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Distribution of mercury in the Chernaya River (Khabarovsk, territory of Outer Manchuria) as a function of catchment land use and hydrochemical conditions

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Abstract

The concentrations of major hydrochemical parameters, as well as mercury in water and bottom sediments of small watercourses, were determined under the hydrogeochemical conditions of the Khabarovsk urban agglomeration (using the Chernaya River as an example) in the territory of Outer Manchuria. It was established that the content of dissolved mercury species in water did not exceed the maximum permissible concentration, remaining below 10 ng/L. The influence of environmental factors on the processes of mercury accumulation and remobilization in bottom sediments was examined. A relationship was demonstrated between anthropogenic pressure on the catchment area and mercury content. Ecological risk was assessed at different reaches of the watercourse. Mean mercury concentrations in bottom sediments at sites of “considerable” risk ranged from 102 to 137 µg/kg, while in the least contaminated sites they did not exceed 40 µg/kg. The relative stability of mercury concentrations in bottom sediments was observed, which persisted both in the warm and cold seasons and was independent of variations in hydrochemical parameters within the observed ranges.

Keywords: Mercury, Outer Manchuria; Small rivers, Chernaya River, Catchment land use

1. INTRODUCTION

In environmental quality assessments of urban environments, increasing attention is being paid to the study of small rivers in urbanized areas. This is quite justified, as surface runoff introduces all mobile and thus most reactive forms of pollutants into these watercourses. In evaluating anthropogenic impacts, it is necessary to investigate not only water composition but also bottom sediments. The latter, as the final link in the migration pathway of chemical substances, integrate the geochemical characteristics of drainage basins, technogenic discharges, and the water bodies themselves over extended time intervals. More than 90% of pollutants entering water bodies are accumulated here (Filgueiras et al., 2004). Their condition significantly affects aquatic biota and facilitates the entry of a range of substances, including highly toxic

ones, into food chains. As a complex multicomponent system, bottom sediments may, depending on the conditions prevailing in a water body, serve either as a source of chemical compounds to the water column or as a filter- their accumulator.

Monitoring studies of water and sediment quality make it possible to identify areas with the most intense anthropogenic pressure, track its changes, and the chemical composition of pollutants indicates their probable sources. The study of local hydrogeochemical conditions of water bodies enables the calculation of allowable anthropogenic load boundaries for a specific watercourse, considering its self-purification capacity, as well as the likelihood of secondary water pollution.

Mercury, as a global pollutant, is of growing concern worldwide due to its high toxicity and bioaccumulation in ecosystems (Yang et al., 2019; Wei et al., 2022; Meng et al., 2023; Kondo et al., 2025). Mercury occurs in nature predominantly in a dispersed state. Hg enters the environment from both natural sources (weathering of rocks, volcanic activity, emissions from the land surface, emissions from ocean depths, etc.) and anthropogenic ones. Currently, the greatest contribution to anthropogenic mercury pollution comes from gold mining, coal and municipal solid waste combustion, cement production, metal smelting, and others. The media of contamination are the atmosphere, hydrosphere, and soils. The leading supplier countries of mercury are China, Indonesia, and India, whose contribution is determined not only by current emissions but also by secondary emissions from previously contaminated areas (Gworek et al., 2020; Lyman et al., 2020; Qi et al., 2019). The Hg content in surface freshwaters is generally low, although it can vary over a rather wide range. The Clarke value in river waters is 70 ng/L (Drever, 2005).

The low concentrations of dissolved mercury in freshwaters are due to its rapid sorption by clays, Fe and Mn hydroxides, as well as its binding to organic matter, forming strong complexes with humic acids (Wang et al., 2025; Vernon et al., 2014). This, together with Hg sorption onto suspended particles followed by their sedimentation, leads to the concentration of the metal in bottom sediments (Moore et al., 1984).

In its compounds, mercury exhibits oxidation states of +2 and, less frequently, +1. Hg^{2+} ions form a large number of complex compounds with coordination numbers 2, 3, 4, 5, 6, and 8, the bonds of which are covalent and highly stable. Most ligands in natural waters containing halogen, N, P, S, and C atoms form stable complexes with mercury. The high ionization potential allows mercury to be reduced to the elemental form Hg^0 under sediment conditions and to be readily involved in methylation processes (Ali et al., 2026).

The object of this study is to investigate the accumulation and release of mercury in bottom sediments of small watercourses under the hydrogeochemical conditions of the Khabarovsk urban agglomeration, using the Chernaya River as an example.

2. MATERIALS AND METHODS

The Chernaya River, flowing through the territory of Khabarovsk and its surroundings (beyond the eastern outskirts of the city), was selected as the object of study (Figure 1). The total channel length is 48 km, and the catchment area is 255 km². The drained territories include multi-story and low-rise residential areas, agricultural lands, industrial zones, and transport interchanges (Table 1).

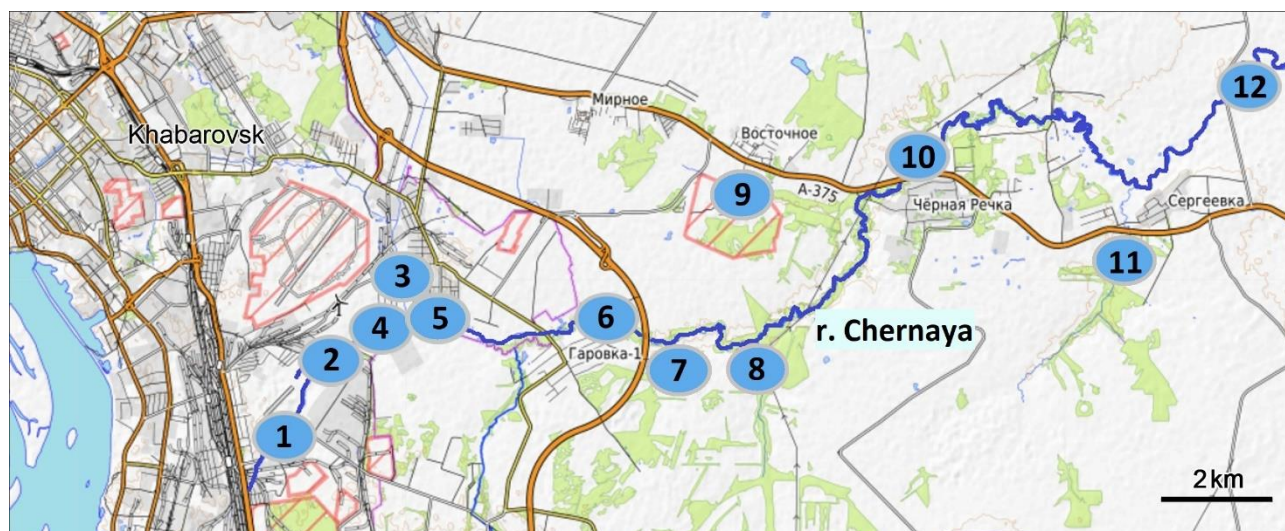


Fig. 1: Location map of sampling points from the main channel of the Chernaya River in Khabarovsk and its vicinity (Kaminsky et al., 2025a)

Table 1: Distribution of land categories in the Chernaya River basin

Land category	Area, km ²	% of total basin area
Residential lands		
Multi-story built-up area	4.253241	1.7
Low-rise built-up area	13.839358	5.4
Industrial lands		
Industrial-storage	14.676685	5.8
Industrial-utilization	0.082457	0.03
Linear-nodal, transport	2.352132	0.9
Agricultural lands		
Arable land	104.601407	41.01
Garden plots	18.911072	7.4
Conditionally natural lands		
Open areas (wastelands with ruderal vegetation)	22.18604	8.7

Secondary small-leaved forests	25.939921	10.2
Floodplain of the Chernaya River	27.13357	10.6
Wetlands	21.083308	8.3
Total:	255.058963	100

The Chernaya River basin is located within the Middle Amur Lowland on the right bank of the Amur River. The main part of the studied catchment is confined to a lacustrine-alluvial plain of Middle Pleistocene age (Q_2), composed predominantly of dense clays with an admixture of silt, underlain by fine- and medium-grained sands. The total thickness of the lacustrine-alluvial deposits exceeds 30 m. Within the Chernaya River valley, a wide (about 200 m) swampy floodplain is distinguished, composed of Holocene sandy-clayey deposits, on which silty-sod-gley and silty-peat-gley soils have formed. The riverbed is filled with clayey-silty alluvium. The Chernaya River basin has undergone significant anthropogenic transformation associated with land leveling for construction purposes and the creation of embankments and dumps, including within floodplains, which results in the gradual enrichment of bottom sediments with technogenic clastic material.

The river is fed by groundwater, tributary waters, surface runoff, as well as direct discharges of treated wastewater and emergency releases of untreated wastewater into both the river channel and its tributaries. Consequently, part of the channel remains open year-round. The Chernaya River is the largest tributary of the Sita River, which flows into Lake Petropavlovskoye, connected to the Amur River via the Malyshevskaya channel.

Water and bottom sediment sampling was carried out at 7 points located along the river channel from the 5th to the 39th km, as well as from 5 tributaries near their confluence with the main channel. The coordinates of sampling sites and the characteristics of the catchment area are given in Table 2.

Sampling was carried out at all 12 sites during the main phases of the hydrological regime: spring snowmelt flood (March--early April), summer low-water period (May--July), summer flash flood (August--September), and autumn low-water period (October--November). Thus, four sampling campaigns were conducted per year at each site. Water samples for mercury analysis were collected simultaneously with sediment sampling.

Table 2: Characteristics of sampling sites

No	watercourse name	Geographic coordinates	Location of sampling site	Description of catchment area and anthropogenic pollution sources
1.	Chernaya River	48.427837, 135.139195	5 km from the river source, at the point where the river enters the urban	Meadows, broad-leaved forest patches, low-rise built-up area, railway junction.

development zone			
2. Chernaya River	48.444067, 135.154101	2.2 km downstream of point No. 1	Low-rise built-up area, arable land, industrial-storage areas.
3. Gnilaya Pad River (left tributary)	48.456960, 135.175523	0.6 km above the mouth of the Gnilaya Pad River	Low- and multi-story built-up area, industrial-storage areas, arable land, wastelands, and forest areas.
4. Chernaya River	48.451475, 135.176404	0.02 km downstream of the mouth of the Gnilaya Pad River	The site is affected by wastewater from a sewage pumping station discharged into the Gnilaya Pad River 100 m above its mouth, as well as wastewater from a poultry farm entering the main channel of the Chernaya River 800 m upstream of the sampling point.
5. Chernaya River	48.450723, 135.180436	0.3 km downstream of point No. 4	Low-rise built-up area, arable land, meadows.
6. Chernaya River	48.447688, 135.214595	2.6 km downstream of point No. 5	Arable land, meadows, low-rise built-up area, small forest patches.
7. Pervy Creek (right tributary)	48.444103, 135.243182	0.5 km above the creek mouth	Arable land, meadows, small forest patches.
8. Fedorov Creek (right tributary)	48.444246, 135.269623	0.4 km above the creek mouth	Arable land, meadows, low-rise built-up area, small forest patches.
9. Creek at Vostochnoye village (left tributary)	48.474791, 135.264955	2.5 km above the creek mouth	Low- and multi-story built-up area, arable land, forests, wetlands.
10. Chernaya River	48.473101, 135.297033	9 km downstream of point No. 6 and 0.1 km below the confluence of the Vostochnoye creek	Low-rise built-up area, arable land, meadows, wetland areas.
11. Gryaznaya River (right tributary)	48.466884, 135.368968	1 km above the river mouth	Arable land, meadows, wetland areas, low-rise built-up area.
12. Chernaya River	48.490070, 135.394574	12.5 km downstream of point No. 10 and 3.5 km below the	Wetland areas, fields, forest areas, low- rise built-up area.

confluence of the Gryaznaya

River tributary

Seasonal monitoring was conducted during the open-channel period of 2022–2025. Water sampling was performed from the subsurface layer in accordance with GOST R 59024-2020. As microbiological indicators of the presence of various organic substances, the abundance of ecological-physiological groups of bacteria cultivated on various substrates was used. Culturable heterotrophic bacteria (CHB) were determined on fish-peptone agar diluted 10-fold; ammonifying bacteria (AMB) on FPA; nitrifying bacteria (NB) on starch-ammonia agar; denitrifying bacteria (DNB) on Giltay's medium (Kuznetsov et al., 1989); sulfate-reducing bacteria (SRB) on Postgate's medium (Postgate et al., 1984). Microbial abundance was expressed in colony-forming units (CFU/mL), using the mean value with standard deviation for three replicates.

Sample preparation included filtration through MFAS-OS-2 membrane (where prescribed by measurement procedures). Certified reference materials were used for calibration curve construction. Bottom sediments were sampled from a depth of 0–5 cm according to GOST 17.1.5.01-80. Sample preparation included air-drying at room temperature, grinding in a porcelain mortar, and sieving through a 1-mm mesh sieve. Total mercury content in bottom sediments was determined (M 03-09-2013). Accuracy control was performed using certified reference soil samples GSO 2498-2500-83 (SDPS set). All studies were conducted at the Shared-Use Center of the Institute of Water and Ecological Problems, FEB RAS, using laboratory equipment: a SevenMulti S47-K combined meter, a UV mini-1240 spectrophotometer, and a RA-915+ mercury analyzer.

For water samples, dissolved mercury species were determined according to PND F 14.1:2:4.271-2012. The measurement range for mass concentration of mercury is 0.010 to 2000 µg/L. The limit of quantification (LOQ) for water samples was 10 ng/L. All dissolved Hg concentrations below this LOQ were treated as censored data and were not used for calculating means, seasonal comparisons, or statistical correlations with hydrochemical parameters.

For bottom sediments, total mercury content was determined according to M 03-09-2013. The measurement range for the mass fraction of mercury is 0.005 - 250 mg/kg. The relative expanded uncertainty is 45% for the range 0.005 -- 0.1 mg/kg and 27% for higher concentrations. Samples were air-dried at room temperature, ground in a porcelain mortar, and sieved through a 1-mm mesh sieve prior to analysis.

Currently, the requirements for water quality and safety for various uses are elaborated in detail and reflected in regulatory legal acts. The maximum permissible concentration (MPC) values established therein will be used in this work to assess water quality. At the same time, a comparable legal framework for bottom sediments is completely lacking. For their assessment, comparison with background values is commonly used. However, in most regions, background levels of chemical substances in bottom sediments have not been studied, and regional standards have not been developed. In this regard, researchers themselves select sites whose hydrochemical conditions are taken as background; such a choice is not always sufficiently justified. All this complicates the assessment of the ecological state of territories. In this work, when assessing mercury content in bottom sediments, we rely on the previously established pattern

(Khomchenko, 2022) that in bottom sediments of watercourses not experiencing direct anthropogenic pressure, total mercury content does not exceed that in uncontaminated surrounding soils. The average mercury content in soils of the water protection zone of the Chernaya River is 42 µg/kg (range 23–76 µg/kg) (Koshelkov et al., 2018). This generally corresponds to the Clarke value of 50 µg/kg, which was used as the background value. The selection of a local reference sediment site is extremely challenging in the studied area due to the absence of a watercourse of comparable length, flow regime, and catchment characteristics that is entirely free from anthropogenic pressure. Therefore, the use of a regional background derived from local soils and Clarke values is considered a justified and practical alternative. The degree of bottom sediment contamination was assessed using the contamination factor ($C_f < 1$ – low contamination; $1 < C_f < 3$ – moderate contamination; $3 < C_f < 6$ – considerable contamination; $C_f > 6$ – very high contamination), the potential ecological risk factor ($E_r \leq 40$ – low risk; $40 < E_r \leq 80$ – moderate risk; $80 < E_r \leq 160$ – considerable risk; $160 < E_r \leq 320$ – high risk; $E_r > 320$ – very high risk) (Hakanson, 1980; Guo et al., 2018), and the geoaccumulation index ($I_{geo} \leq 0$ – background; $0 < I_{geo} \leq 1$ – from uncontaminated to moderately contaminated; $1 < I_{geo} \leq 2$ – moderately contaminated; $2 < I_{geo} \leq 3$ – from moderately to strongly contaminated; $3 < I_{geo} \leq 4$ – strongly contaminated; $4 < I_{geo} \leq 5$ – from strongly to extremely contaminated; $I_{geo} > 5$ – extremely contaminated) (Birch et al., 2013).

3. RESULTS AND DISCUSSION

The hydrochemical conditions of the Chernaya River and its tributaries are characterized by elevated concentrations of nitrite and ammonium nitrogen, as well as phosphates and iron. Exceedances of the maximum permissible concentrations for fishery water bodies for these parameters were observed at almost all sampling sites, differing only in the degree of such exceedances. At many sites, a deficit of dissolved oxygen was observed, along with an excess of organic matter, assessed through permanganate oxidizability (Kaminsky et al., 2025b).

Analysis of the quantitative distributions of ammonium, nitrite, and nitrate nitrogen in water samples from the main tributaries allows them to be divided into two groups. The first group includes Fedorov Creek and the Gryaznaya River, which exhibit minimal values of total mineral nitrogen content (Figure 2). At the same time, in the water of Fedorov Creek, the ratio of these forms is characteristic of a stably functioning nitrogen cycle. The total mineral nitrogen content in the water of the Gryaznaya River is also low, but the dominant form of nitrogen is ammonium.

The second group includes the Gnilaya Pad River, Pervy Creek, and the creek flowing through Vostochnoye village. In these watercourses, the total mineral nitrogen content is 3–4 times higher compared to the first group, primarily due to an increase in ammonium forms, which leads to a more strained functioning of the nitrogen cycle.

From the overall picture of water hydrochemistry in the main channel, the first two sampling points stand out. Their nitrogen content, both total and in its forms, makes them similar to the first group of tributaries—relatively clean sites with a stably functioning nitrogen cycle. Although at point 2, the ammonium ion concentration noticeably increases.

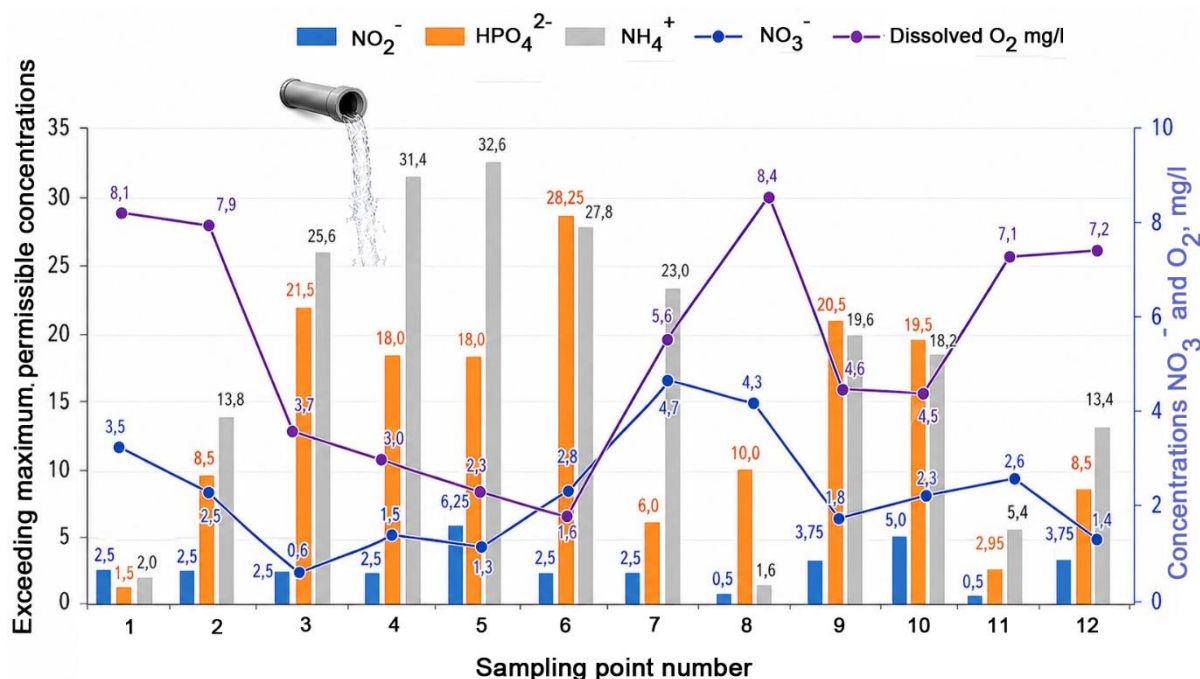


Fig. 2: Mean concentrations of NO_3^- , O_2 , and exceedances of maximum permissible concentrations for NO_2^- , HPO_4^{2-} , NH_4^+ at the studied sites

Somewhat above point №4, additional inflow of waters contaminated with unoxidized organic matter occurs, leading to biochemical transformation of nitrogen in the series: nitrates → nitrites → ammonium. The content of the latter increases so that the waters of the most contaminated tributary—the Gnilya Pad River—begin to exert a partially diluting effect. The main sources of pollution here are the sewage pumping station and the poultry farm treatment facilities. The influence of their discharges is most pronounced at points №4 and №5. Here, the permanganate oxidizability value also reaches its maximum, while oxygen content decreases significantly, resulting in an increase in the abundance of anaerobic denitrifying and sulfate-reducing bacteria.

Further downstream, no additional direct discharges into the river occur, and a gradual decrease in ammonium nitrogen begins due to self-purification processes and the diluting effect of tributaries, as well as an overall reduction in mineral nitrogen content. This allows the conclusion that the nitrogen cycle begins to stabilize. However, this process is hampered by the influence of surface runoff from the catchment area, both of the main channel and of some tributaries, where the proportion of agricultural land and wetland areas increases.

The content of total iron remains stably high in both the main channel waters and tributary waters, but this is a natural feature of the area and is not associated with anthropogenic pollution (Kulakov, 2017; Kaminsky et al., 2025c). Elevated phosphate ion concentrations are also noted at all sites, which are likely of anthropogenic origin, as some relationship is observed between the degree of anthropogenic pressure and their concentration.

The characteristics described above are annual averages. However, they are subject to some seasonal fluctuations. In the cold period, due to the absence of the diluting effect of surface runoff and tributaries, the influence of domestic discharges is more pronounced, manifested in a twofold increase in ammonium nitrogen concentration compared to the warm period, a significant decrease in nitrate and nitrite content,

and an increase in organic matter against a background of low dissolved oxygen content, which is most pronounced at points № 4–6 and continues to be observed downstream.

The concentration of dissolved mercury in the water of all studied sites generally did not exceed the limit of quantification of the method, i.e., was less than 10 ng/L, regardless of season. Rare exceptions occurred during periods when the water was particularly rich in suspended matter, with concentrations rising to 20–30 ng/L. Consequently, the subsequent assessment of the mercury background of the watercourse was based on mercury content in bottom sediments, where the total element content is significantly higher and the likelihood of result distortion is lower.

Mercury concentrations in bottom sediments at most points in the main channel are characterized by considerable temporal constancy, varying within relatively narrow limits across seasons. Significant differences in Hg content, both in the warm and cold periods, were noted only at the initial point (№1), where coefficients of variation (CV) were 0.46 and 0.56, respectively. In absolute values, mercury concentration here ranged from 26 to 66 µg/kg in the warm period and from 43 to 111 µg/kg in the cold period. It should be noted that at this point, the river is not ecologically clean and experiences anthropogenic impact in the form of direct discharges, although cleaner than those entering downstream. However, these waters are warm enough to keep the channel open almost year-round. Mercury content in bottom sediments in the cold period is almost entirely dependent on the quality of these waters. In the warm period, the values decrease due to the diluting effect of surface runoff.

Among the tributaries, significant fluctuations in Hg concentrations in bottom sediments in the warm period were noted in the Gnilaya Pad River (point № 3) (CHg 43–111 µg/kg, CV = 0.49). In the cold period, variability was low (CV = 0.13), and concentrations did not exceed 46 µg/kg. At other sampling sites, the values remained relatively stable year-round (Figure 3).

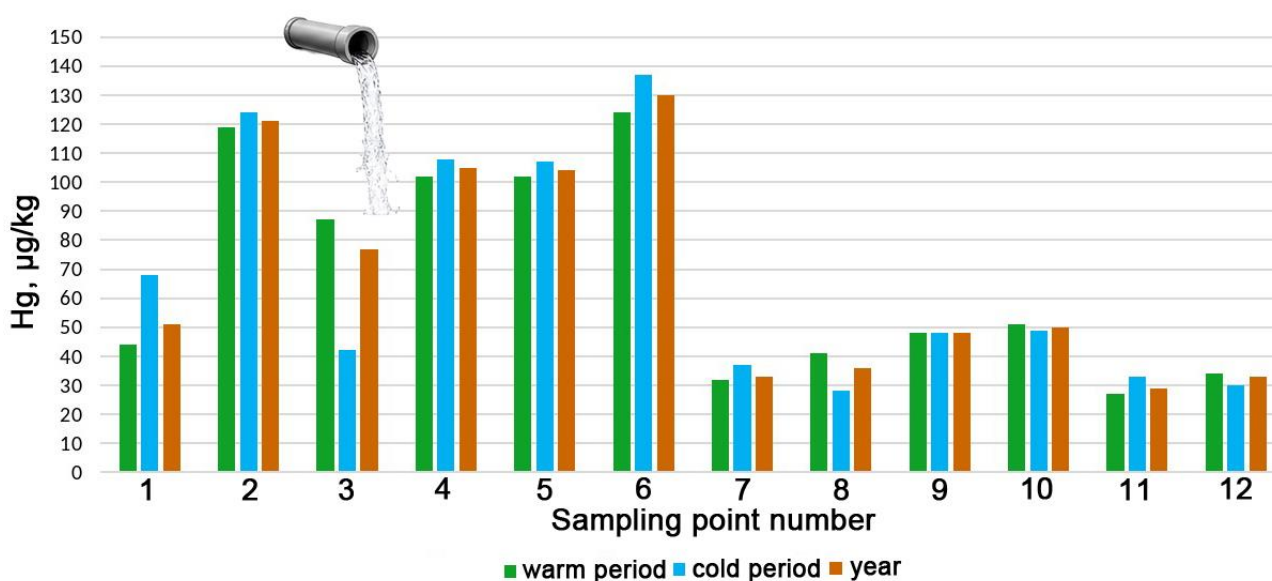


Fig. 3: Mean mercury contents in bottom sediments

All sites can be conditionally divided into uncontaminated, where CHg is generally below 50 µg/kg, and sites of varying degrees of contamination. Uncontaminated sites in the main channel include only point №12, where the influence of anthropogenic discharges is completely neutralized, and the tributaries- Pervy Creek (point №7), Fedorov Creek (№8), and the Gryznaya River (№ 11). The Chernaya River experiences

significant mercury loading in the section from point №2 to point № 6. Analysis of catchment land use indicates an insignificant influence of low-rise and multi-story residential development, garden plots, and arable land, since these features are also present in the catchments of sites with low mercury content in bottom sediments. The greatest contribution comes from direct discharges into the river, the influence of which is manifested at points 4–6.

Sampling point № 2, which can be classified as moderately contaminated based on hydrochemical parameters, is one of the most contaminated in terms of mercury content in bottom sediments. However, no wastewater is discharged here. Although no wastewater discharge occurs at point 2, the most plausible explanation for the elevated Hg levels is the atmospheric deposition from a nearby concrete product manufacturing enterprise (located 0.5 km northeast), as cement production is among the major anthropogenic sources of mercury (Kung et al., 2024). The main component in the production of reinforced concrete structures is cement. Cement production ranks fourth among industries with the highest anthropogenic mercury emissions, behind only gold mining, coal combustion, and waste incineration (Kung et al., 2024). The media of contamination is the atmosphere, where mercury enters mainly in gaseous form with flue gases, as well as in bound form with cement dust (Yanin, 2004). Possibly, in this case, mercury is supplied with cement dust carried during its transshipment or in the concrete manufacturing process, which settles on the adjacent territory and then enters the river channel with surface runoff.

An assessment of the degree of contamination of sites with the highest mercury content in bottom sediments (№2–6) was performed. Depending on the assessment methods used, site contamination is rated from "uncontaminated" to "moderately contaminated," and the potential ecological risk from "moderate" to "considerable" (Table 3).

Table 3: Assessment of contamination degree for selected sampling sites

Characteristic	Calculation formula	№ 2	№ 3	№ 4	№ 5	№ 6
Contamination factor	$C_f = C/C_0$, where C is measured concentration, C_0 is background (50 µg/kg)	2.4	1.5	2.1	2.1	2.6
Potential ecological risk factor	$E_r = T_r \times C_f$, where T_r is Hg toxicity coefficient (40), C_f is contamination factor	96	60	84	84	104
Geoaccumulation index	$I_{geo} = \log_2(C_n/1.5 \times B_n)$, where C_n is measured concentration, B_n is geochemical background level (lithogenic background)	0.69	0.03	0.49	0.49	0.77

The least contaminated site is point №3, followed by points № 4 and № 5, although it is in their immediate vicinity that wastewater is discharged. Next is point № 2, where the presumed mercury source is the reinforced concrete product plant. The most contaminated is point № 6. However, no direct mercury

sources were identified near it, and a decrease in element concentrations would be expected, as dispersion areas are relatively small. It was previously established that the capacity of bottom sediments in our watercourses with respect to mercury under natural conditions is, on average, utilized at 5% (Khomchenko, 2023). Furthermore, desorption of inorganic mercury is extremely low, with its ratio to adsorption over 24 hours being 1:10 for sands, 1:100 for clays, and practically absent for organic matter (Zhang et al., 2009). All this should have led to constant mercury accumulation in bottom sediments at wastewater discharge sites, which consist of technogenic silt with high organic matter content, with a gradual decrease in concentrations downstream. However, instead, we observe relative stability of concentrations at each point. This may result from the establishment of a stable dynamic equilibrium between mercury sorption by bottom sediments and its desorption through conversion into volatile (e.g., organomercury or elemental) forms, presumably through microbial activity. The list of microorganisms capable of mercury methylation is extensive: sulfate-reducing bacteria, iron-reducing bacteria, methanogens, syntrophs (Tang et al., 2020; Lin et al., 2021; Zhang et al., 2020). Among the aforementioned groups, particular attention is paid to sulfate-reducing bacteria as the most active mercury methylators in various habitats. These microorganisms possess specialized genes responsible for mercury methylation. In particular, the ability of representatives of the genera *Desulfovibrio* and *Desulfomicrobium* to methylate mercury at concentrations of 10 mg/L has been demonstrated (Bakour et al., 2025; Regnell et al., 2019).

Many ecological factors affect mercury methylation: oxidative (Lehnherr et al., 2011) and reductive conditions (Sonke et al., 2011); sulfate content (Yu et al., 2010); the presence of dissolved organic matter containing aromatic groups (Waples et al., 2005). It has been established that *Geobacter metallireducens* and *Geobacter sulfurreducens* are capable of producing MeHg when grown on a medium containing Fe(III). Later, it was shown that this process can occur without iron reduction—in the presence of fumarate or nitrate (Kerin, et al., 2007).

Studies of the mechanisms of microbial resistance to mercury contamination continue to attract great interest. Particular attention is paid to mercury methylation processes, its active and passive transport into cells, and its accumulation on their surfaces (Feng et al., 2018).

A moderate correlation ($r = 0.45$) was found between the abundance of sulfate-reducing bacteria in water and mercury content in bottom sediments. However, this association more likely reflects the presence of shared environmental drivers affecting both parameters rather than a direct causal link. Given that microorganisms can alter their mercury-related metabolic activity depending on environmental concentrations (Qin et al., 2023), the observed correlation warrants further investigation into the potential role of microbial communities in maintaining the relatively stable mercury concentrations in the bottom sediments of the studied watercourses.

4. CONCLUSIONS

When Hg concentrations increase due to anthropogenic discharge, the metal is rapidly sorbed by bottom sediments. A general association was observed between the element's concentration in bottom sediments and the degree of anthropogenic pressure in the catchment. Maximum concentrations in bottom sediments are observed at points № 2 and № 4–6. However, they do not exceed the target level of 300 µg/kg. The potential ecological risk factor (according to Hakanson) is characterized as moderate (point № 3) and

considerable (points №2, 4–6), with moderate contamination. Changes in hydrochemical parameters within the observed ranges showed no clear effect on mercury content in the waters and bottom sediments of the Chernaya River in our dataset. The relative stability of total Hg concentrations in bottom sediments in zones of technogenic loading suggests a possible steady-state condition, although the exact mechanisms responsible for this stability require further investigation.

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