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BIOENVIRONMENTAL STUDIES AMCHITKA ISLAND, ALASKA 1975 TASK FORCE REPORT

DECEMBER 1975

LABORATORY OF RADIATION ECOLOGY

COLLEGE OF FISHERIES

UNIVERSITY OF WASHINGTON

SEATTLE, WASHINGTON

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1975 TASK FORCE REPORT

Compiled
by

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December 1975

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ABSTRACT

Bioenvironmental studies at Amchitka Island, Alaska, have been sponsored by the Atomic Energy Commission-Nevada Operations Office (now U.S. Energy Research and Development Administration-Nevada Operations Office) since 1967 when the Island was selected as the site for two underground nuclear weapons tests, Milrow in October 1969, and Cannikin in November 1971. Limited bioenvironmental studies were also conducted for the Department of Defense test, Long Shot, in October 1965. Initially, the studies focused on predictions of test effects, recommendations to minimize possible adverse effects, and base line measurements to aid in evaluating the actual effects. After the Cannikin test, the studies focused on the measurement and evaluation of these effects. This report presents the findings of a field survey on Amchitka during the period of 8 August through September 9, 1975.

A background radiation survey conducted on the Island revealed that levels of radioactivity on Amchitka remain comparable to levels in other areas of the United States. Samples of plants, animals, soil and water were also collected for radiometric analyses in the home laboratory.

Results of the tritium analyses of the water samples (excepting those from the Long Shot area) indicate that ^3H values are what would be expected at an island station at a similar latitude in the northern hemisphere. The Long Shot mud pits and their drainage system remain contaminated with ^3H. The ^3H concentration is less than in the rainfall at Vienna, Austria, in 1963. Results of the other radiometric analyses will be reported later.

The spawning run of pink salmon was surveyed in 20 streams. The 16 to 19 salmon counted in 1975 was greater than the 5 counted in the brood year, 1973, but was still appreciably lower than the 100 fish estimated for 1971. The decreased runs could be due to one or more man-related or natural causes in previous years, including construction activities, spills of drilling mud, harassment or killing of spawning salmon, high-seas commercial fishing, predation by eagles, weather, and oceanographic conditions.

Dolly Varden char captured in a variable mesh gillnet in Cannikin Lake continue to exhibit a high growth rate, 100 mm in the past year. Many of these fish may be fish from an anadromous strain introduced from other lakes on the Island.

The disturbed areas reseeded in 1973 with Boreal creeping red fescue, highlight chewings fescue, Bering hairgrass, and annual ryegrass exhibited good growth of the fescue and hairgrass emerging through a dense mulch of dead ryegrass stems and leaves from the first two seasons of growth. The vigor of the grass cover varies a good deal, depending on soil, slope, and amount of fertilizer initially applied.

The fungus discovered growing in some of the reseeded areas in 1974 was identified as *Corticium fuciforme*. The fungus was not found on native vegetation adjacent to the plots.

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INTRODUCTION

Three underground nuclear detonations have been conducted at Amchitka Island, Alaska: Long Shot (~80 kilotons) in October 1965, by the U. S. Department of Defense, followed by Milrow (~1 megaton) on 2 October 1969, and Cannikin (less than 5 megaton) on 6 November 1971, by the U. S. Atomic Energy Commision (AEC). Figure 1 indicates the test sites, plus other locations referred to in this report.

Bioenvironmental studies of the Long Shot test, reported by Seymour and Nakatani (1967), provided information useful in planning the bioenvironmental program for the Milrow and Cannikin tests. This program, initiated in 1967 by Battelle Columbus Laboratories (BCL) at the request of the U. S. Atomic Energy Commission, was, as reported by Kirkwood (1975) designed to:

Predict the ecological consequences of AEC-NVOO's activities at Amchitka, including the nuclear tests.

Predict and evaluate the potential hazards to man via marine food chains if there should be an inadvertent release of radioactivity.

Recommend measures for minimizing the adverse ecological effects.

Monitor the long-term ecological effects of AEC-NVOO's activities, including the nuclear tests.

Other geologic and hydrologic studies conducted by the U.S. Geological Survey and other prime contractors of AEC provided information needed to accomplish the above objectives.

Most of the bioenvironmental studies began in 1967, some two years prior to the Milrow test. Many studies were continued at least two years after the Cannikin test and studies concerning the most interesting or significant bioenvironmental effects of the Milrow or Cannikin tests were continued until August 1974, almost three years after the last test, Cannikin. A few of the studies were continued during the August-September 1975 field program. as described in this report. About 100 investigators have participated in the research programs and over 100 publications have resulted from the research. Kirkwood (1975) has compiled a summary of the results of the final large-scale bioenvironmental field survey conducted in August-September 1974.

This report summarizes information obtained during the 8 August to 9 September, 1975, field program The Fall, 1975, studies were reduced from previous years, since the most significant bioenvironmental changes due to the AEC-NVOO test program have been well documented and many of the plant and animal communities affected have recovered to a pre-test condition (e.g., the Dolly Varden in Clevenger Creek) or have reached a state where the rate of change is very slow. Hence, yearly documentation of many of the bioenvironmental effects is no longer necessary, although periodic observations should still provide interesting information.

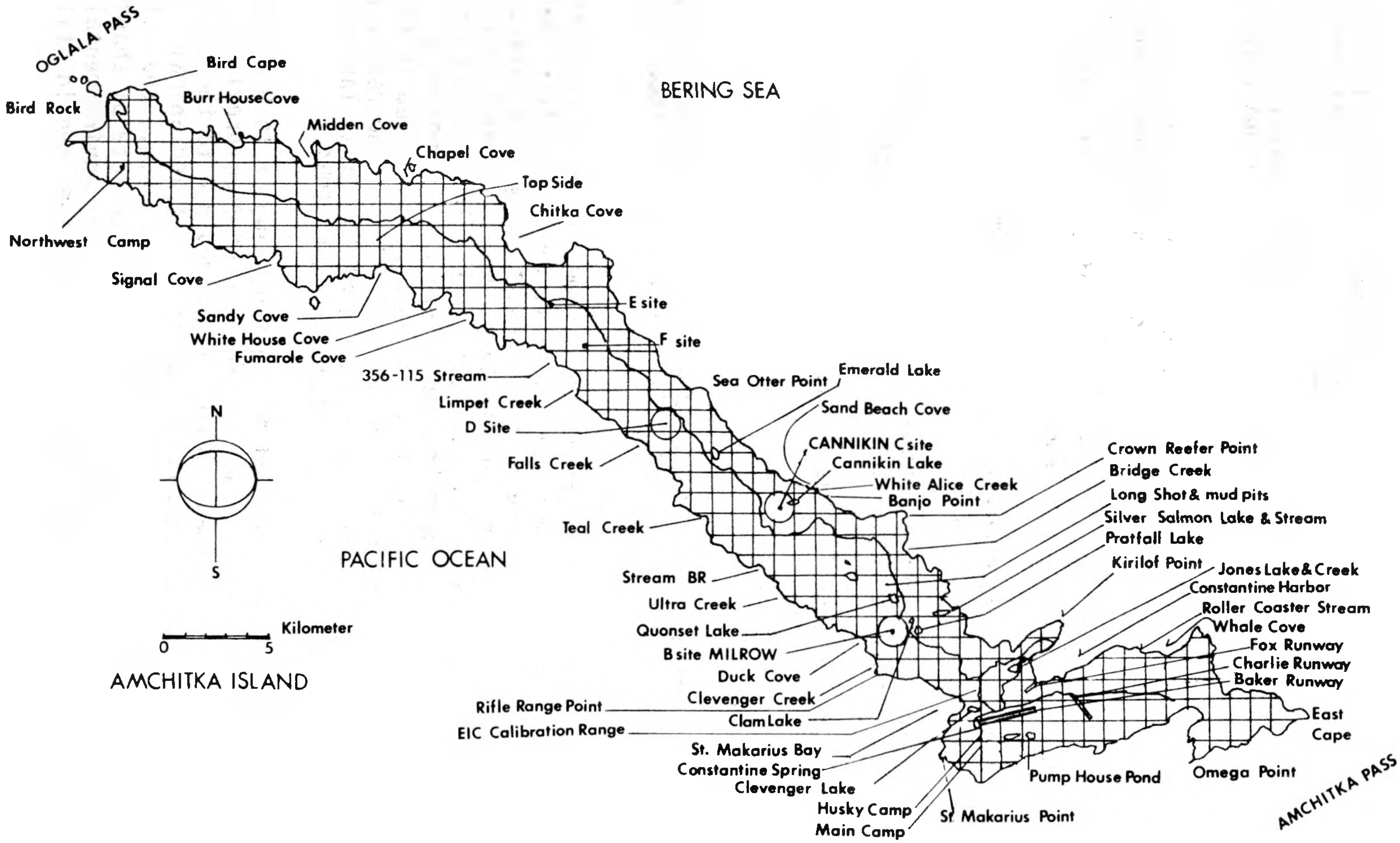

FIGURE 1. MAP OF AMCHITKA ISLAND, ALASKA, SHOWING LOCATIONS REFERRED TO IN THIS REPORT

The 1975 Fall field study sponsored by ERDA-NVOO had the following objectives:

1. To perform a radiological survey of selected areas surveyed previously.

2. To collect biological, soil and water samples for later radiometric analyses to provide data on the kinds and amounts of radionuclides on Amchitka, and to differentiate radionuclides which may be of Amchitka-test origin from naturally occurring or worldwide fallout radionuclides.

3. To estimate the adult pink salmon population in Amchitka streams.

4. To document the biological status of Cannikin Lake.

5. To determine the status and prognosis of the fungus that appeared in 1974 in the reseeded grass plots.

In addition to the ERDA-NVOO sponsored long-term bioenvironmental program, ERDA-DBER sponsored two new short-term research studies during the August-September field program, a sea otter radio-tracking study by Donald Siniff and Larry Kuechle of the University of Minnesota, and a survey by Gary Laursen (Virginia Polytechnic Institute and State University) of the native fungi on Amchitka Island. Results of these studies will be reported elsewhere and will not be discussed here.

FALL, 1975, FIELD STUDIES

As noted in the Introduction, the number and extent of the field studies during the Fall of 1975 were reduced from the previous year. Hence, the only former studies continued in August-September 1975 were the radiological survey and sample collection program, adult pink salmon survey, and a determination of the status of Dolly Varden in Cannikin Lake. These studies were directed by Laboratory of Radiation Ecology personnel. A new study concerning fungus in the reseeded grass plots was initiated this year, at the request of ERDA-NVOO by John Hardison, U. S. Agricultural Research Service at Oregon State University. The ERDA-NVOO project manager, Raymond A. Brechbill, and his support staff of five persons provided logistic support as well as taking an active and essential part in the scientific field program. Representatives of Battelle Columbus Laboratories and the U.S. Fish and Wildlife Service also participated in the scientific field program and aided with logistic support.

Radioactivity

The radiological survey and sampling program during August, 1975, was similar to that conducted during August, 1974, except that sixteen new freshwater and marine sites were added to the water sampling program (27 sites total). The history and objectives of the radiological studies conducted by LRE and other agencies remain as stated in previous reports (Nelson and Seymour, 1975; Kirkwood, 1975) but will be briefly reiterated below.

Radiological studies have periodically been conducted at Amchitka since the 1965 Department of Defense underground nuclear test, Long Shot. LRE and the U.S. Geological Survey initiated radiological surveillance programs for this test. USGS established a long-term water sampling program in 1967 which continued until August 1974. The LRE biological and environmental sampling program was terminated after the post-Long Shot sampling was concluded, but was reactivated in July 1970, prior to the Cannikin detonation in November 1971, and has continued at a decreasing level of effort since the Cannikin test. Other groups formerly involved with radiological surveillance at Amchitka included Battelle Columbus Laboratories, Isotopes, Inc. (Palo Alto Laboratories), and the Eberline Instrument Corp.

Objectives of the 1975 Studies

The objectives of the LRE radiological program were as follows:

1. To conduct a radiation survey of areas surveyed previously, including the areas encompassing the three surface ground zeros.

2. To collect and analyze biological, soil, and water samples from Amchitka and the surrounding waters as part of the continuing program for periodic documentation of naturally occurring and fallout radionuclides of Amchitka.

Results

During the August-September, 1975, field trip, about 45 biological, 4 soil or sand, and 30 water samples were collected by LRE, with aid from ERDA-NVOO and BCL personnel. These samples included water, marine and freshwater fish and algae, marine invertebrates, terrestrial and freshwater vegetation, ptarmigan, and rats. Areas sampled included aquatic and terrestrial sites within the watershed encompassing the three surface ground zeros, similar control sites outside of these watersheds, and marine sites near the mouth of the streams that drain the watersheds. All of the water samples have been analyzed for tritium and four samples (Cannikin Lake, Heart Lake, Long Shot Mud Pit #1, and Jones Lake) will be analyzed for gamma-emitting radionuclides, as will all the biological and soil samples. Selected biological samples will also be analyzed for tritium, iron-55, or plutonium. Results of the tritium analyses of the water samples are presented in Table 1, and results of all these analyses will be reported later in the LRE "Amchitka Radiobiological Program Progress Report" for the period January to December 1975.

The ^{3}H values in seawater and freshwater samples collected in August, 1975, remained about the same as the 1974 values. Seawater values averaged less than 48 pCi/liter (15 tritium units), while freshwater samples, excluding those from the Long Shot area, averaged 110 pCi/liter. In the Long Shot Mud Pits and drainage system, ^{3}H values ranged from about 2800 pCi/liter in Mud Pit #3 to 264 pCi/liter, 500 meters downstream in the drainage system. Values were about 350 pCi/liter at the mouth of the creek which drains the Long Shot Mud Pits.

Comparing the tritium values within the Long Shot drainage system, the concentration of ^{3}H in the samples from Mud Pit #1 in August, 1975, is lower than expected (400 pCi/liter vs. 2800 pCi/liter in Pit #3). The Mud Pit #1 sample was taken from the south side of the pit. This side is furthest from the point where water enters Mud Pit #1 from Mud Pits #2 and #3, and is also furthest from the outlet of Mud Pit #1. Thus, much of the water from the upper mud pits could pass through the north end of Mud Pit #1 without reaching the south side

Table 1. Tritium Concentration in Water Samples Collected at Amchitka Island, 1970-1975.

Date	Collection Site	Number of Samples	Tritium Units[a]	pCi/liter[b]
I Seawater				
1970-71[c]	d	10	32 ± 19	103 ± 61
1972	d	16	28 ± 25	90 ± 81
1973	d	6	22 ± 13	71 ± 42
1974	d	6	<13	<42
1975	d	6	<15	<48
August 1975	Constantine Harbor	1	18 ± 12	57 ± 40
"	Square Bay	1	17 ± 12	56 ± 40
"	Sand Beach Cove	1	<13	<42
"	St. Makarius Bay	1	<13	<42
"	Rifle Range Pt.	1	<13	<42
"	Duck Cove	1	<13	<42
II Freshwater, except Long Shot Area				
1970-71[c]	d	12	92 ± 46	298 ± 149
1972	d	18	49 ± 14	158 ± 45
1973	d	46	50 ± 17	162 ± 55
1974	d	44	32 ± 18	103 ± 58
1975	d	29	34 ± 14	110 ± 45
August 1975	South Hangar (ppt)	1	33 ± 13	106 ± 43
"	Constantine Spring	1	56 ± 13	182 ± 41
"	Jones Lake Outlet	1	28 ± 12	89 ± 40
"	Clevenger Lake Outlet	1	51 ± 13	165 ± 41
"	Clevenger Creek (mouth)	1	30 ± 12	98 ± 40
"	Clevenger Creek (headwaters)	1	26 ± 12	84 ± 40
"	Heart Lake	1	<13	<42
"	Clam Lake	1	24 ± 12	78 ± 38
"	Duck Cove Creek (mouth)	1	41 ± 13	132 ± 38
"	Seep-Duck Cove	1	47 ± 13	151 ± 41
"	Quonset Creek (at road)	1	24 ± 13	78 ± 43
"	Bridge Creek (at road)	1	55 ± 13	177 ± 41
"	Mile Post 12 Creek	1	40 ± 12	129 ± 38

Table 1 (continued)

Date	Collection Site	Number of Samples	Tritium Units[a]	pCi/liter[b]
II. Freshwater (cont)				
August 1975	Cannikin Lake Inlet from Ground Zero	1	<13	<42
"	Cannikin Lake Inlet from Drillback	1	53 ± 13	173 ± 41
"	Cannikin Lake White Alice Inlet	1	41 ± 13	133 ± 41
"	Cannikin Lake Station #1 Surface	1	21 ± 10	67 ± 33
"	Cannikin Lake Station #1 Bottom	1	27 ± 10	87 ± 34
"	Cannikin Lake Station #2 Surface	1	<13	<42
"	Cannikin Lake Station #2 Bottom	1	38 ± 12	124 ± 38
"	Cannikin Lake Station #3 Surface	1	47 ± 11	151 ± 34
"	Cannikin Lake Station #3 Bottom	1	36 ± 10	115 ± 34
"	Cannikin Lake Station #4 Surface	1	46 ± 11	148 ± 34
"	Cannikin Lake Station #4 Bottom	1	33 ± 10	108 ± 34
"	Cannikin Lake Outlet	1	19 ± 12	63 ± 40
"	Ice Box Lake Inlet[e]	1	31 ± 12	102 ± 40
"	Ice Box Lake Outlet[e]	1	57 ± 13	183 ± 41
"	DK-45 Lake	1	<13	<42
"	Seep-Sand Beach Cove	1	45 ± 13	144 ± 41
III. Long Shot Mud Pits				
1970-71[c]	Mud Pit #3	3	3500 ± 460	11300 ± 1500
1974	"	1	2900 ± 460	9400 ± 160
August 1975	"	1	867 ± 19	2802 ± 61
1970-71[c]	Mud Pit #1	3	1800 ± 260	5800 ± 840
1972	"	4	2050 ± 240	6600 ± 780
1973	"	2	1900 ± 420	6100 ± 1400
1974	"	2	1300 ± 250	4200 ± 810
August 1975	"	1	122 ± 11	395 ± 36

Table 1 (continued)

Date	Collection Site	Number of Samples	Tritium Units[a]	pCi/liter[b]
IV. Long Shot Mud Pit Drainage				
August 1975	3 meters below Mud Pit #1	1	872 ± 19	2817 ± 61
"	Infantry Road	1	666 ± 16	2153 ± 52
"	100 meters below road	1	424 ± 15	1369 ± 47
"	500 " " "	1	82 ± 13	264 ± 42
"	200 " above Sq. Bay	1	121 ± 13	390 ± 44
"	Mouth of creek	1	107 ± 13	347 ± 43

a. The error shown for single samples is a one-sigma counting error, while the error for more than one sample is the one-sigma sample error one-standard deviation of the mean.

b. One TU equals 3.23 pCi/liter.

c. Pre-Cannikin

d. Samples were pooled from several collection sites.

e. A small lake formed in the north fork of White Alice Creek after surface subsidence occurred at the Cannikin site.

of Mud Pit #1 where the sample was taken. Water in this area is likely to be a mixture of surface runoff from recent rainfall (low tritium value) and Mud Pit #3 water (high tritium value), resulting in a lower tritium value than measured in Mud Pit #3 or in the drainage ditch just below Mud Pit #1. Tritium concentrations in water samples from stations other than the Long Shot area are within the range of values expected for tritium in rainwater collected at other locations at the same latitude as Amchitka. Tritium values in the Long Shot Mud Pits continue to decrease from levels measured in previous years.

A radiation survey was performed, using an Eberline survey meter (Model E-510) which had a probe with a window thickness that was less than 2 mg/cm^2. Readings were taken with the beta shield off. The probe was capable of detecting beta energies down to 40 keV and has a gamma sensitivity of about 5000 cpm/mR/hr for ^{60}Co. Tritium, which has a beta energy of about 18 keV, was not detectable with this probe. Thirteen areas between Charlie Runway and E-Site were surveyed; locations and results of these measurements are given in Table 2. Areas surveyed included the Long Shot, Milrow, and Cannikin surface ground zeros and adjacent areas. Maximum values recorded while holding the survey instrument 1 meter above the ground ranged from 0.03 mR/hr to 0.05 mR/hr. Average values were about 0.01 mR/hr or less. These average values are similar to the survey meter values generally recorded in other areas of the United States.

Pink Salmon Survey

Estimates of the number of adult pink salmon, Oncorhynchus gorbuscha, in Amchitka streams were made annually during the spawning run from 1970 to 1974 by personnel from Utah State University. During the August-September, 1975, field trip, this survey was conducted by personnel from LRE, NVOO and the support groups on the Island.

Methods

Twenty Amchitka streams (Figure 2) were visited over a four-week period to estimate the number of adult pink salmon on the Island. This was the sixth consecutive year that these streams were surveyed. The surveys of 1970, 1971, and 1972 were made with helicopter support, while the later surveys were not. Thus, the frequency of visits to the streams was less in the later surveys and it is possible that the number of salmon counted may be low, due to this fact; however, the length of this survey (12 August to 8 September 1975) and the fact that salmon were seen in two streams previously known to have only even-year runs lead us to believe that the estimate of salmon seen is fairly accurate.

Since adult pink salmon in Amchitka streams are usually found in the lowermost 100m of a stream, survey efforts were concentrated in these areas, although the higher areas accessible to salmon were also checked. Two men conducted most of the surveys; one man wading in the stream, probing undercut banks and deep holes, while the second man walked on the bank and counted startled fish. A few of the streams located near roads were sometimes checked by only one man, who usually looked closely only at known spawning or resting areas in the stream. These streams were also checked by two men on a less frequent basis. Because of the limited number of spawners per stream, no fish were taken as samples; thus, sex ratio, size, weight, or state of maturity of the fish were not obtainable. The final count of adult pink salmon in all streams was the maximum number of fish seen on any one occasion except in Midden Creek where one fish, believed to have entered the stream on 6 September, was also added to the maximum count, 10 to 13 fish, obtained on 4 September.

Table 2. Radiation Survey of Selected Sites on Amchitka Island

	Radiation Level[a], mR/hr			
	Average Reading		Maximum Reading	
Location	Aug. 1974	Aug. 1975	Aug. 1974	Aug. 1975
Decon Facility	0.01	0.01	0.05	0.04
Inside "D" Barracks	0.01	<0.01	0.04	0.04
Husky Camp	<0.01	0.01	0.04	0.05
Jones Creek Effluence	<0.01	<0.01	0.04	0.04
EIC Calibration Range	<0.01	0.01	0.04	0.04
Rifle Range Target Area	0.01	0.01	0.04	0.05
Duck Cove	<0.01	<0.01	0.03	0.04
Milrow SGZ & Vicinity	<0.01	0.01	0.04	0.04
Long Shot SGZ & Vicinity	0.01	0.01	0.05	0.05
Cannikin SGZ & Vicinity	0.01	0.01	0.04	0.04
Cannikin Drillback	0.01	0.01	0.05	0.04
Sand Beach Cove	<0.01	<0.01	0.04	0.04
D-Site	0.01	<0.01	0.05	0.03
E-Site	0.01	<0.01	0.03	0.04

(a) Eberline G-M detector, Model 510, probe window thickness less than 2 mg/cm^2.

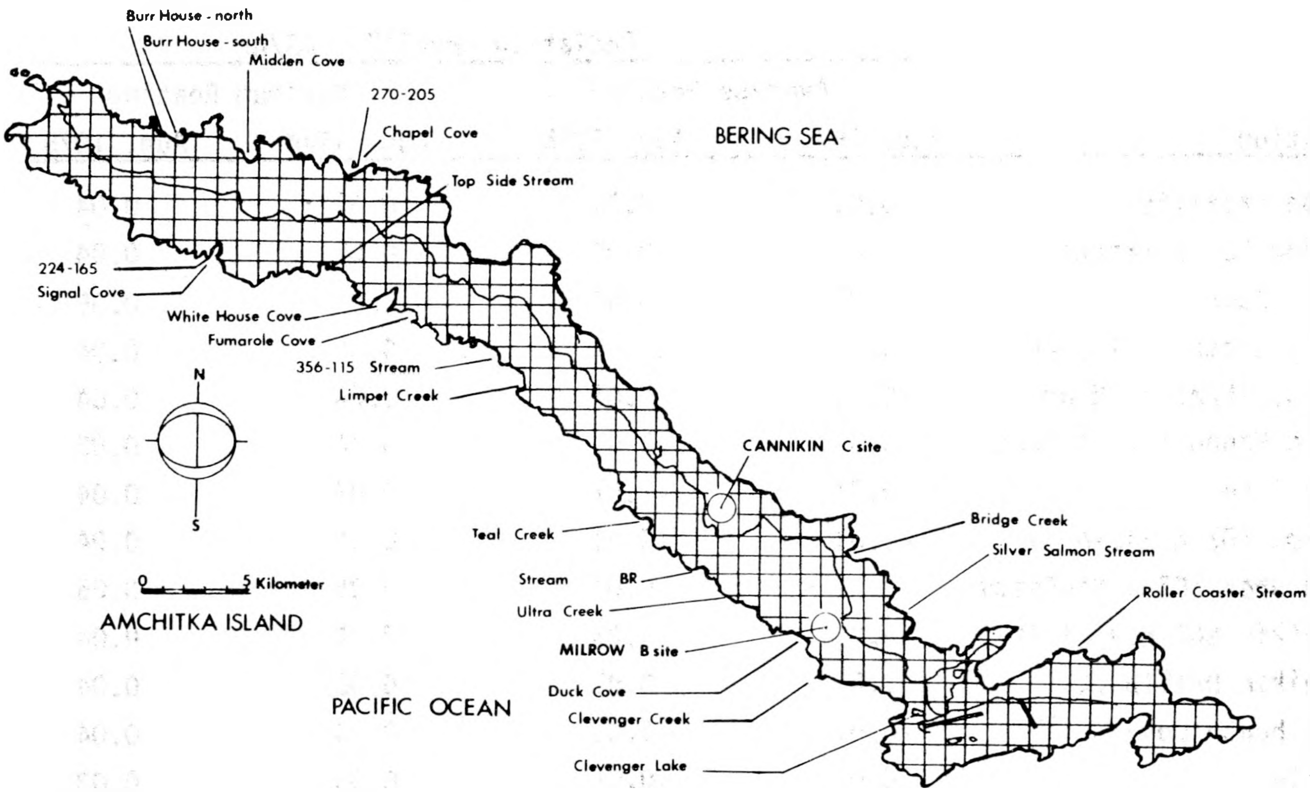

FIGURE 2. LOCATIONS OF SALMON STREAMS ON AMCHITKA ISLAND

Table 3. Schedule of Amchitka Stream Surveys and Estimated Number of Adult Pink Salmon Observed in August-September, 1975.

Stream	Number of Visits	Period Surveyed	Date of 1st Salmon Sighting	Number of Salmon	Comments
Roller Coaster	6	24 Aug - 7 Sept	-	0	
Clevenger Creek	18	12 Aug - 8 Sept	6 Sept	3	First odd-year record
Duck Cove	12	12 Aug - 7 Sept	-	0	
Silver Salmon	3	24 Aug - 6 Sept	-	0	
Clevenger Lake	8	17 Aug - 7 Sept	-	0	
Bridge Creek	6	19 Aug - 7 Sept	-	0	
Ultra	1	26 Aug	-	0	
BR	1	7 Sept	-	0	
Teal	1	7 Sept	-	0	
Limpet	2	2,7 Sept.	-	0	Salmon off mouth, 7 Sept.
Chapel Cove	2	1,5 Sept	-	0	Many eagles, 5 Sept.
270-205	1	1 Sept	-	0	
Midden Cove	6	23 Aug - 8 Sept	4 Sept	11-14	Maximum, 10-13, on 4 Sept.
Burr House - So.	3	18 Aug - 5 Sept	-	0	
Burr House - No.	3	18 Aug - 5 Sept	-	0	
Fumarole Cove	4	23 Aug - 6 Sept	4 Sept	1	One gorged eagle, 4 Sept.
White House	1	27 Aug	-	0	
Top Side	2	27 Aug, 5 Sept	5 Sept	1	First odd-year record
224-165	1	28 Aug	-	0	
Signal Cove	1	28 Aug	-	0	
Total	82			16 - 19	

Results

A total of 16 to 19 adult pink salmon was estimated for the 20 streams surveyed on Amchitka in 1975 (Table 3). Additional salmon may not have been counted in the streams visited or may have ascended other streams not visited. However, Midden Creek, the stream known to have the largest odd-year salmon run in 1971 and 1973, was visited twice after the first salmon were sighted, and fewer salmon were noted in the later stream surveys. Thus, I believe that the estimate of salmon in this stream is accurate.

As in previous years, Midden Cove Creek had the most adult pink salmon, 11 to 14, while Clevenger Creek had three and Fumarole and Top Side creeks each had one (Table 4). The fish counted in Clevenger and Top Side creeks were the first recorded in these streams during the odd-year cycle. The fish seen in Top Side, Clevenger, and Fumarole creeks were all in the lower 100 meters of the stream, whereas, in Midden Creek, the fish were seen up to 400 meters above the stream mouth.

Intertidal spawning was not seen in any of the stream deltas, although fish were seen off the mouth of Clevenger and Limpet creeks.

The entrance of fish into the creeks did not begin until 4 September, somewhat later than the time period when records for earlier years showed peak numbers of adult fish--20 to 31 August. This delay was probably a result of the low stream flow which was due to the dry summer on Amchitka and the occurrence of only one significant storm during the 1975 survey.

Discussion

Pink salmon have a two-year cycle, thus the runs of the even years are related, as are those of the odd years. The return of pink salmon to Amchitka streams is greatest during the even years, while the runs during 1973 and 1975 have been insignificant.

When comparing the odd-year runs, a significant reduction (95%) in the total run occurred between 1971 and 1973. The count in 1973 may have been low, since the 1971 survey was conducted with helicopter support while the 1973 count was conducted on foot over only a one-week period. However, the results of the 1975 survey confirm the 1973 results and indicate that a definite decrease in the population of pink salmon during the odd years has occurred since 1971, although the 1975 counts are somewhat greater than 1973 (16 to 19 fish in 1975 vs. 5 in 1973). A similar decrease in the even-year run was noted by Utah State University (USU) personnel in 1974 (Kirkwood, 1975).

An extensive discussion of possible reasons for the decline in the pink salmon runs on Amchitka was presented in Kirkwood (1975) by USU workers who concluded that a variety of causes may have contributed to the decline, including: man's activities on the Island (not including the actual Milrow or Cannikin detonations) such as mud spills, road construction or maintenance, direct human interference with spawning salmon; the high-seas commercial salmon fishery; and numerous environmental factors which may affect survival of the eggs in the stream, fish at sea, or adult fish during the spawning run into the stream. Any one or a combination of these factors may have contributed to the decline

Table 4. Estimates of Adult Pink Salmon in Amchitka Streams[a]

Stream	Estimates by Year[b] 1970	1971	1972	1973	1974	1975
Roller Coaster	10	0	10	0	10[c]	0
Clevenger Creek	12	0	12	0	13	3
Duck Cove	6	0	0	0	0	0
Silver Salmon	30	0	0	0	0	0
Clevenger Lake	25	0	0	0	0[d]	0
Bridge Creek	15	0	0	0	4	0
Ultra	12	0	2	-	0	0
BR	10	0	0	-	0	0
Teal Creek	6	0	10	-	2[e]	0
Limpet Creek	6	0	15	-	10	0
365-115	6	0	0	0	0	-
Chapel Cove	50	0	15	0	5	0
270-205	5	0	7	0	-	0
Midden Cove	300	80	600	4	175[f]	11 to 14
Burr House - south	20	0	0	-	5	0
Burr House - north	30	5	12	-	5	0
Fumarole Cove	35	15	35	1	20	1
White House	6	0	5	-	0	0
Top Side	60	0	20	0	10	1
224-165	5	0	0	-	2	0
Signal Cove	25	0	0	-	2	0
Totals	674	100	743	5	263	16 to 19

a. The 1970 to 1974 data are from Kirkwood (1975), while the 1975 data are from this report.

b. Zero indicates the stream was visited but no salmon encountered. Dash indicates that the stream was not visited.

c. Counts by Ray Brechbill and Ian Mercier.

d. One pink salmon caught intertidally by angler, Clyde Fancher.

e. Final count by James Kirkwood on August 30.

f. Final count by Ray Brechbill and Clyde Fancher on September 5.

of the pink salmon runs on Amchitka Island, or in any individual stream; however, it is impossible to delineate any cause-effect relationship, especially with the lack of long-term data on the fish runs at Amchitka.

Cannikin Lake Dolly Varden

The formation of Cannikin Lake after the Cannikin detonation presented a unique opportunity to study the effects of an expanded habitat on an exclusively freshwater population of Dolly Varden char. This study was confounded by the introduction into Cannikin Lake by local fishermen of anadromous populations of Dolly Varden from Fox Runway Lake and Jones Lake. Hence, it is now impossible to determine the origin of the fish sampled.

During the Fall, 1975, survey, a 125-foot gillnet was set for four hours, 50 meters from the Cannikin Lake outlet. The net consisted of five 25-foot panels. The 25-foot panel closest to shore had ½ inch square mesh, and the mesh size increased by ½-inch increments as the distance from shore increased. Thus, the four succeeding panels had net mesh sizes of 1, 1½, 2, and 2½ inches, respectively. Fifteen Dolly Varden were captured, ranging in size from 270 to 330 mm standard length (average - 303 mm). Twenty-four-hour sets in 1973 and 1974 yielded four fish (133 mm average S.L.) and 23 fish (208 mm average S.L.), respectively (Kirkwood, 1975). The number of fish taken in these gillnet sets can not be directly related to population size because changes in variables such as light intensity, weather, water turbidity, fish movement, soak time of the net, etc. can greatly change the catch from one gillnet set to another (Berst, 1961).

Whatever the origin of the fish in the lake, they are exhibiting good growth, if the results of the gillnet catches represent the total population of Dolly Varden in the lake. However, the gillnet catches may not adequately sample the smaller size classes, since the catch efficiency in a variable mesh gillnet such as we used increases with size up to a certain point, beyond which there is no direct evidence whether fish vulnerability continues to increase (Ricker, 1949). The size of the fish in the gillnet catches can thus be used to estimate the growth rate of the larger fish but not of the total fish population in the lake unless the population is composed only of these large fish. Even if the gillnet used is not collecting a truly representative sample of the lake's Dolly Varden population, the growth rate of the larger fish in the lake since 1973 has been significant. Calculations of the growth rate from otoliths should provide further information on the growth rate of individual fish.

Otoliths and stomach contents of six of the Cannikin Lake Dolly Varden were analyzed by Dr. Richard Valdez of Utah State University to determine the age and diet of the fish taken in 1975. Valdez found that the fish were 5 and 6 years old and fed on a diet consisting mainly of Chironomous sp. larvae and pupae and on the snail, Lymnaea abrussa.

Fungus in Reseeded Grass Plots

Research involving trial plantings of disturbed areas on Amchitka was begun in 1971 by W. W. Mitchell, University of Alaska, Agricultural Experiment Station. Seed from Amchitka plant stocks were proposed for the reseeding, but a survey conducted in September, 1970, determined that sufficient stocks were not available. Thus, with permission of the U.S. Fish and Wildlife Service, introduced seeds were used for the reseeding project.

From preliminary trials with 24 perennials, studies of the native flora and natural revegetation, three perennial species were chosen for reseeding disturbed areas. These were: highlight chewings fescue (*Festuca rubra* var. commutata), Boreal creeping red fescue (*Festuca rubra* L.), and Bering hairgrass (*Deschampsia beringensis* Hult). During the sumer of 1973, these species, plus annual ryegrass (*Lolium multiflorum* Lam.) were used to reseed about 74 hectares of disturbed areas. During August, 1974, at the end of the second growing season, a fungal growth was observed in some of the reseeded grass plots, but was not detected on any native vegetation adjacent to the reseeded plots.

During the Spring of 1975, arrangements were made between ERDA-NVOO and the U.S. Department of Agriculture for John R. Hardison (USDA Agricultural Research Service, Western Region, Corvallis, Oregon) to visit Amchitka during August, 1975, to study the fungus in the reseeded plots. A summary of his field observations is given below.

Field Observations, Fall of 1975

Many of the reseeded grass plots were examined in August, 1975. Dead remains of the annual ryegrass covered the plots with moderate stands of red fescue emerging through the dead grass. No living annual ryegrass was found.

A fungus identified as *Corticium fuciforme* was observed on the red fescue in reseeded plots at South Bight, Engineer's Pit, Long Shot, Cannikin area and the main camp. *C. fuciforme* was not detected on native plants outside of these reseeded areas.

In his report to ERDA-NVOO (October, 1975) Hardison states, "The apparent absence of *C. fuciforme* in native grasses and uniform presence of the fungus in seeded revegetation plantings on Amchitka leads to the conclusion that the pathogen was introduced with the grass seed planted ... The Boreal fescue seed is strongly suspect as a carrier of the pathogen, because it is highly susceptible to *C. fuciforme*."

Hardison concludes that further studies of *C. fuciforme*, including determination of its life history and conditions necessary for sporulation, and pathogenicity to grasses native to Amchitka would be needed to determine the potential *C. fuciforme* has for damage to native grasses on Amchitka. He also states that, "It is doubtful if the pathogen could be totally eliminated from Amchitka after its introduction in widely scattered locations from which spread by fragments and basidiospores has been possible the past two years." However, *C. fuciforme* can be tolerated (by the grass plots) by addition of nitrogen fertilizer and application of fungicides."

General Observations

In addition to the scheduled studies described above, general observations of the plots and other areas affected by AEC testing activities on Amchitka were made by R. G. Fuller, former project scientist for the BCL bioenvironmental program on Amchitka. These observations add to the information obtained during the Fall, 1975, survey concerning the effects of nuclear testing activity on Amchitka.

Excerpts of Fuller's trip report (unpublished) to Davidson and Evans (BCL), dated 8 September 1975, are presented below:

> An early impression, gained from driving up-island as far as the Cannikin site, and out to Duck Cove, was that a very thorough and quite successful cleanup and restoration program had been carried out by AEC contractors during the rollup. This impression was largely confirmed during my stay, which included trips to South Bight, Northwest Camp, and numerous other locations of special interest. Litter and debris from the AEC occupation was generally conspicuous by its absence, although WW II debris is still a very conspicuous feature of the landscape.
>
> The revegation effort has been quite successful in the short term (grass seedings were made during June-August, 1973). Living annual ryegrass has disappeared from the seedings, leaving the fescues and Bering hairgrass, generally emerging through a dense mulch of dead grass stems and leaves from previous seasons. The vigor of the grass cover varies a good deal, depending on soil, slope, and on amount of fertilizer applied.
>
> I looked at several of the seeded areas to see whether native plants are invading the grassed areas, but as yet there is little sign of this. There are a few instances of individual native plants (mostly forbs) among the seeded grasses, but my impression is that the present cover of well rooted grass, combined with the mat of dead stems and leaves from past seasons, does not provide a very receptive habitat for the seedlings of native plants. This microhabitat should improve as the dead grass residues decay, leaving space between the grass clumps.
>
> Natural revegetation of the bottom of drained lakes is proceeding at various rates, depending on the nature of the substrate, and the time elapsed since draining. Heart Lake, adjacent to the Milrow drill pad, is an example. The southeastern part of the drained portion has a rather good cover of sedges, mixed grasses, and mixed forbs, all more or less representative of the mix of higher plants in the surrounding tundra. The peat lake bottom in this portion is evidently a good substrate for plants. The northwestern part of the drained bottom is rocky mineral soil, and the vegetation is sparse, although sedges are colonizing it, apparently by underground runners from plants on the old lake margin.
>
> I visited the rock bench areas where uplift in the intertidal zone attributable to Milrow (Duck Cove) and to Cannikin (Sand Beach Cove) occurred. The Duck Cove area has changed markedly in appearance since the uplift was first observed in the spring of 1970. The extensive areas of dead coralline algae then visible on the uplifted side are now gone, leaving some bare areas and large patches of _Fucus_ and _Halosaccion_.

The uplifed bench area at Sand Beach Cove on the Bering Sea coast, caused by Cannikin, is still in the process of stabilizing. Traces of dead algae bases are still visible on the vertical faces, as thin calcareous layers. Horizontal surfaces are mostly bare in the areas of maximum uplift.

Lake and stream states suggest that rainfall on Amchitka was unusually low this summer. Water levels were 12-24" below normal in most lakes and ponds, and stream flows were correspondingly low. Cannikin Lake, in which the water level is about 15" below previous levels, is still discharging from the outlet. The outlet stream flows over a firm, stable peat bottom and has a very gentle gradient near the outlet, which suggests that the lake should retain its present configuration for a long time.

Although not a part of the original field program, Fuller's observations are helpful in capturing a general picture of the state of the Island at the time of the Fall, 1975, survey; hence, they have been presented above.

SUMMARY

The most important effects of the AEC activities are described in numerous reports listed by Kirkwood and Fuller (1972) and Kirkwood (1975). Some of these effects were re-evaluated during the period from 8 August to 9 September 1975, and a summary of the findings is as follows:

1. No radioactivity attributed to nuclear testing at Amchitka was encountered during a field radiation survey. (However, this survey would not detect the tritium at Long Shot.)

2. Samples of plants, animals, soil and water were collected for radiometric analyses.

   a. Results of the tritium analyses of the water samples (excepting those from the Long Shot area) indicate that ^3H values are what would be expected at an island station at a similar latitude in the northern hemisphere.

   b. The Long Shot mud pits and their drainage system remain contaminated with ^3H. The ^3H concentration is less than in the rainfall at Vienna, Austria, in 1963.

   c. Results of the other radiometric analyses will be reported later.

3. The total number of pink salmon adults observed in 1975 was 16 to 19 versus 5 in 1973 and 100 in 1971. The lower numbers in 1973 and 1975 could be due to one or more natural or man-related causes.

4. Dolly Varden in Cannikin Lake continue to exhibit an exceptionally fast growth rate, 100 mm between August, 1974, and August, 1975.

5. The fungus present in five of the revegetated plots was identified as Corticium fuciforme. The fungus was not found in native vegetation adjacent to the plots.

REFERENCES

Berst, A. H. 1961. Selectivity and Efficiency of Experimental Gill Nets in South Bay and Georgian Bay of Lake Huron. Trans. Am. Fish. Soc. 90(4):413-418.

Kirkwood, J. B. 1975. Bioenvironmental and Hydrologic Studies, Amchitka Island, Alaska, Fall 1974, Task Force Report. Battelle, Columbus Laboratories, U.S. AEC Report, BMI-171-158. 39 p. and appendixes.

Kirkwood, J. B. and R. G. Fuller. 1972. Amchitka Bioenvironmental Program. Bioenvironmental Safety Studies, Amchitka Island, Alaska; Cannikin D+2 Months Report. Battelle, Columbus Laboratories, U. S. AEC Report, BMI-171-147. 62 p and appendixes.

Nelson, V. A. and A. H. Seymour. 1975. Amchitka Radiobiological Program Progress Report, January 1974 to December 1974. University of Washington, College of Fisheries, Laboratory of Radiation Ecology, U.S. ERDA Report, NVO-269-23. 49 p.

Ricker, W. E. 1949. Mortality Rates in some Little-Exploited Populations of Freshwater Fishes. Trans. Am. Fish. Soc. 77:114-128.

Seymour, A. H. and R. A. Nakatani. 1967. Long Shot Bioenvironmental Safety Program, Final Report. University of Washington, College of Fisheries, Laboratory of Radiation Ecology, Report RL-1385-1. 47 p.

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