

## LEGISLATION ANALYSIS RELATED TO HEAVY METAL POLLUTION OF MARINE HYDROBIONTS AND THEIR ENVIRONMENT

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### ABSTRACT

The purpose of the study was to analyze the national and European legislation related to the pollution of marine ecosystems with various heavy metals. The subject of examination was regulatory documents that determine the maximum levels of certain heavy metals in hydrobionts and their environment. Summary analysis and historical review of Ordinance No. 5/2015 determining the maximum levels of certain contaminants in foods has been performed, as well as an analysis of Regulation 1881/2006 (EC) and Directive 2013/39/EU. Based on current research we could make the following conclusions: European legislation in this field has been fully implemented in national regulation act; values and maximum available concentration of heavy metals in marine water and inhabitants were presented in various documents, which make their interpretation complicated.

**Key words:** hydrobionts, heavy metal, National and European legislation.

### Introduction

Fish is one of the valuable sources of many essential nutrients for humans. Rich in protein, carbohydrates and vitamins, it is often present in many healthy diets. In addition to its beneficial effects, fish consumption can carry a risk to human health in the event of heavy metal contamination. (Azaman et al. 2015, Isangedighi and David, 2019).

When heavy metals are accumulated in the body and their concentration is exceeded, they can possess carcinogenic, teratogenic or mutagenic effect. These elements mainly attack the liver and kidneys, and their concentration can be determined in muscles, bones or brain. (Mielczarek and Szydowski, 2017).

In relation to the protection of human health and food safety, the maximum level of heavy metals in fish is widely considered and is covered by national and European legislation. (Ordinance No. 31 of 2004 on the maximum levels of contaminants in foodstuffs, Ordinance No. 12 of 21.05.2002 on the maximum levels for heavy metals as contaminants in foodstuffs, Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.)

In Directive 2013/39/EU, Annex II are determined environmental quality standards for priority substances and certain other pollutants, setting an average annual value, the maximum permissible concentration in inland surface waters.

Directive 2000/60/EC, for its part, establishes a common framework for Community action in the field of water policy, and a list of the main pollutants, including metals and their constituents, is provided in ANNEX VIII of the same regulatory document.

Over the years, a number of changes have occurred in the texts of the regulatory documents concerning the species composition and maximum levels of the heavy metals for the relevant hydrobionts.

The purpose of the current study was to analyze the national and European legislation related to the pollution of the marine ecosystems by various heavy metals.

### Materials and methods

The subject of examination is the regulatory documents that determine the maximum levels for certain heavy metals in hydrobionts over a period of three decades. The analysis covers national laws and ordinances and European regulations. Studied and submitted to content analysis (Krippendorff, 2004) are regulations at national and European level in the field of legislation on the maximum level of heavy metals in foodstuffs, in their different versions.

### Results and discussion

In the Food Law, Art. 5. (1) The Minister of Health, in coordination with the Minister of Agriculture, Food and Forestry, determine the maximum permissible amounts of pollutants and pesticide residues in the foods with Ordinance No. 5 of 09.02.2015, on the determination of maximum levels of certain contaminants in foodstuffs, Issued by the Minister of Health (ed. and Suppl. 11 of 2/02/2018, effective 2/02/2018). In this ordinance are described the hygiene standards for the maximum levels of heavy metals allowed in foodstuffs.

In Ordinance No. 5 of 09.02.2015, art. 11, is noted that the maximum levels of certain contaminants in the foodstuffs are laid down in Regulation (EC) No 1881/2006, which in practice creates the condition for the application of this document in Bulgaria, also mentioned in § 2 of the same ordinance.

Table 1 presents the maximum levels for certain heavy metals in the fish as defined in the Commission Regulation (EC) No 1881/2006 and Commission Regulation (EC) No 466/2001 of 8 March 2001 determining the maximum levels for certain pollutants in the foods.

**Table 1: Maximum levels for lead, mercury and cadmium in hydrobionts.**

Group	COMMISSION REGULATION (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs		COMMISSION REGULATION (EC) No 466/2001 of 8 March 2001 setting maximum levels for certain contaminants in foodstuffs	
	LEAD	Maximum level (mg/kg wet weight)	LEAD	Maximum level (mg/kg wet weight)
1. Muscle meat of fish		0.30	Muscle meat of fish as defined in category (a), (b) and (e) of the list in Article 1 of Council Regulation (EC) No 104/2000 (18), excluding fish species listed in point 2.	0.2

Group	COMMISSION REGULATION (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs		COMMISSION REGULATION (EC) No 466/2001 of 8 March 2001 setting maximum levels for certain contaminants in foodstuffs	
	LEAD	Maximum level (mg/kg wet weight)	LEAD	Maximum level (mg/kg wet weight)
2.			Muscle meat of wedge sole ( <i>Dicologlossa cuneata</i> ), eel ( <i>Anguilla anguilla</i> ), spotted sea-bass ( <i>Dicentrarchus punctatus</i> ), horse mackerel or scad ( <i>Trachurus trachurus</i> ), grey mullet ( <i>Mugil labrosus labrosus</i> ), common two-banded seabream ( <i>Diplodus vulgaris</i> ), grunt ( <i>Pomadasys benneti</i> ) and sardine ( <i>Sardina pilchardus</i> )	0.4
3.	Crustaceans, excluding brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans ( <i>Nephropidae</i> and <i>Palinuridae</i> )	0.50	Crustaceans, excluding brown meat of crab	0.5
4.	Bivalve molluscs	1.5	Mussels	1.0
<b>CADMIUM</b>				
1.	Muscle meat of the following fish, excluding species listed in 2, and 3.	0.050	Muscle meat of fish as defined in category (a), (b) and (e) of the list in Article 1 of Regulation (EC) No 104/2000, excluding fish species listed in 2.	0.05
2.	Muscle meat of the following fish: anchovy ( <i>Engraulis</i> species) bonito ( <i>Sarda sarda</i> ) common two-banded seabream ( <i>Diplodus vulgaris</i> ), eel ( <i>Anguilla anguilla</i> ), grey mullet ( <i>Mugil labrosus labrosus</i> ), horse mackerel or scad ( <i>Trachurus</i> species), louvar or luvar ( <i>Luvarus imperialis</i> ), sardine ( <i>Sardina pilchardus</i> ), sardinops ( <i>Sardinops</i> species), tuna ( <i>Thunnus</i> species, <i>Euthynnus</i> species, <i>Katsuwonus pelamis</i> ), wedge sole ( <i>Dicologlossa cuneata</i> )	0.10	Muscle meat of wedge sole ( <i>Dicologlossa cuneata</i> ), eel ( <i>Anguilla anguilla</i> ), European anchovy ( <i>Engraulis encrasicolus</i> ), louvar or luvar ( <i>Luvarus imperialis</i> ), horse mackerel or scad ( <i>Trachurus trachurus</i> ), grey mullet ( <i>Mugil labrosus labrosus</i> ), common two-banded seabream ( <i>Diplodus vulgaris</i> ), European pilchard or sardine ( <i>Sardina pilchardus</i> )	0.1
3.	Muscle meat of swordfish ( <i>Xiphias gladius</i> )	0.30		
4.	Crustaceans, excluding brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans ( <i>Nephropidae</i> and <i>Palinuridae</i> )	0.50	Crustaceans, excluding brown meat of crab	0.5
5.	Bivalve molluscs	1.0	Mussels	1.0

Group	COMMISSION REGULATION (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs		COMMISSION REGULATION (EC) No 466/2001 of 8 March 2001 setting maximum levels for certain contaminants in foodstuffs	
	LEAD	Maximum level (mg/kg wet weight)	LEAD	Maximum level (mg/kg wet weight)
	<b>MERCURY</b>			
1.	Fishery products and muscle meat of fish, excluding species listed in 2. The maximum level applies to crustaceans, excluding the brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans (Nephropidae and Palinuridae)	0.50	Fishery products, excluding species listed in 2.	0.5
2.	Muscle meat of the following fish: anglerfish (Lophius species), atlantic catfish (Anarhichas lupus), bonito (Sarda sarda), eel (Anguilla species), emperor, orange roughy, rosy soldierfish (Hoplostethus species), grenadier (Coryphaenoides rupestris), halibut (Hippoglossus hippoglossus), marlin (Makaira species), megrim (Lepidorhombus species), mullet (Mullus species), pike (Esox lucius), plain bonito (Orcynopsis unicolor), poor cod (Tricopterus minutus), portuguese dogfish (Centroscymnus coelolepis), rays (Raja species), redfish (Sebastes marinus, S. mentella, S. viviparus), sail fish (Istiophorus platypterus), scabbard fish (Lepidopus caudatus, Aphanopus carbo), seabream, pandora (Pagellus species), shark (all species), snake mackerel or butterfish (Lepidocybium flavobrunneum, Ruvettus pretiosus, Gempylus serpens), sturgeon (Acipenser species), swordfish (Xiphias gladius), tuna (Thunnus species, Euthynnus species, Katsuwonus pelamis).	1.0	Anglerfish (Lophius spp.), atlantic catfish (Anarhichas lupus), bass (Dicentrarchus labrax), blue ling (Molva dipterygia), bonito (Sarda spp.), eel (Anguilla spp.), halibut (Hippoglossus hippoglossus), little tuna (Euthynnus spp.), marlin (Makaira spp.), pike (Esox lucius), plain bonito (Orcynopsis unicolor), Portuguese dogfish (Centroscymnus coelolepis), rays (Raja spp.), redfish (Sebastes marinus, S. mentella, S. viviparus), sail fish (Istiophorus platypterus), scabbard fish (Lepidopus caudatus, Aphanopus carbo), shark (all species), snake mackerel (Lepidocybium flavobrunneum, Ruvettus pretiosus, Gempylus serpens), sturgeon (Acipenser spp.), swordfish (Xiphias gladius), tuna (Thunnus spp.)	1.0

The data presented in Table 1 shows the maximum level of lead in muscle tissue of fish Regulation (EC) No 1881/2006, compared to Regulation (EC) No 466/2001, where values are set for individual fish species. There is also a change in the maximum level of lead, which increases to 0.3 from 0.2 mg/kg.

The maximum levels for cadmium and mercury are retained in group 1 and 2, but in Regulation (EC) No 1881/2006 the species composition in group 2 is significantly expanded, and also have an increase of the maximum level to 0.1 mg/kg. The Regulation (EC) No 1881/2006, as compared to the Regulation (EC) No 466/2001, also lays down a specific maximum level for the muscle of swordfish *Xiphias gladius*. With the entry into force of Commission Regulation (EC) No 1881/2006 of 19 December 2006, Commission Regulation (EC) No 466/2001 of 8 March 2001 for determining the

maximum levels of certain contaminants in food is repealed, and thus increasing the control of heavy metals in hydrobionts.

The paragraph 5 of Ordinance No. 5 of February 9, 2015 states that this ordinance repeals Ordinance No. 31 of 2004 on the maximum levels of contaminants in food (promulgated, SG No. 88/2004; amend. Suppl., issue 51 of 2006.

In Art. 9 (1) of the repealed Ordinance No. 31 of 2004, the maximum levels for contaminants in foodstuffs are specified, and the maximum levels for lead, mercury, cadmium, aluminum, arsenic, copper, nickel and chrome are specified in Annex 1, Table 5 and Table 5a. The ordinance text shows that by 2015, the maximum levels for aluminium, arsenic, copper, nickel and chromium are indicated, which are not covered by Regulation (EC) No 1881/2006.

In the first text of Ordinance No. 31 of 29.07.2004 promulgated in the State Gazette, issue. 88 of 8.10.2004 and the amendment and suppl. 51 dated 23.06.2006, an accordance with the maximum levels for the heavy metals was observed, but there was a discrepancy in the fish species, seen in table № 2.

The paragraph 4 of Ordinance No. 31 of July 29, 2004 states that it repeals the Ordinance No. 5 on the hygiene maximum levels of chemical and biological contaminants in foodstuffs (promulgated SG 39/98; issue 5 of 1986; amend and supplement, issue 15 of 1987, issue 87 of 1989, issue 66 of 1992 and issue 24 of 1999), and Ordinance No. 12 on the maximum levels of heavy metals as contaminants in foodstuffs (SG, issue 55 of 2002).

Table 2 lists the maximum levels for lead, cadmium and mercury by Ordinance No. 12 of 21.05.2002 on the maximum levels of heavy metals as contaminants in foodstuffs (Issued by the Minister of Health, promulgated SG, issue. 55 of June 4, 2002, effective June 1, 2004, repealed, issue 88 of October 8, 2004) and Ordinance No. 31 of 2004 on the maximum levels of contaminants in food, with both and amendments by 2004 and 2006.

**Table 2: Lists the maximum levels for lead, cadmium and mercury.**

Group	ORDINANCE No. 12 of 21.05.2002 on the maximum levels for heavy metals as contaminants in foodstuffs. Issued by the Minister of Health, am and add., SG, No. 55 of 4.06.2002., Effective as of 1.06.2004, repealed, issue. 88 of 8.10.2004.		Ordinance No. 31 of 2004 on the maximum levels of contaminants in foodstuffs			
	Foodstuff	Max. level (mg/kg wet weight)	Foodstuff	Max. level (mg/kg wet weight)	Foodstuff	Max. level (mg/kg wet weight)
<b>LEAD</b>						
1	Muscle meat of fish, excluding species listed in 2 and annex № 1	0.2	Fish meat: live fish; fish, fresh, chilled or frozen; fillets and other fish meat, whether or not minced, fresh, chilled or frozen; fish, dried, salted or in brine; smoked fish, whether or not hot smoked, flours, semolina and agglomerates in the form of	0.2	Muscle meat of fish (1) (2),, excluding species listed in 2 and annex № 1	0.20

Group	ORDINANCE No. 12 of 21.05.2002 on the maximum levels for heavy metals as contaminants in foodstuffs. Issued by the Minister of Health, am and add., SG, No. 55 of 4.06.2002., Effective as of 1.06.2004, repealed, issue. 88 of 8.10.2004.		Ordinance No. 31 of 2004 on the maximum levels of contaminants in foodstuffs			
	Foodstuff	Max. level (mg/kg wet weight)	Foodstuff	Max. level (mg/kg wet weight)	Foodstuff	Max. level (mg/kg wet weight)
			granules of fish fit for human consumption; prepared or preserved fish; caviar and substitutes therefor prepared on the basis of fish eggs, with the exception of the species of fish listed 2.			
2	Muscle meat of fish: wedge sole, eel, bass, horse mackerel or scad, grey mullet, common two-banded seabream, grunt and sardine		Muscle meat of fish bonito ( <i>Sarda sarda</i> ); common two-banded seabream ( <i>Diplodus vulgaris</i> ); eel ( <i>Anguilla anguilla</i> ); grey mullet ( <i>Mugil labrosus labrosus</i> ); grunt ( <i>Pomadasys benneti</i> ); horse mackerel or scad ( <i>Trachurus trachurus</i> ); sardine ( <i>Sardina pilchardus</i> ); sardinops ( <i>Sardinops spp.</i> ); bass ( <i>Dicentrarchus unctatus</i> ); tuna ( <i>Thunnus</i> species and <i>Euthynnus</i> species); wedge sole ( <i>Dicologlossa cuneata</i> )	0.4	Muscle meat of the following fish: common two-banded seabream ( <i>Diplodus vulgaris</i> ); eel ( <i>Anguilla anguilla</i> ); grey mullet ( <i>Mugil labrosus labrosus</i> ); grunt ( <i>Pomadasys benneti</i> ); horse mackerel or scad ( <i>Trachurus</i> species); sardine ( <i>Sardina pilchardus</i> ); sardinops ( <i>Sardinops</i> species); bass ( <i>Dicentrarchus punctatus</i> ), wedge sole ( <i>Dicologlossa cuneata</i> )	0.4
3	Crustaceans, excluding brown meat of crab	0.5	Crustaceans, excluding brown meat of crab	0.5	Crustaceans, excluding brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans ( <i>Nephropidae</i> and <i>Palinuridae</i> )	0.50
4			Bivalve molluscs (mussels, oysters, etc.)	1.5	Bivalve molluscs (mussels, oysters, etc.)	1.5

Group	ORDINANCE No. 12 of 21.05.2002 on the maximum levels for heavy metals as contaminants in foodstuffs. Issued by the Minister of Health, am and add., SG, No. 55 of 4.06.2002., Effective as of 1.06.2004, repealed, issue. 88 of 8.10.2004.		Ordinance No. 31 of 2004 on the maximum levels of contaminants in foodstuffs			
	Foodstuff	Max. level (mg/kg wet weight)	Foodstuff	Max. level (mg/kg wet weight)	Foodstuff	Max. level (mg/kg wet weight)
	<b>CADMIUM</b>					
1	Muscle meat of fish, excluding species listed in 2 and annex № 1	0.05	Meat of fish: live fish; fish, fresh, chilled or frozen; fillets and other fish meat, whether or not minced, fresh, chilled or frozen; fish, dried, salted or in brine; smoked fish, whether or not hot smoked, flours, semolina and agglomerates in the form of granules of fish fit for human consumption; prepared foods and canned fish; caviar and substitutes therefor prepared on the basis of fish eggs, except for fish listed in	0.05	Meat of fish: live fish, except for the fish species listed in 2 and 3	0.05
2	Muscle meat of the following fish: wedge sole, eel, sprat, louvar or luvar, horse mackerel or scad, grey mullet, common two-banded seabream and sardine	0.1	Muscle meat of the following fish: bonito ( <i>Sarda sarda</i> ); common two-banded seabream ( <i>Diplodus vulgaris</i> ); eel ( <i>Anguilla anguilla</i> ); grey mullet ( <i>Mugil labrosus labrosus</i> ); grunt ( <i>Pomadasys benneti</i> ); horse mackerel or scad ( <i>Trachurus trachurus</i> ); sardine ( <i>Sardina pilchardus</i> ); sardinops ( <i>Sardinops</i> spp.); bass ( <i>Dicentrarchus punctatus</i> ); tuna ( <i>Thunnus</i> species и <i>Euthynnys</i> species); wedge sole ( <i>Dicologlossa cuneata</i> )	0.1	Muscle meat of the following fish (1) and (2): anchovy ( <i>Engraulis</i> species); bonito ( <i>Sarda sarda</i> ); common two-banded seabream ( <i>Diplodus vulgaris</i> ); eel ( <i>Anguilla anguilla</i> ); grey mullet ( <i>Mugil labrosus labrosus</i> ); horse mackerel or scad ( <i>Trachurus</i> species); louvar or luvar ( <i>Luvarus imperialis</i> ); sardine ( <i>Sardina pilchardus</i> ); sardinops ( <i>Sardinops</i> species); tuna ( <i>Thunnus</i> species, <i>Euthynnys</i> species and <i>Katsuwonus pelamis</i> ); wedge sole ( <i>Dicologlossa cuneata</i> )	0.10
3					Muscle meat of swordfish ( <i>Xiphias gladius</i> )	0.30
4	Crustaceans, excluding brown meat of crab	0.5	Crustaceans, excluding brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans ( <i>Nephropidae</i> and <i>Palinuridae</i> )	0.5	Crustaceans, excluding brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans ( <i>Nephropidae</i> and <i>Palinuridae</i> )	0.5
5	Mussels	1.0	Bivalve molluscs (mussels, oysters, etc.)	1.0	Bivalve molluscs (mussels, oysters, etc.)	1.0

Group	ORDINANCE No. 12 of 21.05.2002 on the maximum levels for heavy metals as contaminants in foodstuffs. Issued by the Minister of Health, am and add., SG, No. 55 of 4.06.2002., Effective as of 1.06.2004, repealed, issue. 88 of 8.10.2004.		Ordinance No. 31 of 2004 on the maximum levels of contaminants in foodstuffs		
	Foodstuff	Max. level (mg/kg wet weight)	Foodstuff	Max. level (mg/kg wet weight)	Foodstuff
			am and add., SG, No 88 of 8.10.2004		am. and add. 51 of 23.06.2006
<b>MERCURY</b>					
1	Fishery products, except those in 2	0.50	Fishery products, except those in 2	0.50	Muscle meat of fish and fishery products and products thereof, excluding 2.
2	Fishery products: anglerfish, atlantic catfish, blue ling, bas, bonito, eel, Atlantic halibut, little tunny, marlin, pike, plain bonito, Portuguese dogfish, rays, redfish, sail fish, scabbard fish, shark ( all species), snake mackerel, Muscle meat of swordfish, tuna, sturgeon,	1.0	Fishery product: anglerfishes (Lophius species); atlantic catfish (Anarhichas lupus); bass (Dicentrarchus labrax); blue ling (Molva dipterygia); bonito (Sarda sarda); eel (Anguilla species); (Hoplostethus atlanticus); (Coryphaenoides rupestris); Atlantic halibut (Hippoglossus hippoglossus); little tunny marlin (Makaira species); pike (Esox lucius); plain bonito (Orcynopsis unicolor); portuguese dogfish (Centroscymnes coelolepis); rays (Raja species); red fish (Sebastes marinus, S. Mentella, S. viviparus); sail fish (Istiophorus platypterus); scabbard fish (Lepidopus caudatus, Aphanopus carbo); shark (all species); snake mackerel (Lepidocybium flavobrunneum, Rivettus pretiosus, Gempylus serpens); sturgeon (Acipenser species); Muscle meat of swordfish (Xiphias gladius); tuna (Thunus species и Euthynnus species)	1.0	Muscle meat of (1) (2): anglerfish (Lophius species); atlantic catfish (Anarhichas lupus); bonito (Sarda sarda); eel (Anguilla species); emperor, orange roughy, rosy soldierfish (Hoplostethus species); grenadier (Coryphaenoides rupestris); halibut (Hippoglossus hippoglossus); marlin (Makaira species); megrim (Lepidorhombus species); mullet (Mullus species); pike (Esox lucius); plain bonito (Orcynopsis unicolor); poor cod (Tricopterus minutes), portuguese dogfish (Centroscymnes coelolepis); rays (Raja species); redfish (Sebastes marinus, S. Mentella, S. viviparus); sail fish (Istiophorus platypterus); scabbard fish (Lepidopus caudatus, Aphanopus carbo); seabream, pandora (Pagellus species); sharks (all species); snake mackerel (Lepidocybium flavobrunneum, Rivettus pretiosus, Gempylus serpens); sturgeon (Acipenser species); Muscle meat of swordfish (Xiphias gladius); tuna (Thunus species species, Euthynnus species and Katsuwonus pelamis).

**Table 3: The maximum levels for aluminum, arsenic, copper, nickel, chromium and zinc in foodstuff in ORDINANCE No. 12 of 21.05.2002 and Ordinance No. 31 (prom, SG No. 88 of 8 October 2004 and amended and supplemented, issue 51 of 23 June 2006).**

Foodstuff	Aluminum mg/kg	Arsenic mg/kg	Copper mg/kg	Nickel mg/kg	Chromium mg/kg	Zinc mg/kg
1. Freshwater fish	30.0	1.00	10.0	0.5	0.3	50.0
2. Marine fish	30.0	5.00**	10.0**	0.5	0.3	50.0
3. Mussels, crustaceans, etc.	-	2.00**	30.0**	-	-	200.0

In the repealed Ordinance No. 5 on the hygiene maximum levels of chemical and biological contaminants in foodstuffs promulgated SG, issue no. 39 of May 18, 1984, until the cancellation and issue no. 88 of the State Gazette of October 8, 2004, the norms for aluminium, arsenic, copper, nickel, chromium and zinc have been saved in Ordinance No. 31 of 2004, which are presented in Table (No.) 3

### Conclusion

Based on the analysis of the national and European legislation in relation to the maximum levels for heavy metals in hydrobionts, the following conclusions can be drawn:

- Compared to the regulations that are not in force, the current legislation increases the fish species with postulated higher maximum levels for heavy metals;
- The Commission Regulation (EC) No 1881/2006 specifies a separate maximum level of cadmium for muscle meat of swordfish (*Xiphias gladius*).
- The maximum levels for aluminium, arsenic, copper, nickel, chromium and zinc in hydrobionts, were present only in the analyzed repealed regulatory documents.
- In the current legislation, the hydrobionts safety in regard to heavy metal contamination is related only to the control of lead, cadmium and mercury (only).

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