Mercury contents in *Eledone cirrhosa* from the Northern Tyrrhenian Sea

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It is known that the cinnabar anomaly of Mount Amiata (Italy) strongly influences the mercury content in the abiotic and biotic components of the ecosystem of the Northern Tyrrhenian Sea. (BALDI *et al.*, 1979; BARGHIGIANI *et al.*, 1991).

Hg analyses of several different species of marine organisms used for food from the area shown in Fig. 1 demonstrated a phenomenon of metal accumulation to concentrations often much higher than 0.7 μg g^{-1} fresh weight, the maximum limit accepted by the EC for the edible parts of marine organisms (BARGHIGIANI *et al.*, 1991).

The subject of this paper is the study of Hg concentration in muscle tissue of *Eledone cirrhosa*, a small octopus-like cephalopod. This is the most abundant cephalopod species in the Northern Tyrrhenian Sea, it is widespread in the Mediterranean Sea, and is also largely used as human food, with an average production of 100 t per year just by the Porto S. Stefano fishing fleet (DE RANIERI *et al.*, 1988).

The sampling of specimens was performed monthly by trawl surveys from March 1989 to August 1990 in the study area indicated in Fig. 1. Length, weight, sex and maturative stage were determined for each specimen. Hg analyses were performed on muscle tissue. Total Hg was determined by atomic absorption spectrometry on cold vapour before sample mineralization with nitric acid in a pressurized digestion system at 120 ° C f or 6 h .

From Fig. 2 it appears that *Eledone cirrhosa* accumulated high amounts of mercury which were correlated with the specimens size, notwithstanding the short life cycle of just two years (BELCARI *et al.*, 1990). It must be pointed out that many specimens had mercury contents over the EC limit. On the basis of the maturative stage it was possible to single out a single cohort and to follow it monthly during the whole life cycle; Fig. 3 reports the average monthly Hg concentrations related to the studied cohort throughout the life cycle. The analyses on males and females (Fig. 4) demonstrated that no statistically significant difference in mercury accumulation existed between the two sexes. The comparison with samples at the same maturative stage collected in the Ligurian Sea (Table 1), about 100 miles north of the study area, showed a greater Hg accumulation in our specimens which was statistically significant (t=6.582; p<0.001).

In conclusion, from our results it appears that this organism is a strong Hg concentrator and that a high consumption of specimens collected in contaminated areas such as the northern Tyrrhenian Sea could be dangerous for human health. Furthermore, due to its particular life cycle *Eledone* could be useful as a Hg biomonitor for evaluating environmental variations of the metal at different times. Indeed, according to what was observed by BELCARI *et al.* (1990), on the basis of the month of collection and the maturative stage, it is possible to evaluate approximately the age of the specimens.

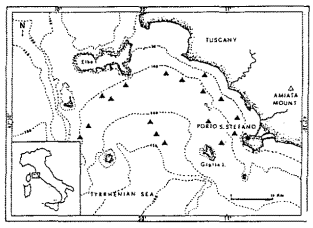

Fig. 1. Study area with sampling stations.

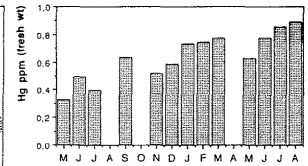

Fig. 3. Average monthly Hg concentration of samples of a single cohort.

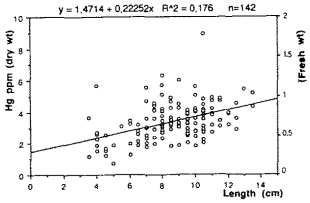

Fig. 2. Hg concentration versus length of organisms of a single cohort.

Table 1 - Comparison with samples at the same maturative stage collected in the Ligurian sea.

	STUDY AREA	LIGURIAN SEA
No. of specimens	15	10
Length cm	6.5-9	8-10
Hg (ppm ± S.D. d.w.)	3.310±1.252	1.136±0.215

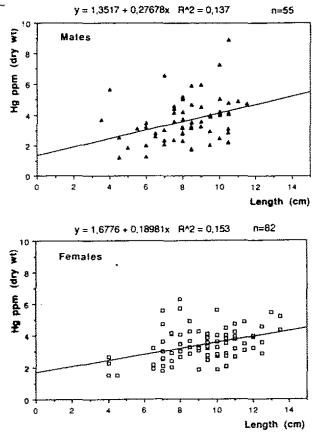

Fig. 4. Hg concentration versus organism length in males and females of a single cohort.

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

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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.

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.

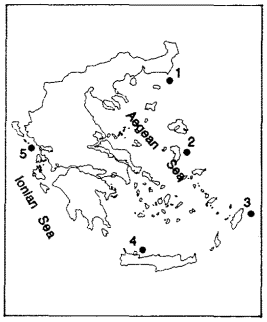

Figure 1. Location of Stations where samples have been taken.
1 = Alexandroupolis, 2 = Chios,
3 = Rhodes, 4 = Chania, 5 = Parga.

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			Cu				Cd			
	Station	N	avg	std	min	max	avg	std	min	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

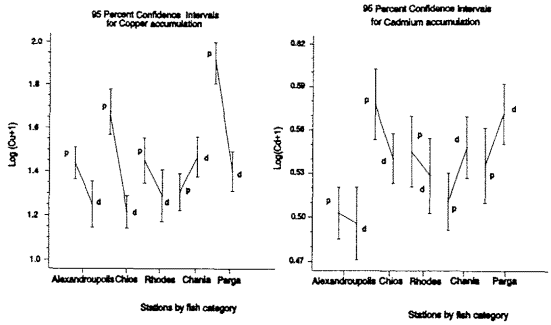

Figure 2. Mean values and 95% Confidence Intervals for Cu and Cd accumulation in the fish muscle from the five selected stations (p = pelagic, d = demersal).

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