

Assessment of Marine Pollution at Bay of Oran, Algeria

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Received 2 July 2015; accepted 6 September 2015; published 9 September 2015

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Abstract

This work aims to the assessment of marine pollution in the Bay of Oran, including zinc, copper, iron and lead. These toxic elements represent a real danger to living organisms. Many factors have increased the marine pollution and marine traffic including the transport of hydrocarbons, industrial and domestic discharges and fishing activities, etc. This study shows essentially the bioconcentration of heavy metals in the species *Mytilus galloprovincialis*, these filter bivalves have a broad geographical distribution in our study area, so they allow us to better estimate the degree of pollution at the Bay of Oran. The study of changes in metal concentrations has marked some important points for, the four metallic elements are present in the flesh of mussels analyzed at the port of Oran. This study is part of assessment of pollution at the coast of western Algeria to protect the marine environment.

Keywords

Wastewater, Pollution, Chemical Pollution, Heavy Metals, Mussels *Mytilus galloprovincialis*, Littora

1. Introduction

Our study is part of the monitoring of coastal western Algeria; it's a marine pollution study including heavy metal at the port of Oran. This project uses mussel as tools for determination of this pollution, hence the followed method have been proposed for the first time, in the world, by Goldberg in 1975, under the term "Mussel Watch". This proposal has been implemented successfully in two types of strategies: those that use the native

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populations of wild or cultivated mussels (bio passive monitoring) and those who have recourse to transplants of individuals from a reference site considered as less polluted place (bio active monitoring). Several researchers have used the mussel as a bio-indicator, in this context we can cite that the mussel *Mytilus edulis* used to assess the mercury at the French coastline [1]; another research is based on studying of the ecotoxicology of heavy metals (cadmium, copper, lead, zinc) in the mussel *Mytilus galloprovincialis* in the Bay of Bourgneuf, France [2]; the authors in [3] studied the relationship between the availability of heavy metals in sediments and their accumulation by the mussel *Mytilus edulis*.

Other researchers have chosen to study two different marine species sharing the same habitat to better interpret the results [4], they are based on the evaluation of all metal content (not only heavy metals). This study took place at Eckwarderhorne, Cuxhaven/Altenbruch and Königshafen and the Baltic Sea (Germany), using these two species *Fucus vesiculosus* and *Mytilus edulis*. Moreover the mussel *Perna viridis* is chosen to study the accumulation of organic pollution, the results are compared with the accumulation in fish *Lateolabrax japonicus*, *Parasomus magor*, *Miichthys miiuy* and *Epinephalus awoara* [5].

Urban and industrial activities located on the coast, introduce a significant amount of heavy metals in the marine environment, the study of the impact of this pollution is the subject of many studies [5]-[8]. In order to assess the level of pollution in bays, the mussel *Mytilus galloprovincialis* L. 1758 is used for biomonitoring of Turkish bay [9]. These molluscs can be used to assess the metal and chemical pollution [10]-[14] and to evaluate their toxic effect in mice [15].

The genus *Mytilus* is widely used for several reasons: wide distribution, long life, reasonable size, a high tolerance for accumulation [16] [17], the mussels are less immigrants, their life is sessile and euryhaline [18], so their reproduction is continuous [19]. For the aquatic organisms, bioaccumulation of metals can have three sources: water, food and sediment, moreover, the penetration of mussels thus through their gills or by absorption at the surface of body [20].

The present work focuses on the assessment of the degree of pollution and contamination through the concentrations of metals (Pb, Cu, Zn, and Fe) in mussels.

2. Location of Study Site

Algeria has a coastline of 1200 km along 11 commercial ports which offer a chance for the competitiveness of the national economy, because the sea is the axis of the less expensive goods, as well as Algeria enjoys a privileged geographical position.

Our study area is the port of Oran, situated at the bottom of golf, between the tip of Canastel and Cape Falcon northwest of Ain el Turk. It offers a water level of more than 122 hectares, left eight basins. Solid land occupies an area of 200,000 m² and shops Storage 20,332 m² [21].

The port of Oran has a location in the foreground: Height: 35.43 North, Longitude: 0.39 west.

The choice of sampling site is based in part on the ease of access, the abundance of species and secondly on its proximity to sources of pollution (the main sewage outfall of the city of Oran, hot water from the power plant); Port of Oran has geostrategic position, industrial and commercial importance (Figure 1).

3. Materials and Methods

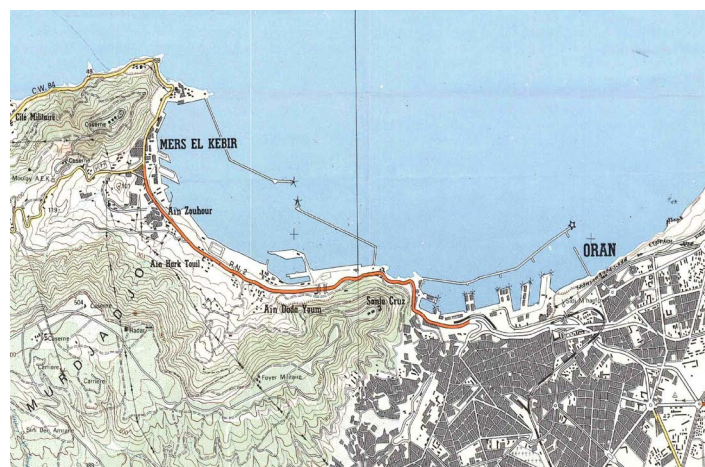
3.1. Sampling and Analysis

Fishing for these mollusk is performed on bedrock at depths not exceeding 10 meters, mussels collected is cleared of various wastes, sediments and algae all glued to their shells; are then stored and transported in a cooler filled the sea water, then they are stored at -4°C until the day of analysis.

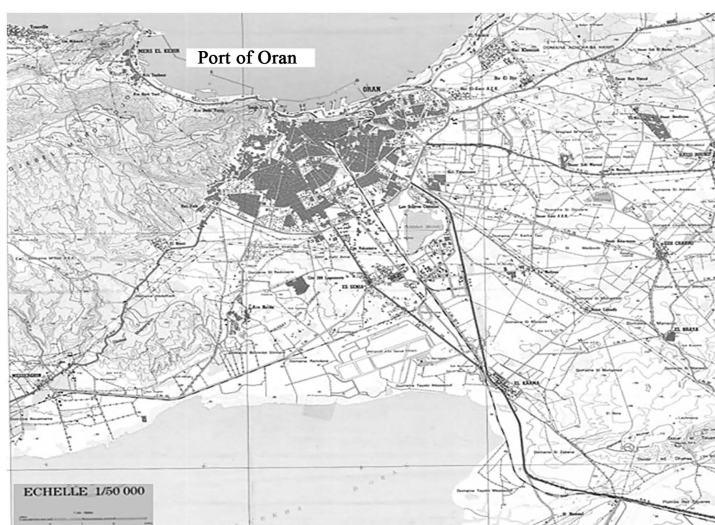
The mussel was been collected is a period of six-month (February, March, April, May, June, July) 2010, and each sample was consisted of 30 - 40 individual, measuring 2 to 7 cm (mean 4 cm). The following parameters are considered: sampling date, station, size, and weather data.

After cleaned out theirs stomach, the mussels were sorted by size. The flesh is weigh and dried in an oven at 80°C to constant weight, after drying, the mussel was finely grounded; the grinding is performed in a laboratory agate mortar to obtain a powder light brown called dry powder mussel.

The metals are extracted after mineralization, which was ensured by an attack by the nitric acid and hydrochloric acid (V/V), three test of 50 mg dry powder mussel were taken and mineralized for one hour at a tempera-



(a)



(b)

Figure 1. Location of sampling sites (Port of Oran–Algeria) (a), (b).

ture of 120°C. The solution obtained is recovered after cooling of the glassware (risk of thermal shock) once rinsed with water double distilled to recover the maximum amount of sample water, everything was put into a glass bottles sealed and stored (to avoid loss and evaporation) to the assay by the method of atomic absorption spectrometry (AAS).

Mean concentrations are expressed in part per million (ppm) relative to 1 gram of the dry powder of mussels ppm (dw).

For more precision and clarity in the development of our results and to conduct a thorough interpretation we studied the concentrations found in mussels “*Mytilusgalloprovincialis*” according to two size groups: Group 1 (45 - 70 mm), Group 2 (20 - 44 mm).

3.2. Statistical Analysis

The variability of the metal contents was studied by analysis of variance of two factors (monthly and size) performed by the Student test; n roughly 12 (n: it’s mean the effective number of our samples for each month).

4. Results and Discussion

Practically, during the winter, spring and summer, we noticed the existence of a fluctuation justified primarily

by the influence of climate parameters, resting on the rate of precipitation that changes from one season to another, the speed and direction of wind, if we take for example the winter season, The days planned for sampling are accompanied by a more or less considerable precipitation, the latter is practically zero for the other seasons. For the second parameter which is obviously the biological species selected, indeed, mussels are filter-marine molluscs (filter up to 100 liters of water per day). They can bio accumulate more organic contaminants and respond particularly well to the main classes of environmental pollutants [22] (Figure 2).

As all trace metals (Pb, Zn, Cd, Cu) were present, so we assume that contamination of marine waters by these elements exists, but estimating their impact remains limited. Moreover, we can cite some works that have been the subject of study of biological stress caused by concentrations that generally exceed the maximum permissible doses (DMA) [23] [24]. In addition, the study of biological stress and biomarkers is a new approach, moving beyond traditional methods to evaluate the quality of the environment and the danger of consumption of these species [25].

The results obtained show that there is more or less considerable difference between sizes of mussels selected where the metals studied appear to be more accumulated in mussels Group 2 (20 - 44 mm), that are younger. Furthermore, the size of the mussel has the influence on their metal accumulation and particularly in the ripening periods [26]. We recorded periods of rising and falling concentrations of the metal element, the average values of lead and zinc are the most significant comparatively to the other metals, in addition, the maritime traffic is the main cause of the elevated levels of lead [27]. Moreover, the degradation of the anti-fouling covering the hulls of ships, due to corrosion paint, justifies the high contents of lead and zinc [28].

For the essential metals such as copper and zinc, their accumulation is done in two ways: in a dissolved form or by ingestion of food [29]. Cadmium accumulates unlike only in dissolved form. This may also explain the high levels of Zinc. However, copper and zinc can be harmful when their concentration exceeds a certain threshold [30].

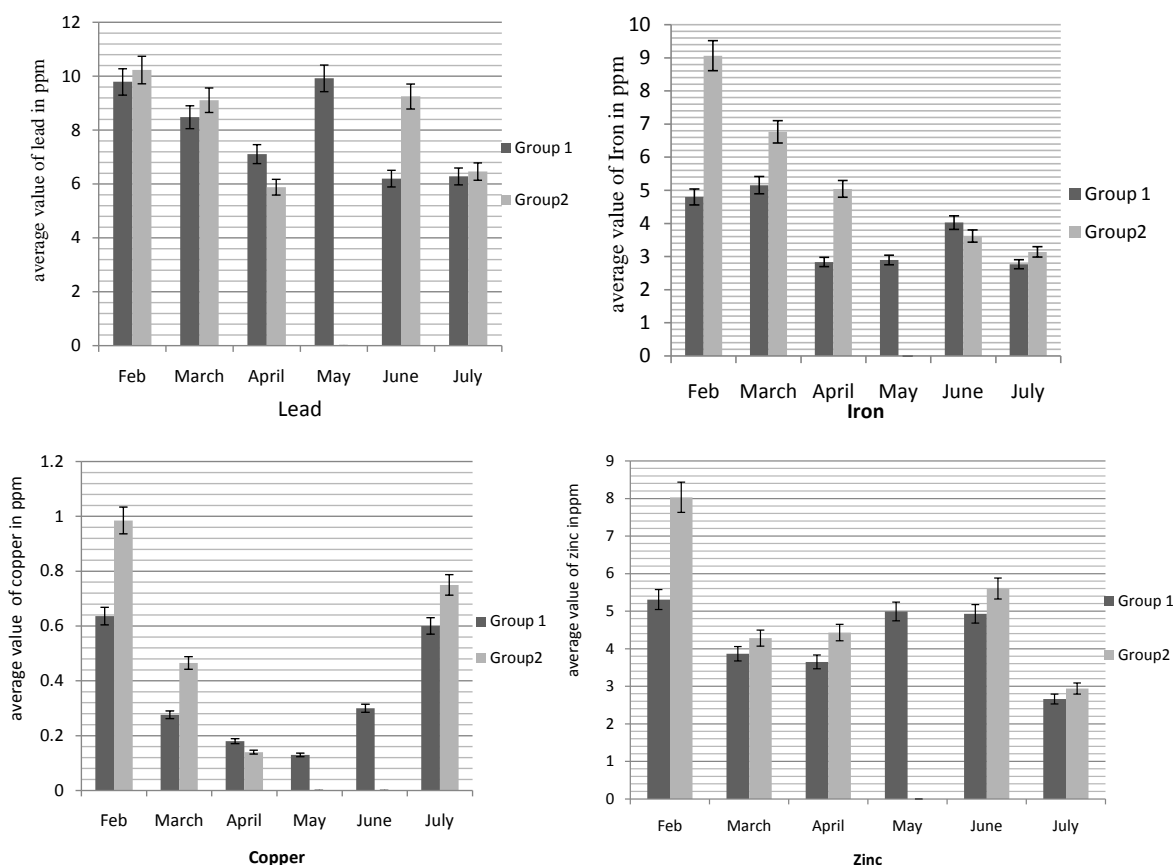


Figure 2. Variation of the average content of heavy metals. Group 1: the size of mussel “*Mytilus galloprovincialis*” between 45mm and 70 mm; Group 2: the size of mussel “*Mytilus galloprovincialis*” between 20 mm and 44 mm.

The competitive of cadmium disrupts the absorption of copper, this may justify medium contents of copper and cadmium detected when their concentrations are generally close [6] [31].

The physico-chemical parameters of the environment have an effect on the accumulation of metals by organisms [3] [20]. During our study, we observed an increase in concentration of trace metals in February and March according to a maximum rainfall and consequently a decline in total salinity. Our findings are in agreement with the results of [20] [26] [27] [32]. They showed that the concentration tissue of Zn, Pb, Cd increased significantly with decreased salinity. In addition, the wastewater and temperature may also affect the salinity. Then, shipping is the major source of lead pollution [9].

Beside, the temperature and salinity have some influence on physiological processes related to metabolism and especially the reproduction [20], the mussels are the main target of contamination by trace metals and their ability to fix many toxic elements both inorganic and organic [33] [34].

So, the pollution of marine ecosystems is related with the production of marine toxins that concentrate in mussels which generates consumption poisoning in humans.

The results obtained at the port of Oran (Cadmium: 0.12 ppm; Copper: 1.16 ppm; Lead: 1.48 ppm) [35], showed a low contents then those founded in our study, especially as part the lead. Furthermore, the average concentration of the latter has undergone 5.3 times rise. This can be justified by the continuing evolution of the pollution, as well as changes in food resources or sexual status, and the choice of the sampling period which is a key factor.

Comparing our results with those obtained at the French coast, average lead concentrations recorded are much higher than indicated by the National Observation Network in 2003 (NON) (1.49 ppm.dw) (France).

Comparison with Other Authors

The mussels were the object of many studies; some of them are given in the **Table 1** in order to compare them with our results.

Table 1 shows that the comparison of our results with those of other researchers. In the metal concentrations obtained for the mussel *Mytilus galloprovincialis* at the port of Oran, the concentrations of lead are the highest.

The analysis of variances performed on metal contents showed significant differences for all the metals studied, $p < 0.05$.

5. Conclusions

According to the results presented, it seems that the oldest mussels are the least contaminated and the youngest mussels appear to be the target of these micropollutants, generally we have touched the monthly variation of bioaccumulation in mussels "*Mytilus galloprovincialis*".

The accumulation of these metals generally follows the following order: Pb > Zn > Cd > Cu.

Acknowledgements

The authors thank the divers and all members of associations: "Friends of the sea and Phynicia" and the Laboratory of Physical Chemistry of Materials, Catalysis and Environment at the University of Science and Technology

Table 1. Metal concentrations in ppm observed in molluscs*.

Authors Specie	Origin	Pb (ppm)	Cu (ppm)	Zn (ppm)	Cd (ppm)
Tuncer and Mg Yaramaz** (1982) [36]	Bay of Izmir (Turkey)	1.36	6.92	2791.1	
Asso** (1984) [37] Pp	Bay of Algiers (Algeria)	6.31	13.1	200	1.26
Coimbra** <i>et al.</i> (1991) [38] Me	Littoral of Portugais	-	13.4	542	1.25
Pempkowiak** <i>et al.</i> Me (1999) [39]	Sea of Baltic	5.22	13.40	269	-
Tahiri*** <i>et al.</i> (2005) [34] Mg	Bouregreg (Morocco)	4.08	8.77	225	0.48
Our study*** Mg	Port of Oran (Algeria)	7.85	0.37	4.59	0.97

*Me: *Mytilus edulis*; Pp: *Perna perna*; Mg: *Mytilus galloprovincialis*. **The value of P for the statistical analysis it's not mentioned. ***The value of P for the statistical analysis is <0.05.

of Oran and Laboratory of GNL1 complex/Z (Sonatrach) which have been performed all physico-chemical analyses and those of metals reported in this study.

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