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Assessment of contamination by heavy metals (lead, cadmium and zinc) of a teleost the spotted weever (*Trachinus araneus* Cuvier, 1829) caught in the Bay of Oran

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Abstract

Our study focused on the evaluation of the three trace elements: lead, cadmium and zinc, a common bony fish in the western Mediterranean coast of Algeria, Spotted weever (*Trachinus araneus,* Cuvier, 1829).
Sampling took place over a period of three months from February to April, 2013, two bodies were considered representative for the edible part man and gills that represent the filter unit muscle. The concentrations of the metal elements were determined by Atomic Absorption Spectrophotometry The flame , according to three parameters (gender, height and month) and levels of metal accumulation were determined.
In this study, the results reveal that the Spotted weever (*T. araneus*) bioaccumulate three xenobiotics sought; the higher levels are those of zinc, lead to higher concentrations in the lower and lower concentrations are those of cadmium. The results were statistically processed demonstrated no significant difference between the levels of heavy metals in both sexes in muscle tissue against significant values are noted in the gill tissue. The study reveals that the accumulation of pollutants is higher in females than in males. Similarly, it is clear the chemical pressure is marked in younger individuals. Levels of concentrations of metallic elements reflect a certain pollution of the study area (Bay of Oran).
In this study, trace metals recorded in the flesh of the living spider does not exceed the limit of the Maximum Allowable Dose (D.MA), but can lead to serious dysfunction in these fish.

Keywords: Spotted weever*, Trachinus araneus*, metals (lead, cadmium, zinc), contamination, Muscle, Gill, DMA, Bay of Oran, Algeria.

Introduction

Metal contaminants released from current and past human activities are ubiquitous in the environment, especially in the sediments of rivers, these compounds tend to accumulate, which pose a potential threat to aquatic organisms.
It is in this context that our work is. This is to assess the state of the quality of the coastal environment by studying contaminants (Cd, Pb, Zn) in muscle and organs and bronchial muscle of the living spider caught in the Bay of Oran since it forms an important link in the trophic chain.

Materials and Methods

Oran Bay (Fig. 1) is located north west of Algeria and South West of the Mediterranean, it belongs to the Coast Mountains Tel Septentrional (Jebel JebelMurdjadjo and Khar) (Leclaire, 1972).

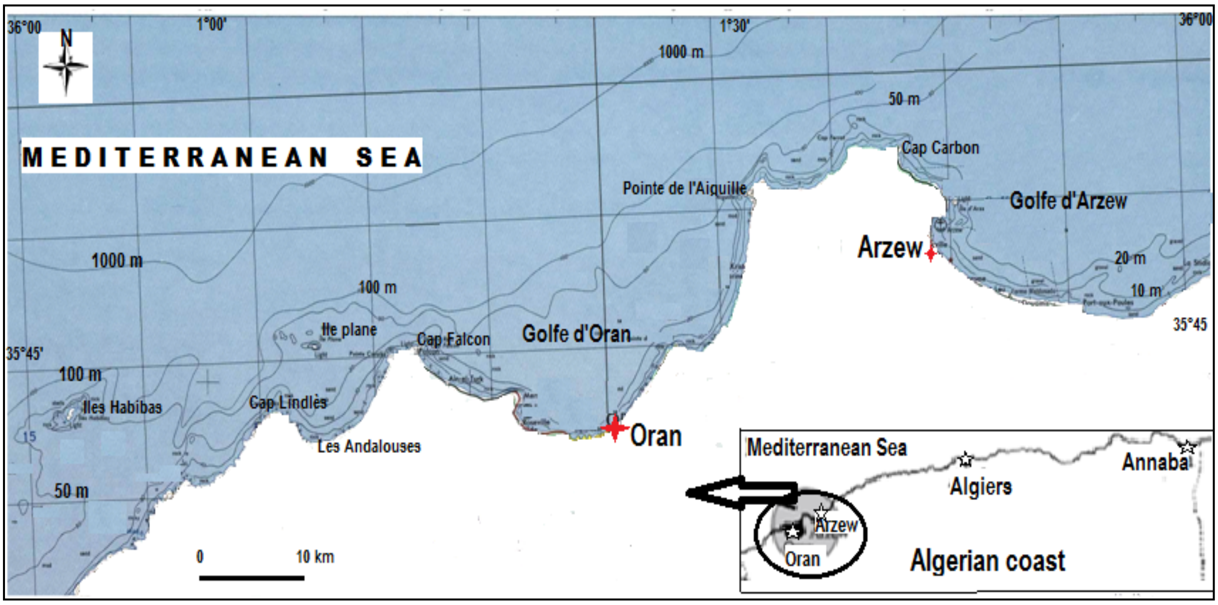

Figure 1: Geographical position of the study area: the Bay of Oran

Bright (Fig. 2) are a family of marine fish perciformes. Vivid found in the eastern Atlantic and the Mediterranean to the Black Sea. They stand near the coast in summer and offshore in winter. Bright spider *Trachinus araneus* (Cuvier, 1829) (Fig. 3) is a coastal benthic species that lives buried in the substrate on coarse detrital sandy and sandy mud, up to about 100 m depth are revealing that their spines erected and the top of their head (Geistdoerfer 1983; Skeie, 1966).

Figure 2: Sampling brightly *Trachinus araneus*

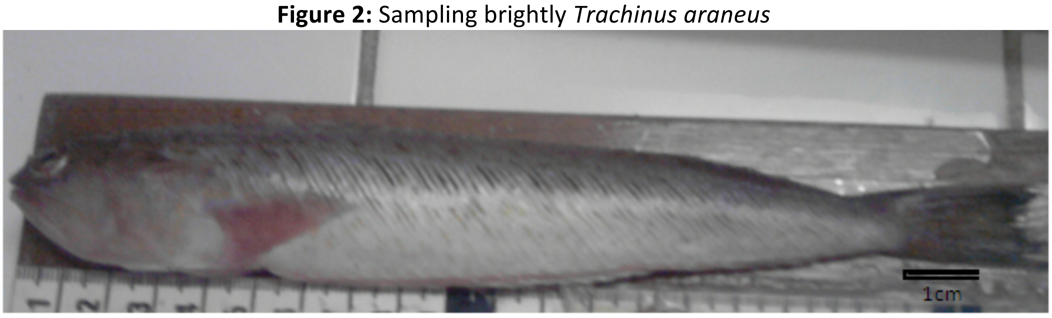

Figure 3: The random spider *Trachinus araneus* Cuvier, 1829.

Sampling took place over a period of three months from February to April 2013, two bodies were taken into consideration: the muscle is consumed for and gills that represent the body breathing and filtration.

The first step in our technique is to group individuals into batches of size classes and sex. In a second step, one proceeds with mineralization (wet flue), depositing 1 g fresh weight of each sample (muscle bronchies) in a flask to which was added 1 ml of nitric acid (HNO_3) and 65% purity the temperature at 95 °C is heated for one hour, after cooling, the complete contents to 4 ml of double-distilled water, the solution is ready to mix with the atomic absorption spectrophotometry flame (SAA af) (Amiard et *al*, 1987).

The statistical treatment of the results was performed on PC using Microsoft Excel Version 2007 To compare the mean concentrations of heavy metals between two independent groups from the same population the Student t test (test of equalities hopes two observation of equal variance) was used to assess the significance of differences between the concentrations of metal contaminants. This difference was considered significant at a probability level (p) of less than 5% ($p < 0.05$).

To test the homogeneity of the concentrations of heavy metals with respect to different size classes of individuals, analysis of variance was used

Results and discussion

Each series of mineralization of our samples is automatically accompanied by a hand, by mineralization white, consisting of the reagent solutions containing mineralization (nitric acid) and suffer from the same experimental conditions as the sample, and secondly, by a series of inter-calibration samples on standard laboratory equipment Fucus sp coded 140/ TM, provided by the International Atomic Energy Agency, Monaco (IAEA, 1995); allowing, thus defining the coefficients of variation for each of the desired metals: lead (Pb), cadmium (Cd) and zinc (Zn) and check the correctness and accuracy of the protocol analytique.les results obtained are summarized in Table 1.

Table 1: Results of the inter-calibration exercises in ppm DW (dry weight)

Element	Reference Value (A.I.E.A, 1995, Monaco)		Value Found
	Min -Max	Medium	
Cadmium	(0,18 - 0,19)	0,18	0,11
Lead	(0,10- 0,14)	0,12	3,35
Zinc	(66,3 - 67,9)	67,1	66,65

These intercalibration exercises have shown that our analyzes were carried out in satisfactory conditions, the analytical technique used was reliable and accurate.

The average water content in the muscle of the living spider is 76.06%. We adapted this mode of expression, as it allows a good comparison with different values from the literature.

Among the various chemicals from industrial wastes, agricultural and domestic waste water, and pollute the marine environment, heavy metals have a significant ecological impact.

This metal pollution of coastal waters can result in a less stable bioaccumulation in the tissues of marine organisms, they can teach us about environmental contamination in which they operate.

Changes in levels of heavy metals based on sex (Pb, Cd, Zn)

Figure 4 leaves appear that female individuals display higher than males average concentrations of lead and cadmium. The rate of cadmium is noticeably lower for both sexes.

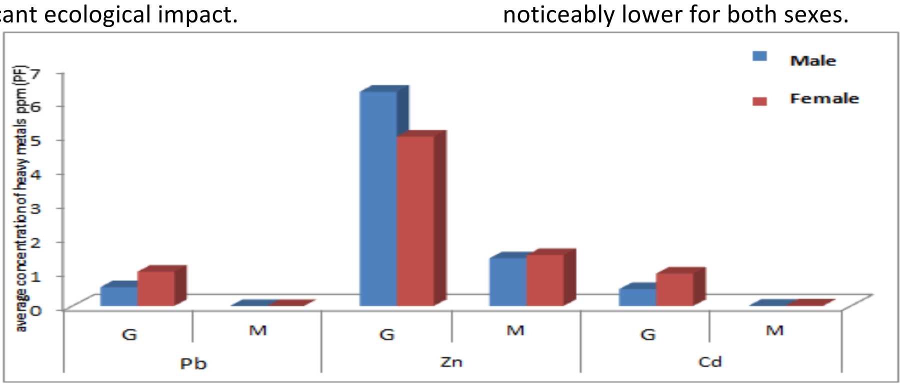

Figure 4: Changes in mean levels of heavy metals (mean ± SD ppm FW) by sex in the living spider (*Trachinus araneus*) caught in the Bay of Oran.

Changes in levels of heavy metals in organ function

The mean levels of Pb found in the different organs of the living spider show that the highest value is in the range of 0.95 mg/kg obtained in the gills. While the content is zero in the muscles. According to the contents, we can establish an order of accumulation of Pb in different organs of the living spider: Gills > Muscles.

Average Zn concentrations found in the different organs of the living spider show that the highest value is in the range of 5.12 mg/kg obtained in the gills. While the lowest level is in the range of 1.48 mg/kg obtained in muscles.

The mean levels of Cd found in the different organs of the living spider show that the highest level is in the range of 0.904 mg / kg obtained in the gills. While the lowest level is in the range of 0.01 mg/kg obtained in muscles. According levels can establish an order of Cd accumulation in different organs of *Trachinus araneus*: Gills > Muscle.

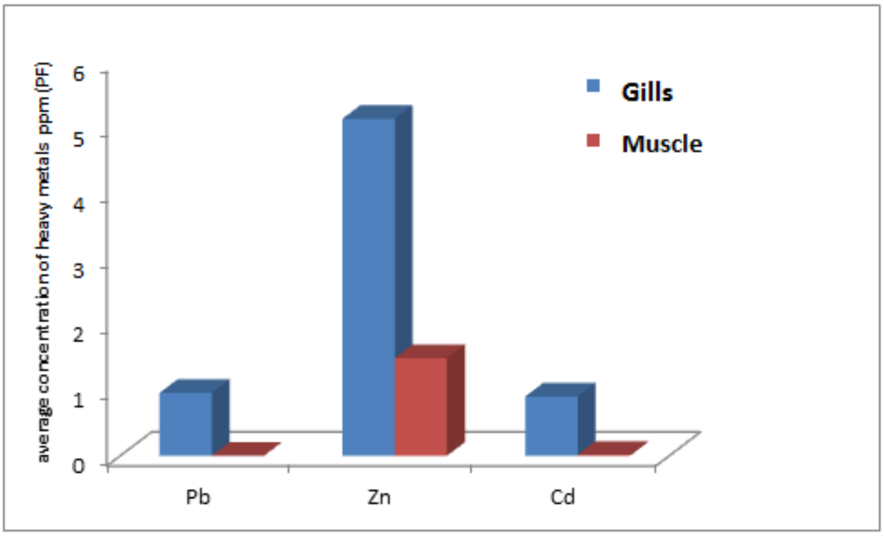

Figure 5: Changes in mean levels of heavy metals (mean ± SD ppm FW) by sex in the living spider (*Trachinus araneus*) caught in the Bay of Oran.

Monthly changes of heavy metals (Pb, Cd, Zn) in the living spider. In this study, size parameters, and sex have not been considered. The results are illustrated in Figure 6.

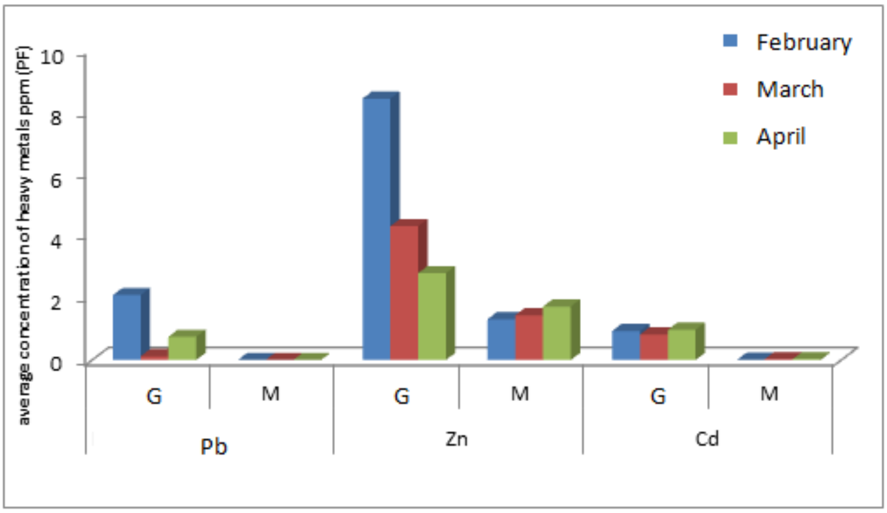

Figure 6: Evaluation monthly average concentrations of heavy metals (Pb, Cd, Zn) in mg/kg of fresh weight in the living spider in the Oran bay.

Changes in levels of heavy metals in relation to classes of sizes:

For clarity in the presentation of results, we studied the concentrations found for the three metals in the living spider according to different size classes from our sample (Fig 7), namely three classes: 13-20 cm / cm 20-27 / 27-34 cm

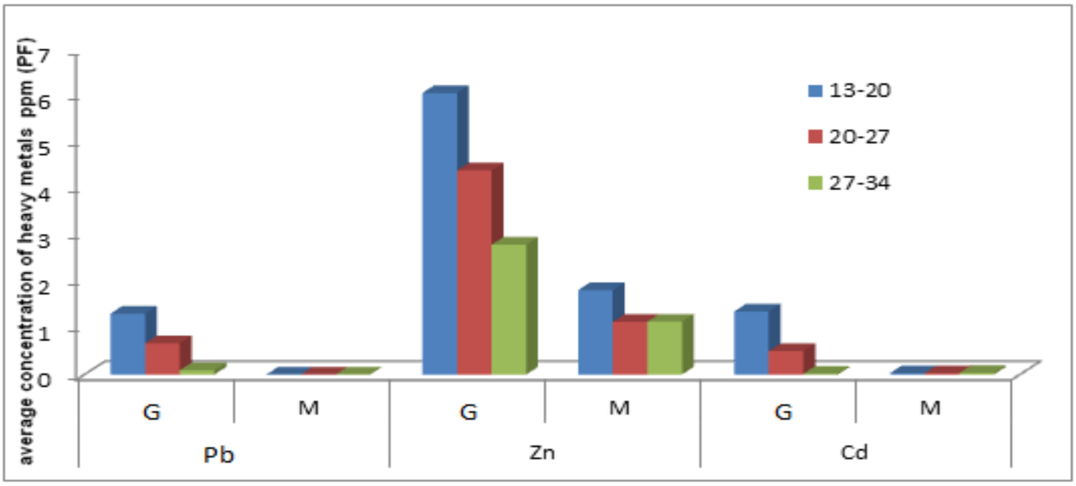

Figure 7: Change in average concentrations of heavy metals in office size in the living spider caught in the Bay of Oran.

Discussion:

It is clear that the process of bioaccumulation depends on the extent of the environmental contamination. The accumulation of metal elements in aquatic organisms resulting net balance of capture process and excretion. Two mechanisms have to be considered metal, excretion and storage in the body (Casas, 2005).

The statistical processing of the results obtained show that the concentrations of three metals analyzed in the organs (muscle, gills) against bright spider come in the following descending order: Zn>Pb> Cd.

The concentrations of heavy metals are highly heterogeneous and vary parameters considered (sex, body size and month). These coinciding closely with the affirmation of Langston & Spence (1995) data for biological factors such as age, size, growth, the permeability of the outer membrane, eating habits, and the nature of internal ligands contribute significantly in variability bioaccumulation of heavy metals.

Based on the results in Figure 1, we can argue that the bioaccumulation of three pollutants (Pb, Cd, Zn) is higher in females than in males individuals individuals. Cadmium has a low concentration in both sexes and in both organs.

Metal concentrations are better bioaccumulate through the gills and muscle females, than those measured in males that may be migrating to the polluted coastline, which explains the high contamination by heavy metals via the various sources of pollution. According Thibaud (1976), slightly higher levels were found in fish caught near the coast. For males and females of the area of study the student test records no significant difference (P> 0.05) between the concentrations of both sexes. By (Grahn, 1990; Schofied and Trajnar 1980; Fekhaoui 1983) for pollution, respiratory process may be disrupted.

Some authors have shown that the metal gills procession best reflects the relative importance of different metals in the environment. In fact they were chosen as a suitable tissue for monitoring of metals in the environment (Boudou,1982; Fekhaoui 1983; Chaffai, El Morhit 1993, 2009). Siddall et *al.*, (2002) suggest that the ionized metals are mainly bioaccumulate in fish gills and transported through the bloodstream to different organs. Indeed, apart from contamination gills contain advantage Zn, involved in respiratory mechanics (Chaffai, 1993).

In addition, some authors have suggested that in the wild the presence of significant levels of metals in the gills can be attributed to the presence and metal adsorption at the gills (sedimentation) (Rehwold, 1972); rather than biological activity raised by these metals (bioaccumulation) (Szefer et *al.,* 2003). These observations raised for Cd reveal the importance of the way of direct contamination compared to the trophic way as has been proven in some studies (Delache and Ribeyre 1978; Boudou, 1982; Belhoucine et *al*., 2008; Belhoucine et *al*. 2014).

For Pb, levels recorded at the gills are unexpected because this metal is known for its ability to accumulate in the bone organs such as gills, our observations coincide perfectly with those of El Morhit (2009).

In our study, most of the muscle samples have low levels of metals in the living spider. This can be explained by the ecotoxicological behavior of this related body excretion to bioaccumulation processes.

Our results for all of the trace elements and for the two target organs (muscle, gill) confirm the results of El Morhit et *al*. 2009.

Location level of metal contamination *Trachinus araneus* against the maximum permissible dose (DMA).

Comparing the heavy metal concentrations in the muscle of the living spider compared to the tolerated threshold (Tab.2), it seems that the levels of trace element Zn (6.16 ppm D.W) is in the range of the results provided by the DMA The average rates of cadmium recorded in samples Trachinusaraneus (0.06 ppm D.W) are observed in the range of those recommended by Augier et *al* (1988).

Table 2: Comparison of heavy metal concentrations (ppm F.W) in *Trachinus araneus* against the maximum permissible dose (DMA)

(a) Augier et *al*, (1988) – (b) G.I.P.P.M (1973) – (c) C.N.R.S (1971) (d) O.M.S (1971) – (e) F.A.O (1971) – (f) CSHPF (1990) - (g) CNRMS d'Australie (1992)– (h) I.O.P.R (1996)

Metal species	**Cadmium**	**lead**	**Zinc**
Present study *Trachinus araneus*	1,68 ppm F.W 0,41 ppm D.W	5,80 ppm F.W 1,41 ppm D.W	11,29 ppm F.W 2,75 ppm D.W
Fishes	1 ppm D.W (a) 0.15-3 ppm D.W(h) 0.1 ppm F.W (f)	0.3 à 6 mg/Kg D.W (b) 0.5 mg/Kg F.W(f)	5 mg/g D.W (g)

F.W: Fresh Weight; D.W: Dry Weight

This finding does not diminish the potential risk for humans in the medium and long term, if urgent measures are not put in place to monitor the safety of products from the sea. Reliable assessment of risks from as these pollutants on human health and the environment is a major challenge (Maroni et *al*, 2000; Eason and O'Halloran, 2002; Alavanja et *al*, 2004).

Changes in average concentrations of trace heavy metals (mean ± SD PF ppm) in different marine organisms

Pollutant concentrations of animal species reflect a more representative average situation of the state of a medium.

Different previous studies in the laboratory Network Monitoring Environmental LRSE search Oran allowed the demonstration of the interest of some indicators to determine the level or degree of contamination of the coastal marine environment Oran. Table 3 shows a comparative study of these marine organisms used as biological indicators and represent some links of the trophic chain with distinct characteristics, namely that some are pelagic and others with distinct characteristics, namely that some are pelagic and other benthic (Boutiba et *al*, 2003).

Table 3: Changes in mean levels of heavy metal traces (mean ± SD F.W ppm) in different marine organisms caught along the coast of Oran.

Species	Metals			
	Cd	Pb	Zn	**Authors**
Boops boops	0,021±0,01	0,40±0,18	13,5±3,55	Aoudjit (2000)
Mullus barbatus	0,08±0,02	1,19±0,04	13,25±0,08	Bensahla (2001)
Mullus surmuletus	0,15±0,01	0,23± 0,98	21,23± 3,21	Borsali (2006)
Trachurus trachurus	0,01±0,003	0,06±0,04	2,76±1,27	Benadda (2009)
Diplodus argus	0,11±0,12	0,32±1,85	3,006±1,85	Ayad (2010)
Mullus cephalus	0.3±0.02	0.4±0.021	9.09±0.58	Bouhadiba (2011)
Merluccius merluccius	0,24±0,11	0,27±0,16	7,89±0,47	Belhoucine (2012)
Trachinus araneus	0.001 ± 0.077	0.001 ± 0.08	1.48 ± 0.823	Present study

Conclusion

Because of the large volume of water in the Mediterranean has a great capacity to absorb pollution, but the large amounts of waste discharged can not be assimilated in coastal areas. This pollution is such a serious threat, and anxiety is so high in public opinion that states seek individually and jointly, all the necessary tools to stop, reduce or stop this marine pollution.

Man, the end consumer marine products and occupying the final link in the food chain, may at any time be vulnerable. The use of marine organisms for evaluating and determining the level of contamination have been facing in the light of this objective.

The results of this study revealed that:

The three metal elements bioaccumulate in the gill tissue better than in the trace elements among the muscle tissue zinc concentration still much higher than the lead and cadmium.

Compared to the size of individuals, juveniles are more contaminated than adults because as and as they age, fish salt out some of the contaminants from their bodies lay. Their size is often based on their age, larger fish contain less contaminants, this factor is closely linked to growth imposes on individuals a diet rich. The latter being carnivorous type, it potentially increases the risk of bioaccumulation.

The average concentrations of metals seems well below the maximum permissible dose (DMA), it seems not presented a real danger to the consumer, but it should be remembered that these micro have a cumulative effect through the food chain, and they also have a detrimental long-term effect on public health.

For the sound management and control of water pollution, we must come to study everything related inputs (expenses), the distribution and fate of contaminants, including heavy metals from land that drain into aquatic ecosystems. It is particularly important to study the quantity and quality characteristics, and the routes they travel when they disperse, their destiny and their effects on biota.

Bibliography

A.I.E.A., 1995. Echantillons pour comparaisons inter- oratoire -Matière de référence - Doc. Des Services de contrôle de la qualité des Analyses. 40p.

Alavanja, M.C., Hoppin, J.A., Kamel, F., 2004. Health effects of chronic pesticide exposure cancer and neurotoxicity. *Annu Rev Public Health* 25: 155-197

Amiard-Triquet, C., Pinneau, A., Boiteau, H.L., Metayer, C., Amiard-Triquet, C., 1987. Application de la Spectrophotomètrie d'absorption atomique Zeeman au dosage de 8 éléments traces (Hg, Cd, Cr, Mn, Ni, Pb, Se) dans les matières biologiques solides. *Waters* 21 (6), 693-697.

Aoudjit, N., 2001 **-** Etude de certains facteurs biologiques et de la contamination de la Bogue (*Boops Boops*) par les métaux lourds provenant de la baie d'Oran. *Thèse de Magister*: Université d'Oran. 243p.

Auguier, H., Ramanda, G., Santimone, M., 1988. Teneurs en métaux lourds des oursins comestibles (*Paracentrotus lividus*, LmK) dans les zones à grandes activités touristiques de l'île de Port Cros. *Actes Colloque Intern*. Sur l'oursin comestible *Paracentrotus lividus*. Carry -Le Rouet : 271-284.

Ayed, F., 2010 **-** Evaluation de la pollution métallique par trois métaux lourds **(**Cd, Pb, Zn) dans les organes (Foie, gonades et muscle) chez le Sar *Diplodus sargus* (Linné, 1758) pêché dans la baie de Béni Saf et la baie d'Oran**.** *Thèse de Magister*. Université d'Oran. 112p.

Belhoucine, F., Bouderbala, M., Boutiba, Z., 2008. Evaluation de la contamination métallique du merlu *(Merluccius merluccius* L., 1758*)* de la baie d'Oran. *Actes des Dixièmes Journées Tunisiennes des Sciences de la Mer et de la Première Rencontre Tuniso-Française d'Ichtyologie:* (13) *(Sousse* Tunisie (20-23 décembre 2008).

Belhoucine, F., 2012. Etude de la biologie de la croissance et de la reproduction d'un poisson téléostéen le merlu (*Merluccius merluccius* L., 1758) et son utilisation comme indicateur biologique de la pollution par les métaux lourds (Zinc, Plomb et Cadmium) dans la baie d'Oran (Algérie). *Thèse de Doctorat*. Sciences de l'Environnement, Département de Biologie. Faculté des Sciences de la Nature et de la Vie, Université d'Oran. 275p

Belhoucine, F., Alioua, A., Bouhadiba , S., Boutiba, Z., 2014. Impact of some biotics and abiotics factors on the accumulation of heavy metals by a biological model *Merluccius merluccius* in the bay of Oran in Algeria. *Journal of Biodiversity and Environmental Sciences* (JBES). 5 (6) : 33-44.

Benadda, H., 2009. Evaluation de la pollution marine par trios éléments en trace métalliques (plomb, cadmium et zinc) sur un poisson pélagique: La Saurel, *Trachurus trachurus* (Linné, 1758) péchée dans la baie d'Oran, *Thèse Magister.* Université d'Oran 82p

Bensahla-Talet, L., 2001. Contribution à l'étude des caractères biologiques du rouget (*Mullus barbatus*) du golf d'Oran et sa contamination par les métaux lourds. *Thèse de Magister,* Dépt. de Biologie, Faculté des Sciences, Université d'Oran: 156p.

Boudou, A., 1982. Recherches en écotoxicologie expérimentale sur les processus de bioaccumulation et de transfert des dérivés du mercure. *Thèse de doctorat d'Etat*, Université de Bordeaux 1: 297p.

Bouhadiba., S. 2011. Evaluation des concentrations des quatre métaux lourds (Pb, Cd, Cu, Zn) chez le Mulet (*Mugil cephalus* Linné 1758) pêché dans les baies d'Oran et de Béni Saf *Thèse. Magister*. Université d'Oran. 110p

Boutiba, Z., Taleb, Z., Abi-Ayad, S.M.E.A., 2003. Etat de la pollution marine de la côte oranaise. Edt. Dar El Gharb, 69p.

Borsali, S., 2006**.** Contamination du Rouget de roche (*Mullus surmuletus,* L., 1758) dans les organes (foie, muscle et gonades) par trois métaux lourds (Cadmium, Plomb et Zinc), pêché dans la baie d'Oran. *Mémoire de Magister* Université d'Oran, 197p.

Cassas, S., 2005. Modélisation de la bioaccumulation des métaux traces (Hg, Cd, Pb, Cu et Zn) chez la moule, *Mytilus galloprovincialis*, en milieu méditerranéen. Thèse de Doctorat Océa. Biologique. Env. Mar. Université Sud Toulon. 314p.

Chaffai-Hamza, A., 1993. Bioaccumulation métallique et métallothionéines chez des poissons de la côte de Sfax (Golfe de Gabès), Doctorat de spécialité, Université de Sfax; 1993. 168p

Delache A., Ribeyre, F., 1978. Chaîne trophique expérimentale en milieu limnique. Thèse 3ème cycle en science Biologiques, Uni Bordeau I, 265p.

Eason, C., O'Halloran, K., 2002. Biomarkers in toxicology versus ecological risk assessment. *Toxicology* 181-182, 517-521

El Morhit, M., 2009. Impact des activités hydro-agricoles sur la qualité des sédiments de l'estuaire du bas Loukkos (Maroc). Problématiques des déchets solides. Société Marocaine de Toxicologie Faculté de Médecine et de Pharmacie, 28 avril 2009, Rabat. Maroc.

El Morhit, M., Fekhaoui, M., Serghini, A., El Blidi, S., El Abidi, A., Bennaakam R., Yahyaoui A., M. Jbilou, 2009. Impact de l'aménagement hydraulique sur la qualité des eaux et des sédiments de l'estuaire du Loukkos (cote atlantique, Maroc), *Bull. Inst. Sci.,* 30 : 39–47.

Fekhaoui, M., 1983. Toxico cinétique de trois polluants métallique majeurs chez la truite arc-en ciel (*Salmo gaidneri*), le chrome le cuivre et le zinc. Thèse de troisième cycle, université de Claude Bernard- Lyon, 125p.

Geistdoerfer, P., 1986. Nouvelles captures et redescription d'un poisson Zoarcidae (Pisces, Perciformes, Zoarcoidei) des sites hydrothermaux de la ride du Pacifique oriental, *Bull. Mus. natn. Hist. nat.*, Paris, 4e sér, 8 A4, 969-980.

Grahn, M., 1990. Seasonal changes in ranging behavior and territoriality in the European Jay Garrulus *G. glandarius*. Ornis Scand. 21: 195-201

Langston, W.J., Chesman, B.S., Burt, G.R., Pope, N.D., McEvoy, J., 2002. Metallothionein in liver of eels *Anguilla anguilla* from the Thames Estuary: An indicator of environmental quality? *Marine Environmental Research* 53: 263–293.

Leclaire, L., 1972. La sédimentation holocène sur le versant Méridional du bassin Algéro-Baléares (Précontinent Algérien). Tome XXIV. Edition de Muséum, Paris, France*,* 391p.

Maroni, M., Colosio, C., Ferioli, A., Fait, A., 2000. Biological monitoring of Pesticide Exposure: a review. Introduction. Toxicology 143, 1-118.

Rehwold, R., 1972. Distribution of selected metals in tissue samples of *Cyprinus carpis*; bull. Environ. *Contron. Toxicol.,* 15: 3374–377.

Siddall, M., D.A. Smeed, E.J. Rohling., Mathiessen, S., 2002. Modelling the seasonal cycle of the exchange flow in the Straits of Bab al Mandab (Red Sea), Deep Sea Res., Part I, 49, 1551 -1569,

Schofied, C.L., Trajner, J.R., 1980. Aluminum toxicity to fish in acidiced water. In: pollution rain, *Plessum press, New York,* 17: 347–366p.

Skeie, E., 1966. Weeverfish stings: frequency, occurrence, clinical course, treatment and studies on the venom apparatus of the weeverfish, the nature of the toxin, and immunological aspects. Dan Med Bull 13: 119-121.

Szefer, P., Glasby G.P., Stüben D., Kusak A., Geldon J., Berner Z., Neumann T., Warzocha, J., 1999. Distribution of selected heavy metals and rare earth elements in surficial sediments from the polish sector of the Vistula Lagoon. *Chemosphere*, 39(15), 2785-2798.

Thibaud, Y., 1976. Niveau de présence des métaux lourds. In : Résidus chimiques et additifs dans les aliments et boissons. *Rapp. I.S.T.P.M. Sci. Tech. Et Contrôle*. 10 mai 1976. Nantes (France): 74p.