# COPPER AND NICKEL IN MARINE FISH FROM GREEK WATERS

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**Abstract**

This study deals with the levels of Cu and Ni in flesh and gills of the demersal fish *Mullus barbatus*, collected during 1988 to 1995 from three different areas of the Aegean Sea (Greece). The concentrations of Cu and Ni in edible tissue are comparable to those from the literature. Gills have higher levels than flesh. No major differences in metal levels in fish between sampling sites were observed.

*Key-words: metals, Aegean Sea*

**Introduction**

At suitable concentrations some heavy metals are essential for enzymatic activity but they also form an important group of enzyme inhibitors when natural concentrations are exceeded (1). Consequently most heavy metals, whether essential or not, are potentially toxic to living organisms. Fish are widely used as sentinels of contamination in aquatic environments (2). Contaminant accumulation in various fish tissues is used as a measure of contaminant exposure and effects. According to the mechanisms of absorption, regulation, storage and excretion of trace metals, different tissues have different roles in these processes (3).

**Methodology**

Samples of similar sized fish *M. barbatus* (striped mullet) were collected twice a year (spring and autumn) from three different areas of the Aegean Sea. For the purposes of the MEDPOL programme, heavy metals have been regularly monitored in fish from Greek waters since 1988. The determination of heavy metals was made by digestion with nitric acid in teflon vessels under pressure. A Varian SPECTR AA 20 Plus Atomic Absorption Spectrophotometer was used (4). A total of 536 samples were analysed for Cu and Ni. The accuracy and precision of the analytical methodology was tested with the reference material of BCR N° 279 (*Ulva lactuca*).

**Results and discussion**

The results of metal analysis are given in Table 1. Figures 1 and 2 analytically present all concentrations fom every sample by tissue, station and year. Cu ranged between 0.28 and 20.56 ppm and Ni values varied from 0.08 to 52.68 ppm. It is noteworthy that, in most cases, fluctuation of the values is not high. It must be emphasised that fish are not exactly in the same metabolic state (different seasons and size), and due to their movement they do not necessarily integrate the same pollution (different areas and depth in the vertical water column). Heavy metal concentrations in fish are a function of both space (where they have been) and time (how long they were in each area), and the two effects cannot be separated. Generally the uptake, retention, toxicity and tolerance of metals by fish are governed by many environmental and biological factors (1).

Table 1. Metal concentrations (mean and range) in flesh and gills of striped mullet from the Aegean Sea during 1988 to 1995 (in $\mu$ g/g dry weight)

| stations | flesh | Cu | Ni | gills | Cu | Ni |
|---|---|---|---|---|---|---|
| Alexandroupoli | N=88 | 1.68±0.77 | 1.73±1.86 | N=88 | 5.09±2.44 | 6.40±4.89 |
| | | (0.68-3.75) | (0.08-14.12) | | (0.4 -15.20) | (0.22-23.55) |
| Hios | N=90 | 1.63±0.80 | 1.72±1.31 | N=90 | 4.26±1.75 | 7.75±8.57 |
| | | (0.59-5.67) | (0.16-5.01) | | (2.24-10.25) | (0.40-52.68) |
| Hania | N=90 | 1.96±0.99 | 1.72±1.06 | N=90 | 4.96±2.51 | 6.15±4.67 |
| | | (0.28-4.98) | (0.15--5.00) | | (1.61-20.56) | (0.27-19.66) |

Results showed that the two analysed tissues accumulate metals to different levels. The ratio of the metal concentrations in gills and flesh is greater than 1 (concentrations of metals in gills / concentrations of metals in flesh > 1) for Cu and Ni in all cases (stations and years). It is known that fish gills are a primary target for direct metal absorption from the external environment and thus serve as a major route for metal uptake by these species (5). On the other hand the lower metal concentration of flesh samples is partially due to the lower metabolic activity of this tissue in comparison with gills. Metal uptake by the gills does not involve direct and rapid transfer from the water to the blood, but rather an intermediate step for metal transport to the other tissues. Furthermore, flesh is the tissue most commonly chosen because of the implications it carries for human consumption and related health risks.

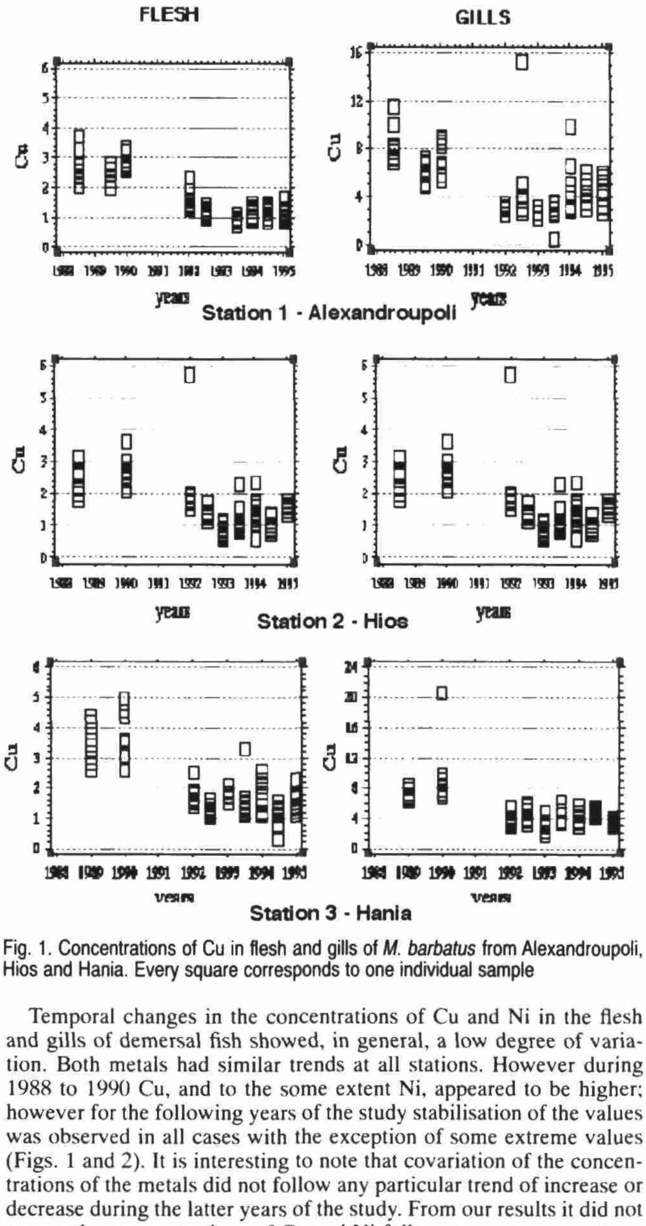


Fig. 1. Concentrations of Cu in flesh and gills of *M. barbatus* from Alexandroupoli, Hios and Hania. Every square corresponds to one individual sample

Temporal changes in the concentrations of Cu and Ni in the flesh and gills of demersal fish showed, in general, a low degree of variation. Both metals had similar trends at all stations. However during 1988 to 1990 Cu, and to the some extent Ni, appeared to be higher; however for the following years of the study stabilisation of the values was observed in all cases with the exception of some extreme values (Figs. 1 and 2). It is interesting to note that covariation of the concentrations of the metals did not follow any particular trend of increase or decrease during the latter years of the study. From our results it did not appear that concentrations of Cu and Ni follow any common pattern. This could be attributed to the fact that every metal probably originated from a different source. Furthermore, marine organisms, tend to accumulate heavy metals from the environment and are adapted to handle natural fluctuations by slight regulating changes in their bioavailability from water or food.

The distribution of the frequency of the determined concentrations is not symmetrical. For both metals, large numbers of the values in flesh were between 1 and 2 ppm (especially for Ni). In gills, values were not limited to a strictly defined range and the distribution of the frequency seems to be more normal. Although there is not a clear trend in metal concentration in the two tissues of the fish through the years,