Short communication

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Participation of water deer (Hydropotes inermis argyropus) in mercury transport in the ecosystem of Southern Primorye

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ABSTRACT. We present the first opportunity to study mercury in the fur of a water deer that recently entered Russia.13 samples from 7 animals (fur was taken from the back and belly) were collected similarly to the World Health Organization recommendations for humans. The mean concentration of total mercury in the fur of water deer was 0.01 ± 0.003 mg/kg, which roughly coincides with the mercury in the fur of other herbivorous animals. For a more accurate assessment, it is necessary to obtain data for other deers in the study region.

Keywords: aquatic and terrestrial ecosystems, total mercury concentration, *Hydropotes inermis argyropus*

1. Introduction

Mercury problems are important in themselves (Minamata Convention ..., 2013), but research related to rare and dispersing species is particularly intriguing. The latter includes the water deer. The water deer was once widespread around the Yellow Sea, from the west coast of the Korean Peninsula to the lower reaches of the Yangtze River. By the mid-20th century, only two locations of the species survived: the Chinese water deer (*Hydropotes inermis inermis*) in southern China and the Korean water deer (*H. i. argyropus*) on the border of South and North Korea. The number of Korean subspecies has increased many times in recent decades due to its high fertility, and the population exceeds half a million individuals (Kim et al., 2011; Eom et al., 2018). Annual population growth can be more than 50% (Eom et al., 2018). Since 2015, this deer has been recorded on the territory of the Land of the Leopard National Park (Darman et al., 2019), and in 2019 it was recognized as a new, 327th, mammal species in the fauna of Russia (Darman et al., 2019). Increasingly frequent encounters with water deer and the remains of dead animals, victims of predators, indicate that this deer can become a common food for the Far Eastern leopard (Darman and Sedash, 2020).

The water deer or marsh musk deer, as it is called by Russian border guards (Darman et al., 2019) lives in grassy thickets along the banks of rivers and lakes and in swamps. Its food objects are mainly grass, as well as leaves, mushrooms and young shoots. It was important to assess the mercury levels in the samples of water deer fur collected at the protected area "Land of the Leopard" to understand its significance for the specially protected wild cats of the Southern Primorye.

2. Materials and methods

The material for the study was collected by the staff of the protected areas on the territory of the national park "Land of the Leopard" (Fig. 1). The fur of water deer was collected from animals found dead due to natural causes or as a result of poaching from 2010 to 2021.

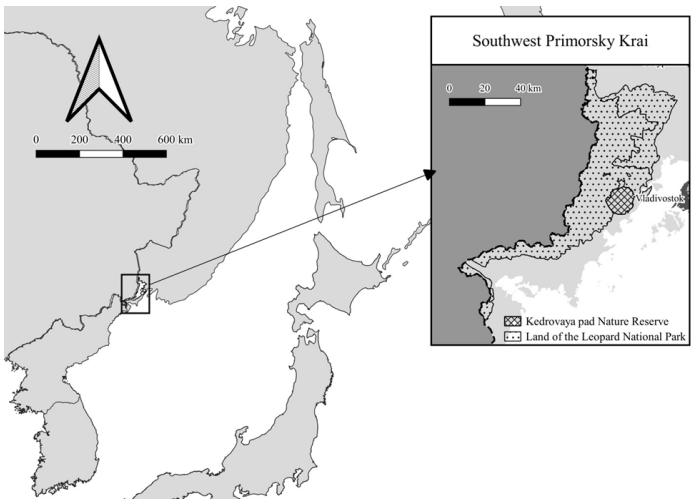

Fig.1. Map of the research area.

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The material included 13 samples from 7 animals (fur was taken from the back and belly). The samples were collected similarly to the World Health Organization recommendations for humans. They were dried and stored in self-sealing plastic bags. For one month, they were kept in the freezer (to destroy possibly trapped eggs of skin worms or moths). Thereafter, for several months, the wool samples were stored at room temperature in sealed plastic boxes. The material was processed in the ecological and analytical laboratory of Cherepovets State University. Fur analysis was performed on a RA-915M+ mercury analyzer with the PYRO-915+ attachment by the atomic adsorption method of cold vapor. To verify the accuracy of the device, mercury concentrations were determined in reference samples (DORM-4, DOT-5) with a known mercury concentration (mg/kg).

3. Results and discussion

The distribution of values in the sample was checked for normality using the Shapiro–Wilk test and the Kolmogorov–Smirnov test. Due to the lack of normality in the distribution of values, nonparametric statistical methods were used. The Mann–Whitney U–test was used to compare two independent samples.

The study revealed that the mean total mercury concentration in a water deer the fur was 0.008 ± 0.003 mg/kg, from 0.001 mg/kg to 0.026 mg/kg (Table).

The Mann—Whitney U–test used to evaluate the differences between two independent samples (Fig. 2) turned out to be $p = 0.26$, which indicates that there were no significant differences between the samples. Possibly, this was due to a small sample size. The mean mercury content, median and quartiles in the fur of a water deer from the back and belly are shown in Fig. 2.

The data on the mercury concentration in the fur of water deer corresponded to the mercury level in other herbivorous mammals. Thus, THg in beaver fur was 0.06 mg/kg, elk – 0.009 mg/kg (Ivanova et al., 2014), muskrats, hares and artiodactyls fur – about 0.2 mg/kg (Ivanova et al., 2014; Scheuhammer et al., 2007), and THg in red vole fur varied from 0.001 to 0.147 mg/kg (Ivanova et al., 2014).

4. Conclusions

Thus, the mean concentration of total mercury in the fur of water deer was 0.01 ± 0.003 mg/kg, which roughly coincides with the mercury levels in the fur of other herbivorous animals. For a more accurate assessment, it is necessary to obtain data for other deer in the study region.

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Conflict of interest

The authors declare no conflict of interest.

Table. Statistical characteristics of the sample.

Mean	Median	Min	Max	First Quartile	Third Quartile	SD	Standard Error
0.01	0.008	0.001	0.026	0.003	0.015	0.007	0.003

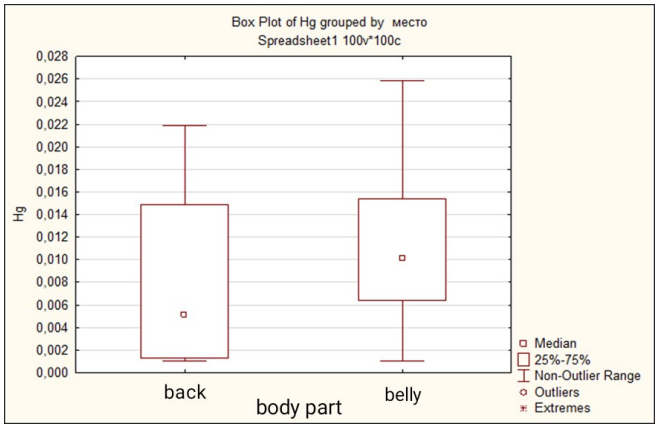

Fig.2. Mercury concentrations of water deer depending on body part.

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