Radioecological researches in the Taranto Gulf

by

B. SCHREIBER*, L. TASSI-PELATI* et M.G. MEZZADRI**
**Istituto di zoologia, Università, Parma (Italie)*
***Radiochemistry Service, C.I.S.E., Milan (Italie)*

The Department of Zoology of Parma University, interested for a long time in the radioecological study of the Mediterranean Sea, began in 1968 a series of cruises in the Taranto Gulf (Ionian Sea) to amplify our knowledges on the radioactivity level of Italian Seas.

In the Taranto Gulf the zone studied till now is that facing the coast between Metaponto and Trebisacce, also owing to the Trisaia nuclear reprocessing plant set up near the Sinni river mouth.

Several samples of sea water, sediment, plankton and benthic organisms have been subjected to radiometric analysis.

Sea water

The gross beta radioactivity in sea water has been determined following the very quick method of Hamada [2] sensitive enough for the detection of little quantities of radioactivity from fission and also activation nuclides (sensitivity 9 pCi/1) [6].

The gross beta radioactivity of sea water resulted at the detection limit of the method (the same order of the blank) and didn't show remarkable variations from 1968 to 1969; therefore the artificial radioactivity content may be considered quite insignificant.

Sediments

Gross beta radioactivity measurements of several sediment samples let us get a picture of the radioactivity distribution both in surface and in the first decimetres of sediment. The superficial radioactivity of the bottom reflects the general situation of the marine environment with long life fallout nuclides and nuclides of the natural chains : in the years 1968 and 1969 we didn't record remarkable variations. By means of the determination of K^{40} contribution to gross beta radioactivity and through a careful control of the decay rate of the various samples we could state that the artificial radioactivity contribution in sediments is about the 10 p. 100 of the total.

Plankton and benthic organisms

The various organisms analysed, as Seaweeds, Molluscs, Echinoderms etc., show a noticeable variability in the gross beta radioactivity depending on the group under examination, the ash/dry ratio and the different accumulation capability of artificial and natural radionuclides.

The plankton compared with the benthic organisms shows a higher capability to concentrate artificial radionuclides. From the analysis of K and from the decay rate of the various samples it has been possible to state that more than the 80 p. 100 of the total radioactivity of the plankton is due to artificial radionuclides [4]. In fact the plankton, for its wider adsorbing surface, can catch a higher quantity of arti-

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ficial nuclides; moreover, living in the upper layers, it comes into contact with fallout fresher than the one reaching the other benthic organisms. To these last the fallout arrives already old, in part impoverished by the catch processes during the sedimentation to the bottom. It's so confirmed the function of plankton as sensitive and immediate indicator of an eventual contamination of marine environment.

The radiometric measurements pointed out a radioactivity content remarkably higher in the plankton samples of 1969 than in those of 1968. This must be attributed partly to the different composition of the samples in the two cases : the sample of 1968 was chiefly zooplankton rather rich and various, the one of 1969 showed a high percentage of fitoplankton and the zoological component was rather monotonous [1].

This raising may be attributed without doubt also to a general increase of the environmental radioactivity recorded by us also in other zones of the Mediterranean Sea (Ligurian Sea) and confirmed by the presence of Ce^{144} and Zr^{95} found by gamma spectrometry in the various samples [5].

In Table 1 we report synthetically a comparison between the radioactivity levels found in the different substrata in 1968 and 1969.

In Table 2 we show the contribution of K^{40} to the gross beta radioactivity in the different substrata measured in 1968.

To conclude we can say that in about 10 years of study of the radioactivity in the Italian Seas (Ligurian-Tyrrhenian, Adriatic, Ionian Seas) we always remarked a perfect parallelism between the fallout trend and the plankton radioactivity [7].

As in the period from 1967 to 1969 we noticed that the plankton radioactivity of the Ligurian Sea and the one of the Ionian Sea were very similar, it seems us possible to draw some general considerations on the radioactivity of the Italian Seas.

The gross beta radioactivity of plankton samples collected in 1960-61 was about 10-14 cpm/g ashes, in the 1961 itself, immediately after the Russian and American nuclear tests, it had got very high values and till 1963 it oscillated around 400 cpm/g ashes. Later on the value lowered to about 30 cpm/g ashes and only in correspondence with fresh fallout it raised bluntly (200-300 cpm/g ashes). Such a situation protracted from 1964 to 1969.

TABLE 1

Gross beta radioactivity in sea water, sediment and marine organisms : comparison between 1968 and 1969.

	Sampling zone	Sea water (cpm/1)	Sediment (cpm/g dry)	Marine organisms (cpm/g ash)		
1968	In front of Sinni mouth	TA 2 0.19	TM 13 11.55	TP 1 + TP 2	Plankton	31.30
		TA 4 0.03	TM 14 9.85	TB 1	Brown seaweeds	45.05
		TA 5 0.04	TM 17 10.55	TB 6	Mollusca	13.65
		TA 11 0.16	TM 28 12.15	TB 3 + TB 7	Starfishes	1.32
1969	Trebisacce	TrA 3 0.25	TrC 3 13.40	TrP 1	Plankton	215
	Sinni	TA 46 0.18	TC 18 13.65	TP 6	Plankton	365
	Sinni	—	—	TB 19	Mollusca	37.65
	Sinni	—	—	TB 23	Starfishes	1.90
	Metaponto	MA 3 0.20	MC 3 11.55	MP 1	Plankton	222
	Taranto	—	—	TB 24	Green seaweeds	36.80

Now if we consider that the K^{40} contribution to the gross beta radioactivity of plankton is 5 cpm/g ashes on the average, we can see how, already long since, the various plankton organisms undergo doses of radiations remarkably higher than the normal ones, chiefly due to K^{40}.

We agree with POLIKARPOV when he says that « it is possible that the evolutionary process of the inhabitants of the sea may be modified by the effect of additional doses of radiation. It is of fundamental significance that the ontogeny of many marine forms begins with a free, unprotected ovum, readily capable of adsorbing considerable quantities of a number of radionuclides, and therefore readily affected by increased biologically effective doses of ionizing radiation » [3].

We point out this fact as for the moment we don't know anything on the genetic and evolutionary effects of radiations on planktonic populations.

TABLE 2

Gross beta radioactivity and K^{40} in biological samples, sea water (dry residue) and sediment sample collected during 1968.

MARINE ORGANISMS		% 450° C ashes on dry	mg K/g ash	pCi K^{40}/g ash	gross beta cpm/g ash	gross beta besides K^{40} (%)
TB1	Brown seaweeds	25.20	36.60	29.65	45.50	65
TB2	Mantis shrimps	35.00	1.38	1.12	2.22	73
TB3 + TB7	Starfishes	82.50	1.47	1.19	1.32	54
TB4	Prawns	16.20	3.80	3.08	4.75	65
TB5	Crabs	55.40	1.38	1.12	1.85	68
TP1 + TP2	Plankton	43.15	11.30	9.15	31.30	84
SEDIMENT		% clay	mg K/g clay	pCi K^{40}/g clay	cpm/g clay	gross beta besides K^{40} (%)
TM 28	m 12	22.50	15.68	12.70	12.15	44
TM 17	m 15	46.65	15.94	12.91	10.55	35
TM 5	m 25	96.50	16.18	13.11	9.30	25
TM 6	m 50	98.50	13.93	11.28	9.90	39
TM 7	m 100	99.91	19.38	15.70	10.90	23
TM 8	m 600	99.89	19.05	15.43	11.90	31
SEA WATER		—	mg K/l	pCi K^{40}/l	cpm/l	gross beta besides K^{40} (%)
TA 13	—	—	439.48	355.98	165.80	0

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