and is not a result of the Cannikin detonation."

In Table 25, the values for 27 samples of seawater that were collected from inshore and offshore stations between September 1970 and September 1972 are given. Some values for surface water and inshore stations approached 100 TU, whereas the values for other samples were 40 TU or less.

A guide to the expected values for ^3H in seawater can be found in the values for ^3H in Pacific Ocean seawater at Canton Island, Ponape, Hawaii, and Adak for the years 1959 to 1968 as shown in Figure 8 which was prepared from data in Table 1, Tritium in Surface Ocean Water, from Dockins et al, 1967. The figure clearly indicates that the ^3H values increase with latitude and that the greatest ^3H values are at the most northerly station, Adak Island. By extrapolation from Figure 8, and in consideration of the limited testing of nuclear devices in the atmosphere after 1968, the present (1973) values for ^3H in open ocean water at Adak and Amchitka would be expected to range from about 15 to 30 TU. However, ^3H values in surface water near islands at times of heavy rainfall could be as great as 100 TU, due to the movement of stratospheric ^3H into the troposphere and its removal from the

Prepared by W.R. Schell from Data in Dockins et al, 1967d

FIGURE 8. Tritium Concentration in Pacific Ocean Water Related to Latitude and Year

troposphere by precipitation. Tritium values in precipitation are at a maximum during the spring and summer seasons when the transfer of ^3H from the stratosphere to the troposphere is the greatest. The observed values for ^3H in seawater at Amchitka are consistent with the values for ^3H to be expected from fallout.

Table 26 shows the ^3H values for Amchitka freshwater samples taken between May 1970 and October 1972. Between May 1970 and October 1972, 119 samples were collected. Tritium values of 180 TU or less were observed at all stations, except the Long Shot ponds. For Long Shot pond samples, the maximum value was 4,300 TU in May 1971. The amount of ^3H to be expected in precipitation at Amchitka can be predicted from the amount of ^3H in precipitation at Valentia, Ireland, from 1954 to 1971, as shown in Figure 9 which was prepared from data in the International Atomic Energy Agency Technical Report Series 96, 117, and 129. Valentia is a marine station at a latitude about the same as Amchitka and, since the fallout of ^3H is latitudinally dependent throughout the hemisphere, the amount of ^3H in precipitation at Valentia and Amchitka should be similar. By extrapolation from Figure 9, ^3H in the precipitation at Amchitka should range from about 20 TU in the winter to about 150 TU in the summer. The amount of ^3H presently in groundwater and in aquifers at Amchitka will reflect the amount of ^3H that was in the rainwater that supplied the groundwater and aquifers, less the ^3H lost by decay. Although ^3H in precipitation reached a peak of about 2,000 TU at Valentia in the summer of 1963, it is expected that the amount of ^3H in below surface water at Amchitka would not greatly exceed 200 TU unless contaminated with ^3H from local sources.

Table 27 shows the values for ^3H in free water of the three Dolly Varden trout caught in Ice Box Lake on October 1, 1972. The ^3H values ranged from 38 to 55 TU and are comparable to ^3H values for the water in which they were living. The results of these analyses were of special interest because the analyses of three Dolly Varden caught by E. Campbell, AEC/NV, in the same lake a month earlier (September 1972) gave initial values of several thousand TU. However, it was found that the September samples had been temporarily stored in a refrigerator at the University of Washington that was contaminated with ^3H . The results of analyses of the second sample (October) indicates that the anomalous value for the first sample was entirely due to the contaminated refrigerator. This experience demonstrates the ease with which samples can become contaminated with ^3H and, as Schell and Payne (1971) have pointed out, a person wearing a wrist watch with ^3H in the paint on the watch dial will contaminate himself, as well as the area in which he works.

4. SUMMARY AND CONCLUSIONS

A program for periodical sampling of biological and environmental samples at Amchitka and for analyses of the samples for radionuclide content began in July 1970. Two previous progress reports give an account of the results of analyses for samples collected from the commencement of the program up to March 1972, four months after the Cannikin detonation. In this, the third progress report, the account of the program is extended through December 1972.

Prepared by W.R. Schell from Data in IAEA Technical
Report Series Nos. 96, 117 & 129^{1,m,n}

FIGURE 9. Tritium in Precipitation at a Continental and a Marine Station, 1961-1971

Tables from the previous progress report were revised to include new data. These included the tables that related to gamma-emitting radionuclides in air filters, the freshwater moss Fontinalis, the freshwater plant Ranunculus, marine algae, lichens, marine invertebrates, marine fish, salmon, birds, seawater, freshwater, and Long Shot pond water. Also, there are new tables of subjects not previously reported that include sea otter, aufwuchs, ^{90}Sr in rats and ptarmigan, gamma-emitting radionuclides in plants from dosimeter stations, and ^3H in seawater, freshwater, and Dolly Varden trout. The limit of detection for ^3H in the samples recorded in this report is about 15 TU, whereas the limit was 200 TU in previous reports.

In addition to the new data that have been appended to the tables, three changes in the tables have also been made. One change was the reduction of all of the pre-Cannikin data to a value for the mean, standard deviation, and range. Another, was the conversion of the composite value of $^{95}\text{Zr} + ^{95}\text{Nb}$ to individual values of ^{95}Zr and ^{95}Nb and correction of the decay factor calculation. And thirdly, values for ^7Be were calculated and added to the tables.

The changes in the tables increase the accuracy and the reliability of the data, but in no way changes the conclusions of the previous progress reports. All of the data--old, revised, new--point to the same general conclusion; namely,

- a. The most abundant radionuclides present are naturally occurring ^7Be and ^{40}K .
- b. Trace quantities of fission products and induced radionuclides have been detected in amounts that would be expected from world fallout.
- c. The abundance of fallout radionuclides continues to decline steadily from year to year and to fluctuate seasonally within years.
- d. No new radionuclides or unexpected radionuclides or radionuclide ratios have been detected.
- e. Tritium values in seawater and in freshwater are no different than the values that would be expected at an island station at the same latitude in the northern hemisphere.
- f. Some of the ponds in the immediate vicinity of the Long Shot hole remain contaminated with ^3H . The concentration is less than in rainfall at Vienna, Austria, in 1963 and about twice as great as at Valentia, Ireland, in the same year.
- g. An extensive search with sensitive instruments for radionuclides in biological and environmental samples--marine, terrestrial, freshwater--collected during the first 14 months after the Cannikin detonation of November 6, 1971, indicates that no other radionuclides have escaped to the surface environment.

TABLE 1

Scientific And Common Names And Wet Weight to Dry
Weight Ratios of Some Amchitka Island Organisms

Species (a)	Tissue	Wet/Dry Ratio	Standard Deviation
<u>VERTEBRATES</u>			
<u>MAMMALS</u>			
<u>Enhydra lutris</u> Sea Otter	Liver	4.03	_____
	Skin	3.14	_____
	Kidney	5.00	_____
	Muscle	4.28	_____
<u>Rattus norvegicus</u> Rat	Bone	_____	_____
<u>FISH</u>			
<u>Salvelinus malma</u> Dolly Varden	Kidney	4.52	0.02
	Muscle	3.62	0.70
	Gonad	2.94	0.05
	Stomach contents	6.58	_____
	Viscera	4.20	0.42
	Remains	3.51	0.63
	Liver	3.24	0.19
<u>Oncorhynchus keta</u> Chum Salmon	Muscle	3.28	0.19
	Viscera	3.90	_____
	Liver	3.48	0.37
	Remains	2.60	_____
	Whole (eviscerated)	2.87	0.16
<u>Oncorhynchus nerka</u> Sockeye Salmon	Liver	3.25	0.51
	Muscle	3.67	0.54
<u>Oncorhynchus gorbuscha</u> Pink Salmon	Kidney	5.00	_____
	Gonad	4.51	_____
	Muscle	4.33	_____
	Liver	4.49	0.69

See footnotes at end of table.

TABLE 1 (continued)

Species (a)	Tissue	Wet/Dry Ratio	Standard Deviation
<u>VERTEBRATES</u> (continued)			
<u>Oncorhynchus kisutch</u> Coho Salmon	Liver	3.52	0.58
	Muscle	3.83	—
	Gonad	4.30	—
<u>Oncorhynchus tshawytscha</u> King Salmon	Muscle	2.94	0.20
	Liver	3.06	—
<u>Lepidopsetta bilineata</u> Rock Sole	Liver	4.08	0.56
	Muscle	4.62	0.34
	Remains	3.90	0.01
	Gonad	5.70	—
	Kidney	5.30	—
<u>Hippoglossus stenolepis</u> Halibut	Kidney	4.90	—
	Gonad	5.30	—
	Remains	4.50	—
	Muscle	4.01	0.58
	Liver	3.63	0.04
	Skin	2.47	—
<u>Theragra chalcogramma</u> Alaskan Pollack	Muscle	5.08	0.44
Walleye Pollack	Liver	1.51	0.11
	Skin	3.42	0.24
<u>Sebastes alutus</u> Ocean Perch	Muscle	4.37	0.05
	Liver	2.89	0.15
	Gonad	2.90	—
	Skin	2.80	—
<u>Gadus macrocephalus</u> Pacific Cod	Liver	3.00	0.77
	Muscle	5.47	0.28
	Skin	3.36	0.27

See footnotes at end of table.

TABLE 1 (continued)

Species (a)	Tissue	Wet/Dry Ratio	Standard Deviation
<u>VERTEBRATES</u> (continued)			
<u>Sebastes ciliatus</u>			
Dusky Rockfish	Liver	2.62	
	Muscle	4.42	0.08
	Remains	3.26	0.05
	Gonad	4.30	
<u>Hexagrammos lagocephalus</u>			
Rock Greenling	Liver	3.43	0.41
	Muscle	4.83	0.14
	Viscera	2.13	0.04
	Remains	4.08	0.87
	Kidney	5.22	0.12
	Gonad	5.42	0.42
	Skin	3.10	
	Whole (eviscerated)	4.40	
<u>Coryphaenoides sp.</u>			
Rattail	Liver	1.35	0.014
<u>Atheresthes stomias</u>			
Arrowtooth Flounder	Liver	3.28	
<u>Gasterosteus sp.</u>			
Stickleback	Evis. whole	3.76	0.75
	Viscera	2.54	
<u>Bathylagus stilbuis</u>			
California Smooth Tongue	Entire	4.17	
<u>Stenobranchius leucopsaurus</u>			
Northern Lampfish	Entire	3.12	
<u>BIRDS</u>			
<u>Haematopus bachmani</u>			
Black Oystercatcher	Liver	3.36	
	Muscle	3.96	
<u>Uria lomvia</u>			
Thick-billed Murre	Muscle	1.67	
	Liver	3.31	

See footnotes at end of table.

TABLE 1 (continued)

Species (a)	Tissue	Wet/Dry Ratio	Standard Deviation
<u>VERTEBRATES</u> (continued)			
<u>Cepphus columba</u> Pigeon Guillemot	Muscle	4.15	0.42
	Liver	3.33	0.24
<u>Lagopus mutus</u> Rock Ptarmigan	Liver	3.52	0.32
	Muscle	3.54	0.08
<u>Philacte canagica</u> Emperor Goose	Liver	3.15	0.08
	Muscle	3.21	0.14
<u>Larus glaucescens</u> Glaucous-winged Gull	Liver	3.11	—
	Muscle	3.58	—
<u>Troglodytes troglodytes</u> Wren (Winterwren)	Entire (b)	3.43	—
<u>Cyclorhynchus psittacula</u> Parakeet Auklet	Entire (b)	3.41	0.09
<u>Erolia ptilocnemis</u> Rock Sandpiper	Entire (b)	3.44	—
<u>Aethia pusilla</u> Least Auklet	Entire (b)	3.55	—
<u>Sterna paradisaea</u> Arctic Tern	Entire (b)	3.33	—
<u>Anas crecca</u> Common Teal	Muscle	3.74	—
	Liver	3.08	—
<u>Lunda cirrhata</u> Tufted Puffin	Muscle	3.41	—
	Liver	1.96	—

See footnotes at end of table.

TABLE 1 (continued)

Species (a)	Tissue	Wet/Dry Ratio	Standard Deviation
<u>INVERTEBRATES</u>			
<u>Acanthomysis</u>			
Mysids	Entire	8.41	4.7
Plankton	Entire	20.98	2.72
Sponge (rust)	"	6.1	—
(yellow)	"	4.5	—
(buff)	"	4.9	—
(green)	"	9.5	—
Euphausiids			
Krill	Entire	5.2	—
Medusae			
(Cyanea)	"	26.8	—
(Aurellia)	"	10.1	—
<u>Pecten</u> sp.			
Scallop	Soft parts	5.9	—
Basket Star	Soft parts	4.51	—
" "	Gonads	4.37	—
" "	Remains	2.41	—
<u>Gonatus</u>			
Pelagic Squid	Entire	5.41	—
<u>Stronglocentrotus</u> sp.			
Urchin	Test	2.41	0.07
	Gonad	5.87	0.38
	Soft parts	6.19	1.97
<u>Octopus</u> sp.			
Octopus	Viscera	5.25	—
	Evis. whole	6.42	—
<u>Littorina</u> sp.			
Snail	Entire	2.16	0.20
<u>Thais</u> sp.			
Snail	Soft parts	4.0	—
	Shell	1.2	—

See footnotes at end of table.

TABLE 1 (continued)

Species (a)	Tissue	Wet/Dry Ratio	Standard Deviation
<u>INVERTEBRATES</u> (continued)			
<u>Mytilus</u> sp.			
Mussel	Soft parts	6.21	0.92
	Shell	1.08	0.05
Isopoda	Entire	3.04	0.07
Amphipoda (Gammaridae)	Entire	4.42	0.01
<u>Parolithodes</u> sp.			
King Crab	Muscle	6.63	0.51
	Viscera	7.10	—
	Exoskeleton	2.30	0.71
	Hepatopancreas	3.92	0.04
	Gonad	2.02	—
<u>Lithodes</u> <u>aequispina</u>			
False King Crab	Exoskeleton	2.17	0.12
	Hepatopancreas	4.62	1.89
	Muscle	6.79	0.78
	Eggs	1.94	0.099
	Remainder	4.57	1.12
<u>Chionectes</u> <u>tanneri</u>			
Tanner Crab	Muscle	4.91	0.53
	Exoskeleton	2.40	0.23
	Hepatopancreas	4.71	1.70
	Remainder	4.55	1.65
<u>Erimacrus</u> <u>isenbeckii</u>			
Horse Crab	Exoskeleton	2.52	—
	Hepatopancreas	6.67	—
	Remainder	3.95	—
<u>MARINE ALGAE</u>			
<u>Hypophyllum</u> <u>sessile</u>			
Marine algae	Entire	7.77	2.38
<u>Fucus</u> <u>distichus</u>			
Marine algae	Entire	4.94	1.4

See footnotes at end of table.

TABLE 1 (continued)

Species (a)	Tissue	Wet/Dry Ratio	Standard Deviation
<u>MARINE ALGAE (continued)</u>			
<u>Halosaccion glandiforme</u> Marine algae	Entire	7.23	1.00
<u>Alaria</u> sp. Marine algae	Entire	5.95	0.99
<u>Porphyra</u> sp. Marine algae	Entire	4.5	—
<u>Corallina</u> sp. Coralline algae	Entire	2.1	—
<u>Constantina</u> sp. Marine algae	Entire	—	—
<u>Ulva</u> sp. Marine algae	Entire	8.54	0.86
<u>Thalassophyllum</u> sp. Marine algae	Entire	—	—
<u>Laminaria longipes</u> Marine algae	Entire	5.30	0.25
<u>FRESHWATER PLANTS</u>			
<u>Cladophora</u> sp. Filamentous algae	Entire	5.1	—
<u>Fontinalis</u> sp. Moss	Entire	4.83	0.89
<u>Ranunculus</u> sp. Freshwater plant	Entire	12.2	4.10
<u>AUFWUCHS</u>			
<u>Periphyton</u> and other organisms	Entire	7.27	2.40

See footnotes at end of table.

TABLE 1 (continued)

Species (a)	Tissue	Wet/Dry Ratio	Standard Deviation
<u>LAND PLANTS</u>			
<u>Cladonia</u> sp. Lichens	Entire	3.75	0.87
<u>Calomagrastis</u> sp. Grass	—	—	—
<u>Empetra</u> sp. Crowberry	—	—	—
<u>Agrostis</u> sp. Grass	—	—	—

(a) Names are from "Common and Scientific Names of Fishes from the United States and Canada" (Third Edition), 1970 American Fisheries Society Special Pub. No. 6.

(b) Less head, feathers, and skin.

TABLE 2

Some Gamma-Emitting Radionuclides on Air Filters at Ground Level at the Amchitka Island Base Camp

Collection Date	Δt^b	$10^3 m^3$	Gamma-Emitting Radionuclides (pCi/thousand cubic meters) ^a					
			^7Be	$^{95}Zr^c$	$^{95}Nb^c$	^{103}Ru	^{137}Cs	
Post-Cannikin								
Oct 29 - Nov 12, 1971	6	17.8	23 ± 2.6	1.1 ± 0.1	2.1 ± 0.3	---	0.56 ± 0.13	
Feb 23 - 28, 1972	8	5.3	29 ± 15	0.5 ± 0.2	1.1 ± 0.4	---	0.70 ± 0.47	
Feb 28 - March 6, 1972	4	8.9	16 ± 3.4	0.2 ± 0.1	0.5 ± 0.2	---	---	
March 6 - 13, 1972	4	9.9	47 ± 3.0	0.4 ± 0.1	0.8 ± 0.2	---	0.86 ± 0.25	
March 13 - 20, 1972	7	13.2	22 ± 1.5	0.2 ± 0.1	0.3 ± 0.1	---	0.45 ± 0.15	
March 20 - 27, 1972	4	13.2	17 ± 3.2	0.1 ± 0.03	0.2 ± 0.05	---	0.38 ± 0.15	
March 27 - April 3, 1972	7	13.2	19 ± 1.5	---	---	---	---	
6 April 3 - 10, 1972	8	13.1	42 ± 2.3	0.6 ± 0.1	1.2 ± 0.2	0.46 ± 0.15	0.69 ± 0.14	
April 10 - 17, 1972	7	12.1	32 ± 2.5	0.4 ± 0.1	0.8 ± 0.2	---	0.60 ± 0.20	
April 17 - 24, 1972	3	11.1	36 ± 2.2	2.1 ± 0.2	4.3 ± 0.4	1.1 ± 0.2	0.72 ± 0.18	
April 24 - May 1, 1972	11	11.1	19 ± 1.8	0.5 ± 0.1	1.0 ± 0.3	---	0.45 ± 0.18	
May 1 - 9, 1972	6	13.0	12 ± 1.5	0.3 ± 0.1	0.6 ± 0.2	0.38 ± 0.08	0.38 ± 0.08	
May 9 - 15, 1972	5	9.3	10 ± 1.6	2.4 ± 0.2	5.2 ± 0.4	0.75 ± 0.22	---	
May 15 - 22, 1972	8	11.1	20 ± 0.9	1.5 ± 0.1	3.2 ± 0.2	1.6 ± 0.2	0.54 ± 0.09	
May 22 - 29, 1972	7	11.1	36 ± 5.3	2.7 ± 0.3	5.8 ± 0.7	0.82 ± 0.76	0.54 ± 0.17	
May 29 - June 5, 1972	6	11.1	31 ± 1.1	6.2 ± 0.3	7.0 ± 0.3	3.3 ± 0.2	---	
June 5 - 12, 1972	7	11.2	13 ± 1.4	2.1 ± 0.4	3.0 ± 0.3	1.5 ± 0.2	0.36 ± 0.18	
June 12 - 19, 1972	3	10.9	19 ± 1.8	3.9 ± 0.5	4.6 ± 0.1	---	0.56 ± 0.17	
June 19 - 26, 1972	7	11.2	6.2 ± 0.6	2.1 ± 0.2	1.3 ± 0.1	0.93 ± 0.07	0.11 ± 0.05	
June 26 - July 3, 1972	4	11.2	10 ± 1.2	1.9 ± 0.4	1.6 ± 0.2	---	0.21 ± 0.11	
July 3 - 10, 1972		11.1	Data Missing					
July 10 - 17, 1972	8	11.1	3.3 ± 1.0	0.40 ± 0.27	1.3 ± 0.2	0.49 ± 0.12	---	
July 17 - 24, 1972	7	11.2	3.8 ± 0.9	---	0.85 ± 0.17	0.57 ± 0.14	---	
July 24 - 31, 1972	4	11.2	---	---	0.23 ± 0.11	0.25 ± 0.11	---	

See footnotes at end of table.

TABLE 2 (continued)

Collection Date	Δt^b	$10^3 m^3$	Gamma-Emitting Radionuclides (pCi/thousand cubic meters) ^a				
			^7Be	$^{95}\text{Zr}^c$	$^{95}\text{Nb}^c$	^{103}Ru	^{137}Cs
July 31 - Aug 7, 1972	4	11.0	4.2 ± 0.9	---	0.46 ± 0.11	0.44 ± 0.11	---
Aug 7 - 14, 1972	4	11.2	5.3 ± 0.9	0.61 ± 0.24	0.85 ± 0.17	0.57 ± 0.11	---
Aug 14 - 21, 1972	8	11.2	5.3 ± 0.9	---	0.73 ± 0.17	0.36 ± 0.14	---
Aug 21 - 28, 1972	3	11.1	7.5 ± 1.2	0.49 ± 0.24	1.2 ± 0.2	0.79 ± 0.14	0.16 ± 0.11
Aug 28 - Sept 4, 1972	4	11.2	7.4 ± 1.2	---	0.79 ± 0.17	---	0.11 ± 0.05
Sept 4 - 11, 1972	3	11.0	15 ± 1.5	---	1.1 ± 0.1	0.58 ± 0.07	---
Sept 11 - 18, 1972	4	11.2	7.6 ± 1.2	---	0.62 ± 0.12	0.33 ± 0.11	---
Sept 18 - 25, 1972	4	11.1	6.1 ± 1.1	---	0.99 ± 0.15	0.29 ± 0.10	---
Sept 25 - Oct 2, 1972	4	11.2	16 ± 1.6	0.55 ± 0.26	0.91 ± 0.26	0.42 ± 0.12	0.29 ± 0.13
30 Oct 2 - 9, 1972	4	11.0	11 ± 1.4	---	0.39 ± 0.14	---	---
Oct 9 - 16, 1972	5	11.2	9.8 ± 1.3	---	0.33 ± 0.12	---	0.18 ± 0.12
Oct 16 - 23, 1972	3	11.1	12 ± 1.4	0.36 ± 0.18	0.28 ± 0.13	---	0.11 ± 0.10
Oct 23 - 30, 1972	3	11.3	21 ± 1.4	0.39 ± 0.15	0.34 ± 0.11	0.18 ± 0.08	0.22 ± 0.09
Oct 30 - Nov 6, 1972	5	11.0	12 ± 1.0	---	0.21 ± 0.08	0.09 ± 0.07	0.09 ± 0.08
Nov 6 - 13, 1972	8	11.2	14 ± 1.2	0.22 ± 0.19	0.48 ± 0.12	0.18 ± 0.09	0.24 ± 0.09
Nov 13 - 20, 1972	10	10.4	5.0 ± 0.9	---	---	---	0.13 ± 0.08
Nov 20 - 27, 1972	4	11.5	25 ± 1.5	---	0.86 ± 0.14	0.20 ± 0.08	0.41 ± 0.10
Nov 27 - Dec 4, 1972	4	11.1	19 ± 1.4	---	0.31 ± 0.10	0.08 ± 0.07	0.18 ± 0.09
Dec 4 - 11, 1972	4	11.1	15 ± 1.5	---	0.55 ± 0.15	---	0.14 ± 0.10
Dec 11 - 19, 1972	16	12.6	22 ± 1.5	---	0.23 ± 0.12	---	0.15 ± 0.09
Dec 19 - 26, 1972	7	11.4	17 ± 1.7	---	0.12 ± 0.11	---	0.15 ± 0.11
Jan 3 - 10, 1973	6	11.1	14.1 ± 1.4	---	---	---	0.13 ± 0.09

See footnotes at end of table.

TABLE 2 (continued)

Period and Statistics	Δt^b	$10^3 m^3$	Gamma-Emitting Radionuclides (pCi/thousand cubic meters)				
			^7Be	$^{95}Zr^c$	$^{95}Nb^c$	^{103}Ru	^{137}Cs
Comparison of Pre- and Post-Cannikin Data							
Pre-Cannikin ^d							
Range	4-131	16.3-30.0	4.2-42.0	0.5-6.6	1.1-14.1	NS-4.3	0.22-1.3
Mean $\pm$ SD	19	24.5 $\pm$ 3.7	20 $\pm$ 9	2.8 $\pm$ 2.1	5.9 $\pm$ 4.5	0.7 $\pm$ 1.1	0.7 $\pm$ 0.3
Post-Cannikin ^e							
Range	---	5.3-17.8	3.3-47	---	---	---	---
Mean $\pm$ SD	---	11.3 $\pm$ 1.6	16.8 $\pm$ 10.6	0.7 $\pm$ 1.2	1.3 $\pm$ 1.6	0.37 $\pm$ 0.59	0.24 $\pm$ 0.24

- a. Single sample error values are two-sigma, propagated, counting errors.
- b. The time in days between the collection and counting of a sample.
- c. Air filters taken before May 29, 1972, were counted on NaI detectors. The ^{95}Zr and ^{95}Nb values from the filters counted on a NaI detector were calculated as discussed in the text. Filters after May 29, 1972, were counted on a Ge(Li) detector.
- d. Twenty-eight samples were taken in the post-Cannikin period, October 1970 to October 1971.
- e. Forty-five samples were taken in the post-Cannikin period, November 1971 to January 1973. Results shown are for single sample analyses only.

TABLE 3

Gamma-Emitting Radionuclides in the Freshwater
Moss Fontinalis Collected at Amchitka Island

Location and Date	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry) ^a									
		⁷ Be	⁴⁰ K	⁵⁴ Mn	⁶⁰ Co	⁹⁵ Zr ^c	⁹⁵ Nb ^c	¹⁰³ Ru	¹⁰⁶ Ru	¹²⁵ Sb	¹³⁷ Cs
Post-Cannikin											
Clevenger Creek											
December 1971	62	3.8±1.1	6.6±0.5	0.09± .03	0.05± .02	0.3±0.1	0.6±0.1	---	1.5±0.3	0.9±0.2	3.6±0.1
February 1972	49	9.9±2.1	5.1±0.8	0.07± .06	0.06± .05	0.5±0.1	1.2±0.2	0.81±0.40	1.2±0.6	---	1.7±0.1
April 1972 ^d	98	---	9.3±0.3	---	---	1.0±0.4	5.3±1.0	---	---	---	1.3±0.2
July 1972 ^d	52	---	3.7±1.7	---	---	0.9±0.3	2.4±0.4	0.46±0.20	---	---	0.6±0.1
October 1972	105	---	6.2±0.9	---	---	0.3±0.1	0.7±0.2	2.1 ±1.5	---	---	2.5±0.1
Bridge Creek											
³² December 1971	57	5.6±1.5	7.5±0.4	0.11± .03	0.10± .03	0.7±0.1	1.4±0.2	0.6 ±0.3	2.9±0.4	1.3±0.2	5.5±0.1
February 1972	47	9.0±1.2	5.2±1.2 ^e	---	---	2.0±0.3	4.4±0.3	1.9 ±0.2	---	---	3.5±0.2
April 1972	34	9.2±1.7	6.6±0.9	0.15± .06	---	0.7±0.1	1.6±0.2	---	2.0±0.7	0.7±0.3	2.8±0.1
July 1972 ^d	41	2.8±1.2	6.8±0.9 ^e	---	---	1.1±0.3	2.9±0.4	0.3 ±0.2	0.5±0.3	---	2.2±0.2
October 1972	100	4.6±4.3	7.7±0.7	---	0.06± .05	0.3±0.1	0.7±0.1	---	---	---	2.7±0.1
Duck Cove Creek											
December 1971	59	7.3±1.3	6.8±0.5	0.11± .03	0.07± .03	0.4±0.1	0.9±0.1	---	2.4±0.4	1.7±0.2	2.9±0.1
February 1972	48	14 ±4	6.0±1.0	0.17± .07	0.15± .06	0.7±0.1	1.4±0.3	1.9 ±0.7	1.4±0.8	1.2±0.4	0.8±0.1
April 1972	35	7.9±2.1	4.8±0.9	---	0.08± .06	0.6±0.1	1.3±0.2	---	1.9±0.7	0.9±0.3	1.4±0.1
July 1972 ^d	55	2.6±0.1	6.3±0.8 ^e	---	---	0.8±0.3	2.6±0.4	0.2 ±0.2	0.5±0.1	0.4±0.1	1.0±0.1
October 1972	101	---	6.4±0.9	0.08± .07	---	0.2±0.1	0.5±0.1	2.4 ±1.2	---	1.4±0.4	2.4±0.1

See footnotes at end of table.

TABLE 3 (continued)

Location and Statistics	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry)									
		^7Be	^{40}K	^{54}Mn	^{60}Co	$^{95}\text{Zr}^c$	$^{95}\text{Nb}^c$	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs
Summary of Pre-Cannikin Data											
Clevenger Creek ^f											
Range	41 to 76	3-12	1.7-8.9	0.09-0.24	0.04-0.11	0.5-2.7	0.8-6.1	NS-1.1	2.0-4.8	0.7-2.1	2.1-5.8
Mean $\pm$ SD	58	8 $\pm$ 4	5.8 $\pm$ 3.0	0.16 $\pm$ .08	0.07 $\pm$ .04	1.4 $\pm$ 1.0	2.9 $\pm$ 2.3	0.28 $\pm$ 0.54	3.2 $\pm$ 1.2	1.4 $\pm$ 0.6	4.0 $\pm$ 1.5
Bridge Creek ^g											
Range	45 to 76	5-14	5.4-11	0.15-0.22	0.08-0.15	0.8-3.4	2.1-7.4	---	2.5-7.3	0.6-2.1	2.7-7.6
Mean $\pm$ SD	63	10 $\pm$ 5	7.3 $\pm$ 3.2	0.18 $\pm$ .04	0.12 $\pm$ .04	1.7 $\pm$ 1.4	3.9 $\pm$ 3.1	---	4.4 $\pm$ 2.5	1.2 $\pm$ 0.8	4.1 $\pm$ 3.0
Duck Cove Creek ^g											
Range	47 to 63	5-11	3.6-8.2	0.06-0.30	NS-0.09	06. -2.5	1.3-5.4	NS-1.2	1.6-4.5	0.8-1.7	1.3-3.3
Mean $\pm$ SD	55	8 $\pm$ 3	6.6 $\pm$ 2.6	0.16 $\pm$ .12	0.05 $\pm$ .04	1.3 $\pm$ 1.1	2.7 $\pm$ 2.3	0.5 $\pm$ 0.6	2.8 $\pm$ 1.5	1.4 $\pm$ 0.5	2.6 $\pm$ 1.1

a. Single sample error values are two-sigma, propagated, counting errors.

b. The time in days between the collection and counting of a sample.

c. Zirconium-95 and ^{95}Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.

d. Samples counted on Ge(Li) detector. All other samples were counted on NaI detector.

e. Potassium-40 value from NaI detector.

f. Four samples were taken between September 1970 and November 1971.

g. Three samples were taken between February 1971 and November 1971.

TABLE 4

Gamma-Emitting Radionuclides in the Freshwater
Plant Ranunculus Collected at Amchitka Island

Location and Date	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry) ^a									
		⁷ Be	⁴⁰ K	⁵⁴ Mn	⁶⁰ Co	⁹⁵ Zr ^c	⁹⁵ Nb ^c	¹⁰³ Ru	¹⁰⁶ Ru	¹²⁵ Sb	¹³⁷ Cs
Post-Cannikin											
Clevenger Creek											
December 1971	60	---	16 ±0.8	---	0.06± .05	0.1 ±0.1	0.3 ±0.1	0.7 ±0.5	---	0.6±0.2	1.8 ±0.1
February 1972	47	20 ±3	19 ±1.0	0.2 ± .1	---	1.2 ±0.1	2.6 ±0.2	1.2 ±0.6	1.8 ±0.7	0.6±0.3	1.5 ±0.1
April 1972	22	4.9±1.4	16 ±0.7	0.09± .04	0.04± .04	0.4 ±0.1	0.9 ±0.2	0.8 ±0.3	---	1.3±0.2	2.7 ±0.1
July 1972 ^d	58	---	15 ±0.6 ^e	---	---	---	0.95±0.33	---	1.0 ±0.5	---	0.90±0.15
October 1972	100	---	15 ±3.4	---	---	0.12±0.06	0.20±0.15	---	---	---	1.2 ±0.1
³⁴ Bridge Creek											
December 1971	58	---	22 ±1	---	0.09± .08	0.2 ±0.1	0.5 ±0.3	---	---	---	1.8 ±0.1
February 1972	52	10 ±2	14 ±0.9	0.1 ± .06	0.07± .05	0.6 ±0.1	1.3 ±0.2	0.7 ±0.4	2.0 ±0.6	0.9±0.3	4.1 ±0.1
April 1972	23	8.2±1.4	14 ±1	---	---	0.6 ±0.1	1.3 ±0.2	---	1.1 ±0.6	0.7±0.3	3.0 ±0.1
July 1972	31	---	24 ±1.5	---	---	0.15±0.03	0.32±0.06	0.24±0.19	---	---	0.43±0.04
October 1972	105	---	32 ±1.3	---	---	0.25±0.15	0.49±0.31	---	---	---	1.8 ±0.1
Duck Cove Creek											
December 1972	61	2.0±1.1	26 ±0.5	---	---	0.25± .06	0.52± .13	0.4 ±0.3	0.7 ±0.3	0.7± .1	1.7 ±0.1
February 1972	42	21 ±3	17 ±0.8	0.1 ± .06	0.1 ± .05	0.8 ± .1	1.8 ± .2	1.6 ±0.5	2.0 ±0.7	1.1± .3	2.5 ±0.1
April 1972	24	8.1±1.6	18 ±0.8	0.1 ± .05	---	0.4 ± .1	0.8 ± .2	0.6 ±0.3	1.3 ±0.5	0.9± .2	1.0 ±0.1
July 1972 ^d	61	---	23 ±0.5 ^e	---	---	0.45± .24	1.2 ± .3	---	0.33±0.19	---	0.4 ±0.1
October 1972	93	---	14 ±0.7	---	---	0.19± .05	0.4 ± .1	---	---	0.5± .3	2.2 ±0.1

See footnotes at end of table.

TABLE 4 (continued)

Location and Date	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry) ^a									
		⁷ Be	⁴⁰ K	⁵⁴ Mn	⁶⁰ Co	⁹⁵ Zr ^c	⁹⁵ Nb ^c	¹⁰³ Ru	¹⁰⁶ Ru	¹²⁵ Sb	¹³⁷ Cs
Clevenger Lake Outlet											
December 1971	58	2.8±1.1	11 ±0.5	0.1 ± .03	0.06± .03	0.32± .06	0.69± .13	---	1.7 ±0.4	0.3±0.2	1.2 ±0.1
February 1972	52	37 ±7	15 ±2	0.2 ± .1	0.1 ± .09	0.9 ± .2	1.9 ± .4	3.1 ±1.0	1.6 ±1.4	---	0.9 ±0.2
April 1972	23	9.4±1.6	14 ±0.8	0.07± .05	---	0.5 ± .1	1.0 ± .2	---	1.1 ±0.6	0.4±0.3	1.2 ±0.1
July 1972	31	5.8±1.8	19 ±0.6 ^e	---	---	2.2 ± .5	6.6 ± .6	1.2 ±0.3	0.7 ±0.4	---	1.2 ±0.2
October 1972	105	6.1±1.7	34 ±3.1	---	---	---	2.4 ± .5	0.3 ±0.2	1.0 ±0.6	---	1.1 ±0.1

Location and Statistics	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry)									
		⁷ Be	⁴⁰ K	⁵⁴ Mn	⁶⁰ Co	⁹⁵ Zr ^c	⁹⁵ Nb ^c	¹⁰³ Ru	¹⁰⁶ Ru	¹²⁵ Sb	¹³⁷ Cs
Summary of Pre-Cannikin Data											
Clevenger Creek ^f											
Range	39-76	NS- 8.4	15-24	0.1 -0.4	NS-0.1	NS-1.8	NS-3.6	---	NS-3.6	NS-1.3	0.5 -3.2
Mean ± SD	60	4.1± 4.7	21± 4	0.2 ± .1	0.06± .04	0.6 ±0.8	1.3 ±1.6	NS	1.9 ±1.8	0.3±0.6	1.7 ±1.1
Bridge Creek ^g											
Range	45-77	4-15	14-19	NS-0.2	---	0.6 -1.4	1.3 -3.2	---	1.5 -2.5	NS-1.0	3.0 -3.4
Mean ± SD	64	8.4± 5.8	17± 3	0.1 ± .1	NS	1.0 ±0.4	2.3 ±1.0	NS	2.1 ±0.5	0.5±0.5	3.2 ±0.2
Duck Cove Creek ^g											
Range	62-77	NS- 6.3	7-22	NS-0.2	---	0.25- .55	0.52-1.14	---	NS-2.0	0.4-1.2	0.9 -1.7
Mean ±SD	70	4.0± 3.5	15± 8	0.09± .10	NS	0.41± .15	0.86± .32	NS	1.0 ±1.0	0.7± .5	1.3 ±0.4

See footnotes at end of table.

TABLE 4 (continued)

Location and Statistics	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry)									
		^7Be	^{40}K	^{54}Mn	^{60}Co	$^{95}\text{Zr}^c$	$^{95}\text{Nb}^c$	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs
Summary of Pre-Cannikin Data											
Clevenger Lake ^h Outlet											
Range	40-57	NS- 4.9	2.8- 7.7	NS-0.1	---	0.33- .43	0.70- .92	NS-0.7	NS-0.9	0.5-0.6	NS-1.1
Mean $\pm$ SD	49	2.5 $\pm$ 2.2	5.3 $\pm$ 3.5	0.05 $\pm$ .05	NS	0.39 $\pm$ .07	0.81 $\pm$ .16	0.4 $\pm$ 0.5	0.5 $\pm$ 0.6	0.6 $\pm$ 0.1	0.6 $\pm$ 0.8

a. Single sample error values are two-sigma, propagated, counting errors.

b. The time in days between the collection and counting of a sample.

c. Zirconium-95 and ^{95}Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.

d. Samples counted on Ge(Li) detector. All other samples were counted on NaI detector.

e. Potassium-40 value from NaI detector.

f. Four samples were taken between September 1970 and November 1971.

g. Three samples were taken between February 1971 and November 1971.

h. Two samples were taken between September 1970 and November 1971.

TABLE 5

Some Gamma-Emitting Radionuclides in the Marine
Algae Fucus Collected at Amchitka Island

Location and Date	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry) ^a				
		⁷ Be	⁴⁰ K	⁹⁵ Zr ^c	⁹⁵ Nb ^c	¹³⁷ Cs
Post-Cannikin						
Constantine Harbor						
February 1972	44	5.0 ±1.8	33±1.0	---	---	---
April 1972	29	2.3 ±1.2	36±0.7	0.07±0.05	0.16±0.10	---
June 1972	57	---	32±0.6	0.07±0.04	0.13±0.07	---
October 1972	99	2.7 ±2.6	36±0.8	---	---	---
Duck Cove						
December 1971	42	2.0 ±1.4	30±0.8	0.06±0.06	0.14±0.11	---
February 1972	36	2.5 ±1.1	33±1.0	0.03±0.03	0.07±0.06	---
April 1972	30	---	41±0.7	0.07±0.04	0.14±0.08	---
June 1972	61	1.1 ±0.1	34±0.5	0.08±0.02	0.16±0.04	0.06±0.02
September 1972	101	4.1 ±3.7	39±0.9	---	---	---
IA-2 or -3						
November 1971	103	---	28±0.6	0.06±0.06	0.12±0.12	---
December 1971	42	1.8 ±1.2	29±1.0	0.07±0.03	0.15±0.06	---
February 1972	45	4.7 ±1.4	30±0.9	0.18±0.03	0.36±0.06	---
April 1972	124	7.7 ±2.3	28±0.5	0.45±0.08	0.98±0.16	0.05±0.03
June 1972	67	7.1 ±1.9	18±0.6	0.49±0.08	1.0 ±0.2	---
September 1972	15	1.4 ±0.9	23±0.6	0.04±0.03	0.06±0.06	---

See footnotes at end of table.

TABLE 5 (Continued)

Location and Statistics	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry)				
		^7Be	^{40}K	$^{95}\text{Zr}^c$	$^{95}\text{Nb}^c$	^{137}Cs
Summary of Pre-Cannikin Data						
Constantine Harbor ^d						
Range	30-51	0.40-0.65	20-31	0.03-0.19	0.04-0.38	0.03-0.06
Mean $\pm$ SD	43	0.52 $\pm$ 0.18	25 $\pm$ 6	0.10 $\pm$ 0.08	0.21 $\pm$ 0.17	0.05 $\pm$ 0.02
Duck Cove ^d						
Range	37-102	NS-1.0	21-24	0.02-0.09	0.04-0.23	0.02-0.06
Mean $\pm$ SD	66	0.8 $\pm$ 0.3	23 $\pm$ 2	0.07 $\pm$ 0.04	0.15 $\pm$ 0.10	0.04 $\pm$ 0.02
IA-2 or -3 ^e						
Range	32-158	NS-2.4	16-34	0.04-0.17	0.06-0.36	0.03-0.11
Mean $\pm$ SD	73	0.09 $\pm$ 0.09	26 $\pm$ 6	0.08 $\pm$ 0.06	0.17 $\pm$ 0.14	0.06 $\pm$ 0.03

a. Single sample error values are two-sigma, propagated, counting errors.

b. The time in days between the collection and counting of a sample.

c. Zirconium-95 and ^{95}Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.

d. Three samples were taken between September 1970 and May 1971.

e. Five samples were taken between September 1970 and November 1971.

TABLE 6

Gamma-Emitting Radionuclides in Lichens
Collected at Amchitka Island

Location and Date	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry) ^a									
		⁷ Be	⁴⁰ K	⁵⁴ Mn	⁶⁰ Co	⁹⁵ Zr ^c	⁹⁵ Nb ^c	¹⁰³ Ru	¹⁰⁶ Ru	¹²⁵ Sb	¹³⁷ Cs
Post-Cannikin											
Clam Lake											
December 1971	45	24 ±6.4	16 ±1.5	0.51± .12	0.32± .09	1.9±0.3	4.0±0.8	1.6±1.2	10 ±1.8	9.6± 0.1	67± 0.5
February 1972	81	8.1±5.2	4.9±1.4	---	---	0.6±0.2	1.4±0.4	---	2.0±1.3	2.2± 0.6	20± 0.3
April 1972	34	6.4±2.4	3.5±0.8	0.10± .06	0.12± .05	0.3±0.1	0.6±0.2	---	2.9±0.8	2.1± 0.4	19± 0.2
July 1972	32	3.2±2.2	4.2±0.7	0.09± .06	0.09± .05	0.8±0.1	1.7±0.2	0.8±0.4	---	1.8± 0.4	14± 0.2
October 1972 ^d	106	7.0±2.2	2.6±0.9	0.10± .04	---	---	0.8±0.2	---	3.0±0.5	1.1± 0.2	15± 0.3
Ice Box Lake											
October 1972	101	---	28 ±1.2	---	0.11± .08	0.7±0.1	1.4±0.3	3.8±2.0	---	2.6± 0.7	14± 0.2
Cannikin Lake											
July 1972	29	5.3±1.7	2.0±0.7	0.08± .05	0.11± .04	0.7±0.1	1.6±0.1	0.6±0.3	---	0.2± 0.4	21± 0.2

See footnotes at end of table.

TABLE 6 (continued)

Statistics	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry)									
		^7Be	^{40}K	^{54}Mn	^{60}Co	$^{95}\text{Zr}^c$	$^{95}\text{Nb}^c$	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs
Summary of Pre-Cannikin Data at Clam Lake ^e											
Range	23-109	7-20	2-19	0.07-0.59	0.05-0.56	0.3-3.1	0.7-6.4	NS-8.2	NS-11.8	1.8-21.5	13-122
Mean $\pm$ SD	64	14.7 $\pm$ 6.1	4.5 $\pm$ 6.4	0.19 $\pm$ .18	0.16 $\pm$ .18	1.0 $\pm$ 1.0	2.1 $\pm$ 1.9	1.5 $\pm$ 3.1	5.4 $\pm$ 3.2	5.6 $\pm$ 7.2	37 $\pm$ 39

a. Single sample error values are two-sigma, propagated, counting errors.

b. The time in days between the collection and counting of a sample.

c. Zirconium-95 and ^{95}Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.

d. Samples counted on Ge(Li) detector. All other samples were counted on NaI detector.

e. Seven samples were taken between September 1970 and November 1971.

TABLE 7

Some Gamma-Emitting Radionuclides in Invertebrates
Collected at Amchitka Island

Collection Date	Δt^b	Specimen No.	Collection Site	Organism	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry) ^a			
						⁷ Be	⁴⁰ K	⁹⁵ Zr ^c	⁹⁵ Nb ^c
May 1971	62	245	IA-3	Littorina	Entire	0.25±0.22	2.1±0.2	0.03±0.02	0.05±0.04
Sept. 1971	86	576	IA-3	Plankton	Entire	---	11 ±1.1	---	---
Sept. 1971	88	605	IA-3	Plankton	Entire	---	15 ±0.8	---	---
Sept. 1971	95	581	Off Sea Otter Pt.	Scallop	Soft Parts	---	13 ±1.2	---	---
Sept. 1971	106	580	Off Sea Otter Pt.	Scallop	Shell	---	0.3±0.3	---	---
Sept. 1971	145	730	Off Bat Island	Sea Urchin	Soft Parts	---	13 ±1.4	---	---
Sept. 1971	150	760	Crown Reefer Pt.	Sea Urchin	Soft Parts	---	11 ±0.7	---	---
Sept. 1971	151	762	Crown Reefer Pt.	Sea Urchin	Gonad	---	11 ±1.5	0.45±0.30	1.0 ±0.6
Sept. 1971	153	755	Off C-site	Sea Urchin	Soft Parts	---	10 ±0.8	0.16±0.05	0.35±0.14
Sept. 1971	163	756	St. Makarius Bay	Sea Urchin	Soft Parts	---	11 ±1.2	0.63±0.23	1.3 ±0.6
Sept. 1971	163	758	Off C-site	Sea Urchin	Soft Parts	---	12 ±1.4	0.63±0.34	1.3 ±0.8
Sept. 1971	173	798	Off East Cape	Plankton	Entire	3.1 ±2.9	9.9±0.6	---	---
Oct. 1971	31	454	Off Kirilloff Pt.	Scallop	Soft Parts	32 ±5	11 ±4.9	0.5 ±0.4	1.0 ±0.8
Oct. 1971	32	487	Off Bat Island	Horse Crab	Muscle	---	15 ±0.8	---	---
Oct. 1971	44	551	Off Bat Island	Sea Urchin	Soft Parts	---	64 ±5	0.46±0.27	1.0 ±0.6
Oct. 1971	56	485	Off Bat Island	Tanner Crab	Skeleton	---	5.2±1.2	0.22±0.11	0.44±0.22
Oct. 1971	56	488	Off Bat Island	Horse Crab	Skeleton	---	6.6±0.9	---	---
Oct. 1971	57	555	Off Bat Island	Sea Urchin	Soft Parts	1.6 ±1.1	11 ±1	0.09±0.07	0.22±0.13
Oct. 1971	60	550	Off Bat Island	Sea Urchin	Test.	---	2 ±0.4	0.04±0.02	0.08±0.04
Oct. 1971	63	553	Off Bat Island	Sea Urchin	Test.	---	3 ±0.5	0.04±0.03	0.08±0.06
Oct. 1971	63	554	Off Bat Island	Sea Urchin	Gonad	---	6 ±1.3	---	---
Oct. 1971	66	486	Off Bat Island	Tanner Crab	Remainder	---	6.2±0.9	---	---
Oct. 1971	66	490	Off Bat Island	Horse Crab	Remainder	---	---	1.1±0.8	2.3 ±1.7
Oct. 1971	77	480	Off Bat Island	Tanner Crab	Skeleton	---	5.8±1.2	---	---
Oct. 1971	125	728	Kirilloff Point	Scallop	Soft Parts	---	8.8±2.2	---	---

See footnotes at end of table.

TABLE 7 (continued)

Collection Date	Δt^b	Specimen No.	Collection Site	Organism	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry) ^a			
						⁷ Be	⁴⁰ K	⁹⁵ Zr ^c	⁹⁵ Nb ^c
Nov. 1971	103	764	Off St. Makarius Point	Octopus	Viscera	---	13 ±1.5	0.27±0.21	0.54±0.48
Nov. 1971	131	765	Off St. Makarius Point	Octopus	Remainder	---	7.8±0.4	---	---
Dec. 1971	49	727	Duck Cove	Green sponge	Entire	2.4±0.6	8.4±0.6	0.07±0.05	0.15±0.10
Feb. 1972	210	085	Duck Cove	Green sponge	Entire	6.4±5.9	9.5±0.7	---	---
April 1972	113	003	Duck Cove	Green sponge	Entire	---	15 ±0.7	---	---
June 1972	59	058	Sand Beach Cove	Green sponge	Entire	---	6.8±1.7	0.24±0.13	0.54±0.28
June 1972	65	060	Sand Beach Cove	Mussel	Shell	---	---	---	---
June 1972	66	039	Duck Cove	Green sponge	Entire	2.0±0.4	9.7±0.3	0.14±0.04	0.28±0.06
Aug. 1972	76	123	Off Kirilloff Pt.	Plankton	Entire	---	9 ±0.5	---	---
Sept. 1972	53	121	Off Kirilloff Pt.	Plankton	Entire	---	17 ±0.7	---	---
Sept. 1972	60	107	Off Kirilloff Pt.	Plankton	Entire	0.7±0.6	10 ±0.6	---	---
Sept. 1972	61	108	Off Kirilloff Pt.	Plankton	Entire	0.6±0.5	10 ±0.5	---	---
Sept. 1972	73	109	Off Kirilloff Pt.	Plankton	Entire	2.1±1.9	11 ±0.6	---	---
Sept. 1972	75	115	Off C-site	Plankton	Entire	---	12 ±0.4	---	---
Sept. 1972	86	122	Off Kirilloff Pt.	Plankton	Entire	---	10 ±0.8	---	---

a. Single sample error values are two-sigma, propagated, counting errors.

b. The time in days between the collection and counting of a sample.

c. Zirconium-95 and ⁹⁵Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.

TABLE 8

Gamma-Emitting Radionuclides in Crab, Lithodes aequispina,
Collected at Amchitka Island

Collection Date	Specimen No.	Tissue	Grams Dry Samples	Gamma-Emitting Radionuclides (pCi/g, dry) ^a			
				⁶⁰ Co	⁶⁵ Zn	⁹⁵ Zr- ⁹⁵ Nb	¹³⁷ Cs
October 1971	446	Muscle	16.8	0.4 ± 0.09	-----	2.6 ± 0.6	2.4 ± 0.4
" "	"	Eggs	15.0	-----	-----	-----	0.2 ± 0.1
" "	451	Muscle	25.1	0.3 ± 0.1	0.4 ± 0.30	0.3 ± 0.1	0.2 ± 0.1
" "	"	"Liver" ^b	13.4	-----	-----	0.4 ± 0.2	0.3 ± 0.1
" "	456	Muscle	27.0	0.28 ± 0.08	0.5 ± 0.30	0.3 ± 0.1	0.2 ± 0.1
" "	"	"Liver"	18.5	-----	0.4 ± 0.2	0.1 ± 0.1	-----
" "	"	Eggs	22.7	-----	-----	-----	-----
" "	"	Remainder	51.1	-----	-----	-----	-----
" "	462	Muscle	22.5	0.3 ± 0.1	-----	0.3 ± 0.1	0.2 ± 0.1
" "	"	Skeleton	40.0	0.31 ± 0.09	0.5 ± 0.3	0.4 ± 0.1	0.2 ± 0.1
" "	"	Remainder	23.9	-----	-----	-----	-----
" "	466	Muscle	17.0	-----	-----	-----	-----
" "	"	Eggs	21.1	-----	-----	-----	0.08 ± 0.07
" "	"	Skeleton	40.1	0.21 ± 0.07	0.5 ± 0.3	0.2 ± 0.1	0.16 ± 0.09
" "	476	Skeleton	40.5	-----	-----	-----	-----
" "	500	Muscle	28.5	-----	-----	-----	-----
" "	"	"Liver"	5.0	-----	-----	-----	-----
" "	"	Eggs	18.3	0.18 ± 0.07	-----	-----	-----
" "	"	Remainder	50.0	-----	-----	-----	-----

See footnotes at end of table.

TABLE 8 (continued)

Collection Date	Specimen No.	Tissue	Grams Dry Samples	Gamma-Emitting Radionuclides (pCi/g, dry) ^a			
				⁶⁰ Co	⁶⁵ Zn	⁹⁵ Zr- ⁹⁵ Nb	¹³⁷ Cs
October 1971	506	Muscle	28.9	-----	-----	0.3 ± 0.1	-----
" "	"	Remainder	50.0	0.06 ± 0.05	-----	-----	-----
" "	515	Skeleton	47.9	0.13 ± 0.04	-----	0.14 ± 0.08	-----
Nov. 18, 1971 ^c	666	"Liver"	13.4	0.11 ± 0.09	0.6 ± 0.3	0.4 ± 0.2	-----
" " " ^c	670	"Liver"	23.8	0.12 ± 0.06	-----	0.2 ± 0.1	-----

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

b. Hepatopancreas

c. Post-Cannikin

TABLE 9

 ^{137}Cs and ^{40}K in Marine Fish Collected Off Amchitka Island

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)		
					⁴⁰ K	¹³⁷ Cs	
Pre-Cannikin ^a							
May 1971	Constantine Harbor	Greenling (21-31)	19	Muscle	16 ± 0.7	0.37 ± 0.42	
May 1971	Constantine Harbor	Greenling (21-31)	19	Liver	10 ± 1.4	0.03 ± 0.04	
May 1971	Constantine Harbor	Greenling (21-31)	19	Bone	8.6 ± 1.3	---	
May 1971	Constantine Harbor	Greenling (21-31)	19	Stomach content	15 ± 2.1	0.17 ± 0.23	
May 1971	Constantine Harbor	Greenling (21-31)	19	Viscera	13 ± 0.7	0.15 ± 0.05	
May 1971	Constantine Harbor	Greenling (21-31)	19	Gonad	9.8 ± 1.7	0.04 ± 0.05	
May 1971	Constantine Harbor	Greenling (21-31)	19	Remainder	7.5 ± 0.4	0.06 ± 0.01	
May 1971	Sand Beach	Greenling (23-31)	27	Muscle	15 ± 1.2	0.07 ± 0.02	

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					⁴⁰ K	¹³⁷ Cs
May 1971	Sand Beach	Greenling (23-31)	27	Liver	12 ± 3.5	0.05 ± 0.09
May 1971	Sand Beach	Greenling (23-31)	27	Bone	8 ± 1.2	0.04 ± 0.06
May 1971	Sand Beach	Greenling (23-31)	27	Stomach content	13 ± 1.5	0.19 ± 0.17
May 1971	Sand Beach	Greenling (23-31)	27	Viscera	13 ± 0.6	0.02 ± 0.02
May 1971	Sand Beach	Greenling (23-31)	27	Gonad	9.7 ± 1.2	0.02 ± 0.03
May 1971	Sand Beach	Greenling (23-31)	27	Remainder	8.7 ± 0.3	0.05 ± 0.04
Aug 1971	Bering Sea (Off C-site)	Halibut (67-123)	4	Muscle	18 ± 1.7	0.06 ± 0.08
Aug 1971	Bering Sea (Off C-site)	Halibut (67-123)	4	Liver	13 ± 5.9	0.27 ± 0.28

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					⁴⁰ K	¹³⁷ Cs
Oct 1971	Bering Sea (51°30'N 179°20'E)	Rattail (91)	3	Liver	1.3 ± 1.1	---
Oct 1971	Pacific Ocean ^b	Ocean Perch (19-29)	5	Liver	9.5 ± 1.1	0.05 ± 0.05
Oct 1971	Pacific Ocean ^b	Ocean Perch (19-29)	4	Muscle	14 ± 0.5	0.06 ± 0.04
Oct 1971	Pacific Ocean ^b	Ocean Perch (19-29)	2	Viscera	8.8 ± 1.2	0.06 ± 0.01
Oct 1971	Pacific Ocean ^b	Pacific Cod (47-70)	3	Liver	3.8 ± 0.1	---
Oct 1971	Pacific Ocean ^b	Pacific Cod (47-70)	2	Muscle	16 ± 0.6	0.04 ± 0.06
Oct 1971	Pacific Ocean ^b	Pollack (42-44)	3	Liver	3.1 ± 0.5	---
Oct 1971	Pacific Ocean ^b	Pollack (42-44)	3	Muscle	15 ± 0.5	0.10 ± 0.03

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					⁴⁰ K	¹³⁷ Cs
Post-Cannikin ^c						
Feb 1972	Constantine Harbor	Greenling (29)	1	Muscle	14 ± 0.5	---
Feb 1972	Constantine Harbor	Greenling (33)	1	Muscle	15 ± 0.6	0.06 ± 0.04
Feb 1972	Constantine Harbor	Greenling (31)	1	Muscle	14 ± 0.5	0.05 ± 0.03
84 Feb 1972	Constantine Harbor	Greenling (29)	1	Muscle	16 ± 0.9	0.11 ± 0.06
April 1972	Constantine Harbor	Greenling (27)	1	Muscle	14 ± 0.8	---
April 1972	Constantine Harbor	Greenling (27)	1	Muscle	15 ± 1.2	---
April 1972	Constantine Harbor	Greenling (28)	1	Muscle	15 ± 0.6	---
April 1972	Constantine Harbor	Greenling (29)	1	Muscle	14 ± 0.6	0.11 ± 0.04
April 1972	Constantine Harbor	Greenling (32)	1	Muscle	15 ± 0.5	0.05 ± 0.04

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					⁴⁰ K	¹³⁷ Cs
July 1972	Constantine Harbor	Greenling (26)	1	Muscle	12 ± 0.5	---
July 1972	Constantine Harbor	Greenling (27)	1	Muscle	15 ± 0.7	---
July 1972	Constantine Harbor	Greenling (26)	1	Muscle	17 ± 0.8	---
July 1972	Constantine Harbor	Greenling (29)	1	Muscle	14 ± 0.8	---
Oct 1972	Constantine Harbor	Greenling (24-33)	6	Muscle	17 ± 0.6	0.09 ± 0.04
Nov 1971	Sand Beach	Greenling (30)	1	Muscle	12 ± 1.4	---
Nov 1971	Sand Beach	Greenling (33)	1	Muscle	13 ± 1.1	---
Nov 1971	Sand Beach	Greenling (32)	1	Muscle	16 ± 0.9	0.09 ± 0.06
Nov 1971	Sand Beach	Greenling (32)	1	Muscle	14 ± 0.8	---

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)		
					⁴⁰ K	¹³⁷ Cs	
Feb 1972	Sand Beach	Greenling (26)	1	Muscle	14 ± 0.7	0.08 ± 0.05	
Feb 1972	Sand Beach	Greenling (27)	1	Muscle	17 ± 1.1	---	
Feb 1972	Sand Beach	Greenling (28)	1	Muscle	15 ± 0.7	---	
Feb 1972	Sand Beach	Greenling (26)	1	Muscle	13 ± 0.7	---	
April 1972	Sand Beach	Greenling (25)	1	Muscle	15 ± 0.7	---	
April 1972	Sand Beach	Greenling (26)	1	Muscle	14 ± 0.5	0.07 ± 0.03	
April 1972	Sand Beach	Greenling (27)	1	Muscle	16 ± 0.6	---	
April 1972	Sand Beach	Greenling (27)	1	Muscle	14 ± 0.8	---	
April 1972	Sand Beach	Greenling (29)	1	Muscle	15 ± 0.8	---	

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					⁴⁰ K	¹³⁷ Cs
Oct 1972	Sand Beach	Greenling (18-29)	7	Muscle	16 ± 0.5	0.12 ± 0.03
Feb 1972	Duck Cove	Greenling (29)	1	Muscle	17 ± 0.7	---
Feb 1972	Duck Cove	Greenling (28)	1	Muscle	14 ± 0.6	0.13 ± 0.04
April 1972	Duck Cove	Greenling (28)	1	Muscle	15 ± 0.5	---
April 1972	Duck Cove	Greenling (26)	1	Muscle	15 ± 0.6	0.05 ± 0.04
April 1972	Duck Cove	Greenling (28)	1	Muscle	15 ± 0.6	---
April 1972	Duck Cove	Greenling (30)	1	Muscle	16 ± 0.5	0.11 ± 0.03
April 1972	Duck Cove	Greenling (29)	1	Muscle	16 ± 0.5	0.05 ± 0.03
Oct 1972	Duck Cove	Greenling (21-29)	7	Muscle	17 ± 1.0	0.13 ± 0.06

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					⁴⁰ K	¹³⁷ Cs
Nov 1971	Bering Sea (Off C-site)	Halibut (33)	1	Muscle	19 ± 1.1	---
Nov 1971	Bering Sea (Off C-site)	Halibut (49)	1	Muscle	19 ± 0.7	0.08 ± 0.04
Nov 1971	Bering Sea (Off C-site)	Halibut (49)	1	Liver	5.8 ± 1.0	---
Nov 1971	Pacific Ocean (Off C-site)	Halibut	1	Muscle	19 ± 0.9	0.18 ± 0.06
52 Aug 1972	Pacific Ocean (Off C-site)	Halibut (100)	1	Muscle	15 ± 1.1	---
Aug 1972	Pacific Ocean (Off C-site)	Halibut (123)	1	Muscle	16 ± 1.0	---
Aug 1972	Pacific Ocean (Off C-site)	Halibut (23)	1	Testes	28 ± 1.0	---
Aug 1972	Pacific Ocean (Off C-site)	Halibut (126)	1	Muscle	18 ± 0.9	---
Aug 1972	Pacific Ocean (Off C-site)	Halibut (119)	1	Muscle	16 ± 1.0	---
Aug 1972	Pacific Ocean (Off C-site)	Halibut (119)	1	Testes	28 ± 1.1	0.09 ± 0.06

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					^{40}K	^{137}Cs
Sept 1972	Pacific Ocean (Off C-site)	Halibut (150)	1	Muscle	15 ± 0.9	---
Sept 1972	Pacific Ocean (Off C-site)	Halibut (150)	1	Ovary	6.4 ± 0.9	---
Sept 1972	Pacific Ocean (Off C-site)	Halibut (99)	1	Muscle	18 ± 1.2	---
Aug 1972	Off St. Makarius Point	Pacific Cod (44)	1	Muscle	17 ± 0.9	---
Aug 1972	Off Kirilof Pt.	Pollack (37)	1	Viscera	16 ± 3.9	---
Nov 1971	Bering Sea	Lantern Fish (4-10)	35	Entire	6.3 ± 0.5	0.06 ± 0.04
Aug 1972	Off Kirilof Pt.	Lantern Fish (7-10)	40	Eviscerated Whole	6.3 ± 0.4	---
Aug 1972	Off Kirilof Pt.	Lantern Fish (7-10)	40	Viscera	4.8 ± 0.4	---
Nov 1971	Bering Sea	Smelt (12-14)	5	Entire	11 ± 1.8	---

See footnotes at end of table.

TABLE 9 (continued)

Period and Collection Date	Collection Site	Common Name (size cm)	No. of Fish	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					^{40}K	^{137}Cs
Aug 1972	Off Kirilof Pt.	Smelt (12-14)	5	Eviscerated whole	7.7 ± 0.7	0.10 ± 0.05
Aug 1972	Off Kirilof Pt.	Whiting (37)	1	Muscle	16 ± 0.5	0.06 ± 0.03
Aug 1972	Off Kirilof Pt.	Whiting (37)	1	Remainder	10 ± 0.4	0.08 ± 0.02

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a. Pre-Cannikin ^{40}K and ^{137}Cs values are given as the mean $\pm$ SD.

b. These fish were caught within the area bounded by $179^{\circ}9'\text{E}$ to $179^{\circ}21'\text{E}$ longitude and $51^{\circ}14'\text{N}$ to $51^{\circ}15.5'\text{N}$ latitude in the Pacific Ocean off Amchitka.

c. Post-Cannikin error values are two-sigma, propagated, counting errors for single samples.

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TABLE 10

 ^{137}Cs and ^{40}K in Salmon Collected in the Bering Sea off Amchitka Island^a

Collection Date	Common Name	No. of Fish	Fish Size (cm)	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry) ^b	
					⁴⁰ K	¹³⁷ Cs
Post-Cannikin						
Nov 1971 ^c	Sockeye	7	37-51	Muscle	13 ± 1.1	0.04 ± 0.03
Nov 1971 ^c	Sockeye	4	37-44	Liver	10 ± 1.1	0.27 ± 0.08
Aug 1972	Chum	1	67	Muscle	11 ± 0.9	---
Aug 1972	Chum	1	63	Muscle	12 ± 0.9	---
Aug 1972	Pink	1	44	Muscle	14 ± 1.0	---
Aug 1972	Pink	1	43	Muscle	13 ± 1.1	---
Aug 1972	Pink	1	43	Muscle	11 ± 1.0	---
Aug 1972	Pink	1	43	Muscle	12 ± 1.0	---
Aug 1972	Pink	1	43	Muscle	21 ± 2.2	---
Aug 1972	Pink	1	48	Muscle	13 ± 1.0	---
Aug 1972	Pink	1	40	Muscle	15 ± 1.0	---
Aug 1972	Pink	1	40	Muscle	13 ± 1.2	---

See footnotes at end of table.

TABLE 10 (continued)

Statistic	Common Name	No. of Fish	Fish Size (cm)	Tissue	Gamma-Emitting Radionuclides (pCi/g, dry)	
					⁴⁰ K	¹³⁷ Cs
Summary of September 1971 Pre-Cannikin Data						
Range	Chum	29	37-75	Muscle	8 - 14	NS - 0.12
Range	Chum	29	37-75	Liver	7 - 12	NS - 0.23
Range	Chum	2	38-55	Ovary	3.1 - 4.6	NS - 0.10
Range	Chinook	2	68-78	Muscle	7.6 - 11	NS - 0.05
Mean ± SD ^b	Chum	29	37-75	Muscle	11 ± 1.7	0.04 ± 0.03
Mean ± SD ^b	Chum	29	37-75	Liver	9.8 ± 1.8	0.10 ± 0.08
Mean ± SD ^b	Chum	2	38-55	Ovary	3.9 ± 1.1	0.05 ± 0.06
Mean ± SD ^b	Chum	1	67	Testes	25 ± 1.6	---
Mean ± SD ^b	Chinook	2	68-78	Muscle	9.3 ± 2.4	0.03 ± 0.03
Mean ± SD ^b	Chinook	1	78	Liver	10 ± 1	0.11 ± 0.07
Mean ± SD ^b	Pink	1	57	Muscle	15 ± 0.8	0.10 ± 0.05
Mean ± SD ^b	Pink	1	57	Testes	11 ± 1.4	---

See footnotes at end of table.

TABLE 10 (continued)

- a. All salmon were collected in the Bering Sea with the exception of one Chinook salmon which was from the Pacific side of Amchitka.
- b. The error values for single fish are two-sigma, propagated counting errors.
- c. The values for November 1971 sockeye are the mean $\pm$ SD.

TABLE 11

Iron-55 Specific Activity Values in Fish Collected
at Amchitka Island

Species	N	September - October 1969			Sept. - Oct. 1970		
		⁵⁵ Fe (pCi)	Fe (mg)	⁵⁵ Fe (pCi)	N ^a	⁵⁵ Fe (pCi)	
		g, Dry	g, Dry	mg Fe		g, Dry	mg Fe
Pre-Cannikin							
Halibut							
Muscle	1	0.31	0.031	10.1	1/26	0.117	12.7
Liver	-	-	-	-	2/27	2.48	13.4
Greenling							
Muscle	-	-	-	-	5/60	0.559	13.2
Liver	-	-	-	-	5/60	8.33	14.3
Kidney	-	-	-	-	4/45	13.2	28.1
Gonad	-	-	-	-	4/55	12.5	45.4
Pacific Ocean Perch (1969); rockfish (1970)							
Muscle	1	3.55	0.014	254	2/11	1.84	173
Liver	1	66.8	0.31	216	2/11	16.9	41.4
Kidney	-	-	-	-	2/11	21.0	65.5
Dolly Varden							
Muscle	11	0.19 ± 0.19	0.025 ± 0.007	7.82 ± 9.01	2/22	1.63	91.3 _b
Liver	7	10.8 ± 14.6	0.71 ± 0.30	16.3 ± 20.3	2/22	3.70	78.4 _b
Pink Salmon							
Muscle	2	6.70 ± 4.29	0.074 ± 0.051	93.1 ± 6.6	-	-	-
Liver	2	58.8 ± 8.0	0.59 ± 0.03	99.6 ± 9.1	1/1	55	65.1
Silver Salmon							
Muscle	1	1.60	0.048	33.5	-	-	-
Liver	1	18.1	0.19	95.1	1/1	21.1	83.8
Chum Salmon							
Muscle	7	1.64 ± 1.22	0.026 ± 0.008	59.8 ± 28.5	-	-	-
Liver	7	71.8 ± 45.2	0.68 ± 0.24	100 ± 31	-	-	-
Sockeye Salmon							
Muscle	5	1.31 ± 0.45	0.023 ± 0.004	58.0 ± 22.4	-	-	-
Liver	6	76.8 ± 25.6	0.85 ± 0.41	102 ± 36	-	-	-
Rock Sole (1969); sole (1970)							
Muscle	3	0.12 ± 0.02	0.015 ± 0.007	9.71 ± 4.61	2/46	1.76	185
Liver	3	7.04 ± 2.20	0.20 ± 0.003	33.6 ± 10.3	1/26	1.41	4.95
Kidney	-	-	-	-	1/26	16.1	45.7
Gonad	-	-	-	-	1/26	23.2	516
Alaska Pollack							
Muscle	2	0.90 ± 0.25	0.013 ± 0.000	71.8 ± 21.8	-	-	-
Pacific Cod							
Muscle	7	0.69 ± 0.52	0.012 ± 0.006	69.5 ± 55.3	-	-	-
Liver	6	5.64 ± 5.81	0.10 ± 0.06	71.8 ± 86.8	-	-	-

See footnotes at end of table.

TABLE 11 (continued)

		August - October 1972		
Species	Location	⁵⁵ Fe (pCi)	Fe (mg)	⁵⁵ Fe (pCi)
		g, Dry	g, Dry	mg Fe
Post-Cannikin ^c				
Chum Salmon				
Muscle	Off Kirilof Pt.	0.45 ± 0.02	.025	18.0
Muscle	" " "	0.56 ± 0.03	.026	21.5
Liver	" " "	7.1	.31	22.9
Pink Salmon				
Muscle	Midden Cove	0.54 ± 0.02	.029	18.6
Muscle	" "	1.06 ± 0.02	.051	20.8
Muscle	" "	0.39 ± 0.02	.024	16.2
Muscle	" "	0.46 ± 0.04	.032	14.4
Liver	" "	14.5 ± 0.1	.678	21.4
Dolly Varden				
Muscle	DE-45 Lake	0.49 ± 0.10	.039	12.6
Muscle	" "	0.23 ± 0.02	.042	5.5
Greenling				
Muscle	Constantine Harbor	0.05 ± 0.02	.029	1.72
Muscle	Sand Beach Cove	0.17 ± 0.02	.018	.94
Muscle	Duck Cove	0.04 ± 0.01	.053	.75
Halibut				
Muscle	Sand Beach Cove	0.35 ± 0.02	.051	6.86
Liver	" " "	3.07 ± 0.08	.099	31.0
Muscle	Off Kirilof Pt.	0.36 ± 0.02	.034	10.6
Liver	" " "	3.07 ± 0.06	.146	21.0
Pacific Cod				
Muscle	Off St. Makarius Pt.	0.05 ± 0.02	.055	0.91
Muscle	" " " "	0.11 ± 0.02	.021	5.24

a. Number of pooled samples/total number of fish in all samples.

b. N equals 1/4. No stable Fe value for 18 fish in one pooled sample.

c. Single samples.

TABLE 12

Iron-55 Specific Activity Values in Canned Salmon from the
Bristol Bay Pack

Species	N	⁵⁵ Fe (pCi/g, dry)		pCi ⁵⁵ Fe/mg Fe	
		Range	Mean ± SD	Range	Mean ± SD
1971 Pack ^a					
Sockeye	14	0.61 - 1.34	0.98 ± 0.23	16.7 - 35.6	26.8 ± 5.9
Chinook	8	0.45 - 1.05	0.65 ± 0.20	15.2 - 28.4	22.8 ± 4.0
Chum	9	0.71 - 1.58	1.21 ± 0.23	21.9 - 37.0	31.9 ± 4.9
All Species	31	0.45 - 1.58	0.96 ± 0.30	15.2 - 37.0	27.3 ± 6.1

Species	Location	⁵⁵ Fe (pCi) g, Dry	Fe (mg) g, Dry	⁵⁵ Fe (pCi) mg Fe
1972 Pack ^b				
Sockeye	Egegik	0.69	0.035	19.7
"	Nushagak	1.22	0.049	24.9
"	Togiak	0.83	0.032	25.9
Chinook	Nushagak	3.68	0.029	127
"	Togiak	0.66	0.027	24.4
Chum	Nushagak	0.76	0.030	25.3
"	Togiak	1.03	0.042	24.5
"	Naknek	1.30	0.025	52.0

a. Ugashik, Egegik, Naknek, Nushagak, and Togiak.

b. Single samples.

TABLE 13

Some Gamma-Emitting Radionuclides in Birds Collected at Amchitka Island

Collection Date	Common Name	Tissue	No. of Samples	Gamma-Emitting Radionuclides (pCi/g, dry)*		
				⁴⁰ K	⁶⁰ Co	¹³⁷ Cs
Pre-Cannikin						
June 1971	Herring Gull	Liver	1	7.7 ± 1.1	---	---
June 1971	Herring Gull	Muscle	1	8.3 ± 0.6	---	0.09 ± 0.05
June 1971	Tufted Puffin	Liver	1	7.2 ± 1.8	---	---
June 1971	Tufted Puffin	Muscle	1	11 ± 0.7	0.10 ± 0.05	---
June 1971	Murre	Liver	1	7.6 ± 1.4	---	---
June 1971	Murre	Muscle	1	11 ± 0.5	0.03 ± 0.03	---
Dec 1971	Rock Ptarmigan	Muscle	1	9.9 ± 0.8	---	0.65 ± 0.05
Post-Cannikin						
Feb 1972	Rock Ptarmigan	Muscle	1	13 ± 0.5	---	0.73 ± 0.03
Feb 1972	Rock Ptarmigan	Muscle	1	11 ± 0.7	---	0.72 ± 0.05
Feb 1972	Rock Ptarmigan	Feathers	1	0.6 ± 0.5	---	0.14 ± 0.04
Feb 1972	Herring Gull	Feathers	1	0.5 ± 0.2	---	0.02 ± 0.01
Feb 1972	Herring Gull	Muscle	1	10 ± 0.7	---	0.06 ± 0.05
Feb 1972	Herring Gull	Liver	1	8.1 ± 0.9	---	---
Feb 1972	Herring Gull	Feathers	1	0.3 ± 0.2	---	2.1 ± 0.03

See footnote at end of table.

TABLE 13 (continued)

Collection Date	Common Name	Tissue	No. of Samples	Gamma-Emitting Radionuclides (pCi/g, dry)*		
				^{40}K	^{60}Co	^{137}Cs
Feb 1972	Herring Gull	Muscle	1	9.9 ± 0.7	---	0.08 ± 0.06
Feb 1972	Herring Gull	Liver	1	7.8 ± 0.7	---	0.09 ± 0.04
Summary of Pre-Cannikin Data Between December 1970 and April 1971						
Statistic	Common Name	Tissue	No. of Samples	^{40}K	^{60}Co	^{137}Cs
Range	Rock Ptarmigan	Liver	1	---	---	---
Range	Rock Ptarmigan	Muscle	4	11 - 12	---	0.26 - 1.7
Range	Rock Ptarmigan	Bone	1	2.6	0.09	0.17
Range	Rock Ptarmigan	Feathers	4	NS - 1.5	NS - 0.23	0.12 - 0.28
Mean ± SD	Rock Ptarmigan	Liver	1	---	---	---
Mean ± SD	Rock Ptarmigan	Muscle	4	11 ± 0.5	---	1.0 ± 0.6
Mean ± SD	Rock Ptarmigan	Bone	1	2.6 ± 1.1	0.09 ± 0.07	0.17 ± 0.08
Mean ± SD	Rock Ptarmigan	Feathers	4	1.0 ± 0.7	0.09 ± 0.10	0.17 ± 0.07

*These single sample error values are two-sigma, propagated, counting errors.

TABLE 14

Efficiency of Filter-Sorption Beds for Collection of ^{95}Zr + ^{95}Nb
from Seawater and Pond Water at Amchitka Island, August 1971

Location	Liter Sampled	Filter-Sorption Beds ^a (pCi/liter) ^b				Collection Efficiency of Al ₂ O ₃ (pCi/Liter) ^b (1-B/A) ^c
		Bed A		Bed B		
		Filter	Al ₂ O ₃	Filter	Al ₂ O ₃	
Constantine ^c Harbor Dock (Station 1)	1395	0.0038 ± 0.0016	0.052 ± 0.0074	Background	0.0094 ± 0.0050	0.82 ± 0.10
"	"	0.0038 ± 0.0012	0.044 ± 0.0080	"	0.0137 ± 0.0088	0.69 ± 0.21
51°27.6' North 179°13.0' East (Station 2)	1786	0.0044 ± 0.0014	0.064 ± 0.0048	"	0.024 ± 0.0064	0.63 ± 0.10
51°26.6' North 179°14.3' East (Station 3)	2832	0.0038 ± 0.0006	0.040 ± 0.0024	"	0.0171 ± 0.0036	0.57 ± 0.09
Long Shot Mud Pit 1	63	4.7 ± 0.10	Background	"	Background	-----

a. Beds A and B were connected in series with the water flowing first through Bed A, then through Bed B.

b. The error values are two-sigma, propagated, counting errors for single samples.

c. Samples collected the morning and afternoon of the same day.

TABLE 15

Gamma-Emitting Radionuclides in Samples Collected with a Filter-Sorption Bed from
Intertidal Areas of Amchitka Island

Location and Date	Δt^b	Liters Sampled	Fraction ^c	Gamma-Emitting Radionuclides (pCi/liter) ^a					
				⁷ Be	⁶⁰ Co	⁶⁵ Zn	⁹⁵ Zr ^d	⁹⁵ Nb ^d	¹³⁷ Cs
Post-Cannikin									
Constantine Harbor									
Dec 1971	27	524	Part.	---	---	---	0.005±.004	0.013±.009	---
Dec 1971	32	524	Sol.	0.49 ±0.48	---	---	---	---	0.09 ±0.03
Feb 1972	35	1190	Part.	---	---	---	0.002±.001	0.004±.003	0.004±.002
Feb 1972	38	1190	Sol.	0.19 ±0.16	---	0.036±.032	---	---	---
April 1972	38	1520	Part.	---	---	0.006±.004	---	---	---
April 1972	26	1520	Sol.	---	---	0.035±.028	0.009±.008	0.021±.020	---
July 1972 ^e	23	341	Part.	---	---	---	---	---	---
July 1972 ^e	21	341	Sol.	---	---	---	---	---	---
Sept 1972 ^e	102	83	Part.	---	---	---	---	---	---
Sept 1972 ^e	123	83	Sol.	---	---	---	---	---	---
Duck Cove									
May 1971	6	931	Part.	0.035±0.022	---	---	0.007±.002	0.016±.004	---
May 1971	7	931	Sol.	---	---	---	---	---	---
Nov 1971	35	391	Part.	---	---	---	---	---	---
Nov 1971	35	391	Sol.	---	---	0.008±.007	0.003±.002	0.006±.005	---
Nov 1971 ^f	13	420	Part.	---	---	---	---	---	0.021±.020
Nov 1971 ^f	11	420	Sol.	---	---	---	---	---	---
Dec 1971	24	380	Part.	---	---	---	---	---	0.007±.006
Dec 1971	10	380	Sol.	---	---	0.035±.027	0.013±.012	0.027±.024	---
Feb 1972	32	353	Part.	0.19 ±0.09	---	---	0.006±.002	0.013±.005	---
Feb 1972	18	353	Sol.	---	---	---	---	---	---

See footnotes at end of table.

TABLE 15 (Continued)

Location and Date	Δt^b	Liters Sampled	Fraction ^c	Gamma-Emitting Radionuclides (pCi/liter) ^a					
				⁷ Be	⁶⁰ Co	⁶⁵ Zn	⁹⁵ Zr ^d	⁹⁵ Nb ^d	¹³⁷ Cs
Duck Cove (Cont.)									
April 1972	27	513	Part.	---	---	0.018±.013	---	---	---
April 1972	27	513	Sol.	---	---	---	---	---	---
July 1972 ^e	34	44	Part.	---	---	---	---	---	---
July 1972 ^e	41	44	Sol.	---	---	---	---	---	---
Sept 1972 ^e	109	121	Part.	---	---	---	---	---	---
Sept 1972 ^e	127	121	Sol.	---	---	---	---	---	---
5 Sand Beach Cove									
Nov 1971 ^f	23	566	Part.	---	---	---	---	---	0.008± .004
Nov 1971 ^f	17	566	Sol.	---	---	---	---	---	---
Dec 1971	19	479	Part.	---	0.007±.003	---	---	---	---
Dec 1971	9	479	Sol.	---	---	0.11 ± .09	---	---	---
Feb 1972	33	832	Part.	---	---	---	---	---	0.008± .003
Feb 1972	34	832	Sol.	0.43±0.22	0.013±.010	---	---	---	---
April 1972	14	589	Part.	---	---	---	0.013±.005	0.028±.008	---
April 1972	18	589	Sol.	---	---	0.12 ± .08	---	---	0.017± .007
July 1972 ^e	30	352	Part.	---	---	---	0.01 ±.01	0.02 ±.01	---
July 1972 ^e	18	352	Sol.	---	---	---	---	---	---
Sept 1972 ^e	105	145	Part.	---	---	---	---	---	---

See footnotes at end of table.

TABLE 15 (Continued)

Statistic	Δt^b	Liters Sampled	Fraction ^c	Gamma-Emitting Radionuclides (pCi/liter)					
				⁷ Be	⁶⁰ Co	⁶⁵ Zn	⁹⁵ Zr ^d	⁹⁵ Nb ^d	¹³⁷ Cs
Summary of Pre-Cannikin Data Collected in Constantine Harbor ^g									
Range	7-139	950-5,974	Part.	NS-0.63	NS-0.09	NS-0.12	NS-0.006	NS-0.012	NS-0.004
Range	8-222	950-5,974	Sol.	NS-2.4	NS- .11	NS-1.4	NS-0.02	NS-0.04	NS-0.11
Mean $\pm$ SD	54	2,590	Part.	0.009 $\pm$ 0.011	0.013 $\pm$ 0.030	0.019 $\pm$ 0.040	0.002 $\pm$ 0.008	0.006 $\pm$ 0.007	0.001 $\pm$ 0.001
Mean $\pm$ SD	64	2,590	Sol.	0.38 $\pm$ 0.81	0.018 $\pm$ 0.037	0.20 $\pm$ 0.47	0.003 $\pm$ 0.017	0.012 $\pm$ 0.015	0.002 $\pm$ 0.035

a. Single sample error values are two-sigma, propagated, counting errors.

b. The time in days between the collection and counting of a sample.

c. Part. (particulate)--that portion retained by the 0.3 micron porosity filter.

Sol. (soluble)--that portion which passes through the 0.3 micron filter and is absorbed by the Al₂O₃.

Traces of ⁶⁰Co, ¹⁰³Ru, ¹⁰⁶Ru-¹⁰⁶Rh, and ¹⁴⁴Ce-¹⁴⁴Pr were also identified in some samples, but quantitative determinations have not been made.

d. Zirconium-95 and ⁹⁵Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.

e. Sample counted on a Ge(Li) detector. All other samples were counted on a NaI detector.

f. Post-Cannikin

g. Ten samples of each fraction were taken between September 1970 and November 1971.

TABLE 16

Gamma-Emitting Radionuclides in Samples Collected with a Filter-Sorption Bed From
Lakes on Amchitka Island

Location and Date	Δt^b	Liters Sampled	Fraction ^c	Gamma-Emitting Radionuclides (cPi/liter) ^a				
				⁷ Be	⁶⁵ Zn	⁹⁵ Zr ^d	⁹⁵ Nb ^d	¹³⁷ Cs
Post-Cannikin								
Jones Lake								
Dec 1971	49	277	Part.	0.4 ±0.1	---	---	---	0.02±0.01
Dec 1971	77	277	Sol.	6.4 ±3.6	---	0.34±0.16	0.75±0.34	0.23±0.20
Feb 1972	34	109	Part.	0.7 ±0.4	---	0.02±0.01	0.04±0.02	---
Feb 1972	47	109	Sol.	---	0.03±0.01	0.02±0.01	0.03±0.01	---
April 1972	29	251	Part.	---	0.03±0.02	0.02±0.01	0.05±0.03	---
April 1972	28	251	Sol.	---	---	---	---	---
July 1972	24	79	Part.	---	---	---	---	---
July 1972	47	79	Sol.	---	---	---	---	---
Sept 1972	102	53	Part.	---	---	---	---	---
Lake DK-45								
Nov 1971 ^e	---	201	Part.	Data missing				
Nov 1971 ^e	---	201	Sol.	Data missing				
Dec 1971	17	98	Part.	0.43±0.35	---	0.01±0.01	0.02±0.01	---
Dec 1971	15	98	Sol.	---	---	---	---	---
Feb 1972	30	375	Part.	0.36±0.14	---	0.02±0.01	0.05±0.01	0.02±0.01
Feb 1972	17	375	Sol.	20. ±7.8	---	---	---	---
April 1972	28	152	Part.	---	0.06±0.04	0.11±0.03	0.23±0.07	0.35±0.02
April 1972	20	152	Sol.	---	0.50±0.21	---	---	---
July 1972	24	79	Part.	---	---	0.22±0.05	0.47±0.13	---
July 1972	48	79	Sol.	---	---	---	---	---
Oct 1972	107	38	Part.	---	---	---	---	---

See footnotes at end of table.

TABLE 16 (Continued)

Location and Date	Δt^b	Liters Sampled	Fraction ^c	Gamma-Emitting Radionuclides (cPi/liter) ^a				
				⁷ Be	⁶⁵ Zn	⁹⁵ Zr ^d	⁹⁵ Nb ^d	¹³⁷ Cs
Cannikin Lake								
Feb 1972	68	8	Part.	---	---	0.33±0.14	0.68±0.29	---
April 1972	88	10	Part.	---	---	---	---	---
Ice Box Lake								
Oct 1972	110	31	Part.	---	---	---	---	---

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Statistic	Δt^b	Liters Sampled	Fraction ^c	Gamma-Emitting Radionuclides (pCi/liter)				
				⁷ Be	⁶⁵ Zn	⁹⁵ Zr ^d	⁹⁵ Nb ^d	¹³⁷ Cs
Summary of Pre-Cannikin Data Collected in Jones Lake ^f								
Range	17-148	76-219	Part.	NS-1.5	NS-0.06	NS-0.1	NS-0.19	NS-0.08
Range	---	76-219	Sol.	---	NS-0.09	NS-0.03	NS-0.07	NS-0.05
Mean $\pm$ SD	65	278	Part.	---	0.02 $\pm$ 0.03	0.05 $\pm$ 0.04	0.11 $\pm$ 0.08	0.02 $\pm$ 0.04
Mean $\pm$ SD	12	278	Sol.	---	0.02 $\pm$ 0.04	0.01 $\pm$ 0.01	0.02 $\pm$ 0.02	0.02 $\pm$ 0.02

a. Single sample error values are two-sigma, propagated, counting errors.

b. The time in days between the collection and counting of a sample.

c. Part. (particulate)--that portion retained by the 0.3 micron porosity filter.

Sol. (soluble)--that portion which passes through the 0.3 micron filter and is absorbed by the Al₂O₃.

Traces of ⁶⁰Co, ¹⁰³Ru, ¹⁰⁶Ru-¹⁰⁶Rh, and ¹⁴⁴Ce-¹⁴⁴Pr were also identified in some samples, but quantitative determinations have not been made.

TABLE 16 (continued)

- d. Zirconium-95 and ^{95}Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.
- e. Pre-Cannikin.
- f. Four samples were collected between February 1971 and October 1971.

TABLE 17

Some Gamma-Emitting Radionuclides in Samples Collected with a Filter-Sorption Bed
from Long Shot Mud Pit No. 1 on Amchitka Island

Collection Date	Δt^b	Liters Sampled	Fraction ^c	Gamma-Emitting Radionuclides (pCi/liter) ^a			
				⁷ Be	⁹⁵ Zr ^d	⁹⁵ Nb ^d	¹³⁷ Cs
Post-Cannikin							
Dec 1971	42	66	Part.	3.2± 1.0	0.06 ±0.03	0.13 ±0.008	---
Dec 1971	39	66	Sol.	---	---	---	---
Feb 1972	33	125	Part.	1.2± 0.1	0.06 ±0.03	0.14 ±0.04	---
Feb 1972	27	125	Sol.	2.2± 1.5	---	---	---
April 1972	20	29	Part.	---	0.58 ±0.14	1.2 ±0.3	0.16±0.14
April 1972	16	29	Sol.	---	---	---	---
July 1972 ^e	46	34	Part.	1.4± 0.5	0.55 ±0.16	0.93 ±0.15	---
July 1972 ^e	104	34	Sol.	---	---	---	---
Sept 1972 ^e	78	28	Part.	---	---	---	---
Sept 1972 ^e	118	28	Sol.	---	---	---	---

Statistic	Δt^b	Liters Sampled	Fraction ^c	Gamma-Emitting Radionuclides (pCi/liter)			
				⁷ Be	⁹⁵ Zr ^d	⁹⁵ Nb ^d	¹³⁷ Cs
Summary of Pre-Cannikin Data ^f							
Range	19-150	63-950	Part.	NS-10	0.01 -1.3	0.03 -2.7	NS-0.06
Range	14-212	63-950	Sol.	NS-41	NS-0.01	NS-0.03	NS-0.45
Mean ± SD	81	418	Part.	4.0± 4.7	0.4 ±0.6	0.9 ±1.2	0.02±0.03
Mean ± SD	103	418	Sol.	10.9±17.6	0.002±0.003	0.006±0.009	0.08±0.18

a. Single sample error values are two-sigma, propagated, counting errors.

b. The time in days between the collection and counting of a sample.

TABLE 17 (continued)

- c. Part. (particulate)--that portion retained by the 0.3 micron porosity filter.
Sol. (soluble)--that portion which passes through the 0.3 micron filter and is absorbed by the Al_2O_3 .
Traces of ^{60}Co , ^{103}Ru , ^{106}Ru - ^{106}Rh , and ^{144}Ce - ^{144}Pr were also identified in some samples, but quantitative determinations have not been made.
- d. Zirconium-95 and ^{95}Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.
- e. Sample counted on a Ge(Li) detector. All other samples were counted on a NaI detector.
- f. Six samples of each fraction were taken between September 1970 and October 1971.

TABLE 18

Efficiency of the In Situ Probe and Reproducibility of
Measurements for $^{40}\text{K}^{\text{a}}$ in Seawater Near Amchitka Island,
August 1971

Station No.	^{40}K net c/m ^b	Salinity ^c	^{40}K pCi/liter ^d	Efficiency c/m/pCi/liter
2	52.8 ± 0.6	33.6	311	0.170
3	52.9 ± 0.6	33.5	310	0.170
4	53.8 ± 0.6	33.5	310	0.174
5	53.0 ± 0.6	33.5	310	0.171
6	52.8 ± 0.6	33.4	310	0.170
7 ^e	50.6 ± 0.5	33.5	310	0.163
8	52.0 ± 0.5	33.4	310	0.168
9	53.2 ± 0.6	33.6	311	0.171
10	54.4 ± 0.6	33.6	311	0.175
11	52.8 ± 0.6	33.4	310	0.170
Avg ± SD	52.8 ± 1.0	33.5 ± 0.08	310 ± 0.7	0.170 ± 0.003

Counts at Station 1 (Constantine Harbor Boat Dock)

Date	Time Count Started	Minutes Counted	^{40}K net c/m ^a
August 5, 1971	2115	525	54.2 ± 0.3
August 7, 1971	1650	780	54.1 ± 0.3
August 9, 1971	0650	730	54.9 ± 0.3
" " "	1907	672	53.8 ± 0.3
August 10, 1971	1755	180	54.8 ± 0.6
" " "	2055	180	54.9 ± 0.6
" " "	2355	180	55.0 ± 0.6
August 11, 1971	0255	180	54.8 ± 0.6
Avg ± SD	----	---	54.56±0.46

- No other radionuclides were detected.
- The error values are one-sigma counting errors for individual determinations.
- Measured with an ST probe, parts per thousand.
- Calculated from salinity values.
- The spectrum was degraded because of an error in operation of the pulse height analyzer.

TABLE 19

Stations for In Situ Gamma-Spectrum Measurements, Amchitka Island

Station No.	Date	Time Started	Water Depth (meters)	Gamma Probe Depth	Latitude N	Longitude E
1	a	a	----	12	----	----
2	August 6, 1971	0825	22	15	51°27.6'	179°13'
3	" " " b	1300	40	38	51°26.6'	179°14.3'
4	August 7, 1971 ^c	0800	57	46	51°7.1'	179°14'
5	" " "	1215	64	55	51°27'	179°15.3'
6	August 8, 1971 ^d	0940	18	12	51°23.1'	179°8.5'
7	" " "	1410	70	64	51°22.7'	179°6.9'
8	" " "	1820	27	23	51°25.2'	179°4.3'
9	" " "	2220	70	64	51°24'	179°3'
10	August 10, 1971	0825	25	21	51°29.2'	179°8.5'
11	" " "	1245	27	24	51°30'	179°6.5'

a. Gamma counts were made on August 5, 7, 9, and 10, 1971. See Table 18 for information.

b. Strong offshore current; cable angle on ST probe 45°-60°.

c. Very strong offshore current; could not keep ST probe down.

d. ST probe angle 30°-50°.

TABLE 20

Some Gamma-Emitting Radionuclides in a Sea Otter
Collected at Amchitka Island

Collection Date	Tissue	No. of Samples	Gamma-Emitting Radionuclides (pCi/g, dry)*		
			^{40}K	^{60}Co	^{137}Cs
Feb 1971	Liver	1	8.6±1.1	0.16±0.07	0.27±0.08
Feb 1971	Skin	1	1.1±0.9	---	---
Feb 1971	Kidney	1	9.8±1.0	---	---
Feb 1971	Muscle	1	10. ±0.5	---	---

*The error values are two-sigma, propagated, counting errors for single samples.

TABLE 21

Gamma-Emitting Radionuclides in Freshwater Aufwuchs
Collected from the Long Shot Pond, Amchitka Island

Collection Date	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry) ^a								
		⁷ Be	⁴⁰ K	⁵⁴ Mn	⁹⁵ Zr ^c	⁹⁵ Nb ^c	¹⁰³ Ru	¹⁰⁶ Ru	¹²⁵ Sb	¹³⁷ Cs
Post-Cannikin										
Dec 1971 ^d	288	---	12 ±0.2	---	---	---	---	---	0.4±0.2	0.6±0.1
Feb 1972 ^d	39	7.4±1.1	8.4±1.5	---	1.4±0.2	3.7± 0.4	1.2 ±0.2	---	0.2±0.1	0.5±0.1
April 1972	34	2.5±2.0	9.9±0.9	---	0.2±0.1	0.4± 0.3	---	---	0.5±0.3	0.5±0.1
July 1972	52	6.0±1.5	11 ±0.5 ^e	---	2.3±0.5	6.6± 0.7	0.76±0.23	---	---	0.3±0.1
Sept 1972	97	---	11 ±0.5	0.06±0.04	0.1±0.1	0.3± 0.1	---	0.9± 0.4	0.8±0.2	0.4±0.1

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Statistic	Δt^b	Gamma-Emitting Radionuclides (pCi/g, dry)								
		^7Be	^{40}K	^{54}Mn	$^{95}\text{Zr}^c$	$^{95}\text{Nb}^c$	^{103}Ru	^{106}Ru	^{125}Sb	^{137}Cs
Summary of Pre-Cannikin Data										
Range	27-137	NS-36	46-15	0.08-0.06	1.1-6.5	2.1-13.4	NS-7.2	1.9-13	NS-2.9	0.7-3.4
Mean $\pm$ SD	65	15 $\pm$ 12	9 $\pm$ 4	0.28 $\pm$ 0.17	3.1 $\pm$ 1.8	6.7 $\pm$ 3.9	2.1 $\pm$ 2.7	5.8 $\pm$ 4.1	1.5 $\pm$ 0.9	1.8 $\pm$ 0.9

- Single sample error values are two-sigma, propagated, counting errors.
- The time in days between the collection and counting of a sample.
- Zirconium-95 and ⁹⁵Nb values, from samples counted on NaI detectors, were calculated as discussed in the text.
- Samples counted on Ge(Li) detector. All other samples were counted on NaI detector.
- Potassium-40 value from NaI detector.

TABLE 22

Strontium-90 in Bone from Rats and Ptarmigan Collected at Amchitka Island

Collection Date	Location	Organism	pCi/g, ash ^a	pCi/g, dry ^b	pCi/g, Ca ^c
October 13, 1971	Sand Beach Cove	Rat	1.0±0.2	0.7	---
October 13, 1971	Sand Beach Cove	Rat	3.8±0.2	2.5	---
December 5, 1971	Sand Beach Cove	Rat	14.8±0.6	10.1	---
December 5, 1971	Sand Beach Cove	Rat	2.5±0.3	1.6	---
November 4, 1971	Clevenger Creek	Ptarmigan	43.7±1.3	27.0	---
November 4, 1971	Baker Runway	Ptarmigan	50.4±1.5	35.2	---
December 1, 1971	Base Camp	Ptarmigan	30.4±0.9	18.3	---
December 3, 1971	C-site (Cannikin)	Ptarmigan	43.9±1.3	30.7	170

- a. Errors are one-sigma, analytical errors.
- b. Based on individual dry/ash ratios.
- c. Based on total calcium for C-site ptarmigan.

TABLE 23

Gamma-Emitting Radionuclides in Vegetation Collected at Dosimeter Stations^a

Location & Miles from C-Site ^c	Dominant Vegetation	Time of Collection ^d	Gamma-Emitting Radionuclides (pCi/g, dry) ^b							
			⁷ Be	⁴⁰ K	⁶⁰ Co	⁹⁵ Zr ^e	⁹⁵ Nb ^e	¹⁰⁶ Ru	¹²⁵ Sb	¹³⁷ Cs
Engineer Rd. (13.7)	Grass, <u>Calo-</u> <u>magrastis</u> sp.	Pre	---	3.9±1.1	0.17±.08	---	---	1.6 ±1.4	3.7 ±0.6	24 ±.3
		Post	---	5.1±0.9	0.17±.06	0.54± .44	1.2±0.9	1.7 ±1.0	2.8 ±0.4	23 ±.2
White house (9.4)	Grass, <u>Calo-</u> <u>magrastis</u> sp.	Pre	---	11 ±1.0	---	0.51± .28	1.0±0.6	2.3 ±0.9	0.74±0.3	6.9±.2
		Post	---	11 ±0.7	0.06±.04	0.34± .04	0.7±0.4	0.84±0.5	0.84±0.2	3.4±.1
Kirilof Pt. (9.3)	Moss	Pre	---	7.4±1.3	---	---	---	---	2.8 ±0.6	19 ±.3
		Post	14 ± 9.6	6.6±1.2	0.14±.08	0.98± .33	2.0 ±0.7	2.4 ±1.2	1.9 ±0.5	18 ±.3
77 Jones Lake Outlet(8.7)	Moss	Pre	27 ±13	4.7±1.2	---	1.2 ± .4	2.4 ±0.9	3.9 ±1.3	2.7 ±0.5	12 ±.3
		Post	---	3.5±1.0	0.12±.06	0.79± .48	1.7 ±1.0	2.2 ±1.0	3.6 ±0.4	13 ±.2
St. Makarius Pt. (8.9)	Crowberry, <u>Empetra</u> sp.	Pre	---	2.4±0.9	---	0.71±0.54	1.5 ±1.1	2.3 ±1.1	2.5 ±0.4	8.6±.2
		Post	---	2.9±0.8	0.11±.05	---	---	1.6 ±0.9	1.9 ±0.3	5.7±.1
Square Bay (4.2)	Crowberry, <u>Empetra</u> sp. & Moss	Pre	20 ±14	3.7±1.2	---	1.1 ±0.4	2.3 ±0.9	3.4 ±1.3	2.7 ±0.6	17 ±.3
		Post	---	4.6±0.8	0.11±.05	0.79±0.42	1.6 ±1.0	1.0 ±0.9	2.7 ±0.4	23 ±.2
Milrow (5.0)	Grass, <u>Agios-</u> <u>tis</u> sp.	Pre	---	5.8±0.8	0.06±.05	1.0 ±0.38	2.1 ±0.8	1.7 ±0.9	2.4 ±0.4	9.9±.2
		Post	---	3.9±0.6	0.08±.04	0.28±0.23	0.7 ±0.6	1.7 ±0.7	1.7 ±0.3	8.7±.1
Long Shot SGZ (4.0)	Grass, <u>Calo-</u> <u>magrastis</u> sp.	Pre	---	4.6±0.9	0.15±.06	0.88±0.52	1.9 ±1.0	2.1 ±1.1	3.1 ±0.4	21 ±.2
		Post	---	3.0±0.8	0.09±.05	0.44±0.34	1.0 ±0.8	2.5 ±0.9	2.3 ±0.4	10 ±.2

See footnotes at end of table.

TABLE 23 (Continued)

Location & Miles from C-Site ^c	Dominant Vegetation	Time of Collection ^d	Gamma-Emitting Radionuclides (pCi/g, dry) ^b							
			⁷ Be	⁴⁰ K	⁶⁰ Co	⁹⁵ Zr ^e	⁹⁵ Nb ^e	¹⁰⁶ Ru	¹²⁵ Sb	¹³⁷ Cs
CTB No. 21 (1.1)	Crowberry, <u>Em- petra</u> sp. & Grass, <u>Calo- magrastis</u> sp.	Pre	---	5.9±0.9	0.06±.06	---	---	1.2 ±1.0	2.2 ±0.4	14 ±.2
		Post	---	7.7±1.1	0.15±.07	0.59±0.29	1.2±0.6	1.2 ±1.0	2.2 ±0.4	13 ±.2
CTB No. 20 (0.7)	Moss, Crow- berry, <u>Empetra</u> sp.	Pre	---	3.4±1.0	---	---	---	1.3 ±1.1	1.0 ±0.4	7.1±.2
		Post	---	3.5±1.2	---	0.63±0.32	1.3±0.7	---	1.8 ±0.4	11 ±.2
Sandia Trailer Park (1.2)	Moss, Crow- berry, <u>Em- petra</u> sp.	Pre	13 ± 8.2	2.0±1.0	0.08±.06	0.40±0.27	0.9±0.5	1.9 ±1.0	2.0 ±0.4	16 ±.2
		Post	---	3.1±1.1	0.08±.07	0.60±0.33	1.3±0.7	---	1.7 ±0.4	10 ±.2
CTB No. 16 (3.4)	Moss, Crow- berry, <u>Em- petra</u> sp.	Pre	---	3.8±1.1	0.10±.07	---	---	---	2.3 ±0.5	13 ±.3
		Post	12 ± 9.8	5.2±0.9	0.12±.06	0.71±0.30	1.4±0.7	---	2.5 ±0.4	14 ±.2
CTB No. 10 (9.0)	Moss	Pre	---	5.7±0.9	0.08±.06	---	---	---	2.5 ±0.4	13 ±.2
		Post	---	5.8±0.8	0.22±.05	0.79±0.39	1.7±0.8	2.1 ±0.9	1.6 ±0.4	9.7±.2
Microwave Relay Station (16.0)	Moss, Crow- berry, <u>Em- petra</u> sp.	Pre	15 ± 9.6	3.5±1.0	0.14±.06	0.66±0.31	1.5±0.6	2.1 ±1.1	2.8 ±0.5	18 ±.2
		Post	3.4± 1.6	2.7±0.8	0.08±.05	0.68±0.26	1.5±0.6	1.2 ±0.7	1.9 ±0.4	20 ±.2
Northwest Camp (22.6)	Moss, Crow- berry, <u>Em- petra</u> sp.	Pre	9.6± 6.6	2.1±0.8	---	0.65±0.19	1.5±0.5	1.8 ±0.8	1.9 ±0.4	11 ±.2
		Post	1.5± 1.0	2.6±0.8	---	0.32±0.13	0.7±0.3	---	1.2 ±0.3	6.7±.1
S-8 near Generator House (4.8)	Moss	Pre	11 ± 9.4	3.0±1.2	---	0.81±0.32	1.8±0.7	2.7 ±1.2	2.3 ±0.5	11 ±.2
		Post	26 ±14	3.6±1.4	0.09±.09	1.1 ±0.4	2.2±0.9	2.5 ±1.4	2.4 ±0.6	11 ±.2

See footnotes at end of table.

TABLE 23 (continued)

- a. Pre- and Post-Cannikin test.
- b. The error values are two-sigma, propagated, counting errors for single samples.
- c. Straight-line distance.
- d. Pre-Cannikin collections were made on November 4, 1971; post-Cannikin collections were made on December 7, 1971, except Stations 14 and 15 which were made on April 21, 1972.
- e. The ^{95}Zr and ^{95}Nb values were calculated as discussed in the text.

TABLE 24

Instrument and TLD Measurements of Environmental Radiation at
Amchitka Island, November-December 1971^a

Station No.	Location & Miles from C-Site	Instrument Readings, CPM ^b			TLD Readings ^c mrad
		D-2	D+1	D+30	
1	South Bight (13.7)	275	---	300	9, 9, 8, 9
2	Main Camp (9.4)	475	---	500	11, 8, 10, 10
3	Kirillof Point (9.3)	300	---	275	11, 11, 12, 12
4	Jones Lake (8.7)	325	---	275	8, 8, 8, 8
5	St. Makarius Point (8.9)	250	---	250	9, 10, 10, 10
6	Square Bay (4.2)	250	---	225	14, 15, 13, 13
7	Milrow Surface Zero (5)	300	300	300	Data Missing
8	Long Shot Surface Zero (4)	250	250	225	9, 10, 10, 10
9	CTB 21 (1.1)	225	---	225	12, 11, 13, 10
10	CTB 20 (0.7)	225	---	225	9, 9, 8, 7
11	Sandia Trailer Park (1.2)	250	---	225	10, 11, 12, 13
12	CTB 16 (3.4)	325	---	325	13, 23, 12, 11
13	CTB 10 (9)	400	---	425	11, 16, 19, 20
14	Microwave Relay Station (16)	425	---	d	d
15	Northwest Camp (22.6)	275	---	"	"
16	Generator, S-8 Beach (4.8)	225	---	"	"

- a. Summarized from memo of December 14, 1971, from K. W. Gustafson, Eberline Instrument Co. to Test Manager's Representative.
- b. Eberline PRM-4; 1 x 1 1/4 inch NaI crystal detector; natural background, 225 to 500 CPM; D = November 6, 1971.
- c. Readings for each of 4 chips per packet; TLD's set out on D-2, retrieved on D+30 and read on D+34; background not subtracted.
- d. Not recovered or no reading because of snow.

TABLE 25

Tritium Values for Amchitka Seawater Samples

1970-1972

Collection Date	Collection Site	Tritium Units*
April 18, 1972	Constantine Harbor	28±13
July 17, 1972	Constantine Harbor	16±13
September 29, 1972	Constantine Harbor	<13
February 11, 1972	Small Boat Dock	99±14
May 20, 1972	Small Boat Dock	75±14
September 19, 1970	Off Mouth, Clevenger Creek	78±13
July 17, 1972	St. Makarius Bay	<13
September 20, 1970	Duck Cove Fault Line	21±13
September 18, 1970	Duck Cove	36±13
April 19, 1972	Duck Cove	33±14
July 17, 1972	Duck Cove	26±14
September 30, 1972	Duck Cove	<13
May 21, 1971	IA-1 (near buoy)	<16
December 6, 1971	Square Bay	54±13
February 21, 1972	Square Bay Point	33±13
February 21, 1972	Sand Beach Cove	27±13
April 20, 1972	Sand Beach Cove	<13
April 20, 1972	Sand Beach Cove	<13
April 20, 1972	Sand Beach Cove	<13
July 17, 1972	Sand Beach Cove	<13
September 30, 1972	Sand Beach Cove	<13
September 19, 1970	Shallow Station, 50 fm(10M)	19±12
	51°23'N 178°59'E	
September 19, 1970	51°23'N 178°59'E (40M)	18±12
September 19, 1970	51°23'N 178°59'E (80M)	40±13
September 19, 1970	Deep Station, 150 fm(Surface)	43±13
	51°25'N 178°59'E	
September 19, 1970	51°25'N 178°59'E (40M)	23±12
September 19, 1970	51°25'N 178°59'E (80M)	30±13

*The error shown is a one-sigma counting error.

TABLE 26
Tritium Values for Amchitka Freshwater Samples
1970-1972

Collection Date	Collection Site	Tritium Units ^a
December 6, 1971	Lake Near Engineer Pit (1/4 Mile N. of Pit)	46±13
February 21, 1972	Lake Near Engineer Pit (1/4 Mile N. of Pit)	23±13
July 17, 1972	Lake Near Engineer Pit (1/4 Mile N. of Pit)	51±13
December 6, 1971	Small Pond, Kirilof Point	77±13
February 21, 1972	Small Pond, Kirilof Point	56±13
May 20, 1970	Jones Lake	87±14
February 16, 1971	Jones Lake	100±14
August 12, 1971	Jones Lake	82±13
February 21, 1972	Jones Lake	53±13
April 18, 1972	Jones Lake	53±14
December 6, 1971	Jones Lake Outlet	62±13
February 21, 1972	Jones Lake Outlet	36±13
July 17, 1972	Jones Lake Outlet	40±13
September 18, 1972	Jones Lake Outlet	54±13
December 6, 1971	Small Pond Near White House (Base Camp)	60±13
February 21, 1972	Small Pond Near White House (Base Camp)	57±13
September 21, 1970	Sink of Hus-Key Camp, FRI Lab	78±13
December 6, 1971	Pond on St. Makarius Point	99±13
February 21, 1972	Pond on St. Makarius Point	44±13
September 21, 1970	Clevenger Creek	110±13
September 19, 1970	Clevenger Creek	73±13
February 16, 1971	Clevenger Creek	85±13
May 21, 1971	Clevenger Creek	87±14
July 17, 1972	Clevenger Creek	57±13
September 21, 1970	Milrow Pond at Well 17	140±14
September 21, 1970	Milrow Pond at Well 3	170±14
September 18, 1970	Milrow Pond at Well 2	90±13
September 21, 1970	Milrow Seep Between GZ and Well 2	130±13
September 21, 1970	Milrow Pond	150±14
December 6, 1971	Milrow GZ	24±13
February 21, 1972	Milrow GZ	31±13
July 17, 1972	Milrow GZ	55±13
September 20, 1970	Clam Lake	180±14
February 16, 1971	Clam Lake	78±14
May 21, 1971	Clam Lake	<13
September 18, 1970	Duck Cove Creek	130±13
February 16, 1971	Duck Cove Creek	24±13
May 21, 1971	Duck Cove Creek	140±14
December 6, 1971	Duck Cove Creek	81±13

See footnotes at end of table.

TABLE 26 (continued)

Collection Date	Collection Site	Tritium Units ^a
February 21, 1972	Duck Cove Creek	50±13
July 17, 1972	Duck Cove Creek	52±14
February 16, 1971	Quonset Lake	140±14
May 21, 1971	Quonset Lake	120±14
September 20, 1970	Spring at Cyril Cove	120±13
September 20, 1970	Long Shot Mud Pit 1 ^b	1600±33
September 20, 1970	Long Shot Mud Pit 2	2300±35
September 20, 1970	Long Shot Mud Pit 3	3100±52
September 20, 1970	Long Shot Pond A	180±14
September 20, 1970	Long Shot Pond B	170±14
September 20, 1970	Long Shot Pond C	190±14
September 20, 1970	Long Shot Pond D	220±15
September 20, 1970	Long Shot Pond E	140±14
September 20, 1970	Long Shot Well, WL-1	330±16
September 20, 1970	Long Shot Well, WL-2	680±21
September 20, 1970	Long Shot Well No. 8	2400±44
September 21, 1970	Long Shot Well No. 9	430±17
September 20, 1970	Long Shot Well No. 1	110±13
February 12, 1971	Long Shot Mud Pit 1 Surface	1100±26
May 20, 1971	Long Shot Mud Pit 3 No. 1	4100±55
May 20, 1971	Long Shot Mud Pit 3 No. 2	4000±63
May 20, 1971	Long Shot Mud Pit 3 No. 3	4000±62
May 20, 1971	Long Shot Mud Pit 3 No. 4	3900±61
May 20, 1971	Long Shot Mud Pit 3 No. 5	4000±64
May 20, 1971	Long Shot Mud Pit 3 No. 6	4000±62
May 20, 1971	Long Shot Mud Pit 3 No. 7	3900±61
May 20, 1971	Long Shot Mud Pit 3 No. 8	4300±66
May 20, 1971	Long Shot Mud Pit 3 No. 9	4100±64
May 20, 1971	Long Shot Mud Pit 3 No. 10	4100±69
May 20, 1971	Long Shot Mud Pit 3 No. 11	4100±69
May 20, 1971	Long Shot Mud Pit 3 No. 12	4200±64
May 20, 1971	Long Shot Mud Pit 3 No. 13	4100±69
May 20, 1971	Long Shot Mud Pit 3 No. 14	4000±69
May 20, 1971	Long Shot Mud Pit 3 No. 15	4000±62
May 20, 1971	Long Shot Mud Pit 3 No. 16	4000±68
May 20, 1971	Long Shot Mud Pit 2 No. 17	3000±49
May 20, 1971	Long Shot Mud Pit 1 No. 18	2100±38
August 13, 1971	Long Shot Mud Pit 1	1700±31
August 13, 1971	Long Shot Mud Pit 2	2500±42
August 13, 1971	Long Shot Mud Pit 3	3400±55
December 7, 1971	Long Shot Mud Pit 1	480±17
February 21, 1972	Long Shot Mud Pit 1 Outlet	170±14
February 21, 1972	Long Shot Mud Pit 1	2100±38
April 18, 1972	Long Shot Mud Pit 1	2200±35
July 17, 1972	Long Shot Mud Pit 1	2200±33
September 29, 1972	Long Shot Mud Pit 1	1700±31

See footnotes at end of table.

TABLE 26 (continued)

Collection Date	Collection Site	Tritium Units ^a
February 16, 1971	Bridge Creek	78±14
May 21, 1971	Bridge Creek	100±14
July 17, 1972	Bridge Creek	67±14
February 16, 1971	Creek 0.8 Mile SE of Bridge Creek	100±14
December 6, 1971	Creek Near CTB 21	110±13
February 21, 1972	Creek Near CTB 21	58±13
December 6, 1971	Pond Near CTB 20	44±13
February 21, 1972	Creek Near CTB 20	37±13
July 17, 1972	Creek (Between Milepost 12 and 11) Near Cannikin	82±14
February 20, 1972	Cannikin Lake Inlet	<13
February 20, 1972	Pump Near Cannikin Lake	<13
October 1, 1972	Ice Box Lake (Lake 04-47)	43±14
September 18, 1972	Ice Box Lake (Lake 04-47) A	52±13
September 18, 1972	Ice Box Lake (Lake 04-47) B	58±13
September 18, 1972	Ice Box Lake (Lake 04-47) C	44±13
September 18, 1972	Ice Box Lake Outlet (Lake 04-47)	56±13
July 17, 1972	DK-45 Lake	49±14
October 1, 1972	DK-45 Lake	33±14
February 21, 1972	DK-45 Lake Outlet	54±13
April 19, 1972	DK-45 Lake Outlet	46±14
July 17, 1972	Lake (South of DK-45) Below Pan Am Photo Tower	62±14
July 17, 1972	Sand Beach Cove Seepage	79±14
December 6, 1971	Sandia Trailer	72±13
February 21, 1972	Sandia Trailer	28±13
September 20, 1970	CTB 17	120±13
December 6, 1971	Lake 1/4 Mile SW of CTB 16	71±13
February 21, 1972	Lake 1/4 Mile SW of CTB 16	26±13
December 6, 1971	Lake Near CTB 13	92±13
February 21, 1972	Lake Near CTB 13	59±13
July 18, 1972	Lake Near CTB 13	60±13
April 21, 1972	Lake Near CTB 7, 1 Mile N. TLD Station (Microwave Relay Station)	58±14
July 18, 1972	Lake Near CTB 7	54±13
July 18, 1972	200 M. South of Bunker, NW Camp	65±14
April 21, 1972	Lake Near TLD Station, NW Camp	19±14

a. The error shown is a one-sigma counting error.

b. The locations of the Long Shot mud pits and ponds are shown in Figure 5.

TABLE 27

Tritium Values for Amchitka Dolly Varden

Collection Date	Collection Site	Tritium Units*
October 1, 1972	Ice Box Lake	43±13
October 1, 1972	Ice Box Lake	55±13
October 1, 1972	Ice Box Lake	38±13

*The error shown is a one-sigma counting error.

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6. TABLE AND MAP INDEX

<u>Collection Site</u>	<u>Figure No.(s)</u>	<u>Table No.(s)</u>	<u>Remarks</u>
Baker Runway	3	22	Part of Base Camp
Base Camp	2 & 3	2 & 22	
Bering Sea	1 & 2	1, 7, 9, 11, 14, 18, & 19	
			Collection sites located: a) Off C-Site, b) at 51° 30'N 179° 20'E, c) Off Bat Island, d) Off East Cape, e) Off Sea Otter Point, f) At Station 2 (51° 28'N 179° 13'E), g) At Station 3 (51° 27'N 179° 14'E), h) At 51° 29'N 179° 18'E, and i) Off Kirilof Point
Bridge Creek	4	3, 4, & 26	
Cannikin Lake	6	6 & 16	
Cannikin Lake Inlet	6	26	
Cannikin Site	2 & 6	22 & 26	
Clam Lake	4	6 & 26	
Clevenger Creek	4	3, 4, 22, & 26	
Clevenger Lake Outlet	3	4	
Constantine Harbor	2 & 3	5, 9, 11, 15, & 25	
Constantine Harbor Boat Dock	3	14 & 18	Station 1
Creek	4 & 6	26	Collection sites located: a) 0.8 mile SE of Bridge Creek, b) Near CTB 20 & 21, and c) Between Milepost 11 & 12 (near Cannikin)
Crown Reefer Point	2 & 4	7	
CTB 10	2	23 & 24	Station 13
CTB 16	2	23 & 24	Station 12
CTB 17	2	26	
CTB 20	6	23 & 24	Station 10
CTB 21	6	23 & 24	Station 9
Cyril Cove	4		
Duck Cove	4	5, 7, 9, 11 & 15	
Duck Cove Creek	4	3, 4, & 26	
Duck Cove Fault Line	None	25	
Egegik	1	12	Bristol Bay Area
Engineer Road	2 & 3	23	Part of Base Camp
Generator	4	24	S-8 Beach (Station 16)
IA-1	4	25	Near Buoy
IA-2	6	5	
IA-3	6	5 & 7	
Ice Box Lake	6	6 & 26	Lake 04-47

<u>Collection Site</u>	<u>Figure No.(s)</u>	<u>Table No.(s)</u>	<u>Remarks</u>
Infantry Road	2, 4-6	None	Collection sites located: a) Near Engineer Pit (1/4 mile N of pit), b) 1/4 mile SW of CTB 16, c) South of Lake DK-45 (below Pan Am Photo Tower), d) Near CTB 7 (1 mile N of Microwave Relay Station) and CTB 13, and e) Near TLD Station (Northwest Camp)
Jones Lake	3	16, 24, & 26	
Jones Lake Outlet	3	23 & 26	
Kirilof Point	2 & 3	3, 23, & 24	
Lakes	2, 3, & 6	26	
Lake DK-45	6	11, 16, & 26	Collection sites located at: a) Station 8; b) Mud Pits Nos. 1, 2, & 3; c) Ponds A, B, & C; and d) Wells WL-1, WL-2, and No. 1, 8, & 9.
Lake DK-45 Outlet	6		
Long Shot	2, 4, & 5	14, 17, 21, 23, 24, & 26	
Main Camp	3	24	Station 2, Part of Base Camp
Microwave Relay			
Station	1	23 & 24	Station 14
Midden Cove	2	11	
Milrow	2 & 4	23, 24, & 26	Collection sites located at: a) Station 7; b) Ponds near Well Nos. 2, 3, & 17; c) The Seep (between GZ & Well No. 2)
Naknek	1	12	Bristol Bay Area
Northwest Camp	2	23, 24, & 26	Collection sites located at: a) Station 15 and b) 200 meters south of bunker
Nushagek	1	12	Bristol Bay Area
Pacific Ocean	1, 2, & 4	7, 9, 11, & 25	Collection sites located: a) Off Clevenger Creek Mouth, b) At Deep Station (150 fm) 51° 25'N 178° 59'E, c) At Shallow Station (50 fm) 51° 23'N 178° 59'E, d) Off C-Site, and e) Off St. Makarius Point.
Ponds	2, 3, & 6	26	Collection sites located: a) On St. Makarius Point; b) Near White House, CTB 20, and Cannikin Lake; and c) On Kirilof Point.

<u>Collection Site</u>	<u>Figure No.(s)</u>	<u>Table No.(s)</u>	<u>Remarks</u>
Pump	6	26	Near Cannikin Lake
Quonset Lake	4	26	
St. Makarius Bay	2 & 3	7 & 25	Station 5
St. Makarius Point	2	23 & 24	
Sand Beach	6	9	
Sand Beach Cove	6	7, 11, 22, & 25	
Sandia Trailer Park	6	23, 24, & 26	Station 11
Sink	3	26	FRI Lab. at Hus Key Camp (Main Camp)
Small Boat Dock	3	25	Located in Constantine Harbor
South Bight	2	24	Station 1
Spring	4	26	Cyril Cove
Square Bay	4	23, 24, & 25	
Square Bay Point	4	25	
Station 1	None	19	
Station 4	None	18 & 19	
Station 5	None	18 & 19	
Station 6	None	18 & 19	
Station 7	None	18 & 19	
Station 8	None	18 & 19	
Station 9	None	18 & 19	
Station 10	None	18 & 19	
Station 11	None	18 & 19	
S-8	4	23	Near Generator House
Ugashik	1	12	Bristol Bay Area

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