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INTERNATIONAL
WHALING COMMISSION

TOXICOLOGY RESEARCHES AND MONITORING OF GRAY WHALES OFF CHUKOTKA PENINSULA (RUSSIA), 2008-2021

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Samples from organs and tissues of Gray whales *Eschrichtius robustus* were necropsied after aboriginal whaling and landing by Chukotka Natives (Table) in 2008-2021, which were collected by Chukotka scientists.

Table – Heavy metals' concentration (mg/kg mass) and radioactivity (Bk/kg) of organs and tissue samples of Gray whales, landed in the Mechigmensky Bay (Western Bering Sea), 2008-2021

		2008[i]	2010[ii]	2015[i]	2016[i]	2017	2019[iii]	2020[iii]	2021[iii]	MPL[iv]
Hg	mean ± SD	0.006±0.006	0.063±0.080	0.030±0.014	0.034±0.022	0.027±0.041	0.188±0.038	0.051±0.010	0.017±0.007	0.5
	range	0.001-0.022	0.007-0.120	0.014-0.048	0.007-0.087	0.000-0.189	No data	0.029-0.060	0.005±0.030	
	N of samples	14	2	5	19	37	10	15	30	
As	mean ± SD	1.178±0.810	0.255±0.186	3.000±1.042	0.262±0.311	0.334±0.424	0.006±0.003	0.021±0.009	0.034±0.009	5.0
	range	0.170-2.760	0.020-0.600	1.800-4.000	0.030-1.310	0.010-1.860	No data	0.010-0.033	0.012±0.046	
	N of samples	14	13	5	19	37	10	15	30	
Cd	mean ± SD	0.055±0.088	0.287±0.232	0.054±0.098	0.041±0.046	0.053±0.075	0.031±0.012	0.029±0.005	0.063±0.012	0.2
	range	0.005-0.317	0.007-0.700	0.005-0.230	0.003-0.155	0.001-0.289	No data	0.017-0.036	0.034±0.083	
	N of samples	14	14	5	19	37	10	15	30	
Pb	mean ± SD	1.011±1.404	0.204±0.116	0.206±0.111	0.099±0.098	0.027±0.026	0.24±0.09	0.035±0.011	0.233±0.167	1.0
	range	0.070-4.200	0.053-0.450	0.100-0.390	0.011-0.344	0.000-0.160	No data	0.005-0.059	0.019±0.060	
	N of samples	14	14	5	19	37	1	15	30	
Radioactivity, Bk/kg mass										
Cs^{137}	mean ± SD						3.05	5.971±2.160		130.0
	range						No data	3.9-10.2		
	N of samples						1	7		
Sr^{90}	mean ± SD							4.586±1.366		100.0
	range							3.4-7.5		
	N of samples							7		

[i] Kovekovdova et al., 2017
[ii] Tsygankov, 2015
[iii] data of Rospotrebnadzor
[iv] Maximum permissible levels

Necropsy samples for heavy metals analysis included muscle, kidney, liver, blubber by 200-300 g (7.0-10.5 ounce) and blood 50-100 ml (1.7-3.4 fl.ounceUS). All samples were froze at -24ºC (-11.2F) and delivered to Laboratory of Applied Ecology of Vladivostok and to Veterinary Centers of Petropavlovsk-Kamchatsky and Anadyr (Russia), which have different measuring equipment. The preparation of tissue and organ samples for measuring was performed by acidic mineralization method using nitric acid following GOST 26929-94 [1].

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.

Concentrations of heavy metals and radioactivity levels did not exceed the MPL in the studied intestines samples of Gray whales in 2021.

Number of Gray whales in Mechigmensky bay was 14.3 per day in 2021, and a multiannual level firstly from 1999 showed a tiny elevation within 37 years period of coastal counts. Distribution of whales in the bay is changing annually from E to W and from coastal line (3-7 km) farther to the sea (9-12 km) and back.

In 2021 in the Severtsov Institute the serum-positivity to eight pathogens (*Toxoplasma gondii*, *Mycoplasma* sp., *Trichinella* sp., *Candida* sp., *Chlamydia* sp., Morbillivirus, Herpes and Parvovirus) was determined for serum in 33 gray whales, harvested in Chukotka at 2018-2021, all of which were serum-negative to Herpes virus. The highest (C=10%) positivity level they had to *Toxoplasma gondii*, which was firstly found in Gray whales. Also we firstly found *Trichinella* sp. (C=6%), *Candida* sp. and Morbillivirus (each by C=3%), *Chlamydia* sp. and *Mycoplasma* sp. (each by C=2%).

It is still unclear how negative could be the Toxoplasma infection for the gray whale and other marine mammals. Toxoplasma is an important cause of mortality in sea otters, leading to the development of encephalitis; also it causes the fatal development of toxoplasmosis in Pacific harbor seals. **Isolated cases of lethal toxoplasmosis in marine mammals are often associated with animal immunosuppression as a result of morbillivirus infections**. *T*. gondii infection can also kill marine mammals, affecting their behavior and increasing the risk of injury and death from predators and marine mammal hunters.

Apparently, the consumption of gray whale meat by Natives can pose a certain danger due to infection with trichinella and toxoplasma with insufficient heat treatment of whaling products.

Also this year in the Biology Institute of Karelian Research Centre, an analysis of fatty acids from 25 gray whales was carried out by gas-liquid chromatography. For the first time in Russia, data were obtained on the vertical stratification of fatty acids of common lipids from harvested Gray whales, and the specific features of the spectrum of fatty acids in different layers of fat were revealed. Sex and age-related differences in fatty acid profiles have been established, and differences between "stinky" and normal whales have been identified.

Stable nitrogen and carbon isotope analyzes were performed on 64 skin samples from 16 gray whales, harvested in Lorino/ Different sample storage methods were compared prior to analysis, and the effect of chemical lipid extraction on the results was assessed. The $\delta^{15}N$ content in Chukotka whales has been shown to be higher than the reported $\delta^{15}N$ content in whales from Sakhalin.

In parallel, Moscow State University scientists analyzed the isotopic composition of carbon and nitrogen in 46 skin samples of gray whales collected in different parts of Chukotka: 22 samples from the Senyavin Strait, 19 samples from Lorino, 2 samples from Sireniki, and 3 samples from Inchoun [5]. Also there were 7 whales that had a medical odor to varying degrees. One sample had a very strong odor, four had a moderate odor, and two had a faint, barely perceptible odor. Despite a significant variation in $\delta^{15}N$ values, the content of heavy nitrogen $\delta^{15}N$ was significantly lower in stinky whales than in common ones'. Moreover, the sample with the strongest medicinal odor had the lowest $\delta^{15}N$ content of all samples in general at 11.5‰. It is assumed that "stinky" whales fed on objects of a lower trophic level than ordinary ones. However, **it is possible that changes in the isotope composition may reflect pathological processes or disturbances in the nitrogen metabolism of whales**.

So the one of the reasons of stinky gray whale phenomena may consist in two parts:

1) "Isolated cases of lethal toxoplasmosis in marine mammals are often associated with animal immunosuppression as a result of morbillivirus infections".

2) changes in the isotopic composition may reflect pathological processes (possibly, infection with several pathogens at once [i.e. the gray whale female caught on August 16, 2019 was "stinky", inedible and was affected by MORBILLIVIRUS, chlamydia and candida] … or disturbances in the nitrogen metabolism of whales [5].

Nevertheless the absence of skinny Gray whales during coastal counts and harvest monitoring, their good body conditions and stabile prey content in whale stomachs, as well as other researches in period 2013-2021 indirectly indicate that the existing aboriginal Gray whales hunting has no negative impact to its population and feeding conditions in Chukotka waters, and thus can be implemented in the future in the same amount.

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