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RADIOACTIVITY SURVEY DATA in Japan

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National Institute of Radiological Sciences
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Radioactivity Survey Data in Japan

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Contents

Environmental and Dietary Materials*

(Japan Chemical Analysis Center)

1. Collection and pretreatment of samples

(1) Rain and dry fallout

Rain and dry fallout was collected monthly on a sampling tray, approximately 5000 cm^2 in area, which was filled with water to a depth of 1 cm at the beginning of every month.

The sample was filtered after strontium and cesium carriers were added. The tray was washed with 5ℓ of distilled water and the washing was combined to the filtrate. The sample was passed through a cation exchange column (500 mℓ of Dowex 50W X8, 50 ~ 100 mesh, Na form) at a rate of 80 mℓ/min.

(2) Airborne dust

Airborne dust was collected by an electrostatic precipitator or a filter air sampler for every three months at a rate of more than 3000 m^3 per month. The sampling was done 1 to 1.5 meters above the ground.

(3) Service water and freshwater

Service water, 100ℓ each, was collected at an intake of the water-treatment plant and at the tap after water was left running for five minutes. Water, to which added carriers of strontium and cesium immediately after sampling, was vigorously stirred and filtered. The subsequent process was the same as that described in the section (1). Freshwater was treated in the same way as the service water.

(4) Soil

Soil was collected from the location in the spacious and flat area without past disturbance on the surface caused by duststorms, inflow and outflow due to precipitation, and so on. Any places located under trees in a forest, in a stony area or inside of river banks were avoided. Soil was taken from two layers of different depths, 0 ~ 5 cm and 5 ~ 20 cm. In the course of air-drying, lumps were crushed by hand, and roots of plants and pebbles were removed. The soil was then passed through a 2 mm sieve to remove small gravels.

(5) Sea water

Sea water was collected at the fixed stations where the effect of terrestrial fresh water from rivers was expected to be negligibly small. A special consideration was also given to weather conditions. The sampling was carried out when there was no rainfall for the last few days. To prevent contamination, water samples were collected at the bow of a sampling boat just before she stood still by scooping surface water using a polyethylene bucket. Immediately after the collection, the samples were acidified to a pH lower than 3 by adding concentrated hydrochloric acid in a ratio of 1 mℓ to 1 ℓ of sea water, and then stored in 20 ℓ polyethylene containers. The sampling equipments as well as containers were thoroughly rinsed with dilute hydrochloric acid and then with distilled water before use. Two hundred milliliters of sea water was also collected at the same stations for the determination of chlorinity.

(6) Sea sediments

Sediment was collected in the same area as that for the sea water sample, taking the following criteria into account:

a. The depth of water exceeds 1 m at low tide.
b. No significant sedimental movement is observed in the vicinity of concern.
c. Mud, silt and fine sand are preferable.

A conventional sediment sampling device was used for collecting the top few centimeters of surface sediment. Approximately 4 kg of the sample in wet weight was spread on a large porcelain dish and dried in an electric oven at 105 to 110 °C to a constant weight.

(7) Total diet

A full one day ordinary diet including three meals, water, tea and other in-between snacks for five persons was collected as a sample of "total diet". The sample in a large stainless steel pan was carbonized carefully by direct application of gas flame, and was transferred to a porcelain dish and then ashed at 500°C in an electric muffle furnace.

(8) Rice

Polished rice was collected in producing districts at the harvest and in consuming areas when new crops were first put on sale. The sample was carbonized and ashed in a porcelain dish.

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* Samples were sent to the Center from 32 contracted prefectures.

(9) Milk

Raw milk was collected in producing districts and commercial milk was purchased in consuming districts. Milk in a stainless steel pan or a porcelain dish was evaporated to dryness followed by carbonization and ashing.

(10) Vegetables

Spinach and Japanese radish were selected as the representatives for leaf vegetables and for non-starch roots, respectively. After removing soil, the edible part of vegetable sample was dried and carbonized in a stainless steel pan or a porcelain dish.

(11) Tea

Five hundred grams of manufactured green tea was collected, carbonized and ashed in a stainless steel pan or a porcelain dish.

(12) Fish, shellfish and seaweeds

a. Sea fish and freshwater fish

Fish was rinsed with water and blotted with a filter paper. Only the edible part was used in case of larger sized fish, and the whole part was used in case of smaller ones. Each sample was weighed and placed in a stainless steel pan or a porcelain dish. After carbonized, the sample was ashed in an electric muffle furnace.

b. Shellfish

Approximately 4 kg of shellfish including the shells was collected or purchased. After removing the shells, it was treated in the same way as that for the sea fish.

c. Seaweeds

Edible seaweeds were collected and rinsed with water to remove sand and other adhering matters on the surface. These were removed of excess water, weighed, dried and ashed.

Table 1 shows detailes of sample collection.

Table 1 Details of sample collection

Sample	Frequency of sampling	Quantity of sample
= Environmental materials =		
(1) Rain and dry fallout		
1 for domestic program	monthly	
2 for WHO program	monthly	
(2) Airborne dust	quarterly	>3000 m^3/month
(3) Service water and freshwater		
1 Service water (sourse water)	semiyearly (June and December)	100 ℓ
2 Service water (tap water)	semiyearly (June and December)	100 ℓ
3 Freshwater	yearly (fishing season)	100 ℓ
(4) Soil		
1 0 ~ 5 cm	yearly (June or July)	4 kg
2 5 ~ 20 cm	yearly (June or July)	4 kg
(5) Sea water	yearly (July or August)	40 ℓ
(6) Sea sediments	yearly (July or August)	4 kg
= Dietary materials =		
(7) Total diet	semiyearly (June, November or December)	daily amount for 5 person
(8) Rice		
1 producing districts	yearly (harvesting season)	5 kg (polished rice)
2 consuming districts	yearly (harvesting season)	5 kg (polished rice)
(9) Milk		
1 producing districts for WHO program	quarterly (February, May, August and November)	3 ℓ
2 producing districts for domestic program	semiyearly (February and August)	3 ℓ

Sample	Frequency of sampling	Quantity of sample
3 consuming districts	semiyearly (February and August)	3 ℓ
4 powdered milk	semiyearly (April and October)	2 ~ 3 kg
(10) Vegetables		
1 producing districts	yearly (harvesting season)	4 kg
2 consuming districts	yearly (harvesting season)	4 kg
(11) Tea	yearly (the first harvesting season)	500 g (manufactured tea)
(12) Fish, shellfish, and seaweeds		
1 Sea fish	yearly (fishing season)	4 kg
2 Freshwater fish	yearly (fishing season)	4 kg
3 Shellfish	yearly (fishing season)	4 kg
4 Seaweeds	yearly (fishing season)	2 ~ 3 kg

2. Preparation of samples for analysis

(1) Rain, service water and freshwater

Strontium and cesium were eluted with hydrochloric acid from the cation exchange column. The residue of rain sample on the filter paper was ashed in an electric muffle furnace and the ash was dissolved in hydrochloric acid. The insoluble part was filtered and washed. The filtrate and the washings were combined to the previous eluate and used for radiochemical analysis.

(2) Soil

Air-dried soil was passed through a 20 mesh sieve. The sieved sample was heated, in the presence of strontium and cesium carriers, together with sodium hydroxide. The sample was then heated with hydrochloric acid and the insoluble part was filtered and washed. The combined solution of the filtrate and washings was used for radiochemical analysis.

(3) Sea sediments

After removal of pebbles, shells and other foreign matters, the sediment sample was dried in a hot-air oven and ground finely with a mortar. The sample was passed through a 20 mesh sieve. The further preparation of the sample was the same as that described in the section 2-(2).

(4) Rice

The ashed sample was pulverlized with a porcelain mortar and passed through a 42 mesh sieve. The sieved sample to which both strontium and cesium carriers were added, was digested with hydrochloric acid by heating. After the sample was heated again with nitric acid to dryness, strontium and cesium were extracted with hydrochloric acid and water. The insoluble part was filtered and washed. The filtrate and washings were combined for subsequent radiochemical analysis.

(5) Airborne dust, diet, milk, vegetable, fish and shellfish, seaweeds, tea, and others

These ashed samples were treated with the same procedure as that described in the section 2-(4).

3. Separation of strontium-90 and cesium-137

(1) Strontium-90

Sample solutions, prepared as in the foregoing sections 2-(1) through 2-(5), were neutralized with sodium hydroxide. After sodium carbonate was added, the precipitate of strontium and calcium carbonates was separated. The supernatant solution was retained for cesium-137 determination. The carbonates were dissolved in hydrochloric acid and calcium and strontium were precipitated as oxalates. The precipitate was dissolved in nitric acid and strontium was separated from calcium by successive fuming nitric acid separations. Iron scavenge was made after addition of ferric iron carrier followed by barium chromate separation after addition of barium carrier to remove radium, its daughters and lead. Strontium was recovered as carbonate, and the precipitate was dried and weighed to determine strontium recovery. The strontium carbonate was dissolved in hydrochloric acid and the iron carrier was added. The solution was allowed to stand

for two weeks for strontium-90 and yttrium-90 to attain equilibrium. The yttrium-90 was coprecipitated with ferric hydroxide and the precipitate was filtered off, washed and counted.

(2) Cesium-137

The supernatant separated from the strontium fraction in the solution was acidified with hydrochloric acid. While stirring the solution, cesium was adsorbed on ammonium molybdophosphate.

After filtered off and washed with dilute nitric acid, the precipitate was dissolved in 2.5N sodium hydroxide solution. Ammonia was removed completely from the solution by boiling. The solution was adjusted to pH 8.2 with hydrochloric acid and allowed to cool. Molybdenum hydroxide which came out in the solution, was filtered off and washed with water. In such circumstance that ontamination by rubidium-87 was not negligible for the measurement of cesium-137, the following ion-exchange procedure was applied. A fixed amount of ferric chloride solution was added to the solution dissolved with 2.5N sodium hydroxide. Ammonia and molybdenum hydroxide were removed as described above. Ethylenediaminetetraaceticacid tetrasodium salt was added to the filtrate and washings. Cesium and rubidium were adsorbed on a cation exchange resin. Cesium was separated from rubidium by eluting with hydrochloric acid.

To this eluate or the filtrate and washings after removing molybdenum hydroxide, chloroplatinic acid solution was added to precipitate cesium. The precipitate was filtered onto a tared paper in a demountable filter and washed with water and then ethanol. After fixing the filter paper on a tared planchette and drying it, the chemical yield of cesium was determined by weighing the precipitate with the planchette. Radioactivity from cesium-137 was measured for this precipitate.

4. Determination of stable strontium, calcium and potassium

A weighed amount of soil or sea sediment was treated under heating with sodium hydroxide and then with hydrochloric acid for extraction. A weighed aliquot of ashed samples of total diet, vegetables, milk, fish, shellfish or seeweeds was digested using hydrochloric acid or nitric acid, hydrofluoric acid being used when necessary. The extract was made up to an appropriate volume with dilute hydrochloric acid. The sample solution was analyzed for calcium by titration with standard potassium permanganate solution after separating calcium as oxalate. Atomic absorption spectroscopy was applied when appropriate. Stable strontium and potassium were determined by atomic absorption and flame emission spectrometry, respectively.

5. Counting

After the radiochemical separation, the mounted precipitates were counted for activity using low background beta counters normally for 60 min. Net sample counting rates were corrected for counter efficiency, recovery, self-absorption and decay to obtain the content of strontium-90 and cesium-137 radio activity per sample aliquot. From the results, concentrations of these nuclides in the original samples were calculated.

6. Results

(1)-1 Strontium-90 and Cesium-137 in Rain and dry fallout (for domestic program) (from Apr. 1981 to Jul. 1981)

– continued from No. 57 of this publication –

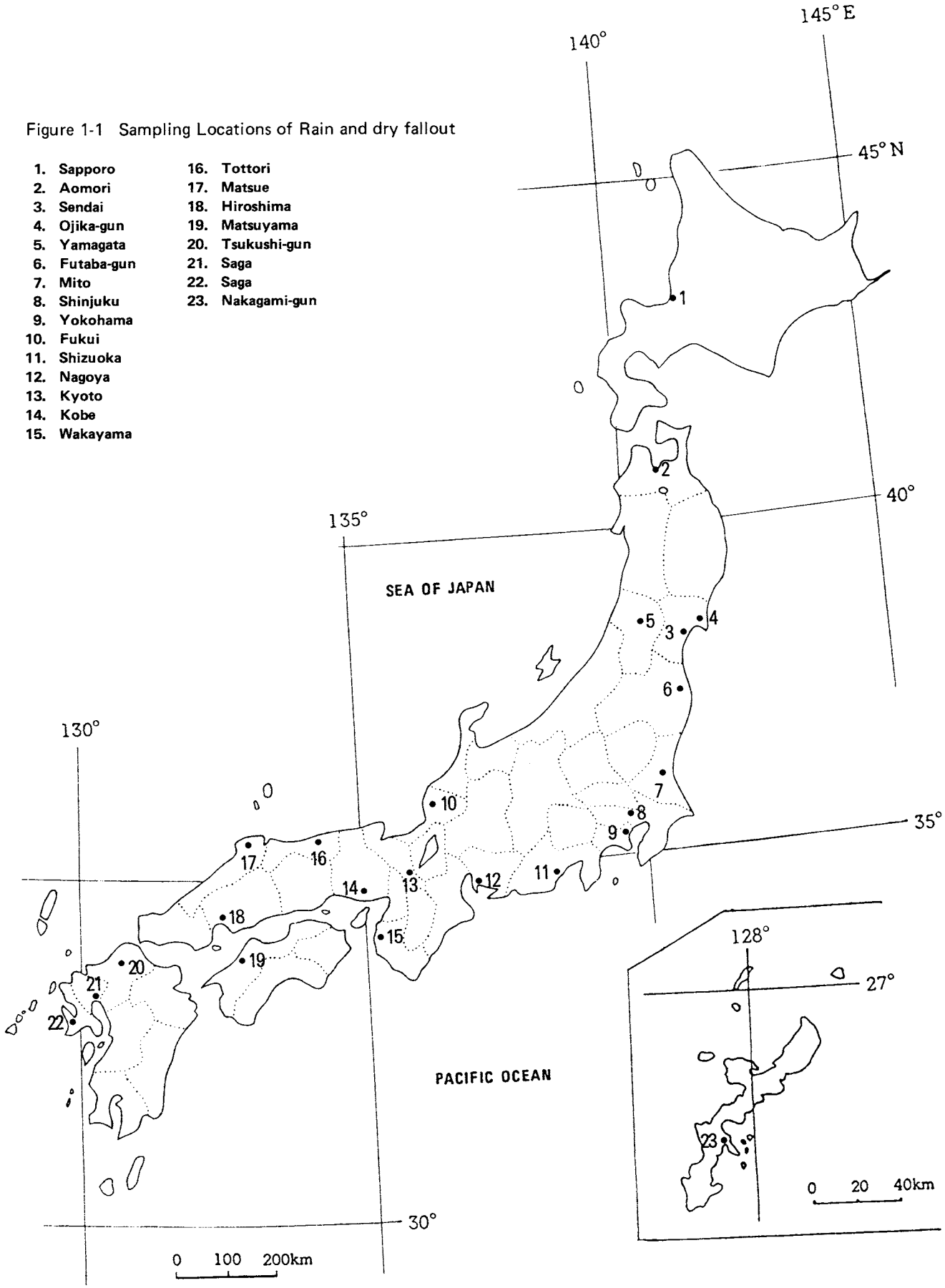
Table (1)-1: Strontium-90 and Cesium-137 in Rain and dry fallout

Location	Duration (Days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
April, 1981				
Sapporo, HOKKAIDO	31	86.0	0.045 ± 0.0016	0.067 ± 0.0020
Aomori, AOMORI	31	27	0.060 ± 0.0019	0.089 ± 0.0023
Sendai, MIYAGI	30	159.2	0.089 ± 0.0022	0.13 ± 0.003
Yamagata, YAMAGATA	30	51.5	0.053 ± 0.0017	0.081 ± 0.022
Futaba-gun, FUKUSHIMA	31	171	0.11 ± 0.002	0.21 ± 0.003
Mito, IBARAGI	31	148.5	0.10 ± 0.002	0.15 ± 0.003
Shinjuku, TOKYO	30	145	0.070 ± 0.0021	0.11 ± 0.002
Yokohama, KANAGAWA	32	215.8	0.11 ± 0.003	0.18 ± 0.003
Fukui, FUKUI	31	132.3	0.082 ± 0.0023	0.15 ± 0.003
Shizuoka, SHIZUOKA	30	380.0	0.13 ± 0.003	0.22 ± 0.004
Nagoya, AICHI	31	162	0.084 ± 0.0021	0.13 ± 0.003
Kyoto, KYOTO	30	161.5	0.073 ± 0.0021	0.10 ± 0.002
Kobe, HYOGO	32	124.1	0.079 ± 0.0021	0.13 ± 0.003
Wakayama, WAKAYAMA	30	130	0.059 ± 0.0019	0.079 ± 0.0022
Tottori, TOTTORI	31	169.04	0.080 ± 0.0022	0.13 ± 0.003
Matsue, SHIMANE	31	127.9	0.085 ± 0.0024	0.12 ± 0.003
Hiroshima, HIROSHIMA	30	175.1	0.095 ± 0.0025	0.14 ± 0.003
Matsuyama, EHIME	32	136.0	0.053 ± 0.0018	0.080 ± 0.0022
Tsukushi-gun, FUKUOKA	30	154.4	0.088 ± 0.0024	0.14 ± 0.003
Saga, SAGA	30	186.2	0.081 ± 0.0021	0.13 ± 0.003
Nagasaki, NAGASAKI	30	200.5	0.092 ± 0.0022	0.13 ± 0.003
Nakagami-gun, OKINAWA	35	118.5	0.023 ± 0.0012	0.038 ± 0.0015
May, 1981				
Sapporo, HOKKAIDO	32	70.5	0.084 ± 0.0022	0.13 ± 0.003
Aomori, AOMORI	31	117.6	0.077 ± 0.0022	0.12 ± 0.003
Ojika-gun, MIYAGI	32	149.0	0.11 ± 0.003	0.10 ± 0.002
Yamagata, YAMAGATA	33	121	0.066 ± 0.0019	0.10 ± 0.002
Fukushima, FUKUSHIMA	32	196	0.12 ± 0.002	0.19 ± 0.003

Location	Duration (Days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
Mito, IBARAGI	32	166.5	0.10 ± 0.003	0.16 ± 0.003
Shinjuku, TOKYO	32	145	0.091 ± 0.0023	0.15 ± 0.003
Yokohama, KANAGAWA	32	150.6	0.066 ± 0.0018	0.12 ± 0.003
Fukui, FUKUI	32	225.5	0.11 ± 0.003	0.18 ± 0.003
Shizuoka, SHIZUOKA	32	174.0	0.11 ± 0.003	0.18 ± 0.003
Nagoya, AICHI	32	179	0.097 ± 0.0023	0.18 ± 0.003
Kyoto, KYOTO	32	208.9	0.13 ± 0.003	0.18 ± 0.003
Kobe, HYOGO	32	132.2	0.062 ± 0.0020	0.12 ± 0.003
Wakayama, WAKAYAMA	32	143	0.069 ± 0.0021	0.11 ± 0.003
Tottori, TOTTORI	32	193.28	0.11 ± 0.002	0.16 ± 0.003
Matsue, SHIMANE	32	132.5	0.084 ± 0.0022	0.12 ± 0.003
Hiroshima, HIROSHIMA	32	113.2	0.044 ± 0.0018	0.053 ± 0.0019
Matsuyama, EHIME	32	99	±	0.078 ± 0.0021
Tsukushi-gun, FUKUOKA	31	131.4	0.062 ± 0.0019	0.091 ± 0.0022
Saga, SAGA	32	171.3	0.070 ± 0.0019	0.010 ± 0.002
Nagasaki, NAGASAKI	32	148.5	0.073 ± 0.0019	0.11 ± 0.002
Nakagami-gun, OKINAWA	27	171.5	0.032 ± 0.0014	0.056 ± 0.0018
June, 1981				
Sapporo, HOKKAIDO	31	50.0	0.048 ± 0.0017	0.078 ± 0.0021
Aomori, AOMORI	31	128.3	0.093 ± 0.0024	0.13 ± 0.003
Yamagata, YAMAGATA	30	246.1	0.11 ± 0.002	0.17 ± 0.003
Futaba-gun, FUKUSHIMA	31	193	0.093 ± 0.0024	0.16 ± 0.003
Shinjuku, TOKYO	31	187.7	0.048 ± 0.0017	0.073 ± 0.0021
Yokohama, KANAGAWA	30	122.3	0.049 ± 0.0017	0.077 ± 0.0021
Shizuoka, SHIZUOKA	31	168.5	0.052 ± 0.0018	0.087 ± 0.0022
Nagoya, AICHI	31	144	0.042 ± 0.0016	0.068 ± 0.0021
Kyoto, KYOTO	31	186.6	0.043 ± 0.0016	0.074 ± 0.0021
Kobe, HYOGO	33	167.1	0.062 ± 0.0020	0.097 ± 0.0023
Wakayama, WAKAYAMA	33	178.7	0.060 ± 0.0020	0.089 ± 0.0024
Tottori, TOTTORI	31	234.68	0.049 ± 0.0018	0.067 ± 0.0020
Hiroshima, HIROSHIMA	34	328.0	0.029 ± 0.0014	0.12 ± 0.003
Nagasaki, NAGASAKI	31	491.0	0.041 ± 0.0015	0.065 ± 0.0019
Nakagami-gun, OKINAWA	31	44.0	0.014 ± 0.0009	0.022 ± 0.0013
July, 1981				
Yamagata, YAMAGATA	32	83.3	0.021 ± 0.0012	0.039 ± 0.0015
Nagoya, AICHI	32	161	0.016 ± 0.0010	0.029 ± 0.0014
Kobe, HYOGO	32	79.0	0.014 ± 0.0010	0.026 ± 0.0013

Figure 1-1 Sampling Locations of Rain and dry fallout

1. Sapporo
2. Aomori
3. Sendai
4. Ojika-gun
5. Yamagata
6. Futaba-gun
7. Mito
8. Shinjuku
9. Yokohama
10. Fukui
11. Shizuoka
12. Nagoya
13. Kyoto
14. Kobe
15. Wakayama
16. Tottori
17. Matsue
18. Hiroshima
19. Matsuyama
20. Tsukushi-gun
21. Saga
22. Saga
23. Nakagami-gun



(1)-2 Strontium-90 and Cesium-137 in Rain and dry fallout (for WHO program) (from Apr. 1981 to Jul. 1981)

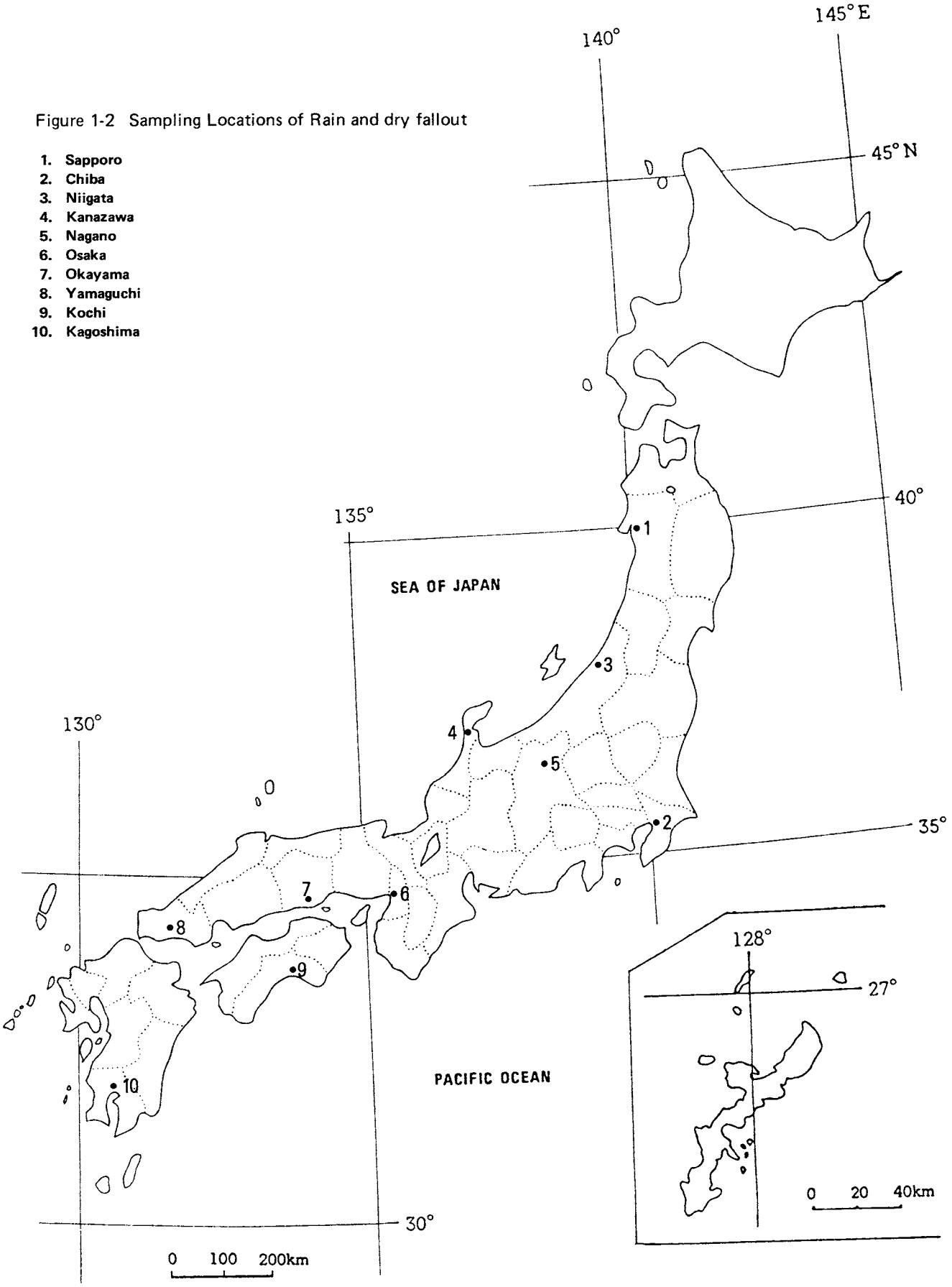
– continued from No. 57 of this publication –

Table (1)-2: Strontium-90 and Cesium-137 in Rain and dry fallout

Location	Duration (Days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
April, 1981				
Akita, AKITA	31	115.9	0.081 ± 0.0021	0.14 ± 0.003
Niigata, NIIGATA	32	84.81	0.055 ± 0.0018	0.077 ± 0.0021
Kanazawa, ISHIKAWA	31	147.0	0.099 ± 0.0024	0.14 ± 0.003
Nagano, NAGANO	31	61.0	±	0.066 ± 0.0020
Osaka, OSAKA	31	162.87	0.069 ± 0.0020	0.11 ± 0.002
Okayama, OKAYAMA	30	118	0.023 ± 0.0012	0.040 ± 0.0016
Yamaguchi, YAMAGUCHI	32	271.5	0.10 ± 0.002	0.17 ± 0.003
Kochi, KOCHI	30	330.5	0.19 ± 0.003	0.30 ± 0.004
Kagoshima, KAGOSHIMA	30	260.5	0.11 ± 0.002	0.14 ± 0.003
Chiba, CHIBA	28	187.2	0.081 ± 0.0025	0.13 ± 0.003
May, 1981				
Akita, AKITA	32	183.1	0.14 ± 0.003	0.21 ± 0.003
Niigata, NIIGATA	32	174.70	0.14 ± 0.003	0.20 ± 0.003
Kanazawa, ISHIKAWA	32	192.5	0.16 ± 0.003	0.25 ± 0.004
Nagano, NAGANO	32	127.0	0.063 ± 0.0020	0.095 ± 0.0023
Osaka, OSAKA	32	156.59	0.083 ± 0.0021	0.13 ± 0.003
Okayama, OKAYAMA	32	116.2	0.064 ± 0.0019	0.11 ± 0.002
Yamaguchi, YAMAGUCHI	32	119.5	0.054 ± 0.0018	0.088 ± 0.0022
Kochi, KOCHI	32	107.9	0.057 ± 0.0018	0.072 ± 0.0020
Kagoshima, KAGOSHIMA	32	173.8	0.073 ± 0.0020	0.12 ± 0.003
Chiba, CHIBA	35	125.1	0.047 ± 0.0017	0.081 ± 0.0021
June, 1981				
Akita, AKITA	31	216.5	0.12 ± 0.003	0.20 ± 0.003
Niigata, NIIGATA	31	183.62	0.060 ± 0.0019	0.093 ± 0.0033
Kanazawa, ISHIKAWA	32	260.0	0.061 ± 0.0019	0.12 ± 0.003
Nagano, NAGANO	31	138.0	0.051 ± 0.0018	0.079 ± 0.0021
Osaka, OSAKA	31	147.76	0.037 ± 0.0015	0.064 ± 0.0019
Okayama, OKYAMA	31	296.2	0.057 ± 0.0019	0.094 ± 0.0024
Yamaguchi, YAMAGUCHI	31	517.0	0.045 ± 0.0017	0.072 ± 0.0020
Kochi, KOCHI	31	181.1	0.038 ± 0.0015	0.061 ± 0.0019
Kagoshima, KAGOSHIMA	31	181	0.025 ± 0.0013	0.052 ± 0.0018
Chiba, CHIBA	31	133.7	0.075 ± 0.0022	0.12 ± 0.003
July, 1981				
Chiba, CHIBA	31	34.6	0.012 ± 0.0010	0.025 ± 0.0013

Figure 1-2 Sampling Locations of Rain and dry fallout

1. Sapporo
2. Chiba
3. Niigata
4. Kanazawa
5. Nagano
6. Osaka
7. Okayama
8. Yamaguchi
9. Kochi
10. Kagoshima



(2) Strontium-90 and Cesium-137 Airborne dust (from Apr. 1981 to Jun. 1981)

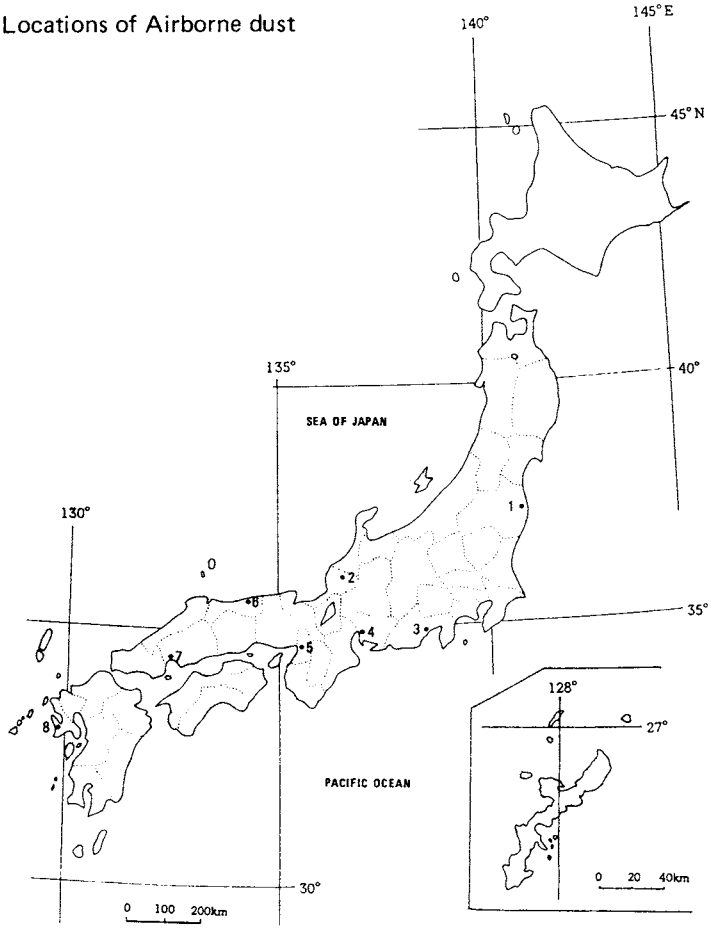
– continued from No. 57 of this publication –

Table 2: Strontium-90 and Cesium-137 in Airborne dust

Location	Sampling period	Absorption volume (m^3)	^{90}Sr (10^{-3}pCi/m^3)	^{137}Cs (10^{-3}pCi/m^3)
April ~ June 1981				
Futaba-gun, FUKUSHIMA	4 ~ 6	9,321	0.6 ± 0.05	1.0 ± 0.05
Fukui, FUKUI	4 ~ 6	26,313	1.2 ± 0.03	2.1 ± 0.04
Shizuoka, SHIZUOKA	4 ~ 6	10,429	1.5 ± 0.07	2.4 ± 0.07
Nagoya, AICHI	4 ~ 6	11,707	4.6 ± 0.19	2.0 ± 0.06
Osaka, OSAKA	4 ~ 6	8,424	0.9 ± 0.06	1.4 ± 0.06
Tottori, TOTTORI	4 ~ 6	11,531.0	1.4 ± 0.06	2.1 ± 0.06
Hiroshima, HIROSHIMA	4 ~ 6	10,800	0.8 ± 0.05	1.3 ± 0.05
Nagasaki, NAGASAKI	4 ~ 6	10,105	1.8 ± 0.07	3.1 ± 0.08

Figure 2 Sampling Locations of Airborne dust

1. **Futaba-gun**
2. **Fukui**
3. **Shizuoka**
4. **Nagoya**
5. **Osaka**
6. **Tottori**
7. **Hiroshima**
8. **Nagasaki**



(3) Strontium-90 and Cesium-137 in Service water (from Jun. 1981 to Jul. 1981)

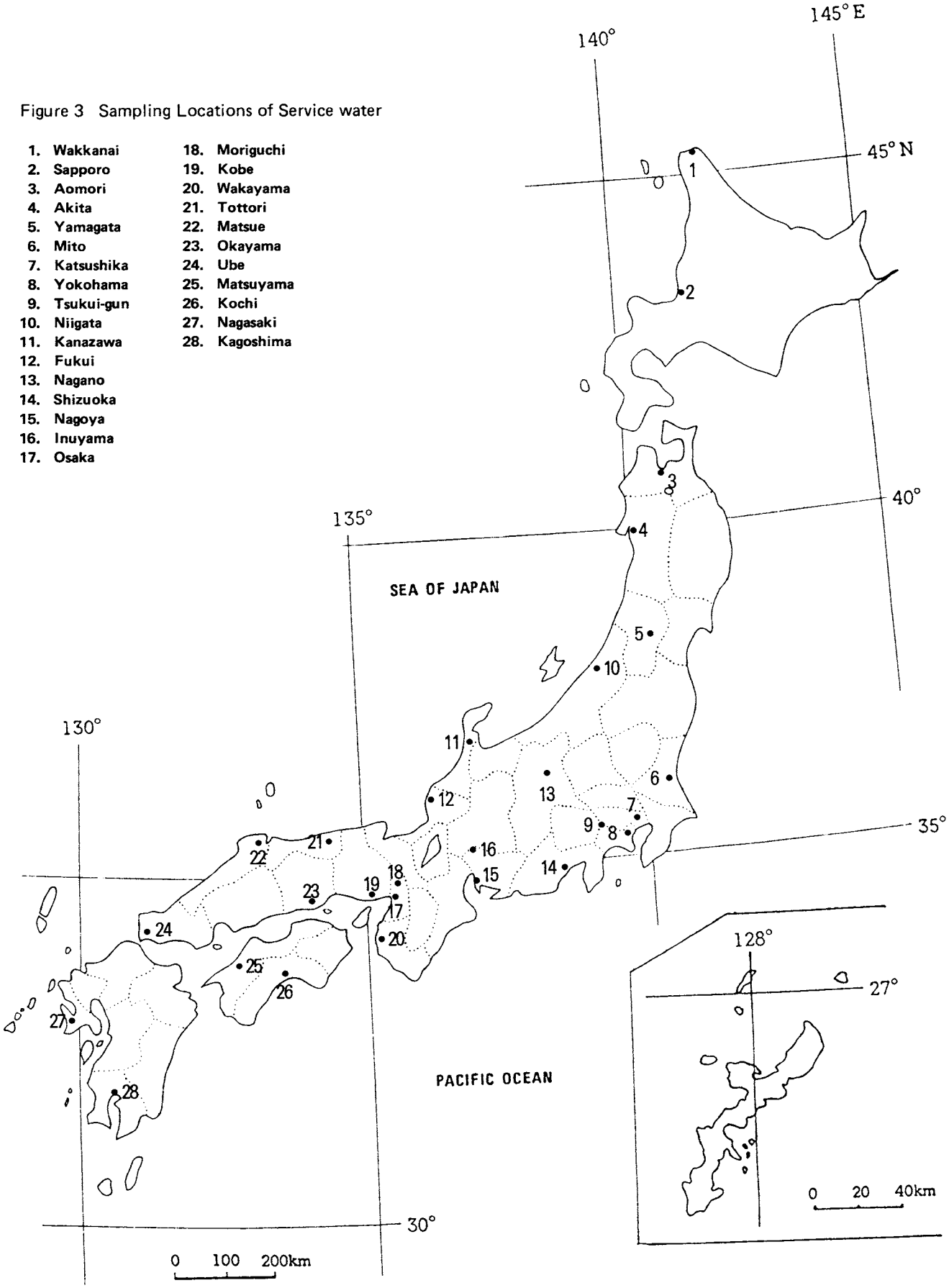
– continued from No. 57 of this publication –

Table 3: Strontium-90 and Cesium-137 in Service water

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
(Source water)			
June, 1981			
Sapporo, HOKKAIDO	6.9	0.07 ± 0.005	0.01 ± 0.004
Katsushika, TOKYO	6.9	0.11 ± 0.006	0.02 ± 0.004
Tsukui-gun, KANAGAWA	7.3	0.03 ± 0.004	0.01 ± 0.003
Inuyama, AICHI	6.8	0.11 ± 0.006	0.01 ± 0.004
Moriguchi, OSAKA	7.0	0.25 ± 0.008	0.01 ± 0.004
(Tap water)			
June, 1981			
Aomori, AOMORI	6.5	0.06 ± 0.005	0.01 ± 0.004
Akita, AKITA	6.95	0.20 ± 0.008	0.01 ± 0.003
Yamagata, YAMAGATA	7.2	0.10 ± 0.006	0.01 ± 0.004
Mito, IBARAGI	6.2	0.08 ± 0.005	0.01 ± 0.003
Katsushika, TOKYO	6.9	0.13 ± 0.007	0.01 ± 0.004
Yokohama, KANAGAWA	6.5	0.04 ± 0.004	0.005 ± 0.003
Niigata, NIIGATA	7.12	0.16 ± 0.008	0.01 ± 0.003
Kanazawa, ISHIKAWA	7.1	0.12 ± 0.007	0.01 ± 0.003
Fukui, FUKUI	6.8	0.01 ± 0.003	0.002 ± 0.003
Nagano, NAGANO	7.29	0.04 ± 0.004	0.01 ± 0.004
Shizuoka, SHIZUOKA	7.1	0.004 ± 0.003	0.00 ± 0.003
Nagoya, AICHI	6.5	0.09 ± 0.006	0.004 ± 0.003
Osaka, OSAKA	7.0	0.19 ± 0.008	0.003 ± 0.003
Kobe, HYOGO	6.36	0.13 ± 0.007	0.01 ± 0.003
Wakayama, WAKAYAMA	7.5	0.09 ± 0.007	0.02 ± 0.004
Tottori, TOTTORI	7.5	0.11 ± 0.006	0.001 ± 0.003
Okayama, OKAYAMA	6.7	0.04 ± 0.004	0.01 ± 0.003
Matsuyama, EHIME	6.97	0.06 ± 0.005	0.03 ± 0.004
Kochi, KOCHI	7.1	0.007 ± 0.005	0.00 ± 0.003
Nagasaki, NAGASAKI	7.2	0.07 ± 0.005	0.01 ± 0.003
Kagoshima, KAGOSHIMA	6.95	0.01 ± 0.003	0.003 ± 0.003
July, 1981			
Wakkanai, HOKKAIDO	7.0	0.40 ± 0.012	0.02 ± 0.004
Matsue, SHIMANE	6.4	0.12 ± 0.006	0.01 ± 0.003
Ube, YAMAGUCHI	6.0	0.08 ± 0.006	0.01 ± 0.003

Figure 3 Sampling Locations of Service water

1. Wakkanai
2. Sapporo
3. Aomori
4. Akita
5. Yamagata
6. Mito
7. Katsushika
8. Yokohama
9. Tsukui-gun
10. Niigata
11. Kanazawa
12. Fukui
13. Nagano
14. Shizuoka
15. Nagoya
16. Inuyama
17. Osaka
18. Moriguchi
19. Kobe
20. Wakayama
21. Tottori
22. Matsue
23. Okayama
24. Ube
25. Matsuyama
26. Kochi
27. Nagasaki
28. Kagoshima



(4) Strontium-90 and Cesium-137 in Freshwater (from Dec. 1980 to Jul. 1981)

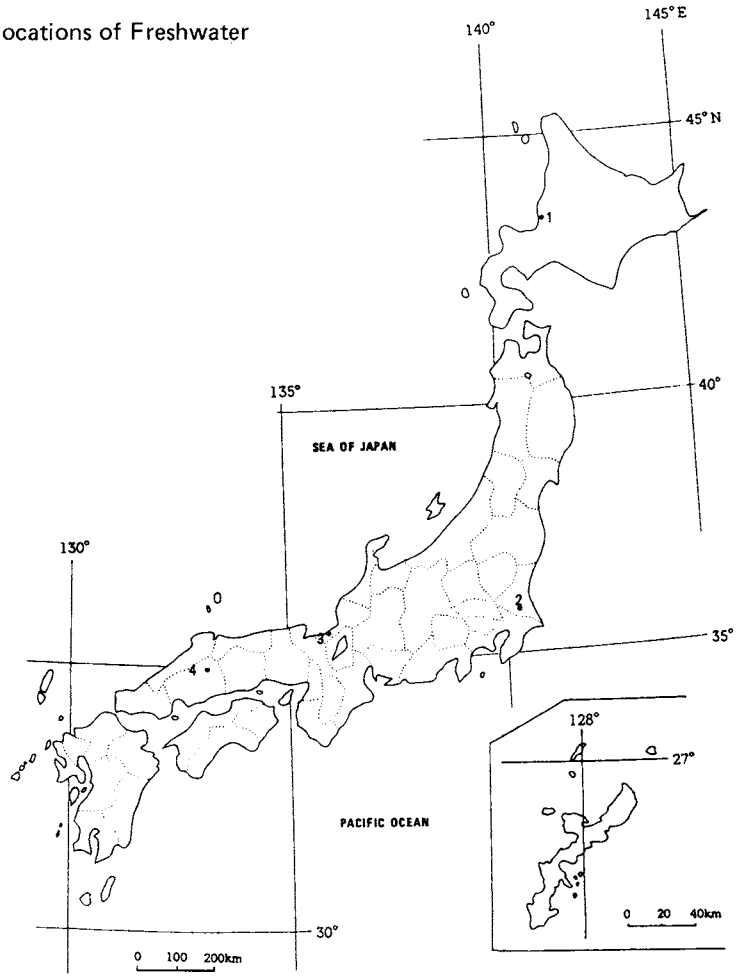
– continued from No. 54 of this publication –

Table 4: Strontium-90 and Cesium-137 in Freshwater

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
December, 1980			
Mikata-lake, FUKUI	6.9	0.21 ± 0.008	0.06 ± 0.005
Shobara, HIROSHIMA	7.5	0.05 ± 0.005	0.03 ± 0.004
May, 1981			
Kasumigaura, IBARAGI	7.6	0.24 ± 0.009	0.05 ± 0.005
July, 1981			
Ishikari-gun, HOKKAIDO	7.2	0.15 ± 0.007	0.04 ± 0.004

Figure 4 Sampling Locations of Freshwater

1. **Ishikari-gun**
2. **Kasumigaura**
3. **Mikata-lake**
4. **Shobara**



(5) Strontium-90 and Cesium-137 in Soil (from May 1981 to Jul. 1981)

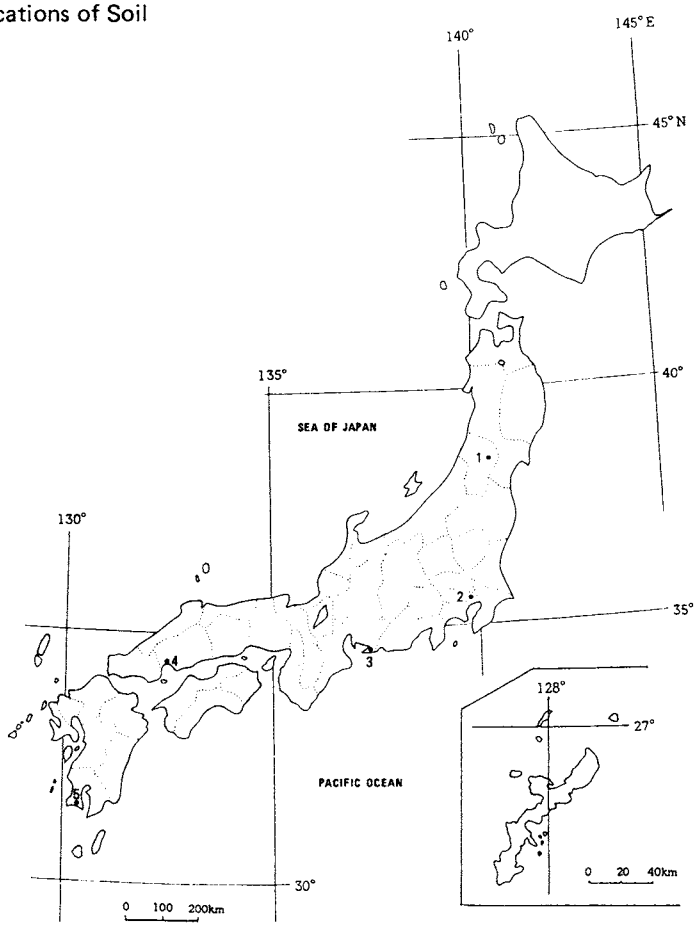
– continued from No. 54 of this publication –

Table 5: Strontium-90 and Cesium-137 in Soil

Location	Sampling Depth (cm)	^{90}Sr (pCi/kg)	^{90}Sr (mCi/km^2)	^{137}Cs (pCi/kg)	^{137}Cs (mCi/km^2)
May, 1981					
Atsumi-gun, AICHI	0 ~ 5	39 ± 4.1	2.4 ± 0.25	700 ± 14	43 ± 0.8
〃	5 ~ 20	41 ± 4.2	8.3 ± 0.83	320 ± 9	65 ± 1.9
July, 1981					
Yamagata, YAMAGATA	0 ~ 5	310 ± 10	12 ± 0.4	1,200 ± 20	46 ± 0.7
〃	5 ~ 20	170 ± 8	21 ± 1.0	120 ± 7	15 ± 0.8
Katsushika, TOKYO	0 ~ 5	30 ± 3.8	3.4 ± 0.43	37 ± 4.4	4.2 ± 0.50
〃	5 ~ 20	80 ± 5.5	12 ± 0.8	310 ± 9	46 ± 1.4
Ibusuki-gun, KAGOSHIMA	0 ~ 5	150 ± 7	7.5 ± 0.35	850 ± 15	43 ± 0.8
〃	5 ~ 20	250 ± 9	38 ± 1.3	510 ± 12	76 ± 1.8

Figure 5 Sampling Locations of Soil

1. **Yamagata**
2. **Katsushika**
3. **Atsumi-gun**
4. **Hiroshima**
5. **Ibusuki-gun**



(6) Strontium-90 and Cesium-137 in Total diet (from May 1981 to Jul. 1981)

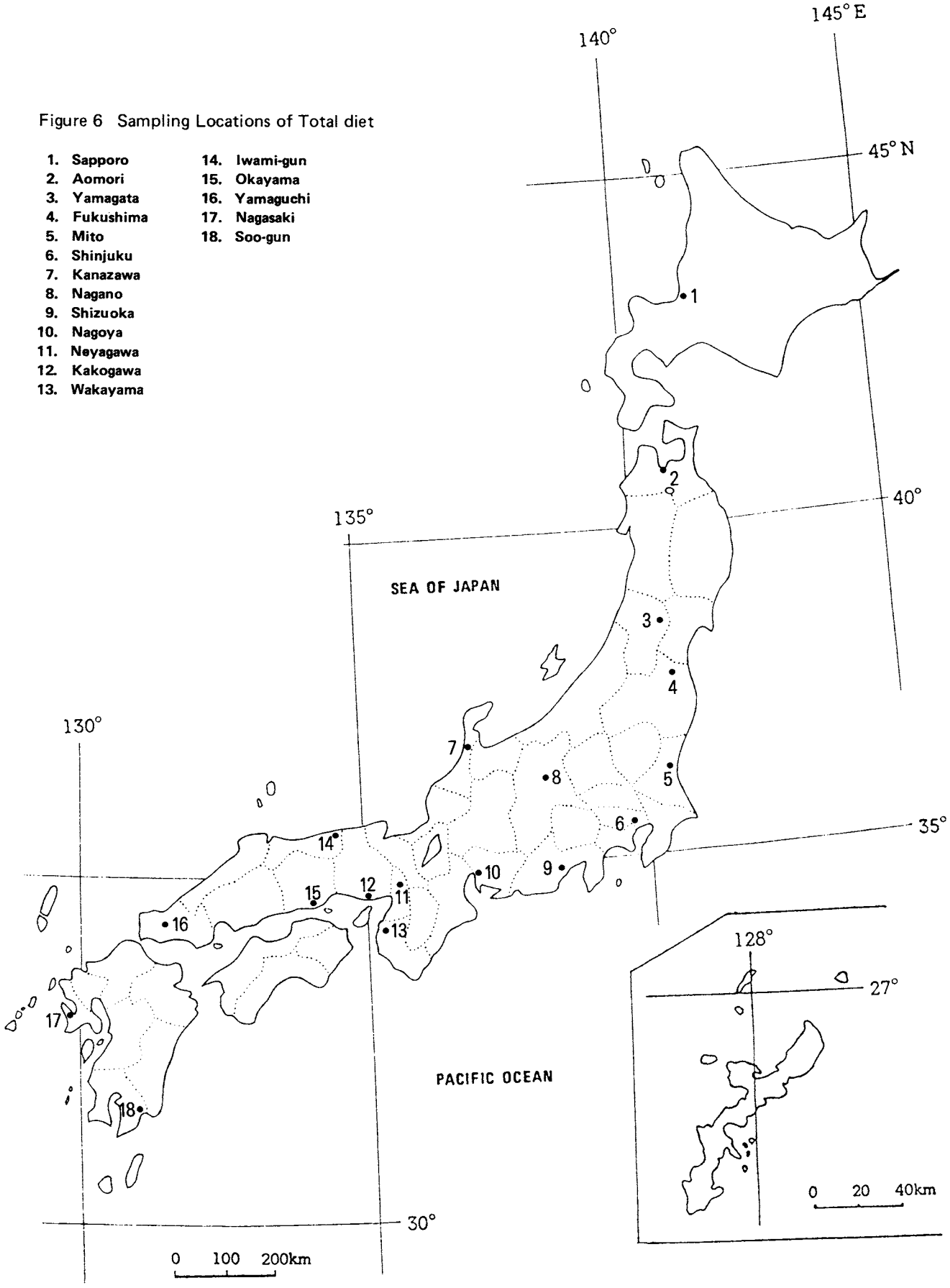
– continued from No. 57 of this publication –

Table 6: Strontium-90 and Cesium-137 in Total diet

Location	Ash	Ca	K	^{90}Sr		^{137}Cs	
	(g/p/d)	(mg/p/d)	(mg/p/d)	pCi/p/d	S.U.	pCi/p/d	C.U.
May, 1981							
Wakayama, WAKAYAMA	13.9	591	1,520	2.6 ± 0.28	4.3 ± 0.47	1.6 ± 0.22	1.1 ± 0.14
June, 1981							
Sapporo, HOKKAIDO	17.7	571	1,870	4.2 ± 0.39	7.3 ± 0.68	3.3 ± 0.31	1.8 ± 0.16
Aomori, AOMORI	19.5	859	2,130	5.1 ± 0.44	5.9 ± 0.52	2.8 ± 0.32	1.3 ± 0.15
Fukushima, FUKUSHIMA	16.7	551	2,290	4.0 ± 0.40	7.2 ± 0.73	4.1 ± 0.33	1.8 ± 0.14
Mito, IBARAGI	18.3	482	2,410	3.1 ± 0.37	6.5 ± 0.77	3.5 ± 0.33	1.4 ± 0.14
Shinjuku, TOKYO	13.3	417	1,660	2.2 ± 0.28	5.3 ± 0.68	3.7 ± 0.27	2.2 ± 0.16
Kanazawa, ISHIKAWA	20.4	582	2,170	2.3 ± 0.38	4.0 ± 0.64	4.0 ± 0.36	1.8 ± 0.17
Nagano, NAGANO	18.9	652	2,410	3.0 ± 0.39	4.7 ± 0.60	2.1 ± 0.29	0.9 ± 0.12
Shizuoka, SHIZUOKA	17.8	548	2,520	2.7 ± 0.35	5.0 ± 0.64	4.1 ± 0.33	1.6 ± 0.13
Nagoya, AICHI	14.3	658	2,090	3.1 ± 0.30	4.8 ± 0.46	3.9 ± 0.29	1.9 ± 0.14
Neyagawa, OSAKA	12.0	308	1,850	1.9 ± 0.29	6.1 ± 0.95	1.9 ± 0.22	1.0 ± 0.12
Kakogawa, HYOGO	12.1	534	1,880	2.8 ± 0.26	5.2 ± 0.50	1.7 ± 0.21	0.9 ± 0.11
Iwami-gun, TOTTORI	14.8	399	2,040	3.5 ± 0.36	8.7 ± 0.90	2.1 ± 0.24	1.0 ± 0.12
Okayama, OKAYAMA	15.4	446	1,760	2.8 ± 0.36	6.2 ± 0.81	1.3 ± 0.22	0.7 ± 0.13
Nagasaki, NAGASAKI	13.2	395	1,820	1.8 ± 0.26	4.6 ± 0.66	2.1 ± 0.22	1.2 ± 0.12
July, 1981							
Yamagata, YAMAGATA	16.0	295	1,880	1.4 ± 0.28	4.9 ± 0.97	3.0 ± 0.27	1.6 ± 0.15
Yamaguchi, YAMAGUCHI	14.3	317	1,610	1.4 ± 0.38	4.3 ± 1.2	3.7 ± 0.47	2.3 ± 0.29
Soo-gun, KAGOSHIMA	15.1	591	2,080	1.5 ± 0.27	2.5 ± 0.45	4.5 ± 0.31	2.1 ± 0.15

Figure 6 Sampling Locations of Total diet

1. Sapporo
2. Aomori
3. Yamagata
4. Fukushima
5. Mito
6. Shinjuku
7. Kanazawa
8. Nagano
9. Shizuoka
10. Nagoya
11. Neyagawa
12. Kakogawa
13. Wakayama
14. Iwami-gun
15. Okayama
16. Yamaguchi
17. Nagasaki
18. Soo-gun



(7)-1 Strontium-90 and Cesium-137 in Milk (producing districts for WHO program) (from May 1981 to Jun. 1981)

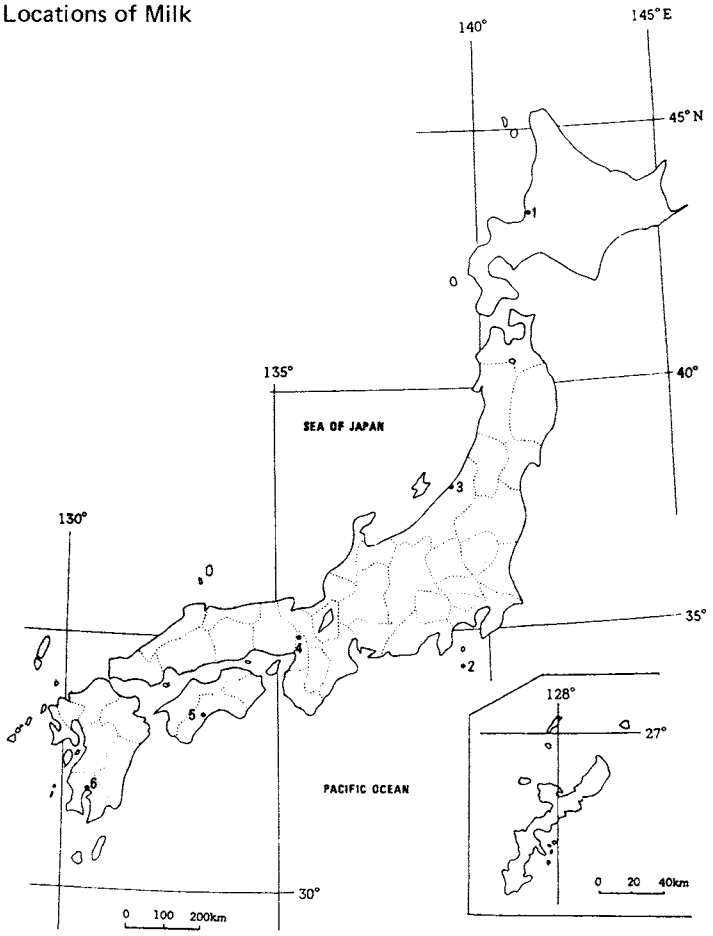
– continued from No. 57 of this publication –

Table (7)-1: Strontium-90 and Cesium-137 in Milk

Location	Ash	Ca	K	^{90}Sr		^{137}Cs	
	(g/p/d)	(mg/p/d)	(mg/p/d)	pCi/p/d	S.U.	pCi/p/d	C.U.
May, 1981							
Hachijyo-Island, TOKYO	5.89	0.872	1.36	4.4 ± 0.36	5.1 ± 0.41	24 ± 0.6	17 ± 0.4
Toyono-gun, OSAKA	7.42	1.11	1.60	1.4 ± 0.26	1.3 ± 0.23	1.3 ± 0.22	0.8 ± 0.14
Kochi, KOCHI	7.19	1.05	1.67	3.9 ± 0.32	3.8 ± 0.31	5.5 ± 0.34	3.3 ± 0.20
June, 1981							
Sapporo, HOKKAIDO	7.21	1.18	1.66	2.9 ± 0.32	2.5 ± 0.27	9.0 ± 0.41	5.4 ± 0.24
Nishikanbara-gun, NIIGATA	7.46	1.09	1.72	2.1 ± 0.30	1.9 ± 0.28	9.0 ± 0.40	5.2 ± 0.23
Aira-gun, KAGOSHIMA	6.94	1.05	1.59	1.8 ± 0.25	1.7 ± 0.24	4.2 ± 0.29	2.7 ± 0.18

Figure 7-1 Sampling Locations of Milk

1. **Sapporo**
2. **Hachijyo-Island**
3. **Nishikanbara-gun**
4. **Toyono-gun**
5. **Kochi**
6. **Aira-gun**



(7)-2 Strontium-90 and Cesium-137 in Milk (consuming districts) (Jun. 1981)

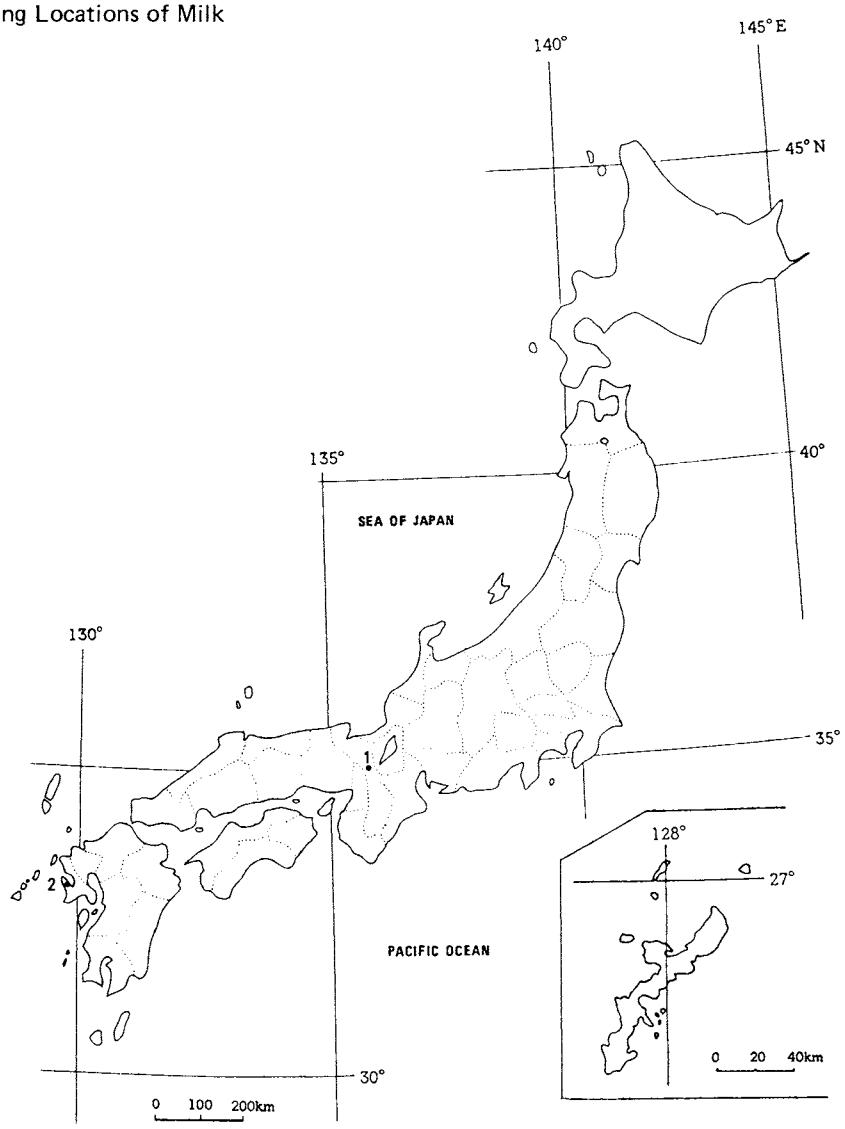
– continued from No. 57 of this publication –

Table (7)-2: Strontium-90 and Cesium-137 in Milk

Location	Ash	Ca	K	^{90}Sr		^{137}Cs	
	(g/p/d)	(mg/p/d)	(mg/p/d)	pCi/p/d	S.U.	pCi/p/d	C.U.
June, 1981							
Kyoto, KYOTO	6.92	1.02	1.62	1.7 ± 0.27	1.7 ± 0.26	1.6 ± 0.23	1.0 ± 0.14
Nagasaki, NAGASAKI	7.04	1.04	1.69	1.6 ± 0.25	1.6 ± 0.24	3.0 ± 0.27	1.8 ± 0.16

Figure 7-2 Sampling Locations of Milk

1. **Kyoto**
2. **Nagasaki**



(7)-3 Strontium-90 and Cesium-137 in Milk (powdered milk) (May 1981)

– continued from No. 54 of this publication –

Table (7)-3: Strontium-90 and Cesium-137 in Milk

Name of manufacturer	Component			^{90}Sr		^{137}Cs	
	Ash (%)	Ca (%)	K (%)	pCi/kg	S.U.	pCi/kg	C.U.
May, 1981							
Morinaga	2.28	0.347	0.508	3.8 ± 0.40	1.1 ± 0.12	13 ± 0.6	2.5 ± 0.12
Yukijirushi	2.34	0.384	0.452	7.3 ± 0.55	1.9 ± 0.14	45 ± 1.1	9.9 ± 0.25
Meiji	2.74	0.452	0.600	12 ± 0.7	2.7 ± 0.15	63 ± 1.3	11 ± 0.2
Wakodo	2.37	0.341	0.585	4.4 ± 0.45	1.3 ± 0.13	9.4 ± 0.6	1.6 ± 0.10
*Morinaga	8.56	1.35	1.93	23 ± 1.1	1.7 ± 0.08	26 ± 1.0	1.3 ± 0.05
*Meiji	8.39	1.29	1.96	44 ± 2.1	3.4 ± 0.17	150 ± 2	7.8 ± 0.12

*Skim milk

(8)-1 Strontium-90 and Cesium-137 in Vegetables (producing districts) (May 1981)

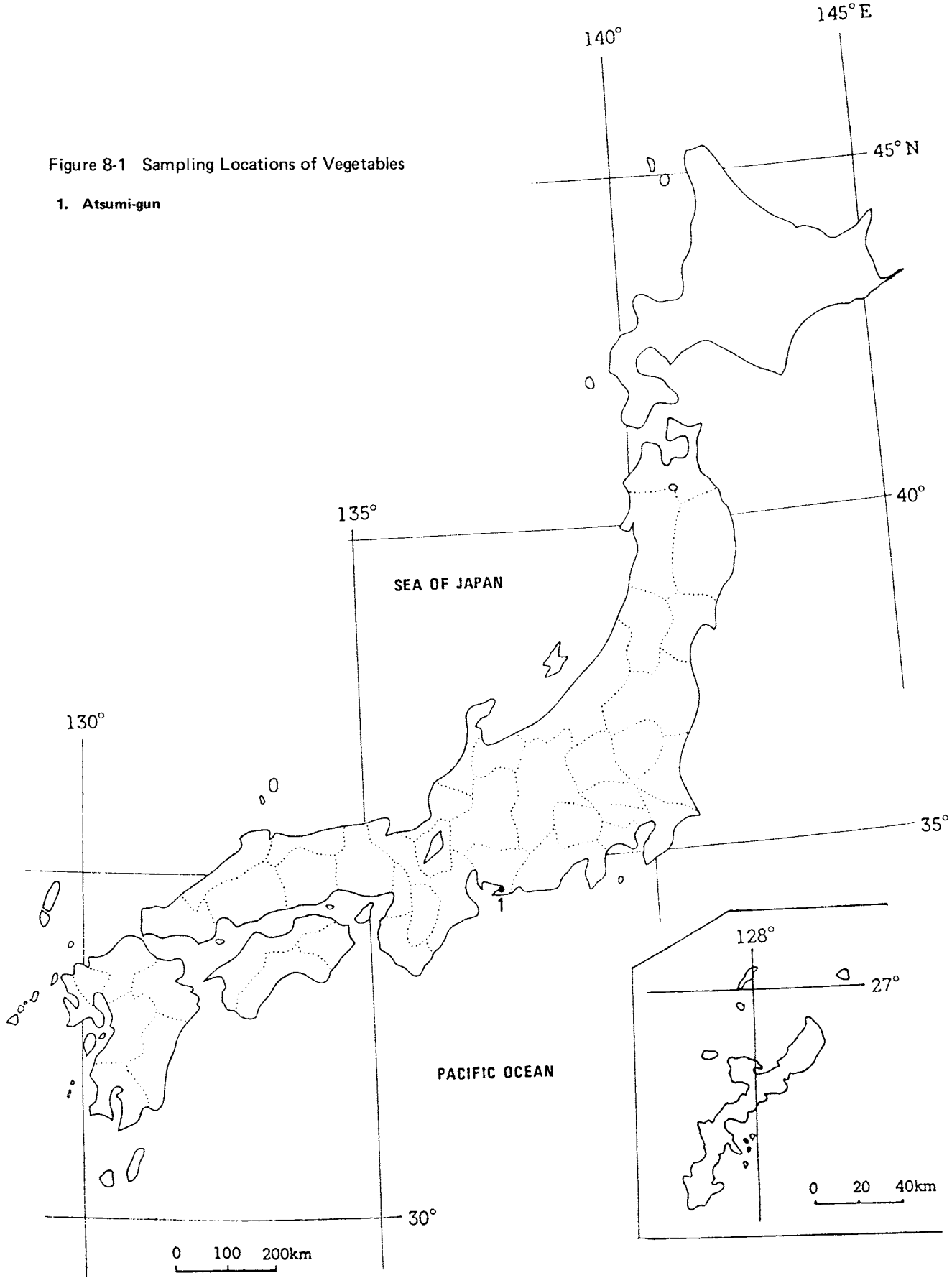
– continued from No. 57 of this publication –

Table (8)-1: Strontium-90 and Cesium-137 in Vegetable

Location	Component			^{90}Sr		^{137}Cs	
	Ash (%)	Ca (%)	K (%)	pCi/kg	S.U.	pCi/kg	C.U.
(Japanese radish)							
May, 1981							
Atsumi-gun, AICHI	0.719	0.028	0.322	2.5 ± 0.31	8.9 ± 1.1	0.3 ± 0.18	0.1 ± 0.06
(Spinach)							
May, 1981							
Atsumi-gun, AICHI	1.35	0.046	0.545	3.1 ± 0.36	6.6 ± 0.77	3.0 ± 0.33	0.5 ± 0.06

Figure 8-1 Sampling Locations of Vegetables

1. Atsumi-gun



(8)-2 Strontium-90 and Cesium-137 in Vegetables (consuming districts) (Jun. 1981)

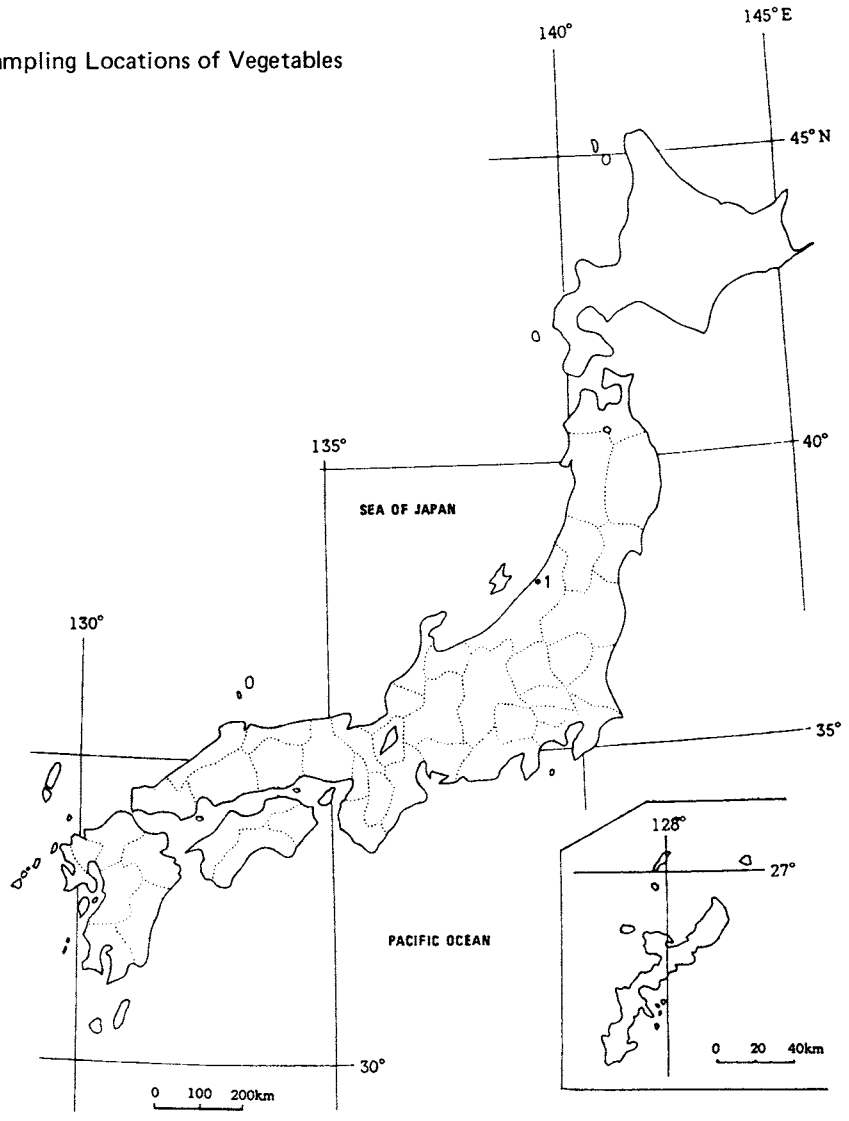
– continued from No. 57 of this publication –

Table (8)-2: Strontium-90 and Cesium-137 in Vegetables

Location	Component			^{90}Sr		^{137}Cs	
	Ash (%)	Ca (%)	K (%)	pCi/kg	S.U.	pCi/kg	C.U.
(Spinach)							
June, 1981							
Niigata, NIIGATA	1.31	0.077	0.491	9.4 ± 0.55	12 ± 0.7	5.8 ± 0.44	1.2 ± 0.09

Figure 8-2 Sampling Locations of Vegetables

1. Niigata



(9) Strontium-90 and Cesium-137 in Tea (Japanese tea) (from May 1981 to Jul. 1981)

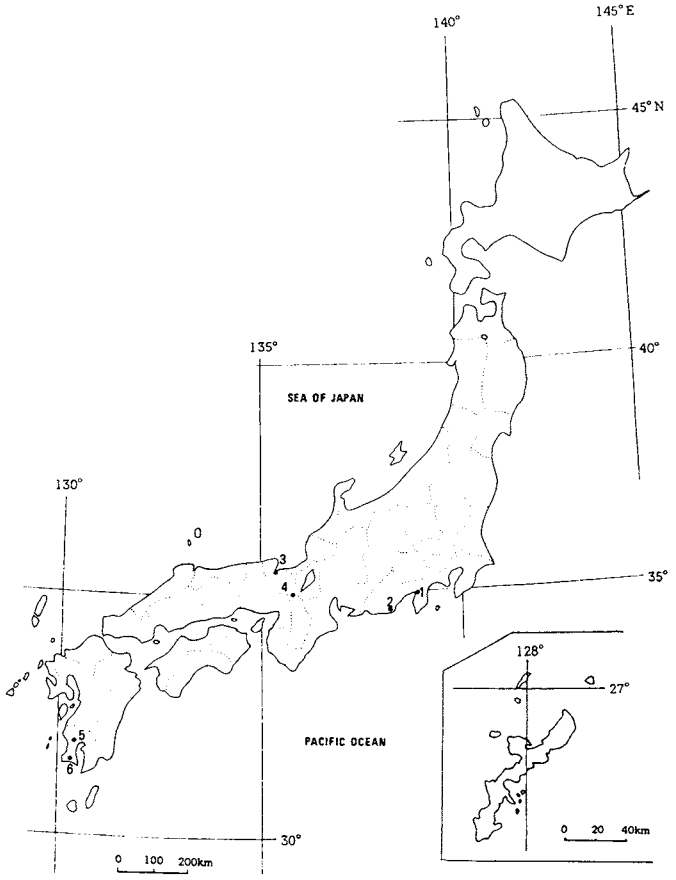
– continued from No. 53 of this publication –

Table 9: Strontium-90 and Cesium-137 in Tea

Location	Component			^{90}Sr		^{137}Cs	
	Ash (%)	Ca (%)	K (%)	pCi/kg	S.U.	pCi/kg	C.U.
May, 1981							
Yosa-gun, KYOTO	4.99	0.310	1.90	100 ± 4	33 ± 1.3	160 ± 4	8.5 ± 0.21
Uji, KYOTO	5.11	0.257	2.01	64 ± 3.3	25 ± 1.3	72 ± 2.9	3.6 ± 0.14
June, 1981							
Tagata-gun, SHIZUOKA	4.99	0.422	1.68	140 ± 5	34 ± 1.1	100 ± 3	6.1 ± 0.20
Iwata, SHIZUOKA	5.11	0.313	1.82	54 ± 3.0	17 ± 1.0	92 ± 3.2	5.0 ± 0.18
Satsuma-tun, KAGOSHIMA	5.24	0.303	2.00	89 ± 4.0	29 ± 1.3	150 ± 4	7.4 ± 0.21
July, 1981							
Kawabe-gun, KAGOSHIMA	5.22	0.268	2.15	53 ± 3.4	20 ± 1.3	160 ± 4	7.5 ± 0.20

Figure 9 Sampling Locations of Tea (Japanese tea)

1. **Tagata-gun**
2. **Iwata**
3. **Yosa-gun**
4. **Uji**
5. **Satsuma-gun**
6. **Kawabe-gun**



(10) Strontium-90 and Cesium-137 in Sea fish (from May 1981 to Jun. 1981)

– continued from No. 57 of this publication –

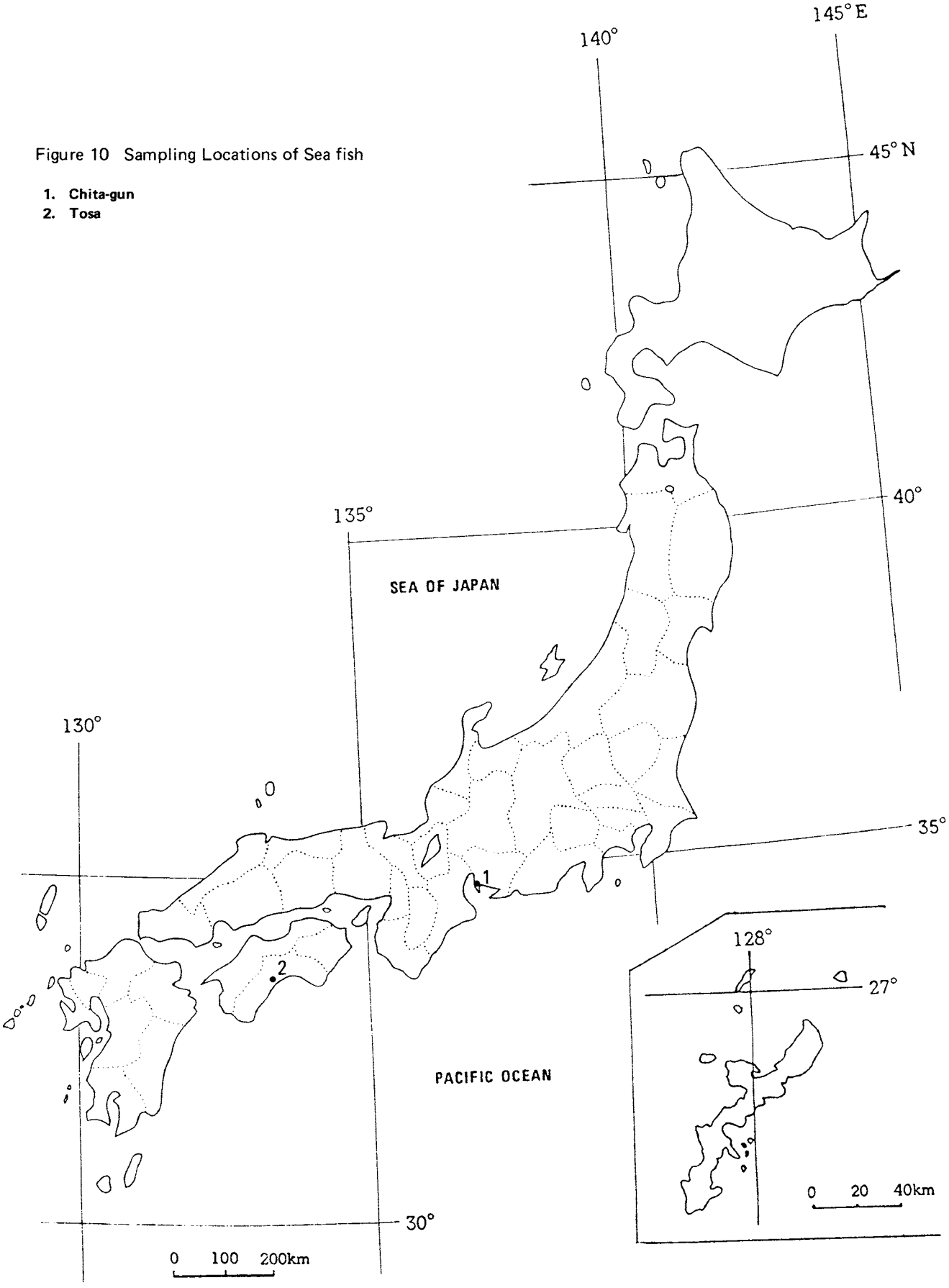
Table 10: Strontium-90 and Cesium-137 in Sea fish

Location	Sampling Date	Component			^{90}Sr		^{137}Cs	
		Ash (%)	Ca (%)	K (%)	pCi/kg	S.U.	pCi/kg	C.U.
Sillago sihame								
Chita-gun, AICHI	Jun. 1981	3.58	22.6	8.67	0.7 ± 0.24	0.1 ± 0.03	3.4 ± 0.31	1.1 ± 0.10
Katsuwonus pelamis								
Tosa, KOCHI	May 1981	1.36	3.78	31.1	0.1 ± 0.20	0.2 ± 0.37	19 ± 0.5	4.2 ± 0.12

Scientific name	English name	Japanese name
Sillago sihame	Sillago	Kisu
Katsuwonus pelamis	Bonito	Katsuo

Figure 10 Sampling Locations of Sea fish

1. **Chita-gun**
2. **Tosa**



(11) Strontium-90 and Cesium-137 in Freshwater fish (Jul. 1981)

– continued from No. 54 of this publication –

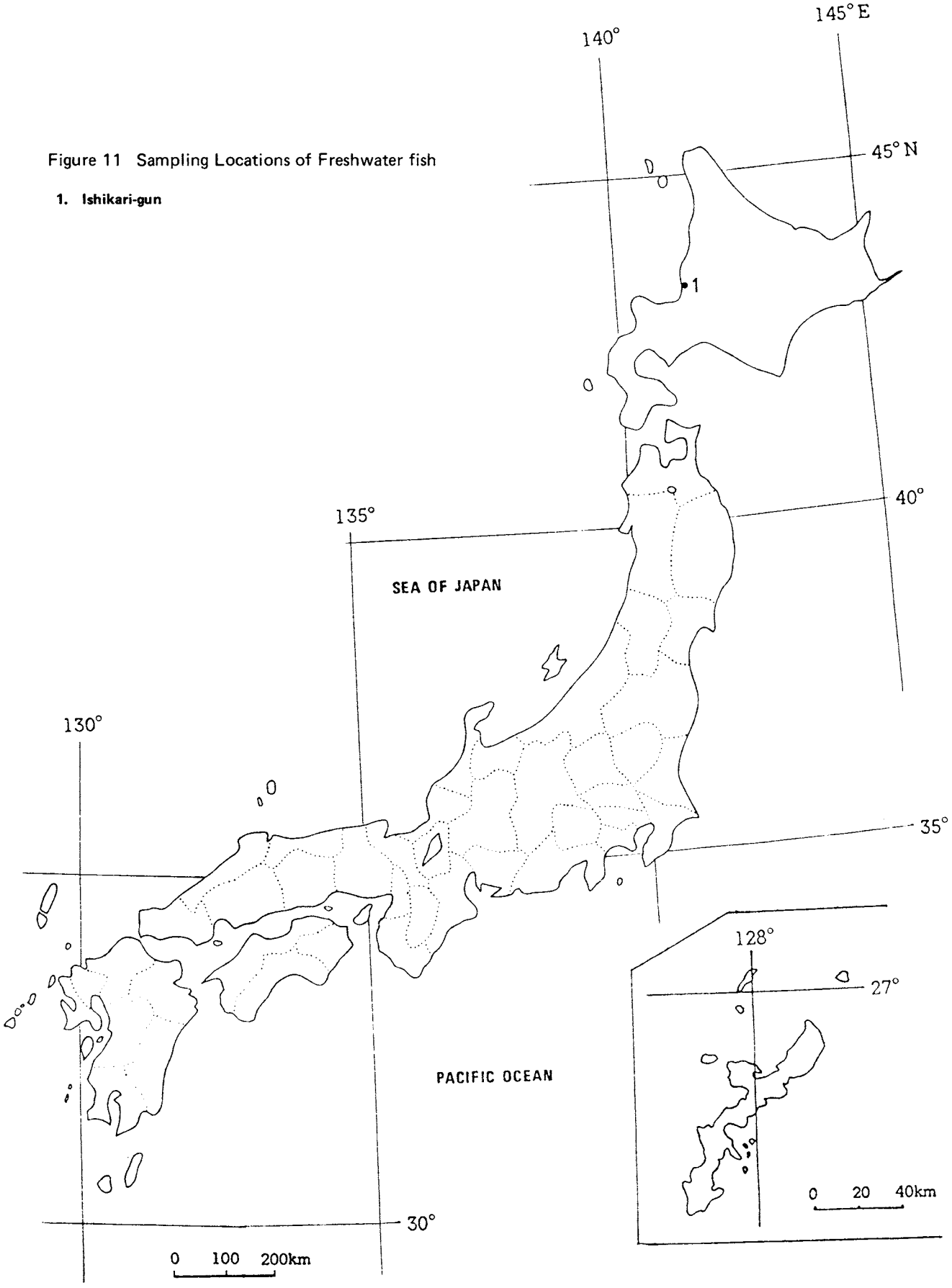
Table 11: Strontium-90 and Cesium-137 in Freshwater fish

Sampling Location	Date	Ash (%)	Component (% by weight)		^{90}Sr		^{137}Cs	
			Ca (%)	K (%)	pCi/kg	S.U.	pCi/kg	C.U.
Carassius auratus								
Ishikari-gun, HOKKAIDO	Jul. 1981	3.94	21.4	6.84	41 ± 1.2	4.9 ± 0.14	5.4 ± 0.42	2.0 ± 0.16

Scientific name	English name	Japanese name
Carassius auratus	A crucian carp	Funa

Figure 11 Sampling Locations of Freshwater fish

1. Ishikari-gun



(12) Strontium-90 and Cesium-137 in Shellfish (from May 1981 to Jul. 1981)

— continued from No. 57 of this publication —

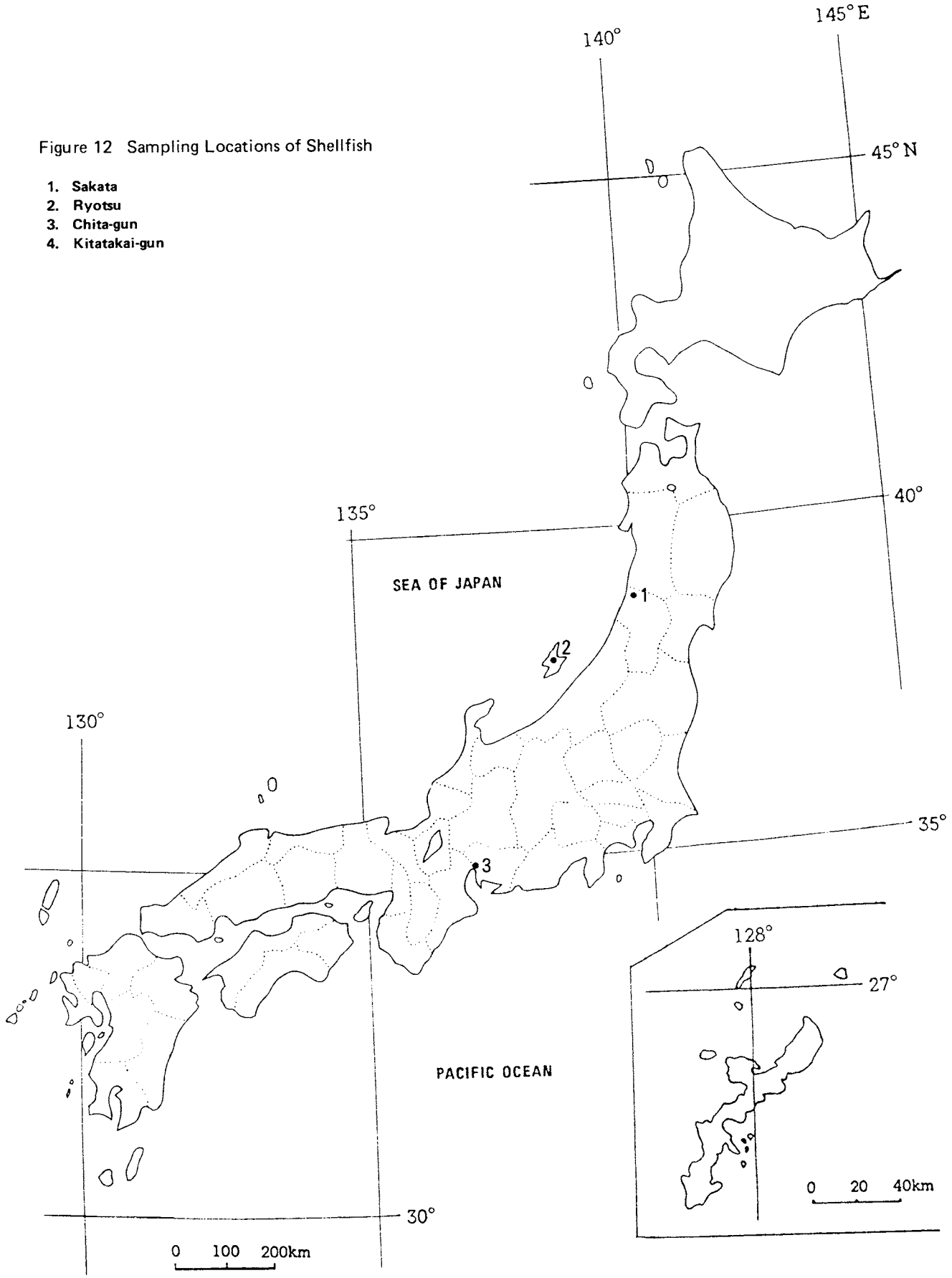
Table 12: Strontium-90 and Cesium-137 in Shellfish

Location	Sampling Date	Component			^{90}Sr		^{137}Cs	
		Ash (%)	Ca (%)	K (%)	pCi/kg	S.U.	pCi/kg	C.U.
Turbo cornutus								
Sakata, YAMAGATA	Jul. 1981	2.68	9.29	9.39	0.0 ± 0.12	0.0 ± 0.12	1.5 ± 0.33	0.6 ± 0.13
Ryotsu, NIIGATA	May 1981	2.19	2.46	15.7	0.0 ± 2.34	0.0 ± 4.20	2.1 ± 1.0	0.6 ± 0.29
Venerupis phillipinarum								
Chita-gun, AICHI	Jun. 1981	1.26	1.63	24.5	1.1 ± 0.66	5.5 ± 3.2	0.7 ± 0.56	0.2 ± 0.18
Kitatakaki-gun, NAGASAKI	Jun. 1981	2.67	4.15	8.79	0.0 ± 0.73	0.0 ± 0.66	1.3 ± 0.62	0.5 ± 0.26

Scientific name	English name	Japanese name
Turbo cornutus	Wreath shell	Sazae
Venerupis phillipinarum	Short-necked clam	Asari

Figure 12 Sampling Locations of Shellfish

1. Sakata
2. Ryotsu
3. Chita-gun
4. Kitatakai-gun



(13) Strontium-90 and Cesium-137 in Seaweeds (from Apr. 1981 to Jun. 1981)

– continued from No. 57 of this publication –

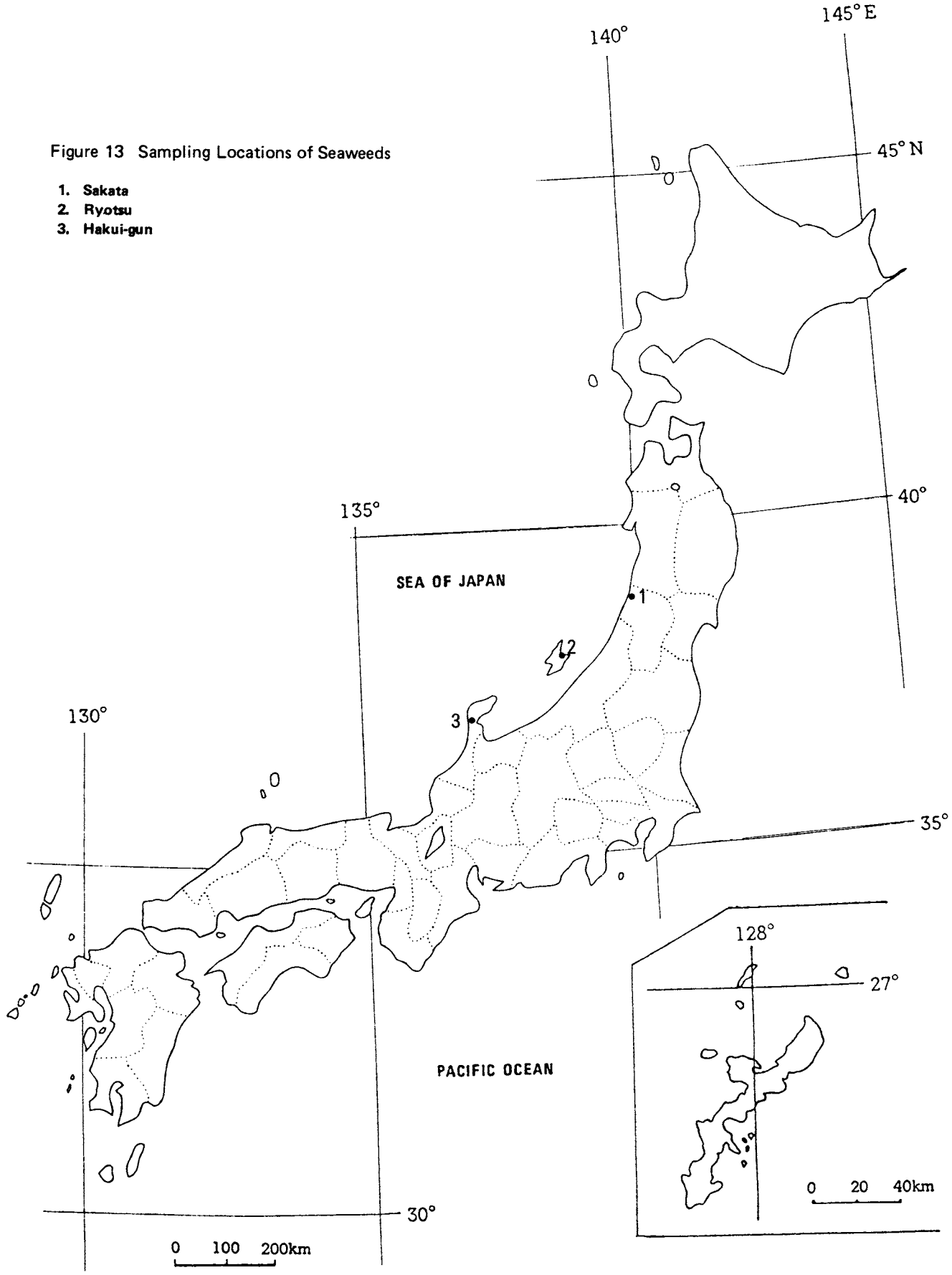
Table 13: Strontium-90 and Cesium-137 in Seaweeds

Location	Sampling Date	Component			^{90}Sr		^{137}Cs	
		Ash (%)	Ca (%)	K (%)	pCi/kg	S.U.	pCi/kg	C.U.
Undaria pinnatifida								
Sakata, YAMAGATA	Jun. 1981	0.885	9.06	11.6	2.0 ± 0.18	2.5 ± 0.23	0.3 ± 0.11	0.3 ± 0.10
Ryotsu, NIIGATA	May 1981	3.18	3.71	28.4	2.3 ± 0.39	1.9 ± 0.32	1.7 ± 0.29	0.2 ± 0.03
Hakui-gun, ISHIKAWA	Apr. 1981	1.98	4.31	30.6	2.9 ± 0.36	3.4 ± 0.42	1.9 ± 0.28	0.3 ± 0.05

Scientific name	English name	Japanese name
Undaria pinnatifida	Wakame seaweed	Wakame

Figure 13 Sampling Locations of Seaweeds

1. **Sakata**
2. **Ryotsu**
3. **Hakui-gun**



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