

Presence of "red water" and environmental condition in some meromictic brackish-water lagoons of the Pontine Region

by

GIAN CARLO CARRADA and MARIA RIGILLO TRONCONE

Zoological Station of Naples and Institute of Sanitary Engineering of the University, Naples (Italie)

The presence of bacterial "red water" in meromictic environments from various regions of Europe and United States has been reported by several authors [TRÜPER & GENOVESE, 1968]. A complete review of the existing bibliography for the mediterranean area has been given by GENOVESE [1961, 1968].

It should be noted that the information collected so far was obtained from rather deep basins: Mar Piccolo of Taranto [CERRUTI, 1938]; lakes of Veliko and Malo Jezero [CVIČ, 1955, 1960]; lake of Faro [GENOVESE, 1961, 1963].

These basins have morphological and hydrographic characteristics which are different from those found in the more typical-shallow brackish-water lagoons of the tyrrhenian coasts, such as Lago Lungo on which this preliminary report is based.

Lago Lungo is a lagoon on the coast of the Pontine Region, one hundred kilometers north of Naples. A description of the geographical and physico-chemical characteristics of this lagoon is given by SOMMANI [1954]: its length is 1750 m, maximum breadth is 437 m and depth 7 m. The lagoon runs parallel to the coast and is separated from the sea by a dune, crossed by the canal which connects the lagoon to the sea.

This canal is quite insufficient for a good circulation of the water in the lagoon, so that its outstanding feature is a permanent state of meromixis, with a chemocline at about 3 m.

Physico-chemical data shown in Table I are the result of a sampling made in may 1972 in the central and deepest part of the lagoon. The results are in good agreement with those obtained from previous samplings made for the study of nycthemeral variations of nutrients in the same lagoon.

Chemical stratification of the water is as follows. The oxygenated layer has a depth of 3.5 m with values of oxygen progressively decreasing from 10.08 to 1.00 mg/l. The temperature varies from 20.5° C at the surface to 17.4° C at the bottom; the corresponding pH from 8.5 to 6.9.

In the anaerobic layer hydrogen sulphide ranges from 1.53 mg/l at a depth of 3 m to 13.55 mg/l at the bottom.

Between the aerobic and anaerobic layers a third layer of "red water" is found with a thickness of about 2 m. Its marked rose-colour is clearly visible in the samples collected between 3 and 5 m.

This transitional layer of "red water" is characterized by hydrogen sulphide concentrations between 1.53 and 12.10 mg/l. At 3.0 m and 3.5 m depth oxygen is still present in concentrations of 1.56 and 1.00 mg/l respectively; pH ranges from 7.7 to 6.9.

The presence of purple sulphur bacteria has been confirmed by means of the Winogradsky culture-aquarium containing mud and water from the maximum depth.

"Red water" developed after four days and maximum colour intensity was reached after eight day.

Given the results obtained at Lago Lungo, investigation were carried out in other two brackish-water lagoons of the Pontine Region : Sabaudia and Caprolace, both characterized by a well marked and constant meromixis.

As reported earlier [MILO DI VILLAGRAZIA, 1961], "red water" was found only at Sabaudia which, from its morphological characteristics, is more similar to the environments studied by CVIČ & GENOVESE (*cit.*) than to Lago Lungo.

The lagoon of Sabaudia has an irregular shape as a result of the damming by the recent dune of five fluvial valleys, digged in the würmian dune.

Its maximum length is 6.7 km; maximum breadth 2.4 km; perimeter 20 km; maximum and medium depth 11.3 and 3.5 m respectively. The lagoon is connected to the sea through two canals at the opposite ends of the sand bar.

But these canals are not sufficient to provide a complete circulation of the waters of the lagoon so that deeper layers are practically unaffected by incoming sea-water.

Data on the bathymetrical variation of the principal physico-chemical factors are shown in Table I and give good evidence at the meromictic character of this lagoon.

The "red water" layer has a thickness of about 1 m and is found immediately under the thermocline, at 4 m depth.

Sulphur bacteria cultures in Winogradsky columns developed after two days and reached maximum colour intensity after eight days.

A survey at the lagoon of Caprolace in which previous workers [GRANDORI R. & L., 1933; GRANDORI L., 1939] had reported the occurrence of "red water", gave no evidence of it. Enlargement works of its canal to the sea, as well as the installation of a water-scooping plant, may account for the basic change of the hydrographical conditions of the lagoon and the disappearance of "red water".

From our results it may be concluded that the presence of bacterial "red water" is a constant characteristic of all those environments in which a chemocline divides an oxygenated epilimnion from a hydrogen sulphide rich hypolimnion, both in deep- as in shallow-water basins.

Research is in progress at Lago Lungo in order to determine the role that "red water" bacteria play in the trophic processes of the lagoon.

Depth m	Lago Lungo, 10 - V - 1972						Lago di Sabaudia, 30 - V - 1972					
	t °C water	pH	O ₂ mg/l	O ₂ %	H ₂ S mg/l	Cl %	t °C water	pH	O ₂ mg/l	O ₂ %	H ₂ S mg/l	Cl %
0	20,5	8,5	10,08	112,00	0,00	3,38	23,8	7,9	6,88	87,98	0,00	11,91
0,5	20,8	8,4	9,84	109,82	0,00	3,38	24,1	8,0	6,88	88,55	0,00	11,91
1,0	24,6	7,8	18,16	234,32	0,00	11,50	24,0	8,0	6,16	79,07	0,00	11,93
1,5	25,2	8,0	16,32	218,47	0,00	13,75	23,7	7,8	5,64	72,03	0,00	11,93
2,0	24,4	7,7	11,08	147,14	0,00	14,10	23,2	7,5	5,84	74,20	0,00	11,96
2,5	21,6	7,6	2,08	26,33	0,00	14,10	23,2	7,6	5,84	74,20	0,00	11,96
3,0	19,8	7,7	1,56	19,19	1,53	14,29	23,1	7,6	5,92	75,03	0,00	11,96
3,5	18,4	7,4	1,00	12,00	3,15	14,39	23,1	7,6	4,88	61,85	0,85	12,01
4,0	17,3	7,2	0,00	—	6,30	14,39	22,5	7,5	0,96	12,12	1,45	12,50
4,5	17,4	6,6	0,00	—	9,03	14,49	20,2	7,4	0,00	—	5,79	13,54
5,0	17,2	6,9	0,00	—	12,10	14,51	18,5	7,2	0,00	—	16,70	14,08
5,5	17,2	6,9	0,00	—	11,25	14,59	17,2	7,2	0,00	—	30,34	14,79
6,0	17,4	6,9	0,00	—	10,40	14,74	16,5	7,1	0,00	—	33,23	15,11
6,5	17,4	6,9	0,00	—	13,55	14,89	16,2	7,1	0,00	—	34,43	15,30
7,0							16,0	6,9	0,00	—	34,77	15,30
7,5							15,6	6,7	0,00	—	35,79	15,40
8,0							15,8	6,6	0,00	—	38,52	15,45
8,5							15,5	6,6	0,00	—	38,52	15,45
9,0							15,6	6,6	0,00	—	38,52	15,50
9,5							15,5	6,7	0,00	—	40,22	15,50

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