Copper and Cadmium Levels in Fish from the Greek Waters (Aegean & Ionian Seas)

F. BEI, V.A. CATSIKI & E. PAPATHANASSIOU
National Centre for Marine Research, ATHENS (Greece)

Heavy metals are considered as the most important pollutants of the marine environment, due to their toxicity and their ability to be accumulated by the marine organisms. Although metal pollution in Greece is limited near the great industrial zones, the knowledge of the metal levels in marine organisms, especially in fish, is extremely useful. Fish muscle provides low metal content because of its low metabolic activity (CATSIKI et BEI, 1991). However it is very important to study the metal levels in this tissue in order to estimate metal quantities which enter to human by the fish consumption.

This work deals with Cu and Cd concentrations in fish species from the Aegean and Ionian sea and has been done within the framework of MED-POL Monitoring Program. Specimens of two categories of fishes : a) demersal, *M. barbatus* (size 15-16 cm), *M. surmuletus* (size 16-20 cm) and b) pelagic, *S. pilchardus* (size 14-16 cm), *B. boops* (size 16-20 cm) were collected during spring and autumn of 1989 from 5 greek marine areas of Aegean and Ionian sea : Alexandroupolis, Chios, Rhodes, Chania and Parga (Fig. 1). Ten specimens from each station were analysed. Individual samples from muscle tissue were prepared, lyophilised and digested with nitric acid under pressure and analyzed following the procedure described by CATSIKI *et al.*, (1991). The accuracy and precision of the methodology were tested during the UNEP Intercalibration Testing Exercise of 1984 and 1989. The data were statistically treated after log transformation log (x+1). In order to estimate if there are any differences among the sampling stations as well as among the two categories of fishes the two-way ANOVA was used (ZAR, 1984).

On the whole 131 samples were analyzed. Copper and cadmium concentrations, expressed in μg/g dry weight (ppm), are summarized in Table 1. Mean values of Cu ranged from 2.5 ppm to 3.37 ppm for demersal fish and from 2.74 ppm to 5.94 ppm for the pelagic fish. Mean Cd concentrations ranged from 0.64 ppm to 0.77 ppm for demersal fish and from 0.65 ppm to 0.78 ppm for pelagic fish (Table 1). The results of the present study are in agreement with levels in fish tissues reported from other Mediterranean regions (UNEP, 1986). Metal concentrations in the selected fish from this investigation did not show a great variability between the different regions, for both metals.

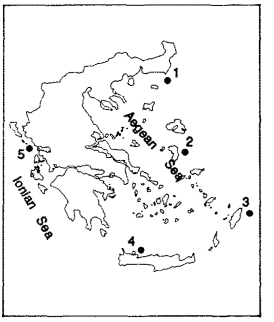

Figure 1. Location of Stations where samples have been taken.
1 = Alexandroupolis, 2 = Chios,
3 = Rhodes, 4 = Chania, 5 = Parga.

Statistical analysis showed that for Cu content Parga was significantly different ($F = 12.192$ $p < 0.001$) from all the other stations, especially as regards the accumulation of Cu from the pelagic samples (Fig 2) Cd concentrations showed that Alexandroupolis was different from the other stations having lower values ($F = 9.818$ $p < 0.001$) (Fig. 2).
The two categories of fish presented significant differences in metal accumulation ($p<0.001$ for Cu and Cd) observed at the interactions between station and category of fishes for both metals.

Generally pelagic fish exhibit higher concentrations of heavy metals, especially for Cu, mostly due to their ecology and physiology than other environmental factors (UNEP, 1986; KANETI *et al.*, 1987; CATSIKI & BEI, 1991).

TABLE 1

Fish Category	Station	N	Cu avg	Cu std	Cu min	Cu max	Cd avg	Cd std	Cd min	Cd max
DEMERSAL	Alexandroupolis	10	2.50	0.31	2.00	2.80	0.64	0.04	0.54	0.68
	Chios	20	2.47	0.86	1.20	4.15	0.72	0.09	0.54	0.97
	Rhodes	9	2.65	0.44	2.04	3.27	0.70	0.10	0.49	0.86
	Chania	13	3.37	0.55	2.60	4.40	0.73	0.09	0.60	0.88
	Parga	14	3.12	0.67	2.00	4.19	0.77	0.05	0.71	0.87
PELAGIC	Alexandroupolis	20	3.28	0.77	2.04	4.60	0.65	0.05	0.50	0.78
	Chios	10	4.44	1.20	3.20	7.45	0.78	0.07	0.66	0.88
	Rhodes	10	3.31	0.62	2.20	4.56	0.73	0.08	0.60	0.87
	Chania	16	2.74	0.63	1.98	4.20	0.67	0.03	0.60	0.76
	Parga	9	5.94	1.32	3.15	7.49	0.71	0.10	0.66	0.99

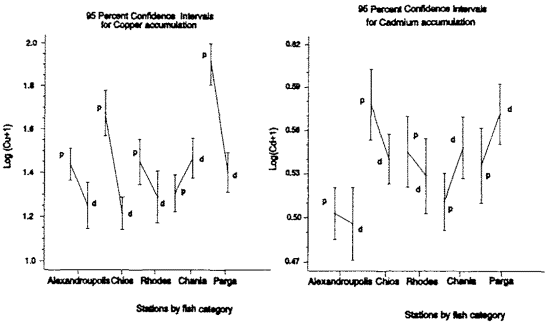

Figure 2. Mean values and 95% Confidence Intervals for Cu and Cd accumulation in the fish muscle from the five selected stations (p = pelagic, d = demersal).

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