SC/67A/E/08

Toxic and active elements (Fe, Zn, u, Hg, As, Cd, Pb, Se, Mn) in tissues and organs of gray whales and Pacific walrus harvested in the Mechigmensky Bay (Western Bering Sea, Russia), 2008-2016

Lidiya T. Kovekovdova, Mikhail V. Simokon, Sergey A. Blokhin, Dennis I. Litovka

INTERNATIONAL WHALING COMMISSION

TOXIC AND ACTIVE ELEMENTS (Fe, Zn, Cu, Hg, As, Cd, Pb, Se, Mn) IN TISSUES AND ORGANS OF GRAY WHALES AND PACIFIC WALRUS HARVESTED IN THE MECHIGMENSKY BAY (WESTERN BERING SEA, RUSSIA), 2008-2016.

Lidiya T. Kovekovdova[1], Mikhail V. Simokon[1], Sergey A. Blokhin[1], **Dennis I. Litovka**[2]

[1] – TINRO-Center, Shevchenko Alley, 4, Vladivostok, RUSSIA, 690950
[2] – Chukotka branch of TINRO-Center, Otke Str., 56, Anadyr, Chukotka, RUSSIA, 689000
E-mails: *Kovekovdova@mail.ru; s.a.blokhin@mail.ru; d-litovka@yandex.ru*

In coastal waters of the Chukchi Peninsula (the Mechigmensky Bay, Western Bering Sea, Russia) contamination levels of marine mammal tissue and organ samples were investigated by TINRO-Center and ChukotTINRO. Organs and tissues of Gray whales (*Eschrichtius robustus)* and Pacific walrus (*Odobenus rosmarus)* were necropsied after aboriginal whaling and landing by Chukotka Natives (Figure, Table) in 2008-2016.

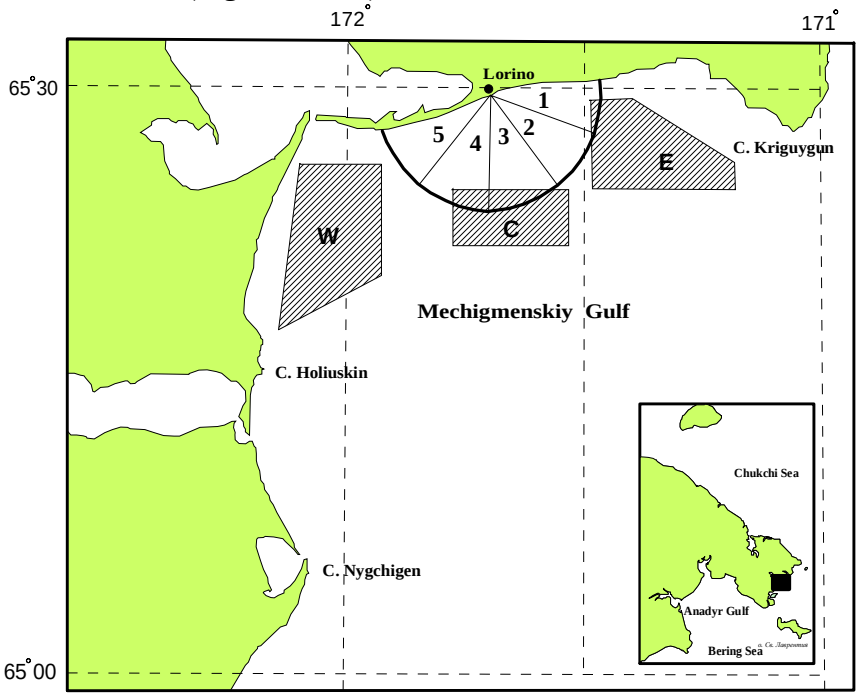

Figure - Observation water area and whaling sectors in the Mechigmensky Bay of the Western Bering Sea (Blokhin, Litovka, SC IWC 2009-2014)

Necropsy samples included muscle, kidney, liver, blubber by 50-100 g (1.8-3.5 ounce) and blood 50-100 ml (1.7-3.4 fl.ounceUS). All samples were freezed at - 24ºC (-11.2F) and delivered to Laboratory of ApplEcology of TINRO-Center. The preparation of tissue and organ samples for measuring was performed by acidic mineralization method using nitric acid following GOST 26929-94 [1].

In 2008-2015 measuring the concentrations of iron, zinc and copper was performed on the atomic absorption spectrophotometer «Shimadzu» Aa-6800. As an atomizer we used a single split burner, as a combustible mixture we used an acetylene-air. The background was corrected by a deuterium lamp. Concentrations of cadmium, arsenic and lead was determined with the atomic absorption spectrophotometer «Shimadzu» Aa-6800. The atomizer was a graphite cuvette, and background corrector was the deuterium lamp.

In 2016 the measuring the concentrations of selen, manganese, iron, zinc, copper, cadmium, arsenic and lead was performed using the atomic absorption spectrophotometer

Agilent 7700 Series ICP-MS.

The mercury concentrations in the samples were determined using a flameless atomic absorption method with the direct mercury analyzer DMA-80 MILESTONE.

The elements determining standard errors were less than 7-10%.

As standard samples we used State Standard Metal Solutions Samples (GSORM).

The biologically active components of Fe, Zn and Cu had the highest amounts, but Cd and Hg had the lowest concentration levels in the tested animal tissues and organs in the Mechigmensky Bay (Table). The highest concentrations of As, Cd and Se were detected in animals kidneys irrespectively to animals sex.

The levels of Fe, Zn, Cu, As and Hg were significantly higher in the liver of animals. This is due to the fact that the regulation of elements content in the body is not so much limiting their content in muscles, as by between-organs redistribution of elements. Therefore heavy metals concentrated by the depositing and filtering organs in levels, dozens times higher than in other tissues and organs, regardless of animal species.

Chukotka Natives consume intestines and meat of whales and walruses. The RSSEHR - Russian State Sanitary, Epidemiological and Hygienic Requirements [2] are controlling and limiting the level of toxic elements of As, Cd, Hg etc. in the marine mammals tissues and organs. The MPL (maximum permissible levels) are (in mg / kg mass) As = 5.0; Cd = 0.2; Hg = 0.5, Pb = 1.0 [2].

The concentrations of toxic elements in the studied muscle and blubber samples of gray whales and walrus did not exceed the maximum permitted levels.

The cadmium concentration exceeded the MPL only twice at 58.5% (#1 in Table) in liver of "stinky" gray whale male in 2008 and at 15% of permitted level in 2015 in edible female's (#7) liver.

The lead concentration exceeded the MPL three times in "stinky" whales organs and only at 2008: 1-2/ at 4.2 times in liver and 2.4 times in kidney of (#1) male; 3/ at 3.8 times in also inedible (#3) male's kidney.

The concentrations of active biological elements such as iron, selen, manganese, zinc and copper are not regulated by the RSSEHR in the tissues and organs of harvested and consumed marine mammals.

The multiple excess concentrations of cadmium and lead in liver and kidney might be one of the reasons of "stinky" gray whales phenomena, which has to be better studied. Our investigation shown that most valuable products, i.e. meet and blubber, of all studied animals and even of "stinky" whales are about edible as to toxic (As, Cd, Hg, Pb) and active (Fe, Cu, Mn, Zn, Se) elements. Portable operational method of measuring toxic elements in marine mammals tissues and organs might be critically useful to avoid consuming inedible and dangerous traditional food products by Native people.

REFERENCES

1. GOST 26929-94 (Set of technical standards maintained by the Euro-Asian Council for Standardization, Metrology and Certification). Raw materials and food products. Preparation of samples. Mineralization for the toxic elements determination. - Moscow, 1994. 123 pp.

2. The Russian State Sanitary, Epidemiological and Hygienic Requirements for goods, subject to Russian sanitary-epidemiological control. Amended January 15, 2013. Decision of the Customs Union Commission dated May 28, 2010 number 299. Chapter II, section 1.

Table - Toxic elements' concentration in organs and tissue samples of Gray whales and Pacific walrus (mg/kg mass), landed in Mechigmensky Bay (Western Bering Sea) in 2008-2016
[in grey color the excess of maximum permissible levels are shown]

# sample	Landing date dd/mm/yy	Sex	Size. m	Organ	Fe	Zn	Cu	Hg	As	Cd	Pb	Mn	Se
1	6.08.08	♂	8.1	Muscle	29.5	94.1	1.80	0.002	0.24	0.007	0.78		
				Liver	373.3	46.8	112	0.010	1.97	0.317	4.20		
				Kidney	28.4	10.9	3.27	0.002	0.17	0.027	2.41		
				Blood	308	8.3	1.33	0.003	0.82	0.008	0.89		
				Blubber	20.4	3.59	0.72	0.006	1.08	0.014	0.21		
2	31.07.08	♂	8.2	Muscle	59.4	105	1.17	0.005	2.76	0.005	0.12		
				Liver	638.7	54.5	81.	0.004	2.04	0.018	0.23		
				Blood	113.6	11.0	0.68	0.001	1.25	0.03	0.07		
				Blubber	5.8	2.9	1.1	0.022	1.91	0.014	0.15		
3	20.07.08.	♂	8.3	Muscle	40.2	100	2.9	0.002	0.25	0.100	0.20		
				Liver	420	68.4	134	0.010	1.60	0.170	0.58		
				Kidney	30.8	19.0	4.2	0.002	0.21	0.040	3.80		
				Blood	320	8.4	1.0	0.003	0.89	0.008	0.32		
				Blubber	8.6	5.3	0.7	0.010	1.30	0.01	0.20		
4	?	?	?	Muscle	64.1	110	2.1	0.005	3.6	0.005	0.12		
				Liver	650	556	79.0	0.007	2.04	0.150	0.29		
				Blood	150.6	11.8	0.68	0.000	1.29	0.03	0.06		
				Blubber	15.8	4.0	1.18	0.022	1.0	0.014	0.15		
5	?	?	?	Muscle	44.8	100	2.2	0.005	4.0	0.005	0.09		
				Liver	590	101	83.0	0.005	3.00	0.180	0.32		
				Blood	144.4	8.8	0.37	0.000	1.40	0.03	0.05		
				Blubber	15.8	5.0	0.9	0.008	1.0	0.016	0.15		
6	13.08.15.	♀	13.0	Muscle	80.4	94.6	2.0	0.035	3.9	0.010	0.10		
				Blubber	18.2	8.3	0.8	0.020	1.8	0.010	0.20		
7	14.07.15.	♀	9.5	Muscle	68.9	89.8	1.9	0.035	3.3	0.005	0.14		
				Blubber	16.4	10.9	0.6	0.014	2.0	0.016	0.20		
				Liver	623	110	90.0	0.048	4.0	0.230	0.39		
8	Walrus date unknown	?	?	Muscle	70.1	86.6	1.1	0.005	3.6	0.004	0.08		
				Liver	500	350	1200	0.007	2.0	0.150	0.43		
				Blood	130.7	10.8	0.48	0.000	1.40	0.030	0.04		
				Blubber	10.0	4.7	0.8	0.025	0.9	0.020	0.13		
9	17.06.16	♀	9.7	Muscle	49.51	16.08	0.74	0.022	0.05	0.03	0.267	0.81	0.027
				Kidney	30.7	7.70	1.09	0.016	0.38	0.155	0.054	0.45	0.789
				Liver	496	24.61	9.36	0.035	0.11	0.125	0.107	2.77	0.081
				Blubber	12.49	1.74	0.73	0.087	0.54	0.012	0.344	0.12	0.081
10	15.07.16	♂	9.5	Muscle	66.43	22.34	0.63	0.043	0.51	0.005	0.143	0.14	0.14
				Kidney	14.02	4.40	0.21	0.052	0.18	0.066	0.011	0.15	0.247
				Liver	706.12	24.05	10.0	0.071	0.15	0.072	0.052	1.06	0.467
				Blubber	9.38	1.55	0.25	0.051	0.25	0.003	0.03	0.07	0.06
11	04.06.16	♂	9.0	Muscle	27.8	8.51	0.34	0.039	0.03	0.004	0.037	0.10	0.051
				Kidney	37.62	13.80	1.38	0.037	0.56	0.104	0.068	0.51	1.141
				Blubber	2.37	0.96	0.16	0.020	0.04	0.004	0.064	0.11	0.04
12	20.06.16	♂	8.8	Muscle	69.29	28.73	0.37	0.035	0.06	0.003	0.03	0.23	0.083
				Kidney	59.46	12.97	1.92	0.014	0.36	0.076	0.06	2.97	1.062
				Liver	288	19.65	2.41	0.017	0.10	0.033	0.028	2.54	0.05
				Blubber	15.04	1.73	0.28	0.053	0.05	0.003	0.042	0.19	0.095
13	08.06.16	♀	9.1	Muscle	59.84	21.50	0.72	0.010	0.06	0.004	0.251	0.25	0.029
				Kidney	39.53	8.84	0.36	0.007	1.31	0.041	0.040	15.23	0.122
				Liver	556	22.14	11.2	0.016	0.17	0.035	0.040	2.28	0.703
				Blubber	13.21	2.10	0.35	0.014	0.07	0.007	0.222	0.12	0.128