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Radioecological Phenomena of the Kojanovskoe Lake

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Abstract. During post Chernobyl radiation monitoring of water ecosystems made by the Complex Radioecological Expedition of the Russian Academy of Sciences in 1992, a lake with abnormal high ^{137}Cs contents in fish muscles was discovered in the Bryansk area. The concentration of ^{137}Cs in fish muscles from this lake is about a hundred times higher than in fish from other lakes in this area and even higher than in fish from the Cooling Pond of the Chernobyl NPP. This lake is called Kojanovskoe. It was suggested to investigate this phenomenon in the frame of the ECP 3 project. During 1993-1995 the ichthyofauna of the lake, the fish feeding specificity and the ^{137}Cs contents in fish muscles in comparison with fish from other water bodies was investigated. Some suggestions about reasons for the phenomenon are made. An idea to organize an international radioecological reserve on the lake Kojanovskoe is put forward.

1. Introduction

After the Chernobyl accident in April 1986 a large-scale contamination of aquatic system located in CIS countries took place [1,2,3]. Because of active using of rivers, lakes and reservoirs for fishing in CIS, radioecological investigations of the contaminated areas are of great practical and scientific interest. From 1986 the Complex Radioecological Expedition started studying the consequences of the accident. From 1993 on the work is continued in the frame of the ECP 3 project. Fish from Cooling Pond of the Chernobyl NPP, river Pripyat and the northern part of Kiev reservoir was studied. In 1992 ten fish farms in the Bryansk area in Russia also were investigated. The results achieved during 1993-1994 on the catchment areas of different water bodies indicated Kojanovskoe lake as the most highly contaminated.

The Kojanovskoe lake is situated at 400 km northwest from Chernobyl. A swampy landscape surrounds it. There is a thick layer of sediments on the bottom. The surface area of the lake is about 6 km^2, the average depth is about 1,5 m, the out-flowing stream is about 0,25 m^3/sec. Vegetation is abundant in the lake. The deposition measured in 1993 is about 100 kBq/m^2, the concentration of K^+ in dependence of seasons is 1,6-2,7 mg/l, concentration of ^{137}Cs in water 1,2-1,9 Bq/l. It was estimated that there is 3,7 x 10^9 kBq of ^{137}Cs in this lake.

For the radioecological investigations all fish was collected with gill nets (stretch mesh 0.16 - 12 cm) and separated in species. More than 300 samples were taken. Each sample consisted of whole fishes and muscle tissue.

Eight species of fish were found in the lake. Among them the main marketable fish species are: golden cart *(Carassius auratus gibelio)*, pike *(Esox lucius)*, perch *(Perca fluviatilis)*, ruff *(Gynocephalus acerinus)* and roach *(Rutilus rutilus)*.

2. ^{137}Cs concentration in fish muscles

During the investigation at 10 fish farms in the Bryansk area in 1992, in samples from 9 of them, the ^{137}Cs concentration in fish muscles was not beyond 100 Bq/kg ww. Only in one farm it was 300 Bq/kg ww. During the radioecological monitoring in the Disna river no specimens with a concentration above 60 Bq/kg ww has been measured. In the Iput river six places were investigated in 1992. Only in one of them one specimen of pike was discovered with a ^{137}Cs concentration of 800 Bq/kg ww.

To compare these data with those in the Cooling Pond of the Chernobyl NPP in 1987, the concentration reached 200 kBq/kg ww among predatory fishes [4]. Till 1990 through it did not exceed 10 kBq/kg ww. At the same time in the Kiev reservoir the average ^{137}Cs concentrations were: 1,6 kBq/kg ww in pike, 1,9 kBq/kg ww in perch. In 1992 the ^{137}Cs concentration decreased approximately 3 times. It became 0,6 kBq/kg ww in pike and 1 kBq/kg ww in perch.

Meanwhile it turned out that the ^{137}Cs contents in fish muscles of some specimens from the Kojanovskoe lake was about a hundred times higher than in fish from other water bodies. On the whole ^{137}Cs contents varied in different species. The highest ^{137}Cs concentration of 30 kBq/kg was noticed among predatory species (pike, perch) while the lowest was in roach and ruffe (5-8 kBq/kg ww). Golden carp was in an intermediate position (14 kBq/kg ww). Figure 1 shows the average of the ^{137}Cs concentration in different fish species from Kojanovskoe lake (1994).

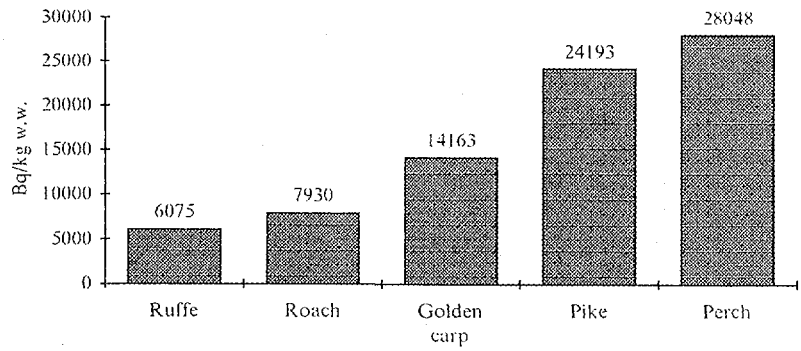

Fig.1

Figure 2 gives a picture comparing the ^{137}Cs concentration in fish muscles from Kojanovskoe lake river Iput and Kiev reservoir.

It is noteworthy that for the three years of investigations the ^{137}Cs concentration among the fish species belonging to different trophic levels has not reduced to a great extent. In the meantime the ^{137}Cs concentration in similar fish species from other water bodies, for instance from the river Iput (Bryansk region) has decreased about twice and from the Kiev reservoir 3-4 times.

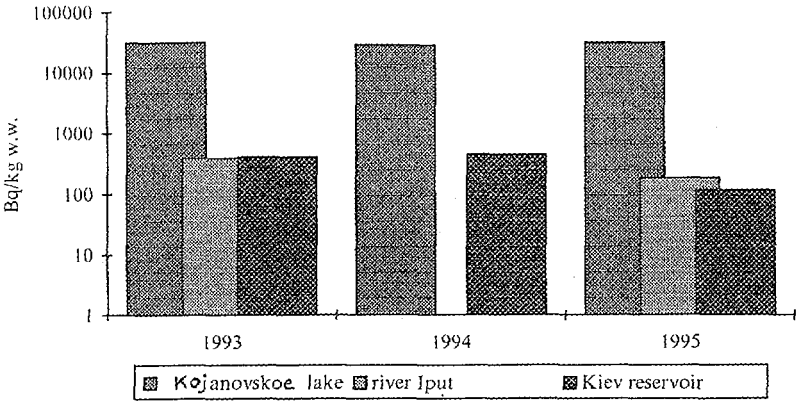

Fig.2

3. Specificity of the fish feeding

During a comparison of food contents in some specimen of the same species taken from different water bodies some peculiarities are found. Thus in spike from Kojanovskoe lake the number of food items was less than in spike from the Kiev reservoir. Besides the latter used much more golden carp in their diet. It is worth to pay a special attention to this fact as in this species the ^{137}Cs contamination is usually higher than in other cyprinid fishes.

Figures 3 and 4 present some results concerning pike feeding from Kojanovskoe lake.

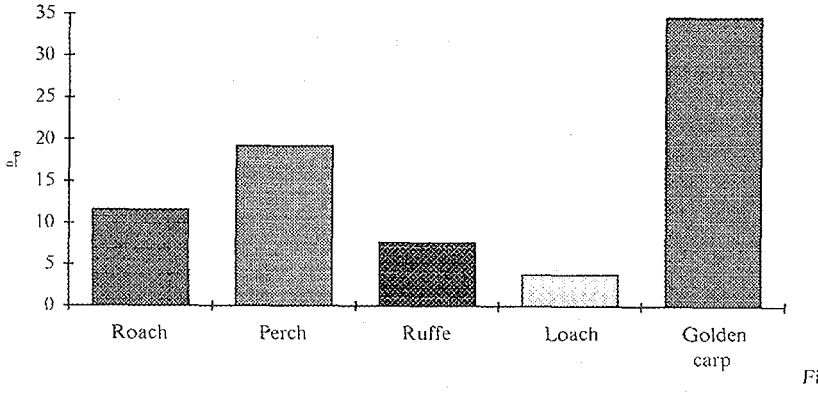

Fig.3

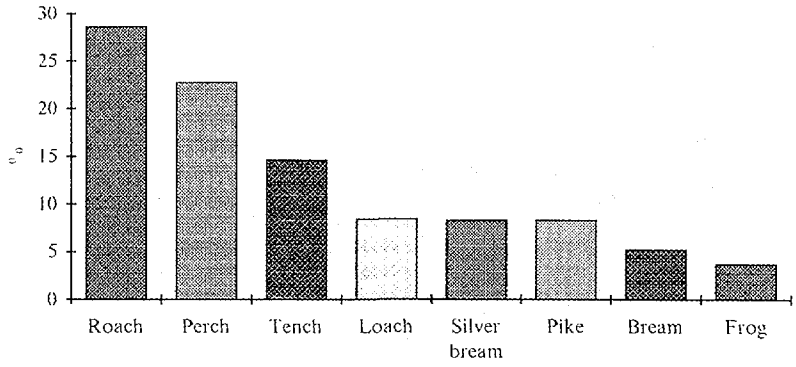

Fig.4

4. Conclusions

The results of the investigations indicated that during 1993-1995 the ^{137}Cs concentration in fish muscles from the Kojanovskoe lake practically has not decreased while the concentration in fish from Kiev reservoir has decreased in 4 times. In pike in average 113 Bq/kg in 1995 while 429 Bq/kg in 1993. In the Iput river the concentration decreased twice since 1995. In 1995 it was only 184 Bq/kg ww. In all water reservoirs except the Kojanovskoe lake the ^{137}Cs concentration was lower than permissible limits (600 Bq/kg ww). It may be supposed that because of specific local conditions of some reservoirs like the Kojanovskoe lake the ^{137}Cs concentration in hydrobionts is supported at high level during long time.

It may be suggested that the following factors serve as a reason of the relatively high contamination level of the Kojanovskoe lake: the high level of the contamination of food items and the water in the lake; the low turnover-time of the water in the lake; the low content of K^+ in water. For predator fish (pike, perch) and increased percentage of bentos fishes in their diet in comparison with other species may serve as an additional factor. Considering that the natural clearing rate of the lake is slow it may persist several decades. No doubt that it is necessary to take measures for banning fishing and other economic uses of the Kojanovskoe lake. At the same time it is reasonable to organize an international radioecological reserve in this place.

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