

Mercury Contamination in Guadalquivir River Marshes, Spain, Using Samarugo, *Valencia hispanica*, as Biological Indicator

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The fluvial waters of Andalusia can be considered as having a lower degree of mercury pollution than other more highly industrialized areas, according to the annual reports on points in the fluvial network inspected for the quality of its water set up by the Department of Hydraulics at the Ministry of Works (Ministerio de Obras Públicas y Urbanismo 1985).

Some authors have demonstrated the positive use of marine organisms as biological indicators of environmental contamination by mercury (Sorentino 1979; Pena and Alberto 1984).

This research paper claims to make a contribution to the awareness of mercury pollution in the marshes of the Guadalquivir River (Spain) using samarugo fish (*Valencia hispanica*, Val 1846) as a biological indicator.

MATERIALS AND METHODS

In the summer of 1984, 85 samarugo (*V. hispanica*) were netted from marshes of Guadalquivir River (Figure 1). After catching the fish samples, individuals were weighed and measured and then stored at -20°C until required for analysis.

Total mercury concentrations were determined by flameless atomic absorption method first described by Hatch and Ott (1968) and later modified by Armstrong and Uthe (1971), adapted to the Perkin-Elmer Mercury/Hydride System-10 using 3% v/v NaOH and 1% w/v Na(BH₄) as the reducing agent. This System were connected on a Perkin-Elmer Model 2380 atomic absorption spectrophotometer equipped with a mercury hollow cathode lamp, operated at 253.7 nm. The detection limit (3 SD) was 2.6 ng and the quantification limit (10 SD) was 7.1 ng using a reaction volume of 10 mL. The recovery was 95.3% at 100 ng level.

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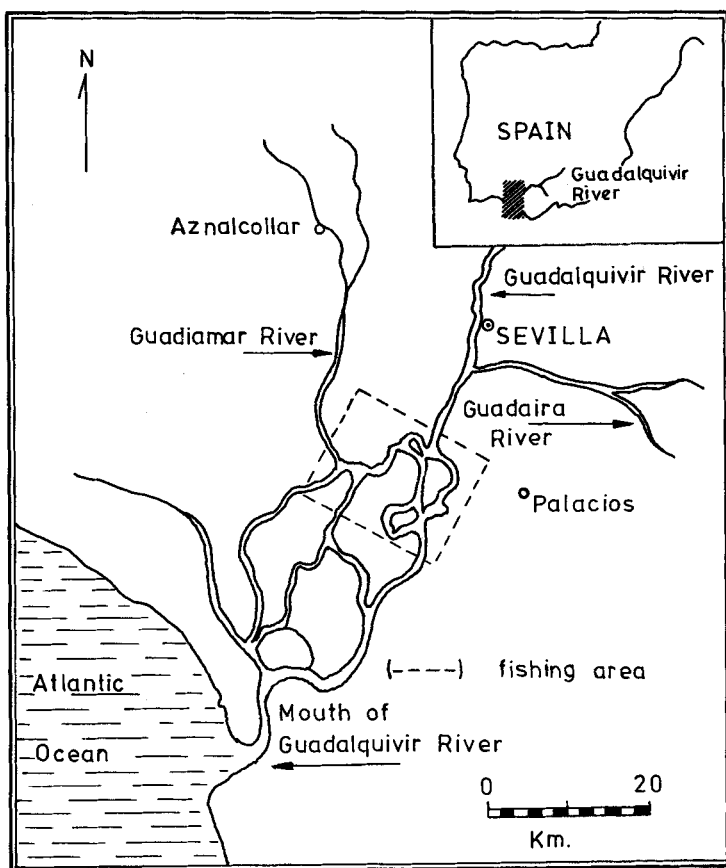


Figure 1. Geographical location of the marshes of the Guadalquivir River.

RESULTS AND DISCUSSION

A summary of the results obtained is shown in Table 1. Although the growth curves observed in both sexes are similar (Figure 2), the females in our sampling were larger, their size being statistically significant at the 0.001 level ($t = 4.86$ in the case of the variable weight and $t = 3.55$ for the variable length) although the average concentration of mercury found in both sexes did not reveal any statistically significant difference ($t = 1.05$). This led from the beginning to the supposition that there was hardly any relation weight/mercury or length/mercury.

A statistical study subsequently made showed that the relation between the variables was non-existent (Table 2.)

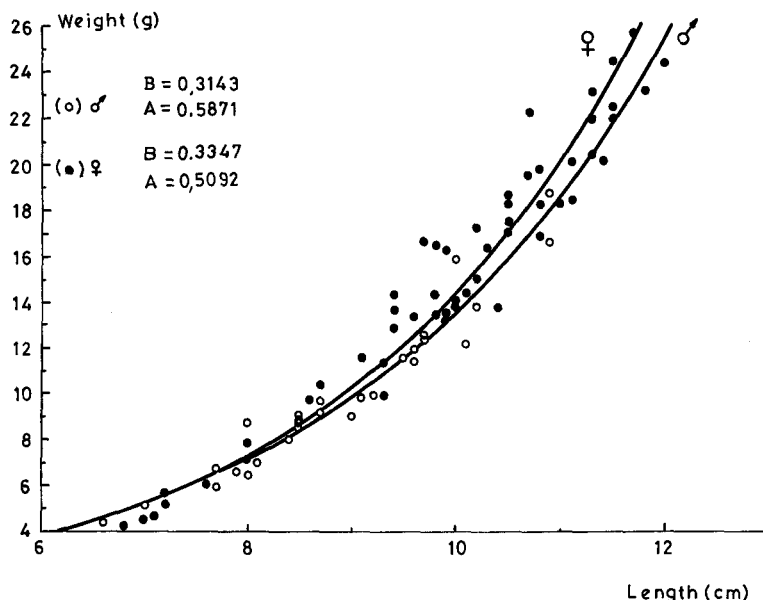


Figure 2. Growth curves for both sexes, where A and B are coefficients of the equation: $\text{Weight} = A \times \text{Exp}(B \times \text{Length})$.

Table 1. Summary of the results and values obtained for the comparison of the different variables in the two groups studied.

	males (n = 28)	females (n = 57)	t
	$\bar{X} \pm \text{SD}$	$\bar{X} \pm \text{SD}$	
Weight (g)	10.1 ± 3.4	15.0 ± 5.6	4.86 ^a
Length (cm)	8.8 ± 1.0	9.8 ± 1.3	3.55 ^a
Mercury (ppb) ^c	85.0 ± 21.5	92.0 ± 38.3	1.05 ^b

^a Statistically significant at the 0.001 level

^b Not statistically significant

^c ng g⁻¹

According to Hernando (1978), 28.8% of the diet of *V. hispanica* in the area referred to is made up of individuals of the genus *Isopoda* and 14.55% by fish (*Gambusia affinis*, *Aphanius iberus*, *Atherina monchon*, *Gobius* sp.), so that it can be said that in the omnivorous diet of this species there is a major predatory element. In a study carried out on samples of the same species coming from a different location (marshland in several salt flats

in Cadiz, Spain), Arias and Drake (1985) have deduced that they have an omnivorous diet with a clear predominance of prey of animal origin. In any case, this type of diet places this species in a valuable position in the trophic chain as a biological indicator of the mercury contamination in the marshes of the Guadalquivir River since, as has been pointed out by Yannai and Sachs (1978), their position in the trophic chain and their size are the two factors which determine the total mercury concentrations in fish. Another interesting factor about the species under study is that it is indigenous to this area.

Table 2. Relation between weight/mercury and length/mercury (mercury expressed in ng g^{-1} , weight in g and length in cm) in the population studied, were A = intercept on Y axis, B = regression coefficient, r = correlation coefficient.

	weight/mercury	length/mercury
A	6.12	25.08
B	7.82	-149.10
r	0.07 ^a	0.00 ^a

^aNot statistically significant

For Bull et al. (1981) the increase in mercury content related to an increase in size is associated with a high concentration of mercury in the environment. According to the Ministry of Works (Ministerio de Obras Públicas y Urbanismo 1985) and previous results obtain by us (Pozo-Lora et al. 1985), the average concentration of mercury in the water where the fish was caught is under 0.2 ng mL^{-1} which indicates very little environmental pollution since the area is not unduly industrialized. This fact may account for the scant relation found by us as per weight/mercury and length/mercury and backs up the Bull et al. (1981) hypothesis.

Statistically significant regressions and correlations have been described between the variables mercury/weight/length/age in several species but these are usually caught in water in highly contaminated areas (Bache et al. 1971; Sorrentino 1979; Bull et al. 1981; Pena and Alberto 1984) resulting in higher levels of mercury concentration the axial muscle (although in species other than *V. hispanica*) than were found by us. However, the difference in the species makes comparisons impossible because although an elevated position in the trophic chain shows a tendency towards a high mercury concentration (Yannai and Sachs 1978; Pena and Alberto 1984), one of the primary factors that determines the concentration of mercury in creatures of a species, apart from their alimentary habits, is the metabolism typical of that species (Bull et al. 1981).

The lack of relationship found between weight/mercury and length/mercury and the low mercury environmental pollution in the fishing area, are two events which are closely connected when using V. hispanica as biological indicator of mercury contamination in the Marshes of Guadalquivir River.

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