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# Heavy Metals in Stopping Guenitra (Skikda, Algeria) and its Tributary Wadi Sedjane

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**Abstract:** The study is focused on the dam of Guenitra and this tributary oued Sedjane and shows the relation of the trilogy: Water, fish and concentration of heavy metals. Sampling, during the program 2002/2003, gathered the physico-chemical analysis of water and the fresh water community combined with the weather statements. The approach tests the concentrations of toxic metals in the flesh of fish and the water of 3 stations. Thus, the statistical analysis (test of Wilcoxon) treated 9 chemical variables and 7 piscicultural individuals. The results obtained confirmed that cyprinidaes retain more heavy metals: With 70 % out of zinc, 87 % out of manganese and 108% out of iron. These cyprinidaes can be recommended to cleanse, partly, the water of the reserve built on examine of iron which will be equipped with pilot hatcheries.

**Key words:** Heavy concentration, eco toxicology, environment, metals, water, poisson, pollution, reserve, Wadi

## INTRODUCTION

The study relates to Guenitra reserve of water of Skikda (East Algeria) (Fig. 1) and its Sedjane tributary who drains water of an iron mine thus polluting the environment. This reserve is between 5° 12' N (latitude), 35 ° 32' E (longitude) and to 110 m of altitude. Its rough capacity is 125 water $Km^3$ and extends on an area catchment from 202 $km^2$ (Fig. 2). It receives an annual average pluviometry of 840 mm (Fig.3). The important hydrous resources make of it an interesting carpicole exploitation by raising *Cyprinus carpio* L, *Ctenopharyngodon idella* Val., *Aristichthys mobilis* R. *and Hpophtalmichthys molitrix* Val.

The problems of the use of water and the flesh of fish by the population are the contamination by heavy metals (Gaspic *et al*., 2002; Green and Knutzen, 2003; Bertho, 2003 ) resulting from the iron mine of Sidi Kambar located upstream. The objective is to set up a carpicole hatchery for a sowing and a minimization of the contents of metals in the presence of water and of fish used by the consumer while trying to show if the family of cyprinidés accumulates these contents from their trophic modes (phytophagous and omnivorous even carnivorous) because the ions fix itself in the watery sediments and vegetable parts (Angelier, 2000; Kress *et al*., 1999). For this purpose, the investigation approaches a short outline of meteorology, hydrology and the chemistry of water and ichtyology (Balayun, 2001; Marques, 2001; Ramade, 2004).

The meteorology relates to the temperatures, precipitations, evaporations, the insolations and the winds, statements of the registers of the station of the stopping and milked in marketing year 2002/2003.

The hydrology is characterised by the importance and the vastness of the basins slopes contribute to ensure a significant volume of water. Basins of the wadi Sedjane (18,62 $km^2$) supplying reserve with height of 30,1 %. The Fig. 2 shows the 3 stations of study.

The chemistry of water presents a pollution pronounced by heavy metals (Cu, Pb, Cd, Hg, Zn, ferrous Fe, Ni, Mn etc.) (AFNOR Norme, 1986; Rodier, 1996) resulting from the mine of iron and drained by the wadi Sedjane (Fig. 2). These metals contaminate the environment and are fixed on the flesh of the aquatic animals compromising the health of the consumers.

The ichtyology is composed various piscicultural species met include three species autochtones: Bleak: *Alburnus alburnus* L, Barbel: *Barbus callensis* L, Eel: *Anguilla anguilla* L and four immigrants: Common carp: *Cyprinus carpio* L, herbivorous Carp:

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Fig. 1: Geographical situation of the stopping Guenitra (Skikda, Algeria)

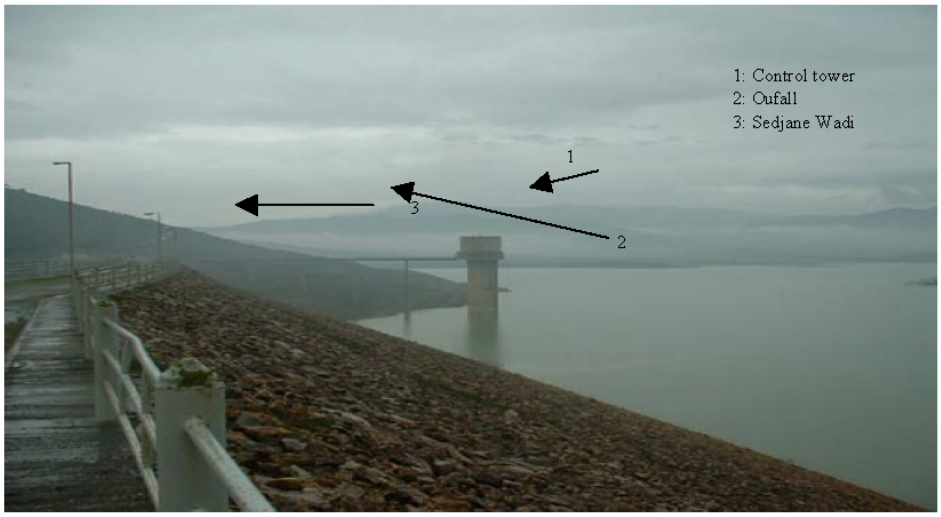


Fig. 2: Hydrographic network of the Guenitra stopping and its tributary wadi Sedjane (Skikda-Algeria)

*Ctenopharyngodon idella* Val., marbled Carp: *Aristichthys mobilis* R. and silver plated Carp: *Hypophtalmichthys molitrix* Val.

The sterile carpi were the subject of imports repeated of Hungary, in 1985, 1989 and 2001. Imports eliminated by an installation from a hatchery conceived according to rules' from the genetic engineering.

## MATERIALS AND METHODS

**Sites of studies:** The sites are localised with the tower of control, the outfall and the Sedjane wadi. The intake points inform about the chemistry of water and ichtyology

**Chemistry of water:** The operations of monthly taking away were carried out, from September 2002 to August 2003, in order to determine the content of toxic metals resulting from the residues mining and carted by the Sedjane wadi in reserve (Fig. 2) (Grosse *et al*., 1997). Thus, fifty liters of water are conveyed at the laboratory, each beginning of the month by taking away of 5 L, to proportion the following elements: copper, lead, cadmium, mercury, zinc, nickel, ferro-iron, manganese and aluminium (Miramand *et al*., 2004; Moiseenko and Kudryavtseva, 2001). The cations and the anions were proportioned by atomic absorption on spectrometer Perkin Elmer 2380 with flame with acetylene with respective lengths of waves

324,8; 228,8 and 248,3 Nm according to standard AFNOR NF T 90-112, 1986 (Rodier, 1996).

**Ichtyology**

**Zones of capture:** Fishings was carried out at the same time as the other taking away by means of nets three and of seines. At least two individuals, by station and fishing (140 subjects in all), are transported cooled (4°C) at the laboratory to diagnose the contents of heavy metals in the flesh (Amara, 2002; Angelier, 2000). The chromatographic and immunochemical techniques made it possible to obtain metal concentrations in the muscles of studied fish. The proportioning of heavy metals was carried out at the laboratory of the Food National office of Cattle (ONAB) of El Harrouch (Fig. 1).

**Statistical study:** A sampled data processing was carried out by means of the test of Wilcoxon and made it possible to know the bonds between the chemistry of water (9 variables: Copper, lead, cadmium, zinc, mercury, nickel, ferro-iron, manganese and aluminium) (Balayun, 2001; Moiseeko and Kudryavtseva, 2001) and the ichtyofaune (7 species: *Alburnus alburnus* L, *Barbus Callensis* L, *Anguilla anguilla* L, *Cyprinus carpio* L, *Ctenopharyngodon idella* Val., *Aristichthys mobilis* R. and *Hypophtalmichthys molitrix* Val.).

## RESULTS AND DISCUSSION

**Meteorology:** The synthesis of the statements of the monthly registers made it possible to trace the figure letting appear a seasonal fluctuation at least accentuated. The temperatures, per season, oscillate between 16,9 (winter) and 26°C (summer), precipitations vary from 1,0 to 15,0 mm and evaporations record a seasonal hollow of 20 mm and a peak of 100 mm. Whereas, the insolation is accentuated as from May to attenuate at November (Fig. 3).

**Chemistry of water:** The histograms represent the fluctuations of 9 heavy metals in water and the sediments. Thus teeth of saws are traced for each 3 station of sampling. Metalliferous variations in fish and water are more or less significant in comparison with references in the literature.

The results present the heavy metal concentrations measured in water and the sediments at the 3 various intake points as Fig. 4-6 show it.

**Fish:** The captures revealed a very reduced number of indigenous species. Harvests of sown carps as well as the fish autochthonous reveal heavy metal concentrations in their muscles, concentrations omnipresent in all the zones investigated in the flesh of respective fish: Barbel, Eel, Bleak, herbivorous Carp, C. marbled, C. silver plated, C. commune as 1 following stipulates it.

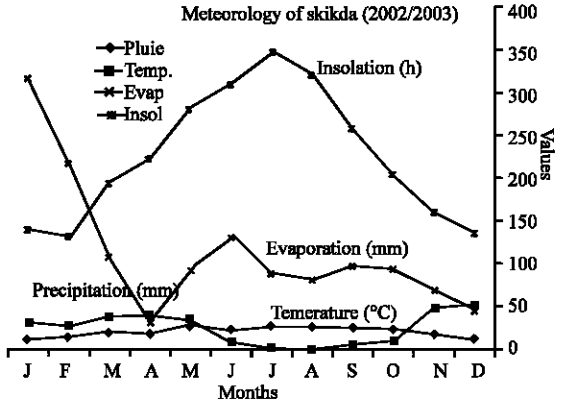


Fig. 3: Climatology (temperature (°C) precipitation (mm), evaporation (mm), insolation (h.) and wind (m $s^{-1}$), of the area of Skikda (September 2002-August 2003)

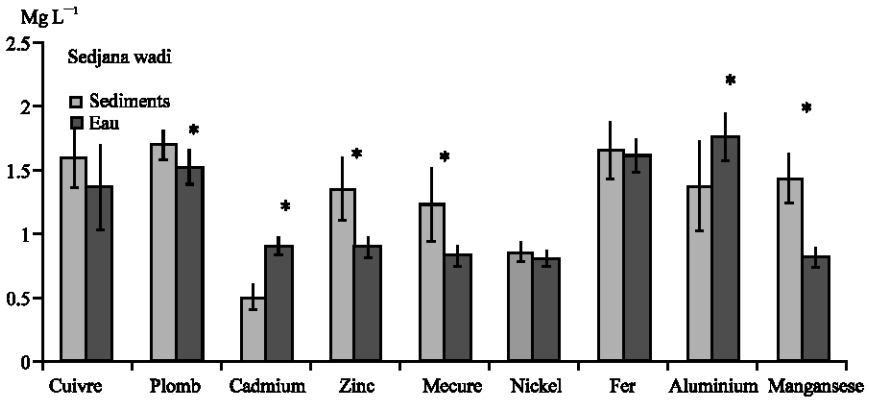


Fig. 4: Metalliferous concentrations in water and the sediments in the Sedjane wadi

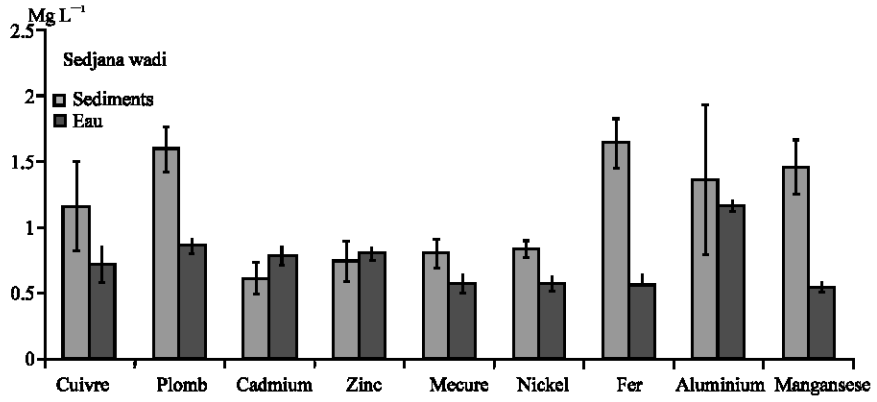


Fig. 5: Concentration of new heavy metals in water and the sediments of the Tower of control

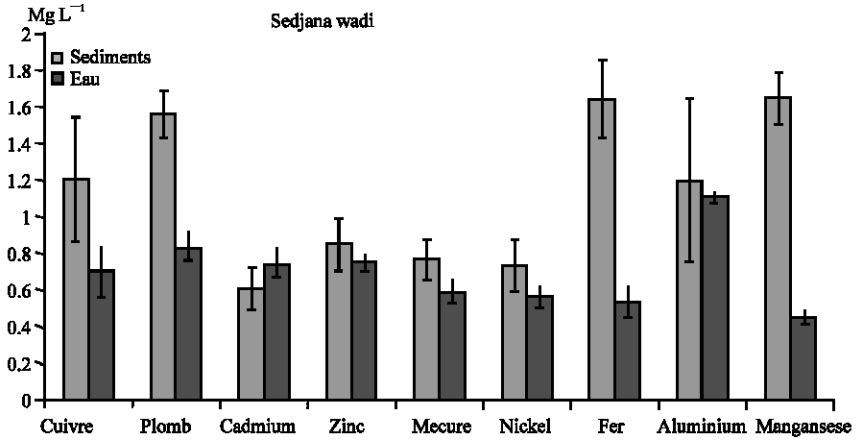


Fig. 6: Concentration of new heavy metals in water and the sediments of the outfall

Table 1: Heavy metal concentrations in fish

| Elements | Correlation | Fish | Water | Sediment |
|---|---|---|---|---|
| Copper | Cor | Bleak | Cor | Cor |
| Lead | No cor. | / | / | / |
| Cadmium | / | Barbel | 42 % | / |
| Zinc | / | common Carp | Cor / | / / |
| Zinc | / | herbivorous Carp Silver Carp | Inver. Cor | Inver. Cor |
| Mercury | / / | common Carp | Cor Cor | /Cor |
| Mercury | / | common Carp | Cor | Cor |
| Nickel | / / / | Barbel Eel Bleak | Cor Cor Cor | CorCorCor |
| Ironr | / / / | Barbel Eel Bleak | Cor Cor Cor | Cor.n.sig./7 |
| Aluminium | Significative/ | Barbell Bleak | / / | / / |
| Manganese | Non signif. | / | / | / |

Legend: No cor. : No correlation, no signif. Cor.: no significant correlation, Inver cor.: conversely correlated

The concentrations are marked according to modes of the chain trophy (Table 2).

Within sight of these references, Copper approaches the contents in digger fish the such carps, Zinc is located below the Omnivores and of Digger but in top of thecarnivores, lead is significant due as for Cadmium to the mining residues which continue to oxidize in connection with the chemical composition of the water of the stopping.

Table 2: Comparison of the results

| Heavy metals | Carnivorous | Omnivorous | Digger | Study (confused trophic mode)) |
|---|---|---|---|---|
| Copper | 12.3 | 12.2 | 23 | 25.3 |
| Zinc | 66.6 | 144.3 | 122.8 | 87.2 |
| Lead | 0.88 | 1.05 | 3 | 4.8 |
| Cadmium | 5.5 | 33.6 | 45.1 | 54.7 |

## DISCUSSION

The contribution to the study of the watery and ichtyologic chemical quality of reserve Guenitra (Marques, 2001) and its tributaries highlighted heavy metal concentrations in water, fish and the sediments. These concentrations prove to be toxic, by their accumulation of harmful heavy substances, for the human populations consuming either water, or the fish (Tandjir, 1994). Thus, the Sedjane wadi retains the ions in the outfall. With the instar of work of Angelier (2000) and Ramade (2004), the results show that certain carp species present heavy metal concentrations high. These fish, bio accumulating of metalliferous pollution compared from data's Moiseenko and Kudryavtseva (2001), are

recommended in the projected piscicultural breeding. They could thus be high to retain the excess of toxic metals in the watery ecosystem of a feature hatchery with the help of the techniques getting the reproducible biological material (eggs, youthful, parents) while taking care of the respect of the trilogy: Health, Environment and Regulation obeying the "programs control monitoring of heavy metals" (Miramand *et al*., 2004).

These harmful metals can be returned to the tolerable thresholds only with one project of pilot hatcheries (*cyprinidaes, anguillidaes*...) developing the water levels on the one hand and reducing the toxicity of these metals in water of the area, on the other hand (Balayun, 2001) because the current toxic threshold, in fish and water, carries damage to the man and his environment (Green and Knutzen, 2003). From the health point of view, the fish provide food which cannot be contaminated by heavy metals which, detected in the water and the flesh of fish, prove to be prejudicial (attack of the nervous system, urinary tracts, respiratory...) (Tandjir, 1994; Gaspic *et al*., 2002). Also, of accumulations of undesirable metals, in the living organisms and the biological mechanisms of fauna and the flora (Degrémont, 1998) unbalance disturb. Water having a metalliferous toxicity (Grosse, 1997) contaminates the fish which, by bio-accumulation, can then generate harmful consequences for all ecology watery and terrestrial (Marques, 2001). Concerning the regulation, the Directives, circulars, decrees, decisions..., regional, national even international (Ministry for Health, of the environment, WHO, FAO, the EEC...) publish standards of contents of heavy metals to respect. Any project of fresh-water piscicultural valorization must refer to it. One notes for example for muds and sediments, the contents following for cadmium (40, 20), mercury (20, 10), lead (1600, 200) (Miramand *et al*., 2004; Turkey *et al*., 1999) and nickel (400,200). Just as for the harmful contents in current fish, "fish and the fish exceptions", the tolerated thresholds are located between 0.2 and 0.5 for lead; 0.05 and 0.2 for cadmium and between 0.5 and 1.0 for mercury (Boularbah *et al*., 2006).

## CONCLUSION

Finally, within sight of the quoted references and according to the directives such as: Dir. 75/440/CEE of the 16/06/75, MOD Dir.79/869 (surface Waters intended for food water), Dir.

76/464/CEE of the 4/05/76 (watery Pollution), Dir. 78/659/CEE of the 18/07/78 (fresh Waters) and Dir. 98/83/CE of the 3/11/98 (Water for human consumption), our results show concentrations which could attenuate only with the introduction into the powerful accumulating medium of bio such as the species highlighted in this research. To this end, a pilot hatchery, installation, producing indicating and tolerant carp species, will minimize certainly the rate of these heavy metals of water and the sediments of the artificial tank Guenitra.

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