

INORGANIC MERCURY IN THE ROCK POOL ENVIRONMENT
(LIGURIAN SEA)

L. Pane, *R. Capelli, L. Paganelli, A.M. Carli,

Dip. di Biologia Sperimentale, Ambientale ed Applicata
Sezione di Ecologia Applicata ed Educazione Ambientale

*Dip. di Chimica Farmaceutica ed Alimentare

Università di Genova

INTRODUCTION

The environment of the rock pools is characterised by drastic variations of the physical-chemical factors as regards meteo-marine changes and these fluctuations influence the structure and the dynamics of the ecological communities (1).

Various studies on the rock pools of superior middle coast plane in the Gulf of Genoa (Ligurian Sea) were carried out (2-6); recently, the variations of physical-chemical parameters and the fluctuations of the population of the *Tigriopus fulvus* (Copepoda Harpacticoida), characteristic of this environment were examined (3,7,8). In particular, the bacteria and copepod association was studied (9), as a model for the evaluation of the degradation of organic matter in the marine environment and also regarding the suitability for survival and growth of human and animal pathogen bacteria (10-14).

Despite this, there is little knowledge about the heavy metals found in Ligurian coastal rock pools, probably due to the analytical difficulty connected with a scarce biological matter present in the environment; therefore few studies concerning the heavy metal (mercury) interaction with a biotic component have been carried out. In general, in the Ligurian Sea ecosystem, the processes of changes and accumulation of mercury presence in sea water, in benthos, in nekton and in marine mammals are not well known (15,16). Here the results of a 1-year study of mercury

concentrations in the rock pool environment are reported.

MATERIALS AND METHODS

The study examines a rock pool of superior middle coast of the Ligurian Sea (Genova-Nervi); the research was carried out from September '94 to September '95, with monthly investigations. As regards the physical parameters, pH and temperature of the rock pool water (portable pH-meter, HAMEL) were measured in situ. At the same time water samples were collected to evaluate the dissolved oxygen and salinity in laboratory (17). Samples of rock pool water (1 litre) for mercury analysis (water, organisms and particulate matter), were collected; the Teflon sampling bottles were treated with 5% HNO₃/ water solution. In laboratory the samples were pre-filtered (plankton net, mesh 200 μ to separate the copepods; male and female copepods were separated and then put into the stove at 70°C for one night to determine their dry weight. To separate the particulate matter, the residual sample was filtered on glass fibre filter (Whatman GF/F, O = 47 mm), before conditioning (12 hours, 70°C) and weighing. The mercury was determined, before treatment with acid and in microwave oven for about three minutes, with the cold vapour method, and detected with atomic fluorescence spectrometry. The instrument was tested with copepods sample standard with inorganic mercury concentration equal to 0.28 μ g/g (MA-A-1, n° 555 IAEA, Monaco).

RESULTS

Results regarding rock pool water are reported in Tabs. 1 and 2. The lowest temperature was recorded in January (9°C), and the maximum in June (32°C). The pH changed from 8.3 in December and January to 9.0 in February and September '95 (mean value = 8.7). The oxygen changed from 9.4 mg/l (September 94) to 13.7 mg/l (May). The minimum value of salinity (15.8‰) was recorded in November, the maximum (85.59‰) in June. The mercury concentration in the rock pool water changed from 0.11 ng/l to 1.86 ng/l (mean value = 0,92 ng/l). In the particulate matter there

is a variation from 6.24 ng/g (June) to 1349.32 ng/g dry weight (November) (mean value = 312.05 ng/g). The concentration range of mercury in the males of *Tigriopus fulvus* is 91.65-2675.95 ng/g dry weight (mean value 743.38 ng/g); in the females the value changes from 63.75 to 867.409 ng/g dry weight (mean value 439.58 ng/g). In July the rock pool was dry.

Tab. 1 - Physical-chemical parameters.

DATE	T(°C)	pH	O2 (mg/l)	Salinity (%)	Rainfall(mm)
Sept. '94	26	8.5	9.4	-	152.8
Oct. '94	19	8.6	11.9	22.16	64.8
Nov. '94	17	8.6	12.5	15.80	82.8
Dec. '94	15	8.3	11.2	35.46	0.0
Jan. '95	9	8.3	11.6	44.81	0.0
Feb. '95	15	9.0	13.6	27.83	28.4
Mar. '95	17	8.7	10.2	44.52	0.0
Apr. '95	24	8.9	13.1	40.82	27.6
May. '95	27	8.7	13.7	37.94	2.4
Jun. '95	32	8.6	10.8	85.59	0.4
Jul. '95	-	-	-	-	-
Aug. '95	28	8.7	11.3	27.90	16.6
Sept. '95	27	9.0	13.6	21.83	12.8

Tab. 2 - Mercury values in the component of rock pool environment.

DATE	Water (ng/l)	Particulate (ng/g)	Male <i>T. fulvus</i> (ng/g)	Female <i>T. fulvus</i> (ng/g)
Sept. '94	0.27	-	2675.95	469.15
Oct. '94	0.8	123.77	1837.18	816.12
Nov. '94	1.32	1349.32	918.46	748.68
Dec. '94	1.16	634.99	716.43	634.33
Jan. '95	0.32	192.96	663.16	562.54
Feb. '95	1.14	122.10	304.14	359.85
Mar. '95	1.41	33.74	-	63.75
Apr. '95	1.29	56.99	183.64	432.06
May. '95	0.11	631.69	116.99	68.95
Jun. '95	0.37	6.24	107.28	84.84
Jul. '95	-	-	-	-
Aug. '95	1.86	61.04	91.65	167.34
Sept. '95	0.94	219.72	562.35	867.409

DISCUSSION

The study permitted to focus an analytical method for mercury determination in copepods, organisms with high density, but low biomass; this method allows the analysis of samples with dry weight of about 0.25. The influence of some parameters on mercury concentration has been evaluated (Figs. 1,2,3).

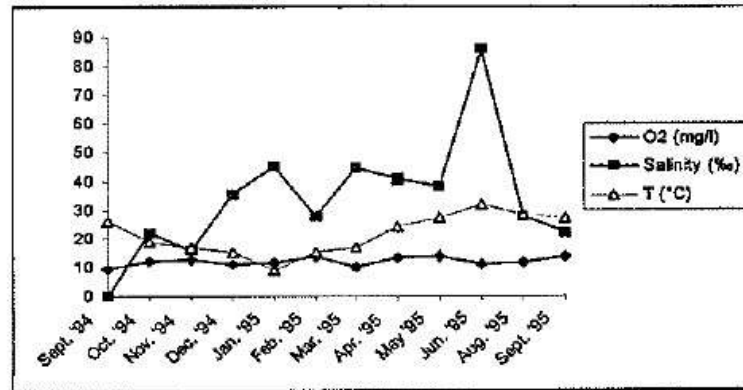


Fig. 1 - Physical-chemical parameters.

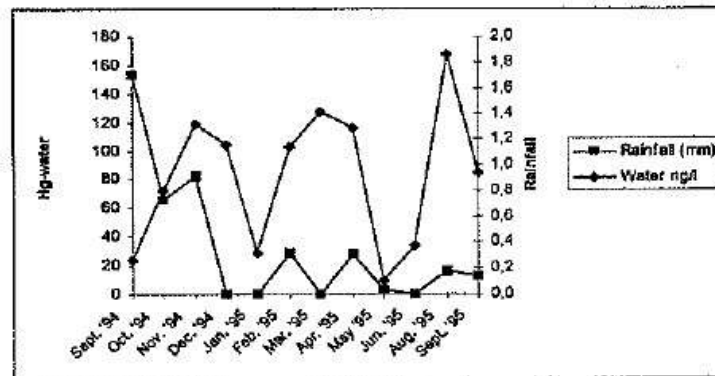


Fig. 2 - Relation with water, mercury and rainfall.

These data show that *T. fulvus* males, except May '95, have a greater mercury concentration than females. In order to avoid the reduction of the natural population it was impossible to analyze the females with egg sacs, to establish if the physiological condition influences the mercury concentrations.

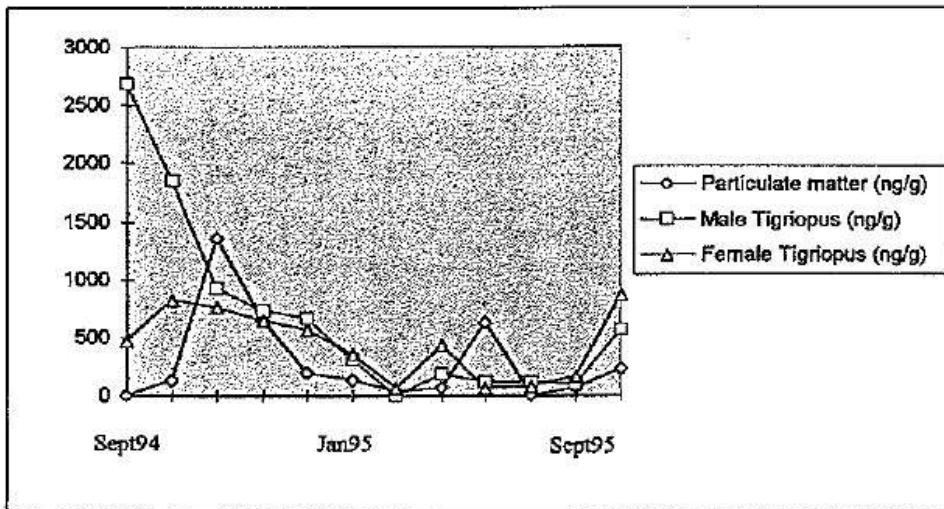


Fig. 3 - Mercury in the particulate matter and in *Tigriopus fulvus*.

The analysis of the various parameters, enables to hypothesise that the mercury concentration falls with the increase of temperature, more in females than in males; instead, the concentration seems to increase with rainfall. The negative correlation between rainfall and density and salinity parameters may be due to the influence of the sea state and temperature on the rock pool. There are no significant correlations between the rock pool water and the particulate matter.

Data for Oceanographic Campaigns (15,16) show that the reactive mercury concentration in water samples collected in the pelagic zone of the Ligurian Sea (depth 0-10m), is from 0.1 ng/l and 0.5 ng/l, while in the neritic zone (depth 0.1 m), the concentration is 0.15-0.30 ng/l.

We observed that the reactive mercury value in the water rock pool (0.11-1.86 ng/l) is in average greater than in the Ligurian Sea.

In the present study the mercury concentration has been investigated in three components of a rock pool environment of Genoa Nervi (Ligurian Sea): water, particulate matter and *Tigriopus fulvus* (Harpacticoid copepod). The influence of some parameters (pH, temperature, salinity, rainfall) on mercury concentration has been evaluated.

These data show that the mercury concentration is greater in *Tigriopus* males than in females and that the concentration also depends on temperature variations.

-
- 1) GANNING B., *Ophelia*, 1971, 9, 51-105.
 - 2) PANE L., FELETTI M., CARLI A., *Atti S.it.E.*, 1996, 17, 317-320.
 - 3) BRIAN A., *Studi del Laboratorio Marino di Quarto dei Mille presso Genova*, 1921, 3-41, 1-121.
 - 4) CARLI A., *Natura*, 1967, 58, 208-220.
 - 5) CARLI A., *Boll. Pesca Piscic. Idrobiol.*, 1968, 23, 143-162.
 - 6) CARLI A., COLACELLO F., VALENTE T., *Atti Soc. Ital. Sci. Nat. Mus. Civ. Stor. Nat. Milano*, 1983, 124, (1-2), 11-22.
 - 7) CARLI A., FIORI M.A., *Natura*, 1977, 68, 101-110.
 - 8) CARLI A., MARIOTTINI G.L., PANE L., *Bull. Inst. Oceanogr. Monaco*, 1989, n° spécial 5, 295-300.
 - 9) CARLI A., PANE L., CASARETTO L., BERTONE S., PRUZZO C., *Appl. Environ. Microbiol.*, 1993, 6, 1960-1962.
 - 10) COLWELL R.R., *Biotechnology in the marine sciences*, Wiley Intersciences, New York, 1981.
 - 11) COLWELL R.R., *Science*, 1996, 274, 2025-2031.
 - 12) HUQ A., WEST P.A., SMALL E.B., HUQ I., COLWELL R.R., *Appl. Environ. Microbiol.*, 1984, 48, 420-424.
 - 13) MONTANARI M.P., PRUZZO C., PANE L., COLWELL R.R., *FEMS Microbiol. Ecol.*, 1999, 29, 241-247.
 - 14) PRUZZO C., CRIPPA A., BERTONE S., PANE L., CARLI A., *Microbiology*, 1996, 142, 2181-2186.
 - 15) CAPELLI R., MINGANTI V., *Environmental Inorganic Chemistry*, 1985, 15, 155-165.
 - 16) CAPELLI R. et al., *Adv. Environ. Res.*, 2000, 4, 31-43.
 - 17) FAO, *Fish. Tech. Pap.*, 1975, 137, 1-238.

KEY WORDS: Copepod, *Tigriopus fulvus*, mercury, rock pool.

Lectured at the meeting held in Genova on December 21, 2000.
Received: December 27, 2000; accepted: January 10, 2001.

Address reprint requests/correspondence to Dr. L. Pane, Dip. di Biologia Sperimentale Ambientale ed Applicata, Università degli Studi di Genova Viale Benedetto XV 5, I-16132 Genova.