Pollution by ions of heavy metals of surface waters of the rivers of the Siberian region

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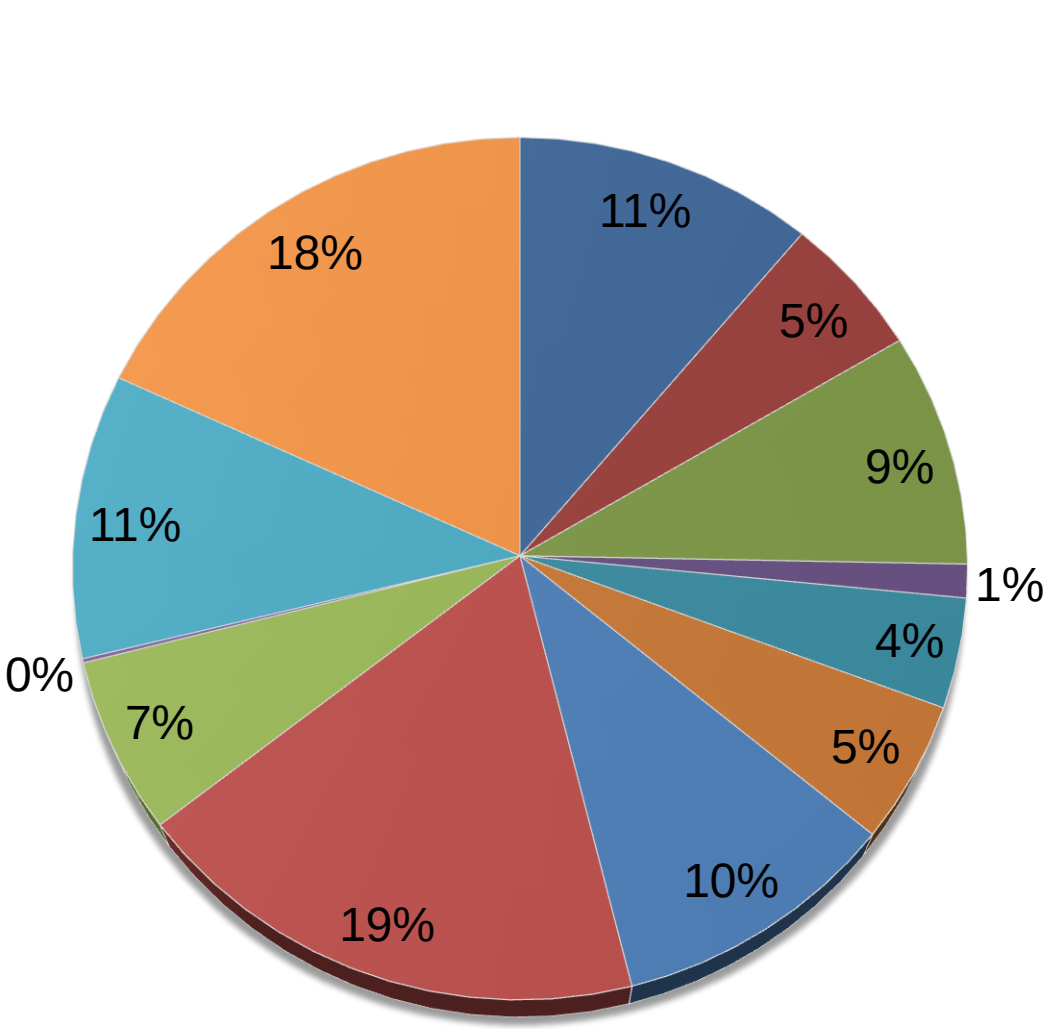
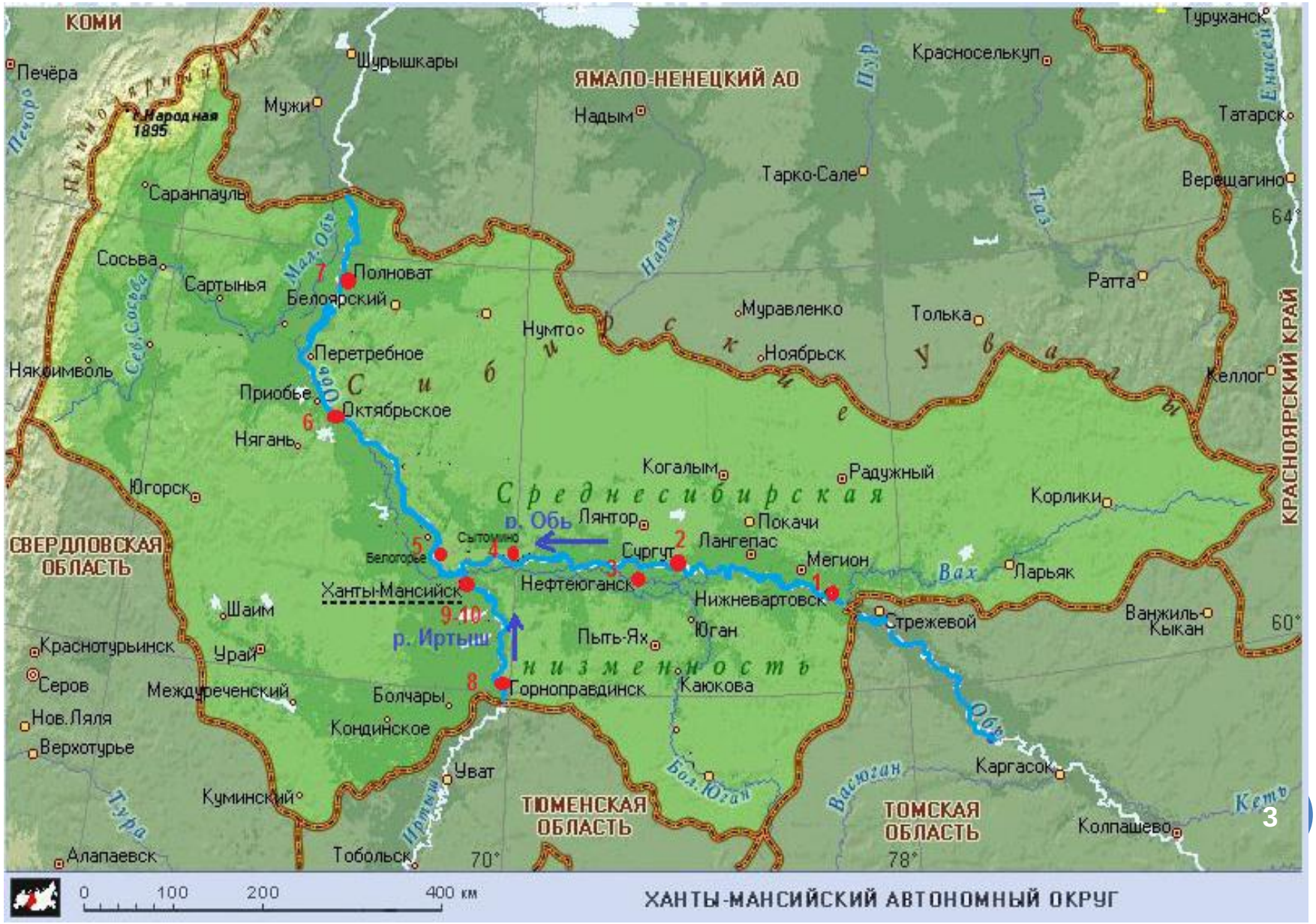
Indicators of general morbidity due to the influence of environmental factors,%



- инфекционныеи паразитные заболевания
- новообразования
- болезни эндокринной системы, обмена веществ и иммунитета
- болезни крови и кроветворных органов
- болезни нервной системы
- психические расстройства
- болезни органов пищеварения
- болези мочеполовой системы
- болезни кожи
- врожденные аномалии
- травмы и отравления
- болезни органов дыхания

SAMPLING POINTS



Sampling and pre-processing

- GOST R 51592-2000 “Water. General requirements for sampling " R 52.24.353-2012 "Sampling of land surface waters and treated waste waters".

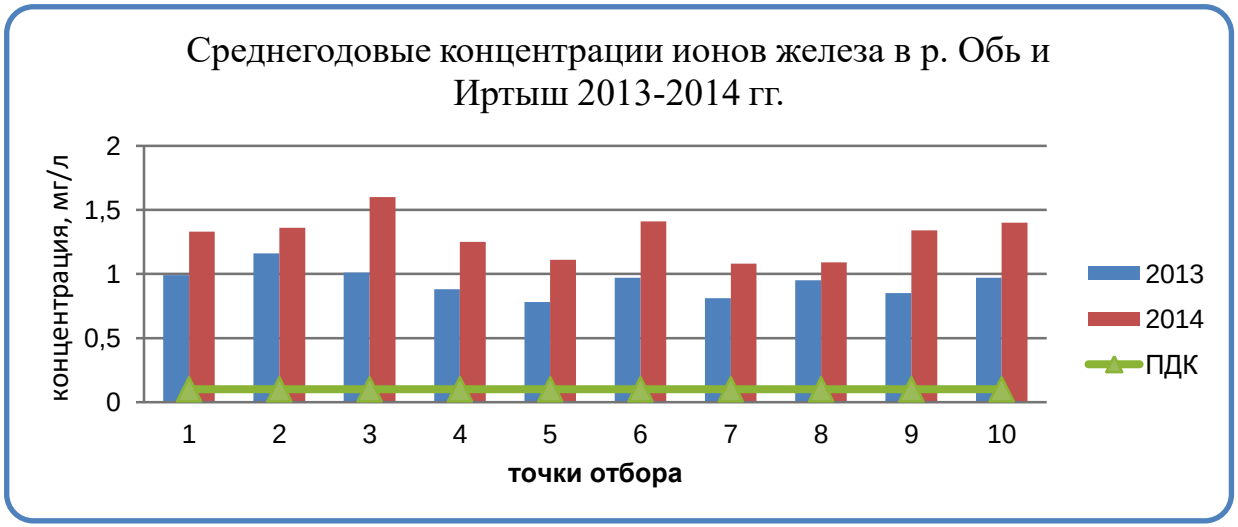
Sampling device PE-1220

Polycarbonate filter unit with manual vacuum pump

MPC OF METALS FOR WATER BODIES OF VARIOUS PURPOSES

Metal ion	MPC for water bodies (μg / dm^3)	
	Cultural and household and household and drinking purposes	Fishery purposes
Iron total	300	100
Mn	100	10
Cu	1000	1
Zn	1000	10
Ni	20	10
Cr (VI)	50	20
Hg	0,5	0,01
Pb	10	6

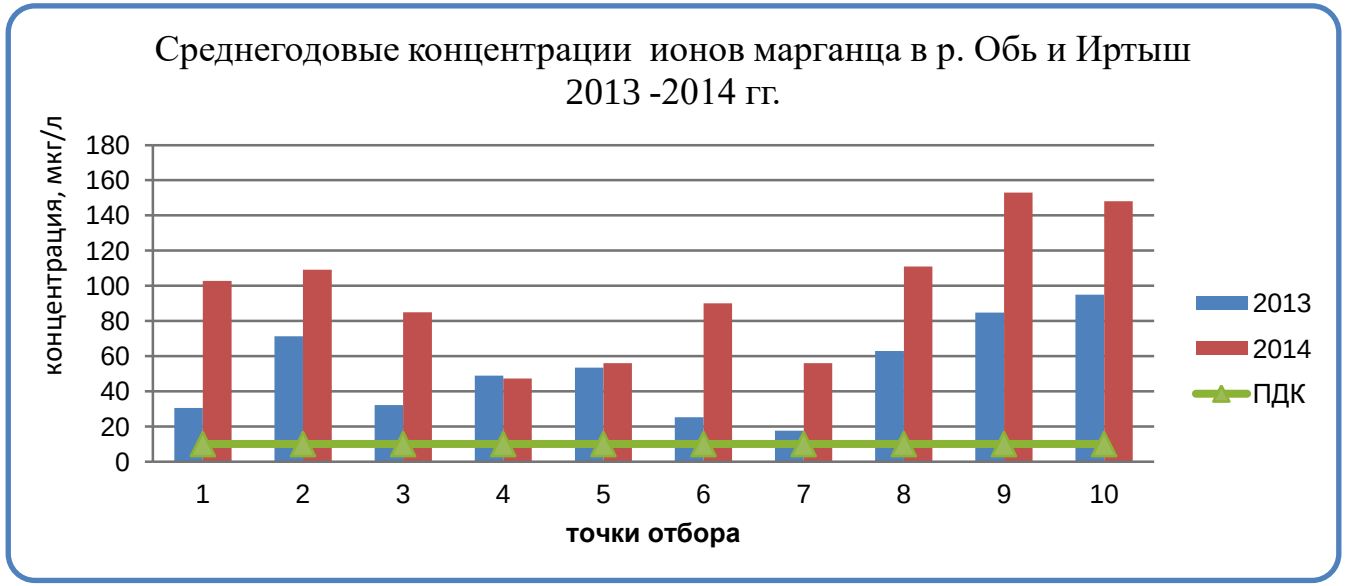
Results of determination of the content of dissolved forms of iron in waters according to AAS



Comparative analysis of the total iron content in the river

	1	2	3	4	5	6	7	8	9	10
$t_{эксп}$	1,34	0,66	2,35	1,32	1,02	2,00	1,04	3,12	1,52	2,13
$t_{таб}$	1,96	1,96	1,96	2,13	2,13	1,96	2,13	1,96	1,96	1,96

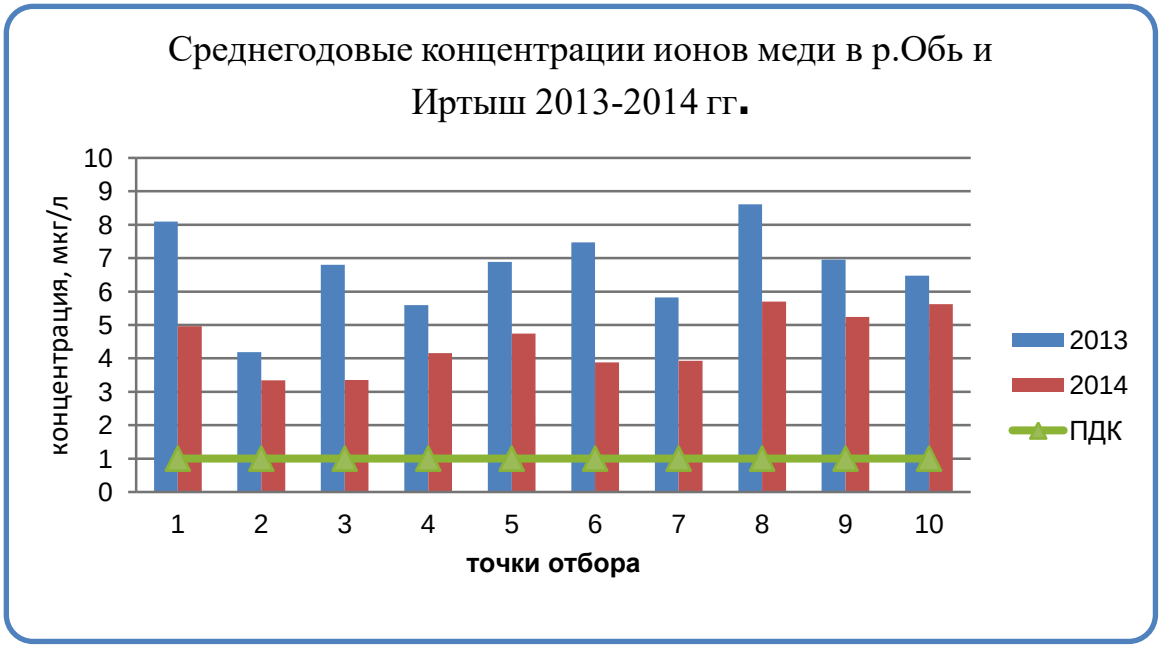
Results of determination of the content of dissolved forms of manganese in waters according to AAS



Comparative analysis of the content of manganese ions

	1	2	3	4	5	6	7	8	9	10
$t_{эксп}$	2,79	0,80	1,87	0,04	0,10	2,87	2,60	1,84	0,96	0,81
$t_{таб}$	1,96	1,96	1,96	2,13	2,13	1,96	2,13	1,96	1,96	1,96

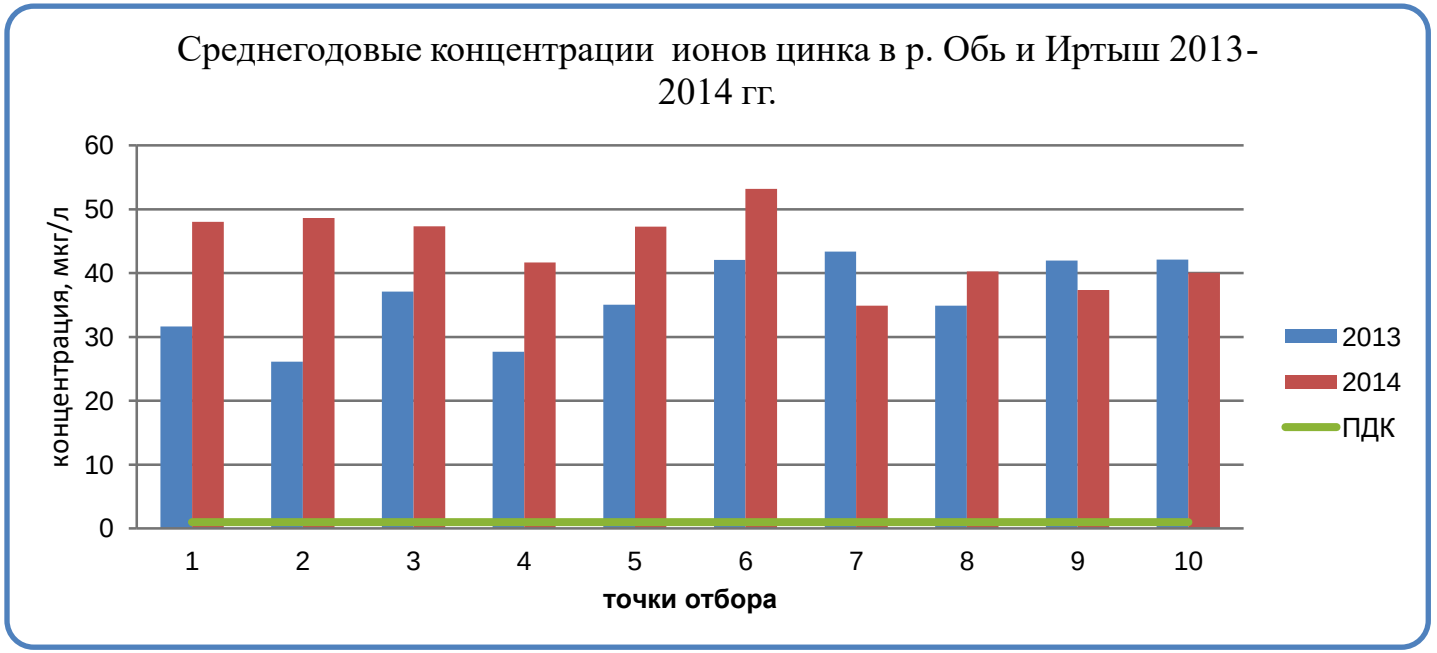
Results of determining the content of dissolved copper ions in waters according to AAS



Comparative analysis of the content of copper ions in the river

	1	2	3	4	5	6	7	8	9	10
$t_{эксп}$	2,02	1,37	1,25	1,05	1,95	1,38	2,08	1,22	0,65	2,02
$t_{таб}$	1,96	1,96	2,13	2,13	1,96	2,13	1,96	1,96	1,96	1,96

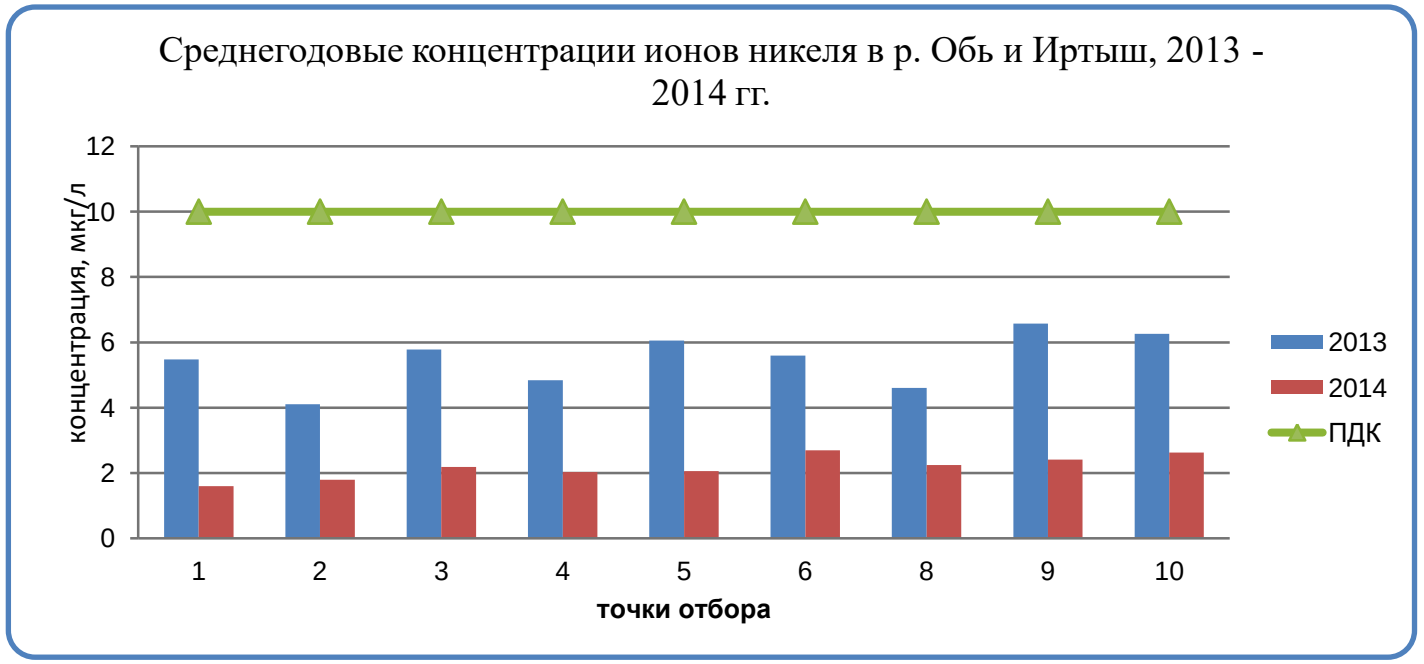
Results of determination of the content of dissolved zinc ions in waters using AAS



Comparative analysis of the content of zinc ions in the river

	1	2	3	4	5	6	7	8	9	10
$t_{эксп}$	1,51	3,40	0,88	1,52	1,05	0,99	1,02	0,63	0,42	0,19
$t_{таб}$	1,96	1,96	1,96	2,13	2,13	1,96	2,13	1,96	1,96	1,96

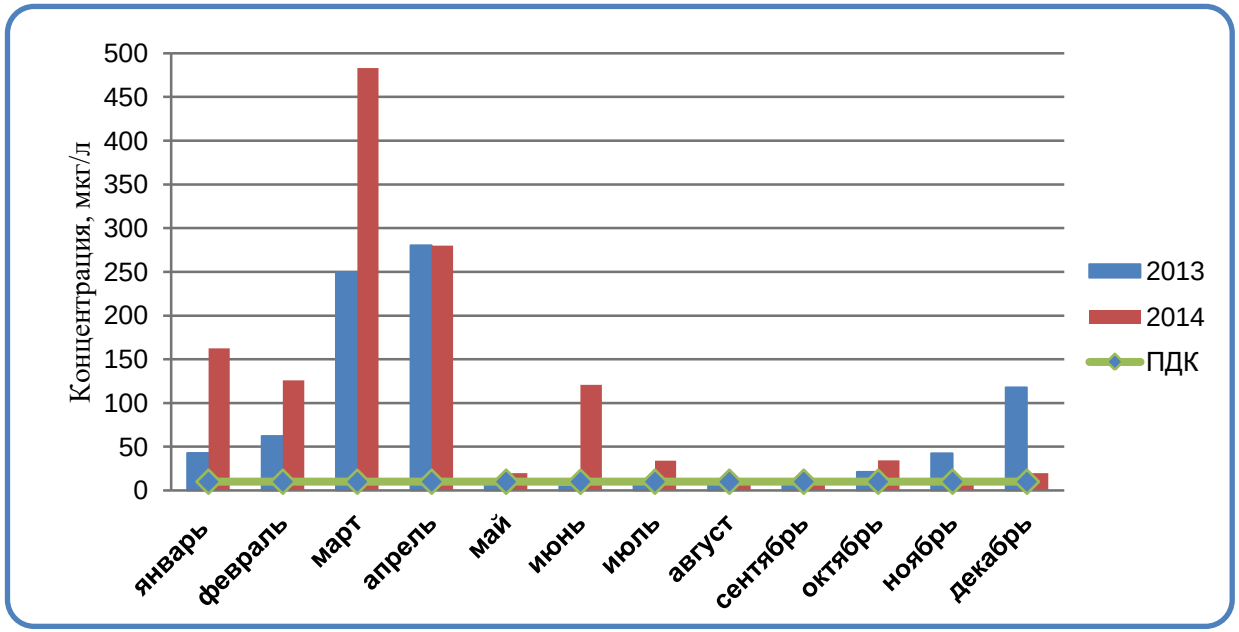
Results of determining the content of dissolved nickel ions in waters using AAS

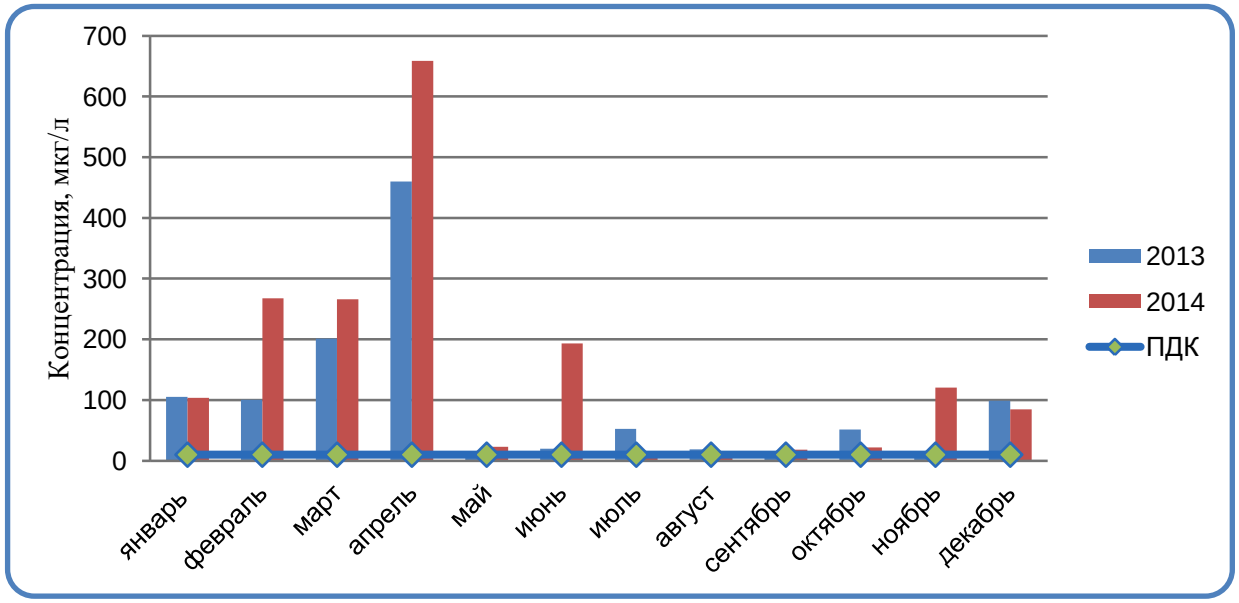


Comparative analysis of the content of nickel ions in the river

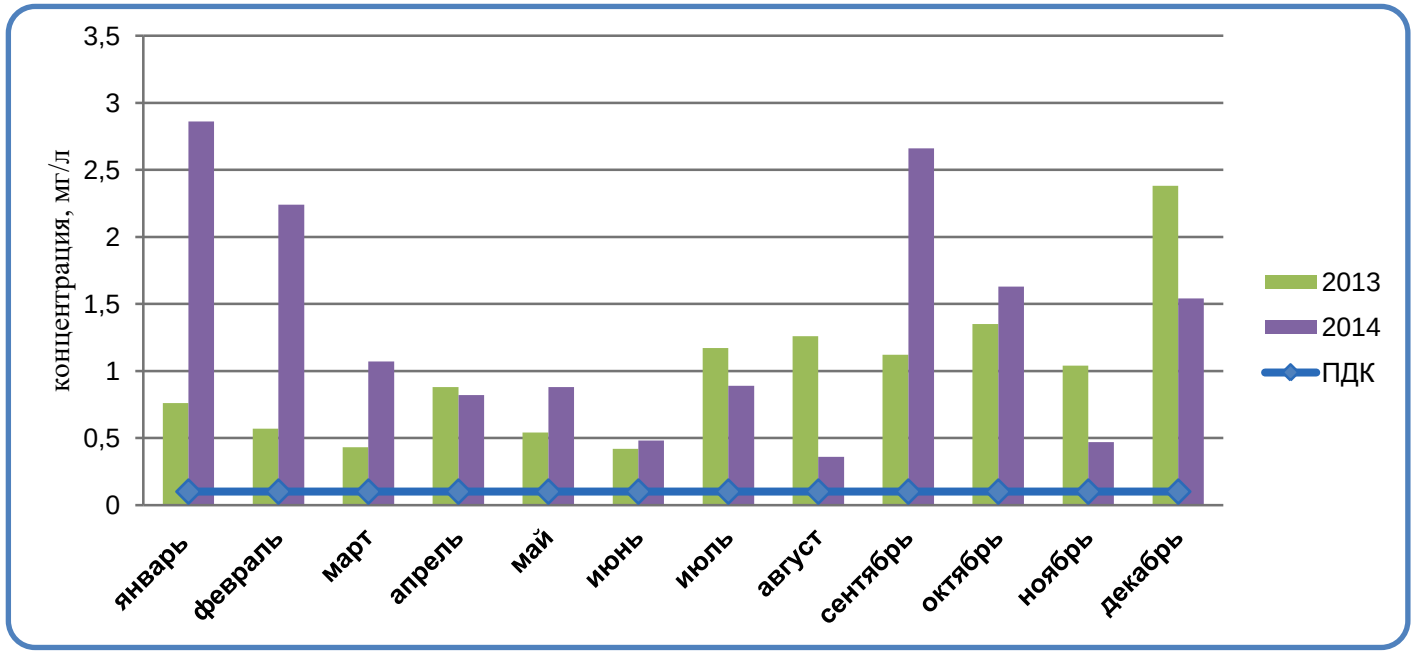
	1	2	3	4	5	6	8	9	10
$t_{эксп}$	1,60	3,63	2,57	3,27	2,53	1,73	2,47	2,67	2,87
$t_{таб}$	1,96	1,96	1,96	2,13	2,13	1,96	1,96	1,96	1,96

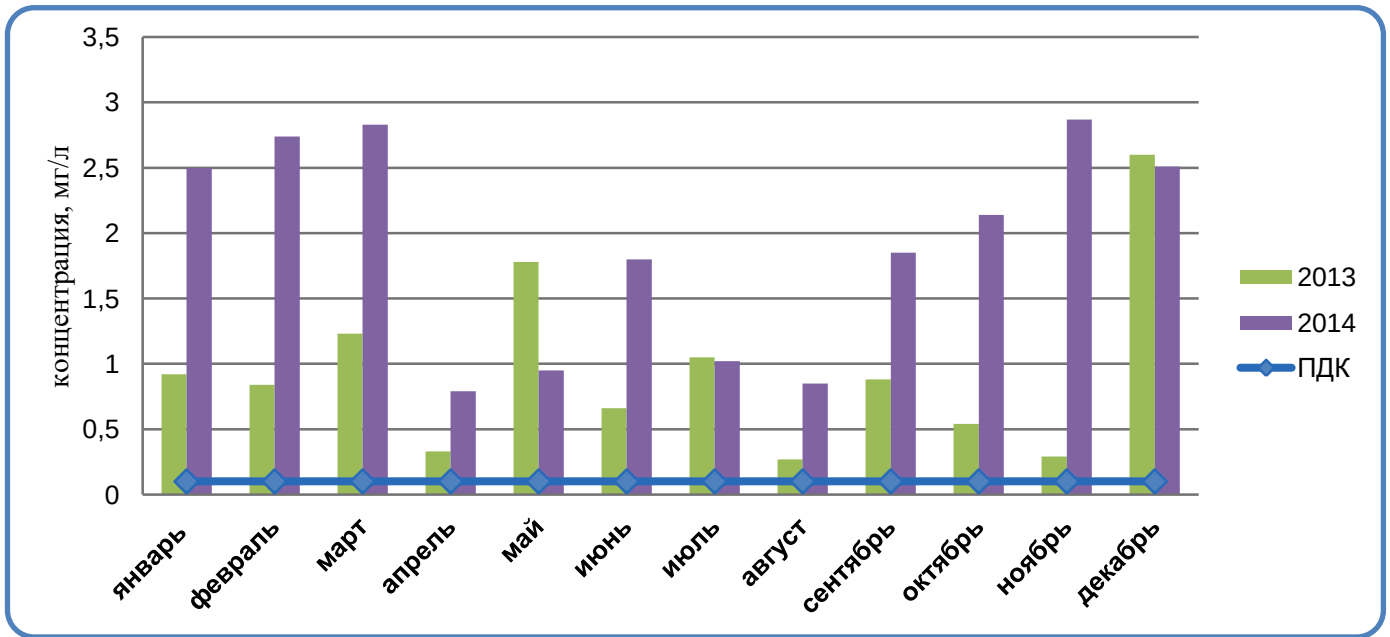
SEASONAL DYNAMICS OF MANGANESE IONS IN THE RIVER



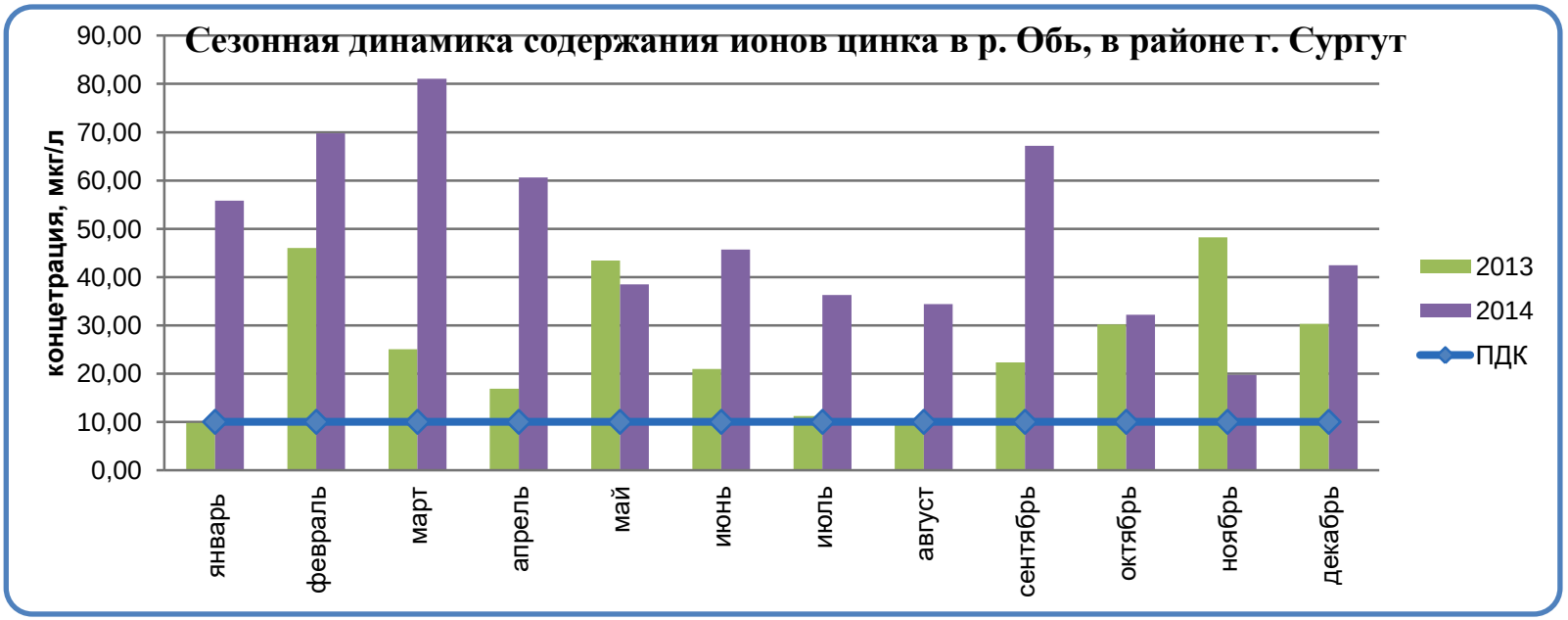


SEASONAL DYNAMICS OF IRON IONS IN THE RIVER

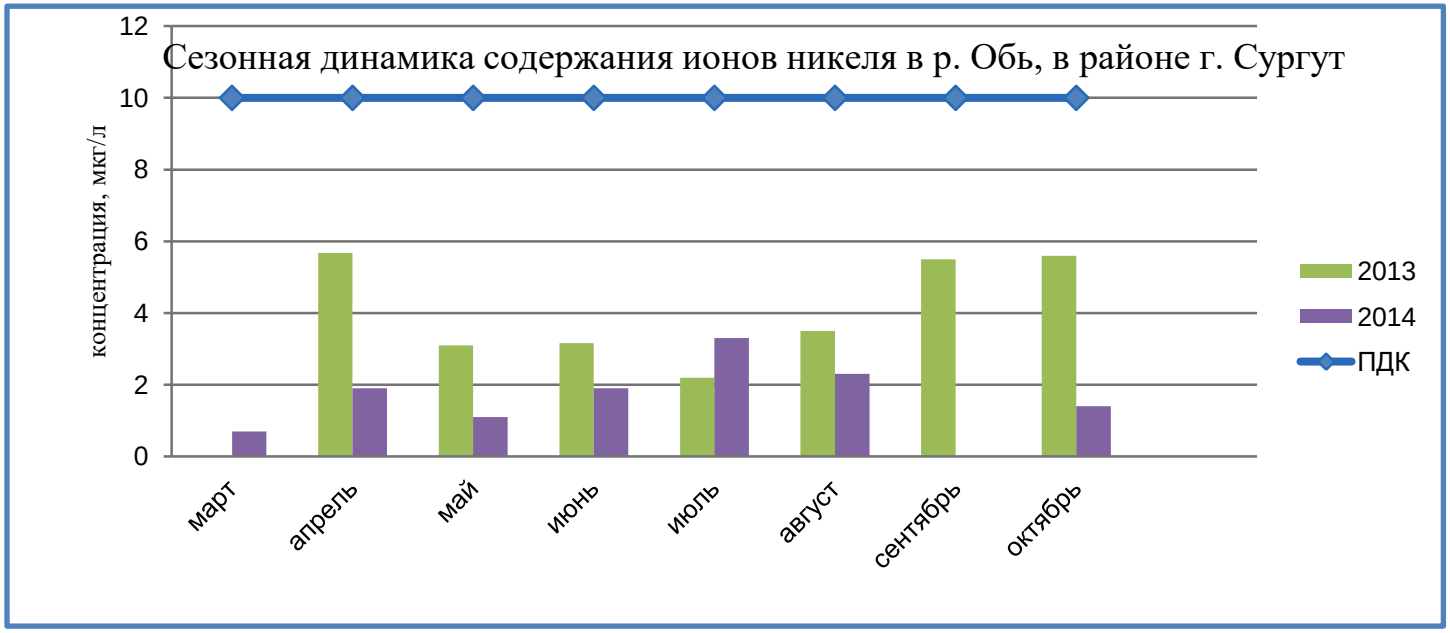




Seasonal dynamics of zinc and copper ions in the r. Ob and Irtysh



Seasonal dynamics of nickel ions in the river. Ob and Irtysh



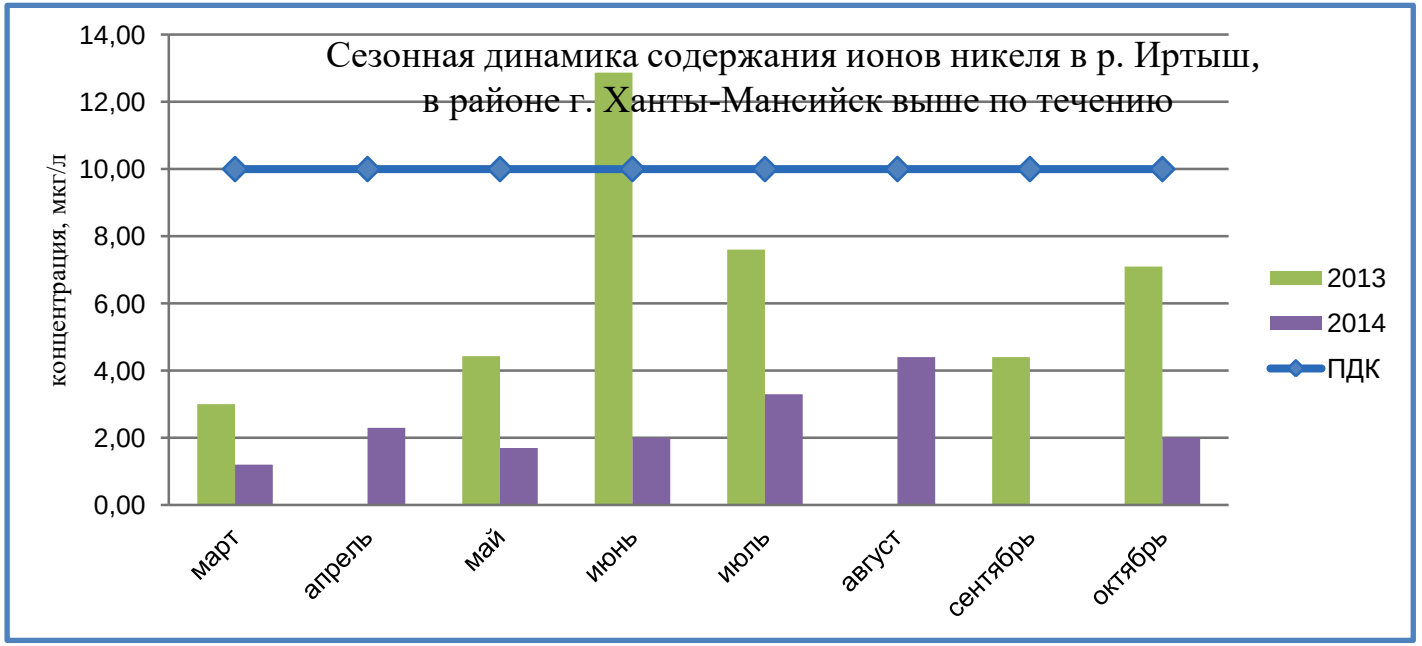
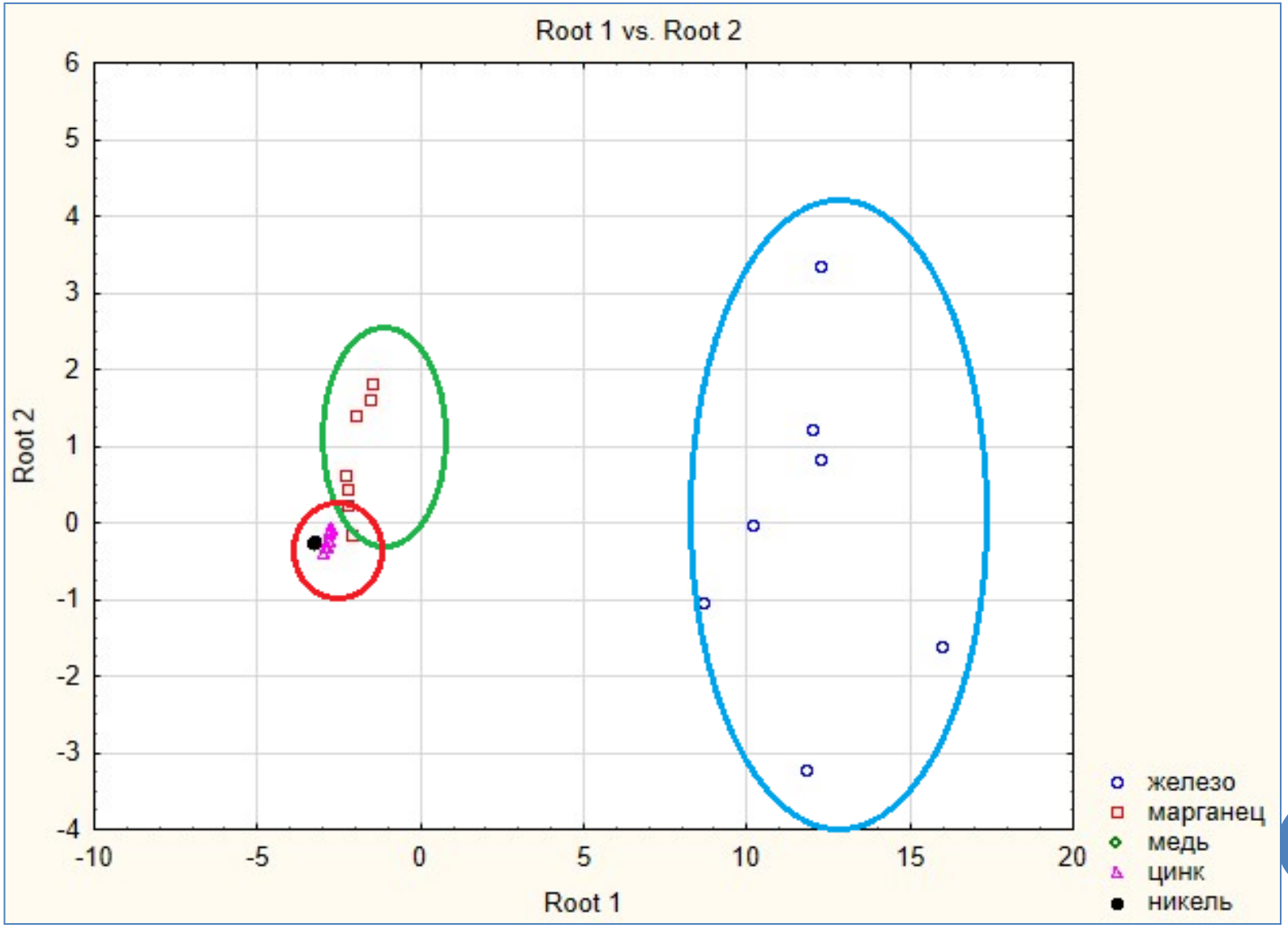


Diagram of the distribution of iron, manganese, copper, zinc and nickel ions by seasons



Water Pollution Index (WPI)

- **WPI** = $1/n\sum \frac{C_i}{ПДК}$,

Conditionally estimates, in the form of a dimensionless number, the share of the polluting effect introduced into the total degree of water pollution caused by the simultaneous presence of a number of pollutants, on average one of the ingredients and water quality indicators taken into account when calculating the combinatorial index.
Water classification depending on the value of the water pollution index (RD 52.24.643-2002 Method for the comprehensive assessment of the degree of surface water pollution by hydrochemical indicators)

Воды	Значения ИЗВ	Классы качества воды
Очень чистые	<0,2	1
Чистые	0,2 – 1,0	2
Умеренно загрязненные	1,0 – 2,0	3
Загрязненные	2,0 – 4,0	4
Грязные	4,0 – 6,0	5
Очень грязные	6,0 – 10,0	6
Чрезвычайно грязные	>10,0	7

WPI AS A CHARACTERISTIC OF CHANGES IN WATER QUALITY BY SEASONS

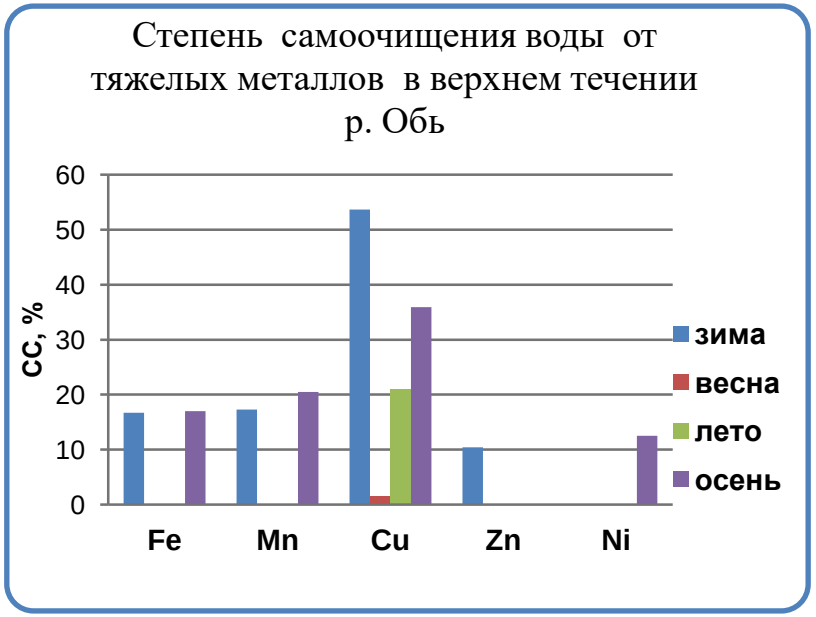
Водный объект, № пункта наблюдения	Сезоны года	Качество поверхностных вод		
		ИЗВ	класс качества	классификация загрязненности
р. Обь, т 1	Зима Весна Лето Осень	6,4 6,8 4,8 5,5	6 5	Очень грязная Грязная
р. Обь, т 2	Зима Весна Лето Осень	4,8 9,7 4,6 4,6	6 5	Очень грязная Грязная
р. Обь, т3	Зима Весна Лето Осень	3,1 7,5 6,0 5,0	4 6 5	Очень загрязненная Очень грязная Грязная
р. Обь, т4	Весна Лето Осень	5,4 5,4 4,5	5	Грязная
р. Обь, т5	Весна Лето Осень	5,8 4,7 5,2	5	Грязная

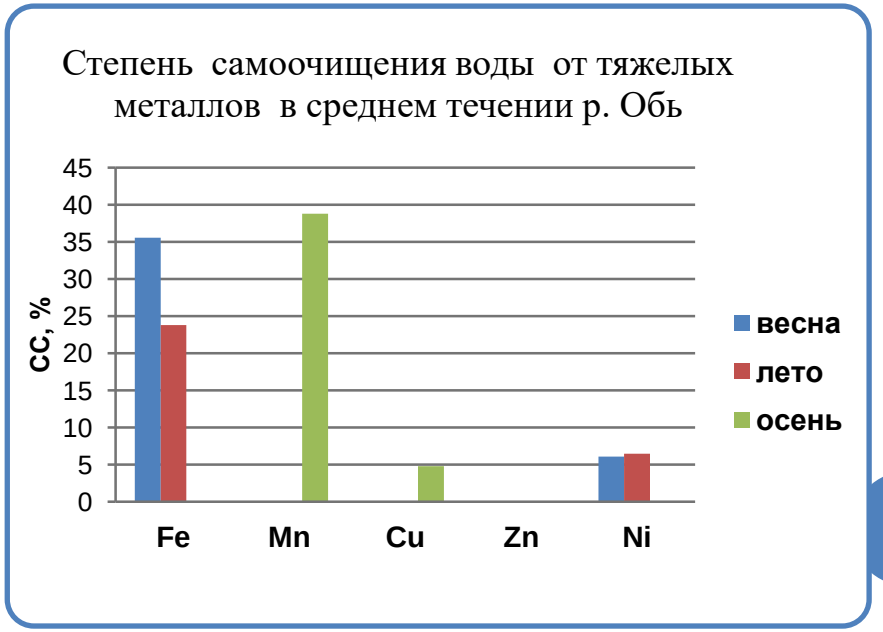
WPI AS A CHARACTERISTIC OF CHANGES IN WATER QUALITY BY SEASONS

Водный объект, № пункта наблюдения	Сезоны года	Качество поверхностных вод		
		ИЗВ	класс качества	классификация загрязненности
р. Обь, т 6	Зима	3,1	4	Очень загрязненная
	Весна	8,3	6	Очень грязная
	Лето	6,1	5	Грязная
	Осень	5,2		
р. Обь, т 7	Весна	5,7	5	Очень загрязненная
	Лето	6,6	4	Грязная
	Осень	3,9		
р. Иртыш, т8	Зима	5,9	4	Очень загрязненная
	Весна	7,2	6	Очень грязная
	Лето	6,5	5	Грязная
	Осень	8,5		
р. Иртыш, 5т9	Зима	6,3	4	Очень загрязненная
	Весна	10,8	6	Очень грязня
	Лето	5,9	5	Грязная
	Осень	5,8		
р. Иртыш, т10	Зима	6,1	4	Очень загрязненная
	Весна	11,0	6	Очень грязная
	Лето	6,4	5	Грязная
	Осень	5,6		

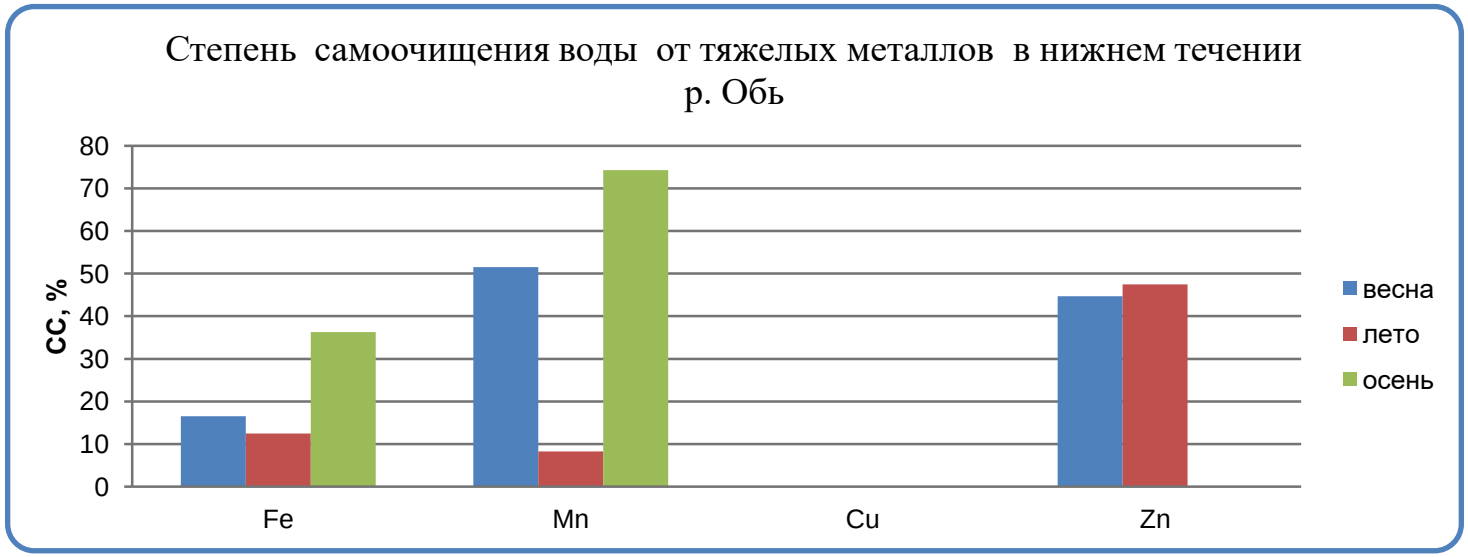
Self-cleaning degree (SS)

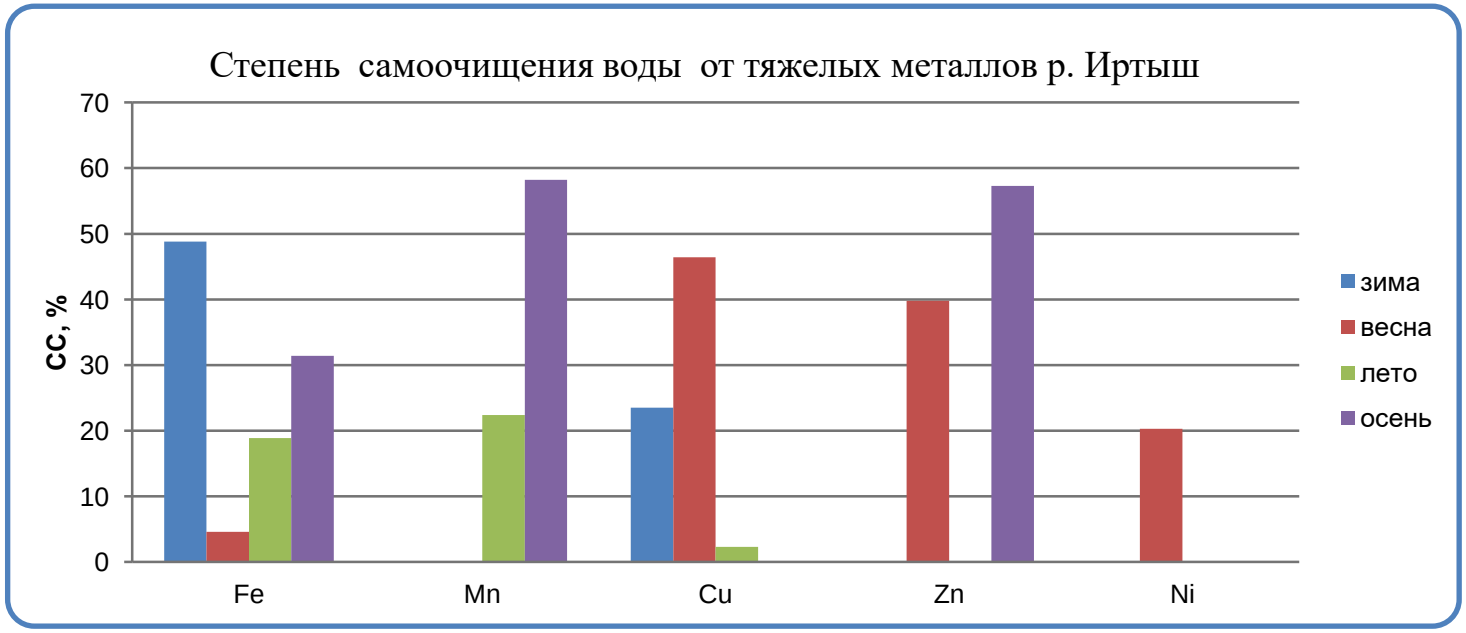
- SS = 100 * (Sn-Sk) / Sn,Where CC is the degree of self-cleaning,%; Cn and Ck are metal concentrations in the initial and final section of the reservoir, respectively (Spravochnik po gidrokhimii, 1989).The investigated water basin of the r.
- The Ob was conditionally divided into three sections:-upstream (from Nizhnevartovsk to Surgut);-the middle course (from the village of Sytomino to the village of Belogorye);-lower current (from the town of Oktyabrskoye to the item Polnovat).





Self-cleaning degree (SS)





CONCLUSIONS

- Using the AAS method, the concentrations of HMs in the river were determined. Ob and r. Irtysh :for iron, zinc and copper ions, an excess of maximum permissible concentration is characteristic in 100% of cases, and the concentrations of nickel ions exceed the maximum permissible concentration in isolated cases;a tendency towards an increase in the average annual concentrations of iron, manganese and zinc ions and a decrease in the average annual concentrations of copper and nickel ions is shown.
- The seasonal dynamics of HM was established: an increase in the spring period (March-April), then a decrease in the summer-autumn period (for iron and manganese ions); the nature of the distribution of zinc, copper and nickel ions does not depend on the seasons of the year.
- Calculated WPI:WPI values are minimal in the summer-autumn period;it was noted that in 2014 compared to 2013, there is a deterioration in water quality.
- The degree of self-cleaning is calculated:the highest CC values are observed in the autumn period in the lower reaches of the river. Ob: iron 36%, manganese 74%;maximum values of CC in water in the river. Irtysh is typical for manganese and zinc in the autumn period (about 60%); for iron in winter (49%) and in autumn (31%).