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**CONTAMINATED SITES**  
**ZNEČISTENÉ ÚZEMIA**  
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# CONTAMINATED SITES 2022

SENEC, SLOVAK REPUBLIC, 12 – 14 OCTOBER 2022

*The activity has been implemented within the framework of national project  
**Information and providing advice on improving the quality of environment in Slovakia.**  
The project is cofinanced by Cohesion Fund of the EU under Operational programme Quality of Environment.*

# Mercury contents in Largemouth bass (*Micropterus salmoides*) from the Valdezogues river, Almadén Hg mining district, South Central Spain

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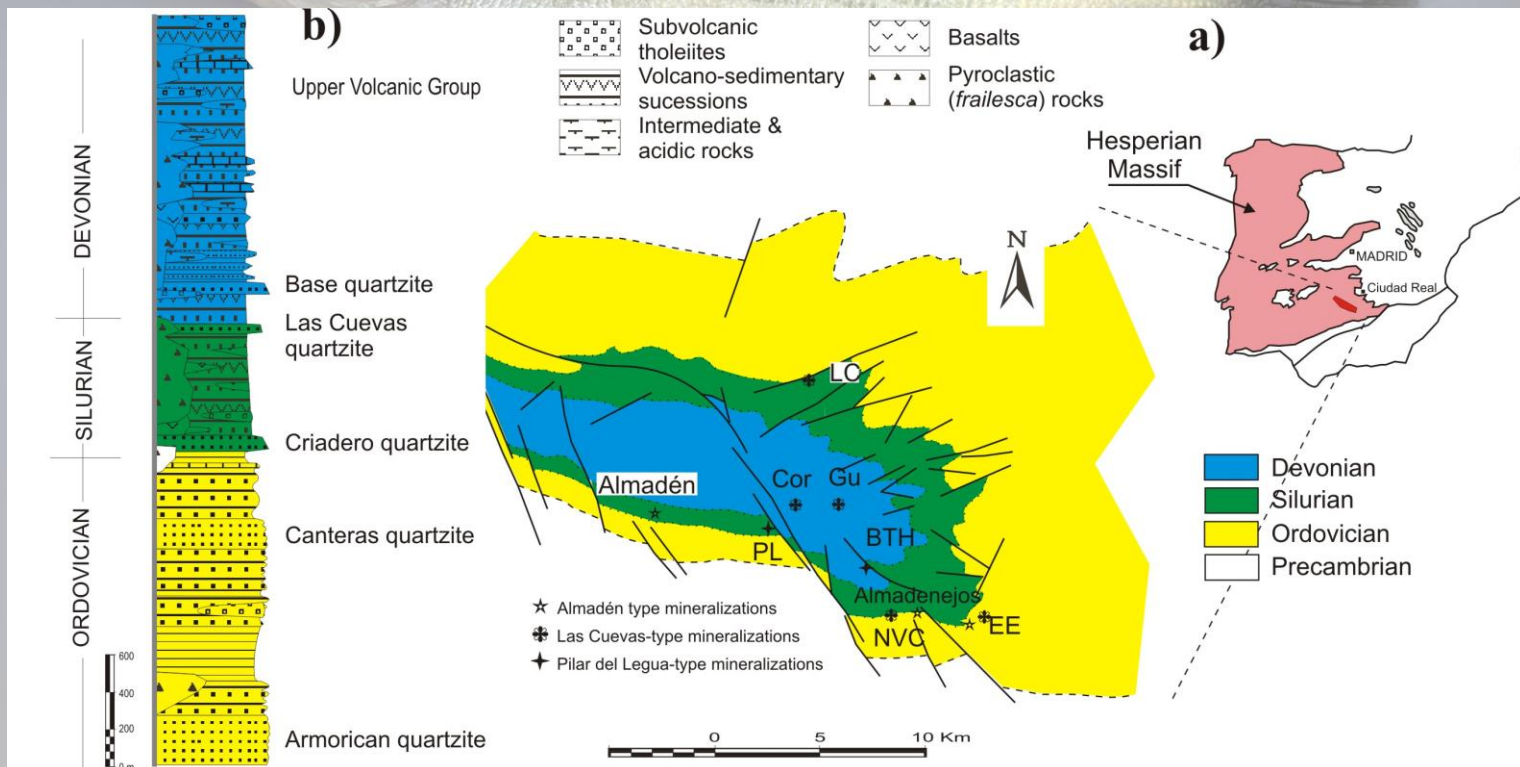
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# The Almadén mercury mining district

The Almadén region (Geological Report of Frigola, Madrid) is a Neoproterozoic high-grade metamorphic complex (2750°C) and the site of the most extensive (about 1000 km<sup>2</sup>) and richest (total of 7250 t Hg) and most diverse (about 6000 t of primary products) mercury mineralization in the world. It is a primary source of mercury with a total of 10000 t of primary products due to the intensity of mining activity.



# The Almadén mercury mining district

The district has been the subject of a large number of scientific research, aimed to understand the dispersion and fate of mercury in the different environmental compartments represented in the area

- **Water and sediments:** extremely high values in the proximity of Almadén, decreasing away downstream
- **Soils:** highly polluted, depending on the presence of Hg mines, prospects and showings
- **Air:** very extremely high values during mining and metallurgical activity. Very low values after the closure and reclamation
- Total affected area: some 125 km<sup>2</sup>



# The Almadén mercury mining district

The district has been the subject of a large number of scientific research, aimed to understand the dispersion and fate of mercury in the different environmental compartments represented in the area – **Biota**:

- **Plants:** Demonstrated uptake of Hg by foliar uptake – very high concentrations in some edible leaves, as most important concern
- **Terrestrial fauna:** scarce information, mostly concerning large game (deer and wild boar)
- **Aquatic organisms:** crayfish concentrations in hepatopancreas ('head') much higher than regulated for human consumption
- **Humans (hair):** concentrations slightly higher than those from out-of-Almadén people ( $<4 \text{ ng g}^{-1}$ )

# The Black bass (*Micropterus salmoides*)

This fish corresponds to a piscivorous species introduced in Almadén (and most of Spain) as a species for sportive fishing; but it has been also extensively fished for human consumption. It is particularly well spread in the main hydrologic basin coincident with the Almadén syncline and Hg mining district:

- **The Valdeazogues (meaning mercury valley) river system**

Up to date, no data on Hg concentration in this species has been studied and published for this area



Image: <https://www.cotodepezca.com/pescar-black-basses-inactivos-utilizando-diferentes-tecnicas/>

# Sampling

Fishing of this species was carried out at July 12<sup>th</sup>, 2022, following a transect of the Valdezogues river

Total distance from first to last captures along the transect: **36.3 km.**

First samples were taken in *El Entredicho* open pit, the largest of the minor Hg mines in the district

Valdezogues river is a stational water course, characteristic of this semiarid area of Spain

Fishing was only possible in 'large' pond areas along the transect

Conventional rods were used for sampling



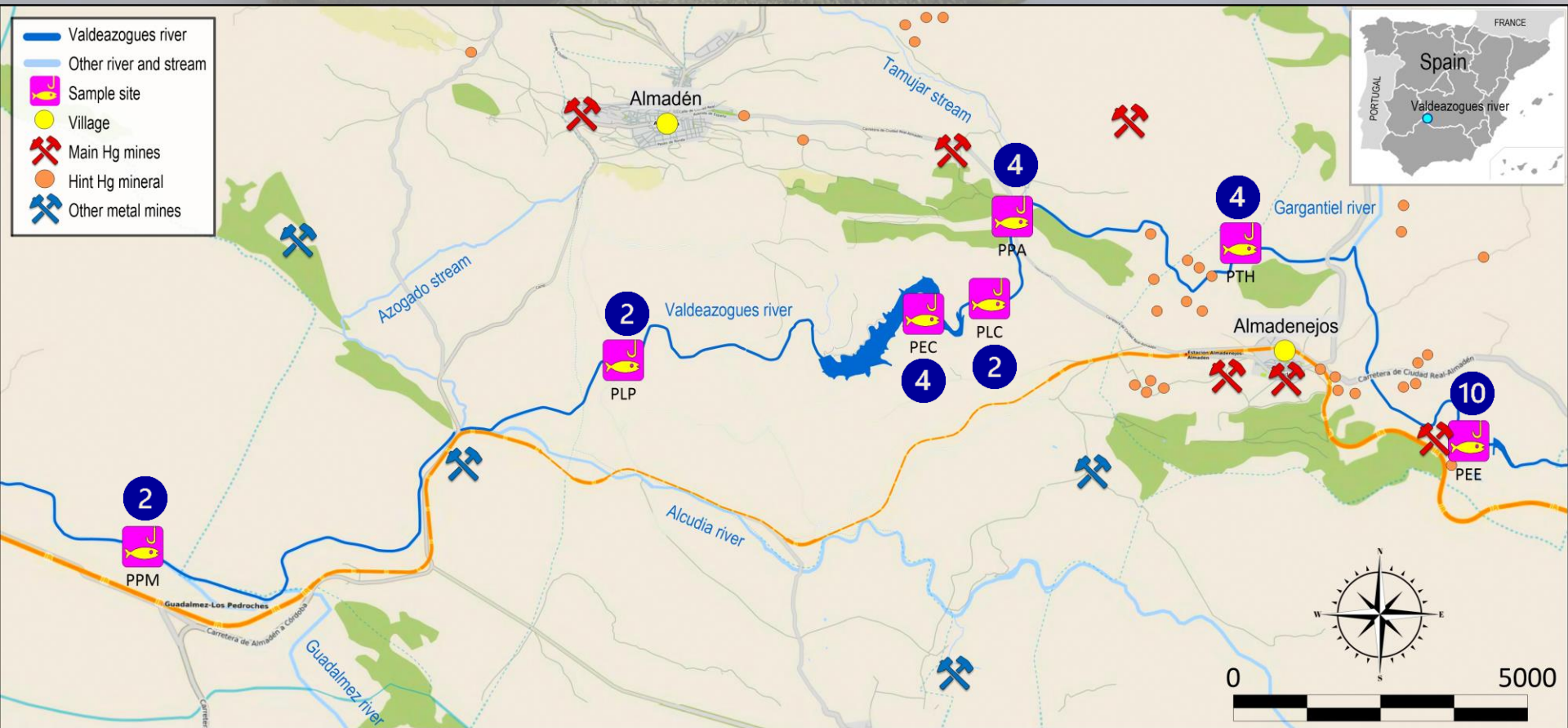
# Sampling





# Sampling

Sampling sites: distributed along the Valdeazogues river course, from El Entredicho Hg open pit to downstream the Azogado stream confluence



# Sampling

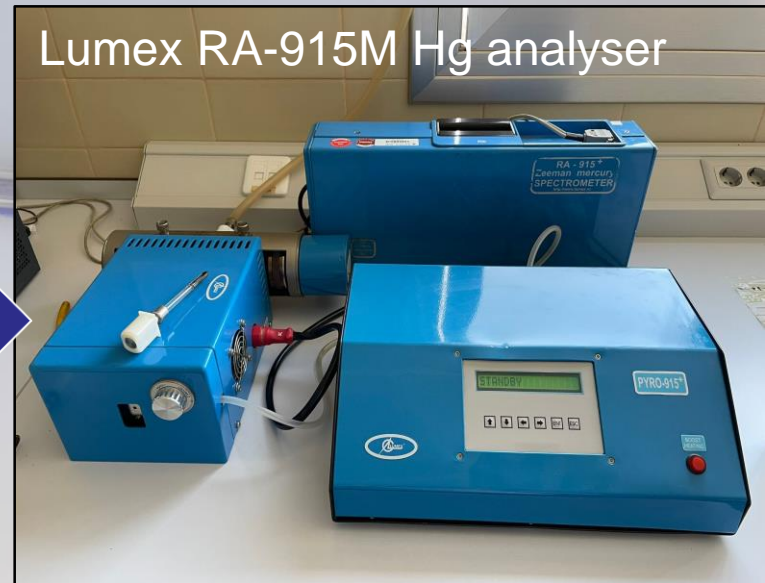
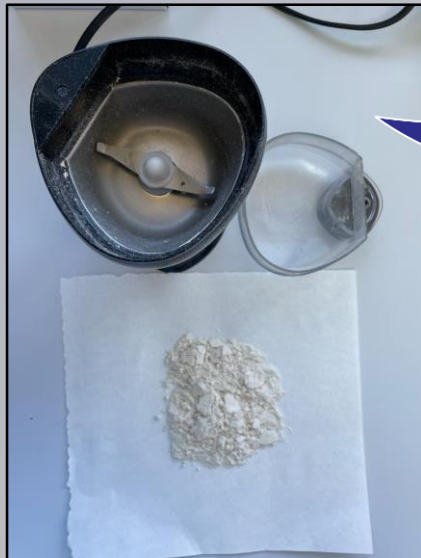


Specimens from Entredicho Hg open pit





# Specimen preparation and analysis



# Results

## El Entredicho Open pit:

Statistics Hg	Mean	StDev	VarCoef (%)	Min	Max
Wet weight (ng g <sup>-1</sup> )	5,177	1,159	22.4	3,115	7,613
Dry weight (ng g <sup>-1</sup> )	18,987	4,225	22.3	12,400	24,500

## Other sites:

Statistics Hg	Mean	StDev	VarCoef (%)	Min	Max
Wet weight (ng g <sup>-1</sup> )	1,084	413	38.1	473	2,058
Dry weight (ng g <sup>-1</sup> )	4,097	1,912	46.7	1,656	9,490

In fish, some 80% of total mercury corresponds to the highly toxic methylmercury

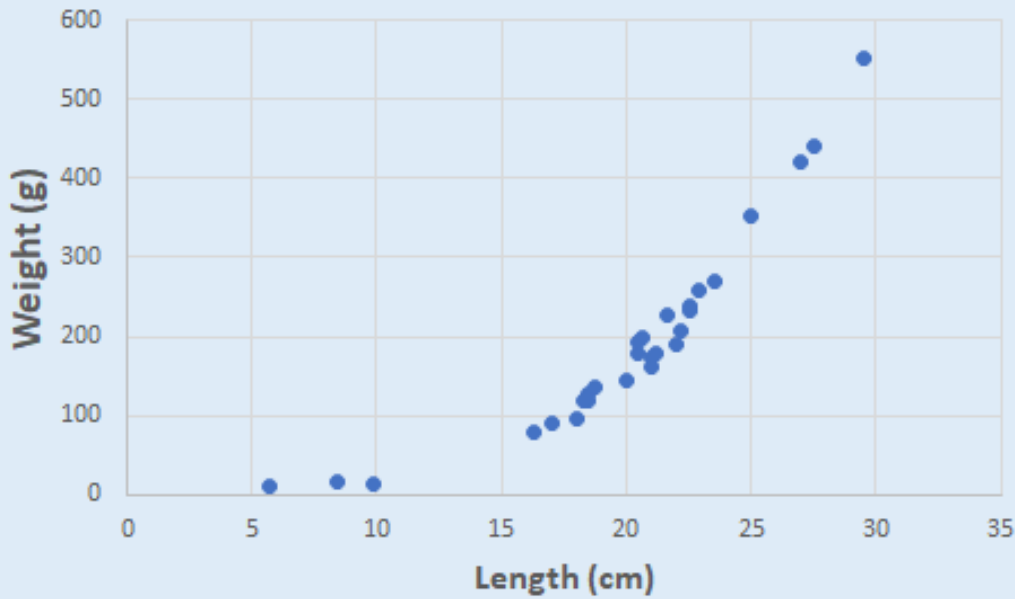
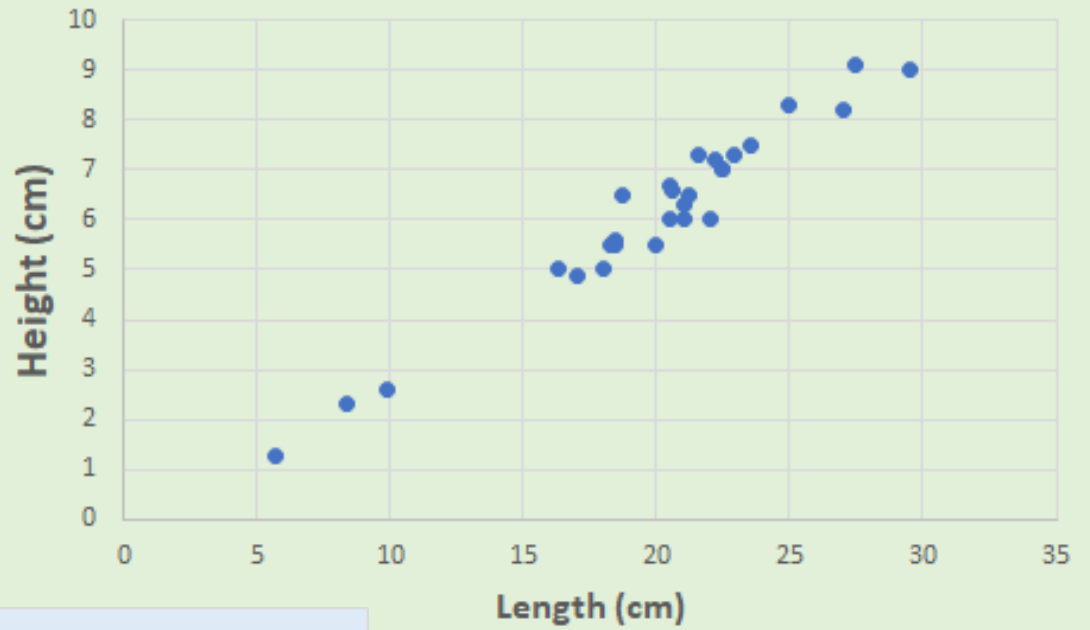


# Results



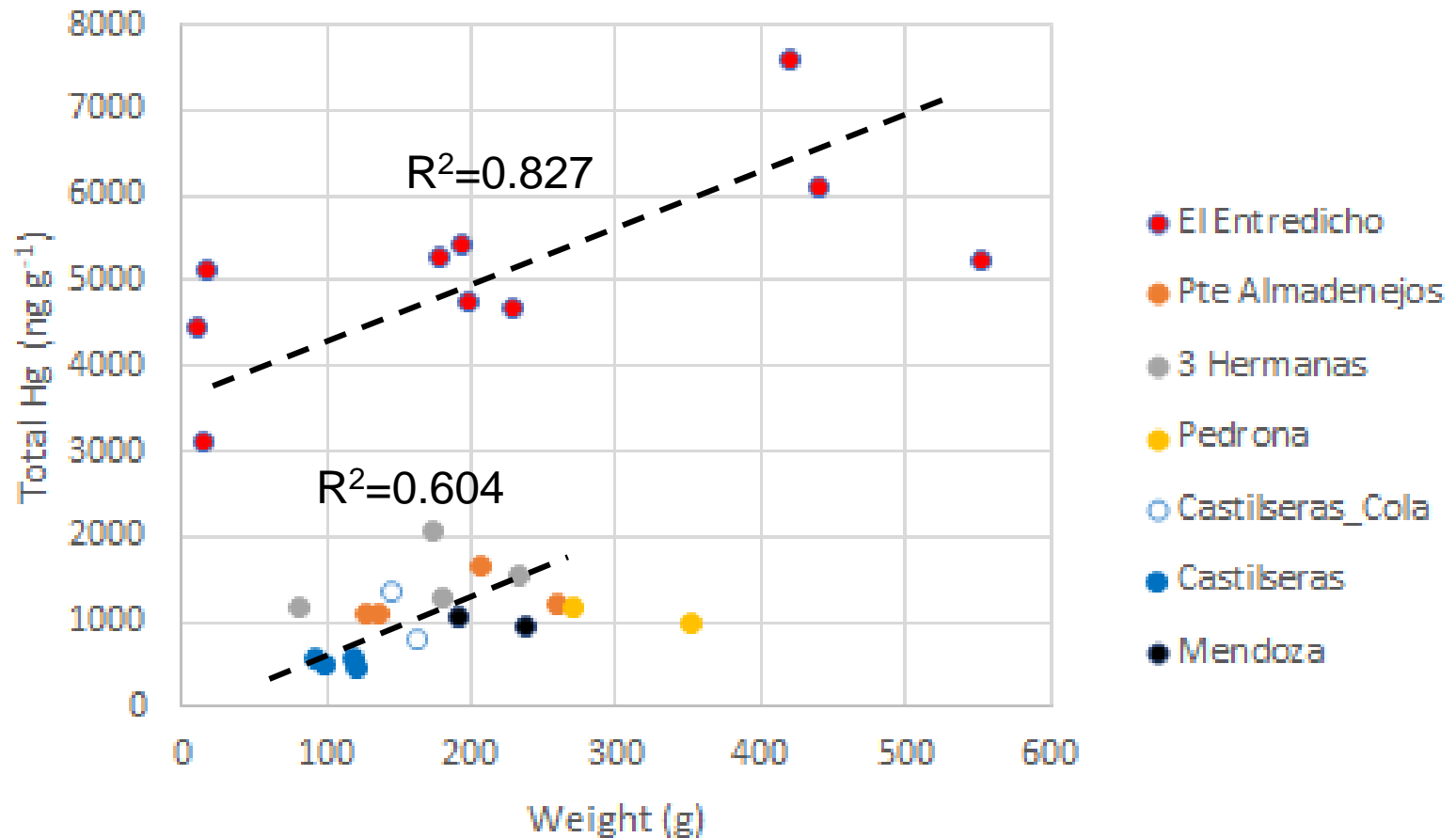
Distribution of Hg concentrations per sampling site

# Results



Relationships between morphological parameters

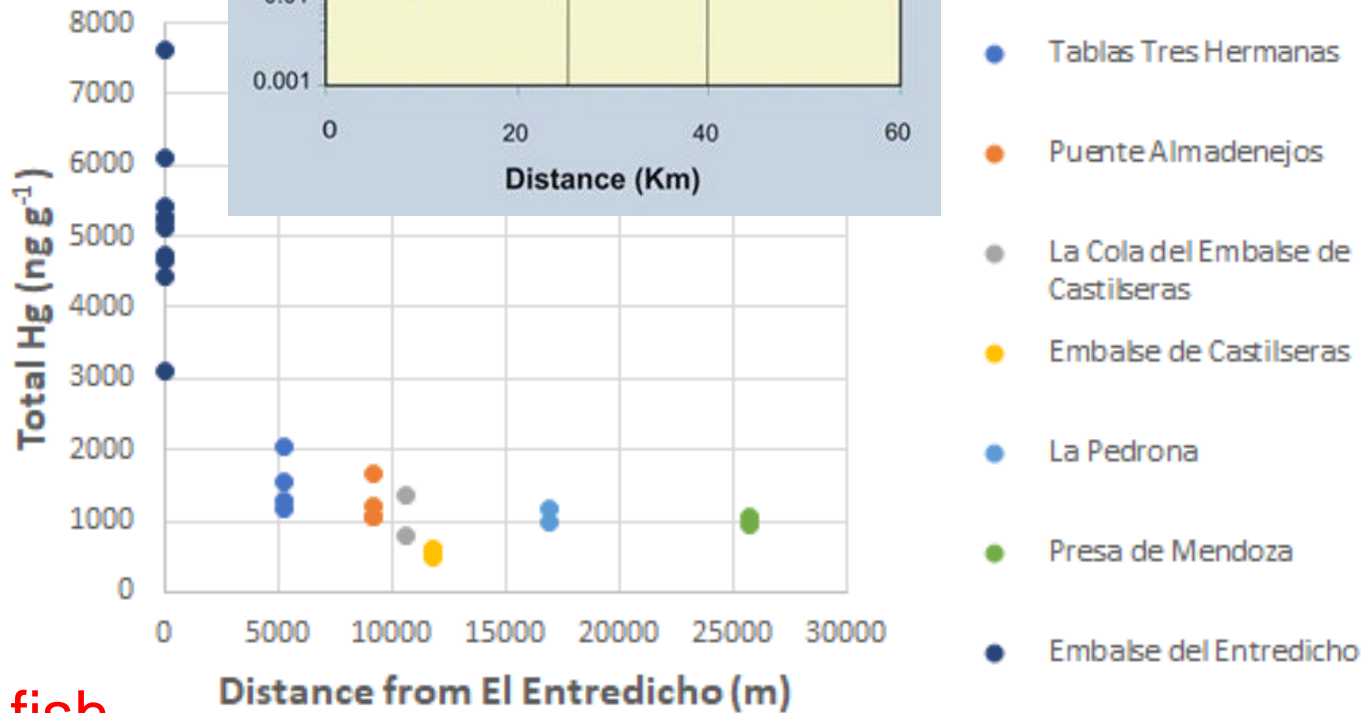
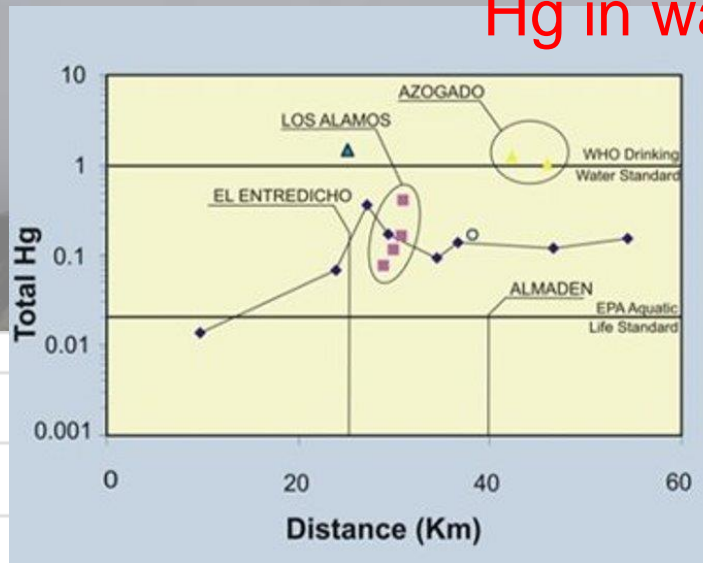
# Results



Distribution of **Hg concentrations** versus **weight** per sampling site

# Results

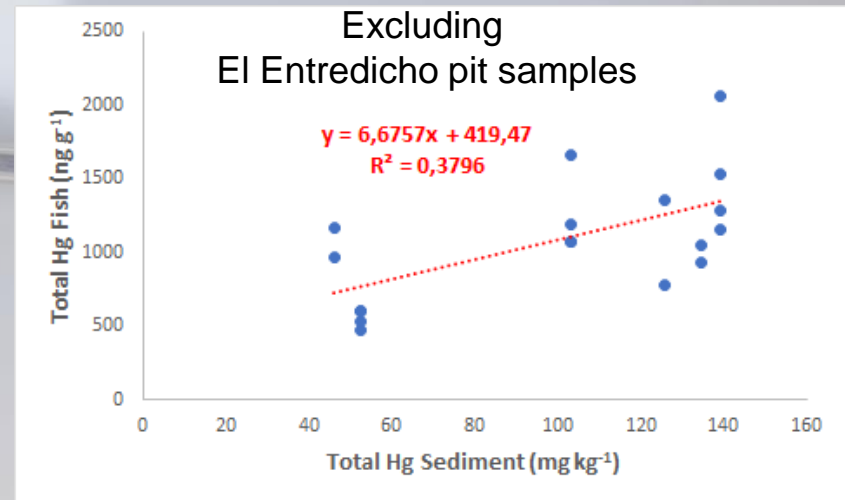
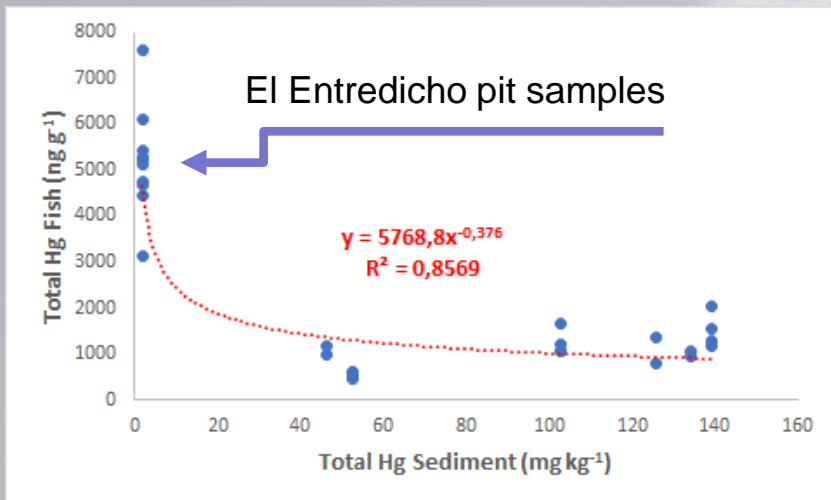
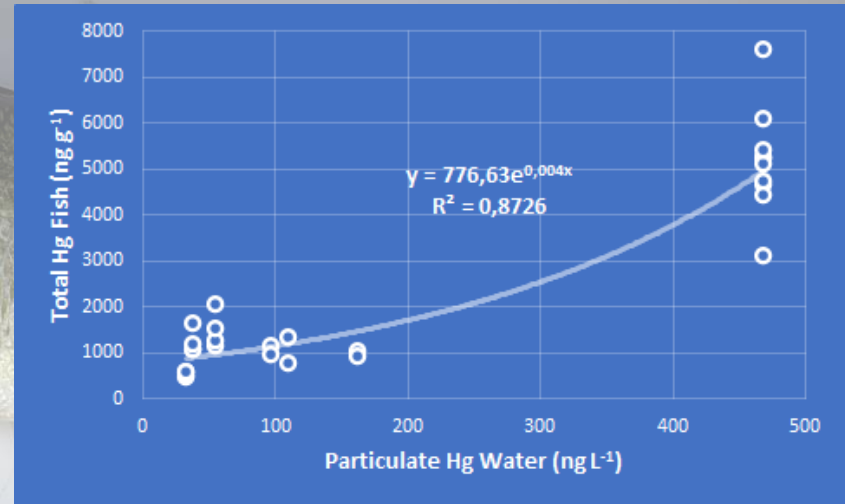
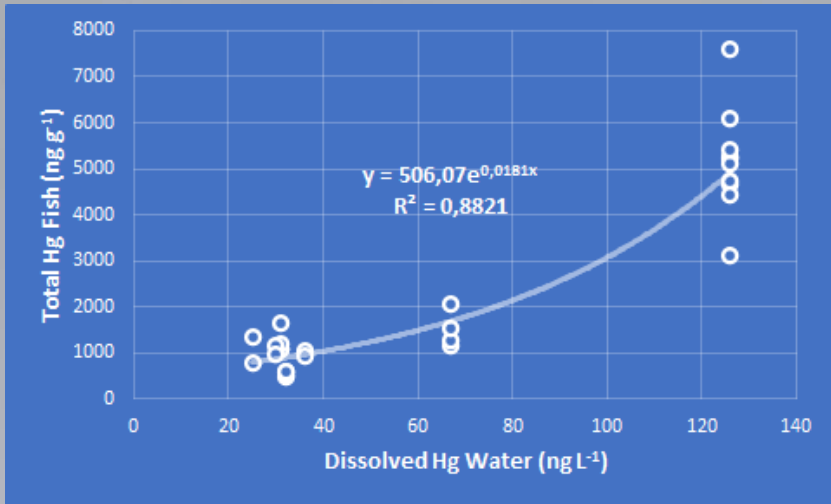
## Hg in water



## Hg in fish

Evolution of total Hg levels along Valdeazogues River

# Results



Distribution of Hg in fish vs. Hg in water and in sediments



# Results

European regulations establish  $500 \text{ ng g}^{-1}$  as the maximum recommended level for methylmercury in fish (wet weight)

All the studied specimens overcome this level, up to 15 times this threshold (5 times for average concentration)



# Results

Tolerable daily intake of total Hg for adults:  $0.57 \text{ ng g}^{-1}$   
body weight per day

Considering a medium body weight of 60 kg and that the  
100% of total Hg is retained in the body, an adult would  
be able to take  $34.2 \text{ } \mu\text{g}$  Hg per day

Intake of more than **72 grams** of *Largemouth bass*  
exceeds this tolerable daily intake in all sections of the  
Valdeazogues River (**4.5 g** for El Entredicho specimens)

# Conclusions

- Largemouth bass (*Micropterus salmoides*) has proven to be an extreme bioaccumulator species for mercury
- There is a clear relationship between Hg concentrations in fish, in water and in stream sediments along the studied transect
- Bioaccumulation is maxima in the El Entredicho open pit, where maxima Hg concentrations in the water can be found
- Concentrations in fish are in average 5 times higher than human consumption threshold, reaching up to 15 times this threshold
- All specimens exceed the tolerable daily intake of Hg for adults, being maximum daily portion 72 gr per day.

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