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RADIOBIOLOGICAL RESURVEY OF BIKINI ATOLL DURING THE SUMMER OF 1947

Applied Fisheries Laboratory
University of Washington
Seattle, Washington

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Director

December 1947

Operated by the University of Washington under Contract No. W-28-094-eng-33 with the Atomic Energy Commission.

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RADIOBIOLOGICAL RESURVEY OF BIKINI ATOLL DURING THE SUMMER OF 1947.*

INTRODUCTION AND PROBLEM

The studies in radiobiology conducted during the resurvey of Bikini Atoll, in the summer of 1947, were continuations of some of the studies initiated prior to, and immediately following the bomb tests of 1946. The 1947 studies were designed to determine: (1) the presence or absence of radiation in the various marine organisms; (2) the distribution of radioactive substance in the plants and animals from different geographical locations; and (3) the amounts of radioactive substances in certain tissues and organs.

Some of the material was ashed, counted and analyzed in the field but a large collection was also brought back to the University of Washington for continuing studies. Most of the collection includes whole animals but in some instances only tissue samples were preserved.

Personnel

The personnel for the Division of Radiobiology was made up of the following group of men:

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*This report is based on work performed under Contract No. W-28-094-eng-33 with the Atomic Energy Commission and in cooperation with the U. S. Navy.

Name	Assignment	Previous Assignment
*Lauren R. Donaldson	Group leader	Associate Professor of Fisheries, Director of Applied Fisheries, University of Washington
*Arthur D. Welander	Associate Scientist	Instructor in Fisheries, University of Washington
*Clarence F. Pautzke	Associate Scientist	Chief Fisheries Biologist Washington State Department of Game.
*Frederick H. Rodenbaugh, Sr.	M. D. Medical Legal Board	Radiologist
Allyn H. Seymour	Associate Scientist	Biologist, International Fisheries Commission
Richard F. Foster	Associate Scientist	Hanford Engineering Works
Robert C. Meigs	Associate Scientist	Assistant Fisheries Biologist Washington State Department of Game.
F. Hase Rodenbaugh, Jr.	Assistant Scientist	Medical Student, Stanford University
Lorence B. Marquiss	Assistant Scientist	Medical Student, University of Washington
Richard H. Osborn	Assistant Scientist	Medical Student, University of Washington
Jesse P. Pflueger	Assistant Scientist	Medical Student, University of Washington

For the Resurvey the above group were attached to the University of Washington, Applied Fisheries, under Contract No. W-28-094-eng-33 with the Atomic Energy Commission.

The Navy made available the services of Lt. (j.g.) Burris D. LaMar, Monte K. Nichols, C.Ph.M. and Thomas W. Ritchie, S/1. The Navy also provided the many services attendant to transportation, subsistence, administration, and report writing.

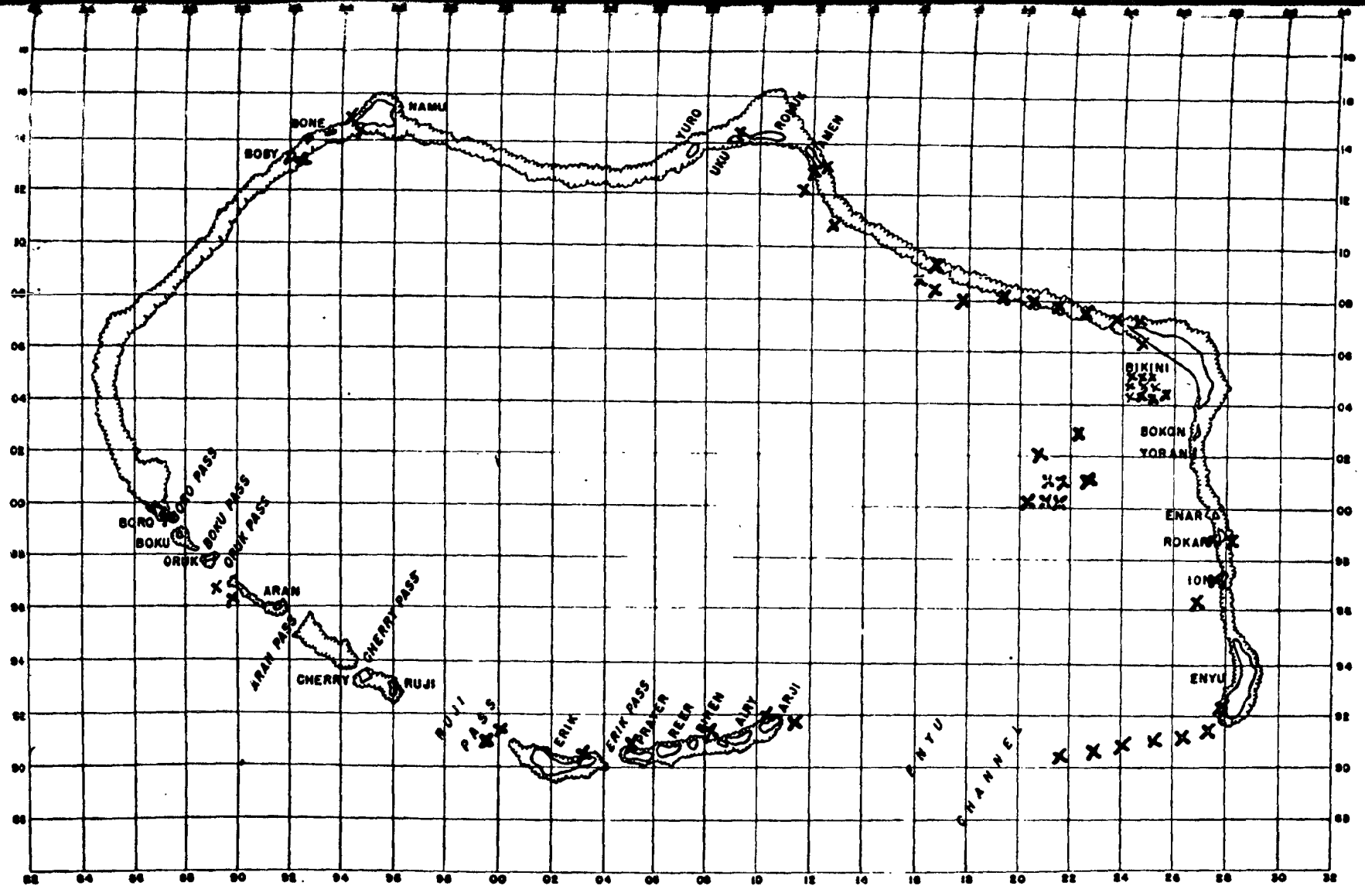
* Were on the staff of Operations Crossroads, Radiological Safety Section in 1946.

Figure 1. (ABCR 5101-9) This group, headed by Dr. Donaldson represented the University of Washington Radiobiology group in the Bikini Resurvey

Left to right front row:
Richard H. Osborn
Robert C. Meigs
Richard F. Foster
Lt. (j.g.) B. D. LaMar USN
CPHM Monte K. Nichols USN

Standing, left to right:
Frederick Hase Rodenbaugh, Jr.
Jesse P. Pflueger
Clarence F. Pautzke
Lorence B. Marquiss
Allyn H. Seymour
Dr. Arthur D. Welander
Dr. Frederick H. Rodenbaugh, Sr.
Dr. Lauren R. Donaldson

Figure 2. Major collection stations in the Bikini Atoll during 1947 resurvey. Data from Table 1.



BIKINI ATOLL

Figure 2.

Table 1: Collections of Marine Organisms from Bikini, Rongerik and Kwajalein Atolls Used for the Study of Radioactivity or preserved for future study.

Date	Area	Activity Counts	Preserved	Total	Remarks
Jul 15, 47	Bikini Island	1	-	1	Hermit Crab
16	2504 (Chilton)	2	2	4	Fishing off fantail
16	2407 N.W.Bikini	15	154	169	Poisoning in 2'-4' water in reef flat
16	Between Bikini & Amen	2	-	2	Trolling
17	Enyu Channel	2	-	2	Trolling
17	2307 N.W.Bikini	22	132	154	Poisoning in 2'-4' water in reef flat
18	1709 Bikini-Amen Spit	27	224	251	Poisoning in 2'-4' water in reef flat
18	2504 (Chilton)	-	1	1	Fishing off fantail
19	1213 Amen	12	235	247	Poisoning in 2'-4' water in reef flat
19	2504 (Chilton)	3	1	4	Fishing off fantail
21	1213 Amen	3	-	3	Growth on metal Pontoon Dock
21	0914 Uku	22	343	365	Poisoning in 2'-4' water reef flat
22	Enyu Channel	1	-	1	Trolling
22	2504 (Chilton)	3	1	4	Fishing off fantail
23	Enyu Channel	12	5	17	Trolling
24	2007 N.W.Bikini	14	174	188	Poisoning in 33' water around Coral Head
24	2504 (Chilton)	5	1	6	Fishing off fantail
25	Ruji	7	4	11	Trolling

Date	Area	Activity	Preserved	Total	Remarks
Jul 25, 47	2504 (Chilton)	1	-	1	Fishing off fantail
26	Ruji Channel	11	1	12	Trolling
26	S.W. Bikini Atoll	3	-	3	Trolling
26	S.E. Bikini Atoll	4	-	4	Trolling
28	2101U (Saratoga)	4	-	4	Collected by divers in 90' - 210' of water
28	Between Bikini & Amen	2	-	2	Coral Head (Clam)
28	Between Bikini & Amen	7	-	7	Trolling
29	2101U (Saratoga)	7	-	7	Collected by divers in 90- 210' of water
29	2504 (Chilton)	3	-	3	Fishing off fantail
30	2899 Rokar	7	-	7	Poisoning in 2'-4' of water in reef flat
30	2798 Rokar	13	305	318	Poisoning in 3'-6' of water on lagoon side
31	1709 Amen-Bikini Spit	11	241	252	Poisoning in 30' of water around Coral Head.
31	Namu-Boro Spit	1	-	1	Found dead on beach
31	2504 (Chilton)	10	1	11	Fishing off fantail
Aug 1, 47	2407 N.W.Bikini	1	-	1	Reef flat (Spider Snail)
1	2797 Ion	22	365	387	Poisoning in 3'-8' of water on Lagoon side
3	Kwajalein (Prinz Eugen)	18	2	20	Poisoning in 40' water
4	2504 (Chilton)	16	-	16	Fishing off fantail
5	1092 Arji	25	606	631	Poisoning in 3'-8' water on lagoon side

Date	Area	Activity Counts	Preserved	Total	Remarks
Aug 6, 47	Between Bikini & Enyu	3	-	3	Trolling
7,	2796 Enyu	37	234	271	Poisoning in 25' water around Coral Head.
8	Enyu Chahnel	-	1	1	Trolling
8	Enyu Channel	1	-	1	From stomach of 45# dogtooth Tuna
12	Target Area	4	-	4	Trolling
12	Rongerik Atoll	15	-	15	Trolling
12	Arji Channel	6	-	6	Trolling
13	2504 (Chilton)	2	-	2	Fishing off fantail
14	0891 Airy	28	46	74	Poisoning in 25' of water around Coral Head
14	Rongerik Atoll	16	-	16	Trolling
14	Latoback (Rongerik)	-	180	180	Poisoning in 2'-6' of water on lagoon side
15	2201H (Pilotfish)	7	-	7	Collected by divers in 180' of water
16	9514 Namu	27	219	246	Poisoning in 2'-6' of water on lagoon side
16	9415 Namu	19	110	129	Poisoning in 2'-8' of water in reef flat
17	2000J (Apogon)	2	-	2	Collected by divers in 180' of water
18	0390 Erik	23	169	192	Poisoning in 3'-6' of water on lagoon side
18	0591 Eman	27	175	202	Poisoning in 6' of water near Coral Head
19	2792 Enyu	23	358	381	Poisoning in 4' of water on lagoon side
19	Bock (Rongerik)	-	111	111	Poisoning in 2'-4' of water in reef flat

Table 1 (Cont'd)

Date	Area	Activity Counts	Preserved	Total	Remarks
Aug 19, 47	Bock (Rongerik)	4	-	4	Trolling
20	2107 W. Bikini	21	201	222	Poisoning in 2'-6' of water in reef flat
20	2207 W. Bikini	38	274	312	Poisoning in 1'-2' of water in reef flat
20	Latobock (Rongerik)	3	-	3	Spiny Lobster from reef flat
21	1211 Amen	44	148	192	Poisoning in 25' water around Coral Head
21	2000J (Apogon)	2	-	2	Collected by divers in 180' of water
22	8799 Boro	50	123	173	Poisoning in 2'-8' of water on lagoon side and reef flat
24	2000J (Apogon)	3	-	3	Still fishing off Coucal
24	2407 Bikini	-	1	1	Speared in surge channel on outer reef
25	S.W.Bikini Atoll	11	-	11	Trolling
	TOTAL	735	5148	5883	

Collecting material.

The nature of the study conducted by the Division of Radiobiology made it necessary to collect a wide variety of plants and animals from as many locations as possible. On Figure 2 are marked the general locations where collections were made, while in Table 1 are listed the collecting areas and numbers of fish collected.

Since fish made up the greatest bulk of the material collected for counting the activity of substances in tissues, and fish occur in greatest abundance on and near the coral reefs, the majority of collections were made in selected spots, during low tide periods, after finely ground derris root had been spread into the water. In the warm water, the active ingredient in the derris root, rotonone, stunned or killed the fish within a few minutes. Men were dispersed about the area with dip nets to collect the fish as they succumbed to the poison (see Figure 3).

To collect fish in deeper waters, 20-36 feet, similar techniques were employed, except that the actual spreading of the poison and gathering of most of the material was performed by men operating in shallow water diving outfits. For this type of collecting coral heads were selected that were somewhat isolated from adjacent coral outgrowths. Divers worked in pairs with one navy diver accompanying one of the scientific group, so that advantage could be taken of the training of each. A total of five diving collections were made. (See Table 1).

Collections of invertebrate material were made on the sunken target vessels by the divers on the U.S.S. Coucal. Material from these sunken ships was brought to the surface and the living material removed for study.

Hook and line fishing was resorted to in capturing some of the larger fish and to spread the area of sampling to regions and species that were not suited to rotonone poisoning. A fishing contest held for crew members of

Figure 3 (ABCR 5026-8)

Men in party picking up fish after poison was spread in water.

the U.S.S. Chilton yielded 144 fish. These fish were used to provide material for activity counts and because of their availability near laboratory spaces, they were also used to provide tissues for future study.

The collections of the more sedentary forms, such as clams, sea urchins, sea cucumbers, snails, coral, and algae, were usually made in the intertidal zone or water shallow enough for skin or shallow water divers to penetrate.

Preservation of material.

An attempt was made to use as much of the material as possible while still in a fresh condition. Thermos jugs with ice were carried to the collecting areas and organisms to be used fresh for activity counts placed in these jugs for transportation back to the laboratories on the Chilton. Both a refrigerator and a freezer were provided aboard the Chilton for temporary storage of material.

Of the total of 5883 organisms collected (Table 1) 735 were used fresh for measuring activity (Table 2) and 5148 were preserved in alcohol or formalin for shipment to laboratories on the mainland for further study.

Ashing and activity counting.

Specimens to be counted were selected in the field at the scene of the collection and immediately placed on ice in thermos jugs to slow down decay. This could not be done with large fish caught on hook and line. An attempt was made to select species which were likely to be found at all sampling stations again.

The following series of tissues were dissected from the fish so far as was practical: bone; gills; skin, including scales; muscle; faeces; a section of the intestine; liver; spleen; gonads; and kidney. Similar tissues were selected from some of the invertebrates. Many of the small fish and invertebrates were used in their entirety.

Table 2

Gross Beta - Gamma Activity of Marine Organisms Collected at Bikini Atoll During July - August, 1947*

Area	Common Name	Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Chilton 2504	Siganid	7/22		4.81	4.28	4.28	3.31	55.7	41.6					
" "	"	7/22		1.81	4.39	5.52	.99	72.8	27.7					
" "	"	7/24		1.49	2.21	10.2	7.82	86.0	82.4		27.8			
" "	"	8/4		0	3.83	6.78	.15	1.26	87.3	205.				
" "	"	8/4						1.77	201.5					
" "	"	8/4						56.1	44.6					
" "	"	8/4						27.2	73.5					
" "	"	8/3						21.3	28.2					
" "	"	8/6						59.3	33.8					
" "	"	8/6						71.8	34.4					
" "	"	7/31		0	2.28	0	1.43	38.6	21.4					
" "	"	7/31		5.00	2.24	5.54	1.48	16.8	3.66		0			
" "	"	7/31		4.38	0		0	1.09						
" "	Snapper A	7/19		5.44	6.57	10.7	10.1	19.2	27.7	31.2	38.0			
" "	"	8/3		0	3.49	0	3.01	31.4	6.33					
" "	"	8/4						6.50	4.00					
" "	"	8/4						36.0						
" "	"	8/2						44.0	25.6					
" "	"	8/3							6.75	40.5				
" "	"	7/31		0	0	0.59	.16	2.91	4.14	9.36	.45			
" "	"	7/31		0	.93	2.65	0	2.13	8.10	111.	9.06	4.52		Ovary
" "	"	7/24		.85	.77	3.82	1.72	10.8	9.01	35.9	35.3			
" "	" B	7/16			0		.75		13.5	10.7				
" "	"	8/5		0	0	0	0	10.5						
" "	" C	7/31		1.85	0	4.49	0	7.93	0	4.00	41.7	23.8		Ovary
" "	"	7/31		1.56	0	1.27	0	6.09	6.55	70.0		30.0		Ovary
" "	Grouper A	7/19			.29				13.8	4.11			.01	Stomach
" "	"	7/19							23.6					
" "	"	7/24		.40	0	1.74	.35	19.2	12.1	6.73				
" "	"	7/31		0	.68	0	.07	0	20.8	12.6	.83			
" "	" B	8/5		0	3.04	0	2.33	0	16.6					
" "	" C	7/22							21.6					
" "	Jack A	7/25		15.9	20.5	8.97	1.74	.88	9.08	10.5	6.57		4.18	Liver Cysts

* For total c/min./gram of wet tissue, uncorrected for absorption, multiply by 4.5.

Table 2 (Cont'd)

Area	Common Name		Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Chilton 2504	Jack	A	8/13		1.91	9.38	0	.97	3.55	11.9	6.60	6.00			
" "	"	B	7/24		3.52	.98	2.00	1.02	10.8	17.2	8.20	5.60			
" "	"		8/4		.31	11.3	0	0	12.4	2.28	12.9				
" "	"		7/31		2.04	5.78	3.20	.31	14.4	338.	37.7	76.2			
" "	Tuna, dog tooth		7/16		.98	13.9	2.20	2.27		1.06	4.32	13.6	7.53	2.59	Testes-g.i.
" "	Remora		7/24		.14	2.53	.99	0		58.0	56.8	2.01			tract
" "	"		8/2		0	.93	3.92	3.16	0	24.4					
" "	"		7/31		1.26	2.50	1.93	2.54	7.46	92.2					
" "	"		7/31		.57	0	2.47	.20	.92	14.6					
" "	Shark	B	7/29							1.68					
" "	"		7/29							1.49					
" "	"		8/13		0	3.60	0	0	2.61	.58	2.93	2.87	3.62		Egg
" "	"	A	7/29							0					
Trolling Target Area	Tuna, dog tooth		8/12		0	2.33	3.67	0	8.81	7.85	17.9	7.40	3.22		Ovary
" "	Skipjack	A	8/12		1.05	1.64	0	.33	33.0	24.9	14.8	3.28	9.60		Testes
" "	Runner, rainbow		8/12		0	.51	.23	.82	3.03	6.73	2.46	4.47	1.17		Testes
" "	"		8/12		0	.12	.57	2.75	4.14	19.3	12.5	12.8	3.68		Ovary
Apogon 2000J	Shark	B	8/24				2.21	1.32	0	1.78					
" "	Puffer	B	8/24							20.8					
" "	Snapper	A	8/24		13.2	13.4	22.9	2.31	43.5	15.0					
N.W. Tip Bikini 2407	Grouper	A	7/16		0	0	.33	.05	0	0					
" "	Siganid		7/16		2.00	2.89	0	0	1.45	54.8					
" "	Parrot fish	A	7/16		0	5.22	0	0	.28	0					
" "	Squirrelfish	A	7/16											.79	1/2 of fish
" "	Damsel fish	A	7/16		0										
" "	"	"	7/16			0	0		1.59	0			0		Gonads
" "	"	"	7/16			.57	0	0	0	0					Wet Count
N.W. Bikini 2307	Damsel fish	A	7/17	2.55											
" "	"	"	7/17		3.6	0	0	0	22.3						

Table 2 (Cont'd)

Area	Common Name	Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
N.W. of Bikini 2307	Squirrel Fish A	7/17	1.73											Less head & tail
" "	Goat Fish A	7/17		.38	5.42	1.87	1.93	56.0	30.8		0			
" "	Wrasse A	7/17	.37											
" "	Grouper B	7/17	0											
" "	"	7/17		1.43	4.73	4.8	.91	5.14	39.5					
" "	Surgeon A	7/17		11.8	8.33		4.56	23.8	39.4			14.7		Eggs
" "	" B	7/17		8.58	12.0	19.70	3.5	6.94	13.0					
" "	Siganid	7/17		2.97	9.82	0	4.79	31.2	29.6		5.4			
" "	"	7/17							20.0					
" "	Parrot Fish A	7/17		1.33	5.43	1.00	1.72	82.6	19.4	31.1		3.55		Testes
W. of Bikini 2207	Grouper A	8/20		.20	6.53	0	0	7.75	51.2					
" "	"	8/20		0	2.35	5.13	.83	2.29	16.2					
" "	"	8/20		0	9.20	8.50	0	.88	22.10					
" "	Surgeon C	8/20		1.65	0	5.72	0	6.60	11.0					
" "	"	8/20											6.35	Viscera
" "	" A	8/20											53.6	Viscera
" "	"	8/20											28.7	Viscera
" "	" D	8/20		2.99	0	4.59	0	58.4	13.0					
" "	Wrasse A	8/20	2.46											
" "	"	8/20											2.32	Viscera
" "	"	8/20											28.2	Viscera
" "	"	8/20											17.2	Viscera
" "	"	8/20											35.0	Viscera
" "	"	8/20											3.36	Viscera
" "	Puffer A	8/20	2.88											
" "	Damsel A	8/20	2.85											
" "	Goat Fish A	8/20	0											
" "	"	8/20	.45											
" "	"	8/20											45.0	Viscera
" "	"	8/20											12.6	Viscera
" "	Trigger Fish	8/20		5.24		2.21	2.34	3.62	3.21					
" "	Squirrel Fish A	8/20	.58											Less head & tail
" "	"	8/20	1.40											

Table 2 (Cont'd)

Area	Common Name		Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
W. of Bikini 2207	Lizard Fish		8/20	1.27											
" "	"		8/20											.25	Viscera
" "	"		8/20											5.64	Viscera
" "	Cardinal Fish	A	8/20	1.42											
" "	"		8/20											11.5	Viscera
W. of Bikini 2107	Grouper	A	8/20		0	2.37	4.56	0	7.95	6.94					
" "	"		8/20		3.87	0	1.37	.62	7.16	10.2					
" "	Surgeon	C	8/20		0	3.02	0	0	32.5	96.0					
" "	"	A	8/20		0	0	1.20	1.10	8.00						
" "	Goat Fish	A	8/20		.94	5.00	4.12	1.11	5.17	3.18					
" "	Lizard Fish		8/20		0	0	5.64	.35						12.6	Viscera
" "	Blenny	A	8/20		8.57	165.0	0	3.83	1.33						
" "	Damsel	A	8/20											0	Midsection
" "	"		8/20											3.17	Midsection
Coral Head W. of Bikini 2007	Squirrel Fish	A	7/24		0	6.15	16.8	2.09	0	13.8					
" "	Wrasse	B	7/24		1.06	40.5	5.00	0	14.7						
" "	Goat Fish	A	7/24		1.74	16.5	2.74	1.91	96.2	63.5					
" "	Damsel	A	7/24		7.93	1.87	5.75	0	126.						
" "	"	F	7/24		3.64	8.24	1.41	0	119.	122.					
" "	Grouper	A	7/24		2.59	16.2	.50	2.49	4.53	28.0					
" "	Siganid		7/24		14.4	3.59	1.91	.70	80.9	75.5					
" "	Surgeon	B	7/24		10.4	22.1	12.7	1.49	61.2	146.					
" "	Cardinal	A	7/24		.41	1.74	.49	0	17.2	6.1					
Bikini-Amen 1709	Surgeon	B	7/18	8.77											
" "	Squirrel Fish	A	7/18											1.47	Midsection
" "	Grouper	A	7/18	4.42											
" "	"		7/18		5.35	5.00	4.20	2.95	12.4	4.48			32.0		Testes
" "	Flatfish		7/18		35.7	1.73	.60	2.37	5.32	17.0					
" "	Surgeon	C	7/18	11.0											Less tail & head
" "	"		7/18		24.8	23.0	9.35	6.98	5.20	78.7			27.4		Roe

Table 2 (Cont'd)

Area	Common Name		Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Bikini-Amen 1709	Damsel	B	7/18							6.95					
" "	"	A	7/18	.62											Less head & tail
" "	Goat Fish	A	7/18	1.56											
" "	Blenny	A	7/18						65.2						
Coral Head Bikini-Amen 1709	Squirrel Fish	A	7/31		1.22	5.24	0	1.03	3.59	17.4	24.4	3.79			
" "	"	C	7/31		1.96	3.33	10.6	4.61	76.3	78.7					
" "	Surgeon	A	7/31		4.61	11.2	21.6	.22	261.	166.					
" "	Goat Fish	A	7/31		10.5	4.47	0	0	93.3	0					
" "	Flathead		7/31		134.	0	10.6	0	0	35.0			9.09		Ovary
" "	"		7/31							60.5					
" "	Cardinal	A	7/31		0	1.36	5.45	1.16	11.7	48.7			3.13		Ovary
" "	"		7/31						20.0						
" "	Damsel	A	7/31		0	104.	9.74	.16	4.45	67.8					
" "	Parrot	A	7/31		0	13.8	19.2	.49	59.6	19.5					
Bikini-Amen (Trolling)	Mackeral		7/16		2.55	3.25	6.00	.89	4.96	12.0	3.2		4.85		
" "	Skipjack	A	7/16		1.58	4.90	1.71	2.44	13.3	11.2	11.2	6.68	4.90	3.78	Liver Flukes
" "	Jack	B	7/28		1.76	1.67	1.55	4.05	34.0	42.6	12.3	18.5			Inside reef
" "	Grouper	D	7/28		.38	0	1.27	1.72	2.89	52.4					Inside reef
" "	"		7/28		1.46	6.36	3.38	2.01	90.4	2.24					Inside reef
" "	"		7/28		1.11	0	0	0	6.99	38.1					Inside reef
" "	"		7/28		.18	1.34	0	1.29	23.1	12.7	19.2	4.62			Inside reef
" "	"		7/28		0	0	0	1.41	9.15	13.9	12.6	19.2			Inside reef
" "	Snapper	A	7/28		0	1.59	0	2.49	.70	41.2	47.7				Inside reef
Coral Head Near Amen Is. 1211	Squirrel Fish	C	8/21		.77	2.06	0	.19	9.74	28.1					
" "	"		8/21		1.21	1.90	0	4.24	0	11.29	74.0				
" "	"		8/21						5.44	36.2					
" "	"		8/21						11.1	20.3					
" "	"		8/21						21.7	17.3					
" "	"	D	8/21		1.34	0	.33	1.54	0	6.67					
" "	"		8/21		0	0	0	1.27	5.6	14.3			0		Ovary
" "	"		8/21						1.12	4.40					

Table 2 (Cont'd)

Area	Common Name	Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Coral Head Near Amen Island 1211	Squirrel Fish A	8/21						.12	62.4					
" "	"	8/21						4.07	94.8					
" "	Wrasse A	8/21		0	0	4.19	2.48	14.8	0					
" "	"	8/21						5.92	107.0					
" "	Porgy	8/21		.28	0	1.11	12.2	10.5	16.9					
" "	Cardinal Fish A	8/21		1.85	.37	0	0	0	3.64					
" "	"	8/21		0	8.82	0	1.03	0	1.26					
" "	"	8/21		2.29	0	0	.81	1.55	10.1					
" "	"	8/21											10.2	Viscera
" "	"	8/21											5.54	Viscera
" "	Flathead	8/21		1.02	0	2.72	0	0	12.1					
" "	Parrot Fish A	8/21		.10	13.3	1.91	.96	379.	11.2	44.8				
" "	"	8/21		0	1.91	2.69	1.75	14.85	94.4					
" "	"	8/21						19.3	19.9					
" "	"	8/21						42.9	29.0					
" "	Goat Fish C	8/21		0	0	0	0	14.1	6.33					
" "	"	8/21						19.8	25.9					
" "	" A	8/21		1.50	4.41	0	0	34.5	22.4					
" "	"	8/21						16.0	18.2					
" "	Damsel Fish A	8/21		3.29	0	4.87	0	14.7	25.5					
" "	"	8/21						27.3	10.4					
" "	"	8/21						38.8	26.7					
" "	"	8/21						55.4	6.50					
" "	" F	8/21											5.17	Viscera
" "	Surgeon Fish A	8/21		2.34	3.70	3.58	1.75	19.85	40.8					
" "	"	8/21						5.39	22.3					
" "	"	8/21						9.30	46.6					
" "	"	8/21											14.9	Viscera
" "	"	8/21						6.31	101.					
" "	" E	8/21		3.45	7.01	.34	.11	2.37	24.2					
" "	"	8/21		0	0	0	0	1.60	10.3	11.1				
" "	Grouper D	8/21		0	0	1.09	.37	.54	3.48	8.00				
" "	"	8/21		.13	0	0	0	.32	0	25.0				
" "	Puffer A												3.46	Viscera

Table 2 (Cont'd)

Area	Common Name	Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
1213 S.E. End of Amen Island	Squirrel Fish A	7/19		5.10	8.27	1.44	4.18		17.4			12.3	9.90	Intestine & Spleen
" "	Goat Fish A	7/19		5.26	19.4	11.8	9.00	33.8	42.0					
" "	Mullet	7/19		12.5	14.0	8.34	6.30	9.40	28.5					
" "	Flounder	7/19		4.40	8.56	12.8	2.39	5.32	13.2					
" "	Trigger Fish	7/19		4.83	4.43	4.30	5.00	29.8	2.81	24.7				
" "	Grouper A	7/19		3.11	3.33	.57	1.63	1.45	5.67					
" "	Damsel Fish C	7/19		0	.90	7.20	5.10	8.43	4.78					
" "	Eel A	7/19	.47											
Uku 0914	Grouper A	7/21		0	.33	.96	0	0	6.43					
" "	Squirrel Fish C	7/21		3.5	0	2.89	2.13	.43	26.2					
" "	" B	7/21		0	0	5.00	1.57	6.50	11.2					
" "	" A	7/21		0	.42	0	0	0	10.5					
" "	Surgeon Fish C	7/21		4.18	.44	0	2.38	4.13	.72					
" "	Flounder	7/21		1.26	1.17	0	.32	4.47		0	10.0			
" "	Parrot Fish A	7/21		0	82.0	2.13	0	.97	0(?)					
" "	Damsel Fish E	7/21	2.03											
" "	" F	7/21	1.21											
" "	"	7/21	1.73											
" "	Goat Fish C	7/21		0	6.42	0	0	11.8	4.20					
" "	Wrasse A	7/21											1.36	Viscera
" "	Blenny A	7/21		8.40	1.90	1.54	1.78	19.2						
Namu 9514 Inner	Puffer A	8/16	.73											
" "	Trigger Fish	8/16		.15	3.78	.83	.63	3.49	0			4.21		Ovary
" "	Siganid	8/16		0	0	6.80	1.48	7.08	12.5					
" "	Surgeon Fish C	8/16		2.50	.22	0	0	2.62	0					
" "	" A	8/16		.26	3.15	0	0	0	1.62					
" "	Grouper A	8/16		0	0	17.3	1.45	0	3.04					
" "	"	8/16		1.13	0	3.64	.05	1.32	2.50					
" "	"	8/16		0	0	0	.06	0	2.28					
" "	"	8/16		0	0	.40	0	.08	5.19					
" "	Flounder	8/16		0	.20	0	0	0	3.47					
" "	Blenny A	8/16		0	.44	0	0	0	55.9					
" "	"	8/16		.38	0	0	0	0						
" "	Wrasse D	8/16											0	Digestive tract
" "	"	8/16											.65	Digestive tract

Table 2 (Cont'd)

Area	Common Name		Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Namu 9514															
Inner	Wrasse	D	8/16											0	Digestive tract
" "	"	C	8/16											0	" " & faeces
" "	"	A	8/16						3.86						
" "	Damsel Fish	A	8/16						4.65						
" "	"		8/16						13.9						
" "	"		8/16						5.91						
" "	"		8/16	.94											
" "	Lizard Fish		8/16											0	Digestive tract & faeces
" "	Cardinal Fish		8/16											0	" " " "
" "	"		8/16											0	" " " "
Namu 9415															
Outer reef	Wrasse	A	7/31	0											Collected by V. Brock
" "	"		8/16											1.71	Digestive tract & faeces
" "	"		8/16											0	" " " "
" "	Squirrel Fish	A	8/16		61.1	.69	3.85	.90	0	4.80					
" "	"		8/16		0	.76	.48	0	0	1.81					
" "	"		8/16											0	Digestive tract & faeces
" "	"		8/16											.57	" " " "
" "	Grouper	A	8/16		.77	0	0	.51	3.74	.74					
" "	"		8/16		0	3.53	0	0	1.31	0					
" "	"		8/16						.41	.88					
" "	"		8/16						0	4.75					
" "	"		8/16						0	0					
" "	"		8/16						6.63	7.50					
" "	Lizard Fish		8/16											0	Digestive tract & faeces
" "	"		8/16											0	" " " "
" "	Surgeon Fish	C	8/16											1.75	" " " "
" "	Damsel Fish	A	8/16											0	" " " "
" "	"		8/16											5.04	" " " "
Boro Island 8700															
Outside	Surgeon Fish	A	8/22		.45	.31	.89	2.39	28.6	7.38					
" "	"		8/22		.63	4.40	1.07	0	35.0	12.0					
" "	"		8/22		0	0	3.99	0	22.7	14.8					
" "	"		8/22		0	1.67	7.82	1.61						6.11	Liver and faeces
" "	"		8/22						5.56	19.7					
" "	"		8/22											4.06	Complete Viscera

Table 2 (Cont'd)

Area	Common Name	Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Mucous	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Boro Island 8700 Outside	Surgeon Fish A	8/22						5.48	9.90					
" "	"	8/22											8.75	Complete Viscera
" "	Wrasse A	8/22	1.89											
" "	"	8/22	0											
" "	"	8/22	0											
" "	"	8/22											2.87	Complete Viscera
" "	Wrasse D	8/22											19.0	Complete Viscera
" "	Goat Fish A	8/22		.96	.96	.17	2.37	3.37	.67					
" "	"	8/22		9.34	0	.41	.69	4.71	0					
" "	Cardinal Fish A	8/22		0	0	0	0	0	0					
" "	"	8/22	0											
" "	"	8/22						0	9.88					
" "	Butterfly Fish	8/22		.22	0	0	1.89						16.0	Liver & Testes
" "	Grouper A	8/22		0	1.37	1.39	1.81	.10	1.29					
" "	Squirrel Fish A	8/22	0											
" "	"	8/22						0	0					
" "	Damsel Fish A	8/22	.67											
" "	"	8/22	.84											
" "	Lizard Fish	8/22	1.66											
" "	"	8/22	.78											
" "	"	8/22												
" "	Parrot Fish A	8/22		2.26	.93	.74	.62	10.4	2.37					
" "	"	8/22		0	1.98	0	.98	9.92	0					
" "	"	8/22												
" "	Eel B	8/22							.60				7.58	Complete Viscera
													0	Viscera
Boro Island 8799 Inside	Wrasse A	8/22	.59											
" "	"	8 22							4.2	0				
" "	"	8/22											.48	Body parts
" "	Damsel Fish A	8/22	0											
" "	"	8/22							8.10	8.89				
" "	Grouper A	8/22	.74											
" "	"	8/22											50.5	Viscera
" "	Parrot Fish B	8/22		0	.99	0	.28	15.4	.22					
" "	"	8/22		.82	0	9.29	1.10	20.3	.27					
" "	A	8/22						16.0	0					
" "	Surgeon Fish A	8/22		.29	1.30	1.32	0	14.6	15.4					

Table 2 (Cont'd)

Area	Common Name	Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Boro Island														
8799 Inside	Surgeon Fish A	8/22		0	0	0	0	12.0	7.39					
" "	Goat Fish A	8/22		0	8.69	0	3.26	0	9.24					
S.W. Part of														
Atoll	Tuna, yellowfin	7/25		.89	0	0	1.00	.41	1.26	1.56	.49			
" "	Tuna, dogtooth	7/25		0	0	1.75	.94	1.86	2.96	5.12	3.10			
" "	"	7/26		.15	4.05	6.00	0	0	.69	1.29	7.94			
" "	"	8/25							0					
" "	"	8/25							2.80					
" "	"	8/25							2.21					
" "	"	8/25							1.61					
" "	Skipjack A	7/25		0	3.03	1.02	1.76	25.7	29.8	6.92	12.3			
" "	"	7/25							17.9					
" "	"	7/26							.52					
" "	"	7/26							1.60					
" "	"	7/26		4.68	1.34	2.61	2.67	2.06	1.15	6.73	3.82	1.68		Ovary
" "	"	7/26		.98	.30	2.91	2.67	.82	1.64	7.48	1.80			
" "	" B	8/25							12.3					
" "	"	8/25							9.46					
" "	"	8/25							3.83					
" "	"	8/25							8.12					
" "	Wahoo	7/26		0	.43	1.25	3.21	3.60	1.35		1.86	.78	11.5	Testes-flukes in stomach
" "	"	8/25							0					
" "	Barracuda (small)	7/26		6.48	24.6	4.35	10.0	6.65	9.85	17.6	11.7			
" "	"	7/26		0	.07	2.71	0	10.8	2.04	1.51	0	.16		Ovary
" "	" (small)	7/26		26.3	3.78	.64	.38	1.97	5.42	8.65	1.05			
" "	" (large)	7/25		6.28	1.33	12.6	4.48	6.00	5.25	6.18	5.98			
" "	" "	7/25							1.92					
" "	" "	7/26		2.97	0	0	0	1.74	0	.80	5.00			
" "	Mackerel	7/26		7.67	2.95	1.18	.61	0	.68	0	4.00	1.15		Ovary
" "	Runner, rainbow	8/25							23.4					
" "	"	8/25							11.6					
" "	Jack B	7/26		0	1.45	0	1.64	1.31	8.80	14.2	12.5	1.07		Testes
" "	Snapper A	7/26		2.68	0	0	0	.52	6.64	7.12	4.25			
" "	Grouper D	7/25		2.18	0	0	0	2.74	1.02	.68	.64			
" "	" C	7/26		.44	4.76	7.08	2.87	3.38	6.57	19.1	10.9			
Erik Island														
0390	Siganid	8/18		2.33	1.73	0	0	1.02	9.00					
" "	Grouper A	8/18		0	0	0	.45	0	0					

Table 2 (Cont'd)

Area		Common Name		Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Erik Island																
0390		Grouper		8/18		0	0	0	1.41						0	Faeces & Viscera
"	"	Parrot Fish	A	8/18		0	2.50	0	.55	6.67	2.35					
"	"	"		8/18		1.96	0	0	0	11.9	6.44					
"	"	Goat Fish	A	8/18		0	.17	2.92	1.93	4.18	2.18					
"	"	"	C	8/18		0	0	0	0	.79	1.72					
"	"	Squirrel Fish	A	8/18		0	0	0	0	0	2.29					
"	"	Damsel Fish	A	8/18		.13	.26	0	.29	1.81	0					
"	"	"		8/18		0	0	3.09	2.09	.78	0					
"	"	Surgeon Fish	A	8/18		0	0	0	.60	2.71	7.78			1.36		Ovary
"	"	"		8/18		0	1.74	1.84	0						4.71	Viscera
"	"	Flathead		8/18		0	0	2.65	0						0	Viscera
Prayer Island																
0591		Siganid		8/18		0	1.39	0	1.49	2.26	23.5					
"	"	"		8/18		0	.69	0	0	1.93	8.53					
"	"	"		8/18		1.19				2.02	22.3					
"	"	"		8/18		1.64				1.69	16.6					
"	"	"		8/18		4.11				6.17	31.7					
"	"	Wrasse	A	8/18											.69	Cross section through middle
"	"	"	D	8/18											2.77	" " " "
"	"	Surgeon	A	8/18		0	1.22	.39	.92	11.8	0					
"	"	"		8/18		.31	1.00	0	2.83	7.76	0					
"	"	"	C	8/18		0				4.28	.25					
"	"	Squirrel Fish	A	8/18		0				3.26	0					
"	"	"		8/18		0					15.3				0	Viscera
"	"	"		8/18		0					0				0	Viscera
"	"	"		8/18		.48					0				0	Viscera
"	"	"	D	8/18		0					8.81				.38	Viscera
"	"	Goat Fish	A	8/18		.22					0				0	Viscera
"	"	Damsel Fish	A	8/18		.32					0				7.52	Viscera
"	"	"		8/18		1.77					7.32				4.67	Viscera
"	"	"		8/18		0					1.02				7.38	Viscera
"	"	Trigger Fish		8/18		0				4.10	2.50					
"	"	Grouper	A	8/18		0				0	1.45					
"	"	"		8/18		0				0	.96					
"	"	Lizard Fish		8/18		0				0	0					

Table 2 (Cont'd)

Area	Common Name	Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Prayer Island														
0591	Eel B	8/18		0				9.26	28.3					
" "	Cardinal Fish A	8/18							0					
Coral Head														
Airy-Biren														
Island 0891	Squirrel Fish D	8/14		1.40	1.84	6.24	.88	2.54	7.47					
" "	"	8/14						7.50	19.7					
" "	"	8/14						2.60	16.2					
" "	Grouper A	8/14		.53	0	.51	.68	.79	3.00					
" "	"	8/14		3.10	4.20	.53	2.73	0	4.00					
" "	"	8/14			0				6.25					
" "	" D	8/14		1.20	.67	.64	1.71	1.76	6.80	3.68				
" "	"	8/14		1.92	2.21	2.47	1.23	.33	5.73	2.59				
" "	"	8/14											3.11	Viscera
" "	"	8/14							5.14					
" "	Lizard Fish	8/14		.48	.64	1.62							1.45	Viscera
" "	"	8/14											3.57	Viscera
" "	"	8/14											0	Viscera
" "	Cardinal Fish A	8/14					.40*						2.03	Viscera *Caudal Peduncle
" "	"	8/14											0	Viscera
" "	"	8/14											2.42	
" "	Damsel Fish F	8/14					0 *						.77	Viscera *Caudal Peduncle
" "	"	8/14											0	Viscera
" "	"	8/14											.98	Viscera
" "	Butterfly Fish	8/14			0		0 *		0				19.4	Viscera *Caudal Peduncle
" "	Surgeon Fish B	8/14			0		6.59*		8.28				2.59	Viscera *Caudal Peduncle
" "	"	8/14							8.00				7.83	Viscera
" "	Wrasse D	8/14			0		1.70*						6.14	Viscera *Caudal Peduncle
" "	" C	8/14											0	Midsection
" "	Eel A	8/14	3.02											
" "	" B	8/14											1.37	Midsection
Arji Island														
1092	Trigger	8/5		0	0	0	1.40	9.77	0					
" "	Siganid	8/5		4.05	0	0	.41	15.9	12.3					
" "	Grouper A	8/5		0	4.45	1.32	4.01	1.47	1.62					
" "	"	8/5		0	3.52	0	1.09	2.86	1.47					
" "	Goat Fish A	8/5		0	0	0	2.13	8.56	1.40					
" "	"	8/5		0	3.74	.96	0	10.8	.69					

Table 2 (Cont'd)

Area	Common Name		Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Arji Island	Parrot Fish	B	8/5		1.22	1.20	0	.83	4.67	2.04					
1092	"	A	8/5		0	8.40	0	0	14.5	7.78					
" "	Wrasse	A	8/5						10.2	0					
" "	"		8/5	.10											
" "	Squirrel Fish	D	8/5						4.85	0					
" "	"	A	8/5						2.54	0					
" "	Damsel Fish	A	8/5						15.6	14.7					
" "	"		8/5						0	81.2					
" "	"		8/5	.77											
" "	Lizard Fish		8/5						0	.93					
" "	Surgeon Fish	A	8/5		.16	.53	0	.67	10.0	12.3					
" "	"		8/5						12.0	5.88					
S.E. part of Atoll	Barracuda, small		7/17							3.99					
" "	"		7/17							3.00					
" "	"		7/23							0			0		Testes
" "	"		7/23							1.84					
" "	"		7/23		.18	0	0	.62	.94	1.37	10.1	7.68			
" "	"		7/23		1.14	2.02	3.19	.92	0	6.04	9.26	11.4			
" "	"		7/23							.19					
" "	"		7/23							2.90					
" "	"		7/23							2.83					
" "	"		7/26		.59	.44	1.17	1.79	.90	.80	5.48	3.54			
" "	"		8/12		.79	2.10	.81	.95	5.66	5.82	11.3	11.8			
" "	"	largs	7/26		.15	2.69	5.20	.21	1.99	0	.75	2.27			
" "	Shark	B	8/12		1.98	.92	0	.71	0	1.09	.46	1.29			
" "	Snapper	B	7/22		0	0	1.40	.21	2.44	4.43			1.67		Ovary
" "	"	A	7/23							5.20					
" "	Jack	A	7/23						0	4.25					
" "	"		7/23		0	3.64	0	1.32				6.00	2.17		Testes
" "	"		8/6		1.41	0	0	1.74	18.2	14.6	6.10	14.3			
" "	"	B	7/23		0	.26	2.25	1.08	0	4.99	9.58	1.02			
" "	"		7/23		4.26	1.25	.63	0	.86	8.95	2.10				
" "	"		7/26		0	.14	2.12	1.36	5.40	3.46	3.91	2.11			
" "	"		8/6		0	2.40	.96	2.18	3.96	8.18	7.28	5.00			
" "	"		8/12		0	2.48	0	1.03	26.4	0	18.4	3.65			
" "	Mackerel		7/23							4.84					
" "	"		7/26		1.98	.72	4.07	1.06	4.30	4.49	4.50	2.56	2.99		
" "	Tuna, dog tooth		7/23		0	.70	.72	.84	0	.55					

Table 2 (Cont'd)

Area	Common Name		Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
S.E. part of Atoll	Tuna, dog tooth		8/12		.37	1.43	1.40	3.09	10.6	1.63	1.96	3.65			
	Runner, rainbow		8/6		2.02	2.67	3.64	2.64	.26	28.4	24.4	10.5	2.63		Ovary
" "	"		8/12		0	.56	0	1.02	2.72	.32	10.0	6.44			
" "	Skipjack	A	8/12		.38	0	1.98	.15	2.56	15.6	16.3	8.99			
Enyu Island															
2792 Inner	Squirrel Fish	D	8/19		1.16	.45	0	.09	1.42	2.52					
" "	"		8/19		0	0	0	.07	0	1.21		0			
" "	"		8/19							.39				0	Viscera
" "	"		8/19						0	7.23					
" "	"	A	8/19		0	0	0	0	3.38	2.22					
" "	"		8/19		0	0	1.26	0	2.89	0					
" "	Surgeon	A	8/19		.22	.65	.31	10.2	1.92	17.4					
" "	"		8/19		0	1.70	.85	0	40.7	11.7					
" "	"								18.1	40.5					
" "	"	D	8/19		.80	0	0	2.16	8.16	1.19					
" "	Eel	B	8/19		0	0	0	0	0	0					
" "	Damsel Fish	A	8/19		0	0	0	0	10.4	21.1					
" "	"	F	8/19		0	1.43	0	0	7.20	23.9					
" "	"		8/19						15.5	4.40					
" "	"		8/19						.64	5.22					
" "	Parrot Fish	A	8/19		0	0	0	0	9.48	4.57					
" "	"		8/19		.29	1.25	0	1.14	4.33	1.07					
" "	"		8/19						30.3	6.58					
" "	Blenny	A	8/19		.86	0	0	0	34.0	1.88					
" "	"		8/19		1.43	0	.91	1.38	1.20	54.8					
Coral Head North of Enyu 2796	Squirrel Fish	C	8/7		0	0	14.7	3.16	4.45	1.08					
" "	"		8/7		.55	0	3.88	.48	3.17	31.0					
" "	"		8/7		1.96	.36	0	1.08	3.67	30.0					
" "	"		8/7		4.45	0	0	0	.19	5.24					
" "	"		8/7		0	0	5.85	2.89	1.58	.97					
" "	"	D	8/7		0	0	1.26	.47	5.28	0					
" "	"		8/7		3.40	0	1.08	.16	7.35	5.22					
" "	"	A	8/7						2.86	5.67					
" "	"		8/7						3.40	17.7					
" "	Surgeon Fish	A			2.59	0	.79	.15	11.2	141.					
" "	"				1.43	6.93	0	.99	37.8	36.0					
" "	"								30.6	4.00					
" "	"								9.55	13.5					

Table 2 (Cont'd)

Area	Common Name		Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Ion Island															
2797	Lizard		8/1		0	1.25	.41	.35	.71						
" "	Squirrel Fish	C	8/1		4.55	4.43	0	15.2	0	26.4					
" "	"	A	8/1			0								14.0	Viscera
" "	Wrasse	A	8/1			0								14.8	Viscera
" "	Damsel Fish	A	8/1			11.0								19.6	Viscera
Rokar Island															
2798 Inner	Siganid		7/30		4.66	6.03	1.58	1.42	16.9	49.4	35.0	23.6			
" "	Squirrel Fish	D	7/30		0	0	.33	0	11.4	18.8					
" "	Grouper	A	7/30		0	0	0	.67	17.4	8.89	.83				
" "	Goat Fish	B	7/30		0	12.8	17.2	.63	8.22	32.1	13.1	22.0			
" "	Damsel Fish	B	7/30		0	.51	.77	1.12	0	1.52					
" "	"	A	7/30			2.50			21.1	102.					
" "	Wrasse	C	7/30		0	.88	0	0	8.31	10.0	22.0				
" "	Surgeon Fish	B	7/30		6.73	2.82	0	1.97	28.3						
" "	"	C	7/30		0	0	0	0	.86	12.7					
" "	Cardinal Fish	A	7/30		0	0	0	0	4.12	0					
Rokar Island															
2899 Outer	Squirrel Fish	D	7/30		1.49	0	.24	.73	.62	1.02					
" "	"		7/30			7.15								9.78	Viscera
" "	"		7/30			1.25								5.19	Viscera
" "	Bretulid		7/30	1.29											
" "	Surgeon Fish	A	7/30		17.8	16.5	11.6	0	11.3	4.71					
" "	"		7/30		3.75	9.42	0	2.52	5.20	0					
" "	Wrasse	A	7/30			0								0	Viscera
Rongerik	Tuna, dog tooth		8/12							0					
"	"		8/12							.34					
"	"		8/12							1.02					
"	"		8/14							0					
"	"		8/14							0					
"	"		8/14							0					
"	"		8/14							0					
"	"		8/14							0					
"	"		8/14							0					
"	"		8/14							0					
"	"		8/19							0					
"	"		8/19							0					
"	Tuna, yellow fin		8/12							1.02					
"	"		8/12							1.20					

Table 2 (Cont'd)

Area	Common Name	Date Collected	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonad	Misc.	Remarks
Coral Head North of Enyu 2796	Siganid	8/7		.09	0	0	0	8.95	41.4					
" "	"	8/7		.80	.95	0	1.02	5.06	41.4					
" "	"	8/7		1.32	4.75	1.80	1.12	6.90	148.8					
" "	"	8/7		0	12.9	1.67	1.70	13.5	162.					
" "	Wrasse D	8/7		0	.26	0	1.10	1.53						
" "	Grouper D	8/7		0	0	0	2.75	8.46						
" "	"	8/7		1.20	0	0	8.61	1.07	49.6					
" "	"	8/7		0	0	0	6.70	1.89	0					
" "	" B	8/7		.98	0	0	4.59	.45	12.2	4.0	4.23			
" "	Snapper C	8/7		0	1.21	0	0	1.95	.18					
" "	Damsel Fish A	8/7	2.69											
" "	" F	8/7											2.62	Viscera
" "	Cardinal Fish A	8/7						80.0	1.36					
" "	"	8/7						0	9.49					
" "	Goat Fish A	8/7		3.88	1.41	1.18	.56	15.0	2.46					
" "	"	8/7		3.16	3.02	1.69	2.71	6.67	42.4					
" "	Parrot Fish B	8/7		0	.68	0	1.13	19.6	.62					
" "	" A	8/7		0	.48	.49	.68	31.7	6.62					
" "	Lizard Fish	8/7		2.13	4.29	0	1.18	6.59	0					
Ion Island 2797	Parrot Fish B	8/1		0	1.54	1.28	1.72	112.0	12.9	7.82	14.8			
" "	Goat Fish A	8/1		0	0	2.59	.40	13.8	57.8	265.	59.7			
" "	"	8/1		2.93	3.18	0	1.12	28.4	45.7					
" "	"	8/1		1.86	1.96	0	1.29	9.65	41.1					
" "	Cardinal Fish C	8/1		0	3.58	0	.69	28.1	67.9	.42				
" "	Grouper A	8/1		5.71	6.57	0	6.92	0	0					
" "	"	8/1			0								2.88	Viscera
" "	" D	8/1		6.05	0	0	.68	3.02	11.9					
" "	Shark D	8/1							4.15					
" "	Surgeon A	8/1		5.70	6.47	0	0	61.3	19.6	0				
" "	"	8/1			0								18.5	Viscera
" "	"	8/1			0								3.71	Viscera
" "	" C	8/1		1.14	6.14	0	.40	14.1	25.4					
" "	"	8/1			0								18.6	Viscera
" "	Flounder	8/1		0	0	0	2.81	5.98						

Area	Common Name		Collected	Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney
Rongerik	Tuna, yellow fin		8/12							0		
"	"		8/12							1.29		
"	"		8/12							.18		
"	"		8/12							.38		
"	"		8/14							2.30		
"	"		8/14							0		
"	"		8/14							0		
"	"		8/14							0		
"	"		8/14							0		
"	"		8/14							0		
"	"		8/14							0		
"	Skipjack		8/12							0		
"	"		8/12							.67		
"	"		8/12							0		
"	"		8/12							.78		
"	"		8/12							.27		
"	"		8/14							10.5		
"	"		8/14							3.07		
"	Barracuda, large		8/12							.92		
"	Grouper	D	8/19							0		
"	Jack	A	8/19							.16		
Kwajalein	Tube Snout		8/3		0	1.28	3.75	.26	0	0	0	0
"	Groüper	A	8/3		0	0	.31	.83	0	.38	3.77	0
"	Damsel Fish	F	8/3	0								
"	"		8/3	.98								
"	"		8/3	.86								
"	"		8/3	0								
"	"		8/3	1.04								
"	"		8/3	0								
"	"		8/3	0								
"	"		8/3	1.16								
"	"	D	8/3	1.07								
"	Wrasse	A	8/3	.90								
"	"		8/3	2.21								
"	Cardinal Fish	A	8/3	1.34								
"	"		8/3	1.24								

Area	Name	Date Collected	Entire Organism	Shell	Soft Part	Muscle	Digestive Gland	Mantle	Gonad	Skin	Fae
Apogon	Oyster (Ostrea sp.)	8/17	333.								
"	New Coral Growth	8/17	13.6								
"	Oyster (Ostrea sp.)	8/21	22.9								
"	"	8/21	915.								
"	Young Clam (Arca sp.)	8/21	1054.								
"	"	8/21	680.								
Pilot Fish	Young Clam (Arca sp.)	8/15	249.								
"	Oyster (Ostrea sp.)	8/15			126.						
"	"	8/15			424.						
"	Clam (Spondylus sp.)	8/15			1420.						
"	"	8/15	391.								
"	"	8/15	91.3								
"	"	8/15	520.								
Saratoga	Sea Cucumber	7/28	12.4								
"	Holothurian (Euapta sp)	7/28	37.9								
"	Clam (Arca sp.)	7/27	171.								
"	"	7/29	645.								
"	" (Spondylus sp.)	7/28			78.5						
"	"	7/29		545.	778.						
"	"	7/29	314.								
"	Oyster (Ostrea sp.)	7/29	420.								
"	Sea urchin	7/29	826.								
"	Spider Crab	7/29	1350.								
"	Finely branched Coral	7/29	3840.								
Bikini Island	Hermit Crab	7/15		13.3	0						
N.W. Tip of Bikini Island 2407	Sea Urchin	7/16		0	.62						
" "	Clam (Tridacna sp.)	7/16		0		0	9.85	0	0		
" "	Sea Cucumber	7/16			2.46					0	
" "	"	7/16			1.27						
" "	Nudibranch	7/16			1.22					0	
" "	Snail, cats eye	7/16			0						
" "	"	7/16			2.10						
" "	Snail, spider	8/1			2.92						

Table 2 Part b (Cont'd)

Area	Name	Date Collected	Entire Organism	Shell	Soft Parts	Muscle	Digestive Gland	Mantle	Gonad	Skin	Faeces	Gills	Remarks
N.W. of Bikini													
2307	Sea Urchin	7/17		0	41.8								
"	Clam (Tridacna sp.)	7/17		11.2		6.31		4.82					
"	Snail, cats eye	7/17			89.5	8.40							
"	Sea Cucumber	7/17								208.	50.7		
W. of Bikini													
2207	Oyster (Ostrea sp.)	8/20			4.85								
"	Clam (Tridacna sp.)	8/20					81.0	3.04					
"	Sea Cucumber	8/20								25.2	120.		
"	Crab, grapsoid	8/20	16.4										
"	"	8/20	14.9										
"	Sea Urchin	8/20	2.04										1/2 of
"	Sea Urchin, slate pencil	8/20		.45	19.8								
"	Octopus	8/20	12.1										
2107	Crab - sm. br. spot	8/21	1.60										
"	Octopus	8/21	1.25										
"	"	8/21	1.26										
"	Sea Urchin, sm. br.	8/21	4.45										
"	"	8/21	4.44										
"	Snail, cats eye	8/21				7.49	100.						
"	Sea Cucumber	8/21					9.88			0	9.02		
"	Clam (Tridacna sp.)	8/21					49.0	5.29					
2007	Sponge	7/24	400.										
"	Coral	7/24	28.6										
1709	Sponge	7/18	672.										
"	"	7/18	705.										
"	Lobster, spiny	7/18		1.25		8.65	241.						
"	Oyster (Ostrea sp.)	7/18		16.6	45.0								
"	Clam (Tridacna sp.)	7/18			252.								
"	Snail	7/18			7.82								
"	Snail, green cowry	7/18			76.4								
"	Crab, grapsoid sm.	7/18	4.12										
"	Crab, hermit	7/18	28.5										
"	"	7/18			30.8								
"	Sea Cucumber	7/18			60.0					20.2			

Table 2 Part b (Cont'd)

Area	Name	Date Collected	Entire Organism	Shell	Soft Parts	Muscle	Digestive Gland	Mantle	Gonad	Skin	Faeces	Gills	Remarks
1211	Sea Cucumber	8/21								28.4	48.4		
1213	Clam (Tridacna sp.)	7/19		7.85	19.9	3.38		13.2					
"	Snail, cat's eye	7/19			21.1								
"	Sea Cucumber	7/19								6.48	1.34		
"	Snails, small	7/21		4.58	10.1								
Between Bikini and Amen	Clam (Tridacna sp.)	7/28					7.48	0.43	1.45				
"	"	7/28				4.66	44.8	7.95					
0914	Clam (Tridacna sp.)	7/21				5.07	26.7	4.35					
"	"	7/21				1.00	15.4					2.52	
"	Sea Cucumber, brown	7/21			19.6					1.81			
"	" , tan	7/21			5.80								
"	Snail (Cypraea moneta)	7/21		1.72	12.6								
"	" (Nerita sp.)	7/21		0									
"	Octopus	7/21			2.44	0.0							
"	Oyster (Ostrea sp.)	7/21		9.7	16.0								
"	Sponge, black	7/21	83.0										
9514	Sea Cucumber	8/16					15.9			.20	1.83		
9415	Clam (Tridacna sp.)	8/16						0					
"	Octopus	8/16				1.69							
8700	Sponge	8/22	478.										
"	"	8/22	1170.										
8799	Sponge	8/22	103.										
"	"	8/22	77.8										
0390	Snail (Cypraea moneta)	8/18			.67								
"	" (Nerita sp.)	8/18			2.27								
"	" cat's eye	8/18				3.87	26.1						
"	"	8/18				3.21	164.						
"	Crab, spotted rock	8/18				2.26	0		0		3.28	.40	
"	Shrimp	8/18	6.03										
"	Oyster (Ostrea sp.)	8/18		0	4.07								
"	Clam (Tridacna sp.)	8/18					1.96	0					

Table 2 Part b (Cont'd)

Area	Name	Date Collected	Entire Organism	Shell	Soft Parts	Muscle	Digestive Gland	Mantle	Gonad	Skin	Faeces	Gills	Remarks
1092	Clam (Tridacna sp.)	8/5					11.9	1.12					
"	Oyster (Ostrea sp.)	8/5			.30								
"	"	8/5			6.05								
"	Sponge	8/5	138.										
"	"	8/5	49.7										alive
"	Crab, cancroid	8/5	1.87										1/2 of
2792	Sea Cucumber	8/19			.67					.53	20.5		
"	Sea Urchin, brown	8/19			0								
"	Shrimp, striped	8/19	0										
"	"	8/19	3.33										
"	"	8/19	8.33										
2796	Clam (Tridacna sp.)	8/7				1.25	1.38	159.	9.66				
"	Octopus	8/7				2.21	42.8						
2797	Sponge	8/1	129.										
2899	Sea Cucumber	7/30			0					1.44			
Kwajalein	Oyster (Ostrea sp.)	8/3		.37	2.78								
"	" (Margaritifera)	8/3			1.59								
"	Snail-triton	8/3	.86										

Table 2 Part d

Miscellaneous

Area	Common Name	Date Collected	Count	Remarks
Saratoga	Rust	7/29	4690.	
Bikini Island				
2704	Papaya	7/20	1.11	Skin
			0.	Meat
			.40	Seed
N.W. of Bikini				
2307	Pandanus Fruit	7/17	2830.	From Beach
Amen Island	Tent Canvas	7/21	213.	
0914	Coconut	7/21	1.44	Outer husk
			0.	Inner shell
			1.08	Meat
"	Pandanus Fruit	7/21	5.01	
Uku Island	Pandanus Fruit	7/21	0.	Tip end
			.21	Soft parts

Table 3: Common Names, Listed Alphabetically, and Scientific Names of Fish Used for Activity Counts.

Common Name		Scientific Name	
		Genus	Species
Barracuda, Large		Sphyraena	commersonii
" Small		"	helleri
Blenny	A	Salarias	gibbifrons
"	B	Exallias	sp.
Brotulid		Brotula	sp.
Butterfly Fish		Chaetodon	lunula
Cardinal Fish	A	Cheilodipterus	lineatus
" "	B	Apogon	maculifera
" "	C	"	erythrina
Cornet Fish		Fistularia	petimba
Damsel Fish	A	Abudefduf	melas
" "	B	"	abdominalis
" "	C	"	sordidus
" "	D	"	sindonis
" "	E	Dascyllus	aruanus
" "	F	Chromis	sp.
Eel	A	Muraenichthys	sp.
"	B	Lycodontis	sp.
"	C	Gymnothorax	sp.
Flathead		Bembradium	sp.
Flounder		Platophrys	mancus
Goat fish	A	Psuedopeneus	bifasciatus
"	B	Mulloidichthys	auriflamma
"	C	"	sp.
Goby			
Grouper	A	Epinephalus	sp. (tauvina?)
"	B	"	sp.
"	C	Cephalopholis	argus
"	D	Serranus	sp.
Halfbeak		Hyporhamphus	pacificus
Jack	A	Caranx	lugubris
"	B	"	melampygus
Lizard Fish		Synodus	various
Mackeral		Grammatorcynus	bilineatus
Mullet		Neomyxus	chaptalli
Needlefish		Belone	platyura
Parrot Fish	A	Leptoscarus	viridescens
" "	B	"	vaigiensis
Porgy		Monotaxis	granoculis
Puffer	A	Canthigaster	rivulatus
"	B	Tetraodon	meleagris
Rainbow Runner		Elagatis	bipinnulatis
Remora		Echeneis	remora

Table 3: Common Names, Listed Alphabetically, and Scientific Names of Fish Used for Activity counts (Cont'd.).

Common Name		Scientific Name	
		Genus	Species
Shark	A	Nebrius	sp.
"	B	Triaenodon	obesus
"	C	Eulamia	limbatus
"	D	Ginglymostoma	sp.
Siganid		Siganus	sp.
Skipjack	A	Katsuwanis	pelamis
"	B	"	alletteratus
Snapper	A	Aprion	virescens
"	B	Lutjanus	sp.
"	C	"	sp.
Squirrel Fish	A	Holocentrus	diadema
" "	B	"	sammara
" "	C	"	ensifer
" "	D	Myripristis	sp.
Surgeon Fish	A	Hepatus	umbra
" "	B	"	fuliginosus
" "	C	"	triostegus
" "	D	"	achilles
" "	E	"	olivaceus
Trigger Fish		Balistapus	rectangulus
Tuna, Dog-tooth		Gymnosarda	nuda
" Yellow-Fin		Neothunnus	macropterus
Wahoo		Acanthocybium	solandri
Wrasse	A	Stethojulis	albovittata
"	B	"	axillaris
"	C	Thallasoma	sp.
"	D	Coris	sp.

These samples were placed on weighed, stainless steel discs, one and one-half inches in diameter.

The discs containing the samples were then weighed again on a torsion analytical balance accurate to .01 gram. Due to the motion of the ship, however, an accuracy of probably not more than .03 gram was obtainable. The size of the sample used depended upon the amount of material available but in most cases was approximately a gram.

The discs holding the samples were next placed on an asbestos tray and heated to about 300° C. which dried and charred the tissue. Several drops of concentrated nitric acid were then added to further oxidize the material and to reduce the residue to a minimum. Samples were then placed in the furnace. The nitric acid treatment was usually repeated several times until the residue was spread as evenly as possible over the bottom of the plate. Finally the temperature of the muffle furnace was raised to about 800° C. to complete the ashing.

After cooling, the plates were mounted on cards bearing an identification number and were sent to the counting room. All samples were counted in an aluminum shelf sample holder, with a thin window, argon-alcohol Geiger tube, and a Tracerlab autoscaler circuit. The geometry of this arrangement was about 22%. Total absorption, exclusive of self absorption which varied widely for different samples, was about 6 mg cm^{-2}. Counter background averaged 18.5 c/min. The tabulated data refer to the above arrangement, and if total counts uncorrec for absorption are desired, the tabulated values should be multiplied by 4.5.

A total count of 128 was obtained on most samples. In cases where greater than average radioactive materials were present, however, total counts of 256, 512, or 1024 were made. To determine the background the time to record a count of 1024 and occasionally of 4096 was obtained each day.

Figure 4. (ABCR 5043-8) Mr. Nichols weighs specimen of fish.

Figure 5. (ABCR 5043-9)

Dr. L. R. Donaldson and Dr. F. H. Rodenbaugh dissect fish to procure tissues for study of contained fission products.

Figure 6. (ABCR 5043-7)

Mr. R. F. Foster weighs samples of fish tissue prior to placing in muffle furnace to reduce it to an ash.

Figure 7. (ABCR 5045-2)

Working in their laboratory on the fantail of the U.S.S. Chilton a group of scientists are engaged in dissecting, weighing and ashing fish and other tissues for radioactivity counts. Shown front to rear are:

M. K. Nichols, C.Ph.M., USN
Mr. R. H. Osborn
Mr. F. H. Rodenbaugh, Jr.
Dr. L. R. Donaldson
Dr. F. H. Rodenbaugh, Sr.
T. W. Ritchie, S/1, USN

Figure 8. (ABCR 5043-12)

Mr. Jesse P. Pflueger, Assistant Scientist, University of Washington, reads counting on machine in laboratory on board the U.S. S. Chilton.

Figure 9. (ABCR 5043-10)

Dr. Arthur D. Welander, Associate Scientist, University of Washington, inspects fish in laboratory aboard the U. S. S. Chilton.

Identification of material.

The incompleteness of our knowledge of the fauna and flora of Bikini at times made the positive identification of material difficult or about impossible. For convenience in keeping the records, descriptive common names were used for identification (Tables 2, 5 and 6). The common names of the fishes are listed in Table 3, together with the generic and specific names of the forms that have been adequately described. A more accurate analysis of the preserved species will be made in the near future to correct and complete the identifications.

DISCUSSION OF RESULTS

Presence of active substance.

Measurable amounts of activity from fission products were found in every part of Bikini Lagoon sampled. The date of collection, the area, number and use of the organisms obtained, together with specific notes on the method of collecting are summarized in Table 1. Figure 2 shows the distribution of the major collecting stations about the atoll.

The data on the gross beta-gamma activity of marine organisms is given in Table 2, with the information on fission products found in fish summarized in Table 4.

Distribution of active materials.

The presence of fission products in the tissues of fish is summarized by geographical location in Table 4. These data are grouped by area starting with the U.S.S. Chilton anchorage in area 2504, then to areas about the target ships and the sunken submarine Apogon. Starting next with the northwestern tip of Bikini Island the collections have been arranged so as to group material along the northern reef followed by northern and western islands, then around the southern portion of the atoll and finally the eastern portion of the atoll.

Table 4

Average Gross Beta - Gamma Activity of Fish Tissues Collected at Bikini Atoll during July - August 1947*
(Number of samples in parenthesis)

Area	Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney	Gonads
Chilton 2504		2.01(27)	5.74(32)	2.98(28)	1.58(29)	34.8 (36)	37.2 (43)	34.1 (20)	17.7 (15)	19.9 (5)
Trolling-Target Area		0.26(4)	1.15(4)	1.12(4)	0.97(4)	12.2 (4)	14.7 (4)	11.9 (4)	6.99(4)	4.42(4)
Apogon 2000J		19.2 (1)	13.4 (1)	12.5 (2)	1.81(2)	21.7 (2)	12.5 (3)			
N.W. Tip of Bikini 2407	0	0.51(5)	1.62(5)	0.08(4)	0.01(4)	0.66(5)	11.0 (5)			
N.W. of Bikini 2307	1.16(4)	4.30(7)	6.53(7)	4.56(6)	2.49(7)	32.57(7)	27.4 (7)	31.1 (1)	2.70(2)	9.12(2)
W. of Bikini 2207	1.49(9)	1.68(6)	3.62(5)	4.36(6)	0.53(6)	17.3 (19)	19.5 (6)			
W. of Bikini 2107		1.91(7)	25.0 (7)	2.41(7)	1.00(7)	8.67(9)	29.1 (4)			
Coral Head W. of Bikini 2007		4.68(9)	13.0 (9)	5.26(9)	.97(9)	61.1 (9)	64.7 (7)			
Bikini-Amen 1709	5.27(5)	21.9 (3)	9.91(3)	4.72(3)	4.10(3)	22.1 (4)	26.8 (4)			24.7 (2)
Coral Head Bikini-Amen 1709		19.1 (88)	17.5 (8)	9.65(8)	.95(8)	58.8 (9)	54.8 (9)	24.4 (1)	3.79(1)	6.11(2)
Trolling Bikini-Amen		1.00(9)	2.12(9)	1.55(9)	1.81(9)	27.1 (9)	25.1 (9)	17.7 (6)	12.2 (4)	4.87(2)
Coral Head Near Amen Island 1211		9.75(20)	2.17(20)	1.13(20)	1.43(20)	20.0 (42)	26.0 (37)	32.6 (5)		
S.E. End of Amen Island 1213	.47(1)	5.02(7)	8.42(7)	6.64(7)	4.80(7)	14.7 (6)	16.4 (7)	24.7 (1)		12.3 (1)
Uku 0914	1.68(3)	1.93(9)	10.3 (9)	1.32(9)	0.91(9)	5.28(9)	8.46(7)	0 (1)	10.0 (1)	
Namu-Inner 9514	.84(2)	0.40(11)	0.71(11)	2.64(11)	0.33(11)	2.86(15)	8.65(10)			4.21(1)
Namu-Outer 9415	0 (1)	15.47(4)	1.24(4)	1.08(4)	0.35(4)	1.24(17)	2.56(8)			
Boro Island-outside 8700	0.69(9)	0.66(11)	1.00(11)	1.50(11)	1.12(11)	9.55(22)	4.70(14)			
Boro Island-inside 8799	0.42(3)	0.22(5)	2.17(5)	0.91(5)	0.93(5)	13.05(6)	14.16(10)			
S.W. part of Atoll		3.63(17)	2.83(17)	2.60(17)	1.90(17)	4.09(17)	5.52(32)			
Erik Island 0390		0.34(13)	0.49(13)	0.81(13)	0.56(13)	2.66(13)	3.18(10)			1.36(1)
Prayer Island 0591		0.46(22)	1.07(4)	0.10(4)	1.29(4)	3.25(24)	7.33(23)			
Coral Head Airy-Biren Is. 0891	3.02(1)	1.44(6)	1.06(9)	2.00(6)	1.59(10)	2.92(23)	7.55(12)	3.13(2)		
Arji Island 1092	.43(2)	0.60(9)	2.43(9)	0.25(9)	1.16(9)	7.73(16)	8.90(16)			
S.E. part of Atoll		0.76(20)	1.20(20)	1.48(20)	1.14(20)	4.33(20)	4.86(29)	8.35(17)	6.02(17)	1.89(5)
Enyu Island-Inner 2792		0.34(14)	0.39(14)	0.24(14)	1.07(14)	9.97(19)	10.4 (20)		0 (1)	
Coral Head N. of Enyu 2796	2.69(1)	1.16(24)	1.55(24)	1.43(24)	1.80(24)	10.5 (31)	28.7 (28)	4.0 (1)	4.23(1)	
Ion Island 2797		2.33(12)	2.43(19)	0.35(12)	2.63(12)	19.4 (19)	28.4 (11)	68.3 (4)	34.2 (2)	
Rokar Island-Inner 2798		1.26(9)	2.55(10)	2.21(9)	0.65(9)	11.7 (10)	26.2 (9)	17.7 (4)	22.8 (2)	
Rokar Island-Outer 2899	1.29(1)	7.68(3)	5.72(6)	3.95(3)	1.08(3)	4.35(6)	1.91(3)			
Average	1.58(42)	2.45(302)	4.16(302)	2.67(284)	1.49(276)	14.53(428)	18.66(387)	29.51(67)	11.64(50)	8.16(25)

*For total c/mm./gm of wet tissue, uncorrected for absorption, multiply by 4.5.

Table 5.

Gross Beta - Gamma Activity of Specimens Collected at Kwajalein Atoll, August 3, 1947.*

part a.

Fish Tissues (Number of samples in parenthesis)

Entire Organism	Bone	Gills	Skin	Muscle	Faeces	Liver	Spleen	Kidney
0.83(13)	0(2)	0.64(2)	2.03(2)	0.54(2)	0(2)	0.19(2)	1.88(2)	0(2)

part b.

Invertebrates

Common Name	Entire Organism	Shell	Soft Parts
Oyster (Ostrea sp.)		0.37	2.78
" (Margaritifera)	0.86		1.53
Snail - triton			

part c.

Algae

Common Name	Count
Algae	3.37

*For total C/min./gm. of wet tissue, uncorrected for absorption, multiply by 4.5.

Table 6.

Gross Beta - Gamma Activity of Liver Samples from Fish Caught at Rongerik Atoll, August 12 to 19, 1947.*

Common Name		**	Average Count
Tuna, dog tooth		(12)	0.11
Tuna, yellow fin		(13)	0.49
Skipjack		(7)	2.32
Barracuda, large		(1)	0.92
Grouper	D	(1)	0.
Jack	A	(1)	0.16

* For total C/min/gm. of wet tissue, uncorrected for absorption, multiply by 4.5.

** Number of samples.

Using the summaries of activity counts, as found in the liver, faeces, and muscle, Figure 10 was drawn. The data for the counts in the liver and faeces show an extremely high degree of correlation. The greatest amounts of activity in these samples was found to be present in the fish collected about the coral heads in areas 2007 and 1709 in 20 to 30 feet of water. The activity counts for the bone, gills, and skin are plotted on Figure 11. The data assembled indicates that these tissues contain active materials in varying amounts in areas sampled. On the average the tissues collected from animals living along the northern portion of the atoll contained more fission products than from other areas on the outer rim of the atoll.

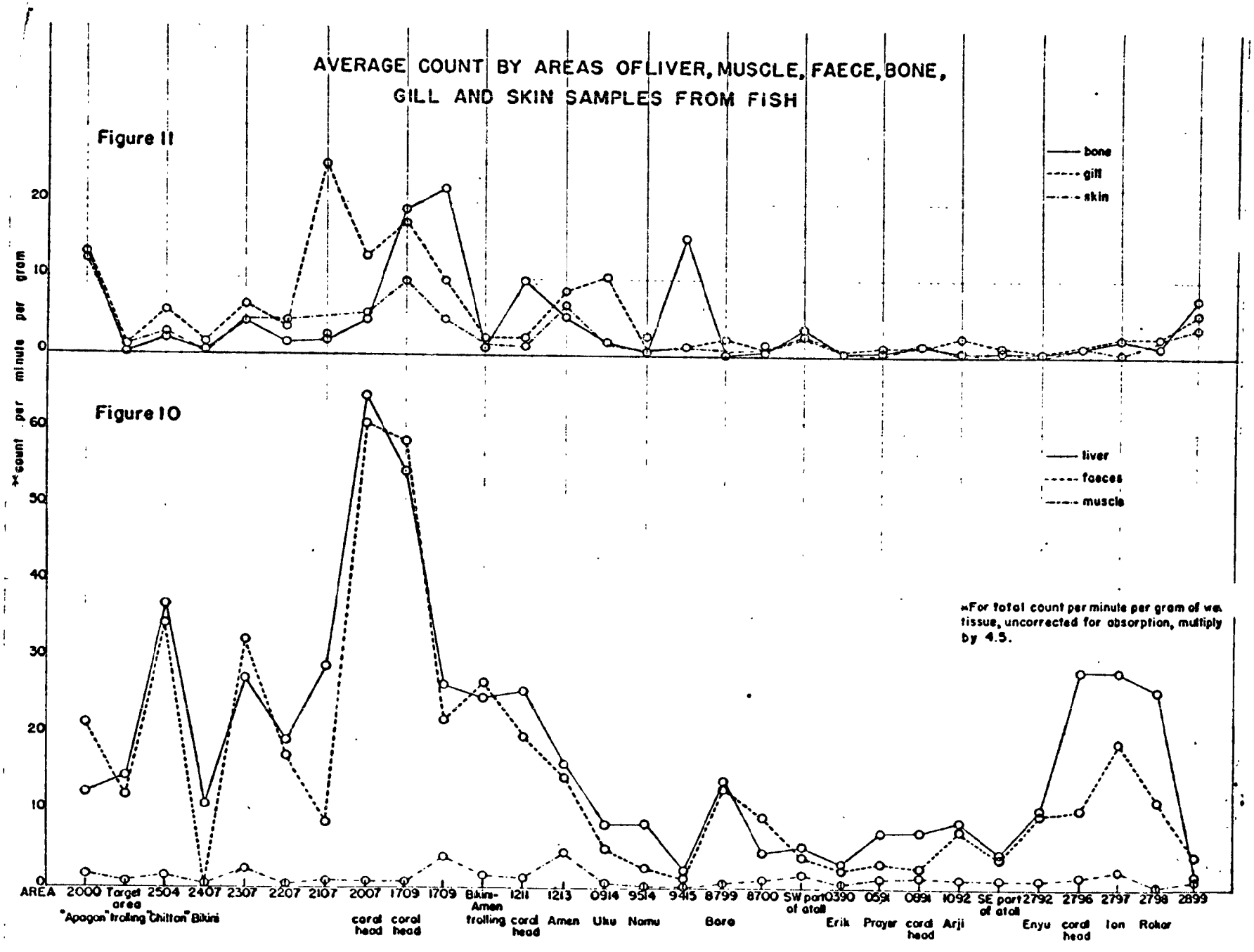
Amounts of radioactive substances in various tissues.

The fish tissues studied have been summarized by tissue in Table 4. These data give the average count above background per minute, per gram of wet tissue, uncorrected for absorption. The geometry of the counter arrangement was about 22%, so to obtain the total c./min./gr. of wet tissue, uncorrected for absorption, multiply by 4.5.

The greatest average values were recorded from sections of fish spleen where the average of 67 specimens was 23.51 c./min./gr. The liver was next with 387 specimens having an average count of 18.66. A total of 428 counts of fish feaces had an average count of 14.53. The kidney tissue was next with 50 counts for an average of 11.64. The gonads recorded 8.16, the gills 4.16, skin 2.67, bone 2.45 and the muscle 1.49.

Invertebrate material from the target area.

The divers operating from the U.S.S. Coucal and working on the sunken ships in the target area brought to the surface objects from which organisms were recovered. These organisms were young forms that had developed since the ships had been on the bottom. It was observed that most of the oyster



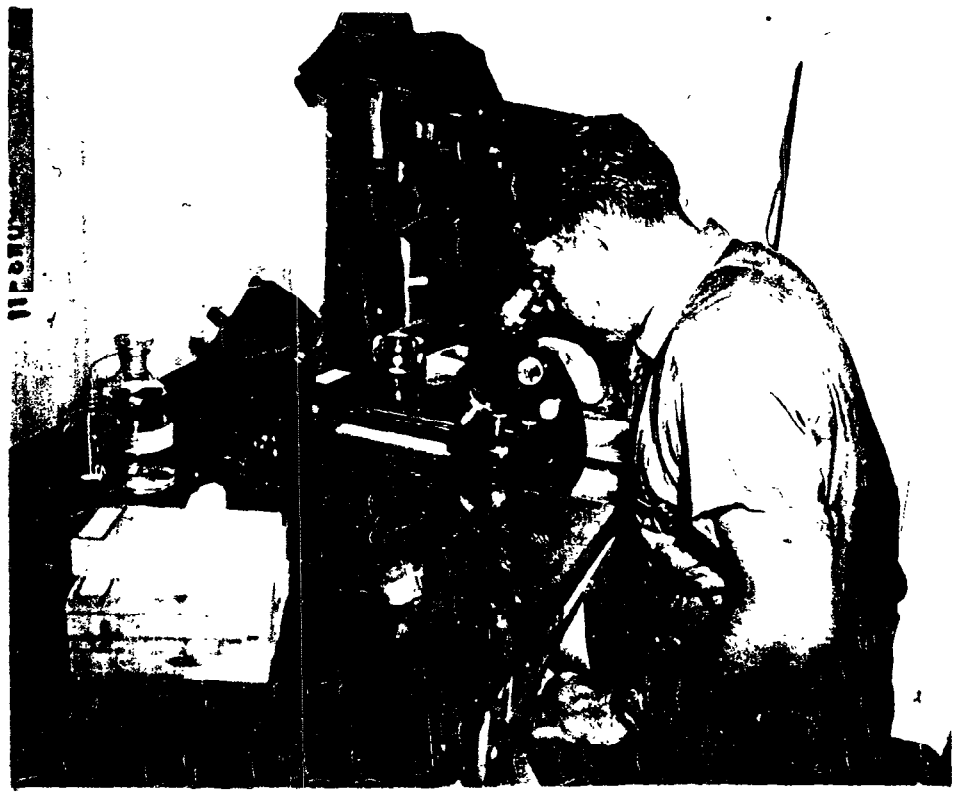


Figure 12. (ABCR 5043-11)

Mr. Lorence B. Marquiss takes blood counts on fish specimens.

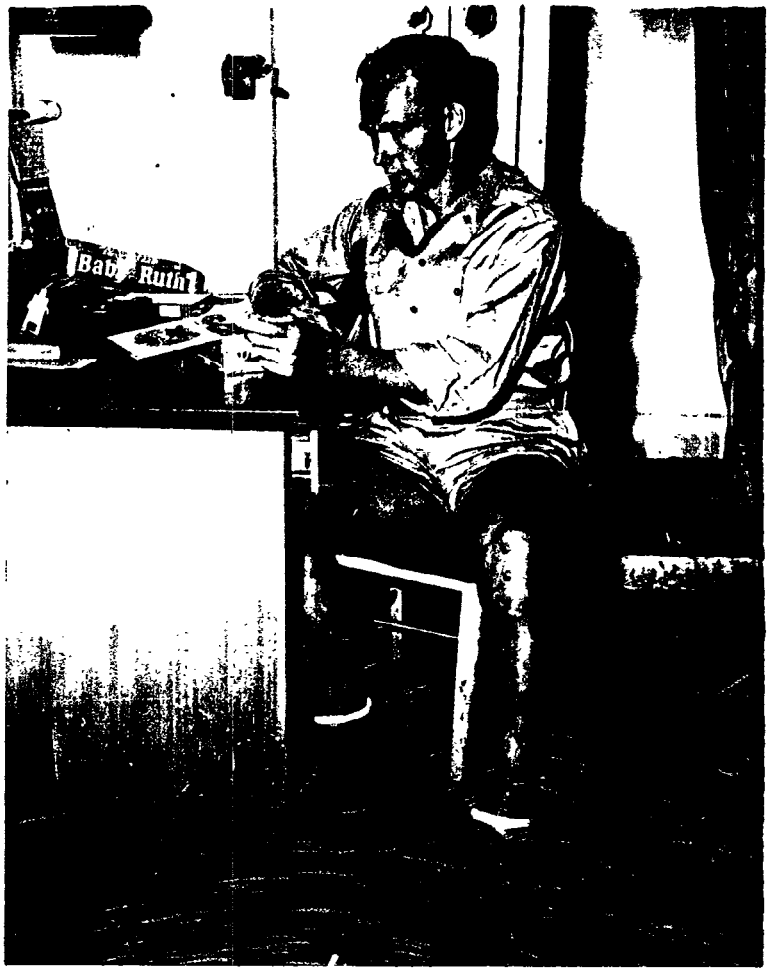


Figure 13. (ABCR 5111-6)

Mr. Allyn H. Seymour, Fisheries Biologist, making slide rule calculations on contained activity before entering same into log book.

shells, (Ostrea sp.) found on the pieces of wreckage were empty. This was especially true of the larger and, thus possibly older forms, that had reached the larger size before dying.

The entire organism was usually reduced to an ash for gross beta-gamma counting. In other cases the soft parts were removed from the shell and reduced to an ash before placing the residue in the counter. The gross beta-gamma counts are summarized in Table 2, part b. The counts due to fission products in this material were consistantly greater than similar tissues collected elsewhere about the atoll.

Some radioautographs were prepared from material collected in the target area. The prints made are included as figures 14, 15, 16, 17 and 18, to visually show the radiation emanating from the fission products that are contained in these organisms.

Invertebrate material from other parts of the lagoon.

A variety of invertebrate forms were collected at or near the locations where fish collections were made. The data on the area of collection, name of organism, date collected, and activity counts of the tissues sampled are listed in Table 2, part b.

The counts per gram of sample removed from the invertebrates, in the main, exceed the average counts from active substances from fish collected in the same area (Table 2).

The activity counts found in sponges average greater than counts in other organisms from similar areas.

The digestive glands of the invertebrates had the greatest average concentration of fission products.

Algae.

Samples of algae were collected at the various sampling locations. This material was ashed and the activity determined. The data summarizing this portion of the project is contained in Table 2, part c.

Active materials were present in the various species of algae collected from the waters in the lagoon. The amounts of active substances differed from one location to another and from species to species from the same general area. An unfortunate accident to the samples during the packing operations makes it impossible to further identify the specimens.

RONGERIK STUDIES

During the exploratory studies conducted at Rongerik Atoll during the period from August 12 to 19, 1947, a number of tuna and tuna-like fishes were fishes were captured by the representatives of the U. S. Fish and Wildlife Service. Sections of the livers of 35 of these fish were removed and returned to the laboratories on board the U.S.S. Chilton at Bikini for ashing and counting. The liver from one of these fish contained activity counts higher than chance variation (10.5 x 4.5). It is possible that this fish had obtained active fission products by direct or indirect contact with material from Bikini.

The data on the counts of the activity found in the livers of the Rongerik fish is given in Table 2, with a summary provided in Table 6.

COLLECTION OF MATERIAL FROM KWAJALEIN ATOLL

A small collection of fish, invertebrates, and algae was made near the stern of the Prinz Eugen in the Kwajalein lagoon on August 3, 1947. This material was packed in iced containers and returned to the U.S.S. Chilton at

Bikini where the amounts of fission products were determined.

The data listing the counts for the material collected is given in Table 2, and summarized in Table 5.

The counts obtained indicate a small trace of active materials to be found in some of the organisms living on or near the Prinz Eugen.

Additional studies should be conducted to further explore this problem. Material should be collected from the fouling growths on the hull, from animals living in the vicinity and possibly feeding on the forms living near or in contact with the hull, and from organisms that live along the intertidal zone of Carlton Island, down wind from the Prinz Eugen.

FUTURE WORK

It is impossible at this time to foresee all the problems and interpretations of the results that may arise from the material and data collected this far. It does, however, appear that a number of projects need further investigation.

1. Identification of the collections. The fish, invertebrates, and algae collected during the 1946 and 1947 seasons need to be positively identified. Specialists in the taxonomy of the various groups should be contacted to aid in working up the nomenclature of the material.

2. During the field work 2562 samples were prepared for counting gross beta-gamma activity. The samples that contained appreciable counts above background were retained. These ashed samples should be further analysed to determine the presence and amount of alpha emitters, the nature of the material responsible for the beta radiations, rate of decay, distribution of the various active substances in different tissues, etc.

3. Radioautographs produced with the new techniques should be made to trace the paths of the active materials. This work should amplify the gross radioautograph work as attempted during and immediately subsequent to the field work.

4. Tissue study of a basic nature is needed to know the normal histological and cytological pattern of some of the key organisms. This sort of study is necessary before comparative studies may be made on changes that may have been induced by the fission products.

5. Experiments under controlled laboratory conditions should be made to trace the cycles of radioactive elements from water to plants to animals. The degenerative effects on the organisms should be noted and described.

Figure 14.

Photograph shows sponge from which accompanying radioautograph was made. Sponge (probably horny type - species unknown) was picked up on beach along Bikini-Amen sand spit (grid chart references: 1709) on July 18, 1947. Magnification: app. life size.

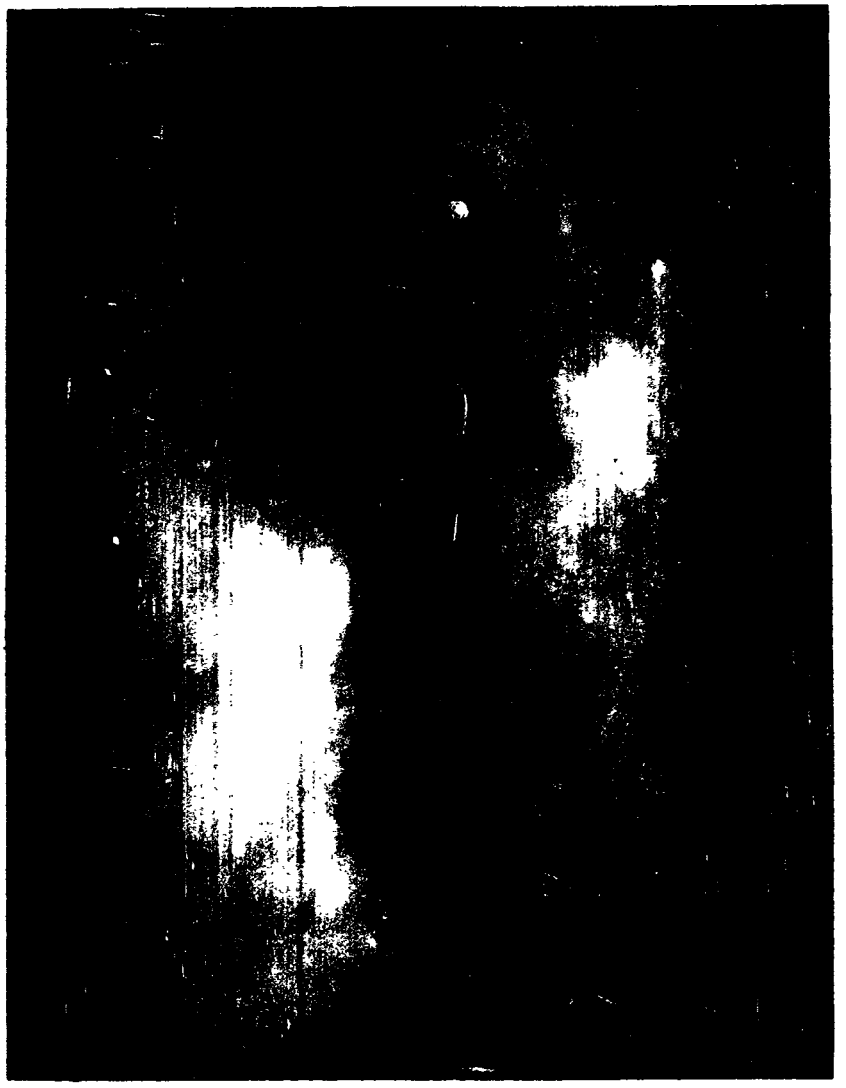
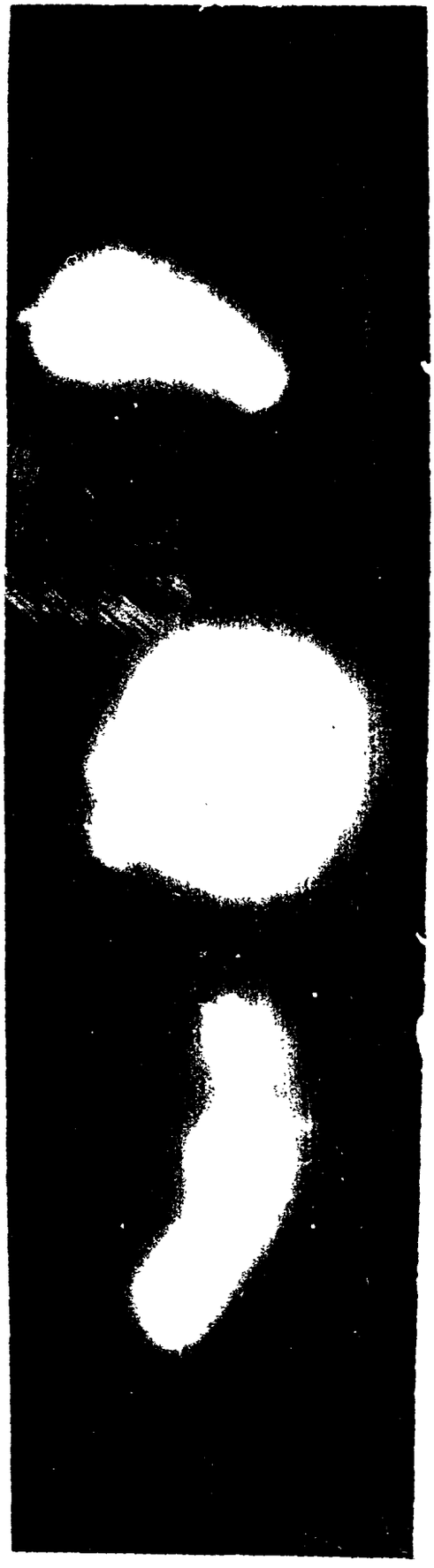


Figure 15.

Radioautograph made by sponge (probably horny type - species unknown) picked up on beach along Bikini-Amen sand spit (grid chart reference: 1709) on July 18, 1947. Magnification: app. life size.

Figure 16.

Radioautograph (left) and Photograph (right) shows three worm tubes (species unknown) taken off scraps of wreckage obtained by divers from U.S.S. SARATOGA on July 29, 1947. Magnification: app. 4 X.



shows
scraps
ARATOGA

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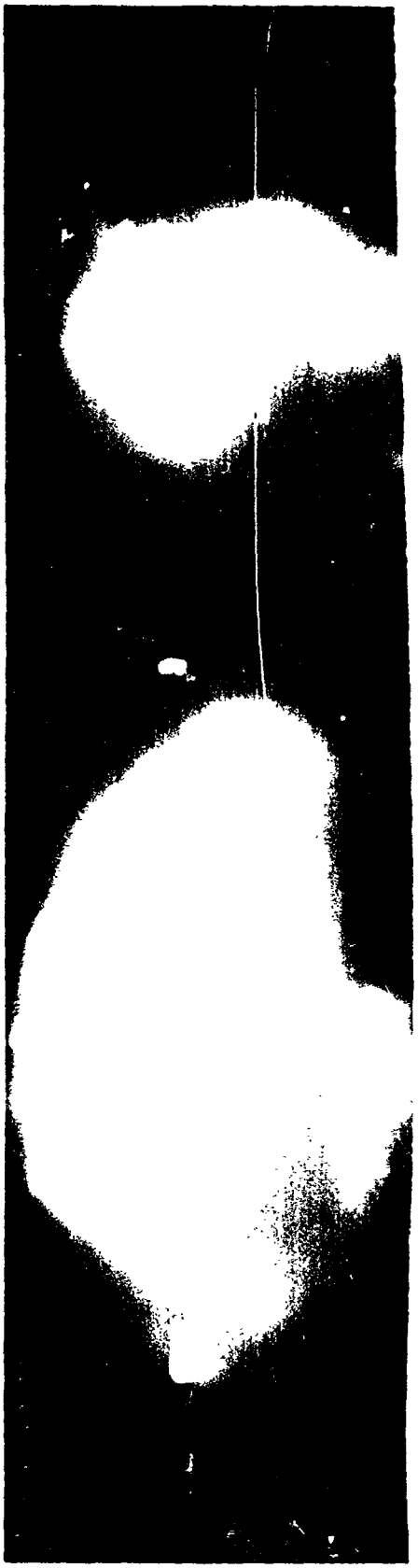
Figure 17.

Radioautograph (left) and Photograph (right) shows two oysters (genus: Ostrea - species unknown) taken off scraps of wreckage obtained by divers from U. S. S. SARATOGA on July 29, 1947. Magnification: app. 3-1/2X.



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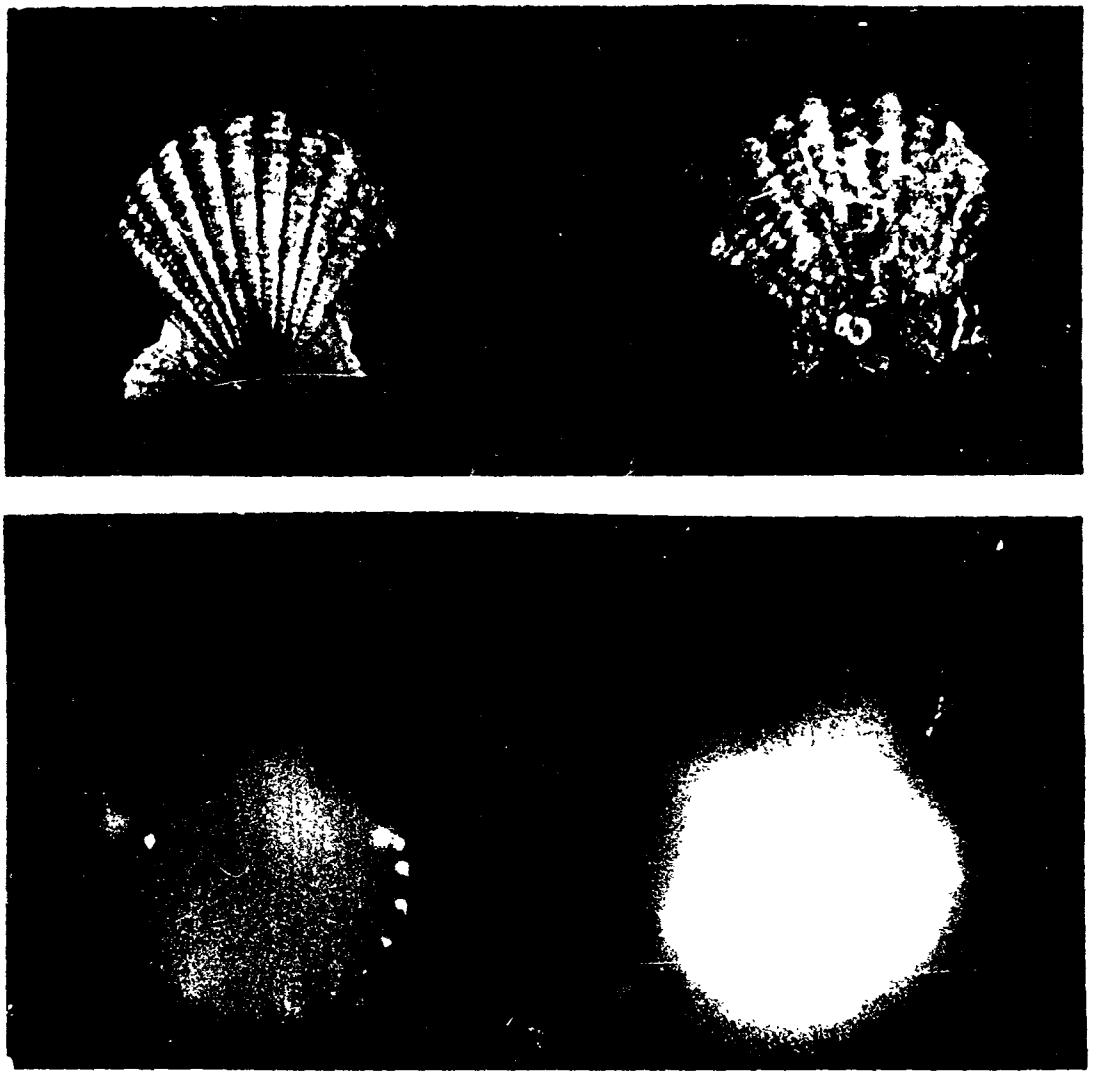

Figure 18.

Photograph (upper) and Radioautograph (lower) shows two small Pectens (Pecten spectabilis) taken off scraps of wreckage obtained by divers from U.S.S. SARATOGA on July 29, 1947. Magnification: app. 4-1/2X.