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RADIOACTIVITY SURVEY DATA in Japan

Part 2
= Dietary Materials =

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National Institute of Radiological Sciences
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Number 85

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Contents

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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.

Strontium and cesium carrier solutions were added after the sample was filtered. The tray was washed with 5 ℓ 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 flow 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, 100 ℓ each, was collected at the intake of the water-treatment plant and at the tap after water was left running for five minutes. Strontium and cesium carriers were added to the filtered water sample. 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 surface disturbance caused by duststorms, inflow and outflow due to precipitation, etc.. 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, 0-5cm and 5-20cm. The soil lumps were crushed by hands and dried in a drying oven regulated 105 ℃. The soil was then passed through a 2 mm sieve to remove plant roots and pebbles.

(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 1mℓ 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 4kg of the sample in wet weight was spread on a stenless steel dish after removed of the pebbles, shells and other foreign materials, and dried in a drying oven regulated at 105℃.

(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 transfered to a porcelain dish and then ashed at 450 ℃ 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.

* 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 (source water)	semiyearly	100 ℓ
2. Service water (tap water)	semiyearly	100 ℓ
3. Freshwater	yearly (fishing season)	100 ℓ
(4) Soil		
1. 0～5 cm	yearly	4 kg
2. 5～20cm	yearly	4 kg
(5) Sea water	yearly	40 ℓ
(6) Sea sediments	yearly	4 kg
=Dietary materials=		
(7) Total diet	semiyearly	daily amount for 5 persons
(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)	500g (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 and Sea sediment

Dried soil was crushed to smaller ones than 0.25 mm in size by a crusher. The sieved sample was ashed in an electric muffle furnace regulated at 450℃ . The sample was then heated with hydrochloric acid, strontium and cesium carrier solutions and the mixture was heated. The insoluble constituent was filtered off and washed with water.

The dried sample was crushed to smaller ones than 0.25 mm by a crushing machine. The further preparation of the sample was the same as that described in the section 2-(2).

(3) Rice

The ashed sample was pulverized with a porcelain mortar and passed through a 0.35 mm sieve. The sieved sample to which both strontium and cesium carriers were added, was digested with nitric 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 constituent was filtered and washed. The filtrate and washings were combined for subsequent radiochemical analysis.

(4) Airborne dust, diet, milk, vegetables, 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-(4), 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 strontium and calcium were precipitated as oxalates. The precipitate was dissolved in nitric acid and strontium was separated from calcium by successive fuming nitric acid separation. 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 iron carrier was added. The solution was allowed to stand for two weeks for strontium-90 and yttrium-90 to attain equilibrium. 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 was acidified with hydrochloric acid. While stirring, cesium was adsorbed on the ammonium molybdophosphate added.

After filtered off and washed with hydrochlotric acid the precipitate was dissolved in 2.5N sodium hydroxide solution. The solution was adjusted to pH 8.2 with hydrochloric acid and allowed to cool. Resultant molybdenum hydroxide which separated out in the solution, was filtered off and washed with water. EDTA was added to the filtrate and washings. Cesium and rubidium were adsorbed on a cation exchange column and cesium was separated from rubidium by eluting with hydrochloric acid.

The eluate was evaporated to dryness and was dissolved. The solution was filtered. Chloroplatinic acid was added to precipitate cesium. The precipitate was filtered onto a tared paper using a demountable filter and washed with water and then ethanol. After drying, the chemical yield of cesium was determined by weighing the precipitate. Cesium-137 radioactivity was measured for this precipitate.

4. Determination of stable strontium, calcium and potassium

A weighed amount of soil or sea sediment was heated in a electric muffle furnace at 450 ℃ and then treated with hydrochloric acid for extraction. A weighed aliquot of ashed samples of total diet, vegetables, milk, fish, shellfish or seaweeds was digested with hydrofluoric acid and nitric acid. 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 to 90 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 per sample aliquot. From the results, concentrations of these nuclides in the original samples were calculated.

6. Results

(1) Strontium-90 and Cesium-137 in Total Diet
(from Nov. 1987 to Jun. 1988)

-continued from NO. 83 of this publication-

Table (1): 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.
November, 1987							
Hiratsuka, KANAGAWA	16.5	607	1890	2.4±0.31	3.9±0.52	2.5±0.25	1.3±0.13
Nagoya, AICHI	17.0	1150	2510	2.7±0.36	2.3±0.31	3.3±0.31	1.3±0.12
December, 1987							
Aomori, AOMORI	19.2	550	2160	2.9±0.36	5.2±0.66	2.8±0.29	1.3±0.13
Tokyo, TOKYO	9.83	258	981	1.5±0.33	6 ±1.3	0.8±0.20	0.8±0.20
Nagano, NAGANO	18.3	681	2410	3.1±0.36	4.5±0.52	9.8±0.48	4.1±0.20
Kyoto, KYOTO	19.4	956	2360	2.8±0.38	2.9±0.40	4.7±0.35	2.0±0.15
January, 1988							
Naha, OKINAWA	15.7	505	2150	0.8±0.26	1.6±0.51	24 ±0.7	11 ±0.3
February, 1988							
Toyama, TOYAMA	15.6	730	1990	1.5±0.26	2.0±0.35	3.8±0.28	1.9±0.14
Kouhu, YAMANASHI	18.0	630	2540	2.3±0.32	3.6±0.51	6.8±0.40	2.7±0.16
Ooita, OOITA	16.5	512	2260	1.9±0.32	3.8±0.63	2.4±0.25	1.1±0.11
March, 1988							
Morioka, IWATE	15.1	500	2330	2.3±0.30	4.7±0.60	4.6±0.32	2.0±0.14
Utsunomiya, TOCHIGI	20.2	557	2480	2.4±0.35	4.3±0.62	5.7±0.39	2.3±0.16
June, 1988							
Yamagata, YAMAGATA	13.2	523	1580	2.3±0.32	4.3±0.62	3.6±0.30	2.3±0.19
Fukui, FUKUI	15.1	1170	1550	2.1±0.33	1.8±0.28	1.6±0.25	1.0±0.16
Kakogawa, HYOGO	14.9	762	1910	1.4±0.32	1.8±0.42	1.3±0.23	0.7±0.12

(2)-1 Strontium-90 and Cesium-137 in Rice(producing districts)
(from Sep. 1987 to Feb. 1988)

-continued from NO. 83 of this publication-

Table (2)-1: Strontium-90 and Cesium-137 in Rice

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
September, 1987							
Utsunomiya, TOCHIGI	0.813	0.045	1.45	0.4 ±0.22	10± 4.8	0.7 ±0.18	0.5 ±0.12
December, 1987							
Kosugi-machi, TOYAMA	0.661	0.058	1.12	0.6 ±0.23	11± 4.0	0.7 ±0.17	0.6 ±0.15
February, 1988							
Takisawa-mura, IWATE	0.510	0.045	1.05	0.4 ±0.26	10± 5.8	12 ±0.5	12 ±0.5
Nagasaka-machi, YAMANASHI	0.663	0.048	1.13	0.0 ±0.24	0± 4.9	0.6 ±0.19	0.6 ±0.17

(2)-2 Strontium-90 and Cesium-137 in Rice(consuming districts)
(from Nov. 1987 to Jan. 1988)

-continued from NO. 83 of this publication-

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

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
November, 1987 Kyoto, KYOTO	0.545	0.041	1.00	0.0 ±0.21	0± 5.1	0.1 ±0.12	0.1 ±0.12
January, 1988 Nagasaki, NAGASAKI	0.467	0.044	0.807	0.04±0.21	1± 4.9	0.8 ±0.18	1.0 ±0.22

(3)-1 Strontium-90 and Cesium-137 in Milk(producing districts for domestic program)
(from Feb. 1988 to Mar. 1988)

-continued from NO. 83 of this publication-

Table (3)-1: Strontium-90 and Cesium-137 in Milk

Location	Component			^{90}Sr		^{137}Cs	
	Ash(g/ℓ)	Ca(g/ℓ)	K(g/ℓ)	pCi/ℓ	S.U.	pCi/ℓ	C.U.
February, 1988							
Aomori, AOMORI	7.49	1.19	1.67	1.3±0.21	1.1±0.18	2.1±0.21	1.2±0.13
Takisawa-mura, IWATE	7.38	1.31	1.73	0.9±0.20	0.7±0.15	4.6±0.30	2.7±0.17
Mito, IBARAGI	7.80	1.21	1.57	0.7±0.19	0.6±0.16	0.7±0.14	0.5±0.09
Nishinasuno-machi, TOCHIGI	7.52	1.14	1.79	1.5±0.23	1.3±0.20	3.3±0.26	1.8±0.15
Tonami, TOYAMA	7.51	1.26	1.61	0.9±0.22	0.7±0.18	1.8±0.21	1.1±0.13
Oshimizu-machi, ISHIKAWA	6.89	1.06	1.41	1.0±0.20	0.9±0.18	2.3±0.19	1.7±0.14
Mihara-machi, HYOGO	7.51	1.19	1.53	1.1±0.21	0.9±0.18	1.1±0.15	0.7±0.10
Matsuyama, EHIME	7.49	1.19	1.57	0.4±0.19	0.4±0.16	1.0±0.19	0.6±0.12
Kujuu-machi, OOITA	8.84	1.35	2.03	1.1±0.26	0.8±0.19	6.0±0.33	3.0±0.16
March, 1988							
Takane-machi, YAMANASHI	7.05	1.08	1.59	0.9±0.28	0.8±0.26	1.2±0.22	0.8±0.14

(3)-2 Strontium-90 and Cesium-137 in Milk(producing districts for WHO program)
(from Nov. 1987 to May 1988)

-continued from NO. 83 of this publication-

Table (3)-2: Strontium-90 and Cesium-137 in Milk

Location	Component			^{90}Sr		^{137}Cs	
	Ash(g/ℓ)	Ca(g/ℓ)	K(g/ℓ)	pCi/ℓ	S.U.	pCi/ℓ	C.U.
November, 1987							
Kajiki-machi, KAGOSHIMA	8.50	1.28	1.74	1.0±0.27	0.8±0.21	2.5±0.27	1.4±0.15
February, 1988							
Sapporo, HOKKAIDO	7.66	1.18	1.64	1.6±0.22	1.3±0.19	3.9±0.26	2.4±0.16
Hachijo-Island, TOKYO	7.40	1.22	1.51	3.5±0.29	2.9±0.24	14 ±0.5	9.2±0.30
Nishikawa-machi, NIIGATA	7.40	1.18	1.59	0.5±0.18	0.4±0.15	0.9±0.17	0.6±0.10
Katsuyama, FUKUI	7.36	1.14	1.52	0.6±0.18	0.5±0.16	3.9±0.25	2.6±0.17
Kochi, KOCHI	7.30	1.08	1.54	2.2±0.28	2.0±0.26	2.1±0.24	1.4±0.15
Fukuma-machi, FUKUOKA	8.11	1.20	1.74	0.3±0.22	0.3±0.19	2.7±0.28	1.5±0.16
Kajiki-machi, KAGOSHIMA	7.45	1.10	1.59	0.7±0.21	0.6±0.19	1.1±0.16	0.7±0.10
April, 1988							
Hikawa, SHIMANE	7.17	0.980	1.80	1.7±0.24	1.7±0.25	1.3±0.18	0.7±0.10
May, 1988							
Sapporo, HOKKAIDO	7.05	1.07	1.58	1.3±0.26	1.3±0.24	3.4±0.24	2.1±0.15
Hachijo-Island, TOKYO	7.61	1.22	1.50	3.2±0.31	2.6±0.25	21 ±0.6	14 ±0.4
Nose-machi, OSAKA	7.52	1.12	1.59	0.6±0.20	0.5±0.18	0.8±0.16	0.5±0.10
Takamiya-machi, HIROSHIMA	6.80	1.04	1.47	0.7±0.21	0.6±0.20	1.3±0.18	0.9±0.12
Kochi, KOCHI	7.29	1.12	1.53	1.7±0.27	1.5±0.24	1.6±0.19	1.0±0.12
Fukuma-machi, FUKUOKA	7.13	1.05	1.62	0.7±0.21	0.6±0.20	1.3±0.17	0.8±0.10

(3)-3 Strontium-90 and Cesium-137 in Milk(consuming districts) (from Jan. 1988 to May 1988)

-continued from NO. 83 of this publication-

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

Location	Component			^{90}Sr		^{137}Cs	
	Ash(g/ℓ)	Ca(g/ℓ)	K(g/ℓ)	pCi/ℓ	S.U.	pCi/ℓ	C.U.
January, 1988							
Yonagusuku-mura, OKINAWA	7.27	1.09	1.63	0.6±0.20	0.5±0.18	0.4±0.11	0.3±0.07
February, 1988							
Sapporo, HOKKAIDO	7.56	1.14	1.59	1.5±0.22	1.3±0.19	3.3±0.24	2.1±0.15
Yamagata, YAMAGATA	6.89	1.04	1.48	0.7±0.17	0.7±0.16	1.8±0.17	1.2±0.12
Fukushima, FUKUSHIMA	7.43	1.15	1.59	0.8±0.22	0.7±0.19	0.9±0.15	0.6±0.10
Shinjuku, TOKYO	7.04	1.08	1.49	1.8±0.23	1.7±0.21	4.5±0.26	3.0±0.18
Yokohama, KANAGAWA	7.17	1.07	1.61	0.8±0.19	0.7±0.17	0.9±0.16	0.6±0.10
Niigata, NIIGATA	7.67	1.17	1.64	1.3±0.25	1.1±0.21	2.0±0.22	1.2±0.13
Katsuyama, FUKUI	6.87	1.01	1.51	1.7±0.22	1.7±0.22	3.5±0.23	2.3±0.15
Shizuoka, SHIZUOKA	7.26	1.09	1.52	1.0±0.20	0.9±0.18	2.2±0.20	1.5±0.13
Nagoya, AICHI	7.13	1.08	1.46	0.7±0.18	0.6±0.17	0.6±0.12	0.4±0.08
Wakayama, WAKAYAMA	6.94	1.06	1.45	0.9±0.20	0.9±0.18	0.8±0.14	0.6±0.10
Yonago, TOTTORI	7.29	1.12	1.51	1.0±0.21	0.9±0.19	3.9±0.25	2.6±0.17
Okayama, OKAYAMA	6.94	1.04	1.45	1.1±0.21	1.0±0.20	1.3±0.16	0.9±0.11
Yamaguchi, YAMAGUCHI	7.17	1.10	1.52	1.0±0.22	0.9±0.20	1.0±0.19	0.6±0.12
Matsuyama, EHIME	7.41	1.03	1.44	0.9±0.21	0.8±0.20	1.3±0.21	0.9±0.14
Kochi, KOCHI	7.17	1.05	1.49	0.9±0.22	0.9±0.21	1.3±0.20	0.9±0.13
Chikushino, FUKUOKA	7.40	1.11	1.54	0.6±0.23	0.5±0.21	1.3±0.20	0.8±0.13
Nagasaki, NAGASAKI	6.45	0.961	1.43	0.7±0.19	0.7±0.19	0.8±0.14	0.5±0.09
Kagoshima, KAGOSHIMA	7.48	1.14	1.61	0.8±0.22	0.7±0.19	1.7±0.19	1.1±0.12
March, 1988							
Nagano, NAGANO	7.05	1.06	1.58	0.7±0.26	0.7±0.24	1.6±0.23	1.0±0.14
May, 1988							
Hiroshima, HIROSHIMA	6.90	1.04	1.52	1.0±0.22	1.0±0.21	1.7±0.20	1.1±0.13

(4)-1 Strontium-90 and Cesium-137 in Vegetables(producing districts)
(from Nov. 1987 to May 1988)

-continued from NO. 83 of this publication-

Table (4)-1: Strontium-90 and Cesium-137 in Vegetables

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
(Japanese radish)							
November, 1987							
Tamayama-mura, IWATE	0.585	0.328	2.62	1.9±0.28	5.7±0.84	0.1 ±0.12	0.05±0.05
Kanuma, TOCHIGI	0.435	0.258	1.83	11 ±0.6	41 ±2.3	0.8 ±0.20	0.5 ±0.11
December, 1987							
Kosugi-machi, TOYAMA	0.479	0.261	1.94	0.6±0.26	2.1±1.0	0.2 ±0.18	0.1 ±0.09
Usa, OOITA	0.540	0.204	2.64	2.9±0.35	14 ±1.7	0.2 ±0.12	0.1 ±0.04
January, 1988							
Hiroshima, HIROSHIMA	0.403	0.209	1.76	1.0±0.24	5 ±1.1	0.4 ±0.13	0.2 ±0.07
Yuya-machi, YAMAGUCHI	0.514	0.283	2.24	1.1±0.26	3.8±0.92	0.0 ±0.14	0.0 ±0.06
Kubokawa-machi, KOCHI	0.540	0.402	2.07	12 ±0.6	30 ±1.5	0.4 ±0.15	0.2 ±0.07
February, 1988							
Takane-machi, YAMANASHI	0.634	0.399	2.61	1.6±0.32	3.9±0.81	0.1 ±0.14	0.1 ±0.05
May, 1988							
Tahara-machi, AICHI	0.621	0.168	2.97	1.7±0.26	10 ±1.5	0.01±0.09	0.0 ±0.03
(Cabbage)							
January, 1988							
Kumatori-machi, OSAKA	0.568	0.366	2.19	2.1±0.33	5.9±0.91	0.1 ±0.16	0.1 ±0.07
(Spinach)							
December, 1987							
Toyama, TOYAMA	1.83	0.900	6.96	13 ±0.6	15 ±0.7	1.9 ±0.25	0.3 ±0.04
January, 1988							
Takane-machi, YAMANASHI	2.25	0.506	10.1	3.1±0.39	6.0±0.77	0.3 ±0.15	0.03±0.01
Hiroshima, HIROSHIMA	1.38	0.561	6.21	1.0±0.27	1.8±0.49	0.4 ±0.17	0.1 ±0.03
Yuya-machi, YAMAGUCHI	1.63	0.479	7.71	1.5±0.29	3.1±0.61	0.4 ±0.16	0.1 ±0.02
Kubokawa-machi, KOCHI	1.96	1.09	7.80	16 ±0.7	15 ±0.7	0.9 ±0.19	0.1 ±0.02
May, 1988							
Tahara-machi, AICHI	1.54	0.463	7.15	1.5±0.29	3.3±0.63	0.2 ±0.11	0.02±0.02

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
(Chinese cabbage)							
November, 1987							
Tamayama-mura, IWATE	0.489	0.359	2.06	3.5±0.34	9.6±0.96	1.5 ±0.22	0.7 ±0.10
Kanuma, TOCHIGI	0.642	0.445	2.48	37 ±1.0	82 ±2.3	1.8 ±0.24	0.7 ±0.10
December, 1987							
Usa, OOITA	0.588	0.367	2.37	2.3±0.35	6.1±0.94	0.2 ±0.12	0.1 ±0.05

(4)-2 Strontium-90 and Cesium-137 in Vegetables(consuming districts)
(from Nov. 1987 to Feb. 1988)

-continued from NO. 83 of this publication-

Table (4)-2: Strontium-90 and Cesium-137 in Vegetables

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
(Japanese radish)							
January, 1988							
Nagasaki, NAGASAKI	0.492	0.244	2.20	2.1±0.36	8 ±1.5	0.1 ±0.14	0.1 ±0.06
February, 1988							
Yokohama, KANAGAWA	0.413	0.162	1.74	0.2±0.21	1 ±1.3	0.2 ±0.15	0.1 ±0.09
(Spinach)							
November, 1987							
Kyoto, KYOTO	1.41	1.26	3.97	3.9±0.38	3.1±0.30	1.0 ±0.21	0.3 ±0.05
Osaka, OSAKA	1.60	0.833	6.74	4.1±0.39	4.9±0.47	0.4 ±0.15	0.1 ±0.02
January, 1988							
Nagasaki, NAGASAKI	1.29	0.489	5.82	1.5±0.30	3.1±0.62	0.5 ±0.13	0.1 ±0.02
February, 1988							
Yokohama, KANAGAWA	1.60	0.580	7.36	8.9±0.54	15 ±0.9	0.5 ±0.18	0.1 ±0.02

(5) Strontium-90 and Cesium-137 in Sea Fish
(from Nov. 1987 to Mar. 1988)

-continued from NO. 83 of this publication-

Table (5): Strontium-90 and Cesium-137 in Sea Fish

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
(Trachurus japonicus)							
December, 1987							
Odawara, KANAGAWA	1.41	0.360	4.53	0.0±0.26	0.0 ±0.72	10 ±0.5	2.3 ±0.11
(Limanda herzensteini)							
February, 1988							
Ootake, HIROSHIMA	2.92	3.74	3.77	0.7±0.24	0.2 ±0.06	3.5±0.31	0.9 ±0.08
(Scomber japonicus)							
November, 1987							
Kyoto, KYOTO	1.23	1.05	2.78	0.0±0.19	0.0 ±0.18	6.2±0.39	2.2 ±0.14
January, 1988							
Sakaiminato, TOTTORI	1.32	0.633	3.13	0.1±0.22	0.2 ±0.35	6.3±0.40	2.0 ±0.13
(Caesio chrysozonus cuvier)							
November, 1987							
Yonagusuku-mura, OKINAWA	3.85	8.95	4.14	0.4±0.22	0.04±0.02	5.2±0.38	1.3 ±0.09
(Sebastes inermis)							
March, 1988							
Ajisu-machi, YAMAGUCHI	4.70	13.0	3.46	0.7±0.27	0.1 ±0.02	5.1±0.38	1.5 ±0.11

Sea Fish

Japanese name	English name	Scientific name
Aji	Horse mackerel	Trachurus japonicus
Karei	Flatfish	Limanda herzensteini
Saba	Common mackerel	Scomber japonicus
Takasago	Black-tipped fusilier	Caesio chrysozonus cuvier
Mebaru	Black Rockfish	Sebastes inermis

(6) Strontium-90 and Cesium-137 in Freshwater Fish (Dec. 1987)

-continued from NO. 83 of this publication-

Table (6): Strontium-90 and Cesium-137 in Freshwater Fish

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
(Carassius auratus) December, 1987 Uji, KYOTO	5.14	14.9	3.22	36 ±1.0	2.4 ±0.07	3.6±0.33	1.1 ±0.10

Freshwater Fish

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

(7) Strontium-90 and Cesium-137 in Shellfish
(Feb. 1988)

-continued from NO. 83 of this publication-

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

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
(Ostrea gigas)							
February, 1988							
Hatsukaichi-machi, HIROSHIMA	1.68	0.535	2.33	0.2±0.54	0.3 ±1.0	1.3±0.38	0.5 ±0.16
(Pecter Yessoensis)							
February, 1988							
Yamada-machi, IWATE	1.94	0.299	3.39	0.0±0.23	0.0 ±0.76	1.8±0.25	0.5 ±0.07

Shellfish

Japanese name	English name	Scientific name
Kaki	Oyster	Ostrea gigas
Hotategai	Scallop	Pecter Yessoensis

(8) Strontium-90 and Cesium-137 in Seaweeds (Feb. 1988)

-continued from NO. 83 of this publication-

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

Location	Component			^{90}Sr		^{137}Cs	
	Ash(%)	Ca(g/Kg)	K(g/Kg)	pCi/Kg	S.U.	pCi/Kg	C.U.
(Undaria pinnatifida)							
February, 1988							
Minamichita-machi, AICHI	2.66	0.753	8.68	0.8±0.25	1.0 ±0.33	0.9±0.22	0.1 ±0.03
Hiroshima, HIROSHIMA	1.20	0.345	3.29	0.5±0.25	1.3 ±0.73	0.9±0.21	0.3 ±0.07
Shimabara, NAGASAKI	2.99	0.780	9.99	0.8±0.26	1.0 ±0.33	1.2±0.22	0.1 ±0.02

Seaweeds

Japanese name	English name	Scientific name
Wakame	Wakame seaweed	Undaria pinnatifida

* * * Total Diet * * *

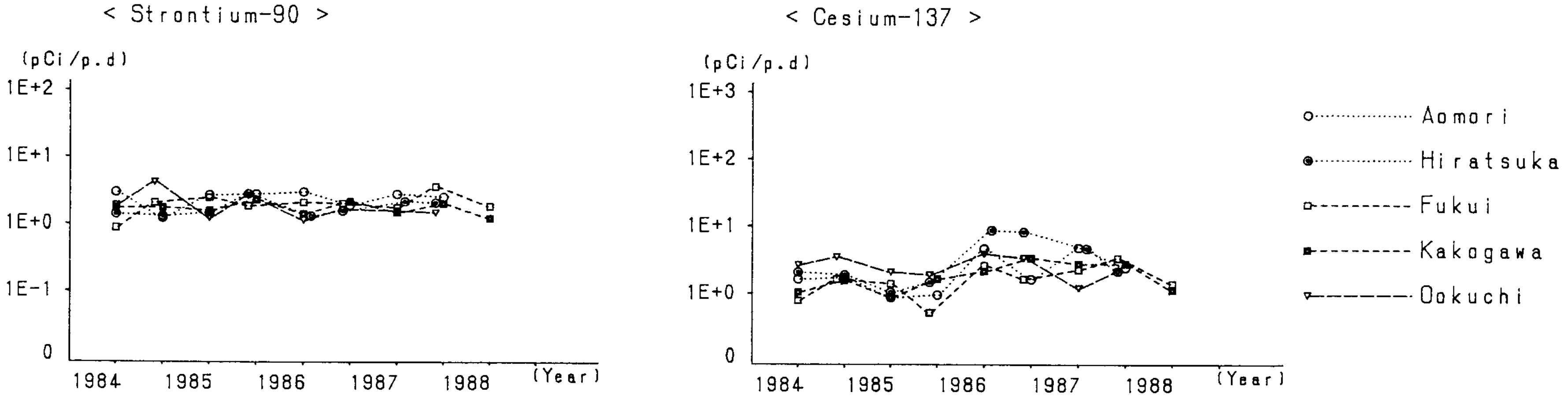

Fig.1

* * * Rice(producing districts) * * *

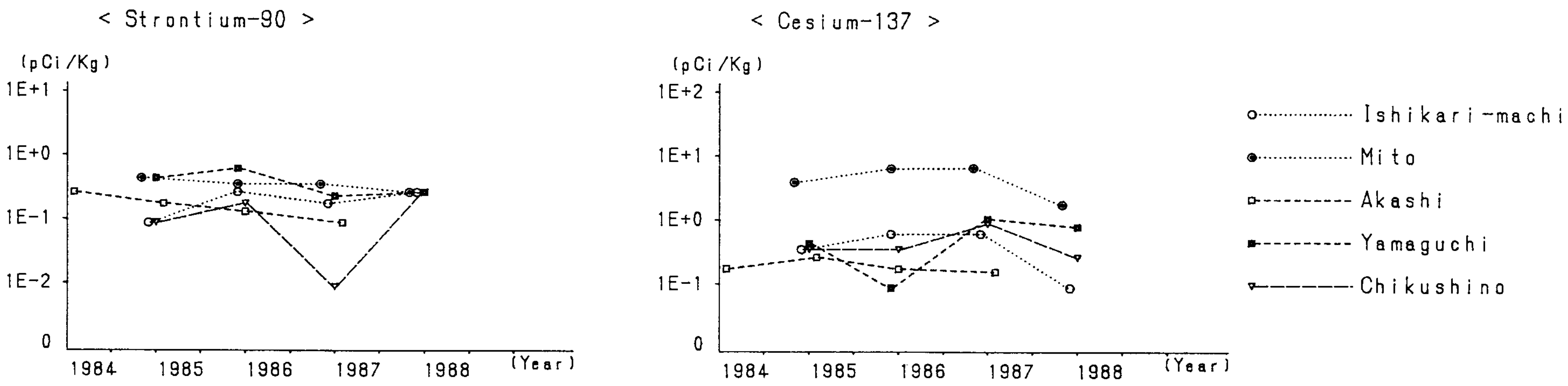

Fig.2-1

* * * Rice(consuming districts) * * *

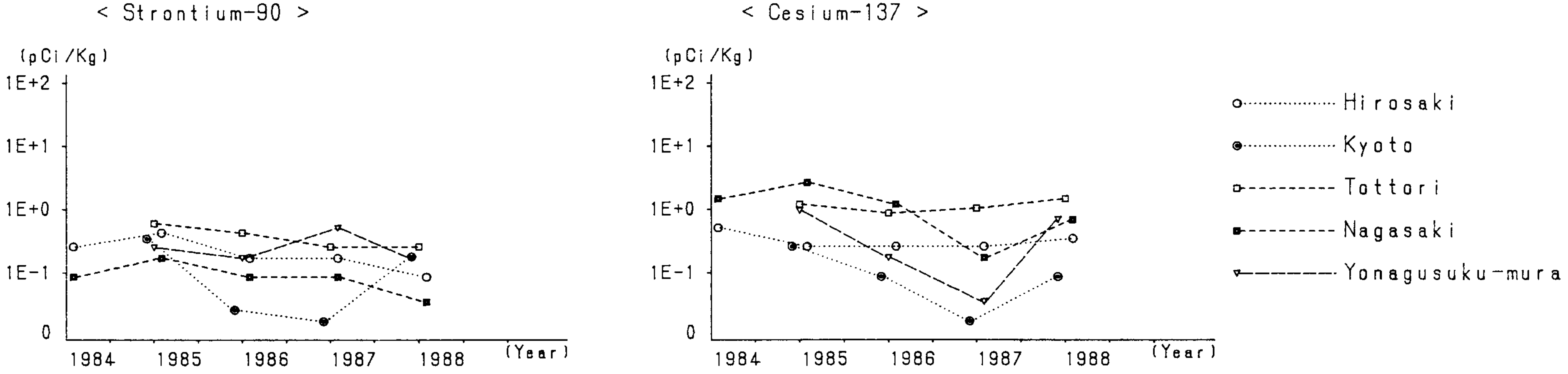

Fig.2-2

* * * Milk (producing districts for domestic program) * * *

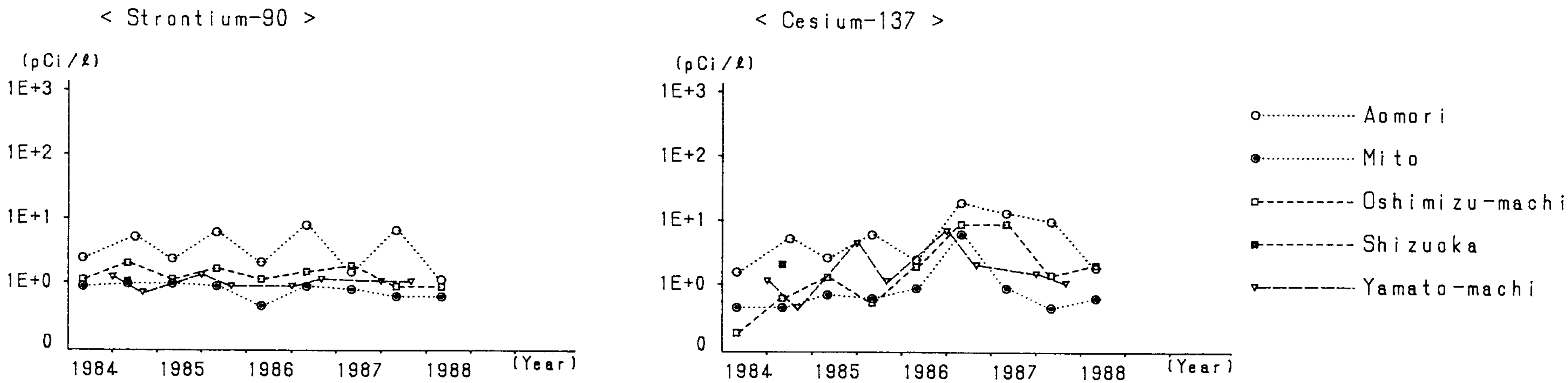

Fig.3-1

＊＊＊ Milk(producing districts for WHO program) ＊＊＊

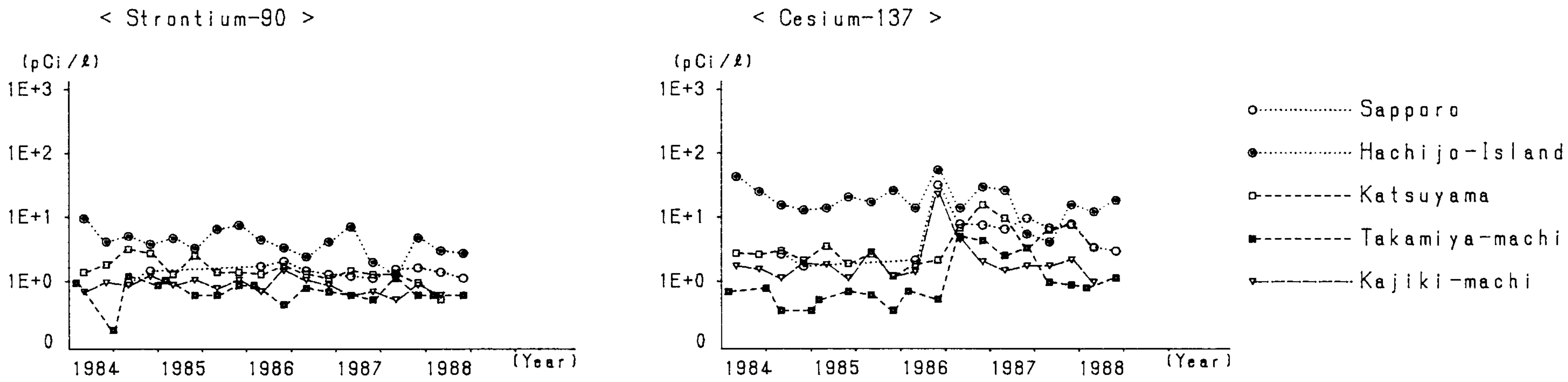

Fig.3-2

＊＊＊ Milk(consuming districts) ＊＊＊

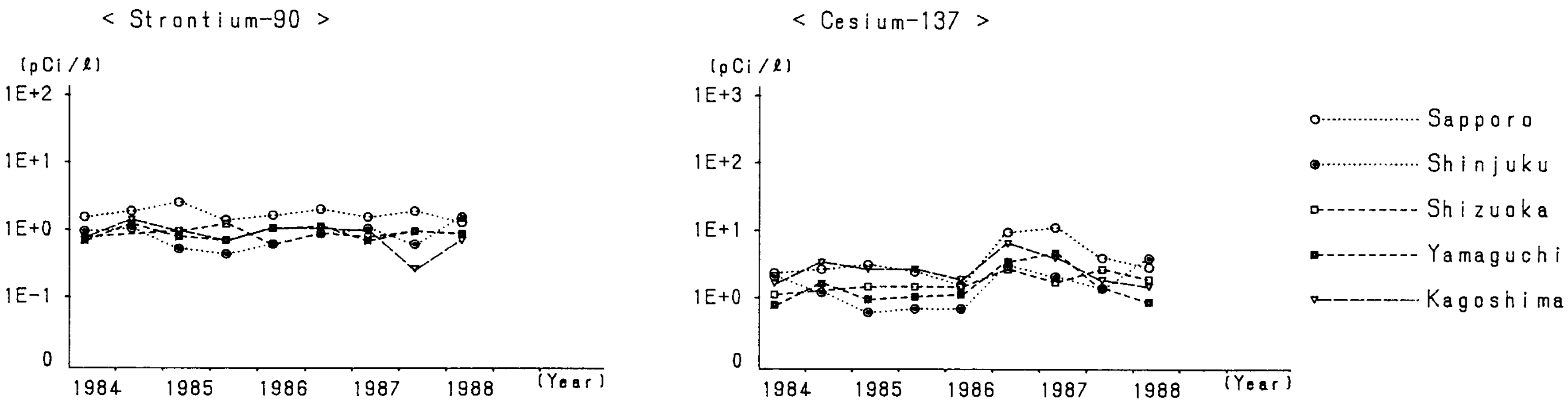

Fig.3-3

* * * Vegetables(producing districts) * * *

[Japanese radish]

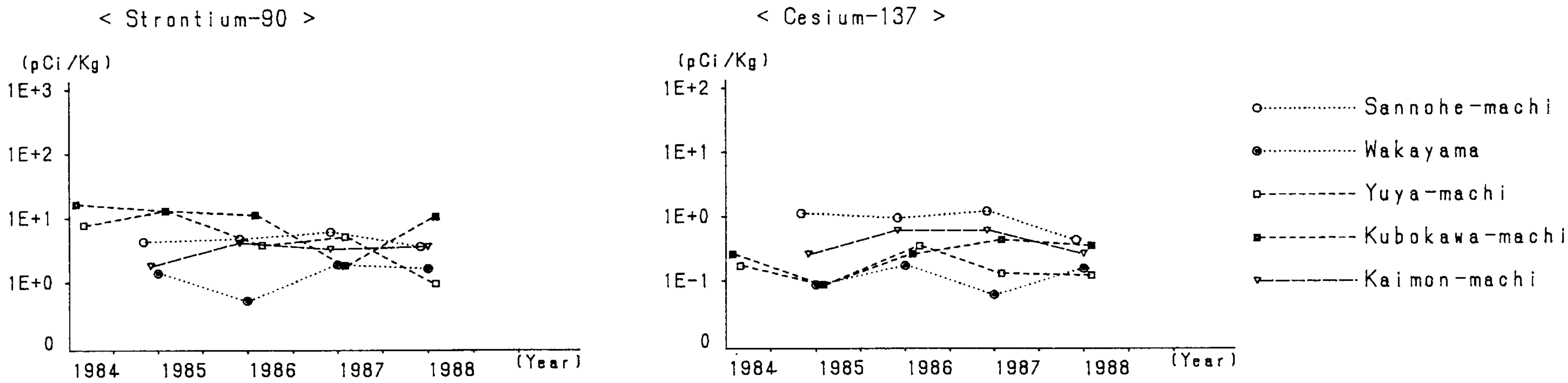

Fig.4-1

＊＊＊ Vegetables(consuming districts) ＊＊＊

[Japanese radish]

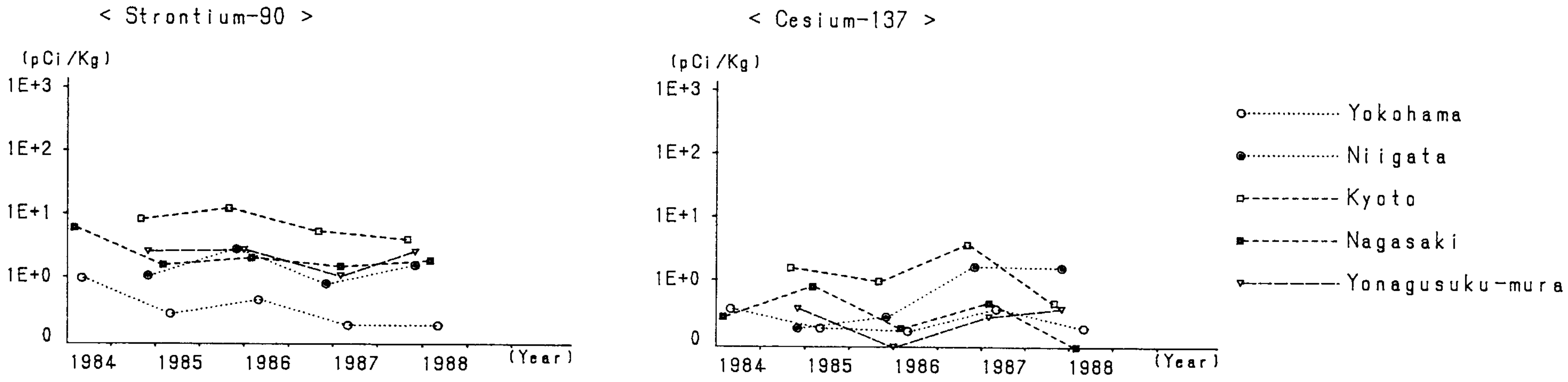

Fig.4-2

* * * Sea Fish * * *

(Scomber japonicus)

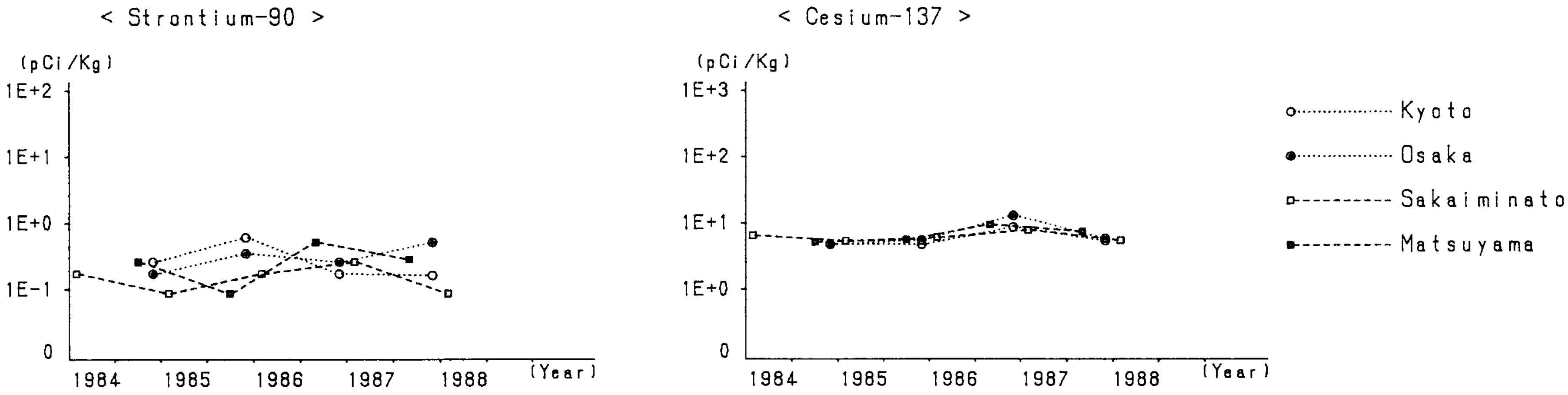

Fig.5

* * * Seaweeds * * *

[Undaria pinnatifida]

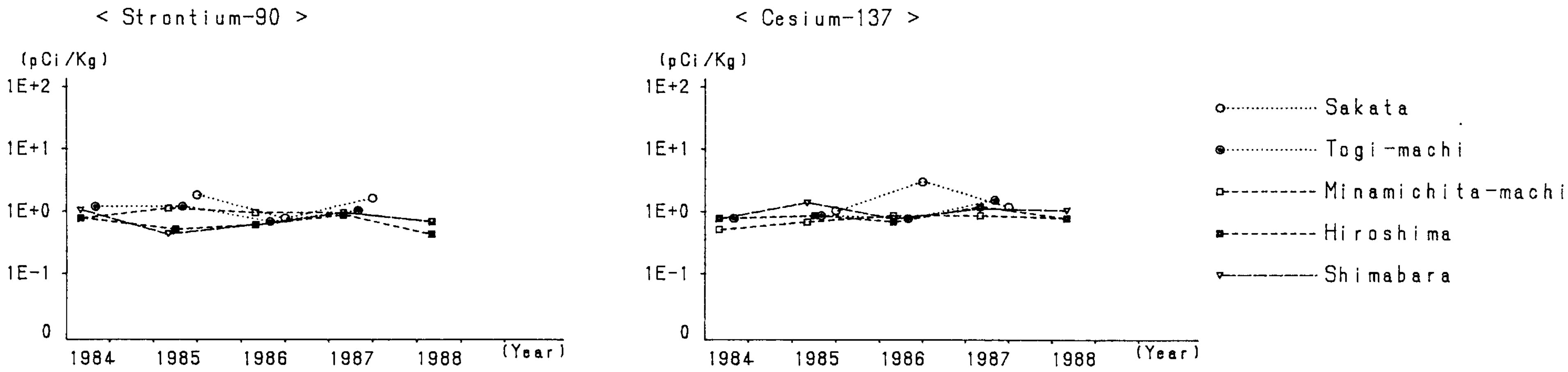

Fig.6

** Sampling Locations in Japan **

1 : Sapporo
2 : Aomori
3 : Morioka
4 : Akita
5 : Sendai
6 : Yamagata
7 : Fukushima
8 : Niigata
9 : Mito
10 : Utsunomiya
11 : Chiba
12 : Shinjuku
13 : Nagano
14 : Yokohama
15 : Kouhu
16 : Toyama
17 : Kanazawa
18 : Shizuoka
19 : Fukui
20 : Nagoya
21 : Kyoto
22 : Osaka
23 : Tottori
24 : Kobe
25 : Wakayama
26 : Okayama
27 : Matsue
28 : Hiroshima
29 : Kochi
30 : Matsuyama
31 : Yamaguchi
32 : Ooita
33 : Fukuoka
34 : Saga
35 : Nagasaki
36 : Kagoshima
37 : Naha