Radiological Survey in the Indian Ocean in 1961*

Kaname Saitō

Abstract

Radioactivity of the sea water, plankton and fishes, obtained from the Indian Ocean in 1961 was inspected.

1) High radioactivity in the plankton was found in the area situated between about 4°N, 77°E and 4°S, 78°E. The half-life of radioactive elements in the plankton is about 15 days.
2) No radioactivity was detected from the sea water.
3) Radioactivity may be concentrated to liver, kidney and spleen in the fishes. The activity in muscles was very poor, though the red muscle held always higher activity than the ordinary muscle of the same fish. The correlation between the stomach contents and tissues in regard to strength of activity could not be made sure.

Introduction

The training ship "Kagoshima Maru" was sent out by the faculty of Fisheries of Kagoshima University, for the purpose of Tuna Long-line fishing tests

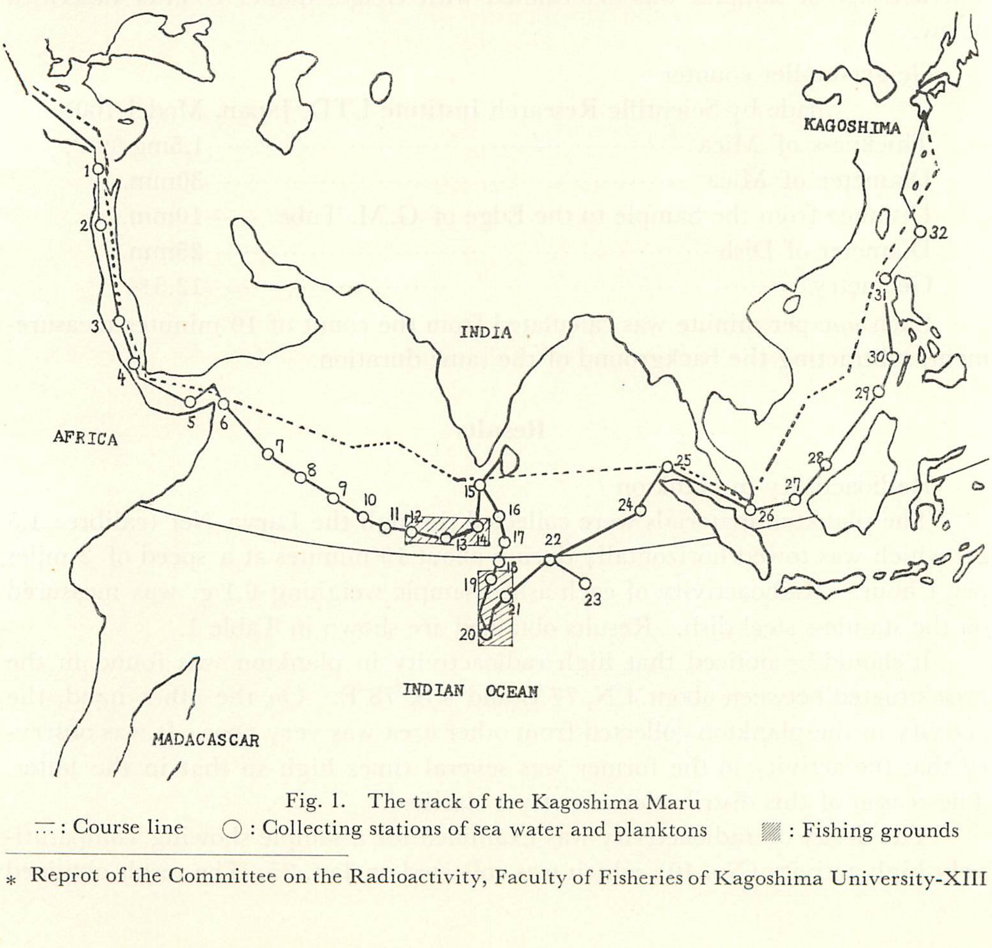

Fig. 1. The track of the Kagoshima Maru

⋯ : Course line ○ : Collecting stations of sea water and planktons ▨ : Fishing grounds

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and scientific investigation in the Indian Ocean, dering the period from Oct. 1960 to Jan. 1961. The author was nominated as a member of the scientific corps of the expedition. The track of the "Kagoshima Maru" are shown in Fig. 1.

Radiological contamination of sea water, plankton and fishes obtained from the North Equatorial Current and the Kuroshio region, was already published[1)]. In the present paper, the author dealt with the radioactivity on the materials, obtained from the Indian Ocean.

Measurement of radioactivity

It is very difficult to determine radioactivity precisely in any sample in its raw state due to so weak activity. For the more accurate measurement of activity, it is necessary to be conducted with ashed samples. Fishes were dissected carefully, and several tissues (liver, kidney, spleen, muscle etc) were obtained. These samples were weighed, dried on the hot-plate at 105°C. and ashed in a muffle furnace at about 550°C. Thus ashed samples were placed in a dish of stainless steel, each having a diameter of 2.5 cm. and an inside depth of 0.7 cm. The activity of samples was determined with Geiger-müller counter described below.

Geiger-müller counter
(made by Scientific Research Institute LTD, Japan, Model-100)
Thickness of Mica ············ $1.5mg/cm^2$.
Diameter of Mica ············ 30mm.
Distance from the Sample to the Edge of G.M. Tube ······ 10mm.
Diameter of Dish ············ 25mm.
Geometry ············ 12.5%

Each $\mu\mu c$ per minute was calculated from the count of 10 minutes measurement, subtracting the background of the same duration.

Results

Radioactivity in plankton

The plankton materials were collected through the Larva Net (calibre; 1.5 m) which was towed horizontally during about 15 minutes at a speed of 2 miles per 1 hour. Radioactivity of each ashed sample weighing 0.1 g. was measured on the stainless steel dish. Results obtained are shown in Table 1.

It should be noticed that high radioactivity in plankton was found in the area situated between about 4°N, 77°E and 4°S, 78°E. On the other hand, the activity in the plankton collected from other area was very poor. It was observed that the activity in the former was several times high so that in the latter. The reason of this distribution is not yet clarified.

The decay of radioactivity was examined for a sample showing comparatively high activity (No. 19), which was collected on Jan. 25. The result obtained

Table 1. Results of inspection on radioactivity of sea water and planktons.

Sample No.	Date of collection		Collecting station		Radioactivity	
			Lat.	Long.	Plankton $\mu\mu c/100mg.$*	Sea water** $\mu\mu c/l.$
1	Dec.	22	27°15′ N	34°37′ E	79. 1	3. 7
2		23	23°55′ N	36°57′ E	0. 0	1. 9
3		24	19°58′ N	39°37′ E	135. 0	0. 0
4		26	13°17′ N	42°57′ E	20. 6	13. 1
5		27	12°11′ N	48°30′ E	36. 1	0. 7
6		29	8°26′ N	55°50′ E	53. 5	6. 3
7		30	7°22′ N	57°40′ E	112. 3	7. 4
8		31	6°07′ N	61°16′ E	99. 9	2. 6
9	Jan.	1	5°07′ N	64°37′ E	262. 6	3. 0
10		3	4°32′ N	65°50′ E	210. 1	0. 0
11		6	3°17′ N	70°44′ E	580. 9	0. 0
12		8	7°46′ N	77°31′ E	140. 1	0. 0
13		9	7°39′ N	77°48′ E	103. 1	1. 3
14		10	7°26′ N	77°57′ E	143. 2	3. 4
15		12	7°40′ N	77°31′ E	120. 6	0. 0
16		20	4°52′ N	78°10′ E	422. 3	0. 0
17		22	1°00′ S	77°55′ E	226. 6	0. 0
18		24	4°06′ S	77°59′ E	533. 5	4. 4
19		25	4°32′ S	78°00′ E	704. 5	16. 9
20		26	3°05′ S	78°22′ E	412. 0	1. 5
21		28	1°40′ S	81°57′ E	211. 1	0. 0
22		29	4°32′ S	78°00′ E	163. 8	0. 0
23		30	2°42′ N	88°45′ E	166. 9	0. 0
24		31	4°54′ N	93°22′ E	142. 1	8. 3
25	Feb.	1	5°10′ N	97°32′ E	51. 5	0. 0
26		2	2°52′ N	100°57′ E	0. 0	1. 1
27		8	3°57′ N	112°27′ E	83. 4	0. 0
28		9	7°45′ N	115°30′ E	53. 5	0. 0
29		10	10°44′ N	118°08′ E	96. 8	4. 0
30		11	15°22′ N	119°27′ E	51. 5	7. 1
31		12	20°05′ N	120°50′ E	0. 0	3. 0

* Ashed matter   ** Surface water

are shown in Fig. 2. The half-life of radioactive elements in the plankton is about 15 days. Classifying the contaminated plankton into each species, it was found that *Cavolinia* sp. showed high radioactivity of 824 $\mu\mu c/0.1g.$, *Lepas* and *Phyllosoma* 103~206 $\mu\mu c/0.1g.$, and Jelly-fish showed about 51.5$\mu\mu c/0.1g.$

Radioactivity in sea water (surface water)

It is difficult to measure the radioactivity in sea water directly by a simple evaporation method owing to its high salinity. Therefor, the carrier method[2)] is adopted. Results obtained are shown in Table 1. According to this Table, no

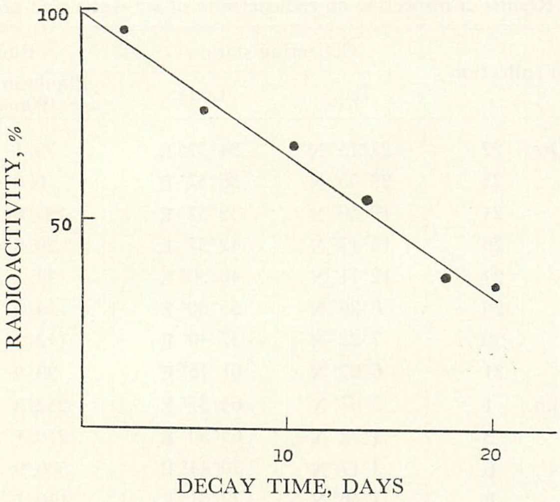

Fig. 2. Decaying state of radioactive elements in the plankton (sample No. 19)

radioactivity was detected from the sea water collected in the Indian Ocean. However, it must be remembered that there are some doubtful points about the absorptiveness of radioactive elements by the precipitans in this method. A precise research on the accuracy of the measuring method may be necessary.

Radioactivity in fishes

Several tissues in fourteen samples of fish caught from different fishing grounds (see Fig. 1), have been examined radiologically. Their morphological data as well as the name of fishes, localities and dates of eatch are summarized in Table 2. Radioactivity of each ashed sample weighing 0.5 g. was measured on the stainless steel dish. Results obtained are shown in Table 2.

It may be concluded that the most radioactive parts of these fish are the liver, kidney and spleen. The radioactivity in muscles was very poor, though the red muscle held always higher activity than the ordinary muscle of the same fish. It must be added that a fish which has a high potency of the activity in the dark muscle seems to indicatea high strength in the kidoney also.

Comparing the results reported in the previous paper[3], the conciderable high activity could not be detected in the samples collected in this expedition. The correlation between the stomach contents and tissues in regard to strength of radioactivity could not be made sure. In spite of the fact that the tissues was contaminated, the activity in the stomach contents was not detected. According to the earlier conception[4] on the radiological contamination of fish, ashes of fission products fell down into the sea, adhered to the planktons and came into fish bodies. However, radioactivity of the tissues may depend upon not only the food which has been already contaminated, probably upon other routes of contamination such as gill and body surface, through which radioactive elements may be introduced. Because marine fish are capable of keeping their osmotic

Table 2. Radioactivity detected in various tissues and organs of fishes.

Species	Sample No.	fishing station Lat.	fishing station Long.	Date of catch	Body length cm.	Body weight kg.	Sex	Radioactivity, $\mu\mu c$/500mg. (Ashed matter) Heart	Stomach	Stomach content	Intestine	Liver	Spleen	Kidney	Muscle	Dark muscle
Neothunus macropterus	1	14° N	65° E	Jan. 4	141	58.5	♀	12.3	32.9	21.6	37.0	105.6	138.0	273.1	5.1	80.3
	2	14° N	65° E	4	133	33.5	♂	30.9	40.1	0.0	16.4	123.7	250.2	248.2	23.6	37.0
	3	4° S	78° E	25	142	53.5	♂	0.0	17.5	30.9	0.0	53.5	110.2	85.4	31.9	49.4
	4	4° S	78° E	25	138	64.5	♀	0.0	0.0	0.0	35.0	220.4	83.4	200.8	44.2	63.8
Parathunus sibi	1	14° N	65° E	4	131	53.5	♂	20.6	2.0	0.0	47.3	260.5	429.5	154.5	0.0	53.5
	2	14° N	65° E	4	132	42.0	♂	0.0	23.6	21.6	0.0	234.8	107.1	261.6	11.3	93.7
	3	4° S	78° E	25	117	38.0	♂	16.4	0.0	24.7	13.3	136.9	150.3	184.3	26.7	70.0
	4	4° S	78° E	25	115	33.0	♂	0.0	0.0	18.5	22.6	209.0	264.7	207.0	0.0	78.2
Makaira mazara	1	14° N	65° E	4	223	177.0	♀	26.7	47.3	45.3	0.0	72.1	92.7	172.1	0.0	60.7
	2	14° N	65° E	4	183	91.0	♂	5.1	36.0	25.7	31.9	213.2	80.3	207.3	37.0	43.2
Istiophorus orientalis	1	14° N	65° E	5	198	49.5	♂	0.0	24.7	0.0	0.0	186.4	117.3	331.6	32.9	86.5
	2	14° N	65° E	5	175	42.0	♂	84.4	27.8	37.0	0.0	341.9	276.0	186.4	0.0	63.8
Makaira marlina	1	14° N	65° E	4	189	155.0	♀	35.0	25.7	0.0	40.1	135.9	179.2	250.2	42.2	94.7
	2	3° S	78° E	23	248	178.0	♀	29.8	0.0	15.4	20.6	109.1	156.5	172.2	4.1	39.1

independence against sea water surrounding their bodies.

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