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CONTENTS

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MONITORING THE LEVEL OF POLYCHLORATED BIPHENILES POLLUTION IN THE ILE RIVER FALLS

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Abstract: One of the important environmental issues under current conditions is the pollution of Kazakhstan's water bodies and watercourses by persistent organic substances, particularly the highly toxic polychlorinated biphenyls (PCBs) included in their list, which determines the relevance of this study. The aim of the work was to assess the PCB contamination level of the main tributaries of the Ili River based on long-term observations. The investigations were conducted in 2014, 2015, 2018, 2019, as well as in 2023 and 2024. Water sample analysis was carried out in accordance with STB ISO 6468-2003 (2004) using a "Khromos GC-1000" gas chromatograph with dedicated software. PCB contamination was identified in the waters of all studied watercourses, along with the presence of a large number of individual congeners, including strictly regulated "marker" and dioxin-like ones. The main sources of PCB contamination in the examined rivers were identified,

and their diverse origin was demonstrated, as evidenced by the wide variety of the toxicant's congener composition. Altogether, these findings suggest increased toxicity of the river water resources with respect to PCBs. Significant interannual variability in the level of contamination was revealed, as well as a noticeable decrease in 2023 and 2024 compared with the previous period.
The results of the study may be used by national and local environmental authorities in developing practical measures to protect rivers from contamination by these highly toxic pollutants, in accordance with the requirements of the Stockholm Convention on POPs.

Keywords: polychlorinated biphenyls, transboundary runoff, transformation, congeners

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ІЛЕ ӨЗЕНІ САЛАЛАРЫНЫҢ ПОЛИХЛОРЛАНҒАН БИФЕНИЛДЕРМЕН ЛАСТАНУ ДЕҢГЕЙІН МОНИТОРИНГІЛЕУ

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Аннотация: Қазіргі жағдайда Қазақстанның су айдындары мен ағын суларының тұрақты органикалық заттармен, әсіресе олардың тізіміне кіретін жоғары уытты полихлорланған бифенилдермен (ПХБ) ластануы маңызды экологиялық проблемалардың бірі бола отырып, осы зерттеудің өзектілігін айқындайды. Жұмыстың мақсаты – көпжылдық бақылаулар негізінде Іле өзенінің негізгі салаларының ПХБ-мен ластану деңгейін бағалау. Зерттеулер 2014, 2015, 2018, 2019, сондай-ақ 2023 және 2024 жылдары жүргізілді. Су сынамаларының талдауы СТБ ИСО 6468-2003, 2004 стандартына сәйкес арнайы бағдарламалық қамтамасыз етуі бар «Хромос ГХ-1000» газдық хроматографында орындалды. Барлық зерттелген су ағындарының суларында ПХБ-мен ластану және олардың ішінде қатаң бақыланатын «маркерлік» және диоксин тәрізділерін қоса алғанда, көптеген жеке конгенерлердің болуы анықталды. Зерттелген өзендердің ПХБ-мен ластануының негізгі көздері белгіленді және олардың әртүрлі шығу тегі көрсетілді, бұл уыттанудың конгенерлік құрамының кең ауқымымен де дәлелденеді. Мұның барлығы өзендердің су ресурстарының ПХБ тұрғысынан жоғары уыттылығын болжауға негіз береді. Өзен суларының ластану деңгейінің айтарлықтай жылдық өзгергіштігі және алдыңғы кезеңмен салыстырғанда 2023 және 2024 жылдары оның айтарлықтай төмендеуі анықталды. Зерттеу нәтижелері осы жоғары уытты ластағыштардан өзендерді қорғауға бағытталған практикалық шараларды әзірлеу кезінде мемлекеттік және жергілікті табиғат қорғау органдары тарапынан пайдаланылуы мүмкін және Стокгольм конвенциясының СОЗ бойынша талаптарына сәйкес келеді.

Түйін сөздер: полихлорланған бифенилдер, трансшекаралық ағын, трансформация, конгенерлер

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МОНИТОРИНГ УРОВНЯ ЗАГРЯЗНЕННОСТИ ПРИТОКОВ РЕКИ ИЛЕ ПОЛИХЛОРИРОВАННЫМИ БИФЕНИЛАМИ

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Аннотация. Одной из значимых экологических проблем современности является загрязнение водоемов и водотоков Казахстана стойкими органическими соединениями, прежде всего высокотоксичными полихлорированными бифенилами (ПХБ), что определяет актуальность данного исследования. Цель работы заключается в оценке уровня загрязненности ПХБ основных притоков р. Иле на основе многолетних наблюдений. Исследования проводились в 2014, 2015, 2018, 2019, а также в 2023 и 2024 гг. Анализ проб воды выполнялся в соответствии со стандартом СТБ ИСО 6468-2003 (2004) на газовом хроматографе «Хромос ГХ-1000» с использованием специализированного программного обеспечения. Установлено загрязнение воды всех изученных водотоков ПХБ и присутствие значительного количества индивидуальных конгенеров, в том числе строго контролируемых «маркерных» и диоксиноподобных форм. Определены основные источники загрязнения ПХБ исследуемых рек и показано их разнообразное происхождение, что подтверждается широким спектром конгенерного состава токсиканта. Эти результаты свидетельствуют о повышенной токсической нагрузке ПХБ на водные ресурсы региона. Выявлены большая межгодовая изменчивость уровня загрязненности речных вод и заметное снижение концентраций ПХБ в 2023–2024 гг. по сравнению с предыдущими годами. Полученные данные могут быть использованы государственными и местными природоохранными органами при разработке мероприятий по предотвращению загрязнения рек высокотоксичными поллютантами, что соответствует требованиям Стокгольмской конвенции о стойких органических загрязнителях (СОЗ).

Ключевые слова: полихлорированные бифенилы, трансграничный сток, трансформация, конгенеры

Introduction. The Ile River is the main transboundary artery feeding Lake Balkhash, carrying up to 70% of all river water entering the lake. It originates on the Muzart glaciers in Central Tanirtau (Kazakhstan) at the source of the Tekes River. Tekes. The total length of the river is 1439 km, within Kazakhstan - 815 km. The total area of the Ile River basin is 140,000 km^2 (approximately 75% of the catchment area of Lake Balkhash), of which 7,740 km^2 are in the territory of the Republic of Kazakhstan. The forming part of the basin is located in China,

where the hydrographic network is quite developed (from 0.6 to 3 km/km2). About 30% of the Ile River water resources are formed on the territory of Kazakhstan (Kaganat Publishing House, 2002). The Ile River in the left-bank part of the basin in the middle reaches is joined by a number of mountain rivers: Charyn, Shelek, Turgen, Issyk, Talgar, Kaskelen with tributaries Small and Big Almatinka, Kurty, forming the flow on the northern slope of the Zailiyskiy Alatau. The largest of these tributaries are the Shelek and Turgen rivers with a length of 245 km and a basin area of 4950 km^2 and 116 km, 625 km^2 respectively, and the Issyk River with a basin area of 256 km^2 and a total length of 121 km (Burlibayev et al, 2014). These watercourses flow through the cities of Almaty, Kaskelen, Talgar, Yesik and other settlements before flowing into the reservoir, which has a significant impact on the quality indicators of their water resources.

Among the priority pollutants of the environment, including water resources of Kazakhstan and the Ile River basin, requiring systematic analytical control, are persistent organic pollutants (POPs). Organochlorine pesticides (OCPs): (DDT, aldrin, hexachlorobenzene, HCH, etc.), polychlorinated biphenyls (PCBs), which are included in the list of persistent organic pollutants (POPs), are characterised by high toxicity to living organisms at extremely low concentration levels in natural objects. Xenobiotics are typical for high persistence to physical, chemical and biological factors, global distribution by air, water and migratory species, high cumulative capacity in living organisms, active migration along trophic chains.

POPs are recognised by the international community as substances that pose a high risk to human health and the environment. In order to take measures to protect human and natural environment, a global international agreement, the Stockholm Convention on POPs, was accepted in 2001 (Stockholm, 2001). It entered into force in 2004, Kazakhstan ratified it in 2007. The Convention sets the following goals: immediate cessation of POPs production, cessation of their use by 2025 and destruction of all wastes by 2028 at the latest by environmentally safe methods. The problem related to POPs is quite acute for Kazakhstan as well.

Polychlorinated biphenyls (PCBs) are one of the most toxic and globally widespread POPs. At present, on the territory of the Republic of Kazakhstan (RK) a large amount of PCB-containing equipment and eight ‘hot spots’ of PCB-contaminated territories have been identified (Ishankulov, 2008; Berkinbaev et al, 2009). The most powerful among them is the territory of the northern and western shore of Lake Balkash, which is close to the Ile River basin.

In water bodies of Kazakhstan, there is practically no purposeful monitoring for the purpose of realisation of national tasks under the Stockholm Convention on POPs. Observation of these xenobiotics is not conducted by the Kazhydromet and other bodies of the Republic of Kazakhstan. However, studies conducted by us in the last decades have shown a significant level of contamination of water resources of a number of large transboundary basins of Kazakhstan (Amirgaliyev et al, 2023; Amirgaliyev et al, 2022) and atmospheric precipitation of the vast territory of the Republic (Amirgaliyev et al, 2022) with these hazardous pollutants.

This report considers the results of our research of PCB pollution level in the main tributaries of the Ile River, water resources of which are widely used for household needs of the population of a few cities and large settlements of the south-eastern region of the republic. Runoffs of these watercourses have an important role in formation of quality input of Kapshagay reservoir, Ile River and in its transformation along the river flow.

Material and methods. Water samples from the rivers under consideration for polychlorinated biphenyls analysis were collected during comprehensive ecotoxicological studies conducted in 2014 and 2015, 2018 and 2019, and 2023 and 2024. The water sampling points at the watercourses are shown in Figure 1.

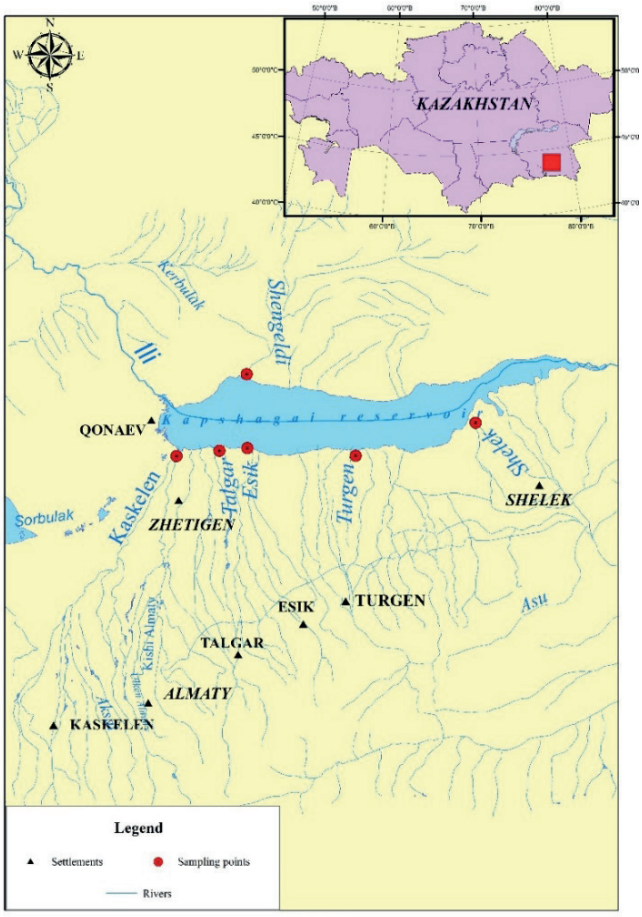

Figure 1 – Water sampling points on the Ile River tributaries

PCBs in water were analysed in accordance with (STB ISO 6468-2003, 2004) on a gas chromatograph (Chowdhury et al, 2022) 'Chromos GC-1000' with software, electron-capture detector (ECD) and using a capillary column 30 m × 0.32 mm long.

Chromatography conditions: column temperature 220 °C, evaporator temperature 240 °C, detector temperature 300 °C, carrier gas flow rate (nitrogen 'Osch') - 38 ml/min. As a standard we used State standard samples (SSS) composition of Sovol solution in hexane, which is a mixture of PCB-52, PCB-101, PCB-138, PCB-153 and the sum of tetra-, penta- and hexachlorobiphenyls.

The essence of the method consists in extraction of PCBs from the sample of analysed water with an organic solvent (n-Hexane), concentration and purification of the extract from associated compounds, analysis of the extract by gas chromatography using an electron capture detector (ECD), with subsequent determination of mass concentrations of individual PCB congeners using the absolute graduation method.

Determination of PCBs in the selected samples was carried out in the testing laboratory 'Nutritest' LLP of the Kazakh Academy of Nutrition Accreditation Certificate Nº KZ.T.02. E0177 from 06.05 2021.

Research results and discussion. The study of water pollution of the main tributaries of the Ile River by these highly toxic pollutants was conducted for the first time in 2014 and 2015. In 2014 the presence of PCBs was registered in the water of three rivers out of seven surveyed, and in 2015 in the water of all rivers flowing into the reservoir (Table 1). Their content in the water of individual watercourses is characterised by generally close values. In 2014, it varied in the range from 0.018 to 0.027 µg/L, and in 2015. - from 0.021 to 0.168 µg/L. More elevated values of PCB concentration were observed in 2015 in waters of Esik, Talgar and Kishi Almaty rivers.

The obtained data indicate a significant increase in the level of PCB contamination of river waters in 2015, compared to the previous year. There is not only a noticeable increase in their content in the water of a number of rivers, but also susceptibility of water resources of all watercourses to pollution by these pollutants.

Table 1 – Content of PCBs and their congeners in water of the Ile River tributaries in 2014 and 2015.

Indicators	Rivers					
	Shelek	Yesik	Talgar	Turgen	Kishi Almaty	Kaskelen
2014						
Congeners	66	n/a	n/a	n/a	118	n/a
Total PCBs, µg/L	0,018	n/a	n/a	n/a	0,027	n/a
2015						
Congeners	66	66	66;151;171	86	66;87;110;153	66;115
Total PCBs, µg/L	0,059	0,142	0,168	0,021	0,134	0,092
Note: «n/a» – no data available						

Congeneric composition of PCBs in river waters turned out to be rather wide, 9 individual congeners of PCBs belonging to homological groups from tetrachlorobiphenyls (PCB 44, 66) to heptachlorobiphenyls (PCB 171) were

registered. Among the isomers found is the congener PCB 153, which belongs to the ‘marker’ group.

Comparatively wide variety of congeners is characterised by water of Talgar and Kishi Almaty rivers. One congener was detected in water of Shelek, Turgen and Yesik rivers. PCB 66 congeners were present in water of five rivers. A wider structural diversity of PCB congeners according to the studies (Agapkina et al, 2011; Kannan 2000; Victor et al, 2023) is a sign that sources of different origin are involved in pollution of water bodies and watercourses with these toxic compounds. These can be contamination by industrial PCB mixtures, atmospheric transport or of pyrogenic origin caused by industrial and domestic waste incineration processes.

The character of distribution of relative content of congeners in river waters, on the example of 2015, is shown in Figure 2. The dominant position from 75 to 100 % belongs to ‘light’ congeners (PCBs 44, 66 and 86), which are characterised by relatively increased solubility in water. The specific weight of more ‘heavy’ isomers (PCB 151, 153, 155 and 171), belonging to the homological groups of hexa- and heptachorbiphenyls, ranges from 2.4 to 25 %. More diverse congeneric composition of PCBs in waters of Talgar, Kishi Almaty and Kaskelen rivers is obviously caused by different sources of pollution with these toxicants.

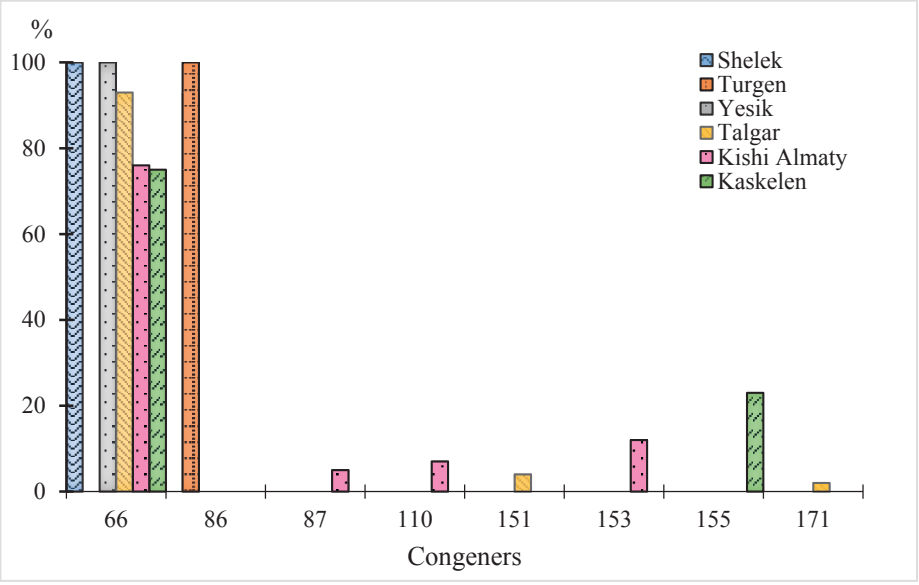

Figure 2 – Relative content of PCB congeners in watercourse water

PCB content in the water of the watercourses under consideration is characterised by close values with the data we obtained for river water flowing into Lake Balkhash. The average concentration of PCBs in the waters of rivers flowing into the Kapshagai reservoir; was 0.090 μg/L in 2015, and in 2014 for individual watercourses from 0.018 to 0.143 μg/L. These data indicate, in general,

the susceptibility of river water resources of the Ile-Balkhash basin to pollution by these toxic compounds of similar origin.

Thus, the researches carried out in 2014 and 2015 allowed for the first time to obtain an objective idea of the current level of pollution by toxic xenobiotics in the water of the tributaries of the Ile River. The main factors causing the accumulation of PCBs in the ecosystem of watercourses are their contamination of effluents and air emissions of industrial and municipal enterprises, transport on the territory of cities and large settlements through which they flow. Water bodies are the primary means for the disposal of industrial effluents. These effluents from industries have a great deal of impact on the pollution of the rivers. Thus, these effluents can change the physicochemical and biological properties of the receiving rivers. The occurrence of PCBs in water rivers is an issue of concern for water quality because they concentrate on the sediments by attaching to the organic matter the moment, they enter into water bodies. (Irerhievwie et al, 2020) Wide diversity of PCB congener composition in water of watercourses, established as a result of the research, is an indicator of presence of different sources of pollution of the natural environment of the region with these toxicants.

It should also be noted that PCBs coming as part of river water are obviously accumulated in the Kapshagai reservoir. Such regularity in PCBs migration was revealed by a number of foreign scientists and it is caused by the fact that PCBs due to low solubility and high specific weight migrate primarily with suspended solids contained in river water, which are deposited when water flow decreases. In the water of tributaries of the Ile River, PCB concentration in 2018 varied in a wide range from 0.117 in the water of the Shengeldy River to 4.68 μg/L - Talgar River (Table 2).

Table 2 – Concentration and congeneric composition of PCBs in the water of major tributaries of the Ile River in 2018.

River	Concentration of PCB congeners, μg/L								Total PCB amount, μg/L
	44	48	52	66,95	110	118	119	115	
Kaskelen								0.732	0.732
Talgar								4.68	4.68
Shengeldy								0.117	0.117
Yesik		0.408						0.732	1.14
Turgen	0.014		0.019					0.204	0.236
Shelek	0.018			0.021	0.033	0.038	0.007	0.245	0.363
Sharyn								0.776	0.776

Sufficiently high pollutant content was also registered in the water of the Yesik River (1.14 μg/L). These two rivers - Talgar and Yesik flow through the cities of the similar names, where a number of industrial facilities are located. It is quite obvious their negative impact on the environment, including accumulation of PCBs

in river waters. In the water of all studied tributaries of the Ile River PCB congener 155 from the homological group of hexachlorobiphenyls was detected, which was characteristic for the water of the Ile River. For water resources of Kaskelen, Talgar and Shengeldy rivers this congener was the only one. The congener composition in the water of the Shelek River is relatively wide. Dioxin-like congener PCB 118 was detected in the water of this river, and 'marker' PCB 52 was detected in the water of the Turgen River in relatively low concentrations.

The distribution of relative content of congeners in tributary waters is generally similar to that characteristic of the Ile River water itself (Figure 3). In the waters of watercourses from 64 to 100 % fall on the share of PCB 155 congener, in the water of the Yesik river light PCB 48 congener was found in the amount of 36 %. The relative share of the representative of strictly controlled 'marker' congeners PCB 52 and dioxin-like PCB 118 is not high - 8 and 11 %.

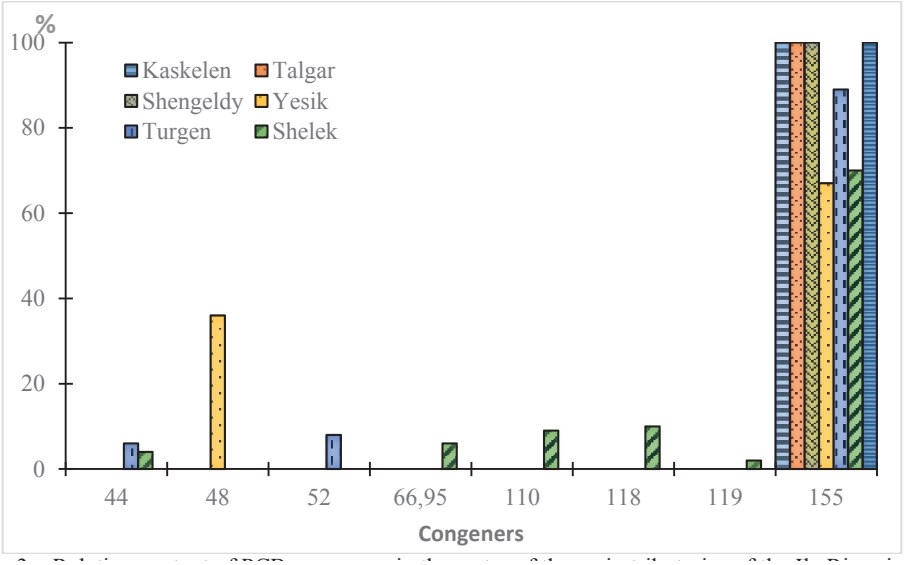

Figure 3 – Relative content of PCB congeners in the water of the main tributaries of the Ile River in 2018

In 2019, water in the tributaries of the Ile River was polluted with PCBs of lower degree from 0.018 to 0.300 μg/L (Table 3). The highest PCB content was registered in the water of the Shengeldy River, flowing into the northern coast of Kapshagay reservoir (KR), flowing through a number of settlements and military-strategic objects.

Table 3 – PCB concentrations and congeneric composition in water of major tributaries of the Ile River in 2019.

River	Concentration of PCB congeners, μg/L			Total PCB amount, μg/L
	42	44	155	
Kaskelen	0.018			0.018
Talgar	n/a			n/a
Shengeldy		0.300		0.300
Yesik	n/a			n/a
Turgen			0.036	0.036
Shelek	n/a			n/a
Sharyn		0.089		0.089
Tekes		0.150		0.150
Note: «n/a» – no data available				

In 2019, the congener composition of PCBs in tributary waters was also extremely limited, congeners 42, 44 and 155 were present, i.e. it had a similar character to their composition in the Ile River water. PCB congener 44 was dominant in quantitative terms in tributary waters, the others were presented sporadically.

Some decrease in the concentration of the toxicant in the tributary water observed in May 2019 should obviously be considered a temporary phenomenon. The results of studies conducted in this water basin for a number of years have shown the extreme variability of the level of pollution of water resources by persistent organic pollutants, including PCBs, in interannual and seasonal aspects.

In 2019, for the first time, water samples were taken from the Tekes River flowing into the Ile River near the PRC border, in which PCBs were detected at 0.150 μg/L. This represents a transboundary inflow of the toxicant from the neighbouring territory.

In 2023, the study of POPs contamination level in water resources of the main tributaries of the Ile River was conducted in November and December of this year. In the waters of the studied tributaries of the Ile River during this period the PCB content was found within the range of 0.018 - 0.039 μg/L, a higher value was observed in the water of the Talgar River (Table 4).

Table 4 – General characterisation of PCB contamination of Ile River tributaries water in November and December 2023

Sampling Location	Date	Congeners PCB	Total PCB amount, μg/L
Shelek	03.12.2023	40; 48; 49; 52; 70,76; 74; 82; 85; 86; 97; 101; 105; 110; 114; 118; 119; 121; 128; 129; 137; 138; 146; 151; 153; 171	0.032
Yesik	03.12.2023		0.023
Turgen	05.12.2023		0.018
Talgar	05.12.2023		0.039
Kaskelen	08.12.2023		0.027
Shengeldy	08.12.2023		0.027

One of the important issues in PCBs study is the assessment of concentration level in water of water bodies and watercourses, strictly controlled in natural objects 'marker' and highly toxic dioxin-like congeners of PCBs, which give higher toxicity to waters.

As follows from the data in Table 5, 4 congeners from the 'marker' group and 3 congeners from the dioxin-like group were registered in the water of all studied tributaries. The concentration of 'marker' congeners was in the range of 0.002-0.006 μg/L. The relative content of 'marker' congeners was between 7-16%.

Concentration of dioxin-like congeners in tributary waters varied within narrow limits of 0.002-0.004 μg/L, extreme values of their relative content were in the range from 4 to 19%.

Thus, based on the analysis of the material obtained in November and December 2023, it can be noted about the continuing pollution of water resources of the main tributaries of the Ile River by PCBs. Taking into account the wide congeneric composition of PCBs and the presence of 'marker' and dioxin-like congeners strictly controlled in natural objects, it can be assumed that the waters of the studied water bodies have an increased level of toxicity in relation to PCBs.

Table 5 – Concentration and relative content of 'marker' and dioxin-like congeners in waters of the studied watercourses in 2023.

Sampling points	Date	Total PCB amount, μg/L	"marker"								dioxin-like					
			PCBs 52		PCBs 101		PCBs 138		PCBs 153		PCBs 105		PCBs 114		PCBs 118	
			μg/L	%	μg/L	%	μg/L	%	μg/L	%	μg/L	%	μg/L	%	μg/L	%
Shelek	03.12.	0.032							0.002	7						
Yesik	03.12.	0.023	0.002	10	0.004	16			0.002	10					0.002	9
Turgen	05.12.	0.018	0.003	14					0.004	23					0.004	19
Talgar	05.12.	0.039	0.006	16			0.003	7							0.002	4
Kaskelen	08.12.	0.027	0.002	7			0.003	12	0.002	7	0.002	7	0.003	11		
Shengeldi	08.12.	0.027			0.002	7										

The main tributaries of the Ile River were studied in the spring of 2024 to assess the level of their pollution by PCBs. The results of chromatographic analysis showed the contamination of water of all studied watercourses with these toxic compounds (Table 6).

Table 6 – Concentration and congeneric composition of PCBs in the waters of the Ile River tributaries.

Sampling location	Date	Congeners	Total PCB amount, µg/L
Kurshelek	16.03.2024	41,61,71; 44; 49; 52; 66,95; 70,76; 74; 82; 85; 86; 87,115; 97; 101; 105; 110; 114; 118; 121; 128; 129; 138; 141; 146; 151; 153; 155; 171	0.037
Turgen	16.03.2024		0.031
Yesik	16.03.2024		0.048
Talgar	16.03.2024		0.023
Kaskelen	16.03.2024		0.029
Shengeldi	17.03.2024		0.059

The total PCB content in river waters varied in the ranges of 0.023 - 0.059 µg/L. Maximum concentrations of the toxicant were registered in waters of the Shengeldy and Yesik rivers.

The data in Table 7 show that the concentrations of found dioxin-like and 'marker' congeners in the water of the studied watercourses are close to each other and have values of the same order. The absolute content of 'marker' and dioxin-like congeners ranged from 0.002 to 0.005 µg/L. 'Marker' congeners occurred 5-21% of the time in the analysed water samples and the occurrence of dioxin-like congeners was 4-13%. Similar occurrence rates were observed in 2023.

Table 7 – Concentration and relative content of 'marker' and dioxin-like congeners in the waters of the tributaries of the Ile River in 2024

Sampling points	Date	"marker"								dioxin-like					
		PCB 52		PCB 101		PCB 138		PCB 153		PCB 105		PCB 114		PCB 118	
		µg/L	%	µg/L	%	µg/L	%	µg/L	%	µg/L	%	µg/L	%	µg/L	%
Shelek	16.03.							0.003	8	0.004	10			0.003	8
Turgen	16.03.	0.003	10	0.002	8	0.002	8			0.002	8				
Yesik	16.03.														
Talgar	16.03.					0.005	21			0.003	12	0.002	8		
Kaskelen	16.03.			0.002	6					0.004	13				
Shengeldi	17.03.	0.003	5			0.005	9	0.003	5			0.002	4		

Conclusion. Over the nearly decade-long study period, PCB contamination was recorded in the waters of all investigated tributaries of the Ili River. The level of watercourse contamination showed considerable interannual variability. The most contaminated waters in terms of PCB content were those of the Yesik, Talgar, and Shengeldi rivers. The main factors contributing to the accumulation of PCBs in river ecosystems are the contamination of wastewater and atmospheric emissions from industrial and municipal enterprises, as well as transport within cities and large settlements through which the rivers flow. The wide congener composition of PCBs, including the presence of highly toxic "marker" and dioxin-like congeners strictly controlled in environmental media, indicates that the studied water bodies

have an increased level of PCB-related toxicity. It also reflects the existence of multiple pollution sources of different origins contributing to the contamination of the region's natural environment with these toxicants.

An analysis of long-term data shows a significant decrease in the level of water pollution in 2023 and 2024 compared with the previous period. However, these small rivers remain the main sources of PCB pollution in the Kapchagay Reservoir and the deltaic watercourses.

A promising direction for organizational measures by governmental environmental protection bodies and for further scientific research is the identification of the main sources of PCB contamination within the basins of the studied rivers and the development of strategies to reduce their impact on river water quality. It is also important to advance scientific research on the problems of persistent organic pollutants, taking into account the commitments undertaken by the Republic of Kazakhstan in the basins of the Ili River and other major transboundary rivers. The RSE "Kazhydromet" should expand the list of toxic substances analyzed in river waters to include polychlorinated biphenyls.

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